The right choice for the ultimate yield!

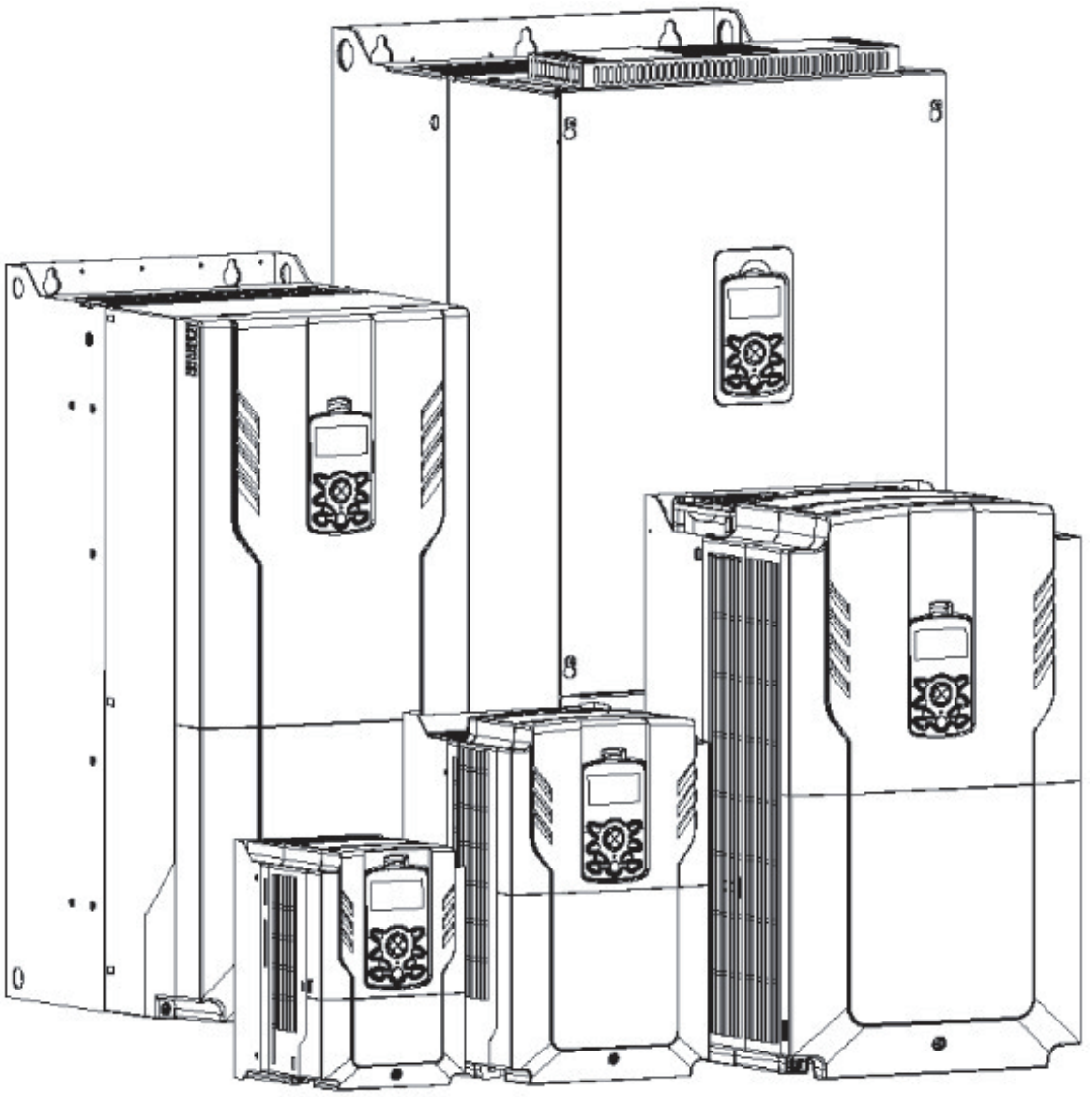
LS Electric strives to maximize your profits and appreciates your choice in partnering with us.

AC Variable Speed Drive

LSLV-H100+ Series

User Manual

0.75–90kW [200V] / 0.75–750kW [400V] / 5.5–300kW [600V]



⚠ Safety Instructions

- Read this manual carefully before installing, wiring, operating, servicing, or inspecting this equipment
- Keep this manual within easy reach for quick reference.

LS ELECTRIC

This operation manual is intended for users with basic knowledge of electricity and electric devices.

* LSLV-H100+ is the official name for the H100+ series inverters.

* The H100+ series software may be updated without prior notice for better performance. To check the latest software, visit our website at http://www.ls-electric.com.

Revision History

No	Date	Edition	Changes
0	2023.12	New	-
1	2025.05	1st Edition	Add H100 110–300kW 575V Type Series S/W Version up • Main: V602.10 DB0.03 → V602.11 DB0.08 • I/O: V602.00 DB0.04 → V602.00 DB0.05 Lead-Lag Function Update The following parameters are available V602.11 or later • [DRV-27] [BAS-17,39,40] [ADV-79,80,81] [COM-39–46, 59–66,68,69,78–81] [AP1-1–13] [AP2-35,36,76,77]
2	2026.07	2nd Edition	S/W Version up. • Main: V602.12 DB0.04 → V602.12 DB0.09 • I/O: V602.00 DB0.05 → V602.00 DB0.06 Updated Contents • Temperature Derating Based on Carrier Frequency • Single Rating • Follow Lead • Sleep Mode Setting • PM V/F Control

Safety Information

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

Safety symbols in this manual

⚠ Warning

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

ⓘ Caution

- 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.
- Supply earthing system: TT, TN, not suitable for corner-earthed systems

ⓘ Caution

- 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.
- Do not place heavy objects on top of electric cables. Doing so may damage the cable and result in an electric shock.

Note

Maximum allowed prospective short-circuit current at the input power connection is defined in IEC 60439-1 as 100 kA. LSLV-H100+ is suitable for use in a circuit capable of delivering not more than 100kA RMS at the drive's maximum rated voltage, depending on the selected MCCB. RMS symmetrical amperes for recommended MCCB are the following table.

Remarque

Le courant maximum de court-circuit présumé autorisé au connecteur d'alimentation électrique est défini dans la norme IEC 60439-1 comme égal à 100 kA. Selon le MCCB sélectionné, la série LSLV-H100 peut être utilisée sur des circuits pouvant fournir un courant RMS symétrique de 100 kA maximum en ampères à la tension nominale maximale du variateur. Le tableau suivant indique le MCCB recommandé selon le courant RMS symétrique en ampères.

Working Voltage	UTE100 (E/N)	UTS150 (N/H/L)	UTS250 (N/H/L)	UTS400 (N/H/L)
240V(50/60Hz)	50/65kA	65/100/150kA	65/100/150kA	65/100/150kA
480V(50/60Hz)	25/35kA	35/65/100kA	35/65/100kA	35/65/100kA

Working Voltage	ABS33c	ABS53c	ABS63c	ABS103c	ABS203c	ABS403c
240V(50/60Hz)	30kA	35kA	35kA	85kA	85kA	75kA
480V(50/60Hz)	7.5kA	10kA	10kA	26kA	26kA	35kA

Working Voltage	3VA6110-0HL31-0AA0	3VA6115-0HL31-0AA0	3VA6225-0HL31-0AA0	3VA6340-0HL31-0AA0	3VA64600-0HL31-0AA0
600V(60Hz)	100kA	100kA	100kA	100kA	100kA

Working Voltage	ABS33c	ABS53c	ABS63c	ABS103c	ABH103c	ABH203c
600V(60Hz)	2.5kA	5kA	5kA	8kA	10kA	10kA

Working Voltage	ABL403c	ABL603c
600V(60Hz)	14kA	14kA

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1 Preparing the Installation

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

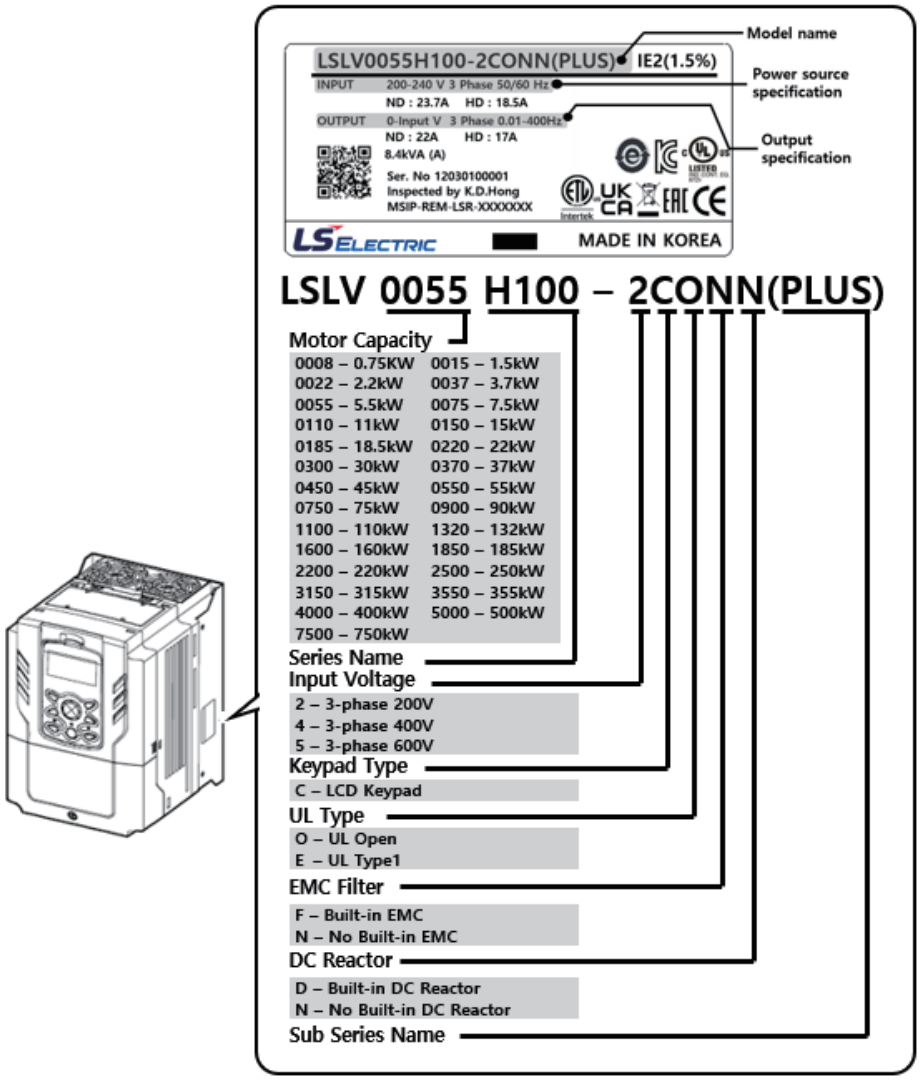
1.1 Product Identification

The H100+ Inverter is manufactured in a range of product groups based on drive capacity and power source specifications. Product name and specifications are detailed on the rating plate.

Check the rating plate before installing the product and make sure that the product meets your requirements. For more detailed product specifications, refer to *"10.1 Technical Specification" on page 428*.

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.



Note

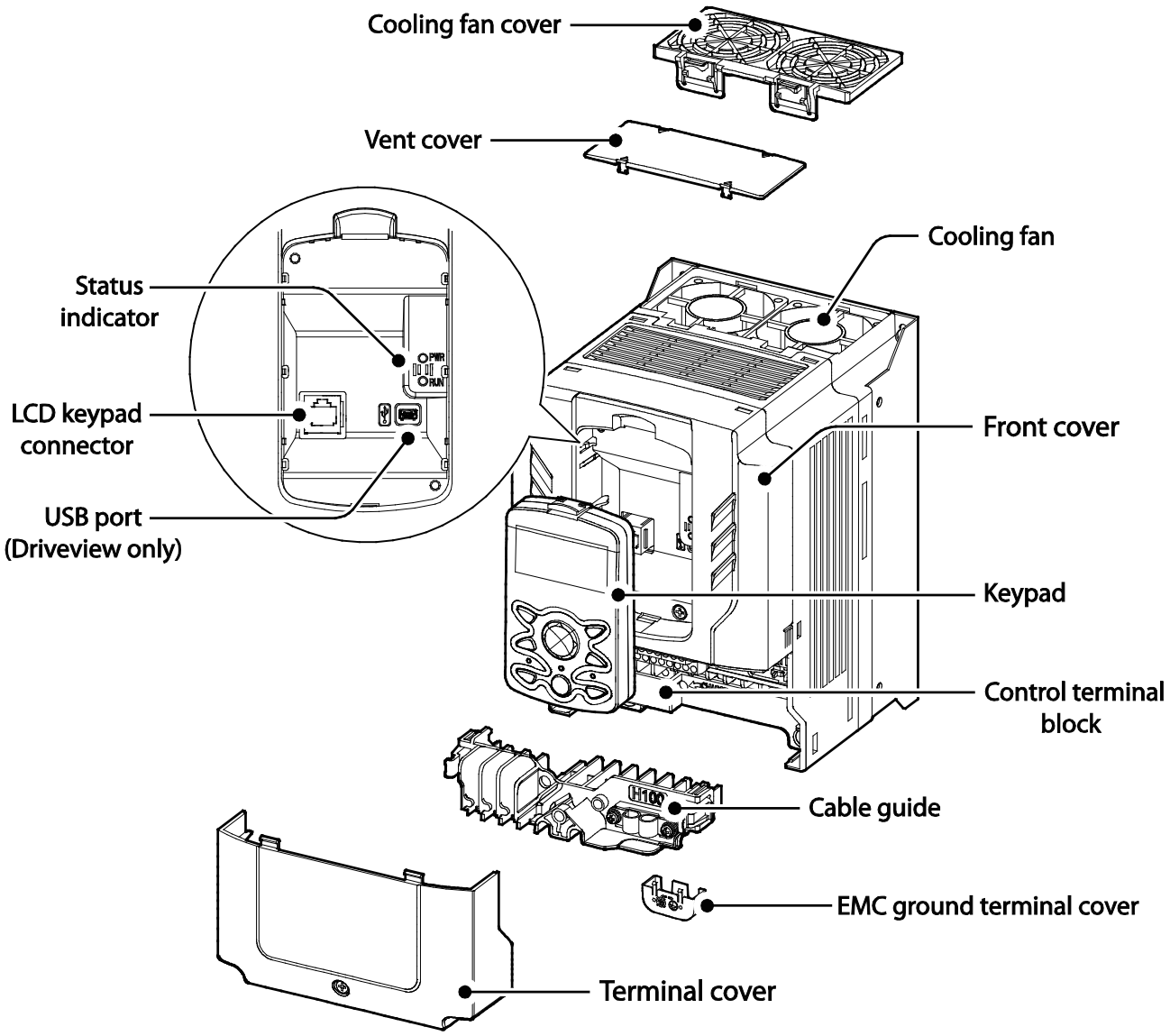
The H100+ 75/90 kW, 400 V inverters satisfy the EMC standard EN61800-3 without installation of optional EMC filters.

1.2 Part Names

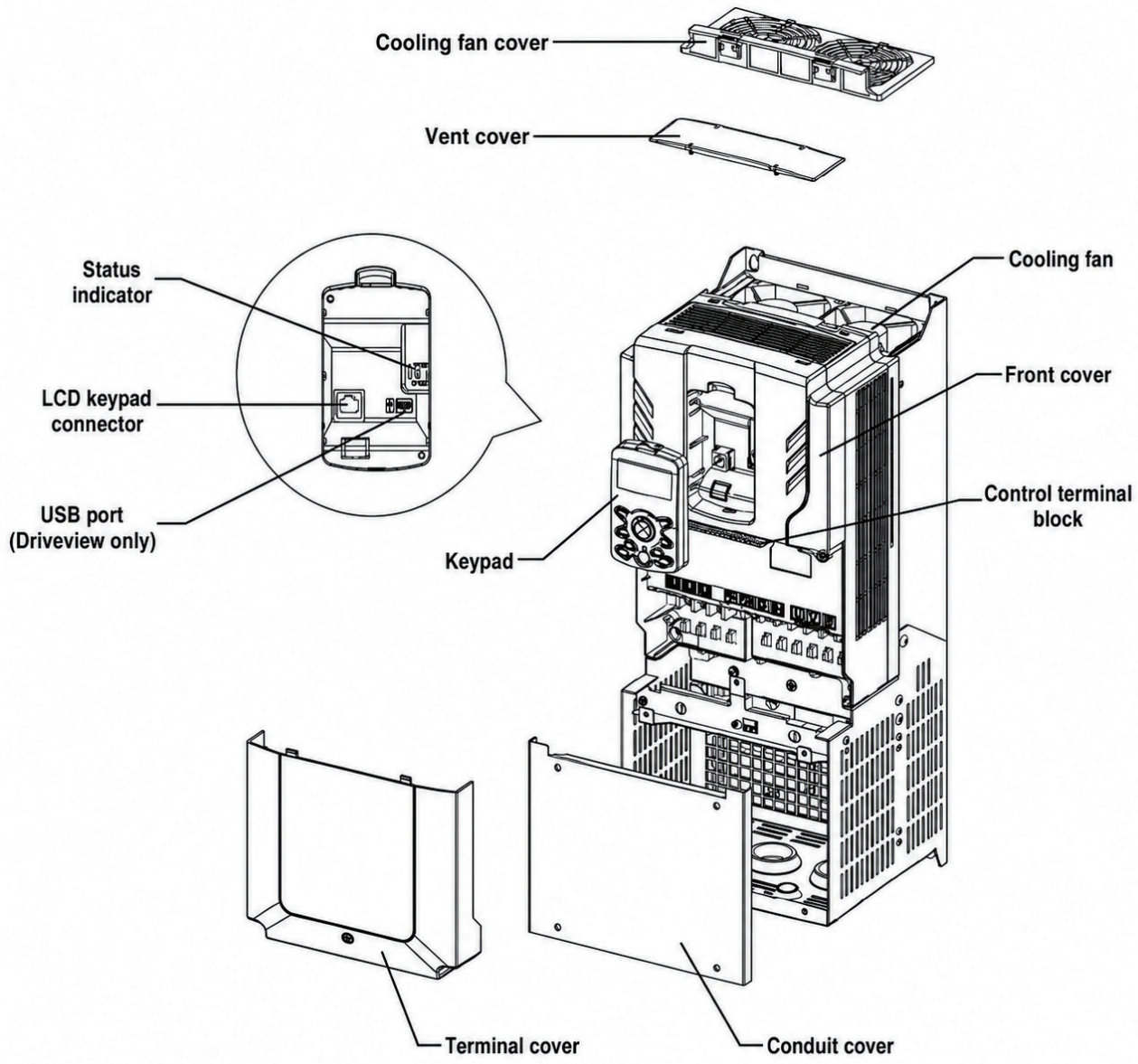
The illustration below displays part names. Details may vary between product groups.

200V : 0.75–18.5 kW (3-Phase)

400V : 0.75–30 kW (3-Phase)

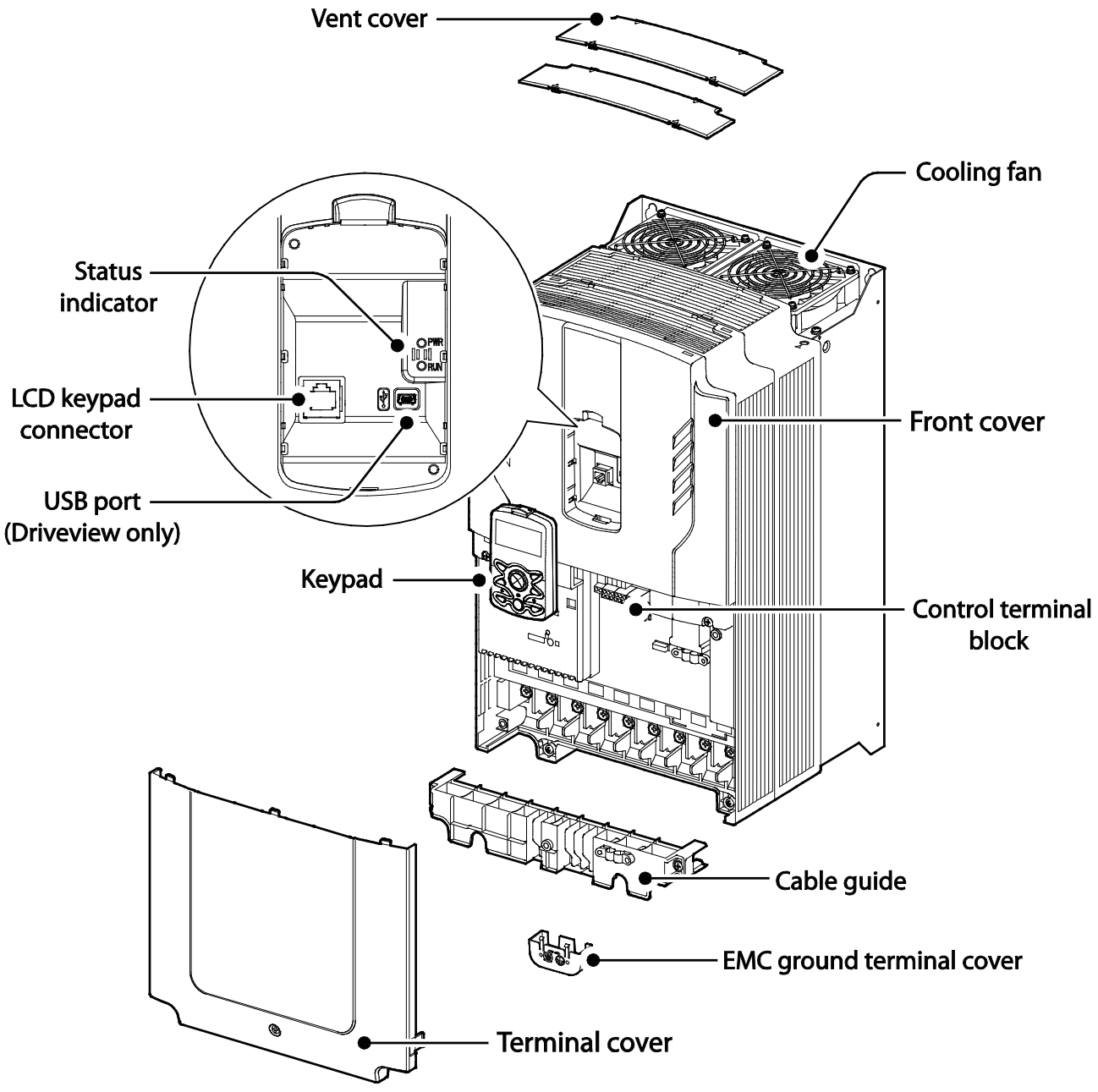


600V : 5.5–30 kW (3-Phase)



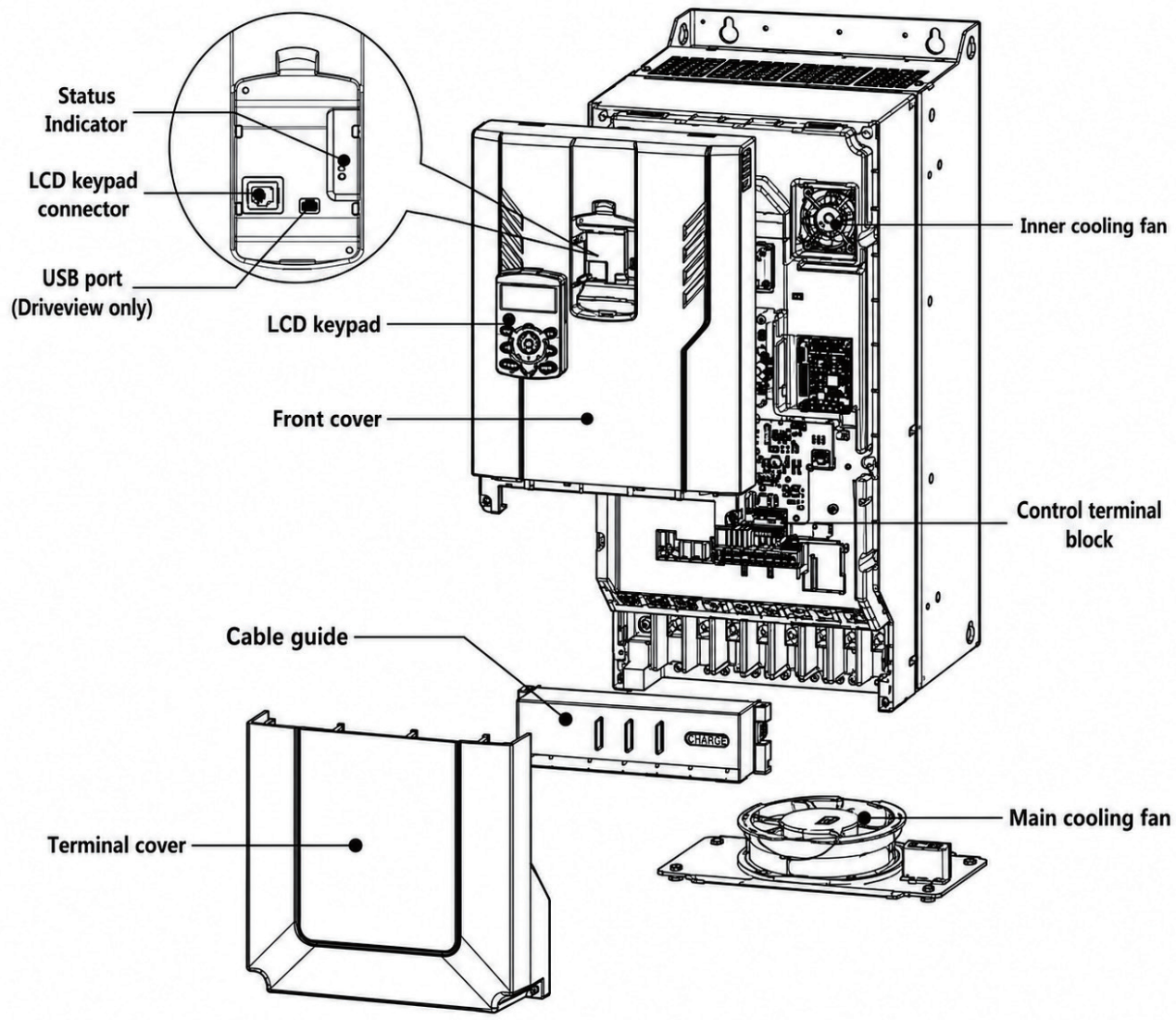
200V : 22–45 kW (3-Phase)

400V / 600V : 37–90 kW (3-Phase)



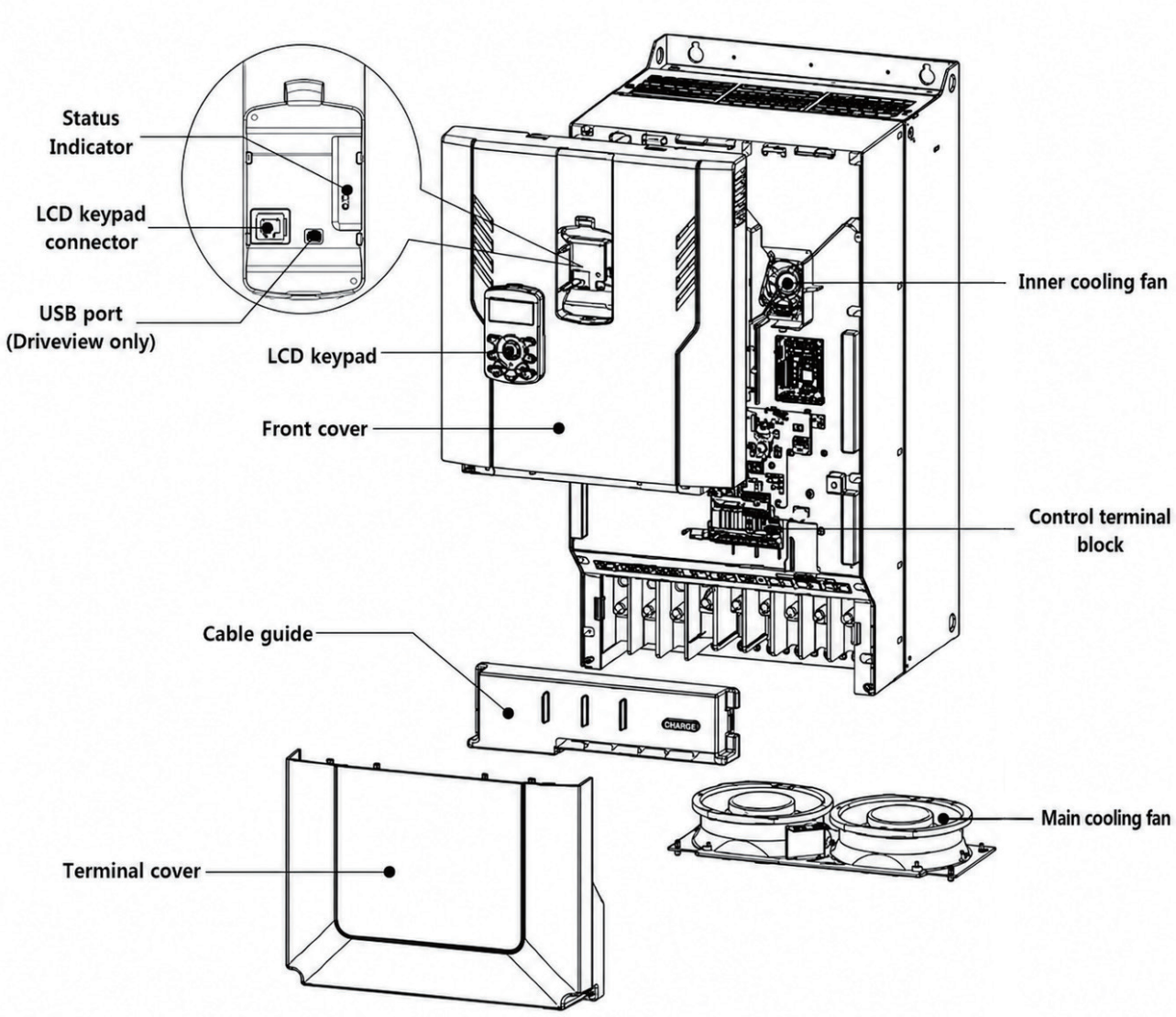
200V : 55 / 75 kW (3-Phase)

400V : 110–132 kW (3-Phase)

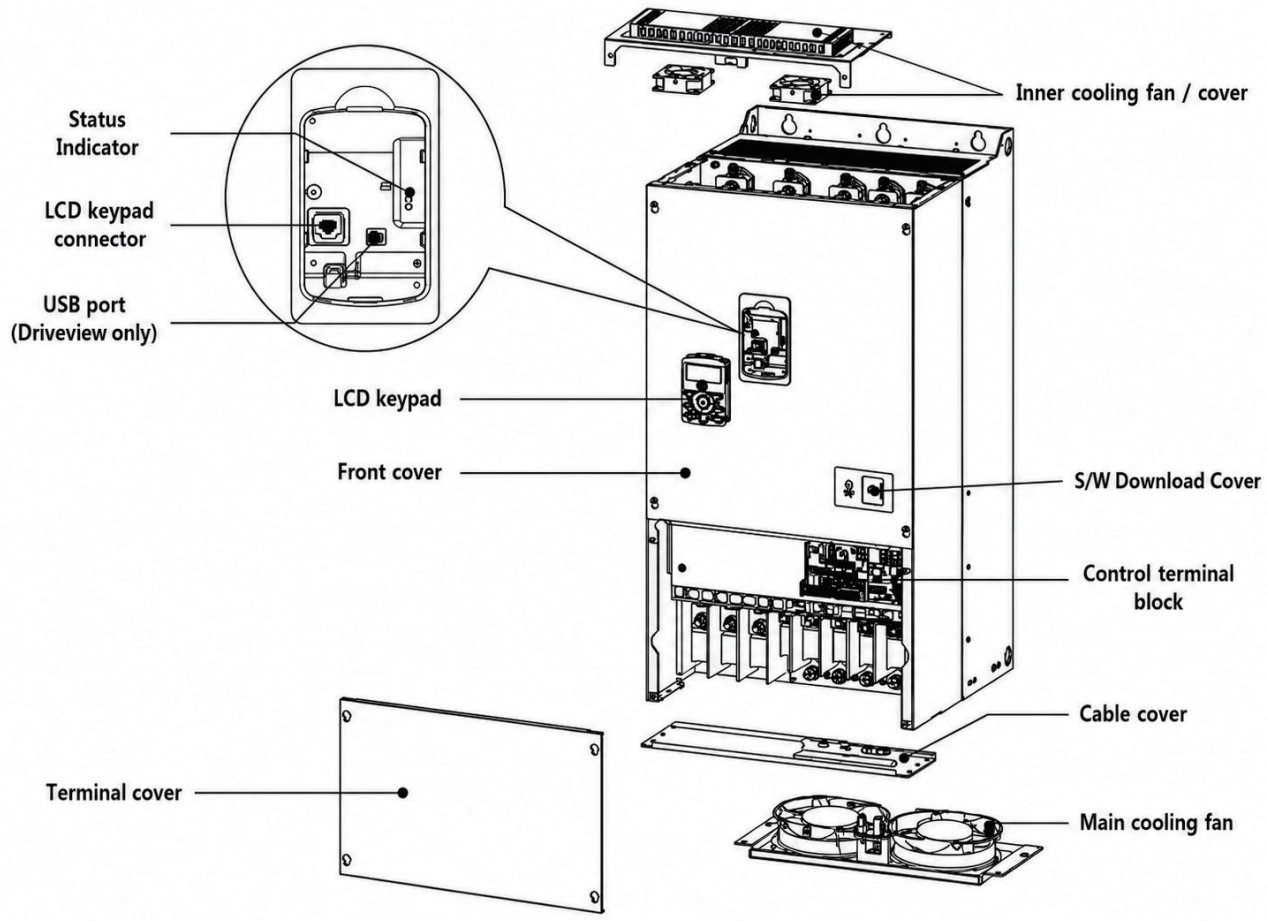


200V : 90 kW (3-Phase)

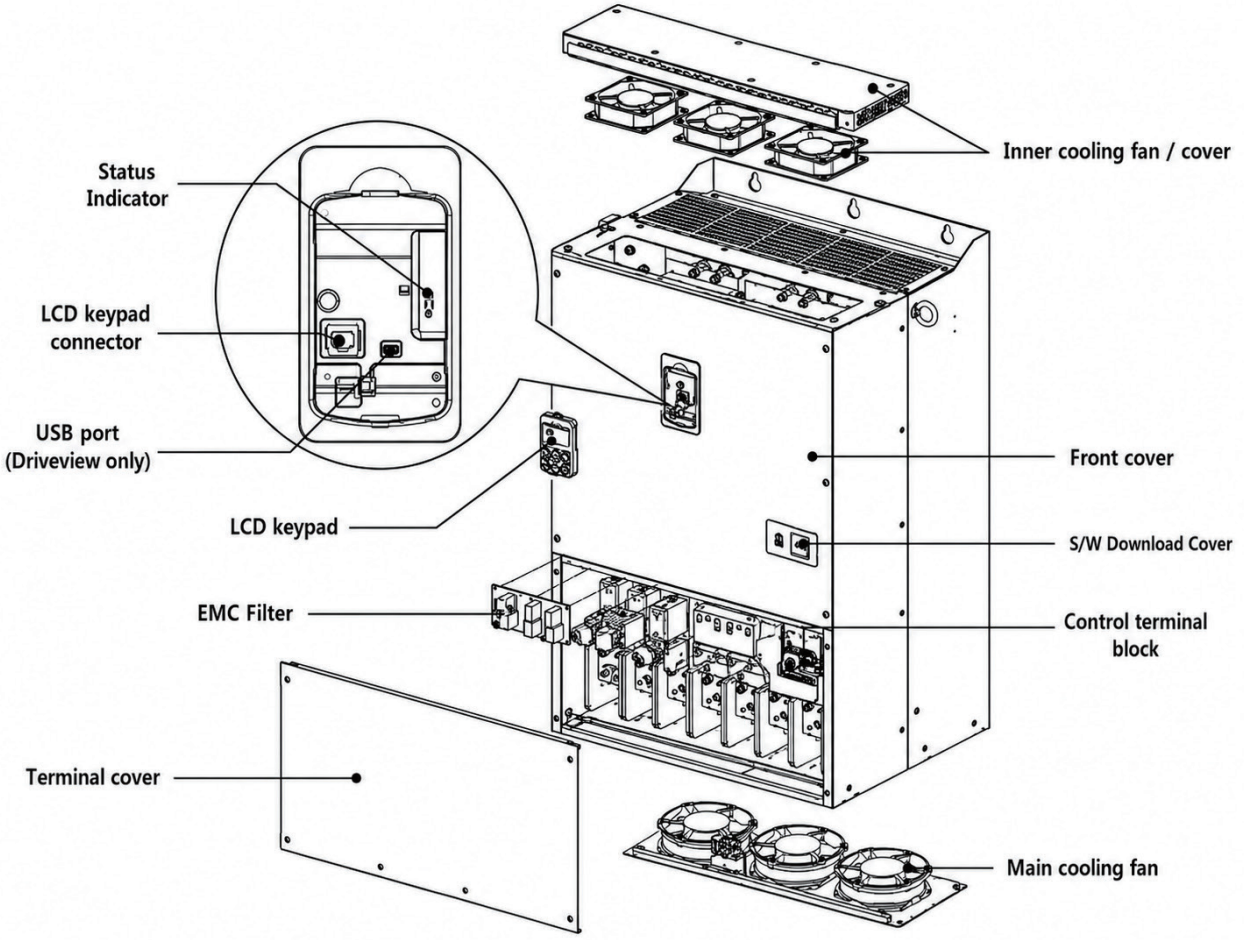
400V : 160–185 kW (3-Phase)
600V : 110–200 kW (3-Phase)



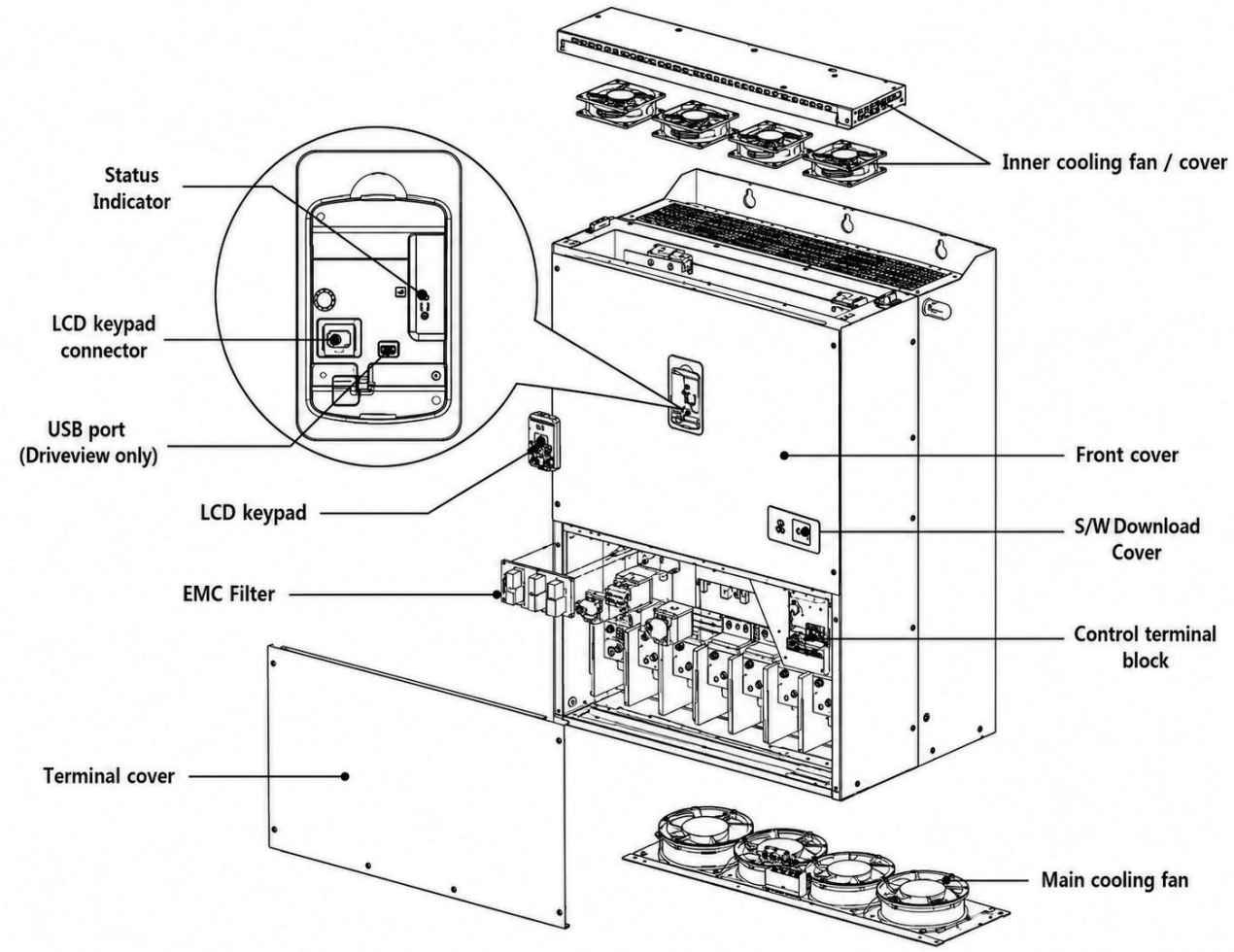
400V : 220–250 kW (3-Phase)
600V : 250–300 kW (3-Phase)



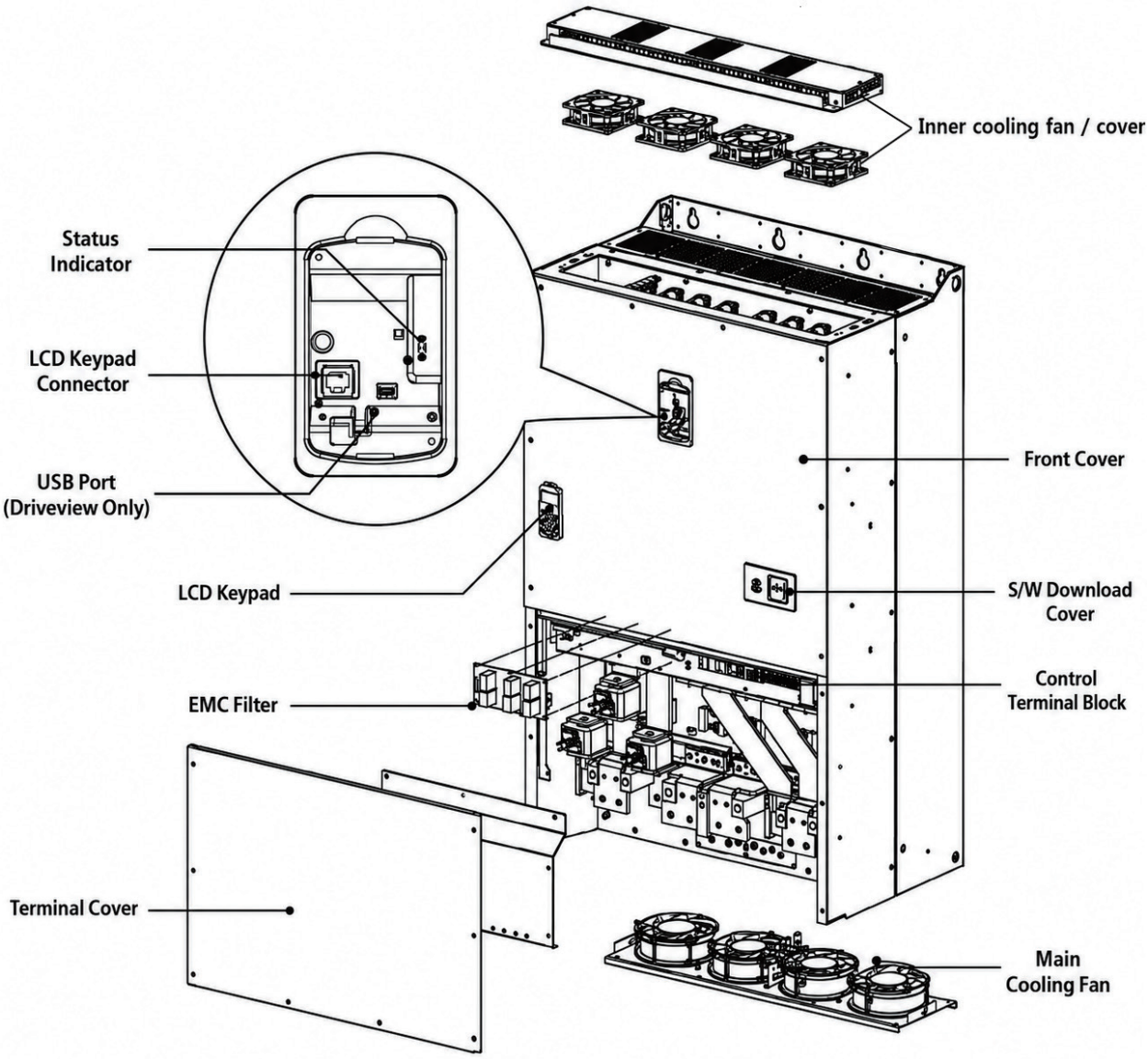
400V : 315–400 kW (3-Phase)



400V : 500 kW (3-Phase)



400V : 750 kW (3-Phase)

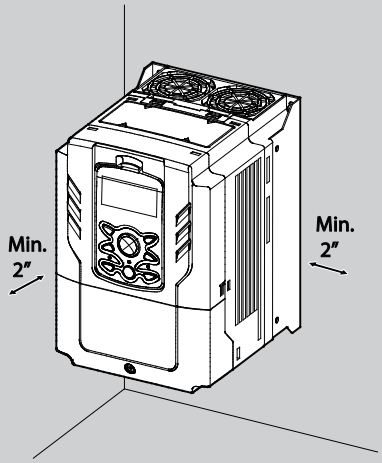


1.3 Installation Considerations

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

Items	Description
Ambient Temperature*	-10 °C–50 °C. A 2.5% current derating is applied above 40 °C. (For 220-750 kW-4, a 1.0% current derating is applied for each 1 °C from 40 °C to 45 °C, and a 2.0% current derating is applied for each 1 °C above 45 °C. The inverter must be operated at less than 75% of its rated capacity when the ambient temperature exceeds 50 °C.)
Ambient Humidity	95% relative humidity (no condensation)
Storage Temperature	-4–149 °F (-20–65 °C)
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. After that the driver rated voltage and the rated output current derating by 1% for every extra 328 ft (100m) up to 13,123 ft (4,000m).
Vibration	less than 1.0 G (9.8m/sec^2) (750kW-4 is based on UL 61800-5-1)
Air Pressure	70 –106 kPa

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



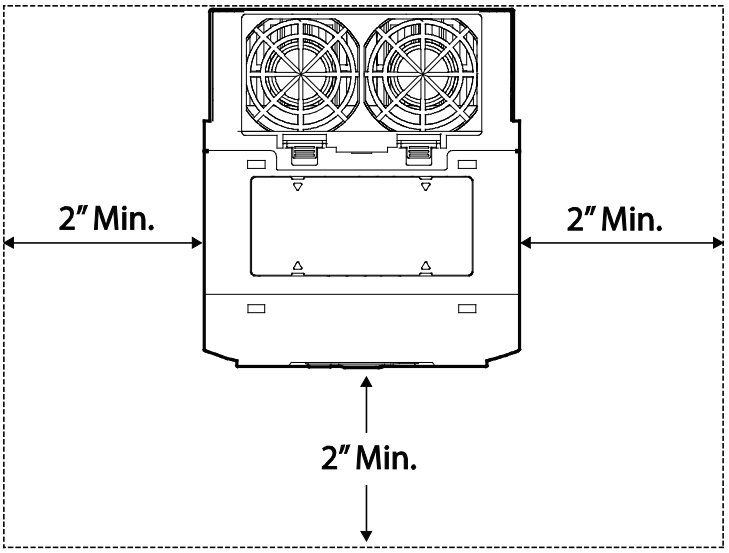
Caution

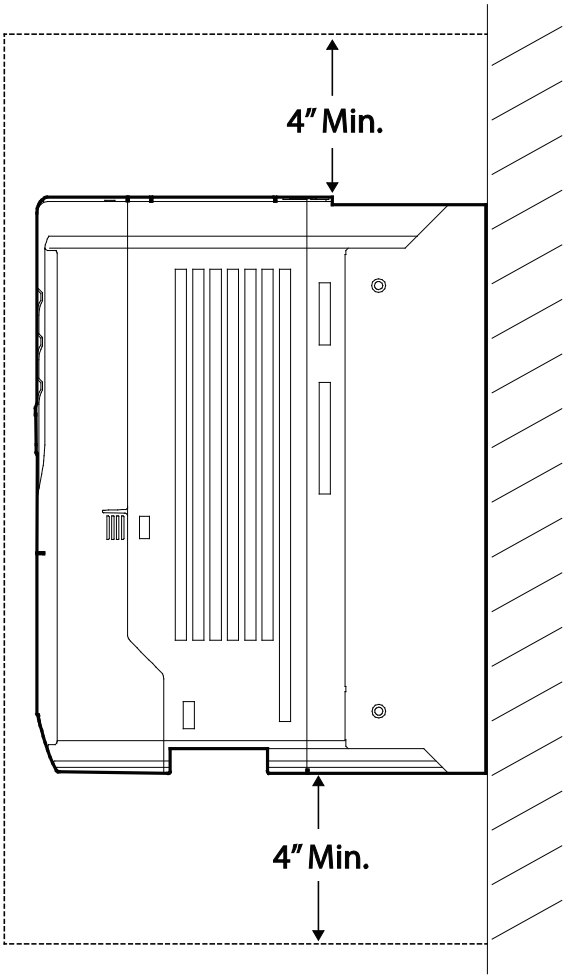
Do not allow the ambient temperature to exceed the allowable range while operating the inverter.

1.4 Selecting and Preparing a Site for Installation

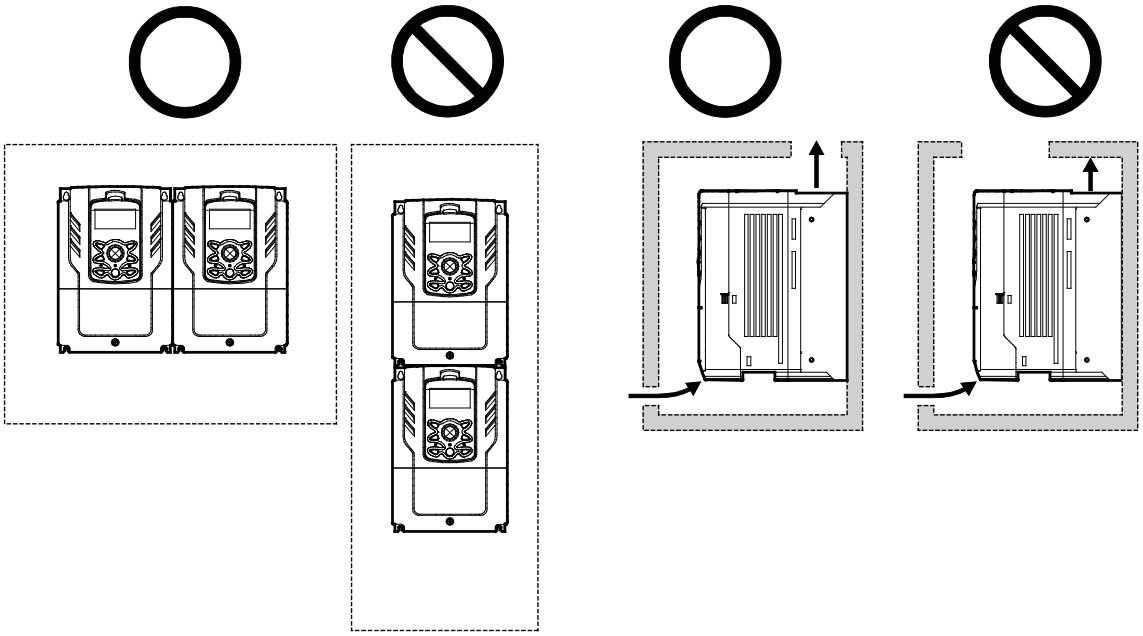
When selecting an installation location consider the following points:

- 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.

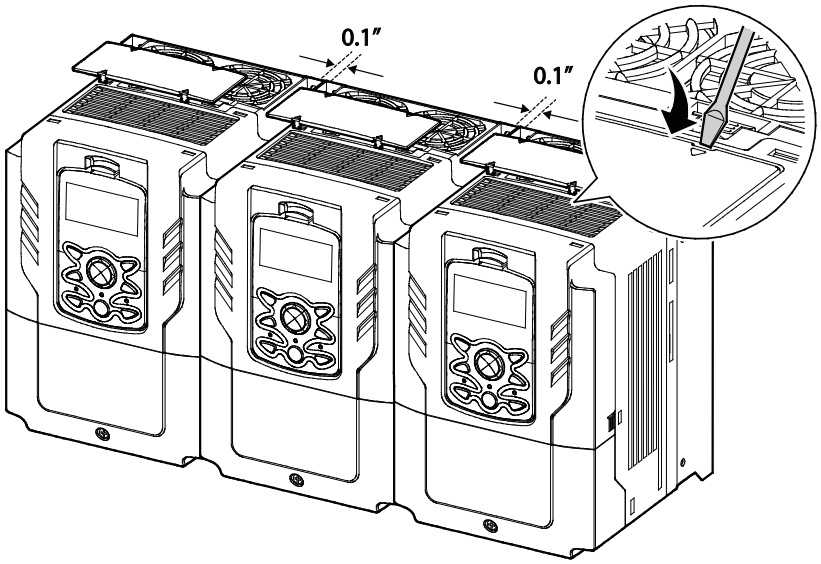




- Ensure sufficient air circulation is provided around the inverter when it is installed. If the inverter is to be installed inside a panel, enclosure, or cabinet rack, carefully consider the position of the inverter's cooling fan and the ventilation louver. The cooling fan must be positioned to efficiently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



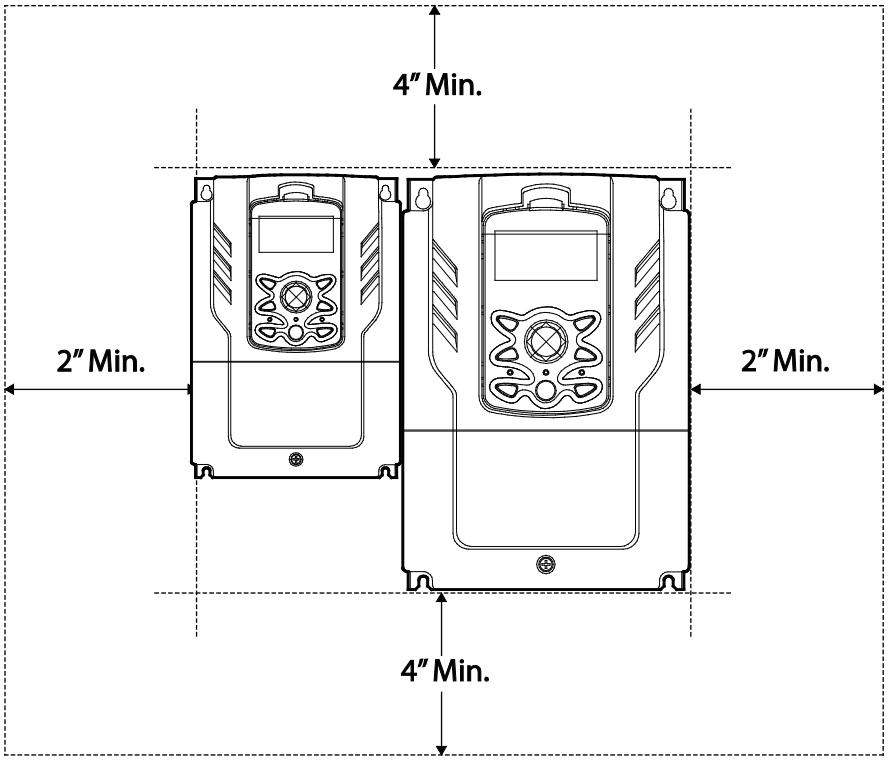
- If you are installing multiple inverters in one location, arrange them side-by-side and remove the vent covers. Use a flat head screwdriver to remove the vent covers. Only the H100+ inverters rated for up to 30 kW may be installed side-by-side.



Note

- The vent covers must be removed for side-by-side installations.
- Side-by-side installation cannot be used for the H100+ inverters rated for 37 kW and above.
- For the H100+ inverters rated for 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 and causing trouble, 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 H100+ inverters rated for up to 30 kW may be installed side-by-side.



1.5 Cable Selection

When you install power and signal cables in the terminal blocks, only use cables that meet the required specification for the safe and reliable operation of the product. 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, 75 ℃ for power terminal wiring.
- Use copper cables rated for 300 V, 75 ℃ for control terminal wiring.
- The inverters in the range between 15 and 90 kW must be grounded conveniently with fixed connections.
- The inverters in the range between 5.5 kW and 11 kW must be grounded with and industrial connector according to IEC 60309.
- The minimum size of the protective earthing conductor shall comply with the local safety regulations for high protective earthing conductor current equipment.
- Only one conductor per terminal should be simultaneously connected

Ground Cable and Power Cable Specifications

Load (kW)		Ground Wire		Input/Output Power Wire			
		mm2	AWG	mm2		AWG	
				R/S/T	U/V/W	R/S/T	U/V/W
3-Phase 200 V	0.75	3.5	12	1.5	1.5	16	16
	1.5						
	2.2						
	3.7			2.5	2.5	14	14
	5.5	10	10	4	4	12	12
	7.5			6	6	10	10
	11			10	10	8	8
	15	14	6	16	16	6	6
	18.5			25	22	4	4
	22	25	4	25	25	4	4
	30			50	50	1/0	1/0
	37	38	2	70	70	1/0	1/0
	45					2/0	2/0
	55	50x2	1x2	70x2	70x2	1/0x2, 300	1/0x2, 300
	75			95x2	95x2	2/0x2, 400	2/0x2, 400
	90	50x2 75x2	1/0x2	95x2	95x2	4/0x2	4/0x2
3-Phase 400 V	0.75	2	14	1.5	1.5	16	16
	1.5						
	2.2						
	3.7						
	5.5	4	12	2.5	2.5	14	14
	7.5			4	2.5	12	14
	11			4	4	12	12
	15	14	9	6	6	10	10
	18.5			16	10	6	8
	22	16	6	16	10	6	8
	30			25	16	4	6
	37	25	4	25	25	4	4
	45			25	25	4	4
	55			50	50	1/0	1/0
	75	38	2	70	70	1/0	1/0
	90			70	70	2/0	2/0
	110	50x2	1x2	70x2	70x2	1/0x2, 300	1/0x2, 300
	132			95x2	95x2	2/0x2, 400	2/0x2, 400
	160	50x2,70x2	1/0x2	95x2	95x2	4/0x2	4/0x2
	185	70x2,95x2	3/0x2	120x2	120x2	250x2	250x2

Load (kW)		Ground Wire		Input/Output Power Wire			
		mm2	AWG	mm2		AWG	
				R/S/T	U/V/W	R/S/T	U/V/W
3-Phase 400 V	220	95x2	250x2	150x2	150x2	300x2	300x2
	250		300x2	185x2	185x2	350x2	350x2
	315	60x4, 150x2	2/0x4	120x4 400x2	120x4 400x2	250x4 800x2	250x4 800x2
	355	70x4, 150x2	3/0x4				
	400	95x4, 200x2	4/0x4				
	500	120x4 350x2	4/0x4 750x2	185x4 630x2	185x4 630x2	350x4 1500x2	350x4 1500x2
	750	127x4	250kcmilx4	253x4	253x4	500kcmilx4	500kcmilx4
3-Phase 600 V	5.5	2.5	14	2.5	2.5	14	14
	7.5		12			14	12
	11		10			12	10
	15	4	10	4	4	10	10
	18.5	6	8	4	6	8	8
	22	10	8	6	10	8	8
	30		6	10	10	8	6
	37	16	4	16	16	4	4
	45			16	25	4	4
	55			25	35	3	2
	75	25	3	50	50	1	1/0
	90	35	2	70	70	2/0	2/0
	110	50	1	95	95	3/0	3/0
	132	70	2/0	120	120	250	250
	160	35 x2	2/0	70 x2	70 x2	2/0	2/0
		95		150	150	350	350
	200	35 x2	1 x2	70 x2	70 x2	3/0 x2	3/0 x2
		95	3/0				
	250	50 x2	1/0 x2	95 x2	95 x2	4/0 x2	4/0 x2
		95	4/0				
	300	70 x2	1/0 x2	120 x2	120 x2	250 x2	250 x2
			250				

* Lugs of the field wiring must be UL approved.

* Cable thickness : mm^2 is based on IEC standard,and AWG is based on UL standard.

Signal (Control) Cable Specifications

Terminals	Wire thickness 1)	
	mm^2	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 H100+ 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.

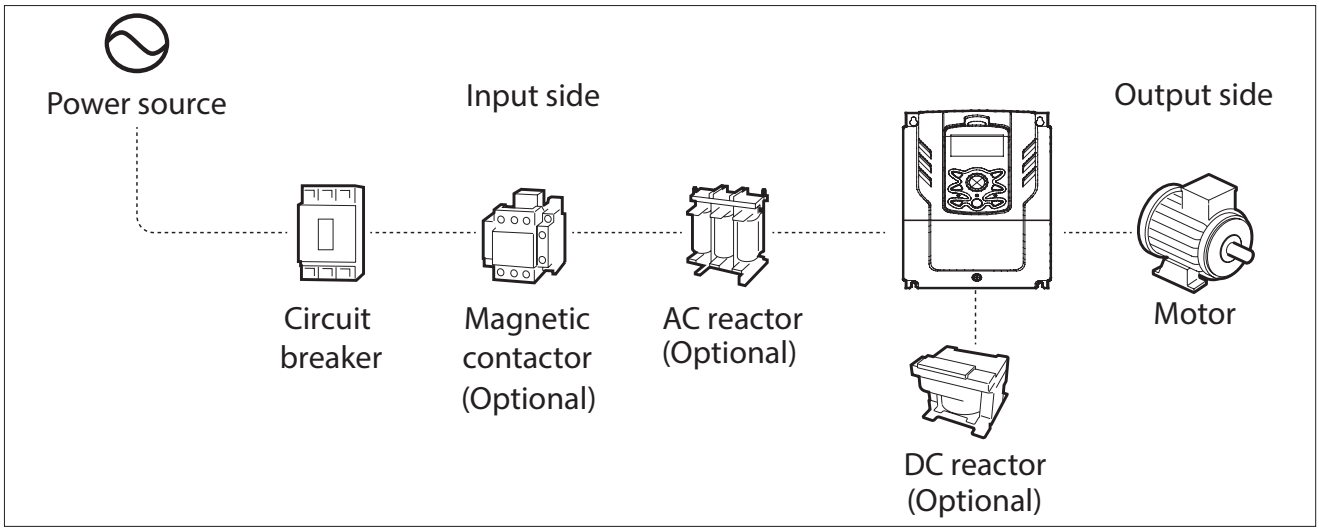


Basic configuration diagram

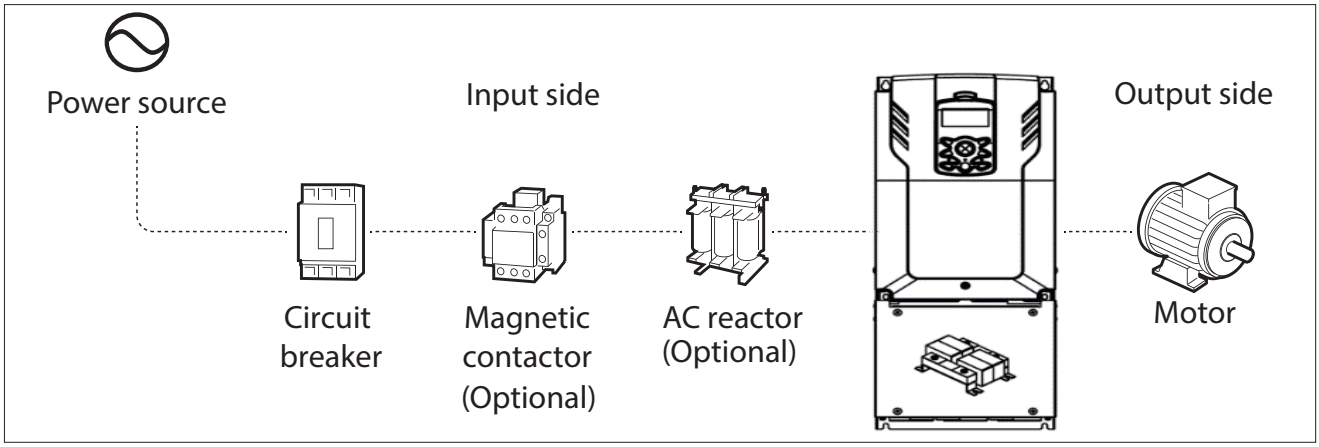
The reference diagram below shows a typical system configuration showing the inverter and peripheral devices.

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 (resistor brakes, contactors, noise filters, etc.) are available.

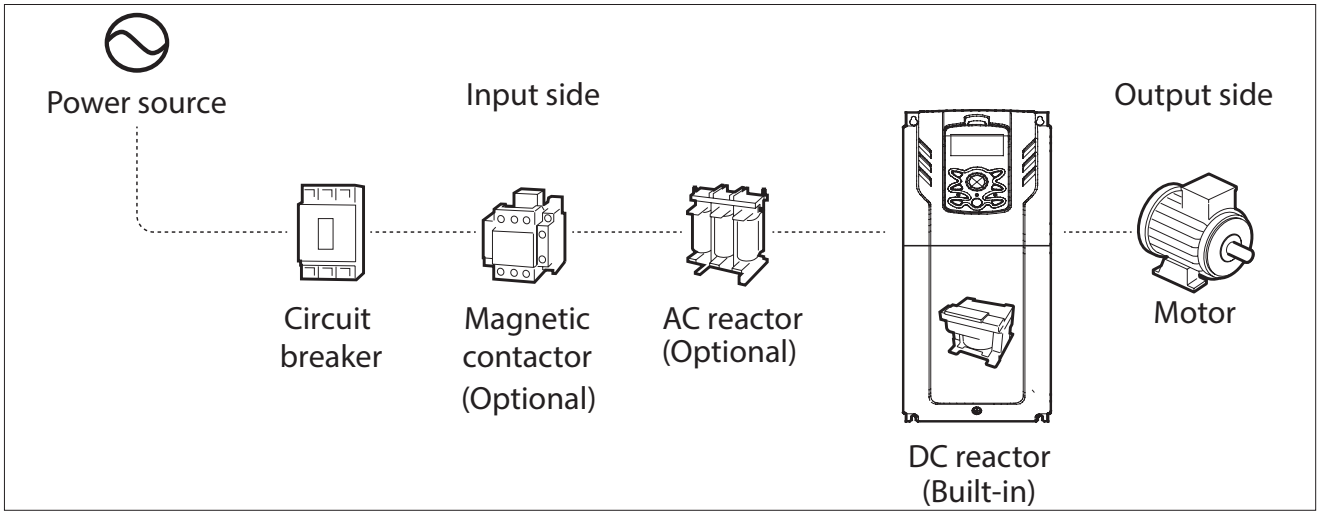
200[V] : 0.75–18.5kW, 400[V] : 0.75–30kW



600[V] : 5.5-30kW (Built-in) DC Reactor)



200[V] : 22–90kW, 400[V] : 37–750kW, 600[V] : 37–300kW



Caution

- Figures in this manual are shown with covers or circuit breakers removed to show a more detailed view of the installation arrangements. Install covers and circuit breakers 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.
- 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. Refer to *"10.5 Fuse and Reactors Specifications" on page 447* and carefully select a reactor that meets the requirements.

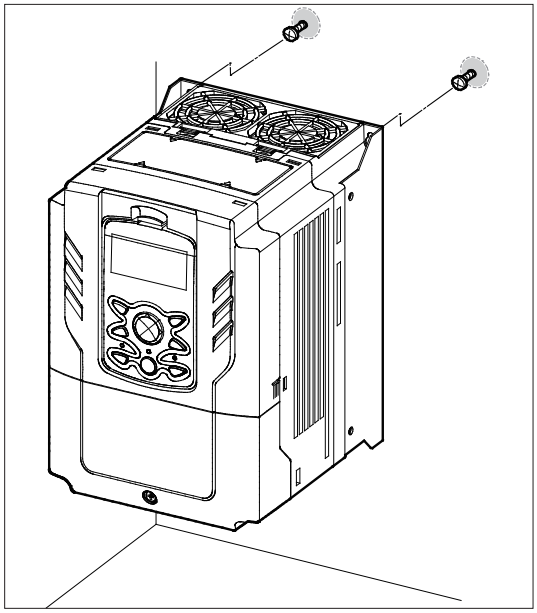
2.1 Mounting the Inverter

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 airflow.

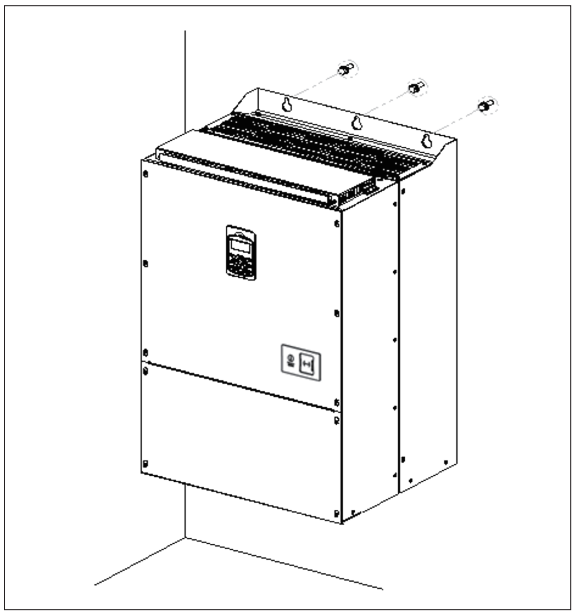
Select a wall or panel suitable to support the installation. Refer to *"10.3 External Dimensions" on page 437* and check the inverter's mounting bracket dimensions.

- Use a level to draw a horizontal line on the mounting surface, and then carefully mark the fixing points.
- Drill the two upper mounting bolt holes, and then install the mounting bolts. Do not fully tighten the bolts at this time. Fully tighten the mounting bolts after the inverter has been mounted.
- Mount the inverter on the wall or inside a panel using the two upper bolts, and then fully tighten the upper mounting bolts.

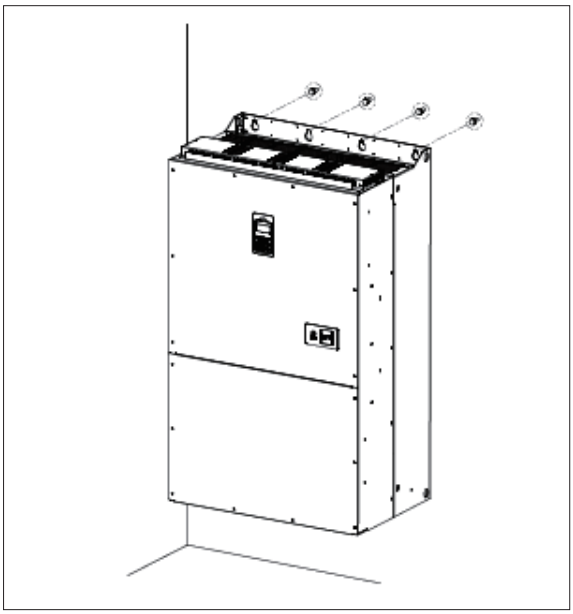
200[V] : 0.75–90kW, 400[V] : 0.75–185kW, 600[V] : 37–200kW



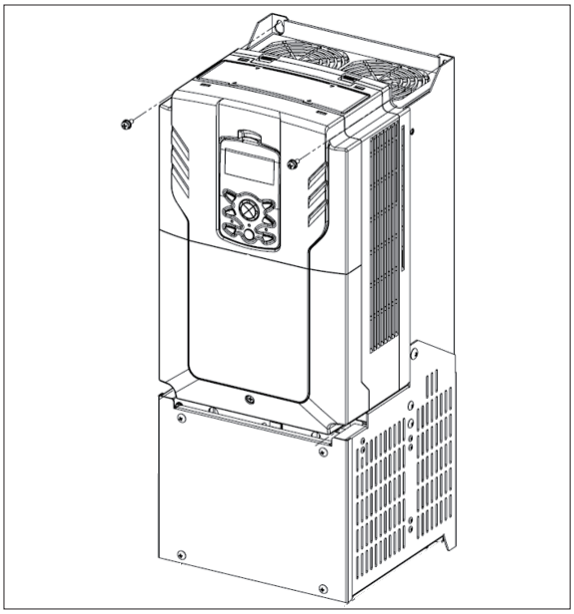
400[V] : 220–500kW, 600[V] : 250–300kW



400[V] : 750kW



600[V] : 5.5–30kW



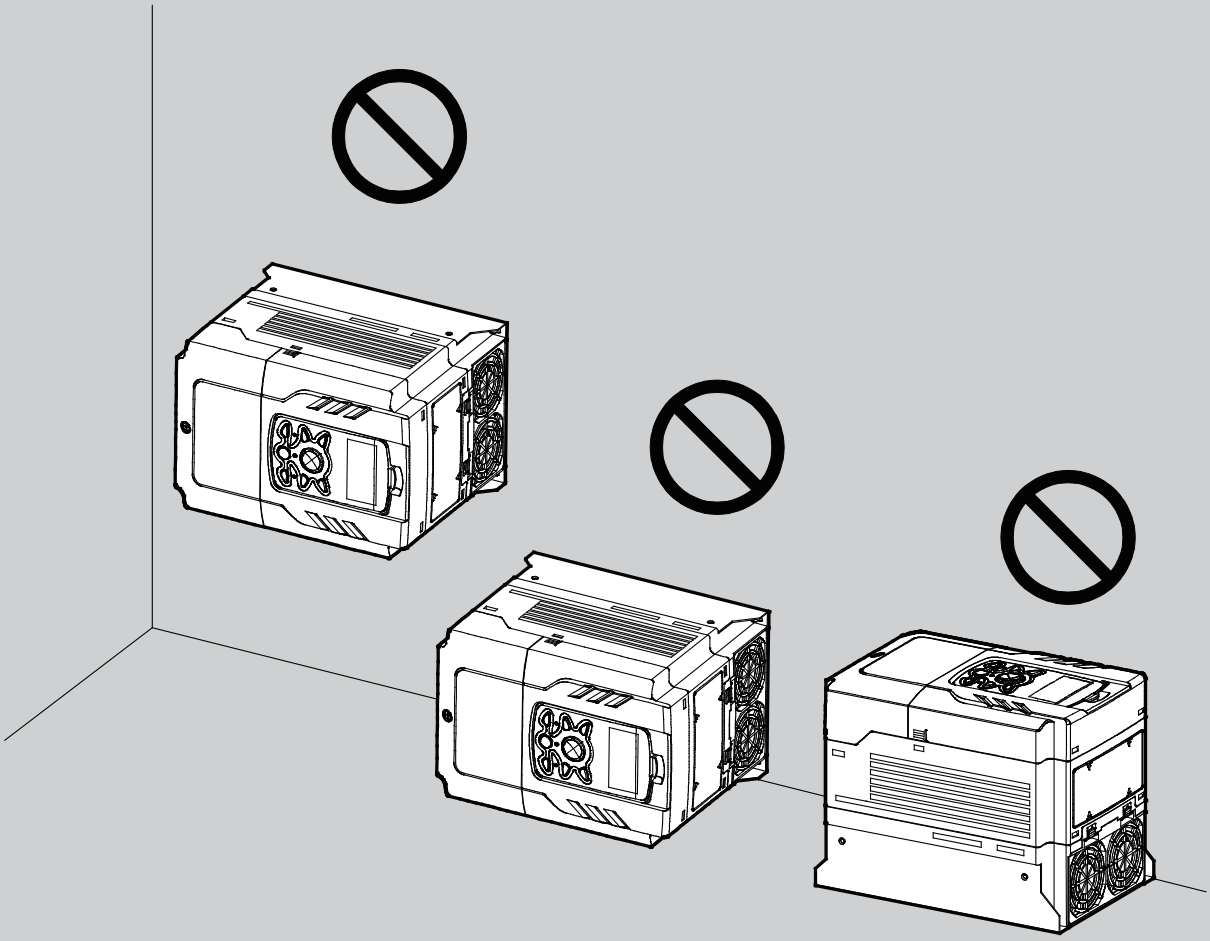
- Install the two lower mounting bolts. Ensure that the inverter is placed flat on the mounting surface, and that the installation surface can securely support the weight of the inverter.

⚠ Caution

Do not transport the inverter by lifting with the inverter's covers or plastic surfaces. The inverter may tip over if covers break, causing 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 method that is suitable for the weight.

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 H100+ series inverter comes from the factory with a CR2032 lithium-manganese battery pre-installed on the I/O 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

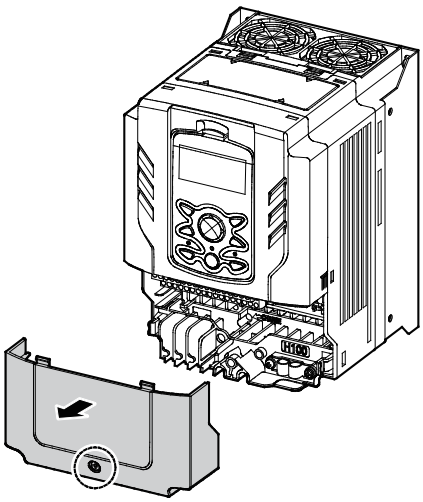
ESD (Electrostatic discharge) from the human body may damage sensitive electronic components on the PCB. Therefore, be extremely careful not to touch the PCB or the components on the PCB with bare hands while you work on the I/O PCB.

To prevent damage to the PCB from ESD, touch a metal object with your hands to discharge any electricity before working on the PCB, or wear an anti-static wrist strap and ground it on a metal object.

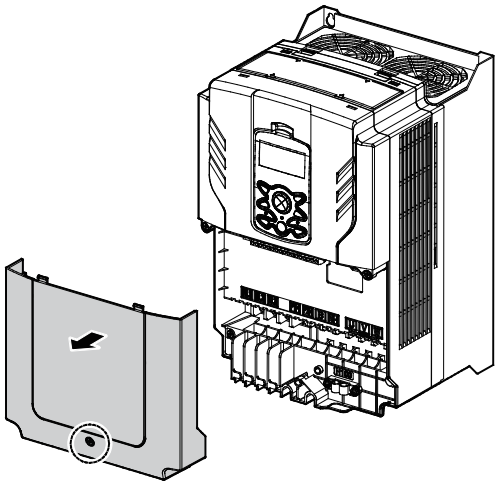
Follow the instructions below to remove the protective insulation strip and enable the RTC feature on the H100+ series inverters.

1. Turn off the inverter and make sure that DC link voltage has dropped to a safe level.
2. Loosen the screw on the power cover then remove the power cover.

200/400/600V

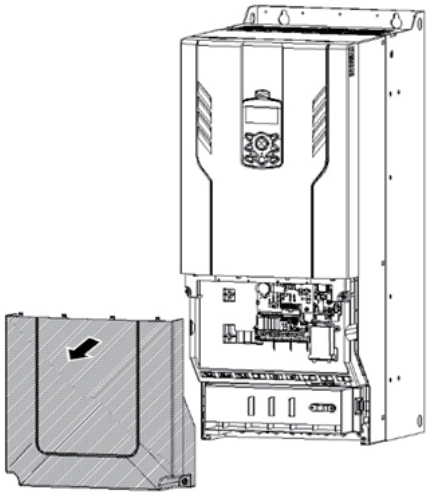


0.75–18.5 kW-2 Models
0.75–30 kW-4 Models

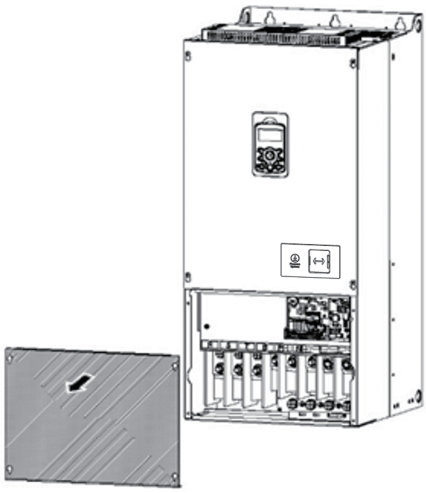


22–45 kW-2 Models
37–90 kW-4 Models
37–90 kW-5 Models

200/400/600V

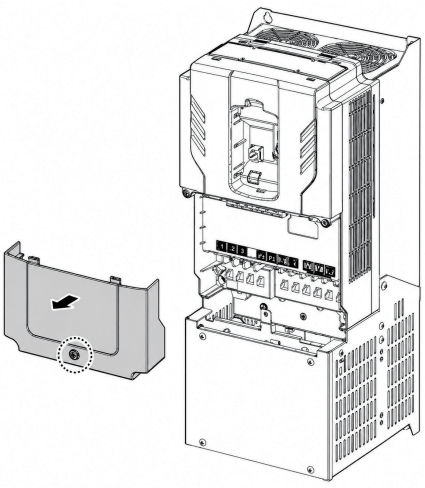


55–90 kW-2 Models
110–185 kW-4 Models
110–200 kW-5 Models



220–750 kW-4 Models
250–300 kW-5 Models

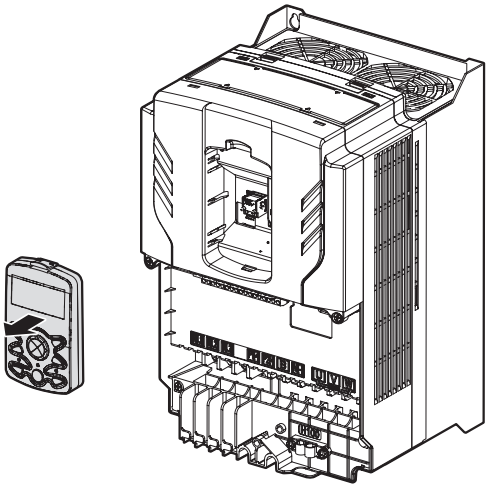
600V



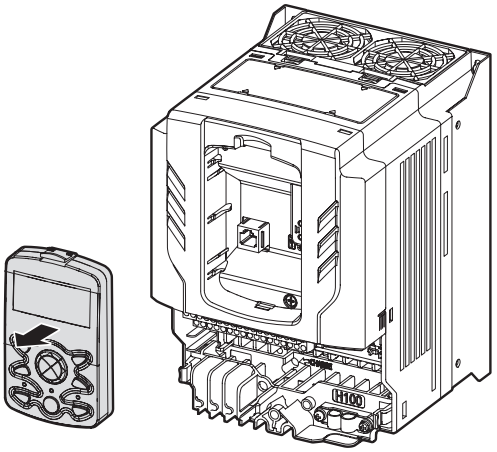
5.5–30kW Models

3. Remove the keypad from the inverter body.

200/400/600V

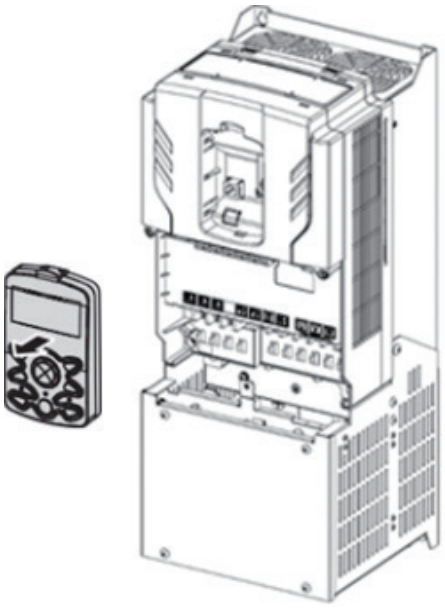


0.75–18.5 kW-2 Models
0.75–30 kW-4 Models



22–45 kW-2 Models
37–90 kW-4 Models
37–90 kW-5 Models

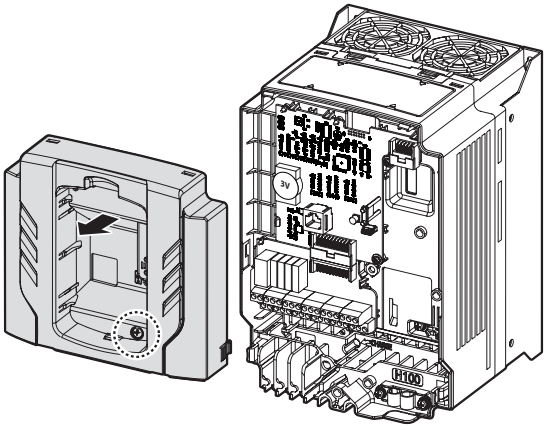
600V



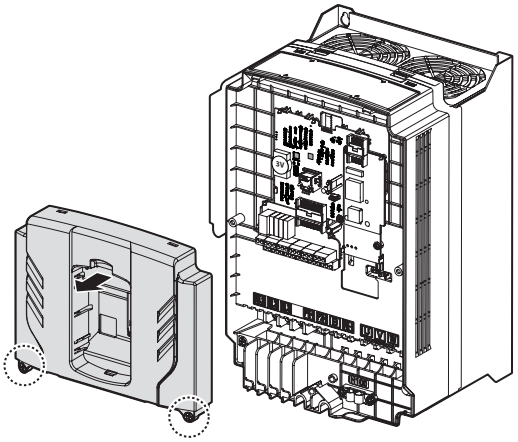
5.5–30 kW Models

4. Loosen the screws securing the front cover and remove the front cover by lifting it. The main PCB is exposed.

200/400/600V

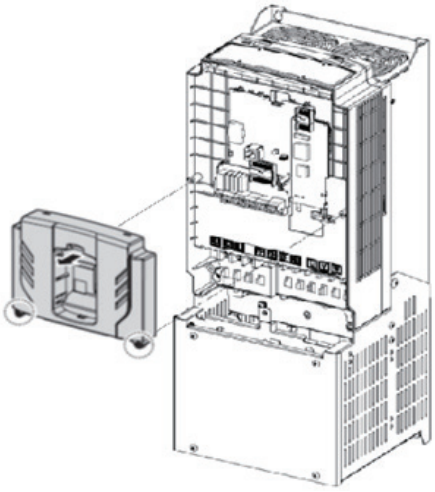


0.75–18.5 kW-2 Models
0.75–30 kW-4 Models



22–45 kW-2 Models
37–90 kW-4 Models
37–90 kW-5 Models

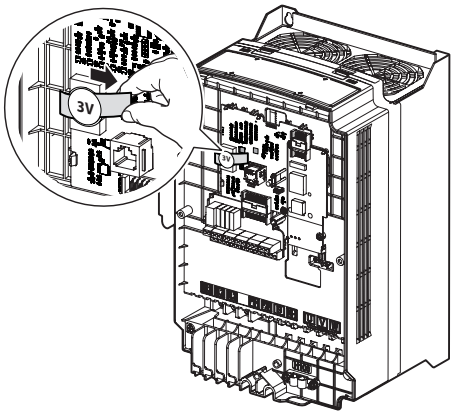
600V



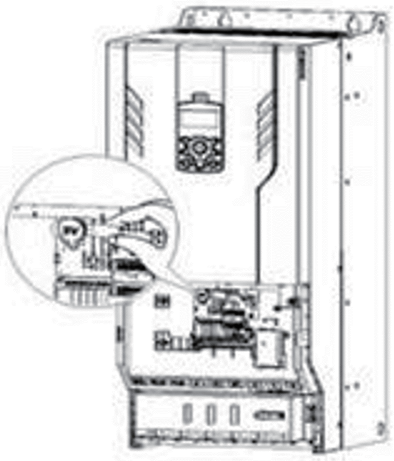
5.5–30 kW Models

5. Locate the RTC battery holder on the I/O PCB, and remove the protective insulation strip by gently pulling it.

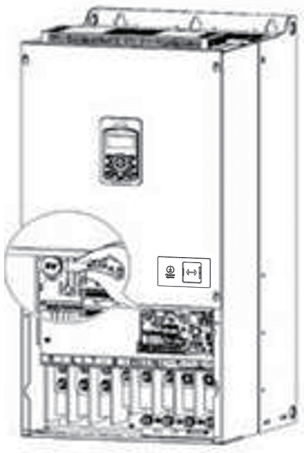
200/400/600V



0.75-45 kW-2 Models
0.75-90 kW-4 Models
37–90 kW-5 Models

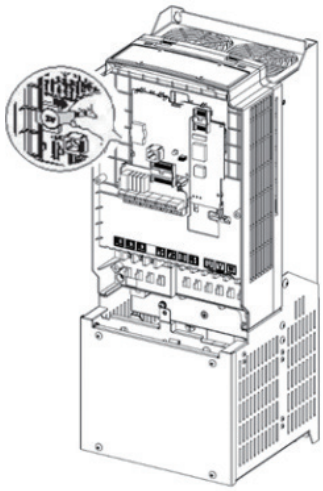


55-90 kW-2 Models
110-185 kW-4 Models
110-120 kW-5 Models



220-750 kW-4 Models
250-300 kW-5 Models

600V



5.5–30 kW Models

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

⚠ Caution

Ensure that the inverter is turned off and DC link voltage has dropped to a safe level before opening the terminal cover and installing the RTC battery.

2.3 Cable Wiring

Open the terminal cover, remove the cable guides, and then install the ground connection as specified. 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 before carrying out wiring connections to the inverter. All warning instructions must be followed.

⚠ Caution

- Install the inverter before carrying out wiring connections.
- Ensure that no small metal debris, such as wire clippings, remain inside the inverter. Metal debris in the inverter may cause inverter failure.
- Tighten terminal screws to their specified torque. Loose terminal block screws may allow the cables to disconnect and cause a short circuit or inverter failure. Refer to *"10.6 Terminal Screw Specifications" on page 449*.
- Do not place heavy objects on top of electric cables. Heavy objects may damage the cable and result in electric shock.
- Use cables with the largest cross-sectional area, appropriate for power terminal wiring, to ensure that voltage drops do not exceed 2%.
- Use copper cables rated at 600 V, 75 °C for power terminal wiring.
- Use copper cables rated at 300 V, 75 °C for control terminal wiring.
- If you need to re-wire the terminals due to wiring-related faults, ensure that the inverter keypad display is turned off and the charge lamp under the terminal cover is off before working on wiring connections. The inverter may hold a high voltage electric charge long after the power supply has been turned off.
- The accessible connections and parts listed below are of protective class 0. It means that the protection of these circuits relies only upon basic insulation and becomes hazardous in the event of a failure of the basic insulation. Therefore, devices connected to these circuits must provide electrical-shock protection as if the device was connected to supply mains voltage. In addition, during installation these parts must be considered, in relation with electrical-shock, as supply mains voltage circuits.

  [Class 0 circuits]

  ➜ MULTI FUNCTION INPUT : P1-P7, CM

  ➜ ANALOG INPUT : VR, V1, I2, TI

  ➜ ANALOG OUTPUT : AO1, AO2, TO

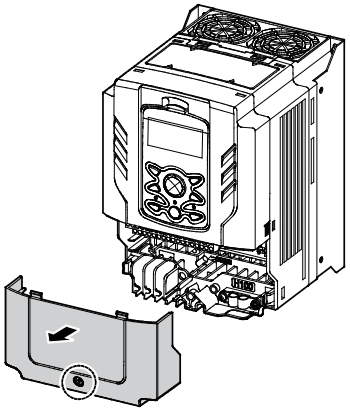
  ➜ CONTACT : Q1, EG, 24,A1, C1, B1, A2–5, C2–5, S+, S-, SG

Step 1 Terminal Cover and Cable Guide

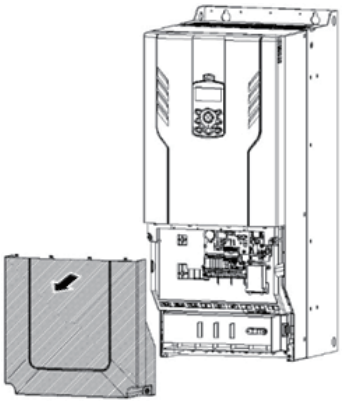
The terminal cover and cable guide must be removed to install cables. Refer to the following procedures to remove the covers and cable guide. The steps to remove these parts may vary depending on the inverter model.

- Loosen the bolt that secures the terminal cover. Then remove the cover by lifting it from the bottom and away from the front.

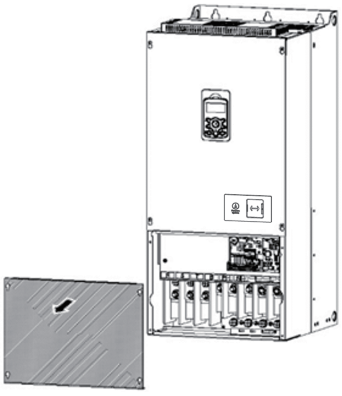
200/400/600V



0.75-45 kW-2 Models
0.75-90 kW-4 Models
37–90 kW-5 Models

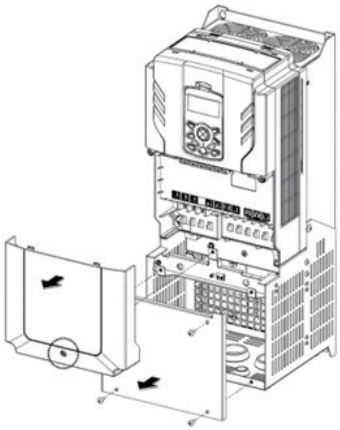


55-90 kW-2 Models
110-185 kW-4 Models
110-120 kW-5 Models

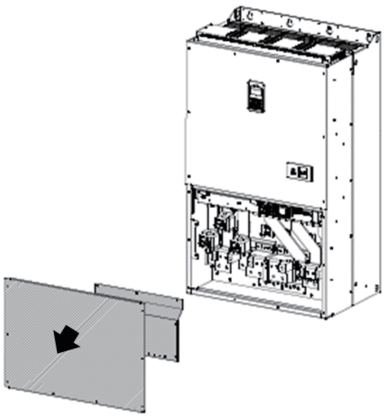


220-500 kW-4 Models
250-300 kW-5 Models

400V/600V



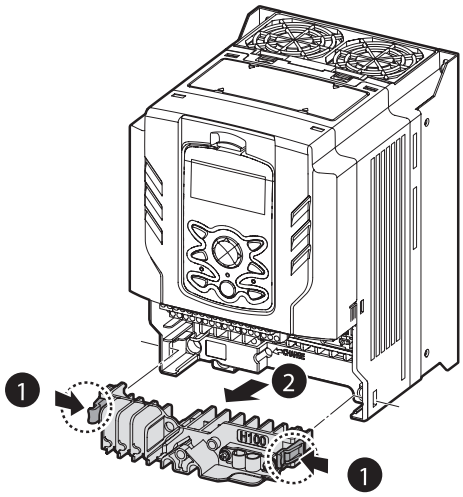
5.5–30 kW Models



750kW-4 Models

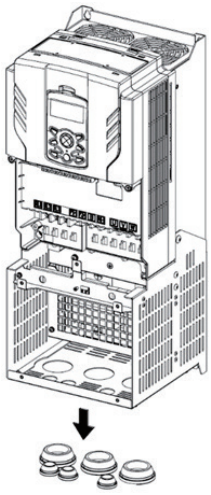
- Push and hold the levers on both sides of the cable guide (❶) and then remove the cable guide by pulling it directly away from the front of the inverter (❷). In some models (37–90kW) where the cable guide is secured by a bolt, remove the bolt first.

200/400/600V



0.75–18.5 / 55–90 kW-2 Models
0.75–30 / 110–185 kW-4 Models
110-200 kW-5 Models

600V



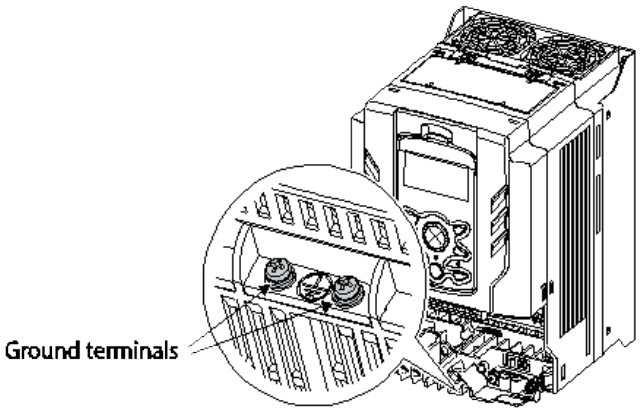
5.5–30 kW Model

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

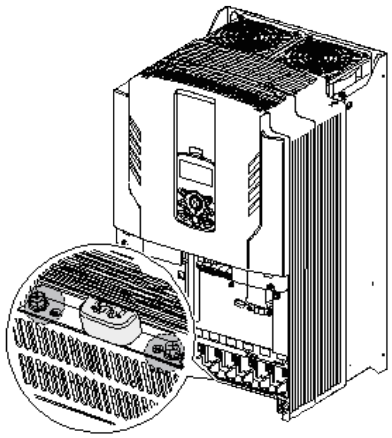
Step 2 Ground Connection

Remove the terminal cover(s) and cable guide. Then follow the instructions below to install the ground connection for the inverter.

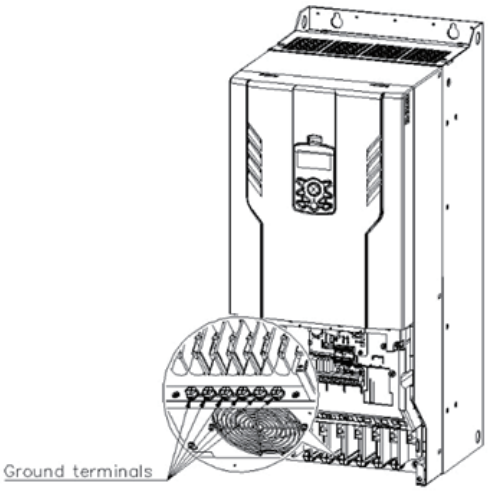
- Locate the ground terminal and connect an appropriately rated ground cable to the terminals. Refe *"1.5 Cable Selection" on page 14* to find the appropriate cable specification for your installation.



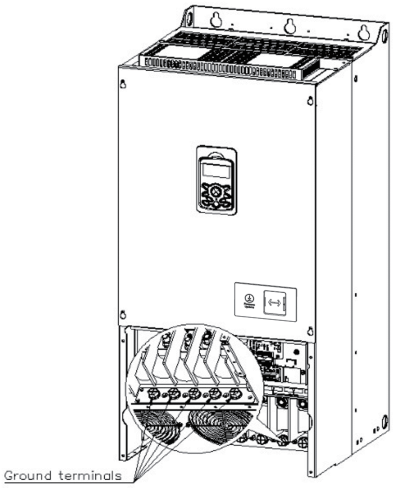
0.75–18.5 kW-2 Models (3Phase)
0.75–30 kW-4 Models (3Phase)
5.5-30 kW-5 (3-Phase)



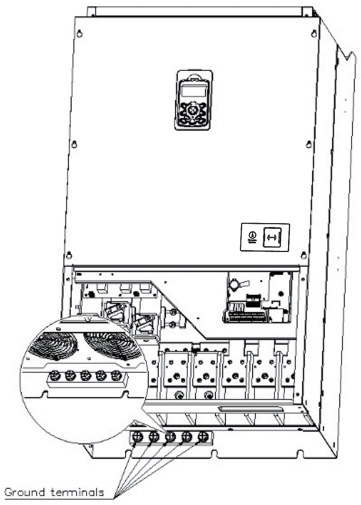
22–45 kW-2 Models (3Phase)
37–90 kW-4 Model (3Phase)
37-90 kW-5 (3-Phase)



55–90 kW-2 Models (3Phase)
110–185 kW-4 Models (3Phase)
110-200 kW-5 (3-Phase)



220–250 kW-4 Model (3Phase)
250-300 kW-5 (3-Phase)



315–750 kW-4 Models (3 Phase)

- Connect the other ends of the ground cables to the supply earth (ground) terminal

Note

- 200 V products require Class 3 grounding. Resistance to ground must be ≤ 100 Ω.
- 400 V 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 protective earthing conductor. If a RCD or monitoring (RCM) device is used for protection, only RCD or RCM of 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 detailed descriptions to understand the function and location of each terminal before making wiring connections. Ensure that the cables selected meet or exceed the specifications *"1.5 Cable Selection" on page 14* before installing them.

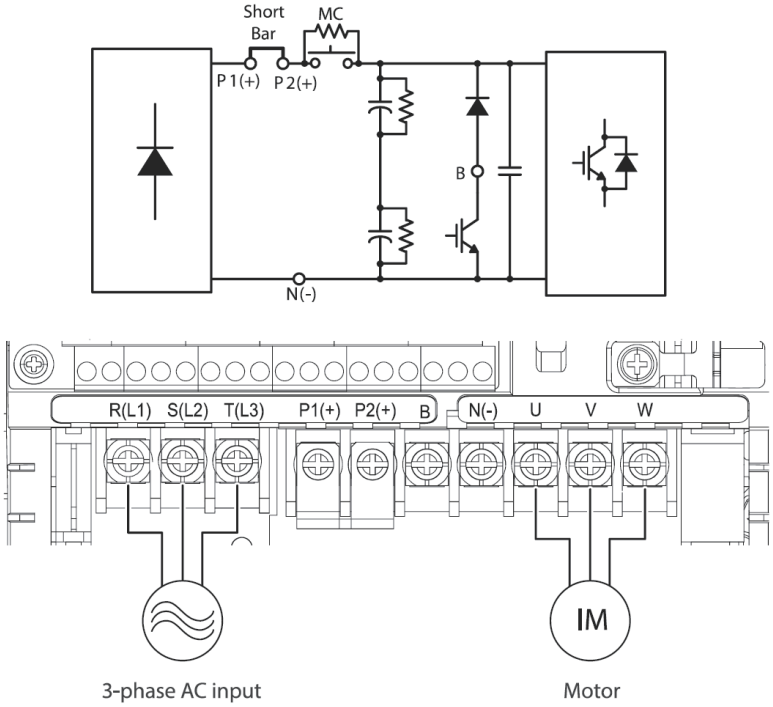
ⓘ Caution

- 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, 75 ℃ rating for the power terminal wiring, and 300 V, 75 ℃ rating for the control terminal wiring.
- Power supply wirings must be connected to the R, S, and T terminals. Connecting them to the U, V, W terminals causes internal damages to the inverter. Motor should be connected to the U, V, and W Terminals. Arrangement of the phase sequence is not necessary.
- Equipment must only be fitted to the closed electric operating areas.

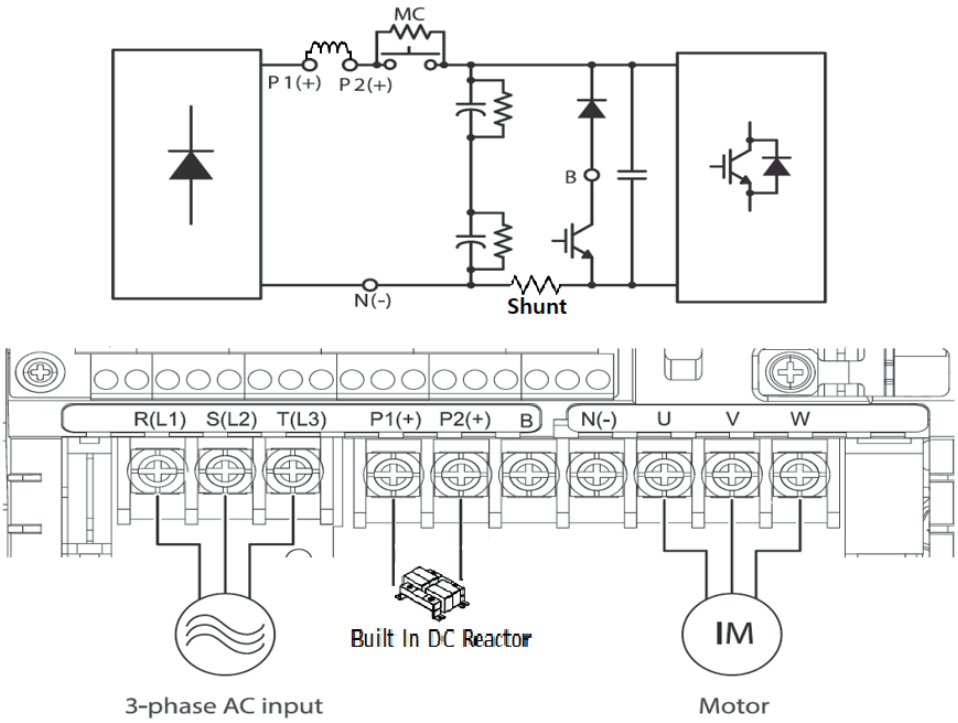
Attention

- Appliquer des couples de marche aux vis des bornes. Des vis desserrées peuvent provoquer des courts-circuits et des dysfonctionnements. Ne pas trop serrer la vis, car cela risque d'endommager les bornes et de provoquer des courts-circuits et des dysfonctionnements.
- Utiliser uniquement des fils de cuivre avec une valeur nominale de 600 V, 90 °C pour le câblage de la borne d'alimentation, et une valeur nominale de 300 V, 75 °C pour le câblage de la borne de commande.
- Les câblages de l'alimentation électrique doivent être connectés aux bornes R, S et T. Leur connexion aux bornes U, V et W provoque des dommages internes à l'onduleur. Le moteur doit être raccordé aux bornes U, V et W. L'arrangement de l'ordre de phase n'est pas nécessaire.

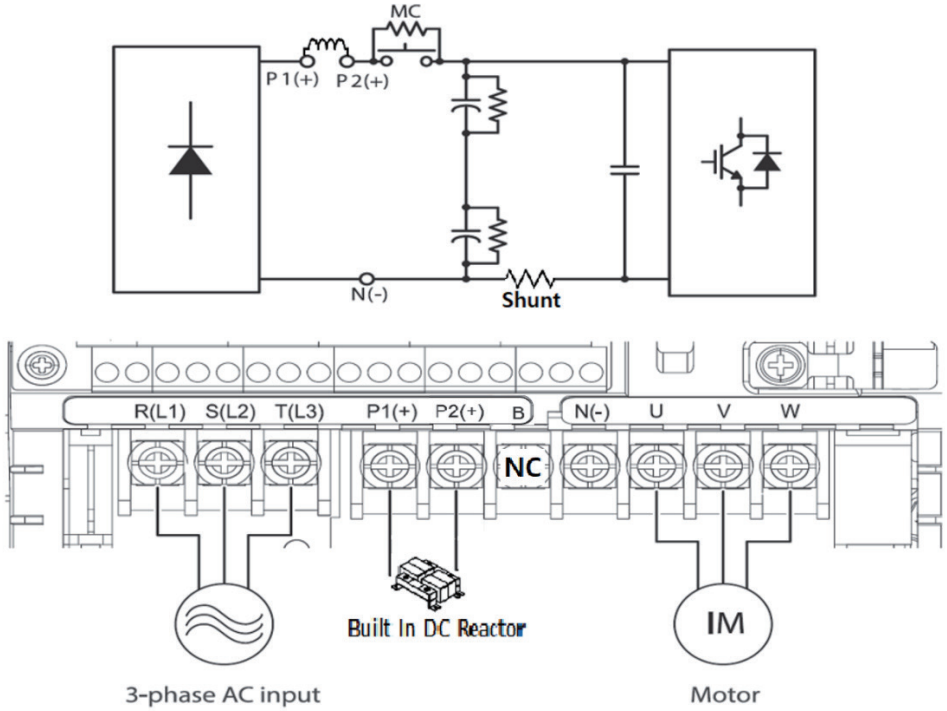
200V : 0.75–18.5 kW (3-Phase) & 400V : 0.75–30 kW (3-Phase)



600V : 5.5-18.5 kW (3-Phase, Built-in DC Reactor)



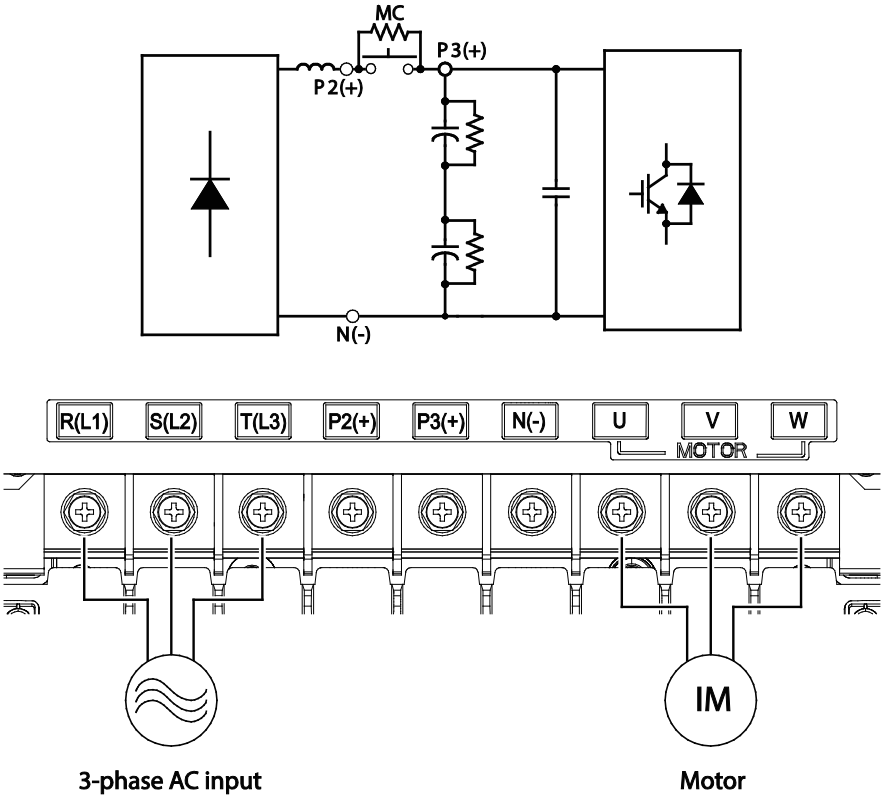
600V : 22-30kW (3-Phase, Built-in DC Reactor)



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 link terminal	DC voltage terminals.
P1(+) / P2(+)	DC Reactor terminal	DC Reactor wiring connection. (When you use the DC Reactor, must remove short-bar)
P2(+) / B	Brake resistor terminals	Brake resistor wiring connection.
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

200V : 22–45 kW (3-Phase), 400V : 37–90 kW (3-Phase), 600V : 37–90 kW (3-Phase)

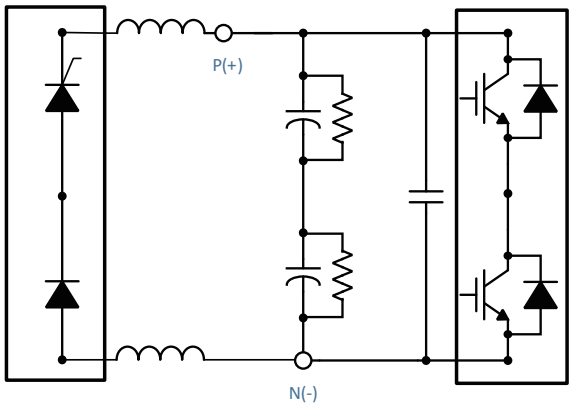


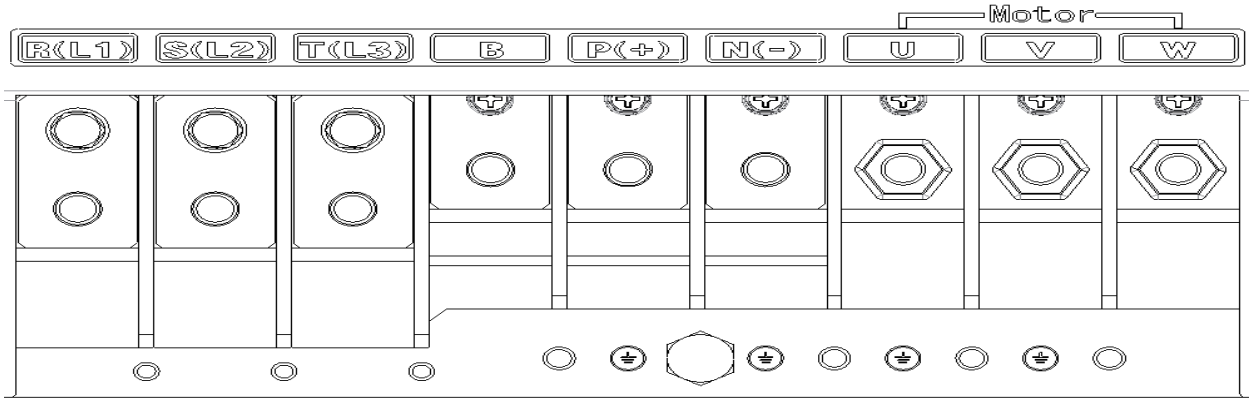
Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
P2(+) / N(-)	DC link terminal	DC voltage terminals.

Terminal Labels	Name	Description
P3(+) / N(-)	Brake unit terminals	Brake unit wiring connection.
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

200V : 55–90kW (3-Phase), 400V : 110–250kW (3-Phase), 600V : 110–300 kW (3-Phase)

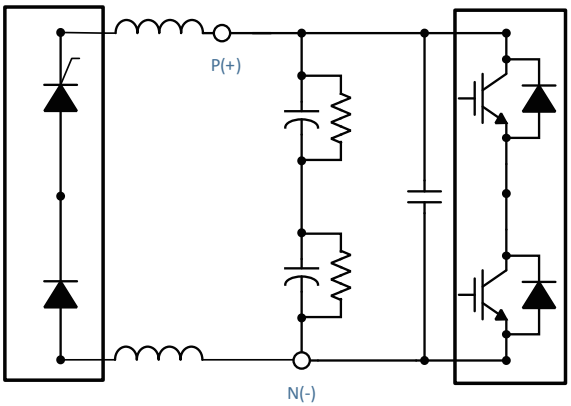


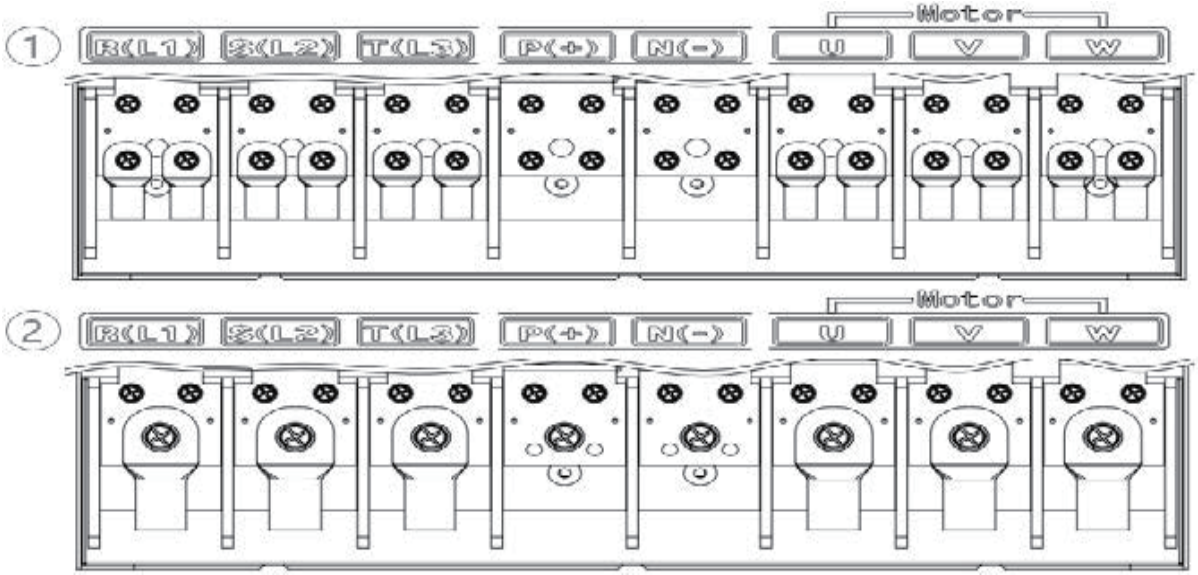


Power Terminal Labels and Descriptions

Terminal Labels	Name	Description
R(L1) / S(L2) / T(L3)	AC power input terminal	Mains supply AC power connections.
B	-	It can not be used because it does not provide a braking module
P(+) / N(-)	DC link terminal (or Brake unit terminals)	DC voltage terminals. (or Brake unit wiring connection)
U / V / W	Motor output terminals	3-phase induction motor wiring connections.

400V : 315–750kW (3-Phase)





Power Terminal Labels and Descriptions

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

Wiring Instruction

1. For the wiring diagram marked as ①, connect two wries per bolt using the provided bolts.
   - This is the recommended method by LS ELECTRIC.
2. For the wiring diagram marked as ②, remove the two bolts provided in diagram ①, and obtain bolts suitable for the product capacity described as below to connect two wires.
   - Bolt sizes : 315-400 kW (M12 x L20), 500kW (M16 x L30)
3. For 750kW model, only ① is applicable, and ② is not applicable.

Note

- Apply a DC input to the P2 (+) and N (-) terminals to operate the inverter on DC voltage input.
- Use STP (Shielded Twisted Pair) cables to connect a remotely located motor with the inverter. Do not use 3 core cables.
- Make sure that the total cable length does not exceed 492 ft (150 m). For inverters < = 3.7 kW capacity, ensure that the total cable length does not exceed 165 ft (50 m).
- Long cable runs can cause reduced motor torque in low frequency applications due to voltage drop. Long cable runs also increase a circuit's susceptibility to stray capacitance and may trigger over-current protection devices or result in malfunction of equipment connected to the inverter.
- Voltage drop is calculated by using the following formula:
- Voltage Drop (V) = [√3 X cable resistance (mΩ/m) X cable length (m) X current (A)] / 1000
- Use cables with the largest possible cross-sectional area to ensure that voltage drop is minimized over long cable runs. Lowering the carrier frequency and installing a micro surge filter may also help to reduce voltage drop.

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

⚠ Warning

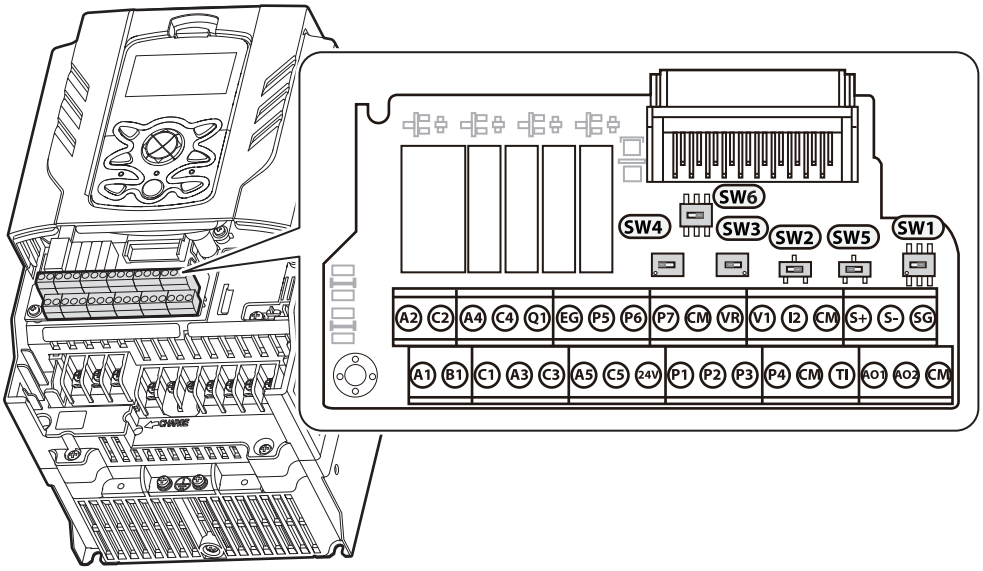
Do not connect power to the inverter until installation has been fully completed and the inverter is ready to be operated. Doing so may result in electric shock.

ⓘ Caution

- Power supply cables must be connected to the R, S, and T terminals. Connecting power cables to other terminals will damage the inverter.
- Use insulated ring lugs when connecting cables to R/S/T and U/V/W 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.
- To avoid circuit interruption or damaging connected equipment, do not install phase-advanced condensers, surge protection, or electronic noise filters on the output side of the inverter.
- Connect the MC to the output of the inverter and avoid MC ON / OFF state during operation.
  (It may cause inverter trip and burn-out.)

Step 4 Control Terminal Wiring

The illustrations below show the detailed layout of control wiring terminals and control board switches. Refer to the detailed information provided below and *"1.5 Cable Selection" on page 14* before installing control terminal wiring and ensure that the cables used meet the required specifications.

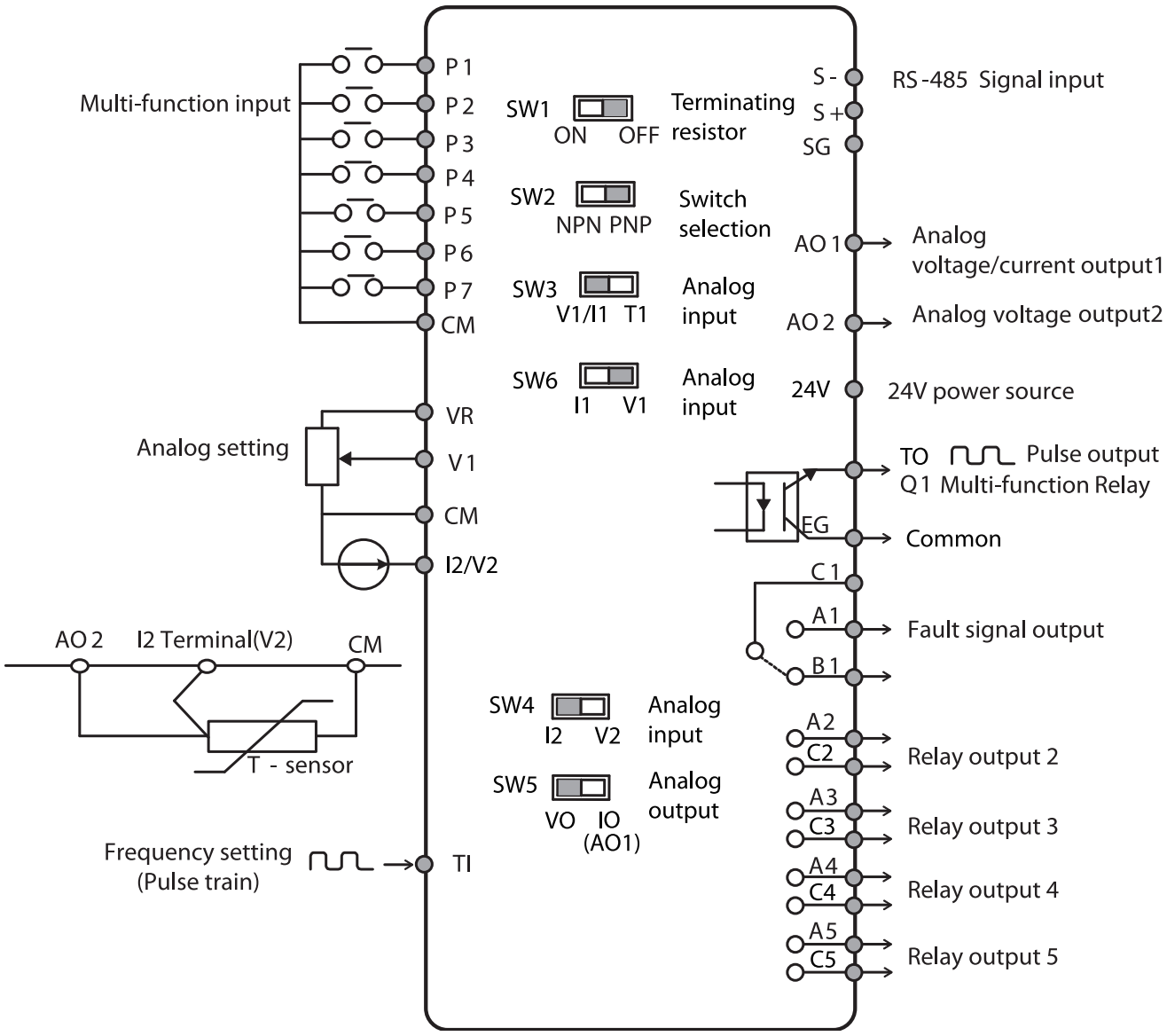


Switch Symbols and Description

Switch	Description	Factory Default
SW1	Terminating Resistor selection switch (Left: On, Right: Off)	Right: OFF
SW2	NPN/PNP mode selection switch (Left: PNP, Right: NPN)	Right: NPN
SW3	V1,I1/T1 (PTC) mode selection switch (Left: V1/I1, Right: T1)	Left: V1/I1
SW4	analog voltage/current input terminal selection switch (Left: I2, Right: V2)	Left: I2
SW5	analog voltage/current output terminal selection switch (Left: VO, Right: IO) *Output to AO1 terminal when setting IO	Left: VO
SW6	analog voltage/current input terminal selection switch (Left: I1, Right: V1) *SW3 has to be turned to left, prior to setting SW6	Right: V1

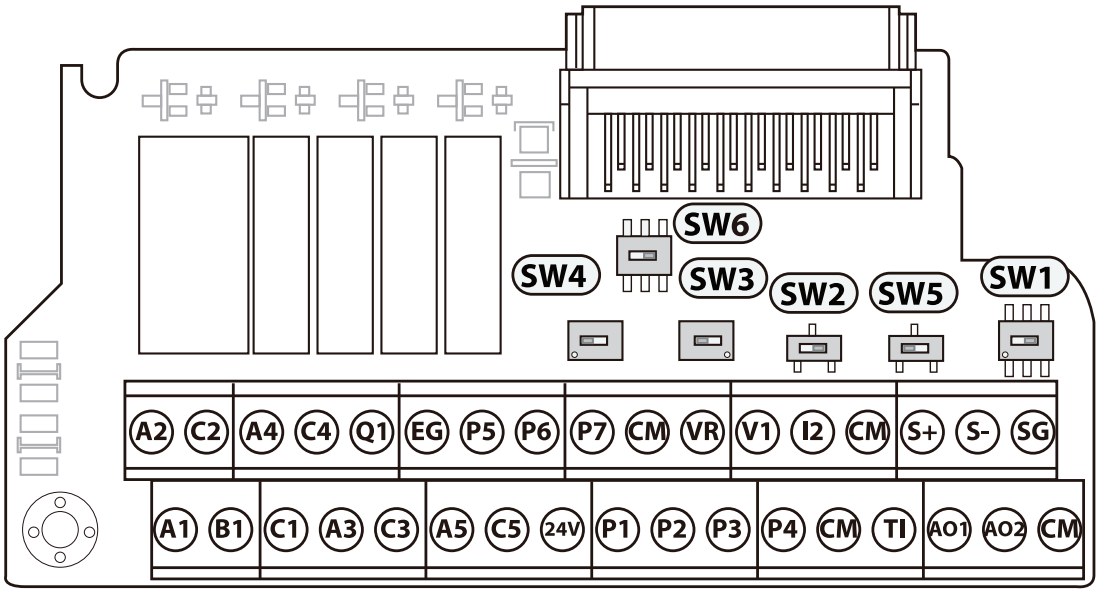
*SW6 is available from Drive Software Version <SW602.10> or greater

Input and Output Control Terminal Block Wiring Diagram



*The default value is displayed in black color.

Input Terminal Labels and Descriptions



*SW6 is available from Drive Software Version <SW602.10> or greater.

*The default value is displayed in black color.

Function	Label	Name	Description
Multi-function terminal configuration	P1–P7	Multi-function Input 1-7	Configurable for multi-function input terminals. Factory default terminals and setup are as follows : P1: Fx P2: Rx P3: BX P4: RST P5: Speed-L P6: Speed-M P7: Speed-H
	CM	Common Sequence	Common terminal for contact input and analog input / output terminals. All three CM terminals are the same circuit. Please use it where wiring is easy.
Analog input configuration	VR	Potentiometer power supply	Used to setup or modify a frequency reference via analog voltage or current input. Maximum Voltage Output: 12V Maximum Current Output: 12mA Potentiometer : 1–10kΩ
	V1/ I1	Voltage input for frequency reference	Used to setup or modify a frequency reference via analog voltage/current input terminal. <Voltage> -Unipolar: 0–10V (12 V Max) -Bipolar: -10–10V (±12 V Max) <Current> -Input current 0-20mA (24mA Max) -Input resistance 250Ω (±5%)

Function	Label	Name	Description
Analog input configuration	V2/I2	Voltage/current input for frequency reference input	Used to setup or modify a frequency reference via analog voltage or current input terminals. Switch between voltage (V2) and current (I2) modes using a control board switch (SW4). Input current: 0–20mA Maximum Input current: 24mA Input resistance 249Ω
	TI	Pulse input for frequency reference input (pulse train)	Setup or modify frequency references using pulse inputs from 0 to 32kHz. Low Level: 0–0.8V, High Level: 3.5–12V

Output/Communication Terminal Labels and Descriptions

Function	Label	Name	Description
Analog output	AO	Voltage/Current Output	Used to send inverter output information to external devices: output frequency, output current, output voltage, or a DC voltage. Operate switch (SW5) to select the signal output type (voltage or current(AO1)) at the AO terminal. Output Signal Specifications: Output voltage: 0–10V Maximum output voltage/current: 12V/10mA Output current: 0–20mA Maximum output current: 24mA Factory default output: Frequency
Terminal Contacts	Q1	Multi-function (Open Collector) Pulse Output	Selects a multi-function output signal or pulse output, output frequency, output current, output voltage, DC voltage by selecting one of the outputs. DC 26V, 50mA or less Pulse output terminal Output frequency: 0–32kHz Output voltage: 0–12V
	EG	Common	Common ground contact for an open collector (with external power source)
	24	24V power supply	-Maximum output current: 100mA -Do not use this terminal for any purpose other than supplying power to a PNP mode circuit configuration (e.g. supplying power to other external devices).
Terminal Contacts	A1/C1/B1	Fault relay output A,B contact	Sends out alarm signals when the inverter's safety features are activated. (N.O.: AC250V ≤2A , DC 30V ≤3A N.C.: AC250V ≤1A , DC 30V ≤1A) Fault condition: A1 and C1 contacts are connected (B1 and C1 open connection) Normal operation: B1 and C1 contacts are connected (A1 and C1 open connection) Factory default: Frequency
	A2/C2 A3/C3 A4/C4 A5/C5	Multi-function relay output A contact	Defined in the inverter signal features such as output via the multi-function output terminal. (AC 250V≤5A, DC 30V≤5A).
	S+/S-/SG	RS-485 signal line	Used to send or receive RS-485 signals.

Note

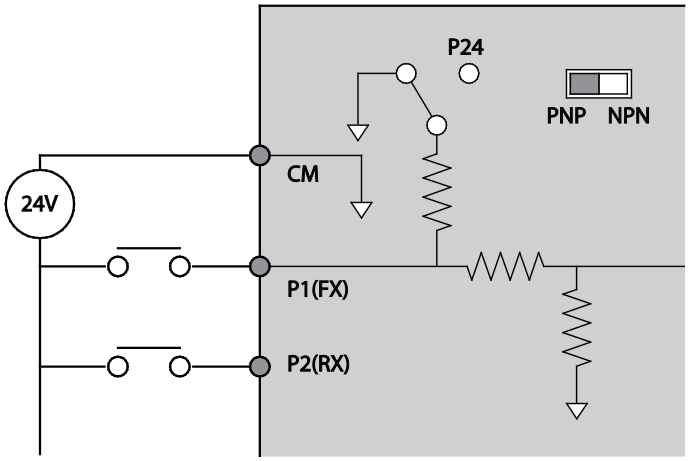
- While making wiring connections at the control terminals ensure that the total cable length does not exceed 165 ft (50 m).
- Ensure that the length of any safety related wiring does not exceed 100 ft (30 m).
- Ensure that the cable length between the keypad and the inverter does not exceed 10 ft (3.04 m). Cable connections longer than 10 ft (3.04 m) may cause signal errors.
- Use ferrite material to protect signal cables from electro-magnetic interference.
- Take care when supporting cables using cable ties, to apply the cable ties no closer than 6 inches from the inverter. This provides sufficient access to fully close the terminal cover.

Step 5 PNP/NPN Mode Selection

The H100+ inverter supports both PNP (Source) and NPN (Sink) modes for sequence inputs at the terminal. Select an appropriate mode to suit requirements using the PNP/NPN selection switch (SW2) on the control board. Refer to the following information for detailed applications.

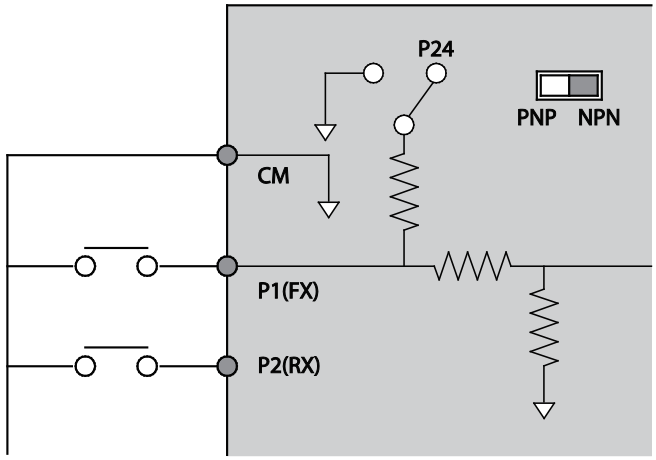
PNP Mode (Source)

Select PNP using the PNP/NPN selection switch (SW2). Note that the factory default setting is NPN mode. CM is the common ground terminal for all analog inputs at the terminal, and P24 is 24 V internal source. If you are using an external 24 V source, build a circuit that connects the external source (-) and the CM terminal.



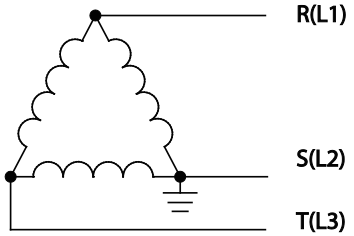
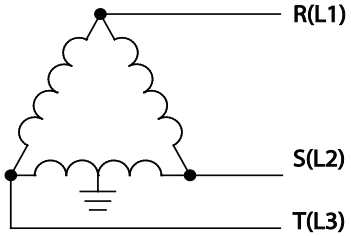
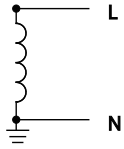
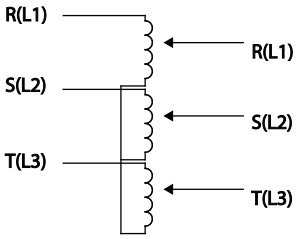
NPN Mode (Sink)

Select NPN using the PNP/NPN selection switch (SW2). Note that the factory default setting is NPN mode. CM is the common ground terminal for all analog inputs at the terminal, and P24 is 24 V internal source.



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

H100+, 400 V 0.75–55 kW, 110–750kW(3 phase) inverters have EMC filters built-in and activated as a factory default design. An EMC filter prevents electromagnetic interference by reducing radio emissions from the inverter. EMC filter use is not always recommended, as it increases leakage current. If an inverter uses a power source with an asymmetrical grounding connection, the EMC filter must be turned off.

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

- Do not activate the EMC filter if the inverter uses a power source with an asymmetrical grounding structure (corner-earthed systems), for example a grounded delta connection. 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.

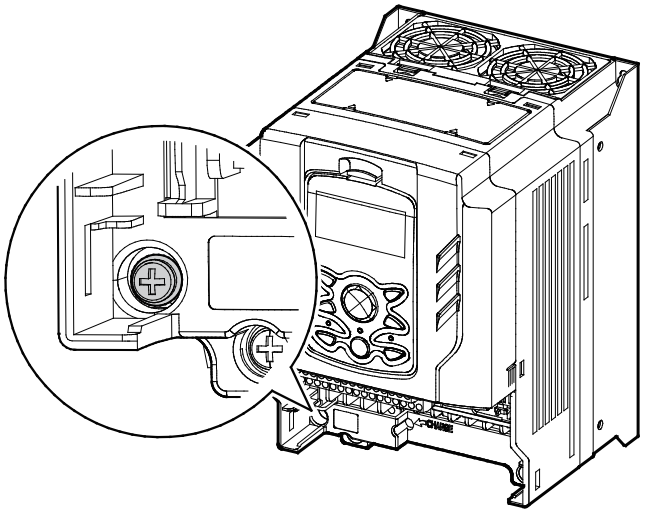
Before using the inverter, confirm the power supply's grounding system. Disable the EMC filter if the power source has an asymmetrical grounding connection.

Disabling the Built-in EMC Filter for 0.75–30 kW-4 (3–Phase) Inverters

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.

