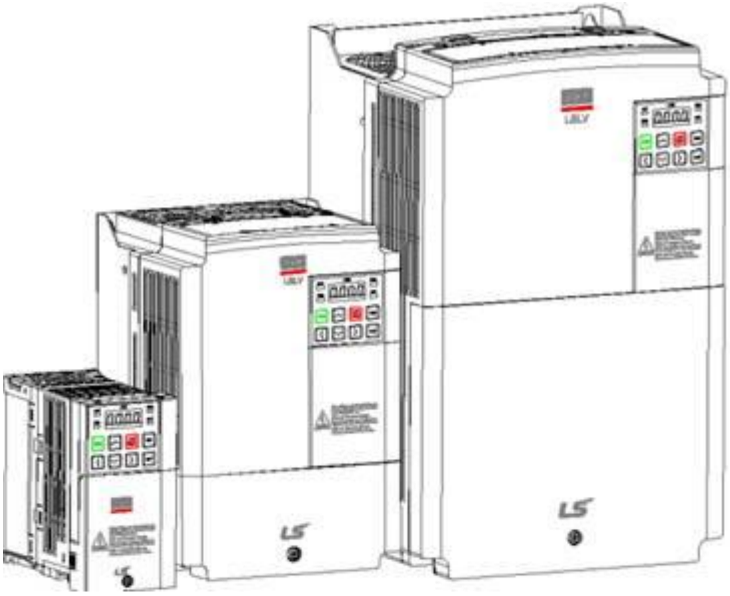
AC Variable Speed Drive

0.4 -22 kW [200, 400V]

LSLV-S100 User Manual



Safety Precautions

- Please read the Safety Precautions before using this product.
- After using this manual, please place it in a location where people can easily find it.

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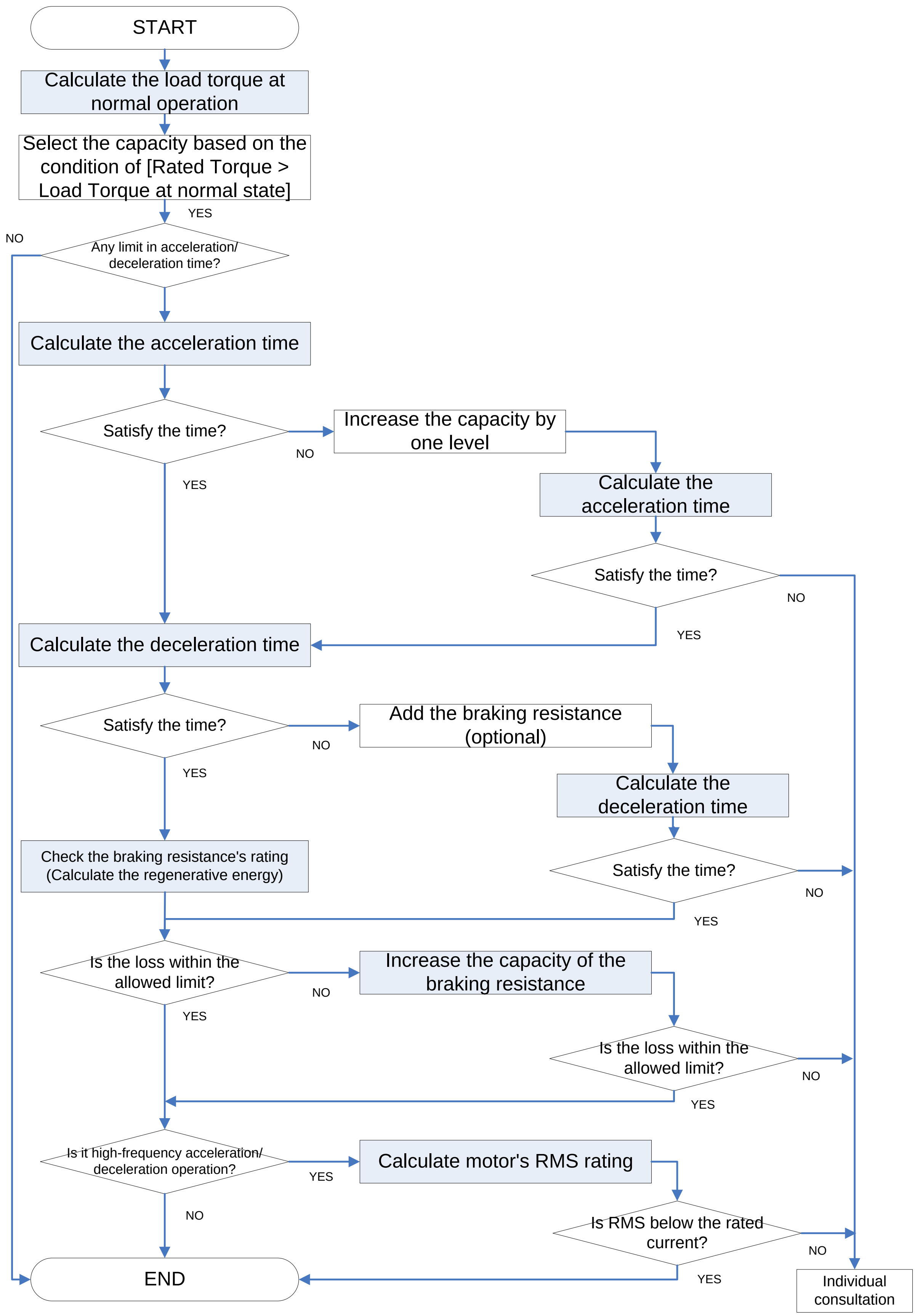
About This Manual

This manual explains the specifications, installation, operation, features and maintenance of LSLV-S100 series inverter for users with basic knowledge on the inverter.

Before using LSLV-S100 series inverter, please read this manual and understand the functionality, performance, installation and usage of the product. In addition, please ensure that the end user and maintenance manager have read this manual.

Product Capacity Selection Process



Safety Precautions

Safety Precautions help you prevent accidents before they happen and allow you to use the inverter safely and properly. Make sure to adhere to all Safety Precautions outlined in this manual.

There are two types of warning labels: Warning and Caution. These labels mean the following:

Precaution		Definition
⚠	**Warning**	Warning labels alert users to the possibility of serious injuries or death from failure to follow the instructions provided.
⚠	**Caution**	Caution labels alert users to the possibility of minor injuries or damage to the inverter from failure to follow the instructions provided.

The icons displayed on the inverter and in the manual mean the following:

Notes
Even Caution labels can warn users of potentially serious results depending on the situation.

The icons displayed on the inverter and in the manual mean the following:

Icon	Definition
⚠	**Danger: there is the possibility of accidents occurring.**
⚡	**Danger: there is the possibility of an electric shock.**

After reading the manual, please place it in a location where people can easily find it. Please read this manual carefully to ensure LSLV-S100 inverter is used safely and effectively.

⚠ Warning

- THIS INVERTER MUST BE EARTHED/ GROUNDED!
- Do not open the cover while the power is on or at any time during operation.
  Otherwise, it may result in an electric shock.
- Do not operate the inverter while the cover is open.
  Exposing the High voltage terminal or charging area to the external environment may result in an electric shock.
- Do not open the cover even when the power supply has been switched off. This excludes necessary maintenance or regular inspection.
  Opening the cover may result in an electric shock even if the power supply is off. The inverter may hold a charge long after the power supply has been switched off.
- Do not conduct maintenance or inspection without first ensuring that the DC voltage of the inverter has been fully discharged. To ensure this, use a voltage tester at least ten minutes after the power supply has been cut off.
  Otherwise, it may result in an electric shock. (DC 30V or less)
- Do not operate switches on the inverter with wet hands.
  Otherwise, it may result in an electric shock.
- Do not use the inverter if the cable has been damaged.
  Otherwise, it may result in an electric shock.
- Do not place a heavy object on the cable.
  Placing heavy object on the cable could damage its sheath and may result in an electric shock.

⚠ Caution

- Equipment is intended for installation in closed electrical operating areas only.
- Do not install the product near any flammable materials.
  Mounting the inverter on or near flammable materials may start a fire.
- Switch off the power supply to a faulty inverter.
  Failure to switch off the power supply to a faulty inverter may start a fire.
- Do not touch the inverter while the power supply is on or within ten minutes of switching the power supply off.
  Touching the inverter may result in a burn because of its high operating temperatures.
- Do not supply power to a faulty inverter even when its installation has been completed.
  Otherwise, it may result in an electric shock.
- Make sure that any foreign substances such as screws, metal, water and oil do not enter the inverter.
  Introducing foreign substances to the inverter may start a fire.

Usage Precautions

■ Transport and Installation

- Transport the inverter in a using a method appropriate for its weight.
- Do not stack inverters over the limit specified by the manual.
- Install the inverter according to the instructions provided by the manual.
- Do not open the cover of the inverter while transporting it.
- Do not place heavy objects on the inverter.
- Make sure to install the inverter in the direction specified by the manual.
- The inverter is a precision instrument. Do not drop it or expose it to heavy impact.
- The inverter requires Class 3 (200 V product) and Special Class 3 (400 V product) grounding.
- Immediately place any detached PCB on a conductor if you have detached it for installation or repair. The inverter can be damaged by static electricity.
- Do not expose the inverter to snow, rain, fog or dust.
- Do not cover or obstruct the cooling fan vents. This could result in the inverter overheating.
- For safety, make sure that the power of the inverter is turned off before installation.
- Ensure that the cables are in good condition to minimize the risk of fire or electric shock. Do not use an inferior quality cable or extend the length of the existing cable.

Use the inverter under the following conditions.

Item		Details
Environment	Temperature	▪ Open Type - Maximum Surrounding Air Temperature : 50 °C (Heavy duty), 40 °C (Normal duty) ▪ Enclosure Type 1 – Maximum Ambient Temperature : 40 °C
	Ambient humidity	90% RH or less (no condensation)
	Storage temperature	- 20 - 65 ℃
	Ambient environment	There should not be corrosive gas, inflammable gas, oil residue, dirt, etc.
	Altitude/vibration	Altitude of 1,000 m or less / vibrations of 5.9m/sec² (= 1G) or less
	Ambient pressure	70 - 106 kPa

■ Wiring

- Do not install phase advanced capacitor, surge filter, or radio noise filter on the output of the inverter.
- Connect output side (terminals U, V and W) in the correct order.
- The inverter may be damaged if the terminals are connected incorrectly.

- Be careful. Connecting input side (terminals R, S, T) into output side (terminals U, V, W) incorrectly, and vice versa, may damage the inverter.

⚠ Caution
▪ **Wiring or inspection must be performed by a qualified technician.**

- Install the inverter before wiring.

Starting the inverter

- Check all parameters before operation. Parameter change may be necessary depending on the load.
- Do not supply a voltage to each terminal which exceeds the range outlined by the manual. Providing excess voltage may damage the inverter.

Usage

- If you selected the auto-restart function, please keep in mind that operation automatically restarts after a stop caused by a trip condition.
- Since the stop key on the keypad works when it is set to use, install an emergency stop switch separately.
- The inverter restarts when you reset a trip condition while the operating signal is inputted. Press the RESET switch after checking the operating signal.
- Do not modify the interior workings of the inverter.
- The electronic thermal function may not protect the motor under some conditions.
- Do not start or stop the inverter with a magnetic contactor that is installed on the input power supply.
- Minimize electromagnetic interference by using a noise filter, etc. Some electronic devices may not work correctly if they are used near the inverter. Be sure to take precautions.
- If the input current is unbalanced, install a reactor. Phase advanced capacitors or generators may overheat and get damaged by the power frequency from the inverter.
- If you initialize parameters, the parameter values are restored to factory defaults. Therefore please reconfigure the parameters as required if you operate after initialization.
- The inverter is capable of operating a motor at high speeds. Before increasing the inverter maximum output frequency make sure that the motor's maximum operating speeds are not exceeded.
- Stopping torque does not occur when the inverter's DC braking is used. If a stop torque is required, please install a braking resistor.
- The inverter is designed for 3-phase motor operation. Do not use the inverter to operate a single phase motor.

Prevention Measures for Abnormal Situations

- If the inverter is damaged and becomes uncontrollable, the machine may cause a dangerous situation. Install an additional safety device such as an emergency brake to prevent these situations.
- This product can cause a d.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for

protection in case of direct contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

Repair, Inspection and Parts Replacement

- Do not conduct a Megger test (measuring insulation resistance) against the control circuit of the inverter.
- For details about regular inspection (part replacement intervals), see chapters 11.611.6 Daily Inspection and Regular Inspection List.

■ Disposal

- Dispose of the inverter according to your local regulations regarding the disposal of common industrial waste.
- Recycle all recyclable components contained in this inverter to preserve energy and resources. All packing materials and metal components of this product are recyclable in most areas. Plastic parts are recyclable or you may be able to burn them in a controlled environment, depending on local regulations.

■ General

- Figures in this manual are shown with covers or circuit breakers omitted for more detailed explanation. Install covers and circuit breakers according to the regulations before operation. Operate the product according to the instructions in this manual.
- Turn off the inverter when it is not in use.

■ Cleaning

- Be sure to turn off the inverter power supply and remove all plugs that are connected to the inverter socket before cleaning. Clean with a dry cloth. Never use water or a wet cloth on the inverter.

■ Long-term Storage

If you are not planning on using your inverter for a long period of time, store it under the following conditions:

- Comply with the recommended storage environment guidelines. (refer to Page vii)
- If the storage period exceeds three months, store the inverter at an ambient temperature of -10 - +30˚C to prevent the thermal degradation of the electrolytic capacitor.
- Package the inverter to prevent moisture from building up inside the inverter. Keep the relative humidity of the inverter under 70% by putting a desiccant (silica gel) packet inside the package.
- If the inverter is exposed to humidity or dust (e.g. if it is installed on construction equipment), detach it from any equipment before storing it under the conditions set forth on Page vi.

⚠ Caution
▪ If the inverter is not supplied with electricity for a long period of time, the electrolytic condenser may suffer thermal degradation. To prevent this from happening, connect the power supply to the inverter for 30 - 60 minutes at least once a year. Do not perform any wiring or operation to the inverter on the output (secondary) side.

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1. Basic Considerations

This section provides precautions and basic considerations you need to know before you use the inverter.

1.1 Features

- More powerful functions
  - V/F function
  - Slip compensation
  - Sensorless vector control
- User-oriented interface and eco-friendly design
  - iS7 Graphic LCD Keypad supported (Using specific cable for iS7)
  - Electric thermal system for motor protection
  - Input/output open-phase protection for inverter and sequence protection
  - EMC filter to reduce electromagnetic emission (400 V class built in)

1.2 Delivery Check

After unpacking the inverter, check the product rating plate on the housing to ensure that the type and rated output of the inverter are correct. Be sure to examine the product to ensure that it has not been damaged during transport.

Table 1-1 S100 Product

<table>
<tr><th>LS
LV</th><th colspan="2">0000</th><th>S100</th><th>-</th><th>2</th><th>E</th><th>O</th><th>F</th></tr>
<tr><td rowspan="13">LS Inverter</td><td colspan="2">Motor Capacity</td><td>Type</td><td rowspan="13">-</td><td>Input Voltage</td><td>I/O Type</td><td>UL Type</td><td>EMC</td></tr>
<tr><td>0004</td><td>0.4 [kW]</td><td rowspan="12">Standard inverter</td><td rowspan="12">1: Single phase
200-240[V]

2: Three-phase
200-240[V]

4: Three-phase
380-480[V]</td><td rowspan="12">S :
Standard I/O

E :
Extention I/O</td><td rowspan="12">O :
UL open & Enclosed Type1[1]

X: IP66</td><td rowspan="12">Blank : Without Filter

F :
With Filter</td></tr>
<tr><td>0008</td><td>0.75 [kW]</td></tr>
<tr><td>0015</td><td>1.5 [kW]</td></tr>
<tr><td>0022</td><td>2.2 [kW]</td></tr>
<tr><td>0037</td><td>3.7 [kW]</td></tr>
<tr><td>0040</td><td>4 [kW]</td></tr>
<tr><td>0055</td><td>5.5 [kW]</td></tr>
<tr><td>0075</td><td>7.5 [kW]</td></tr>
<tr><td>0110</td><td>11 [kW]</td></tr>
<tr><td>0150</td><td>15 [kW]</td></tr>
<tr><td>0185</td><td>18.5 [kW]</td></tr>
<tr><td>0220</td><td>22 [kW]</td></tr>
</table>

* iS7 inverter control is only applied for AC asynchronous(Induction Motor). Synchronous motor is excluded.

■ Components

If any component is missing or the product is damaged, please contact one of our agencies or LSIS offices (refer to the back cover of the user manual).

■ Preparation of devices and components required for operation

Prepare components required for operation. Devices and components required for operation may be different depending on the application.

■ Installation

Consider the location, direction and surrounding space before installation to ensure longer product life and performance.

■ Wiring

Connect the power, motor and operation signal (control signal) to the terminal block. Be careful as the inverter and other devices may be damaged if not correctly connected.

[1] The Enclosed Type 1 is a class that satisfies the requirements when adding a separate conduit option to S100 products.

1.3 Part Names

■ Full product (5.5-22.0 kW)

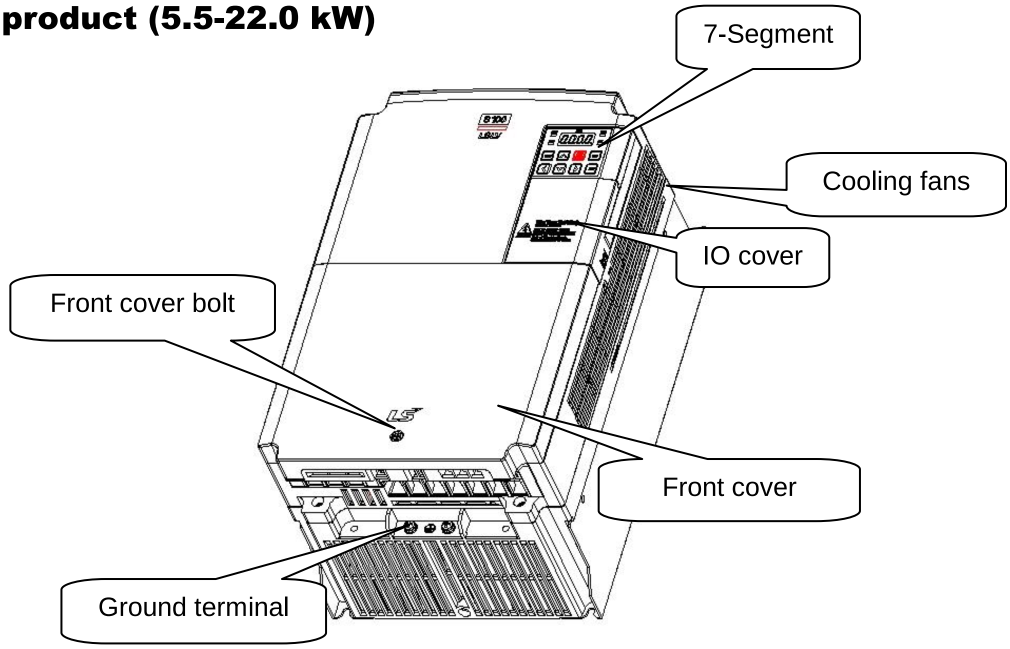


Figure 1-1 Full product

■ Front cover and IO cover removed (5.5-22.0 kW)

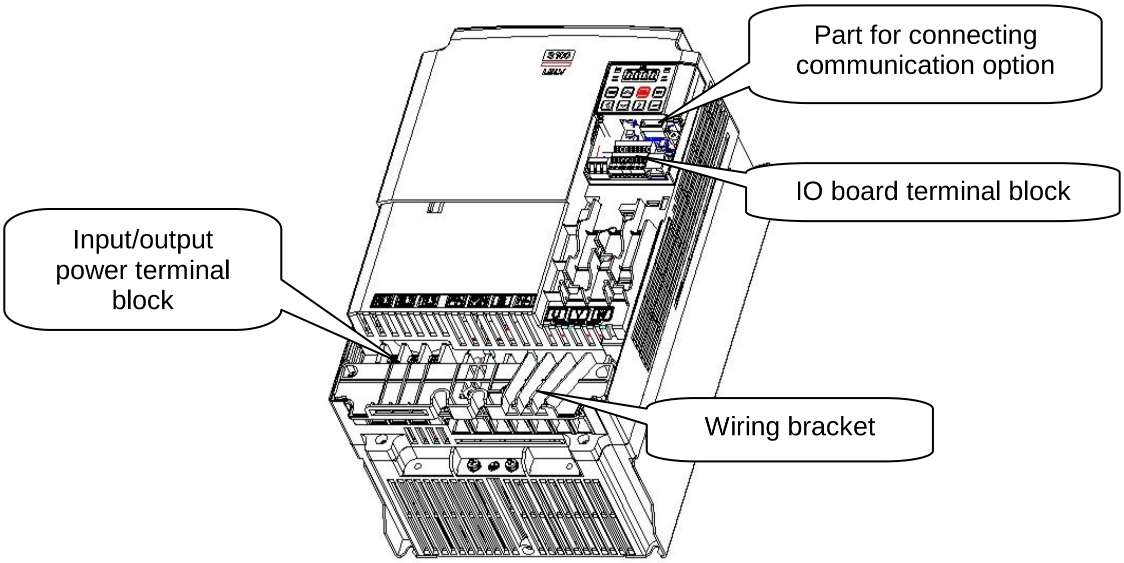


Figure 1-2 Front cover removed

2. Standard

2.1 Input and Output Rating

2.1.1 Input Voltage: Single Phase 200 V Product

(1) 0.4 - 2.2 kW

<table>
<tr><th colspan="3">Type Name: LSLV xxxx S100 – 1xxx</th><th>0004</th><th>0008</th><th>0015</th><th>0022</th></tr>
<tr><td colspan="2" rowspan="2">Applicable motors[2]</td><td>HP</td><td>0.5</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>kW</td><td>0.4</td><td>0.75</td><td>1.5</td><td>2.2</td></tr>
<tr><td rowspan="5">Output rating</td><td colspan="2">Rated capacity[3][kVA]</td><td>1.0</td><td>1.9</td><td>3.0</td><td>4.2</td></tr>
<tr><td rowspan="2">Rated current[4] [A]</td><td>Heavy load</td><td>2.5</td><td>5.0</td><td>8.0</td><td>11.0</td></tr>
<tr><td>Light load</td><td>3.1</td><td>6.0</td><td>9.6</td><td>12.0</td></tr>
<tr><td colspan="2">Output frequency</td><td colspan="4">0 - 400 [Hz] (IM Sensorless: 0-120[Hz]) [5]</td></tr>
<tr><td colspan="2">Output voltage [V]</td><td colspan="4">3 phase 200 - 240 V [6]</td></tr>
<tr><td rowspan="4">Input rating</td><td colspan="2">Voltage [V]</td><td colspan="4">1 phase 200 - 240 VAC (-15% - +10%)</td></tr>
<tr><td colspan="2">Input frequency</td><td colspan="4">50 - 60 [Hz] (±5%)</td></tr>
<tr><td rowspan="2">Rated current [A]</td><td>Heavy load</td><td>2.0</td><td>5.8</td><td>7.5</td><td>11.0</td></tr>
<tr><td>Light load</td><td>3.9</td><td>7.3</td><td>10.8</td><td>13.9</td></tr>
<tr><td colspan="3">Weight [Kg]</td><td>0.9</td><td>1.3</td><td>1.5</td><td>2.0</td></tr>
</table>

[2] The applicable motor shows the max applicable capacity when 4-pole standard motor is used. (200 V product is based on 220 V, 400 V product on 440 V.)

[3] For the rated capacity, 200 V product's input capacity is based on 220 V while 400 V product's input capacity is based on 440 V. The current rating is based on the heavy duty current.

[4] There is a current limit on output rating according to the carrier frequency (Cn-04) settings.

[5] If the control mode (dr.09 Control Mode) is set to No. 4 IM-Sensorless, 120Hz is the maximum frequency permitted.

[6] The max output voltage cannot exceed the power voltage. The output voltage can be set to any value below the power voltage.

2.1.2 Input Voltage: 3-Phase 200V Product

(1) 0.4 - 4 kW

Type Name: LSLV xxxx S100 – 2xxx			0004	0008	0015	0022	0037	0040
Applicable motors		HP	0.5	1	2	3	5	5.4
		kW	0.4	0.75	1.5	2.2	3.7	4
Output rating	Rated capacity[kVA]		1.0	1.9	3.0	4.2	6.1	6.5
	Rated current [A]	Heavy load	2.5	5.0	8.0	11.0	16.0	17.0
		Light load	3.1	6.0	9.6	12.0	18.0	18.0
	Output frequency		0 - 400 [Hz] (IM-Sensorless : 0 - 120 Hz)					
	Output voltage [V]		3 phase 200 - 240 V					
Input rating	Voltage [V]		3 phase 200 - 240 VAC (-15% - +10%)					
	Input frequency		50 - 60 [Hz] (±5%)					
	Rated current [A]	Heavy load	2.0	5.8	7.5	11.0	18.9	21.0
		Light load	3.9	7.3	10.8	13.9	24.0	24.0
Weight [Kg]			0.9	0.9	1.3	1.5	2.0	2.0

(2) 5.5 - 22 kW

Type Name: LSLV xxxx S100 – 2xxx			0055	0075	0110	0150		
Applicable motors		HP	7.5	10	15	20		
		kW	5.5	7.5	11	15		
Output rating	Rated capacity[kVA]		9.1	12.2	17.5	22.9		
	Rated current [A]	Heavy load	24	32	46	60		
		Light load	30	40	56	69		
	Output frequency		0 - 400 [Hz] (IM-Sensorless : 0-120[Hz]					
	Output voltage [V]		3 phase 200 - 240 V					
Input rating	Voltage [V]		3 phase 200 - 240 VAC (-15% - +10%)					
	Input frequency		50 - 60 [Hz] (±5%)					
	Rated current [A]	Heavy load	25.8	34.9	50.8	66.7		
		Light load	32.7	44.2	62.3	77.2		
Weight [Kg]			3.3	3.3	4.6	7.1		

2.1.3 Input Voltage: 3-Phase 400 V Product

(1) 0.4 - 4 kW

Type Name: LSLV xxxx S100 – 4xxx			0004	0008	0015	0022	0037	0040
Applicable motors		HP	0.5	1	2	3	5	5.4
		kW	0.4	0.75	1.5	2.2	3.7	4
Output rating	Rated capacity[kVA]		1.0	1.9	3.0	4.2	6.1	6.5
	Rated current [A]	Heavy load	1.25	2.5	4.0	5.5	8.0	9.0
		Light load	1.56	3.1	5.0	6.9	10.0	10.0
	Output frequency		0 - 400 [Hz] (IM-Sensorless : 0 - 120 Hz)					
	Output voltage [V]		3 phase 380 - 480V					
Input rating	Voltage [V]		3 phase 380 - 480 VAC (-15% - +10%)					
	Input frequency		50 - 60 [Hz] (±5%)					
	Rated current [A]	Heavy load	1.8	3.2	4.4	6.0	10.4	11.0
		Light load	2.1	4.3	5.9	8.1	14.0	14.0
Weight [Kg]			0.9	0.9	1.3	1.5	2.0	2.0

(2) 5.5 - 22 kW

Type Name: LSLV xxxx S100 – 4xxx			0055	0075	0110	0150	0185	0220
Applicable motors		HP	7.5	10	15	20	25	30
		kW	5.5	7.5	11	15	18.5	22
Output rating	Rated capacity[kVA]		9.1	12.2	17.5	22.9	28.2	33.5
	Rated current [A]	Heavy load	12	16	24	30	39	45
		Light load	16	23	30	38	44	58
	Output frequency		0 - 400 [Hz] (IM-Sensorless : 0 - 120 Hz)					
	Output voltage [V]		3 phase 380 - 480V					
Input rating	Voltage [V]		3 phase 380 - 480 VAC (-15% - +10%)					
	Input frequency		50 - 60 [Hz] (±5%)					
	Rated current [A]	Heavy load	12.9	17.5	26.5	33.4	43.6	50.7
		Light load	17.5	25.4	33.4	42.5	49.5	65.7
Weight [Kg]			3.3	3.4	4.6	4.8	7.5	7.5

2.1.4 Common Features

(1) Control

Control method	V/F control, slip compensation, sensorless vector
Frequency setting resolution	Digital command: 0.01Hz Analog command: 0.06 Hz (Max. frequency: 60 Hz)
Frequency level	1% of max. output frequency
V/F pattern	Linear, square, user V/F
Overload tolerance	Heavy load current rating: 150% 1 minute, light load current rating: 120% 1 minute
Torque boost	Manual torque boost, automatic torque boost

(2) Operation

<table>
<tr><td colspan="2">Operation type</td><td colspan="2">Select one from keypad, terminal block and communication operation.</td></tr>
<tr><td colspan="2">Frequency setting</td><td colspan="2">Analog type: -10 - 10[V], 0 - 10[V], 0 - 20[mA]
Digital type: Keypad, pulse train input</td></tr>
<tr><td colspan="2">Operation function</td><td colspan="2">PID control, up-down operation 3-wire operation, direct current braking, frequency limit, frequency jump, 2nd function, slip compensation, reverse rotation prevention, automatic restart, commercial electricity switching, auto-tuning, flying start, energy buffering operation, power braking, flux braking, leakage reduction operation</td></tr>
<tr><td rowspan="3">Input</td><td rowspan="2">Multi-functional terminal[7]
(7 points) P1 - P7</td><td colspan="2">Selectable between NPN (Sink) and PNP (Source)</td></tr>
<tr><td colspan="2">Function: Forward direction operation, reverse direction operation, reset, outside trip, emergency stop, jog operation, multi-step speed frequency - high, medium and low, multi-step acceleration/deceleration - high, medium and low, DC braking on stop, 2nd motor section, frequency increase, frequency decrease, 3-wire operation, conversion to general operation during PID operation, conversion to body operation during option operation, frequency fixation of analog command, acceleration/deceleration stop.</td></tr>
<tr><td>Pulse train</td><td colspan="2">0 Hz - 32 kHz, low level: 0 - 0.8 V, high level : 3.5 - 12 V</td></tr>
<tr><td rowspan="4">Output</td><td>Multiple functions open collector terminal</td><td rowspan="2">Failure output and inverter operation status output</td><td>DC 24V 50mA or less</td></tr>
<tr><td>Multi-functional relay terminal</td><td>(N.O., N.C.) AC 250 V 1 A or less,
DC 30V 1A or less</td></tr>
<tr><td>Analog output</td><td colspan="2">0 - 12 Vdc (4 - 20 mA): Selectable from frequency, output current, output voltage and DC link voltage</td></tr>
<tr><td>Pulse train</td><td colspan="2">Max. 32 kHz, 0 - 12[V]</td></tr>
</table>

[7] Functions related to multi-functional terminal can be selected based on IN group In.65-71 parameter settings.

(3) Protection function

Trip	Overcurrent, overvoltage, low voltage, outside trip, ground fault current detection, inverter overheating, motor overheating, input/output open-phase, overload protection, lightload protection, communication error, frequency command loss, hardware failure, cooling fan failure, Pre-PID operation failure, no motor trip, outside brake trip, option failure, safety contact failure, inverter temp sensor failure, parameter writing error, IO board failure.
Warning	Stall prevention, overload, light load, cooling fan failure, frequency command loss, DB utilization, rotor time constant tuning failure
Instantaneous power interruption	Heavy load level 16 ms or less (light load level 8 ms or less): Continues to operate. (should be within rated input and output voltage) Heavy load level 16 ms or higher (light load level 8 ms or higher): Automatic restart operation allowed

(4) Structure and usage environment

Cooling method	Forced air-cooling structure ▪ Forced cooling: 5.5 - 22 kW 200/400 V product
Protection structure	IP 20 (Default), UL Open & Enclosed Type 1 (Option)[8]
Ambient temperature	Ambient temperature under the conditions without ice or frost ▪ Heavy load: - 10 - 50℃ ▪ Light load: - 10 - 40℃ [if used at 50℃ for light load, 80% or less load is recommended.]
Storage temperature	-20°C - 65°C
Ambient humidity	90% relative humidity or less (no condensation)
Altitude, vibration	1,000 m or less, 5.9 m/sec^2 (1G) or less
Ambient environment	There should be no corrosive gas, flammable gas, oil residue, dirt, etc., in the ambient environment. (Pollution Degree 2 Environment)

[8] UL Enclosed type 1 with conduit box installed.

2.1.5 Dimensions (IP20 Type)

■ LSLV0004 S100 (single-phase 200 V), LSLV0004 S100 – 0008 S100(3-phase 200 V/3-phase 400 V)

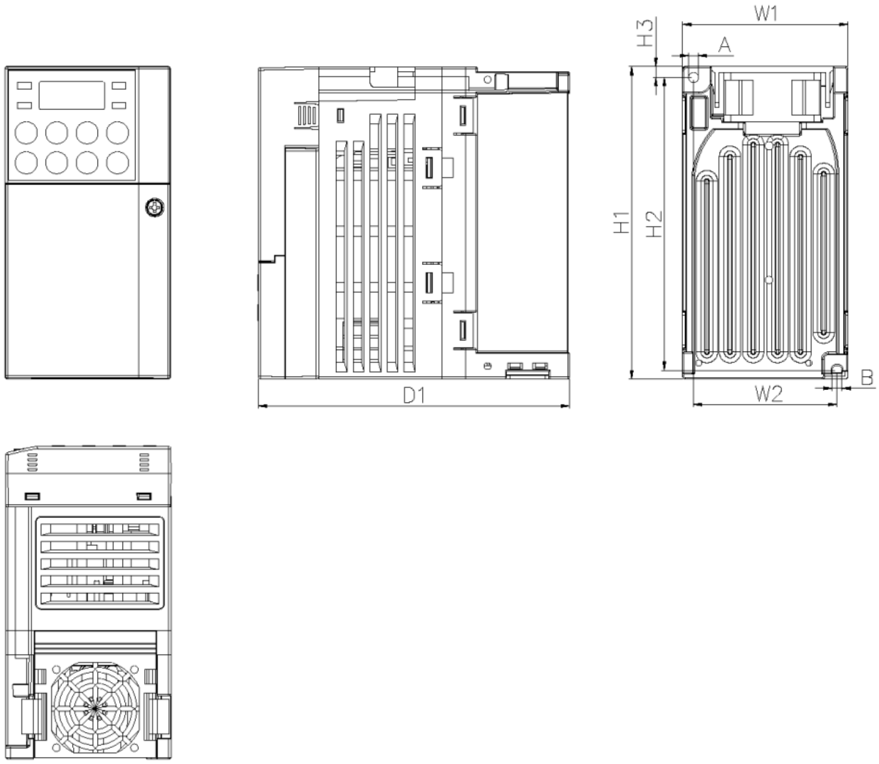


Figure 2-1 LSLV0004 S100(single-phase 200 V), LSLV0004 S100 – 0008 S100 (3-phase 200 V/3-phase 400 V)

■ LSLV0008 – 0015 S100 (single-phase 200 V), LSLV0015 S100 – 0022 S100 (3-phase 200 V/3-phase 400 V)

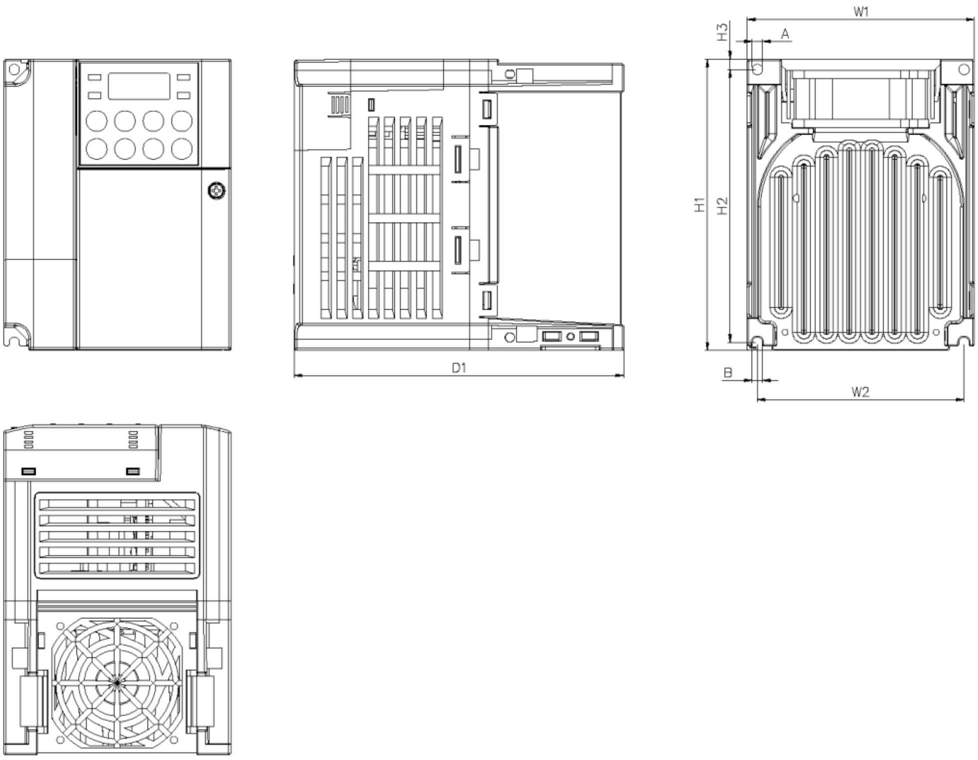


Figure 2-2 LSLV0008 – 0015 S100(single-phase 200 V), LSLV0015 S100 – 0022 S100 (3-phase 200 V/3-phase 400 V)

■ LSLV0022 S100 (single-phase 200 V), LSLV0037 S100 – 0040 S100 (3-phase 200 V/3-phase 400 V)

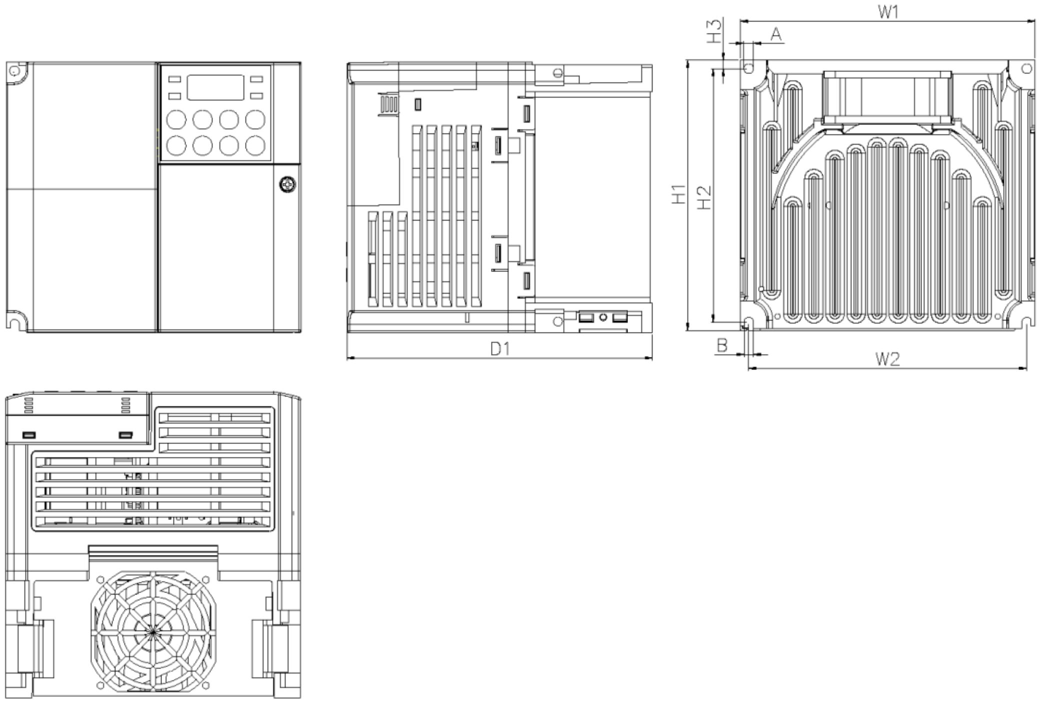


Figure 2-3 LSLV0022 S100 (single-phase 200 V), LSLV0037 S100 – 0040 S100 (3-phase 200 V/3-phase 400 V)

■ LSLV0055 - 0220 S100 (3-phase 200 V/3-phase 400 V)

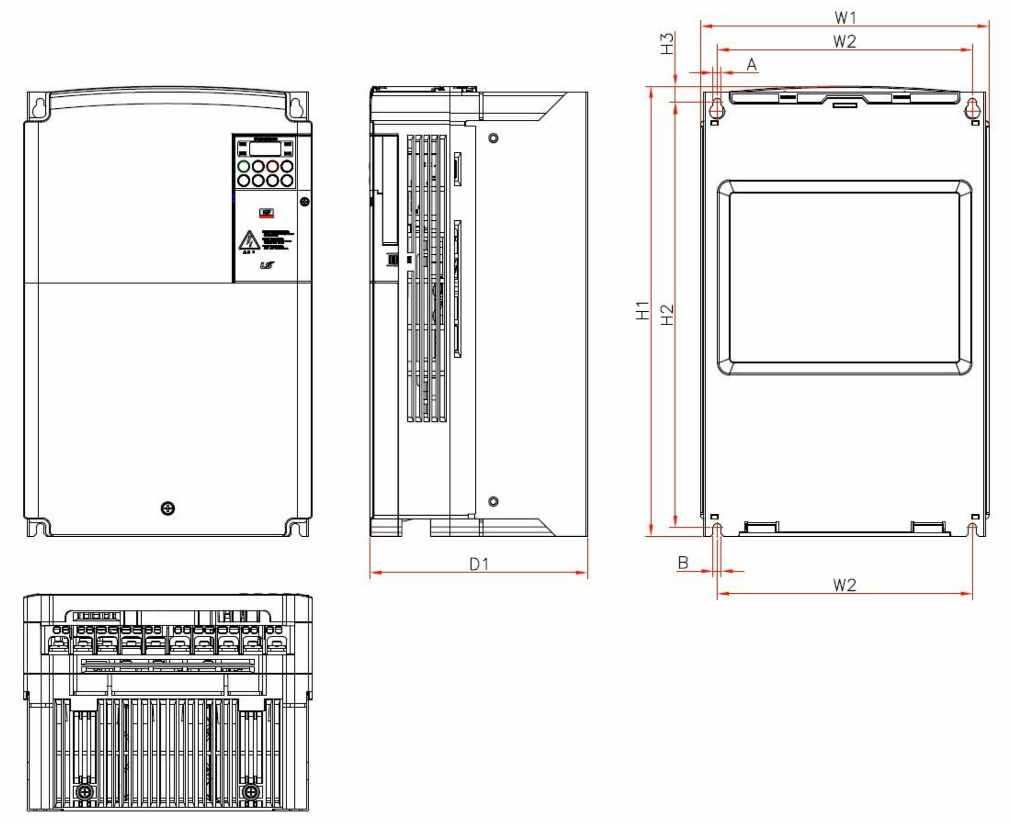


Figure 2-4 LSLV0055 – 0220 S100 (200 V/400 V)

Table 2-1 Dimensions per frame (single-phase 200 V)

mm (inches)

Inverter capacity	W1	W2	H1	H2	H3	D1	A	B	Φ
LSLV0004S100-1	68 (2.68)	59 (2.32)	128 (5.04)	120 (4.72)	4.5 (0.18)	128 (5.04)	4 (0.16)	4 (0.16	4 (0.16)
LSLV0008S100-1	100 (3.94)	91 (3.58)	128 (5.04)	120 (4.72)	4.5 (0.18)	130 (5.12)	4.5 (0.18)	4.5 (0.18)	4.5 (0.18)
LSLV0015S100-1	100 (3.94)	91 (3.58)	128 (5.04)	120 (4.72)	4.5 (0.18)	145 (5.71)	4.5 (0.18)	4.5 (0.18)	4.5 (0.18)
LSLV0022S100-1	140 (5.51)	132 (5.20)	128 (5.04)	120 (4.72)	4 (0.16)	145 (5.71)	4.5 (0.18)	4.25 (0.17)	4.5 (0.18)

Table 2-2 Dimensions per frame (3-phase 200 V)

mm (inches)

Inverter capacity	W1	W2	H1	H2	H3	D1	A	B	Φ
LSLV0004S100-2	68 (2.68)	59 (2.32)	128 (5.04)	120 (4.72)	4.5 (0.18)	123 (4.84)	4 (0.16)	4 (0.16	4 (0.16)
LSLV0008S100-2	68 (2.68)	59 (2.32)	128 (5.04)	120 (4.72)	4.5 (0.18)	128 (5.04)	4 (0.16)	4 (0.16	4 (0.16)
LSLV0015S100-2	100 (3.94)	91 (3.58)	128 (5.04)	120 (4.72)	4.5 (0.18)	130 (5.12)	4.5 (0.18)	4.5 (0.18)	4.5 (0.18)
LSLV0022S100-2	100 (3.94)	91 (3.58)	128 (5.04)	120 (4.72)	4.5 (0.18)	145 (5.71)	4.5 (0.18)	4.5 (0.18)	4.5 (0.18)
LSLV0037S100-2 LSLV0040S100-2	140 (5.51)	132 (5.20)	128 (5.04)	120 (4.72)	4 (0.16)	145 (5.71)	4.5 (0.18)	4.25 (0.17)	4.5 (0.18)
LSLV0055S100-2 LSLV0075S100-2	160 (6.30)	137 (5.39)	232 (9.13)	216.5 (8.52)	10.5 (0.41)	140 (5.51)	5 (0.20)	5 (0.20)	
LSLV0110S100-2	180 (7.09)	157 (6.18)	290 (11.4)	273.7 (10.8)	11.3 (0.44)	163 (6.42)	5 (0.20)	5 (0.20)	
LSLV0150S100-2	220 (8.66)	193.8 (7.63)	350 (13.8)	331 (13.0)	13 (0.51)	187 (7.36)	6 (0.24)	6 (0.24)	
LSLV0185S100-2 LSLV0220S100-2	250 (9.84)	221 (8.70)	390 (15.4)	368.5 (14.5)	14 (0.55)	188.5 (7.42)	7 (0.28)	7 (0.28)	

Table 2-3 Dimensions per frame (3-phase 400 V)

mm (inches)

Inverter capacity	W1	W2	H1	H2	H3	D1	A	B	Φ
LSLV0004S100-4	68 (2.68)	59 (2.32)	128 (5.04)	120 (4.72)	4.5 (0.18)	123 (4.84)	4 (0.16)	4 (0.16	4 (0.16)
LSLV0008S100-4	68 (2.68)	59 (2.32)	128 (5.04)	120 (4.72)	4.5 (0.18)	128 (5.04)	4 (0.16)	4 (0.16	4 (0.16)
LSLV0015S100-4	100 (3.94)	91 (3.58)	128 (5.04)	120 (4.72)	4.5 (0.18)	130 (5.12)	4.5 (0.18)	4.5 (0.18)	4.5 (0.18)
LSLV0022S100-4	100 (3.94)	91 (3.58)	128 (5.04)	120 (4.72)	4.5 (0.18)	145 (5.71)	4.5 (0.18)	4.5 (0.18)	4.5 (0.18)
LSLV0037S100-4 LSLV0040S100-4	140 (5.51)	132 (5.20)	128 (5.04)	120 (4.72)	4 (0.16)	145 (5.71)	4.5 (0.18)	4.25 (0.17)	4.5 (0.18)
LSLV0055S100-4 LSLV0075S100-4	160 (6.30)	137 (5.39)	232 (9.13)	216.5 (8.52)	10.5 (0.41)	140 (5.51)	5 (0.20)	5 (0.20)	-
LSLV0110S100-4 LSLV0150S100-4	180 (7.09)	157 (6.18)	290 (11.4)	273.7 (10.8)	11.3 (0.44)	163 (6.42)	5 (0.20)	5 (0.20)	-
LSLV0185S100-4 LSLV0220S100-4	220 (8.66)	193.8 (7.63)	350 (13.8)	331 (13.0)	13 (0.51)	187 (7.36)	6 (0.24)	6 (0.24)	-

2.1.6 Power Terminal Block Wiring and External Fuse Specifications

Table 2-4 Specifications for terminal screws

Applicable inverter		Terminal screw size	[1)]screw torque (Kgf·cm)	[2)]cable mm² R,S,T	mm² U,V,W	AWG R,S,T	AWG U,V,W
200V Single phase	0.4 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	0.75 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	1.5 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	2.2 kW	M4	2.1 - 6.1	1.5	1.5	16	16
200V Three-phase	0.4 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	0.75 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	1.5 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	2.2 kW	M3.5	2.1 - 6.1	2.5	2.5	14	14
	3.7 kW	M4	2.1 - 6.1	4	4	12	12
	4 kW	M4	2.1 - 6.1	4	4	12	12
	5.5 kW	M4	2.1 - 6.1	6	6	10	10
	7.5 kW	M4	2.1 - 6.1	6	6	10	10
	11 kW	M5	4.0 - 10.2	10	10	8	8
	15 kW	M5	4.0 - 10.2	16	16	6	6
	18.5 kW	M6	6.1 - 10.2	25	25	4	4
	22 kW	M6	6.1 - 10.2	35	35	2	2
400V Three-phase	0.4 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	0.75 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	1.5 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	2.2 kW	M3.5	2.1 - 6.1	1.5	1.5	16	16
	3.7 kW	M4	2.1 - 6.1	1.5	1.5	16	16
	4 kW	M4	2.1 - 6.1	1.5	1.5	16	16
	5.5 kW	M4	2.1 - 6.1	2.5	2.5	14	14
	7.5 kW	M4	2.1 - 6.1	4	4	12	12
	11 kW	M5	4.0 - 10.2	4	4	12	12
	15 kW	M5	4.0 - 10.2	6	6	10	10
	18.5 kW	M5	4.0 - 10.2	10	10	8	8
	22 kW	M5	4.0 - 10.2	10	10	8	8

1) Please tighten the terminal screws with specified torques. Any loose screw can cause short circuit and malfunction.
2) Copper cable of 600 V and 90℃ should be used.
3) You should use UL-approved ring or fork terminal for LSLV0185S100-2 and LSLV0220S100-2.

The total wiring length should be within 200 m. Especially when connecting with a remote motor, the overcurrent protection may be activated or a device connected to the output side may malfunction due to increase in the ground leakage current within the wiring. Therefore when connecting with a motor, the total wiring length should be within 200 m. Even when multiple motors are connected, the total wiring length should be within 200 m. When connecting with a remote motor, do not use 3 core cable. (but if a 3.7 kW or less motor is used, the length should be 50 m or less)

Line drop [V] = (√3 X cable resistance [mΩ/m] X wiring length [m] X current[A]) / 1000

If you want to reduce the line drop when the wiring length is long, please use thick cables. At this time, lower the carrier frequency or use an output circuit filter (micro surge filter).

Distance between inverter and motor	Up to 50 m (54.68 yd)	Up to 100 m (109.36 yd)	100 m (109.36 yd) or longer
Allowed carrier frequency	15 kHz or less	5 kHz or less	2.5 kHz or less

Note **Short Circuit Rating**

- Maximum allowed prospective short-circuit current at the input power connection as defined in IEC 60439-1 is 100 kA. The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the drive maximum rated voltage.
- RMS Symmetrical Amperes for S100 series are 5,000 A.

WARNING

- Power supply must be connected to the R, S, and T Terminals.
- Connecting it to the U, V, W terminals causes internal damages to the inverter. Arranging the phase sequence is not necessary.
- Motor should be connected to the U, V, and W Terminals.
- If the forward command (FX) is on, the motor should rotate counter clockwise when viewed from the load side of the motor. If the motor rotates in the reverse, switch the U and V terminals.

2.2 Continuous Rated Current Derating for Inverters

2.2.1 Rated Current Derating for Carrier Frequency

When changing the carrier frequency, refer to Figure 2-5 for heavy load and Figure 2-6 for light load.

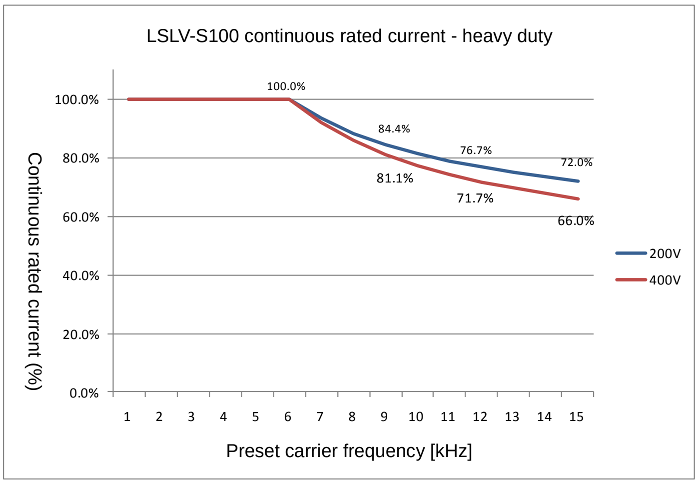


Figure 2-5 Continuous rated current for heavy load

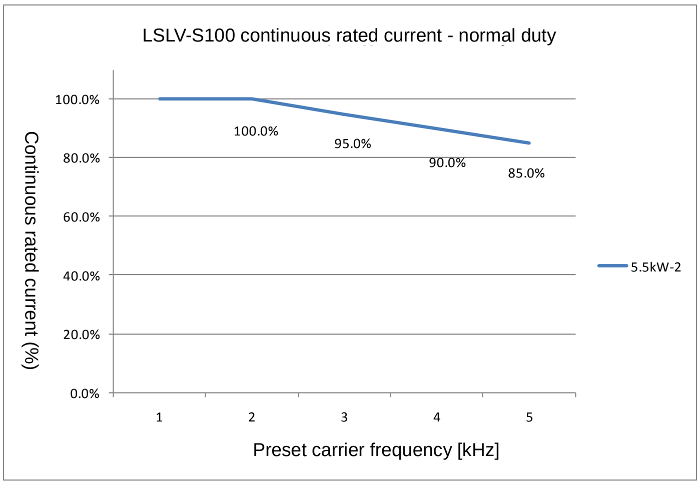


Figure 2-6 Continuous rated current for light load (5.5 kW 200 V)

2.2.2 Rated Current Derating for Input Voltage

The rated current capacity changes according to the inverter input voltage. Refer to Figure 2-7 and 2-8.

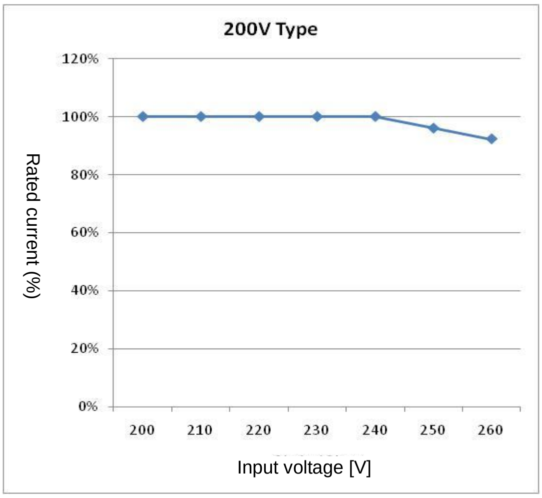


Figure 2-7 3-phase 200 V type continuous rated current

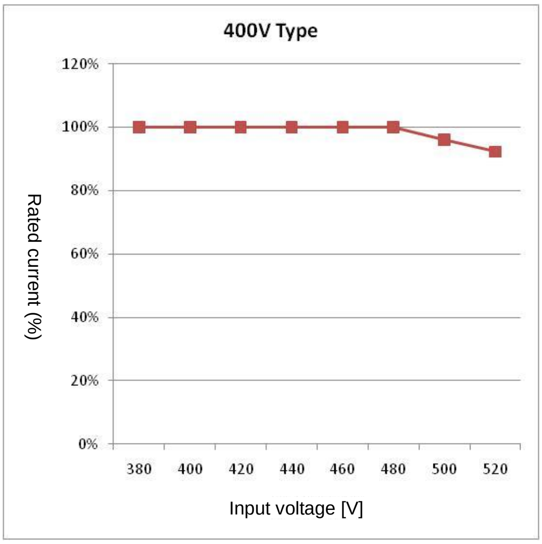


Figure 2-8 3-phase 400 V type continuous rated current

2.2.3 Rated Current Derating based on Ambient Temperature and Installation Method

Ambient temperature and installation method (e.g.: side-by-side installation) affects the inverter's rated current capacity. Refer to Figure 2-9.

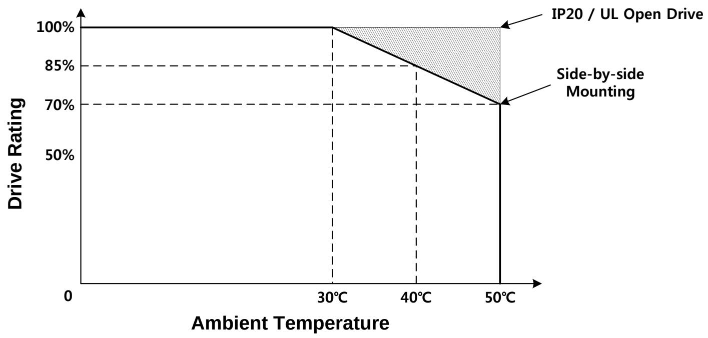
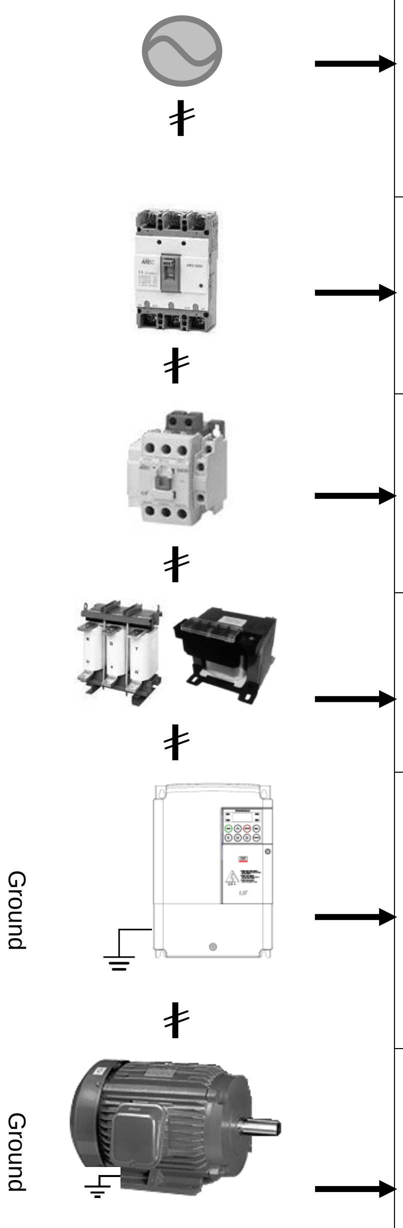


Figure 2-9 Continuous rated current based on ambient temperature and installation method

2.3 Types of Peripheral Devices

2.3.1 Precautions before Peripheral Device Installation

It is necessary to select and connect the peripheral devices correctly. Incorrect system configuration and connection hinder normal operation or reduce the inverter's life significantly. In the worst-case scenario, the inverter may be damaged. Therefore, adhere to the precautions in the manual.



Power specifications	Use the power within the scope of power specifications allowed by the inverter. ▪ 200V product: 200 - 240V (-15% - +10%) ▪ 400 V product: 380 - 480 V (-15% - +10%)
Molded case circuit breaker or earth leakage breaker	Inrush current can be significant at power on. Be sure to use the correct class breaker.
Magnetic contactor	Installation is not required. If magnetic contactor is installed, do not use it to turn on/off the inverter frequently otherwise, the inverter's life may be reduced.
AC and DC reactor (Optional)	A reactor may be used to improve the power factor or when input power capacity is large (1000 kVA or more, within 10m wiring length). Please select the reactor carefully.
Inverter location and wiring	Since the inverter's life is severely affected by the ambient temperature, do not allow the ambient temperature to exceed the allowed limit. Incorrect wiring may damage the product. Please follow the installation method. Ground terminal should be grounded.
Inverter output terminal	Do not install phase advanced capacitor, surge killer, or radio noise filter on the output side otherwise, the inverter may be damaged or operate abnormally. Ground terminal should be grounded.

2.3.2 Molded Case Circuit Breaker, Magnetic Contactor and Reactor Specifications

(1) Molded case circuit breaker and contactor specifications

Table 2-5 Molded case circuit breaker and contactor specifications

Inverter type	Molded case circuit breaker	Earth leakage breaker	Magnetic contactor
LSLV0004S100-1	TD125U	EBS 33c	MC-9
LSLV0008S100-1	TD125U	EBS 33c	MC-9
LSLV0015S100-1	TD125U	EBS 33c	MC-12
LSLV0022S100-1	TD125U	EBS 33c	MC-18
LSLV0004S100-2	TD125U	EBS 33c	MC-9
LSLV0008S100-2	TD125U	EBS 33c	MC-9
LSLV0015S100-2	TD125U	EBS 33c	MC-12
LSLV0022S100-2	TD125U	EBS 33c	MC-18
LSLV0037S100-2	TD125U	EBS 33c	MC-32
LSLV0040S100-2	TD125U	EBS 33c	MC-32
LSLV0055S100-2	TD125U	EBS 53c	MC-40
LSLV0075S100-2	TD125U	EBS 63c	MC-50
LSLV0110S100-2	TD125U	EBS 103c	MC-65
LSLV0150S100-2	TD125U	EBS 203c	MC-100
LSLV0185S100-2	TS250U	EBS 203c	MC-100
LSLV0220S100-2	TS250U	EBS 203c	MC-125

Inverter type	Molded case circuit breaker	Earth leakage breaker	Magnetic contactor
LSLV0004S100-4	TD125U	EBS 33c	MC-9
LSLV0008S100-4	TD125U	EBS 33c	MC-9
LSLV0015S100-4	TD125U	EBS 33c	MC-9
LSLV0022S100-4	TD125U	EBS 33c	MC-12
LSLV0037S100-4	TD125U	EBS 33c	MC-18
LSLV0040S100-4	TD125U	EBS 33c	MC-18
LSLV0055S100-4	TD125U	EBS 33c	MC-32
LSLV0075S100-4	TD125U	EBS 33c	MC-32
LSLV0110S100-4	TD125U	EBS 53c	MC-40
LSLV0150S100-4	TD125U	EBS 63c	MC-50
LSLV0185S100-4	TD125U	EBS 103c	MC-65
LSLV0220S100-4	TD125U	EBS 103c	MC-65

(2) Fuse and reactor specifications

Table 2-6 Fuse and reactor specifications

Inverter type	AC input fuse [external fuse]		AC reactor		DC reactor	
	Current [A]	Voltage [V]	Inductance [mH]	Current [A]	Inductance [mH]	Current [A]
LSLV0004S100-1	10	600	1.20	10	4	8.67
LSLV0008S100-1	10	600	1.20	10	4	8.67
LSLV0015S100-1	15	600	0.88	14	3	13.05
LSLV0022S100-1	20	600	0.56	20	1.3	18.45
LSLV0004S100-2	10	600	1.20	10	4	8.67
LSLV0008S100-2	10	600	1.20	10	4	8.67
LSLV0015S100-2	15	600	0.88	14	3	13.05
LSLV0022S100-2	20	600	0.56	20	1.3	18.45
LSLV0037S100-2	32	600	0.39	30	1.3	26.35
LSLV0040S100-2	50	600	0.39	30	1.3	26.35
LSLV0055S100-2	50	600	0.30	34	1.60	32
LSLV0075S100-2	63	600	0.22	45	1.25	43
LSLV0110S100-2	80	600	0.16	64	0.95	61
LSLV0150S100-2	100	600	0.13	79	0.70	75
LSLV0185S100-2	125	600	0.11	94	0.50	89
LSLV0220S100-2	160	600	0.08	125	0.35	120
LSLV0004S100-4	10	600	4.81	4.8	16	4.27
LSLV0008S100-4	10	600	4.81	4.8	16	4.27
LSLV0015S100-4	10	600	3.23	7.5	12	6.41
LSLV0022S100-4	15	600	2.34	10	8	8.9
LSLV0037S100-4	20	600	1.22	15	5.4	13.2
LSLV0040S100-4	32	600	1.22	15	5.4	13.2
LSLV0055S100-4	32	600	1.12	19	3.20	17
LSLV0075S100-4	35	600	0.78	27	2.50	25
LSLV0110S100-4	50	600	0.59	35	1.90	32
LSLV0150S100-4	63	600	0.46	44	1.40	41
LSLV0185S100-4	70	600	0.40	52	1.00	49
LSLV0220S100-4	100	600	0.30	68	0.70	64

Note — **Short Circuit FUSE/BREAKER Marking**

- Use Class H or RK5 UL Listed Input Fuse and UL Listed Breaker Only. See the table above For the Voltage and Current rating of the fuse and the breaker.

3. Installation

3.1 Precautions before Installation

The inverter uses plastic parts. Handle the inverter carefully so as not to damage it.

Warning
▪ Do not move the product by only holding the cover.

Install the inverter vertically with bolts on the firm surface that can support the weight of the inverter. Since the inverter's life can be severely affected by the ambient temperature, do not allow the ambient temperature of the installation place to exceed the allowed temperature (heavy load: -10 - 50°C, light load: -10 - 40°C).

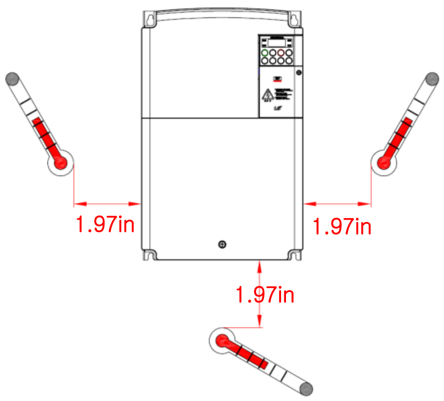


Figure 3-1 Positions for measuring ambient temperature

Since the inverter may be heated during use, install it on fire retardant surface. Leave sufficient ambient space around the inverter to prevent heat saturation. The inverter produces a substantial amount of heat.

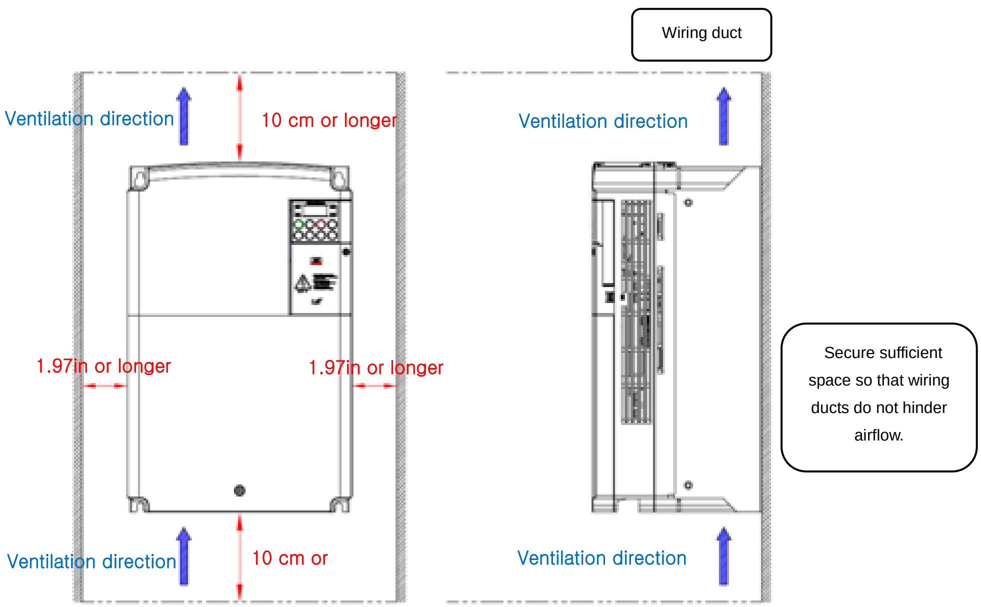


Figure 3-2 Ambient spacing

When installing multiple inverters inside a panel, select the locations for ventilation fan and inverters carefully. When installing an inverter, install it vertically on the surface and use screws and bolts to fasten it to the surface.

