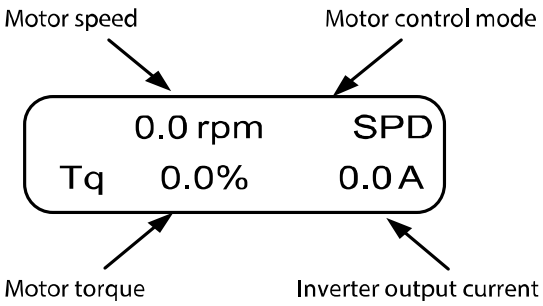
6 Detailed operation by the function groups

6.1 Display (DIS) group

6.1.1 DIS_00 (Motor operation monitoring)

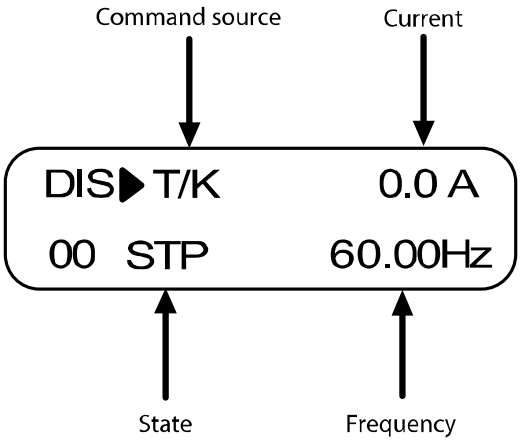
Motor operation monitoring is the default code displayed when the inverter is turned on. On the keypad, the motor speed, motor control mode, motor torque, and the output current from the inverter are displayed.



6.1.1.1 Display information for Speed and Speed (Synch) mode operation

Code	Name	Unit	Description	
DIS_00	Motor speed	rpm	Actual motor speed	
	Motor control mode		SPD	Speed control mode
			BX	Emergency stop state
			BAT	Operation on battery
	Motor torque	%	Motor torque as a percentage of the rated output	
	Inverter output current	A	Actual output current from the inverter	

6.1.1.2 Display information for V/F and Slip Comp mode operation



Code	Name	Description		
DIS_00	Command source	Operation command	T	Operation command by terminal input
			K	Operation command by keypad
			O	Operation command by built-in RS-485 communication
		Frequency command	A	Frequency command by analog input
			K	Frequency command by keypad
			O	Frequency command by built-in RS-485 communication
	Current	Actual output current from the inverter		
	State	STP		Inverter stopped
		FWD		Inverter operating in forward direction
		REV		Inverter is operating in reverse direction
	Frequency	Output frequency (when the inverter is operating) / frequency reference (when the inverter is stopped)		

6.1.2 User defined information (DIS_01, 02, 03)

You can configure codes DIS_01, 02, and 03 to choose to display on the keypad one of the following information listed in the following table.

By default, DIS_01 is set to "PreRamp Ref," DIS_02 to "DC Bus Volt," and DIS_03 to "Terminal In".

Code	Keypad display	Name	Unit	Description
DIS_01 - DIS_03	Ai1 Value – Ai3 Value	Multi-function analog	%	Multifunction analog input value is displayed in a percentage (10 V/100%, 20 mA /100%)
	PreRamp Ref	Speed reference before acceleration or deceleration	rpm	Displays motor rpm reference before an acceleration/deceleration routine.
	PostRamp Ref	Speed reference after acceleration or deceleration	rpm	Displays motor rpm reference after an acceleration/deceleration routine.
	ASR Inp Ref	Speed controller input reference	rpm	Displays the actual reference that is given to the speed controller.
	Output Freq	Output frequency	Hz	Displays the inverter output frequency.
	Motor Speed	Motor Rotation speed	rpm	Displays the actual motor rotation speed.
	Speed Dev	Speed deviation	rpm	Displays the difference between the speed reference and the actual motor rotation.
	ASR Out	Speed controller output	%	Displays the speed controller output in a percentage to the rated torque.
	Torque Bias	Torque bias	%	Displays the torque bias in a percentage to the rated torque.

Code	Keypad display	Name	Unit	Description
	PosTrq Limit	Forward torque limit	%	Displays the forward torque limit in a percentage to the rated torque.
	NegTrq Limit	Reverse torque limit	- %	Displays the reverse torque limit in a percentage to the rated torque.
	RegTrq Limit	Torque limit at regeneration	%	Displays the torque limit at regeneration in a percentage to the rated torque.
	IqeRef	Torque current (Q-axis current) Reference	A	Displays the torque current reference in a percentage to the rated torque.
	Iqe	Torque current (Q-axis current)	A	Displays the actual torque current in a percentage to the rated torque.
	Flux Ref	Flux reference	%	Displays the flux reference in a percentage to the rated flux.
	IdeRef	Direct axis (D-axis) current reference	A	Displays the direct axis (D-axis) current reference in a percentage to the rated direct axis current.
	Ide	Direct axis (D-axis) current	A	Displays the actual direct axis (D-axis) current in a percentage to the rated direct axis current.
	ACR_Q Out	Q-axis current controller output	V	Displays the Q-axis current controller output.
	ACR_D Out	D-axis current controller output	V	Displays the D-axis current controller output.
	VdeRef	D-axis voltage reference	V	Displays the D-axis voltage reference.
	VqeRef	Q-axis voltage reference	V	Displays the Q-axis voltage reference.

<table>
<tr><th>Code</th><th>Keypad display</th><th>Name</th><th>Unit</th><th>Description</th></tr>
<tr><td></td><td>Out Amps RMS</td><td>Output current</td><td>A</td><td>Displays the actual inverter output current.</td></tr>
<tr><td></td><td>Out Volt RMS</td><td>Output voltage</td><td>V</td><td>Displays the actual inverter output voltage.</td></tr>
<tr><td></td><td>Power</td><td>Output power</td><td>kW</td><td>Displays the motor output power.</td></tr>
<tr><td></td><td>DC Bus Volt</td><td>DC link voltage</td><td>V</td><td>Displays the inverter DC link voltage.</td></tr>
<tr><td></td><td>MotTemp NTC</td><td>Motor NTC temperature</td><td>deg</td><td>Displays the motor temperature if an NTC temperature sensor is installed (without an NTC sensor, a fixed temperature of 25℃ is displayed).</td></tr>
<tr><td></td><td>Inv Temp</td><td>Inverter temperature</td><td>deg</td><td>Displays the inverter heat sink temperature.</td></tr>
<tr><td></td><td>MP Output</td><td>MOP output</td><td>%</td><td>Displays the parameter settings for operations with digital potentiometer (via terminal input).</td></tr>
<tr><td></td><td>Control Mode</td><td>Control mode</td><td></td><td>Displays the control mode in use [Speed, V/F, Slip Comp, Speed (Sync)].</td></tr>
<tr><td></td><td>Run Time</td><td>Operation time</td><td></td><td>Displays the duration of inverter's operation since the power-on.</td></tr>
<tr><td></td><td>Terminal In</td><td>Input terminal status</td><td></td><td>Displays the ON (1)/OFF (0) status of the input terminal.
<table>
<tr><td>Input terminal</td><td>FX</td><td>RX</td><td>BX</td><td>RST</td><td>P1</td></tr>
<tr><td>0 (OFF)
1 (ON)</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td></tr>
<tr><td>P2</td><td>P3</td><td>P4</td><td>P5</td><td>P6</td><td>P7</td></tr>
<tr><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td></tr>
</table></td></tr>
<tr><td></td><td>Terminal Out</td><td>Output terminal status</td><td></td><td>Displays the ON (1)/OFF (0) status of the open collector output, relay terminal output, and the fault relay.
<table>
<tr><td>Output terminal</td><td>AX1</td><td>AX2</td><td>OC1</td><td>30A (30B)</td></tr>
<tr><td>0: OFF /
1: ON</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Code</th><th>Keypad display</th><th>Name</th><th>Unit</th><th>Description</th></tr>
<tr><td></td><td>Terminal Opt</td><td>Command via network communication status</td><td></td><td>Displays the network command communication status.
<table>
<tr><td>Input terminal</td><td>STOP</td><td>FX</td><td>RX</td><td>RST</td><td>BX</td></tr>
<tr><td>0: OFF
1: ON</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td></tr>
<tr><td>P1</td><td>P2</td><td>P3</td><td>P4</td><td>P5</td><td>P6</td></tr>
<tr><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td></tr>
<tr><td>P7</td><td colspan="5" rowspan="2"></td></tr>
<tr><td>0/1</td></tr>
</table></td></tr>
<tr><td></td><td>Run Status</td><td>Operation status</td><td></td><td>Displays the inverter operation status.</td></tr>
<tr><td></td><td>PhInOpenLvl</td><td>Open phase detection level</td><td>A</td><td>Displays the open phase detection level value for the open phase detection function that can be turned on at PRT_18 PhInOpenLvl.</td></tr>
<tr><td></td><td>IuP
IuM</td><td>Synchronous motor phase current average</td><td>A</td><td>This parameter is used for initial pole position estimation. It is displayed only when Speed (Synch) mode is in use, to show the motor phase current.
IuP: Uphase + value
IuM: Uphase–value</td></tr>
<tr><td></td><td>IvP
IvM</td><td>Synchronous motor phase current average</td><td>A</td><td>This parameter is used for initial pole position estimation. It is displayed only when Speed (Synch) mode is in use, to show the motor phase current.
IuP: Vphase + value
IuM: Vphase–value</td></tr>
<tr><td></td><td>IwP
IwM</td><td>Synchronous motor phase current average</td><td>A</td><td>This parameter is used for initial pole position estimation. It is displayed only when Speed (Synch) mode is in use, to show the motor phase current.
IuP: Wphase + value
IuM: Wphase–value</td></tr>
</table>

6.1.3 Fault status display (DIS_05)

This code may be configured to display the current fault status, trip history (2 most recent faults) and the number of previous faults (it may also be used to clear the number of faults). At DIS_05, press [SHIFT/ESC] to change the setting values.

Code	Keypad display	Name	Description
DIS_05	Faults	Current fault condition	Displays the inverter trip information. When the inverter is operating without fault, "————————" is displayed.
	Last Fault1	Previous fault condition1	For more information, refer to *8.1 Fault trips* on page *317*.
	Last Fault2	Previous fault condition2	Displays motor rpm reference after an acceleration/deceleration routine.
	Fault Count	Total number of faults	Displays the total number of fault since the last initialization.

Press [PROG] and [▲] / [▼] before pressing [RESET] to see the following conditions at the time of the fault: Speed reference, speed feedback, output frequency, output current and voltage, Q-axis current reference and the actual value, DC-link voltage, input terminal status, output terminal status, operation status, and duration.

Press [ENT] to return to the main screen. The current fault is saved as "Last Fault1" when you press [RESET]. For more information, refer to 8 *Troubleshooting* on page *317*.

No	Fault trips	Keypad display	No	Fault trips	Keypad display
1	Short circuit at the IGBT	Arm Short	17	Inverter overload	Inv. OLT
2	Blown fuse	Fuse Open	18	Input phase open	Input PO
3	Ground fault protection	Ground Fault	19	Motor overheat	MotOver Heat
4	Overcurrent trip	Over Current	20	Inverter thermal sensor fault	InvThem OP
5	Overvoltage trip	Over Voltage	21	Motor thermal sensor fault	MotThem Err
6	FAN error	FAN Error	22	Motor Overspeed	Over Speed
7	Battery operation fault	BatRun Fault	23	Floor selection fault	Flr/FHM Data
8	IGBT short circuit DB	Arm Short–DB	24	Slow down switch fault	SDS Error
9	Encoder fault	Encoder Err	25	A3 safety fault	A3 Safety
10	Low voltage trip	Low Voltage	26	LV2 (Low voltage 2) fault	Low Voltage 2
11	Inverter overheat	InvOver Heat	27	Safety fault	SAFETY A/B
12	E-thermal protection trip	E-Thermal	28	Speed deviation fault	Spd Dev Err
13	Overload trip	Over Load	29	ADC fault	ADC Error
14	H/W fault trip	HW-Diag	30	SINCOS input connection fault	SINCOS input connection fault
15	External trip-terminal B	External-B	31	EnDat option board data clock configuration fault	EnDat Data Clock
16	Output phase open	Output PO	32	Data save fault	EEP Error

Note

If multiple fault trips occur at the same time, fault trips with higher priority are displayed first (fault trips with smaller numbers have higher priority). Check the fault trip history to view the rest of the fault trips.

6.1.4 Software version display (DIS_06)

This code is used to display the current software version of the inverter.

6.1.5 User group display options (DIS_10)

You may select frequently accessed codes to create a user group.

When configuring the user group display, there are three options available depending on the parameter setting at DIS_10: Do not display User group / Show Display group and User Group only / Show all code groups including User group.

Code	Keypad display	Name	Description	
DIS_10	Usr Grp Disp	User group display options	Not Used	Do not display User group.
			Dis+Usr Grp	Show Display group and User Group only. When this option is selected, you can access other codes by manually switching to the codes in the User group, or by changing the parameter setting to allow display of other code groups.
			Display ALL	Show all code groups including User group. • M2 group is displayed only when the second motor group is configured. • EXT group is displayed only when a communication option board is installed.

6.2 Parameter (PAR) group

6.2.1 Jump code (PAR_00)

PAR_00 code is used to directly access a certain code.

The following is an example of jumping directly to PAR_56 from PAR_00 code.

1 Press [PROG].

2 Use [SHIFT/ESC], [▲], or [▼] to change the code number to "56".

3 Press [ENT] to access PAR_56 code. If an invalid code number is entered, the next available code number is automatically selected.

Note

After jumping directly to a code, you can move to other codes by pressing [▲] or [▼].

6.2.2 Parameter-related settings

6.2.2.1 Parameter initialization (PAR_01)

Parameter initialization resets all inverter parameter settings to the default settings. Parameter initialization is available for selected groups or for all the groups. After initialization, the motor capacity must be re-configured at PAR_09 (Motor Select).

Code	Keypad display	Name	Range	Unit	Default setting
PAR_01	Para. init	Initialize to default setting	0 (No) 1 (All Groups) 2 (DIS) 3 (PAR) 4 (DIO) 5 (AIO) 6 (FUN) 7 (CON) 8 (E/L) 9 (PRT) 10 (COM) 11 (M2) 13 (USR)		0 (No)

Note

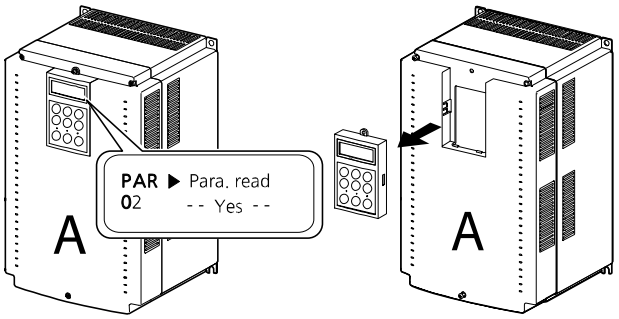
Configure the parameter settings again after performing a parameter initialization. All parameter settings revert to the factory default after an initialization.

6.2.2.2 Duplicating parameter settings (PAR_02, 03)

Using the keypad, you can copy (read) the parameter settings of a certain inverter and paste (write) them into multiple inverters.

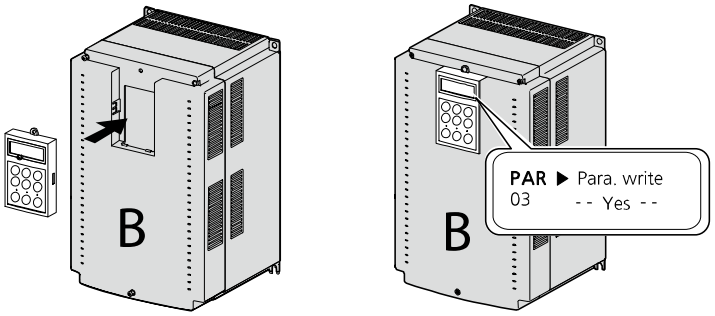
1 On the inverter that has the parameter settings to duplicate (A), set PAR_02 (Read all codes) to "Yes".

All the parameter settings are copied into the keypad for duplication.



2 Remove the keypad from the inverter and install it on another inverter to which the parameter settings will be written to (B), and then set PAR_03 (Write all codes) to "Yes".

All the parameter settings stored in the keypad are copied into the other inverter.



Note

To duplicate the parameter settings between the inverters, the source and target inverters must have the same software version. Otherwise, a software version error message ("VER. Err") will be displayed, and the process will not be completed.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_02	Para. read	Read all codes	No/Yes		No
PAR_03	Para. write	Write all codes	No/Yes		No

Note

After parameter setting duplication, re-configure each code in DIS and USR groups. All the parameter settings for the codes in DIS and USR groups will revert to the default setting after duplication.

⚠ Caution

Parameter duplication affects the motor parameters. After parameter duplication, ensure that the motor-related parameters are set correctly.

6.2.2.3 Prohibiting modification of codes (PAR_04)

Set PAR_04 to "12" to lock all codes to prohibit modification. Reset the parameter setting to the original value to unlock the codes and allow modification again.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_04	Para. lock	Lock all codes	0–255		0

6.2.2.4 Setting the password (PAR_05)

Set and use a password to prevent unauthorized access to codes. Set PAR_05 to any 4-digit number other than "0000," and then restart the inverter to allow the change to take effect. When a password is set, only the codes in Display group are displayed on the keypad.

To gain access other groups, press [Mode] to display password input screen (PAR_05). Once a correct password is entered, all the other codes become accessible again.

Set PAR_05 to "0" to disable the password option.

The master password for the inverter is "5052". Use the master password to disable the password option and gain access to the codes in case you cannot remember the password. Upon entering the master code, PAR_05 is set to "0" and automatically disables the password option.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_05	Password	Password	0–9999		0

6.2.3 Motor-related settings

6.2.3.1 Control mode options (PAR_07)

The LSLV-iV5L inverters provide speed control and vector (torque) control modes. To operate the inverter in vector control mode, a speed feedback device (encoder) must be installed.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_07	Control Mode	Control mode options	2 (Speed mode) 4 (V/F mode) 5 (Slip Comp mode) 6 (Speed (Synch) mode)		2 (Speed)

6.2.3.2 Application mode options (PAR_08)

Set the inverter application mode to suit your needs. The LSLV-iV5L inverters may be configured for general vector (General Vect) mode, as well as for elevator application (Elevator) mode.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_08	Application	Application mode options	General Vect Elevator (available with elevator I/O board)		General Vect

6.2.3.3 Motor capacity settings (PAR_09) / Motor capacity user define (PAR_10)

Select correct motor capacity before operating the inverter. The default motor capacity value is set at the factory as one that is equivalent to the inverter capacity.

Once a motor capacity is selected, appropriate motor parameter values for the motor is automatically configured (based on the Higen vector motor specifications).

To use capacity settings for a motor other than those provided by the inverter, set PAR_09 to "User Define," and set PAR_10 to define your own.

Before user-define the motor capacity, set PAR_52–PAR_59 codes to the values provided on your motor's rating plate and run auto-tuning. You must use the parameter values obtained from the auto-tuning when setting the user defined motor capacity.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_09	Motor select	Motor capacity settings	2.2–22.0 User Define	kW	A capacity equivalent to the inverter capacity
PAR_10	UserMotorSel	User-defined motor capacity	2.2–22.0	kW	7.5

6.2.3.4 Setting the maximum motor speed (PAR_11)

Set PAR_11 to define the maximum motor speed. The maximum motor speed is the maximum output for the maximum speed reference.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_11	Max Speed	Maximum motor speed	1200.0–3600.0	Rpm	1800.0

6.2.3.5 Setting the minimum motor speed (PAR_12)

This code is displayed when PAR_07 is set to "V/F" or "Slip Comp" mode. Once the minimum motor speed is set, the inverter only operates when it receives a speed reference that is equal to, or greater than this minimum motor speed. If a speed reference smaller than the minimum motor speed is received during operation, the inverter recognizes it as a stop command, and performs a decelerating stop.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_12	Min Speed	Maximum motor speed	0.5–10.00	Hz	0.5

Caution

- When FUN_23 is set to "Yes", the maximum value of PAR_12 is limited to the value set in FUN_24.
- The minimum value of FUN_24 is limited to PAR_12.

6.2.3.6 Setting the motor base frequency (PAR_13)

A base frequency is the inverter's output frequency (in Hz) at its rated voltage. Refer to the motor's rating plate to set this parameter value. This parameter is required for V/F and slip compensation control mode operations.

6.2.3.7 Setting the motor base speed (PAR_14)

A base speed is the motor speed (in rpm) at the inverter's rated voltage. Refer to the motor's rating plate to set this parameter value. This parameter is required for speed control and speed (sync) control mode operations.

6.2.3.8 Setting the rated motor voltage (PAR_15)

Refer to the motor's rating plate to set this parameter value.

6.2.3.9 Setting the motor pole number (PAR_16)

Refer to the motor's rating plate to set this parameter value. The pole number affects the motor speed (rpm).

6.2.3.10 Setting the motor efficiency (PAR_17)

Refer to the motor's rating plate to set this parameter value. Use the default setting if the value is not specified on the motor's rating plate.

6.2.3.11 Setting the motor rated slip (PAR_18)

Refer to the motor's rating plate to set this parameter value. The rated slip value provides information on the deviation of the the motor speed from the inverter frequency at rated load.

6.2.3.12 Setting the motor rated current (PAR_19)

Refer to the motor's rating plate to set this parameter value.

6.2.3.13 Setting the input voltage (PAR_20)

Use this code to set the inverter input voltage.

6.2.3.14 Setting the switching frequency (PAR_21)

Set PAR_21 to a value between 2.5–10.0 (kHz) to define the inverter's switching frequency [in Speed (Sync) control mode, a value between 2.5–8.0 kHz must be used].

Adjust the switching frequency to reduce the operation nose, or to avoid overheating problems.

A lower switching frequency increases the operation noise, but lowers the inverter temperature and decreases the inverter noise and leakage current.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_21	PWM Freq	Switching frequency setting	MinFreq–MaxFreq	kHz	8 kHz

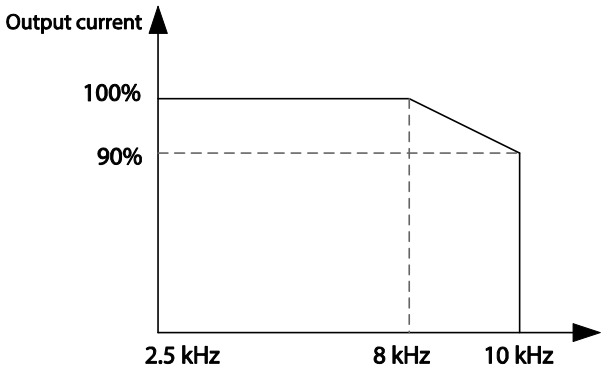
Switching frequency by the inverter capacity / default setting

Voltage	Motor type	Inverter capacity	Range	Default setting
400 V	Induction motor	5.5–22 kW	2.5–10 kHz	8 kHz
	Synchronous motor	5.5–22 kW	2.5–8 kHz	8 kHz

Continuous rated current derating

The LSLV-iV5L inverter has the following derating specifications for different switching frequency.

Rated current derating by the switching frequency



These derating specifications apply only when the inverter's ambient temperature is within the acceptable range. If the inverter is installed in an enclosure, check to make sure that the enclosure is well ventilated, and it provides acceptable operating temperature for the inverter.

The output current in the graph is the percentage value of the output to the inverter's rated current. It applies when a motor within the rated load is used with the inverter.

6.2.3.15 Setting the motor cooling options (PAR_22)

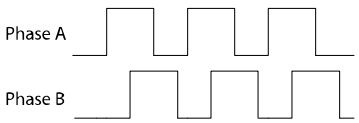
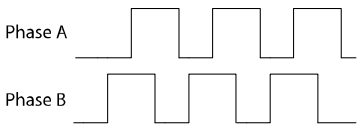
Set PAR_22 to select the cooling options for a motor. Motor cooling options are used to determine the motor overload. Set it to "Self-cool" for a self-cooling motor, and "Forced-cool" for a forced cooling motor.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_22	Cooling Mtd	Motor cooling options	0 (Self-cool) 1 (Forced-cool)		1 (Forced-cool)

6.2.3.16 Setting the encoder-related parameters): Input pulse number and direction (PAR_24–25) / Error detection / LPF (PR_09–10)

Set PAR_24 (Encoder pulse number) to define the number of input pulse for the encoder that is installed at the motor.

PAR_25 (Encoder directions) enables you to choose to advance phase A or phase B while the motor is rotating in the forward direction. It provides an easy solution to rearrange the phase order (phases A/B, or phases U/V/W) without physically re-doing the cable wiring when the phase connections are not made correctly.

Code	Name	Settings	Description	Encoder pulse (FX operation)
PAR_25	Encoder directions	A Phase Lead	Phase A is advanced during FX operation. Phase B is advanced during RX operation.	
		B Phase Lead	Phase B is advanced during FX operation. Phase A is advanced during RX operation.	

Note

If PRT_09 (Encoder error detection) is set to "Yes," encoder fault trips occur when open circuits or wiring errors are detected. The detection function does not work with open collector encoders. Set PRT_09 to "No," if an open collector type encoder is installed.
Adjust PRT_10 (Encoder LPF time) to reduce the interference if the encoder receives noisy pulse input. Incorrect encoder-related parameters may lead to abnormal speed control and frequent overcurrent and overvoltage fault trips. For detailed information, refer to 8 *Troubleshooting*.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_24	Enc Pulse	Encoder pulse number	360–32767		1024
PAR_25	Enc Dir Set	Encoder direction	0 (A Phase Lead) 1 (B Phase Lead)		A Phase Lead
PRT_09	Enc Err Chk	Encoder error detection	0 (No) 1 (Yes)		1 (Yes)
PRT_10	Enc LPF	Encoder LPF time	0–100	msec	1

6.2.3.17 Setting the encoder types (PAR_23), EnDat encoder directions (PAR_26), and encoder tuning options (PAR_28)

Set PAR_23 to define the encoder types. PAR_28 and PAR_25 codes are displayed only when the encoder type is set to "EnDat" or "Sin/Cos". For details, refer to the instruction manuals that are provided with the Sin/Cos EnDat encoder option board.

Keypad display	Description
PAR ▶ Enc Type 23 Normal	This setting is used for generic incremental encoders, or for the Sin/Cos option boards (previous version).
PAR ▶ Enc Type 23 EnDat	This setting is used for generic incremental encoders, or for the Sin/Cos option boards (previous version). This setting is used for HEIDENHAIN ECN 413 and ECN 1313 series encoders. Parameter value "EnDat" is available only when a Sin/Cos EnDat option board is installed.
PAR ▶ Enc Type 23 Sin/Cos	This setting is used for HEIDENHAIN ERN487and ERN 1387series encoders. Parameter value "Sin/Cos" is available only when a Sin/Cos EnDat option board is installed.

Code	Keypad display	Name	Range	Unit	Settings
PAR_23	Enc Type	Encoder type	0 (Normal) 1 (EnDat) 2 (Sin/Cos)		Normal
PAR_26	EnDat Dir	EnDat encoder directions	0 (CW)/ 1 (CCW)		CW
PAR_28	Enc Tuning	Encoder tuning options	0 (No) 1 (Yes)		No

6.2.4 Auto-tuning

Auto-tuning is used to estimate an induction motor's stator resistance (Rs), stator inductance (Ls), leakage factor (Lsigma), flux current (Flux-Curr), and rotor time constant (Tr). For a synchronous motor, auto-tuning is used to estimate the stator resistance (Rs), d/q-axis inductance (Ld, Lq), and the pole position.

There are two types of auto-tuning procedures. Rotating tuning requires motor operation, while static tuning does not. For an induction motor, both types may be used if it is set for speed control mode, and in other control modes, only static auto-tuning can be used. For synchronous motors, static auto-tuning must be used regardless of the control modes.

6.2.4.1 Setting the motor/encoder parameter for auto-tuning

Motor parameters required for vector control can only be obtained when correct motor information is provided. Such information includes the motor's capacity, base speed, rated voltage, pole number, efficiency, rated slip, rated current, and the encoder pulse number.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_09	Motor Select	Motor capacity	2.2–22.0	kW	7.5
PAR_10	UserMotorSel	User-define motor capacity	2.2–22.0	kW	7.5
PAR_14	Base Speed	Motor base Speed	100.0–3600.0	rpm	1800.0
PAR_15	Rated Volt	Motor rated voltage	120–560	V	380
PAR_16	Pole Number	Motor pole number	2–12		4
PAR_17	Efficiency	Motor efficiency	0.0–100.0	%	87.5
PAR_18	Rated-Slip	Motor rated slip	10.0–250.0/ 1.0–25.0	rpm/ Hz	Varies depending on the motor capacity
PAR_19	Rated-Curr	Motor rated Current	1.0–1000.0	A	
PAR_24	Enc Pulse	Encoder pulse number	360–32767		1024

Use PAR_09 to select a motor capacity. To use a motor whose capacity is not given for selection, set it to "User Define," which brings up PAR_10 (User-define motor capacity) options, where the motor capacity can be manually entered.

PAR_14 (Motor base Speed) is used to set the motor speed at which the inverter outputs its rated voltage. The rated speed must be set within the range of the motor's maximum speed.

Set the motor base speed and rated voltage as they read on the motor's rating plate. When operating a 4-pole standard motor, the base speed is 60 Hz (1,800 rpm).

$$rpm = \frac{120 \times Base\_frequency}{Pole\_number} \quad , \quad 1{,}800\,rpm = \frac{120 \times 60\,Hz}{4}$$

By default, PAR_15 (Motor rated voltage) is set as 380 (V) at the factory. Refer to the motor's rating plate for the rated input voltage. The rated voltage must be set correctly. The setting value is provided to the voltage controller to prevent voltage saturation. Also, it affects the measurement of flux current during an auto-tuning.

Set PAR_17 (Motor efficiency) only if the motor efficiency information is given on the rating plate (do not modify it if it is not specified on the rating plate).

For PAR_18 (Motor rated slip), subtract "motor rated speed" from "motor base speed" on the rating plate, and enter the resulting value.

For example, if the motor base speed is 1,800 (rpm) and the rated speed is 1,740 (rpm), the rated slip is 60 (rpm).

6.2.4.2 Running a rotating auto-tuning for induction motors

Preparation

Caution

Before running a rotating auto-tuning, disconnect and remove the machinery that is connected to the motor axis, and leave the motor unloaded. Unintended operation of the machinery during tuning may lead to personal injury and/or mechanical damage. A braking resistor must be connected to the inverter when running an auto-tuning. Abrupt accelerations and decelerations are required to find an optimal rotor time constant.

Setting the parameters for auto-tuning

Code	Keypad display	Name	Range	Unit	Parameter setting
PAR_31	AutoTuneType	Auto-tuning options	0 (Rotational) 1 (StandStill)	-	0 (Rotational)
PAR_32	Kp for If	If tuning error protection p gain	1–1000	-	20
PAR_33	Ki for If	If tuning error protection I gain	1–1000	-	40
PAR_34	Inertia Tune	Motor inertia tuning options	0 (No) 1 (Yes)		No
PAR_35	J Spd Time	Inertia tuning acc/ dec time	0.500–10.000	sec	0.500
PAR_36	Inertia LPF	Inertia low pass filter	0.010–50.000	msec	0.100
PAR_41	AsynAutoTune	Induction motor auto-tuning option	0 (None) 1 (ALL1) 2 (ALL2) 3 (Encoder Test) 4 (Rs Tuning) 5 (Lsigma) 6 (Flux Curr) 7 (Ls Tuning) 8 (Tr Tuning) 9 (InertiaTuning)	-	None

The LSLV-iV5L inverter provides 9 different types of rotating auto-tuning. The "ALL2" type auto-tuning detects stator resistance (Rs), leakage factor (Lsigma), flux current, rotor time constant (Tr), stator inductance (Ls) and inertia values. If you perform the "ALL1" type auto-tuning, "ALL2" tuning is performed after the encoder test.

Note

- "Inertia Tuning" options are available only when PAR_34 is set to "Yes".
- Rotor time constant (Tr) can be correctly estimated only after stator resistance (Rs), leakage factor (Lsigma), and stator inductance (Ls) values are obtained through an auto-tuning.
  Adjust PAR_32 (If tuning Error protection P gain) and PAR_33 (If tuning error protection I gain) parameter values if errors occur during an excitation current tuning. Increase the PAR_35 (Inertia tuning acc/dec time) parameter value if a high inertial load is connected to the motor. Increase the PAR_36 (Inertia LPF) parameter value if a large amount of fluctuation is observed with high inertia loads.
- The FWD and REV operation indicators on the keypad flash simultaneously during an auto-tuning.
- Auto-tuning is based on a motor base speed of 1,800 rpm.

Auto-tuning types	Description
None	Do not perform auto-tuning.
ALL1	Perform auto-tuning in the order of Rs, Lsigma, flux current, Ls, and Tr tuning after completing an encoder test.
ALL2	Perform auto-tuning in the order of Rs, Lsigma, flux current, Ls, and Tr tuning without an encoder test.
Encoder Test	Tests the encoder wiring connections by rotating the motor at 1,500 rpm in the forward direction.
Rs Tuning	Determines motor stator resistance without rotating the motor.
Lsigma	Determines motor leakage factor (Lsigma) without rotating the motor.
Flux Curr	Determines flux current by rotating the motor at 1,500 rpm.
Ls Tuning	Determines stator inductance by rotating the motor at 1,500 rpm.
Tr Tuning	Determines rotor time constant after accelerating and decelerating the motor multiple times. Elapsed time may vary each time it is performed. Rotor time constant tuning must be performed after stator resistance (Rs), leakage factor (Lsigma), stator inductance (Ls) values are obtained.
Inertia Tuning	Determines the inertia value by rotating the motor at 1/3 of its base speed (600 rpm), to forward and reverse directions.

Keypad operation for a rotating auto-tuning

Keypad display	Description	Tuning time
PAR ▶ AsynAuto Tune 31 Rotational	At PAR_31, set the induction motor auto-tuning option to "Rotational".	-
PAR ▶ AsynAuto Tune 41 ALL 1 PAR ▶ AsynAuto Tune 41 Enc Testing	At PAR_41, set auto-tuning mode to "ALL1". Auto-tuning begins immediately and a test is performed to check the encoder wiring connections by rotating the motor at 1,500 rpm in the forward direction.	30–35 sec
PAR ▶ AsynAuto Tune 41 Rs Tuning	Determines motor stator resistance without rotating the motor.	10–20 sec
PAR ▶ AsynAuto Tune 41 sL Tuning	Determines motor leakage factor without rotating the motor.	5–20 sec
PAR ▶ AsynAuto Tune 41 IF Tuning	Determines flux current by rotating the motor at 1,500 rpm.	30–60 sec
PAR ▶ AsynAuto Tune 41 Ls Tuning	Determines stator inductance by rotating the motor at 1,500 rpm.	50–60 sec
PAR ▶ AsynAuto Tune 41 Tr Tuning	Determines rotor time constant after accelerating and decelerating the motor multiple times. Elapsed time may vary each time it is performed. Abrupt accelerations and decelerations are required to find an optimal rotor time constant. Therefore, a braking resistor must be connected to the inverter when running an auto-tuning. Otherwise, overvoltage trip faults may occur during the tuning process.	20–60 sec

Keypad display	Description	Tuning time
PAR ▶ AsynAuto Tune 41 None PAR ▶ AsynAuto Tune 41 [][]Error	After obtaining the values required, PAR_41 is automatically changes to "None" to stop auto-tuning. Error message will be displayed if correct values cannot be obtained. If this happens, ensure that all the motor and encoder parameters were entered correctly, and then repeat the auto-tuning procedure. If an error message persists, stop the auto-tuning procedure and contact LSIS technical service at 1544-2080.	Total time elapsed: 3–5 min

6.2.4.3 Running static auto-tuning for induction motors

Preparation

Before running a static auto-tuning, fix the motor axis so that it won't move during the auto-tuning. Accurate values can be obtained only when the motor axis is in a static condition.

Setting the parameters for auto-tuning

Code	Keypad display	Name	Range	Parameter setting
PAR_31	AutoTuneType	Auto-tuning options	0 (Rotational) 1 (StandStill)	1 (StandStill)
PAR_41	AsynAutoTune	Induction motor auto-tuning option	0 (None) 1 (ALL1) 2 (Rs Tuning) 3 (if/Tr/Ls Tune) 4 (InertiaTuning)	None

The LSLV-iV5L inverter provides 4 different types of static auto-tuning. The "ALL1" type auto-tuning detects stator resistance (Rs), leakage factor (Lsigma), If, stator inductance (Ls), rotor time constant (Tr) - it does not perform a test on the encoder. However, if PAR_41 is set to "4 (Inertia Tuning)," you may enable encoder test by setting PAR_34 to "Yes".

ⓘ Caution

Inertia tuning involves motor rotation even if it is a type of static auto-tuning. Therefore, before performing an inertial tuning, make sure that the restriction (fixture) on the motor axis is removed and the motor axis can rotate freely.

At PAR_41, each option (Rs Tuning, Lsigma, If/Tr/Ls Tune, Inertia Tuning) may be used to identify the individual value of the relevant parameter.

Auto-tuning type	Description
None	Do not perform auto-tuning.
ALL1	Performs auto-tuning in the order of Rs, Lsigma, and If/Tr/Ls tuning (test on the encoder is not performed).
Rs Tuning	Determines motor stator resistance without rotating the motor.
Lsigma	Determines motor leakage factor (Lsigma) without rotating the motor.
If/Tr/Ls Tune	Determines motor flux current, rotor time constant, and stator inductance at the same time by applying direct current to the motor, without rotating the motor axis.
Inertia Tuning	Determines the inertia value by rotating the motor at 1/3 of its base speed (600 rpm).

Note

The FWD and REV operation indicators on the keypad flash simultaneously during auto-tuning.

Keypad operation for a static auto-tuning

Keypad display	Description	Tuning time
PAR ▶ AsynAuto Tune 31 StandStill	At PAR_31, set the induction motor auto-tuning option to "StandStill".	-
PAR ▶ AsynAuto Tune 41 ALL 1	At PAR_41, set auto-tuning mode to "ALL1". Auto-tuning begins immediately.	-
PAR ▶ AsynAuto Tune 41 Rs Tuning	Determines motor stator resistance without rotating the motor.	20–30 sec
PAR ▶ AsynAuto Tune 41 sL Tuning	Determines motor leakage factor without rotating the motor.	5–10 sec
PAR ▶ AsynAuto Tune 41 If/Tr/Ls Tuning	Determines motor flux current, rotor time constant, and stator inductance at the same time by applying direct current to the motor, without rotating the motor axis.	15–60 sec
PAR ▶ AsynAuto Tune 41 None PAR ▶ AsynAuto Tune 41 [][]Error	After obtaining the values required, PAR_41 is automatically changes to "None" to stop auto-tuning. If correct values cannot be obtained, and error message will be displayed. If this is the case, ensure that all the motor and encoder parameters were entered correctly, and then repeat the auto-tuning procedure. If an error message persists, stop the auto-tuning procedure and contact LSIS technical service at 1544-2080.	Total time elapsed: 1–2 min

6.2.4.4 Detecting the initial pole position of a synchronous motor

The following table explains the parameter setting for initial pole position detection which is required for operating a synchronous motor. The result can be viewed at DIS_08.

Code	Keypad display	Name	Range	Unit	Parameter setting
PAR_42	ReDet Num	Number of detections to be made	0–65535		0
PAR_43	DetAve Num	Number of detections for average	1–30		5
PAR_44	MagDet Volt	Pole position detection voltage	5–500	V	60
PAR_45	MagDet Curr	Pole position detection current	10–150	%	40

- When using the Endat option board, these parameters are not available if Enc Type is Endat mode.

Preparation

If this is the first pole position detection, and if PAR_23 (Enc Type) is set to "Normal," follow the steps listed below.

Note

If PAR_23 (Enc Type) is set to "EnDat," or "Sin/Cos," refer to the instruction manual that is supplied with the Sin/Cos EnDat encoder option board.

1. Set the speed reference to "0 (rpm)".
2. Keep the brake in the held position during operation.
3. Set PAR_42 (Number of detections to be made) to "1".
4. Check the initial angle detected on the keypad (DIS_08), and then stop the operation.
5. Repeat step 4 for 5 times.
6. Initial pole position detection is successful if the difference of the angles displayed at DIS_08 is less than 5 degrees. If the difference is more than 5 degrees, repeat the steps 1 through 5 after adjusting PAR_44 (Pole detection voltage) and PAR_45 (Pole detection current).

Number of detections for average (PAR_43)

PAR_43 is used to set the number of detections for calculating the average. It is recommended to use the default setting for PAR_43. Using lower setting values shortens the elapsed time for pole detection, but it may result in lower credibility.

Note

Some motors require higher setting values than the default setting for accurate pole position detection.

Pole position detection voltage (PAR_44) and current (PAR_45)

PAR_44 and PAR_45 are used to configure the voltage and current for pole position detection. When detecting the pole position, lower voltage decreases the noise. The current level for PAR_45 is set as a percentage of the motor's rated current (PAR_19).

Number of detections to be made (PAR_42)

PAR_42 is used to configure the number of initial pole position detections to be made. Refer to the following table for details.

Note

If PAR_23 (Enc Type) is set to "EnDat," or "Sin/Cos," refer to the instruction manual that is supplied with the Sin/Cos EnDat encoder option board.

Keypad display	Description
PAR ▶ ReDet Num 42 0	If PAR_42 is set to "0," the inverter performs the pole position detection once at start-up. This is the smallest number that can be configured for PAR_42.
PAR ▶ ReDet Num 42 1	If PAR_42 is set to "1," the inverter performs the pole position detection before every operation. This setting is only for the initial pole position testing. Do not use this setting for normal operation.
PAR ▶ ReDet Num 42 100	If PAR_42 is set to "100," the inverter performs the pole position detection once every 100 operations. Use a number that is suited for the inverter's installation and configuration.

6.2.4.5 Running static auto-tuning for synchronous motors

Preparation

Before running a static auto-tuning, fix the motor axis so that it won't move during auto-tuning. Accurate values can be obtained only when the motor axis is in a static condition.

Setting the parameters for auto-tuning

Code	Keypad display	Name	Range	Unit	Parameter setting
PAR_31	AutoTuneType	Auto-tuning options	0 (Rotational) 1 (StandStill)	-	1 (StandStill)
PAR_43	DetAve Num	Number of detections for average	1–30		5
PAR_44	MagDet Volt	Pole position detection voltage	5–500	V	60
PAR_45	MagDet Curr	Pole position detection current	10–150	%	40
PAR_46	TuneLvl_LdLq	Ld/Lq detection current level	20.0–50.0	%	33.3
PAR_47	TuneHz_LdLq	Ld/Lq detection frequency	100.0–200.0	%	150.0
PAR_51	SynAutoTune	Auto-tuning options for synchronous motors	0 (None) 1 (All) 2 (RsTuning) 3 (Ld/Lq Tuning) 4 (Mag Pole Est)	None	

Static auto-tuning is used for synchronous motors to obtain the motor's stator resistance (Rs), d/q-axis inductance (Ld, Lq), and the initial pole position.

The Ld/Lq detection current level is set at PAR_46, as a percentage to the motor's rated current. The Ld/Lq detection frequency is set at PAR_47 as a percentage which is a multiplication factor to the motor's rated current; at 100%, the detection frequency is twice the rated current, and at 200%, four times the rated current. The inductance value may vary depending on the parameter settings at PAR_46 and PAR_47.

Auto-tuning type	Description
None	Do not perform auto-tuning.
ALL	Determines motor stator resistance and d/q-axis inductance (Ld, Lq) without rotating the motor.
Rs Tuning	Determines motor stator resistance without rotating the motor.
Ld/Lq Tuning	Determines motor d/q-axis inductance (Ld, Lq) without rotating the motor.
Mag Pole Est	Estimates initial pole position of the synchronous motor.

Note

The FWD and REV operation indicators on the keypad flash simultaneously during auto-tuning.

Keypad operation for a static auto-tuning for a synchronous motor

Keypad display	Description	Tuning time
PAR ▶ AsynAuto Tune 31 StandStill	When auto-tuning synchronous motors, only "Standstill" option is available.	-
PAR ▶ AsynAuto Tune 51 ALL	Determines motor stator resistance and d/q-axis inductance (Ld, Lq) without rotating the motor.	Approximately 90 sec
PAR ▶ SynAutoTune 51 Rs Tuning	Determines motor stator resistance without rotating the motor.	Approximately 30 sec
PAR ▶ SynAutoTune 51 Ld/Lq Tuning	Determines motor d/q-axis inductance (Ld, Lq) without rotating the motor.	Approximately 60 sec
PAR ▶ SynAutoTune 51 Mag Pole Est	Estimates initial pole position of the synchronous motor by applying DC current, without rotating the motor.	Approximately 5 sec
PAR ▶ SynAutoTune 51 None	After obtaining the values required, PAR_51 automatically changes to "None" to stop auto-tuning.	Total time elapsed: 1–2 min

Keypad display	Description	Tuning time
PAR ▶ SynAuto Tune 51 [][]Error	Error message will be displayed if correct values cannot be obtained. If this happens, ensure that all the motor and encoder parameters were entered correctly, and then repeat the auto-tuning procedure. If an error message persists, stop the auto-tuning procedure and contact LSIS technical service at 1544-2080.	

Caution

Make sure to perform an auto-tuning before operating a synchronous motor with an inverter. Parameter values related to a synchronous motor and its initial pole position may affect the inverter's control ability.

6.2.4.6 Motor constant

Auto-tuning ensures that correct motor parameters are used for operation. The following table lists motor parameters required for proper operation.

For induction motors, the default parameter values are set based on Higen vector motors. For synchronous motors, there are no preset default values.

If a synchronous motor is connected to the inverter, use the values provided by the manufacturer, or use the parameter values obtained from an auto-tuning.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_52	Flux-Curr	Motor flux current	0.0–70% of motor rated current	A	(Induction motor)
PAR_53	Tr	Rotor time constant	30–3000	msec	(Induction motor)
PAR_54	Ls	Motor inductance	0.00–500.00	mH	(Induction motor)
PAR_55	Lsigma	Motor leakage factor (Lsigma)	0.00–300.00	mH	(Induction motor)

Code	Keypad display	Name	Range	Unit	Default setting
PAR_56	Rs	Motor stator resistance	0.000–15.000	ohm	(Induction/synchronous motor)
PAR_57	Inertia	Motor inertia factor	0.001–60.000	kg·m^2	(Induction motor)
PAR_58	Ld	Motor d-axis inductance	0.01–500.00	mH	(Synchronous motor)
PAR_59	Lq	Motor q-axis inductance	0.01–500.00	mH	(Synchronous motor)
PAR_60	Init Theta	Initial pole position	0–360	deg	(Synchronous motor)

Note

- Press [STOP] anytime during auto-tuning to interrupt the process.
- If the encoder test fails during rotating auto-tuning of an induction motor, stator resistance (Rs) tuning is not performed and an error ("Encoder Err") is displayed. If this happens, press [Reset] and run the encoder test again. Check the encoder for wiring errors and other faults if the encoder error persists.
- Rotor time constant (Tr) tuning may fail multiple times before it is performed successfully. Repeat the tuning process 2, 3 times if failure occurs.