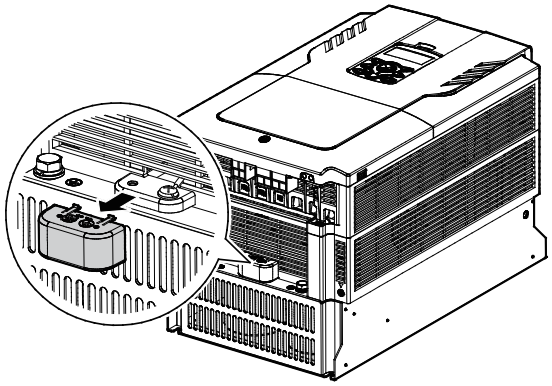
If the EMC filter is required in the future, reverse the steps and replace the plastic bolt with the metal bolt to enable the EMC filter.

Steel bolt	Plastic bolt
	
EMC ON	EMC OFF

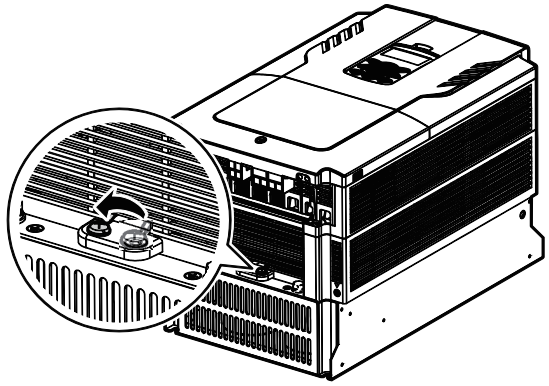


Disabling the Built-in EMC Filter for 22–45 kW-2 / 37–55 kW-4 (3–Phase) Inverters

Follow the instructions listed below to disable the EMC filters for the H100+ inverters rated for 37–55 kW. Remove the EMC ground cover located at the bottom of the inverter.



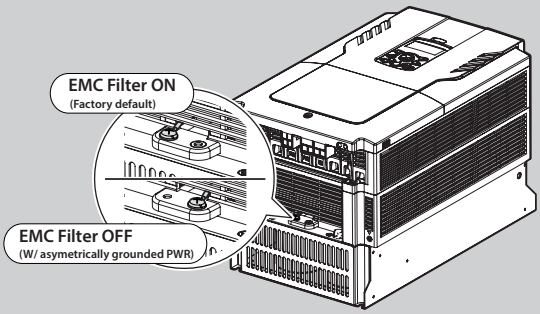
Remove the EMC ground cable from the right terminal (EMC filter-ON / factory default), and connect it to the left terminal (EMC filter-OFF / for power sources with asymmetrical grounding).



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.

Note

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 (for power sources with asymmetrical grounding).



Disabling the Built-in EMC Filter for 55–90 kW-2 / 110–750 kW-4 / 110–300 kW-5 (3–Phase) Inverters

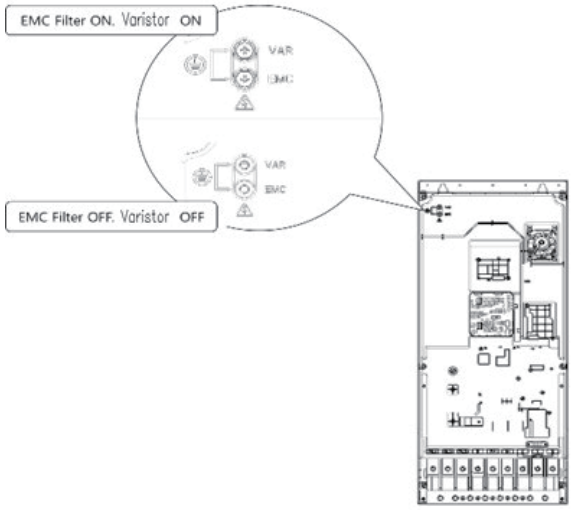
Follow the instructions listed below to disable the EMC filters for the H100+ inverters rated for 110–750 kW.

1. Remove the front cover located at the top of the inverter.

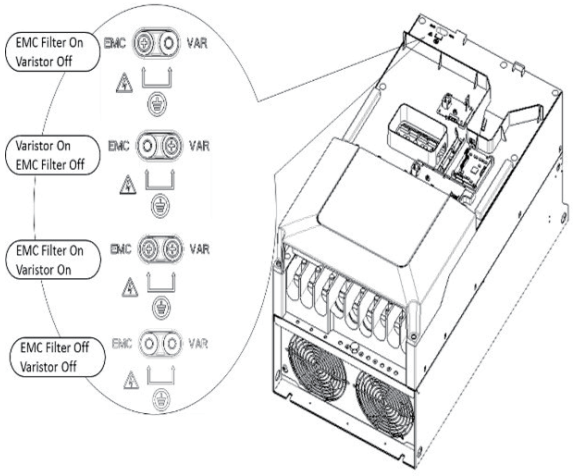
2. Remove the EMC ground cable from the right terminal (EMC filter-ON / factory default)

and connect it to the left terminal (EMC filter-OFF / for power sources with asymmetrical grounding).

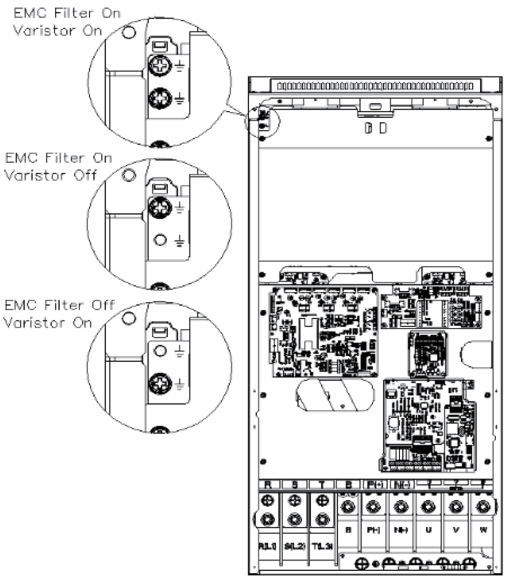
55/75 kW-2 (3-Phase)
110–132 kW-4 (3Phase)



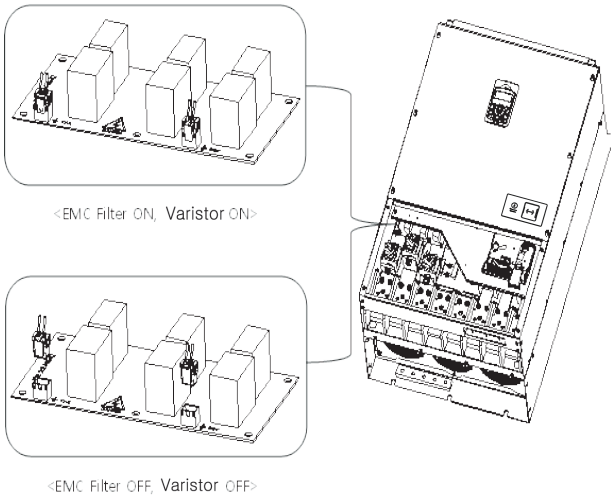
90 kW-2 (3-Phase)
160–185 kW-4 (3Phase)
110–200 kW-5 (3-Phase)



220–250 kW-4 (3Phase)
250–300 kW-5 (3-Phase)



315–750 kW-4 (3Phase)



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 Test Run

After the post-installation checklist has been completed, follow the instructions below to test the inverter.

- Turn on the power supply to the inverter. Ensure that the keypad display light is on.
- Select the command source.
- 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 at VR?

  - 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?

- Set the acceleration and deceleration time.
- 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

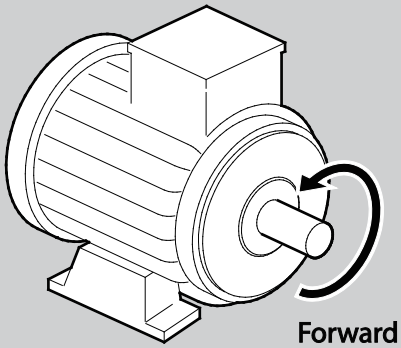
If the forward command (Fx) is on, the motor should rotate counterclockwise when viewed from the load side of the motor. If the motor rotates in the reverse direction, switch the cables at the U and V terminals.

Remarque

Si la commande avant (Fx) est activée, le moteur doit tourner dans le sens anti-horaire si on le regarde côté charge du moteur. Si le moteur tourne dans le sens inverse, inverser les câbles aux bornes U et V.

Verifying the Motor Rotation

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



Forward operation

ⓘ 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 speeds do not accidently exceed the motor's rated capacity.

3 Perform Basic Operations

This chapter describes the keypad layout and functions. It also introduces parameter groups and codes 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 how the inverter actually operates.

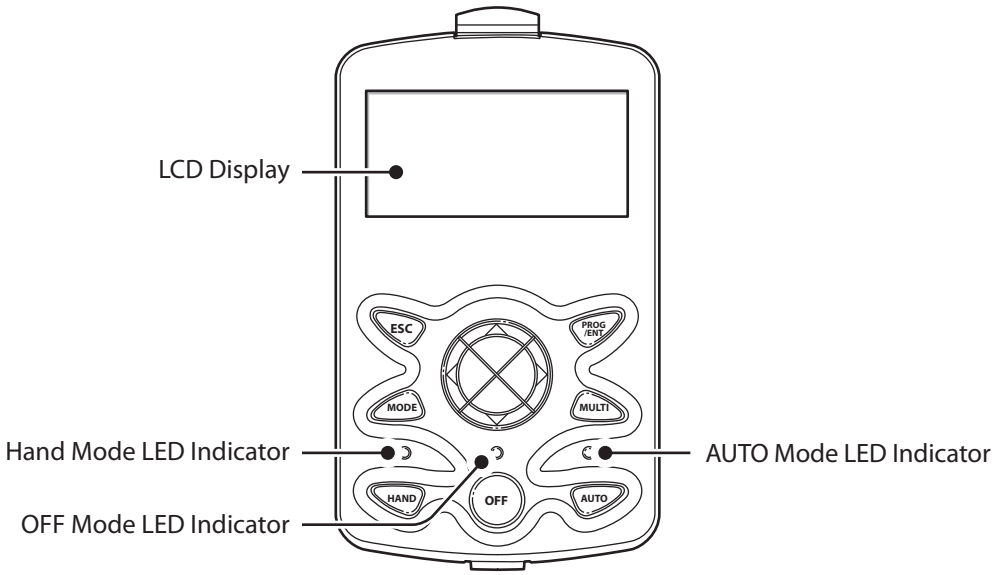
3.1 About the Keypad

The keypad is composed of two main components–the display and the operation (input) keys. Refer to the following illustration to identify part names and functions.

3.1.1 Operation Keys

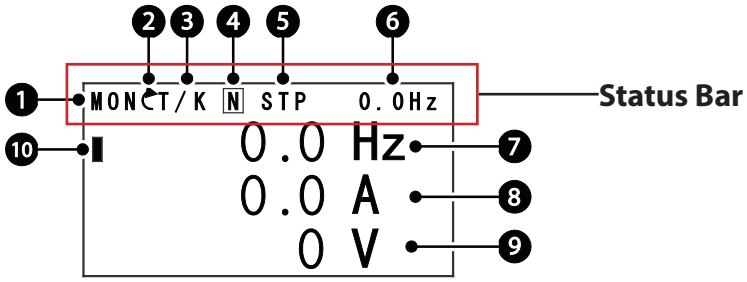
The following table lists the names and functions of the keypad's operation keys.

Key	Name	Description
	[MODE] Key	Used to switch between modes.
	[PROG / ENT] Key	Used to select, confirm, or save a parameter value.
	[Up] [Down] key	Switch between codes or increase or decrease parameter values.
	[Left] [Right] key	Switch between groups or move the cursor during parameter setup or modification.
	[RESET / MULTI] Key	Used to perform special functions, such as user code registration. (Factory Default Value–RESET function)
	[ESC] Key	Used to cancel an input during parameter setup. Pressing the [ESC] key before pressing the [PROG / ENT] key reverts the parameter value to the previously set value. Pressing the [ESC] key while editing the codes in any function group makes the keypad display the first code of the function group. Pressing the [ESC] key while moving through the modes makes the keypad display Monitor mode.
	[HAND] Key	Used to switch to HAND (local/manual) operation mode.
	[OFF] Key	Used to switch to OFF (standby) mode or to reset the inverter faults.
	[AUTO] Key	Used to switch to AUTO (remote) operation 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 then a fault trip occurs. The LED turns on red (steady) again when the fault trip condition is released.
	AUTO LED	Turns on green (steady) when the inverter operates in Auto mode, and flashes green when the inverter is in AUTO mode, but is not operating.



3.1.2 About the Display

Monitor mode display

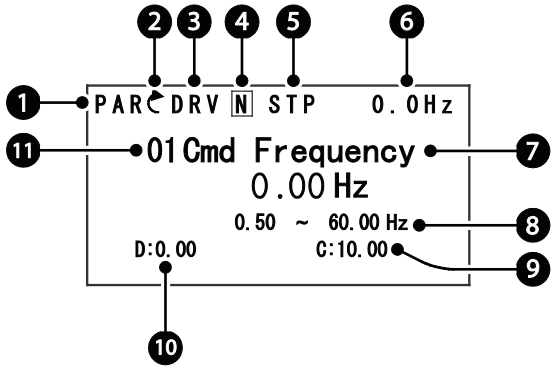


The following table lists display icons and their names/functions.

No.	Name	Description
1	Operation mode	Displays one of the following inverter 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: - Fx or Rx.

No.	Name	Description
3	Command Source / Frequency reference	Displays a combination of a command source and a frequency reference. Command source K: Keypad O: Optional Fieldbus module A: Application option E: Time event R: Built-in RS-485 communication T: Terminal block 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 frequency 1–7: Multi-step frequency
4	Multi-function key configuration	0: None [N] (Not used) 1: UserGrp SelKey [U] (used to register or delete User group parameters in Parameter mode.) 2: RST [R](Used to reset a fault.) (factory default) 3: Now Time [T] (Used to display the current time set in [AP3-1/2/3].)
5	Operating status	Displays one of the following operation states: STP: Stop FWD: Forward operation REV: Reverse operation : Forward command given : Reverse command given 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 LTS: Load tuning CAP: Capacity diagnostics PCL: Pump clean
6	Status display item	Status bar display item
7	Monitor mode item 1	Monitor mode display item 1
8	Monitor mode item 2	Monitor mode display item 2
9	Monitor mode item 3	Monitor mode display item 3
10	Monitor mode cursor	Used to highlight currently selected items.

Parameter edit mode display



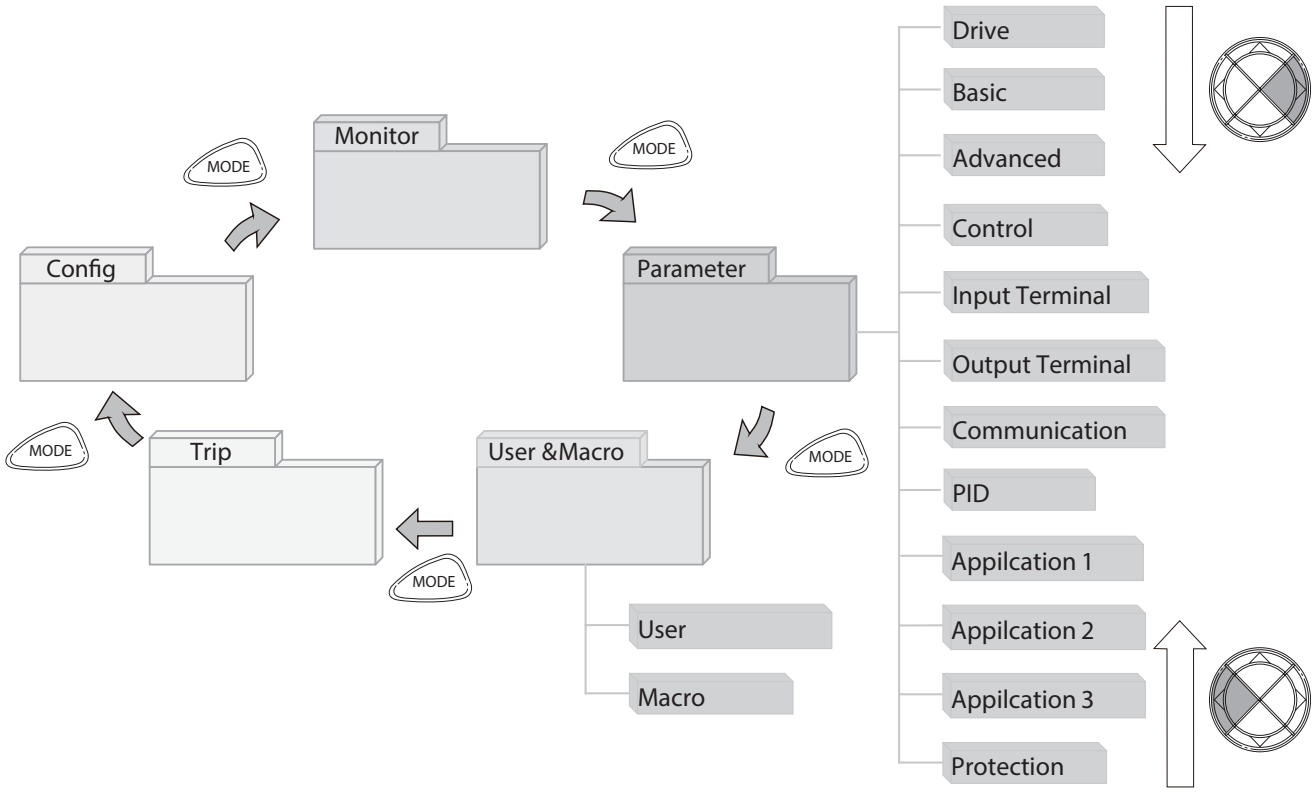
The following table lists display icons and their names/functions.

No.	Name	Description
1	Operation mode	Displays one of the following inverter 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: - Fx or Rx.
3	Parameter group	Displays one of the following parameter group names: DRV: Drive group BAS: Basic group ADV: Advanced group CON: Control group IN: Input terminal group OUT: Output terminal group COM: Communication group PID: PID group EPI: External PID group AP1: Application 1 group AP2: Application 2 group AP3: Application 3 group PRT: Protection function group M2: 2nd motor group
4	Multi-function key configuration	0: None [N] (Not used) 1: UserGrp SelKey [U] (used to register or delete User group parameters in Parameter mode.) 2: RST [R](Used to reset a fault.) (factory default) 3: Now Time [T] (Used to display the current time set in [AP3-1/2/3].)
5	Operating status	STP: Stop FWD: Forward operation REV: Reverse operation : Forward command given : Reverse command given DC: DC output WAN: Warning STL: Stall SPS: Speed search

No.	Name	Description
5	Operating status	OSS: S/W over current protection is on OSH: H/W overcurrent protection TUN: Auto tuning PHT: Pre-heat FIR: Fire mode operation LTS: Load tuning CAP: Capacity diagnostics PCL: Pump clean
6	Display item	Displays the value of a monitor display item selected at CNF-20 (Anytime Para).
7	Parameter value	Displays the parameter value of currently selected code.
8	Setting range	Displays the value range for the selected parameter.
9	Set value	Displays the currently set value for the code.
10	Default	Displays the factory default value for the code.
11	Code no. and name	Displays the number and name of the currently selected code.

Display Modes

Navigate and select different parameters by using the directional arrows on the keypad while in the PAR Mode.



From the main screen, the [MODE] key will change the keypad to display the Parameter (PAR) mode. The PAR mode contains all parameters and monitors. These parameters and monitors are divided into intuitive groups. Pressing the LEFT or RIGHT arrows will move through the different parameter groups. While the UP and DOWN arrows will navigate through the different parameter code #'s in the selected group.

Any of the above parameters settings can be changed by pressing the [PROG/ENT] key, selecting the new setting with the arrows, and pressing [PROG/ENT] again to save.

Table of Display Modes

The following table lists the 5 display modes used to control the inverter functions.

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 functions required to operate the inverter. These functions are divided into 14 groups based on purpose and complexity.
User & Macro mode	U&M	Used to define User groups and Macro groups. These user-definable groups allow specific functions of the inverter to be grouped and managed in separate groups. This mode is not displayed when you navigate through the modes if no user groups or Macro groups have been defined.
Trip mode	TRP	Used to monitor the inverter's fault trip information, including the previous fault trip history. When a fault trip occurs during inverter operation, the operation frequency, output current, and output voltage of the inverter at the time of the fault may be monitored. This mode is not displayed if the inverter is not at fault and fault trip history does not exist.
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 keypad display language options, monitor mode environment settings, communication module display settings, and parameter duplication and initialization.

Parameter Setting Mode

The following table lists the functions groups under Parameter mode.

Function Group Name	Keypad Display	Description
Drive	DRV	Configures basic operation parameters. These include jog operation, motor capacity evaluation, and torque boost.
Basic	BAS	Configures basic operation parameters. These parameters include motor parameters and multi-step frequency parameters.
Advanced	ADV	Configures acceleration or deceleration patterns, frequency limits, energy saving features, and, regeneration prevention features.
Control	CON	Configures the features related to speed search and KEB (kinetic energy buffering).
Input Terminal	IN	Configures input terminal–related features, including digital multi–functional inputs and analog inputs.
Output Terminal	OUT	Configures output terminal–related features, including digital multi–functional outputs and analog outputs.

Function Group Name	Keypad Display	Description
Communication	COM	Configures the USB-related features and communication features for the RS-485, Modbus-RTU, LS Bus, 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.
EPID process	EPI	Configures the external PID control-related features.
Application 1	AP1	Configures the Sleep Boost, SoftFill, and Multiple motor control (MMC) features related to the PID control.
Application 2	AP2	Configures the HVAC features by setting the features such as load tuning, pump cleaning, and pay back counter.
Application 3	AP3	Configures the time event-related features.
Application 4	AP4	Configures PI auxiliary and flow control related features.
Protection	PRT	Configures motor and inverter protection features.
Motor 2 (Secondary motor)	M2	Configures the secondary motor-related features.

User & Macro Mode

Function Group Name	Keypad Display	Description
User	USR	Used to put the frequently accessed function parameters together into a group. User parameter groups can be configured using the multi-function key on the keypad.
Macro	MCx	Provides different factory-preset groups of functions based on the type of load. Groups MC1, MC2, or MC3 is displayed when the user selects the type of desired load. Macro groups can be selected in CNF mode.

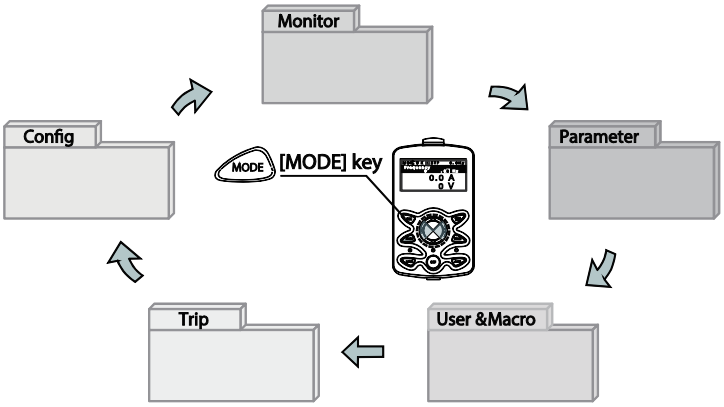
3.2 Learning to Use the Keypad

The keypad enables movement between groups and codes. It also enables users to select and configure functions. At code 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 codes in each function group, refer to *"8 Table of Functions" on page 354*. Confirm the correct values (or the correct range of the values), then follow the examples below to configure the inverter with the keypad.

3.2.1 Display Mode Selection

The following figure illustrates how the display modes change when you press the [Mode] button on the keypad. You can continue to press the [Mode] key until you get to the desired mode.

User & Macro mode and Trip mode are not displayed when all the inverter settings are set to the factory default (User & Macro mode must be configured before it is displayed on the keypad, and Trip mode is displayed only when the inverter is at fault, or has previous trip fault history).



3.2.2 Operation Modes

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 for remote control via communication. On the other hand, the inverter stops operating when it is in OFF mode. Select one of the modes (HAND / AUTO / OFF) to operate the inverter or stop the operation.

Follow the examples below to learn how to switch between operation modes.

Operating the Inverter in HAND mode

- Turn on the inverter. The inverter enters OFF mode and the OFF LED turns on.
- Move to Parameter mode and set DRV-07 (frequency reference) to '0 (keypad)'.
- Press the [HAND] key to enter HAND mode (local control mode). HAND mode LED turns on (the OFF LED turns off) and the inverter begins to operate.
- Press the [OFF] key to stop the inverter operation. The inverter stops operating and the OFF LED turns on.

Operating the inverter in AUTO Mode

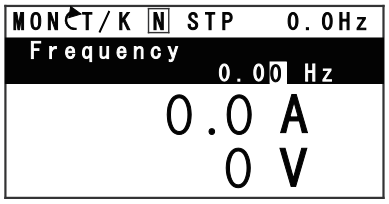
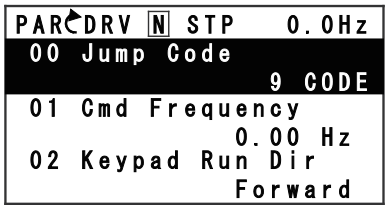
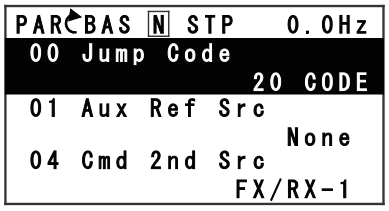
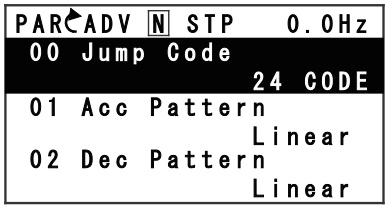
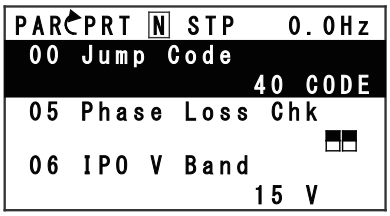
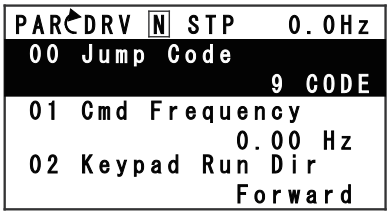
- In OFF mode (when the OFF LED is on), move to Parameter mode and configure the command source at DRV-07 (frequency reference source).
- Press the [AUTO] key to enter AUTO mode. In AUTO mode, the inverter operates based on the input from the command source set at DRV-07. For example, if DRV-07 (frequency reference source) is set to '0 (Keypad)', the frequency reference is set, and the run command is set to 'ON', the inverter starts operating as soon as the [AUTO] key on the keypad is pressed.
- Press the [Auto] key again to stop the inverter operation using the keypad. In AUTO mode, the inverter begins or stops operating when the [AUTO] key is pressed.

Note

- You can stop the inverter operation by pressing the [OFF] key when the command source is set to 'Keypad.' In this case, however, the inverter enters OFF mode from AUTO mode.
- If the network communication is set as the command source, the inverter is operable only in AUTO mode. For example, if the run command is set to 'ON' via the network communication and the inverter is in OFF mode, the [AUTO] key must be pressed to start the inverter operation.
- The inverter is operable only in HAND and AUTO modes, but the Fire mode functions operate even when the inverter is in OFF mode.

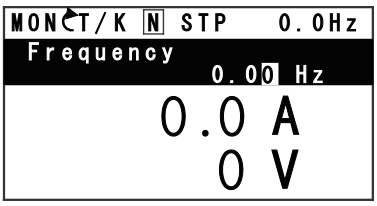
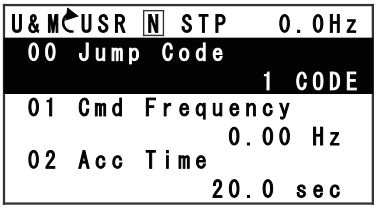
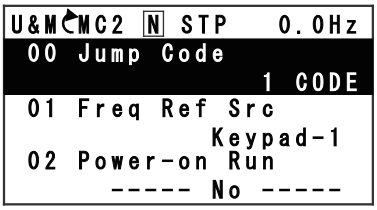
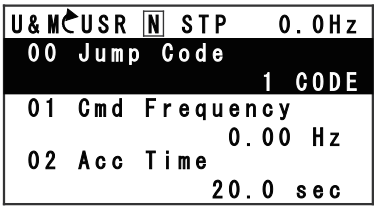
3.2.3 Switching between Groups in Parameter Display Mode

After entering Parameter mode from Monitor mode, press the [Right] key to move to the next code. Press the [Left] key to go back to the previous code.

	• The keypad OFF LED is turned OFF, and the keypad displays Monitor mode. • Press the [Mode] key to change the mode.
	• Parameter mode is displayed. • The Drive group is currently selected. • Press the [Right] key.
	• The Basic group is selected. • Press the [Right] key.
	• The Advanced group is selected. • Press the [Right] key 9 times.
	• The Protection group is selected. • Press the [Right] key.
	• The Drive group is selected again.

3.2.4 Switching between Groups in User & Macro Mode

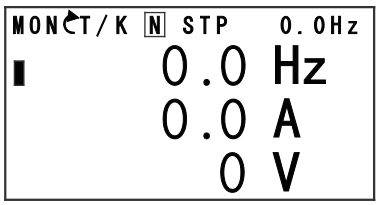
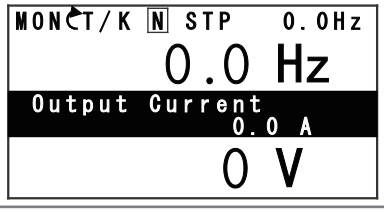
User & Macro mode is accessible only when the user codes are registered or when the macro features are selected. Refer to *"8.16 Macro Groups" on page 417* for details about user code registration or macro group selection. After registering the user codes, or selecting a macro group, follow the examples below to access the User & Macro group.

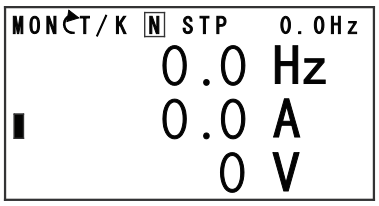
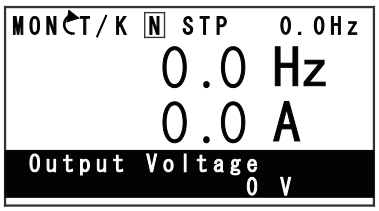
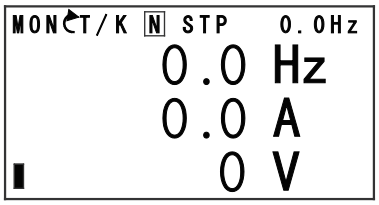
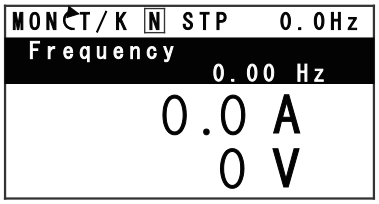
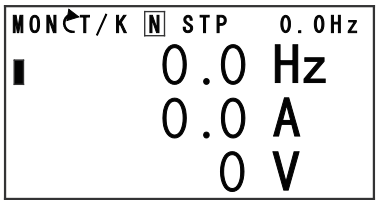
	• Monitor mode is displayed on the keypad. • Press the [MODE] key twice.
	• User (USR) group in User & Macro mode is displayed. • Press the [Right] key.
	• The Macro (MC2) group in User & Macro mode is displayed. • Press the [Right] key.
	• User (USR) group in User & Macro mode is displayed again.

3.2.5 Navigating through the Codes (Functions)

Code Navigation in Monitor mode

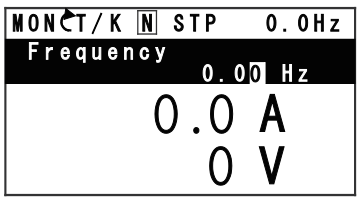
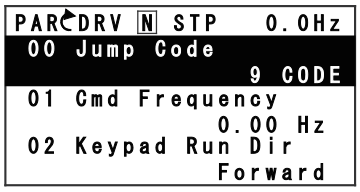
The display items in Monitor mode are available only when the inverter is in AUTO mode. In Monitor mode, press the [Up] or [Down] key to move the cursor up or down. Different values, such as the operating frequency, the output current, or voltage are displayed according to the cursor position. The cursor does not move up or down in HAND mode or in OFF mode.

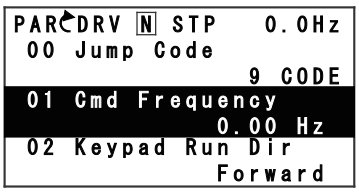
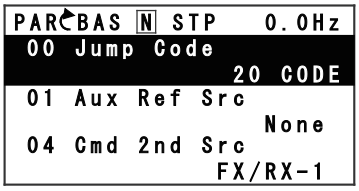
	• In AUTO mode, the cursor appears to the left of the frequency information. • Press the [Down] key.
	• Information about the second item in Monitor mode (Output Current) is displayed. • Wait for 2 seconds until the information on the display disappears.

	• Information about the second item in Monitor mode (Output Current) disappears and the cursor reappears to the left of the second item. • Press the [Down] key.
	• Information about the third item in Monitor mode (Output Voltage) is displayed. • Wait for 2 seconds until the information on the display disappears.
	• Information about the third item in Monitor mode (Output Voltage) disappears and the cursor appears to the left of the third item. • Press the [Up] key twice.
	• Information about the first item in Monitor mode (Frequency) is displayed. • Wait for 2 seconds until the information on the display disappears.
	• Information about the first item in Monitor mode (Frequency) disappears and the cursor appears to the left of the first item. • Press the [Up] or [Down] key to move to a desired item and view the information.

Code Navigation in Parameter mode

The following examples show you how to move through codes in different function groups (Drive group and Basic group) in Parameter mode. In Parameter mode, press the [Up] or [Down] key to move to the desired functions.

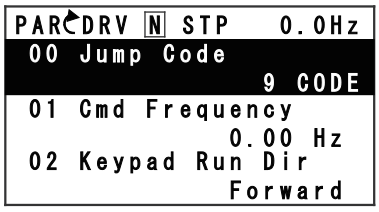
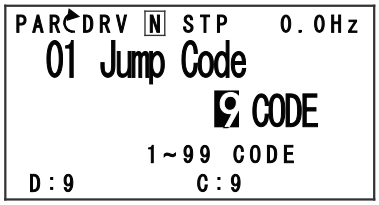
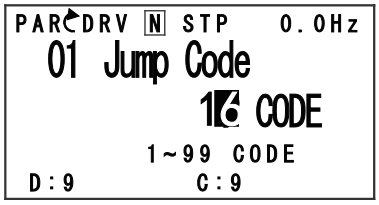
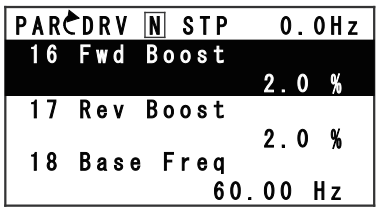
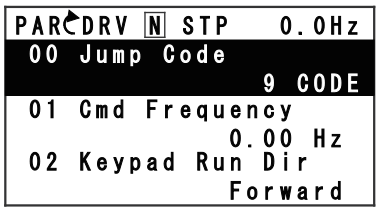
	• Display turns on when the inverter is powered on. Monitoring mode is displayed. • Press the [MODE] key.
	• Drive group (DRV) in Parameter mode is displayed. The first code in the Drive group (DRV 00 Jump Code) is currently selected. • If any other group is displayed, press the [MODE] key until the Drive group is displayed, or press the [ESC] key.

	• Press the [Down] key to move to the second code (DRV 01) of the Drive group. • Press the [Right] key to move to the next function group.
	• The Basic group (BAS) is displayed. • Press the [Up] or [Down] key to move to the desired codes and configure the inverter functions.

3.2.6 Navigating Directly to Different Codes

Parameter mode, User & Macro mode, and Config mode allow direct jumps to specific codes. The code used for this feature is called the Jump Code. The Jump Code is the first code of each mode. The Jump Code feature is convenient when navigating for a code in a function group that has many codes.

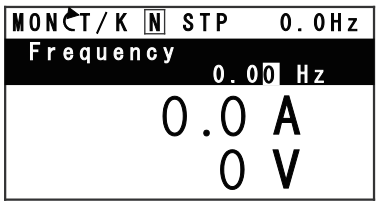
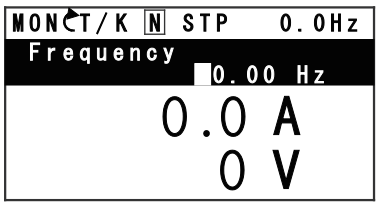
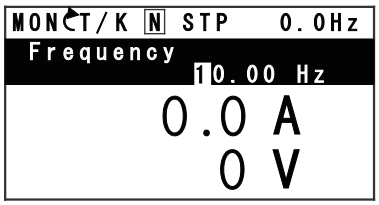
The following example shows how to navigate directly to code DRV- 09 from the initial code (DRV-00 Jump Code) in the Drive group.

	• The Drive group (DRV) is displayed in Parameter mode. Make sure that the fist code in the Drive group (DRV 00 Jump Code) is currently selected. • Press the [PROG/ENT] key.
	• The Code input screen is displayed and the cursor flashes. A flashing cursor indicates that it is waiting for user input. • Press the [Up] key to increase the number to 16, and then press the [PROG/ENT] key to jump to code DRV-16.
	• DRV-16 (Fwd boost) is displayed. • Press the [MODE] key to view the options available and use the [Up] or [Down] key to move to a desired option.
	• Press the [PROG/ENT] key to save the selection. • The setting is saved and the code is displayed again.
	• Press the ESC key to go back to the initial code of the Drive group (DRV-00).

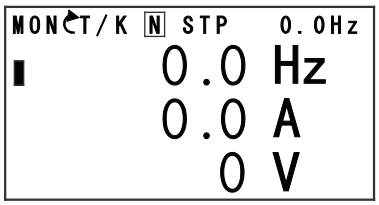
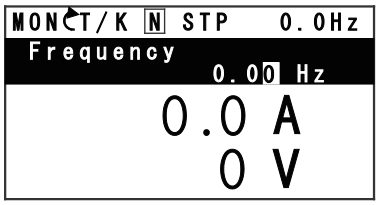
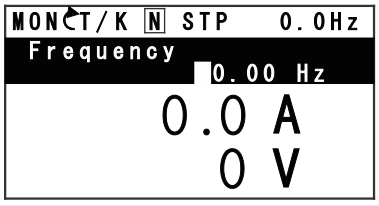
3.2.7 Parameter Settings available in Monitor Mode

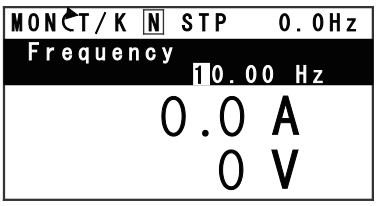
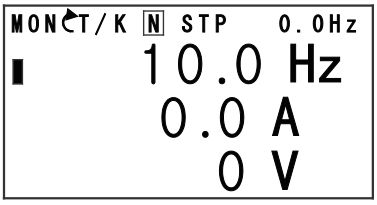
The H100+ inverter allows basic parameters, such as the frequency reference, to be modified in Monitor mode. When the inverter is in Hand or OFF mode, the frequency reference can be entered directly from the monitor screen. When the inverter is in AUTO mode, press the [PROG/ENT] key to access the input screen for a frequency reference.

Parameter setting in HAND/OFF mode

	• Ensure that the cursor is at the frequency reference item. If not, move the cursor to the frequency reference item. • When the cursor is at the frequency reference item, detailed information is displayed and the cursor flashes at the input line. A flashing cursor indicates that it is waiting for user input.
	• Press the [Left] or [Right] key to change places.
	• Press the [Up] or [Down] keys to increase or decrease the numbers, and then press the [Prog/ENT] key to save the change.

Parameter setting in AUTO mode

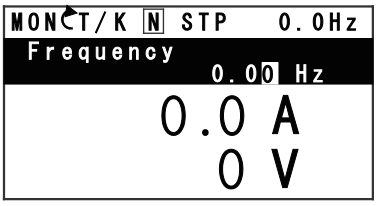
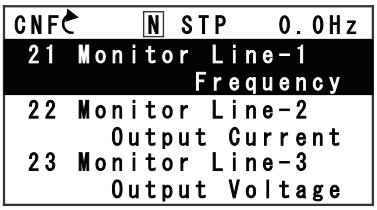
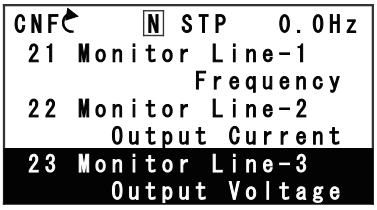
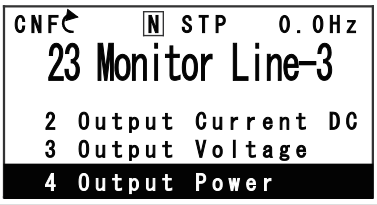
	• Ensure that the cursor is at the frequency reference item. If not, move the cursor to the frequency reference item. • While the cursor is at the frequency reference monitor item, press the [PROG/ENT] key to edit the frequency reference.
	• Detailed information is displayed and the cursor flashes at the input line. A flashing cursor indicates that it is waiting for user input.
	• Press the [Left] or [Right] key to move the cursor.

	• Press the [Up] or [Down] key to increase or decrease the numbers. • When you are done changing the frequency reference, press [PROG/ENT] key to finish setting the parameters.
	• The newly entered frequency reference is displayed.

3.2.8 Setting the Monitor Display Items

In Monitor mode, 3 different items may be monitored at once. Certain monitor items, such as the frequency reference, are selectable. The display items to be displayed on the screen can be selected by the user in the Config (CNF) mode. However, in HAND mode or in OFF mode, the first display item is permanently fixed as the frequency reference. On the top-right corner of the keypad display's status bar, another frequency item is displayed. This item refers to the frequency reference when the inverter is not operating and the output frequency when the inverter is operating.

The following example shows how to configure the display items in HAND mode.

	• Monitor mode is displayed on the keypad. The output frequency, output current, and output voltage are displayed (factory default).
	• Go to the Config (CNF) mode. In the Config mode, codes CNF-21–23 are used to select the three monitoring display items. The currently selected display item and its setting are highlighted.
	• To view the available display items and change the setting for the third monitoring display item, press the [Down] key to move to CNF-23 and press the [PROG/ENT] key. • The currently selected display item for CNF-23 (Monitor Line–3) is 'Output Voltage.'
	• Press the [Up] or [Down] key to view the available display items. • Move to '4 Output Power' and press the [PROG/ENT] key to change the setting.

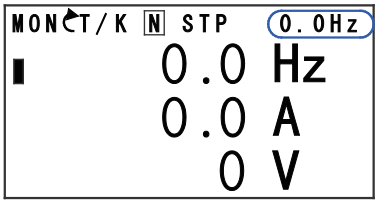
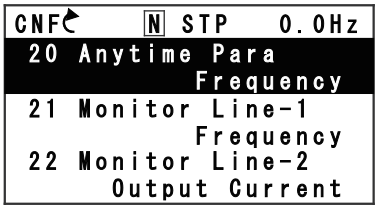
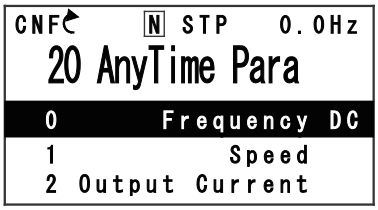
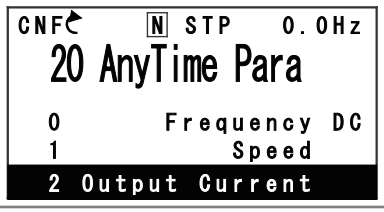
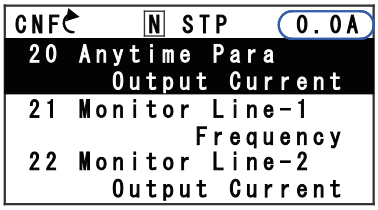
	• Press the [MODE] key to go back to Monitor mode. The third display item has been changed to the inverter output power (kW)

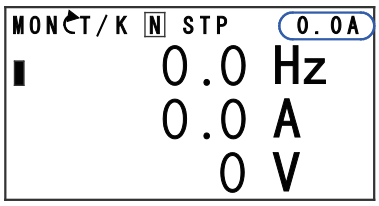
3.2.9 Selecting the Status Bar Display Items

On the top-right corner of the display, there is a monitoring display item. This monitoring item is displayed as long as the inverter is turned on, regardless of the mode the inverter is operating in. Configure this monitoring item to display the type of information that suits your needs.

This item can be configured only when the inverter is operating in AUTO mode. In HAND or OFF mode, this monitoring item displays frequency reference only.

The following example shows how to configure this monitoring item in AUTO mode.

	• Monitor mode is displayed. • On the top-right edge of the display, the frequency reference is displayed (factory default).
	• Enter Config mode and go to CNF-20 to select the items to display.
	• Press the [PROG/ENT] key. The currently selected item is highlighted.
	• Press the [Down] key twice to move to '2 (Output Current)', and then press the [PROG/ENT] key to select it.
	• The currently selected item is highlighted at CNF- 20 (the display item is changed from 'Frequency' to 'Output Current').

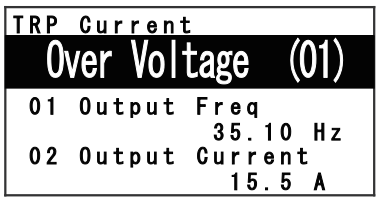


- Press the [MODE] key to return to Monitor mode.

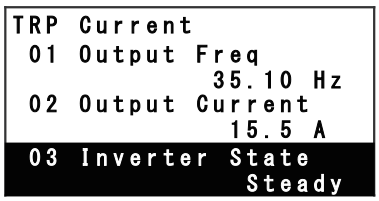
3.3 Fault Monitoring

3.3.1 Monitoring Faults during Inverter Operation

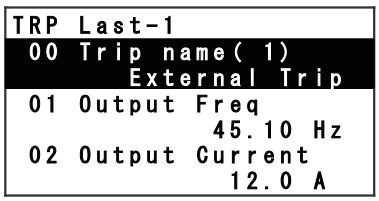
The following example shows how to monitor faults that occurred during inverter operation.



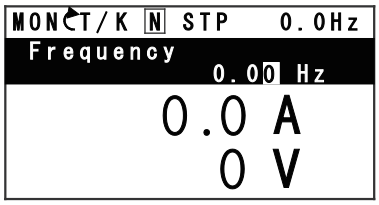
- If a fault trip occurs during inverter operation, the inverter enters Trip mode automatically and displays the type of fault trip that occurred.



- Press the [Down] key to view the information on the inverter at the time of fault, including the output frequency, output current, and operation type.



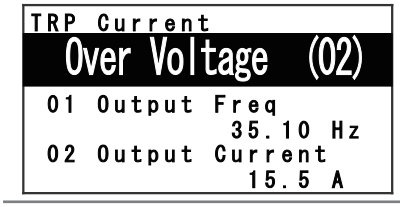
- If there were any fault trips that occurred previously, press the [Right] key to display the fault trip information at the times of previous fault trips.



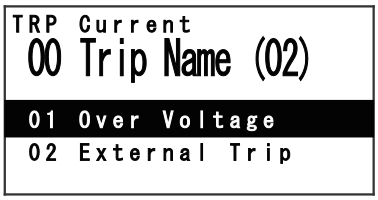
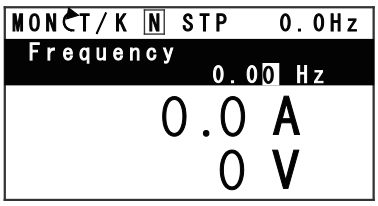
- When the inverter is reset and the fault trip is released, the keypad display returns to the screen it was at when the fault trip occurred.

3.3.2 Monitoring Multiple Fault Trips

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

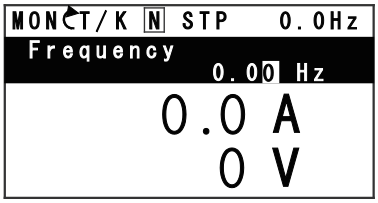
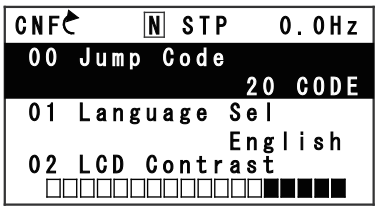
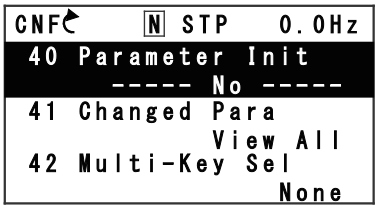
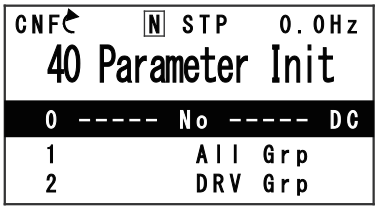
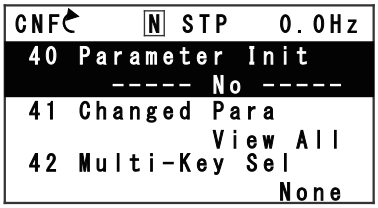


- If multiple fault trips occur at the same time, the number of fault trips occurred is displayed on the right side of the fault trip type.
- Press the [PROG/ENT] key to view the list of all the fault trips.

	• The list of all the fault trips is displayed. • Press the [Down] key to view the types of fault trips that occurred. • Press the [Right] key to display the fault trip information.
	• When the inverter is reset and the fault trip is released, the keypad display returns to the screen it was at when the fault trip occurred.

3.4 Parameter Initialization

The following example demonstrates how to revert all the parameter settings back to the factory default (Parameter Initialization). Parameter initialization may be performed for separate groups in Parameter mode as well.

	• Monitor mode is displayed.
	• Press the [MODE] key to move to the Config (CNF) mode.
	• Press the [Down] key to go to CNF-40 (Parameter Init). • Press the [PROG/ENT] key to configure the parameter initialization options.
	• In the list of options, select '1(All Grp),' and then press the [PROG/ENT] key to perform parameter initialization.
	• The parameter initialization option is displayed again when the initialization is complete.

4 Learning Basic Features

This chapter describes the basic features of the H100 inverter. Check the reference page in the table to see the detailed description for each of the advanced features.

Basic Tasks	Description	Ref.
Operation mode selection (HAND / AUTO / OFF)	How to set up the option of operating the H100+ both in the local and remote controls	p.68
Frequency reference source configuration for the keypad	Configures the inverter to allow you to setup or modify a frequency reference using the Keypad.	p.72
Frequency reference source configuration for the terminal block (input voltage)	Configures the inverter to follow the input voltages at the terminal block (V1, V2) as a frequency reference source.	p.73
Frequency reference source configuration for the terminal block (input current)	Configures the inverter to follow the milliamp reference at the terminal block (I2) as a frequency reference source.	p.77
Frequency reference source configuration for the terminal block (input pulse)	Configures the inverter to follow the input pulse reference at the terminal block (TI) as a frequency reference source.	p.79
Frequency reference source configuration for RS-485 communication	Configures the inverter to follow a RS-485 communication signal as a frequency reference source, such as a PLC or building management system.	p.80
Parameter Settings available in Monitor Mode	The keypad can configure key operating parameters such as speed, amps and volts, while monitoring.	p.61
Multi-step speed (frequency) configuration	Configures multi-step frequency operations by receiving an input at the terminals defined for each step frequency.	p.82
Command source configuration	Command source configuration. Various devices can be selected as command input devices for the H100 inverter. Input devices available to select include keypad, multi-function input terminal, RS-485 communication and field bus adapter.	p.83
Forward or Reverse Run Prevention	Configures the inverter to limit a motor's rotation direction.	p.85
Automatic start-up at power-on	Configures the inverter to start operating at power-on. With this configuration, the inverter begins to run and the motor accelerates as soon as power is supplied to the inverter. To use automatic start-up configuration, the operation command terminals at the terminal block must be turned on.	p.86
Automatic restart after reset of a fault trip condition	Configures the inverter to start operating when the inverter is reset following a fault trip. In this configuration, the inverter starts to run and the motor accelerates as soon as the inverter is reset following a fault trip condition. For automatic start-up configuration to work, the operation command terminals at the terminal block must be turned on.	p.87
Acc/Dec time configuration based on the Max. Frequency	Configures the acceleration and deceleration times for a motor based on a defined maximum frequency.	p.88
Acc/Dec time configuration based on the frequency reference	Configures acceleration and deceleration times for a motor based on a defined frequency reference.	p.90
Multi-stage Acc/Dec time configuration using the multi-function terminal	Configures multi-stage acceleration and deceleration times for a motor based on defined parameters for the multi-function terminals.	p.91

Basic Tasks	Description	Ref.
Acc/Dec time transition speed (frequency) configuration	Enables modification of acceleration and deceleration gradients without configuring the multi-functional terminals.	p.93
Acc/Dec pattern configuration	Enables modification of the acceleration and deceleration gradient patterns. Basic patterns to choose from include linear and S-curve patterns.	p.94
Acc/Dec stop command	Stops the current acceleration or deceleration and controls motor operation at a constant speed. Multi-function terminals must be configured for this command.	p.96
Linear V/F pattern operation	Configures the inverter to increase or decrease the output voltage at a fixed rate for different operation frequencies based on V/F characteristics. A linear V/F pattern is particularly useful when a constant torque load is applied.	p.96
Square reduction V/F pattern operation	Square reduction V/F pattern is ideal for loads such as fans and pumps. It provides non-linear acceleration and deceleration patterns to sustain torque throughout the whole frequency range.	p.97
User V/F pattern configuration	Enables the user to configure a V/F pattern to match the characteristics of a motor. This configuration is for special-purpose motor applications to achieve optimal performance.	p.97
Manual torque boost	Manual configuration of the inverter to produce a momentary torque boost. This configuration is for loads that require a large amount of starting torque, such as elevators or lifts.	p.101
Automatic torque boost	Automatic configuration of the inverter that may require "auto tuning" that produces a momentary torque boost. This configuration is for loads that require a large amount of starting torque, such as elevators or lifts.	p.101
Output voltage adjustment	Adjusts the output voltage to the motor when the power supply to the inverter differs from the motor's rated input voltage.	p.102
Accelerating start	Accelerating start is the general way to start motor operation. The typical application configures the motor to accelerate to a target frequency in response to a run command.	p.103
Start after DC braking	Configures the inverter to perform DC braking before the motor starts rotating again. This configuration is used when the motor will be rotating before the voltage is supplied from the inverter.	p.103
Deceleration stop	Deceleration stop is the typical method used to stop a motor. The motor decelerates to 0 Hz and stops on a stop command.	p.104
Stopping by DC braking	Configures the inverter to apply DC braking during motor deceleration. The frequency at which DC braking occurs must be defined and during deceleration, when the motor reaches the defined frequency, DC braking is applied.	p.104
Coast stop	Configures the inverter to stop output to the motor using a stop command. The motor will free-run until it slows down and stops.	p.105
Power braking	Configures the inverter to provide optimal, motor deceleration, without causing a trip due to over-voltage condition.	p.105
Start/maximum frequency limit configuration	Configures the frequency reference limits by defining a start frequency and a maximum frequency.	p.106
Upper/lower frequency limit configuration	Configures the frequency reference limits by defining an upper limit and a lower limit.	p.106
Frequency jump	Configures the inverter to avoid running a motor by not allowing the motor to run at certain frequencies that can cause mechanical damage.	p.107

Basic Tasks	Description	Ref.
2nd Operation mode configuration	Used to configure the 2nd operation mode which allows the inverter to follow a different speed reference source.	p.108
Multi-function input terminal control configuration	Enables the user to improve the responsiveness of the multi-function input terminals by allowing the use of On/Off delay and the ability to change the input from NO to NC.	p.109

4.1 Switching between the Operation Modes (HAND / AUTO / OFF)

The H100 series inverters have two operation modes– HAND and AUTO. HAND mode is used for local control using the keypad. AUTO mode is used for remote control using the terminal inputs or networks commands (the keypad may still be used in AUTO mode if the command source is set as 'keypad').

HAND Mode Operation

Please follow the instructions below for HAND mode inverter operation.

- Use the [Up], [Down], [Left] and [Right] keys to set the frequency reference.
- If you press the [HAND] key or turn on the multi-function input terminal set as {HAND State}, the HAND LED lights up and the inverter starts HAND mode operation.
- If you press the [OFF] key or turn off the multi-function input terminal set by {HAND State}, the OFF LED lights up and the inverter stops running.

AUTO Mode Operation <When [DRV-08 AUTO Mode Sel] is Enabled>

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

- Press the [AUTO] key to switch to AUTO mode.
- Operate the inverter using the terminal block input, commands via communication, or keypad input.
- Press the [OFF] key. The OFF LED turns on and the inverter stops operating.

AUTO mode operation <When [DRV-08 AUTO Mode Sel] is Disabled>

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

- Operate the inverter with commands through terminal block input, communication, and keypad without changing the AUTO mode.
- When the [OFF] key is pressed or the operation command is removed, the OFF LED lights up and the inverter stops operation. Mode Keys and LED Status

Keys / LED	Description
	Used to enter the HAND operation mode.
	Used to enter the OFF mode (standby mode) or to reset fault trips.
	Used to enter the AUTO operation mode or to start or 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 trip occurs. The LED turns on red (steady) again when the fault trip condition is released.

Keys / LED	Description
AUTO LED	Turns on green (steady) when the inverter operates in Auto mode, and flashes green when the inverter is in AUTO mode, but is not operating.

Basic HAND/AUTO/OFF Mode Operations

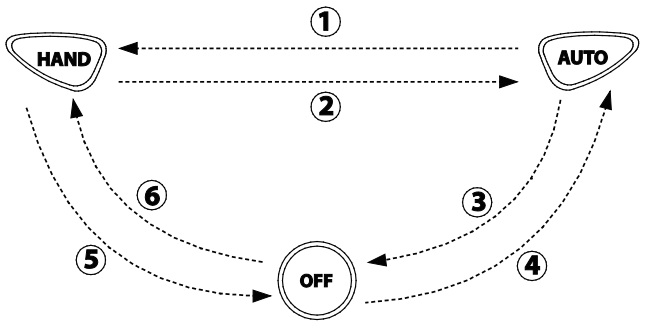
Mode	Description
HAND Mode (Locally controlled operation mode)	This is the state of operation through the HAND key on the keypad or the multi-function input terminal set with {HAND State}. In Monitor mode, the currently set frequency reference is displayed at all times. Also, in HAND mode: • The first monitoring item is used to adjust the frequency with the up/down and left/right keys. The set frequency is reflected in DRV-02 (HAND Cmd Freq). • 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, and multi-step acc/dec operation related terminal functions). • Fire mode commands take the highest priority (if any are given). • The following advanced features are not available: - PID / EPID control - 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.
OFF Mode (Standby)	In OFF mode, the inverter operation stops. Pressing the OFF key during HAND/AUTO mode operations will cause the OFF LED to turn on. Then, the inverter stops operating or decelerates and stops, according to the deceleration options set by the user. Also, in AUTO mode: • Terminal block functions do not operate (with the exception of BX, External Trip and multi-step acc/dec operation related terminal functions). • Fire mode commands take the highest priority (if any are given).
AUTO Mode (Remotely controlled operation mode)	In AUTO mode, the inverter operates based on the command from the command source set at DRV-06 (Cmd Source), with the frequency reference from the source set at DRV-07 (Freq Ref Src).

Function Codes related to HAND/AUTO/OFF Operation Modes

Codes / Functions	Description
DRV-01 Cmd Frequency	Frequency reference in AUTO mode when DRV-07 is set to' KeyPad'.

<table>
<tr><th>Codes / Functions</th><th>Description</th></tr>
<tr><td>DRV-02
KeyPad Run Dir</td><td>Rotation direction of the keypad command in the HAND or AUTO mode.
<table>
<tr><td colspan="2">Settings</td><td>Description</td></tr>
<tr><td>0</td><td>Forward</td><td>Fx operation</td></tr>
<tr><td>1</td><td>Reverse</td><td>Rx operation</td></tr>
</table></td></tr>
<tr><td>DRV-05
KPD H.O.A Lock</td><td>To make HAND-OFF-AUTO enabled/disabled
<table>
<tr><td colspan="2">Settings</td><td>Description</td></tr>
<tr><td>0</td><td>Locked</td><td>To make HAND-OFF-AUTO disabled and turn Auto mode</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 is enabled only during working</td></tr>
<tr><td>2</td><td>OFF Key Enable</td><td>Under the same conditions as During Run, only the OFF key is activated.</td></tr>
<tr><td>3</td><td>Unlocked</td><td>To make HAND-OFF-AUTO enabled</td></tr>
</table></td></tr>
<tr><td>DRV-08 AUTO Mode Sel</td><td>Set whether to use AUTO mode.
<table>
<tr><td colspan="2">Settings</td><td>Description</td></tr>
<tr><td>0</td><td>Enabled</td><td>Use the normal AUTO mode.
In AUTO mode, operation starts when the operation command is input.</td></tr>
<tr><td>1</td><td>Disabled</td><td>Even in OFF mode, when an operation command is input, it automatically switches to AUTO mode and starts operation.</td></tr>
</table></td></tr>
<tr><td>DRV-24 Hand Key Sel</td><td>This function enables/disables the HAND key on the keypad.
<table>
<tr><td colspan="2">Settings</td><td>Description</td></tr>
<tr><td>0</td><td>None</td><td>Follow the settings of [DRV-05 KPD H.O.A Lock].</td></tr>
<tr><td>1</td><td>Disabled</td><td>Regardless of the setting of [DRV-05 KPD H.O.A Lock], the HAND key is disabled.</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 key is pressed in other modes (default frequency reference for HAND mode).</td></tr>
<tr><td>DRV-26
HAND Ref Mode :</td><td>Set Hand frequency reference source.
<table>
<tr><td>Setting</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>Freq. Ref. Source</td><td>Hand Parameter</td><td>V1</td><td>V2</td><td>V3</td><td>I1</td><td>I2</td><td>I3</td><td>Follow Auto</td></tr>
</table></td></tr>
<tr><td>OUT-31–36
Relay 1–5</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</td><td>Set HAND State (37) to ensure that the inverter is in HAND mode.</td></tr>
</table>

Switching between the HAND/AUTO/OFF Modes



<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td>①AUTO→HAND</td><td>When the HAND key is pressed in AUTO mode or the multi-function input terminal set as {HAND State} is turned on, the operation is as follows according to the value set in the DRV-26's Hand Ref Mode.
<table>
<tr><td colspan="2">Settings</td><td>Description</td></tr>
<tr><td>0</td><td>Hand Parameter</td><td>The inverter operates 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>
<tr><td>1</td><td>Follow Auto</td><td>The inverter takes over the operation 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>If the AUTO key is pressed during HAND operation, the inverter operates according to the operation command method and operation frequency command set in DRV-06 and DRV-07.</td></tr>
<tr><td>③AUTO→OFF</td><td>Press the OFF key in AUTO mode to stop the inverter operation. In case [DRV-08 AUTO Mode Sel] is {Disabled}, operation is stopped when the input operation command is removed and it is converted to OFF mode.</td></tr>
<tr><td>④OFF→AUTO</td><td>Press the AUTO key 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-08 AUTO Mode Sel] is {Disabled}, even if the AUTO key is not pressed, if the operation command set in DRV-06 is input, it operates according to the operation frequency set in DRV-07.
(If DRV-06 (Cmd Source) is set to 'keypad' press the AUTO key once again to start inverter operation.)</td></tr>
<tr><td>⑤HAND→OFF</td><td>If the OFF key is pressed during HAND operation, operation is stopped.
If the multi-function input terminal set by {HAND State} is turned off, the operation stops and it becomes OFF mode. (However, when [DRV-05 KPD H.O.A Lock] is set to {Locked}, it is converted to AUTO mode.)</td></tr>
<tr><td>⑥OFF→HAND</td><td>If you press the HAND key in the OFF state or turn on the multi-function input terminal set as {HAND State}, the driving direction is the direction set in DRV-02 (Keypad Run Dir) and the monitor screen mode or DRV-25 (HAND Cmd). Freq) operates at the frequency indicated.</td></tr>
</table>

Operation Mode at Power Recovery

If the inverter's input power is cut off and then the power is turned on again, the inverter's operation status is set to [ADV-10 Power-on Run], [ADV-18 KPD Pwr-on Run], and [COM-96 PowerOn Resume]. It may vary.

Note

To operate the inverter using the keypad in AUTO mode, set DRV-06 (CMD Source) to 'KeyPad' and press the AUTO key to enter AUTO mode. Then, press the AUTO key on the keypad once again to start the inverter operation.
If a fault trip occurs during an operation in the AUTO or HAND mode, the inverter can be reset by pressing the OFF key. After the reset, the fault trip is released and the inverter enters OFF mode.
If a fault trip occurs during an operation in the AUTO mode, the inverter can be reset using the reset signal from the multi-function input terminal as well. In this case, the inverter turns back on in AUTO mode after the fault trip is released.

⚠ Caution

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

4.2 Setting Frequency Reference

The H100 inverter provides several methods to setup and modify a frequency reference for an operation. The keypad, analog inputs [for example voltage (V1, V2) and current (I2) signals], or RS-485 (digital signals from higher-level controllers, such as PC or PLC) can be used.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	7	Frequency reference source	Freq Ref Src	0	KeyPad-1	0–11	-
				1	KeyPad-2		
				2	V1		
				3	I1		
				4	V2		
				5	I2		
				6	Int 485		
				7	Field Bus		
				9	Pulse		
				10*	V3		
				11	I3		

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

4.2.1 Keypad as the Source (KeyPad-1 setting)

You can modify frequency reference by using the keypad and apply changes by pressing the [ENT/PROG] key. 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 an operation at DRV-01 (Frequency reference).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	01	Frequency reference	Cmd Frequency	0.00		0.00, Low Freq–High Freq*	Hz
	07	Frequency reference source	Freq Ref Src	0	KeyPad-1	0–11	-

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

4.2.2 Keypad as the Source (KeyPad-2 setting)

You can use the [UP] and [DOWN] cursor keys to modify a frequency reference. To use this as a second option, set the keypad as the source of the frequency reference, by going 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] cursor keys.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	1	KeyPad-2	0–11	-
	01	Frequency reference		0.00		0.00, Low Freq–High Freq*	Hz

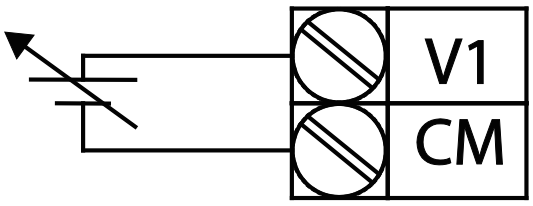
*You cannot set a frequency reference that exceeds the Max. Frequency, as configured with DRV-20.

4.2.3 V1 Terminal as the Source

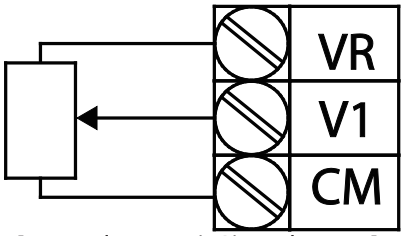
You can set and modify a frequency reference by setting voltage inputs when using the V1 terminal. Use voltage inputs ranging from 0–10 V (unipolar) for forward only operation. Use voltage inputs ranging from -10 to +10 V (bipolar) for both directions, where negative voltage inputs are used in reverse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

4.2.3.1 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]

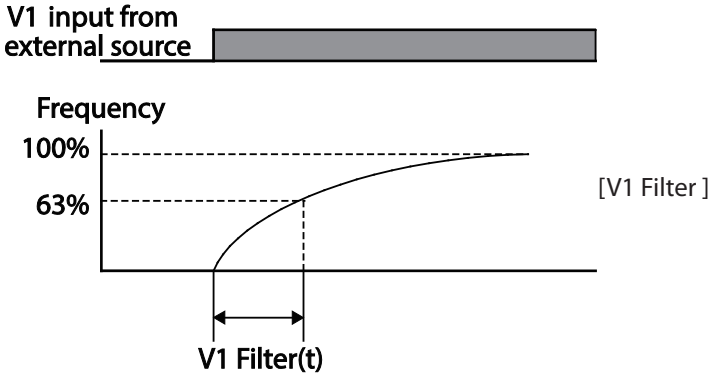
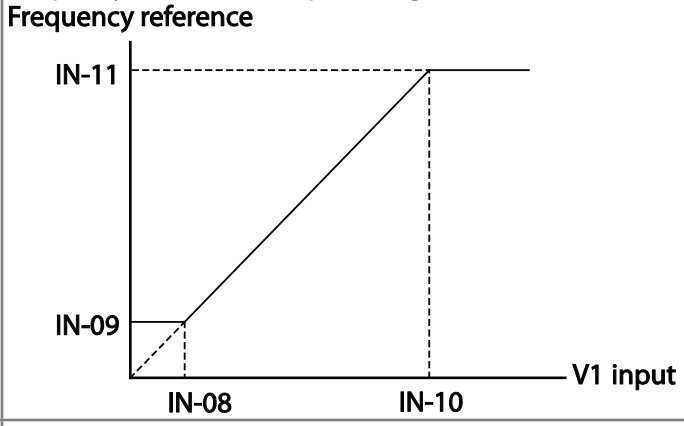


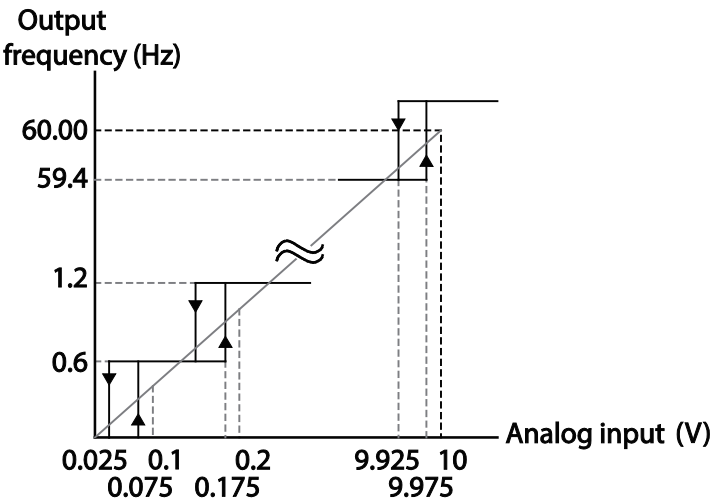
[Internal source (VR) application]

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	V1 output at 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	V1 output at maximum voltage (%)	V1 Perc y2	100.00		0–100	%
	12	V1 input at minimum voltage (%)	V1-Volt x1"	0.00		-10.00–0.00	V
	13	Output at V1 minimum voltage (%)	V1-Perc y1"	0.00		-100.00–0.00	%
	14	V1 input at maximum voltage (%)	V1-Volt x2"	-10.00		-12.00–0.00	V
	15	Output at V1 maximum voltage (%)	V1-Perc y2"	-100.00		-100.00–0.00	%
	16	Rotation direction options	V1 Inverting	0	No	0–1	-
	17	V1 Quantizing level	V1 Quantizing	0.04		0.00*, 0.04–10.00	%

*Quantizing is disabled if '0' is selected.

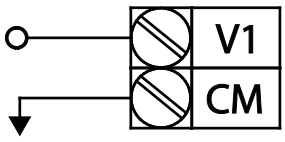
0–10 V Input Voltage Setting Details

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 code IN-01 becomes the maximum frequency only if the value set in code IN-11 (or IN-15) is 100 (%). Set code IN-01 to 40.00 and use default values for codes IN-02–IN-16. Motor will run at 40.00 Hz when a 10 V input is provided at V1. Set code IN-11 to 50.00 and use default values for codes 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]	Configures the inverter to monitor the input voltage at V1.
IN-07 V1 Filter	V1 Filter may be used when there are large variations between reference frequencies. Variations can be mitigated by increasing the time constant, but this requires an increased response time. 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.  [V1 Filter]
IN-08 V1 volt x1– IN-11 V1 Perc y2	These parameters are used to configure the gradient level and offset values of the Output Frequency, based on the Input Voltage. 
IN-16 V1 Inverting	Inverts the direction of rotation. Set this code to '1 (Yes)' if you need the motor to run in the opposite direction from the current rotation.

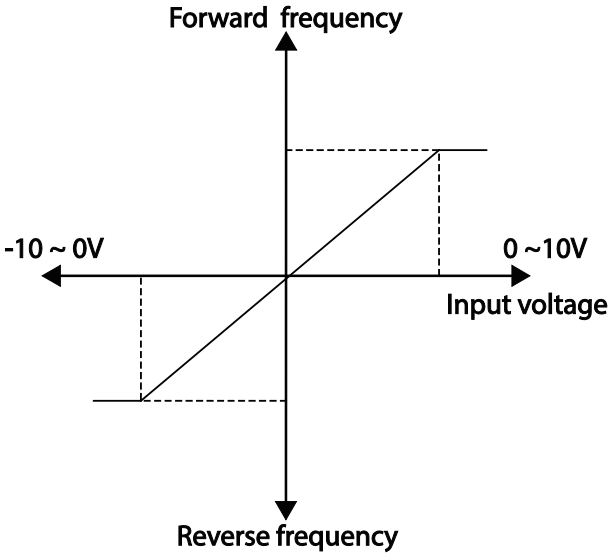
Code	Description
IN-17 V1 Quantizing	Quantizing may be used when the noise level is high in the analog input (V1 terminal) signal. Quantizing is useful when you are operating a noise-sensitive system, because it suppresses any signal noise. However, quantizing will diminish system sensitivity (resultant power of the output frequency will decrease based on the analog input). You can also turn on the low-pass filter using code IN-07 to reduce the noise, but increasing the value will reduce responsiveness and may cause pulsations (ripples) in the output frequency. Parameter values for quantizing refer to a percentage based on the maximum input. Therefore, if the value is set to 1% of the analog maximum input (60 Hz), the output frequency will increase or decrease by 0.6 Hz per 0.1 V difference. When the analog input is increased, an increase to the input equal to 75% of the set value will change the output frequency, and then the frequency will increase according to the set value. Likewise, when the analog input decreases, a decrease in the input equal to 75% of the set value will make an initial change to the output frequency. As a result, the output frequency will be different at acceleration and deceleration, mitigating the effect of analog input changes over the output frequency. (ripple)  [V1 Quantizing]

4.2.3.2 Setting a Frequency Reference for -10–+10 V 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 input to V1.



[V1 terminal wiring]



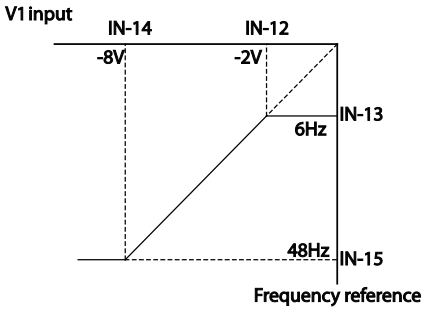
[Bipolar input voltage and output frequency]

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-15 V1- Perc y2	Sets the gradient level and off-set value of the output frequency in relation to the input voltage. These codes 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 *p.73*.

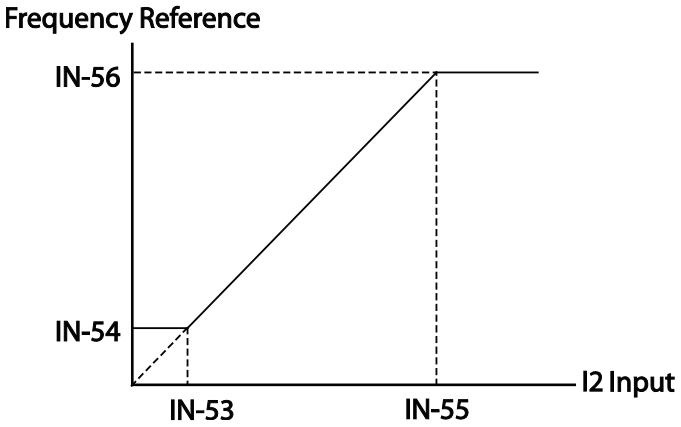
4.2.3.3 Setting a Reference Frequency using Input Current (I2)

You can set and modify a frequency reference using input current at the I2 terminal after selecting current input at SW4. Set DRV-07 (Frequency reference source) to '5 (I2)' and apply 0–20 mA input current to I2.

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	%
	57	I2 rotation direction options	I2 Inverting	0	No	0–1	-
	58	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-55 is set to 100%). If IN-01 is set to 40.00, and default settings are used for IN-53–56, 20 mA input current (max) to I2 will produce a frequency reference of 40.00 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	Used to monitor 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.
IN-53 I2 Curr x1– IN-56 I2 Perc y2	Configures the gradient level and off-set value of the output frequency.  [Gradient and off-set configuration based on output frequency]

4.2.4 Setting a Frequency Reference with Input Voltage (Terminal I2)

Set and modify a frequency reference using input voltage at I2 (V2) terminal by setting SW2 to V2. Set the DRV-07 (Frequency reference source) to 4 (V2) and apply 0–12 V input voltage to I2 (=V2, Analog current/voltage input terminal). Codes IN-35–47 will not be displayed when I2 is set to receive current input (DRV-07 is set to '5').

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

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	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.

4.2.5 Setting a Frequency with TI Pulse Input

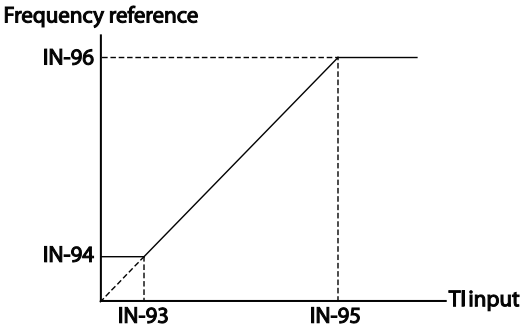
Set a frequency reference by setting the Frq (Frequency reference source) code (code 07) in DRV group to 9 (Pulse) and provide 0–32.00 kHz pulse frequency to TI terminal.

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	msec
	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 codes 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 codes 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).

Code	Description
IN-93 TI Pls x1– IN-96 TI Perc y2	Configures the gradient level and offset values for the output frequency. 
IN-97 TI Inverting– IN-98 TI Quantizing	Identical to IN-16–17 (refer to IN-16 V1 Inverting/IN-17 V1 Quantizing on *p.73*)

4.2.6 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 the Frq (Frequency reference source) code (code 07) in the DRV group to 6 (Int 485) and use the RS-485 signal input terminals (S+/S-/SG) for communication. Refer to *"7 RS-485 Communication Features" on page 316*.

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	0–6	-
				2	LS INV 485		
				4	BACnet		
				5	Metasys-N2		
				6**	Modbus Master		
	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	Reserved		
				2	D8/PE/S1		
				3	D8/PO/S1		

*If AP1-40 is set to '4(Serve Drv)', MaxComID is '8', and if COM-02 is set to '4(BACnet), MaxComID is '127'. Otherwise MaxComID is '250'.

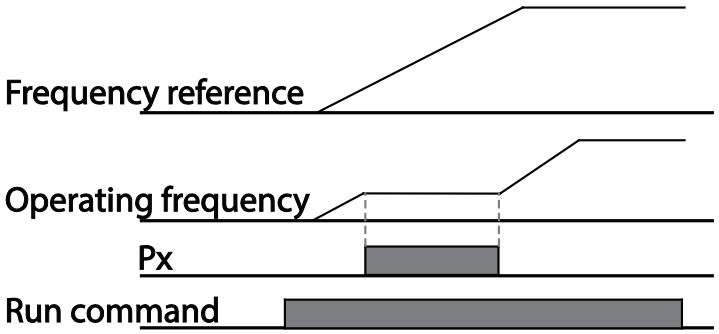
** COM-02 is automatically set to '6(Modbus Master)' when AP1-40 is set to '2 or 3'. Otherwise a user can set the parameter value at user's choice.

4.3 Frequency Hold by Analog Input

If you set a frequency reference via analog input at the control terminal block, you can hold the operation frequency of the inverter by assigning a multi-function input as the analog frequency hold terminal. The operation frequency will be fixed upon an analog input signal.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	0	Keypad-1	0–11	-
				1	Keypad-2		
				2	V1		
				3	I1		
				4	V2		
				5	I2		
				6	Int 485		
				7	Fied Bus		
				9	Pulse		
				10*	V3		
				11	I3		
IN	65–71	Px terminal configuration	Px Define (Px: P1–P7)	23	Analog Hold	0–55	-

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



4.4 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		

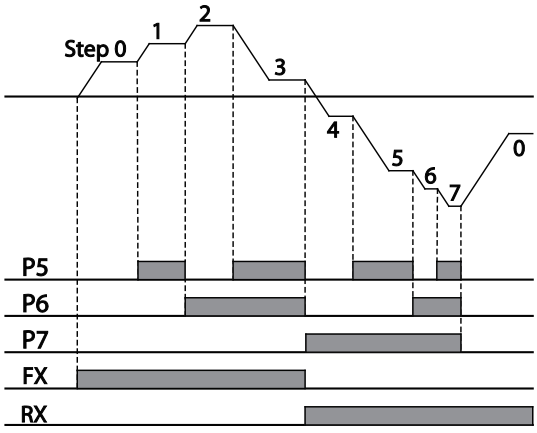
4.5 Setting Multi-step Frequency

Multi-step operations can be carried out by assigning different speeds (or frequencies) to the Px terminals. Step 0 uses the frequency reference source set at DRV-07. Px terminal parameter values 7 (Speed-L), 8 (Speed-M) and 9 (Speed-H) are recognized as binary commands and work in combination with Fx or Rx run commands. The inverter operates according to the frequencies set with BAS-50–56 (multi-step frequency 1–7) 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	-		0.00, Low Freq–High Freq*	Hz
IN	65–71	Px terminal configuration	Px Define(Px: P1–P7)	7	Speed-L	0–55	-
				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 Group 50–56	Configure multi-step frequency 1–7.
IN-65–71 Px Define	Choose the terminals to setup as multi-step inputs, and then set the relevant codes (IN-65–71) to 7 (Speed-L), 8 (Speed-M), or 9 (Speed-H). Provided that terminals P5, P6, and P7 have been set to Speed-L, Speed-M and Speed-H respectively, the following multi-step operation will be available.



[An example of a multi-step operation]

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

Code	Description
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.

4.6 Command Source Configuration

Various devices can be selected as command input devices for the H100 inverter. Input devices available to select include keypad, multi-function input terminal, RS-485 communication and field bus adapter.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command Source	Cmd Source	0	Keypad	0–6	-
				1	Fx/Rx-1		
				2	Fx/Rx-2		
				3	Int 485		
				4	Field Bus		
				5	Time Event		
				6	Follow Lead		

4.6.1 The Keypad as a Command Input Device

To use the keypad as the command source, press the [AUTO] key to enter AUTO mode. 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).

Since the keypad is now the command source, operation starts when the AUTO key is pressed, and it stops when the AUTO key is pressed again.

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

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	0	KeyPad	0–6	-

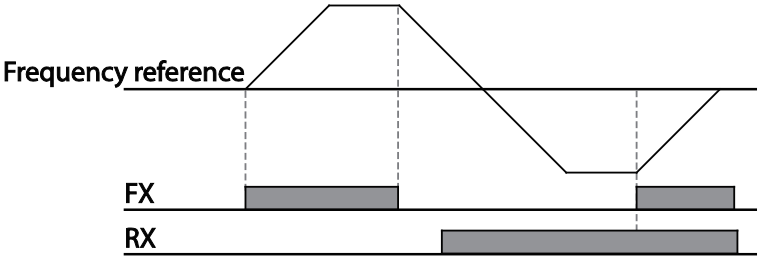
4.6.2 Terminal Block as a Command Input Device (Fwd/Rev run commands)

Multi-function terminals can be selected as a command input device. This is configured by setting DRV-06 (command source) in the Drive group to '1 (Fx/Rx)'. Select 2 terminals for the forward and reverse operations, and then set the relevant codes (2 of the 7 multi-function terminal codes, IN-65–71 for P1–P7) to '1 (Fx)' and '2 (Rx)' respectively. This application enables both terminals to be turned on or off at the same time, constituting a stop command that will cause the inverter to stop operation.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	02	Operation direction for Keypad	Keypad Run Dir	0	Reverse	0–1	-
				1	Forward		
DRV	06	Command source	Cmd Source	1	Fx/Rx-1	0–6	-
IN	65–71	Px terminal configuration	Px Define(Px: P1– P7)	1	Fx	0–55	-
				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.



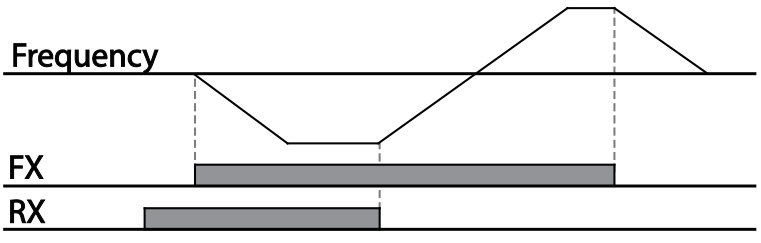
4.6.3 Terminal Block as a Command Input Device (Run and Rotation Direction Commands)

Multi-function terminals can be selected as a command input device. This is configured by setting DRV-06 (command source) in the Drive group to 2(Fx/Rx-2). Select 2 terminals for run and rotation direction commands, and then select the relevant codes (2 of the 5 multi-function terminal codes, IN-65–71 for P1–P7) to 1 (Fx) and 2 (Rx) respectively. This application uses an Fx input as a run command, and an Rx input to change a motor's rotation direction (On: Rx, Off: Fx).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	2	Fx/Rx-2	0–6	-
IN	65–71	Px terminal configuration	Px Define (Px: P1–P7)	1	Fx	0–55	-
				2	Rx		

Run Command and Fwd/Rev Change 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).



4.6.4 RS-485 Communication as a Command Input Device

Internal RS-485 communication can be selected as a command input device by setting DRV-06 (command source) in the Drive group to '3 (Int 485)'. This configuration uses upper level controllers such as PCs or PLCs to control the inverter by transmitting and receiving signals via the S+, S-, and RS-485 signal input terminals at the terminal block. For more details, refer to *"7 RS-485 Communication Features" on page 316*.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	3	Int 485	0–6	-
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 AP1-40 is set to '4(Serve Drv)', MaxComID is '8', and if COM-02 is set to '4(BACnet), MaxComID is '127'. Otherwise MaxComID is '250'

4.7 Forward or Reverse Run Prevention

The rotation direction of motors can be configured to prevent motors to only run in one direction. Pressing the [REV] key on the keypad when direction prevention is configured, will cause the motor to decelerate to 0 Hz and stop. The inverter will remain on.

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	Do not set run prevention.
	1	Forward Prev	Set forward run prevention.
	2	Reverse Prev	Set reverse run prevention.

4.8 Power-on Run

The inverter starts operating at power-on when the following conditions are met.

Keypad input as the command source

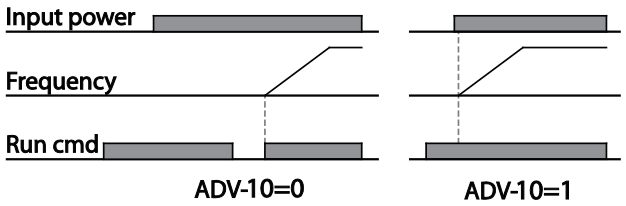
If [AVD-18 KPD Pwr-on Run] is set to Yes, if the operation was performed according to the keypad operation command (HAND key, AUTO key) when the input power was cut off, operation is automatically performed even if there is no keypad operation command after power recovery.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	0, x	AUTO key operation : set to {0: Keypad} HAND key operation : x (no relation)	0–6	-
ADV	18	Power-on run (Keypad)	KPD Pwr-on Run	1	Yes	0–1	-

Terminal block input as the command source

When [AVD-10 Power-on Run] is set to Yes, if it was in AUTO mode when the input power was cut off, the inverter starts immediately according to the terminal block operation command input status when power is restored. This function is available when 1 (Fx/Rx-1) or 2 (Fx/Rx-2) is selected on the DRV-06.

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	0–6	-
ADV	10	Power-on run	Power-on Run	1	Yes	0–1	-



Communication as the command source

To enable power-on resume, set COM-96 (PowerOn Resume) to 'YES', and set DRV-06 to '3 (Int 485)' or '4 (Field Bus).' 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. If COM-96 (PowerOn Resume) is set to 'Yes', the inverter starts operating based on these settings as soon as the power supply resumes.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	3	Int 485	0 - 6	-
				4	Field Bus		
COM	96	Power-on resume	PowerOn Resume	0	No	0 - 1	-
				1	Yes		

Note

- To prevent a repeat fault trip from occurring, set CON-71 (speed search options) bit 4 the same as bit 1. The inverter will perform a speed search at the beginning of the operation.
- If the speed search is not enabled, the inverter will start its operation in a normal V/F pattern and accelerate the motor. If the inverter has been turned on without 'reset and restart' enabled, the terminal block command must be first turned off, and then turned on again 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.

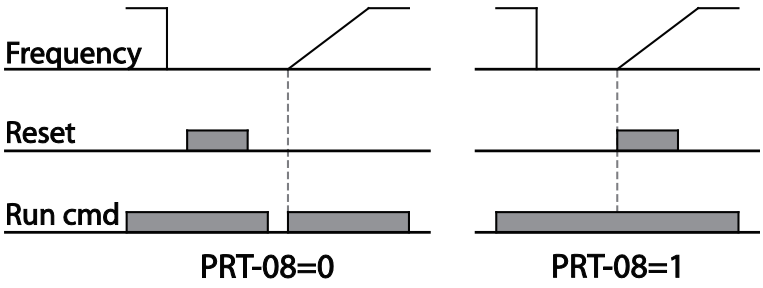
4.9 Reset and Restart

Reset and restart operations can be setup for inverter operation following a fault trip, based on the terminal block operation command (if it is configured). When a fault trip occurs, the inverter cuts off the output and the motor will coast stop. Another fault trip may be triggered if the inverter begins its operation while motor load is in a coast stop state. In PRT-08, bit 1 sets the option for all the fault trips, other than low voltage trips, and bit 2 sets the option for low voltage trips. PRT-10 sets the delay time for restart (the time for the inverter to wait before it restarts).

Setting										Function
Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
									√	Standard Trips except the below
								√		Low Voltage Trip
							√			Low Feedback Trip
						√				High Feedback Trip
					√					SetPoint Timeout
				√						Overcycle Trip
			√							High Flow Trip
		√								Accum Flow Trip
	√									Lost Feedback
√										Lost Command

The number of auto-restarts (PRT-09) is the number of times the inverter will try to restar. If fault trips occur again after restarting, the retry number counts down each time the inverter restarts until the number becomes '0.' Once the inverter restarts successfully after the initial fault trip, the inverter does not restart until the next fault trip occurs. The number of auto-restarts set at PRT-09 that decreased after a restart reverts to the original setting value if successful operation continues for certain period of time.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	1	Fx/Rx-1	0–6	-
PRT	08	Reset restart setup	RST Restart	0000 0000		0000 0000 –1111 1111	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



Note

To prevent a repeat fault trip from occurring, set CON-71 (speed search options) bit 2 the same as bit 1. The inverter will perform a speed search at the beginning of the operation.
If the speed search is not enabled, the inverter will start its operation in a normal V/F pattern and accelerate the motor. If the inverter has been turned on without 'reset and restart' enabled, the terminal block command must be first turned off, and then turned on again 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.

4.10 Setting Acceleration and Deceleration Times

4.10.1 Acc/Dec Time Based on Maximum Frequency

Acc/Dec time values can be set based on maximum frequency, not on inverter operation frequency. To set Acc/Dec time values based on maximum frequency, set BAS- 08 (Acc/Dec reference) in the Basic group to '0 (Max Freq)'.

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, the value set at the DRV-04 (Deceleration time) refers to the time required to return to a stopped state (0 Hz) from the maximum frequency.

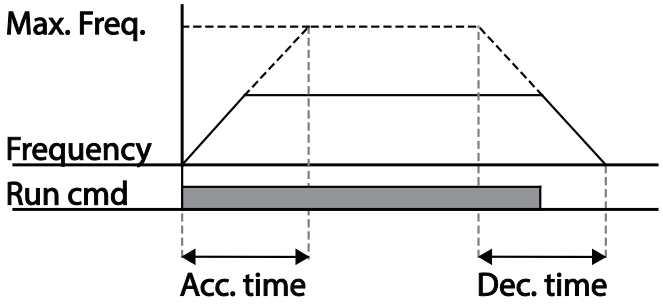
Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	03	Acceleration time	Acc Time	20.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0–600.0	sec
				60.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				100.0	315–750kW-4		
	04	Deceleration time	Dec Time	30.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0–600.0	Sec
				90.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				150.0	315–750kW-4		
	20	Maximum frequency	Max Freq	60.00		40.00–400.00	Hz
BAS	08	Acc/Dec reference frequency	Ramp T Mode	0	Max Freq	0–1	-
	09	Time scale	Time scale	1	0.1 sec	0–2	-

Acc/Dec Time Based on Maximum Frequency–Setting Details

Code	Description
BAS-08 Ramp T Mode	Set the parameter value to 0 (Max Freq) to setup Acc/Dec time based on maximum frequency.

Configuration		Description
0	Max Freq	Set the Acc/Dec time based on maximum frequency.
1	Delta Freq	Set the Acc/Dec time based on operating frequency.

If, for 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).



BAS-09 Time scale

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.

Configuration		Description
0	0.01 sec	Sets 0.01 second as the minimum unit.
1	0.1 sec	Sets 0.1 second as the minimum unit.
2	1 sec	Sets 1 second as the minimum unit.

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.

4.10.2 Acc/Dec Time Based on Operation Frequency

Acc/Dec times can be set based on the time required to reach the next step frequency from the existing operation frequency. To set the Acc/Dec time values based on the existing operation frequency, set BAS-08 (acc/dec reference) in the Basic group to '1 (Delta Freq)'.

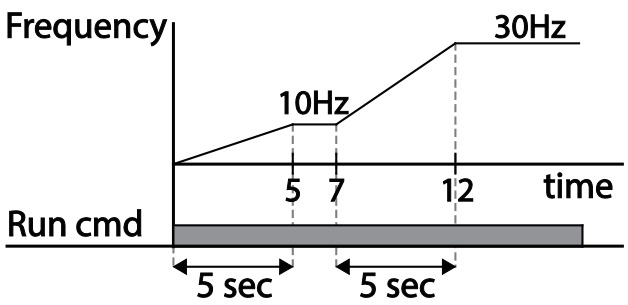
Group	Code	Name	LCD Display	Settings		Setting Range	Unit
DRV	03	Acceleration time	Acc Time	20.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0 - 600.0	sec
				60.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				100.0	315–750kW-4		
	04	Deceleration time	Dec Time	30.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0 - 600.0	sec
				90.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				150.0	315–750kW-4		
BAS	08	Acc/Dec reference	Ramp T Mode	1	Delta Freq	0 - 1	-

Acc/Dec Time Based on Operation Frequency–Setting Details

Code	Description
BAS-08 Ramp T Mode	Set the parameter value to 1 (Delta Freq) to set Acc/Dec times based on Maximum frequency.

Configuration		Description
0	Max Freq	Set the Acc/Dec time based on Maximum frequency.
1	Delta Freq	Set the Acc/Dec time based on Operation frequency.

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).



4.10.3 Multi-step Acc/Dec Time Configuration

Acc/Dec times can be configured via a multi-function terminal by setting the ACC (acceleration time) and DEC (deceleration time) codes in the DRV group.

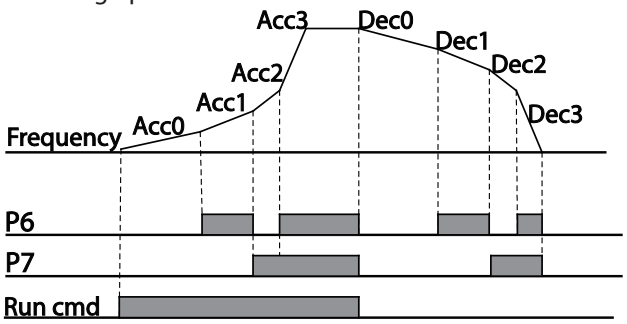
Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	03	Acceleration time	Acc Time	20.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0–600.0	sec
				60.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				100.0	315–750kW-4		
	04	Deceleration time	Dec Time	30.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0–600.0	sec
				90.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				150.0	315–750kW-4		
BAS	70–83*	Multi-step acceleration/ Deceleration time1–7	Acc Time 1–7	x.xx		0.0–600.0	sec
			Dec Time 1–7	x.xx		0.0–600.0	sec
IN	65–71	Px terminal configuration	Px Define (Px: P1–P7)	11	XCEL-L	0–55	-
				12	XCEL-M		
				13	XCEL-H		
	89	Multi-step command delay time	In Check Time	1		1–5000	ms

*BAS 70-83 parameters are not available until IN 65-71 is set to XCEL.

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

Code	Description
BAS-70–82 Acc Time 1–7	Set multi-step acceleration time1–7.
BAS-71–83 Dec Time 1–7	Set multi-step deceleration time1–7.

<table>
<tr><th>Code</th><th>Description</th></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><td colspan="2">Configuration</td><td>Description</td></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.
If, for example, the P6 and P7 terminals are set as XCEL-L and XCEL-M respectively, the following operation will be available.


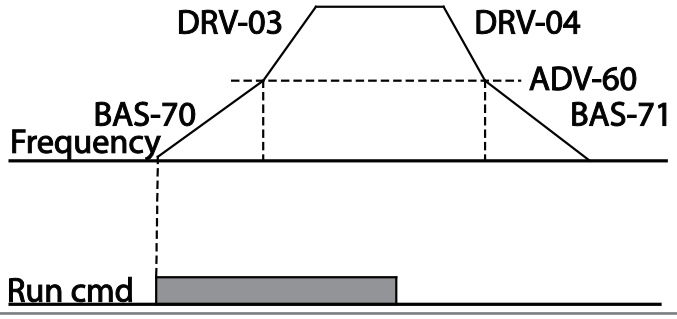
<table>
<tr><th>Acc/Dec time</th><th>P7</th><th>P6</th></tr>
<tr><td>0</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>-</td><td>✓</td></tr>
<tr><td>2</td><td>✓</td><td>-</td></tr>
<tr><td>3</td><td>✓</td><td>✓</td></tr>
</table>
[Multi-function terminal P6, P7 configuration]</td></tr>
<tr><td>IN-89 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>

4.10.4 Configuring Acc/Dec Time Switch Frequency

You can switch between two different sets of Acc/Dec times (Acc/Dec gradients) by configuring the switch frequency without configuring the multi-function terminals.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	03	Acceleration time	Acc Time	20.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0–600.0	sec
				60.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				100.0	315–750kW-4		
	04	Deceleration time	Dec Time	30.0	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.0–600.0	sec
				90.0	5.5–90kW-2 110–250kW-4 110–300kW-5		
				150.0	315–750kW-4		
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
ADV	60	Acc/Dec time switch frequency	Xcel Change Fr	30.00		0–Maximum frequency	Hz

Acc/Dec Time Switch Frequency Setting Details

Code	Description
ADV-60 Xcel Change Fr	After the Acc/Dec switch frequency has been set, Acc/Dec gradients configured at BAS-70 and 71 will be used when the inverter's operation frequency is at or below the switch frequency. If the operation frequency exceeds the switch frequency, the gradient level configured for the acceleration and deceleration times (set at DRV-03 and DRV-04) will be used. If you configure the P1–P7 multi-function input terminals for multi-step Acc/Dec gradients (XCEL-L, XCEL-M, XCEL-H), the inverter will operate based on the Acc/Dec inputs at the terminals instead of the Acc/Dec switch frequency configurations. The 'Xcel Change Fr' parameter is applied only when ADV-24 (Freq Limit Mode) is set to 'NO'. 

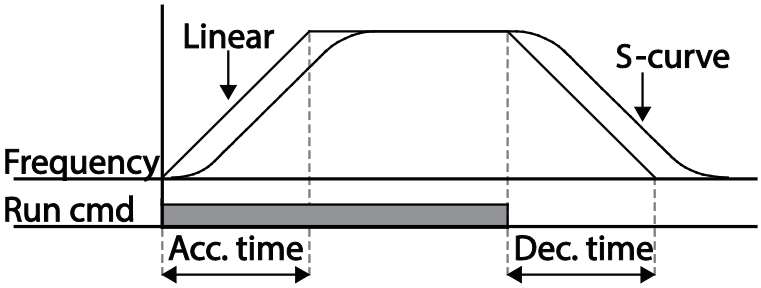
4.11 Acc/Dec Pattern Configuration

Acc/Dec gradient level patterns can be configured to enhance and smooth the inverter's acceleration and deceleration curves. Linear pattern features a linear increase or decrease to the output frequency, at a fixed rate. For an S-curve pattern a smoother and more gradual increase or decrease of output frequency, ideal for lift-type loads or elevator doors, etc. S-curve gradient level can be adjusted using codes ADV-03–06 in the advanced group.

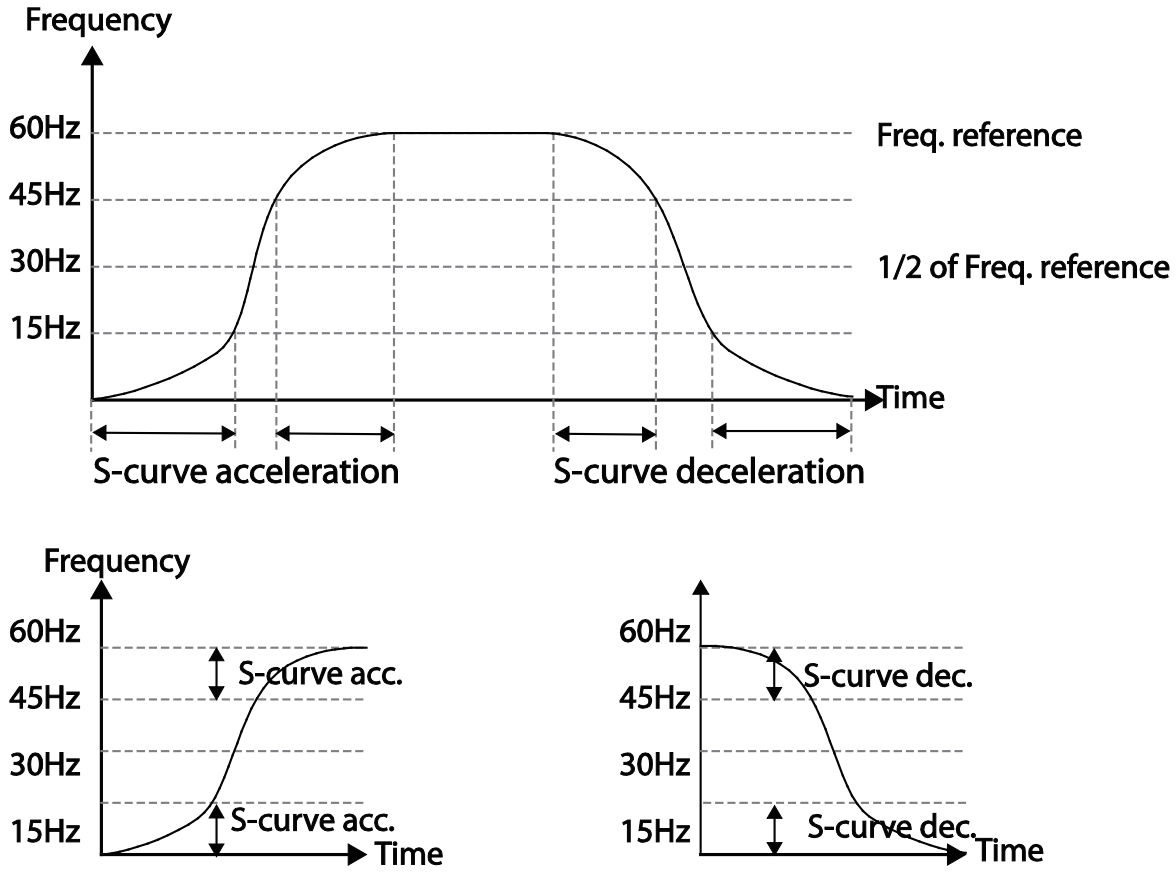
Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
BAS	08	Acc/Dec reference	Ramp T mode	0	Max Freq	0–1	-
ADV	01	Acceleration pattern	Acc Pattern	0	Linear	0–1	-
	02	Deceleration pattern	Dec Pattern	1	S-curve		-
	03	S-curve Acc start gradient	Acc S Start	40		1–100	%
	04	S-curve Acc end gradient	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	Sets the gradient level as acceleration starts when using an S-curve, Acc/Dec pattern. ADV-03 defines S-curve gradient level as a percentage, up to half of total acceleration. If the frequency reference and maximum frequency are set at 60 Hz and ADV-03 is set to 50%, ADV-03 configures acceleration up to 30 Hz (half of 60 Hz). The inverter will operate S-curve acceleration in the 0-15 Hz frequency range (50% of 30 Hz). Linear acceleration will be applied to the remaining acceleration within the 15–30 Hz frequency range.
ADV-04 Acc S End	Sets the gradient level as acceleration ends when using an S-curve Acc/Dec pattern. ADV-03 defines S-curve gradient level as a percentage, above half of total acceleration. If the frequency reference and the maximum frequency are set at 60 Hz and ADV-04 is set to 50%, setting ADV-04 configures acceleration to increase from 30 Hz (half of 60 Hz) to 60 Hz (end of acceleration). Linear acceleration will be applied within the 30-45 Hz frequency range. The inverter will perform an S-curve acceleration for the remaining acceleration in the 45–60 Hz frequency range.
ADV-05 Dec S Start – ADV-06 Dec S End	Sets the rate of S-curve deceleration. Configuration for codes ADV-05 and ADV-06 may be performed the same way as configuring codes ADV-03 and ADV-04.



[Acceleration / deceleration pattern configuration]



[Acceleration / deceleration S-curve pattern configuration]

Note

The Actual Acc/Dec time during an S-curve application
Actual acceleration time = user-configured acceleration time + user-configured acceleration time x starting gradient level/2 + user-configured acceleration time x ending gradient level/2.
Actual deceleration time = user-configured deceleration time + user-configured deceleration time x starting gradient level/2 + user-configured deceleration time x ending gradient level/2.

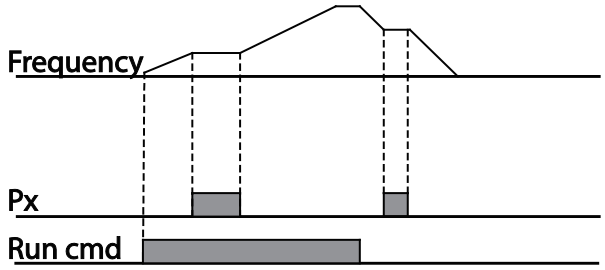
⚠ Caution

Note that actual Acc/Dec times become greater than user defined Acc/Dec times when S-curve Acc/Dec patterns are in use.

4.12 Stopping the Acc/Dec Operation

Configure the multi-function input terminals to stop acceleration or deceleration and 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	0–55	-



4.13 V/F (Voltage/Frequency) Control

Configure the inverter's output voltages, gradient levels, 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.

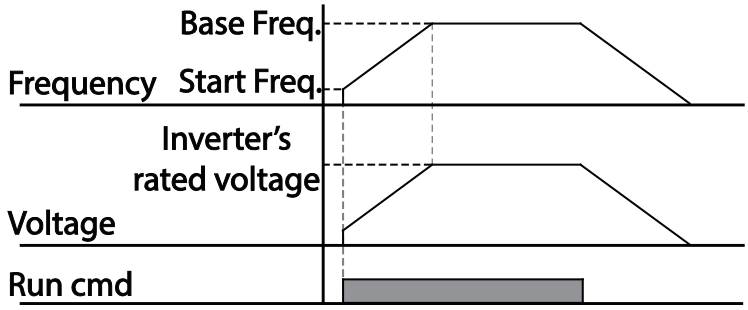
4.13.1 Linear V/F Pattern Operation

A linear V/F pattern configures the inverter to increase or decrease the output voltage at a fixed rate for different operation frequencies based on V/F characteristics. A linear V/F pattern is particularly useful when a constant torque load is applied.

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

Code	Description
DRV-18 Base Freq	Sets the base frequency. A base frequency is the inverter's output frequency when running at its rated voltage. Refer to the motor's rating plate to set this parameter value.

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). 

4.13.2 Square Reduction V/F Pattern Operation

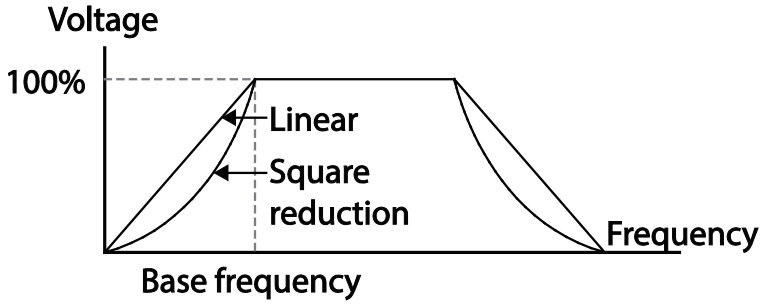
Square reduction V/F pattern is ideal for loads such as fans and pumps. It provides non-linear acceleration and deceleration patterns to sustain torque throughout the whole frequency range.

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

Code	Description
BAS-07 V/F Pattern	Sets the parameter value to '1 (Square)' or '3 (Square2)' according to the load's start characteristics.

Setting		Function
1	Square	The inverter produces output voltage proportional to 1.5 square of the operation frequency.
3	Square2	The inverter produces output voltage proportional to 2 square of the operation frequency. This setup is ideal for variable torque loads such as fans or pumps.



4.13.3 User V/F Pattern Operation

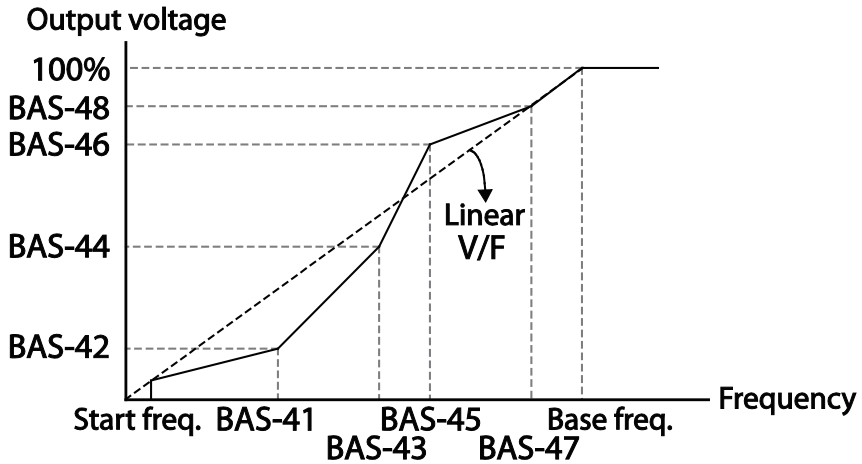
The H100 inverter allows the configuration of user-defined V/F patterns to suit the load characteristics of special motors.

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 not operate.

4.13.4 PM V/F Control Operation

PM (permanent magnet) V/F control is a control method that enables users to easily and simply control PM motors without requiring auto-tuning or complicated parameter settings. While PM sensorless vector control requires many parameter settings, PM V/F control is intended for applications where the high performance of sensorless vector control is not required and user convenience is important.

When a PM motor is operated in the standard V/F control mode, the current may diverge and control may be lost under certain operating conditions because there is no damping element. Set DRV-41 (PM V/f Sel) to '1 (Yes)' to activate the PM V/F current stabilization controller in V/F control mode. The current stabilization controller acts as a damping element and suppresses current divergence during PM V/F operation. PM V/F control also provides a current reduction function (DRV-43) that determines the d-axis (reactive) current ratio and reduces the output current under no-load or light-load conditions.

Before starting PM V/F operation, set the motor parameters as shown on the motor rating plate - motor capacity (DRV-14), base/start/maximum frequency (DRV-18–20), number of poles (BAS-11), rated current (BAS-13), rated voltage (BAS-15), and AC input voltage (BAS-19).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	09	Control mode	Control Mode	0	V/F	0–1	-
	41	PM V/F mode selection New	PM V/f Sel	1	Yes	0–1	-
	42	PM V/F stabilization controller gain New	PM V/f Kctrl	2.00		0.00–10.00	-
	47	PM V/F power filter New	PM V/f Filter	1.0		0.1–20.0	Hz
	43	PM V/F current reduction New	PM VF Cur Reduc	1	Yes	0–1	-
	44	PM V/F D-axis current limit New	PM VF Curr Lmt	70.0		30.0–120.0	%
	45	PM V/F current reduction compensation New	PM VF Comp Perc	30.0		0.0–200.0	%

* DRV-42, DRV-43, and DRV-47 are displayed when DRV-41 is set to '1 (Yes)'. DRV-44 and DRV-45 are displayed when both DRV-41 and DRV-43 are set to '1 (Yes)'.

PM V/F Control Operation – Setting Details

<table>
<tr><th>Codes</th><th>Description</th></tr>
<tr><td>DRV-41
PM V/f Sel</td><td>Enables the PM V/F control function that uses the current stabilization controller.
<table>
<tr><th colspan="2">Settings</th><th>Description</th></tr>
<tr><td>0</td><td>No</td><td>The inverter performs standard induction motor V/F control in V/F control mode. When a PM motor is operated, the current may diverge and control may be lost under certain operating conditions because there is no damping element.</td></tr>
<tr><td>1</td><td>Yes</td><td>The PM V/F current stabilization controller is activated in V/F control mode. The stabilization controller acts as a damping element and suppresses current divergence during PM V/F operation.</td></tr>
</table></td></tr>
<tr><td>DRV-42
PM V/f Kctrl</td><td>Sets the gain of the Kctrl current stabilization controller for PM V/F control. Set a smaller value for a larger motor capacity, and a larger value for a smaller motor capacity.
If current hunting occurs, increase the setting value. If an over voltage trip occurs during a step load at high speed, decrease the setting value.</td></tr>
</table>

Codes	Description
DRV-47 PM V/f Filter	Sets the cutoff frequency of the power high-pass filter (HPF) used by the PM V/F current stabilization controller.
DRV-43 PMVF Cur Reduc	Enables the current reduction function under light-load conditions during PM V/F control operation (DRV-41: Yes).

Settings		Description
0	No	The output voltage is determined by the V/F pattern and a constant voltage is output in the steady state. Because of this, a large current generally flows in the no-load condition.
1	Yes	When the operation reaches the steady state, the inverter calculates the d-axis current ratio. If the d-axis current ratio is higher than the DRV-44 setting value, the inverter reduces the output voltage by the scale set in DRV-45.

DRV-44 PMVF Curr Lmt	Sets the reference d-axis current ratio for the current reduction function. Set it lower to reduce the current at a higher load level. If it is set too low, control may be lost.
DRV-45 PMVF Comp Perc	Sets the scale of the voltage compensation (the current reduction value) used to reduce the current. If it is set too high, the voltage required for control may become insufficient.

⚠ Caution

If a PM motor is operated in V/F control mode with DRV-41 (PM V/f Sel) set to '0 (No)', the current may diverge and an over current trip may occur depending on the operating conditions. Set DRV-41 to '1 (Yes)' before operating a PM motor.

Note

When DRV-41 (PM V/f Sel) is set to '1 (Yes)', the current hunting prevention function for induction motor V/F control (CON-13 AHR Sel) is automatically changed to '0 (No)'. When DRV-41 is set back to '0 (No)', CON-13 is automatically changed to '1 (Yes)'.

PM V/F Operation Example

The following example compares the control stability and the current level according to the PM V/F control and the current reduction settings, at the rated speed under the no-load condition (H100+ 11.0 kW-4, PM motor 11.0 kW-4 / 100 Hz / 380 V).

Parameter Settings for the Example	
DRV-01 Cmd Frequency = 100.00 Hz	DRV-41 PM V/f Sel = No or Yes
DRV-09 Control Mode = 0: V/F	DRV-42 PM V/f Kctrl = 2.00
DRV-18 Base Freq = 100.00 Hz	DRV-43 PMVF Cur Reduc = No or Yes
DRV-20 Max Freq = 100.00 Hz	DRV-44 PMVF Curr Lmt = 70.0% / DRV-45 PMVF Comp Perc = 30.0%

Case	Setting	Result
1	PM V/F disabled (DRV-41 = 0: No)	After reaching the target frequency (100 Hz), the current diverges and an over current trip occurs.
2	PM V/F enabled, current reduction disabled (DRV-41 = 1: Yes, DRV-43 = 0: No)	After reaching the target frequency (100 Hz), the motor is controlled stably without current divergence (steady-state current: 11.9 A).
3	PM V/F enabled, current reduction enabled (DRV-41 = 1: Yes, DRV-43 = 1: Yes)	After reaching the target frequency (100 Hz), the motor is controlled stably without current divergence (steady-state current: 7.0 A).

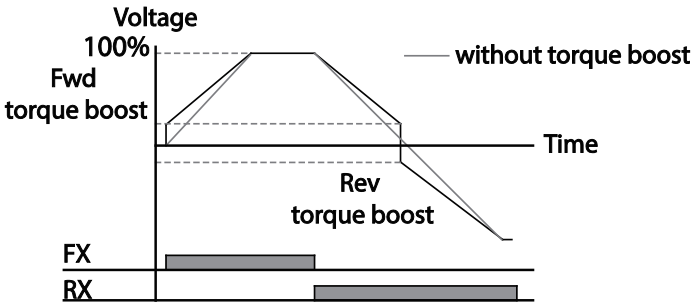
4.14 Torque Boost

4.14.1 Manual Torque Boost

Manual torque boost enables users to adjust output voltage during low speed operation or motor start. Increase low speed torque or improve motor starting properties by manually increasing output voltage. Configure manual torque boost while running loads that require high starting torque, such as lift-type loads.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	15	Torque boost options	Torque Boost	0	Manual	0–2	-
	16	Forward torque boost	Fwd Boost	2.0	0.75–90kW-2	0.0–15.0	%
				1.0	110–750kW-4		
				1.2	5.5–90kW-5		
				0.8	110–300kW-5		
	17	Reverse torque boost	Rev Boost	2.0	0.75–90kW-2	0.0–15.0	%
				1.0	110–750kW-4		
				1.2	5.5–90kW-5		
				0.8	110–300kW-5		

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: Excessive torque boost will result in over-excitation and motor overheating

4.14.2 Auto Torque Boost

Set DRV-15 to 'Auto 1' or 'Auto 2' to select the type of torque boost. While manual torque boost adjusts the inverter output based on the setting values regardless of the type of load used in the operation, auto torque boost 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 requires motor-related parameters such as stator resistance, inductance, and no-load current, auto tuning (BAS-20) has to be performed before auto torque boost can be configured. Similarly to manual torque boost, configure auto torque boost while running a load that requires high starting torque, such as lift-type loads. Refer to *"5.30 Auto Tuning" on page 195*.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	15	torque boost mode	Torque Boost	1	Auto 1	0–2	-
BAS	20	auto tuning	Auto Tuning	3	Rs+Lsigma	0–3	-

4.14.3 Advanced Auto Torque Boost (No Motor Parameter Tuning Required)

Manual Torque Boost, regardless of load characteristics, outputs the inverter voltage according to the torque boost amount set by the user. Auto Torque Boost automatically calculates the boost amount, but auto tuning the motor is required. For Advanced Auto Torque Boost, the inverter outputs the inverter voltage by adjusting the boost amount according to the load itself without auto tuning the motor.

Advanced Automatic Torque Boost is adjusted according to the load determined by the Adv ATB M Gain, Adv ATB G Gain of DRV-34 and 35 values and it can be used when starting torque is insufficient or when excessive current flows.

Group	Code	Name	LCD Display	Settings		Setting Range	Unit
DRV	15	Torque boost mode	Torque Boost	2	Advanced Auto	0–2	-
	16	Forward Torque boost	Fwd Boost	2.0		0.0 - 15.0	%
	27	Reverse Torque boost	Rev Boost	2.0		0.0 - 15.0	%
	33	Auto torque boost filter gain	Adv ATB Filter	100		1 - 9999	msec
	34	Auto torque boost motoring voltage gain	Adv ATB M Gain	50.0		0 - 300.0	%
	35	Auto torque boost generating voltage gain	Adv ATB G Gain	50.0		0 - 300.0	%

Note

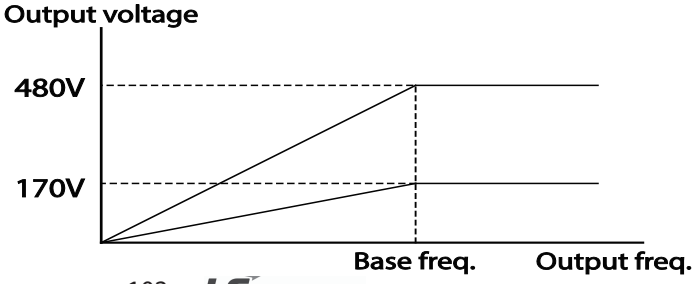
The Advanced ATB function is in drive software from the version <S602.01_D00.00_C602.01>.
Previous software versions have different functionality.

4.15 Output Voltage Setting

Output voltage settings are required when a motor's rated voltage differs from the input voltage to the inverter. Set BAS-15 to configure the motor's rated operating voltage. The set voltage becomes the output voltage of the inverter's base frequency. When the inverter operates above the base frequency, and when the motor's voltage rating is lower than the input voltage at the inverter, the inverter adjusts the voltage and supplies the motor with the voltage set at BAS-15 (motor rated voltage). If the motor's rated voltage is higher than the input voltage at the inverter, the inverter will supply the inverter input voltage to the motor.

If BAS-15 (motor rated voltage) is set to '0', the inverter corrects the output voltage based on the input voltage in the stopped condition. If the frequency is higher than the base frequency, when the input voltage is lower than the parameter setting, the input voltage will be the inverter output voltage.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
BAS	15	Motor rated voltage	Rated Volt	0	0.75–90kW-2	170–264V	V
					0.75–90kW-4	320–528V	
					110–750kW-4	320–550V	
					5.5–300kW-5	525–600V	



4.16 Start Mode Setting

Select the start mode to use when the operation command is input with the motor in the stopped condition.

4.16.1 Acceleration Start

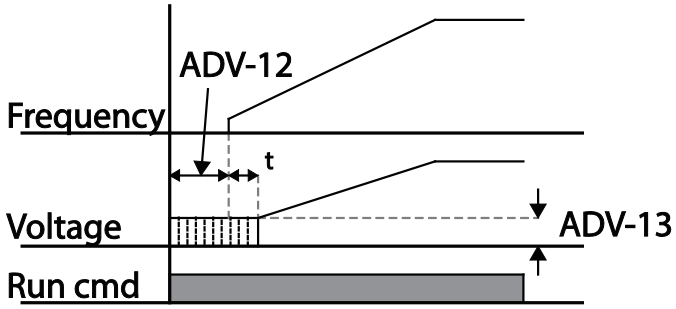
Acceleration start is a general acceleration mode. If there are no extra settings applied, the motor accelerates directly to the frequency reference when the command is input.

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

4.16.2 Start After DC Braking

This start mode supplies a DC voltage for a set amount of time to provide DC braking before an inverter starts to accelerate a motor. If the motor continues to rotate 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 with a mechanical brake connected to a motor shaft when a constant torque load is applied, if a constant torque is required after the the mechanical brake is released.

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. Do not use DC braking resistance values that can cause current draw to exceed the rated current of the inverter. If the DC braking resistance is too high or brake time is too long, the motor may overheat or be damaged

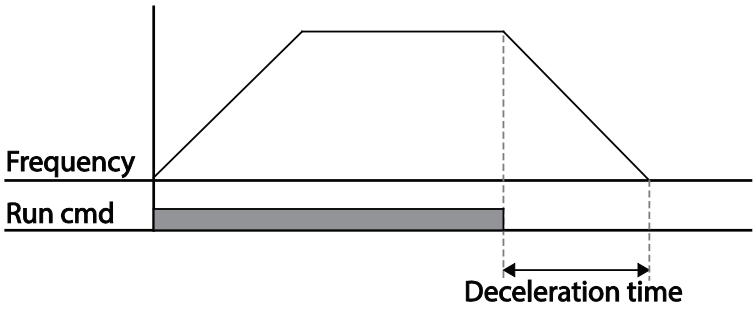
4.17 Stop Mode Setting

Select a stop mode to stop the inverter operation.

4.17.1 Deceleration Stop

Deceleration stop is a general stop mode. If there are no extra settings applied, the motor decelerates down to 0 Hz and stops, as shown in the figure below.

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



4.17.2 Stop After DC Braking

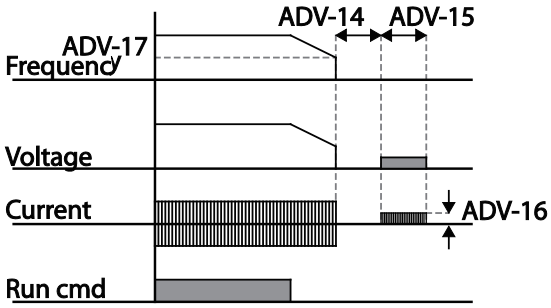
When the operation frequency reaches the set value during deceleration (DC braking frequency) the inverter stops the motor by supplying DC power to the motor. With a stop command input, the inverter begins decelerating the motor. When the frequency reaches the DC braking frequency set at ADV-17, the inverter supplies DC voltage 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	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	0.00–60.00	sec
				2.00	55–90kW-2 110–750kW-4 110–300kW-5		
	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 the time to block the inverter output before DC braking. If the inertia of the load is great, or if DC braking frequency (ADV-17) is set too high, a fault trip may occur due to overcurrent conditions when the inverter supplies DC voltage to the motor. Prevent overcurrent fault trips by adjusting the output block time before DC braking.
ADV-15 DC-Brake Time	Set the time duration for the DC voltage supply to the motor.

Code	Description
ADV-16 DC-Brake Level	Set the amount of DC braking to apply. The parameter setting is based on the rated current of the motor.
ADV-17 DC-Brake Freq	Set the frequency to start DC braking. When the frequency is reached, the inverter starts deceleration. If the dwell frequency is set lower than the DC braking frequency, dwell operation will not work and DC braking will start instead.



Caution

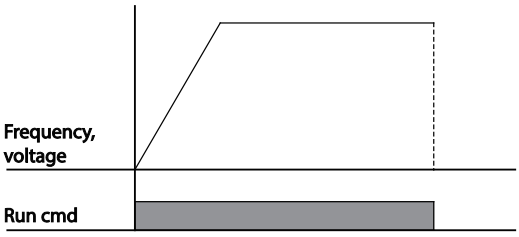
Note that the motor can overheat or be damaged if excessive amount of DC braking is applied to the motor or DC braking time is set too long.

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.

4.17.3 Coast Stop

When the Operation command is off, the inverter output turns off, and the load stops due to residual inertia.

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



Caution

Note that when there is high inertia on the output side and the motor is operating at high speed, the load's inertia will cause the motor to continue rotating even if the inverter output is blocked

4.17.4 Power Braking

When the inverter's DC voltage rises above a specified level due to motor regenerated energy a control is made to either adjust the deceleration gradient level or 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 trip.

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, and 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 trip may occur.
Note that if a free run stop is used, the actual deceleration time can be longer than the pre-set deceleration time.

4.18 Frequency Limit

Operation frequency can be limited by setting maximum frequency, start frequency, upper limit frequency, and lower limit frequency.

4.18.1 Frequency Limit Using Maximum 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	Hz

Frequency Limit Using Maximum Frequency and Start Frequency - Setting Details

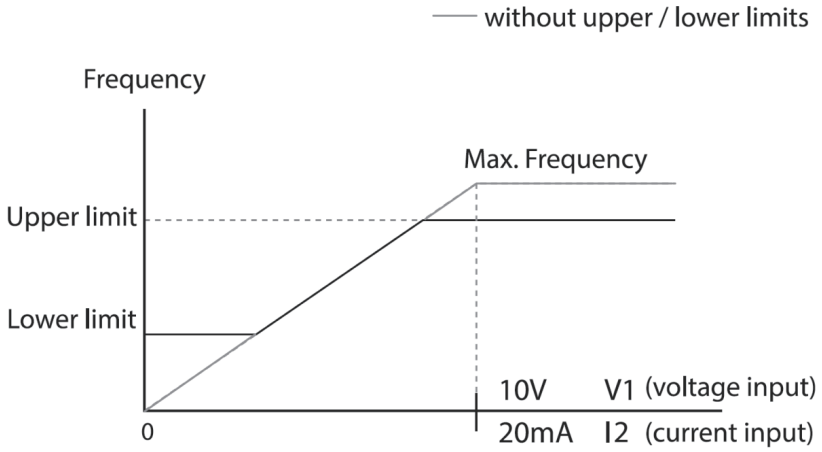
Code	Description
DRV-19 Start Freq	Set the lower limit value for speed unit parameters that are expressed in Hz or rpm. If an input frequency is lower than the start frequency, the parameter value will be 0.00.
DRV-20 Max Freq	Set upper and lower frequency limits. All frequency selections are restricted to frequencies from within the upper and lower limits. This restriction also applies when you in input a frequency reference using the keypad. If you use a high speed motor over 60Hz, there will be individual response due to the difference in characteristics. Please contact LS ELECTRIC.

4.18.2 Frequency Limit Using Upper and Lower Limit Frequency Values

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		minimum–maximum frequency	Hz

Frequency Limit Using Upper and Lower Limit Frequencies - Setting Details

Code	Description
ADV-24 Freq Limit	The initial setting is '0 (No)'. Changing the setting to '1 (Yes)' allows the setting of frequencies between the lower limit frequency (ADV-25) and the upper limit frequency (ADV-26).
ADV-25 Freq Limit Lo ADV-26 Freq Limit Hi	Set an upper limit frequency to all speed unit parameters that are expressed in Hz or rpm, except for the base frequency (DRV-18). Frequency cannot be set higher.



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.

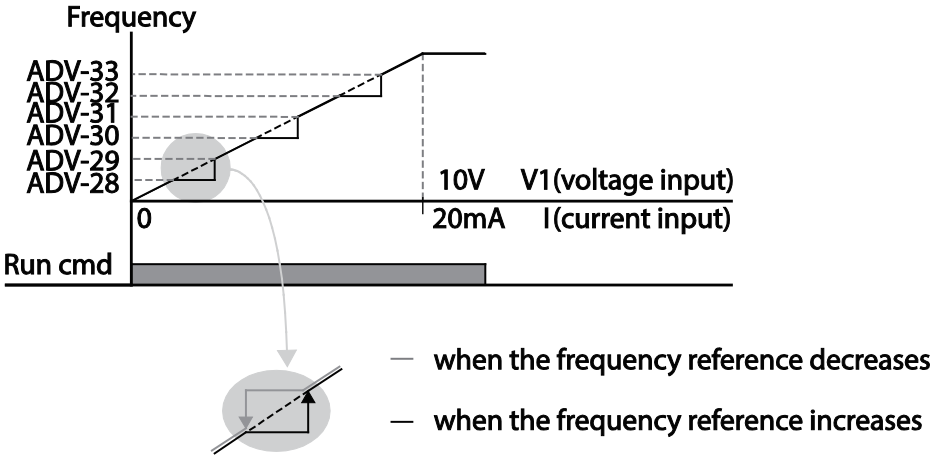
4.18.3 Frequency Jump

Use frequency jump to avoid mechanical resonance frequencies. The inverter will avoid identified ranges during acceleration and deceleration. Operation frequencies cannot be set within the pre-set frequency jump band.

When a frequency setting is increased, while the frequency parameter setting value (voltage, current, RS-485 communication, keypad setting, etc.) is within a jump frequency band the frequency will be maintained at the lower limit value of the frequency band. Then, the frequency will increase when the frequency parameter setting exceeds the range of frequencies used by the frequency jump band.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	27	Frequency jump	Jump Freq	0	0–1	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

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
ADV	33	Jump frequency upper limit 3	Jump Hi 3	35.00	Jump frequency lower limit 3–Maximum frequency	Hz



4.19 2nd Operation Mode Setting

Apply two types of operation modes and switch between them as required. For both the first and second command source, set the frequency after shifting operation commands to the multi-function input terminal. Mode switching can be used to stop remote control during an operation using the communication option and to switch operation mode to operate via the local panel, or to operate the inverter from another remote control location. Select one of the multi-function terminals from codes IN-65–71 and set the parameter value to 15(2nd Source).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source	1	Fx/Rx-1	0–6	-
	07	Frequency reference source	Freq Ref Src	2	V1	0–11	-
BAS	04	2nd Command source	Cmd 2nd Src	0	Keypad	0–5	-
	05	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	0–55	-

2nd Operation Mode Setting Details

Code	Description
BAS-04 Cmd 2nd Src BAS-05 Freq 2nd Src	If signals are provided to the multi-function terminal set as the 2nd command source (2nd Source), the operation can be performed using the set values from BAS-04-05 instead of the set values from the DRV-7 and DRV-01. The 2nd command source settings cannot be changed while operating with the 1st command source (Main Source).

Caution

When setting the multi-function terminal to the 2nd command source (2nd Source) and input (On) the signal, operation state is changed because the frequency setting and the Operation command will be changed to the 2nd command. Before shifting input to the multi-function terminal, ensure that the 2nd command is correctly set. Note that if the deceleration time is too short or inertia of the load is too high, an overvoltage fault trip may occur. Depending on the parameter settings, the inverter may stop operating when you switch the command modes.

4.20 Multi-function Input Terminal Control

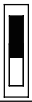
Filter time constants and the type of multi-function input terminals can be configured to improve the response of input terminals.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
IN	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	000 0000*	-	-
IN	90	Multi-function input terminal status	DI Status	000 0000*	-	-

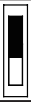
* From the last bit to the first, the bits are for multi-purpose input 1–7 (the last bit is for input 1, and the first bit for input 7).

Multi-function Input Terminal Control Setting Details

Code	Description
IN-85 DI On Delay, IN-86 DI Off Delay	If the input terminal's state is not changed during the set time, when the terminal receives an input, it is recognized as On or Off.
IN-87 DI NC/NO Sel	Select terminal contact types for each input terminal. The position of the indicator light corresponds to the segment that is on as shown in the table below. With the bottom segment on, it indicates that the terminal is configured as a A terminal (Normally Open) contact. With the top segment on, it indicates that the terminal is configured as a B terminal (Normally Closed) contact. Terminals are numbered P1–P7, from right to left.

Type	B terminal status (Normally Closed)	A terminal status (Normally Open)
Keypad		

Code	Description
IN-90 DI Status	Display the configuration of each contact. When a segment is configured as A terminal, using DRV-87, the On condition is indicated by the top segment turning on. The Off condition is indicated when the bottom segment is turned on. When contacts are configured as B terminals, the segment lights behave conversely. Terminals are numbered P1–P7, from right to left.

Type	A terminal setting (On)	A terminal setting (Off)
Keypad		

4.21 Multi-function Input Terminal On/Off Delay Control

Availability of using On/Off Delay about Multi-function Input Terminal can be set

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
IN	83	Availability of applying DI On Delay.	DI On DelayEn	111 1111	000 0000 – 111 1111	-
	84	Availability of applying DI Off Delay.	DI Off DelayEn	111 1111	000 0000 – 111 1111	-

Multi-function Input Terminal On/Off Delay Control Setting Details

Code	Description
IN-83 DI On Delay En IN-84 DI Off Delay En	Every Input Terminal, it is possible to set availability of using On/Off Delay of Input Terminal. From right, Availability of using On/Off Delay about Multi-function Input Terminal can be set with a sequence such as P1–P7. 1: Activate D1 On/Off Delay 0: Inactivate D1 On/Off Delay

4.22 Output Voltage Drop Improvement Function

This function reduces the output current by improving the output voltage drop by making it possible to obtain more output voltage by fully using the output voltage command area under low input power and overload conditions.

Output voltage drop improvement parameter setting

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	87	Setting the over-modulation mode	OVM Mode Sel	1	Yes	0–1	-

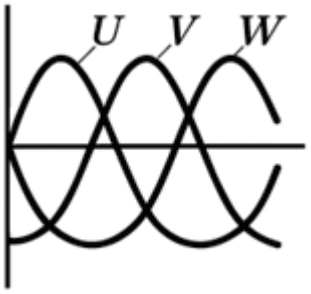
Code	Name	Description
ADV-87	Setting the over-modulation mode	When ADV-87 OVM Mode Sel is set to No, the command voltage is limited to the range that the inverter can output linearly. If OVM Mode Sel is set to Yes, the over-modulation area can also be output, and the command voltage range is expanded and the output voltage command area is fully used to obtain more output voltage.

