Fuji Electric

Innovating Energy Technology

FRENIC-Lift

LM2A series

Reference Manual

INR-SI47-1909a-E

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The purpose of this manual is to provide accurate information in handling, setting up and operating of the FRENIC-Lift (LM2A) series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

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Preface

This manual provides the roles of function codes available for the FRENIC-Lift (LM2A) series of inverters, their overview lists, and details of each function code. Carefully read this manual for proper use. Incorrect handling of the inverter may prevent the inverter and/or related equipment from operating correctly, shorten their lives, or cause problems.

The table below lists the other materials related to the use of the FRENIC-Lift (LM2A). Read them in conjunction with this manual as necessary.

Name	Material No.	Description
Instruction Manual	INR-SI47-1894-E	Acceptance inspection, mounting & wiring of the inverter, operation using the keypad, running the motor for a test, troubleshooting, and maintenance and inspection

The materials are subject to change without notice. Be sure to obtain the latest editions for use.

How this manual is organized

This manual contains Chapters 1, 2, and 3.

Chapter 1 BLOCK DIAGRAMS FOR CONTROL LOGIC

This chapter describes the main block diagrams for the control logic of the FRENIC-Lift (LM2A) series of inverters.

Chapter 2 FUNCTION CODES

This chapter contains overview lists of nine groups of function codes available for the FRENIC-Lift (LM2A) series of inverters and details of each function code.

Chapter 3 OPERATION USING "TP-A1-LM2"

This chapter describes how to operate FRENIC-Lift (LM2A) using with optional multi-function keypad "TP-A1-LM2A".

Icons

The following icons are used throughout this manual.

Note This icon indicates information which, if not heeded, can result in the inverter not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

Tip This icon indicates information that can prove handy when performing certain settings or operations.

This icon indicates a reference to more detailed information.

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Chapter 1

BLOCK DIAGRAMS FOR CONTROL LOGIC

This chapter describes the main block diagrams for the control logic of the FRENIC-Lift (LM2A).

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FRENIC-Lift (LM2A) series of inverters for lifting machines such as elevators are equipped with a number of function codes to match a variety of motor operations required in your system. Refer to Chapter 2 "FUNCTION CODES" for details of the function codes.

The function codes have functional relationship to each other. Several special function codes also work with execution priority each other depending on their functions or data settings.

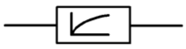
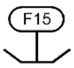
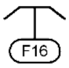
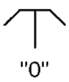
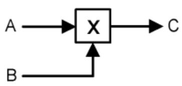
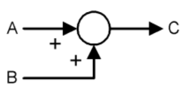
This chapter explains the main block diagrams for control logic in the inverter. You are requested to fully understand the inverter's control logic together with the function codes in order to specify the function code data correctly.

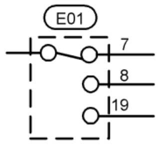
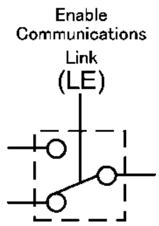
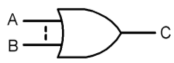
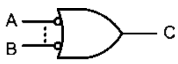
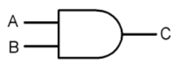
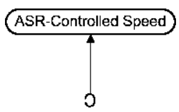
The block diagrams contained in this chapter show only function codes having mutual relationship. For the function codes that work independently and for detailed explanation of each function code, refer to Chapter 2 "FUNCTION CODES."

1.1 Symbols Used inside the Block Diagrams and their meanings

Table 1.1 lists symbols commonly used inside the block diagrams and their meanings with some examples.

Table 1.1 Symbols and Meanings

Symbol	Meaning
[FWD], [Y1] etc.	Input/output signals to/from the inverter's control terminal block.
(FWD), (REV) etc.	Control commands assigned to the control terminal block input signals.
	Low-pass filter: Features appropriate characteristics by changing the time constant through the function code data.
Reference Speed	Internal control command for inverter logic.
	High limiter: Limits the upper value by a constant or data set to a function code.
	Low limiter: Limits the lower value by a constant or data set to a function code.
	Zero limiter: Prevents data from dropping to a negative value.
	Gain multiplier for reference frequencies given by current and/or voltage input or for analog output signals. C = A × B
	Adder for 2 signals or values. C = A + B If B is negative then C = A – B (acting as a subtracter).

Symbol	Meaning
F01	Function code.
	Switch controlled by a function code. Numbers assigned to the terminals express the function code data.
	Switch controlled by an external control command. In the example shown on the left, the enable communications link command (LE) assigned to one of the digital input terminals from [X1] to [X5] controls the switch.
	OR logic: In normal logic, if any input is ON, then C = ON. Only if all inputs are OFF, then C = OFF.
	NOR (Not-OR) logic: In normal logic, if any input is OFF, then C = ON. If all inputs are ON, C = OFF.
	AND logic: In normal logic, only if A = ON and B = ON, then C = ON. Otherwise, C = OFF.
	Detection point. Shows a detection point for a value indicated in the frame at the checkpoint Ↄ.

1.2 Reference Speed (pre-ramp) Command Generator

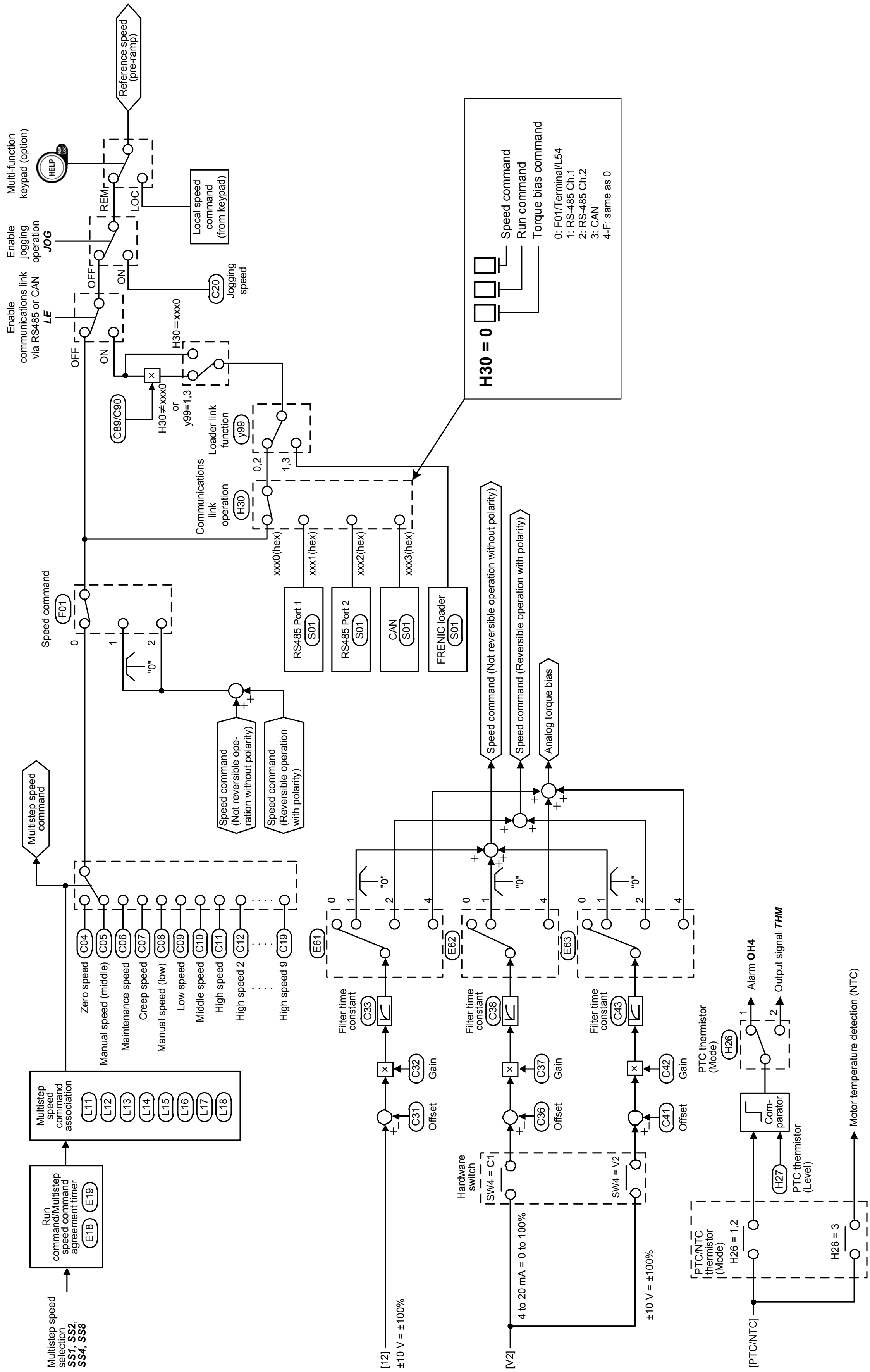


Figure 1.1 Block Diagram of Reference Speed (pre-ramp) Command Generator

1.3 Reference Torque Command Generator

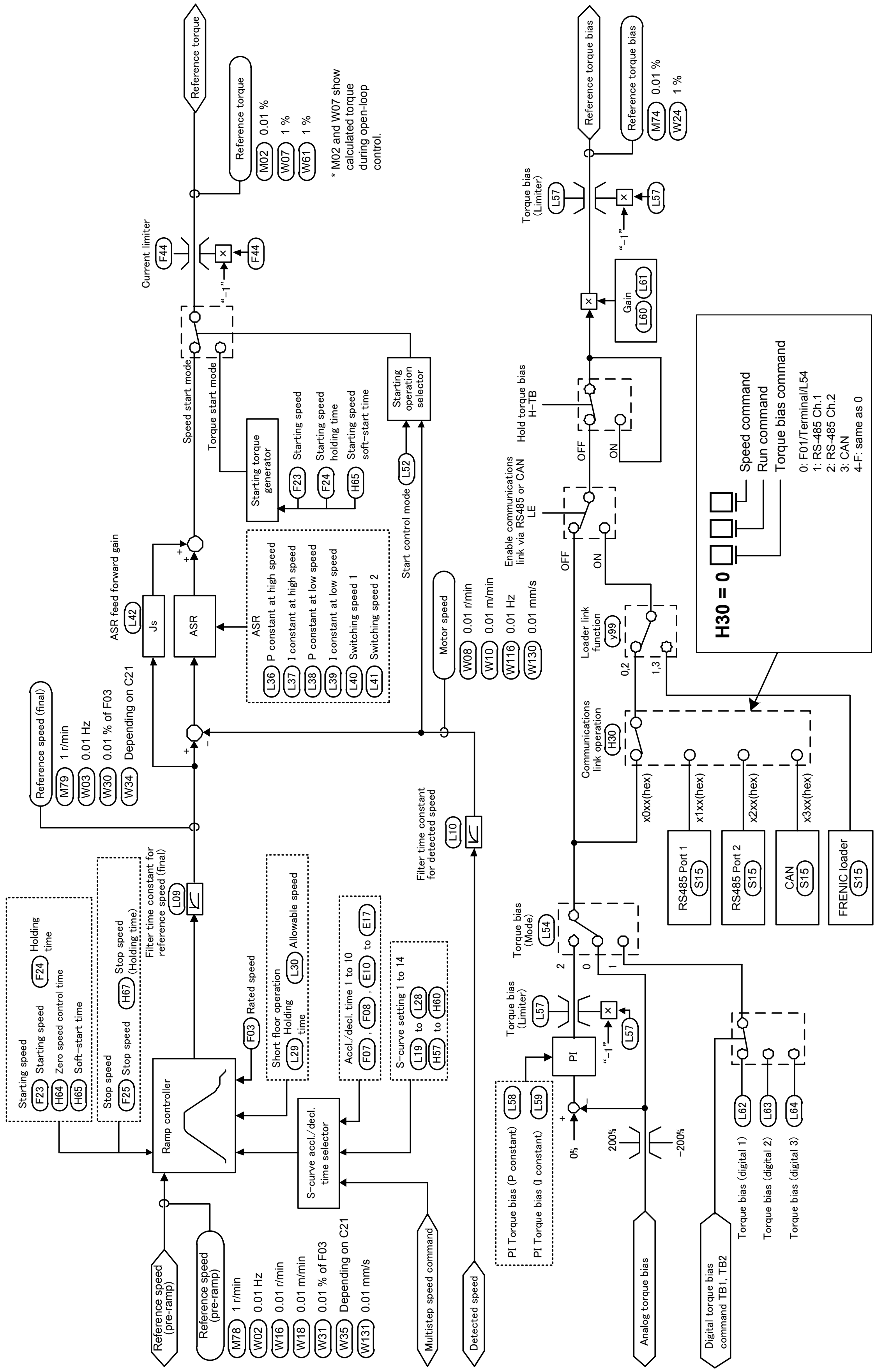


Figure 1.2 Block Diagram of Reference Torque Command Generator

1.4 Drive Command Controller

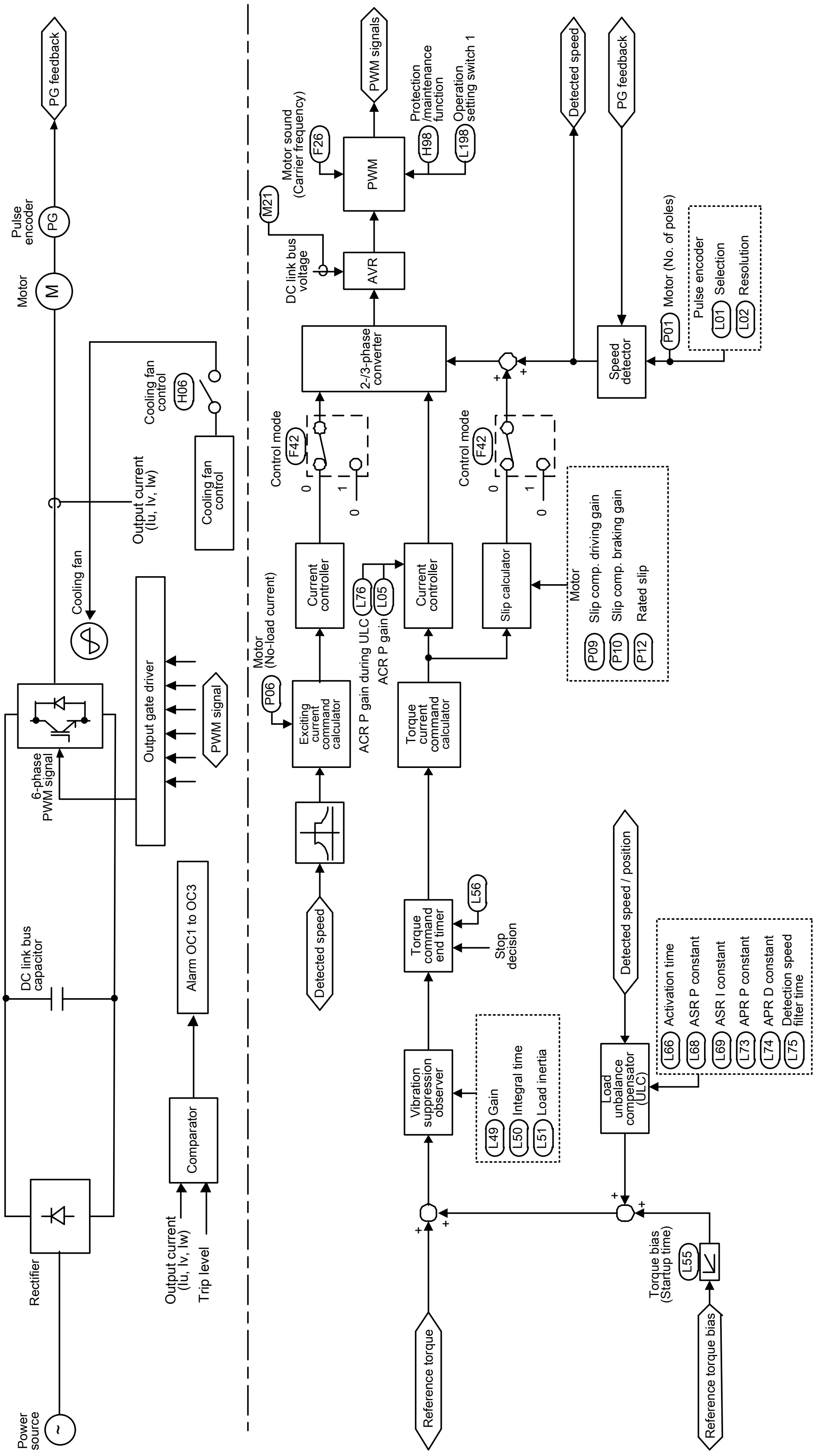


Figure 1.3 Block Diagram of Drive Command Controller

Chapter 2

FUNCTION CODES

This chapter contains overview lists of nine groups of function codes available for the FRENIC-Lift (LM2A) series of inverters and details of each function code.

Contents

2.1 Function Code Tables

Function codes enable the FRENIC-Lift (LM2A) series of inverters to be set up to match your system requirements.

Each function code consists of a 3-letter alphanumeric string. The first letter is an alphabet that identifies its group and the following two letters are numerals that identify each individual code in the group. The function codes are classified into nine groups: Fundamental Functions (F codes), Extension Terminal Functions (E codes), Control Functions (C codes), Motor Parameters (P codes), High Performance Functions (H codes and H1 codes), Customizable logic operation (U codes and U1 codes), Link Functions (y codes), Lift Functions (L codes, L1 codes, and L2 codes), and Keypad Functions (K codes). To determine the property of each function code, set data to the function code.

The following descriptions supplement those given in the function code tables on page 2-3 and subsequent pages.

■ Changing, validating, and saving function code data when the inverter is running

Function codes are indicated with the following notations based on whether they can be changed or not when the inverter is running:

Notation	Change when running	Validating and saving function code data
Y*	Possible	If the data of the codes marked with Y* is changed with ⌃ / ⌄ / ‹ / › keys, the change will immediately take effect; however, the change is not saved into the inverter's memory. To save the change, press the SET key. If you press the RESET key without pressing the SET key to exit the current state, then the changed data will be discarded and the previous data will take effect for the inverter operation.
Y	Possible	Even if the data of the codes marked with Y is changed with ⌃ / ⌄ / ‹ / › keys, the change will not take effect. Pressing the SET key will make the change take effect and save it into the inverter's memory.
N	Not possible	—

■ Copying data

The keypad is capable of copying of the function code data stored in the inverter's memory into the keypad's memory. With this feature, you can easily transfer the data saved in a source inverter to other destination inverters.

If the specifications of the source and destination inverters differ, some code data may not be copied to ensure safe operation of your power system. Whether data will be copied or not is detailed with the following symbols in the "Data copying" column of the function code tables given later.

Y: Will be copied unconditionally.
Y1: Will not be copied if the rated capacity differs from the source inverter.
Y2: Will not be copied if the rated input voltage differs from the source inverter.
N: Will not be copied. (The function code marked with "N" is not subject to the Verify operation, either.)

If necessary, set up not copied code data manually

■ Using negative logic for programmable I/O terminals

The negative logic signaling system can be used for the general-purpose input and output terminals by setting the function code data specifying the properties for those terminals. Negative logic refers to the inverted ON/OFF (logical value 1 (true)/0 (false)) state of input or output signal. An active-ON signal (the function takes effect if the terminal is short-circuited.) in the normal logic system is functionally equivalent to active-OFF signal (the function takes effect if the terminal is opened.) in the negative logic system. An active-ON signal can be switched to active-OFF signal, and vice versa, with the function code data setting.

To set the negative logic system for an I/O signal terminal, enter data of 1000s (by adding 1000 to the data for the normal logic) in the corresponding function code.

For example, if the "Enable coast-to-stop" command ***BX*** (data = 7) is assigned to any one of digital input terminals [X1] to [X8] by setting any of function codes E01 through E08, then turning ***BX*** on will make the motor coast to a stop. Similarly, if the ***BX*** (data = 1007) is assigned, turning ***BX*** off will make the motor coast to a stop.

■ Control mode

The FRENIC-Lift (LM2A) series of inverters supports the following control modes.

- Vector control with PG for asynchronous motor
- Vector control with PG for synchronous motor
- Torque vector control (without PG for asynchrnonous motor)
- V/f control (for asynchronous motor)

These control modes can be switched by the combination of function codes F42 (Control Mode) and terminal command ***PG/Hz*** as listed below.

F42 (Control Mode)	***PG/Hz****1	Control Mode Selected
0	ON	Vector control with PG (for asynchronous motor) *2
0	OFF	Torque Vector control (without PG for asynchronous motor)
1	ON	Vector control with PG (for synchronous motor) *2
1	OFF	V/f control (for asynchronous motor)
2	ON/OFF	Torque Vector control (without PG for asynchronous motor)

*1 The ON/OFF states in this table are expressed in the normal logic. No assignment of ***PG/Hz*** to any terminal is treated as ON.

*2 An option card is needed. For details, refer to the instruction manual of the option card.

⚠CAUTION

V/f control should apply to a test run only. Applying V/f control to elevator operation is dangerous. With this setting, the inverter may not run in sufficient performance. Torque Vector control is a control mode that doesn't use the encoder. The accuracy of the speed control is inferior to that of the vector control with PG. Use it after doing the initial evaluation.

An accident or physical injury may result.

In the torque vector control, some function codes are invalid. Whether a function code is valid or invalid is indicated with the following notations in the Torque vector control column of the function code tables given below.

Y: Valid. (The function code data affects the inverter operations.)

N: Invalid. (The function code data does not affect the inverter operations.)

■ Corresponding software version

Function code list also shows software version in which the function was added. If software version column is left blank means that the function is available since the first version.

The software version can be checked by the followings.

- Maintenance screen (PRG > 3 > 3 > [8/9]) or Unit information screen (PRG > 3 > 4) on the multi functional keypad TP-A1-LM2 (option).
- Maintenance information (PRG/RESET > 5.CHE) on parameter 5_ 14 on basic keypad TP-E1U (option), when E52=2.
- Reading function code M25 through communication.

The following tables list the function codes available for the FRENIC-Lift (LM2A) series of inverters.

■ F codes: Fundamental Functions

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
F00	Data Protection	0: Disable data protection (Function code data can be edited) 1: Enable data protection Note: This setting is effective if H99 = 0000H.	-	-	Y	N	0	1	Y	
	(Password entry)	0001H to FFFFH Note: This setting is effective if H99 = other than 0000H. Data of H99 is your password								
F01	Frequency Command	0: Multistep speed command (***SS1***, ***SS2***, ***SS4***, ***SS8***) 1: Analog speed command (Not reversible) 2: Analog speed command (Reversible) 3: Analog multistep speed command	-	-	N	Y	0	1	Y	
F03	Rated speed	30.0 to 6000 *1 (Equivalent with 1.00 to 200.00 Hz)	Variable	r/min	N	Y	1450*2	37	Y	
F04	Base speed	30.0 to 6000 *1 (Equivalent with 1.00 to 200.00 Hz)	Variable	*3	N	Y	1500	37	Y	
F05	Rated Voltage	80 to 240 (for 200 V class series) 160 to 500 (for 400 V class series)	1	V	N	Y2	230 380	1	Y	
F07	Acceleration/Deceleration Time 1	0.00 to 99.9 Note: Acceleration/Deceleration time is ignored at 0.00.	Variable	s	Y	Y	1.80	12	Y	
F08	Acceleration/Deceleration Time 2		Variable	s	Y	Y	1.80	12	Y	
F09	Torque boost	0.0 to 5.0	0.1	-	Y	Y	*9	3	Y*8	
F10	Electronic Thermal Overload Protection for Motor (Select motor characteristics)	1: For general-purpose motors with built-in self-cooling fan 2: For inverter-driven motors or high-speed motors with forced-ventilation fan 3: For general-purpose motors with built-in self-cooling fan (Mode2)	-	-	Y	Y	2	1	Y	500
F11	(Overload detection level)	OFF (0.00): Disable 1 to 200% of the rated current (allowable continuous drive current) of the inverter	Variable	A	Y	Y1 Y2	Refer to default table	24	Y	
F12	(Thermal time constant)	0.5 to 75.0	0.1	min	Y	Y	2.0	3	Y	
F20	DC Braking (Starting Speed)	0.00 to 150.0 *1 (Equivalent with 0.00 to 5.00 Hz)	Variable	*3	N	Y	0.0	37	Y*8	
F21	(Braking Level)	0 to 100	1	%	N	Y	0	1	Y*8	
F22	(Braking Time)	OFF (0.00): Disable 0.01 to 30.00	0.01	s	N	Y	OFF	5	Y*8	
F23	Starting Speed	0.00 to 150.0 *1 (Equivalent with 0.00 to 5.00 Hz)	Variable	*3	N	Y	0.00	37	Y	
F24	(Holding time)	0.00 to 10.00	0.01	s	N	Y	0.80	5	Y	
F25	Stop Speed	0.00 to 150.0 *1 (Equivalent with 0.00 to 5.00 Hz)	Variable	*3	N	Y	3.00	37	Y	
F26	Motor Sound (Carrier frequency)	5 to 16	1	kHz	N	Y	15	1	Y	
F30	FMA Terminal (Output gain)	0 to 300	1	%	Y	Y	100	1	Y	
F31	(Function selection)		-	-	Y	Y	0	1	-	
		0: Reference speed (Final)							Y	
		1: Primary frequency							Y	
		2: Output current							Y	
		3: Output voltage							Y	
		4: Output torque							Y	
		8: Actual speed							N	
		9: DC link bus voltage							Y	
		10: Universal AO							Y	
		14: Calibration (+)							Y	
		18: Inverter heat sink temperature							Y	
		19: Inverter internal temperature							Y	
		111: Customizable logic output signal 1 to 120: Customizable logic output signal 10							Y	
F42	Control Mode	0: Vector control with PG for asynchronous motor 1: Vector control with PG for synchronous motor 2: Torque vector control	-	-	N	Y	0	1	Y	
F44	Current Limiter (Level)	Auto(32767): Maximum current of each inverter automatically applies. 100 to 230 (Percentage to the rated current of the inverter)	1	%	Y	Y	Auto	1	N	
F50	Electronic thermal overload protection for braking resistor (Discharging capacity)	OFF(32767): Disable 1 to 9000	1	kWs	Y	Y1 Y2	OFF	1	Y	
F51	(Allowable average loss)	0.001 to 99.99	Variable	kW	Y	Y1 Y2	0.001	45	Y	
F52	(Resistance)	None(0.00): Not applicable 0.01 to 999	Variable	Ohm	Y	Y1 Y2	None	12	Y	

*1 The data setting range is variable. Refer to Section 2.2.
*2 The factory default setting varies depending on the shipping destination.
*3 The unit changes depending on the setting of C21.
*8 This function code is only for the torque vector control.
*9 FRN0025LM2A-4_ (11kW) to FRN0045LM2A-4_ (22kW): 0.3
Other: 0.0.

■ E codes: Extension Terminal Functions

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
E01	Command Assignment to: [X1]	Selecting function code data assigns the corresponding function to terminals [X1] to [X8] as listed below.	-	-	N	Y	0	1	-	
E02	[X2]	Setting the value of 1000s in parentheses( ) shown below	-	-	N	Y	1	1	-	
E03	[X3]	assigns a negative logic input to a terminal.	-	-	N	Y	2	1	-	
E04	[X4]		-	-	N	Y	8	1	-	
E05	[X5]		-	-	N	Y	60	1	-	
E06	[X6]		-	-	N	Y	61	1	-	
E07	[X7]		-	-	N	Y	62	1	-	
E08	[X8]		-	-	N	Y	63	1	-	
		0 (1000): ***SS1*** Select multistep speed 1							Y	
		1 (1001): ***SS2*** Select multistep speed 2							Y	
		2 (1002): ***SS4*** Select multistep speed 4							Y	
		3 (1003): ***SS8*** Select multistep speed 8							Y	
		7 (1007): ***BX*** Coast-to-stop							Y	
		8 (1008): ***RST*** Reset alarm							Y	
		9 (1009): ***THR*** Enable external alarm trip							Y	
		10 (1010): ***JOG*** Enable jogging operation							Y	
		24 (1024): ***LE*** Enable communication link							Y	
		25 (1025): ***U-DI*** Universal DI							Y	
		27 (1027): ***PG/Hz*** Enable PG vector control							-	
		60 (1060): ***TB1*** Select torque bias 1							N	
		61 (1061): ***TB2*** Select torque bias 2							N	
		62 (1062): ***H-TB*** Hold torque bias							N	
		63 (1063): ***BATRY*** Enable battery operation							Y	
		64 (1064): ***CRPLS*** Start creepless operation							Y	
		65 (1065): ***BRKE*** Check brake control							Y	
		66 (1066): ***DRS*** Force to decelerate							Y	
		67 (1067): ***UNBL*** Start unbalance load compensation							N	
		69 : ***PPT*** Start magnetic pole position offset tuning							N	
		80 (1080): ***CLC*** Customizable logic cancel							Y	
		81 (1081): ***CLTC*** Customizable logic all timer clear							Y	
		98 : ***FWD*** Run forward							Y	
		99 : ***REV*** Run reverse							Y	
		100 : ***NONE*** No function assigned							Y	
		101 (1101): ***THR2*** Enable external alarm trip 2							Y	
		102 (1102): ***RTDEC*** Start reference torque decreasing							N	
		103 (1103): ***CS-MC*** Check status MC operation							Y	
		108 (1108): ***CAN_LE*** CAN link enable							Y	
		111 (1111): ***BRKE1*** Check brake control 1							Y	
		112 (1112): ***BRKE2*** Check brake control 2							Y	
		114 : ***RBRK*** Enable rescue operation by means of brake control							N	
		115 (1115): ***SCCF*** Short-circuit control feedback							Y	
		117 (1117): ***STBY*** Stand-by mode							Y	
		118 : ***ULSG*** Unlocking safety gear operation							N	0400
		Note: In the case of ***THR***, ***DRS***, ***THR2***, data (1009), (1066), (1101) are for normal logic, and "9", "66", "101" are for negative logic, respectively.								
E10	Acceleration/Deceleration Time 3	0.00 to 99.9	Variable	s	Y	Y	1.80	12	Y	
E11	Acceleration/Deceleration Time 4	Acceleration/Deceleration time is ignored at 0.00.	Variable	s	Y	Y	1.80	12	Y	
E12	Acceleration/Deceleration Time 5		Variable	s	Y	Y	1.80	12	Y	
E13	Acceleration/Deceleration Time 6		Variable	s	Y	Y	1.80	12	Y	
E14	Acceleration/Deceleration Time 7		Variable	s	Y	Y	1.80	12	Y	
E15	Acceleration/Deceleration Time 8		Variable	s	Y	Y	1.80	12	Y	
E16	Acceleration/Deceleration Time 9		Variable	s	Y	Y	1.80	12	Y	
E17	Acceleration/Deceleration Time 10		Variable	s	Y	Y	1.80	12	Y	
E18	Run Command/		-	-	N	Y	2	1	-	
	Multistep (Mode)	0: None							Y	
	Speed	1: ***FWD***, ***REV***							Y	
	Command Assignment to:	2: ***SS1***, ***SS2***, ***SS4***, ***SS8***							Y	
	Agreement	3: ***FWD***, ***REV*** , ***SS1***, ***SS2***, ***SS4***, ***SS8***							Y	
E19	Timer (Time)	0.000 to 0.100	0.001	s	N	Y	0.005	7	Y	

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
E20	Signal Assignment to (Transistor signal) [Y1]	Selecting function code data assigns the corresponding function to terminals [Y1] to [Y2], [Y3A/C] to [Y5A/C], and [30A/B/C] as listed below.	-	-	N	Y	12	1	-	
E21	[Y2]	Setting the value of 1000s in parentheses ( ) shown below	-	-	N	Y	78	1	-	
E22	(Relay contact signal) [Y3A/C]	assigns a negative logic output to a terminal.	-	-	N	Y	2	1	-	
E23	[Y4A/C]		-	-	N	Y	12	1	-	
E24	[Y5A/C]		-	-	N	Y	57	1	-	
E27	[30A/B/C]		-	-	N	Y	99	1	-	
		0 (1000): ***RUN*** Inverter running							Y	
		1 (1001): ***FAR*** Speed arrival							Y	
		2 (1002): ***FDT*** Speed detected							Y	
		3 (1003): ***LU*** Undervoltage detected							Y	
		10 (1010): ***RDY*** Inverter ready to run							Y	
		12 (1012): ***SW52-2*** MC control							Y	
		25 (1025): ***FAN*** Cooling fan operation							Y	
		26 (1026): ***TRY*** Auto-resetting							Y	
		27 (1027): ***U-DO*** Universal Do							Y	
		28 (1028): ***OH*** Overheat early warning							Y	
		30 (1030): ***LIFE*** Service life alarm							Y	
		31 (1031): ***FDT2*** Speed detected							Y	
		35 (1035): ***RUN2*** Inverter output on							Y	
		37 (1037): ***ID*** Current detected							Y	
		38 (1038): ***ID2*** Current detected 2							Y	
		52 (1052): ***FRUN*** Encoder rotating in forward direction							N	
		53 (1053): ***RRUN*** Encoder rotating in reverse direction							N	
		55 (1055): ***AX2*** Run command activated							Y	
		56 (1056): ***THM*** Motor overheat detected(PTC)							Y	
		57 (1057): ***BRKS*** Brake control							Y	
		70 (1070): ***DNZS*** Speed existence							N	
		71 (1071): ***DSAG*** Speed agreement							N	
		72 (1072): ***FAR3*** Speed arrival 3							Y	
		73 (1073): ***DACC*** During acceleration							Y	
		74 (1074): ***DDEC*** During deceleration							Y	
		75 (1075): ***DZR*** During zero speed							N	
		76 (1076): ***PG-ABN*** PG abnormal							N	
		78 (1078): ***DOPEN*** Door control							Y	
		99 (1099): ***ALM*** Alarm output							Y	
		101 (1101): ***DECF*** EN terminal detection circuit error							Y	
		102 (1102): ***ENOFF*** EN terminal OFF							Y	
		104 (1104): ***LVD*** Low voltage detected							Y	
		105 (1105): ***EAC*** Electrical angle cycle							Y	
		107 (1107): ***DTUNE*** During pole position offset tuning							N	
		109 (1109): ***RRD*** Recommended running direction							N	
		110 (1110): ***ALM2*** Drive continuance alarm output							Y	
		111 (1111): ***SD*** Shutdown confirmation							Y	
		112 (1112): ***IPL*** Input power limitation							Y	
		114 (1114): ***SW52-3*** MC control(Run command activated)							Y	
		115 (1115): ***PTD*** Pole tuning done							N	
		116 (1116): ***DSD*** Detection speed direction							N	
		121 (1121): ***TDCL*** Travel direction changes lifetime early warning							Y	
		122 (1122): ***TDCP*** Travel direction changes pulse							Y	
		123 (1123): ***SCC*** Short-circuit control							Y	
		124 (1124): ***CEND*** Deliverrance operation Calculation end							N	500
		126 (1126): ***PTD-Z*** Pole tuning done with reference to Z-signal							N	
		127 (1127): ***LC1*** Loadcell LV1 detection							N	
		128 (1128): ***LCF*** Loadcell full load detection							N	
		129 (1129): ***LCO*** Loadcell overload detection							N	
		141 (1141): ***CLO1*** Customizable logic output signal 1							Y	
		142 (1142): ***CLO2*** Customizable logic output signal 2							Y	
		143 (1143): ***CLO3*** Customizable logic output signal 3							Y	
		144 (1144): ***CLO4*** Customizable logic output signal 4							Y	
		145 (1145): ***CLO5*** Customizable logic output signal 5							Y	
		146 (1146): ***CLO6*** Customizable logic output signal 6							Y	
		147 (1147): ***CLO7*** Customizable logic output signal 7							Y	
		148 (1148): ***CLO8*** Customizable logic output signal 8							Y	
		149 (1149): ***CLO9*** Customizable logic output signal 9							Y	
		150 (1150): ***CLO10*** Customizable logic output signal 10							Y	

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
E30	Speed Arrival (FAR) (Hysteresis)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	14.5 *2	37	Y	
E31	Speed Detection (FDT) (Detection level)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	1450 *2	37	Y	
E32	(Hysteresis)	0.00 to 900.0 *1 (Equivalent with 0.00 to 30.00 Hz)	Variable	*3	Y	Y	14.5 *2	37	Y	
E34	Current Detection 1 (ID) (Level 1)	When you set 1 to L98:bit0, E34 and E35 are effective over torque current alarm (0t). 0.00: (Disable) Current value of 1 to 200% of the inverter rated current	Variable	A	Y	Y1 Y2	Refer to default table	24	Y	
E35	(Time)	0.01 to 600.00								
E36	Speed Detection 2 (FDT2) (Detection level)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	1450 *2	37	Y	
E37	Current Detection 2 (ID2) (Level 2)	0.00: (Disable) Current value of 1 to 200% of the inverter rated current	Variable	A	Y	Y1 Y2	Refer to default table	24	Y	
E39	Recommended running direction (RRD) (Detection level)	0 to 100	1	%	N	Y	0	1	N	
E43	LED Monitor		-	-	Y	Y	0	1	-	
		0: Speed monitor (Select by E48)							-	
		3: Output current							Y	
		4: Output voltage							Y	
		8: Calculated torque							Y	
		9: Input power							Y	
		18: Reference torque							N	
		19: Torque bias balance adjustment (Offset) (BTBB)							N	
		20: Torque bias gain adjustment (BTBG)							N	
E45	Reserved *4	-	-	-	Y	Y	0	1	Y	
E46	Reserved *4	-	-	-	Y	Y	1	1	Y	
E47	Reserved *4	-	-	-	Y	Y	5	1	Y	
E48	LED Monitor (Speed monitor item)		-	-	Y	Y	0	1	-	
		0: Reference speed (final)							Y	
		2: Reference speed (pre-ramp)							Y	
		3: Motor speed							Y*5	
		5: Elevator speed							Y*5	
		8: Elevator speed (mm/s)							Y*5	
E52	Keypad(Menu display mode)	0: Function code data editing mode 1: Function code data check mode 2: Full-menu mode	1	-	N	Y	0	1	Y	
E59	Terminal [C1] Type selection (C1/V2)	0: Current input: 0 to 20 mA (C1 function) 1: Voltage input: 0 to 10 V (V2 function)	1	-	Y	Y	1	1	Y	
E61	Analog Input for: (Extension function selection) [12]	Selecting function code data assigns the corresponding function to terminals [12], [C1] and [V2] as listed below.	-	-	N	Y	0	1	-	
E62	[C1]		-	-	N	Y	0	1	-	
E63	[V2]		-	-	N	Y	0	1	-	
		0: None							Y	
		1: Speed command (Not reversible operation with polarity)							Y	
		2: Speed command (Reversible operation with polarity) (Nothing for [C1])							Y	
		4: Torque bias command							N	
E98	Command Assignment to: [FWD]	Selecting function code data assigns the corresponding function to terminals [FWD] and [REV] as same as E01.	-	-	N	Y	98	1	-	
E99		Additional available settings against E01 are listed below.	-	-	N	Y	99	1	-	
		98: FWD Run forward							Y	
		99: REV Run reverse							Y	

*1 The data setting range is variable. Refer to Section 2.2.
*2 The factory default setting varies depending on the shipping destination.
*3 The unit changes depending on the setting of C21.
*4 Reserved for particular manufacturers. Do not access this function code.
*5 It is indicated depending on reference speed (final).

■ C codes: Control Functions

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
C01	Battery Operation (Input power limit level)	0 to 100 OFF(32767): Torque limit level is F44.	1	%	Y	Y	OFF	1	N	
C02	(Limit time)	0.0: C01 is effective during battery operation. 0.1 to 30.0	0.1	s	Y	Y	0.0	3	N	
C03		0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	50.00	37	Y	
C04	Multistep Speed Zero Speed	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	0.00	37	Y	
C05	Manual Speed (Middle)		Variable	*3	Y	Y	0.00	37	Y	
C06	Maintenance Speed		Variable	*3	Y	Y	500.0	37	Y	
C07	Creep Speed		Variable	*3	Y	Y	75.00	37	Y	
C08	Manual Speed (Low)		Variable	*3	Y	Y	0.00	37	Y	
C09	Low Speed		Variable	*3	Y	Y	0.00	37	Y	
C10	Middle Speed		Variable	*3	Y	Y	0.00	37	Y	
C11	High Speed		Variable	*3	Y	Y	1450	37	Y	
C12	igh Speed 2		Variable	*3	Y	Y	0.00	37	Y	
C13	High Speed 3		Variable	*3	Y	Y	0.00	37	Y	
C14	High Speed 4		Variable	*3	Y	Y	0.00	37	Y	
C15	High Speed 5		Variable	*3	Y	Y	0.00	37	Y	
C16	High Speed 6		Variable	*3	Y	Y	0.00	37	Y	
C17	High Speed 7		Variable	*3	Y	Y	0.00	37	Y	
C18	High Speed 8		Variable	*3	Y	Y	0.00	37	Y	
C19	High Speed 9		Variable	*3	Y	Y	0.00	37	Y	
C20	Jogging Operation Speed	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	50.00	37	Y	
C21	Speed Command Unit	0: r/min 1: m/min 2: Hz 3: mm/s	-	-	Y	Y	0	1	Y	
C22	Analog Input Type	0: Analog voltage control 1: Switch control	-	-	N	Y	0	1	Y	
C31	Analog Input Adjustment for [12] (Offset)	-100.0 to +100.0	0.1	%	Y*	Y	0.0	4	Y	
C32	(Gain)	0.00 to 200.00	0.01	%	Y*	Y	100.00	5	Y	
C33	(Filter time constant)	0.000 to 5.000	0.001	s	Y	Y	0.050	7	Y	
C36	Analog Input Adjustment for [C2] (Offset)	-100.0 to +100.0	0.1	%	Y*	Y	0.0	4	Y	
C37	(Gain)	0.00 to 200.00	0.01	%	Y*	Y	100.00	5	Y	
C38	(Filter time constant)	0.000 to 5.000	0.001	s	Y	Y	0.050	7	Y	
C41	Analog Input Adjustment for [V2] (Offset)	-100.0 to +100.0	0.1	%	Y*	Y	0.0	4	Y	
C42	(Gain)	0.00 to 200.00	0.01	%	Y*	Y	100.00	5	Y	
C43	(Filter time constant)	0.000 to 5.000	0.001	s	Y	Y	0.050	7	Y	
C89	Setpoint factor via communication (Numerator)	-32768 to 32767	1	-	Y	Y	1	2	Y	
C90	(Denominator)	-32768 to 32767	1	-	Y	Y	1	2	Y	

*1 The data setting range is variable. Refer to Section 2.2.
*3 The unit changes depending on the setting of C21.

■ P codes: Motor Parameters

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
P01	Motor (No. of poles)	2 to 100	2	Poles	N	Y1 Y2	4	1	Y	
P02	(Rated capacity)	0.01 to 55.00	0.01	kW	N	Y1 Y2	Refer to default table	11	Y	
P03	(Rated current)	0.00 to 500.0	Variable	A	N	Y1 Y2	Refer to default table	24	Y	
P04	(Auto-tuning)	0: Disable 1: Enable (Tune %R1 and %X while the motor is stopped.) 2: Enable (Tune %R1, %X, no-load current, and rated slip whilethe motor is stopped.) 3: Enabl (Tune %R1, %X and rated slip while the motor is stopped. no-load current is calculated by the motor constant) 4: Enable (Auto tuning current loop (ACR) proportional gain)	-	-	N	N	0	21	Y	
P06	(No-load current)	0.00 to 500.0	Variable	A	N	Y1 Y2	Refer to default table	24	Y	
P07	(%R1)	0.00 to 50.00	0.01	%	Y	Y1 Y2	Refer to default table	5	Y	
P08	(%X)	0.00 to 50.00	0.01	%	Y	Y1 Y2	Refer to default table	5	Y	
P09	(Slip comp. driving gain)	0.0 to 200.0	0.1	%	Y	Y	100.0	3	Y	
P10	(Slip comp. braking gain)	0.0 to 200.0	0.1	%	Y	Y	100.0	3	Y	
P11	(Slip comp. response time)	0.05 to 1.00	0.01	s	Y	Y	1.00	5	Y*8	
P12	(Rated slip)	0.00: Rated slip of Fuji standard motor 0.01 to 15.00	0.01	Hz	Y	Y1 Y2	0.00	5	Y	
P60	(Armature resistance - Rs)	0.000 to 50.000	0.001	Ohm	N	Y1 Y2	0.000	45	N	
P62	(Armature q-axis reactance - Xs)	0.000 to 50.000	0.001	Ohm	N	Y1 Y2	0.000	45	N	
P63	(Interphase inductive voltage - E)	0 to 500	1	V	N	Y1 Y2	0	1	N	

*8 This function code is only for the torque vector control.

■ H codes: High Performance Functions

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
H03	Data Initialization	0: Disable initialization 1: Initialize all function code data to the factory defaults (vector control for IM) 2: Initialize all function code data to vector control for PMSM 3: Initialize all function code data to open loop control for IM 11: Initialize all function code data to the factory defaults without Link parameters 12: Initialize customizable logic parameters	-	-	N	N	0	1	Y	
H04	Auto-reset (Times)	0: Disable 1 to 10: Auto reset number of times								
H05	(Reset interval)	0.5 to 20.0	0.1	s	Y	Y	5	3	Y	
H06	Cooling Fan Control	Auto(0.0): Automatic ON/OFF depending upon temperature OFF(32767): Disable (Always ON) 0.5 to 10.0 min: OFF by timer	0.1	min	Y	Y	Auto	3	Y	
H26	PTC/NTC Thermistor (Mode)	0: Disable 1: Enable (Upon detection of (PTC), the inverter immediately trips and stops with ***0h4*** displayed.) 2: Enable(Upon detection of (PTC), the inveter continues running while outputting alarm signal TMH.) 3: Enable(Upon detection of (NTC), the inveter detects motor temperature)								
H27	(Level)	0.00 to 5.00	0.01	V	Y	Y	1.60	5	Y	
H30	Communications Link Operation	Each digit of hexadecimal number specifies the source of following commands. **H30 = 0 □ □ □** Speed command Run command Torque bias command 0: F01/Terminal/L54 1: RS-485 Ch.1 2: RS-485 Ch.2 3: CAN 4-F: same as 0 Additionally, following alternative settings are also available for compatibility with FRENIC-Lift (LM1): 0x0005 : Equivalent with 0x0030 0x0006 : Equivalent with 0x0033 0x000E : Equivalent with 0x0333	-	-	Y	Y	0000_H	1	Y	
H42	Capacitance of DC Link Bus Capacitor	Meas(0): Initial value measurement Failed(1): Measurement failure 2 to 65535: Indication for replacing DC link bus capacitor	-	-	N	N	-	1	Y	
H43	Cumulative Run Time of Cooling Fan	0 to 9999: Indication of cumulative run time of cooling fan in 10 hours for replacement	-	-	N	N	-	74	Y	
H47	Initial Capacitance of DC Link Bus Capacitor	0 to 65535: Indication for replacing DC link bus capacitor	-	-	N	N	Set at factory shipping	1	Y	
H48	Cumulative Run Time of Capacitors on Printed Circuit Board	0 to 9999: Indication for replacing capacitors on printed circuit boards	-	-	N	N	-	74	Y	
H54	Acceleration Time (Jogging)	0.00 to 99.9	Variable	s	Y	Y	1.80	12	Y	
H55	Deceleration Time (Jogging)	0.00 to 99.9	Variable	s	Y	Y	1.80	12	Y	
H56	Deceleration Time for Forced to Decelerate	0.00 to 99.9	Variable	s	Y	Y	1.20	12	Y	
H57	S-curve Setting 11	0 to 50% of max. speed	1	%	Y	Y	20	1	N	
H58	S-curve Setting 12		1	%	Y	Y	20	1	N	
H59	S-curve Setting 13		1	%	Y	Y	20	1	N	
H60	S-curve Setting 14		1	%	Y	Y	20	1	N	

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
H64	Zero Speed Holding Time	0.00 to 10.00	0.01	s	N	Y	0.00	5	N	
H65	Starting Speed (Soft start time)	0.0 to 60.0	0.1	s	N	Y	0.0	3	Y	
H66	Stop Speed (Detection method)	0: Use detected speed 1: Use reference speed (final)	-	-	N	Y	0	1	Y	
H67	(Holding time)	0.00 to 10.00	0.01	s	N	Y	1.00	5	Y	
H72	Main power shutdown detection (Mode selection)	0:Invalid 1:Valid								
H74	Speed Agreement (Hysteresis)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	10.00	37	N	
H75	(OFF delay time)	0.00 to 1.00	0.01	s	Y	Y	0.20	5	N	
H76	PG Error Detection for Mode 3 (Detection level)	0 to 50	-	-	Y	Y	0000_H	1	Y	
H77	(Detection time)	0.0 to 10.0	-	-	Y	Y	0000_H	1	Y	
H80	Exciting current damping gain	0.00 to 1.00	0.01	-	Y	Y	0.20	5	Y*8	
H81	Auto Reset (Mode selection 1)	0000_H to $FFFF_H$	-	-	Y	Y	0000_H	1	Y	
H82	(Mode selection 2)	0000_H to $FFFF_H$	-	-	Y	Y	0000_H	1	Y	
H89	Strore electronic thremal overload protection data for motor	0: Clears cumulative value of thermal by inverter power-off. 1: Retains cumulative value of thermal after inverter power-off.	1	-	Y	Y	0	1	Y	500
H94	Cumulative Run Time of Motor	0 to 9999: Cumulative run time can be modified or reset in units of 10 hours	-	-	N	N	0	74	Y	
H95	Clear bbE Alarm	0 to 255	1	-	N	N	0	1	Y	
H96	Check brake control select	0: BRKE is active 1: BRKE1 and BRKE2 are active	-	-	N	Y	0	1	Y	
H97	Clear Alarm Data	If H97= 1, its data returns to zero after clearing alarm data.	-	-	Y	N	0	1	Y	
H98	Protection/Maintenance Function	00000000b to 11111111b (0 to 255)	-	-	Y	Y	01010001 (81)	1	-	
		Bit 0: Lower the carrier frequency automatically							Y	
		Bit 1: Detect input phase loss							Y	
		Bit 2: etect output phase loss							Y	
		Bit 3: Select life judgment criteria of DC link bus capacitor							Y	
		Bit 4: Judge the life of DC link bus capacitor							Y	
		Bit 5 Reserved							Y	
		Bit 6: Detect DB-Tr broken							Y	
		Bit 7: Detect thermistor disconnect for heat sink							Y	
H99	Password Protection	0000H to FFFFH 0000_H: Disable password protection 0001_H to $FFFF_H$: Enable password protection	-	-	Y	N	0000_H	1	Y	
H190	Terminal [UVW] Output order	0: Normal (FWD = UVW) 1: Inverse (FWD = UWV)	-	-	N	Y	1	1	Y	

*3 The unit changes depending on the setting of C21.
*8 This function code is only for the torque vector control.