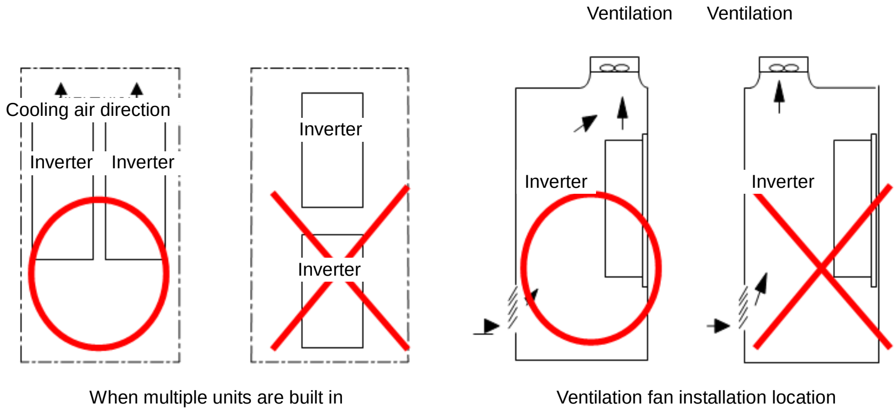


Figure 3-3 Ventilation fan and inverter installation locations

When installing multiple inverters closely side by side, remove the inverter top cover as shown in the figure 3-5.

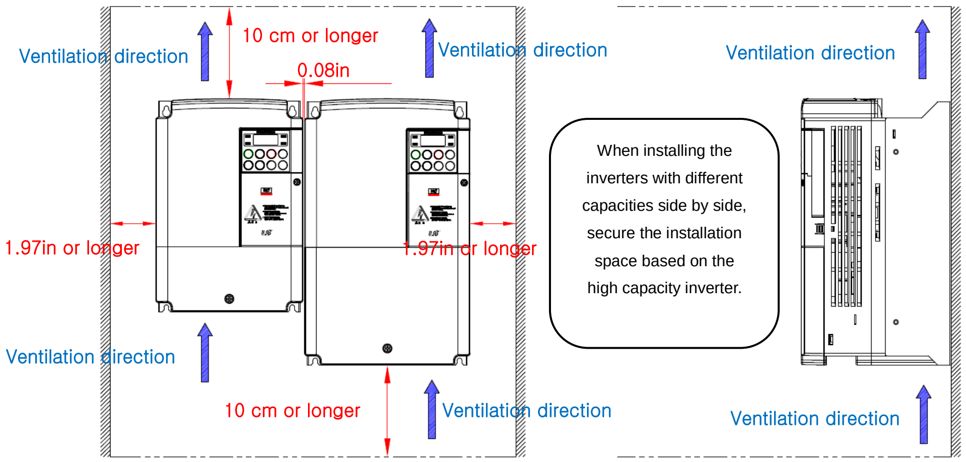


Figure 3-4 Side by side installation

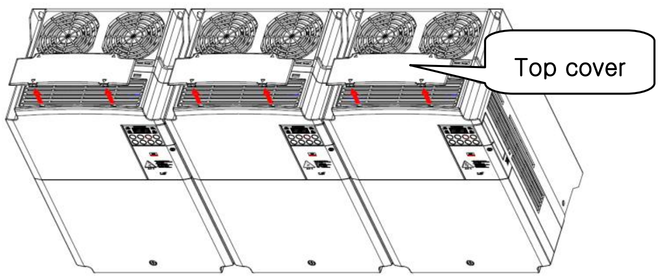


Figure 3-5 Remove the top covers for the side by side installation

Notes

- Install the panel so that the high-temperature air generated by the inverter can be exhausted with ease.

⚠ Caution

- For compliance with EMC requirements, product must be installed inside of metallic cabinet

3.2 Installation Checklist

Check the mechanical and electrical installation environment before starting the inverter. Read the following checklist carefully. Be sure to read the safety precautions in this manual before using the inverter.

Checklist
▪ Mechanical installation checklist • Check if the ambient environment satisfies the operation conditions. (Check 'Precautions before Installation'.) • Leave sufficient ambient space around the inverter to prevent heat saturation. The inverter produces a substantial amount of heat. • Check if the air is circulating normally. • Check if the motor and drive device are ready to start. ▪ Electrical installation checklist • Check that the inverter is securely grounded. • Please replace any condenser that is 2 years old or more. • Match the input voltage with inverter's rated input voltage • Connect the input power to inverter input terminal (R,S,T) and use the correct torque for fastening. • Check that the correct input power fuse or protective device and breaker are installed. • Place the motor cable away from other cables. • Check the external input/output connection. • Make sure that input power is not connected to the inverter's output terminal.

3.3 Installation and Commissioning Procedures

Check the purchased product.

↓

Check if the place and environment are suitable for installation of S100.

↓

Install the unit.

↓

Check if the standard settings are suitable for the intended use.

- Motor's rated frequency: 50 or 60Hz
- Load type: Pump and others

Max. output frequency: 50 Hz

↓

Connect the control cables.

↓

Apply power.

↓

Adjust the acceleration/deceleration time as neccessary.

↓

Set the rotation speed value and input the start signal.

↓

Motor accelerates up to the preset speed.

4. Wiring

4.1 Wiring Precautions

- The inverter may be damaged if the input power is connected to the inverter's output terminal (U,V,W).
- For the power and motor terminals, use a crimp terminal with insulation cap.
- Ensure that there are no pieces of wire left inside the inverter after wiring. Any remaining wire residue may cause failure or malfunction.
- Use correctly rated cable for input/output wiring so that the voltage drop is below 2%. If the wiring between the inverter and motor is long, the motor torque goes down due to voltage drop in main circuit wiring during the low frequency operation.
- The wiring length between the inverter and motor should be below 200 m. If wiring between the inverter and motor is too long, the overcurrent protection may be activated or a device connected to the output side may malfunction due to increase in the floating capacity within the wiring. For motor cablesin excess of 50m a sinusoidal filter or other precautions may be required.
- Since the main circuit input/output of the inverter include harmonic waves, communication device placed near the inverter can be affected by radio interference. It is recommended that an EMC filter be installed in the input side to reduce interference.
- Do not install phase advanced capacitor, surge killer, or radio noise filter on the output side of the inverter. Otherwise, inverter trip may occur or condenser or surge killer may be damaged.
- If a problem occurs during operation and the wiring needs to be changed, first ensure that the body LED or charge lamp near the power terminal block are off. The inverter's internal condenser is charged with high voltage for a while even after the power has been turned off.
- Do not connect magnetic contactor to the inverter output and turn it on/off during operation. (Inverter trip may occur or inverter may be damaged.)
- Apply the rated torque to terminal screws. Loosen screws can cause of short circuit and malfunction. Tighting the screw too much can damage the terminals and cause short circuit and mulfuction.
- Use copper wires only with 600V, 75℃ ratings for wiring.
- To avoid interference with sensitive electronic equipment nearby the motor cable should be screened and the screen should be connected to ground at both the motor and inverter ends.

4.2 Ground

- The motor and inverter **MUST** be grounded, as the inverter passes leakage current during high switching operation.
- 200 V product belongs to Class 3 grounding, with grounding resistance below 100 Ω (Ohm) while 400 V product belongs to Special Class 3 grounding, with grounding resistance below 10 Ω (Ohm).
- Connect grounding wire to the dedicated grounding terminal. Do not use the case or sash screw as the grounding terminal.
- Use thick wire for grounding if possible. Use the wire thickness specified below and keep wiring short if possible.

Table 4-1 Grounding wire specifications based on the motor capacity

Motor Capacity	Grounding wire specifications			
	mm^2		AWG	
	200V product	400 V product	200V product	400 V product
0.4 - 4 kW	4	2.5	12	14
5.5 - 7.5 kW	6	4	10	12
11 - 15 kW	16	10	6	8
18.5 - 22 kW	22	16	4	6

4.3 Wiring Method

(1) Removing the front cover and wiring bracket (5.5 kW 200/400 V - 15 kW 400 V)

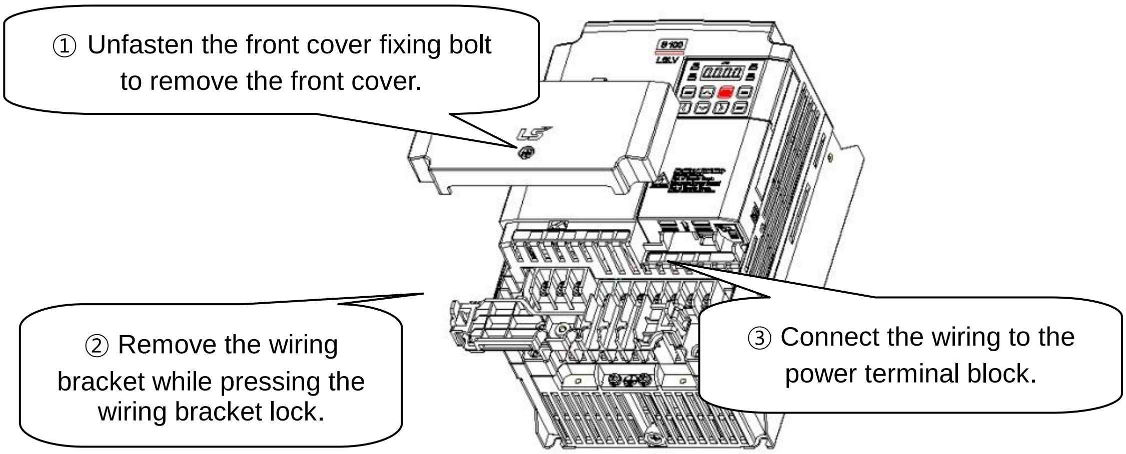


Figure 4-1 Removing the front cover and wiring bracket (5.5 kW 200/400 V - 15 kW 400 V)

1. Unfasten the front cover fixing bolt to remove the front cover.
2. Remove the wiring bracket while pressing the wiring bracket lock.
3. Connect the wiring to the power terminal block.

(2) Removing the front cover and wiring bracket (15 kW 200 V - 22 kW 200/400 V)

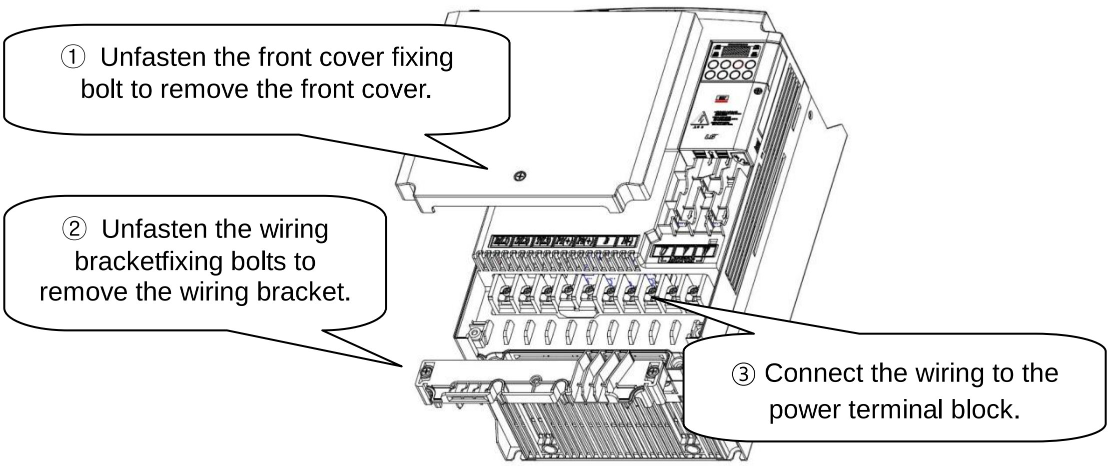


Figure 4-2 Removing the front cover and wiring bracket (15 kW 200 V -22 kW 200/400 V)

1. Unfasten the front cover fixing bolt to remove the front cover.
2. Unfasten the wiring bracket fixing bolts to remove the wiring bracket.
3. Connect the wiring to the power terminal block.

(3) Removing IO bracket (5.5 ~ 22kW 200/400V)

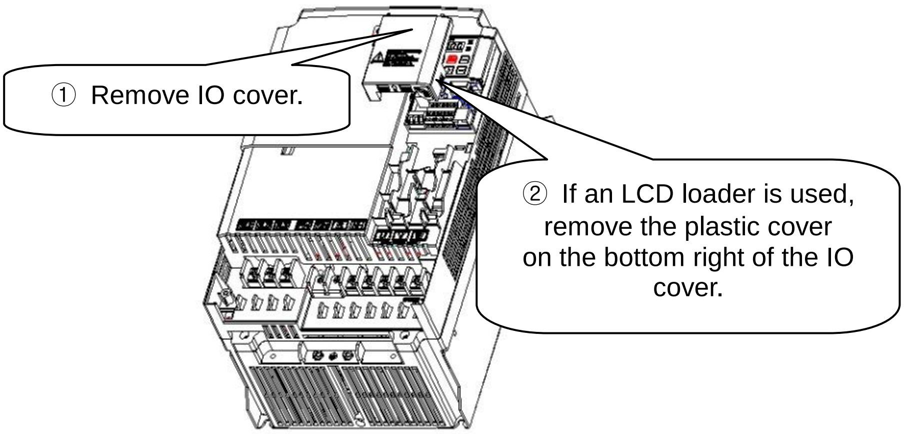
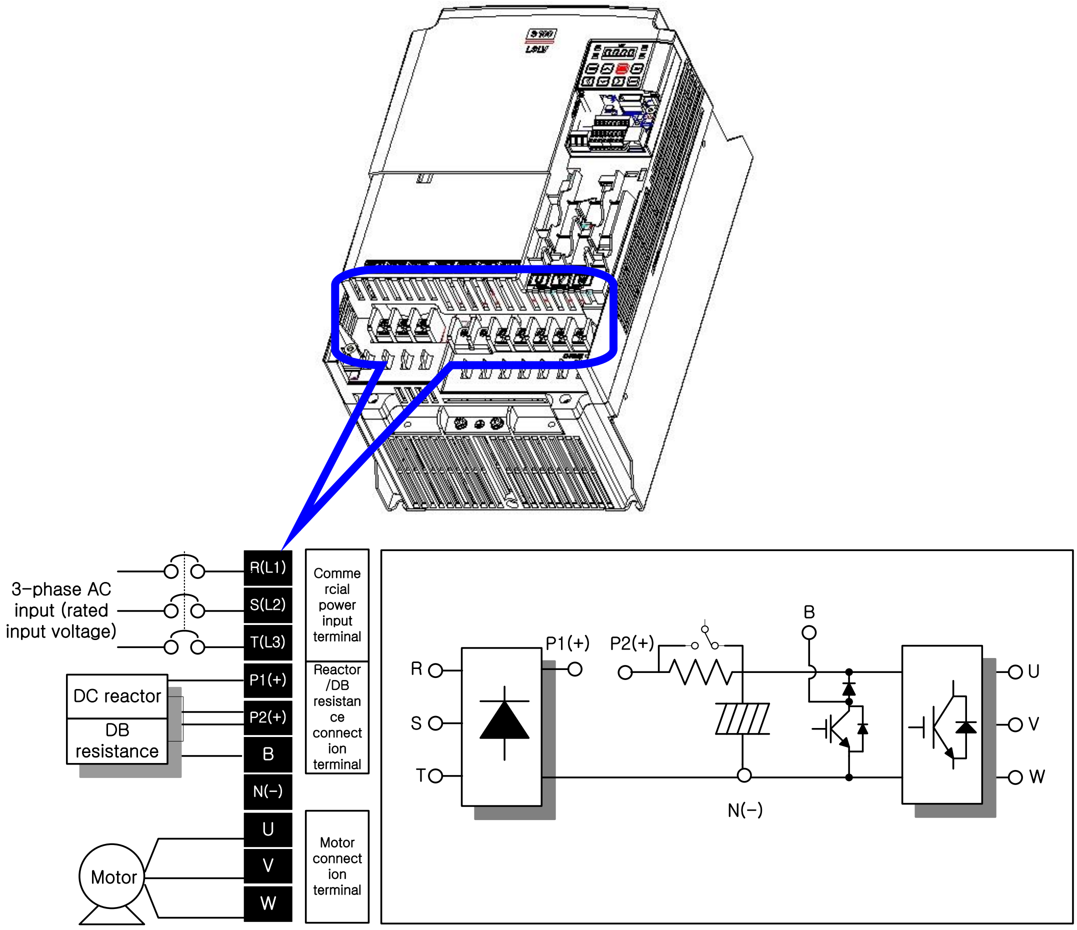


Figure 4-3 Removing IO bracket

1. Unfasten the front cover fixing bolt to remove the front cover.
2. Remove the IO cover.
3. If an LCD loader is used, remove the plastic cover on the lower side of the IO cover.
4. Connect the wiring to the IO terminal. (If an LCD loader is used, connect the loader cable to the RJ-45 connector.)

4.4 Power Terminal Wiring Diagram

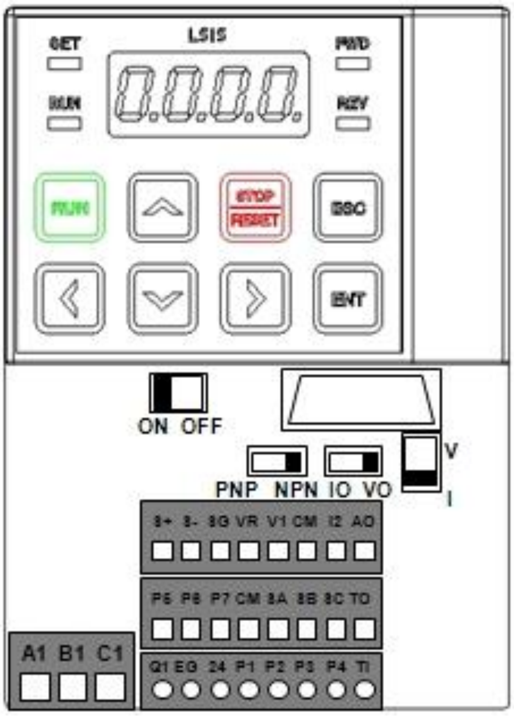


Note: Necessary screen around motor wires not shown for clarity

Table 4-2 0.4 - 22 kW (200 V/400 V) main circuit terminal name and description

Terminal symbol	Terminal name	Description of the terminal
R(L1), S(L2), T(L3)	AC power input	Connects the commercial AC input.
P1(+)	(+) DC voltage terminal	(+) DC link voltage terminal.
N(-)	(-) DC voltage terminal	(-) DC link voltage terminal.
P2(+), B	Braking resistance connection terminal	Connects the braking resistance.
U, V, W	Inverter output	Connects the 3-phase induction motor.

4.5 Control Terminal Block Wiring Diagram



Please refer to the diagram for I/O terminal setting at back side of I/O cover.

Figure 4-4 Standard I/O terminal

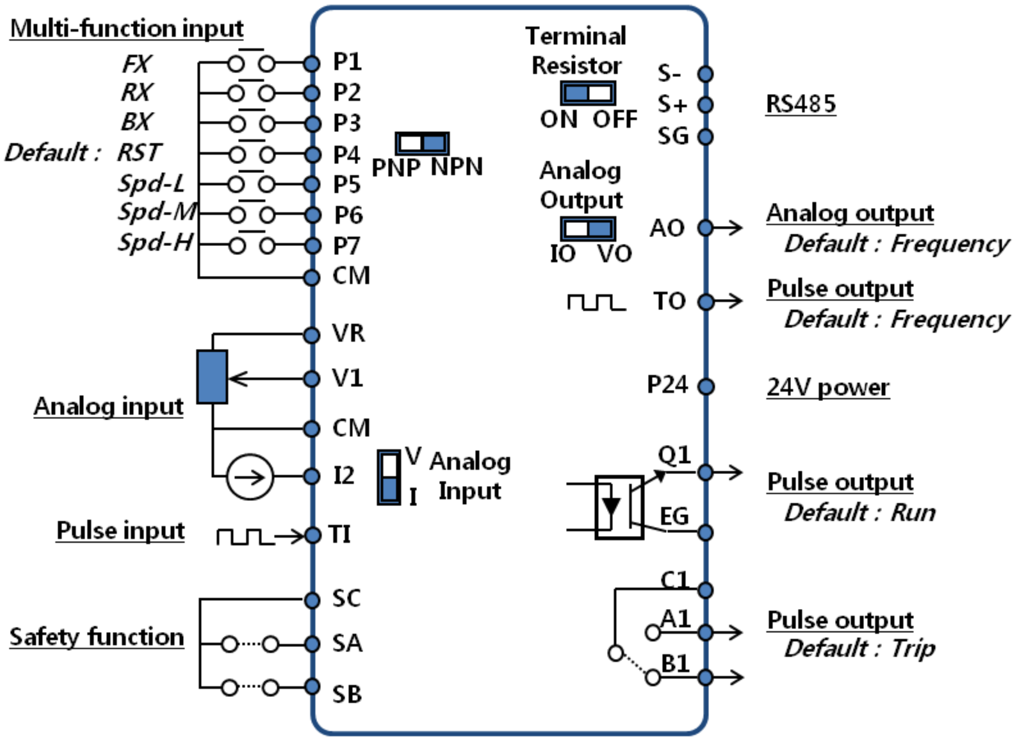


Figure 4-5 Power Terminal Wiring Diagram

Table 4-3 Control circuit terminal description

Category		Terminal symbol	Terminal name	Description of the terminal
Input Signal	Selecting the contact start function	P1 - P7	Multi-functional input 1-7	These terminals are digital multi-function and their use can be defined.
		CM	Sequence common terminal	Common terminal for contact input and analog input/output.
	Analog frequency setting	VR	Power (+) terminal for frequency setting	+12V DC power supply for setting the analog frequency. Max power is +12 V at 100 mA.
		V1	Frequency setting (voltage)	Input DC 0~10V, -10~10V used to set motor frequency(speed). Max input voltage : Unipolar (0 ~ 12V), Bipolar (-12V ~ 12V)
		I2	Frequency setting (current)	Input 4 - 20 mA used to set motor frequency(speed). Max input current : 0~24mA The input resistance is 249 Ω. It can be used as unipolar voltage input V2 depending on the SW2 setting.
		TI	Frequency setting (pulse train)	Input 0 - 32 kHz can be set to the required motor frequency. ▪ Low level: 0 ~ 0.8V ▪ High level: 3.5 ~ 12 V
	Safety function setting	SA	Safety input A	If an emergency occurs, the motor power can be securely cut off externally. Operation is described below depending on the connection status of SA, SB and SC. ▪ Both SA and SB connected to SC: Normal operation ▪ Either of A or B connected to SC or Both disconnected: Motor power cut off
		SB	Safety input B	
		SC	Safety input power	DC 24V and 25mA or less
Output signal	Analog	AO	Analog voltage / current output terminal	Can be configured to output one of the following: output frequency, output current, output voltage and DC voltage. You can select voltage or current output as shown below according to SW3. ▪ Voltage • Output voltage: 0 ~ 10 V • Max. output voltage: 12V • Max. output current: 10mA • Output current: 0 ~ 20mA • Max. output current: 24mA
		TO	Pulse output terminal	Selectively outputs one among output frequency, output current, output voltage and DC voltage. ▪ Output frequency: 0 ~32kHz ▪ Output voltage: 0 ~ 12 V
	Contact	Q1	Multi-functional terminal (open	DC 26V and 100mA or less

Category		Terminal symbol	Terminal name	Description of the terminal
			collector)	
		EG	Common terminal for open collector	Common grounding terminal for external power for open collector.
		24	24 V power	Max. output current: 150 mA DC.
		A1,C1,B1	Fault signal output	Relay changes state when the inverter's protection function is activated to cut off the output. AC 250 V 1 A or less, DC 30 V 1 A or less ▪ Abnormal: A1-C1 CLOSED (B1-C1) ▪ Normal: B1-C1 OPEN (A1-C1)
		S+, S-, SG	RS-485 signal Input Terminal	RS-485 signal line. (Refer to Chapter 9 Communication Function (Page 9-1) in the user manual.)

⚠ **Caution**

- **Do not use more than 3m remote cable for the keypad. Failure of the signals on the keypad might occur.**
- To prevent radiated emissions in the analog and digital signals, a ferrite may be required around the wires of these signals.

■ Setting NPN (Sink) / PNP (Source)

The control circuit's sequence input terminal supports both NPN mode (Sink mode) and PNP mode (Source mode). You can use NPN(Sink)/PNP(Source) setting terminal (SW1) to switch the input terminal logic between NPN mode (Sink mode) and PNP mode (Source mode). The connection methods per mode are as follows.

- NPN mode (Sink Mode)

  Set NPN (Sink) / PNP (Source) switch to NPN. CM terminal (24 V GND) is the common terminal for contact input signals. The factory default is NPN mode (Sink mode).

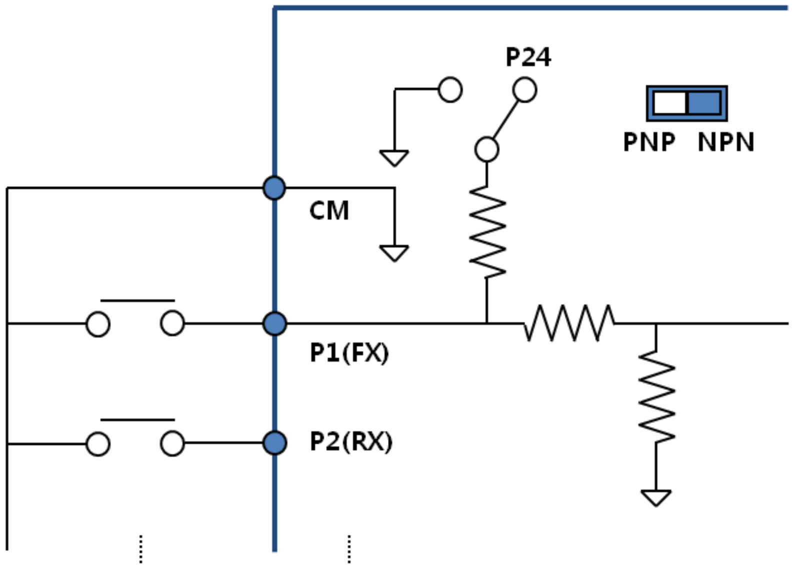


Figure 4-6 NPN (Sink) mode

- PNP mode (Source mode)

  Set NPN (Sink) / PNP (Source) switch to PNP. 24 terminal (24 V internal power) is the common terminal for contact input signals. If you want to use external 24 V power, connect (-) terminal of the external power with CM (24 V GND) terminal.

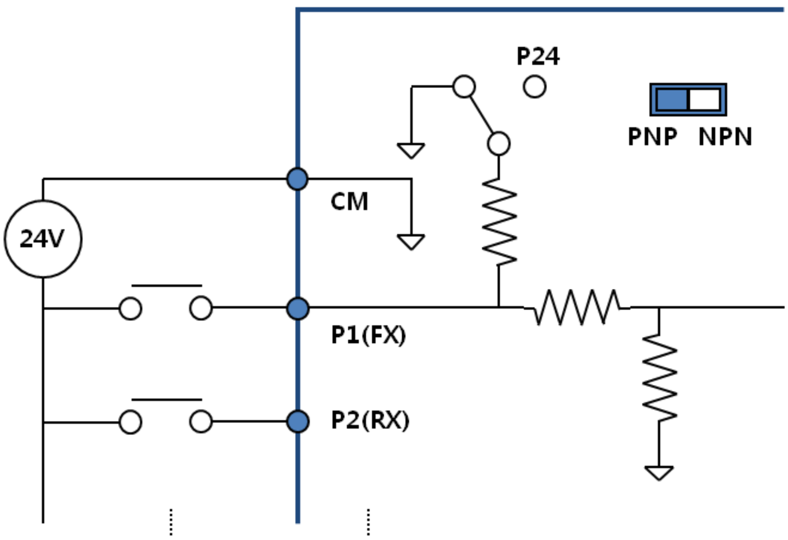


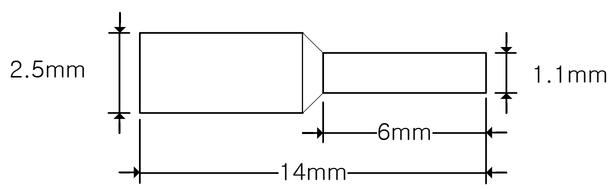
Figure 4-7 PNP (Source) mode

4.6 Signal Terminal Block Wiring Specifications

Table 4-4 Signal terminal block wiring specifications

Terminal type	Recommended wiring thickness [mm²] (AWG)		Terminal screw	Torque [Nm]	Electrical specifications
	Crimp terminal not used	Crimp terminal used			
P1 - P7					-
CM					-
VR					Output voltage: 12V Maximum output current: 100mA Potentiometer: 1 - 5 kΩ
V1					Maximum input voltage: -12 V - +12 V input
I2	0.75 (18)	0.5 (20)	M2	0.22-0.25	0 - 20 mA input Internal resistance: 249 ohm
AO					Maximum output voltage: 12 [V] Maximum output current: 10mA
Q1					DC 26 V, 100 mA or less
EG					-
24					Maximum output current: 150 mA
SA, SB, SC[9]					DC 24V and 25mA or less
S+, S-, SG					-
A1, B1, C1	1.0(17)	1.5(15)	M2.6	0.4	AC 250 V, 1 A or less, DC 30 V and 1 A or less

■ Recommended crimp terminal size for signal wiring



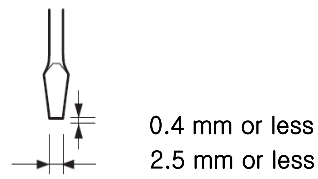
Note 1) when you use the cable tie, etc. to organize the control wiring, do it 15 cm or more away from the inverter. Otherwise, it may be impossible to assemble the front cover.

Note 2) Use copper wire satisfying 300 V and 75 ℃ limits.

Note 3) Apply required torque for terminal screw.

Note 4) When you engage the terminal block, use

a screwdriver of 2.5 m or less width and 0.4 mm or less thickness.



[9] Please ensure that safety input 's wiring length is below 30m.

4.7 Built-in EMC Filter

The 400 V S100 inverter has a built-in EMC filter to reduce electromagnetic interference from the inverter. The default setting for EMC filter is on. To turn it off, replace the EMC filter grounding bolt with the plastic bolt in the wiring bracket.

■ Disabling EMC filter function

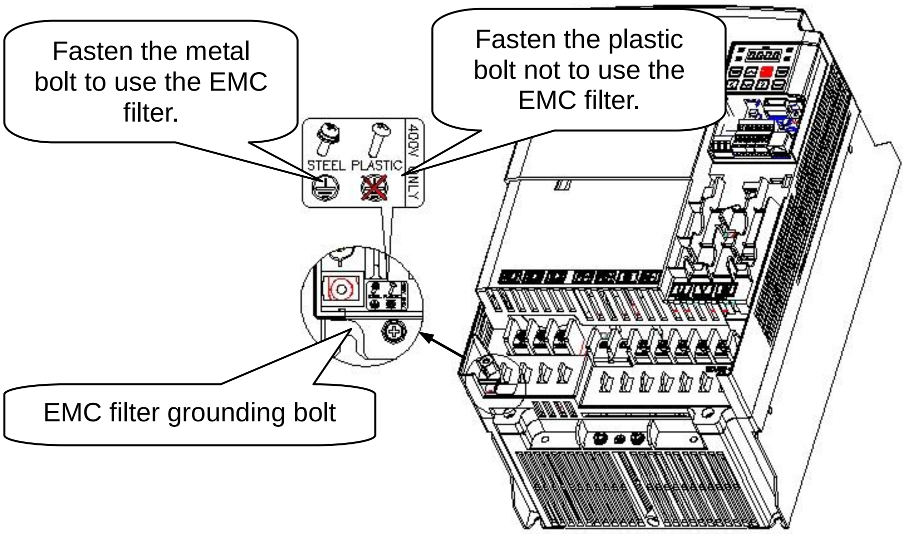


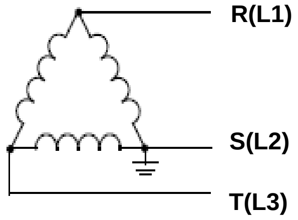
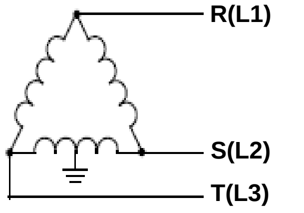
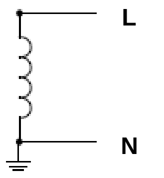
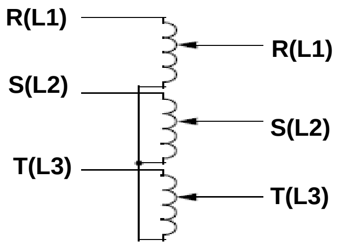
Figure 4-8 Disabling 5.5-22 kW or less EMC filter function

1. Replace the EMC filter grounding bolt with the plastic bolt in the wiring bracket to disable the EMC filter function.

Before starting to work, use a voltage tester to check the DC voltage across P1(+) and N(-) 10 minutes after cutting off the inverter power.

⚠ Caution
▪ If EMC filter is on, leakage current increases. ▪ If the input power is an asymmetrical grounding structure such as Delta connection, do not use the EMC filter. Otherwise, it may result in an electric shock. ▪ Disconnect the internal EMC filter when installing the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over30 ohms] power system), otherwise the system will be connected to ground potential Through the EMC filter capacitors. This may cause danger or damage the drive.Disconnect the internal EMC filter when installing the drive on a corner-grounded TN system, otherwise the drive will be damaged.

Table 4-5 Asymmetrical grounding structure

Asymmetrical grounding structure			
A phase of delta connection is grounded (TN systems)		The intermediate tab of a phase of delta connection is grounded (TN systems)	
Grounded on the end of single phase (TN systems)		3-phase connection not grounded (IT systems)	

4.8 Dynamic Braking Resistor

■ Option type of dynamic braking resistor

Following table has reference to DC braking torque: 150%, %ED: 5%. Rated power of DBU has to be doubled when %ED is 10%.

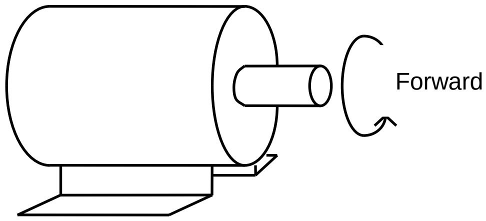
150% Baraking Torque, 5% ED						
Inverter Capacity [kW]	Single-phase 200V		Three-phase 200V		Three-phase 400V	
	Resistor [ohm]	Watt [W]	Resistor [ohm]	Watt [W]	Resistor [ohm]	Watt [W]
0.4kW	300	100	300	100	1,200	100
0.75kW	150	150	150	150	600	150
1.5kW	60	300	60	300	300	300
2.2kW	50	400	50	400	200	400
3.7kW	-	-	33	600	130	600
4.0kW	-	-	33	600	130	600
5.5kW	-	-	20	800	85	1,000
7.5kW	-	-	15	1,200	60	1,200
11kW	-	-	10	2,400	40	2,000
15kW	-	-	8	2,400	30	2,400
18.5kW	-	-	5	3,600	20	3,600
22kW	-	-	5	3,600	20	3,600

4.9 Normal Operation Check

■ Check the motor for forward/reverse direction and use keypad operation to check for smooth operation

Use keypad to set the operation group's drv code to 0 number key and set the command frequency to a specific speed and then press the RUN button to send the command to the inverter to operate in the forward direction.

At this time, the induction motor axis rotates CCW on the load side. If not, you should change two of the inverter output terminals (U, V, W)



4.10 Wiring Checklist

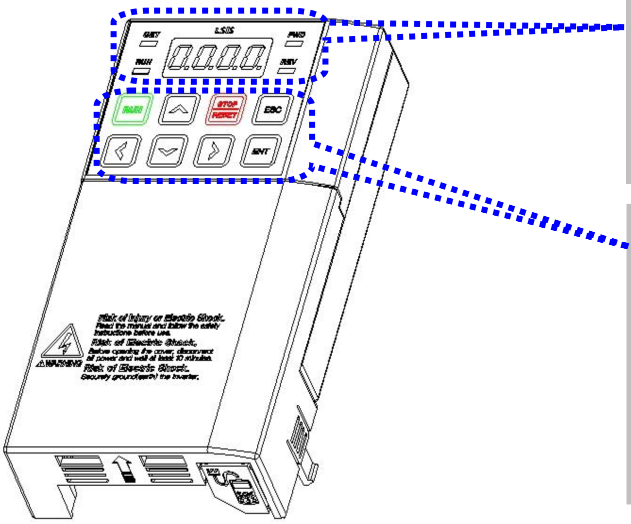
Check the main circuit and control circuit wiring before starting the inverter. Read the following checklist carefully.

Checklist
▪ **Inverter, peripheral devices, option cards** • Is the inverter type as ordered? • Are the types and number of the peripheral devices (resistor, DC reactor, noise filter, etc.) as ordered? • Is the type of option card as ordered? ▪ **Installation location and method** • Are the installation location and method appropriate? ▪ **Power voltage and output voltage** • Is the power voltage within the inverter input voltage specifications? • Do all rated outputs satisfy the inverter output specifications? • Is the rating correct? ▪ **Main circuit wiring** • Is the power being entered through an MCB or MCCB? • Is the rating and type of the MCB or MCCB correct? • Is the wiring of the power supply connected correctly to the inverter input terminal? [The inverter may be damaged if the input power is connected to the inverter's output terminal (U,V,W).] • Is the wiring of motor connected to the inverter's output terminal in the order of phases? (if not, the motor rotates in the reverse direction.) • Do the power and motor use 600 V vinyl (PVC) insulated wire? • Is the wire size of main circuit appropriate? • Is the installation and size of the grounding cable correct? • Are the screws of inverter's main circuit terminal and grounding terminal fastened firmly? • If a single inverter is used to operate multiple motors, is overload protection circuit provided at each motor? • If a braking resistor or braking resistor unit is used, is the inverter separated from the power due to overload protection by magnetic contactor on the inverter power side? • Make sure that phase advanced capacitor, surge killer, or radio noise filter is not connected to the output side. ▪ **Control circuit wiring** • Is twisted pair shielded wire used for the inverter's control circuit wiring? • Is the shield connected to the ground terminal? • If operating in 3-wire sequence, have you changed the parameters of multi-function contact input terminal and correctly connected the wiring to the control circuit? • Is the wiring for options correct? • Is there any incorrect wiring? • Are the screws of inverter's control circuit terminal fastened firmly? • Is the any wire residues or screws left? • Check and remove any stray wiring strands are could short circuit to other terminals. • Is the wiring of control and main circuits separated within the duct and control board? • Is the wiring length below 50 m? • Is the wiring length of safety input below 30 m?

Notes
▪ It is highly recommended that the motor cable is of the screened type with screen being connected to ground at both ends. ▪ It is also recommended that twisted-pair cable with overall screen is used for control signals. **Twisted-pair wires coated with highly conductive materials help block the influence from outside electrical and magnetic fields.**

5. Using the Keypad

5.1 Layout the Keypad



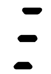
- Display
  - SET/RUN indicator lamp
  - FWD/REV indicator lamp
  - 7-segment

- Key
  - RUN
  - STOP/RESET
  - Increase, decrease [▲, ▼]
  - Left and right movement [◀, ▶]
  - Enter [ENT]
  - ESC

<table>
<tr><th colspan="3">Display</th></tr>
<tr><td>FWD</td><td>Turns on when operating in the forward direction.</td><td rowspan="4">Blinks when a failure has occurred.</td></tr>
<tr><td>REV</td><td>Turns on when operating in the reverse direction.</td></tr>
<tr><td>RUN</td><td>Turns on when operating.
Blinks when accelerating or decelerating.</td></tr>
<tr><td>SET</td><td>Turns on when setting the parameters.
Blinks when ESC key operates as the multi-key.</td></tr>
<tr><td>7-segment</td><td colspan="2">Displays operation status and parameter information.</td></tr>
</table>

<table>
<tr><th colspan="3">Key</th></tr>
<tr><td colspan="2">RUN</td><td>Operation command</td></tr>
<tr><td colspan="2">STOP/RESET</td><td>STOP: Command to stop, RESET: Command to reset when a failure has occurred</td></tr>
<tr><td>▲</td><td>Up</td><td>Use when moving codes or increasing the parameter value.</td></tr>
<tr><td>▼</td><td>Down</td><td>Use when moving codes or decreasing the parameter value.</td></tr>
<tr><td>◀</td><td>Left Shift</td><td>Use when moving between groups or moving to the left in the parameter setting.</td></tr>
<tr><td>▶</td><td>Right Shift</td><td>Use when moving between groups or moving to the right in the parameter setting.</td></tr>
<tr><td colspan="2">ENT</td><td>Use when changing the parameter values or saving the changed parameters.</td></tr>
<tr><td colspan="2">ESC</td><td>Jog or remote/local switch key. Use it to cancel during editing.</td></tr>
</table>

5.2 Display List for Numerals and Letters

	0		A		K		U
	1		B		L		V
	2		C		M		W
	3		D		N		X
	4		E		O		Y
	5		F		P		Z
	6		G		Q		
	7		H		R		
	8		I		S		
	9		J		T		

5.3 Menu Structure

LSLV-S100 series inverter is composed of 11 groups as shown in the following table.

Table 5-1 Function description per parameter group

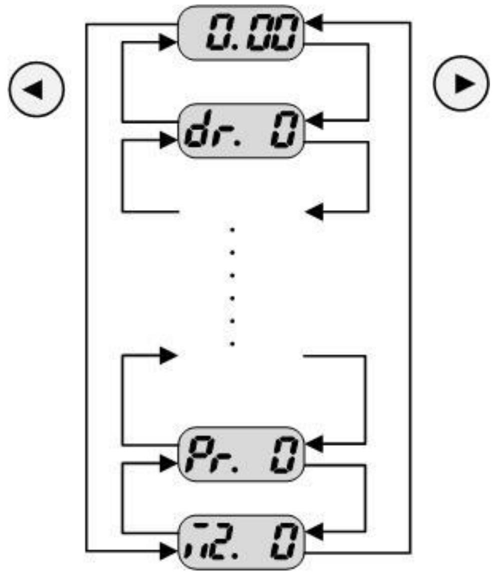
Group name	Sign	Function description
Operation group[10]	-	Basic parameters needed for operation, such as target frequency and acceleration/deceleration time, etc.
Drive group	dr	Basic operation parameters such as jog operation, motor capacity selection and torque boost and keypad operation-related parameters
Basic function group	bA	You can set the basic functions for motor parameters and multi-step frequency.
Advanced function group	Ad	You can set acceleration/deceleration patterns and frequency limitation.
Control function group	Cn	You can set the functions related to sensorless and vector controls.
Input terminal block function group	In	You can set functions related to inverter input terminal block such as multi-functional digital input and analog input.
Output terminal block function group	OU	You can set output terminal block functions including relay and analog output.
Communication function group	CM	If the inverter is equipped with built-in 485 communication and communication option card, you can set the related functions.
Application function group	AP	You can set functions for PID control sequence and other operations.
Protection function group	Pr	You can set protection functions for motor and inverter.
2nd motor function group (Motor 2) [11]	M2	This is displayed if you selected the 2nd motor among multi-functional input terminal functions. You can set the functions related to the 2nd motor.

[10] If the inverter is equipped with LCD keypad, only the target frequency is displayed.

[11] You should set the In.65 – 71 multi-functional input terminal function to no. 26 (2^{nd} Motor) to display it.

5.4 Moving between groups

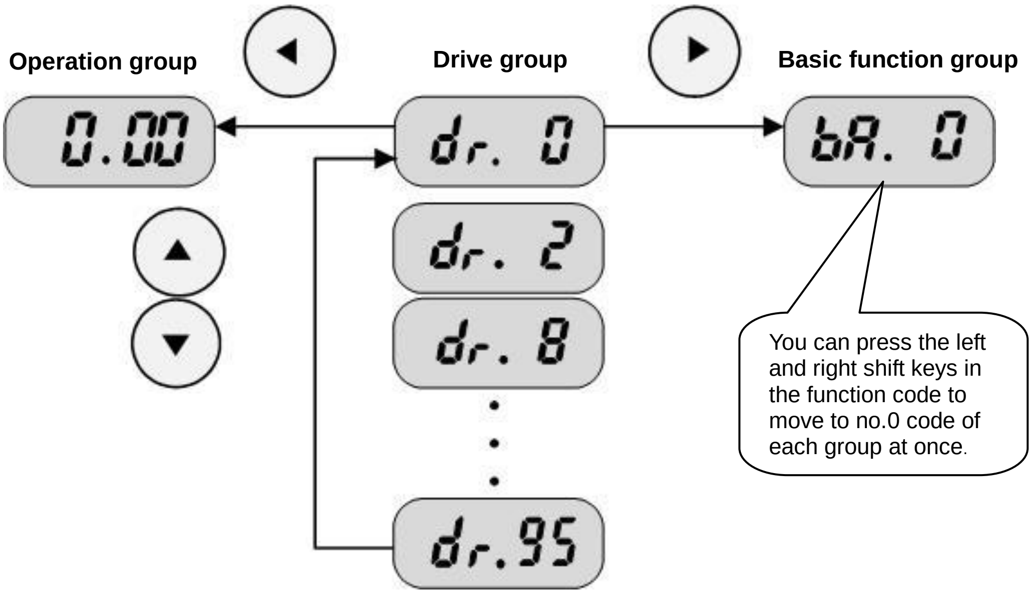
How to move between groups in the first code of each group

Group name	Sign	Moving between groups
Operation group[12]	-	
Drive group	dr	
Basic function group	bA	
Advanced function group	Ad	
Control function group	Cn	
Input terminal block function group	In	
Output terminal block function group	OU	
Communication function group	CM	
Application function group	AP	
Protection function group	Pr	
2nd motor function group (Motor 2) [13]	M2	

[12] If the inverter is equipped with LCD keypad, only the target frequency is displayed. The first code of the operation group is used to set the target frequency. Therefore, it is set to 0.00 at default, but if the user changes the operation frequency, the changed operation frequency is displayed.

[13] You should set the In.65 – 71 multi-functional input terminal function to no. 26 (2nd Motor) to display it.

How to move between groups in the position which is not the first code of each group

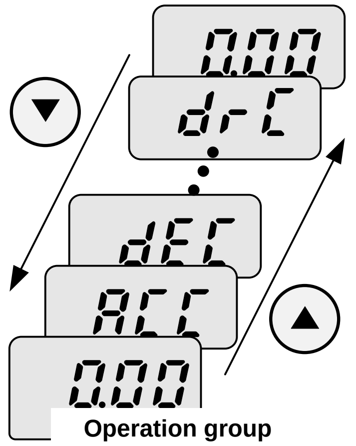


Do as follows to move from no.96 code of the drive group to the basic function group.

1	dr.95	▪ Indicates no.95 code of the drive group. ▪ Press the right shift key (▶) or left shift key (◀).
2	dr.0	▪ Indicates dr. 0, the first code of the drive group. ▪ Press the right shift key (▶).
3	bA.0	▪ Indicates bA. 0, the first code of the basic function group.

5.5 Moving between Codes within the Group

■ How to move between codes within the operation group

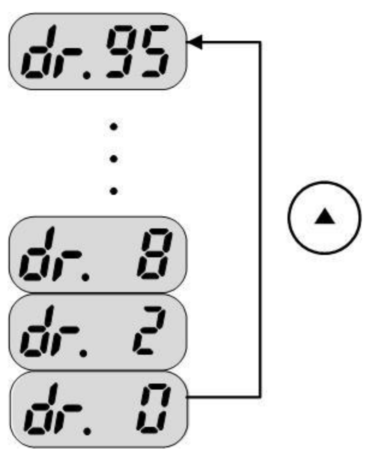


1	0.00	▪ Indicates the first code of the operation group, 0.00. ▪ Press the up key (▲).
2	ACC	▪ Indicates the 2nd code of the operation group, ACC. ▪ Press the up key (▲).
3	dEC	▪ Indicates the 3rd code of the operation group, dEC. ▪ Press and hold the up key (▲).
4	drC	▪ Indicates the last code of the operation group, drC. ▪ In the last code of the operation group, press the up key (▲) once more.
5	0.00	▪ Return to the first code of the operation group.

You can use the down key (▼) to move in the opposite order.

■ How to use the jump code

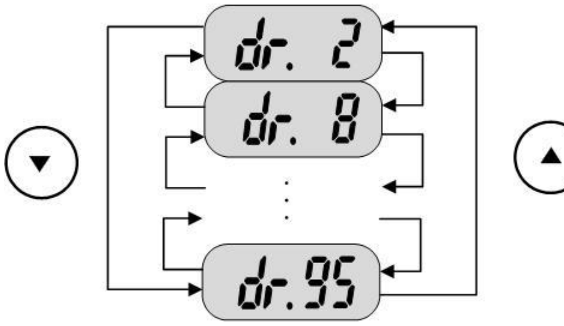
When moving from the first code of the drive group (dr. 0) to no.95 code.



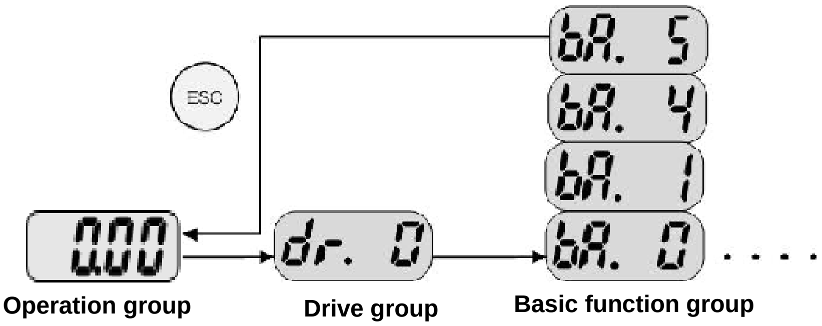
1	dr. 0	▪ Indicates the first code of the drive group, dr. 0. ▪ Press the Enter key (ENT).
2	9	▪ It shows that you can move to no.9 code (toggles at one second interval). ▪ Use the down key (▼) to set to 5.
3	05	▪ Press the left shift key (◀) to move the cursor to the left to display 05. 0 is toggled at one second interval. ▪ Use the up key (▲) to set to 9.
4	95	▪ It shows that you can move to no.95 code. ▪ Press the Enter key (ENT).
5	dr.95	▪ Indicates the No.95 code of the drive group.

You can also move between codes in other groups in the same way as described above.

■ How to move between codes in the same group

<table>
<tr><td colspan="4">When moving from No.2 code to No.95 code in the drive group</td></tr>
<tr><td rowspan="3">
</td><td>1</td><td>
</td><td>▪ Indicates the No.2 code of the drive group.
▪ Until dr. 95 is displayed, press the up key (▲).</td></tr>
<tr><td>2</td><td>
</td><td>Indicates the No.95 code of the drive group.</td></tr>
<tr><td colspan="3">You can also move between codes in other groups in the same way as described above.</td></tr>
<tr><td colspan="4">When using the up key (▲) or down key (▼) to move between codes in each group, sometimes the code number skips instead of increasing or decreasing by 1. This is because the inverter program keeps the number empty, reserving them for functions to be added later, or it has hidden the functions not used by the users. For detailed information, refer to Chapter 10 Function Display List.
    E.g.) If the frequency upper/lower limit selection (Ad.24) is set to 0 (No), Ad.25 (frequency upper limit) and Ad.26 (frequency lower limit) are not displayed when you move between codes.
But if the frequency upper/lower limit selection (Ad.24) is set to 1 (Yes), Ad.25 and Ad.26 are visible.</td></tr>
</table>

5.6 Moving to the Initial Position

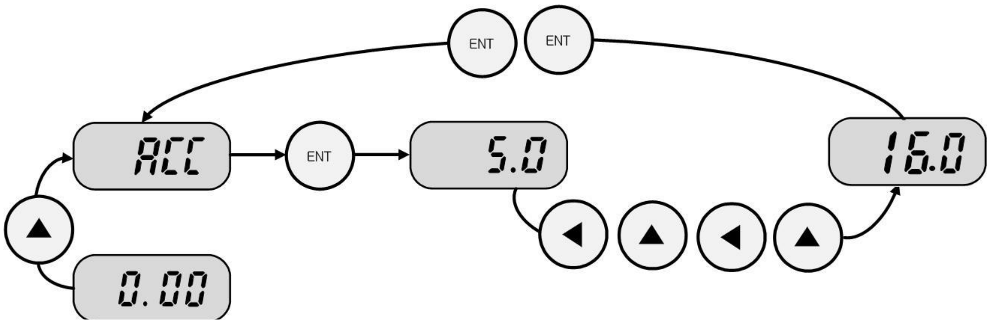


For the ESC key, the initial value (dr.90) is preset to 0 (move to the initial position). Therefore, if you press the ESC key in any code position in a group, you will be moved to the first position of the operation group. For other functions of the ESC key, refer to 5.11 Using the Multi-keys.

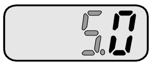
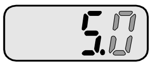
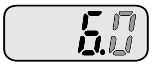
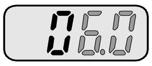
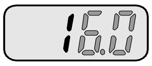
5.7 Setting the Parameters

■ Changing operation group parameters

When changing the acceleration time from 5.0 sec to 16.0 sec



Operation group

1		▪ Indicates the first code information of the operation group. ▪ Press the up key (▲).
2		▪ Indicates the 2nd code of the operation group, which is the acceleration time ACC. ▪ Press the Enter key (ENT).
3		▪ 0 of 5.0 blinks at one second interval. ▪ Press the left shift key (◀).
4		▪ 5 of 5.0 blinks to show that value 5 can be changed. ▪ Press the up key (▲).
5		▪ The value is changed to 6.0. ▪ Press the left shift key (◀).
6		▪ 06.0 is displayed while 0 of 06.0 is blinking. ▪ Press the up key (▲).
7		▪ Displays 16.0. ▪ Press the Enter key (ENT). ▪ 16.0 blinks[14]. ▪ Press the Enter key (ENT).
8		▪ Displays ACC. The acceleration time is changed to 16.0 sec.

[14] Blinking, when modifying the parameters, is to ask whether to input the modified values. At this time, press the Enter key (ENT) to confirm the input. If you do not want to confirm the modified values, you can cancel it by pressing left, right, up and down keys (◀)(▶)(▲)(▼) except the Enter key (ENT) while blinking.

■ Frequency setting

When setting the operation frequency to 30.05 [Hz] in the operation group

Operation group

1	0.00	▪ Indicates the first code information of the operation group. ▪ Press the Enter key (ENT).
2	0.00	▪ Press the left shift key (◀).
3	0.00	▪ The position to be set moves to the left. ▪ Press the left shift key (◀) twice.
4	00.00	▪ Use the up key (▲) to set to 3.
5	30.00	▪ The value is changed to 30.00. ▪ Press the right shift key (▶) three times.
6	30.00	▪ You can change the 2nd decimal place number. ▪ Press the up key (▲) until it reaches 5.
7	30.05	▪ Press the Enter key (ENT). ▪ 30.05 blinks. ▪ Press the Enter key (ENT).
8	30.05	▪ When 30.05 stops blinking, the operation frequency is set to 30.05.

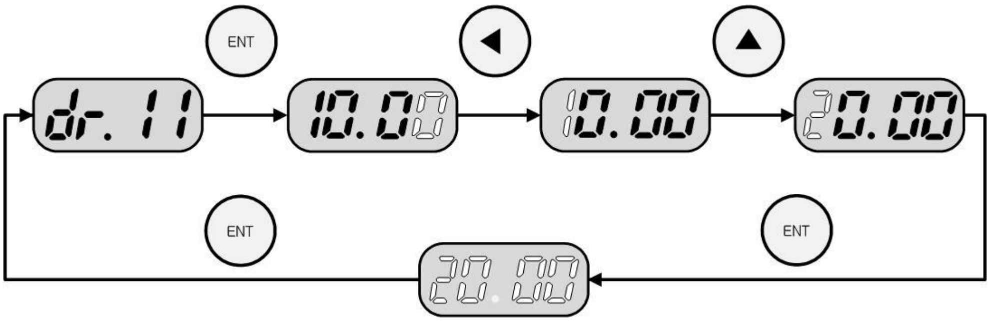
LSLV-S100 series has 4 places in the display, but you can use the left shift key (◀) and right shift key (▶) to extend up to 5 places to set and monitor the parameters.

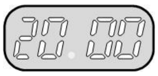
If you press the direction keys except for the Enter key (ENT) while 30.05 is blinking in the above step 7, you can cancel the parameter settings.

You can cancel the current task and exit the editing mode by pressing the ESC key during editing.

■ Changing input/output group parameters

When changing the 11th code of the drive group (dr. 11) from 10.00 to 20.00



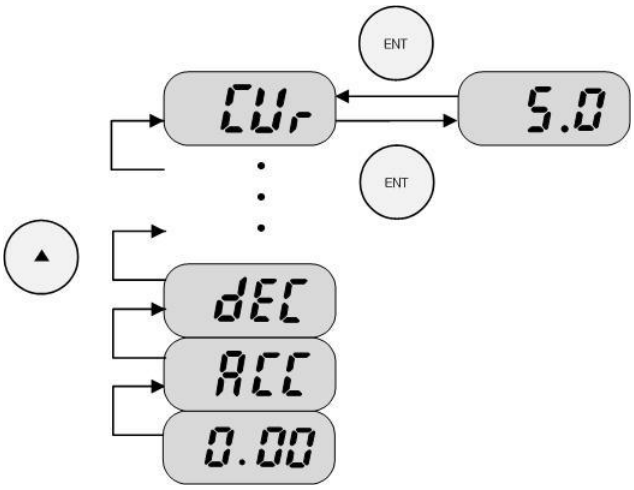
1		▪ It indicates that the current position is No.11 code of the drive group. ▪ Press the Enter key (ENT).
2		▪ It indicates that the preset value of No.11 code is 10.00. ▪ Use the left shift key (◀) to blink 1.
3		▪ It indicates that the cursor is on 1.
4		▪ Use the up key (▲) to increase up to 2. ▪ Press the Enter key (ENT).
5		▪ Press the Enter key (ENT).
6		▪ 20.00 blinks and then the code number is displayed. The parameter change is complete.

You can also move between codes in other groups in the same way as described above.

5.8 Monitoring Operation Status

■ Displaying output current

How to monitor the output current in the operation group

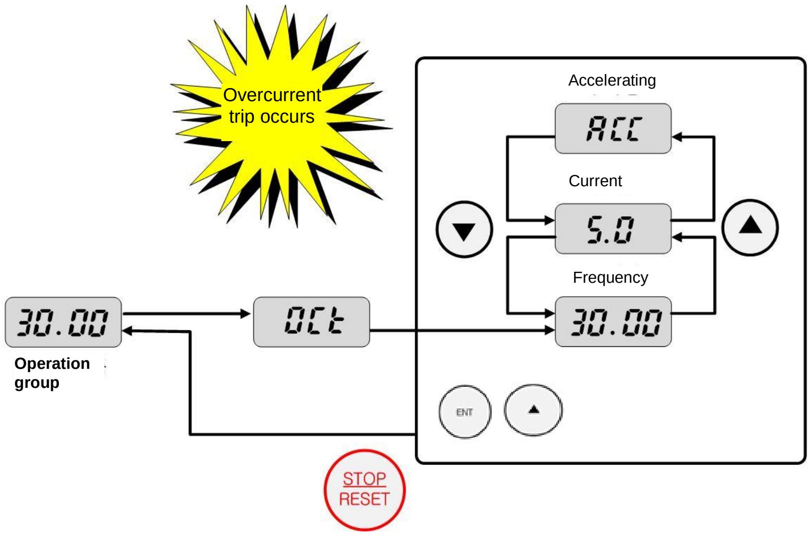


1		▪ Indicates the first code of the function group 1. ▪ Press the up key (▲) or down key (▼) until CUr is displayed.
2		▪ Indicates the code that can monitor the output current. ▪ Press the Enter key (ENT).
3		▪ Indicates that the inverter output current is currently 5 [A]. ▪ Press the Enter key (ENT).
4		▪ The output current monitor code is displayed.

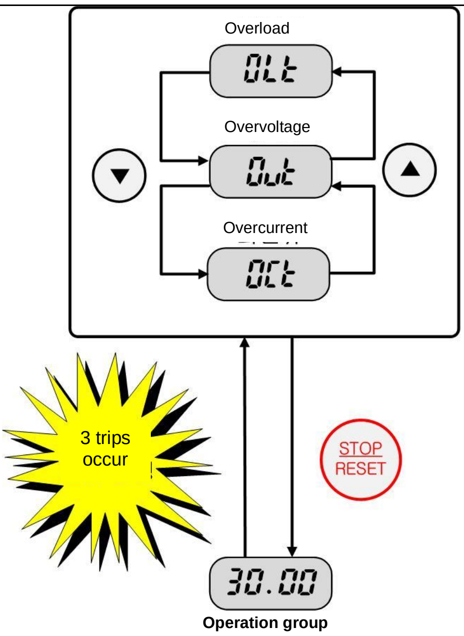
The dCL (inverter DC link voltage) or VOL (inverter output voltage) in the operation group can be monitored in the same way as described above.

■ Displaying failure status

How to monitor the inverter failure status in the operation group



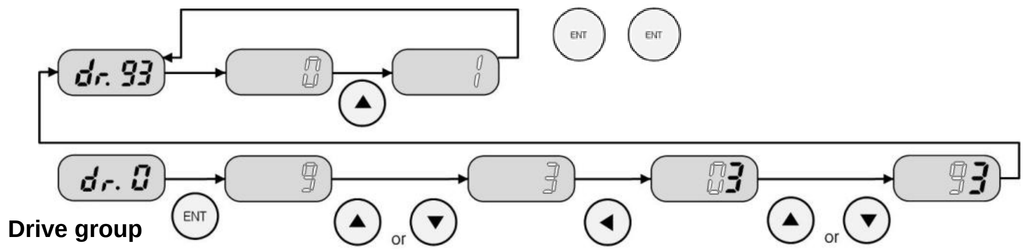
1	OCt	▪ If the overcurrent trip occurs, it is marked as shown in the left. ▪ Press the Enter key (ENT). Press the up key (▲).
2	30.00	▪ Indicates the operation frequency when a trip occurs. ▪ Press the up key (▲).
3	5.0	▪ Indicates the output current when a trip occurs. ▪ Press the up key (▲).
4	ACC	▪ Indicates the operation status. A trip has occurred during acceleration. ▪ Press the STOP/RST key.
5	30.00	▪ The trip is released and the preset frequency is displayed.

If multiple trips occur at the same time	
	▪ If different types of trips occur at the same time, the information of up to 3 trips is displayed as shown in the left figure.

If a warning is issued at 30 Hz operation	
	▪ When a warning is issued, the current screen and "WArn" turns on and off alternatively at one second interval. ▪ You can find the warning details in Pr.90.

5.9 Parameter initialization

If all drive groups are initialized in dr.93 code of the drive group



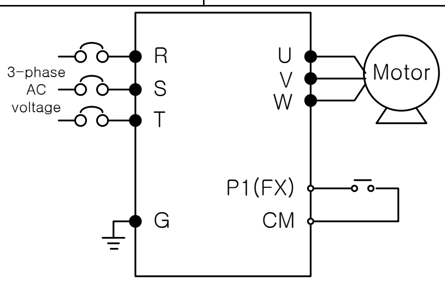
1	dr. 0	▪ Indicates the first code of the drive group. ▪ Press the Enter key (ENT).
2	9	▪ The code number to move displays the initial value 9. ▪ Use the up key (▲) or down key (▼) to change the value to 3.
3	3	▪ The code number to move displays 3. ▪ Press the left shift key (◀).
4	03	▪ 0 blinks to show that the value can be changed. ▪ Use the up key (▲) or down key (▼) to change the value to 9.
5	93	▪ The code number to move displays 93. ▪ Press the Enter key (ENT).
6	dr. 93	▪ It indicates that the current position is No. 93 code of the drive group. ▪ Press the Enter key (ENT).
7	0	▪ Indicates the standby state for parameter initialization. ▪ Press the up key (▲).
8	1	▪ Press the Enter key (ENT). The number blinks. Press the Enter key again.
9	dr. 93	▪ The code number is displayed again. The parameter initialization is complete. ▪ Press the left shift key (◀) or right shift key (▶).
10	dr. 0	▪ Moved to the first code of the drive group.

5.10 Frequency Setting and Basic Operation Method

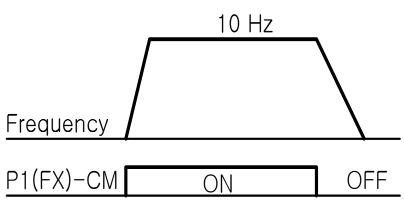
> ⚠ **Caution**
>
> - The following descriptions assume that all parameters are set as the factory default. Therefore, if you changed the parameters after purchase, the parameters displayed may be different from the following. If this is the case, initialize the parameters to the factory defaults (refer to 5.9 Parameter initialization) and operate according to the following descriptions.

■ If using a potentiometer to set the frequency and issuing the operation command from the inverter terminal block

1		▪ Power on the inverter.
2	0.00	▪ Check if the mark as shown in the left appears on the inverter display. ▪ Press the up key (▲) 4 times.
3	Frq	▪ Moved to the code that can change the frequency setting method. ▪ Press the Enter key (ENT).
4	0	▪ The current frequency setting method is set to No.0 (frequency setting using the keypad). ▪ Press the up key (▲) 2 times.
5	2	▪ Check if it indicates 2 (use the volume resistance to set the frequency). ▪ Press the Enter key (ENT).
6	Frq	▪ If 2 blinks, press the Enter key (ENT) once more. ▪ When Frq is displayed, the frequency setting method is changed to the volume resistance. ▪ Press the down key (▼) 4 times to move to the frequency display status. ▪ Turn the volume resistance to 10 Hz.
7	10.00	▪ Turn on the switch between P1 (FX) and CM terminals in the following wiring diagram. ▪ RUN (in operation) indicator lamp blinks on the inverter display, FWD (forward direction operation) indicator lamp is on, and the number display shows the accelerating frequency. ▪ When the operation frequency reaches 10 Hz, the display shows the left figure. ▪ Turn off the switch between P1 (FX) and CM terminals.
8	10.00	▪ RUN (in operation) indicator lamps resumes blinking on the inverter display and the number display shows the decelerating frequency. ▪ when the operation frequency reaches 0 Hz, RUN (in operation) and FWD (forward direction operation) indicators turn off and the number display shows 10.00.