Caution

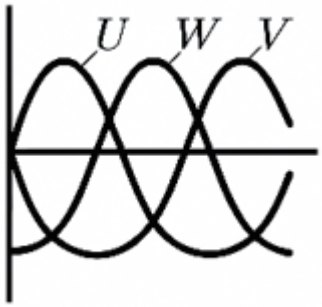
Distortion may occur in the current waveform out of the linear range.
The motor output voltage may be higher under the condition that the input voltage is greater than the motor rated voltage.
During high-speed operation, the current display value may appear to fluctuate faster, but the amount of current change does not increase significantly.
The output voltage compensation value is compensated below the parameter set motor rated voltage.
If the input voltage is higher than the output voltage, OVM Mode does not operate.

4.23 Output Phase Rotation

This function allows the motor's rotation direction to be reversed without modifying the wiring between the inverter and the motor. Instead of rewiring the motor connections, the output phase sequence is internally swapped preserving the inverter's Forward/Reverse logic while achieving the opposite rotation direction.



[ABC- Normal Phase Sequence (UVW)]



[ACB- Reversed Phase Sequence (UWV)]

Code	Name	LCD Display	Parameter Setting		Default	Description
ADV-91	Output Phase Rotation	Output Ph. Rot	0	ABC	0	0: ABC (Forward rotation) 1: ACB (Reverse rotation)
			1	ACB		

5 Learning Advanced Features

This chapter describes the advanced features of the H100+ inverter. Check the reference page in the table to see the detailed description for each of the advanced features.

Advanced Tasks	Description	Ref.
Auxiliary frequency operation	Use the main and auxiliary frequencies in the predefined formulas to create various operating conditions. Auxiliary frequency operation is ideal for Draw Operation as this feature enables fine-tuning of operation speeds.	p.115
Jog operation	Jog operation is a manual operation. The inverter operates to a set of parameter settings predefined for Jog operation while the Jog command button is pressed.	p.120
Up-down operation	Use the upper and lower limit value switch output signals (i.e. signals from a flow meter) as Acc/Dec commands to motors.	p.121
3-wire operation	3-wire operation is used to latch an input signal. This configuration is used to start and stop the inverter by a a momentary contact start push button and and maintained contact stop push button.	p.122
Safe operation mode	This feature allows for external inputs to control whether or not it is safe to operate the inverter. This feature is useful when extra caution is needed in operating the inverter using the multi-purpose terminals.	p.123
Dwell operation	Use this feature for the lift-type loads such as elevators, when the torque needs to be maintained while the brakes are applied or released.	p.124
Slip compensation	This feature ensures that the motor rotates at a constant speed, by compensating for the motor slip as a load increases.	p.126
PID control	PID control provides constant automated control of flow, pressure, and temperature by adjusting the output frequency of the inverter.	p.126
Sleep-wake up operation	When the inverter operation continues below the PID conditions for a set time period, the PID Setpoint is automatically adjusted to extend the operation standby time. This keeps the inverter in a standby (sleep) mode when the demand is very low.	p.141
Pump minimum speed	The minimum frequency the inverter runs at can be configured for both Auto and Hand mode.	p.150
Thrust bearing protection	This feature provides acceleration/deceleration time switching to protect the bearings of the submersible pump.	p.151
No-flow control	The protective function to prevent pump damage in no flow condition. The inverter detects no flow condition by monitoring pressure changes while changing the output frequency. When detected, the inverter puts the pump to sleep.	p.152
Flow monitoring	The inverter can use the flow meter feedback to monitor flow rate, to calculate the flow integrated amount, to display, to limit, and to trigger digital output, warning or trip.	p.156
PI auxiliary control	PI Aux control monitors and manages the suction, water, or cavitation level on the inlet side while maintaining the output pressure.	p.162
Over-cycling protection	Using this protective function allows users to limit the number of sleep and wake cycles in a given time.	p.170
Differential Level Detection	The inverter can monitor and measure the difference between two feedbacks, typically before and after filter, to trigger digital output, warning or trip.	p.172

Advanced Tasks	Description	Ref.
Low/High feedback Detection	Using this function allows the inverter to detect when feedback value is above or below predefined high/low feedback level, and to trigger warning, digital output, or trip.	p.174
Lost Feedback	Triggers warning, digital output, or trip, when there is no feedback to the inverter.	p.176
Setpoint Timeout	If the difference between the setpoint and the feedback is greater than a set level for more than predefined time, the inverter triggers warning, digital output, or trip.	p.177
Current limit	Performs the function of reverting to a value lower than the set current value during the operation to prevent over current. This feature is only applicable if the load is variable torque. That is, it only works with loads that increase current as speed increases	p.179
Backspin Timer	This function can be used to limit re-starting for a certain time after stop or trip, in order to prevent pump damages in a backspinning condition.	p.180
Damper operation	Controls the fan motor optimally when a damper is used in the system.	p.182
Lubrication operation	Supplies lubricant to the machinery before starting the inverter and the mechanical system connected to it.	p.183
Flow compensation	Compensates for pressure loss in a system with long pipelines.	p.183
Pump clean operation	Cleans the pumps by removing the scales or deposits that are attached to the impeller.	p.185
Valve deceleration time setting	Prevents possible pump damage that may be caused by abrupt deceleration.	p.188
Load tuning	Creates load-specific curves for light load operations and the pump clean operation.	p.189
Level detection	Detects and displays the level set by the user.	p.190
Pipe breakage detection	Detects breakages in the pipeline during a PID operation.	p.193
Motor preheating	Prevents motors and pumps from freezing when they are not operated.	p.194
Auto-tuning	Used to automatically measure the motor control parameters to optimize the inverter's control mode performance.	p.195
Scheduled operation	Uses the built-in real-time clock (RTC) to operate the inverter according to the desired time schedule.	p.198
Energy buffering operation	Used to maintain the DC link voltage for as long as possible by controlling the inverter output frequency during power interruptions, thus to delay a low voltage fault trip.	p.208
Fire mode operation	Operates the inverter in a way to cope with emergency situations, such as fire, by controlling the operation of ventilation (intake and exhaust) fans.	p.210

Advanced Tasks	Description	Ref.
Speed search operation	This allows the inverter to determine whether or not the motor is turning while stopped. If the inverter determines the motor is running, it will then attempt to speed match and then ramp the motor to the commanded speed.	p.212
Auto restart operation	Auto restart configuration is used to automatically restart the inverter when a trip condition is released, after the inverter stops operating due to activation of protective devices (fault trips).	p.216
Power source switch operation	Used to switch the power source to the motor from the inverter output to DOL (Direct on Line), or vice versa.	p.219
Cooling fan control	This function turns the inverter's heat-sink cooling fan on and off, or automode based on inverter's internal temperature. It is used in situations where the load stops and starts frequently or a noise-free environment is required. The correct use of cooling fan controls can extend the cooling fan's life.	p.220
MMC / Lead-lag	The MMC (Multiple Motor Control) function is used to control multiple motors for a pump system. The main motor connected with the inverter output is controlled by the PID controller. The auxiliary motors are connected with the supply power and turned on and off by the relay within the inverter. The Multiple Drive Control (Lead-Lag) function connects drives individually to each pump and controls the entire system with one drive as the master.	p.230
Multi-function output On/Off control	Set standard values and turn On/Off the output relays or multi-function output terminals according to the analog input value.	p.278
Regeneration prevention for press operation.	Used during a press operation to avoid motor regeneration, by increasing the motor operation speed.	p.279

5.1 Operating with Auxiliary References

(only works in Auto Mode)

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

Group	Code	LCD Display	LCD Display	Parameter Setting		Setting Range	Unit
DRV	07	Frequency reference source	Freq Ref Src	0	Keypad-1	0–11	-
BAS	01	Auxiliary frequency reference source	Aux Ref Src	1	V1	0–13	-
	02	Auxiliary frequency reference calculation type	Aux Calc Type	0	M+(G*A)	0–7	-
	03	Auxiliary frequency reference gain	Aux Ref Gain	100.0	100.0	-200.0–200.0	%
IN	65– 71	Px terminal configuration	Px Define	31	dis Aux Ref	0–55	-

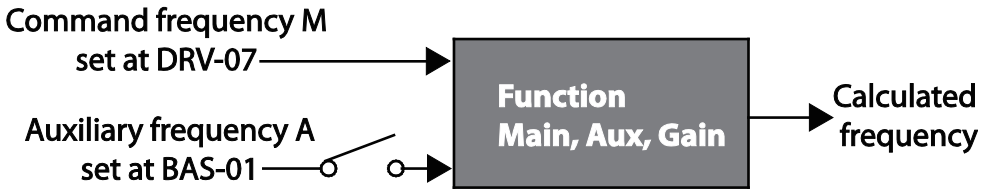
The table above lists the available calculated conditions for the main and auxiliary frequency references. Refer to the table to see how the calculations apply to an example where the DRV-07 Frq Src code has been set to '0 (Keypad-1)', and the inverter is operating at a main reference frequency of 30.00 Hz. Signals at -10 to +10 V are received at terminal V1, with the reference gain set at 5%. In this example, the resulting frequency reference is fine-tuned within the range of 27.00–33.00 Hz [Parameter IN-01–16 must be set to the default values, and IN-06 (V1 Polarity), set to '1 (Bipolar)']

Auxiliary Reference Setting Details

Code	Description
BAS-01 Aux Ref Src	Set the input type to be used for the auxiliary frequency reference.

Configuration		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 I2 (voltage) terminal at the control terminal block as the source of auxiliary frequency reference (SW4 must be set to 'voltage').
4	I2	Sets the I2 (current) terminal at the control terminal block as the source of auxiliary frequency reference (SW4 must be set to 'current').
5	Pulse	Sets the TI (pulse) terminal at the control terminal block as the source of auxiliary frequency reference.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>BAS-02
Aux Calc Type</td><td>Set the auxiliary reference gain with BAS-03 (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.
<table>
<tr><th colspan="2">Configuration</th><th>Formula for frequency reference</th></tr>
<tr><td>0</td><td>M+(G*A)</td><td>Main reference +(BAS-03x BAS-01xIN-01)</td></tr>
<tr><td>1</td><td>M*(G*A)</td><td>Main reference x(BAS-03x BAS-01)</td></tr>
<tr><td>2</td><td>M/(G*A)</td><td>Main reference /(BAS-03x BAS-01)</td></tr>
<tr><td>3</td><td>M+{M*(G*A)}</td><td>Main reference +{ Main reference x(BAS-03x BAS-01)}</td></tr>
<tr><td>4</td><td>M+G*2*(A-50)</td><td>Main reference + BAS-03x2x(BAS-01–50)xIN-01</td></tr>
<tr><td>5</td><td>M*{G*2*(A-50)}</td><td>Main reference x{ BAS-03x2x(BAS-01–50)}</td></tr>
<tr><td>6</td><td>M/{G*2*(A-50)}</td><td>Main reference /{ BAS-03x2x(BAS-01–50)}</td></tr>
<tr><td>7</td><td>M+M*G*2*(A-50)</td><td>Main reference + Main reference x BAS-03x2x(BAS-01–50)</td></tr>
</table>
M: Main frequency reference (Hz or rpm)
G: Auxiliary reference gain (%)
A: Auxiliary frequency reference (Hz or rpm) or gain (%)</td></tr>
<tr><td>BAS-03 Aux Ref Gain</td><td>Adjust the size of the input (BAS-01 Aux Ref Src) configured for auxiliary frequency.</td></tr>
<tr><td>IN-65–71 Px Define</td><td>Set one of the multi-function input terminals to 31 (dis Aux Ref) and turn it on to disable the auxiliary frequency reference. The inverter will operate using the main frequency reference only.</td></tr>
</table>



Auxiliary Reference Operation Ex #1

Keypad Frequency Setting is Main Frequency and V1 Analog Voltage is Auxiliary Frequency

- Main frequency: Keypad (operation frequency 30 Hz)
- Maximum frequency setting (DRV-20): 400 Hz
- Auxiliary frequency setting (BAS-01): I1[Display by percentage(%) or auxiliary frequency (Hz) depending on the operation setting condition]
- Auxiliary reference gain setting (BAS-03): 50%
- From IN-01 to IN-32 is the factory default setting

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

Setting *		Calculating final command frequency**
0	M[Hz]+(G[%]*A[Hz])	30 Hz(M)+(50%(G)x36 Hz(A))=48 Hz
1	M[Hz]*(G[%]*A[%])	30 Hz(M)x(50%(G)x60%(A))=9 Hz
2	M[Hz]/(G[%]*A[%])	30 Hz(M)/(50%(G)x60%(A))=100 Hz
3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30 Hz(M)+{30[Hz]x(50%(G)x60%(A))}=39 Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30 Hz(M)+50%(G)x2x(60%(A)–50%)x60 Hz=36 Hz
5	M[HZ]*{G[%]*2*(A[%]-50[%])}	30 Hz(M)x{50%(G)x2x(60%(A)–50%)}=3 Hz
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30 Hz(M)/{50%(G)x2x(60%–50%)}=300 Hz
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30 Hz(M)+30 Hz(M)x50%(G)x2x(60%(A)–50%)=33 Hz

* 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 Ex #2

Keypad Frequency Setting is Main Frequency and I2 Analog Voltage is Auxiliary Frequency

- Main frequency: Keypad (Operation frequency 30 Hz)
- Maximum frequency setting (BAS-20): 400 Hz
- Auxiliary frequency setting (BAS-01): I2 [Display by percentage (%) or auxiliary frequency (Hz) depending on the operation setting condition]
- Auxiliary reference gain setting (BAS-03): 50%
- IN-01–32: Factory default

Example: an input current of 10.4 mA is applied to I2, with the frequency corresponding to 20 mA of 60 Hz. The table below shows auxiliary frequency as 24 Hz(=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 Ex #3

V1 is Main Frequency and I2 is Auxiliary Frequency

Main frequency: V1 (frequency command setting to 5 V and is set to 30 Hz)
Maximum frequency setting (DRV-20): 400 Hz
Auxiliary frequency (BAS-01): I2[Display by percentage (%) or auxiliary frequency (Hz) depending on the operation setting condition]
Auxiliary reference gain (BAS-03): 50%
IN-01–32: Factory default

Example: An input current of 10.4 mA is applied to I2, with the frequency corresponding to 20 mA of 60 Hz. The table below shows auxiliary frequency Aas 24 Hz (=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])	30 Hz(M)+(50%(G)x24 Hz(A))=42 Hz
1	M[Hz]*(G[%]*A[%])	30 Hz(M)x(50%(G)x40%(A))=6 Hz
2	M[Hz]/(G[%]*A[%])	30 Hz(M)/(50%(G)x40%(A))=150 Hz
3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30 Hz(M)+{30[Hz]x(50%(G)x40%(A))}=36 Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30 Hz(M)+50%(G)x2x(40%(A)–50%)x60 Hz=24 Hz
5	M[HZ]*{G[%]*2*(A[%]-50[%])}	30 Hz(M)x{50%(G)x2x(40%(A)–50%)}=-3 Hz(Reverse)
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30 Hz(M)/{50%(G)x2x(60%–40%)}=-300 Hz(Reverse)
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30 Hz(M)+30 Hz(M)x50%(G)x2x(40%(A)–50%)=27 Hz

*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.

5.2 Jog Operation

The jog operation allows for a temporary control of the inverter. You can enter a jog operation command using the multi-function terminals.

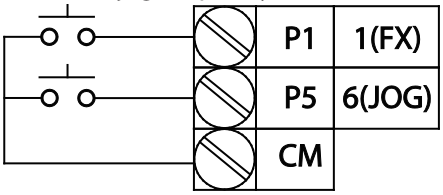
The jog operation is the second highest priority operation, after the dwell operation. If a jog operation is requested while operating the multi-step, up-down, or 3-wire operation modes, the jog operation overrides all other operation modes.

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

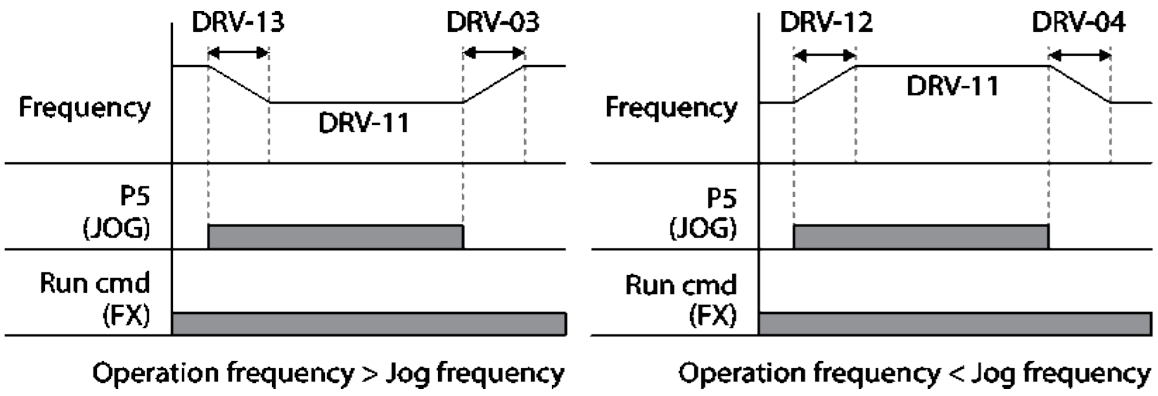
The jog operation is available in either forward or reverse direction, using the keypad or multi-function terminal inputs. The table below lists parameter setting for a forward jog operation using the multi-function terminal inputs.

Group	Code	LCD Display	LCD Display	Parameter Setting		Setting Range	Unit
DRV	11	Jog frequency	JOG Frequency	10.00		0.00, Low Freq–High Freq	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	0-55	-

Forward Jog Description Details

Code	Description
IN-65–71 Px Define	Select the jog frequency from P1- P7 and then select 6. Jog from IN-65-71.  [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.

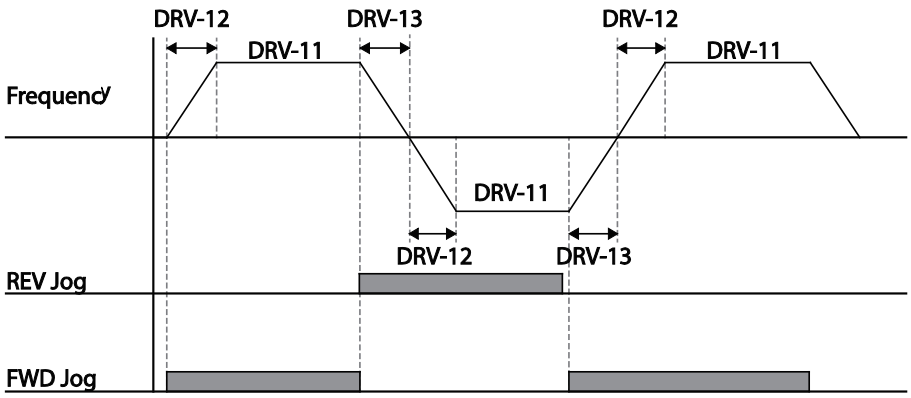
If a signal is entered at the jog terminal while an FX operation command is on, the operation frequency changes to the jog frequency and the jog operation begins.



5.2.2 Jog Operation 2-Forward/Reverse Jog by Multi-function Terminal

For jog operation 1, an operation command must be entered to start operation, but while using jog operation 2, a terminal that is set for a forward or reverse jog also starts an operation. The priorities for frequency, Acc/Dec time and terminal block input during operation in relation to other operating modes (Dwell, 3-wire, up/down, etc.) are identical to jog operation 1. If a different operation command is entered during a jog operation, it is ignored and the operation maintains the jog frequency.

Group	Code	Name	LCD Display	Parameter setting		Setting Range	Unit
DRV	11	Jog frequency	JOG Frequency	10.00		0.00, Low Freq–High Freq	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	0-55	-
				33	REV JOG		

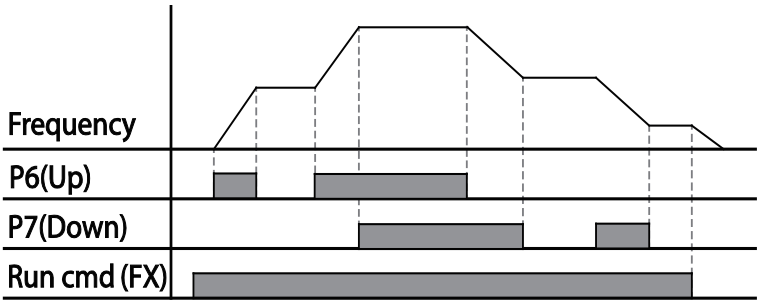
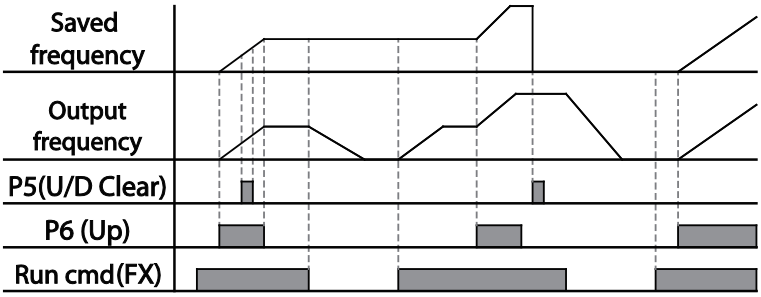


5.3 Up-down Operation

The Acc/Dec time can be controlled through input at the multi-function terminal block. Similar to a flowmeter, the up-down operation can be applied easily to a system that uses the upper-lower limit switch signals for Acc/Dec commands.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	65	Up-down operation frequency save	U/D Save Mode	1	Yes	0–1	-
IN	65–71	Px terminal configuration	Px Define(Px: P1–P7)	19	Up	0–55	-
				20	Down		
				22	U/D Clear		

Up-down Operation Setting Details

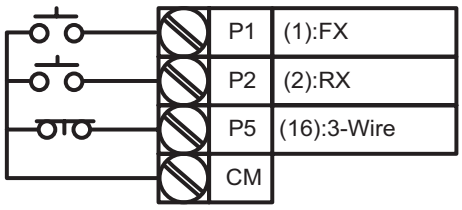
Code	Description
IN-65–71 Px Define	Select two terminals for up-down operation and set them to '19 (Up)' and '20 (Down)', respectively. With the operation command input, acceleration begins when the Up terminal signal is on. Acceleration stops and constant speed operation begins when the signal is off. During operation, deceleration begins when the Down signal is on. Deceleration stops and constant speed operation begins when both Up and Down signals are entered at the same time. 
ADV-65 U/D Save Mode	During a constant speed operation, the operating frequency is saved automatically in the following conditions: the operation command (Fx or Rx) is off, a fault trip occurs, or the power is off. When the operation command is turned on again, or when the inverter regains the power source or resumes to a normal operation from a fault trip, it resumes operation at the saved frequency. To delete the saved frequency, use the multi-function terminal block. Set one of the multi-function terminals to 22 (U/D Clear) and apply signals to it during constant speed operation. The saved frequency and the up-down operation configuration will be deleted. 

5.4 3- Wire Operation

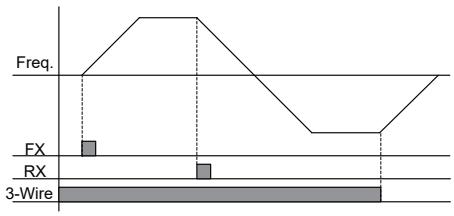
The 3-wire operation latches the signal input (the signal stays on after the button is released), and is used when operating the inverter with a push button.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	06	Command source	Cmd Source*	1	Fx/Rx - 1	0–6	-
IN	65– 71	Px terminal configuration	Px Define(Px: P1–P7)	16	3-Wire	0-55	-

To enable the 3-wire operation, the following circuit sequence is necessary. The minimum input time (t) for 3-wire operation is 2 ms, and the operation stops when both forward and reverse operation commands are entered at the same time.



[Terminal connections for 3-wire operation]



[3- wire operation]

5.5 Safe Operation Mode

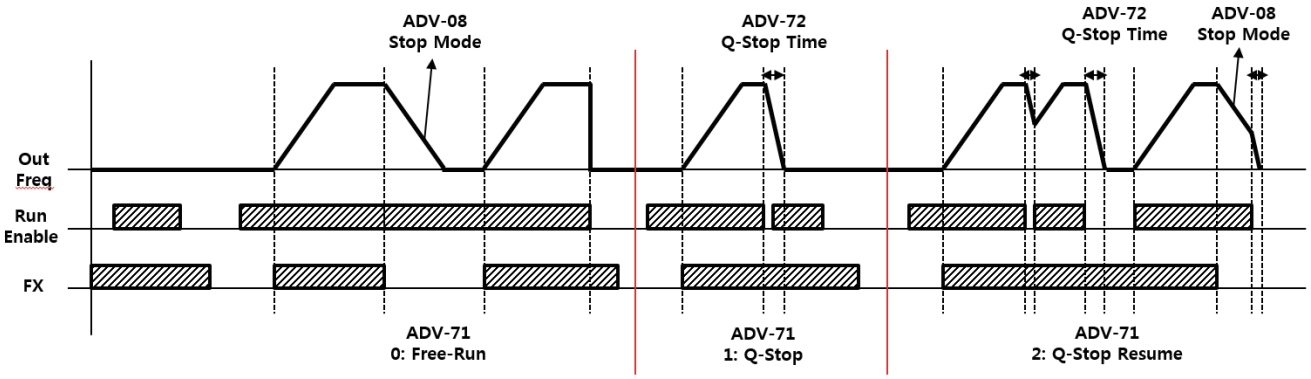
When the multi-function terminals are configured to operate in safe mode, operation commands can be entered in the Safe operation mode only. Safe operation mode is used to safely and carefully control the inverter through the multi-function terminals.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	70	Safe operation selection	Run En Mode	1	DI Dependent	0-1	-
	71	Safe operation stop mode	Run Dis Stop	0	Coast Stop	0–2	-
	72	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	0-55	-

Safe Operation Mode Setting Details

Code	Description
IN-65–71 Px Define	From the multi-function terminals, select a terminal to operate in safe operation mode and set it to '15 (RUN Enable)'.
ADV-70 Run En Mode	Setting: 0 Always Enable — Function: Enables safe operation mode Setting: 1 DI Dependent — Function: Recognizes the operation command from a multi-function input terminal.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>ADV-71 Run Dis Stop</td><td>Set the operation of the inverter when the multi-function input terminal in safe operation mode is off.
When the safety operation mode terminal signal is given, the inverter decelerates based on the settings at the Q-Stop time. The inverter decelerates and stops based on the deceleration time (Dec Time) settings if the run command is off.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Coast Stop</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 multi-function terminal is on, the operation resumes as soon as the operation command is entered again.</td></tr>
</table></td></tr>
<tr><td>ADV-72 Q-Stop Time</td><td>Sets the deceleration time when ADV-71 Run Dis Stop is set to ‘1 (Q-Stop)’ or ‘2 (Q-Stop Resume)’.</td></tr>
</table>

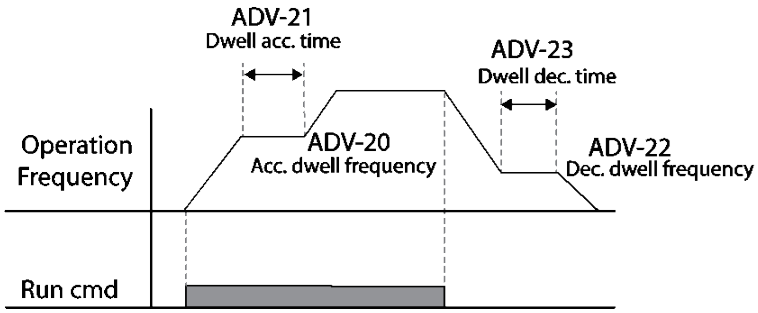


5.6 Dwell Operation

The dwell operation is used to maintain torque during the application and release of the mechanical brakes on lift-type loads. Inverter dwell operation is based on the Acc/Dec dwell frequency and the dwell time set by the user. The following points also affect dwell operation.

- **Acceleration Dwell Operation:** When an operation command runs, acceleration continues until the acceleration dwell frequency and constant speed is reached within the acceleration dwell operation time (Acc Dwell Time). After the Acc Dwell Time has passed, acceleration is carried out based on the acceleration time and the operation speed that was originally set.
- **Deceleration Dwell Operation:** When a stop command is run, deceleration continues until the deceleration dwell frequency and constant speed are reached within the deceleration dwell operation time (Dec Dwell Freq). After the set time has passed, deceleration is carried out based on the deceleration time that was originally set, then the operation stops.

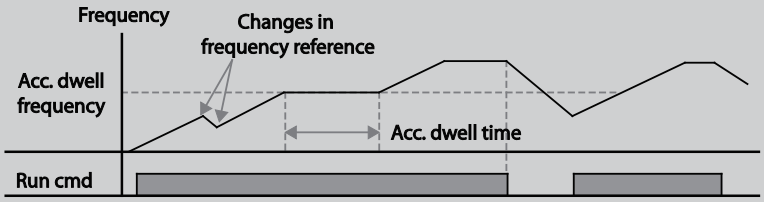
Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
ADV	20	Dwell frequency during acceleration	Acc Dwell Freq	5.00	Start frequency – Maximum frequency	Hz
	21	Operation time during acceleration	Acc Dwell Time	0.0	0.0–10.0	sec
	22	Dwell frequency during deceleration	Dec Dwell Freq	5.00	Start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



Note

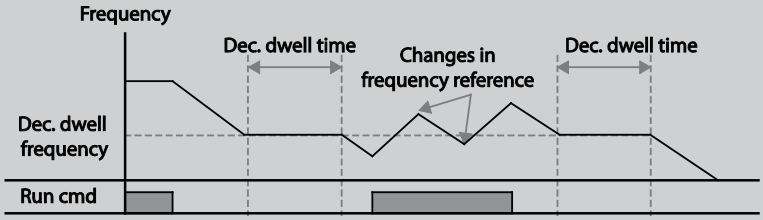
Dwell operation does not work when:

- Dwell operation time is set to 0 sec or dwell frequency is set to 0 Hz.
- Re-acceleration is attempted from stop or during deceleration, as only the first acceleration dwell operation command is valid.



[Acceleration dwell operation]

- Although deceleration dwell operation is carried out whenever stop commands are entered and the deceleration dwell frequency is passed through, it does not work during a deceleration by simple frequency change (which is not a deceleration due to a stop operation), or during external brake control applications.



[Deceleration dwell operation]

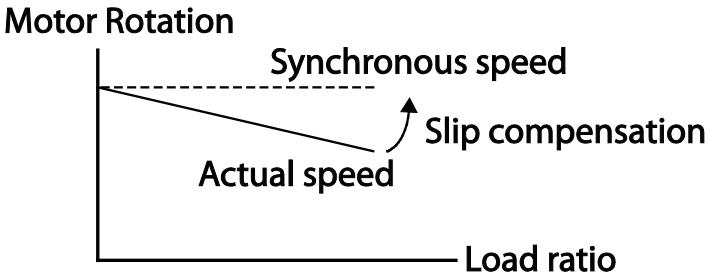
5.7 Slip Compensation Operation

Slip refers to the variation between the setting frequency (synchronous speed) and motor rotation speed. As the load increases there can be variations between the setting frequency and motor rotation speed. 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	-	-
	14	Motor Capacity	Motor Capacity	2	5.5 kW	0–20	-
BAS	11	Number of motor poles	Pole Number	4		2–48	-
	12	Rated slip speed	Rated Slip	40 (5.5 kW based)		0–3000	Rpm
	13	Rated motor current	Rated Curr	3.6 (5.5 kW based)		1.0–1000.0	A
	14	Motor no-load current	Noload Curr	1.6 (5.5 kW based)		0.5–1000.0	A
	16	Motor efficiency	Efficiency	72 (5.5 kW based)		70–100	%

Slip Compensation Operation Setting Details

Code	Description
DRV-09 Control Mode	Set DRV-09 to '2 (Slip Compen)' to carry out the slip compensation operation.
DRV-14 Motor Capacity	Set the capacity of the motor connected to the inverter.
BAS-11 Pole Number	Enter the number of poles from the motor rating plate.
BAS-12 Rated Slip	Enter the number of [Rated Motor Speed–Motor Nameplate Speed]. - = Rated frequency, P= Number of motor poles
BAS-13 Rated Curr	Enter the rated current from the motor rating plate.
BAS-14 Noload Curr	Enter the measured current when the load on the motor axis is removed and when the motor is operated at the rated frequency. If no-load current is difficult to measure, enter a current equivalent to 30-50% of the rated motor current.
BAS-16 Efficiency	Enter the efficiency from the motor rating place.



5.8 PID Control

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 drive operation are as follows:

Purpose	Function
Speed Control	Controls speed by monitoring the current speed levels of the equipment or machinery being controlled. Control maintains consistent speed or operates at the target speed.
Pressure Control	Controls pressure by monitoring the current pressure levels of the equipment or machinery being controlled. Control maintains consistent pressure or operates at the target pressure.
Flow Control	Controls flow by monitoring the current amount of flow in the equipment or machinery being controlled. Control maintains consistent flow or operates at a target flow.
Temperature Control	Controls temperature by monitoring the current temperature levels of the equipment or machinery to be controlled. Control maintains a consistent temperature or operates at a target temperature.

5.8.1 PID Basic Operation

PID operates by controlling the output frequency of the drive, through automated system process control to maintain speed, pressure, flow, temperature, or tension.

Shaded rows in the below table are parameters displayed when advanced PID is chosen.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
PID	01	PID Options	PID Sel	0	No	0–1	-
	02	PID access Level	PID Access Lev	0	Basic	0–1	
	03	PID output monitor	PID Output	-		-	-
	04	Setpoint monitor	Setpoint Value	-		-	-
	05	PID feedback monitor	Feedback Value	-		-	-
	06	PID error monitor	Err Monitor				
	10	PID setpoint 1 source selection	PID SP 1 Src	0	Keypad	0–10	-
	11	PID setpoint 1 setting	PID SP 1 Set	0.0		Unit Min–Unit Max	Unit
	12	PID setpoint 1 auxiliary source selection	PID SP1 AuxSrc	0	None	0–11	-
	13	PID setpoint 1 auxiliary mode selection	PID SP1 AuxMod	0	M+(G*A)	0–13	-
	14	PID setpoint1 auxiliary gain	PID SP1 Aux G	0.0		-200.0–200.0	%
	15	PID setpoint 2 auxiliary source selection	PID SP 2 Src	0	Keypad	0–10	-
	16	PID setpoint 2 keypad setting	PID SP 2 Set	50.0		Unit Min–Unit Max	Unit
	17	PID setpoint 2 auxiliary source selection	PID SP2 AuxSrc	0	None	0–11	-

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
PID	18	PID setpoint 2 auxiliary mode selection	PID SP2 AuxMod	0	M+(G*A)	0–13	-
	19	PID setpoint 2 auxiliary gain	PID SP2 Aux G	0.0		-200.0–200.0	%
	20	PID feedback source selection	PID Fdb Source	0	V1	0–9	
	21	PID feedback auxiliary source selection	PID Fdb AuxSrc	0	None	0–11	
	22	PID feedback auxiliary mode selection	PID Fdb AuxMod	0	M+(G+A)	0–13	
	23	PID feedback auxiliary gain	PID Fdb Aux G	0.0		-200.0–200.0	%
	24	PID feedback band	PID Fdb Band	0		0–Unit Band	Unit
	25	PID proportional gain 1	PID P-Gain 1	100.00		0.0–300.00	%
	26	PID integral time 1	PID I-Time 1	2.0		0.0–200.0	sec
	27	PID differential time 1	PID D-Time 1	0.00		0–1.00	sec
	28	PID feed forward gain	PID FF-Gain	0.0		0.0–1000.0	%
	29	PID output filter	PID Out LPF	0.00		0–10.00	sec
	30	PID output upper limit	PID Limit Hi	100.00		PID Limit Lo–100.00	%
	31	PID output lower limit	PID Limit Lo	0.00		-100.00–PID Limit Hi	%
	32	PID proportional gain 2	PID P-Gain 2	50.00		0.0–300.00	%
	33	PID integral time 2	PID I-Time 2	10.0		0.0–200.0	sec
	34	PID differential time 2	PID D-Time 2	0.00		0–1.00	sec
	35	PID output mode setting	PID Out Mode	2		0–2	
	36	PID output reverse	PID Out Inv	0	No	0–1	-
	37	PID output scale	PID Out Scale	100.0		0.1–1000.0	%
	38	PID input limit	PID InputLimit	100.00		0.00–100.00	%
	39	PID integral time limit	PID I Limit	100.00		-100.00–100.00	%
	40	PID multi-step setpoint setting 1	PID Step SP 1	40.0		Unit Min–Unit Max	Unit
	41	PID multi-step setpoint setting 2	PID Step SP 2	50.0		Unit Min–Unit Max	Unit
	42	PID multi-step setpoint setting 3	PID Step SP 3	60.0		Unit Min–Unit Max	Unit

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
PID	43	PID multi-step setpoint setting 4	PID Step SP 4	70.0		Unit Min–Unit Max	Unit
	44	PID multi-step setpoint setting 5	PID Step SP 5	80.0		Unit Min–Unit Max	Unit
	45	PID multi-step setpoint setting 6	PID Step SP 6	90.0		Unit Min–Unit Max	Unit
	46	PID multi-step setpoint setting 7	PID Step SP 7	30.0		Unit Min–Unit Max	Unit
	50	PID controller unit selection	PID Unit Sel	2	PSI	0–41	-
	51	PID control setting scale	PID Unit Scale	1	X 10	0–4	-
	52	PID control 0% setting figure	PID Unit 0%	0.00		Differ depending on PID-51 setting	Unit
	53	PID control 100% setting figure	PID Unit 100%	100.00		Differ depending on PID-51 setting	Unit
	54	Ramp PID setpoint at run	RampPIRef AtRun	0	No	0–1	-
	55	PID acceleration/ deceleration time	PID Acc/Dec Tm	0.00		0.00–600.00	sec
	56	Pump minimum speed	Pump Min Speed	0.00		Differ depending on ADV-26 setting	Hz
	57	Wake up level type	WakeUpLev Type	1	Deviation	0–1	-
	58	Sleep activated level	Sleep Act Lev	0.00		Differ depending on PID-59 setting	Hz
	59	Sleep level type	Sleep Lev Type	1	Output Freq	0–6	-
	60	Sleep boost setting	Sleep Bst Set	0.00		Differ depending on PID-50 setting	Unit
	61	Sleep boost frequency	Sleep Bst Freq	0.00		0.00–400.00	Hz
	62	PID sleep 0 delay time	PID Sleep 0 DT	10.0		0.0–6000.0	sec
	63	PID sleep 0 level	PID Sleep 0 Lev	0.00		Differ depending on PID-59 setting	Unit
	64	PID wake up 0 delay time	PID WakeUp0 DT	10.0		0.0–6000.0	sec
	65	PID wake up 0 level	PID WakeUp0Lev	20.00		Differ depending on PID-50 setting	Unit
	66	PID sleep 1 delay time	PID Sleep 1 DT	10.0		0.0–6000.0	sec
	67	PID sleep 1 level	PID Sleep 1 Lev	0.00		Differ depending on PID-59 setting	Unit
	68	PID wake up 1 delay time	PID WakeUp1 DT	10.0		0.0–6000.0	sec
	69	PID wake up 1 level	PID WakeUp1Lev	20.00		Differ depending on PID-50 setting	Unit

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
PID	70	PID sleep 2 delay time	PID Sleep 2 DT	10.0	0.0–6000.0	sec
	71	PID sleep 2 level	PID Sleep 2 Lev	0.00	Differ depending on PID-59 setting	Unit
	72	PID wake up 2 delay time	PID WakeUp2 DT	10.0	0.0–6000.0	sec
	73	PID wake up 2 level	PID WakeUp2Lev	20.00	Differ depending on PID-50 setting	Unit
	74	PID sleep 3 delay time	PID Sleep 3 DT	10.0	0.0–6000.0	sec
	75	PID sleep 3 level	PID Sleep 3 Lev	0.00	Differ depending on PID-59 setting	Unit
	76	PID wake up 3 delay time	PID WakeUp3 DT	10.0	0.0–6000.0	sec
	77	PID wake up 3 level	PID WakeUp3Lev	20.00	Differ depending on PID-50 setting	Unit
	78	PID sleep 4 delay time	PID Sleep 4 DT	10.0	0.0–6000.0	sec
	79	PID sleep 4 level	PID Sleep 4 Lev	0.00	Differ depending on PID-59 setting	Unit
	80	PID wake up 4 delay time	PID WakeUp4 DT	10.0	0.0–6000.0	sec
	81	PID wake up 4 level	PID WakeUp4Lev	20.00	Differ depending on PID-50 setting	Unit
	82	PID sleep 5 delay time	PID Sleep 5 DT	10.0	0.0–6000.0	sec
	83	PID sleep 5 level	PID Sleep 5 Lev	0.00	Differ depending on PID-59 setting	Unit
	84	PID wake up 5 delay time	PID WakeUp5 DT	10.0	0.0–6000.0	sec
	85	PID wake up 5 level	PID WakeUp5Lev	20.00	Differ depending on PID-50 setting	Unit
	86	PID sleep 6 delay time	PID Sleep 6 DT	10.0	0.0–6000.0	sec
	87	PID sleep 6 level	PID Sleep 6 Lev	0.00	Differ depending on PID-59 setting	Unit
	88	PID wake up 6 delay time	PID WakeUp6 DT	10.0	0.0–6000.0	sec
	89	PID wake up 6 level	PID WakeUp6Lev	20.00	Differ depending on PID-50 setting	Unit
	90	PID sleep 7 delay time	PID Sleep 7 DT	10.0	0.0–6000.0	sec
	91	PID sleep 7 level	PID Sleep 7 Lev	0.00	Differ depending on PID-59 setting	Unit
	92	PID wake up7 delay time	PID WakeUp7 DT	10.0	0.0–6000.0	sec
	93	PID wake up 7 level	PID WakeUp7Lev	20.00	Differ depending on PID-50 setting	Unit

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
PID	94	Wake up Mode	Wake up Mode	0	Hold Sleep	0-1	-
				1	Min Spd Start		
PID	95	Sleep off mode selection	Disable WakeUp	0	No	0–1	-
PID	96	Sleep Warning Selection	Sleep Warn Sel	0	None	0–1	-
				1	Warning		

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 Band = Unit 100%-Unit 0%
- PID control may be utilized for the following operations:
  Soft fill, auxiliary PID reference compensation, MMC, flow compensation, pipe breakage detection.
- During a PID operation, the PID output becomes the frequency reference. The drive accelerates or decelerates to the frequency reference based on the Acc/Dec times.

PID Basic Operation Setting Details

Code	Description
PID-01 PID Sel	Sets the code to '1 (Yes)' to select functions for the process PID.
PID-02 PID Access Lev	The Default value only allows access to the basic parameters in the PID group. The rest are hidden. When set to "Advanced" all parameters are shown.
PID-03 PID Output	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.
PID-04 PID Setpoint Value	Displays the existing setpoint value set for the PID controller. The unit, gain, and scale that were set in the PID group are applied on the display.
PID-05 PID Feedback Value	Displays the latest feedback value of the PID controller. The unit, gain, and scale that were set in the PID group are applied on the display.
PID-06 PID Err Value	Displays the differences 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.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PID-10 PID Ref 1 Src</td><td>Selects the reference input for the PID control. If the V1 terminal is set to a PID feedback source (PID F/B Source), the V1 terminal cannot be set to the PID reference source (PID Ref Source). To set V1 as a reference source, change the feedback source.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Keypad</td><td>Keypad</td></tr>
<tr><td>1</td><td>V1</td><td rowspan="2">V1 analog input terminal
[When the analog input terminal dip switch (SW3) is set to V1/I1, SW6 switch can be set to either voltage or current input 0–10 V or 0-20 mA]</td></tr>
<tr><td>2</td><td>I1</td></tr>
<tr><td>3</td><td>V2</td><td rowspan="2">I2 analog input terminal
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.</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>6</td><td>FieldBus</td><td>Communication command via a communication option card</td></tr>
<tr><td>8</td><td>Pulse</td><td>TI Pulse input terminal (0-32 kHz Pulse input)</td></tr>
<tr><td>9</td><td>V3</td><td rowspan="2">V3 analoge input terminal of Extension IO option
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.</td></tr>
<tr><td>10</td><td>I3</td></tr>
</table></td></tr>
<tr><td>PID-11 PID SP Set</td><td>A reference value can be entered if the PID Setpoint type (PID-10) is set to ‘0 (Keypad)’.</td></tr>
<tr><td>PID-12 PID SP1AuxSrc</td><td>Selects the external input source to be used as the reference for a PID control. If an 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 SP1AuxMod.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>None</td><td>Not used</td></tr>
<tr><td>1</td><td>V1</td><td rowspan="2">V1 analog input terminal
[When the analog input terminal dip switch (SW3) is set to V1/I1, SW6 switch can be set to either voltage or current input 0–10 V or 0-20 mA]</td></tr>
<tr><td>2</td><td>I1</td></tr>
<tr><td>3</td><td>V2</td><td rowspan="2">I2 analog input terminal
[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]</td></tr>
<tr><td>4</td><td>I2</td></tr>
<tr><td>6</td><td>Pulse</td><td>TI Pulse input terminal (0-32 kHz Pulse input)</td></tr>
<tr><td>7</td><td>Int. 485</td><td>RS-485 input terminal</td></tr>
<tr><td>8</td><td>FieldBus</td><td>Communication command via a communication option card</td></tr>
<tr><td>10</td><td>V3</td><td rowspan="2">V3 analog input terminal of Extension IO option
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.</td></tr>
<tr><td>11</td><td>I3</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PID-13 PID SP1 AuxMod</td><td>PID-13 (PID SP1) provides formulas to calculate the reference 1 value. If PID-12 (PID SPAuxSrc) 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).
<table>
<tr><td colspan="2">Setting</td></tr>
<tr><td>0</td><td>M+(G*A)</td></tr>
<tr><td>1</td><td>M*(G*A)</td></tr>
<tr><td>2</td><td>M/(G*A)</td></tr>
<tr><td>3</td><td>M+(M*(G*A))</td></tr>
<tr><td>4</td><td>M+G*2*(A-50)</td></tr>
<tr><td>5</td><td>M*(G*2*(A-50))</td></tr>
<tr><td>6</td><td>M/(G*2*(A-50))</td></tr>
<tr><td>7</td><td>M+M*G*2*(A-50)</td></tr>
<tr><td>8</td><td>(M-A)^2</td></tr>
<tr><td>9</td><td>M^2+A^2</td></tr>
<tr><td>10</td><td>MAX(M,A)</td></tr>
<tr><td>11</td><td>MIN(M,A)</td></tr>
<tr><td>12</td><td>(M+A)/2</td></tr>
<tr><td>13</td><td>Square Root(M+A)</td></tr>
</table>
M= Value by the source set at PID-10
G= Gain value set at PID-14
A= Value input by the source set at PID-12</td></tr>
<tr><td>PID-14 PID SP1 Aux G</td><td>Gain value for the formulas provided by PID-13.</td></tr>
<tr><td>PID-20 PID Fdb Src</td><td>Selects feedback input for PID control. If the V1 terminal is set as the PID feedback source (PID F/B Source), the V1 terminal cannot be set as the PID reference source (PID Ref Source). To set V1 as a feedback source, change the reference source.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>V1</td><td rowspan="2">V1 analog input terminal
[When the analog input terminal dip switch (SW3) is set to V1/I1, SW6 switch can be set to either voltage or current input 0–10 V or 0-20 mA]</td></tr>
<tr><td>1</td><td>I1</td></tr>
<tr><td>2</td><td>V2</td><td rowspan="2">I2 analog input terminal
[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]</td></tr>
<tr><td>3</td><td>I2</td></tr>
<tr><td>4</td><td>Int. 485</td><td>RS-485 input terminal</td></tr>
<tr><td>5</td><td>FieldBus</td><td>Communication command via a communication option card</td></tr>
<tr><td>6</td><td>Network</td><td>Network communication of the lead-lag system</td></tr>
<tr><td>7</td><td>Pulse</td><td>TI Pulse input terminal (0-32 kHz Pulse input)</td></tr>
<tr><td>8</td><td>V3</td><td rowspan="2">V3 analog input terminal of Extension IO option
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.</td></tr>
<tr><td>9</td><td>I3</td></tr>
</table></td></tr>
</table>

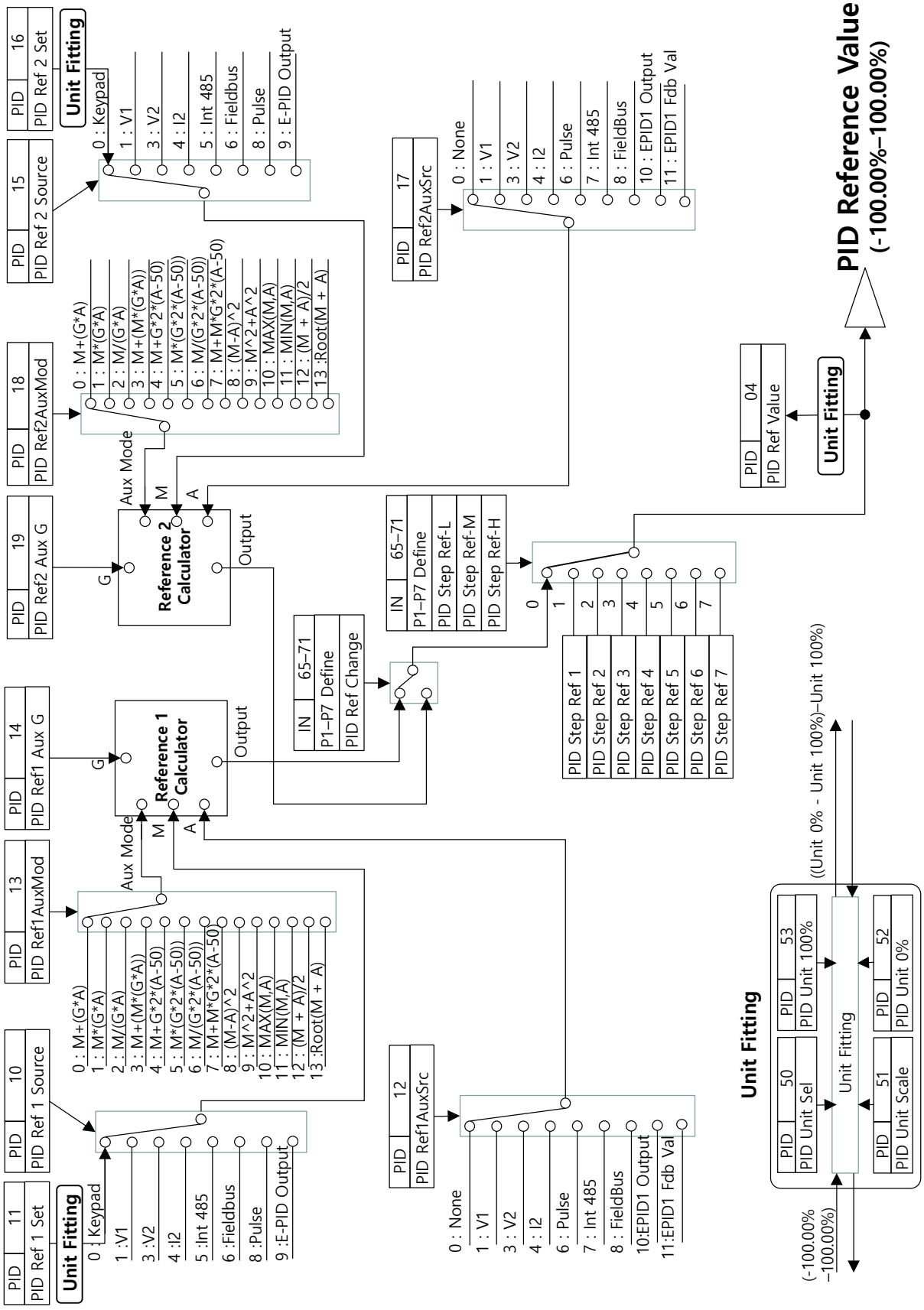
<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PID-21 PID Fdb AuxSrc</td><td>Selects the external input source to be used as the reference for a PID control. When the external input source is selected, the reference is determined using the input value at the source (set at PID-10) and the value set at PID-13 PID Ref1AuxMod.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Not used</td></tr>
<tr><td>1</td><td>V1</td><td rowspan="2">V1 analog input terminal
[When the analog input terminal dip switch (SW3) is set to V1/I1, SW6 switch can be set to either voltage or current input 0–10 V or 0-20 mA]</td></tr>
<tr><td>2</td><td>I1</td></tr>
<tr><td>3</td><td>V2</td><td rowspan="2">I2 analog input terminal
[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]</td></tr>
<tr><td>4</td><td>I2</td></tr>
<tr><td>6</td><td>Pulse</td><td>TI Pulse input terminal (0-32 kHz Pulse input)</td></tr>
<tr><td>7</td><td>Int. 485</td><td>RS-485 input terminal</td></tr>
<tr><td>8</td><td>FieldBus</td><td>Communication command via a communication option card</td></tr>
<tr><td>10</td><td>V3</td><td rowspan="2">V3 analog input terminal of Extension IO option
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.</td></tr>
<tr><td>11</td><td>I3</td></tr>
</table></td></tr>
<tr><td>PID-22 PID FDB AuxMod</td><td>The PID-22 (PID FDB AuxMod) provides formulas to calculate the final feedback value. If PID-21 (PID FdbAuxSrc) is set to any other value than ‘None,’ the final feedback is calculated using the input values at the sources (set at PID-31 and PID-32).
<table>
<tr><td colspan="2">Setting</td></tr>
<tr><td>0</td><td>M+(G*A)</td></tr>
<tr><td>1</td><td>M*(G*A)</td></tr>
<tr><td>2</td><td>M/(G*A)</td></tr>
<tr><td>3</td><td>M+(M*(G*A))</td></tr>
<tr><td>4</td><td>M+G*2*(A-50)</td></tr>
<tr><td>5</td><td>M*(G*2*(A-50))</td></tr>
<tr><td>6</td><td>M/(G*2*(A-50))</td></tr>
<tr><td>7</td><td>M+M*G*2*(A-50)</td></tr>
<tr><td>8</td><td>(M-A)^2</td></tr>
<tr><td>9</td><td>M^2+A^2</td></tr>
<tr><td>10</td><td>MAX(M,A)</td></tr>
<tr><td>11</td><td>MIN(M,A)</td></tr>
<tr><td>12</td><td>(M+A)/2</td></tr>
<tr><td>13</td><td>Square Root(M+A)</td></tr>
</table>
M= Value by the source set at PID-05
G= Gain value set at PID-23
A= Value by the source set at PID-21</td></tr>
<tr><td>PID-23 PID Fdb Aux G</td><td>Gain value used a formula set at PID-22.</td></tr>
<tr><td>PID-24 PID Fdb Band</td><td>Sets the maximum and minimum value by adding or subtracting the PID Fdb Band value (set at PID-24) from the reference value. When the feedback value is between the maximum and minimum value, this code maintains the PID output.</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PID-25
PID P-Gain1
PID-32
PID P-Gain2</td><td>Set the output ratio for differences (errors) between the reference and feedback.
If the P Gain is set to 50%, then 50% of the error is output.</td></tr>
<tr><td>PID-26
PID I- Time 1
PID-33
PID I- Time 2</td><td>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 block is set to ‘24 (I-Term Clear)’ and is turned on, all of the accumulated errors are deleted.

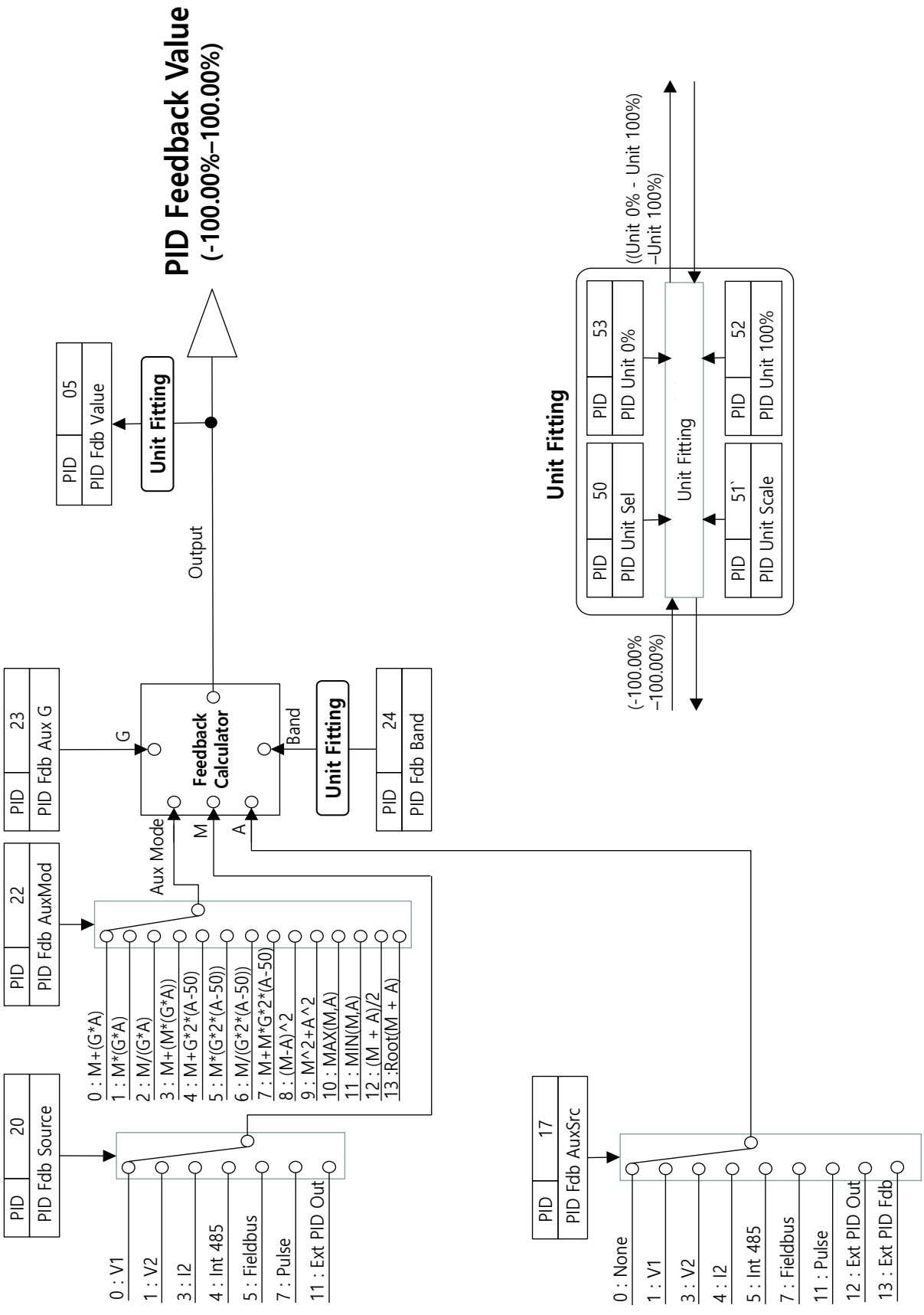
PID output (final frequency reference) is affected by the gains set at PID-26, PID-33, and the Acc/Dec times to achieve the PID output change based on the DRV-03 and DRV-04 settings. Therefore, consider the relationship between these values when configuring the gains and the Acc/Dec times.</td></tr>
<tr><td>PID-27
PID D-Time 1
PID-34
PID D-Time 2</td><td>Sets the output volume for the rate of change in errors. If the differential time (PID D-Time) is set to 1 ms and the rate of change in errors per sec is 100%, output occurs at 1% per 10 ms.</td></tr>
<tr><td>PID-28 PID FF-Gain</td><td>Sets the ratio that adds the target to the PID output. Adjusting this value leads to a faster response.</td></tr>
<tr><td>PID-29
PID Out LPF</td><td>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.</td></tr>
<tr><td>PID-30 PID Limit Hi,
PID-31 PID Limit Lo</td><td>Limit the output of the controller.</td></tr>
<tr><td>PID-35
PID Out Mode</td><td>Selects one of the PID output modes to modify the 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.
<table>
<tr><td colspan="2">Setting</td></tr>
<tr><td>0</td><td>PID Output</td></tr>
<tr><td>1</td><td>PID+Main Freq</td></tr>
<tr><td>2</td><td>PID or Main</td></tr>
</table></td></tr>
<tr><td>PID-36
PID Out Inv</td><td>When PID-36 (PID Out Inv) is set to ‘Yes,’ the difference (error) between the reference and the feedback is set as the feedback–reference value.</td></tr>
<tr><td>PID-37 PID Out Scale</td><td>Adjusts the volume of the controller output.</td></tr>
<tr><td>PID-38 PID Input Limit</td><td>Maximum allowable PID input, needed in many Pump Applications such as Pivot to limit PID oscillation.</td></tr>
<tr><td>PID-39 PID I Limit</td><td>Output limit of I controller among PID controllers. Prevents integral windup. Required by many pump applications such as Pivot to limit integral wind-up issues to the maximum value that can be output from an integral block.</td></tr>
<tr><td>PID-40–46 Step SP 1–7</td><td>Sets the PID Setpoint by multi-function input settings at IN 65–71.</td></tr>
</table>

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PID-50
PID Unit Sel</td><td>Sets the unit for the control variable.
0: CUST is a custom unit defined by the user.
<table>
<tr><td colspan="6">Setting</td></tr>
<tr><td>0</td><td>CUST</td><td>15</td><td>kW</td><td>30</td><td>gl/m</td></tr>
<tr><td>1</td><td>%</td><td>16</td><td>HP</td><td>31</td><td>gl/h</td></tr>
<tr><td>2</td><td>PSI</td><td>17</td><td>mpm</td><td>32</td><td>ft/s</td></tr>
<tr><td>3</td><td>˚F</td><td>18</td><td>ft</td><td>33</td><td>f3/s(ft3/min)</td></tr>
<tr><td>4</td><td>˚C</td><td>19</td><td>m/s</td><td>34</td><td>f3/m</td></tr>
<tr><td>5</td><td>inWC</td><td>20</td><td>m3/s(m 3/S)</td><td>35</td><td>f3/h</td></tr>
<tr><td>6</td><td>inM</td><td>21</td><td>m 3/m(m 3/min)</td><td>36</td><td>lb/s</td></tr>
<tr><td>7</td><td>mBar</td><td>22</td><td>m 3/h(m 3/h)</td><td>37</td><td>lb/m</td></tr>
<tr><td>8</td><td>Bar</td><td>23</td><td>l/s</td><td>38</td><td>lb/h</td></tr>
<tr><td>9</td><td>Pa</td><td>24</td><td>l/m</td><td>39</td><td>ppm</td></tr>
<tr><td>10</td><td>kPa</td><td>25</td><td>l/h</td><td>40</td><td>pps</td></tr>
<tr><td>11</td><td>Hz</td><td>26</td><td>kg/s</td><td>41</td><td>Hg</td></tr>
<tr><td>12</td><td>Rpm</td><td>27</td><td>kg/m</td><td colspan="2"></td></tr>
<tr><td>13</td><td>V</td><td>28</td><td>kg/h</td><td colspan="2"></td></tr>
<tr><td>14</td><td>A</td><td>29</td><td>gl/s</td><td colspan="2"></td></tr>
</table></td></tr>
<tr><td>PID-51
PID Unit Scale</td><td>Adjusts the scale to fit the unit selected at PID-50 PID Unit Sel.</td></tr>
<tr><td>PID-52
PID Unit 0 %
PID-53
PID Unit 100%</td><td>Sets the Unit 0% and Unit 100% values as the minimum and maximum values set at PID-50.</td></tr>
<tr><td>PID-54
Ramp PI Ref At Run
PID-55
PID Acc/Dec Tm</td><td>Acceleration / Deceleration time for PID Setpoint.
This function helps to prevent hunting, overshoot, or undershoot.</td></tr>
<tr><td>PID-56
Pump Min Speed</td><td>Minimum Limit operates based on the greatest value of following:
① AP2 40 Thrust Frequency
② PID 56 Pump Minimum Speed
③ ADV 25 Freq Limit Lo</td></tr>
</table>

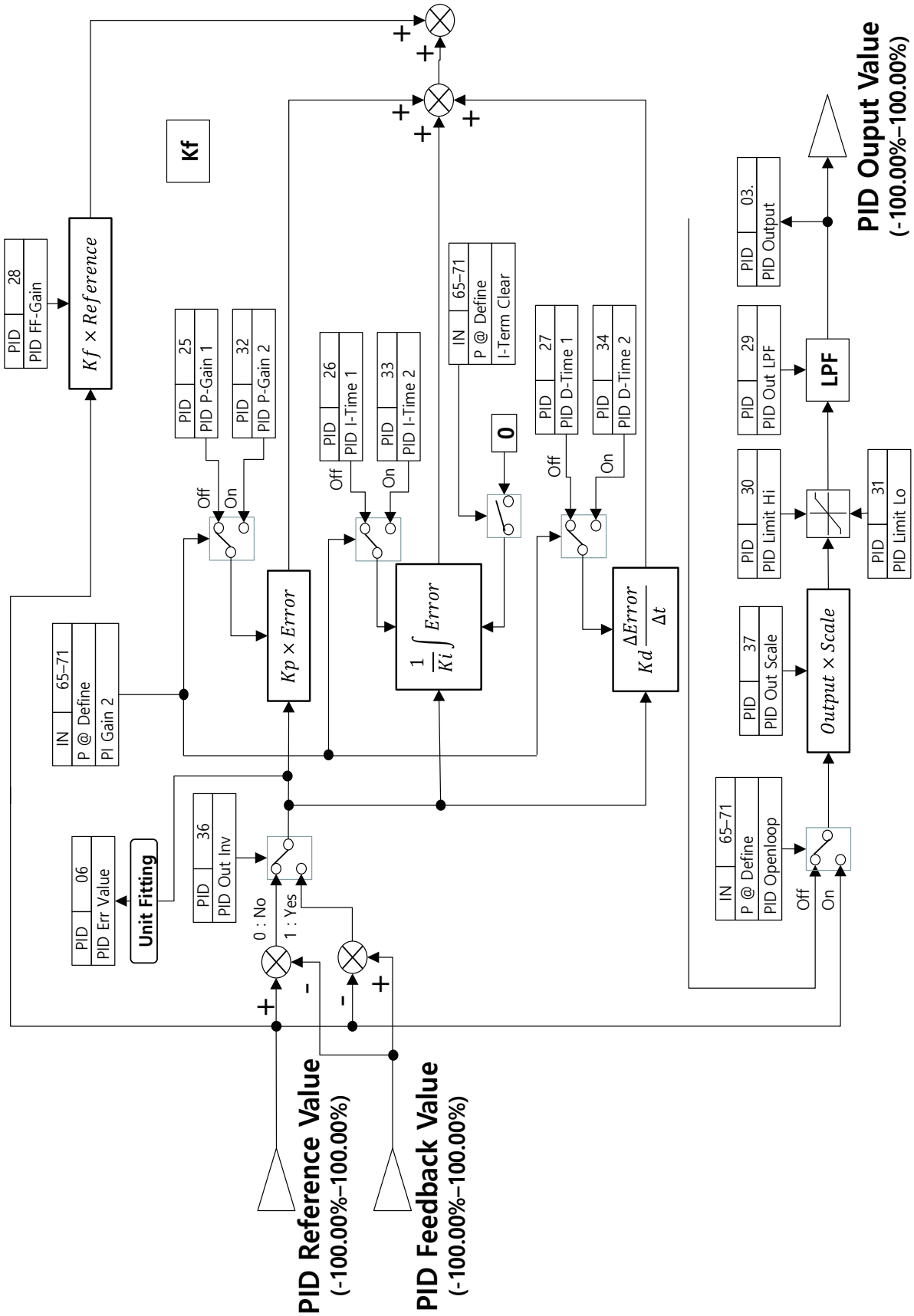
PID Command Block



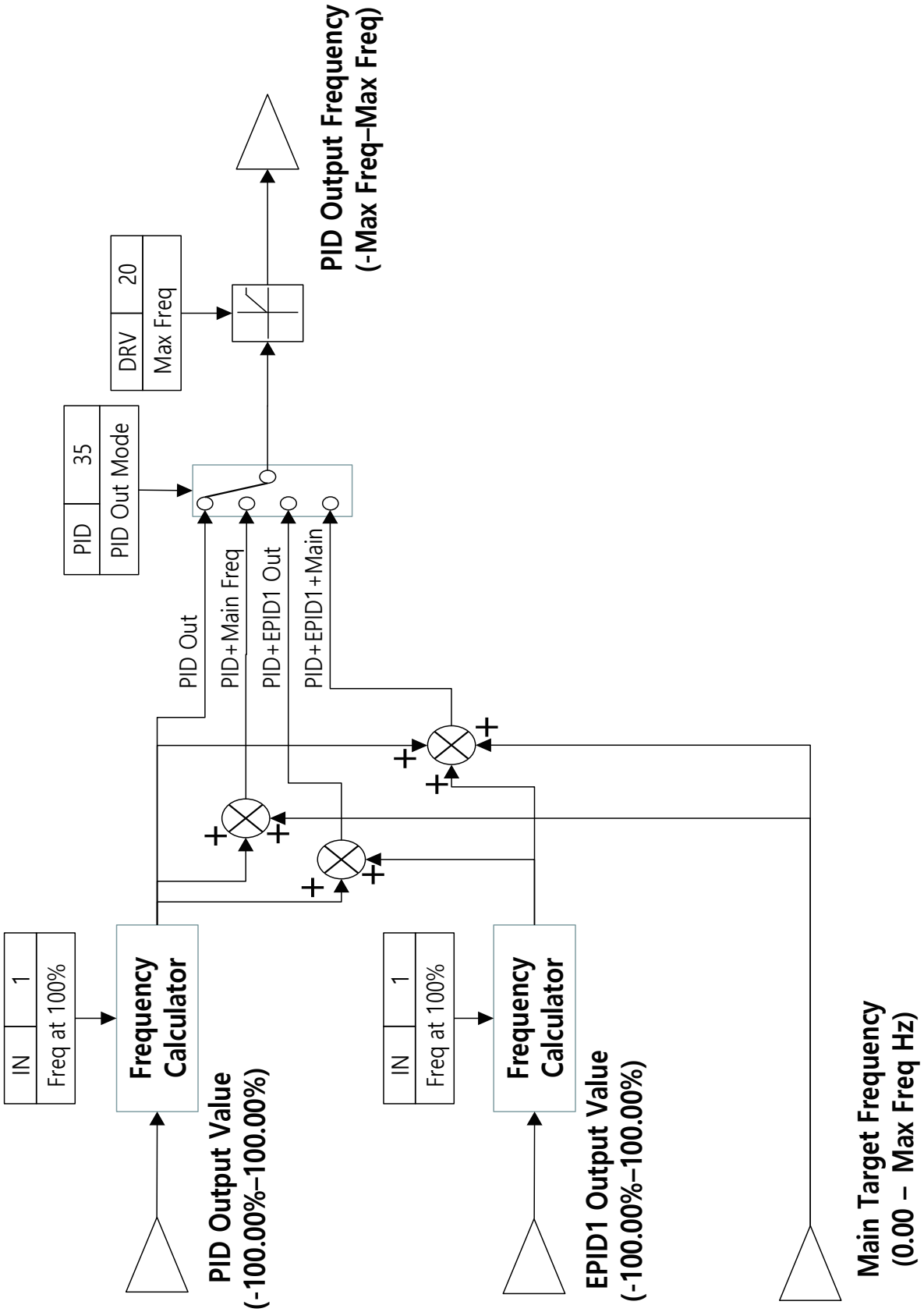
PID Feedback Block



PID Output Block



PID Output Mode Block



5.8.2 PID Sleep Mode

If an operation continues at a frequency lower than the PID operation conditions, a boost operation is performed to extend Sleep mode by raising the PID Reference, and then the drive enters PID sleep mode. Alternatively, according to [PRT-27 Op Sel for UL] setting, it enters into PID operation standby (Sleep) mode without boost operation when light load occurs. In PID sleep mode, the drive resumes PID operation when the PID feedback falls below the PID Wakeup level and maintains the condition for the time set at PID-64 (PID WakeUp0 DT).

Note

If PID-57 is set to "0. Absolute", the drive wakes-up when the PID Feedback drops below the level "PID-65 PID WakeUp0Lev" for the time set in PID-64 PID WakeUp0DT. For PID out inverse = Yes, the PID Feedback has to be above this level for the time set in PID-64 PID WakeUp0DT.

If PID-57 is set to "1. Deviation", PID Wakeup level will be calculated using the following formula:

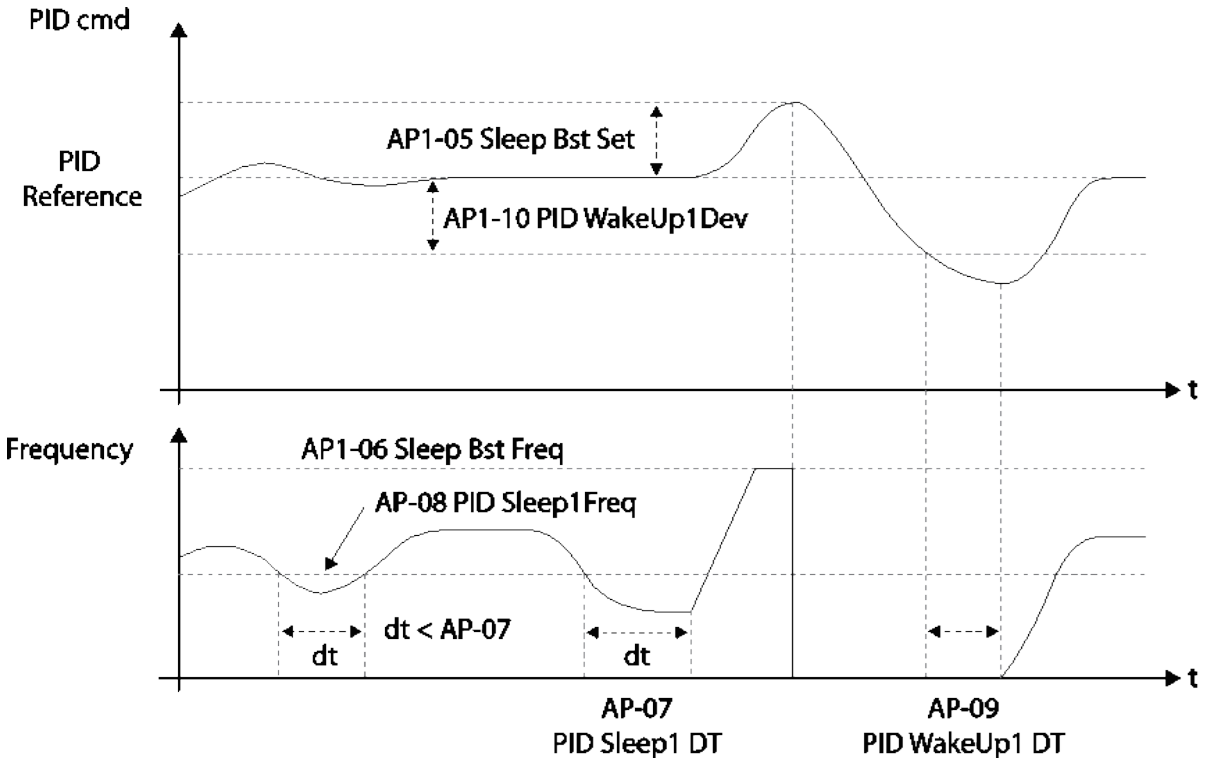
PID Wakeup Level = PID-04 (PID SetPoint Value)–PID-65(PID WakeUp0Lev)

Eight sets of configurations are available in PID sleep mode for sleep mode frequency, sleep mode delay time, wakeup variation, and wakeup delay time. One of the eight configurations will be selected depending on the multi-step setpoint. If multi-step setpoint is not used, basically PID-62 PID Sleep 0 DT, PID-63 PID Sleep0Lev, PID-64 PID WakeUp0DT, PID-65 PID WakeUp0Lev will be applied for sleep and wake-up operation.

PID Operation Sleep Mode Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PID-57
Wake Up Lev Type</td><td>Through Wake-up method function, user can determine whether to set the Wake-up level as an absolute value or a relative value against the PID setpoint (Deviation) after the drive enters Sleep mode.
<table>
<tr><td colspan="2">Setting</td></tr>
<tr><td>0</td><td>Absolute</td></tr>
<tr><td>1</td><td>Deviation</td></tr>
</table></td></tr>
<tr><td>PID-58
Sleep Act Lev</td><td>Sleep Activate Level function disables the sleep function below a certain level to prevent entering Sleep mode during startup.</td></tr>
<tr><td>PID-59
Sleep Lev Type</td><td>The following sleep level types can be selected:
<table>
<tr><td colspan="2">Setting</td></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>1</td><td>Output Freq</td></tr>
<tr><td>2</td><td>Output Current</td></tr>
<tr><td>3</td><td>Feedback Value</td></tr>
<tr><td>4</td><td>Output RPM</td></tr>
<tr><td>5</td><td>Flow Rate Mon</td></tr>
<tr><td>6</td><td>PID Tar. Value</td></tr>
</table></td></tr>
<tr><td>PID-60
Sleep Bst Set</td><td>Sets the sleep boost volume. Feedback must reach the boost level (PID Setpoint+Sleep Bst Set) for the drive to enter Sleep mode.</td></tr>
<tr><td>PID-61
Sleep Bst Freq</td><td>Sets the drive operation frequency to reach sleep boost level.</td></tr>
</table>

Code	Description
PID-62,66,70,74,78,82,86,90 PID Sleep 0/1/2/3/4/5/6/7 DT PID-63,67,71,75,79,83,87,91 PID Sleep0/1/2/3/4/5/6/7 Lev	If the operating frequency stays below the frequencies set to PID-63–91 for the set times to PID-62–90 when PID-59 is default, the drive enters sleep (standby) mode. When PID-59 is set to "2. Output Current–5. Flow Rate Mon", Sleep activates when the selected level type reaches the programmed sleep level for the time set in PID-62–90 PID Sleep @ DT. Setting PID-59 Sleep Lev Type to "0. Disabled" disables the function. If PID-60 Sleep Bst Set is set to any other value than zero, the drive accelerates to the PID sleep boost frequency (PID Sleep Bst Freq) after meeting sleep condition. Then, when the feedback reaches the value set at the boost level, the drive enters sleep (standby) mode.
PID-64,68,72,76,80,84,88,92 PIDWakeUp0/1/2/3/4/5/6/7DT PID-65,69,73,77,81,85,89,93 PIDWakeUp00/1/2/3/4/5/6/7Lev	Sets the reference for PID operation in PID sleep mode. If PID-57 is set to "1. Deviation", PID operation resumes when PID feedback variation (from the PID reference) exceeds the values set to PID-65–93 and maintains the condition for times set to PID64–92. If PID-57 is set to "0. Absolute", PID operation resumes when PID feedback value (from the PID reference) drops below the values set to PID-65–93 and maintains the condition for times set to PID64–92.
PID-94 Wake Up Mode	When set to "Hold Sleep," the inverter monitors the current feedback value at startup. If the wake-up level is not satisfied, the inverter enters Sleep mode. When set to "Min Spd Start," the inverter starts operation without monitoring the feedback value.
PID-95 Disable Wake-up	When "Disable Wake-up" is activated, the inverter is turned to Off status after entering into Sleep during PID operation. At this status, wake-up is not operated at the wake-up level, but only by pushing on Auto key. This function can be used when Wake-up is not to be operated based on the pressure feedback value.
PID-96 Sleep Warning Message Selection	When set to "Warning," a warning message appears on the display during Sleep mode. When set to "None," no warning message is displayed during Sleep mode.



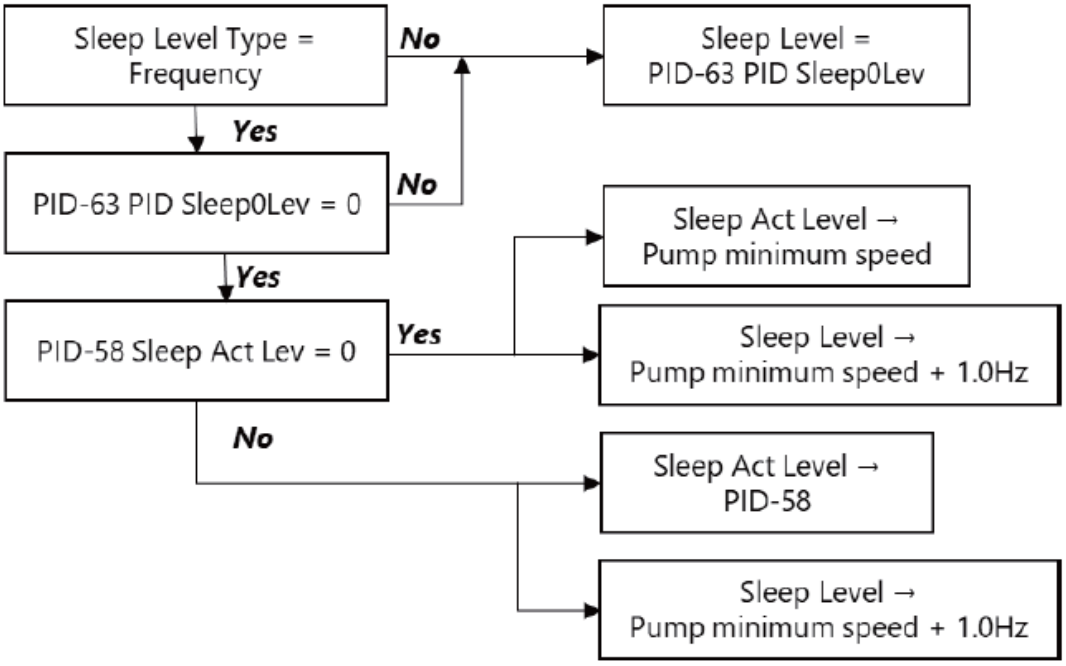
Sleep Activate Level

Set the reference frequency for Sleep behavior to prevent Sleep from operating in unused low-speed zones.

Code	Description
PID-58 Sleep Activate Level	Only when PID 59 Sleep level type is set to {1. Output Freq}, {4: Output RPM}, the Sleep function is activated when the output frequency is set to PID 58 or higher. If it is set to '0', Minimum Freq becomes the activation criterion of Sleep function.

The Sleep Activate level is used to determine when Sleep should start working at the start of operation. If the output frequency is lower than the Sleep Activate level after the start of operation, Sleep will not operate. After the output frequency rises above the Sleep Activate level at least once, the Sleep function starts monitoring the system regardless of the Sleep Activate level.

However, if [PID-58 Sleep Act Lev] is set to '0' as shown in the diagram below, the actual Sleep Activate level becomes the minimum pumping speed.



Sleep Mode & Method (Frequency, Feedback, Current)

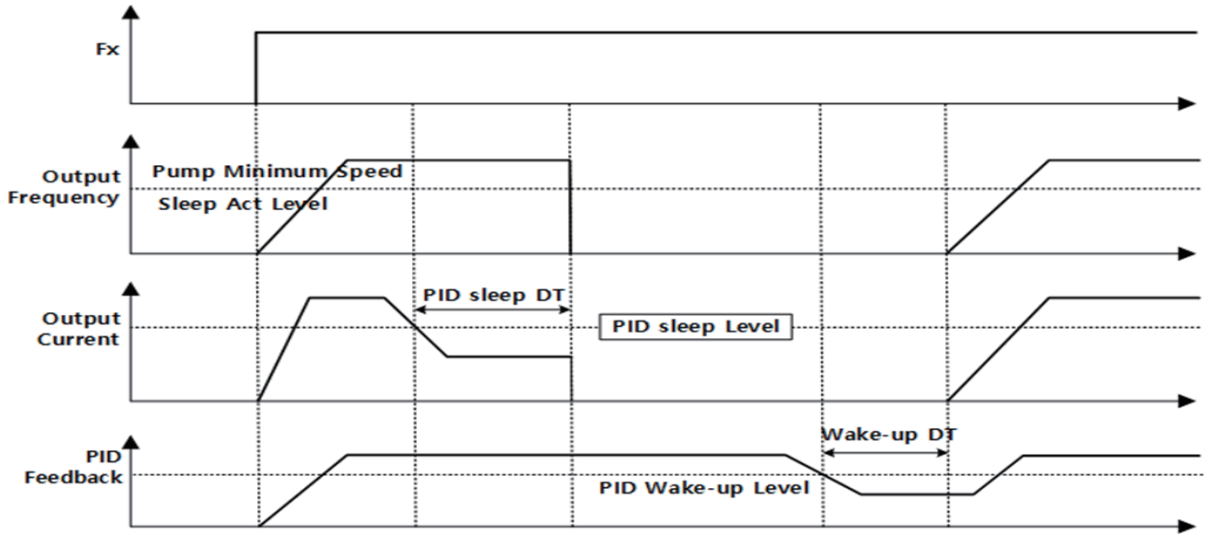
This feature provides a pump-intuitive way to handle "No Demand" (sleep) conditions for pump customers. It provides various sleep conditions based on frequency, speed, high (low) feedback, and current.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PID-59
Sleep Level Type Selection</td><td>The following sleep level types can be selected:
<table>
<tr><td colspan="2">Setting</td></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>1</td><td>Output Freq</td></tr>
<tr><td>2</td><td>Output Current</td></tr>
<tr><td>3</td><td>Feedback Value</td></tr>
<tr><td>4</td><td>Output RPM</td></tr>
<tr><td>5</td><td>Flow Rate Mon</td></tr>
<tr><td>6</td><td>PID Tar. Value</td></tr>
</table>
Output Frequency and Output RPM
The default behavior is the same as before, but if the set sleep frequency is less than the minimum frequency, the actual sleep frequency will be the minimum frequency.
(Example: minimum 10Hz, sleep frequency 5Hz, currently driving at 10Hz, enter sleep)

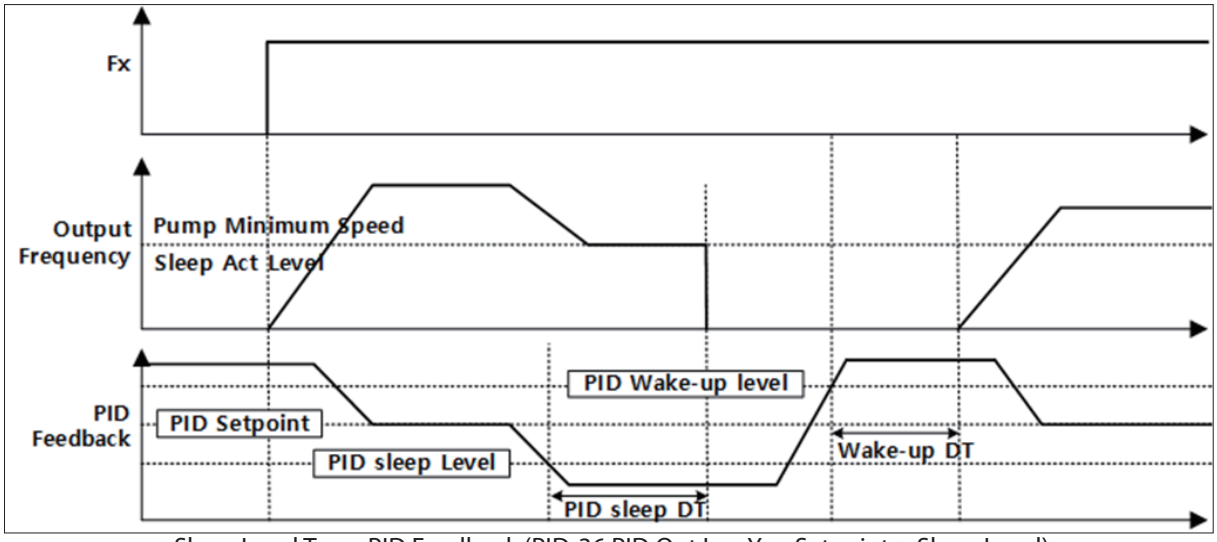
Output Current
Only the sleep reference becomes the output current and the PID direction is the same. Regardless of the setting of [PID-36 PID Out Inv], the VFD enters Sleep when the Output Current is below the Sleep Level and the Delay time is satisfied.
The VFD starts the Sleep Delay Timer only when the output current falls below the Sleep Level. When the output current returns to the Sleep Level or higher, the Sleep Delay Timer is reset to zero. If the output current falls below the Sleep Level for the time set in the Sleep Delay Timer, the VFD stops according to the set stop method.
If the PID feedback remains below the wake-up level during the wake-up DT, the VFD will start operating again. When the VFD wakes up from sleep, it will restart if all relevant functions are enabled (e.g. Pre-PID, Lubrication, Pump Clean, etc.).

Feedback Value
It is used in applications such as level control and tank emptying and is usually used in Inverse Acting conditions.
In the Inverse Acting condition (PID Out Inv: Yes), if Setpoint>Sleep Level, the frequency starts to decrease when the feedback value falls below the Setpoint like the existing PID behavior, but if Setpoint<Sleep Level, the frequency starts to decrease when it falls below the Sleep Level. In this case, Sleep Level behaves like Setpoint.
Similarly, in the case of PID Out Inv: No, if Setpoint<Sleep Level is large, the frequency starts to decrease when the Setpoint is reached like normal PID operation, but if Setpoint>Sleep Level, the frequency starts to decrease when the output frequency reaches the Sleep Level.</td></tr>
</table>

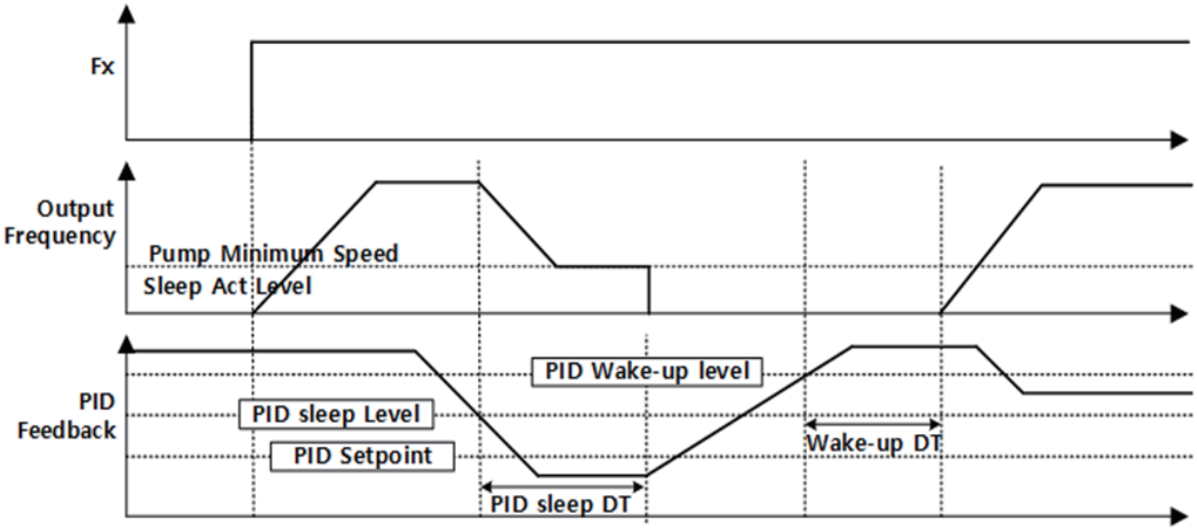
PID-59 Sleep Level Type Selection	**PID Tar. Value** This functionality is required for field drainage systems. It is used to prevent excess runoff water from overwatering crops. PID sleep function can work off of a percentage (%) of feedback. When enabled, the sleep level is set as a % of the PID setpoint. Sleep level is active when feedback drops based on set % of setpoint and set delay time. The wakeup level is set as a % of PID setpoint. Wakeup occurs when feedback rises to set % level. VFD does not go to sleep based on frequency like the default currently. When setting [PID-59 Sleep Lev Type] to "6. PID Tar. Value", the units of the sleep&wake-up parameters will be changed to [%], automatically changed to 2 decimal places, and [PID-59 WakeUpLev type] will be disappeared. Sleep & Wake-up Level will be calculated as follows. • Sleep Level = [PID-04 Setpoint Value] x [PID Sleep@Lev]% • Wake-up Level = [PID-04 Setpoint Value] x [PID Sleep@Lev]% *"PID Tar. Value" is available from Drive Software Version <SW602.01_D00.00_C602.01> or greater.



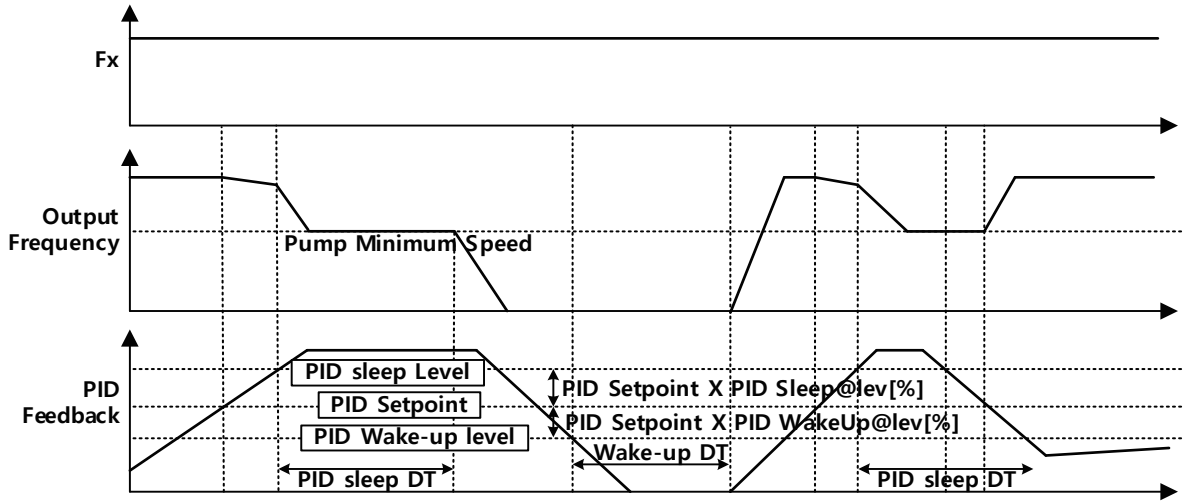
<Sleep level type: Current>



< Sleep Level Type: PID Feedback (PID-36 PID Out Inv: Yes, Setpoint > Sleep Level)>



<Sleep Level Type: PID Feedback (PID-36 PID Out Inv: Yes, Setpoint < Sleep Level)>

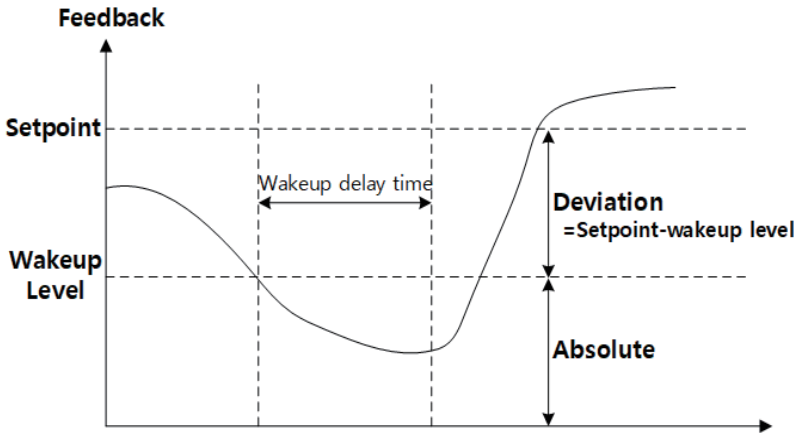
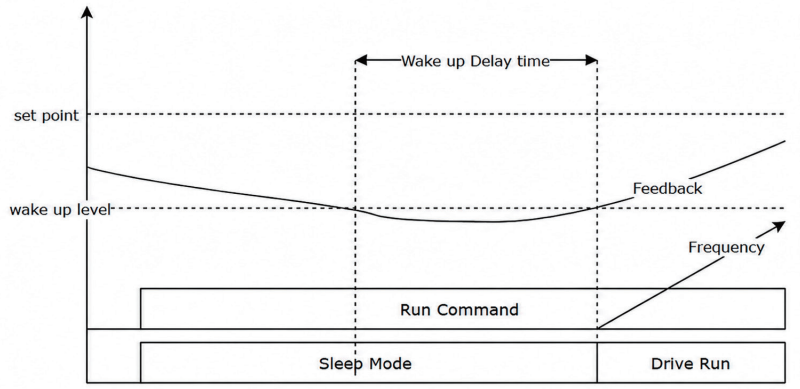
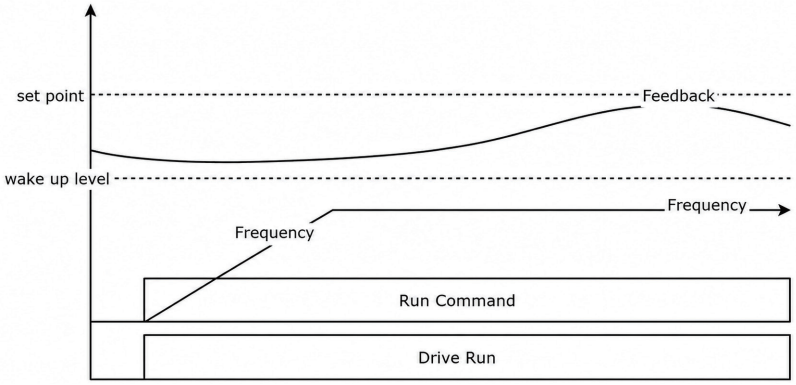


<Sleep Level Type: PID Tar. Value (PID-36 PID Out Inv: No>

5.8.3 PID Wake-up operation

Wake-up method (Absolute, Deviation)

This feature allows you to select the wake-up behavior level in both relative (Deviation) and absolute (Absolute) values.

Code	Description
PID-57 Wake Up Level type (WakeUpLev type)	The following sleep level types can be selected: 0. Absolute 1. Deviation 
PID-94 Wake Up Mode	When PID-94 (Wake Up Mode) is set to "0. (Hold Sleep)" and the inverter receives a run command, it monitors the feedback value. If the feedback value is higher than the wake-up level, the inverter enters Sleep mode. If the feedback value decreases later, the wake-up delay time and the wake-up level are satisfied, and the wake-up function is activated.  When PID-94 (Wake Up Mode) is set to "1. Min Spd Start" and the inverter receives a run command, it starts operating regardless of the feedback value. 

Disable Wake-up

During PID operation, when the sleep condition causes the operation standby state (Sleep) to be entered, the operation standby state is not entered, but the stop state is entered. When the Inverter enables Sleep Off Mode, it will not enter the Sleep state when the Sleep condition is met during PID operation but will enter the Stop state and will not restart when a wake-up condition occurs.

Code	Description
PID-95 Disable Wake Up	Enable Sleep Off Mode to set whether to enter a stop state instead of a sleep state on a sleep condition. If PID-95 is No The Inverter will sleep when the sleep condition occurs and will run again when the wake-up condition is met. If PID-95 is Yes When a Sleep condition occurs, the Inverter will stop without entering Sleep, and a {Disable WakeUp} Warning occurs. At this time, it does not run even if the wake-up condition is met. {Disable WakeUp} Warning is cleared by the following conditions. • When entering the keypad HAND/OFF/ AUTO key • On reset • When re-entering driving commands However, if you press the Auto Button on the keypad, it will restart. (Regardless of the [DRV-08 AUTO Mode Sel] setting). If [DRV-05 KPD H.O.A Lock] is set to {0: Locked}, the HAND, OFF, and AUTO keys on the keypad are disabled, so you must turn the driving command OFF->ON to drive.

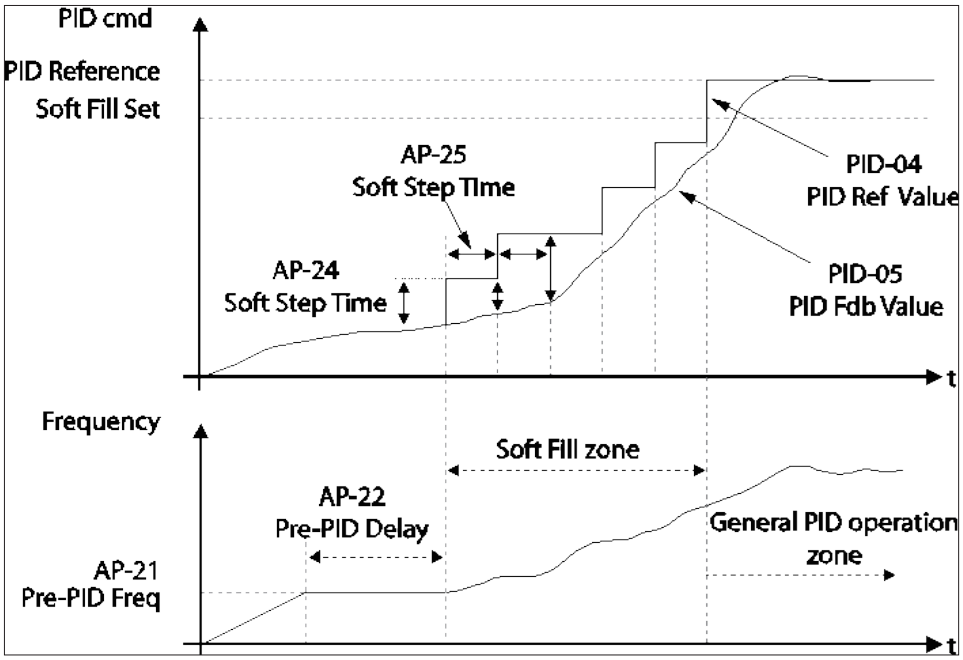
5.8.4 Soft Fill Operation

A soft fill operation is used to prevent excessive pressure from building in the pipe system at the initial stage of a pump operation. When the operation command is given, a general acceleration (without PID control) begins and continues until the output reaches the frequency set at AP1-21, for the time set at AP1-22. Then, the soft fill PID operation is performed unless the feedback value has reached the value set at AP1-23 (Soft Fill Set value). The soft fill PID operation continues until the feedback or the soft fill PID reference value reaches the value set at AP1-23 (Soft Fill Set value). When the soft fill operation ends, a normal PID operation starts.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
AP1	20	Soft Fill options	Soft Fill Sel	0	No	0–1	-
	21	Pr- 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

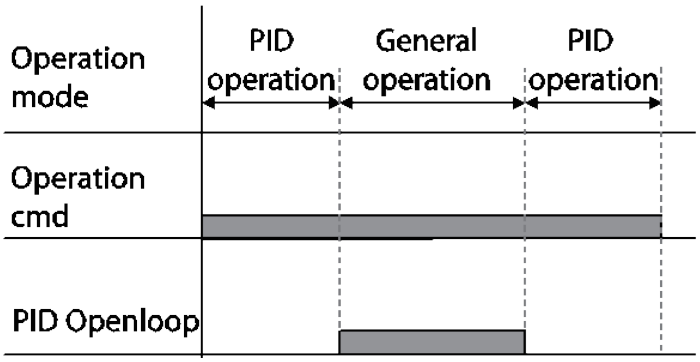
Code	Description
AP1-20 Soft Fill Sel	Enables or disables the soft fill PID.
AP1-21 Pre-PID Freq	Sets the frequency range for a general acceleration without PID control. If AP1-21 (Pre-PID Freq) is set to 30 Hz, general operation is performed until the PID feedback reaches the value set at AP1-23 (Soft Fill Set). However, if the PID reference or feedback exceeds the value set at AP1-23 during the pre-PID operation, a normal PID operation starts immediately.
AP1-22 Pre-PID Delay AP1-23 Soft Fill Set	In general, a PID operation starts when the feedback volume (controlled variables) of PID controller exceeds the value set at AP1-23. However, if AP1-22 (Pre-PID Delay) is set, the feedback after the set time becomes the default value for the soft fill PID reference, and the inverter starts the soft fill operation. When the feedback or the Soft Fill PID Reference exceeds the Soft Fill Set value, the soft fill operation ends and a normal process PID operation begins.
AP1-24 Fill Step Set AP1-25 Fill Step Time AP1-26 Fill Fdb Diff	The Soft Fill PID Reference increases each time the set time [at AP1-25 (Fill Step Time)] is elapsed, by the amount set at AP1-24 (Fill Step Set). However, note that if the difference between the Soft Fill PID Reference value and the feedback value is greater than the value set at AP1-26 (Fill Fdb Diff value), the Soft Fill PID Reference value does not increase.



When a PID process is performed after the soft fill PID operation, the PID Reference value becomes the PID-11 PID Ref1 Set value.

5.8.5 PID Switching (PID Openloop)

When one of the multi-function terminals (IN-65–71) is set to '25 (PID Openloop)' and is turned on, the PID operation stops and is switched to general operation. When the terminal turns off, the PID operation starts again.



5.9 Pump Minimum Speed

A lower speed limit is necessary because many pumps will not pump below a certain speed.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP2	40	Thrust Frequency	Thrust Freq	0.00	0.00–High Freq	Hz

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
PID	56	Pump Minimum Speed	Pump Min Speed	0.00	0.00–High Freq	Hz
ADV	25	Frequency limit low	Freq Limit Lo	0.00	0.00–High Freq	Hz

Minimum pump speed is the highest of the following three values.

PID-56: Minimum Pump Speed

AP2-40: Thrust Frequency

ADV-25: Freq Limit Lo

[ADV-25 Freq Limit Lo] is only valid when [ADV-24 Freq Limt] is Yes.

Code	Description
AP2-40 Thrust Frequency	On startup, accelerate to this frequency with the AP2-41 acceleration time. During deceleration, decelerate from this. frequency to the deceleration time of AP2-42.
PID-56 Pump Minimum Speed	Applies to both Hand Mode and Auto Mode as the minimum frequency at which the Inverter will operate. NOTE: Thrust mode, Frequency Limit low, the highest value of this parameter will operate as Minimum frequency.
ADV-25 Frequency limit low	Minimum frequency applied when [ADV-24: Freq Limit] sets to "Yes"

5.10 Thrust Bearing Protection

This feature provides acceleration/deceleration time switching to protect the bearings of the submersible pump.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP2	40	Thrust Frequency	Thrust Freq	30.00	0.0–Max Freq.	Hz
	41	Thrust Bearing Acceleration Time	Thrust Acc Time	1.0	0–600.0	sec
	42	Thrust Bearing Deceleration Time	Thrust Dec Time	5.0	0–600.0	sec

Thrust bearing protection Setting Details

Code	Description
AP2-40 Thrust Frequency	AP2-40 sets the thrust frequency. The AP2-40 thrust frequency can also function as the minimum frequency of the Inverter. When [ADV-24 Freq Limit] is Yes, if AP2-40 is set to a value higher than PID-56 (Pump Min Speed) and ADV-24 (Freq Limit Lo), AP2-40 thrust frequency becomes Minimum output speed. If AP2-40 is operating at the minimum speed of the Inverter and the fixed command frequency (ex. Hand freq., or multi-speed) is set to be less than AP2-40, the AP2-40 frequency is applied.

Code	Description
AP2-41 Thrust bearing Acceleration Time	When AP2-40 is set to a value other than "0", the Inverter accelerates the speed from "0" to the value set in AP2-40 to the time in AP2-41 (Delta Freq operation). During time AP2-41, the Inverter will display "Thrust Mode" on the keypad. Similarly, the output contacts set to Thrust mode during the AP2-41 time are closed. At output frequencies above AP2-40, the Inverter's default acceleration time is applied, PID operation is enabled, and the display and output contacts disappear.
AP2-42 Thrust bearing Deceleration Time	When AP2-40 is set to a value other than "0", the Inverter decelerates from the AP2-40 frequency to 0 Hz with the time set in AP2-42 (Delta Freq operation). During AP2-42 time, the Inverter will display "Thrust Mode" on the keypad. Similarly, the output contacts set to thrust mode during the AP2-42 time are closed. At output frequencies above AP2-40, the Inverter's default deceleration time is applied, PID operation is enabled, and the display and output contacts disappear.

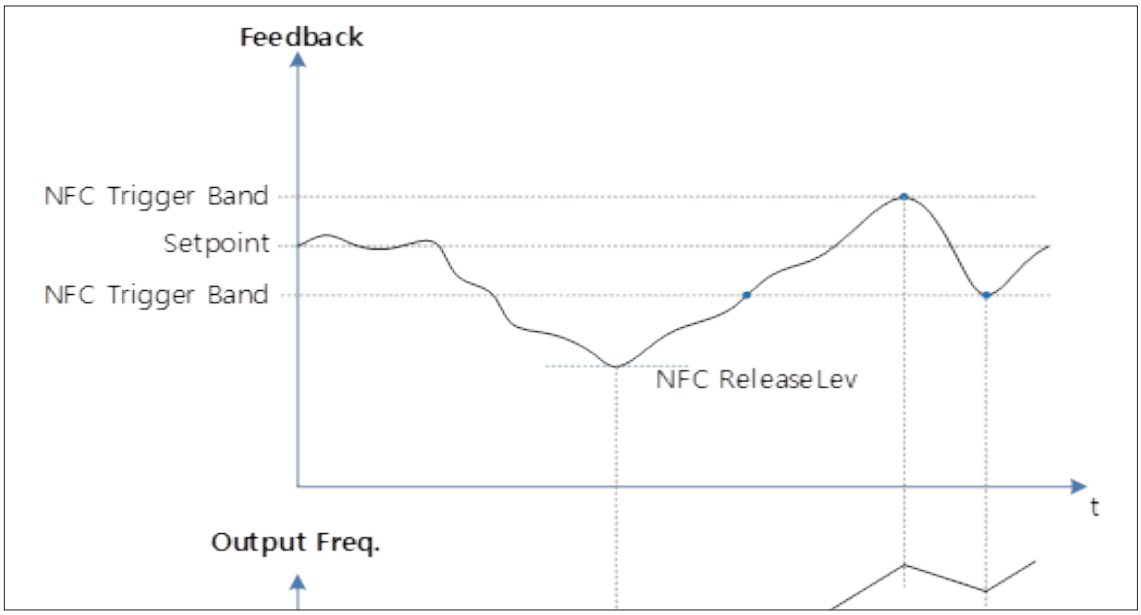
Note: Accel/Decel Rate Priority

- Highest Priority
  - Coast Stop
  - Thrust Accel / Decel (AP2-40–42)
  - Multi-step acceleration/deceleration (BAS70–83)
  - Acceleration/Deceleration Shift Frequency (ADV60)
- Lowest Priority
  - Standard Acc/Dec Rates

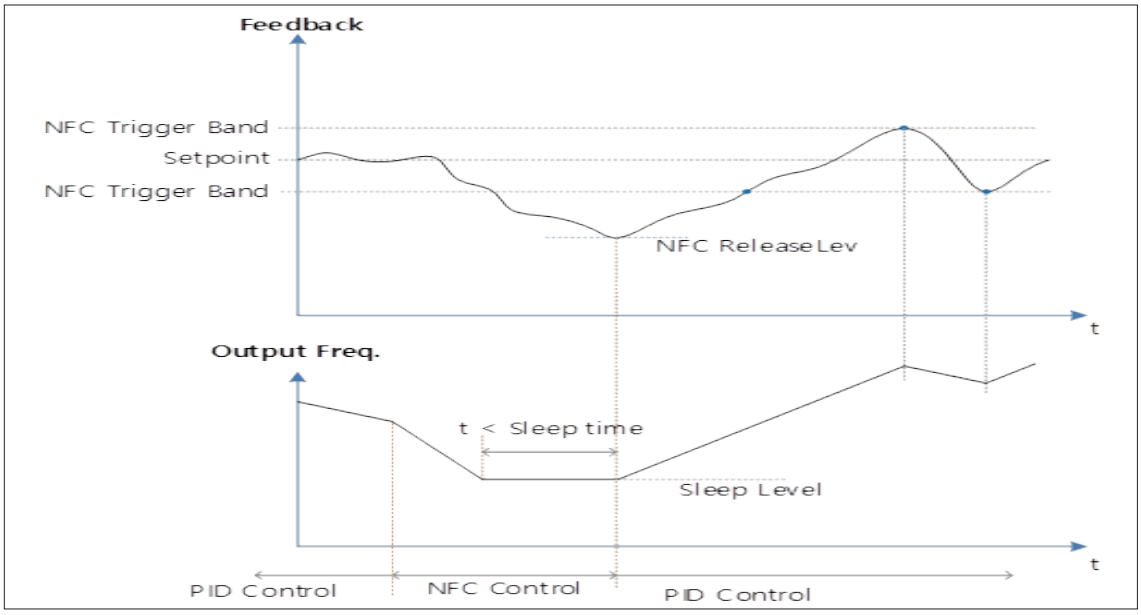
5.11 No-Flow Control

This feature detects a "No-Flow" condition and allows you to go to sleep. When the Inverter detects that the pump is no longer affecting the overall system pressure with speed changes due to the no-flow condition, it will increase the deceleration rate and normal sleep behavior will follow. This feature only works when the Sleep level type is Frequency or Speed. This function is used to protect the motor from spinning continuously when the actual pressure is not adjusted even though the Inverter adjusts the output frequency. If the Inverter is no longer adjusting pressure due to a no- flow condition, it will rapidly decelerate to sleep level.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
PRT	66	No-Flow-Control Bandwidth	NFC Bandwidth		0.00–4.00	%
	67	No-Flow-Control Detection Time	NFC Det Time		0–60.0	sec
	68	No-Flow-Control ReleaseLev	NFC ReleaseLev		0.00–10.00	PID unit
	69	No-Flow-Control Timer	NFC Timer	-	-	sec



< NFC operation sequence >



< NFC exit sequence >

Code	Name (LCD Display)	Parameter setting	Default	Description
AP4-30	Flow Control Enable (Flow Control)	0: No 1: Yes 2: AccumRst->Yes	0: No	You can enable/disable the Flow Control feature. i.e. Parameters of Flow Control function become available. when {2: AccumRst>Yes} is set, it initializes [AP4- 38–41] parameters '0'. Once the initialization is done, AP4-30 set value is automatically changed to {1: Yes}.

Code	Name (LCD Display)	Parameter setting	Default	Description
AP4-31	Flow Meter Source (Flow Meter Src)	0: V1 1: I1 2: V2 3: I2 4: Pulse 5: Reserved 6: V3 7: I3	0: V1	Select the Source that will be entered as the Flow Meter.
AP4-32	Flow Rate Monitor (Flow Rate Mon)	Read Only		AP4-31 displays the current Flow Rate entered.
AP4-33	Turbine Scale (Turbine Scale)	0–30000	0	If AP4-31 is set to Pulse, enter the PPG, PPM scaling of the Flow Meter.
AP4-34	Flow Unit (Flow Units 0%)	0–300.00	0.00	If AP4-31 is set to Analog, set the flow rate equivalent to 0%.
AP4-35	Flow Unit (Flow Units 100%)	0–300.00	100.00	If AP4-31 is set to Analog, set the flow amount equivalent to 100%
AP4-36	Flow Unit Selection (Flow Unit Sel)	0: gl/m 1: gl/h 2: f3/m 3: m3/h	0: gl/m	Set the Unit of Flow Meter.
AP4-37	Flow Decimal Point Scale (Flow Dec Scale)	0: X100 1: X10 2: X1	2: X1	Displays the number of decimal places for the Flow Meter. (The default number of places is two decimal places.)
AP4-38	Accumulation Level Million (AccumLvMillion)	0–65535	0	Displays the number of Levels in Million of the current accumulated flow.
AP4-39	Accumulation Level Thousand (AccumLvThou)	0–999	0	Displays the number of Levels in Thousands of the currently accumulated flow.
AP4-40	Accumulation Level Ones (AccumLvOnes)	0–999	0	Displays the number of Levels in Ones of the currently accumulated flow.
AP4-41	Accumulation Level Decimal Point (AccumLvDecimal)	0–0.99	0.00	Displays the number of decimal places in the Level of the currently accumulated flow.
AP4-42	Low Flow Level (Low Flow Level)	0.00–300.00	0.00	Set the flow level to activate Low Flow Detection.
AP4-43	Low Flow Delay time (Low Flow DT)	0–6000 (Sec)	10	Sets the Delay Time for Low Flow Detection operation.
AP4-44	Low Flow Selection (Low Flow Sel)	0: None 1: Warning 2: Trip & Coast 3: RST Restart	0: None	Low Flow Detection Sets the behavior when detected.
AP4-45	Low Flow Start Delay Time (LowFlow St DT)	0–3600.0(Min)	0.0	Set the time to not detect Low Flow when the Inverter starts.

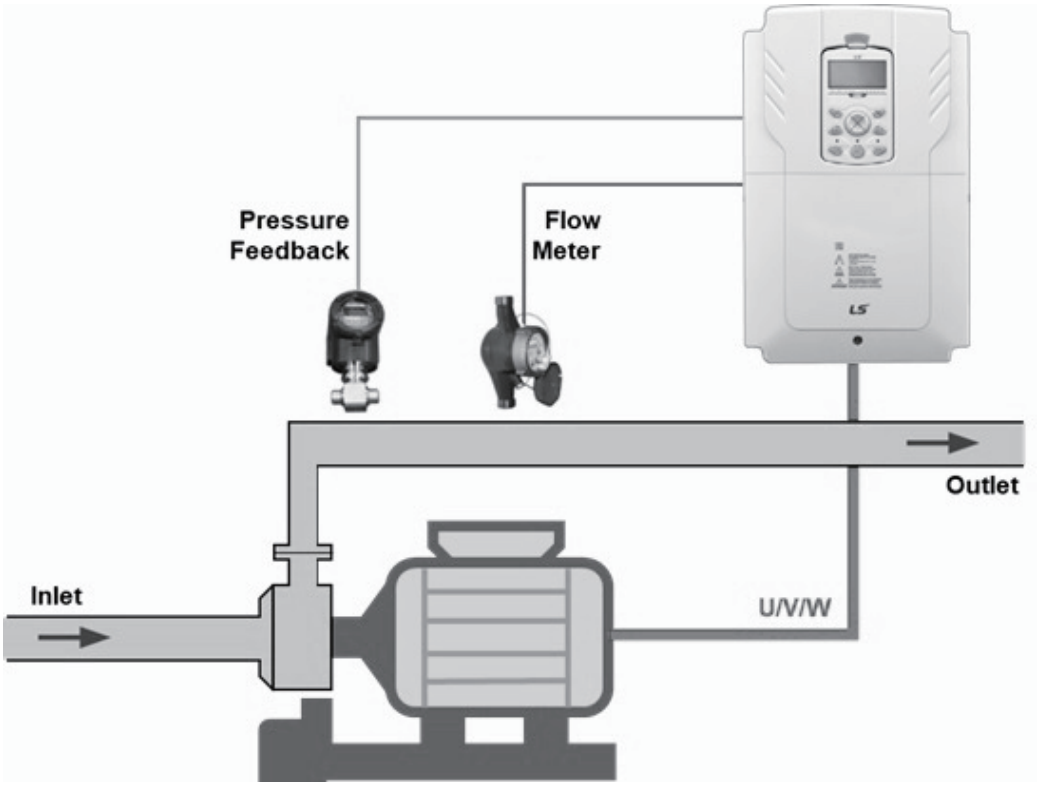
Code	Name (LCD Display)	Parameter setting	Default	Description
AP4-46	Low Flow Start Delay OFF time (StartDlyOFF Tm)	0–6000(Sec)	5.0	If the Inverter does not detect for the set time of AP4-45 when starting up, but the current Flow Level exceeds the Low Flow Level and runs for more than the set time of AP4-46, the Low Flow Detection function is activated, overriding AP4-45
AP4-47	High Flow Level (High Flow Lev)	0.00–300.00	0.00	Set the Flow Level at which High Flow Detection will be activated.
AP4-48	High Flow Delay time (High Flow DT)	0–6000 (Sec)	10	Sets the Delay Time for High Flow Detection operation.
AP4-49	High Flow Selection (High Flow Sel)	0: None 1: Warning 2: Trip & Coast	0: None	Select whether to trigger warning or Trip & Coast stop, when high flow is detected
AP4-50	Set Accumulation Level Million (SetAccumLv M))	0–65535	0	Displays the number of Million units in the Level that you want the Accumulation Flow feature to operate on.
AP4-51	Set Accumulation Level Thousand (SetAccumLv K)	0–999	0	Displays the number of Levels in Thousands for which you want the Accumulation Flow feature to work.
AP4-52	Set Accumulation Level Ones (SetAccumLv One)	0–999	0	Displays the number of Ones units in the Level for the Accumulation Flow function to operate on.
AP4-53	Set Accumulation Level Decimal Point (SetAccumLv Dec)	0–0.99	0.00	Displays the number of decimal places in the Level for the Accumulation Flow function to operate.
AP4-54	Accumulation Flow Selection (Accum Flow Sel)	0: None 1: Warning 2: Trip & Coast 3: Trip &RstAccum	0: None	Sets the behavior when Accumulation Flow Detection is detected. When [3: Trip &RstAccum] is set, the accumulation flow of [AP4-38–41] after the trip occurs is cleared to 0.
AP4-55	Flow Limit Selection (Flow Limit Sel)	0: Disable 1: High 2: Low	0: Disable	Activates the flow limit function. If it is lower/ higher than the value set in AP4-56, the Flow Limit function operates.
AP4-56	Flow Limit Level (Flow Limit Lev)	0–300.00	0.00	Set the level at which you want the Flow Limit feature to operate.
AP4-57	Flow Limit P-Gain (FlowLim P-Gain)	0–250.00	1.00	Sets the P-gain at which the Flow Limit controller operates.
AP4-58	Flow Limit I-Gain (FlowLim I-Gain)	0–100.00(sec)	1.00	Sets the I gain at which the Flow Limit controller operates.
AP4-59	Flow Limit Delay Time (Flow Limit DT)	0–6000(sec)	10	Set the Delay Time after which the Flow Limit controller operates.
AP4-60	Low Flow RST Restart Time (LowFlow RST Tm)	0–6000.0(Min)	3.0	Set the restart time when AP4-44 is set to RST Restart. The number of restarts is equal to [PRT-09 Retry Number].

5.12 Flow Monitoring

This function receives analog or pulse signals to calculate the flow rate and calculate the accumulated flow amount. It can detect and limit warning trips for high, low, and accumulation of the calculated rate or accumulation.

By connecting a flow meter to the system, the Inverter can detect the flow in the system and perform the following actions.

- Check the flow rate of the system
- Detect the high/low level of the flow and set actions such as digital output, warning, trip, etc.
- Accumulate and store the flow rate in real time and set actions such as warning and tripping with the accumulated flow rate.
- Detects low or high flow conditions and reflects them in the Inverter operating frequency.



Parameters for flow monitoring

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP4	30	Flow Control enable	Flow Control	1: Yes	0: No 1: Yes 2: AccumRst->Yes	
	31	Flow Meter Source	(Flow Meter Src)	0: V1	0: V1 1: I1 2: V2 3: I2 4: Pulse 5: Reserved 6: V3 7: I3	
	32	Flow Rate Monitor	(Flow Rate Mon)	-	Read Only	
	33	Turbine Scale	(Turbine Scale)	0	0–30000	
	34	Flow Unit	(Flow Units 0%)	0.00	0–300.00	
	35	Flow Unit	(Flow Units 100%)	100.00	0–300.00	
	36	Flow Unit Selection	(Flow Unit Sel)	0: gl/m	0: gl/m 1: gl/h 2: f3/m 3: m3/h	
	37	Flow Decimal Point Scale	(Flow Dec Scale)	2: X1	0: X100 1: X10 2: X1	
	38	Accumulation Level Million	(AccumLvMillion)	0	0–65535	
	39	Accumulation Level Thousand	(AccumLvThou)	0	0–999	
	40	Accumulation Level Ones	(AccumLvOnes)	0	0–999	
	41	Accumulation Level Decimal Point	(AccumLvDecimal)	0.00	0–0.99	
	42	Low Flow Level	(Low Flow Level)	0.00	0.00–300.00	
	43	Low Flow Delay time	(Low Flow DT)	10	0–6000	sec
	44	Low Flow Selection	(Low Flow Sel)	0: None	0: None 1: Warning 2: Trip & Coast 3: RST Restart	
	45	Low Flow Start Delay Time	(LowFlow St DT)	0.0	0–3600.0	min
	46	Low Flow Start Delay OFF time	(StartDlyOFF Tm)	5.0	0–6000	sec
	47	High Flow Level	(High Flow Lev)	0.00	0.00–300.00	
	48	High Flow Delay time	(High Flow DT)	10	0–600	sec
	49	High Flow Selection	(High Flow Sel)	0: None	0: None 1: Warning 2: Trip & Coast	
	50	Set Accumulation Level Million	SetAccumLv M	0	0–65535	

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP4	51	Set Accumulation Level Thousand	SetAccumLv K	0	0–999	
	52	Set Accumulation Level Ones	SetAccumLv One	0	0–999	
	53	Set Accumulation Level Decimal Point	SetAccumLv Dec	0.00	0–0.99	
	54	Accumulation Flow Selection	Accum Flow Sel	0: None	0: None 1: Warning 2: Trip & Coast 3: Trip &RstAccum	
	55	Flow Limit Selection	Flow Limit Sel	0: Disable	0: Disable 1: High 2: Low	
	56	Flow Limit Level	Flow Limit Lev	0.00	0–300.00	
	57	Flow Limit P-Gain	FlowLim P-Gain	1.00	0–250.00	
	58	Flow Limit I-Gain	FlowLim I-Gain	1.00	0–100.00	sec
	59	Flow Limit Delay Time	Flow Limit DT	10	0–6000	sec
	60	Low Flow RST Restart Time	LowFlow RST Tm	3.0	0–6000.0	min

Flow Limiter

The Flow Rate Limiter function controls system pressure by reducing the rate when the current flow rate [AP4-32 Flow Rate Mon] reaches the upper or lower limit.

The Flow Rate Limiter function is activated after [AP4-59 Flow Limit DT] seconds after initial startup.

If [AP4-55 Flow Limit Sel] is set to 1 (High), the Flow Limiter function is activated when the current flow rate [AP4-32 Flow Rate Mon] is above the level set in [AP4-56 Flow Limit Lev].

If [AP4-55 Flow Limit Sel] is set to 2 (Low), the Flow Limiter function is activated when the current flow rate [AP4-32 Flow Rate Mon] becomes below the level set in [AP4-56 Flow Limit Lev].

When the Flow Limiter function is activated, the output rate is reduced by the PI controller according to [AP4-57/58 FlowLim P/I-Gain], and a {Flow Limit Lev} Warning occurs.

The output speed is limited to the values of Minimum Pump Speed (PID-56) or Thrust Bearing Frequency (AP2-40) and Frequency Limit Low (ADV-25), and the Flow Limiter function is operated only above this limited output speed.

When the Flow Limit Delay Time (AP6-59) timer expires, the output speed may change rapidly depending on the Flow Limit Level (AP4-56) and the current Flow Level, so AP4-59 must be set appropriately so that the system can stabilize the flow rate.

Flow meter input

For Flow Input, enter the appropriate Analog or Pulse specification in [AP4-31 Flow Meter Src]. For analog specifications, enter the appropriate values for [AP4-34/35 Flow Units 0%/100%], and for pulse input, enter the PPG value for the Flow Meter's setting in the parameter [AP4-33 Turbine Scale].

Notes: If a pulse input is used for the Flow Meter, the maximum frequency of the input is 32 kHz.

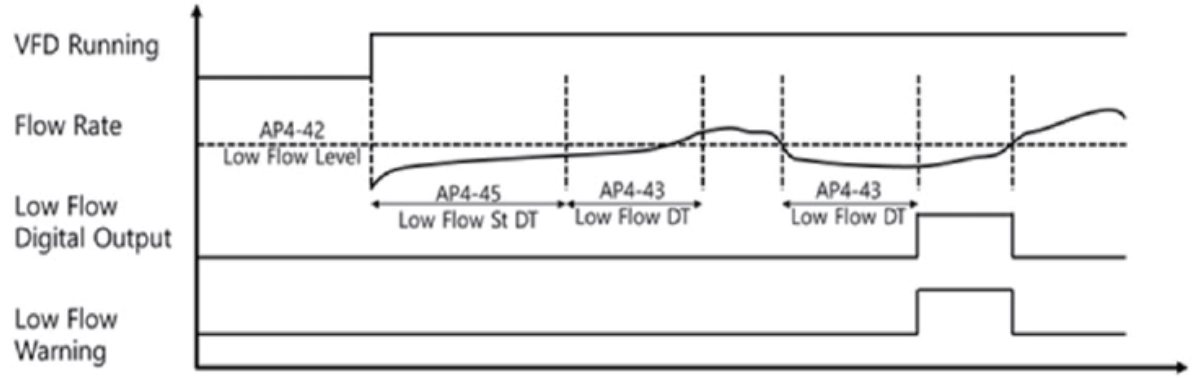
Low Flow Rate Digital Output/Alarm/Fault

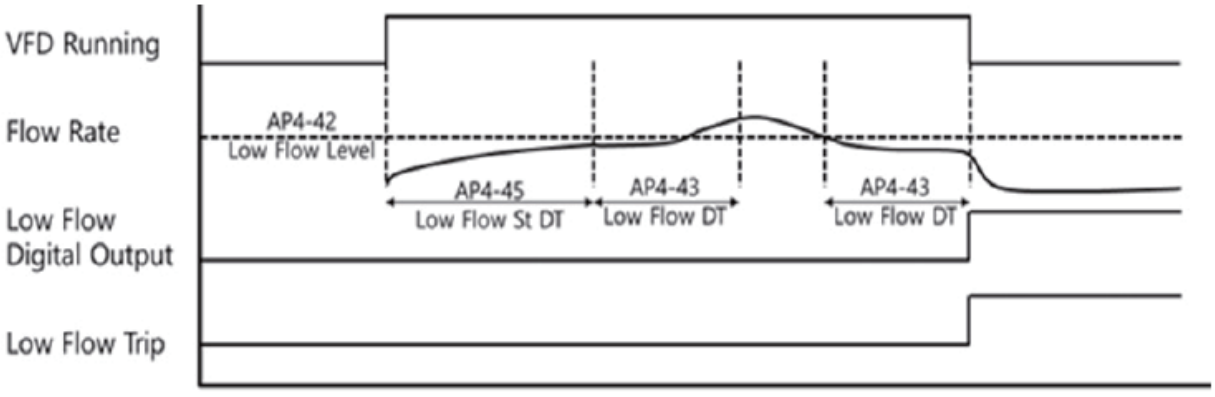
Low Flow Rate detection is enabled in the following cases:

- There is a valid flow meter input, such as pulse input, analog input, etc.
- The [AP4-42 Low Flow Level] parameter is set to a value greater than 0.
- The current flow rate [AP4-32 Flow Rate Mon] is less than [AP4-42 Low Flow Level] and the Low Flow Delay Time (AP-43) has elapsed.

If the [AP4-44 Low Flow Sel] parameter is set to "Warning" (AP4-44 = 1), the Inverter will display a "Low Flow Level" alarm under the above conditions, and the DO set to {46: low Flow Level} will be On.

The alarm is cleared when the Inverter stops running, or when the current flow rate [AP4-32 Flow Rate Mon] becomes [AP4-42 Low Flow Level] or higher, and the DO is turned Off.





If the [AP4-44 Low Flow Sel] parameter is set to (Trip & Coast) or (RST Restart), in the above condition, the Inverter will generate a "Low Flow Level" trip and stop the Coast Stop, and the DO set to {46: low Flow Level} will be turned on.

When the "Low Flow Level" Trip is cleared, the DO is also turned off.

Low Flow Detection Delay at Start Cancel

Considering that the current flow rate [AP4-32 Flow Rate Mon] rises slowly after starting the Inverter, it does not detect for the time set in Low Flow Start Delay Time (AP4-45) after starting.

However, if the current flow rate [AP4-32 Flow Rate Mon] exceeds [AP4-42 Low Flow Level] and runs for more than the set time in [AP4-46 StartDlyOff Tm], the Low Flow Detection function is activated by ignoring [AP4-45 LowFlow St DT].

Low Flow Rate Fault Auto Restart Time

If Low Flow Select (AP4-44 = 3) is set to RST Restart, when a Low Flow Level Trip occurs, the Inverter will wait the time set in AP4-60 before restarting and will reset and restart. The number of automatic resets is equal to [PRT-09 Retry Number].

High Flow Rate Digital Output/Alarm/Fault

High Flow Rate detection is enabled in the following cases:

- There is a valid flow meter input, such as pulse input, analog input, etc.
- The [AP4-47 High Flow Level] parameter is set to a value greater than 0.
- [The current flow rate [AP4-32 Flow Rate Mon] is greater than [AP4-47 High Flow Level] and more than [AP4-48 High Flow DT] time has elapsed.

When the [AP4-49 High Flow Sel] parameter is set to "Warning" (AP4-49 = 1)

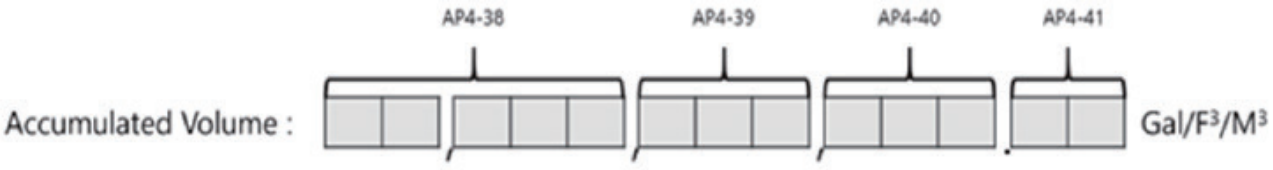
Under the above conditions, the Inverter will display a "High Flow Level" alarm, and the DO set to {47: High Flow Lev} will turn On.

The alarm will be cleared when the Inverter stops running, or when the current flow rate [AP4-32 Flow Rate Mon] becomes [AP4-49 High Flow Sel] or less, and the DO will be Off.

Total Accumulated Volume Monitors

The current flow rate [AP4-32 Flow Rate Mon] is accumulated in real time in [AP4-38 to 41]. AP4-38 to AP4-41 display the Total Accumulated Volume as shown below.

The unit of Accumulated Volume is displayed in the Volume unit selected in AP4-36.



When the Accumulated Volume reaches the maximum value, it is not automatically initialized and "0" must be entered in the parameter manually, and the data is stored in the Inverter's internal EEPROM.

If you need to set an offset value, you can set the value of [AP4-38–41] arbitrarily, and the subsequent operation value is calculated by accumulating the offset value.

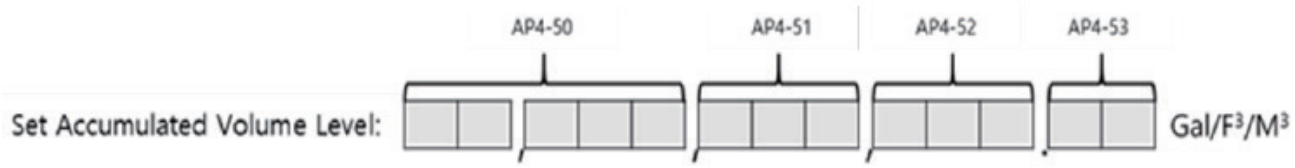
When [AP4-30 Flow Control] is set to {2: AccumRst->Yes}, Accumulated Volume is initialized to '0'.

Total Accumulated Volume of [AP4-38–40] can be monitored as one parameter in [CNF-69 Total Volume]. The decimal point (=[AP4-41 AccumLvDecimal]) and "," mark are omitted, and the maximum value that can be expressed is 4,200,000,000.

Accumulated Volume Digital Output/Warning/Trip

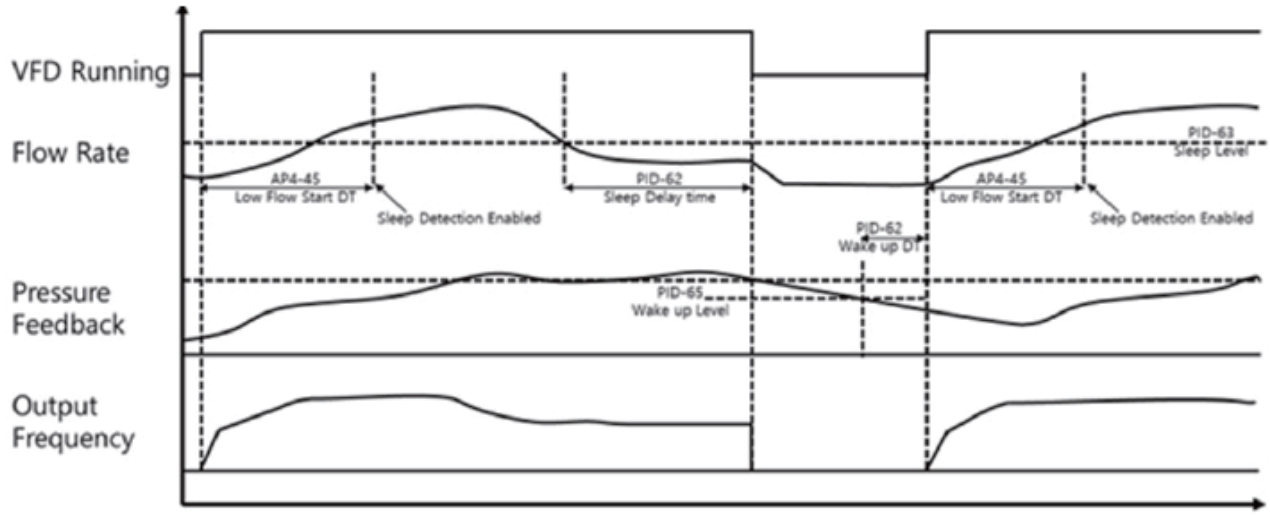
The total accumulated volume of [AP4-38–41] can be compared with the volume value of [AP4-50–53] set by the user to set the behavior of Digital Output/Warning/Trip etc.