■ U codes: Application Functions (Customizable logic)

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
U00	Customizable logic (Mode selection)	0: Disable 1: Enable (Customizable logic operation) ECL alarm occurs when the value is changed from 1 to 0 during the inverter running.	-	-	Y	Y	0	1	Y	
U01	Customizable logic: Step 1 (Block selection)	0: No function assigned **[Digital]** 10 to 15: Through output + Timer 20 to 25: Logical AND + Timer 30 to 35: Logical OR + Timer 40 to 45: Logical XOR + Timer 50 to 55: Set priority flip-flop + Timer 60 to 65: Reset priority flip-flop + Timer 70, 72, 73: Rising edge detector + Timer 80, 82, 83: Falling edge detector + Timer 90, 92, 93: Rising & falling edges detector + Timer 100 to 105: Hold + Timer 110: Increment counter 120: Decrement counter 130: Timer with reset input * Timer function (Least significant digit 0 to 5) _0: No timer _1: On-delay timer _2: Off-delay timer _3: Pulse (1 shot) _4: Retriggerable timer _5: Pulse train output **[Analog]** 2001: Adder 2002: Subtracter 2003: Multiplier 2004: Divider 2005: Limiter 2006: Absolute value of input 2007: Inverting adder 2008: Variable limiter 2009: Linear function 2051 to 2056: Comparator1 to 6 2071, 2072: Window comparator1, 2 2101: High selector 2102: Low selector 2103: Average of inputs **[Digital + Analog]** 4001: Hold 4002: Inverting adder with enable 4003, 4004: Selector 1, 2 4005: LPF(Low-pass filter) with enable 4006: Rate limiter with enable 5000: Selector 3 5100: Selector 4 6001: Reading function code 6002: Writing function code 6003: Temporary change of function code	-	-	N	Y	0	1	Y	

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
U02	Customizable logic: Step 1	**[Digital]**	-	-	N	Y	100	1	Y	
U03	(Input 1) (Input 2)	0 to 129: Same as E20 value. However, 27, 141 to 150 cannot be selected. 2001 to 2200 (3001 to 3200): Output of Step 1 to 200 4001 (5001): X1 terminal input signal 4002 (5002): X2 terminal input signal 4003 (5003): X3 terminal input signal 4004 (5004): X4 terminal input signal 4005 (5005): X5 terminal input signal 4006 (5006): X6 terminal input signal 4007 (5007): X7 terminal input signal 4008 (5008): X8 terminal input signal 4010 (5010): FWD terminal input signal 4011 (5011): REV terminal input signal 4101 (5101): X1 terminal input signal (only terminal) 4102 (5102): X2 terminal input signal (only terminal) 4103 (5103): X3 terminal input signal (only terminal) 4104 (5104): X4 terminal input signal (only terminal) 4105 (5105): X5 terminal input signal (only terminal) 4106 (5106): X6 terminal input signal (only terminal) 4107 (5107): X7 terminal input signal (only terminal) 4108 (5108): X8 terminal input signal (only terminal) 4110 (5110): FWD terminal state (only terminal) 4111 (5111): REV terminal state (only terminal) 8002: Output current 8003: Output voltage 8004: Output torque 8008: Actual speed/estimated speed 8009: DC link bus voltage 8018: Inverter heat sink temperature 8019: Inverter internal temperature 9001: Analog 12 terminal input signal 9002: Analog C1 terminal input signal 9003: Analog V2 terminal input signal	-	-	N	Y	100	1	Y	
U04	(Function 1)	-9990 to 0.00 to 9990	Variable	-	N	Y	0.00	12	Y	
U05	(Function 2)	-9990 to 0.00 to 9990	Variable	-	N	Y	0.00	12	Y	

Customizable logic Step 1 to 14 function code is assigned as follows: Setting value is the same as U01 to U05.

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10	Step 11	Step 12	Step 13	Step 14
Block selection	U01	U06	U11	U16	U21	U26	U31	U36	U41	U46	U51	U56	U61	U66
Input 1	U02	U07	U12	U17	U22	U27	U32	U37	U42	U47	U52	U57	U62	U67
Input 2	U03	U08	U13	U18	U23	U28	U33	U38	U43	U48	U53	U58	U63	U68
Function 1	U04	U09	U14	U19	U24	U29	U34	U39	U44	U49	U54	U59	U64	U69
Function 2	U05	U10	U15	U20	U25	U30	U35	U40	U45	U50	U55	U60	U65	U70

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
U71	Customizable logic (Output selection) Output signal 1	0: Disable	1	-	N	Y	0	1	Y	
U72	Output signal 2	1 to 200: Output of Step 1 to 200 "SO001" to "SO200"	1	-	N	Y	0	1	Y	
U73	Output signal 3		1	-	N	Y	0	1	Y	
U74	Output signal 4		1	-	N	Y	0	1	Y	
U75	Output signal 5		1	-	N	Y	0	1	Y	
U76	Output signal 6		1	-	N	Y	0	1	Y	
U77	Output signal 7		1	-	N	Y	0	1	Y	
U78	Output signal 8		1	-	N	Y	0	1	Y	
U79	Output signal 9		1	-	N	Y	0	1	Y	
U80	Output signal 10		1	-	N	Y	0	1	Y	
U81	Customizable logic (Function selection) Output signal 1	0xxx (1xxx): Same as E01	-	-	N	Y	100	1	Y	
U82	Output signal 2	8xxx: The value with 8000 added to E61	-	-	N	Y	100	1	Y	
U83	Output signal 3		-	-	N	Y	100	1	Y	
U84	Output signal 4		-	-	N	Y	100	1	Y	
U85	Output signal 5		-	-	N	Y	100	1	Y	
U86	Output signal 6		-	-	N	Y	100	1	Y	
U87	Output signal 7		-	-	N	Y	100	1	Y	
U88	Output signal 8		-	-	N	Y	100	1	Y	
U89	Output signal 9		-	-	N	Y	100	1	Y	
U90	Output signal 10		-	-	N	Y	100	1	Y	
U91	Customizable logic timer monitor (Step selection)	0: Disable 1 to 200: Step 1 to 200	1	-	Y	Y	0	1	Y	
U100	Task process cycle setting	0: Auto select from 2, 5, 10 or 20 ms depending on the number of steps. 2: 2 ms (Up to 10 step) 5: 5 ms (Up to 50 step) 10: 10 ms (Up to 100 step) 20: 20ms (Up to 200 step)								
U121	Customizable logic (User parameter 1)	-9990.00 to 0.00 to 9990.00	Variable	-	Y	Y	0.00	12	Y	
U122	(User parameter 2)		Variable	-	Y	Y	0.00	12	Y	
U123	(User parameter 3)		Variable	-	Y	Y	0.00	12	Y	
U124	(User parameter 4)		Variable	-	Y	Y	0.00	12	Y	
U125	(User parameter 5)		Variable	-	Y	Y	0.00	12	Y	
U126	(User parameter 6)		Variable	-	Y	Y	0.00	12	Y	
U127	(User parameter 7)		Variable	-	Y	Y	0.00	12	Y	
U128	(User parameter 8)		Variable	-	Y	Y	0.00	12	Y	
U129	(User parameter 9)		Variable	-	Y	Y	0.00	12	Y	
U130	(User parameter 10)		Variable	-	Y	Y	0.00	12	Y	
U131	(User parameter 11)		Variable	-	Y	Y	0.00	12	Y	
U132	(User parameter 12)		Variable	-	Y	Y	0.00	12	Y	
U133	(User parameter 13)		Variable	-	Y	Y	0.00	12	Y	
U134	(User parameter 14)		Variable	-	Y	Y	0.00	12	Y	
U135	(User parameter 15)		Variable	-	Y	Y	0.00	12	Y	
U136	(User parameter 16)		Variable	-	Y	Y	0.00	12	Y	
U137	(User parameter 17)		Variable	-	Y	Y	0.00	12	Y	
U138	(User parameter 18)		Variable	-	Y	Y	0.00	12	Y	
U139	(User parameter 19)		Variable	-	Y	Y	0.00	12	Y	
U140	(User parameter 20)		Variable	-	Y	Y	0.00	12	Y	
U171	Customizable logic (Strage area 1)	-9990.00 to 0.00 to 9990.00	Variable	-	Y	Y	0.00	12	Y	
U172	(Strage area 2)		Variable	-	Y	Y	0.00	12	Y	
U173	(Strage area 3)		Variable	-	Y	Y	0.00	12	Y	
U174	(Strage area 4)		Variable	-	Y	Y	0.00	12	Y	
U175	(Strage area 5)		Variable	-	Y	Y	0.00	12	Y	
U190	Customizable logic setting step Setting step (Step number)	1 to 200	1	-	Y	Y	15	1	Y	
U191	(Select block)	Same as U01	-	-	N	Y	0	1	Y	
U192	(Input 1)	Same as U02	-	-	N	Y	100	1	Y	
U193	(Input 2)	Same as U03	-	-	N	Y	100	1	Y	
U194	(Function 1)	Same as U04	Variable	-	N	Y	0.00	12	Y	
U195	(Function 2)	Same as U05	Variable	-	N	Y	0.00	12	Y	
U196	Customizable logic ROM version Upper digit (Monitor)	0 to 9999	1	-	N	N	0	1	Y	
U197	(For User setting)	0 to 9999	1	-	N	Y	0	1	Y	
U198	Customizable logic ROM version Lower digit (Monitor)	0 to 9999	1	-	N	N	0	1	Y	
U199	(For User setting)	0 to 9999	1	-	N	Y	0	1	Y	

■ y codes: Link Functions

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
y01	RS485 Communication 1 (Station address)	1 to 255	1	-	N	Y	1	1	Y	
y02	(Communications error processing)	0: Immediately trip with alarm er8 1: Trip with alarm er8 after running for the period specified by timer y03 2: Retry during the period specified by timer y03. If retry fails, trip with alarm er8. If it succeeds, continue to run. 3: Continue to run	-	-	Y	Y	0	1	Y	
y03	(Error processing time)	0.0 to 60.0	0.1	s	Y	Y	2.0	3	Y	
y04	(Baud rate)	1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	-	-	Y	Y	3	1	Y	
y05	(Data length)	0: 8 bits 1: 7 bits	-	-	Y	Y	0	1	Y	
y06	(Parity check)	0: None (Stop bit 2) 1: Even parity 2: Odd parity 3: None (Stop bit 1)	-	-	Y	Y	0	1	Y	
y07	(Stop bits)	0: 2 bits 1: 1 bit	-	-	Y	Y	0	1	Y	
y08	(No-response error detection time)	OFF(0): No detection 1 to 60	1	s	Y	Y	OFF	1	Y	
y09	(Response latency time)	0.00 to 1.00	0.01	s	Y	Y	0.01	5	Y	
y10	(Protocol selection)	0: Modbus RTU protocol 1: SX protocol (FRENIC Loader protocol) 2: Reserved for particular manufacturers 5: DCP3	-	-	Y	Y	1	1	Y	
y11	RS485 Communication 2 (Station address)	1 to 255	1	-	N	Y	1	1	Y	
y12	(Communications error processing)	0: Immediately trip with alarm er8 1: Trip with alarm er8 after running for the period specified by timer y03 2: Retry during the period specified by timer y03. If retry fails, trip with alarm ***er8***. If it succeeds, continue to run. 3: Continue to run	-	-	Y	Y	0	1	Y	
y13	(Error processing time)	0.0 to 60.0	0.1	s	Y	Y	2.0	3	Y	
y14	(Baud rate)	1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	-	-	Y	Y	3	1	Y	
y15	(Data length)	0: 8 bits 1: 7 bits	-	-	Y	Y	0	1	Y	
y16	(Parity check)	0: None (Stop bit 2) 1: Even parity 2: Odd parity 3: None (Stop bit 1)	-	-	Y	Y	0	1	Y	
y17	(Stop bits)	0: 2 bits 1: 1 bit	-	-	Y	Y	0	1	Y	
y18	(No-response error detection time)	OFF(0): No detection 1 to 60	1	s	Y	Y	OFF	1	Y	
y19	(Response latency time)	0.00 to 1.00	0.01	s	Y	Y	0.01	5	Y	
y20	(Protocol selection)	0: Modbus RTU protocol 1: SX protocol (FRENIC Loader protocol) 2: Reserved for particular manufacturers 5: DCP3	-	-	Y	Y	0	1	Y	

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
y21	CAN Communication (Node-ID)	1 to 127	1	-	N	Y	1	1	Y	
y24	(Baud rate)	0: 10 kbps 1: 20 kbps 2: 50 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 800 kbps 7: 1 Mbps	1	-	N	Y	3	1	Y	
y25	(User-defined I/O parameter 1)	0000_H to $FFFF_H$	-	-	N	Y	0000_H	1	Y	
y26	(User-defined I/O parameter 2)		-	-	N	Y	0000_H	1	Y	
y27	(User-defined I/O parameter 3)		-	-	N	Y	0000_H	1	Y	
y28	(User-defined I/O parameter 4)		-	-	N	Y	0000_H	1	Y	
y29	(User-defined I/O parameter 5)		-	-	N	Y	0000_H	1	Y	
y30	(User-defined I/O parameter 6)		-	-	N	Y	0000_H	1	Y	
y31	(User-defined I/O parameter 7)		-	-	N	Y	0000_H	1	Y	
y32	(User-defined I/O parameter 8)		-	-	N	Y	0000_H	1	Y	
y33	(Operation)	0: Disable 1: Enable (CiA 402)	-	-	N	Y	0	1	Y	
y34	(Communications error processing)	This function code is valid in case of y36=-4 or -5 0: Set the motor immediately in coast-to-stop mode and trip with Ert. 1: After the time specified by y35, coast to a stop and trip with Ert. 2: If the inverter receives any data within the time specified by y35, ignore the communications error. After the timeout, coast to a stop and trip with Ert. 3 to 15: Same as y34=0	-	-	Y	Y	0	1	Y	
y35	(Communication time-out detection timer)	0.0 to 60.0	0.1	s	Y	Y	0.0	3	Y	
y36	(Operation selection in abort status)	-5 to 3	1	-	Y	Y	1	2	-	
y37	(Compatibility selection)	0: Standard 1: Compatible with FRENIC-Lift (LM1)	-	-	N	Y	0	1	-	
y41	Setting method of speed command by communication	0: Speed command 1: Acceleration command	-	-	N	Y	0	1	-	
y95	Data clear processing for communications error	0: Do not clear the data of function codes Sxx when a communications error occurs. (compatible with the conventional inverters) 1: Clear the data of function codes S01/S05/S19 when a communications error occurs. 2: Clear the run command assigned bit of function code S06 when a communications error occurs. 3: Clear both data of S01/S05/S19 and run command assigned bit of S06 when a communications error occurs. * Related alarms: Er8, ErP, Ert	-	-	Y	Y	0	1	Y	
y97	Communication data storage selection	0: Store into nonvolatile memory (Rewritable times are limited) 1: Write into temporary memory (Rewritable times are unlimited) 2: Save all data from temporary memory to nonvolatile memory (After all save, return to Data 1)	-	-	Y	Y	0	1	Y	
y99	Loader Link Function (Mode)	Control command / Run command 0: Follow H30 / Follow H30 1: Via Loader / Follow H30 2: Follow H30 / Via Loader 3: Via Loader / Via Loader Note: Control commands include Speed command, Torque current command, and Torque bias command.	-	-	Y	N	0	1	Y	

■ L codes: Lift Functions

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
L01	Pulse Encoder (Selection)		-	-	N	Y	0	1	-	
		A/B phase / ABS signal								
		0: 12/15 V (Complementary / Open collector), 5 V Line driver / None							N	
		1: 12/15 V (Complementary / Open collector), 5 V Line driver / Z							N	
		4: Sinusoidal differential voltage (1 V p-p) / EnDat 2.1 (ECN1313 compatible)							N	
		5: Sinusoidal differential voltage (1 V p-p) / SIN/COS (ERN1387 compatible)							N	
		6: Sinusoidal differential voltage (1 V p-p) / BiSS-C (Sendix5873 compatible)							N	
		7: Sinusoidal differential voltage (1 V p-p) / SSI (ECN1313 compatible)							N	
		8: Sinusoidal differential voltage (1 V p-p) / Hiperface (SRS50 compatible)							N	
L02	(Resolution)	360 to 60000	1	P/R	N	Y	1024	1	N*7	
L03	Magnetic Pole Position Offset (Tuning)		-	-	N	N	0	21	N	
		0: Disable							Y	
		1: Reserved for particular manufacturers							N	
		3: Reserved for particular manufacturers							N	
		4: Enable (motor stopped)							N	
		5: Enable (motor rotated)							N	
		Note: This setting is effective if F42 = 1. 1 to 4 : It is a recommended condition that the brake is a close. 5 : It is necessary condition that the brake is a release and without load.								
L04	(Offset angle)	0.00 to 360.00 (Return value of L03) Note: This setting is effective if F42 = 1.	0.01	deg	N	Y	0.00	5	N	
L05	ACR P constant	-	-	-	Y	Y	1.5	3	N	
L06	ACR I constant	-	-	-	Y	Y	0.80	5	N	
L07	Auto magnetic Pole Position tuning mode select		-	-	N	N	0	21	N	
		0: Disable							Y	
		1: Enable							N	
		3: Enable (with checking accuracy)							N	
		4: Enable (for SPM)							N	
		Note: This setting is effective if F42 = 1. 1 to 4 : It is a recommended condition that the brake is a close.								
L09	Filter Time Constant for Reference Speed (Final)	0.000 to 0.100	0.001	s	Y	Y	0.000	7	Y	
L10	Filter Time Constant for Detected Speed	0.000 to 0.100	0.001	s	Y	Y	0.005	7	N*7	
L11	Multistep Speed Command Combination Zero Speed	00000000_b to 00000111_b (0 to 7) Note: If a binary value within the range from 00000000_b to 00000111_b is double-assigned, the inverter trips with alarm Er6.	1	-	N	Y	0	1	Y	
L12	Manual Speed (Middle)		1	-	N	Y	1	1	Y	
L13	Maintenance Speed		1	-	N	Y	2	1	Y	
L14	Creep Speed		1	-	N	Y	3	1	Y	
L15	Manual Speed (Low)		1	-	N	Y	4	1	Y	
L16	Low Speed		1	-	N	Y	5	1	Y	
L17	Middle Speed		1	-	N	Y	6	1	Y	
L18	High Speed		1	-	N	Y	7	1	Y	
L19	S-curve Setting 1	0 to 50% of max. speed	1	%	Y	Y	20	1	Y	
L20	2		1	%	Y	Y	20	1	Y	
L21	3		1	%	Y	Y	20	1	Y	
L22	4		1	%	Y	Y	20	1	Y	
L23	5		1	%	Y	Y	20	1	Y	
L24	6		1	%	Y	Y	20	1	Y	
L25	7		1	%	Y	Y	20	1	Y	
L26	8		1	%	Y	Y	20	1	Y	
L27	9		1	%	Y	Y	20	1	Y	
L28	10		1	%	Y	Y	20	1	Y	
L29	Short Floor Operation (Holding time)	OFF(32767): Disable 0.00 to 10.00	0.01	s	N	Y	0.00	5	Y	
L30	(Allowable speed)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	N	Y	0.00	37	Y	
L31	Elevator Parameter (Speed)	1 to 4000 (Elevator speed at maximum speed of the motor)	1	mm/s	N	Y	1000	1	Y	
L32	(Over speed level)	50 to 120	1	%	N	Y	120	1	N	
L33	(Over speed timer)	0.000 to 0.500	0.001	s	N	Y	0.000	7	N	
L34	(Moving distance in creepless operation)	0.0 to 6553.5	0.1	mm	N	Y	0.0	3	Y	

*1 The data setting range is variable. Refer to Section 2.2.
*3 The unit changes depending on the setting of C21.
*7 If the speed detection is effective, it operates.

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
L36	ASR (P constant at high speed)	0.01 to 200.00	0.01	-	Y	Y	10.00	5	N	
L37	(I constant at high speed)	0.001 to 1.000	0.001	s	Y	Y	0.100	7	N	
L38	(P constant at low speed)	0.01 to 200.00	0.01	-	Y	Y	10.00	5	N	
L39	(I constant at low speed)	0.001 to 1.000	0.001	s	Y	Y	0.100	7	N	
L40	(Switching speed 1)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	150.0	37	N	
L41	(Switching speed 2)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	Y	Y	300.0	37	N	
L42	(Feed forward gain)	0.000 to 10.000	0.001	s	Y	Y	0.000	7	N	
L49	Vibration Suppression Observer (Gain)	OFF(0.00): Disable 0.01 to 1.00	0.01	-	Y	Y	OFF	5	N	
L50	(Integral time)	0.005 to 1.000	0.001	s	Y	Y	0.100	7	N	
L51	(Load inertia)	0.01 to 655.35	0.01	kgm^2	Y	Y	0.01	5	N	
L52	Start Control Mode	0: Enable speed start mode 1: Enable torque start mode	1	-	Y	Y	0	1	N	
L54	Torque Bias (Mode)	0: Analog 1: Digital 2: PI control 3: DCP	-	-	N	Y	0	1	N	
L55	(Startup time)	0.00 to 1.00	0.01	s	Y	Y	0.20	5	N	
L56	(Reference torque end time)	OFF(0.00): Disable 0.01 to 20.00	0.01	s	Y	Y	0.20	5	N	
L57	(Limiter)	0 to 200	1	%	Y	Y	100	1	N	
L58	(P constant)	0.01 to 10.00	0.01	-	Y	Y	1.00	5	N	
L59	(Integral time)	0.00 to 1.00	0.01	s	Y	Y	1.00	5	N	
L60	(Driving gain)	-1000.0 to 1000.0	0.1	%	Y*	Y	100.0	4	N	
L61	(Braking gain)	-1000.0 to 1000.0	0.1	%	Y*	Y	100.0	4	N	
L62	(Digital 1)	-200 to 200	1	%	Y	Y	0	2	N	
L63	(Digital 2)	-200 to 200	1	%	Y	Y	0	2	N	
L64	(Digital 3)	-200 to 200	1	%	Y	Y	0	2	N	
L65	Unbalanced Load Compensation (Operation)	0: Disable 1: Enable	-	-	N	Y	1	1	N	
		2: Enable(Backlash correction)								0500
L66	(Activation time)	0.00 to 2.00	0.01	s	N	Y	2.00	5	N	
L68	(ASR P constant)	0.00 to 200.00	0.01	-	Y	Y	10.00	5	N	
L69	(ASR I constant)	0.001 to 1.000	0.001	s	Y	Y	0.100	7	N	
L73	(APR P constant)	0.00 to 10.00	0.01	-	Y	Y	0.00	5	N	
L74	(APR D gein)	0.0 to 10.0	0.1	-	Y	Y	0.0	3	N	
L75	(Filter Time Constant for Detected Speed)	0.000 to 0.100	0.001	s	Y	Y	0.000	7	N	
L76	(ACR P constant)	0.0 to 15.0	0.1	-	Y	Y	0.0	3	N	
L80	Brake Control (Mode)	1: Brake control by time 2: Brake control by output current	-	-	N	Y	1	1	Y	
L81	(Operation level)	0 to 200	1	%	N	Y	100	1	Y	
L82	(ON delay time)	0.00 to 10.00	0.01	s	N	Y	0.20	5	Y	
L83	(OFF delay time)	0.00 to 100.00	0.01	s	N	Y	0.10	5	Y	
L84	(Brake check time)	0.00 to 10.00	0.01	s	N	Y	0.00	5	Y	
L85	MC Control (Startup delay time)	0.00 to 10.00	0.01	s	N	Y	0.10	5	Y	
L86	(MC OFF delay time)	0.00 to 10.00	0.01	s	N	Y	0.10	5	Y	
L87	Door Control (Door open starting speed)	0.00 to 6000 *1 (Equivalent with 0.00 to 200.00 Hz)	Variable	*3	N	Y	450.0	37	Y	
L88	(Door open delay time)	0.0 to 10.0	0.1	s	N	Y	1.0	3	Y	
L89	(Door open period)	0.1 to 30.0	0.1	s	N	Y	5.0	3	Y	

*1 The data setting range is variable. Refer to Section 2.2.
*3 The unit changes depending on the setting of C21.

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
L90	PG Error Detection		-	-	N	Y	1	1	-	
	(Mode)	0: Continue to run							Y	
		1: Trip at alarm mode 1 with alarm ErE							N	
		2: Trip at alarm mode 2 with alarm ErE							N	
		3: Trip at alarm mode 3 with alarm ErE							N	
L91	(Detection level)	0 to 50	1	%	Y	Y	10	1	N	
L92	(Detection time)	0.0 to 10.0	0.1	s	Y	Y	1.0	3	N	
L93	Overheat Early Warning Level	1 to 20	1	deg	Y	Y	5	1	Y	
L97	Magnetic Pole Position Tuning (Voltage)	1.00 to 50.00	0.01	%	N	Y	20.00	5	N	
L98	Protecting operation selection switch	00000000_b to 11111111_b (0 to 255) (In each bit, "0" for disabled, "1" for enabled.)	-	-	N	Y	01000000 (64)	1	-	
		Bit0: Over torque alarm (Ot)							N	
		Bit1: Drive continuance mode when specific alarm							Y	
		Bit2: Reserved							-	
		Bit3: ***ENOFF*** signal output mode							Y	
		Bit4: Calculate ASR with only speed command during ULC							N	
		Bit5: Reserved							-	
		Bit6: FAN ON/OFF control during battery operation							Y	
		Bit7: Reserved							-	
L99	Control Switch	00000000_b to 11111111_b (0 to 255) (In each bit, "0" for disabled, "1" for enabled.)	-	-	N	Y	00000010 (2)	1	-	
		Bit0: Current confirmation when starting (for synchronous motor)							N	
		Bit1: Rewrite magnetic pole position offset angle (tuning by ***PPT***)							N	
		Bit2: Torque bias operation with offset							N	
		Bit3: Select short floor operation mode							Y	
		Bit4: Rise direction definition for DCP							Y	
		Bit5: S1 bit selection for DCP							Y	
		Bit6: ***DOPEN*** function change							Y	
		Bit7: Reserved							-	
L101	Unlock Safety Gear (Operation)	0: Normal 1: Inverse	1	-	N	Y	0	1	N	0400
L102	(Level)	10 to 200	1	%	N	Y	140	1	N	
L103	(Pluse time)	0.1 to 2.0	0.1	s	N	Y	0.5	3	N	
L104	(Rest time)	0,1 to 1,0	0.1	s	N	Y	0.2	3	N	
L105	(Pluse)	1 to 5	1	-	N	Y	3	1	N	
L106	(Speed limit)	0 to 20	1	%	N	Y	10	1	N	
L108	Encoder Rotation (Detection speed)	0.0 to 500.0	0.1	mm/s	N	Y	10.0	3	N	
L109	Travel direction counter *6 (Password setting)	0000_H to $FFFF_H$ 0000_H: Disable TDC function 0001_H to $FFFF_H$: Enable TDC function	-	-	N	N	0000_H	1	Y	
L110	(Password unlock)	0000_H to $FFFF_H$	-	-	N	N	0000_H	1	Y	
L111	(Travel limit)	OFF(0.00): Disable 0.01 to 10.00 (1.00 means 1 million times)	0.01	-	N	N	OFF	5	Y	
L112	(Warning level)	OFF(0): Disable 1 to 90 (Percentage of L111)	1	%	N	N	80	1	Y	
L113	(Partial number of direction changes)	Monitor data (1.00 means 1 million times) *Allows setting only "0.00" to reset the partial counter for replacing.	-	-	N	N	-	5	Y	
L114	(Total number of direction changes)	Monitor data (1.00 means 1 million times)	-	-	N	N	-	5	Y	
L115	(Number of counter resets)	Monitor data	-	-	N	N	-	1	Y	
L117	Rescue operation by brake control (Speed limit)	0.0 to 500.0	0.1	mm/s	N	Y	100.0	3	N	
L118	(Apply time)	0.10 to 2.00	0.01	s	N	Y	0.20	5	N	
L119	(Speed detection delay time)	0.00 to 3.00	0.01	s	N	Y	0.50	5	N	
L120	Short circuit control (Mode)	0: Short circuit always 1: Short circuit only under certain conditions	-	-	N	Y	0	1	N	
L121	(Check time)	0.10 to 10.00	0.01	s	N	Y	0.30	5	N	
L122	Deliverance Operation (Input power detection level)	1 to 200	0.01	%	N	Y	100	1	N	0500
L123	(Direction Caluculation Setup)	000b to 111b (0 to 7)	1	-	N	Y	000 (0)	1	N	
		Bit0: Activation							N	
		Bit1: Input power level reached criteria							N	
		Bit2: Directions test criteria							N	
L124	(Direction Calculation Delay Timer)	0.00 to 1.00	1	s	N	Y	0.3	5	N	
L125	UPS/batteries minimum operation level	OFF(0): Disable 20 to 220 (200V series)	1	V	N	Y2	24	1	Y	
		30 to 440 (400V series)					30			

*4 Reserved for particular manufacturers. Do not access this function code.
*6 These function code are excepted from normal password protection and normal data copy function. Dedicated TDC password and TDC data copy function are available.

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
L130	Sheave diameter (Ds)	0.0 to 6553.5	0.1	mm	N	Y	0	3	Y	
L131	Encoder diameter (De)	0.0 to 6553.5	0.1	mm	N	Y	0	3	Y	
L132	Theta compensation band	1 to 90	1	deg	N	Y	45	1	Y	
L133	Theta compensation gain lower limiter	0.0 to 1.0	0.1	-	N	Y	0.8	3	Y	
L134	Backlash (Delay Time)	0.00 to 10.00	0.01	s	N	Y	0	5	N	0500
L135	Encoder Electronic name plate (EEPROM bank number)	0 to 255	1	-	N	Y	0	1	-	
L136	(Mode)	0: Disable 1: Read 2: Write	-	-	N	Y	0	1	-	
L140	Emergency sensor less for PMSM (Current command)	10 to 200 % (Percentage to the rated current of the motor)	1	%	N	Y	80	1	N	0600
L141	(Operation setting)	0: Disable 1: Enable	-	-	N	N	0	1	N	
L143	Load cell function (Overload mode selection)	0: Continue running 1: LCO trip	-	-	N	Y	0	1	N	
L144	(Timer)	0.00 to 1.00	0.01	s	N	Y	0.15	5	N	
L145	(LC1 detection level)	0.00 to 200.0	0.01	%	N	Y	10.00	5	N	
L146	(LCF detection level)	0.00 to 200.0	0.01	%	N	Y	100.00	5	N	
L147	(LCO detection level)	0.00 to 200.0	0.01	%	N	Y	110.00	5	N	
L197	Warning selection switch	00000000_b to 11111111_b (0 to 255)	-	-	N	Y	00000000 (0)	1	-	0400
		Bit0: TDC lifetime early warning							Y	
		Bit1: Reserved							-	
		Bit2: Reserved							-	
		Bit3: Reserved							-	
		Bit4: Reserved							-	
		Bit5: Reserved							-	
		Bit6: Reserved							-	
		Bit7: Reserved							-	
L198	Operation setting switch 1	00000000_b to 11111111_b (0 to 255)	-	-	N	Y	00000000 (0)	1	-	
		Bit0: Fixation of the carrier frequency (1: Enable 16kHz fixed mode)							Y	
		Bit1: Masked parameters depending on set control mode (1: Hidden enable (depends on F42))							Y	
		Bit2: Reserved							-	
		Bit3: Reserved							-	
		Bit4: Reserved							-	
		Bit5: Reserved							-	
		Bit6: Ground fail detection cancel (1: Cancel)							Y	
		Bit7: Short detection cancel (1: Cancel)							Y	
L199	Operation setting switch 2	00000000_b to 11111111_b (0 to 255) (In each bit, "0" for disabled, "1" for enabled.)	-	-	N	Y	00000000 (0)	1	-	
		Bit0-Bit7: Reserved for particular manufacturer							Y	
L201	Pulse output (OPC-PR/PS/PSH) (AB pulse output rate)	1 to 10000 (1 pulse = 4 count)	-	P/R	N	Y	1024	1	Y	
L202	(AB pulse output order)	0: Normal 1: Inverse	-	-	N	Y	0	1	Y	
L203	(Z pulse output)	0: Enable 1: Disable	-	-	N	Y	1	1	Y	
L204	Reserved *4	-	-	-	N	Y	4	1	-	
L205	Pulse output (AB pulse output hysteresis)	0: Disable 1: Enable	1	-	N	Y	1	1	Y	
L207	Reserved *4	-	-	-	N	Y	0	1	-	
L208	Reserved *4	-	-	-	N	Y	1	1	-	
L209	Serial encoder communication (Number of ST bits)	0 to 25	1	-	N	Y	13	1	Y	
L210	Reserved *4	-	-	-	N	Y	0	1	-	
L211	Reserved *4	-	-	-	N	Y	1	1	-	
L212	Reserved *4	-	-	-	N	Y	0	1	-	
L213	Reserved *4	-	-	-	N	Y	0	1	-	
L214	Reserved *4	-	-	-	N	Y	0	1	-	
L215	Reserved *4	-	-	-	N	Y	0	1	-	
L216	Reserved *4	-	-	-	N	Y	0	1	-	
L218	Reserved *4	-	-	-	N	Y	228	1	-	
L219	Reserved *4	-	-	-	N	Y	500	1	-	

*4 Reserved for particular manufacturers. Do not access this function code.

■ K codes: Keypad Functions (optional)

Code	Name	Data setting range	Increment	Unit	Change when running	Data copying	Default setting	Data format No.	Torque vector control	Software version which can be used
K01	LCD Monitor (Language selection)	0: Japanese 1: English	-	-	Y	Y	1 *2	1	Y	
		2: German 3: French 4: Spanish 5: Italian 6: Chinese 8: Russian 9: Greek 10: Turkish 11: Polish 12: Czech 13: Swedish 14: Portuguese 15: Dutch 100: User-customizable								0400
K02	(Backlight off time)	OFF (0.00): Always OFF 1 to 30: Automatic OFF after specific minutes from last key-in	1	min	Y	Y	5	1	Y	
K03	(Backlight brightness control)	0 (Dark) to 10 (Light)	1	-	Y	Y	5	1	Y	
K04	(Contrast control)	0 (Low) to 10 (High)	1	-	Y	Y	15	1	Y	
K08	(Status Display/Hide Selection)	0: Hide 1: Display	-	-	Y	Y	1	1	Y	
K15	(Status Display/Hide Selection)	0: Numeric values (2x programable sub monitors) 1: Bar charts (3x programable bar charts)	-	-	Y	Y	0	1	Y	
K16	(Sub monitor 1)		-	-	Y	Y	13	1	-	
K17	(Sub monitor 2)		-	-	Y	Y	19	1	-	
		1: Reference speed (Final)							Y	
		3: Reference speed (pre-ramp)							Y	
		4: Motor speed							Y*5	
		6: Elevator speed							Y*5	
		9: Elevator speed (mm/s)							Y*5	
		13: Output current							Y	
		14: Output voltage							Y	
		18: Calculated torque							Y	
		19: Input power							Y	
		28: Reference torque							N	
		29: Torque bias balance adjustment (Offset) (BTBB)							N	
		30: Torque bias gain adjustment (BTBG)							N	
K20	(Bar chart 1)		-	-	Y	Y	1	1	-	
K21	(Bar chart 2)		-	-	Y	Y	13	1	-	
K22	(Bar chart 3)		-	-	Y	Y	19	1	-	
		1: Reference speed (Final)							Y	
		13: Output current							Y	
		14: Output voltage							Y	
		18: Calculated torque							Y	
		19: Input power							Y	
		28: Reference torque							N	
		29: Torque bias balance adjustment (Offset) (BTBB)							N	
		30: Torque bias gain adjustment (BTBG)							N	
K23	(Traveling direction display)	0: FWD = UP direction 1: REV = UP direction	-	-	Y	Y	0	1	Y	
K91	(< key shortcut selection)	0: OFF (Disable) 11 to 99: Enable shortcut function to each display mode * For example, "21" means "PRG>2>1".	-	-	Y	Y	0	1	Y	
K92	(> key shortcut selection)		-	-	Y	Y	0	1	Y	

*2 The factory default setting varies depending on the shipping destination.
*5 It is indicated depending on reference speed (final).

Default Table

Type	P02	F11,E34,E37,P03	P06	P07	P08
FRN0006LM2A-4_	2.20[kW]	5.50[A]	3.40[A]	6.82[%]	9.91[%]
FRN0010LM2A-4_	3.70[kW]	9.00[A]	5.70[A]	5.54[%]	8.33[%]
FRN0015LM2A-4_	5.50[kW]	13.50[A]	8.40[A]	4.05[%]	11.72[%]
FRN0019LM2A-4_	7.50[kW]	18.50[A]	9.80[A]	4.23[%]	13.01[%]
FRN0025LM2A-4_	11.00[kW]	24.50[A]	13.90[A]	3.22[%]	12.27[%]
FRN0032LM2A-4_	15.00[kW]	32.00[A]	17.90[A]	2.55[%]	11.47[%]
FRN0039LM2A-4_	18.50[kW]	37.00[A]	16.20[A]	1.98[%]	11.97[%]
FRN0045LM2A-4_	22.00[kW]	45.00[A]	19.00[A]	2.11[%]	12.35[%]
FRN0060LM2A-4_	30.00[kW]	58.00[A]	21.40[A]	2.14[%]	14.62[%]
FRN0075LM2A-4_	37.00[kW]	72.00[A]	30.80[A]	1.86[%]	11.99[%]
FRN0091LM2A-4_	45.00[kW]	85.00[A]	31.10[A]	1.96[%]	13.40[%]
FRN0011LM2A-7_	2.20[kW]	11.00[A]	7.20[A]	6.82[%]	9.91[%]
FRN0018LM2A-7_	3.70[kW]	18.00[A]	11.40[A]	5.54[%]	8.33[%]

2.2 Before setting the function code

⚠CAUTION

Set the function code in following order. Otherwise, a different value might be set.

1. C21 (Speed Command Unit) should be set. The speed can be specified by the selected unit.

C21 data	Speed Command Unit	Related function code
0	r/min	P01
1	m/min	P01, F03, L31
2	Hz	None
3	mm/s	P01, F03, L31

2. P01 (Motor, Number. of poles) should be set.
3. F03 (Rated Speed) and L31 (Elevator Parameter, Speed) should be set.

Tip F03 (Rated speed) depends on P01 (motor, number of poles). Set the date of F03 again when you change P01. For details, refer to the descriptions of function codes F03.

Changing any data of C21, P01, F03 and L31 requires modifying again the data of the function codes listed below.

Function code(Name)	Inverter internal value [Hz]	Function code(Name)	Inverter internal value [Hz]
F04(Base Speed)	1.00 to 200.0	C03 Battery Operation Speed)	0.00 to 200.0
F20(DCB Starting Speed)	0.00 to 5.00	C04(Zero Speed) to C19(High Speed 9)	0.00 to 200.0
F23(Starting Speed)	0.00 to 5.00	C20(Jogging Operation Speed)	0.00 to 200.0
F25(Stop Speed)	0.00 to 5.00	H74((Speed Agreement, Hysteresis)	0.00 to 200.0
E30(Speed Arrival, Hysteresis)	0.00 to 200.0	L30((Short Floor Operation, Allowable speed)	0.00 to 200.0
E31(Speed Detection, Detection level)	0.00 to 200.0	L40(ASR, Switching speed 1)	0.00 to 200.0
E32(Speed Detection, Hysteresis)	0.00 to 30.00	L41(ASR, Switching speed 2)	0.00 to 200.0
E36(Speed Detection 2, Detection level)	0.00 to 200.0	L87((Door Control, Door open starting speed))	0.00 to 200.0

Relational expression of r/min and Hz	$[\mathrm{r/min}] = 120 \times \frac{[\mathrm{Hz}]}{Pe}$
Relational expression of mm/s and Hz	$[\mathrm{mm/s}] = \frac{\mathrm{Vmax}}{\mathrm{Nmax}} \times 120 \times \frac{[\mathrm{Hz}]}{Pe}$
Relational expression of m/min and Hz	$[\mathrm{m/min}] = \frac{\mathrm{Vmax}}{\mathrm{Nmax}} \times 120 \times \frac{[\mathrm{Hz}]}{Pe} \times \frac{60}{1000}$

Symbols definition:

Pe : P01(Motor, No. of poles) (pole)

Nmax : F03 (Rated Speed) (r/min)

Vmax : L31 (Elevator Speed) (mm/s)

2.3 Overview of Function Codes

This section provides a detailed description of the function codes available for the FRENIC-Lift (LM2A) series of inverters. In each code group, its function codes are arranged in an ascending order of the identifying numbers for ease of access. Note that function codes closely related each other for the implementation of an inverter's operation are detailed in the description of the function code having the lowest identifying number. Those related function codes are indicated in the right end of the title bar as shown below.

2.3.1 F codes (Fundamental functions)

F00	Data Protection	H99 (Password Protection)

■ Data protection (F00)

F00 specifies whether to protect function code data from getting changed accidentally.

When the multi-function keypad is connected, simultaneous keying of STOP + ∧ or STOP + ∨ switches the data protection from disable to enable or vice versa, respectively.

- Data setting range: 0000H (Disable data protection)
  0001H (Enable data protection)

■ Password protection (H99)

H99 specifies a password, which enables the password protection.

To change password-protected function code data, enter the specified password to F00 to disable the password protection *temporarily*. With that state, setting H99 to 0000 *permanently* disables the password protection.

When the multi-function keypad is connected, simultaneous keying of STOP + ∧ or STOP + ∨ switches the password protection from disable to enable or vice versa, respectively.

- Data setting range: 0000H (Disable password protection)
  0001H to FFFFH (Enable password protection)

Function code data (Specified state)		Changing function code data	Checking function code data	Initialization of function code data (H03)
H99 = 0000	F00 = 0000 (Data protection disabled)	Y	Y	Y
	F00 = 0001 (Data protection enabled)	N (Y)*1	Y	N (Y)*1
H99 ≠ 0000	F00 ≠ H99 (Password protection enabled)	N	N	Y*2
	F00 = H99 (Password protection *temporarily* disabled)	Y	Y	Y

*1 Using a communications link can change or initialize function code data even if the data protection is enabled. However, it cannot if the password protection is enabled.

*2 Even if the password protection is enabled, using H03 can initialize all function code data including password to the factory defaults. This is useful when the user forgot his/her password.

Note Neither F00 data nor H99 data can be changed via a communications link

F01	Speed Command	F07, F08 (Acceleration/Deceleration Time 1, 2) E10 to E17 (Acceleration/Deceleration Time 3 to 10) E61 to E63 (Analog Input for [12] and [V2]) C04 to C19 (Multistep Speed) C22 (Analog Input Type) L11 to L18 (Multistep Speed Command Combination) L19 to L28 and H57 to H60 (S-curve Setting 1 to 14) L29 (Short Floor Operation)

F01 selects the source that specifies the motor speed set point.

Data for F01	Function	
0	Enable multistep speed command with S-curve acceleration/deceleration	
1	Enable analog speed command (Setting "1" or "2" enables analog input: voltage input to terminals [12] and [V2](V2 function) and current input to terminal [V2] (C1 function).)	Not reversible
2		Reversible
3	Enable analog multistep speed command with S-curve acceleration/deceleration	

In the case of "Reference speed (pre-ramp) < Stop speed" and "Reference speed (pre-ramp) < Starting speed," the inverter runs with the reference speed (pre-ramp) of 0.00 r/min (in closed loop).

■ Multistep speed command with S-curve acceleration/deceleration (L11 to L18 and C04 to C19)

The FRENIC-Lift (LM2A) series of inverters can configure a multistep speed command with sixteen speeds: Zero Speed, Manual Speed (Middle), Maintenance Speed, Creep Speed, Manual Speed (Low), Low Speed, Middle Speed and High Speed 1 through 9 provided for operation purposes.

To configure the multistep speed command, specify L11 to L18 data that combine general-purpose input terminal commands ***SS1***, ***SS2***, and ***SS4*** with eight reference speeds (pre-ramp) defined by C04 to C11. In the case of using ***SS8***, reference speeds (pre-ramp) are defined by C12 to C19 (fixed combinations).

The setting ranges of the acceleration/deceleration times and S-curve zones are determined according to the switching of reference speeds (pre-ramp) as described later.

Combining *SS1*, *SS2*, and *SS4* with reference speeds (pre-ramp)

Function Code	Reference Speed Commands	Setting Range	Factory Default	Description
L11	Zero Speed Command	00000000$_b$ to 00000111$_b$	00000000$_b$	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the zero speed defined by C04.
L12	Manual Speed (Middle) Command		00000001$_b$	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the manual speed (middle) defined by C05.
L13	Maintenance Speed Command		00000010$_b$	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the maintenance speed defined by C06.
L14	Creep Speed Command		00000011$_b$	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the creep speed defined by C07.
L15	Manual Speed (Low) Command		00000100$_b$	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the manual speed (low) defined by C08.
L16	Low Speed Command		00000101$_b$	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the low speed defined by C09.
L17	Middle Speed Command		00000110$_b$	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the middle speed defined by C10.

L18	High Speed 1 Command		00000111 b	Defines the combination of states of terminal commands ***SS1***, ***SS2*** and ***SS4*** that enables the high speed defined by C11.

Definition of Setting Value for L11 to L18

0 0 0 0 0 1 1 1 b

SS1 0:OFF 1:ON
SS2 0:OFF 1:ON
SS4 0:OFF 1:ON

0: Inactive, 1: Active	
Active logic Terminal ON: 1 Terminal OFF: 0	Negative logic Terminal ON: 0 Terminal OFF: 1

Factory default combination of *SS1*, *SS2*, *SS4* and *SS8* states to enable reference speeds (pre-ramp)

SS8	***SS4***	***SS2***	***SS1***	L11 to L18	Reference speed (pre-ramp) selected
OFF	OFF	OFF	OFF	L11 = 00000000 b	Zero speed defined by C04
OFF	OFF	OFF	ON	L12 = 00000001 b	Manual speed (middle) defined by C05
OFF	OFF	ON	OFF	L13 = 00000010 b	Maintenance speed defined by C06
OFF	OFF	ON	ON	L14 = 00000011 b	Creep speed defined by C07
OFF	ON	OFF	OFF	L15 = 00000100 b	Manual speed (low) defined by C08
OFF	ON	OFF	ON	L16 = 00000101 b	Low speed defined by C09
OFF	ON	ON	OFF	L17 = 00000110 b	Middle speed defined by C10
OFF	ON	ON	ON	L18 = 00000111 b	High speed 1 defined by C11
ON	OFF	OFF	OFF	—	High speed 2 defined by C12
ON	OFF	OFF	ON	—	High speed 3 defined by C13
ON	OFF	ON	OFF	—	High speed 4 defined by C14
ON	OFF	ON	ON	—	High speed 5 defined by C15
ON	ON	OFF	OFF	—	High speed 6 defined by C16
ON	ON	OFF	ON	—	High speed 7 defined by C17
ON	ON	ON	OFF	—	High speed 8 defined by C18
ON	ON	ON	ON	—	High speed 9 defined by C19

Example combination of *SS1*, *SS2*, *SS4* and *SS8* states to enable reference speeds (pre-ramp)

To select zero speed by turning on ***SS1***, for example, configure a multistep speed command by setting ***SS1, SS2, SS4 and SS8*** and L11 to L18 as listed below.