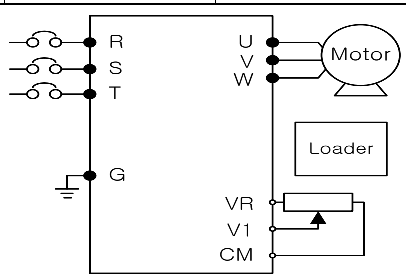
Wiring diagram



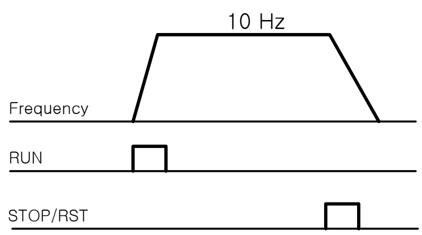
Operation pattern

■ If using a potentiometer to set the frequency and using the RUN key of the keypad to issue operation command

1		▪ Power on the inverter.
2	0.00	▪ Check if 0.00 as shown on the left appears on the inverter display. ▪ Press the up key (▲) 3 times.
3	drv	▪ Moved to the code that can change the operation command method. ▪ Press the Enter key (ENT).
4	1	▪ The operation command method is currently set to No.1 (inverter terminal block). ▪ Press the down key (▼).
5	0	▪ Check if it indicates 0 and enter the Enter key (ENT). ▪ If 0 blinks, press the Enter key (ENT) once more.
6	drv	▪ If drv is displayed, the operation command method is changed to RUN key of the keypad. ▪ Press the up key (▲) 1 times.
7	Frq	▪ Moved to the code that can change the frequency setting method. ▪ Press the Enter key (ENT).
8	0	▪ The current frequency setting method is preset to No.0 (frequency setting using the keypad). ▪ Press the up key (▲) 2 times.
9	2	▪ Check if it indicates 2 (using a potentiometer to set the frequency) and press the Enter key (ENT). ▪ If 2 blinks, press the Enter key (ENT) once more.
10	Frq	▪ When Frq is displayed, the frequency setting method is changed to the keypad volume. ▪ Press the down key (▼) 4 times to move to the frequency display status. ▪ Turn the volume resistance to 10 Hz.
11	10.00	▪ Press the RUN key of the inverter keypad. ▪ RUN (in operation) indicator lamp blinks on the inverter display, FWD (forward direction operation) indicator lamp is on, and the number display shows the accelerating frequency. ▪ When the operation frequency reaches 10 Hz, the display shows the left figure. ▪ Press STOP/RESET key of the inverter keypad.
12	10.00	▪ RUN (in operation) indicator lamps resumes blinking on the inverter display and the number display shows the decelerating frequency. ▪ when the operation frequency reaches 0 Hz, RUN (in operation) and FWD (forward direction operation) indicators turn off and the number display shows 10.00.



Wiring diagram

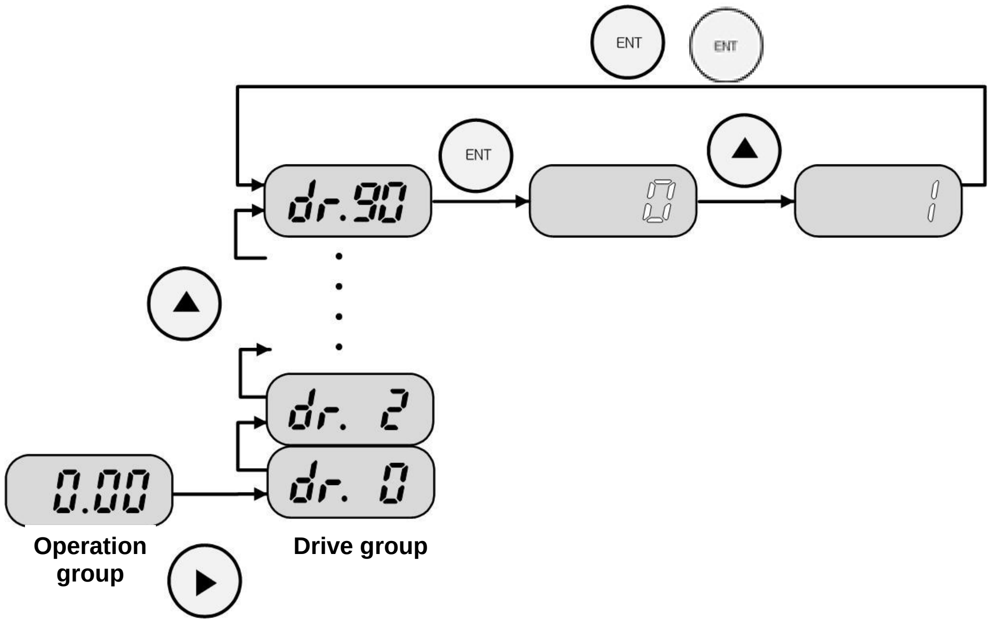


Operation pattern

5.11 Using ESC Key

- Move to initial location (refer to 5.6)
- Jog operation (refer to 7.3)
- Remote/local (refer to 6.7)

If using the jog operation to set the ESC key function



1		▪ Indicates the first code of the operation group. ▪ Press the right shift key (▶).
2		▪ Indicates the first code of the drive group. ▪ Press the up key (▲) or the down key (▼) until the ESC key setting code, 90, appears.
3		▪ Indicates the ESC key code, dr.90. ▪ Press the Enter key (ENT).
4		▪ Indicates the initial value, 0 (move to the initial location). ▪ Press the up key (▲) so that the jog operation mode, 1, is displayed.
5		▪ Indicates the jog operation mode, 1. ▪ Press the Enter key (ENT). The number blinks. Press the Enter key again.

If you press the ESC key when ESC-key mode is set to Jog (1) or remote/local (2), then SET LED blinks.

6. Basic Functions

6.1 Introduction of S100 Basic Functions

Table 6-1 Introduction of S100 basic functions

Basic Functions	Usage Examples
Setting frequency with keypad	Setting operation frequency with keypad
Setting frequency by voltage input into the terminal block	Setting operation frequency by voltage input (V1, V2) of terminal block
Setting frequency by current input into the terminal block	Setting operation frequency by current input (I2) of terminal block
Setting frequency via RS-485 communications	Setting frequency by communicating with the upper level controller (PLC or PC) using terminal block (S+, S-)
Frequency fixation of analog command	Holding operation frequency by the input of the terminal selected as Analog Hold among multi-function terminals
Changing frequency to revolution	Changing the display method of motor revolutions (Hz or rpm)
Multi-step speed frequency setting	Multi-step speed operation using multi-function terminal
Operation command setting via keypad	Starting operation using the forward operation key (FWD) and the reverse operation key (REV), and stopping operation using the stop key (Stop)
Operation command setting via terminal block	Controlling operation command using terminal block FX/RX
Operation command setting via RS-485 communications	Setting operation command by communicating with the upper level controller (PLC or PC) using terminal block (S+, S-)
Local/remote switching operation using ESC keys	When operating with an operation command based on a method other than keypad such as terminal block or communication, checking inverter operation and facility without any parameter setting change or switching to manual operation using the keypad
Prohibition of forward or reverse rotation	Selecting prohibited direction of motor rotation
Starting with power on	When power is supplied to the inverter, the motor accelerates if the terminal block operating command is turned on
Starting on initialization after a trip takes place	When initialized after a trip takes place, the motor accelerates if the terminal block operating command is turned on
Acc/Dec time setting based on max. frequency	Setting acceleration and deceleration time based on maximum frequency
Acc/Dec time settingbased on operation frequency	Setting acceleration and deceleration time based on the time elapsed from the current constant frequency to the target frequency of the next step
Multi-step Acc/Dec time setting using multi-function terminal	Setting multi-step acceleration and deceleration time using multi-function terminal
Changing Acc/Dec time by setting Acc/Dec time transition frequency	Changing acceleration and deceleration gradient without using multi-step terminal

Basic Functions	Usage Examples
Setting Acc/Dec pattern	Used when the pattern of acceleration and deceleration gradient is needed (Linear, S-curve)
Acc/Dec stop command	Stopping acceleration or deceleration or operating in constant speed using multi-function terminal
Linear V/F pattern operation	Used for load requiring constant torque irrespective of frequency
Square reduction V/F pattern operation	Operation pattern suitable for the load with the starting characteristics of square reduction, such as fan, pump, etc.
User V/F pattern operation	When the user changes the setting according to the V/F and load patterns of special motor instead of general induction motor
Manual torque boost	When a large amount of starting torque is needed such as in elevator load, etc.
Automatic torque boost	When selecting automatic adjustment function if a large amount of starting torque is required
Motor output voltage adjustment	Setting the motor voltage when the input power supply is different from the motor voltage specification
Accelerating start	A general acceleration method. When there is no function selection, it accelerates directly to the target frequency on operation command input.
Start after DC braking	When the motor is rotating before the voltage is supplied from the inverter, it stops the motor revolution by DC braking and then makes acceleration.
Deceleration stop	A general deceleration method. When there is no function selection, it decelerates down to 0 Hz and then stops.
Stopping by DC braking	Stopping the motor by supplying direct current at the preset frequency during deceleration
Free-run stop	When the operation command is turned off, the inverter output is blocked.
Power braking	Optimally decelerating without overvoltage trip
Frequency limit using maximum and start frequency	Limiting operation frequency by setting the maximum frequency and the start frequency
Frequency limit using the upper/lower limits	Limiting operation frequency using the upper and lower frequency limit function
Frequency jump	Avoiding mechanical resonance frequency
Multi-function input terminal control	Improving the response of input terminal

6.2 Frequency Setting Methods

Group	Code number	Name	Setting range and how to display the LCD keypad	
Operation	Frq	Frequency setting method	0	KeyPad-1
			1	KeyPad-2
			2	V1
			4	V2[15]
			5	I2
			6	Int 485
			8	Field Bus
			12	Pulse

Select the frequency setting method from the Frq code of the operation group. The operation frequency can be set from an external controller through digital setting using keypad, analog setting using voltage (V1, V2) and current (I2) input of the control terminal block, and the use of the built-in RS-485 port or communication option.

■ Frequency Setting by Keypad 1: KeyPad-1

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	0.00	Command frequency		0.00		0 - Max. frequency	Hz
Operation	Frq	Frequency setting method	Freq Ref Src	0	KeyPad-1	-	-

After changing the frequency with keypad, press the program (ENT) key to apply the change. Set the operation group Frq code to 0 Keypad-1. When setting the desired frequency from the command frequency code (0.00) of the operation group, press the setting key (ENT) to apply the frequency change. It is not possible to set beyond the max. frequency (dr. 20).

■ Frequency Setting by Keypad 2: KeyPad-2

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	0.00	Command frequency		0.00		0 - Max. frequency	Hz
Operation	Frq	Frequency Setting Methods	Freq Ref Src	1	KeyPad-2	-	-

Select 1 from the Frq code of the operation group.

To set the desired frequency from the command frequency code (0.00) of the operation group, press the Up key (▲) or Down key (▼) to change the frequency immediately. Select this function if you want to use the Up and Down keys for volume resistance.

It is not possible to set beyond the max. frequency (dr. 20).

[15] I2 terminal input when switch of Analog Input (I2) is selected as V.

■ Frequency Setting by Terminal Block V1 (Voltage Input): V1

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	2	V1	-	-

Using the voltage (V1) input terminal of the terminal block, supply -10 to +10 V or 0 to +10 V. When supplying -10 to +10 V, you can change the rotating direction of the motor depending on the sign of voltage signal.

1. When supplying 0 to +10 V

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	2	V1	-	-
In	01	Frequency for maximum analog input	Freq at 100%	60.00		0.00 - Max. frequency	Hz
In	05	V1 input amount display	V1 Monitor [V]	0.00		0.00 - 12.00	V
In	06	V1 input polarity selection	V1 Polarity	0	Unipolar	0 - 1	-
In	07	Time constant of V1 input filter	V1 Filter	10		0 - 10000	msec
In	08	Minimum input voltage of V1	V1 volt x1	0.00		0.00 - 10.00	V
In	09	Output at V1 minimum voltage (%)	V1 Perc y1	0.00		0.00 - 100.00	%
In	10	Maximum input voltage for V1	V1 Volt x2	10.00		0 .00 - 12.00	V
In	11	Output at V1 maximum voltage (%)	V1 Perc y2	100.00		0 - 100	%
In	16	Changing rotation direction	V1 Inverting	0	No	0 - 1	-
In	17	V1 quantization level	V1 Quantizing	0.04		0.04 - 10.00	%

Set In.06 related with the input terminal block to Unipolar no. 0.

Make an input to V1 terminal with a potentiometer using the voltage output of the external controller or the VR output terminal of the inverter control terminal block, as shown in the figure below.

External power source

Internal power source

Figure 6-1 Frequency setting by voltage input into the terminal block

2. **When using 0 to +10 V of external circuit**

In.01 (Freq at 100%) for connecting potentiometer to terminal block: Set the operation frequency on max. voltage input. Set the operation frequency when the value set at In.11 or 15 of the input terminal block function group is 100%.

- **Example 1)** When setting In.01 to 40.00 and other codes up to In.16 to the default value and then supplying 10 V to the V1 terminal, the system operates at 40.00 Hz.
- **Example 2)** When setting In.11 to 50% and other codes from In.01 to In.16 to the default value and then supplying 10 V to the V1 terminal, the system operates at 30.00 Hz which is equal to 50% of 60 Hz, the maximum frequency.

In.05 Monitor [V]: Shows the magnitude of the voltage input to the V1 terminal. Used to monitor the magnitude of the present voltage input.

In.07 V1 Filter: Use this filter when the frequency setting value varies largely due to noisy environment, etc. Setting the filter time constant sufficiently large may reduce the width of frequency variation, but the responsiveness may be slowed. The larger the time constant is, the longer the time t. The set time means the time required to increase the frequency up to approximately 63% of the frequency set within the inverter when the voltage input is supplied in steps, as shown in the figure below.

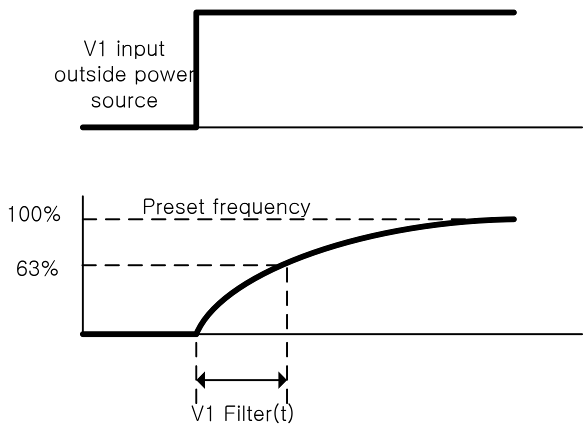


Figure 6-2 In.07 V1 Filter

In.08 V1 Volt x1 - In.11 V1 Perc y2: Able to set the gradient of output frequency, offset value, etc. for the magnitude of the input voltage.

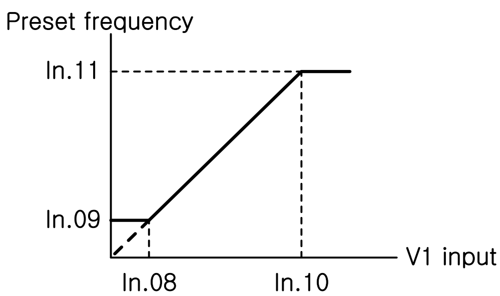


Figure 6-3 In.08 V1 Volt x1 - In.11 V1 Perc y2

In.16 V1 Inverting: Able to rotate in the opposite of the current rotation direction by setting to 1 Yes.

In.17 V1 Quantizing: Used when the analog signal input to the V1 terminal has high noise. Using the value of low-pass filter of In.07 may reduce the noise to a certain level; however, increasing the value will impair the responsiveness and create pulsation with a long period (ripple) in the output frequency. The resolution of the output frequency to the analog input will be reduced, but the noise effect will be reduced by the quantizing function in a system sensitive to noise.

The quantization setting value is the percentage compared to the max. analog input value. Thus, if the max. input value is 10 V and the quantization value is set to 1%, the frequency will vary by 0.6 Hz (at the max. frequency of 60 Hz) with the interval of 0.1 V. The output frequencies corresponding to when the input value is increased and decreased are different from each other, in order to eliminate the impact caused by the variation of analog input value. As shown in the figure below, if, after dividing the quantizing value into four equal parts, the analog input value is increased, inputting a value corresponding to 3/4 of the quantizing value will change the output frequency, and then, from the next step, it will be increased according to the quantizing value. In the case that the analog input value is decreased, reducing the input as much as a value corresponding to 1/4 of the quantizing value will change the output frequency.

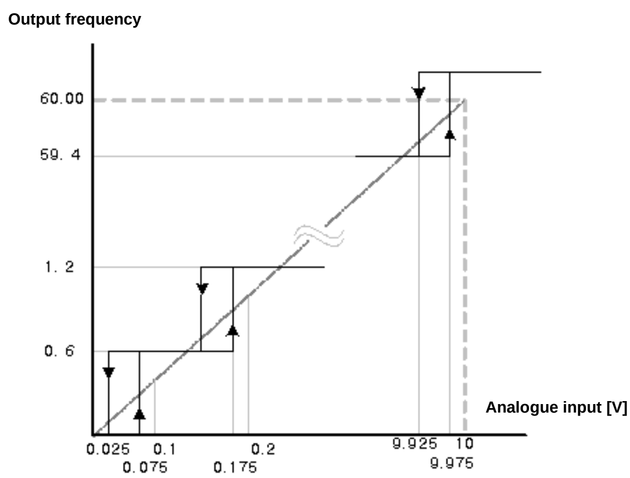


Figure 6-4 In.17 V1 Quantizing

3. When supplying -10 to +10 V

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	2	V1	-	-
In	01	Frequency for maximum analog input	Freq at 100%	60.00		0 - Max. frequency	Hz
In	05	V1 input amount display	V1 Monitor	0.00		0.00 - 12.00 V	V
In	06	V1 input polarity selection	V1 Polarity	1	Bipolar	0 - 1	-
In	12	V1–Minimum input voltage	V1-volt x1’	0.00		10.00 - 0.00 V	V
In	13	Output (%) at the V1–min. voltage	V1-Perc y1’	0.00		-100.00 - 0.00%	%
In	14	V1–Maximum input voltage	V1-Volt x2’	-10.00		-12.00 - 0.00 V	V
In	15	Output (%) at the V1–max. voltage	V1-Perc y2’	-100.00		-100.00 - 0.00%	%

Set In.06 to 1 Bipolar.

Codes from In.12 to 15 are displayed only for Bipolar, and you can make settings for the voltage with the range of 0 to -10 V supplied to the V1 terminal. Make an input to V1 terminal with a potentiometer using the voltage output of the external controller as shown in the figure below.

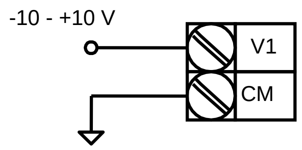


Figure 6-5 Settings for the voltage with the range of -10 to 10 V supplied to the V1 terminal

The output frequency for the bidirectional voltage input (-10 to +10 V) will show the following behavior:

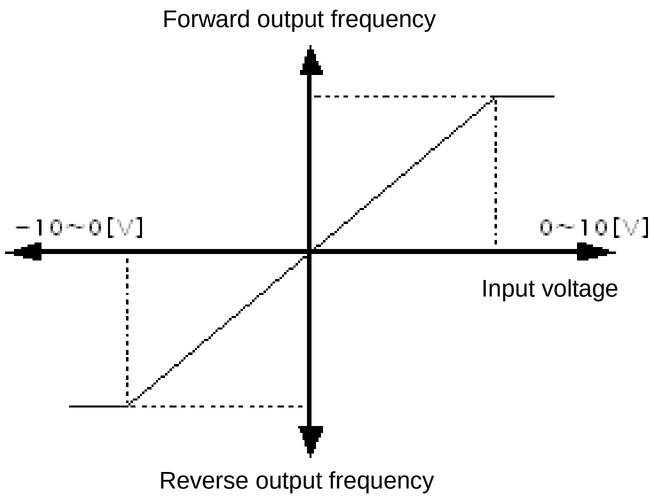


Figure 6-6 Output frequency for the bidirectional voltage input (-10 to +10 V)

In.12 V1 –volt x1' - In.15 V1 –Perc y2': Able to set the gradient of output frequency, offset value, etc. for the magnitude of the negative input voltage as follows:

Example) If the minimum and maximum negative input voltages of V1 are -2 V and -8 V respectively and the output ratios to them are set to 10% and 80% accordingly, the output frequency will vary between 6 Hz and 48 Hz.

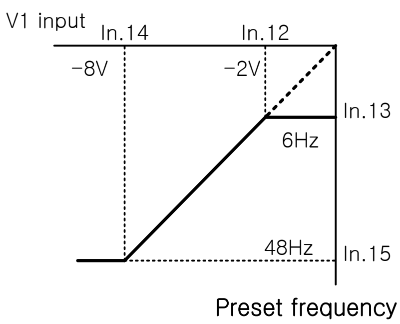


Figure 6-7 Example of In.12 V1-volt X1 - In.15 V1 Perc y2

For more information on settings for 0 - +10 V, please refer to In.08 V1 Volt x1 - In.11 V1 Perc y2 (page 6-5).

The table below shows how to select the keypad or the direction of terminal block and the motor rotation by bidirectional voltage input.

Table 6-2 How to select the keypad or the direction of terminal block and the motor rotation by bidirectional voltage input

Voltage input / Operation command	0 - 10 V	-10 - 0 V
FWD	Forward	Reverse
REV	Reverse	Forward

■ Frequency Setting by Terminal Block I2 (Current Input)

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	5	I2	-	-
In	01	Frequency for maximum analog input	Freq at 100%	60.00		0 - Max. frequency	Hz
In	50	I2 input amount display	I2 Monitor	0.00		0.00 - 20.00	mA
In	52	I2 input filter time constant	I2 Filter	10		0 - 10000	ms
In	53	I2 minimum input current	I2 Curr x1	4.00		0.00 - 20.00	mA
In	54	Output (%) at the I2 min. current	I2 Perc y1	0.00		0 - 100	%
In	55	I2 maximum input current	I2 Curr x2	24.00		0.00 - 24.00	mA
In	56	Output (%) at the I2 max. current	I2 Perc y2	100.00		0.00 - 100.00	%
In	61	Changing rotation direction of I2	I2 Inverting	0	No	0 - 1	-
In	62	I2 quantization level	I2 Quantizing	0.04		0.04 - 10.00	%

Select 5 I2 from the Frq code of the operation group. Set the frequency by supplying current ranging from 0 to 20 mA to the I2 terminal of the terminal block.

In.01 Freq at 100%: Set the operation frequency on max. current input. Set the operation frequency when the value set from In.56 is 100%.

Example 1) When setting In.01 to 40.00 and other codes from In.53 to 56 to the default value and then supplying 20 mA to the I2 terminal, the system operates at 40.00 Hz.

Example 2) When setting In.56 to 50% and the setting values of In.01 and from In.53 to 55 are identical to the default value and then supplying 20 mA to the I2 terminal, the system operates at 30.00 Hz.

In.50 I2 Monitor: Shows the magnitude of the current input to the I2 terminal. Used to monitor the magnitude of the present current input.

In.52 I2 Filter: The set time means the time required to increase the frequency up to approximately 63% of the I2 value made by step input within the inverter when the current input is supplied in steps.

In.53 I2 Curr x1 - In.56 I2 Perc y2: Able to set the gradient of output frequency, offset value, etc. for the magnitude of the current as follows:

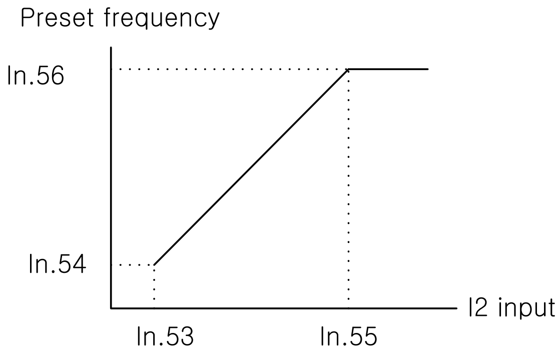


Figure 6-8 Setting the gradient of output frequency and offset value for the magnitude of current

■ Frequency Command by Terminal Block I2 (Voltage Input)

Depending on the SW2 setting, the terminal block I2 is able to input voltage (0 to 12 V). (Refer to 4.5 Wiring Diagram of Control Terminal Block.)

- ***0 to +12 V input***

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	07	Frequency Setting Methods	Freq Ref Src	4	V2	-	-
In	35	V2 input amount display	V2 Monitor	0.00		0.00 - 12.00	V
In	37	V2 input filter time constant	V2 Filter	10		0 - 10000	msec
In	38	Minimum input voltage of V2	V2 Volt x1	0.00		0.00 - 12.00	V
In	39	Output (%) at the V2–min. voltage	V2 Perc y1	0.00		0.00 - 100.00	%
In	40	Maximum input voltage of V2	V2 Volt x2	10.00		0 – 12.00	V
In	41	Output (%) at the V2 max. voltage	V2 Perc y2	100.00		0.00 - 100.00	%
In	46	V2 rotation direction change	V2 Inverting	0	No	0 - 1	-
In	47	V2 quantization level	V2 Quantizing	0.04		0[16], 0.04 - 10.00	%

If the SW2 is set to current input (I), In.35 to 47 codes are invisible.

[16] With 0 set, quantizing is not used.

■ Frequency Setting by Terminal Block TI (Pulse Input)

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	12	Pulse	-	-
In	01	Frequency for maximum analog input	Freq at 100%	60.00		0.00 - Max. frequency	Hz
In	91	Pulse input amount display	Pulse Monitor	0.00		0.00 - 50.00	kHz
In	92	TI input filter time constant	TI Filter	10		0 - 9999	msec
In	93	Minimum input pulse of TI	TI Pls x1	0.00		0.00 - 32.00	kHz
In	94	Output (%) at the TI min. pulse	TI Perc y1	0.00		0.00 - 100.00	%
In	95	Maximum input pulse of TI	TI Pls x2	32.00		0.00 - 32.00	kHz
In	96	Output (%) at the TI max. pulse	TI Perc y2	100.00		0.00 - 100.00	%
In	97	Changing rotation direction	TI Inverting	0	No	0 - 1	-
In	98	TI quantization level	TI Quantizing	0.04		0.00[17], 0.04 - 10.00	%

Select 12 Pulse from the Frq code of the operation group. Set the frequency by supplying pulse ranging from 0 to 32.00 kHz to the TI terminal of the terminal block.

In.01 Freq at 100%: Set the operation frequency on max. pulse input. Set the operation frequency when the value set from In.96 is 100%.

Example 1) When setting In.01 to 40.00 and other codes from In.93 to In.96 to the default value and then supplying 32 kHz to the TI terminal, the system operates at 40.00 Hz.

Example 2) When setting In.96 to 50% and the setting values of In.01 and from In.93 to 95 are identical to the default value and then supplying 32.00 kHz to the TI terminal, the system operates at 30.00 Hz.

In.91 Pulse Monitor: Shows the magnitude of the pulse frequency to the TI terminal. Used to monitor the magnitude of the present pulse frequency.

In.92 TI Filter: The set time means the time required to increase the frequency up to approximately 63% of the TI value made by step input within the inverter when the pulse input is supplied in steps.

In.93 TI Pls x1 - In.96 TI Perc y2: Able to set the gradient of output frequency, offset value, etc. for the magnitude of the pulse frequency as follows:

[17] With 0 set, quantizing is not used.

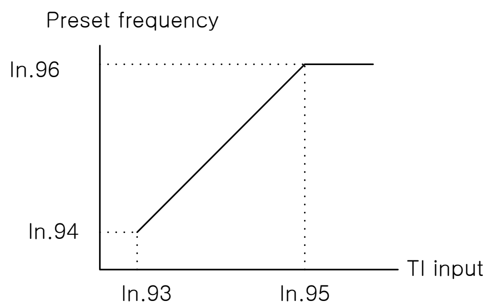


Figure 6-9 Setting the gradient of output frequency and offset value for the magnitude of pulse

In.97 TI Inverting: Able to change the rotation direction of the present operation.

In.98 TI Quantizing: Identical to the V1 Quantizing function of In.17. Please refer to page 6-6, 'In.17 V1 Quantizing.'

■ Frequency setting via RS-485 communications: Int 485

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	6	Int 485	-	-
CM	01	Built-in communication inverter ID	Int485 St ID	-	1	1 - 250	-
CM	02	Built-in communication protocol	Int485 Proto	0	ModBus RTU	0 - 2	-
				1	Reserved		-
				2	LS Inv 485		-
CM	03	Built-in communication speed	Int485 BaudR	3	9600 bps	0 - 7	-
CM	04	Built-in communication frame setting	Int485 Mode	0	D8 / PN / S1	0 - 3	-
				1	D8 / PN / S2		-
				2	D8 / PE / S1		-
				3	D8 / PO / S1		-

When setting the operation group Frq code to 6 Int 485, you can control the inverter by communicating with the upper level controller (PLC or PC) using the RS-485 terminals (S+, S-, SG) of the terminal block. For more information, refer to Chapter 9-1 Communication Function.

Notes

- For details on other communication options such as CANopen, please refer to the relevant manual.

6.3 Frequency HOLD of Analog Command

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	0	Keypad-1	0 - 12	-
				1	Keypad-2		
				2	V1		
				4	V2		
				5	I2		
				6	Int 485		
				8	Field Bus		
				12	Pulse		
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	21	Analog hold	0 - 49	-

In the case of setting frequency using the analog input of the control terminal block, this function holds the operation frequency when the terminal selected as Analog Hold among multi-function terminals is input.

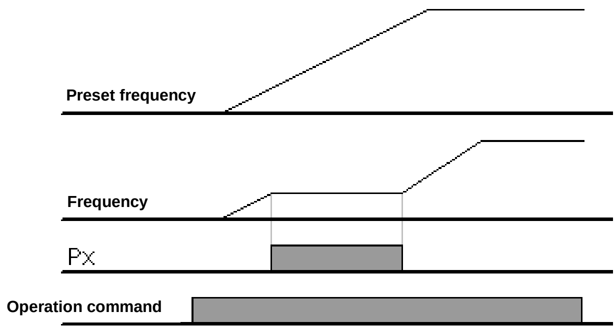


Figure 6-10 Frequency HOLD of analog command

6.4 Changing the display from Frequency to Revolutions (RPM) [18]

When setting the value of dr.21 Hz/Rpm Sel to 1 Rpm Display, the frequency is changed to revolution for display.

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	21	Speed unit selection	Hz/Rpm Sel	1	Rpm Display	-	-

6.5 Multi-Step Speed Frequency Setting

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	St1 - St3[19]	Multi-step speed frequencies 1 - 3	Step Freq – 1-3	-		0 - Maximum frequency	Hz
bA	53 - 56	Multi-step speed frequencies 4 - 7	Step Freq - 4-7	-		0 - Maximum frequency	Hz
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	7	Speed-L	0 - 49	-
In				8	Speed-M		-
In				9	Speed-H		-
In	89	Multi-step command delay time	InCheck Time	1		1 - 5000	ms

It is possible to perform multi-step speed operation using multi-function terminal. The 0 speed frequency uses the frequency command selected in the Freq code of the operation group. Input the desired step frequency into St1 to St3 codes of the operation group and 53 to 56 codes of the bA group. After selecting a terminal to be used as the multi-step input among multi-function terminals P1 to P7, set one of multi-step functions (7: Speed-L, 8: Speed-M, 9: Speed-H) respectively. Speed-L, Speed-M, and Speed-H are recognized as binary code, so the system operates by selecting the frequency set from St1 to St3 and bA.53 to bA.56. If the multi-function terminals P5, P6, and P7 are set to Speed-L, Speed-M, and Speed-H respectively, the system operates as follows:

[18] It is visible only on the LCD keypad.

[19] When using LCD, it corresponds to IN.50 – In.52 Step Freq-1 – 3.

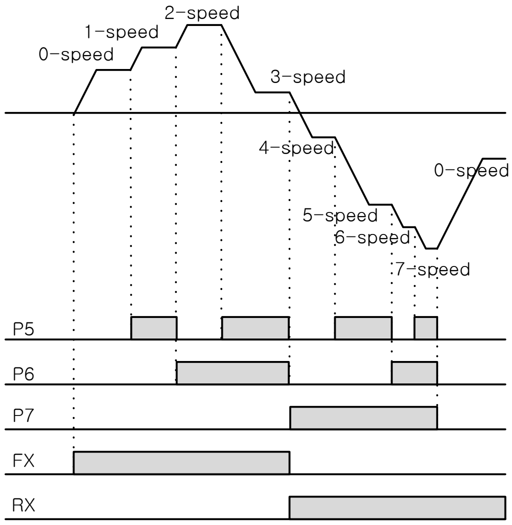


Figure 6-11 Example of 8 speed setting

Table 6-3 Example of 8 speed setting

Speed	FX or RX	P7	P6	P5
0	✓	-	-	-
1	✓	-	-	✓
2	✓	-	✓	-
3	✓	-	✓	✓
4	✓	✓	-	-
5	✓	✓	-	✓
6	✓	✓	✓	-
7	✓	✓	✓	✓

In.89 In Check Time: Using the multi-function input terminal with the multi-step speed frequency setting, you can set the time to check the terminal block input within the inverter. For example, with the In Check Time of the terminal block set to 100 ms and the multi-function terminal P6 input, the system will check if there is any input from another terminal block for 100 ms. When 100 ms has elapsed, it accelerates or decelerates to the frequency relevant to the P6 terminal.

6.6 Setting Method of Operation Command

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source[20]	0	Keypad	0 – 4	
				1	Fx/Rx-1		
				2	Fx/Rx-2		
				3	Int 485		
				4	Field Bus		
Operation	drC	Select rotation direction	-[21]	F	Forward	F, r	
				r	Reverse		

Select the operation command setting method from the drv code of the operation group. In addition to basic operation using keypad and multi-function terminal, the operation command is able to use built-in RS-485 communication, fieldbus option card, and so on.

(1) Keypad Operating Command: KeyPad

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	0	KeyPad	0 - 4	-

If setting the drv code[22] of the operation group to 0 Keypad, start the operation using the operation command key (RUN) on the inverter keypad and stop it using the stop key (STOP).

(2) Terminal Block Operating Command 1: Fx/Rx-1

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	1	Fx/Rx-1	0 - 4	-
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	1	FX	0 - 49	-
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	2	RX		-

Set the drv code[23] of the operation group to 1 Fx/Rx-1. After selecting terminals to be used as the forward (FX) and the reverse (RX) operation command out of multi-function terminals P1 to P7, set the functions of the corresponding terminals, among In. 65 to 71 of the terminal block input group, to FX and RX. In the case that the FX terminal and the RX terminal are simultaneously turned on or off, the inverter will stop.

[20] When using LCD, it will be displayed in DRV-06.

[21] When using LCD, it will be invisible.

[22] When using LCD Loader, corresponds to DRV-06 Cmd Source.

[23] When using LCD Loader, corresponds to DRV-06 Cmd Source.

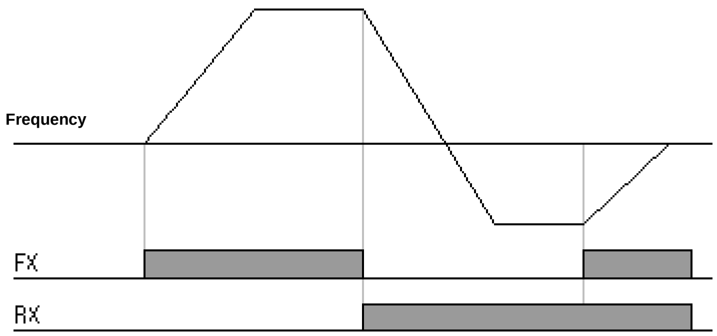


Figure 6-12 Terminal Block Operating Command 1

(3) Terminal Block Operating Command 2: Fx/Rx-2

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	2	Fx/Rx-2	0 - 4	-
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	1	FX	0 - 49	-
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	2	RX		-

The FX terminal is used as operation command, and the rotation direction is selected by the RX terminal. Set the drv code[24] of the operation group to 2 Fx/Rx-2. After selecting terminals to be used as the forward (FX) and the reverse (RX) operation command out of multi-function terminals P1 to P7, set the functions of the corresponding terminals, among In. 65 to 71 of the terminal block input group, to FX and RX.

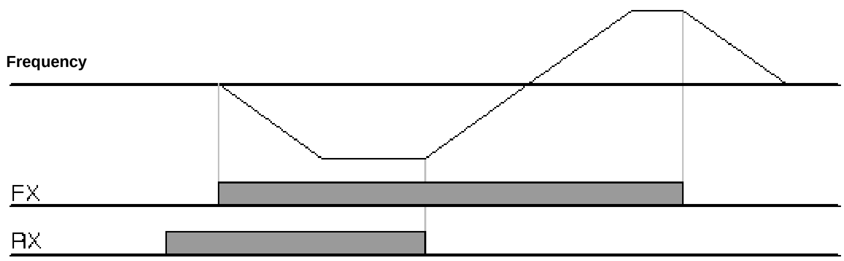


Figure 6-13 Terminal Block Operating Command 2

[24] When using LCD Loader, corresponds to DRV-06 Cmd Source.

(4) Operation Command by RS-485 Communications: Int 485

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	3	Int 485	0 - 4	-
CM	01	Built-in communication inverter ID	Int485 St ID	1		1 - 250	-
CM	02	Built-in communication protocol	Int485 Proto	0	ModBus RTU	0 - 2	-
CM	03	Built-in communication speed	Int485 BaudR	3	9600 bps	0 - 7	-
CM	04	Built-in communication frame setting	Int485 Mode	0	D8 / PN / S1	0 - 3	-

When setting the drv code[25] of the operation group to 3 Int 485, you can control the inverter by communicating with the upper level controller (PLC or PC) using the RS-485 terminals (S+, S-) of the terminal block. For more information, please refer to Chapter 9 Communication Function (page 9-1).

[25] When using LCD Loader, corresponds to DRV-06 Cmd Source.

6.7 Local/Remote Switching Operation Using ESC Key

(In the case of checking the inverter operation and facilities without changing the existing parameter settings)

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	90	ESC –key function selection	-	2	Local/Remote	0 - 2	-
Operation	drv	Operation command method	Cmd Source	1	Fx/Rx-1	0 - 4	-

⚠ Caution

- Be careful when you use the local/remote switching operation, because improper usage of the switching operation may cause serious problems to facility such as abnormal stop while operating the inverter.

When operating with a command based on a method other than keypad such as terminal block or communication, it may be used when checking inverter operation and facility without changing any parameter setting or switching to manual operation using the keypad.

■ Definition of Local

Local means all operation commands and frequency commands or torque commands can be operated by the keypad. In this case, JOG command is ignored. (Operation will be possible only when, out of In.65 - 71 multi-function terminals P1 to P7, 13 RUN Enable is set and this terminal is on.)

■ Definition of Remote

In Remote mode the inverter will only respond to external command, frequency and communication signals, i.e. will not operate from the keypad (Local mode).

■ dr.90 ESC Key Setting

When setting to 2 Local/Remote, the ESC Key will act as the local/remote function. In this case, there is no change for the inverter operation because it operates depending on the already set parameters by the Remote mode. If you want to switch to the Local mode, just press the ESC Key to make the SET LED blink and operate the inverter with the RUN key on the keypad setting. Pressing the ESC Key again causes the SET LED to be turned off, and the inverter operates according to the operation command method selected in the operation group drv.

■ When Switching from Remote to Local

If you switch from Remote to Local, the system stops if it has been operating.

■ When Switching from Local to Remote

If you switch from Local to Remote, the display is changed according to the already set command source and frequency source.

It is still possible to switch to Remote while the system is operating in the Local mode. However, the operation depends on which source is set.

1. When the terminal block is the command source

If you switch to the Remote mode while operating in the Local mode, it operates according to the command from the terminal block. In other words, if the reverse operation terminal (RX) is input to the terminal block and the motor rotates in the forward direction in the Local mode, it will rotate in the reverse direction when you switch to Remote.

2. When it is the digital command source

Digital command source refers to all of the command sources except for the terminal block source. That is, the digital command source includes communication and keypad sources. For these digital command sources, the inverter stops first and then begins to operate with the next command. At this moment, the target frequency is set to the currently set frequency source.

■ State in Which a Terminal is Turned On When Power is On

If the terminals of FX, RX, FWD_JOG, REV_JOG, and PRE EXCITE are turned on already when Ad.10 Power-on Run is set to 0 No, it is possible to operate the inverter with the keypad by switching to the Local mode. However, it will not operate if you switch to the Remote mode again. In other words, if at least one of the five terminals mentioned above is set and turned on when the power is on, the motor will operate in neither FX nor RX. Thus, when the Power-on Run is set to No, make sure to turn on the inverter and then turn off all of the above terminals, in order to run the motor with the relevant terminal.

■ State in Which the Motor Stopped Due to Trip While Operating

When the motor stops due to trip and the initialization is performed again, keypad operation is still possible in Local mode. But when switching to Remote mode again, the inverter will not operate the motor even if the operation command is input to the terminal block. That is, the motor can run only if the operation command terminal is turned on again after all of the operation terminals are turned off.

6.8 Prohibition of Forward or Reverse Rotation: Run Prevent

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	09	Selection of prohibited rotation direction	Run Prevent	0	None	0 - 2	-
				1	Forward Prev		
				2	Reverse Prev		

Prohibited direction of motor rotation may be selected.

0 : None: Both forward and reverse rotations are possible.

1 : Forward Prev: Forward operation is prevented.

2 : Reverse Prev: Reverse operation is prevented.

*. When Inverter is operated by LCD Loader, REV is limited. when Inverter is decreased to 0hz by REV button while FWD driving, Inverter maintains present state during driving.

6.9 Starting with Power on: Power-on Run

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	1 2	Fx/Rx-1 or Fx/Rx-2	0 - 4	-
Ad	10	Starting with power on	Power-on Run	1	Yes	0 - 1	-

When power is supplied to the inverter, the motor accelerates if the terminal block operating command is turned on. It is valid only if the selection of the drv operation command (Cmd Source) of the operation group is set to 1 (Fx/Rx-1) or 2 (Fx/Rx-2). At this moment, a trip may occur if the inverter begins to operate when the fan load is in free-run state. Thus, if you set the bit 4 to 1 in the Cn.71 speed search, the inverter will start to operate by performing speed search on startup. If the speed search is not selected, it will accelerate to the normal V/F pattern without speed search on acceleration. If this function is not selected, the operation command of the terminal block should be turned off and then on, in order to begin operation.

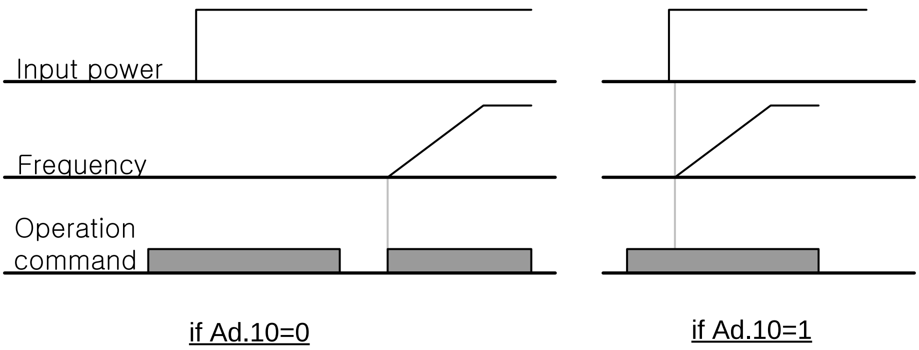


Figure 6-14 Comparison of the Power-on Run function when it is set to Ad.10=0 or Ad.10= 1

> ⚠ **Caution**
>
> - When using this function, be aware of the risk of accident because the motor will rotate as soon as the power is supplied.

6.10 Starting on Reset After a Trip Takes Place: Reset Restart

Group	Code	Name	LCD display	Setting		Setting range	Unit
operation	drv	Operation command method	Cmd Source	1 2	Fx/Rx-1 or Fx/Rx-2	0 - 4	-
Pr	08	Selection of startup on trip reset	RST Restart	1	Yes	0 - 1	-
Pr	09	Number of automatic restarts	Retry Number	0		0 - 10	-
Pr	10	Delay time of automatic restart	Retry Delay	1.0		0 - 60	sec

When reset after a trip takes place, the motor accelerates if the terminal block operating command is turned on. When an inverter trip occurs, the inverter will cut off the power so that the motor will be in free-run state. At this moment, a trip may occur again if the inverter begins to operate; thus, if you set the bit 2 to 1 in the Cn.71 speed search, the inverter will start to operate by performing speed search on fault reset. If the speed search is not selected, it will accelerate to the normal V/F pattern without speed search on acceleration. If this function is not required, the operation command should be turned off and then on after reset, in order to begin operation.

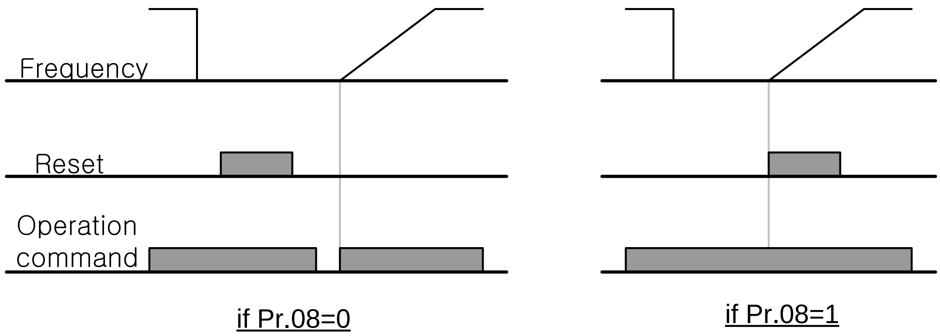


Figure 6-15 Comparison of the RST Restart function when it is set to Pr.08 = 0 or Pr.08 = 1

> ⚠ **Caution**
>
> - When using this function, be aware of the risk of accident because the motor will rotate if a RUN command is present on the terminal block or the keypad after a trip has been reset.

6.11 Setting Acc/Dec Time

(1) Acc/Dec time setting based on max. frequency

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	ACC	Acceleration time	Acc Time	20.0		0.0 - 600.0	sec
Operation	dEC	Deceleration time	Dec Time	30.0		0.0 - 600.0	sec
dr	20	Maximum frequency	Max Freq	60.00		40.00 - 400.00	Hz
bA	08	Acc/Dec reference frequency	Ramp T Mode	0	Max Freq	0 - 1	-
bA	09	Time unit setting	Time scale	1	0.1 sec	0 - 2	-

If you set 08 in the basic function group (bA) to Max Freq, you can accelerate and decelerate with the same gradient based on the maximum frequency irrespective of the operation frequency. The acceleration time set from 03 of the drive group (dr) is the time elapsed from 0 Hz to the maximum frequency, while the deceleration time from 04 is that from the maximum frequency to 0 Hz.

Example) If you set the maximum frequency to 60.00 Hz, Acc/Dec time to 5 sec, and the operation frequency to 30 Hz, the time required to reach 30 Hz will be 2.5 sec.

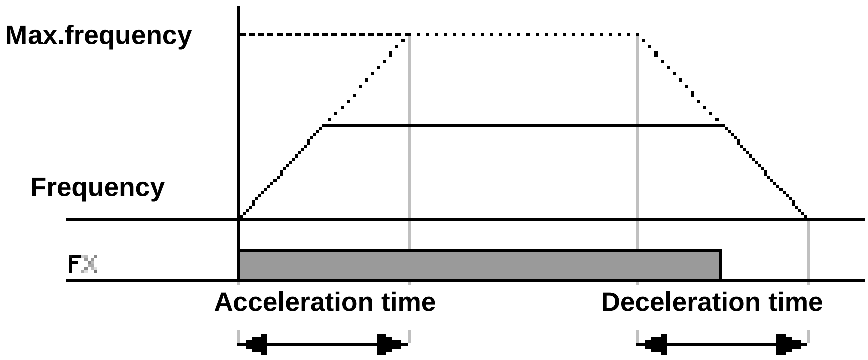


Figure 6-16 Setting Acc/Dec time

bA.09 Time scale: Used when precise acceleration/deceleration time is necessary depending on the load characteristic or it is required to increase the maximum set time. Change the units of all functions related to time.

Setting type		Range of setting Acc/Dec time	Setting details
0	0.01 sec	0.00 - 60.00	Able to set down to the unit of 0.01 sec.
1	0.1 sec	0.0 - 600.0	Able to set down to the unit of 0.1 sec.
2	1 sec	0 - 6000	Able to set down to the unit of 1 sec.

⚠ **Caution**

- Be careful when you change the unit because the maximum allowable time will be changed as well. With the acceleration time set to 1000 sec, it will be changed to 60.00 sec if you change the bA.09 Time scale to the type 0 (0.01 sec).

(2) Setting Acc/Dec Time Based on Operation Frequency

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	ACC	Acceleration time	Acc Time	20.0		0.0 - 600.0	sec
Operation	dEC	Deceleration time	Dec Time	30.0		0.0 - 600.0	sec
bA	08	Acc/Dec reference frequency	Ramp T Mode	1	Delta Freq	0 - 1	-

If you set 08 in the basic function group (bA) to Delta Freq, you can set the acceleration and deceleration time to the time elapsed from the current operation frequency at constant speed to the target frequency in the next step. With the acceleration time set to 5 sec and 10 Hz/30 Hz step operation at stationary state, the behavior of the acceleration time will be as follows:

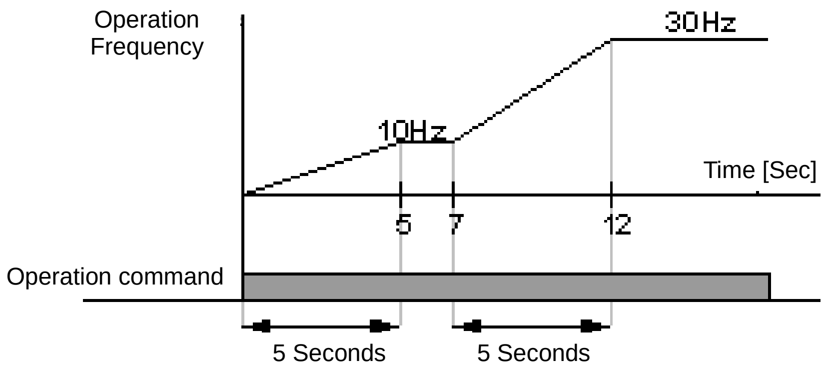


Figure 6-17 Acceleration time set to 5 sec and 10 Hz/30 Hz step operation at stationary state

(3) Setting Multi-step Acc/Dec Time Using Multi-function Terminals

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	ACC	Acceleration time	Acc Time	20.0		0.0 - 600.0	sec
Operation	dEC	Deceleration time	Dec Time	30.0		0.0 - 600.0	sec
bA	70 - 82	Multi-step acceleration time 1 - 7	Acc Time - 1 - 7	x.xx		0.0 - 600.0	sec
bA	71 - 83	Multi-step deceleration time 1 - 7	Dec Time - 1 - 7	x.xx		0.0 - 600.0	sec
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	11	XCEL-L	0 - 49	-
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	12	XCEL-M		-
In	89	Multi-step command delay time	In Check Time	1		1 - 5000	ms

It is possible to change acceleration and deceleration time using multi-function terminals. Set the time for acceleration/deceleration in ACC, dEC of the operation group and the time for Acc Time 1 - 7 and Dec Time 1 - 7 in the codes from 70 to 83. After selecting a terminal to be used as the multi-step acceleration/deceleration time command out of the multi-function terminals P1 to P7, set each one of the multi-step acceleration/deceleration commands (XCEL-L, XCEL-M, XCEL-H). XCEL-L and XCEL-M are recognized as binary codes, so the system operates by selecting the acceleration/deceleration time set from bA.70 to bA.83. If the multi-function terminals P6 and P7 are set to XCEL-L , XCEL-M and XCEL-H individually, the system operates as follows:

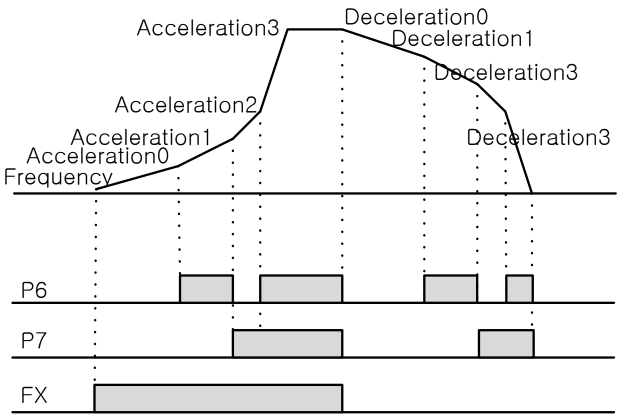


Figure 6-18 Setting multi-step Acc/Dec time using multi-function terminals

Table 5-4 Setting multi-function terminals P6 and P7

Acc/Dec time	P7	P6
0	-	-
1	-	✓
2	✓	-
3	✓	✓

In.89 In Check Time: Using the multi-function input terminal with the multi-step acceleration/deceleration setting, you can set the time to check the terminal block input within the inverter. For example, with the In Check Time of the terminal block set to 100 ms and the multi-function terminal P6 input, the system will check if there is any input from another terminal block for 100 ms. When 100 ms has elapsed, it will be set to acceleration/deceleration time relevant to the P6 terminal.

(4) Changing Multi-step Acc/Dec Time by Setting Acc/Dec Time Transition Frequency

Group	Code	Name	LCD display	Setting	Setting range	Unit
Operation	ACC	Acceleration time	Acc Time	10.0	0.0 - 600.0	sec
Operation	dEC	Deceleration time	Dec Time	10.0	0.0 - 600.0	sec
bA	70	Multi-step acceleration time 1	Acc Time-1	20.0	0.0 - 600.0	sec
bA	71	Multi-step deceleration time 1	Dec Time-1	20.0	0.0 - 600.0	sec
Ad	60	Acc/Dec time transition frequency	Xcel Change Fr	30.00	0 - Max. frequency	Hz

It is possible to change acceleration and deceleration gradient without using multi-function terminal. The system will operate with the gradient set in bA.70 and 71 at below the Acc/Dec transition frequency set in Ad.60 by the operation frequency. However, when the operation frequency increases to higher than the Acc/Dec transition frequency, it will operate with the Acc/Dec gradient set in ACC and dEC of the operation group. If the multi-function input terminal function is set and input to the multi-step Acc/Dec (XCEL-L , XCEL-M and XCEL-H), it will operate with multi-step Acc/Dec input irrespective of the Acc/Dec transition frequency.

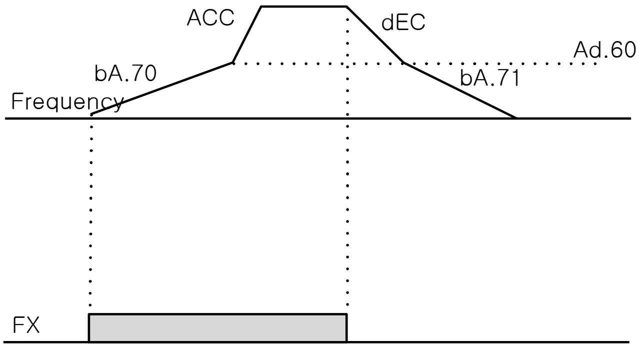


Figure 6-19 Changing multi-step Acc/Dec time by setting Acc/Dec time transition frequency

6.12 Setting Acc/Dec Pattern

Group	Code	Name	LCD display	Setting		Setting range	Unit
bA	08	Acc/Dec reference frequency	Ramp T mode	0	Max Freq	0 - 1	-
Ad	01	Accelerating pattern	Acc Pattern	0	Linear	0 - 1	-
Ad	02	Decelerating pattern	Dec Pattern	1	S-Curve		-
Ad	03	S-curve acceleration start point gradient	Acc S Start	40		1 - 100	%
Ad	04	S-curve acceleration end point gradient	Acc S End	40		1 - 100	%
Ad	05	S-curve deceleration start point gradient	Dec S Start	40		1 - 100	%
Ad	06	S-curve deceleration end point gradient	Dec S End	40		1 - 100	%

Set the patterns of acceleration and deceleration gradient. There are two types of patterns with the following functions:

<table>
<tr><th colspan="2">Setting type</th><th>Function</th></tr>
<tr><td>0</td><td>Linear</td><td>The output frequency has a constant magnitude and linearly increases or decreases.</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">S-curve</td><td>Used for applications where smooth acceleration/deceleration is required such as elevator load or door. S-curve ratio is adjustable by using the functions from 03 to 06.</td></tr>
<tr><td>⚠ Caution</td></tr>
<tr><td>▪ Pay attention when setting the Acc/Dec pattern to S-curve because it will cause the relevant time to be longer than the set Acc/Dec time. For actual Acc/Dec time, refer to page 6.11Setting Acc/Dec Time.</td></tr>
</table>

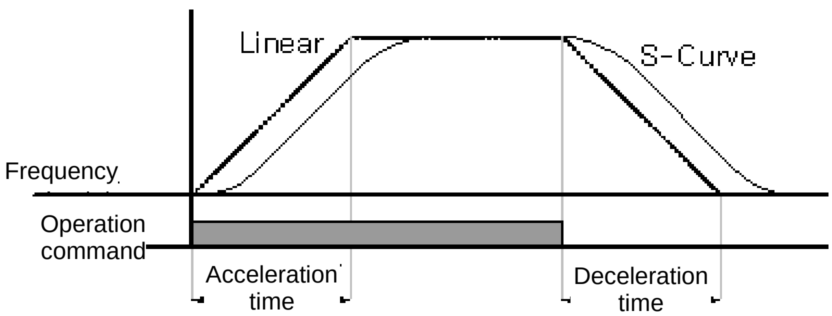


Figure 6-20 Setting Acc/Dec pattern

Ad.03 Acc S Start: When setting the Acc/Dec pattern to S-curve, the curve gradient may be adjustable. Used to adjust the S-curve ratio when beginning to accelerate. The curve ratio is based on 1/2 of the target frequency; thus, be sure to set the ratio that the curve acceleration occupies out of the 1/2 frequency. For example, if the target frequency is identical to the maximum frequency (max Freq [Hz]), the value will be 60 Hz. Thus, with Ad.03 Acc S Start set to 50%, the frequency range which the curve acceleration will occupy when the S-curve accelerates to 30 Hz will be 0 to 15 Hz, and the 15 Hz - 30 Hz section will be linear acceleration.

Ad.04 Acc S End: The curve gradient can be adjusted at the moment when the operation frequency reaches the target frequency. In the same manner for Acc S Start, set the ratio that the curve acceleration occupies out of the remaining section based on 1/2 frequency of the target frequency. In the case of setting like the example of Acc S Start, the system will accelerate with a linear gradient from 30 to 45 Hz while accelerating with a curve gradient from 45 to 60 Hz, and then operate at constant speed.

Ad.05 Dec S Start - Ad.06 Dec S End: Set the curve deceleration gradient ratio for deceleration. It is the same as the acceleration ratio described above the setting method.

Acc/Dec time at the S-curve:

Actual acceleration time = set acceleration time + set acceleration time * starting point slope/2 + set acceleration time * ending point slope/2

Actual deceleration time = set deceleration time + set deceleration time * starting point slope/2 + set deceleration time * ending point slope/2

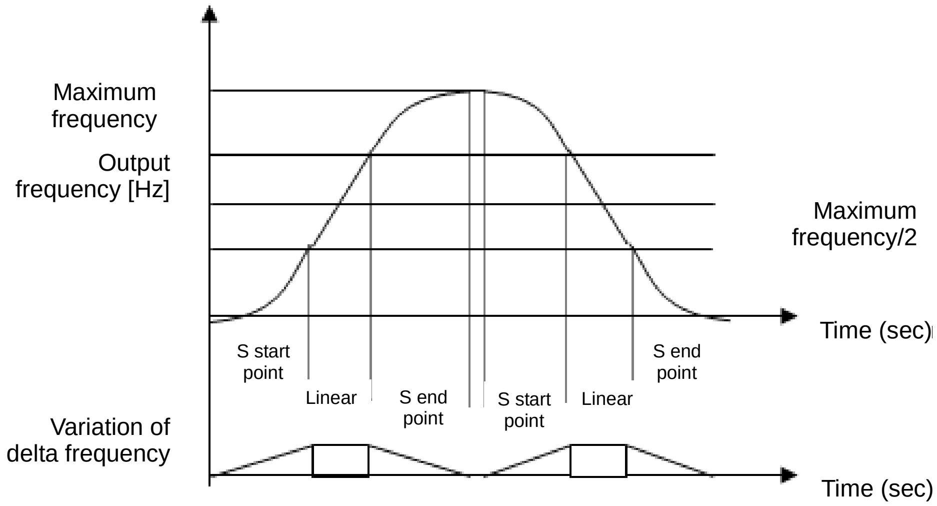


Figure 6-21 S-Curve Acc/Dec pattern

6.13 Acc/Dec Stop Command

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	25	XCEL Stop	-	-

It is possible to stop acceleration or deceleration and operate at constant speed using the multi-function terminal. The figure below shows the use of the multi-function terminal P7.

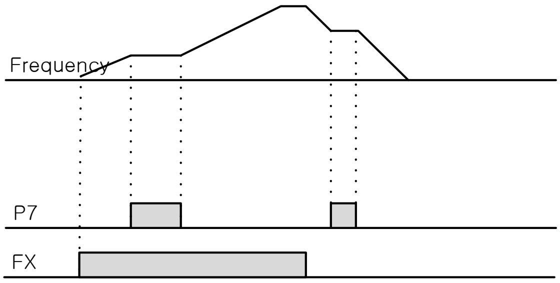


Figure 6-22 Acc/Dec stop command using the terminal P7

6.14 V/F Voltage Control

Set the magnitude and gradient of voltage, output pattern, etc. according to the output frequency. In addition, adjust the amount of torque boost at low speed.

■ Linear V/F Pattern Operation

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	09	Control mode	Control Mode	0	V/F	0 - 4	-
dr	18	Base frequency	Base Freq	60.00		30.00 - 400.00	Hz
dr	19	Start frequency	Start Freq	0.50		0.01 - 10.00	Hz
bA	07	V/F pattern	V/F Pattern	0	Linear	0 - 3	-

The output voltage is increased and decreased at a certain rate according to the ratio of voltage/frequency (V/F), depending on the fluctuation of frequency. It is used for constant torque load requiring a constant torque irrespective of frequency.

- **dr.18 Base Freq**: Sets the base frequency. This is the frequency in which the inverter's rated voltage is output. Enter the frequency stated on the motor nameplate.
- **dr.19 Start Freq**: Sets the start frequency. This is the frequency in which the inverter voltage begins to be output. If the target frequency is lower than the start frequency, no voltage is output from the inverter. If it began to operate above the start frequency and then decelerates to stop, however, it will stop as shown in the figure below.

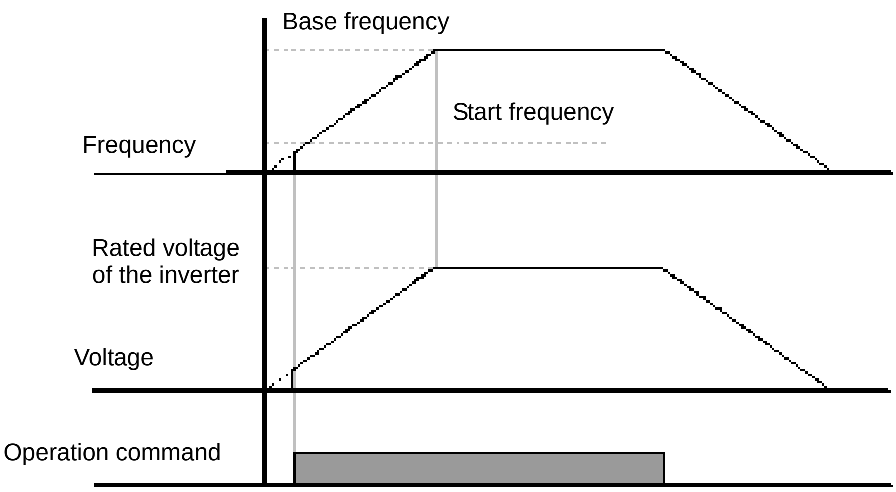


Figure 6-23 In the case of operating above the start frequency and then decelerating to stop

■ Square Reduction V/F Pattern Operation (Operation When Using Fan and Pump Load)

Group	Code	Name	LCD display	Setting		Setting range	Unit
bA	07	V/F pattern	V/F Pattern	1	Square	0 - 3	-
				3	Square 2		

This is an operation pattern suitable for a load with the starting characteristics of square reduction, such as fan, pump, etc. Select the Square or Square 2 for use depending on the start characteristic of load.

- **Square**: The voltage is output proportionally to the value of the frequency raised to the 1.5th power (command frequency * 1.5).
- **Square 2**: The voltage is output proportionally to the value of the frequency raised to the 2nd power (command frequency * 2). It is used for variable torque (VT) load such as fan or pump.

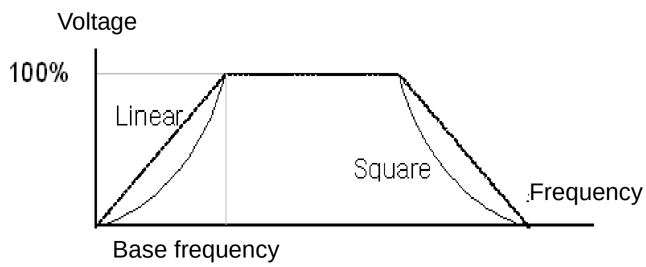


Figure 6-24 Square reduction V/F pattern operation

■ User defined V/F Pattern Operation

Group	Code	Name	LCD display	Setting		Setting range	Unit
bA	07	V/F pattern	V/F Pattern	2	User V/F	0 - 3	-
bA	41	User frequency 1	User Freq 1	15.00		0 - Max. frequency	Hz
bA	42	User voltage 1	User Volt 1	25		0 - 100%	%
bA	43	User frequency 2	User Freq 2	30.00		0 - Max. frequency	Hz
bA	44	User voltage 2	User Volt 2	50		0 - 100%	%
bA	45	User frequency 3	User Freq 3	45.00		0 - Max. frequency	Hz
bA	46	User voltage 3	User Volt 3	75		0 - 100%	%
bA	47	User frequency 4	User Freq 4	60.00		0 - Max. frequency	Hz
bA	48	User voltage 4	User Volt 4	100		0 - 100%	%

The user can make the setting according to the V/F and load patterns of a special motor instead of a general induction motor.

- **bA.41 User Freq 1 - bA.48 User Volt 4**: Select an arbitrary frequency between the start frequency and the maximum frequency to set the user frequency (User Freq x), and set the voltages corresponding to each frequency to the user voltage (User Volt x).

Notes

- The output voltage 100% is based on the bA.15 Rated Volt setting.
- However, it is based on the input voltage if the bA.15 Rated Volt is set to '0.'

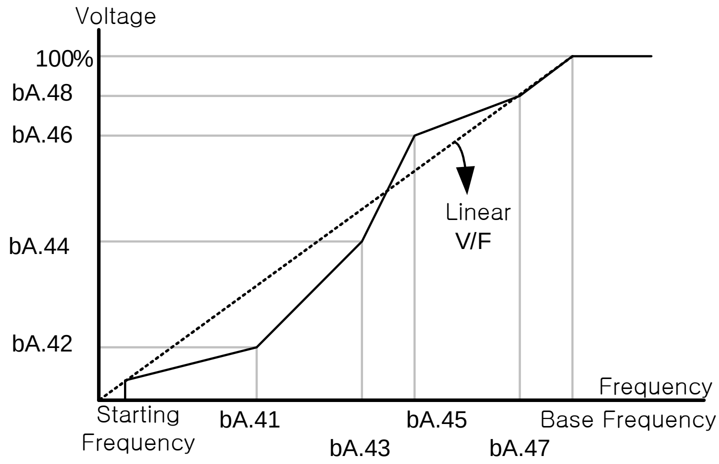


Figure 6-25 bA.41 User Freq 1 - bA.48 User Volt 4 user V/F pattern operation

⚠ Caution

- If you set the pattern so that it deviates greatly from the linear V/F pattern when using a general induction motor, the torque may become insufficient or the motor may overheat due to excessive excitation.
- When you use the user V/F pattern, the forward torque boost (dr.16 Fwd Boost) and the reverse torque boost (dr.17 Rev Boost) do not work.