- Warning (AP4-54 = 1): When the set level is exceeded, the DO set by {48: accum Level} is turned on and a Warning message is displayed.
- Trip & Coast (AP4-54 = 2): When the set level is exceeded, the DO set by {48: accum Level} is turned on, the Trip message is displayed, and the Inverter stops.
- Trip & RstAccum (AP4-54 = 3): When the set level is exceeded, a Trip message is displayed, the Inverter stops, and the Total Accumulated Volume of [AP4-38–41] is reset to '0'. (DO set to {48: accum Level} is not turned on.



Sleep Function Using the Flowmeter

The Sleep function can be activated by the current flow rate [AP4-32 Flow Rate Mon]. To use this function, the PID must be running, [AP4-30 Flow Control] must be set to Yes, and the Sleep Level Type must be set to "Flow Meter Monitoring" (PID-59 = 5). After activation, if the current flow rate [AP4-32 Flow Rate Mon] falls below the Sleep Level (PID-63) for a time greater than the PID Sleep X DT (PID-62), the Inverter will enter Sleep mode. Wake up is controlled by pressure. (Sleep is not judged during the [AP4-45 LowFlow St DT] time after the start of operation).



5.13 PI Auxiliary Control

Suction Pressure Control:

This function controls the pressure at the outlet to maintain proper pressure at the inlet of the pump. If the suction pressure (Pump inlet pressure) drops below the PI Aux Setpoint, the Inverter will decelerate to prevent the suction pressure from decreasing. The Inverter can sleep, wake up, or alarm/fault depending on the suction pressure.

Vacuum Control:

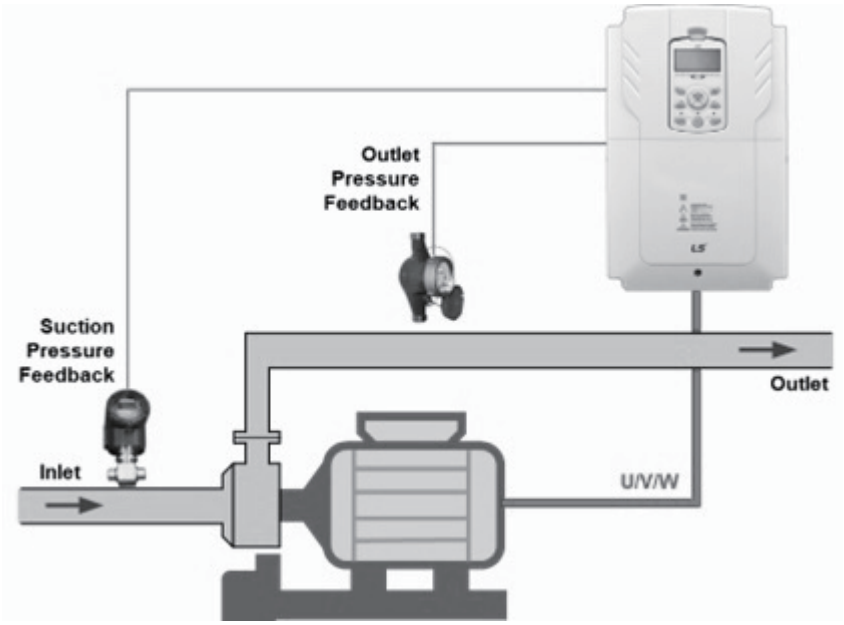
This function allows the Inverter to control the pressure at the outlet when there is not too much vacuum at the input of the pump. When the vacuum at the pump input increases to the PI Aux Setpoint, the vacuum at the input is controlled and the pressure at the outlet drops. The Inverter does not sleep due to vacuum control..

Water Level Control:

This function allows the Inverter to control the pressure at the outlet when there is an adequate amount of water in the well. If the amount of water in the well drops below the PI Aux Setpoint, the Inverter will control the water level in the well and the pressure at the outlet will drop. The Inverter will sleep, wake up, and alarm/fault based on the water level.

Custom Inverse/Direct:

PI Auxiliary Control allows the Inverter to control pressure when the PI Aux level is appropriate. When the PI Aux control level drops to the PI Aux Setpoint value, the Inverter will regulate according to the PI Aux level and pressure will drop.



<Suction control>

PI Auxiliary Control allows the Inverter to control pressure when the PI Aux level is appropriate. When the PI Aux control level drops to the PI Aux Setpoint value, the Inverter will regulate according to the PI Aux level and pressure will drop.

Parameters for PI Auxiliary Control

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP4-1	PI Auxiliary Control Selection (PI Aux Sel)	0 : None 1 : Suction (PSI) 2 : Vacuum (Hg) 3 : Water Lvl (ft) 4 : Custom_Normal 5 : Custom_Inverse	0 : None	Select the control mode for PI Aux control.
AP4-2	PI Auxiliary Control Feedback Unit 100% (PIAuxUnit 100%)	5.0–3000.0 (Unit)	100.0	Set the full scale (20mA) of the pressure transducer connected to the Analog input set in AP4-3.
AP4-3	PI Auxiliary Control feedback Source (PI Aux Fbk Src)	0 : V1 1 : -- Reserved -- 2 : V2 3 : I2 4 : Int 485 5 : FieldBus 6 : -- Reserved -- 7 : Pulse 8 : V3 9 : I3	3. I2	Select the feedback input source for the PI Aux control.
AP4-4	PI Auxiliary Control Setpoint (PIAux Setpoint)	0.0–100.0 (Unit)	20.0	Set the PI Aux Control Setpoint value that the Inverter will attempt to regulate.
AP4-5	PI Auxiliary Control feedback Value Monitor (PIAuxFbk Mon)			Displays the feedback value of the PI Aux control. The units, gain, and scale set in the AP4 group are applied.
AP4-6	PI Auxiliary Control Sleep Level (PIAuxSleep Lev)	0.0–1200.0 (Unit)	10.0	Sets the Sleep Level when PI Auxiliary Control is enabled. The value to be compared is PI Auxiliary feedback. For Suction, Water level and Custom Inverse: If the water level drops below the set value and the time set by AP4-7 continues, it will enter the sleep operation. For Custom_Direct: If the water level rises above the set value and the time set in AP4-7 lasts, it enters sleep operation. For Vacuum control: Disabled
AP4-7	PI Auxiliary Control sleep delay time (PIAux Sleep DT)	0–3600 (sec)	5	Sets the Delay Time for Sleep on PI Auxiliary Control. For Vacuum control: Disabled
AP4-8	PI Auxiliary Control Wake-up Level (PIAuxWake Lev)	0.0–3000.0 (Unit)	30.0	Set the Wake-up Level when PI Auxiliary Control. For Vacuum control: Disabled
AP4-9	PI Auxiliary Control Wake-up delay time (PIAuxWake DT)	0–3600 (sec)	1	Set the Wake-up Delay Time for PI Auxiliary Control. For Vacuum control: Disabled

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP4-10	PI Auxiliary Control Activation Level (PI Aux Act Lev)	0.0–100.0 (Unit)	0.0	When '0', the PI Aux controller is always active. For Suction, Water level and Custom Inverse: If the PI Aux feedback value drops below the corresponding set value and lasts for the AP4-11 set time, the PI Aux controller is activated and affects the output frequency. If the PI Aux feedback value rises above its set value and lasts the AP4-11 set time, the PI Aux controller is disabled and has no effect on the frequency. For Vacuum and Custom_Direct: If the PI Aux feedback rises above its set value and lasts for the AP4-11 set time, the PI Aux controller is enabled and affects the output frequency. If the PI Aux feedback value falls below its set value and remains below its set value for the AP4-11 set time, the PI Aux controller is disabled and has no effect on the frequency. The PI Aux controller is always enabled when its set value is 0.
AP4-11	PI Auxiliary Control Activation / Deactivation Delay (PI Aux Act DT)	0–3600 (sec)	2	Activation/Deactivation settings for PI Aux control Delay value
AP4-12	PI Auxiliary Control minimum speed (PI Aux Min Spd)	0.00–400.00 (Hz)	0.50	Set the minimum speed when the Inverter is under PI Aux control. It operates at the highest value when the Inverter controls the pressure at the outlet or when it is set lower than Pump minimum speed, Thrust freq. and Lo Limit.
AP4-13	PI Auxiliary Control Low Level Detection (Low Lev Detect)	0.0–100.0 (Unit)	0.0	Set the low-level detection value for the PI Aux control.
AP4-14	PI Auxiliary Control Low Level Detection Time (Low Lev Det Tm)	0.0–6000.0 (sec)	0.1	Sets the low-level detection delay time for the PI Aux control.
AP4-15	PI Auxiliary Control Low Level Detection Selection (LowLev Det Sel)	0. None 1. Warning 2. Trip & Coast 3. RST Restart	0 : None	Select the behavior mode on PI Aux control low level detection.
AP4-16	PI Auxiliary Control Low Level Detection Restart Time (Low Lev RST Tm)	0.0–3000.0 (Min)	5.0	Restart Sets the time it takes to restart when set. The number of restarts is equal to [PRT-09 Retry Number].
AP4-17	PI Auxiliary Control High Level Detection (HighLev Detect)	0.0–100.0 (Unit)	0.0	Sets the high-level detection value of PI Aux control.
AP4-18	PI Auxiliary Control High Level Detection Time (HighLev Det Tm)	0.0–6000.0 (sec)	0.1	Sets the high-level detection delay time for PI Aux control.

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP4-19	PI Auxiliary Control High Level Detection Selection (HighLevDet Sel)	0. None 1. Warning 2. Trip & Coast 3. RST Restart	1 : Warning	Select the behavior mode when PI Aux control high level detection.
AP4-20	PI Auxiliary Control High Level Detection Restart Time (HighLevRST Tm)	0.0–3000.0 (Min)	5.0	AP4-19 Set the time to restart when RST Restart is set.
AP4-23	PI Auxiliary Control P Gain (PI Aux P-Gain)	0.00–650.00 (%)	100.00	Set the output ratio for the difference between reference and feedback in the PI Aux controller.
AP4-24	PI Auxiliary Control I Time (PI Aux I-Time)	0.0–200.0 (sec)	2.0	Set the time for the PI Aux controller to output the accumulated error amount.
AP4-25	PI Auxiliary Speed Control Selection (PIAux Spd Ctrl)	0. No 1. Yes	1. Yes	Set whether to let the PI Aux controller affect the output frequency.
AP4-26	PI Auxiliary Control Unit Scale (PIAuxUnitScale)	0 : x 100 1 : x 10 2 : x 1	1 : x 10	Set the scale of the PI Aux Unit.
AP4-27	PI Auxiliary Control Unit sel (PIAux Unit Sel)	0–41	2 : PSI	Set the units to be used by the PI Aux control. When [AP4-01 PI Aux Sel] is set to either {4: Custom_Normal} or {5: Custom_Inverse}, the units for [AP4-02, 04, 05, 06, 08, 10, 13, and 17] is changed.

Multi-function output settings

Setting	Description
OUT-31–36 49: Low lev Detection	When [AP4-5: PI Aux Fbk Mon] falls below [AP4-13: Low Lev Detect], the set digital Output is closed
OUT-31–36 50: High lev Detection	If [AP4-5: PI Aux Fbk Mon] goes up to [AP4-17: High Lev Detect] or higher, the set digital Output is closed

Trips

Trip Indication LCD	Description	Cause	Countermeasures	Auto-restart
Low lev Detection	PI Aux feedback is low	[AP4-5: PI Aux Fbk Mon] falls below [AP4-13: Low Lev Detect],	Check PI Aux feedback, sensor, pipe, valve, and wires.	Set [AP4-15: LowLev Det Sel] to [3. RST Restart].
High lev Detection	PI Aux feedback is high	[AP4-5: PI Aux Fbk Mon] goes up to [AP4-17: High Lev Detect] or higher	Check PI Aux feedback, sensor, pipe, valve, and wires.	Set [AP4-19: HighLevDet Sel] to [3. RST Restart].

Function description

Enabling PI Aux Control:

When an item is selected in AP4-1, PID mode is enabled, and [AP4-25 PIAux Spd Ctrl] is set to Yes, PI Aux control and Pressure control are performed.

Operation direction according to [AP4-01 PI Aux Sel] setting

1. Suction (PSI) → Inverse Acting
2. Vacuum (Hg) → Direct Acting
3. Water Lvl (ft) → Inverse Acting
4. Custom_Direct → Direct Acting
5. Custom_Inverse → Inverse Acting

- Inverse Acting : Alarms and digital outputs operate simultaneously, and trips and digital outputs operate separately.
- Direct Acting : When setting Warning, the digital output is closed below the set level, but no alarm is generated, and a warning is generated only in the trip condition (detection timeout).

When Trip is set, the digital output is closed at the set level or lower, but no alarm is generated, and a trip occurs when the trip condition is satisfied.

Outlet Pressure & PI Aux Pressure Control (When Suction Control is applied)

When the pressure in the suction is adequate, the Inverter regulates the pressure in the outlet with normal PI control. When pressure drops in the suction, the Inverter behaves in one of two ways.

PI Aux Setpoint (AP4-04) ≥ PI Aux Sleep Level (AP4-06)

The Inverter tries to match the pressure in the suction to the PI Aux Setpoint. If the suction pressure (PI Aux Pressure) becomes below the PI Aux Setpoint, the Inverter will reduce the speed to maintain the suction pressure, thereby reducing the pressure and flow rate at the outlet. (If the suction pressure (PI Aux Pressure) is greater than the PI Aux Setpoint, the smaller value becomes the output frequency by comparing the Primary PID output and the Auxiliary PID output).

The responsiveness of the Inverter when adjusting the suction pressure can be adjusted using [AP4-23/24 PI Aux P/I-Gain]. However, if the pressure on the suction side falls below [AP4-06 PIAuxSleep Lev] during the PI Aux Sleep delay time (AP4-7), the Inverter switches to Sleep mode. (Boost operation is not performed.) If the pressure on the suction side rises above the PI Auxiliary Control Wake-up Level (AP4-8) during the PI Aux Wake-up Delay time (AP4-9), it wakes up and resumes normal operation.

PI Aux Setpoint (AP4-04) < PI Aux Sleep Level (AP4-06)

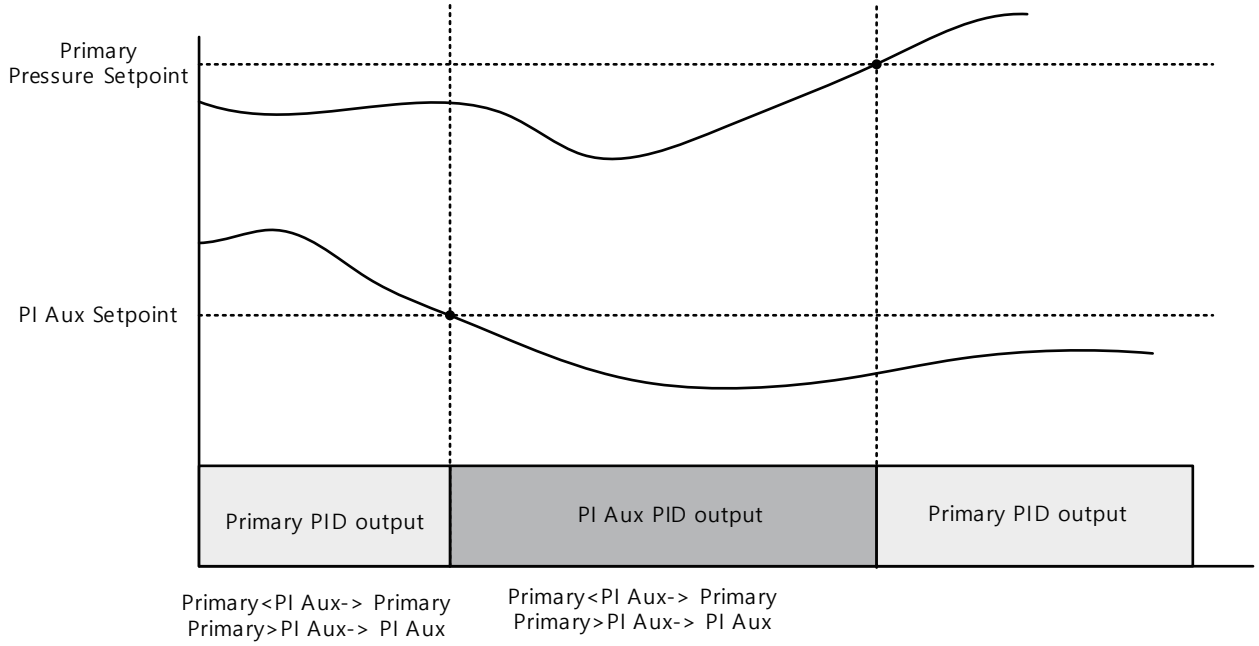
If the pressure on the suction side falls below the PI Aux Sleep Level during the PI Aux Sleep delay time (AP4-7), the Inverter switches to Sleep mode.

If the pressure on the suction side rises above the PI Auxiliary Control Wake-up Level (AP4-8) during the PI Aux Wake-up Delay time (AP4-9), the Inverter will wake up and resume normal operation.

PI Aux Activation Level (AP4-10)

When AP4-10 = 0,

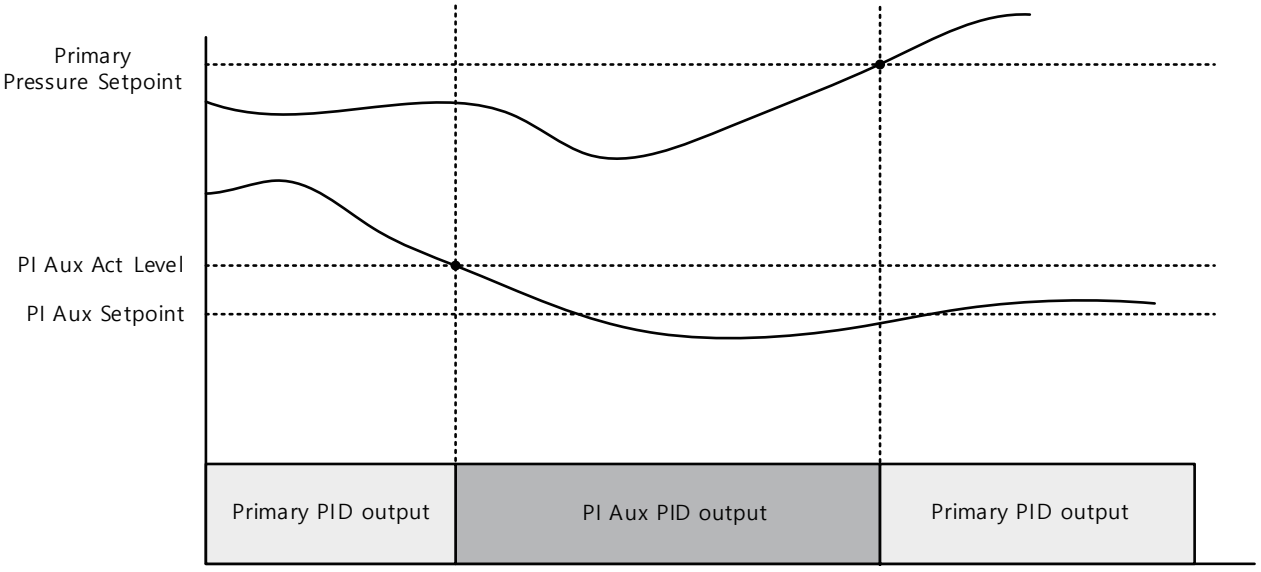
The smaller of the PI Auxiliary Controller output and the primary PID output will be the final output frequency. (In other words, PI Auxiliary Control is always active).



When AP4-10 > 0,

If PI Aux Feedback falls below the level set in [AP4-10 PI Aux Act Lev] for the time set in [AP4-11 PI Aux Act DT], the PI Auxiliary Controller is activated.

Conversely, if the Suction Pressure is greater than [AP4-10 PI Aux Act Lev] for the [AP4-11 PI Aux Act DT] time, the PI Aux Controller is deactivated.



In general, if the Primary Feedback value is below the Setpoint and the PI Aux Feedback is below the PI Aux Setpoint, the output of the PI Aux Control becomes the final output frequency. (Situation where the primary PID output is large, and the PI Aux Control's output is small)

However, if Primary PID output < PI Aux output (Primary Feedback exceeds Setpoint), Primary PID output becomes the final output frequency.

Sleep & Wake-Up Methods:

Inverters enter sleep in one of two ways.

- PI Aux Sleep & Wake-up

Sleep: If the suction pressure becomes below (above) the PI Auxiliary Control Sleep Level during the PI Auxiliary

Wake-up: If the suction pressure becomes PI Auxiliary Control Wake-up Level (AP4-8) or higher (or lower) during Auxiliary Control Wake-up delay time (AP4-9), and the standard wake-up condition is satisfied, it wakes up

- Standard Sleep & Wake-up

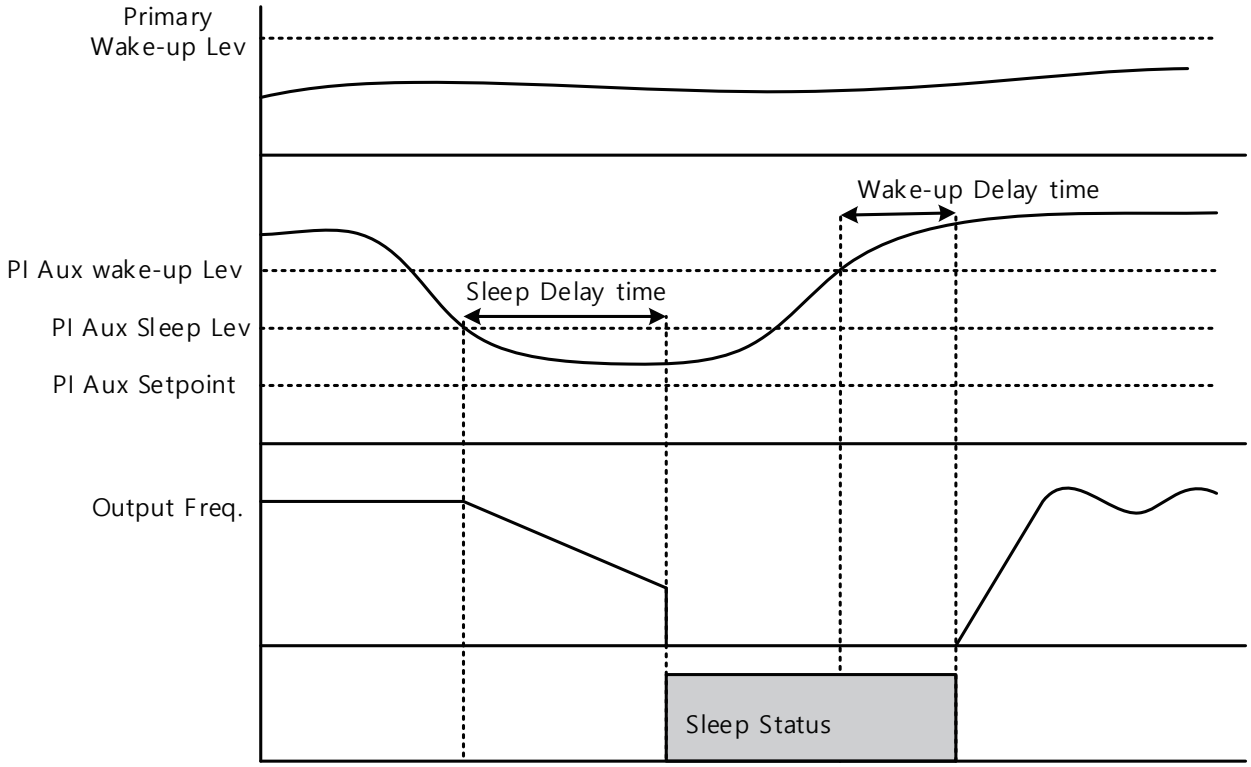
Sleep: The Inverter can enter sleep based on the Standard sleep setting by PID-62, 63, etc. If the Inverter enters standard sleep, the sleep boost (if set) will work.

Wake-up: Both Standard Wake-up condition and PI Aux Wake-up condition must be satisfied to wake up.

PI Aux Sleep & Wake-up Example

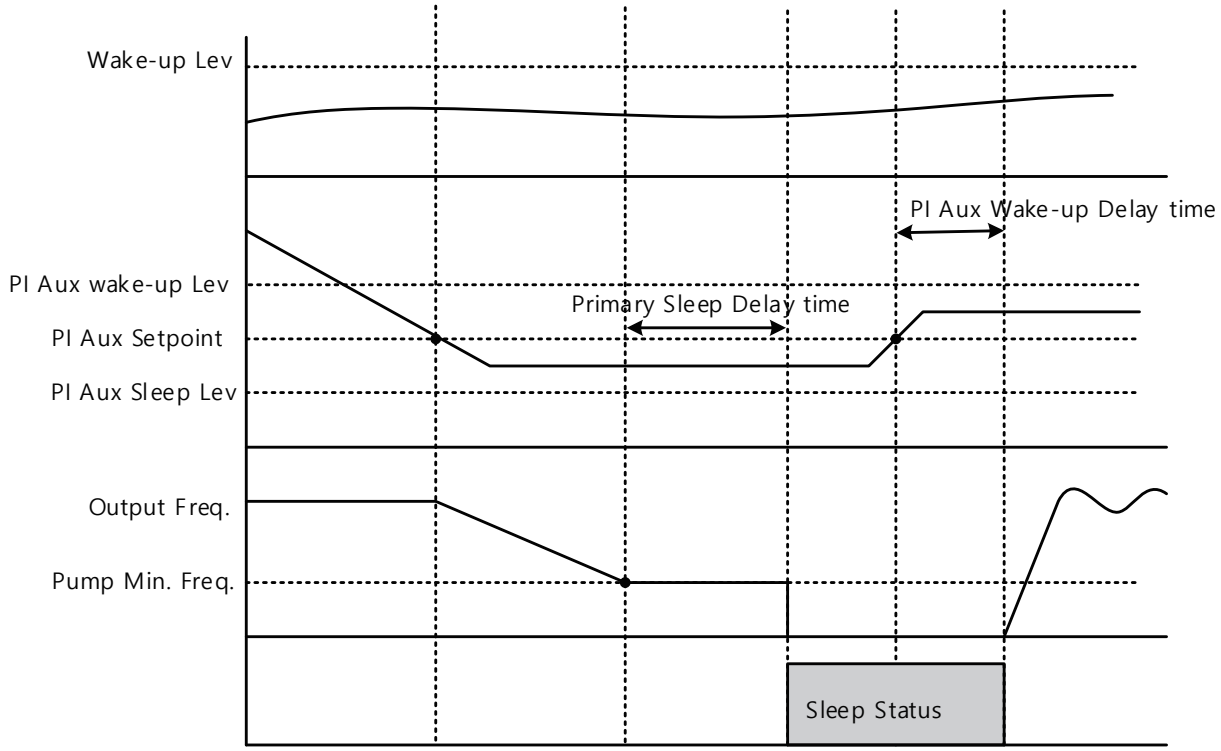
- PI Aux Sleep Level > PI Aux Setpoint

Typical PI Aux Feedback Sleep & Wake-up Behavior



• PI Aux Sleep Level < PI Aux Feedback < PI Aux Setpoint

When PI Aux Feedback is maintained between PI Aux Setpoint and PI Aux Sleep Level, since it is below PI Aux Setpoint, the frequency slows down to reach the minimum frequency and enters sleep when the standard sleep condition (frequency, delay time) is satisfied. If both Standard Wake-up condition and PI Aux Wake-up condition are satisfied, it will wake up.



PI Aux Low Level Detection

To enable PI Aux Low Level Detection, select an action for [AP4-15 LowLev Det Sel] and set a value other than "0" for [AP4-13 Low Lev Detect].

[AP4-15] 0. None:

When PI Aux Feedback falls below AP4-13 level, only Digital Output is closed when "49. Low Lev Detect" is set for OUT 31–36.

[AP4-15] 1. Warning:

Same as None setting, output contacts and "Low Lev Detect" Warning screen are output.

[AP4-15] 2. Trip & Coast:

When the output frequency is greater than 0 and PI Aux Feedback falls below AP4-13 Level, Digital output and Warning are activated immediately. If the PI Aux Feedback remains below the AP4-13 Low Lev Detect level for the AP4-14 Low Lev Det Tm time, the Inverter will disable the Warning and a "Low Lev Detect" Trip will occur.

[AP4-15] 3. RST Restart:

It operates the same as item 2 (Trip & Coast) and Reset Restart after the time set in AP4-16 Low Lev RST Tm. The number of restarts is common to PRT-09.

PI Aux High Level Detection

To enable PI Aux Low Level Detection, select an action in [AP4-19 HighLevDet Sel] and set a value other than "0" in [AP4-17 HighLev Detect].

If PI Aux Feedback goes up to AP4-17 or higher, only Digital Output is closed when "50. HighLev Detect" is set to OUT 31–36.

[AP4-19] 0. None: If PI Aux Feedback goes up to AP4-17 or higher, only Digital Output is closed when "50. HighLev Detect" is set to OUT 31–36.

[AP4-19] 1. Warning: The output contacts and "50. HighLev Detect" Warning screen are displayed as the same as the None setting.

[AP4-19] 2. Trip & Coast: When the output frequency is greater than 0 and PI Aux Feedback rises above AP4-17 Level, Digital output and Warning are activated immediately. If PI Aux Feedback remains above AP4 18 High Lev Detect level for AP4-18 HighLev RST Tm time, the Inverter will trip "High Lev Detect".

[AP4-19] 3. RST Restart: It operates the same as item 2 (Trip & Coast) and Reset Restart after the time set in AP4-20 HighLevRST Tm. The number of restarts is common to PRT-09.

5.14 Over-cycling protection

Over cycle protection is a feature that counts the number of sleep cycles in a set amount of time to prevent frequent sleep/wake-up behavior

If the sleep cycle occurs a set number of times, the Inverter will issue a warning, trip, etc.

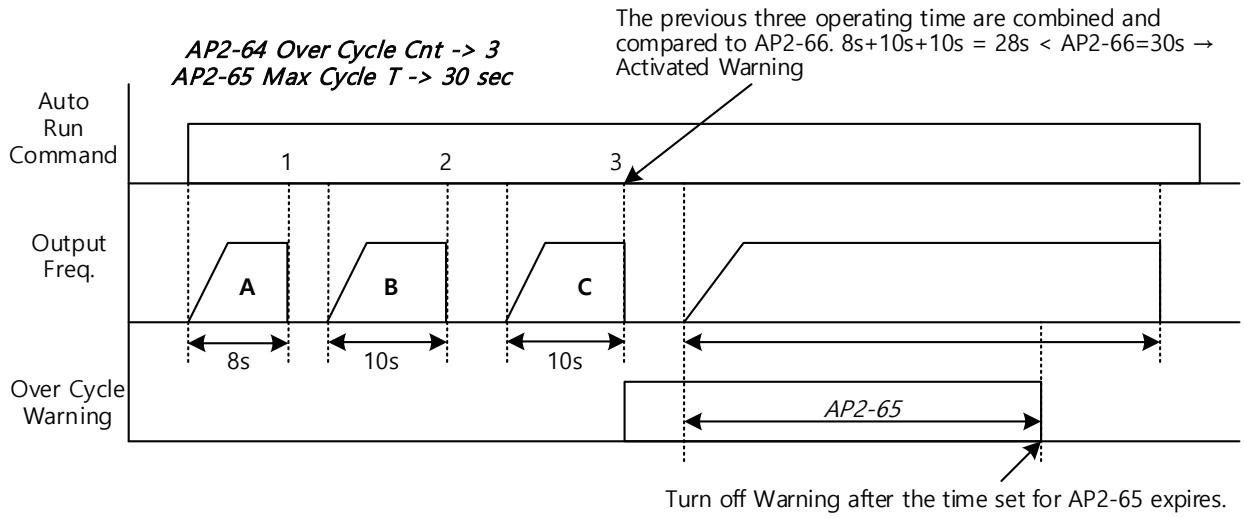
Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP2-65	Maximum allowable number of cycles (Over Cycle Cnt)	0-10	0	The maximum number of cycles allowed within the time specified in AP2-66. One cycle is when the Inverter transitions from normal operation in Auto mode to Sleep mode.
AP2-66	Maximum Cycling Protection Time (Max. Cycle T)	0-3600 (sec)	300	After starting, if the number of cycles set in AP2-65 occurs, the normal operation time before each cycle is summed up, and if the time set in AP2-66 is exceeded, the operation set in AP2-67 is performed.
AP2-67	OverCycle Protection Mode (OverCycle Mode)	0: None 1: Warning 2: Trip & Coast	0: None	Select an action to take when an over cycle occurs.

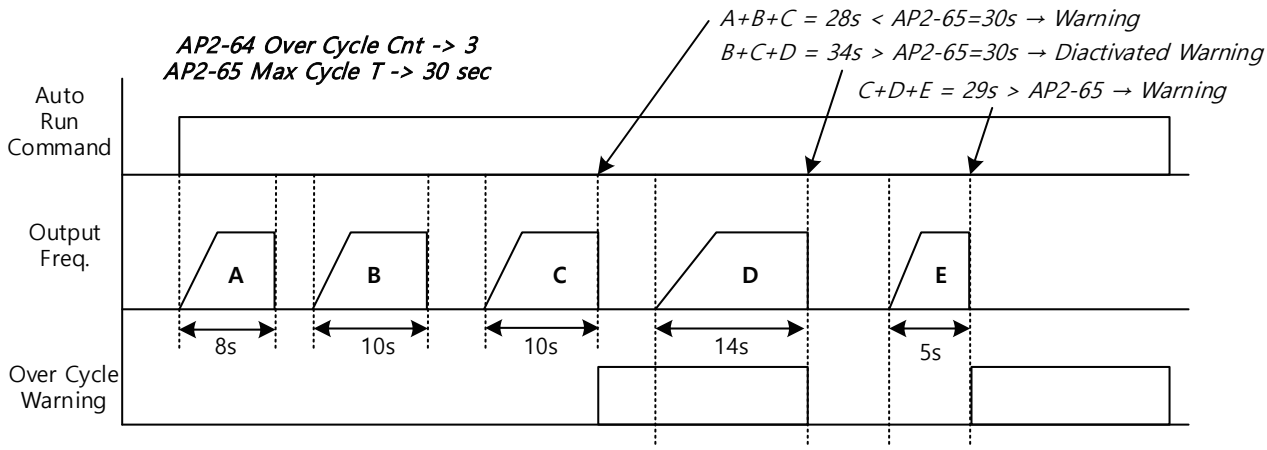
Over Cycle Protection–Warning

The Inverter will clear all timers and counters associated with the pump over cycle when the "Auto" state run command is released.

The first time the Inverter enters Sleep mode after an "Auto" state run command is issued, the cycle counter is incremented. If the "Auto" Run command is maintained, the cycle counter will increment each time the Inverter enters Sleep mode. When the cycle counter reaches the number of times set in AP2-65, the normal operation time of each is summed up and a warning is generated if it is less than the time set in AP2-66.

For example, if AP2-65 is set to 3, when sleep occurs 3 times after startup, the over cycle is determined by summing each normal operation time, and when sleep occurs again after wake-up, the over cycle is determined by summing the last 3 normal operation times, excluding the first normal operation time.



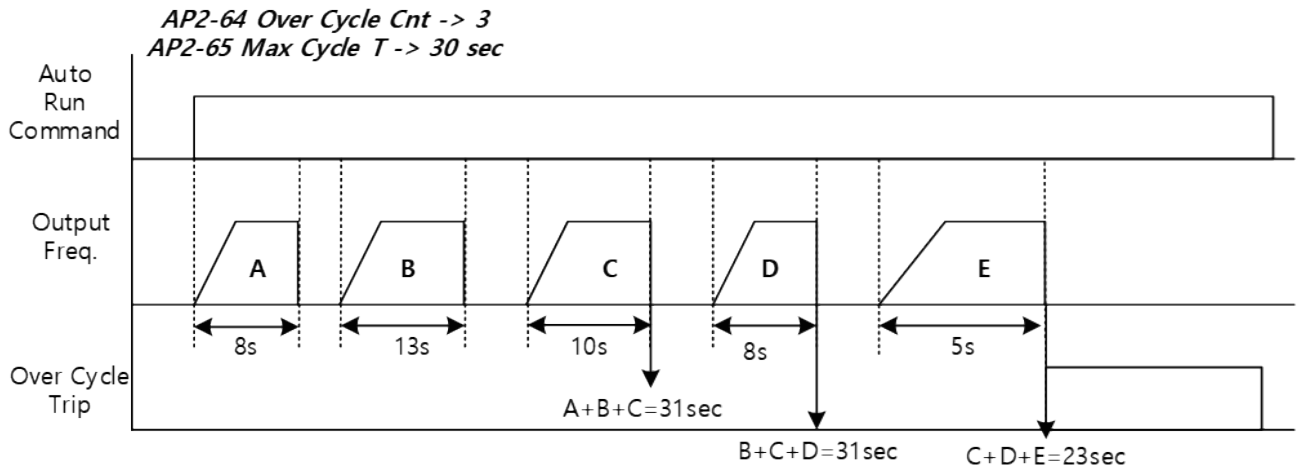


Over Cycle Protection–Trip

The Inverter will clear all timers and counters associated with the pump over cycle when the "Auto" state run command is released.

The first time the Inverter enters Sleep mode after an "Auto" state run command is issued, the cycle counter is incremented. As long as the "Auto" Run command is maintained, the cycle counter will increment each time the Inverter enters Sleep mode. When the cycle counter reaches the number of times set in AP2-65, the normal operating time of each is summed up and a TRIP occurs if it is less than the time set in AP2-66.

For example, if AP2-65 is set to 3, when Sleep occurs 3 times after startup, the normal operating time of each (operating time before each of the 3 Sleep occurrences) is summed up to generate an over cycle trip.



When sleep occurs as many times as set in AP2-65 (ex. 3 times)

5.15 Differential Level Detection

Differential Level Detection detects the pressure difference between the PID feedback and the secondary pressure feedback device. Detects pressure deviation of PID feedback and secondary pressure feedback device and provides Warning / Trip / Digital Output.

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP2-60	Differential Level Detection Mode (Diff Fdb Mode)	0: None 1: Warning 2: Trip & Coast	0 : None	Set for the Inverter response of Differential Detected. 0: None (and Digital Out) 1: Alarm (and Digital Out) 2: Trip & coast stop (Alarm & Digital Out)
AP2-61	Differential Level Detection Source (Diff Fdb Src)	0: V1 2: V2 3: I2 4: Int 485 5: FieldBus 7: Pulse 8: V3 9: I3	2 : V1	Set the input feedback source for Differential Level Detection.
AP2-62	Differential Level Detection Time (Diff Fdb Time)	0.0–1200.0 (sec)	10.0	AP2-60 Sets the time that the difference between the PID feedback and the Secondary feedback must exceed the value of AP2-63 before it behaves as set
AP2-63	Differential Feedback Level (Diff Fdb Level)	0.00–100.00 (Unit)	10.00	Sets the maximum allowed difference between PID feedback and Differential feedback. If the difference exceeds the value set in this parameter for the time set in AP2-62, it will act according to the settings in AP2-60.

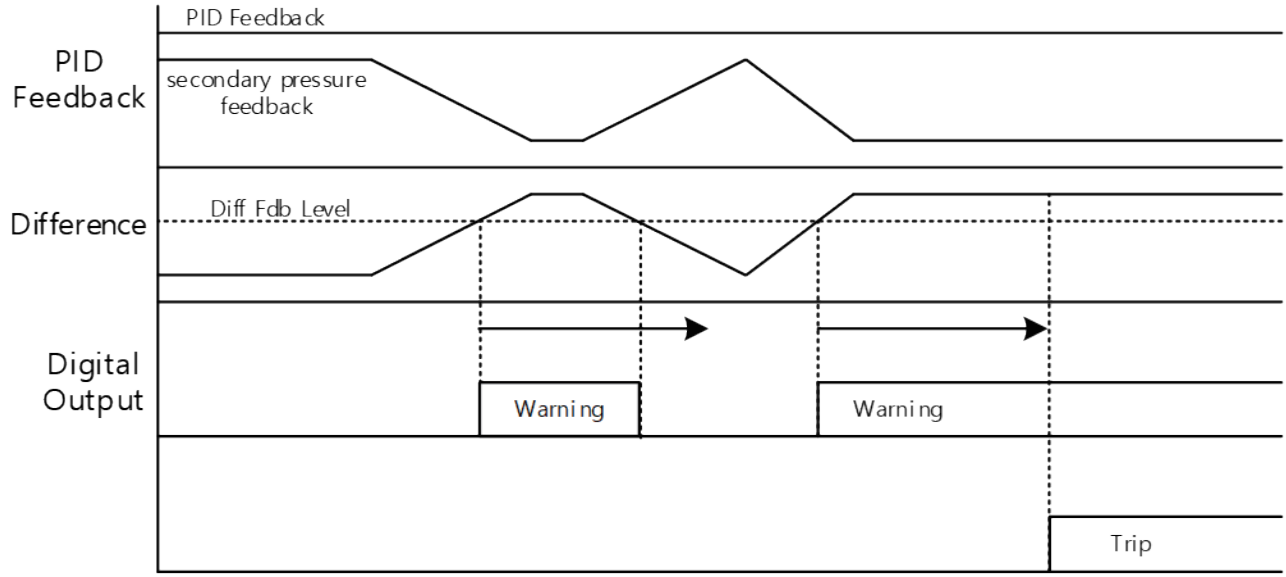
Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP2-64	Differential Feedback Value Monitoring (Diff Fdb Value)			Source Monitoring selected in AP2-61 will follow the Source Monitoring Main PID Scale value selected in AP2-61.

Multi-function output settings

Setting	Description
OUT-31–36 45: Diff Fdb Level	The difference between the PID feedback and the secondary feedback exceeds the level set in [AP2-63: Diff Fdb Level]

Trips

Trip Indication LCD	Description	Cause	Countermeasures	Auto-restart
Diff Fdb Level	The difference between the PID feedback and the secondary feedback exceeds the level set in [AP2-63: Diff Fdb Level]	There is a large difference between the PID feedback and the secondary feedback	Check PID feedback and secondary feedback, sensors, pipes, valves, and wires.	[PRT-8: RST Restart]'s 0 bit turns on.



Differential PI Feedback Detection is enabled when all of the following conditions are met.

- The Inverter is not in the Pump Clean state
- The PID must be running
- The difference between the PID feedback and the secondary feedback exceeds the level set in AP2-63.

Regardless of AP2-60 setting, the digital output set to "Diff Fdb Level" is closed when the difference between PID feedback and Secondary feedback exceeds the level set in AP2-63.

If AP2-60 is set to Warning:

Trigger "Diff Fdb Level" Warning when the above operation condition is satisfied. AP2-60 triggers Trip & Coast:

"Diff Fdb Level" Warning is triggered when the above operation condition is satisfied, and "Diff Fdb Level" Trip is triggered after AP2-62 seconds. The output contact is closed while the "Diff Fdb Level" trip is active.

5.16 Low/High feedback Detection

Detect whether the PID feedback is higher than a set Level or lower than a preset Level.

Parameters for low/high feedback detection

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP2 48 (0x1A30)	High Feedback Mode (High Fdb Mode)	0: None 1: Warning 2: Trip & Coast	0 : None	0: None 1: Alarm (and Digital Out) 2: Trip & coast stop (Alarm & Digital Out)
AP2 49 (0x1A31)	High Feedback Level Fault Delay Time (High Fdb Time)	0.0–1200.0 (sec)	5.0	Sets the amount of time that the high feedback level should be maintained until a high feedback trip occurs.
AP2 50 (0x1A32)	High Feedback Level (High Fdb Level)	- PID Unit Max –+ PID Unit Max	95.0	Set the High Feedback Detection Level
AP2 51 (0x1A33)	Low Feedback Mode (Low Fdb Mode)	0: None 1: Warning 2: Trip & Coast	0: None	0: None 1: Alarm (and Digital Out) 2: Trip & coast stop (Alarm & Digital Out)
AP2 52 (0x1A34)	Low Feedback Level Fault Delay Time (Low Fdb Time)	0.0–120.0 (sec)	10.0	Set how long the low feedback level should be maintained until a low feedback trip occurs
AP2 53 (0x1A35)	Low Feedback Level (Lost Fdb Level)	- PID Unit Max –+ PID Unit Max	0.00	Low Feedback Detection Setting Value
AP2 54 (0x1A36)	Hysteresis Level (Hysteresis Level)	- PID Unit Max –+ PID Unit Max	0.00	Hysteresis Level value to clear the High/Low Feedback state

Multi-function output settings

Setting	Description
OUT-31–36 43: High Fdb Level	The feedback value is higher than the High Feedback Level set in AP2-50
OUT-31–36 44: Low Fdb Level	The feedback value is lower than the Low Feedback Level set in AP2-53
OUT-31–36 53: Pump Trip	Pump Fault Closed when any of the following faults are active: Low Feedback High Feedback Pump Over Cycle SetPnt Timeout

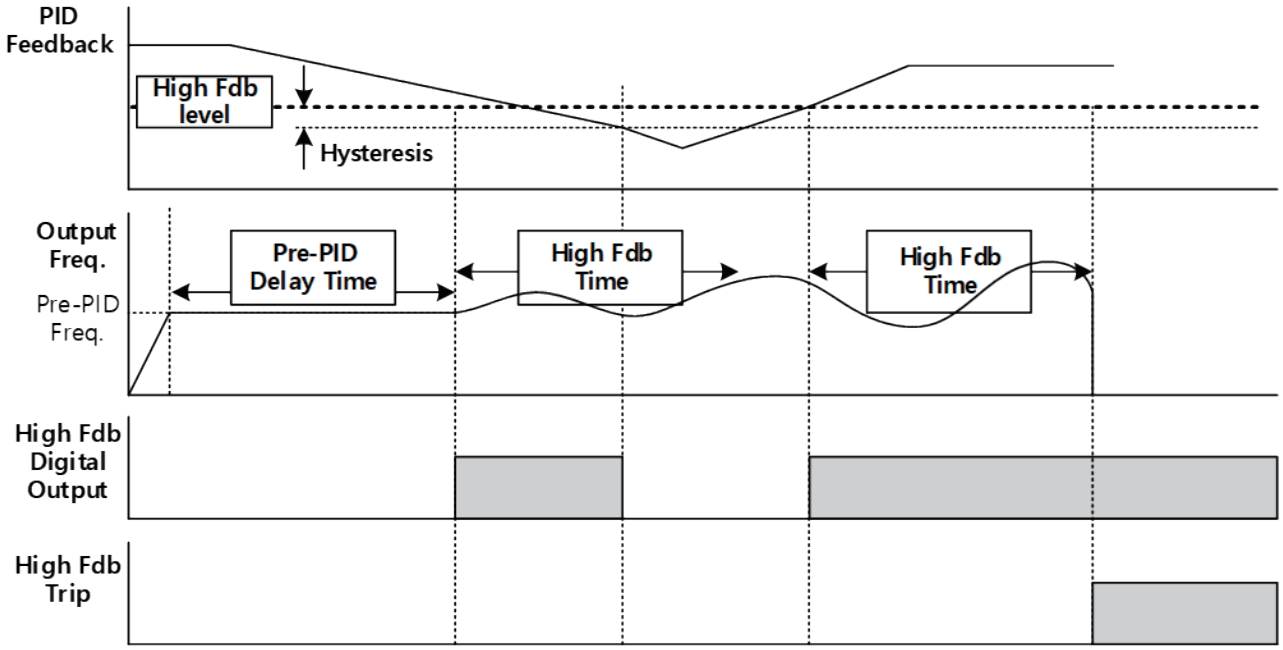
Trips

Trip Indication LCD	Description	Cause	Countermeasures	Auto-restart
High Fdb Level	PID feedback is high	The feedback is higher than [AP2-50: high feedback level]	Check PID feedback and secondary feedback, sensors, pipes, valves, wires	[PRT-8: RST Restart]'s 3bit turns on, Range: 0bit–7bit
Low Fdb Level	PID feedback is low	The feedback is lower than [AP2-53: Low Feedback Level]	Check PID feedback and secondary feedback, sensors, pipes, valves, and wires	[PRT-8: RST Restart]'s 2bit turns on, Range: 0bit–7bit

High Pressure Feedback Detection:

This function is used when the Inverter is in Run state and the AP2-48 setting parameter is in Warning/Free-run state, Warning occurs if the input feedback value is higher than the High Feedback Level set in AP2-50, and Free-run occurs if AP2-48 is {2: Trip & Coast} and lasts as long as the AP2-49 setting time. If it is set to Warning, the input Feedback value must be less than the AP2-50 setting value by AP2-54 Hysteresis Level to cancel it.

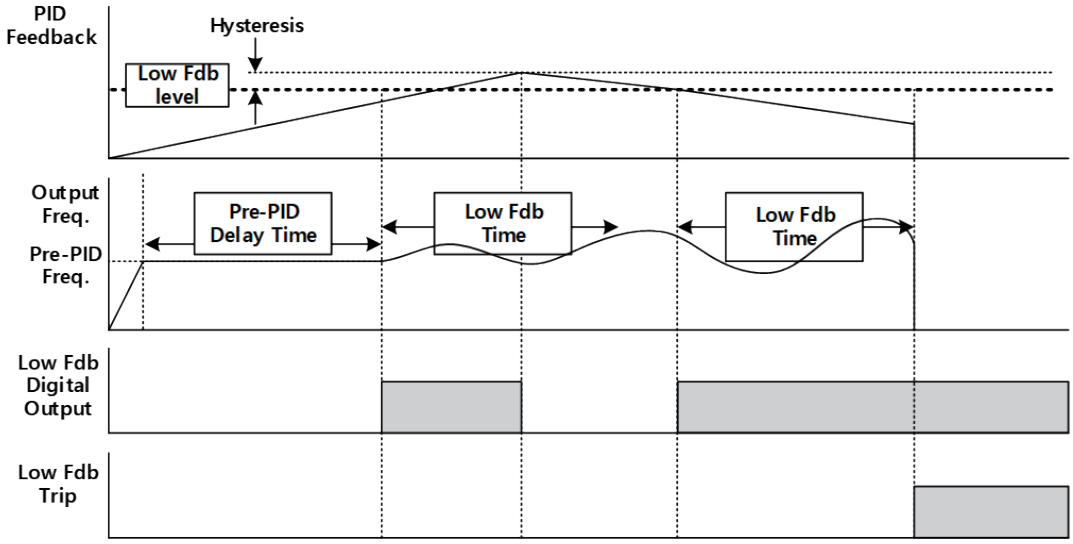
If {Bit2: High Feedback Trip} is set in [PRT-08 RST Restart], Reset Restart is performed when the feedback value is less than the High Feedback Level set in AP2-50.



Low Pressure Feedback Detection:

This function is performed when the Pre-PID and Soft-Fill functions are terminated, the output frequency of the Inverter is above the minimum operating frequency, and the input feedback value is lower than the Lost Feedback Level set in AP2-53 when the AP2-51 setting parameter is in Warning/Free-run state, and a Warning occurs when the AP2-51 is {2:Trip & Coast} and the Free-run lasts for the AP2-52 setting time. If it is set to Warning, the input Feedback value must be higher than AP2-53 setting value by AP2-54 Hysteresis Level to cancel it.

If {Bit1: Low Feedback Trip} is set in [PRT-08 RST Restart], Reset Restart is performed after [PRT-11 Retry Delay] regardless of the feedback value.



5.17 Lost Feedback

Lost feedback is used for the loss of command status in analog feedback source, apart from lost command.

This function is similar to Lost Command, but added for user convenience. Pump users are more familiar with Lost feedback.

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP2-75	Lost Feedback Mode (LostFbkMode)	0: No 1: Warning 2: Trip&Coast 3: Lost Preset	0: No	
AP2-76	Feedback source switch mode (FbkSourceMode)	0: None 1: Ana ▶ Net. Alarm 2: Ana ▶ Net. NoAlarm	0: None	When the feedback source is analog and lost command occurs, the feedback source switches to Network. Alarm can be triggered depending on the setting. (Valid only in Lead Lag systems.)
AP2-77	Lost feedback tolerance (Fbk Tolerance)	0.00-30.00(%)	5.00	Sets the tolerance level for lost command. It is applied as % of the maximum value. For a 4-20mA current input, a 5% setting detects at below 3mA or above 21mA. (20mA * 5% = 1mA)

The common parameters of Lost Command of PRT-14,15,16 are used. In addition, the existing Lost Command does not reset unless the condition is cleared after the trip occurs, but Lost Command and Lost Feedback are trips that occur only in Auto Mode, and the trip is deactivated when switching from Auto to Off state.

5.18 Setpoint Timeout

This function monitors the PID feedback and generates a warning or trip if the feedback deviates too far from the PID Setpoint. This feature can help detect a broken pipe or blocked impeller.

Parameters for low/high feedback detection

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP2-55	Setpoint Timeout Selection (SP Timeout Sel)	0: None 1: Warning 2: Trip & Coast	0: None	Select an action when a setpoint timeout occurs. 0: None 1: Alarm (and Digital Out) 2: Free-run (Alarm & Digital Out)
AP2-56	Setpoint Timeout Delay Time (SP Timeout DT)	0.0–6000.0 (sec)	10.0	Sets the amount of time that the Setpoint Timeout condition must hold for the Setpoint Timeout to occur.
AP2-57	Setpoint Timeout maximum difference level (SP Timeout Lev)	0.00–100.00 (Unit)	0.00	When the Inverter is running, if the difference of the setpoint and feedback exceeds the value set in AP2-56, it will perform in accordance with the set value in AP2-55. Disabled when set to "0". This function is only active when driving in Auto Mode. If Pump mode is selected for Mobus network, it is enabled on the lead drive, but if this trip occurs, all Inverters on thenetwork will stop.

Multi-function output settings

Setting	Description
OUT-31–36 53: Pump Trip	Pump Fault Closed when any of the following faults are active: Low Feedback High Feedback SetPnt Timeout Pump Over Cycle
OUT-31–36 52: Setpnt Timeout	The PID feedback exceeds Setpoint plus [AP2-57: SP Timeout Lev] (Setpoint+Timeover Lev) or falls below Setpoint minus Timeout Lev (Setpoint-Timeover Lev)

Trips

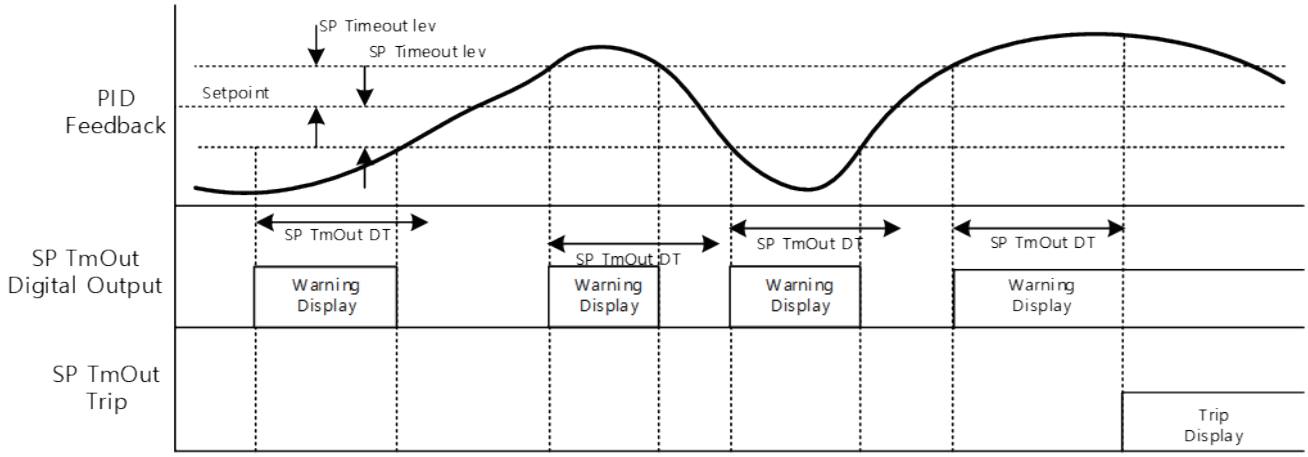
Trip Indication LCD	Description	Cause	Countermeasures	Auto-restart
SetPnt Timeout	The PID feedback exceeds Setpoint	There is a large difference between the PID feedback and the Setpont	Check PID feedback, sensors, pipes, valves, and wires	[PRT-8: RST Restart]'s 4bit turns on, Range: 0bit–7bit

SetPnt Timeout is enabled when the following conditions are met: (all must be true)

- The Inverter is in PID operation.
- The Inverter is not in pre-PID Mode.
- The Inverter is not in hand mode.
- The Inverter is not in Sleep state.
- When the Inverter is not in Pump clean state
- AP2-55 When SP Timeout lev > 0

If set to Warning, if the PID feedback exceeds Setpoint plus AP2-57 SP Timeout Lev (Setpoint+Timeover Lev) or falls below Setpoint minus Timeover Lev (Setpoint-Timeover Lev), the digital output is closed with "SetPnt Timeout" warning displayed on the keypad. When the PID feedback returns to within the Timeout Level, the keypad indication will disappear, and the digital output will open immediately.

If set to Trip, if the PID feedback exceeds Setpoint plus AP2-57 SP Timeout Lev (Setpoint+Timeover Lev) or falls below Setpoint minus Timeout Lev (Setpoint-Timeover Lev), the keypad will display "SetPnt Timeout" Warning and the digital output will be closed. If the PID feedback returns to within the Timeout Level before the AP2-56 time expires, the Keypad indication disappears, the Digital Output is immediately opened, and the Timer is initialized. However, if the Setpoint Timeout state lasts longer than AP2-56, it will stop due to the "SetPnt Timeout" trip. The digital output will remain closed until the "SetPnt Timeout" trip is reset.



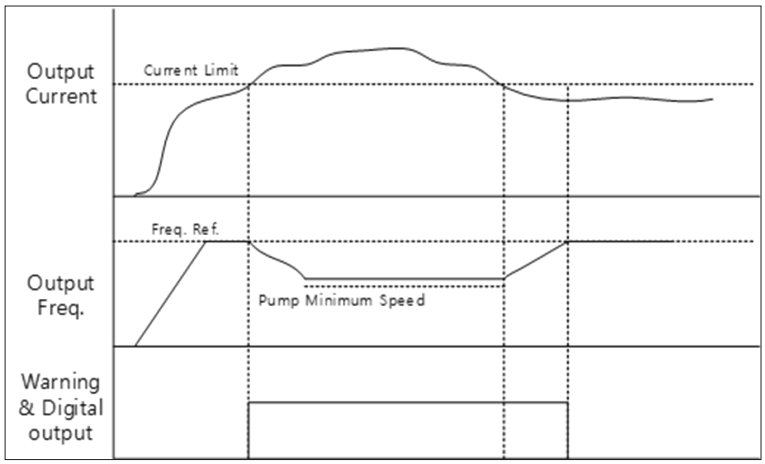
5.19 Current Limit

Performs the function of reverting to a value lower than the set current value during the operation to prevent over current. This feature is only applicable if the load is variable torque. That is, it only works with loads that increase current as speed increases.

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
AP2-70	Output Current limit control select (Curr Lim Sel)	0: No 1: Yes	0 : No	Select whether to enable Current Limit
AP2-71	Output Current limit level (Current Limit)	0.0–1000.0 (A)	0.0	Set the current limit value
AP2-72	Current Limit Control Proportional Gain (CurrLim P-gain)	0.00–300.00 (%)	100.00	Sets the responsiveness by the P-gain of the current limit regulator. Higher = more responsive
AP2-73	Current Limit Control Integration Time (CurrLim I-time)	0.0–200.0 (sec)	2.0	Set responsiveness to the I-time of the current limit regulator. Lower = more responsive.
AP2-74	Current Limit Control Filter Time (CurrLim Filter)	0.00–10.00 (sec)	1.00	Primary filter time used to control the Current Limit

The Inverter attempts to limit the output current by reducing the frequency reference. The current limit setpoint is determined by AP2-71. In practice, when the current of the motor is greater than the setpoint, the output frequency is reduced by the PI controller. The output frequency is lower-limit by the highest value of AP2-40 thrust Frequency, PID-56 (Pump Min Speed) and ADV-24 (Freq Limit Lo).

- Only works while PID is running.
- (PID controller's output) > (Current limit controller's output).
- Exit if (PID controller output) <= (Current limit controller output).
- Reduces output frequency to provide an overall output current limit.
- Used to prevent overload conditions for long periods of time.
- Reduces the output frequency up to the pump minimum speed +1Hz (internal fixed value).
- When the pump minimum speed is the sleep frequency, +1.00Hz is used as an internal fixed value to prevent sleep by the current limit function.
- If the output frequency is reduced due to the current limit, it is signaled as Digital output.



5.20 Backspin Timer

This function restricts operation for a specified period of time when the Inverter stops/trips.

For the purpose of pump protection, if the pump has a large total head, the operation signal is prohibited for the time it takes for the accumulated flow to be completely discharged.

If the value of Timer is set, it outputs a warning message for the specified time and ignores all signals from Run, Run after forced trip, and Reset Restart.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range		Unit
PRT	01	Backspin Timer	Backspin Time	0.0		0.0–6000.0		Sec Min Hour
	05	Backspin Timer memory Selection1	BackspinT save	1	Yes	-		-
	06	Backspin Timer Unit2	Backspin Unit	0	Sec	0	Sec	-
						1	Min	
						2	Hour	

*1,2: PRT-05, 06 is available from Drive Software Version <SW602.01_D00.00_C602.01> or greater.

Backspin timer Function Setting Details

Code	Description
PRT-01 Backspin Time	When Run command is removed or Trip occurs, "Backspin Time" Warning displays for a set time, and the inverter cannot operate even if the run command is re-issued. While the "Backspin Timer" is in operation, the time remaining until "Backes is displayed.
PRT-05 BackspinT save	Selects if the Backspin Timer is saved to the EEPROM during power loss.

Setting		Function
0	No	When the Backspin Timer memory (PRT-05) is set to 0 (No), the Backspin Timer is never saved during power loss. When the drive power is restored, the Backspin Timer would be reset.
1	Yes	When Backspin Timer is in operation, the inverter will continue counting the timer without resetting, even after power loss.

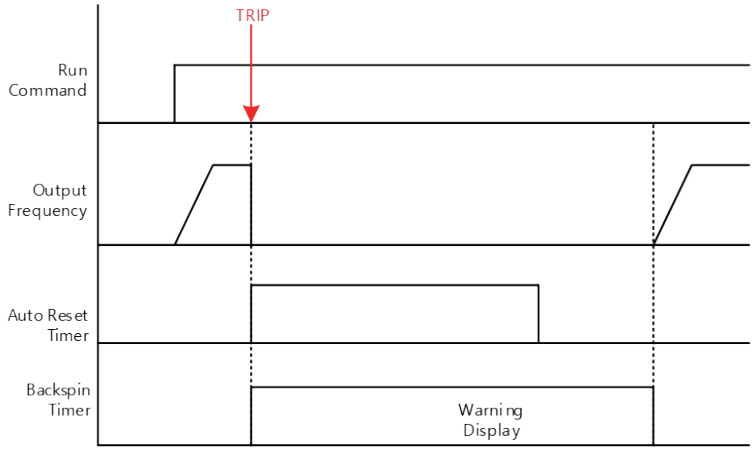
PRT-06 Backspin Unit	0: sec, 1: Min, 2: Hour

When the value of [PRT-01 Backspin Time] is "0.0", the function is disabled.

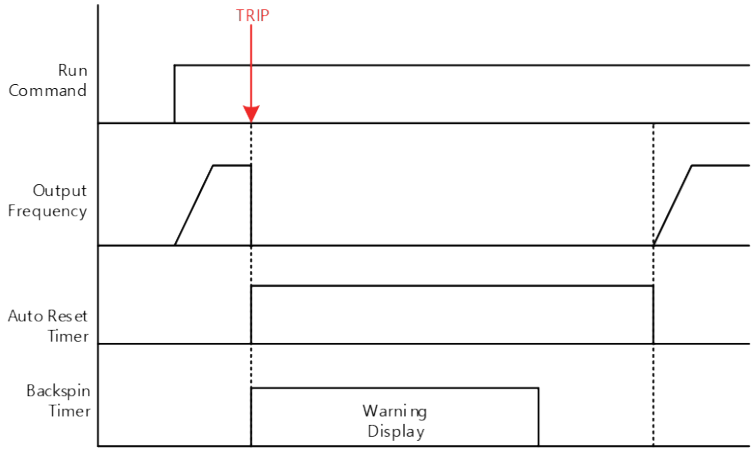
If the output frequency becomes "0" when stopped by a stop command or trip, operation is prohibited for the [PRT-01 Backspin Time] time and a warning called "Backspin Time" occurs. If the operation command is re-entered during a deceleration stop, operation is performed immediately without applying the PRT-01 Backspin Time time.

After the [PRT-01 Backspin Time] time, the vehicle is automatically restarted according to the setting status of [PRT-08 RST Restart] / [PRT-09 Retry Number] / [PRT-11 Retry Delay].

Sleep function for PID will not operates while Backspin timer is in operation.



<Sleep level type: Current>



<Sleep level type: Current>

Backspin Timer memory selection Setting Details

When the [PRT-05 BackspinT save] is set to "0. No", the Backspin Timer is not saved during power loss. When the drive power is restored, the drive will reset the Backspin Timer and the VFD will be allowed to run.

When the [PRT-05 BackspinT save] is set to "1. Yes" and the battery for RTC is enabled, the inverter will utilize the backspin time and subtract the time elapsed during the power outage when power is restored.

Note

When PRT05 is set to "1. Yes" and the battery for RTC is not enabled, the inverter will add the remaining time before power-loss occurred to the backspin time when power is restored. For example, if the power loss time is 10 minutes, 10 minutes will be added to the set backspin time.

5.21 Damper Operation

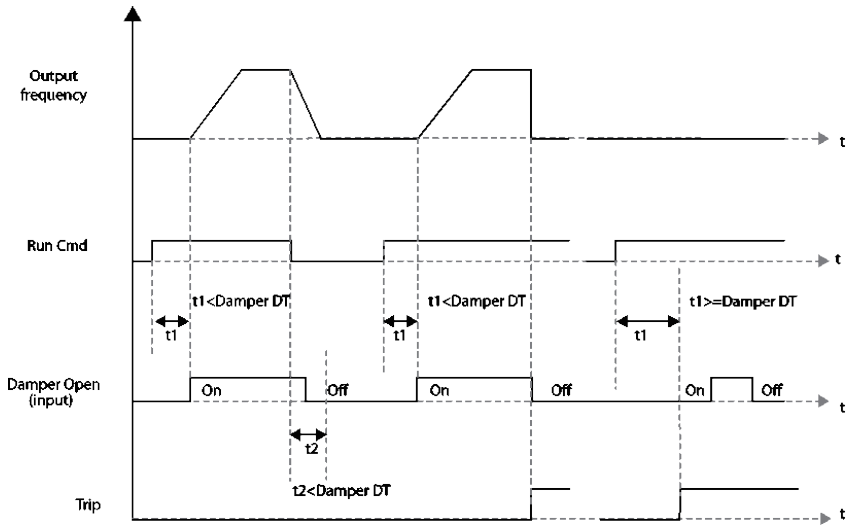
A damper is a device that controls the flow in a ventilation system. If a fan and a damper are used together in a system, the inverter may be configured to operate according to the damper's operation status. During a damper operation, one of the relay outputs OUT-31–35 (Relay 1–5) may be set to '33 (Damper Control)' to output a signal based on the damper's operation status. One of the multi-function terminal inputs (IN-65–71) may also be set to '37 (Damper Open)' to receive the damper status input. The inverter starts operating when both the run command and the damper open signal are turned on (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 AP2-43 (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 AP2-43 (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	43	Damper check time	Damper DT	-	0.1–600.0	sec
IN	65-71	P1–7 Px terminal configuration	P1–P7 Define	37 (Damper open)	-	-
OUT	31-35	Multi-function relay 1–5	Relay 1–5	33 (Damper Control)	-	-

Damper Operation Setting Details

Code	Description
AP2-43 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 AP2-43 elapses.
IN-65–71 P1–7 define	Sets one of the multi-functional terminals to '37 (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.

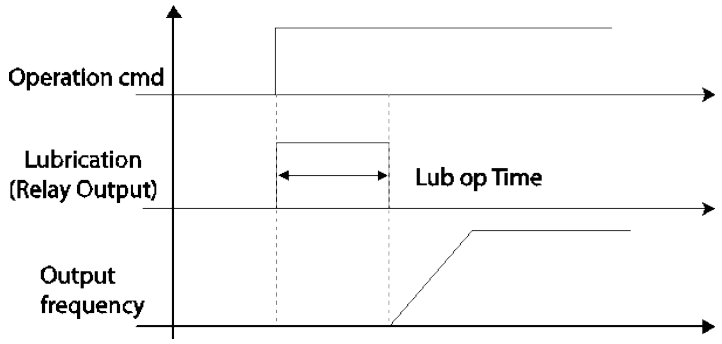
5.22 Lubrication Operation

During a lubrication operation, 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	44	Lubrication operation time	Lub Op Time	5.0	0.1–600.0	(sec)
OUT	31-35	Multi-function relay 1–5	Relay 1–5	30 (Lubrication)	-	-

Lubrication Operation Setting Details

Code	Description
AP2-44 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 AP2-44 (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.

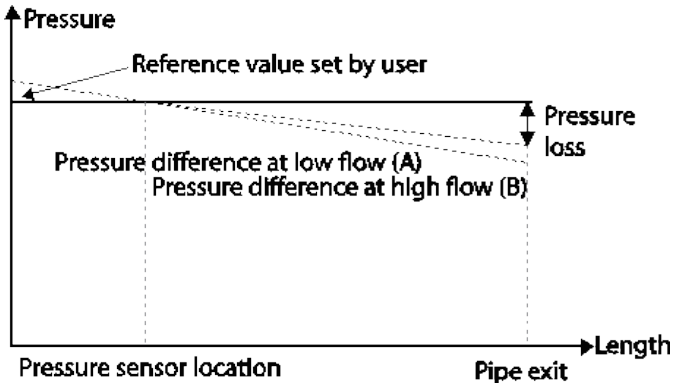
5.23 Flow Compensation

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 volume 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 volume. This function is based on a PID operation. The volume is given the same unit used for the PID reference.

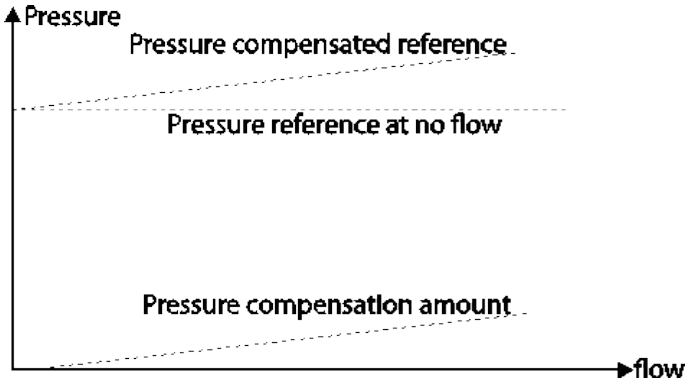


Longer pipes cause the actual pressure to decrease, which in turn increases the difference between the pressure reference and the actual pressure. When the pipe lengths are equal in two different systems, more pressure loss is caused in the system with greater flow. This explains the pressure difference between (A) and (B) in the figure (when the flows are different). To compensate for the pressure loss above, the value of AP1-31 is set to the maximum volume of compensation when the inverter has the maximum frequency, and adds to the PID reference after calculating compensation volume based on the output frequency.

The final PID reference=PID-11+Compensation amount, and 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

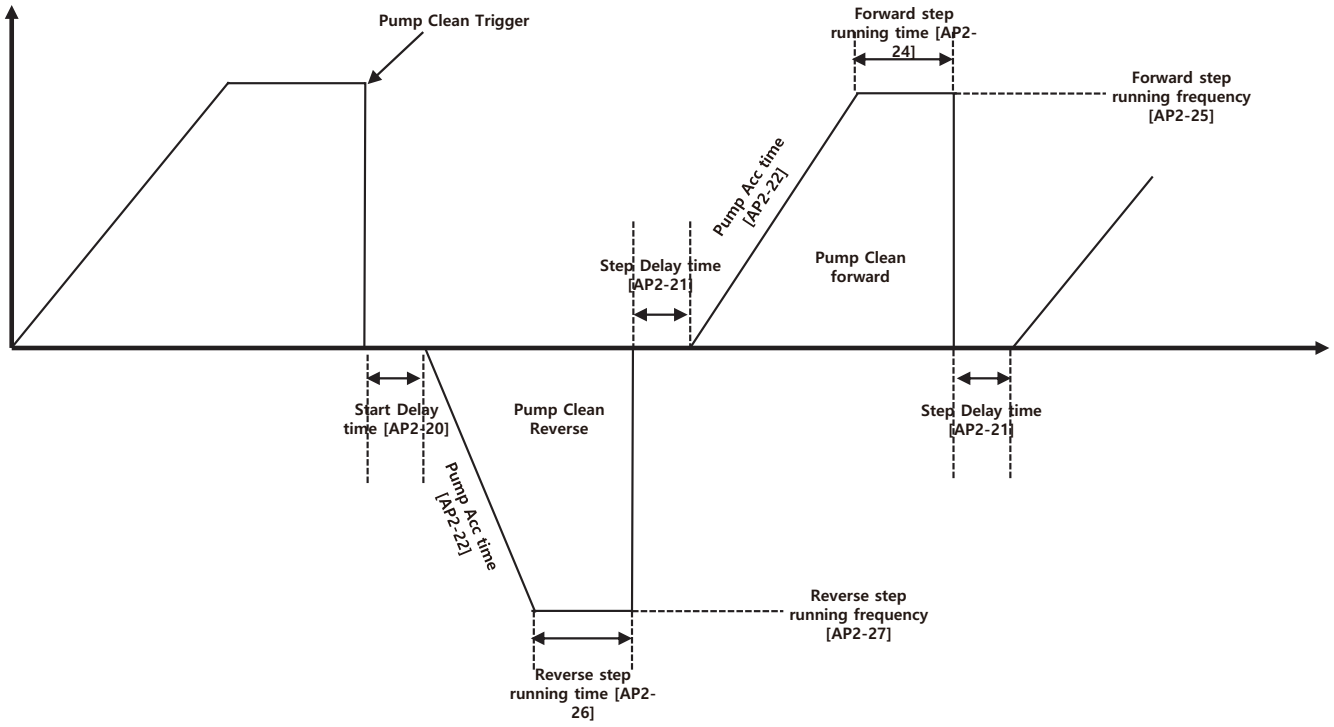


5.24 Pump Clean Operation

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	100.0	100.0–200.0		%
	18	Pump clean reference band	PC Curve Band	5.0	0.0–100.0		%
	19	Pump clean operation delay time	PC Curve DT	60.0	0–6000.0		sec
	20	Pump clean start delay time	PC Start DT	10.00	0.0–600.00		Sec
	21	0 speed operating time at Fx/Rx switching	PC Step DT	5.00	0.1–600.00		Sec
	22	Pump clean Acc time	PC Acc Time	10.0	0.0–600.0		Sec
	23	Pump clean Dec time	PC Dec Time	10.0	0.0–600.0		Sec
	24	Forward step run time	Fwd Steady T	10.00	0.0–60.00		Sec
	25	Forward step run frequency	Fwd SteadyFreq	30.00	0.00, Low Freq– High Freq		Hz
	26	Reverse step run time	Rev Steady T	10.00	0.0–60.00		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	2	0–10		-
	29	Pump clean cycle monitoring	Repeat Num Mon	-	-		-
	30	Pump clean repeat number	Repeat Num Set	2	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		-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP2	34	Pump clean count	Pump Clean Cnt	0	0–65535		-
	35	Pump clean Exit mode	PC Exit Mode	0: No	0	No	-
					1	Yes	
	36	Pump clean stop mode	PC Stop Mode	2: Coast Stop	0	Dec	-
					1	DC Brake	
					2	Coast Stop	
					4	Power Braking	



<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 reverse and forward 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 reverse direction and another step in the forward 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>Description</th></tr>
<tr><td>AP2-15 PumpClean Mode</td><td>Sets the pump mode.
<table>
<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>Output 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>Output 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>
</table></td></tr>
<tr><td>AP2-16 PumpClean Sel</td><td>Sets the pump clean start mode.
<table>
<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>
</table></td></tr>
<tr><td>AP2-17 PC Curve Rate
AP2-18 PC Curve Band
AP2-19 PC Curve DT</td><td>If AP2-15 is set to either 'Output Power' or 'Outpur Current', the load curve's chracteristic to operate pump clean function is re-calibrated by multiplying the set values in AP2-2 –AP2-10 and AP2-17 * (100[%]+AP2-17[%]).
Refer to Load Tune function for AP2-2–AP2-10 function details.
The set value of AP2-18 is indivisually multiplied to the rated motor power and rated inverter current, and those calculated values are added on the base pump clean curve made by AP2-17 for the final curve.
When the inverter is operating more than the time set in AP2-19, the inverter performs pump clean operation</td></tr>
<tr><td>AP2-20 Clean Start DT</td><td>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>Sets the time for the inverter to maintain 0 speed (stop) before the inverter switches from forward to reverse operation during a pump clean.</td></tr>
<tr><td>AP2-22 PumpClean AccT
AP2-23 PumpClean DecT</td><td>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>Sets the time to maintain forward and reverse operations.</td></tr>
<tr><td>AP2-25 Fwd SteadyFreq
AP2-27 Rev SteadyFreq</td><td>Sets the forward and reverse operation frequencies.</td></tr>
<tr><td>AP2-28 PC Num of Steps</td><td>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>
<tr><td>AP2-31 PC End Mode</td><td>Determines the inverter operation after pump clean operation.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></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>
</table>

Code	Description
AP2-29 Repeat Num Mon	Displays the number of the current pump cleaning cycle.
AP2-30 Repeat Num Set	Sets the number of cycles for one pump clean operation set at AP2-21–AP2-28.
AP2-32 PC Limit Time AP2-33 PC Limit Num	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.
AP2-34	Pump clean count: Displays the total number of pump clean operations. It is not automatically reset, and to reset, you must initialize the number by entering "0" in the corresponding parameter.
AP2-35	When the reverse pump clean step is operated, the Pump Clean operation level (Power/Current) is detected, and the corresponding step is stopped and changed to the next step.
AP2-36	Sets the stopping method of the pump clean step.

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 key 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.

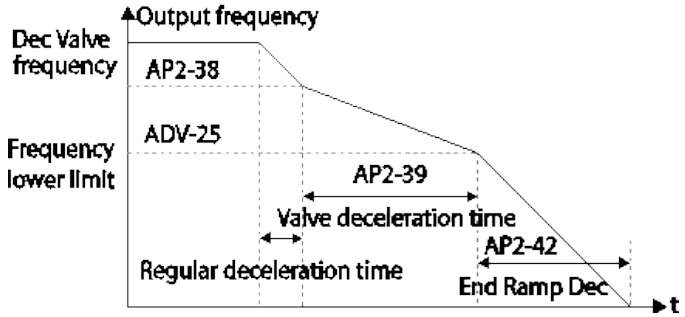
5.25 Decelerating Valve Ramping

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

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)'.

Deceleration Valve Ramping Setting Details

Code	Description
AP2-38 Dec Valve 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.

5.26 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 (DRV-18 Base Freq) by default. The load tuning result values are saved at codes AP2-2–AP2-10. These values are user definable as well.

The minimum set point for the load tuning begins at 15% of the base frequency (DRV-18 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

Code	Description
AP2-01 Load Tune	The inverter performs an automatic tuning to generate an ideal system load curve. Setting: 0 None — Load tuning is not used. Setting: 1 Load Tune — Start load tuning.
AP2-02 Load Fit LFreq	Defines the first frequency set point for load tuning (user definable).
AP2-03 Load Fit LCurr AP2-04 Load Fit LPwr	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.
AP2-08 Load fit HFreq	Defines the second frequency set point for load tuning(user definable).
AP2-09 Load Fit HCurr AP2-10 Load Fit HPwr	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.
AP2-11 Load Curve Cur AP2-12 Load Curve PWR	Monitors the load curve value set at AP2-1 (Load Tune) based on the current output frequency.

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.

5.27 Level Detection

When the inverter is operating at or above the frequency set at PRT-74 (LDT Level), this function is used to triggers a fault trip or sets 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 trip is released.

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

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
PRT	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

Level Detection Setting Details

PRT-70 LDT Sel — Determines the inverter operation when a level detection trip occurs.

Setting		Functions
0	None	No operation
1	Warning	The inverter displays a warning message.
2	Trip&Coast	The inverter free-runs, then stops.
3	Decel stop	The inverter decelerates, then stops.
4	RST Restart	The inverter free-runs and reset the trip & re-start operation.

PRT-71 Level Detect — Sets the level detection range.

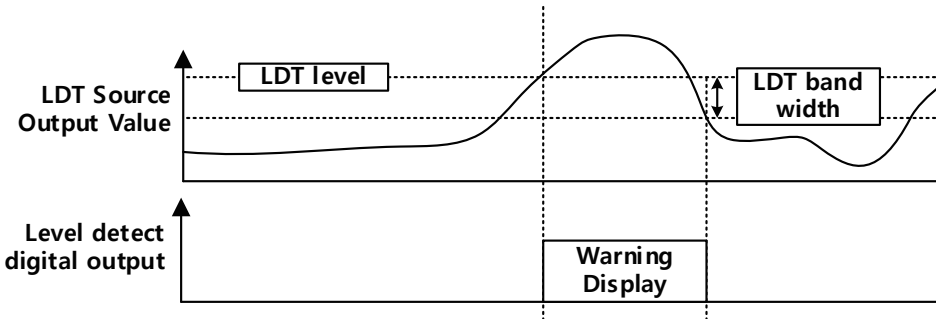
Setting		Operation
1	Below	Triggers a level detect fault trip when the inverter operates below the frequency set by the user.
2	Above	Triggers a level detect fault trip when the inverter operates above the frequency set by the user.

PRT-72 LDT Source — Selects a source for level detection.

Setting		Function
0	Output Current	Sets the output current as the source.
1	DC Link Voltage	Sets the DC link voltage as the source.
2	Output Voltage	Sets the output voltage as the source.
3	kW	Sets the output power as the source.
4	hp	Sets the output power as the source.
5	V1	Sets the V1 terminal input as the source.
6	V2	Sets the V2 terminal input as the source.
7	I2	Sets the I2 terminal input as the source.
8	Setpoint value	Sets the PID setpoint as the source.
9	Feedback value	Sets the PID feedback as the source.
10	Output torque	Sets the torque as the source.
11	V3	Sets the V3 terminal input as the source.
12	I3	Sets the I3 terminal input as the source.

PRT-73 LDT Dly Time — Sets the delay time for the operation set at PRT-70.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-74 LDT Level</td><td>Sets the level 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 (2 Type)
0–900 V (4 Type)</td></tr>
<tr><td>Output Voltage</td><td>230
460</td><td>0–250 (2 Type)
0–500 (4 Type)</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>Setpoint value</td><td>50</td><td>PID Unit Min–PID Unit Max</td></tr>
<tr><td>Feedback value</td><td>50</td><td>PID Unit Min–PID Unit Max</td></tr>
<tr><td>Output torque</td><td>50</td><td>-1000.00%–1000.0%</td></tr>
<tr><td>V3</td><td>9.00</td><td>-12.00–12.00</td></tr>
<tr><td>I3</td><td>18.00</td><td>0.00–25.00</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 trip.
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 trip.
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-70 (RST restart) is set to ‘RST restart,’ the inverter restarts after the time set at PRT-73 elapses when an LDT trip is released. The LDT Restart operates each time an LDT trip is released.
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 released. However, the inverter stays in OFF mode and does not restart the operation instantly.</td></tr>
<tr><td>OUT-31–35 Relay 1–5</td><td>Sets one of the output relays to ‘32 (Level Detect)’ to monitor the level detection status.</td></tr>
</table>



<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 and the detection value is greater than the value of PRT-74. The LDT operation is released if the value is less than the value subtracted from the value of band of, when the value of the feedback is set from PRT-74 to PRT-75.

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.

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.

If PRT-72 LDT source is set to "output current", "kW", or "output torque", LCD keypad will display "Loss Of Prime" when level detection condition is met. It is to help users to distinguish the current level detection source from other ones.

5.28 Pipe Break Detection

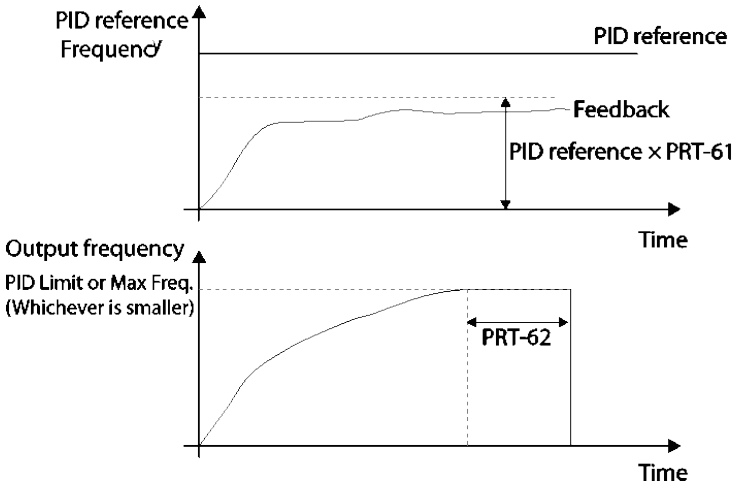
This function detects Pipe Breaks while the PID operation is on. The fault trip or a warning signal will occur if the feedback does not reach the level set by users during the operation with the maximum output (PID maximum output or the maximum speed set).

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
PRT	60	Pipe Break Detection setting	PipeBroken Sel	0	0	None	
					1	Warning	
					2	Trip & Coast	
					3	Decel Stop	
	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 while detecting Pipe Breaks
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.
OUT31–36 Define	If Pipe Break (28) is set, when a Pipe Break occurs, the inverter sends out output with Relay.

Setting		Function
0	None	No operation
1	Warning	The inverter displays a warning message.
2	Trip & Coast	The inverter free-runs, then stops.
3	Decel Stop	The inverter decelerates, then stops.



In the graph above, Pipe Break 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 DRV-20).

5.29 Pre-heating Function

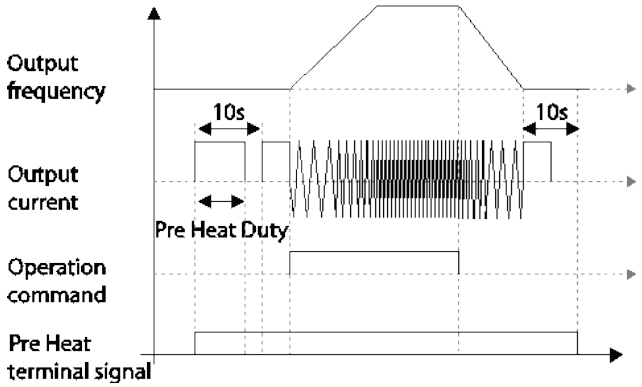
This function uses current to heat up the motor or pump to avoid the motor or the pump freezing when not in operation.

Group	Code	Name	LCD Display	Settings		Setting Range	Unit
IN	65-71	Terminal block input 1-7	P1-7 Define	36	Pre Heat	0–51	-
AP2	45	Initial heating output current Level	Pre Heat Level	20		1–100	%
	46	Initial heating output duty	Pre Heat Duty	30		1 - 100	%
	47	DC input delay time	DC Inj Delay T	60.0		0.0–600.0	sec

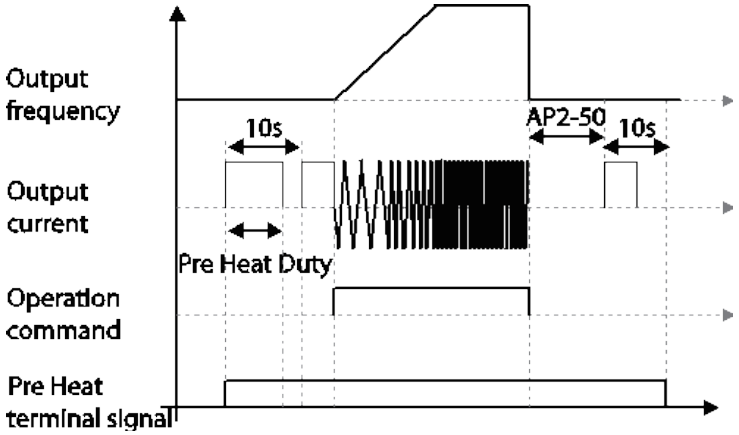
Initial Heating Setting Details

Code	Description
IN-65–71 P1–7 Define	Performs the Pre Heat function if the Pre Heat (36) terminal is set. After setting this, AP2-45 and 46 will be appeared.
AP2-45 Pre Heat Curr	Sets the current to be used for initial heating. Sets the current to motor no-load current % value.
AP2-46 Pre Heat Duty	Sets the duty (time) for the current to be used for initial heating, from 10 seconds to % value.
AP2-47 DC Inj Delay T	Sets a certain delay time to prevent from an over current trip that may occur when a DC input is performed after the inverter Coast to stop.

The initial heating function continually operates when the set multi-function input terminal is on and until the inverter command is on. If an inverter command is input while the initial heating function is operating, the inverter starts operation immediately.



The initial heating operation starts to run after an inverter operation stops, when the initial heating function's terminal input is on after the inverter operation command is off.



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 AP2-50 Pre Heat Curr is above the rated motor current value, it is limited by the rated motor current value.
- If the value for AP2-50 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.

5.30 Auto Tuning

The motor parameters can be measured automatically and can be used for an auto torque boost.

Example - Auto Tuning Based on 5.5 kW, 200 V Motor

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	14	Motor capacity	Motor Capacity	9	5.5 kW	7–20	-

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
BAS	11	Motor pole number	Pole Number	4		2–48	-
	12	Rated slip speed	Rated Slip	45		0–3000	Rpm
	13	Rated motor current	Rated Curr	21.0		1.0–1000.0	A
	14	Motor no-load current	Noload curr	7.1		0.5–1000.0	A
	15	Motor rated voltage	Rated Volt	220		170–480	V
	16	Motor efficiency	Efficiency	85		70–100	%
	20	Auto tuning	Auto Tuning	0	None	-	-
	21	Stator resistance	Rs	0.314		Depends on the motor setting	Ω
	22	Leakage inductance	Lsigma	3.19		Depends on the motor setting	mH

Auto Tuning Default Parameter Setting

Motor Capacity (kW)		Rated Current (A)	No-load Current (A)	Rated Slip Frequency (Hz)	Stator Resistance (Ω)	Leakage Inductance (mH)
200 V	0.75	3.4	1.7	3.00	2.60	17.94
	1.5	6.4	2.6	2.67	1.17	2.29
	2.2	8.6	3.3	2.3	0.84	6.63
	3.7	13.8	5.0	2.3	0.50	4.48
	5.5	21.0	7.1	1.50	0.314	3.19
	7.5	28.2	9.3	1.33	0.169	2.844
	11	40.0	12.4	1.00	0.120	1.488
	15	53.6	15.5	1.00	0.084	1.118
	18.5	65.6	19.0	1.00	0.0676	0.819
400 V	0.75	2.0	1.0	3.00	7.81	53.9
	1.5	3.7	1.5	2.67	3.52	27.9
	2.2	5.0	1.9	2.3	2.52	19.95
	3.7	8.0	2.9	2.3	1.50	13.45
	5.5	12.1	4.1	1.50	0.940	9.62
	7.5	16.3	5.4	1.33	0.520	8.53
	11	23.2	7.2	1.00	0.360	4.48
	15	31.0	9.0	1.00	0.250	3.38
	18.5	38.0	11.0	1.00	0.168	2.457
	22	44.5	12.5	1.00	0.168	2.844
	30	60.5	16.9	1.00	0.1266	2.133
	37	74.4	20.1	1.00	0.1014	1.704
	45	90.3	24.4	1.00	0.0843	1.422
	55	106.6	28.8	1.00	0.0693	1.167
	75	141.6	35.4	1.00	0.0507	0.852
	90	167.6	41.9	1.00	0.0399	0.715

Motor Capacity (kW)		Rated Current (A)	No-load Current (A)	Rated Slip Frequency (Hz)	Stator Resistance (Ω)	Leakage Inductance (mH)
400 V	110	203.5	48.8	1.00	0.0326	0.585
	132	242.3	58.1	1.00	0.0272	0.488
	160	290.5	69.7	1.00	0.0224	0.403
	185	335.0	77.0	1.00	0.0210	0.380
	220	405.0	93.1	1.00	0.1630	2.930
	250	467.8	104.9	1.00	0.1455	2.615
	315	604.0	132.8	1.00	0.1140	2.040
	355	687.8	146.4	1.00	0.1020	1.820
	400	782.0	161.2	1.00	0.0906	1.616
	500	985.3	206.2	1.00	0.0700	1.330

Auto Tuning Parameter Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>DRV-14 Motor Capacity</td><td>Sets the motor capacity to be used. The maximum motor capacity is limited by the inverter capacity and the keypad only displays the inverter capacity.</td></tr>
<tr><td>BAS-20 Auto Tuning</td><td>Select an auto tuning type and run it. Select one of the options and then press the [ENT] key to run the auto tuning.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>None</td><td>Auto tuning function is disabled. Also, if you select one of the auto tuning options and run it, the parameter value will revert back to ‘0’ when the auto tuning is complete.</td></tr>
<tr><td>1</td><td>All (rotating type)</td><td>Measures all motor parameters while the motor is rotating, including stator resistance (Rs), no-load current (Noload Curr), rotor time constant (Tr), etc. Since the motor is rotating while the parameters are being measured, if the load is connected to the motor spindle, the parameters may not be measured accurately. For accurate measurements, remove the load attached to the motor spindle.
Note that the rotor time constant (Tr) must 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, including stator resistance (Rs), no-load current (Noload Curr), rotor time constant (Tr), etc. Since the motor is not rotating while the parameters are measured, the measurements are not affected when the load is connected to the motor spindle. However, when measuring parameters, do not rotate the motor spindle on the load side.</td></tr>
</table></td></tr>
<tr><td>BAS-14 Noload Curr,
BAS-21 Rs–BAS-24 Tr</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.
- If [DRV-08 AUTO Mode Sel] is Enabled, auto-tuning works only in the stop state of the inverter AUTO mode.
- If [DRV-08 AUTO Mode Sel] is Disabled, auto-tuning operates only in the inverter OFF mode and in the AUTO mode stopped.
- Before you run auto tuning, check the motor pole number, rated slip, rated current, rated voltage, and efficiency on the motor's rating plate and enter the data. The default parameter setting is used for values that are not entered.
- When measuring all parameters after selecting 2 (All-static type) at BAS-20: compared with rotation type auto tuning where parameters are measured while the motor is rotating, parameter values measured with static auto tuning may be less accurate. Inaccuracy of the measured parameters may degrade the performance of operations. Therefore, run static-type auto tuning by selecting 2 (All) only 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).
- If auto tuning operates without wiring the motor, 'Rs Tune Err' or 'Lsig Tune Err' warning messages are displayed. It can be reset if you press 'STOP/RESET' button of the keypad.

5.31 Time Event Scheduling

Time Event function enables the user to operate the inverter using the RTC (Real-Time Clock) feature at certain times that the user would like to set. An RTC battery is installed on the I/O board of the H100+ inverter, and it lasts approximately 25,800 hours with the inverter turned off, and 53,300 hours with the inverter turned on.

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.

Time Period	Description
Time Period	Used to set the time of operation.
Time Event	Used to set the time of operation.
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.

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
	06	Date display format	Date Format	MM/DD/YYYY	0	YYYY/MM/DD	
					1	MM/DD/YYYY	
					2	DD/MM/YYYY	
	10	Period connection status	Period Status	-	-		-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP3	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
	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		-
	20	Time Period 4 Start time	Period4 StartT	24: 00	00:00–24:00		Min
	21	Time Period 4 End time	Period4 Stop T	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-Event1 Period	000000000000	000000000000 –111111111111		
	73	Time Event 1 functions	T-Event1 Define	0: None	0	None	
					1	Fx	
					2	Rx	
					3	Speed-L	
					4	Speed-M	
					5	Speed-H	
					7	Xcel-L	

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP3	73				8	Xcel-M	
					9	Xcel-H	
					10	Xcel Stop	
					11	Run Enable	
					12	Exchange	
					13	Analog Hold	
					14	I-Term Clear	
					15	PID Openloop	
					16	PID Gain 2	
					17	PID Ref Change	
					18	Timer In	
					19	Dias Aux Ref	
					20	Pre Heat	
					21	Sleep Wake Chg	
					22	PID Step Ref L	
					23	PID Step Ref M	
					24	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

Code	Description
AP3-01 Now Date AP3-02 Now Time AP3-03 Now Weekday	Sets the current date, time, and day of the week. The Time Event function is based on the setting. When the user sets Daylight Savings 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.
AP3-04 Summer T Start AP3-05 Summer T Stop	Set the summer time start date and stop date. The current time is added or subtracted by 1 hour according to the Summer Time date set by the user. Ex) If [AP3-04 Summer T Start] is set to April 1st, and it is currently 1:59 on April 1st, it will be 3:00 on April 1 instead of 2:00 after 1 minute. [AP3-05 Summer T Stop] is set to December 25th, and if it is currently December 25th at 1:59, it will be 1:00 on December 25 instead of 2:00 after 1 minute.
AP3-06 Date format	Select the desired date format.

Configuration		Function
0	YYYY/MM/DD	Year/Month/Day is displayed.
1	MM/DD/YYYY	Month/Day/Year is displayed (USA).
2	DD/MM/YYYY	The format of Day/Month/Year is displayed (Europe).

<table>
<tr><th>Code</th><th>Description</th></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><td colspan="7">Bit</td></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><td colspan="2">Setting</td><td>Function</td></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 selected.
<table>
<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>
</table></td></tr>
</table>

Code	Description
AP3-73–87 T-Event1–8 Define	Select the desired Event.

Setting			
0	None	12	Exchange
1	Fx	13	Analog Hold
2	Rx	14	I-Term Clear
3	Speed-L	15	PID Openloop
4	Speed-M	16	PID Gain 2
5	Speed-H	17	PID Ref Change
6	Reserved	18	Timer In
7	Xcel-L	19	Dias Aux Ref
8	Xcel-M	20	Pre Heat
9	Xcel-H	21	Sleep Wake Chg
10	Xcel Stop	22	PID Step Ref L
11	Run Enable	23	PID Step Ref M
		24	PID Step Ref H

Time Period Parameter Setting

Time Period	Schedule
Time Period 1	Every Sunday, Monday, Wednesday, Thursday, and Friday at 06: 00 (On) and 18: 00 (Off)

Time Schedule		
Code	Function	Setting
AP3-11	Period1 StartT	06: 00
AP3-12	Period1 StopT	18: 00
AP3-13	Period1 Day	1101110

Time Period 2	Every Sunday and Saturday for 24 hours (On)

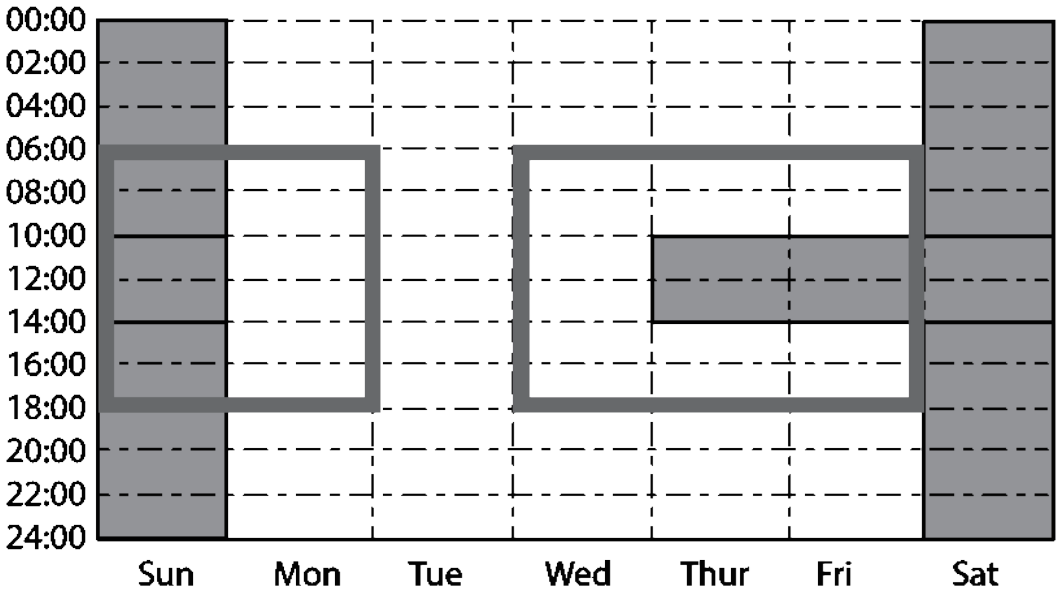
Time Schedule		
Code	Function	Setting
AP3-14	Period2 StartT	00: 00
AP3-15	Period2 StopT	24: 00
AP3-16	Period2 Day	1000001

Time Period 3	Every Sunday, Thursday, Friday, and Saturday at 10: 00 (On) and 14: 00 (Off)

Time Schedule		
Code	Function	Setting
AP3-17	Period3 StartT	10: 00
AP3-18	Period3 StopT	14: 00
AP3-19	Period3 Day	1000111

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.

The tables below 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 as shown in the tables below, 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)

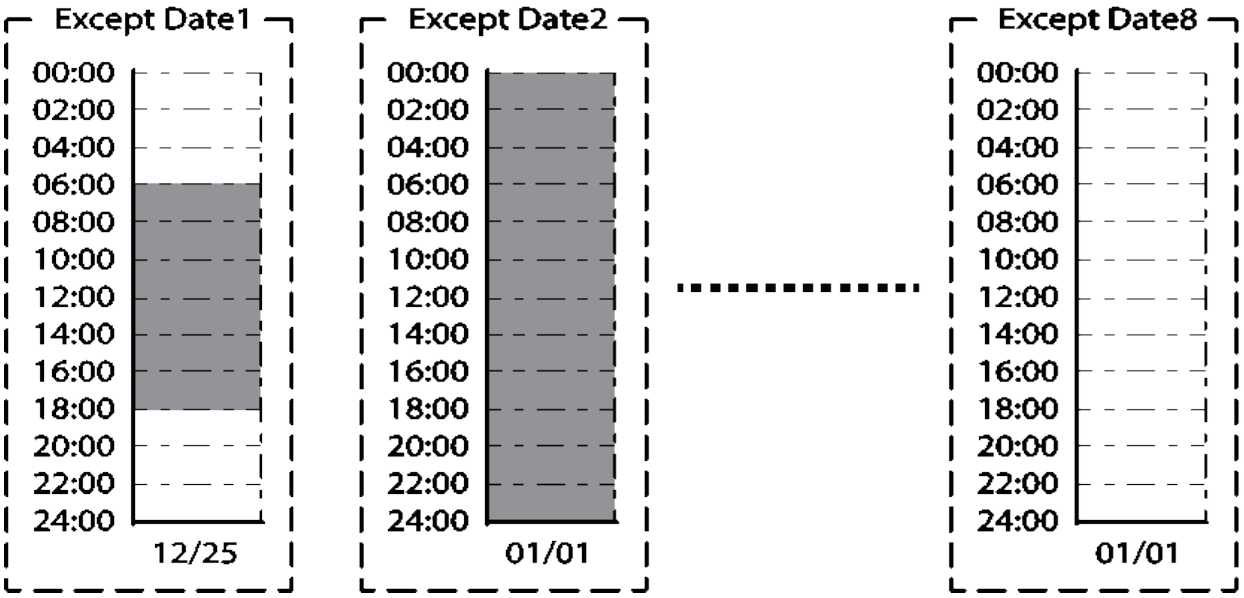
<table>
<tr><th>Time Period</th><th>Schedule</th></tr>
<tr><td>Exception Date 1</td><td>Every Sunday, Monday, Wednesday, Thursday, and Friday at 06: 00 (On) and 18: 00 (Off)
<table>
<tr><td colspan="3">Time Schedule</td></tr>
<tr><td>Code</td><td>Function</td><td>Setting</td></tr>
<tr><td>AP3-30</td><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>
</table></td></tr>
<tr><td>Exception Date 2</td><td>Every Sunday and Saturday for 24 hours (On)
<table>
<tr><td colspan="3">Time Schedule</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>
</table></td></tr>
</table>

Time Period	Schedule
Exception Date 3	Every Sunday, Thursday, Friday, and Saturday at 10: 00 (On) and 14: 00 (Off)

Time Schedule

Code	Function	Setting
AP3-36	Except3 StartT	10: 00
AP3-37	Except3 StopT	14: 00
AP3-38	Except3 Day	01/01

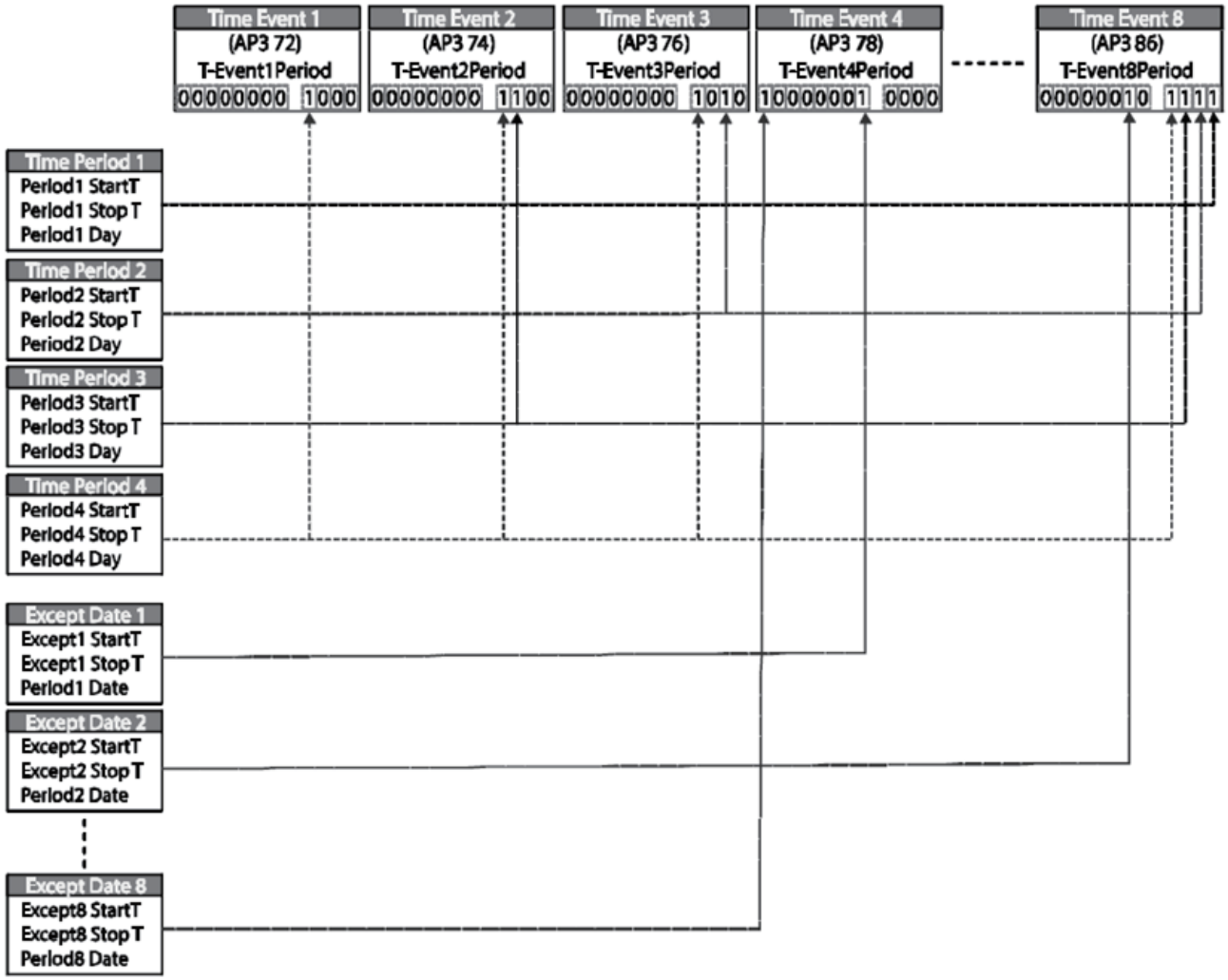
Title	Setting Range	Remarks
Except1–8 StartT	00: 00–24: 00	Hour: Minutes (by the minute)
Except1–8 Stop T	00: 00–24: 00	Hour: Minutes
Except1–8 Date	1/1–12/31	Select the particular date (between 1/1 and 12/31)



<The Time Chart for the Exception Day>

The 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. 30 functions can be set (refer to *p.198*). 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	-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
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	00000000001	000000000001–111111111111		
	73	Time Event 1 functions	T-Event1Define	1: Fx	0	None	
					1	Fx	
					2	Rx	
					3	Speed-L	
					4	Speed-M	
					5	Speed-H	
					6	Reserved	
					7	Xcel-L	
					8	Xcel-M	
					9	Xcel-H	
					10	Xcel Stop	
					11	Run Enable	
					12	Exchange	
					13	Analog Hold	
					14	I-Term Clear	
					15	PID Openloop	
					16	PID Gain 2	
					17	PID Ref Change	
					18	Timer In	
					19	Dias Aux Ref	
					20	EPID2 Run	
					21	Sleep Wake Chg	
					22	PID Step Ref L	
					23	PID Step Ref M	
					24	PID Step Ref H	

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP3	74	Time Event 2 connection	T-Event1Period	00000000010	000000000001–111111111111	
	75	Time Event 2 functions	T-Event2Define	3: Speed-L	Refer to AP3-73	

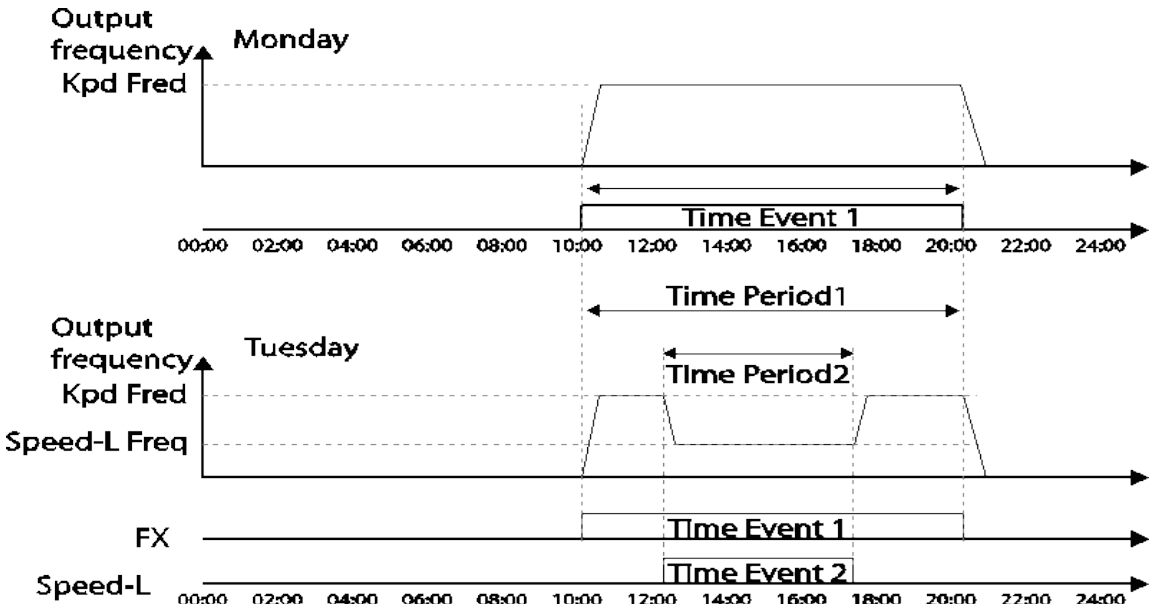
The parameters in the table above shows the frequency command sources for the keypad and the operation command sources for the Time Event.

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 trip 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 released.
- 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.

5.32 Kinetic Energy Buffering

When the input power supply is disconnected, the inverter's DC link voltage decreases, and a low voltage trip occurs blocking the output. A kinetic energy buffering operation uses regenerative energy generated by the motor during the blackout to maintain the DC link voltage. This extends the time for a low voltage trip to occur, after an instantaneous power interruption.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
CON	77	Kinetic energy buffering selection	KEB Select	1	Yes	0–1	-
	78	Kinetic energy buffering start level	KEB Start Lev	0.75–90kW-2/4	125.0	110–140	%
				110–750kW-4	115.0		
				5.5–300W-5	130.0		
	79	Kinetic energy buffering stop level	KEB Stop Lev	0.75–90kW-2/4	130.0	KEB Start Lev * 125.0–145.0(%)	%
				110–750kW-4	125.0		
				5.5–300kW-5	135.0	KEB Start Lev * 130.0–145.0(%)	
	80	Kinetic energy buffering slip gain	KEB Slip Gain	0.75–30kW-2 0.75–750kW-4	300	0–20000	-
				37–90kW-2	100		
				5.5–300kW-5	25		
	81	Kinetic energy buffering P-Gain	KEB P Gain	0.75–30kW-2 0.75–750kW-4	1000	0–20000	-
				37–90kW-2	1800		
				5.5–37kW-5	3000		
				45–300kW-5	1500		
	82	Kinetic energy buffering I gain	KEB I Gain	0.75–500kW-2/4	500	1–20000	-
				5.5–300kW-5	200		
	83	Kinetic energy buffering acceleration time	KEB Acc Time	0.75–90kW-2/4	10.0	0.0–600.0	Sec
				110–750kW-4	30.0		
				5.5–300kW-5	5.0		

Kinetic Energy Buffering Operation Setting Details

Code	Description
CON-77 KEB Select	Select the kinetic energy buffering operation when the input power is disconnected. Setting: 0 No — General deceleration is carried out until a low voltage trip occurs. Setting: 1 Yes — The inverter power frequency is controlled and the regeneration energy from the motor is charged by the inverter.
CON-78 KEB Start Lev, CON-79 KEB Stop Lev	Sets the start and stop points of the kinetic energy buffering operation. The set values must be based on the low voltage trip level at 100%, and the stop level (CON-79) must be set higher than the start level (CON-78).
CON-80 KEB Slip Gain	Used to prevent malfunctions caused by low voltage from initial kinetic energy buffering occurring due to power interruptions.
CON-81 KEB P Gain	Used to maintain the voltage during the kinetic energy buffering operation. It operates the inverter by modifying the set value to prevent malfunctions caused by low voltage after power interruptions.
CON-82 KEB I Gain	Used to maintain the voltage during the kinetic energy buffering operation. Sets the gain value to maintain the operation until the frequency stops during the kinetic energy buffering operation.
CON-83 KEB Acc Time	Sets the acceleration time for the frequency reference when the inverter's operation becomes normal after the kinetic energy buffering operation.

- **Note**
- The KEB functions may perform differently depending on the size of the loads. The KEB Gains can be set for a better performance.
- 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 be improved by increasing the KEB I Gain and the KEB Slip Gain.
- If motor vibration or torque variation occurs during the KEB function operation after power interruptions, the KEB functions can be improved by increasing the KEB P Gain or decreasing the KEB I Gain.

⚠ 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. Motors may vibrate during kinetic energy buffering operation for some loads, except for variable torque loads (for example, fan or pump loads).

5.33 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 oscillation, 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	
CON	14	Anti-hunting regulation P-Gain	AHR P-Gain	1000		0–32767		-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	15	Anti-hunting regulation start frequency	AHR Low Freq	50	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

Code	Description
CON-13 AHR Sel	Selects the Anti-hunting regulator operation. Setting: 0 No — Disable anti-hunting regulation. Setting: 1 Yes — Enable anti-hunting regulation.
CON-14 AHR P-Gain	Increasing AHR proportional gain improves responsiveness of the anti-hunting regulation. However, current oscillation may result if AHR proportional gain is set too high.
CON-15 AHR Low Freq CON-16 AHR High Freq	Sets the lower limit frequency (CON-15) and the maxim limit frequency (CON-16) for anti-hunting regulation.

5.34 Fire Mode Operation

This function is used to allow the inverter to ignore minor faults during emergency situations, such as fire, and provides continuous operation to protect other systems, such as ventilating fans. In Fire mode, the inverter continues to operate based on the Fire mode run direction and frequency set at PRT-46 and PRT-47.

PRT-46 and PRT-47 can be set after setting PRT-45 to "2.Test Mode."

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	65–75	Digital input configuration	Px Define	40: Fire Mode	0-55		-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
OUT	31–35	Digital output configuration	Relay1-5	27: Fire Mode	0-42	-
	36	TR output configuration	Q1 define	27: Fire Mode	0-42	-

When the multi-function terminal configured for Fire mode is turned on, 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 any faults, other than 'ASHT,' 'Over Current 1,' 'Over Voltage,' 'Ground F,' and continues to operate. If any of the faults that can stop inverter operation occur, the inverter automatically performs a reset restart to continue the operation.

Fire Mode Function Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-44 Fire Mode PW</td><td>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>PRT-45 Fire Mode Sel</td><td>Sets the Fire Mode.
<table>
<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</td></tr>
<tr><td>2</td><td>Test Mode</td><td>Fire mode test mode
In Fire test mode, faults are normally processed. Using Fire test mode does not increase the count value at PRT-48 (Fire Mode Cnt).</td></tr>
</table></td></tr>
<tr><td>PRT-46 Fire Mode Dir</td><td>Sets the run direction for Fire mode operation.</td></tr>
<tr><td>PRT-47 Fire Mode Freq</td><td>Sets the operation frequency for Fire mode.</td></tr>
<tr><td>PRT-48 Fire Mode Cnt</td><td>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.</td></tr>
</table>

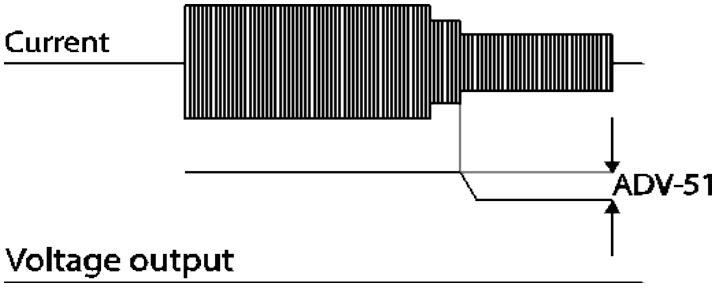
Caution

- 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 fault trips or perform a reset restart. All the fault trips 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.

5.35 Energy Saving Operation

5.35.1 Manual Energy Saving Operation

If the inverter output current is lower than the current set at BAS-14 (Noload Curr), the output voltage must be reduced as low as the level set at ADV-51 (Energy Save). The voltage before the energy saving operation starts will become the base value of the percentage. Manual energy saving operation will not be carried out during acceleration and deceleration.



Group	Code	Name	LCD Display	Parameter Setting		Setting Range		Unit
ADV	50	Energy saving operation	E-Save Mode	1	Manual	0	None	-
						1	Manual	
						2	Auto	
	51	Energy saving amount	Energy Save	30		0–30		%

5.35.2 Automatic Energy Saving Operation

The inverter finds the optimal energy saving point for the time set at ADV-52 based on the rated motor current and the voltage output. The Energy saving operation is effective for the 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	0–2	-
	52	Energy saving point search time	E-Save Det T	20.0		0.0–100.0	Sec

Caution

If the operation frequency is changed, or acceleration or deceleration is carried out during an energy saving operation, the actual Acc/Dec time may take longer than the set time due to the time required to return to general operations from the energy saving operation.

5.36 Speed Search Operation

Speed search operation is used to prevent fault trips that can occur when the inverter voltage output is disconnected and the motor is idling. Since this feature estimates the motor rotation speed based on the inverter output current, it does not give the exact speed.

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
	72	Speed search reference current	SS Sup-Current	90	0.75–90kW-2	50–120	%
				90	0.75–250kW-4		
				80	315–750kW-4		
				90	0.75–300kW-5		
	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	Multi-function relay 1 item	Relay 1	19	Speed Search	-	-
	33	Multi-function output 1 item	Q1 Define				

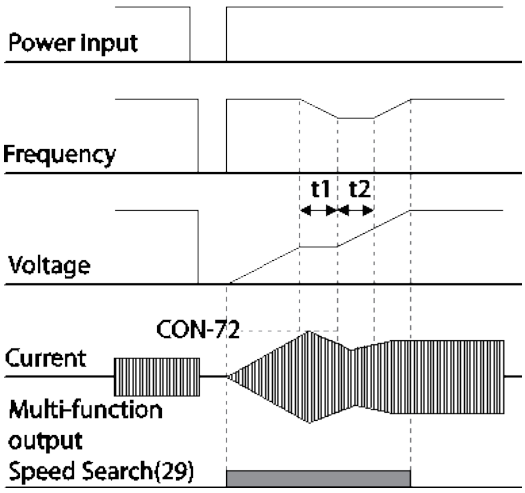
Speed Search Operation Setting Details

Code	Description
CON-70 SS Mode	**Select a speed search type** Setting: 0 Flying Start-1 Function: The speed search is carried out as it controls the inverter output current during idling below the CON-72 (SS Sup-Current) parameter setting. If 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 operation command at restart are different, the speed search does not produce a satisfactory result because the direction of idling cannot be established.
CON-70 SS Mode	Setting: 1 Flying Start-2 Function: 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. Because this mode establishes the direction of the idling motor (forward/reverse), the speed search function is stable regardless of the direction of the idling motor and direction of operation command. However because the ripple current is used which is generated by the counter electromotive force at idle (the counter electromotive force is proportional to the idle speed), the idle frequency is not determined accurately and re-acceleration may start from zero speed when the speed search is performed for the idling motor at low speed (about 10 - 15 Hz, though it depends on motor characteristics).

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CON-71 Speed Search</td><td>Speed search can be selected from the following 4 options. If the top display segment is on, it is enabled (On). If the bottom segment is on, it is disabled (Off).

<table>
<tr><td>Item</td><td>Bit Setting On Status</td><td>Bit setting Off Status</td></tr>
<tr><td>Keypad</td><td>  </td><td>  </td></tr>
</table>
Type and Functions of Speed Search Setting
<table>
<tr><td colspan="4">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>bit4</td><td>bit3</td><td>bit2</td><td>bit1</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 trip</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>
Speed search for general acceleration: If bit 1 is set to ‘1’ and the inverter operation command runs, acceleration starts with the speed search operation. When the motor is rotating under load, a fault trip may occur if the operation command is run for the inverter to provide voltage output. The speed search function prevents such fault trips from occurring.</td></tr>
<tr><td>CON-71 Speed Search</td><td>Initialization after a fault trip other than an LV trip: If bit 2 is set to ‘1’ and PRT-08 (RST Restart) is set to ‘1 (Yes)’, the speed search operation automatically accelerates the motor to the operation frequency used before the fault trip when the [Reset] key is pressed (or the terminal block is initialized) after a fault trip.

Automatic restart after a power interruption: If bit 3 is set to ‘1,’ and if a low voltage trip occurs due to a power interruption but the power is restored before the internal power shuts down, the speed search operation accelerates the motor back to its frequency reference before the low voltage trip.
If an instantaneous power interruption occurs and the input power is disconnected, the inverter generates a low voltage trip and blocks the output. When the input power returns, the operation frequency before the low voltage trip and the voltage is increased by the inverter’s inner PI control.
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-27, the voltage increases again and the frequency stops decelerating (t2 zone). When the normal frequency and voltage are resumed, the speed search operation accelerates the motor back to its frequency reference before the fault trip.</td></tr>
</table>

Code	Description
CON-71 Speed Search	 **Starting with power-on:** Set bit 4 to '1' and ADV-10 (Power-on Run) to '1 (Yes)'. If inverter input power is supplied while the inverter operation command is on, the speed search operation will accelerate the motor up to the frequency reference
CON-72 SS Sup-Current	The amount of current flow is controlled during speed search operation based on the motor's rated current. If CON-70 (SS mode) is set to '1 (Flying Start-2)', this code 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, based on motor capacity, are used and defined in DRV-14 (Motor Capacity).
CON-75 SS Block Time	The block time parameter prevents overvoltage trips due to counter electromotive force.

Note

If operated within the rated output, the H100+ series 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 Speed search function (normal acceleration) for a proper re-operation during a free-run.
If the speed search function (normal acceleration) is not selected during the acceleration, an over current trip or an overload trip may occur.

5.37 Auto Restart Settings

When inverter operation stops due to a fault and a fault trip is activated, the inverter automatically restarts based on the parameter settings.

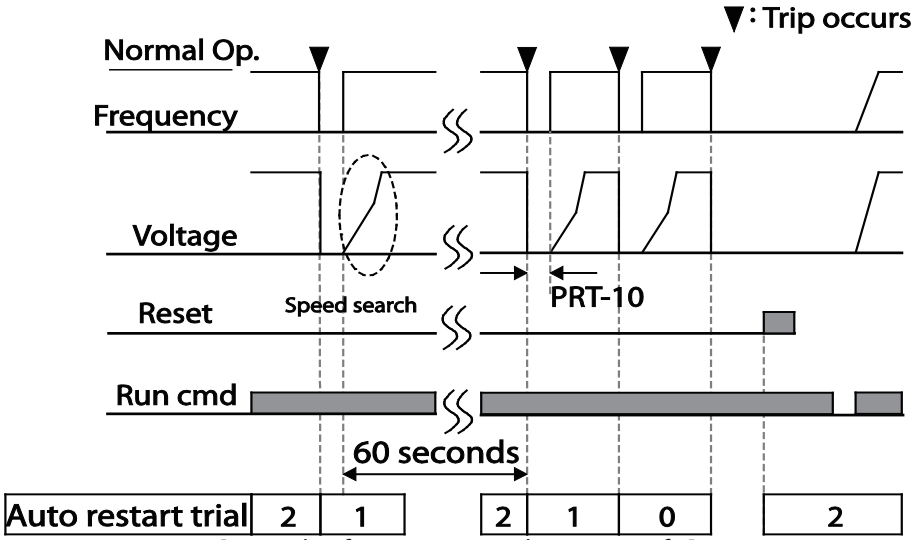
Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
PRT	08	Select start at trip reset	RST Restart	0000 0000	0000 0000 – 1111 1111	-
	09	The number of Auto restart	Retry Number	0	0–10	-
	10	Auto restart number count	Rtry Num Count	-	-	
	11	Auto restart delay time	Retry Delay	5.0	0.1–60.0	sec
CON	71	Select speed search operation	Speed Search	-	0000–1111	bit
	72	Speed search startup current	SS Sup-Current	90	70–120	%
	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	0.0–60.0	sec

Auto Restart Setting Details

Code	Description
PRT-08 RST Restart	The Reset restart function can be performed by one of the two different types. If the top segment is turned on, it indicates the function is on. If the bottom segment is turned on, it indicates the function is off. Type: Bit On / Bit Off LCD Display:  
PRT-08 RST Restart	**Reset Start Function**

Setting										Function
Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
									√	Standard Trips except the below
								√		Low Voltage Trip
							√			Low Feedback Trip
						√				High Feedback Trip
					√					SetPoint Timeout
				√						Overcycle Trip
			√							High Flow Trip
		√								Accum Flow Trip
	√									Lost Feedback
√										Lost Command

Code	Description
	Standard Trips except the below: If the Bit 0 is turned on, the inverter restarts after standard trips occur and triggers a reset. **For Low voltage fault trips:** If the Bit 1 is turned on, the inverter restarts after a LV trip occurs and triggers a reset. **For Low feedback fault trips:** If the Bit 2 is turned on, the inverter restarts after a low feedback detection trip occurs and triggers a reset. **For High feeback fault trips:** If the Bit 3 is turned on, the inverter restarts after a high feedback detection trip occurs and triggers a reset. **For setpoint timeout fault trips:** If the Bit 4 is turned on, the inverter restarts after a setpoint timeout trip occurs and triggers a reset. **For overcycle fault trips:** If the Bit 5 is turned on, the inverter restarts after a overcyling trip occurs and triggers a reset. **For high flow fault trips:** If the Bit 6 is turned on, the inverter restarts after a high flow detection trip occurs and triggers a reset. **For accum flow fault trips:** If the Bit 7 is turned on, the inverter restarts after a accum flow trip occurs and triggers a reset. **For Lost feedback fault trip:** If the Bit8 is turned on, the inverter restarts after a lost feedback trip occurs and triggers a reset. **For Lost command fault trip:** If the Bit9 is turned on, the inverter restarts after a lost command trip occurs and triggers a reset.
PRT-09 Retry Number, PRT-11 Retry Delay	The number of available auto restarts can be set at PRT-09. If a fault trip occurs during an operation, the inverter restarts after the time set at PRT-11 (Retry Delay). At each restart, the inverter counts the number of tries and subtracts it from the number set at PRT-09 until the retry number count reaches 0. After an auto restart, if a fault trip does not occur within 60 sec, it will increase the restart count number. The maximum count number is limited by the number set at PRT-09. If the inverter stops due to over current or hardware diagnosis, an auto restart is not activated. At auto restart, the acceleration options are identical to those of speed search operation. Codes CON-72–75 can be set based on the load. Information about the speed search function can be found *"5.36 Speed Search Operation" on page 212*.



[Example of auto restart with a setting of 2]

Caution

- If the auto restart number is set, be careful when the inverter resets from a fault trip. The motor may automatically start to rotate.
- In HAND mode, auto restart resets the trip condition, but it does not restart the inverter operation.
- In AUTO mode,

  - if the auto restart is configured, the inverter restarts after a trip condition is released (command via digital input is used to restart the operation).

  - if the auto restart is not configured and the trip condition is released using the OFF key, or the switches at the terminal input, the inverter stays in the OFF state. Because the command information is reset along with the trip condition, a new command is required to operate the inverter.

5.38 Operational Noise Settings (Carrier Frequency Settings)

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
CON	04	Carrier Frequency	Carrier Freq	200V			kHz
				1.0–15.0 (kHz)	0.75–18.5 kW	3.0	
				1.0–10.0 (kHz)	22–30 kW	3.0	
				1.0–7.0 (kHz)	37–45 kW	3.0	
				1.0–5.0 (kHz)	55–90 kW	2.0	
				400V			
				1.0–15.0 (kHz)	0.75–30 kW	3.0	
				1.0–10.0 (kHz)	37–55 kW	3.0	
				1.0–7.0 (kHz)	75–90 kW	3.0	
				1.0–5.0 (kHz)	110–355 kW	2.0	
				1.0–4.0 (kHz)	400–750 kW	2.0	
				600V			
				1.0–15.0 (kHz)	5.5–22 kW		
				1.0–10.0 (kHz)	30–55 kW	2.3	
				1.0–7.0 (kHz)	75–90 kW		
				1.0–4.0 (kHz)	110–300 kW	2.0	
	05	Switching Mode	PWM* Mode	0 Normal PWM	0–1		-

*PWM: Pulse width modulation

Operational Noise Setting Details

Code	Description
CON-04 Carrier Freq	Adjusts motor operational noise by changing carrier frequency settings. Power transistors (IGBT) in the inverter generate and supply high frequency switching voltage to the motor. The switching speed in this process refers to the carrier frequency. If the carrier frequency is set high, it reduces operational noise from the motor. If the carrier frequency is set low, it increases operational noise from the motor.

Code	Description
CON-05 PWM Mode	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 (LowLeakage 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 a 2 phase PWM modulation mode, which helps minimize degradation and reduces switching loss by approximately 30%.

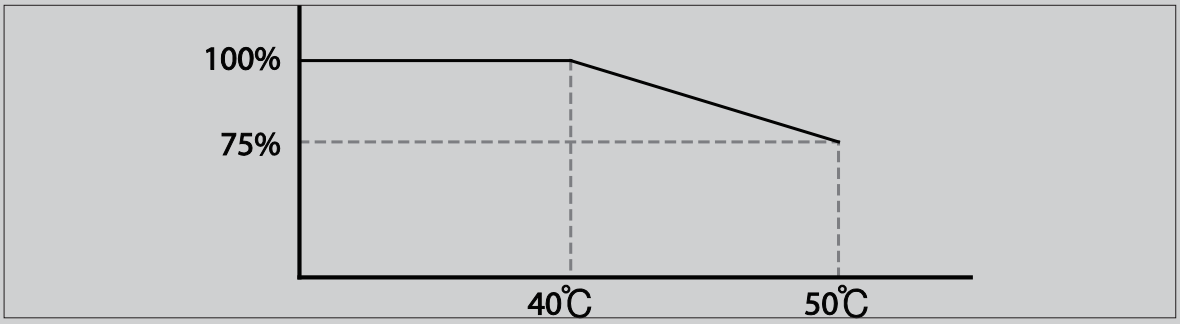
Item	Carrier Frequency	
	1.0 kHz	15 kHz
	LowLeakage PWM	Normal PWM
Motor noise	↑	↓
Heat generation	↓	↑
Leakage current	↓	↑
Leakage current	↓	↑

Note

- **Carrier Frequency at Factory Default Settings:**

  - 0.75–90kW : 3 kHz, 110–355kW : 2kHz, 400/500kW : 1.5kHz

- **H100+ Series Inverter Derating Standard (Derating):** The over load 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 overload capacity on the H100+ series inverter is 120%/1 min for normal loads. The current rating differs from the load rating, as it also has an ambient temperature limit.



- For derating specifications refer to *"10.8 Inverter Continuous Rated Current Derating" on page 462*.
- Current rating for ambient temperature at normal load operation.

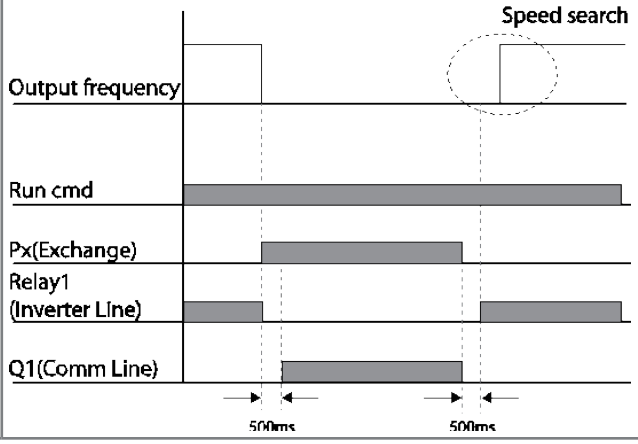
5.39 Supply Power Transition

A supply power transition is used to switch the power source for the motor connected to the inverter from the inverter output power to the main supply power source (commercial power source), or 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	0-51	-

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	31	Multi-function relay 1 items	Relay1	17	Inverter Line	0-55	-
	33	Multi-function output 1 items	Q1 Define	18	Comm Line	0-55	-

Supply Power Transition Setting Details

Code	Description
IN-65–71 Px Define	When the motor power source changes from inverter output to main supply power, select a terminal to use and set the code value to '18 (Exchange)'. Power will be switched when the selected terminal is on. To reverse the transition, switch off the terminal.
OUT-31 Relay 1– OUT-36 Q1 Define	Set multi-function relay or multi-function output to '17 (Inverter Line)' or '18 (Comm Line)'. The relay operation sequence is as follows. 

5.40 Cooling Fan Control

This function turns the inverter's heat-sink cooling fan on and off. It is used in situations where the load stops and starts frequently or a noise-free environment is required. The correct use of cooling fan controls can extend the cooling fan's life.

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	See table below

Settings		Description
0	During Run	The cooling fan runs when the power is supplied to the inverter and the operation command is on. The cooling fan stops when the power is supplied to the inverter and the operation command is off. When the inverter heat sink temperature is higher than its set value, the cooling fan operates automatically regardless of its operation status.
1	Always On	Cooling fan runs constantly if the power is supplied to the inverter.
2	Temp Control	With power connected and the run operation command on: if the setting is in Temp Control, the cooling fan will not operate unless the temperature in the heat sink reaches the set temperature.

Note

Despite setting ADV-64 to '0 (During Run)', if the heat sink temperature reaches a set level by current input harmonic wave or noise, the cooling fan may run as a protective function.