6.2.4.7 Auto-tuning error messages

Keypad display	Description and solution
PAR ▶ AsynAuto Tune 41 Enc Error	Occurs when the difference between the speed reference and the encoder feedback speed exceeds motor's rated slip, or when the encoder phase A or B is open. Check the encoder power terminals (PE and GE) for proper connection to the A and B phases.
PAR ▶ AsynAuto Tune 41 Enc AB Chgd	Occurs when the encoder's phases A and phase B, or the motor's phases U, V, W are connected in a wrong order. Check the wiring for correct wiring orders, or change the encoder direction to "B Phase Lead" at PAR_25.
PAR ▶ AsynAuto Tune 41 Rs Error	Occurs when the detected motor stator resistance is out of the normal range of 0.002 –10Ω. Check the wiring between the inverter and the encoder, or check if the motor has not been burnt. This error may occur when the motor capacity is too small for the inverter.
PAR ▶ AsynAuto Tune 41 sL Error	Occurs when the detected motor leakage factor exceeds 100 mH. Check the wiring between the inverter and the encoder, or check if the motor has not been burnt.
PAR ▶ AsynAuto Tune 41 IF Error	Occurs when the motor speed exceeds 1,650 rpm (on an 1,800 rpm motor) during flux current tuning, or when the inverter fails to detect the flux current for a long time. Check the motor pole number and the wiring condition between the inverter and the motor.
PAR ▶ AsynAuto Tune 41 Ls Error	Occurs when the motor speed exceeds 1,650 rpm (on an 1,800 rpm motor) during stator inductance tuning, or when the inverter fails to detect the stator inductance for a long time. Check the motor pole number and the wiring condition between the inverter and the motor.
PAR ▶ AsynAuto Tune 41 PAR 53 DOWN	Occurs if the motor time constant is set too long at PAR_52 during a rotor time constant tuning. Decrease the value at PAR_53 by 30% and try again.

Keypad display	Description and solution
PAR ▶ AsynAuto Tune 41 PAR 53 UP	Occurs if the motor time constant is set too short at PAR_53 during a rotor time constant tuning. Increase the value at PAR_53 by 30% and try again.
PAR ▶ SynAuto Tune 51 Rs Error	Occurs when the detected synchronous motor stator resistance is out of the normal range of 0.002 –10Ω. Check the wiring between the inverter and the encoder, or check if the motor has not been burnt. This error may occur when the motor capacity is too small for the inverter.
PAR ▶ SynAuto Tune 51 Ld/Lq Error	This error may occur when the motor capacity is too small for the inverter.

6.2.4.8 Setting the input voltage

The voltage set at PAR_20 is used as a reference to decide the voltage at which a low voltage error occurs.

$$V_{dc}(LVT\ \ ON) = \sqrt{2} \times PAR\_20 \times 0.745$$
$$V_{dc}(LVT\ \ OFF) = \sqrt{2} \times PAR\_20 \times 0.856$$

V_{dc} (LVT ON): Voltage reference for a low voltage fault trip.
Vdc (LVT OFF): Voltage reference for releasing the low voltage fault trip.

If the inverter has an open phase, the DC voltage ripple band increases when the inverter's output increases. Low input voltage in this condition triggers a low voltage fault trip at the low side of the ripple. Set PAR_20 to the input voltage to prevent this low voltage fault trip and allow the inverter to call an input phase trip. Set PAR_20 to a voltage greater than 342 V to meet the LVT level which is set to 360 Vdc.

6.3 Digital input and output (DIO) group

6.3.1 Jump code (DIO_00)

DIO_00 is used to move directly to a code.

■ **(Eg.) Jumping to DIO_05**

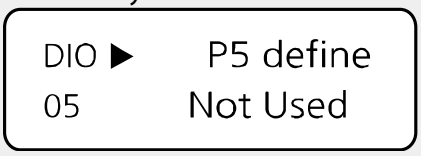
1 Press [PROG].

2 Press [SHIFT/ESC], [▲], or [▼] to change the code to DIO_05.

3 Press [ENT] to move directly to DIO_05.

Note

If the code you entered is not available, then the closest code to it will be accessed.



After the jump, you can press [▲] or [▼] to move to other codes.

6.3.2 Multifunction digital input terminal

6.3.2.1 Defining the multifunction digital input terminal P1–P7 (DIO_01–DIO_07)

Codes DIO_01 to DIO_07 are used to define the multifunction digital input terminals P1to P7. The following table lists the functions available for these multifunction digital input terminals. Only one function may be assigned to one terminal at a time, and the setting cannot be changed during operation. If you try to assign a function to more than one terminal, the setting will not be saved on the second terminal, and its original function will be retained.

No	Fault trips	Keypad display	No	Fault trips	Keypad display
1	Speed-L	Multistep speed-L	15	Prohibit REV	Reverse run prevention
2	Speed-M	Multistep speed-M	17	Timer Input	Timer input
3	Speed-H	Multistep speed-H	18	SoftStrtCncl	Cancel soft start
4	Jog Speed	Jog speed	19	ASR Gain Sel Note 1)	ASR gain switching
5	MOP Up	MOP Up operation	20	ASR P/PI Sel Note 1)	ASR P/PI switching
6	MOP Down	MOP Down operation	21	Flux Ref Sel Note 1)	Flux reference switching
7	MOP Clear	Clear MOP speed	22	PreExcite Note 1)	Pre-excitation
8	MOP Save	Save MOP speed	24	Use Max Trq	Use maximum torque
9	2nd Motor Note 2)	2nd Motor operation	25	Use Trq Bias Note 3)	Use torque bias
10	Xcel-L	Multistep acc/dec-L	26	A3 Safety	Use auxiliary reference
11	Xcel-H	Multistep acc/dec-H	28	LVT Disable	Disable low voltage trip
12	3-Wire	3-wire operation	29	Battery Run	Enable battery operation
13	Ext Trip-B	External trip B terminal			
14	Prohibit FWD	Forward run prevention			

- Note 1) This option is not available if PAR_07 is set to "V/F,""Slip Comp," or "Speed(Sync)".
- Note 2) This option is not available if PAR_07 is set to "Speed(Sync)" and the option is automatically changed to "NotUsed" if PAR_07 is selected to "Speed(Sync)" when this option is selected.
- Note 3) Not available if PAR_07is set to "V/F", or "Slip Comp".

Performing multistep speed (H, M, L) and JOG operations

When you set multifunction input terminals P1–P7 to "Speed-L", "Speed-M", "Speed-H," or "Jog Speed," the combination of the terminal inputs is used as the speed reference to run the commands (multispeed 0–7, or jog operation) that are defined at codes FUN_12 through FUN_20.

Eg.:

When multifunction input terminal P1, P2, and P3 are set to Speed-L, Speed-M, and Speed-H respectively, and another terminal, P4 is set to "Jog Speed," the following operation becomes available.

Note

Jog Speed takes priority over other speed references (commands).

Code	Keypad display	Name	Range	Unit	Parameter setting
DIO _01	P1 define	Define multifunction Input terminal P1 input	-	-	Speed-L
DIO _02	P2 define	Define multifunction input terminal P2 input	-	-	Speed-M
DIO _03	P3 define	Define multifunction input terminal P3 input	-	-	Speed-H
DIO _04	P4 define	Define multifunction input terminal P4 input	-	-	Jog Speed

The following table lists the multistep speed by the combination of terminals P1, P2, and P3. If multispeed 0 is selected (terminals P1, P2, P3 are OFF), one of the three sources is used as the speed reference: Digital input set by the keypad (FUN_12: Speed 0), analog input at the terminal block, or network communication signal.

If terminal P4 is set for jog operation, jog operation takes priority over other inputs. All the other inputs are ignored while the input is given for jog operation. Jog operation takes the parameter value set at FUN_20 as the speed reference.

P1	P2	P3	P4	Speed
OFF	OFF	OFF	OFF	Speed reference source set at FUN_02
ON	OFF	OFF	OFF	FUN_13 (Speed 1)
OFF	ON	OFF	OFF	FUN_14 (Speed 2)
ON	ON	OFF	OFF	FUN_15 (Speed 3)
OFF	OFF	ON	OFF	FUN_16
ON	OFF	ON	OFF	FUN_17
OFF	ON	ON	OFF	FUN_18
ON	ON	ON	OFF	FUN_19
X	X	X	ON	FUN_20 (JOG speed reference)

MOP Up / MOP Down / MOP Clear / MOP Save

If multifunction input terminals P1–P7are set for "MOP up" and "MOP down" operations, acceleration or deceleration operations are available by the terminal inputs.

In general, MOP operation is used to control the speed only with the on/off signals at the terminal block. MOP operation takes higher priority than the command sources set at FUN_02. Therefore, the command reference source setting at FUN_02 is ignored, once MOP up/down operations are defined.

To cancel MOP operation, set the multifunction terminal inputs defined for MOP up/down operations to "Not Used".

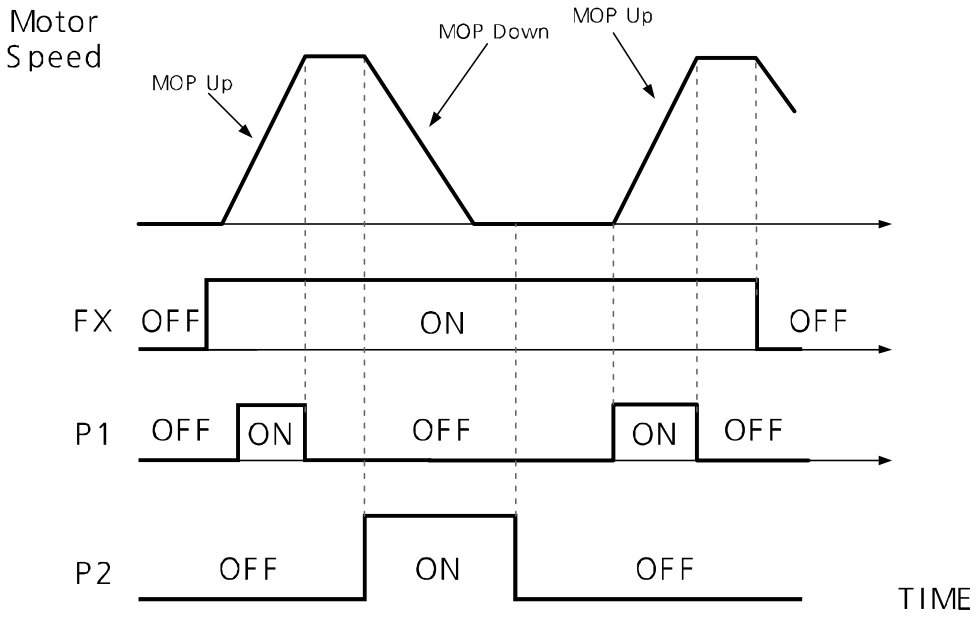
The maximum speed available for MOP operation is the maximum motor speed (that is set at PAR_11).

When 'MOP Save' signal is received, the current MOP speed reference is saved. The saved speed reference is used when a subsequent MOP operation is defined and run. MOP Clear function initializes all the MOP input data to "0". This function must be used before making changes to the saved MOP data.

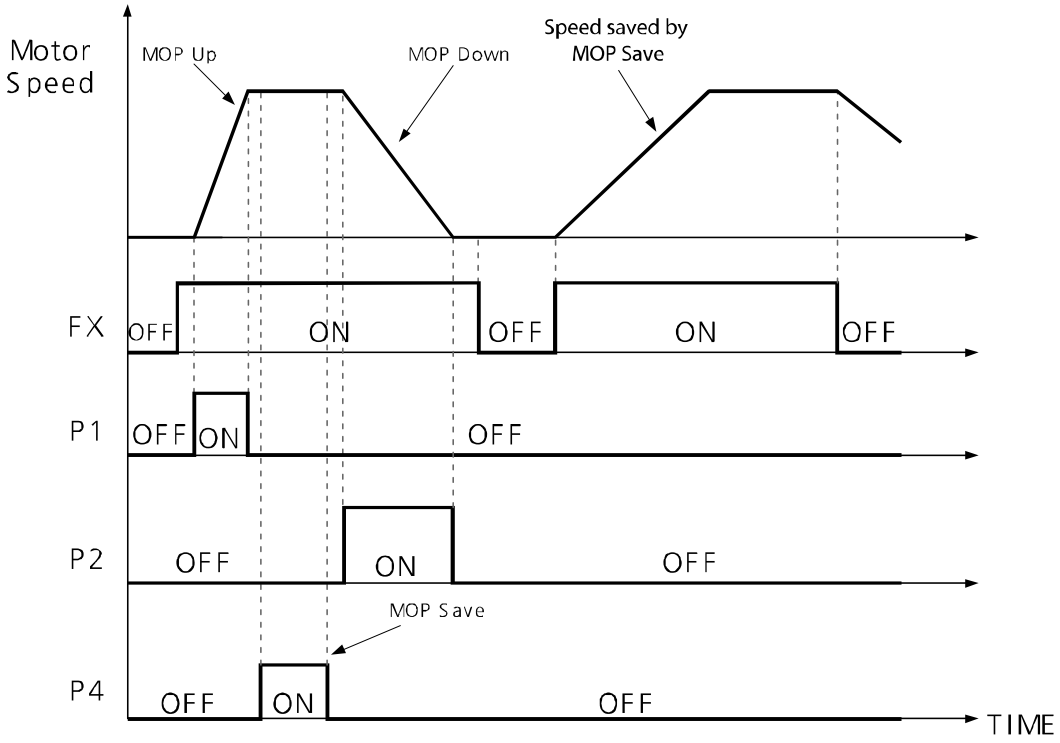
Eg.:

The following table lists examples of defining and running MOP operations.

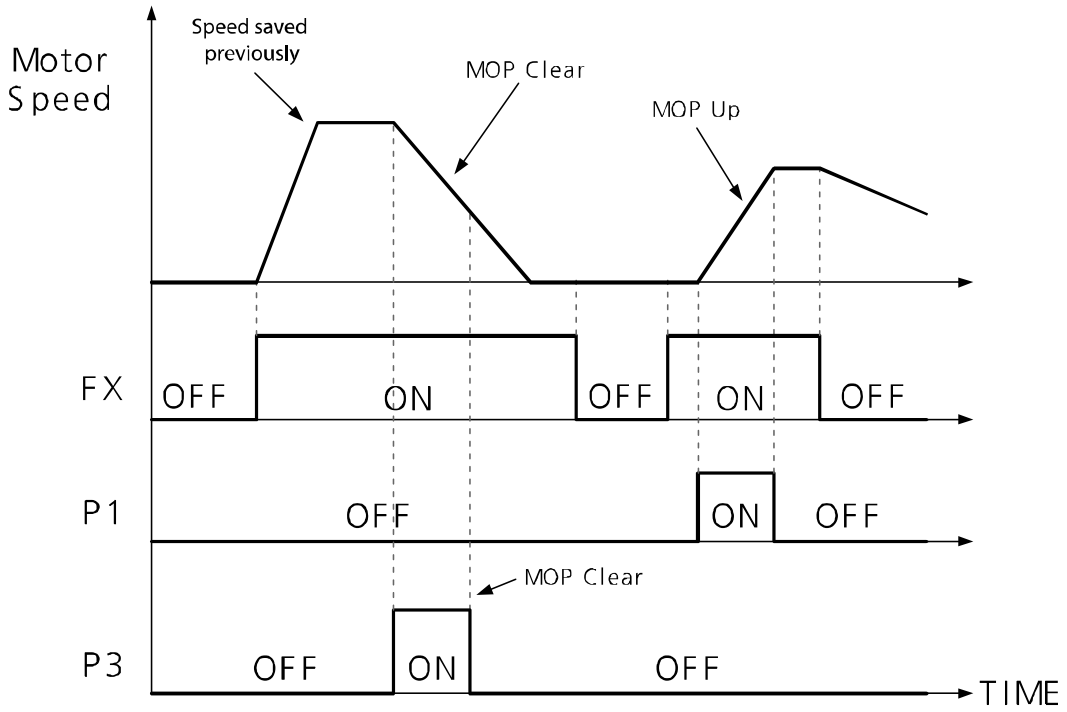
Code	Keypad display	Name	Range	Unit	Parameter setting
DIO _01	P1 define	Define multifunction input terminal P1 input	-	-	MOP Up
DIO _02	P2 define	Define multifunction input terminal P2 input	-	-	MOP Down
DIO _03	P3 define	Define multifunction input terminal P3 input	-	-	MOP Clear
DIO _04	P4 define	Define multifunction input terminal P4 input	-	-	MOP Save



When 'MOP Save' signal is received, the current MOP speed reference is saved. The saved speed reference is used when a subsequent MOP operation is defined and run.



An example of MOP Clear: The 'MOP Clear' function initializes all saved MOP data. Ensure the terminal defined as MOP Clear is ON and then change it to OFF. The saved MOP speed reference will be initialized. If this function is used during inverter operation, the motor decelerates to "zero-speed." If the inverter is not operating, it will initialize the saved MOP speed reference to "0."



Setting the second motor operation [not available when PAR_07 is set to "Speed(Sync)"]

The second motor operation may be used to switch between two motors after connecting them to one inverter. The second motor group is displayed on the keypad only when the function is defined at the terminal block.

Define the multifunction terminals for "2nd Motor" and turn the terminals for the second motor parameters to take effect. The first motor is operated whenever the "2nd Motor" function is not defined and turned on at the multifunction terminal.

All the other parameter settings that are not described below commonly apply to the second motor operation. The following table lists the second motor parameter settings in comparison with the first motor parameters.

The second motor group is displayed on the keypad only when the function is defined at the terminal block. Ensure that you have configured the following second motor parameters before operating the second motor.

Features	Second motor parameters		First motor parameters	
acceleration time	M2_07	M2 Acc time	FUN_41	Acc. Time 1
deceleration time	M2_08	M2 Dec time	FUN_42	Dec. time 1
Encoder-related	M2_28–M2_31		PAR_24–PAR_27	
Motor-related values	M2_16–M2_25		PAR_15–PAR 19, PAR_52–PAR_57	
E-thermal 1minut level	M2_35	M2 ETH 1min	PRT_02	ETH 1min
E-thermal continuous operation level	M2_36	M2 ETH Cont	PRT_03	ETH Cont

Note

- Stop the inverter operation before switching the motors. The second motor operation settings will not apply until the inverter is stopped, and operated again.
- The 2nd motor operation is not available with synchronous motors.

XCEL-L / XCEL-H

For details, refer to FUN_41–48 (Acceleration/Deceleration time 1–4).

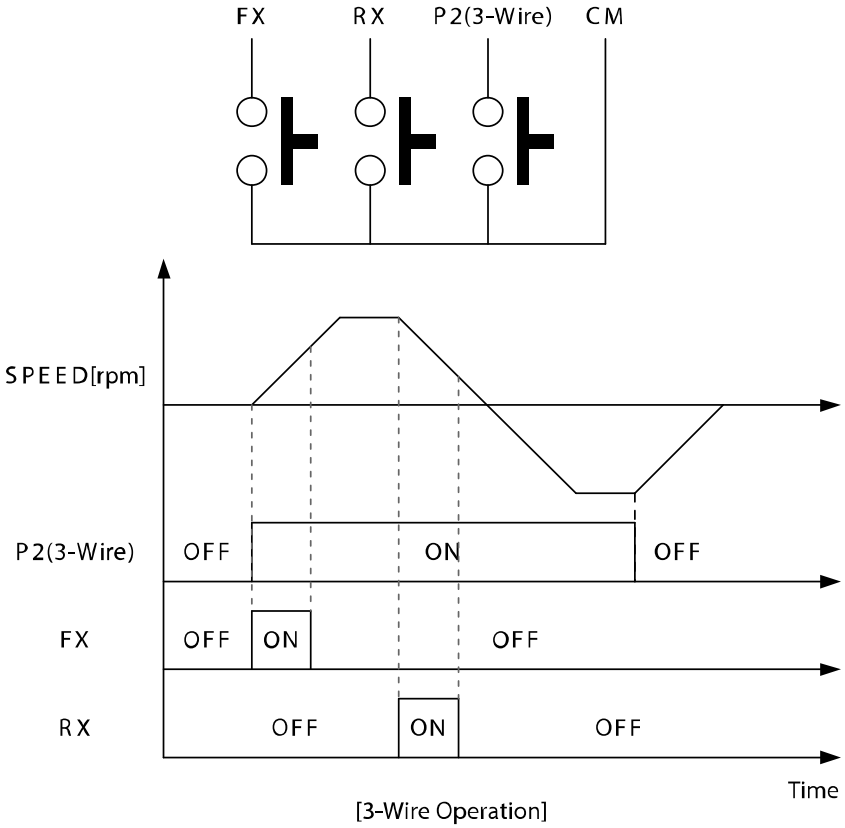
Code	Keypad display	Description	Unit	Default setting
				2.2–37 kW
FUN_41	Acc Time-1	Acceleration time 1	sec	2.00
FUN_42	Dec Time-1	Deceleration time 1	sec	2.00
FUN_43	Acc Time-2	Acceleration time 2	sec	3.00
FUN_44	Dec Time-2	Deceleration time 2	sec	3.00
FUN_45	Acc Time-3	Acceleration time 3	sec	4.00
FUN_46	Dec Time-3	Deceleration time 3	sec	4.00
FUN_47	Acc Time-4	Acceleration time 4	sec	5.00
FUN_48	Dec Time-4	Deceleration time 4	sec	5.00

3-wire operation

3-wire operation is used to lock an operation signal. You can turn on the terminal for the forward or reverse 3-wire operation to commence an operation, and the operation continues after the input signal to the terminal is turned off.

A simple sequence with push buttons is required to run 3-wire operation. If a multifunction input is set for 3-wire operation, the multifunction terminal must be turned on before a 3-wire operation can be operated with the 3 wire pulse inputs (forward or reverse).

Eg.: When terminal P2 is set for 3-wireoperation.



[3-Wire Operation]

External fault trip signal terminal B (Ext Trip-B)

When this function is set, if the signal is turned off during an operation, the inverter turns off its output and performs a free-run stop. Inverter External fault trip signal at terminal B (Ext Trip-B) is displayed on the keypad, and the [STOP] indicator flashes.

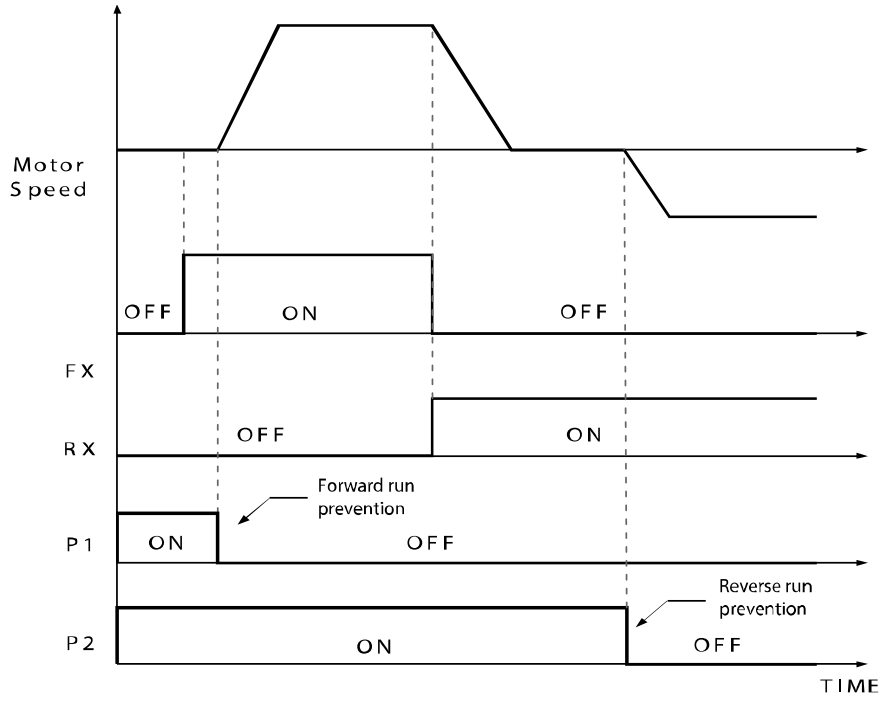
This function may be set to receive a latch-type external fault trip signal.

Run prevention (Prohibit FWD / Prohibit REV)

This function is used to set a run prevention to forward or reverse direction, by setting the multifunction input terminal.

If a reverse prevention is set, negative (-) speed reference is treated as "0". Likewise, positive (+) speed reference is treated as "0" when a forward run prevention is set.

The following is an example of an inverter operation when multifunction input terminal P1is set for forward run prevention, and input terminal P2 is set for reverse run prevention.

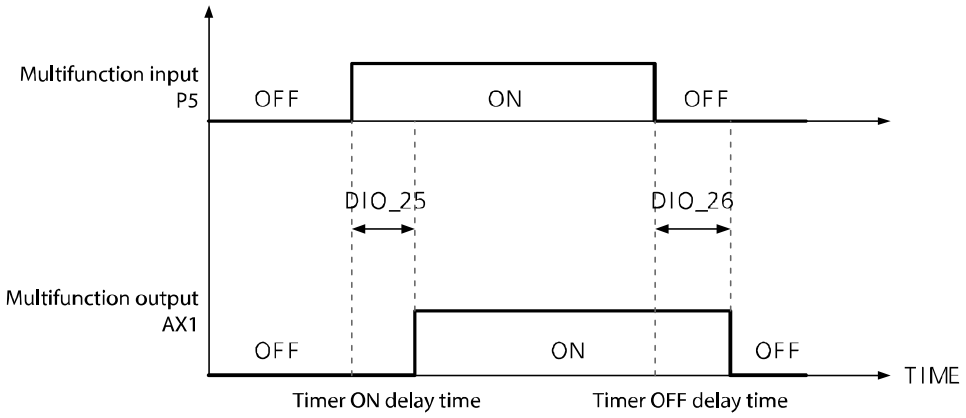


Timer input

When multifunction input terminals P1–P7 are set to receive timer input signal, "Timer ON delay time (DIO_25)" and "Timer OFF delay time (DIO_26)" may be defined and applied to the inverter output.

The following is an example when DIO_05 (multifunction input terminal P5) is set for timer input, and DIO_11 (AX1, multifunction aux output terminal) is set for timer output.

Code	Keypad display	Name	Range	Unit	Parameter setting
DIO_05	P5 Define	Define multifunction input terminal P5	-	-	Timer Input
DIO_11	AX1 Define	Define multifunction auxiliary output terminal AX1	-	-	Timer Out
DIO_25	TimerOn Dly	Timer ON delay time	0.1–3600.0	sec	-
DIO_26	TimerOff Dly	Timer OFF delay time	0.1–3600.0	sec	-



Cancel soft start function (SoftStartCncl)

This function is used to override any specified settings for smooth acceleration or deceleration and accelerate or decelerate at the highest available settings. To enable this feature, define a multifunction input terminal as "SoftStartCncl". If soft start is canceled, the acceleration and deceleration times are based on the load conditions and the responsiveness of the speed controller.

The following is an example of an operation where input terminals P1, P2, and P3 are used to switch between the acceleration or deceleration time settings, or to cancel the soft start feature.

P1 (Xcel-L)	P2 (Xcel-H)	P3 (SoftStartCncl)	Acceleration/Deceleration time
OFF	OFF	OFF	Acceleration/Deceleration 1
ON	OFF	OFF	Acceleration/Deceleration 2
OFF	ON	OFF	Acceleration/Deceleration 3
ON	ON	OFF	Acceleration/Deceleration 4
X	X	ON	Fastest Acceleration/Deceleration

ASR gain switching (ASR Gain Sel)

The speed PI controller uses one of the two P/I gain combinations depending on the ASR gain switching option ("ASR Gain Sel") that are set at the multifunction input terminals.

The following is an example where multifunction input terminal P5 is set for the ASR gain switching.

Code	Keypad display	Name	Range	Unit	Parameter setting
DIO_05	P5 Define	Define multifunction input terminal P5			ASR Gain Sel
CON_03	ASR P Gain1	Speed controller proportional gain 1	0.1–500.0	%	P5: OFF
CON_04	ASR I Gain1	Speed controller integral time 1	0–50000	msec	
CON_05	ASR LPF1	Speed controller input LPF time constant 1	0–20000	msec	

Code	Keypad display	Name	Range	Unit	Parameter setting
CON_06	ASR P Gain2	Speed controller proportional gain 2	0.1–500.0	%	P5: ON
CON_07	ASR I Gain2	Speed controller integral time 2	0–50000	msec	
CON_08	ASR LPF2	Speed controller input LPF time constant 2	0–20000	msec	

ASR P/PI switching (ASR P/PI Sel)

The ASR P/PI switching option (ASR P/PI Sel) allows the speed PI controller to control the operation with P control only. The ramping time set at CON_10 prevents any negative effects on the system caused by the abrupt change in proportional gain or integral time during an ASR Gain or P/PI control switching.

Code	Keypad display	Name	Range	Unit	Parameter setting
DIO_05	P5 Define	Define multifunction input terminal P5			ASR Gain Sel

Flux reference switching (Flux Ref Sel)

The flux reference switching option (Flux Ref Sel) allows the speed control by the flux reference. When the switching is turned off, the controller uses the rated flux (100%) as reference. When the switching is turned on, the flux rate in a percentage to the analog voltage input (-10–10 V) is transformed into the flux rate in a percentage to the rated flux (10–100%).

Pre-excitation (PreExcite)

In pre-excitation, a voltage is supplied to the motor stator and generates a magnetic field inside the motor before it operates. The addition of flux to the motor's stator prepares the motor and enhances its acceleration response.

Set a multifunction input terminal to "PreExcite" to enable pre-excitation. While a pre-excitation signal is input, no-load current is provided to the motor to create a flux.

Using the maximum torque (Use Max Torque)

Configure a multifunction input terminal to "Use Max Trq" to set torque at the maximum level. When the terminal is activated, the torque limit is set at the maximum value available. When it is not activated, the settings at CON_34–CON_36 are the reference values. This function provides temporary operation only and is not for continuous operation.

Caution

Prolonged operation at the maximum torque may damage the motor and/or inverter.

Torque bias options (Use Trq Bias)

There are three options available to apply torque bias to the inverter operation, depending on the multifunction input terminal settings:

- When a multifunction input (P1–P7) is set to "Use Trq Bias", torque bias is applied to the operation whenever the relevant input terminal is activated. To disable torque bias, turn off the signal to the terminal.
- When "Use Trq Bias" setting is not used, and CON_37 (Trq Bias Src) is set to "Keypad", torque value set at CON_38 (Trq Bias) is used.
- When a multifunction input (P1–P7) is not set to "Use Trq Bias" and CON_37 is set to "Analog", the analog input corresponding to the torque bias set at CON_38 is applied to the operation regardless of the multifunction terminal ON/OFF status.
- To disable torque bias in this option, set CON_37 (Trq Bias Src) to "None", or set it to "Use Trq Bias" and turn of the terminal input.

A3 safety terminal

You can set one of the multifunction input terminals to receive "A3 Safety" signal. Signal to the input enables or disables the PWM output of the inverter. For more information, refer to *6.7 Protection (PRT) group* on page *265*.

Disable low voltage trip detection (LVT Disable)

This function uses an auxiliary power supply to test the control board for hardware faults other than low voltage trip faults before supplying mains power to the inverter. Output fault signals are provided for faults other than low voltage trip.

Input operation commands cannot be transmitted to the inverter while auxiliary power is supplied. The "INV Ready" function at the multifunction input terminals will not work either.

The following table lists the hardware fault trip detection status when the "LVT Disable" function is used.

"LVT Disable"	Power Conditions	"INV Ready" Output	Fan error detection	H/W faults other than LVT and Fan error
ON	Before	OFF	X	O

- The existing trip is reset when "LVTDisable" feature is applied while the power is On.

Operation by battery power (Battery Run)

When the inverter is used to operate elevators, battery power may be used as the emergency power source if power failure occurs during elevator operation.

For more details, refer to *6.5.12 Setting the operation speed and input voltage for battery operation* on page *231*.

6.3.2.2 Reversing the multifunction terminal input (DIO_08)

Multifunction input terminals are "Form A" contacts by default. The DIO_08 parameter is used to change the contact type to "Form B" by setting the binary code for each terminal to "1."

When the contact type for a terminal is changed, the setting is maintained until it is modified again by the user.

Note that setting the external trip B terminal to a "Form B" contact makes it work as the external trip A terminal.

On the keypad display, the binary digits as they appear from left to right represent the contact type for the FX, RX, BX, RST, P1, P2, P3, P4, P5, P6, and P7 terminals.

(P1-P7: Form A contact)

DIO ▶ Neg Func.In
08 00000000000

(P1, P6: Form B contact)

DIO ▶ Neg Func.In
08 00001000010

6.3.2.3 Setting the LPF (Low pass filter) time constant for terminal input (DIO_09)

The low pass filter is used to reduce the level of electronic signal interference. The setting at DIO_09 configures the responsiveness of the input terminals (FX, RX, BX, RST, and P1–P7). Increasing the time constant decreases the responsiveness of the input terminal and decreasing it increases the responsiveness. The approximate response time of a terminal can be calculated by:

Setting value × 2.5 msec

6.3.3 Multifunction digital output terminal

6.3.3.1 Reversing the multifunction auxiliary output terminals (DIO_10)

Multifunction auxiliary output terminals are "Form A" contacts by default. The DIO_10 parameter is used to change the contact type to "Form B" by setting the binary code that corresponds to the terminal to "1."

When the contact type for a terminal is changed, the setting is maintained until it is modified again by the user.

On the keypad display, the binary digits as they appear from left to right represent the contact type for the AX1, AX2, and OC1 terminals.

(AX1-OC1: Form A contact)

(AX1, OC1: Form B contact)

6.3.3.2 Setting the multifunction auxiliary output terminals (DIO_11–13)

Codes DIO_11 to DIO_13 are used to assign functions to the multifunction auxiliary output and open collector output terminals. Once the conditions are met for the functions, outputs are made at the corresponding terminals.

No.	Parameter setting	Description	No.	Parameter setting	Description
1	INV Ready	Inverter ready	12	Speed Agree Note 1)	Speed agreement
2	Zero Spd Det Note 1)	Zero-speed detection	13	Trq Det. Note 1)	Torque detection
3	Spd Det.	Speed detection	14	Trq Lmt Det. Note 1)	Torque limit detection
4	Spd Det(ABS)	Speed detection (non-polar)	15	OverLoad	Overload warning
5	Spd Arrival	Reference speed reached	16	Stop	Stop operation in progress
6	Timer Out	Timer output	17	MC on/off	MC signal output

No.	Parameter setting	Description	No.	Parameter setting	Description
7	LV Warn	Low voltage warning	18	FAN Status	Fan failure status
8	Run	In operation	19	ALLS Status	ALLS operation status
9	Regenerating	Regeneration in progress	20	Steady	Steady operation
10	Mot OH Warn	Motor overheat warning	21	Brake Output	Brake output
11	INV OH Warn	Inverter overheat warning			

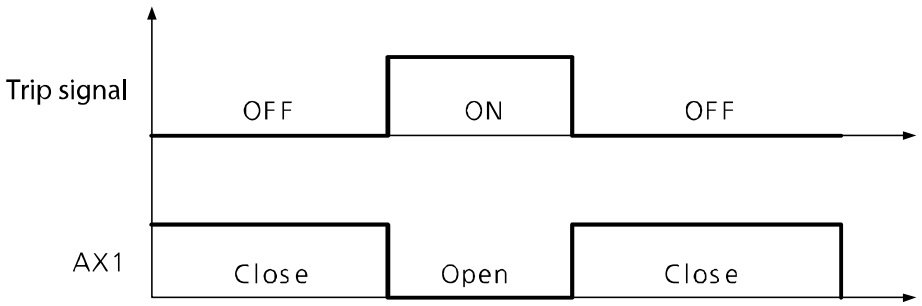
Note 1) Available in "Speed," or "Speed(Sync)" modes only.

Not Used

This setting is used to disable the multifunction digital output.

INV Ready

This setting allows the multifunction terminal to output a signal to inform the user that the inverter is ready for operation. The output circuit opens when a fault trip occurs.



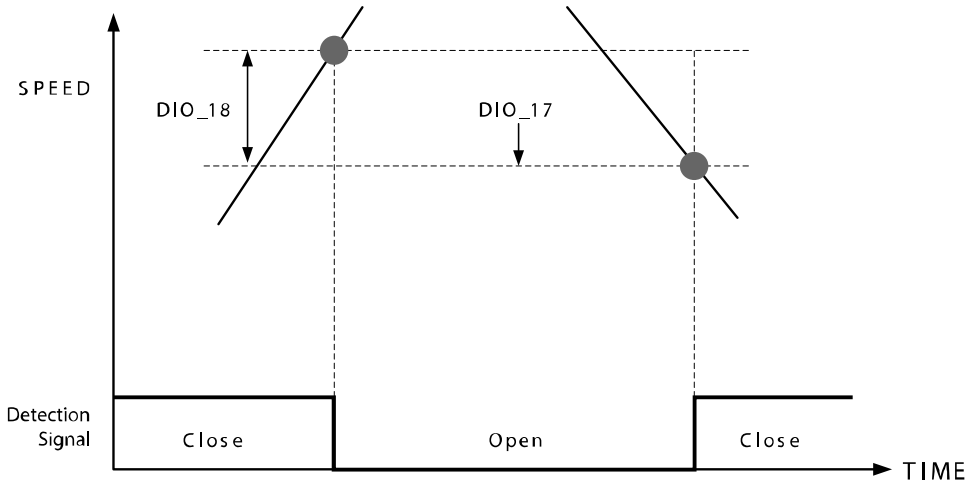
The "INV Ready" signal is output during a run on battery power as well. When the inverter is running on battery, the inverter is still operable although the DC_Link voltage is low.

Zero Spd Det

This setting is used to detect the motor's zero-speed.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_17	ZSD Level	Zero-speed detection level	0.0–480.0	rpm	10
DIO_18	ZSD Band	Zero-speed detection band	0.1–10.0	%	0.5

The setting value for DIO_18 (ZSD Band) is expresses in a percentage of the motor's maximum speed (PAR_11).

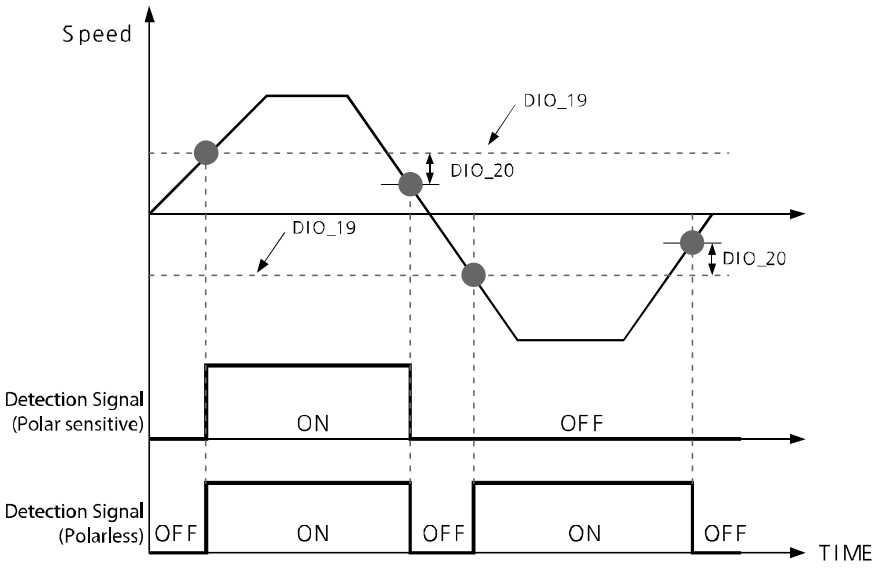


Spd Det. / Spd Det. (ABS)

This setting is used to detect a certain motor speed. Depending on the setting, the detection speed may either be non-polar or polar sensitive.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_19	SD Level	Speed detection level	-3600–3600	rpm	0
DIO_20	SD Band	Speed detection band	0.1–10.0	%	0.5

The setting value for DIO_20 (SD Band) is expresses in a percentage of the motor's maximum speed (PAR_11).



Reference speed acquisition (Spd Arrival)

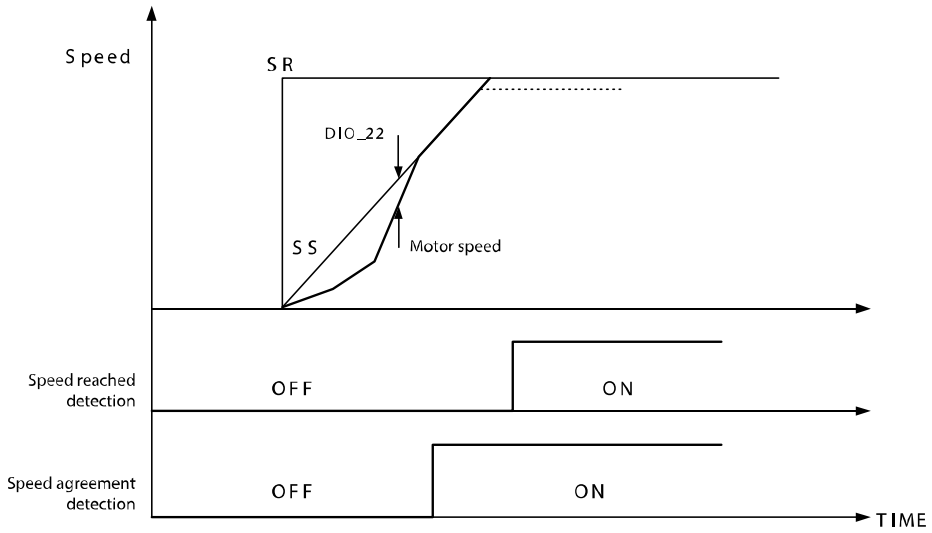
This setting is used to detect if the motor speed has reached its speed reference.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_21	SA Band	Reference speed reached detection band	0.1–10.0	%	0.5

Reference speed agreement (Spd Agree)

This setting is used to detect if the motor speed deviates from the reference during acceleration or deceleration.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_22	SEQ Band	Speed agreement band	0.1–10.0	%	0.5

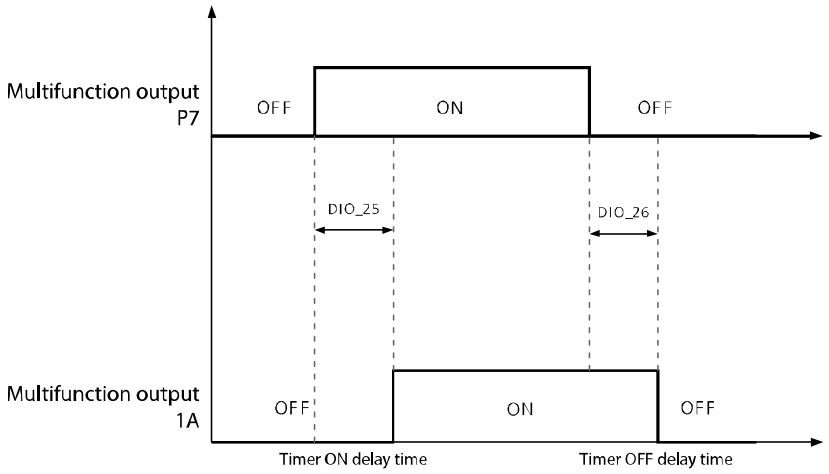


Timer output

This setting is used to assign a timer output function to one of the multifunction output terminals. DIO _26 (timer OFF delay time) is used to set the delay time for this output signal.

The following table lists an example of multifunction input and output terminal settings, and the diagram below explains the inverter operation.

Code	Keypad display	Name	Range	Unit	Parameter setting
DIO_07	P7 Define	Define multifunction input terminal P7			Timer Input
DIO_11	AX1 Define	Define multifunction auxiliary output terminal AX1 (1A, 1B)			Timer Out
DIO_25	TimerOn Dly	Timer ON delay time	0.1–3600.0	sec	0.1
DIO_26	TimerOff Dly	Timer OFF delay time	0.1–3600.0	sec	0.1



LV Warn

This setting is used to output a signal when the inverter's DC link voltage drops below the low voltage limit.

Run

This setting is used to output a signal during inverter operation.

Regenerating

This setting is used to output a signal when regeneration is in progress. This setting is not available when the control mode is set to "V/F," or "Slip Comp".

Inv OH Warn

This setting is used to output a signal when the inverter is overheated. Refer to *6.7.13 Overload limit selection, level, time (PRT 22–24)* on page *279* for more information.

Mot OH Warn

This setting is used to output a signal when the motor is overheated. Refer to *6.7.14 Inv OH Warn* on page *279* for more information.

Trq Det.

This setting is used to detect a certain torque.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_23	TD Level	Torque detection level	0.0–250.0	%	0.0
DIO_24	TD Band	Torque detection band	0.1–10.0	%	0.5

Trq Lmt Det

This setting is used to detect the torque limit output by the speed controller.

Stop

This setting is used to output a signal when the inverter is in a stop state.

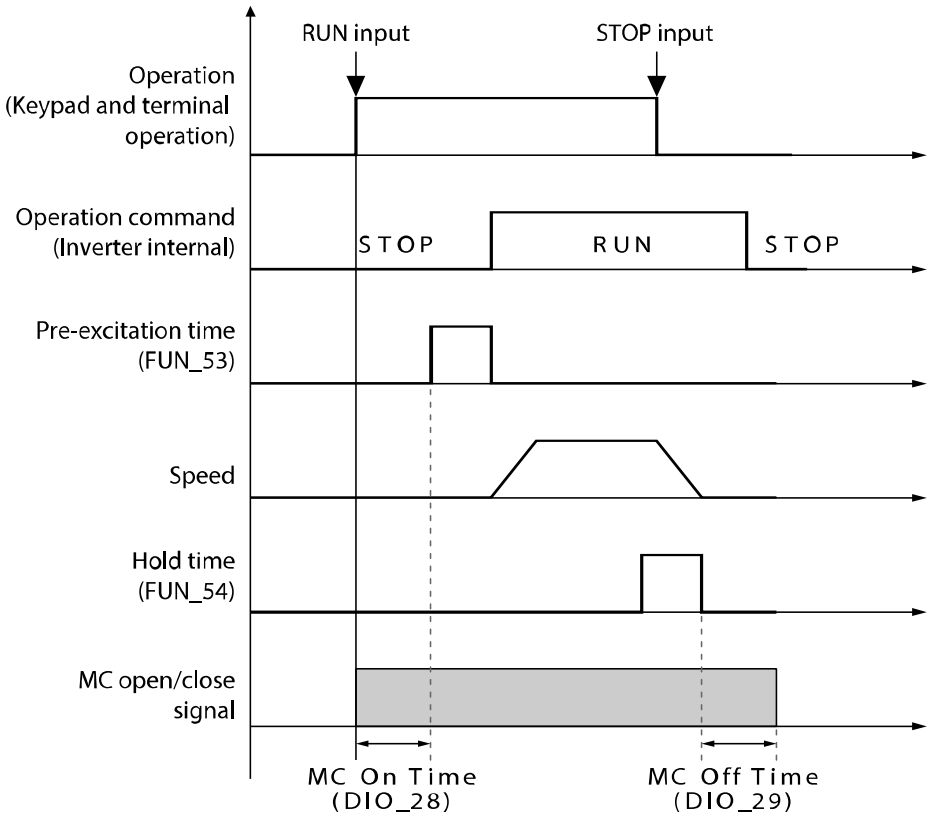
Controlling magnetic contactors (MC)

The DIO group controls settings for magnetic contactors (MC) that are installed in elevator circuits. The MC settings ensure that the MC is engaged (ON) before the inverter starts the operation and disengaged (OFF) after the inverter completes the operation.