6.15 Torque Boost

■ Manual Torque Boost (When a high start torque is required for certain load types.)

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	15	Torque boost method	Torque Boost	0	Manual	0 - 1	-
dr	16	Forward torque boost	Fwd Boost	2.0		0.0 - 15.0	%
dr	17	Reverse torque boost	Rev Boost	2.0		0.0 - 15.0	%

Adjusts the output voltage during low speed operation or when starting. You can increase the output voltage in the low speed area to improve the start characteristic or raise the low speed torque.

- **dr.16 Fwd Boost**: Adjusts the amount of torque boost during forward rotation.
- **dr.17 Rev Boost**: Adjusts the amount of torque boost during reverse rotation.

⚠ Caution

- If you set the amount of torque boost too large, the motor may overheat at low speed due to excessive excitation.

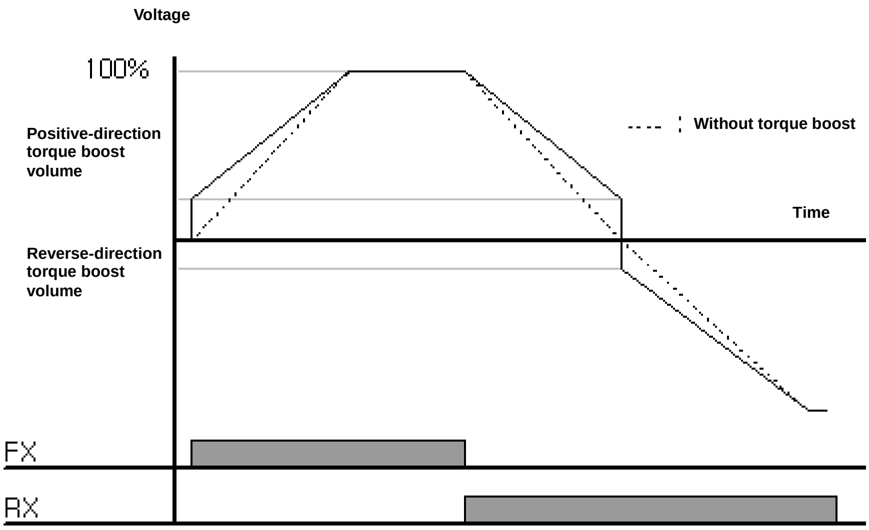


Figure 6-26 Manual torque boost

■ Auto Torque Boost (When a large amount of starting torque is required or automatic adjustment function is used)

Group	Code number	Function display	Setting display		Setting Range
dr	15	Torque Boost	1	Auto	0 - 1
bA	20	Auto Tuning	3	Rs+Lsigma	-

Using the motor parameters, the inverter will automatically calculate the amount of torque boost and output the voltage. Since the stator resistance, the inductance value and no-load current value of the motor are required to have the automatic torque boost function to operate properly, be sure to perform auto-tuning (bA.20 Auto Tuning) prior to use. (See page 7.10 Auto-Tuning)

6.16 Adjustment of Motor Output Voltage

(Setting the motor voltage when the input power supply is different from the motor voltage specification)

Group	Code	Name	LCD display	Setting	Setting range	Unit
bA	15	Rated motor voltage	Rated Volt	0	0, 170 - 480	V

Enter the voltage stated on the motor nameplate. The set voltage value becomes the output voltage value at the base frequency. At a level higher than the base frequency, the output voltage will be dependent on the set value if the input voltage is higher than the set voltage. But if it is lower, the input voltage will be output.

If setting it to '0,' the output voltage will be compensated based on the input voltage while the inverter is stationary. At a level higher than the base frequency, the input voltage will be output if the input voltage is lower than the set voltage.

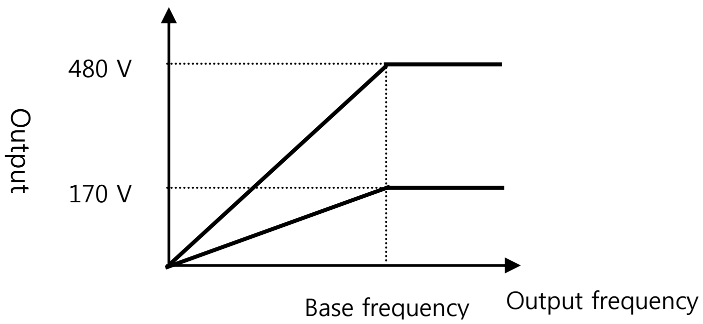


Figure 6-27 Setting the motor voltage when the input power supply is different from the motor voltage specification

6.17 Start Mode Selection

Select the start mode when the operation command is input at stationary state.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	07	Start mode	Start mode	0	Acc	0 - 1	-
Ad	12	DC braking time at startup	Dc-Start Time	0.00		0.00 - 60.00	sec
Ad	13	Amount of applied DC	Dc Inj Level	50		0 - 200	%

■ Accelerating Start

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	07	Start mode	Start mode	0	Acc	0 - 1	-

It is a general acceleration method. When there is no function selection, it accelerates directly to the target frequency on operation command input.

■ Start after DC Braking

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	07	Start mode	Start Mode	1	Dc-Start	0 - 1	-
Ad	12	DC braking time at startup	Dc-Start Time	0.00		0.00 - 60.00	sec
Ad	13	Amount of applied DC	Dc Inj Level	50		0 - 200	%

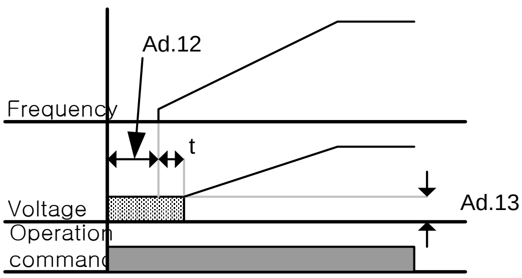


Figure 6-28 Start after DC braking

Accelerates after supplying DC voltage to the motor for a set time. When the motor is rotating before the voltage is supplied from the inverter, it can stop the motor revolution by DC braking and then make acceleration. Also, when applying mechanical brake to the motor shaft, it may be used if a constant torque is required even after opening the mechanical brake.

⚠ Caution

- The DC braking quantity is the basis of the set motor rated current, so do not set the current value higher than the inverter rated current. Or the motor may be overheated or damaged.
- If the DC braking quantity is too large or the braking time is too long, the motor may be overheated or damaged.

6.18 Stop Mode Selection

Select a method to stop the motor when a stop command is input to the inverter during its operation.

■ Deceleration Stop

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	08	Stop mode	Stop Mode	0	Dec	-	-

This is a general deceleration method. When there is no function selection, the motor decelerates(ramps) down to 0 Hz and then stops, as shown in the figure below.

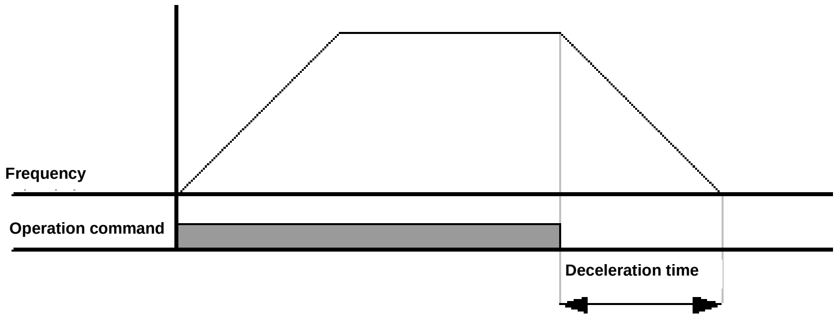


Figure 6-29 Deceleration stop

■ Stopping using DC Braking

(Stopping the motor by supplying direct current at a preset frequency during deceleration)

When the frequency reaches the set value during deceleration, the motor will be stopped by DC braking.

Group	Code	Name	LCD display	Setting display		Range	Unit
Ad	08	Stop mode	Stop Mode	1	DC-Brake	-	-
Ad	14	Output prior to DC braking	Dc-Block Time	0.10		0.00 - 60.00	sec
Ad	15	DC braking time	Dc-Brake Time	1.00		0 - 60	sec
Ad	16	DC braking quantity	Dc-Brake Level	50		0 - 200	%
Ad	17	DC braking frequency	Dc-Brake Freq	5.00		0.00 - 60.00	Hz

When the deceleration begins with the stop command input and the frequency reaches the DC braking frequency (Ad.17 Dc-Brake Freq), the motor receives DC voltage and stops.

- **Ad.14 Dc-Block Time**: Set the time to block the inverter output before starting DC braking. If the load inertia is large or the DC braking frequency (Ad.17 Dc-Brake Freq) is high, a trip may occur due to overcurrent when supplying DC voltage to the motor. Therefore, adjust this time to prevent an overcurrent trip.
- **Ad.15 Dc-Brake Time**: Set the time to supply DC voltage to the motor.

- **Ad.16 Dc-Brake Level**: You can adjust the DC braking quantity. The reference is the rated current of the motor.
- **Ad.17 Dc-Brake Freq**: Set the start frequency for DC braking. When the inverter begins to decelerate and reaches this frequency, it begins DC braking.

Notes
▪ If you use the dwell frequency and set it to a level lower than the DC braking frequency, the dwell operation will not work, but the DC braking will be performed instead.

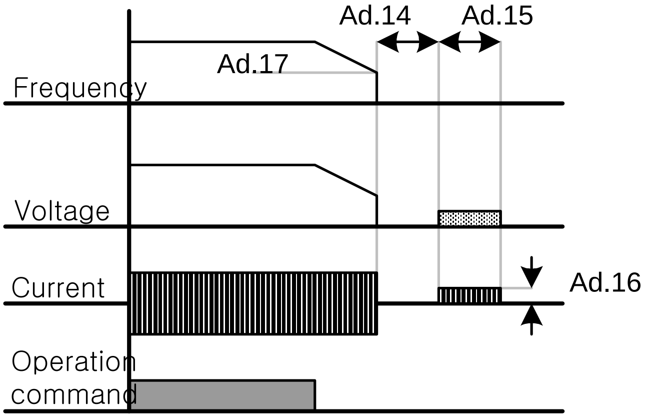


Figure 6-30 Stop after DC braking

⚠ Caution
▪ If the DC braking quantity is too large or the braking time is too long, the motor may be overheated or damaged, so be careful about this matter. ▪ The DC braking quantity is the basis of the set motor rated current, so do not set the current value higher than the inverter rated current. Or the motor may be overheated or damaged.

■ Free-run stop (Coasting)

Group	Code	Name	LCD display	Setting display		Setting range	Unit
Ad	08	Stop mode	Stop mode	2	Free-Run	-	-

When the operation command is turned off, the inverter output is blocked and the motor free-wheels without power to stop.

⚠ Caution
▪ When the inertia on the motor load side is large and the motor is operating at high speed, the motor may still rotate due to the load inertia even when the inverter output is blocked, so caution is required.

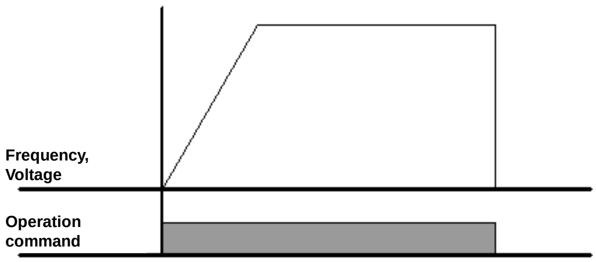


Figure 6-31 Free-run stop

■ Power Braking

(Optimally decelerating without overvoltage trip)

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	08	Stop mode	Stop Mode	4	Power Braking	-	-

In the case that the inverter DC voltage rises above a certain level due to the motor regenerative energy, adjust the deceleration gradient or perform the acceleration again to reduce the regenerative energy. Power braking can be used when a short deceleration time is needed without any other braking resistance and braking unit. However, the deceleration time may be longer than the set deceleration time, be careful not to cause any damage due to motor overheating when using power braking for a load with frequent deceleration.

⚠ Caution

- Do not use this function where frequent deceleration takes place or the motor may be overheated or damaged.
- The stall prevention and power braking functions work only during deceleration, the latter takes higher priority. For example, when both BIT3 of Pr.50 and the power braking of Ad.08 are set, the power braking will function. Overvoltage trip may occur when the deceleration time is too short or the inertia is large.

6.19 Frequency Limit

You can limit the operation frequency setting using the maximum frequency, start frequency, upper/lower limit of frequency, etc.

■ Limiting Frequency Using the Maximum Frequency and the Start Frequency

Group	Code	Name	LCD display	Setting	Setting range	Unit
dr	19	Start frequency	Start Freq	0.50	0.01 - 10.00	Hz
dr	20	Maximum frequency	Max Freq	60.00	40.00 - 400.00	Hz

- **dr.19 Start Freq**: Has lower limit function for the parameter with the unit related to speed (Hz, rpm). It is set to 0.00 if you set the frequency lower than the start frequency.
- **dr.20 Max Freq**: Has upper limit function for the parameter with all speed units (Hz, rpm) except for the base frequency (dr.18 Base Freq). It is not possible to set the base frequency higher than the maximum frequency.

■ Limiting Frequency Using the Upper and Lower Limit of Frequency

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	24	Frequency limit	Freq Limit	0	No	0 - 1	-
Ad	25	Lower limit frequency	Freq Limit Lo	0.50		0.0 - upper limit	Hz
Ad	26	Upper limit frequency	Freq Limit Hi	60.00		0.50 - Max. frequency	Hz

- **Ad.24 Freq Limit**: When setting to Yes(1) with the initial setting of No(0), the frequency can be set only between the lower limit (Ad.25) and the upper limit (Ad.26). With the setting of No, the Ad.25 and Ad.26 codes are invisible.
- **Ad.25 Freq Limit Lo, Ad.26 Freq Limit Hi**: Set the upper limit and lower limit, respectively. The maximum and minimum settings of the upper and lower limits are limited to the lower limit and the upper limit, respectively. In addition, when setting the frequency with the keypad, the frequency can be set between the upper limit and the lower limit.

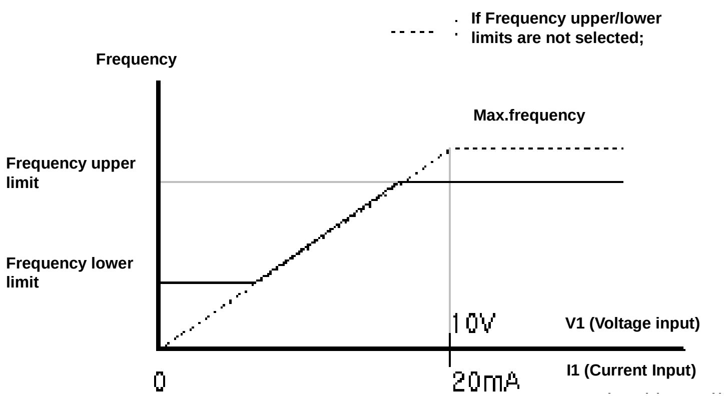


Figure 6-32 Limiting frequency using the upper and lower limit of frequency

■ Frequency Jump

(Avoiding mechanical resonance frequency)

The frequency jump function is to prevent the frequency setting so as not to operate within the resonance frequency band where any resonance may occur in the user's mechanical system. The frequency jump band will be passed while the motor accelerates or decelerates; thus, you cannot set the frequency within the set frequency jump band.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	27	Frequency jump	Jump Freq	0	No	0 - 1	-
Ad	28	Lower limit 1 of jump frequency	Jump Lo 1	10.00		0.00 - Upper limit 1 of jump frequency	Hz
Ad	29	Upper limit 1 of jump frequency	Jump Hi 1	15.00		Lower limit 1 of jump frequency 1 - Max. frequency	Hz
Ad	30	Lower limit 2 of jump frequency	Jump Lo 2	20.00		0.00 - Upper limit 2 of jump frequency	Hz
Ad	31	Upper limit 2 of jump frequency	Jump Hi 2	25.00		Lower limit 2 of jump frequency 1 - Max. frequency	Hz
Ad	32	Lower limit 3 of jump frequency	Jump Lo 3	30.00		0.00 - Upper limit 3 of jump frequency	Hz
Ad	33	Upper limit 3 of jump frequency	Jump Hi 3	35.00		Lower limit 3 of jump frequency 1 - Max. frequency	Hz

In the case of increasing the frequency setting, when the frequency setting value (voltage, current, RS-485 communication, keypad setting, etc.) is within the jump frequency band, it will be maintained at the lower limit value of the frequency jump and then the frequency will be increased when the value gets out of the frequency jump band.

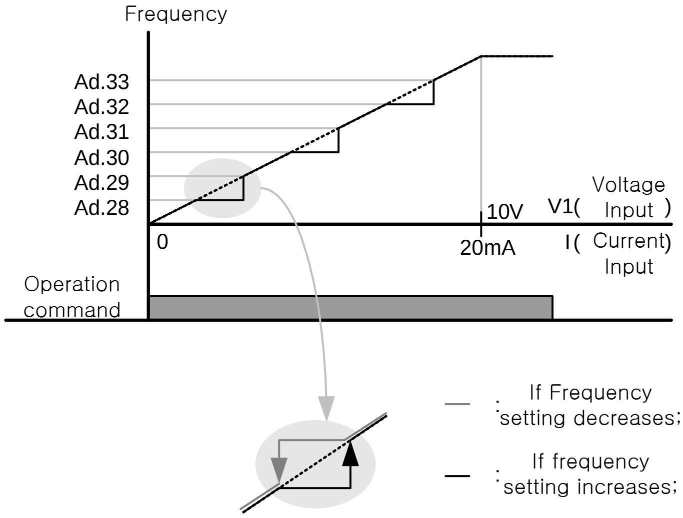


Figure 6-33 Frequency jump

6.20 Selection of Second Operation Method

(Switching to another operation method)

Using a multi-function input terminal, you can input the frequency setting, operation command, etc. as the second setting value. You can use this function to stop remote control and operate on the inverter body, when you are performing remote operation using any communication option.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	1	Fx/Rx-1	0 - 4	-
Operation	Frq	Frequency setting Action	Freq Ref Src	2	V1	0 - 12	-
bA	04	The second operation command method	Cmd 2nd Src	0	Keypad	0 - 4	-
bA	05	The second frequency setting method	Freq 2nd Src	0	KeyPad-1	0 - 12	-
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	15	2nd Source	0 - 49	-

Select it as 15 2nd Source by selecting one of the multi-function terminals between In.65 and In.71 of the terminal block input group.

- **bA.04 Cmd 2nd Src, bA.05 Freq 2nd Src**: If the multi-function input terminal set as the 2nd Source is turned on, the operation can be performed with the set values from the bA.04 and 05 instead of the set values from the drv code and the Frq code of the operation group.
- **Cmd 2nd Src is the main source, which cannot be changed during operation.**

⚠ Caution

- If you set a multi-function input terminal to the 2nd Source and turn it on, the operation state will be changed because all of the relevant commands including the frequency command and the operation command will be changed to the 2nd commands. Therefore, ensure that the 2nd commands are correctly set before inputting the selected multi-function terminal. Overvoltage trip may occur when the deceleration time is too short or the inertia is large.

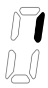
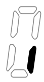
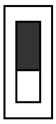
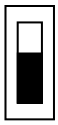
6.21 Multi-function Input Terminal Control

(Improving the response of input terminals)

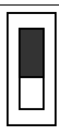
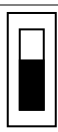
Filter time constant, contact type, and so on for the multi-function input terminal of the inverter terminal block can be set.

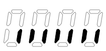
Group	Code	Name	LCD display	Setting	Setting range	Unit
In	85	Multi-function input terminal on filter	DI On Delay	10	0 - 10000	ms
In	86	Multi-function input terminal off filter	DI Off Delay	3	0 - 10000	ms
In	87	Selection of multi-function input contact	DI NC/NO Sel	000 0000[26]	-	-
In	90	State of multi-function input terminal	DI Status	000 0000	-	-

- **In.85 DI On Delay, In.86 DI Off Delay**: When the input terminal state does not change during the set time after the terminal is input, it is recognized as on or off.
- **In.87 DI NC/NO Sel**: You can select the contact type of the input terminal. Used as A contact state (normal open) when setting the dot position of the switch corresponding to each bit to the below position, while used as B contact state (normal close) when setting it to the above position. The order is P1, P2 …, and P7 from the right..

Display	B contact state	A contact state
Segment		
LCD		

- **In.90 DI Status**: Displays the state of the input terminal block. If you set the corresponding bit to A contact in dr.87, the On state will be indicated when the dot mark of the switch is above while the Off state is indicated when it is below. It acts in the opposite way when it is set to B contact. The states are displayed in the order of P1, P2 …, and P7 from the right.

Display	Bit setting state when setting A contact (On)	When setting A contact Bit setting off state (Off)
Segment		
LCD		

[26] The initial value 000 0000 is displayed as  in the SEG.

7. Application Functions

7.1 Various Application Operation Functions of S100

Table 7-1 Various application operation functions of S100 and their usage examples

Types of Operation	Usage Examples
Jog operation	Mainly used as manual operation. It operates based on the manual operation parameters.
Draw operation	A type of open loop tension control. It utilizes the speed difference between the motors that operate at the rate for the main speed command to keep the tension of the materials hanging between them consistent.
Up-down operation	Used where 2 switches control output. Swtich 1 is acceleration command, Switch 2 is deceleration command.
3-wire operation	A function that latches the inputted signals and carries out operation. Used when intending to operate the inverter by using push button, etc.
Safety mode operation	Used when a higher level of safe ‘torque-off’ condition is required when using the inverter control terminals to stop the motor.
Dwell operation	Used to ensure enough torque is available in a motor to prevent roll-back when brake is lifted.
Slip compensation operation	Used when intending to compensate for the motor slip, which increases when load increases, to rotate at a consistent speed.
PID control	PID-controls the output frequency of the inverter to control flow, pressure, temperature, etc.
Auto-tuning	The inverter measures and uses internal motor parameters for high performance operation.
Sensorless vector control	Controls the magnetic flux and torque components of the motor current to give higher starting torque than V/F control.
Torque control	Used when controlling the motor so that the torque is generated as set by the torque command value.
Droop control	Used to balance loads when multiple motors are used to drive one load, or to prevent the saturation of speed controller in vector control, etc.
Kinetic energy buffering	If power failure occurs in the input power, the voltage in the inverter DC power part is lowered, which leads to low voltage failure, and power is cut off. During power failure, it controls the inverter power frequency and maintains the voltage level in the DC power part. Therefore it is possible to keep longer the time from instantaneous power interruption to low voltage failure.
Energy saving operation	Used when intending to reduce voltage supplied to the motor at light load or no load in the applications of fans and pumps.
Speed search operation	Used in order to prevent the failure that could happen when the inverter voltage is outputted while the motor and load are free-wheeling.
Automatic restart operation	Used to automatically re-start the driven motor in case of some inverter trip conditions.
2nd motor operation	If an inverter is connected for switching between two motors, the 2nd motor can be operated as long as the input of the terminal defined as the 2nd function is 1 as the parameter group for 2nd motor.
Commercial power operation switching	Used when the load operated by the inverter is switched to the commercial power or vice versa.

Types of Operation	Usage Examples
Cooling fan control	Used to control the fan to cool the heat sink of inverter's body.
Timer function	You can power on or off multi-function output (including relay) after a certain period of time.
Brake control	Used to control the on/off operation of a mechanical brake in the load system using inverter multi-function relay or output terminal.
Multi-function power on/off control	You can power on or off the output relay or multi-function output terminal if the analog input value is above the set value.
Regeneration avoidance for press	While operating a press, prevents regeneration area by increasing the motor operation speed automatically in the motor regeneration status.

7.2 Setting the Override Frequency Using the Aux Frequency Command

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	Frq	Frequency Setting Methods	Freq Ref Src	0	Keypad-1	0 - 12	-
bA	01	Auxiliary command setting method	Aux Ref Src	1	V1	0 - 4	-
bA	02	Auxiliary command motion selection	Aux Calc Type	0	M + G * A	0 - 7	-
bA	03	Auxiliary command gain	Aux Ref Gain	0.0		200.0 - 200.0	%
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	40	dis Aux Ref	-	-

Used when using main and aux speeds to set the frequencies of various calculation conditions. You can use two frequency setting methods at the same time to set the operation frequency. The main speed can be use to set the main operation frequency and the aux speed can be used for fine tuning during the main operation.

For example, assume that settings were made as in the above table. With Keypad-1 as the main speed and 30.00 Hz operation, if -10 - +10V voltage is supplied to V1 terminal at 5% gain (variable from In.01 to In.16 are the initial values and In.06 V1 polarity is set as bipolar), it is possible to fine tune up to 33.00 - 27.00 Hz.

- **bA.01 Aux Ref Src**: Select the input type to be used as aux speed.

Table 7-2 Aux speed setting types

Setting type		Function
0	None	No aux speed operation
1	V1	Select the voltage input terminal of the control terminal block as aux speed command.
3	V2	Select the voltage input of terminal I2 (SW2 should be set as V) as aux speed command.
4	I2	Select the current input of terminal I2 (SW2 should be set as I) as aux speed command.
5	Pulse	Select pulse row input of terminal TI as aux speed command.

- **bA.02 Aux Calc Type**: You can determine the size of aux speed by using the gain (bA.03 Aux Ref Gain) and then use the four rules of arithmetic (addition, subtraction, multiplication and division) to set the application rate of the main speed.

Table 7-3 How to calculate the final command frequency

Setting type		Formula	How to calculate the final frequency command
0	M + (G * A)	M[Hz]+(G[%]*A[Hz])	Main speed command value + (bA03 x bA01 x IN01)
1	M * (G * A)	M[Hz]*(G[%]*A[%])	Main speed command value x (bA03 x bA01)
2	M / (G * A)	M[Hz]/(G[%]*A[%])	Main speed command value / (bA03 x bA01)
3	M+{M*(G*A)}	M[Hz]+{M[Hz]*(G[%]*A[%])}	Main speed command value + {Main speed command value x (bA03 x bA01)}
4	M+G*2*(A-50)	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	Main speed command value + bA03 x 2 x (bA01 – 50) x IN01
5	M*{G*2*(A-50)}	M[HZ]*{G[%]*2*(A[%]-50[%])}	Main speed command value x {bA03 x 2 x (bA01 – 50)}
6	M/{G*2*(A-50)}	M[HZ]/{G[%]*2*(A[%]-50[%])}	Main speed command value / {bA03 x 2 x (bA01 – 50)}
7	M+M*G*2*(A-50)	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	Main speed command value + Main speed command value x bA03 x 2 x (bA01 – 50)
M: Frq setting-based main speed frequency command (Hz or RPM), G: Aux speed gain (%), A: Aux speed frequency command (Hz or RPM) or gain (%)			

⚠ Caution

- If the max. frequency is high, the output frequency error may occur due to the analog input error or calculation error.

In the above setting types, the single-direction analog input can allow (+) or (-) operation at least four times.

- **bA.03 Aux Ref Gain**: Controls the size of the input (bA.01 Aux Ref Src) set as aux speed. If aux speed is selected to V1 or I2 and parameters from 01 to 32 in the terminal block input group are initial values, the aux speed frequency operates as in the following.
- **In.65 - 71 Px Define**: When the terminal set as dis Aux Ref (No.40) among the multi-function input terminals is inputted, it does not operate with the aux speed command and, instead, it operates only with main speed command.

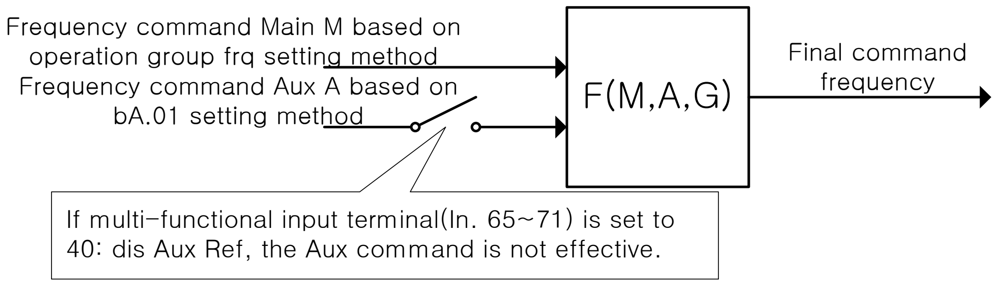


Figure 7-1 Setting the override frequency using the aux frequency command

- **M: Frq setup-based main speed frequency command (Hz or RPM)**
  G: Aux speed gain (%)
  A: Aux speed frequency command (Hz or RPM) or gain (%)
- **Usage example** 1) Frequency keypad setting is main speed and V1 analog voltage is aux speed
- ***Conditions:***
  - Main speed (M) setting (Frq): Keypad (frequency set as 30 Hz)
  - Max. frequency (Max Freq) setting (dr.20): 400 Hz

- Aux speed (A) setting (A: bA.01): V1 (expressed as aux speed (Hz) or percentage (%) depending on the calculation conditions)
- Aux speed gain (G) setting (bA.03): 50%, In.01 - 32: Factory default

- Assuming that 6 V is inputted to V1, the frequency for 10 V is 60 Hz and therefore the aux speed A in the following table is 36 Hz (= 60[Hz] x (6[V] / 10[V])) or 60% (= 100[%] X (6[V] / 10[V]) depending on the conditions.

Table 7-4 Usage example 1) Frequency keypad setting is main speed and V1 analog voltage is aux speed

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

- **M: Frq setup-based main speed frequency command (Hz or RPM)**
  G: Aux speed gain (%)
  A: Aux speed frequency command (Hz or RPM) or gain (%)
- * If the frequency is changed to RPM, RPM will be used instead of Hz.
- **Usage example 2)** Frequency keypad setting is main speed and I2 analog voltage is aux speed
- ***Conditions:***
  - Main speed (M) setting (Frq): Keypad (frequency set as 30 Hz)
  - Max. frequency (Max Freq) setting (dr.20): 400 Hz
  - Aux speed (A) setting (bA.01): I2 (expressed as aux speed (Hz) or percentage (%) depending on the conditions)
  - Aux speed gain (G) setting (bA.03): 50%
  - In.01 - 32: Factory default
- If 10.4 mA is inputted to I2, the frequency for 20 mA is 60 Hz. Therefore, in the following table, aux speed A is 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])}.

Table 7-5 Usage example 2) Frequency keypad setting is main speed and I2 analog voltage is aux speed

Setting type		Final command frequency
0	M[Hz]+(G[%]*A[Hz])	30Hz(M) + (50%(G) x 24Hz(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 direction)
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%–40%)} = -300Hz (reverse direction)
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x(40%(A)–50%) = 27Hz

- **M: Frq setting-based main speed frequency command (Hz or RPM), G: Aux speed gain (%)**
  A: Aux speed frequency command (Hz or RPM) or gain (%)
- **Usage example 3) V1 is main speed and I2 is aux speed**
- ***Conditions:***
  - Main speed (M) setting (Frq): V1 (the frequency command is set as 30 Hz at 5 V)
  - Max. frequency (Max Freq) setting (dr.20): 400 Hz
  - Aux speed (bA.01): I2 (expressed as aux speed [Hz] or percentage [%] depending on the conditions)
  - Aux speed gain (bA.03): 50% (indicates G in the following table. The value is 0.5)
  - IN01 - 32: Factory default
- Assuming that 10.4 mA is inputted to I2, the frequency for 20 mA is 60 Hz. Therefore the aux speed A in the following table is 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])}.

Table 7-6 Usage example 3) V1 is main speed and I2 is aux speed

Setting type		Final command frequency
0	M[Hz]+(G[%]*A[Hz])	30Hz(M) + (50%(G) x 24Hz(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 direction)
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%–40%)} = -300Hz (reverse direction)
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x(40%(A)–50%) = 27Hz

- **M: Frq setting-based main speed frequency command (Hz or RPM), G: Aux speed gain (%)**
  A: Aux speed frequency command (Hz or RPM) or gain (%)

7.3 Jog Operation

You can operate jog by using the terminal block or keypad multi-keys.

(1) Terminal block based jog operation 1

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	11	Jog frequency	JOG Frequency	10.00		0.50 - Max. frequency	Hz
dr	12	Jog operation acceleration time	JOG Acc Time	20.00		0.00 - 600.00	sec
dr	13	Jog operation deceleration time	JOG Dec Time	30.00		0.00 - 600.00	sec
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	6	JOG	-	-

Select the jog frequency setting terminal among P1 - P7 of multi-function terminal block and select No.6 (JOG) for the function of the terminal block among In.65 - In.71. If the jog terminal is inputted with operation command inputted, the operation frequency moves to the jog frequency explained below.

- **dr.11 JOG Frequency**: Sets the frequency for jog operation. The jog operation is the first priority, except Dwell operation. Therefore, if a jog command is inputted while operating with multi-step operation, up-down operation or 3-wire operation, it operates based on the jog frequency.
- **dr.12 JOG Acc Time, dr.13 JOG Dec Time**: This is acceleration and deceleration time when moved to the jog frequency.

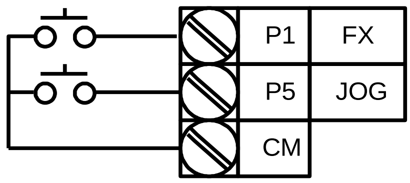


Figure 7-2 Terminal setting

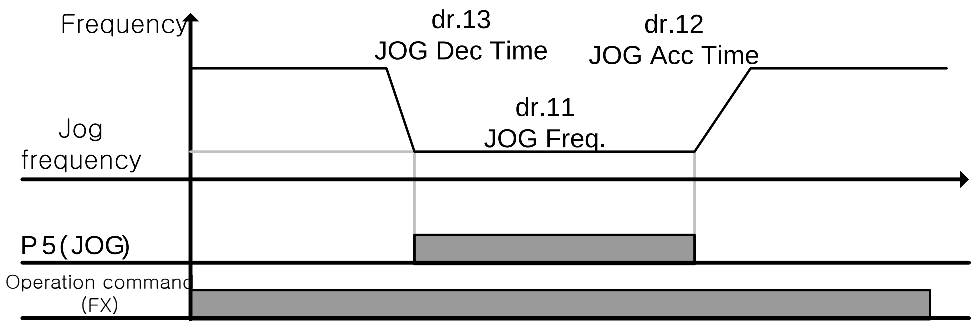


Figure 7-3 Terminal block based jog operation

If the jog terminal is inputted with operation command (FX) inputted, the operation frequency moves to the jog frequency.

(2) Terminal block based jog operation 2

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	11	Jog frequency	JOG Frequency	10.00		0.50 - Max. frequency	Hz
dr	12	Jog operation acceleration time	JOG Acc Time	20.00		0.00 - 600.00	sec
dr	13	Jog operation deceleration time	JOG Dec Time	30.00		0.00 - 600.00	sec
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	46	FWD JOG	-	-
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	47	REV JOG	-	-

Jog operation 1 needs the operation command, but jog operation 2 can carry out jog operation just by using the terminal set to FWD JOG or REV JOG. During jog operation, the priority for Acc/Dec time and terminal block input (Dwell, 3-wire, up/down, etc.) is the same with jog operation 1, and even if operation command is inputted, operation continues with jog frequency.

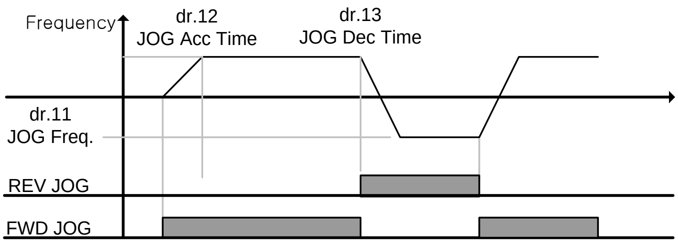


Figure 7-4 Terminal block based jog operation 2

(3) Keypad based jog operation

Group	Code	Name	LCD display	Setting display		Setting range	Unit
dr	90	ESC–key function selection	-	1	JOG Key	-	-
dr	06	Operation command methods	Cmd Source	0	Keypad	-	-

Set dr.90 to No.1 JOG Key and the drv code of the operation group to 0 Keypad. Pressing ESC key will make SET LED blinking and the jog operation becomes possible. Press and hold the operation key (RUN) of the keypad to operate at the set jog frequency (dr.11 JOG Frequency). Releasing the operation key (RUN) will stop the operation. The Acc/Dec time to the jog operation frequency is set I n dr.12 and dr.13.

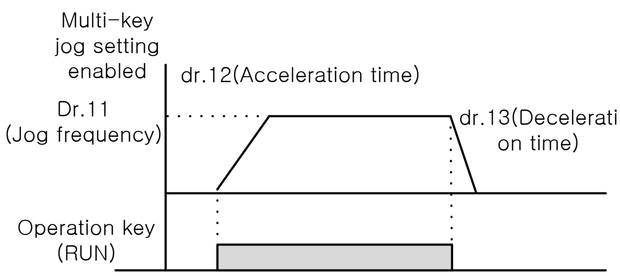


Figure 7-5 Keypad based jog operation

7.4 Up-down operation

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	65	Up/down operation frequency save	U/D Save Mode	1	Yes	0 - 1	-
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	17	Up	-	-
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	18	Down	-	-
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	20	U/D Clear	-	-

You can use the multi-function terminal block to control acceleration and deceleration. You can use it in the systems where the upper-lower limit switch signal is used as deceleration command.

Table 7-7 Up-down operation code description

Group	Code number	Function display	Code description
Ad	65	U/D Save Mode	▪ If the operation command (FX or RX terminal) is off or has a trip or power failure during the constant speed operation, the frequency used for operation is saved in the memory. ▪ When the operation command is on again or returns to the normal status, the saved frequency can be used. Use the multi-function terminal block to delete the saved frequency. Set one of multi-function terminals to No.20 U/D Clear and input the terminal during stop or constant speed status to delete the frequency saved in the up-down operation.
In	65 - 71	Px Define (Px: P1 - P7)	▪ Select the terminal to be used for up-down operation and then set relevant terminal functions to 17 up and 18 down, respectively. ▪ When the operation command is inputted, if the UP terminal signal is on, the speed goes up and if off, the speed stops accelerating and becomes constant. ▪ During operation, if the DOWN signal is on, the peed goes down, and if off, the speed stops deceleration and becomes constant. ▪ If UP and DOWN signals are on at the same time, acceleration and deceleration stop.

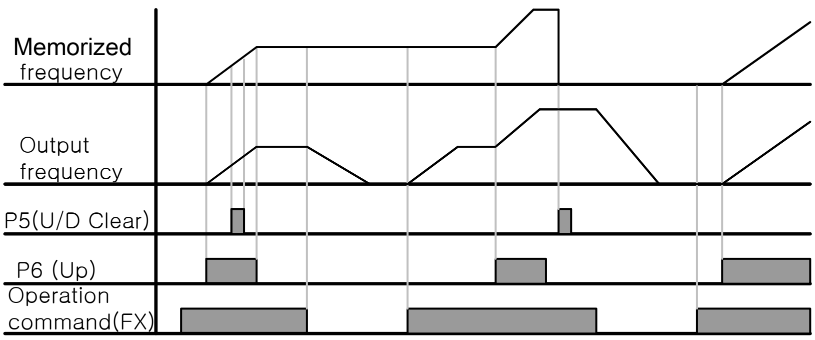


Figure 7-6 U/D Save Mode graph

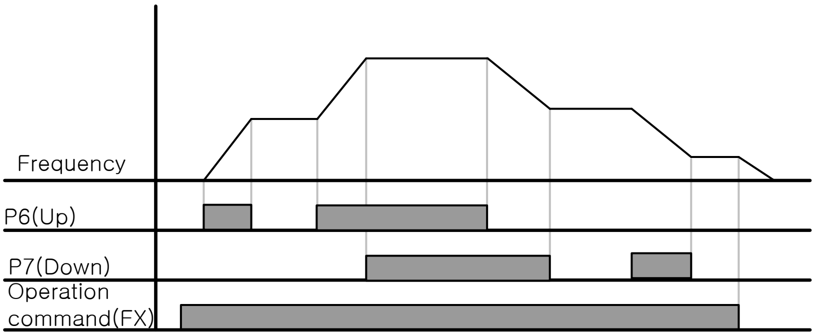


Figure 7-7 Px Define graph

7.5 3-wire operation

■ When using push buttons to operate the inverter

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	1	Fx/Rx - 1	-	-
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	14	3-Wire	-	-

A function that latches the inputted signals and carries out operation as shown in the following figure. Therefore you can use push buttons to configure a simple sequence circuit as shown below. The minimum input time (t) for input terminal should be 1 ms or longer. When forward and reverse operation commands are inputted at the same time, the operation stops.

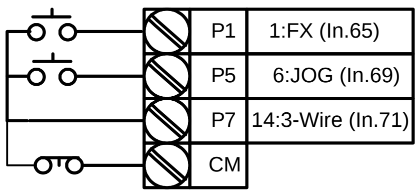


Figure 7-8 Terminal wiring

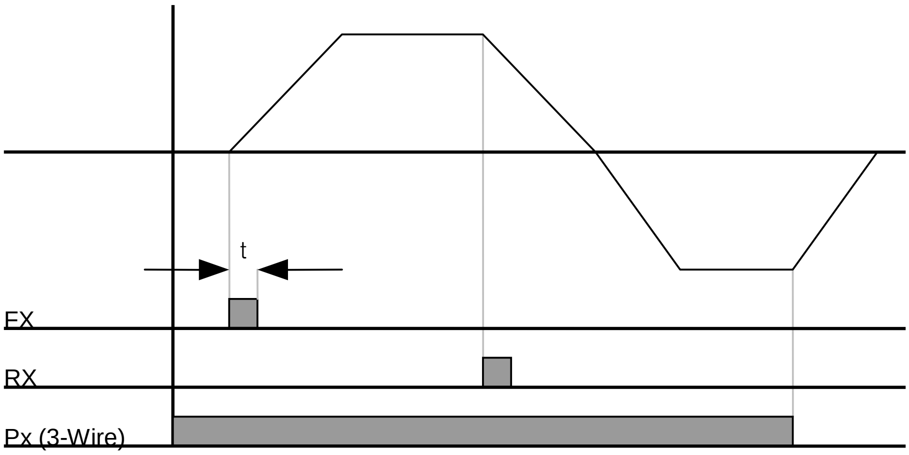


Figure 7-9 3-wire operation

7.6 Safe Operation Mode

■ When inputting the terminal to limit the operation

Group	Code	Name	LCD display	Function settings		Range	Unit
Ad	70	Safe operation selection	Run En Mode	1	DI Dependent	-	-
Ad	71	Safe operation stop method	Run Dis Stop	0	Free-Run	0 - 2	-
Ad	72	Safe operation deceleration time	Q-Stop Time	5.0		0.0 - 600.0	sec
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	13	RUN Enable	-	-

A function that uses the multi-function input terminal to make the operation command effective by software.

Table 7-8 Safe operation mode code description

Group	Code number	Function display	Code description
In	65 - 71	Px Define (Px: P1 - P7)	▪ Of the multi-function input terminals, select a terminal for No.13 safe operation mode (RUN Enable). (The safe operation function does not work if you only set the multi-function terminal block to RUN Enable.)
Ad	70	Run En Mode	▪ 1: DI Dependent The operation command is recognized by multi-function input terminals. ▪ 0: Always Enable The safe operation mode does not work.
Ad	71	Run Dis Stop	▪ Sets the inverter operation when the multi-function input terminal set to the safe operation mode is off. ▪ 0: Free-Run When the multi-function terminal is off, the inverter output power is cut off. ▪ 1: Q-Stop Use the safe operation mode deceleration time (Q-Stop Time) to decelerate. You need to input the operation command again to enable operation even if the multi-function terminal is on. ▪ 2: Q-Stop Resume Use the safe operation mode deceleration time (Q-Stop Time) to decelerate. With the operation command on, the operation starts normally when the multi-function terminal is inputted.
Ad	72	Q-Stop Time	▪ If Ad.71 Run Dis Stop is set to NO.1 Q-Stop or No.2 Q-Stop Resume, set the deceleration time.

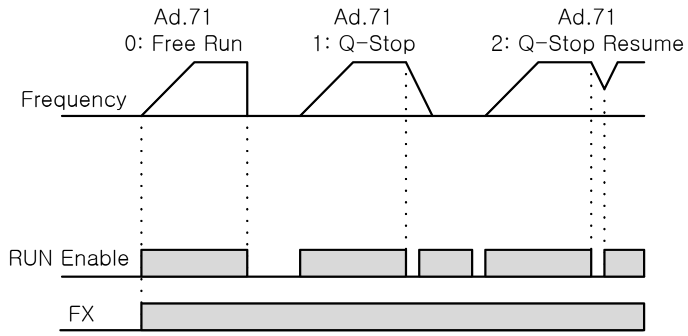


Figure 7-10 Safe operation mode

7.7 Dwell operation

Group	Code	Name	LCD display	Setting	Setting range	Unit
Ad	20	Dwell frequency on acceleration	Acc Dwell Freq	5.00	Start frequency - Max. frequency	Hz
Ad	21	Dwell operation time on acceleration	Acc Dwell Time	0.0	0.0 - 10.0	sec
Ad	22	Dwell frequency on deceleration	Dec Dwell Freq	5.00	Start frequency - Max. frequency	Hz
Ad	23	Dwell operation time on deceleration	Dec Dwell Time	0.0	0 .0 - 60.0	sec

When an operation command is inputted, constant speed operation is carried out at acceleration dwell frequency during acceleration dwell time and then acceleration resumes. When a stop command is inputted, constant speed operation is carried out at the deceleration dwell frequency during the deceleration dwell time and then the motor stops. If the control mode (dr.09 Control Mode) is set as No.0 V/F mode, this feature can be used to open the mechanical brake in a lift or hoist application.

⚠ **Caution**

- If the dwell operation is carried out at larger frequency than motor's rated slip in the above load, overcurrent flows in the motor, damaging the motor or affecting the motor life.

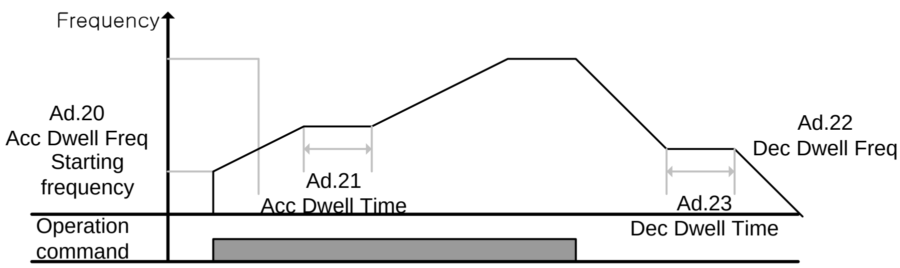


Figure 7-11 Dwell operation

■ Detailed dwell operation description

The dwell operation function is used to secure torque when opening the brake in a lift type load. When the operation command is inputted, the dwell operation accelerates up to the dwell frequency based on the set acceleration time. When the dwell acceleration operation time (Acc Dwell Time) set in the dwell operation frequency expires, the operation continues based on the speed settings. if a stop command is inputted during operation, the operation decelerates to the dwell operation frequency, and if the set dwell deceleration operation time (Dec Dwell Time) expires, the operation stops according to the previous deceleration time.

If the dwell operation time is 0 or the dwell frequency is set to 0, the dwell operation does not work. The acceleration dwell operation command is effective only once when the first command is issued and if re-accelerating after the acceleration dwell frequency, the operation doesn't work. The deceleration dwell operates when going through the deceleration dwell frequency whenever the stop command is inputted. It does not work for simple frequency deceleration which is not deceleration by stop. If external brake control is on, the dwell operation feature does not work.

1. Acceleration Dwell

   The acceleration dwell operation command is effective only once when the first command is issued and if re-accelerating after the acceleration dwell frequency, the operation doesn't work.

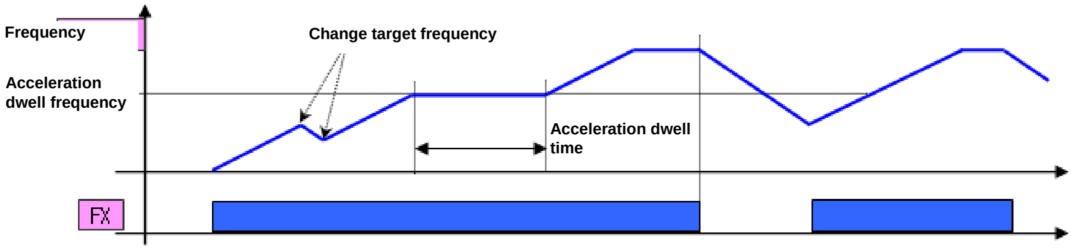


Figure 7-12 Acceleration dwell

2. Deceleration Dwell

   The deceleration dwell operates when going through the deceleration dwell frequency whenever the stop command is inputted. It does not work for simple frequency deceleration which is not deceleration by stop command.

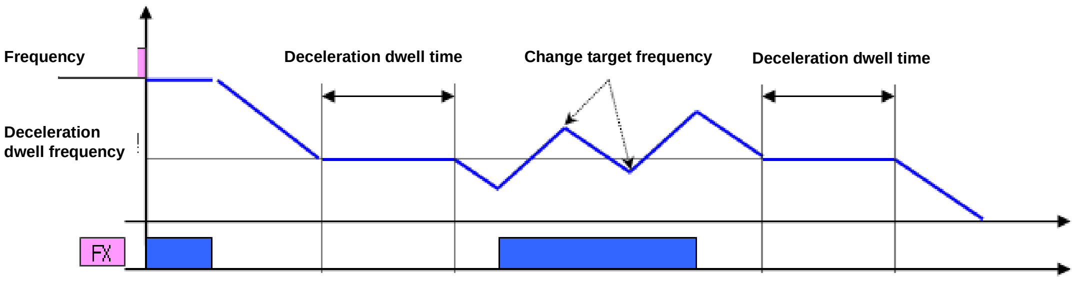


Figure 7-13 Deceleration dwell

7.8 Slip compensation operation

In the induction motor, the difference between motor rotation speed and frequency (synchronous speed) gets bigger depending on the load factor. This speed difference (slip) is used for a load that needs compensation.

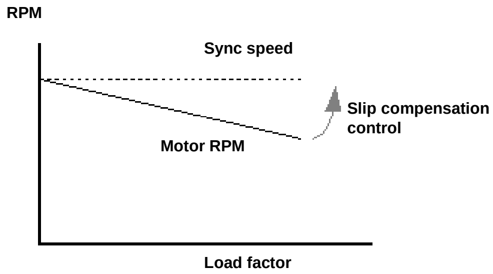


Figure 7-14 Slip compensation operation

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	09	Control mode	Control Mode	2	Slip Compen	-	-
dr	14	Motor capacity	Motor Capacity	2	0.75 kW (0.75 kW is standard)	0 - 15	-
bA	11	Number of motor poles	Pole Number	4		2 - 48	-
bA	12	Rated slip speed	Rated Slip	90 (0.75 kW is standard)		0 - 3000	rpm
bA	13	Rated motor current	Rated Curr	3.6 (0.75 kW is standard)		1.0 - 1000.0	A
bA	14	Motor no-load current	Noload Curr	1.6 (0.75 kW is standard)		0.5 - 1000.0	A
bA	16	Motor efficiency	Efficiency	72 (0.75 kW is standard)		70 - 100	%
bA	17	Load inertia rate	Inertia Rate	0 (0.75 kW is standard)		0 - 8	-

- **dr.09 Control Mode**: Check if the control mode is set to No.2 Slip Compen.
- **dr.14 Motor Capacity**: Set the capacity of the motor connected to the output of the inverter.
- **bA.11 Pole Number**: Input the pole number stated on the motor nameplate.
- **bA.12 Rated Slip**: Use the rated RPM on the motor nameplate to input the rated slip
- **bA.13 Rated Curr**: Input the rated current stated on the motor nameplate.
- **bA.14 Noload Curr**: Input the current measured when operating the motor at the rated frequency after removing load devices connected to the motor shaft. If it is difficult to measure no-load current, input 30% for large motors - 50% for small motors of the rated current.
- **bA.16 Efficiency**: Input the efficiency stated on the motor nameplate.
- **bA.17 Inertia Rate**: Select load inertia based on the motor inertia.

  (0: less than 10 times the motor inertia, 1: 10 times the motor inertia, 2-8: more than 10 times the motor inertia)

$$f_s = f_r - \left(\frac{rpm \times P}{120}\right)$$

Here, f_s =Rated slip frequency, f_r =Rated frequency, rpm =Motor rated RPM, P =Number of motor poles

7.9 PID Control

■ Usage of PID control

For the usage of PID control using the inverter, please refer to the following table.

Purpose	Control details
Speed control	Feedback the current speed of the device to be controlled to maintain a constant speed.
Pressure control	Feedback the current pressure of the system to be controlled to maintain a constant pressure.
Flow control	Feedback the current flow of the system to be controlled to maintain a constant flow.
Temperature control	Feedback the current temperature of the system to be controlled to maintain a constant temperature.

■ PID basic operation

This is the most commonly used control type among the automatic control types. In PID, P stands for proportional,
I stands for integral, and D stands for Derivative. A flexible control is achieved by combining these three elements.

Group	Code	Name	LCD display	Setting		Setting range	Unit
AP	01	Application function selection	App Mode	2	Proc PID	0-2	-
	16	PID output monitor	PID Output	-		-	-
	17	PID reference monitor	PID Ref Value	-		-	-
	18	PID feedback monitor	PID Fdb Value	-		-	-
	19	PID reference setting	PID Ref Set	50.00		-100.00 - 100.00	%
	20	PID reference selection	PID Ref Source	0	Keypad	0 - 11	-
	21	PID feedback selection	PID F/B Source	0	V1	0 - 10	-
	22	PID controller proportional gain	PID P-Gain	50.0		0.0 - 1000.0	%
	23	PID controller integral time	PID I-Time	10.0		0.0 - 200.0	sec
	24	PID controller differentiation time	PID D-Time	0		0 - 1000	msec
	25	PID controller feed-forward compensation gain	PID F-Gain	0.0		0 - 1000	%

Group	Code	Name	LCD display	Setting		Setting range	Unit
	26	Proportional gain scale	P Gain Scale	100.0		0.0 - 100.0	%
	27	PID output filter	PID Out LPF	0		0 - 10000	ms
	29	PID upper limit frequency	PID Limit Hi	60.00		-300.00 - 300.00	Hz
	30	PID lower limit frequency	PID Limit Lo	0.5		-300.00 - 300.00	Hz
	31	PID output reverse	PID Out Inv	0	No	0 - 1	-
	32	PID output scale	PID Out Scale	100.0		0.1 - 1000.0	%
	34	PID controller motion frequency	Pre-PID Freq	0.00		0 - Max. frequency	Hz
	35	PID controller motion level	Pre-PID Exit	0.0		0.0 - 100.0	%
	36	PID controller motion delay time	Pre-PID Delay	600		0 - 9999	sec
	37	PID sleep mode delay time	PID Sleep DT	60.0		0 - 999.9	sec
	38	PID sleep mode frequency	PID Sleep Freq	0.00		0 - Max. frequency	Hz
	39	PID wake-up level	PID WakeUp Lev	35		0 - 100	%
	40	PID wake-up mode setting	PID WakeUp Mod	0	Below Level	0 - 2	-
	42	PID controller unit selection	PID Unit Sel	0	%	0 - 12	-
	43	PID unit gain	PID Unit Gain	100.0		0 - 300	%
	44	PID unit scale	PID Unit Scale	2	x 1	0 - 4	-
	45	PID 2nd proportional gain	PID P2-Gain	100.00		0 - 1000	%
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	22	I-Term Clear	-	-
	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	23	PID Openloop	-	-
	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	24	P Gain 2	-	-

PID-controls the output frequency of the inverter to control the flux, temperature, tension and other system processes.

- **AP.01 App Mode**: Set to No.2 Proc PID to set the functions for process PID.
- **AP.16 PID Output**: Display the current output value of PID controller.
- The unit, gain and scale defined in AP.42, AP.43 and AP.44 are applied to the value.

- **AP.17 PID Ref Value**: Display the reference currently defined in PID controller.
- The unit, gain and scale defined in AP.42, AP.43 and AP.44 are applied to the value.
- **AP.18 PID Fdb Value**: Display the input currently in feedback in PID controller.

  The unit, gain and scale defined in AP.42, AP.43 and AP.44 are applied to the value.
- **AP.19 PID Ref Set**: If PID control's reference type (AP.20) is set to Keypad (0:Keypad), you can input the reference value. If the reference type is set to a value which is not the Keypad, the value defined in AP.19 is ignored.
- **AP.20 PID Ref Source**: Select the reference input in PID control. (The items in gray color will be provided as options in the future.) If V1 terminal is set to PID F/B Source, V1 cannot be set to PID Ref Source. Change the F/B Source to another item to set V1 to Ref Source.

Table 7-9 Setting types and functions of AP.20 PID Ref Source

Setting type		Function	PID F/B Source
0	Keypad	Input PID reference in the inverter keypad.	X
1	V1	-10 - 10 V voltage input terminal of terminal block	O
3	V2	Analog input terminal of terminal bock I2	O
4	I2	(When SW2 is I, input 4 - 20 mA and when it is V, input 0 - 10 V)	O
5	Int. 485	RS-485 input terminal of terminal block	O
7	FieldBus	Communication command by communication option card	O
11	Pulse	Pulse input terminal of terminal block TI 0 - 32 kHz pulse input	O

You can display the defined PID reference in AP.17 if using 7-Segment. If using LCD keypad, you can monitor it in the item defined as No.17 PID Ref Value out of CNF.06 - 08 in Config Mode (CNF).

- **AP.21 PID F/B Source**: Select the feedback input in PID control Among the reference input types, you can select inputs except keypad input (Keypad-1, Keypad-2). You cannot set the feedback by using the same input with the type selected in the reference.

  For instance, if you select AP.20 Ref Source as No.1 V1 terminal, you have to select inputs except V1 in AP.21 PID F/B Source. When using LCD keypad, you can monitor feedback flow by selecting No.18 PID Fbk Value among CNF.06 - 08.
- **AP.22 PID P-Gain, AP.26 P Gain Scale**: Define the output rate for the difference (error) between the reference and feedback. If P gain is set to 50%, 50% of errors are outputted. The range of P gain is from 0.0 to 1000.0%. If you need rates lower than 0.1%, use P Gain Scale in AP.26.
- **AP.23 PID I- Time**: Define the time for outputting the accumulated error value. Define the time until when 100% output is reached, if error is 100%. If the integral time (PID I-Time) is set to one second, 100% is outputted in one second if error is 100%. You can use the integral time to reduce the normal error. Set the function of the multi-function terminal block to No.21 I-Term Clear and turn on the terminal block to delete all accumulated integral volume.
- **AP.24 PID D-Time**: Define the output value for the error's change rate. If the differential time (PID D-Time) is set to 1 ms, 1% is outputted every 10 ms, when the rate of change per second is 100%.
- **AP.25 PID F-Gain**: You can add the defined target volume to PID output and define the rate for it. You can get a fast response.

- **AP.27 PID Out LPF**: Use this when the PID controller output changes too fast or the entire system becomes unstable as the oscillation gets severe. Usually small values (default value is 0) are used to increase the response, but you can increase stability by using large values. If you use large values, the PID controller output becomes more stable, but the response may be slow.
- **AP.29 PID Limit Hi, AP.30 PID Limit Lo**: Limit the output of PID controller.
- **AP.32 PID Out Scale**: Adjust the output of the controller.
- **AP.42 PID Unit Sel**: Define the unit of control volume (applied only on LCD keypad)

Table 7-10 AP.42 PID Unit Sel setting types and functions[27]

Setting type			Function
0	%	-	Indicate it in percentage without a physical quantity.
1	Bar	Pressure	You can select various units of pressure.
2	mBar		
3	Pa		
4	kPa		
5	Hz	Speed	Indicate the inverter output frequency or motor rotation speed.
6	rpm		
7	V	Voltage	Indicated in voltage, current, wattage or horse power.
8	I	Current	
9	kW	Wattage	
10	HP	Horse power	
11	^{o}C	Temperature	Indicate in Celsius or Fahrenheit.
12	^{o}F		

- **AP.43 PID Unit Gain, AP.44 PID Unit Scale**: Adjust the size to suit the unit selected in AP.42 PID Unit Sel.
- **AP.45 PID P2-Gain**: You can use the multi-function terminal to change the PID controller gain. If you set the function of terminal block selected out of In.65 to 71 to No.24 P Gain2 and the selected terminal is inputted, you can switch to the gain defined in AP.45 instead of the gain defined in AP.22 and AP.23.

[27] Can only be set when the LCD loader is installed.

■ PID control block diagram

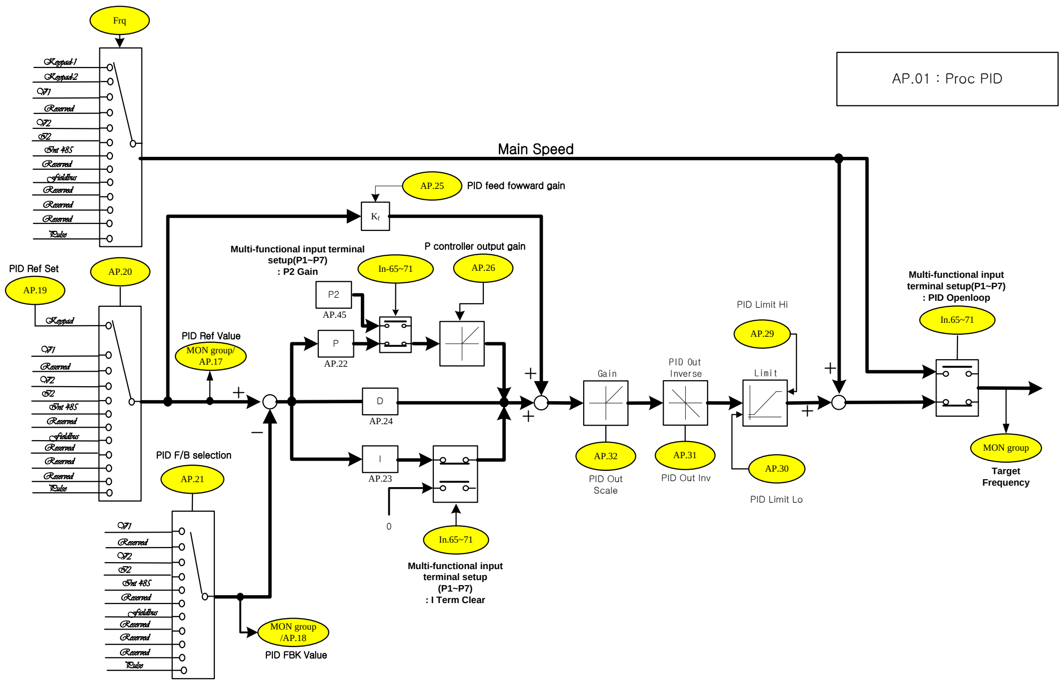


Figure 7-15 PID control block diagram

Notes

- When PID switching operation (switching from PID operation to general operation) is inputted in the multi-function input (P1 - P11), [%] values are converted to [Hz] values.
- The polarity of normal PID output PID OUT is single-directional and limited by AP.29 (PID Limit Hi) and AP.30 (PID Limit Lo).
- 100.0% is based on dr.20 (maxFreq).

■ Pre-PID operation

When the operation command is inputted, the general acceleration is carried out without PID operation up to the defined frequency and if the control volume reaches a certain level, PID operation starts.

- **AP.34 Pre-PID Freq**: If you need general acceleration without PID control, input the frequency up to the general acceleration.

  For instance, if Pre-PID Freq is set to 30 Hz, the general operation is carried out at 30 Hz until the control volume (PID feedback volume) exceeds the size defined in AP.35.

- **AP.35 Pre-PID Exit, AP.36 Pre-PID Delay**: When PID controller's feedback volume (control volume) is larger than the value in AP.35, PID control operation starts. But, if smaller volume than the value defined in AP.35 is kept during a period defined in AP.36, 'Pre-PID Fail' trip occurs and power is cut off.

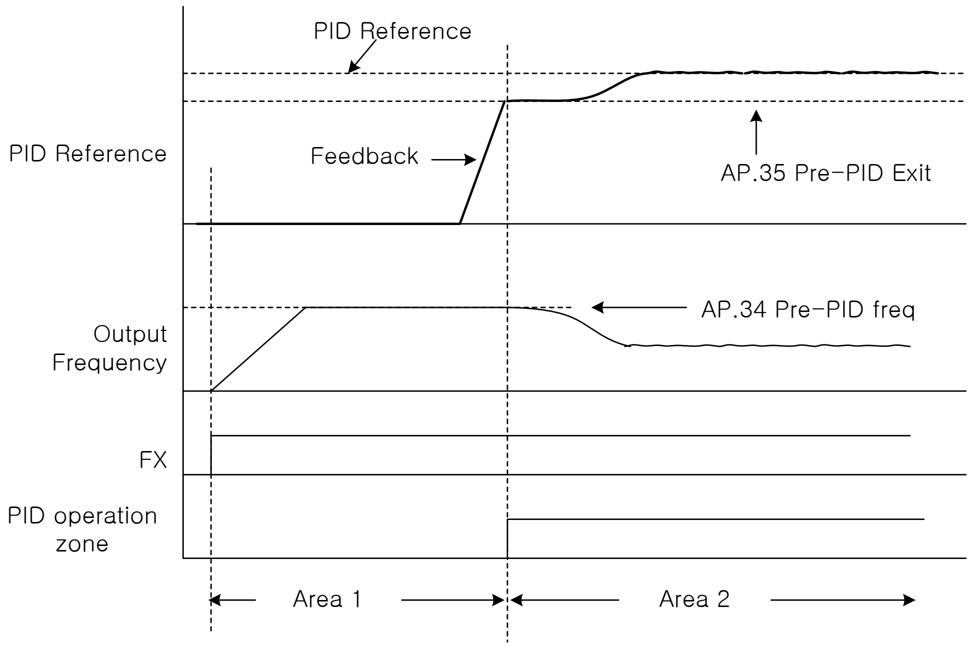


Figure 7-16 Pre-PID operation

■ PID sleep mode

AP.37 PID Sleep DT, AP.38 PID Sleep Freq: If the inverter continues to operate during a period defined in AP.37 PID Sleep DT under the frequency defined in AP.38 Sleep Freq, the operation stops and enters the PID sleep mode. For the criteria for returning to PID operation mode from PID sleep mode, refer to AP.39 PID WakeUp Lev.

AP.39 PID WakeUp Lev, AP.40 PID WakeUp Mod: Set the criteria for starting PID operation from the PID sleep mode explained above.

If 0 (below level) is selected in AP.40, PID operation restarts in the case that the feedback value is below the size defined in AP.39 PID WakeUp Lev. If 1 (above level) is selected, the operation starts when it is more than the value defined in AP.39 If 2 (beyond level) is selected, the operation restarts when the difference between reference and feedback is more than the value defined in AP.39.