A capacity of 110 kW or more has a small built-in fan installed to cool the internal temperature. The internal fan controls on / off in conjunction with the operation command of the inverter main control fan

5.41 Input Power Frequency and Voltage Settings

Select the frequency for inverter input power. If the frequency changes from 60 Hz to 50 Hz, all other frequency (or RPM) settings, including the maximum frequency, base frequency, etc., will change to 50 Hz. Likewise, changing the input power frequency setting from 50 Hz to 60 Hz will change all related function item 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 Sel	0	60 Hz	0–1	-

Set Inverter input power voltage. Low voltage fault trip level changes automatically to the set voltage standard.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
BAS	19	Input power voltage	AC Input Volt	240V	0.75–90kW-2	170-240V	
				480V	0.75–90kW-4	320–480V	
					110–750kW-4	320-550V	
				600V	5.5–300kW-5	446–660V	

5.42 Read, Write, and Save Parameters

Use read, write, and save function parameters on the inverter to copy parameters from the inverter to the keypad or from the 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 keypad. Saved parameters on the keypad will be deleted and replaced with the copied parameters.
CNF-47 Parameter Write	Copies saved parameters from the keypad to the inverter. Saved parameters on the inverter will be deleted and replaced with the copied parameters. If an error occurs during parameter writing, the previously saved data will be used. If there is no saved data on the Keypad, 'EEP Rom Empty' will be displayed.
CNF-48 Parameter Save	As parameters set during communication transmission are saved to RAM, the setting values will be lost if the power goes off and on. When setting parameters during communication transmission, select '1 (Yes)' at CNF-48 to save the set parameter.

5.43 Parameter Initialization

User changes to parameters can be initialized (reset) to factory default settings on all or selected groups. However, during a fault trip situation or operation, parameters cannot be reset.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	40	Parameter initialization	Parameter Init	0	No	0–15	

Parameter Initialization Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CNF-40
Parameter Init</td><td>
<table>
<tr><td colspan="2">Setting</td><td>LCD Display</td><td>Function</td></tr>
<tr><td>0</td><td>No</td><td>No</td><td>-</td></tr>
<tr><td>1</td><td>Initialize all groups</td><td>All Grp</td><td>Initialize all data. Select '1 (All Grp)' and press the [PROG/ENT] key to start initialization. On completion, '0 (No)' will be displayed.</td></tr>
<tr><td>2</td><td>Initialize DRV group</td><td>DRV Grp</td><td rowspan="13">Initialize data by groups. Select initialize group and press the [PROG/ENT] key to start initialization. On completion, '0 (No)' will be displayed.</td></tr>
<tr><td>3</td><td>Initialize BAS group</td><td>BAS Grp</td></tr>
<tr><td>4</td><td>Initialize ADV group</td><td>ADV Grp</td></tr>
<tr><td>5</td><td>Initialize CON group</td><td>CON Grp</td></tr>
<tr><td>6</td><td>Initialize IN group</td><td>IN Grp</td></tr>
<tr><td>7</td><td>Initialize OUT group</td><td>OUT Grp</td></tr>
<tr><td>8</td><td>Initialize COM group</td><td>COM Grp</td></tr>
<tr><td>9</td><td>Initialize PID group</td><td>PID Grp</td></tr>
<tr><td>10</td><td>Initialize AP1 group</td><td>AP1 Grp</td></tr>
<tr><td>11</td><td>Initialize AP2 group</td><td>AP2 Grp</td></tr>
<tr><td>12</td><td>Initialize AP3 group</td><td>AP3 Grp</td></tr>
<tr><td>13</td><td>Initialize AP4 group</td><td>AP4 Grp</td></tr>
<tr><td>14</td><td>Initialize PRT group</td><td>PRT Grp</td></tr>
</table>
</td></tr>
</table>

5.44 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	Un-locked	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 allow access to parameter view lock. Follow the steps below to register a password.
<table>
<tr><td>No</td><td>Procedure</td></tr>
<tr><td>1</td><td>[PROG/ENT] key on CNF-51 code 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, code 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. The [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>

5.45 Parameter Lock

Use parameter lock to prevent unauthorized modification of parameter settings. To enable parameter lock, register and enter a user password first.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
CNF	52	Parameter lock	Key Lock Set	Un-locked	0–9999	-
	53	Parameter lock password	Key Lock Pw	Password	0–9999	-

Parameter Lock Setting Details

Code	Description
CNF-53 Key Lock PW	Register a password to prohibit parameter modifications. Follow the procedures below to register a password.
CNF-52 Key Lock Set	To enable parameter lock, enter the registered password. The [Locked] sign will be displayed on the screen to indicate that prohibition is enabled. Once enabled, pressing the [PROG/ENT] key at once function code will not allow the display edit mode to run. To disable parameter modification prohibition, re-enter the password. The [Locked] sign will disappear.

No	Procedures
1	Press the [PROG/ENT] key on CNF-53 code 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.
2	If a saved password has been set, enter the saved password.
3	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).
4	Register a new password.
5	After registration, Code CNF-53 will be displayed.

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.

5.46 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	Changedparameter display	Changed Para	0	View All	-	-

Changed Parameter Display Setting Details

Code	Description		
CNF-41 Changed Para	Setting		Function
	0	View All	Display all parameters
	1	View Changed	Display changed parameters only

5.47 User Group

Create a user defined group and register user-selected parameters from the existing function groups. The user group can carry up to a maximum of 64 parameter registrations.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	42	Multi-function key settings	Multi Key Sel	1	UserGrp SelKey	-	-
	45	Delete all user registered codes	UserGrp AllDel	0	No	-	-

User Group Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CNF-42 Multi Key Sel</td><td>Select 1 (UserGrp SelKey) from the multi-function key setting options. If user group parameters are not registered, setting the multi-function key to the user group select key (UserGrp SelKey) will not display user group (USR Grp) items on the Keypad.
Follow the procedures below to register parameters to a user group.</td></tr>
<tr><td>CNF-42 Multi Key Sel</td><td>
<table>
<tr><td>No</td><td>Procedure</td></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 below information will be displayed on the screen.

❶ Group name and code number of the parameter
❷ Name of the parameter
❸ Code number to be used in the user group. Pressing the [PROG/ENT] key on the code number (40 Code) will register DRV-01 as code 40 in the user group.
❹ Existing parameter registered as the user group code 40
❺ Setting range of the user group code. Entering ‘0’ cancels the settings.</td></tr>
<tr><td>3</td><td>❸ Set a code number to use to register the parameter in the user group. Select the code number and press the [PROG/ENT] key.</td></tr>
<tr><td>4</td><td>Changing the value in ❸ will also change the value in ❹. If no code 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 code 2, code 11, and more in the user group.</td></tr>
</table>
Follow the procedures below to delete parameters in the user group.
<table>
<tr><td>No.</td><td>Settings</td></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>As pressing [Mode] key in the PAR mode, USR group in U&M mode will be displayed. In the USR group in U&M mode, move the cursor to the code to be deleted.</td></tr>
<tr><td>3</td><td>Press the [MULTI] key.</td></tr>
<tr><td>4</td><td>Move to ‘YES’ on the deletion confirmation screen, and press the [PROG/ENT] key.</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>

5.48 Easy Start On

Run Easy Start On to easily setup the basic motor parameters required to operate a motor in a batch. Set CNF-61 (Easy Start On) to '1 (Yes)' to activate the feature, initialize all parameters by setting CNF-40 (Parameter Init) to '1 (All Grp)', and restart the inverter to activate Easy Start On.

To access the Quick Start menu when already powered up, set DRV-31 (PopUp EzStart) to "Yes" to return to the Ez Start menu.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	61	Parameter easy start settings	Easy Start On	1	Yes	0: No 1: Yes	-
DRV	31	Pop up easy start	PopUp Ezstart	1	Yes	0: No 1: Yes	

Easy start on Setting Details

Step	Parameter	Description
1	CNF-43: Select a macro.	0. Basic (Default) 1. Pressure Ctrl 2. Lead Lag Sel
2	DRV 32: Regional Set	0. US 1. International 2. KR 3. KSA
3	AP3-01 Now Date	Set Date
4	AP3-02 Now Time	Set Time
5	PRT-02 Load Duty	0. Normal Duty 1. Heavy Duty
6	DRV-14 Motor Capacity	Set HP rating
7	BAS-10 60/50 Hz Sel	Set motor rated frequency
8	BAS-13 Rated Curr	Set motor rated current
9	BAS-15 Rated Volt	Set motor rated voltage
10	BAS-11 Pole Number	Set motor pole number.
11	BAS-19 AC Input Volt	Set input voltage.
12	DRV-06 Cmd Source	Cmd Source: Set command source.
13	DRV-07 Freq Ref Src	Set Frequency Reference source.
14	DRV-03 Accel Time	Sets the time to accelerate from 0 to maximum frequency
15	DRV-04 Decel Time	Sets the time to decelerate from maximum frequency to 0.
16	ADV-08 Stop mode	Stopping Method 0. Decel stop 1. DC-Brake 2. Coast stop 4. Power Braking
17	ADV-09 Run Prevent	Choose a direction to prevent 1. Forward Prev 2. Reverse Prev

<table>
<tr><th>Step</th><th>Parameter</th><th>Description</th></tr>
<tr><td>18</td><td>PRT-03 Phase loss check</td><td>When open-phase protection is operating, input and output configurations are displayed differently. When the LCD segment is On, the corresponding bit is set to 'Off'.
<table>
<tr><td colspan="2">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>Bit 1</td><td>Bit 0</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>19</td><td>PRT-08 Select start at trip reset</td><td>Select start at trip reset
<table>
<tr><td colspan="10">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>Bit 9</td><td>Bit 8</td><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><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></td><td></td><td></td><td></td><td></td><td>√</td><td>Standard Trips except the below</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td><td>Low Voltage Trip</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td><td></td><td>Low Feedback Trip</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td><td></td><td></td><td>High Feedback Trip</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>√</td><td></td><td></td><td></td><td></td><td>SetPoint Timeout</td></tr>
<tr><td></td><td></td><td></td><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td>Overcycle Trip</td></tr>
<tr><td></td><td></td><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td>High Flow Trip</td></tr>
<tr><td></td><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Accum Flow Trip</td></tr>
<tr><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Lost Feedback</td></tr>
<tr><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Lost Command</td></tr>
</table></td></tr>
<tr><td>20</td><td>PRT-09 Retry Number</td><td>Sets the number of restart trial when performing a trip reset.</td></tr>
<tr><td>21</td><td>PRT-20 OL Trip Select</td><td>0. None
1. Trip & Coast
2. Decel Stop</td></tr>
<tr><td>22</td><td>PRT-21 OL Trip Level</td><td rowspan="2">When the current supplied to the motor is greater than the preset value of the overload trip level (OL Trip Level) and continues to be supplied during the overload trip time (OL Trip Time), the inverter output is either blocked according to the preset mode from PRT-17 or slows to a stop after deceleration.</td></tr>
<tr><td>23</td><td>PRT-22 OL Trip Time</td></tr>
<tr><td>24</td><td>PRT-40 ETH Trip Sel</td><td>0. None
1. Trip & Coast
2. Decel Stop</td></tr>
<tr><td>25</td><td>PRT-41 Motor Cooling</td><td>0. Self-cool
1. Forced-cool</td></tr>
<tr><td>26</td><td>PRT-42 ETH 1 min</td><td>The amount of input current that can be continuously supplied to the motor for 1 minute, based on the motor-rated current (BAS-13).</td></tr>
</table>

⚠ Caution

Use caution when turning on the inverter after Easy Start On configuration. If codes such as PRT-08 (Reset Restart), COM-96 (PowerOn Resume), or CON-71 (SpeedSearch) are configured in Easy Start On, the inverter may start operating as soon as it is powered on.

5.49 Config (CNF) Mode

The config mode parameters are used to configure keypad related features.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
CNF	2	LCD brightness/ contrast adjustment	LCD Contrast	-	-	
	10	Inverter S/W version	Inv S/W Ver	x.xx	-	
	11	Keypad S/W version	Keypad S/W Ver	x.xx	-	-
	12	Keypad title version	KPD Title Ver	x.xx	-	-
	30–32	Power slot type	Option-x Type	None	-	-
	44	Erase trip history	Erase All Trip	No	-	-
	60	Add title update	Add Title Up	No	-	-
	62	Initialize accumulated electric energy	WH Count Reset	No	-	-

Config Mode Parameter Setting Details

Code	Description
CNF-2 LCD Contrast	Adjusts LCD brightness/contrast on the keypad.
CNF-10 Inv S/W Ver, CNF-11 Keypad S/W Ver	Checks the OS version in the inverter and on the keypad.
CNF-12 KPD Title Ver	Checks the title version on the keypad.
CNF-30–32 Option-x Type	Checks the type of option board installed in the option slot. The H100+ inverters use type-1 option boards only (CNF-30 Option-1 Type). CNF-31 and CNF-32 are not used.
CNF-44 Erase All Trip	Deletes the stored trip history.
CNF-60 Add Title Up	When inverter SW version is updated and more code is added, CNF-60 settings will add, display, and operate the added codes. Set CNF-60 to '1 (Yes)' and disconnect the keypad from the inverter. Reconnecting the keypad to the inverter updates titles.
CNF-62 WH Count Reset	Initialize the accumulated electric energy consumption count.

5.50 Regional Setting

If DRV-32 is changed, the values of frequency, input/motor voltage and unit of motor capacity can be changed all at once.This parameter setting depends on each country's standard.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	32	Regional setting	Regional Set	0	US	0–3	-
				1	International		
				2	KR		
				3	KSA		

Regional setting Details

Selection	frequency	Input Voltage	Motor Voltage	Unit	Sleep Warn Sel	Stop Mode
0. US	60Hz	240V / 480V	230V / 460V	HP	-	-
1. International	50Hz	230V / 400V	230V / 400V	kW	-	-
2. KR	60Hz	220V / 380V	220V / 380V	kW	-	-
3. KSA	50Hz	380V	0V	kW	None	Dec

5.51 Macro Selection

The Macro selection function is used to put various application functions together in a group. For applications with the H100 series inverters, 7 basic Macro configurations are currently available. Macro functions cannot be added by the user, but the data can be modified.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	43	Macro selection	Macro Select	0	Basic	0–2	-
				1	Pressure Ctrl		
				2	Lead Lag Sel		

Macro Selection Details

Code	Description
CNF-43 Macro Select	A list of Macro settings is displayed for user selection. When a Macro function is selected, all the related parameters are automatically changed based on the inverter's Macro settings. If '0 (Basic)' is selected, all the inverter parameters, including the parameters controlled by the Macro function, are initialized. For other macro application settings (settings 1–2), refer to *"8.16 Macro Groups" on page 417*

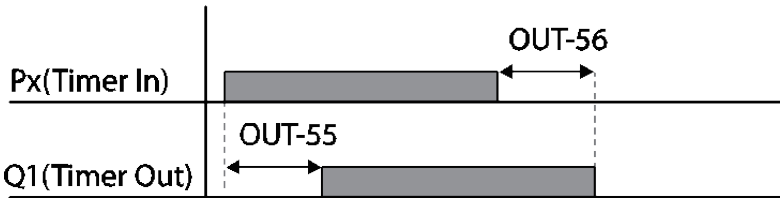
5.52 Timer Settings

Set a multi-function input terminal to a timer. Sets the On/Off controls to the multi-function outputs and relays according to the timer settings.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
IN	65–71	Px terminal configuration	Px Define (Px: P1–P7)	35	Timer In	0-55	-
OUT	31	Multi-function relay 1	Relay 1	22	Timer Out	0-42	-
	33	Multi-function output 1	Q1 Define				
	55	Timer on delay	TimerOn Delay	3.00		0.00–100.00	sec
	56	Timer off delay	TimerOff Delay	1.00		0.00–100.00	sec

Timer Setting Details

Code	Description
IN-65–71 Px Define	Choose one of the multi-function input terminals and change it to a timer terminal by setting it to '35(Timer In)'.
OUT-31 Relay 1, OUT-36 Q1 Define	Set the multi-function output terminal or relay to be used as a timer to '22 (Timer out)'.
OUT-55 TimerOn Delay, OUT-56 TimerOff Delay	Input a signal (On) to the timer terminal to operate a timer output (Timer out) after the time set at OUT-55 has passed. When the multi-function input terminal is off, the multi-function output or relay turns off after the time set at OUT-56.



5.53 Multiple Motor/Drive Control (MMC/Lead-Lag)

The MMC (Multiple Motor Control) function is used to control multiple motors for a pump system. The main motor connected with the inverter output is controlled by the PID controller. The auxiliary motors are connected with the supply power and turned on and off by the relay within the inverter.

The Multiple Drive Control (Lead-Lag) function connects drives individually to each pump and controls the entire system with one drive as the master.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP1	01	Stage in mode	Stage In Mode	2: Feedback + Fout	0	Output Freq	-
					1	Feedback Value	
					2	Feedback+Fout	
					3	Flow Rate Mon	
	02	Stage out mode	Stage Out Mode	2: Feedback + Fout	0	Output Freq	-
					1	Feedback Value	
					2	Feedback+Fout	
					3	Flow Rate Mon	
	03	Stage in flow rate	Stage In Flow	0	0–30000		-
	04	Stage out flow rate	Stage Out Flow	0	0–30000		-
	05	High feedback De-stage level	Hi FB De-stage	0	-30000–30000		-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
	06	Low feedback De-stage level	Lo FB De-stage	0	-30000–30000		-
	07	Lag speed gain	Lag Speed Gain	100.0	0.0–300.0		%
AP1	08	Lag speed bias	Lag Speed Bias	0.00	-60.00–60.00		Hz
	09	Set point modifier	SP Modifier	0: Number of Pumps	0	Number of Pumps	-
					1	Each Pump	
	10	Lag fixed speed delay time	Lag Fix Spd DT	0	0–1000		Sec
	11	Lag deceleration time	Lag Decel Time	60.0	0.0–1000.0		Sec
	12	Lag deceleration activation time	Lag Dec Act T	0.0	0.0–360.0		Sec
	13	Stabilize time	Stabilize Time	0	0–3600		Sec
	40	Lead lag function selection	Lead Lag Sel	0: None	0	None	-
					1	Contactor Lag	
					2	Follow Lead	
					3	Fixed Lag	
					4[1]	Slave Only	
	41	Bypass selection	Regul Bypass	0: No	0	No	-
					1	Yes	
	42	Number of Pumps	* of pumps	5	1–8[2]		-
	43[3]	Run Priority	Run Priority	1	1–8		-
	44	Number of operating auxiliary Pumps	Lag Pump Run	-	-		-
	45	Auxiliary Pumps (#1– 4) priority	Curr. Prty 1	-	-		-
	46	Auxiliary Pumps (#5– 8) priority	Curr. Prty 2	-	-		-
	47	Lead Lag Status	Lead Lag Status				
	48	Lag Stop Selection	Lag Stop Sel	0: No	0	No	-
					1	Yes	
	49	Alternation Sequence	ALT Sequence	0: FILO	0	FILO	-
					1	FIFO	
					2	Op Time Order	
					3	Stop history	
	50	Stage Pres. Dv	Stage Pres. Dv	5.0	0–100		Unit

1 AP1-47–87 and AP1-91–98 are not displayed when AP1-40 is set to '4(Slave Only)'.

2 If Extension IO option is equipped or AP1-40 is set to '2 or 3', AuxMaxMotor is set to '8'. Otherwise AuxMaxMotor is set to '5'.

3 If AP1-49 is set to '2(Op Time Order)', the parameter cannot be set by a user and it is automatically changed as the operation time of aux motors.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	51	Main Pump acceleration time when auxiliary motor # is reduced	Aux Acc Time	2.0	0–600.0	Sec
AP1	52	Main Pump deceleration time when auxiliary motor is added	Aux Dec Time	2.0	0–600.0	Sec
	53	Auxiliary Pump start delay time	Stage DT	5.0	0.0–3600.0	Sec
	54	Auxiliary pump stop delay time	Destage DT	5.0	0.0–3600.0	Sec
	55	Alternate Mode	Alternate Mode	1: AUX Exchange	0 None 1 AUX Exchange 2 MAIN Exchange	-
	56	Alternate time	Alternate Time	24: 00	00: 00–100: 00	Min
	57	Alternate frequency	Alternate Level	20.00	Low Freq–High Freq	Hz
	58	Alternate operation time	Alt Timer Disp	-	-	-
	59	Destage pressure difference	Destage Pres.	5.0	0–100	Unit
	60	Target frequency of Aux Motor in case of fixed Lag	Lag Freq	60.00	Low Freq– High Freq	Hz
	61[4]	#1 auxiliary pump start frequency	Stage Freq 1	59	Low Freq–High Freq	Hz
	62	#2 auxiliary pump start frequency	Stage Freq 2	59	Low Freq–High Freq	Hz
	63	#3 auxiliary pump start frequency	Stage Freq 3	59	Low Freq–High Freq	Hz
	64	#4 auxiliary pump start frequency	Stage Freq 4	59	Low Freq–High Freq	Hz
	65	#5 auxiliary pump start frequency	Stage Freq 5	59	Low Freq–High Freq	Hz
	66	#6 auxiliary pump start frequency	Stage Freq 6	59	Low Freq–High Freq	Hz
	67	#7 auxiliary pump start frequency	Stage Freq 7	59	Low Freq–High Freq	Hz
	68	#8 auxiliary pump start frequency	Stage Freq 8	59	Low Freq–High Freq	Hz
	70	#1 auxiliary pump stop frequency	Destage Freq 1	40	Low Freq–High Freq	Hz

4 AP1-61–77 are not displayed when AP1-40 is '0'. If AP1-40 is '1', it is displayed as much as the MMC used. If AP1-40 is '2 or 3', only AP1-61 and AP1-70 are displayed, but AP1-62–68 and AP1-71–77 are not displayed.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
	71	#2 auxiliary pump stop frequency	Destage Freq 2	40	Low Freq–High Freq		Hz
	72	#3 auxiliary pump stop frequency	Destage Freq 3	40	Low Freq–High Freq		Hz
AP1	73	#4 auxiliary pump stop frequency	Destage Freq 4	40	Low Freq–High Freq		Hz
	74	#5 auxiliary pump stop frequency	Destage Freq 5	40	Low Freq–High Freq		Hz
	75	#6 auxiliary pump stop frequency	Destage Freq 6	40	Low Freq–High Freq		Hz
	76	#7 auxiliary pump stop frequency	Destage Freq 7	40	Low Freq–High Freq		Hz
	77	#8 auxiliary pump stop frequency	Destage Freq 8	40	Low Freq–High Freq		Hz
	78	Sharing Data with Leader	DataShare	1: Auto	0	None	
					1	Auto	
					2	Manual	
	79	Selection of Communication Error	All CommErr	1: Yes	0	No	
					1	Yes	
	80[5]	#1 auxiliary motor reference compensation	Aux1 Ref Comp	0	0–Unit Band		Unit
	81	#2 auxiliary motor reference compensation	Aux2 Ref Comp	0	0–Unit Band		Unit
	82	#3 auxiliary motor reference compensation	Aux3 Ref Comp	0	0–Unit Band		Unit
	83	#4 auxiliary motor reference compensation	Aux4 Ref Comp	0	0–Unit Band		Unit
	84	#5 auxiliary motor reference compensation	Aux5 Ref Comp	0	0–Unit Band		Unit
	85	#6 auxiliary motor reference compensation	Aux6 Ref Comp	0	0–Unit Band		Unit
	86	#7 auxiliary motor reference compensation	Aux7 Ref Comp	0	0–Unit Band		Unit
	87	#8 auxiliary motor reference compensation	Aux8 Ref Comp	0	0–Unit Band		Unit
	88	Enable Jockey Pump	Jockey Pump	0: No	0	No	
					1	Yes	

5 AP1-80–87 are displayed depending on the number of the auxiliary motors in MMC or Lead Lag.

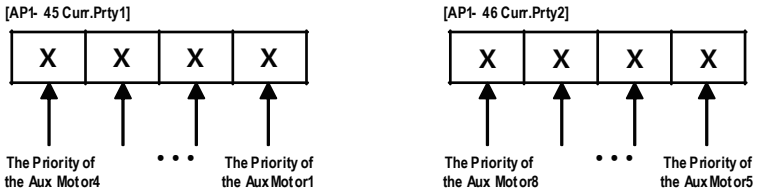
Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
	89	Jockey Pump Turn -Off Delay time	Jockey Dly T	20.0	0-60.0		Sec
AP1	90	Interlock selection	Ext Mrt OL	0: No	0	Disabled	-
					1	En&None Trip	
					2	En&Latch Trip	
					3	En&Level Trip	
	91	Delay time before an operation for the next motor when an interlock on the main motor occur.	Ext Mrt OL T	5.0	0–360.0		Sec
	94	Number of operating auxiliary Drives	* of Drives				
	95[6]	Selecting auxiliary Pump to indicate in [AP1-96] [AP1-97].	RunTimeMonitor	1: Pump 1	1	Pump 1	
					2	Pump 2	
					3	Pump 3	
					4	Pump 4	
					5	Pump 5	
					6	Pump 6	
					7	Pump 7	
					8	Pump 8	
	96	Operating time (Day) of auxiliary Pump chosen in [AP1-95].	pmpRunTime Day	0	0–60000		
	97	Operating time of auxiliary Pump chosen in [AP1-95].	PmpRunTime Min	00:00	00:00–23:59		
	98	Deleting operating time of auxiliary motor.	PmpRunTime Clr	0: None	0	None	
					1	All	
					2	Pump 1	
					3	Pump 2	
					4	Pump 3	
					5	Pump 4	
					6	Pump 5	
					7	Pump 6	
					8	Pump 7	
					9	Pump 8	

6 6(pump 6)–8(pump 8)' of AP1-95 and '7(pump 6)–9(pump 8)' of AP1-98 can be selected depending on the number of pumps in MMC or Lead-Lag

MMC Setting Details

Code	Description
COM-01 Int485 St ID	It means communication station number. If [AP1-40 Lead Lag Sel] is {2: Follow Lead}, {3: Fixed Lag}, {4: Slave Only}, the maximum value is "8". For lead-lag operation, the drives connected to the communication line must not overlap.
PID-20 PID Fdb Source	Select PID Feedback Source. 6 : Slave Only has been added. Select this message when receiving feedback through the network, instead of directly receiving analog feedback.
AP1-01 Stage In Mode	Select the condition for staging a Lag pump during Lead-Lag operation. 0: Output Frequency: Staging a Lag pump is determined based on the current output frequency of the Lead pump. If the frequency exceeds the value set in AP1-61 for longer than the time set in AP1-53, the Lag pump is added. 1: Feedback: Staging a Lag pump is determined based on the feedback of the current Lead pump. If the pressure difference exceeds the value set in AP1-50 for longer than the time set in AP1-53, the Lag pump is added. 2: Feedback + Output Frequency: Staging a Lag pump is determined based on both the current frequency and feedback of the Lead pump. If the frequency exceeds the value set in AP1-61 and the pressure difference exceeds the value set in AP1-50, and both maintained for longer than the time set in AP1-53, the Lag pump is added. 3: Flow Rate: Staging a Lag pump is determined based on the flow rate. If the current flow rate exceeds the value set in AP1-03 for longer than the time set in AP1-53, the Lag pump is added.
AP1-02 Stage Out Mode	Select the condition for de-staging a Lag pump during Lead-Lag operation. 0: Output Frequency: De-staging a Lag pump is determined based on the current output frequency of the Lead pump. If the output frequency is less than the value set in AP1-70 for longer than the time set in AP1-54, the Lag pump is de-staged. 1: Feedback: De-staging a Lag pump is determined based on the feedback of the current Lead pump. If the pressure difference exceeds the value set in AP1-59 for longer than the time set in AP1-54, the Lag pump is de-staged. 2: Feedback + Output Frequency: De-staging a Lag pump is determined based on both the current frequency and feedback of the Lead pump. If the frequency is less than the value set in AP1-70 and the pressure difference exceeds the value set in AP1-59, and both maintained for longer than the time set in AP1-54, the Lag pump is de-staged. 3: Flow Rate: De-staging a Lag pump is determined based on the flow rate. If the current flow rate is less than the value set in AP1-04 for longer than the time set in AP1-54, the Lag pump is de-staged.
AP1-03 Stage In FlowRate Level	This setting becomes valid when AP1-01 Stage In Mode is selected as 3: Flow Rate. After comparing the configured flow rate with the current system's flow rate, if the system's flow rate becomes greater, an additional Lag pump is staged in. The configured flow rate increases proportionally to the number of pumps currently in operation. Example: If 3 pumps are currently running and AP1-03 is set to 10 L/sec, the detection level becomes 30 L/sec.
AP1-04 Stage Out FlowRate Level	This setting becomes valid when AP1-02 Stage Out Mode is selected as 3: Flow Rate. After comparing the configured flow rate with the current system's flow rate, if the system's flow rate becomes less, a Lag pump is staged out. The configured flow rate increases proportionally to the number of pumps currently in operation. Example: If 3 pumps are currently running and AP1-04 is set to 8 L/sec, the detection level becomes 24 L/sec.

Code	Description
AP1-05 High Feedback De-stage Level	De-stage a Lag pump when pressure feedback exceeds the configured value for longer than 2 seconds.
AP1-06 Low Feedback De-stage Level	De-stage a Lag pump when pressure feedback is less than the configured value for longer than 2 seconds. (Valid for PID inverse operation)
AP1-07 Lag Speed Gain	Set Gain value of Lag Speed.
AP1-08 Lag Speed Bias	Set Bias value of Lag Speed.
AP1-09 SP Modifier	The method for Set Point compensation is determined based on the number of Lag motors. 0: Number of Pump: The compensation amount in AP1-80 is added proportionally to the number of Lag pumps. Example: If there are 3 Lag pumps and AP1-80 is set to 3 PSI, the Set Point is increased by 9 PSI. 1: Each pump: The compensation values in AP1-80 through AP1-88 are added individually for each Lag pump. Example: If Lag pumps 2, 3, and 4 are running and AP1-81 is set to 1 PSI, AP1-82 to 2 PSI, and AP1-83 to 3 PSI, the Set Point increases by the sum of these values, resulting in +(1+2+3) PSI.
AP1-10 Lag Fix Spd DT	Set the delay time to maintain the current operating frequency when switching from Lead to Lag.
AP1-11 Lag Decel time	Set the Lag Deceleration time to be applied when switching from Lead to Lag.
AP1-12 lag Decel Act time	Set the effective time for Lag Deceleration to be applied when switching from Lead to Lag.
AP1-13 Stabilize time	Set Stabilize time when a Lag pump is staged in. During Stabilize time, Some Protection functions (Sleep, SPT, NFC) are deactivated.
AP1-40 Lead Lag Sel	Selects the MMC operation settings. -None : Deactivates MMC function -Contactor Lag : Activates general MMC function -Follow Lead : This is how all drives operate at the same frequency as the PID-controlled Main Pump. Drive can be Master depending on the situation and PID feedback should be linked -Fixed Lag: There is only one PID controlled drive, and the rest of the drives operate at the set frequency of [AP1-60 Lag Freq]. Drive can be a leader in some situations and PID feedback should be linked. -Slave Only: This is how you drive according to the leader's command. The Drive cannot be a Leader.
AP1-41 Regul Bypass	Set whether to use the regular bypass function. This is a function that controls the speed with feedback magnitude without PID control. If [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag or Slave Only, it is not displayed.
AP1-42 Number of Pumps	If [AP1-40 Lead Lag Sel] is a Contactor Lag, set the number of motors to use as the MMC If [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag, set the number of drives connected to the Lead-Lag system. The number of drives that perform the actual Lead-Lag operation is set to [AP1-94 * Of Drives]. Not displayed if [AP1-40 Lead Lag Sel] is Slave Only.
AP1-43 Run Priority	Set the ID of the drive you want the highest priority. If the priority changes during operation, it will change automatically If [AP1-49 ALT Sequence] is an Op Time Order, it cannot be set if [AP1-88 Jockey Pump] is Yes.

Code	Description
AP1-44 Lag Pump Run	Indicates the number of Lags currently in operation.
AP1-45–46 Curr. Prty 1–2	Indicates the priority of the drive operating as a MMC or Lead-Lag. Each four-digit numbers for the parameter mean the auxiliary motor numbers and indicate the priority of auxiliary motors. In other words, the most right number of [AP1-45 Curr. Prty1] indicates the priority of Auxiliary motor 1 and the second number from the right of [AP1-46 Curr. Prty2] indicates the priority of Auxiliary motor 2. 
AP1-47 Lead Lag Status	Not displayed, when AP1-40 Lead Lag Sel] is "Contactor Lag". If [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag, or Slave Only, it indicates the current Lead-Lag operation status of the Drive.
AP1-48 Lag Stop Sel	When [AP1-48 Lag Stop Sel] is set to "Yes" during input to stop operating, auxiliary motors are turned off at the same time. When [AP1-48 Aux All Stop] is set to "No", auxiliary motors are turned off gradually based on time of [AP1- 54 Destage DT].
AP1-49 ALT Sequence	Sets the operating Sequence of MMC and Lead-Lag. FIFO : Same as On/Off order of auxiliary motors. FILO: Opposite to On/Off order auxiliary motors. Op Time Order : setting automatically according to operating time of auxiliary motors. Stop history: Opposite to On/Off order of auxiliary motors. Additionally, when the running drive is stopped, it changes to the lowest priority. (Only works in lead-lag systems.)
AP1-50 Stage Pres. Dv AP1-59 Destage Pres.	One of the conditions to turn on and off the next auxiliary motors. Parameters to set the difference when the difference between the Setpoint and feedback is more than regular value Not displayed When [AP1-40 Lead Lag Sel] is "Slave Only".
AP1-51 Acc Time AP1-52 Dec Time	Parameters used when [AP1-40] is set to "Contactor Lag" When an auxiliary motor starts or stops, the main motor stops the PID control, and performs general acceleration and deceleration. When an auxiliary motor starts, the main motor decelerates to the auxiliary motor deceleration frequency set at AP1-70–77 (Destage Freq 1–8) based on the deceleration time set at AP1-52 (Aux Dec Time). When the auxiliary motor stops, the main motor accelerates up to the auxiliary motor restart frequency set at AP1-61–68 (Stage Freq 1–8) based on the acceleration time set at AP1-51 (Aux Acc Time).
AP1-53 Stage DT AP1-54 Destage DT	The auxiliary motors turns on or off after the auxiliary motor stop delay time or the auxiliary motor restart delay time elapses, or if the difference between the current setpoint and the feedback is greater than the value set at [AP1-50 Stage Pres Dv] or less than the value set at [AP1-59 Destage Pres.] .
AP1-60 Lag Freq	Parameters used when [AP1-40] is set to "Fixed Lag" Sets the output frequency of the operating lag drive.

Code	Description
AP1-61–68 Stage freq1–8	When [AP1-40 Lead Lag Sel] is contactor lag. This is the reference frequency for staging the corresponding auxiliary motor number. Ex) If the priority is 1,2,3,4 and auxiliary motors 1 and 2 are currently operating, the output frequency of the main motor must be higher than [Stage freq3] to satisfy the staging condition. When [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag. [AP1-61 Stage freq1] is the reference frequency for Aux Motor staging. [Stage freq 2-8] are not displayed.
AP1-70–77 Destage freq1–8	When [AP1-40 Lead Lag Sel] is contactor lag. This is the reference frequency for destaging the corresponding auxiliary motor number. Ex) If the priority is 1,2,3,4 and auxiliary motors 1 and 2 are currently operating, the output frequency of the main motor must be lower than [Destage freq2] to satisfy the destaging condition. When [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag. [AP1-70 Destage freq1] is the reference frequency for Aux Motor to be destaged. [Destage freq 2-8] are not displayed.
AP1-78 DataShare	Not displayed, when AP1-40 Lead Lag Sel] is "Contactor Lag", "Slave Only" It is a function to share the parameters of Lead Drive with Lag Drives. None: Do not share data. Auto: If you change the parameters of the shared list in Lead Drive, share it with Lag Drive. Manual: Only Lead Drives can be set up, and all parameters in the shared list are shared with Lag Drives.
AP1-79 All CommErr	Sets whether or not the Lead-Lag Drive Trip occurs in the event of a communication error. Not displayed, when AP1-40 Lead Lag Sel] is "Contactor Lag", "Slave Only" No: Only drives with communication failure Trip [CommEr!!] will occur. Yes: All drives have [CommEr!!] in the event of a communication failure Trip will occur.
AP1-80–87 Aux1–8 Ref Comp	Set the PID Setpoint value to be increased depending on whether the Aux Motor is running. The value of [Aux@ Ref Comp] is added to the PID Setpoint according to the number of runs of the Aux Motor. (@ = 1 to 8) Ex) If one Aux Motor runs, the value of [AP1-80 Aux1 Ref Comp] is added to the PID Setpoint. It is not displayed when [AP1-40 Lead Lag Sel] is Slave Only.
AP1-88 Jockey Pump	Sets whether or not the Jockey Pump operates. Only Leader Drive can be set
AP1-89 Jockey Dly T	Sets the Jockey Pump stop time.
AP1-90 Ext. Mrt OL	Sets whether the interlock function is enabled. If [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag or Slave Only, it is not displayed. Interlock operates regardless of setting. 0: Disabled: Interlock operation is not used. 1: En & NoneTrip: Interlock function is used, but Trip does not occur. 2: En & LatchTrip: Interlock function is used, and LatchType Trip occurs. 3: En & LevelTrip: Interlock function is used, and LevelType Trip occurs.
AP1-91 Ext. Mrt OL T	Sets the delay time for Main Pump changes. It is used when [AP1-40 Lead Lag Sel] is Contactor Lag and [AP1-55 Alternate Mode] is Main Exchange. In case the main motor needs to be changed due to an interlock input to the main motor. In case the Main Motor needs to be changed by Alternate operation. If [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag or Slave Only, it is not displayed.

Code	Description
AP1-94 * Of Drives	When [AP1-40 Lead Lag Sel] is "Follow Lead", "Fixed Lag" or "Slave Only", set the number of drives to drive to [Lead-Lag Drive] in the entire Lead-Lag system. Ex) If [AP1-42 * of Pumps] is set to "8" and [AP1-94 * of Drives] is set to "5", only 5 units operate and the remaining 3 units stand by in Standby status. If [AP1-40 Lead Lag Sel] is Contactor Lag or Slave Only, it is not displayed.
AP1-95 RunTimeMonitor	Selects auxiliary Pump to be used in AP1-96 and AP1-97. Lead Drive can be selected for all drives. Lag Drive can only select parameters that correspond to its ID.
AP1-96 PmpRunTime Day	Indicates operating time(day) of auxiliary Pump selected in AP1-95.
AP1-97 PmpRunTime Min	Indicates operating time(min) of auxiliary Pump selected in AP1-95.
AP1-98 PmpRunTime Clr	Deletes operating time of auxiliary Pump.
AP2-76 FbkSource Mode	[AP2-76] setting allows the System's PID Feedback to switch to Network if the analog feedback is lost. 0: When set to None, no switching is performed in the event of PID Feedback loss. 1: When set to Ana->Net, Alarm, PID Feedback lost condition will switch to Network Feedback and "FBK: Ana->Net" Warning is displayed. 2: When set to Ana->Net, No Alarm, PID Feedback lost condition will switch to Network Feedback without displaying a warning.
OUT-31–35 Relay 1–5 OUT-36 Q1 Define	Configure the output terminals to '21 (MMC)' to use the terminals to control the auxiliary motors. The number of the configured output terminals determines the total number of auxiliary motors to be used.

5.54 Multiple Motor Control (MMC)

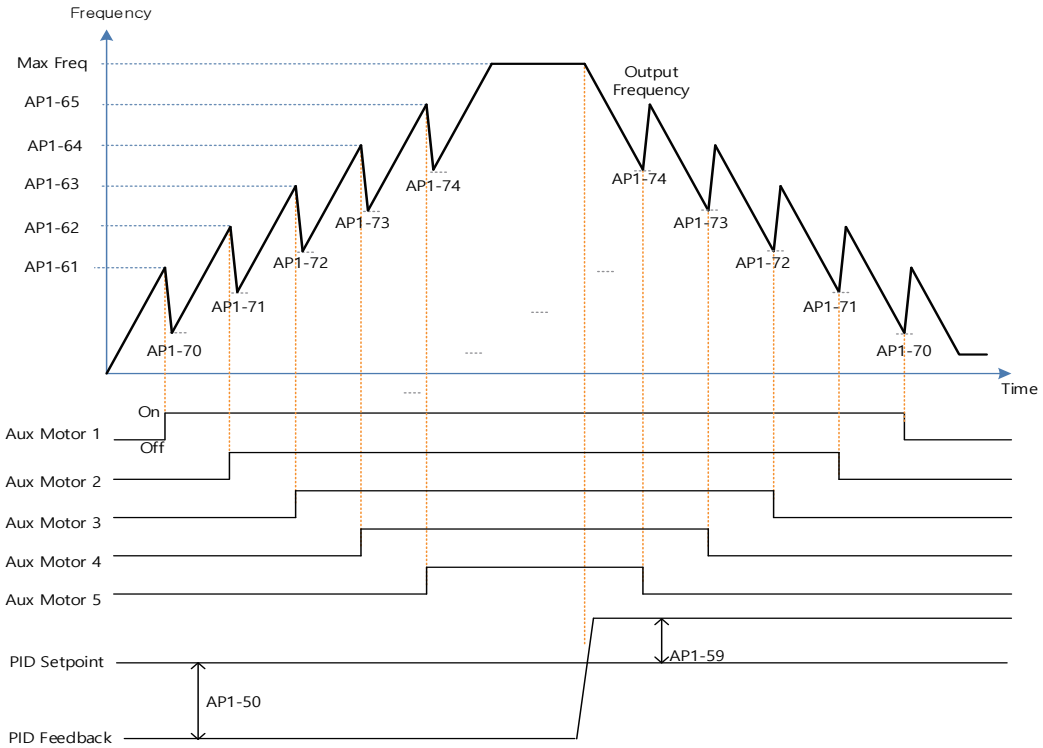
5.54.1 Multiple Motor Control Basic Sequence (Contactor Lag)

Multiple motor control (MMC) is an operation based on PID control. During an MMC operation, the main and auxiliary motors organically operate together.

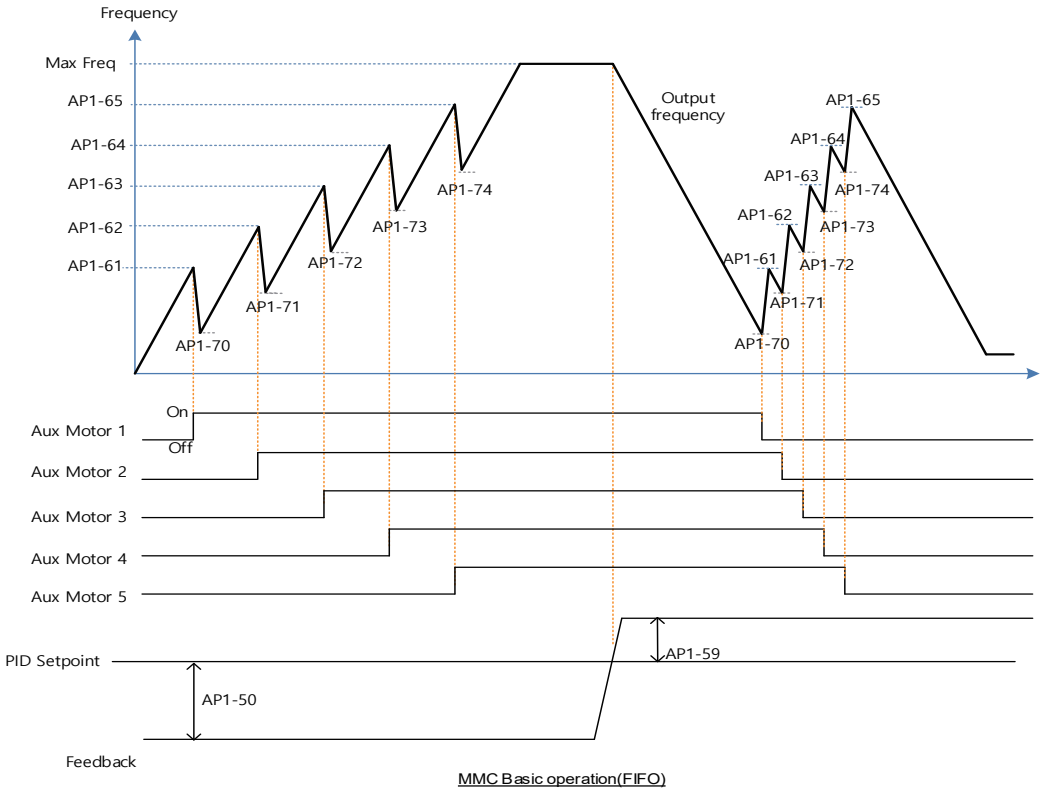
During a PID operation, the auxiliary motors are turned on when the inverter frequency reaches the start frequencies set at AP1-61–65 (Stage Freq1–5.), and the difference between the PID setpoint and feedback is bigger than the value set at AP1-50. Then, the auxiliary motors stop operating when the operation frequency reach the stop frequency set at AP1-70–74 (Stage Freq 1–5) and the difference between the PID feedback and reference becomes greater than the value set at AP1-50.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP1	61–65	#1–5 auxiliary motor start frequency	Stage Freq 1–5	Frequency value within the range	Low Freq– High Freq	Hz
	50	Auxiliary motors pressure difference	Stage pres. Dv	PID unit value within the range	0–Max (PID unit)	%
	70–74	#1–5 auxiliary motor stop frequency	Destage Freq 1–5	Frequency value within the range	Low Freq– High Freq	Hz

The following diagram describes the MMC basic sequence based on FILO and FIFO settings.

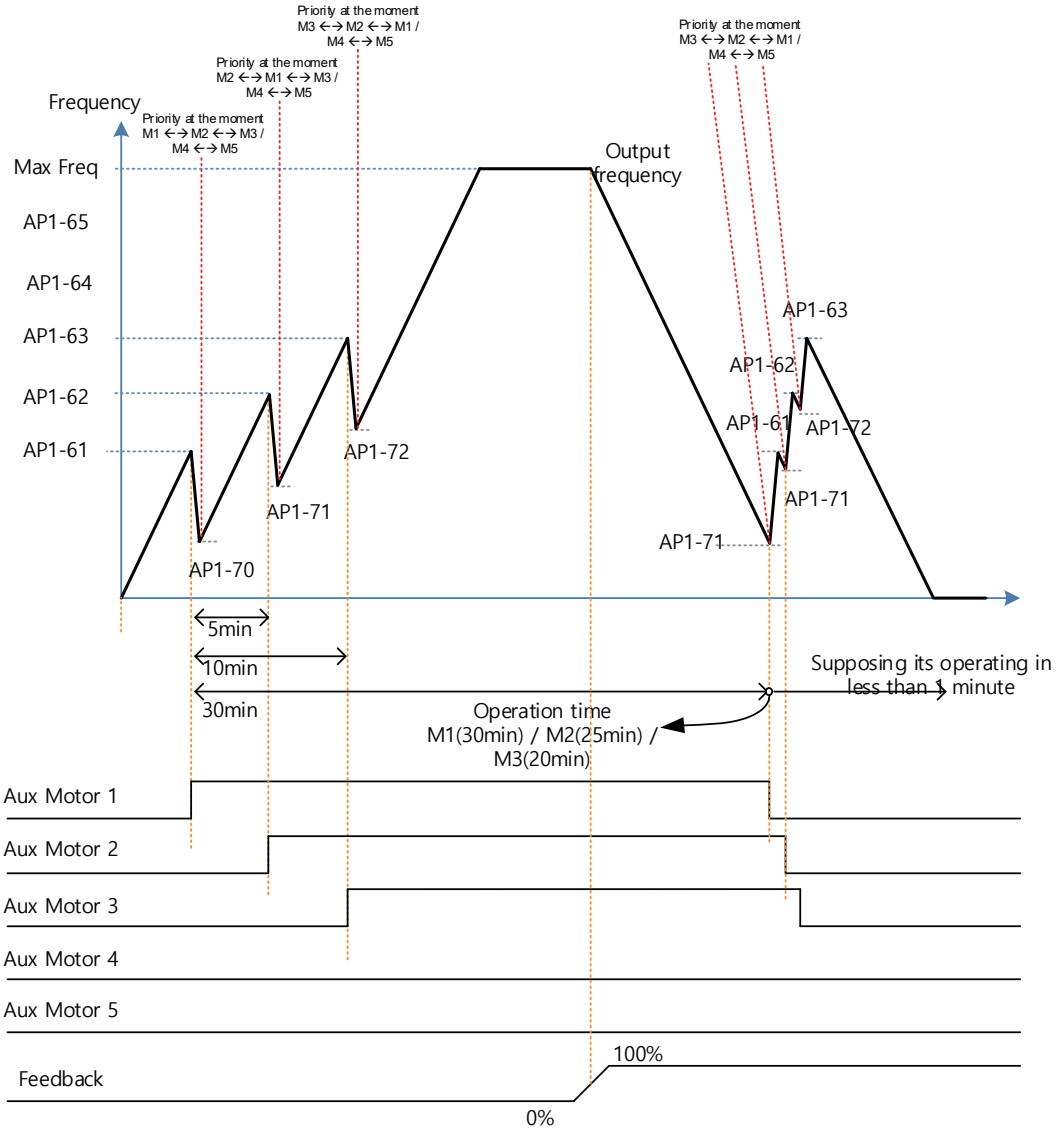


MMC Basic operation(FILO)

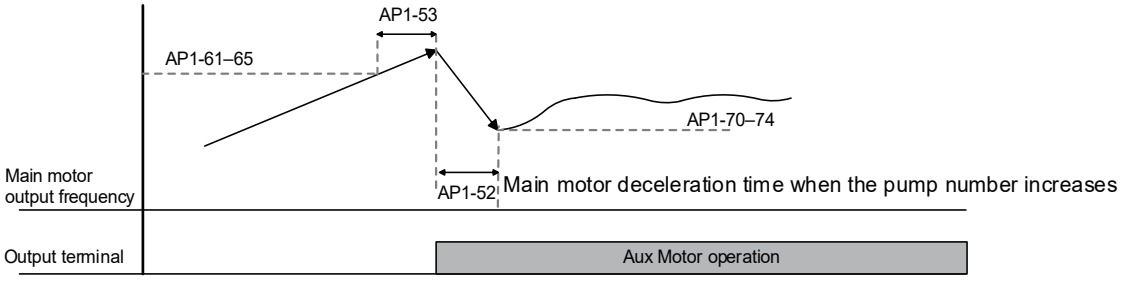


MMC Basic operation(FIFO)

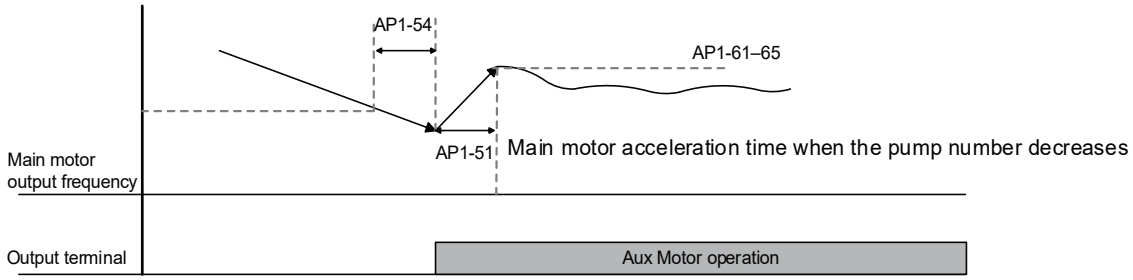
The following diagram is an operation graph based on the start and stop delay times set at AP1-53 (Stage DT) and AP1-54 (Destage DT). When the start or stop frequencies are reached, the auxiliary motor waits for the time set at AP1-53 (Stage DT) or AP1-54 (Destage DT) before it starts or stops.



MMC Basic operation(OP Time Order)



Auxiliary motor start sequence by increased load



Auxiliary Motor stop sequence by decreased load

5.54.2 MMC Standby Motor

In case that the number set to MMC in [Relay 1–5] of OUT group is lower than the number of [Num of Aux], auxiliary motor becomes Standby motor state as much as the difference.

Ex) In case that Relay1, 2, 3 and 4, and 5 are set to MMC and the number of [Num of Aux] is 3.

Relay1	Relay2	Relay3	Relay4	Relay5
Operable	Operable	Operable	Standby	Standby

In this case, though only Relay1, 2, 3 operate MMC function and the output of Relay is set to MMC, it doesn't work as long as the order is not changed by Interlock and Auto Change.

Standby auxiliary motor becomes operable when there is Interlock or Auto change in Operable auxiliary motor.

5.54.3 MMC Alternate

The auto change function enables the inverter to automatically switch operations between main and auxiliary motors. Prolonged continuous operation of a motor deteriorates motor capabilities. The auto change function switches the motors automatically when certain conditions are met to avoid biased use of certain motors and protect them from deterioration.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
AP1	55	Alternate Mode	Alternate Mode	0	None	0–2	-
				1	Aux Exchange		
				2	Main Exchange		
	56	Alternate time	Alternate Time	Time value within the range		00: 00–99: 00	Min.
	57	Alternate frequency	Alternate Level	Frequency value within the range		Low Freq– High Freq	Hz
	58	Alternate operation time	Alt Timer Disp	Time value within the range		-	Sec.

Alternate Details

Code	Description
AP1-55 Alternate Mode	Select the motors to apply the auto change function. Setting: 0 None; 1 Aux Exchange; 2 Main Exchange Refer to Examples of Auto Change Sequences in the following pages for details. Not displayed if [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag, Slave Only.
AP1-56 Alternate Time	Sets the auto change intervals.
AP1-57 AlternateLevel	The parameter is for Main Exchange. In case that [AP1-55 Alternate Mode] is set to Main Exchange, all the conditions for Auto Change are met under the frequency in which output frequency of Main motors are set in AP1-57. AP1-57 is the frequency to activate Auto Change. Not displayed if [AP1-40 Lead Lag Sel] is Follow Lead, Fixed Lag, Slave Only.
AP1-58 Alt Timer Disp	Indicates time to activate Auto Change. In case that other conditions for Auto Change are not met in spite of meeting the condition of AP1-56, the value of time in AP1-58 might be bigger than the value set at Auto Ch Time of AP1-56 because of the failure of Auto Change.

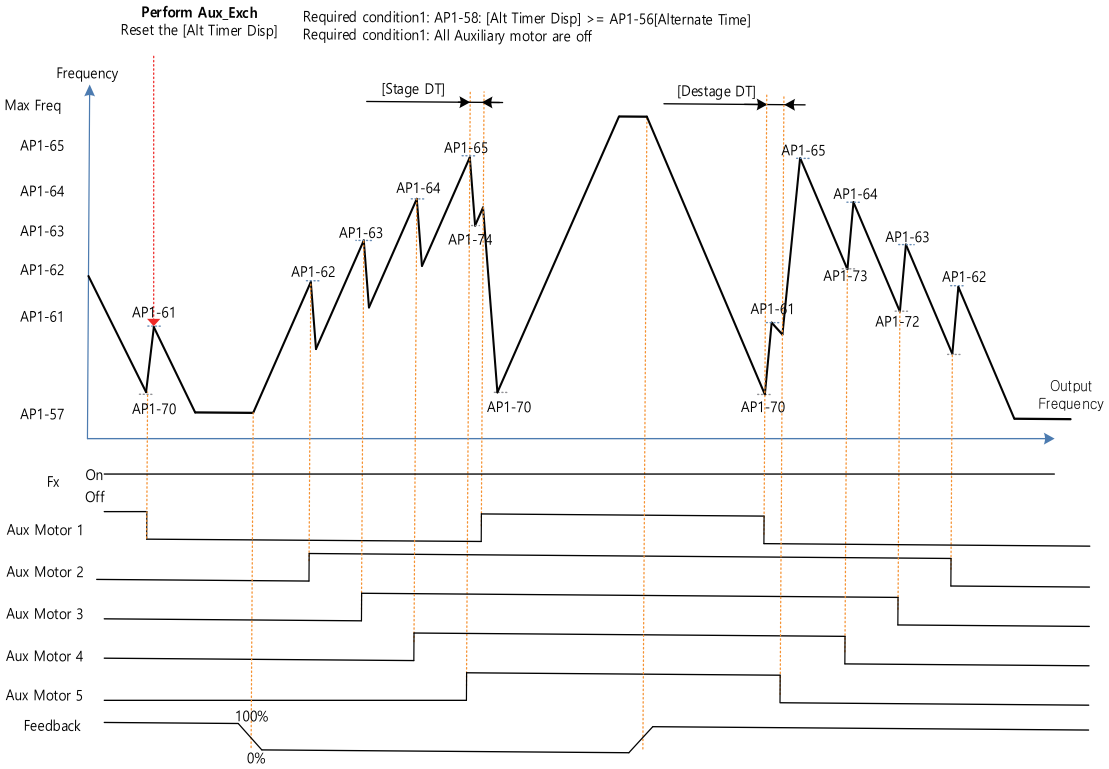
When AP1-55 (Alternate Mode) is set to '0 (None),' the auxiliary motors operates based on the order (sequence) set at AP1-43 (Starting Aux). Auto Change functionality is disabled.

When AP1-55 (Alternate Mode) is set to '1 (Aux Exchange)', the auxiliary motors operate based on the order (sequence) set at AP1-43 (Starting Aux). Auto Change is activated when auxiliary motors are in the operating state over time of AP1-56 and then every auxiliary motor is stopped. Once the auto change is operated, the auxiliary motor that started first is given the lowest priority and all the other auxiliary motors' priority level increases by 1. Then, general MMC operation continues.

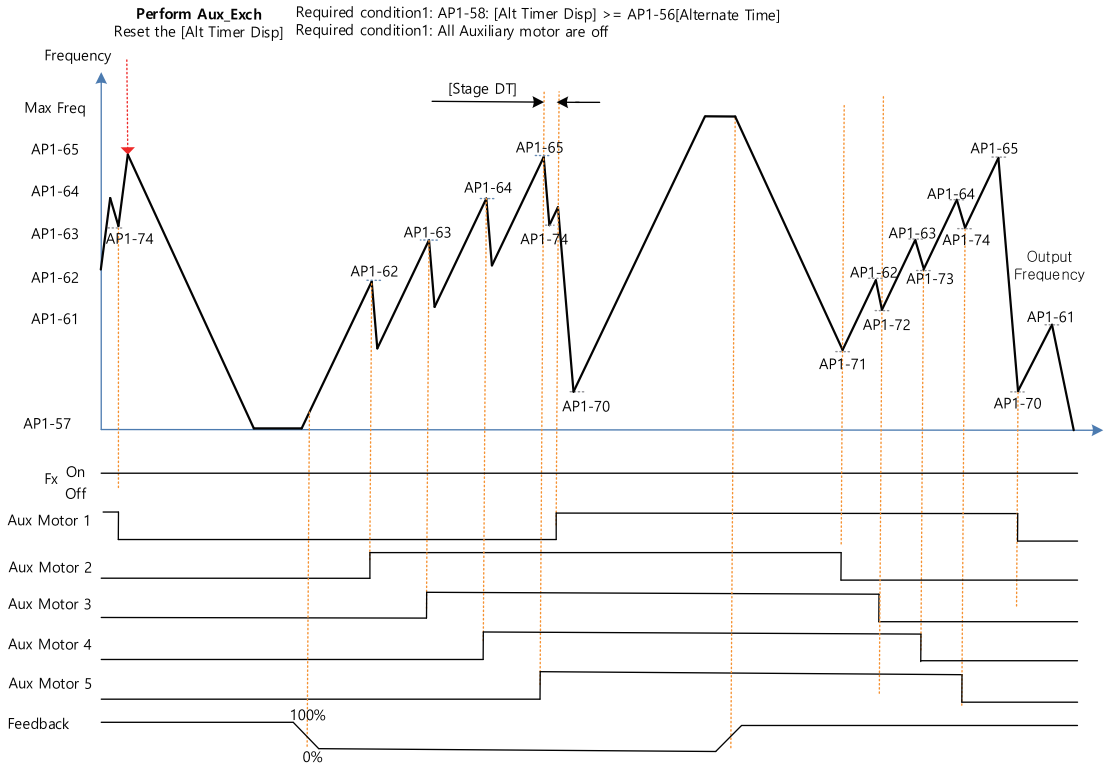
NOTE

Auto change does not work while the auxiliary motors are operating. Auto change is operated only when all the auxiliary motors are stopped and if all the conditions set for the auto change are met. When the inverter stops, all motors stop operating, and the auxiliary motor with the highest priority becomes the starting auxiliary motor. If the inverter power is turned off then turned back on, the auxiliary motor set at AP1-43 (Run Priority) becomes the starting auxiliary motor.

Start and stop orders of the auxiliary motors are based on the order set at AP1-49 (FIFO/FILO).The following diagrams depict the auxiliary motor start and stop sequence, based on a FIFO configuration, when the inverter operation time exceeds the auto change interval set at AP1-58. If all the auxiliary motors are turned off and the inverter operation frequency is below the frequency set at AP1-58 (Alt Timer Disp), auto change is operated. Then, when the inverter frequency increases due to decrease in the feedback, auxiliary motor #2 starts instead of auxiliary motor #1 due to this auto change (auxiliary motor #1 starts last, for it has the lowest priority). Later on during the operation, when the feedback increases and the auxiliary motors begin to stop, the FILO setting is applied to control the order for the auxiliary motors to stop.

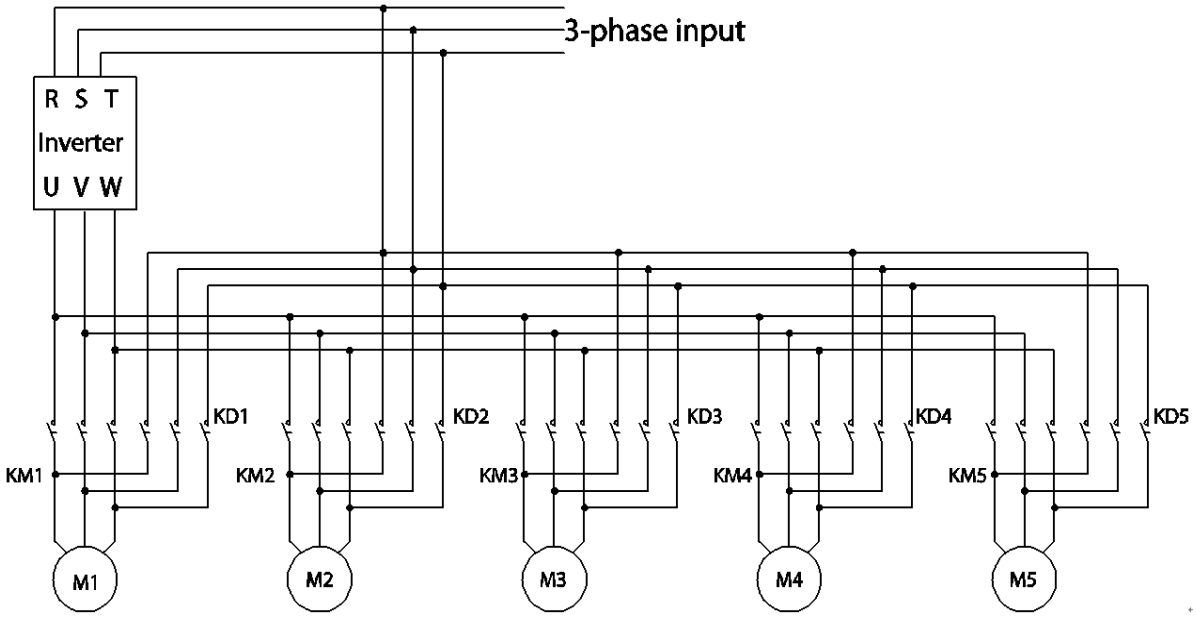


Aux Auto Change operation(FILO)



Aux Auto Change operation(FIFO)

When AP1-55 (Alternate Mode) is set to '2 (Main Exchange)', the system uses all the motors (main and auxiliary motors) regardless of the types. The auxiliary motor with the highest priority is operated first and used as the main motor. Then, when the auto change conditions are met, this motor is stopped and the motor priorities are re-arranged. This way, the system always operates the motor with the highest priority and uses it as the main motor of the MMC operation. In this case, before auto change is operated for the main motor, the interlock delay time set at AP1-91 (Ext. Mrt OL T) is applied.

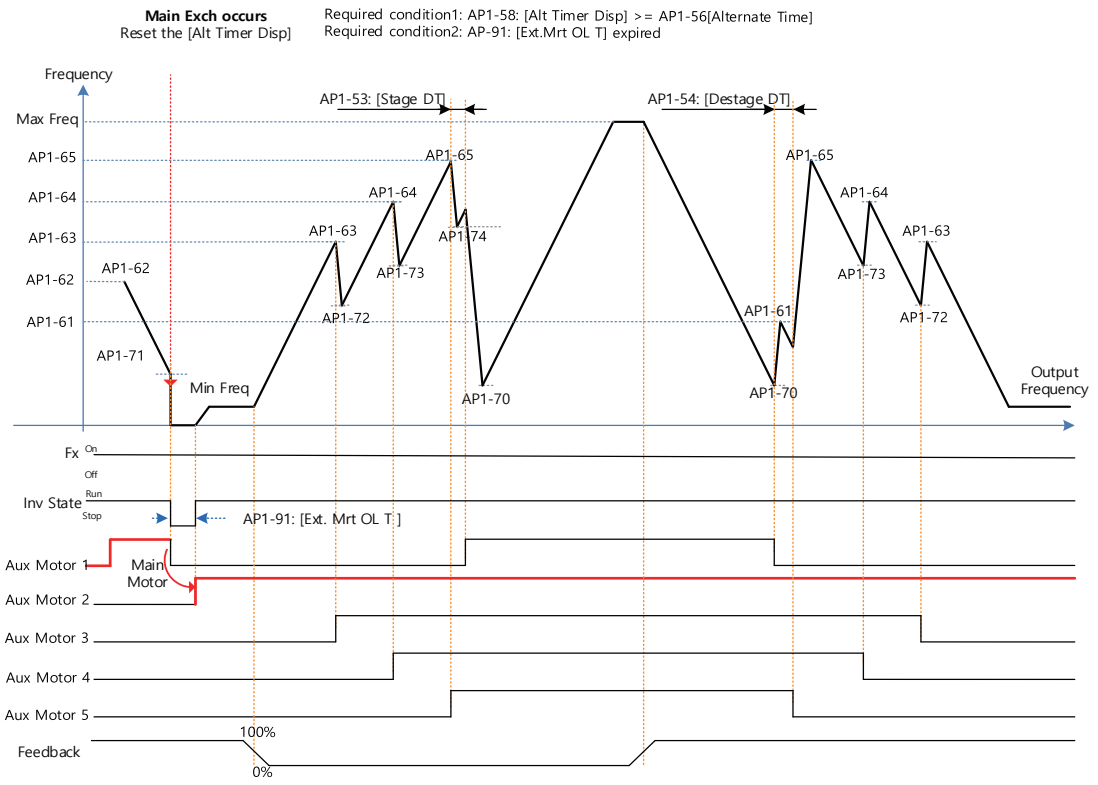


NOTE

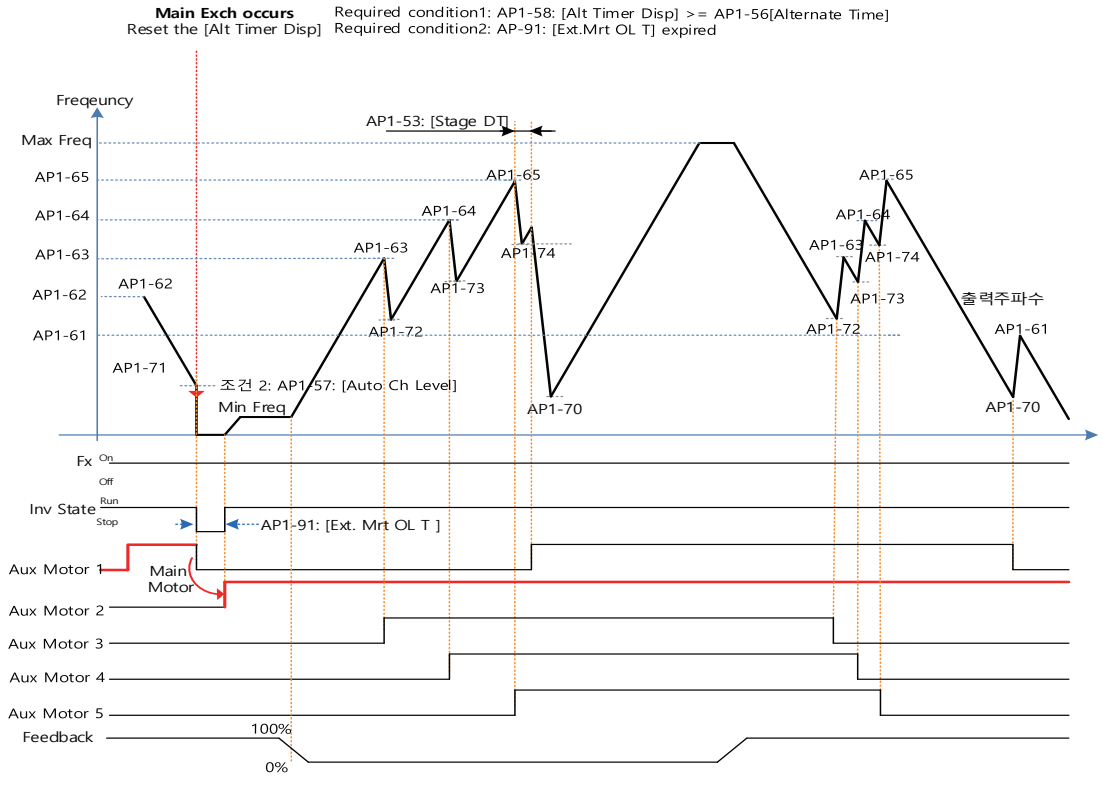
Auto change does not work while the auxiliary motors are operating. Auto change is operated only when all the auxiliary motors are stopped and if all the conditions set for the auto change are met. When the inverter stops, all motors stop operating, and the auxiliary motor with the highest priority becomes the starting auxiliary motor. If the inverter power is turned off then turned back on, the auxiliary motor set at AP1-43 (Run Priority) becomes the starting auxiliary motor.

The following diagrams depict the auto change operation when AP1-55(Alternate Mode) is set to 2(Main Exchange) when the inverter operation time exceeds the auto change interval set at AP1-58. If the inverter operation frequency is below the frequency set at AP1-57, all the auxiliary motors including the start auxiliary motor are turned off. After the delay time set at AP1-91 (Interlock DT) elapses, the 'Main' auto change is operated. After the 'Main' auto change, the auxiliary motor that was turned on after the starting auxiliary motor becomes the main motor.

In the following diagrams, because auxiliary motor #1 is the starting auxiliary motor. Auxiliary motor #2 becomes the main motor after the auto change. The auxiliary motor on/off operation is identical to that of Aux Exchange, and the 'off' conditions differ based on the FIFO/FILO configuration.



Main Auto Change Operation (FILO)



Main Auto Change operation(FIFO)

5.54.4 MMC Interlock

When there is motor trouble, the interlock feature is used to stop the affected motor and replace it with another that is not currently operating (off state). To activate the interlock feature, connect the cables for abnormal motor signal to the inverter input terminal and configure the terminals as interlock 1–5 inputs. Then, the inverter decides the motor's availability based on the signal inputs. The order in which the alternative motor is selected is decided based on the auto change mode selection options set at AP1-55.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
AP1	90	Interlock selection	Ext. Mrt OL	0: Disabled	0	Disabled	-
					1	En&None Trip	
					2	En&Latch Trip	
					3	En&Level Trip	

After configuring the IN-65–71 multi-purpose input terminals as Interlock input 1–5, if an interlock signal is received from an auxiliary motor, the output contacts are turned off for the motor and the motor is excluded from the MMC operation. This causes the priority level of the auxiliary motors with lower priority level than the interlocked motor to be increased by 1.

The interlock is released when the input terminals (IN-65–71) are turned off, and the relevant auxiliary motor is included in the MMC operation again, with lowest priority.

When the inverter stops, all motors stop operating, and the auxiliary motor with the highest priority becomes the starting auxiliary motor.

When the multi-purpose input terminals (IN-65–71, P1–7 Define) are set for the interlock feature, an interlock is 'Off' when the contacts are valid, and 'On' when they are invalid.

5.54.5 Description of MMC Interlock Operations

Description of operation according to [AP1-90 Ext. Mrt OL] setting when the above conditions are satisfied

1. [En & NoneTrip]
   - i Interlock operation is activated, but even if (MMC Interlock Trip occurrence condition) is satisfied, trip does not occur and Coast stop.
   - ii "INT" is displayed at the top of the keypad screen and operation does not occur.
   - iii When one of the {Interlock@} DIs that was off turns on, operation resumes according to the operation command input status.

2. [En & LatchTrip]
   - i Interlock operation is activated, and if (MMC Interlock Trip occurrence condition) is satisfied, Latch Type Trip occurs.
   - ii Even if one of {Interlock@} DIs that was off turns on, trip is not cleared.

3. [En & LevelTrip]
   - i Interlock operation is activated, and if (MMC Interlock Trip occurrence condition) is satisfied, Level Type Trip occurs.
   - ii The keypad display is the same as Latch Type Trip occurrence.
   - iii When one of the {Interlock@} DIs that was turned off turns on, the trip is cleared and operation resumes according to the operating command input status.

InterLock Setting Details

Code	Description
AP1-90 Ext. Mrt OL	Enables or disables the Interlock.
AP1-91 Ext. Mrt OL T	Sets the delay time before the Interlock occurs.

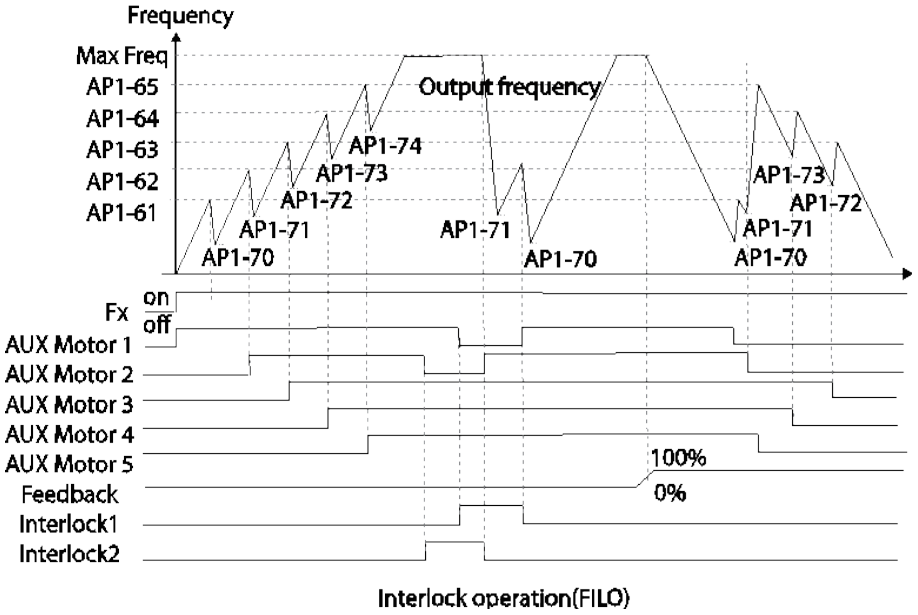
Note

IN-65–71 PxDefine: Select the terminal from the input terminal function group (IN-65–71) and set Interlock 1-5 respectively with the correct motor order. 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).

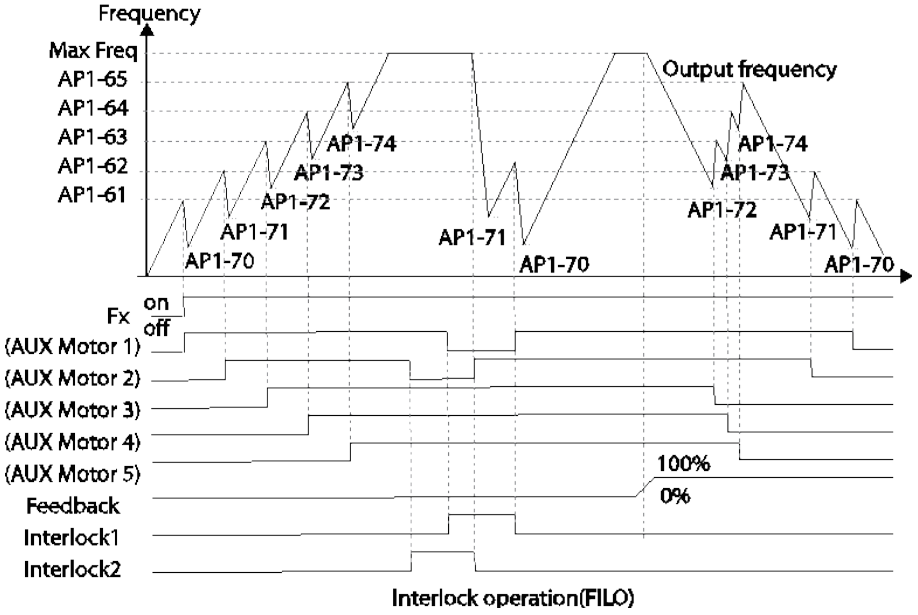
However, if auto change mode selection (AP1-55) is set to '2 (Main)', and the main and auxiliary motors are connected to the inverter output terminal Relay 1,2,3,4, Interlock 1,2,3,4 are the monitors connected to Relay 1,2,3,4.

The figure below shows the motor operating as a sequence by FILO. The motor turns on from the start

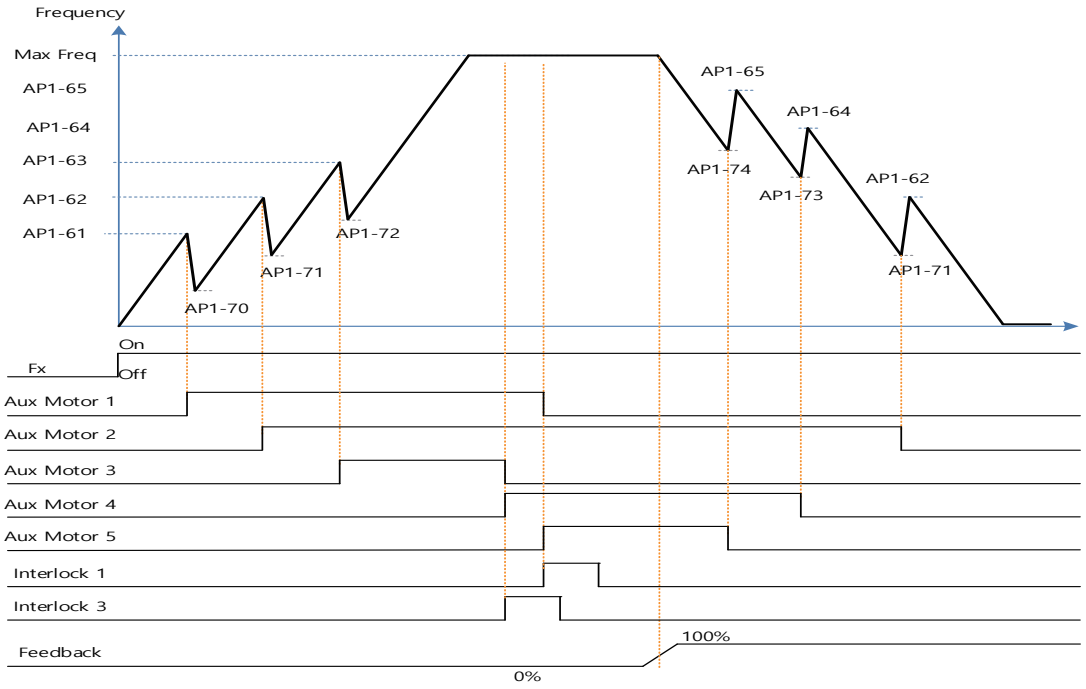
ing auxiliary motor (Starting Aux) by order and turns off depending on the rise of PID feedback. At this point, the interlock occurs at auxiliary motor #2 by multi-function input, the auxiliary motor turns off. The output frequency falls to the frequency set at AP1-71 and rises again. Then, the interlock occurs at auxiliary motor #1. The auxiliary motor stops and falls to the frequency set at AP1-71, and then rises again. Interlock #2 should be released first, then release interlock #1 to let the auxiliary motor operate (When interlocks are released, they will have the lowest priority of the operating motors). If the auxiliary motor turns off by a rise of Feedback, the auxiliary motors turn off in order from 1 to 5, because auxiliary motor #1 turned on last. The interlocked auxiliary motor will have the lowest priority.



Interlock operation(FILO)

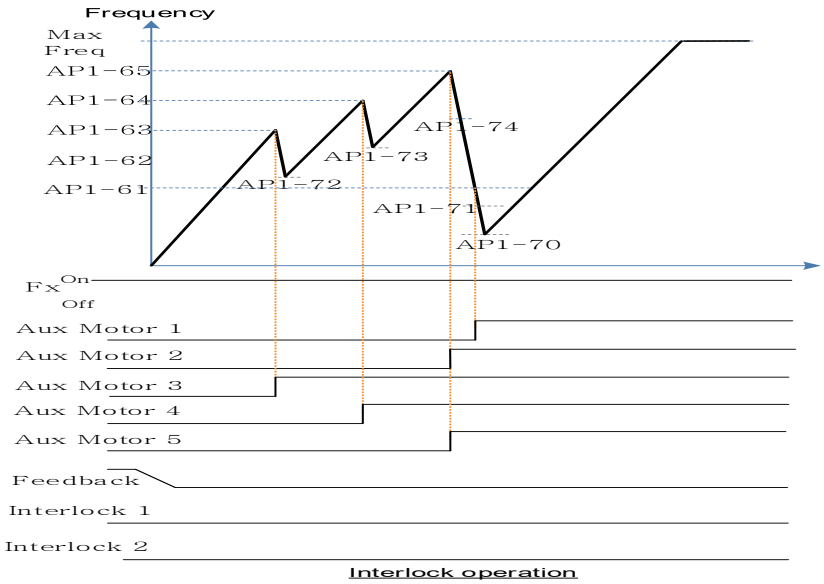


Interlock operation(FILO)



Interlock operation(Op time Order) when Operable Motor and Standby Motor are set to 3 and 2 each

When interlock is released, the auxiliary motor's priority becomes different. When Interlock occurs at auxiliary motor #3, the priority is number 1>3>4>5>2. When it occurs at auxiliary motor #1, the priority is number 3>4>5>2>1. The figure below shows the order of the auxiliary motors activating depending on the priority (of Interlock occurring and releasing). In the figure, the order is the same for FILO/FIFO, because the auxiliary motor turns on.



Interlock operation

In case that Operable Motor and Standby Motor are set to 3 and 2 each, it operates in the order of "Aux Motor 2 ←→ Aux Motor 4 ←→ Aux Motor 5".

5.54.6 MMC Aux Motor Time Change

It is used to set a motor to the smallest number among Drives not inter-locked by [AP1-43 Run Priority] and place others in order based on it when operating time of every motor is deleted through <1:All> of [AP1-98 AuxRunTime Clr].

In case that operating time of each motor is deleted through <2: Aux1>–<6: Aux5> of [AP1-98 PmpRunTime Clr] or changed by combining [AP1-96 PmpRunTime Day] and [AP1-97 PmpRunTime Min], motor stopped changes the priority with motor stopped as operating motor does with operating motor.

The table below shows the case to change the operating time of Aux Motor2 running on the same condition of Sequence1.

Sequences	Aux Priority 1 (Operating time: min)	Aux Priority 2 (Operating time: min)	Aux Priority 3 (Operating time: min)	Aux Priority 4 (Operating time: min)	Aux Priority 5 (Operating time: min)
1	Aux Motor3 (00:30) <Operating>	Aux Motor2 (00:40) <Operating>	Aux Motor1 (00:50) <Operating>	Aux Motor4 (01:30) <Operating>	Aux Motor 5 (01:50) <Operating>
Set <3 Aux2of [AP1-98 PmpRunTime Clr]					
2	Aux Motor2 (00:00) <Operating>	Aux Motor3 (00:30) <Operating>	Aux Motor1 (00:50) <Operating>	Aux Motor4 (01:30) <Operating>	Aux Motor 5 (01:50) <Operating>
Set time of Aux2to 2:00 through [AP1-97 PmpRunTime Min]					
3	Aux Motor3 (00:30) <Operating>	Aux Motor1 (00:50) <Operating>	Aux Motor2 (02:00) <Operating>	Aux Motor4 (01:30) <Stopping>	Aux Motor 5 (01:50) < Stopping >

The table below shows the case to change the operating time of Aux Motor5 stopped on the same condition of Sequence1

Sequences	Aux Priority 1 (Operating time: min)	Aux Priority 2 (Operating time: min)	Aux Priority 3 (Operating time: min)	Aux Priority 4 (Operating time: min)	Aux Priority 5 (Operating time: min)
1	Aux Motor3 (00:30) <Operating>	Aux Motor2 (00:40) <Operating>	Aux Motor1 (00:50) <Operating>	Aux Motor4 (01:30) <Stopping>	Aux Motor 5 (01:50) <Stopping>
Set <6: Aux5> of [AP1-98 PmpRunTime Clr]					
2	Aux Motor3 (00:30) <Operating>	Aux Motor2 (00:40) <Operating>	Aux Motor1 (00:50) <Operating>	Aux Motor 5 (0) <Stopping>	Aux Motor 4 (01:30) <Stopping>
Set time of Aux5 to 2:00 through [AP1-97 PmpRunTime Min]					
3	Aux Motor3 (00:30) <Operating>	Aux Motor2 (00:40) <Operating>	Aux Motor1 (00:50) <Operating>	Aux Motor4 (01:30) <Stopping>	Aux Motor 5 (02:00) <Stopping>

5.54.7 MMC Regular Bypass

This function controls the motor speed based on the feedback amount instead of using the PID. Auxiliary motors may be controlled with this feature based on the feedback amount.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP1	41	Bypass selection	Regul Bypass	1	0 No 1 Yes	-
	61–65	#1–5 auxiliary motor start frequency	Stage Freq 1–5	Frequency value within the range	Freq Low Limit–Freq High limit	Hz
	70–74	#1–5 auxiliary motor stop frequency	Destage Freq 1–5	Frequency value within the range	Low Freq–High Freq	Hz
OUT	31–35	Multi-function relay1–5	Relay 1–5	21 Multiple motor control(MMC)	-	-
	36	Multi-function 1 item	Q1 Define	40 KEB Operation	-	-

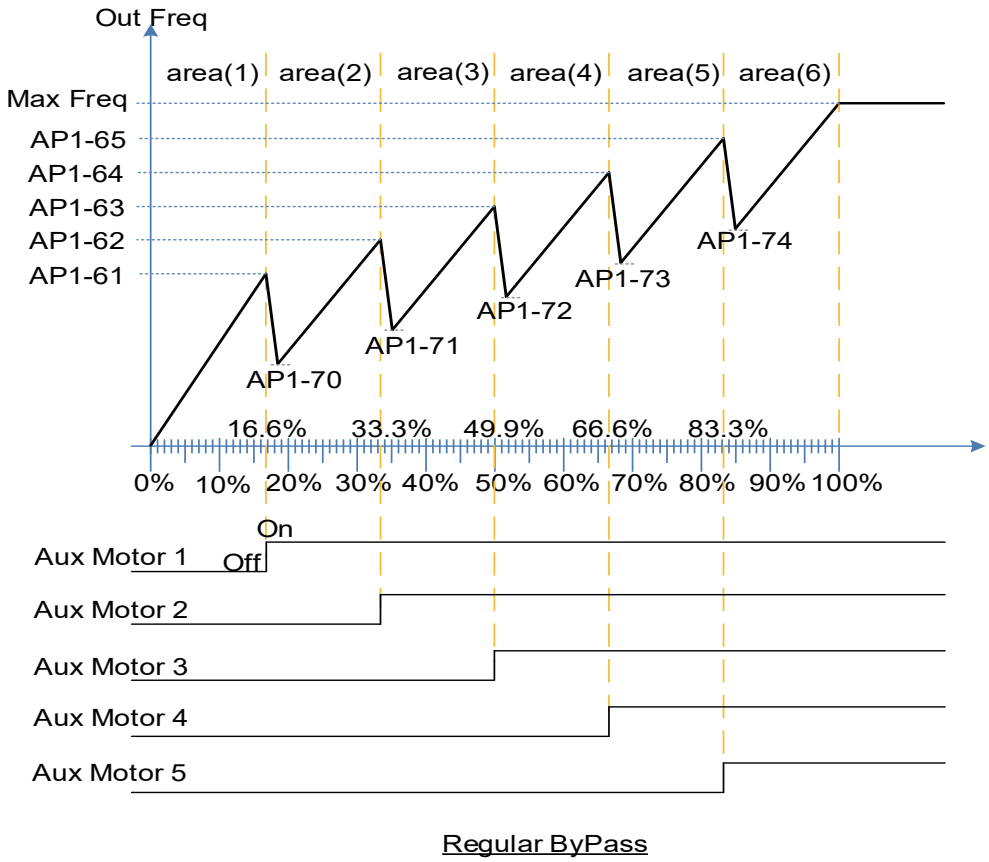
Regular Bypass Detail Settings

Code	Description
AP1-41 Regular Bypass	Sets the regular bypass mode. Mode: 0 – No; 1 – Yes
AP1-61–65 Stage Freq 1–5	Sets the auxiliary motor start frequency.
AP1-70–74 Destage Freq 1–5	Sets the auxiliary motor stop frequency.
OUT-31–35 Relay 1–5 OUT-36 Q1 Define	Set OUT31–35 to '21 (MMC)' to use the out terminal for auxiliary motor operation. The number of configured output terminals determines the total number of auxiliary motors to be used.

When an input set by the PID feedback of the analog input terminal (I or V1 or Pulse) is 100%, divide the area by the number of motors being used (including the main motor). Each auxiliary motor turns on when feedback reaches the relevant level and turns off when feedback goes below the relevant level. The primary motor increases its speed based on the feedback and when it reaches the start frequency of the relevant auxiliary motor and decelerates to the stop frequency.

The primary motor reaccelerates when the frequency increases, depending on the feedback increase. If the relevant auxiliary motor is turned off because of the feedback decrease, the primary motor accelerates from the stop frequency to the start frequency.

To use the regular bypass function, '1 (Yes)' has to be selected in the MMC and PID functions. Only FILO operates between the AP1-49 (FIFO/FILO) in a regular bypass function.

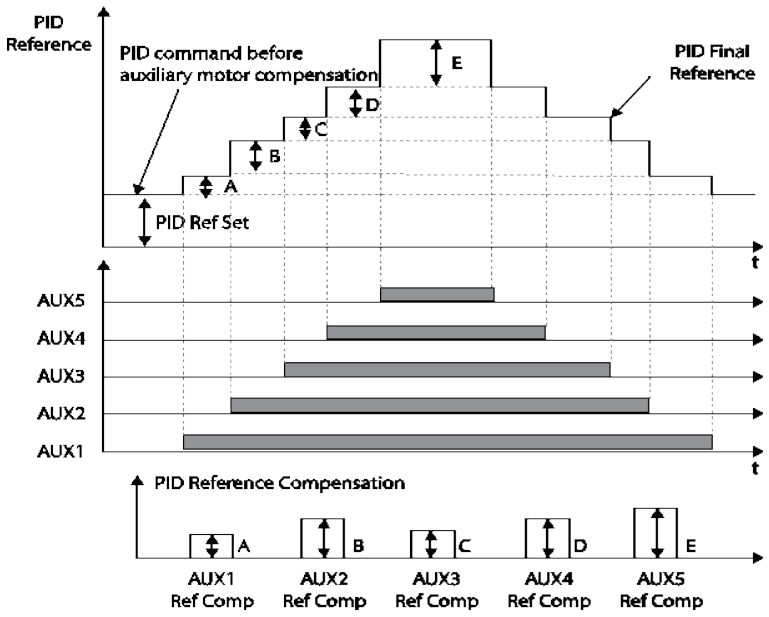


5.54.8 Aux Motor PID Compensation

When the number of operating auxiliary motors increases, the flow rate of the pipe also increases and the pressure of the pipe line decreases. Aux motor PID compensation compensates for this pressure when the number of the auxiliary motor increases. By adding the additional PID reference value (relevant to the auxiliary motor) to the current reference, the loss of pressure can be compensated for.

Auxiliary PID Compensation Detailed Settings

Code	Description
AP1-80–84 Aux 1–5 Ref Comp	Set the relevant PID reference compensation rate whenever the auxiliary motor is turned on. The PID reference can be set over 100%, but when it exceeds 100%, the maximum value of the PID reference is limited to 100%. Unit band value is the value between unit 100%–0%.



< Auxiliary motor PID compensation>

NOTE

When the aux reference value is set to 100%, the final PID reference becomes 100%. In this case, output frequency of the inverter does not decelerate because the PID output does not decelerate even if the input feedback value is 100%.

5.55 Multiple Drive Control (Lead-Lag)

The drive selected [AP1-40 Lead Lag Sel] as <2: Follow Lead> or <3: Fixed Lag> can be {Master Drive}. Among them, the first Drive to be <AUTO State> is {Master Drive}. (If it is <AUTO State> at the same time, the drive with the lowest [COM-01 Int485 St ID] is {Master Drive}. When {Master Drive} is determined, the remaining Drives are {Slave Drive}.

Drives selected as <4: Slave Only> for [AP1-40 Lead Lag Sel] are {Slave Drive} and cannot be {Master Drive}.

{Master Drive} controls PID by receiving feedback from the sensor and controls Multi Drive as a communication master.

{Slave Drive} means the Drive controlled by {Master Drive}.

Each drive number (Drive ID) is [COM-01 Int485 St ID], and all Drive IDs must be set differently.

{Slave Drive} does not operate with {Run Dir Check} Trip (Level Type) if its driving command direction (FWD/REV) is not the same as that of {Master Drive}.

The motor controlled by PID is {Main Motor}. {Main Motor} is always 1 unit and {Aux Motor} may not exist or may be multiple units, and {Main Motor} and {Aux Motor} are changed depending on the situation.

When all motors are stopped, the motor with the highest priority is called {Main Motor}.
Ex) If the order of priority is Drive ID 1,2,3,4, the motor of Drive with ID 1 is {Main Motor}.

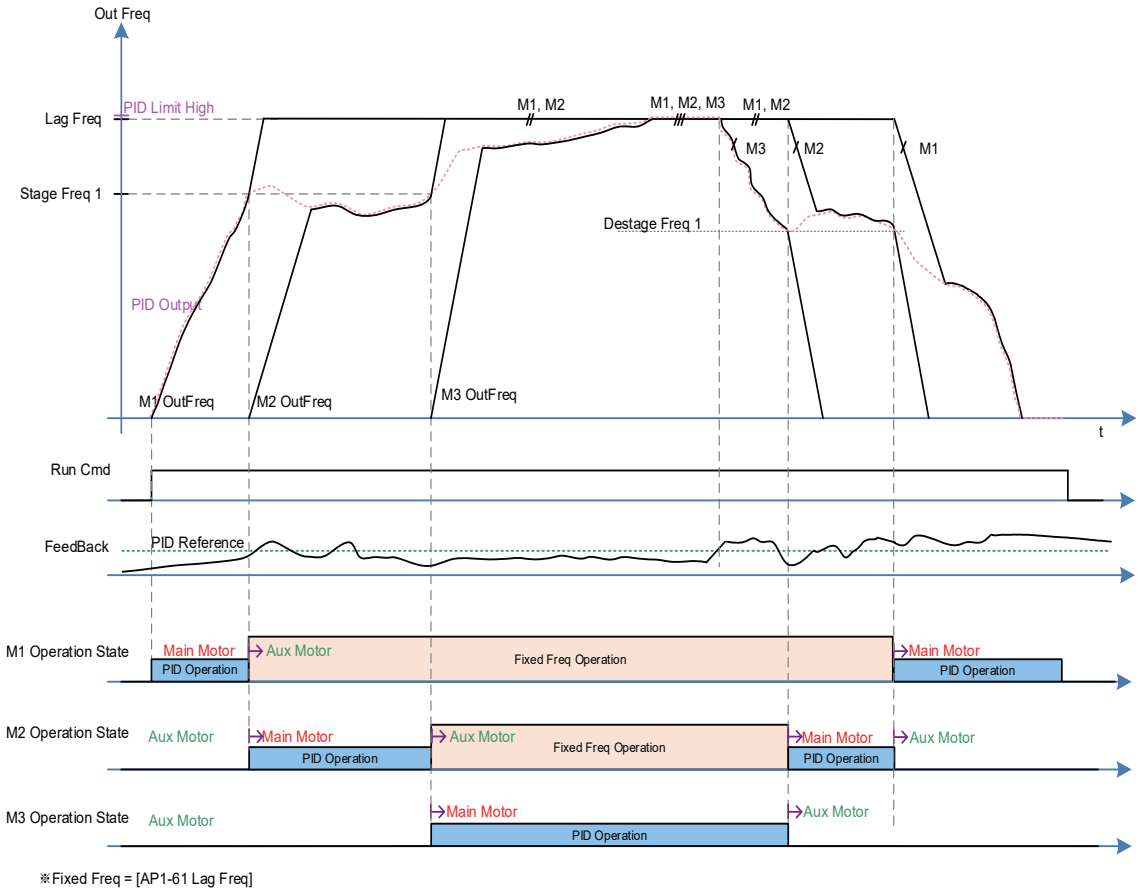
If there is an operating motor, the motor with the slowest priority among the operating motors is called {Main Motor}.
Ex) If the order of priority is Drive ID 1,2,3,4, and Drive ID 1,2 are operating, the motor of Drive with ID 2 is {Main Motor} and the others are {Aux Motor}. If Drive ID3 is driven additionally, the motor of Drive with ID 3 becomes {Main Motor}.

5.55.1 Lead-Lag Fixed Lag

In Fixed Lag mode, only the main motor is PID controlled, and the running Aux motor operates at [AP1-60 Lag Freq] frequency.

The acceleration/deceleration time of the output frequency is changed according to the Master Drive's PID Gain and each drive's [DRV-03 Acc Time] and [DRV-04 Dec Time].

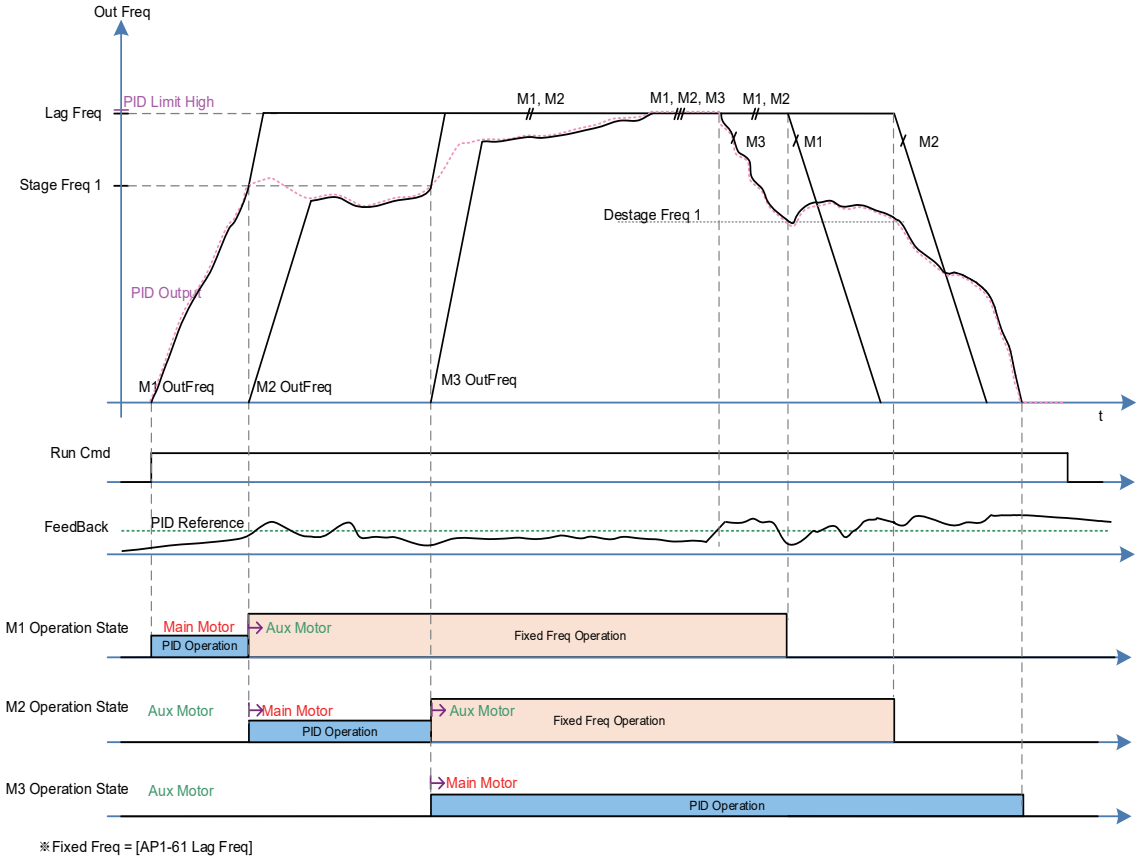
The figure below shows the case where [AP1-49 ALT Sequence] is set to FILO, Op Time Order, and the priority is Motor 1 (M1) -> Motor 2 (M2) -> Motor 3 (M3). (If [AP1-49 ALT Sequence] is set to Op Time Order, the priority of each motor is automatically sorted according to the operation time. The figure below shows the basic operation sequence with unchanged priority.)



※Fixed Freq = [AP1-61 Lag Freq]

The figure below shows the case where [AP1-49 ALT Sequence] is set to FIFO and the priority is Motor 1 (M1) -> Motor 2 (M2) -> Motor 3 (M3).

The on operation of the motor is the same as FILO, OpTime Order operation, but the order of the off operation is different.



Conditions for Aux Motor starts

When the output frequency of the main motor exceeds the [AP1-61 Stage Freq 1], [AP1-44 Lag Pump Run] is increased by 1 after [AP1-53 Stage DT]. The output frequency of the current main motor accelerates or decelerates to [AP1-60 Lag Freq] according to the [DRV-03 Acc Time] and [DRV-04 Dec Time] and becomes an Aux Motor.

At the same time, the next priority motor becomes the Main Motor (PID controlled motor). The priority is [AP1-45/46 Curr. Prty 1/2].

Conditions for Aux Motor Stops (FILO, Op Time Order)

When the output frequency of the main motor is lower than [AP1-70 Destage Freq 1], [AP1-44 Lag Pump Run] is reduced by 1 after [AP1-54 Destage DT]. The current Main Motor is stopped according to [ADV-08 Stop Mode] setting and becomes an Aux Motor.

At the same time, the previous priority motor becomes the Main Motor (PID controlled motor). The priority is [AP1-45/46 Curr. Prty 1/2].

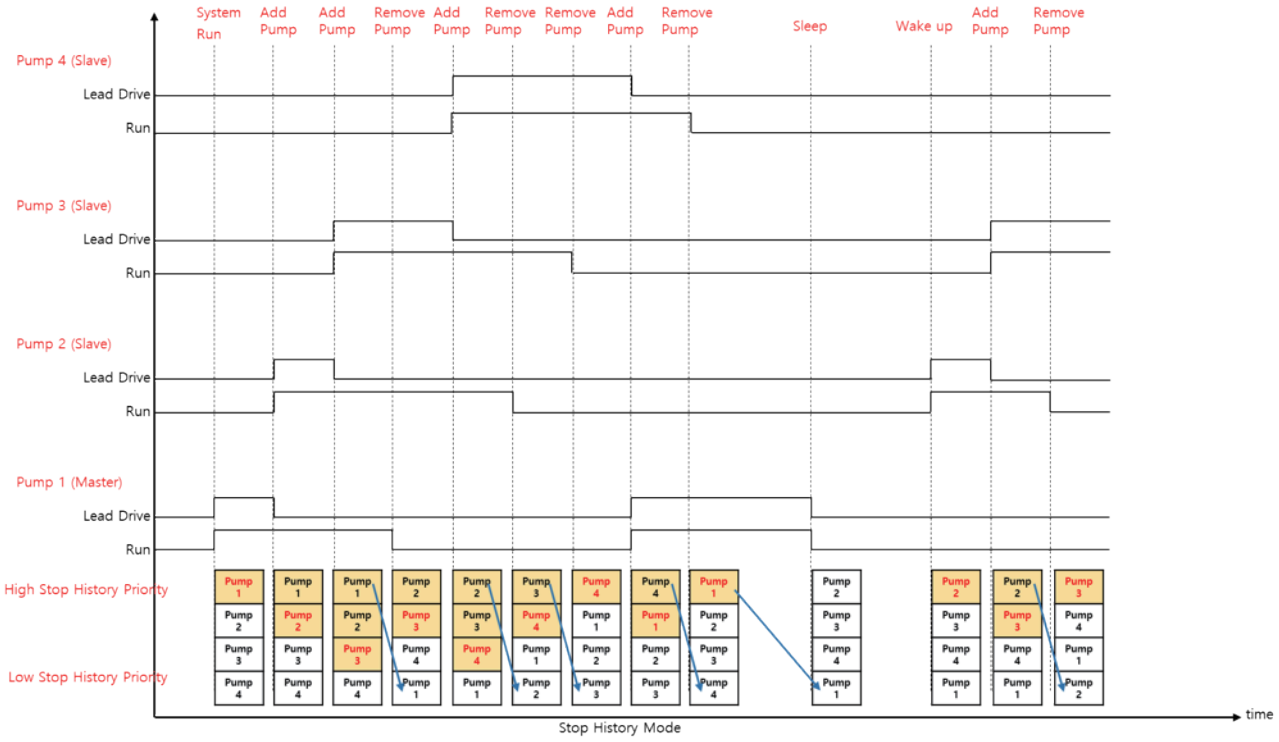
Conditions for Aux Motor Stops (FIFO)

When the output frequency of the main motor is lower than [AP1-70 Destage Freq 1], [AP1-44 Lag Pump Run] is reduced by 1 after [AP1-54 Destage DT].

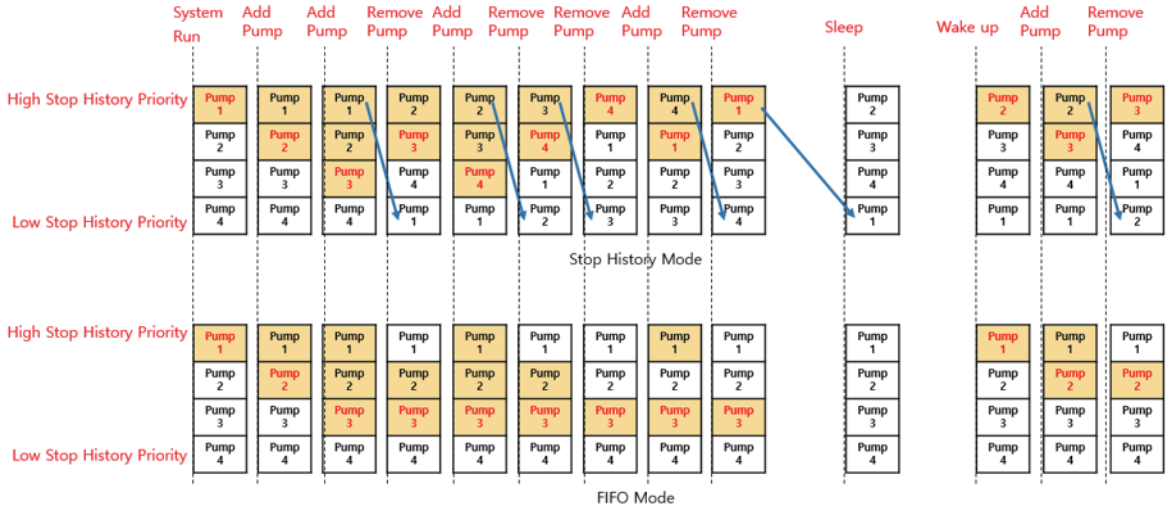
Among the drives currently in operation, the first priority drive stops according to [ADV-08 Stop Mode] setting, but the main motor does not change. The priority is [AP1-45/46 Curr. Prty 1/2].

Conditions for Aux Motor Stops (Stop History)

Stop History Mode basically operates in FIFO mode, and reorders the drives that are stopped to the lowest priority. Also, the system operates by changing the drive that is stopped -> running to the Lead Drive. (Only works in lead-lag systems.)



The difference between FIFO and Stop History is the difference in OFF Sequence, as shown in the figure below.



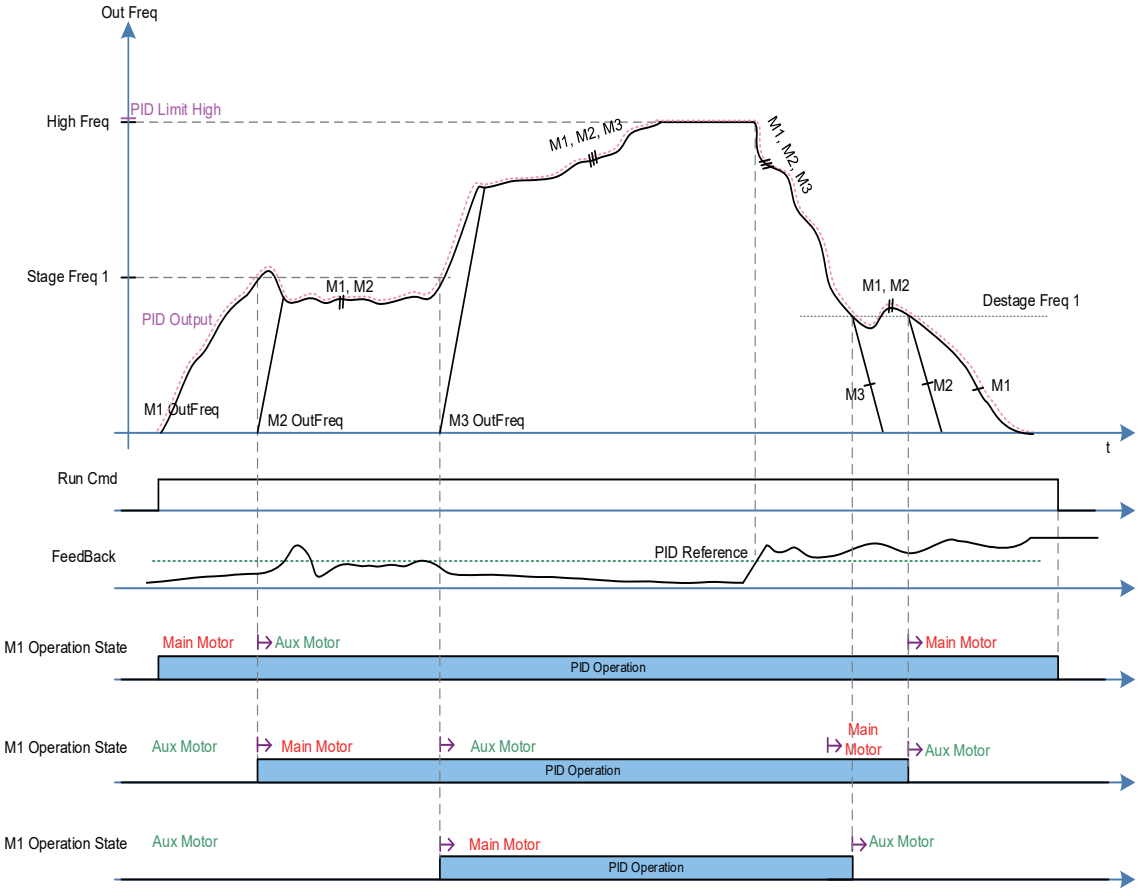
5.55.2 Lead-Lag Follow Lead

In Follow Lead mode, all motors in operation are controlled with the same PID output frequency.

The acceleration/deceleration time of the output frequency is changed according to the Master Drive's PID Gain and each drive's [DRV-03 Acc Time] and [DRV-04 Dec Time].

The figure below shows the case where [AP1-49 ALT Sequence] is set to FILO, Op Time Order, and the priority is Motor 1 (M1) -> Motor 2 (M2) -> Motor 3 (M3).

(If [AP1-49 ALT Sequence] is set to Op Time Order, the priority of each motor is automatically sorted according to the operation time. The figure below shows the basic operation sequence with unchanged priority.)



Conditions for Aux Motor starts

When the output frequency of the main motor exceeds [AP1-61 Stage Freq 1], [AP1-44 Lag Pump Run] is increased by 1 after [AP1-53 Stage DT]. The current Main Motor becomes the Aux Motor and the next priority Aux Motor becomes the Main Motor (PID controlled motor).

At this time, the motor converted to Aux Motor is also controlled with the same output frequency as the Main Motor. The priority is [AP1-45/46 Curr. Prty 1/2].

Conditions for Aux Motor Stops

When the output frequency of the main motor is lower than [AP1-70 Destage Freq 1], [AP1-44 Lag Pump Run] is reduced by 1 after [AP1-54 Destage DT]. The current Main Motor is stopped according to [ADV-08 Stop Mode] setting and becomes an Aux Motor.

At the same time, the previous priority motor becomes the Main Motor (PID controlled motor). The remaining motors in operation continue PID control. The priority is [AP1-45/46 Curr. Prty 1/2.

Priority can be found in [AP1-45/46 Curr. Prty 1/2]. (For FIFO mode, it is the same as the Fixed Lag description).

5.55.3 Lead-Lag Interlock & Trip

Interlock and trip occurring in each drive are collected by Master Drive through communication.

Even if an interlock trip occurs in the master drive, the master is not switched.

Interlock Trip of Lead-Lag is Level Type. (Interlock Trip of MMC is Latch Type.)

When a pipe broken trip occurs in the master drive, the entire driver stops as a whole system trip.

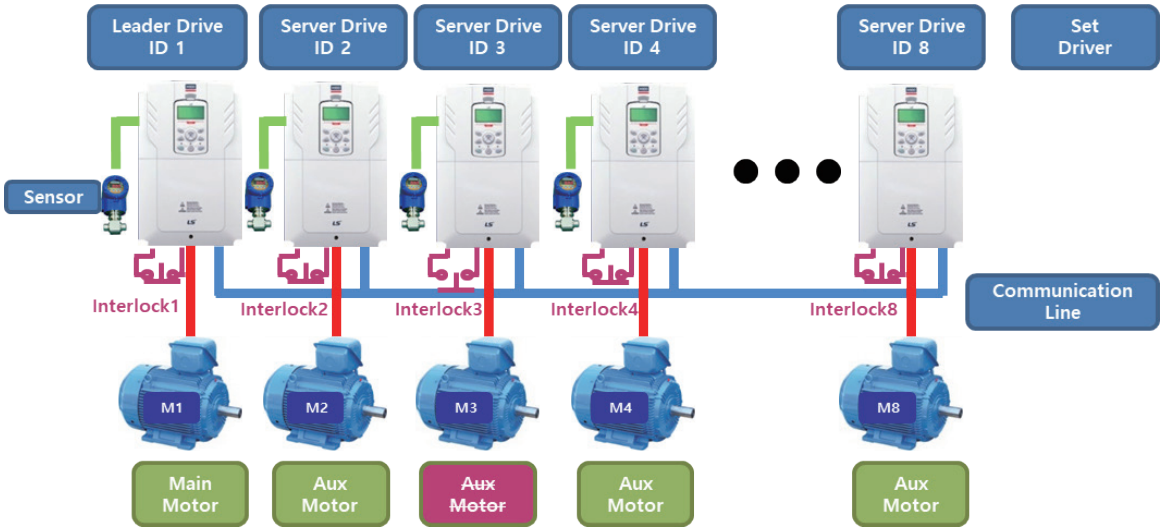
If another trip occurs, the lead-lag operation is continuously performed except for the drive where the trip occurred. (PID control and overall system control are continuously performed by the Master Drive.)

Slave Drive generates interlock trip when interlock signal suitable for its ID is input through multi-function input.

Even if a trip occurs in Lead-Lag mode, the status display of Lead-Lag is maintained, such as “F1+” and “S2“.

Trip can be recognized by the blinking of the red LED on the keypad, but in the case of Warning, "WAN" is displayed first because it is unknown.

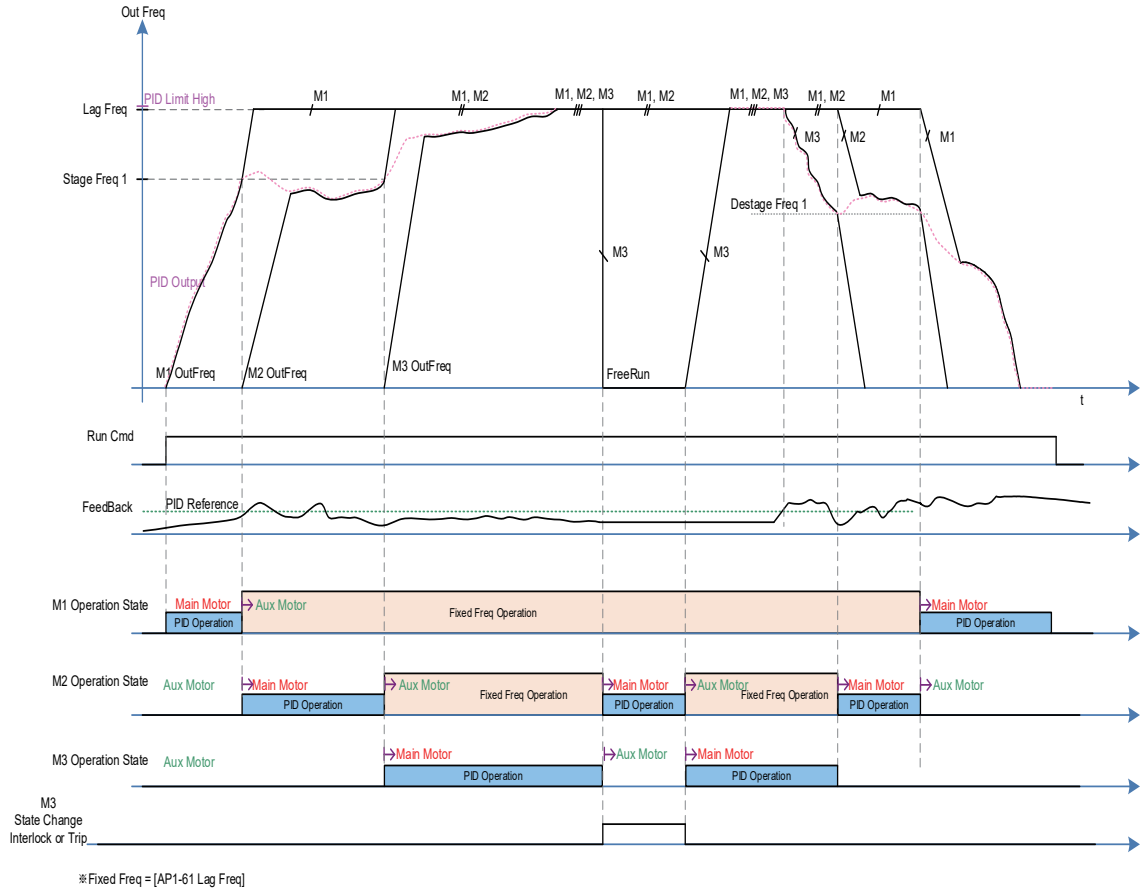
When the operation priority is (M1 ↔ M2 ↔ M3 ↔ M4 ↔ M5 ↔ M6 ↔ M7 ↔ M8), if Interlock3 or any trip occurs in [Slave Drive 3] or manual operation is switched, operation is performed in the order of (M1 ↔ M2 ↔ M4 ↔ M5 ↔ M6 ↔ M7 ↔ M8)



The figure below explains the operation when [AP1-49 ALT Sequence] is set to FILO in Fixed Lag mode.

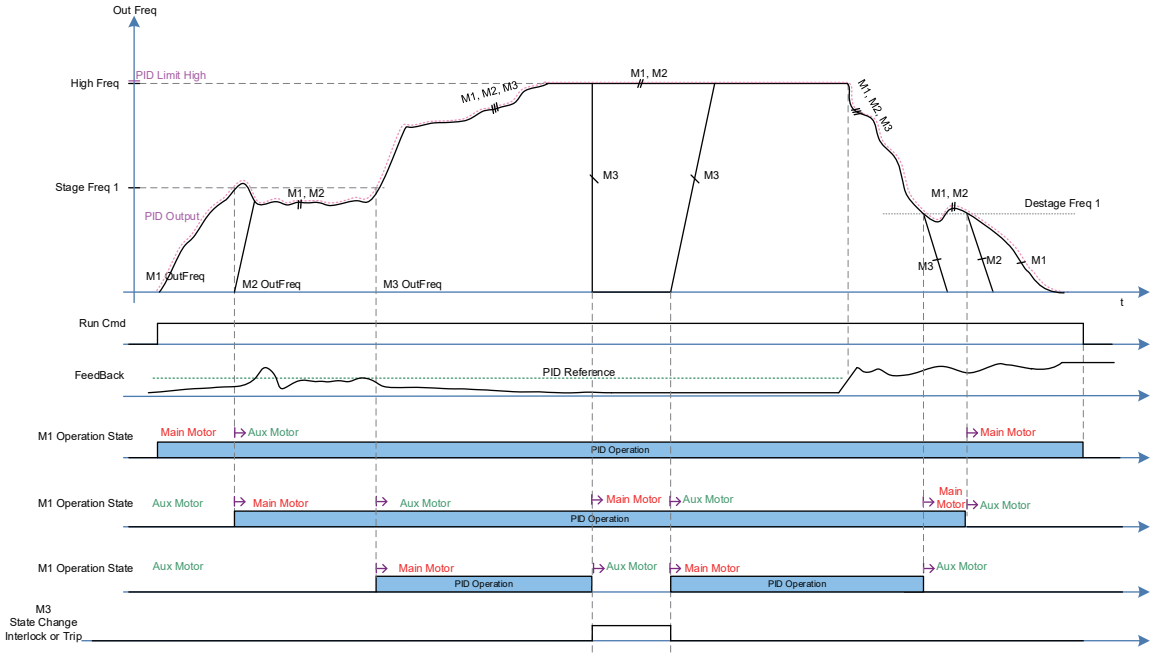
The figure below shows the operation when M3 is switched to manual operation or when interlock or trip occurs.

(Assuming that priority is not changed by operation time), (Interlock multi-function input is NC operation.)



※Fixed Freq = [AP1-61 Lag Freq]

<Fixed Lag Mode, [AP1-49 ALT Sequence] FILO>



<Follow Lead Mode, [AP1-49 ALT Sequence] FILO>

5.55.4 Lead-Lag Priority Change

Priority change by Alternate function

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP1	56	Alternate time	Alternate Time	Time value within the range	00: 00–99: 00	Min.
	58	Alternate operation time	Alt Timer Disp	Time value within the range	-	Sec.

Alternate Details

Code	Description
AP1-56 Alternate Time	Sets the auto change intervals.
AP1-58 Alt Timer Disp	Indicates time to activate Alternate. In case that other conditions for Alternate are not met in spite of meeting the condition of AP1-56, the value of time in AP1-58 might be bigger than the value set at Auto Ch Time of AP1-56 because of the failure of Auto Change.

This function rearranges the priorities according to the time of [AP1-56 Alternate Time].

When more than one motor including the main motor is running, the time of [AP1-58 Alt Timer Disp] is counted.

If the [AP1-58 Alt Timer Disp] time passes [AP1-56 Alternate Time] or more, the priority is rearranged.

Running, stopped, and standby drives are all rearranged.

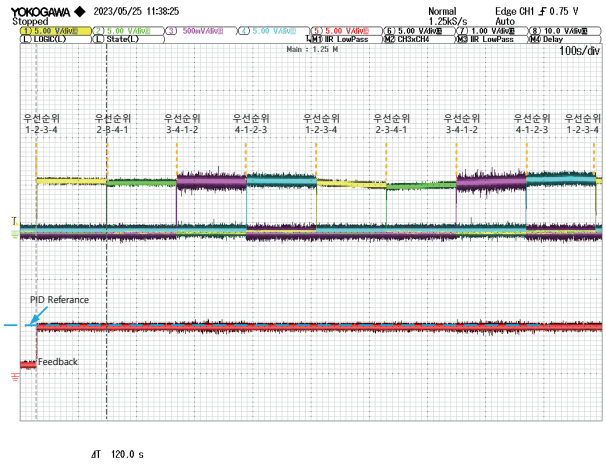
If [AP1-49 ALT Sequence] is FILO or FIFO, the priority is changed by one step.

Ex) If the priority is 1,2,3,4, the entire priority is changed from 1,2,3,4 -> 2,3,4,1 -> 3,4,1,2 -> 4,1,2,3 whenever Alternate operation is performed.

If [AP1-49 ALT Sequence] is Op Time Order, priorities are arranged according to the operation time of each drive.

Ex) If the operation time of each drive is the same when Alternate is operated, the priority is not sorted. Priorities are sorted in the following cases:

- If the priority is 1,2,3,4, only Drive ID 1 is running and Drive IDs 2,3,4 are in stop state
- Assume that the operation time of each drive is 5min, 0min, 0min, 0min
  - Perform Alternate operation
  - Priority is changed to 2,3,4,1 and Drive ID 1 is stopped
  - Drive ID2 starts driving



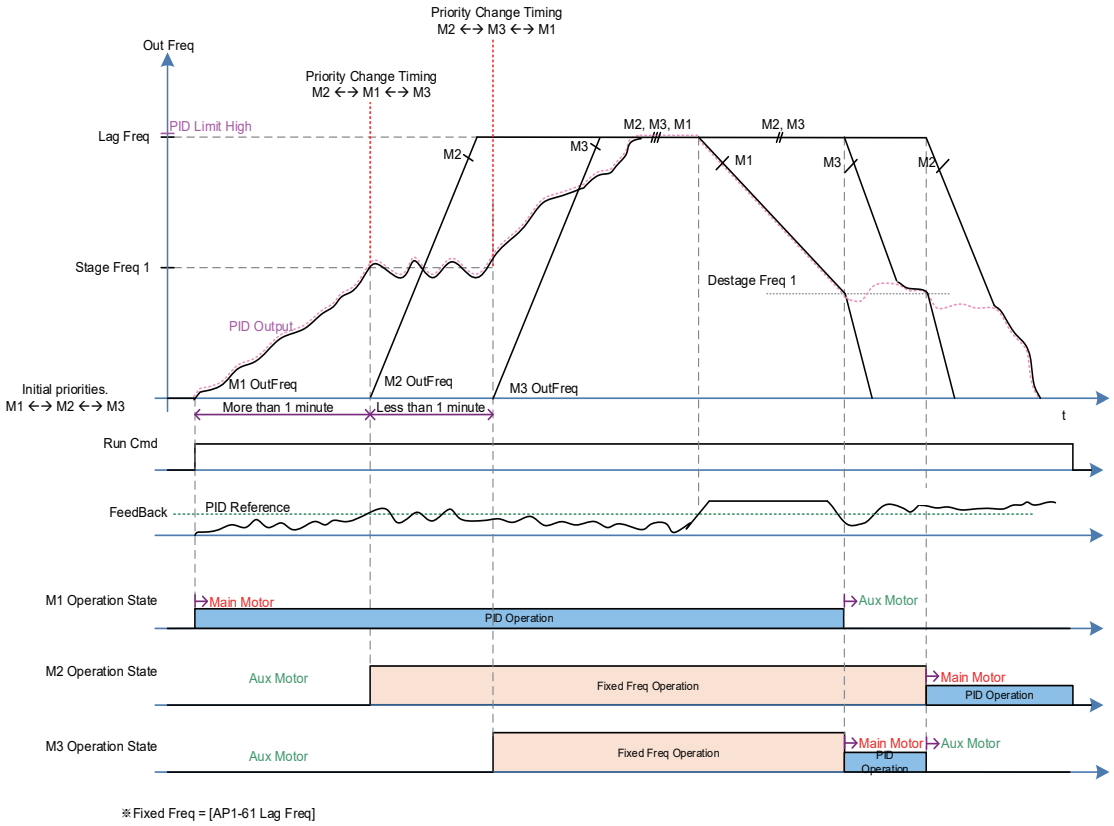
< Alternate operation once every 2 minutes>

- Priority change by individual operation time, interlock, trip, manual operation.

When [AP1-49 ALT Sequence] is Op Time Order

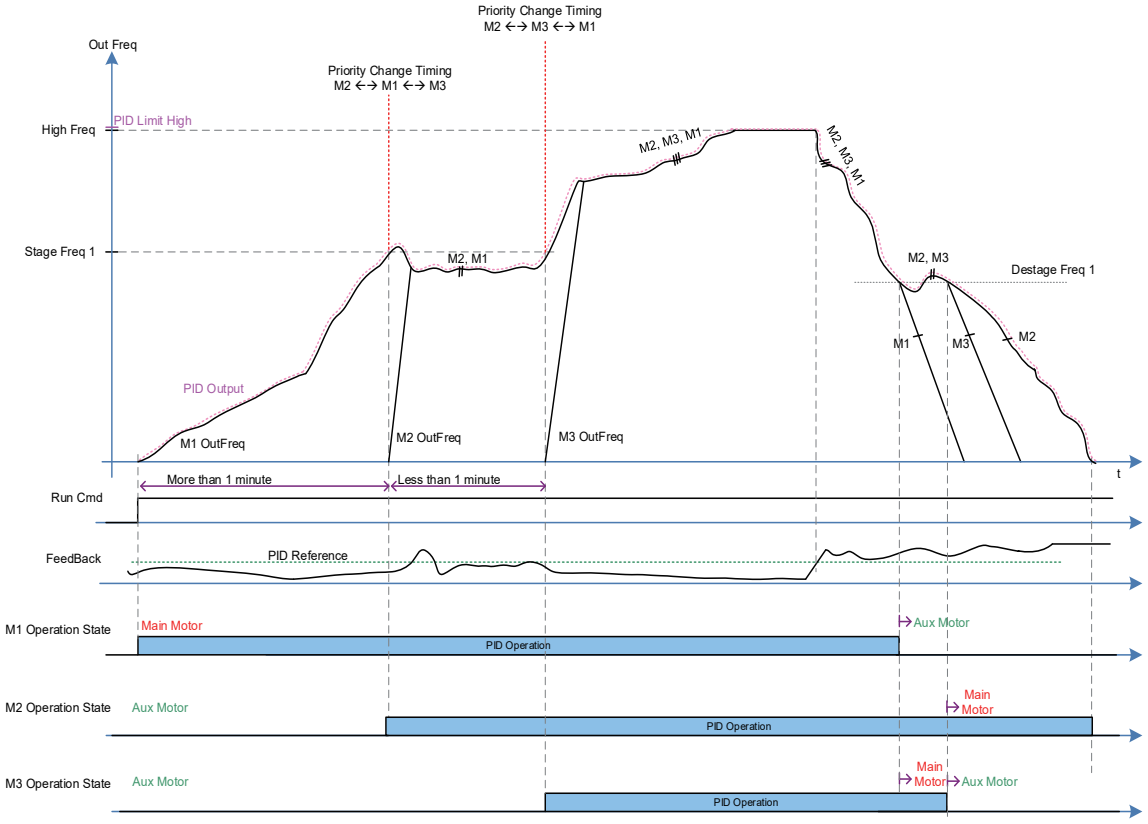
- When the number of motors in operation is changed, they are automatically rearranged according to individual operation times.
- The priority of the motor with the longest operating time is located at the rearmost position. (Comparative time unit is 1 minute)
- Interlock, trip occurrence and manual operation drive are excluded from the lead-lag system, and upon return, they are rearranged according to the operation time.

The figure below shows the longest operation time of M1 when [AP1-49 ALT Sequence] is Op Time Order in Fixed Lag mode.



※Fixed Freq = [AP1-61 Lag Freq]

The figure below shows the longest operating time of M1 when [AP1-49 ALT Sequence] is Op Time Order in Follow Lead mode.



When [AP1-49 ALT Sequence] is FIFO/FILO

- It is not automatically rearranged according to the individual operation time of each drive, but priorities are rearranged when interlock occurs, trip occurs, or manual operation.
- Interlock, trip occurrence and manual operation drive are excluded from the lead-lag system. When returning, it is placed at the bottom of the priority list.
- Ex1) When the priority is 1,2,3,4, if a trip occurs in ID2 Drive, it becomes 1,3,4, and if ID2 Drive's trip is reset, the priority becomes 1,3,4,2.

- Priority changes according to manual time change

If [AP1-98 PmpRunTime Clr] of {Master Drive} is set to <1: All>, the operation time of all drives is initialized, and if [AP1-49 ALT Sequence] is Op Time Order, priority is also initialized.

When deleting the operating time of individual drives through <2: Pump1>–<9: Pump8> of [AP1-98 PmpRunTime Clr] or changing the operating time of individual drives through the combination of [AP1-96 PmpRunTime Day] and [AP1-97 PmpRunTime Min], the priorities are rearranged between running motors and stopped motors.

The table below shows the case of changing the operation time of Drive ID 2 in operation.

(Total Driver is 5 units / Set [* of Pumps]=5)

Step	Priority 1 (Operating time: min)	Priority 2 (Operating time: min)	Priority 3 (Operating time: min)	Priority 4 (Operating time: min)	Priority 5 (Operating time: min)
1	Drive ID 3 (00:30) <Run>	Drive ID 2 (00:40) <Run>	Drive ID 1 (00:50) <Run>	Drive ID 4 (01:30) -Stop-	Drive ID 5 (01:50) -Stop-
Select <3: Pump2> in [AP1-98 PmpRunTime Clr]					
2	Drive ID 2 (00:00) <Run>	Drive ID 3 (00:30) <Run>	Drive ID 1 (00:50) <Run>	Drive ID 4 (01:30) -Stop-	Drive ID 5 (01:50) -Stop-
Change the time of Pump2 to 2:00 via [AP1-97 PmpRunTime Min]					
3	Drive ID 3 (00:30) <Run>	Drive ID 1 (00:50) <Run>	Drive ID 2 (02:00) <Run>	Drive ID 4 (01:30) -Stop-	Drive ID 5 (01:50) -Stop-

The table below shows the case of changing the operation time of Aux Motor 5 in a stopped state.

Step	Priority 1 (Operating time: min)	Priority 2 (Operating time: min)	Priority 3 (Operating time: min)	Priority 4 (Operating time: min)	Priority 5 (Operating time: min)
1	Drive ID 3 (00:30) <Run>	Drive ID 2 (00:40) <Run>	Drive ID 1 (00:50) <Run>	Drive ID 4 (01:30) -Stop-	Drive ID 5 (01:50) -Stop-
Select <6: Pump5> in [AP1-98 PmpRunTime Clr]					
2	Drive ID 3 (00:30) <Run>	Drive ID 2 (00:40) <Run>	Drive ID 1 (00:50) <Run>	Drive ID 5 (00:00) -Stop-	Drive ID 4 (01:30) -Stop-
Change the time of Pump5 to 2:00 via [AP1-97 PmpRunTime Min]					
3	Drive ID 3 (00:30) <Run>	Drive ID 2 (00:40) <Run>	Drive ID 1 (00:50) <Run>	Drive ID 4 (01:30) -Stop-	Drive ID 5 (02:00) -Stop-

5.55.5 Master Conversion

The drive with the lowest ID becomes the new {Master Drive} when the {Master Drive} has the following conditions:

- When IO Board Trip occurs.
- When TB Board Trip occurs.
- When Comm Err Trip occurs.
- When an LV Trip occurs.
- When Low Feedback Trip or High Feedback Trip occurs.
- When driving in manual mode
- When [Communication number] is changed

If the following problems occur in {Master Drive}, stop the entire system without switching {Master Drive}.

- When a Pipe Broken Trip occurs. (Even if the Master is switched to another Drive, the Trip is not resolved.)

Even if your ID is the lowest, if {Master Drive} already exists, the status of {Slave Drive} is maintained.
Ex) If the user turns off the ID1 Drive while ID1 is the Master, ID2 becomes the {Master Drive}, and even if the user turns the power on the ID1 Drive again, ID2 maintains the {Master Drive} state.

When converting {Master Drive}, the entire system follows the settings of the newly {Master Drive} drive.
Ex1) If the operation command of the newly {Master} drive is On, it operates continuously without stopping, and if it is Off, it stops.
Ex2) During Fixed Lag operation, if the newly {Master} Drive is set to Follow Lead, it operates with Follow Lead.

5.55.6 Lead-Lag Standby

In Lead-Lag mode, the number of Standby Drives is [AP1-42 * of Pumps] - [AP1-94 * of Drives].
Ex) If [AP1-42 * of Pumps] is set to 8 and [AP1-94 * of Drives] is set to 3, there are 3 Drives operating as Lead-Lag and the remaining 5 units are Standby Drives.

The table below is an example of the operation under the following conditions.

- When [AP1-49 ALT Sequence] is FILO or FIFO.
- When Alternate occurs.
- Manual driving, Trip, Interlock occurs.
- Total number of drivers is 5 / [* of Pumps]=3.

Lead-Lag Drive			Standby Drive	
Priority 1	2	3	4	5
Drive ID1	Drive ID2	Drive ID3	Drive ID4	Drive ID5
Only drives with IDs 1,2,3 operate. When Alternate occurs, the priority is changed as follows.				
Drive ID2	Drive ID3	Drive ID4	Drive ID5	Drive ID1
Only drives with ID 2,3,4 operate. If manual operation, trip, or interlock occurs in ID3, the priority changes as follows.				
Drive ID2	Drive ID4	Drive ID5	Drive ID1	Drive ID3

5.55.7 Manual Operation

When HAND/OFF key click, PID Openloop, FWD JOG, REV JOG multi-function input signals are input, it is excluded from the Lead-Lag system and operated manually.