SS8	***SS4***	***SS2***	***SS1***	L11 to L18	Reference speed (pre-ramp) selected
OFF	OFF	OFF	ON	L11 = 00000001 $_b$	Zero speed defined by C04
OFF	OFF	OFF	OFF	L12 = 00000000 $_b$	Manual speed (middle) defined by C05
OFF	OFF	ON	OFF	L13 = 00000010 $_b$	Maintenance speed defined by C06
OFF	OFF	ON	ON	L14 = 00000011 $_b$	Creep speed defined by C07
OFF	ON	OFF	OFF	L15 = 00000100 $_b$	Manual speed (low) defined by C08
OFF	ON	OFF	ON	L16 = 00000101 $_b$	Low speed defined by C09
OFF	ON	ON	OFF	L17 = 00000110 $_b$	Middle speed defined by C10
OFF	ON	ON	ON	L18 = 00000111 $_b$	High speed 1 defined by C11
ON	OFF	OFF	ON	—	High speed 2 defined by C12
ON	OFF	OFF	OFF	—	High speed 3 defined by C13
ON	OFF	ON	OFF	—	High speed 4 defined by C14
ON	OFF	ON	ON	—	High speed 5 defined by C15
ON	ON	OFF	OFF	—	High speed 6 defined by C16
ON	ON	OFF	ON	—	High speed 7 defined by C17
ON	ON	ON	OFF	—	High speed 8 defined by C18
ON	ON	ON	ON	—	High speed 9 defined by C19

Note: Do not double assign the same data to L11 (Zero Speed) to L18 (High Speed 1). Eight values are available, ranging from "00000000" to "00000111." Double assignment results in a trip with alarm **Er6** the moment a run command is entered.

Tip: It is recommended that, speeds from zero to high speed 1 are used for same purpose as the function code name. To use any of them for different purposes, confirm the setting ranges of its acceleration/deceleration time and S-curve acceleration/deceleration time.

Acceleration/deceleration times to be applied when the reference speed (pre-ramp) is changed after the reference speed (final) reaches the speed (pre-ramp)

The table below lists the acceleration/deceleration times to be applied when the reference speed (pre-ramp) is changed after the reference speed (final) reaches the previously commanded reference speed (pre-ramp). Those times are specified by function codes F07, F08, and E10 to E17.

In the table below, "Stop" refers to a run command being off. F07/F08 indicates that F07 and F08 apply during acceleration and deceleration, respectively.

Before change \ After change	Stop	Zero speed	Manual speed (middle)	Maintenance speed	Creep speed	Manual speed (low)	Low speed	Middle speed	High speed (1 to 9)
Stop	-/F08	F07	F07	F07	F07	F07	F07	F07	F07
Zero speed	E16	F07/F08	E10	F07	F07/F08	F07	F07	E10	E12
Manual speed (middle)	E16	E11	F07/F08	F07/F08	E11	F07/F08	F07/F08	F07/F08	F07/F08
Maintenance speed	E16	F08	F07/F08	F07/F08	F07/F08	F07/F08	F07/F08	F07/F08	F07/F08
Creep speed	E15	E14	F07/F08	F07/F08	F07/F08	F07/F08	F07/F08	F07/F08	F07/F08
Manual speed (low)	E16	F08	F07/F08	F07/F08	F08	F07/F08	F07/F08	F07/F08	F07/F08
Low speed	E16	F08	F07/F08	F07/F08	F08	F07/F08	F07/F08	F07/F08	F07/F08
Middle speed	E16	E11	F07/F08	F07/F08	E11	F07/F08	E11	F07/F08	F07/F08
High speed (1 to 9)	E16	E13	F07/F08	F07/F08	E13	F07/F08	E13	F07/F08	F07/F08 *

* When the speed is changed to high speed (1 to 9) from the other # of high speed, E12 is used.

S-curve starting/ending zones to be applied when the reference speed (pre-ramp) is changed after the reference speed (final) reaches the speed (pre-ramp)

The table below lists the S-curve starting/ending zones to be applied when the reference speed (pre-ramp) is changed after the reference speed (final) reaches the speed (pre-ramp). They are specified by function codes L19 to L28 and H57 to H60.

In the table below, for example, L19/L22 indicates that L19 and L22 apply at the starting and ending zones, respectively.

When two different creep speeds are applied, set the low speed for the higher creep one.

Before change \ After change	Stop	Zero speed	Manual speed (middle)	Maintenance speed	Creep speed	Manual speed (low)	Low speed	Middle speed	High speed (1 to 9)
Stop	-/-	H57/H58	H57/H58	-/-	H57/H58	H57/H58	H57/H58	H57/H58	H57/H58
Zero speed	H59/ H60	-/-	L19/L22	-/-	H57/H58	L19/L20	L19/L20	L19/L22	L19/L24
Manual speed (middle)	H59/ H60	L23/L28	-/-	-/-	L23/L26	H59/H60	H59/H60	H59/H60	H59/H60
Maintenance speed	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
Creep speed	L27	L28	H57/H58	-/-	-/-	H57/H58	H57/H58	H57/H58	H57/H58
Manual speed (low)	H59/ H60	L21/L28	H57/H58	-/-	L21/L26	-/-	H57/H58	H57/H58	H57/H58
Low speed	H59/ H60	L21/L28	H57/H58	-/-	L21/L26	H59/H60	-/-	H57/H58	H57/H58
Middle speed	H59/ H60	L23/L28	H59/H60	-/-	L23/L26	H59/H60	L23/L26	-/-	H57/H58
High speed (1 to 9)	H59/ H60	L25/L28	H59/H60	-/-	L25/L26	H59/H60	L25/L26	H59/H60	H57/H58

Tip In the condition of EN OFF or BX ON, it is judged as “Stop” command.

When the reference speed (pre-ramp) is changed before the reference speed (final) reaches that speed (pre-ramp) (during acceleration/deceleration)

The inverter immediately aims at the newly changed reference speed (pre-ramp), applying the acceleration/deceleration times and S-curve acceleration/deceleration zones defined on the previous page, just as when the reference speed (pre-ramp) is changed after the reference speed (final) reaches the previously commanded reference speed (pre-ramp).

The differences between operations before and after the reference speed (final) reaches the speed (pre-ramp) are as described below.

When the reference speed (pre-ramp) change yields deceleration during acceleration (Reference speed (final) at the time of change > Reference speed (pre-ramp)), the inverter performs a short floor operation.

Refer to the description of function code L29 for a short floor operation.

On the contrary, when the speed changes to acceleration during deceleration, the inverter immediately starts S-curve acceleration, which may make an impact on the load.

Acceleration/deceleration times in S-curve operation

In an S-curve operation, the acceleration/deceleration time "t" can be calculated by the following formulae.

- If the speed deviation exceeds the S-curve zone: $|N2 - N1| \geq N\max \times \frac{S1 + S2}{100}$

$$t = \left(\frac{N2 - N1}{N\max} + \frac{S1 + S2}{100} \right) \times T$$

- If the speed deviation is within the S-curve zone: $|N1 - N2| < N\max \times \frac{S1 + S2}{100}$

$$t = 2\sqrt{\frac{|N2 - N1|}{N\max} \times \frac{100}{S1 + S2}} \times \left(\frac{S1 + S2}{100} \right) \times T$$

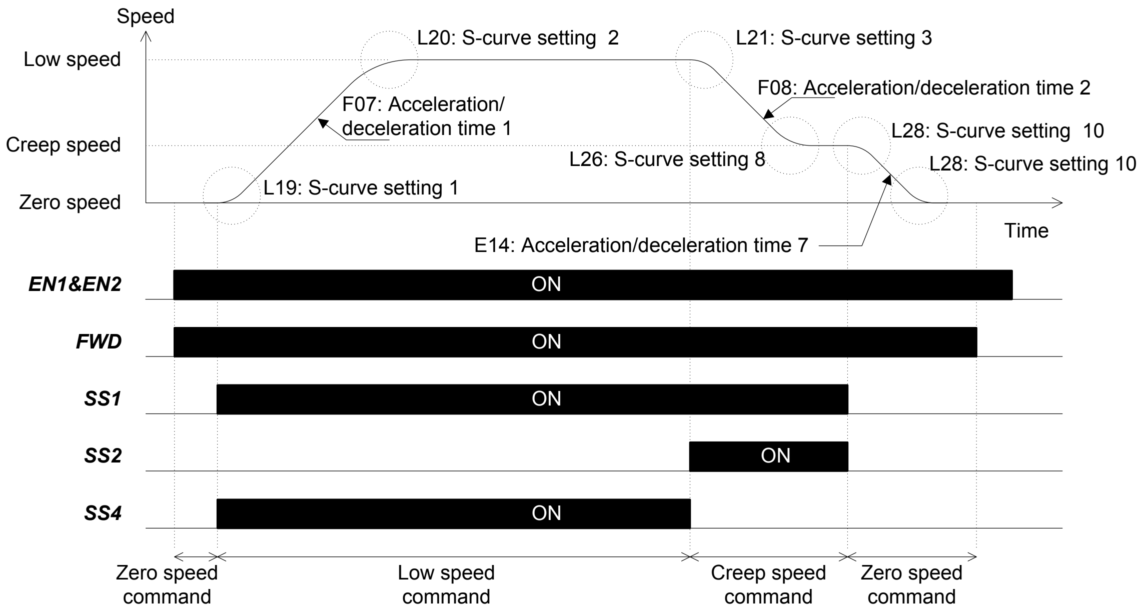
Where,

Nmax	:	Maximum speed (r/min)
N1	:	Speed before the start of acceleration/deceleration (r/min)
N2	:	Speed after the end of acceleration/deceleration (r/min)
S1	:	S-curve zone (% of the maximum speed) at the start of acceleration (at the end of deceleration)
S2	:	S-curve zone (% of the maximum speed) at the end of acceleration (at the start of deceleration)
T	:	Acceleration period (s) required from 0.00 r/min to the rated speed (F03) or Deceleration period (s) required from the rated speed (F03) to 0.00 r/min
t	:	Acceleration/deceleration period (s) required from N1 to N2

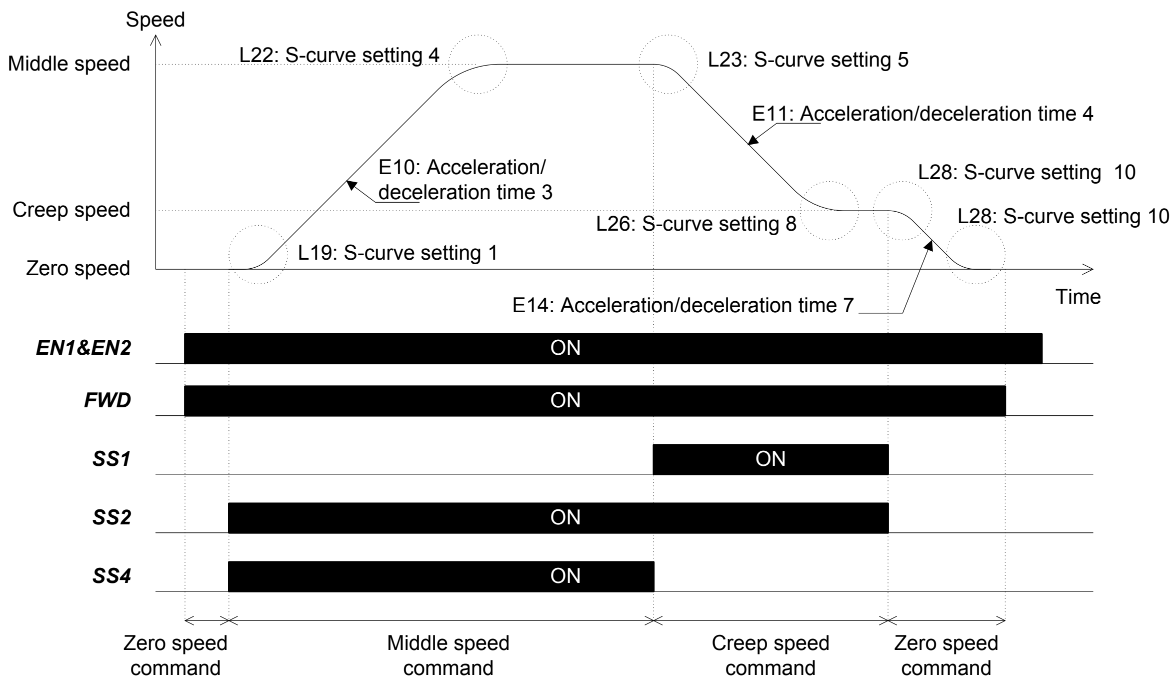
Operation examples

The following diagrams show operation examples given when the inverter runs by factory defaults of function codes L11 to L18. Changing those code data makes the relationship between terminal commands ***SS1, SS2, SS4 and SS8*** and the reference speed (pre-ramp) selected different from the following diagrams.

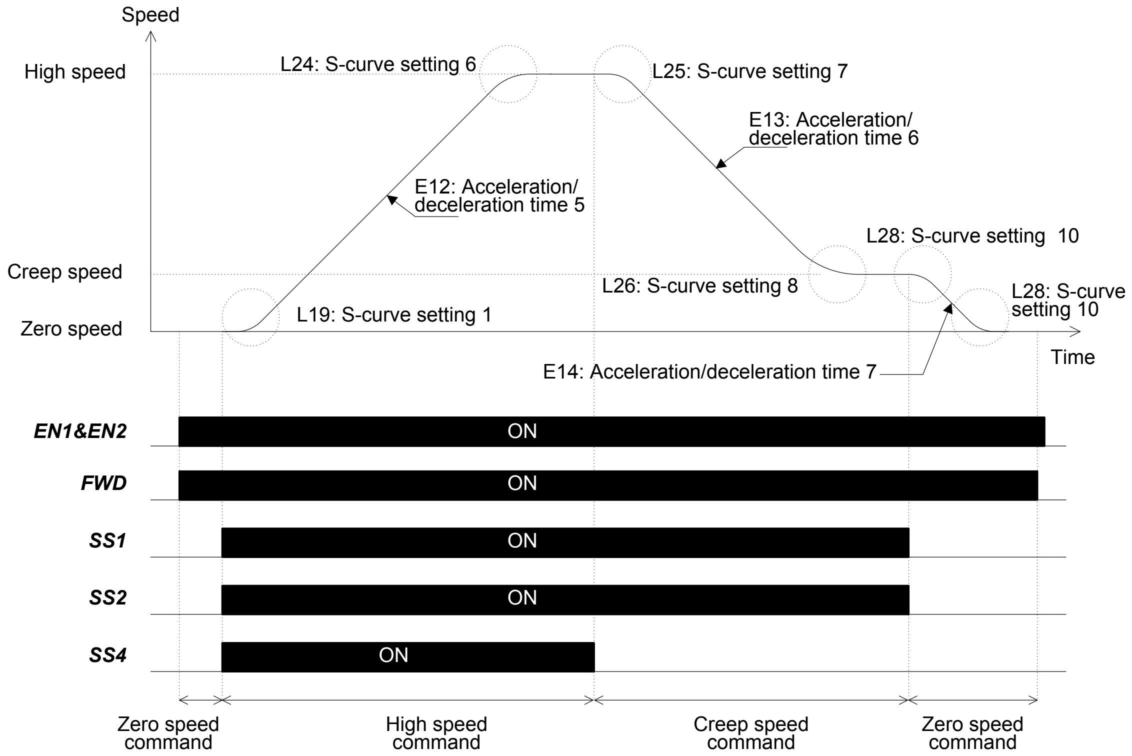
Low speed



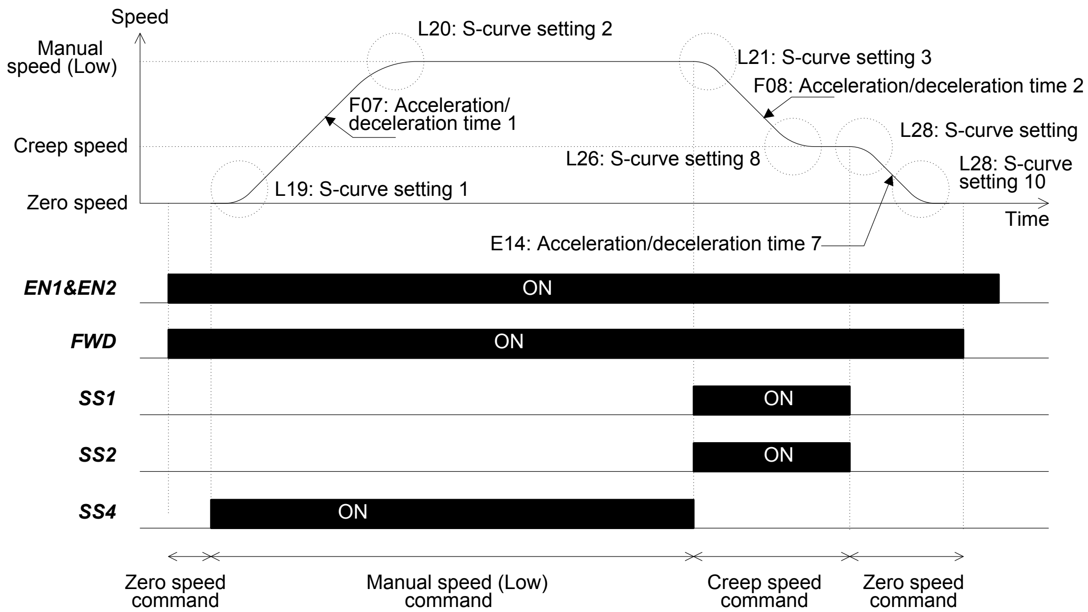
Middle speed



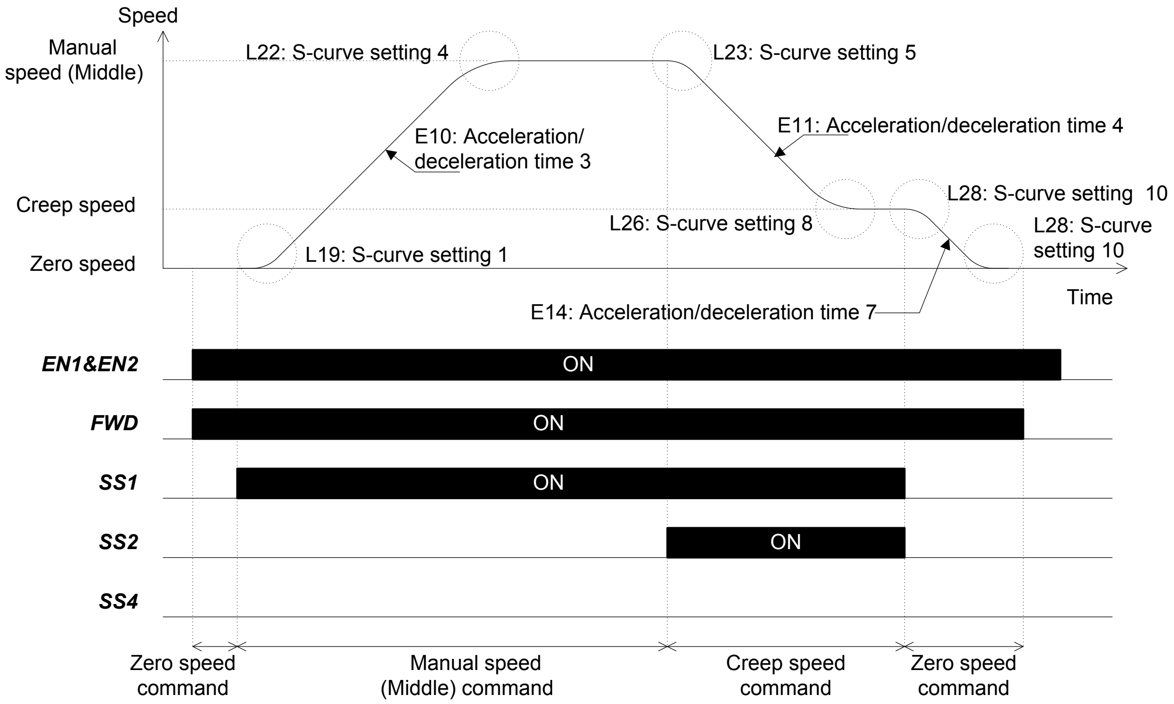
High speed



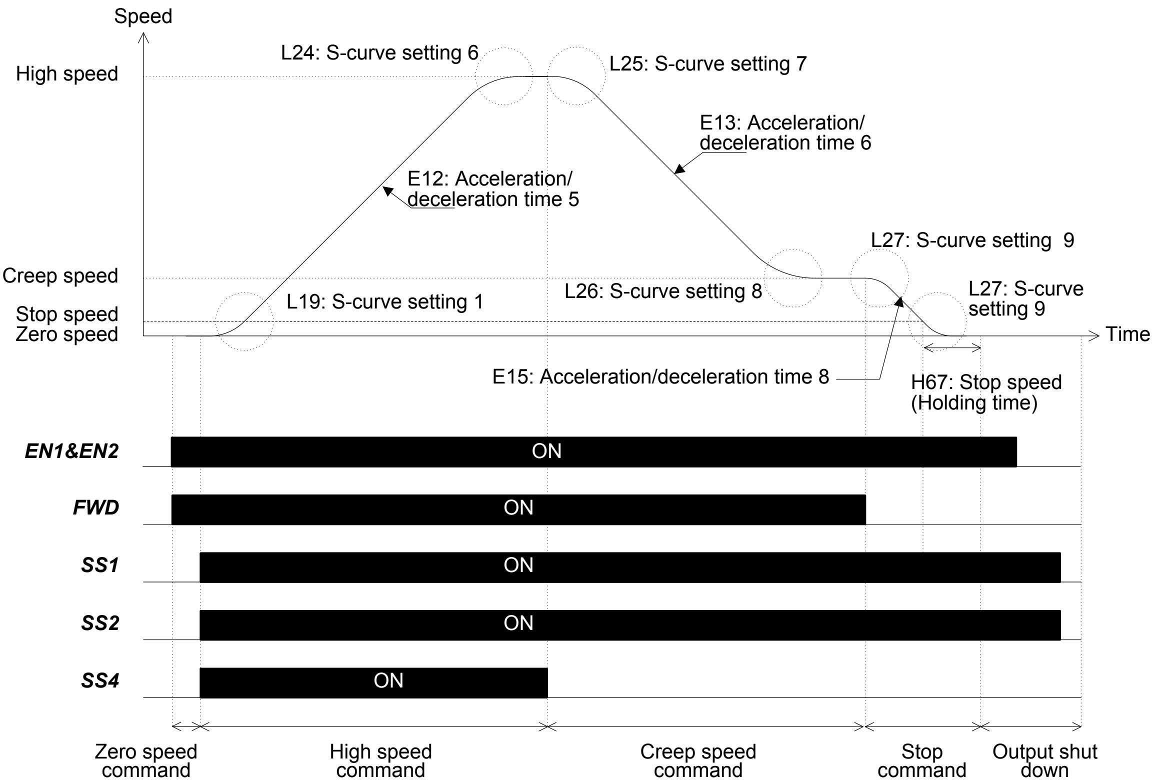
Manual speed (Low)



Manual speed (Middle)



Creep speed to stop

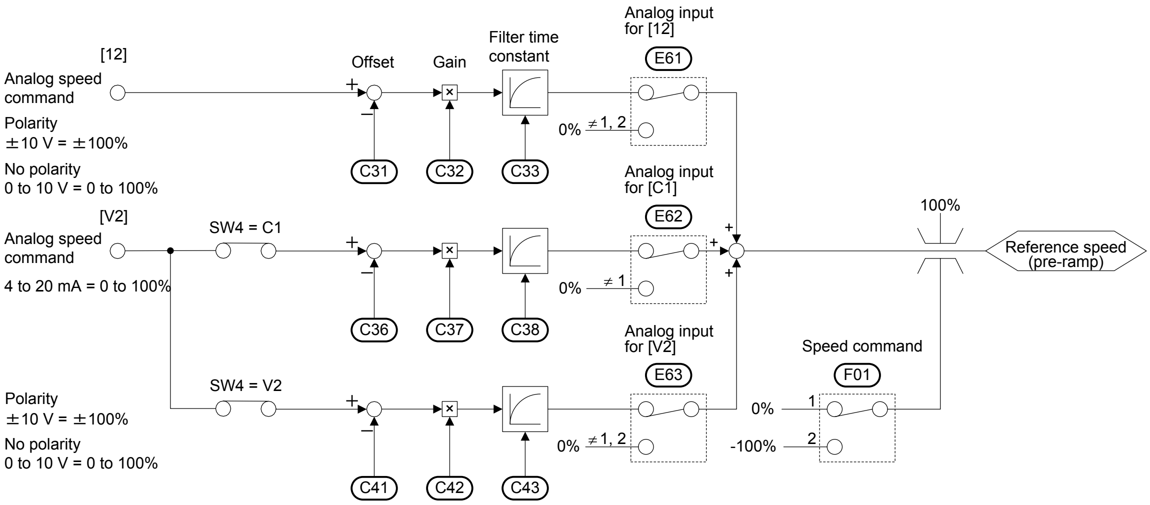


■ Analog speed command

Enabling an analog speed command (F01 = 1 or 2) and assigning a speed command to terminal [12] (E61 = 1 or 2) or [V2] (V2 function) (E63 = 1 or 2) runs the inverter by analog voltage set point. Enabling an analog speed command (F01 = 1 or 2) and assigning a speed command to terminal [V2] (C1 function) (E62 = 1) runs the inverter by analog current set point. These inputs are added. Refer to the block diagram below.

Selecting an analog speed command cannot invoke an S-curve operation. It disables a multistep speed command. When "Reference speed (pre-ramp) < Stop speed" or "F01 = 1," the reference speed (pre-ramp) of 0.00 r/min or below will be regarded as 0.00 r/min. The acceleration/deceleration times specified by F07 and F08 apply, respectively. However, the inverter will linearly decelerate, in accordance with the time specified by E16 if the run command is turned off during running. Exception is linear deceleration for the time specified by E16 when a run command is turned off during running.

Refer to the description of function code F23 for the timing chart to be applied when an analog speed command is selected.

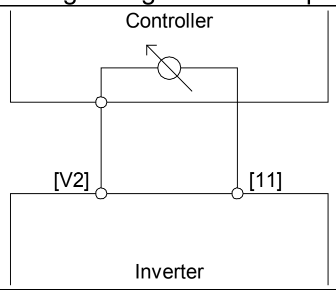
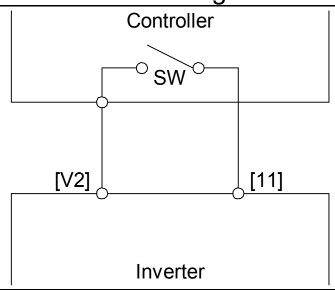


Tip: Offset, gain and filter time constant can be specified for analog input: voltage input to terminals [12] and [V2] (V2 function) and current input to terminal [V2] (C1 function). Refer to C31 to C33, C36 to C38, and C41 to C43.

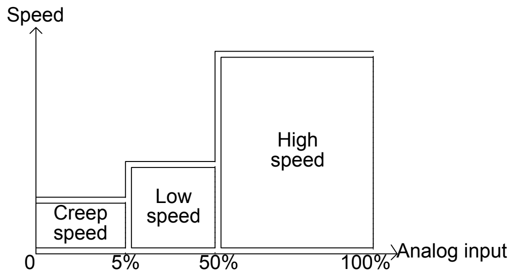
■ Analog multistep speed command

Setting "3" to the function code F01, enables analog multistep speed command. In this mode, C22 specifies the analog input type of this function.

C22	Function
0	This type selects reference speed by analog voltage/current.
1	This type selects reference speed by switch.

C22	0	1
Control type	Analog voltage/current output	Switching
Circuit		
Speed select	3 speeds *1	2 speeds *2
Analog input	([V2] or [C1])*3 or [12] *4	

*1 Creep, Low, High (See the figure below)



*2 Creep, High (See the table below)

Switch	Multistep speed
OFF	Creep speed
ON	High speed

*3 Voltage input [V2] or current input [C1] can be selected by SW4 on the control PCB.

*4 When two or more analog inputs are used at the same time, analog input is added.

F03 Rated Speed

F03 specifies the Rated (maximum) speed to limit a reference speed (pre-ramp). Specifying the maximum speed exceeding the rating of the equipment driven by the inverter may cause damage or a dangerous situation. Make sure that the maximum speed setting matches the equipment rating.

- Data setting range: $\frac{120\times 1}{\mathrm{P01}}$ to $\frac{120\times 200}{\mathrm{P01}}$ (r/min)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

In case of induction motor, the recommended value of F03 is the rated speed (speed at rated torque), not the synchronous speed.

Make sure with the lift manufacturer which is the lift speed and if it matches with motor's rated speed. In some cases lift speed is below motor's rated speed. In this case please adjust F03 to lift speed, otherwise problems may occur (bad confort, speed limiter activation, etc).

⚠WARNING

The inverter can easily accept high-speed operation. When changing the settings, carefully check the specifications of motors or equipment beforehand.

Otherwise injuries could occur.

Note: Some function codes may be modified by changing maximum speed. Refer to section 2.2.

F04	Base Speed
F05	**Rated Voltage**

F04 and F05 specify the base speed and voltage of the motor that the inverter drives.

■ Base speed (F04)

Set the rated speed of the motor. In the case of an induction motor, please set the synchronous speed of the motor. If the speed command units are r/min (Speed Command Unit function C21 equals 0), the value of F04 can be obtained from the following expression:

$$F04 = \frac{120 \times f_r (\mathrm{Hz})}{P01}$$

Where f_r is the rated frequency of the motor, in Hz.

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Rated voltage (F05)

Set the rated voltage printed on the motor's nameplate.

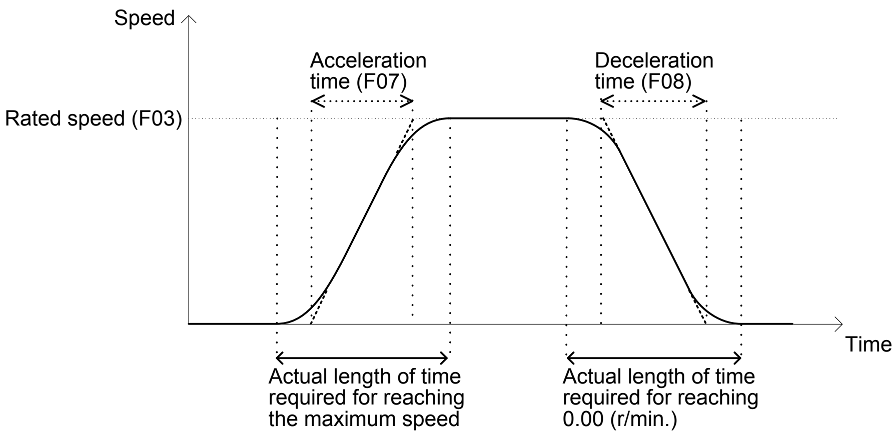
Note that the inverter cannot output the voltage exceeding the inverter's input voltage.

- Data setting range: 80 to 240 (V) 200V series
  : 160 to 500 (V) 400V series

F07, F08	Acceleration/Deceleration Time 1, 2	E10 to E17 (Acceleration/Deceleration Time 3 to 10)

F07 and F08 specify the acceleration and deceleration times in linear acceleration/deceleration zones excluding S-curve zones. The acceleration/deceleration time is the time duration required for the speed to increase linearly from 0.00 r/min to the rated speed (F03) or decrease from the rated speed to 0.00 r/min, respectively.

- Data setting range: 0.00 to 99.9 (s)



Tip

When the inverter runs by an analog speed command, the acceleration and deceleration times specified by F07 and F08 apply. When speed profile is generated on the controller with analog signal, please set F07 and F08 to 0.00 s. On the other hand, a small value on F07 and F08 (0.01 s or similar) may help if speed generated by the controller is not good enough (to achieve smoother operation).

Also in local mode, the acceleration and deceleration times specified by F07 and F08 apply.

F09	Torque boost

Determines the torque boost for torque vector control. Basically, there is no need to modify the default setting. If you need more torque, please change the value. However, as too much setting of F09 may cause larger current, do not modify the default setting unless it is necessary.

- Data setting range: 0.0 to 5.0

Note It is a special code of the torque vector control.
Refer to page 2-2 for the control mode of the inverter.

F10	Electronic Thermal Overload Protection for Motor (Select motor characteristics)
F11	Electronic Thermal Overload Protection for Motor (Overload detection level)
F12	Electronic Thermal Overload Protection for Motor (Thermal time constant)

F10 through F12 specify the thermal characteristics of the motor for its electronic thermal overload protection that is used to detect overload conditions of the motor by the inverter.

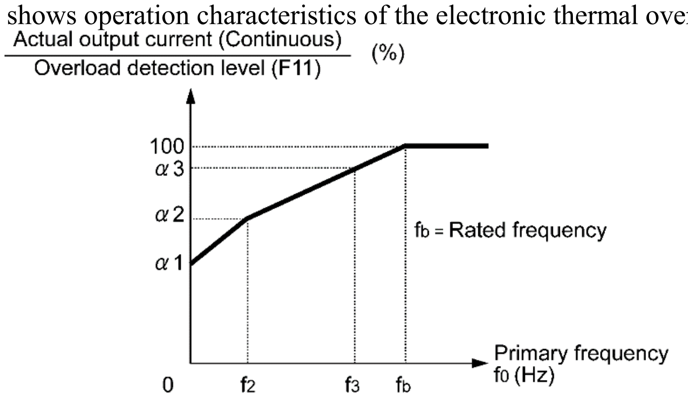
■ Select motor characteristics (F10)

F10 specifies the cooling mechanism of the motor: built-in cooling fan or externally powered forced-ventilation fan.

Data for F10	Function
1	For general-purpose motors with built-in self-cooling fan (The cooling effect will decrease in low speed operation.)
2	For inverter-driven motors or high-speed motors with forced-ventilation fan (The cooling effect will be kept constant regardless of the output speed.)
3	For general-purpose motors with built-in self-cooling fan (Mode2) (The cooling effect will decrease in low speed operation.)

About F10=1 or 3.

The figure below shows operation characteristics of the electronic thermal overload protection.



Cooling Characteristics of Motor Equipped with a Self-cooling Fan

Characteristics in F10=1

Applicable motor rating (kW)	Thermal time constant (Factory default)	Switching frequency for motor characteristic factor		Characteristic factor (%)		
		f2	f3	α1	α2	α3
2.2 to 4.0 kW	2 min	5 Hz	7 Hz	85	85	100
5.5 to 11 kW			6 Hz	90	95	100
15 kW			7 Hz	85	85	100
18.5, 22 kW			5 Hz	92	100	100
30 to 45 kW		Base frequency ×33%	Base frequency ×83%	54	85	95

Characteristics in F10=3

Applicable motor rating (kW)	Thermal time constant (Factory default)	Switching frequency for motor characteristic factor		Characteristic factor (%)		
		f2	f3	α1	α2	α3
2.2 to 4.0 kW	2 min	Base frequency ×33%	Base frequency ×83%	85	85	100
5.5 to 11 kW				90	95	100
15 kW				85	85	100
18.5, 22 kW				92	100	100
30 to 45 kW				54	85	95

■ Overload detection level (F11)

F11 specifies the level at which the electronic thermal overload protection becomes activated.

- Data setting range: 0.00 (Disable)
  1 to 200% of the rated current (allowable continuous drive current) of the inverter.

In general, set F11 to the allowable continuous drive current of the motor when driven at the rated speed (i.e. 1.0 to 1.1 multiple of the rated current of the motor). To disable the electronic thermal overload protection, set F11 to "0.00."

■ Thermal time constant (F12)

F12 specifies the thermal time constant of the motor. The time constant refers to the time required for the electronic thermal overload protection to detect a motor overload when the current of 150% of the overload detection level specified by F11 has flown continuously.

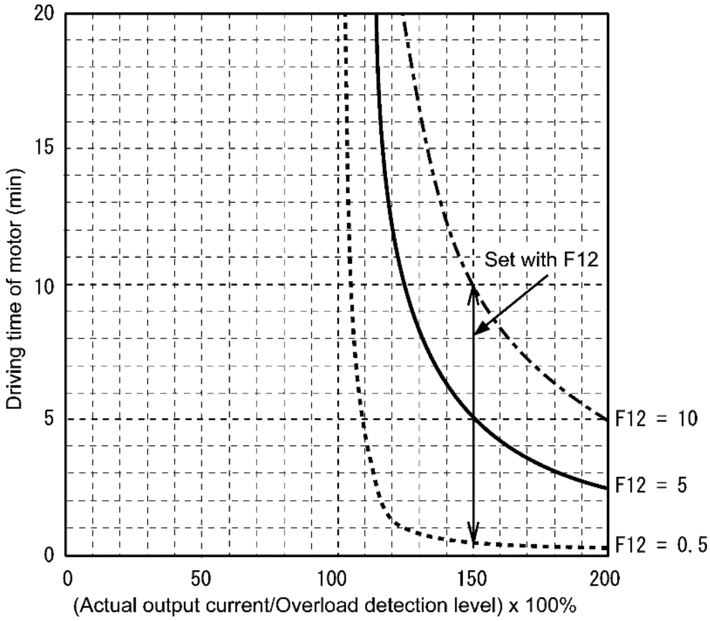
- Data setting range: 0.5 to 75.0 (min)

(Example) When F12 is set at "5.0" (5 minutes)

As shown below, the electronic thermal overload protection is activated to detect an alarm condition (Alarm **OL1**) when an output current of 150% of the overload detection level (specified by F11) flows for 5 minutes.

The actual activation time required for issuing a motor overload alarm tends to be shorter than the one specified by F12 since it takes into account the time period from when the output current exceeds the rated current (100%) until it reaches 150% of the overload detection level.

Example of Operating Characteristics


20
15
10
5
0
Driving time of motor (min)
0
50
100
150
200
(Actual output current/Overload detection level) x 100%
Set with F12
F12 = 10
F12 = 5
F12 = 0.5

F20	DC Braking(Starting Speed)
F21	**DC Braking(Operation Level)**
F22	**DC Braking(Operation Time)** **H64(Zero speed holding time)**

The starting speed, the operation level, and the operation time of the DC braking are set. The DC braking doesn't operate when using it by the vector control with PG.

■ DC Braking (Starting Speed)(F20)

The starting speed of the DC braking when decelerating to stop is set.

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ DC Braking (Operation Level)(F21)

Sets the output current of the DC braking. This level is used at start (during H64) and at stop (during F22).

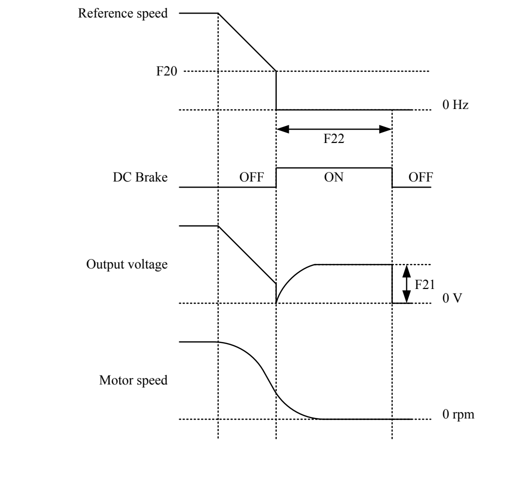
- Data setting range: 0 to 100 (%)

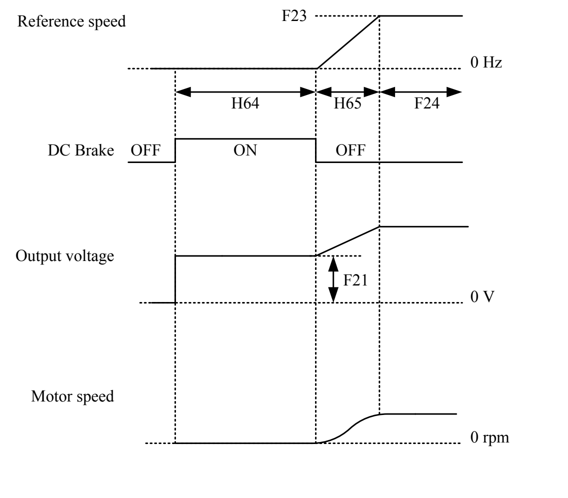
■ DC Braking (Operation Time)(F22)

The operation time of the DC braking is set. This timer will start to count only when decelerating to stop, in other words, when decelerating F20 speed level is reached. The stop speed operation is carried out when set to 0.00 s.

- Data setting range: 0.00 to 30.00 (s)

Timing diagram at stop	Timing diagram at start





Note: DC braking operates at the stop speed when the stop speed (F25) is bigger than DCB starting speed (F20).

F23	Starting Speed	H65 (Starting Speed, Soft start time) L52 (Start Control Mode)
F24	**Starting Speed (Holding time)**	

F23, F24, H65 and L52 specify the starting speed, its holding time, soft start time, and start control mode, respectively, to reduce an impact to the load at the start of running.

■ Starting speed (F23)

F23 specifies the starting speed for the inverter.

- Data setting range: 0.00 to 150.0 (r/min)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Holding time (F24)

F24 specifies the holding time of running at the starting speed. Accelerating after running at the starting speed for that duration can reduce an impact to the load at the start of running.

- Data setting range: 0.00 to 10.00 (s)

■ Zero speed control time (H64)

In case of Vector control with PG

As soon as IGBT gates are ON, Zero speed control time starts to count. During this time, motor is controlled at zero speed. Brake will open as well (BRKS to ON). When this time is elapsed motor accelerates to starting speed (according to soft start time if it is different than zero).This function doesn't operate when the setting is 0.00s.

In case of Torque Vector control

As soon as IGBT gates are ON, “DC braking at start” operation starts. Brake will open as well (BRKS to ON). When this time is elapsed motor accelerates to starting speed (according to soft start time if it is different than zero).This function doesn't operate when the setting is 0.00s. This function is enabled only in multi step speed command F01=0 or analog speed command (not reversible) F01=1.

- Data setting range: 0.00 to 10.00 (s).

Refer to page 2-2 for the control mode of the inverter.

■ Soft start time (H65)

This function code specifies the acceleration time from zero speed to starting speed (F23). The soft start can reduce an impact to the load at the start of running.

- Data setting range: 0.0 to 60.0 (s)

■ Start control mode (L52)

The soft start is available in two start control modes: Speed start and torque start modes. L52 selects the start control mode.

Start control mode (L52)	Multistep speed command *1 (F01 = 0)	Analog speed command (Not reversible) (F01 = 1)	Analog speed command (Reversible) *2 (F01 = 2)
Speed start mode (L52 = 0)	Y	Y	N *4
Torque start mode (L52 = 1)	Y	N *3	N *4

*1 Including keypad command operations and jogging operation
*2 Including commands entered via a communications link
*3 Functionally equivalent to the operation with L52 = 0.
*4 Soft start to the starting speed is disabled.

Note Once the inverter speed decreases to less than the stop speed, increasing the reference speed (pre-ramp) with a run command being ON does not activate a soft start to the starting speed. To soft start the motor up to the starting speed, turn the run command OFF once.

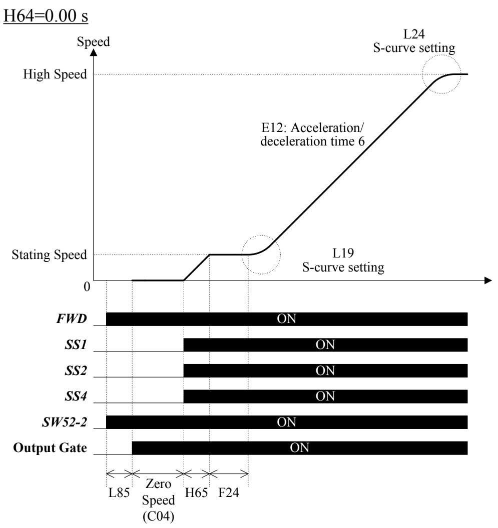
■ <u>In case of Vector control with PG</u>

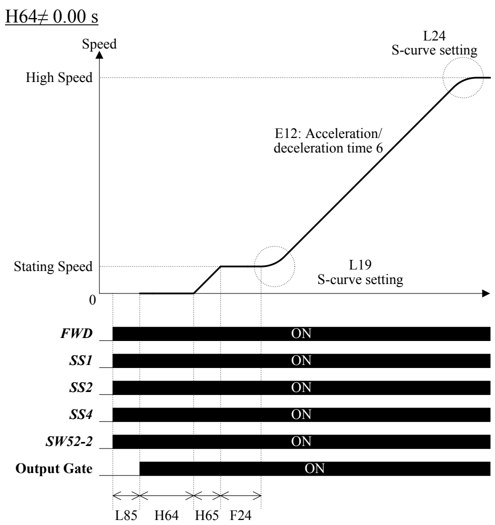
<u>Speed start mode</u>

Setting L52 data to "0" enables the speed start mode.

(i) When a multistep speed command with S-curve acceleration/deceleration is enabled (F01 = 0)

If the reference speed (pre-ramp) exceeds the starting speed, the inverter activates a soft start to the starting speed. After starting speed holding time (F24) is elapsed, the inverter accelerates up to the reference speed (pre-ramp).

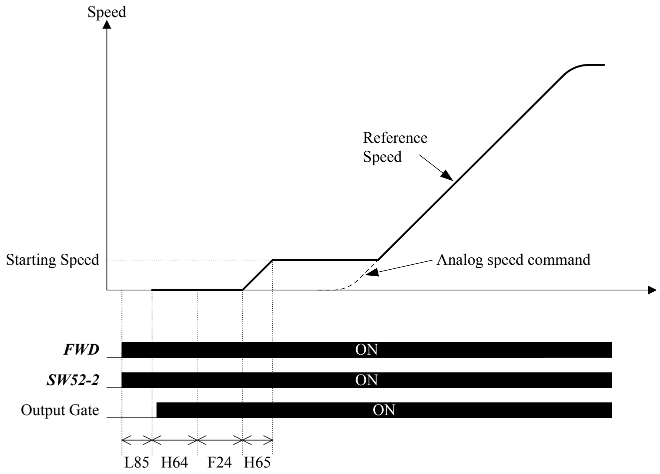




Note If stop speed set value (F25) is higher than starting speed set value (F23), the inverter does not activate a soft start as long as the reference speed (pre-ramp) does not exceed the stop speed.

(ii) When an analog speed command (Not reversible) is enabled (F01 = 1)

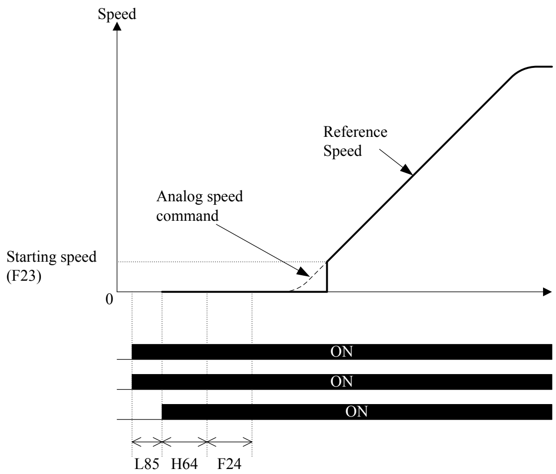
As soon as run command is ON, soft start operation starts. As soon as soft start operation is finished, inverter will keep starting speed as long as reference speed is below starting speed. When the reference speed (pre-ramp) exceeds the starting speed, the inverter immediately accelerates from the current speed up to the reference speed (pre-ramp).



Note Inverter does not start acceleration to the reference speed (pre-ramp) as long as the reference speed (pre-ramp) does not exceed the stop speed.

(iii) When an analog speed command (Reversible) is enabled (F01 = 2)

During this operation soft start is disabled. When the reference speed (pre-ramp) exceeds the starting speed, the inverter starts acceleration from starting speed to the reference speed (pre-ramp).