The FWD and REV indicators flash when the "MC On Time," and "MC Off Time" commands are being used.

The following table lists the time setting values available for the MC on/off control. When this function is not used, the delay times are automatically set to "0" (MC On Time=0, MC Off Time=0).

Code	Keypad display	Name	Range	Unit	Default setting
DIO_28	MC On Time	MC on delay time	100–60000	msec	1000
DIO_29	MC Off Time	MC off delay time	100–60000	msec	1000



FAN Status

This setting is used to output a signal when a fan warning is turned on, or a fan failure occurs. Refer to *6.7.17 A3 Safety* on page *281* for more information.

ALLS Status

This setting is used to output a signal when the inverter is running an ALLS operation.

Steady

This setting is used to output a signal when the inverter is operating at a fixed speed.

Brake Output

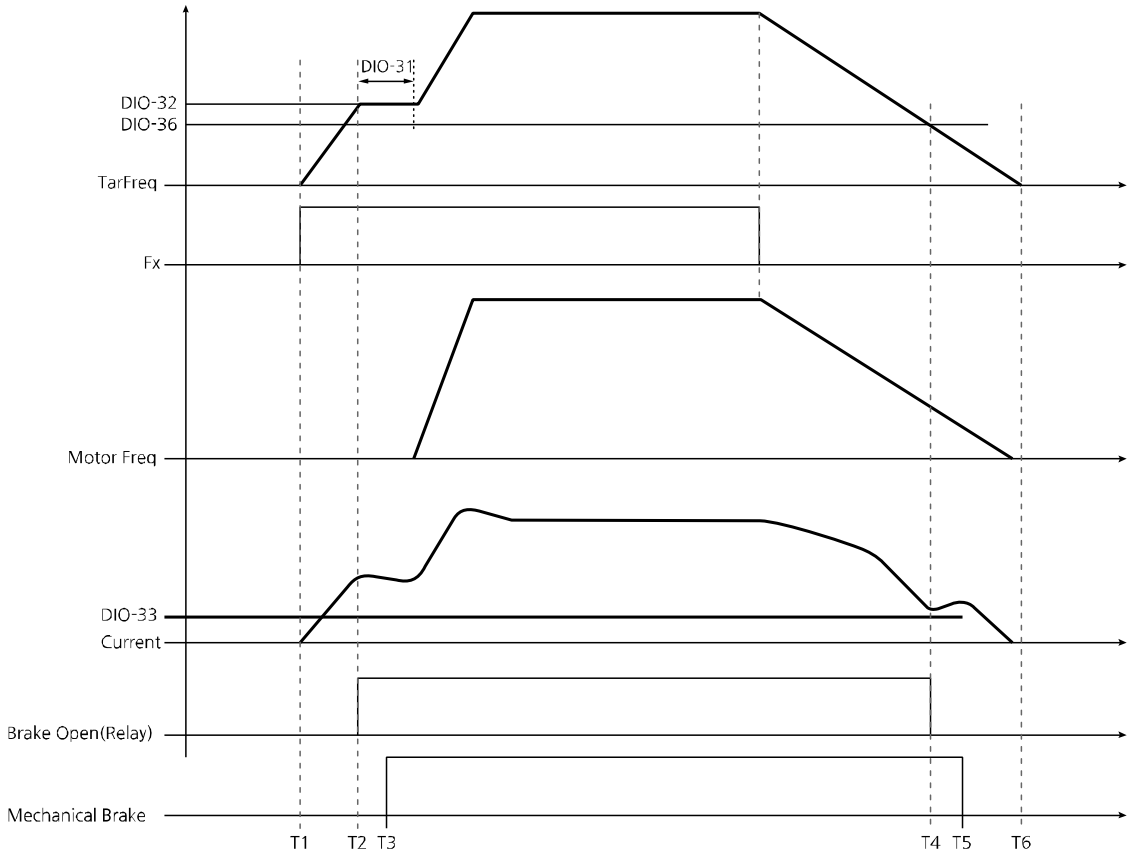
This setting is used to output brake on (engaged) or brake off (released) signals.

Code	Keypad display	Name	Range	Unit	Default setting
FUN-03	Stop mode	Stop options	0 (Decel) 1(Free-run) 2 (Dc-brake)	Msg	0: Decel
FUN-06	DcBr Freq	DC braking frequency	PAR_12–PAR_11	Hz	1.00
FUN-07	DcBlk Time	PWM output block time before DC braking	0–6000	msec	0
FUN-08	DcBr Value	DC braking value	0–200	%	10
FUN-09	DcBr Time	DC braking time	0–600	sec	10
FUN_10	Dcst Value	DC amount at start-up	0–200	%	10
FUN_11	Dcst Time	DC braking time at start-up	0.0–60.0	sec	60.0
DIO-30	BK On Delay	Brake output on delay time	0–FUN_11	sec	0
DIO-34	BK Off Delay	Brake output off delay time	0.1–60.0	sec	0.1
DIO-11–13	AX1/Ax2/OC1 Define	Define multifunction output terminal	0–21 (2: Brake Output)	Msg	0: Not Used
DIO-31	BKOpen Time	Brake open time	0.1–300.0	msec	0.1
DIO-32	BKOpen Spd	Brake open speed	1–5000	Hz	setFreq
DIO-33	Release Curr	Brake release current	2.00–15.00	%	2.00
FUN-53	PreExct Time	Motor pre-excitation time	0–10000	msec	0
FUN-54	Hold Time	Hold time	10–10000	msec	1000

Note

DIO_33 (brake release current) value is expressed in a percentage to the motor's rated current.

■ Braking operation in "V/F" and "slip compensation" modes



<Brake operation in V/F and slip compensation modes>

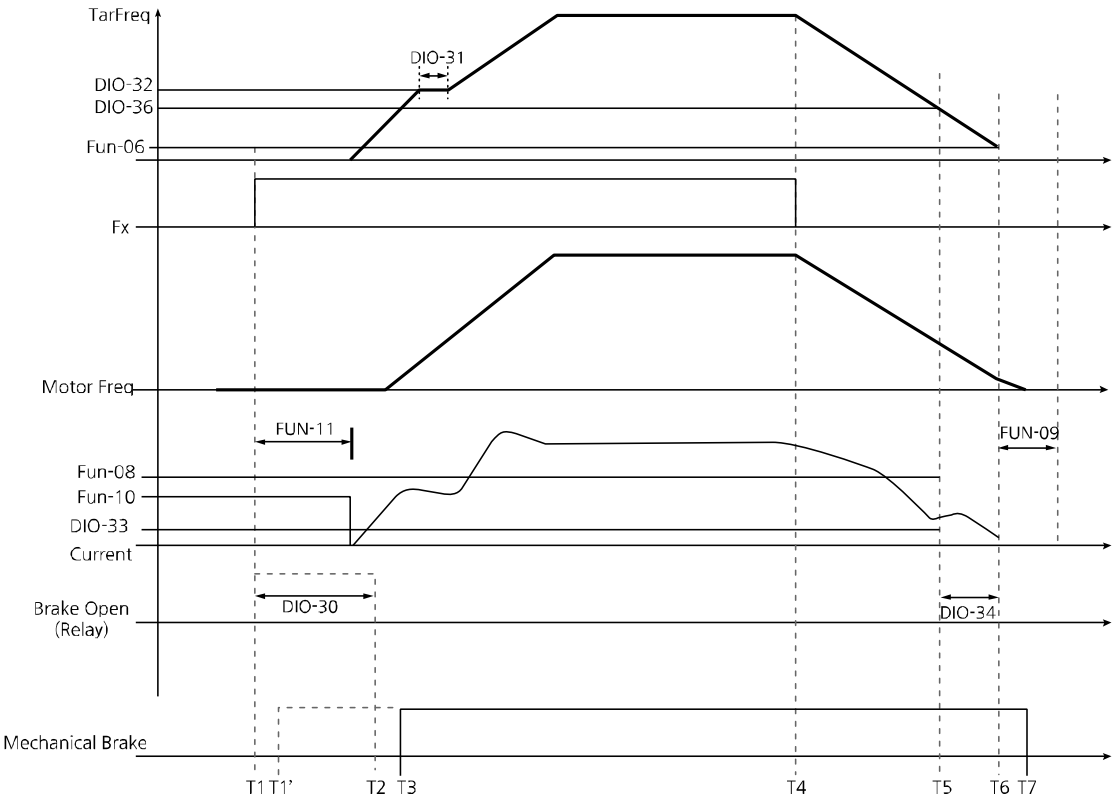
When a forward operation command is given at T1 on the timeline, if the output frequency is greater than the brake open speed set at DIO-32, and if the output current is greater than the value set at DIO-33, the brake open signal is output (T2 on the timeline). From there on, the frequency is maintained for the time set at DIO-31, and then the acceleration continues to the frequency reference.

The mechanical brake is disengaged slightly later at T3 on the timeline. Mechanical brakes in general have slight delays when they operate.

During deceleration, if the output frequency reaches the brake close (engage) level set at DIO-36, and if the output current is greater than the 90% of value set at DIO-33, the break open signal is turned off (T4).

The mechanical brake is engaged at T5 due to the mechanical delay.

■ **Braking operation in "V/F," or "slip compensation+ DC start" and "DC braking" modes**



If DIO_30 (BK On Delay) is not set, a brake open signal is sent as soon as an operation command is sent (T1 on the graph above).

DIO_30 (BK On Delay) can be set to delay opening the brake until T2. This can be used to enable the brake to open at the end of the DC start phase. Or, at any stage after the elevator is in a position that it will not descend from if the brake is disengaged.

When an operation command is received, the inverter provides the amount of DC current set at FUN_10 (DcSt Value) for the time set at FUN_11. Then, the inverter accelerates until it reaches the speed set at DIO_32 (BK Open Speed), maintains the speed for the time set at DIO_31, and accelerates again until the frequency reference is reached.

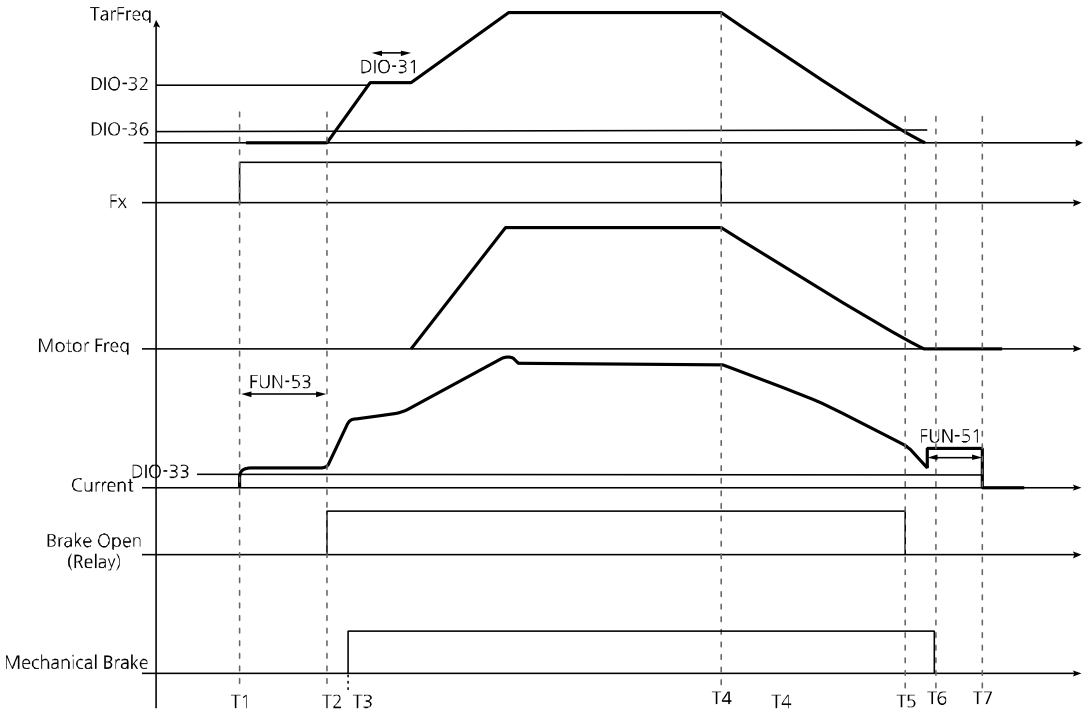
When the operation command is turned off, the inverter decelerates (T4). If the output frequency reaches the brake close speed set at DIO_36 (BKClose Spd)and if the current exceeds 90% of the brake release current set at DIO_33, the brake open signal stops (T5 on the graph).

DIO_34 (BK Off Delay) can be used to adjust the brake opening time. The brake open signal OFF time can be adjusted from T5 to T6 on the graph.

When the inverter output frequency reaches the frequency set at FUN_06, the inverter output is blocked for the time set at FUN_07. Then, the amount of DC current set at FUN_08 is applied for the time set at FUN_09.

If the DC braking frequency exceeds the frequency during brake closing, the DC braking value set at DIO_36 (BK Close Spd) is applied when the brakes are closed. If the brake closing frequency exceeds the DC brake frequency, a brake close signal is sent when the frequency set at DIO_36 (BK Close Spd) is reached, and DC braking is applied at the frequency set at FUN_06 (Dcbr Freq).

■ **Braking operation in "Speed" mode**



When an operation command is received at T1, the inverter supplies flux current to the motor for the time set at FUN_53.

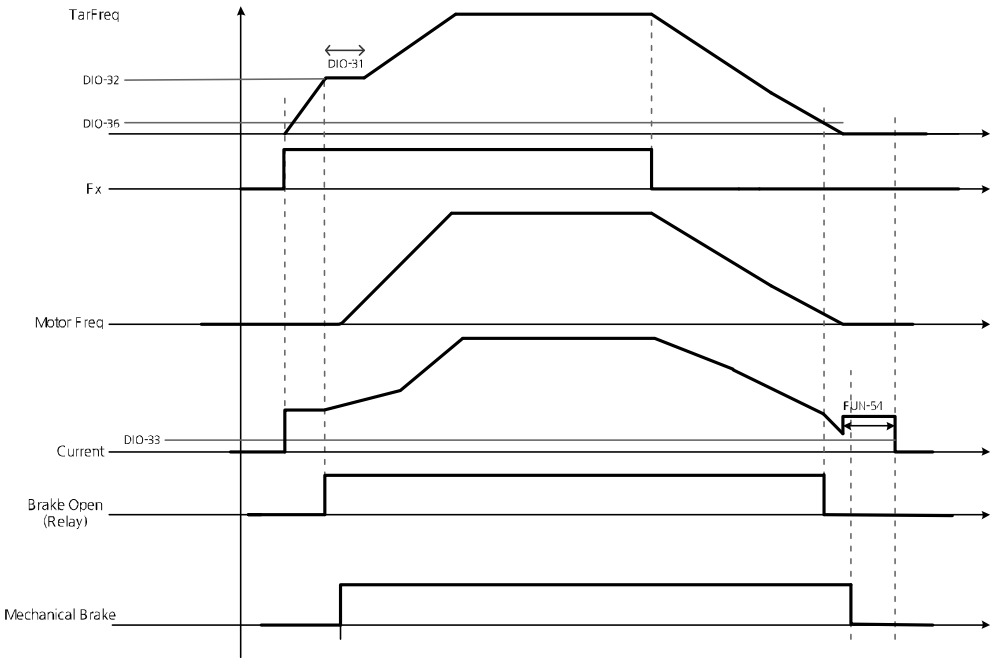
A brake open signal is received when the output current is greater than the amount set at DIO_33 at T2, and after a mechanical delay, the brakes are released at T3 as illustrated in the graph above.

When the inverter's output frequency reaches the frequency set at DIO_32, the frequency is maintained for the time set at DIO_31. Then, the motor accelerates until it reaches the frequency reference. Once the frequency reference is reached, the inverter maintains the speed and continues to operate.

When the operation command is turned off, the inverter decelerates at T4 as illustrated in the graph above. If the output frequency reaches the brake closing frequency set at DIO_36 (BKClose Spd) and the current exceeds 90% of the brake release current set at DIO_33, the brake signal is turned off at T5 in the graph above. The brakes are applied until T6 because of mechanical delay.

When the inverter output frequency is "0," the inverter is operated at zero-speed for the time set at FUN_54 (Hold Time) and fully stops at T7 as illustrated in the graph above.

■ **Braking operation in "Speed(Synch)" mode**



The basic braking operation in "Speed(Synch)" mode is identical to that used in "Speed" mode, with one exception. Pre-excitation is not required because synchronous motors do not require the injection of flux current.

ⓘ Caution

In the control mode other than "Speed(Sync)", brake open singnal is forced to become Offifthe output current becomes less than 90% of the set brake open current value even when the brake open signal is On and operating normally.

Output relay options (DIO_16)

Relays 30A, 30B, and 30 C receive fault output signals when the inverter has a fault. The signal code can define individual bits for low voltage or inverter fault trip conditions and restart options.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_16	Relay Mode	Relay mode (A, B, C terminals)	000–111		011

Code	Bit 2 (Auto restart)	Bit 1 (Inverter fault trip)	Bit 0 (LVT)
DIO_16	0/1	0/1	0/1

Bit	Setting	Description
Bit 0 (LVT)	0	No LVT ouput signal.
	1	LVT output signal.
Bit 1 (Inverter trip)	0	No inverter trip output signal.
	1	Inverter trip output signal.
Bit 2 (Restart trial)	0	No auto restart output signal.
	1	Restart attempt duration output signal.

6.4 Analog input and output (AIO) group

6.4.1 Jump code (AIO_00)

AIO_00 code is used to directly access a certain code.

The following is an example of jumping directly to AIO_13 from AIO_00 code.

1 Press [PROG].

2 Use [SHIFT/ESC], [▲], or [▼] to change the code number to "13".

3 Press [ENT] to access code AIO 13. If an invalid code number is entered, the next available code number is automatically selected.

Note

After jumping directly to a code, you can move to other codes by pressing [▲] or [▼].

6.4.2 Multifunction analog input

6.4.2.1 Multifunction analog input terminals AIO_01–38 (settings, input options, minimum input, bias, maximum input, gain, low pass filter time constant, and lost command conditions)

The LSLV-iV5L inverter provides three analog input terminals- Ai1, Ai2, and Ai3. The Ai1 and Ai2 terminals allow voltage or current inputs depending on the jumper settings, while the Ai3 terminal allows voltage or motor NTC input depending on the selection switch setting. The analog input terminals allow –10–10 V voltage inputs, or 0–20 mA current inputs.

Analog input terminals can be defined for one of the five different functions. Only one function may be assigned to one terminal at a time. If you try to assign a function to more than one terminal, the setting will not be saved on the second terminal, and its original function will be retained.

If an analog input terminal that was previously defined is defined again for another function, the previously set values will be initialized to "0".

Bit	Setting	Description
Speed Ref	Speed reference	The speed reference becomes ±100% of the motor's maximum speed when the input signal is ±10 V.
Flux Ref	Flux reference	The flux reference becomes 100% of the motor's rated flux when the input signal is ±10 V.
Torque Bias	Torque bias	The torque bias becomes ±100% of the motor's rated torque when the input signal is ±10 V. The available range is –250–250% of the motor's rated torque, depending on gain and bias settings.
Torque Limit	Torque limit	The torque limit is 100% of the motor's rated torque when the input signal is 10 V. The available range is 0–250% of the motor's rated torque, depending on gain and bias settings.
Use Mot NTC	Motor NTC input	Used to input motor's NTC sensor signals. This setting displays motor temperature on the keypad, and allows for detection of motor overheating warning or fault trip. This function is available only with Higen motor products.

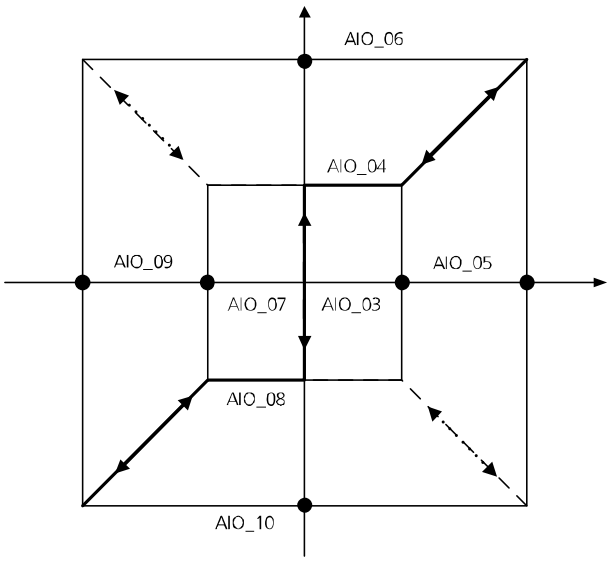
The following table lists the functions available for these multifunction analog input terminals.

Code	Keypad display	Function	Range	Unit	Description
AIO_01	Ai1 Define	Define multifunction analog input Ai1	0 (Speed Ref) 5 (Flux Ref) 6 (Torque Bias) 7 (Torque Limit)		Defines types of multifunction analog input Ai1.
AIO_02	Ai1 Source	Input source for multifunction analog input Ai1	0 (-10 → 10 V) 1 (10 → -10 V) 2 (0 → 10 V) 3 (10 → 0 V) 4 (0 → 20 mA) 5 (20 → 0 mA)		Defines input options of multifunction analog input Ai1.
AIO_03	Ai1 In X1	Minimum value for multifunction analog input Ai1	AIO_07 –AIO_05	%	Sets the minimum amount of Analog Input. Regardless of the settings at AIO_02, the reference voltage is 0[V], and the reference current is 0[mA].
AIO_04	Ai1 Out Y1	Minimum input bias for multifunction analog input Ai1	AIO_08 –AIO_06	%	Defines the value set at AIO_01 based on the analog input at AIO_03
AIO_05	Ai1 In X2	Maximum input for multifunction analog input Ai1	0.00–100.00	%	Defines the maximum input value for analog input.
AIO_06	Ai1 Out Y2	Maximum input gain for multifunction analog input Ai1	0.00–250.00	%	Defines the value set at AIO_01 based on the analog input at AIO_05.

Code	Keypad display	Function	Range	Unit	Description
AIO_07	Ai1 In -X1	Minimum negative input for multifunction analog input Ai1	AIO_09 –AIO_03	%	Defines the minimum negative value for the analog input. Regardless of the settings at AIO_02, the reference voltage is 0[V], and the reference current is 0[mA].
AIO_08	Ai1 Out -Y1	Minimum negative input bias for multifunction analog input Ai1	AIO_10 –AIO_04	%	Defines the value set at AIO_01 based on the analog input at AIO_07.
AIO_09	Ai1 In -X2	Maximum negative input for multifunction analog input Ai1	-100.00–0.00	%	Defines the maximum negative value for the analog input.
AIO_10	Ai1 Out -Y2	Maximum negative input gain for multifunction analog input Ai1	-250.00–0.00	%	Defines the value set at AIO_01 based on the analog input at AIO_09.
AIO_11	Ai1 LPF	Ai1 input low-pass filter time constant	0–2000	msec	Defines the low-pass filter time constant for the analog input.
AIO_12	Ai1 Wbroken	Lost command for multifunction analog input Ai1	0 (None) 1 (Half of x1) 2 (Below x1)		Defines the lost command conditions for the analog input Ai1.

Codes AIO_13 to AIO_36 contain parameters for Ai2 and Ai3, which are basically identical in functions to the codes AIO_01 to AIO_12 (for analog Ai1), except that analog input terminal Ai3 does not allow current input.

AIO_03 expresses the minimum voltage or current input that can be recognized by the inverter in a percentage to the maximum input voltage (10 V) or current (20 mA). For example, if AIO_03 is set to 20%, this stands for 2 V in voltage, or 4 mA in current. If AIO_04 is set to 0%, any input to the analog input terminal that is smaller than 2 V or 4 mA is not regarded as an effective input.



Analog input concept diagram

AIO_03 is used to define the range of current input at the analog input terminals. In general, AIO_03 is set to 0%, and AIO_05 is set to 100%. However, for those analog input devices that generate chattering with 0% AIO_03 setting value, you may adjust the value to avoid the chattering.

When the main controller receives voltage or current inputs at the analog input terminals, inaccuracy of the analog input or output devices may create deviations in the signals. AIO_04 and AIO_06 are similar to bias and gain settings which are used to correct the deviation in the inverter's main controller. Codes AIO_07 through AIO_10 are identical to AIO_03 through AIO_06 in their functions, except that these codes are for negative analog input values.

As it is represented in the concept diagram, not only does the LSLV-iV5L inverter allow analog inputs in quadrant I & III, it also allows inputs in quadrant II & IV, depending on the settings at AIO_02. By defining codes AIO_03 through AIO_10, inputs expressed in broken lines become available.

6.4.2.2 Adjusting bias and gain using the keypad (Out Y1 and Out Y2)

■ **Setting the bias at AIO_04 (Ai1 Out Y1)**

Connect voltage or current input source to multifunction analog terminals Ai1 through 5G, and set AIO_03 to 0%. Provide 0 V or 0 mA input, and then follow the instructions below to adjust analog input bias.

Key operation	Keypad display	Description
	AIO ▶ Ai1 Out Y1 04 0.00%	Initial LCD display
PROG	AIO ▶ Ai1 0.18% 04 Bias 0.00%	Press [PROG]. The first line on the display shows the input/output ratio in a percentage, which is calculated at the controller. The second line shows the currently set bias value.
▲	AIO ▶ Ai1 0.00% 04 Bias 0.18%	To adjust the bias so that 0.00% output is made with 0 V input, press [▲] until 0.00% is displayed in the first line.
ENT	AIO ▶ Ai1 Out Y1 04 0.18%	After adjusting the bias, press [ENT] to save it.

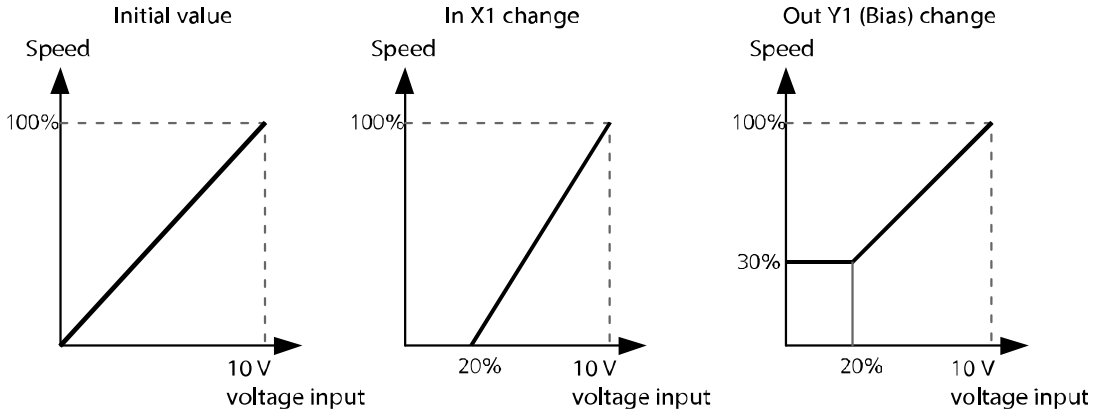
■ Setting the gain at AIO_06 (Ai1 Out Y2)

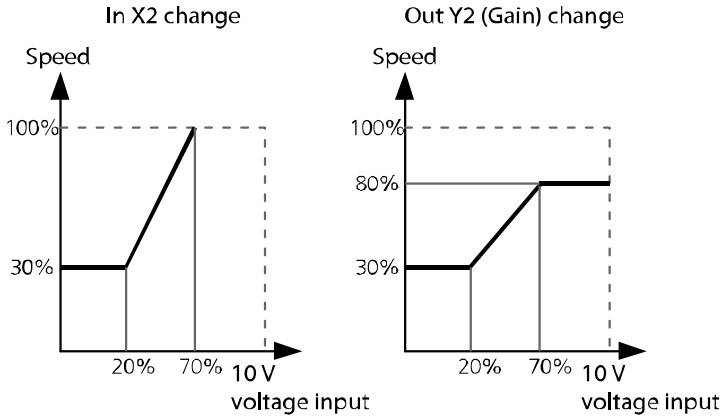
Connect voltage or current input source to multifunction analog terminals Ai1 through 5G, and set AIO_05 to 100%. Provide 10 V or 20 mA input, and then follow the instructions below to adjust analog input gain.

Key operation	Keypad display	Description
	AIO ▶ Ai1 Out Y2 06 100.00%	Initial LCD display
PROG	AIO ▶ Ai1 98.00% 06 Gain 100.00%	Press [PROG]. The first line on the display shows the input/output ratio in a percentage, which is calculated at the controller. The second line shows the currently set gain value.
▲	AIO ▶ Ai1 100.00% 06 Gain 102.00%	To adjust the gain so that 100.00% output is made with 10 V input, press the [▲] until 102.00% is displayed in the second line.
ENT	AIO ▶ Ai1 Out Y2 06 102.00%	After adjusting the gain, press [ENT] to save it.

You can set other analog input bias and gain values including codes AIO_08 and AIO_10 using the procedures as provided above.

For the multifunction analog inputs, if In X1 is set to 20%, In X2 to 70%, Out Y1 to 30%, and Out Y2 to 80%, the change in the outputs to 0–10 V analog inputs are as follows.


Initial value
Speed
100%
10 V
voltage input
In X1 change
Speed
100%
20%
10 V
voltage input
Out Y1 (Bias) change
Speed
100%
30%
20%
10 V
voltage input


In X2 change
Speed
100%
30%
20%
70%
10 V
voltage input
Out Y2 (Gain) change
Speed
100%
80%
30%
20%
70%
10 V
voltage input

6.4.2.3 Lost command conditions for multifunction analog input Ai1 (AIO_1)

The following table lists lost command options available for multifunction analog input terminals.

<table>
<tr><th>Code</th><th>Keypad display</th><th>Function</th><th>Range</th><th>Unit</th><th>Description</th></tr>
<tr><td rowspan="3">AIO_12</td><td rowspan="3">Ai1 Wbroken</td><td rowspan="3">Lost command conditions for multi-function analog input Ai1</td><td>0 (None)</td><td></td><td>Do not use analog input lost command options.</td></tr>
<tr><td>1(x1/2)</td><td></td><td>Analog input lost command is decided when analog input based on AIO_02 (Ai1 source) is in the following range.
<table>
<tr><td>-10 → 10 V</td><td>(AIO_07 Ai1 -In X1)/2 – (AIO_03 Ai1 In X1)/2</td></tr>
<tr><td>10 → -10 V</td><td>(AIO_07 Ai1 -In X1)/2 – (AIO_03 Ai1 In X1)/2</td></tr>
<tr><td>0 → 10 V</td><td>0–(AIO_03 Ai1 In X1)/2</td></tr>
<tr><td>10 → 0 V</td><td>0–(AIO_03 Ai1 In X1)/2</td></tr>
<tr><td>0 → 20 mA</td><td>0–(AIO_03 Ai1 In X1)/2</td></tr>
<tr><td>20 → 0 mA</td><td>0–(AIO_03 Ai1 In X1)/2</td></tr>
</table></td></tr>
<tr><td>2 (<x1)</td><td></td><td>Analog input lost command is decided when analog input based on AIO_02 (Ai1 source) is in the following range.
<table>
<tr><td>-10 → 10 V</td><td>(AIO_07 Ai1 -In X1) – (AIO_03 Ai1 In X1)</td></tr>
<tr><td>10 → -10 V</td><td>(AIO_07 Ai1 -In X1) – (AIO_03 Ai1 In X1)</td></tr>
<tr><td>0 → 10 V</td><td>0–(AIO_03 Ai1 In X1)</td></tr>
<tr><td>10 → 0 V</td><td>0–(AIO_03 Ai1 In X1)</td></tr>
<tr><td>0 → 20 mA</td><td>0–(AIO_03 Ai1 In X1)</td></tr>
<tr><td>20 → 0 mA</td><td>0–(AIO_03 Ai1 In X1)</td></tr>
</table></td></tr>
</table>

The same lost command conditions may be set for all the other multifunction analog inputs.

6.4.2.4 Multifunction analog input command lost command decision time (AIO_37 Time out)

AIO_37 (Time Out) is used to define the time values to make analog input lost command decisions. The inverter decides that the command is lost after the time set has been elapsed.

Code	Keypad display	Function	Range	Unit	Description
AIO_37	Time out	Multi-function analog input lost command decision time	0.1–120.0	sec	If the conditions for multifunction analog input lost command is met, and is maintained for the set time, the inverter decides that the command is lost.

The lost command decision time set at AIO_37 applies to analog input terminal parameters at AIO_12, AIO_24, AIO_36. When multifunction analog input is lost, the inverter performs a deceleration stop or a free-run stop.

6.4.2.5 Operation when multifunction analog input command is lost (AIO_38 Ai Lost Comm)

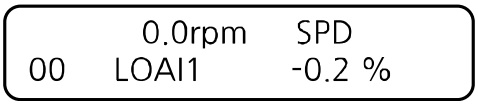
AIO_38 is used to define the inverter operation when the analog input command is lost. If the lost command conditions are met, and if the condition is maintained for the time set at AIO_37 (Time Out), the inverter decides that the analog input command is lost.

For multifunction analog input lost command conditions and the decision time, refer to *6.4 Analog input and output (AIO) group* on page *186*.

If the inverter operation is stopped due to a lost command, the inverter does not restart automatically when the lost command condition is released. If the inverter is run by terminal block inputs, the forward operation command must be turned off, and then turned on again for the operation to begin again. If it is run by the keypad, the FWD or REV keys must be pressed again.

Code	Keypad display	Function Range	Unit	Description
AIO_38	Lost Command	0 (None)	-	Continue operation when a multifunction analog input lost command happens.
		1(Free-run)	-	Perform a free-run stop when a multifunction analog input lost command happens.
		2 (Decel)	-	Perform a deceleration stop when a multi-function analog input lost command happens.

When a lost command takes place, an "LOAI [input terminal #]" message is displayed on the keypad. The percentage value in the second line shows the analog input value. Adjust this value to make it stay out of range of the lost command conditions to make the message disappear and change the status of the inverter operable.



6.4.3 Analog output

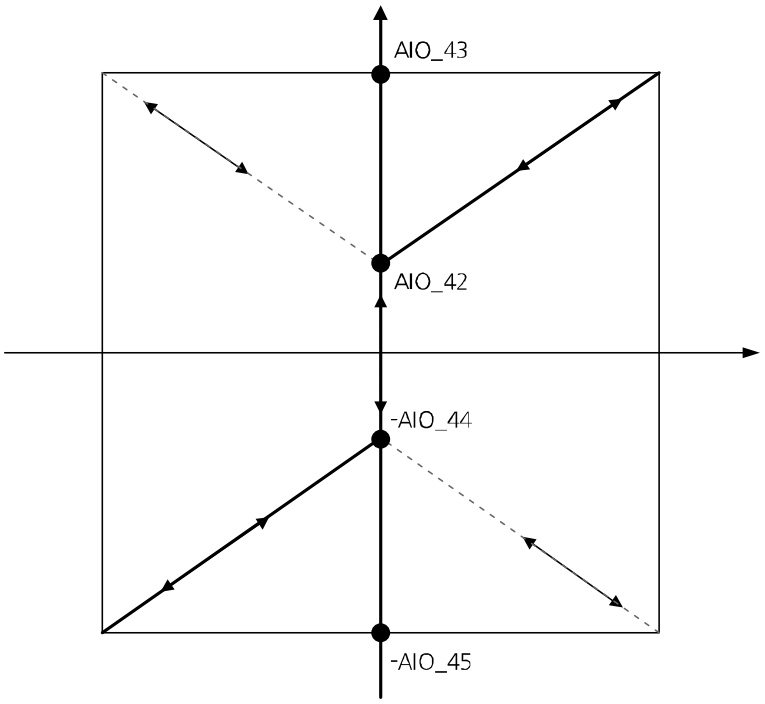
6.4.3.1 Defining the multifunction analog output terminal and setting output options, bias, gain, and an absolute value (AIO_40–53)

The LSLV-iV5L inverter provides two analog output terminals that can be user defined for various use.

The output signal range is -10 V–+10 V, and the output types are as follows.

Code	Keypad display	Function	Range	Unit	Description
AIO_40	AO1 Define	Define multifunction analog output AO1			Defines the type of multifunction analog output AO1.
AIO_41	AO1 Source	Multifunction analog output AO1 output range	0(-10 → 10 V) 1(10 → -10 V) 2(0 → 10 V) 3(10 → 0 V)		Defines output range for multifunction analog output AO1.
AIO_42	AO1 Bias	Multifunction analog output AO1 bias	0–AIO_43	%	Defines bias for multifunction analog output AO1.
AIO_43	AO1 Gain	Multifunction analog output AO1 gain	0.0–500.0	%	Defines gain for multifunction analog output AO1.
AIO_44	AO1 -Bias	Multifunction analog output AO1 bias	AIO_45–0	%	Defines negative bias for multifunction analog output AO1.
AIO_45	AO1 -Gain	Multifunction analog output AO1 gain	-500.0 –0	%	Defines negative gain for multifunction analog output AO1.
AIO_46	AO1 ABS	Multifunction analog output AO1 absolute value	0(No) / 1(Yes)		Allows the analog output AO1 to always provide positive outputs.

The same setting options provided above are available for other multifunction analog output terminals. The following is a concept diagram that explains the analog outputs. By defining AO1 Source, outputs in the dotted line become available.



Analog output concept diagram

The following table lists the type and setting for multifunction analog outputs.

Output types	Description	Output signal level
AiX Value	Analog input value	+10 V: 10 V, 20 mA
PreRamp Ref	Speed command before acceleration/deceleration	+10 V: MaxSpeed
PostRamp Ref	Speed command after acceleration/deceleration	+10 V: MaxSpeed
ASR Inp Ref	Speed controller input command	+10 V: MaxSpeed
Output Freq	Output frequency	+10 V: MaxSpeed
Motor Speed Note 1)	Motor speed	+10 V: MaxSpeed
Speed Dev Note 1)	Speed deviation	+10 V: Rated slip x 2
ASR Out Note 1)	Speed controller output	+10 V: 250%
Torque Bias Note 1)	Torque bias	+6 V: 150%
PosTrq Limit Note 1)	Forward torque limit	10 V: 250%
NegTrq Limit Note 1)	Reverse torque limit	10 V: 250%
RegTrq Limit Note 1)	Torque limit at regeneration	10 V: 250%
IqeRef Note 1)	Torque current reference	+10 V: 250% of the rated torque current
Iqe Note 1)	Torque current	+10 V: 250% of the rated torque current
Flux Ref Note 2)	Flux reference	10 V: Rated flux x 2
IdeRef Note 1)	Flux current reference	+10 V: Rated flux current x 2
Ide Note 1)	Flux current	+10 V: Rated flux current x 2
ACR_Q Out Note 1)	Q-axis current controller output	+10 V: 600
ACR_D Out Note 1)	D-axis current controller output	+10 V: 600
VdeRef	D-axis voltage	+10 V: 600

Output types	Description	Output signal level
VqeRef	Q-axis voltage	+10 V: 600
Out Amps RMS	Output current	10 V: Inverter rated Current x 2
Out Volt RMS	Output voltage	+10 V: 600
Power	Output power	+10 V: rated output x 2
DC Bus Volt	DC-link voltage	10 V: 1000 V
Mot NTC Temp	Motor temperature	+10 V: 150℃
Inv Temp	Inverter temperature	+10 V: 10℃

Note 1) Available only when the control mode is set to "Speed," or "Speed(Sync)" at PAR_07.

Note 2) Available only when the control mode is set to "Speed" at PAR_07.

6.4.3.2 Adjusting bias and gain using the keypad

■ **Setting the bias at AIO_42 (AO1 bias)**

Follow the procedures below to set the analog output bias for AO1. Actual output is made when the output exceeds the bias value.

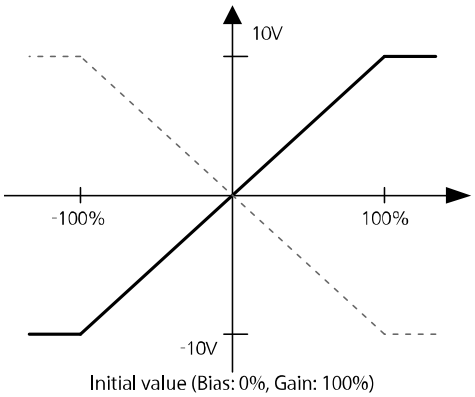
Key operation	Keypad display	Description
	AIO ▶ AO1 Bias 42 0.0%	Initial LCD display
PROG	AIO ▶ AO1 0.0% 42 Bias 0.0%	Press [PROG]. The first line on the display shows the output ratio in a percentage, which is calculated at the controller. The second line shows the currently set bias value.
▲	AIO ▶ AO1 30.0% 42 Bias 30.0%	To adjust the bias so that the actual output is made when the output exceeds 30.0%, press the [▲] until 30.0% is displayed in the first line.
ENT	AIO ▶ AO1 Bias 42 30.0%	After adjusting the bias, press [ENT] to save it.

■ Setting the gain at AIO_43 (AO1 gain)

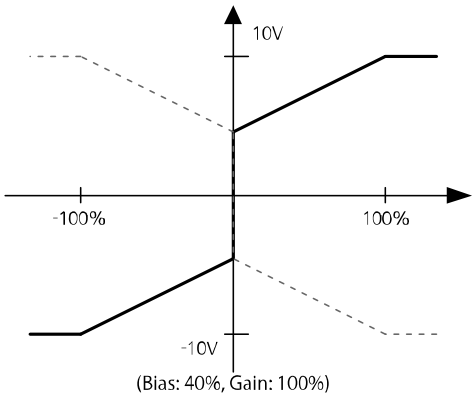
Follow the procedures below to set the analog output gain for AO1 to adjust the output gradient where the maximum output value is 10V.

Key operation	Keypad display	Description
	AIO ▶ AO1 Gain 43 100.0%	Initial LCD display
PROG	AIO ▶ AO1 30.0% 43 Gain 100.0%	Press [PROG]. The first line on the display shows currently set bias value. The second line shows the currently set gain value.
▲	AIO ▶ AO1 30.0% 43 Gain 200.0%	To adjust the gain so that a 10V output is made when the gain exceeds 200.0%, press [▲] until 200.0% is displayed in the first line.
ENT	AIO ▶ AO1 Gain 43 200.0%	After adjusting the gain, press [ENT] to save it.

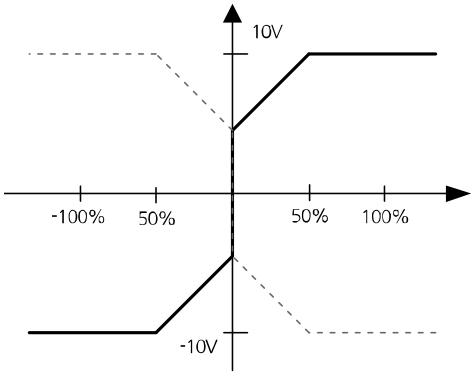
Examples of multifunction analog outputs to -10–10 V analog inputs depending on different bias and gain settings are as follows.



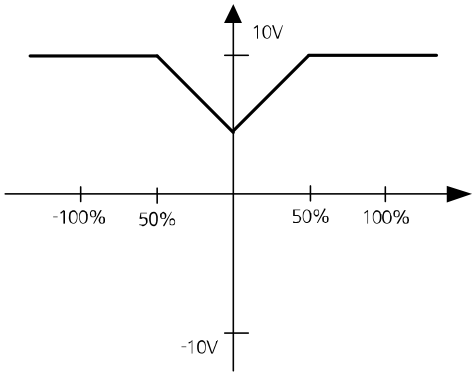
Initial value (Bias: 0%, Gain: 100%)



(Bias: 40%, Gain: 100%)



(Bias: 40%, Gain: 200%)



(Bias: 40%, Gain: 200%), Absolute value

ⓘ Caution

- Analog output may fluctuate when the inverter starts. These analog output characteristics must be considered when an inverter is used in a control system.
- Analog output values outside the inverter's operable range are regarded as invalid.

6.5 Function (FUN) group

6.5.1 Jump code (FUN_00)

FUN_00 code is used to directly access a certain code.

The following is an example of jumping directly to FUN_02 from FUN_00 code.

1 Press [PROG].

2 Use [SHIFT/ESC], [▲], or [▼] to change the code number to "02".

3 Press [ENT] to access FUN_02 code. If an invalid code number is entered, the next available code number is automatically selected.

Note

After jumping directly to a code, you can move to other codes by pressing [▲] or [▼].

6.5.2 Selecting the command source

6.5.2.1 Setting the run/stop command source (FUN_01)

The LSLV-iV5L inverter provides four different options for run and stop commands: two terminal inputs (terminal 1 and 2) that uses digital input FX/RX, keypad input, and network input utilizing the built-in 485 communication option board. The default setting for the input option is the analog terminal input using the terminal 1.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_01	Run/Stop Src	RUN/STOP command source	0 (Terminal 1) 1 (Terminal 2) 2 (Keypad) 4 (Int485)		Terminal 1

Terminal inputs: Terminal 1 and 2

Run/stop command source	Input settings		Operation command
Terminal 1	FX	ON	Forward operation command
		OFF	Stop command
	RX	ON	Reverse operation command
		OFF	Stop command
Terminal 2	FX	ON	Operation command
		OFF	Stop command
	RX	ON	Set reverse
		OFF	Set forward

When voltage is used for speed reference, positive voltage is used for forward operation and negative voltage is used for reverse operation. The following table lists the motor's rotating directions depending on the voltage operation command signals.

Analog speed signal range	FX / FWD / Network FWD command	RX / REV / Network REV command
0–+10 V	Forward	Reverse
-10–0 V	Reverse	Forward

6.5.2.2 Setting the operation speed (FUN_02)

The LSLV-iV5L inverter provides four different options for operation speed commands: digital input via the keypad ("Keypad1"), digital input via the keypad ("Keypad2"), analog terminal input, and network input utilizing the built-in 485 communication option board.

When "Keypad1" is selected for speed reference, set FUN_12 (Speed 0) to the required speed reference using the [▲] and [▼], and then press [ENT] to apply it.

When "Keypad2" is selected, the speed reference is applied as soon as it is set on the keypad, without pressing [ENT].

Code	Keypad display	Name	Range	Unit	Default setting
FUN_02	Spd Ref Src	Speed reference source	0(Analog) 1(Keypad 1) 2(Keypad 2) 4(Int485)	-	Keypad 1

6.5.2.3 Setting the stop mode options (FUN_03)

FUN_03 (Stop Mode) is used to select stop mode options.

If "Decel" is selected for the stop mode, the motor decelerates based on the "deceleration time1" set at FUN_42 before it fully stops. If it fails to stop within the deceleration time, the motor free-runs after deceleration.

If "Free-run" is selected, the motor performs a free-run without deceleration.