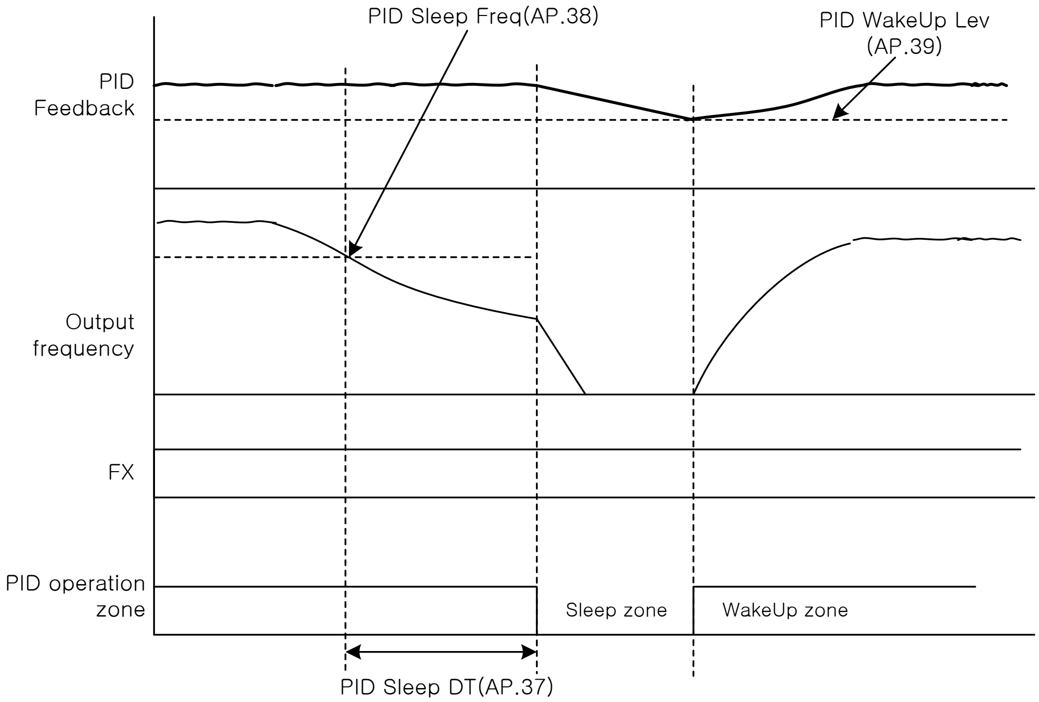


Figure 7-17 PID sleep mode

■ PID operation switching (PID Openloop)

In the multi-function terminal block, if the terminal set to No.23 PID Openloop in In.65 - 71 Px Define is inputted, the PID operation stops and is switched to the general operation. if the terminal is off, the PID operation restarts.

7.10 Auto-Tuning

You can measure the motor parameters automatically. The motor parameters measured by auto tuning are used in auto torque boost, sensorless vector control, etc.

Example) 0.75 kW and 220 V motor

Table 7-11 0.75 kW and 220 V motor auto tuning - example

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	14	Motor capacity	Motor Capacity	1	0.75 kW	0 - 15	-
bA	11	Number of motor poles	Pole Number	4		2 - 48	-
bA	12	Rated slip speed	Rated Slip	40		0 - 3000	rpm
bA	13	Rated motor current	Rated Curr	3.6		1.0 - 1000.0	A
bA	14	Motor no-load current	Noload curr	1.6		0.5 - 1000.0	A
bA	15	Rated motor voltage	Rated Volt	220		170 - 480	V
bA	16	Motor efficiency	Efficiency	72		70 - 100	%
bA	20	Auto-tuning	Auto Tuning	0	None	-	-
bA	21	Stator resistor	Rs	26.00		Dependent on motor setting	Ω
bA	22	Leakage inductance	Lsigma	179.4		Dependent on motor setting	mH
bA	23	Stator inductance	Ls	1544		Dependent on motor setting	mH
bA	24	rotor time constant	Tr	145		25 - 5000	ms

⚠ Caution

- Be sure to carry out auto tuning after the motor stops.
- Be sure to input the number of motor poles, rated slip, rated current, rated voltage and efficiency stated in the motor nameplate before carrying out auto tuning. The items not inputted use the default settings.

Table 7-12 Auto tuning automatic settings

Input Voltage	Motor capacity [kW]	Rated current [A]	No-load current [A]	Rated slip frequency [Hz]	stator resistor [Ω]	Leakage Inductance [mH]
200	0.2	1.1	0.8	3.33	14.0	40.4
	0.4	2.4	1.4	3.33	6.70	26.9
	0.75	3.4	1.7	3.00	2.600	17.94
	1.5	6.4	2.6	2.67	1.170	9.29
	2.2	8.6	3.3	2.33	0.840	6.63
	3.7	13.8	5.0	2.33	0.500	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	0.068	0.819
	22	76.8	21.5	1.00	0.056	0.948
400	0.2	0.7	0.5	3.33	28.00	121.2
	0.4	1.4	0.8	3.33	14.0	80.8
	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	2.33	2.520	19.95
	3.7	8.0	2.9	2.33	1.500	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

■ Motor parameter tuning (Rs, Lsigma, Ls, Tr, Noload curr)

bA.20 Auto Tuning: Select the type of auto tuning and carry out auto tuning. Select one from the following items and press the Enter (ENT) key to execute auto tuning.

- **0: None**

  Display the initial auto tuning items. Indicate that auto tuning is completed after it is finished.

- **1: ALL**

  The motor, while rotating, measures the motor parameters. Stator resistor (Rs), leakage inductance (Lsigma), stator inductance (Ls), no-load current (Noload Curr), rotor time constant (Tr), etc. are measured.

  Since the motor measures the parameters while it is rotating, if the load is connected to the motor shaft, parameter measurement may not be correct. Therefore, in order to measure correctly, remove all loads from the motor. The rotor time constant (Tr), however, is tuned in the stop position.

- **2: ALL (Stdstl)**

  Measure the parameters with the motor in the stop position. Stator resistor (Rs), leakage inductance (Lsigma), rotor time constant (Tr), etc. are measured at the same time.

⚠ Caution
▪ If all parameters are measured with the motor in the stop position by selecting “2:ALL(Stdstl)” in bA20(Auto tuning), the accuracy of estimating the parameters is a little lower than selecting “1: ALL” to measure the motor parameters while it is spinning. Therefore, the performance of sensorless operation mode may decrease. ▪ In auto tuning, select “2: ALL(Stdstl)” only when you cannot rotate the motor (when it is difficult to separate gears and belts, or when it is impossible to separate the motor from the load physically).

- **3: Rs+Lsigma**

  Measure the parameters with the motor in the stop position. The measured values are used in auto torque boost and sensorless vector control. Since the motor does not rotate, the parameter measurement is not affected even if the load is connected to the motor shaft. But ensure that the load does not rotate the motor shaft.

- **6: Tr(Stdstl)**

  When Control Mode (dr.09) is IM Sensorless, measure the rotor time constant (Tr) with the motor in the stop position.

- **bA.21 Rs - bA.24 Tr, bA.14 Noload Curr**: Display the motor parameters measured in auto tuning.

For the parameters that are not included in the measurement list, the default settings are displayed.

7.11 Sensorless Vector Control

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	09	Control mode	Control Mode	4	IM Sensorless	-	-
dr	14	Motor capacity	Motor Capacity	x	Variable depending on the motor capacity	0 - 15	-
dr	18	Base frequency	Base Freq	60		30 - 400	[Hz]
bA	11	Number of motor poles	Pole Number	4		2 - 48	-
bA	12	Rated slip speed	Rated Slip	Variable depending on the motor capacity		0 - 3000	Hz
bA	13	Rated motor current	Rated Curr	Variable depending on the motor capacity		1 - 1000	A
bA	14	Motor no-load current	Noload curr	Variable depending on the motor capacity		0.5 - 1000	A
bA	15	Rated motor voltage	Rated Volt	220/380/440/480		170 - 480	V
bA	16	Motor efficiency	Efficiency	Variable depending on the motor capacity		70 - 100	%
bA	20	Auto-tuning	Auto Tuning	1	All	-	-
Cn	09	Initial excitation time	PreExTime	1.0		0.0 - 60.0	Sec
Cn	10	Initial excitation amount	Flux Force	100.0		100.0 - 300.0	%
Cn	20	Sensorless 2nd gain display setting	SL2 G View Sel	1	Yes	0 - 1	-
Cn	21	Sensorless speed controller proportional gain1	ASR-SL P Gain1	Variable depending on the motor capacity		0 - 5000	%
Cn	22	Sensorless speed controller integral gain1	ASR-SL I Gain1	Variable depending on the motor capacity		10 - 9999	ms
Cn	23[28]	Sensorless speed controller proportional gain2	ASR-SL P Gain2	Variable depending on the motor capacity		1 - 1000	%
Cn	24	Sensorless speed controller integral gain2	ASR-SL I Gain2	Variable depending on the motor capacity		1 - 1000	%
Cn	26	Flux estimator proportional gain	Flux P Gain	Variable depending on the motor capacity		10 - 200	%

[28] If set to Cn.20 No.1 Yes, Cn.23 – Cn.32 / Cn.85 – Cn.95 are visible.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Cn	27	Flux estimator integral gain	Flux I Gain	Variable depending on the motor capacity		10 - 200	%
Cn	28	Speed estimator proportional gain	S-Est P Gain1	Variable depending on the motor capacity		0 - 32767	-
Cn	29	Speed estimator integral gain1	S-Est I Gain1	Variable depending on the motor capacity		100 - 1000	-
Cn	30	Speed estimator integral gain2	S-Est I Gain2	Variable depending on the motor capacity		100 - 10000	-
Cn	31	Sensorless current controller proportional gain	ACR SL P Gain	75		10 - 1000	-
Cn	32	Sensorless current controller integral gain	ACR SL I Gain	120		10 - 1000	-
Cn	52	Torque controller output filter	Torque Out LPF	0		0 - 2000	msec
Cn	53	Setting torque limit	Torque Lmt Src	0	Keypad-1	0 - 12	-
Cn	54	Positive-direction reverse torque limit	FWD +Trq Lmt	180.0		0.0 - 200.0	%
Cn	55	Positive-direction regeneration torque limit	FWD -Trq Lmt	180.0		0.0 - 200.0	%
Cn	56	Negative-direction reverse torque limit	REV +Trq Lmt	180.0		0.0 - 200.0	%
Cn	57	Negative-direction regeneration torque limit	REV -Trq Lmt	180.0		0.0 - 200.0	%
Cn	85	Flux estimator proportional gain1	Flux P Gain1	370		100 - 700	-
Cn	86	Flux estimator proportional gain2	Flux P Gain2	0		0 - 100	-
Cn	87	Flux estimator proportional gain3	Flux P Gain3	100		0 - 500	-
Cn	88	Flux estimator integral gain1	Flux I Gain1	50		0 - 200	-
Cn	89	Flux estimator integral gain2	Flux I Gain2	50		0 - 200	-
Cn	90	Flux estimator integral gain3	Flux I Gain3	50		0 - 200	-
Cn	91	Sensorless voltage compensation1	SL Volt Comp1	30		0 - 60	-

Group	Code	Name	LCD display	Setting	Setting range	Unit
Cn	92	Sensorless voltage compensation2	SL Volt Comp2	20	0 - 60	-
Cn	93	Sensorless voltage compensation3	SL Volt Comp3	20	0 - 60	-
Cn	94	Sensorless field weakening start frequency	SL FW Freq	95.0	80.0 - 110.0	%
Cn	95	Sensorless gain switching frequency	SL Fc Freq	2.00	0.00 - 8.00	Hz

⚠ Caution

- For high performance operation, the parameters of the motor connected to the inverter output should be measured. Use auto tuning (bA.20 Auto Tuning) to measure the parameters before carrying out sensorless vector operation. To carry out high performance control of sensorless vector control, the inverter and the motor should have the same capacity. If the motor capacity is smaller by two level or more than the inverter capacity, there could be a problem with control. In that case, change the control mode to V/F control. When operating with sensorless vector control, do not connect multiple motors to the inverter output.

■ Sensorless vector control operation method

Carry out the sensorless vector control operation as in the following sequence.

- Step 1: Set dr.09 Control Mode to 4 (IM Sensorless).
- Step 2: Select the motor capacity to use for dr.14 Motor Capacity.
- Step 3: Input the nameplate information of the motor to use.
  - drv.18 Base Freq (base frequency)
  - bA.11 Pole Number (number of motor poles)
  - bA.11 Pole Number (number of poles)
  - bA.12 Rated Slip (rated slip)
  - bA.13 Rated Curr (rated current)
  - bA.15 Rated Volt (rated voltage)
  - bA.16 Efficiency (efficiency): If there is no information on efficiency on the nameplate, use the default value.
- Step 4: In bA.20 Auto Tuning. select 1 (All) or 2 (All(Stdstl) to execute Auto-Tuning. 1 (All) is more accurate than 2 (StdStl). Select 1 (All) except the application areas where the motor cannot rotate. When Auto-Tuning is completed, bA.14, bA.21, bA.22, bA.23 and bA.24 values are automatically changed.
- Step 5: Define the set frequency, Acc/Dec time and operation command method according to the application areas before getting into operation.

Cn.20 SL2 G View Sel: If No.1 Yes is selected, the user can set various gains (Cn.23 ASR-SL P Gain2, Cn.24 ASR-SL I Gain2, Cn.26 Flux P Gain, Cn.27 Flux I Gain Gain3, Cn.28 S-Est P Gain1, Cn.29 S-Est I Gain1, Cn.30 S-Est I Gain1, Cn.31 ACR SL P Gain, Cn.32 ACR SL I Gain) applied when the motor rotates at the middle speed (1/2 of base frequency) by the sensorless (Ⅱ) vector control. If No.0 No is selected, the parameters are not displayed.

■ Initial excitation

- **Cn.09 PreExTime**: Define the initial excitation time. You can start operation after performing excitation up to the motor rated flux.
- **Cn.10 Flux Force**: You can reduce the initial excitation time. The motor flux increases up to the rated flux with the time constant as in the following figure. Therefore, in order to reduce the time that takes to increase up to the rated flux, provide higher motor flux base value than the rated flux. When the magnetic flux reaches the rated flux, the provided motor flux base value is reduced.

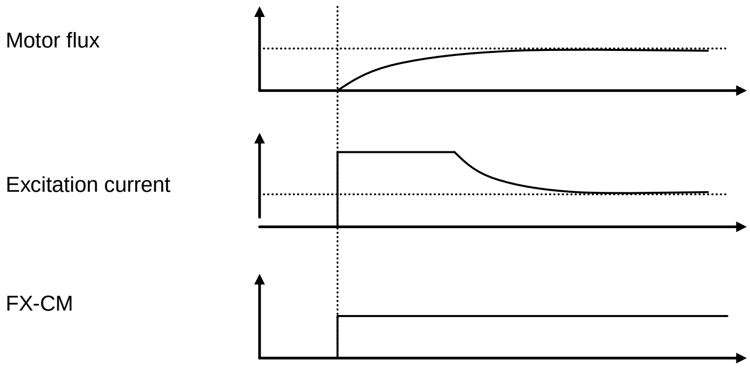


Figure 7-18 Flux Force

■ Zero-speed control when stopped: Hold Time

Cn.11 Hold Time: When the motor is slowed down and stopped by the stop command, the zero-speed operation continues during the defined time and then the power is cut off.

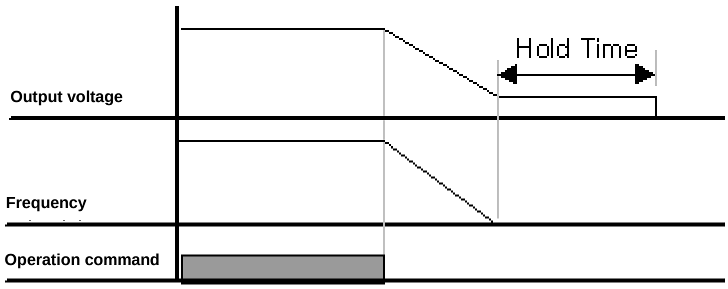


Figure 7-19 Hold Time

■ Speed controller gain

Cn.21 ASR-SL P Gain1, Cn.22 ASR-SL I Gain1: You can change the speed PI controller gain of the sensorless vector control. For PI speed controller, the speed controller P gain is a proportional gain for the speed error. If the speed error becomes larger, the torque output command become larger. Therefore the larger the value is, the faster the speed deviation decreases. The speed controller I gain is the integral gain for speed errors. It is the time until when the gain becomes the rated torque output command when a constant speed error continues. The smaller the value is, the faster the speed deviation decreases.

The speed controller gain can improve the speed control waveform while watching the changes in the speed. If the speed deviation does not decrease fast, increase the speed controller P gain or decrease I gain (time in ms). However if the P gain is too high or I gain is too low, severe vibration could be caused. If an oscillation occurs in the speed waveform, try to increase I gain (time in ms) or reduce P gain for adjustment.

- **Cn.23 ASR-SL P Gain2, Cn.24 ASR-SL I Gain2**: It is only visible when No.1 Yes is selected for SL2 G View Sel(Cn.20). You can change the speed controller gain above the middle speed (about 1/2 of base frequency) when controlling the sensorless vector.

  Cn.23 ASR-SL P Gain2 is set as percentage to the low speed gain Cn.23 ASR-SL P Gain1. That is, if P Gain 2 is less than 100.0%, the response goes down. For example, if Cn.23 ASR-SL P Gain1 is 50.0% and Cn.23 ASR-SL P Gain2 is 50.0%, the middle-speed or faster speed controller P gain is 25.0%.

  Cn.24 ASR-SL I Gain2 is also set as percentage to the lCn.24 ASR-SL I Gain1. For I gain, the smaller the I gain 2 is, the slower the response time is. For example, if Cn.23 ASR-SL I Gain1 is 100ms and Cn.23 ASR-SL I Gain2 is 50.0%, the middle-speed or faster speed controller I gain is 200 ms. The controller gain is set according to the default motor parameters and Acc/Dec time.

Flux estimator gain

Cn.26 Flux P Gain, Cn.27 Flux I Gain, Cn.85-87 Flux P Gain1-3, Cn.88-90 Flux I Gain1-3 : The rotor flux estimator is required to control the sensorless vector. For the adjustment of flux estimator gain, refer to the sensorless vector control operation guide.

Speed estimator gain

Cn.28 S-Est P Gain1, Cn.29 S-Est I Gain1, Cn.30 S-Est I Gain2: You can change the speed estimator gain of the sensorless vector control. For the adjustment of speed estimator gain, refer to the sensorless vector control operation guide.

Sensorless current controller gain

Cn.31 ACR SL P Gain, Cn.32 ACR SL I Gain : Adjust the P and I gains of the sensorless current controller. For the adjustment of sensorless current controller gain, refer to the sensorless vector control operation guide.

Torque limit

- It is possible to limit the amount of torque generated in the motor in forward and reverse directions and in both driving and regenerating modes of operation.
- **Cn.53 Torque Lmt Src**: Select the types to set torque limits. You can use the keypad, terminal block analog input (V1 and I2) or communication options to set the torque limit.
  - 0: Keypad-1, 1: Keypad-2
- Use the keypad to set torque limits. You can set up to 200% based on the motor rated torque. The rotation direction and reverse/regeneration limits are set in the following code.
- **Cn.54 FWD +Trq Lmt**: Positive direction reverse (motoring) operation torque limit
- **Cn.55 FWD –Trq Lmt**: Positive regeneration operation torque limit
- **Cn.56 REV +Trq Lmt**: Negative direction reverse operation torque limit

- **Cn.57 REV –Trq Lmt**: Negative direction regeneration operation torque limit
  - 2: V1, 4: V2, 5: I2

    Use the inverter terminal block's analog input terminal to set the torque limit. Use 'In.02 Torque at 100%' item to set the max. torque. For example, if In.02 is set to 200% and voltage input (V1) is used, the torque limit is 200% when 10V is inputted. But, when the function of VI terminal is set as the factory default and the torque limit setting uses a method other than the keypad, check the settings in the monitor mode. In the Config Mode CNF.21 - 23[29], select No.21 Torque Limit.
  - 6: Int 485

    Use the inverter terminal block's communication terminal to set the torque limit.

■ Voltage compensation

Cn.91-93 SL Volt Comp1-3: You can change the output voltage compensation values of sensorless vector control. For the output voltage compensation, refer to the sensorless vector control operation guide.

⚠ Caution
▪ The controller gain can be adjusted according to the load characteristics. However, the motor can overheat or the system can be unstable depending on the controller gain settings.

[29] It is visible when LCD keypad is installed.

■ Sensorless vector control operation guide

Abnormal symptoms and problems	Relevant function codes	Troubleshooting
The starting torque is insufficient	bA.24: Tr Cn.09: PreExTime Cn.10: Flux Force Cn.31: ACR SL P Gain Cn.54-57: Trq Lmt Cn.93: SL Volt Comp3	-. Set Cn.09 value to be 3 times bA.24 or more, or increase Cn.10 value in increments of 50%. If Cn.10 value is large, OCT could occur during start. If this is the case, decrease Cn.31 value in decrements of 10. -. Increase Trq Lmt(Cn.54-57) value in increments of 10%. -. Increase Cn.93 value in increments of 5.
The output frequency is higher than the base frequency during no-load operation at low speed (10Hz or lower)	Cn.91: SL Volt Comp1	-. Decrease Cn.91 value in decrements of 5.
The motor hunts or the torque is not sufficient while the load is increasing at low speed (10Hz or lower)	Cn.04: Carrier Freq Cn.21: ASR-SL P Gain1 Cn.22: ASR-SL I Gain1 Cn.93: SL Volt Comp3	-. If the motor hunts at low speeds, increase Cn.22 value by 50 msec. If it does not, increase Cn.21 value by 10% to find the optimal operation conditions. -. If torque is insufficient, increase Cn.93 value in increments of 5. -. If the motor hunts and torque is insufficient in 5-10 Hz, decrease Cn.04 value in decrements of 1 Hz (Cn.04 set to exceed by 3 kHz)
The motor hunts and OCT occurs in regeneration load at low speed (10 Hz or lower)	Cn.92: SL Volt Comp2 Cn.93: SL Volt Comp3	-. Increase Cn.92 and 93 at the same time in increments of 5.
“OVT”[1)] occurs due to sudden Acc/Dec or sudden load fluctuation at mid speed (30Hz or higher)	Cn.24: ASR-SL I Gain2	-. Decrease Cn.24 value in decrements of 5%.

1) DB resistance is not connected.

Abnormal symptoms and problems	Relevant function codes	Troubleshooting
OCT occurs due to sudden load fluctuation at high speed (50 Hz or higher)	Cn.54-57: Trq Lmt Cn.94: SL FW Freq	-. Decrease CN.54-57 value in decrements of 10% (the set value is 150% or more) -. Increase/decrease Cn.94 value in increments/decrements of 5%. It should be lower than 100%.
The motor hunts when the load increases at the base frequency or higher.	Cn.22: ASR-SL I Gain1 Cn.23: ASR-SL I Gain2	-. Increase Cn.22 value in increments of 50 msec or decrease Cn.24 value in decrements of 5%.
The motor hunts when the load increases.	Cn.28: S-Est P Gain1 Cn.29: S-Est I Gain1	-. If it is low speed (10 Hz or lower), increase Cn.29 value in increments of 5. -. If it is mid speed (30 Hz) or higher, increase Cn.28 value in increments of 500. OCT may occur at low speed if the set value is too high.
The motor speed level falls	bA.20: Auto Tuning	- Select 6(Tr(stdstl)) in bA.20 to carry out bA.24 rotor time constant turning.

■ Torque controller output filter

Cn.52 Torque Out LPF: This is the filter time constant of torque command.

7.12 Kinetic Energy Buffering

If AC power fails to the inverter the internal DC voltage can drop quickly and a low-voltage trip can occur. Kinetic Energy Buffering (KEB) can help support the internal DC voltage to prevent this occurring when there is an instantaneous power interruption. Requires high inertia load.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Cn	77	Energy buffering selection	KEB Select	1	Yes	-	-
Cn	78	Energy buffering start level	KEB Start Lev	130		110 - 140	%
Cn	79	Energy buffering stop level	KEB Stop Lev	135		125 - 145	%
Cn	80	Energy buffering gain	KEB Gain	1000		1 - 20000	-

- **Cn.77 KEB Select**: If the input power is cut off, select energy buffering operation. If you select No.0 No, the general deceleration operation is carried out until low voltage failure occurs. If No.1 KEB Select(Yes) is selected, the inverter power frequency is controlled and the regeneration energy from the motor is sent to charge the inverter DC part.
- **Cn.78 KEB Start Lev and Cn.79 KEB Stop Lev**: These set the start and stop point for energy buffering operation. Set the low voltage level based on 100% so that the stop level (Cn.79) is higher than start level (Cn.78).
- **Cn.80 KEB Gain**: This is the gain that uses load-side inertia moment quantity to control the energy buffering operation. If the load inertia is large, use a lower gain value. If the load inertia is small, use a higher gain value. If the input power is cut off and the motor vibrates severely when this function (KEB) operates, set the gain (Cn.80: KEB Gain) to be half the previously set value. But if the gain is lowered too much, low voltage trip could occur during energy buffering operation (KEB).

⚠ Caution

- For energy buffering operation, a low voltage trip may occur during deceleration due to instantaneous power interruption or load inertia.
- During energy buffering operation, the motor may vibrate at the loads except variable torque load (load from fans and pumps).

7.13 Energy Saving Operation

■ Manual energy saving operation

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	50	Energy saving operation	E-Save Mode	1	Manual	-	-
Ad	51	Energy saving amount	Energy Save	30		0 - 30	%

If the inverter output current is smaller than the current set in bA.14 Noload Curr (motor no-load current), the output voltage is reduced as much as the level set in Ad.51 Energy Save. The voltage before energy saving operation starts become the base value of the percentage. It does not work during acceleration/deceleration.

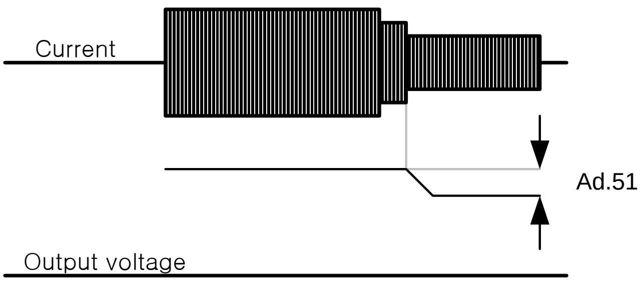


Figure 7-20 Manual energy saving operation

■ Automatic energy saving operation

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	50	Energy saving operation	E-Save Mode	2	Auto	-	-

The energy saving amount is automatically calculated based on the motor rated current (bA.13) and no-load current (bA.14) to adjust the output voltage.

⚠ Caution

- If the operation frequency is changed or acceleration/deceleration is carried by stop command or others during energy saving operation, the Acc/Dec time may be longer than the set Acc/Dec time due to the time required to return to the normal operation from the energy saving operation.

7.14 Speed Search Operation

This operation is used to prevent failure that could happen when the inverter outputs voltage if the inverter output voltage is cut off and the motor is idling. This feature estimates the motor rotation speed based on the inverter output current, not measuring the accurate speed.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD display</th><th colspan="3">Setting</th><th>Setting range</th><th>Unit</th></tr>
<tr><td>Cn</td><td>70</td><td>Speed search mode selection</td><td>SS Mode</td><td>0</td><td colspan="2">Flying Start-1</td><td>-</td><td>-</td></tr>
<tr><td>Cn</td><td>71</td><td>Speed search operation selection</td><td>Speed Search</td><td colspan="3">0000[30]</td><td>-</td><td>Bit</td></tr>
<tr><td>Cn</td><td>72</td><td>Speed search reference current</td><td>SS Sup-Current</td><td>-</td><td>75 kW or less</td><td>150</td><td>80 - 200</td><td>%</td></tr>
<tr><td>Cn</td><td>73</td><td>Speed search proportional gain</td><td>SS P-Gain</td><td colspan="3">100</td><td>0 - 9999</td><td>-</td></tr>
<tr><td>Cn</td><td>74</td><td>Speed search integral gain</td><td>SS I-Gain</td><td colspan="3">200</td><td>0 - 9999</td><td>-</td></tr>
<tr><td>Cn</td><td>75</td><td>Output blocking time before speed search</td><td>SS Block Time</td><td colspan="3">1.0</td><td>0 - 60</td><td>sec</td></tr>
<tr><td>OU</td><td>31</td><td>Multi-function relay 1 item</td><td>Relay 1</td><td rowspan="2">19</td><td colspan="2" rowspan="2">Speed Search</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>OU</td><td>33</td><td>Multi-function output 1 item</td><td>Q1 Define</td></tr>
</table>

- Cn.70 SS Mode: You can select the type of speed search.
  - “0: Flying Start-1” carries out the speed search while keeping the inverter output current below Cn.72 SS Sup-Current during idling. If the direction of the motor idling 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 motor idling and the direction of operation command at restart are different, the speed search does not produce satisfactory result as there is no way to find out the direction of idling.
  - “1: Flying Start-2” carries out the speed search by PI controlling in the inverter the ripple current generated by the counter electromotive force at idling. Since this method can find out the direction of motor idling (forward/reverse), the speed search function is stable regardless of the direction of motor idling and direction of operation command. However since the ripple current is used which is generated by the counter electromotive force at idling (the counter electromotive force is proportional to idling speed), the idling frequency is not determined accurately and re-acceleration may start from zero speed when the speed search is performed for motor idling at low speed (about 10 - 15 Hz though there are differences depending on motors).

[30] The initial value 0000 will be displayed in SEG as .

- Cn.71 Speed Search: The speed search can be selected from the following four types. If the point of the switch is displayed at the top, the bit is set. if at the bottom, no bit is set.

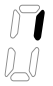
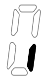
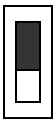
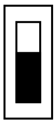
	Bit setting status (On)	Bit setting off state (Off)
Segment		
LCD		

Table 7-13 Types and functions of speed search setting

Setting type				Function
Bit 4	Bit 3	Bit 2	Bit 1	Right end side of the display is bit 1.
			✓	Select speed search for acceleration
		✓		When starting on initialization after trip
	✓			When restarting after instantaneous power interruption
✓				When starting with power on

■ Select speed search for acceleration

If bit 1 is set to 1 and inverter operation command is inputted, the acceleration starts with speed search operation. If the motor is rotating by the load-side environment and the operation command is inputted to the inverter for voltage output, a trip can occur and the motor can be stressed. In this case, you can accelerate without having a trip by using the search function.

⚠ Caution

- When operating in the sensorless II mode at the load that starts during free-run, you have to set the "Select speed search for acceleration" option to operate smoothly. Overcurrent trip or overload trip may occur.

■ Starting on initialization after a trip takes place

If Bit 2 is set to 1 and Pr.08 RST Restart is set to No.1 Yes, acceleration is carried out up to the frequency before trip with speed search operation if the reset key is inputted (or terminal block is initialized) after trip.

■ Restart after instantaneous power interruption

If power returns before the inverter internal DC voltage falls too low after the inverter input power is off and a low voltage trip occurs, acceleration is carried out up to the frequency before trip with speed search operation. Set start bit 4 to 1 at the same time with power input and set Ad.10 Power-on Run to No.1 Yes. If the inverter operation command is on and the inverter input power is inputted, acceleration is carried out up to the target frequency with the speed search operation.

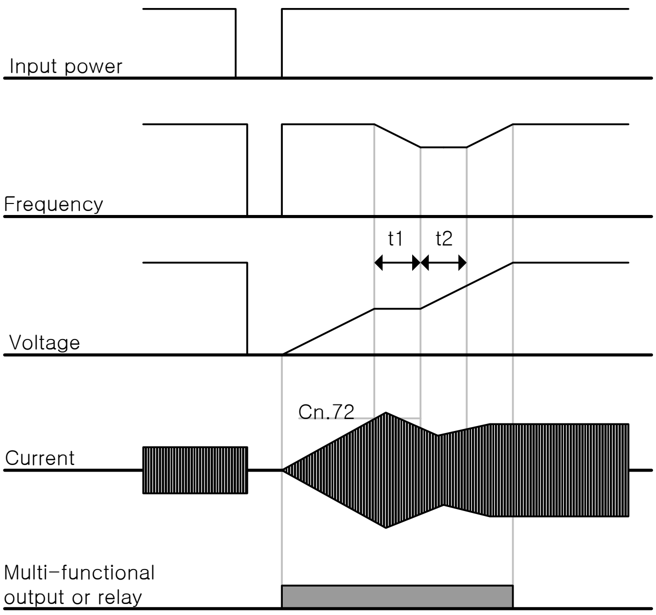


Figure 7-21 Speed search operation after instantaneous power interruption occurs and power returns

1. If instantaneous power interruption occurs and input power is cut off, the inverter generates a low voltage trip (Lvt) to block the output.
2. If the input power returns, the frequency before low voltage trip is outputted and the voltage is increased by inverter inner PI control.
3. If the current increases above the size set in Cn.72, the voltage stops increasing and frequency decreases. (t1 zone)
4. If the current falls below the size set in Cn.27 code, the voltage increases again and the frequency stops deceleration. (t2 zone)
5. If the normal frequency and voltage are recovered, acceleration is carried out with the frequency before trip.

Cn.72 SS Sup-Current: It controls the size of the current during speed search operation based on the motor rated current. If Cn.70 (SS mode) is set to No.1 “Flying Start-2”, this code is not visible.

Cn.73 SS P/I-Gain: Adjust P/I gain of the speed search controller. If Cn.70 (SS Mode) is set to No.1 “Flying Start-2”, they have different factory defaults depending on the motor capacities defined in dr14 Motor Capacity.

Cn.75 SS Block Time: Starts operation after the output is cut off during the time defined before starting the speed search operation. The speed search operation is mainly used for large-inertia loads. It is recommended to restart after stopping for a load with high frictional force.

The S100 series, if used within the rated output, is designed to operate normally for 15 ms or less Instantaneous power interruption. If the input voltage to inverter is 200 - 230 Vac for inverter with 200 V level input voltage or 380 - 460 Vac for inverter with 400 V level input voltage, protection is provided for instantaneous power interruption and the current is based on heavy duty operation.

The DC voltage inside the inverter may change depending on the output load. Therefore if the instantaneous power interruption time is 15 ms or more, a low voltage trip may occur.

7.15 Automatic restart operation

Group	Code	Name	LCD display	Setting	Setting range	Unit
Pr	08	Selection of startup on trip reset	RST Restart	0 No	0 - 1	-
Pr	09	Number of automatic restarts	Retry Number	0	0 - 10	-
Pr	10	Delay time of automatic restart	Retry Delay	1.0	0.0 - 60.0	sec
Cn	71	Speed search operation selection	Speed Search	-	0000[31] - 1111	Bit
Cn	72	Speed search reference current	SS Sup-Current	150	80 - 200	%
Cn	73	Speed search proportional gain	SS P-Gain	100	0 - 9999	
Cn	74	Speed search integral gain	SS I-Gain	200	0 - 9999	
Cn	75	Output blocking time before speed search	SS Block Time	1.0	0.0 - 60.0	sec

Used to prevent a system stop when the inverter's protection function is activated.

Pr.08 RST Restart, Pr.09 Retry Number, Pr.10 Retry Delay: They operate only when Pr.08 RST Restart is set to No.1 Yes, and the number of automatic restarts is set to Pr.09. If a trip occurs during operation, the inverter starts automatic restart operation after the time set in Pr.10 Retry Delay.

The number of restarts allowed decreases by 1 every time automatic restart is performed. When it becomes zero, no automatic restart is performed even if a trip occurs. If a trip does no occur within 60 seconds after automatic restart, the number of automatic restarts allowed again increases. The number of max. increases is limited to the number of restarts.

Automatic restart is not performed if the inverter is stopped due to low voltage, emergency stop (Bx), inverter overheat, or hardware error (HW Diag). The acceleration operation at automatic restart has the same characteristics as the speed search operation. Therefore the functions of Cn.72-75 can be set depending on the load. For the speed search function, refer to Page 7-36..

⚠ Caution

- If the number of automatic restarts is set, the initialization is disabled and motor rotates automatically after a trip occurs.

[31] The initial value 0000 will be displayed in SEG as .

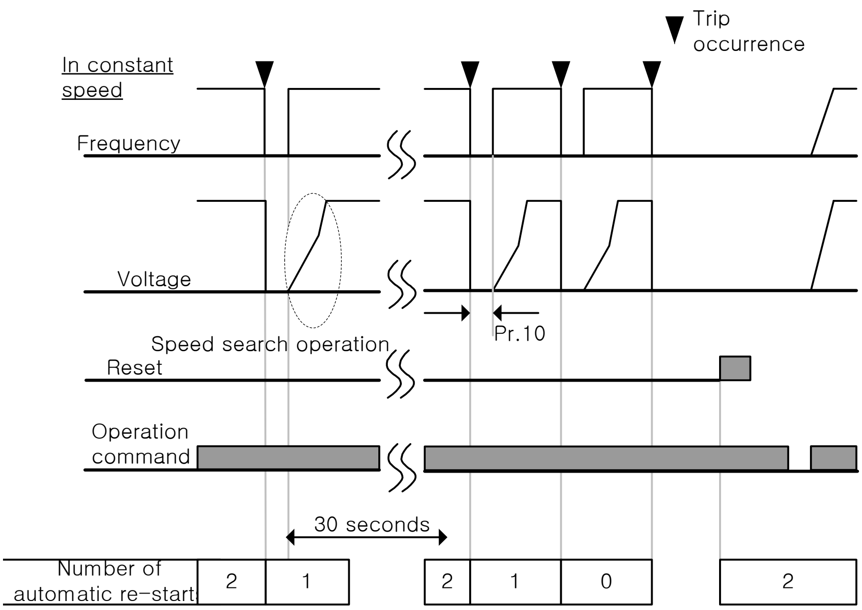


Figure 7-22 Number of automatic restarts set to 2

7.16 Motor audible noise adjustment

Group	Code	Name	LCD display	Setting		Setting range	Unit
Cn	04	Carrier frequency	Carrier Freq	3.0		1.0 - 15.0	kHz
Cn	05	Switching mode	PWM Mode	1	Normal PWM	0 - 1	-

Cn.04 Carrier Freq: Select the operation sound generated in the motor. The power device (IGBT) in the inverter generates the switching voltage of high frequency. This high frequency is referred to as the carrier frequency. If the carrier frequency is high, the operation sound goes down. If it is low, the motor operation sound goes up.

Cn.05 PWM Mode: You can reduce heat loss and leakage current generated in the inverter based on the load rate. Selecting Low Leakage PWM will reduce heat loss and size of leakage current more than in Normal PWM. But the noise generated by the motor increases.

The followings are the advantages and disadvantages in carrier frequency size and load rate selection.

Table 7-14 Advantages and disadvantages in carrier frequency size and load rate selection

Carrier frequency (Carrier Freq) / Disadvantages	1.0 kHz	15 kHz
	LowLeakage PWM	Normal PWM
Motor noise	↑	↓
Generated heat	↓	↑
Electronic noise (interference)	↓	↑
Leakage current	↓	↑

Factory default carrier frequency per inverter capacity is as follows.

Table 7-15 Factory default carrier frequency per inverter capacity

0.4 - 22 kW	
Light load	Heavy load
2 kHz (Max 5 kHz)	3 kHz (Max 15 kHz)

S100 Inverter supports two types of load rates. The overload rates are 150%/1 min for heavy duty and 120%/1 min for normal duty. Therefore the current ratings are different per usage load rate and there is limit to the current rating depending on the ambient temperature.

- **Rated current derating specifications per temperature**: The following is rated current limits for ambient temperature if the inverter operates at normal duty.

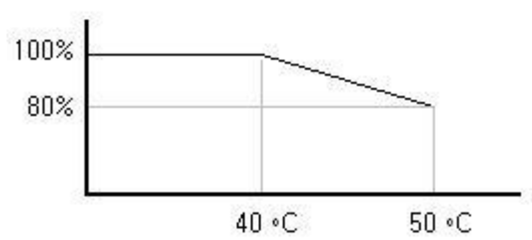


Figure 7-23 Rated current limits for ambient temperature if the inverter operates at normal duty

- **Rated current derating specifications per carrier**: The following is the rated current guarantee area for the carrier frequency according to the load.

Table 7-16 Rated current guarantee area for the carrier frequency according to the load

Inverter capacity	Light load	Heavy load
0.4 - 22 kW	2 kHz	6 kHz

7.17 2nd Motor Operation

If you want to use one inverter to operate two motors for switching operation

If an inverter is connected with two motors for switching operation, the 2nd motor can be operated as long as the input of the terminal defined as the 2nd function is 1 which selects the parameter settings PAR-M2 for the 2nd motor.

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	26	2nd Motor	-	-

- **In 65 - 71 Px Define**: If the function item of the multi-function input terminal is set to No.26 2nd motor, M2 group (2nd motor group) is displayed. If the multi-function terminal set as the 2nd motor is inputted, operation is carried out by the code set in the following. During operation, the multi-function terminal does not work as the 2nd motor parameter even if it is inputted.
- In order to use M2.28 M2-Stall Lev, set Pr.50 Stall Prevent to the value you want to use.
- In order to use M2.29 M2-ETH 1min and M2.30 M2.ETH Cont, set Pr.40 ETH Trip Sel to the value you want to use.

Table 7-17 Code for inputting the multi-function terminal set as the 2nd motor

Code Number	Function	Details
04	M2-Acc Time	Acceleration time
05	M2-Dec Time	Deceleration time
06	M2-Capacity	Motor Capacity
07	M2-Base Freq	Motor base frequency
08	M2-Ctrl Mode	Control mode
10	M2-Pole Num	Number of poles
11	M2-Rate Slip	Rated slip
12	M2-Rated Curr	Rated current
13	M2-Noload Curr	No-load current
14	M2-Rated Volt	Motor rated voltage
15	M2-Efficiency	Motor efficiency
16	M2-Inertia Rt	Load inertia rate
17	M2-Rs	Stator resistor

Code Number	Function	Details
18	M2-Lsigma	Leakage inductance
19	M2-Ls	Stator inductance
20	M2-Tr	Rotor time constant
25	M2-V/F Patt	V/F pattern
26	M2-Fwd Boost	Forward direction torque boost
27	M2-Rev Boost	Reverse direction torque boost
28	M2-Stall Lev	Stall prevention level
29	M2-ETH 1min	One minute rating of electronic thermal
30	M2-ETH Cont	Continuous rating of electronic thermal

- **Usage example**: In order to use the 2nd motor operation function to use P3 terminal in the existing 7.5 kW motor for 3.7 kW switching operation, define as follows:

Table 7-18 Usage example: 2nd motor operation function

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	67	P3 terminal function setting	P3 Define	26	2nd Motor	-	-
M2	06	Motor Capacity	M2-Capacity	-	3.7 kW	-	-
M2	08	Control mode	M2-Ctrl Mode	0	V/F	-	-

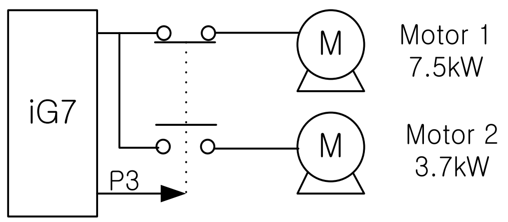


Figure 7-24 Usage example: 2nd motor operation function

7.18 Commercial Switching Operation

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	16	Exchange	-	-
OU	31	Multi-function relay 1 item	Relay1	17	Inverter Line	-	-
OU	33	Multi-function output 1 item	Q1 Define	18	Comm Line	-	-

The load operated by the inverter can be switched to the commercial power or vise versa.

- **In.65 - 71 Px Define:** Input if you set to No.16 Exchange and switch to commercial power from the inverter. Turn off the terminal if you want to switch the motor from the commercial power to the inverter output terminal.
- **OU.31 Relay 1 - OU.33 Q1 Define**: Set the multi-function relay or output to No.16 inverter line and No.17 Comm Line. For relay operation sequence, refer to the following figure.

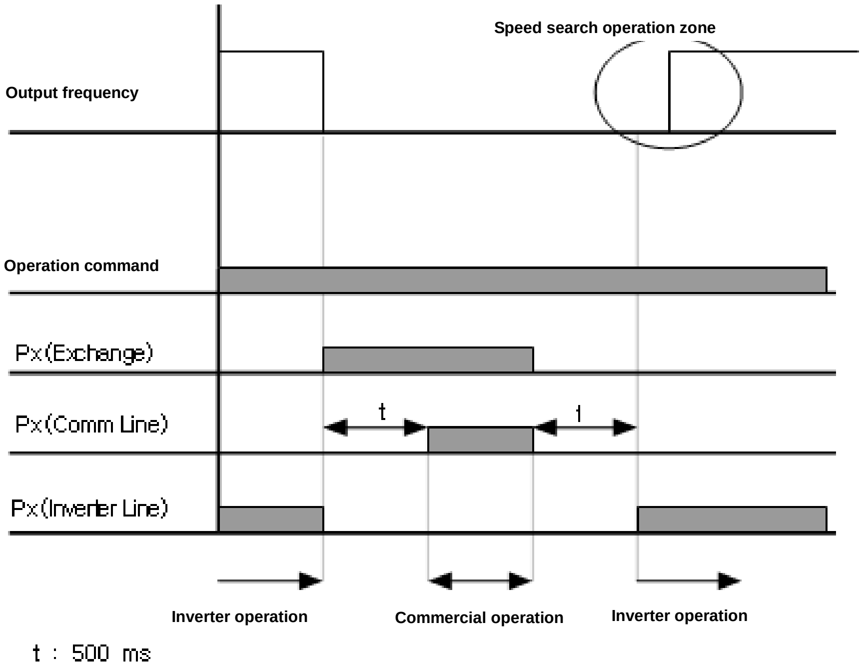


Figure 7-25 Relay operation sequence

7.19 Cooling fan control

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	64	Cooling fan control	FAN Control	0	During Run	0 - 2	-

Turn on or off the fans installed to cool the heat sink of the inverter body. This is used when start/stop is frequent or a quiet environment free from fan noise is required and the life of the cooling fan(s) are extended.

No.1 During Run (only activated during operation): If the power is supplied to the inverter and operation command is inputted, the cooling fan is activated. If the operation command is off and inverter output is cut off, the cooling fan stops. If the heat sink temperature is above a certain level, the cooling fan is activated regardless of the operation command.

- **No.1 Always On (always activated)**: When the power is supplied to the inverter, the fan is always activated.
- **No.2 Temp Control (temperature monitoring)**: Even if the power is supplied to the inverter and operation command is inputted, the cooling fan is not activated. However, if the heat sink temperature is above a certain level, the cooling fan is activated.

⚠ Caution

- Even if Ad.64 is set to 'During Run', if the heat sink temperature is above a certain level due to harmonic waves or noise, the cooling fan is activated as a protection.

7.20 Input Power Frequency Selection

Group	Code	Name	LCD display	Setting		Setting range	Unit
bA	10	Input power frequency	60/50 Hz Sel	0	60 Hz	0 - 1	-

Select the input power frequency. When it is changed from 60 Hz to 50 Hz, all the frequency (or rpm) related items set to 60 Hz or higher change to 50 Hz. When it is changed from 50 Hz to 60 Hz, all 50 Hz function items are changed to 60 Hz.

7.21 Inverter Input Voltage Selection

Group	Code	Name	LCD display	Setting		Setting range	Unit
bA	19	Input power voltage	AC Input Volt	220 V	220	170 - 240	V
				400 V	380	320 - 480	

Set the inverter input power voltage. The low voltage failure level is automatically changed based on the defined voltage.

7.22 Reading, Writing and Saving Parameters[32]

Group	Code	Name	LCD display	Setting		Setting range	Unit
CNF	46	Read parameters	Parameter Read	1	Yes	-	-
CNF	47	Write parameters	Parameter Write	1	Yes	-	-
CNF	48	Save parameters	Parameter Save	1	Yes	-	-

This function copies the parameters saved in the inverter main memory to the keypad, or copy the parameters saved in the keypad to the inverter main memory.

- **CNF.46 Parameter Read**: This function copies the parameters in the inverter main memory to the keypad. All the existing parameters in the keypad are deleted.
- **CNF.47 Parameter Write**: This function copies the parameters saved in the keypad to the inverter main memory. All the existing parameters in the inverter main memory are deleted. If an error occurs while writing parameters, you can use the existing data as they are. If there is no data saved in the keypad, 'EEP Rom Empty' message is displayed.
- **CNF.48 Parameter Save**: Since the parameters defined via communication are saved in the RAM area, they are deleted if you power off the inverter. If you define the parameters via communication and select Yes in CNF.48 Parameter Save, the parameters are not deleted even if you power off the inverter.

[32] Only displayed when the LCD is installed.

7.23 Parameter Initialization

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	93[33]	Parameter initialization	-	0	No	0 - 13	-
CNF[34]	40	Parameter initialization	Parameter Init	0	No	0 - 13	-

You can initialize the parameters changed by the user to the factory default. You can initialize data in all groups or by group. If a trip has occurred or the inverter is operating, you cannot initialize the parameters.

No.	Name	LCD display	Contents
0	No	No	
1	Initialize all groups	All Grp	All data is initialized. If you select No.1 All Groups and press the PROG key, the initialization starts. When completed, No.0 No is displayed.
2	dr group initialization	DRV Grp	You can initialize by group. If you select a group and press the PROG key, the initialization starts. When completed, No.0 No is displayed.
3	bA group initialization	BAS Grp	
4	Ad group initialization	ADV Grp	
5	Cn group initialization.	CON Grp	
6	In group initialization	IN Grp	
7	OU group initialization	OUT Grp	
8	CM group initialization	COM Grp	
9	AP group initialization	APP Grp	
12	Pr group initialization	PRT Grp	
13	M2 group initialization	M2 Grp	

33 It is visible if the LCD loader is not installed.

34 Only displayed when the LCD loader is installed.

7.24 Hide Parameter Mode And Prohibit Parameter Change

■ Hide parameter mode function

Group	Code	Name	LCD display	Setting	Setting range	Unit
CNF[35]	50	Hide parameter mode	View Lock Set	Un-locked	0 - 9999	-
CNF[36]	51	Passward for hiding parameter mode	View Lock PW	Passward	0 - 9999	-

You can use the password registered by the user to hide parameter mode.

- **CNF.51 View Lock Pw**: Register the password to be used to hide parameter mode. Register the password as in the following sequence.

Table 7-19 Registration of password to be used to prohibit the parameter change

Order	Description
1	Press the ENT key in CNF.51 View Lock Pw code to see the previous password registration display window. The factory default is No.0. For the first registration, enter No.0.
2	If there is a previous password, register it.
3	If the entered password matches the previous password, a display window appears for you to register new password.
4	If the entered password is different from the previous password, the previous password registration window is displayed.
5	Register the new password.
6	When registration is completed, CNF.51 View Lock Pw is displayed again.

- **CNF.50 View Lock Set**: if you enter the registered password with the hide parameter mode function disabled, 'Locked' is displayed and you cannot see parameter mode to change parameters. If you enter the password again, UL mark disappears and the hide parameter mode function is disabled.

■ Prohibit parameter change

Group	Code	Name	LCD display	Setting	Setting range	Unit
dr	94	Password registration	-	-	0 - 9999	-
dr	95	Parameter lock setting	-	-	0 - 9999	-
CNF[37]	52	Lock parameter edit	Key Lock Set	Un-locked	0 - 9999	-
CNF[38]	53	Password for locking parameter mode	Key Lock PW	Passward	0 - 9999	-

[35] Only displayed when the LCD loader is installed.

[36] Only displayed when the LCD loader is installed.

[37] Only displayed when the LCD loader is installed.

[38] Only displayed when the LCD loader is installed.

You can use the password registered by the user to prohibit the parameter change.

- **CNF.53 Key Lock PW**: Register the password to be used to prohibit the parameter change. Register the password as in the following sequence.

Table 7-20 Registration of password to be used to prohibit the parameter change

Order	Description
1	Press the PROG key in CNF.52 code to display the previous password registration window. The factory default is No.0. For the first registration, enter No.0.
2	If there is a previous password, register it.
3	If the entered password matches the previous password, a display window appears for you to register new password.
4	If the entered password is different from the previous password, the previous password registration window is displayed.
5	Register the new password.
6	When registration is completed, CNF.53 Key Lock PW is displayed again.

- **CNF.52 Key Lock Set**: if you enter the registered password with the prohibit change function disabled, 'Locked' is displayed and you cannot switch to the Editor mode even if you press the PROG key in the function code you want to change to change parameters. If you enter the password again, Unlocked mark disappears and the prohibit change function is disabled.

⚠ Caution

- When the hide parameter mode function or the prohibit parameter change function is activated, you cannot change the functions related with the inverter operation. Therefore, be sure to remember the registered password.

7.25 Display Changed Parameters Function[39]

Group	Code	Name	LCD display	Setting		Setting range	Unit
CNF	41	Display changed parameters	Changed Para	0	View All	-	-

This function shows only the parameters different from the factory defaults. Use it when you want to track a modified parameter.

Select No1 View Changed to display only the changed parameters. Select No.0 View All to display all parameters.

[39] Can only be set when the LCD is installed.

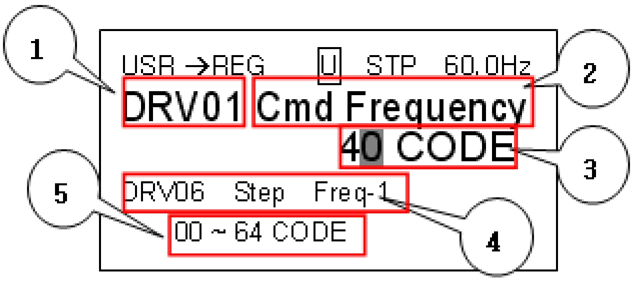
7.26 Add User Group (USR Grp)[40]

Group	Code	Name	LCD display	Setting		Setting range	Unit
CNF	42	Setting ESC Key item	Multi-Key Sel	3	UserGrp SelKey	-	-
CNF	45	Delete all user registration codes	UserGrp AllDel	0	No	-	-

You can put together only the selected data from the groups in the parameter mode for data modification. You can register up to 64 parameters in the user group.

- **CNF.42 Multi-Key Sel**: Select No.3 UserGrp SelKey among the ESC Key functions. Even if the above ESC Key is set to UserGrp SelKey, the user group is not displayed if you do not register the user group parameter.

Table 7-21 Registering parameters in the user group

Order	Description
1	First select Multi-Key in CNF Mode Code 42 and then 4.UserGrp SelKey. U mark appears at the top of the screen.
2	In PAR mode, go to the parameter you want to register and press MULTI Key. For example, press MULTI Key in Cmd Frequency (DRV Group Code No.1) to view the following screen.  Figure 7-26 Screen shown after pressing MULTI Key in DRV Group Code No.1 **Screen description** ▪ 1: Parameter group and code number to register ▪ 2: Name of the parameter to register ▪ 3: Code number to register in the user group (if you press PROG/ENT Key at 40, it is registered in the user group code No.40.) ▪ 4: Information of the parameter previously registered in the user group code No.40 ▪ 5: User group's code setting range (0 means cancellation of code setting)
3	In the above screen, set the code number registered in the user group (No. 3). And then select the code number you want and press the PROG/ENT key.
4	If the values are changed in No.3, then the values in No.4 are also changed. No.4 shows the information of the parameters previously registered and if none is registered in the code number, 'Empty Code' is displayed. 0 is cancellation of code setting.
5	These parameters are registered in U&M Mode's user group. (if required, parameters may be registered multiple times. For example, a parameter can be registered multiple times in user group code No.2, code No.11, etc.)

[40] Can only be set when the LCD is installed.

Table 7-22 Deleting parameters saved in the user group individually

Order	Description
1	First, select Multi-Key in CNF Mode Code 42 and then 4.UserGrp SelKey. U mark appears at the top of the screen.
2	In U&M Mode USR Group, move the cursor to the code to delete.
3	Press MULTI Key.
4	A prompt appears asking you if you want to delete the parameter.
5	Select YES and press the PROG/ENT key.
6	Deletion is completed.

- **CNF.25 UserGrp AllDel**: Select No.1 Yes to delete all parameters in the user group.

7.27 Add Macro Group (Macro Grp)[41]

Group	Code	Name	LCD display	Setting		Setting range	Unit
CNF	43	Macro function item	Macro Select	0	None	-	-

If the applied load is selected, the inverter selects the related functions so that you can make changes in the macro group collectively.

- **CNF.43 Macro Select**: Various application functions are put together into a group for easy setup. Now the Draw function is supported. In the user & macro mode (U&M), a macro group called 'MC1' (Draw function) is displayed.

  The function is provided by the inverter. Users cannot add or delete a function item included in the macro, but can change the data in the macro group.

  The Draw function is a type of open loop tension control. It utilizes the speed difference between the motors that operate at the rate for the main speed command to keep the tension of the materials hanging between them consistent.

  For details, refer to '7.2 Setting the Override Frequency Using the Aux Frequency Command' (Page 7-3).

[41] Can only be set when the LCD is installed.

7.28 Easy Start[42]

Group	Code	Name	LCD display	Setting		Setting range	Unit
CNF	61	Parameter easy start setup	Easy Start On	1	Yes	-	-

- **CNF.61 Easy Start On**: If this code is set to Yes and All is selected in CNF.40 Parameter Init to initialize all parameters in the inverter, Easy Start starts when the power is turned off/on the first time.

Table 7-23 Starting Easy Start

Order	Description
1	Set CNF.61 Easy Start On to Yes.
2	Select All in CNF.40 Parameter Init to initialize all parameters in the inverter.
3	Easy Start starts when the inverter power is turned off/on the first time. If the parameters appear on the digital keypad in the following sequence, set them with appropriate values. (Press ESC on the digital keypad at each stage to exit Easy Start.) **1.** Start Easy Set: select Yes. **2.** DRV-14 Motor Capacity: select the motor capacity. **3.** BAS-11 Pole Number: select the number of motor poles. **4.** BAS-15 Rated Volt: select the rated voltage of the motor. **5.** BAS-10 60/50Hz Sel: select the rated frequency of the motor. **6.** BAS-19 AC Input Volt: set the input voltage. **7.** DRV-06 Cmd Source: select the method of operation command. **8.** DRV-01 Cmd Frequency: select the operation frequency. Now exit to the monitoring screen. Now that minimal parameters are set to operate the motor, use the operation command method set in DRV-06 to operate the motor.

[42] Can only be set when the LCD loader is installed.

7.29 Other Config (CNF) Mode Parameters[43]

Group	Code	Name	LCD display	Setting	Setting range	Unit
CNF	2	LCD contrast adjustment	LCD Contrast	-	-	
CNF	10	Main body S/W version	Inv S/W Ver	x.xx	-	
CNF	11	Keypad S/W version	Keypad S/W Ver	x.xx	-	-
CNF	12	Keypad title version	KPD Title Ver	x.xx	-	-
CNF	30 - 32	Option slot types	Option-x Type	None	-	-
CNF	44	Fault history deletion	Erase All Trip	No	-	-
CNF	60	Additional title update	Add Title Up	No	-	-
CNF	62	Initialize accumulated power consumption	WH Count Reset	No	-	-

- **CNF.2 LCD Contrast**: You can control the LCD contrast of the digital keypad.
- **CNF.10 Inv S/W Ver, CNF.11 Keypad S/W Ver**: You can check the OS versions of the main body and digital keypad.
- **CNF.12 KPD Title Ver**: You can check the title version of the digital keypad.
- **CNF.30 - 32 Option-x Type**: You can check the types of option boards inserted in slot 1 - 3.
- **CNF.44 Erase All Trip**: Deletes all saved fault history.
- **CNF.60 Add Title Up**: When the inverter body software version is upgraded and added with new codes, this ensures that the display and add functions of the codes added to the previous version keypad are activated. If you set this code to Yes and remove and re-insert the keypad, the digital keypad title is updated.
- **CNF.62 WH Count Reset**: The accumulated power consumption is deleted.

[43] Can only be set when the LCD loader is installed.

7.30 Timer Function

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	38	Timer In	-	-
OU	31	Multi-function relay 1 item	Relay 1	28	Timer Out	-	-
OU	33	Multi-function output 1 item	Q1 Define				
OU	55	Timer On Delay	TimerOn Delay	3.00		0.00 - 100	sec
OU	56	Timer Off Delay	TimerOff Delay	1.00		0.00 - 100	sec

This is a timer function of the multi-function input terminals. You can switch on or off multi-function output (including relay) after a user-defined period of time.

- **In.65 - 71 Px Define**: Set the terminal for the timer among the multi-function input terminals to No.38 Timer In. When the set terminal is inputted, the set output is activated to Timer Out after the period of time set by OU.55 TimerOn Delay. When the multi-function input terminal is off, the multi-function output (or relay) is turned off after the period of time set by OU.56 TimerOff Delay.

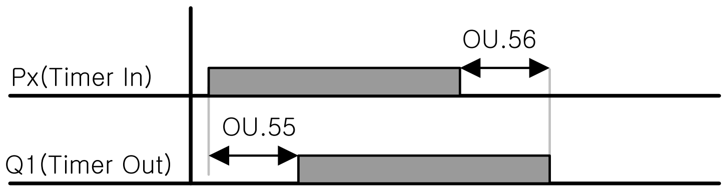


Figure 7-27 Timer function of multi-function input terminal

7.31 Brake Control

Group	Code	Name	LCD display	Setting		Setting range	Unit
dr	09	Control mode	Control Mode	0	V/F	-	-
Ad	41	Brake release current	BR Rls Curr	50.0		0.0 - 180%	%
Ad	42	Brake release delay time	BR Rls Dly	1.00		0.0 - 10.0	sec
Ad	44	Brake release forward frequency	BR Rls Fwd Fr	1.00		0 - Maximum frequency	Hz
Ad	45	Brake release reverse frequency	BR Rls Rev Fr	1.00		0 - Maximum frequency	Hz
Ad	46	Brake engage delay time	BR Eng Dly	1.00		0.00 - 10.00	sec
Ad	47	Brake engage frequency	BR Eng Fr	2.00		0 - Maximum frequency	Hz
OU	31	Multi-function relay 1 item	Relay 1	35	BR Control	-	-
OU	33	Multi-function output 1 item	Q1 Define				

Used to control the on/off operation of a mechanical brake in a load system using the electronic brake output control. The activation sequence differs depending on the control mode (dr.09) settings.
Set the required operation using the parameters in the above table. If the brake control is working, the DC brake at start (Ad.12) and dwell operation (ad.20-23) do not operate.

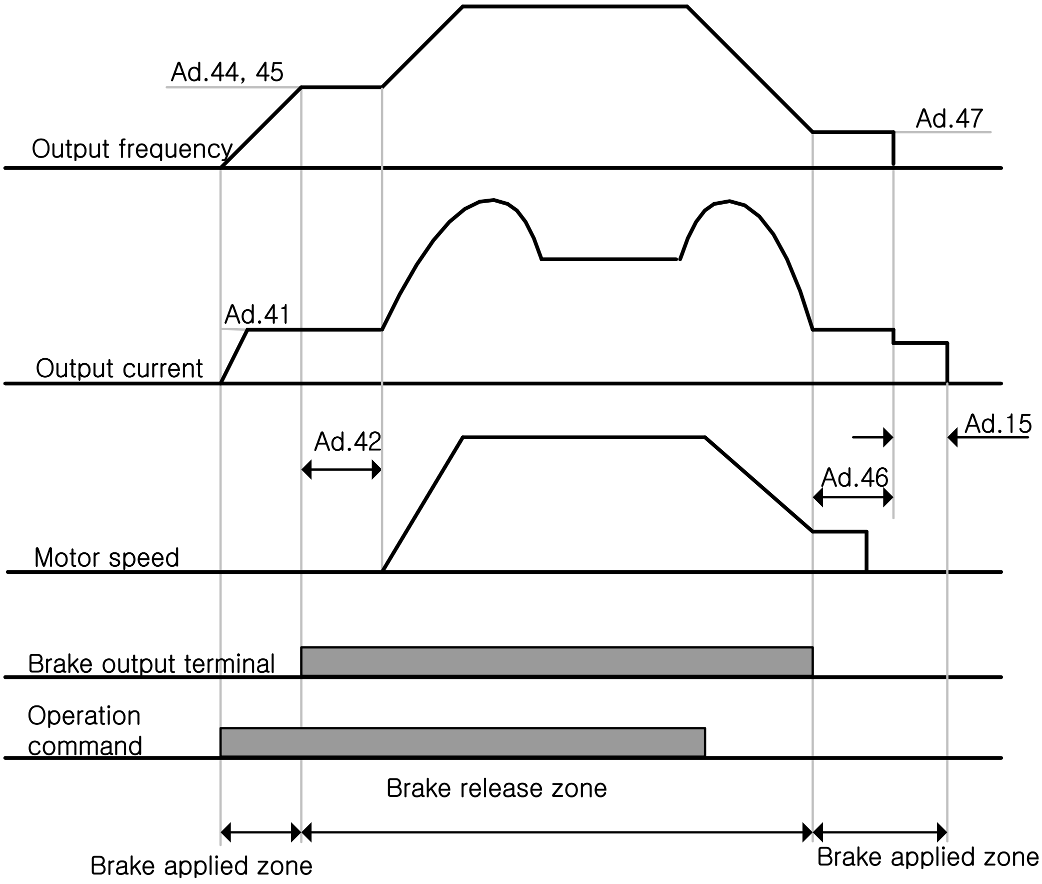


Figure 7-28 Brake operation sequence

- Brake release sequence

  If the motor is stopped and an operation command is given, the motor accelerates up to the brake release frequency (Ad.44, 45) according to forward or reverse direction. When the brake release frequency is reached and the current flowing in the motor reaches the brake release current (BR Rls Curr), then the brake release signal is outputted to the output relay defined for brake control or multi-function output terminal. Maintain the frequency during the brake release delay time (BR Rls Dly) and then accelerate.

- Brake engage sequence

  If the motor is running and a stop command is given, the motor decelerates. If the output frequency reaches the brake engage frequency (BR Eng Fr), the deceleration stops and the brake engage signal is issued to the output terminal. After maintaining the frequency during the brake engage delay time (BR Eng Dly), the output frequency becomes '0'. If the DC brake time (Ad.15) and DC braking quantity (Ad.16) are defined, cut off the inverter power after DC braking. For DC brake activation, refer to Page 6-34.

7.32 Multi-Function terminal on/off Control

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	66	Output contact On/Off control method	On/Off Ctrl Src	1	V1	-	-
Ad	67	Output contact On level	On-C Level	90.00		10.00 - 100.00%	%
Ad	68	Output contact Off level	Off-C Level	10.00		0.00 - Output contact On level	%
OU	31	Multi-function relay 1 item	Relay 1	34	On/Off Control	-	-
OU	33	Multi-function output 1 item	Q1 Define	34	On/Off Control	-	-

You can swtich the output relay or multi-function output terminal if the analog input value is above the set value. Select the analog input to be used for on/off input in Ad.66 and then define the level, in Ad.68 and 68, at which the output terminals are turned on and off respectively. If the analog input is above the value defined in Ad.67, the output terminal is turned on. If below the value in Ad.68, it is turned off.

7.33 Regeneration avoidance for Press applications

■ Used to avoid braking in the regeneration condition during press operation

While operating the press, it prevents regeneration area by increasing the motor operation speed automatically in the motor regeneration status.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Ad	74	Selection of regeneration evasion function for press	RegenAvd Sel	0	No	0 - 1	-
Ad	75	Voltage level of regeneration evasion motion for press	RegenAvd Level	350 V		200 V product: 300 - 400 V	V
				700 V		400 V product: 600 - 800 V	
Ad	76	Compensation frequency limit of regeneration evasion for press	CompFreq Limit	1.00 [Hz]		0.00 - 10.00 Hz	Hz
Ad	77	Regeneration evasion for press P gain	RegenAvd Pgain	50.0[%]		0 .0 - 100.0%	%
Ad	78	Regeneration evasion for press I gain	RegenAvd Igain	500 [ms]		20 - 30000 ms	ms

- **Ad.74 RegenAvd Sel (Selection of regeneration evasion function for press):** When the regeneration voltage such as press load occurs frequently during constant speed motor operation, select this function to suppress DC link voltage to avoid the activation of braking unit, if the braking unit is damaged or its life is shortened due to excessive operation of braking unit.
- **Ad.75 RegenAvd Level (Setting the level for regeneration evasion for press):** Set the voltage level for regeneration avoidance for press if DC link voltage goes up due to the regeneration voltage.
- **Ad.76 CompFreq Limit (Compensation frequency limit of regeneration evasion for press):** Set the variable frequency width for actual command frequency during regeneration operation area avoidance.
- **Ad.77 RegenAvd Pgain (Compensation controller P gain setting for regeneration avoidance for a press),**
  Ad.78 RegenAvd Igain (Compensation controller I gain setting for regeneration evasion for press): Set P and I gains for DC Link voltage suppression PI controller to avoid the regeneration operation area.