When the HAND key is clicked, it operates according to [DRV-25 HAND Cmd Freq], [DRV-03 Acc Time], and [DRV-04 Dec Time].

If the operation command is On when the PID Openloop multifunction input is On, it operates according to [DRV-01 Cmd Frequency], [DRV-03 Acc Time], and [DRV-04 Dec Time].

When FWD JOG, REV JOG multi-function input is On, it operates according to [DRV-11 JOG Frequency], [DRV-12 JOG Acc Time], and [DRV-13 JOG Dec Time].

If the state of the keypad returns to Auto State after manual operation is released, follow the sequence of Lead-Lag.

5.55.8 Lead-Lag Operation Status Display

Display definition of Operating status (upper 3 characters on keypad)

- First digit: "S" (stop) / "F" (forward operation) / "R" (reverse operation)
- Second digit: "0" (does not drive) / "1–8" (indicates own priority) / "-" (Master and Standby Drive)
- Third digit: "+" (Master Drive) / "-" (Slave and Standby Drive) / Blank (Slave Drive)
- During Lead-Lag operation, [AP1-47 Lead Lag Status] displays the current operation status.

No	state	Description
1	Trip	Trip occurrence status
2	Manual	Manual operation state (Keypad HAND, OFF state, multi-function input FWD JOG, REV JOG, PID Openloop input state)
3	Interlock	interlock state
4	Standby	Standby Drive
5	Sleep	Sleep mode state
6	Stop	Stop state (state where no operation command is input)
7	Ready	Operation ready status (Operation command received by Master, but output frequency is 0)
8	Proc PID	When operating as a main motor (operating under PID control by the master)
9	Constant	Operation with [AP1-60 Lag Freq] in case of Fixed Lag mode

5.55.9 Data Share

Function to share the setting parameters of Master Drive with Slave Drives

List of shared parameters

[DRV-03 Acc Time]	[AP1-59 Destage Pres.]	[PID-50 PID Unit Sel]
[DRV-04 Dec Time]	[AP1-60 Lag Freq]	[PID-51 PID Unit Scale]
[ADV-08 Stop Mode]	[AP1-61 Stage freq 1]	[PID-53 PID Unit 100%]
[AP1-42 * of Pumps]	[AP1-70 Destage freq 1]	[PID-60 Sleep Bst Set]
[AP1-48 Lag Stop Sel]	[AP1-78 DataShare]	[PID-61 Sleep Bst Freq]
[AP1-49 ALT Sequence]	[AP1-79 All CommErr]	[PID-62 PID Sleep 0 DT]
[AP1-50 Stage Pres. Dv]	[AP1-94 * Of Drives]	[PID-63 PID Sleep0Lev]
[AP1-53 Stage DT]	[PID-11 PID SP 1 Set]	[PID-64 PID WakeUp0 DT]
[AP1-54 Destage DT]	[PID-20 PID Fdb Source]	[PID-65 PID WakeUp0Lev]
[AP1-56 Alternate Time]	[PID-26 PID I-Time 1]	

When [AP1-78 DataShare] is set to Manual.

All parameters in the above shared parameter list are shared with slaves at once. Warning {DataShare} occurs while sharing. After completing data sharing, [AP1-78 DataShare] will return to the previous setting.

When [AP1-78 DataShare] is set to AUTO.

When the user changes the above parameters, the changed parameters are shared with Slaves.

5.55.10 Jockey Pump

If Master Drive is set to Jockey Pump, slave drives' [AP1-40 Lead Lag Sel] is automatically changed to {Slave Only}. (Only Master Drive can be set.)

When the power of the Master Drive is turned off, the system stops without changing the master.

The priority of the Master Drive that selects Jockey Pump as Yes is always the 1st priority, and the priority of the other drives follows the setting in [AP-49 ALT Sequence].

Alternation operation applies only to drives other than Jockey Pump.

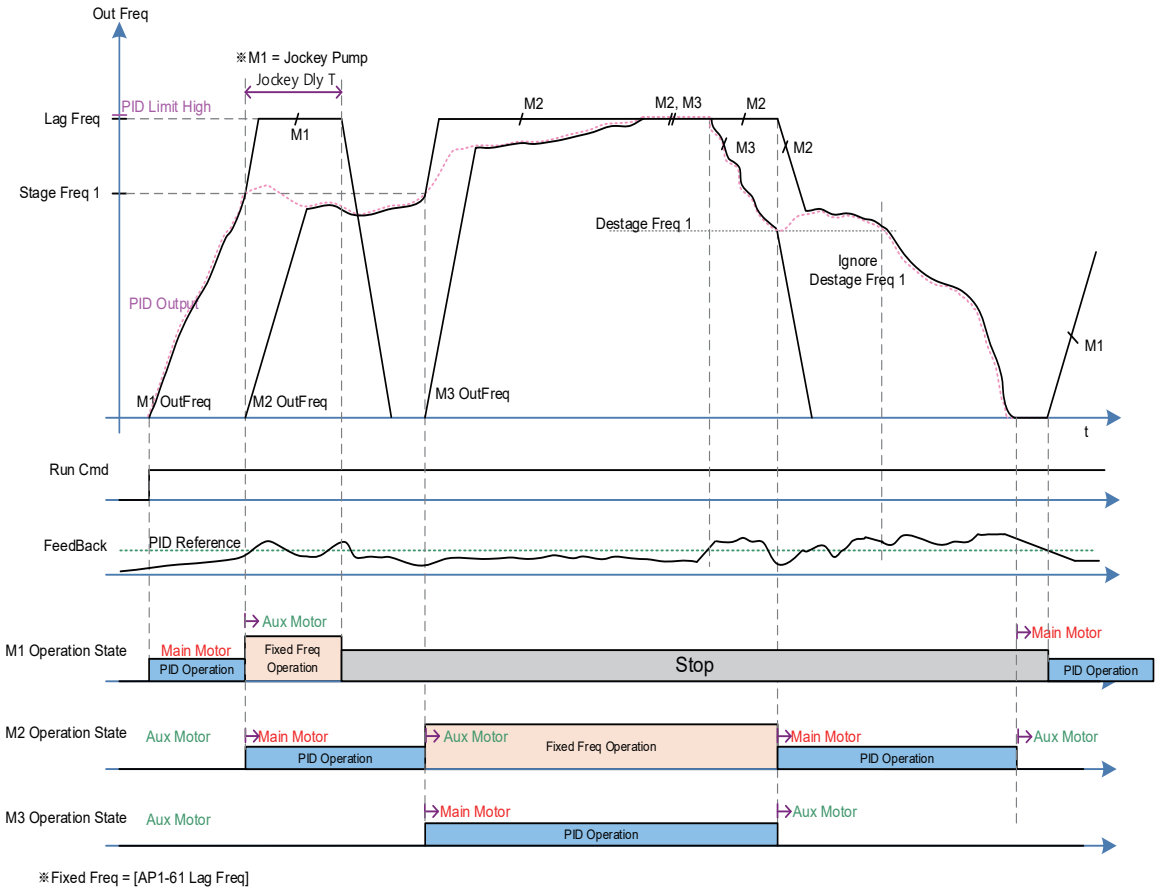
[AP1-43 Run Priority] is fixed to the Jockey Pump Drive ID (=[COM-01 Int485 St ID]) and cannot be changed.

Jockey Pump operates under the following conditions:

- When driving command is input
- When waking up after sleeping
- When all motors accelerate again after stopping

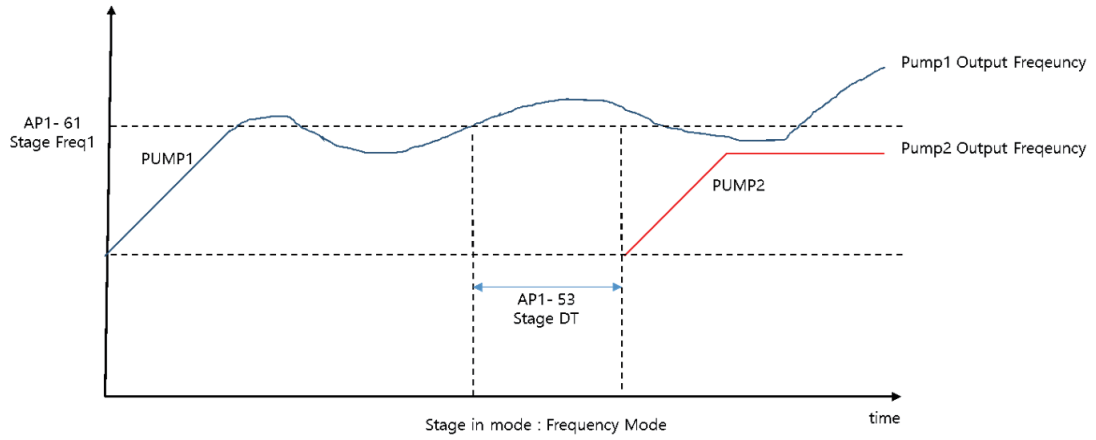
Jockey Pump stops under the following conditions:

- When a stop command is entered
- When [Jockey Dly T] time has passed after Aux Motor operation

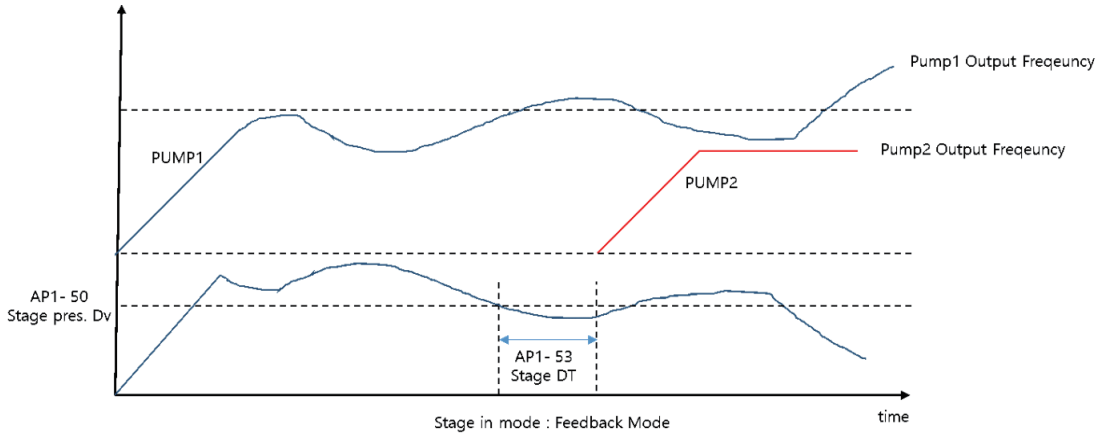


<Jockey Operation Sequence>

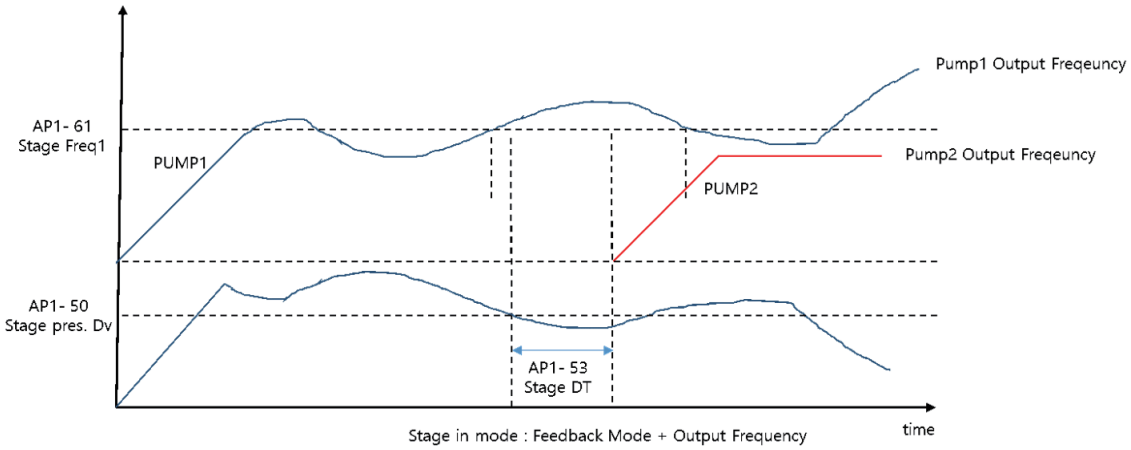
5.55.11 Stage In Out Mode



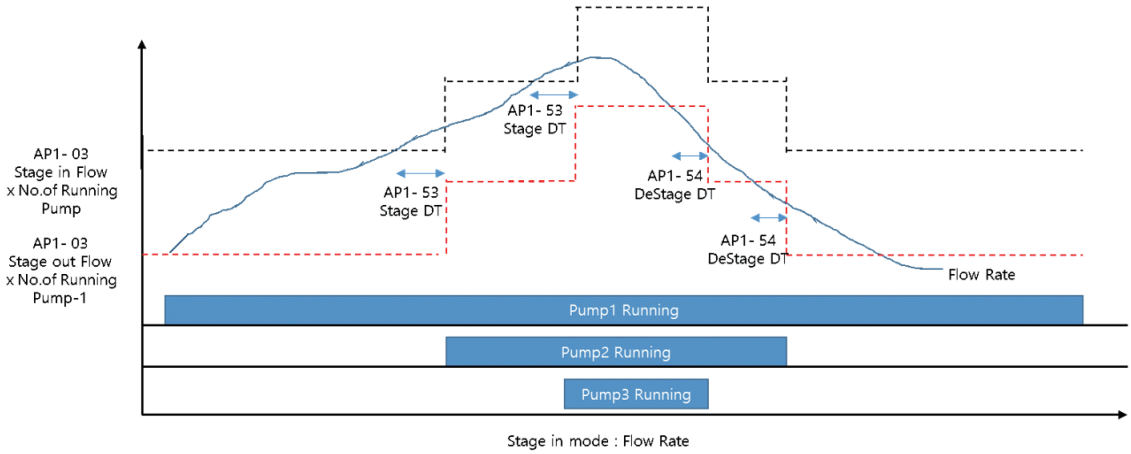
<Frequency Mode>



<Feedback Mode>



< Feedback Mode + Output Frequency>

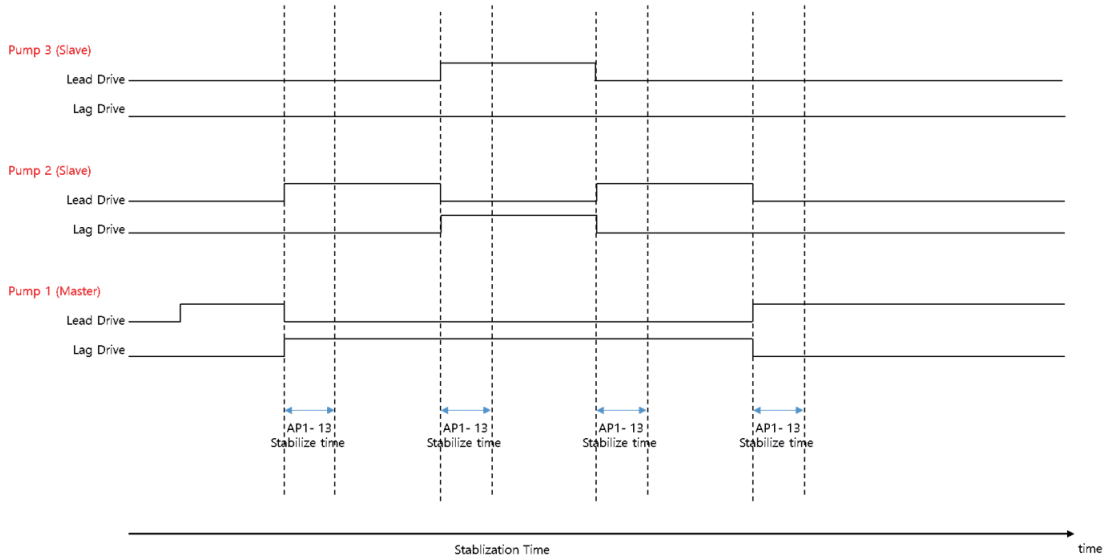


<Flow Rate>

Code	Keypad Display	Description	Setting Range	Factory Default	Units	Write Mode
AP1-01	Stage In Mod	Stage In Mode Selection	0: Output Frequency 1: Feedback 2: Feedback + Output Frequency 3: Flow Rate	2	Msg	△

1. Output Frequency: The criterion for additional reduction of the Lag Pump is determined by the output frequency.
2. Feedback: The criterion for additional reduction of the Lag Pump is determined by feedback.
3. Feedback + Output Frequency: The criterion for additional reduction of the Lag Pump is determined by frequency and feedback. It will operate only if both conditions are satisfied.
4. Flow Rate: The criterion for additional reduction of the Lag Pump is determined by the Flow Rate. The Flow Rate Level is proportional to the number of pumps currently in operation.

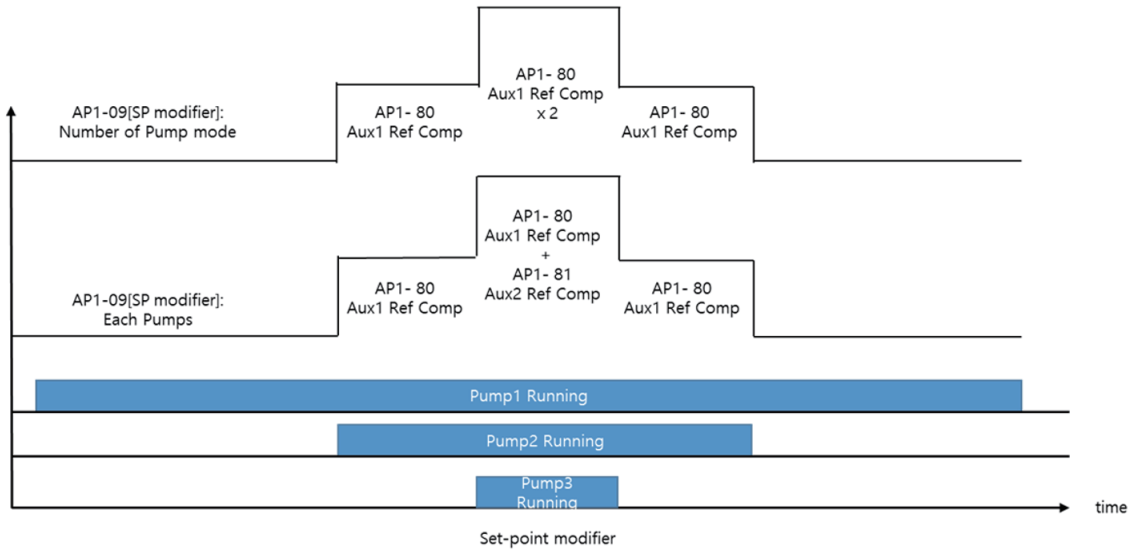
5.55.12 Stabilization Time after Staging/De-staging



Code	Keypad Display	Description	Setting Range	Factory Default	Units	Write Mode
AP1-13	Stabilize time	Stabilize time	0–3600 sec	0 sec	sec	-

1. Set the Stabilize time when Lag Pump is added/reduced. Some protection functions are disabled during the Stabilize time.
2. The functions that are disabled are Sleep, Set-point Time out, and No Flow Control.

5.55.13 SetPoint Modifier

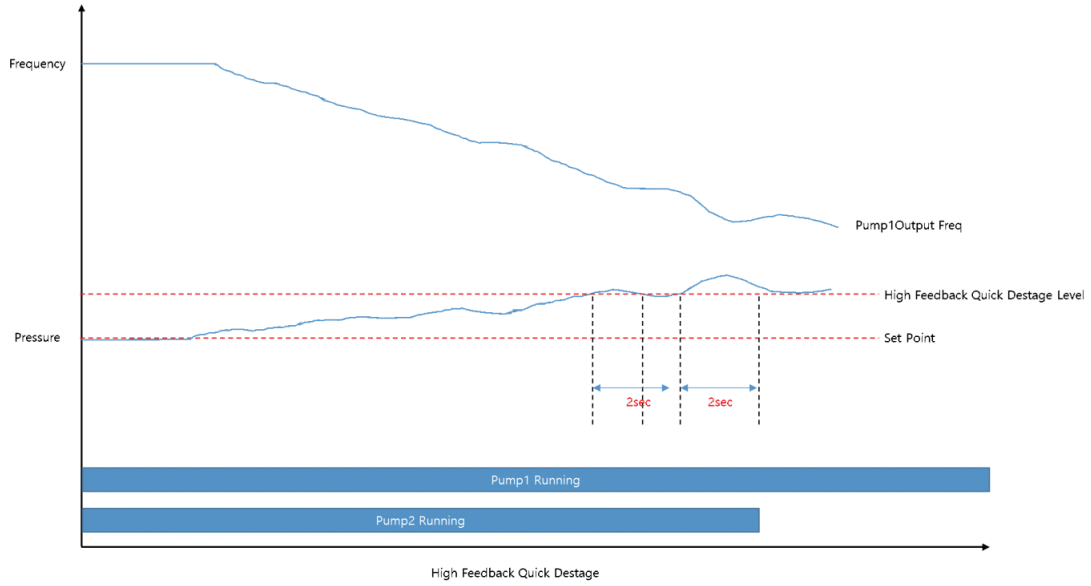


Set-point modifier

Code	Keypad Display	Description	Setting Range	Factory Default	Units	Write Mode
AP1-09	SP Modifier	Set Point Modifier Selection	0: Number of Pump 1: Each pumps	0	Msg	-

1. A feature that compensates the SetPoint by a parameter value set to account for losses due to pumps and pipes as additional Lag Pumps are added.
2. The Number of Pump Mode is determined based on the number of Lag Pumps currently in operation.
3. Each Pump is adjusted individually according to each Lag Pump, while the Aux Ref Comp value corresponding to the Lead Pump is not applied.

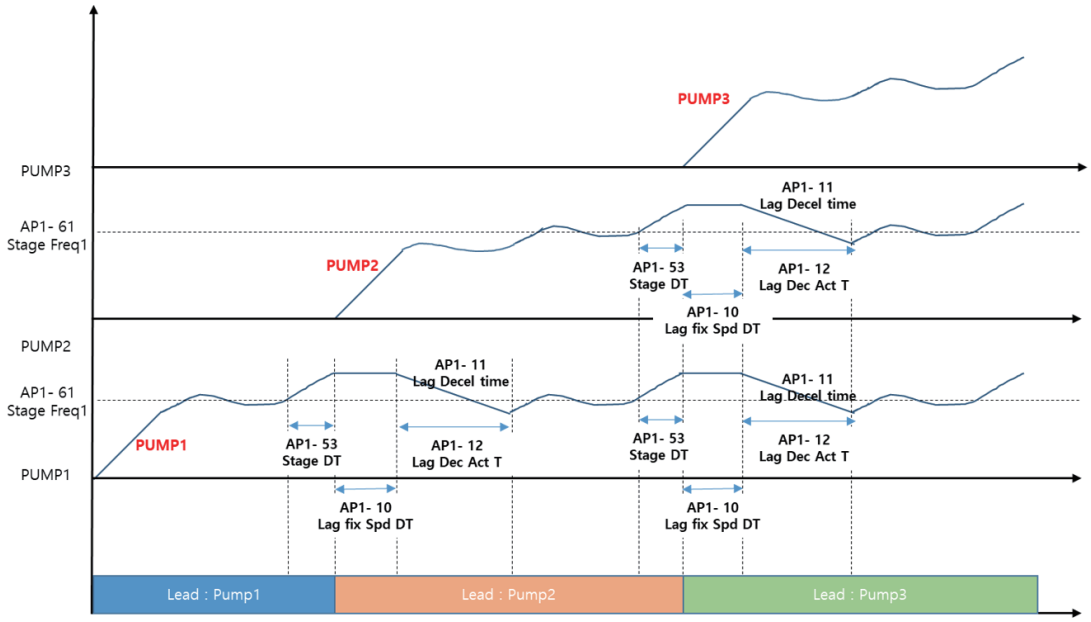
5.55.14 High and Low Feedback Quick Destage



Code	Keypad Display	Description	Setting Range	Factory Default	Units	Write Mode
AP1-05	High Feedback Destage	High Feedback Quick Destage Level	0–Max PID Unit	0.0	PID Unit	-
AP1-06	Low Feedback Destage	Low Feedback Quick Destage Level	0–Max PID Unit	0.0	PID Unit	

1. In cases where the pressure suddenly becomes abnormally high or low, if there is a pump currently operating in lag mode, this function quickly performs destage to lower the pressure.
2. If the high feedback quick destage level is maintained for longer than 2 seconds, the number of lag motors is reduced through destaging, even if other destage conditions are not met.
3. The low feedback quick destage operation works in PID inverse mode, while the high feedback quick destage operates in PID normal mode.

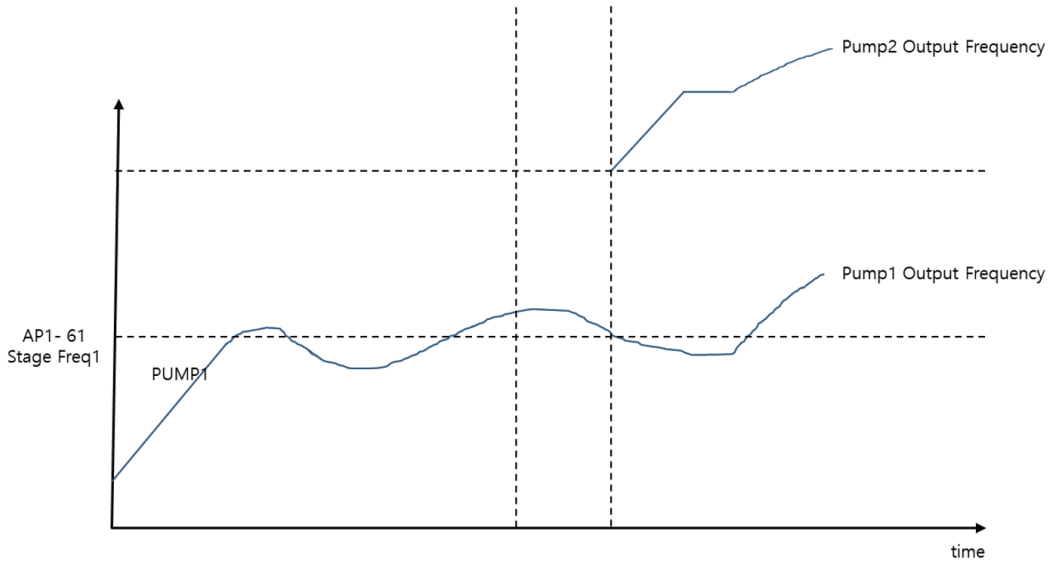
5.55.15 Lag Fixed Speed Delay Time



Code	Keypad Display	Description	Setting Range	Factory Default	Units	Write Mode
AP1-10	Lag fix Spd DT	Lag Fixed Speed Delay time	0–1000sec	0sec	Sec	-
AP1-11	Lag Decel Time	Lag Deceleration time	0.0–1000.0sec	60.0sec	sec	-
AP1-12	Lag Dec Act time	Lag Deceleration Active Time	0.0–360.0	0.0sec	sec	-

1. In a staging situation where the lag pumps are additionally increased, there can be repeated staging and de-staging due to changes in feedback or frequency. The function modifies the running frequency and deceleration time of the lag pumps in order to avoid the repeated staging and de-staging.
2. Lag Fixed Speed Delay Time: Fixes the output frequency of the lag pumps during a staging state where the lead is changing.
3. Lag Decel Time and Activation Time: Applies the Lag Dec Time [AP1-11] to the deceleration time of the lag pumps during a staging state where the lead is changing and maintains the deceleration time for the duration of the Lag Act Time.

5.55.16 Lag Speed Gain & Bias



Lag Drive Speed = (Lead Drive Speed x Lag Follower Gain) + Lag Follower Bais

Code	Keypad Display	Description	Setting Range	Factory Default	Units	Write Mode
AP1-07	Lag Speed Gain	Lag Speed Gain	0–300.0%	100%	%	-
AP1-08	Lag Speed Bias	Lag Speed Bias	0–60.00Hz	0.00Hz	Hz	-

When [AP1-40 Lead Lag Sel] is set to "Follow Lead", all Lag pumps operates in accordance with the speed of Lead Drive.

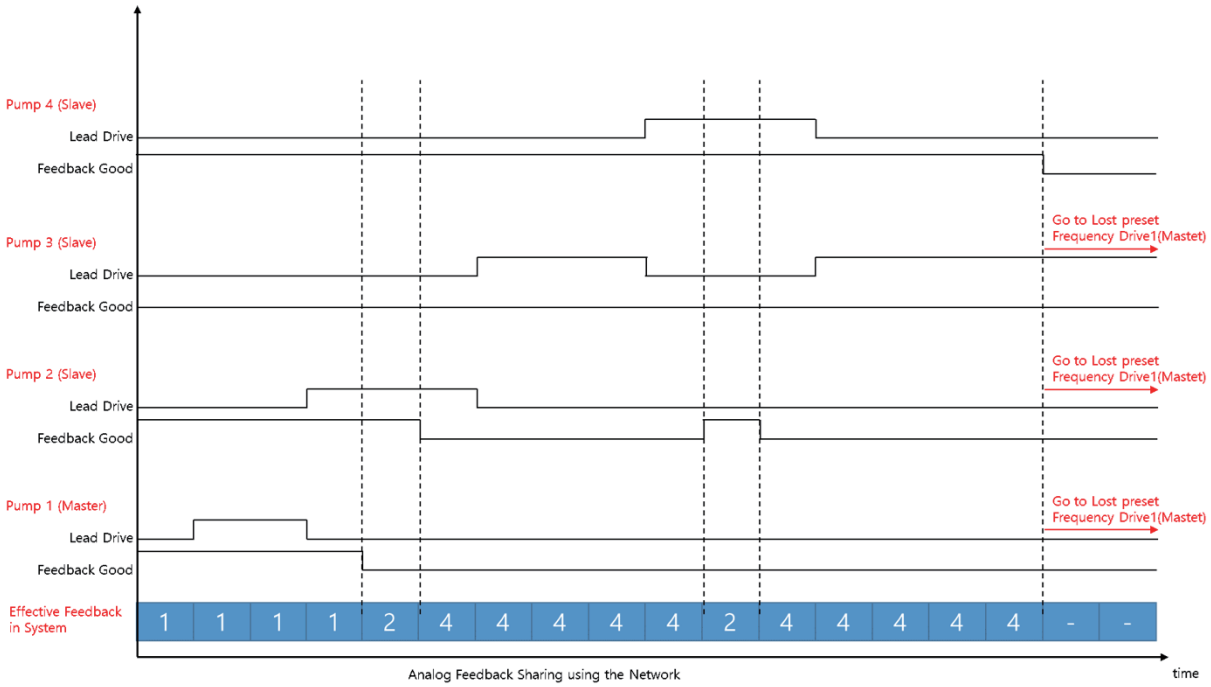
In this case, the speed of the lag pumps can be configured by individually setting gain and bias values based on the speed of the lead drive.

Lag Drive Speed = (Lead Drive Speed x Lag Follower Gain) + Lag Follower Bais

Ex) Lead Drive Speep 50Hz, [AP1-07 Lag Speed Gain] : 80%, [AP1-08 Lag Speed Bias]:
8.00Hz -> (50.00x0.8) + 8.00Hz = 48Hz

Therefore, the lag drive operating frequency is 48.00 Hz

5.55.17 Analog Feedback Sharing using the Network



Code	Keypad Display	Description	Setting Range	Factory Default	Units	Write Mode
PID-20	Feedback Source Mode	Feedback Source Mode	6: Slave Only	3: I2	MSG	-
AP4-03	PI Aux Source Mode	PI Aux Source Mode	6: Slave Only	3: I2	MSG	-
AP4-31	FlowRate Source Mode	FlowRate Source Mode	5: Slave Only	0: V1	MSG	-
AP2-61	Diff Fdb Src	Different Feedback Source Mode	6: Slave Only	0: V1	MSG	-
AP2-76	Feedback Switch Mode	Feedback Switch Mode	0: None 1: Ana -> Net, Alarm 2: Ana -> Net, No Alarm	0: None	MSG	-

1. The analog input values connected to the Lead Lag system can be shared via the network. (Feedback, Flowrate, Water Level, Different Feedback)
2. The analog values for two or more source inputs have the following priorities:
   ⅰ. First Priority: The analog values connected to the system's communication master is applied with the highest priority in the system
   ⅱ. Second Priority: If the analog value from the master gets lost or switched to Network, or if [AP2-76 FbkSource Mode] is set to Network, the master scans and applies the valid analog values in the order set for each slave in [COM-01 Int485 St ID].
3. If the corresponding Slave's analog value is lost or set to Network, the Master scans the valid analog value in the order of [COM-01 Int485 St ID]. The validity is determined when each Slave drive is set to Analog, by the reference of the set value in [PRT-16 AI Lost Level].
4. If the system's PID feedback is in the condition of Analog Lost, it switches to Network in accordance with the setting in [AP2-76 FbkSource Mode]
5. If none of the feedback value is valid on the Network, Master drive operates by the reference of the set value in [AP2-75 Lost Fdb Mode] (None, Warning, Trip & Coast, Lost Preset).

5.55.18 Fault Reset Retry using the Lead Lag System

1. The Master drive controls all drives in the Lead Lag system. Therefore, the Pumps System fault also occurs in Master drive.
2. The Pump System Fault are listed as below.
   - All Interlock (Level)
   - Different PI Feedback Trip (Latch)
   - Lost Feedback Trip (level)
   - Low Feedback Trip (Latch)
   - High Feedback Trip (Latch)
   - Set point timeout Trip (Latch)
   - High Flow Rate Trip (Latch)
   - Low Flow Rate Trip (Latch)
   - Low Aux PI Feedback Trip (Latch) (Suction, Water Level, Vacuum, ..)
   - High Aux PI Feedback Trip (Latch) (Suction, Water Level, Vacuum, ..)
   - Accumulation Flow Trip (Latch)
   - Pipe Broken Trip (Latch)
3. When the Pump System Fault occurs, all Pumps stop, and operates based on the Trip reset or retry setting values [PRT-08–11]. Also, the individual Slave drives display "Sys.Trip Check" Massage, and the Master drive check the Trip occurred.
4. After the occurrence of the Pump System Fault in the Lead Lag system, operation resumes after reset while System Run (Master drive's Run command) is On state.

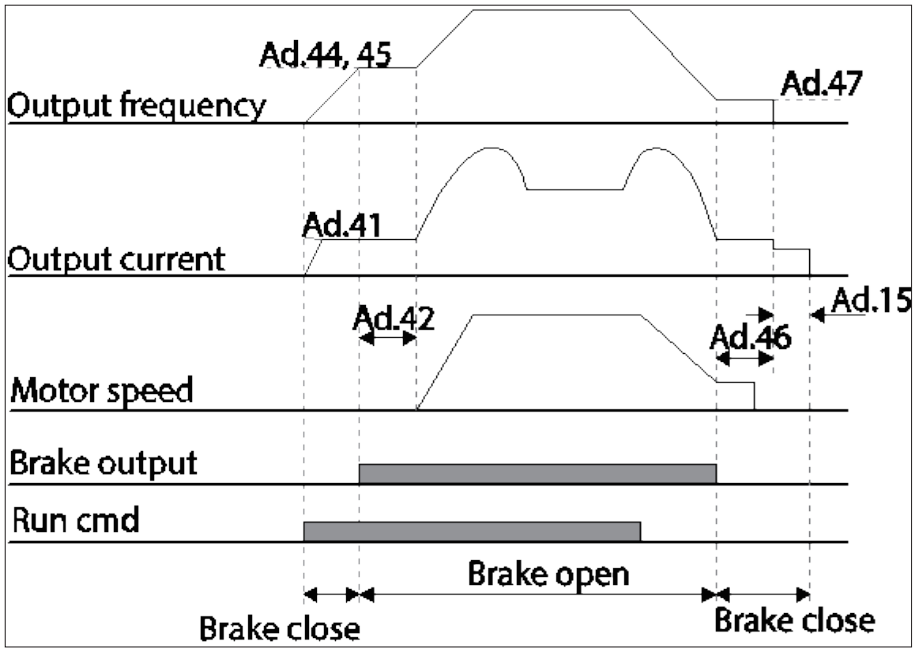
5.56 Brake Control

Brake control is used to control the On/Off operation of electronic brake load system.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
DRV	09	Control Mode	Control Mode	0	V/F	-	-
ADV	41	Brake release current	BR Rls Curr	50.0		0.0–180.0	%
	42	Brake release delay time	BR Rls Dly	1.00		1.00–10.0.0	sec
	44	Brake release forward frequency	BR Rls Fwd Fr	1.00		0.00–Max. freq.	Hz
	45	Brake release reverse frequency	BR Rls Rev Fr	1.00		0.00–Max. freq.	Hz
	46	Brake release engage delay time	BR Eng Dly	1.00		0.0–100.0	sec
	47	Brake release engage frequency	BR Eng Fr	2.00		0.00–Max. freq.	Hz
OUT	31–35	Multi-function relay1-5	Relay 1-5	42	BR Control	-	-
	36	Multi-function output1 item	Q1 Define				

When brake control is activated, DC braking (ADV 12) at inverter start and dwell operation (ADV 20–23) do not operate.

- **Brake release sequence:** During motor stop state, if an operation command is entered, the inverter accelerates up to brake release frequency (ADV 44– 45) in forward or in reverse direction. After reaching brake release frequency, if motor current reaches brake release current (BR Rls Curr), the output relay or multi function output terminal for brake control sends a release signal. Once the signal has been sent, acceleration will begin after maintaining frequency for brake release delay time (BR Rls Dly).
- **Brake engage sequence**: If a stop command is sent during operation, the motor decelerates. Once the output frequency reaches brake engage frequency (BR Eng Fr), the motor stops deceleration and sends out a brake engage signal to a preset output terminal. Frequency is maintained for the brake engage delay time (BR Eng Dly) and will become 0 afterwards. If DC braking time (ADV 15) and DC braking level (ADV 16) are set, inverter output is blocked after DC braking. For DC braking, refer to *"4.17.2 Stop After DC Braking" on page 104*.



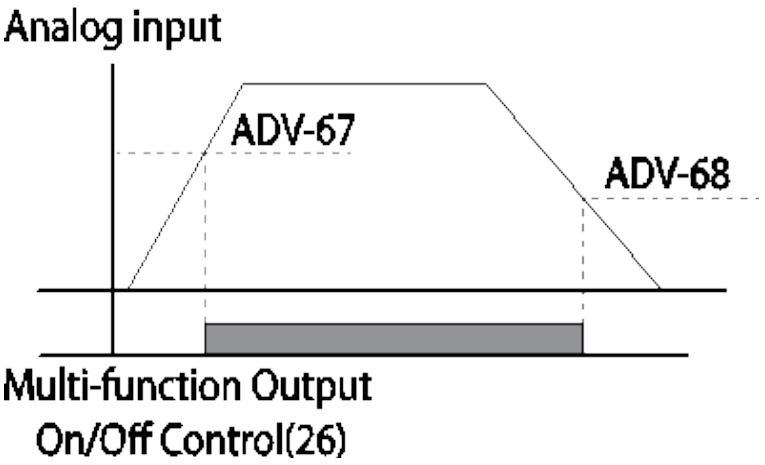
5.57 Multi-function Output On/Off Control

Set reference values (on/off level) for analog input and control output relay or multi-function output terminal on/off status accordingly.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV	66	Output terminal on/off control mode	On/Off Ctrl Src	1	V1	0–8	-
	67	Output terminal on level	On-C Level	90.00		Output terminal off level–100.00%	%
	68	Output terminal off level	Off-C Level	10.00		0.00–Output terminal on level	%
OUT	31	Multi-function relay 1 item	Relay 1	26	On/Off	-	-
	33	Multi-function output 1 item	Q1 Define				

Multi-function Output On/Off Control Setting Details

Code	Description
ADV-66 OnOff Ctrl Src	Select analog input On/Off control.
ADV-67 On Ctrl Level , ADV-68 Off Ctrl Level	Set On/Off level at the output terminal.



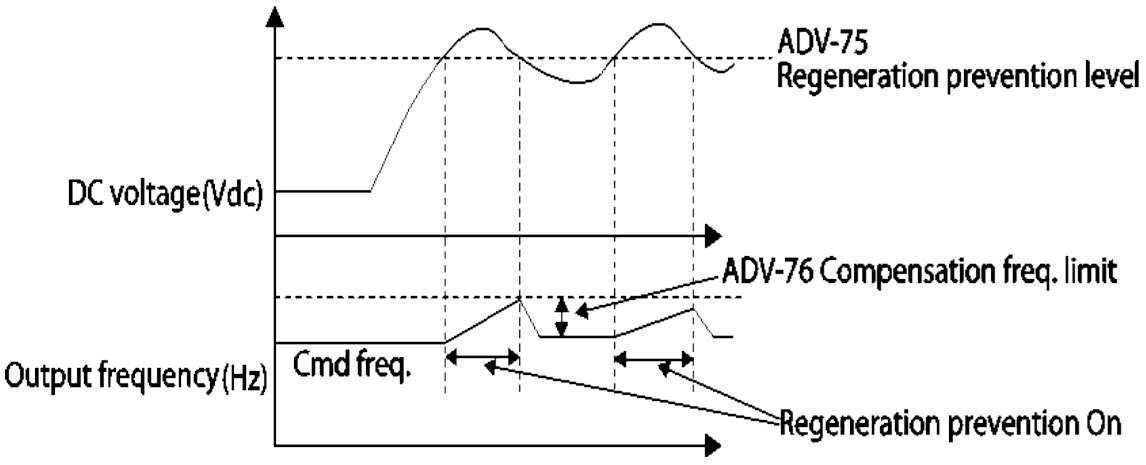
5.58 Press Regeneration Prevention

Press regeneration prevention is used during press operations to prevent braking during the regeneration process. If motor regeneration occurs during a press operation, motor operation speed automatically goes up 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	350 V		200 V class: 300–400 V	V
				700 V		400 V class: 600–800 V	
	76	Press regeneration prevention compensation frequency limit	CompFreq Limit	1.00 (Hz)		0.00–10.00 Hz	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)		20–30000 ms	ms

Press Regeneration Prevention Setting Details

Code	Description
ADV-74 RegenAvd Sel	Frequent regeneration voltage from a press load during a constant speed motor operation may force excessive stress on the brake unit, which may damage or shorten brake life. To prevent this, select ADV-74 (RegenAvd Sel) to control DC link voltage and disable the brake unit operation.
ADV-75 RegenAvd Level	Set brake operation prevention level voltage when the DC link voltage goes up due to regeneration.
ADV-76 CompFreq Limit	Set an alternative frequency width that can replace actual operation frequency during regeneration prevention.
ADV-77 RegenAvd Pgain ADV-78 RegenAvd Igain	To prevent regeneration zone, set P-Gain/I gain in the DC link voltage suppress PI controller.



Note

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

5.59 Analog Output

An analog output terminal provides an output of 0–10 V voltage, 4–20 mA current, or 0–32 kHz pulse.

5.59.1 Voltage and Current Analog Output

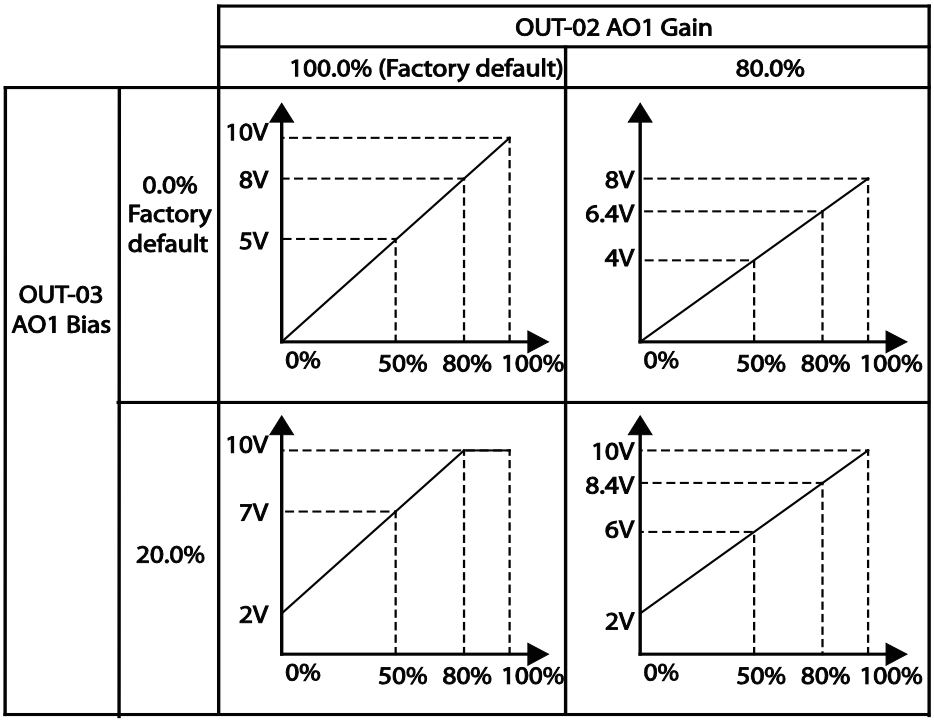
An output size can be adjusted by selecting an output option at the AO (Analog Output) terminal. Set the analog voltage/current output terminal setting switch (SW5) to change the output type (voltage/current).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	01	Analog output1	AO1 Mode	0	Frequency	0–18	-
	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	0–18	-
	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

Code	Description
OUT-01 AO1 Mode OUT-07 AO2 Mode	Select a constant value for output. The following example for output voltage setting.

Setting		Function
0	Frequency	Outputs operation frequency as a standard. 10 V output is made from the frequency set at DRV-20 (Max Freq).
1	Output Current	10 V output is made from 150% of inverter rated current.
2	Output Voltage	Sets the outputs based on the inverter output voltage. 10 V output is made from a set voltage in BAS-15 (Rated V). If 0 V is set in BAS-15, 200 V/400 V models output 10 V based on the actual input voltages (240 V and 480 V respectively).
3	DC Link Voltage	Outputs inverter DC link voltage as a standard. Outputs 10 V when the DC link voltage is 410 V DC for 200 V models, and 820 V DC for 400 V models.
4	Output Power	Monitors output wattage. 150% of rated output is the maximum display voltage (10 V).
6	Flow Rate Mon	Displays the current Flow Rate entered.
7	Target Freq	Outputs set frequency as a standard. Outputs 10 V at the maximum frequency (DRV-20).
8	Ramp Freq	Outputs frequency calculated with Acc/Dec function as a standard. May vary with actual output frequency. Outputs 10 V.
9	Setpoint Value	Outputs command value of a PID controller as a standard. Outputs approximately 10 V at 100%.
10	Feedback Value	Outputs feedback volume of a PID controller as a standard. Outputs approximately 10 V at 100%.
11	PID Output	Outputs output value of a PID controller as a standard. Outputs approximately 10 V at 100%.
12	Constant	Outputs OUT-05 (AO1 Const %) value as a standard.
13	PI Aux Setpoint	Outputs command value of a PID Auxiliary controller as a standard. Outputs approximately 10 V at 100%.
14	PIAuxFbk Mon	Outputs feedback volume of a PID Auxiliary controller as a standard. Outputs approximately 10 V at 100%.
15	PI Aux Output	Outputs output value of a PID Auxiliary controller as a standard. Outputs approximately 10 V at 100%.

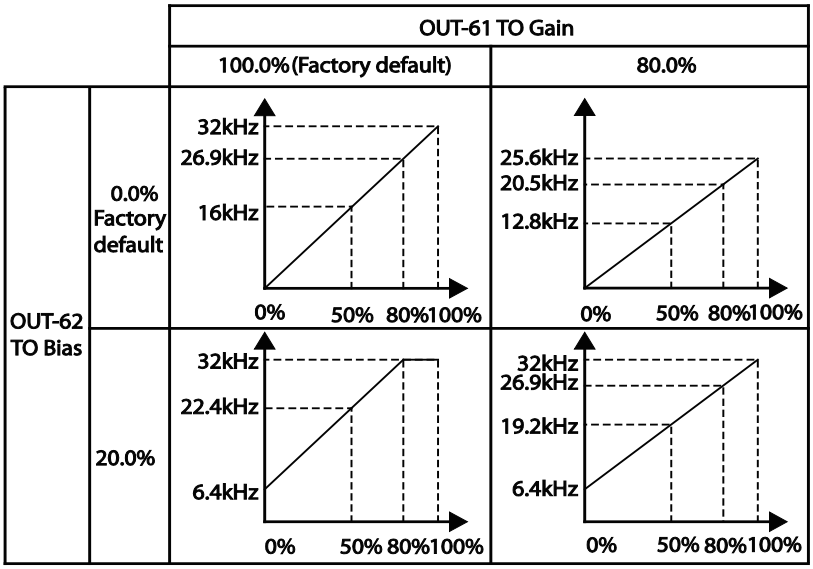
Code	Description
OUT-02 AO1 Gain, OUT-03 AO1 Bias OUT-08 AO2 Gain, OUT-09 AO2 Bias	Adjusts output value and offset. If frequency is selected as an output item, it will operate as shown below. $AO1 = \frac{Frequency}{MaxFreq} \times AO1\ \ Gain + AO1\ \ Bias$ The graph below illustrates how the analog voltage output (AO1) changes depending on OUT-02 (AO1 Gain) and OUT-3 (AO1 Bias) values. The Y-axis is analog output voltage (0–10 V), and the X-axis is a % value of the output item. Example, if the maximum frequency set at DRV-20 (Max Freq) is 60 Hz and the present output frequency is 30 Hz, then the x-axis value on the next graph is 50%. 
OUT-04 AO1 Filter OUT-10 AO2 Filter	Set filter time constant on analog output.
OUT-05 A01 Const % OUT-11 A02 Const %	If the analog output at OUT-01 AO1/OUT-07 AO2 Mode is set to '12 (Constant)', the analog voltage output is dependent on the set parameter values (0–100%).
OUT-06 AO1 Monitor OUT-12 AO2 Monitor	Monitors the analog output value. Displays the maximum output voltage as a percentage (%) with 10 V as the standard.

5.59.2 Analog Pulse Output

Output item selection and pulse size adjustment can be made for the TO (Pulse Output) terminal.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	61	Pulse output setting	TO Mode	0	Frequency	0–15	-
	62	Pulse output gain	TO Gain	100.0		-1000.0–1000.0	-
	63	Pulse output bias	TO Bias	1000.0		-100.0–100.0	-
	64	Pulse output filter	TO Filter	5		0–10000	-
	65	Pulse output constant output2	TO Const %	0.0		0.0–100.0	%
	66	Pulse output monitor	TO Monitor	0.0		0–1000.0	%

Analog Pulse Output Setting Details

Code	Description
OUT-62 TO Gain, OUT-63 TO Bias	Adjusts output value and offset. If frequency is selected as an output, it will operate as shown below. $TO = \frac{Frequency}{MaxFreq} \times TO\ \ Gain + TO\ \ Bias$ The following graph illustrates that the pulse output (TO) changes depend on OUT-62 (TO Gain) and OUT-63 (TO Bias) values. The Y-axis is an analog output current (0–32 kHz), and X-axis is a % value of the output item. For example, if the maximum frequency set at DRV-20 (Max Freq) is 60 Hz and present output frequency is 30 Hz, then the x-axis value on the next graph is 50%. 
OUT-64 TO Filter	Sets filter time constant on analog output.
OUT-65 TO Const %	If the analog output item is set to constant, the analog pulse output is dependent on the set parameter values.
OUT-66 TO Monitor	Monitors the analog output value. It displays the maximum output pulse (32 kHz) as a percentage (%) of the standard.

NOTE

OUT-08 AO2 Gain and OUT-09 AO2 Bias Tuning Mode on 0–20 mA output

- Set OUT-07 (AO2 Mode) to 'constant' and set OUT-11 (AO2 Const %) to 0.0 %.
- Set OUT-09 (AO2 Bias) to 20.0% and then check the current output. 4 mA output should be displayed.
  - If the value is less than 4 mA, gradually increase OUT-09 (AO2 Bias) until 4 mA is measured.
  - If the value is more than 4 mA, gradually decrease OUT-09 (AO2 Bias) until 4 mA is measured.
- Set OUT-11 (AO2 Const %) to 100.0%.
- Set OUT-08 (AO2 Gain) to 80.0% and measure the current output at 20 mA.
  - If the value is less than 20 mA, gradually increase OUT-08 (AO2 Gain) until 20 mA is measured.
  - If the value is more than 20 mA, gradually decrease OUT-08 (AO2 Gain) until 20 mA is measured.
- The functions for each code are identical to the descriptions for the 0–10 V voltage outputs with an output range 4–20 mA.

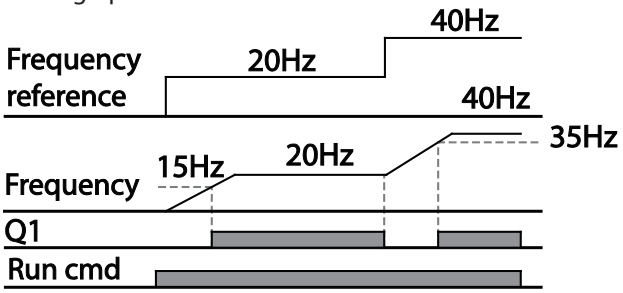
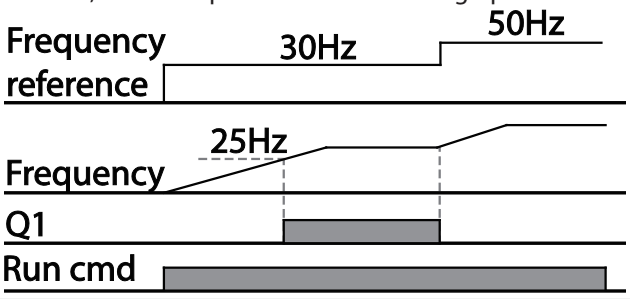
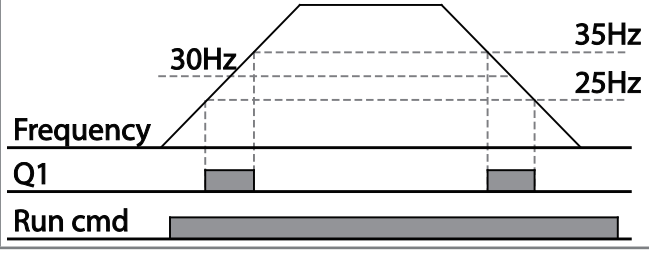
5.60 Digital Output

5.60.1 Multi-function Output Terminal and Relay Settings

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OUT	31	Multi-function relay 1 setting	Relay 1	23	Trip	-	-
	32	Multi-function relay 2 setting	Relay 2	14	Run	-	-
	33	Multi-function relay 3 setting	Relay 3	0	None	-	-
	34	Multi-function relay 4 setting	Relay 4	0	None	-	-
	35	Multi-function relay 5 setting	Relay 5	0	None	-	-
	36	Multi-function output setting	Q1 define	0	None	-	-
	41	Multi-function output monitor	DO Status	-		00–11	bit
	57	Detection frequency	FDT Frequency	30.00		0.00–Maximum frequency	Hz
	58	Detection frequency band	FDT Band	10.00			
IN	65–71	Px terminal configuration	Px Define	18	Exchange	0-51	-

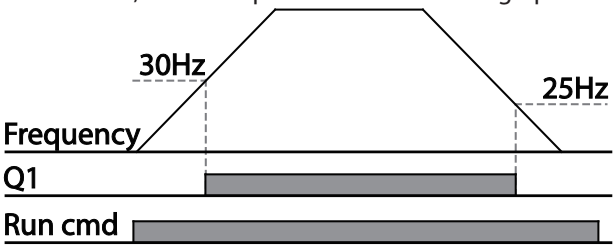
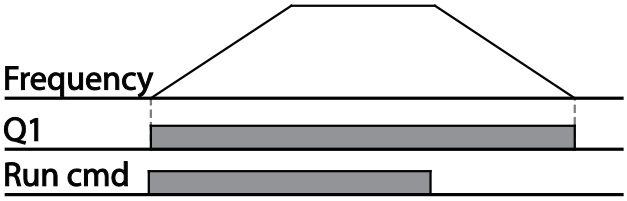
Multi-function Output Terminal and Relay Setting Details

Code	Description
OUT-31–35 Relay1–5	Set relay (Relay 1–5) output options.

Setting		Function
0	None	No output signal
1	FDT-1	Detects inverter output frequency reaching the user set frequency. Outputs a signal when the absolute value (set frequency–output frequency) < detected frequency width/2. When the detected frequency width is 10 Hz, FDT-1 output is as shown in the graph below. 
2	FDT-2	Outputs a signal when the user-set frequency and detected frequency (FDT Frequency) are equal, and fulfills FDT-1 condition at the same time. [Absolute value (output frequency-detected frequency) < detected frequency width/2 & FDT-1] Detected frequency width is 10 Hz. When the detected frequency is set to 30 Hz, FDT-2 output is as shown in the graph below. 
3	FDT-3	Outputs a signal when the Absolute value (output frequency– detected frequency) < detected frequency width/2. Detected frequency width is 10 Hz. When the detected frequency is set to 30 Hz, FDT-3 output is as shown in the graph below. 

Code	Description

OUT-31–35
Relay1–5

Setting		Function
4	FDT-4	The output signal can be separately set for acceleration and deceleration conditions. In acceleration: Operation frequency ≧ Detected frequency In deceleration: Operation frequency > (Detected frequency– Detected frequency width/2) Detected frequency width is 10 Hz. When the detected frequency is set to 30 Hz, FDT-4 output is as shown in the graph below. 
5	Over Load	Outputs a signal at motor overload.
6	IOL	Outputs a signal when the inverter input current exceeds the rated current and a protective function is activated to prevent damage to the inverter, based on inverse proportional characteristics.
7	Under Load	Outputs a signal at load fault warning.
8	Fan Warning	Outputs a signal at fan fault warning.
9	Stall	Outputs a signal when a motor is overloaded and stalled.
10	Over Voltage	Outputs a signal when the inverter DC link voltage rises above the protective operation voltage.
11	Low Voltage	Outputs a signal when the inverter DC link voltage drops below the low voltage protective level.
12	Over Heat	Outputs signal when the inverter overheats.
13	Lost Command	Outputs a signal when there is a loss of analog input terminal and RS-485 communication command at the terminal block. Outputs a signal when communication power is present and an I/O expansion card is installed. It also outputs a signal when losing analog input and communication power commands.
14	RUN	Outputs a signal when an operation command is entered and the inverter outputs voltage. No signal output during DC braking. 
15	Stop	Outputs a signal at operation command off, and when there is no inverter output voltage.

Code	Description

OUT-31–35
Relay1–5

Setting		Function
16	Steady	Outputs a signal in steady operation.
17	Inverter Line	Outputs a signal while the motor is driven by the inverter line.
18	Comm Line	Outputs a signal when multi-function input terminal (switching) is entered. Refer to *"5.39 Supply Power Transition" on page 219.*
19	Speed Search	Outputs a signal during inverter speed search operation. For details, refer to *"5.36 Speed Search Operation" on page 212*.
20	Ready	Outputs a signal when the inverter is in stand by mode and ready to receive external operation commands.
21	MMC	Used as a multi-motor control function. By configuring the relay output and the multi-function output to MMC and configuring the AP1-40–AP1-92, it can conduct the necessary operations for multi-motor control function.
22	Timer Out	A timer function to operate terminal output after a certain time by using multi-function terminal block input. For details, refer to *"5.52 Timer Settings" on page 229*.
23	Trip	Outputs a signal after a fault trip. Refer to *"5.57 Multi-function Output On/Off Control" on page 278*.
24	Lost keypad	Outputs a signal when PRT-11 lost keypad is set to 1-3 and communication error with the keypad or connection occurs.
25	DB Warn %ED	Refer to *"6.2.5 Dynamic Braking (DB) Resistor Configuration" on page 304*.
26	On/Off Control	Outputs a signal using an analog input value as a standard. Refer to *"5.57 Multi-function Output On/Off Control" on page 278*..
27	Fire Mode	Outputs a signal when Fire mode is in operation.
28	Pipe Break	Outputs a signal when a pipe is broken.
29	Damper Err	*"5.21 Damper Operation" on page 182.*
30	Lubrication	Outputs a signal when a lubrication function is in operation.
31	PumpClean Sel	Outputs a signal when a pump cleaning function is in operation.
32	Level Detection Trip	Outputs a signal when an LDT (Level Detection) 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 on.
34	CAP.Warning	Outputs a signal when value of the PRT-85 is lower than the value of the PRT-86 (CAP life cycle examination do not operate properly).
35	Fan Exchange	Outputs a signal when fan needs to be replaced.
36	AUTO State	Outputs a signal in AUTO mode.
37	HAND State	Outputs a signal in HAND mode.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>OUT-31–35
Relay1–5</td><td>
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>38</td><td>TO</td><td>Outputs a signal at pulse output.</td></tr>
<tr><td>39</td><td>Except Date</td><td>Outputs a signal when operating the exception day schedule.</td></tr>
<tr><td>40</td><td>KEB Operating</td><td>Outputs a signal at KEB operation.</td></tr>
<tr><td>41</td><td>BrokenBelt</td><td>Outputs a signal when a Broken belt is in operation.</td></tr>
<tr><td>42</td><td>BR control</td><td>Outputs a brake release signal. Refer to "5.56 Brake Control" on page 277</td></tr>
<tr><td>43</td><td>High Fdb Level</td><td>Outputs a signal when the PID feedback is higher than a set Level after setting high feedback level detection.</td></tr>
<tr><td>44</td><td>Low Fdb Level</td><td>Outputs a signal when the PID feedback is lower than a set Level after setting low feedback level detection</td></tr>
<tr><td>45</td><td>Diff Fdb Level</td><td>Outputs a signal when detecting pressure deviation of PID feedback and secondary pressure feedback.</td></tr>
<tr><td>46</td><td>Low Flow Level</td><td>Outputs a Low flow level detection signal with flow limiter.</td></tr>
<tr><td>47</td><td>High Flow Level</td><td>Outputs a High flow level detection signal with flow limiter.</td></tr>
<tr><td>48</td><td>Accum Level</td><td>Outputs a signal when total accumulated volume exceeds the set level.</td></tr>
<tr><td>49</td><td>Low Level Detect</td><td>Outputs a signal of low-level detection for the PI Aux control.</td></tr>
<tr><td>50</td><td>High Level Detect</td><td>Outputs a signal of high-level detection for the PI Aux con-trol.</td></tr>
<tr><td>51</td><td>Current Limit</td><td>Outputs a signal at current limit operation.</td></tr>
<tr><td>52</td><td>SetPoint Timeout</td><td>Outputs a signal when if the feedback deviates too far from the PID Setpoint.</td></tr>
<tr><td>53</td><td>Pump Trip</td><td>Outputs a pump trip signal when Low Feedback, High Feedback, SetPnt Timeout, Pump Over Cycle Trip occurs</td></tr>
<tr><td>54</td><td>FWD Run</td><td>Outputs a signal when the inverter outputs voltage and the motor rotates in the forward direction.</td></tr>
<tr><td>55</td><td>REV Run</td><td>Outputs a signal when the inverter outputs voltage and the motor rotates in the reverse direction.</td></tr>
<tr><td>56</td><td>Bypass MC TRIP</td><td>Outputs a signal from the OL detector and Bypass MC Trip occurs when motor overheat occurs during the bypass operation
- only for SP100.</td></tr>
<tr><td>57</td><td>Bypass Run</td><td>Outputs a signal when the motor operates on line power without inverter output - only for SP100.</td></tr>
<tr><td>58</td><td>Sleep</td><td>Outputs a signal when the inverter is in the sleep status while PID operating.</td></tr>
</table>
</td></tr>
<tr><td>OUT-36 Q1 Define</td><td>Select an output item for the multi-function output terminal (Q1) of the terminal block. Q1 stands for the open collector TR output.</td></tr>
<tr><td>OUT-41 DO State</td><td>Used to check On/Off state of the D0 by each bit.</td></tr>
</table>

ⓘ 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 key 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.

5.60.2 Fault Trip Output using Multi-function Output Terminal and Relay

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

The inverter can output a fault trip state using the multi-function output terminal (Q1) and relay (Relay 1).

Fault Trip 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>Fault trip relay operates based on the fault trip output settings.
Select a fault trip output terminal/relay and select '29' (Trip Mode) at codes OUT- 31–33. When a fault trip occurs in the inverter, the relevant terminal and relay will operate. Depending on the fault trip type, terminal and relay operation can be configured as shown in the table below.
<table>
<tr><td>Item</td><td>bit on</td><td>bit off</td></tr>
<tr><td>Keypad display</td><td></td><td></td></tr>
</table>
Select a fault trip output terminal/relay and select '29' (Trip Mode) at codes OUT- 31–33. When a fault trip occurs in the inverter, the relevant terminal and relay will operate. Depending on the fault trip type, terminal and relay operation can be configured as shown in the table below.
<table>
<tr><td colspan="4">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>bit4</td><td>bit3</td><td>bit2</td><td>bit1</td></tr>
<tr><td></td><td></td><td></td><td>✓</td><td>Operates when low voltage fault trips occur</td></tr>
<tr><td></td><td></td><td>✓</td><td></td><td>Operates when fault trips other than low voltage occur</td></tr>
<tr><td></td><td>✓</td><td></td><td></td><td>Operates when auto restart fails (PRT-08–09)</td></tr>
<tr><td>✓</td><td></td><td></td><td></td><td>Operates when Lead-Lag Interlock trip occurs</td></tr>
</table>
</td></tr>
<tr><td>OUT-31–35
Relay1–5</td><td>Set relay output (Relay 1–5).</td></tr>
<tr><td>OUT-36
Q1 Define</td><td>Select output for multi-function output terminal (Q1). Q1 is open collector TR output.</td></tr>
</table>

5.60.3 Multi-function Output Terminal Delay Time Settings

Set on-delay and off-delay times separately to control the output terminal and relay operation times. The delay time set at codes OUT-50–51 applies to multi-function output terminal (Q1) and relay, except when the multi-function output function is in fault trip mode.

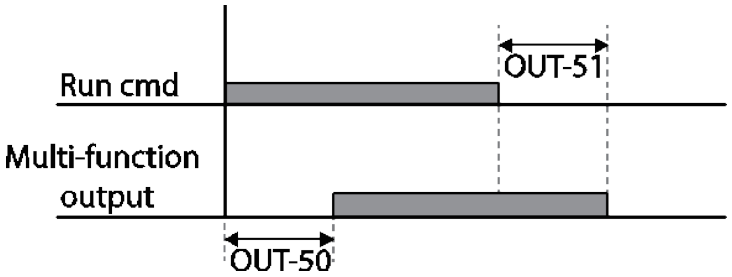
Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
OUT	50	Multi-function output On delay	DO On Delay	0.00	0.00–100.00	sec
	51	Multi-function output Off delay	DO Off Delay	0.00	0.00–100.00	sec
	52	Select multi-function output terminal	DO NC/NO Sel	000000*	00 0000 –11 1111	bit

*Multi-function output terminals are numbered. Starting from the right (number 1), the number increases to the left.

Output Terminal Delay Time Setting Details

Code	Description
OUT-50 DO On Delay	When a relay operation signal (operation set in OUT 31–35, 36) occurs, the relay turns on or the multi-function output operates after the time delay set at OUT-50.
OUT-51 DO Off Delay	When relay or multi-function output is initialized (off signal occurs), the relay turns off or multi-function output turns off after the time delay set at OUT-54.
OUT-52 DO NC/NO Sel	Select the terminal type for the relay and multi-function output terminal. By setting the relevant bit to '0,' it will operate A terminal (Normally Open). Setting it to '1' will operate B terminal (Normally Closed). Shown below in the table are Relay 1–5 and Q1 settings starting from the right bit.

Item	B terminal (Normal close)	A terminal (Normal open)
Keypad display		



5.60.4 Operation State Monitor

The inverter's operation condition can be monitored using the keypad. If the monitoring option is selected in config (CNF) mode, a maximum of four items can be monitored simultaneously. Monitoring mode displays three different items on the keypad, but only one item can be displayed in the status window at a time.

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	-	-

Operation State Monitor Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>CNF-20 AnyTime Para</td><td>Select items to display on the top-right side of the keypad screen. Choose the parameter settings based on the information to be displayed. Codes CNF-20–23 share the same setting options as listed below.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Frequency</td><td>On stop, displays the set frequency. During operation, displays the actual output frequency (Hz).</td></tr>
<tr><td>1</td><td>Speed</td><td>On 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 link 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 P1–P8.</td></tr>
<tr><td>8</td><td>DO Status</td><td>Displays output terminal status of the terminal block. Starting from the right: Relay1, Relay2, and Q1.</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 -10 V, 0 V, +10 V 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 the PID controller output.</td></tr>
<tr><td>18</td><td>Setpoint Value</td><td>Displays the scale of the reference value and sets the value of PID reference.</td></tr>
<tr><td>19</td><td>Feedback Value</td><td>Displays the PID controller feedback volume.</td></tr>
<tr><td>20</td><td>Now Date</td><td>Displays current date.</td></tr>
<tr><td>21</td><td>Now Time</td><td>Displays current time.</td></tr>
<tr><td>22</td><td>Now Weekday</td><td>Displays current weekday.</td></tr>
</table></td></tr>
</table>

Code	Description
CNF-21–23 Monitor Line-x	Select the items to be displayed in monitor mode. Monitor mode is the first mode displayed when the inverter is powered on. A total of three items, from monitor line-1 to monitor line- 3, can be displayed simultaneously.
CNF-24 Mon Mode Init	Selecting '1 (Yes)' initializes CNF-20–23.

Note

Inverter power consumption

Values are calculated using voltage and current. Electric power is calculated every second and the results are accumulated. Setting CNF-62 (WH Count Reset) value to '1 (Yes)' will reset cumulated electric 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 65,535 MW will reset the value to 0, and units will return to kW. It will be displayed in 999.9 kW format).

5.61 Operation Time Monitor

This feature is used to monitor the inverter and fan operation times.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	70	Cumulated inverter power-on time	On-time	00000DAY 00:00		-	Day hh:mm
	71	Cumulated inverter operation time	Run-time	00000DAY 00:00		-	Day hh:mm
	72	Inverter operation accumulated time initialization	Time Reset	0	No	0–1	-
	74	Cooling fan operation accumulated time	Fan time	00000DAY 00:00		-	Day hh:mm
	75	Cooling fan operation accumulated time initialization	Fan Time Reset	0	No	0–1	-

Operation Time Monitor Setting Details

Code	Description
CNF-70 On-time	Displays accumulated power supply time. Information is displayed in [Day Hr: Min (00000DAY 00:00)] format.
CNF-71 Run-time	Displays accumulated time of voltage output by operation command input. Information is displayed in [Day Hr: Min (00000DAY 00:00)] format.
CNF-72 Time Reset	Setting '1 (Yes)' will delete the power supply accumulated time (On-time) and operation accumulated time (Run-time)
CNF-74 Fan time	Displays accumulated time of the inverter cooling fan operation. Information will be displayed in [Day Hr: Min (00000DAY 00:00)] format.
CNF-75 Fan Time Reset	Setting '1 (Yes)' will delete the cooling fan operation accumulated time (Fan-time)

5.62 Display Current Date / Time / Day Using Multi Key

The current date, time, and day of the week are displayed on the monitoring screen using the Multi key on the keypad.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF	42	Multi key item	Multi key sel	3	Now Time	0–2	-

The current date is [AP3-01 Now Date], the current time is [AP3-02 Now Time], and the current day is the parameter value set in [AP3-03 Now Weekday].

When [CNF-42 Multi-Key Sel] is selected as {3: Now Time}, (T) image is displayed on the top of the keypad.

When you press the <MULTI> key on the keypad, the image (T) is displayed on the top of the keypad, and the monitor display mode is changed to the monitor value automatically as follows:? (Keypad parameters of Monitor Line 1/2/3 of CNF group Is changed and only the display on the monitoring screen is changed)

Line1: Now Date (= value of AP3-01)

Line2: Now Time (= value of AP3-02)

Line3: Now Weekday (= value of AP3-03)

When you press <MULTI> key on the keypad again, (T) image is displayed on the top of the keypad, and the monitoring display value is changed to the state that the user has already set.

You can individually set {26: Now Date}, {27: Now Time} and {28: Now Weekday} in [CNF-21/22/23 Monitor Line-1/2/3]

[CNF-20 Anytime Para] can not be set to {26: Now Date} or {28: Now Weekday}

6 Learning Protection Features

Protection features provided by the H100 series inverter are categorized into two types: protection from overheating damage to the motor and protection against the inverter malfunction.

6.1 Motor Protection

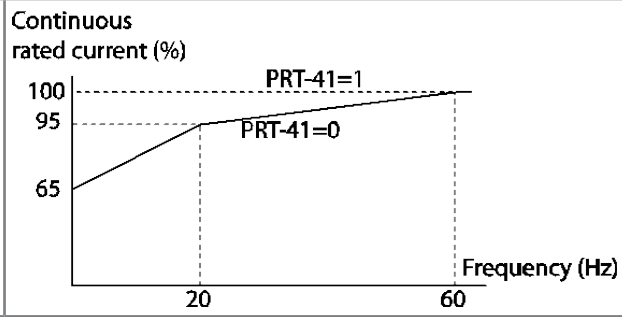
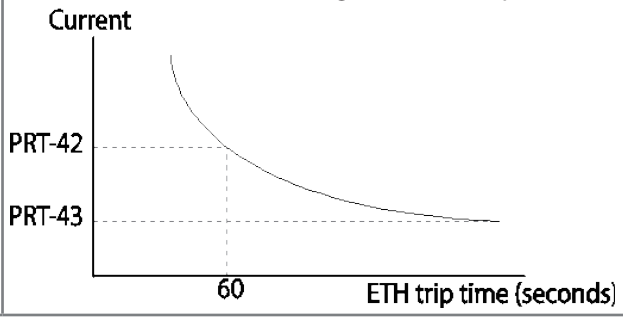
6.1.1 Electronic Thermal Motor Overheating Prevention (ETH)

ETH is a protective function that uses the output current of the inverter, without a separate temperature sensor, to predict a rise in motor temperature to protect the motor based on its heat characteristics.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	40	Electronic thermal prevention fault trip 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	115		100–150	%
	43	Electronic thermal prevention continuous rating	ETH Cont	100		50–115	%

Electronic Thermal (ETH) Prevention Function Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-40 ETH Trip Sel</td><td>ETH can be selected to provide motor thermal protection. The LCD screen displays"E-Thermal."
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>None</td><td>The ETH function is not activated.</td></tr>
<tr><td>1</td><td>Trip & Coast</td><td>The inverter output is blocked. The motor coasts to a halt (free-run).</td></tr>
<tr><td>2</td><td>Decel Stop</td><td>The inverter decelerates the motor to a stop.</td></tr>
</table></td></tr>
<tr><td>PRT-41 Motor Cooling</td><td>Select the drive mode of the cooling fan, attached to the motor.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Self-cool</td><td>As the cooling fan is connected to the motor axis, the cooling effect varies based on motor speed. Most universal induction motors have this design.</td></tr>
<tr><td>1</td><td>Forced-cool</td><td>Additional power is supplied to operate the cooling fan. This provides extended operation at low speeds. Motors designed for inverters typically have this design.</td></tr>
</table></td></tr>
</table>

Code	Description
PRT-41 Motor Cooling	
PRT-42 ETH 1 min	The amount of input current that can be continuously supplied to the motor for 1 minute, based on the motor-rated current (BAS-13).
PRT-43 ETH Cont	Sets the amount of current with the ETH function activated. The range below details the set values that can be used during continuous operation without the protection function. 

6.1.2 Motor Over Heat Sensor

To operate the motor overheat protection, connect the overheat protection temperature sensor (PT 100, PTC) installed in the motor to the inverter's analog input terminal.

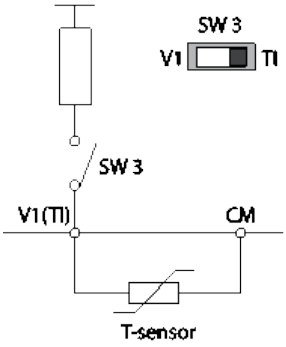
Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
PRT	34	Selecting the operation after the detection of the motor overheat detection sensor	Thermal-T Sel	0	None	0–2	-
	35	Selecting the input of the motor overheat detection sensor	Thermal In Src	0	Thermal In	0–1	
	36	Fault level of the motor overheat detection sensor	Thermal-T Lev	50.0		0.0–100.0	%
	37	Fault area of the motor overheat detection sensor	Thermal-T Area	0	Low	0–1	
OUT	07	Analog output 2 item	AO2 Mode	12	Constant	0–14	
	08	Analog output 2 gain	AO2 Gain	100		0–100	%

Motor Overheat Protect Sensor Input Detail Settings

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-34
Thermal-T Sel</td><td>Sets the inverter operation state when motor is overheated.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Do not operate when motor overheating is detected.</td></tr>
<tr><td>1</td><td>Trip & Coast</td><td>When the motor is overheated, the inverter output is blocked and the motor will free-run by inertia.</td></tr>
<tr><td>2</td><td>Decel Stop</td><td>When the motor is over heated, the motor decelerates and stops.</td></tr>
</table></td></tr>
<tr><td>PRT-35
Thermal In Src</td><td>Selects the type of the terminal when the motor overheat protect sensor is connected to the volt (V1) or current (I2) input terminal of the terminal block in the inverter.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Thermal In</td><td>Configure the motor overheat protect sensor connection to terminal block V1.</td></tr>
<tr><td>1</td><td>V2</td><td>Configure the motor overheat protect sensor connection to terminal block I2.</td></tr>
</table></td></tr>
<tr><td>PRT-36
Thermal-T Lev</td><td>Configure the fault level of the motor overheat detect sensor.</td></tr>
<tr><td>PRT-37
Thermal-T Area</td><td>
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Low</td><td>Operates when the motor overheat sensor input is smaller than PRT-36.</td></tr>
<tr><td>1</td><td>High</td><td>Operates when the motor overheat sensor input is bigger that PRT-36.</td></tr>
</table></td></tr>
<tr><td>OUT-07 AO2 Mode,
OUT-08 AO2 Gain</td><td>Used when supplying the constant current to the temperature sensor and receives input through the I2 or V1 terminal block by using the analog output terminal.</td></tr>
</table>

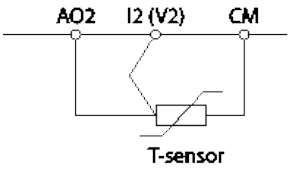
Using the temperature sensor (PTC) by connecting it to the analog input terminal

When the AO2(analog current output) terminal is connected to the temperature sensor installed on a motor, the inverter supplies constant current to the temperature sensor. Then, connecting the motor signal wire to one of the inverter's analog input terminals allows the inverter to detect the changes in the PTC resistance and translates it into voltage. If the I2 terminal is used to receive the signal, set the selection switch on the I/O board to V2. If the V1 terminal is used, set the switch to T1. The sensor does not operate if SW3 is set to 'V1'.



To receive PTC signal at V1 input terminal, set PRT-35 (Thermal InSrc) to '0 (Thermal In)' and set the Analog1 input selection switch (SW3) to T1.





To receive PTC signal at I2 input terminal, set PRT-35 (Thermal InSrc) to '1 (V2)' and set SW 4 (Analog2 input selection switch) to V2. The sensor does not operate if SW4 is set to 'I2'.When the inverter detects a motor overheat, motor overheat trip occurs with internal delay time. The trip delay time is not reset instantly when the trip condition is released, but it only decreases as time passes.

6.1.3 Overload Early Warning and Trip

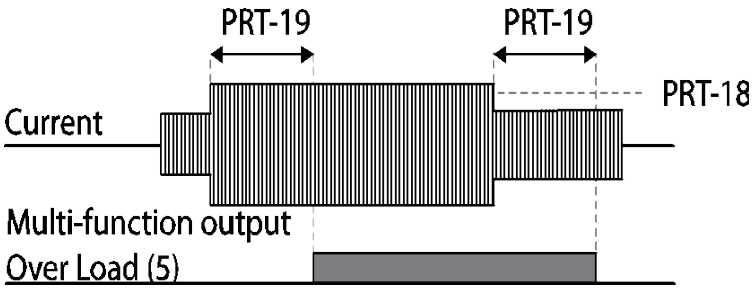
A warning or fault trip (cutoff) occurs when the motor reaches an overload state, based on the motor's rated current. The amount of current for warnings and trips can be set separately.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	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	Trip & Coast	0–2	-
	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 relay 1–5 item	Relay 1–5	5	Over Load	0–55	-
	36	Multi-function output 1 item	Q1 Define				

Overload Early Warning and Trip Setting Details

Code	Description
PRT-17 OL Warn Select	If the overload reaches the warning level, the terminal block multi-function output terminal and relay are used to output a warning signal. If '1 (Yes)' is selected, it will operate. If '0 (No)' is selected, it will not operate.
PRT-18 OL Warn Level, PRT-19 OL Warn Time	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 multi-function output (Relay 1, Q1) sends a warning signal. When Over Load is selected at OUT-31, OUT-33, the multi-function output terminal or relay outputs a signal. The signal output does not block the inverter output.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-20
OL Trip Select</td><td>Select the inverter protective action in the event of an overload fault trip.
<table>
<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>Trip & Decel</td><td>In the event of an overload fault, inverter output is blocked and the motor will free-run due to inertia.</td></tr>
<tr><td>3</td><td>Decel Stop</td><td>If a fault trip occurs, the motor decelerates and stops.</td></tr>
</table></td></tr>
<tr><td>PRT-21 OL Trip Level,
PRT-22 OL Trip Time</td><td>When the current supplied to the motor is greater than the preset value of the overload trip level (OL Trip Level) and continues to be supplied during the overload trip time (OL Trip Time), the inverter output is either blocked according to the preset mode from PRT-17 or slows to a stop after deceleration.</td></tr>
</table>



Note

Overload warnings warn of an overload before an overload fault trip occurs. The overload warning signal may not work in an overload fault trip situation, 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).

6.1.4 Stall Prevention and Flux Braking

The stall prevention function is a protective function that prevents motors from stalling due to overloads. If a motor stall occurs due to an overload, the inverter operation frequency is adjusted automatically. When a stall is caused by overload, high currents induced in the motor may cause motor overheating or damage the motor and interrupt operation of the motor-driven devices.

In this case, the motor decelerates with optimum deceleration without a brake resistor by using flux braking. If the deceleration time is too short, an over voltage fault trip may occur because of regenerative energy from the motor. The flux braking makes the motor use regenerate energy, therefore optimum deceleration is available without over voltage fault trip.

To protect the motor from overload faults, the inverter output frequency is adjusted automatically, based on the size of load.

Group	Code	Name	LCD Display	Parameter Setting	Setting range	Unit
PRT	50	Stall prevention and flux braking	Stall Prevent	0100	-	bit
	51	Stall frequency 1	Stall Freq 1	60.00	0.5–60.00	Hz
	52	Stall level 1	Stall Level 1	130	30–150	%
	53	Stall frequency 2	Stall Freq 2	60.00	0.5–60.00	Hz
	54	Stall level 2	Stall Level 2	130	30–150	%

Group	Code	Name	LCD Display	Parameter Setting		Setting range		Unit
PRT	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		0–150	0.75–45kW-2 0.75–90kW-4 5.5–90kW-5	-
						0–10	5.5–90kW-2 110–750kW-4 110–300kW-5	
OUT	31 –35	Multi-function relay 1–5 item	Relay 1–5	9	Stall	-		-
	36	Multi-function output 1 item	Q1 Define					

Stall Prevention Function and Flux Braking Setting Details

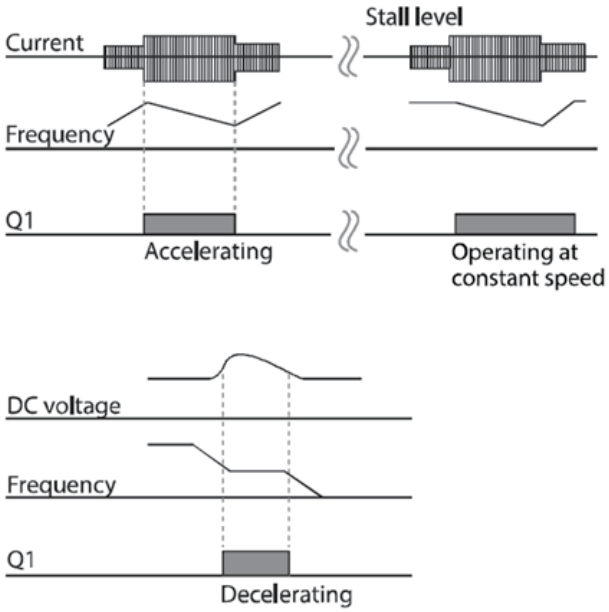
Code	Description
PRT-50 Stall Prevent	Stall prevention can be configured for acceleration, deceleration, or while operating a motor at constant speed.When the LCD segment is on, the corresponding bit is off.

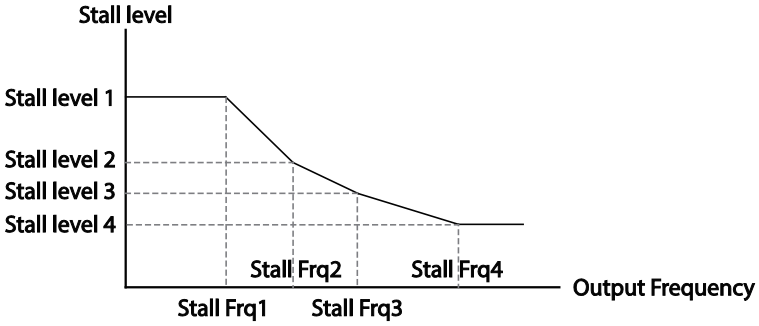
Item	Bit Status (On)	Bit Status (Off)
Keypad display		

PRT-50 Stall Prevent

Setting				Function
Bit 4	Bit 3	Bit 2	Bit 1	
			✓	Stall protection during acceleration
		✓		Stall protection while operating at a constant speed
	✓			Stall protection during deceleration
✓				Flux braking during deceleration

Setting		Function
0001	Stall protection during acceleration	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 level stays above the stall level, the motor decelerates to the start frequency (DRV-19). If the current level causes deceleration below the preset level while operating the stall protection function, the motor resumes acceleration.
0010	Stall protection while operating at constant speed	Similar to stall protection function during acceleration, the output frequency automatically decelerates when the current level exceeds the preset stall level while operating at constant speed. When the load current decelerates below the preset level, it resumes acceleration.
0100	Stall protection during deceleration	The inverter decelerates and keeps the DC link voltage below a certain level to prevent an over voltage fault trip during deceleration. As a result, deceleration times can be longer than the set time depending on the load.

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-50 Stall Prevent</td><td>
<table>
<tr><th colspan="2">Setting</th><th>Function</th></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>
<tr><td>PRT-51 Stall Freq 1– PRT-58 Stall Leve l4</td><td>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).


</td></tr>
<tr><td>PRT-59 Flux Brake Kp</td><td>A gain used to decelerate without over voltage fault trip. It compensates for the inverter output voltage.</td></tr>
</table>

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 trip 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 during acceleration. 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.

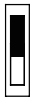
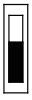
6.2 Inverter and Sequence Protection

6.2.1 Open-phase Protection

Open-phase protection is used to prevent over current levels induced by the inverter inputs due to an open-phase within the input power supply. Open-phase output protection is also available. An open-phase at the connection between the motor and the inverter output may cause the motor to stall, due to a lack of torque.

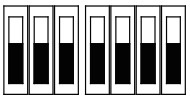
Group	Code	Name	LCD Display	Parameter Setting	Setting range	Unit
PRT	03	Input/output open-phase protection	Phase Loss Chk	00	-	bit
	04	Open-phase input voltage band	IPO V Band	40	1–100 V	V

Input and Output Open-phase Protection Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-03 Phase Loss Chk
PRT-04 IPO V Band</td><td>When open-phase protection is operating, input and output configurations are displayed differently. When the LCD segment is On, the corresponding bit is set to ‘Off’.
<table>
<tr><td>Item</td><td>Bit status (On)</td><td>Bit status (Off)</td></tr>
<tr><td>Keypad display</td><td>  </td><td>  </td></tr>
</table>
<table>
<tr><td colspan="2">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>Bit 2</td><td>Bit 1</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>
</table>

6.2.2 External Trip Signal

Set one of the multi-function input terminals to 4 (External Trip) to allow the inverter to stop operation when abnormal operating conditions arise.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65–71	Px terminal setting options	Px Define (Px: P1–P7)	4	External Trip	0-51	-
	87	Multi-function input contact selection	DI NC/NO Sel			-	bit

External Trip Signal Setting Details

Code	Description
IN-87 DI NC/NO Sel	Selects the type of input contact. If the mark of the switch is at the bottom (0), it operates as an A contact (Normally Open). If the mark is at the top (1), it operates as a B contact (Normally Closed). The corresponding terminals for each bit are as follows:

Bit	7	6	5	4	3	2	1
Terminal	P7	P6	P5	P4	P3	P2	P1

6.2.3 Inverter Overload Protection (IOLT)

When the inverter input current exceeds the rated current, a protective function is activated to prevent damage to the inverter, based on inverse proportional characteristics.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
OUT	31–35	Multi-function relay 1–5	Relay 1–5	6	IOL	1–55	-
	36	Multi-function output 1	Q1 Define	6	IOL	1–55	-

Note

A warning signal output can be provided in advance by the multi-function output terminal before the inverter overload protection function (IOLT) operates. When the overcurrent time reaches 60% of the allowed overcurrent (120%, 1 min; 140%, 5 sec), a warning signal output is provided (signal output at 120%, 36 sec).

6.2.4 Speed Command Loss

When setting operation speed using an analog input at the terminal block, communication options, or the keypad, speed command loss setting can be used to select the inverter operation for situations when the speed command is lost due to the disconnection of signal cables.

Group	Code	Name	LCD Display	Parameter Setting		Setting range		Unit
PRT	12	Keypad command loss operation mode	Lost KPD Mode	0	None	0	None	-
						1	Warning	
						2	Trip & Coast	
						3	Decel Stop	
	13	Speed command loss operation mode	Lost Cmd Mode	1	Trip & Coast	0	None	-
						1	Trip & Coast	
						2	Decel & Stop	
						3	Hold Input	
						4	Hold Output	

Group	Code	Name	LCD Display	Parameter Setting		Setting range		Unit
PRT	14	Time to determine speed command loss	Lost Cmd Time	1.0		0.1–120.0		sec
	15	Operation frequency at speed command loss	Lost Preset F	0.00		Start frequency–Max. frequency		Hz
	16	Analog input loss decision level	AI Lost Level	0	Half of x1	0	Half of x 1	-
						1	Below x 1	
OUT	31 –35	Multi-function Relay 1–5	Relay 1–5	13	Lost Command	-		-
	36	Multi-function output 1	Q1 Define					

Speed Command Loss Setting Details

Code	Description
PRT-12 Lost KPD Mode	Set the operation command source to keypad. If there is a communication error with the keypad or connection problem between the keypad and the inverter, select the inverter's operation.

Setting		Function
0	None	The speed command immediately becomes the operation frequency without any protection function.
1	Warning	Select 24: Lost keypad from OUT-31–36, one of the multi function terminal blocks, outputs a relevant warning signal when abnormal operating conditions arise.
2	Trip & Coast	The inverter blocks output. The motor performs in free-run condition.
3	Decel Stop	The motor decelerates and then stops at the time set at PRT-07 (Trip Dec Time).

Code	Description
PRT-13 Lost Cmd Mode	In situations when speed commands are lost, the inverter can be configured to operate in a specific mode:

Setting		Function
0	None	The speed command immediately becomes the operation frequency without any protection function.
1	Trip & Coast	The inverter blocks output. The motor performs in free-run condition.
2	Decel Stop	The motor decelerates 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 command 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 command and uses it as the speed reference.
5	Lost Preset	The inverter operates at the frequency set at PRT- 14 (Lost Preset F).

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-16 AI Lost Level,
PRT-14 Lst Cmd Time</td><td>Configure the voltage and decision time for speed command loss when using analog input.
<table>
<tr><th colspan="2">Setting</th><th>Function</th></tr>
<tr><td>0</td><td>Half of x1</td><td>Based on the values set at IN-08 and IN-12, a protective operation starts when the input signal is reduced to half of the initial value of the analog input set using the speed command (DRV-01) and it continues for the time (speed loss decision time) set at PRT-13 (Lost Cmd Time). For example, set the speed command to ‘2 (V1)’ at DRV-07, and set IN-06 (V1 Polarity) to ‘0 (Unipolar)’. When the voltage input drops to less than half of the value set at IN-08 (V1 Volt x 1), the protective function is activated.</td></tr>
<tr><td>1</td><td>Below of x1</td><td>The protective operation starts when the signal becomes smaller than the initial value of the analog input set by the speed command and it continues for the speed loss decision time set at PRT-13 (Lost Cmd Time). Codes IN-08 and IN-12 are used to set the standard values.</td></tr>
</table>
If the set value of the IN-08 and IN-12 is ‘0,’ the LostCmd function does not operate.</td></tr>
<tr><td>PRT-15 Lost Preset F</td><td>In situations where speed commands are lost, set the operation mode (PRT-12 Lost Cmd Mode) to ‘5 (Lost Preset)’. This operates the protection function and sets the frequency so that the operation can continue.</td></tr>
</table>

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

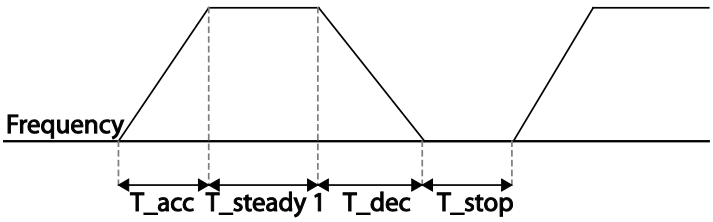
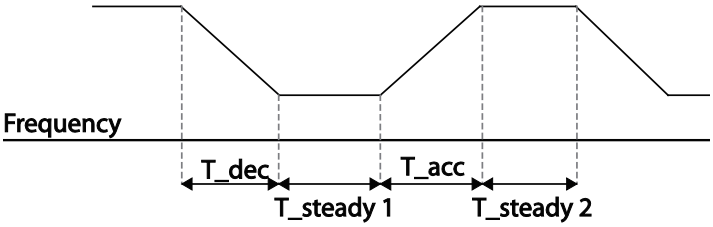
If speed command is lost while using communication options or the integrated RS-485 communication, the protection function operates after the command loss decision time set at PRT-13 (Lost Cmd Time) is elapsed.

6.2.5 Dynamic Braking (DB) Resistor Configuration

For H100 plus series, the brake resistor transistor is integrated inside the inverter.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	63	Brake resistor configuration	DB Warn %ED	0		0–30	%
OUT	31–35	Multi-function relay 1–5 item	Relay 1–5	25	DB Warn %ED	0–55	-
	36	Multi-function output 1 item	Q1 Define				

Dynamic Brake resistor Setting Details

Code	Description
PRT-63 DB Warn %ED	Set the brake resistor configuration (%ED: Enable Duty). The brake resistor configuration sets the rate at which the brake resistor operates for one operation cycle. The maximum time for continuous braking is 15 sec and the brake resistor signal is not output from the inverter after the 15 sec period elapses. An example of brake resistor set up is as follows: [Example 1]  [Example 2]  • 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

Caution

Do not set the brake 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.

6.2.6 Low Battery Voltage Warning

The H100 series has a battery low voltage warning feature. 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 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

- Be careful when replacing the battery. Remaining voltage in the battery may cause electric shock.
- Make sure that the battery doesn't fall inside of the inverter.

6.2.7 Input Phase Selection

This function is necessary when using single phase input. If BAS-06 is set to 1: Single phase, the reference of the motor current set internally in the inverter changes to match the single-phase input. This is to change the level of the protection function according to the inverter rated current, which complies with the UL description.

Code (Address)	Name (LCD Display)	Parameter setting	Default	Description
BAS-06	Input phase selection (Input Phase)	0: 3 Phase 1: 1 Phase	0: 3 Phase	Setting the input phase

6.3 Under Load Fault Trip and Warning

The following table lists the under load fault trip and warning features of the H100 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	Trip&Coast	0-3	-
	28	Under load trip timer	UL Trip Time	30.0		0–600.0	sec
	29	Under load trip retry number	UL Retry Num	2		0–10	-
	30	Under load trip delay time	UL Retry Dly	10.0		0.0–6000.0	sec

Under Load Trip and Warning Setting Details

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

Code	Description
PRT-26 UL Warn Time	A protection function operates when under load level condition explained above maintains for the warning time set.
PRT-27 UL Trip Sel	Sets the inverter operation mode for situations when an underload trip occurs. If set to '1 (Trip & Coast Stop)', the output is blocked in an underload fault trip event. If set to '2 (Dec)', the motor decelerates and stops when an underload trip occurs.
PRT-28 UL Trip Time	A protection function operates when underload level conditions explained above maintain for the trip time set.
PRT-29 UL Retry Num	The UL Retry Num is the number of times the inverter will try to restart its operation when UL trip occurs.
PRT-30 UL Retry Dly	The UL Rery Dly is the delay time before the inverter tries to restart.

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.

6.3.1 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	0–55	-
OUT	36	Multi-function output 1	Q1 Define				

* With a capacity of 110 kW or more, failure mode of internal fan is selected by selection of PRT-79.

Fan Fault Detection Setting Details

Code	Description
PRT-79 Fan Trip Mode	Set the cooling fan fault mode. Setting: 0 Trip — The inverter output is blocked and the fan trip is displayed when a cooling fan error is detected. Setting: 1 Warning — When OUT-36 (Q1 Define) and OUT-31–35 (Relay1–5) are set to '8 (FAN Warning)', the fan error signal is output and the operation continues.
OUT-36 Q1 Define, OUT-31–35 Relay1–5	When the code value is set to '8 (FAN Warning)', the fan error signal is output and operation continues. However, when the inverter's inside temperature rises above a certain level, output is blocked due to activation of overheat protection.

6.3.2 Low Voltage Fault Trip

When inverter input power is lost and the internal DC link voltage drops below a certain voltage level, the inverter stops output and a low voltage trip occurs.

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		-
	36	Multi-function output 1	Q1 Define				

Low Voltage Fault Trip Setting Details

Code	Description
PRT-81 LVT Delay	If the code value is set to '11 (Low Voltage)', the inverter stops the output first when a low voltage trip condition occurs, then a fault trip occurs after the low voltage trip decision time elapses. The warning signal for a low voltage fault trip can be provided using the multi-function output or a relay. However, the low voltage trip delay time (LVT Delay time) does not apply to warning signals.

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	

If input power is disconnected during inverter operation and 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 the user unlocks the fault state.

6.3.3 Output Block via the Multi-function Terminal

When the multi-function input terminal is set as the output block signal terminal and the signal is input to the terminal, then the operation stops.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65–71	Px terminal setting options	Px Define (Px: P1–P7)	5	BX	0-55	-

Output Block by Multi-function Terminal Setting Details

Code	Description
IN-65–71 Px Define	When the operation of the multi-function input terminal is set to '5 (BX)' and is turned on 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 monitored. The inverter resumes operation when the BX terminal turns off and operation command is input.

6.3.4 Trip Status Reset

Restart the inverter, using the keypad or analog input terminal, to reset the trip status.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
IN	65–71	Px terminal setting options	Px Define (Px: P1–P7)	3	RST	0-55	-

Trip Status Reset Setting Details

Code	Description
IN-65–71 Px Define	Press the [Stop/Reset] key on the keypad or use the multi-function input terminal to restart the inverter. Set the multi-function input terminal to '3' (RST) and turn on the terminal to reset the trip status.

6.3.5 Operation Mode for Option Card Trip

Option card trips may occur when an option card is used with the inverter. Set the operation mode for the inverter when a communication error occurs between the option card and the inverter body, or when the option card is detached during operation.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	80	Operation mode for option card trip	Opt Trip Mode	1	Trip & Coast	0–2	-

Operation Mode on Option Trip Setting Details

Code	Description		
PRT-80 Opt Trip Mode	Setting		Function
	0	None	No operation
	1	Trip & Coast	The inverter output is blocked and fault trip information is shown on the keypad.
	2	Decel Stop	The motor decelerates to the value set at PRT-07 (Trip Dec Time).

6.3.6 No Motor Trip

If an operation command is run when the motor is disconnected from the inverter output terminal, a 'no motor trip' occurs and a protective operation is performed by the system.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
PRT	31	Operation for no motor trip	No Motor Trip	0	None	0-1	-
	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 (BAS-13)] 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,' due to a lack of output current, will occur when the 'no motor trip' operation is set.

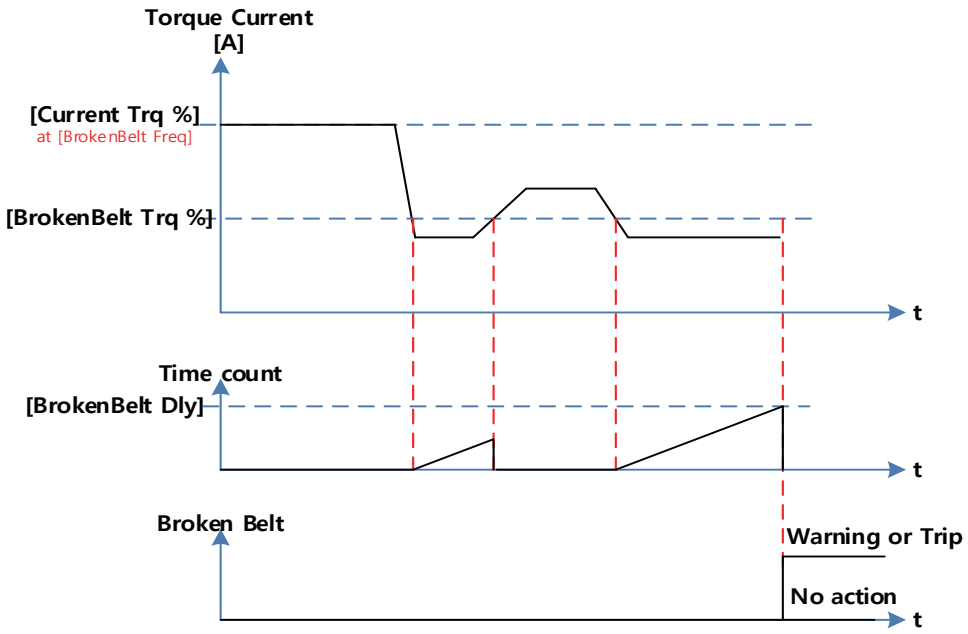
Broken Belt

It is a function to detect a problem in case that a Belt or Coupling is broken while a pump is used.

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	Trip & Coast	
	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 in the frequency over PRT-92 and current torque reaches the limit set at PRT-94 and then it meets the conditions at the time above set PRT-95, Broken Belt is activated.



6.4 Parts Life Expectancy

Examine the life cycle of the parts (fan and main capacitor) of the inverter. By examining these parts you can use inverter more safely.

6.4.1 Main Capacitor Life Estimation

The life of the main capacitor in the inverter can be predicted by looking at the changes in the capacitance value.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range		Unit
PRT	83	Estimated current level of the capacitance	CAP.Diag Perc	0.0		10.0–100.0		%
	84	CAP estimating mode	CAP.Diag	0	None	0	None	%
						1	CAP. Diag 1	
						2	CAP. Diag 2	
						3	CAP. Init	
	85	CAP. deterioration level	CAP.Level1	0		0.0–100.0		%
	86	CAP. detected level	CAP.Level2	0		0.0–100.0		%
OUT	31–35	Output relay 1–5	Relay 1–5	34		CAP. Warning		-

Main Capacitor Life Estimation Detail Settings

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-83 CAP. Diag Perc</td><td>Configure the current level of the inverter's output when capacitance life examination is in operation. For life examination, the value must be set higher than 0%.</td></tr>
<tr><td>PRT-84 CAP. Diag</td><td>Configure the capacitance life examination mode. This mode is separated into installing the inverter mode and maintenance mode. To use the capacitance life examination function, proper setting is required.
<table>
<tr><td>Setting</td><td></td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>Do not use capacitance life examination function.</td></tr>
<tr><td>1</td><td>CAP. Diag 1</td><td>When installing the inverter for the first time, estimate initial capacitance.</td></tr>
<tr><td>2</td><td>CAP. Diag 2</td><td>Estimate the capacitance while maintaining the inverter.</td></tr>
<tr><td>3</td><td>CAP. Init</td><td>Initialize the estimated value of the capacitance to 0.</td></tr>
</table></td></tr>
<tr><td>PRT-85 CAP. Level 1</td><td>Set the standard level for the capacitance replacement.</td></tr>
<tr><td>PRT-86 CAP. Level 2</td><td>Display estimated capacitance value according to the mode in PRT-84. If this value is lower than the value set in PRT-85, the warning message"CAP Warning" appears on the display.</td></tr>
</table>

Caution

- Be careful when replacing the battery. Remaining voltage in the battery may cause electric shock.
- Make sure that the battery doesn't fall inside of the inverter.
- The main capacitor life examination is only for reference and cannot be used as an absolute value.
- When [DRV-08 AUTO Mode Sel] is Enabled, capacitor life diagnosis works only in the stop state of the inverter AUTO mode.
- If [DRV-08 AUTO Mode Sel] is Disabled, capacitor life diagnosis works only in inverter OFF mode and AUTO mode stop status.

6.4.2 Fan Life Estimation

The inverter records the amount of time the fan is used and sets off the alarm to replace the fan if the fan is used longer than the certain period of time.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range		Unit
PRT	87	Fan accumulated time percentage	Fan Time Perc	0.0		-		%
	88	Fan replacement alarm level	Fan Exchange	0.0		0.0–100.0		%
CNF	75	Initializing the accumulation time of the fan operation	Fan Time Rst	0	No	0	No	
						1	Yes	
OUT	31–35	Relay 1–5 output	Relay 1–5	35	Fan Exchange	0-41		-

When PRT-88 value is 0%, Fan Exchange alarm does not occur and user can use the function when it is set to a value other than 0%.

Fan Life Estimation Setting Details

Code	Description
PRT-87 Fan Time Perc	Displays the time the fan is used in percentage based on 43,200 hours. If this value is bigger than the value in PRT-88, the warning message"Fan Exchange" appears on the display.
PRT-88 Fan Exchange	Displays the life replacement standard of the fan in percentage.
CNF-75 Fan Time Rst	Initializes the accumulation time of the fan operation.

Setting		Function
0	No	Do not initialize the accumulated operation time of the fan.
1	Yes	Initialize the accumulated operation time of the fan.

Caution

- Be careful when replacing the battery. Remaining voltage in the battery may cause electric shock.
- Make sure that the battery doesn't fall inside of the inverter.
- Fan life examination is only for the reference and cannot be used as an absolute value.

6.5 Fault/Warning List

The following list shows the types of faults and warnings that can occur while using the H100+ inverter.
For details, refer to *"6 Learning Protection Features" on page 294.*

Category		LCD Display	Details
Major fault	Latch type	Over Current1	Over current trip
		Over Voltage	Over voltage trip
		External Trip	Trip due to an external signal
		NTC Open	Temperature sensor fault trip
		Over Current2	ARM short current fault trip
		Option Trip-x*	Option fault trip
		Over Heat	Over heat fault trip
		Out Phase Open	Output open-phase fault trip
		In Phase Open	Input open-phase fault trip
		Ground Trip	Ground fault trip
		Fan Trip	Fan fault trip
		E-Thermal	Motor overheat fault trip
		IO Board Trip	IO Board connection fault trip
		No Motor Trip	No motor fault trip
		Low Voltage2	Low voltage fault trip during operation
		ParaWrite Trip	Write parameter fault trip
		Pipe Broken	Pipe Break fault trip
		Damper Err	Damper Err trip
		Over Load	Motor overload fault trip
		Under Load	Motor under load fault trip
		CleanRPTErr	Pump clean trip
		Level Detect	Level detect trip
		MMC Interlock	MMC Interlock 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
		Fuse Open	Fuse Open trip (315–500kW)
		InFAN Trip	Inner Fan trip (110–500kW)
		Comm Err!!	Communication error during lead-lag operation
		Diff Fdb Level:	Differential Level Detection
		TB Trip	Terminal block trip
		Ext-Brake	External brake trip
		Low Fdb Level	Low feedback level trip
		High Fdb Level	High feedback level trip
		SetPnt Timeout	Set point timeout trip
		Over Cycle Cnt	Over-cycling protection

Category		LCD Display	Details
Major fault	Latch type	Low Flow Trip	Low flow trip when No-Flow Control
		High Flow Trip	high flow trip when No-Flow Control
		AccumFlow Trip	Accumulation flow trip when no-Flow Control
		Low Lev Detect	PI Auxiliary Control Low Level Detection
		HighLev Detect	PI Auxiliary Control High Level Detection
	Level type	Low Voltage	Low voltage fault trip
		BX	Emergency stop fault trip
		Lost Command	Command loss trip
		Lost Keypad	Lost keypad trip
		Interlock	Lead-Lag Interlock
		Run Dir Check	Different run Command between Lead-Lag Master and Slave
		Lost Fdb Mode	Lost feedback trip
	Hardware damage (Fatal)	EEP Err	External memory error
		ADC Off Set	Analog input error
		IO Board Trip	IO Board connection fault trip
	Hardware damage (Fatal)	Watch Dog-1	CPU Watch Dog fault trip
		Watch Dog-2	

Category	LCD Display	Details
Warning	Lost Command	Command loss fault trip warning
	Over Load	Overload warning
	Under Load	Under load warning
	Inv Over Load	Inverter overload warning
	Fan Warning	Fan operation warning
	DB Warn %ED	Brake resistor braking rate warning
	Low Battery	Low battery warning
	Fire Mode	Fire mode warning
	Pipe Broken	Pipe Break warning
	Level Detect	Level detect warning
	CAP. Warning	Capacitor lifetime warning
	Fan Exchange	Fan replacement 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 (110–500kW)
	KPD H.O.A Lock	Keypad lock warning (When HAND-OFF-AUTO is disabled)
	Sleep	Standby (Sleep) mode warning
	Backspin Time	Backspin timer operation warning

Category	LCD Display	Details
Warning	DataShare	Parameter share warning between master and slave during Lead-Lag operation
	Int485 St ID	This occurs when an attempt is made to change the parameter when [COM-01 Int485 St ID] is "0". *When [CNF-43 Macro Select] is set to (2: Lead Lag Sel), [COM-01 Int485 St ID] becomes "0".
	Low Flow Level	Lower current flow than set flow rate warning
	High Flow Lev	Hiher current flow than set flow rate warning
	Low Lev Detect	PI auxiliary control feedback source is lower than PI Aux. low level
	High Lev Detect	PI auxiliary control feedback source is lower than PI Aux. high level
	Thrust Mode	Thrust mode warning
	SetPnt Timeout	Setpoint time out (large difference between PID feedback and setpoint) warning
	Disable WakeUp	Wake up disable warning

Note

- In a latch type trip, the inverter cannot unlock the fault if the user does not reset the inverter, even if the trip state is released after the trip occurs.
- In level type trip, the inverter can unlock the fault by itself if the trip state is unlocked after the trip occurs.
- In a fetal type trip, there is no way to unlock the fault other than turning the inverter off then back on after the trip occurs.

7 RS-485 Communication Features

This section in the user manual explains how to control the inverter with a PLC or a computer over a long distance using the RS-485 communication features. To use the RS-485 communication features, connect the communication cables and set the communication parameters on the inverter. Refer to the communication protocols and parameters to configure and use the RS-485 communication features.

7.1 Communication Standards

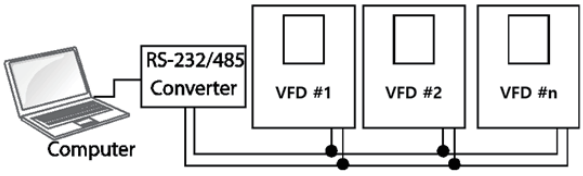
Following the RS-485 communication standards, H100 products exchange data with a PLC and computer. The RS-485 communication standards support the Multi-drop Link System and offer an interface that is strongly resistant to noise. Please refer to the following table for details about the communication standards.

Item	Standard
Communication method/ Transmission type	RS-485/Bus type, Multi-drop Link System
Inverter type name	H100
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 - insulated 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 / LS Bus: ASCII
Stop bit length	1-bit/2-bit
Frame error check	2 bytes
Parity check	None/Even/Odd

7.2 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 converter must be integrated with the computer, so that it can communicate with the inverter through the RS-232/RS-485 converter. 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.



7.2.1 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 terminals on the PLC and inverter are connected. SG terminals prevent communication errors due to electronic noise interference.

7.2.2 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.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
COM	01	Built-in communication inverter ID	Int485 St ID	1		1–MaxComID[1]	-
	02	Built-in communication protocol	Int485 Proto	0	ModBus RTU	0-6	-
	03	Built-in communication speed	Int485 BaudR	3	9600 bps	0–8	-
	04	Built-in communication frame setting	Int485 Mode	0	D8/PN/S1	0–3	-
	05	Transmission delay after reception	Resp Delay	5		0–1000	msec

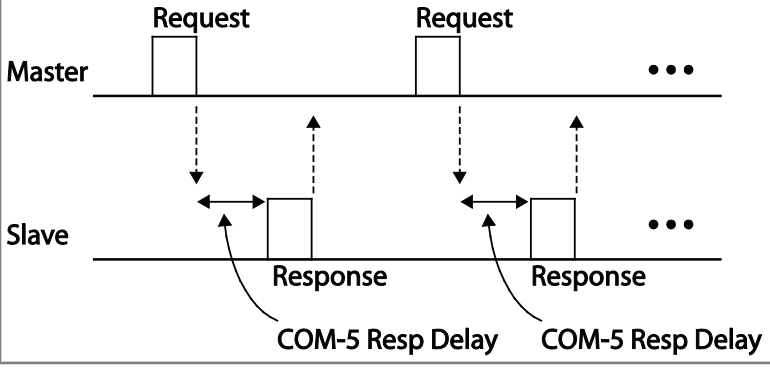
Communication Parameters Setting Details

Code	Description
COM-01 Int485 St ID	Sets the inverter station ID between 1 and MaxComID.
COM-02 Int485 Proto	Select one of the four built-in protocols: Modbus-RTU, LS INV 485, BACnet or Metasys-N2.

Setting		Function
0	Modbus-RTU	Modbus-RTU compatible protocol
2	LS INV 485	Dedicated protocol for the LS inverter
4	BACnet	BAC net protocol
5	Metasys-N2	Metasys-N2 protocol
6	ModBus Master	Dedicated protocol for ModBus Master

1 If AP1-40 is set to '4(Slave Only)', MaxComID is '8', and if COM-02 is set to '4(BACnet), MaxComID is '127'. Otherwise MaxComID is '250'.

<table>
<tr><th>Code</th><th>Description</th></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><td>Setting</td><td>Communication Speed</td></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>
If the COM-02 Int485 Proto setting is BACnet, the available communication speed settings are 9600 bps, 19200 bps, 76.8 kbps.
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><td colspan="2">Setting</td><td>Function</td></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>Reserved</td><td></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 code to an appropriate value for smooth master-slave communication.
 
</td></tr>
</table>

7.2.3 Setting Operation Command and Frequency

After setting the DRV-06 Cmd Source code to '3 (Int 485)' and DRV-07 Freq Ref Src code 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 *"4.6.4 RS-485 Communication as a Command Input Device" on page 85* and about the frequency command, refer to *"4.2.6 Setting a Frequency Reference via RS-485 Communication" on page 80*.

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	0–6	-
	07	Frequency setting method	Freq Ref Src	6	Int 485	0–11	-

7.2.4 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	13	Speed command loss operation mode	Lost Cmd Mode	0	None	0–5	-
	14	Time to determine speed command loss	Lost Cmd Time	6	1.0	0.1–120.0	sec

Command Loss Protective Operation Setting Details

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>PRT-12 Lost Cmd Mode,
PRT-13 Lost Cmd Time</td><td>Select the operation to run when a communication error has occurred and lasted exceeding the time set at PRT-13.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>The speed command immediately becomes the operation frequency without any protection function.</td></tr>
<tr><td>1</td><td>Trip & Coast</td><td>The inverter blocks output. The motor performs in coast stop condition.</td></tr>
<tr><td>2</td><td>Decel Stop</td><td>The motor decelerates and then stops.</td></tr>
<tr><td>3</td><td>Hold Input</td><td>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.</td></tr>
<tr><td>4</td><td>Hold Output</td><td>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.</td></tr>
<tr><td>5</td><td>Lost Preset</td><td>The inverter operates at the frequency set at PRT-15 (Lost Preset F).</td></tr>
</table>
</td></tr>
</table>

7.3 LS INV 485/Modbus-RTU Communication

7.3.1 Setting Virtual Multi-function Input

Multi-function input can be controlled using a communication address (0h0385). Set codes 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 operates independently from IN-65–71 analog 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 code 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	0–50	-
	82	Communication multi-function input monitoring	Virt DI Status	0000 0000		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'.

7.3.2 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	

7.3.3 Total Memory Map for Communication

Communication Area	Memory Map	Details
Communication common compatible area	0h0000–0h00FF	iP5A, S100, H100, iS7, G100, M100, S300 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	VFD monitoring area
	0h0380–0h03DF	VFD control area
	0h03E0–0h03FF	VFD memory control area
	0h0400–0h0FFF	Reserved
	0h1100	DRV Group
	0h1200	BAS Group
	0h1300	ADVGroup
	0h1400	CON Group
	0h1500	IN Group
	0h1600	OUT Group
	0h1700	COM Group

Communication Area	Memory Map	Details
Communication common area	0h1800	PID Group
	0h1900	AP1 Group
	0h1A00	AP2 Group
	0h1B00	AP3 Group
	0h1C00	AP4 Group
	0h1D00	PRT Group
	0h1E00	APO Group

7.3.4 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	31-46	Output communication address x	Para Status-x (x: 1–8)	-	0000–FFFF	Hex
	51-66	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.

7.3.5 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 (MAC 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) access)
0h0201	User Grp. Code 2	Parameter value registered at U&M > USR → 2 (Read/Write) access)

Address	Parameter	Assigned Content by Bit
. . .	. . .	. . .
0h023E	User Grp. Code 63	Parameter value registered at U&M > USR → 63 (Read/Write) (Read/Write access)
0h023F	User Grp. Code 64	Parameter value registered at U&M > USR → 64 (Read/Write) (Read/Write access)

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

7.3.6 LS INV 485 Protocol

The slave device (inverter) responds to read and write requests from the master device (PLC or PC).

Request

ENQ	Station ID	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n bytes	2 bytes	1 byte

Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Error Response

NAK	Station ID	CMD	Error code	SUM	EOT
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

- A request starts with ENQ and ends with EOT.
- A normal response starts with ACK and ends with EOT.
- An error response starts with NAK and ends with EOT.
- A station ID indicates the inverter number and is displayed as a two-byte ASCII-HEX string that uses characters 0-9 and A-F.
- CMD: Uses uppercase characters (returns an IF error if lowercase characters are encountered)—please refer to the following table.

Character	ASCII-HEX	Command
'R'	52h	Read
'W'	57h	Write
'X'	58h	Request monitor registration
'Y'	59h	Perform monitor registration

- Data: ASCII-HEX (for example, when the data value is 3000: 3000 →'0"B"B"8'h →30h 42h 42h 38h)
- Error code: ASCII-HEX (refer to *"7.3.6.4 Error Code" on page 325*)
- Transmission/reception buffer size: Transmission=39 bytes, Reception=44 bytes
- Monitor registration buffer: 8 Words
- SUM: Checks communication errors via sum.
- SUM=a total of the lower 8 bits values for station ID, command and data (Station ID+CMD+Data) in ASCII-HEX.
- For example, a command to read 1 address from address 3000: SUM='0'+'1'+'R'+'3'+'0'+'0'+'0'+'1' = 30h+31h+52h+33h+30h+30h+30h+31h = 1A7h (the control value is not included: ENQ, ACK, NAK, etc

ENQ	Station ID	CMD	Address	Number of Addresses	SUM	EOT
05h	'01'	'R'	'3000'	'1'	'A7'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

Note

Broadcasting

Broadcasting sends commands to all inverters connected to the network simultaneously. When commands are sent from station ID 255, each inverter acts on the command regardless of the station ID. However no response is issued for commands transmitted by broadcasting

7.3.6.1 Detailed Read Protocol

Read Request: Reads successive n words from address XXXX.

ENQ	Station ID	CMD	Address	Number of Addresses	SUM	EOT
05h	'01'–'FA'	'R'	'XXXX'	'1'–'8' = n	'XX'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

Total bytes=12. Characters are displayed inside single quotation marks(').

Read Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'–'FA'	'R'	'XXXX'	'XX'	04h
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (7 x n x 4): a maximum of 39

Read Error Response

NAK	Station ID	CMD	Error code	SUM	EOT
15h	'01'-'FA'	'R'	'**'	'XX'	04h

NAK	Station ID	CMD	Error code	SUM	EOT
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

7.3.6.2 Detailed Write Protocol

Write Request

ENQ	Station ID	CMD	Address	Number of Addresses	Data	SUM	EOT
05h	'01'–'FA'	'W'	'XXXX'	'1'–'8' = n	'XXXX…'	'XX'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (12 + n x 4): a maximum of 44

Write Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'–'FA'	'W'	'XXXX…'	'XX'	04h
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (7 + n x 4): a maximum of 39

Write Error Response

NAK	Station ID	CMD	Error Code	SUM	EOT
15h	'01'–'FA'	'W'	'**'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

7.3.6.3 Monitor Registration Detailed Protocol

Monitor registration request is made to designate the type of data that requires continuous monitoring and periodic updating.

Monitor Registration Request: Registration requests for n addresses (where n refers to the number of addresses. The addresses do not have to be contiguous.)

ENQ	Station ID	CMD	Number of Addresses	Address	SUM	EOT
05h	'01'–'FA'	'X'	'1'–'8'=n	'XXXX…'	'XX'	04h
1 byte	2 bytes	1 byte	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (8 + n x 4): a maximum of 40

Monitor Registration Normal Response

ACK	Station ID	CMD	SUM	EOT
06h	'01'–'FA'	'X'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes=7

Monitor Registration Error Response

NAK	Station ID	CMD	Error Code	SUM	EOT
15h	'01'–'FA'	'X'	'**'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

Monitor Registration Perform Request: A data read request for a registered address, received from a monitor registration request

ENQ	Station ID	CMD	SUM	EOT
05h	'01'–'FA'	'Y'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes=7

Monitor Registration Execution Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'–'FA'	'Y'	'XXXX…'	'XX'	04h
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Totalbytes= (7 + n x 4): a maximum of 39

Monitor Registration Execution Error Response

NAK	Station ID	CMD	Error Code	SUM	EOT
15h	'01'–'FA'	'Y'	'**'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

7.3.6.4 Error Code

Code	Abbreviation	Description
ILLEGAL FUNCTION	IF	The requested function cannot be performed by a slave because the corresponding function does not exist.
ILLEGAL DATA ADDRESS	IA	The received parameter address is invalid at the slave.
ILLEGAL DATA VALUE	ID	The received parameter data is invalid at the slave.
WRITE MODE ERROR	WM	Tried writing (W) to a parameter that does not allow writing (read-only parameters, or when writing is prohibited during operation)
FRAME ERROR	FE	The frame size does not match.

7.3.6.5 ASCII Code

Character	Hex	Character	Hex	Character	Hex
A	41	q	71	@	40
B	42	r	72	[	5B
C	43	s	73	\	5C
D	44	t	74	]	5D
E	45	u	75		5E
F	46	v	76		5F
G	47	w	77		60
H	48	x	78	{	7B
I	49	y	79	|	7C
J	4A	z	7A	}	7D
K	4B	0	30	–	7E
L	4C	1	31	BEL	07
M	4D	2	32	BS	08
N	4E	3	33	CAN	18
O	4F	4	34	CR	0D
P	50	5	35	DC1	11
Q	51	6	36	DC2	12
R	52	7	37	DC3	13
S	53	8	38	DC4	14
T	54	9	39	DEL	7F
U	55	space	20	DLE	10
V	56	!	21	EM	19
W	57	“	22	ACK	06
X	58	#	23	ENQ	05
Y	59	$	24	EOT	04
Z	5A	%	25	ESC	1B
a	61	&	26	ETB	17
b	62	‘	27	ETX	03
c	63	(	28	FF	0C
d	64	)	29	FS	1C
e	65	*	2A	GS	1D
f	66	+	2B	HT	09
g	67	,	2C	LF	0A
h	68	-	2D	NAK	15
i	69	.	2E	NUL	00
j	6A	/	2F	RS	1E
k	6B	:	3A	S1	0F
l	6C	;	3B	SO	0E
m	6D	<	3C	SOH	01
n	6E	=	3D	STX	02
o	6F	>	3E	SUB	1A
p	70	?	3F	SYN	16
				US	1F
				VT	0B

7.3.7 Modbus-RTU Protocol

7.3.7.1 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 *"7.3.8 Compatible Common Area Parameter" on page 329*.

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

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

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].

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.

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

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

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

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.

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

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

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

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.

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
Description	COM-01 Int 485 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
Description	COM-01 Int485 St ID	Preset Multi- ple Register	Starting Address-1 (0x1103-1)	-	-

7.3.8 Compatible Common Area Parameter

The following are common area parameters partly compatible with the iP5A, S100, H100, iS7, G100, M100, S300 series inverters. (Addresses 0h0000-0h0011 are for compatible common area parameters. Addresses 0h0012-0h001B are for H100 series inverter parameters.)

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit
0h0000	VFD model	-	-	R	0h0014 : H100+
0h0001	VFD capacity	-	-	R	0: 0.75kW, 1: 1.5kW, 2: 2.2kW 3: 3.7kW 4: 5.5kW, 5: 7.5kW 6: 11kW, 7: 15kW, 8: 18.5kW 9: 22kW, 10: 30kW, 11: 37kW 12: 45kW ,13: 55kW, 14: 75kW, 15: 90kW, 16: 110kW, 17: 132kW 18: 160kW, 19: 185kW, 20: 220kW 21: 250kW, 22: 315kW, 23: 355kW 24: 400kW, 25: 500kW, 26: 750kW
0h0002	VFD input voltage	-	-	R	0: 220 V product 1: 440 V product 2: 575V product

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit	
0h0003	Version	-	-	R	(Example) 0h0064: Version 1.00	
					(Example) 0h0065: Version 1.01	
0h0004	Reserved	-	-	R	-	
0h0005	Command frequency	0.01	Hz	R/W	-	
0h0006	Operation command (option)	-	-	R	B15	0: Keypad Freq, 2-16: Terminal block multi-step speed 17: Up, 18: Down 19: STEADY 22: V1, 24: V2, 25: I2, 26: PULSE 27: Built-in 485 28: Communication option 30: JOG, 31: PID, 33:V3, 34:I3
					B14	
					B13	
					B12	
					B11	
					B10	
					B9	
					B8	0: Keypad 1: Fx/Rx-1 2: Fx/Rx-2 3: Built-in 485 4: Communication option 5: Time Event 6: Follow Lead
					B7	
					B6	
				R/W	B5	Reserved
					B4	Emergency stop
					B3	W: Trip initialization (0→1), R: Trip status
					B2	Reverse operation (R)
					B1	Forward operation (F)
					B0	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	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	Brake Open
					B9	Jog mode

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit	
					B8	Drive stopping
					B7	DC Braking
					B6	Speed reached
					B5	Decelerating
					B4	Accelerating
					B3	Fault Trip - operates according to OUT-30 setting
					B2	Operating in reverse direction
					B1	Operating in forward direction
					B0	Stopped
0h000F	Fault trip 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–B9	Reserved
					B8	P9 (Option)
					B7	P8 (Option)
					B6	P7
					B5	P6
					B4	P5
					B3	P4
					B2	P3
					B1	P2
					B0	P1
0h0011	Output terminal information	-	-	R	B15–B9	Reserved
					B8	Relay 8 (Option)
					B7	Relay 7 (Option)
					B6	Relay 6 (Option)

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit	
					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	
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	

7.3.9 H100 Expansion Common Area Parameter

7.3.9.1 Monitoring Area Parameter (Read Only)

Comm. Address	Parameter	Scale	Unit	Assigned content by bit
0h0300	VFD model	-	-	H100: 0014h
0h0301	VFD 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, 185 kW: 4B90h, 220 kW: 4DC0h, 250 kW: 4FA0h, 315 kW: 53B0h, 355 kW: 5630h, 400 kW: 5900h, 500 kW: 5F40h 750 kW: 6EE0h
0h0302	VFD input voltage/power (Single phase, 3-phase)/ cooling method	-	-	200 V 3-phase forced cooling: 0231h
				400 V 3-phase forced cooling: 0431h
0h0303	VFD S/W version	-	-	(ex) 0h0064: Version 1.00
				0h0065: Version 1.01

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0304	VFD capacity (HP)	-	-	1HP: 4010h 2HP: 4020h – 800HP: 7200h Ex) 7200h–4000h = 3200h (3200h -> 800)	
0h0305	VFD operation state	-	-	B15	0: Normal state 4: Warning occurred 8: Fault occurred
				B14	
				B13	
				B12	
				B11– B8	-
				B7	1: Speed searching 2: Accelerating 3: Operating at constant rate 4: Decelerating 5: Decelerating to stop 6: H/W OCS 7: S/W OCS 8: Dwell operating
				B6	
				B5	
				B4	
				B3	0: Stopped 1: Operating in forward direction 2: Operating in reverse direction 3: DC operating
				B2	
				B1	
				B0	
0h0306	VFD operation frequency command source	-	-	B15	Operation command source 0: Keypad 1: Communication option 3: Built-in RS 485 4: Terminal block 5: Time Event
				B14	
				B13	
				B12	
				B11	
				B10	
				B9	
				B8	
				B7	Frequency command source 0: Keypad speed 1: Keypad torque 2-4: Up/Down operation speed 5: V1, 7: V2, 8: I2 9: Pulse 10: Built-in RS 485 11: Communication option 13: Jog 25-31: Multi-step speed frequency
				B6	
				B5	
				B4	
				B3	
				B2	
				B1	
				B0	
0h0307	Keypad S/W version	-	-	(Ex.) 0h0064: Version 1.00	
0h0308	Keypad title version	-	-	(Ex.) 0h0065: Version 1.01	

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0309	IO Board Version	-	-	(Ex.) 0h0064: Version 1.00 (Ex.) 0h0065: Version 1.01	
0h030A–0h30F	Reserved	-	-	-	
0h0310	Output current	0.1	A	-	
0h0311	Output frequency	0.01	Hz	-	
0h0312	Output rpm	0	Rpm	-	
0h0313	Reserved	-	-	-	
0h0314	Output voltage	1	V	-	
0h0315	DC Link voltage	1	V	-	
0h0316	Output power	0.1 1	kW kW	*note: the scale for 400V type 110kW–500kW is 1	
0h0317	Reserved	-	-	-	
0h0318	PID reference	0.1	%	PID Setpoint %	
0h0319	PID feedback	0.1	%	PID feedback %	
0h031A	Display the number of poles for the 1st motor	-	-	Displays the number of poles for the first motor	
0h031B	Reserved	-	-	-	
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–B9	Reserved
				B8	P9 (Option)
				B7	P8 (Option)
				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	Relay 8 (Option)
				B7	Relay 7 (Option)
				B6	Relay 6 (Option)
				B5	Q1
				B4	Relay 5
				B3	Relay 4
				B2	Relay 3

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0321	Digital output information	-	-	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	Reserved	-	-	-	
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	AI3	-	-	Analog input V3 or I3 (Option)	
0h0327	Reserved	-	-	Reserved	
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	Bypass OverLoad (to be updating)
				B9	NTC Open
				B8	Lead-Lag Communication error
				B7	Pipe Broken
				B6	In Phase Open
				B5	Out Phase Open
				B4	Low Voltage2
				B3	E-Thermal
				B2	Inverter OLT (VFD Overload)
				B1	Under Load

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
				B0	Over Load
0h0331	Latch type trip information - 2	-	-	B15	Reserved
				B14	Interlock
				B13	Inner fan Trip
				B12	Fuse Open
				B11	Reserved
				B10	Option Trip-1
				B9	No Motor Trip
				B8	External Brake Trip
				B7	IO Board Trip
				B6	Broken Belt
				B5	ParaWrite Trip
				B4	TB Trip
				B3	Fan Trip
				B2	Thermal Trip
				B1	Reserved
				B0	Different Feedback Level
0h0332	Level type trip information	-	-	B15–B8	Reserved
				B7	Lost Feedback
				B6	Lead-Lag Direction Error
				B5	Lead-Lag Interlock
				B4	Lost Keypad
				B3	Lost Command
				B2	Reserved
				B1	Low Voltage
				B0	BX
0h0333	H/W Diagnosis Trip information	-	-	B15–B6	Reserved
				B5	Queue Full
				B4	Gate Power Loss
				B3	Reserved
				B2	Reserved
				B1	EEP Err
				B0	ADC Offset
0h0334	Warning information-1	-	-	B15	RS Tune Error
				B14	Parameter write error
				B13	Low battery for real time clock
				B12	Load Tune
				B11	Fan Exchange

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0334	Warning information-1	-	-	B10	Pipe Broken
				B9	Capacitor Exchange Warning
				B8	Low Feedback Level
				B7	Fire Mode
				B6	DB Warn %ED
				B5	Hand/Off/Auto lock
				B4	Lost Keypad
				B3	Lost Command
				B2	Inv Overload (VFD Over Load)
				B1	Under Load
				B0	Over Load
0h0335	Latch type trip information -3	-	-	B15–6	Reserved
				B5	Accumulated flow trip
				B4	High flow trip
				B3	Sleep over cycle count trip
				B2	Setpoint timeout trip
				B1	High feedback level
				B0	Low feedback level
0h0336	Warning information-2	-	-	B15	High Flow Level
				B14	Low Flow Level
				B13	Inner Fan warning
				B12	Accumulated flow warning
				B11	Sleep over cycle count warning
				B10	Difference Feedback Level
				B9	High Feedback Level
				B8	Int 485 station ID is 0, when Lead-lag
				B7	Lead-Lag Data sharing
				B6	Broken Belt
				B5	TR tune warning
				B4	Backspin timer
				B3	Fan warning
				B2	Lsig Tune warning
				B1	Lost Feedback
				B0	Flow limit level

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h0337	Warning information-3	-	-	B6-15	Reserved
				B5	Disable wakeup
				B4	Setpoint timeout warning
				B3	Level detection/Loss of prime warning
				B2	Thrust mode
				B1	High Level warning for PI Aux
				B0	Low Level warning for PI Aux
0h0338	Latch type trip information -4	-	-	B3	High Level Trip for PI Aux
				B2	Low Level Trip for PI Aux
				B1	Low Flow Level Trip
				B0	Level detection/Loss of prime Trip
0h0339	Latch type trip information -5	-	-	B3	Overcurrent2 Trip
				B2	Overvoltage Trip
				B1	Overcurrent1 Trip
				B0	Ground Fault Trip
0h033A	PID Output	0.01	%	Process PID Output (%)	
0h033B	PID Unit Scaled setpoint	Proc Unit	Proc Unit	Unit Scaled Process PID Setpoint value	
0h033C	PID Unit Scaled Feedback	Proc Unit	Proc Unit	Unit Scaled Process PID feedback value	
0h0340	On Time date	0	Day	Total number of days the VFD 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 VFD 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 –0h0349	Reserved	-	-	Reserved	
0h034A	Option 1	-	-	0: None, 5: LonWorks, 20:Ext-I/O	
0h034B	Reserved	-	-	Reserved	
0h034C	Reserved			Reserved	
0h034D– 0h035B	Reserved	-	-	Reserved	

Comm. Address	Parameter	Scale	Unit	Assigned content by bit	
0h035C	Application Status	-	-	B15–B2	Reserved
				B1	Fire Mode
				B0	Pump Clean
0h035D	Inv Temperature	0	℃	Heatsink Temperature	
0h035E	Power Factor	0.1	-	Output power factor	
0h035F	VFD cooling Fan Time	-	%	VFD Cooling Fan running time(%)	
0h0360	Multi motor control terminal output	-	-	B15	Reserved
				–	Reserved
				B5	Reserved
				B4	5th motor running
				B3	4th motor running
				B2	3rd motor running
				B1	2nd motor running
				B0	1st motor running

7.3.9.2 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: Coast 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)

Comm. Address	Parameter	Scale	Unit	Assigned Content by Bit	
0h0386	Digital output control (0: Off, 1: On)	-	-	B15–B9	Reserved
				B8	Relay 8 (Option)
				B7	Relay 7 (Option)
				B6	Relay 6 (Option)
				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 : Locked during Run, 2 : Locked hand and auto key during Run 3 : Unlocked	
0h0388	PID setpoint	0.1	%	Process PID setpoint (%)	
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	PID Unit Scaled setpoint	Proc Unit	Proc Unit	Unit Scaled Process PID Setpoint value	
0h038F	PID Unit Scaled Feedback	Proc Unit	Proc Unit	Unit Scaled Process PID feedback value	
0h0390–0h0399	Reserved	-	-	Reserved	
0h039A	Anytime Para	-	-	Set the CNF-20 value (refer to *"5.60.4 Operation State Monitor" on page 290*)	
0h039B	Monitor Line-1	-	-	Set the CNF-21 value (refer to *"5.60.4 Operation State Monitor" on page 290*)	
0h039C	Monitor Line-2	-	-	Set the CNF-22 value (refer to *"5.60.4 Operation State Monitor" on page 290*)	
0h039D	Monitor Line-3	-	-	Set the CNF-23 value (refer to *"5.60.4 Operation State Monitor" on page 290*)	
0h039E–0h039F	Reserved			Reserved	
0h03A0	PID Ref 1 Aux Value	0.1	%	PID Aux 1 setpoint	
0h03A1	PID Ref 2 Aux Value	0.1	%	PID Aux 2 setpoint	
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 setpoint	
0h03A4	Proc PID Aux 2 Unit Scale	Proc Unit	Proc Unit	Unit Scale PID Aux 2 sepoint	
0h03A5	Proc PID Fdb Aux Unit Scale	Proc Unit	Proc Unit	Unit Scale PID Aux feedback	

Comm. Address	Parameter	Scale	Unit	Assigned Content by Bit
0h03A6–0h03BF	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:

- Set DRV-07 to 'Keypad-1' and select a target frequency.
- Set the frequency via communication into the parameter area frequency address (0h1101).
- 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.