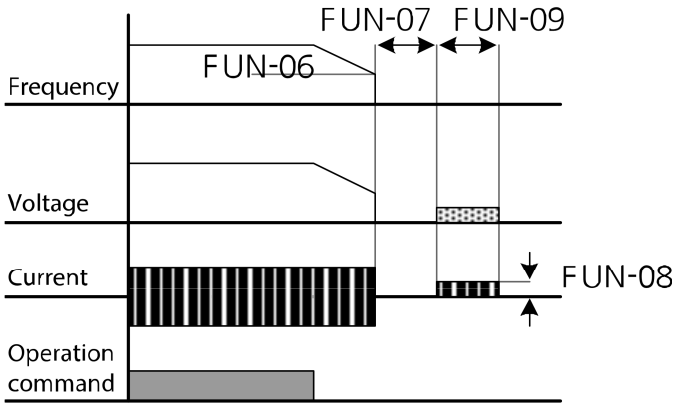
If "DC-Brake" is selected, DC voltage is injected into the motor during deceleration to brake and stop it. This option is available only when the control mode is set to "V/F", or "Slip Comp".

Code	Keypad display	Name	Range	Unit	Default setting
FUN_03	Stop Mode	Stop mode options	0(Decel) 1(Free-run) 2(DC-Brake)		Decel

6.5.3 DC-braking stop (FUN_06–FUN_09)

Codes FUN_06 through FUN_09 are used to set the DC-braking options. When a stop command is given, the inverter decelerates the motor. During motor deceleration, when the operation frequency reaches the DC-braking frequency set at FUN_06, DC voltage is provided to the motor and stops it.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_06	Dcbr Freq	DC braking start frequency	PAR_12–PAR_11	Hz	1.00
FUN_07	Dcblk Time	Output block time before DC braking	0.0–60.0	sec	0.00
FUN_08	Dcbr Value	DC braking amount	0–200	%	10
FUN_09	Dcbr Time	DC braking time	0.0–60.0	sec	1.0

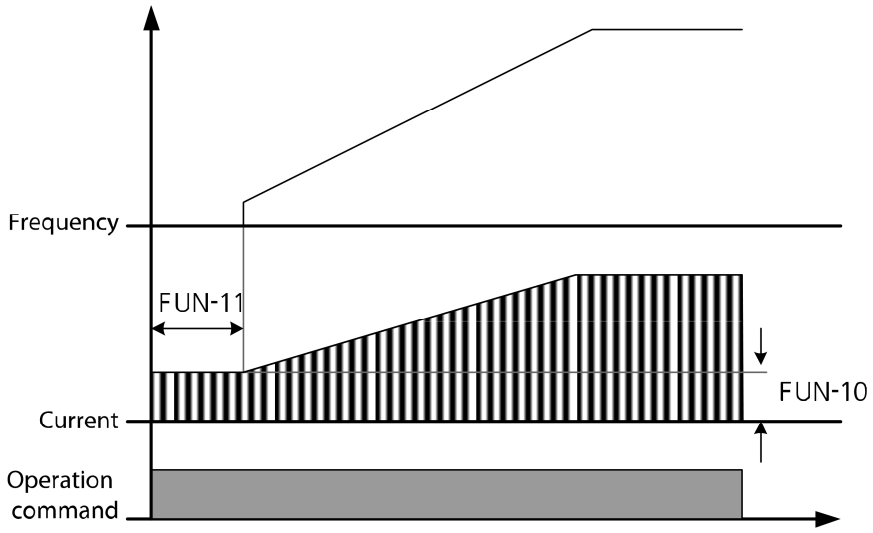


6.5.4 Start after DC-braking: Dc-Start (FUN_10–FUN_11)

FUN_10 and FUN_11 are used to set options when stopping the motor using DC-braking, and then restarting it. DC voltage is applied to the motor for a set time to stop it, and then the inverter accelerates the motor from its stopped state.

This function is useful in the operations where the motor has to be fully stopped before it runs again, and the motor is still rotating from the previous operation.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_10	Dcst Value	DC-braking amount for start after DC-barking	0–200	%	10
FUN_11	Dcst Time	DC-braking time for start after DC-braking	0.0–60.0	sec	0.0



If a DC-braking amount that exceeds the inverter's rated current is set for this operation, the DC-braking amount is limited to the inverter's rated current.

⚠ Caution

- While using "DC-braking stop" or "start after DC-braking," if a DC-braking amount that exceeds the inverter's rated current is set, the DC-braking amount is limited to the inverter's rated current. The motor may be overheated and be damaged, or an inverter overload fault trip may occur if the DC-braking amount is set too great, or if the DC-braking time is set too long. If motor overheating or inverter overload fault trip occurs, decrease the DC-braking amount or time.
- DC-braking is available only when FUN_03 (Stop mode) is set to "DC-Brake".

6.5.5 Setting the speed reference for multistep, jog and dwell operations

6.5.5.1 Multistep speed 0–7 (FUN_12–19) / jog speed (FUN_20)

When the multifunction input terminals are set for multispeed or jog operation, the speed reference is decided by a combination of multifunction terminal inputs (P1–P7) or jog speed input.

The following table lists the multistep speed by a combination of inputs at terminals P1, P2, P3, and P4.

P1	P2	P3	P4	Speed
OFF	OFF	OFF	OFF	Speed reference by the setting at FUN_02
ON	OFF	OFF	OFF	FUN_13
OFF	ON	OFF	OFF	FUN_14
ON	ON	OFF	OFF	FUN_15
OFF	OFF	ON	OFF	FUN_16
ON	OFF	ON	OFF	FUN_17
OFF	ON	ON	OFF	FUN_18
ON	ON	ON	OFF	FUN_19
X	X	X	ON	FUN_20 (JOG speed command)

If multistep speed 0 (P1, P2, P3 are all turned off) is selected, digital input on the keypad, analog input at the terminal block, or the network input via built-in RS 485communication option board may be used as the speed reference depending on the frequency reference source settings.

Jog operation takes priority over other operations. If jog operation signal is received at terminal P4, all other terminal inputs are ignored, and jog operation is performed based on the jog speed set at FUN_20.

The following table lists the range of multistep speed references and the default settings.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_12	Speed 0	Multispeed 0	0.0–PAR_11	rpm Note 1)	0.0
FUN_13	Speed 1	Multispeed 1	0.0–PAR_11	rpm Note 1)	0.0
FUN_14	Speed 2	Multispeed 2	0.0–PAR_11	rpm Note 1)	0.0
FUN_15	Speed 3	Multispeed 3	0.0–PAR_11	rpm Note 1)	0.0
FUN_16	Speed 4	Multispeed 4	0.0–PAR_11	rpm Note 1)	0.0
FUN_17	Speed 5	Multispeed 5	0.0–PAR_11	rpm Note 1)	0.0
FUN_18	Speed 6	Multispeed6	0.0–PAR_11	rpm Note 1)	0.0
FUN_19	Speed 7	Multispeed 7	0.0–PAR_11	rpm Note 1)	0.0
FUN_20	Jog Speed	JOG speed command	0.0–PAR_11	rpm Note 1)	100.0

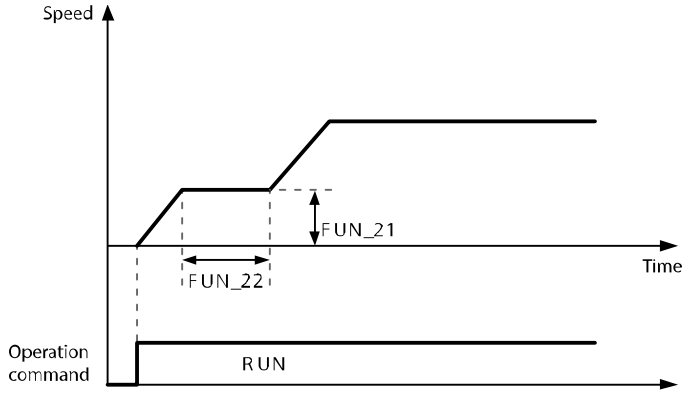
- PAR_11 is used to setup the maximum motor speed.
- Note 1) Speed unit "Hz" is used if "V/F" or "Slip Comp" is selected for operation modes.

6.5.5.2 Setting dwell speed command (FUN_21) and dwell time (FUN_22)

When the motor load is heavy, dwell operation is used to generate enough motor torque to drive it.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_21	Dwell Speed	Dwell Speed	0.0–PAR_11	rpm	100.0
FUN_22	Dwell Time	Dwell time	0.00–100.00	sec	0.00

Setting dwell time to "0" disables dwell operation.

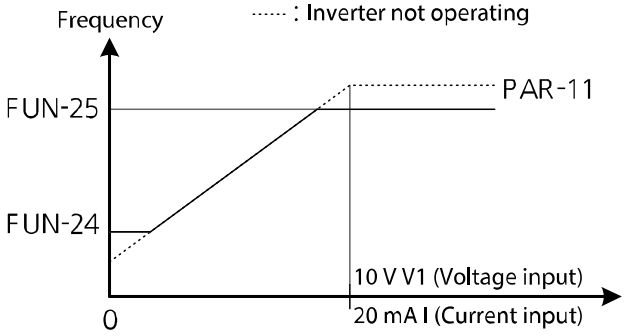


6.5.6 Setting the speed limits

This function may be used to define the maximum and minimum values for the inverter output (frequency). Speed limit settings are available in V/F and Slip Comp modes.

When the speed limits are set, all the inverter output is limited by the setting value.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_23	Speed Limit	Use frequency limits	0(No) 1(Yes)		0 (No)
FUN_24	Spd Limit L	Frequency lower limit	PAR_12– FUN_25	Hz	0.5
FUN_25	Spd Limit H	Frequency upper limit	FUN_24– PAR_11	Hz	60.00



Note

- If FUN_23 (Speed Limit) is set to "Yes", the maximum value of PAR_12 (Min Speed) is limited to the value in FUN_24.
- The minimum value of FUN_24 (Spd Limit L) is limited to the value in PAR_12 (Min Speed).

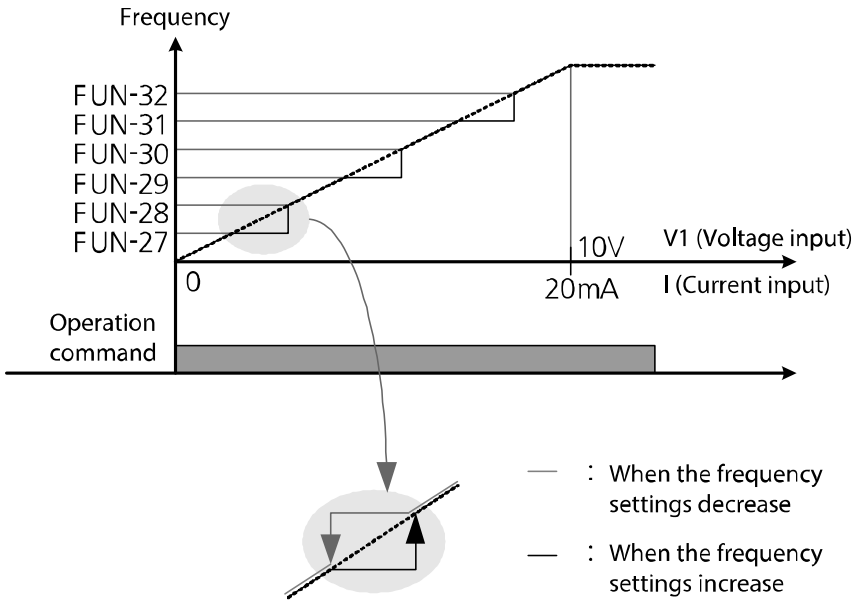
6.5.7 Frequency jump (Jump Freq)

Frequency jump is used to avoid mechanical resonance of the inverter, with other devices. The inverter will not accept frequency settings that are within a preset frequency jump band during acceleration or deceleration.

Any frequency that belongs in the jump frequency ranges cannot be used as the inverter's frequency reference.

If jump frequencies are reached during acceleration, the inverter maintains the frequency jump low limit, and then resumes acceleration when the speed reference (digital, analog, or RS-485) gets out of the jump frequency.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_27	Jump Lo 1	Jump frequency low limit 1	0.00–FUN_28	Hz	10.00
FUN_28	Jump Hi 1	Jump frequency high limit 1	FUN_27–FUN_29	Hz	15.00
FUN_29	Jump Lo 2	Jump frequency low limit 2	FUN_28–FUN_30	Hz	20.00
FUN_30	Jump Hi 2	Jump frequency high limit 2	FUN_29–FUN_31	Hz	25.00
FUN_31	Jump Lo 3	Jump frequency low limit 3	FUN_30–FUN_32	Hz	30.00
FUN_32	Jump Hi 3	Jump frequency high limit 3	FUN_31–PAR_11	Hz	35.00

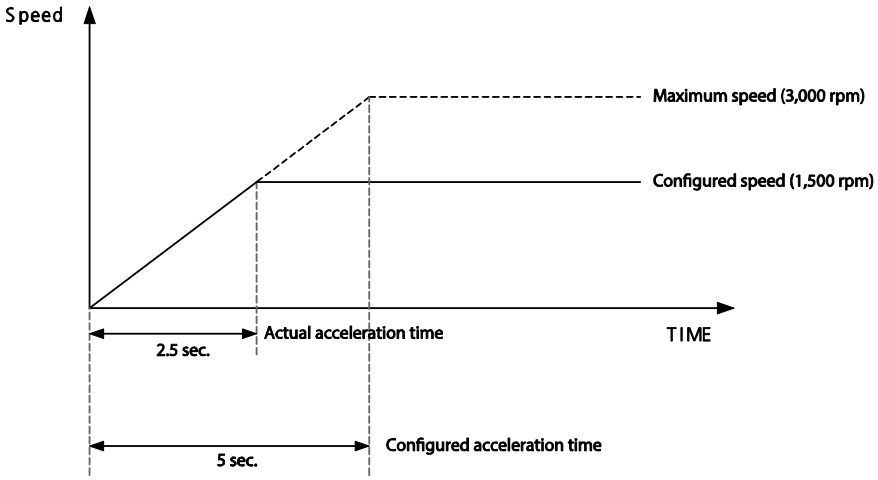


6.5.8 Setting acceleration and deceleration patterns and times

6.5.8.1 Setting acceleration/deceleration speed reference (FUN_33)

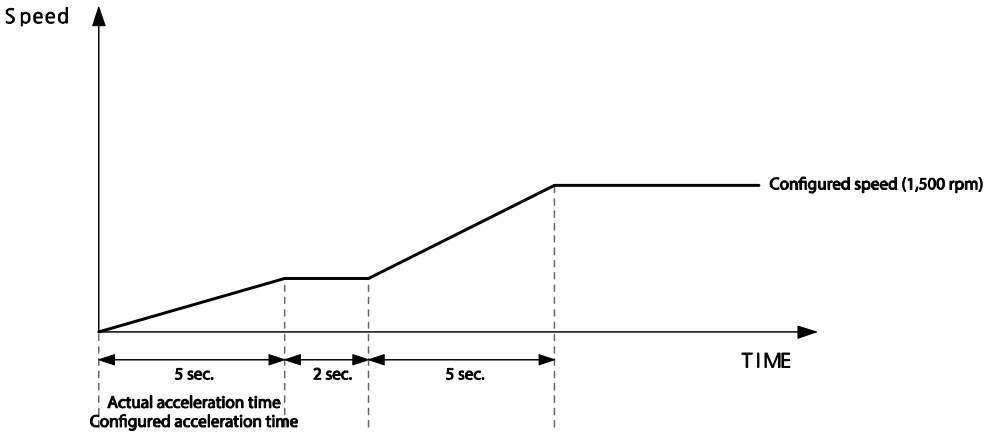
FUN_33 is used to define acceleration and deceleration time based on the motor maximum speed or speed reference.

For example, when FUN_33 is set to "Max Speed", if motor maximum speed is set to 3,000 rpm, and the acceleration time is set to 5 seconds, acceleration time taken for the motor to reach 1,500 rpm becomes 2.5 seconds.



When FUN_33 is set to "Ref Speed," the acceleration and deceleration times can be configured based on the time taken to reach the next speed reference regardless of the motor maximum speed.

For example, for a multistep operation of 2 speeds (500 and 1,500 rpm), if acceleration time is set to 5 seconds, the operation can be illustrated as shown in the figure below.



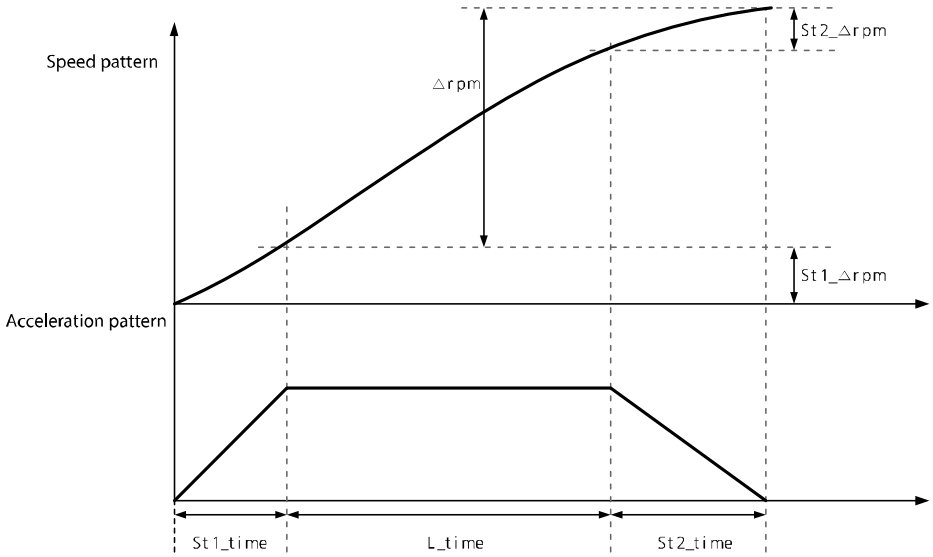
6.5.8.2 S-curve acceleration/deceleration pattern 1–2 (FUN_36–39)

Acceleration/deceleration gradient level patterns can be configured to enhance and smooth the inverter's acceleration and deceleration curves. While linear pattern features a linear increase or decrease to the output frequency, at a fixed rate, an S-curve pattern provides a smoother and more gradual increase or decrease of output frequency, ideal for lift-type loads or elevator doors, etc.

Acceleration/deceleration patterns can be defined by the parameter settings listed in the following table. Codes FUN_36–FUN_39 define the curvature. Codes FUN_36 and FUN_37are for acceleration, while FUN_38, FUN_39 are for deceleration.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_36	Acc S Start	S-curve rate at acceleration 1	0.0–50.0	%	0.0
FUN_37	Acc S End	S-curve rate at acceleration 2	0.0–50.0	%	0.0
FUN_38	Dec S Start	S-curve rate at deceleration 1	0.0–50.0	%	0.0
FUN_39	Dec S End	S-curve rate at deceleration 2	0.0–50.0	%	0.0

■ Examples of S-curve acceleration/deceleration patterns



■ Basic formula

St1_time = AccTime * (S-curve rate deceleration 1/ 50.0%)

St2_time = AccTime * (S-curve rate at acceleration 2/ 50.0%)

St1_Δrpm = St1_time * (MaxSpeed / AccTime) * 0.5

St2_Δrpm = St2_time * (MaxSpeed / AccTime) * 0.5

■ Calculation 1

When Δrpm ≥ (St1_Δrpm + St2_Δrpm), where Δrpm is the difference between the current speed and the speed reference:

L_time = (Δrpm–St1_Δrpm–St2_Δrpm) x (AccTime / MaxSpeed)

Total acceleration time = St1_time + L_time + St2_time

■ Calculation 2

When Δrpm **<** (St1_Δrpm + St2_Δrpm), where Δrpm is the difference between the current speed and the speed reference:

$St1'\_time = \sqrt{\{ [\Delta rpm \times AccTime^2 \times St1\_time^2] / [25 \times MaxSpeed \times (St1\_time + St2\_time)] \}}$

$St2'\_time = \sqrt{\{ [\Delta rpm \times AccTime^2 \times St2\_time^2] / [25 \times MaxSpeed \times (St1\_time + St2\_time)] \}}$

Total acceleration time = St1'_time + St2'_time

- MaxSpeed is set at PAR_11
- AccTime is set at FUN_41, 43, 45, 47
- St1_Δrpm: S-curve acceleration setting 1 (FUN_36) is used when accelerating, and S-curve deceleration setting 2 (FUN_39) is used when decelerating.
- St2_Δrpm: S-curve acceleration setting 2 (FUN_37) is used when accelerating, and S-curve deceleration setting 2 (FUN_38) is used when decelerating.
- St1_time: St1_Δrpm section
- St2_time: St2_Δrpm section

■ S-curve acceleration gradient 1 (FUN_36)

Sets the gradient level as acceleration starts when using an S-curve acceleration pattern. The gradient is for the first half of the acceleration section.

When the speed reference is 60 Hz and the maximum frequency is 60 Hz, if FUN_36 is set to 50%, S-curve acceleration gradient 1 is used for the 0–30 Hz section of the acceleration.

■ S-curve acceleration gradient 2 (FUN_37)

Sets the gradient level as acceleration ends when using an S-curve acceleration pattern. The gradient is for the second half of the acceleration section.

When the speed reference is 60 Hz and the maximum frequency is 60 Hz, if FUN_37 is set to 50%, S-curve acceleration gradient 2 is used for the 30–60 Hz section of the acceleration.

■ **S-curve deceleration gradient 1 (FUN_38)**

Sets the gradient level as deceleration starts when using an S-curve deceleration pattern. The gradient is for the first half of the deceleration section.

When the speed reference is 60 Hz and the maximum frequency is 60 Hz, if FUN_38 is set to 50%, S-curve deceleration gradient 1 is used for the 60–30 Hz section of the deceleration.

■ **S-curve deceleration gradient 2 (FUN_39)**

Sets the gradient level as deceleration ends when using an S-curve deceleration pattern. The gradient is for the second half of the acceleration section.

When the speed reference is 60 Hz and the maximum frequency is 60 Hz, if FUN_39 is set to 50%, S-curve acceleration gradient 2 is used for the 30–0 Hz section of the deceleration.

6.5.8.3 Acceleration/deceleration times 1–4 (FUN_41–48)

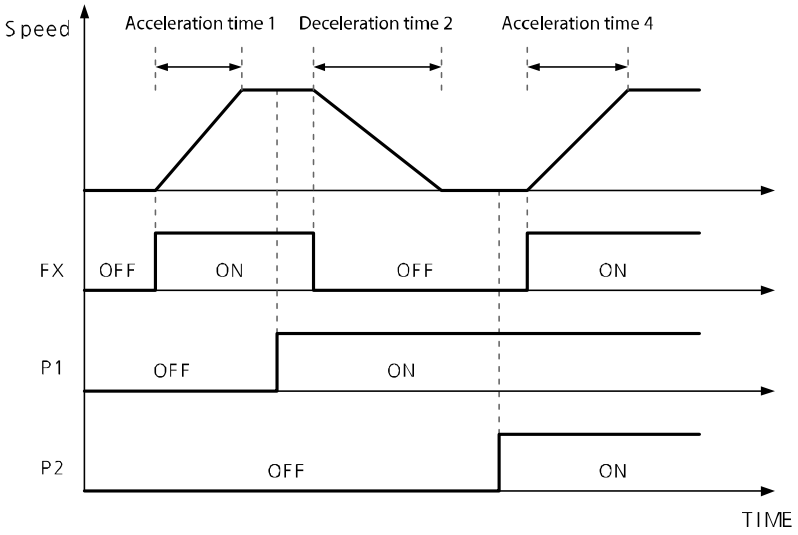
You can define 4 different acceleration or deceleration times to use with the selected patterns.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_41	Acc Time-1	acceleration time 1	0.00–600.00	sec	2.00
FUN_42	Dec Time-1	deceleration time 1	0.00–600.00	sec	2.00
FUN_43	Acc Time-2	acceleration time 2	0.00–600.00	sec	3.00
FUN_44	Dec Time-2	deceleration time 2	0.00–600.00	sec	3.00
FUN_45	Acc Time-3	acceleration time 3	0.00–600.00	sec	4.00
FUN_46	Dec Time-3	deceleration time 3	0.0–600.00	sec	4.00
FUN_47	Acc Time-4	acceleration time 4	0.00–600.00	sec	5.00
FUN_48	Dec Time-4	deceleration time 4	0.00–600.00	sec	5.00

Set the multifunction input terminals for acceleration/deceleration time selection to switch between the acceleration or deceleration times.

The following is an example where multifunction input terminals P1 and P2 are used for acceleration/deceleration time selection.

Code	Keypad display	Name	Range	Unit	Parameter setting
DIO_01	P1 Define	Defines P1 input			Xcel–L
DIO_02	P2 Define	Defines P2 input			Xcel–H



The following is an example of setting multifunction terminals P1, P2, and P3 to switch between the acceleration/deceleration times, and to use the soft start cancel function.

P1 (Xcel-L)	P2 (Xcel-H)	P3 (SoftStartCncl)	Acc/Dec time
OFF	OFF	OFF	Acceleration/Deceleration 1
ON	OFF	OFF	Acceleration/Deceleration 2
OFF	ON	OFF	Acceleration/Deceleration 3
ON	ON	OFF	Acceleration/Deceleration 4
X	X	ON	Fastest Acceleration/Deceleration available

6.5.8.4 Zero-speed deceleration time options (FUN_49) and zero-speed deceleration time (FUN_50)

Zero-speed deceleration time is the time it takes to reach 0 rpm from a certain speed. Zero-speed deceleration time is used when FUN_49 is set to "Yes". If it is set to "No", a regular deceleration time is used.

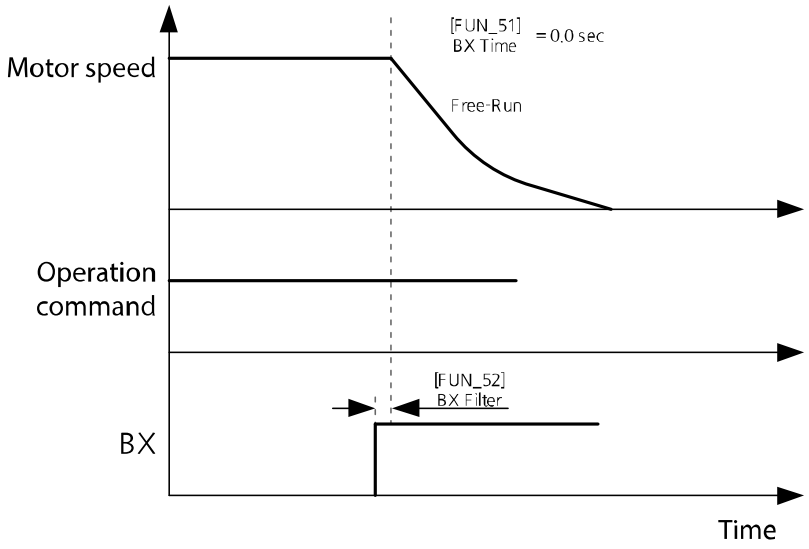
Code	Keypad display	Name	Range	Unit	Default setting
FUN_49	Use 0 Dec T	Zero-speed deceleration time options	0(No) / 1(Yes)		No
FUN_50	0 Dec Time	Zero-speed deceleration time	0.00–600.00	sec	3.00

6.5.8.5 Emergency stop deceleration time (FUN_51) and emergency stop terminal input low pass filter (FUN_52)

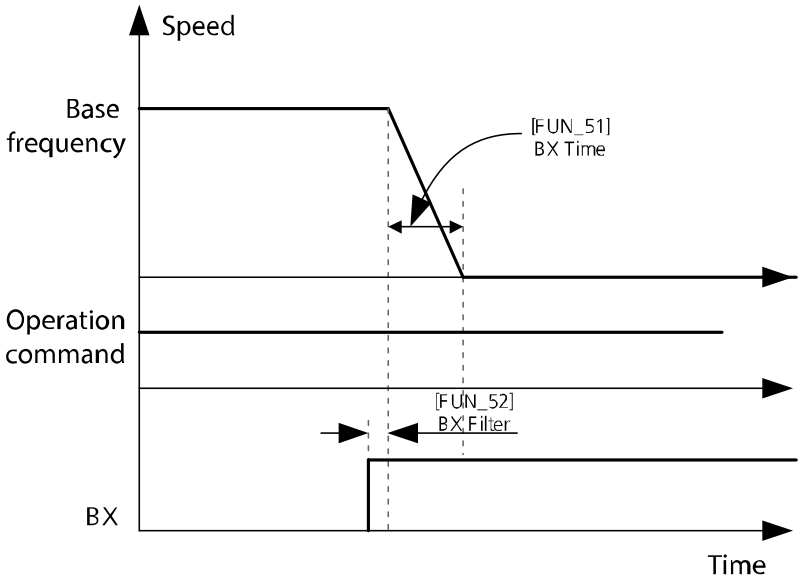
If any emergency arises during operation, you can use the BX (emergency stop) signal input at the terminal block to stop the motor operation immediately. Once the BX input is provided, the motor decelerates based on the "Emergency stop deceleration gradient" set at FUN_51, and then it stops. If the motor cannot complete a full-stop within the set time, it continues to perform a free-run stop. If you need to allow to motor to free run as soon as the BX signal input is provided, set FUN_51 to "0".

Also, set the time constant for the low pass filter at FUN_52 (BX Termi LPF) to avoid noise interference if the noise level is high at the installation site.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_51	BX Time	Emergency stop deceleration time	0.0–6000.0	sec	0.0
FUN_52	BX Termi LPF	Emergency stop terminal input low pass filter	0–2000	msec	0



<BX time (FUN_51) set to "0">



< BX time (FUN_51) set to a value other than "0">

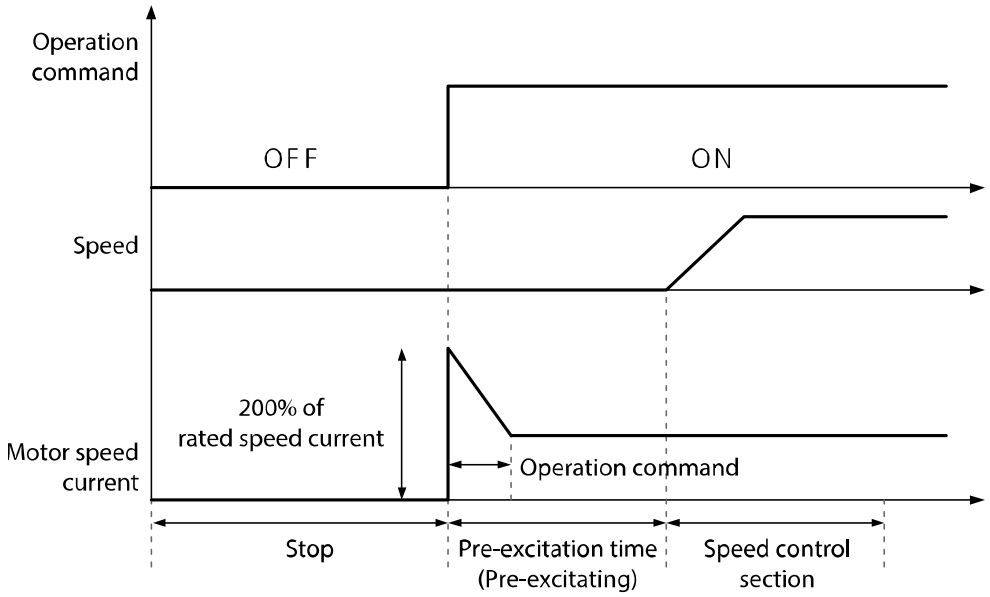
6.5.8.6 Setting the Motor Pre-excite time (FUN_53)

Pre-excitation refers to a process where power is supplied to the coils in the motor to magnetize them before the operation command is given. Because pre-excitation creates flux in a motor by magnetizing the coils and gets the motor ready to run, it enhances motor's acceleration response in a system where a high starting torque is required.

During pre-excitation, the [FWD] and [REV] indicators flash simultaneously.

- The pre-excite time set at FUN_53 is used only when FUN_02 (Spd Ref Sel) is set to "Keypad1", or "Keypad2".

Code	Keypad display	Name	Range	Unit	Default setting
FUN_53	PreExct Time	Motor Pre-excite time	0–10000	msec	0



6.5.8.7 Zero-speed time after a stop (FUN_54)

FUN_54 (Hold time) is used to set the time for the motor to stay at the zero-speed after a deceleration stop. When the motor is running a load with high inertia, this function can prevent a motor movement by the residual inertia.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_54	Hold Time	Zero-speed time after a stop	100–10000	msec	1000

6.5.8.8 Acceleration/deceleration time scale (FUN_40)

FUN_40 (Acc/dec time scale) is used when the precise acceleration/deceleration time is need depending on the characteristics of load or the maximum acceleration/deceleration time needs to be increased.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_11	Time Scale	Acc/dec time scale	0 (0.01 sec) 1 (0.1 sec)	Msg	0 (0.01 sec)

The parameters that acceleration/deceleration time scale is applied is as follows.

Code	Keypad display	Name	Code	Keypad display	Name
FUN_41	Acc Time-1	Acceleration time 1	FUN_45	Acc Time-3	Acceleration time 3
FUN_42	Dec Time-1	Deceleration time 1	FUN_46	Dec Time-3	Deceleration time 3
FUN_43	Acc Time-2	Acceleration time 2	FUN_47	Acc Time-4	Acceleration time 4
FUN_44	Dec Time-2	Deceleration time 2	FUN_48	Dec Time-4	Deceleration time 4
			FUN_50	0 Dec Time	Zero-speed deceleration time

6.5.9 Power-on start options (FUN_55)

If FUN_55 (Power-on run) is set to "No," the motor operation does not begin when you supply power to the inverter even if the run signal is turned on. You must first turn the signal off, and then turn it on again to restart the operation. If FUN_55 is set to "Yes," and if the terminal input is turned on (FX terminal ON or RX terminal ON), the motor operation begins when you supply power to the inverter.

Power –on start options may cause over current fault trips if it is tried during a free-run.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_55	Power-On Run	Power-on start	No Yes		No

ⓘ Caution

Use caution before supplying power to the inverter when this option is turned on. The motor will operate immediately at power on and may perform unintended operation causing personal injuries or property damage.

6.5.10 Setting parameters for short floor operations (FUN_56, FUN_57)

When the multistep speed operation is used to control elevator speed, repeated short trip patterns can reduce the overall riding quality of the elevator. Use the inverter's 'Short Floor' function to improve elevator speed control FUN_56 (ShortFlr speed) and FUN_57 (ShortFlr time).

The inverter's short floor control is for acceleration speed only and is not available in the features dedicated for elevators that use ELIO.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_56	ShortFlr Spd	Short floor operation speed	0.0–PAR_11	rpm	0.0
FUN_57	ShortFlrTime	Short floor operation time	0.00–100.00	sec	0.00

For example, when multifunction input terminals P1 and P2 are set to "Speed-L" and "Speed-M," and if FUN_12 and FUN_13 are set with smaller values the setting at FUN_56, and the setting at FUN_14 is greater than the settings at FUN_56, the following operation becomes available. (Set FUN_57 to "0" or other fixed value).

■ **Eg. 1: Elevator running speed is less than the short floor speed and the short floor speed is not set at "0".**

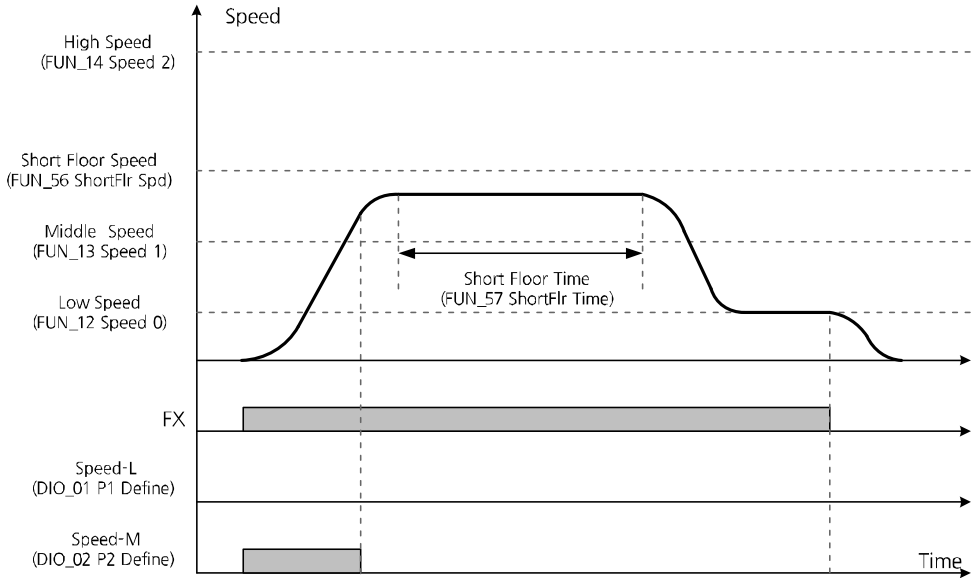
When the motor starts and accelerates in the forward direction and multifunction input P2 is ON, a new speed reference is calculated if the signal at P2 is OFF. If the new speed reference is less than the speed set at FUN_56 (ShortFlr Spd), the motor accelerates to the new speed reference and maintains the speed for the time set at FUN_57.

After the operation time has elapsed, the motor runs at the speed set at FUN_12.

Use the following formula to calculate the new speed reference.

New speed reference = Current speed + ([FUN_04] x [FUN_37])

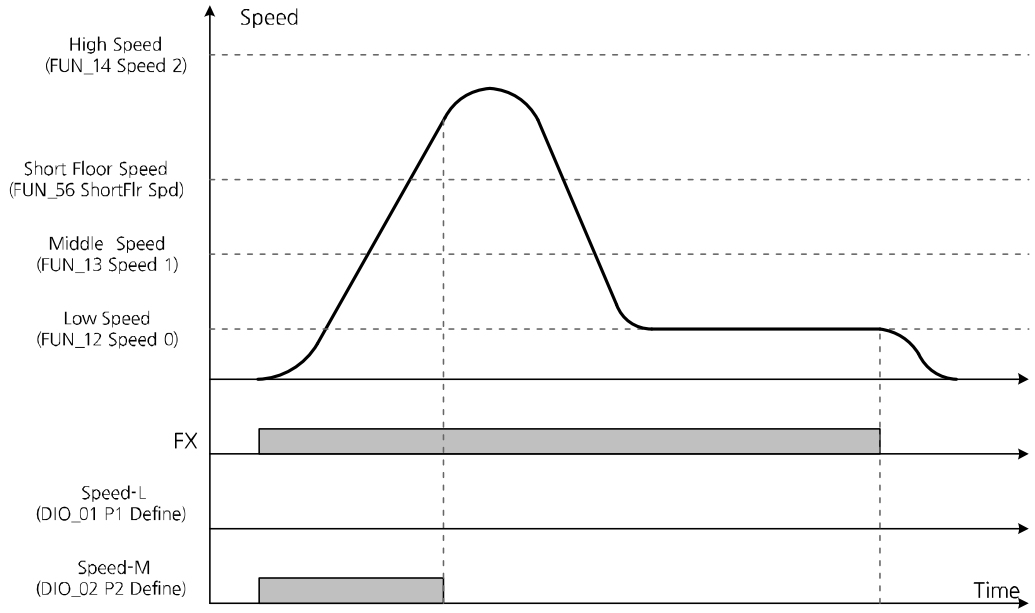
If FUN_37 is set to "0", the current speed becomes the new speed reference.



■ **Elevator running speed is higher than the short floor speed and the short floor speed is not set at "0".**

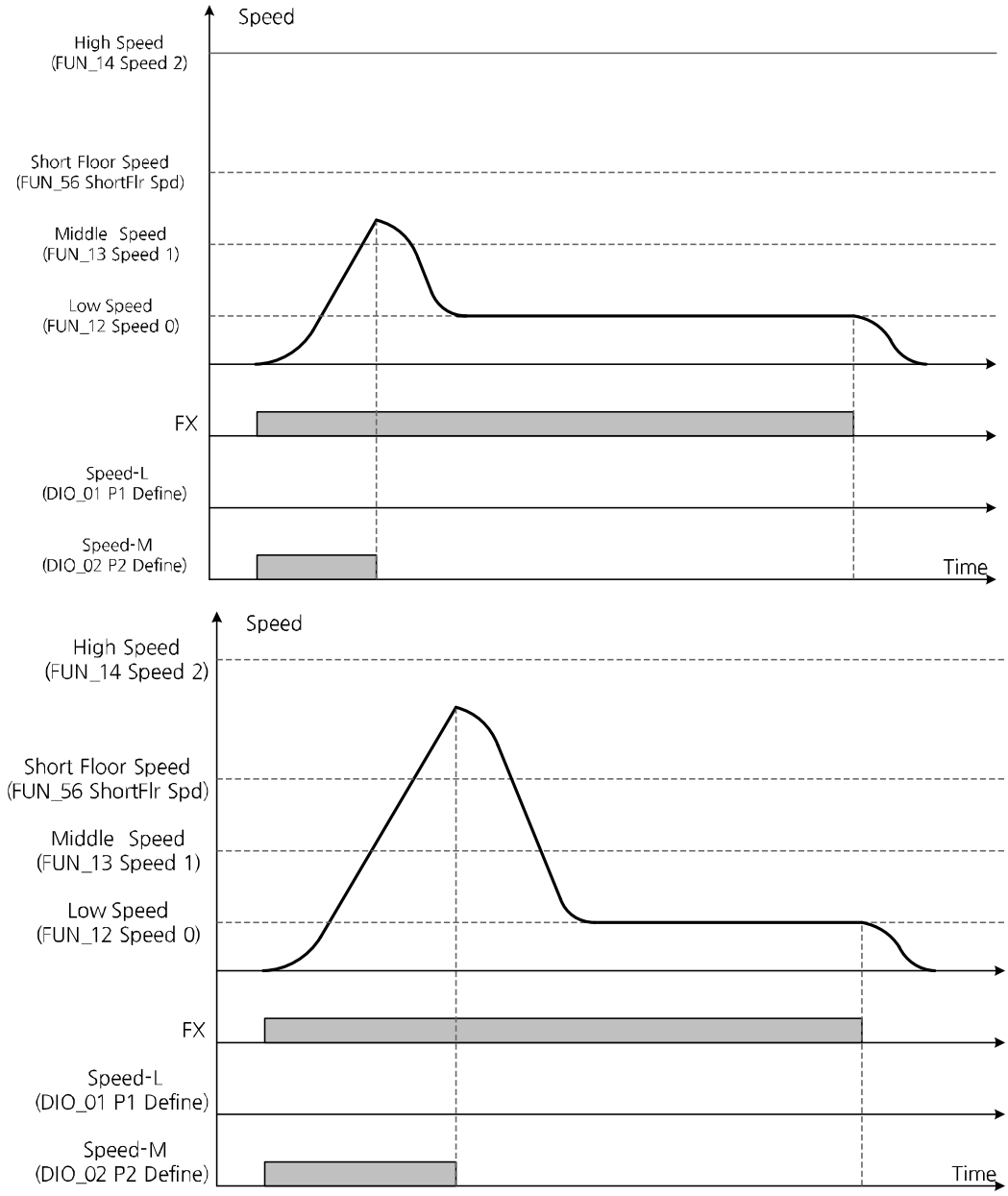
When the motor starts and accelerates in the forward direction and multifunction input P2 is ON, a new speed reference is calculated when the signal at P2 is turned OFF. If the new speed reference is higher than the speed set at FUN_56 (ShortFlr Spd), the motor decelerates to the new speed reference set at FUN_12. If the FX signal is OFF, the motor stops.

Use the formula in the previous example to calculate the new speed reference command.



■ **Elevator running speed is less than the short floor speedor the elevator the short floor speed is set to "0".**

If FUN_57 is set to "0", the motor decelerate from the current speed regardless of the setting at FUN_56, without applying the S-curve gradient. Then, it operates again at the speed set at FUN_12. Turning the FX signal OFF stops the motor. The new deceleration speed reference changes to the current operation speed.



6.5.11 Setting parameters for anti-hunting regulator

During inverter operation, current hunting (distortion or oscillation of current) by mechanical resonance or other factors may adversely affect the load system. Set the anti-hunting regulation parameters to avoid it.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_58	AHR Sel	Anti-hunting regulator options	0 (No) / 1 (Yes)	-	0(No)
FUN_59	AHR PGain	Anti-hunting regulator P gain	0.00–100.00	-	3.00
FUN_60	AHR Low Freq	Anti-hunting regulator start frequency	0–60.00	Hz	3.00
FUN_61	AHR Hi Freq	Anti-hunting regulator end frequency	FUN_60–PAR_11	Hz	60.00

■ **Anti-hunting regulator options (FUN_58)**

Set the parameter to enable or disable the anti-hunting regulator function.

■ **Anti-hunting regulator P gain (FUN_59)**

Higher AHR (anti-hunting regulator) proportional gain enhances the responsiveness of the system. However, unstable current conditions may result if you set it too high.

■ **Anti-hunting regulator start/end frequency (FUN_60/FUN_61)**

FUN_60 and 61 are used to define the minimum and maximum frequency where the AHR function will operate.

6.5.12 Setting the operation speed and input voltage for battery operation

Battery operation is an emergency measures to continue the inverter operation using the external battery when the power source is interrupted due to blackout or other reasons.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_67	Batt. Speed	Battery operation speed	DIO_32–200.0	rpm	50.0
FUN_68	Batt. Volt	Battery input voltage	12–PAR_15	V	48

FUN_67 and FUN_68 are displayed only when one of the multifunction inputs DIO_01 –07 is set for "Battery Run".

FUN_67 is used to define the operation speed during the emergency operation on battery power.

FUN_68 is used to define the battery input voltage during the emergency operation on battery power.

To enable the inverter operation on battery, turn on the signal at the multifunction input that is set for the battery operation ("Battery Run"). The inverter runs on battery based on the speed set at FUN_67, and the low voltage fault trip level is lowered.

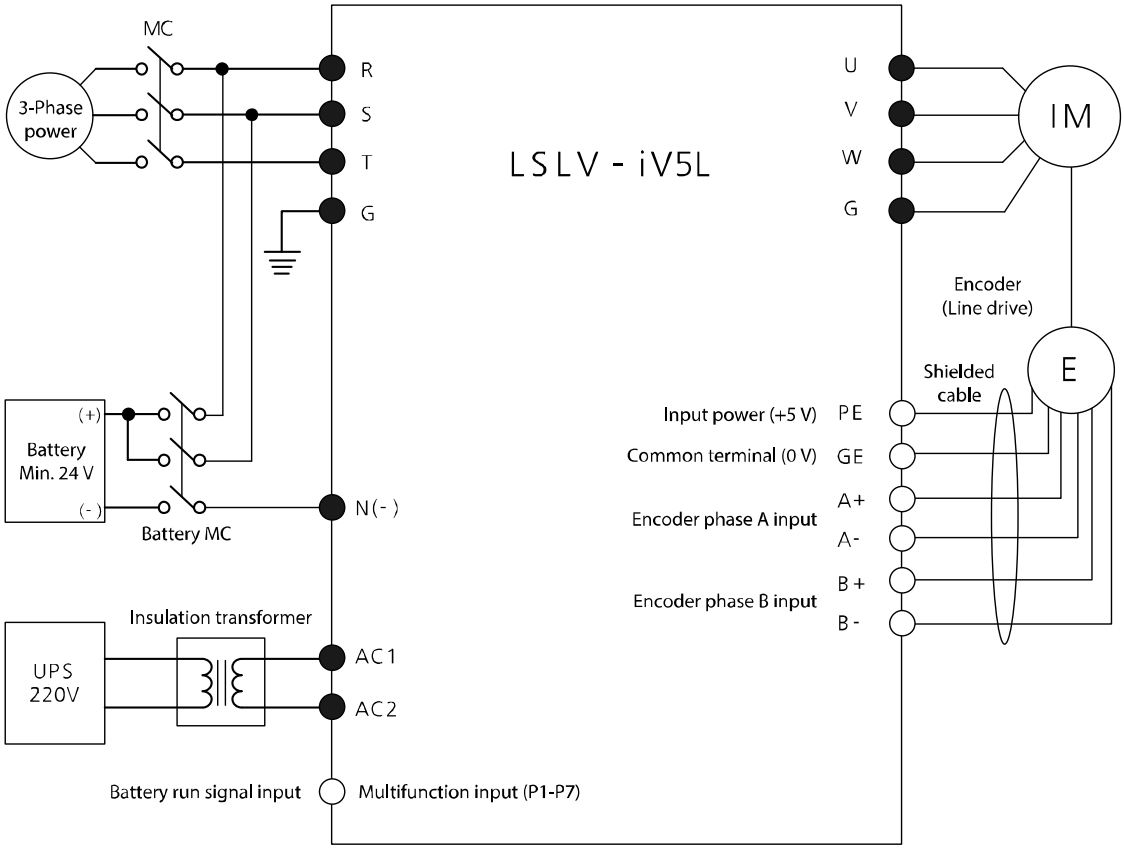
To resume normal operation, turn off the signal at the multifunction input that is set for the battery operation ("Battery Run"). The inverter runs on the original power source and all other operating conditions will be reverted.