Note Inverter does not start acceleration to the reference speed (pre-ramp) as long as the reference speed (pre-ramp) does not exceed the stop speed.

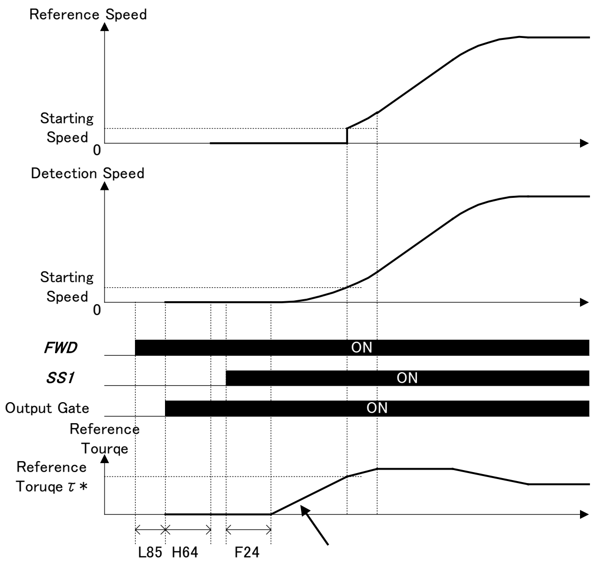
Torque start mode

Setting L52 data to "1" enables the torque start mode.

In this mode, the inverter increases the output voltage to generate torque along the slope specified by the time (F24) in the rotation direction specified by a run command. When the detected speed exceeds the starting speed (F23), the inverter starts the speed control to accelerate smoothly.

When F23 = 0.00, this mode is disabled.

Note In the torque start mode, a PG error may occur or the ***DSAG*** command on the general-purpose output terminal may go OFF depending upon the starting speed setting.

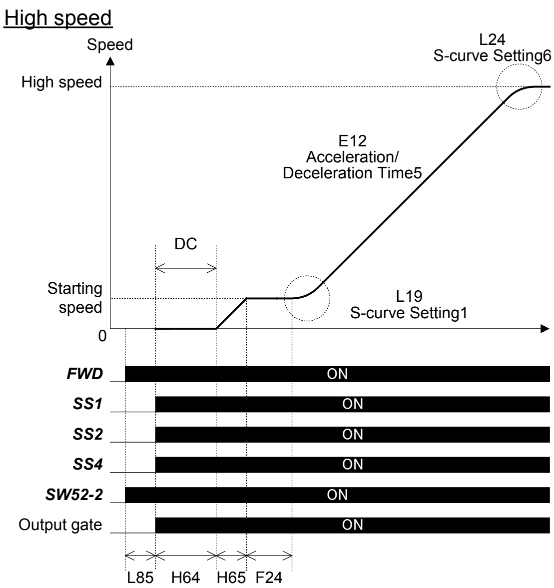


$$\frac{\Delta\tau^*}{\Delta t} = \frac{100}{H65} \ (\%/s)$$

■ In case of Torque Vector control

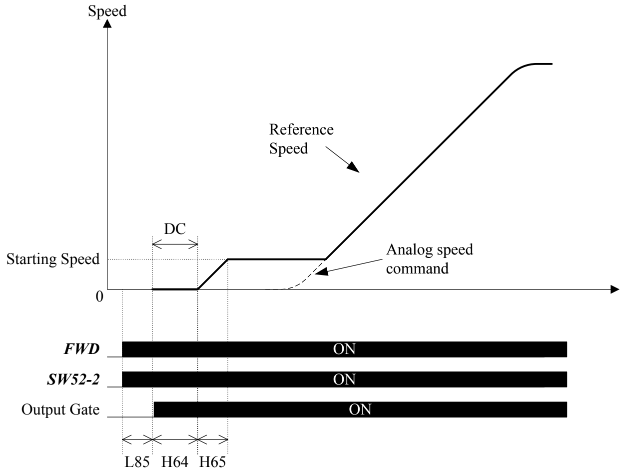
(i) When a multistep speed command with S-curve acceleration/deceleration is enabled (F01 = 0)

If the reference speed (pre-ramp) exceeds the starting speed, the inverter activates the DC braking operation. After the DC braking operation, the inverter activates a soft start to the starting speed. After starting speed holding time (F24) elapses, the inverter accelerates up to the reference speed (pre-ramp).



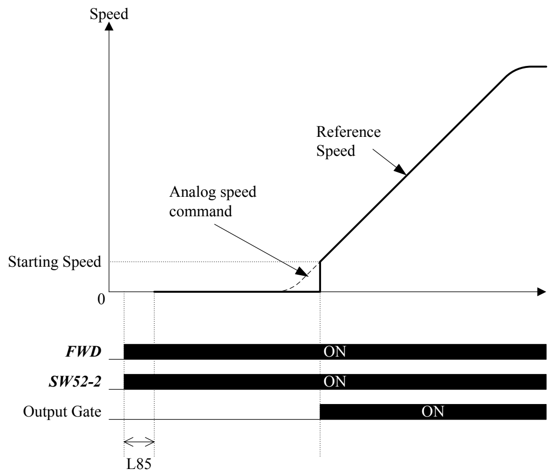
(ii) When an analog speed command (Not reversible) is enabled (F01 = 1)

As soon as run command is ON DC braking operation starts. After the DC braking operation, the inverter activates a soft start to the starting speed. After H64 timer is elapsed, inverter accelerates the motor up to starting speed (F23) by means of soft start acceleration ramp (H65). When the reference speed (pre-ramp) exceeds the starting speed, the inverter immediately accelerates from the current speed up to the reference speed (pre-ramp).



(iii) When an analog speed command (Reversible) is enabled (F01 = 2)

During this operation, no DC braking neither soft start operations are available. When the reference speed (pre-ramp) exceeds the starting speed, the inverter starts acceleration from starting speed to the reference speed (pre-ramp).



F25	Stop Speed	H66 (Stop Speed, Detection method) H67 (Stop Speed, Holding time)

F25, H66, and H67 specify the stop speed, its detection method, and its holding time, respectively, to reduce an impact to the load at the end of travel.

■ Stop speed (F25)

F25 has diferent behaviors depending on the control mode. In case of Torque vector control it is stop speed, in other words, at deceleration to stop motor will keep running at F25 speed as long as run command is ON. In case of Vector control (with PG) it is just a speed level, in other words, motor will decelerate to 0.00 rpm at stop even F25 is different than 0.00 rpm.

- Data setting range: 0.00 to 150.0 (r/min)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Detection method (H66)

H66 selects whether to use the detected speed or reference speed (final) for detecting the stop speed.

Data for H66	Function
0	Use detected speed*
1	Use reference speed (final)

* In case of Torque vector control, inverter will use reference speed (final) as well.

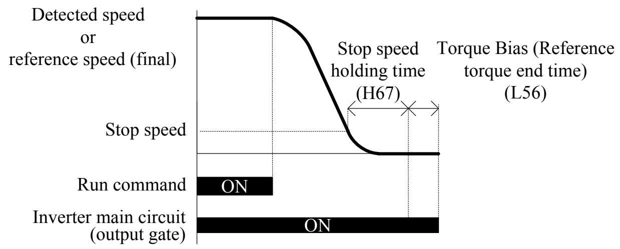
■ Holding time (H67)

H67 specifies the time that, inverter will keep main output circuit ON after stop speed (F25) level is reached even run command is removed before.

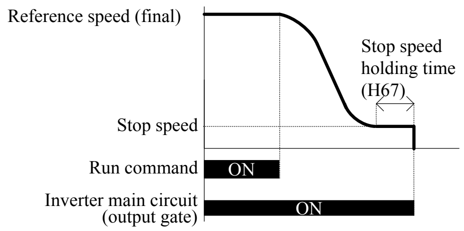
If H67 is 0.00 s, and run command is removed before stop speed (F25) level is reached, inverter will switch OFF main output circuit as soon as F25 level is reached.

- Data setting range: 0.00 to 10.00 (s)

In case of Vector control with PG



In case of Torque Vector control



F26	Motor Sound (Carrier frequency)	H98 (Protection/Maintenance Function) L198 (Operation setting switch 1)

F26 controls the carrier frequency so as to reduce an audible noise generated by the motor or inverter itself, and to decrease a leakage current from the main output (secondary) wirings.

Carrier frequency	5 kHz ↔ 16 kHz
Motor sound noise emission	High ↔ Low
Motor temperature (due to harmonics components)	High ↔ Low
Ripples in output current waveform	Large ↔ Small
Leakage current	Low ↔ High
Electromagnetic noise emission	Low ↔ High
Inverter loss	Low ↔ High

■ Operation setting switch 1 - Fixation of the carrier frequency (L198 bit0)

If F26 is set to 16 and L198 bit0 is set to 1, the inverter will be running at 16 kHz of carrier frequency independently of the output frequency.

Note Specifying a too low carrier frequency will cause the output current waveform to have a large amount of ripples (many harmonics components). As a result, the motor loss increases, causing the motor temperature to rise. Furthermore, the large amount of ripples tends to cause a current limiting alarm.

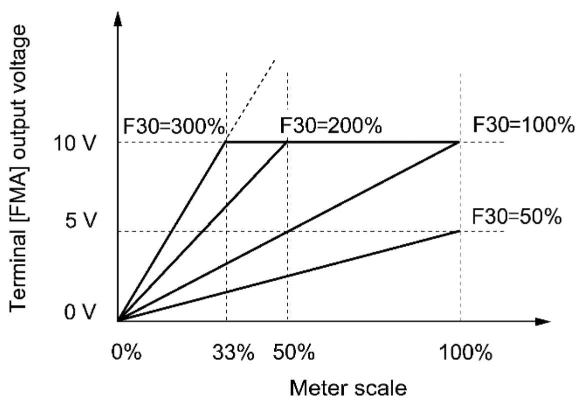
When a high carrier frequency is specified, the temperature of the inverter may rise due to an ambient temperature rise or an increase of the load. If it happens, the inverter automatically decreases the carrier frequency to prevent the inverter overheat alarm OH3 or inverter overload alarm OLU. In order to keep low acustic noise level on the motor, this function can be disabled (see function code H98).

F30 to F31	Analog Output [FMA] (Output gain, Function selection)

These function codes allow terminal [FMA] to output monitored data such as the output frequency and the output current in an analog DC voltage or current. The magnitude of such analog voltage or current is adjustable.

■ Output gain (F30)

F30 allows you to adjust the output voltage within the range of 0 to 300%.



■ Function selection (F31)

F31 specify which data is monitored at the output terminals [FMA].

F31 data	[FMA] output	Data	Definition of monitor amount 100%
0	Reference speed (Final)	Output frequency of the inverter (Equivalent to the motor rated speed)	Rated Speed (F03)
1	Primary frequency	Output frequency of the inverter	Rated Speed (F03)
2	Output current	Output current (RMS) of the inverter	Twice the inverter rated current
3	Output voltage	Output voltage (RMS) of the inverter	200 V class: 250 V 400 V class: 500 V
4	Output torque	Motor shaft torque	Twice the rated motor torque
8	Actual speed	Speed detected through the PG interface	Maximum speed as 100%
9	DC link bus voltage	DC link bus voltage of the inverter	200 V class: 500 V 400 V class: 1000 V
10	Universal AO	Command from communication (📖 RS-485 communication user manual)	20,000/100%
14	Calibration (+)	For meter calibration Full scale output	Always full scale (equivalent to 100%) Output
18	Inverter heat sink temperature	Heat sink detection temperature of inverter	200°C/100%
19	Inverter internal temperature	Internal detection temperature of inverter	200°C/100%
111	Customizable logic output signal 1	Only when analog output has been defined.	100% / 100%
112	Customizable logic output signal 2	Only when analog output has been defined.	100% / 100%
113	Customizable logic output signal 3	Only when analog output has been defined.	100% / 100%
114	Customizable logic output signal 4	Only when analog output has been defined.	100% / 100%
115	Customizable logic output signal 5	Only when analog output has been defined.	100% / 100%
116	Customizable logic output signal 6	Only when analog output has been defined.	100% / 100%
117	Customizable logic output signal 7	Only when analog output has been defined.	100% / 100%
118	Customizable logic output signal 8	Only when analog output has been defined.	100% / 100%
119	Customizable logic output signal 9	Only when analog output has been defined.	100% / 100%
120	Customizable logic output signal 10	Only when analog output has been defined.	100% / 100%

F42 Control Mode

F42 selects the control mode.

Data for F42	Function
0	Vector control with PG for asynchronous motor
1	Vector control with PG for synchronous motor
2	Torque Vector control without PG for asynchronous motor

📖 Refer to page 2-2 for the control mode of the inverter.

F44	Current Limiter (Level)

F44 specifies the activation level of the current limiter.

When the output current of the inverter exceeds the level specified by F44, the current limiter works to manage the output current and reduce the motor torque.

When the output current drops below the level specified by F44, the inverter returns to the normal operation.

- Data setting range: 100 to 230 (%) (Percentage to the rated current of the inverter)
  Auto (The maximum current of each inverter automatically applies.)

Note Since the current limit operation with F44 is performed by software, it may cause a delay in control.

F50 to F52	Electronic thermal overload protection for braking resistor (Discharging capability, Allowable average loss and Braking resistance value)

These function codes specify the electronic thermal overload protection feature for the braking resistor.

Set the discharging capability, allowable average loss and resistance to F50, F51 and F52, respectively. These values are determined by the inverter and braking resistor models.

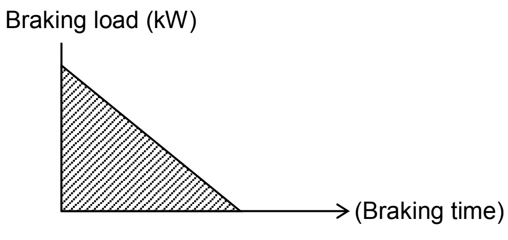
Default setting of these parameters might not be suitable for your braking resistor therefore, before using this function ask for the correct data to your braking resistors supplier.

Note Depending on the thermal characteristics of the braking resistor, the electronic thermal overload protection feature may act so that the inverter issues the overheat protection alarm dbH even if the actual temperature rise is not large enough. If this happens, review the relationship between the performance index of the braking resistor and settings of related function codes.

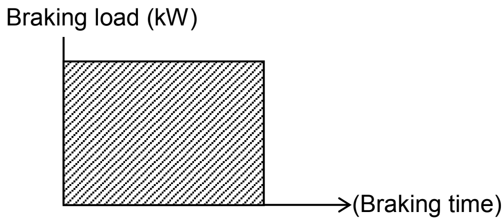
Calculating the discharging capability and allowable average loss of the braking resistor and configuring the function code data

Ask to the resistor manufacturer about the resistor rating and then configure the related function codes.

In lift applications the braking load is constant (vertical load). Use Expressions (1) and (2) given below.



<Applying braking load during deceleration>



<Applying braking load during running at a constant speed>

■ Discharging capability (F50)

The discharging capability refers to kWs allowance for a single braking cycle. It can be calculated from braking.

F50 data	Function
1 to 9000	1 to 9000 (kWs)
OFF	Disable the electronic thermal overload protection

$$\text{Discharging capability (kWs)} = \frac{\text{Braking time (s)} \times \text{Motor rated capacity (kW)}}{2} \qquad (1)$$

■ Allowable average loss (F51)

Allowable average loss is the required resistor capacity that allows continuous operation of motor. It can be calculated from ED (%) and motor capacity (kW).

F51 data	Function
0,001 to 99,99	0,001 to 99,99 kW

Allowable average loss (kW) = (%ED(%)/100) x Motor rated capacity (kW) (2)

■Braking resistance value (F52)

F52 specifies the resistance of the braking resistor.

F52 data	Function
None (0.00)	Not applicable, set this parameter different than 0.
0.01 to 999	0.01 to 999 (Ω)

2.3.2 E codes (Extension terminal functions)

E01 to E08 | **Command Assignment to [X1] to [X8]** | **E98 and E99 (Command Assignment to [FWD] and [REV])**

E01 to E08, E98 and E99 allow you to assign commands to terminals [X1] to [X8], [FWD], and [REV] which are general-purpose, programmable input terminals.

These function codes may also switch the logic system between normal and negative to define how the inverter logic interprets either ON or OFF status of each terminal. The default setting is normal logic system "Active ON." Following table show the commands that can be assigned with the general-purpose programmable input terminals [X1] to [X8], [FWD], and [REV]. Explanations for the commands that follow are given in normal logic system "Active ON."

⚠CAUTION

To the general-purpose programmable input terminals, you can assign commands to the switching means for the run command and its operation, the reference speed (pre-ramp) and the motor drive power.

Be aware of that switching of any of such signals may cause a sudden start (running) or an abrupt change in speed.

An accident or physical injury may result.

Function code data		Terminal commands assigned	Symbol
Active ON	Active OFF		
0	1000	Select multistep speed 1	***SS1***
1	1001	Select multistep speed 2	***SS2***
2	1002	Select multistep speed 4	***SS4***
3	1003	Select multistep speed 8	***SS8***
7	1007	Enable coast-to-stop	***BX***
8	1008	Reset alarm	***RST***
1009	9	Enable external alarm trip	***THR***
10	1010	Enable jogging operation	***JOG***
24	1024	Enable communications link via RS485 or CAN	***LE***
25	1025	Universal DI	***U-DI***
27	1027	Enable PG vector control	***PG/Hz***
60	1060	Select torque bias 1	***TB1***
61	1061	Select torque bias 2	***TB2***
62	1062	Hold torque bias	***H-TB***
63	1063	Enable battery operation	***BATRY***
64	1064	Start creepless operation	***CRPLS***
65	1065	Check brake control	***BRKE***
1066	66	Force to decelerate	***DRS***
67	1067	Start unbalance load compensation	***UNBL***
69	-	Magnetic pole position offset tuning command	***PPT***
80	1080	Customizable logic Cancel	***CLC***
81	1081	Customizable logic All timer clear	***CLTC***
98	-	Run forward (Exclusively assigned to [FWD] and [REV] terminals by E98 and E99)	***FWD***
99	-	Run reverse (Exclusively assigned to [FWD] and [REV] terminals by E98 and E99)	***REV***
100	-	No function assigned	***NONE***

Function code data		Terminal commands assigned	Symbol
Active ON	Active OFF		
101	1101	External alarm 2	***THR2***
102	1102	Start reference torque decreasing	***RTDEC***
103	1103	Inverter Output MC confirmation	***CS-MC***
108	1108	CAN Enable	***CAN_LE***
111	1111	Check brake control 1	***BRKE1***
112	1112	Check brake control 2	***BRKE2***
114	1114	Enable rescue operation by means of brake control	***RBRK***
115	1115	Short-circuit control feedback	***SCCF***
117	1117	Stand-by mode	***STBY***
118	-	Unlocking safty gear operation	***ULSG***

Note Any negative logic (Active OFF) command can be assigned to the functions marked with "—" in the "Active OFF" column.

The "Enable external alarm trip" and "Force to decelerate" are fail-safe terminal commands. For example, when data = "9" in "Enable external alarm trip", it becomes Active OFF (alarm is triggered when OFF); when data = 1009, it becomes Active ON (alarm is triggered when ON).

Terminal function assignment and data setting

■ Select multistep speed -- SS1, SS2,SS4 and SS8 (Function code data = 0, 1, 2, and 3)

The combination of the ON/OFF states of digital input signals ***SS1***, ***SS2***, ***SS4*** and ***SS8*** selects one of 16 different frequency commands defined beforehand by 16 function codes C04 to C19 (Multi-frequency 0 to 15). With this, the inverter can drive the motor at 16 different preset frequencies.

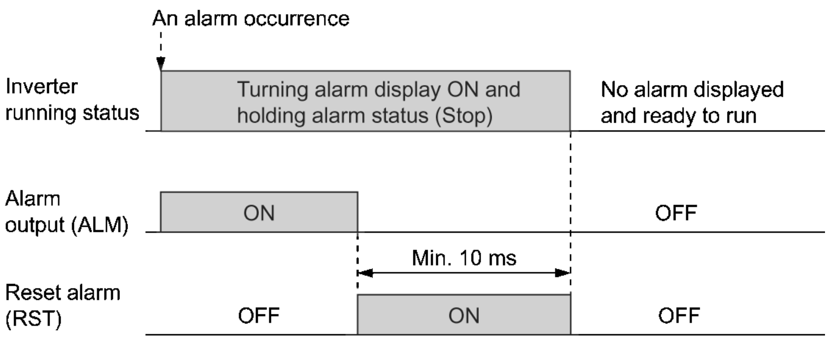
For details, refer to the description of function code F01 (Speed Command).

■ Coast to a stop -- *BX* (Function code data = 7)

Turning this terminal command ON immediately stops the inverter output so that the motor coasts to a stop without issuing any alarm. Turning it OFF restarts the inverter.

■ Reset alarm -- *RST* (Function code data = 8)

Turning this terminal command ON clears the ***ALM*** state, alarm output (for any alarm). Turning it OFF erases the alarm display and clears the alarm hold state. When you turn the ***RST*** command ON, keep it ON for 10 ms or more. This command should be kept OFF for the normal inverter operation.



■ **Enable external alarm trip -- *THR***
(Function code data = 9)

Turning this terminal command OFF immediately shuts down the inverter output (so that the motor coasts to a stop), displays the alarm OH2, and outputs the alarm relay (for any alarm) ***ALM***. The ***THR*** is self-held, and is reset when an alarm reset takes place.

Tip Use a trip command from external equipment when you have to immediately shut down the inverter output in the event of an abnormal situation in a peripheral equipment.

■ **Enable jogging operation -- *JOG***
(Function code data = 10)

Turning this terminal command ON enables jogging operation.

For details, refer to the description of function code C20 (Jogging Speed).

■ Enable communications link via RS485 or CAN -- *LE*
(Function code data = 24)

Turning this terminal command ON runs the motor according to the frequency commands or run commands received via the communications link selected with function code H30 (RS485, CAN or DCP).

No ***LE*** assignment is functionally equivalent to the ***LE*** being ON.

For details, refer to the description of function code H30 (Communications Link Operation).

■ **Universal DI -- *U-DI***
(Function code data = 25)

Using ***U-DI*** enables the inverter to monitor digital signals sent from the peripheral equipment via an RS485 or CAN communications link by feeding those signals to the digital input terminals. Signals assigned to the universal DI are simply monitored and do not operate the inverter.

For an access to universal DI via the RS485 or CAN communications link, refer to their respective Instruction Manuals.

■ **Enable PG vector control -- *PG/Hz***
(Function code data = 27)

Turning this terminal command OFF cancels the PG vector control and switches to the V/f control. The ON/OFF switching when the inverter is in operation will not be validated; it will become effective after the inverter stops. Whenever this terminal command is not assigned, the PG vector control is effective by default.

■ **Torque Bias 1 and 2 -- *TB1* and *TB2***
(Function code data = 60 and 61)

Selecting ***TB1*** or ***TB2*** allows you to set digital torque bias.

For details, refer to the description of function code L54 (Torque Bias, Mode).

■ **Hold torque bias -- *H-TB***
(Function code data = 62)

Turning this terminal command ON holds torque bias setting. Turning it OFF release the hold status.

For details, refer to the description of function code L55 (Torque Bias, Startup time).

■ **Enable battery operation -- *BATRY***
(Function code data = 63)

Turning this terminal command ON selects operation by batteries.

For details, refer to the description of function code C03 (Battery Operation Speed).

■ Start creepless operation -- *CRPLS* (Function code data = 64)

Turning this terminal command ON starts creepless operation.

For details, refer to the description of function code L34 (Elevator Parameter, Moving distance in creepless operation).

■ Check brake control -- *BRKE* (Function code data = 65)

This terminal command is used to check whether or not the actual brake is working normally, using the ***BRKS*** output from the inverter. Configure an external circuit that turns this command ON or OFF when the brake is released or applied, respectively.

For details, refer to the descriptions of function codes L80 to L84 (Brake Control) and H96.

■ Force to decelerate -- *DRS* (Function code data = 66)

In normal inverter operation, this terminal command should be ON. If this terminal command is OFF, the motor will be forced to decelerate with deceleration time specified by function code H56.

For details, refer to the description of function code H56 (Deceleration Time for Forced to Decelerate).

■ Start unbalance load compensation -- *UNBL* (Function code data = 67)

Turning this terminal command ON starts unbalance load compensation. It is used to synchronize brake control signal from the user controller. When this terminal command is OFF, unbalance load compensation will be started after run command is ON.

For details, refer to the descriptions of function codes L65 to L76 (Unbalanced Load Compensation).

■ Magnetic pole position offset tuning command -- *PPT* (Function code data = 69)

PPT is a function for the ABZ encoder. The ABZ encoder doesn't have angle information.
The motor cannot be driven because there is no means to know the magnetic pole position at this time. Turning ON terminal command ***PPT*** starts the execution of the pole position detection.

In case of L99 bit1 = 0

When magnetic pole position offset tuning is done, magnetic pole position offset value (L04) is not changed.

In case of L99 bit1 = 1

When magnetic pole position offset tuning is done, magnetic pole position offset value (L04) is changed. At this time, it is necessary to rotate the motor more than one rotation.

You should carry out the tuning with L99 bit=1 when you begin to use the motor or change the encoder. After the trial run ends, the setting of L99 bit1 = 0 is recommended.

For details, refer to the descriptions of function codes L07 and L99.

■ Cancel customizable logic – "*CLC*" (Function code data = 80), Clear all customizable logic timers – "*CLTC*" (Function code data = 81)

Terminal command "CLC" stops the operation of customizable logic. Terminal command "CLTC" clears all customizable logic timers.

For details, refer to the descriptions of function codes U codes.

■ **Run forward – "*FWD*"**
(Function code data = 98)

Turning this terminal command ON runs the motor in the forward direction; turning it OFF decelerates it to stop.

Tip This terminal command "FWD" can be assigned only to E98 or E99.

■ **Run reverse – "*REV*"**
(Function code data = 99)

Turning this terminal command "REV" ON runs the motor in the reverse direction; turning it OFF decelerates it to stop.

Tip This terminal command "REV" can be assigned only to E98 or E99.

■ **No function assigned – "*NONE*" (Function code data = 100)**
(Function code data = 100)

It allows the inverter to run unaffected by ON/OFF of signals. It is used when a signal is externally input using customizable logic. It is also used to temporarily disable a terminal function.

■ **External alarm 2 – *THR2***
(Function code data = 101)

Before the alarm will happen, if inverter keeps driving for ten seconds. When the inverter shut down the output within ten seconds, alarm will happen.

For details, refer to the descriptions of function codes L98 (bit1).

■ **Start reference torque decreasing – *RTDEC***
(Function code data = 102)

The inverter decreases reference torque to initial torque bias, when turning ***RTDEC*** command OFF.

For details, refer to the descriptions of function codes L99 (bit2).

■ **Output MC confirmation – *CS-MC***
(Function code data = 103)

The correct operation of the output functions ***SW52-2*** and ***SW52-3*** can be confirmed by this function.

For details, refer to the descriptions of function codes L84 to L86.

■ **CAN Enable – *CAN_LE***
(Function code data = 108)

When ***CAN_LE*** is turned on, the CAN communication becomes effective.

■ **Check brake control 1 – *BRKE1* (Function code data = 111)**
Check brake control 2 – *BRKE2* (Function code data = 112)

Motor brakes are expected to work according ***BRKS*** output from the inverter.
These terminal commands are used to monitor the brake operation (status) according to the requirements of Unintended Car Movement as prescribed in EN 81-1:1998 + A3:2009 9.11.3. Use certified motor brakes microswitches to turn these terminal commands ON or OFF when brakes are released or applied respectibelly.

For details, refer to the descriptions of function codes L80 to L84 (Brake Control) and H96. For additional information, refer to related Application Note (AN-Lift2-0002v100EN).

■ **Enable rescue operation by means of brake control – *RBRK***
(Function code data = 114)

When this function is programed to any of the digital inputs, and it becomes ON, behavior of the output function ***BRKS*** changes. ***BRKS*** function is not dependant anymore of RUN command.

For details, refer to the descriptions of function codes L117 to L119.

■ **Short-circuit control feedback – *SCCF***
(Function code data = 115)

SCCF input function is used to get a feedback from the auxiliary contacts of the motor phases short circuit device (mini contactor or power relay).

To feedback the status of the short circuit device is mandatory. Feedback is needed in order to avoid that, inverter enables IGBT gates before motor phases short circuit is removed. In case that any digital output is programed with the function ***SCC*** and no input is programmed with the function ***SCCF*** inverter will trip **Er6**.

For details, refer to the descriptions of function codes L120 and L121.

■ **Stand-by mode – *STBY***
(Function code data = 117)

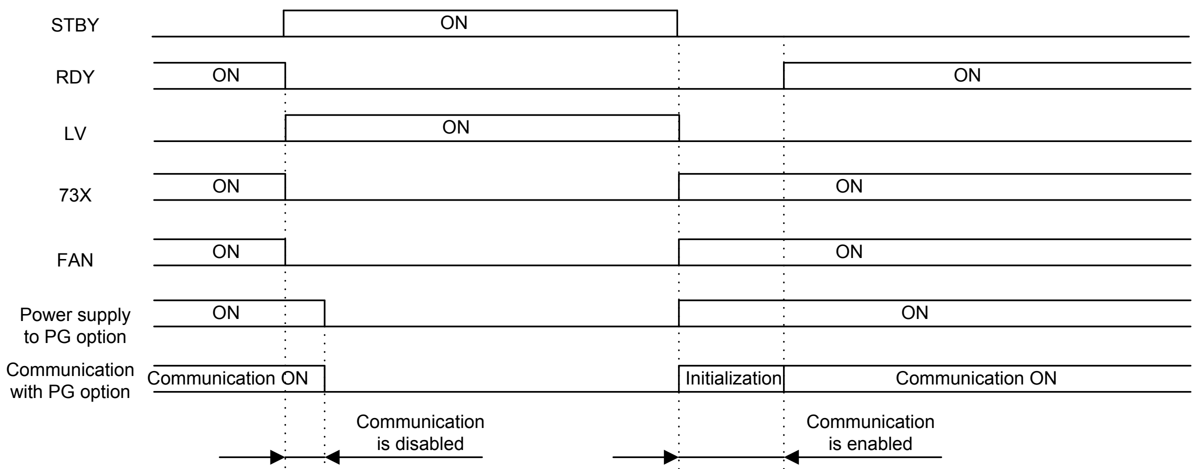
When following conditions are met, inverter enters Stand-by mode:

・***STBY*** terminal command is ON
・Inverter is stopped (No operation command and IGBT gates are OFF)

When inverter enters Stand-by mode the following actions are executed:

・***RDY*** : OFF
・Power supply to built-in option is stopped in order to reduce power consumption
・Cooling fan is stopped
・The bypass contact of the charging circuit (73X) is turned OFF

Time diagram for ***STBY*** function is show below:



It may take a maximum time of 2 seconds until inverter becomes ready to RUN when it returns to normal state from stand-by mode.

Tip

( ) above **No.1000** are logical inversion signals.(active OFF), except the followings.

THR	1009:active ON, 9	:active OFF
DRS	1066:active ON, 66	:active OFF
THR2	1101:active ON, 101	:active OFF

■ Unlocking safty gear operation – *ULSG* (Function code data = 118)

Turning this terminal command ON stars Unlocking safty gear operation.

For details, refer to the descriptions of function codes L101 to L106.

E10 to E17 — Acceleration/Deceleration Time 3 to 10

F07 and F08 (Acceleration/Deceleration Time 1 and 2)

E10 to E17 specify the acceleration or deceleration time in linear acceleration/deceleration zones excluding S-curve zones.

For details, refer to the descriptions of function codes F07 to F08 (Acceleration/Deceleration Time 1, 2).

E18 — Run Command/Multistep Speed Command Agreement Timer (Mode)

E19 — Run Command/Multistep Speed Command Agreement Timer (Time)

E18 and E19 set the run command/multistep speed command agreement timer to avoid signals chattering problems.

■ Mode (E18)

E18 specifies applicable commands for the agreement timer.

Data for E18	Applicable commands	
	FWD, ***REV***	***SS1***, ***SS2***, ***SS4***, ***SS8***
0	--	--
1	√	--
2	--	√
3	√	√

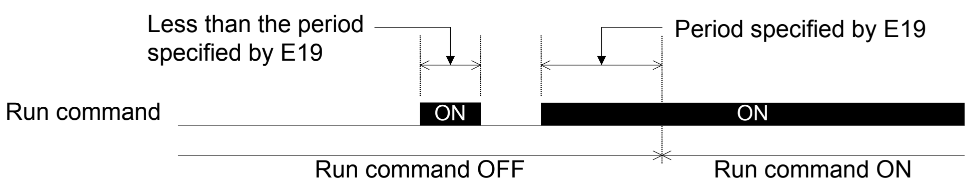
■ Time (E19)

E19 specifies the period to confirm whether the terminal command ***FWD***/***REV*** or ***SS1***/***SS2***/***SS4***/***SS8*** is kept ON or OFF after the command is switched ON or OFF. If the command is kept ON during time specified in E19, the inverter recognizes the command being ON.

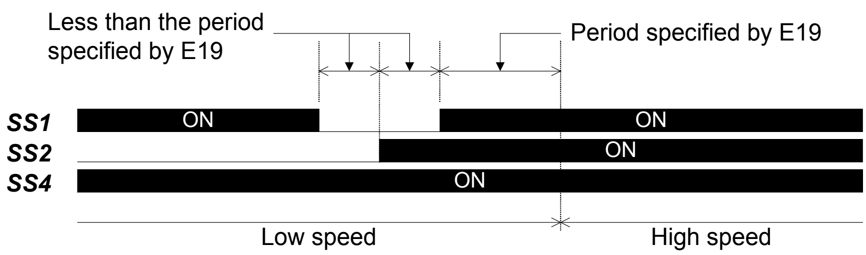
- Data setting range: 0.000 to 0.100 (s)

<u>Application of the agreement timer</u>

- Confirmation for run command



- Confirmation for multistep speed command



E20, E21 E22 to E27	Signal Assignment to [Y1] to [Y2] (Transistor signal) Signal Assignment to [Y3A/C], to [Y5A/C] and [30A/B/C](Relay contact signal)

E20 to E24 and E27 assign output signals (listed on the next page) to general-purpose, programmable output terminals [Y1], [Y2], [Y3A/C] to [Y5A/C] and [30A/B/C]. These function codes can also switch the logic system between normal and negative to define the property of those output terminals so that the inverter logic can interpret either the ON or OFF status of each terminal as active. The factory default settings are "Active ON."

Terminals [Y1] and [Y2] are transistor outputs and terminals, [Y3A/C] to [Y5A/C] and [30A/B/C] are relay contact outputs. In normal logic, if an alarm occurs, the relay will be energized so that [30A] and [30C] will be closed, and [30B] and [30C] opened. In negative logic, the relay will be deenergized so that [30A] and [30C] will be opened, and [30B] and [30C] closed. This may be useful for the implementation of failsafe power systems.

Note

- When a negative logic is employed, all output signals are active (e.g. an alarm would be recognized) while the inverter is powered OFF. To avoid causing system malfunctions by this, interlock these signals to keep them ON using an external power source. Furthermore, the validity of these output signals is not guaranteed for approximately 3 seconds after power-on, so introduce such a mechanism that masks them during the transient period.
- Terminals [Y3A/C] to [Y5A/C] and [30A/B/C]) use mechanical contacts that cannot stand frequent ON/OFF switching. Where a frequent ON/OFF switching is required, use transistor outputs [Y1] and [Y2]. The service life of a relay is approximately 200,000 times if it is switched ON and OFF at one-second intervals.

The table on the following page lists functions that can be assigned to terminals [Y1], [Y2], [Y3A/C] to [Y5A/C] and [30A/B/C].

To make the explanation simpler, the examples shown below are all written for the normal logic (Active ON).

Function code data		Functions assigned	Symbol
Active ON	Active OFF		
0	1000	Inverter running	***RUN***
1	1001	Speed arrival	***FAR***
2	1002	Speed detected	***FDT***
3	1003	Undervoltage detected	***LU***
10	1010	Inverter ready to run	***RDY***
12	1012	MC control	***SW52-2***
25	1025	Cooling fan in operation	***FAN***
26	1026	Auto-resetting	***TRY***
27	1027	Universal DO	***U-DO***
28	1028	Overheat early warning	***OH***
30	1030	Service life alarm	***LIFE***
31	1031	Speed detected	***FDT2***
35	1035	Inverter output ON	***RUN2***
37	1037	Current detected	***ID***
38	1038	Current detected 2	***ID2***
52	1052	Encoder rotating in forward direction	***FRUN***
53	1053	Encoder rotating in reverse direction	***RRUN***
55	1055	Run command activated	***AX2***
56	1056	Motor overheat detected (PTC)	***THM***
57	1057	Brake control	***BRKS***
70	1070	Speed existence	***DNZS***
71	1071	Speed agreement	***DSAG***
72	1072	Speed arrival 3	***FAR3***
73	1073	During acceleration	***DACC***
74	1074	During deceleration	***DDEC***
75	1075	During zero speed	***DZR***
76	1076	PG abnormal	***PG-ABN***
78	1078	Door control	***DOPEN***
99	1099	Alarm output (for any alarm)	***ALM***
101	1101	EN detection circuit fault	***DECF***
102	1102	EN terminal off	***ENOFF***
104	1104	Low voltage detected	***LVD***
105	1105	Electric angle cycle	***EAC***
107	1107	Magnetic pole position offset tuning	***DTUNE***
109	1109	Recommended running direction in battery operation	***RRD***
110	1110	Drive continuance alarm	***ALM2***
111	1111	Shutdown confirmation	***SD***
112	1112	Input power limitation	***IPL***
114	1114	MC control 2	***SW52-3***
115	1115	Pole tuning done	***PTD***

Function code data		Functions assigned	Symbol
Active ON	Active OFF		
116	1116	Detected speed direction	***DSD***
121	1121	Travel Direction Changes lifetime early warning	***TDCL***
122	1122	Travel Direction Changes pulse	***TDCP***
123	1123	Short-circuit control	***SCC***
124	1124	Deliverance operation Calculation end	***CEND***
126	1126	Pole tuning done with reference to Z-signal	***PTD_Z***
127	1127	Loadcell LV1 detection	***LC1***
128	1128	Loadcell Full load detection	***LCF***
129	1129	Loadcell Overload detection	***LCO***
141	1141	Customizable logic output signal 1	***CLO1***
142	1142	Customizable logic output signal 2	***CLO2***
143	1143	Customizable logic output signal 3	***CLO3***
144	1144	Customizable logic output signal 4	***CLO4***
145	1145	Customizable logic output signal 5	***CLO5***
146	1146	Customizable logic output signal 6	***CLO6***
147	1147	Customizable logic output signal 7	***CLO7***
148	1148	Customizable logic output signal 8	***CLO8***
149	1149	Customizable logic output signal 9	***CLO9***
150	1150	Customizable logic output signal 10	***CLO10***

■ Inverter running – *RUN* (Function code data = 0)

This output signal is used to tell the external equipment whether the inverter is running. Turning the inverter main circuit (output gate) ON or OFF switches the ***RUN*** signal ON or OFF, respectively. This signal is also OFF when the motor is being tuned.

If this signal is assigned in negative logic (Active OFF), it can be used as a signal indicating "inverter being stopped."

■ Speed arrival – *FAR* (Function code data = 1)

This output signal comes ON when the difference between the detected speed and reference speed (pre-ramp) comes within the allowable error zone (specified by E30).

When the inverter's run command is OFF, this output signal also comes OFF.

📖 For details, refer to the description of function code E30 (Speed Arrival).

■ Speed detected – *FDT* (Function code data = 2)
Speed detected – *FDT2* (Function code data = 31)

These output signals FDT or FDT2 come ON when the detected speed exceeds the speed detection level specified by E31 or E36 respectively, and it goes OFF when the detected speed drops below the "Detection level (E31 or E36) - Hysteresis band width (E32)". These output signals are not affected by the run command.

📖 For details, refer to the description of function codes E31, E36 and E32 (Speed Detection).

■ Undervoltage detected – *LU* (Function code data = 3)

This output signal comes ON when the DC link bus voltage of the inverter drops below the specified undervoltage level, and it goes OFF when the voltage exceeds the level.

■ Inverter ready to run – *RDY* (Function code data = 10)

This output signal comes ON when the inverter becomes ready to run by satisfying all of the following conditions.

- Terminal [EN1]/[EN2] ON
- ***BX*** OFF
- No alarm detected
- DC link bus voltage higher than the specified undervoltage level
- Initialization of options completed

Note that the activation of a ***BATRY*** command always turns the ***RDY*** signal OFF.

■ MC control – *SW52-2* (Function code data = 12)

This output signal is used for MC control.

📖 For details, refer to the descriptions of function codes L85 and L86 (MC Control).

■ Cooling fan in operation – *FAN* (Function code data = 25)

This output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control.

■ **Auto-resetting – *TRY***
(Function code data = 26)

This output signal comes ON when auto-resetting is in progress.

📖 The auto-reset is specified by H04 and H05. Refer to the descriptions of function codes H04 and H05 for details about the number of resetting times and reset interval.

■ **Universal DO – *U-DO***
(Function code data = 27)

Assigning this output signal to an inverter's output terminal and connecting the terminal to a digital input terminal of peripheral equipment, allows to use the inverter to send commands to the peripheral equipment via the communications link RS485 or CAN.

The universal DO can be used as an output signal independent of the inverter operation.

📖 For the procedure for access to Universal DO via the communications link RS485 or CAN, refer to the respective instruction manual.

■ **Overheat early warning – *OH***
(Function code data = 28)

This output signal issues an overheat early warning before an overheat trip actually occurs due to the temperature on the inverter's heat sink (OH1) or inside the inverter (OH3) or due to an inverter overload (OLU).

If this signal is turned ON, take any appropriate measures such as stop of the inverter operation and enhancement of external cooling.

📖 For details, refer to the description of L93 (Overheat Early Warning Level).

■ **Service life alarm – *LIFE***
(Function code data = 30)

This output signal comes ON when it is judged that the service life of any capacitors (reservoir capacitor in the DC link bus and/or electrolytic capacitors on the printed circuit boards) and cooling fan has expired.

This signal should be used as a guide for replacement of the capacitors and cooling fan. If this signal comes ON, use the specified maintenance procedure to check the service life of these parts and determine whether the parts should be replaced or not.

📖 For details, refer to the FRENIC-Lift (LM2A) Instruction Manual (INR-SI47-1894-E), Section 6.3.

■ **Inverter output on – *RUN2***
(Function code data = 35)

This output signal comes ON when the inverter turns ON its main circuit (output gate).

It also comes ON when the motor is being tuned.

■ **Current detected and Current detected 2 – *ID* and *ID2***
(Function code data = 37 and 38)

The ***ID*** or ***ID2*** signal comes ON when the output current of the inverter exceeds the level specified by E34 or E37 (Current Detection, Level) respectively for the time longer than the one specified by E35 (Current Detection, Time), provided that "37" or "38" is assigned to any general-purpose output terminal, respectively. The minimum ON-duration is 100 ms.

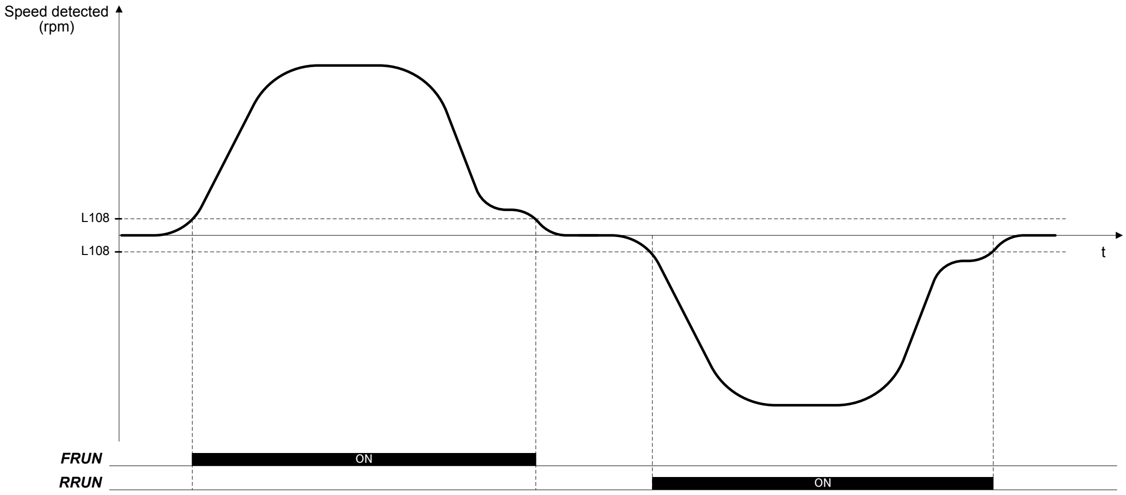
It goes OFF when the output current drops below 90% of the rated operation level.

📖 For details, refer to the descriptions of function codes E34, E35 and E37.

■ **Encoder rotating in forward direction – "FRUN" (Function code data = 52),**
Encoder rotating in reverse direction – "RRUN" (Function code data = 53)

This output signals come ON by encoder's rotation direction and speed regardless of running status of the inverter.

In following figure, a speed diagram is shown with activation/deactivation of these signals. As soon as speed reaches L108 (Encoder Rotation (Detection speed)) ***FRUN*** or ***RRUN*** are activated depending on the rotation detection.



Tip In the case of torque vector control, these signals will keep OFF state.

■ **Run command activated – *AX2***
(Function code data = 55)

This output signal comes ON by satisfying all of the following conditions.

- Run command ON
- ***LU*** is OFF
- No alarm (***ALM*** is OFF)

This output signal comes OFF by satisfying either of the following conditions.

- Run command OFF
- ***LU*** is ON
- Alarm (***ALM*** is ON)

■ **Motor overheat detected (PTC) – *THM***
(Function code data = 56)

This output signal indicates that a temperature alarm condition has been detected by a PTC (Positive Temperature Coefficient) thermistor on the motor.

With this output signal assigned, setting function code H26 (PTC or NTC Thermistor) to "2" enables the inverter to continue running instead of stopping with the alarm OH4 even if a temperature alarm condition has been detected.

For details of the PTC thermistor, refer to the descriptions of function codes H26 and H27 (PTC Thermistor, Mode and Level).

■ **Brake control – *BRKS***
(Function code data = 57)

This signal outputs a brake control command.

For details, refer to the descriptions of function codes L80 to L84 (Brake Control) and H96.

■ **Speed existence – *DNZS***
(Function code data = 70)

This output signal comes ON when the detected speed is equal to or higher than the stop speed. It is not affected by any run command to the inverter.

■ **Speed agreement – *DSAG***
(Function code data = 71)

This output signal comes ON when the difference between reference speed (final) and detected speed is within the range specified by H74 and it goes OFF when the difference is out of the allowable band for the time longer than the one specified by H75. It is not affected by any run command to the inverter.

For details, refer to the description of function codes H74 and H75 (Speed Agreement).

■ **Speed arrival 3 – *FAR3***
(Function code data = 72)

This output signal comes ON when the difference between the detected speed and reference speed (pre-ramp) comes within the allowable error zone (specified by E30).

It is not affected by any run command to the inverter.

For details, refer to the description of function code E30 (Speed Arrival).

■ **During acceleration and During deceleration – *DACC* and *DDEC***
(Function code data = 73 and 74)

The output signal ***DACC*** or ***DDEC*** come ON depending on whether the motor is accelerating or decelerating by comparing the reference speed (pre-ramp) with the detected speed. These output signals are not affected by any run command to the inverter.

For details, refer to the description of function code E30 (Speed Arrival).

■ **During zero speed – *DZR***
(Function code data = 75)

This output signal comes ON when the main circuit (output gate) of the inverter is ON and the detected speed is lower than the stop speed specified by function code F25.

■ **PG abnormal – *PG-ABN***
(Function code data = 76)

This output signal comes ON when any PG error is detected.

For details, refer to the description of function codes L90 to L92 (PG Error Detection).

■ **Door control – *DOPEN***
(Function code data = 78)

This output signal controls the elevator door.

For details, refer to the description of function codes L87 to L89 (Door Control) and L99 (bit6).

■ **Alarm output (for any alarm) – *ALM***
(Function code data = 99)

■ **EN detection circuit fault – *DECF***
(Function code data = 101)

This output signal comes ON when the [EN1]/[EN2] status detection circuit is defective. It can be outputted separately from the relay alarm output.

■ **EN terminal off – *ENOFF***
(Function code data = 102)

This is a status output signal that comes ON when the [EN1]/[EN2] terminals are not active. It goes OFF when the output signal ***DECF*** is ON.

■ Low voltage detected – *LVD* (Function code data = 104)

This output signal comes ON when a low voltage is detected.