Inverter Memory Control Area Parameter (Read and Write)

Comm. Address	Parameter	Scale	Unit	Changeable 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: 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 13: AP4 Grp 14: PRT Grp 15: APO Grp Setting is prohibited during fault trip interruptions.
0h03E3	Display changed	-	-	O	0: No, 1: Yes	
0h03E4	Macro Function Setting	-	-	X	0. Basic 1. Pressure Ctrl 2. Lead Lag Sel	
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	

Comm. Address	Parameter	Scale	Unit	Changeable During Running	Function
0h03EB	Initialize inverter operation accumulative time	-	-	O	0: No, 1: Yes
0h03EC	Initialize cooling fan accu- mulated 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 [8: 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 returns0xFFFF 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.

7.4 BACnet Communication

7.4.1 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.

7.4.2 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

7.4.3 BACnet Quick Communication Start

Follow the instructions below to configure the BACnet network for a quick start.

- 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 monitors 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 monitors connected to Relay 1,2,3,4. Set COM-04 Int485 Mode.

- Set the Device Object Instances for COM-84 and 85 and dfine the values. The device object instances must have unique values.
- 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.
- 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	12001)	
					1	24001)	
					2	48001)	
					3	9600	
					4	19200	
					5	38400	
					6	56Kbps1)	
					7	76.8Kbps	
					8	115.2Kbps1)	
	04	Communication Mode	Int485 Mode	D8/PN/S1	0	D8/PN/S1	
					1	Reserved	
					2	D8/PE/S1	
					3	D8/PO/S1	
	83	Maximum number of BAC -net Masters	BAC Max Master	127	1–127		-
	84	BACnet device number 1	BAC Dev Inst1	237	0–4194		-
	85	BACnet device number 2	BAC Dev Inst2	0	0–999		-
	86	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.

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 Max 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.

Code	Description
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).

7.4.4 Protocol Implementation

The following table sums 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-84 and COM-85.	
MAX Master Property	Set at COM-83 (MAX Master Value).	

7.4.5 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						

Property	Object Type						
	Device	BI	BV	AI	AO	MSI	MVI
Model Name	O						
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.

7.4.5.1 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

Instance ID	Object Name	Description	Setting Range	Units	R/W
AV6	PIDFeedbackSet	PID feedback setting	0–100.0	%	R/W
AV7	CommAo1	Comm. AO 1 Setting	0–100.0	%	R/W
AV8	CommAo2	Comm. AO 2 Setting	0–100.0	%	R/W
AV9	CommAo2	Comm. AO 3 Setting (Ext. I/O)	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) is set 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.
- If user wants to set the value of analog output via BACnet communication, [OUT-01 AO1 Mode], [OUT-07 AO2 Mode], and [APO-30 AO3 Mode] have to be set to {16: Comm Output 1} or {17: Comm Output 2} or {18: Comm Output 3}

7.4.5.2 Multi-state Value Object Instance

Instance ID	Object Name	Description	Setting Range	Units	R/W
MSV1	LostCommand	Command lost operation setting	0: None 1: Coast Stop 2: Decel Stop 3: HoldInput 4: HoldOutput 5: LostPreset	MSG	R/W

7.4.5.3 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

7.4.5.4 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
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	PidReferenceValue	PID Setpoint Value	%	R
AI27	PidFeedbackValue	PID Feedback Value	%	R
AI28	AI3	Values of Analog 3	%	R

*Refer to the relevant addresses *"7.3.8 Compatible Common Area Parameter" on page 329*

7.4.5.5 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
BI31	P8	P8 State (Extension I/O)	R
BI32	P9	P9 State (Extension I/O)	R
BI33	Relay6	Relay6 state (Extension I/O)	R
BI34	Relay7	Relay7 state (Extension I/O)	R
BI35	Relay8	Relay8 state (Extension I/O)	R

⚠ Caution

OUT-31–39 (Relay1–8) must be set to '0 (none)' to control outputs via communication.

7.4.5.6 MultiState Input Object Instance

Instance ID	Object Name	Description	Units	R/W
MSI1	UnitsDisplay	Displays Unit setting	1 Hz / 2 RPM	R

7.4.5.7 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

7.5 Metasys-N2 Communication

7.5.1 Metasys-N2 Quick Communication Start

Follow the instructions below to configure the Metasys-N2 network for a quick start.

- Set COM-02 (Int485 Proto) to '5 (Metasys-N2)'.
- Set the network communication speed to '9600 bps.'
- Configure the communication modes and make sure that they are fixed to Data Bit 8 / No Parity Bit/ Start Bit 1 / Stop Bit 1.
- Test the network and make sure Metasys-N2 communication is working properly.

7.5.2 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

7.5.3 Metasys-N2 Protocol I/O Point Map

7.5.3.1 Analog Output

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) is set to 'Int 485'.

7.5.3.2 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

7.5.3.3 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 trip information 1 (Refer to Common Area parameter address 0h0330)*
AI6	Latch Trip Info2	-	'Latch' type fault trip information 2 (Refer to Common Area parameter address 0h0331)*
AI7	Latch Trip Info3	-	'Latch' type fault trip information 3 (Refer to Common Area parameter address 0h0335)*
AI8	Level Trip Info	-	'Level' type fault trip information (Refer to Common Area parameter address 0h0332)(1)
AI9	H/W Diagnosis Trip Info	-	H/W Diagnosis fault trip information (Refer to Common Area parameter address 0h0333)(1)
AI10	Warning Info	-	Warning information (Refer to Common Area parameter address 0h0334)(1)

* Refer to *"7.3.8 Compatible Common Area Parameter" on page 329*

7.5.3.4 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 trip 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

7.5.3.5 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').

8 Table of Functions

This chapter lists all the function settings for the H100 series inverter. Use the references listed in this document to set the parameters. If an entered set value is out of range, the messages that will be displayed on the keypad are also provided in this chapter. In these situations, the [ENT] key will not operate to program the inverter.

8.1 Drive Group (DRV)

Data in the following table will be displayed only when the related code has been selected.

***O: Write-enabled during operation, Δ: Write-enabled when operation stops, X: Write-disabled**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
DRV-00 (-)	Jump Code	Jump Code	1–99		-		X	p.60
DRV-01 (0h1101)	Target frequency	Cmd Frequency	0.00, Low Freq– High Freq		0.00		O	p.72
DRV-02 (0h1102)	Keypad run direction	Keypad Run Dir	0	Reverse	1		O	p.69
			1	Forward				
DRV-03 (0h1103)	Acceleration time	Acc Time	0.0–600.0 (sec)		20.0	0.75–90kW-2/4	v	p.88
					60.0	110–250kW-4 110–300kW-5		
					100.0	315–750kW-4		
					20.0	5.5–90kW-5		
DRV-04 (0h1104)	Deceleration time	Dec Time	0.0–600.0 (sec)		30.0	0.75–90kW-2/4	O	p.88
					90.0	110–250kW-4 110–300kW-5		
					150.0	315–750kW-4		
					30.0	5.5–90kW-5		
DRV-05 (0h1105)	HAND-OFF-AUTO Key Lock	KPD H.O.A Lock	0	Locked	2: OFF key Enable		Δ	p.69
			1	During Run				
			2	OFF key Enable				
			3	Unlocked				
DRV-06 (0h1106)	Command source	Cmd Source	0	Keypad	1: Fx/Rx-1		Δ	p.83
			1	Fx/Rx-1				
			2	Fx/Rx-2				
			3	Int 485				
			4	Field Bus				
			5	Time Event				
			6	Follow Lead				
DRV-07 (0h1107)	Frequency reference source	Freq Ref Src	0	Keypad-1	0: Keypad-1		Δ	p.72
			1	Keypad-2				
			2	V1				
			3	I1				
			4	V2				
			5	I2				
			6	Int 485				
			7	FieldBus				

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial value	Property*	Ref.
			9	Pulse			
DRV-07 (0h1107)			10	V3			
			11	I3			
DRV-08 (0h1108)	AUTO mode selection	AUTO Mode Sel	0	Enabled	1: Disabled	Δ	p.68
			1	Disabled			
DRV-09 (0h1109)	Control mode	Control Mode	0	V/F	0: V/F	Δ	p.96 p.126
			1	Slip Compen			
DRV-11 (0h110B)	Jog frequency	Jog Frequency	0.00, Low Freq–High Freq		10.00	O	p.120
DRV-12 (0h110C)	Jog run acceleration time	Jog Acc Time	0.0–600.0 (sec)		20.0	O	
DRV-13 (0h110D)	Jog run deceleration time	Jog Dec Time	0.0–600.0 (sec)		30.0	O	
DRV-14 (0h110E)	Motor capacity	Motor Capacity	0	0.2 kW(0.3HP)	Dependent on motor setting	Δ	p.195
			1	0.4 kW(0.5HP)			
			2	0.75kW(1.0HP)			
			3	1.1 kW(1.5HP)			
			4	1.5 kW(2.0HP)			
			5	2.2 kW(3.0HP)			
			6	3.0 kW(4.0HP)			
			7	3.7 kW(5.0HP)			
			8	4.0 kW(5.5HP)			
			9	5.5 kW(7.5HP)			
			10	7.5 kW (10.0HP)			
			11	11.0 kW(15.0HP)			
			12	15.0 kW(20.0HP)			
			13	18.5 kW(25.0HP)			
			14	22.0 kW(30.0HP)			
			15	30.0 kW(40.0HP)			
			16	37.0 kW(50.0HP)			
			17	45.0 kW(60.0HP)			
			18	55.0 kW(75.0HP)			
			19	75.0kW(100.0HP)			
			20	90.0kW(125.0HP)			
			21	110.0kW(150.0HP)			
			22	132.0kW(220.0HP)			
			23	160.0kW(250.0HP)			
			24	185.0kW(300.0HP)			
			25	220.0kW(350.0HP)			

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial value		Property*	Ref.
DRV-14 (0h110E)			26	250.0kW(400.0HP)				
			27	315.0kW(500.0HP)				
			28	355.0kW(550.0HP)				
			29	400.0kW(650.0HP)				
			30	500.0kW(800.0HP)				
			31	750.0kW(1000.0HP)				
DRV-15 (0h110F)	Torque boost options	Torque Boost	0	Manual	0: Manual		Δ	p.101
			1	Auto 1				
			2	Advanced Auto[1]				
DRV-16[2] (0h1110)	Forward Torque boost	Fwd Boost	0.0–15.0 (%)		2.0	0.75–90kW-2/4	Δ	
					1.0	110–750kW-4		
					1.2	5.5–90kW-5		
					0.8	110–300kW-5		
DRV-17 (0h1111)	Reverse Torque boost	Rev Boost	0.0–15.0 (%)		2.0	0.75–90kW-2/4	Δ	
					1.0	110–750kW-4		
					1.2	5.5–90kW-5		
					0.8	110–300kW-5		
DRV-18 (0h1112)	Base frequency	Base Freq	0.75–500kW (240/480V)	30.00–400.00 (Hz)	60.00		Δ	p.96
			5.5–90kW (600V)	40.00-120.00 (Hz)				
DRV-19 (0h1113)	Start frequency	Start Freq	0.01–10.00 (Hz)		0.50		Δ	p.106
DRV-20 (0h1114)	Maximum frequency	Max Freq	0.75–500kW (240/480V)	40.00-400.00 (Hz)	60.00		Δ	
			5.5–90kW (600V)	40.00-120.00 (Hz)				
DRV-21 (0h1115)	Select speed unit	Hz/Rpm Sel	0	Hz Display	0: Hz Display		O	p.81
			1	RPM Display				
DRV-24 (0h1118)	HAND key selection	Hand Key Sel	0	None	0: None		Δ	p.68
			1	Disabled				
DRV-25 (0h1119)	Hand mode operation frequency	HAND Cmd Freq	0.00, Low Freq- High Freq		0.00		O	
DRV-26 (0h111A)	Hand mode operation Frequency reference source	HAND Ref Mode	0	HAND Parameter	0: HAND Parameter		Δ	
			1	V1				
			2	V2				
			3	V3				
			4	I1				
			5	I2				
			6	I3				
			7	Follow AUTO				

1 "Advanced Auto" is available from Drive Software Version <SW602.01> or greater
2 DRV-16–17 are displayed when DRV-15 is not set to "1 (Auto 1)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial value	Property*	Ref.
DRV-30 (0h111E)	kW/HP unit selection	kW/HP Unit Sel	0	kW	1:HP	O	
			1	HP			
DRV-31 (0h111F)	PopUp easy start	PopUp EzStart	0	No	0: No	Δ	
			1	Yes			
DRV-32 (0h1120)	Regional setting	Regional Set	0	US	0: US	Δ	
			1	International			
			2	KR			
			3	KSA			
DRV-33[3] (0h1121)	AdvancedAuto torque boost filter gain	Adv ATB Filter	1–1000 (msec)		100 msec	O	p.102
DRV-34 (0h1122)	AdvancedAuto torque boost Motoring gain	Adv ATB M Gain	0.0–300.0 (%)		50.0	O	
DRV-35 (0h1123)	AdvancedAuto torque boost Generating gain	Adv ATB G Gain	0.0–300.0 (%)		50.0	O	
DRV-41[4] (0h1129)	PM V/F mode selection New	PM V/f Sel	0	No	0: No	O	p.102
			1	Yes			
DRV-42 (0h112A)	PM V/F stabilization controller gain New	PM V/f Kctrl	0.00–10.00		2.00	Δ	p.102
DRV-43 (0h112B)	PM V/F current reduction New	PMVF Cur Reduc	0	No	0: No	O	p.102
			1	Yes			
DRV-44 (0h112C)	PM V/F D-axis current limit New	PMVF Curr Lmt	30.0–120.0 (%)		70.0	O	p.102
DRV-45 (0h112D)	PM V/F current reduction compensation New	PMVF Comp Perc	0.0–200.0 (%)		30.0	O	p.102
DRV-47 (0h112F)	PM V/F power filter New	PM V/f Filter	0.1–20.0 (Hz)		1.0	Δ	p.102
DRV-54 (0h1836)	Model Name	H100 plus	Display Only		-	X	
DRV-55 (0h1837)	Drive Capacity	XX.X HP	Display Only		-	X	
DRV-56 (0h1837)	Voltage Class	200/400 Type	Display Only		-	X	
DRV-91 (0h115B)	Smart Copy	SmartCopy	0	None	0: None	Δ	
			1	SmartDownload			
			3	SmartUpload			
DRV-95 (0h115F)	Display the code version	Code Version	-		-	X	
DRV-96 (0h1160)	Display the main software version	Inv S/W Ver	-		-	X	
DRV-97 (0h1161)	Display the debug version	Inv Debug Ver	-		-	X	
DRV-98 (0h1162)	Display I/O,S/W Version 1	I/O S/W Ver 1	-		-	X	

3 DRV-33–35 are displayed when DRV-15 is not set to "1 (Auto 1)".

4 DRV-42, DRV-43, and DRV-47 are displayed when DRV-41 is set to "1 (Yes)". DRV-44–45 are displayed when both DRV-41 and DRV-43 are set to "1 (Yes)".

Code (Comm. Address)	Name	LCD Display	Setting Range	Initial value	Property*	Ref.
DRV-99 (0h1163)	Display I/O,S/W Version 2	I/O S/W Ver 2	-	-	X	

8.2 Basic Function Group (BAS)

Data in the following table will be displayed only when the related code has been selected.

***O: Write-enabled during operation, Δ: Write-enabled when operation stops, X: Write-disabled**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial value	Property*	Ref.
BAS-00 (-)	Jump Code	Jump Code	1-99		-	X	p.60
BAS-01 (0h1201)	Auxiliary reference source	Aux Ref Src	0	None	0: None	Δ	p.115
			1	V1			
			2	I1			
			3	V2			
			4	I2			
			6	Pulse			
			7	Int 485			
			8	FieldBus			
			10	V3			
			11	I3			
BAS-02[5] (0h1202)	Auxiliary command calculation type	Aux Calc Type	0	M+(G*A)	0: M+(G*A)	Δ	p.115
			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)			
BAS-03 (0h1203)	Auxiliary command gain	Aux Ref Gain	-200.0-200.0 (%)		100.0	O	
BAS-04 (0h1204)	Second command source	Cmd 2nd Src	0	Keypad	1: Fx/Rx-1	Δ	p.108
			1	Fx/Rx-1			
			2	Fx/Rx-2			
			3	Int 485			
			4	FieldBus			
			5	Time Event			
			6	Follow Lead			

5 BAS-02–03 are displayed when BAS-01 is not "0 (None)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial value	Property*	Ref.
BAS-05 (0h1205)	Second frequency source	Freq 2nd Src	0	Keypad-1	0: Keypad-1	O	
			1	Keypad-2			
			2	V1			
			3	I1			
			4	V2			
			5	I2			
			6	Int 485			
			7	FieldBus			
			9	Pulse			
			10[6]	V3			
			11	I3			
BAS-06 (0h1206)	Input Phase	Input Phase	0	3 Phase	0: 3 Phase	Δ	
			1	Singe Phase			
BAS-07 (0h1207)	V/F pattern options	V/F Pattern	0	Linear	0: Linear	Δ	p.96
			1	Square			
			2	User V/F			
			3	Square 2			
BAS-08 (0h1208)	Acc/Dec standard frequency	Ramp T Mode	0	Max Freq	0: Max Freq	Δ	p.88
			1	Delta Freq			
BAS-09 (0h1209)	Time scale settings	Time Scale	0	0.01 sec	1: 0.1 sec	Δ	
			1	0.1 sec			
			2	1 sec			
BAS-10 (0h120A)	Input power frequency	60/50 Hz Sel	0	60 Hz	0: 60 Hz	Δ	p.221
			1	50 Hz			
BAS-11 (0h120B)	Number of motor poles	Pole Number	2 - 48		Dependent on motor setting	Δ	p.126
BAS-12 (0h120C)	Rated slip speed	Rated Slip	0 - 3000 (RPM)				
BAS-13 (0h120D)	Motor rated current	Rated Curr	0.0 - 6000.0 (A)				
BAS-14 (0h120E)	Motor no-load current	NoloadCurr	0.0 - 1000.0 (A)				
BAS-15 (0h120F)	Motor rated voltage	Rated Volt	0.75–90kW-2	170–264V	230V	Δ	p.102
			0.75–90kW-4	320–528V	460V		
			110–750kW-4	320–550V			
			5.5–300kW-5	525–600V	575 V		
BAS-16 (0h1210)	Motor efficiency	Efficiency	70-100 (%)		Dependent on motor setting	Δ	p.195
BAS-17 (0h1211)	UVW output current G-gain	UVW Out Curr-G	50-100 (%)		100 %	O	
BAS-18 (0h1212)	Trim power display	Trim Power %	70-130 (%)		100	O	

6 "10(V3)–11(I3)" of BAS-05 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial value	Property*	Ref.
BAS-19 (0h1213)	Input power voltage	AC Input Volt	0.75–90kW-2	170–264V	240 V	O	p.221
			0.75–90kW-4	320–528V	480 V		
			110–750kW-4	320–550V			
			5.5–300kW-5	525–600V	600 V		
BAS-20 (-)	Auto Tuning	Auto Tuning	0	None	0: None	Δ	p.195
			1	All (Rotation type)			
			2	All (Static type)			
			3	Rs+ Lsigma (Rotation type)			
BAS-21 (-)	Stator resistor	Rs	0.000-9.999 (Ω)		Dependent on motor setting	Δ	
BAS-22 (-)	Leakage inductance	Lsigma	0.00-99.99 (mH)			Δ	
BAS-41[7] (0h1229)	User frequency1	User Freq 1	0.00 - Maximum frequency (Hz)		15.00	Δ	p.97
BAS-42 (0h122A)	User voltage1	User Volt 1	0–100 (%)		25	Δ	
BAS-43 (0h122B)	User frequency2	User Freq 2	0.00-Maximum frequency (Hz)		30.00	Δ	
BAS-44 (0h122C)	User voltage2	User Volt 2	0-100 (%)		50	Δ	
BAS-45 (0h122D)	User frequency3	User Freq 3	0.00 - Maximum frequency (Hz)		45.00	Δ	
BAS-46 (0h122E)	User voltage3	User Volt 3	0-100 (%)		75	Δ	
BAS-47 (0h122F)	User frequency4	User Freq 4	0.00 - Maximum frequency (Hz)		60.00	Δ	
BAS-48 (0h1230)	User voltage4	User Volt 4	0-100 (%)		100	Δ	p.97
BAS-50[8] (0h1232)	Multi-step speed frequency1	Step Freq-1	Low Freq- High Freq		10.00	O	p.82
BAS-51 (0h1233)	Multi-step speed frequency2	Step Freq-2	Low Freq- High Freq		20.00	O	
BAS-52 (0h1234)	Multi-step speed frequency3	Step Freq-3	Low Freq- High Freq		30.00	O	
BAS-53 (0h1235)	Multi-step speed frequency4	Step Freq-4	Low Freq- High Freq		40.00	O	
BAS-54 (0h1236)	Multi-step speed frequency5	Step Freq-5	Low Freq- High Freq		50.00	O	
BAS-55 (0h1237)	Multi-step speed frequency6	Step Freq-6	Low Freq- High Freq		60.00	O	
BAS-56 (0h1238)	Multi-step speed frequency7	Step Freq-7	Low Freq-High Freq		60.00	O	
BAS-70 (0h1246)	Multi-step acceleration time1	Acc Time-1	0.0-600.0 (sec)		20.0	O	p.91

7 BAS-41–48 are displayed when BAS-07 or M2-25 is set to "2 (User V/F)".
8 BAS-50–56 are displayed whenIN-65-71 is set to "Speed–L/M/H".

Code (Comm. Address)	Name	LCD Display	Setting Range	Initial value	Property*	Ref.
BAS-71 (0h1247)	Multi-step deceleration time1	Dec Time-1	0.0-600.0 (sec)	20.0	O	
BAS-72[9] (0h1248)	Multi-step acceleration time2	Acc Time-2	0.0-600.0 (sec)	30.0	O	
BAS-73 (0h1249)	Multi-step deceleration time2	Dec Time-2	0.0-600.0 (sec)	30.0	O	
BAS-74 (0h124A)	Multi-step acceleration time3	Acc Time-3	0.0-600.0 (sec)	40.0	O	
BAS-75 (0h124B)	Multi-step deceleration time3	Dec Time-3	0.0-600.0 (sec)	40.0	O	
BAS-76 (0h124C)	Multi-step acceleration time4	Acc Time-4	0.0-600.0 (sec)	50.0	O	
BAS-77 (0h124D)	Multi-step deceleration time4	Dec Time-4	0.0-600.0 (sec)	50.0	O	
BAS-78 (0h124E)	Multi-step acceleration time5	Acc Time-5	0.0-600.0 (sec)	40.0	O	
BAS-79 (0h124F)	Multi-step deceleration time5	Dec Time-5	0.0-600.0 (sec)	40.0	O	
BAS-80 (0h1250)	Multi-step acceleration time6	Acc Time-6	0.0-600.0 (sec)	30.0	O	
BAS-81 (0h1251)	Multi-step deceleration time6	Dec Time-6	0.0-600.0 (sec)	30.0	O	
BAS-82 (0h1252)	Multi-step acceleration time7	Acc Time-7	0.0-600.0 (sec)	20.0	O	
BAS-83 (0h1253)	Multi-step deceleration time7	Dec Time-7	0.0-600.0 (sec)	20.0	O	

8.3 Expanded Function Group (ADV)

Data in the following table will be displayed only when the related code has been selected.

***O: Write-enabled during operation, Δ: Write-enabled when operation stops, X: Write-disabled**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
ADV-00 (-)	Jump Code	Jump Code	1-99		-	X	p.60
ADV-01 (0h1301)	Acceleration pattern	Acc Pattern	0	Linear	0: Linear	Δ	p.94
			1	S-curve			
ADV-02 (0h1302)	Deceleration pattern	Dec Pattern	0	Linear	0: Linear	Δ	
			1	S-curve			
ADV-03[10] (0h1303)	S-curve acceleration start point gradient	Acc S Start	1–100 (%)		40	Δ	
ADV-04 (0h1304)	S-curve acceleration end point gradient	Acc S End	1–100 (%)		40	Δ	

9 BAS-72–83 are displayed when IN-65–71is set to "Xcel-L/M/H"

10 ADV-03–04 are displayed when ADV-01 is set to "1 (S-curve)"

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
ADV-05[11] (0h1305)	S-curve deceleration start point gradient	Dec S Start	1–100 (%)		40	Δ	
ADV-06 (0h1306)	S-curve deceleration end point gradient	Dec S End	1–100 (%)		40	Δ	
ADV-07 (0h1307)	Start Mode	Start Mode	0	Acc	0: Acc	Δ	p.103
			1	DC-Start			
ADV-08 (0h1308)	Stop Mode	Stop Mode	0	Dec	2: Coast Stop	Δ	p.104
			1	DC-Brake			
			2	Coast Stop			
			4	Power Braking			
ADV-09 (0h1309)	Selection of prohibited rotation direction	Run Prevent	0	None	0: None	Δ	p.85
			1	Forward Prev			
			2	Reverse Prev			
ADV-10 (0h130A)	Starting with power on	Power-on Run	0	No	0: No	O	p.86
			1	Yes			
ADV-11[12] (0h130B)	Power-on run delay time	Power-On Delay	0.0 -6000.0 (sec)		0.0	O	
ADV-12[13] (0h130C)	DC braking time at startup	DC-Start Time	0.00-60.00 (sec)		0.00	Δ	p.103
ADV-13 (0h130D)	Amount of applied DC	DC Inj Level	0–200 (%)		50	Δ	
ADV-14[14] (0h130E)	Output blocking time before DC braking	DC-Block Time	0.00- 60.00 (sec)		200V	Δ	p.103
					0.00	0.75-45kW	
					2.00	55-90kW	
					400V		
					0.00	0.75-90kW	
					2.00	110-750kW	
					600V		
					0.00	5.5–90kW	
					2.00	110-300kW	
ADV-15 (0h130F)	DC braking time	DC-Brake Time	0.00- 60.00 (sec)		1.00	Δ	
ADV-16 (0h1310)	DC braking rate	DC-Brake Level	0–200 (%)		50	Δ	
ADV-17 (0h1311)	DC braking frequency	DC-Brake Freq	Startfrequency -60 Hz		5.00	Δ	
ADV-18 (0h1312)	Keypad power-on run enable	KPD Pwr-on Run	0	No	0: No	O	p.86
			1	Yes			
ADV-19 (0h1313)	Keypad power-on run delay time	KPD Pwr-on Dly	0.0–6000.0 (sec)		0.0	O	

11 ADV-05–06 are displayed when ADV-02 is set to "1 (S-curve)"
12 ADV-11 is displayed when ADV-10 is set to "1 (YES)"
13 ADV-12 is displayed when ADV-07 is set to "1 (DC-Start)"
14 ADV-14 is displayed when ADV-08 is set to "1 (DC-Brake)"

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
ADV-20 (0h1314)	Dwell frequency on acceleration	Acc Dwell Freq	Start frequency-Maximum frequency (Hz)		5.00	Δ	p.124
ADV-21 (0h1315)	Dwell operation time on acceleration	Acc Dwell Time	0.0-60.0 (sec)		0.0	Δ	
ADV-22 (0h1316)	Dwell frequency on deceleration	Dec Dwell Freq	Start frequency-Maximum frequency (Hz)		5.00	Δ	
ADV-23 (0h1317)	Dwell operation time on deceleration	Dec Dwell Time	0.0-60.0 (sec)		0.0	Δ	
ADV-24 (0h1318)	Frequency limit	Freq Limit	0	No	0: No	Δ	p.106
			1	Yes			
ADV-25 (0h1319)	Frequency lower limit value	Freq Limit Lo	0.00-Upper limit frequency (Hz)		0.50	Δ	
ADV-26 (0h131A)	Frequency upper limit value	Freq Limit Hi	Lower limit frequency-Maximum frequency (Hz)		Max freq	Δ	
ADV-27 (0h131B)	Frequency jump	Jump Freq	0	No	0: No	Δ	p.107
			1	Yes			
ADV-28[15] (0h131C)	Jump frequency lower limit1	Jump Lo 1	0.00-Jump frequency upper limit1 (Hz)		10.00	O	
ADV-29 (0h131D)	Jump frequency upper limit1	Jump Hi 1	Jump frequency lower limit1-Maximum frequency (Hz)		15.00	O	
ADV-30 (0h131E)	Jump frequency lower limit2	Jump Lo 2	0.00-Jump frequency upper limit2 (Hz)		20.00	O	
ADV-31 (0h131F)	Jump frequency upper limit2	Jump Hi 2	Jump frequency lower limit2-Maximum frequency (Hz)		25.00	O	
ADV-32 (0h1320)	Jump frequency lower limit3	Jump Lo 3	0.00-Jump frequency upper limit3 (Hz)		30.00	O	
ADV-33 (0h1321)	Jump frequency upper limit3	Jump Hi 3	Jump frequency lower limit3-Maximum frequency (Hz)		35.00	O	
ADV-41[16] (-)	Brake release current	BR Rls Curr	0.0–180.0 [%]		50.0	X	p.277
ADV-42 (-)	Brake release delay time	BR Rls Dly	1.00–10.0.0 [sec]		1.00	X	
ADV-44 (-)	Brake release forward frequency	BR Rls Fwd Fr	0.00–Max. freq. (Hz)		1.00	X	
ADV-45 (-)	Brake release reverse frequency	BR Rls Rev Fr	0.00–Max. freq. (Hz)		1.00	X	
ADV-46 (-)	Brake release engage delay time	BR Eng Dly	0.0–100.0 (sec)		1.0	X	
ADV-47 (-)	Brake release engage frequency	BR Eng Fr	0.00–Max. freq. (Hz)		2.00	X	
ADV-51[17] (0h1333)	Energy saving level	Energy Save	0–30 (%)		0	O	

15 ADV-28–33 are displayed when ADV-27 is set to "1 (Yes)".
16 ADV-41–47 are displayed when any one of OUT-31–39 is set tp "42 (BR Control)".
17 ADV-51 is displayed when ADV-50 is set to "1 (Manual)". and ADV-52 is displayed when ADV-50 is set to "2 (Auto)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
ADV-52 (0h1334)	Energy saving point search time	E-Save Det T	0.0-100.0 (sec)		20.0	O	
ADV-60 (0h133C)	Acc/Dec time transition frequency	Xcel Change Fr	0.00-Maximum frequency (Hz)		0.00	Δ	p.93
ADV-64 (0h1340)	Cooling fan control	Fan Control	0	During Run	2: Temp Control	O	p.220
			1	Always ON			
			2	Temp Control			
ADV-65 (0h1341)	Up/Down operation frequency save	U/D Save Mode	0	No	0: No	O	p.121
			1	Yes			
ADV-66 (0h1342)	Output contact On/Off control options	On/Off Ctrl Src	0	None	0: None	O	p.278
			1	V1			
			3	V2			
			4	I2			
			6	Pulse			
			7[18]	V3			
			8	I3			
ADV-67 (0h1343)	Output contact On level	On-Ctrl Level	Output contact off level-100.00%		90.00	Δ	
ADV-68 (0h1344)	Output contact Off level	Off-Ctrl Level	-100.00-outputcontact on level (%)		10.00	Δ	
ADV-70 (0h1346)	Safe operation selection	Run En Mode	0	Always Enable	0: Always Enable	Δ	p.123
			1	DI Dependent			
ADV-71[19] (0h1347)	Safe operation stop options	Run Dis Stop	0	Coast Stop	0: Trip&Coast	Δ	
			1	Q-Stop			
			2	Q-Stop Resume			
ADV-72 (0h1348)	Safe operation deceleration time	Q-Stop Time	0.0-600.0 (sec)		5.0	O	p.123
ADV-74 (0h134A)	Selection of regeneration evasion function for press	RegenAvdSel	0	None	0: None	Δ	p.279
			1	OVS 1			
			2	OVS 2			
ADV-75[20] (0h134B)	Voltage level of regeneration evasion motion for press	RegenAvd Level	200 V: 300-400 V		350	Δ	
			400 V: 600-800 V		700		
			600 V: 800-980 V		870		
ADV-76 (0h134C)	Compensation frequency limit of regeneration evasion for press	CompFreq Limit	0.00-10.00 Hz		1.00	Δ	
ADV-77 (0h134D)	Regeneration evasion for press P-Gain	RegenAvd Pgain	200V 400V	0.0-100.0%	50.0	O	
			600V	0.0-200.0%	100.0		

18 "10(V3)–11(I3)" of ADV-66 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

19 ADV-71–72 are displayed when ADV-70 is set to "1 (DI Dependent)".

20 ADV-75–78 are displayed when ADV-74 is set to "1 (OVS1)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
ADV-78 (0h134E)	Regeneration evasion for press I gain	RegenAvd Igain	20–30000 (msec)		500	O	
ADV-79[21] (0h134F)	Regeneration evasion 2 mode Activating	RegenAvd Act	Bit	000–111	000	O	
			Bit 0	At acceleration			
			Bit 1	At constant speed			
			Bit 2	At deceleration			
ADV-80 (0h1350)	Regeneration evasion 2 mode limit gain	RegenAvd Lgain	-1000 - 1000		50	O	
ADV-81 (0h1351)	Regeneration evasion 2 mode low Pass filter	RegenAvd LPF	0-65535 (msec)		500	O	
ADV-87 (0h1357)	Overmodulation mode selection	OVM Mode Sel	0	No	1: Yes	Δ	p.111
			1	Yes			
ADV-91 (0h135B)	Output Phase Rotation	Output Ph. Rot	0	ABC	0: ABC	Δ	p.111
			1	ACB			

8.4 Control Function Group (CON)

Data in the following table will be displayed only when the related code has been selected.

***O: Write-enabled during operation, Δ: Write-enabled when operation stops, X: Write-disabled**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
CON-00 (-)	Jump Code	Jump Code	1-99				X	p.60
CON-04 (0h1404)	Carrier frequency	Carrier Freq	200V				O	p.218
			1.0–15.0 (kHz)		0.75–18.5 kW	3.0		
			1.0–10.0 (kHz)		22–30 kW	3.0		
			1.0–7.0 (kHz)		37–45 kW	3.0		
			1.0–5.0 (kHz)		55–90 kW	2.0		
			400V					
			1.0–15.0 (kHz)		0.75–30 kW	3.0		
			1.0–10.0 (kHz)		37–55 kW	3.0		
			1.0–7.0 (kHz)		75–90 kW	3.0		
			1.0–5.0 (kHz)		110–355 kW	2.0		
			1.0–4.0 (kHz)		400–750 kW	2.0		
			600V					
			1.0–15.0 (kHz)		5.5–22 kW	2.3		
			1.0–10.0 (kHz)		30–55 kW			
			1.0–7.0 (kHz)		75–90 kW			
			1.0–4.0 (kHz)		110–300 kW	2.0		
CON-05 (0h1405)	Switching mode	PWM Mode	0	Normal PWM	0: Normal PWM		Δ	p.218
			1	Low leakage PWM				

21 ADV-79–81 are displayed when ADV-74 is set to "2 (OVS2)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
CON-13 (0h140D)	Anti-hunting regulator mode	AHR Sel	0	No	1 : Yes		Δ	p.209
			1	Yes				
CON-14 (0h140E)	Anti-hunting regulator P-Gain	AHR P-Gain	0-32767		1000		O	
CON-15 (0h140F)	Anti-hunting regulator start frequency	AHR Low Freq	0.00-AHR High Freq		0.50		O	
CON-16 (0h1410)	Anti-hunting regulator end frequency	AHR High Freq	AHR Low Freq-400.00		400.00		O	
CON-17 (0h1411)	Anti-hunting regulator compensation voltage limit rate	AHR limit	0-20		2		O	
CON-70 (0h1446)	Speed search mode selection	SS Mode	0	Flying Start-1	0: Flying Start-1		Δ	p.212
			1	Flying Start-2				
CON-71 (0h1447)	Speed search operation selection	Speed Search	Bit	0000- 1111	0000		Δ	
			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				
CON-72[22] (0h1448)	Speed search reference current	SS Sup-Current	50–120 (%)		0.75–90kW-2 0.75–250kW-4	90	O	
					315–750kW-4	80		
					5.5–300kW-5	90		
CON-73[23] (0h1449)	Speed search proportional gain	SS P-Gain	0-9999		Flying Start-1 : 100		O	p.212
					Flying Start-2 : Dependent on motor setting			
CON-74 (0h144A)	Speed search integral gain	SS I-Gain	0-9999		Flying Start-1 : 200		O	
					Flying Start-2 : Dependent on motor setting			
CON-75 (0h144B)	Output block time before speed search	SS Block Time	0.0-60.0 (sec)		1.0		Δ	
CON-77 (0h144D)	Energy buffering selection	KEB Select	0	No	0: No		Δ	p.208
			1	Yes				
CON-78[24] (0h144E)	Energy buffering start level	KEB Start Lev	110.0-140.0 (%)		125.0	0.75–90kW-2 0.75–90kW-4	Δ	p.208
					115.0	110–750kW-4		
					130.0	5.5–300kW-5		

22 CON-72 is displayed after Flying Start-1 and when any CON-71 bit is set to "1".
23 CON-73–75 are displayed when any CON-71bit is set to "1".
24 CON-78–83 are displayed when CON-77 is set to "1 (Yes)".

Code (Comm. Address)	Name	LCD Display	Setting Range	Initial Value		Property*	Ref.
CON-79 (0h144F)	Energy buffering stop level	KEB Stop Lev	KEB Start Lev * 125.0-145.0 (%)	130.0	0.75–90kW-2 0.75–90kW-4	Δ	
				125.0	110–750kW-4		
			KEB Start Lev * 130.0-145.0 (%)	135.0	5.5–300kW-5		
CON-80 (0h1450)	Energy buffering slip gain	KEB Slip Gain buffering slip gain	0-20000	300	0.75–30kW-2 0.75–750kW-4	O	
				100	37–90kW-2		
				25	5.5–300kW-5		
CON-81 (0h1451)	Energy buffering P-Gain	KEB P Gain	0-20000	1000	0.75–30kW-2 0.75–750kW-4	O	
				1800	37–90kW-2		
				3000	5.5–37kW-5		
				1500	5.5–300kW-5		
CON-82 (0h1452)	Energy buffering I gain	KEB I Gain	1-20000	500	0.75–750kW	O	
				200	5.5–300kW-5		
CON-83 (0h1453)	Energy buffering acceleration time	KEB Acc Time	0.0-600.0	10.0	0.75–90kW-2 0.75–90kW-4	O	
				30.0	110–750kW-4		
				5.0	5.5–300kW-5		

8.5 Input Terminal Group (IN)

Data In the following table will be displayed only when the related code has been selected.

***O: Write-enabled during operation, Δ: Write-enabled when operation stops, X: Write-disabled**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
IN-00 (-)	Jump Code	Jump Code	1-99		-	X	p.60
IN-01 (0h1501)	Frequency at maximum analog input	Freq at 100%	Start frequency- Maximum frequency (Hz)		Maximum frequency	O	p.73
IN-05[25] (0h1505)	V1 input voltage display	V1 Monitor(V)	-		0.00	X	
IN-06[26] (0h1506)	V1 input polarity selection	V1 Polarity	0	Unipolar	0: Unipolar	Δ	
			1	Bipolar			
IN-07 (0h1507)	Time constant of V1 input filter	V1 Filter	0–10000 (ms)		10	O	
IN-08 (0h1508)	V1 minimum input voltage	V1 Volt x1	0.00-10.00 (V)		0.00	O	

25 "IN-05" setting range can be changed according to the "IN-06" settings.

26 IN-05–11 are displayed when the selection switch (SW6) is selected on V1.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
IN-09 (0h1509)	Output at V1 minimum voltage (%)	V1 Perc y1	0.00-100.00 (%)		0.00	O	p.73
IN-10 (0h150A)	V1 maximum input voltage (%)	V1 Volt x2	0.00-12.00 (V)		10.00	O	
IN-11 (0h150B)	Output at V1 maximum voltage (%)	V1 Perc y2	0.00-100.00 (%)		100.00	O	
IN-12[27] (0h150C)	V1 input at minimum voltage (%)	V1 –Volt x1"	-10.00- 0.00 (V)		0.00	O	
IN-13 (0h150D)	Output at V1 minimum voltage (%)	V1 –Perc y1"	-100.00-0.00 (%)		0.00	O	
IN-14 (0h150E)	V1 maximum input voltage (%)	V1 –Volt x2"	-12.00- 0.00 (V)		-10.00	O	
IN-15 (0h150F)	Output at V1 maximum voltage (%)	V1 –Perc y2"	-100.00-0.00 (%)		-100.00	O	
IN-16 (0h1510)	V2 rotation direction change	V1 Inverting	0	No	0: No	O	
			1	Yes			
IN-17 (0h1511)	V1quantization change	V1 Quantizing	0.00[28], 0.04-10.00 (%)		0.04	O	
IN-20[29] (0h1514)	Temperature monitor	T1 Monitor	-		0.00	X	p.295
IN-21[30] (0h1515)	I1 input monitor	I1 input monitor (mA)	0-24.00 (mA)		-	O	p.77
IN-22 (0h1516)	I1 input filter time	I1 Filter	0–10000 (msec)		10	O	
IN-23 (0h1517)	I1 minimum input power supply	I1 Curr x1	0.00-20.00 (mA)		4.00	O	
IN-24 (0h1518)	Output at I1 maximum current (%)	I1 Perc y1	0.00-100.00 (%)		0.00	O	
IN-25 (0h1519)	I1 maximum input current	I1 Curr x2	I2 Curr x1 - 24.00 (mA)		20.00	O	
IN-26 (0h151A)	Output at I1 maximum current (%)	I1 Perc y2	0.00-100.00 (%)		100.00	O	
IN-27 (0h151B)	I1 rotation direction options	I1 Inverting	0	No	0: No	O	
			1	Yes			
IN-28 (0h151C)	I1 Quantizing level	I1 Quantizing	0.00 0.04-10.00 (%)		0.04	O	
IN-35[31] (0h1523)	V2 input rate monitor	V2 Monitor (V)	0.00-12.00 (V)		0.00	O	p.78
IN-37 (0h1525)	V2 input filter time	V2 Filter	0-10000 (msec)		10	O	
IN-38 (0h1526)	V2 minimum input voltage	V2 Volt x1	0.00-10.00 (V)		0.00	O	

27 IN-12–17 are displayed when IN-06 is set to "1 (Bipolar)".
28 * Quantizing is disabled if "0" is selected.
29 IN-20 is displayed when the analog current/voltage input circuit selection switch (SW3) is selected on T1.
30 IN-21 is displayed when the selection switch (SW6) is selected on I1.
31 IN-35–47 are displayed when the analog current/voltage input circuit selection switch (SW4) is selected on V2.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
IN-39 (0h1527)	Output at V2 minimum voltage (%)	V2 Perc y1	0.00-100.00 (%)		0.00	O	p.78
IN-40 (0h1528)	V2 maximum input voltage	V2 Volt x2	0.00-10.00 (V)		10.00	O	
IN-41 (0h1529)	Output at V2 maximum voltage (%)	V2 Perc y2	0.00-100.00 (%)		100.00	O	
IN-46 (0h152E)	V2 Rotation direction options	V2 Inverting	0	No	0: No	O	
			1	Yes			
IN-47 (0h152F)	V2 Quantizing level	V2 Quantizing	0.00[32], 0.04- 10.00 (%)		0.04	O	
IN-50[33] (0h1532)	I2 input monitor	I2 Monitor (mA)	-		0.00	X	p.77
IN-52 (0h1534)	I2 input filter time	I2 Filter	0–10000 (msec)		10	O	
IN-53 (0h1535)	I2 minimum input power supply	I2 Curr x1	0.00-20.00 (mA)		4.00	O	
IN-54 (0h1536)	Output at I2 minimum current (%)	I2 Perc y1	0.00-100.00 (%)		0.00	O	
IN-55 (0h1537)	I2 maximum input current	I2 Curr x2	I2 Curr x1 - 24.00 (mA)		20.00	O	
IN-56 (0h1538)	Output at I2 maximum current (%)	I2 Perc y2	0.00-100.00 (%)		100.00	O	
IN-57 (0h1539)	I2 rotation direction options	I2 Inverting	0	No	0: No	O	
			1	Yes			
IN-58 (0h153A)	I2 Quantizing level	I2 Quantizing	0.00[34] 0.04-10.00 (%)		0.04	O	
IN-65 (0h1541)	P1 Px terminal configuration	P1 Define	0	None	1: Fx	Δ	p.83
			1	Fx			
IN-66 (0h1542)	P2 Px terminal configuration	P2 Define	2	Rx	2: Rx	Δ	
IN-67 (0h1543)	P3 Px terminal configuration	P3 Define	3	RST	5: BX	Δ	p.308
IN-68 (0h1544)	P4 Px terminal configuration	P4 Define	4	External Trip	3: RST	Δ	p.301
IN-69 (0h1545)	P5 Px terminal configuration	P5 Define	5	BX	7: Sp-L	Δ	p.308
IN-70 (0h1546)	P6 Px terminal configuration	P6 Define	6	JOG	8: Sp-M	Δ	p.120
IN-71 (0h1547)	P7 Px terminal configuration	P7 Define	7	Speed-L	9: Sp-H	Δ	p.82
IN-72[35] (0h1548)	P8 Px terminal configuration	P8 Define	8	Speed-M	0: None	Δ	p.82

32 * Quantizing is disabled if "0" is selected.

33 IN-50–58 are displayed when the analog current/voltage input circuit selection switch (SW5) is selected on I2.

34 * Quantizing is disabled if "0" is selected.

35 IN-72–73 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
IN-73 (0h1549)	P9 Px terminal configuration	P9 Define	9	Speed-H	0: None	Δ	p.82
			11	XCEL-L			p.91
			12	XCEL-M			p.91
			13	XCEL-H			p.91
			14	XCEL Stop			p.96
			15	RUN Enable			p.123
			16	3-Wire			p.122
			17	2nd Source			p.108
			18	Exchange			p.219
			19	Up			p.121
			20	Down			p.121
			22	U/D Clear			p.121
			23	Analog Hold			p.81
			24	I-Term Clear			p.127
			25	PID Openloop			p.127
			26	PID Gain2			p.127
			27	PID Ref Change			p.127
			28	Pre Excite			-
			29	Timer In			p.229
			31	dis Aux Ref			p.115
			32	FWD JOG			p.121
			33	REV JOG			p.121
			34	Sleep Wake Chg			p.210
			35	Time Event En			p.198
			36	Pre Heat			p.194
			37	Damper Open			p.182
			38	PumpClean			p.185
			40	PID Step Ref L			p.127
			41	PID Step Ref M			p.127
			42	PID Step Ref H			p.127
			43	Interlock1			p.248
			44	Interlock2			p.248
			45	Interlock3			p.248
			46	Interlock4			p.248
			47	Interlock5			p.248
			48	Interlock6			p.248
			49	Interlock7			
			50	Interlock8			
			51	Hand State			
IN-83 (0h1553)	DI On Delay Selection	DI On DelayEn	000 0000–111 1111		111 1111	Δ	

Code (Comm. Address)	Name	LCD Display	Setting Range	Initial Value	Property*	Ref.
IN-84 (0h1554)	DI Off Delay Selection	DI Off DelayEn	000 0000–111 1111	111 1111	Δ	
IN-85 (0h1555)	Multi-function input terminal On filter	DI On Delay	0–10000 (msec)	10	O	p.109
IN-86 (0h1556)	Multi-function input terminal Off filter	DI Off Delay	0–10000 (msec)	3	O	
IN-87 (0h1557)	Multi-function input terminal selection	DI NC/NO Sel	000 0000–111 1111	000 0000	Δ	
			0 A Terminal (NO)			
			1 B Terminal (NC)			
IN-89 (0h1559)	Multi-step command delay time	InCheck Time	1–5000 (msec)	1	Δ	p.82
IN-90 (0h155A)	Multi-function input terminal status	DI Status	-	000 0000	X	p.109
IN-91 (0h155B)	Pulse input amount display	TI Monitor	-	0.00	X	p.79
IN-92 (0h155C)	TI minimum input pulse	TI Filter	0–9999 (msec)	10	O	
IN-93 (0h155D)	TI minimum input pulse	TI Pls x1	0 - TI Pls x2	0.00	O	
IN-94 (0h153E)	Output at TI minimum pulse (%)	TI Perc y1	0.00-100.00 (%)	0.00	O	
IN-95 (0h155F)	TI maximum input pulse	TI Pls x2	TI Pls x1-32.00	32.00	O	
IN-96 (0h1560)	Output at TI maximum pulse (%)	TI Perc y2	0.00-100.00 (%)	100.00	O	
IN-97 (0h1561)	TI rotation direction change	TI Inverting	0 No	0: No	O	
			1 Yes			
IN-98 (0h1562)	TI quantization level	TI Quantizing	0.00[36], 0.04-10.00 (%)	0.04	O	

36 Quantizing is disabled if "0" is selected.

8.6 Output Terminal Block Function Group (OUT)

Data in the following table will be displayed only when the related code has been selected.

***O: Write-enabled during operation, Δ: Write-enabled when operation stops, X: Write-disabled**

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
OUT-00 (-)	Jump Code	Jump Code	1-99		-	X	p.60
OUT-01 (0h1601)	Analog output1	AO1 Mode	0	Frequency	0: Frequency	O	p.280
			1	Output Current			
			2	Output Voltage			
			3	DCLink Voltage			
			4	Output Power			
			6	Flow Rate Mon			
			7	Target Freq			
			8	Ramp Freq			
			9	Setpoint Value			
			10	Feedback Value			
			11	PID Output			
			12	Constant			
			13	PIAux Setpoint			
			14	PIAux Fbk Mon			
			15	PI Aux Output			
OUT-02 (0h1602)	Analog output1 gain	AO1 Gain	-1000.0-1000.0 (%)		100.0	O	
OUT-03 (0h1603)	Analog output1 bias	AO1 Bias	-100.0-100.0 (%)		0.0	O	
OUT-04 (0h1604)	Analog output1 filter	AO1 Filter	0–10000 (msec)		5	O	
OUT-05 (0h1605)	Analog constant output1	AO1 Const %	0.0-100.0 (%)		0.0	O	
OUT-06 (0h1606)	Analog output1 monitor	AO1 Monitor	-		0.0	X	
OUT-07 (0h1607)	Analog output2	AO2 Mode	Identical to the OUT-02 AO1 Mode selected range		0: Frequency	O	
OUT-08 (0h1608)	Analog output2 gain	AO2 Gain	-1000.0-1000.0 (%)		100.0	O	
OUT-09 (0h1609)	Analog output2 bias	AO2 Bias	-100.0-100.0 (%)		0.0	O	
OUT-10 (0h160A)	Analog output2 filter	AO2 Filter	0–10000 (msec)		5	O	
OUT-11 (0h160B)	Analog constant output2	AO2 Const %	0.0-100.0 (%)		0.0	O	
OUT-12 (0h160C)	Analog output2 monitor	AO2 Monitor	-		0.0	X	

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
OUT-30 (0h161E)	Fault output item	Trip OutMode	Bit	0000-1111	1010	O	p.289
			Bit 0	Low voltage			
			Bit 1	Any faults other than low voltage			
			Bit 2	Automatic restart final failure			
			Bit 3	Lead-Lag Interlock Trip			
OUT-31 (0h161F)	Multi-function relay1	Relay 1	0	None	23:Trip	O	p.284
			1	FDT-1			
			2	FDT-2			
			3	FDT-3			
			4	FDT-4			
			5	Over Load			
			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	MMC			
			22	Timer Out			
			23	Trip			
			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			
			34	CAP.Warning			
			35	Fan Exchange			

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
OUT-31 (0h161F)			36	AUTO State			p.284
			37	Hand State			
			38	TO			
			39	Except Date			
			40	KEB Operating			
			41	BrokenBelt			
			42	BR Control			
			43	High Fdb Level			
			44	Low Fdb Level			
			45	Diff Fdb Level			
			46	Low Flow Level			
			47	High Flow Level			
			48	Accum Level			
			49	Low Lev Detect			
			50	High Lev Detect			
OUT-32 (0h1620)	Multi-function relay2	Relay 2	51	Current Limit	14: RUN	O	
OUT-33 (0h1621)	Multi-function relay3	Relay 3	52	SetPnt Timeout	0: None	O	
OUT-34 (0h1622)	Multi-function relay4	Relay 4	53	Pump Trip	0: None	O	
OUT-35 (0h1623)	Multi-function relay5	Relay 5	54	FWD Run	0: None	O	
OUT-36 (0h1624)	Multi-function 1 item	Q1 Define	55	REV Run	0: None	O	
OUT-37[37] (0h1625)	Multi-function relay6	Relay 6	56	Bypass MC TRIP	0: None	O	
OUT-38 (0h1626)	Multi-function relay7	Relay 7	57	Bypass Run	0: None	O	
OUT-39 (0h1627)	Multi-function relay8	Relay 8	58	Sleep	0: None	O	
OUT-41 (0h1629)	Multi-function output monitor	DO Status	-		00 0000	X	
OUT-50 (0h1632)	Multi-function output On delay	DO On Delay	0.00-100.00 (sec)		0.00	O	p.290
OUT-51 (0h1633)	Multi-function output Off delay	DO Off Delay	0.00-100.00 (sec)		0.00	O	
OUT-52 (0h1634)	Multi-function output contact selection	DO NC/NO Sel	Q1, Relay5 - Relay1 (00 0000–11 1111)		00 0000	Δ	
			0	A contact (NO)			
			1	B contact (NC)			
OUT-53 (0h1635)	Fault output On delay	TripOutOnDly	0.00-100.00 (sec)		0.00	O	p.289

37 OUT-37–39 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
OUT-54 (0h1636)	Fault output Off delay	TripOutOffDly	0.00-100.00 (sec)		0.00	O	
OUT-55 (0h1637)	Timer On delay	TimerOn Delay	0.00-100.00 (sec)		0.00	O	p.229
OUT-56 (0h1638)	Timer Off delay	TimerOff Delay	0.00-100.00 (sec)		0.00	O	
OUT-57 (0h1639)	Detected frequency	FDT Frequency	0.00-Maximum frequency (Hz)		30.00	O	p.284
OUT-58 (0h163A)	Detected frequency band	FDT Band	0.00-Maximum frequency (Hz)		10.00	O	
OUT-61 (0h163D)	Pulse output item	TO Mode	0	Frequency	0: Frequency	O	p.283
			1	Output Current			
			2	Output Voltage			
			3	DCLink Voltage			
			4	Output Power			
			6	Flow Rate Mon			
			7	Target Freq			
			8	Ramp Freq			
			9	Setpoint Value			
			10	Feedba Value			
			11	PID Output			
			12	Constant			
			13	PIAux Setpoint			
			14	PIAuxFbk Mon			
			15	PIAux Output			
OUT-62 (0h163E)	Pulse output gain	TO Gain	-1000.0-1000.0 (%)		100.0	O	
OUT-63 (0h163F)	Pulse output bias	TO Bias	-100.0-100.0 (%)		0.0	O	
OUT-64 (0h1640)	Pulse output filter	TO Filter	0-10000 (msec)		5	O	
OUT-65 (0h1641)	Pulse output constant output 2	TO Const %	0.0-100.0 (%)		0.0	O	
OUT-66 (0h1642)	Pulse output monitor	TO Monitor	-		0.0	X	

8.7 Communication Function Group (COM)

Data in the following table will be displayed only when the related code has been selected.

***O: Write-enabled during operation, Δ: Write-enabled when operation stops, X: Write-disabled**

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
COM-00 (-)	Jump Code	Jump Code	1-99		-	X	p.60
COM-01 (0h1701)	Built-in communication inverter ID	Int485 St ID	1-MaxComID[38]		1	O	p.317
COM-02 (0h1702)	Built-in communication protocol	Int485 Proto	0	ModBus RTU	0: ModBusRTU	O	
			2	LS Inv 485			
			4	BACnet			
			5	Metasys-N2			
			6[39]	ModBus Master			
COM-03 (0h1703)	Built-in communication speed	Int485 BaudR	0	1200 bps	3: 9600 bps	O	
			1	2400 bps			
			2	4800 bps			
			3	9600 bps			
			4	19200 bps			
			5	38400 bps			
			6	56 Kbps			
			7	76.8 kbps			
			8	115.2 Kbps[40]			
COM-04 (0h1704)	Built-in communication frame setting	Int485 Mode	0	D8/PN/S1	0: D8/PN/S1	O	
			1	Reserved			
			2	D8/PE/S1			
			3	D8/PO/S1			
COM-05 (0h1705)	Transmission delay after reception	Resp Delay	0-1000 (msec)		5	O	
COM-06[41] (0h1706)	Communication option S/W version	FBus S/W Ver	-		-	O	
COM-07 (0h1707)	Communication option inverter ID	FBus ID	0-255		1	O	

38 If AP1-40 is set to "4(Serve Drv)", MaxComID is "8", and if COM-02 is set to "4(BACnet), MaxComID is "127". Otherwise MaxComID is "250".

39 COM-02 is automatically set to "6(Modbus Master)" when AP1-40 is set to "2 or 3". Otherwise a user can set the parameter value at user"s choice.

40 115,200 bps

41 COM-06–09 are displayed only when a communication option card is installed.
Please refer to the communication option manual for details.

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
COM-08 (0h1708)	FIELD BUS communication speed	FBUS BaudRate	0	9600 bps	0: 9600 bps	O	
			1	19200 bps			
			2	38400 bps			
			3	56 kbps			
			4	76.8kbps			
			5	112 kbps			
			6	125 kbps			
			7	250 kbps			
			8	500 kbps			
			10	1 Mbps			
			12	5 Mbps			
			14	10 Mbps			
COM-09 (0h1709)	Communication option LED status	FieldBus LED	-		-	O	
COM-28 (0h171C)	USB Protocol	USB Protocol	0	Modbus RTU	2: LS INV 485	O	
			2	LS INV 485			
COM-30 (0h171E)	Number of output parameters	ParaStatus Num	0-16		3	O	p.321
COM-31 (0h171F)	Output Communication address1	Para Status-1	0000-FFFF Hex		000A	O	
COM-32 (0h1720)	Output Communication address2	Para Status-2	0000-FFFF Hex		000E	O	
COM-33 (0h1721)	Output Communication address3	Para Status-3	0000-FFFF Hex		000F	O	
COM-34 (0h1722)	Output Communication address4	Para Status-4	0000-FFFF Hex		0000	O	
COM-35 (0h1723)	Output Communication address5	Para Status-5	0000-FFFF Hex		0000	O	
COM-36 (0h1724)	Output Communication address6	Para Status-6	0000-FFFF Hex		0000	O	
COM-37 (0h1725)	Output Communication address7	Para Status-7	0000-FFFF Hex		0000	O	
COM-38 (0h1726)	Output Communication address8	Para Status-8	0000-FFFF Hex		0000	O	
COM-39 (0h1727)	Output Communication address9	Para Status-9	0000-FFFF Hex		0000	O	

Code (Comm. Address)	Name	LCD Display	Parameter Setting	Initial Value	Property*	Ref.
COM-40 (0h1728)	Output Communication address10	Para Status- 10	0000-FFFF Hex	0000	O	
COM-41 (0h1729)	Output Communication address11	Para Status-11	0000-FFFF Hex	0000	O	
COM-42 (0h172A)	Output Communication address12	Para Status- 12	0000-FFFF Hex	0000	O	
COM-43 (0h172B)	Output Communication address13	Para Status- 13	0000-FFFF Hex	0000	O	
COM-44 (0h172C)	Output Communication address14	Para Status- 14	0000-FFFF Hex	0000	O	
COM-45 (0h172D)	Output Communication address15	Para Status- 15	0000-FFFF Hex	0000	O	
COM-46 (0h172E)	Output Communication address16	Para Status- 16	0000-FFFF Hex	0000	O	
COM-50 (0h1732)	Number of input parameters	Para Ctrl Num	0-16	2	O	
COM-51 (0h1733)	Input Communication address1	Para Control-1	0000-FFFF Hex	0005	O	
COM-52 (0h1734)	Input Communication address2	Para Control-2	0000-FFFF Hex	0006	O	p.321
COM-53 (0h1735)	Input Communication address3	Para Control-3	0000-FFFF Hex	0000	O	
COM-54 (0h1736)	Input Communication address 4	Para Control-4	0000-FFFF Hex	0000	O	
COM-55 (0h1737)	Input Communication address 5	Para Control-5	0000-FFFF Hex	0000	O	
COM-56 (0h1738)	Input Communication address 6	Para Control-6	0000-FFFF Hex	0000	O	
COM-57 (0h1739)	Input Communication address 7	Para Control-7	0000-FFFF Hex	0000	O	
COM-58 (0h173A)	Input Communication address 8	Para Control-8	0000-FFFF Hex	0000	O	
COM-59 (0h173B)	Input Communication address9	Para Control-9	0000-FFFF Hex	0000	O	
COM-60 (0h173C)	Input Communication address10	Para Control- 10	0000-FFFF Hex	0000	O	
COM-61 (0h173D)	Input Communication address11	Para Control- 11	0000-FFFF Hex	0000	O	
COM-62 (0h173E)	Input Communication address 12	Para Control- 12	0000-FFFF Hex	0000	O	
COM-63 (0h173F)	Input Communication address 13	Para Control- 13	0000-FFFF Hex	0000	O	
COM-64 (0h1740)	Input Communication address 14	Para Control- 14	0000-FFFF Hex	0000	O	

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
COM-65 (0h1741)	Input Communication address 15	Para Control- 15	0000-FFFF Hex		0000	O	
COM-66 (0h1742)	Input Communication address 16	Para Control- 16	0000-FFFF Hex		0000	O	
COM-70 (0h1746)	Communication multi-function input 1	Virtual DI 1	0	None	0: None	O	p.319
COM-71 (0h1747)	Communication multi-function input 2	Virtual DI 2	1	Fx	0: None	O	
COM-72 (0h1748)	Communication multi-function input 3	Virtual DI 3	2	Rx	0: None	O	
COM-73 (0h1749)	Communication multi-function input 4	Virtual DI 4	3	RST	0: None	O	
COM-74 (0h174A)	Communication multi-function input 5	Virtual DI 5	4	External Trip	0: None	O	
COM-75 (0h174B)	Communication multi-function input 6	Virtual DI 6	5	BX	0: None	O	
COM-76 (0h174C)	Communication multi-function input 7	Virtual DI 7	6	JOG	0: None	O	
COM-77 (0h174D)	Communication multi-function input 8	Virtual DI 8	7	Speed-L	0: None	O	
			8	Speed-M			
			9	Speed-H			
			11	XCEL-L			
			12	XCEL-M			
			13	XCEL-H			
			14	XCEL-Stop			
			15	Run Enable			
			16	3-wire			
			17	2nd source			
			18	Exchange			
			19	Up			
			20	Down			
			22	U/D Clear			
			23	Analog Hold			
			24	I-Term Clear			
			25	PID Openloop			
			26	PID Gain 2			
			27	PID Ref Change			
			28	Pre Excite			
			29	Timer In			
			31	dis Aux Ref			
			32	FWD JOG			

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
			33	REV JOG			
			34	Fire Mode			
			35	Time Event En			
			36	Pre Heat			
			37	Damper Open			
			38	PumpClean			
			40	PID Step Ref L			
			41	PID Step Ref M			
			42	PID Step Ref H			
			43	Interlock1			
			44	Interlock2			
			45	Interlock3			
			46	Interlock4			
			47	Interlock5			
			48[42]	Interlock6			
			49	Interlock7			
			50	Interlock8			
			51	Hand State			
COM-82 (0h1752)	Communication multi-function input monitoring	Virt DI Status	-		0000 0000	X	p.319
COM-83 (0h1753)	BACnet maximum master number	BAC Max Master	1–127		127	O	p.343
COM-84 (0h1754)	BACnet device number1	BAC Dev Inst1	0–4194		237	O	
COM-85 (0h1755)	BACnet device number2	BAC Dev Inst2	0-999		0	O	
COM-86 (0h1756)	BACnet password	BAC PassWord	0-32767		0	O	
COM-94 (-)	Communication update	Comm Update	0	No	0 : No	Δ	
			1	Yes			
COM-96 (0h1760)	Communication operation auto resume	Power On Resume	0	No	0: No	O	p.86
			1	Yes			
COM-97 (0h1761)	Select operation when app command is lost	APP. Lost Mode	0	None	1: Trip & Coast	Δ	
			1	Trip & Coast			
			2	Decel Stop			

42 "48(Interlock6)–50(Interlock8)" of IN-65–71 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information

8.8 PID Function Group

Data in the following table will be displayed only when the related code has been selected.

Unit MAX = PID Unit100% (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%

The Default Value for "PID-02 PID Access Lev" only allows access to the basic parameters in the PID group.

The rest are hidden. When set to "Adanced" all paramters are shown.

***O /X: Write-enabled during operation,Δ: Writing available when operation stops**

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
PID-00(-)	Jump Code	Jump Code	1–99		50	O	p.60
PID-01 (0h1801)	PID mode selection	PID Sel	0	No	0: No	Δ	p.127
			1	Yes			
PID-02 (0h1802)	PID Access Level	PID Access Lev	0	Basic	0: Basic	O	
			1	Advanced			
PID-03 (0h1803)	PID output monitor	PID Output	-		0.00	X	
PID-04 (0h1804)	PID Setpoit monitor	Setpoint Value	-		0.00	X	
PID-05 (0h1805)	PID feedback monitor	Feedback Value	-		0.00	X	
PID-06 (0h1806)	PID error monitor value	Err Value	-		0.00	X	
PID-10 (0h180A)	PID Setpoint 1 source selection	PID SP 1 Src	0	KeyPad	0: Keypad	Δ	
			1	V1			
			2	I1			
			3	V2			
			4	I2			
			5	Int485			
			6	Fieldbus			
			8	Pulse			
			9[43]	V3			
			10	I3			
PID-11 (0h180B)	PID Setpoint 1 keypad value	PID SP 1 Set	Unit Min–Unit Max		Unit Default	O	p.127

43 "10(V3)–11(I3)" of PID-10 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
PID-12[44] (0h180C)	PID Setpoint 1 auxiliary source selection	PIDSP1AuxSrc	0	None	0: None	Δ	
			1	V1			
			2	I1			
			3	V2			
			4	I2			
			6	Pulse			
			7	Int 485			
			8	FieldBus			
			10[45]	V3			
			11	I3			
PID-13 (0h180D)	PID Setpoint 1 auxiliary mode selection	PID SP1AuxMod	0	M+(G*A)	0: M+(G*A)	O	
			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)			
PID-14 (0h180E)	PID reference auxiliary gain	PID SP1 Aux G	-200.0–200.0 (%)		0.0	O	
PID-15 (0h180F)	PID Setpoint 2 auxiliary source selection	PID SP 2 Src	0	Keypad	0: KeyPad	Δ	
			1	V1			
			2	I1			
			3	V2			
			4	I2			
			5	Int 485			
			6	FieldBus			
			8	Pulse			
			9[46]	V3			
			10	I3			
PID-16 (0h1810)	PID Setpoint 2 keypad setting	PID SP 2 Set	Unit Min–Unit Max		Unit Default	O	p.127

44 PID-12–19 are displayed when PID-02 is set to "1 (Advanced)".

45 "12(V3)–13(I3)" of PID-12 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

46 "10(V3)–11(I3)" of PID-15 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
PID-17 (0h1811)	PID Setpoint 2 auxiliary source selection	PID SP2AuxSrc	0	None	0: None	Δ	p.127
			1	V1			
			2	I1			
			3	V2			
			4	I2			
			6	Pulse			
			7	Int 485			
			8	FieldBus			
			10	EPID1 Output			
			11	EPID1 Fdb Val			
			12[47]	V3			
			13	I3			
PID-18 (0h1812)	PID Setpoint 2 auxiliary mode selection	PID SP2AuxMod	0	M+(G*A)	0: M+(G*A)	O	
			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)			
PID-19 (0h1813)	PID Setpoint 2 auxiliary gain	PID SP2 Aux G	-200.0–200.0 (%)		0.0	O	
PID-20 (0h1814)	PID feedback selection	PID Fdb Source	0	V1	3: I2	Δ	
			1	I1			
			2	V2			
			3	I2			
			4	Int 485			
			5	FieldBus			
			6	Network			
			7	Pulse			
			8[48]	V3			
			9	I3			

47 "12(V3)–13(I3)" of PID-17 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

48 "10(V3)–11(I3)" of PID-20 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
PID-21[49] (0h1815)	PID feedback auxiliary source selection	PID Fdb Aux Src	0	None	0: None	Δ	p.127
			1	V1			
			2	I1			
			3	V2			
			4	I2			
			6	Pulse			
			7	Int 485			
			8	FieldBus			
			10[50]	V3			
			11	I3			
PID-22 (0h1816)	PID feedback auxiliary mode selection	PID FdbAuxMod	0	M+(G*A)	0: M+(G*A)	O	
			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)			
PID-23 (0h1817)	PID feedback auxiliary gain	PID Fdb Aux G	-200.0–200.0 (%)		0.0	O	
PID-24 (0h1818)	PID feed back band	PID Fdb Band	0.00–Unit Band		0.00	O	
PID-25 (0h1819)	PID controller proportional gain 1	PID P-Gain 1	0.00–300.00 (%)		100.00	O	
PID-26 (0h181A)	PID contro ller integral time 1	PID I-Time 1	0.0–200.0 (sec)		2.0	O	
PID-27[51] (0h181B)	PID controller differential time 1	PID D-Time 1	0.00–1.00 (sec)		0.00	O	
PID-28 (0h181C)	PID controller feed forward gain	PID FF-Gain	0.0–1000.0 (%)		0.0	O	
PID-29 (0h181D)	PID output filter	PID Out LPF	0.00–10.00 (sec)		0.00	O	
PID-30 (0h181E)	PID output upper limit	PID Limit Hi	PID Limit Lo–100.00		100.00	O	

49 PID-21–24 are displayed when PID-02 is set to "1 (Advanced)".

50 "12(V3)–13(I3)" of PID-21 are available when Extension IO option is equipped. Refer to Extension IO option manual for more detailed information.

51 PID-27–35 are displayed when PID-02 is set to "1 (Advanced)".

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
PID-31 (0h181F)	PID output lower limit	PID Limit Lo	-100.00–PID Limit Hi		0.00	O	p.127
PID-32 (0h1820)	PID controller proportional gain 2	PID P-Gain 2	0.00–300.00 (%)		50.0	O	
PID-33 (0h1821)	PID controller integral time 2	PID I-Time 2	0.0–200.0 (sec)		10.0	O	
PID-34 (0h1822)	PID controller differential time 2	PID D-Time 2	0.00–1.00 (sec)		0.00	O	
PID-35 (0h1823)	PID output mode	PID Out Mode	0	PID Output	2 : PID or Main	O	
			1	PID+ Main Freq			
			2	PID or Main			
PID-36 (0h1824)	PID output inverse	PID Out Inv	0	No	0: No	Δ	
			1	Yes			
PID-37[52] (0h1825)	PID output scale	PID Out Scale	0.1–1000.0 (%)		100.0	Δ	
PID-38 (0h1826)	PID input limit	PID Input Limit	0.00–100.00 (%)		100.00	O	
PID-39 (0h1827)	PID integral gain limit	PID I Limit	-100.00–100.00		100.00	O	
PID-40 (0h1828)	PID multi-step Setpoint setting 1	PID Step SP 1	Unit Min–Unit Max		Unit Default	O	
PID-41 (0h1829)	PID multi-step Setpoint setting 2	PID Step SP 2	Unit Min–Unit Max		Unit Default	O	
PID-42 (0h182A)	PID multi-step Setpoint setting 3	PID Step SP 3	Unit Min–Unit Max		Unit Default	O	
PID-43 (0h182B)	PID multi-step Setpoint setting 4	PID Step SP 4	Unit Min–Unit Max		Unit Default	O	
PID-44 (0h182C)	PID multi-step Setpoint setting 5	PID Step SP 5	Unit Min–Unit Max		Unit Default	O	
PID-45 (0h182D)	PID multi-step Setpoint setting 6	PID Step SP 6	Unit Min–Unit Max		Unit Default	O	
PID-46 (0h182E)	PID multi-step Setpoint setting 7	PID Step SP 7	Unit Min–Unit Max		Unit Default	O	
PID-50 (0h1832)	PID controller unit selection	PID Unit Sel	Refer to the Unit List		2: PSI	O	
			0	CUST			
			1	%			
			2	PSI			
			3	˚F			
			4	˚C			

52 PID-37–46 are displayed when PID-02 is set to "1 (Advanced)".

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
			5	inWC			p.127
			6	inM			
			7	mBar			
			8	Bar			
			9	Pa			
			10	kPa			
			11	Hz			
			12	rpm			
			13	V			
			14	A			
			15	kW			
			16	HP			
			17	mpm			
			18	ft			
			19	m/s			
			20	m3/s			
			21	m3/m			
			22	m 3/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			
			41	Hg			
PID-51 (0h1833)	PID unit scale	PID Unit Scale	0	x100	1: x 10	O	
			1	x10			
			2	x1			
			3	x 0.1			
			4	x0.01			

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
PID-52 (0h1834)	PID control 0% setting figure	PID Unit 0%	X100	-30000-Unit Max	Range varies depending on PID-50 setting	O	p.127
			X10	-3000.0-Unit Max			
			X1	-300.00-Unit Max			
			X0.1	-30.000-Unit Max			
			X0.01	-3.0000-Unit Max			
PID-53 (0h1835)	PID control 100% setting figure	PID Unit 100%	X100	Unit Min-30000	Range differs depending on PID-50 setting	O	
			X10	Unit Min-3000.0			
			X1	Unit Min-300.00			
			X0.1	Unit Min-30.000			
			X0.01	Unit Min-3.0000			
PID-54[53] (0h1836)	PID acceleration/ deceleration time enable	RampPIRef AtRun	0	No	0	Δ	
			1	Yes			
PID-55 (0h1837)	PID accelration/ deceleration time	PID Acc/Dec Tm	0.00–600.00 (sec)		0.00	O	
PID-56 (0h1838)	Pump minimum speed	Pump Min Speed	0.00–600.00 (Hz)		0.00	Δ	
PID-57 (0h1839)	Wakeup level type	WakeUpLev type	0	Absolute	1	Δ	p.147
			1	Deviation			
PID-58 (0h183A)	Sleep activation level	Sleep Act Lev	0.00–600.00 (Hz)		0.00	O	p.141
PID-59 (0h183B)	Sleep Level type	Sleep Lev Type	0	Disabled	1	O	
			1	Otuput Freq			
			2	Output Current			
			3	Feedback Value			
			4	Output RPM			
			5	Flow Rate Mon			
			6	PID Tar. Value			
PID-60[54] (0h183C)	Sleep boost setting	Sleep Bst Set	0.0–100.0		0.0	O	
PID-61 (0h183D)	Sleep boost frequency	Sleep Bst Freq	0.00–60.00 (Hz)		0.00	O	
PID-62 (0h183E)	PID sleep 0 delay time	PID Sleep 0 DT	0.0–6000.0 (sec)		10.0	O	
PID-63 (0h183F)	PID sleep 0 level	PID Sleep0Lev	0.00–300.00		0.00	O	
PID-64 (0h1840)	PID wakeup 0 delay time	PID WakeUp0 DT	0.0–6000.0 (sec)		10.0	O	
PID-65 (0h1841)	PID wakeup 0 level	PID WakeUp0Lev	0.0–3000.0		2000	O	
PID-66 (0h1842)	PID sleep 1 delay time	PID Sleep 1 DT	0.0–6000.0 (sec)		10.0	O	

53 PID-54–55 are displayed when PID-02 is set to "1 (Advanced)".
54 PID-60–61, 66–93, 95 are displayed when PID-02 is set to "1 (Advanced)".

Code (Comm. Address)	Name	LCD Display	Parameter Setting	Initial Value	Property*	Ref.
PID-67 (0h1843)	PID sleep 1 level	PID Sleep1Lev	0.00–30.00	0.00	O	p.141
PID-68 (0h1844)	PID wakeup 1 delay time	PID WakeUp1 DT	0.0–6000.0 (sec)	10.0	O	
PID-69 (0h1845)	PID wakeup 1 level	PID WakeUp1Lev	0.0–3000.0	20.0	O	
PID-70 (0h1846)	PID sleep 2 delay time	PID Sleep 2 DT	0.0–6000.0 (sec)	10.0	O	
PID-71 (0h1847)	PID sleep 2 level	PID Sleep2Lev	0–30000	0	O	
PID-72 (0h1848)	PID wakeup 2 delay time	PID WakeUp2 DT	0.0–6000.0 (sec)	10.0	O	
PID-73 (0h1849)	PID wakeup 2 level	PID WakeUp2Lev	0–60000	20.00	O	
PID-74 (0h184A)	PID sleep 3 delay time	PID Sleep 3 DT	0.0–6000.0 (sec)	10.0	O	
PID-75 (0h184B)	PID sleep 3 level	PID Sleep3Lev	0–30000	0	O	
PID-76 (0h184C)	PID wakeup 3 delay time	PID WakeUp3 DT	0.0–6000.0 (sec)	10.0	O	
PID-77 (0h184D)	PID wakeup 3 level	PID WakeUp3Lev	0–60000	20.00	O	
PID-78 (0h184E)	PID sleep 4 delay time	PID Sleep 4 DT	0.0–6000.0 (sec)	10.0	O	
PID-79 (0h184F)	PID sleep 4 level	PID Sleep4Lev	0–30000	0	O	
PID-80 (0h1850)	PID wakeup 4 delay time	PID WakeUp4 DT	0.0–6000.0 (sec)	10.0	O	
PID-81 (0h1851)	PID wakeup 4 level	PID WakeUp4Lev	0–60000	20.00	O	
PID-82 (0h1852)	PID sleep 5 delay time	PID Sleep 5 DT	0.0–6000.0 (sec)	10.0	O	
PID-83 (0h1853)	PID sleep 5 level	PID Sleep5Lev	0–30000	0	O	
PID-84 (0h1854)	PID wakeup 5 delay time	PID WakeUp5 DT	0.0–6000.0 (sec)	10.0	O	
PID-85 (0h1855)	PID wakeup 5 level	PID WakeUp5Lev	0–60000	20.00	O	
PID-86 (0h1856)	PID sleep 6 delay time	PID Sleep 6 DT	0.0–6000.0 (sec)	10.0	O	
PID-87 (0h1857)	PID sleep 6 level	PID Sleep6Lev	0.00–300.00	0.00	O	
PID-88 (0h1858)	PID wakeup 6 delay time	PID WakeUp6 DT	0.0–6000.0 (sec)	10.0	O	
PID-89 (0h1859)	PID wakeup 6 level	PID WakeUp6Lev	0.0–3000.0	20.0	O	
PID-90 (0h185A)	PID sleep 7 delay time	PID Sleep 7 DT	0.0–6000.0 (sec)	10.0	O	
PID-91 (0h185B)	PID sleep 7 level	PID Sleep7Lev	0.00–300.0	0.00	O	

Code (Comm. Address)	Name	LCD Display	Parameter Setting		Initial Value	Property*	Ref.
PID-92 (0h185C)	PID wakeup 7 delay time	PID WakeUp7 DT	0.0–6000.0 (sec)		10.0	O	
PID-93 (0h185D)	PID wakeup 7 level	PID WakeUp7Lev	0.0–3000.0		20.0	O	p.141
PID-94 (0h185E)	Wake up Mode	Wake up Mode	0	Hold Sleep	0	O	p.141
			1	Min Spd Start			
PID-95 (0h185F)	Disable Wake-up	Disable WakeUp	0	No	0	Δ	p.147
			1	Yes			
PID-96 (0h1860)	Sleep Warning Selection	Sleep Warn Sel	0	None	1	O	p.141
			1	Warning			

8.9 Application 1 Function Group (AP1)

Data in the following table will be displayed only when the related code has been selected.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP1-00 (-)	Jump Code	Jump Code	1–99		20	O	p.60
AP1-01 (0h1901)	Stage in mode	Stage In Mode	0	Output Freq	2: Feedback + Fout	Δ	
			1	Feedback Value			
			2	Feedback+Fout			
			3	Flow Rate Mon			
AP1-02 (0h1902)	Stage out mode	Stage Out Mode	0	Output Freq	2: Feedback + Fout	Δ	
			1	Feedback Value			
			2	Feedback+Fout			
			3	Flow Rate Mon			
AP1-03[55] (0h1903)	Stage in flow rate	Stage In Flow	0.00–100.00		0.00	O	
AP1-04 (0h1904)	Stage out flow rate	Stage Out Flow	0.00–100.00		0.00	O	
AP1-05 (0h1905)	High feedback De-stage level	Hi FB De-stage	-100.00–100.00		0.00	O	
AP1-06 (0h1906	Low feedback De-stage level	Lo FB De-stage	-100.00–100.00		0.00	O	
AP1-07 (0h1907)	Lag speed gain	Lag Speed Gain	0.0–300.0 (%)		100.0	O	
AP1-08 (0h1908)	Lag speed bias	Lag Speed Bias	-60.00–60.00 (Hz)		0.00	O	
AP1-09 (0h1909)	Set point modifier	SP Modifier	0	Number of Pumps	0: Number of Pumps	O	p.60
			1	Each Pump			
AP1-10 (0h190A)	Lag fixed speed delay time	Lag Fix Spd DT	0–1000 (sec)		0	O	

55 AP1-3–4 are displayed when AP-4-30 is set to "2 (Yes)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP1-11 (0h190B)	Lag deceleration time	Lag Decel Time	0.0–1000.0 (sec)		60.0	O	p.60
AP1-12 (0h190C)	Lag deceleration activation time	Lag Dec Act T	0.0–360.0 (sec)		0.0	O	
AP1-13 (0h190D)	Stabilize time	Stabilize Time	0–3600 (sec)		0	O	
AP1-20 (0h1914)	Soft Fill function options	Soft Fill Sel	0	No	0: No	O	p.149
			1	Yes			
AP1-21 (0h1915)	Pre- PID operation frequency	Pre-PID Freq	Low Freq– High Freq		30.00	O	
AP1-22 (0h1916)	Pre- PID delay time	Pre-PID Delay	0.0–600.0 (sec)		60.0	O	
AP1-23 (0h1917)	Soft Fill escape value	Soft Fill Set	Unit Min–Unit Max		20.00	O	
AP1-24 (0h1918)	Soft Fill reference increasing value	Fill Step Set	0.00–Unit Band		2.00	O	
AP1-25 (0h1919)	Soft Fill reference increasing cycle	Fill Step Time	0–9999 (sec)		20	O	
AP1-26 (0h191A)	Soft Fill changing amount	Fill Fdb Diff	0.00–Unit Band		0.00	O	
AP1-30 (0h191E)	Flow Comp function options	Flow Comp Sel	0	No	0: No	O	p.183
			1	Yes			
AP1-31 (0h191F)	Max Comp amount	Max Comp Value	0.00–Unit Band		0.00	O	
AP1-40[56] (0h1928)	Lead Lag selection	Lead Lag Sel	0	None	0: None	Δ	p.230
			1	Contactor Lag			
			2	Follower Lead			
			3	Fixed Lag			
			4	Slave Only			
AP1-41[57] (0h1929)	Bypass selection	Regul Bypass	0	No	0: No	Δ	p.253
			1	Yes			
AP1-42 (0h192A)	Total number of motor	* of Pumps	1–5		5	Δ	p.230
AP1-43 (0h192B)	First priority motor number	Run Priority	1–5		1	Δ	
AP1-44 (0h192C)	Number of auxiliary motor in operation	Lag Pump Run	-		0	X	
AP1-45 (0h192D)	Operation priority display1	Curr. Prty1	-		0000	X	
AP1-46 (0h192E)	Operation priority display2	Curr. Prty2	-		0000	X	
AP1-47 (0h192F)	LeadLag Status	LeadLag Status	-		0: Trip	X	

56 Set PID-1 to "YES" to configure AP1-40.
57 Set AP1-40 to " Contactor Lag " to configure AP1-41.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP1-48 (0h1930)	Auxiliary motor options for inverter stop	Lag Stop Sel	0	No	1: Yes	O	p.230
			1	Yes			
AP1-49 (0h1931)	Auxiliary motor stop order.	ALT Sequence	0	FILO	0: FILO	Δ	
			1	FIFO			
			2	Op time Order			
			3	Stop History			
AP1-50 (0h1932)	Server drive staging pressure	Stage Pres. Dv	0–60000		500	O	
AP1-51 (0h1933)	Main motor acceleration time when the number of auxiliary motors is reduced	Aux Acc Time	0.0–600.0 (sec)		2.0	O	
AP1-52 (0h1934)	Main motor acceleration time when the number of auxiliary motors is increased	Aux Dec Time	0.0–600.0 (sec)		2.0	O	
AP1-53 (0h1935)	Auxiliary motors start delay time	Stage DT	0.0–3600.0 (sec)		5.0	O	
AP1-54 (0h1936)	Auxiliary motors stop delay time	Aux Stop DT	0.0–3600.0 (sec)		5.0	O	
AP1-55 (0h1937)	Auto change mode selection	Auto Ch Mode	0	None	1: AUX Exchange	Δ	
			1	AUX Exchange			
			2	Main Exchange			
AP1-56 (0h1938)	Alternative interval setting	Alternate Time	00: 00–99: 00		72: 00	O	
AP1-57 (0h1939)	Alternate operating dondition frequency	Alternate Level	Low Freq– High Freq		20.00	O	
AP1-58 (0h193A)	Timer display	Auto Op Time	-		0:00	X	
AP1-59 (0h193B)	Pressure deviation level for destaging	Destage Pres.	0.0–100.0		5.0	O	
AP1-60[58] (0h193C)	Target frequency of Aux motor during Multi Master	Lag Freq	Low Freq – High Freq		60.00	O	
AP1-61[59] (0h193D)	#1 auxiliary motor start frequency	Stage Freq 1	Low Freq - High Freq		59.00	O	
AP1-62 (0h193E)	#2 auxiliary motor start frequency	Stage Freq 2	Low Freq - High Freq		59.00	O	
AP1-63 (0h193F)	#3 auxiliary motor start frequency	Stage Freq 3	Low Freq - High Freq		59.00	O	

58 API-60 only appears when AP1-40 Lead Lag Sel is set to "2" or "3".

59 AP1-61–77 only appear when AP1-40 is not set to "1" or "4". The number of displayed parameters depends on the setting of AP1-42 and the number of OUT-31–39 parameters set to "21 (MMC)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP1-64 (0h1940)	#4 auxiliary motor start frequency	Stage Freq 4	Low Freq - High Freq		59.00	O	p.230
AP1-65 (0h1941)	#5 auxiliary motor start frequency	Stage Freq 5	Low Freq - High Freq		59.00	O	
AP1-66 (0h1942)	#6 auxiliary motor start frequency	Stage Freq 6	Low Freq - High Freq		59.00	O	
AP1-67 (0h1943)	#7 auxiliary motor start frequency	Stage Freq 7	Low Freq - High Freq		59.00	O	
AP1-68 (0h1944)	#8 auxiliary motor start frequency	Stage Freq 8	Low Freq - High Freq		59.00	O	
AP1-70 (0h1946)	#1 auxiliary motor stop frequency	Destage Freq 1	Low Freq - High Freq		40.00	O	
AP1-71 (0h1947)	#2 auxiliary motor stop frequency	Destage Freq 2	Low Freq - High Freq		40.00	O	
AP1-72 (0h1948)	#3 auxiliary motor stop frequency	Destage Freq 3	Low Freq - High Freq		40.00	O	
AP1-73 (0h1949)	#4 auxiliary motor stop frequency	Destage Freq 4	Low Freq - High Freq		40.00	O	
AP1-74 (0h194A)	#5 auxiliary motor stop frequency	Destage Freq 5	Low Freq - High Freq		40.00	O	
AP1-75 (0h194B)	#6 auxiliary motor stop frequency	Destage Freq 6	Low Freq - High Freq		40.00	O	
AP1-76 (0h194C)	#7 auxiliary motor stop frequency	Destage Freq 7	Low Freq - High Freq		40.00	O	
AP1-77 (0h194D)	#8 auxiliary motor stop frequency	Destage Freq 8	Low Freq - High Freq		40.00	O	
AP1-78[60] (0h194E)	PID related parameter sharing	Data Share	0	None	1: Auto	Δ	
			1	Auto			
			2	Manual			
AP1-79 (Oh194F)	Determine communication error action	All CommErr	0	No	0: No	O	
			1	Yes			
AP1-80 (0h1950)	#1 auxiliary motor reference compensation	Aux1 Ref Comp	0.00–Unit Band		0.00	O	
AP1-81 (0h1951)	#2 auxiliary motor reference compensation	Aux2 Ref Comp	0.00–Unit Band		0.00	O	
AP1-82 (0h1952)	#3 auxiliary motor reference compensation	Aux3 Ref Comp	0.00–Unit Band		0.00	O	
AP1-83 (0h1953)	#4 auxiliary motor reference compensation	Aux4 Ref Comp	0.00–Unit Band		0.00	O	
AP1-84 (0h1954)	#5 auxiliary motor reference compensation	Aux5 Ref Comp	0.00–Unit Band		0.00	O	

60 AP1-78–79 only appears when AP1-40 is set to "2" or "3".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP1-85 (0h1955)	#6 auxiliary motor reference compensation	Aux6 Ref Comp	0.00–Unit Band		0.00	O	p.230
AP1-86 (0h1956)	#7 auxiliary motor reference compensation	Aux7 Ref Comp	0.00–Unit Band		0.00	O	
AP1-87 (0h1957)	#8 auxiliary motor reference compensation	Aux8 Ref Comp	0.00–Unit Band		0.00	O	
AP1-88[61] (0h1958)	Jockey Pump	Jockey Pump	0	NO	0: No	Δ	
			1	YES			
AP1-89 (0h1959)	Jockey Pump Delay Time	Jockey Dly T	0.0–60.0		20.0	O	
AP1-90[62] (0h195A)	Interlock operation	Ext. Mrt OL	0	Disabled	0: Disabled	Δ	
			1	En & None Trip			
			2	En & Latch Trip			
			3	En & Level Trip			
AP1-91 (0h195B)	The delay time when exchanging the main motor	Ext. Mrt OL T	0.1–360.0 (Sec)		5.0	O	
AP1-94 (0h195E)	Total number of drives used in lead-lag	* of Drives	1–8		5	Δ	
AP1-95[63] (0h195F)	Motor selection for running time display	Run Time Monitor	0	Pump 1	0: Pump 1	O	
			1	Pump 2			
			2	Pump 3			
			3	Pump 4			
			4	Pump 5			
			5	Pump 6			
			6	Pump 7			
			7	Pump 8			
AP1-96 (0h1960)	Running time(Day) display	Pump Run Time Day	0–65535		0	O	
AP1-97 (0h1961)	Running time(hour:minute) display	Pump Run Time Min	00:00 - 23:59		00:00	O	
AP1-98 (0h1962)	Clear running time for lag motors	Pump Run time Clear	0	None	0: None	O	
			1	All			
			2	Pump 1			
			3	Pump 2			
			4	Pump 3			
			5	Pump 4			
			6	Pump 5			

61 AP1-78–79, 94, 99 only appear when AP1-40 is set to "2" or "3".
62 AP1-90, 91 only appear when AP1-40 is set to "0" or "1".
63 AP1-95–98 is available when MMC and Master Follower functions are performed.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
			7	Pump 6			p.230
			8	Pump 7			
			9	Pump 8			
AP1-99 (0h1963)	Alternation selection at sleep	Alter at sleep	0	No	0: No	O	
			1	Yes			

8.10 Application 2 Function Group (AP2)

Data in the following table will be displayed only when the related code has been selected.

***O/X: Write-enabled during operation,Δ: Writing available when operation stops**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP2-00 (-)	Jump Code	Jump Code	1–99		-	X	p.60
AP2-01[64] (0h1A01)	Load curve Tuning	Load Tune	0	No	No	Δ	p.189
			1	Yes			
AP2-02 (0h1A02)	Low Freq load curve	Load Fit Lfreq	Base Freq*15% –Load Fit HFreq		30.00	Δ	
AP2-03 (0h1A03)	Low Freq current	Load Fit LCurr	0.0–80.0 (%)		40.0	Δ	
AP2-04 (0h1A04)	Low Freq power total	Load Fit LPwr	0.0–80.0 (%)		30.0	Δ	
AP2-08 (0h1A08)	High Freq load curve	Load Fit Hfreq	Load Fit LFreq–HighFreq		51.00	Δ	
AP2-09 (0h1A09)	High Freq current.	Load Fit HCurr	Load Fit LCurr –200.0 (%)		80.0	Δ	
AP2-10 (0h1A0A)	High Freq total power	Load Fit HPwr	Load Fit LPwr –200.0 (%)		80.0	Δ	
AP2-11 (0h1A0B)	Current load curve	Load Curve Cur	-		0.0	X	
AP2-12 (0h1A0C)	Power load curve	Load Curve Pwr	-		0.0	X	
AP2-15 (0h1A0F)	Pump clean setting1	Pump Clean Mode1	0	None	0: None	O	p.185
			1	DI Dependent			
			2	Output Power			
			3	Output Current			
AP2-16 (0h1A10)	Pump clean setting2	Pump Clean Mode2	0	None	0: None	Δ	
			1	Start			
			2	Stop			
			3	Start and Stop			
AP2-17 (0h1A11)	Pump clean load setting	PC Curve Rate	0.1–200.0 (%)		100.0	O	

64 Set the operation mode to AUTO to configure AP2-01.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP2-18 (0h1A12)	Pump clean reference band	PC Curve Band	0.0–100.0 (%)		5.0	O	p.185
AP2-19 (0h1A13)	Pump clean operation delay time	PC Curve DT	0.0–6000.0 (sec)		60.0	O	
AP2-20 (0h1A14)	Pump clean start delay time	PC Start DT	0.0–600.00 (sec)		10.00	O	
AP2-21 (0h1A15)	0 speed operating time at Fx/Rx switching	PC Step DT	0.0–600.00 (sec)		5.00	O	
AP2-22 (0h1A16)	Pump clean Acc time	PC Acc Time	0.0–600.0 (sec)		10.0	O	
AP2-23 (0h1A17)	Pump clean Dec time	PC Dec Time	0.0–600.0 (sec)		10.0	O	
AP2-24 (0h1A18)	Forward step maintaining time	FwdSteadyTime	0.0–60.00 (sec)		10.00	O	
AP2-25 (0h1A19)	Forward step maintaining frequency	FwdSteadyFreq	0.00, Low Freq– High Freq		30.00	O	
AP2-26 (0h1A1A)	Reverse step running time	Rev SteadyTime	0.0–60.00 (sec)		10.00	O	
AP2-27 (0h1A1B)	Reverse step running frequency	Rev SteadyFreq	0.00, Low Freq–High Freq		30.00	O	
AP2-28 (0h1A1C)	Pump clean number of Fx/Rx steps	PC Num of Steps	1–10		2	O	
AP2-29 (0h1A1D)	Pump clean function cycle monitoring	Repeat Num Mon	-		0	X	
AP2-30 (0h1A1E)	Number of pump clean repetitions	Repeat Num Set	0–10		2	O	
AP2-31 (0h1A1F)	Operation after pump clean end	PC End Mode	0	Stop	0:Stop	Δ	
			1	Run			
AP2-32 (0h1A20)	Pump clean continuous limit time	PC Limit Time	6–60 (min)		10	O	
AP2-33 (0h1A21)	Pump clean continuous limit numbers	PC Limit Num	0–10		3	O	p.189
AP2-34 (0h1A22)	Pump clean count	Pump Clean Cnt	0–65535		0	O	p.189
AP2-35 (0h1A23)	Pump clean Exit mode	PC Exit Mode	0	No	0:No	O	
			1	Yes			
AP2-36 (0h1A24)	Pump clean stop mode	PC Stop Mode	0	Dec	2:Coast Stop	O	
			1	DC Brake			
			2	Coast Stop			
			4	Power Braking			
AP2-38 (0h1A26)	Dec valve operation frequency	Dec Valve Freq	Low Freq– High Freq		40.00	O	p.188
AP2-39 (0h1A27)	Dev valve dec time	Dev Valve Time	0.0–6000.0 (sec)		0.0	O	

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP2-40 (0h1A28)	Thrust frequency	Thrust Freq	0.00–High Freq		0.00	Δ	p.151
AP2-41 (0h1A29)	Thrust accelrataion time	Thrust Acc Tm	0.0–600.0 (sec)		1.0	O	
AP2-42 (0h1A2A)	Thrust deceleration time	Thrust Dec Tm	0.0–600.0 (sec)		5.0	O	
AP2-43 (0h1A2B)	Damper check time	Damper Check T	0.0–600.0 (sec)		5.0	O	p.182
AP2-44 (0h1A2C)	Lubrication operation time	Lub Op Time	0.0–600.0 (sec)		5.0	O	p.183
AP2-45[65] (0h1A2D)	Initial heating output current level	Pre Heat Level	1–100		20	O	p.194
AP2-46 (0h1A2E)	Initial heating output duty	Pre Heat Duty	1–100		30	O	
AP2-47 (0h1A2F)	DC injection delay time	DC Inj Delay T	0.0–600.0 (sec)		60.0	O	
AP2-48 (0h1A30)	High feedback detection mode	High Fdb Mode	0	None	0: None	O	p.174
			1	Warning			
			2	Trip & Coast			
AP2-49 (0h1A31)	High feedback level fault delay time	High Fdb Time	0.0–1200.0 (sec)		5.0	O	
AP2-50 (0h1A32)	High feedback detection level	High Fdb Level	- PID Unit Max– PID Unit Max		PID Unit 100%*0.95	O	
AP2-51 (0h1A33)	Low feedback detection mode	Low Fdb Mode	0	None	0: None	O	
			1	Warning			
			2	Trip & Coast			
AP2-52 (0h1A34)	Low feedback level fault delay time	Low Fdb Time	0.1–120.0 (sec)		10.0	O	
AP2-53 (0h1A35)	Low feedback detection level	Low Fdb Level	- PID Unit Max– PID Unit Max		0	O	
AP2-54 (0h1A36)	Hysteresis level	Hysteresis Lev	- PID Unit Max– PID Unit Max		0	O	
AP2-55 (0h1A37)	Setpoint timeout selection	SP Timeout Sel	0	None	0: None	O	p.177
			1	Warning			
			2	Trip & Coast			
AP2-56 (0h1A38)	Setpoint timeout delay time	SP Timeout DT	0.0-6000.0 (sec)		10.0	O	
AP2-57 (0h1A39)	Setpoint timeout maximum difference level	SP Timeout Lev	0-PID Unit 100%		0	O	
AP2-60 (0h1A3C)	Differential level detection mode	Diff Fdb Mode	0	None	0: None	O	p.172
			1	Warning			
			2	Trip & Coast			

65 AP2-45–46 only appear when any one of IN-64–71 is set to "36 (Pre heat)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP2-61 (0h1A3D)	Differential level detection source	Diff Fdb Src	0	V1	0: V1	Δ	p.172
			1	I1			
			2	V2			
			3	I2			
			4	Int485			
			5	Fieldbus			
			7	Pulse			
			8	V3			
			9	I3			
AP2-62 (0h1A3E)	Differential level detection time	Diff Fdb Time	0.0–1200.0 (sec)		10.0	O	
AP2-63 (0h1A3F)	Differential level feedback level	Diff Fdb Level	0–30000		3000	O	
AP2-64 (0h1A40)	Differential feedback value monitor	Diff Fdb Value	-		0	X	
AP2-65 (0h1A41)	Maximum allowable number of cycles	Over Cycle Cnt	0–10		0	O	p.170
AP2-66 (0h1A42)	Mximum cycling protection time	Max Cycle Time	0–3600 (sec)		300	O	
AP2-67 (0h1A43)	Over cycle protection mode	OverCycle Mode	0	None	0: None	O	
			1	Warning			
			2	Trip & Coast			
AP2-70 (0h1A46)	Output current limit control selection	Curr Lim Sel	0	No	0: No	Δ	p.179
			1	Yes			
AP2-71 (0h1A47)	Output current limit level	Current Limit	0.0–1000.0 (A)		0.0	Δ	
AP2-72 (0h1A48)	Current limit control proportional gain	CurrLim P-gain	0.00–300.00 (%)		100.00	Δ	
AP2-73 (0h1A49)	Current limit control integral time	CurrLim I-time	0.0–200.0 (sec)		2.0	Δ	
AP2-74 (0h1A4A)	Current limit control filter time	CurrLim Filter	0.00–10.00 (sec)		1.00	Δ	
AP2-75 (0h1A4B)	Lost Feedback Mode	Lost Fdb Mode	0	None	0. None	O	p.176
			1	Warning			
			2	Trip & Coast			
			3	Lost Preset			
AP2-76 (0h1A4C)	Feedback source switch mode	FbkSource Mode	0	None	0. None	O	p.176
			1	Ana▶Net,Al arm			
			2	Ana▶Net,N oAlrm			
AP2-77 (0h1A4D)	Lost feedback tolerance	Fbk Tolerance	0.00–30.00 (%)		5.00	O	

8.11 Application 3 Function Group (AP3)

Data In the following table will be displayed only when the related code has been selected.

***O/X: Write-enabled during operation,Δ: Writing available when operation stops**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP3-00 (-)	Jump code	Jump Code	1–99		-	X	p.60
AP3-01 (0h1B01)	Current date	Now Date	01/01/2000–12/31/2099(Date)		01/01/2000	O	p.198
AP3-02 (0h1B02)	Current time	Now Time	00: 00–23: 59 (min)		0: 00	O	
AP3-03 (0h1B03)	Current day	Now Weekday	0000000–1111111 (Bit)		0000001	O	
AP3-04 (0h1B04)	Summer Time Start date	Summer T Start	01/01 – Summer T Stop		04/01	O	
AP3-05 (0h1B05)	Summer Time Finish date	Summer T Stop	Summer T Start –12/31(Date)		11/31	O	
AP3-06 (0h1B06)	Date display format	Date Format	0	YYYY/MM/DD	MM/DD/YYYY	O	
			1	MM/DD/YYYY			
			2	DD/MM/YYYY			
AP3-10 (0h1B0A)	Period connection status	Period Status	-		0000 0000 0000	X	
AP3-11 (0h1B0B)	Time Period1 Start time configuration	Period1 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-12 (0h1B0C)	Time Period1 End time configuration	Period1 Stop T	Period1 Start T –24: 00 (min)		24: 00	O	
AP3-13 (0h1B0D)	Time Period1 Day of the week configuration	Period1 Day	000 0000–111 1111 (Bit)		000 0000	O	
AP3-14 (0h1B0E)	Time Period2 Start time configuration	Period2 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-15 (0h1B0F)	Time Period2 End time configuration	Period2 Stop T	Period2 Start T –24: 00 (min)		24: 00	O	
AP3-16 (0h1B10)	Time Period2 Day of the week configuration	Period2 Day	000 0000–111 1111 (Bit)		000 0000	O	
AP3-17 (0h1B11)	Time Period3 Start time configuration	Period3 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-18 (0h1B12)	Time Period3 End time configuration	Period3 Stop T	Period3 Start T –24: 00 (min)		24: 00	O	
AP3-19 (0h1B13)	Time Period3 Day of the week configuration	Period3 Day	000 0000–111 1111 (Bit)		000 0000	O	
AP3-20 (0h1B14)	Time Period4 Start time configuration	Period4 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-21 (0h1B15)	Time Period4 End time configuration	Period4 Stop T	Period4 Start T –24: 00 (min)		24: 00	O	
AP3-22 (0h1B16)	Time Period Day of the week configuration	Period4 Day	000 0000–111 1111 (Bit)		000 0000	O	
AP3-30 (0h1B1E)	Except1 Date Start time configuration	Except1 Start T	0: 00–24: 00 (min)		24: 00	O	

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP3-31 (0h1B1F)	Except1 Date End time configuration	Except1 Stop T	Except1 StartT –24: 00 (min)		24: 00	O	p.198
AP3-32 (0h1B20)	Except1 Date configuration	Except1Date	01/01–12/31 (Date)		01/01	O	
AP3-33 (0h1B21)	Except2 Date Start time configuration	Except2 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-34 (0h1B22)	Except2 Date Stop time configuration	Except2 Stop T	Except2 StartT –24: 00 (min)		24: 00	O	
AP3-35 (0h1B23)	Except2 Date configuration	Except2Date	01/01-12/31(Date)		01/01	O	
AP3-36 (0h1B24)	Except3 Date Start time configuration	Except3 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-37 (0h1B25)	Except3 Date End time configuration	Except3 Stop T	Except3 StartT –24: 00 (min)		24: 00	O	
AP3-38 (0h1B26)	Except3 Date configuration	Except3Date	01/01–12/31 (Date)		01/01	O	
AP3-39 (0h1B27)	Except4 Date Start time configuration	Except4 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-40 (0h1B28)	Except4 Date End time configuration	Except4 Stop T	Except4 StartT –24: 00 (min)		24: 00	O	
AP3-41 (0h1B29)	Except4 Date configuration	Except4Date	01/01–12/31 (Date)		01/01	O	
AP3-42 (0h1B2A)	Except5 Date Start time configuration	Except5 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-43 (0h1B2B)	Except5 Date End time configuration	Except5 Stop T	Except5 StartT –24: 00 (min)		24: 00	O	
AP3-44 (0h1B2C)	Except5 Date configuration	Except5 Date	01/01–12/31 (Date)		01/01	O	
AP3-45 (0h1B2D)	Except6 Date Start time configuration	Except6 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-46 (0h1B2E)	Except6 Date End time configuration	Except6 Stop T	Except6 StartT –24: 00 (min)		24: 00	O	
AP3-47 (0h1B2F)	Except6 Date configuration	Except6 Date	01/01-12/31(Date)		01/01	O	
AP3-48 (0h1B30)	Except7 Date Start time configuration	Except7 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-49 (0h1B31)	Except7 Date End time configuration	Except7 Stop T	Except7 StartT –24: 00 (min)		24: 00	O	
AP3-50 (0h1B32)	Except7 Date configuration	Except7 Date	01/01–12/31 (Date)		01/01	O	
AP3-51 (0h1B33)	Except8 Date Start time configuration	Except8 Start T	0: 00–24: 00 (min)		24: 00	O	
AP3-52 (0h1B34)	Except8 Date End time configuration	Except8 Stop T	Except8 StartT –24: 00 (min)		24: 00	O	
AP3-53 (0h1B35)	Except8 Date configuration	Except8 Date	01/01–12/31 (Date)		01/01	O	
AP3-70 (0h1B46)	Time Event function configuration	Time Event En	0	No	0: NO	Δ	
			1	Yes			

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP3-71 (0h1B47)	Time Event configuration status	T-Event Status	-		0000 0000	X	p.198
AP3-72 (0h1B48)	Time Event 1 connection status	T-Event1 Period	0000 0000 0000 –1111 1111 1111		0000 0000 0000	Δ	
AP3-73 (0h1B49)	Time Event 1 functions	T-Event1 Define	0	None	0: None	Δ	
			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	Exchange			
			13	Analog Hold			
			14	I-Term Clear			
			15	PID Openloop			
AP3-73 (0h1B49)			16	PID Gain 2			
			17	PID Ref Change			
			18	Timer In			
			19	dis Aux Ref			
			20	Pre Heat			
			21	Sleep Wake Chg			
			22	PID Step Ref L			
			23	PID Step Ref M			
			24	PID Step Ref H			
AP3-74 (0h1B4A)	Time Event 2 connection configuration	T-Event2 Period	0000 0000 0000 –1111 1111 1111		0000 0000 0000	Δ	
AP3-75 (0h1B4B)	Time Event 2 functions	T-Event2 Define	Identical to the setting range for AP3-73		0: None	Δ	
AP3-76 (0h1B4C)	Time Event 3 connection configuration	T-Event2 Period	0000 0000 0000 –1111 1111 1111		0000 0000 0000	Δ	
AP3-77 (0h1B4D)	Time Event 3 functions	T-Event3 Define	Identical to the setting range for AP3-73		0: None	Δ	
AP3-78 (0h1B4E)	Time Event 4 connection configuration	T-Event4 Period	0000 0000 0000 –1111 1111 1111		0000 0000 0000	Δ	
AP3-79 (0h1B4F)	Time Event 4 functions	T-Event4 Define	Identical to the setting range for AP3-73		0: None	Δ	
AP3-80 (0h1B50)	Time Event 5 connection configuration	T-Event5 Period	0000 0000 0000 –1111 1111 1111		0000 0000 0000	Δ	
AP3-81 (0h1B51)	Time Event 5 functions	T-Event5 Define	Identical to the setting range for AP3-73		0: None	Δ	
AP3-82 (0h1B52)	Time Event 6 connection configuration	T-Event6 Period	0000 0000 0000 –1111 1111 1111		0000 0000 0000	Δ	

Code (Comm. Address)	Name	LCD Display	Setting Range	Initial Value	Property*	Ref.
AP3-83 (0h1B53)	Time Event 6 functions	T-Event6 Define	Identical to the setting range for AP3-73	0: None	Δ	p.198
AP3-84 (0h1B54)	Time Event 7 connection configuration	T-Event7 Period	0000 0000 0000 –1111 1111 1111	0000 0000 0000	Δ	
AP3-85 (0h1B55)	Time Event 7 functions	T-Event7 Define	Same setting range for AP3-73	0: None	Δ	
AP3-86 (0h1B56)	Time Event 8 connection configuration	T-Event8 Period	0000 0000 0000 –1111 1111 1111	0000 0000 0000	Δ	
AP3-87 (0h1B57)	Time Event 8 functions	T-Event8 Define	Same setting range as AP3-73	0: None	Δ	

8.12 Application 4 Function Group (AP4)

Data In the following table will be displayed only when the related code has been selected.

***O/X: Write-enabled during operation, Δ: Writing available when operation stops**

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP4-00 (-)	Jump code	Jump Code	1–99		-	X	p.60
AP4-01 (0h1C01)	PI auxiliary control selection	PI Aux Sel	0	None	0: None	Δ	p.162
			1	Suction (PSI)			
			2	Vacuum (Hg)			
			3	Water Lvl (ft)			
			4	Custom_Normal			
			5	Custom_Inverse			
AP4-02[66] (0h1C02)	PI auxiliary control feedback unit 100%	PI Aux Unit 100%	5.0–3000.0		100.0	O	
AP4-03 (0h1C03)	PI auxiliary control feedback source	PI Aux Fbk Src	0	V1	3: I2	Δ	
			1	I1			
			2	V2			
			3	I2			
			4	Int485			
			5	Fieldbus			
			6	Network			
			7	Pulse			
			8	V3			
			9	I3			
AP4-04 (0h1C04)	PI auxiliary control setpoint	PIAux Setpoint	0.0– PIAuxUnit 100%		20.0	O	
AP4-05 (0h1C05)	PI auxiliary control feedback vlaue monitor	PIAuxFbk Mon	-		0.0	X	

66 AP4-2–27 are displayed when AP4-01 is not set to "0 (None)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP4-06 (0h1C06)	PI auxiliary control sleep level	PIAux Sleep Lev	0.0–1200.0		10.0	O	p.162
AP4-07 (0h1C07)	PI auxiliary control sleep delay time	PIAux Sleep DT	0–3600 (sec)		5	O	
AP4-08 (0h1C08)	PI auxiliary control wake-up level	PIAux Wake Lev	0.0–3000.0		30.0	O	
AP4-09 (0h1C09)	PI auxiliary control wake-up delay time	PIAux Wake DT	0–3600 (sec)		1	O	
AP4-10 (0h1C0A)	PI auxiliary control activation level	PI Aux Act Lev	0.0–3600.0		0.0	O	
AP4-11 (0h1C0B)	PI auxiliary control activation/ deactivation delay	PI Aux Act DT	0–3600 (sec)		2	O	
AP4-12 (0h1C0C)	PI auxiliary control minimum speed	PI Aux Min Spd	0.00–400.00 (Hz)		0.50	O	
AP4-13 (0h1C0D)	PI auxiliary control low level detection	Low Lev Detect	0.0– PIAuxUnit 100%		0.0	O	
AP4-14 (0h1C0E)	PI auxiliary control low level detection time	Low Lev Det Tm	0.0–6000.0 (sec)		0.1	O	
AP4-15 (0h1C0F)	PI auxiliary control low level detection selection	LowLev Det Sel	0	None	0: None	O	
			1	Warning			
			2	Trip & Coast			
			3	RST Restart			
AP4-16 (0h1C10)	PI auxiliary control low level detection restart time	Low Lev RST Tm	0.0–3000.0 (Min)		5.0	O	
AP4-17 (0h1C11)	PI auxiliary control high level detection	HighLev Detect	0.0– PIAuxUnit 100%		0.0	O	
AP4-18 (0h1C12)	PI auxiliary control high level detection time	HighLev Det Tm	0.0–6000.0 (sec)		0.1	O	
AP4-19 (0h1C13)	PI auxiliary control high level detection selection	HighLevDet Sel	0	None	1: Warning	O	
			1	Warning			
			2	Trip & Coast			
			3	RST Restart			
AP4-20 (0h1C14)	PI auxiliary control high level detection restart time	HighLev RST Tm	0.0–3000.0 (Min)		5.0	O	
AP4-23 (0h1C17)	PI auxiliary control proportional gain	PI Aux P-Gain	0.00–650.00 (%)		100.00	O	
AP4-24 (0h1C18)	PI auxiliary control Integral gain	PI Aux I-Time	0.0–200.0 (sec)		2.0	O	
AP4-25 (0h1C19)	PI auxiliary speed control selection	PIAux Spd Ctrl	0	No	1: Yes	O	
			1	Yes			

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP4-26 (0h1C1A)	PI auxiliary control unit scale	PIAuxUnitScale	0	x 100	1: x10	O	p.162
			1	x 10			
			2	x 1			
			3	x 0.1			
			4	x 0.01			
AP4-27 (0h1C1B)	PI auxiliary control unit selection	PIAux Unit Sel	0	CUST	2: PSI	O	
			1	%			
			2	PSI			
			3	F			
			4	C			
			5	in WC			
			6	in M			
			7	mBar			
			8	Bar			
			9	Pa			
			10	kPa			
			11	Hz			
			12	Rpm			
			13	V			
			14	A			
			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			

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP4-27 (0h1C1B)			38	lb/h			
			39	ppm			
			40	pps			
			41	Hg			
AP4-30 (0h1C1E)	Flow Control Selection	Flow Control	0	No	0: No	Δ	p.156
			1	Yes			
			2	AccumRst →Yes			
AP4-31[67] (0h1C1F)	Flow Meter Source Selection	Flow Meter Src	0	V1	0: V1	O	
			1	I1			
			2	V2			
			3	I2			
			4	Pulse			
			5	Network			
			6	V3			
			7	I3			
AP4-32 (0h1C20)	Flow rate monitor	Flow Rate Mon	-		0.00	X	
AP4-33 (0h1C21)	Turbine Input Scaling	Turbine Scale	0–32000		0	O	
AP4-34 (0h1C22)	Flow Unit 0%	Flow Unit 0%	0.00–100.00		0.00	O	
AP4-35 (0h1C23)	Flow Unit 100%	Flow Unit 100%	0.00–300.00		100.00	O	
AP4-36 (0h1C24)	Flow Unit Selection	Flow Unit Sel	0	gl/m	0: gl/m	O	
			1	gl/h			
			2	f3/m			
			3	m3/h			
AP4-37 (0h1C25)	Flow Decimal Scale	Flow Dec Scale	0	x 100	2: x1	O	
			1	x 10			
			2	x 1			
			3	x 0.1			
			4	x 0.01			
AP4-38 (0h1C26)	Accumulation Level -Millions	AccumLvMillion	0–65535		0	O	
AP4-39 (0h1C27)	Accumulation Level -Thousands	AccumLvThou	0–999		0		
AP4-40 (0h1C28)	Accumulation Level -Ones	AccumLvOnes	0–9999		0	O	
AP4-41 (0h1C29)	Accumulation Level – Decimal	AccumLv Decimal	0.00–0.99		0.00	O	
AP4-42 (0h1C2A)	Low Flow Level	Low Flow Level	0.00–300.00		0.00	O	

67 AP4-31–60 are displayed when AP4-30 is set to "1 (Yes)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
AP4-43 (0h1C2B)	Low Fow Detection Delay Time	Low Flow DT	0–6000 (sec)		10	O	p.156
AP4-44 (0h1C2C)	Low Flow Selection	Low Flow Sel	0	None	0: None	O	
			1	Warning			
			2	Trip & Coast			
			3	RST Restart			
AP4-45 (0h1C2D)	Low Flow Start Delay Time	LowFlow St DT	0.0–3600.0 (Min)		0.0	O	
AP4-46 (0h1C2E)	Low Flow Start Delay OFF time	StartDlyOff Tm	0–6000 (sec)		5	O	
AP4-47 (0h1C2F)	High Flow Level	High Flow Lev	0.00–300.00		0.00	O	
AP4-48 (0h1C30)	High Flow Detection Delay Time	High Flow DT	0–6000 (Sec)		10	O	
AP4-49 (0h1C31)	High Flow Selection	High Flow Sel	0	None	0: None	O	
			1	Warning			
			2	Trip & Coast			
AP4-50 (0h1C32)	Set Accumulation Level Millions	SetAccumLv M	0–65535		0	O	
AP4-51 (0h1C33)	Set Accumulation Level Thousands	SetAccumLv K	0–999		0	O	
AP4-52 (0h1C34)	Set Accumulation Level Ones	SetAccumLv One	0–999		0	O	
AP4-53 (0h1C35)	Set Accumulation Level Decimal	SetAccumLv Dec	0.00–0.99		0.00	O	
AP4-54 (0h1C36)	Accumulation Flow Selection	Accum Flow Sel	0	None	0: None	O	
			1	Warning			
			2	Trip & Coast			
			3	Trip& RstAccum			
AP4-55 (0h1C37)	Flow Limit Selection	Flow Limit Sel	0	Disabled	0: Disabled	O	
			1	High			
			2	Low			
AP4-56 (0h1C38)	Flow Limit Level	Flow Limit Lev	0.00–300.00		0.00	O	
AP4-57 (0h1C39)	Flow Limit P-Gain	FlowLim P-Gain	0.00-250.0		1.00	O	
AP4-58 (0h1C3A)	Flow Limit I-Gain	FlowLim I-time	0.00-100.00 (sec)		1.00	O	
AP4-59 (0h1C3B)	Flow Limit Delay Time	Flow Lim DT	0-6000 (sec)		10	O	
AP4-60 (0h1C3C)	Low Flow RST Restart Time	LowFlow RST Tm	0.0-6000.0 (Min)		3.0	O	

8.13 Protection Function Group (PRT)

Data In the following table will be displayed only when the related code has been selected.

O : Write-enabled during operation, Δ: Write-enabled when stopped, X: Write disabled

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
PRT-00 (-)	Jump Code	Jump Code	1–99		-		X	p.60
PRT-01 (0h1D01)	Backspin time	Backspin Time	0–6000.0 (sec or Min or Hour)		0.0		O	p.180
PRT-02 (0h1D02)	Load duty	Load Duty	0	Normal Duty	0: Normal Duty		X	
			1	Heavy Duty				
PRT-03 (0h1D03)	Input/output open-phase protection	Phase Loss Chk	Bit	00–11	00		Δ	p.301
			Bit0	Output open phase				
			Bit1	Input open phase				
PRT-04 (0h1D04)	Input voltage range during open-phase	IPO V Band	1–100 (V)		15	0.75–90kW-2 0.75–750kW-4	O	
					40	5.5–300kW-5		
PRT-05[68] (0h1D05)	Backspin Timer Save	BackspinT Save	0	No	1: Yes		O	p.180
			1	Yes				
PRT-06 (0h1D06)	Backspin time Unit Sel	Backspin Unit	0	Sec	0: Sec		O	
			1	Min				
			2	Hour				
PRT-07 (0h1D07)	Deceleration time at fault trip	Trip Dec Time	0.0–600.0 (sec)		3.0	0.75–45kW-2 0.75–90kW-4	O	
					90.0	55–90kW-2 110–750kW-4 110–300kW-5		
					3.0	5.5 –90kW-5		
PRT-08 (0h1D08)	Selection of startup on trip reset	RST Restart	Bit	00000000–11111111	0000000000		O	p.216
			Bit 0	Standard Trips except the below				
			Bit 1	Low Voltage Trip				
			Bit 2	Low Feedback Trip				
			Bit 3	High Feedback Trip				
			Bit 4	SetPoint Timeout				
			Bit 5	Overcycle Trip				
			Bit 6	High Flow Trip				
			Bit 7	Accum Flow Trip				
			Bit 8	Lost Feedback				
			Bit 9	Lost Command				
PRT-09 (0h1D09)	Number of automatic restarts	Retry Number	0–10		0		O	

68 PRT-05–06 are available from Drive Software Version <SW602.01> or greater

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
PRT-10 (0h1D0A)	Automatic restart delay time	Rtry Num Count	-		0	X	
PRT-11 (0h1D0B)	Automatic restart delay time	Retry Delay	0.1–600.0 (sec)		5.0	O	
PRT-12 (0h1D0C)	Lost keypad mode	Lost KPD Mode	0	None	0:None	O	p.302
			1	Warning			
			2	Trip&Coast			
			3	Decel Stop			
PRT-13 (0h1D0D)	Speed command loss operation mode	Lost Cmd Mode	0	None	0: None	O	
			1	Trip&Coast			
			2	Decel Stop			
			3	Hold Input			
			4	Hold Output			
			5	Lost Preset			
PRT-14[69] (0h1D0E)	Time to determine speed command loss	Lost Cmd Time	0.1–120.0 (sec)		1.0	O	
PRT-15 (0h1D0F)	Operation frequency at speed command loss	Lost Preset F	0.00, Low Freq–High Freq		0.00	O	
PRT-16 (0h1D10)	Analog input loss decision level	AI Lost Level	0	Half of x1	0: Half of x1	O	
			1	Below x1			
PRT-17 (0h1D11)	Overload warning selection	OL Warn Select	0	No	0: No	O	p.297
			1	Yes			
PRT-18 (0h1D12)	Overload warning level	OL Warn Level	30–OL Trip Level(%)		110	O	
PRT-19 (0h1D13)	Overload warning time	OL Warn Time	0.0–30.0 (sec)		10.0	O	
PRT-20 (0h1D14)	Motion at overload trip	OL Trip Select	0	None	1: Trip&Coast	O	
			1	Trip&Coast			
			2	Decel Stop			
PRT-21 (0h1D15)	Overload trip level	OL Trip Level	30–150 (%)		120	O	
PRT-22 (0h1D16)	Overload trip time	OL Trip Time	0.0–60.0 (sec)		60.0	O	
PRT-23 (0h1D17)	Under load detection Source	UL Source	0	Output Current	0: Output Current	Δ	p.306
			1	Output Power			
PRT-24 (0h1D18)	Under load detection band	UL Band	0.0–100.0 (%)		10.0	Δ	
PRT-25 (0h1D19)	Under load warning selection	UL Warn Sel	0	No	0: No	O	
			1	Yes			
PRT-26 (0h1D1A)	Under load warning time	UL Warn Time	0.0–600.0 (sec)		10.0	O	

69 PRT-13–15 are displayed when PRT-12 is not set to "0 (NONE)".

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value		Property*	Ref.
PRT-27 (0h1D1B)	Under load trip selection	UL Trip Sel	0	None	0: None		O	
			1	Trip&Coast				
			2	Decel Stop				
PRT-28 (0h1D1C)	Under load trip timer	UL Trip Time	0.0–600.0 (sec)		30.0		O	
PRT-29 (0h1D1D)	Under load trip Retry Number	UL Retry Num	0–10		2		O	p.306
PRT-30 (0h1D1E)	Under load trip delay time	UL Retry Dly	0.0–6000.0 (sec)		10.0		O	
PRT-31 (0h1D1F)	Operation on no motor trip	No Motor Trip	0	None	0: None		O	p.309
			1	Trip&Coast				
PRT-32 (0h1D20)	No motor trip current level	No Motor Level	1–100 (%)		5		O	
PRT-33 (0h1D21)	No motor detection time	No Motor Time	0.1–10.0 (sec)		3.0		O	
PRT-34 (0h1D22)	Operation at motor overheat detection	Thermal-T Sel	0	None	0: None		O	p.295
			1	Trip&Coast				
			2	Decel Stop				
PRT-35 (0h1D23)	Thermal sensor input	Thermal In Src	0	Thermal In	0: Thermal In		O	
			1	V2				
PRT-36 (0h1D24)	Thermal sensor fault level	Thermal-T Lev	0.0–100.0 (%)		50.0		O	
PRT-37 (0h1D25)	Thermal sensor fault range	Thermal-T Area	0	Low	0: Low		O	
			1	High				
PRT-38[70] (0h1D26)	Motor overheat detection sensor	Thermal Monitor	-		-		X	
PRT-40 (0h1D28)	Electronic thermal prevention fault trip selection	ETH Trip Sel	0	None	0: None		O	p.294
			1	Trip&Coast				
			2	Decel Stop				
PRT-41 (0h1D29)	Motor cooling fan type	Motor Cooling	0	Self-cool	0: Self-cool		O	
			1	Forced-cool				
PRT-42 (0h1D2A)	Electronic thermal one minute rating	ETH 1 min	ETH Cont–150 (%)		115	0.75–750kW	O	
PRT-43 (0h1D2B)	Electronic thermal prevention continuous rating	ETH Cont	50– ETH 1 min (%)		100		O	
PRT-44 (0h1D2C)	Fire mode password	Fire Mode PW	0–9999		3473		O	p.210
PRT-45[71] (0h1D2D)	Fire mode setting	Fire Mode Sel	0	None	0: None		O	
			1	Fire Mode				
			2	Test Mode				

70 PRT-38 is displayed when PRT-34 is not set to "0 (NONE)".

71 PRT-45 can only be set when PRT-44 is in Fire mode. To change the mode in PRT-44, create a new password for PRT-44.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
PRT-46[72] (0h1D2E)	Fire mode direction setting	Fire Mode Dir	0	Reverse	1: Forward	O	
			1	Forward			
PRT-47[73] (0h1D2F)	Fire mode frequency setting	Fire Mode Freq	0.00–max Freq		60.00	O	
PRT-48 (0h1D30)	Number of fire mode operations	Fire Mode Cnt	-		0	X	p.210
PRT-50 (0h1D32)	Stall prevention and flux braking	Stall Prevent	Bit	0000–1111	0100	Δ	p.298
			Bit 0	At acceleration			
			Bit 1	At constant speed			
			Bit 2	At deceleration			
			Bit 3	Flux braking			
PRT-51 (0h1D33)	Stall frequency 1	Stall Freq 1	Start frequency-Stall frequency2 (Hz)		60.00	O	
PRT-52 (0h1D34)	Stall level 1	Stall Level 1	30-150 (%)		130	Δ	
PRT-53 (0h1D35)	Stall frequency 2	Stall Freq 2	Stall frequency1-Stall frequency3(Hz)		60.00	O	
PRT-54 (0h1D36)	Stall level 2	Stall Level 2	30-150 (%)		130	Δ	
PRT-55 (0h1D37)	Stall frequency 3	Stall Freq 3	Stall frequency2-Stall frequency4(Hz)		60.00	O	
PRT-56 (0h1D38)	Stall level 3	Stall Level 3	30–150 (%)		130	Δ	
PRT-57 (0h1D39)	Stall frequency 4	Stall Freq 4	Stall frequency3-Maximum frequency (Hz)		60.00	O	
PRT-58 (0h1D3A)	Stall level 4	Stall Level 4	30–150 (%)		130	Δ	
PRT-59 (0h1D3B)	Flux braking gain	Flux Brake Kp	0.75–45kW-2 0.75-90kW-4	0–150 (%)	0	O	
			55–90kW-2 110-750kW-4 110–300kW-5	0–10 (%)			
PRT-60 (0h1D3C)	Pipe break detection setting	PipeBrokenSel	0	None	0: None	O	p.193
			1	Warning			
			2	Trip&Coast			
			3	Decel Stop			
PRT-61 (0h1D3D)	Pipe break detection variation	PipeBroken Lev	0.0–100.0 (%)		97.5	O	
PRT-62 (0h1D3E)	Pipe break detection time	PipeBroken DT	0.0–6000.0 (Sec)		10.0	O	
PRT-63 (0h1D3F)	Brake resistor configuration	DB Warn %ED	0–30 (%)		0	0.75–90kW-2 0.75–750kW-4	O	p.304
					5	5.5–300kW-5		

72 PRT-46–47 are displayed when PRT-45 is not set to "0 (NONE)".

73 When Fire mode is set at PRT-45, PRT-46 is automatically set to forward, and the frequency set at PRT-47 cannot be edited. When PRT-45 is set to Test mode, PRT-46 and PRT-47 settings are editable.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
PRT-66 (0h1D42)	No-flow-control bandwidth	NFC Bandwidth	0.00–4.00 (%)		0.00	O	p.152
PRT-67 (0h1D43)	No-flow-control detection time	NFC Det Time	1.0–60.0 (sec)		10.0	O	
PRT-68 (0h1D44)	No-flow-control release level	NFC Release Lev	0.0–100.0		30.0	O	
PRT-69 (0h1D45)	No-flow-control timer	NFC Timer	-		1.0	X	
PRT-70 (0h1D46)	Level detect mode selection	LDT Sel	0	None	0: None	O	p.190
			1	Warning			
			2	Trip&Coast			
			3	Decel Stop			
			4	RST Restart			
PRT-71 (0h1D47)	Level detect range setting	LDT Area Sel	0	Below Level	0: Below Level	O	
			1	Above Level			
PRT-72 (0h1D48)	Level detect source	LDT Source	0	Output Current	0: Output Current	O	
			1	DC Link Voltage			
			2	Output Voltage			
			3	kW			
			4	HP			
			5	V1			
			6	I1			
			7	V2			
			8	I2			
			9	Setpoint Value			
			10	Feedback Value			
			11	Torque Out LPF			
			12	V3			
			13	I3			
PRT-73 (0h1D49)	Level detect delay time	LDT DlyTime	0–9999 (sec)		2	O	
PRT-74 (0h1D4A)	Level detect standard set value	LDT Level	Source setting		Source setting	O	
PRT-75 (0h1D4B)	Level detect band width	LDT Band width	Source setting		Source setting	O	
PRT-76 (0h1D4C)	Level detect frequency	LDT Freq	0.00–High Freq (Hz)		20.00	O	
PRT-77 (0h1D4D)	Level detect trip restart time	LDT Restart DT	0.0–3000.0 (Min)		60.0	O	
PRT-79 (0h1D4F)	Cooling fan fault selection	Fan Trip Mode	0	Trip	1: Warning	O	p.307
			1	Warning			

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
PRT-80 (0h1D50)	Operation mode on optional card trip	Opt Trip Mode	0	None	1: Trip&Coast	O	p.309
			1	Trip&Coast			
			2	Decel Stop			
PRT-81 (0h1D51)	Low voltage trip decision delay time	LVT Delay	0.0–60.0 (sec)		0.0	Δ	p.308
PRT-82 (0h1D52)	Low voltage trip decision during operation	LV2 Trip Sel	0	No	0: No	Δ	
			1	Yes			
PRT-83 (0h1D53)	Remaining capacitor life diagnosis level	CAP.DiagPerc	10–100 (%)		0	O	p.311
PRT-84[74] (0h1D54)	Capacitor life diagnosis mode	CAP. Diag	0	None	0: None	Δ	
			1	Cap.Diag 1			
			2	Cap.Diag 2			
			3	Cap.Init			
PRT-85 (0h1D55)	Capacitor life diagnosis level 1	CAP. Level1	50.0–95.0 (%)		0.0	Δ	
PRT-86[75] (0h1D56)	Capacitor life diagnosis level 2	CAP. Level2	-		-	X	
PRT-87 (0h1D57)	Fan accumulated operating time operation %	Fan Time Perc	-		0.0	X	p.312
PRT-88 (0h1D58)	Fan replacement alarm level	Fan Exchange	0.0–100.0 (%)		0.0	O	
PRT-90 (0h1D5A)	Low battery voltage setting	Low Battery	0	None	0:None	O	p.305
			1	Warning			
PRT-91 (0h1D5B)	Setting the function of Broken belt	Broken Belt Sel	0	None	0:None	Δ	p.310
			1	Warning			
			2	Trip&Coast			
PRT-92 (0h1D5C)	Operating the frequency of Broken belt	Broken Belt Freq	15.00–MzxFreq		15.00	Δ	
PRT-93 (0h1D5D)	Motor torque current	Current Trq	-		0.0	X	
PRT-94 (0h1D5E)	Torque current of operating Broken belt	Broken Belt Trq	0.0–100.0%		10.0	Δ	
PRT-95 (0 h1D5F)	Delay of operating Broken belt	Broken Belt Dly	0–600.0[sec]		10.0	Δ	

74 PRT-84–86 is displayed when PRT-83 is set to more than "0(%)". PRT- 84 can only be set in Auto-State.

75 PRT-86 is read only.

8.14 Option Module Function Group (APO)

Data In the following table will be displayed only when the related code has been selected.