Additional wiring connections are required for battery operation.

- Run cables from two of the input terminals (R, S, or T) to the battery's positive terminal via a magnetic contactor.
- At the main input terminals, connect the DCN terminal N (-) to the battery negative terminal.
- Supply UPS input voltage (220 V) to terminals AC1 and AC2.

Caution

- To prevent inverter damage, an isolating transformer (100 VA) must be installed in the control board of the auxiliary power supply.
- When the battery power is off, inverter may be damaged if the main power returns to on before the Low Voltage trip occurs. Turn on the main power after the Low Voltage trip occurs when the battery power is off.
- For battery operation, the battery power always must be on when the auxiliary power is connected, and the auxiliary power must be off after the battery power turns off.



Note) ● : Power terminal block , ○ : Control terminal block

During operation on battery, the current operation mode and "BAT" are displayed alternately on the top right corner of the keypad display.

If a multifunction output is set to "INV Ready," the relevant terminal is turned off during a battery operation.

After the power source is switched to battery, it takes about two seconds to release the fault trip and adapt the internal voltage until the inverter is ready for operation.

If the voltage drops below 53% of the setting value at FUN_68, a low voltage fault trip occurs.

When operating the inverter on battery, take the battery capacity into consideration and operate the inverter slower than usual.

When setting the battery operation speed (FUN_67), the battery voltage (FUN_68), base speed (PAR_14), and motor rated voltage (PAR_15) must be considered.

Before switching the battery power to mains power, de-energize the battery's magnetic contactor and stop the battery input signal. Then, supply mains power after a low voltage trip occurs.

6.5.13 ALLS (Automatic light load search) (FUN_69–FUN_72)

When the inverter is running on battery, the ALLS function is used to move the elevator to the next closest floor that reduces the load. Set FUN-69 (ALLS Enable) to "1 (Enabled)" to activate this function.

If the battery run signal is OFF while the inverter is operating via the battery supply, a fault trip occurs at the inverter.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_69	ALLS Enable	ALLS options	0 (Disabled) 1 (Enabled)	Msg	0 (No)
FUN_70	ALLS DirChgT	Hold time at internal FX, RX switching	1.0–10.0	sec	5.0
FUN_71	ALLS Time	Light load search time	(FUN-72)–10.0	sec	5.0
FUN_72	ALLS LoadCkT	Light load checking time	1.0–5.0	sec	2.0

■ ALLS options (FUN_69)

Enable or disable ALLS options. This option is available only when a multifunction input is set to "Battery Run".

■ Hold time at internal FX, RX switching (FUN_70)

When ALLS is enabled, set the hold time (zero-speed time) for direction switching.

■ Light load search time (FUN_71)

When ALLS is enabled, set the load time at the FX/RX speed reference.

■ Light load checking time (FUN_72)

Sets the time period for the inverter to detect the direction of the light load.

■ When forward operation has a lighter load

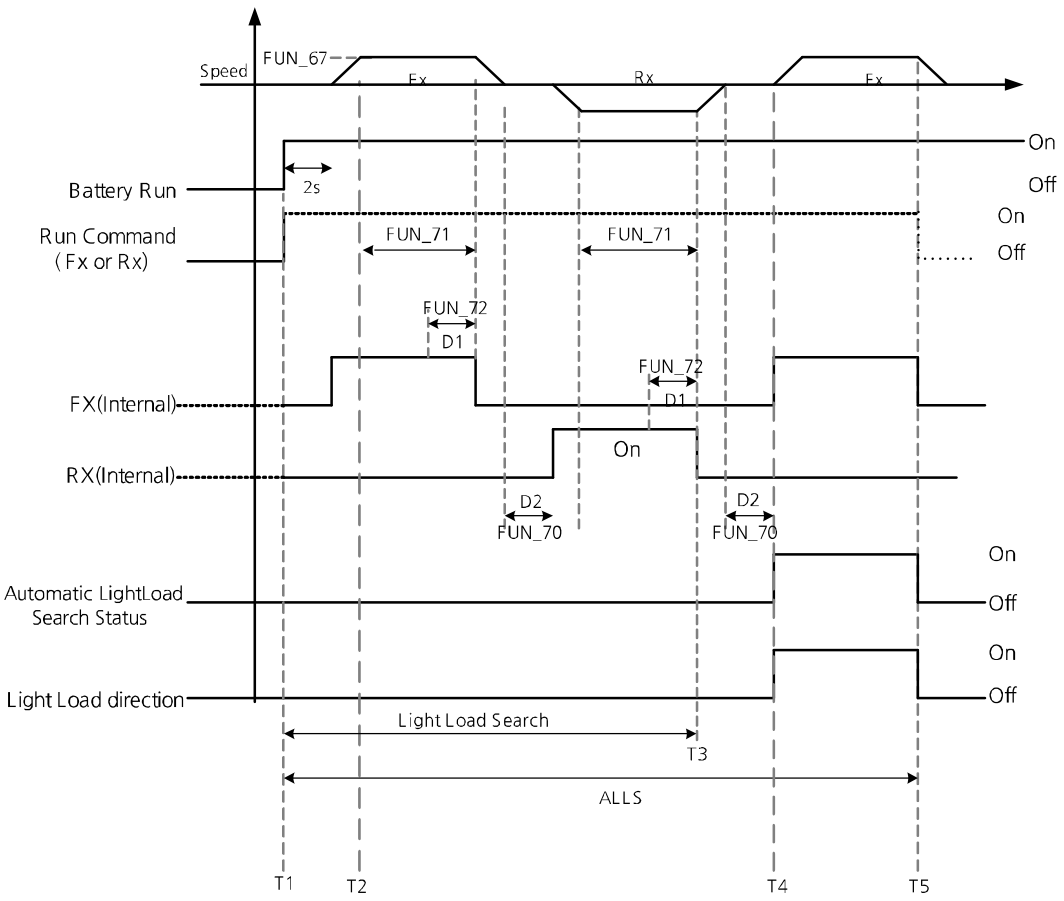
The graph below shows an example of an ALLS. In the example, the forward operation has a lighter load than the reverse operation.

A forward or a reverse ALLS operation is run two seconds after an ALLS [T1] starts.

When the output frequency reaches the value set at FUN_67 (T2), the operation speed is maintained for the time set at FUN_71. During this time, ALLS is performed for the time set at FUN_72 (D1 section). After the time set at FUN_71 has elapsed, the motor decelerates and stops. The motor remains in the stopped condition for the time set at FUN_70 (D2 section), and then another ALLS is performed in the other rotational direction until it reaches T3.

When ALLS is complete, the motor stops for the time set at FUN_70 (T4). Then, the motor runs in the direction with the least load.

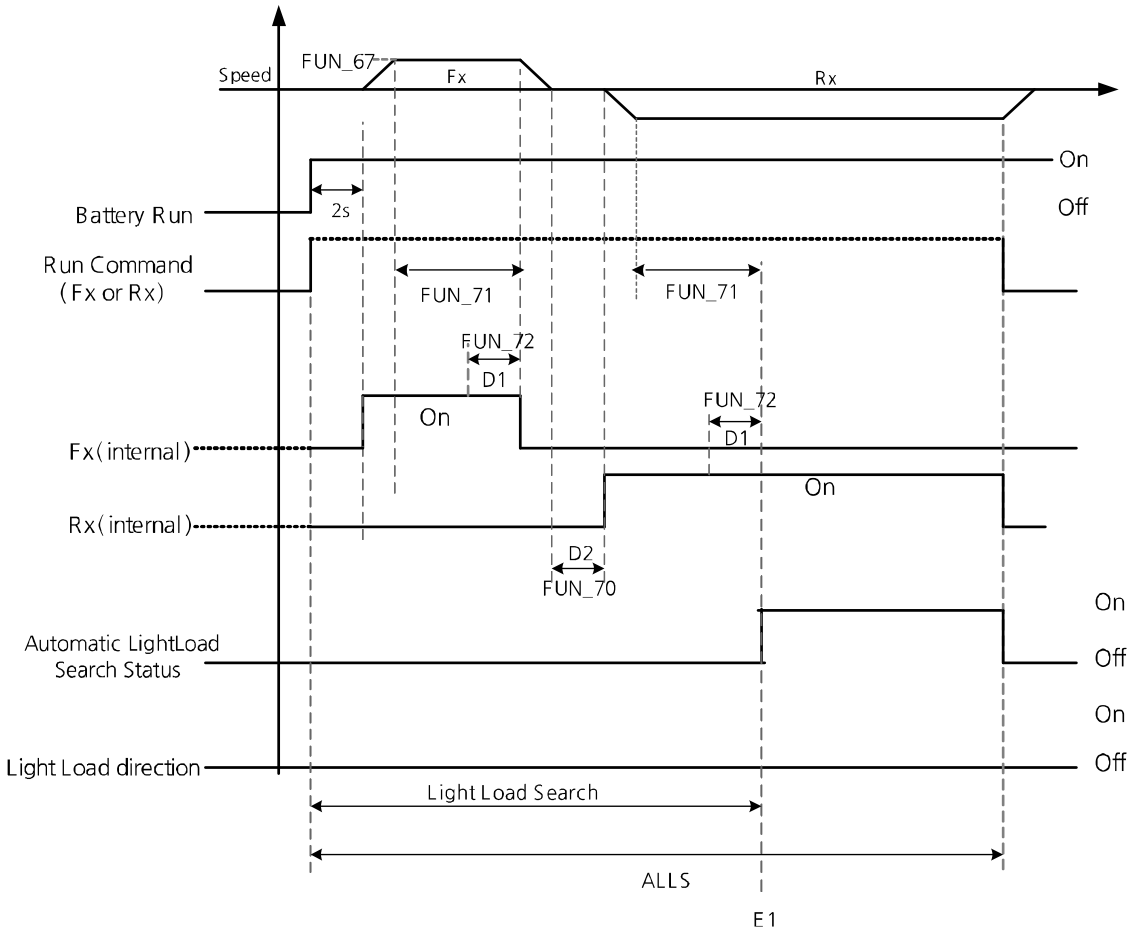
If a stop command is received during ALLS (T5), the motor decelerates and stops.



< When forward operation has a lighter load>

■ When reverse operation has a lighter load

The graph below shows an example of an ALLS. In the example, the reverse operation has a lighter load than the forward operation. The operating principle is identical to an ALLS when the forward operation has a lighter load. However, once the inverter detects that the reverse direction has a lighter load (E1), an ALLS starts in the reverse direction without stopping the motor.



< When reverse operation has a lighter load >

■ **Loss of battery run signal during ALLS**

The battery run signal must be ON and FUN_69 (ALLS Enable) must be set to "YES" for ALLS to run. If the battery run signal is OFF during ALLS, the inverter output is immediately blocked, the motor decelerates at free-run, and then stops.

⚠ Caution

If the battery run signal is OFF during ALLS, a "BatRun Fault" occurs.

6.5.14 Automatic load cell calculation

Automatic load cell calculations allows for easy configuration of related parameters when an improvement is required to correct operational problems including roll-backs. When you operate the inverter with a load cell, full-load climbing and no-load descending operations must be performed to correctly configure the related parameters.

6.5.14.1 Preparing a load cell calculation

1 Connect the load cell output (0–10 V) to Ai1-5G terminal.

2 Ensure that the load cell signals are correctly output during inverter operation.

3 If any incorrect load cell signals are noticed, eliminatie signal noise to correct it.

Keypad display	Description
AIO ▶ Ai1 Define 01 Torque Bias	Set AiO_01to "Torque Bias".
AIO ▶ Ai1 Source 02 0 ~ 10V	Set AIO_02to "0–10 V".
	For AIO_03 through AIO–10, use the default setting values unless adjustments are necessary.
AIO ▶ Ai1 LPF 11 50ms	Set AIO_11to 50ms, and then adjust the time value based on the presence of noise interference.

6.5.14.2 Full-load climbing operation

1 Move the elevator to the bottom floor, and load with its maximum capacity to make it fully loaded.

2 Set the manual operation speed reference to "0 rpm" to perform a climbing operation.

3 Refer to the following table and write down the values that are displayed on the keypad.

Keypad display	Description
DIS ▶ Ai1 Value 01 100%	Move to DIS_01 and press [PROG]. The cursor flashes. Press [▲] until "Ai1 Value" is displayed. Then, note the value that is displayed.
0.0 rpm SPD Tq 100% 50A	**<For a multistep speed operation mode>** Set the manual operation speed reference to "0 rpm". Then, record the torque that is displayed.
Tq 100% MAN UP --F 50A	**<For an ELIO mode operation>** Set the manual operation speed reference to "0 rpm". Then, record the torque that is displayed. To display the torque on the keypad, E/L_58 (Display Sel) must be set to "Trq Output".

6.5.14.3 No-load descending operation

1 Move the elevator to the top floor, and unload it to make it a no-load condition.

2 Set the manual operation speed reference to "0 rpm" to perform a descending operation.

3 Refer to the following table and write down the values that are displayed on the keypad.

Keypad display	Description
DIS▶ Ai1 Value 01 0%	Move to DIS_01 and press [PROG]. The cursor flashes. Press [▲] until "Ai1 Value" is displayed. Then, note the value that is displayed.
0.0 rpm SPD Tq -100% 50A	**<For a multistep speed operation mode>** Set the manual operation speed reference to "0 rpm". Then, write down the torque that is displayed.
Tq -100% MAN DN --F 50A	**<For an ELIO mode operation>** Set the manual operation speed reference to "0 rpm". Then, write down the torque that is displayed. To display the torque on the keypad, E/L_58 (Display Sel) must be set to "Trq Output".

6.5.14.4 Keypad input

1 Set CON_37 (Trq Bias Src) to "Analog".

Keypad display	Description
CON ▶ Trq Bias Src 37 Analog	Set CON_37 (Trq Bias Src) to "Analog.

2 Set FUN_73 (Use LoadCell) to "Yes". Input the torque and Ai1 values for full-load climb at FUN_74–77. AIO_06 and CON_40 will be automatically set.

Code	Keypad display	Name	Range	Unit	Default setting
FUN_73	Use LoadCell	Use auto loadcell	0(No)/ 1(Yes)		No
FUN_74	FullLoad Trq	Full-load climb torque	-250.0–250.0	%	100.0
FUN_75	FullLoad Ai	Full-load climb Ai1	-100.0 –100.0	%	100.0
FUN_76	No load Trq	No-load descent torque	-250.0–250.0	%	0.0
FUN_77	No load Ai	No-load descent Ai1	-100.0 –100.0	%	0.0

3 Check the following parameter setting values for correct calculation.

Keypad display	Description
AIO ▶ Ai1 Out Y2 06 200%	(Climb torque – Descent torque) ÷ (Climb Ai1 –descentI1)
CON ▶ Trq Balance 40 100%	(No-load descent torque) – (AIO_06 × (No-load descent Ai1))

Note

For correct calculation results, the analog input terminal Ai1 must be used when using the automatic load cell calculation.

6.6 Control (CON) group

6.6.1 Code jumping - accessing certain codes directly (CON_00)

CON_00 code is used to directly access a certain code.

The following is an example of jumping directly to CON_03 from CON_00 code.

1 Press [PROG].

2 Use [SHIFT/ESC], [▲], or [▼] to change the code number to "03".

3 Press [ENT] to access CON_03 code. If an invalid code number is entered, the next available code number is automatically selected.

Note

After jumping directly to a code, you can move to other codes by pressing [▲] or [▼].

6.6.2 Speed controller gain constant

Code	Keypad display	Name	Range	Unit	Parameter setting
CON_02	ASR PI Ratio	Speed controller gain ratio	1.0–500.0	%	100.0
CON_03	ASR P Gain1	Speed Controller proportional gain 1	0.1–500.0	%	50.0
CON_04	ASR I Gain1	Speed Controller integral time 1	0–50000	msec	300

Exception) CON_02 is only used with a synchronous motor, and the default values of parameter setting for CON_03 and CON_04 are changed according to the motor type.

6.6.3 Speed controller (Automatic Speed Regulator: ASR)

■ **Speed controller LPF time constant 1(CON_05)/Speed Controller LPF time constant 2 (CON_08)**

When you switch two types of speed controller PI gain, LPF time constant (speed command value) also changes according to the selected gain. If the multifunction input terminal is set to OFF, the gain1 and LPF time constant are selected. If the multifunction input terminal is set to ON, the gain2 and LPF time constant are selected.

Eg. The following table lists the examples of code settings when multifunction terminal P4 is set for ASR PI Gain switching.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_04	P4 define	Multifunction input terminal P4 Definition			ASR Gain Sel

The following table lists the examples of LPF time constant code settings.

Code	Keypad display	Name	Range	Unit	Default setting
CON_05	ASR LPF1	ASR input LPF time constant 1	0–20000	msec	0
CON_08	ASR LPF2	ASR input LPF time constant 2	0–20000	msec	0

■ Speed controller PI gain 1 (CON_03–04)/Speed Controller PI gain 2 (CON_06–07)

You can set speed PI controller to P gain or I gain according to the "ARS Gain Sel" of the multifunction input terminal.

Code	Keypad display	Name	Range	Unit	Default setting	
CON_03	ASR P Gain1	Speed Controller proportional gain 1	0.1–500.0	%	Induction motor	50.0
					Synchronous motor	10.0
CON_04	ASR I Gain1	Speed Controller integral time 1	0–50000	msec	Induction motor	300
					Synchronous motor	50
CON_06	ASR P Gain2	Speed Controller proportional gain 2	0.1–500.0	%	Induction motor	50.0
					Synchronous motor	10.0
CON_07	ASR I Gain2	Speed Controller integral time 2	0–50000	msec	Induction motor	300
					Synchronous motor	50

■ Speed controller gain switching ramp time (CON_10)/Speed Controller gain switching Speed (CON_11)

Also, you can set speed PI controller only to P gain according to the "ASR P/PI switching" of the multifunction input terminal.

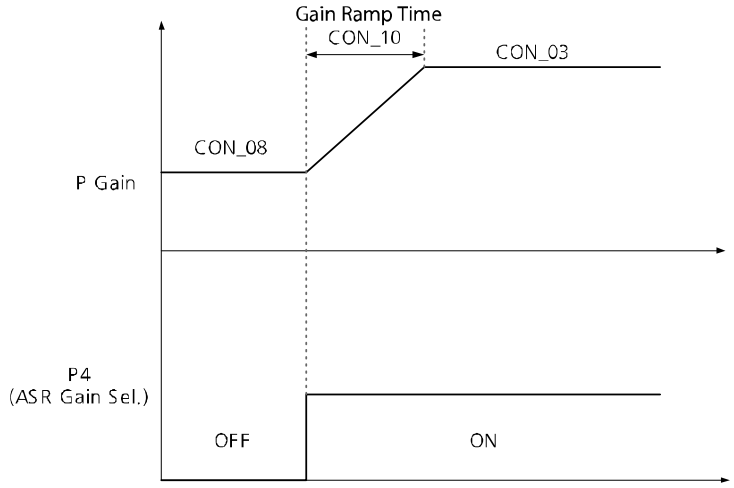
Eg. The following table lists examples of code settings when multifunction terminal P6 is set for ASR P/PI switching.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_06	P6 define	Multifunction input terminal P6 Definition			ASR P/PI Sel

This is the function to prevent a shock applied to the system due to a sudden change between P gain and I gain while switching ARS gain. When another value except for 0 is entered for CON_11 and the inverter's speed exceeds the entered value, the P gain changes to Ramp, and the P gain 2 changes to the P gain 1.

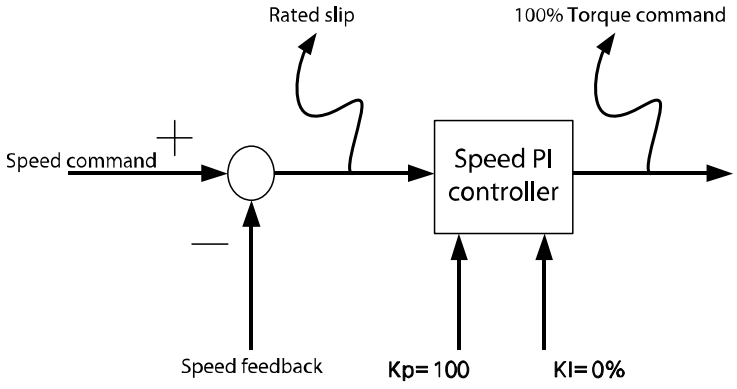
When the multifunction input terminal is set to "ARS Gain Sel" and the terminal is on, the speed gain switching activates. When the terminal is off, the speed gain switching deactivates.

Code	Keypad display	Name	Range	Unit	Default setting
CON_10	ASR Ramp	Speed controller gain switching ramp time	10–10000	msec	1000
CON_11	ASR TarSpd	Speed controller gain switching speed	0.0–3600.0	rpm	0.0



■ How to set proportional gain and integral time of speed controller

The proportional gain (%) of speed controller is scaled to have the same value of the torque proportion (%) when the speed error is rated slip. The integral time is the accumulated values of the output torque from 0 to 100% when the speed error is rated slip. When the proportional gain is 100% and the speed error is rated slip, the speed controller output has the same value of 100% torque.



■ **Speed Controller response set**

You need to check the response time after each parameter adjustment.

Eg.) Check the response after adjusting CON_02 → Check the response after adjusting CON_03

Option	CON_02[1)]	CON_03	CON_04	Note
To speed up the response	Slower	Faster	Slower	The respond times speed up, but the system is unstable and the motor vibration and overshoot are increased.
To slow down the response	Faster	Slower	Faster	Motor vibration and overshoot are decreased, but the response times speed down.

1) Appears only when the PAR_07 Speed (Sync) is set.

6.6.4 Overshoot Prevention

■ **overshoot prevention description**

This function prevents the motor's feedback speed from overshooting.

■ **overshoot prevention gain (CON_09)**

If a value other than '0' is set at CON_09, the overshoot prevention function is active. The overshoot rate for motor feedback speed varies based on the motor's inertia set at (PAR_57).

Code	Keypad display	Name	Range	Unit	Default setting
CON_09	ASR FF Gain	Overshoot prevention gain	0–1000	%	0

6.6.5 About torque

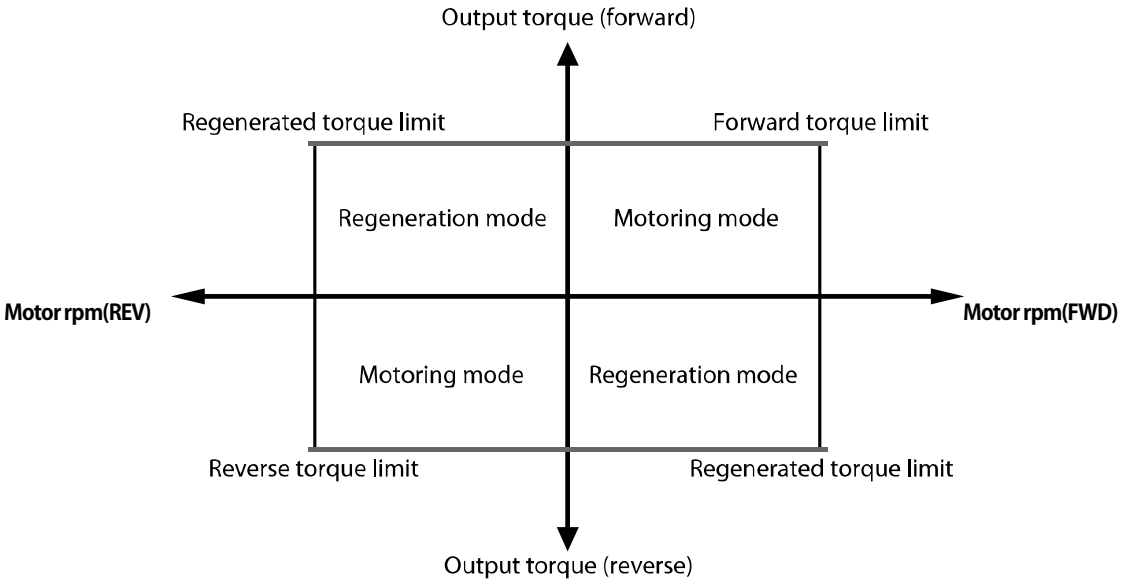
■ The torque limit definition, forward/backward/ regenerated torque limit (CON_33–36)

Because the motor's torque output is calculated internally in the vector control, the torque limit can be set within a specific value. Use this function when you want to permit the torque within a specific limit or when you want a certain amount of regenerated energy.

The torque limit can be set differently by Forward, Reverse, or Regeneration mode which is changed according to the motor operation type.

Each mode may be configured to take inputs from the keypad, analog input terminal, and built-in 485 communication.

Code	Keypad display	Name	Range	Unit	Default setting
CON_33	Trq Lmt Src	Torque limit definition			Kpd Kpd Kpd



Torque limit definition

The torque limit value is set according to the CON_33 code value.

CON_33 code setting	Forward torque limit	Reverse torque limit	Regeneration torque limit
0 (Kpd Kpd Kpd)	CON_34	CON_35	CON_36
1 (Kpd Kpd Ax)	CON_34	CON_35	Vx
2 (Kpd Ax Kpd)	CON_34	Vx	CON_36
3 (Kpd Ax Ax)	CON_34	Vx	Vx
4 (Ax Kpd Kpd)	Vx	CON_35	CON_36
5 (Ax Kpd Ax)	Vx	CON_35	Vx
6 (Ax Ax Kpd)	Vx	Vx	CON_36
7 (Ax Ax Ax)	Vx	Vx	Vx
9 (485 485 485)	485 Forward torque limit	485 Reverse torque limit	485 Regeneration torque limit

Vx is the value set as the torque limit from the terminal block Analog input.

■ The torque current standard

The torque current standard is used to transform torque reference input into current reference. The torque current standard is calculated from the motor's rated current and flux current. By default, the motor's rated current and flux current are set for HEIGEN vector motors based on the motor capacity set at PAR_09.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_09	Motor Select	Motor capacity option	2.2–22.0	kW	7.5
PAR_19	Rated-Curr	Motor rated current	1.0–1000.0	A	19.7
PAR_52	Flux-Curr	Motor flux current	0.0-70% of PAR_19	A	6.6

■ Torque bias options (CON_37)/torque bias value (CON_38)

Give the torque bias by entering the torque bias in CON_38 code, by setting the multifunction terminal block analog input to "Torque Bias", and by using the internal 485 communication. When you use the multifunction terminal block voltage input, –10–10 V is converted to–100–100% and available to –250–250% due to gain and bias.

Code	Keypad display	Name	Range	Unit	Default setting
CON_37	Trq Bias Src	Torque bias option	0 (None) 1 (Analog) 2 (Keypad) 4 (Int485)		None
CON_38	Trq Bias	Torque bias value	-150.0–150.0	%	0.0

■ Torque bias options

Configure a multifunction input terminal to "Use Trq Bias". When the multifunction input definition is set to "Use Trq Bias", the torque bias is entered by the opening or closing of input contacts. When the multifunction input definition is not set to "Use Trq Bias" and the CON_37 is set to "Keypad", the torque bias of CON_38 is entered automatically regardless of the position of the input contacts. To stop using torque bias, set CON_37 to "None" or define the multifunction input terminal as "Use Trq Bias" and deactivate the input contact.

Eg. The following table lists examples of code settings when multifunction terminal P5 is set for this function.

Code	Keypad display	Name	Range	Unit	Default setting
DIO_05	P5 Define	Multifunction input terminal P5 Definition			Use Trq Bias

■ Torque bias compensation for loss by friction (CON_39)

This is the torque bias to compensate the loss by friction. Because the loss by friction is changed by the motor's rotation direction, the torque bias is added by multiply the sign according to the rotation direction.

Code	Keypad display	Name	Range	Unit	Default setting
CON_39	Trq Bias FF	torque bias compensation for loss by friction	-150.0–150.0	%	0.0

■ Torque balance value (CON_40)

Use a load cell to balance the overloaded torque feedback while operationing lift-type loads. When a load cell is used, the load must be balanced first before compensation is made, based on the load cell's output torque. Balance the load of the lift and the counterweight to be exactly even, and then set CON_40 to 50%. The value that appears when you press [PROG] on the keypad is the load cell voltage input to the inverter. Press [▲] or [▼] to adjust the percentage (%) to make this value the reference for compensation.

Code	Keypad display	Name	Range	Unit	Default setting
CON_40	Trq Balance	Torque balance value	0.0–100.0	%	50.0

6.6.6 Torque boost

Manual torque boost enables users to adjust output voltage at low speed or during motor start. This feature increases low speed torque or improves motor starting properties by manually increasing output voltage. Manual torque boost is suited for loads that require high starting torque, such as elevators.

6.6.6.1 Manual torque boost

When the inverter control mode is set to V/F or slip comp, the inverter controls the open loop. To prevent situations where users cannot start the inverter due to insufficient torque, users can set a torque boost values and provide additional voltage to the inverter. The additional voltage is generated at a fixed ratio of a frequency.

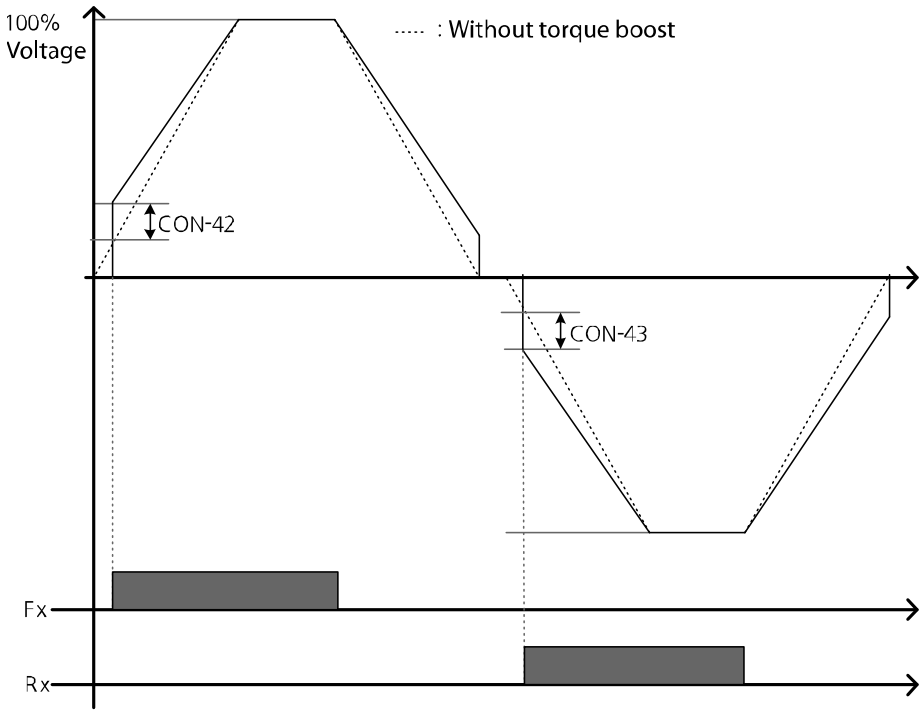
Code	Keypad display	Name	Range	Unit	Default setting
CON-41	Torque boost	Torque boost method	0 (Manual) 1 (Auto)		0 (Manual)
CON-42	Fwd boost	Forward torque boost	0.0–20.0	%	2.0
CON-43	Reverse boost	Reverse torque boost	0.0–20.0	%	2.0

■ **Forward torque boost (CON_42)**

When the inverter rotates the motor in the forward direction, this function adjusts the level of torque boost.

■ Reverse torque boost (CON_43)

When the inverter rotates the motor in the reverse direction, this function adjusts the level of torque boost.



Manual torque boost adjusts the inverter output based on the setting values regardless of the type of load.

ⓘ Caution

- Excessive torque boost will result in a inverter failure due to overheat or overcurrent.
- An overcurrent trip may occur also when the load is heavy and the torque boost is low.

6.6.6.2 Auto torque boost

Auto torque boost can be used when CON_41 is selected to Auto. Auto torque boost enables the inverter to automatically calculate the amount of output voltage required for torque boost based on the type of load. It automatically compensates for the type of load unlike manual torque boost that adjusts the inverter output regardless of the type of load. Auto torque boost adjusts the output voltage based on the ATB Gain_M and ATB Gain_G values at CON_46 and CON_47. It is used when the torque is insufficient for motor starting or in overcurrent conditions.

Code	Keypad display	Name	Range	Unit	Default setting
CON-41	Torque boost	Torque boost method	0 (Manual) 1 (Auto)		0 (Manual)
CON-42	Fwd boost	Forward torque boost	0.0–20.0	%	2.0
CON-43	Reverse boost	Reverse torque boost	0.0–20.0	%	2.0
CON-45	ATB Filter Gain	Auto torque boost filter gain	1–10000	msec	200
CON-46	ATB Gain M	Auto torque boost reverse voltage gain	0–300.0	%	15.0
CON-47	ATB Gain G	Auto torque boost regeneration voltage gain	0–300.0	%	10.0

■ **The auto torque boost filter gain (CON_45)**

The filter gain used to calculate the auto torque boost value.

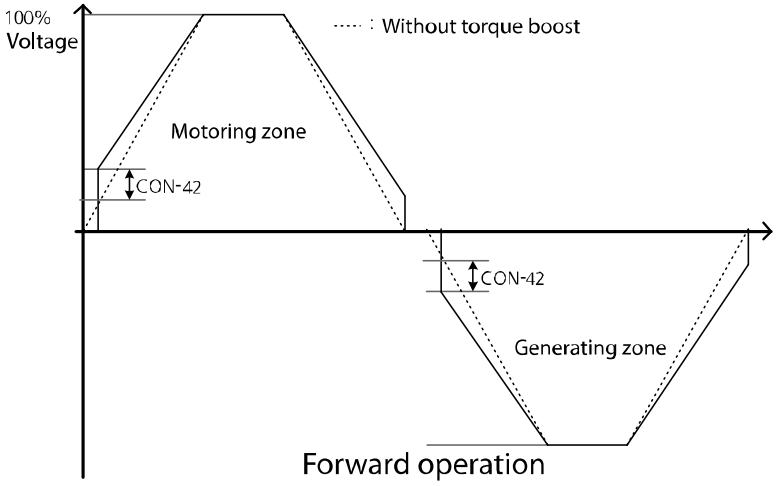
■ **The auto torque boost reverse voltage gain (CON_46)**

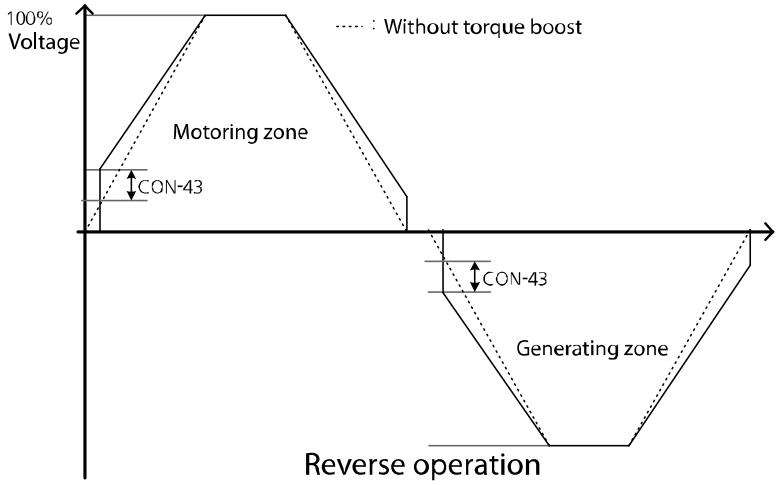
The voltage gain used to calculate the reverse auto torque boost value.

■ The auto torque boost regeneration voltage gain (CON_47)

This is the voltage gain used to calculate the regeneration auto torque boost value.

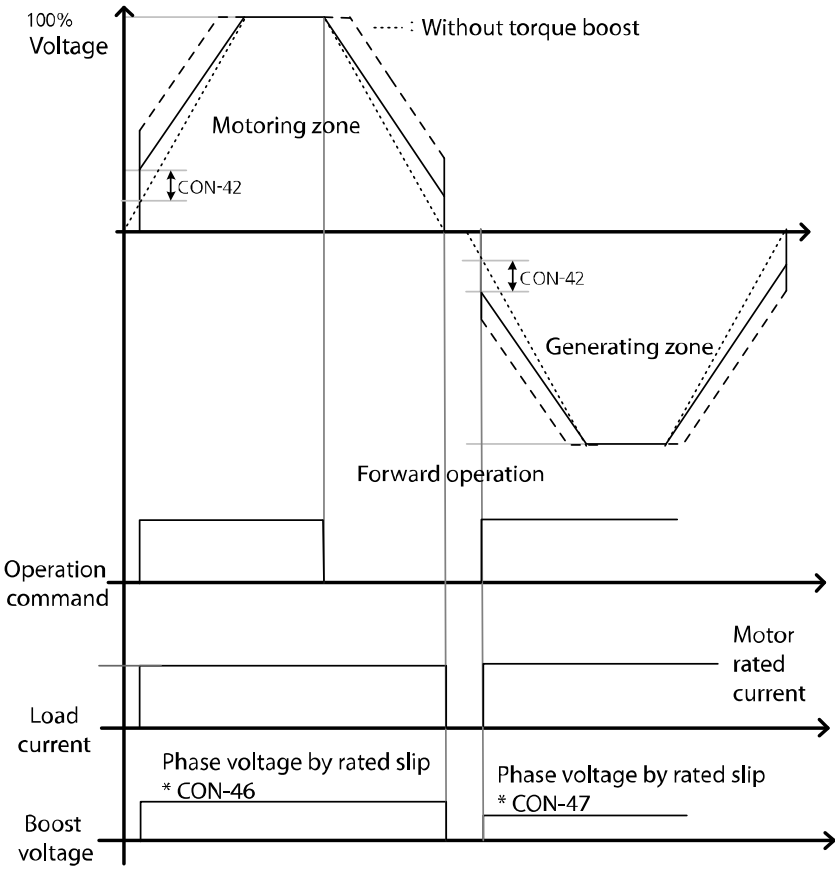
■ When not loaded

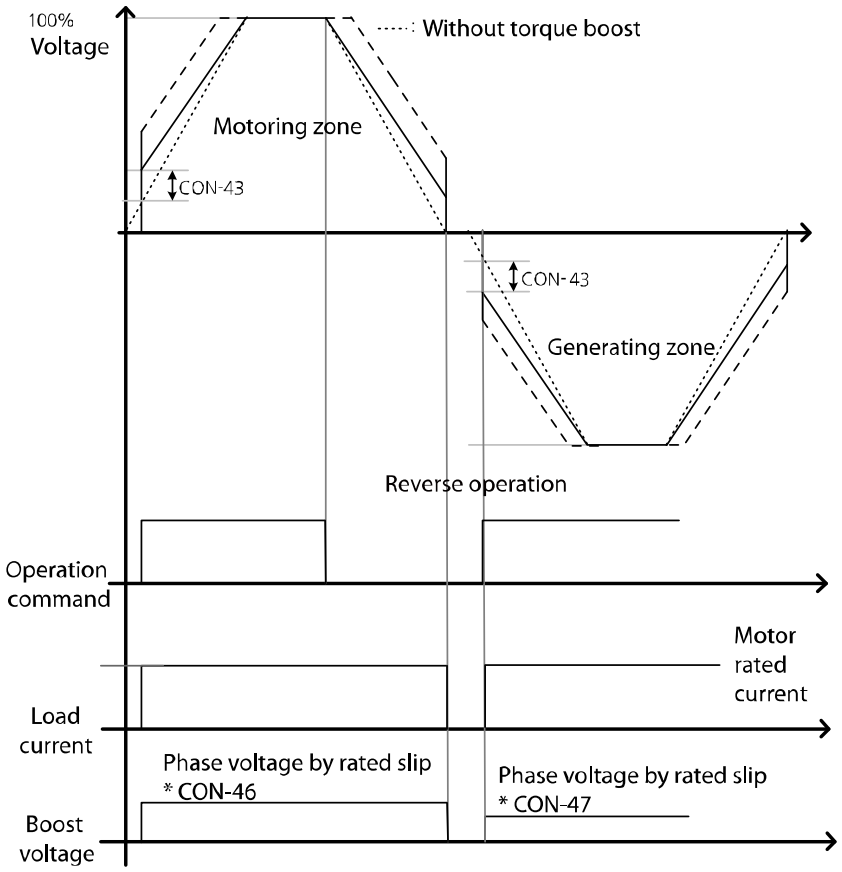




When not loaded, the additional voltage for the auto torque boost is 0. It is same as the normal manual boost value.

■ When loaded


100%
Voltage
: Without torque boost
Motoring zone
CON-42
CON-42
Generating zone
Forward operation
Operation
command
Motor
rated
current
Load
current
Phase voltage by rated slip
* CON-46
Phase voltage by rated slip
* CON-47
Boost
voltage



The graph above shows the auto torque boost wave when overloaded. If loaded, voltage compensation varies depending on the operation direction and reverse operation.

When the control mode is set to "Slip Comp", the CON_41 Torque Boost mode is automatically configured to Auto.

The current hunting may occur if the value in CON_42 and CON 43 are different when using the torque boost while not loaded.

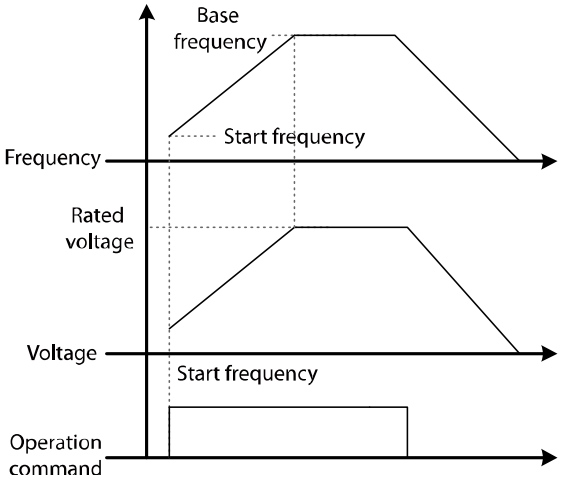
6.6.7 V/F (Voltage/Frequency) control

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

6.6.7.1 V/F voltage pattern

■ **CON_48 V/F pattern: Linear**

A linear V/F pattern configures the inverter to increase or decrease the output voltage at a fixed rate for different operating frequencies based on V/F characteristics.

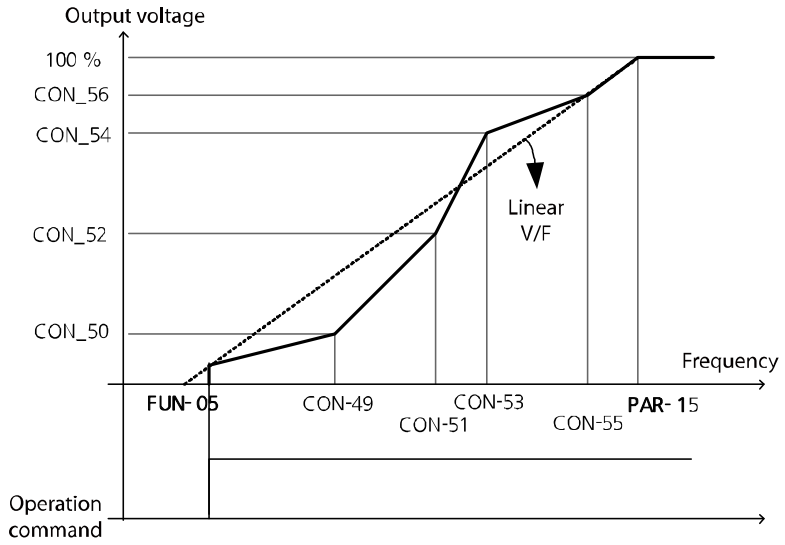


6.6.7.2 User V/F pattern (User V/F)

You can set the configuration of user-defined V/F patterns to suit the load characteristics of special-purpose motors.

Code	Keypad display	Name	Range	Unit	Default setting
CON-48	V/F pattern	Output voltage pattern for output frequency	0 (Linear) 2 (User V/F)		0: Linear
CON-49	User freq 1	User freq 1	0–CON_51	Hz	15.00
CON-50	User volt 1	User volt 1	0–100	%	25
CON-51	User freq 2	User freq 2	CON_49 – CON_53	Hz	30.00
CON-52	User volt 2	User volt 2	0–100	%	50
CON-53	User freq 3	User freq 3	CON_51 – CON_55	Hz	45.00
CON-54	User volt 3	User volt 3	0–100	%	75
CON-55	User freq 4	User freq 4	CON_55 – PAR_11	Hz	60.00
CON-56	User volt 5	User volt 4	0–100	%	100

When the base frequency, minimum frequency, and motor rated voltage are set in the inverter, and users want to generate the V/F voltage pattern after setting the user V/F, users should set CON_49–CON_56. When the setting is entered, the inverter generates the user-defined voltage values for a specific frequency when the operation command is ON.



For induction motors, a pattern that deviates sharply from linear V/F pattern must not be used. Patterns that deviates sharply from linear V/F pattern can result in over-excitation and cause insufficient motor torque or motor overheating. When a user V/F pattern is in use, torque boost does not operate.

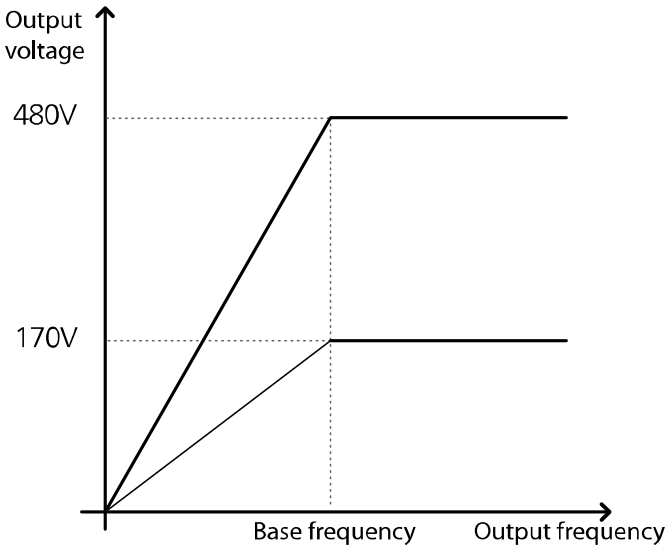
ⓘ Caution

When the control mode is V/F, or Slip Comp, the direction cannot be changed during operation. To change the current direction, stop the elevator and allow the operation command in the required direction.