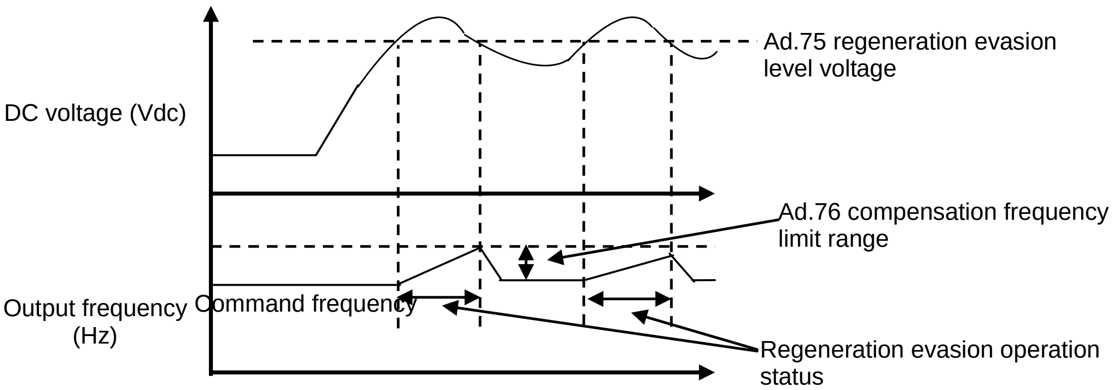


Figure 7-29 Regeneration evasion for press

⚠ Caution
▪ The regeneration avoidance for press only works when the motor operation status is in constant speed zone. (No operation in Acc/Dec zone) Even if in constant speed operation during the regeneration avoidance, the output frequency can change as much as the frequency set in Ad.76 CompFreq Limit.

7.34 Analog Output

■ 0 -10V voltage /4-20 mA current output

Group	Code	Name	LCD display	Setting		Setting	Unit
OU	01	Analog output 1 item	AO1 Mode	0	Frequency	0 - 15	-
OU	02	Analog output 1 gain	AO1 Gain	100.0		-1000.0 - 1000.0	%
OU	03	Analog output 1 bias	AO1 Bias	0.0		-100.0 - 100.0	%
OU	04	Analog output 1 filter	AO1 Filter	5		0 - 10000	ms
OU	05	Analog constant output 1	AO1 Const %	0.0		0.0 - 100.0	%
OU	06	Analog output 1 monitor	AO1 Monitor	0.0		0.0 - 1000.0	%

You can select SW2 at the top of IO terminal to change the output type (voltage/current).

Select items outputted from AO (Analog Output) terminal of inverter terminal block and adjust their sizes.

- **OU.01 AO1 Mode**: Select the types of output items.

Table 7-24 Types of output items

Item		Function
0	Frequency	Output the operation frequency. 10 V is outputted at the frequency set in dr.20 Max Freq.
1	Output Current	10 V is outputted at 200% of inverter rated current (Heavy Duty).
2	Output Voltage	Output the inverter output voltage. 10 V is outputted at the voltage set in bA.15 Rated Volt. If 0 V is set in bA.15, 10 V is outputted based on 220 V for 200 V product and 440 V for 400 V product.
3	DC Link Volt	Output the inverter DC power terminal voltage. 10 V is outputted when it is 410 Vdc for 200 V product and 820 Vdc for 400 V product.
4	Torque	Output the generation torque 10 V is outputted at 250% of the motor rated torque.
5	Output Power	Monitor the output watt. 200% of the rated output is the max indicated voltage (10 V).
6	Idse	The max voltage is outputted at 200% of no-load current.
7	Iqse	The max voltage is outputted at 250% of rated torque current. $\text{Rating Torque Current} = \sqrt{\text{Rated Current}^2 - \text{No-load current}^2}$
8	Target Freq	Output the set frequency. 10 V is outputted at dr.20 max. frequency.
9	Ramp Freq	This is the frequency after going through acceleration and deceleration functions. There could be a difference from the actual output frequency. 0-10V is output.

Item		Function
12	PID Ref Value	Output the PID controller command value. About 6.6 V is outputted when it is 100%.
13	PID Fdk Value	Display the feedback volume of PID controller. About 6.6 V is outputted when it is 100%.
14	PID Output	Display the current output values of PID controller. About 10 V is outputted when it is 100%.
15	Constant	Output OU.05 AO1 Const % values.

- **OU.02 AO1 Gain and OU.03 AO1 Bias**: You can adjust the size and offset. If the frequency is selected as the output item, the operation works as in the following.

$$AO1 = \frac{Frequency}{MaxFreq} \times AO1Gain + AO1Bias$$

- The actual voltage output based on OU.02 AO1 Gain and OU.03 AO1 Bias parameter settings operate as in the next page.
- **OU.04 AO1 Filter**: Define the filter time constant of analog output.
- **OU.05 A01 Const %:**Analog voltage is outputted as set in this parameter after the analog output item is set to Constant (AO1 Mode: 15).
- **OU.06 AO1 Monitor**: You can monitor the analog output values. Max output voltage 10 V is displayed in percentage.

The following figure shows how the analog voltage output (AO1) changes according to the OU.02 AO1 Gain and OU.3 AO1 Bias. Here, Y axis shows the analog output voltage (0-10 V), while X axis shows the % value of the item to be outputted. For example, when dr.20 Max Freq is 60 Hz and the current output frequency is 30 Hz, X axis is 50% in the following figure.

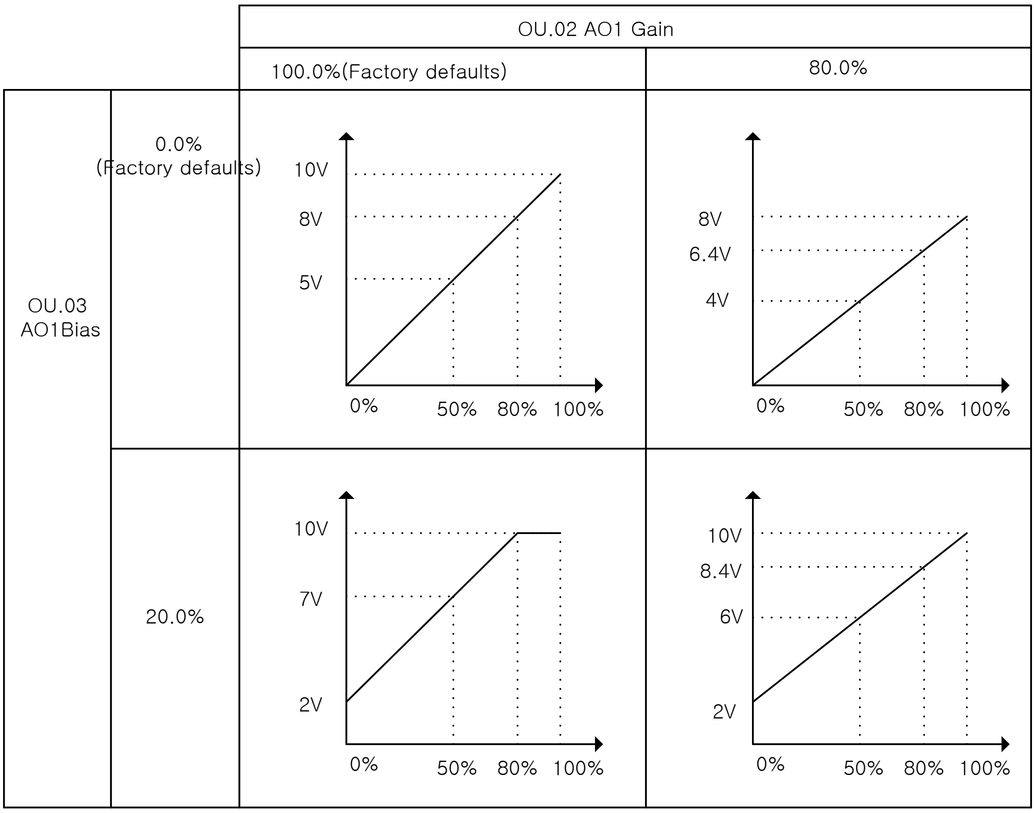


Figure 7-30 Analog voltage output change when dr.20 Max Freq is 60 Hz and the current output frequency is 30 Hz

■ 0 - 32 kHz pulse output

Group	Code	Name	Function display	Setting		Setting range	Unit
OU	61	Pulse output item	TO Mode	0	Frequency	0 - 15	-
OU	62	Pulse output gain	TO Gain	100.0		-1000.0 - 1000.0	%
OU	63	Pulse output bias	TO Bias	0.0		-100.0 - 100.0	%
OU	64	Pulse output filter	TO Filter	5		0 - 10000	ms
OU	65	Pulse output constant output 2	TO Const %	0.0		0.0 - 100.0	%
OU	66	Pulse output monitor	TO Monitor	0.0		0.0 - 1000.0	%

Select items outputted from TO (Pulse Output) terminal of inverter terminal block and adjust their sizes.

- **OU.63 TO Filter, OU.64 TO Const %, OU.65 TO Monitor**: The functions are the same as AO1.
- **OU.61 TO Gain, OU.62 TO Bias**: You can adjust the size and offset. If the frequency is selected as the output item, the operation works as in the following.

$$TO = \frac{Frequency}{MaxFreq} \times TOGain + TOBias$$

The figure on the next page shows how the pulse output (TO) changes according to the values of OU.61 TO Gain and OU.62 TO Bias. Here, Y axis shows the analog output current (0-32 kHz), while X axis shows the % value of the item to be outputted. For example, when dr.20 Max Freq is 60 Hz and the current output frequency is 30 Hz, X axis is 50% in the following figure.

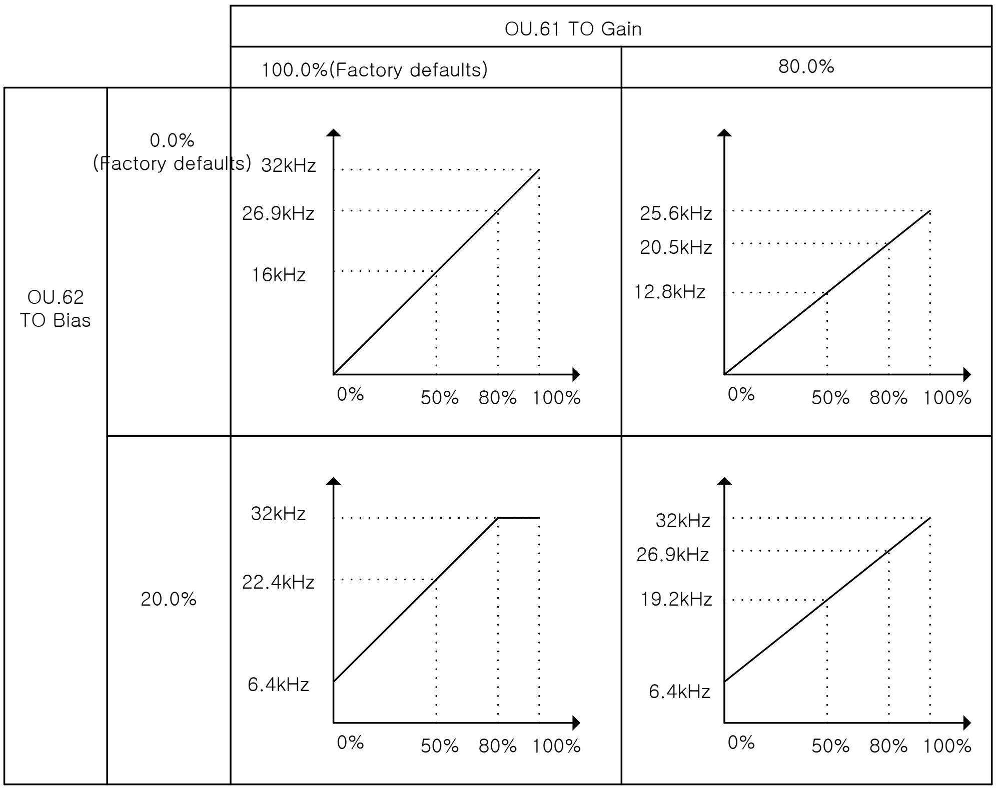


Figure 7-31 Pulse output change when dr.20 Max Freq is 60 Hz and the current output frequency is 30 Hz

Notes

The following shows how to tune OU.08 AO2 Gain and OU.09 AO2 Bias when 4 - 20 mA is used for output, not 0 - 20 mA.

1. **Set OU.07 AO2 Mode to Constant and OU.11 AO2 Const % to 0.0%.**
2. **Set OU.09 AO2 Bias to 20.0% and then measure the current output to check if it is 4 mA. If it is smaller than 4 mA, increase OU.09 AO2 Bias little by little, until 4 mA is measured.** On the contrary, if it is larger than 4 mA, decrease OU.09 AO2 Bias little by little, until 4 mA is measured.
3. **Set OU.11 AO2 Const % to 100.0%.**
4. **Set OU.08 AO2 Gain to 80.0% and then measure the current output to check if it is 20 mA. If it is smaller than 20 mA, increase OU.08 AO2 Gain little by little, until 20 mA is measured.** On the contrary, if it is larger than 20 mA, decrease OU.08 AO2 Gain little by little, until 20 mA is measured.
5. **The function for each code is the same as the items of 0 - 10 V voltage output above explained and the output range is 4 - 20 mA.**

7.35 Digital Output

■ Select terminal block multi-function output terminal and relay function

Group	Code	Name	LCD display	Setting		Setting range	Unit
OU	30	Fault output item	Trip Out Mode	010[44]		-	bit
OU	31	Multi-function relay 1 item	Relay 1	29	Trip	-	-
OU	33	Multi-function output 1 item	Q1 Define	14	Run	-	-
OU	41	Multi-function output monitoring	DO Status	-		00 - 11	bit

The fault relay is activated based on OU.30 fault output selection.

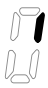
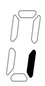
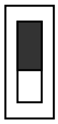
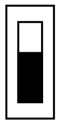
	Bit setting status (On)	Bit setting off state (Off)
Segment		
LCD		

Table 7-25 Fault relay bit setting function

Item			Function
Bit 3	Bit 2	Bit 1	Right end side of the display is bit 1.
		✓	Activated when a low voltage trip occurs
	✓		Activated when a trip other than low voltage trip occurs
✓			Activated when the inverter failed finally after setting the time of automatic restarts (Pr.08 - 09) after a trip occurs.

Select the output item for multi-function output terminal (Q1) and relay (Relay 1) of inverter terminal block. Q1 is Open Collector TR output.

■ Multi-function output terminal and relay setting function

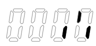
- 0: None

  No operation.

- 1: FDT-1

  Check if the inverter output frequency has reached the frequency that the user selected. Activated when the following requirements are satisfied.

Absolute value (set frequency – output frequency) < detected frequency width / 2

[44] The initial value 010 will be displayed in SEG as .

The detected frequency width is set in the following and the figure shows that the detected frequency width is set to 10 Hz.

Group	Code	Name	LCD display	Setting	Setting range	Unit
OU	58	Detected frequency band	FDT Band	10.00	0.00 - Max. frequency	Hz

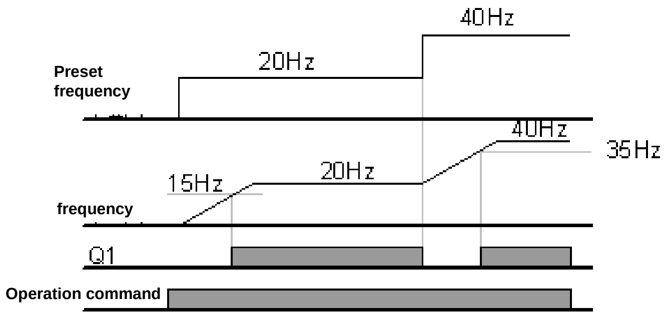


Figure 7-32 FDT-1 when the detected frequency width is set to 10 Hz

- 2: FDT-2

Activated when the user-defined frequency matches the detected frequency (FDT frequency) and above No.0 FDT-1 is satisfied.

[Absolute value (set frequency – detected frequency) < detected frequency width / 2] & [FDT-1]

In the following graph, the detected frequency width is 10 Hz and the detected frequency is 30 Hz.

Group	Code	Name	LCD display	Setting	Setting range	Unit
OU	57	Detected frequency	FDT Frequency	30.00	0.00 - Max. frequency	Hz
OU	58	Detected frequency band	FDT Band	10.00	0.00 - Max. frequency	Hz

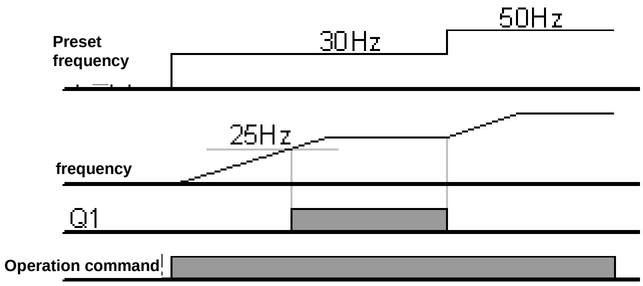


Figure 7-33 FDT-2 when the detected frequency width is 10 Hz and the detected frequency is 30 Hz

- 3: FDT-3

  Activated when the operation frequency is as follows.

Absolute value (output frequency – operation frequency) < detected frequency width / 2

Group	Code	Name	LCD display	Setting	Setting range	Unit
OU	57	Detected frequency	FDT Frequency	30.00	0.00 - Max. frequency	Hz
OU	58	Detected frequency band	FDT Band	10.00	0.00 - Max. frequency	Hz

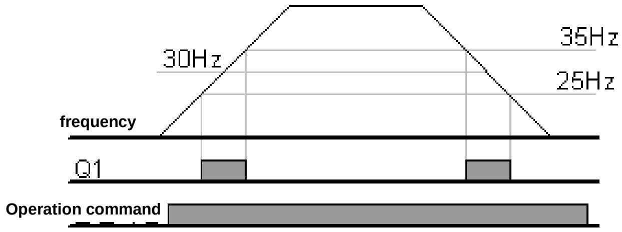


Figure 7-34 FDT-3 when the detected frequency width is 10 Hz and the detected frequency is 30 Hz

- 4: FDT-4

  You can set the conditions separately for acceleration and deceleration.

  - Acceleration: Operation frequency >= Detected frequency
  - Deceleration: Operation frequency > (Detected frequency – Detected frequency width / 2)

Group	Code	Name	LCD display	Setting	Setting range	Unit
OU	57	Detected frequency	FDT Frequency	30.00	0.00 - Max. frequency	Hz
OU	58	Detected frequency band	FDT Band	10.00	0.00 - Max. frequency	Hz

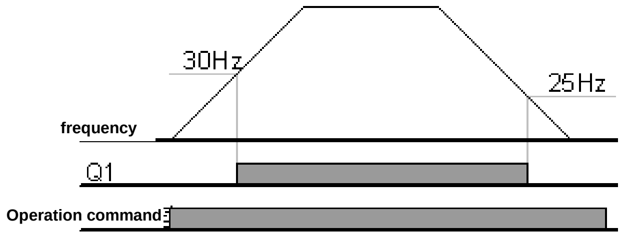


Figure 7-35 FDT-4 when the detected frequency width is 10 Hz and the detected frequency is 30 Hz

- 5: Over Load (motor overload)

  Activated when the motor is overloaded.

- 6: IOL (inverter overload)

  Activated when a failure occurs due to the inverter overload according to the characteristics in case of inverse proportion.

- 7: Under Load (underload warning)

  Activated when underload warning is issued.

- 8: Fan Warning

  Set the multi-function output to '8:Fan Warning' to inform the user that fan warning has been issued.

- 9: Stall (motor stall)

  Activated when the motor is stalled by the motor overload.

- 10: Over Voltage (overvoltage failure)

  Activated when the inverter DC power terminal voltage rises above the protection voltage.

- 11: Low Voltage (low voltage failure)

  Activated when the inverter DC power terminal voltage decreases below the low voltage protection level.

- 12: Over Heat (inverter cooling fins overheat)

  Activated when the inverter heat sink is too hot.

- 13: Lost Command

  Activated when the analog input terminal of the inverter terminal block and RS-485 communication command are lost. The communication option and extension I/O card are installed. Also activated when the analog input and communication command are lost.

- 14: RUN

  Activated when the operation command is inputted and the inverter is outputting the voltage. Not activated during DC braking.

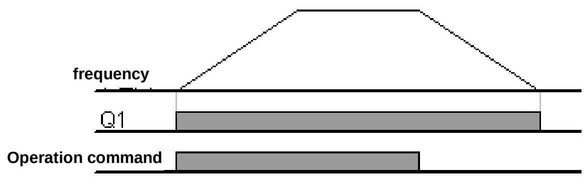


Figure 7-36 Run

- 15: Stop

  Activated when the operation command is off and there is no inverter output voltage.

- 16: Steady (constant speed operation)

  Activated during constant speed operation.

- 17: Inverter Line (inverter operation), 18: Comm Line (during commercial power operation)

If the commercial switching operation is required, it can be used as signal source to operate the sequence relay or magnetic contactor. Use the aux relay of inverter terminal block and multi-function output (MO1). Select one of multi-function inputs for commercial switching (Exchange). For details, refer to '7.24 Commercial Switching Operation' (Page 7-44).

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	16	Exchange	-	-
OU	31	Multi-function relay 1 item	Relay 1	17	Inverter Line	-	-
OU	33	Multi-function output 1 item	Q1 Define	18	Comm Line	-	-

- 19: Speed Search (speed search operation)

  Outputs while the inverter is working with the speed search function. For details on the speed search, refer to '7.20 Speed Search Operation' (Page 7-36).

- 22: Ready (ready for operation command)

  Output is on when inverter is healthy (not tripped) and is waiting for an external run command.

- 28: Timer Out

  You can use the multi-function terminal block input to activate the contact output after a certain period of time.

Group	Code	Name	LCD display	Setting		Setting range	Unit
OU	01	Analog output 1 item	AO1 Mode	0	Frequency	0 - 15	-

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Px terminal function setting	Px Define (Px: P1 - P7)	38	Timer In	-	-
OU	55	Timer On Delay	TimerOn Delay	0.00		0.00 - 100.00	sec
OU	56	Timer Off Delay	TimerOff Delay	0.00		0.00 - 100.00	sec

- 29: Trip[45]
- 31: DB Warn %ED [46]
- 34: On/Off Control[47]
- 35: BR Control[48]

45 Refer to Chapter 7.32

46 Refer to Chapter 8.8

47 Refer to Chapter 7.27

48 Refer to Chapter 7.26

7.36 Alarm or fault Status Output Using the Terminal Block Multi-Function Output Terminal

You can use the multi-function terminal (Q1) and relay (Relay 1) to output the inverter failure status.

Group	Code	Name	LCD display	Setting		Setting range	Unit
OU	30	Fault output item	Trip Out Mode	010		-	bit
OU	31	Multi-function relay 1 item	Relay 1	29	Trip	-	-
OU	33	Multi-function output 1 item	Q1 Define	14	Run	-	-
OU	53	Fault output On delay	TripOut OnDly	0.00		0.00 - 100.00	sec
OU	54	Fault output Off delay	TripOut OffDly	0.00		0.00 - 100.00	sec

- **OU.30 Trip Out Mode**: Select the terminal and relay to be used for a fault output and then No.29 failure mode (Trip Mode) in OU.31 and 33. When the inverter has a fault, then the relevant terminal and relay are activated. You can set the activation condition according to the types of fault as in the following.

Table 7-26 Setting the activation condition based on the types of failure

Item			Function
Bit 3	Bit 2	Bit 1	Right end side of the display is bit 1.
		✓	Activated when a low-voltage occurs.
	✓		Activated when a failure other than low voltage fault.
✓			Activated upon Pr.08 or Pr.09 when the inverter failed to restart automatically.

- OU.53 TripOut On Dly, OU.54 TripOut OffDly: If a fault occurs, the fault relay or multi-function output are activated after the time defined in OU.53. When a reset is inputted, the contact becomes off after the time defined in OU.54.

7.37 Output Terminal Delay Time And Contact Types

You can adjust the activation time of the terminal block output terminals and relays. You can set the on and off delay times. You can select the contact A (normal open) or contact B (normal closed).

■ Output terminal delay time

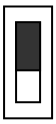
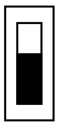
Group	Code	Name	LCD display	Setting	Setting range	Unit
OU	50	Multi-function output On delay	DO On Delay	0.00	0.00 - 100.00	sec
OU	51	Multi-function output Off delay	DO Off Delay	0.00	0.00 - 100.00	sec

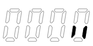
The delay time set in OU.50, 51 are applied both to the multi-function output terminal (Q1) and relay (Relay 1), except when the multi-function output is in the failure mode.

■ Select the type of output signal contact

Group	Code	Name	LCD display	Setting	Setting range	Unit
OU	52	Multi-function output contact selection	DO NC/NO Sel	00[49]	00 - 11	bit

Select the types of relay and multi-function output terminals. If you add extension I/O, three additional bits for terminal block contact type selection are added. If you set the relevant bit to 0, contact A (NO) is used. If set to 1, contact B (NC) is used. Displays Relay 1 and Q1 from the right bit.

	Bit setting status (On)	Bit setting off state (Off)
Segment		
LCD		

[49] The initial value 00 will be displayed in SEG as .

7.38 keypad Language Selection[50]

Mode	Code number	Function display	Initial settings display		Unit
CNF	01	Language Sel	0	English	-
			1	Korean	

Select the language of the keypad display window. You can select a language in Keypad S/W Ver 1.04 or later.

7.39 Monitoring Operation Status[51]

You can use the keypad of the inverter to monitor the operation status. You can select monitoring items in Config Mode (CNF). You can view three items in the monitor mode and display one item in the status display window.

■ Select the monitor mode display

Mode	Group	Code number	Function display	Initial setting display		Unit
CNF	-	21	Monitor Line-1	0	Frequency	Hz
CNF	-	22	Monitor Line-2	2	Output Current	A
CNF	-	23	Monitor Line-3	3	Output Voltage	V
CNF	-	24	Mon Mode Init	0	No	-

CNF.21 - 23 Monitor Line-x: Select the items to be displayed in the monitor mode. The monitor mode is the first mode that is displayed when the inverter turns on. You can display three items from Monitor Line-1 to Monitor Line-3 at the same time. Select items according to the lines to display in the following. If you select Yes in CNF.24 Mon Mode Init, CNF.21 to 23 are initialized.

Setting type		Function
0	Frequency	Displays the defined frequency during stoppage and the operation frequency currently being outputted in Hz during operation.
1	Speed	This works in the same way as with No.0 and is displayed in RPM.
2	Output Current	Displays motor (output) current.
3	Output Voltage	Displays the output voltage.
4	Output Power	Displays the output power.
5	WHour Counter	Displays the inverter's power consumption
6	DCLink Voltage	Displays the DC power terminal voltage within the inverter.
7	DI Status	Displays the status of input terminals of inverter terminal block. Displays P1, P2,…, P8 from the right.
8	DO Status	Displays the status of output terminals of inverter terminal block. Displays Relay1, Relay2 and Q1 from the right.
9	V1 Monitor[V]	Displays the voltage value inputted in the V1, the voltage input terminal of inverter terminal block.

50 Can only be set when the LCD loader is installed.

51 Can only be set when the LCD loader is installed.

Setting type		Function
10	V1 Monitor[%]	Displays the voltage in percentage in the above paragraph 9. If -10 to +10V is inputted, -100 - 100% is displayed.
13	V2 Monitor[V]	The input signal voltage of terminal V2 is displayed.
14	V2 Monitor[%]	Displays V2 input voltage in percentage.
15	I2 Monitor[mA]	The mA signal value of I2 terminal is displayed.
16	I2 Monitor[%]	Displays the input current of I2 terminal in percentage.
17	PID Output	Displays the output of PID controller.
18	PID Ref Value	Displays the Set-point value of the PID controller.
19	PID Fdb Value	Display the feedback value into the PID controller.
20	Torque	If the torque reference command method (DRV-08) is set to a method other than the keypad (No.0 or No.1), the torque reference is displayed.
21	Torque Limit	If the torque limit setting method (DRV-08) is set to a method other than the keypad (No.0 or No.1), the torque limit is displayed.
23	Spd Limit	If the torque control mode's speed limit setting method (CON-62) is set to a method other than the keypad (No.0 or No.1), the speed limit value is displayed.

- WHour Counter: The following is the description on No.5 WHour Counter (inverter power consumption) among monitoring items described above. For the power consumption, a value calculated using voltage and current is used. The power consumption is accumulated every one second. The power consumption is displayed as in the following.

  a. If it is less than 1,000 kW, use KW as the unit and display as in 999.9 kW.

  b. If it is between 1 and 99 MW, use MW as the unit and display as in 99.99 MWh.

  c. If it is between 100 and 999 MW, use MW as the unit and display as in 999.9 MWh.

  d. If it is more than 1,000 MW, use MW as the unit and display as in 9,999 MWh (up to 65,535 MW).

  e. If it is more than 65,535 MW, it is initialized to 0 and use KW again as the unit and display as in 999.9 kW.

  f. If CNF.62 WH Count Reset is set to YES, the user can clear the power consumption.

■ Select the status display window

Mode	Code number	Function display	Initial settings display		Unit
CNF	20	AnyTime Para	0	Frequency	-

You can select the variable to be displayed at the top of the keypad display (LCD). The items include the followings. The items without description have the same function with the items described in the monitor mode selection items.

Table 7-27 Variables to be displayed at the top of the keypad display

Setting type	Function	Setting type	Function
0	Frequency	14	V2 Monitor[%]
1	Speed	15	I2 Monitor[mA]
2	Output Current	16	I2 Monitor[%]
3	Output Voltage	17	PID Output

Setting type	Function	Setting type	Function
4	Output Power	18	PID Ref Value
5	WHour Counter	19	PID Fbk Value
6	DCLink Voltage	20	Torque
9	V1 Monitor[V]	21	Torque Limit
10	V1 Monitor[%]	23	Speed Limit
13	V2 Monitor[V]		

7.40 Operation Time Monitor[52]

Mode	Code number	Function display	Initial settings display		Unit
CNF	70	On-time	-	0/00/00 00:00	min
CNF	71	Run-time	-	0/00/00 00:00	min
CNF	72	Time Reset	0	No	-
CNF	74	Fan time	-	0/00/00 00:00	min
CNF	75	Fan Time Reset	0	No	-

- **CNF.70 On-time**: When the power is supplied to the inverter, the time is accumulated. The display window shows the following information.

  Year/month/day hour: minute (0/00/00 00: 00)

- **CNF.71 Run-time**: The operation command is inputted and the accumulated time during which the voltage is outputted from the inverter is displayed.

  The information on the display window is the same with the accumulated power supply time (On-time).

- **CNF.72 Time Reset**: If it is set to No.1 Yes, the accumulated power supply time (on-time) and accumulated operation time (run-time) are deleted and 0/00/00 00:00 is displayed.
- **CNF.74 Fan time**: Display the accumulated time during which the inverter cooling fan operates. The information on the display window is the same with the accumulated time of cooling fan operation (On-time).
- **CNF.75 Fan Time Reset**: If it is set to No.1 Yes, the accumulated time of cooling fan operation (on-time) and accumulated operation time (run-time) are deleted and 0/00/00 00:00 is displayed.

[52] Can only be set when the LCD loader is installed.

8. Protection Function

Protection functions provided by LSLV-S100 series are mainly categorized into two types. One is to protect the overheating and damage of the motor, and the other is to protect the inverter itself and prevent malfunction.

8.1 Motor Protection Function

■ Electronic Thermal (Motor Overheating Prevention Function)

Electronic thermal function is a protection function that uses the output current of the inverter without a separate temperature sensor to predict the rise of the motor temperature and protect the motor according to the heat characteristics.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Pr	40	Electronic thermal fault selection	ETH Trip Sel	0	None	0 - 2	-
Pr	41	Motor cooling fan type	Motor Cooling	0	Self-cool	-	-
Pr	42	Electronic thermal 1 minute rating	ETH 1min	150		120 - 200	%
Pr	43	Electronic thermal continuous rating	ETH Cont	120		50 - 150	%

- **Pr.40 ETH Trip Sel**: You can select the inverter motion in case of electronic thermal protection operation. Keypad displays the fault status that says "E-Thermal".
  - 0: None

    Electronic thermal protection function is not activated.
  - 1: Free-Run

    Inverter output is blocked. Motor coasts to a halt (free-run).
  - 2: Dec (Deceleration)

    The inverter decelerates the motor to stop.
- **Pr.41 Motor Cooling**: Selects the drive mode of the cooling fan that is attached to the motor.

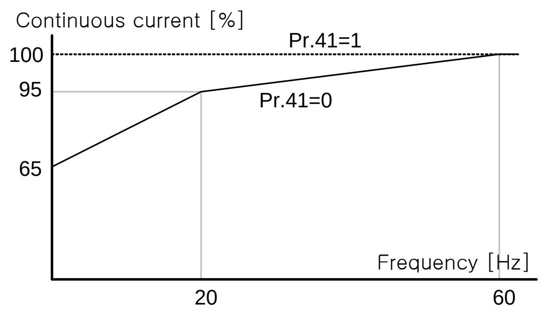


Figure 8-1 Drive mode of the cooling fan

- 0: Self-cool

  Since the cooling fan is connected to the motor axis, cooling effect varies depending on the revolution. Most of the universal induction motor have this structure.

- 1: Forced-cool

  This is a separately excited cooling fan mounted on the motor. This type of cooling is independent of shaft speed and is required for prolonged operation at low-speed and high-torque.

- **Pr.42 ETH 1min**: Input the amount of current that can be continuously supplied to the motor for 1 minute based on motor rated current (bA.13).
- **Pr.43 ETH Cont**: Set the amount of current when electronic thermal protection function is activated. In the range below the set value, it can be continuously operated without protection function.

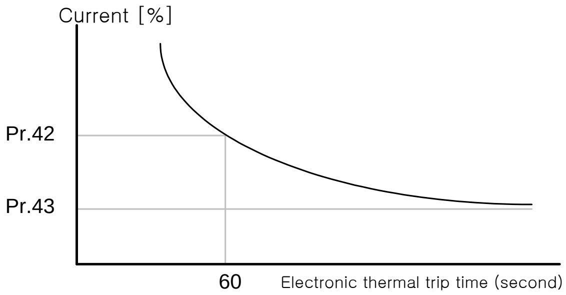


Figure 8-2 Electronic thermal protection function

8.2 Overload Early Warning and Trip

Warning signal and troubleshooting information are provided when the motor reaches the overload based on the rated motor current. The amount of current for warning and troubleshooting can be set respectively.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Pr	04	Load level setting	Load Duty	1	Heavy Duty	-	-
Pr	17	Overload warning selection	OL Warn Select	1	Yes	0 - 1	-
Pr	18	Overload warning level	OL Warn Level	150		30 - 180	%
Pr	19	Overload warning time	OL Warn Time	10.0		0 - 30	sec
Pr	20	Motion at overload fault	OL Trip Select	1	Free-Run	-	-
Pr	21	Overload fault level	OL Trip Level	180		30 - 200	%
Pr	22	Overload fault time	OL Trip Time	60.0		0 - 60.0	sec
OU	31	No motor Motion at detection	Relay 1	5	Over Load	-	-
OU	33	No motor detection delay	Q1 Define				

- **Pr.04 Load Duty**: Select the load level.
  - 0: Normal Duty

    It is used in underloads like fan and pump.

    (Overload tolerance: 120% of rated underload current 1 minute)
  - 1: Heavy Duty

    It is used in heavy loads like hoist, crane and parking device.
    (Overload tolerance: 150% of rated heavy load current 1 minute)
- **Pr.17 OL Warn Select**: In case the overload reaches a warning level, terminal block multi-function output terminal and relay are used to output warning signal. If you select 1 Yes, it will operate. If you select 0 No, it will not operate.
- **Pr.18 OL Warn Level, Pr.19 OL Warn Time**: When the current that is supplied to the motor is larger than the overload warning level (OL Warn Level) and continues during the overload warning time (OL Warn Time), multi-function outputs (Relay 1, Q1) output a warning signal. When Over Load is selected at OU.31 and 33, multi-function output terminal and relay output a signal. Inverter output is not blocked.
- **Pr.20 OL Trip Select**: Selects the inverter motion in case of overload fault.
  - 0: None
    Protection motion for overload fault is not performed.
  - 1: Free-Run
    In case of overload fault, inverter output is blocked and motor performs free-run by inertia.
  - 2: Dec
    The motor decelerates and stops in case of a malfunction.

- **Pr.21 OL Trip Level, Pr.22 OL Trip Time**: When the current that is supplied to the motor is larger than the preset value at overload trip level (OL Trip Level) and continues during the overload trip time (OL Trip Time), inverter output is blocked according to the preset method from Pr. 17 or decelerates then stops.

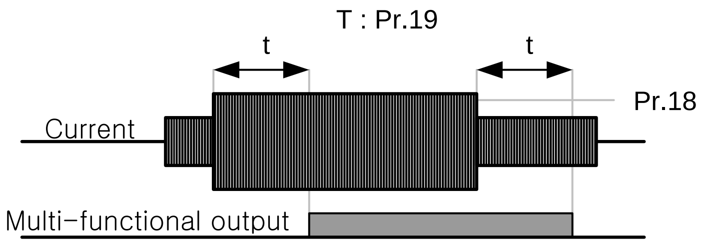


Figure 8-3 Overload warning and troubleshooting

Notes
▪ Overload warning is a function that warns of an overload before overload Trip. Overload warning signal may not work in case of overload trip, if overload warn level (OL Warn Level) and overload warn time (OL Warn Time) are set larger than the overload trip level (OL Trip Level) and overload trip time (OL Trip Time).

8.3 Stall Prevention Function and Flux Braking

If motor stall occurs due to overload, overcurrent is supplied to the motor. This might cause overheating and damage to the motor, and lead the motor load side system to stop operation. In order to protect the motor from overload, the inverter output frequency is automatically adjusted according to the size of load.

■ Flux Braking

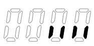
When a faster stopping time is required without using braking resistor and chopper unit.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD display</th><th colspan="2">Setting</th><th>Setting range</th><th>Unit</th></tr>
<tr><td>Pr</td><td>50</td><td>Stall prevention motion and flux braking</td><td>Stall Prevent</td><td colspan="2">0000[53]</td><td>-</td><td>bit</td></tr>
<tr><td>Pr</td><td>51</td><td>Stall frequency 1</td><td>Stall Freq 1</td><td colspan="2">60.00</td><td>Start frequency-Stall Freq 1</td><td>Hz</td></tr>
<tr><td>Pr</td><td>52</td><td>Stall level 1</td><td>Stall Level 1</td><td colspan="2">180</td><td>30 - 250</td><td>%</td></tr>
<tr><td>Pr</td><td>53</td><td>Stall frequency 2</td><td>Stall Freq 2</td><td colspan="2">60.00</td><td>Stall Freq 1 - Stall Freq 3</td><td>Hz</td></tr>
<tr><td>Pr</td><td>54</td><td>Stall level 2</td><td>Stall Level 2</td><td colspan="2">180</td><td>30 - 250</td><td>%</td></tr>
<tr><td>Pr</td><td>55</td><td>Stall frequency 3</td><td>Stall Freq 3</td><td colspan="2">60.00</td><td>Stall Freq 2 - Stall Freq 4</td><td>Hz</td></tr>
<tr><td>Pr</td><td>56</td><td>Stall level 3</td><td>Stall Level 3</td><td colspan="2">180</td><td>30 - 250</td><td>%</td></tr>
<tr><td>Pr</td><td>57</td><td>Stall frequency 4</td><td>Stall Freq 4</td><td colspan="2">60.00</td><td>Stall Freq 3 - Maximum frequency</td><td>Hz</td></tr>
<tr><td>Pr</td><td>58</td><td>Stall level 4</td><td>Stall Level 4</td><td colspan="2">180</td><td>30 - 250</td><td>%</td></tr>
<tr><td rowspan="2">OU</td><td>31</td><td>Multi-function relay 1 item</td><td>Relay 1</td><td rowspan="2">9</td><td rowspan="2">Stall</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>33</td><td>Multi-function output 1 item</td><td>Q1 Define</td></tr>
</table>

When the deceleration time is short, overvoltage trip can occur due to the regenerative energy from the motor. When using flux braking, deceleration time can be set shorter because the regenerative energy is dissipated in the motor.

⚠ Caution

- Stall prevention during deceleration and flux braking functions only operate during deceleration. To achieve the shortest and the most optimal OV Tripless deceleration characteristics for the load with large inertia and short deceleration time, 3rd and 4th bit of Pr.50 (Stall Prevent) should be On.
- Do not use this function when frequent deceleration of the load is required or the motor may overheat and be damaged.

[53] The initial value 0000 will be displayed in SEG as .

- **Pr.50 Stall Prevent**: When accelerating/decelerating and driving at constant speed, stall prevention motion can be selected separately. When the dot mark of the switch is at the top, corresponding bit is set. When it is at the bottom, it does not operate.

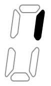
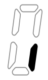
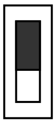
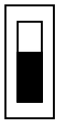
	Bit setting status (On)	Bit setting off state (Off)
Segment		
LCD		

Table 8-1 Stall protection bit setting function

Item				Function
Bit 4	**Bit 3**	**Bit 2**	**Bit 1**	**Right end side of the display is bit 1.**
			✓	Selection of stall protection function during acceleration
		✓		Selection of stall protection function while driving at constant speed
	✓			Selection of stall protection function during deceleration
✓				Selection of flux braking function during deceleration

- 0001: Stall protection during acceleration

  When the amount of inverter output current exceeds the preset stall level (Pr.52, 54 etc,) during acceleration, acceleration stops and then it decelerates. When the amount of current remains above the stall level, it is decelerated to start frequency (dr.19 Start Freq). When the amount of current decelerates to below the preset level while operating the stall protection functions, it accelerates again.

- 0010: Stall protection at constant speed

  Similar to the stall protection function during acceleration, output frequency is automatically decelerated when the amount of current exceeds the preset stall level while driving at a constant speed. When the load current decelerates below the preset level it accelerates again.

- 0100: Stall protection during deceleration

  Inverter decelerates and keeps the DC voltage of the DC supply section below the certain level in order to prevent overvoltage trip during deceleration. Therefore, deceleration time can be longer than the set time depending on the load.

- 1000: Flux braking function during deceleration

  When using flux braking, deceleration time can be set shorter because the regenerative energy is spent at the motor.

- 1100: Stall protection during deceleration + flux braking

  Stall protection function and flux braking operate together during deceleration to achieve the shortest and the optimal deceleration characteristics.

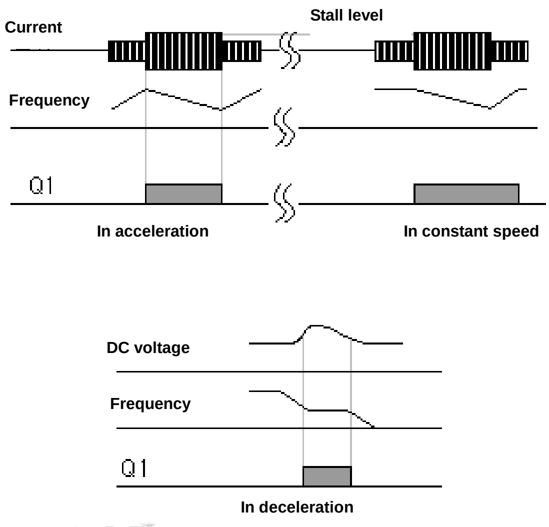


Figure 8-4 Stall protection during acceleration, deceleration and at a constant speed

⚠ Caution
▪ Be careful as the deceleration time can be longer than the set time depending on the load when stall protection function is set during deceleration. ▪ Acceleration stops when stall protection function operates during acceleration. This might increase the actual acceleration time longer than the preset acceleration time.

- **Pr.51 Stall Freq 1 - Pr.58 Stall Level 4**: Separate stall protection level can be set for different frequency depending on the types of the load. As shown in the figure below, stall level can be set above the base frequency. Lower limit and upper limit are set in the order of the number of stall frequency. For example, set range for Stall Freq 2 (Stall Frequency 2) becomes a lower limit for Stall Freq 1 (Stall Frequency 1), an upper limit for Stall Freq 3 (Stall Frequency 3).

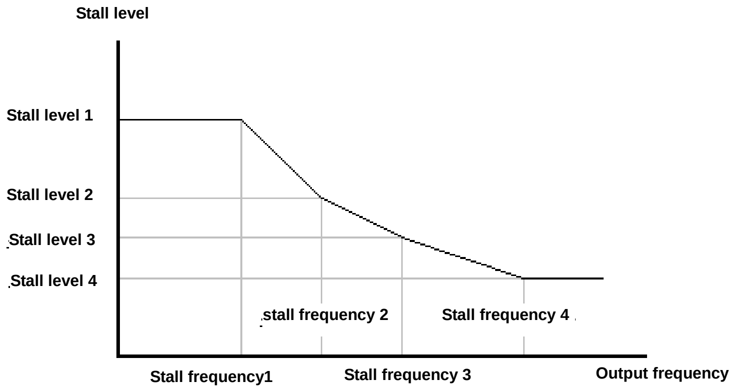


Figure 8-5 Stall level setting

⚠ Caution
▪ Regardless of other stall set levels, when stall protection function operates, everything is decided by stall level 1 at the start.

8.4 Inverter and Sequence Protection Function

■ Open-phase Protection of Input and Output

Open-phase protection function for input is used to prevent overcurrent of the inverter input part caused by open-phase of input power. As open-phase at the connection between the motor and inverter output might cause motor stall by the lack of torque, open-phase protection function for output is also used.

Group	Code	Name	LCD display	Setting	Setting range	Unit
Pr	05	Input/output open-phase protection	Phase Loss Chk	00[54]	-	Bit
Pr	06	Open-phase of input voltage band	IPO V Band	40	1 - 100 V	V

Open-phase for input and output can be selected respectively. When the dot mark of the switch is at the top, corresponding bit is set. When it is at the bottom, it does not operate. (Top: 1, Bottom: 0)

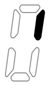
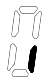
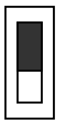
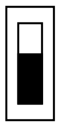
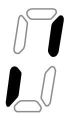
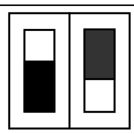
	Bit setting status (On)	Bit setting off state (Off)
Segment		
LCD		

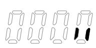
Table 8-2 Input/output open-phase protection bit function

Item		Function
Bit 2	Bit 1	Right end side of the display is bit 1.
	✓	Protection operation for output open-phase is selected.
✓		Protection operation for input open-phase is selected.
✓	✓	Protection operation for input and output open-phase is selected.

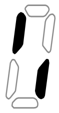
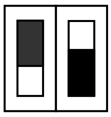
- Open-phase protection of output

	Output open-phase bit setting
Segment	
LCD	

If more than one out of U, V, and W of inverter output terminal blocks are open-phase, inverter blocks the output and Out Phase Open is displayed.

[54] The initial value 00 will be displayed in SEG as .

- Open-phase protection of input

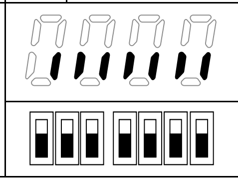
	Output open-phase bit setting
Segment	
LCD	

If one of the incoming phases to R, S, or T power terminals is missing the inverter output switches off and ‘Phase Open’ is displayed on keypad. Protection for input open-phase only operates when a certain amount (70 to 80% of inverter rated output current) of current is supplied to the motor.

Pr.06: **IPO V Band**: If an incoming phase is missing or one or more phases are at too low level the DC link ripple voltage can be significant and can damage the DC link capacitors. Input open-phase trip occurs if the band of the ripple voltage set in this function code is exceeded. IPO V Band varies depending on the power supply facility environment. When the amount of output load exceeds the capacity of the power supply facility causing input open-phase trip during normal operation, IPO V Band should be set at a value greater by from 1 to 10. When the amount of output load is less than the capacity of the power supply facility IPO V Band should be set at a value smaller by from 1 to 10.

Notes
▪ Set the motor rated current (bA. 13 Rated Curr) correctly. When the rated current of the motor in-use and the set value of bA. 13 are different, open-phase protection might not operate. ▪ When the load is high and the input voltage supplied to the inverter is small, low voltage protection function (Low Voltage) can operate before the operation of input open-phase protection function. In this case, use the low voltage protection function 2 (Low Voltage 2) to more precisely find out the input open-phase. For more details, please refer to 11. Troubleshooting and Inspection Item.

8.5 External Fault Signal

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	4	External Trip	-	-
In	87	Selection of multi-function input contact	DI NC/NO Sel			-	Bit

When using No. 4 External Trip (External fault) among multi-function input terminal functions, the operation of the inverter can be stopped if an external fault occurs.

- **In.87 DI NC/NO Sel**: You can select the type of the input contact. If the dot mark of the switch is at the bottom (0), it operates as A contact (Normal Open). If the mark is at the top (1), it operates as B contact (Normal Closed).

Corresponding terminal for each bit is as follows:

Bit	11	10	9	8	7	6	5	4	3	2	1
Multi-function Terminal					P7	P6	P5	P4	P3	P2	P1

Figure 8-6 Corresponding terminal for each bit

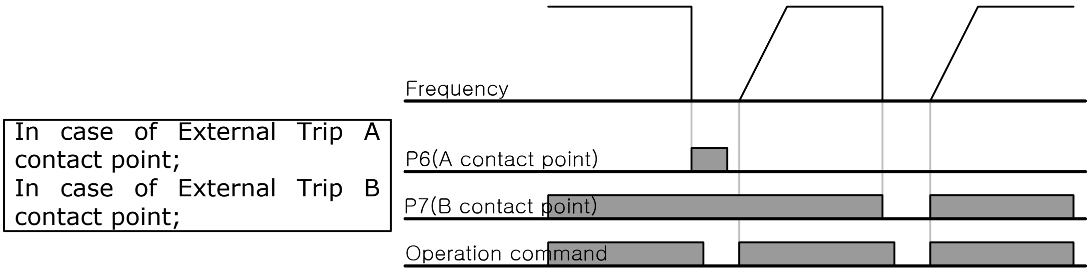


Figure 8-7 Selection of the type of input contact

8.6 Inverter Overload

When the inverter output current exceeds the motor rated current, the protection operates to protect the inverter according to the characteristics in case of inverse proportion.

Group	Code	Name	LCD display	Setting		Setting range	Unit
OU	31	Multi-function relay 1 item	Relay 1	6	IOL	-	-
OU	33	Multi-function output 1 item	Q1 Define				

Warning signal can be output in advance using the multi-function output terminal before inverter overload protection function (IOLT) operates. When it reaches 60% of accumulated time (150%, 36 sec) to operate inverter overload protection operation (150%, 1 min), warning signal is output.

8.7 Command Loss

■ Speed Command Loss

Setting speed via analog input of the terminal block, communication option, or keypad etc., you can select the motion of inverter in case speed command is lost due to signal cable disconnection and so on.

Group	Code	Name	LCD display	the speed command		Setting range	Unit
Pr	12	Motion at speed command loss	Lost Cmd Mode	1	Free-Run	-	-
Pr	13	Time to judge speed command loss	Lost Cmd Time	1.0		0.1 - 120	sec
Pr	14	Operation frequency at speed command loss	Lost Preset F	0.00		Start frequency - Max. frequency	Hz
Pr	15	Analog input loss judgement level	AI Lost Level	0	Half of x1	-	-
OU	31	Multi-function relay 1 item	Relay 1	13	Lost Command	-	-
OU	33	Multi-function output 1 item	Q1 Define				

Pr.12 Lost Cmd Mode: In case of speed command loss, inverter motion is selected.

Table 8-3 Inverter motion setting in case of speed command loss XML

Item		Function
0	None	Speed command immediately becomes operation frequency without protective operation.
1	Free-Run	Inverter blocks output. Motor performs free-run.
2	Dec	Motor decelerates and then stops to time set at Pr.07 Trip Dec Time.
3	Hold Input	For 10 seconds until judging the speed command loss, it keeps operating at an input average value.

Item		Function
4	Hold Output	For 10 seconds until judging the speed command loss, it keeps operating at an output average value.
5	Lost Preset	Inverter operates at the frequency set at Pr. 14 Lost Preset F.

Pr.15 AI Lost Level, Pr.13 Lost Cmd Time: Set the voltage and judgment time based on speed command loss regarding analog input.

- 0: Half of x1

  Protective operation starts when the input signal is reduced to half of initial set value of analog input set with speed command (Frq code of operation group) and continues during the time set at Pr. 13 Lost Cmd Time (speed loss judgment time). Values set at In.08 and In.12 of terminal block input group are the standard. For example, set speed command to 2 V1 at Frq code of operation code, In.06 V1 Polarity to 0 Unipolar and voltage input to the half amount of the value set at In.08 V1 Volt x 1, then protective operation is activated.

- 1: Below of x1

  Protective operation starts when the signal becomes smaller than the initial set value of analog input set with speed command continues during the time set at Pr.13 Lost Cmd Time (speed loss judgment time). In.08 and In.12 of terminal block input group are standard value.

- **Pr.14 Lost Preset F**: In case of speed command loss, set the operation method (Pr.12 Lost Cmd Mode) to 5 Lost Preset, then protection function operates and sets the frequency for further operation.

  Set Pr.15 Al Lost Level to 1 Below x 1, Pr.12 Lost Cmd Mode to 2 Dec, Pr.13 Lost Cmd Time to 5 sec, then it will operate as follows:

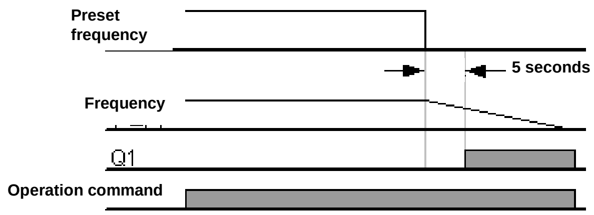


Figure 8-8 Set Pr.15 Al Lost Level to 1, Pr.12 Lost Cmd Mode to 2, Pr.13 Lost Cmd Time to 5 sec

In case of speed command loss due to option card and internal 485, protection function operates when there is no speed command during the time set at Pr.13 Lost Cmd Time (speed loss judgment time).

8.8 Usage Setting of Dynamic Braking (DB) Resistor

For S100 series, braking circuit is integrated inside the inverter body.

<table>
<tr><th>Group</th><th>Code</th><th>Name</th><th>LCD display</th><th colspan="2">Setting</th><th>Setting range</th><th>Unit</th></tr>
<tr><td>Pr</td><td>66</td><td>DB resistor warning level</td><td>DB Warn %ED</td><td colspan="2">10</td><td>0 - 30</td><td>%</td></tr>
<tr><td>OU</td><td>31,</td><td>Multi-function relay 1 item</td><td>Relay 1</td><td rowspan="2">31</td><td rowspan="2">DB Warn %ED</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>OU</td><td>33</td><td>Multi-function output 1 item</td><td>Q1 Define</td></tr>
</table>

- **Pr.66 DB Warn %ED**: Set braking resistor usage (%ED: Duty). Braking resistor usage sets the rate at which braking resistor operates within 1 operation cycle. Maximum time for continuous braking resistor is 15 seconds, braking resistor usage signal is not output from inverter when it exceeds 15 seconds.

⚠ Caution

- Use correct resistor power rating (Watts) as overheating and fire can occur if overloaded. When using the resistor with heat sensor, sensor output can be used as external fault signal of inverter multi-function input.

Example 1)

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

- T_acc: Acceleration time to set frequency
- T_steady: Operation time in constant speed at set frequency
- T_dec: Deceleration time to frequency lower than constant speed operation
- or stop time from constant speed operation frequency
- T_stop: Stop time until it starts operating again

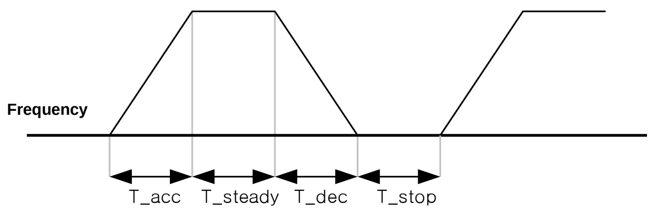


Figure 8-9 Example 1 of setting braking resistor usage

Example 2)

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

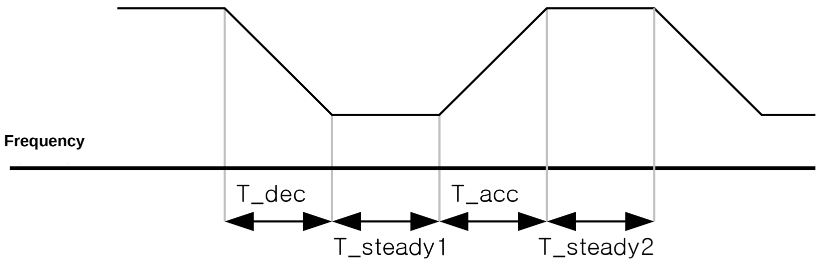


Figure 8-10 Example 2 of setting braking resistor usage

8.9 Underload Warning and Fault

Group	Code number	Function display	Setting display		Setting range	Unit
Pr	04	Load Duty	0	Normal Duty	-	-
Pr	25	UL Warn Sel	1	Yes	0 - 1	-
Pr	26	UL Warn Time	10.0		0 - 600	sec
Pr	27	UL Trip Sel	1	Free-Run	-	-
Pr	28	UL Trip Time	30.0		0 - 600	sec
Pr	29	UL LF Level	30		10 - 100	%
Pr	30	UL BF Level	30		10 - 100	%

- **Pr.27 UL Trip Sel**: In case of underload fault, set the operation method for inverter. If this is set to No. 1 Free-Run, output is blocked in underload fault situation. If this is set to No. 2 deceleration (Dec), the motor decelerates and stops.
- **Pr.25 UL Warn Sel**: Select underload warning. If you set multi-function output terminal from OU.31 and 33 of terminal output group to No. 7 UnderLoad, signal is output in underload warning condition.
- **Pr.29 UL LF Level, Pr.30 UL BF Level**: Set the range necessary for underload detection depending on the type of load.

  Set underload rate at twice the operation frequency of motor rated slip speed (bA.12 Rated Slip) at Pr.27.

Underload upper limit level

Underload lower limit level

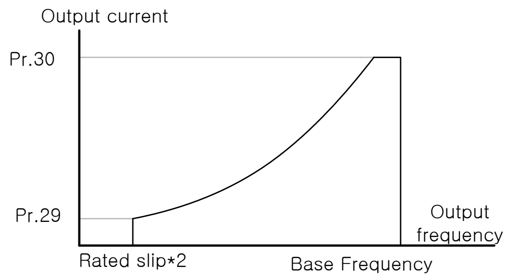


Figure 8-11 Setting underload rate (normal duty)

Set underload rate at base frequency (dr.18 Base Freq) at Pr.28. When variable torque is required like fan and pump, set Pr.04 Load Duty (load rate) to 0 Normal Duty (normal load rate). In case of No. 1 Heavy Duty (heavy load rate), set it at the load operated at constant torque like elevator and conveyor.

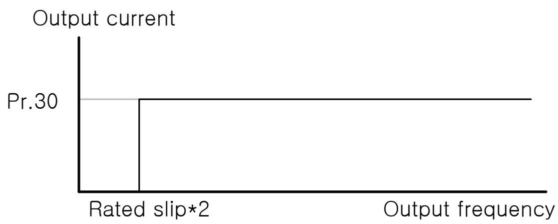


Figure 8-12 Setting Heavy load rate (heavy duty)

- **Pr.26 UL Warn Time, Pr.28 UL Trip Time**: Protection function operates when underload level condition explained above is maintained during set warning time or fault time. This function does not operate in case of energy saving operation (Ad.50 E-Save Mode).

8.10 Fan Fault Detection

Group	Code	Name	LCD display	Setting		Setting range	Unit
Pr	79	Cooling fan fault selection	FAN Trip Mode	0	Trip		-
OU	31	Multi-function relay 1 item	Relay 1	8	FAN Warning		-
OU	33	Multi-function output 1 item	Q1 Define				

When Pr.79 cooling fan fault mode is set to No. 0 Trip, inverter output is blocked and fan fault is displayed when cooling fan error is detected. When it is set to No. 1 Warning and multi-function output terminal or relay to No. 8 FAN Warning is selected, fan error signal is output and operation continues. However, when inside temperature of the inverter rises above a certain temperature, output is blocked due to heat sink overheat.

8.11 Selection of Operation in Case of Low Voltage Fault

Group	Code	Name	LCD display	Setting		Setting range	Unit
Pr	81	Low voltage fault judgement delay time	LVT Delay	0.0		0 - 60	sec
OU	31	Multi-function relay 1 item	Relay 1	11	Low Voltage		-
OU	33	Multi-function output 1 item	Q1 Define				

When inverter input power is lost and internal DC link voltage drops below the trip threshold, inverter stops output and Low Voltage fault is displayed. When Pr.81 LVT Delay is set and low voltage fault occurs, inverter blocks output and fault occurs after a set time is passed. Warning signal for low voltage fault can be output using multi-function output or relay. However, LVT Delay time does not apply for warning signal.

8.12 Output Block by Multi-Function Terminal

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	5	BX	-	-

When the operation of multi-function input terminal is set to No. 5 BX and it is turned on during operation, inverter blocks output and BX is displayed on the keypad display. In case of BX input, information such as frequency and current etc. can be monitored. If BX terminal turns Off when operation command is input, the motor accelerates again.

8.13 Fault Status Reset Method

Group	Code	Name	LCD display	Setting		Setting range	Unit
In	65 - 71	Setting Px terminal function	Px Define (Px: P1 - P7)	3	RST		-

In order to reset fault status, press Reset key on the keypad or use multi-function input terminal. Fault status is reset when the function of multi-function input terminal is set to No. 3 RST and terminal is turned On after a trip condition.

8.14 Selection of Operation in the case of Option Card Fault

Group	Code	Name	LCD display	Setting		Setting range	Unit
Pr	80	Motion selection at option trip	Opt Trip Mode	0	None	0 - 3	-
				1	Free-Run		
				2	Dec		

Select the operation status of inverter when communication error between option card and inverter body occurs or option card is detached during operation. In case of No. 1 Free-Run, inverter output is blocked and fault information is displayed on the keypad. In case of No. 2 Dec, the motor decelerates to the value set at Pr.07 Trip Dec Time.

8.15 Detection of Motor Disconnection at Inverter Output Terminal

Group	Code	Name	LCD display	Setting		Setting range	Unit
Pr	31	Operate under no motor detection	No Motor Trip	0	None	-	-
Pr	32	No motor detection current level	No Motor Level	5		1 - 100	%
Pr	33	No motor detection delay	No Motor Time	3.0		0.1 - 10	sec

If operation command is issued when motor is disconnected from the inverter output terminal, No Motor Trip occurs and protective operation is performed by the system. When output current of the inverter is continued for Pr.33 No Motor Time below Pr.32 No Motor Level compared to rated current (bA.13), No Motor Trip occurs.

⚠ Caution

- Set Pr.32 No Motor Level below the factory default value in case bA.07 V/F Pattern is set to No. 1 Square. Otherwise, No Motor Trip might occur due to lack of output current under No Motor Trip operation.

8.16 Fault / Warning List

Table 8-4 Fault / Warning list

Category		Keypad Display	Trip details
Major fault	Latch type	Over Current1	Overcurrent trip
		Over Voltage	Overvoltage trip
		External Trip	Trip due to external signal
		NTC Open	Temperature sensor trip
		Over Current2	Arm short current trip
		Option Trip-x[55]	Option trip
		Over Heat	Overheat trip
		Out Phase Open	Output open-phase trip
		In Phase Open	Input open-phase trip
		Inverter OLT	Inverter overload trip
		Ground Trip	Ground fault trip
		Fan Trip	Fan trip
		E-Thermal	Motor overheat trip
		Pre-PID Fail	Pre-PID operation failure
		IO Board Trip	IO Board connection trip
		Ext-Brake	External brake trip
		No Motor Trip	No Motor trip
		Low Voltage 2	Low voltage trip during operation
		ParaWrite Trip[56]	Write parameter trip
	Level type	Low Voltage	Low voltage trip
		BX	Emergency stop trip
		Lost Command	Command loss trip
		Safety A(B) Err	Safety A (B) contact trip
	Hardware damage	EEP Err	External memory error
		ADC Off Set	Analog input error
		Watch Dog-1	CPU Watch Dog trip
		Watch Dog-2	
Minor fault		Over Load	Motor overload trip
		Under Load	Motor underload trip
Warning		Lost Command	Command loss trip warning
		Over Load	Overload warning
		Under Load	Underload warning
		Inverter OLT	Inverter overload warning
		Fan Warning	Fan operation warning
		DB Warn %ED	Braking resistor braking rate warning
		Retry Tr Tune	Rotor time constant tuning error

[55] Only applies when option board is used.

[56] Only applies when LCD Loader is used.

9. RS-485 Communication Function

9.1 Introduction of Communication Function

This user manual explains the standards, installation and programs of the serial communication of the LSLV-S100 inverter for communicating with PC or FA computer. Communication method for LSLV-S100 inverter is designed to operate or monitor LSLV-S100 series inverter from long distance using CPU or FA computer (below).

■ Advantages Using Communication Method

Since the inverter can be operated or monitored by a user-programmed PC or PLC, it is easily applicable to factory automation.

- Changing or monitoring parameter by computer is possible.
  (Ex: Acc/Dec Time, Frequency Command, etc.)
- Interface type of RS-485 standards:
  - **a.** Communication between inverter and computers of various companies is possible.
  - **b.** Since it is multi-drop link system, single computer can control up to 16 inverters simultaneously.
  - **c.** Highly immune to electro-magnetic interference.

The inverter is capable of communicating with the RS-232 card integrated computer via commonly sold RS-232/485 converter. Specifications and performance of converter vary depending on the manufacturer, but basic functions are identical. Please refer to user manual of the manufacturer for details about specifications and usage method.

⚠ Caution
▪ Read this manual carefully before you install or run the inverter.
▪ Failure to comply with this manual may result in injury or damage to other instruments.
▪ Make sure to connect PLC and inverter SG. Communication error by noise might occur.