■ Electric angle cycle – *EAC* (Function code data = 105)

When Magnetic pole position offset value of a synchronous motor is set by manual tuning.ower, ***EAC*** is used. If 90° ≦ electric angle θ ＜270° , ***EAC*** is ON.

■ Magnetic pole position offset tuning – *DTUNE* (Function code data = 107)

DTUNE is turned ON while Magnetic pole position offset tuning is operating. The end of the magnetic pole position tuning done by ***PPT*** can be confirmed.

■ Recommended running direction at battery operation – *RRD* (Function code data = 109)

The inverter recommends the direction that should operate during the battery operation by using digital outputs ***RRD***. In other words, it recommends always the braking direction.
If ***RRD*** is ON, it means that inverter recomends rescue in FWD direction. On the other hand, if ***RRD*** is OF, it means that inverter recomends rescue in REV direction.

These signals are saved when the power supply to the inverter is shut off, and kept until the next operation begins. They are kept as well under battery operation.

■ Drive continuance alarm – *ALM2* (Function code data = 110)

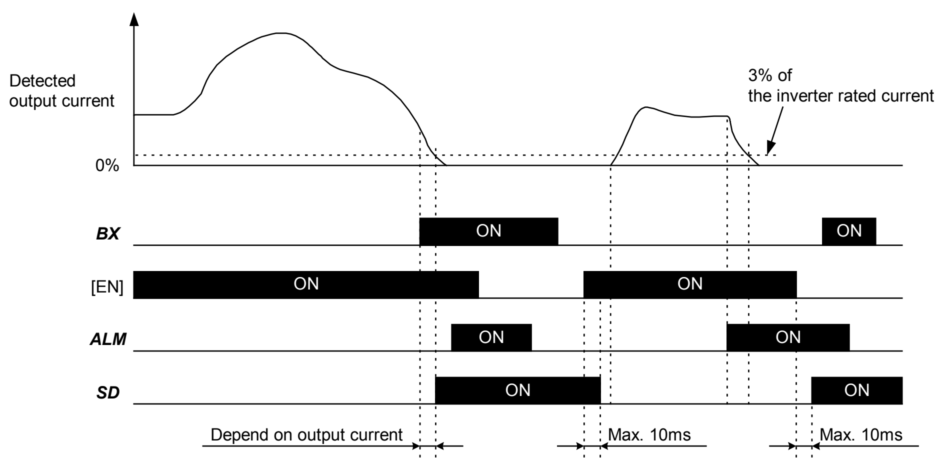
When some special alarm happens, the inverter keeps driving the motor for ten seconds. At the same time, drive continuance alarm comes ON. Moreover, the drive continuance alarm keeps the same condition without resetting.

For details, refer to the descriptions of function codes L98 (bit1).

■ Shutdown confirmation – *SD* (Function code data = 111)

Shutdown confirmation comes ON when the output current of the inverter equals the 3% of the inverter rated current and satisfying any of the following condition.

- Terminal [EN1]/[EN2] OFF
- ***BX*** ON



■ **Input power limitation – *IPL***
(Function code data = 112)

During battery operation when the input power has exceeded the level specified C01 and the input power continues longer than the period specified by C02 (Limit time) the inverter stops automatically and ***IPL*** is turned ON. It turns OFF when FWD or REV command turns OFF.

For details, refer to the descriptions of function codes C01 to C02.

■ **MC control 2 – SW52-3**
(Function code data = 114)

This output signal is used for MC control. This signal is a logical sum (OR gate) of ***SW52-2*** (MC control) and ***AX2*** (Run command activated).

Compared with **SW52-2**, even if ***EN*** terminal is OFF or ***BX*** terminal is ON, ***SW52-3*** comes ON and MC can be turned ON as soon as run command is ON.

For details, refer to the descriptions of function codes L85 and L86 (MC Control).

■ **Pole tuning done – *PTD* (Function code data = 115)**
Pole tuning done with reference to Z-signal – *PTD_Z* (Function code data = 126)

If the Pole tuning is not done, the signal is OFF, therefore the drive is informing to the external equipment that Pole tuning must be performed. If pole tuning is performed ***PTD*** signal is set to ON when the tuning has been finished without errors. After that, when detecting a Z-phase pulse (or similar correction signal) of AB-Z encoder, ***PTD-Z*** signal is set to ON. When any of the following condition is met, these signals are reset.

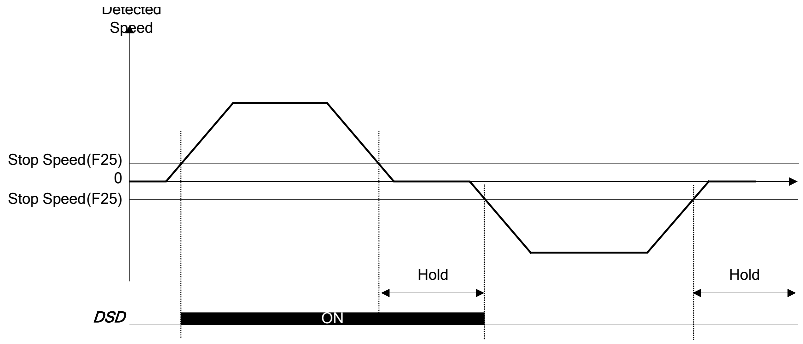
- Power-off the inverter.
- The inverter tripped during the magnetic pole position tuning.
- Magnetic pole position tuning is canceled before ending.
- F42, P01, L01 or L02 is changed.

These signals show the status of magnetic pole position tuning as follow:

PTD	*PTD-Z*	State of the magnetic pole position tuning
OFF	OFF	Magnetic pole position tuning has not been completed successfully.
OFF	ON	Combination not possible.
ON	OFF	Although the pole position tuning has been completed successfully, Z-phase pulse has not been detected (correction is not performed).
ON	ON	Magnetic pole position tuning has been completed successfully, the correction by Z-phase pulse has been also completed successfully.

■ Detected speed direction – *DSD* (Function code data = 116)

This signal shows the direction of the detected speed. The detected speed is assumed as positive in FWD operation and negative in REV operation. If the detected speed is higher than F25, ***DSD*** is turned ON. If the detected speed is smaller than (- F25), ***DSD*** is turned OFF. F25 is the hysteresis width. The state is maintained when the detection speed is inside the hysteresis width.



■ Travel Direction Changes lifetime early warning – *TDCL* (Function code data = 121)

This output function will go from OFF to ON when L113 reaches the level set in L112. Function L112 is a percentage of the limit set in L111.

When output function is in ON condition, and L113 becomes smaller than L111 percentage of L112, output will go to OFF condition.

Lifetime early warning terminal function is linked to the light alarm **tCW**.

L112 set to 0% is understood as disabled. So in this case inverter will not show any warning, and output will not go from OFF to ON even 120 (or 1120) is set.

For details, refer to the descriptions of function codes L109 to L115 (TDC) and L197. For additional information, refer to related Application Note (AN-Lift2-0004v100EN).

■ Travel Direction Changes pulse – *TDCP* (Function code data = 122)

This ouput function generates a pulse each time that L113 counter is increased. In other words, digital output generates a pulse each time that RUN command changes from FWD ro REV or from REV to FWD.

When [EN1]/[EN2] terminal signals are not ON, pulse is not generated, as no real lift travel can be performed.

This pulse has a duration of 0.5 s.

For details, refer to the descriptions of function codes L109 to L115 (TDC). For additional information, refer to related Application Note (AN-Lift2-0004v100EN).

■ Short-circuit control – *SCC* (Function code data = 123)

SCC output function is used to control motor phases short circuit device (mini contactor or power relay).

This output function has to be wired to the control terminals (for example the coil) of the motor phases short circuit device. Short circuit contact has to be a normally closed contact. In other words, when inverter is not supplied, motor phases has to be short circuited. When SCC output function is in ON state, voltage is applied to the short circuit device control terminals and it opens.

For details, refer to the descriptions of function codes L120 and L121.

■ **Deliverance operation Calculation end – *CEND* (Function code data = 123)**

This output signal comes ON when Deliverance operation direction is decided.

For details, refer to the descriptions of function codes L122 to L124.

■ **Loadcell LV1 detection – *LC1* (Function code data = 127)**

This output function turns ON (and is kept ON) when, after timer L144 is elapsed, torque detected is below level set in L145. After RUN command is removed, it turns automatically to OFF.

When the torque detected is over the level set in L145, and timer L144 has elapsed, it will remain OFF.

For details, refer to the descriptions of function codes L143 to L147.

■ **Loadcell Full load detection – *LCF* (Function code data = 128)**

This output function turns ON (and is kept ON) when, after timer L144 is elapsed, torque detected is equal or higher than L146 level and below L147. After RUN command is removed, it turns automatically to OFF.

When torque detected is out of torque range specified by levels L146 and L147, and timer L144 is elapsed, it will remain OFF.

For details, refer to the descriptions of function codes L143 to L147.

■ **Loadcell Overload detection – *LCO* (Function code data = 129)**

This output function turns ON (and is kept ON) when, after timer L144 is elapsed, torque detected is above level set in L147. After RUN command is removed, it turns automatically to OFF.

When torque detected is below level set on L147, and timer L144 is elapsed, it will remain OFF.

For details, refer to the descriptions of function codes L143 to L147.

■ **Customizable logic output signal 1 to 10 – *CLO1* to *CLO10* (Function code data =141 to 150)**

Outputs the result of customizable logic operation.

For details, refer to the descriptions of U function codes.

Note ( ) above **No.1000** are logical inversion signals.(active OFF).

E30	Speed Arrival (Hysteresis) H75 (Speed Agreement, Delay time)

E30 specifies the detection range of the speed arrival signal.

- Data setting range: 0.00 to 6000 (r/min)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Output signals "Speed arrival *FAR*", "Speed arrival 3 *FAR3*", "During acceleration *DACC*" and "During deceleration *DDEC*"

The output signal ***FAR*** can be assigned to a general-purpose, programmable output terminal by setting "1" (E20 to E24 and E27). The ***FAR*** comes ON when the detected speed against the reference speed (pre-ramp) is within the specified range. However, if the run command is OFF or the reference speed (pre-ramp) is less than 0.00 (r/min) (less than the stop speed), it will not come ON.

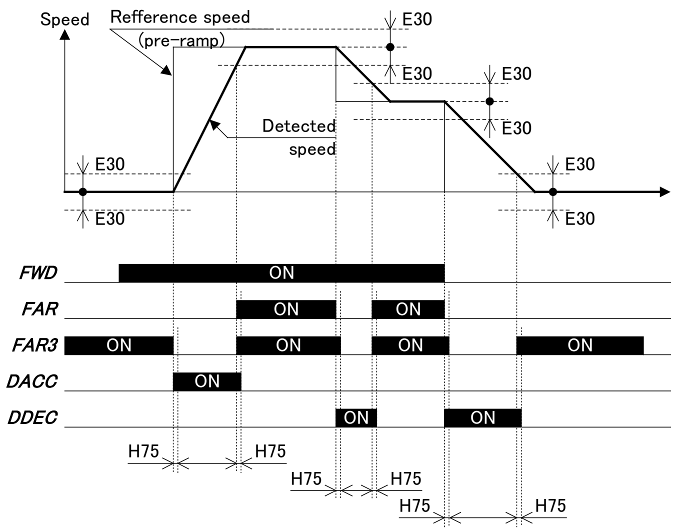
The output signal ***FAR3*** can be also assigned by setting "72." The ***FAR3*** comes ON when the detected speed against the reference speed (pre-ramp) is within the specified range. This output signal is not affected by any run command.

The output signals ***DACC*** and ***DDEC*** can be also assigned by setting "73" and "74," respectively. The ***DACC*** or ***DDEC*** comes ON depending on whether the motor is accelerating or decelerating by comparing the reference speed (pre-ramp) with the detected speed. These output signals during accelerating and decelerating are turned OFF according to the level of the speed arrival hysteresis specified by E30.

Tip When the output signals ***FAR***, ***DACC*** and ***DDEC*** are assigned, the ON-to-OFF delay time can be specified by function code H75 in order to prevent chattering. H75 can be used for the output signal ***DSAG***.

Note When the torque vector control is selected reference speed (final) is used instead of detected speed.

Following is a timing chart for these output signals.



E31	Speed Detection (FDT) (Detection level) E36 (Speed Detection 2 (FDT) (Detection level))
E32	Speed Detection (FDT) (Hysteresis)

E31.E36 and E32 specify the speed detection level and hysteresis band width for the output signal ***FDT*** or ***FDT2*** assigned to a general-purpose programmable output terminal by any of E20 to E24 and E27.

■ Speed detection level (E31 or E36)

The output signal ***FDT*** or ***FDT2*** are turned ON when the detected speed has exceeded the speed detection level specified by E31 or E36 respectively.

- Data setting range: 0.00 to 6000 (r/min)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Speed detection hysteresis (E32)

The ***FDT*** is turned OFF when the detected speed becomes lower than the "Detection level (E31 or E36) - Hysteresis band width (E32)."

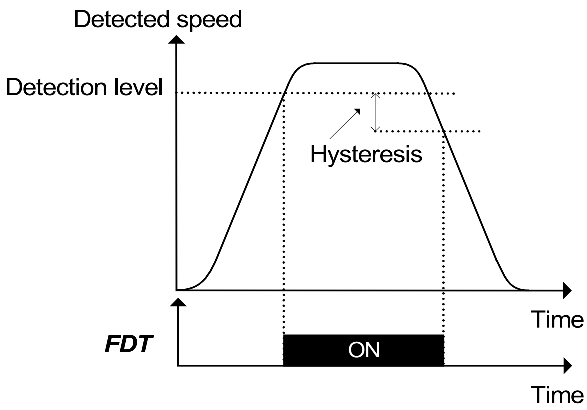
- Data setting range: 0.00 to 900 (r/min)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Speed detection

Setting any of E20 to E24 and E27 data to "2" assigns the output signal ***FDT*** or to "31" assigns the output signal ***FDT2*** to the specified general-purpose programmable output terminal. The ***FDT*** or ***FDT2*** signal comes ON when the detected speed has exceeded the speed detection level (E31 or E36). It goes OFF when the detected speed becomes lower than below the "Detection level (E31 or E36) - Hysteresis band width (E32).

Note: Reference speed is used for detection speed to change when the torque vector is control is used.



E34	Current Detection 1 (Level 1)
E35	Current Detection 1 (Time)

Refer to the description of E37.

E36	Speed Detection 2 (FDT) (Detection level) (refer to E31)

Refer to the description of E31.

E37	Current Detection 2 (Level 2)

Function code E34, E35 and E37 specify current detection level and timer.

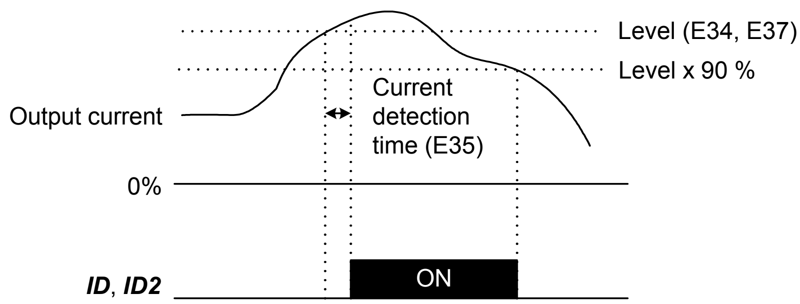
- Data setting range (E34 and E37): Current value of 1 to 200% of the inverter rated current in units of amperes. (0.00: disable)
- Data setting range (E35): 0.01 to 600.00 (s)

E34, E35 are set for over torque current detection (Ot) when L98 (bit 0) is set to 1.

For details, refer to the description of function codes L98 (bit 0).

■ Current detection

Setting any of E20 to E24 and E27 data to "37" or "38" assigns the output signal "Current detected 1, ***ID***" or "Current detected 2, ***ID2***" to the general-purpose programmable output terminals respectively. The ***ID*** or ***ID2*** comes ON when the output current of the inverter has exceeded the level specified (by E34 for ***ID*** or by E37 for ***ID2***) and the output current continues longer than the period specified by E35 (Current detection time). It turns OFF when the output current drops below 90% of the rated operation level. (minimum width of the output signal: 100 ms).



E39	RRD Detection Level

This parameter sets the detection level of the recommended running direction at battery operation.

- Data setting range: 0 to 100 (%) (operation level)

■ Judgment of recommended running direction

When inverter is controlling a motor with low efficiency (like worm gear motor), load variation between car and counterweight might not be detected. In this case, please set this level to detect ***RRD*** correctly.

Tip

Please follow the procedure below:

1. With balanced load, run the elevator in up direction and observe the torque command at constant speed.
2. With same condition, run the elevator in down direction and observe the torque command at constant speed.
3. Please set E39 to the larger torque command observed among step 1 and 2.

E43 specifies the monitoring item to be displayed on the LED monitor of basic keypad (TP-E1U).

■ LED monitor (Item selection) (E43)

Data for E43	Function (Item to be displayed)	Description
0	Speed monitor	Sub items selected by function code E48
3	Output current	Inverter output current expressed in RMS (A)
4	Output voltage	Inverter output voltage expressed in RMS (V)
8	Calculated torque	Reference torque (%) based on the motor rated torque *1
9	Input power	Inverter's input power (kW)
18	Reference torque	Reference torque (%) based on the motor rated torque
19	Torque bias balance adjustment (Offset) (BTBB)	For adjustment of analog torque bias
20	Torque bias gain adjustment (BTBG)	

*1 In vector control with PG, this item shows the reference torque.

Specifying the speed monitor (E43 = 0) provides a choice of speed monitor items specified with E48 (LED Monitor, Speed monitor item).

Define the speed-monitoring format on the LED monitor as listed below.

■ LED monitor (Speed monitor item) (E48)

Data for E48	Display format of the sub item	
0	Reference speed (final)	Expressed in units selected by C21
2	Reference speed (pre-ramp)	Expressed in units selected by C21
3	Motor speed	Expressed in r/min
5	Elevator speed	Expressed in m/min
8	Elevator speed (mm/s)	Expressed in mm/s

E48 | LED Monitor (Speed monitor item) | E43 (LED Monitor, Item selection)

E48 specifies speed monitor item to be displayed on the LED monitor when the speed monitor is selected in E43.

For details, refer to the description of function code E43.

E52 | Keypad (Menu display mode)

E52 specifies the menus to be displayed on the standard keypad (TP-E1U). E52 provides a choice of three menu display modes as listed below:

E52 data	Menu display mode	Menus to be displayed
0	Function code data editing mode	Menus #0, #1 and #7
1	Function code data check mode	Menus #2 and #7
2	Full-menu mode	Menus #0 through #7

There are eight menus as shown in the table below:

Menu #	LED monitor shows:	Function	Display content
0	0. Fnc	Quick setup	Quick setup function code
1	1. F_ _	Data setting F to o	F to K group function code
2	2. rEP	Data check	Modified function code
3	3. oPE	Operation monitor	Operation status indication
4	4. I_o	I/O check	DIO, AIO status indication
5	5. CHE	Maintenance	Maintenance information indication
6	6. AL	Alarm information	Alarm information indication
7	7. CPY	Data copy	Data copy function

E59 | Terminal [V2] function selection (C1 function//V2 function)

Specifies whether terminal [V2] is used with current input +4 to +20 mA or voltage input 0 to +10 V. In addition, switch SW4 on the interface board must be switched.

E59 data	Input form	Switch SW4
0	Current input: 4 to 20 mA (C1 function)	C1
1	Voltage input: 0 to 10 V (V2 function)	V2

For details about SW4, refer to the Instruction manual.

⚠WARNING

Failure to set correctly SW4 switch as explained above may cause a wrong analog input value, possibly leading to unexpected operation of the inverter.

Injuries may occur.

Failure may occur.

E61	**Analog Input for [12] (Extension function selection)** **C31 (Analog Input Adjustment for [12], Offset)** **C32 (Analog Input Adjustment for [12], Gain)** **C33 (Analog Input Adjustment for [12], Filter time constant)**
E62	**Analog Input for [V2] (C1 function) (Extension function selection)** **C36 (Analog Input Adjustment for [V2], Offset)** **C37 (Analog Input Adjustment for [V2], Gain)** **C38 (Analog Input Adjustment for [V2], Filter time constant)**
E63	**Analog Input for [V2] (V2 function) (Extension function selection)** **C41 (Analog Input Adjustment for [V2], Offset)** **C42 (Analog Input Adjustment for [V2], Gain)** **C43 (Analog Input Adjustment for [V2], Filter time constant)**

E61, E62, and E63 define the functions of terminals [12], [V2] (V2 function), and [V2] (C1 function), respectively.
Terminals [12] and [V2] (V2 function) are voltage input terminals, and terminal [V2] (C1 function) is a current input terminal.

Data for E61, E62, or E63	Input assigned to [12] and [V2]	Description
0	None	--
1	Speed command (Operation is not reversible with the polarity)	Input an analog speed command to terminal [12] or [V2] (V2 function) by 0 to 10 VDC, and [V2] (C1 function) by 4 to 20 mADC for 0 to 100% of the maximum speed.
2	Speed command (Operation is reversible with the polarity)	Input an analog speed command to terminal [12] or [V2] (V2 function) by -10 to 10 VDC for -100 to 100% of the maximum speed. Do not assign this data for the terminal [V2] (C1 function).
4	Torque bias command	Input an analog torque bias to terminal [12] or [V2] (V2 function) by -10 to 10 VDC for -100 to 100% of the rated torque in analog command value. Input an analog torque bias to terminal [V2] (C1 function) by 4 to 20 mADC for 0 to 100% of the rated torque in analog command value.

When C22 is 0

Set 1 or 2 to E61 (E62, E63) when you want to use the analog multistep speed command.

When C22 is 1

Set 1 or 2 to E63 when you want to use the analog multistep speed command.
Do not set 1 or 2 to E61 and E62.

Refer to the descriptions of function codes F01, L54 for analog speed commands, analog torque bias, respectively. Offset, gain, and filter time constant can be specified for individual terminals by function codes C31 to C33, C36 to C38 and C41 to C43.

Note: If these terminals have been set up by function codes to have the same data, the specified values will be added up.

E98	**Command Assignment to [FWD]**	**E01 to E08 (Command Assignment to [X1] to [X8])**
E99	**Command Assignment to [REV]**	**E01 to E08 (Command Assignment to [X1] to [X8])**

Function codes E98 and E99 specify the functions assigned to terminals [FWD] and [REV].

For details, refer to the descriptions of function codes E01 to E08 (Command Assignment to [X1] to [X8]).

2.3.3 C codes (Control functions)

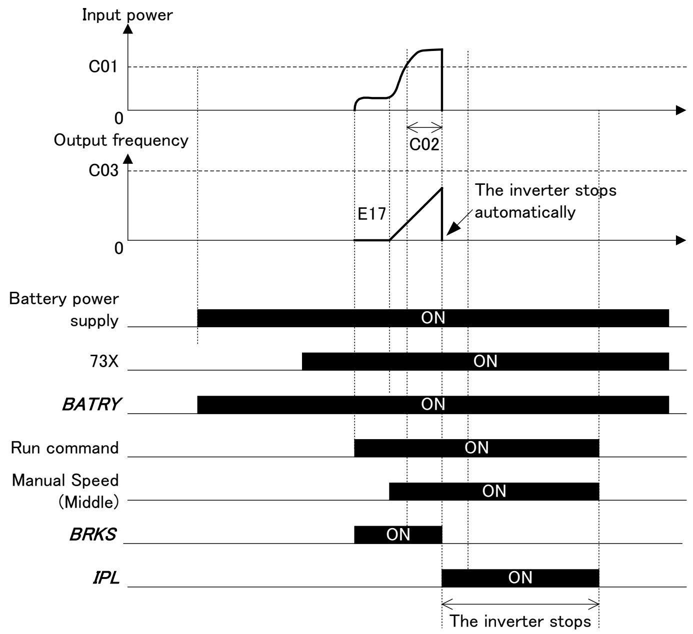
C01	Battery Operation (Limit level)
C02	Battery Operation (Limit time)

C01 and C02 specify the limitation level and detection time in battery operation. The limitation method is depending on the control mode.

- Data setting range(C01): 0 to 100 (%) (The meaning of 100% is 10kW)
  OFF (no operation)
- Data setting range(C02): 0.0 to 30.0 (s)

■ Input power limitation

When the input power has exceeded the level specified C01 and this condition continues longer than the period specified by C02 (Limit time) the inverter stops automatically and ***IPL*** comes ON. It turns OFF when FWD or REV command turns OFF.



C03	Battery Operation Speed

C03 specifies the battery operation speed. When the manual speed (middle) is selected in battery operation, the inverter operates with this speed.

- Data setting range: 0.00 to 6000 (r/min)

📖 Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Battery operation

The battery operation allows an inverter to run the elevator with a battery (or UPS) in undervoltage condition. The purpose of this funtion is to rescues the passengers from the cabin stopped halfway due to a power failure. Using battery operation, the inverter moves the cabin to the nearest floor.

■ Requirements for battery operation

(1) ***BATRY*** (data = 63) must be assigned to any digital input terminal.

(2) A DC voltage (or AC voltage in case of using UPS) must be supplied to the main circuit (R-T or S-T). The necessary DC voltage depends on the operation speed and load.

(3) Only in the case of using batteries, control board has to be supplied additionally. Control board supply terminals depend on inverter capacity:

- FRN0032LM2A-4_ or below: +24V/-24V
- FRN0039LM2A-4_ or above: R0/T0

For additional information about external power supply terminals, refer to Instruction manual.

(4) ***BATRY*** must be turned ON.

■ Specifications

(1) The under voltage protection (**LU**) is disabled.

(2) The inverter can run the elevator even in the under voltage condition.

(3) The ***RDY*** ("Inverter ready to run" signal) is forced to go OFF.

(4) The bypass contact of the charging circuit (73X ON) is delayed a defined time (T1) specified in table 1 from ***BATRY*** ON. After that delay time it takes 0.1s (T2) as the start waiting time.

Situation	Waiting time (T1)
After control power supply goes OFF, battery power supply and control power supply turns ON	200ms
The control power supply remains ON or after momentary power failure happens.	200ms

Table 1. Delay time from ***BATRY*** ON to 73X ON (T1).

(5) During the battery operation, if manual speed (middle) is selected (if the L11 to L18 are default setting, the terminal conditions are ***SS1***=ON, ***SS2***=OFF, ***SS4***=OFF and ***SS8***=OFF), inverter runs the elevator at the speed specified by C03. Even if the analog speed command is selected and the manual speed (middle) is selected via general-purpose digital input terminals, inverter runs the elevator at the speed specified by C03 also.

When the multistep speed other than the manual speed (middle) is selected, the inverter runs the elevator at the speed specified by the corresponding function code.

(6) In battery operation, the acceleration/deceleration time specified by E17 is selected. The S-curve is disabled in acceleration or deceleration.

When the inverter runs by analog speed command in battery operation, E10 for acceleration time and E11 for deceleration time are selected.

(7) Decide the battery operation speed by calculating with the following formula based on the battery voltage. The battery voltage should be above 48 VDC in case of 400 V inverter.

$$\text{Reference speed (pre-ramp) during battery operation} \leq \frac{\text{Batter voltage} - 5[V]}{\sqrt{2} \times \text{Rated voltage}} \times \text{Rated speed} \times k$$

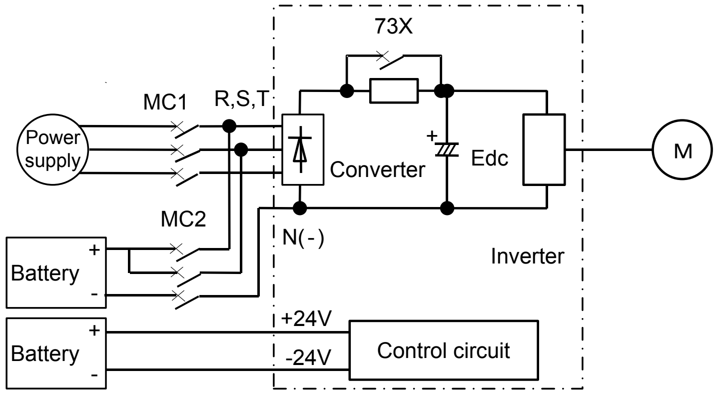
Reference speed (pre-ramp) during battery operation :
Setting of C03 in the multistep speed operation (when the manual speed (middle) is selected)

Base speed : F04

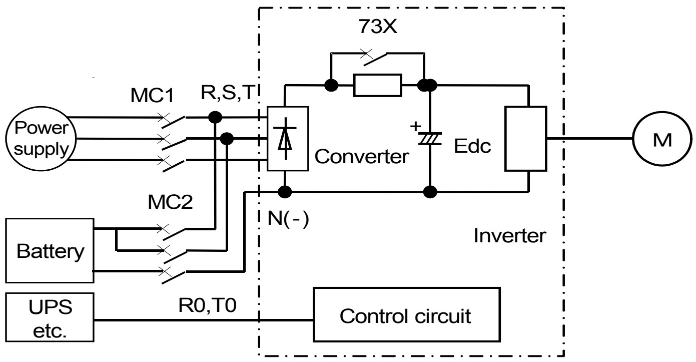
Rated voltage : F05 (motor rated voltage (V))

k: Safety coefficient (less than 1 and may be about 0.8)

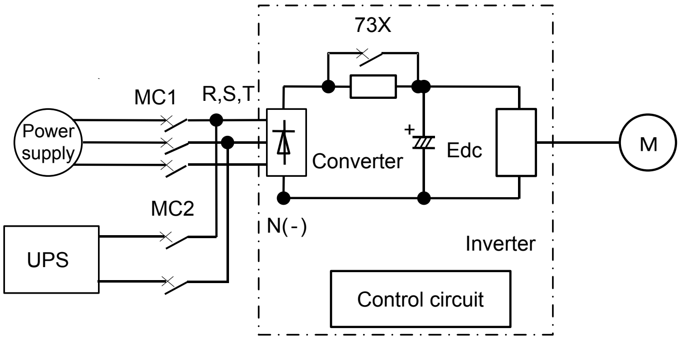
■ **Connection diagram in case of batteries and FRN0032LM2A-4_ or below:**



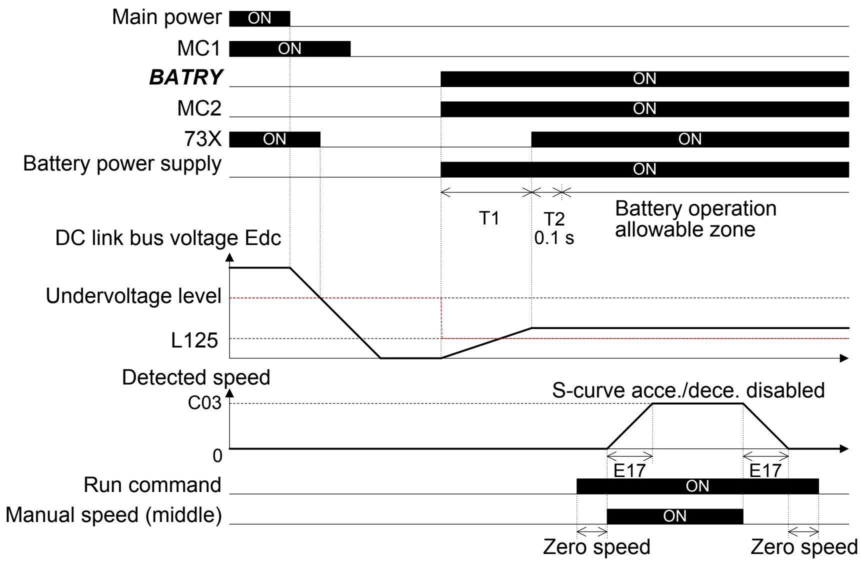
■ **Connection diagram in case of batteries and FRN0039LM2A-4_ or above:**



■ **Connection diagram in case of UPS:**



■ Operation Time Diagram



The time duration of T1 changes depending on the voltage and capacity. Refer to the description of specifications (4).

■ Precautions

(1) The battery power supply must be connected before ***BATRY*** signal is turned ON. Alternatively connect the battery power supply at the same time as turning ON ***BATRY*** signal.

(2) As shown above, inverter operation is possible within the battery operation allowable zone. There must be a delay of the "T1 + T2" period from when the ***BATRY***, MC, and battery power supply are turned ON. After that the inverter becomes ready to run.

(3) The ***BATRY*** should not be turned ON as long as the voltage level is higher than the specified undervoltage level (that is, before the **LV** appears after a power failure). Doing so blocks 73X to go OFF.

(4) During battery operation, avoid operation with a driving load and run the elevator with a balanced or regenerative load. Low battery voltage cannot generate sufficient torque and it causes the motor to stall.

(5) These precautions are given for an inverter operation with an extremely low voltage that prevents normal operation. For battery operation with a high voltage (such as 600 V for 400 V class series inverter), do not use the ***BATRY*** but run the inverter in a normal manner at a low speed and be careful with the battery capacity,

(6) In the case of normal operation, turn off ***BATRY***. If the main power supply is turned ON with ***BATRY*** being ON, it could damage the inverter rectifier diode due to the inrush current by 73X ON state.

C04 to C19 | Multistep Speed | F01 (Speed Command)

C04 through C19 specify zero speed to high speed for multistep speed selection. Turning ***SS1***, ***SS2***, ***SS4*** and ***SS8*** assigned to digital input terminals ON and OFF changes the selected speed.

- Data setting range: 0.00 to 6000 (r/min)

📖 Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

📖 For details, refer to function code F01.

C20 | Jogging Operation Speed | H54 (Acceleration time, Jogging) H55 (Deceleration time, Jogging)

C20 specifies the jogging operation speed.

- Data setting range: 0.00 to 6000 (r/min)

📖 Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Jogging operation

The terminal command ***JOG*** can be assigned to a programmable input terminal by setting "10." With the ***JOG*** being ON, turning ***FWD*** or ***REV*** ON starts the jogging operation regardless of the F01 setting.

In jogging operation, the acceleration and deceleration times specified by H54 and H55 apply, respectively.

Note: Turning the ***JOG*** ON when the inverter is already in normal operation cannot switch the inverter to jogging operation. Stop the inverter once and switch to jogging operation.

A run command (e.g., ***FWD***) and ***JOG*** command should be entered within 100 ms. Note that if the input of a run command precedes that of the ***JOG*** command, the inverter runs in normal operation until the input of the ***JOG*** command.

C21 Speed Command Unit

C21 specifies units for setting the speed.

Data for C21 and the specified units are as follows.

Data for C21	Speed command unit
0	r/min
1	m/min
2	Hz
3	mm/s

Changing C21 data converts previously specified function code data into a newly specified unit for display. It also modifies the setting range automatically.

Note Changing the C21 data requires modifying the data of some function codes. For details, refer to section 2.2.

Relational equations between (Hz) and other units

1. (r/min) and (Hz)

$$[r/\min] = 120 \times \frac{[Hz]}{Pe}$$

2. (m/min) and (Hz)

$$[m/\min] = \frac{V\max}{N\max} \times 120 \times \frac{[Hz]}{Pe} \times \frac{60}{1000}$$

3.(mm/s)and(Hz)

$$[mm/s] = \frac{V\max}{N\max} \times 120 \times \frac{[Hz]}{Pe}$$

Where,

Pe : Motor, No. of poles (P01) (poles)

N max : Rated speed (F03) (r/min)

V max : Elevator speed (L31) (mm/s)

Note As shown in the above equations, changing the data of any of function codes P01, F03, and L31 automatically modifies the inverter's speed settings specified in r/min or m/min.

C22 Analog Input Type

C22 selects the analog input type of analog multistep speed command.C22 is valid when F01 is set to 3.

For details, refer to function code F01.

C31 to C33	Analog Input Adjustment for [12] (Offset) (Gain) (Filter time constant)
C36 to C38	Analog Input Adjustment for [V2] (C1 function) (Offset) (Gain) (Filter time constant)
C41 to C43	Analog Input Adjustment for [V2] (V2 function) (Offset) (Gain) (Filter time constant)

These function codes specify the gain, offset, and filter time constant for analog input terminals.

■ Offset (C31, C36, and C41)

These function codes specify the offset adjustment for analog input voltage or current.

- Data setting range: -100.0 to 100.0 (%)

■ Gain (C32, C37, and C42)

These function codes specify the gain adjustment for analog input voltage or current.

- Data setting range: 0.00 to 200.00 (%)

■ Command values

The following formula indicates the relationship between the command value, gain (%), offset (%), and analog input (%).

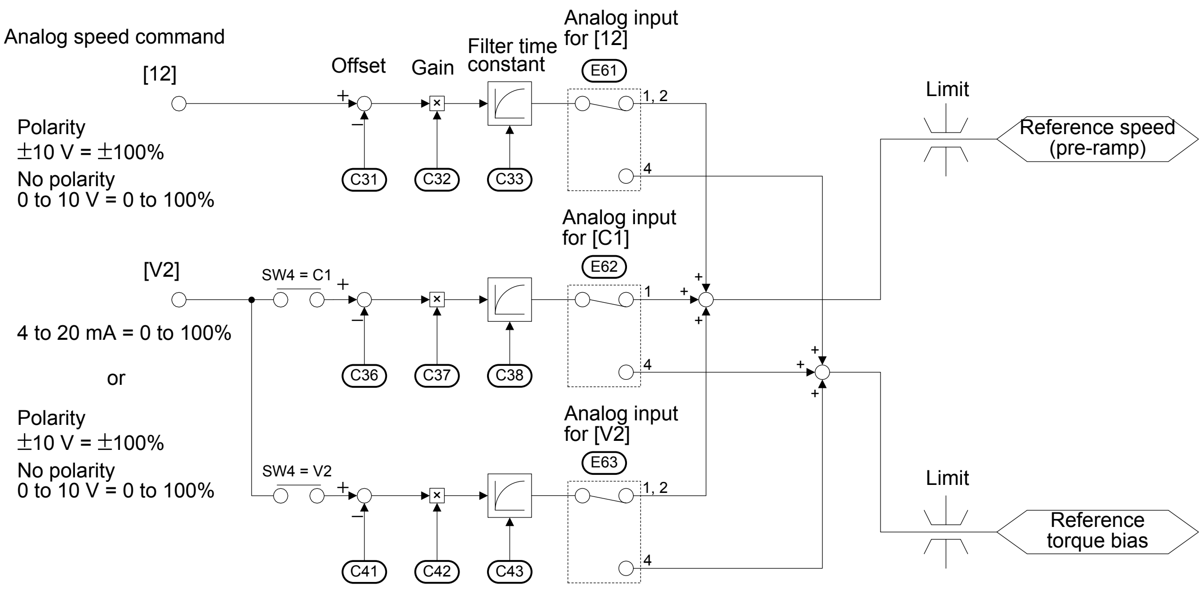
Command value = (Analog input - Offset) × Gain × Reference value

Where, the analog input -100 to 100% corresponds to -10 to 10 V in voltage input, and 0 to 100%, to 4 to 20 mA in current input.

The table below lists the reference values and limits.

Commands	Reference values	Limits
Reference speed (pre-ramp)	Maximum speed	Maximum speed × -100 to 100%
Reference torque bias	100% of motor rated torque	Motor rated torque × -200 to 200%

Setting F01 to "1: Analog speed command (Not reversible)" limits the reference speed (pre-ramp) at 0% or 100% of the maximum speed.

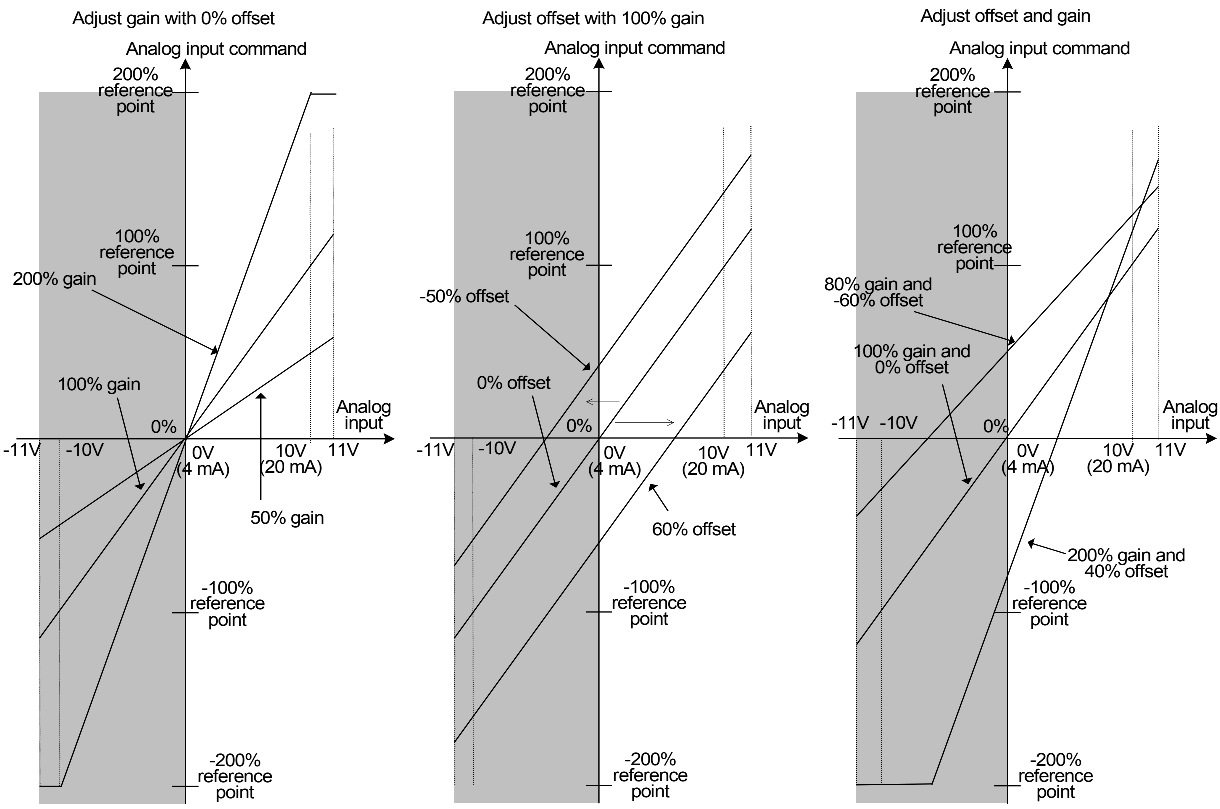


Simplified Block Diagram of Analog Inputs

■ Operation examples

The following graphs show operation examples using the gain and offset settings.

Current input or non-polar voltage input makes shaded areas invalid (as 0 V or 4 mA), and polar voltage input makes the shaded areas valid.



■ Filter time constant (C33, C38, and C43)

These function codes specify the filter time constant for analog input voltage or current on terminals [12], and [V2]. Increasing the filter time constant delays the response from machinery or equipment, and that is, the time constant should be specified considering speed response. If the input voltage fluctuates due to noise, large filter time constant attenuates it.

- Data setting range: 0.000 to 5.000 (s)

C89	Setpoint factor (Numerator) via communication
C90	**Setpoint factor (Denominator) via communication**

These function codes specify the ratio for the reference speed (pre-ramp) sent via RS-485 or CAN communications.

$$\text{Actual reference speed (pre-ramp)} = \text{Reference speed (pre-ramp) via communications} \times \frac{C89}{C90}$$

- Data setting range: -32768 to 32767

For details, refer to the descriptions of Chapter 1 Figure 1.1

2.3.4 P codes (Motor parameters)

P01	Motor (No. of poles)

P01 specifies the number of poles of the motor. The following formula is used for the conversion.

$$\text{Motor speed (r/min)} = \frac{120}{\text{No. of poles}} \times \text{Frequency (Hz)}$$

- Data setting range: 2 to 100 (poles)

Note: Changing the P01 data requires modifying the data of some function codes. For details, refer to section 2.2.

P02	Motor (Rated capacity)

P02 specifies the rated capacity of the motor. Enter the rated value shown on the nameplate of the motor.

- Data setting range: 0.01 to 55.00 (kW)

P03	Motor (Rated current)

P03 specifies the rated current of the motor. Enter the rated value shown on the nameplate of the motor.

- Data setting range: 0.00 to 500.0 (A)

P04 Motor (Auto-tuning)

The inverter automatically detects the motor parameters and saves them in its internal memory. Basically, it is not necessary to perform tuning when a Fuji standard motor is used with a standard connection with the inverter.

P04 = 1, 2, and 3 are only for asynchronous motors. P04 = 4 can be used for both types of motors. For synchronous motors, the magnetic pole position offset tuning (L03) should be executed.

P04 data	Auto-tuning	Action	Motor parameters to be tuned
0	Disable	—	—
1	Tune the motor while it is stopped	Tune %R1 and %X while the motor is stopped	Primary resistance (%R1) (P07) Leakage reactance (%X) (P08)
2	Tune the motor while it is stopped	Tune %R1, %X, no-load current, and rated slip while the motor is stopped	No-load current (P06) Primary resistance (%R1) (P07) Leakage reactance (%X) (P08) Rated slip frequency (P12)
3	Tune the motor while it is stopped	No-load current is calculated.Others are same as the P04 = 2.	No-load current (P06) Primary resistance (%R1) (P07) Leakage reactance (%X) (P08) Rated slip frequency (P12)
4	(Reserved)	—	—

Note In any of the following cases, perform auto-tuning. This is because you may not obtain the best performance under the PG vector control since the motor parameters are different from that of Fuji standard motors.

- The motor to be driven is a non-Fuji motor or a non-standard motor.
- Cabling between the motor and the inverter is long. (Generally, 20 m (66 ft) or longer)
- A reactor is inserted between the motor and the inverter.

Other applicable cases

P06	Motor (No-load current)
P07	Motor (%R1)
P08	Motor (%X)

These function codes specify no-load current, %R1, and %X. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor. By performing auto tuning, these parameters are automatically set as well.

■ No-load current (P06)

Enter the value obtained from the motor manufacturer.

- Data setting range: 0.00 to 500.0 (A)

■ %R1 (P07)

Enter the value calculated by the following formula.

$$\%R1 = \frac{R1 + \text{Cable } R1}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

where,

R1: Primary resistance of the motor (Ω)

Cable R1: Resistance of the output cable (Ω)

V: Rated voltage of the motor (V)

I: Rated current of the motor (A)

- Data setting range: 0.00 to 50.00 (%)

■ %X (P08)

Enter the value calculated by the following formula.

$$\%X = \frac{X1 + X2 \times XM / (X2 + XM) + \text{Cable } X}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

X1: Primary leakage reactance of the motor (Ω)

X2: Secondary leakage reactance of the motor (converted to primary) (Ω)

XM: Exciting reactance of the motor (Ω)

Cable X: Reactance of the output cable (Ω)

V: Rated voltage of the motor (V)

I: Rated current of the motor (A)

- Data setting range: 0.00 to 50.00 (%)

Note For reactance, choose the value at the base speed (F04).

P09 Motor (Slip comp. driving gain)

P10 Motor (Slip comp. braking gain)

P09 and P10 specify the slip compensation gain in percentage to the rated slip (P12) at the driving and braking sides, respectively.

- Data setting range: (P09, P10): 0.0 to 200.0 (%)

P11 Motor (Slip comp. response time)

Determines the response time for slip compensation. Basically, there is no need to modify the default setting.

- Data setting range: 0.05 to 1.00 (s)

Note It is a special code of the torque vector control.
Refer to page 2-2 for the control mode of the inverter.

P12 Motor (Rated slip)

P12 specifies the rated slip frequency of the motor.

- Data setting range: 0.00 to 15.00 (Hz)

The rated slip frequency is calculated with the following formula.

$$\text{Rated slip frequency (Hz)} = \text{Rated frequency (Hz)} \times \frac{\text{Synchronous speed (r/min) - Rated speed (r/min)}}{\text{Synchronous speed (r/min)}}$$

When the P12 is set to 0.00, the applied value corresponds to Fuji standard motor's rated slip frequency.

Motor capacity (P02)	Value applied when P12=0.00
2.2kW	1.93 Hz
3.7kW	1.57 Hz
5.5kW	1.18 Hz
7.5kW	1.28 Hz
11kW	0.95 Hz
15kW	0.90 Hz
18.5kW	0.72 Hz
22kW	0.72 Hz
30kW	0.91 Hz
37kW	0.64 Hz
45kW	0.72 Hz

P60, P62 and P63 Motor (Armature resistance – Rs) (Armature q-axis reactance – Xs) (Interphase inductive voltage - E)

P60, P62 and P63 specify the armature resistance, q-axis inductance, and interphase inductive voltage of the motor, respectively.

These functions are used with L130 to L133.

2.3.5 H codes (High performance functions)

H03	Data Initialization

Initialize all function code data to the factory defaults.