6.6.8 Motor output voltage control (CON_57)

When the input power and rated motor voltage are different, enter the voltage displayed on the motor's nameplate to configure the motor voltage. The configured voltage value becomes the output voltage for the base frequency.

If the frequency is higher than the base frequency and the input voltage is higher than the parameter setting, the inverter regulates it and supplies the rated voltage to the motor. However, if the frequency is higher than the base frequency and the input voltage is lower than the rated motor voltage, the inverter supplies the input voltage to the motor.



6.6.9 Slip compensation

Slip refers to the variation between the set frequency (synchronous speed) and the motor rotation speed. As the load increases, variations between the set frequency and the motor rotation speed can occur. Slip compensation is used for loads that experience speed variations and require compensating speed.

Code	Keypad display	Name	Range	Unit	Default setting
CON_63	SlipCompFreq	Slip compensation operation frequency	0.00–120.00	Hz	5.00
CON_64	SlipGain_MH	Slip compensation motoring gain H	0.0–500.0	%	50.0
CON_65	SlipGain_GH	Slip compensation generation gain H	0.0–500.0	%	50.0
CON_66	SlipGainFrq	Slip compensation gain switching frequency	0.00–120.00	Hz	0.50
CON_67	SlipGain_ML	Slip compensation motoring gain L	0.0–300.0	%	10.0
CON_68	SlipGain_GL	Slip compensation generation gain L	0.0–300.0	%	10.0
CON_69	Slip Filter	Slip compensation filter time constant	100–10000	msec	500
PAR-07	Control Mode	Control mode	2 (Speed) 4 (V/F) 5 (Slip Comp) 6 (Speed(Synch))		4 (V/F)
PAR-12	Min Speed	Inverter output minimum frequency	0.5–10.0	rpm /Hz	0.0
PAR-13	Base Freq	Inverter base frequency	30.00–120.00	Hz	60.00
PAR-15	Rated Volt	Motor rated voltage	240–560	V	380
PAR-18	Rated Slip	Motor rated slip	1.0–1000.0	A	70.0
PAR-19	Rated Curr	Motor rated current	0–Motor rated Current	A	19.7
PAR-52	Flux-Curr	Excitation current (Motor no load current)	0–Motor rated Current	A	6.6

Code	Keypad display	Name	Range	Unit	Default setting
CON-48	V/F pattern	Output voltage pattern	0 (linear) 2 (User V/F)		0 (Linear)
CON-41	Torque boost	Torque boost method	0 (Manual) 1 (Auto)		1 (Auto)
CON-42	Fwd boost	Forward torque boost	0.0–20.0	%	2.0
CON-43	Reverse boost	Reverse torque boost	0.0–20.0	%	2.0
CON-45	ATB Filter Gain	Auto torque boost filter gain	1–10000	msec	200
CON-46	ATB Gain M	Auto torque boost reverse voltage gain	0–300.0	%	15.0
CON-47	ATB Gain G	Auto torque boost regeneration voltage gain	0–300.0	%	10.0

■ Slip compensation starting frequency (CON_63)

Set the frequency to use when slip compensation starts.

■ Slip compensation motoring/generation gain (CON_64, CON_65)

Set values for motoring gain and generation gain when the output frequency exceeds the slip compensation gain frequency.

■ Slip compensation gain switching frequency (CON_66)

Set the frequency that triggers slip compensation gain.

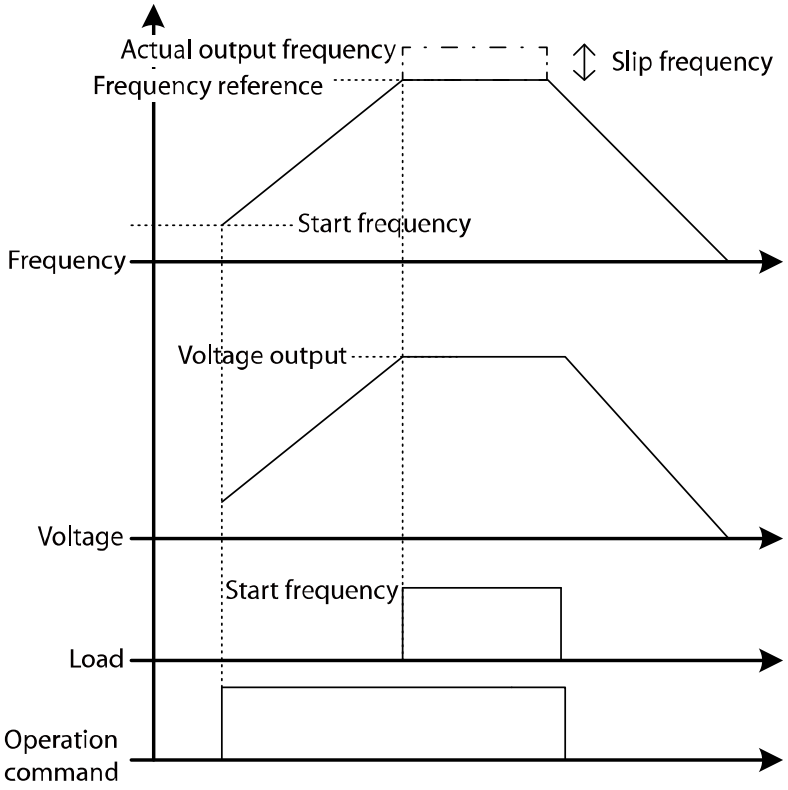
■ Slip compensation motoring/generation gain (CON_67, CON_68)

Set values for motoring gain and generation gain when the output frequency is lower than the slip compensation gain frequency.

■ **Slip compensation filter time constant (CON_69)**

The required current during slip compensation is based on the filter time constant.

■ **If load is allowed after reaching the target frequency**



When the loads is not allowed and the target frequency is reached, the inverter output is the combined user-defined target frequency and slip frequency.

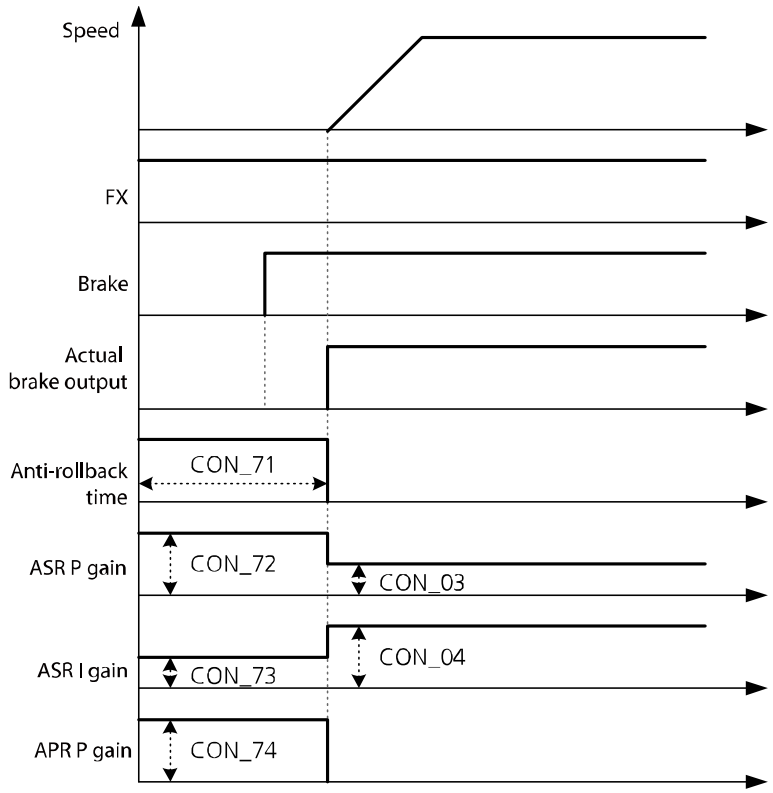
⚠ Caution

When the control mode is V/F or Slip Comp, the direction of rotation cannot be changed during operation. To change the direction of rotation, stop the motor and configure the operation command for the desired direction.

6.6.10 Anti Rollback Function

■ Anti Rollback description

Use this function to prevent roll back and to maintain the operating torque. The function does this by compensating for initial load without using the loadcell while operating the elevator.



■ Anti Rollback time (CON_71)

If a value other than '0' is set at CON_71 Anti-Rollback Time, the anti-rollback function is active.

Code	Keypad display	Name	Range	Unit	Default setting
CON_71	ARF Time	Anti rollback time	0–10000	msec	0

■ Anti Rollback speed controller P/I gain (CON_72–73)

When anti-rollback is active, Speed Controller P/I gain can be set.

The value set at CON_72 must be higher than the value set at CON_03. Rollback will increase and vibration and noise will decrease.

Enter a value at CON_73 that is less than the value set at CON_04. Rollback will decrease and vibration and electronic interference will increase.

Code	Keypad display	Name	Range	Unit	Default setting
CON_72	ARF ASR P	Anti rollback ASR P gain	1–3000	%	100
CON_73	ARF ASR I	Anti rollback ASR I gain	1–50000	msec	5

■ Anti Rollback location control P gain (CON_74)

Set the location controller P gain for anti-rollback. Rollback will increase and vibration and noise will decrease.

Code	Keypad display	Name	Range	Unit	Default setting
CON_74	ARF APR P	Anti rollback APR P gain	1–9999	%	200

■ Motor inertia value (PAR_57)

Enter a value for motor inertia. When an inertia value is shown on the motor's rating plate, enter the rated value. If an inertia value is not shown, adjust the settings based on anti-rollback performance.

Code	Keypad display	Name	Range	Unit	Default setting
PAR_57	Inertia	Motor inertia number	0.001–60.000	kgm^2	Asynch: 0.072 Synch: 5.000

Note

The motor can generate noise based on the anti-rollback settings for APR and ASR gain.

6.7 Protection (PRT) group

6.7.1 Jump code (PRT_00)

PRT_00 code is used to directly access a specific code.

The following is an example for jumping directly to code PRT_00.

1 Press [PROG].

2 Use [SHIFT/ESC], [▲], or [▼] to change the code number to "03".

3 Press [ENT] to access PRT_00 code. If an invalid code number is entered, the next available code number is automatically selected.

Note

After jumping directly to a code, you can move to other codes by pressing [▲] or [▼].

6.7.2 Motor thermal protection (I^2T)

Use this function to protect the motor from overheating without a separate thermal relay. It detects if the motor is overheated by calculating the motor's theoretical temperature rise using various parameters and adjusting for overcurrent conditions. When thermal protection is activated, the inverter output is blocked and a trip message appears.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_01	ETH Select	Electronic thermal on/off	0 (No) 1 (Yes)		No
PRT_02	ETH 1 Min	Electronic thermal one minute rating	PRT_03–200	%	150
PRT_03	ETH Cont	Electronic thermal continuous rating	50–PRT_02 (150% max)	%	100
PAR_22	Cooling Mtd	Motor cooling fan type	Self-cool Forced-cool		Forced-cool

The electronic thermal level is ratio (%) to "Motor rated Current" set at PAR_19.

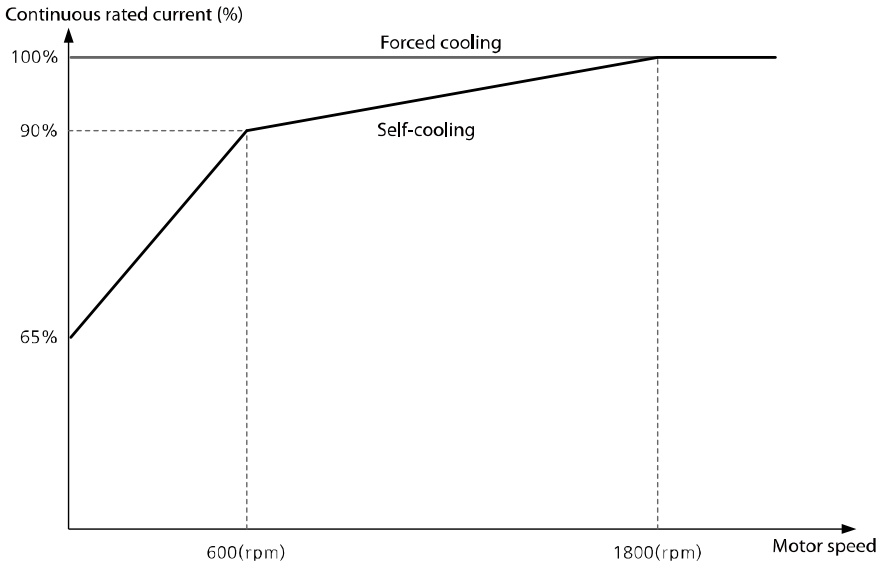
"Electronic thermal one minute rating" (PRT_02) is the amount of input current that is supplied to the motor for one minute until the motor is considered as overheated.

"Electronic Thermal continuous rating" (PRT_03) is the amount of input current that the motor is not overheated when the current is continuously supplied to the motor.

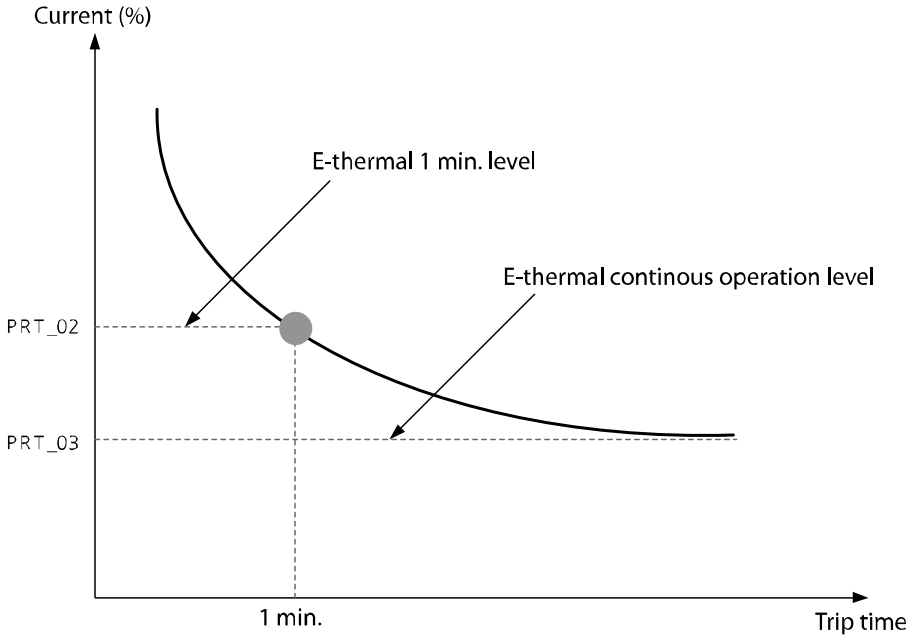
For the motor's rated current (100%), set a lower value than the value of Electronic Thermal one minute rating. The motor continuously operates to the configured value.

"Motor cooling fan type" (PRT_22) is for setting the motor's cooling fan type for the electronic thermal function.

- Self-cool: Select the Self-cool mode when operating the cooling fan attached to the motor axis. This mode is for universally designed induction motors. In this case, the cooling capacity greatly decreases when the motor is operated at low speed. The motor overheats rapidly at lower speed. Therefore, depending on the motor speed, the electric thermal function operates with reduced continuous rated current set at "ETH Cont" (PRT_02) as shown in the graph below.
- Forced-cool: Select the Forced-cool mode when operating a cooling fan independently, with a separate power supply. The continuous rated current set at "ETH Cont" (PRT_03) is applied regardless of the motor speed.



Continuous rated current derating by operation frequency (based on a 4-pole, 60 Hz motor).



E-thermal inverse time characteristics curve

- When the inverter output current changes due to the load variation or frequent acceleration/deceleration, the motor protection is possible because I2T is calculated and accumulated.

6.7.3 Reset restart selection (PRT_04)

If "No" is selected, the inverter restarts when an OFF and then an ON input signal is received at the terminal block. This condition occurs even when a fault condition exists and inverter's terminals are configured for operation.

If "Yes" is selected, the inverter restarts without the terminal block receiving an OFF or an ON signal. In this situation, the terminal block remains active after a fault condition is cleared when a trip has occurred while the inverter is running.

However, if the number of automatic restarts is exceeded and PRT_05 is set to Yes, the user must manually reset an error to allow the inverter to run again. When an inverter output error occurs, the inverter's output connection is blocked and the motor runs in free-run condition (the terminal block must be configured to allow motor free-run).

Be careful when operating the inverter at high motor speed while the motor is in free-run condition. It may cause over current error.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_04	RST Restart	Reset restart selection	0 (No) 1 (Yes)		No

Caution

For LV error, it will not operate even the trip is off and operation command is registered to a running state.

6.7.4 Automatic restart operation

■ **Number of automatic restarts (PRT_05)/Automatic restart delay time(PRT_06)**

This function enables the inverter to automatically restart after the motor is stopped by an inverter fault trip and the error condition has been cleared. If the number of automatic restarts is set and the terminal block is active, the inverter is automatically reset and restarted, and then continues operation.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_05	Retry Number	Number of automatic restarts	0–10		0
PRT_06	Retry Delay	Automatic restart delay time	0.0–60.0	sec	1.0

When a fault trip occurs, the inverter will restart based on the setting at PRT_05 (Retry Number). Following a fault trip, a restart is performed after the time delay set at PRT_06 (Retry Delay). If the number of automatic restarts is exceeded, the inverter will stop attempting to restart, block the inverter output, and display an error message.

For example, automatic restart succeeds and no trip occurs anymore, the number is not counted. If the automatic restart fails and a trip occurs again, an attempt of automatic restart will be added. The number of automatic restart will not be reset and accumulate.

The condition for resetting the number of restart is:

- Turning off the inverter and tuning it back on resets the accumulated number of restart.
- When the number of restart is accumulated to the number set at PRT_04, automatic restart does not operate. The accumulated number of automatic restart will be reduced by one if the status without an error continues for 30 seconds.

ⓘ Caution

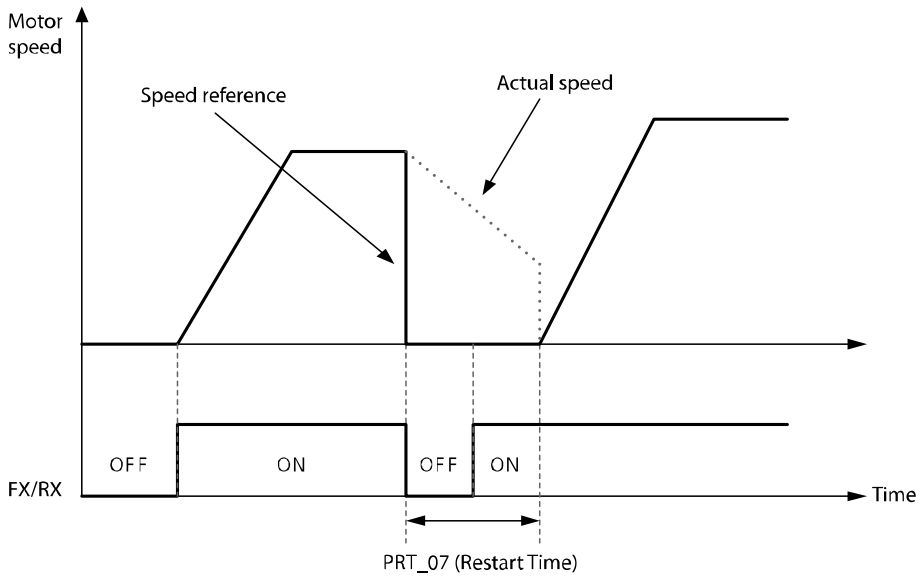
- Check the operation signal status before resetting the inverter. The inverter operates as soon as it is reset if the operation signal is ON at the terminal block.
- Automatic restart is not allowed for the fault trips listed below.
  - Low Voltage
  - Arm Short-U (V, W, DB)
  - Fuse Open
  - Ground Fault
  - Fan Error (Fan malfunction)
  - BatRun Fault
  - Input PO
  - HW-Diag
  - Output PO
  - InvThem OP
  - MOTTHERM Err
  - Encoder Err
  - Over Load
  - A3 Safety
  - SAFETY A/B
  - Spd dev Err
  - External-B
  - Flr/FHM Data
  - SDS Error
  - ADC Error
  - SINCOS Open
  - ENDAT ERROR
- If a trip occurs within 30 seconds during normal operation after restart, the automatic restart number will increase by one. Maximum restart number is limited to the setting at PRT_04.

6.7.5 Restart delay time after stop command

This function only operates when stop mode (FUN_03) is set to free-run. The PRT_07 (Restart Time) option is only available for this function and this function only operates when operating the inverter using the control terminal block.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_07	Restart Time	Restart delay time after stop command	0.00–10.00	sec	0.00
FUN_03	Stop mode	Stop mode	0 (Decel) 1 (Free-run) 2 (DC-Brake)		Decel

When this function is used, a time delay is configured that controls the terminals. Inverter operation will start even if a subsequent input command is received after the stop command.



6.7.6 EnDat option-board-related function setting

PRT_08 is used to set EnDat option board related fault trip functions. When an EnDat encoder is used, an initial pole position estimation or a reset is performed for an error condition based on this configuration.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_08	EnDat Func	EnDat option error and initial pole position estimation setting	1111–0000	bit	0011

■ **Bit 0: 'EnDat Error' setting**

When you set Bit 0 to "1" at PRT-08, if EnnDat option board's clock or data input signal cable is not connected, a communication error occurs. The inverter outputs "EnDat Error" upon a start or an end of the operation.

■ **Bit 1: 'SINCOS Open' setting**

When you set Bit 1 to "1" at PRT-08, if one or more EnDat option board's input signal cables for Sin-, Cos-, Sin+, Cos+ are not connected, the inverter outputs the "Sincos Open" error upon a start or an end of the operation.

■ **Bit 2: Initial pole position estimation after fault reset (Endat mode only)**

When you set Bit 2 to "1" at PRT-08, an intial pole position estimation is performed upon the first operation after a fault reset.

■ **Bit 3: Initial pole position estimation after power reset (Endat mode only)**

When you set Bit 3 to "1" at PRT-08, an intial pole position estimation is performed upon the first operation after a fault reset by the inverter power off.

6.7.7 Encoder error detection

If the encoder is disconnected or there is a connection error when "Detection of encoder error" at PRT-09 is set to "Yes", the inverter detects the encoder error. For open-collector encoders, set PRT-09 to "No" as encoder error detection is not available for this type of encoders.

If electronic interference distorts the encoder's input wave, adjust the "Encoder LPF time constant" setting at PRT-10 to reduce the distortion.

When the encoder settings are not accurate, normal speed control does not work. And the inverter frequently generates trips such as "over current" or "over voltage". In such case, refer to chapter 9.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_09	Enc Err Chk	Detection of encoder error	0 (No) 1 (Yes)		Yes
PRT_10	Enc LPF	Encoder LPF time constant	0–100	msec	1

6.7.8 Software encoder error detection (PRT_11–12: Detection time of encoder error, encoder error based on the speed rate)

Accurate motor speed detection is critical for motor speed control when an encoder is installed. The accuracy of speed control is affected by encoder connection and motor connection errors. If there are input signal errors such as an encoder disconnection, and the encoder or motor continues to operate, the operation may not work properly. Also, the resultant high current flow may result in motor damage. It is essential to ensure that encoder error and connection problems are closely monitored.

The LSLV-iV5L inverter detects encoder error with hardware diagnosis (when PRT_09 is set to "Yes"). This is for checking the status of encoder pulse that is input to detect the hardware damage by some reason such as a disconnection of encoder. However, error of connection cannot be detected only with hardware diagnosis. Set PAR_31 to "Rotational" and perform an encoder test when performing the auto-tuning. By this procedure, you can rotate the motor to detect speed value for detecting connection error.

And there is a case that a random rotation of motor cannot be performed such as elevator overload. In such case, the encoder test described above may be impossible to carry. When performing the encoder test is difficult, you can enable the eoftware encoder error detection to detect the connection errors.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_11	EncFaultTime	Motor error detection time	0.00–10.00	sec	0.00
PRT_12	EncFaultPerc	Motor error standard speed rate	0.0–50.0	%	25.0
PAR_18	Rated-Slip	Motor rated slip	10–250	rpm	70

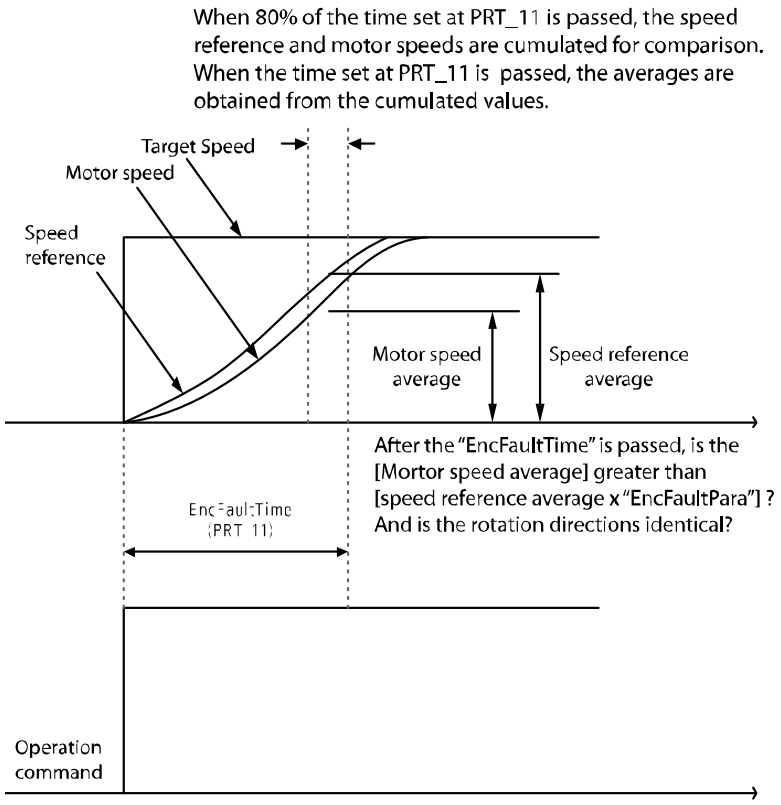
If the encoder or motor cable connection is incorrect, abnormal current exceeding the torque limit current may result, affecting the acceleration. Software encoder error detection is used to detect input pulse errors or improper acceleration caused by cable connection problems. The graphs below illustrate how this function works. When the time set at PRT_11 elapses, it checks the rate of acceleration for the existing motor speed and compares it with the target speed, and the polarity of the input. An error occurs if the acceleration rate is too low, or the polarity is incorrect.

The software encoder error detection does not operate during an auto-tuning. It only works when the control mode is set to speed control mode [when PAR_07 is set to "speed" or "speed (sync)"], and "EncFaultTime" is set to a value except for 0.

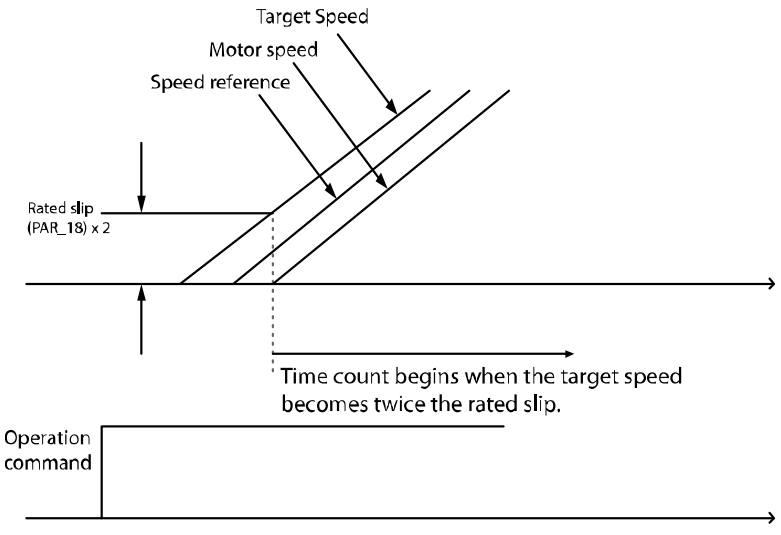
The software encoder error detection compares the motor speed with "EncFaultPerc" multiplied by the speed reference to detect encoder errors. Therefore, error detection is only available during an acceleration after the "EncFaultTime". It does not operate if the motor decelerates before "EncFaultTime" is passed due to termination of inverter operation or target speed change.

The encoder error is detected at an operation start, when the target speed is more than twice the rated slip, after the motor speed has exceeded twice the rated slip.

For example, when the target speed is 500 (rpm) and the rated slip is 40 (rpm), the detection starts at the point when the target speed becomes 80 (rpm).



(a) when FUN_02 is set to "Keypad1" or "Keypad2"



(b) when FUN_02 is set to "Analog" or "Up/down"

6.7.9 Speed deviation error settings

Speed deviation errors output an error signal when a deviation occurs between the command speed and the true motor speed. The deviation must be present for longer than the duration set at PRT_14 (Speed deviation detection time) and faster than the speed set at PRT_13 (speed deviation detection level that is calculated as a percentage of PAR_14 [Motor base speed]). The default settings that are used depend on the type of motor.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_13	SpdErrLevel	Detection level of speed deviation	0–100	rpm	Asynch: 100
					Synch: 10
PRT_14	SpdErrTime	Detection time speed deviation	0–1000	msec	Asynch: 500
					Synch: 50

Note

- "Spd Dev Err" may occur depending on the system when operating using an induction machine. In this case, adjust PRT_13 or PRT_14.
- To disable the speed deviation detection error feature, set one of PRT_13 and PRT_14 to "0".

6.7.10 Overspeed fault detection (Over Speed)

This function detects faults when the motor rotation exceeds prescribed rotation speed and enables detection level and time.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_15	OverSpdLevel	Detection level of over-speed fault	100.0–130.0	%	110.0
PRT_16	OverSpd Time	Detection time of over-speed fault	0.00–2.00	sec	0.00

Detection level of over-speed fault is 100 % based on the motor's maximum speed of PAR_11.

It detects over-speed fault (over speed) after the motor has operated at a greater speed than what is set at PRT_15 (Detection level of over-speed fault) for the set time set at PRT_16 (Detection time of over-speed fault).

If the detection time for over-speed fault is 0.00 (sec) and the speed becomes higher than the fault detection level, then the over–speed fault (Over Speed) is detected.

6.7.11 Input/output open-phase detecting function

This function detects the disconnection of input or output cables. If an input open-phase error occurs, even for connections that do not use open phases, set a high PRT_18 value. For more information about the setting standards, refer to PhInOpenLvl at 01–03 in the DIS group. When a maximum overload occurs, the corresponding value must be set to 150 % of PhInOpenLvl at PRT_18. Open output phase faults cannot be detected for synchronous motors.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_17	PhInOpenChk	input phase open detection	0 (No) 1 (Yes)		No
PRT_18	PhInOpenLvl	input phase open detection voltage level	2–100	V	3
PRT_19	PhOutOpenChk	Output phase open detection	0 (No) 1 (Yes)		No

6.7.12 Overload (OverLoad)

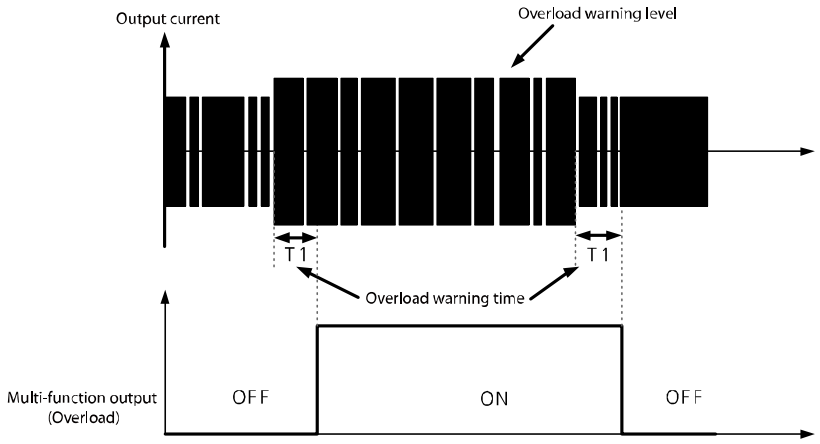
Signal is sent out when the output current is higher than the overload warning level during the operation (based on the motor rated current).

Refer to the information about the overload warning level and time of the PRT_20 and PRT_21.

■ Overload warning level (PRT_20), Overload warning time (PRT_21)

When the inverter's output current is maintained above the value set at PRT_20 during the period set at PRT_21, the inverter sends a warning signal. When the current drops below the overload warning level after an overload warning is triggered, the overload warning signal changes to OFF after a set period.

The overload warning signal is operated via the multifunction auxiliary output terminals (1A-1B, 2A-2B, OC1-EG). Set multifunction auxiliary output terminals DIO_11, DIO_12 (terminals AX1, AX2) and DIO_13 (terminal OC1) to "OverLoad" to enable this function. When and overload condition occurs, the inverter continues to operate and the overload warning signal is sent via the multifunction auxiliary output terminals.



Code	Keypad display	Name	Range	Unit	Default setting
PRT_20	OL Level	Overload warning level	30–250	%	150
PRT_21	OL Time	Overload warning time	0–30	sec	10

Note

The overload warning level is set as a percentage of the motor's rated current.

6.7.13 Overload limit selection, level, time (PRT_22–24)

When the output current of the inverter is maintained above the overload control level during an overload time limit, the inverter cuts off the output and displays a trip message. PRT_22–24 (Overload limit) function cuts off the inverter's output and displays the inverter's output. This function is for detecting the overload error.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_22	OLT Select	Overload limit selection	0 (No) / 1 (Yes)	-	1(Yes)
PRT_23	OLT Level	Overload limit level	30–250	%	180
PRT_24	OLT Time	Overload limit time	0–60	sec	60

Note

Setting value of the overload warning level is set as a percentage of **Motor rated Current**.

6.7.14 Inv OH Warn

When the temperature of the inverter's heat sink exceeds the standard temperature, a signal is sent. The inverter overheat function detects if the temperature of the heat sink of the inverter is exceeds the set detection level.

Code	Keypad display	Name	Range		Unit	Default setting
PRT_25	IH Warn Temp	Inverter overheat detection temperature	5.5/7.5 kW	50–110	°C	95
			11.0–22.0 kW	50–85		75
PRT_26	IH Warn Band	Inverter overheat detection range	0–10		°C	5

6.7.15 Mot OH Warn

If NTC is attached to the Motor to receive temperature information and the received information indicates higher than the standard temperature, the signal is sent out. This function is a Motor overheat warning that detects whether the temperature of the Motor is higher than the detection level. This function is operated at the set level only when Ai3 Define (AIO_25) is set to "Use Mot NTC".

Code	Keypad display	Name	Range	Unit	Default setting
PRT_27	MH Warn Temp	Motor overheat detection temperature	75–130	°C	120
PRT_28	MH Warn Band	Motor overheat detection range	0–10	°C	5

6.7.16 Low Voltage2 function

If the main power supply is interrupted and a low voltage situation occurs, the inverter blocks the output and displays the 'Low Voltage2' error message. Unlike to 'Low Voltage', the trip status remains until a user clears the trip status even if the voltage increases to a normal value. The trip record is not saved.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_29	LV2 Enable	Low Voltage2 activation	0 (No) / 1 (Yes)		0 (No)

6.7.17 A3 Safety

This function enables or disables PWM Output if a multifunction input terminal is defined to recognize A3 Safety signals.

Code	Keypad display	Name	Range	Unit	Default setting
PRT_30	A3 StartTime	A3 signal input delay section when operated	0–60000	msec	1500
PRT_31	A3 Stop Time	A3 signal input delay section when stopped	0–60000	msec	1500
DIO_01 –07	P1–P7 define	Multifunction input settings	0–29 (26: A3 Safety)	Msg	0: Not Used

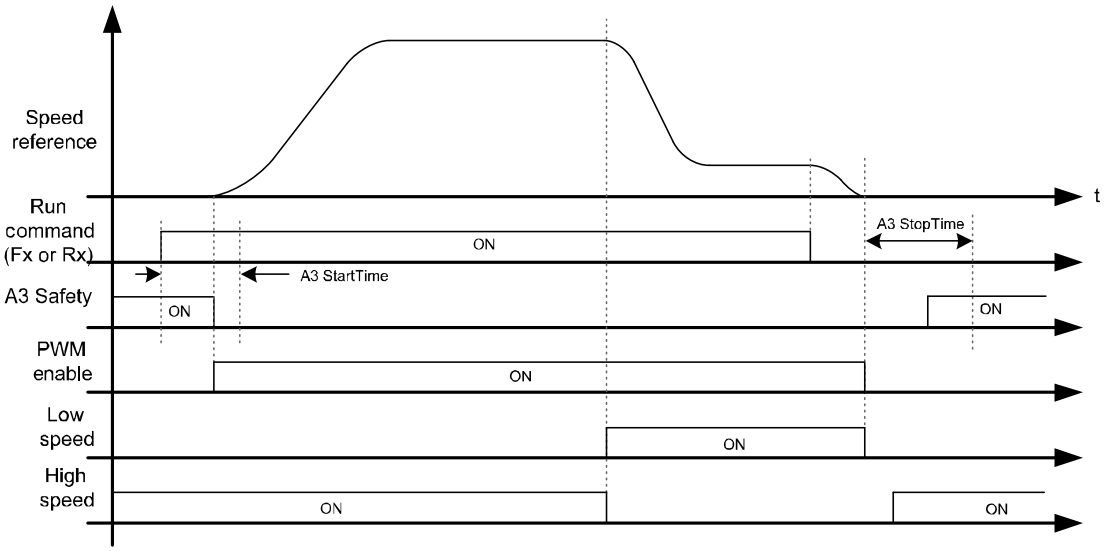
■ Basic operation

To increase PWM Output and Speed, the A3 Safety multifunction input terminal should be set to OFF within the time limit set at [PRT-30 A3 StartTime] after an operation command is received. If the A3 Safety multifunction input terminal is not OFF, an "A3 Safety" fault will occur. If A3 Safety is ON during the operation, PWM stops, the motor decelerates at free-run and stops, and then an "A3 Safety" fault occurs.

After a normal stop (a status that inverter voltage output becomes OFF after the stop operation by user settings), the A3 Safety multifunction input terminal should be ON within the time limit set at [PRT-30 A3 StartTime]. If A3 Safety is not ON, an "A3 Safety" fault occurs.

If you turn off and then on the inverter power when "A3 Safety" fault has occurred, the fault status is maintained regardless of the Multifunction input A3 Safety. To turn off the fault, use the keypad reset button or RST of the terminal clock.

The graph below shows the basic movement sequence of A3 Safety.



6.7.18 Fan fault

You can decide the inverter's inner fan is operating or not according to the user settings.

Code	Keypad display	Name	Range	Unit	Default setting
PRT-32	FAN Control	FAN operation setting	0 (During Run) 1 (Always ON) 2 (Temp Control)		0 (During Run)
PRT-33	FAN Trip Sel	FAN Trip setting	0 (Trip) 1 (Warning)		1 (Warning)
DIO-11–13	AX1/Ax2/OC1 Define	Multifunction Output option setting	0– 21 (18: Fan Faults)		0 (Not Used)

■ **PRT_32 Basic operation of FAN depending on the settings**

- During Run: Operate FAN when PWM Output occurs, and turn OFF the FAN when the PMW Output is cut off and after 60 seconds after the temperature is reduced to 55℃.
- Always ON: Always operate the FAN when the power above LV Level is provided to the inverter.
- Temp Control:
  5.5/7.5 kW: Operate the FAN when the module's internal temperature is 75℃ or higher, and stop the FAN when the temperature is 65℃ or lower.
  11–22 kW: Operate the FAN when the module's internal temperature is 60℃ or higher, and stop the FAN when the temperature is 50℃ or lower.

■ **PRT_33 FAN fault depending on the settings**

When a fan fault occurs, user can set the fan fault type between a warning ("FAN Warning" if the inverter is operated continuously) and Fault ("FAN Fault", Motor Free Run stop). Warning and trips are detected under the same condition by different methods.

6.7.19 Safety Torque Off [STO]

This function cuts off the output based on an input signal coming from an external source via terminals [SA] and [SB]. The two terminals provide a dual safety mechanism when an emergency occurs.

Code	Keypad display	Name	Range	Unit	Default setting
PRT-34	Safety Sel	STO type selection	0 (Latch) 1 (Level)	Msg	0 (Latch)

■ **PRT_34 Latch**

If the Safety Relay is open, the inverter output stops and "SAFETY A (or B)" is ON. During inverter operation and before the Safety Relay is open, a free-run stop occurs regardless of the setting at [FUN-03 Stop Mode]. If the [SA] input signal is open, the PWM output signal is blocked at the internal MCU. If [SB] input signal is open and the inverter's internal PWM buffer output stops, the PWM buffer output stops at the MCU. If a safety fault occurs, perform a reset at the keypad terminal block to clear the fault or close the [SA] and [SB] relays.

■ **PRT_34 Level**

If the Safety Relay is open, the inverter's output stops and "SAFETY A (or B)" is ON. During inverter operation and before the Safety Relay is open, a free-run stop occurs regardless of the setting at [FUN-03 Stop Mode]. If the [SA] input signal is open, the PWM output is blocked at the internal MCU. If the [SB] input signal is open, the inverter's internal PWM buffer output stops and the PWM buffer output stops at the MCU. If a safety fault occurs, the [SA] and [SB] relays are closed and the fault is automatically cleared.

6.8 Second motor (M2) group

Second motor group is a group of parameters related to the second motor control when multiple motors are connected to the inverter. To enable control of the second motor, one of the multifunction terminal inputs (DIO_01–DIO_07) of P1–P7 must be set to '2nd Motor'. The parameters in this group have the same setting options and ranges as the parameters for the first motor. You can switch between the first and second motor parameter settings depending on the input status at the multifunction terminals.

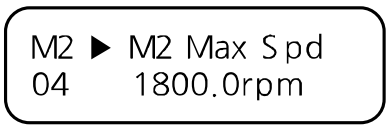
You cannot set the second motor group when the PAR_07 control mode is set to "Speed (Synch) ".

6.8.1 Jump code (M2_00)

You can jump directly to the code you want to move to using M2_00.

■ **(Eg.) When moving to M2_04**

Press the [PROG] and change the code number to "04" by using [SHIFT/ESC], [▲], or [▼]. Press [ENT] and then the display will be shown as below. If you can't select the code you want to jump, the code will move to the next closest code.



After jumping directly to a code, you can move to other codes by pressing [▲] or [▼].

6.8.2 Second motor control mode selection (M2_01)

Speed control, V/F, and Slip Comp modes are available for motor control. Note that the speed control (speed) mode requires a speed feedback device, such as an encoder.

Code	Keypad display	Name	Range	Unit	Default setting
M2_01	M2 Ctl Mode	Second motor control mode selection	2 (Speed) 4 (V/F) 5 (Slip Comp)		2 (Speed)

6.8.3 Second motor speed input

This function allows you to set the maximum speed and multiple speed0 for the second motor.

Code	Keypad display	Name	Range	Unit	Default setting
M2_04	M2 Max Spd	Second motor maximum Speed	400.0–3600.0	rpm	1800.0
M2_06	M2 Spd 0	Second motor multispeed0	0.0–M2_02	rpm	0.0

6.8.4 Second motor acceleration/deceleration-related parameters

For more information about range and the default setting, refer to the code numbers for FUN_36–FUN_41.

Code	Keypad display	Name	Range	Unit	Default setting
M2_07	M2 Acc S St	S curve for Second motor acceleration 1	0.0–50.0	%	0.0
M2_08	M2 Acc S Ed	Second motor type rate 1 of acceleration	0.0–50.0	%	0.0
M2_09	M2 Dec S St	Second motor S type rate 1 of deceleration	0.0–50.0	%	0.0
M2_10	M2 Dec S Ed	Second motor S type rate 2 of deceleration	0.0–50.0	%	0.0

Code	Keypad display	Name	Range	Unit	Default setting
M2_11	Time scale2 Note 1)	Second motor acceleration/deceleration time scale	0 (0.01 sec) 1 (0.1 sec)		0 (0.01 sec)
M2_12	M2 Acc time	Second motor acceleration time	0.01–600.00	sec	10.00
M2_13	M2 Dec time	Second motor deceleration time	0.01–600.00	sec	10.00

Note 1) The parameters that acceleration/deceleration time scale is applied are M2_12 and M2_13.

6.8.5 Second motor parameters

Code	Keypad display	Name	Range	Unit	Default setting
M2_02	Motor select	Second motor capacity selection	2.2–22.0	kW	7.5
M2_03	UserMotorSel	Second motor user Motor capacity selection	2.2 –22.0	kW	7.5
M2_15	M2 BaseSpd	Second motor rated Speed	10.0–3600.0	rpm	1800.0
M2_16	M2 R-Volt	Second motor rated voltage	300–528	V	380
M2_17	M2 Pole #	Second motor pole number	2–12	-	4
M2_18	M2 Mot Eff.	Second motor efficiency	70–100	%	Varies depending on the motor capacity
M2_19	M2 R-Slip	Second motor rated slip	10–250	rpm	
M2_20	M2 R-Curr	Second motor rated Current	1.0–1000.0	A	
M2_21	M2 Flx Cur	Second motor magnetized Current	0.0–70% of M2_20	A	
M2_22	M2 Mot Tr	Second motor time constant	30–3000	msec	

Code	Keypad display	Name	Range	Unit	Default setting
M2_23	M2 Mot Ls	Second motor stator inductance	0.00–500.00	mH	
M2_24	M2 Mot sLs	Second motor leakage coefficient	0.00–300.00	mH	
M2_25	M2 Mot Rs	Second motor stator resistance	0.000–15.000	ohm	
M2_26	M2 Inertia	Second motor inertia	0.001–60.000	Kgm^2	0.072

6.8.6 Second motor encoder-related parameters

Code	Keypad display	Name	Range	Unit	Default setting
M2_28	M2 Enc #	Second motor encoder pulse number	360–4096	%	1024
M2_29	M2 Enc Dir	Second motor encoder direction setting	0 (A Phase Lead) 1 (B Phase Lead)	-	A Phase Lead
M2_30	M2 Enc Chk	Second motor encoder error check	0 (No) 1 (Yes)	-	Yes
M2_31	M2 Enc LPF	Second motor encoder LPF time constant	00–100	msec	1

6.8.7 Second motor V/F control-related parameters

Code	Keypad display	Name	Range	Unit	Default setting
M2_32	M2 V/F	Second motor V/F voltage pattern	Same as the first motor		Linear
M2_33	M2 F-boost	Second motor forward direction boost value	Same as the first motor	%	2.0
M2_34	M2 R-boost	Second motor reverse boost value	Same as the first motor	%	2.0

6.8.8 Other second motor parameters

Code	Keypad display	Name	Range	Unit	Default setting
M2_27	M2 Cool Mtd	Second motor cooling system	Same as the first motor		Forced-cool
M2_35	M2 ETH 1min	Second motor electrical thermal 1min. level	Same as the first motor	%	150
M2_36	M2 ETH Cont	Second motor electrical thermal continuous level	Same as the first motor	%	100

6.9 User (USR) group

You can create a new group with the frequently used group's codes.