9.1.1 Communication Standard

Table 9-1 Communication standard

Item	Standard
Communication method	RS-485
Transmission type	Bus type, Multi drop Link System
Inverter type name	LSLV-S100 series
Number of connected inverters	Maximum 16
Transmission distance	Maximum 1,200 m (Recommended distance: within 700 m)
Recommended wires	0.75 mm^2 (18AWG), Shield Type Twisted-Pare Wire
Installation type	Connect to the dedicated terminal (S+, S-, SG) of control terminal block
Power supply	Use the insulated power from the interior of the inverter as the power supply (supplied by the inverter).
Communication speed	Can be selected among 1,200/2,400/9,600/19,200/38,400/57,600/115,200 bps
Control procedure	Asynchronous communications system
Communication system	Half duplex system
Letter system	Modbus-RTU: Binary, LS Bus: ASCII
Stop bit length	1-bit / 2-bit
Frame error check	2 bytes
Parity check	None/Even/Odd

9.1.2 Communication System Configuration

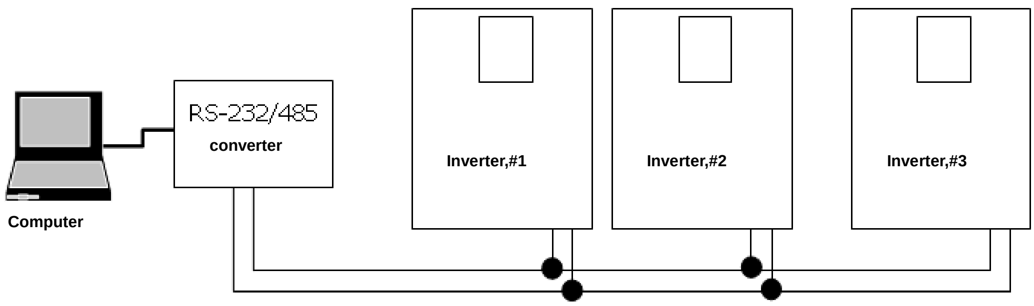


Figure 9-1 Communication system configuration

RS-485 terminal connection: Connect to S+, S-, and SG (Shield line) of terminal block. (Refer to chapter 4 Wiring (page 4-3))

Number of inverters that can be connected: Maximum 16

Number of settable stations (CM.01 Int485 St ID): 1 - 250

Allowed communication line length: Total extension length is 1,200 m, but keep within 700 m for stable communication.

Please use repeater in order to enhance the existing communication speed when using communication line longer than 1,200 m or increasing the number of devices. Repeater is effective when smooth communication is not available due to noise.

9.1.3 Default Setting

Group	Code	Name	LCD display	Setting		Setting range	Unit
CM	01	Built-in communication inverter ID	Int485 St ID	1		1 - 250	-
CM	02	Built-in communication protocol	Int485 Proto	0	ModBus RTU	0, 2	-
CM	03	Built-in communication speed	Int485 BaudR	3	9600 bps	0 - 7	-
CM	04	Built-in communication frame setting	Int485 Mode	0	D8 / PN / S1	0 - 3	-
CM	05	Transmission delay after reception	Resp Delay	5		0 - 1000	msec

CM.01 Int485 St ID: Set inverter station ID.

CM.02 Int485 Proto: Built-in protocol is Modbus-RTU(0) / LS INV 485(2).

Table 9-2 Built-in protocol

Number	Display	Contents
0	Modbus-RTU	Modbus-RTU compatible protocol
2	LS INV 485	Dedicated protocol for LS inverter

CM.03 Int485 BaudR: Set communication speed. Can be set up to 115,200 bps.

Number	Display
0	1200 bps
1	2400 bps
2	4800 bps
3	9600 bps
4	19200 bps
5	38400 bps
6	56 Kbps
7	115 Kbps[57]

CM.04 Int485 Mode: Select communication frame configuration. Set data length, parity check method, and the number of stop bits.

Number	Display	Contents
0	D8 / PN / S1	8-bit data / parity check not done / one stop bit
1	D8 / PN / S2	8-bit data / parity check not done / two stop bits
2	D8 / PE / S1	8-bit data / even number parity check / one stop bit
3	D8 / PO / S1	8-bit data / odd number parity check / one stop bit

[57] Means 115,200 bps.

CM.05 Resp Delay: 485 communication (Modbus-RTU or LS INV 485) integrated in S100 works as slave. S100, as a slave, responds to the master only after the time set in this function code. It is used in a system in which master cannot deal with fast response of slave. Set this function code to appropriate value for smooth master-slave communication.

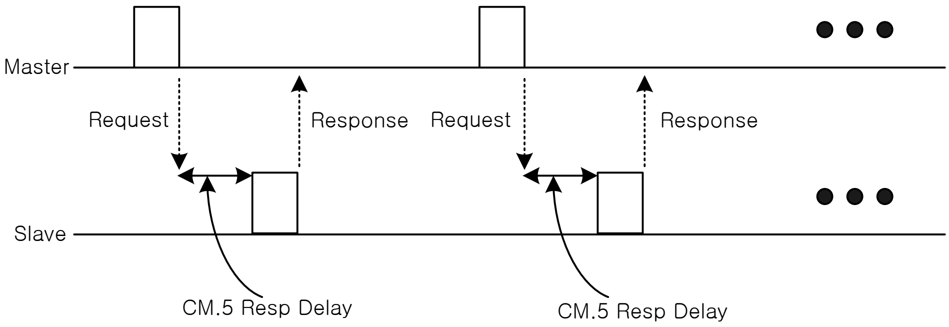


Figure 9-2 CM.05 Resp Delay

9.1.4 Setting Operation Command and Frequency

Group	Code	Name	LCD display	Setting		Setting range	Unit
Operation	drv	Operation command method	Cmd Source	3	Int 485	0 - 4	-
Operation	Frq	Frequency setting method	Freq Ref Src	6	Int 485	0 - 12	-

Select **drv, Frq** of the operation group to No. 3 and 6 Int 485 like above. Then operation command and frequency for parameter in common area can be set via communication function.

9.1.5 Command Loss Protective Operation

Set judging standard and protective operation in case of communication problem during certain time.

Group	Code	Name	LCD display	Setting		Setting range	Unit
Pr	12	Motion at speed command loss	Lost Cmd Mode	1	Free-Run	0 - 5	-
Pr	13	Time to judge speed command loss	Lost Cmd Time	1.0		0.1 - 120 [s]	sec
Pr	14	Operation frequency at speed command loss	Lost Preset F	0.00		Start frequency - Maximum frequency [Hz]	Hz
OU	31	Multi-function relay 1 item	Relay 1	13	Lost Command	0 - 35	-
OU	33	Multi-function output 1 item	Q1 Define				

Pr.12 Lost Cmd Mode, Pr.13 Lost Cmd Time: Select the motion of the inverter when communication error occurred during the time set at Pr.13.

Table 9-3 Selection of inverter motion in case of communication error

Item		Function
0	None	Speed command immediately becomes operation frequency without protective operation.
1	Free-Run	Inverter blocks output. Motor performs free-run.
2	Dec	It decelerates and stops.
3	Hold Input	Operation continues at input speed command until it reaches speed loss.
4	Hold Output	Operation continues at operation frequency before speed loss.
5	Lost Preset	It is operated at the frequency set at Pr. 14 Lost Preset F.

9.1.6 Setting Virtual Multi-Function Input

Group	Code	Name	LCD display	Setting		Setting range	Unit
CM	70 - 77	Communication multi-function input x	Virtual DI x (x: 1-8)	0	None	0 - 49	-
CM	86	Communication multi-function input monitoring	Virt DI Status	-	-	-	-

CM.70 - 77: Can control multi-function input by communication (common area 0h0385: refer to page 9-27).

Function set for each bit operates when desired function at CM.70 to 77 are set and BIT value of the desired function set to 1 at 0h0322. Set operation group drv according to the operation command source. For example, if you want to send Fx command by controlling virtual multi-function input common area via Int485, set CM.70 Virtual Dl 1 to FX and give 0h0001 to 0h0322 area. Then, FX function operates.

Operates independent of In.65 - 71 Px Define and cannot be set redundantly. Can easily check virtual multi-function input at CM.86 Virt Dl Status.

9.1.7 Cautions When Setting Parameters via Communication[58]

Group	Code	Name	LCD display	Setting		Setting range	Unit
CNF	48	48	Parameter Save	0	No	0 - 1	-
				1	Yes		-

Set common area parameters, keypad parameters or drive control via communication. Then, restart the inverter. The settings return to previous value.

Set No. 1 Yes at CNF.48 Parameter Save and all set values are saved in the inverter. This set value is maintained even if you remove power from the inverter.

[58] Can only be set when the LCD loader is installed.

Set 0 to 0h03E0 address via communication and to 1, then all parameter values set currently are saved in the inverter. This set value is maintained even if you restart the inverter. However, it does not work if you reset to 0 from 1.

9.1.8 Setting Special Communications Area

■ Total Memory Map for S100 Communication

Table 9-4 Total memory map for S100 communication

Communication area	Memory map	Details
5 series compatible communication common area	0h0000 - 0h00FF	iS5, iP5A, iV5, iG5A compatible area
Parameter registration type area	0h0100 - 0h01FF	Areas registered at CM.31 - 38 and CM.51 - 58
	0h0200 - 0h023F	Area registered for User Group
	0h0240 - 0h027F	Area registered for Macro Group
	0h0280 - 0h02FF	Reserved
S100 communication common area	0h0300 - 0h037F	Inverter monitoring area
	0h0380 - 0h03DF	Inverter control area
	0h03E0 - 0h03FF	Inverter memory control area
	0h0400 - 0h0FFF	Reserved
	0h1100	dr Grp
	0h1200	bA Grp
	0h1300	Ad Grp
	0h1400	Cn Grp
	0h1500	In Grp
	0h1600	OU Grp
	0h1700	CM Grp
	0h1800	AP Grp
	0h1B00	Pr Grp
	0h1C00	M2 Grp

9.1.9 Parameter Group for Periodic Data Transmission

Can communicate using communication address registered at communication function group (CM). It is convenient since it communicates using various parameters as a communication frame at the same time.

Group	Code	Name	LCD display	Setting		Setting range	Unit
CM	31 - 38	Output communication address x	Para Status-x	-	-	0000 - FFFF	Hex
CM	51 - 58	Input communication address x	Para Control-x	-	-	0000 - FFFF	Hex

■ x : 1 - 8

- **Communication address 0h0100 - 0h0107**: Can read data value of the parameter corresponding to communication code registered at CM.31 -38 Status Para x. (Read-only)
- **Communication address 0h0110 - 0h0117**: Can write and read data value of the parameter corresponding to communication code registered at CM.51 - 58 Control Para x. (Can read / write)

Table 9-5 0h0100 - 0h0117: Currently registered CM Grp parameter

Address	Parameter	Assigned content by bit
0h0100	Status Parameter-1	Parameter communication code value registered at CM.31
0h0101	Status Parameter-2	Parameter communication code value registered at CM.32
0h0102	Status Parameter-3	Parameter communication code value registered at CM.33
0h0103	Status Parameter-4	Parameter communication code value registered at CM.34
0h0104	Status Parameter-5	Parameter communication code value registered at CM.35
0h0105	Status Parameter-6	Parameter communication code value registered at CM.36
0h0106	Status Parameter-7	Parameter communication code value registered at CM.37
0h0107	Status Parameter-8	Parameter communication code value registered at CM.38
0h0110	Control Parameter-1	Parameter communication code value registered at CM.51
0h0111	Control Parameter-2	Parameter communication code value registered at CM.52
0h0112	Control Parameter-3	Parameter communication code value registered at CM.53
0h0113	Control Parameter-4	Parameter communication code value registered at CM.54
0h0114	Control Parameter-5	Parameter communication code value registered at CM.55
0h0115	Control Parameter-6	Parameter communication code value registered at CM.56
0h0116	Control Parameter-7	Parameter communication code value registered at CM.57
0h0117	Control Parameter-8	Parameter communication code value registered at CM.58

⚠ Caution

- When registering parameter to Control Parameter, set operation speed (0h0005,0h0380,0h0381) and operation command (0h0006, 0h0382) parameter to the backmost of the Para Control Frame. That is, set operation speed and command to the highest number of Para Control-h.

  (e.g., when Para Ctrl Num is 5, set operation speed to Para Control-4 and operation command to Para Control-5.)

9.1.10 Parameter Group for U&M Mode User and Macro Grp Transmission[59]

Can communicate using USG Grp. and MAC Grp. communication address registered at U&M mode.

- **U&M>USR → 1 - 64 User Grp. Para h**: USR parameter registered at keypad can be read/write via communication address 0h0200 to 0h023F.
- **U&M>MAC → 1 - 64 Macro Grp. Para h**: Macro parameter set at keypad can be read/write via 0h0240 to 0h02A3.

Table 9-6 0h0200 - 0h023F: Currently registered User Grp parameter

Address	Parameter	Assigned content by bit
0h0200	User Grp. Code 1	Parameter value registered at U&M > USR → 1
0h0201	User Grp. Code 2	Parameter value registered at U&M > USR → 2
. . .	. . .	. . .
0h023E	User Grp. Code 63	Parameter value registered at U&M > USR → 1
0h023F	User Grp. Code 64	Parameter value registered at U&M > USR → 2

Table 9-7 0h0240 - 0h02A3: Currently registered Macro Grp parameter

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

[59] Can only be set when the LCD loader is installed.

9.2 Communication Protocol

9.2.1 LS INV 485 Protocol

The computer or other host is the master, while the inverter is the slave. The inverter, which is the slave, responds to the Read/Write commands issued by the master.

■ Basic Configuration

- 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 * 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

- Details:
  - 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 inverter number and is displayed as 2 byte ASCII-HEX.
  - (ASCII-HEX: hexadecimal display using '0' to '9' and 'A' to 'F'.)
  - CMD: Use capital letter (IF Error in case of small letter)

Table 9-8 CMD: Using capital letter

Character	ASCII-HEX	Command
'R'	52h	Read
'W'	57h	Write
'X'	58h	Request monitor registration
'Y'	59h	Perform monitor registration

  - Data: ASCII-HEX

    Ex) When data value is 3000: 3000 → '0"B"B"8'h → 30h 42h 42h 38h
  - Error code: 2 displayable ASCII (20h - 7Fh)
  - Transmission/reception buffer size: Transmission = 39 bytes, Reception = 44 bytes
  - Monitor registration buffer: 8 Words
  - SUM: Check communication error via sum.

- SUM = Lower 8 bits of (Station ID + CMD + Data) in ASCII-HEX
  Ex) In case of a command to read 1 content from 3000 address like below

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

- SUM = ‘0’ + ‘1’ + ’R’ + ‘3’ + ‘0’ + ‘0’ + ‘0’ + ‘1’

  = 30h + 31h + 52h + 33h + 30h + 30h + 30h + 31h

  = 1**A7**h (Control value is not included: ENQ, ACK, NAK, etc.)

  SUM becomes A7h since lower 1 byte is taken from SUM.

- BroadCast function

  Used when giving a simultaneous command to all inverters connected in network.

  - Method: Give a command via station ID 255.
  - Operation: Each inverter deals with it regardless of set station ID (No response is issued, however)

9.2.2 Detailed Read Protocol

- Read request: In case of read command of successive n words from XXXX address

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, Quotation marks (‘ ‘) indicate character.

- Read normal response:

ACK	Station ID	CMD	Data	SUM	EOT
06h	‘01’ - ‘FA’	‘R’	‘XXXX’	‘XX’	04h
1 byte	2 bytes	1 byte	N * 4 bytes	2 bytes	1 byte

Total bytes = 7 * n * 4 = Maximum 39

- Read error response:

NAK	Station ID	CMD	Error code	SUM	EOT
15h	‘01’ - ‘FA’	‘R’	‘**’	‘XX’	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes = 9

9.2.3 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 * 4 bytes	2 bytes	1 byte

Total bytes = 12 + n * 4 = Maximum 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 * 4 bytes	2 bytes	1 byte

Total bytes = 7 + n * 4 = Maximum 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

9.2.4 Monitor Registration Detailed Protocol

■ Monitor Registration

- Monitor registration request:

  Monitor registration is a function that designates data which needs continuous monitoring and updates data periodically.

  In case of registration request for n addresses (do not need to be continuous)

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 * 4 bytes	2 bytes	1 byte

  Total bytes = 8 + n * 4 = Maximum 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

Perform monitor registration

- Monitor registration perform request:

  Data read request of address registered via 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 perform normal response:

ACK	Station ID	CMD	Data	SUM	EOT
06h	‘01’ - ‘FA’	‘Y’	‘XXXX…’	‘XX’	04h
1 byte	2 bytes	1 byte	n * 4 bytes	2 bytes	1 byte

Total bytes = 7 + n * 4 = Maximum 39

- Monitor registration perform 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

Error Code

Table 9-9 Error code

Code	Abbreviation	Description
01: ILLEGAL FUNCTION	IF	Received function cannot be performed at slave. That is, the corresponding function does not exist.
02: ILLEGAL DATA ADDRESS	IA	Received parameter address is invalid at slave.
03: ILLEGAL DATA VALUE	ID	Received data is invalid at slave.
21: WRITE MODE ERROR	WM	Read only or change prohibition during operation
22: FRAME ERROR	FE	Different frame size or Num

■ ASCII 코드

Table 9-10 ASSCII code

Caracter	Hex	Caracter	Hex	Caracter	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

9.2.5 Modbus-RTU Protocol

■ Function code and protocol (unit: byte)

- Function Code #03 (Read Holding Register)

<Query>	<Response>
Field Name	**Field Name**
Slave Address	Slave Address
Function(0x03)	Function(0x03)
Starting Address Hi	Byte Count
Starting Address Lo	Data Hi
# of Points Hi	Data Lo
# of Points Lo	…
CRC Lo	…
CRC Hi	Data Hi
	Data Lo
	CRC Lo
	CRC Hi

number of Points

- Function Code #04 (Read Input Register)

<Query>	<Response>
Field Name	**Field Name**
Slave Address	Slave Address
Function(0x04)	Function(0x04)
Starting Address Hi	Byte Count
Starting Address Lo	Data Hi
# of Points Hi	Data Lo
# of Points Lo	…
CRC Lo	…
CRC Hi	Data Hi
	Data Lo
	CRC Lo
	CRC Hi

number of Points

- Function Code #06 (Preset Single Register)

<Query>	<Response>
Field Name	**Field Name**
Slave Address	Slave Address
Function(0x06)	Function
Starting Address Hi	Starting Address Hi
Starting Address Lo	Starting Address Lo

<Query>	<Response>
Preset Data Hi	Preset Data Hi
Preset Data Lo	Preset Data Lo
CRC Lo	CRC Lo
CRC Hi	CRC Hi

- Function Code #16 (hex 0h10) (Preset Multiple Register)

<Query>	<Response>
Field Name	**Field Name**
Slave Address	Slave Address
Function(0x10)	Function(0x10)
Starting Address Hi	Starting Address Hi
Starting Address Lo	Starting Address Lo
# of Register Hi	# of Register Hi
# of Register Lo	# of Register Lo
Byte Count	CRC Lo
Data Hi	CRC Hi
Data Lo	
…	
…	
Data Hi	
Data Lo	
CRC Lo	
CRC Hi	

- Exception Code

Code
01: ILLEGAL FUNCTION
02: ILLEGAL DATA ADDRESS
03: ILLEGAL DATA VALUE
06: SLAVE DEVICE BUSY

- Response

Field Name
Slave Address
[1]Function
Exception Code
CRC Lo
CRC Hi

1) The function value is the one set to the top level bit of the query function value.

Example of Modbus-RTU Communication use

When Acc time is changed to 5.0 sec and Dec time is changed to 10.0 sec.

The frame Inverter transmit to master

	Slave Address	Function	Starting Address	# of Register	Byte Count	Data 1	Data 2	CRC
Hex	0x01	0x10-	0x1102	0x0002	0x04	0x0032	0x0064	0x1202
Des-cription	CM.01 Int485 St ID	Preset Multiple Register	Adress for starting communication – 1 (0x1103-1)			50 (ACC time 5.0 is related)	100 (DEC time 10.0 is related)	

The frame mater tramsmit to Inverter

	Slave Address	Function	Starting Address	# of Register	CRC
Hex	0x01	0x10-	0x1102	0x0002	0xE534
Des-cription	CM.01 Int485 St ID	Preset Multiple Register	Adress for starting communication – 1 (0x1103-1)		

9.2.6 Existing iS5 / iP5 / iV5 / iG5 Compatible Common Area Parameter

Communication Address	Parameter	Scale	Unit	R/W	Assigned content by bit
0h0000	Inverter model	-	-	R	6: S100
0h0001	Inverter capacity	-	-	R	0: 0.75 kW 1: 1.5 kW 2: 2.2 kW
					3: 3.7 kW 4: 5.5 kW 5: 7.5 kW
					6: 11 kW 7: 15 kW 8: 18.5 kW
					9: 22 kW
					256 : 0.4 kW 257 : 1.1 kW 258 : 3.0 kW
					259 : 4.0 kW
0h0002	Inverter input voltage	-	-	R	0: 220 V product

Communication Address	Parameter	Scale	Unit	R/W	Assigned content by bit	
					1: 440 V product	
0h0003	Version	-	-	R	(Ex) 0h0100: Version 1.00 0h0101: Version 1.01	
0h0004	Reserved	-	-	R/W		
0h0005	Command frequency	0.01	Hz	R/W		
0h0006	Operation command (option) * Refer to additional description	-	-	R	B15	Reserved
					B14	0: Keypad Freq 1: Keypad Torq 2 - 16: Terminal block multi-step speed 17: Up 18: Down 19: STEADY 22: V1 24: V2 25: I2 26: Reserved 27: Built-in 485 28: Communication option 30: JOG 31: PID
					B13	
					B12	
					B11	
					B10	
					B9	
					B8	0: Keypad 1: FX/RX-1 2: FX/RX-2 3: Built-in 485 4: Communication option
					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 (status of Inverter)	-	-		B15	0: Remote, 1: Keypad Local
					B14	1: Frequency command source performs

Communication Address	Parameter	Scale	Unit	R/W	Assigned content by bit	
						communication (Built-in, Option)
					B13	1: Operation command source performs communication (Built-in, Option)
					B12	Reverse operation command
					B11	Forward operation command
					B10	Brake release signal
					B9	Jog mode
					B8	Drive stopped.
					B7	DC Braking
					B6	Speed reached.
					B5	Decelerating
					B4	Accelerating
					B3	Operates according to the set value of Fault (Trip) *Pr.30 Trip Out Mode.
					B2	Operates in reverse direction.
					B1	Operates in forward direction.
					B0	Stop
0h000F	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

Communication Address	Parameter	Scale	Unit	R/W	Assigned content by bit	
0h0010	Input terminal information	-	-	R	B15	Reserved
					B14	Reserved
					B13	Reserved
					B12	Reserved
					B11	Reserved
					B10	Reserved
					B9	Reserved
					B8	Reserved
					B7	Reserved
					B6	P7
					B5	P6
					B4	P5
					B3	P4
					B2	P3
					B1	P2
					B0	P1
0h0011	Output terminal information	-	-	R	B15	Reserved
					B14	Reserved
					B13	Reserved
					B12	Reserved
					B11	Reserved
					B10	Reserved
					B9	Reserved
					B8	Reserved
					B7	Reserved
					B6	Reserved
					B5	Reserved
					B4	Reserved
					B3	Reserved
					B2	Reserved
					B1	MO
					B0	Relay 1
0h0012	V1	0.01	%	R	V1 voltage input	
0h0013	V2	0.01	%	R	V2 voltage input	
0h0014	I2	0.01	%	R	I2 current input	
0h0015	Motor rotation speed	1	rpm	R	Current motor rotation speed display	
0h0016 - 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	

9.3 S100 Expansion Common Area Parameter

■ Inverter monitoring area parameter (all read only)

Communication Address	Parameter	Scale	Unit	Assigned content by bit	
0h0300	Inverter model	-	-	S100: 0006h	
0h0301	Inverter capacity	-	-	0.4 kW: 1900h 0.75 kW: 3200h	
				1.1 kW: 4011h 1.5 kW: 4015h	
				2.2 kW: 4022h 3.0 kW: 4030h	
				3.7 kW: 4037h 4.0 kW: 4040h	
				5.5 kW: 4055h 7.5 kW: 4075h	
				11 kW: 40B0h 15 kW: 40F0h	
				18.5 kW: 4125h 22 kW: 4160h	
0h0302	Types of inverter input voltage / power (Single phase, 3-phase) / Cooling method	-	-	100 V single phase self cooling: 0120h	
				100 V single phase forced cooling: 0121h	
				200 V single phase self cooling: 0220h	
				200 V 3-phase self cooling: 0230h	
				200 V single phase forced cooling: 0221h	
				200 V 3-phase forced cooling: 0231h	
				400 V single phase self cooling: 0420h	
				400 V 3-phase self cooling: 0430h	
				400 V single phase forced cooling: 0421h	
				400 V 3-phase forced cooling: 0431h	
0h0303	Inverter S/W version	-	-	(Ex) 0h0100: Version 1.00	
				0h0101: Version 1.01	
0h0304	Reserved	-	-	-	
0h0305	Inverter operation state	-	-	B15	0: Normal state 4: Warning occurred 8: Fault occurred (operates according to the set value of Pr.30 Trip Out Mode.)
				B14	
				B13	
				B12	

Communication Address	Parameter	Scale	Unit	Assigned content by bit	
				B11	-
				-	
				B8	
				B7	1: Speed searching 2: Accelerating 3: At constant speed 4: Decelerating 5: Decelerating to stop 6: H/W OCS 7: S/W OCS 8: Dwell operating
				B6	
				B5	
				B4	
				B3	0: Stop 1: Operates in forward direction. 2: Operates in reverse direction. 3: DC operating (0 speed control)
				B2	
				B1	
				B0	
0h0306	Inverter operation, frequency command source	-	-	B15	Operation command source 0: Keypad 1: Communication option 3: Built-in 485 4: Terminal block 5: reserved
				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 485 11: Communication option 13: Jog 14: PID 25 - 39: Multi-step speed frequency
				B6	
				B5	
				B4	
				B3	
				B2	
				B1	
				B0	
0h0307	Keypad S/W version	-	-	(Ex.) 0h0100: Version 1.00	
0h0308	Keypad title version	-	-	(Ex.) 0h0101: Version 1.01	
0h0309 - 0h30F	Reserved	-	-	-	
0h0310	Output current	0.1	A	-	
0h0311	Output frequency	0.01	Hz	-	
0h0312	Output RPM	0	RPM	-	

Communication Address	Parameter	Scale	Unit	Assigned content by bit	
0h0313	Motor feedback speed	0	RPM	-32768rpm - 32767rpm (with directionality)	
0h0314	Output voltage	1	V	-	
0h0315	DC Link Voltage	1	V	-	
0h0316	Output power	0.1	kW	-	
0h0317	Output torque	0.1	%	-	
0h0318	PID reference	0.1	%	-	
0h0319	PID feedback	0.1	%	-	
0h031A	Display the number of poles for the 1st motor	-	-	Display the number of poles for the 1st motor	
0h031B	Display the number of poles for the 2nd motor	-	-	Display the number of poles for the 2nd motor	
0h031C	Display the number of poles for the selected motor	-	-	Display the number of poles for the selected motor	
0h031D	Select Hz/rpm	-	-	0: Hz 1: rpm	
0h031E - 0h031F	Reserved	-	-	-	
0h0320	Digital input information			BI5	Reserved
				BI4	Reserved
				BI3	Reserved
				BI2	Reserved
				BI1	Reserved
				BI0	Reserved
				B9	Reserved
				B8	Reserved
				B7	Reserved
				B6	P7 (Basic I/O)
				B5	P6 (Basic I/O)
				B4	P5 (Basic I/O)
				B3	P4 (Basic I/O)
				B2	P3 (Basic I/O)
				B1	P2 (Basic I/O)
				B0	P1 (Basic I/O)
0h0321	Digital output information	-	-	BI5	Reserved
				~	Reserved
				B8	Reserved
				B7	Reserved
				B6	Reserved
				B5	Reserved
				B4	Reserved
				B3	Reserved
				B2	Reserved
				B1	Q1
				B0	Relay 1

Communication Address	Parameter	Scale	Unit	Assigned content by bit	
0h0322	Virtual digital input information	-	-	B15	Reserved
				~	Reserved
				B8	Reserved
				B7	Virtual DI 8 (CM.77)
				B6	Virtual DI 7 (CM.76)
				B5	Virtual DI 6 (CM.75)
				B4	Virtual DI 5 (CM.74)
				B3	Virtual DI 4 (CM.73)
				B2	Virtual DI 3 (CM.72)
				B1	Virtual DI 2 (CM.71)
				B0	Virtual DI 1 (CM.70)
0h0323	Display the selected motor	-	-	0: The 1st motor / 1: The 2nd motor	
0h0324	AI1	0.01	%	Analog input V1 (basic I/O)	
0h0325	Reserved	0.01	%		
0h0326	AI3	0.01	%	Analog input V2 (basic I/O)	
0h0327	AI4	0.01	%	Analog input I2 (basic I/O)	
0h0328	AO1	0.01	%	Analog output 1 (basic I/O)	
0h0329	AO2	0.01	%	Analog output 2 (basic I/O)	
0h032A	AO3	0.01	%	Reserved	
0h032B	AO4	0.01	%	Reserved	
0h032C	Reserved	-	-	-	
0h032D	Reserved	-	-	-	
0h032E	Reserved	-	-	-	
0h032F	Reserved	-	-	-	
0h0330	Latch type trip information-1	-	-	BI5	Fuse Open Trip
				BI4	Overheat Trip
				BI3	Arm Short
				BI2	External Trip
				BI1	Overvoltage Trip
				BI0	Overcurrent Trip
				B9	NTC Trip
				B8	Reserved
				B7	Reserved
				B6	Input open-phase trip
				B5	Output open-phase trip
				B4	Ground Fault Trip
				B3	E-Thermal Trip
				B2	Inverter Overload Trip
				B1	Underload Trip
				B0	Overload Trip

Communication Address	Parameter	Scale	Unit	Assigned content by bit	
0h0331	Latch type trip information-2	-	-	BI5	Reserved
				BI4	Reserved
				BI3	Blocking the inverter output by the terminal block input on the safety option (Only for the product higher than 90 kW)
				BI2	Reserved
				BI1	Reserved
				BI0	Bad option card
				B9	No Motor trip
				B8	External brake trip
				B7	Bad contact of basic IO board
				B6	Pre PID Fail
				B5	Error while writing parameters
				B4	Reserved
				B3	FAN Trip
				B2	PTC (thermal sensor) trip
				B1	Reserved
				B0	MC Fail Trip
0h0332	Level type trip information	-	-	B15	Reserved
				B14	Reserved
				B13	Reserved
				B12	Reserved
				B11	Reserved
				B10	Reserved
				B9	Reserved
				B8	Reserved
				B7	Reserved
				B6	Reserved
				B5	SafetyB
				B4	SafetyA
				B3	Keypad lost command
				B2	Lost Command
				B1	LV
				B0	BX
0h0333	H/W diagnosis trip information	-	-	B15	Reserved
				~	Reserved
				B6	Reserved
				B5	QueueFull

Communication Address	Parameter	Scale	Unit	Assigned content by bit	
				B4	Reserved
				B3	Watchdog-2 error
				B2	Watchdog-1 error
				B1	EEPROM error
				B0	ADC error
0h0334	Warning information	-	-	B15	Reserved
				~	Reserved
				B10	Reserved
				B9	Auto Tuning failed
				B8	Keypad lost
				B7	Encoder misconnection
				B6	Wrong installation of encoder
				B5	DB
				B4	FAN running
				B3	Lost command
				B2	Inverter Overload
				B1	Underload
				B0	Overload
0h0335 - 0h033F	Reserved	-	-	-	
0h0340	On Time date	0	Day	Total number of days when the inverter is 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 when the inverter drives 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 when the heat sink fan has run	
0h0345	Fan Time minute	0	Min	Total number of minutes excluding the total number of Fan Time days	
0h0346 - 0h0348	Reserved	-	-	-	
0h0349	Reserved	-	-	-	
0h034A	Option 1	-	-	0: None 9: CANopen	
0h034B	Reserved	-	-		
0h034C	Reserved				

■ Inverter control area parameter (both read and write)

Communication 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	-	-	B7	Reserved
				B6	Reserved
				B5	Reserved
				B4	Reserved
				B3	0→1: Free-run stop
				B2	0→1: Trip initialization
				B1	0: Reverse command 1: Forward command
				B0	0: Stop command 1: Run command
				Ex) 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)	-	-	BI5	Reserved
				BI4	Reserved
				BI3	Reserved
				BI2	Reserved
				BI1	Reserved
				BI0	Reserved
				B9	Reserved
				B8	Reserved
				B7	Virtual DI 8 (CM.77)
				B6	Virtual DI 7 (CM.76)
				B5	Virtual DI 6 (CM.75)
				B4	Virtual DI 5 (CM.74)
				B3	Virtual DI 4 (CM.73)
				B2	Virtual DI 3 (CM.72)
				B1	Virtual DI 2 (CM.71)
				B0	Virtual DI 1 (CM.70)
0h0386	Digital output control (0:Off, 1:On)	-	-	BI5	Reserved
				BI4	Reserved
				BI3	Reserved
				BI2	Reserved
				BI1	Reserved
				BI0	Reserved
				B9	Reserved
				B8	Reserved

Communication Address	Parameter	Scale	Unit	Assigned content by bit	
				B7	Reserved
				B6	Reserved
				B5	Reserved
				B4	Reserved
				B3	Reserved
				B2	Reserved
				B1	Q1 (Basic I/O, OU.33: None)
				B0	Relay 1 (Basic I/O, OU.31: None)
0h0387	Reserved	-	-	Reserved	
0h0388	PID reference	0.1	%	Give the PID reference command	
0h0389	PID feedback value	0.1	%	PID feedback value	
0h038A	Motor rated current	0.1	A	-	
0h038B	Motor rated voltage	1	V	-	
0h038C - 0h038F	Reserved			-	
0h0390	Torque Ref	0.1	%	Torque command	
0h0391	Fwd Pos Torque Limit	0.1	%	Forward motoring torque limit	
0h0392	Fwd Neg Torque Limit	0.1	%	Forward regenerative torque limit	
0h0393	Rev Pos Torque Limit	0.1	%	Reverse motoring torque limit	
0h0394	Rev Neg Torque Limit	0.1	%	Reverse regenerative torque limit	
0h0395	Torque Bias	0.1	%	Torque bias	
0h0396 - 0h399	Reserved	-	-	-	
0h039A	Anytime Para	-	-	Set the CNF.20[60] value (see page 10-41)	
0h039B	Monitor Line-1	-	-	Set the CNF.21 value (see page 10-41)	
0h039C	Monitor Line-2	-	-	Set the CNF.22 value (see page 10-41)	
0h039D	Monitor Line-3	-	-	Set the CNF.23 value (see page vii)	

Notes

The frequency set by way of communication into the S100 common area frequency address (0h0380, 0h0005) will not be saved even with the Parameter Save. Perform setting as follows to continuously use the frequency set through communication even after the power cycle:

1. Frequency setting method (dr.07): Set dr.07 (Freq Ref Source) to Keypad-1.
2. Frequency setting (0h1101): Set the frequency through communication into the S100 parameter area frequency address (0h1101).
3. Storing parameters (0h03E0): Perform Parameter Save (0h03E0: '1') before turning off the power.
4. After the power cycle, the frequency set and saved through communication will be displayed.

[60] Displayed when the LCD is installed.

■ Inverter memory control area parameter (both read and write)

The characteristic of this area is that, when the parameter is set, not only the value is reflected to the inverter but also it is saved. However, the parameters set in other areas through communication will be reflected to the inverter, but not saved. It means that all of the setting values will be cleared after the power cycle of the inverter and will revert back to the previous values prior to the setting. Therefore, after setting through communication, be sure to perform the Parameter Save prior to power off. But this area will be saved to the inverter without the need of the Parameter Save.

Communication Address	Parameter	Scale	Unit	Changeable during Operation	Function	Reference page
1)0h03E0	Save parameters	-	-	X	0: No 1:Yes	7-46
1)0h03E1	Monitor mode initialization	-	-	O	0: No 1:Yes	
1)0h03E2	Parameter initialization	-	-	X	0: No 1: All Grp 2: Drv Grp 3:bA Grp 4: Ad Grp 5:Cn Grp 6:In Grp 7:OU Grp 8: CM Grp 9:AP Grp 12:Pr Grp 13:M2 Grp * Setting prohibited during trip	7-47
0h03E3	Display changed parameters	-	-	O	0: No 1:Yes	7-49
0h03E4	Reserved	-	-	-	-	
1)0h03E5	Delete all fault history	-	-	O	0: No 1:Yes	
1)0h03E6	Delete user registration code	-	-	O	0: No 1:Yes	
2)0h03E7	Hide parameter mode	0	Hex	O	Write: 0 - 9999 Read: 0: Unlock 1:Lock	7-48
2)0h03E8	Lock parameter editing	0	Hex	O	Write: 0 - 9999 Read: 0: Unlock 1:Lock	7-48
0h03E9	Easy setting of initial parameters	-	-	O	0: No 1:Yes	
1)0h03EA	Initializing power consumption	-	-	O	0: No 1:Yes	
1)0h03EB	Initializing the accumulative time of inverter operation	-	-	O	0: No 1:Yes	
1)0h03EC	Initialize cooling fan accumulated operation time	-	-	O	0: No 1:Yes	

1) Be sure to set the parameters very carefully. After setting a parameter to 0 through 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. You can find out the previously set value by reading the parameter through communication.

⚠ **Caution**

- Since the data is saved to the inverter, the communication may be lost due to the extended performance time. Therefore, be careful when performing setting.

2) They are parameters for entering the password. When the password is entered first, the state will be changed from Lock to Unlock, and vice versa. When the same parameter value is continuously entered, the parameter is executed just once and then the values will not be reflected afterwards. Therefore, if you want to enter the same value once again, change it to another value and enter the previous value again.
Example) If you want to enter 244 twice, do it in the following order: 244 → 0 → 244

10. Table of Functions

Note) Deal with setting value not allowed

1. Setting value not allocated : "rd "

2. Overlap setting value (Multi-function input, PID Reference, PID Feedback) : "OL "

3. Setting value not allowed (Option, V2, I2) : "no "

Displayed like above. In this case, pushing "ENT" is no operation.

10.1 Operation Group[61]

No.	Communication address	Name	SEG display	Setting range		Initial value	Property[62]	Reference page	Control mode[63]	
									V/F	SL
-	0h1F00	Target frequency	0.00	0 - Max. frequency [Hz]		0.00	O/7	6-3	O	O
-	0h1F01	Acceleration time	ACC	0.0 - 600.0 [s]		20.0	O/7	6-22	O	O
-	0h1F02	Deceleration time	dEC	0.0 - 600.0 [s]		30.0	O/7	6-22	O	O
-	0h1F03	Operation command method	drv	0	Keypad	1: Fx/Rx-1	X/7	6-18	O	O
				1	Fx/Rx-1					
				2	Fx/Rx-2					
				3	Int 485			9-2		
				4	Field Bus			Option[64]		
-	0h1F04	Frequency setting Action	Frq	0	Keypad-1	0: Keypad-1	X/7	6-29	O	O
				1	Keypad-2					
				2	V1					
				4	V2					
				5	I2					
				6	Int 485					
				8	Field Bus					
				12	Pulse					
-	0h1F05	Multi-step speed frequency 1	St1	0.00 - Max. frequency [Hz]		10.00	O/7		O	O
-	0h1F06	Multi-step speed frequency 2	St2	0.00 - Max. frequency [Hz]		20.00	O/7		O	O
-	0h1F07	Multi-step speed frequency 3	St3	0.00 - Max. frequency [Hz]		30.00	O/7		O	O
-	0h1F08	Output current	CUr				-/7		O	O
-	0h1F09	Motor revolution	rPM				-/7		O	O

61 Not visible when the LCD loader is installed.

62 Property: O or X: Write during operation, A: 7SEG/LCD Common, 7: 7SEG Only, L: LCD Only

63 Indicates the effectivity by code dependent on control mode setting: V/F, SL: IM sensorless mode.

64 Refer to separate option user manual for the options.

No.	Communication address	Name	SEG display	Setting range		Initial value	Property[62]	Reference page	Control mode[63]	
-	0h1F0A	Inverter DC voltage	dCL	-		-	-/7		O	O
-	0h1F0B	User selection display	vOL				-/7		O	O
-	0h1F0C	Present fault display	nOn				-/7		O	O
-	0h1F0D	Select rotation direction	drC	F	Forward operation	F	O/7		O	O
				r	Reverse operation					

10.2 Drive group (PAR → dr)

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
00	-	Jump code	Jump Code	1 - 99		9	O/A	-	O	O
01[65]	0h1101	Target frequency	Cmd Frequency	0.00 - Max. frequency [Hz]		0.00	O/L	6-3	O	O
03[66]	0h1103	Acceleration time	Acc Time	0.0 - 600.0 [s]		20.0	O/L	6-22	O	O
04[67]	0h1104	Deceleration time	Dec Time	0.0 - 600.0 [s]		30.0	O/L	6-22	O	O
06[68]	0h1106	Operation command method	Cmd Source	0	Keypad	1: Fx/Rx-1	X/L	6-18	O	O
				1	Fx/Rx-1					
				2	Fx/Rx-2					
				3	Int 485			9-2		
				4	Field Bus			Option		
07[69]	0h1107	Frequency setting Action	Freq Ref Src	0	Keypad-1	0: Keypad-1	X/L	6-3	O	O
				1	Keypad-2					
				2	V1					
				4	V2					
				5	I2					
				6	Int 485					
				8	FieldBus					
				12	Pulse					
09	0h1109	Control mode	Control Mode	0	V/F	0: V/F	X/A	6-29	O	O
				2	Slip Compen			7-15		

[65] Displayed only when the LCD keypad is installed

[66] Displayed only when the LCD keypad is installed

[67] Displayed only when the LCD keypad is installed

[68] Displayed only when the LCD keypad is installed

[69] Displayed only when the LCD keypad is installed

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
				4	IM Sensorless			7-26		
11	0h110B	Jog frequency	Jog Frequency	0.00, 0.50 - Max. frequency [Hz]		10.00	O/A	7-7	O	O
12	0h110C	Jog operation acceleration time	Jog Acc Time	0.0 - 600.0 [s]		20.0	O/A	7-7	O	O
13	0h110D	Jog operation deceleration time	Jog Dec Time	0.0 - 600.0 [s]		30.0	O/A	7-7	O	O
14	0h110E	Motor capacity	Motor Capacity	0: 0.2 kW, 1: 0.4 kW 2: 0.75 kW, 3: 1.1 kW 4: 1.5 kW, 5: 2.2 kW 6: 3.0 kW, 7: 3.7 kW 8: 4.0 kW, 9: 5.5 kW 10: 7.5 kW, 11: 11.0 kW 12: 15.0 kW, 13: 18.5 kW 14: 22.0 kW, 15: 30.0 kW		Dependent on inverter capacity	X/A	7-23	O	O
15	0h110F	Torque boost method	Torque Boost	0	Manual	0: Manual	X/A	6-32	O	X
				1	Auto					
1) 16	0h1110	Forward torque boost	Fwd Boost	0.0 - 15.0[%]		2.0	X/A	6-32	O	X
2) 17	0h1111	Reverse torque boost	Rev Boost	0.0 - 15.0[%]		2.0	X/A	6-32	O	X
18	0h1112	Base frequency	Base Freq	30.00 - 400.00 [Hz]		60.00	X/A	6-29	O	O
19	0h1113	Start frequency	Start Freq	0.01 - 10.00 [Hz]		0.50	X/A	6-29	O	O
20	0h1114	Maximum frequency	Max Freq	40.00 - 400.00		60.00	X/A	6-38	O	O
21	0h1115	Speed unit selection	Hz/Rpm Sel	0	Hz Display	0: Hz Display	O/A		O	O
				1	Rpm Display					
80	0h1150	Display selection upon power supply[70]	-	Select the first item displayed on the inverter indicator upon power supply.		0: Operation frequency	O/7		O	O
				0	Operation frequency					
				1	Acceleration time					

[70] It is not visible on the LCD keypad.

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
				2	Deceleration time					
				3	Operation Command Methods					
				4	Frequency command method					
				5	Multi-step speed frequency 1					
				6	Multi-step speed frequency 2					
				7	Multi-step speed frequency 3					
				8	Output current					
				9	Motor revolution					
				10	Inverter DC voltage					
				11	User selection display (dr.81)					
				12	Present fault status					
				13	Operation direction selection					
				14	Output current 2					
				15	Motor revolution 2					
				16	Inverter DC voltage 2					
				17	User selection display 2 (dr.81)					
81	0h1151	Monitor item selection	-	Monitor one of the following items in the user selection display code.		0: Output Voltage	O/7		O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode V/F	Control mode SL
				0	Output voltage [V]					
				1	Output power [kW]					
				2	Torque [kgf · m]					
89	0h03E3	Display changed parameters	-	0	View All	0: View All	O/7		O	O
				1	View Changed					
90	0h115A	ESC –key function selection	-	0	Movement to initial position	0: None	X/7		O	O
				1	JOG Key					
				2	Local / Remote					
93	0h115D	Parameter initialization	-	0	No	0: No	X/7		O	O
				1	All Grp					
				2	dr Grp					
				3	bA Grp					
				4	Ad Grp					
				5	Cn Grp					
				6	In Grp					
				7	OU Grp					
				8	CM Grp					
				9	AP Grp					
				12	Pr Grp					
				13	M2 Grp					
				16	Operation Grp					
94	0h115E	Password registration		0 – 9999			O/7		O	O
95	0h115F	Parameter lock setting		0 - 9999			O/7		O	O
97	0h1161	Inverter software version	-				-/7		O	O
98	0h1162	IO board version display	IO S/W Ver				-/A		O	O

* Codes in shaded rows are hidden codes that are displayed only after setting other corresponding codes.
1) Can be displayed only when code value of dr.15 (Torque Boost) is "Manual"
2) Can be displayed only when code value of dr.15 (Torque Boost) is "Manual"

10.3 Basic function group (PAR → bA)

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
00	-	Jump code	Jump Code	1 - 99		20	O/A	-	O	O
01	0h1201	Auxiliary command setting method	Aux Ref Src	0	None	0: None	X/A	7-3	O	O
				1	V1					
				3	V2					
				4	I2					
				6	Pulse					
[3]02	0h1202	Auxiliary command motion selection	Aux Calc Type	0	M+(G*A)	0: M+(G*A)	X/A	7-3	O	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%)					
03	0h1203	Auxiliary command gain	Aux Ref Gain	-200.0 - 200.0[%]		100.0	O/A	7-3	O	O
04	0h1204	Second operation command method	Cmd 2nd Src	0	Keypad	1: Fx/Rx-1	X/A	6-41	O	O
				1	Fx/Rx-1					
				2	Fx/Rx-2					
				3	Int 485					
				4	FieldBus					
05	0h1205	Second frequency setting method	Freq 2nd Src	0	Keypad-1	0: Keypad-1	O/A	6-41	O	O
				1	Keypad-2					
				2	V1					
				4	V2					
				5	I2					
				6	Int 485					
				8	FieldBus					
				12	Pulse					
07	0h1207	V/F pattern	V/F Pattern	0	Linear	0: Linear	X/A	6-29	O	X
				1	Square					
				2	User V/F					
				3	Square 2					

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode V/F	Control mode SL
08	0h1208	Acc/Dec reference frequency	Ramp T Mode	0 Max Freq 1 Delta Freq	0: Max Freq	X/A	6-22	O	O
09	0h1209	Time unit setting	Time Scale	0 0.01 sec 1 0.1 sec 2 1 sec	1: 0.1 sec	X/A	6-22	O	O
10	0h120A	Input power frequency	60/50 Hz Sel	0 60 Hz 1 50 Hz	0 : 60Hz	X/A	7-45	O	O
11	0h120B	Number of motor poles	Pole Number	2 - 48	Dependent on inverter capacity	X/A	7-15	O	O
12	0h120C	Rated slip speed	Rated Slip	0 - 3000 [rpm]		X/A		O	O O
13	0h120D	Rated motor current	Rated Curr	1.0 - 1000.0 [A]		X/A		O	O
14	0h120E	Motor no-load current	Noload Curr	0.0 - 1000.0 [A]		X/A		O	O
15	0h120F	Rated motor voltage	Rated Volt	170 - 480 [V]	0	X/A		O	O
16	0h1210	Motor efficiency	Efficiency	70 - 100[%]	Dependent on inverter capacity	X/A		O	O O
17	0h1211	Load inertia rate	Inertia Rate	0 - 8		X/A		O	O O
18	0h1212	Power display trim	Trim Power %	70 - 130[%]		O/A		O	O
19	0h1213	Input power voltage	AC Input Volt	0 / 170 - 480 V	0	O/A	7-45	O	O
20	-	Auto-tuning	Auto Tuning	0 None 1 All 2 ALL (Stdstl) 3 Rs+Lsigma 6 Tr (Stdstl)	0: None	X/A	7-25	X	O
21	-	Stator resistor	Rs	Dependent on motor setting	-	X/A	7-23	X	O
22	-	Leakage inductance	Lsigma	Dependent on motor setting	-	X/A	7-23	X	O
23	-	Stator inductance	Ls	Dependent on motor setting	-	X/A	7-23	X	O
[4] 24	-	Rotor time constant	Tr	25 - 5000 [ms]	-	X/A	7-23	X	O
[5] 41	0h1229	User frequency 1	User Freq 1	0.00 - Max. frequency [Hz]	15.00	X/A	6-30	O	X
42	0h122A	User voltage 1	User Volt 1	0 - 100[%]	25	X/A	6-30	O	X
43	0h122B	User frequency 2	User Freq 2	0.00 - Max. frequency [Hz]	30.00	X/A	6-30	O	X

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode	
								V/F	SL
44	0h122C	User voltage 2	User Volt 2	0 - 100[%]	50	X/A	6-30	O	X
45	0h122D	User frequency 3	User Freq 3	0.00 - Max. frequency [Hz]	45.00	X/A	6-30	O	X
46	0h122E	User voltage 3	User Volt 3	0 - 100[%]	75	X/A	6-30	O	X
47	0h122F	User frequency 4	User Freq 4	0.00 - Max. frequency [Hz]	60.00	X/A	6-30	O	X
48	0h1230	User voltage 4	User Volt 4	0 - 100[%]	100	X/A	6-30	O	X
[6)] 50	0h1232	Multi-step speed frequency 1	Step Freq-1	0.00 - Max. frequency [Hz]	10.00	O/L		O	O
51	0h1233	Multi-step speed frequency 2	Step Freq-2	0.00 - Max. frequency [Hz]	20.00	O/L		O	O
52	0h1234	Multi-step speed frequency 3	Step Freq-3	0.00 - Max. frequency [Hz]	30.00	O/L		O	O
53	0h1235	Multi-step speed frequency 4	Step Freq-4	0.00 - Max. frequency [Hz]	40.00	O/A		O	O
54	0h1236	Multi-step speed frequency 5	Step Freq-5	0.00 - Max. frequency [Hz]	50.00	O/A		O	O
55	0h1237	Multi-step speed frequency 6	Step Freq-6	0.00 - Max. frequency [Hz]	60.00	O/A		O	O
56	0h1238	Multi-step speed frequency 7	Step Freq-7	0.00 - Max. frequency [Hz]	60.00	O/A		O	O
70	0h1246	Multi-step acceleration time 1	Acc Time-1	0.0 - 600.0 [s]	20.0	O/A	6-23	O	O
71	0h1247	Multi-step deceleration time 1	Dec Time-1	0.0 - 600.0 [s]	20.0	O/A	6-23	O	O
[7)]72	0h1248	Multi-step acceleration time 2	Acc Time-2	0.0 - 600.0 [s]	30.0	O/A		O	O
73	0h1249	Multi-step deceleration time 2	Dec Time-2	0.0 - 600.0 [s]	30.0	O/A		O	O
74	0h124A	Multi-step acceleration time 3	Acc Time-3	0.0 - 600.0 [s]	40.0	O/A		O	O
75	0h124B	Multi-step deceleration time 3	Dec Time-3	0.0 - 600.0 [s]	40.0	O/A		O	O
76	0h124C	Multi-step acceleration time 4	Acc Time-4	0.0 - 600.0 [s]	50.0	O/A		O	O

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode	
								V/F	SL
77	0h124D	Multi-step deceleration time 4	Dec Time-4	0.0 - 600.0 [s]	50.0	O/A		O	O
78	0h124E	Multi-step acceleration time 5	Acc Time-5	0.0 - 600.0 [s]	40.0	O/A		O	O
79	0h124F	Multi-step deceleration time 5	Dec Time-5	0.0 - 600.0 [s]	40.0	O/A		O	O
80	0h1250	Multi-step acceleration time 6	Acc Time-6	0.0 - 600.0 [s]	30.0	O/A		O	O
81	0h1251	Multi-step deceleration time 6	Dec Time-6	0.0 - 600.0 [s]	30.0	O/A		O	O
82	0h1252	Multi-step acceleration time 7	Acc Time-7	0.0 - 600.0 [s]	20.0	O/A		O	O
83	0h1253	Multi-step deceleration time 7	Dec Time-7	0.0 - 600.0 [s]	20.0	O/A		O	O

* Codes in shaded rows are hidden codes that are displayed only after setting other corresponding codes.
3) Can be displayed only when bA.01 is not 0
4) bA.24 will be displayed only when dr.09 control mode is "IM Sensorless"
5) bA.41 – 48 will be displayed only when any of bA.07 and M2.25 (M2.V/F Patt) is set to "User V/F"
6) bA.50 – 64 will be displayed only when any of In.65 - 71 multi-function inputs is set to "Multi-step speed (Speed–L.M.H)" In.50 – In.52 will be displayed when LCD display is applied.
7) Displayed only when any of In.72 - 75 multi-function inputs is set to "Multi-step Acc/Dec (Xcel-L, M, H)"

10.4 Expanded function group (PAR → Ad)

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode V/F	Control mode SL
00	-	Jump code	Jump Code	1 - 99	24	O/A	-	O	O
01	0h1301	Accelerating pattern	Acc Pattern	0 Linear	0: Linear	X/A	6-26	O	O
02	0h1302	Decelerating pattern	Dec Pattern	1 S-curve		X/A	6-26	O	O
[8] 03	0h1303	S-curve acceleration start point gradient	Acc S Start	1 - 100[%]	40	X/A	6-26	O	O
04	0h1304	S-curve acceleration end point gradient	Acc S End	1 - 100[%]	40	X/A	6-26	O	O
[9] 05	0h1305	S-curve deceleration start point gradient	Dec S Start	1 - 100[%]	40	X/A	6-26	O	O
06	0h1306	S-curve deceleration end point gradient	Dec S End	1 - 100[%]	40	X/A	6-26	O	O
07	0h1307	Start mode	Start Mode	0 Acc 1 Dc-Start	0: Acc	X/A	6-34	O	O
08	0h1308	Stop mode	Stop Mode	0 Dec 1 Dc-Brake 2 Free-Run 3 Reserved 4 Power Braking	0: Dec	X/A	6-35	O	O
09	0h1309	Selection of prohibited rotation direction	Run Prevent	0 None 1 Forward Prev 2 Reverse Prev	0: None	X/A	6-20	O	O
10	0h130A	Starting with power on	Power-on Run	0 No 1 Yes	0: No	O/A	6-20	O	O
[10] 12	0h130C	DC braking time at startup	Dc-Start Time	0.00 - 60.00 [s]	0.00	X/A	6-34	O	O
13	0h130D	Amount of applied DC	Dc Inj Level	0 - 200[%]	50	X/A	6-34	O	O
[11] 14	0h130E	Output blocking time before DC braking	Dc-Block Time	0.00 - 60.00 [s]	0.10	X/A	6-35	O	O
15	0h130F	DC braking time	Dc-Brake Time	0.00 - 60.00 [s]	1.00	X/A	6-35	O	O
16	0h1310	DC braking quantity	Dc-Brake Level	0 - 200[%]	50	X/A	6-35	O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
17	0h1311	DC braking frequency	Dc-Brake Freq	Start frequency - 60.00 [Hz]		5.00	X/A	6-35	O	O
20	0h1314	Dwell frequency on acceleration	Acc Dwell Freq	Start frequency - Max. frequency [Hz]		5.00	X/A	7-13	O	O
21	0h1315	Dwell operation time on acceleration	Acc Dwell Time	0.0 - 60.0 [s]		0.0	X/A	7-13	O	O
22	0h1316	Dwell frequency on deceleration	Dec Dwell Freq	Start frequency - Max. frequency [Hz]		5.00	X/A	7-13	O	O
23	0h1317	Dwell operation time on deceleration	Dec Dwell Time	0.0 - 60.0 [s]		0.0	X/A	7-13	O	O
24	0h1318	Frequency limit	Freq Limit	0	No	0: No	X/A	6-38	O	O
				1	Yes					
[12]25	0h1319	Lower limit frequency Limit	Freq Limit Lo	0.00 - upper limit [Hz]		0.50	O/A	6-38	O	O
26	0h131A	Upper limit frequency Limit	Freq Limit Hi	0.50 - Max. frequency [Hz]		60.00	X/A	6-38	O	O
27	0h131B	Frequency jump	Jump Freq	0	No	0: No	X/A	6-39	O	O
				1	Yes					
[13]28	0h131C	Jump frequency Lower limit 1	Jump Lo 1	0.00 - jump frequency upper limit 1 [Hz]		10.00	O/A	6-39	O	O
29	0h131D	Jump frequency Upper limit 1	Jump Hi 1	Jump frequency lower limit 1 - Max. frequency [Hz]		15.00	O/A	6-39	O	O
30	0h131E	Jump frequency Lower limit 2	Jump Lo 2	0.00 - jump frequency upper limit 2 [Hz]		20.00	O/A	6-39	O	O
31	0h131F	Jump frequency Upper limit 2	Jump Hi 2	Jump frequency lower limit 2 - Max. frequency [Hz]		25.00	O/A	6-39	O	O
32	0h1320	Jump frequency Lower limit 3	Jump Lo 3	0.00 - jump frequency upper limit 3 [Hz]		30.00	O/A	6-39	O	O
33	0h1321	Jump frequency Upper limit 3	Jump Hi 3	Jump frequency lower limit 3 - Max. frequency [Hz]		35.00	O/A	6-39	O	O
[14]41	0h1329	Brake release current	BR Rls Curr	0.0 - 180.0[%]		50.0	O/A	7-54	O	O
42	0h132A	Brake release delay time	BR Rls Dly	0.00 - 10.00 [s]		1.00	X/A	7-54	O	O

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode V/F	Control mode SL
44	0h132C	Brake release forward frequency	BR Rls Fwd Fr	0.00 - 400.00 [Hz] (V/F, Slip Compen) 0.00 - 120.00 [Hz] (IM Sensorless)	1.00	X/A	7-54	O	O
45	0h132D	Brake release reverse frequency	BR Rls Rev Fr	0.00 - 400.00 [Hz] (V/F, Slip Compen) 0.00 - 120.00 [Hz] (IM Sensorless)	1.00	X/A	7-54	O	O
46	0h132E	Brake engage delay time	BR Eng Dly	0.00 - 10.00 [s]	1.00	X/A	7-54	O	O
47	0h132F	Brake engage frequency	BR Eng Fr	0.00 - 400.00 [Hz] (V/F, Slip Compen) 0.00 - 120.00 [Hz] (IM Sensorless)	2.00	X/A	7-54	O	O
50	0h1332	Energy saving operation	E-Save Mode	0 None 1 Manual 2 Auto	0: None	X/A	7-35	O	O
[15)]51	0h1333	Energy saving level	Energy Save	0 - 30[%]	0	O/A	7-35	O	O
60	0h133C	Acc/Dec time transition frequency	Xcel Change Fr	0.00 - Max. frequency [Hz]	0.00	X/A	6-24	O	O
64	0h1340	Cooling fan control	FAN Control	0 During Run 1 Always ON 2 Temp Control	0: During Run	O/A	7-45	O	O
65	0h1341	Up/down operation frequency save	U/D Save Mode	0 No 1 Yes	0: No	O/A	7-9	O	O
66	0h1342	Output contact On/Off control method	On/Off Ctrl Src	0 None 1 V1 3 V2 4 I2 6 Pulse	0: None	X/A	7-56	O	O
67	0h1343	Output contact On level	On-C Level	10.00 - 100.00[%]	90.00	X/A	7-56	O	O
68	0h1344	Output contact Off level	Off-C Level	-100.00 - Output contact On level [%]	10.00	X/A	7-56	O	O

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode V/F	Control mode SL
70	0h1346	Safe operation selection	Run En Mode	0: Always Enable 1: DI Dependent	0: Always Enable	X/A	7-12	O	O
[16]71	0h1347	Safe operation stop method	Run Dis Stop	0: Free-Run 1: Q-Stop 2: Q-Stop Resume	0: Free-Run	X/A	7-12	O	O
72	0h1348	Safe operation deceleration time	Q-Stop Time	0.0 - 600.0 [s]	5.0	O/A	7-12	O	O
74	0h134A	Selection of regeneration evasion function for press	RegenAvd Sel	0: No 1: Yes	0: No	X/A	7-56	O	O
75	0h134B	Voltage level of regeneration evasion motion for press	RegenAvd Level	200 V: 300 - 400 400 V: 600 - 800	350 V 700 V	X/A	7-56	O	O
[17]76	0h134C	Compensation frequency limit of regeneration evasion for press	CompFreq Limit	0.00 - 10.00 Hz	1.00 [Hz]	X/A	7-56	O	O
77	0h134D	Regeneration evasion for press P gain	RegenAvd Pgain	0.0 - 100.0%	50.0[%]	O/A	7-56	O	O
78	0h134E	Regeneration evasion for press I gain	RegenAvd Igain	20 - 30000 [ms]	500 [ms]	O/A	7-56	O	O

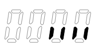
* Codes in shaded rows are hidden codes that are displayed only after setting other corresponding codes.
8) Ad.03 and 04 can be displayed only when Ad. 01 is 1.
9) Ad.05 and 06 can be displayed only when Ad. 02 is 1.
10) Ad.12 will be displayed only when Ad.07 "Start Mode" is set to "Dc-Start".
11) Ad.14 - 17 will be displayed only when Ad.08 "Stop Mode" is set to "DC-Brake".
12) Ad.25 - 26 will be displayed only when Ad.24 (Freq Limit) is set to "Freq Limit".
13) Ad.28 - 33 will be displayed only when Ad.27 (Jump Freq) is set to "Yes".
14) Ad.41 - 47 will be displayed only when any code value of OU.31 or 33 is set to "BR Control".
15) Ad.51 will be displayed only when Ad.50 (E-Save Mode) is set to any value other than "None".
16) Ad.71 - 72 will be displayed only when Ad.70 (Run En Mode) is set to "DI Dependent".
17) Ad.76 - 78 will be displayed only when Ad.74 (RegenAvd Sel) is set to "Yes".

10.5 Control Function Group (PAR → Cn)

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
00	-	Jump code	Jump Code	1 - 99		4	O/A	-	O	O
04	0h1404	Carrier frequency	Carrier Freq	HD	V/F: 1.0 - 15.0 [kHz] SL: 2.0 - 15.0 [kHz]	3.0	X/A	7-41	O	O
				ND	V/F: 1.0 - 5.0 [kHz] SL: 2.0 - 5.0 [kHz]	2.0				
05	0h1405	Switching mode	PWM Mode	0	Normal PWM	0: Normal PWM	X/A	7-41	O	O
				1	Lowleakage PWM					
09	0h1409	Initial excitation time	PreExTime	0.00 - 60.00 [s]		1.00	X/A	7-29	X	O
10	0h140A	Initial excitation amount	Flux Force	100.0 - 300.0%		100.0	X/A	7-29	X	O
11	0h140B	Continued operation duration	Hold Time	0.00 - 60.00 [s]		0.00	X/A	7-29	X	O
20	0h1414	Sensorless 2nd gain display setting	SL2 G View Sel	0	No	0: No	O/A	7-26	X	O
				1	Yes					
21	0h1415	Sensorless speed controller proportional gain1	ASR-SL P Gain1	0 - 5000[%]		Dependent on motor capacity	O/A	7-26	X	O
22	0h1416	Sensorless speed controller integral gain1	ASR-SL I Gain1	10 - 9999 [ms]		Dependent on motor capacity	O/A	7-26	X	O
[18]23	0h1417	Sensorless speed controller proportional gain2	ASR-SL P Gain2	1.0 - 1000.0[%]		Dependent on motor capacity	O/A	7-26	X	O
24	0h1418	Sensorless speed controller integral gain2	ASR-SL I Gain2	1.0 - 1000.0[%]		Dependent on motor capacity	O/A	7-26	X	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
26	0h141A	Flux estimator proportional gain	Flux P Gain	10 - 200[%]		Dependent on motor capacity	O/A	7-26	X	O
27	0h141B	Flux estimator integral gain	Flux I Gain	10 - 200[%]		Dependent on motor capacity	O/A	7-27	X	O
28	0h141C	Speed estimator proportional gain	S-Est P Gain1	0 - 32767		Dependent on motor capacity	O/A	7-27	X	O
29	0h141D	Speed estimator integral gain1	S-Est I Gain1	100 - 1000		Dependent on motor capacity	O/A	7-27	X	O
30	0h141E	Speed estimator integral gain2	S-Est I Gain2	100 - 10000		Dependent on motor capacity	O/A	7-27	X	O
31	0h141F	Sensorless current controller proportional gain	ACR SL P Gain	10 - 1000		Dependent on motor capacity	O/A	7-27	X	O
32	0h1420	Sensorless current controller integral gain	ACR SL I Gain	10 - 1000		Dependent on motor capacity	O/A	7-27	X	O
48	-	Current controller P gain	ACR P Gain	0 - 10000		1200	O/A	7-27	X	O
49	-	Current controller I gain	ACR I Gain	0 - 10000		120	O/A	7-27	X	O
52	0h1434	Torque controller output filter	Torque Out LPF	0 - 2000 [ms]		0	X/A	7-33	X	O
53	0h1435	Torque limit setting method	Torque Lmt Src	0	Keypad-1	0: Keypad-1	X/A	7-30	X	O
				1	Keypad-2					
				2	V1					

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode V/F	Control mode SL
				4	V2					
				5	I2					
				6	Int 485					
				8	FieldBus					
[19)]54	0h1436	Positive-direction reverse torque limit	FWD +Trq Lmt	0.0 - 200.0[%]		180	O/A		X	O
55	0h1437	Positive-direction regeneration torque limit	FWD –Trq Lmt	0.0 - 200.0[%]		180	O/A		X	O
56	0h1438	Negative-direction reverse torque limit	REV +Trq Lmt	0.0 - 200.0[%]		180	O/A		X	O
57	0h1439	Negative-direction regeneration torque limit	REV –Trq Lmt	0.0 - 200.0[%]		180	O/A		X	O
70	0h1446	Speed search mode selection	SS Mode	0	Flying Start-1	0: Flying Start-1	X/A		O	O
				1	Flying Start-2					
71	0h1447	Speed search operation selection	Speed Search	Bit	0000- 1111	0000[71]	X/A		O	O
				0001	Selection of speed search on acceleration					
				0010	When starting on initialization after trip					
				0100	When restarting after instantaneous power interruption					
				1000	When starting with power on					

[71] The initial value 0000 will be displayed in SEG as .