O : Write-enabled during operation, Δ: Write-enabled when stopped, X: Write disabled

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
APO-00 (-)	Jump code	Jump Code	1–99		14	O	p.60
APO-01[76] (0h1E01)	V3 input rate monitor	V3 Monitor[V]	-		0.00	X	
APO-02 (0h1E02)	V3 input filter time	V3 Filter	0–10000 (msec)		10	O	
APO-03 (0h1E03)	V3 minimum input voltage	V3 Volt x1	0.00–12.00 (V)		0.00	O	
APO-04 (0h1E04)	Output at V3 minimum voltage(%)	V3 Perc y1	0.00–100.00 (%)		0.00	O	
APO-05 (0h1E05)	V3 maximum input voltage	V3 Volt x2	0.00–12.00 (V)		10.00	O	
APO-06 (0h1E06)	Output at V3 maximum voltage(%)	V3 Perc y2	0.00–100.00 (%)		100.00	O	
APO-07 (0h1E07)	V3 Rotation direction options	V3 Inverting	0	No	0: No	O	
			1	Yes			
APO-08 (0h1E08)	V3 Quantizing level	V3 Quantizing	0.04–10.00 (%)		0.04	O	
APO-10[77] (0h1E0A)	I3 input monitor	I3 Monitor[mA]	-		0.00	X	
APO-11 (0h1E0B)	I3 input filter time	I3 Filter	0–10000		10	O	
APO-12 (0h1E0C)	I3 minimum input power supply	I3 Curr x1	4.00–20.00 (mA)		4.00	O	
APO-13 (0h1E0D)	Output at I3 minimum current(%)	I3 Perc y1	0.00–100.00 (%)		0.00	O	
APO-14 (0h1E0E)	I3 maximum input current	I3 Curr x2	0.00–24.00 (mA)		20.00	O	
APO-15 (0h1E0F)	Output at I3 maximum current(%)	I3 Perc y2	0.00–100.00 (%)		100.00	O	
APO-16 (0h1E10)	I3 rotation direction options	I3 Inverting	0	No	0: No	O	
			1	Yes			
APO-17 (0h1E11)	I2 Quantizing level	I3 Quantizing	0.04–10.00 (%)		0.04	O	

76 APO-01–08 are displayed when Extension IO option switch (SW2) is selected on V3.

77 APO-10–17 are displayed when Extension IO option switch (SW2) is selected on I3.

Code (Comm. Address)	Name	LCD Display	Setting Range		Initial Value	Property*	Ref.
APO-30 (0h1E1E)	Analog output3	AO3 Mode	0	Frequency	0: Frequency	O	
			1	Output Current			
			2	Output Voltage			
			3	DC Link Voltage			
			4	Output Power			
			7	Target Freq			
			8	Ramp Freq			
			9	Setpoint Value			
			10	Feedback Value			
			11	PID Output			
			12	Constant			
APO-31 (0h1E1F)	AO3 Gain	AO3 Gain	-1000.0–1000.0		100.0	O	
APO-32 (0h1E20)	AO3 Bias	AO3 Bias	-100.0–100.0 (%)		0.0	O	
APO-33 (0h1E21)	AO3 Filter	AO3Filter	0–10000 (msec)		5	O	
APO-34 (0h1E22)	AO3 Const %	AO3Const	0.0–100.0 (%)		0.0	O	
APO-35 (0h1E23)	AO3 Monitor	AO3Monitor	-		0.00	X	

8.15 Trip (TRIP Last-x) and Config (CNF) Mode

8.15.1 Trip Mode (TRP Last-x)

Code	Name	LCD Display	Setting Range		Initial Value	Ref.
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	
08	Trip time after Power on	Trip On Time	-		00/00/00 00: 00	
09	Trip time after operation start	Trip Run Time	-		00/00/00 00: 00	
10	Delete trip history	Trip Delete?	0	No	-	
			1	Yes		

8.15.2 Config Mode (CNF)

Code	Name	LCD Display	Setting Range		Initial Value	Ref.
CNF-00	Jump code	Jump Code	1–99		42	p.60
CNF-01	Keypad language selection	Language Sel	0: English		0: English	
CNF-02	LCD contrast adjustment	LCD Contrast	-		-	p.228
CNF-10	Inverter S/W version	Inv S/W Ver	-		-	
CNF-11	Keypad S/W version	KeypadS/W Ver	-		-	p.228
CNF-12	Keypad title version	KPD Title Ver	-		-	
CNF-20	Display item condition display window	Anytime Para	0	Frequency	0: Frequency	p.290
CNF-21	Monitor mode display 1	Monitor Line-1	1	Speed	0: Frequency	
CNF-22	Monitor mode display 2	Monitor Line-2	2	Output Current	2: OutputCurrent	

Code	Name	LCD Display	Setting Range		Initial Value	Ref.
CNF-23	Monitor mode display 3	Monitor Line-3	3	Output Voltage	3: OutputVoltage	
			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	Setpoint Value		
			19	Feedback Value		
			20	Now Date		
			21	Now Time		
			22	Now Weekday		
CNF-24	Monitor mode initialize	Mon Mode Init	0	No	0: No	
			1	Yes		
CNF-25	LCD Sleep Time	LCD Sleep Time	0-300 Min		0 Min	
CNF-30[78]	Option slot 1 type display	Option-1 Type	-		-	p.228
CNF-31	Option slot 2 type display	Option-2 Type	-		-	
CNF-32	Option slot 3 type display	Option-3 Type	-		-	
CNF-40	Parameter initialization	Parameter Init	0	No	0: No	p.222
			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		
			13	AP4 Grp		
			14	PRT Grp		

78 Please refer to the communication option manual for details.

Code	Name	LCD Display	Setting Range		Initial Value	Ref.
CNF-41	Display changed Parameter	Changed Para	0	View All	0: View All	p.224
			1	View Changed		
CNF-42	Multi key item	Multi Key Sel	0	None	2: RST	p.225
			1	UserGrpSelKey		
			2	RST		
			3	Now Time		
CNF-43	Macro function item	Macro Select	0	Basic	0: Basic	p.229
			1	Pressure Ctrl		
			2	Lead Lag Sel		
CNF-44	Trip history deletion	Erase All Trip	0	No	0: No	p.228
			1	Yes		
CNF-45	User registration code deletion	UserGrpAllDel	0	No	0: No	p.225
			1	Yes		
CNF-46	Read parameters	Parameter Read	0	No	0: No	p.221
			1	Yes		
CNF-47	Write parameters	Parameter Write	0	No	0: No	
			1	Yes		
CNF-48	Save parameters	Parameter Save	0	No	0: No	
			1	Yes		
CNF-50	Hide parameter mode	View Lock Set	0-9999		Un-locked	p.223
CNF-51	Password protection (hide parameters)	View Lock Pw	0-9999		Password	
CNF-52	Lock parameter edit	Key Lock Set	0–9999		Un-locked	p.223
CNF-53	Password for locking parameter edit	Key Lock Pw	0–9999		Password	
CNF-60	Additional title update	Add Title Up	0	No	0: No	p.228
			1	Yes		
CNF-61	Simple parameter setting	Easy Start On	0	No	1: Yes	p.226
			1	Yes		
CNF-62	Power consumption initialization	WHCount Reset	0	No	0: No	p.228
			1	Yes		
CNF-69	Flow accumulation total volume	Total Volume				
CNF-70	Accumulated inverter motion time	On-time	00000DAY 00:00		-	p.292
CNF-71	Accumulated inverter operation time	Run-time	00000DAY 00:00		-	
CNF-72	Accumulated inverter operation time initialization	Time Reset	0	No	0: No	
			1	Yes		

Code	Name	LCD Display	Setting Range		Initial Value	Ref.
CNF-73	Real Time[79]	Real Time	Date-Format			
CNF-74	Accumulated cooling fan operation time	Fan Time	00000DAY 00:00		-	p.292
CNF-75	Reset of accumulated cooling fan operation time	Fan Time Rst	0	No	0: No	
			1	Yes		

8.16 Macro Groups

The following table lists detailed parameter settings for each macro configuration.

8.16.1 Pressure control (MC1) Group

Macro Code	Code	LCD Display	Initial Value		Macro Code	Code	LCD Display	Initial Value	
MC1-0	-	Jump Code	1: CODE		MC1-1	DRV-3	Acc Time	0.75–90kW	10.0
								110–250kW	30.0
								315–750kW	50.0
MC1-2	DRV-4	Dec Time	0.75–90 kW	20.0	MC1-3	DRV-6	Cmd Source	1: Fx/Rx-1	
			110–250kW	60.0					
			315–750kW	100.0					
MC1-4	DRV-7	Freq Ref Src	0: Keypad-1		MC1-5	DRV-24	Hand Key Sel	0. None	
MC1-6	DRV-25	Hand Cmd Freq	-		MC1-7	DRV-26	HAND Ref Mode	-	
MC1-8	ADV-8	Stop Mode	-		MC1-9	DRV- 14	Motor Capacity	-	
MC1-10	BAS-10	60/50 Hz Sel	-		MC1-11	BAS-11	Pole Number	-	
MC1-12	BAS-12	Rated Slip	-		MC1-13	BAS-13	Rated Curr	-	
MC1-14	BAS-15	Motor Volt	1: Yes		MC1-15	ADV- 9	Run Prevent	2. Reverse Prev	
MC1-16	ADV-64	Fan Control	0. During Run		MC1-17	PID-1	PID Sel	1: Yes	
MC1-18	PID-10	PID SP 1 Src	0. Keypad		MC1-19	PID-11	PID SP 1 Set		
MC1-20	PID-20	PID Fdb Source	3. I2		MC1-21	PID-25	PID P-Gain 1	-	
MC1-22	PID-26	PID I-Time 1	-		MC1-23	PID-36	PID Out Inv	0. No	
MC1-24	PID-50	PID Unit Sel	2. PSI		MC1-25	PID-51	PID Unit Scale	1. x 10	
MC1-26	PID-53	PID Unit 100%	100.0		MC1-27	PID-54	RampPIRefAtRun	0. No	
MC1-28	PID-55	PID Acc/Dec Tm	60.00		MC1-29	PID-56	Pump Min Speed	30.00	
MC1-30	PID-57	WakeUpLev type	1. Deviation		MC1-31	PID-59	Sleep Lev Type	1. Output Frequency	
MC1-32	PID-62	PID Sleep 0 DT	10.0		MC1-33	PID-63	PID Sleep0Lev	0	
MC1-34	PID-64	PID WakeUp0 DT	10.0		MC1-35	PID-65	PID WakeUp0Lev	20.0	
MC1-36	AP2-40	Thrust Freq	0.00		MC1-37	AP2-41	Thrust Acc Tm	1.0	
MC1-38	AP2-42	Thrust Dec Tm	5.0		MC1-39	AP2-48	High Fdb Mode	2. Trip&Coast	

79 The date format can be changed according to AP3-06 settings.

Macro Code	Code	LCD Display	Initial Value	Macro Code	Code	LCD Display	Initial Value
MC1-40	AP2-49	High Fdb Time	5.0	MC1-41	AP2-50	High Fdb Level	95.0
MC1-42	AP2-51	Low Fdb Mode	2. Trip&Coast	MC1-43	AP2-52	Low Fdb Time	10.0
MC1-44	AP2-53	Low Fdb Level	0.0	MC1-45	PRT-8	RST Restart	00000011
MC1-46	PRT-9	Retry Number	5	MC1-47	PRT-11	Retry Delay	20
MC1-48	AP2-75	LostFbkMode	1. Yes	MC1-49	PRT-14	Lost Cmd Time	1.0
MC1-50	PRT-15	Lost Preset F	0.00	MC1-51	PRT-66	NFC Bandwidth	0.00
MC1-52	PRT-67	NFC Det Time	10.0	MC1-53	PRT-68	NFC ReleaseLev	3.00

8.16.2 Lead Lag selection (MC2) Group

Macro Code	Code	LCD Display	Initial Value	Macro Code	Code	LCD Display	Initial Value
MC2-0	-	Jump Code	1: CODE	MC2-1	COM-1	Int485 St ID	0
MC2-2	PID-1	PID Sel	1: Yes	MC2-3	AP1-40	Lead Lag Sel	3: Fixed Lag
MC2-4	AP1-49	ALT Sequence	0: FILO	MC2-5	AP1-56	Alternate Time	24:00 Min
MC2-6	AP1-58	Alt Timer Disp	0:00 Min	MC2-7	AP1-42	* of Pumps	5
MC2-8	AP1-94	* of Drives	5	MC2-9	DRV-3	Acc Time	20.00
MC2-10	DRV-4	Dec Time	20.00	MC2-11	AP1-50	Stage Pres. Dv	5.0
MC2-12	AP1-53	Stage DT	5.0	MC2-13	AP1-54	Destage DT	5.0
MC2-14	AP1-59	Destage Pres.	5.0	MC2-15	AP1-60	Lag Freq	60.00
MC2-16	AP1-61	Stage Freq 1	45.00	MC2-17	AP1-70	Destage Freq 1	40.00
MC2-18	AP1-43	Run Priority	1	MC2-19	AP1-44	Lag Pump Run	0
MC2-20	AP1-45	Curr. Prty 1	4321	MC2-21	AP1-46	Curr. Prty 2	0005
MC2-22	AP1-47	LeadLag Status	Manual	MC2-23	AP1-48	Lag Stop Sel	0: No
MC2-24	AP1-78	Datashare	100	MC2-25	AP1-79	All CommErr	1: Yes
MC2-26	AP1-88	Jockey Pump	0: No	MC2-28	AP1-89	Jockey Dly T	20.0
MC2-28	AP1-95	RunTimeMonitor	0: Pump 1	MC2-29	AP1-96	PmpRunTime Day	0
MC2-30	AP1-97	PmpRunTime Min	0:00	MC2-31	AP1-98	PmpRunTime Clr	0
MC2-32	PID-11	PID SP 1 Set	0.0	MC2-33	PID-20	PID Fdb Source	3: I2
MC2-34	PID-26	PID I-Time 1	2.0	MC2-35	PID-50	PID Unit Sel	2: PSI
MC2-36	PID-51	PID Unit Scale	1: X10	MC2-37	PID-53	PID Unit 100%	100.0
MC2-38	PID-60	Sleep Bst Set	0.00	MC2-39	PID-61	Sleep Bst Freq	0.00
MC2-40	PID-62	PID Sleep 0 DT	10.0	MC2-41	PID-63	PID Sleep0Lev	0.00
MC2-42	PID-64	PID WakeUp0 DT	10.0	MC2-43	PID-65	PID WakeUp0Lev	20.0
MC2-44	AP2-55	SP Timeout Sel	0: None	MC2-45	ADV-08	Stop Mode	2: Coast Stop
MC2-46	PID-31	PID Limit Lo	0.00				

9 Troubleshooting

This chapter explains how to troubleshoot a problem when inverter protective functions, fault trips, warning signals, or faults occur. If the inverter does not work normally after following the suggested troubleshooting steps, please contact the LS ELECTRIC customer service center.

9.1 Trip and Warning

When the inverter detects a fault, it stops the operation (trips) or sends out a warning signal. When a trip or warning occurs, the keypad displays the information briefly. Detailed information is shown on the LCD display. Users can read the warning message at PRT-90. When more than 2 trips occur at roughly the same time, the keypad displays the higher priority fault information. In the keypad, fault trips with higher priority are displayed first. Use the [Up], [Down], [Left] or [Right] cursor key on the keypad to view the fault trip information. The fault conditions can be categorized as follows

- Level: When the fault is corrected, the trip or warning signal disappears and the fault is not saved in the fault history.
- Latch: When the fault is corrected and a reset input signal is provided, the trip or warning signal disappears.
- Fatal: When the fault is corrected, the fault trip or warning signal disappears only after the user turns off the inverter, waits until the charge indicator light goes off, and turns the inverter on again. If the inverter is still in a fault condition after powering it on again, please contact the supplier or the LS ELECTRIC customer service center.

9.1.1 Fault Trips

Protection Functions for Output Current and Input Voltage

LCD Display	Type	Description
Over Load	Latch	Displayed when the motor overload trip is activated and the actual load level exceeds the set level. Operates when PRT-20 is set to a value other than '0'.
Under Load	Latch	Displayed when the motor underload trip is activated and the actual load level is less than the set level. Operates when PRT-27 is set to a value other than '0'.
Over Current1	Latch	Displayed when inverter output current exceeds 180% of the rated current.
Over Voltage	Latch	Displayed when internal DC circuit voltage exceeds the specified value.
Low Voltage	Level	Displayed when internal DC circuit voltage is less than the specified value.
Low Voltage2	Latch	Displayed when internal DC circuit voltage is less than the specified value during inverter operation.
Ground Trip	Latch	Displayed when a ground fault trip 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 a 3-phase inverter output has one or more phases in an open circuit condition. Operates when bit 1 of PRT-05 is set to '1'.
In Phase Open	Latch	Displayed when a 3-phase inverter input has one or more phases in an open circuit condition. Operates only when bit 2 of PRT-03 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 of Normal Duty(VT) for the inverter are 120% (–125HP) and 110% (150HP–) for 60 sec, 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'.

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 provided by 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	Displayed when the inverter output is blocked by a signal provided from the multi-function terminal. Set one of the multi-function input terminals at IN-65-71 to '5 (BX)' to enable input block function.
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. Set PRT-79 to '0' to activate fan trip (for models below 22 kW capacity).
InFan Trip	Latch	It occurs when an abnormality is detected in the cooling fan inside the inverter with inverter capacity of 110 kW to 750 kW. Selecting PRT - 79 code to 0 will activate fan trip.
Thermal Trip	Latch	Triggered when the input temperature is higher than the temperature set by the user in PRT-40 (ETH Trip Sel).
Lost KeyPad	Latch	Triggered when a communication error occurs between the keypad and the inverter, when the keypad is the command source, and PRT-12 (Lost KPD Mode) is set to any other value than '0'.
Fuse Open	Latch	If an input stage fuse breaks with an inverter of 315 kW or more, a fault will occur.

General Fault Trips

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 Check T) during a fan operation.
MMC Interlock	Latch	Triggered when AP1-55 is set to '2' and all auxiliary motors are interlocked during an MMC operation.
CleanRPTErr	Latch	Triggered when the pump clean operation is operated frequently. The conditions may be modified with theAP2-36–AP2-37 settings.
Pipe Broken	Latch	Triggered when a pipe is broken during the pump operation. Set PRT-60.
Level Detect	Latch	Triggered when the inverter output current or power is lower or higher than the values set by the user. Set the values at PRT-71–PRT-77.
Broken Belt	Latch	Triggered when PRT-91 is set to Free Run

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-13 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 there is a bad connection.
TB Trip	Latch	It occurs when the control terminal block (Terminal Bolck) is disconnected or the contact state is bad.
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 the communication option card is installed.

9.1.2 Warning Message

LCD Display	Description
Over Load	Displayed when a motor is overloaded. Set PRT-17 to '1' to enable. Set OUT-31–35 or OUT-36 to '5 (Over Load)' to receive the overload warning output signals.
Under Load	Displayed when the motor is underloaded. Set PRT-25 is to '1'. Set the digital output terminal or relay (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 the digital output terminals or relay (OUT-31–35 or OUT-36) to '6 (IOL)' to receive the inverter overload warning output signals.
Lost Command	Lost command warning alarm occurs even with PRT-13 set to '0'. The warning alarm occurs based on the condition set at PRT-14-16. Set the digital output terminals or relay (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'. Set the digital output terminals or relay (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-63.
Fire Mode	When there is a fire, Fire Mode forces the inverter to ignore certain fault trips and continue to operate. Set the digital output terminals or relay (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 the digital output terminals or relay (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-12 (Lost KPD Mode) is set to any other value than '0', and a run command is given from the keypad. Set the digital output terminals or relay (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.
CAP. Warning	Displayed when capacitor life expectancy level goes below the level set by the user. Set the digital output terminals or relay (OUT-31–35 or OUT-36) to '34 (CAPWarning)' to receive the capacitor life warning output signals.
Fan ExChange	Displayed when the cooling fans need replacing. Set the digital output terminals or relay (OUT-31–35 or OUT-36) to '35 (FanExChange)' to receive the fan replacement warning output signals.

LCD Display	Description
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 1 Warning.
Broken Belt	Displayed when PRT-91 is set to warning and the inverter becomes on the condition of broken belt.
Load Tune	Displayed when the values of 'AP2-03 and AP2-04' are more than the values of 'AP2-09 and AP2-10' and the function of load tuning is not normal.
PareWrite Fail	Displayed when the function of smart copier 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	Displayed for 1 sec when H.O.A. keypad is pushed, if [DRV-05 KPD H.O.A Lock] is set to lock HAND-OFF-AUTO keypad (0: Locked, 1: During Run, or 2: Off Key Enable).
InFan Warning	It occurs when an abnormality is detected in the cooling fan inside the inverter with inverter capacity of 110 kW to 750 kW.
Sleep	Indicates that PID operation standby (Sleep) mode is in place.
Backspin Time	Occurs while the Backspin Timer function is in operation.
DataShare	This occurs when parameters are shared between Master and Slave during Lead-Lag operation.
Int485 St ID	This occurs when an attempt is made to change the parameter when [COM- 01 Int485 St ID] is "0". ※When [CNF-43 Macro Select] is set to (2: Lead Lag Sel), [COM-01 Int485 St ID] becomes "0".
Low Flow Level	Occurs when the current flow rate is less than the set flow rate.
High Flow Lev	Occurs when the current flow rate is higher than the set flow rate.
Low Lev Detect	Displayed when [AP4-5: PI Aux Fbk Mon] falls below [AP4-13: Low Lev Detect]
HighLev Detect	Displayed when [AP4-5: PI Aux Fbk Mon] goes up to [AP4-17: High Lev Detect] or higher
Thrust Mode	It indicates that it is operating at Thrust Acc/Dec Time up to Thrust Frequency.
SetPnt Timeout	There is a large difference between the PID feedback and the Setpoint
Disable WakeUp	[PID-95 Disable WakeUp] Occurs when sleep conditions are met according to the settings, but sleep does not occur and operation is stopped.
Sys.Trip Check	Displayed when the drive has been stopped because another drive in the network has a system fault.
Sys. Sleep Chk	Displayed when the drive has been stopped because Master drive in the network is Sleep mode.
FBK : Ana▶Net	Analog feedback has not been detected and the network feedback value is now used.
Not Enabled	"Run Enable" is set to multi-function contact input(IN-65–73 : Run Enable) and the contact is open.

9.2 Troubleshooting Fault Trips

When a fault trip 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 or if there are load issues.
	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 (GD2 Flywheel effect).	Increase Acc/Dec time.
	The inverter load is greater than the rated capacity.	Replace the inverter with a model that has increased capacity.
	The motor was rotating when a run command is given.	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 (GD2 Flywheel effect).	Increase the acceleration time.
	A regenerative 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 protection is too low.	Set an appropriate electronic thermal 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.

Type	Cause	Remedy
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 or motor connection 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 link capacitor needs to be replaced.	Replace the DC link capacitor. Contact the retailer or the LS ELECTRIC 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 ℃.
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 LS ELECTRIC customer service center.
NTC Open	The ambient temperature is too low.	Keep the ambient temperature above -10℃.
	There is a fault with the internal temperature sensor.	Contact the retailer or the LS ELECTRIC 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.

9.3 Troubleshooting Other Faults

When a fault other than those identified as fault trips 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.

Type	Cause	Remedy
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.
	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] key is pressed.	Check that the stop state is normal, if so resume operation normally.
	Motor torque is too low.	Increase the volume 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 control panel side is incorrect.	Check the forward/reverse rotation wiring.
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.

Type	Cause	Remedy
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 volume 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 acceleration time is too long.	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.	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.
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 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.

Type	Cause	Remedy
Too much noise or malfunction of other control device is caused by interter's operation.	Noise occurs due to switching inside the inverter.	Change the carrier frequency to the minimum value, but it would increase audible noise.
		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.	The three phases of input voltage are not well 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 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 input filter time constant (IN-07). This is if DRV-07 is set 2: V1.
	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, if DC braking is enabled.	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.
	The load is too heavy.	Replace the inverter with a bigger 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. (ADV-64)

10 Technical Specification

10.1 Technical Specification

Three Phase 200 V (0.75–3.7 kW)

Model H100 XXXX–2 (PLUS)				0008	0015	0022	0037
Applied Motor	Heavy Duty		HP	0.5	1.0	2.0	3.0
			kW	0.4	0.75	1.5	2.2
	Normal Duty		HP	1.0	2.0	3.0	5.0
			kW	0.75	1.5	2.2	3.7
Rated output	Rated Capacity (kVA)			1.9	3.0	4.5	6.1
	Rated Current(A)	Three-Phase	HD	2.5	5.0	8.0	11.0
			ND	5	8	12	16
		Single-Phase(ND)		2.9	4.4	6.4	8.4
	Output Frequency			0–400 Hz			
	Output Voltage (V)			3-Phase 200–240 V			
Rated input	Working 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		50–60 Hz (±5%)			
	Rated Current (A)	HD		2.4	4.9	8.4	11.8
		ND		4.9	8.4	12.9	17.5
Weight (kg)				3.3	3.3	3.3	3.3

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 200 V inverters is based on a 220 V supply voltage, and 400 V inverters are based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 200 V (5.5–18.5 kW)

Model H100 XXXX–2 (PLUS)				0055	0075	0110	0150	0185
Applied Motor	Heavy Duty		HP	5	7.5	10	15	20
			kW	3.7	5.5	7.5	11	15
	Normal Duty		HP	7.5	10	15	20	25
			kW	5.5	7.5	11	15	18.5
Rated output	Rated Capacity (kVA)			8.4	11.4	16.0	21.3	26.3
	Rated Current (A)	Three-Phase	HD	17	24	32	46	60
			ND	22	30	42	56	69
		Single-Phase(ND)		11	16	23	30	37
	Output Frequency			0–400 Hz				
	Output Voltage (V)			3-Phase 200–240 V				

Model	H100 XXXX–2 (PLUS)		0055	0075	0110	0150	0185
Rated input	Working 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	50–60 Hz (±5%)				
	Rated Current (A)	HD	18.5	26.2	35.4	51.4	67.6
		ND	23.7	32.7	46.4	62.3	77.2
Weight (kg)			3.3	3.3	3.3	4.6	7.1

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 200 V inverters is based on a 220 V supply voltage, and 400 V inverters are based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 200 V (22–90 kW)

Model	H100 XXXX–2 (PLUS)			0220	0300	0370	0450	0550	0750	0900
Applied Motor	Heavy Duty		HP	25	30	40	50	60	75	100
			kW	18.5	22	30	37	45	55	75
	Normal Duty		HP	30	40	50	60	75	100	125
			kW	22	30	37	45	55	75	90
Rated output	Rated Capacity (kVA)			31.2	41.9	54.1	64.4	85	100.6	123.8
	Rated Current (A)	Three-Phase	HD	68	81	106	136	169	195	255
			ND	82	110	142	169	223	264	325
		Single-Phase(ND)		45	58	78	92	122	145	178
	Output Frequency			0–400 Hz						
	Output Voltage (V)			3-Phase 200–240 V						
Rated input	Working 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)		HD	62.1	74.4	97.9	128.0	160.0	185.7	245.7
			ND	74.8	101.0	131.2	159.0	211.1	251.4	313.2
Weight (kg)				25.3	32.9	39.2	41.1	53.6	55.3	72.2

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 200 V inverters are based on a 220 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 400 V (0.75–3.7 kW)

Model H100 XXXX–4 (PLUS)				0008	0015	0022	0037
Applied Motor	Heavy Duty		HP	0.5	1.0	2.0	3.0
			kW	0.4	0.75	1.5	2.2
	Normal Duty		HP	1.0	2.0	3.0	5.0
			kW	0.75	1.5	2.2	3.7
Rated output	Rated Capacity (kVA)			1.9	3.0	4.5	6.1
	Rated Current (A)	Three-Phase	HD	1.3	2.5	4	5.5
			ND	2.5	4	6	8
		Single-Phase(ND)		1.6	2.4	3.5	4.6
	Output Frequency			0–400 Hz			
	Output Voltage (V)			3-Phase 380–480 V			
Rated input	Working 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		50–60 Hz (±5%)			
	Rated Current (A)	HD		1.3	2.4	4.2	5.9
		ND		2.4	4.2	6.5	8.7
Weight (kg)				3.3	3.3	3.3	3.3

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 200 V inverters is based on a 220 V supply voltage, and 400 V inverters are based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 400 V (5.5–22 kW)

Model H100 XXXX–4 (PLUS)				0055	0075	0110	0150	0185	0220
Applied Motor	Heavy Duty		HP	5.0	7.5	10	15	20	25
			kW	3.7	5.5	7.5	11	15	18.5
	Normal Duty		HP	7.5	10	15	20	25	30
			kW	5.5	7.5	11	15	18.5	22
Rated output	Rated Capacity(kVA)			9.1	12.2	18.3	23.0	29.0	34.3
	Rated Current(A)	Three-Phase	HD	8	12	15	22	28	35
			ND	12	16	24	30	38	45
		Single-Phase(ND)		6.8	9.2	14	17	22	26
	Output Frequency			0–400 Hz					
	Output Voltage(V)			3-Phase 380–480 V					
Rated input	Working 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		50–60 Hz (±5%)					
	Rated Current(A)	HD		8.7	13.1	16.6	24.6	31.5	39.4
		ND		12.2	17.5	26.5	33.4	42.5	50.7

Model H100 XXXX–4 (PLUS)	0055	0075	0110	0150	0185	0220
Weight(kg)	3.3	3.3	3.4	4.6	4.8	7.5

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 200 V inverters is based on a 220 V supply voltage, and 400 V inverters are based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 400 V (30.0–90.0 kW)

Model H100 XXXX–4 (PLUS)				0300	0370	0450	0550	0750	0900
Applied Motor	Heavy Duty		HP	30	40	50	60	75	100
			kW	22	30	37	45	55	75
	Normal Duty		HP	40	50	60	75	100	125
			kW	30	37	45	55	75	90
Rated output	Rated Capacity (kVA)			46.5	57.1	69.4	82.0	108.2	128.8
	Rated Current (A)	Three-Phase	HD	41	55	67	81	106	136
			ND	61	75	91	107	142	169
		Single-Phase(ND)		36	39	45	50	73	86
	Output Frequency			0–400 Hz					
	Output Voltage (V)			3-Phase 380–480 V					
Rated input	Working 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	50–60 Hz (±5%)					
	Rated Current (A)		HD	46.7	52.3	64.5	78.0	100.9	134.1
			ND	69.1	69.3	84.6	100.1	133.6	160.0
Weight (kg)				7.5	26	35	35	43	43

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 400 V inverters is based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 400 V (110.0–750.0 kW)

Model H100 XXXX–4 (PLUS)			1100	1320	1600	1850	2200	2500	3150	3550	4000	5000	7500
Applied Motor	Heavy Duty	HP	125	150	200	250	250	300	400	450	500	650	900
		kW	90	110	132	160	185	220	250	315	355	400	600
	Normal Duty	HP	150	200	250	300	350	400	500	550	650	800	1000
		kW	110	132	160	185	220	250	315	355	400	500	750
Rated output	Rated Capacity (kVA)		170	201	248	282	329	367	467	520	587	733	914
	Rated Current (A)	HD	169	195	255	303	345	375	478	541	591	740	1090
		ND	223	264	325	370	432	481	613	683	770	962	1200
	Output Frequency		0–400 Hz										
	Output Voltage (V)		3-Phase 380–500 V										
Rated input	Working Voltage (V)	Three Phase	3-Phase 380–500VAC (-15%–+10%)										
	Input Frequency	Three Phase	50–60 Hz (±5%)										
	Rated Current (A)	HD	159.5	186.2	243.4	291.0	331.3	360.1	461.7	522.5	570.8	714.7	1075.1
		ND	215.1	254.6	315.3	358.9	419.1	469.3	598.1	666.4	751.3	938.6	1183.6
Weight (kg)			55.8	55.8	74.7	74.7	120.0	120.0	185.5	185.5	185.5	265	355

- The standard motor capacity is based on a standard 4-pole motor and is based on 3-phase
- The standard used for 200 V inverters is based on a 220 V supply voltage, and 400 V inverters are based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 600V (5.5–22 kW)

Model H100 XXXX–5 (PLUS)				0055	0075	0110	0150	0185	0220
Applied Motor	Heavy Duty		HP	5	7.5	10	15	20	30
			kW	3.7	5.5	7.5	11	15	18.5
	Normal Duty		HP	7.5	10	15	20	25	30
			kW	5.5	7.5	11	15	18.5	22
Rated output	Rated Capacity (kVA)			9.0	12.0	16.9	22.9	26.9	33.9
	Rated Current (A)	Three-Phase	HD	6.6	9.0	12.0	17.0	23.0	27.0
			ND	9.0	12.0	17.0	23.0	27.0	34.0
	Output Frequency			0–120 Hz (V/Hz, Slip Comp.)					
	Output Voltage (V)			3-Phase 0–575 V					
Rated input	Working Voltage (V)	Three-Phase		3-Phase 525-600 VAC (-15%–+10%)					
	Input Frequency	Three-Phase		50–60 Hz (±5%)					
	Rated Current (A)	HD		6	8.1	11	15.7	21.5	24.7
		ND		8.0	10.7	15.3	20.9	25.0	30.8
Weight (kg)				9.46	9.62	9.92	10.02	10.14	14.3

- The standard motor capacity is based on a standard 4-pole motor and is based on 3-phase
- The standard used for 200 V inverters is based on a 220 V supply voltage, 400 V inverters are based on a 440 V supply voltage, and 575 V inverters are based on a 575 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 600V (30.0–90.0 kW)

Model	H100 XXXX–5 (PLUS)			0300	0370	0450	0550	0750	0900
Applied Motor	Heavy Duty		HP	30	40	50	60	75	100
			kW	22	30	37	45	55	75
	Normal Duty		HP	40	50	60	75	100	125
			kW	30	37	45	55	75	90
Rated output	Rated Capacity (kVA)			42.8	54.8	63.7	79.7	103.6	127.48
	Rated Current (A)	Three-Phase	HD	34.0	43.0	55.0	64.0	80.0	104.0
			ND	43.0	55.0	64.0	80.0	104.0	128.0
	Output Frequency			0–120 Hz (V/Hz, Slip Comp.)					
	Output Voltage (V)			3-Phase 0–575 V					
Rated input	Working Voltage (V)	Three-Phase		3-Phase 525-600 VAC (-15%–+10%)					
	Input Frequency	Three-Phase		50–60 Hz (±5%)					
	Rated Current (A)	HD		32.2	41.6	52	60	80	104
		ND		40.2	52.0	59.8	73.9	101.9	122.4
Weight (kg)				14.66	24.98	33.62	33.68	43.6	43.74

- The standard motor capacity is based on a standard 4-pole motor and is based on 3-phase
- The standard used for 200 V inverters is based on a 220 V supply voltage, 400 V inverters are based on a 440 V supply voltage, and 575 V inverters are based on a 575 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

Three Phase 600 V (110.0–300.0 kW)

Model H100 XXXX–5 (PLUS)				1100	1320	1600	2000	2500	3000
Applied Motor	Heavy Duty		HP	125	150	200	250	300	350
			kW	90	110	132	160	200	250
	Normal Duty		HP	150	200	250	300	350	400
			kW	110	132	160	200	250	300
Rated output	Rated Capacity (kVA)			155	199	241	289	335	398
	Rated Current (A)	Three-Phase	HD	128.0	156.0	200.0	242.0	290.0	336.0
			ND	156.0	200.0	242.0	290.0	336.0	400.0
	Output Frequency			0–120 Hz (V/Hz, Slip Comp.)					
	Output Voltage (V)			3-Phase 0–575 V					
Rated input	Working Voltage (V)	Three-Phase		3-Phase 525-600 VAC (-15%–+10%)					
	Input Frequency	Three-Phase		50–60 Hz (±5%)					
	Rated Current (A)	HD		120.0	146.0	187.0	227.0	271.0	315.0
		ND		146.0	187.0	227.0	271.0	315.0	374.0
Weight (kg)				75	75	75	75	120	121

- The standard motor capacity is based on a standard 4-pole motor and is based on 3-phase
- The standard used for 600 V inverters are based on a 600 V supply voltage.
- The rated output current is limited based on the carrier frequency set at CON-04.

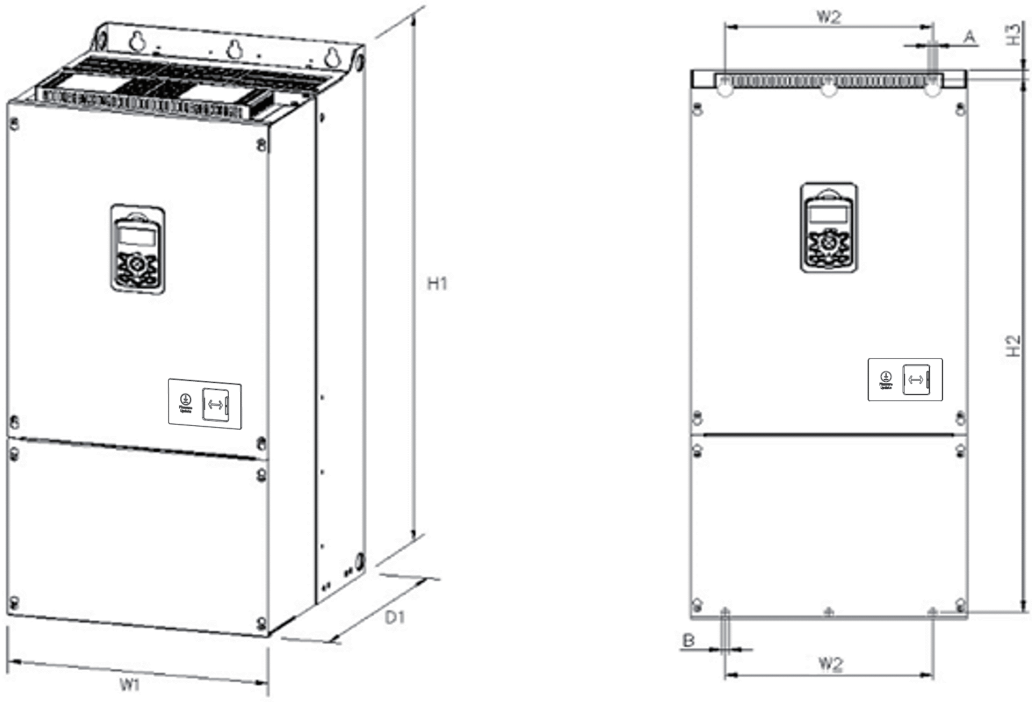
10.2 Product Specification Details

Items			Description	
Control	Control method		V/F control, Slip compensation.	
	Frequency settings power 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		0.75–90kW (200/400V)	Normal Duty 120% 1 min., Heavy Duty 150% 1 min.
			110–750kW (400V) 5.5–300kW (600V)	Normal Duty 110% 1 min., Heavy Duty 150% 1 min.
	Torque boost		Manual torque boost, automatic torque boost.	
Operation	Operation type		Select key pad, terminal strip, or communication operation.	
	Frequency settings		Analog type: -10–10 V, 0–10 V, 0–20 mA Digital type: key pad, pulse train input	
	Operation function		PID control 3-wire operation Frequency limit Second function Anti-forward and reverse direction rotation Commercial transition Speed search Leakage reduction	Up-down operation DC braking Frequency jump Slip compensation Automatic restart Automatic tuning Energy buffering Flux braking Energy Saving Power braking
	Input	Multi-function terminal (7EA) P1-P7	Select PNP (Source) or NPN (Sink) mode. Functions can be set according to IN-65- IN-71 codes and parameter settings.	
			Forward direction operation Reset Emergency stop Multi step speed frequency-high/med/low DC braking during stop 3-wire Select acc/dec/stop Frequency increase	Reverse direction operation External trip Jog operation Multi step acc/dec-high/med/low Second motor selection Frequency reduction Fix analog command frequency Transtion from PID to general operation Pre Heat Pump Cleaning RTC(Time Event) MMC Interlock
		Pulse train	0–32 kHz, Low Level: 0–0.8 V, High Level: 3.5–12 V	
	Output	Multi-function open collector terminal	Fault output and inverter operation status output	Less than DC 26 V, 50 mA
		Fault signal relay terminal		N.O.: Less than AC 250 V 2A, DC 30 V, 3A N.C.: Less than AC 250 V 1A, DC 30 V 1A
		Multi-function relay terminal		Less than AC 250 V, 5 A Less than DC 30 V, 5 A
		Analog output	0–12 Vdc(0–20 mA): Select frequency, output current, output voltage, DC terminal voltage, and others.	
		Pulse train	Maximum 32 kHz, 0–12 V	

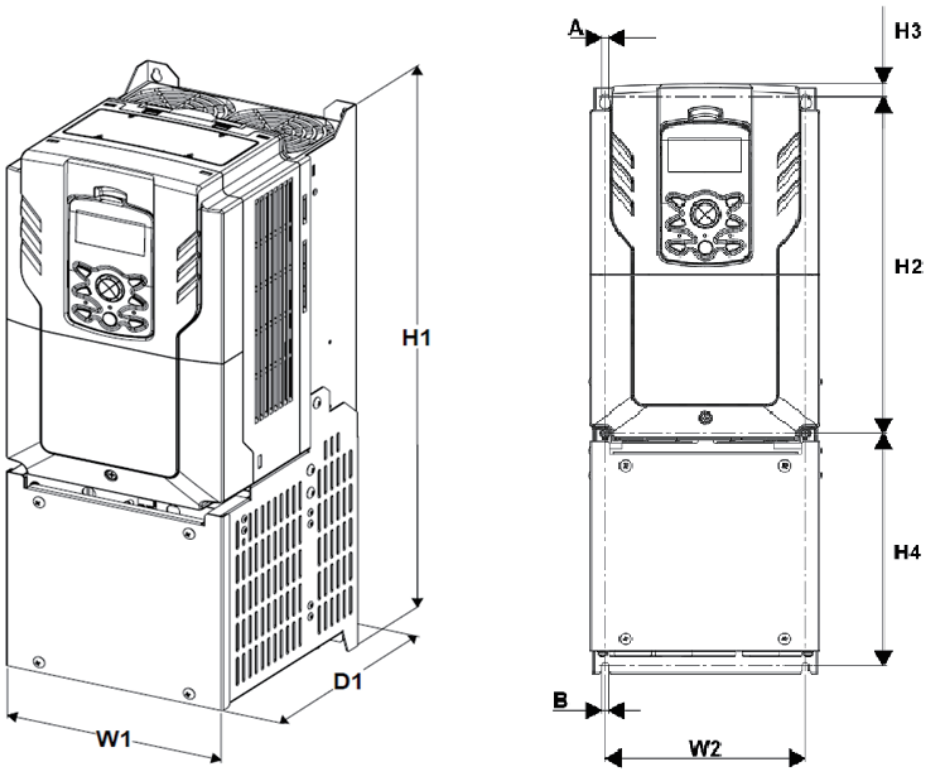
Items		Description		
Protection function	Trip	Over current trip External signal trip ARM short circuit current trip Over heat trip Input imaging trip Ground trip Motor over heat trip I/O board link trip No motor trip Parameter writing trip Emergency stop trip MMC Interlock trip PumpCleannig trip CPU watchdog trip	Over voltage trip Temperature sensor trip Inverter over heat Option trip Output imaging trip Inverter overload trip Fan trip Low voltage trip during operation Low voltage trip Analog input error Motor overload trip Pipe broken trip Keypad command lost trip Damper trip Level Detect trip External memory error Motor under load trip Command loss trip	
	Alarm	Command loss trip alarm, overload alarm, normal load alarm, inverter overload alarm, fan operation alarm, resistance braking rate alarm, Capacitor life alarm, Pump Clean alarm, Fire Mode Alarm, LDT Alarm.		
	Instantaneous blackout	Less than 8 ms: Continue Operation (must be within the rated input voltage and rated output range) More than 8 ms: Auto restart operation		
Structure/ working environment	Cooling type	Forced fan cooling structure		
	Protection structure	- IP 20 (0.75–90kW-2, 0.75–185kW-4/5) - IP 00 (220–750kW-4, 250/300kW-5) - UL Open & Enclosed Type 1 (option) (UL Enclosed Type 1 is satisfied by conduit installation option.) - 5.5–30kW-5 products are basically equipped with Conduit. - ETL (110-750kW-4) • Front: IP21 • Backside: IP54 / Type 12 Enclosure		
	Ambient temperature	Normal Duty	-10 °C–50 °C 2.5% current derating is applied above 40 °C. (For 220-750 kW-4, a 1.0% current derating is applied for each 1 °C from 40 °C to 45 °C, and a 2.0% current derating is applied for each 1 °C above 45 °C. The inverter must be operated at less than 75% of its rated capacity when the ambient temperature exceeds 50 °C.) No ice or frost should be present.	
		Heavy Duty	0.75–90kW	-10 °C–50 °C without derating
			110–750kW	Same as Normal Duty
	Ambient humidity	Relative humidity less than 95% RH (to avoid condensation forming)		
	Storage temperature.	-20 °C-65 °C (-4–149 °F)		
	Surrounding environment	Prevent contact with corrosive gases, inflammable gases, oil stains, dust, and other pollutants. (0.75–750kW Pollution Degree 2 Environment)		
	Operation altitude	Maximum 3,280 ft (1,000m) above sea level for standard operation. After that the driver rated voltage and the rated output current derating by 1% for every extra 328 ft (100m) up to 13,123 ft (4,000m).		
	Operation oscillation	Less than 1.0 G (9.8 m/sec^2). (750kW-4 is based on IEC 61800-5-1)		
	Pressure	70-106 kPa		

10.3 External Dimensions

0.75–18.5 kW-2, 0.75–30 kW-4 (3-phase)

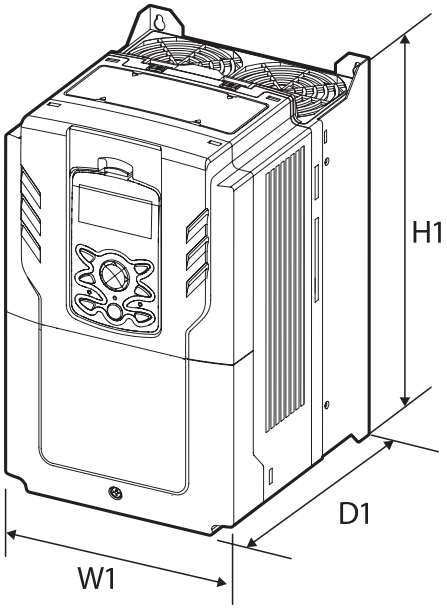


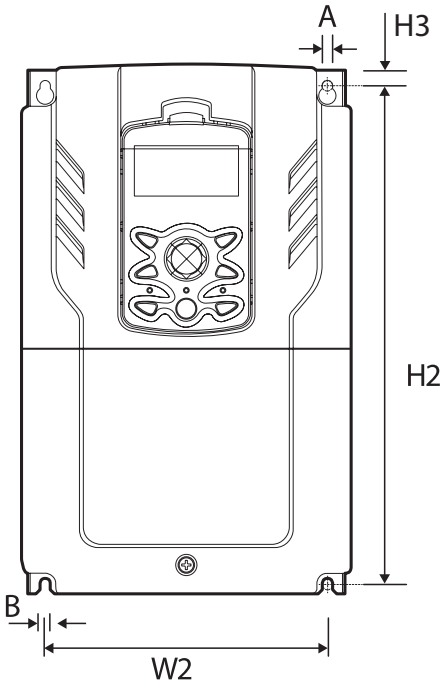
5.5–30 kW-5 (3-phase)



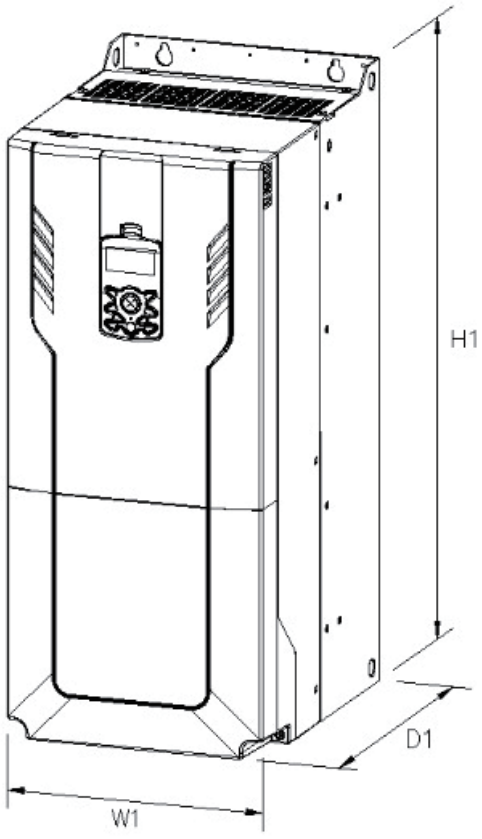
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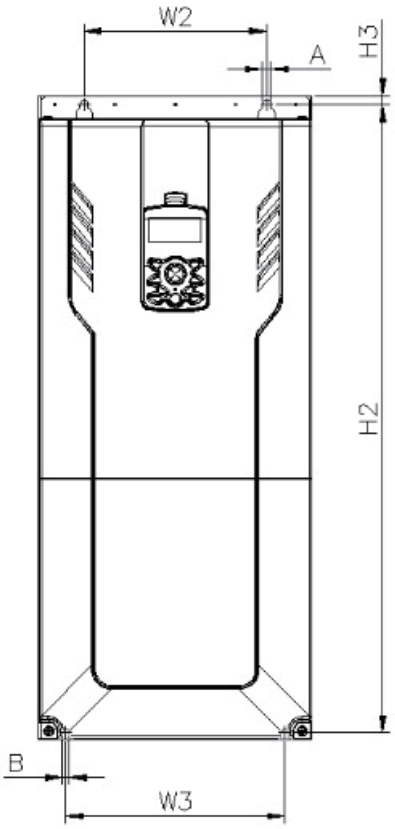
22–45 kW-2, 37–90 kW-4/5 (3-phase)



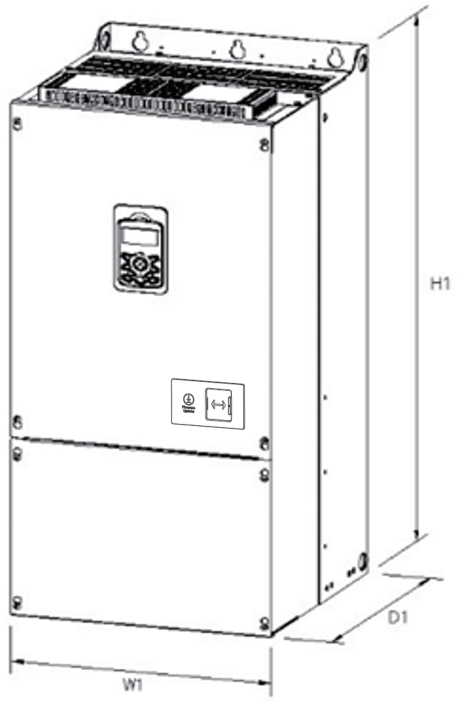


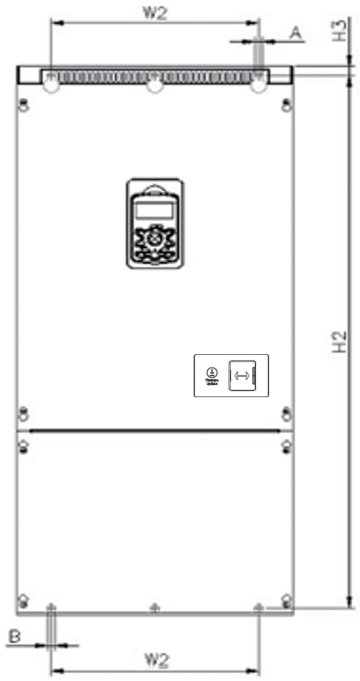
55–90 kW-2, 110–185 kW-4, 110–200 kW-5 (3-phase)





220–750 kW-4, 250–300 kW-5 (3-phase)





Units : mm

Items		W1	W2	W3	H1	H2	H3	H4	D1	A	B	Φ
3-phase 200 V	0008H100-2	160	137	-	232	216.5	10.5	-	181	5	5	-
	0015H100-2	160	137	-	232	216.5	10.5	-	181	5	5	-
	0022H100-2	160	137	-	232	216.5	10.5	-	181	5	5	-
	0037H100-2	160	137	-	232	216.5	10.5	-	181	5	5	-
	0055H100-2	160	137	-	232	216.5	10.5	-	181	5	5	-
	0075H100-2	160	137	-	232	216.5	10.5	-	181	5	5	-
	0110H100-2	160	137	-	232	216.5	10.5	-	181	5	5	-
	0150H100-2	180	157	-	290	273.7	11.3	-	205.3	5	5	-
	0185H100-2	220	193.8	-	350	331	13	-	223.2	6	6	-
	0220H100-2	275	232	-	450	428.5	14	-	284	7	7	-
	0300H100-2	325	282	-	510	486.5	16	-	284	7	7	-
	0370H100-2	325	275	-	550	524.5	16	-	309	9	9	-
	0450H100-2	325	275	-	550	524.5	16	-	309	9	9	-
	0550H100-2	300	200	240	706	688.5	9.5	-	386	9	9	-
	0750H100-2	300	200	240	706	688.5	9.5	-	386	9	9	-
	0900H100-2	380	300	300	705	685.5	9.5	-	396	9	9	-
3-phase 400 V	0008H100-4	160	137	-	232	216.5	10.5	-	181	5	5	-
	0015H100-4	160	137	-	232	216.5	10.5	-	181	5	5	-
	0022H100-4	160	137	-	232	216.5	10.5	-	181	5	5	-
	0037H100-4	160	137	-	232	216.5	10.5	-	181	5	5	-
	0055H100-4	160	137	-	232	216.5	10.5	-	181	5	5	-

Items		W1	W2	W3	H1	H2	H3	H4	D1	A	B	Φ
3-phase 400 V	0075H100-4	160	137	-	232	216.5	10.5	-	181	5	5	-
	0110H100-4	160	137	-	232	216.5	10.5	-	181	5	5	-
	0150H100-4	180	157	-	290	273.7	11.3	-	205.3	5	5	-
	0185H100-4	180	157	-	290	273.7	11.3	-	205.3	5	5	-
	0220H100-4	220	193.8	-	350	331	13	-	223.2	6	6	-
	0300H100-4	220	193.8	-	350	331	13	-	223.2	6	6	-
	0370H100-4	275	232	-	450	428.5	14	-	284	7	7	-
	0450H100-4	325	282	-	510	486.5	16	-	284	7	7	-
	0550H100-4	325	282	-	510	486.5	16	-	284	7	7	-
	0750H100-4	325	275	-	550	524.5	16	-	309	9	9	-
	0900H100-4	325	275	-	550	524.5	16	-	309	9	9	-
	1100H100-4	300	200	240	706	688.5	9.5	-	386	9	9	-
	1320H100-4	300	200	240	706	688.5	9.5	-	386	9	9	-
	1600H100-4	380	300	300	705	685.5	9.5	-	396	9	9	-
	1850H100-4	380	300	300	705	685.5	9.5	-	396	9	9	-
	2200H100-4	426	320	-	922.3	895.5	15.5	-	440	11	11	-
	2500H100-4	426	320	-	922.3	895.5	15.5	-	440	11	11	-
	3150H100-4	600	420	-	1000	972	15	-	500	14	14	-
	3550H100-4	600	420	-	1000	972	15	-	500	14	14	-
	4000H100-4	600	420	-	1000	972	15	-	500	14	14	-
	5000H100-4	776	500	-	1054	1021	20	-	500	14	14	-
	7500H100-4	776	660	-	1300	1267	20	-	500	14	14	-
3-phase 600 V	0055H100-5	180	157	-	480	273.7	11.3	189	205.3	5	5	-
	0075H100-5	180	157	-	480	273.7	11.3	189	205.3	5	5	-
	0110H100-5	180	157	-	480	273.7	11.3	189	205.3	5	5	-
	0150H100-5	180	157	-	480	273.7	11.3	189	205.3	5	5	-
	0185H100-5	180	157	-	480	273.7	11.3	189	205.3	5	5	-
	0220H100-5	220.8	193.8	-	550	331	13	189	223.2	6	6	-
	0300H100-5	220.8	193.8	-	550	331	13	200	223.2	6	6	-
	0370H100-5	275	232	-	450	428.5	14	-	284	7	7	-
	0450H100-5	325	282	-	510	486.5	16	-	284	7	7	-
	0550H100-5	325	282	-	510	486.5	16	-	284	7	7	-
	0750H100-5	325	275	-	550	524.5	16	-	309	9	9	-
	0900H100-5	325	275	-	550	524.5	16	-	309	9	9	-
	1100H100-5	380	300	300	705	685.5	9.5	-	396	9	9	-
	1320H100-5	380	300	300	705	685.5	9.5	-	396	9	9	-
	1600H100-5	380	300	300	705	685.5	9.5	-	396	9	9	-
	2000H100-5	380	300	300	705	685.5	9.5	-	396	9	9	-
	2500H100-5	426	320	-	922.3	895.5	15.5	-	440	11	11	-
	3000H100-5	426	320	-	922.3	895.5	15.5	-	440	11	11	-

Units : inches

Items		W1	W2	W3	H1	H2	H3		D1	A	B	Φ
3-phase 200 V	0008H100-2	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0015H100-2	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0022H100-2	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0037H100-2	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0055H100-2	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0075H100-2	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0110H100-2	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0150H100-2	7.09	6.18	-	11.42	10.78	0.45	-	8.08	0.2	0.2	-
	0185H100-2	8.66	7.63	-	13.78	13.03	0.51	-	8.79	0.24	0.24	-
	0220H100-2	10.83	9.13	-	17.72	16.87	0.55	-	11.18	0.28	0.28	-
	0300H100-2	12.80	11.1	-	20.08	19.15	0.63	-	11.18	0.28	0.28	-
	0370H100-2	12.8	10.83	-	21.65	20.65	0.63	-	12.17	0.35	0.35	-
	0450H100-2	12.80	10.83	-	21.65	20.65	0.63	-	12.17	0.35	0.35	-
	0550H100-2	11.81	7.87	9.45	27.8	27.11	0.37	-	15.20	0.35	0.35	-
	0750H100-2	11.81	7.87	9.45	27.8	27.11	0.37	-	15.20	0.35	0.35	-
	0900H100-2	14.96	11.81	11.81	27.76	26.99	0.37	-	15.59	0.35	0.35	-

Items		W1	W2	W3	H1	H2	H3		D1	A	B	Φ
3-Phase 400 V	0008H100-4	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0015H100-4	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0022H100-4	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0037H100-4	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0055H100-4	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0075H100-4	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0110H100-4	6.3	5.39	-	9.13	8.52	0.41	-	7.13	0.2	0.2	-
	0150H100-4	7.09	6.18	-	11.42	10.78	0.45	-	8.08	0.2	0.2	-
	0185H100-4	7.09	6.18	-	11.42	10.78	0.45	-	8.08	0.2	0.2	-
	0220H100-4	8.66	7.63	-	13.78	13.03	0.51	-	8.79	0.24	0.24	-
	0300H100-4	8.66	7.63	-	13.78	13.03	0.51	-	8.79	0.24	0.24	-
	0370H100-4	10.83	9.13	-	17.72	16.87	0.55	-	11.18	0.28	0.28	-
	0450H100-4	12.8	11.1	-	20.08	19.15	0.63	-	11.18	0.28	0.28	-
	0550H100-4	12.8	11.1	-	20.08	19.15	0.63	-	11.18	0.28	0.28	-
	0750H100-4	12.8	10.83	-	21.65	20.65	0.63	-	12.17	0.35	0.35	-
	0900H100-4	12.8	10.83	-	21.65	20.65	0.63	-	12.17	0.35	0.35	-
	1100H100-4	11.81	7.87	9.45	27.8	27.11	0.37	-	15.2	0.35	0.35	-
	1320H100-4	11.81	7.87	9.45	27.8	27.11	0.37	-	15.2	0.35	0.35	-
	1600H100-4	14.96	11.81	11.81	27.76	26.99	0.37	-	15.59	0.35	0.35	-
	1850H100-4	14.96	11.81	11.81	27.76	26.99	0.37	-	15.59	0.35	0.35	-
	2200H100-4	16.77	12.6	-	36.31	35.26	0.61	-	17.32	0.43	0.43	-
	2500H100-4	16.77	12.6	-	36.31	35.26	0.61	-	17.32	0.43	0.43	-
	3150H100-4	23.62	16.54	-	39.37	38.27	0.59	-	19.69	0.55	0.55	-
	3550H100-4	23.62	16.54	-	39.37	38.27	0.59	-	19.69	0.55	0.55	-
	4000H100-4	23.62	16.54	-	39.37	38.27	0.59	-	19.69	0.55	0.55	-
	5000H100-4	30.55	19.69	-	41.5	40.2	0.79	-	19.69	0.55	0.55	-
	7500H100-4	30.55	25.98	-	51.18	49.88	0.79	-	19.69	0.55	0.55	-

Items		W1	W2	W3	H1	H2	H3		D1	A	B	Φ
3-phase 600 V	0055H100-5	7.09	6.18	-	18.9	10.78	0.45	7.44	8.08	0.2	0.2	-
	0075H100-5	7.09	6.18	-	18.9	10.78	0.45	7.44	8.08	0.2	0.2	-
	0110H100-5	7.09	6.18	-	18.9	10.78	0.45	7.44	8.08	0.2	0.2	-
	0150H100-5	7.09	6.18	-	18.9	10.78	0.45	7.44	8.08	0.2	0.2	-
	0185H100-5	7.09	6.18	-	18.9	10.78	0.45	7.44	8.08	0.2	0.2	-
	0220H100-5	8.69	7.63	-	21.65	13.03	0.51	7.44	8.79	0.24	0.24	-
	0300H100-5	8.69	7.63	-	21.65	13.03	0.51	7.87	8.79	0.24	0.24	-
	0370H100-5	10.83	9.13	-	17.72	16.87	0.55	7. 87	11.18	0.28	0.28	-
	0450H100-5	12.8	11.1	-	20.08	19.15	0.63	-	11.18	0.28	0.28	-
	0550H100-5	12.8	11.1	-	20.08	19.15	0.63	-	11.18	0.28	0.28	-
	0750H100-5	12.8	10.83	-	21.65	20.65	0.63	-	12.17	0.35	0.35	-
	0900H100-5	12.8	10.83	-	21.65	20.65	0.63	-	12.17	0.35	0.35	-
	1100H100-5	14.96	11.81	11.81	27.76	26.99	0.37	-	15.59	0.35	0.35	-
	1320H100-5	14.96	11.81	11.81	27.76	26.99	0.37	-	15.59	0.35	0.35	-
	1600H100-5	14.96	11.81	11.81	27.76	26.99	0.37	-	15.59	0.35	0.35	-
	2000H100-5	14.96	11.81	11.81	27.76	26.99	0.37	-	15.59	0.35	0.35	-
	2500H100-5	16.77	12.6	-	36.31	35.26	0.61	-	17.32	0.43	0.43	-
	3000H100-5	16.77	12.6	-	36.31	35.26	0.61	-	17.32	0.43	0.43	-

10.4 Peripheral Devices

Compatible Circuit Breaker, Leakage Breaker and Magnetic Contactor Models (manufactured by LS ELECTRIC)

⚠ Warning

• Install appropriate branch circuit protection based on required local codes and the user manual.

• The device is suitable for use on a circuit capable of delivering not more than 100kA, 240Vac maximum(200V class), 480 Vac maximum(400V class) and 600 Vac maximum(600V class) when protected by branch circuit protection devices specified in this manual.

Product (kW)		Circuit Breaker				Leakage Breaker		Magnetic Contactor	
		UL unapplied		UL applied		UL unappliednote[1]		UL appliednote[2]	
		Model	Rated Current	Model	Rated Current	Model	Rated Current	Model	Rated Current
3-Phase 200 V	0.75	ABS33c	15	MMS32H	8	EBS33c	15	MC-9a	11
	1.5		15		13		15	MC-18a	18
	2.2		30		22		30	MC-32a	32
	3.7		30		26		30	MC-32a	32
	5.5	ABS53c	50		40	EBS53c	50	MC-50a	55
	7.5	ABS63c	60	MMS63H	50	EBS63c	60	MC-65a	65
	11	ABS103c	100	MMS 100H	75	EBS103c	100	MC-85a	85
	15		100		100			MC-130a	130
	18.5	ABS103c	100		100	EBS103c	100	MC-130a	130
	22	ABS203c	175	UTS250	150	EBS203c	200	MC-150a	150
	30		175		150		200	MC-150a	150
	37		225		225		225	MC-225a	225
	45		250		250		250	MC-265a	265
	55	ABS603c	500	UTS600	500	EBS603c	500	MC-400a	400
	75		500		500		500	MC-400a	400
	90		630		600		630	MC-630a	630

Product (kW)		Circuit Breaker				Leakage Breaker		Magnetic Contactor	
		UL unapplied		UL applied		UL unappliednote[1]		UL appliednote[2]	
		Model	Rated Current	Model	Rated Current	Model	Rated Current	Model	Rated Current
3-Phase 400 V	0.75	ABS33c	10	UTS150	40	EBS33c	10	MC-6a	9
	1.5		10		40		10	MC-6a	9
	2.2		15		40		15	MC-9a	11
	3.7		15		40		15	MC-12a	13
	5.5		30		40	EBS33c	30	MC-22a	22
	7.5		30		40		30	MC-32a	32
	11	ABS53c	50		40	EBS53c	50	MC-50a	50
	15	ABS63c	60		50		50		50
	18.5	ABS103c	100		70	EBS103c	100	MC-85a	85
	22	ABS103c	100		80		100		85
	30	ABS103c	100		100		100	MC-100a	100
	37	ABS203c	175	UTS250	150	EBS203c	200	MC-150a	150
	45	ABS203c	175		150		200		150
	55	ABS203c	175		150		200		150
	75	ABS203c	225		225	EBS203c	225	MC-225a	225
	90	ABS203c	250		250		250	MC-265a	265
	110	ABS603c	500	UTS600	500	EBS603c	500	MC-400a	400
	132	ABS603c	600		600	EBS603c	630	MC-400a	400
	160	ABS603c	630		600	EBS603c	630	MC-630a	630
	185	ABS803c	800	UTS800	800	EBS803c	800	MC-630a	630
	220	ABS803c	800		800	EBS803c	800	MC-800a	800
	250	ABS1003b	1000		800	EBS1003b	1000	MC-800a	800
	315	ABS1203b	1200	UTS1200	1200	EBS1203b	1200	MC-1260a	1260
	355	ABS1203b	1200		1200	EBS1203b	1200	MC-1260a	1260
	400	-	1600		1600				
	500	-	1600		1600				
	750	-	1600	RLF36160 CU33A	1600	-	-	-	-

Product (kW)		Circuit Breaker				Leakage Breaker		Magnetic Contactor	
		UL unapplied		UL applied		UL unappliednote[1]		UL appliednote[2]	
		Model	Rated Current	Model	Rated Current	Model	Rated Current	Model	Rated Current
3-Phase 600 V	5.5	ABS33c	15	3VA6160-0HL31-0AA0	60	-	-	MC-22b	18
	7.5	ABS33c	20			-	-	MC-32a	20
	11	ABS53c	30			-	-	MC-50a	28
	15	ABS53c	40			-	-	MC-65a	35
	18.5	ABS53c	50			-	-	MC-85a	45
	22	ABS63c	60			-	-	MC-100a	65
	30	ABS103c	75	3VA6110-0HL31-0AA0	100	-	-	MC-150a	60
	37	ABS103c	100			-	-	MC-150a	60
	45	ABH103c	125	3VA6115-0HL31-0AA0	150	-	-	MC-185a	120
	55	ABH203c	150			-	-	MC-225a	150
	75	ABH203c	200	3VA6225-0HL31-0AA0	250	-	-	MC-265a	185
	90	ABH203c	250			-	-	MC-265a	185
	110	ABH203c	250	3VA6340-0HL31-0AA0	400	-	-	MC-330a	220
	132	ABL403c	300			-	-	MC-400a	300
	160	ABL403c	400			-	-	MC-500a	380
	200	ABL603c	500			-	-	MC-500a	380
	250	ABL603c	500	3VA6460-0HL31-0AA0	600	-	-	MC-630a	420
	300	ABL603c	630			-	-	MC-800a	630

* In the case of inverter 400-750 kW, there is no Circuit Brake capacity qualified as UL standard.

* Refer to local and national codes for proper circuit breaker sizing.

* If you want to use UL Type products, please use that ACB product.

* Note1) LS Leakage Breaker does not have a separate UL certified product.

* Note2) When using a magnetic contactor non-UL product, please use LS Susol Type(MC-9(9A)–MC-95(95A).

Maximum allowed prospective short-circuit current at the input power connection is defined in IEC 60439-1 as 100 kA. LSLV-H100+ is suitable for use in a circuit capable of delivering not more than 100kA RMS at the drive's maximum rated voltage, depending on the selected MCCB. RMS symmetrical amperes for recommended MCCB are the following table.

Working Voltage	UTE100 (E/N)	UTS150 (N/H/L)	UTS250 (N/H/L)	UTS400 (N/H/L)
240V(50/60Hz)	50/65kA	65/100/150kA	65/100/150kA	65/100/150kA
480V(50/60Hz)	25/35kA	35/65/100kA	35/65/100kA	35/65/100kA

Working Voltage	ABS33c	ABS53c	ABS63c	ABS103c	ABS203c	ABS403c
240V(50/60Hz)	30kA	35kA	35kA	85kA	85kA	75kA
480V(50/60Hz)	7.5kA	10kA	10kA	26kA	26kA	35kA

Working Voltage	3VA6110-0HL31-0AA0	3VA6115-0HL31-0AA0	3VA6225-0HL31-0AA0	3VA6340-0HL31-0AA0	3VA6460-0HL31-0AA0
600V(60Hz)	100kA	100kA	100kA	100kA	100kA

Working Voltage	ABS33c	ABS53c	ABS63c	ABS103c	ABH103c	ABH203c
600V(60Hz)	2.5kA	5kA	5kA	8kA	10kA	10kA

Working Voltage	ABL403c	ABL603c
600V(60Hz)	14kA	14kA

10.5 Fuse and Reactors Specifications

Products(kW)		AC Input Fuse		AC reactor		DC Reactor	
		Current (A)	Voltage (V)	Inductance (mH)	Current (A)	Inductance (mH)	Current (A)
3-Phase 200 V	0.75	10	600[V]	2.02	5	4.04	5
	1.5	10		1.26	8	2.53	8
	2.2	15		0.78	12	1.68	12
	3.7	20		0.59	16	1.26	16
	5.5	50		0.43	24	0.93	25
	7.5	63		0.31	33	0.73	32
	11	80		0.22	46	0.53	50
	15	100		0.16	62	0.32	62
	18.5	125		0.13	77	0.29	80
	22	125		-	-	Built-In	
	30	200		-	-		
	37	250		-	-		
	45	350		-	-		
	55	350		-	-		
	75	400		-	-		
	90	450		-	-		

Products(kW)		AC Input Fuse		AC reactor		DC Reactor	
		Current (A)	Voltage (V)	Inductance (mH)	Current (A)	Inductance (mH)	Current (A)
3-Phase 400 V	0.75	10	600[V]	8.09	2.5	16.17	3
	1.5	10		5.05	4	10.11	4
	2.2	15		3.37	6	6.74	6
	3.7	20		2.25	9	5.05	8
	5.5	32		1.56	13	3.56	13
	7.5	35		1.16	17	2.53	18
	11	50		0.76	27	1.64	26
	15	63		0.61	33	1.42	33
	18.5	70		0.48	43	0.98	42
	22	100		0.40	51	0.88	50
	30	125		0.29	69	0.59	68
	37			0.29	69	Built-In	
	45	160		0.24	85		
	55	200		0.20	100		
	75	250		0.15	134		
	90	350		0.13	160		
	110	350		0.1	217		
	132	400		0.08	257		
	160	450		0.07	318		
	185	550		0.06	362		
	220	630		0.05	423		
	250	700		0.05	474		
	315	800		0.04	604		
	355	1000		0.03	673		
	400	1100		0.03	759		
	500	1250		0.03	948		
	750	1600	700[V]	0.023	1175		

Products(kW)		AC Input Fuse		AC reactor		DC Reactor	
		Current (A)	Voltage (V)	Inductance (mH)	Current (A)	Inductance (mH)	Current (A)
3-phase 600 V	5.5	15	600[V]	-	-	Built-In	
	7.5	20		-	-		
	11	30		-	-		
	15	40		-	-		
	18.5	50		-	-		
	22	60		-	-		
	30	80		-	-		
	37	110		-	-		
	45	125		-	-		
	55	150		-	-		
	75	200		-	-		
	90	250					
	110	300					
	132	350					
	160	400					
	200	500					
	250	600					
	300	800		-	-		

10.6 Terminal Screw Specifications

Input/Output Termianl Screw Specification

Product (kW)		Terminal Screw Size	Screw Torque (Kgf·cm/Nm)
3-Phase 200 V	0.75	M4	12.2–14.3 / 1.2–1.4
	1.5		
	2.2		
	3.7		
	5.5		
	7.5		
	11		
	15	M5	25.3 / 2.5
	18.5		
	22	M8	56.1–67.3 / 5.5–6.6
	30		
	37		
	45		
	55	M10	89.7–122.0 / 8.8–11.96
	75		
	90	M12	182.4–215.0 / 17.87–21.07

Product (kW)		Terminal Screw Size	Screw Torque (Kgf·cm/Nm)
3-Phase 400 V	0.75	M4	12.2–14.3 / 1.2–1.4
	1.5		
	2.2		
	3.7		
	5.5		
	7.5		
	11		
	15	M5	25.3 / 2.5
	18.5		
	22		
	30		
	37	M8	56.1–67.3 / 5.5–6.6
	45		
	55		
	75		
	90		
	110	M10	89.7–122.0 / 8.8–11.96
	132		
	160	M12	182.4–215.0 / 17.87–21.07
	185		
	220		
	250		
	315	M8 X 2 M12 X 1	61.2–91.8 / 6–9 182.4–215.0 / 17.87–21.07
	355		
	400		
	500	M10 X 2 M16 X 1	89.7–122.0 / 8.8–11.96 490.9–511.0 / 48.05–50.11
	750	M12 X 2	182.4–215.0 / 17.87–21.07

Product (kW)		Terminal Screw Size	Screw Torque (Kgf·cm/Nm)
3-Phase 600V	5.5	M5	25.3 / 2.5
	7.5		
	11		
	15		
	18.5		
	22		
	30		
	37	M8	56.1–67.3 / 5.5–6.6
	45		
	55		
	75		
	90		
	110	M12	182.4–215.0 / 17.87–21.07
	132		
	160		
	200		
	250		
	300		

Control Circuit Terminal Screw Specification

Terminal	Terminal Screw Size	Screw Torque (Kgf·cm/Nm)
P1–P7/CM/VR/V1/I2/AO/Q1/ EG/24/TI/ TO/SA,SB,SC/S+,S-,SG,A1/B1/C1	M3	2.2–2.5 / 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 malfuctions. 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.

Attention

Appliquer des couples de marche aux vis des bornes. Des vis desserrées peuvent provoquer des courts-circuits et des dysfonctionnements. Ne pas trop serrer la vis, car cela risque d'endommager les bornes et de provoquer des courts-circuits et des dysfonctionnements. Utiliser uniquement des fils de cuivre avec une valeur nominale de 600 V, 90 °C pour le câblage de la borne d'alimentation, et une valeur nominale de 300 V, 75 °C pour le câblage de la borne de commande.

10.7 Dynamic Braking Unit (DBU) and Resistors

10.7.1 Dynamic Braking Unit (DBU) and Resistors

UL form	Type	Voltage	Capacity of applied motor	Braking unit	Terminal arrangement &Dimensions
UL type	Type A (Resistance of DB Resistor refer to the table of "11.7.6 DB Resistors")	200V	30, 37 kW	SV370DBU-2U	Refer to the appearance of Group 1.
			45, 55 kW	SV550DBU-2U	
			75 kW	SV370DBU-2U, 2Set	
		400V	37 kW	SV370DBU-4U	
			45, 55 kW	SV550DBU-4U	
			75 kW	SV750DBU-4U	
			90 kW	SV550DBU-4U, 2Set	
			110, 132kW	SV750DBU-4U, 2Set	
			160kW	SV750DBU-4U, 3Set	
Non UL type	Type B (Resistance of DB Resistor refer to the manual of DB Unit)	200V	30, 37 kW	SV037DBH-2	Refer to the appearance of Group 2
		400V	37 kW	SV037DBH-4	
			45, 55, 75 kW	SV075DBH-4	
				SV075DB-4	Refer to the appearance of Group 3
			185, 220kW	SV2200DB-4	Refer to the appearance of Group 4
			250–355kW	SV2200DB-4, 2Set	
	Type C (Resistance of DB Resistor refer to the manual of DB Unit)	200V	30, 37 kW	LSLV0370DBU-2LN	Refer to the appearance of Group 5
				LSLV0370DBU-2HN	Refer to the appearance of Group 6
			45, 55, 75 kW	LSLV0750DBU-2LN	Refer to the appearance of Group 5
				LSLV0750DBU-2HN	Refer to the appearance of Group 6
		400V	37 kW	LSLV0370DBU-4LN	Refer to the appearance of Group 5
				LSLV0370DBU-4HN	Refer to the appearance of Group 6
			45, 55, 75kW	LSLV0750DBU-4LN	Refer to the appearance of Group 5
			90 kW	LSLV0900DBU-4HN	Refer to the appearance of Group 6
			110, 132kW	LSLV1320DBU-4HN	
			160kW	LSLV1600DBU-4HN	
			185, 220kW	LSLV2200DBU-4HN	
			250–355kW	LSLV2200DBU-4HN, 2Set	
			400, 500kW	LSLV2200DBU-4HN, 2Set	
			750kW	LSLV2200DBU-4HN, 3Set	

Note

- It is not necessary to use option type dynamic braking unit for H100+ 0.75–18.5kW(200V) and 0.75–30kW(400V) because basically the dynamic braking unit is built in.
- You must refer to dynamic braking unit manual for usage recommended dynamic braking unit in the table above due to changeable table.
- Resistance/watt/braking torque/%ED of DB Resistor for Type A DB Unit refer to the table of "11.7.6 DB Resistors" and Resistance of DB Resistor for type B and C refer to the manual of DB Unit.

10.7.2 Terminal Arrangement

Group 1:

P	N	G	B1	B2

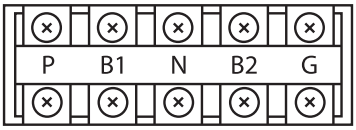
Group 2:

G	N	B2	P/B1

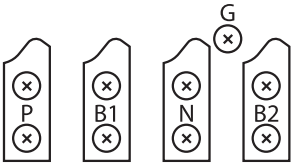
Terminals	Functions
G	Ground Terminal
B2	Terminal for connection with B2 of DBU
B1	Terminal for connection with B1 of DBU
N	Terminal for connection with N of Inverter
P	Terminal for connection with P1 of Inverter

* Note: READ DBU User manual certainly when selecting DB resistors.

Group 3:

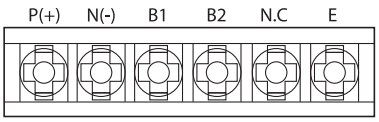


Group 4:



Terminals	Functions
G	Ground Terminal
B2	Terminal for connection with B2 of DBU
B1	Terminal for connection with B1 of DBU
N	Terminal for connection with N of Inverter
P	Terminal for connection with P of Inverter

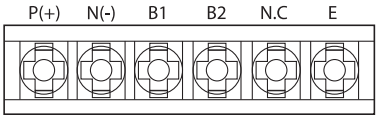
Group 5:



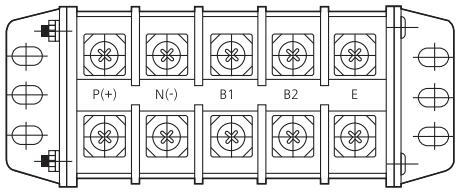
Terminals	Functions
P(+)	Terminal for connection with P of Inverter
N(-)	Terminal for connection with N of Inverter
B1	Terminal for connection with B1 of DBU
B2	Terminal for connection with B2 of DBU
N.C	Unused
E	Ground Terminal

Group6:

A Frame (37kW, 75kW-4)



B /C Frame (75kW-2, 90–220kW)

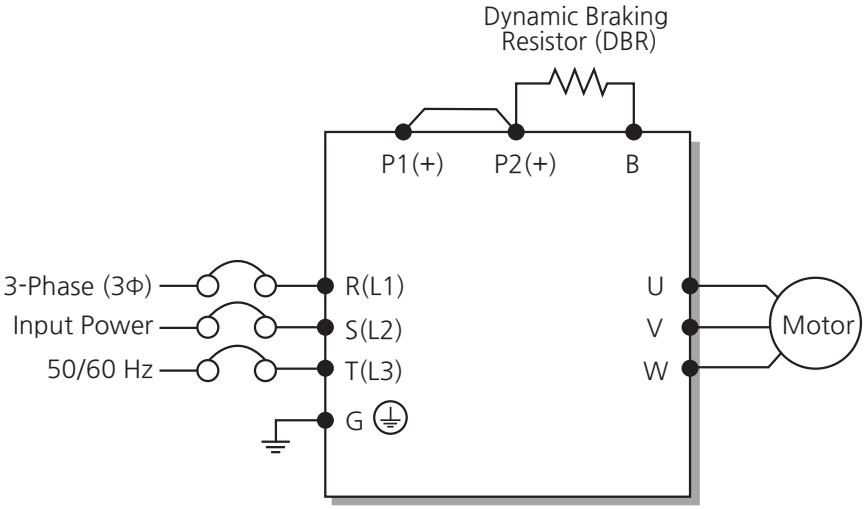


Terminals	Functions
P(+)	Terminal for connection with P of Inverter
N(-)	Terminal for connection with N of Inverter
B1	Terminal for connection with B1 of DBU
B2	Terminal for connection with B2 of DBU
E	Unused

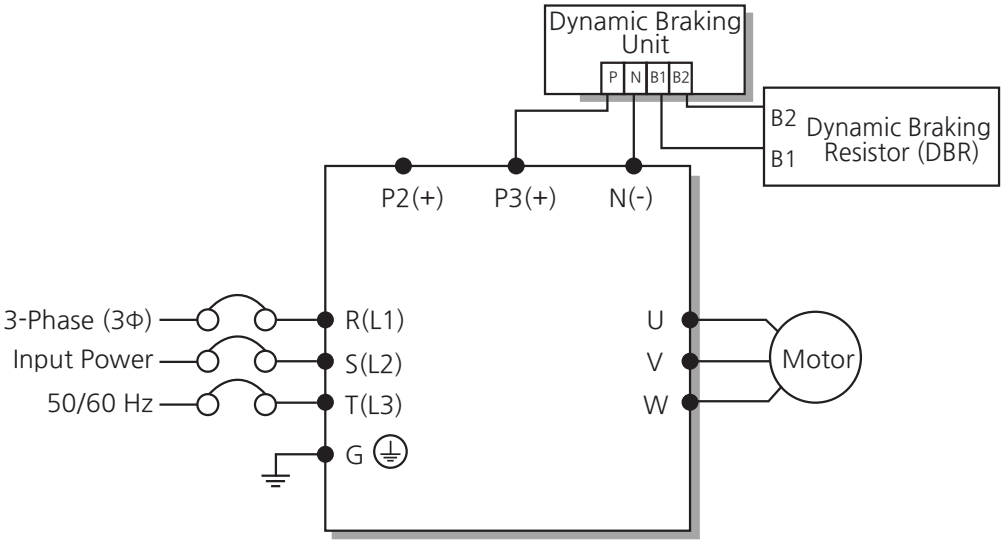
Note
You must refer to dynamic braking unit manual for choice the brake resistor to use the dynamic braking unit.

10.7.3 Dynamic Braking (DB)Unit & DB Resistor Basic Wiring

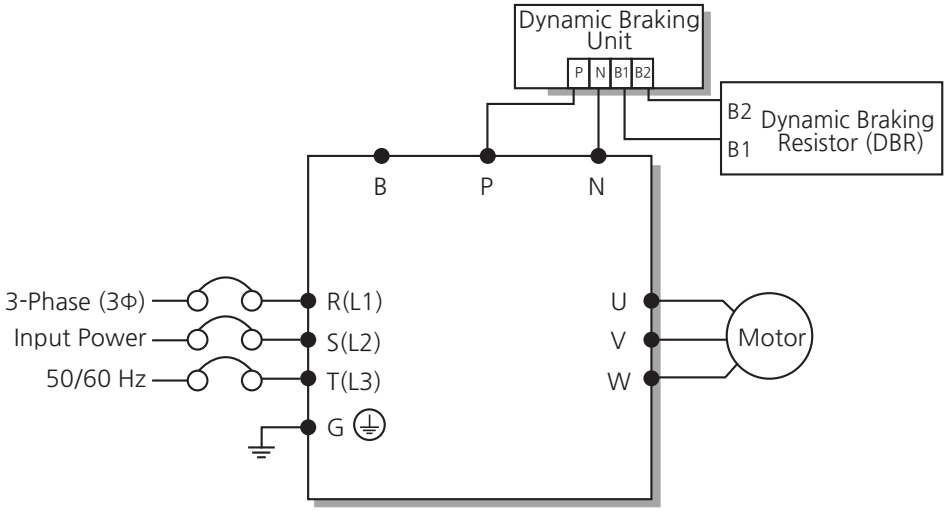
0.75–18.5kW 200V, 0.75–30kW 400V, 5.5–30kW 600V



22–45kW 200V, 37–90kW 400V, 37kW–90kW 600V



55–90kW 200V, 110–750kW 400V, 110–300kW 600V



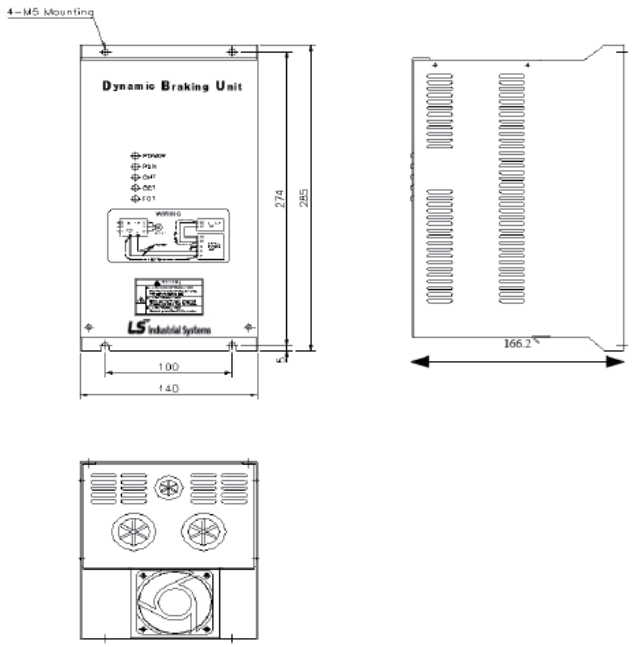
DBU Terminals	Description
B1,B2	Wire correctly referring to wiring diagram. DB Resistors connect with B1, B2 of DB Unit.

In case of large capacity, it may be necessary to connect more than 2 sets of DB Unit according to the usage environment.

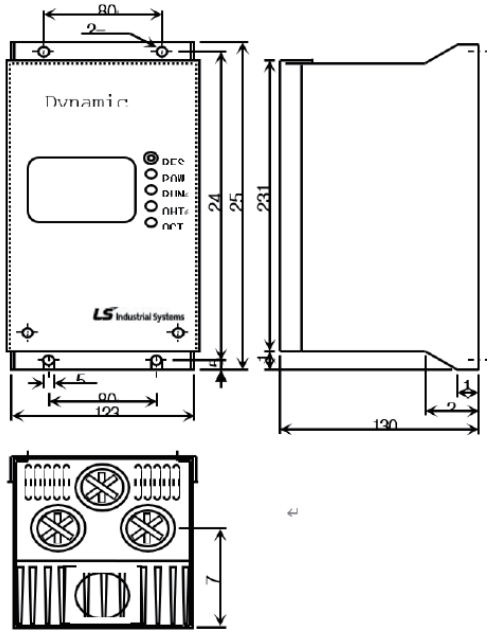
In such cases, check the DB Unit manual.

10.7.4 Dimensions

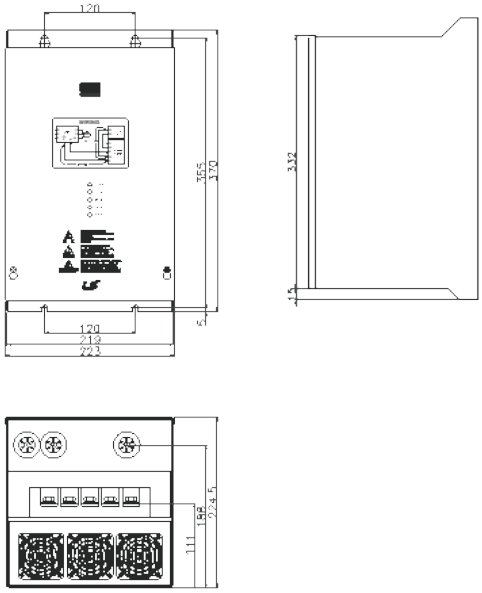
Group1



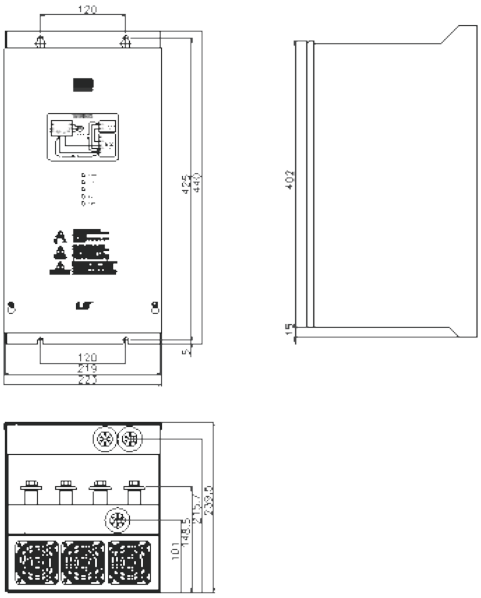
Group2



Group3

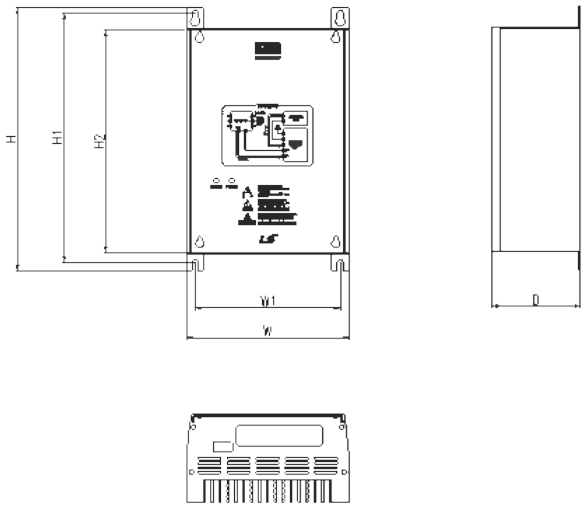


Group4



Voltage	Capacity of applied motor	Dimension (mm)				Hole position for installation (mm)		Weight	Hole size for installation
(V)	(kW)	W	H	H2	D	W1	H1	(kg)	(f)
220	15	140	227.4	192	76.4	125	215.4	1.50	M4
	22							1.55	
	37							1.57	
	75							1.84	
440	15							1.53	
	22							1.55	
	37							1.56	
	75							1.85	

Group5



FRAME	Voltage	Capacity of applied motor	%ED	Dimension (mm)				Hole position for installation (mm)		Weight	Hole size for installation
				W	H	H2	D	W1	H1	(Kg)	(f)
A Frame	220 [V]	37 [kW]	50	200	219	190	165.2	160	208.5	3.77	M6
	440 [V]	37 [kW]	50							3.84	
		75 [kW]	50							3.98	
B Frame	220 [V]	75 [kW]	50	215	340	311		175	329.5	8.26	
		90 [kW]	50							8.48	
	440 [V]	90 [kW]	50							8.30	
		132 [kW]	50							8.40	
C Frame	440 [V]	160 [kW]	50	240	380	351		200	369.5	9.40	
		220 [kW]	50							9.70	

10.7.5 Display Functions

DB Resistors connect with B1, B2 of DB Unit. DBU has 3 LEDs. Red LED which is located in middle displays supplying main power, one Green LED which is right side displays under braking and another green LED which is left side displays Over Heat Trip(OHT).

Displays	Function description
POWER (Red LED)	POWER LED is turned On when main power is supplied. Generally, POWER LED is turn On while main power supplied because DBU is connected with inverter.
RUN (Green LED)	RUN LED is turned off while DBU is ON by regenerative energy of Motor.
OHT (Green LED)	Under Braking, if the temperature is exceeded over setting value due to over heat of Heatsink, Cut the TURN ON signal of DBU and LED is turn on by working overheat protection function.

10.7.6 DB Resistors

Product (kW)		DB unit	Torque 100%			Torque 150%		
			Resistor (Ω)	Wattage [W] (%ED=5%)	Wattage [W] (%ED=10%)	Resistor (Ω)	Wattage [W] (%ED=5%)	Wattage [W] (%ED=10%)
3-Phase 200 V	0.75	-	200	100	200	150	150	300
	1.5	-	100	200	400	60	300	600
	2.2	-	60	300	600	50	400	800
	3.7	-	40	500	1000	33	600	1200
	5.5	-	33	600	1200	20	800	1600
	7.5	-	20	800	1600	15	1200	2400
	11	-	15	1200	2400	10	2400	4800
	15	-	10	2400	4800	8	2400	4800
	18.5	-	8	2400	4800	6	2600	5200
	22	DBU-U	7	2400	4800	5	3600	7200
	30	DBU-U	5	3600	7200	3	6000	12000
	37	DBU-U	4	4800	9600	3	6000	12000
	45	DBU-U	3	6000	12000	2	9600	19200
	55	DBU-U	3	6000	12000	2	9600	19200
	75	DBU-U	2	9600	19200	1.5	12000	24000
	90	DBU-U	2	9600	19200	1	18000	36000

Product (kW)		DB unit	Torque 100%			Torque 150%		
			Resistor (Ω)	Wattage [W] (%ED=5%)	Wattage [W] (%ED=10%)	Resistor (Ω)	Wattage [W] (%ED=5%)	Wattage [W] (%ED=10%)
3-Phase 400 V	0.75	-	900	100	200	600	150	300
	1.5	-	450	200	400	300	300	600
	2.2	-	300	300	600	200	400	800
	3.7	-	200	400	800	130	600	1200
	5.5	-	120	700	1400	85	1000	2000
	7.5	-	90	1000	2000	60	1200	2400
	11	-	60	1200	2400	40	2000	4000
	15		45	2000	4000	32	2400	4800
	18.5	-	35	2400	4800	20	3600	7200
	22	-	30	2400	4800	20	3600	7200
	30	-	20	3600	7200	16	5000	10000
	37	DBU-U	16.9	3200	6400	-	-	-
		DBH	16.9	3200	6400	12	5000	10000
		LSLV-DB	16.9	3200	6400	12	5000	10000
	45	DBU-U	11.4	4800	9600	-	-	-
		DBH	11.4	4800	9600	10	6400	12800
		LSLV-DB	11.4	4800	9600	10	6400	12800
	55	DBU-U	11.4	4800	9600	-	-	-
		DBH	11.4	4800	9600	8.4	7200	14400
		LSLV-DB	11.4	4800	9600	8.4	7200	14400
	75	DBU-U	8.4	6400	12800	-	-	-
		DBH	8.4	6400	12800	6	10000	20000
		DB	8.4	6400	12800	6	10000	20000
	90	LSLV-DB	6	10000	20000	5	13000	26000
	110	LSLV-DB	5	13000	26000	4	16000	32000
	132	LSLV-DB	4	16000	32000	3.4	20000	40000
	160	LSLV-DB	3.4	20000	40000	2.8	24000	48000
	185	LSLV-DB	2.8	24000	48000	2.4	26000	52000
	220	LSLV-DB	2.4	26000	52000	2	30000	60000
	250	132kW DB Unit and Resistor * 2 Set (Parallel)						
	315	160kW DB Unit and Resistor * 2 Set (Parallel)						
	355	185kW DB Unit and Resistor * 2 Set (Parallel)						
	400	220kW DB Unit and Resistor * 2 Set (Parallel)						
	500	185kW DB Unit and Resistor * 3 Set (Parallel)						
	750	220kW DB Unit and Resistor * 4 Set (Parallel)						

Product (kW)		DB unit	Torque 100%			Torque 150%		
			Resistor (Ω)	Wattage [W] (%ED=5%)	Wattage [W] (%ED=10%)	Resistor (Ω)	Wattage [W] (%ED=5%)	Wattage [W] (%ED=10%)
3-Phase 600 V	5.5	Built-In	160	700	1400	100	1100	2200
	7.5		120	900	1800	80	1400	2800
	11		80	1400	2800	54	2000	4000
	15		60	1800	3600	40	2700	5400
	18.5		48	2400	4800	32	3400	6800
	22	-	40	2800	5600	27	4000	8000
	30	-	30	3600	7200	20	5400	10800
	37	-	24	4500	9000	16	6800	13600
	45	-	20	5400	10800	13	8400	16800
	55	-	16	6800	17600	11	10000	20000
	75	-	12	9000	18000	8	14000	28000
	90	-	10	11000	22000	6.5	17000	34000
	110	-	8.2	13200	26400	5.6	20000	40000
	132	-	6.8	16000	32000	4.7	23000	46000
	160	-	5.6	20000	40000	3.9	28000	56000
	200	-	4.7	23000	46000	3.0	36000	72000
	250	-	3.6	30000	60000	2.4	45000	90000
	300	-	3.0	36000	72000	2.0	54000	108000

Note

- It is not necessary to use option type dynamic braking unit for H100+ 0.75–18.5kW (200V), 0.75–30kW (400V) and 5.5–18.5kW (600V) because basically the dynamic braking unit is built in.
- The resistance/rated capacity/braking torque/%ED of DB Resistor are valid only for the DB unit of type A and the values of DB Resistor for type B and C refer to the manual of DB Unit.
- Rating Watt of DBU has to be doubled when %ED is doubled.

10.8 Inverter Continuous Rated Current Derating

Derating by carrier frequency

The continuous rated current of the inverter is limited based on the carrier frequency. Refer to the following graph.

<200V : 0.75-90kW>

Item	Unit	200 V [kW]			
		0.75-18.5	22-30	37-45	55-90
fND/HDDefault	kHz	3	3	3	2
fND/HDMax	kHz	15	10	7	5
fND100%carr	kHz	3	3	3	2
fHD100%carr	kHz	6	6	4	2

Item	Unit	200 V [kW]			
		0.75-18.5	22-30	37-45	55-90
fND/HD DR1%carr	kHz	8	-	-	-
fND/HD DR2%carr	kHz	15	10	7	5
ND_DR1	%	70	-	-	-
ND_DR2	%	60	60	55	76
HD_DR1	%	-	-	-	-
HD_DR2	%	72 68 (18.5kW)	70	70	70

* $f_{ND/HD}$100%carr : Carrier frequency for continued operation

* $f_{ND/HD}$DR1%carr : Carrier frequency where the first current derating ends.

* $f_{ND/HD}$DR2%carr : Carrier frequency where the second current derating ends.

* $f_{ND/HD}$Max : The maximum carrier frequency

<400V : 0.75-750kW>

Item	Unit	400 V [kW]							
		0.75-30	37-55	75-90	110-185	220/250	315/355	400/500	750
fND/HDDefault	kHz	3	3	3	2	2	2	2	2
fND/HDMax	kHz	15	10	7	5	5	5	4	4
fND100%carr	kHz	3	3	3	3	3	2	2	2
fHD100%carr	kHz	6	6	4	3	2	2	2	2
fND/HD DR1%carr	kHz	8	-	-	-	-	-	-	3
fND/HD DR2%carr	kHz	15	10	7	5	5	5	4	4
ND_DR1	%	65	-	-	-	-	-	-	87
ND_DR2	%	55 50 (30k W)	60	55	86	80	80	80	73
HD_DR1	%	-	-	-	-	-	-	-	92
HD_DR2	%	66	70	70 66 (90kW)	62	65	65	65	74

* $f_{ND/HD}$100%carr : Carrier frequency for continued operation

* $f_{ND/HD}$DR1%carr : Carrier frequency where the first current derating ends.

* $f_{ND/HD}$DR2%carr : Carrier frequency where the second current derating ends.

* $f_{ND/HD}$Max : The maximum carrier frequency

<600V : 5.5-300kW>

Item	Unit	600 V [kW]					
		5.5-22	30	37-55	75-90	110-200	250-300
$f_{ND/HD}$Default	kHz	2.3	2.3	2.3	2.3	2	2
$f_{ND/HD}$Max	kHz	15	10	10	7	4	4
f_{ND}100%carr	kHz	3	3	3	2.3	2	2
f_{HD}100%carr	kHz	5	3	3	2.3	2	2
$f_{ND/HD}$ DR1%carr	kHz	10	-	-	-	-	-
$f_{ND/HD}$ DR2%carr	kHz	15	10	10	7	4	4
ND_DR1	%	55	-	-	-	-	-
ND_DR2	%	30	55	60	60 50 (90kW)	75	60
HD_DR1	%	55	-	-	-	-	-
HD_DR2	%	30	55	70	60 50 (90kW)	75	60

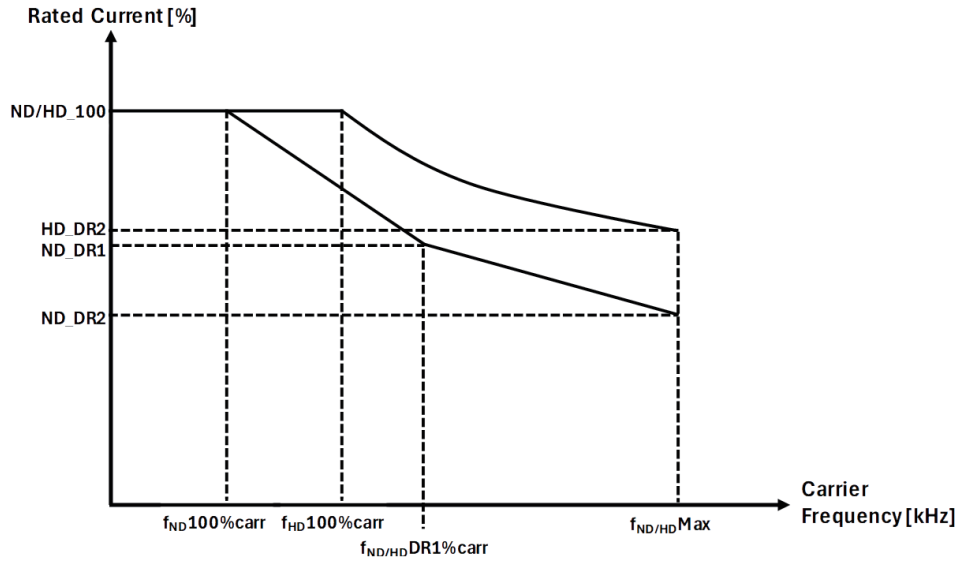
* $f_{ND/HD}$100%carr : Carrier frequency for continued operation

* $f_{ND/HD}$DR1%carr : Carrier frequency where the first current derating ends.

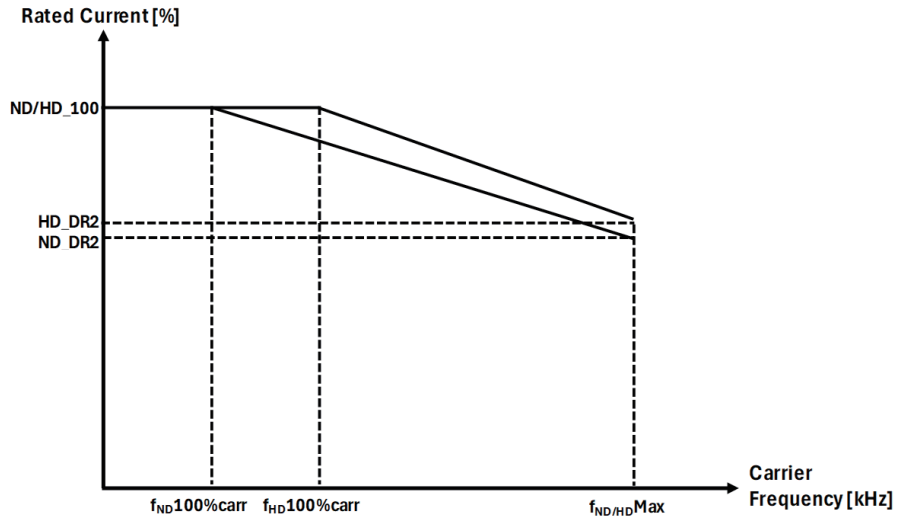
* $f_{ND/HD}$DR2%carr : Carrier frequency where the second current derating ends.

* $f_{ND/HD}$Max : The maximum carrier frequency

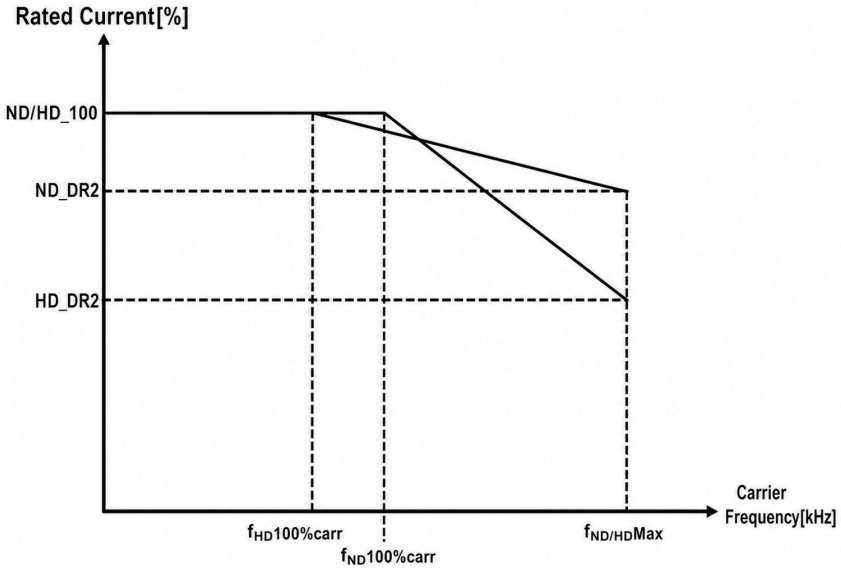
<200[V] 0.75 – 18.5[kW], 400[V] 0.75 – 30[kW]>


Rated Current [%]
ND/HD_100
HD_DR2
ND_DR1
ND_DR2
Carrier
Frequency [kHz]
f_{ND}100%carr
f_{HD}100%carr
$f_{ND/HD}$DR1%carr
$f_{ND/HD}$Max

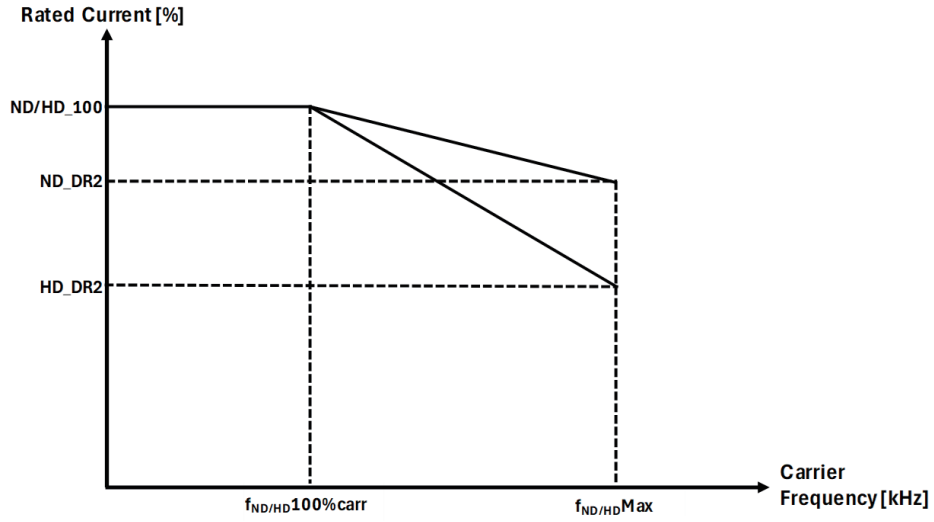
<200[V] 22 – 90[kW], 400[V] 37 – 90[kW]>



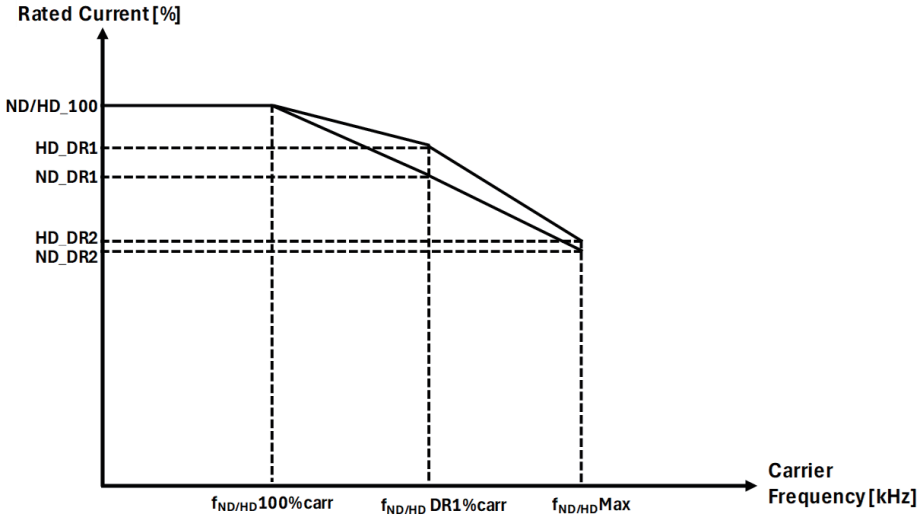
<400[V] 220/250[kW]>



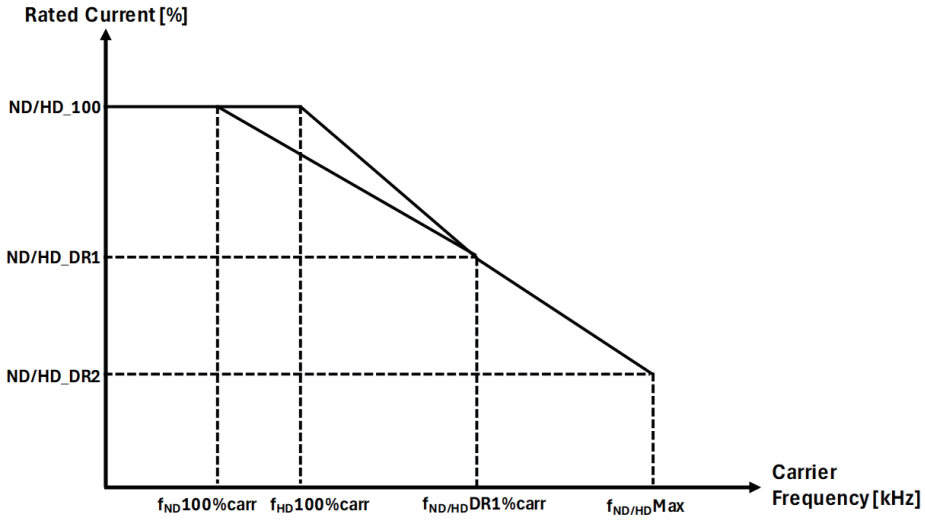
<400[V] 110 – 185[kW], 315 – 500[kW]>



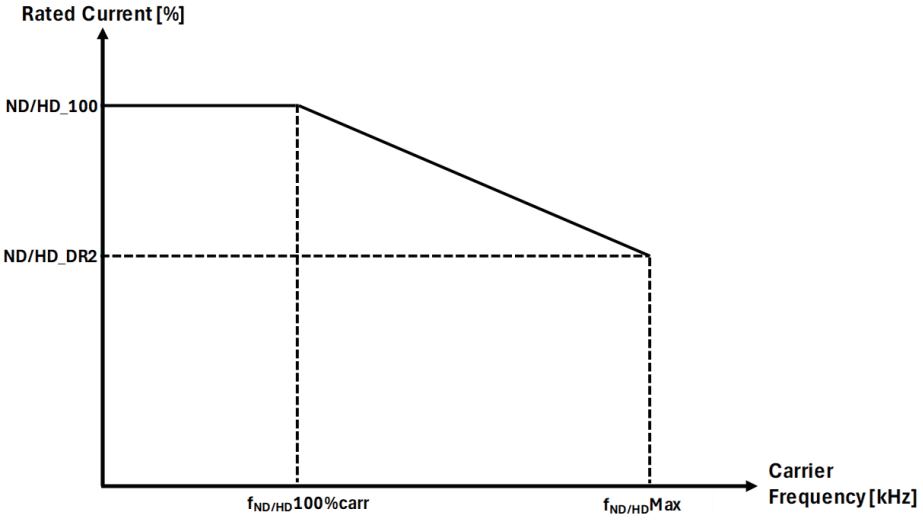
<400[V] 750[kW]>



<600[V] 5.5 – 22[kW]>



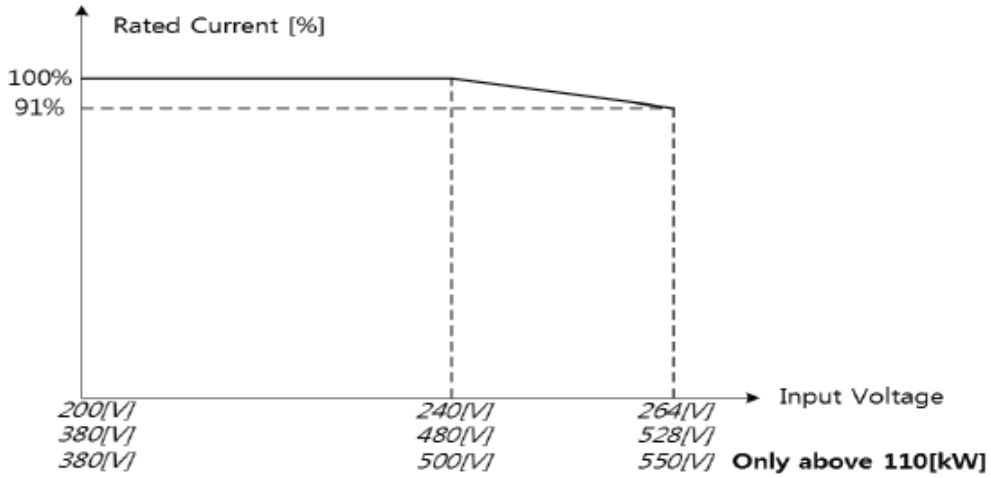
<600[V] 5.5 – 22[kW]>


Rated Current [%]
ND/HD_100
ND/HD_DR2
Carrier
Frequency [kHz]
$f_{ND/HD}$100%carr
$f_{ND/HD}$Max

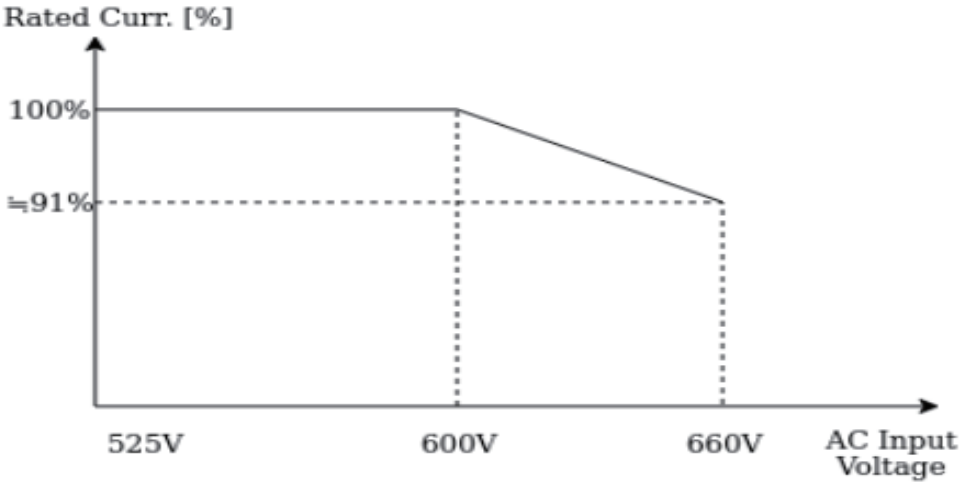
Derating by Input Voltage

The continuous rated current of the inverter is limited based on the input voltage. Refer to the following graph.

<200/400V>



<600V>



Derating by Ambient Temperature and Installation Type

Ambient temperature and installation type determine the constant-rated current of the inverter. Refer to the following graph. A 2.5% current derating is applied above 40 °C. (For 220-750 kW-4, a 1.0% current derating is applied for each 1 °C from 40 °C to 45 °C, and a 2.0% current derating is applied for each 1 °C above 45 °C. The inverter must be operated at less than 75% of its rated capacity when the ambient temperature exceeds 50 °C.)

11 Applying Drives to Single-phase Input

11.1 Introduction

LSLV-H100+ is a three-phase standard variable frequency drive(VFD). When applying single-phase power to a three-phase VFD, there are several constraints that need to be considered. Standard Pulse-Width-Modulated (PWM) VFDs use a 6-pulse diode rectifier. The 6-pulse rectification results in 360 Hz DC bus ripple when used with a three-phase 60 Hz supply.

However, under single-phase use, the DC bus ripple becomes 120 Hz and the VFDs DC bus circuit is subject to higher stress in order to deliver equivalent power.

Additionally, input currents and harmonics increase beyond those encountered with three-phase input.

Input current distortion of 90% THD and greater can be expected under single-phase input, compared to approximately 40% with three-phase input as indicated in Figure 2.

Therefore, single-phase use requires the three-phase VFD power rating be reduced (derated) to avoid over stressing the rectifier and DC link components.

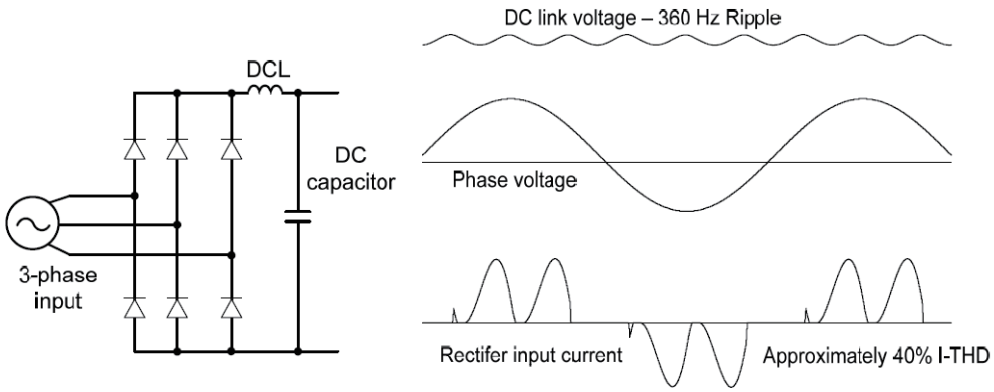


Figure-1 Typical Three-Phase Configuration

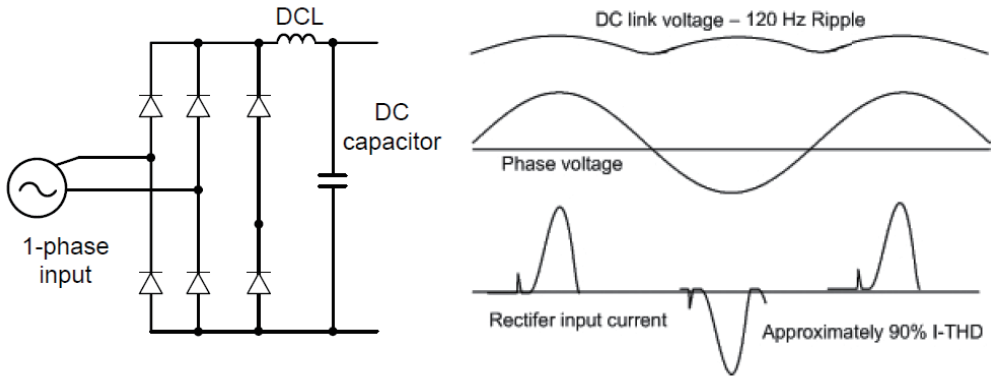


Figure-2 Typical Single-Phase Configuration

11.2 Power(HP), Input Current and Output Current

When using a three-phase VFD with single-phase input, derating the drive's output current and horsepower will be necessary because of the increase in DC bus ripple voltage and current.

In addition, the input current through the remaining two phases on the diode bridge converter will approximately double, creating another derating consideration for the VFD. Input current harmonic distortion will increase beyond that with a three-phase supply making the overall input power factor low. Input current distortion over 100% is likely under single-phase conditions without a reactor.

Therefore, the reactor is always required. When using a motor that is selected by the three-phase drive rating criteria when using single-phase input, it may result in poor performance, premature drive failure. The selected drive of single-phase current ratings must meet or exceed the motor current rating.

In case of single-phase input, the rating of the inverter is smaller than that of the motor. Please check the rating table of 11.1.

11.3 Input Frequency and Voltage Tolerance

For single-phase input AC voltage, products with 90 kW or less are within -5% to + 10% of 240/480 Vac. Products with 110 kW or more are in the range of -5% to + 10% of 380/500 Vac. Standard product with three-phase voltage input has an allowable range of +10% to –15%. Therefore, a stricter input voltage tolerance of +10 to –5% applies when using the drive with a single-phase supply. The average bus voltage with single-phase input is lower than the equivalent of a three-phase input.

Therefore, the maximum output voltage (motor voltage) will be lower with a single-phase input. The minimum input voltage must be no less than 228Vac for 240 volt models and 456Vac for 480 volt models, to ensure motor voltage production of 207Vac and 415Vac, respectively.

Thus, if full motor torque must be developed near base speed (full power) it will be necessary to maintain a rigid incoming line voltage so that adequate motor voltage can be produced. Operating a motor at reduced speed (reduced power), or using a motor with a base voltage that is lower than the incoming AC supply rating (ex. 208Vac motor with a 240Vac supply), will also minimize the effect of voltage deprivation. (240VAC Input 208V motor, 480VAC Input 400V motor)

11.4 Wiring

Please connect single-phase input to R(L1) and T(L3).

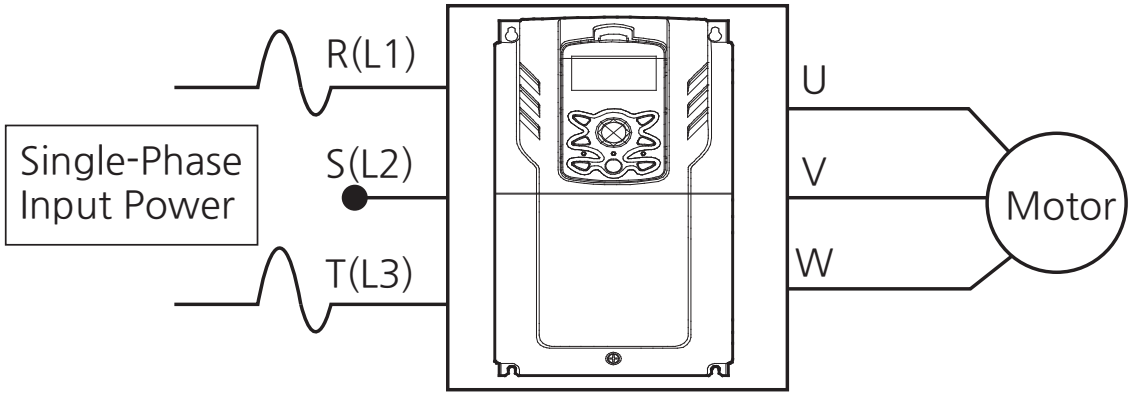


Figure-3 Terminal Wiring Diagram

11.5 Precautions for 1-Phase Input to 3-Phase Drive

- Please connect single-phase input to R(L1) and T(L3).
- AC or DC reactor is necessary to reduce DC ripple. Please select built-in reactor type for 37–750kW. For 0.75–30kW, external AC or DC reactor should be installed.
- Same peripheral devices (including a fuse and reactor) as 3 phases can be used for single phase as well.
- If phase open trip occurs, please turn off the input phase open protection(PRT-05).
- Protection for output current like OCT or IOLT is based on 3-phase input ratings which is larger than single-phase input. User should set the parameters that are relative to motor information(BAS-11–16), overload trip(PRT-17–22) and E-thermal functions(PRT-40–43).
- The minimum input voltage must be larger than 228Vac for 240Vac supply and 456Vac for 480Vac supply to ensure motor voltage production of 207Vac and 415Vac, respectively.
- To minimize the effect of voltage deprivation, please choose 208Vac motor for 240Vac supply and 400Vac motor for 480Vac supply.
- 5.5–300kW (600V) products don't support single-phase input

Product Warranty

1. Warranty Period
The warranty period is 24 months from the date of manufacture.

2. Scope of Warranty
1) The initial diagnosis of faults should be conducted by the user.
   However, upon request, LS ELECTRIC or its representative(s) can undertake this task for a fee. If the cause of the fault is found to be the responsibility of LS ELECTRIC, this service will be free of charge.
2) This warranty only applies if the product is used under normal conditions according to the specifications and precautions described in the handling instructions, user manuals, catalogs, and caution labels.
3) During the warranty period, repairs shall be charged for the following cases:
   (1) Replacement of consumable and life-limited parts (e.g. relays, fuses, electrolytic capacitors, batteries, fan, etc.)
   (2) Failures or damage caused by improper storage, handling, negligence, or accidents by the user
   (3) Failures resulting from the user's hardware or software design
   (4) Failures caused by modifications made without LS ELECTRIC's consent
   (If modifications or repairs are not conducted by LS ELECTRIC or its representative(s), further repairs including paid services will be refused)
   (5) Failures that could have been avoided if the user's equipment, in which the product is incorporated, had safety devices required by legal regulations or common industry standards
   (6) Failures that could have been prevented if maintenance and replacement of consumable parts were performed normally according to the handling instructions or user manuals
   (7) Failures and damage to the product caused due to the connected equipment or use of inappropriate consumables
   (8) Failures caused by external factors such as fire, abnormal voltage, force majeure, and natural disasters such as earthquakes, lightning, salt damage, wind, flood damage, etc.
   (9) Failures that cannot be predicted/solved by current scientific technology at the time of manufacture
   (10) Other failures, damage, or defects recognized as the responsibility of the user.

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”

ETL mark



The ETL Mark is proof of product compliance to North American Safety Standards. Authorities Having Jurisdiction(AHJs) and code officials across the US and Canada accept the ETL Listed Mark as proof of product compliance to published industry standards. Retail buyers accept it on products they’re sourcing. And every day, more consumers recognize it on products they purchase as a symbol of safety.

EC DECLARATION OF CONFORMITY

We, the undersigned,

Representative:	**LS ELECTRIC Co., Ltd.**
Address:	**LS Tower, 127, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea**
Manufacturer:	**LS ELECTRIC Co., Ltd.**
Address:	**56, Samseong 4-gil, Mokcheon-eup, Dongnam-gu, Cheonan-si, Chungcheongnam-do, Korea**

Certify and declare under our sole responsibility that the following apparatus:

Type of Equipment:	**Inverter (Power Conversion Equipment)**
Model Name:	**LSLV-H100 series**
Trade Mark:	**LS ELECTRIC Co.,Ltd.**

This declaration of conformity is under the sole responsibility of the manufacturer.

Conforms to the essential requirements of the directives:

2014/30/EU Directive of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility.

2014/35/EU Directive of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.

2011/65/EU Directive on the restriction of the use certain of certain Hazardous Substances in electrical and electronic equipment –RoHs.-

Based on the following specifications applied:

EN IEC 61800-3:2018
EN 61800-5-1:2007+A1:2017+ A11:2021
EN IEC 63000:2018

and therefore, complies with the essential requirements and provisions of the 2014/30/EU, 2014/35/EU and 2011/65/EU Directives.

Place: **Cheonan, Chungnam,**
Korea

박 창 근 2022. 8. 16 (Signature / Date)

Mr. PARK CHANGKEUN / Manager

RFI FILTERS

THE LS RANGE OF POWER LINE FILTERS FLD/AAND FEP (Standard) SERIES, HAVE BEEN SPECIFICALLY DESIGNED WITH HIGH FREQUENCY LSis INVERTERS. THE USE OF LS FILTERS, WITH THE INSTALLATION ADVICE OVERLEAF HELP TO ENSURE TROUBLE FREE USE ALONG SIDE SENSITIVE DEVICES AND COMPLIANCE TO CONDUCTED EMISSION AND IMMUNITY STANDARS TO EN 50081.

CAUTION

IN CASE OF A LEAKAGE CURRENT PROTECTIVE DEVICES IS USED ON POWER SUPPLY, IT MAY BE FAULT AT POWER-ON OR OFF.
IN AVOID THIS CASE, THE SENSE CURRENT OF PROTECTIVE DEVICE SHOULD BE LARGER

RECOMMENDED INSTALLATION INSTRUCTIONS

To conform to the **EMC** directive, it is necessary that these instructions be followed as closely as possible. Follow the usual safety procedures when working with electrical equipment. All electrical connections to the filter, inverter and motor must be made by a qualified electrical technician.

1-) Check the filter rating label to ensure that the current, voltage rating and part number are correct.

2-) For best results the filter should be fitted as closely as possible to the incoming mains supply of the wiring enclousure, usually directly after the enclousures circuit breaker or supply switch.

3-) The back panel of the wiring cabinet of board should be prepared for the mounting dimensions of the filter. Care should be taken to remove any paint etc... from the mounting holes and face area of the panel to ensure the best possible earthing of the filter.

4-) Mount the filter securely.

5-) Connect the mains supply to the filter terminals marked **LINE**, connect any earth cables to the earth stud provided. Connect the filter terminals marked **LOAD** to the mains input of the inverter using short lengths of appropriate gauge cable.

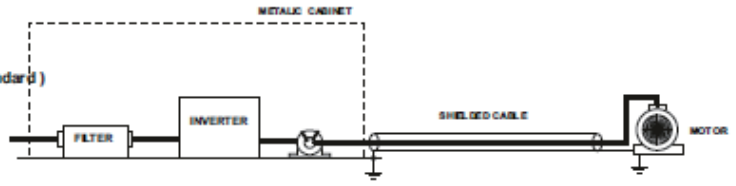
6-) Connect the motor and fit the ferrite core (output chokes) as close to the inverter as possible. Armoured or screened cable should be used with the 3 phase conductors only threaded twice through the center of the ferrite core. The earth conductor should be securely earthed at both inverter and motor ends. The screen should be connected to the enclousure body via and earthed cable gland.

7-) Connect any control cables as instructed in the inverter instructions manual.

IT IS IMPORTANT THAT ALL LEAD LENGHTS ARE KEPT AS SHORT AS POSSIBLE AND THAT INCOMING MAINS AND OUTGOING MOTOR CABLES ARE KEPT WELL SEPARATED.

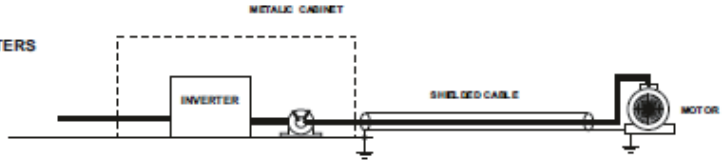
FLD/A FEP SERIES (Standard)

Fig 1



INTERNAL FILTERS

Fig 2



LSLV series / Standard Filters

INVERTER	POWER	CODE	CURRENT	VOLTAGE	LEAKAGE CURRENT	DIMENSIONS L W H	MOUNTING Y X	WEIGHT	MOUNT	FIG.	OUTPUT CHOKES
THREE PHASE					NOM. MAX.						
LSLV0008H100-2	0.75kW	FLD/A 3007	7A	250VAC	0.5mA 27mA	190 x 40 x 70	20 x 180	1.1Kg	----	A	FS – 1
LSLV0015H100-2	1.5kW	FLD/A 3016	16A	250VAC	0.5mA 27mA	250 x 45 x 70	25 x 235	1.7Kg	----	A	FS – 1
LSLV0022H100-2	2.2kW	FLD/A 3030	30A	250VAC	0.5mA 27mA	270 x 50 x 85	30 x 255	1.8Kg	----	A	FS – 1
LSLV0037H100-2	3.7kW	FLD/A 3030	30A	250VAC	0.5mA 27mA	270 x 50 x 85	30 x 255	1.8Kg	----	A	FS – 2
LSLV0055H100-2	5.5kW	FLD/A 3042	42A	250VAC	0.5mA 27mA	310 x 50 x 85	30 x 295	2.4Kg	----	A	FS – 2
LSLV0075H100-2	7.5kW	FLD/A 3055	55A	250VAC	0.5mA 27mA	250 x 85 x 90	60 x 235	2.9Kg	----	A	FS – 2
LSLV0110H100-2	11kW	FLD/A 3075	75A	250VAC	0.5mA 27mA	270 x 80 x 135	60 x 255	3.6Kg	----	A	FS – 2
LSLV0150H100-2	15kW	FLD/A 3100	100A	250VAC	0.75mA 130mA	270 x 90 x 135	65 x 255	5Kg	----	A	FS – 3
LSLV0185H100-2	18.5kW	FLD/A 3130	130A	250VAC	0.75mA 130mA	270 x 90 x 150	65 x 255	6.8Kg	----	A	FS – 3

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LSLV series / Standard Filters

INVERTER	POWER	CODE	CURRENT	VOLTAGE	LEAKAGE CURRENT	DIMENSIONS L W H	MOUNTING Y X	WEIGHT	MOUNT	FIG.	OUTPUT CHOKES
THREE PHASE					NOM. MAX.						
LSLV1100H100-4	110kW	FEP-T320	320A	220-480VAC	1.3mA 150mA	300x260x116	240x235	14.2Kg.	----	B	FS – 4
LSLV1320H100-4	132kW	FEP-T320	320A	220-480VAC	1.3mA 150mA	300x260x116	240x235	14.2Kg.	----	B	FS – 4
LSLV1600H100-4	160kW	FEP-T400	400A	220-480VAC	1.3mA 150mA	300x260x116	240x235	14.2Kg.	----	B	FS – 4
LSLV1850H100-4	185kW	FEP-T600	600A	220-480VAC	1.3mA 150mA	300x260x116	240x235	16.8Kg.	----	B	FS – 4
LSLV2200H100-4	220kW	FEP-T600	600A	220-480VAC	1.3mA 150mA	300x260x116	240x235	16.8Kg.	----	B	FS – 4
LSLV2500H100-4	250kW	FEP-T600	600A	220-480VAC	1.3mA 150mA	300x260x116	240x235	16.8Kg.	----	B	FS – 4
LSLV3150H100-4	315kW	FEP-T1000	1000A	220-480VAC	1.3mA 150mA	350x280x166	290x255	22.5Kg.	----	B	FS – 4
LSLV3550H100-4	355kW	FEP-T1000	1000A	220-480VAC	1.3mA 150mA	350x280x166	290x255	22.5Kg.	----	B	FS – 4
LSLV4000H100-4	400kW	FEP-T1000	1000A	220-480VAC	1.3mA 150mA	350x280x166	290x255	22.5Kg.	----	B	FS – 4
LSLV5000H100-4	500kW	FEP-T1600	1600A	220-480VAC	1.3mA 150mA	400x300x166	340x275	27.4Kg.	----	B	FS – 4

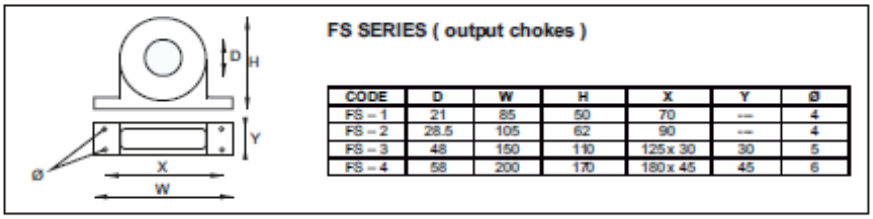
EN 55011 CLASS A IEC/EN 61800-3 C3

LSLV series / Internal Filters

INVERTER	POWER	FIG.	OUTPUT CHOKES
THREE PHASE			
LSLV0008H100-4	0.75kW	2	FS – 1
LSLV0015H100-4	1.5kW	2	FS – 1
LSLV0022H100-4	2.2kW	2	FS – 1
LSLV0037H100-4	3.7kW	2	FS – 2
LSLV0055H100-4	5.5kW	2	FS – 2
LSLV0075H100-4	7.5kW	2	FS – 2
LSLV0110H100-4	11kW	2	FS – 2
LSLV0150H100-4	15kW	2	FS – 3
LSLV0185H100-4	18.5kW	2	FS – 3
LSLV0220H100-4	22kW	2	FS – 3
LSLV0300H100-4	30kW	2	FS – 3
LSLV0370H100-4	37kW	2	FS – 3
LSLV0450H100-4	45kW	2	FS – 4
LSLV0550H100-4	55kW	2	FS – 4
LSLV0750H100-4	75kW	2	FS – 4
LSLV0900H100-4	90kW	2	FS – 4

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FIG. 2

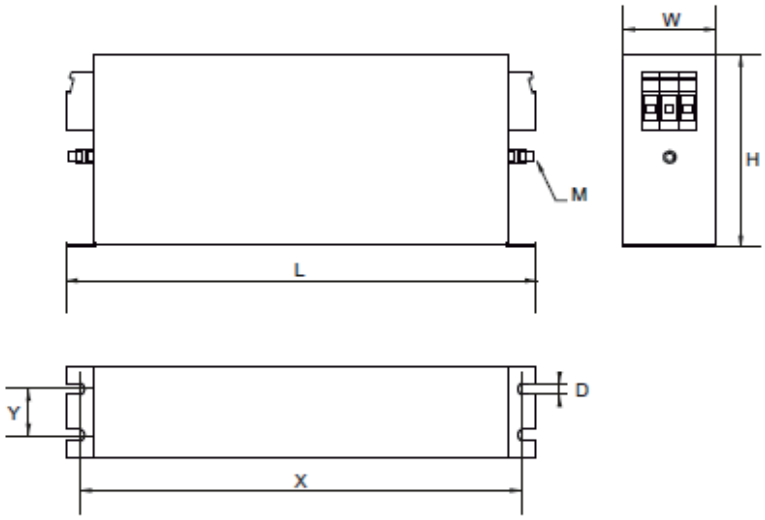


FS SERIES (output chokes)

CODE	D	W	H	X	Y	Ø
FS – 1	21	85	50	70	---	4
FS – 2	28.5	105	62	90	---	4
FS – 3	48	150	110	125 x 30	30	5
FS – 4	58	200	170	180 x 45	45	6

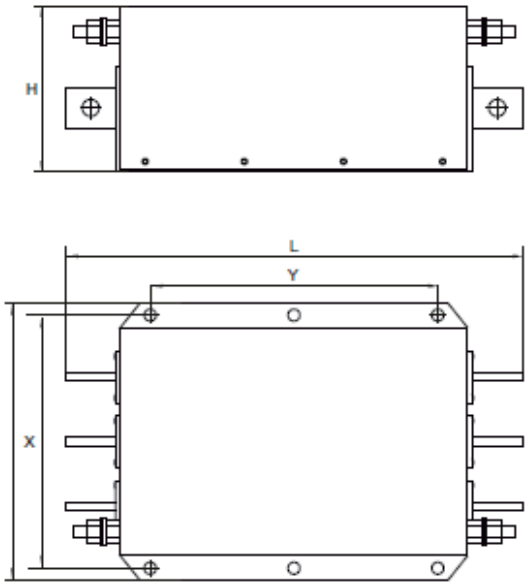
FLD SERIES (Standard)

FIG.A



FEP SERIES

FIG. B



LS ELECTRIC

vector Energy

Vector Energy Global, SLU
C/Montcada 7, P.I. Les Pereres
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LSLV-H100+ / 2026.08