To change the H03 data, it is necessary to press the STOP + ∧ / ∨ keys (simultaneous keying).

H03 data	Function
0	Disable initialization (Settings manually made by the user will be retained.)
1	Initialize all function code data to the factory defaults (Vector control for asynchronous motors)
2	System-specific initialization (Vector control for synchronous motors)
3	System-specific initialization (Open loop control for asynchronous motors)
11	Limited initialization (all except communications function codes)
12	Limited initialization (initialization of customizable logic function U/U1 codes)

Tip Upon completion of the initialization, the H03 data reverts to "0" (factory default).

■ Initialize all function code data to factory defaults (H03 = 1)

Initialize all function code data to the factory defaults. It is suited for vector control for asynchronous motors.

■ Initialize function code data except communication function codes (H03 = 11)

The function codes other than the communication function codes (y codes) are initialized. Communication can be continued after initialization.

■ Initialize customizable logic U/U1 code data (H03 = 12)

Initializes the customizable logic (U/U1 code) data. Any other function code data are not initialized.

■ **System-specific initialization** (H03 = 2, 3)

Initializes data of the specified function codes to the values required for the system as listed below Data of function code shown as "-" or not listed below will be initialized to the factory defaults.

Target function code		Initialized to:	
		H03 = 2	H03=3
F03	Rated Speed	60.00 r/min	-
F04	Base Speed	60.00 r/min	-
F20	DC Braking (Starting Speed)	-	6.00 r/min
F21	DC Braking (Braking Level)	-	50 %
F22	DC Braking (Braking Time)	-	1.00 s
F23	Starting Speed	-	15.00 r/min
F25	Stop Speed	0.20 r/min	6.00 r/min
F42	Control Mode	1	2
E30	Speed Arrival (FAR) (Hysteresis)	0.60 r/min	-
E31	Speed Detection (FDT) (Detection level)	60.00 r/min	-
E32	Speed Detection (FDT) (Hysteresis)	0.60 r/min	-
E36	Speed Detection 2 (FDT2) (Detection level)	60.00 r/min	-
C03	Battery Operation speed	2.00 r/min	-
C06	Maintenance Speed	20.00 r/min	-
C07	Creep Speed	3.00 r/min	-
C11	High Speed 1	60.00 r/min	-
C20	Jogging Operation Speed	30.00 r/min	-
P01	Motor (No. of poles)	20	-
P06	Motor (No-load current)	0.00 A	-
P07	Motor (%R1)	5.00 %	-
H67	Stop Speed (Holding time)	-	0.00 s
H74	Speed Agreement (Hysteresis)	0.40 r/min	-
L01	Pulse Encoder (Selection)	5	-
L02	Pulse Encoder (Resolution)	2048 P/R	-
L36	ASR (P constant at high speed)	2.5	-
L38	ASR (P constant at low speed)	2.5	-
L40	ASR (Switching speed 1)	6.00 r/min	-
L41	ASR (Switching speed 2)	12.00 r/min	-
L65	Unbalanced Load Compensation (Operation)	-	0
L68	Unbalanced Load Compensation (ASR P constant)	2.5	-
L69	Unbalanced Load Compensation (ASR I constant)	0.005 s	0.010 s
L73	Unbalanced Load Compensation (APR P constant)	1.00	-
L83	Brake Control (OFF delay time)	-	0.00 s
L87	Door Control (Door open starting speed)	50.00 r/min	-

H04	Auto-reset (Times) H81 Auto Reset (Mode selection 1) H82 Auto Reset (Mode selection 2)
H05	Auto-reset (Reset interval)

H04 and H05 specify the allowed times and reset interval of Auto-reset function. Trip will be auto-reset when Run command is set to OFF if certain conditions are fulfilled.

On below table, alarms that can be auto-reset are listed. Auto-reset function is enabled/disabled by function codes H81 and H82.

Alarm status	Alarm code	Alarm status	Alarm code
Instantaneous overcurrent	**OC1**, **OC2**, **OC3**	Motor protection	**OH4**
Overvoltage	**OV1**, **OV2**, **OV3**	Overload of motor 1	**OL1**
Heat sink overheat	**OH1**	Inverter overload	**OLU**
Inverter overheat	**OH3**	Undervoltage	**LV**
Speed missmatching	**ErE**	Operation protection	**Er6**
Charging resistor overheat	**OH6**	***EN1, EN2*** terminals chattering	**Eo**

■ Number of auto-reset times (H04)

H04 specifies the number of auto-reset times for automatically releasing the tripped state. If the protective function is activated more than the specified auto-reset times, the inverter issues an alarm (for any faults) and does not attempt to release the tripped state.

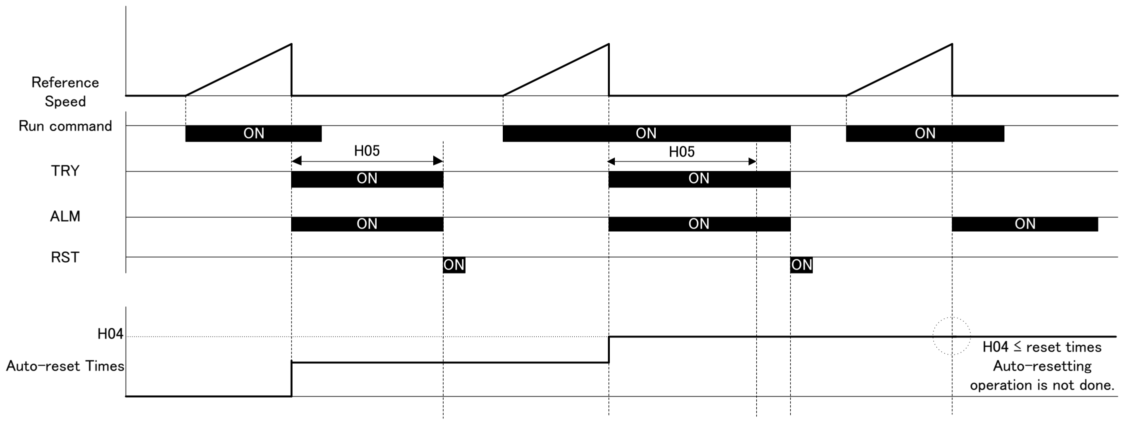
- Data setting range: 0 (disable)
  1 to 10 (times)

■ Reset interval (H05)

H05 specifies the interval time to attempt performing auto-reset the tripped state. Refer to the timing scheme diagram below.

- Data setting range: 0.5 to 20.0 (s)

<u>Operation timing scheme</u>



The auto-reset operates by satisfying all of the following conditions.

- The time of reset interval (H05) passed after the alarm is generated.
- The run command is OFF.
- The auto-reset times are the set value in Number of auto-reset times (H04) or less.
- The specific bit on H81 or H82 is set to 1.

The auto-reset times is reset by satisfying either of the following conditions.

- The alarm was reset by manual operation.
- The alarm was not generated within 24 hours.

■ Auto Reset (Mode selection 1) (H81)

The alarm codes enabled on H81 bits will be auto-reset according to H04 and H05 setting. In other words, a specific function code can be auto-reset only if dedicated bit is set to 1. Table below shows the bit crossreference with alarm codes. The setting on H81 takes priority over H82.

Alarm codes crossreference with H81 bits.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	Eo	OH6	-	-	Er6*1	ErE	OL1	OH4	OH3	OH1	OLU	LV	OVn*2	OCn*2

*1 Only for subcode 8 and 14 (failure in brake sequences). If cause is due to another subcode, alarm code will not be auto reset.

*2 Only for subcode 10 or lower. If subcode 11 or higher occurs, alarm code will not be auto reset.

- Example: H81=012Fh (ErE, OH3, OLU, LV, OVn and OCn can be auto-reset).

■ Auto Reset (Mode selection 2) (H82)

The alarm codes enabled on H82 bits can be auto-reset infinite times, alarm will be reset after H05 time is elapsed. A specific function code can be auto-reset only if dedicated bit is set to 1. Table below shows the bit crossreference with alarm codes. The setting on H81 takes priority over H82. Therefore if bit 2 is set to 1 in H81 and H82, alarm code LV will be reset only H04 times (not infinite times).

Alarm codes crossreference with H82 bits.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	Eo	OH6	-	-	Er6*1	ErE	OL1	OH4	OH3	OH1	OLU	LV	OVn*2	OCn*2

*1 Only for subcode 8 and 14 (failure in brake sequences). If cause is due to another subcode, alarm code will not be auto reset.

*2 Only for subcode 10 or lower. If subcode 11 or higher occurs, alarm code will not be auto reset.

- Example: H81=012Fh (ErE, OH3, OLU, LV, OVn and OCn can be auto-reset).

Tip: The auto-reset state can be monitored from the external equipment via a digital output terminal to which the ***TRY*** signal by setting "26" with E20 to E24 and E27.

Note: The auto-reset function is disabled while auto-tuning or pole position offset tuning are performed.

H06 Cooling Fan Control

H06 specifies the ON-duration of the cooling fan. To prolong the life of the cooling fan and reduce fan noise during running, the cooling fan stops when the temperature inside the inverter drops below a certain level.

Setting the H06 data to 0.0 automatically turns the cooling fan ON/OFF depending upon the temperature even when the inverter is running.

The cooling fan does not restart for 10 seconds after stopping.

- Data setting range: Auto (Auto ON/OFF depending upon temperature)
  0.5 to 10.0 (min.)
  OFF (Disable. Always ON)

Tip: The cooling fan state can be monitored via a digital output terminal to which the ***FAN*** is assigned by setting "25."

H26	PTC / NTC Thermistor (Mode)
H27	**PTC / NTC Thermistor (Level)**

These function codes protect the motor from overheating or output an alarm signal using the PTC (Positive Temperature Coefficient) thermistor or NTC (Negative Temperature Coefficient) thermistor embedded in the motor.

■ PTC thermistor (Mode) (H26)

Selects the function operation mode (protection or alarm) for the PTC thermistor as shown below.

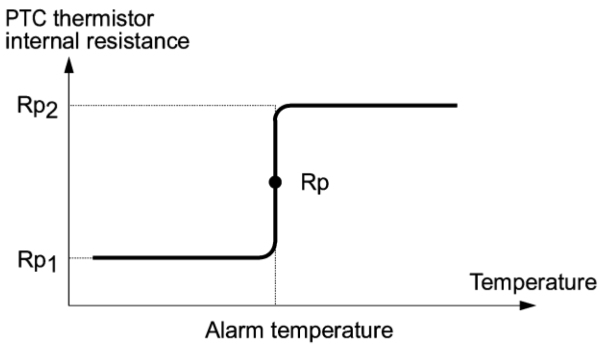
Data for H26	Action
0	Disable
1	Enable When the voltage sensed by the PTC thermistor exceeds the detection level, the motor protective function (alarm **OH4**) is triggered, causing the inverter to enter an alarm stop state.
2	Enable When the voltage sensed by the PTC thermistor exceeds the detection level, a motor alarm signal is output but the inverter continues running. You need to assign the motor overheat protection ***THM*** to one of the digital output terminals beforehand (function code data = 56), by which a temperature alarm condition can be indicated to the external equipment.
3	Enable When the voltage sensed by the NTC thermistor exceeds the detection level, the motor protective function (alarm **OH4**) is triggered, causing the inverter to enter an alarm stop state.

■ PTC thermistor (Level) (H27)

Specifies the detection level for the temperature (expressed in voltage) sensed by PTC thermistor.

- Data setting range: 0.00 to 5.00 (V)

The temperature at which the overheating protection is to be activated depends on the characteristics of the PTC thermistor. The internal resistance of the thermistor will significantly change at the alarm temperature. The detection level (voltage) is specified based on the change of internal resistance.

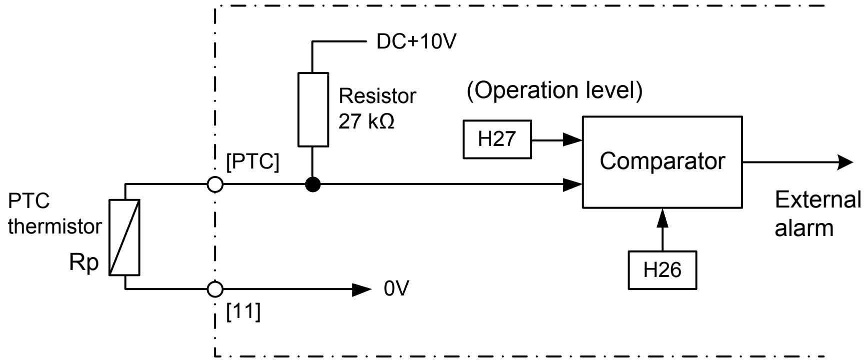


Suppose that the resistance of PTC thermistor at alarm temperature is Rp, the detection (voltage) level V_{v2} is calculated by the equation below. Set the resulting value of V_{v2} to function code H27.

Replace the internal resistance of the PTC thermistor at the alarm temperature with Rp to obtain V_{v2}.

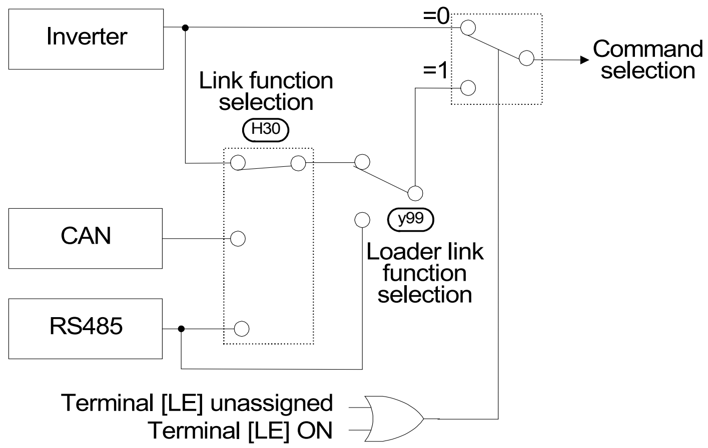
$$V_{V2} = \frac{R_p}{27000 + Rp} \times 10.5\ (V)$$

Connect the PTC thermistor as shown below. The voltage that is obtained by dividing the input voltage to the terminal [PTC] with a set of internal resistors is compared with the preset detection voltage level (H27).



H30	Communications Link Operation

H30 specifies the sources of a speed command and run command: "inverter itself" and "computers or PLCs via the RS485 communications link or the CAN communications link", and setting means of speed command and run command.



Command sources selectable

Command sources	Description
Inverter itself	Command sources except RS485 communications link and CAN communications link Speed command : Source specified by F01 (e.g., multistep speed command) Run command: Via the keypad or digital input terminals
RS485 communications link (port 1)	Via the standard RJ-45 port used for connecting keypad
RS485 communications link (port 2)	Via the terminals DX+ and DX- on the terminal blocks
CAN communications link	Via CAN communications link

■ Command sources specified by H30

Definition of Setting Value for H30

0 □ □ □ (hex)

- 1st □: Torque bias command
- 2nd □: Run command
- 3rd □: Speed command

0: inverter itself
1: RS-485 port 1
2: RS-485 port 2
3: CAN
4 to F: same as 0

Alternative settings as below are available.

- 0x0005 : Equivalent with 0x0030
- 0x0006 : Equivalent with 0x0033
- 0x000E : Equivalent with 0x0333

For details, refer to Chapter 1 "BLOCK DIAGRAMS FOR CONTROL LOGIC" and the RS485 Communication User's Manual or CAN Communication User's Manual.

Note: When the ***LE*** terminal command is assigned to a digital input terminal and the terminal is ON, the settings of function code H30 are effective. When the terminal is OFF, the settings of the function are ineffective, and both speed commands and run commands specified from the inverter itself take control.

H42	Capacitance of DC Link Bus Capacitor

H42 displays the measured capacitance of the DC link bus capacitor (reservoir capacitor).

- Data setting range: 0 to 65535

H43	Cumulative Run Time of Cooling Fan

H43 displays the cumulative run time of the cooling fan in units of 10hours.

- Data setting range: 0 to 9999

H47	Initial Capacitance of DC Link Bus Capacitor

H47 displays the initial value of the capacitance of the DC link bus capacitor (reservoir capacitor).

- Data setting range: 0 to 65535

H48	Cumulative Run Time of Capacitors on Printed Circuit Board

H48 displays the cumulative run time of capacitors on the printed circuit boards in units of 10hours.

- Data setting range: 0 to 9999

H54	Acceleration Time (Jogging)
H55	**Deceleration Time (Jogging)**

H54 and H55 specify the acceleration and deceleration times for jogging operation, respectively. The acceleration time is the one required for accelerating from 0.00 to the maximum speed (r/min) and the deceleration time, for decelerating from the maximum speed to 0.00 (r/min).

- Data setting range: 0.00 to 99.9 (s)

For details, refer to function code C20.

H56	Deceleration Time for Forced to Decelerate

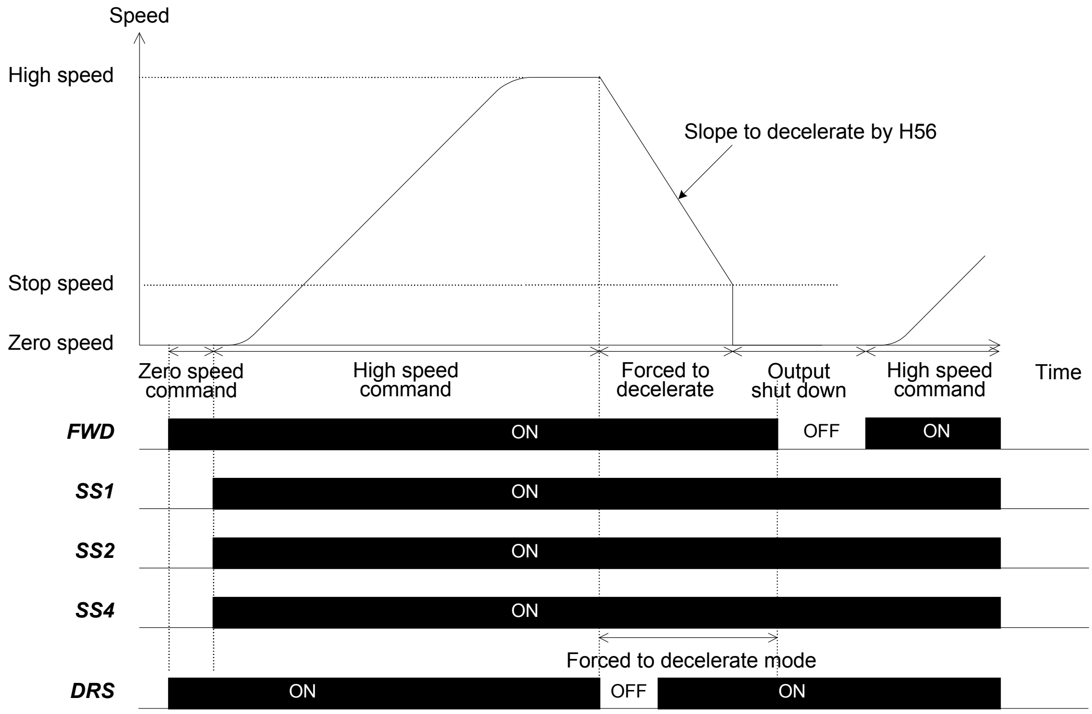
H56 specifies the deceleration time for forced deceleration. The deceleration time is the one required for decelerating from the maximum speed to 0.00 (r/min).

- Data setting range: 0.00 to 99.9 (s)

■ Forced to decelerate

The ***DRS*** command can be assigned to a general-purpose, programmable input terminal by setting "66." The ***DRS*** should be ON when the inverter is running. Turning the ***DRS*** OFF makes the inverter decelerate with the deceleration time specified by H56 and then shuts down the inverter output when reaching the stop speed.

Once the ***DRS*** goes OFF, the inverter no longer runs (that is, the forced-to-decelerate mode will not be canceled) until the run command goes OFF and the inverter output is shut down. The operation scheme is shown below.



H57 to H60 — S-curve Setting 10 to 14 — F01 (Speed Command)

L19 to L28 specify S-curve zones to be applied to operations driven by multistep speed commands with S-curve acceleration/deceleration.

The setting values are indicated in percentage to the maximum speed.

- Data setting range: 0 to 50 (%)

Refer to the description of function code F01 for details.

H64 — Zero speed control time — F23, F24 (Starting Speed)

H64 sets the time duration of zero speed control (or DC braking) from the moment that inverter is turned ON.

- Data setting range: 0.00 to 10.00 (s)

For details, refer to function code F23, F24.

H65 — Starting Speed (Soft start time) — F23 (Starting Speed)

H65 specifies the acceleration time until the speed reaches the starting speed. The specified time is the one required for accelerating from 0.00 to the starting speed (r/min).

- Data setting range: 0.0 to 60.0 (s)

For details, refer to function code F23.

H66 — Stop Speed (Detection method) — F25 (Stop Speed)

H66 specifies the stop speed detection method.

Data for H66	Detection method
0	Use the detected speed.*
1	Use the reference speed (final).

For details, refer to the description of function code F25.

*In case of Torque Vector Control inverter uses Reference Speed (Final)

H67 — Stop Speed (Holding time) — F25 (Stop Speed)

H67 specifies the run command holding time as soon as stop speed is reached.

- Data setting range: 0.00 to 10.00 (s)

For details, refer to function code F25.

H72 Main power shutdown detection (Mode selection)

This function monitors the AC input power supply of the inverter to see if the AC input power supply (main circuit power) is established and prevents inverter operation when the main circuit power is not established.

H72 data	Function
0	Disables main circuit power cutoff detection
1	Enables main circuit power cutoff detection

With power supply via a PWM converter or DC link bus, there is no AC input. When H72 is set to “1”, the inverter cannot operate. Change the data of H72 to “0”.

Note For single-phase supply, consult your Fuji Electric representatives.

H74 Speed Agreement (Hysteresis)

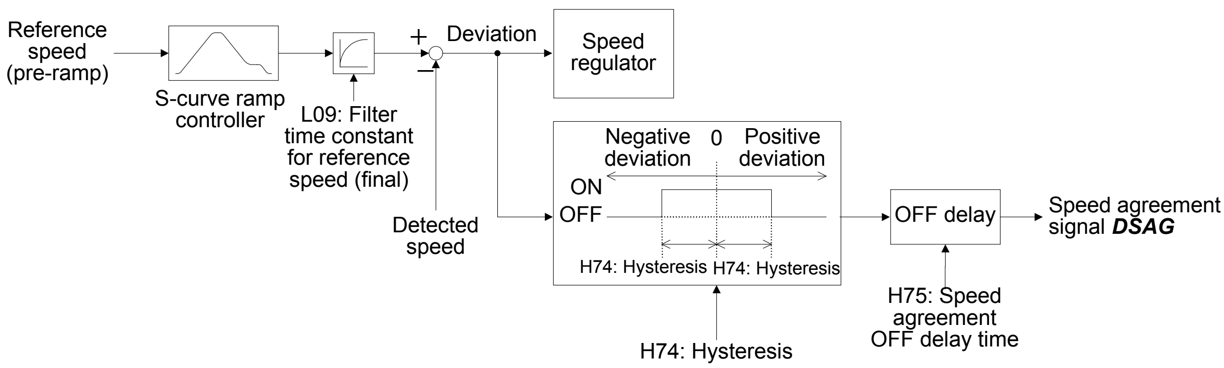
H75 Speed Agreement (OFF delay time)

The ***DSAG*** signal can be assigned to a general-purpose, programmable output terminal by setting "71."

The ***DSAG*** comes ON regardless of the status of a run command when the difference between the commanded and detected speeds is within the hysteresis band specified by H74. The ON-to-OFF delay circuit is available for chattering avoidance. If the difference is larger than the allowable band specified by H74 continuously for the time specified by H75, then the ***DSAG*** signal goes OFF. No OFF-to-ON delay function is available.

- Data setting range (H74): 0.00 to 6000 (r/min)
- Data setting range (H75): 0.00 to 1.00 (s)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.



H76 | **PG Error Detection for Mode3 (Detecting level)** **PG abnormal (operation choice)**
PG Error Detection (Detection level)
PG Error Detection (Detection time)

H77 | **PG Error Detection for mode 3 (Detecting time)**

Sets the detection level and time when using PG abnormal operation mode 3.- Data setting range (H76): 0 to 50 (%)

- Data setting range (H77): 0.0 to 10.0 (s)

For details, refer to function code L90～L92

H80 | **Output Current Fluctuation Damping Gain**

The inverter output current driving the motor may fluctuate due to the motor characteristics and/or backlash in the machine. Modifying the H80 data adjusts the controls in order to suppress such fluctuation. However, as incorrect setting of this gain may cause larger current fluctuation, do not modify the default setting unless it is necessary.

- Data setting range (H80):0.00 to 0.40

Note It is a special code of the torque vector control. Refer to page 2-2 for the control mode of the inverter.

H81 | **Auto Reset (Mode selection 1)** **H04 Auto-reset (Times)**
H05 Auto-reset (Reset interval)

H82 | **Auto Reset (Mode selection 2)**

Certain alarm codes can be automatically reset as explained on the function codes H04 and H05 desciption. H81 and H82 function codes defines the alarm codes which can be auto-reset.

For details, refer to function code H04 and H05.

H89 | **Store electronic thermal overload protection data for motor**

When the electronic thermal overload protection for motor is used, thernal cumulative value of the inverter can be reset or kept at power OFF.

Data for H89	Action
0	Clears cumulative value of thermal by inverter power OFF.
1	Retains cumulative value of thermal after inverter power OFF (factory default).

H94 | **Cumulative Run Time of Motor**

H94 displays the cumulative run time of the motor. This feature is useful for management and maintenance of the mechanical system. With this function code (H94), you can set the cumulative run time of the motor to any value you choose. For example, by specifying "0", the cumulative run time of the motor can be cleared.

- Data setting range: 0 to 65535

H95	Brakes monitor according to UCM (Clear bbE Alarm)
H96	Brakes monitor according to UCM (Check brake control select)

In case of electrical traction lifts, one possible way to fulfill requirements of Unintended Car Movement (UCM) of the standard EN 81-1:1998+A3:2009, is to use the two motor brakes certified according to this standard and additionally monitor their status individually, by using one limit switch for each brake that detects the actual brake status (released or applied). If the detected brake status is not correct the operation of the elevator must be prevented. It is applicable as well to the lift standards EN 81-20:2014 and EN81-50:2014.

This function is not active in factory default settings. It means that this function has to be activated. The parameter used to activate this function is H96. The functionality of H96 is explained below.

On the other hand, if Rescue operation by external brake control is active (input function programed to the function ***RBRK*** by setting the value 114 brake monitoring function is disabled even H96=1. This allows end user to perform a rescue operation by brake control (gravity movement) independently of the inverter, in other words, without locking the inverter due to **bbE** alarm.

■ Brakes monitor according to UCM (Check brake control select) (H96)

This function code selects mode operation (Enabled, disabled) for Brakes monitor according to UCM as shown below.

Data for H96	Action
0	Disable (factory default) Even ***BRKE1*** and ***BRKE2*** functions are correctly programmed and wired, monitoring function for UCM is not active. ***BRKE*** function is enabled.
1	Enable Brakes monitor operation is performed by ***BRKE1*** and ***BRKE2*** according to UCM. When status of ***BRKE1*** and ***BRKE2*** doesn't match with ***BRKS***, brake check timer (L84) starts. **bbE** alarm is generated when ***BRKE1*** or ***BRKE2*** doesn't match with ***BRKS*** for a time longer than the time specified in L84. When the lift is traveling, alarm is not issued; alarm is generated as soon as ***BRKS*** function is OFF and **L84** timer is elapsed.

On the following figures, each possible scenario using ***BRKE1*** and ***BRKE2*** input functions is described.

a) Brake feedback not matching with brake control signal at the second travel start

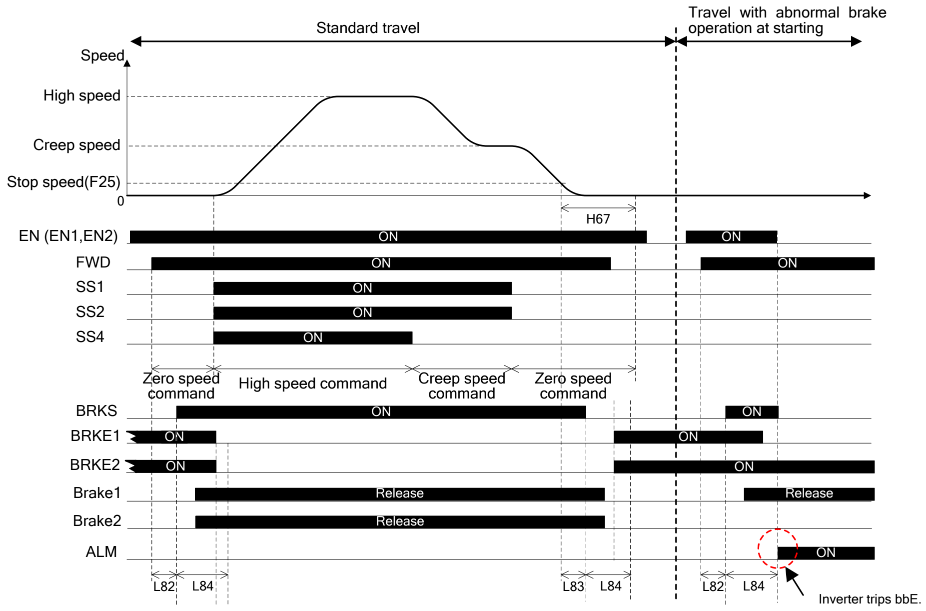


Figure 1. **bbE** alarm at starting of second travel.

On figure 1 two travels are shown. On the first travel, as brake status is matching with brake control signal all the travel, inverter is not tripping. On the other hand, when second travel starts, as brake 2 doesn't open, inverter trips **bbE** after L84 timer is elapsed.

b) Brake feedback not matching with brake control signal at stop

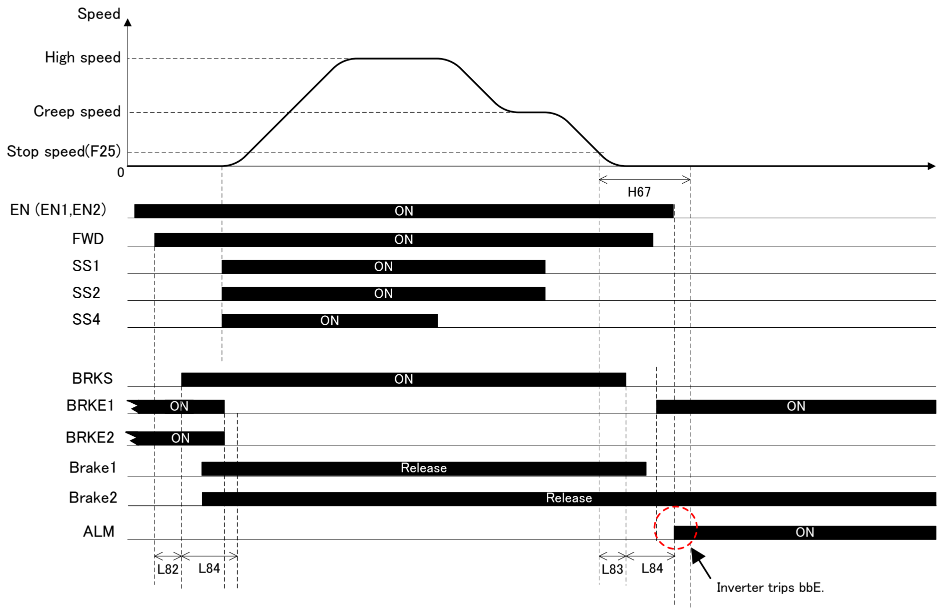


Figure 2. **bbE** alarm at stop.

As it can be observed in figure 2, because brake 2 remains open even signal ***BRKS*** is OFF, inverter is tripping **bbE** alarm at stop.

c) Brake feedback not matching with brake control signal during travel

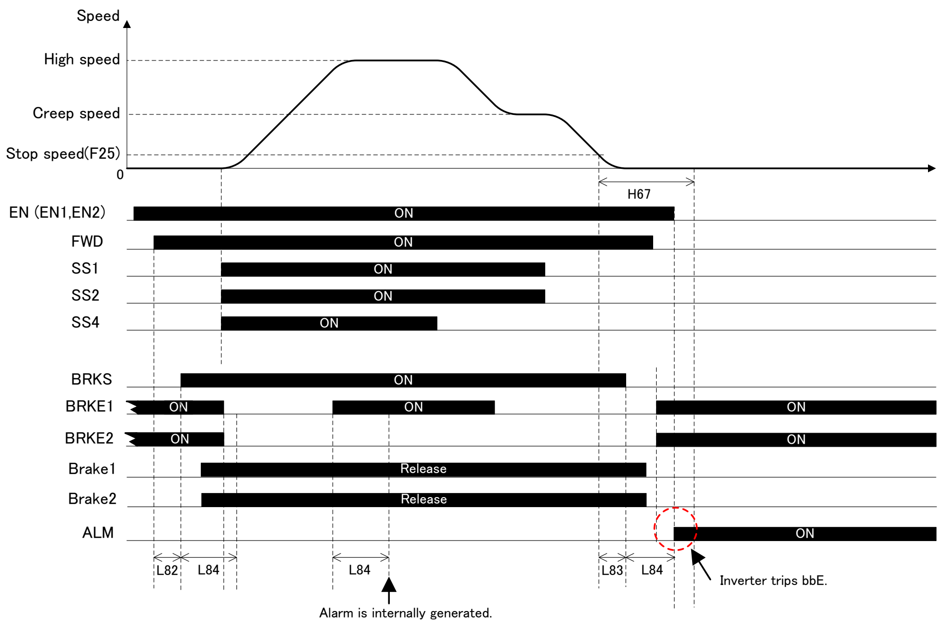


Figure 3. **bbE** alarm at stop due to brake monitoring problem during travel.

As it can be observed in figure 3, brake 1 feedback contact is not working properly. Even real brake status is opened, it shows for a certain periode that brake is not opened (contact chattering). After timer L84 is elapsed, inverter generates internally an alarm that is shown at the end of the travel.

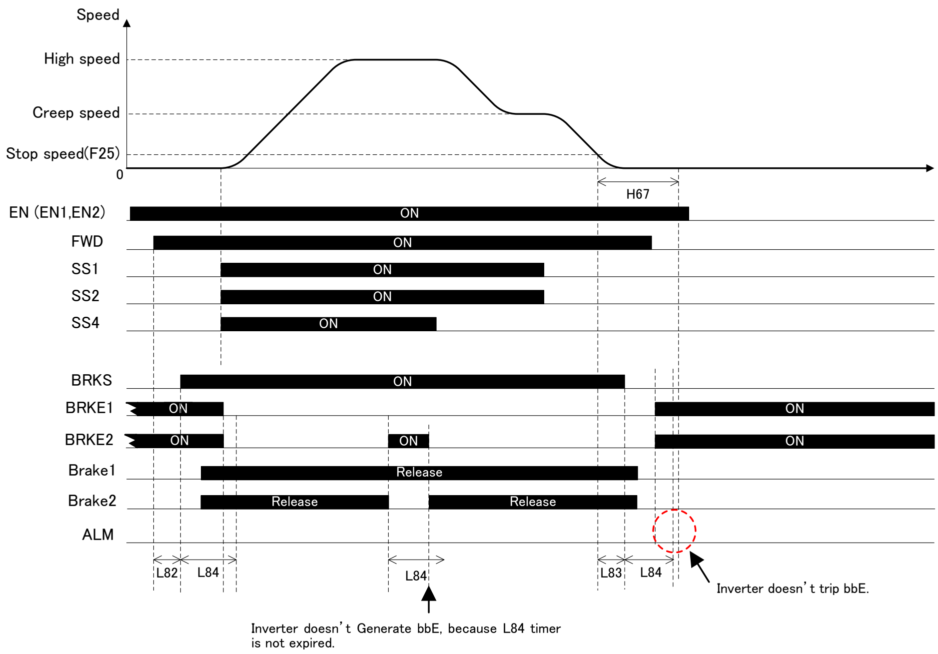


Figure 4. Inverter doesn't trip **bbE** alarm even BRKE2 signal is OFF during travel.

On the other hand, figure 4 shows that brake 2 is not working properly for a while as well, even so, as brake recovers before L84 timer elapses, no alarm is generated.

d) Brake feedback is abnormal when motor is stopped.

In this case there are two possibilities, with and without ***RBRK*** function active (Rescue operation by external brake control active).

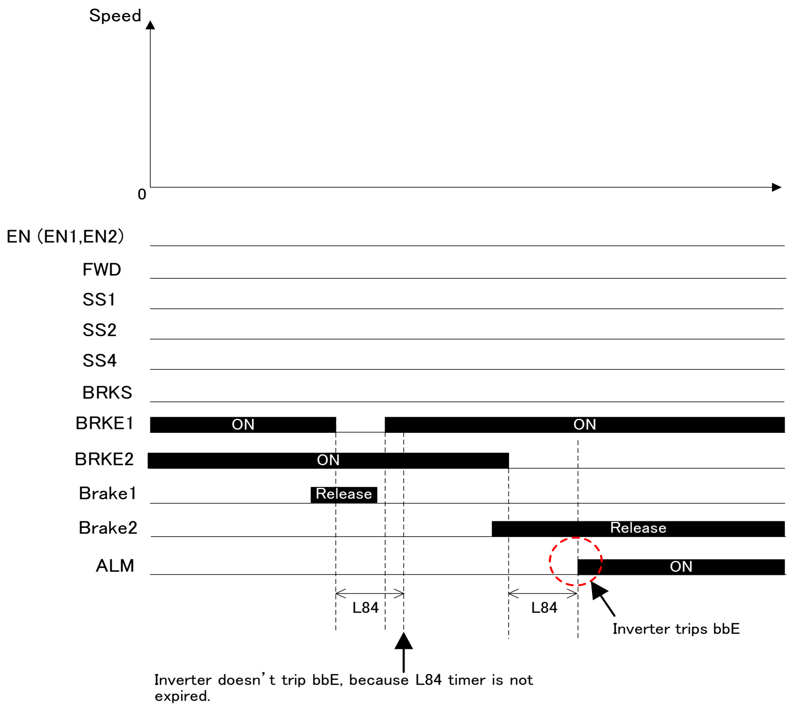


Figure 5. **bbE** alarm while inverter is stopped and ***RBRK*** function is not used.

As it can be observed in figure 5, somebody or something is opening the brake even inverter is not asking to do so. In other words, brake is manipulated even it should be closed. If the brake remains open more than time specified in L84 timer, inverter trips **bbE** alarm.

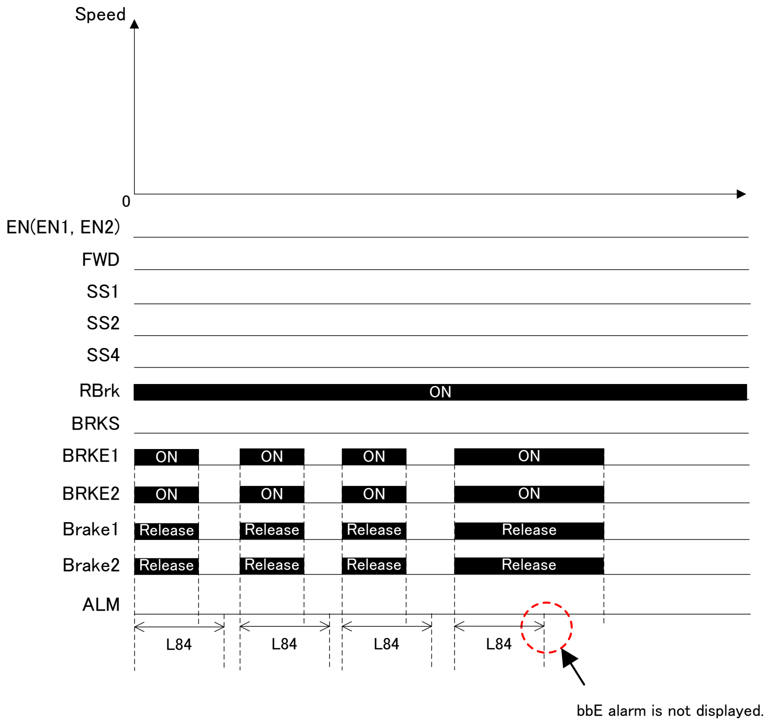


Figure 6. **bbE** alarm while inverter is stopped and ***RBRK*** function is used

As it can be observed in figure 6, somebody or something is opening the brake even inverter is not asking to do so. In other words, brake is manipulated even it should be closed. In this case, because ***RBRK*** input function is activated, inverter is not tripping any alarm. When ***RBRK*** input is activated, inverter understands that brake is being opened by external means in order to rescue people from car. As this is treated as an exceptional operation, inverter does not trip with **bbE** alarm.

■ Brakes monitor according to UCM (Clear bbE alarm) (H95)

As explained before, **bbE** is a specific alarm for this function. Also, alarm **Er6** has a SUB code related to this function. Additional information for each alarm is described in table below:

Table 1. Alarms and SUB codes.

Alarm message displayed	SUB code	Description	Possible causes
Er6	14	H96 is set to 1 but some settings related are missing.	Check that BRKE1 function is correctly set. Check that BRKE2 function is correctly set. Check that BRKS function is correctly set.
bbE	11	BRKE1 signal error	Check status of micro switch in brake 1. Check status of brake 1 and its power supply. Check status of inverter input/output related to brake 1. Check L84 time.
	12	BRKE2 signal error	Check status of micro switch in brake 2. Check status of brake 2 and its power supply. Check status of inverter input/output related to brake 2. Check L84 time.

Because **bbE** alarm blocks the inverter according to UCM, it cannot be reset following the standard procedure. Additionally **bbE** alarm cannot be auto reset by the inverter (H04, H05), neither can be reset by switching OFF and ON inverter's power supply.

In order to reset the alarm, following procedure has to be done:

1. Push key.
2. Set parameter H95 to 111. Cursor can be moved by / keys.
3. Push key. H95 is automatically set to 0.
4. Push key until main screen is shown. In main screen **bbE** alarm is shown.
5. Push key.
6. **bbE** alarm disappears from the display.

Note **bbE** alarm should be reset only after the cause of the alarm has been repaired.

For additional information, refer to related Application Note (AN-Lift2-0002v100EN).

H97 Clear Alarm Data

H97 deletes the information such as alarm history and data at the time of alarm occurrence, including alarms that have occurred during the check-up or adjustment of the machinery. Data is then brought back to a normal state without an alarm.

Deleting the alarm information requires simultaneous keying of + keys.

Data for H97	Function
0	Disable
1	Clear all (This data clears all alarm data stored and returns H97 to "0.")

H98 Protection/Maintenance Function F26 (Motor Sound, Carrier frequency)

H98 specifies whether to enable or disable automatic lowering of the carrier frequency, protection against input phase loss, judgment on the DC link bus capacitor life, the change of judgment criteria on the DC link bus capacitor life, and the selection of short-circuit detection, by setting the corresponding bit combination.

To set data of the function code H98, each function is assigned to one bit (total 8 bits). The table below lists the functions assigned to each bit.

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	Cancel detecting of thermistor cut line	Detect braking transistor breakdown	-	Judge the life of DC link bus capacitor	Select life judgment criteria of DC link bus capacitor	Detect Output phase loss	Detect input phase loss	Lower the carrier frequency automati-cally
Data=0	Disable	Disable	-	Disable	Factory default setting	Disable	Disable	Disable
Data=1	Enable	Enable	-	Enable	User's setting	Enable	Enable	Enable
Default	0	1	0	1	0	0	0	1

Set the not assigned data to 0.

■ Lower the carrier frequency automatically (Bit 0)

Even if the inverter heat sink overheated or is in overload state due to an excessive load, abnormal ambient temperature, or a problem in the cooling system, with this function enabled, the inverter lowers the carrier frequency to avoid tripping (OH1, OH3 or OLU). Note that if this feature is enabled, the motor noise increases. If an overload state is kept for a long time surpassing the inverter capacity, the inverter trips.

■ Detect input phase loss (Lin) (Bit 1)

Upon detecting an excessive ripple on the DC link voltage, because of phase loss or inter-phase imbalance in the 3-phase power supplied to the inverter, this feature stops the inverter and displays an alarm **Lin**.

Note: In configurations where only a light load is driven or a DC reactor is connected, a phase loss or an inter-phase imbalance may not be detected because of the relatively small ripple on the DC link voltage.

■ Detect output phase loss (OPL) (Bit 2)

This function can detect the output phase loss. This function becomes effective by H98 bit2=1. **OPL** is displayed when the loss is detected, and the inverter stops.

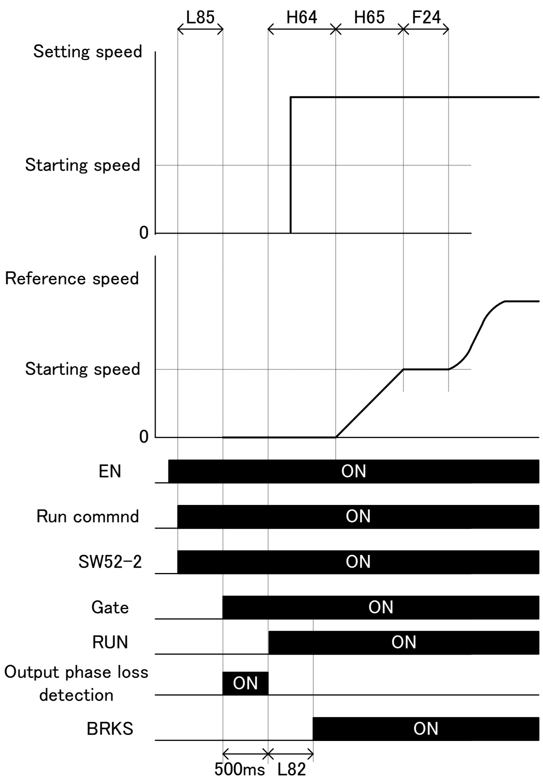
Output phase loss detection is operated before starting the operation. Fix the motor with the brake while output phase loss detection is operated. When the output phase is lost, the inverter trips with **OPL** alarm. **OPL** is not a recoverable alarm by the auto-reset function.

Automatic magnetic pole position tuning is operated after output phase loss detection is done when automatic magnetic pole position tuning is effective.