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
[20]72	0h1448	Speed search reference current	SS Sup-Current	80 - 200[%]		150	O/A	7-36	O	O
73	0h1449	Speed search proportional gain	SS P-Gain	0 - 9999		Flying Start-1: 100 Flying Start-2: 600	O/A	7-36	O	O
74	0h144A	Speed search integral gain	SS I-Gain	0 - 9999		Flying Start-1: 200 Flying Start-2: 1000	O/A	7-36	O	O
75	0h144B	Output blocking time before speed search	SS Block Time	0.0 - 60.0 [s]		1.0	X/A	7-36	O	O
76	0h144C	Speed search Estimator gain	Spd Est Gain	50 ~ 150 [%]		100	O/A		O	O
77	0h144D	Energy buffering selection	KEB Select	0	No	0: No	X/A	7-34	O	O
				1	Yes					
[21]78	0h144E	Energy buffering start level	KEB Start Lev	110.0 - 140.0[%]		125.0	X/A	7-34	O	O
79	0h144F	Energy buffering stop level	KEB Stop Lev	125.0 - 145.0[%]		130.0	X/A	7-34	O	O
80	0h1450	Energy buffering gain	KEB Gain	1 - 20000		1000	O/A	7-34	O	O
[22]85	0h1455	Flux estimator proportional gain1	Flux P Gain1	100 - 700		370	O/A	7-27	X	O
86	0h1456	Flux estimator proportional gain2	Flux P Gain2	0 - 100		0	O/A	7-27	X	O
87	0h1457	Flux estimator proportional gain3	Flux P Gain3	0 - 500		100	O/A	7-27	X	O
88	0h1458	Flux estimator integral gain1	Flux I Gain1	0 - 200		50	O/A	7-27	X	O
89	0h1459	Flux estimator integral gain2	Flux I Gain2	0 - 200		50	O/A	7-27	X	O
90	0h145A	Flux estimator integral gain3	Flux I Gain3	0 - 200		50	O/A	7-27	X	O
91	0h145B	Sensorless voltage compensation 1	SL Volt Comp1	0 - 60		30	O/A	7-27	X	O

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode	
								V/F	SL
92	0h145C	Sensorless voltage compensation 2	SL Volt Comp2	0 - 60	20	O/A	7-27	X	O
93	0h145D	Sensorless voltage compensation 3	SL Volt Comp3	0 - 60	20	O/A	7-27	X	O
94	0h145E	Sensorless field weakening start frequency	SL FW Freq	80.0 - 110.0[%]	100.0	X/A	7-27	X	O
95	0h145F	Sensorless gain switching frequency	SL Fc Freq	0.00 - 8.00 [Hz]	2.00	X/A	7-27	X	O

* Codes in shaded rows are hidden codes that are displayed only after setting other corresponding codes.
18) Cn.23 - 32 will be displayed only when dr.09 (Control Mode) is set to "IM Sensorless" and CON-20 (SL2 G View Sel) is set to "YES".
19) Cn.54 - 57 will be displayed only when dr.09 (Control Mode) is set to "IM Sensorless". In addition, the initial value of torque limit will be changed to 150% when setting the Ad.74 regeneration evasion function.
20) Cn.72 - 76 will be displayed only when any bit of Cn.71 is set to "1". Also, any bit of Cn.72 is set to “1” and Ssmode of Cn.70 is set to ‘0’ (Flying Start-1).
21) Cn.78 - 80 will be displayed only when Cn.77 (KEB Select) is set to "Yes".
22) Cn.23 - 32 will be displayed only when dr.09 (Control Mode) is set to "IM Sensorless" and CON-20 (SL2 G View Sel) is set to "YES".

10.6 Input Terminal Block Function Group (PAR → In)

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
00	-	Jump code	Jump Code	1 - 99		65	O/A	-	O	O
01	0h1501	Frequency for maximum analog input	Freq at 100%	0.00 - Max. frequency [Hz]		60.00	O/A	6-4	O	O
02	0h1502	Torque at maximum analog input	Torque at 100%	0.0 - 200.0[%]		100.0	O/A	-	X	X
05	0h1505	V1 input amount display	V1 Monitor [V]	-12.00 - 12.00 [V]		0.00	O/A	6-4	O	O
06	0h1506	V1 input polarity selection	V1 Polarity	0	Unipolar	0: Unipolar	X/A	6-4	O	O
				1	Bipolar					
07	0h1507	Time constant of V1 input filter	V1 Filter	0 - 10000 [ms]		10	O/A	6-4	O	O
08	0h1508	Minimum input voltage of V1	V1 Volt x1	0.00 - 10.00 [V]		0.00	O/A	6-4	O	O
09	0h1509	Output at V1 minimum voltage (%)	V1 Perc y1	0.00 - 100.00[%]		0.00	O/A	6-4	O	O
10	0h150A	Maximum input voltage for V1	V1 Volt x2	0.00 - 12.00 [V]		10.00	O/A	6-4	O	O
11	0h150B	Output at V1 maximum voltage (%)	V1 Perc y2	0.00 - 100.00[%]		100.00	O/A	6-4	O	O
[23]12	0h150C	V1–minimum input voltage	V1 –Volt x1’	-10.00 - 0.00 [V]		0.00	O/A	6-6	O	O
13	0h150D	Output at V1 minimum voltage (%)	V1 –Perc y1’	-100.00 - 0.00[%]		0.00	O/A	6-6	O	O
14	0h150E	V1–maximum input voltage	V1 –Volt x2’	-12.00 - 0.00[V]		-10.00	O/A	6-6	O	O
15	0h150F	Output at V1 maximum voltage (%)	V1 –Perc y2’	-100.00 - 0.00[%]		-100.00	O/A	6-6	O	O
16	0h1510	V1 rotation direction change	V1 Inverting	0	No	0: No	O/A	6-4	O	O
				1	Yes					
17	0h1511	V1 quantization level	V1 Quantizing	0.00 / 0.04 - 10.00[%]		0.04	X/A	6-4	O	O
[24]35	0h1523	V2 input amount display	V2 Monitor[V]	-12.00 - 12.00 [V]		0.00	O/A	6-9	O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
37	0h1525	V2 input filter time constant	V2 Filter	0 - 10000 [ms]		10	O/A	6-9	O	O
38	0h1526	Minimum input voltage of V2	V2 Volt x1	0.00 - 12.00 [V]		0.00	O/A	6-9	X	X
39	0h1527	Output (%) at the V2–min. voltage	V2 Perc y1	0.00 - 100.00[%]		0.00	O/A	6-9	O	O
40	0h1528	Maximum input voltage of V2	V2 Volt x2	0.00 - 12.00 [V]		10	O/A	6-9	X	X
41	0h1529	Output (%) at the V2 max. voltage	V2 Perc y2	0.00 - 100.00[%]		100.00	O/A	6-9	O	O
46	0h152E	V2 rotation direction change	V2 Inverting	0	No	0: No	O/A	6-9	O	O
				1	Yes					
47	0h152F	V2 quantization level	V2 Quantizing	0.00[72], 0.04 - 10.00[%]		0.04	O/A	6-9	O	O
50	0h1532	I2 input amount display	I2 Monitor[mA]	0 - 25 [mA]		0.00	O/A		O	O
52	0h1534	I2 input filter time constant	I2 Filter	0 - 10000 [ms]		10	O/A		O	O
53	0h1535	I2 minimum input current	I2 Curr x1	0.00 - 20.00 [mA]		4.00	O/A		O	O
54	0h1536	Output (%) at the I2 min. current	I2 Perc y1	0.00 - 100.00[%]		0.00	O/A		O	O
55	0h1537	I2 maximum input current	I2 Curr x2	0.00 - 24.00 [mA]		20.00	O/A		O	O
56	0h1538	Output (%) at the I2 max. current	I2 Perc y2	0.00 - 100.00[%]		100.00	O/A		O	O
61	0h153D	Changing rotation direction of I2	I2 Inverting	0	No	0: No	O/A		O	O
				1	Yes					
62	0h153E	I2 quantization level	I2 Quantizing	0.00[73], 0.04 - 10.00[%]		0.04	O/A		O	O
65	0h1541	P1 terminal function setting	P1 Define	0	None	1: FX	X/A	6-15	O	O
				1	FX					
66	0h1542	P2 terminal function setting	P2 Define	2	RX	2: RX	X/A	6-15	X	X

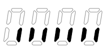
[72] Quantizing is not used when setting to 0.

[73] Quantizing is not used when setting to 0.

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode V/F	Control mode SL
67	0h1543	P3 terminal function setting	P3 Define	3	RST	5: BX	X/A	8-17	O	O
68	0h1544	P4 terminal function setting	P4 Define	4	External Trip	3: RST	X/A	8-10	O	O
69	0h1545	P5 terminal function setting	P5 Define	5	BX	7: Sp-L	X/A	8-16	O	O
70	0h1546	P6 terminal function setting	P6 Define	6	JOG	8: Sp-M	X/A	7-7	O	O
71	0h1547	P7 terminal function setting	P7 Define	7	Speed-L	9: Sp-H	X/A	6-13	O	O
				8	Speed-M					
				9	Speed-H					
				11	XCEL-L					
				12	XCEL-M					
				13	RUN Enable					
				14	3-Wire					
				15	2nd Source					
				16	Exchange					
				17	Up					
				18	Down					
				20	U/D Clear					
				21	Analog Hold					
				22	I-Term Clear					
				23	PID Openloop					
				24	P Gain2					
				25	XCEL Stop					
				26	2nd Motor					
				34	Pre Excite					
				38	Timer In			7-66		
				40	dis Aux Ref			7-3		
				46	FWD JOG			7-8		
				47	REV JOG			7-8		
				49	XCEL-H					
85	0h1555	Multi-function input terminal on filter	DI On Delay	0 - 10000 [ms]		10	O/A	6-42	O	O

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode	
								V/F	SL
86	0h1556	Multi-function input terminal off filter	DI Off Delay	0 - 10000 [ms]	3	O/A	6-42	O	O
87	0h1557	Multi-function input Contact selection	DI NC/NO Sel	P7 – P1 0 A contact (NO) 1 B contact (NC)	000 0000[74]	X/A	6-42	O	O
89	0h1559	Multi-step command delay time	InCheck Time	1 - 5000 [ms]	1	X/A	6-13	O	O
90	0h155A	State of multi-function input terminal	DI Status	P7 – P1 0 Open (Off) 1 Connection (On)	000 0000	O/A	6-42	O	O
91	0h155B	Pulse input amount display	Pulse Monitor [kHz]	0.00 - 50.00 [kHz]	0.00	O/A		O	O
92	0h155C	TI input filter time constant	TI Filter	0 - 9999 [ms]	10	O/A		O	O
93	0h155D	Minimum input pulse of TI	TI Pls x1	0.00 - 32.00 [kHz]	0	O/A		O	O
94	0h153E	Output (%) at the TI min. pulse	TI Perc y1	0.00 - 100.00[%]	0.00	O/A		O	O
95	0h155F	Maximum input pulse of TI	TI Pls x2	0.00 - 32.00 [kHz]	32.00	O/A		O	O
96	0h1560	Output (%) at the TI max. pulse	TI Perc y2	0 - 100[%]	100.00	O/A		O	O
97	0h1561	TI rotation direction change	TI Inverting	0 No 1 Yes	0: No	O/A		O	O
98	0h1562	TI quantization level	TI Quantizing	0.00[75], 0.04 - 10.00[%]	0.04	O/A		O	O

* Codes in shaded rows are hidden codes that are displayed only after other setting corresponding codes.
23) In.12 - 15 will be displayed only when In.06 (V1 Polarity) is set to "Bipolar".
24) In.35 - 47 will be displayed only when SW2 on the IO board is selected to V.
25) In.50 - 62 will be displayed only when SW2 on the IO board is selected to I.

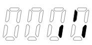
[74] The initial value 000 0000 is displayed as  in the SEG.

[75] Quantizing is not used when setting to 0.

10.7 Output Terminal Block Function Group (PAR → OU)

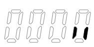
No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL SLT
00	-	Jump code	JumpCode	1 - 99		30	O/A	-	O	O
01	0h1601	Analog output 1 item	AO1 Mode	0	Frequency	0: Frequency	O/A	7-58	O	O
				1	Output Current					
				2	Output Voltage					
				3	DCLink Voltage					
				4	Torque					
				5	Output Power					
				6	Idse					
				7	Iqse					
				8	Target Freq					
				9	Ramp Freq					
				10	Speed Fdb					
				12	PID Ref Value					
				13	PID Fdb Value					
				14	PID Output					
				15	Constant					
02	0h1602	Analog output 1 gain	AO1 Gain	-1000.0 - 1000.0[%]		100.0	O/A	7-58	O	O
03	0h1603	Analog output 1 bias	AO1 Bias	-100.0 - 100.0[%]		0.0	O/A	7-58	O	O
04	0h1604	Analog output 1 filter	AO1 Filter	0 - 10000 [ms]		5	O/A	7-58	O	O
05	0h1606	Analog constant output 1	AO1 Const %	0.0 - 100.0[%]		0.0	O/A	7-58	O	O
06	0h1606	Analog output 1 monitor	AO1 Monitor	0.0 - 1000.0[%]		0.0	-/A	7-58	O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL SLT
30	0h161E	Fault output item	Trip Out Mode	Bit	000 - 111	010[76]	O/A	7-62	O	O
				1	Low voltage					
				2	Any faults other than low voltage					
				3	Automatic restart final failure					
31	0h161F	Multi-function relay 1 item	Relay 1	0	None	29: Trip	O/A	7-62	O	O
				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					
				22	Ready					
				28	Timer Out					
				29	Trip					
				31	DB Warn%ED					
				34	On/Off Control					
				35	BR Control					

[76] The initial value 010 will be displayed in SEG as .

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL SLT
33	0h1621	Multi-function output 1 item	Q1 Define	0	None	14: Run	O/A	7-62	O	O
				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					
				22	Ready					
				28	Timer Out					
				29	Trip					
				31	DB Warn%ED					
				34	On/Off Control					
				35	BR Control					
41	0h1629	Multi-function output monitoring	DO Status	-		00	X/A	7-62	-	-
50	0h1632	Multi-function output On delay	DO On Delay	0.00 - 100.00 [s]		0.00	O/A	7-68	O	O
51	0h1633	Multi-function output Off delay	DO Off Delay	0.00 - 100.00 [s]		0.00	O/A	7-68	O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL SLT
52	0h1634	Multi-function output contact selection	DO NC/NO Sel	Q1, Relay1		00[77]	X/A	7-68	O	O
				0	A contact (NO)					
				1	B contact (NC)					
53	0h1635	Fault output On delay	TripOut OnDly	0.00 - 100.00 [s]		0.00	O/A	7-67	O	O
54	0h1636	Fault output Off delay	TripOut OffDly	0.00 - 100.00 [s]		0.00	O/A	7-67	O	O
55	0h1637	Timer On delay	TimerOn Delay	0.00 - 100.00 [s]		0.00	O/A	7-66	O	O
56	0h1638	Timer Off delay	TimerOff Delay	0.00 - 100.00 [s]		0.00	O/A	7-66	O	O
57	0h1639	Detected frequency	FDT Frequency	0.00 - Max. frequency [Hz]		30.00	O/A	7-63	O	O
58	0h163A	Detected frequency band	FDT Band	0.00 - Max. frequency [Hz]		10.00	O/A	7-63	O	O
61	0h163D	Pulse output gain	TO Mode	0	Frequency	0	O/A	7-60	O	O
				1	Output Current					
				2	Output Voltage					
				3	DCLink Voltage					
				4	Torque					
				5	Output Power					
				6	Idse					
				7	Iqse					
				8	Target Freq					
				9	Ramp Freq					
				10	Speed Fdb					
				12	PID Ref Value					
				13	PID Fdb Value					
				14	PID Output					
				15	Constant					
62	0h163E	Pulse output gain	TO Gain	-1000.0 - 1000.0[%]		100.0	O/A	7-60	O	O
63	0h163F	Pulse output bias	TO Bias	-100.0 - 100.0[%]		0.0	O/A	7-60	O	O

[77] The initial value 00 will be displayed in SEG as .

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode	
								V/F	SL SLT
64	0h1640	Pulse output filter	TO Filter	0 - 10000 [ms]	5	O/A	7-60	O	O
65	0h1641	Pulse output constant output 2	TO Const %	0.0 - 100.0[%]	0.0	O/A	7-60	O	O
66	0h1642	Pulse output monitor	TO Monitor	0.0 - 1000.0[%]	0.0	O/A	7-60	O	O

10.8 Communication Function Group (PAR → CM)

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode V/F	Control mode SL
00	-	Jump code	Jump Code	1 - 99	20	O/A	-	O	O
01	0h1701	Built-in communication inverter ID	Int485 St ID	1 - 250	1	O/A	9-3	O	O
02	0h1702	Built-in communication protocol	Int485 Proto	0 ModBus RTU 2 LS Inv 485	0: ModBus RTU	O/A	9-3	O	O
03	0h1703	Built-in communication speed	Int485 BaudR	0 1200 bps 1 2400 bps 2 4800 bps 3 9600 bps 4 19200 bps 5 38400 bps 6 56 Kbps 7 115 Kbps[78]	3: 9600 bps	O/A	9-3	O	O
04	0h1704	Built-in communication frame setting	Int485 Mode	0 D8/PN/S1 1 D8/PN/S2 2 D8/PE/S1 3 D8/PO/S1	0: D8/PN/S1	O/A	9-3	O	O
05	0h1705	Transmission delay after reception	Resp Delay	0 - 1000 [ms]	5 ms	O/A	9-4	O	O
06[79]	0h1706	Communication option S/W version	FBus S/W Ver	-	0.00	O/A	Option	O	O
07	0h1707	Communication option inverter ID	FBus ID	0 - 255	1	O/A	Option	O	O
08	0h1708	FIELD BUS communication speed	FBUS BaudRate	-	12Mbps	-/A	Option	O	O
09	0h1709	Communication option LED status	FieldBus LED	-	-	O/A	Option	O	O
30	0h171E	Number of output parameters	ParaStatus Num	0 - 8	3	O/A	9-7	O	O
31	0h171F	Output communication address 1	Para Stauts-1	0000 - FFFF Hex	000A	O/A	9-7	O	O

[78] 115,200 bps.

[79] CM 06 – 9 codes will be displayed only after installing the communication option card. Refer to separate option user manual for the option.

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
32	0h1720	Output communication address 2	Para Stauts-2	0000 - FFFF Hex		000E	O/A	9-7	O	O
33	0h1721	Output communication address 3	Para Stauts-3	0000 - FFFF Hex		000F	O/A	9-7	O	O
34	0h1722	Output communication address 4	Para Stauts-4	0000 - FFFF Hex		0000	O/A	9-7	O	O
35	0h1723	Output communication address 5	Para Stauts-5	0000 - FFFF Hex		0000	O/A	9-7	O	O
36	0h1724	Output communication address 6	Para Stauts-6	0000 - FFFF Hex		0000	O/A	9-7	O	O
37	0h1725	Output communication address 7	Para Stauts-7	0000 - FFFF Hex		0000	O/A	9-7	O	O
38	0h1726	Output communication address 8	Para Stauts-8	0000 - FFFF Hex		0000	O/A	9-7	O	O
50	0h1732	Number of input parameters	Para Ctrl Num	0 - 8		2	O/A	9-7	O	O
51	0h1733	Input communication address 1	Para Control-1	0000 - FFFF Hex		0005	X/A	9-7	O	O
52	0h1734	Input communication address 2	Para Control-2	0000 - FFFF Hex		0006	X/A	9-7	O	O
53	0h1735	Input communication address 3	Para Control-3	0000 - FFFF Hex		0000	X/A	9-7	O	O
54	0h1736	Input communication address 4	Para Control-4	0000 - FFFF Hex		0000	X/A	9-7	O	O
55	0h1737	Input communication address 5	Para Control-5	0000 - FFFF Hex		0000	X/A	9-7	O	O
56	0h1738	Input communication address 6	Para Control-6	0000 - FFFF Hex		0000	X/A	9-7	O	O
57	0h1739	Input communication address 7	Para Control-7	0000 - FFFF Hex		0000	X/A	9-7	O	O
58	0h173A	Input communication address 8	Para Control-8	0000 - FFFF Hex		0000	X/A	9-7	O	O
70	0h1746	Communication multi-function input 1	Virtual DI 1	0	None	0: None	O/A	9-27	O	O
71	0h1747	Communication multi-function input 2	Virtual DI 2	1	FX	0: None	O/A	9-27	O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
72	0h1748	Communication multi-function input 3	Virtual DI 3	2	RX	0: None	O/A	9-27	O	O
73	0h1749	Communication multi-function input 4	Virtual DI 4	3	RST	0: None	O/A	9-27	O	O
74	0h174A	Communication multi-function input 5	Virtual DI 5	4	External Trip	0: None	O/A	9-27	O	O
75	0h174B	Communication multi-function input 6	Virtual DI 6	5	BX	0: None	O/A	9-27	O	O
76	0h174C	Communication multi-function input 7	Virtual DI 7	6	JOG	0: None	O/A	9-27	O	O
77	0h174D	Communication multi-function input 8	Virtual DI 8	7	Speed-L	0: None	O/A	9-27	O	O
				8	Speed-M					
				9	Speed-H					
				11	XCEL-L					
				12	XCEL-M					
				13	RUN Enable					
				14	3-Wire					
				15	2nd Source					
				16	Exchange					
				17	Up					
				18	Down					
				20	U/D Clear					
				21	Analog Hold					
				22	I-Term Clear					
				23	PID Openloop					
				24	P Gain2					
				25	XCEL Stop					
				26	2nd Motor					
				34	Pre Excite					
				38	Timer In					
				40	dis Aux Ref					
				46	FWD JOG					
				47	REV JOG					
				49	XCEL-H					
86	0h1756	Communication multi-function input monitoring	Virt DI Status	-		0	X/A	9-5	O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
94[80]	-	Communication data upload	Comm Update	0	No	0: No	-/A		O	O
				1	Yes					

[80] CM 94 code will be displayed only after installing the communication option card.

10.9 Application Function Group (PAR → AP)

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode V/F	Control mode SL
00	-	Jump code	Jump Code	1 - 99	20	O/A	-	O	O
01	0h1801	Application function selection	App Mode	0 None 1 - 2 Proc PID	0: None	X/A	-	O	O
[26)]16	0h1810	PID output monitor	PID Output	[%]	0.00	-/A	7-16	O	O
17	0h1811	PID reference monitor	PID Ref Value	[%]	50.00	-/A	7-16	O	O
18	0h1812	PID feedback monitor	PID Fdb Value	[%]	0.00	-/A	7-16	O	O
19	0h1813	PID reference setting	PID Ref Set	-100.00 - 100.00[%]	50.00	O/A	7-16	O	O
20	0h1814	PID reference selection	PID Ref Source	0 Keypad 1 V1 3 V2 4 I2 5 Int 485 7 FieldBus 11 Pulse	0: Key pad	X/A	7-16	O	O
21	0h1815	PID feedback selection	PID F/B Source	0 V1 2 V2 3 I2 4 Int 485 6 FieldBus 10 Pulse	0: V1	X/A	7-16	O	O
22	0h1816	PID controller proportional gain	PID P-Gain	0.0 - 1000.0[%]	50.0	O/A	7-16	O	O
23	0h1817	PID controller integral time	PID I-Time	0.0 - 200.0 [s]	10.0	O/A	7-16	O	O
24	0h1818	PID controller differentiation time	PID D-Time	0 - 1000 [ms]	0	O/A	7-16	O	O
25	0h1819	PID controller feed-forward compensation gain	PID F-Gain	0.0 - 1000.0[%]	0.0	O/A	7-16	O	O
26	0h181A	Proportional gain scale	P Gain Scale	0.0 - 100.0[%]	100.0	X/A	7-17	O	O
27	0h181B	PID output filter	PID Out LPF	0 - 10000 [ms]	0	O/A	7-17	O	O
29	0h181D	PID upper limit frequency	PID Limit Hi	PID lower limit frequency [Hz] - 300.00 [Hz]	60.00	O/A	7-17	O	O

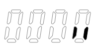
No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
30	0h181E	PID lower limit frequency	PID Limit Lo	-300.00 - PID upper limit frequency [Hz]		-60.00	O/A	7-17	O	O
31	0h181F	PID output inverse	PID Out Inv	0	No	0: No	X/A	7-17	O	O
				1	Yes					
32	0h1820	PID output scale	PID Out Scale	0.1 - 1000.0[%]		100.0	X/A	7-17	O	O
34	0h1822	PID controller motion frequency	Pre-PID Freq	0.00 - Max. frequency [Hz]		0.00	X/A	7-17	O	O
35	0h1823	PID controller motion level	Pre-PID Exit	0.0 - 100.0[%]		0.0	X/A	7-17	O	O
36	0h1824	PID controller motion delay time	Pre-PID Delay	0 - 9999 [s]		600	O/A	7-17	O	O
37	0h1825	PID sleep mode delay time	PID Sleep DT	0.0 - 999.9 [s]		60.0	O/A	7-17	O	O
38	0h1826	PID sleep mode frequency	PID Sleep Freq	0.00 - Max. frequency [Hz]		0.00	O/A	7-17	O	O
39	0h1827	PID wake-up level	PIDWakeUp Lev	0 - 100[%]		35	O/A	7-17	O	O
40	0h1828	PID wake-up mode setting	PID WakeUp Mod	0	Below Level	0: Below Level	O/A	7-17	O	O
				1	Above Level					
				2	Beyond Level					
42	0h182A	PID controller unit selection	PID Unit Sel	0	%	0:%	O/A	7-17	O	O
				1	Bar					
				2	mBar					
				3	Pa					
				4	kPa					
				5	Hz					
				6	rpm					
				7	V					
				8	I					
				9	kW					
				10	HP					
				11	℃					
				12	˚F					
43	0h182B	PID unit gain	PID Unit Gain	0.00 - 300.00[%]		100.00	O/A	7-17	O	O
44	0h182C	PID unit scale	PID Unit Scale	0	x100	2: x 1	O/A	7-17	O	O
				1	x10					
				2	x 1					
				3	x 0.1					
				4	x 0.01					

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode	
								V/F	SL
45	0h182D	PID 2nd proportional gain	PID P2-Gain	0.0 - 1000.0[%]	100.0	X/A	7-17	O	O

* Codes in shaded rows are hidden codes that are displayed only after setting other corresponding codes.
26) AP 16 - 45 will be displayed only when AP.01 (App Mode) is set to "Proc PID".

10.10 Protection Function Group (PAR → Pr)

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
00	-	Jump code	Jump Code	1 - 99		40	O/A	-	O	O
04	0h1B04	Load level setting	Load Duty	0	Normal Duty	1: Heavy Duty	X/A	8-3	O	O
				1	Heavy Duty					
05	0h1B05	Input/output open-phase protection	Phase Loss Chk	Bit	00 - 11	00[81]	X/A	8-8	O	O
				01	Open-phase of output					
				10	Open-phase of input					
06	0h1B06	Open-phase of input voltage band	IPO V Band	1 - 100[V]		15	X/A	8-8	O	O
07	0h1B07	deceleration time at fault	Trip Dec Time	0.0 - 600.0 [s]		3.0	O/A		O	O
08	0h1B08	Selection of startup on trip reset	RST Restart	0	No	0: No	O/A	7-39	O	O
				1	Yes					
09	0h1B09	Number of automatic restarts	Retry Number	0 - 10		0	O/A	7-39	O	O
[27)]10	0h1B0A	Automatic restart delay time	Retry Delay	0.0 - 60.0 [s]		1.0	O/A	7-39	O	O
12	0h1B0C	Motion at speed command loss	Lost Cmd Mode	0	None	0: None	O/A	8-11	O	O
				1	Free-Run					
				2	Dec					
				3	Hold Input					
				4	Hold Output					
				5	Lost Preset					
[28)]13	0h1B0D	Time to judge speed command loss	Lost Cmd Time	0.1 - 120 [s]		1.0	O/A	8-11	O	O
14	0h1B0E	Operation frequency at speed command loss	Lost Preset F	Start frequency - Max. frequency [Hz]		0.00	O/A	8-11	O	O
15	0h1B0F	Analog input loss judgement level	AI Lost Level	0	Half of x1	0: Half of x1	O/A	8-11	O	O
				1	Below x1					
17	0h1B11	Overload warning selection	OL Warn Select	0	No	0: No	O/A	8-3	O	O
				1	Yes					

[81] The initial value 00 will be displayed in SEG as .

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
18	0h1B12	Overload alarm level	OL Warn Level	30 - 200[%]		150	O/A	8-3	O	O
19	0h1B13	Overload warning time	OL Warn Time	0.0 - 30.0 [s]		10.0	O/A	8-3	O	O
20	0h1B14	Motion at overload fault	OL Trip Select	0	None	1: Free-Run	O/A	8-3	O	O
				1	Free-Run					
				2	Dec					
21	0h1B15	Overload fault level	OL Trip Level	30 - 200[%]		180	O/A	8-3	O	O
22	0h1B16	Overload fault time	OL Trip Time	0.0 - 60.0 [s]		60.0	O/A	8-3	O	O
25	0h1B19	Underload warning selection	UL Warn Sel	0	No	0: No	O/A	8-15	O	O
				1	Yes					
26	0h1B1A	Underload warning time	UL Warn Time	0.0 - 600.0 [s]		10.0	O/A	8-15	O	O
27	0h1B1B	Underload fault selection	UL Trip Sel	0	None	0: None	O/A	8-15	O	O
				1	Free-Run					
				2	Dec					
28	0h1B1C	Underload fault time	UL Trip Time	0.0 - 600.0 [s]		30.0	O/A	8-15	O	O
29	0h1B1D	Underload lower limit level	UL LF Level	10 - 30[%]		30	O/A	8-15	O	O
30	0h1B1E	Underload upper limit level	UL BF Level	30 - 100[%]		30	O/A	8-15	O	O
31	0h1B1F	No motor Motion at detection	No Motor Trip	0	None	0: None	O/A	8-17	O	O
				1	Free-Run					
32	0h1B20	No motor detection current level	No Motor Level	1 - 100[%]		5	O/A	8-17	O	O
33	0h1B21	No motor detection delay	No Motor Time	0.1 - 10.0 [s]		3.0	O/A	8-17	O	O
40	0h1B28	Electronic thermal fault selection	ETH Trip Sel	0	None	0: None	O/A	8-1	O	O
				1	Free-Run					
				2	Dec					
41	0h1B29	Motor cooling fan type	Motor Cooling	0	Self-cool	0: Self-cool	O/A	8-1	O	O
				1	Forced-cool					
42	0h1B2A	Electronic thermal 1 minute rating	ETH 1min	120 - 200[%]		150	O/A	8-1	O	O
43	0h1B2B	Electronic thermal continuous rating	ETH Cont	50 - 150[%]		120	O/A	8-1	O	O

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode V/F	Control mode SL
50	0h1B32	Stall prevention motion and flux braking	Stall Prevent	Bit	0000 - 1111	1000[82]	X/A	8-5	O	O
				0001	Accelerating					
				0010	At constant speed					
				0100	At deceleration					
				1000	FluxBraking					
51	0h1B33	Stall frequency 1	Stall Freq 1	Start frequency - stall frequency 1 [Hz]		60.00	O/A	8-5	O	O
52	0h1B34	Stall level 1	Stall Level 1	30 - 250[%]		180	X/A	8-5	O	O
53	0h1B35	Stall frequency 2	Stall Freq 2	Stall frequency 1 - stall frequency 2 [Hz]		60.00	O/A	8-5	O	O
54	0h1B36	Stall level 2	Stall Level 2	30 - 250[%]		180	X/A	8-5	O	O
55	0h1B37	Stall frequency 3	Stall Freq 3	Stall frequency 2 - stall frequency 4 [Hz]		60.00	O/A	8-5	O	O
56	0h1B38	Stall level 3	Stall Level 3	30 - 250[%]		180	X/A	8-5	O	O
57	0h1B39	Stall frequency 4	Stall Freq 4	Stall frequency 3 - Max. frequency [Hz]		60.00	O/A	8-5	O	O
58	0h1B3A	Stall level 4	Stall Level 4	30 - 250[%]		180	X/A	8-5	O	O
66	0h1B42	DB resistor warning level	DB Warn %ED	0 - 30[%]		0	O/A	8-13	O	O
79	0h1B4F	Cooling fan fault selection	FAN Trip Mode	0	Trip	0: Trip	O/A	8-16	O	O
				1	Warning					
80	0h1B50	Motion selection at option trip	Opt Trip Mode	0	None	1: Free-Run	O/A	8-17	O	O
				1	Free-Run					
				2	Dec					
81	0h1B51	Low voltage fault judgement delay time	LVT Delay	0.0 - 60.0 [s]		0.0	X/A	8-16	O	O
90	0h1B5A	Warning information	-			-	-/7		O	O
91	0h1B5B	Fault history 1	-			-	-/7		O	O
92	0h1B5C	Fault history 2	-			-	-/7		O	O
93	0h1B5D	Fault history 3	-			-	-/7		O	O
94	0h1B5E	Fault history 4	-			-	-/7		O	O
95	0h1B5F	Fault history 5	-			-	-/7		O	O

[82] The initial value 0000 will be displayed in SEG as .

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
96	0h1B60	Fault history deletion	-	0	No	0: No	-/7		O	O
				1	Yes					

* Codes in shaded rows are hidden codes that are displayed only after setting other corresponding codes.
27) Pr.10 will be displayed only when Pr.09 (Retry Number) is set to "0" or more.
28) Pr.13 - 15 will be displayed only when Pr.12 (Lost Cmd Mode) is not "NONE".

10.11 2nd Motor Function Group (PAR → M2)[83]

No.	Communication address	Name	LCD display	Setting range	Initial value	Property	Reference page	Control mode V/F	Control mode SL
00	-	Jump code	Jump Code	1 - 99	14	O/A	-	O	O
04	0h1C04	Acceleration time	M2-Acc Time	0.0 - 600.0 [s]	20.0	O/A	7-42	O	O
05	0h1C05	Deceleration time	M2-Dec Time	0.0 - 600.0 [s]	30.0	O/A	7-42	O	O
06	0h1C06	Motor Capacity	M2-Capacity	0: 0.2 kW 1: 0.4 kW 2: 0.75 kW 3: 1.1 kW 4: 1.5 kW 5: 2.2 kW 6: 3.0 kW 7: 3.7 kW 8: 4.0 kW 9: 5.5 kW 10: 7.5 kW 11: 11.0 kW 12: 15.0 kW 13: 18.5 kW 14: 22.0 kW 15: 30.0 kW	-	X/A	7-42	O	O
07	0h1C07	Base frequency	M2-Base Freq	30.00 - 400.00 [Hz]	60.00	X/A	7-42	O	O
08	0h1C08	Control mode	M2-Ctrl Mode	0: V/F 2: Slip Compen 4: IM Sensorless	0: V/F	X/A	7-42	O	O
10	0h1C0A	Number of motor poles	M2-Pole Num	2 - 48	Dependent on motor setting	X/A	7-42	O	O
11	0h1C0B	Rated slip speed	M2-Rated Slip	0 - 3000 [rpm]		X/A	7-42	O	O
12	0h1C0C	Motor rated current	M2-Rated Curr	1.0 - 1000.0 [A]		X/A	7-42	O	O
13	0h1C0D	Motor no-load current	M2-Noload Curr	0.5 - 1000.0 [A]		X/A	7-42	O	O
14	0h1C0E	Motor rated voltage	M2-Rated Volt	170 - 480[V]		X/A	7-42	O	O
15	0h1C0F	Motor efficiency	M2-Efficiency	70 - 100[%]		X/A	7-42	O	O

[83] Displayed when any of In. 65 – 71 is set to "2nd MOTOR"

No.	Communication address	Name	LCD display	Setting range		Initial value	Property	Reference page	Control mode	
									V/F	SL
16	0h1C10	Load inertia rate	M2-Inertia Rt	0 - 8			X/A	7-42	O	O
17	-	Stator resistor	M2-Rs	0.0 - 9.999[Ω]			X/A	7-42	O	O
18	-	Leakage inductance	M2-Lsigma	0.000 - 9.999 [mH]			X/A	7-43	O	O
19	-	Stator inductance	M2-Ls	0.00 - 99.99 [mH]			X/A	7-43	O	O
20	-	Rotor time constant	M2-Tr	25 - 5000 [ms]			X/A	7-43	O	O
25	0h1C19	V/F pattern	M2-V/F Patt	0	Linear	0: Linear	X/A	7-43	O	O
				1	Square					
				2	User V/F					
26	0h1C1A	Forward torque boost	M2-Fwd Boost	0.0 - 15.0[%]		2.0	X/A	7-43	O	O
27	0h1C1B	Reverse torque boost	M2-Rev Boost	0.0 - 15.0[%]			X/A	7-43	O	O
28	0h1C1C	Stall prevention level	M2-Stall Lev	30 - 150[%]		150	X/A	7-43	O	O
29	0h1C1D	Electronic thermal 1 minute rating	M2-ETH 1min	100 - 200[%]		150	X/A	7-43	O	O
30	0h1C1E	Electronic thermal continuous rating	M2-ETH Cont	50 - 150[%]		100	X/A	7-43	O	O

10.12 Group Dedicated for LCD Loader

10.12.1 Trip Mode(TRP Last-x)

No.	Function display	Name	Setting range		Initial value	Reference page
00	Trip Name(x)	Fault type disiplay	-		-	
01	Output Freq	Operation frequency at fault	-		-	
02	Output Current	Output Current at fault	-		-	
03	Inverter State	Acceleration/Deceleration state at fualt	-		-	
04	DCLink Voltage	DC section state	-		-	
05	Temperature	NTC temperature	-		-	
06	DI State	Input terminal state	-		0000 0000	
07	DO state	Output terminal state	-		000	
08	Trip On Time	Fault time after Power on	-		0/00/00 00:00	
09	Trip Run Time	Fault time after operation start	-		0/00/00 00:00	
10	Trip Delete?	Delete fault history	0	No	0: No	
			1	Yes		

10.12.2 Config Mode (CNF)

No.	Function display	Name	Setting range		Initial value	Reference page
00	Jump Code	Jump code	1 - 99		1	-
01	Language Sel	keypad language selection	0: English		English	7-71
			1: Korean			
02	LCD Contrast	LCD contrast adjustment	-		-	7-54
10	Inv S/W Ver	Main body S/W version	-		-	7-54
11	KeypadS/W Ver	Keypad S/W version	-		-	7-54
12	KPD Title Ver	Keypad title version	-		-	7-54
20	Anytime Para	Status window display item	0	Frequency	0: Frequency	7-73
21	Monitor Line-1	Monitor mode display item 1	1	Speed	0: Frequency	7-72
22	Monitor Line-2	Monitor mode display item 2	2	Output Current	2: Output Current	7-72
23	Monitor Line-3	Monitor mode display item 3	3	Output Voltage	3: Output Voltage	7-72
			4	Output Power		
			5	WHour Counter		

No.	Function display	Name	Setting range		Initial value	Reference page
			6	DCLink Voltage		
			7	DI State		
			8	DO State		
			9	V1 Monitor[V]		
			10	V1 Monitor[%]		
			13	V2 Monitor[V]		
			14	V2 Monitor[%]		
			15	I2 Monitor[mA]		
			16	I2 Monitor[%]		
			17	PID Output		
			18	PID Ref Value		
			19	PID Fdb Value		
			20	Torque		
			21	Torque Limit		
			23	Speed Limit		
24	Mon Mode Init	Monitor mode initialization	0	No	0: No	7-72
			1	Yes		
30	Option-1 Type	Option slot 1 type display	0	None	0: None	7-54
31	Option-2 Type	Option slot 2 type display	6	Ethernet	0: None	7-54
32	Option-3 Type	Option slot 3 type display	9	CANopen	0: None	7-54
40	Parameter Init	Parameter initialization	0	No		7-49
			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	APP Grp		
			12	PRT Grp		
			13	M2 Grp		
			16	SPS Grp		
41	Changed Para	Changed parameter Sign	0	View All	0: View All	7-51
			1	View Changed		
42	Multi Key Sel	ESC Key item	0	None	0: None	7-51
			1	JOG Key		
			2	Local / Remote		
			3	UserGrp SelKey		

No.	Function display	Name	Setting range		Initial value	Reference page
43	Macro Select	Macro function item	0	None	0: No	7-53
			1	Draw App		
44	Erase All Trip	Fault history deletion	0	No	0: No	7-54
			1	Yes		
45	UserGrp AllDel	User registration code deletion	0	No	0: No	7-52
			1	Yes		
46	Parameter Read	Read parameters	0	No	0: No	7-47
47	Parameter Write	Write parameters	0	No	0: No	7-47
			1	Yes		
48	Parameter Save	Save parameters	0	No	0: No	7-47
			1	Yes		
50	View Lock Set	Hide parameter mode	0 - 9999		Un-locked	7-50
51	View Lock Pw	Password for hiding parameter mode	0 - 9999		Password	7-50
52	Key Lock Set	Lock parameter edit	0 - 9999		Un-locked	7-50
53	Key Lock Pw	Password for locking parameter edit	0 - 9999		Password	7-50
60	Add Title Up	Additional title update	0	No	0: No	7-54
			1	Yes		
61	Easy Start On	Simple parameter setting	0	No	1: Yes	7-54
			1	Yes		
62	WHCount Reset	Initialize power consumption	0	No	0: No	7-54
			1	Yes		
70	On-time	Inverter accumulated motion time	Year/month/day hour: minute		-	7-74
71	Run-time	Inverter accumulated operation time	Year/month/day hour: minute		-	7-74
72	Time Reset	Initialize inverter accumulated operation time	0	No	0: No	7-74
			1	Yes		7-74
74	Fan Time	Cooling fan accumulated operation time	Year/month/day hour: minute		-	7-74
75	Fan Time Rst	Initialize cooling fan accumulated operation time	0	No	-	7-74

11. Troubleshooting and Inspection

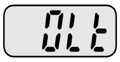
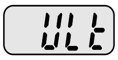
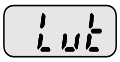
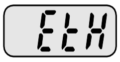
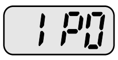
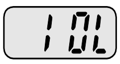
⚠ **Caution**

Be sure to read the safety precautions in the beginning of this manual before checking the inverter.

11.1 Protection Function Item

■ Protection from output current and input voltage

Table 11-1 Protection function item from output current and input voltage

SEG display	LCD display	Type	Contents	Notes
	Over Load	Latch	Occurs if the motor overload fault is selected and the load level exceeds the set level. Works only when Pr.20 is set to any value other than No. 0.	-
	Under Load	Latch	Occurs if the underload protection function is selected and the motor load level is not more than the set underload level. Works only when Pr.27 is set to any value other than No. 0.	-
	Over Current1	Latch	Occurs if the inverter output current is greater than 200 % of the rated current.	-
	Over Voltage	Latch	Occurs if the internal DC circuit voltage increases more than the specified value.	-
	Low Voltage	Level	Occurs if the internal DC circuit voltage decreases less than the specified value.	-
	Low Voltage2	Latch	Occurs if the internal DC circuit voltage decreases less than the specified value during the inverter operation.	-
	Ground Trip	Latch	Occurs if a ground fault occurs in the inverter output side causing a current greater than the specified value to flow. There is a difference in the ground fault detection currents depending on the inverter capacity.	-
	E-Thermal	Latch	Occurs according to the inverse time-limit thermal characteristic to prevent overheating in the motor. Works only when Pr.40 is set to any value other than No. 0.	-
	Out Phase Open	Latch	Occurs if one or more phases to the motor is open circuit. Works only when bit 1 of Pr.05 is set to 1.	-
	In Phase Open	Latch	Occurs if one of the input power phases is missing. Works only when bit 2 of Pr.05 is set to 1.	-
	Inverter OLT	Latch	A protection function for the inverse time-limit thermal characteristic to protect the inverter from overheating. It is based on 150 %, 1 minute and 200 %, 4 seconds according to the inverter rated current. For 200 %, 4 seconds, there is a difference depending on the inverter capacity.	-
	No Motor Trip	Latch	Occurs if the motor is not connected when operating the inverter. Works only when Pr.31 is set to No. 1.	-

Notes
▪ Level: Resets automatically if the fault is corrected. It is not saved in the fault history. ▪ Latch: Resets if the reset signal is input after the fault is corrected. ▪ Fatal: Once the fault is corrected, the fault is reset if you turn off the inverter power and then turn it on again after the internal charge lamp power is turned off. Contact our customer service center if the fault still remains after turning on the power again. ▪ When using the LCD loader, the trip details are displayed in the SEG loader and "TRIP" message is displayed in the SEG regardless of the trip details. ▪ When more than one trip occurs, the first trip is displayed in the SEG and the subsequent trips are displayed by priority in the SEG.

■ Protection via abnormal internal circuit and external signals

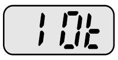
Table 11-2 Protection function item via abnormal internal circuit and external signals

SEG display	LCD display	Type	Contents	Notes
OHt	Over Heat	Latch	This fault occurs if the temperature of the inverter heat sink increases more than the specified value.	-
OC2	Over Current2	Latch	This fault occurs if the DC section in the inverter detects shorted circuit current.	-
EXt	External Trip	Latch	External fault signal by the function selection of the multi-function terminal. Select No.4 External Trip in the functions of No. In.65 - 71.	-
bX	BX	Level	Blocks the inverter output by the function selection of a multi-function terminal. Select No.5 BX in the functions of No. In.65 - 71.	-
HWt	H/W-Diag	Fatal	When the problems occurs in the memory (EEPRom), analog-digital converter output (ADC Off Set), CPU malfunction (Watch Dog-1, Watch Dog-2), and others of the inverter. - EEP Err: When the problem occurs at the parameter read/write due to KPD EEP Rom burn-out, etc. - ADC Off Set: When the problems occurs in the current sensing section (U/V/W CT, etc.)	-
ntC	NTC Open	Latch	This fault occurs if the problem is detected with the temperature detection sensor of the IGBT (Insulated Gate Bipolar Transistor).	-
FAn	Fan Trip	Latch	This fault occurs if a problem is detected in the cooling fan. Works only when Pr.79 is set to No. 0.	Applicable to product below 22 kW
PId	Pre-PID Fail	Latch	If the controlled variable (PID feedback) is input below set value by the function settings of AP.34 - 36 during the Pre-PID operation, it is judged as an error in the load system and the fault occurs.	-
Xbr	Ext-Brake	Latch	Works when operating with external brake signal by the function selection of a multi-function terminal. This fault occurs if the inverter output current at the inverter start remains below Ad-41. Set any of OU-31 and 32 to No. 35 BR Control.	-

SEG display	LCD display	Type	Contents	Notes
 	Safety A(B) Err	Level	This fault occurs if either or both of the safety relay input signals (SA, SB) are lost.	-

■ Protection via option

Table 11-3 Protection function item via keypad and option

SEG display	LCD display	Type	Contents	Notes
	Lost Command	Level	This fault occurs if the frequency command or operation command via the terminal block, communication or other without using the keypad is lost. Works only when Pr.12 is set to any value other than No. 0.	-
	IO Board Trip	Latch	Occurs if basic I/O or external communication card is not connected to inverter or there is poor connection.	-
				-
			Occurs if fault persists for longer than 5 seconds.	-
	ParaWrite Trip	Latch	Occurs if communication is not established during parameter writing due to a Loader cable problem, bad connection, etc.	Applicable when the LCD keypad is used
	Option Trip-1	Latch	Occurs if there is a problem between the inverter main body and an option card (communication).	Applicable when an option is used

11.2 Alarm Function Item

Table 11-4 Alarm function item

SEG display	LCD display	Description
OL	Over Load	This alarm signal occurs if the motor is over-loaded. Works only when Pr.17 is set to 1. If the signal is required to be sent to the output contact, select No. 5 Over Load among the functions of No. OU.31 and 33.
UL	Under Load	If the underload alarm is required, select "1" in the No. Pr.25. For the output signal, select No. 7 Under Load in the functions of No. OU.31 and 33.
IOL	Inv Over Load	This alarm occurs if accumulated time is 60 % of the level of the inverter overheat protection function (Inverter IOLT). For the output signal, select No. 6 IOL in the functions of No. OU.31 and 33.
LC	Lost Command	This alarm signal can be output even if Pr.12 Lost Cmd Mode is selected to No. 0. The alarm occurs under the set condition in the Pr.13 - 15. For the output signal, select No. 13 Lost Command in the functions of OU.31 - 33.
FAn	Fan Warning	This alarm occurs if a problem is detected in the cooling fan with Pr.79 FAN Trip Mode set to No. 1. For the output signal, select No. 8 Fan Warning in the functions of OU.31 and 33.
db	DB Warn %ED	This alarm occurs if DB resistor usage is above the set value. Set the detection level in Pr.66.
trEr	Retry Tr Tune	Works only when DR.9 is set to No. 4. Occurs if the time constant (Tr) of the motor's rotor is too low or too high during auto-tuning.

11.3 Troubleshooting

Type	Cause	Remedy
Over Load	▪ The load is above the motor rated capacity. ▪ The setting of the overload fault level (Pr.21) is too small.	▪ Increase the capacity of the motor and the inverter. ▪ Increase the setting in the overload fault level.
Under Load	▪ There is a problem with the mechanical connection between the motor and the load. ▪ The underload level (Pr.29, 30) is set above the minimum system load.	▪ Check the mechanical/ physical connection between the motor and the load for damage. ▪ Decrease the setting of the underload level.
Over Current1	▪ The Acc/Dec time is too short compared to the load inertia (GD^2). ▪ The inverter load is above the rated capacity. ▪ The inverter output is sent during the motor idling or coasting. ▪ The mechanical brake motion for motor is too fast.	▪ Increase the Acc/Dec time setting. ▪ Replace the inverter with an inverter of higher capacity. ▪ Operate after the motor stops or use the speed search function (Cn.60). ▪ Check the mechanical brake.
Over Voltage	▪ The deceleration time is too short compared to the load inertia (GD^2). ▪ A regenerative load is connected to the inverter. ▪ The input power voltage is too high.	▪ Increase the deceleration time setting. ▪ Use braking resistor(s). ▪ Check that the input power voltage is below the specified value.
Low Voltage	▪ The input power voltage is too low. ▪ A load that is larger than the power capacity is connected to the power system. (welder, direct motor connection, etc.) ▪ A magnetic contactor or other device on the power input side has opened momentarily or malfunctioned.	▪ Check that the input power voltage is above the specified value. ▪ Increase the power capacity. ▪ Replace the magnetic contactor.
Low Voltage2	▪ The input power voltage has decreased during the operation. ▪ An input phase-loss has occurred. ▪ A magnetic contactor or other device on the power input has malfunctioned.	▪ Check that the input power voltage is above the specified value. ▪ Check the input wiring. ▪ Replace the magnetic contactor if broken.
Ground Trip	▪ A ground fault has occurred in the inverter output line. ▪ The motor insulation is damaged.	▪ Check the output terminal wiring of the inverter. ▪ Replace the motor.
E-Thermal	▪ The motor could be overheating. ▪ The inverter load is above the rated capacity. ▪ The electronic thermal level is set too low. ▪ The inverter has operated the motor at low speed for a long time.	▪ Decrease the load or the operation frequency. ▪ Increase the inverter capacity. ▪ Set the electronic thermal level properly. ▪ Use forced cooling method on motor.

Type	Cause	Remedy
Out Phase Open	▪ A magnetic contactor, Isolator or other device is faulty on the inverter output side. ▪ The output wiring is faulty.	▪ Check the device(s) on the output side for faults. ▪ Test the output wiring.
In Phase Open	▪ A magnetic contactor or other devise is faulty on the input side. ▪ The input wiring is faulty. ▪ The inverter DC capacitor(s) needs to be replaced.	▪ Check the magnetic contactor on the inverter input side. ▪ Check the input wiring. ▪ The inverter DC capacitor(s) should be replaced. Contact a local service center.
Inverter OLT	▪ The load is above the inverter rated capacity. ▪ The torque boost level is too high.	▪ Increase the capacity of the motor and the inverter. ▪ Decrease the torque boost level.
Over Heat	▪ The cooling system has a problem. ▪ The inverter is used for longer than the replacement interval of the cooling fan. ▪ Ambient temperature is too high.	▪ Check for any foreign substances in the vent such as the air intake, the exhaust, and others. ▪ The inverter cooling fan should be replaced. ▪ Keep the ambient temperature of the inverter below 50°C.
Over Current2	▪ A short circuit has occurred in the inverter output line. ▪ An inverter IGBT (output switching device) is faulty.	▪ Check the output terminal wiring of the inverter. ▪ Inverter operation is not possible. Contact a local service center.
NTC Open	▪ The ambient temperature is too high. ▪ The internal temperature sensor for the inverter is faulty.	▪ Operate the inverter in area at which the ambient temperature is above -10℃. ▪ Contact a local service center.
FAN Lock	▪ Foreign matter or substance has stuck in the inverter vent in which the fan is located. ▪ The inverter cooling fan needs to be replaced.	▪ Check the air intake and exhaust. ▪ The inverter cooling fan should be replaced.
IP54 FAN Trip	▪ The fan connector is not connected. ▪ The inverter cooling fan needs to be replaced.	▪ Connect the fan connector. ▪ The inverter cooling fan should be replaced.

11.4 Troubleshooting in Case of No Alarm Display

■ You cannot set the parameters.

Cause	Measure
The inverter is in operation. (The inverter is in drive mode.)	Stop the inverter to change to the program mode and then set the parameters.
The parameter access level is incorrect.	Check the correct parameter access level and then set the parameters.
The password is incorrect.	Check the password, reset the parameter UNLOCK and then set the parameters.
Low voltage has been detected.	Check the power input to reset the low voltage status and then set the parameters.

■ The motor does not rotate according to the command even if the Forward key on the keypad is pressed or an external operation signal is input.

- The motor does not rotate.

Cause	Measure
The setting for the frequency command method is incorrect.	Check the setting for the frequency command method.
The setting for the operation command method is incorrect.	Check the setting for the operation command method.
The power is not supplied to the terminal R, S, T.	Check the connection of the terminal R, S, T and U, V, W.
Is the power lamp turned off?	Power on the inverter.
The operation command RUN is off.	Turn on the operation command RUN.
The motor is locked.	Unlock the motor or decrease the load.
The load is too heavy.	Operate the motor independently.
An emergency stop signal is input.	Reset the emergency stop signal and try again.
The wiring for the control circuit terminal is incorrect.	Check the wiring for the control circuit terminal, perform correct wiring and try again.
The selection for the input method of frequency command is incorrect.	Check the input method of frequency command, perform correct setting and try again.
The selection for the voltage/current input of the main frequency command is incorrect.	Check the voltage/current input, perform correct setting and try again.
The selection for the sink mode/source mode is incorrect.	Check the sink mode/source mode setting, change the setting correctly and try again.
The frequency command value is too low.	Check the frequency command to input a value above the minimum frequency and try again.
The STOP key is pressed.	This is normal stop.
The motor torque is too low.	Use a different inverter control type such as V/F, Sensorless, etc.

Cause	Measure
	If the same problem persists, increase the inverter and motor capacity.

- The motor rotates in the direction opposite to the command.

Cause	Measure
The wiring for the motor output cable is incorrect.	Change over any 2 from 3 motor wires (U, V, W).
The connection between the control circuit terminal (forward/reverse rotation) for the inverter and the forward/reverse rotation signal on the control panel side is incorrect.	Check the forward/reverse rotation wiring and make any corrections necessary.

- The motor rotates in only one direction.

Cause	Measure
The reverse rotation prohibition is selected.	Remove the reverse rotation prohibition (Ad.09 = 1 or 2) and try again.
The reverse rotation signal is not input even if the 3-wire sequence is selected.	Check the input signal associated with the 3-wire operation to make the correct adjustment.

■ The motor is overheated.

Cause	Measure
The load is too high.	▪ Decrease the load. ▪ Increase the Acc/Dec time. ▪ Check the parameters associated with the motor and set the correct values. ▪ Replace the motor and the inverter with those of the capacity suitable for the load level.
The ambient temperature of the motor is too high.	▪ Improve the environment to decrease the ambient temperature of the motor.
The phase-to-phase withstanding voltage of the motor is insufficient.	▪ Use a motor whose phase-to-phase surge withstanding voltage is larger than maximum surge voltage. ▪ Use the motor only for 400 V inverter. ▪ Connect an AC reactor to the inverter output side. ▪ (When connecting the AC reactor, set the carrier frequency to 2 kHz.)
The motor fan has stopped or the fan is obstructed with dust and dirt.	Clean the motor fan to remove the foreign substance.

■ The motor stops during acceleration or when the load is connected.

Cause	Measure
▪ The load is too high.	▪ Decrease the load. ▪ Replace the motor and the inverter with those of a higher capacity.

■ The motor does not accelerate/The acceleration time is too long.

Cause	Measure
The frequency command value is low.	▪ Check the frequency command, input a correct value and try again.
The load is too high.	▪ Decrease the load. ▪ Increase the acceleration time. ▪ Check the mechanical brake status.
The acceleration time setting is too long.	▪ Check and change the acceleration time.
The combined value of the motor properties and the inverter parameter settings.	▪ Check and change the parameters associated with the motor.
The level for stall prevention during acceleration is low.	▪ Check and change the stall prevention level.
The level for stall prevention during operation is low.	▪ Check and change the stall prevention level.
The starting torque is insufficient.	▪ Change to vector control operation and try again. Auto-tuning required. ▪ If the same problem persists increase the motor and the inverter capacity.

■ Vibration occurs in rotation during operation.

Cause	Measure
The load variance is too high.	▪ Increase the capacity of the motor and the inverter.
The power voltage changes.	▪ Decrease the power voltage variance.
Vibration occurs at specific frequencies.	▪ Adjust the output frequency to avoid the resonance area.

■ The motor overheats and rotation is unstable.

Cause	Measure
The V/F pattern setting is incorrect.	▪ Set the V/F pattern suitable for the motor specification.

■ The motor deceleration time is too long even if a Dynamic Braking (DB) resistor option is connected.

Cause	Measure
The deceleration time setting is too long.	▪ Check the deceleration time and change the setting.
The motor torque is insufficient.	▪ If the parameters associated with the motor are normal, the motor capacity is insufficient. ▪ Therefore, increase the motor capacity.
The load is above the internal torque limit that is determined from the inverter rated current.	▪ Increase the inverter capacity.

■ Motor speed holding is poor at low speed lightly loaded conditions.

Cause	Measure
The carrier frequency is high.	▪ Decrease the setting of the inverter carrier frequency.
Over-excitation has occurred due to inaccurate V/F setting at low speed.	▪ Decrease the torque boost value to avoid over-excitation.

■ When operating the inverter, other equipment close by operates incorrectly.

Cause	Measure
Radio frequency interference from the motor cable.	▪ Reduce the carrier frequency to minimum. ▪ Install a screened cable between the inverter and the motor. Connect the screen at BOTH ends to ground. .

■ When operating the inverter, the earth leakage breaker is actuated.

Cause	Measure
An earth leakage breaker (RCD) is actuated by the leakage current from the inverter.	▪ Ground the inverter by connecting it to a dedicated ground terminal. ▪ Check that the ground resistance is below 100 ohms for the 200 V series and 10 ohms for the 400 V series. ▪ Check the sensitivity of the earth leakage breaker. Can the trip current be increased safely? ▪ Decrease the setting of the inverter carrier frequency. ▪ Reduce the cable length between the inverter and the motor or fit a sinusoidal filter in the motor cable.

■ When the motor rotates, vibration occurs in the machine.

- The motor vibrates severely and does not rotate normally.

Cause	Measure
▪ The phase voltage balance is poor.	▪ Check the input power voltage to stabilize the power. ▪ Check the motor insulation status.

- Humming noise or other noise occurs in the motor.

Cause	Measure
▪ Resonance occurs between the machine's natural frequency and the carrier frequency.	▪ Increase or decrease the carrier frequency slightly.
▪ Resonance occurs between the machine's natural frequency and the inverter output frequency.	▪ Increase or decrease the inverter command frequency slightly. ▪ Use the frequency jump function to avoid the frequency band in which the resonance occurs.

- Vibration/hunting occurs in the motor.

Cause	Measure
▪ The frequency command contains electronic noise.	▪ If noise gets into the analog input terminal causing disturbance in the frequency command, change the value of the input filter time constant (IN07).
▪ The wiring of the inverter and the motor is long.	▪ Keep the total wiring length of the inverter and the motor within 100 m. (Below 3.7 kW: within 50 m)

■ The motor does not stop completely even if the inverter output stops.

Cause	Measure
DC braking does not work normally at stop therefore it is impossible to decelerate sufficiently.	▪ Adjust the parameters associated with the DC braking. ▪ Increase the DC braking current setting. ▪ Increase the DC braking time setting at stopping.

■ The output frequency is not increased to the command frequency.

Cause	Measure
The command frequency is within the jump frequency range.	▪ Set the command frequency again to outside the jump frequency range.
The upper limit for the frequency command is exceeded.	▪ Set the upper limit for the frequency command to above the command frequency you wish to set.
The stall prevention function is working during acceleration due to high load.	▪ Replace the inverter with the one of next higher capacity.

■ The cooling fan does not rotate.

Cause	Measure
The parameters for the cooling fan control are not set correctly.	▪ Check the parameter setting for the cooling fan control. ▪ During Run (fan working at inverter operation), Always On (fan always working), Temp Control (fan working above certain temperature)

11.5 Cooling Fan Replacement

■ Fan replacement procedure (for 5.5 - 22.0 kW product)

To replace the fan, press the fan bracket on the top of the product in the direction of the arrow and pull it forward, and then disconnect the fan connector.

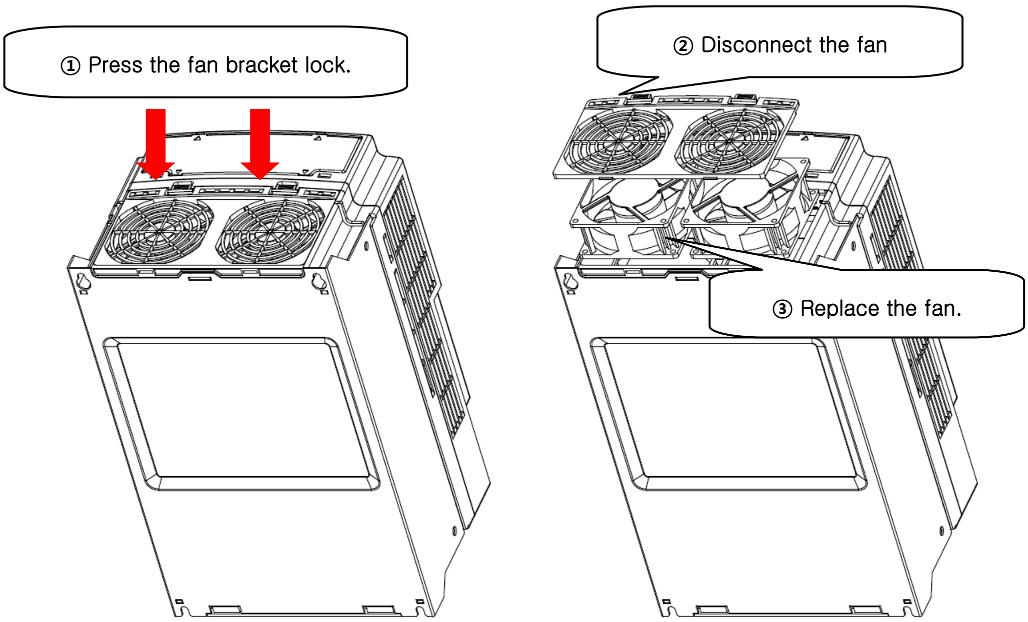


Figure 11-1 5.5 - 22.0 kW

11.6 Daily Inspection and Regular Inspection List

■ Daily inspection

Inspection area	Inspection item	Things to inspect	Inspection method	Judgement criteria	Inspection equipment
All	Ambient environment	Check for ambient temperature, humidity, dust, and others.	Refer to Safety Precautions in page v.	No icing (ambient temperature: -10 - +40) and no condensation (ambient humidity below 50%)	Thermometer, hygrometer, recorder
	Complete device	Is there any abnormal vibration or noise?	Determine it visually or acoustically.	OK or not OK	
	Power voltage	Is main circuit voltage OK?	Measure voltage between inverter terminal board R, S, T-phase.	-	Digital multimeter /tester
Main circuit	Main DC capacitor(s)	1) Is there any leakage? 2) Is capacitor split or swollen?	1) , 2) Check it visually.	1), 2) OK or not OK	-
Cooing system	Cooling fan	1) Is there any abnormal vibration or noise?	1) With power off, turn it by hand.	1) Must be turned smoothly	-
Display	Meter	Is display value OK?	Check display value on the panel.	Check specified value and standard value.	Voltmeter/ ammeter, etc.
Motor	All	1) Is there any abnormal vibration or noise? 2) Is there any abnormal smell?	1) Check it by hand, visually, and acoustically. 2) Check for problem such as overheat or damage.	OK or not OK	-

■ Regular inspection (annually)

Inspection area	Inspection Item	What to Inspect	Inspection method	Judgement criteria	Inspection equipment
Main circuit	All	1) Inspect megger (between main circuit terminal and ground terminal) 2) Is there anything loose in fastening area? 3) Is there any overheat evidence in each part?	1) Disconnect inverter and short R, S, T, U, V, W terminal, and then measure from this section to ground terminal using megger. 2) Tighten screws. 3) Check it visually.	1) Must be above 5 MΩ 2), 3) OK or not OK	DC 500 V megger
	Connecting conductor /wire	1) Is there any corrosion in conductor? 2) Is there any damage to wire sheath?	1) , 2) Check it visually.	1), 2) OK or not OK	-
	Terminal block	Is there any damage?	Check it visually.	Must be OK	-
	Smoothing condenser	Measure electrostatic capacity.	Measure it using capacity meter.	Must be above 85% of rated output capacity	Capacity meter
	Relay	1) Is there any chattering noise during operation? 2) Is there any damage in contact?	1) Check it acoustically. 2) Check it visually.	Relay must operate correctly	-
	Braking resistor	1) Is there any damage in resistor? 2) Check for evidence.	1) Check it visually. 2) Disconnect one side and measure it using tester.	1) OK or not OK 2) Must be within ±10% of resistor rated value	Digital multimeter/ analog tester
Control circuit Protection circuit	Motion check	1) Check each output voltage for unbalance during inverter operation. 2) After testing sequence protection motion, display circuit must be OK.	1) Measure voltage between inverter output terminal U, V, W. 2) Short or open inverter protection circuit output forcibly.	1) Phase-to-phase voltage balance For 200 V (400 V) application, it must be within 4 V (8 V) 2) Circuit must work without any problem according to sequence.	Digital multimeter/ DC voltmeter
Cooing system	Cooling fan	Check the connector and wiring is OK.	Correct any problems in this area.	Cooling fan must operate correctly.	-
Display	Meter	Is display value OK?	Check display value on the panel.	Check specified value and standard value.	Voltmeter/ ammeter, etc.

■ Regular inspection (bi-annually)

Inspection area	Inspection Item	Things to inspect	Inspection method	Judgement criteria	Inspection equipment
Main circuit	All	Megger check (between main circuit terminal and ground terminal)	Disconnect inverter and short R, S, T, U, V, W terminal, and then measure from this section to ground terminal using megger.	5 MΩ or over	DC 500 V megger
Motor	Insulation Resistance	Megger check (between output terminal and ground terminal)	Disconnect U, V, W and tie up motor wiring.	5 MΩ or over	DC 500 V megger

Quality Assurance

Product Name	LSIS Standard Inverter	Date of Installation	
Model Name	LSLV-S100	Warranty Period	

Customer	Name	
	Address	
	Phone	
Retailer	Name	
	Address	
	Phone	

This product was produced under strict quality control and test procedures of LS industrial Systems technicians.

It's term of warranty is 12 months after the date of installation. If no date of installation is written, the warranty is valid for 18 months after the date of manufacture.

However, this term of warranty may change depending on contract terms.

Free Technical Support

If malfunction occurs when the product has been used in a proper manner and the product warranty has not expired, contact one of our agencies or designated service centers. We will repair the product free of charge.

Paid Technical Support

A certain fee will be charged for service in the following cases:

- **Malfunction was caused by the intentional or unintentional negligence of the consumer.**
- **Malfunction was caused by inappropriate voltage or defects of machines connected to the product.**
- **Malfunction was caused by Act of God (fire, flood, gas, earthquake, etc.).**
- **The product was modified or repaired in a place that is not our agency or service center.**
- **The product does not have a LSIS plate attached to it**
- **The warranty has expired.**

Please visit LSIS homepage***(http://www.lsis.biz)*** for more useful information and services:

Manual Revision History

Number	Issued Year and Month	Revised Content	Version No.	Notes
1	2011	First edition	1.00	-
2				

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