You can also use group codes made for specific application.

6.9.1 Jump code (USR_00)

You can jump directly to the code you want to move to using USR_00

■ **(Eg.) When jumping to USR_03**

Press [PROG] and change the code number to "04" by using [SHIFT/ESC], [▲], or [▼]. Press [ENT] and then the display will be shown as below. If you can't select the code you want to jump, the code will move to the next closest code.

After jumping directly to a code, you can move to other codes by pressing [▲] or [▼].

6.9.2 Definition of macro

USR _01 (Macro Init)

Define the initialization of code type for each user-defined application.

Code	Keypad display	Name	Range	Unit	Default setting
USR_01	Macro Init	User macro definition	User Define E/L		User Define

When USR_01 is set to "User Define", all user-defined codes from USR_04 to USR_67 are set to "P1 Define". When "E/L" is set, the code types are initialized as listed in the table below. In this case, USR_61–USR_67 are set as "Not Used", and only the last code (USR_67) is displayed to indicate that these codes are not defined for use.

Function code	Setting	Function code	Setting	Function code	Setting
USR_04	DIO_01	USR_26	PAR_24	USR_48	FUN_43
USR_05	DIO_02	USR_27	PAR_25	USR_49	FUN_44
USR_06	DIO_03	USR_28	PAR_26	USR_50	FUN_45
USR_07	DIO_04	USR_29	PAR_27	USR_51	FUN_46
USR_08	DIO_05	USR_30	FUN_01	USR_52	FUN_47
USR_09	DIO_06	USR_31	FUN_02	USR_53	FUN_49
USR_10	DIO_07	USR_32	FUN_03	USR_54	FUN_50
USR_11	DIO_11	USR_33	FUN_12	USR_55	FUN_51
USR_12	DIO_12	USR_34	FUN_13	USR_56	CON_03
USR_13	PAR_11	USR_35	FUN_14	USR_57	CON_04
USR_14	PAR_07	USR_36	FUN_15	USR_58	CON_05
USR_15	PAR_12	USR_37	FUN_16	USR_59	Not Used
USR_16	PAR_13	USR_38	FUN_17	USR_60	Not Used
USR_17	PAR_14	USR_39	FUN_19	USR_61	Not Used
USR_18	PAR_15	USR_40	FUN_33	USR_62	Not Used
USR_19	PAR_16	USR_41	FUN_36	USR_63	Not Used

Function code	Setting	Function code	Setting	Function code	Setting
USR_20	PAR_17	USR_42	FUN_37	USR_64	Not Used
USR_21	PAR_18	USR_43	FUN_38	USR_65	Not Used
USR_22	PAR_19	USR_44	FUN_39	USR_66	Not Used
USR_23	PAR_20	USR_45	FUN_40	USR_67	Not Used
USR_24	PAR_22	USR_46	FUN_41		
USR_25	PAR_23	USR_47	FUN_42		

USR_02 (User Save)

Save the user code and code number defined by the user for the group.

USR_03 (User Recall)

Display the user code and code number that the user previously saved at "USR_02".

Code	Keypad display	Name	Range	Unit	Default setting
USR_02	User Save	User macro save	0 (No) 1 (Yes)		0 (No)
USR_03	User Recall	User macro recall	0 (No) 1 (Yes)		0 (No)

6.9.3 User code definition (USR_04–67)

Press [PROG] to display the type and code mode of currently set user code. Change the code numbers to navigate through different functions.

If code description is "User Grp" and description is "Not Used", press [PROG] one more time to change the code description.

You can define and save up to 64 user group code. Set the unused codes to "Not Used" to hide them.

The following illustration shows the different screens that are displayed when you change a code for a user group.

Step	Instruction	Keypad display
1	Press [PROG] twice.	USR ▶ User Grp 04 Not Used
2	Press [SHIFT/ESC] to change the group. The groups toggles between the followings: PAR, DIG, AIO, FUN, CON, E/L[Note 1)], PRT, COM, M2[Note 2)], DIS, and PAR.	USR ▶ Max Speed 04 PAR 11
3	Press [▲] or [▼] to change the code, and then press [ENT] to save the code.	USR ▶ Base Speed 04 PAR 14 USR ▶ Base Speed 04 1800.0 rpm
4	Press [PROG], press [▲] or [▼] to change the value, and then press [ENT] to save the value.	USR ▶ Base Speed 04 3600.0 rpm

Note 1) Available only when the I/O option module is installed and PAR-08 is set to Elevator.

Note 2) Available only when the second motor is set to use.

7 RS-485 communication features

This section explains how to remotely control the inverter with a PLC or a computer using the RS-485 communication feature. To use RS-485 communication, connect the communication cables and set the communication parameters on the inverter. Refer to the communication protocols and parameters to configure and use RS-485 communication.

Caution

Read this manual thoroughly before installing and operating the inverter. User may be injured or other devices may be damaged if the directions in this manual are not followed correctly.

7.1 Communication standards

The LSLV-iv5 products exchange data with PLCs and computers using the RS-485 communication protocol. The RS-485 communication standard supports the Multidrop Link System and provides an interface that is strongly resistant to electronic interference. Refer to the following table for information about the communication standard.

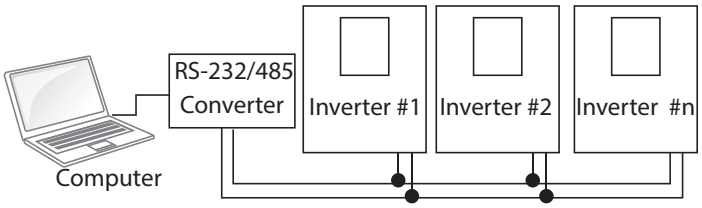
Item	Standard
Communication method/ transmission type	RS-485/Bus type, Multidrop Link System
Inverter model	LSLV-iV5L Series
Converter	RS-232 installed
Number of connected inverters/ transmission distance	8 inverters maximum / 4,000 ft (1,200 m) maximum [however, the recommended transmission distance is within 2,330 ft (700 m)]
Recommended cable size	18 AWG (0.75 mm^2), STP cable
Cable connection	Dedicated terminals (S+/S-/5G485) on the control terminal block
Power supply	Supplied by the inverter - isolated power source from the inverter's internal circuit
Communication speed	1,200/2,400/9,600/19,200/38,400 bps
Communication control	Asynchronous communications system
Communication system	Half duplex system
Character system	LS Bus: ASCII
Stop bit length	1-bit/2-bit

Item	Standard
Frame error check	2 bytes
Parity check	None/Even/Odd

7.2 Communication system configuration

In an RS-485 communication system, the PLC or computer is the master device and the inverter is a slave device. When a computer is used as the master, the RS-232 converter must be integrated with the computer to allow it to communicate with the inverter through the RS-232/RS-485 converter. Converter specifications and performance may vary depending on the manufacturer, but the basic functions are identical. Refer to the manufacturer's user manual for details about the features and specifications of the converter.

Connect the cables and configure the communication parameters on the inverter by referring to the following communication system configuration.



7.2.1 Communication cable connections

Make sure that the inverter is turned off completely, and then connect the RS-485 communication cable to the communication terminal of the control board. The maximum number of inverters you can connect is 8. For communication lines, use STP cables.

It is recommended that the cable length is less than 2,330ft (700 m) to ensure stable communication. If cable lengths exceed the maximum [4,000 ft (1,200 m)] or if multiple inverters are used, install a signal repeater to enhance communication speed. A repeater makes the communication circuit less susceptible to electronic interference.

Caution

When connecting the communication cables, make sure that the 5G 485 terminals on the PLC and inverter are connected. The 5G 485 terminals prevent communication errors due to electronic interference.

7.2.2 Setting communication parameters

Before configuring the communication parameters, make sure that the communication cables are connected properly. Then, turn the inverter on and set the communication parameters.

Group	Code	Name	LCD display	Default setting	Range	Unit
COM	32	Built-in communication inverter ID	Int485 St ID	1	1–250	-
	33	Built-in communication speed	Int485 Baud	3 (9600 bps)	0–5	-
	34	Built-in communication frame setting	Int485 Mode	0 (D8/PN/S1)	0–3	-
	35	Transmission delay after reception	Int485 Delay	5	2–1000	msec
	36	Lost communication command options	Int485 LostC	-	0 (None) 1 (FreeRun) 2 (Decel)	-
	37	Lost communication command timer	Int485 LostT	1.0	1.0–30	sec

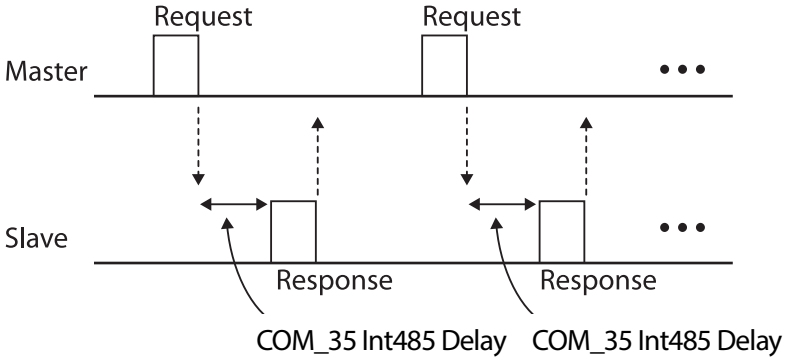
Communication parameters setting details

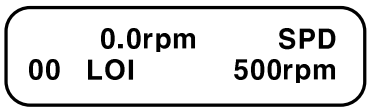
Code	Description
COM-32 Int485 St ID	Sets the inverter station ID between 1 and 250. The default setting is "1".
COM-33 Int485 Baud	Set the communication speed up to 38,400 bps. The maximum speed range changes depending on the communication protocol. Setting / Communication speed 0 / 1,200 bps 1 / 2,400 bps 2 / 4,800 bps 3 / 9,600 bps 4 / 19,200 bps 5 / 38,400 bps The default setting is "3 (9,600 bps)".

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>COM-34
Int485 Mode</td><td>Set the data length, parity check method, and the number of stop bits.

<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>D8/PN/S1</td><td>8-bit data / no parity check / 1 stop bit</td></tr>
<tr><td>1</td><td>D8/PN/S2</td><td>8-bit data / no parity check / 2 stop bits</td></tr>
<tr><td>2</td><td>D8/PE/S1</td><td>8-bit data / even parity / 1 stop bit</td></tr>
<tr><td>3</td><td>D8/PO/S1</td><td>8-bit data / odd parity / 1 stop bit</td></tr>
</table>

The default setting is “0 (D8/PN/S1)”.</td></tr>
<tr><td>COM-35
Int485 Delay</td><td>Set the response time for the slave (inverter) to react to requests from the master. A delayed response time is used in a system where the slave’s response is too fast for the master device to process. Set this code to an appropriate value for smooth master-slave communication.


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

<table>
<tr><th>Code</th><th>Description</th></tr>
<tr><td>COM-36
Int485 LostC</td><td>Set protective functions for the inverter when the RS485 communication is lost.
When COM_36 is set and if the command is lost for the time set at COM_37 (Int485 LostT), the inverter performs the following protective operations.
<table>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>No protection operation is performed. The inverter continues to run the motor at the speed reference provided when communicationl was lost.</td></tr>
<tr><td>1</td><td>FreeRun</td><td>The inverter stops output and the motor stops after free-run.</td></tr>
<tr><td>2</td><td>Decel</td><td>The inverter performs a decelerated stop.</td></tr>
</table>
For these protective operations to work, FUN_01 (Run/Stop Src) must be set to “Int485”. The following information is displayed on the keypad when communication is lost for the time set at COM_37.


The speed (500 rpm) indicates the current motor speed.</td></tr>
<tr><td>COM_37
Int485 LostT</td><td>When RS485 communication is lost for the time set at COM_37 (Int485 LostT), the inverter performs the protective operation set at Com_36.</td></tr>
</table>

7.2.3 Total communication memory map

Communication area	Memory map	Details
5 Series compatible common area	0h0000–0h00FF	5 series compatible area
iS7 communication common area	0h0300–0h037F	Inverter monitoring area
	0h0380–0h03DF	Inverter control area
	0h03E0–0h03FF	Inverter memory control area
Communication common area	0h0500–0h05FF	Common area

7.3 Network protocols

7.3.1 LS INV 485 protocol

The slave device (inverter) responds to read and write requests from the master device (PLC or computer).

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 bytes	2 bytes	1 byte

Error response

NAK	Station ID	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n bytes	2 bytes	1 byte

- A request starts with ENQ and ends with EOT.
- A normal response starts with ACK and ends with EOT.
- An error response starts with NAK and ends with EOT.
- A station ID indicates the inverter number and is displayed as a two-byte ASCII-HEX string that uses characters 0-9 and A-F.
- CMD: Uses uppercase characters (returns an IF error if lowercase characters are encountered)—refer to the table below.

Character	ASCII-HEX	Command
'R'	52h	Read
'W'	57h	Write
'X'	58h	Request buffer monitoring registration
'Y'	59h	Perform buffer monitoring registration

- Data: ASCII-HEX (for example, when the data value is 3000: 3000 → '0"B"B"8'h → 30h 42h 42h 38h)
- Error code: ASCII-HEX
- Transmission/reception buffer size: Transmission=39 bytes, Reception=44 bytes
- Monitor registration buffer: 8 words
- SUM: A check for communication errors.
- SUM=a total of the lower 8 bit values for station ID, command and data (station ID+CMD+data) in ASCII-HEX.
  For example, a command to read an address from address 3000:
  SUM='0'+'1'+'R'+'3'+'0'+'0'+'0'+'1' = 05h+ 30h+31h+52h+33h+30h+30h+30h+31h = 1A7h (the control value is not included: ENQ, ACK, NAK, etc).

ENQ	Station ID	CMD	Address	Number of addresses	SUM	EOT
05h	'01'	'R'	'3000'	'1'	'AC'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

ASCII code table

HEX	DEC	ASCII	HEX	DEC	ASCII	HEX	DEC	ASCII	HEX	DEC	ASCII
00h	0	NUL	20h	32	SP	40h	64	@	60h	96	`
01h	1	SOH	21h	33	!	41h	65	A	61h	97	a
02h	2	STX	22h	34	“	42h	66	B	62h	98	b
03h	3	ETX	23h	35	#	43h	67	C	63h	99	c
04h	4	EOT	24h	36	$	44h	68	D	64h	100	d
05h	5	ENQ	25h	37	%	45h	69	E	65h	101	e
06h	6	ACK	26h	38	&	46h	70	F	66h	102	f
07h	7	BEL	27h	39	‘	47h	71	G	67h	103	g
08h	8	BS	28h	40	(	48h	72	H	68h	104	h
09h	9	HT	29h	41	)	49h	73	I	69h	105	i
0Ah	10	LF	2Ah	42	*	4Ah	74	J	6Ah	106	j
0Bh	11	VT	2Bh	43	+	4Bh	75	K	6Bh	107	k
0Ch	12	FF	2Ch	44	,	4Ch	76	L	6Ch	108	l
0Dh	13	CR	2Dh	45	-	4Dh	77	M	6Dh	109	m
0Eh	14	SO	2Eh	46	.	4Eh	78	N	6Eh	110	n
0Fh	15	SI	2Fh	47	/	4Fh	79	O	6Fh	111	o
10h	16	DLE	30h	48	0	50h	80	P	70h	112	p
11h	17	DC1	31h	49	1	51h	81	Q	71h	113	q
12h	18	DC2	32h	50	2	52h	82	R	72h	114	r
13h	19	DC3	33h	51	3	53h	83	S	73h	115	s
14h	20	DC4	34h	52	4	54h	84	T	74h	116	t
15h	21	NAK	35h	53	5	55h	85	U	75h	117	u
16h	22	SYN	36h	54	6	56h	86	V	76h	118	v
17h	23	ETB	37h	55	7	57h	87	W	77h	119	w
18h	24	CAN	38h	56	8	58h	88	X	78h	120	x
19h	25	EM	39h	57	9	59h	89	Y	79h	121	y
1Ah	26	SUB	3Ah	58	:	5Ah	90	Z	7Ah	122	z
1Bh	27	ESC	3Bh	59	;	5Bh	91	[	7Bh	123	{
1Ch	28	FS	3Ch	60	<	5Ch	92	\	7Ch	124	|
1Dh	29	GS	3Dh	61	=	5Dh	93	]	7Dh	125	}
1Eh	30	RS	3Eh	62	>	5Eh	94	^	7Eh	126	~
1Fh	31	US	3Fh	63	?	5Fh	95	_	7Fh	127	DEL

Note

Broadcasting
A broadcast sends commands simultaneously to all inverters connected to the network. When commands are sent from station ID 255, each inverter responds to the command regardless of the station ID. However, no response is issued for commands transmitted via broadcast.

7.3.2 Read protocol details

Read Request: Reads successive "n" words from address XXXX.

ENQ	Station ID	CMD	Address	Number of addresses	SUM	EOT
05h	'01'–' 1F'	'R'	'XXXX'	'1'–'8' = n	'XX'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

Total bytes=12. Characters are displayed inside single quotation marks (' ').

Read normal response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'–'1F'	'R'	'XXXX'	'XX'	04h
1 byte	2 bytes	1 byte	n + 4 bytes	2 bytes	1 byte

Total bytes= (7 x n x 4): 39 maximum

Read error response

NAK	Station ID	CMD	Error code	SUM	EOT
15h	'01'-'1F'	'R'	'**'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

7.3.3 Write protocol details

Write request

ENQ	Station ID	CMD	Address	Number of addresses	Data	SUM	EOT
05h	'01'–'1F'	'W'	'XXXX'	'1'–'8' = n	'XXXX…'	'XX'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (12 + n x 4): 44 maximum

Write normal response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'–'1F'	'W'	'XXXX…'	'XX'	04h
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (7 + n x 4): 39 maximum

Write Error Response

NAK	Station ID	CMD	Error Code	SUM	EOT
15h	'01'–'1F'	'W'	'**'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

7.3.4 Error codes

Code	Abbreviation	Description
ILLEGAL FUNCTION	IF	The requested function cannot be performed because the corresponding function at the slave does not exist.
ILLEGAL DATA ADDRESS	IA	The received parameter address is invalid at the slave.
ILLEGAL DATA VALUE	ID	The received parameter data is invalid at the slave.
WRITE MODE ERROR	WM	Writing (W) a parameter was attempted that does not allow writing (read-only parameters or when writing is prohibited during operation).
FRAME ERROR	FE	The frame size does not match.

7.3.5 Common parameter compatibility

The table below lists common parameters used with the iS5, iP5A, iV5, iG5A series inverters.

Comm. address	Parameter	Scale	Unit	R/W	Bit assignments by model	
0000h	Inverter model			R	7: LSLV-iV5L	
0001h	Inverter capacity		kW	R	4: 5.5 kW, 5: 7.5 kW, 6: 11 kW, 7: 15 kW, 8: 18.5 kW, 9: 22 kW	
0002h	Inverter input voltage			R	1: 400 V	
0003h	Version				(Eg.) 0h0100: Version 1.00	
					(Eg.) 0h0101: Version 1.01	
0004h	Reserved				-Note 1)	
0005h	Reserved				-Note 1)	
0006h	Operation command and multifunction input			R/W	B0	Stopped
					B1	FX operation
					B2	RX operation

Comm. address	Parameter	Scale	Unit	R/W	Bit assignments by model	
					B3	Reset
					B4	BX
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	P1
					B9	P2
					B10	P3
					B11	P4
					B12	P5
					B13	P6
					B14	P7
					B15	Reserved
0007h	Acceleration time	0.1	sec	R/W		
0008h	Deceleration time	0.1	sec	R/W		
0009h	Output current	0.1	A	R		
000Ah	Output frequency	0.01	Hz	R		
000Bh	Output voltage	1	V	R		
000Ch	DC link voltage	1	V	R		
000Dh	Output power	0.1	kW	R		
000Eh	Operation status			R	B0	Stopped
					B1	FX operation
					B2	RX operation
					B3	Fault trip
					B4	Accelerating
					B5	Decelerating
					B6	Speed reached
					B7	Inverter ready
					B8	Stopped

Comm. address	Parameter	Scale	Unit	R/W	Bit assignments by model	
					B9	FX rotation
					B10	Torque limit reached
					B11	FX operation command
					B12	RX operation command
					B13	Reserved
					B14	Reserved
					B15	Reserved
000Fh	Fault trip information	-	-	R	B0	Overcurrent (OCT U, V, W)
					B1	Overvoltage (OV)
					B2	Reserved
					B3	BX
					B4	Low voltage (LV)
					B5	Fuse open (FO)
					B6	Ground fault (GF)
					B7	Inverter overheat (IOH)
					B8	E-Thermal (ETH)
					B9	Overload (OLT)
					B10	H/W-diag
					B11	External-B (EXT-B)
					B12	Overcurrent2 (armshort U, V, W)
					B13	Reserved
					B14	Encoder error
					B15	Inverter overload (IOLT)
0010h	Input terminal information	-	-	R	B0	FX
					B1	RX
					B2	BX
					B3	RST
					B4	Reserved

Comm. address	Parameter	Scale	Unit	R/W	Bit assignments by model	
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	P1
					B9	P2
					B10	P3
					B11	P4
					B12	P5
					B13	P6
					B14	P7
					B15	Reserved
0011h	Output terminal information	-	-	R	B0	30A-30C
					B1	1A-1B
					B2	2A-2B
					B3	OC1-EG
					B4	Reserved
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	Reserved
					B9	Reserved
					B10	Reserved
					B11	Reserved
					B12	Reserved
					B13	Reserved
					B14	Reserved
					B15	Reserved
0012h	Analog input 1	0.1	%	R	-100.0% (0xFC18)–100.0% (0x03E8)	
0013h	Analog input 2	0.1	%	R	-100.0% (0xFC18)–100.0% (0x03E8)	

Comm. address	Parameter	Scale	Unit	R/W	Bit assignments by model
0014h	Analog input 3	0.1	%	R	-100.0% (0xFC18)–100.0% (0x03E8)
0015h	Motor rotation speed	1	rpm	R	Displays the existing motor rotation speed (in V/F and Slip Comp. control modes, displays output frequency in rpm).
001Dh	Speed reference 1	1/0.1	rpm/ Hz	R	When the control mode is Speed: Target speed reference When the control mode is V/F or Slp Comp.: Ramp frequency reference
001Eh	Speed reference 2	1/0.1	rpm/ Hz	R	When the control mode is Speed: Ramp speed reference When the control mode is V/F or Slp Comp.: Ramp frequency reference
001Fh	Speed controller input reference	1	rpm	R	Speed controller speed reference
0020h	Motor speed	1	rpm	R	Actual speed of motor
0023h	Excitation current	0.1	%	R	The ratio (%) to the rated excitation current
0024–0026h	Reserved	-	-	-	-
0027h	Inverter temperature	1	℃	R	Inverter temperature

Note 1) NAK is transmitted if an unused station ID is read.

7.3.6 iS7 expansion common parameters

Address	Parameter	Scale	Unit	R/W	Bit assignments		
0300h	Inverter model			R	0007h: LSLV-iV5L		
0301h	Inverter		kW	R	4055h: 5.5 40B0h: 11 4125h: 18.5	4075h: 7.5 40F0h: 15 4160h: 22	
0302h	Inverter input voltage/ power supply/ cooling			R	400V 1-phase self-cooling: 0420h 400V 3-phase self-cooling: 0430h 400V 1-phase forced-cooling: 0421h 400V 3-phase forced-cooling: 0431h		
0303h	Inverter s/w version			R	Eg.) 0x0100: Version 1.00 0x0101: Version 1.01		
0304h	Reserved				Note 1)		
0305h	Inverter operation status			R	B0	0: Stopped	
					B1	1: FX operation	
					B2	2: RX operation	
					B3	3: Reserved	
					B4	1: Reserved	2: Accelerating
					B5	3: Steady	4: Decelerating
					B6	5: Decel stopping	6: Reserved
					B7	7: Reserved	8: Dwelling
					B8	Reserved	
					--		
					B11		
					B12	0: Normal 8: Fault	
					B13		
					B14		
					B15		
0306h	Inverter frequency source			R	B0	[Frequency source]	
					B1	0: Keypad speed	1: Keypad torque
					B2	2: MOP up	3: MOP down
					B3	4: MOP up/down	5: Analog
					B4	6: Reserved	7: Reserved
					B5	8: Reserved	9: Reserved
					B6	10: Built-in 485	11: Comm. option
					B7	12: Reserved	13: Jog
						14: Reserved	15-25: Reserved
						26-32: Multistep	33-127: Reserved

Address	Parameter	Scale	Unit	R/W	Bit assignments
					B8 B9 B10 B11 B12 B13 B14 B15 [Command source] 0: Keypad 1: Comm. option 2: Reserved 3: Built-in 485 4: Terminal block 5–127: Reserved
0307h	Keypad s/w version			R	Eg.) 0x0100: Version 1.00 0x0101: Version 1.01
0308h	Keypad title version			R	Eg.) 0x0100: Version 1.00 0x0101: Version 1.01
0309h -030Fh	Reserved				
0310h	Output current	0.1	A	R	
0311h	Output frequency	0.01	Hz	R	
0312h	Output rpm	1	rpm	R	
0313h	Motor feedback speed	1	rpm	R	-32768 rpm - 32767 rpm (directional)
0314h	Output voltage	1	V	R	
0315h	DC Link voltage	1	V	R	
0316h	Output power	0.1	kW	R	
0317h	Output torque	0.1	%	R	
0318h -0319h	Reserved				
031Ah	Motor 1 number of poles			R	Motor 1 number of poles
031Bh	Motor 2 number of poles			R	Motor 2 number of poles

Address	Parameter	Scale	Unit	R/W	Bit assignments	
031Ch	Selected motor number of poles			R	Selected motor's number of poles	
031Dh	Hz/rpm selection			R	0: Hz 1: rpm	
031Eh -031Fh	Reserved					
0320h	Digital input			R	B0	FX
					B1	RX
					B2	BX
					B3	RST
					B4	P1
					B5	P2
					B6	P3
					B7	P4
					B8	P5
					B9	P6
					B10	P7
					B11	Reserved
					B12	Reserved
					B13	Reserved
					B14	Reserved
					B15	Reserved
0321h	Digital output			R	B0	Fault output (30A – 30B)
					B1	Relay 1 (1A – 1B)
					B2	Relay 2 (2A – 2B)
					B3	Open collector output (OC1 – EG)
					B4	Reserved
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	Reserved
					B9	Reserved
					B10	Reserved
					B11	Reserved
					B12	Reserved
					B13	Reserved
					B14	Reserved
					B15	Reserved
0322h	Reserved					

Address	Parameter	Scale	Unit	R/W	Bit assignments	
0323h	Selected motor			R	0: Motor 1 / 1: Motor 2	
0324h	Ai1	0.01	%	R	Analog input 1 (standard I/O)	
0325h	AI2	0.01	%	R	Analog input 2 (standard I/O)	
0326h	AI3	0.01	%	R	Analog input 3 (standard I/O)	
0327h	Reserved					
0328h	AO1	0.01	%	R	Analog output 1 (standard I/O)	
0329h	AO2	0.01	%	R	Analog output 2 (standard I/O)	
032Ah -032Fh	Reserved					
0330h	Latch type trip info-1			R	B0	Overload
					B1	Reserved
					B2	Inverter overload
					B3	E-Thermal
					B4	Ground fault
					B5	Output missing phase
					B6	Input missing phase
					B7	Overspeed
					B8	Reserved
					B9	NTC
					B10	Overcurrent
					B11	Overvoltage
					B12	External-B
					B13	Arm short
					B14	Overheat
					B15	Fuse open
0331h	Latch type trip info -2			R	B0	Reserved
					B1	Encoder error
					B2	Reserved
					B3	FAN error
					B4	Reserved
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	Reserved
					B9	Reserved
					B10	Reserved
					B11	Reserved
					B12	Reserved
					B13	A3 safety
					B14	LV2
					B15	Battery fault

Address	Parameter	Scale	Unit	R/W	Bit assignments	
0332h	Level type trip info			R	B0	Reserved
					B1	LV
					B2	Lost command
					B3	Reserved
					B4	Reserved
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	Reserved
					B9	Reserved
					B10	Reserved
					B11	Reserved
					B12	Reserved
					B13	Reserved
					B14	Reserved
					B15	Reserved
0333h	HW-diag				B0	H/W diag
					B1	Reserved
					B2	Reserved
					B3	Reserved
					B4	Reserved
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	Reserved
					B9	Reserved
					B10	Reserved
					B11	Reserved
					B12	Reserved
					B13	Reserved
					B14	Reserved
					B15	Reserved
0334h -033Fh	Reserved					
0340h	On time days		day	R	Total number of days the inverter has been powered on.	
0341h	On time minutes		min	R	Total minutes left after On time days is calculated.	
0342h	Run time date		day	R	Total number of days the inverter has been operating.	
0343h	Run time minutes		min	R	Total minutes left after Run time days is calculated.	

Address	Parameter	Scale	Unit	R/W	Bit assignments	
0344h	Fan time days		day	R	Total number of days the cooling fan has been operating.	
0345h	Fan time minutes		min	R	Total minutes left after Fan time days is calculated.	
0346h -037Fh	Reserved					
0380h	Frequency command	0.01	Hz	R/W	Frequency command Eg.) Input: 0x03E8 (=1000) Output: 10 Hz (4-pole motor, 300 rpm)	
0381h	rpm command	1	rpm	R/W	rpm command (Set FUN_02 to "Option/Int485") Eg.) Input: 0x03E8 (=1000) Output: 1000 rpm	
0382h	Run command			R/W	B0	0: Stop 1: Run
					B1	0: RX 1: FX
					B2	RST (0➔1: Trip reset)
					B3	BX (0➔1: Free-run stop)
					B4	Reserved
					B5	Reserved
					B6	Reserved
					B7	Reserved
					Eg.) FX run command: 0003h, RX run command: 0001h BX, RST commands are write-only (read as "0") FUN_01 must be set to "Int485"	
0383h	Acc time	0.1	sec	R/W	Set the acceleration time	
0384h	Dec time	0.1	sec	R/W	Set the deceleration time	
0385h	Reserved					
0386h	Digital output			R	B0	Fault relay (30A-30B)
					B1	Open collector 1 (OC1 – EG)
					B2	Relay2 (2A – 2B)
					B3	Relay1 (1A – 1B)
					B4	Reserved
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	Reserved
					B9	Reserved
					B10	Reserved
					B11	Reserved
					B12	Reserved
					B13	Reserved
					B14	Reserved
					B15	Reserved

Address	Parameter	Scale	Unit	R/W	Bit assignments
0387h -0389h	Reserved				
038Ah	Motor rated current	0.1	A	R/W	PAR_19 Rated-Curr
038Bh	Inverter rated voltage			R	400: 400 V
038Ch -0390Fh	Reserved				
0391h	Fwd pos torque limit	0.1	%	R/W	FX motor torque limit Note 1)
0392h	Fwd neg torque limit	0.1	%	R/W	FX regeneration torque limit Note 1)
0393h	Rev pos torque limit	0.1	%	R/W	RX motor torque limit Note 1)
0394h	Rev neg torque limit	0.1	%	R/W	RX regeneration torque limit Note 1)
0395h	Torque bias	0.1	%	R/W	Torque bias
0396h -039Dh	Reserved				

Note 1) Writable only when CON_33 is set to 485 485 485.

Readable even when CON_33 is not set to 485 485 485.

7.3.7 iV5L common parameters

Address	Parameter	Scale	Unit	R/W	Bit assignments	
0500h	Command via option board			R/W	B0	Stop
					B1	FX
					B2	RX
					B3	RST
					B4	BX
					B5	Reserved
					B6	Reserved
					B7	Reserved
					B8	P1
					B9	P2
					B10	P3
					B11	P4
					B12	P5
					B13	P6
					B14	P7
					B15	Reserved
0501h	Multifunction output[Note 1)]		bit	R/W	Bit 1: Ax1	
					Bit 2: Ax2	
					Bit 3: OC1	
0502h	Define speed command			R/W	Define command reference	
0503h	Define Acc time		sec	R/W	Define Acc time	
0504h	Define Dec time		sec	R/W	Define Dec time	
0506h	FX torque limit	0.1	%	R/W	Define FX torque limit	
0507h	RX torque limit	0.1	%	R/W	Define RX torque limit	
0508h	Regeneration torque limit	0.1	%	R/W	Define regeneration torque limit	
0509h	Torque bias	0.1	%	R/W	Define torque bias amount	
050Ah	No-load current Note 2)		A	R/W	Define no-load current	
050Bh -0526h	Reserved					
0527h	Warning info.		bit	R	Bit 0: Fan fault warning	
					Bit 1: Inverter overheat warning	
					Bit 2: Motor overheat warning	
					Bit 3: Overload warning	

0528h	Additional fault info. (latch 1)		bit	R	Bit 0: Fan fault
					Bit 1: Battery signal is lost during a battery operation
					Bit 2: DB LGBT short circuit
					Bit 3: Input phase missing
					Bit 4: Output phase missing
					Bit 5: Inverter NTC Thermistor open
					Bit 6: Motor thermistor open
					Bit 7: Motor overspeed
					Bit 8: Floor number fault
					Bit 9: Forced Dec switch fault
					Bit 10: A3 fault
					Bit 11: Lv2 fault
					Bit 12: Safety A fault
					Bit 13: Safety B fault
					Bit 14: ADC error
					Bit 15: SINCOS missing input phase
0529h	Additional fault info. (latch 2)		bit	R	Bit 0: EnDat option board fault
0530h	Terminal block info		bit	R	Bit 0: FX
					Bit 1: RX
					Bit 2: BV
					Bit 3: RST

Note 1) Set the multifunction output terminals (DIO_11 - DIO_13) to "not used" to use them via network communication. Otherwise, the inverter uses the output terminal(s) for the set functions and multifunction output via network communication becomes unavailable.

Note 2) The no-load command signal uses a defined percentage of the value set at PAR_52. The value set at PAR_52 is set at 100% of the output current.

8 Troubleshooting

This chapter explains how to resolve a problem when the inverter's protective functions, fault trips, or other faults occur. If the inverter does not work normally after following the troubleshooting steps, contact the LSIS customer service center.

8.1 Fault trips

When the inverter detects a fault, it stops operating (trips) or sends a message. Also, when a trip occurs, the keypad displays brief information.

Detailed information can be viewed at PRT-90. If more than two trips occur at approximately the same time, the keypad displays information for the higher priority fault first. The [Up], [Down], [Left], and [Right] cursor keys on the keypad can be used to view fault trip information. Fault conditions can be categorized as follows:

- Level: When the fault is corrected, the trip or warning signal disappears and the fault is not saved in the fault history.
- Latch: When the fault is corrected and a reset input signal is provided, the trip warning signal disappears.
- Fatal: When the fault is corrected, the fault trip or warning signal disappears only after the user turns off the inverter, waits until the charge indicator light goes off, and turns the inverter on again. If the fault condition is still present after powering on the inverter again, contact the supplier or the LSIS customer service center.

Fault trips

LCD display	Priority Note 1)	Type	Description
Over Current	4	Latch	Displayed when inverter output current exceeds the specified fault current.
Ground Fault	3	Latch	Displayed when a ground fault occurs in the inverter's output, and current flow to ground exceeds the specified level.
Over Voltage	5	Latch	Displayed when the internal DC voltage exceeds the specified value (820 VDC).

LCD display	Priority Note 1)	Type	Description
Low Voltage	9	Level	Displayed when the internal DC voltage is less than the specified value (360 VDC).
Over Load	12	Latch	Displayed when the inverter's output current exceeds the specified motor rated current and overload trip time.
Inv OLT	16	Latch	Displayed when the inverter has detected an overload and resultant overheating condition based on inverse time-limit thermal characteristics. Allowable overload rates for the inverter are 150% for 1 min.
InvOver Heat	10	Latch	Displayed when the temperature of the inverter heat sink exceeds the specified value.
InvThem OP	19	Latch	Displayed when the inverter thermistor detects a low temperature.
MotOver Heat	18	Latch	Displayed when the motor temperature exceeds 130℃.
MotThem Err	20	Latch	Displayed when a motor thermistor error occurs in the inverter thermistor.
E-Thermal	11	Latch	Displayed when internal electronic protection detects a high temperature condition at the motor.
External-B	14	Latch	Displayed when an external fault signal is generated.
Arm Short Arm Short-DB	1	Latch	Displayed when IGBT Arm or output fault occurs. Arm Short-DB is only displayed on the 11-22 kW models.
Fuse Open	2	Latch	Displayed when circuit protection is activated by an IGBT fault.
Encoder Err	8	Latch	Displayed when an encoder signal error occurs. Displayed when an inconsistent motor error time is detected when compared to the PRT_11 setting.
BX	-	Latch	Displayed when the inverter output is blocked by a signal from the multifunction terminal.

LCD display	Priority Note 1)	Type	Description
Over Speed	21	Latch	Displayed when the motor speed exceeds the specified maximum speed.
COM Error	-	Fatal	Displayed when communication between the inverter and the keypad is unavailable.
HW-Diag	13	Latch	Displayed when a CPU error is detected.
EEP Error	-	Latch	Displayed when a data saving error occurs.
FAN Error	6	Latch	Displayed when a cooling fan error is detected.
BatRun Fault	7	Latch	Displayed when operation signals are lost during a battery power operation.
Input PO	17	Latch	Displayed when a single phase of a 3-phase power supply is interrupted while the inverter is under load.
Output PO	15	Latch	Displayed when the inverter does not produce an output current.
SpdDev Err	26	Latch	Displayed when the difference between the motor speed and command speed is more than the specified value.
Low Voltage2	24	Latch	Displayed when the internal DC voltage is less than the specified value during inverter operation.
SAFETY A/B	25	Latch Level	Displayed when there is a safety terminal wiring fault on the control board. The response can be set at either Latch or Level.
A3 Safety	23	Latch	Displayed when an A3 Safety error is detected at a multifunction input.
ADC Error	27	Fatal	Displayed when current calibration is incorrect when power is initially supplied to the inverter.
Flr/FHM Data	22	Latch	Displayed when a floor height data error is detected or a floor height measurement failure occurs. Available only when the exclusive elevator mode is used.
SINCOS Open	28	Latch	Displayed when EnDat signals Sin-, Cos-, Sin+, and Cos+ are not connected to a single or multiple lines.

LCD display	Priority Note 1)	Type	Description
ENDAT ERROR	29	Latch	Displayed when EnDat signals for the Clock or Data lines are not connected or a communication error is detected.

Note 1) The display priority when multiple trip occurs. Smaller number has higher priority.

8.2 Confirming the fault status and fault history

8.2.1 Confirming the fault status and storing the fault information

Code	Display	Description
DIS_05	Fan Error	The current fan error status is displayed.

1 Press the [PROG] key and then press the [▲] or [▼] to confirm the operation information before the fault trip occurs and the fault information is displayed.

2 Press the [ENT] key to close the information screen.

3 Press the [RESET] key to store the information to DIS_05.

Only one current fault information is displayed. When multiple faults occur simultaneously, the fault that has higher prioprity (smaller number) is displayed. The information that is stored in the fault history is irrelevant to the priority.

8.2.2 Confirming the fault history

"DIS_05" stores up to two fault histories, and the "Last Fault 1" is the most recent fault trip.

Code	Display	Description
DIS_05	Last Fault 1	Fault history 1
DIS_05	Last Fault 2	Fault history 2

8.3 Resetting fault trips

Follow one of the instructions below to reset the inverter:

- From the keypad, press the [RESET] key.
- From the inverter's control terminal, close the circuit between the RST and CM terminals.
- Turn OFF the inverter, and then turn it ON again.

8.4 Troubleshooting when a fault trip occurs

When a problem occurs, confirm the followings first.

- Are the motor and the inverter connected properly?
  - Refer to page *19*.
- Is the encoder type jumper in the inverter's I/O PCB set correctly?
  - Refer to page *34*.

  If the encoder is complementary or open collector type, set JP1 to "OC" and JP2 to "15V". If the encoder is line drive type, set JP1 to "LD" and JP2 to "5V".
  The initial setting is line drive type.
- Is direction of the motor rotation correct?
  - Refer to page *53*.

  When looking at the motor from the motor's fan, the motor rotates clockwise in the forward operation.
- Is the inverter tested sufficiently in a no load status?
  - Refer to page *54* and *57*.

When a fault trip or warning occurs due to a protection function, refer to the following table for possible causes and remedies.

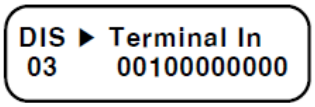
Type	Cause	Remedy
Over Current	Acc/Dec time is too short, compared to load inertia (GD^2).	Increase Acc/Dec time.
	The inverter load is greater than the rated capacity.	Replace the inverter with a model that has increased capacity.
	The mechanical brake of the motor is operating too fast.	Check the mechanical brake.
Ground Fault	A ground fault has occurred in the inverter output wiring.	Check the output wiring.
	The motor insulation is damaged.	Replace the motor.
Over Voltage	Deceleration time is too short for the load inertia (GD^2).	Increase the deceleration time.
	A generative load occurs at the inverter output.	Use the braking unit.
	The input voltage is too high.	Determine if the input voltage is above the specified value.
Low Voltage	The input voltage is too low.	Determine if the input voltage is below the specified value.

Type	Cause	Remedy
	A load greater than the power capacity is connected to the system (a welder, direct motor connection, etc.).	Increase the power capacity.
	The magnetic contactor connected to the power source has a faulty connection.	Replace the magnetic contactor.
Low Voltage2	The input voltage has decreased during the operation.	Determine if the input voltage is below the specified value.
	An input phase-loss has occurred.	Check the input wiring.
	The power supply magnetic contactor is faulty.	Replace the magnetic contractor.
Over Load	The load is greater than the motor's rated capacity.	Ensure that the motor and inverter have appropriate capacity ratings.
	The set value for the overload trip level is too low.	Increase the set value for the overload trip level.
Inv OLT	The load is greater than the rated motor capacity.	Replace the motor and inverter with models that have increased capacity.
	The set value for the overload trip level is too low.	Increase the set value for the overload trip level.
InvOver Heat	There is a problem with the cooling system.	Determine if a foreign object is obstructing the air inlet, outlet, or vent.
	The inverter cooling fan has been operated for an extended period.	Replace the cooling fan.
	The ambient temperature is too high.	Keep the ambient temperature below 50℃.
InvThem OP	The ambient temperature is too low.	Keep the ambient temperature over-10℃.
	An error has been detected on the internal temperature sensor.	Contact the retailer or the LSIS customer service center.
MotOver Heat	There is a problem with the cooling system for the motor.	Determine if a foreign object is obstructing the air inlet, outlet, or vent.
MotThem Err	There is a problem with the motor Thermistor.	Determine if the motor's thermistor operates correctly.
E-Thermal	The motor has overheated.	Reduce the load or operation frequency.
	The inverter load is greater than the rated capacity.	Replace the inverter with a model that has increased capacity.

Type	Cause	Remedy
	The set value for electronic thermal protection is too low.	Set an appropriate electronic thermal level.
	The inverter has been operated at low speed for an extended duration.	Replace the motor with a model that supplies extra power to the cooling fan.
External-B	The external fault B signal is connected.	Determine if the external fault B signal is connected.
Arm Short Arm Short-DB	The IGBT is damaged.	Replaced the power board. Contact the retailer or the LSIS customer service center.
	The wiring is disconnected during the inverter operation.	Determine if the output short circuit has occurred. When using synchronous motors, determine if the 3-phase input short circuit has occurred.
Fuse Open	The inverter input fuse is open.	Replace the fuse. Contact the retailer or the LSIS customer service center.
Encoder Err	The encoder power is not connected.	Determine if the power that meets the encoder requirements is connected.
	The encoder wiring is incorrect.	Determine if the encoder is wired correctly.
BX	The BX signal is connected.	Determine if the BX signal is connected.
		Reset the inverter power.
Over Speed	An error has been detected on speed control.	Check the encoder wiring and the UVW output.
		Tune the encoder at PAR 28. Refer to *6.2.3.17 Setting the encoder types (PAR_23), EnDat encoder directions (PAR_26), and encoder tuning options (PAR_28)* on page *137* for details.
		Adjust the speed control response. Refer to *6.5.4 Start after DC-braking: Dc-Start (FUN_10–FUN_11)* on page *208* for details.
	The over speed error detection level and time is low.	Increase the over speed error detection level and time.
COM Error CPU Error	The keypad cable connection is bad.	Determine if the keypad cable is connected correctly.

Type	Cause	Remedy
	An error has been detected on control board communication.	Reset the inverter power.
	The OS for the control board has not been installed correctly.	Download the OS for the control board.
Input PO	A contact failure has been occurred to the magnetic contactor for the output side.	Check the magnetic contactor for the output side.
	The output wiring is bad.	Determine if the output wiring is correct.
Output PO	A contact failure has been occurred to the magnetic contactor for the input side.	Check the magnetic contactor for the input side.
	The input wiring is bad.	Determine if the input wiring is correct.
	The time to replace the DC link capacitor has come.	Replace the DC link capacitor. Contact the retailer or the LSIS customer service center.
SpdDev Err	An error has been detected on the speed controller.	Check the encoder wiring and the UVW output.
		Tune the encoder at PAR 28. Refer to *6.2.4 Auto-tuning* on page *138* for details.
	The response from the speed controller is high.	Decrease the speed control response. Refer to *6.6.3 Speed controller (Automatic Speed Regulator: ASR)* on page *242* for details.
	The response from the speed controller is low.	Increase the speed control response. Refer to *6.6.3 Speed controller (Automatic Speed Regulator: ASR)* on page *242* for details.
	An error has been detected on opening break and MC.	Check the break operation.
		Check the MC operation.
	The speed deviation error level and time are low.	Increase the speed deviation error level and time.

8.5 Troubleshooting after a test run

Fault	Remedy
The motor does not rotate.	If the LED flashes red: • Go to DIS-05, check for trip errors, and if a trip has occurred reset the inverter. • Check for BX terminal input signals received at DIS_03. If an input signal is ON, change it to OFF and try starting the motor.  Confirm that the command source is set correctly. • If the inverter does not operate via terminal input, try to operate it using the keypad. • If these steps do not resolve the faults refer to Item 5 in this table.
	If the [REV] and [FWD] keys are illuminated green: • Confirm the inverter output connections (U, V, W) are in the correct phase rotation. • Confirm that a braking device is not preventing motor operation. • Check the brake settings and the brake relay settings. • Confirm the pre-ramp reference (DIS_01) is not set to "0." Refer to Item 6 in this table for more information about setting the speed reference. • Confirm the motor capacity (PAR_09) is set correctly. • Confirm the motor base speed (PAR_14) is set correctly. • Confirm the motor rated current (PAR_194) is set correctly. • Confirm the motor flux current (PAR_52) is set correctly (30-40% of the value at PAR_19). • Confirm the motor rated slip (PAR_18) is set correctly. • Confirm the motor time constant (PAR_53) is set correctly (Note: inverter efficiency will decrease significantly if this is incorrect). • Confirm the number of motor poles (PAR_16) is set correctly. • If CON_33 is set at the keypad, are CON_34–CON_36 (torque limits) set correctly? • If an analog torque limit is set at CON_33, is the input configured correctly? [Note: at least one of the parameters (Ai1–Ai3) must be set for analog input.]