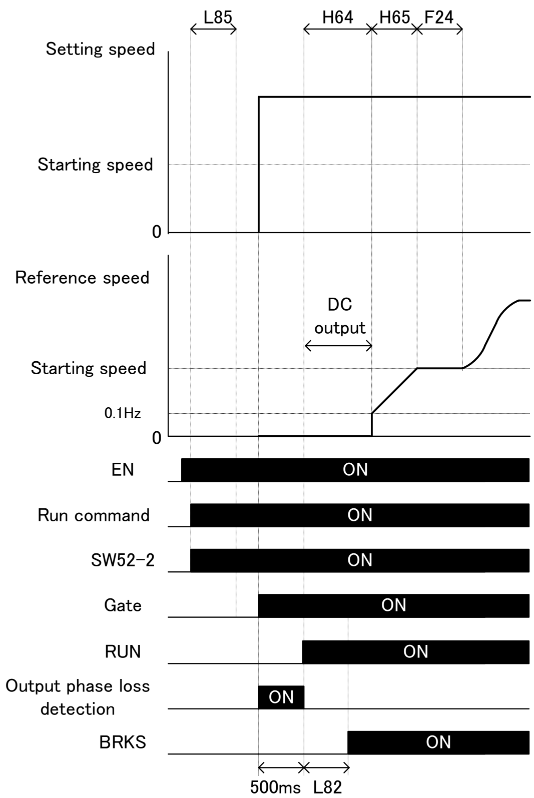
RUN signal is turned OFF during output phase loss detection

<u>Operation sample</u>

a) Multistep speed command (F01=0)

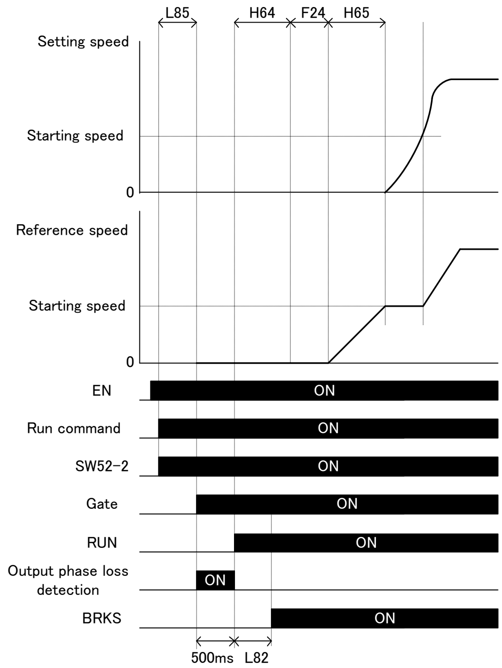


Vector control with PG

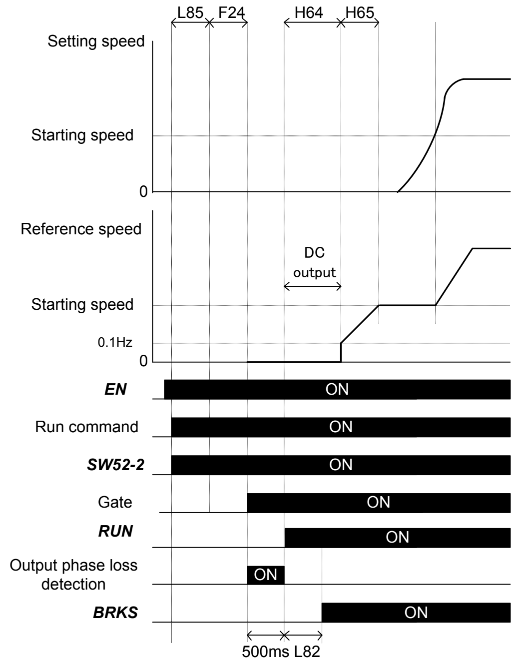


Torque Vector control

b) Analog speed command (Not reversible) (F01=1)

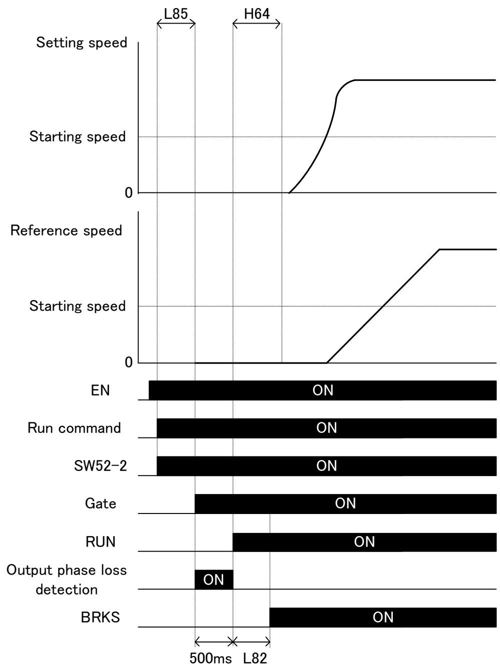


Vector control with PG

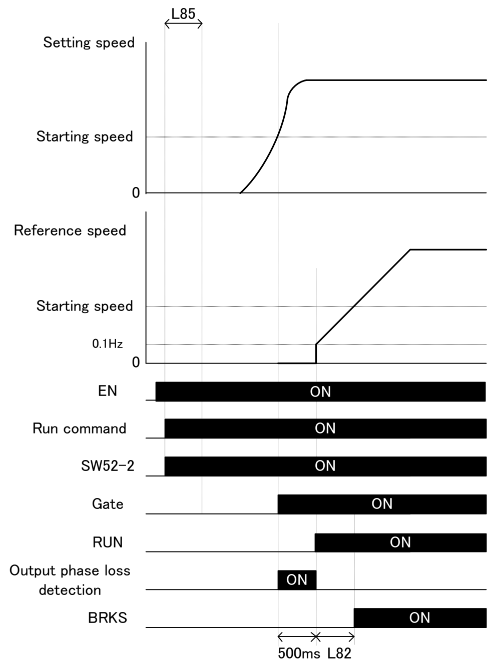


Torque Vector control

c) Analog speed command (Reversible) (F01=2)



Vector control with PG



Torque Vector control

■ Select life judgment criteria of DC link bus capacitor (Bit 3)

H98 allows the user to select the criteria for judging the life of the DC link bus capacitor/s (reservoir capacitor/s) between factory default setting and user own choice.

Note Before specifying the user criteria, the reference level must be measured and confirmed in advance. For details, refer to the FRENIC-Lift (LM2A) Instruction Manual (INR-SI47-1894-E), Chapter 6 "MAINTENANCE AND INSPECTION."

■ Judge the life of DC link bus capacitor (Bit 4)

Whether the DC link bus capacitor (reservoir capacitor) has reached its life is determined by measuring the length of time for discharging after power off. The discharging time is determined by the capacitance of the DC link bus capacitor and the load inside the inverter. Therefore, if the load inside the inverter fluctuates significantly, the discharging time cannot be accurately measured, and as a result, it may be mistakenly determined that the life has been reached. To avoid such an error, the judgment on the life of the DC link bus capacitor can be disabled.

Load may vary significantly in the following cases. Disable the judgment on the life during operation, and either conduct the measurement with the judgment enabled under appropriate conditions during periodical maintenance or conduct the measurement under the actual use conditions.

- Auxiliary input for control power is used
- An option card is used
- Another inverter or equipment such as a PWM converter is connected to the terminals of the DC link bus.

For details, refer to the FRENIC-Lift (LM2A) Instruction Manual (INR-SI47-1894-E), Chapter 6 "MAINTENANCE AND INSPECTION."

■ Braking transistor error detection (Bit 6)

Upon detection of a built-in braking transistor error, this feature stops the inverter and displays the alarm **dbA**. Set data of bit 6 to “0” when the inverter does not use a braking transistor and there is no need of entering the alarm state.

■ Canceling detection of thermistor cut line (Bit 7) (400V series: 37kW and above)

For the inverters with capacity of 37kW and above (400V series), the connection between the thermistor for detecting fan’s temperature and detecting circuit of power printed circuit board is considered as a harness. When the connection is cut, it is possible to choose whether to treate it as an alarm or to continue driving.

H98 bit7=0(Alarm treatment): stop inverter by OH1 alarm.
H98 bit7=1(Continue driving): keeping driving inverter without alarm.

⚠CAUTION

If you select ‘continue driving’ (H98 bit5=1 or bit7=1), the inverter can be driven as emergency measure. However, it drives without the temperature protection function. When the inverter keeps driving under such a condition, there is a possibility of finally causing the damage of the inverter. Please contact our company promptly, and remove the fault (disconnection of the harness).

Doing so could cause fire, an accident or injuries.

H99 | Password Protection | F00 (Data Protection)

H99 specifies a password.

- Data setting range: 0000_H (Disable password protection)
  0001_H to $FFFF_H$ (Enable password protection)

For details, refer to function code F00.

H190 | Terminal [UVW] Output order

H190 specifies the phase sequence order.

Rotation direction is changed by swapping phase sequence of out put terminals U,V and W.

Data for H190	Rotation direction
0	Normal (FWD = UVW)
1	Inverse (FWD = UWV)

To change the H190 data, it is necessary to press the STOP + ∧ / ∨ keys (simultaneous keying).

2.3.6 U codes (Customizable logic operation)

The customizable logic function allows the user to create a logic or operation circuit for digital/analog input/output signals, customize those signals arbitrarily, and configure a simple relay sequence inside the inverter.

In the customizable logic, one step (component), depending on the type, is composed of:

(1) 2 digital inputs, 1 digital output + logical operation (including timer)
(2) 2 analog inputs, 1 analog output/1 digital output + numerical operation
(3) 1 analog input, 1 digital input, 1 analog 1 output + numerical operation, logical operation

and a total of 200 steps can be used to configure a sequence.

■ Modes

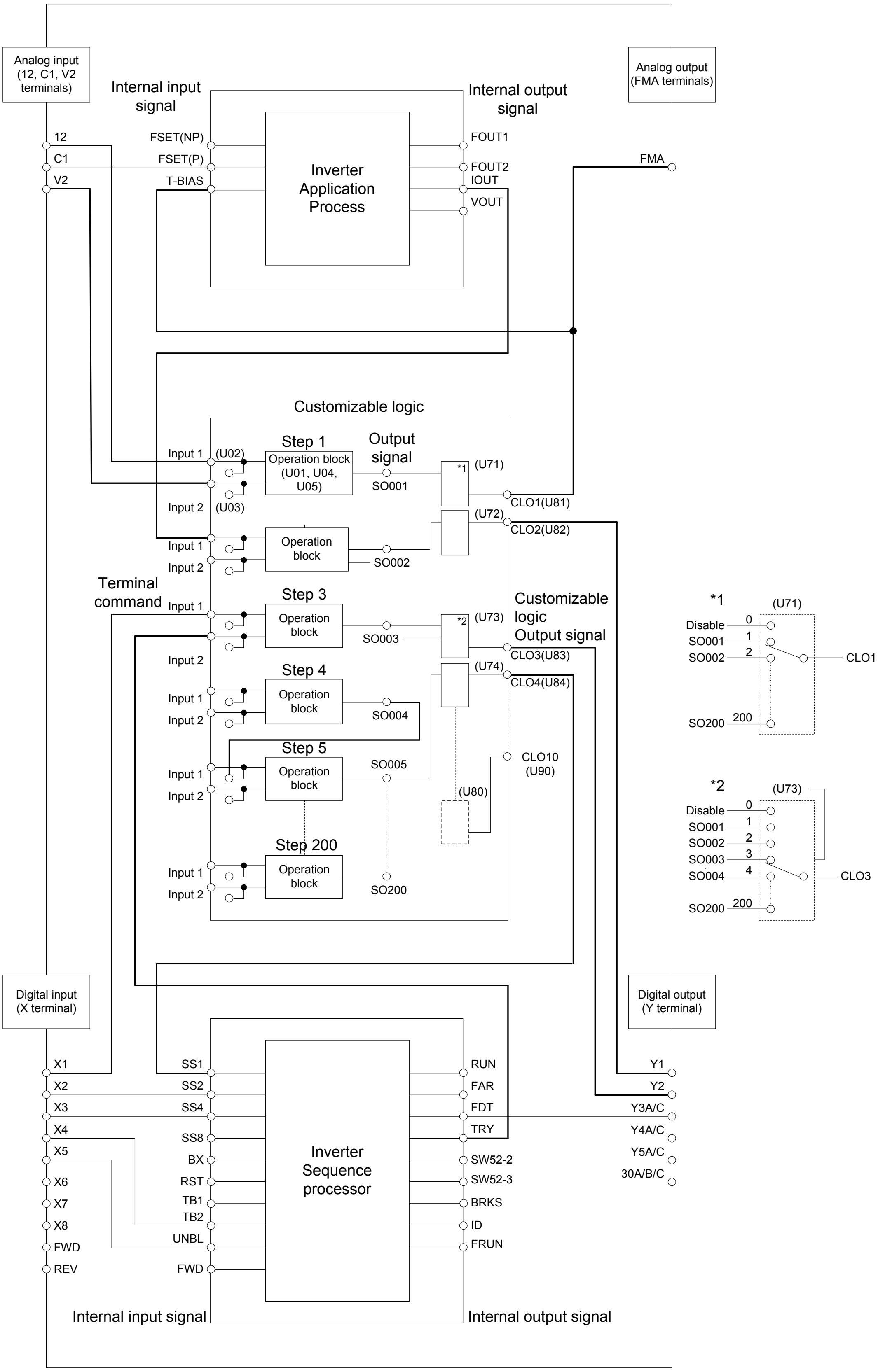
Item	Modes		
Terminal command	2 digital inputs	2 analog inputs	1 analog input 1 digital input
Operation block	Logical operation, counter, etc.: 13 types Timer: 5 types	Numerical operation, comparator, limiter, etc.: 25 types	Selector, hold, etc.: 12 types
Output signal	1 digital output	1 analog output/ 1 digital output	1 analog output
Number of steps	200 steps		
Customizable logic output signal	10 outputs		
Customizable logic processing time	2 ms (max. 10 steps), 5 ms (max. 50 steps), 10 ms (max. 100 steps), 20ms (max. 200 steps) Can be selected with a function code.		
Customizable logic cancellation command "CLC"	Allows to stop all the customizable logic operations by assigning "CLC" to a general-purpose input terminal and turning it ON. It is used when you want to deactivate the customizable logic temporarily.		
Customizable logic timer cancellation command "CLTC"	Resets the timer, counter and all the previous values used in customizable logic by assigning "CLTC" to a general-purpose input terminal and turning it ON. It is used when a customizable logic is changed or if you want to synchronize it with external sequence.		

Note If you use the customizable logic cancellation command and customizable logic timer cancellation command, the inverter can unintentionally start because the speed command is unmasked, depending on the structure of the customizable logic. Be sure to turn OFF the operation command to turn it ON.

A physical injury may result.

A damage may result.

■ Block diagram



Note Mode selection function codes for enabling customizable logic can be modified during operation but the customizable logic output may become temporarily unstable due to the setting modification. Therefore, since unexpected operation can be performed, change the settings if possible when the inverter is stopped.

A physical injury may result.
A damage may result.

U00	**Customizable logic (Mode selection)**
U01 to U70	**Customizable logic: Step 1 to 14 (Mode setting)**
U71 to U80	**Customizable logic: Output signal 1 to 10 (Output selection)**
U81 to U90	**Customizable logic: Output signal 1 to 10 (Function selection)**
U91	**Customizable logic: Timer monitor (Step selection)**
U100	**Customizable logic: Task process cycle setting**
U121 to U140	**Customizable logic: User parameter 1 to 20**
U171 to U175	**Customizable logic: Storage area 1 to 5**
U190 to U195	**Customizable logic: Step 15 to 200 setting**

■ Customizable Logic (Mode selection) (U00)

U00 specifies whether to enable the sequence configured with the customizable logic function or disable it to run the inverter only via its input terminals or others.

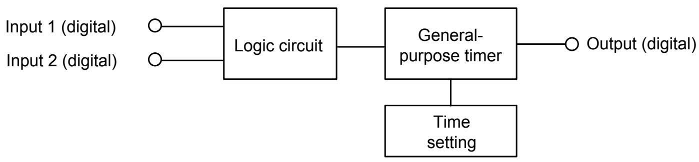
U00 data	Function
0	Disable
1	Enable (Customizable logic operation)

The **ECL** alarm occurs when changing U00 from 1 to 0 during operation.

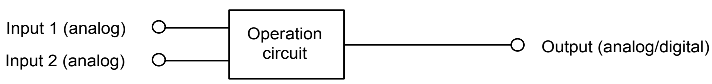
■ Customizable Logic (Mode Setting) (U01 to U70, U190 to U195)

In the customizable logic, the steps are categorized in the following three types:

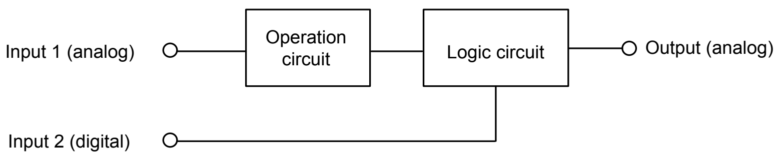
[Input: digital] Block selection (U01, U06, U11, etc.) = 1 to 1999



[Input: analog] Block selection (U01, U06, U11, etc.) = 2001 to 3999



[Input: digital, analog] Block selection (U01, U06, U11, etc.) = 4001 to 5999



The function code settings for each step are as follows:

Step 1 to 14

Step No.	Block selection	Input 1	Input 2	Function 1	Function 2	Output Note)
Step 1	U01	U02	U03	U04	U05	"SO001"
	= 1 to 1999	Digital input 1	Digital input 2	Time setting	Not required	Digital output
	= 2001 to 3999	Analog input 1	Analog input 2	Value 1	Value 2	Analog/digital output
	= 4001 to 6999	Analog input 1	Digital input 2	Value 1	Value 2	Analog output
Step 2	U06	U07	U08	U09	U10	"SO002"
Step 3	U11	U12	U13	U14	U15	"SO003"
Step 4	U16	U17	U18	U19	U20	"SO004"
Step 5	U21	U22	U23	U24	U25	"SO005"
Step 6	U26	U27	U28	U29	U30	"SO006"
Step 7	U31	U32	U33	U34	U35	"SO007"
Step 8	U36	U37	U38	U39	U40	"SO008"
Step 9	U41	U42	U43	U44	U45	"SO009"
Step 10	U46	U47	U48	U49	U50	"SO010"
Step 11	U51	U52	U53	U54	U55`	"SO011"
Step 12	U56	U57	U58	U59	U60	"SO012"
Step 13	U61	U62	U63	U64	U65	"SO013"
Step 14	U66	U67	U68	U69	U70	"SO014"

Note Output is not a function code. It indicates the output signal symbol.

Step 15 to 200

Specify a step number in U190, and set the block selection, input 1, input 2, function 1, function 2 in U191 to U195 respectively.

Step No.	U190	Block selection	Input 1	Input 2	Function 1	Function 2	Output
Step 15	15						"SO015"
Step 16	16						"SO016"
···	···	U191	U192	U193	U194	U195	···
Step 199	199						"SO199"
Step 200	200						"SO200"

[Input: digital] Block function code setting

■ Block selection (U01, U06, etc.) (Digital)

Any of the following items can be selected as a logic function block (with general-purpose timer): The data can be logically inverted by adding 1000.

Data	Logic function block	Description
0	No function assigned	Output is always OFF.
10	Through output + General-purpose timer (No timer)	No logic function. Only a general-purpose timer (11 to 15). No timer (10).
11	(On-delay timer)	Turning the input signal ON starts the on-delay timer. When the period specified by the timer has elapsed, the output signal turns ON. Turning the input signal OFF turns the output signal OFF.
12	(Off-delay timer)	Turning the input signal ON turns the output signal ON. Turning the input signal OFF starts the off-delay timer. When the period specified by the timer has elapsed, the output signal turns OFF.
13	(One-shot pulse output)	Turning the input signal ON issues a one-shot pulse whose length is specified by the timer.
14	(Retriggerable timer)	Turning the input signal ON issues a one-shot pulse whose length is specified by the timer. However, if the input signal is turned ON again during the preceding one-shot pulse length, the logic function block issues another one-shot pulse.
15	(Pulse train output)	If the input signal turns ON, the logic function block issues ON and OFF pulses (whose lengths are specified by the timer) alternately and repeatedly. This function is used to flash a luminescent device.
20 to 25	Logical AND + General-purpose timer	AND function with 2 inputs and 1 output, plus general-purpose timer.
30 to 35	Logical OR + General-purpose timer	OR function with 2 inputs and 1 output, plus general-purpose timer.
40 to 45	Logical XOR + General-purpose timer	XOR function with 2 inputs and 1 output, plus general-purpose timer.
50 to 55	Set priority flip-flop + General-purpose timer	Set priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
60 to 65	Reset priority flip-flop + General-purpose timer	Reset priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
70, 72, 73	Rising edge detector + General-purpose timer	Rising edge detector with 1 input and 1 output, plus general-purpose timer. This detects the rising edge of an input signal and outputs the ON signal for 5 ms (*1).
80, 82, 83	Falling edge detector + General-purpose timer	Falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects the falling edge of an input signal and outputs the ON signal for 5 ms (*1).
90, 92, 93	Rising & falling edges detector + General-purpose timer	Rising and falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects both the falling and rising edges of an input signal and outputs the ON signal for 5 ms (*1).

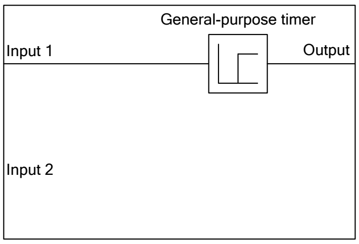
*1: Equals the task cycle: 2 ms for a task cycle of 2 ms, 5 ms for 5 ms, 10 ms for 10 ms, and 20 ms for 20 ms.

Data	Logic function block	Description
100 to 105	Hold + General-purpose timer	Hold function of previous values of 2 inputs and 1 output, plus general-purpose timer. If the hold control signal is OFF, the logic function block outputs input signals; if it is ON, the logic function block retains the previous values of input signals.
110	Increment counter	Increment counter with reset input. By the rising edge of the input signal, the logic function block increments the counter value by one. When the counter value reaches the target one, the output signal turns ON. Turning the reset signal ON resets the counter to zero.
120	Decrement counter	Decrement counter with reset input. By the rising edge of the input signal, the logic function block decrements the counter value by one. When the counter value reaches zero, the output signal turns ON. Turning the reset signal ON resets the counter to the initial value.
130	Timer with reset input	Timer output with reset input. If the input signal turns ON, the output signal turns ON and the timer starts. When the period specified by the timer has elapsed, the output signal turns OFF, regardless of the input signal state. Turning the reset signal ON resets the current timer value to zero and turns the output OFF.

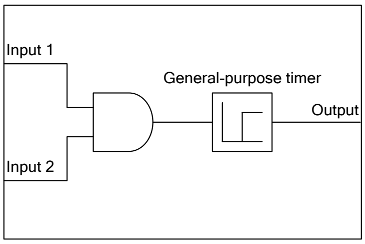
The data can be logically inverted by adding 1000.

The block diagrams for individual functions are given below.

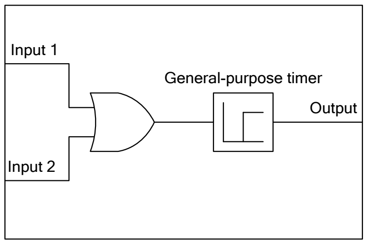
(Data=1□) Through output



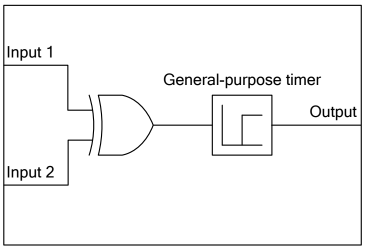
(Data=2□) Logical AND



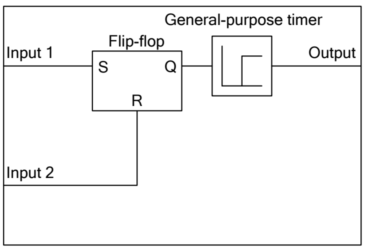
(Data=3□) Logical OR



(Data=4□) Logical XOR

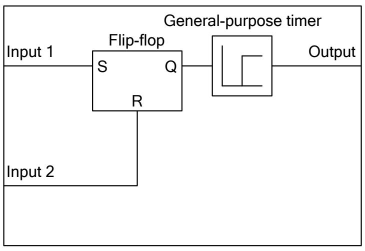


(Data=5□) Set priority flip-flop



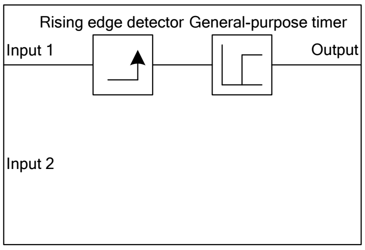
Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
		ON	ON	
	ON	–	OFF	
ON	–	–	ON	Set priority

(Data=6□) Reset priority flip-flop

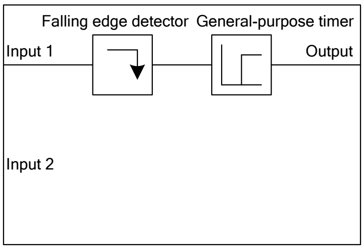


Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
		ON	ON	
–	ON	–	OFF	Reset priority
ON	OFF	–	ON	

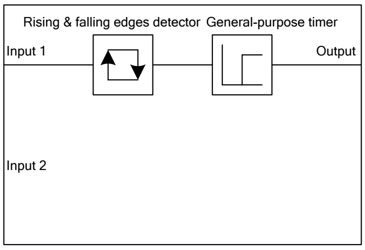
(Data=7□) Rising edge detector



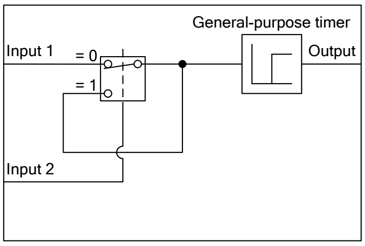
(Data=8□) Falling edge detector



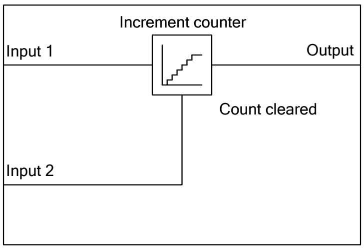
(Data=9□) Rising & falling edges detector



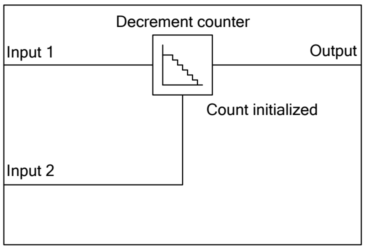
(Data=10□) Hold



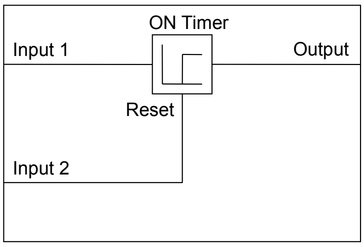
(Data=110) Increment counter

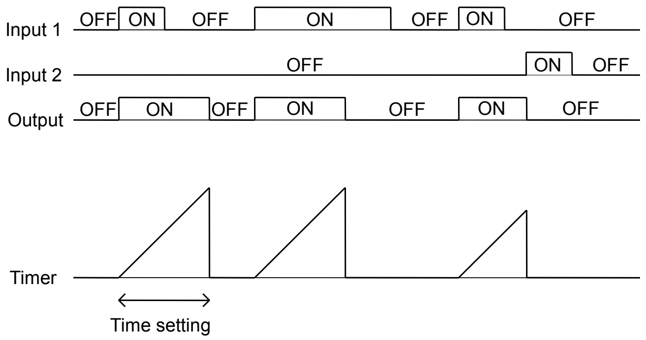


(Data=120) Decrement counter



(Data=130) Timer with reset input

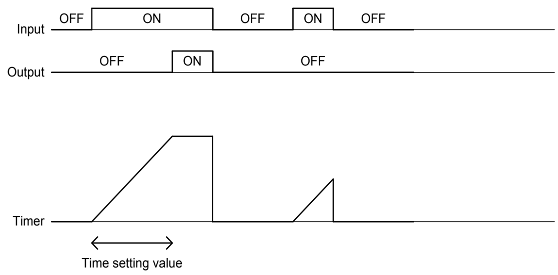




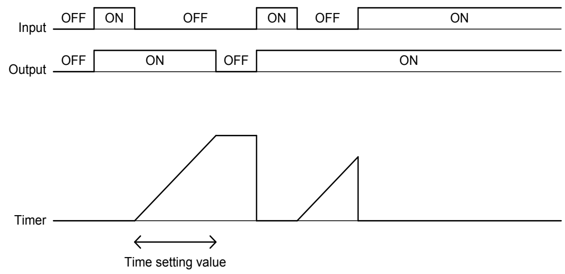
■ Operation of general-purpose timer(Digital)

The operation schemes for individual timers are shown below.

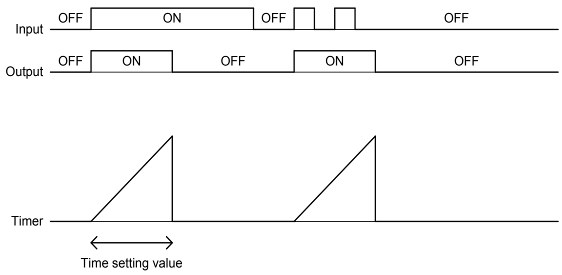
(End 1) On-delay timer



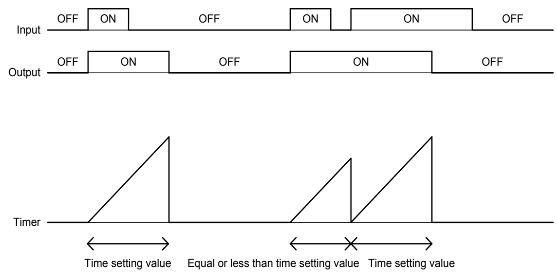
(End 2) Off-delay timer



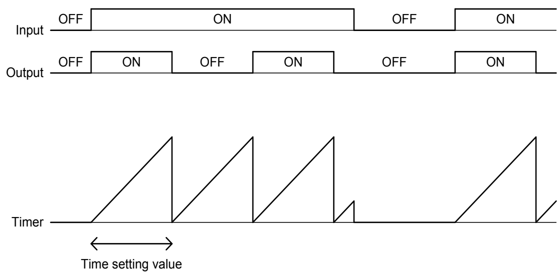
(End 3) One-shot pulse output



(End 4) Retriggerable timer



(End 5) Pulse train output



■ Inputs 1 and 2 (U02, U03, U07, U08, etc.)(Digital)

The following digital signals are available as input signals. Value in ( ) is in negative logic.

Data	Selectable Signals
0000 (1000) to 0129 (1129)	General-purpose output signals Same as the ones specified by E20, e.g., "RUN" (Inverter running), FAR (Frequency (speed) arrival signal), "FDT" (Frequency (speed) detected), "LU" (Undervoltage detected (Inverter stopped)) Note: 27 (Universal DO) is not available. Note: Customizable logic output signals from 141 (1141) to 150 (1150) cannot be selected.
2001 (3001) to 2200 (3200)	Output of step 1 "SO001" to Output of step 200 "SO200"
4001 (5001)	Terminal X1 input signal "X1"
4002 (5002)	Terminal X2 input signal "X2"
4003 (5003)	Terminal X3 input signal "X3"
4004 (5004)	Terminal X4 input signal "X4"
4005 (5005)	Terminal X5 input signal "X5"
4006(5006)	Terminal X6 input signal "X6"
4007(5007)	Terminal X7 input signal "X7"
4008(5008)	Terminal X8 input signal "X8"
4010 (5010)	Terminal FWD input signal FWD
4011 (5011)	Terminal REV input signal REV
6000 (7000)	Final RUN command "FL_RUN" (ON when a run command is given)
6001 (7001)	Final FWD run command "FL_FWD" (ON when a run forward command is given)
6002 (7002)	Final REV run command "FL_REV" (ON when a run reverse command is given)
6007 (7007)	Alarm factor presence "ALM_ACT" (ON when there is no alarm factor)

■ Function 1 (U04, U09, etc.)(Digital)

Function 1 specifies the general-purpose timer period or the increment/decrement counter value.

Data	Function	Description
0.00 to +600.00	Timer	The period is specified in seconds.
	Counter value	The specified value is multiplied by 100 times. (If 0.01 is specified, it is converted to 1.)
-9990.00 to -0.01	—	The timer or counter value works as 0.00. (No timer)
+601.00 to +9990.00	Timer	The period is specified in seconds.

[Input: analog] Block function code setting

■ Block selection, function 1, function 2 (U01, U04, U05, U06, U09, U10, etc.)(Analog)

The following items are available as function block operation.
Note that if the upper and lower limits have the same value, no upper and lower limits are applied.

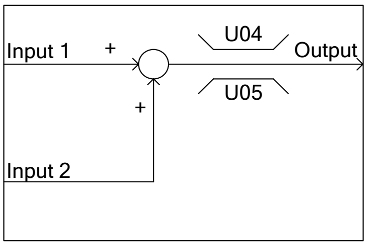
Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
0	No function assigned	This function always outputs 0% (or logical “0: False”; OFF).	Not required	Not required
2001	Adder	Addition function with two inputs (input 1 and input 2). This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2002	Subtracter	Subtraction function with two inputs (input 1 and input 2). This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2003	Multiplier	Multiplication function with two inputs (input 1 and input 2). This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2004	Divider	Division function with two inputs (input 1 and input 2). Input 1 is dividend and input 2 is divisor. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2005	Limiter	Upper and lower limit functions of single input (input 1). The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit
2006	Absolute value of input	Absolute value function of single input (input 1). Negative input numbers become positive. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides upper limit value and the 2nd one provides lower limit value.	Upper limit	Lower limit

Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
2007	Inverting adder	Inverting addition function with single input (input 1). This function subtracts the input 1 with the value specified with the 1st function code, inverts the result. Furthermore, adds this result to the value specified with the 2nd function code and outputs the final result.	Subtraction value (former)	Addition value (latter)
2008	Variable limiter	Variable limit function of single input (input 1). Input 1 provides upper limit value and input 2 provides lower limit value.	Step number	Not required
2009	Linear function	Linear function of single input (input 1). This function takes the single input (input 1) value, calculates pre-defined first-order polynomial, and outputs the result. The 1st and 2nd function codes provide the coefficients of the polynomial. The polynomial is represented by the following formula. $y = K_A \times \chi + K_B$ The output is limited within the range between -9990 and 9990 by the internal limiter.	Factor KA -9990.0 to +9990.0	Factor KB -9990.0 to +9990.0
2051	Comparator 1	Comparison function with hysteresis. This function compares the differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. If the differential value is (threshold value + hysteresis width) or bigger, this function outputs logical “1: True”. On the other hand, if the the differential value is (threshold value - hysteresis width) or smaller, this function outputs logical “0: False”.	Threshold value	Hysteresis width
2052	Comparator 2	Comparison function with hysteresis. This function compares the differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. If the differential value is bigger than (threshold value + hysteresis width), this function outputs logical “1: True”. On the other hand If the value is smaller than (threshold value - hysteresis width), the function outputs logical “0: False”.	Threshold value	Hysteresis width
2053	Comparator 3	Comparison function with hysteresis. This function compares the absolute differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. This function works like as comparator 1	Threshold value	Hysteresis width
2054	Comparator 4	Comparison function with hysteresis. This function compares the absolute differential value between input 1 and input 2 with the threshold value specified with the 1st function code. The 2nd function code provides hysteresis width. This function works like as comparator 2	Threshold value	Hysteresis width
2055	Comparator 5	Comparison function with hysteresis. Input 1 is the input value of this function and input 2 is not used. The 1st function code provides threshold value and the 2nd one provides hysteresis width. If input 1 is (threshold value) or bigger, this function outputs logical “1: True”. On the other hand if input 1 is smaller than (threshold value - hysteresis width), this function outputs logical “0: False”.	Threshold value	Hysteresis width

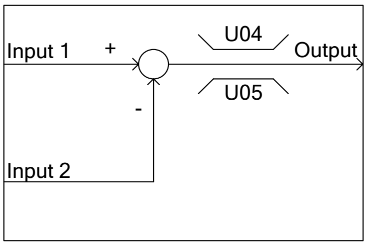
Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
2056	Comparator 6	Comparison function with hysteresis. Input 1 is the input value of this function and input 2 is not used. The 1st function code provides threshold value and the 2nd one provides hysteresis width. If input 1 is (threshold value) or smaller, this function outputs logical “1: True”. On the other hand if input 1 is bigger than (threshold value + hysteresis width), this function outputs logical “0: False”.	Threshold value	Hysteres is width
2071	Window comparator 1	Comparison function with limits. Whether the value of the input is within a preselected range specified with two function codes determines the status of the output. Input 1 is the input value of this function and input 2 is not used. The 1st function code provides upper threshold value and the 2nd one provides lower threshold value. If input 1 is within the range (defined by the two function codes), this function outputs logical “1: True”. On the other hand If input 1 is outside of this range, this function outputs logical “0: False”.	Upper threshold	Lower threshold
2072	Window comparator 2	Comparison function with limit. This function has the inverted logic of “Window comparator 1”.	Upper threshold	Lower threshold
2101	High selector	High selector function. This function receives two inputs (input 1 and input 2), selects the higher one automatically, and outputs it. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides the upper limit value and the 2nd one provides the lower one.	Upper limit	Lower limit
2102	Low selector	Low selector function. This function receives two inputs (input 1 and input 2), selects the lower one automatically, and outputs it. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides the upper limit value and the 2nd one provides the lower one.	Upper limit	Lower limit
2103	Average of inputs	Average function. This function receives two inputs (input 1 and input 2), averages them, and outputs the result. This function has output limiters (upper/lower) specified with two function codes. The 1st function code provides the upper limit value and the 2nd one provides the lower one.	Upper limit	Lower limit

The block diagrams for each operation function block are given below. The setting value for functions 1 and 2 is indicated with U04 and U05.

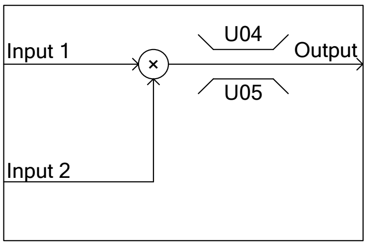
(2001) Adder



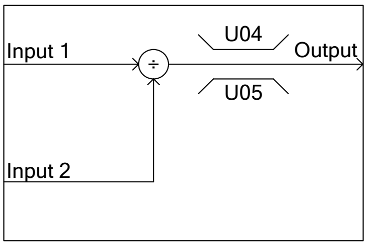
(2002) Subtracter



(2003) Multiplier

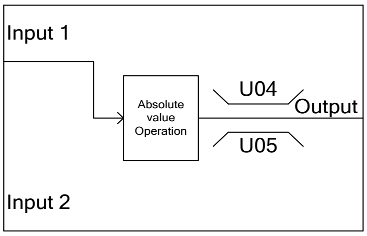


(2004) Divider

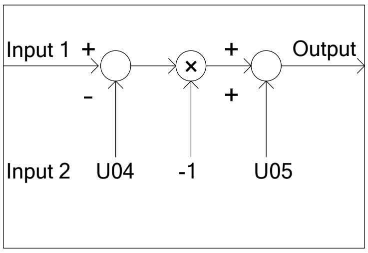


(2005) Limiter

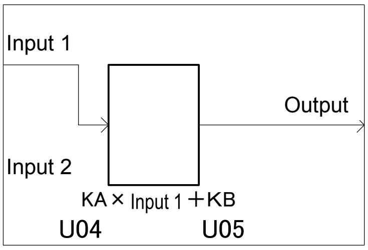
(2006) Absolute value of inputs



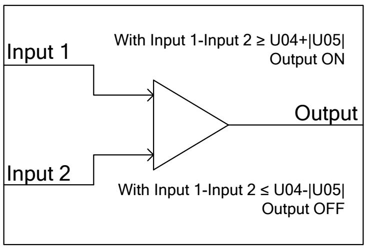
(2007) Inverting adder



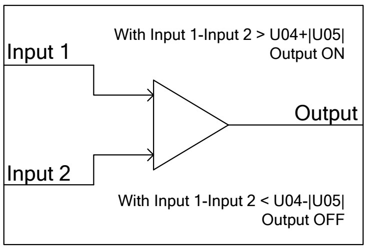
(2009) Linear function



(2051) Comparator 1

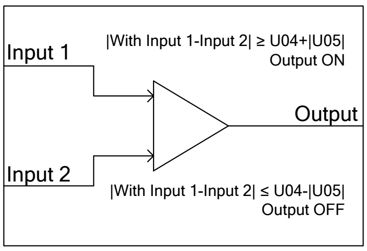


(2052) Comparator 2

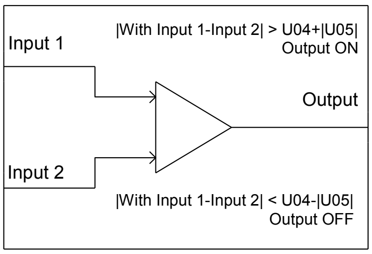


ON is prioritized when both conditions are satisfied.

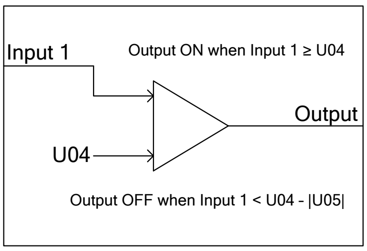
(2053) Comparator 3



(2054) Comparator 4

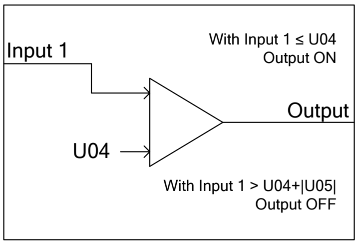


(2055) Comparator 5

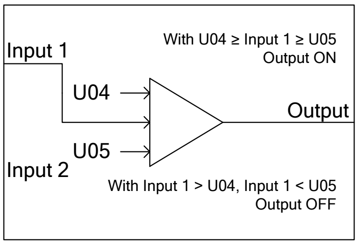


ON is prioritized when both conditions are satisfied.

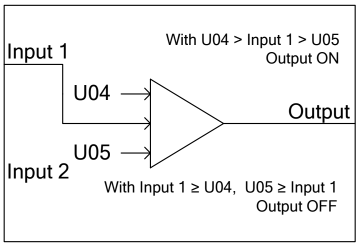
(2056) Comparator 6



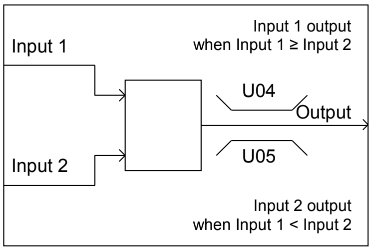
(2071) Window comparator 1



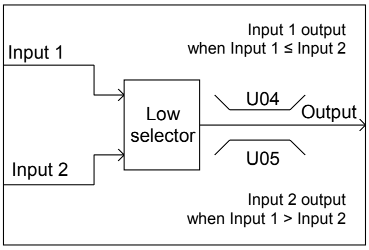
(2072) Window comparator 2



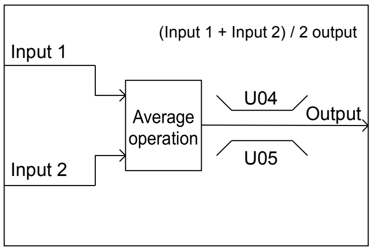
(2101) High selector



(2102) Low selector



(2103) Average of inputs



■ Inputs 1 and 2 (U02, U03, U07, U08, etc.)(Analog)

The following signals are available as analog input signals.

Data	Selectable Signals
8000 to 8019	General-purpose analog output signal (same as signals selected in F31: output frequency 1, output current, output torque, Input power, DC link bus voltage, etc.) Example: For output frequency 1, maximum frequency (100%) is input as 100.00. Example: For output current, 200% of the inverter rated current is input as 100.00. Note: 10 (Universal AO) is not available.
2001 to 2200	Output of step 1 to 200 “SO001” to “SO200”
9001	Analog 12 terminal input signal [12]
9002	Analog C1 terminal input signal [V2] (C1 function)
9003	Analog V2 terminal input signal [V2] (V2 function)

■ Function 1, Function 2 (U04, U05, U09, U10, etc.)(Analog)

Sets the upper limit and lower limit of function block operation.

Data	Function	Description
-9990.00 to 0.00 to +9990.00	Reference value Hysteresis width Upper limit Lower limit Upper threshold Lower threshold	Setting values for the operation of the function block (selected with the corresponding function code such as U01).

[Input: digital, analog] Block function code setting

■ Block selection, function 1, function 2 (U01, U04, U05, etc.) (digital,analog)

The following items are available as function block.

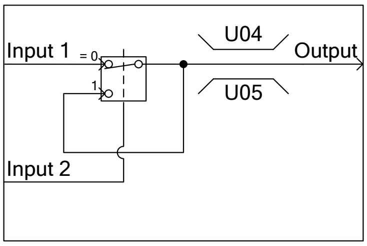
Note that if the upper and lower limits are identical, no upper and lower limits are applied.

Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
4001	Hold	Function to hold analog input 1 based on digital input 2 state.	Upper limit	Lower limit
4002	Inverting adder with enable	Function investing addition function to analog input 1 based on digital input 2 state.	Subtracted value (former)	Addition value (latter)
4003	Selector 1	Function to select analog input 1 and setting value based on digital input 2.	Setting value	Not required
4004	Selector 2	Function to select setting value 1/2 based on digital input 2 state.	Setting value 1	Setting value 2
4005	LPF (Low pass filter) with enable	Value of analog input 1 is filtered through LPF (time constant U04) when the digital input 1 is “1”. When the digital input 1 is “0”, the analog input 1 is directly output. LPF maintains the previous output value. Therefore, when the digital 1 input changes from 0 to 1, the output will be the value with the previous output value added as the initial value of LPF. (No upper/lower limiter)	Time constant 0: No filter 0.01 to 5.00s	Fixed as 0
4006	Rate limiter with enable	Value of analog input 1 is limited with change rate specified in functions 1 and 2 when the digital input 1 is “1”. When the digital input 1 is “0”, the analog 1 input is directly output. When setting the initial value, carry out an operation with the initial value for input 1 and 0 applied to input 2. Then, reflect the result as the initial value (= previous output value) with 1 applied to input 2. During the initialization or when the CLC terminal is ON, the previous output value is cleared to 0.	Upward change rate Time taken to change 100% 0: Same change rate as function 1 0.01 to 600 s	Downward change rate Time taken to change 100% 0: Same change rate as function 1 0.01 to 600 s
5000	Selector 3	Function to select analog input 1 or based on “SO001” to “SO200”.	Step No.	Not required
5100	Selector 4	Function to select analog input 1 or “SO001” to “SO200” based on digital input 2.	Step No.	Not required

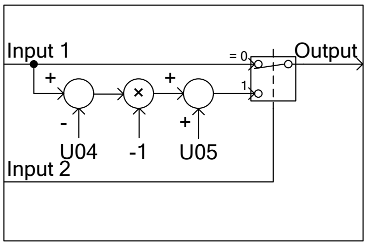
Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
6001	Reading function codes	Function to read the contents of arbitrary function code. Use the 1st function code (such as U04) to specify a function code group, and the 2nd one (such as U05) to specify the last two digits of the function code number. For the function code settings, refer to " □ Configuration of function codes" in page 2-130. Both input 1 and input 2 are not used. Data formats that can be read correctly are as follows (the values are restricted between -9990 and 9990 and, for [29], 20000 is indicated as 100%): [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [12], [22], [24], [29], [35], [37], [45], [61], [67], [68], [74], [92] and [93] Data formats other than the above cannot be read correctly. Do not use them.	0 to 255	0 to 99
6002	Writing function codes	This function writes the value of input 1 to a function code (U171 to U175) on the volatile memory (RAM) when the input 2 becomes "1: True". When the input 2 becomes "0: False", this function stops to write to the function code (U171 to U175) and maintains the previous value. The value of input 1 is stored to the non-volatile memory (EEPROM) when the inverter detects undervoltage. Because the access arbitration from some steps at a time is not possible, only one step is allowed to access to the same function code in the customizable logic. If the access to the target function code from different steps at a time is executed, the alarm is displayed.	39	71 to 75

Block selection (U01 etc.)	Function block	Description	Function 1 (U04 etc.)	Function 2 (U05 etc.)
6003	Temporary change of function code	This function reflects the value of the specified function code on the volatile memory (RAM) when the input 2 becomes “0: False”. On the other hand when the input 2 does not become “0: False”, this function reflects the value of input 1 instead of the function code. The value on the volatile memory (RAM) is cleared when the inverter is powered off, and the value is read from the non-volatile memory and restored when the inverter is powered on. Set the function code group (function type code) to the1st function code (U04, etc.). Set the lower 2 digits of the function code No. to the 2nd function (U05, etc.). If the specified function code (U04, U05, etc.) is not applicable one, this function outputs zero value. Because the access arbitration from some steps at a time is not possible, only one step is allowed to access to the same function code in the customizable logic. When the function code is temporarily changed using 6003 during the customized logic operation and if the PC loader is read or copy to the touch panel is performed, the temporary changed data, may be copied instead of the non-volatile memory data. Stop the customized logic before these operations.	0 to 255	0 to 99

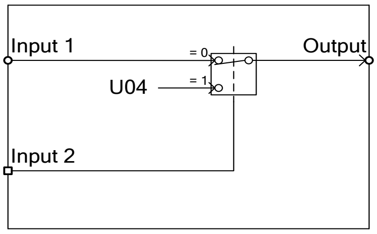
(4001) Hold



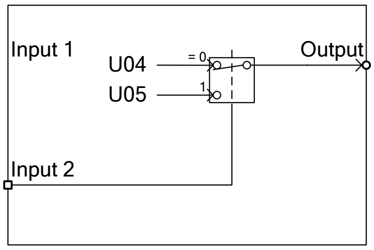
(4002) Inverting adder with enable



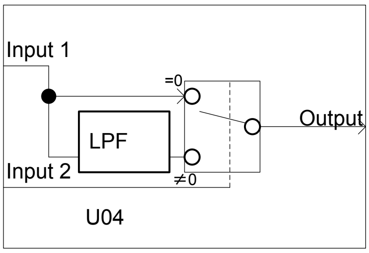
(4003) Selector 1



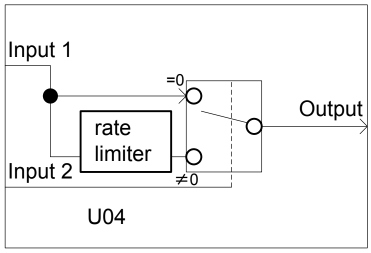
(4004) Selector 2



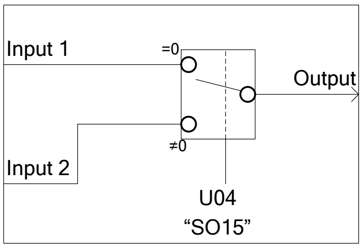
(4005) Low pass filter with enable



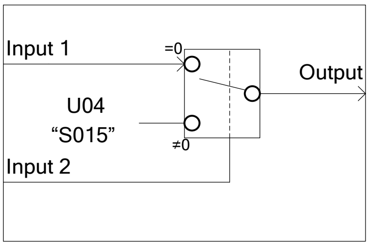
(4006) Rate limiter with enable



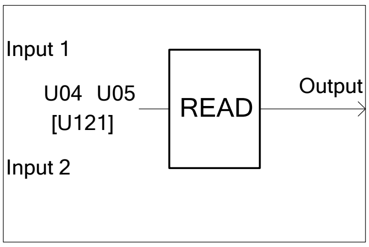
(5000) Selector 3



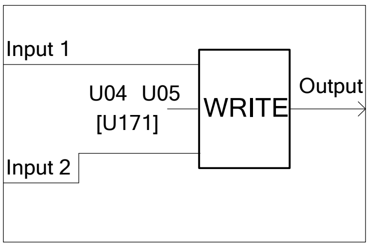
(5100) Selector 4



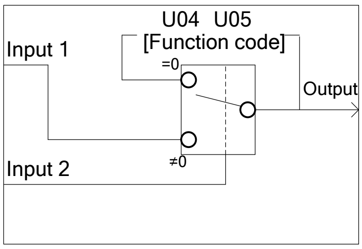
(6001) Reading function codes



(6002) Writing function codes



(6003) Temporary change of function code



■ Output signals (Digital,analog)

In the customizable logic, outputs from steps 1 to 10 are issued to SO001 to SO200, respectively.