Fault	Remedy
Motor rotates but does not accelerate.	Check the encoder pulse setting at PAR_24. • The default setting is "1024" for HIGEN vector motors. If a different type of motor is connected, contact the encoder manufacturer and request the correct pulse setting. Set FUN_01 to "Keypad", FUN_02 to "Keypad1", and FUN_12 (Speed 0) to 100.0 rpm. Then, press [FWD] to check if the motor rotates. If the motor does not rotate, check the encoder cable connection. • If the encoder cables are connected incorrectly, the motor will rotate at low speed (30-60 rpm), the current can get as high as 150% of the rated current, and the motor will rotate in one direction only. If the motor is rotating too slowly (30–60 rpm), stop the motor and swap the positions of the A and B phase cables at the encoder terminals. Confirm that the direction of rotation is correct. If the direction of rotation is reversed refer to Item 3 in this table. • For line-drive encoders, connect the A+ and A- cables to the B+ and B- phases, and the B+ and B- cables to the A+ and A- phases. Or, change the encoder direction at Par_25 (Enc Dir Set) and try again.
Motor speed is correct but the direction of rotation is wrong.	Swap the V and W phase cables at the inverter output terminals and the A and B phases at the encoder terminals. Or, change the encoder direction at PAR_25.
Motor direction of rotation does not change.	Confirm the RUN and STOP commands have been configured correctly. • Confirm the command source set at FUN_01 is correct. • If the current command source is terminal input, change it to keypad input. Check that the motor's direction of rotation is correct. • If the current command source is keypad input, change it to terminal input. Check that the motor's direction of rotation is correct. • Refer to Item 5 in this table for more information if the motor operates abnormally when either of these settings are used. Confirm that the run prevention function is defined using the multifunction inputs. • Check if the parameter settings for the multifunction inputs at DIO_01–DIO_07 are set to "Prohibit FRD" or "Prohibit REV." If either prohibition function is set, compare the input condition at DIS_01–DIS_03 when the corresponding contact terminal is ON and the direction of rotation cannot be changed.

Fault	Remedy
Keypad or terminal input does not respond.	If the [REV], [FWD], or [STOP] keys on the keypad are illuminated red or green: • Refer to Item 1 in this table if the keypad or terminal input commands do not respond correctly. If you cannot modify settings, keypad or terminal input protection may be enabled at PAR_04. To disable keypad or terminal input protection, set PAR_04 to "12". • If you still cannot save changes, an internal component fault may have occurred. Contact LSIS for technical support. If the [STOP] key on the keypad is illuminated red and is flashing: • A trip or emergency stop condition has occurred. Check the current fault trip status at DIS_05. If a fault trip condition exists, clear the error condition, reset the fault trip, and try to operate the inverter again. • Check if the BX (emergency stop) signal is illuminated at the top right side of the keypad. If it is, check the status of the inputs at DIS_01–DIS_03 to see if the BX signal input is ON. If the [REV] or [FWD] key on the keypad is illuminated green and is flashing: • A flashing key indicates that the inverter is accelerating or decelerating. If the motor operates constantly in this state, the applied load is too high for the inverter's capacity. Refer to Item 15 in this table for more information.
Motor speed does not change correctly during operation.	Confirm the speed command settings at FUN_02 are correct. • LSLV-iV5L inverters operate according to the speed commands received at analog input terminals, keypad, or the internal RS-485 communication board. Confirm that the correct speed references are displayed at DIS_01 (PreRamp Ref). • DIS_01–DIS_03 displays the current speed references received from the installation. If the motor speed does not change to the same speed shown on the inverter's display, check the encoder (refer to Item 12 in this table).
0 V analog input signals do not stop the motor.	If AIO_01 (Ai1 define) is set to "Speed Ref": • Adjust the percentage settings (%) at AIO_04 (Ai1 Out Y1) and AIO_08 (Ai1-Out Y1). Adjust the values so that a 0 V input signal generates a 0.0% output, and then press [Enter]. Check the settings for inputs Ai2 and Ai3 and adjust the settings as required.

Fault	Remedy
Speed estimation is initially successful but over time the motor starts to overheat or hunt, and the speed decreases.	Check the motor connections. • If the motor supports 220 V and 380 V input, ensure that the connections are configured for the correct input voltage. • The motor will not operate if the number of poles is set incorrectly. Power supply connection faults generally result in motor damage. If you suspect the wrong voltage has been connected, contact the manufacturer or supplier of the motor. Refer to the terminal block section in this manual for the correct motor wiring connections. Confirm that the motor rating is set correctly. • Check the motor rating set at PAR_09. To confirm the rating, refer to the rating plate on the motor. Confirm that the motor parameters are set correctly. • Motor parameters vary for different manufacturers. The inverter's default motor parameter settings are based on HIGEN vector motor specifications. For motors other than HIGEN vector motors, enter parameter settings based on the specifications of the motor to be used in the installation before operating it.
No display on the keypad.	Check that the inverter is turned on. Check the connection between the inverter and the keypad. • If there is no display on the keypad when the inverter is turned on, and the cable connection appears to be serviceable, contact LSIS for technical support.
The motor speed fluctuates when it should be operating at constant speed.	Confirm that shielded twisted pair (STP) cables are used for all control signal circuits. • STP cables must be used for the encoder signal connection because non-STP cables are susceptible to electronic interference. Electronic interference can affect encoder input signals and can cause speed variation during low speed operations. Variations during high speed operation can also occur if the level of electronic interference is high. The resultant speed fluctuations can affect the motor by generating vibration and sound when the inverter stops. Confirm that the inverter, the motor, and the encoder are correctly grounded. • Inspect and test the ground connection between the inverter and the encoder. If the ground connection is not connected correctly, the inverter may operate abnormally. Check the ground connection at the bottom right of the inverter's control PCB. Loosen the ground connector and then

Fault	Remedy
	retighten it. (For more information, refer to the encoder connection section in this manual). Ensure that the motor's ground terminal is connected directly to the ground terminal at the inverter power terminal block. Ground the motor and the inverter casing to the building's earthing system. • Electronic interference at the encoder input can cause motor speed variations if the inverter is not connected to the building's earthing system. Check the speed gain settings if the motor is under-loaded. • If excessive speed PI gains are set at CON_03 and CON_04, the motor may vibrate when the inverter stops operating. High proportional gain settings and low integral gain settings can also be used to achieve faster responses. However, the system may become unstable if the proportional gain is set too high or low. In general, a setting in the 30–70% range is recommended for integral gain, and 100–500 msec for proportional gain. Increase the encoder's low pass filter setting at PRT_10 (ENC LPF). Check for slip at the motor shaft and the encoder. • Slip can occur between the motor shaft and the encoder depending on the type of encoder installation. A mechanical connection between the encoder and the motor shaft may be required to prevent slip.
The inverter does not save parameters used in the previous operation.	If the inverter does not save parameter changes when the inverter shuts down, contact LSIS for technical support.
"Fuse open" faults occur regularly.	Check the inverter's 3-phase power connections. • Measure the voltage for each incoming phase and confirm there is no voltage imbalance. If the level of imbalance exceeds 2% of the nominal voltage (6 V for 380 V supply), an AC reactor should be installed. If an AC reactor is not installed, the inverter may be damaged. Damage to the inverter caused by power supply imbalance is not covered by the product warranty. Service fees will be charged for repairs due to power supply imbalance even within the warranty period. Check that the inverter output cables are correctly connected at the motor.

Fault	Remedy
	Check for motor insulation damage. • Various symptoms may occur if the motor insulation is damaged. Motor speed may be restricted, excessive load may be applied to the motor, and frequent overcurrent fault trips may occur during regeneration. Also, motor insulation faults can result in regular instances of motor over-temperature and vibration. These symptoms can be present for a period before the "Fuse Open" fault trip occurs. • If these symptoms continue, it is likely that the motor insulation is damaged and the motor will need to be replaced.
Motor input current is too high.	Check the connections at the motor. • Confirm the incoming power supply connections and verify the voltage rating is correct for the motor especially if it supports 220 V and 380 V. Confirm the inverter parameter settings for inverter capacity and motor rating. Confirm the motor time constant settings are correct. • Refer to Items 1 and 8 in this table and perform all required checks for the inverter and the motor.
Overcurrent fault trips occur regularly (high input current fluctuations).	Check that the encoder is properly installed on the motor. • The encoder can move while the motor operates if it is not securely mounted on the motor. Vector motors require accurate feedback signals from the encoder to perform the specified operation. If the encoder position slips, inaccurate motor feedback is provided by the encoder and can result in the motor operating incorrectly and high levels of output current. If this situation occurs, contact the motor manufacturer or the encoder installer. • If a synchronous motor is used, overcurrent fault trips can occur if the inverter fails to locate the motor's rotation position. Refer to the auto-tuning section of this manual for more information. Test the motor's insulation. • Refer to Item 12 in this table.

Fault	Remedy
The [FWD] and [REV] keys flash, and ACC/DEC functions do not operate correctly (the motor is unable to sustain the load or ACC/DEC operation is delayed).	Check the cable connections. Confirm the acceleration and deceleration times at FUN_41–FUN_48 and confirm the motor's load at DIS_00. • - The [FWD] and [REV] keys flash when the motor accelerates or decelerates. If the keys continue to flash during the motor operation, motor torque is too low for the applied load and the motor is unable to operate at constant speed. If this occurs, increase the torque limit to within the motor rating. Applying excessive load to the motor may reduce the inverter's life or damage the inverter. Contact LSIS for technical support.

8.6 Troubleshooting other faults

When faults other than those identified as fault trips or warnings occur, the table below lists possible causes and remedies.

Fault	Cause	Remedy
Parameters cannot be set.	The inverter is running (driving mode).	Stop the inverter, switch to program mode and set the parameter.
	The password is incorrect.	Confirm the password, disable the parameter lock, and then set the parameter.
The motor is not rotating.	The emergency stop signal is activated.	Reset the emergency stop.
	The operating command is set incorrectly.	Check the operating command setting.
	The control circuit connections are incorrect.	Check the control circuit connections.
	The frequency command is set incorrectly.	Check the frequency command setting.
	The input voltage or current for the frequency is incorrect.	Check the input voltage or current for the frequency.
	The PNP/NPN mode is selected incorrectly.	Check the PNP/NPN mode setting.
	[STOP] is pressed.	Check that the inverter is in a normal condition and resume operation.

Fault	Cause	Remedy
	Motor torque is too low.	Increase the torque limit to allow the inverter to accelerate or decelerate to the rated value.
The motor rotates in the opposite direction to the command.	The inverter's output connections for the motor are incorrect.	Check the inverter's output connections.
	The forward/reverse rotation control circuit connections between the inverter and the control panel are incorrect.	Check the forward/reverse rotation control circuit connections.
The motor rotates in only one direction.	Reverse rotation prevention is selected.	Turn off reverse rotation prevention.
	The reverse rotation signal is not provided even when a 3-wire sequence is selected.	Check the input signal for the 3-wire operation and adjust as necessary.
The motor is overheating.	The load is too heavy.	Reduce the load. Increase the Acc/Dec time.
		Check the motor parameters and set the correct values.
		Replace the motor and the inverter with models that are rated for the load.
	The ambient temperature of the motor is too high.	Lower the ambient temperature of the motor.
	The phase-to-phase voltage of the motor is insufficient.	Use motors that can operate at the maximum and minimum level of the phase-to-phase voltage range.
		Only use motors designed to operate with inverters.
		Connect the AC reactor to the inverter output (set the carrier frequency to 2.5 kHz).
	The motor fan has stopped or the fan is obstructed with debris.	Check the motor fan and remove any foreign objects.

Fault	Cause	Remedy
The motor stops during acceleration or when connected to load.	The load is too high.	Reduce the load.
		Replace the motor and the inverter with models that are rated for the load.
The motor does not accelerate. /The acceleration time is too long.	The load is too high.	Reduce the load and increase the acceleration time. Check the mechanical brake status.
	The acceleration time is too long.	Change the acceleration time.
	The inverter parameters are set incorrectly for the motor.	Change the motor related parameters.
The motor deceleration time is too long even with a Dynamic Braking (DB) resistor connected.	The deceleration time is set too long.	Change the deceleration time.
	Motor torque is too low.	If motor parameters are normal, an underrated motor is the likely cause. Replace the motor with a model with increased capacity.
	The load is too high for the inverter's rated torque limit.	Replace the inverter with a model with increased capacity.
During inverter operation, a control unit malfunction occurs or switching noise can be heard.	Switching inside the inverter causes the noise.	Change the carrier frequency to the minimum value.
		Install a surge filter in the inverter output.
During inverter operation, the earth leakage circuit breaker activates.	An earth leakage circuit breaker interrupts power supply if current flows to ground during inverter operation.	Ensure the inverter is connected to ground.
		Check that the ground resistance is less than 10Ω.
		Check the rating and connections of the earth leakage circuit breaker.
		Reduce the carrier frequency.
		Ensure the cable length between the inverter and the motor is as short as possible.

Fault	Cause	Remedy
The motor vibrates severely and does not rotate normally.	The 3-phase power supply is out of balance.	Check the input voltages and balance the phases.
		Check and test the motor's insulation.
The motor hums or makes loud noises.	Resonance occurs between the motor frequency and the carrier frequency.	Increase or decrease the carrier frequency slightly.
	Resonance occurs between the motor frequency and the inverter output frequency.	Increase or decrease the carrier frequency slightly.
		Increase or decrease the command speed slightly.
The motor vibrates or hunts.	The frequency input command is supplied via an external, analog signal.	If operation is affected by electronic interference on the analog input side, change the input filter time constant (AIO 11, 23, 35).
	The cable between the inverter and the motor is too long.	Ensure that the cable length between the inverter and the motor is less than 100 m.
The motor does not come to a complete stop when the inverter output stops.	The motor cannot decelerate sufficiently because the regenerated load is too heavy to stop.	Increase the deceleration time.
		Install a braking resistor.
	The free run option has been selected.	Change the stop method to deceleration stop.
The output frequency does not increase to the frequency reference.	The frequency reference exceeds the upper limit of the frequency command.	Set the upper frequency limit higher than the frequency reference.
The motor is not operating and there is no voltage at the output terminals.	The frequency command source setting is incorrect.	Set the frequency command source correctly.
	The operation command source setting is incorrect.	Set the operation command source correctly.
	Power is not supplied to the R, S, and T terminals.	Check the R, S, T to U, V, W connections.
	Output power is not available and the power lamp is not lit.	Turn on the power.
	The RUN command is not on.	Turn on the RUN command.

Fault	Cause	Remedy
The motor is not operating and there is voltage at the U, V, and W terminals.	The motor is obstructed.	Remove the obstruction and reduce the load.
	The load is too high.	Test the motor by operating it independent of the inverter.
The motor operates in reverse.	The output terminals (U, V, W) are connected incorrectly at the inverter.	Connect the inverter output to the motor input with the correct phase sequence.
	The input terminals (U, V, W) are connected incorrectly at the motor.	
	The control circuit terminals are configured incorrectly.	Ensure FWD is set when operating in the forward direction, and REV when operating in the reverse direction.
The motor does not accelerate.	The load is too high.	Reduce the load.
The motor speed fluctuates during operation.	The change of load is too high.	Replace the motor and the inverter with models that are rated for the load.
	The voltage fluctuates.	Avoid changes of load and voltage during operation.
	Speed fluctuations occur at a specific frequency range.	Adjust the output frequency.
The motor speed is not correct.	The maximum speed setting is not correct.	Set the speed settings according to the motor's specification.

9 Maintenance

This chapter covers general maintenance tasks and explains how to replace the cooling fan, the regular inspections to be made, and how to store and dispose of the product.

An inverter is vulnerable to environmental conditions and faults also occur due to component wear and tear. To prevent breakdowns, please follow the maintenance recommendations in this section.

Routine and regular inspections are required to keep the product in a good working condition at all times. Inspect the parts for deterioration and replace the parts as necessary.

If the following conditions exist at the installation site, more frequency regular inspections may be required:

- High ambient temperature
- Frequent on/off conditions
- Unstable power source
- Excessive shocks and vibrations at the installation site
- Corrosive gas, flammable gas, oil residue, dust, salts, and metal powders at the installation site

ⓘ Caution

- Before you inspect the product, read all safety instructions contained in this manual.
- Before you clean the product, ensure that the power is off.
- Use a clean, dry cloth to clean the inverter. Using a wet cloth, water, solvents, or detergents may result in electric shock or damage to the product.
  ESD (Electrostatic discharge) from the human body may damage sensitive electronic components on the PCB. Therefore, be extremely careful not to touch the PCB or the components on the PCB with bare hands while you work on the I/O PCB.
  To prevent damage to the PCB from ESD, touch a metal object with your hands to discharge any electricity before working on the PCB, or wear an anti-static wrist strap and ground it on a metal object.
- Do not install or remove add-on boards while the inverter is operating.
- Immediately place circuit boards on a conductive material after removing them from the inverter for maintenance or repair. Otherwise, static charge may damage the circuit board components.
- A failure of element that used in the inverter is unpredictable, and the failure of element may cause a power fuse failure or a fault trip. If you suspect a failure of element, contact the LSIS customer center (1544-2080).

Note

- Keep the inverter turned off when it is not being used.
- Keep the inverter clean during operation.
- Do not use cleaning agents containing substances such as benzene, toluene, and alcohol. Doing so may damage the exterior coat of the product.
- Do not use detergents or cleaning solutions when cleaning around the LED indicators. The inverter may malfunction if the liquid leaks into the circuit board.
- The lifespan of the electronic components on the control board is unpredictable. If you think the product failed due to an internal component failure, contact the LSIS service technicians for technical support.

9.1 Regular inspections

9.1.1 Daily inspection

Inspection area	Item	Details	Method	Standard	Required equipment
All	Ambient environment	Is the ambient temperature and humidity within the design range? Is there any dust or are there foreign objects present?	Refer to *1.3 Installation considerations* on page *4*.	No icing (ambient temperature: -10 - +40). No condensation (ambient humidity below 50%)	Thermometer , hygrometer
	Inverter	Are there any abnormal vibrations or noises?	Visual inspection	No abnormality	None
	Voltage	Are the input and output voltages normal?	Measure voltages between the R/ S/ T terminals.	-	Digital multimeter
Input/Output circuit	Capacitor	Is there any leakage from the capacitor?	Visual inspection	No abnormality	-
		Is the capacitor swollen?			
Cooling	Cooling fan	Are there any	Turn off the	Fan rotates	-

Inspection area	Item	Details	Method	Standard	Required equipment
system		abnormal vibrations or noises?	system and check operation by rotating the fan manually.	smoothly	
	Inverter, Motor	Is there excessive heat generated?	Check if the inverter or motor is overloaded.	No abnormality	Thermometer Screwdriver
			Tighten all screws.		
			Check if the inverter's heat sink or motor is dirty.		
			Check the ambient temperature.		
Display	Measuring device	Are the values shown on the display correct?	Check the display value on the panel.	Check and manage specified values.	Voltmeter, ammeter, etc.
Motor	All	Are there any abnormal vibrations or noises?	Visual inspection	No abnormality	-
			Check for overheating or damage.		
		Is there an abnormal smell?	Check all electrical connections.		
			Check the level of vibration at the motor.		
			Tighten all screws.		

9.1.2 Annual inspection

Inspection area	Item	Details	Method	Standard	Equipment
Input/ Output circuit	All	Perform insulation resistance test between the input/output terminals and the ground terminal.	Disconnect the inverter and short the R/S/T/U/V/W terminals. Measure from each terminal to the ground terminal using a Megger.	Resistance must be more than 5 MΩ	DC 500 V Megger
		Are any terminal or components loose inside the inverter?	Tighten all screws.	No abnormality	
		Is there any evidence of overheating components?	Visual inspection		
	Cable connections	Are there any corroded cables?	Visual inspection	No abnormality	-
		Is there any damage to cable insulation?			
	Terminal block	Is there any damage?	Visual inspection	No abnormality	-
	Smoothing condenser	Measure electrostatic capacity.	Test with capacity meter.	Rated capacity over 85%	Capacity meter
	Relay	Is there any relay chatter during operation?	Auditory inspection	No abnormality	-
		Is there any damage to the contacts?	Visual inspection		
	Braking resistor	Is there any damage at the resistor?	Visual inspection	No abnormality	Digital multimeter / analog tester

Inspection area	Item	Details	Method	Standard	Equipment
		Is there an open circuit?	Disconnect one side of the resistor and measure with a tester.	Must be within ±10% of the rated value of the resistor.	
	Diode, IGBT	Is there any dust or foreign objects present?	Visual inspection	Remove any foreign objects or dust. Use dry air to clear the dust.	-
	Circuit board	Is there any abnormal smell, discoloration, corrosion, dust, or oil residue present?	Visual inspection	Clean the circuit board with an antistatic cloth. If the circuit board is still dirty, replace the circuit board.	-
				Do not use solvents on the circuit board.	
		Is the connector connected securely?		Remove dust with dry air.	
				Reconnect the connectors.	
				Replace the inverter when parts that cannot be repaired or replaced are damaged.	
Control circuit protection	Operation check	Check for output voltage imbalance during inverter operation.	Measure the voltage between the inverter output terminals U/V/W.	Balance the voltage between phases to within 8 V.	Digital multimeter or DC voltmeter

Inspection area	Item	Details	Method	Standard	Equipment
		Does the sequence protection test identify any keypad display errors?	Test the protection for the inverter output in both short and open circuit conditions.	The circuit must operate according to the sequence.	
Cooling system	Cooling fan, Cooling fins	Are any parts of the fan loose?	Check all connected parts and tighten all screws.	No abnormality	-
		Is there any dust present on the cooling fan or the cooling fins?	Visual inspection	No dust	
Display	Display device	Is the display value normal?	Check the command value on the display device.	Specified and managed values must match.	Voltmeter, Ammeter, etc.

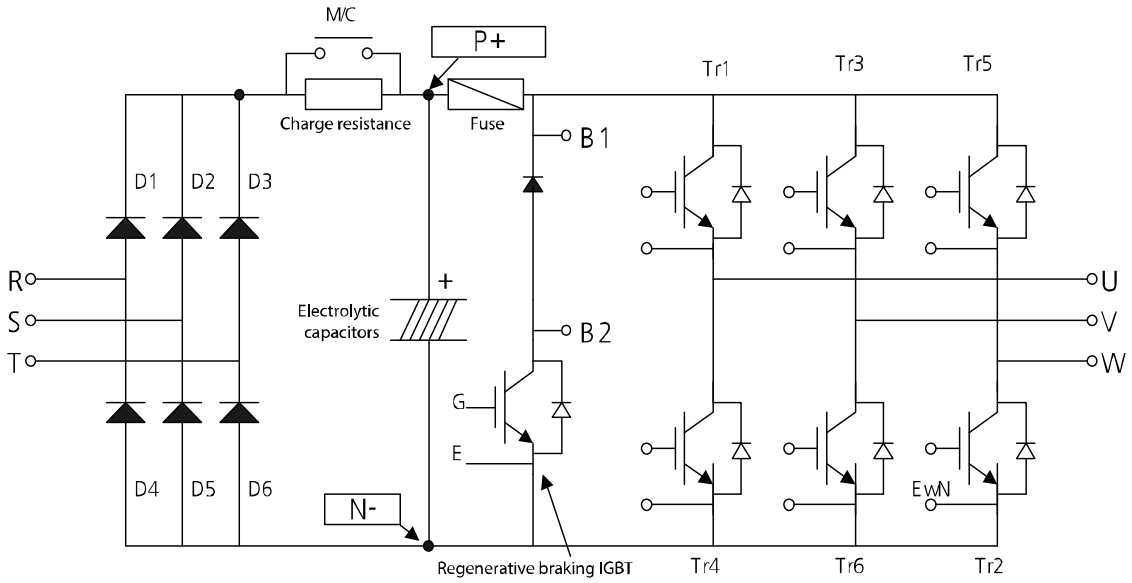
9.1.3 Biannual inspection

Inspection area	Item	Details	Method	Standard	Equipment
Main cirquit	All	Megger test (between the input, output, and earth terminals)	Disconnect the inverter, connect the R, S, T, U, V, and W, and then measure between these terminals and the earth with a megger tester.	Must be above 5 MΩ	DC 500 V Megger
Motor	Insulation resistance	Megger test (between the input, output, and earth terminals)	Disconnect the cables from the U/V/ W terminals and test the wiring.	Must be above 5 MΩ	DC 500 V Megger

Caution

Do not perform insulation resistance tests on control circuits as it may result in damage to the inverter and other control devices.

9.2 Diode module and IGBT inspection



1 Remove the power cables (R, S, T) and the motor output cables (U, V, W).

2 Confirm that the electrolytic capacitors are fully discharged.

3 Check the feedthrough status at the inverter terminals (R, S, T, U, V, W, B1, and N) by measuring the resistance between each terminal using a multimeter.

If current is flowing between the terminals, a low resistance value (Ω) is measured. If current is not flowing between the terminals, a high resistance value (M Ω) is measured.

> **Caution**
>
> If the capacitors are not fully discharged, a low resistance value may be measured even if current is not flowing in the circuit. This may result in incorrect diagnostic procedures.

4 Refer to the circuit diagram above and test the components on the printed circuit board. Measure the resistance at the terminals indicated on the circuit diagram.

9.3 Replacement cycle and maintenance of major components

The inverter consists of many electronic components including semiconductor components. Refer to the following table for the recommended replacement cycle to prevent inverter deterioration and faults.

Component name	Standard replacement cycle	Symptom	Replacement method
Cooling fan	2-3 years	Poor rotation	Replace with a new component.
DC link capacitor	2 years	Capacity reduction	Replace with a new component.
Controller smoothing capacitor	5 years	Capacity reduction	Replace with a new component.
Control board relay	-	Faulty operation	Replace with a new component.
Braking resistor	-	Capacity reduction	Replace with a new component.

9.4 Storage and disposal

9.4.1 Storage

If you are not using the product for an extended period, store it in the following way:

- Store the product in the same environmental conditions as specified for operation (Refer to *1.3 Installation considerations* on page *4*.).
- When storing the product for a period longer than 3 months, store it between -10 ˚C and 30 ˚C, to prevent deterioration of the electrolytic capacitor.
- Do not expose the inverter to snow, rain, fog, or dust.
- Package the inverter in a way that prevents contact with moisture. Keep the moisture level below 70% in the package by including a desiccant, such as silica gel.
- Do not store the inverter in dusty or humid environments. If the inverter is installed in an unsuitable environment (for example, a construction site) and the inverter will be unused for an extended period, remove the inverter and store it in a suitable place.

9.4.2 Disposal

When disposing of the product, categorize it as general industrial waste. Recyclable materials are included in the product. The packing materials and all metal parts can be recycled. For the disposal of other materials, contact the local authorities for guidance.

Caution

If the inverter has not been operated for a long time, capacitors lose their charging characteristics and are depleted. To prevent depletion, turn on the product once a year and allow the device to operate for 30-60 min. Run the device under no-load conditions.

10 Technical specifications

10.1 Input and output specifications

Model iV5L-4			055	075	110	150	185	220
Motor capacity		HP	7.5	10	15	20	25	30
		kW	5.5	7.5	11	15	18.5	22
Rated output	Rated power (kVA)		9.1	12.2	18.3	22.9	29.0	34.3
	Rated current (A)		12	16	24	30	39	45
	Output speed		0–3600 rpm					
	Output voltage (V)		0-380 V (480 V)					
Rated input	Working voltage (V)		3-Phase 380–480 VAC (-10%–+10%)					
	Input frequency		50–60 Hz (±5%)					
	Rated current (A)		17.5	24	28	35	46	53
Weight (lbs (kg))			16.9 (7.7)	16.9 (7.7)	30.2 (13.7)	30.2 (13.7)	44.7 (20.3)	44.7 (20.3)

- The standard motor capacity is based on a standard 4-pole motor.
- 400 V inverters are designed for a 440 V supply voltage.
- The maximum output voltage cannot exceed the input voltage.
- If the input voltage is greater than 480 V, apply input voltage derated by 10% from the rated input voltage. Also, install an AC reactor in the power input side if the voltage imbalance between the phases is greater than 2%. [Voltage imbalance [%] = Max voltage [V] - Min voltage [V] / Three-phase average voltage [V] x 67 (IEC 61800-3 (5.2.3)]

10.2 Product specification details

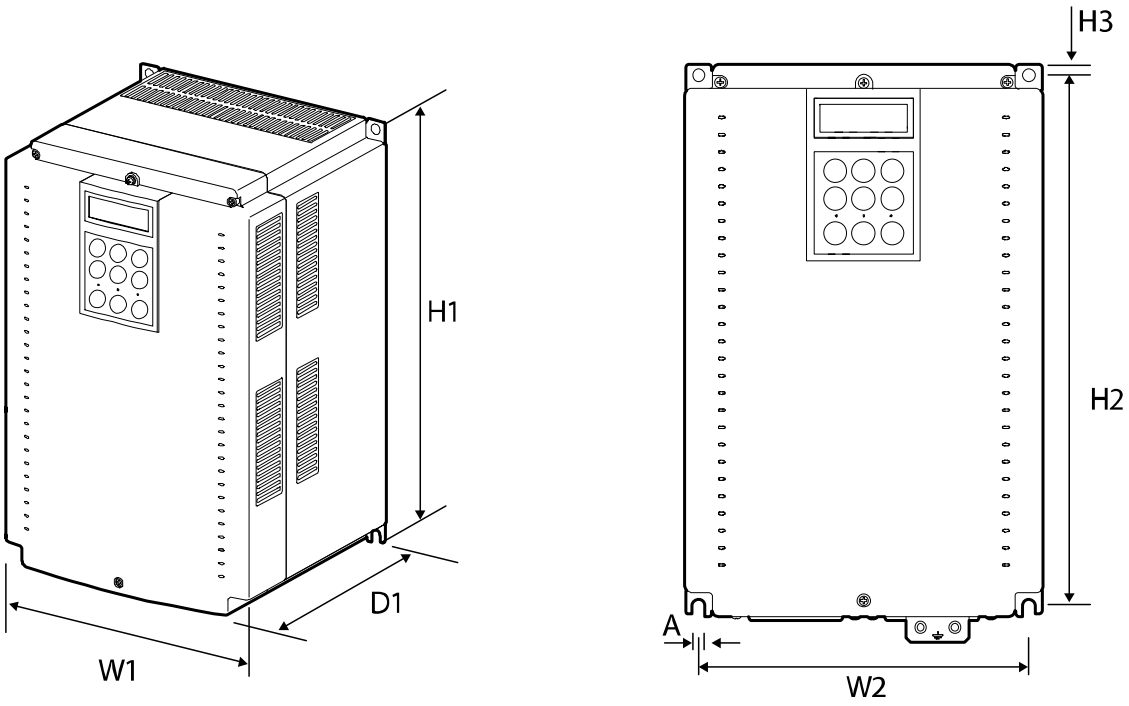
Item			Description	
Circuit system			Voltage type inverter with IGBT	
Control	Control method		Induction motor	Speed (sensored), V/F control, Slip compensation.
			Synchronous motor	Speed (sensored)
	Speed control		Analog settings: ± 0.1 % (25 ±10 ℃) of max speed (1800 rpm) Digital settings: ± 0.1 % (0-40 ℃) of max speed (1800 rpm)	
	Speed setting resolution		Analog settings: ± 0.1 % of max speed Digital settings: 0.1 rpm	
	Speed control response speed		50 Hz	
	Overload capacity		Rated current: 150% 1 min.	
	Acceleration / Deceleration	Time settings	0.00-600.0 sec	
		Combination	4 acceleration/deceleration time choices	
		Pattern	Linear, S-Curve	
Braking	Braking method		Resistance discharge braking	
	Braking torque		150 %	
	Braking resistor		External braking resistor (installation required)	
Input	Speed configuration		Digital settings via the keypad Analog input settings	Multistep configurations via terminal contact input Option settings

Item		Description
	Analog input	3 channels (Ai1, AI2, AI3) -10 → 10 V, 10 → -10 V, 0 → 10 V, 10 → 0 V, 0 → 20 mA, 20 → 0 mA Motor NTC (only available on AI3) 5 choices of multifunction analog input AI3: Motor NTC can be used when using Higen motors
	Terminal contact input	FX, RX, BX, RST, P1, P2, P3, P4, P5, P6, P7 26 function options using the multifunction input terminals (P1-P7).
Output	Analog output	2 channels (AO1, AO2) -10 → 10 V, 10 → -10 V, 0 → 10 V, 10 → 0 V output 30 multifunction analog output options
	Terminal contact output	Multifunction terminal contact output: 2 channels (1A-1B, 2A-2B) Fault terminal contact output: 1 channel (30A-30C, 30B-30C)
	Open collector output	1 channel (OC1/EG)
Trip		Over Current, Ground Fault, Over Voltage, Low Voltage, Over Load, Inv OLT, InvOver Heat, InvThem OP, MotOver Heat, MotThem Err, E-Thermal, External-B, Arm Short, Arm Short-DB, Fuse Open, Encoder Err, BX, Over Speed, COM Error, HW-Diag, EEP Error, FAN Error, BatRUN Fault, Input PO, OUTput PO, SpdDev Err, Low Voltage 2, SAFETY A/B, A3 Safety, ADC Error, Flr/FHM Data, SINCOS Open, ENDAT ERROR
Alarm		Fan alarm, Inverter overheat alarm, Motor overheat alarm, Overload alarm

Item		Description
Working environment	Surrounding environment	Indoors, prevent contact with direct sunlight and corrosive gases (Pollution Degree 2 Environment).
	Ambient temperature	14°F-104°F (-10℃-40℃) (no icing)
	Ambient humidity	Relative humidity less than 90% RH (condensation must not form)
	Cooling type	Forced fan cooling structure
	Protection structure	IP00
	Operation altitude/oscillation	No higher than 3,280 ft (1,000 m). Less than 5.9 m/sec^2 (0.6 G).

10.3 External dimensions

5.5–30 kW (3-phase)



Units: inches (mm)

Item		W1	W2	H1	H2	D1	A
3-phase 400 V	LSLV055iV5L-4 LSLV075iV5L-4	7.87 (200)	7.09 (180)	13.97 (355)	13.38 (340)	7.95 (202)	0.24 (6)
	LSLV110iV5L-4 LSLV150iV5L-4	9.84 (250)	9.06 (230)	15.16 (385)	14.57 (370)	8.70 (221)	0.35 (9)
	LSLV185iV5L-4 LSLV220iV5L-4	11.97 (304)	11.18 (284)	18.11 (460)	17.52 (445)	10.00 (254)	0.35 (9)

10.4 Peripheral devices

Compatible circuit breakers, leakage circuit breakers, and magnetic contactors (manufactured by LSIS).

Product (kW)		Circuit breaker		Leakage circuit breaker		Magnetic contactor	
		Model	Rated current	Model	Rated current	Model	Rated current
3-Phase 400 V	5.5	TD125U	30	EBS 33b	30	MC-22b	22
	7.5		30		30	MC-32a	32
	11		50	EBS 53b	50	MC-40a	40
	15		60	EBS 103b	60	MC-50a	50
	18.5		80		80	MC-65a	65
	22		100		100		65

The drive is suitable for use in a circuit capable of delivering no more than 35 kA rms symmetrical amperes at the drive maximum rated voltage, if it is protected with the recommended circuit breaker.

10.5 Fuse and reactor specifications

Products (kW)		AC input fuse		AC reactor		DC reactor	
		Current (A)	Voltage (V)	Inductance (mH)	Current (A)	Inductance (mH)	Current (A)
3-Phase 400 V	5.5	20	660 V	1.22	15	-	-
	7.5	30		1.14	20	-	-
	11	35		0.81	30	-	-
	15	45		0.61	38	-	-
	18.5	60		0.45	50	-	-
	22	70		0.39	58	-	-

※ The DC reactor specifications are not provided because terminals for the DC reator does not exist in the LSLV-iV5L.

Caution

Use Class H or RK5 UL listed input fuses and UL listed circuit breakers only. See the table above for the voltage and current ratings for the fuses and breakers.

10.6 Terminal screw specifications

Input/output terminal screw specifications

Product (kW)		Terminal screw size	Torque (Kgf·c m/Nm)
3-Phase 400 V	5.5	M4	7.1–12.2/0.7–1.2
	7.5		
	11	M5	30.6–38.2/3–3.8
	15		
	18.5	M6	61.2–91.8/6–9
	22		

Control circuit terminal screw specifications

Terminal	Terminal screw size	Torque(Kgf·cm/Nm)
FX/RX/BX/RST/P1–P7/CM	M2.6	4.0/0.4
Ai1–3/AO1/AO2/5G/ A1/B1/A2/B2/OC1/EG	M2	2.2–2.5/0.22–0.25

Caution

Apply the rated torque to the terminal screws. Loose or overtightened screws can cause short circuits and malfunctions. Use copper stranded cables only that are rated to 600 V, 167°F (75°C) for mains power cables, and rated to 300 V, 167°F (75°C) for control circuit cables.

10.7 Braking resistor specifications

The standard for braking torque is 150% and the working rate (%ED) is 5%. If the working rate is 10%, the rated capacity for braking resistance must be calculated at twice the standard.

Product (kW)		Resistance (Ω) Note 1)	Rated capacity (W) Note 2)
3-Phase 400 V	5.5	85	800
	7.5	60	1200
	11	40	2400
	15	30	2400
	18.5	20	3600
	22	20	3600

Note 1) ED is based on 100 seconds.

Note 2) Rated capacity is based on the self-cooled type.

10.8 Braking resistor connections

A temperature sensor is installed to the LSIS braking resistor to prevent fire. Refer to the followings when using the braking resistor.

Terminals on the braking resistor	Terminals on the inverter	Operation
B1/B2	B1/B2	-
P7/CM	Define one of multifunction input terminals (P1–P7) on the control terminal as "external trip signal contact B".	The contact is ON in a room temperature and becomes OFF when overheated.

EC DECLARATION OF CONFORMITY

We, the undersigned,

Representative:	**LSIS Co., Ltd.**
Address:	**LSTower, 127, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 431-848, Korea**
Manufacturer:	**LSIS Co., Ltd.**
Address:	**56, Samsung 4-gil,Mokchon-Eup, Chonan, Chungnam, 330-845, Korea**

Certify and declare under our sole responsibility that the following apparatus:

Type of Equipment:	**Inverter (Power Conversion Equipment)**
Model Name:	**LSLV-iV5L series**
Trade Mark:	**LSIS Co., Ltd.**

Conforms with the essential requirements of the directives:

2006/95/EC Directive of the European Parliament and of the Council on the harmonisation of the laws of Member States relating to Electrical Equipment designed for use within certain voltage limits

2004/108/EC Directive of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility

Based on the following specifications applied:

EN 61800-3:2004
EN 61800-5-1:2007
EN 12015:2014(*)
EN 12016:2014

and therefore complies with the essential requirements and provisions of the 2006/95/CE and 2004/108/CE Directives.

Place: **Chonan, Chungnam, Korea**

최 인 식 / 2015. 3. 27

(Signature /Date)

Mr.InSik Choi / General Manager
(Full name / Position)

TECHNICAL STANDARDS APPLIED

UNE-EN 12015:2014 Electromagnetic compatibility - Product family standard for lifts, escalators and moving walks – Emission.

(*) LSLV0185iV5L-4CNNN is C3 Class
(*) LSLV0220iV5L-4CNNN is C3 Class

UNE-EN 12016:2014 Electromagnetic compatibility - Product family standard for lifts, escalators and moving walks – Immunity

EMI / RFI POWER LINE FILTERS
LSIS inverters, iV5L series

RFI FILTERS

THE LS RANGE OF POWER LINE FILTERS **FF(Footprint)**, SERIES, HAVE BEEN SPECIFICALLY DESIGNED WITH HIGH FREQUENCY **LS INVERTERS**. THE USE OF LS FILTERS, WITH THE INSTALLATION ADVICE OVERLEAF HELP TO ENSURE TROUBLE FREE USE ALONG SIDE SENSITIVE DEVICES AND COMPLIANCE TO CONDUCTED EMISSION AND IMMUNITY STANDARS TO EN 50081 ->**EN61000-6-3;02 and EN61000-6-1-:02**

CAUTION

IN CASE OF A LEAKAGE CURRENT, PROTECTIVE DEVICE IS USED ON POWER SUPPLY. IT MAY BE FAULT AT POWER ON OR OFF.

IN AVOID THIS CASE, THE SENSE CURRENT OF PROTECTIVE DEVICE SHOULD BE LARGER THAN VALUE OF LAKAGE CURRENT AT WORST CASE IN THE BELOW TABLE.

RECOMMENDED INSTALLATION INSTRUCTIONS

To conform to the EMC directive, it is necessary that these instructionsshould be followed as closely as possible. Follow the usual safetyprocedures when working with electrical equipment. All electricalconnections to the filter, inverter and motor must be made by a qualified electrical technician.

1-) Check the filter rating label to ensure that the current, voltage rating andpart number are correct.

2-) For best results, the filter should be fitted as closely as possible to theincoming mains supply of the wiring enclousure, usually directly after theenclousures circuit breaker or supply switch.

3-) The back panel of the wiring cabinet of board should be prepared for themounting dimensions of the filter. Care should be taken to remove any paintetc... from the mounting holes and face area of the panel to ensure the bestpossible earthing of the filter.

4-) Mount the filter securely.

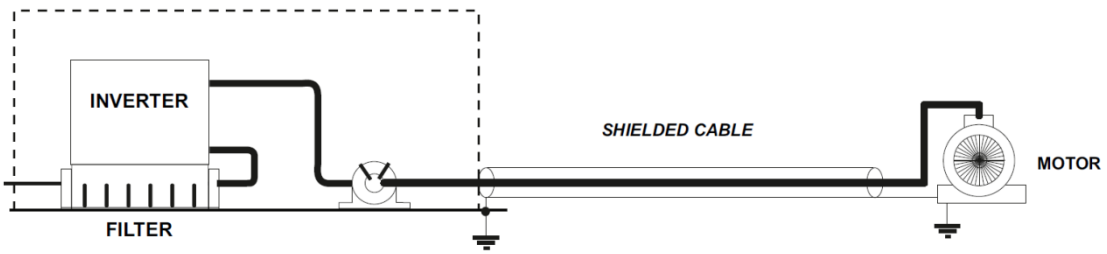
5-) Connect the mains supply to the filter terminals marked LINE, connect anyearth cables to the earth stud provided. Connect the filter terminals markedLOAD to the mains input of the inverter using short lengths of appropriategauge cable.

6-) Connect the motor and fit the ferrite core (output chokes) as close to the inverter as possible. Armoured or screened cable should be used with the 3 phase conductors only threaded twice through the center of the ferrite core. The earth conductor should be securely earthed at both inverter and motor ends.The screen should be connected to the enclousure body via and earthed cable gland.

7-) Connect any control cables as instructed in the inverter instructions manual.

IT IS IMPORTANT THAT ALL LEAD LENGTH ARE KEPT AS SHORT AS POSSIBLE AND THAT INCOMING MAINS AND OUTGOING MOTORCABLES ARE KEPT WELL SEPARATED.

FFSERIES (Footprint)

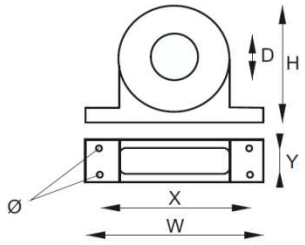


iV5 series / Footprint Filters

INVERTER	POWER	CODE	CURRENT	VOLTAGE	LEAKAGE CURRENT	DIMENSIONS L W H	MOUNTING Y X	WEIGHT	MOUNT	FIG.	OUTPUT CHOKES
THREE PHASE					NOM. MAX.						
LSV0055iV5L-4	5.5kW	**FFV5L-T030-3**	30A	0-480VAC	0.5mA 27mA	400x200x60	384x155.5	2Kg.	M5	A	**FS-3**
LSV0075iV5L-4	7.5kW										
LSV0110iV5L-4	11kW	**FFV5L-T051-3**	51A	0-480VAC	0.5mA 27mA	430x250x65	404.5x180	2.5Kg.	M8	A	**FS-3**
LSV0150iV5L-4	15kW										
LSV0185iV5L-4	18.5kW	**FFV5L-T060-3**	60A	0-480VAC	0.5mA 27mA	505x304x65	480x234	2.8Kg.	M8	A	**FS-3**
LSV0220iV5L-4	22kW	**FFV5L-T070-3**	70A	0-480VAC	0.5mA 27mA	505x304x65	480x234	2.8Kg.	M8	A	**FS-3**

1) LSLV0055~0150 iV5L-4 EN 55011 CLASS B IEC/EN 61800-3 C2

2) LSLV0185~0220 iV5L-4 EN 55011 CLASS A IEC/EN 61800-3 C3



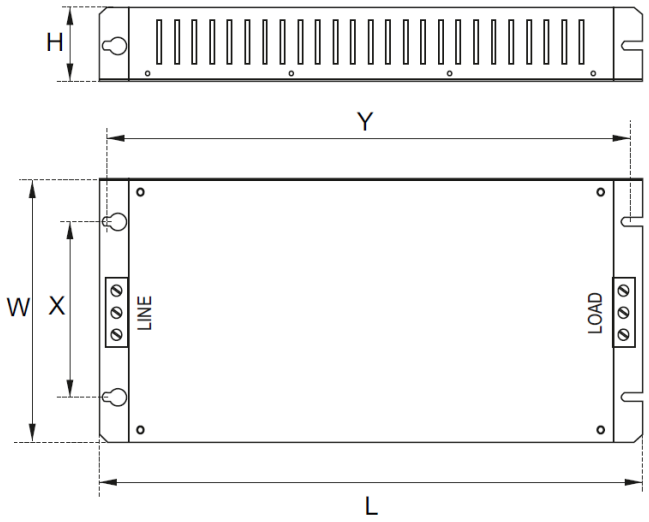
FS SERIES (output chokes)

CODE	D	W	H	X	Ø
FS – 3	48	150	110	125 x 30	5

DIMENSIONS

FF SERIES (Footprint)

FIG. A



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Product warranty

Warranty information

Fill in the warranty information on this page and keep it for future reference or when warranty service is required.

Product name	LSIS Standard Inverter	**Date of installation**	
Model name	LSLV-iV5L	**Warranty period**	
Customer information	Name (or company)		
	Address		
	Contact Info.		
Retailer information	Name		
	Address		
	Contact info.		

Warranty period

The product warranty covers product malfunctions, under normal operating conditions, for 12 months from the date of installation. If the date of installation is unknown, the product warranty is valid for 18 months from the date of manufacture. Product warranty terms may vary depending on purchase or installation contracts.

Warranty service information

During the product warranty period, warranty service (free of charge) is provided for product malfunctions under normal operating conditions. For warranty service, contact an official LSIS agent or service center.

Non-warranty service

A service fee will be charged in the following situations:

- intentional abuse or negligence
- power supply problems or faults caused by other appliances connected to the product
- natural disasters or utility faults (fire, flood, earthquake, gas accidents, etc.)
- modifications or repairs performed by unauthorized persons
- missing authentic LSIS rating plates
- expired warranty period

Visit our website

Visit us at ***http: //www.lsis.com*** for detailed service information.

CE mark

CE

The CE mark indicates that the products carrying this mark comply with European safety and environmental regulations. European standards include the Machinery Directive for machine manufacturers. We have comfirmed that our products comply with EN 61800-5-1.

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