SO001 to SO200 differ in configuration depending upon the connection destination, as listed below. To relay those outputs to any function other than the customizable logic, route them via customizable logic outputs CLO1 to CLO10.

Connection destination of each step output	Configuration	Function code
Input of customizable logic	Select one of the internal step output signals "SO001" to "SO200" in customizable logic input setting.	Such as U02 and U03
Input of inverter sequence processor (such as multistep speed "SS1" or operation command "FWD")	Select one of the internal step output signals "SO001" to "SO200" to be connected to customizable logic output signals 1 to 10 ("CLO1" to "CLO10").	U71 to U80
	Select an inverter's sequence processor input function to which one of the customizable logic output signals 1 to 10 ("CLO1" to "CLO10") is to be connected (same as in E01).	U81 to U90
Analog input (such as Speed command)	Select one of the internal step output signals "SO01" to "SO200" to be connected to customizable logic output signals 1 to 10 ("CLO1" to "CLO10").	U71 to U80
	Select an analog input function to which one of the customizable logic output signals 1 to 10 ("CLO1" to "CLO10") is to be connected (same as in E61).	U81 to U90
General-purpose digital output ([Y] terminals)	Select one of the internal step output signals "SO001" to "SO200" to be connected to customizable logic output signals 1 to 10 ("CLO1" to "CLO10").	U71 to U80
	To specify a general-purpose digital output function (on [Y] terminals) to which one of the customizable logic output signals 1 to 10 ("CLO1" to "CLO10") is to be connected, select one of "CLO1" to "CLO10" by specifying the general-purpose digital output function on any Y terminal.	E20, E21, E27
General-purpose analog output ([FMA] terminals)	Select one of the internal step output signals "SO001" to "SO200" to be connected to customizable logic output signals 1 to 10 ("CLO1" to "CLO10").	U71 to U80
	To specify a general-purpose analog output function (on [FM] terminals) to which one of the customizable logic output signals 1 to 10 ("CLO1" to "CLO10") is to be connected, select one of "CLO1" to "CLO10" by specifying the general-purpose digital output function on any [FM] terminal.	F31

Note General-purpose digital outputs (on [Y] terminals) are updated every 5 ms. To securely output a customizable logic signal via [Y] terminals, include on- or off-delay timers in the customizable logic. Otherwise, short ON or OFF signals may not be reflected on those terminals.

Function codes	Name	Data setting range	Factory default
U71	Customizable logic output signal 1 (Output selection)	0: Disable 1: Output of step 1, “SO001” 2: Output of step 2, “SO002” ••• 199: Output of step 199, “SO199” 200: Output of step 200, “SO200”	0
U72	Customizable logic output signal 2 (Output selection)		0
U73	Customizable logic output signal 3 (Output selection)		0
U74	Customizable logic output signal 4 (Output selection)		0
U75	Customizable logic output signal 5 (Output selection)		0
U76	Customizable logic output signal 6 (Output selection)		0
U77	Customizable logic output signal 7 (Output selection)		0
U78	Customizable logic output signal 8 (Output selection)		0
U79	Customizable logic output signal 9 (Output selection)		0
U80	Customizable logic output signal 10 (Output selection)		0
U81	Customizable logic output signal 1 (Function selection)	■ If the step output is digital The same value as E98 can be specified. 0(1000):Select multistep speed 1 (0 to 1 steps) “SS1” 1(1001) Select multistep speed 1 (0 to 3 steps) “SS2” 2(1002):Select multistep speed 1 (0 to 7 steps) “SS4” 3(1003):Select multistep speed 1 (0 to 15 steps) “SS8” and so on. ■ If the step output is analog 8001: Speed command (Not reversible operation by polarity) 8002: Speed command (Reversible operation by polarity) 8004: orque bias command	100
U82	Customizable logic output signal 2 (Function selection)		100
U83	Customizable logic output signal 3 (Function selection)		100
U84	Customizable logic output signal 4 (Function selection)		100
U85	Customizable logic output signal 5 (Function selection)		100
U86	Customizable logic output signal 6 (Function selection)		100
U87	Customizable logic output signal 7 (Function selection)		100
U88	Customizable logic output signal 8 (Function selection)		100
U89	Customizable logic output signal 9 (Function selection)		100
U90	Customizable logic output signal 10 (Function selection)		100

■ Specific function codes

The following function codes can take values on memory by using the customizable logic "Function code switch (6003)". Overwritten values are cleared at power off.

Function codes	Name
F07	Acceleration / deceleration time 1
F08	Acceleration / deceleration time 2
F21	DC braking 1 (Braking level)
F22	DC braking 1 (Braking time)
F23	Starting frequency 1
F24	Starting frequency 1 (Holding time)
F25	Stop frequency
F44	Current limiter (Level)
E10	Acceleration / deceleration time 3
E11	Acceleration / deceleration time 4
E12	Acceleration / deceleration time 5
E13	Acceleration / deceleration time 6
E14	Acceleration / deceleration time 7
E15	Acceleration / deceleration time 8
E16	Acceleration / deceleration time 9
E17	Acceleration / deceleration time 10
L09	Filter Time Constant for Reference Speed (Final)
L10	Filter Time Constant for Detected Speed
L36	ASR (P constant at high speed)
L37	ASR (I time constant at high speed)
L38	ASR (P constant at low speed)
L39	ASR (I time constant at low speed)
L42	ASR (Feed forward gain)
L55	Torque Bias (Startup timer)
L56	Torque Bias (Reference torque end time)
L57	Torque Bias (Limiter)
L58	Torque Bias (P constant)
L59	Torque Bias (Integral time)
L60	Torque Bias (Driving side gain)
L61	Torque Bias (Braking side gain)
L62	Torque Bias (Digital 1)
L63	Torque Bias (Digital 2)
L64	Torque Bias (Digital 3)
L68	Unbalanced Load Compensation (ASR P constant)
L69	Unbalanced Load Compensation (ASR I constant)
L73	Unbalanced Load Compensation (APR P constant)
L74	Unbalanced Load Compensation (APR D gain)
L75	Unbalanced Load Compensation (Filter Time Constant for Detected speed)
L93	Overheat and Overload Early Warning Level

■ Function codes for the customizable logic

Function code number	Name	Range	Minimum unit	Remarks
U121 to U140	User parameter 1 to 20	-9990.00 to 9990.00 Effective number are 3 digits.	0.01 to 10	
U171 to U175	Storage area 1 to 5	-9990.00 to 9990.00 Effective number are 3 digits.	0.01 to 10	Memorize the data at power off.

■ Configuration of function codes

Set a function code group (code from the following table) to function 1 (such as U04) and set the last two digits of the function code number to function 2 (such as U05) to specify individual function codes.

Group	Code	Name	Group	Code	Name
F	0	Basic function	L1	56	Lift function
E	1	Terminal function	L2	57	Lift function
C	2	Control function	K	28	Keypad function
P	3	Motor1	M	8	Monitor
H	4	High performance function	W	15	Monitor 2
H1	31	High performance function	W1	22	Monitor 3
U	11	Customizable logic	W2	23	Monitor 4
U1	39	Customizable logic	X	16	Alarm 1
y	14	Link function	Z	17	Alarm 2
L	9	Lift function			

■ Task process cycle setting (U100)

U100 data	Data
0	Automatically adjusts the task cycle from 2 ms to 10 ms depending on the number of used steps. This is the factory default. It is recommended to use this value.
2	2 ms: Up to 10 steps. If it exceeds 10 steps, the customizable logic does not work.
5	5 ms: Up to 50 steps. If it exceeds 50 steps, the customizable logic does not work.
10	10 ms: Up to 100 steps. If it exceeds 100 steps, the customizable logic does not work.
20	20 ms Up to 200 steps.

Note that if the number of steps defined in 2, 5 or 10 is exceeded, the customizable logic does not work.

■ Operating precautions

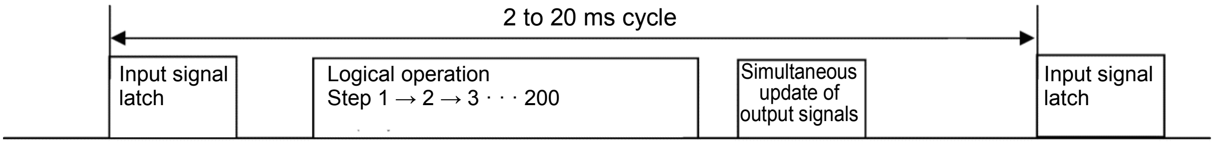
The customizable logics are executed within 2 ms to 20 ms (according to U100) and processed in the following procedure:

(1) First, latch the external input signals for all the customizable logics from step 1 to 200 to maintain synchronism.

(2) Perform logical operations sequentially from step 1 to 200.

(3) If an output of a step is an input to the next step, outputs of step with high priority can be used in the same process.

(4) The customizable logic simultaneously updates the 10 output signals.



Note that if you do not consider the process order of customizable logic when configuring a function block, the expected output may not be obtained, the operation can be slower or a hazard signal can occur, because the output signal of a step is not available until the next cycle.

⚠CAUTION
Changing a functional code related to the customizable logic (U code etc) or turning ON the customizable logic cancel signal "CLC" causes change in operation sequence depending on the setting, which may suddenly start an operation or start an unexpected action. Fully ensure it is safe before performing the operation. **An accident or physical injury may occur.**

■ Customizable logic timer monitor (Step selection) (U91, X89 to X93)

The monitor function codes can be used to monitor the I/O status or timer's operation state in the customized logics.

<u>Selection of monitor timer</u>

Function code	Function	Remarks
U91	0: Monitor not active (the monitor data is 0) 1 to 200: set the step No. to monitor	The setting value is cleared to 0 when powered off.

<u>Monitor method</u>

Monitor method	Function code	Data
Communication	X89 customizable logic (digital I/O)	Digital I/O data for the step defined in U91 (only for monitoring)
	X90 customizable logic (timer monitor)	Data of the timer/counter value for the step defined in U91 (only for monitoring)
	X91 customizable logic (analog input 1)	Analog input 1 data for the step defined in U91 (only for monitoring)
	X92 customizable logic (analog input 2)	Analog input 2 data for the step defined in U91 (only for monitoring)
	X93 customizable logic (analog output)	Analog output data for the step defined in U91 (only for monitoring)

■ Cancel customizable logic "CLC" (function codes E01 to E08 Data = 80)

Customizable logic operations can temporarily be disabled so that the inverter can be operated without the customizable logic's logical circuit and timer operation, for example during maintenance.

"CLC"	Function
OFF	Customizable logic enabled (according to U00 setting)
ON	Customizable logic disabled

Note If you turn ON the customizable logic cancellation signal "CLC", a sequence by the customizable logic is cleared, which can suddenly start operation depending on the settings. Ensure the safety and check the operation before switching the signal.

■ Clear all customizable logic timers "CLTC" (function codes E01 to E08 Data = 81)

If the CLTC terminal function is assigned to a general-purpose input terminal and this input is turn ON, all the general-purpose timers and counters in the customizable logic are reset. It is used to reset and restart the system, when, for example, the timing of external sequence cannot be consistent with internal customizable logic due to a momentary power failure.

"CLTC"	Function
OFF	Normal operation
ON	Resets all the general-purpose timers and counters in the customizable logic. (To reactivate it, turn it OFF again.)

2.3.7 y codes (Link functions)

y01 to y20 | **RS-485 communication setting 1 and 2**

In the RS-485 communication, two systems can be connected.

Port	Connection method	Function code	Equipment that can be connected
Port 1	Via RS-485 communication link (port 1) (RJ-45 connector to connect keypad)	y01 to y10	Multi-function keypad Basic keypad Inverter supporting loader Host equipments (upper equipments)
Port 2	Via RS-485 communications link (port 2) Via digital input terminal blocks (DX+, DX-)	y11 to y20	Host equipments (upper equipments) Inverter supporting loader

Overview of the equipments is given below.

(1) Keypad
Multi-function keypad and basic keypad can be connected to operate and monitor the inverter. Regardless of the y code settings, both of keypads are available.

(2) Inverter supporting loader (FRENIC loader)
Inverter supporting (monitor, function code editing, test operation) can be performed by connecting a computer with the FRENIC Loader software installed.

For the y codes setting, refer to the function codes y01 to y20.

(3) Host equipments (upper equipments)
Host equipments (upper equipments) such as PLC and controller can be connected to control and monitor the inverter. Modbus RTU*1 protocol or DCP*2 protocol can be selected for communication.

*1 Modbus RTU is a protocol defined by Modicon.
*2 DCP is a protocol defined by KOLLMORGEN.

For details, refer to the RS-485 Communication User's Manual.

■ Station addresses (y01, y11)

Set the station addresses for the RS-485 communication. The setting range depends on the protocol.

Protocol	Range	Broadcast
Modbus RTU	1 to 247	0
Protocol for Loader software	1 to 255	—
DCP	—	—

When specifying a value out of range, no response is returned.
To use Loader software the inverter settings should match with the computer's settings.

■ Communications error processing (y02, y12)

Select an operation when an error occurs in the RS-485 communication.

The RS-485 errors are logical errors such as address error, parity error and framing error, transmission errors and disconnection errors (the latter specified in y08 and y18). These errors occur only when the inverter is configured to receive the operation command or frequency command via the RS-485 communication. If the operation command or frequency command is not issued via the RS-485 communication, or when the inverter is stopped, the system does not determine an error.

y02, y12 data	Function
0	Displays the RS-485 communication error (**Er8** for y02, **ErP** for y12), and immediately stops the operation (trip by alarm).
1	Operates for a period specified in the error process timer (y03, y13), and then displays the RS-485 communication error (**Er8** for y02, **ErP** for y12), and stops the operation (trip by alarm).
2	Retries the communication for a period specified in the error process timer (y03, y13), and if the communication is recovered, the operation continues. If the communication is not recovered within the period specified in the error process timer, displays the RS-485 communication error (**Er8** for y02, **ErP** for y12) and stops the operation (trip by alarm).
3	Continues the operation if a communication error occurs.

For details, refer to the RS-485 Communication User's Manual.

■ Error process timer (y03, y13)

Sets the error process timer, as explained above for the communications error processing parameters (y02, y12). Refer also to the section of disconnection detection time (y08, y18).

-Data setting range: 0.0 to 60.0 (s)

■ Baud rate (y04, y14)

Sets the transmission baud rate.

- For inverter supporting loader (via RS-485): Match the value with the computer setting.

y04 and y14 data	Function
1	4800 bps
2	9600 bps
3	19200 bps
4	38400 bps

■ Data length selection (y05, y15)

Sets the character length.

- For inverter supporting loader (via RS-485): The value does not need to be set since it automatically becomes 8 bits. (It also applies to Modbus RTU.)

y05 and y15 data	Function
0	8 bits
1	7 bits

■ Parity selection (y06, y16)

Sets the parity.

- For inverter supporting loader (via RS-485): The value does not need to be set since it automatically becomes even parity.

y06 and y16 data	Function
0	No parity bit (2 stop bits for Modbus RTU)
1	Even parity (1 stop bit for Modbus RTU)
2	Odd parity (1 stop bit for Modbus RTU)
3	No parity bit (1 stop bit for Modbus RTU)

■ Stop bit selection (y07, y17)

Sets the stop bit.

- For inverter supporting loader (via RS-485): The value does not need to be set since it automatically becomes 1 bit.

  For Modbus RTU: The value does not need to be set since it is automatically determined in conjunction with the parity bit (function y06, y16).

y07 and y17 data	Function
0	2 bits
1	1 bit

■ Communication time-out detection timer (y08, y18)

When the operation commands are given using the RS-485 communication, this parameter sets the time to detect a communication time-out (for any reason such as disconnection from the host equipment that is periodically accessing to the inverter). The time is counted from the last valid data received.

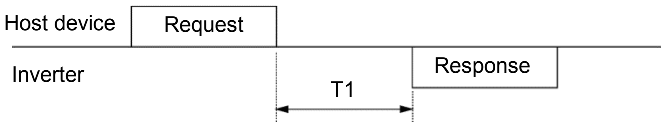
y08 and y18 data	Function
0	Disconnection is not detected.
1 to 60	Detection time from 1 to 60 (s)

For details on processing communication errors, refer to y02 and y12.

■ Response interval time (y09, y19)

Sets a period from the time when the system receives a request from host equipment (upper equipment such as computer or PLC) until the time when it returns a response. In case of the host equipments that are slow to process the task from completed transmission to completed reception preparation, a timing can be synchronized by setting the response interval time.

-Data setting range: 0.00 to 1.00 (s)



T1 = Response interval time + α

α: Processing time inside the inverter. It varies depending on the timing and command.

For details, refer to the RS-485 Communication User's Manual.

Note To set an inverter by the inverter supporting loader via the RS-485 communication, consider the performance and condition of the computer and converter (such as USB-RS-485 converter).
(Some converters monitor communication status and switch transmission and reception with timer.)

■ Protocol selection (y10, y20)

Selects a communication protocol.

y10 and y20 data	Function
0	Modbus RTU protocol
1	FRENIC Loader protocol
2	Reserved for particular manufacturers
5	DCP protocol

y21 to y37	Built-in CANopen communication setting

For details, refer to the CAN Communication User's Manual.

■ Node-ID (y21)

Set the node-ID for CANopen communication. The setting range is 1 to 127.

■ Baud rate (y24)

Sets the transmission baud rate for CAN communication.

y24 data	Function
0	10 kbit/s
1	20 kbit/s
2	50 kbit/s
3	125 kbit/s
4	250 kbit/s
5	500 kbit/s
6	800 kbit/s
7	1 Mbit/s

■ User-defined I/O parameter 1 to 8 (y25-y32)

y25 to y28 : Sets the inverter function code (write) to be mapped to RPDO No.3

y29 to y32 : Sets the inverter function code (read) to be mapped to TPDO No.3

Specify the function code type and number in a 4-digit hexadecimal notation.

□ □ □ □

Function code No. (refer to the description of function code y37)
Function code type (see the table below)

Type	Group code	Type	Group code
S	0x02(2)	X1	0x1A(26)
M	0x03(3)	X2	0x1B(27)
F	0x04(4)	Z1	0x1C(28)
E	0x05(5)	K	0x1D(29)
C	0x06(6)	E1	0x1F(31)
P	0x07(7)	H1	0x20(32)
H	0x08(8)	U1	0x22(34)
L	0x0B(11)	M1	0x23(35)
U	0x0D(13)	U2	0x37(55)
y	0x0F(15)	L1	0x38(56)
W	0x10(16)	L2	0x39(57)
X	0x11(17)	L3	0x3A(58)
Z	0x12(18)	L4	0x3B(59)
W1	0x17(23)	L5	0x3C(60)
W2	0x18(24)	L6	0x3D(61)
W3	0x19(25)		

■ Operation selection (y33)

Sets the operation selection for CAN communication.

y33 data	Function
0	Disable
1	CANopen CiA 402 Enable

■ Communications error processing (y34)

Selects the behavior on CANopen communication error.

y34 data	Function
0	Set the motor immediately in coast-to-stop mode and trip by Ert alarm
1	Set the motor in coast-to-stop mode and trip by Ert alarm when the time set by y35 (Timer) has expired
2	Ignore the alarm condition if the communications link is restored within the timer value specified by y35. If the timer value is exceeded then set the motor in coast-to-stop mode and trip by Ert alarm
3 to 15	Same as y34=0

■ Communication time-out detection timer (y35)

Timer on CANopen communication error.

-Data setting range: 0.0 to 60.0 (s)

■ Operation selection in abort status (y36)

Selectthe operation at the time of communication abort occurs.

y36 data	Function
-5	Error (with NMT state check)
-4	Error (without NMT state check)
-3	No error (with NMT state check)
-2	No error (with NMT state check)
-1	Immediate error (with NMT state check)
0	No error
1	Immediate error (without NMT state check)
2	No error (without NMT state check)
3	No error (without NMT state check)

The possible causes of disconnection are:

(1) Bus-off (Error passive is not included)

(2) Guarding timeout detection

(3) Heartbeat timeout detection

(4) If the NMT state has changed from "Operational"

<table>
<tr><th colspan="2">y36</th><th rowspan="2">y34(y35)</th><th rowspan="2">Operation overview</th></tr>
<tr><th>factor (4)
without NMT state check</th><th>factor (4)
with NMT state check</th></tr>
<tr><td colspan="2">0</td><td>don’t care</td><td>No error</td></tr>
<tr><td>1</td><td>-1</td><td>don’t care</td><td>Immediate error</td></tr>
<tr><td>2</td><td>-2</td><td>don’t care</td><td>“Disable Voltage” command receiving operation
(No error)</td></tr>
<tr><td>3</td><td>-3</td><td>don’t care</td><td>“Quick stop” command receive operation
(No error)</td></tr>
<tr><td rowspan="3">-4</td><td rowspan="3">-5</td><td>1</td><td>Error after time set in y35 expires</td></tr>
<tr><td>2</td><td>The recovery within y35 secons : continue operation
y35 seconds exceeded : error</td></tr>
<tr><td>0, 3 to 15</td><td>Immediate error</td></tr>
</table>

■ Compatibility selection (y37)

Specifies CANopen behaviour as keeping compatibility with FRENIC-Lift (LM1).

To change the y37 data, it is necessary to press the STOP + ⌃ / ⌄ keys (simultaneous keying).
It will be applied after restarting CAN communication.

Behaviour	y37 = 0: Standard	y37 = 1: Compatible with LM1
Device type (0x1000) responses	0001 0192 (hex)	0000 0000 (hex)
Available PDOs	PDO1, PDO2, and PDO3 *PDO3 is configurable.	Only PDO1 *PDO1 is configurable.
Function code settings for PDO	ex. S01 = 0201 (hex)	ex. S01 = 0202 (hex)

y41 Setting method of speed command by communication

Specifies to use either speed command or acceleration command via RS-485 or CANopen communication.

y41 data	Function
0	Speed command (S01, S21)
1	Acceleration command (S16, S17)

y95 Communication data storage selection

If any of the communication error alarms (**Er8**, **ErP**, **Ert**) occurs in RS-485 or CANopen communication, the data of communication command function codes (S codes) can automatically be cleared.

Since the frequency and operation commands are also disabled when the data is cleared, the inverter does not start unintentionally when an alarm is released.

y95 data	Function
0	When a communication error alarm occurs, the function code Sxx data is not cleared (compatible with the conventional mode).
1	When a communication error alarm occurs, the function codes S01, S05 and S21 data is cleared.
2	When a communication error alarm occurs, the bits assigned in function code S06 for operation command are cleared.
3	Clear operations of 1 and 2 above are performed.

y97 Bus function (Mode selection) (Refer to H30)

The inverter memory (non-volatile memory) has a limited rewrite times (100 thousand to 1 million times). If the count immoderately increases, the data cannot be modified or saved, causing a memory error.

If the data should frequently be overwritten via communication, it can be written in the temporary memory instead of the non-volatile memory. This allows to reduce the rewrite times to the non-volatile memory, which can avoid a memory error.

If y97 is set to “2”, the data written in the temporary memory is stored (All Saved) in the non-volatile memory.

To change the y97 data, it is necessary to press the STOP + ∧ / ∨ keys (simultaneous keying).

y97 data	Function
0	Store into nonvolatile memory (Rewritable times are limited)
1	Write into temporary memory (Rewritable times are unlimited)
2	Store all data from temporary memory to nonvolatile memory (After storing all data, the y97 data returns to 1)

y99 Loader Link Function (Mode)

This is a link switching function for FRENIC Loader. Setting the function code data y99 with the loader enable the loader to issue control commands and/or run commands to the inverter. Since the data setting can be done with the loader, no keypad operation is required.

While the loader is selected as the source for the run command, if the PC runs out of control and cannot be stopped by a stop command sent from the loader, disconnect the RS485 communications cable from the loader's port, connect a keypad instead, and reset the y99 to "0." This makes that the control and run commands are generated according to function code H30 setting, as shown in the table below.

Note that the inverter cannot save the setting of y99. When the inverter is turned off, the data in y99 will revert to "0."

Data for y99	Function	
	Control command*	Run command
0	Follow H30	Follow H30
1	Via Loader	Follow H30
2	Follow H30	Via Loader
3	Via Loader	Via Loader

* Control command refers to a speed command or reference torque bias.

2.3.8 L codes (Lift functions)

L01 Pulse Encoder (Selection)

L01 specifies the specifications of a pulse encoder system to be used for speed detection.

Data for L01	Applicable encoder specifications		Required option	Applicable motor
	A/B phase output	Absolute signal spec.		
0	12/15V complementary 12,15V open collector	None	OPC-G1-PG OPC-PG3	Asynchronous motor
	5V line driver	None	OPC-G1-PG2 OPC-PMPG	
1	12/15V complementary	Z	OPC-G1-PG OPC-PG3	Synchronous motor
	5V line driver	Z	OPC-G1-PG2 OPC-PMPG	
4	Sinusoidal differential voltage 1 Vp-p	EnDat2.1 (HEIDENHAIN ECN1313 or its equivalent)	OPC-PS or OPC-PSH	Synchronous motor
5	Sinusoidal differential voltage 1 Vp-p	SIN/COS (HEIDENHAIN ERN1387 or its equivalent)	OPC-PR	Synchronous motor
6	Sinusoidal differential voltage 1 Vp-p	BiSS-C (Kubler Sendix5873 or its equivalent)	OPC-PS or OPC-PSH	Synchronous motor
7	Sinusoidal differential voltage 1 Vp-p	SSI (HEIDENHAIN ECN1313 or its equivalent)	OPC-PS or OPC-PSH	Synchronous motor
8	Sinusoidal differential voltage 1 Vp-p	Hiperface (SICK SRS50 or its equivalent)	OPC-PSH	Synchronous motor

L02 Pulse Encoder (Resolution)

L02 specifies the resolution of the pulse encoder to be used for speed detection.

Improper setting of the resolution causes an incorrect detection of the speed and magnet pole position, making accurate speed control and vector control impossible.

- Data setting range: 360 to 60000 (P/R)

L03 Magnetic Pole Position Offset (Tuning)

L04 Magnetic Pole Position Offset (Offset angle)

L03 specifies the tuning type of the magnetic pole position offset.

Data for L03	Function
0	Disable tuning
1	Reserved for particular manufacturers
3	Reserved for particular manufacturers
4	Enable tuning with motor stopped
5	Enable tuning with motor rotation

Before doing tuning, set up the following function code data.

Function code		Settings guideline
Rated speed	F03	Set the rated speed.
Base speed	F04	Set the base speed of the motor.
Rated voltage	F05	Set the rated voltage of the motor.
Control mode	F42	Set 1.
Motor (No. of poles)	P01	Set the number of poles of the motor.
Motor (Rated capacity)	P02	Set the rated capacity of the motor.
Motor (Rated current)	P03	Set the rated current of the motor.
Motor (%R1)	P07	Set 5%.
Motor (%X)	P08	Unused.
Pulse encoder (Selection)	L01	Set the value according to applied option card and encoder.
Pulse encoder (Resolution)	L02	Set the number of pulses per revolution of the encoder mounted on the motor.
Magnetic pole position offset (Offset angle)	L04	Perform tuning of the magnetic pole position offset. The tuning result is automatically written onto L04 data.
ASR (P constant at high speed)	L36	Set 2.00 or less to run the motor without load.
ASR (P constant at low speed)	L38	Set 2.00 or less to run the motor without load.

When the target motor is of a synchronous motor, complete the wiring between the inverter, motor, and encoder before doing tuning.

Tuning procedure when L03 = "4: Tuning with motor stopped"

(1) Specify the rated speed (F03), base speed (F04), rated voltage (F05), control mode (F42), no. of poles (P01), rated capacity (P02), rated current (P03), %R1 (P07), %X (P08), pulse encoder selection (L01), resolution (L02), ASR P constant at high speed (L36) and ASR P constant at low speed (L38) to match the motor and pulse encoder specifications.

(2) Set function code L03 to "4". When a run command is set, tuning starts.

After tuning, the tuning result is written into L04 data. After tuning, the L03 data will be automatically reset to 0.

(3) Enter run forward and run reverse commands to run the motor at the low speed at least one rotation in the forward and reverse directions, respectively. (Note 1)

(4) Turn the power off and then turn it on again to confirm that the motor runs normally. (Note 2)

Note 1: If the motor fails to run normally, the A and B phases of the pulse encoder may be mistakenly connected in wiring. Once shut down the power and correct the wiring of the A and B phases. After parameter-tuning of the motor, do tuning again with the procedure above.

Note 2: If the motor fails to run normally, the wiring of the magnetic pole position detection signals may be wrong. Correct the wiring.

For details, refer to the instruction manual of the corresponding option card.

L05 ACR P constant

L06 ACR I constant

When a synchronous and induction motor is used, P constant and I constant of ACR (Automatic Current Regulator) are set by parameters L05 and L06 respectively.

- Data setting range (L05): 0.0 to 15.0

- Data setting range (L06): 0.01 to 5.00 (ms)

L07 Automatic pole tuning selection

The automatic magnetic pole position tuning operates before it begins to drive when the magnetic pole position is unknown due to power shutdown or other causes.

For instance, the magnetic pole position is unknown immediately after turning ON the power supply when a synchronous motor is driven by using the encoder of an ABZ type encoder (L01=1). Therefore, before the first operation after power ON the magnetic pole position tuning is automatically performed. After completing successfully the pole tuning, it begins to drive. In second operation or following, because the magnetic pole position has been correctly detected, the magnetic pole position tuning is not done.

Data for L07	Function
0	The automatic magnetic pole position tuning doesn't operate. The tuning is activated by input terminal (configured to ***PPT***) operates in mode L03=4, and operation changes according to of the setting of L99 bit1.
1 to 4	The automatic magnetic pole position tuning operates. The tuning activated by input terminal (configured to ***PPT***) operates according to the mode set in L07. L99 bit1 setting is not effective.

Refer to the explanation of ***PPT*** for details.

Note: When the function of the automatic magnetic pole position tuning is set to be effective, L04 is not used as a magnetic pole position offset.

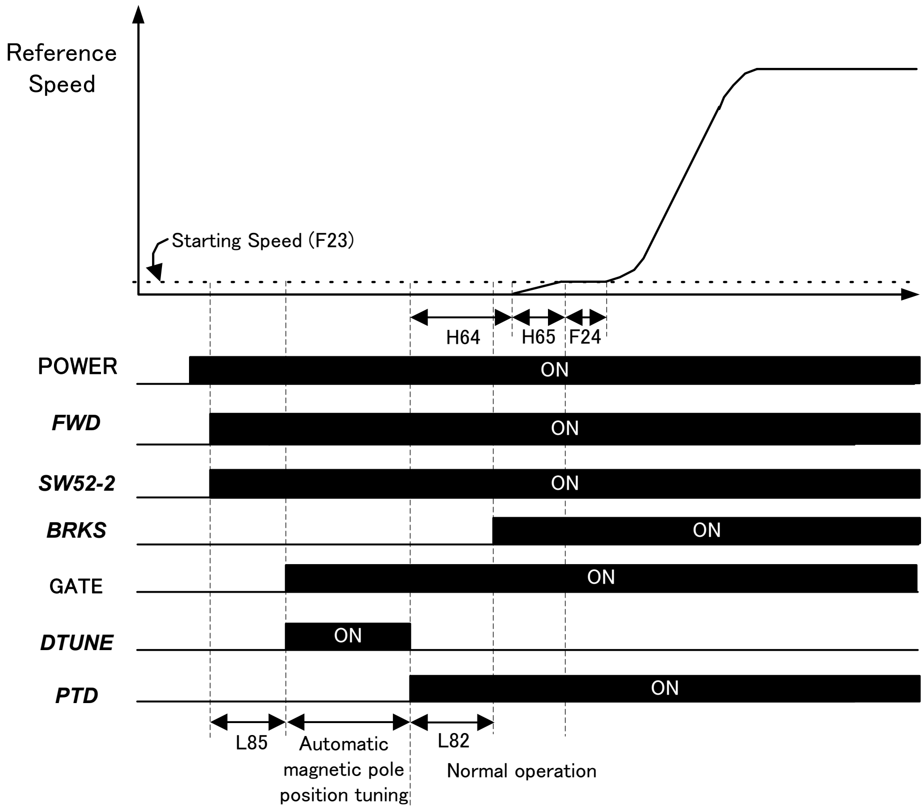
Tip: When the function of the automatic magnetic pole position tuning is set to be effective, the used magnetic pole position offset in this mode is confirmed by function code M58.

If L07 is not 0 and the following conditions are satisfied, the magnetic pole position tuning is automatically executed when operation command is turned ON.

- ***PTD*** is OFF. (The magnetic pole position tuning has not been performed.)
- ***EN*** terminal is ON
- The PG vector control for PMSM is selected.
  F42 is 1 and ***PG/Hz*** is ON. (When this terminal is assigned.)
- Pulse encoder (selection) is selected according to PMSM and option. (L01 = 1, 2, 3, 4, 5)
- DC bus voltage (Edc) is higher than the under voltage level.

Refer to the explanation of ***PTD*** for details.

Operation example



The magnetic pole position tuning operates when providing the first operation command after turning ON the inverter control power supply. The magnetic pole position tuning doesn't operate when providing second and following operation commands.

⚠CAUTION
The validation test must be done for every type of motor to use with this function. After that use this function with the settings with which the tuning result becomes always correct. Please use ***BRKS*** so as not to open the mechanical brake during the automatic magnetic pole position tuning. When you do not use ***BRKS***, make an interlock to prevent opening the mechanical brake when ***PTD*** is OFF. When using battery operation, keep the magnetic pole position value during power failure by supplying the control power from UPS or equivalent, because tuning is impossible in battery operation. When this function is used, the operation start timing is different between the first operation after turning on the power supply and second operation or following. Understand this notice sufficiently and consider when designing the system (like the elevator controller, etc.). ***PPT*** terminal tuning operates according to the mode set in L07. **Not doing so could cause an accident or injuries.**

L09 — Filter Time Constant for Reference Speed (Final)

L09 specifies the filter time constant for the reference speed (final) to be applied after the S-curve ramp control, which reduces an impact produced at rapid acceleration/deceleration.

- Data setting range: 0.000 to 0.100 (s)

L10 — Filter Time Constant for Detected Speed

L10 specifies the filter time constant for the detected speed.

- Data setting range: 0.000 to 0.100 (s)

L11 to L18 — Multistep Speed Command Combination (Zero Speed to High Speed)

F01 (Speed Command)

L11 to L18 assign the combination of commands ***SS1***, ***SS2*** and ***SS4*** (configured to general-purpose input terminals) to the multistep speed commands, zero speed (C04) to high speed (C11).

- Data setting range: 00000000_b to 00000111_b

📖 Refer to the description of function code F01 for details.

L19 to L28 — S-curve Setting 1 to 10

F01 (Speed Command)

L19 to L28 specify S-curve zones of the acceleration/deceleration to be applied when using multistep speed commands.

The setting values are indicated in percentage to the maximum speed.

- Data setting range: 0 to 50 (%)

📖 Refer to the description of function code F01 for details.

L29 — Short Floor Operation (Holding time)

L30 — Short Floor Operation (Allowable speed)

L29 and L30 specify a short floor operation that applies when a deceleration command is entered during acceleration in a multistep speed operation in order to shorten the creep time.

The short floor operation can be also used for resetting elevators.

There are two kinds of short Floor operation (Mode1: Normal Short Floor Operation and Mode2: Short Floor Operation with distance control). The explanation of Mode1 is described below.

📖 Refer to the description of function code L99 for the method of changing short floor operation and the explanation of Mode2.

■ Short floor operation holding time (L29)

L29 specifies the holding time of short floor operation. The holding time starts to count when the speed becomes constant.

- Data setting range: OFF, 0.00 to 10.00 (s)

■ Allowable speed (L30)

L30 specifies the allowable speed, below which the short floor operation can be activated.

When the motor is running at the speed less than the one specified by L30 during acceleration in a multistep speed operation, entering a deceleration command activates the short floor operation.

- Data setting range: 0.00 to 6000 (r/min)

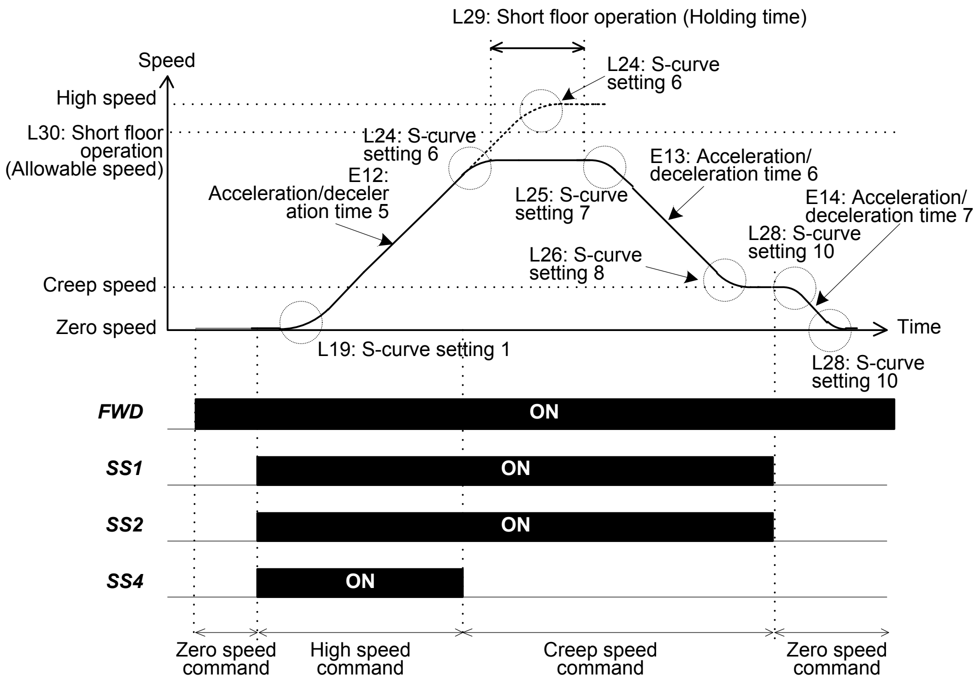
📖 Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

In case of Reference speed (final) < Allowable speed (L30) when a deceleration command is entered and L29≠OFF

(1) Upon receipt of a deceleration command, an S-curve operation starts for finishing the current acceleration.

(2) After completion of the S-curve operation, reached speed is hold during L29 time.

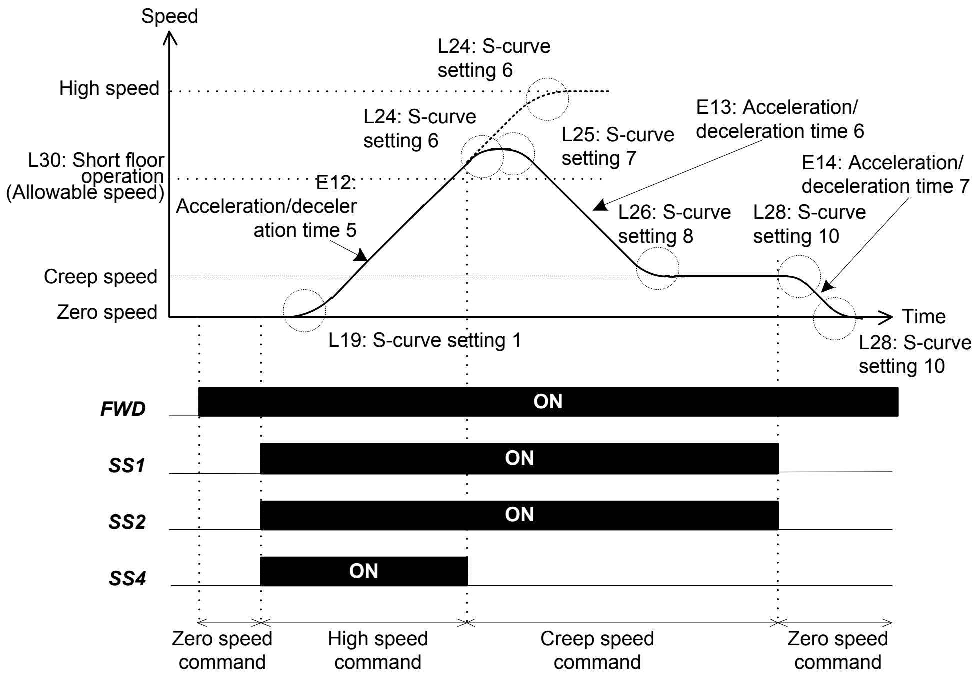
(3) The inverter decelerates the motor to creep speed in the specified S-curves and ramp.



In case of Reference speed (final) ≥ Allowable speed (L30) and Holding time (L29) ≠ OFF when a deceleration command is entered

(1) Upon receipt of a deceleration command, an S-curve operation starts for finishing the current acceleration.

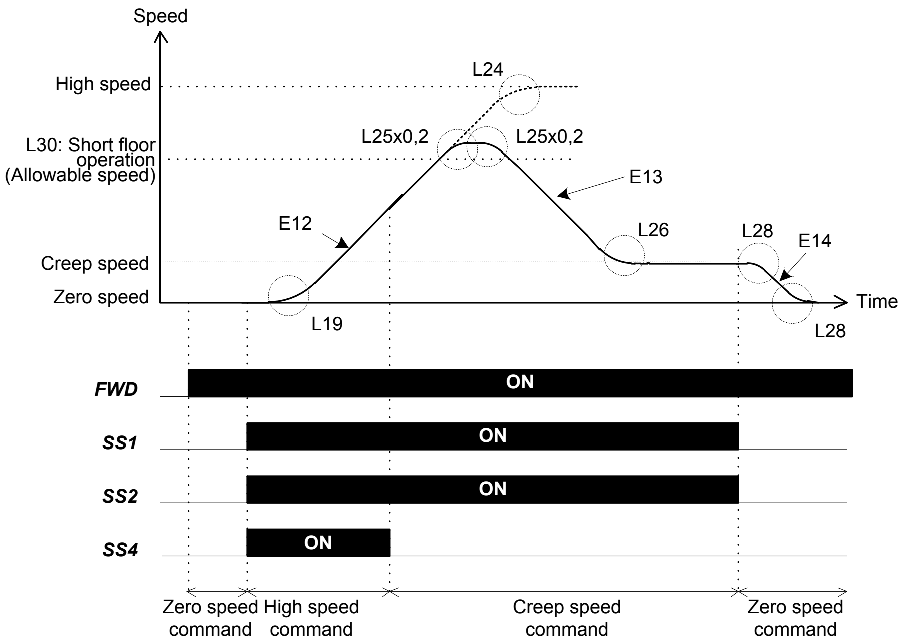
(2) After completion of the S-curve operation, the inverter decelerates the motor to creep speed in the specified S-curves and ramp.



In case of Reference speed (final) < Allowable speed (L30) and Holding time (L29) = OFF when a deceleration command is entered

(1) Upon receipt of a deceleration command, an S-curve operation with L25×0.2 starts for finishing the current acceleration after L30 allowable speed is reached.

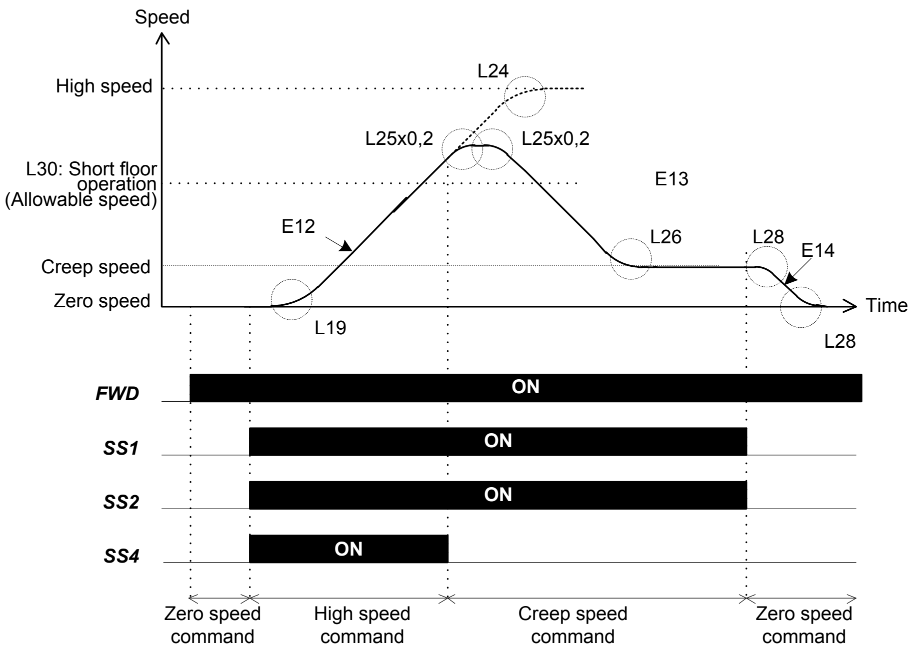
(2) After completion of the S-curve operation, the inverter decelerates in an S-curve operation with L25×0.2 to the creep speed.



In case of Reference speed (final) ≧ Allowable speed (L30) and Holding time (L29) = OFF when a deceleration command is entered

(1) Upon receipt of a deceleration command, an S-curve operation with L25×0.2 starts for finishing the current acceleration.

(2) After completion of the S-curve operation, the inverter decelerates in an S-curve operation with L25×0.2 to the creep speed.



L31	Elevator Parameter (Speed)

L31 specifies the elevator speed (mm/s) relative to the inverter's rated speed (F03).

The elevator speed (L31) can be calculated with the following equation.

L31 = Maximum speed (r/min) / Detected speed (r/min) × Elevator rated speed (mm/s)

(Example) If the elevator rated speed is 750 mm/s, the detected speed is 1350 r/min, and the maximum speed is 1800 r/min:

L31 = 1800/1350 x 750 = 1000 (mm/s)

- Data setting range: 1 to 4000 (mm/s)

Note: Changing the elevator parameter (L31) requires modifying the data of other function codes. Refer to section 2.2.

L32	Elevator Parameter (Over speed protection level)

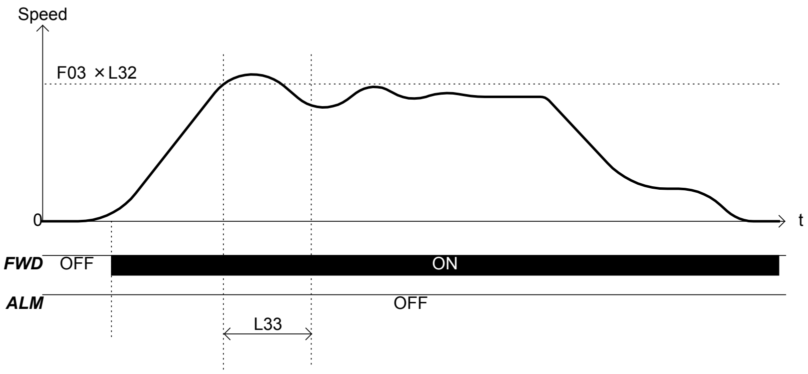
L32 specifies over speed protection level. If the speed of motor exceeds the over speed protection level for a duration longer than the time set in L33, inverter will stop. When there is no L32, protection level is constant 120%.

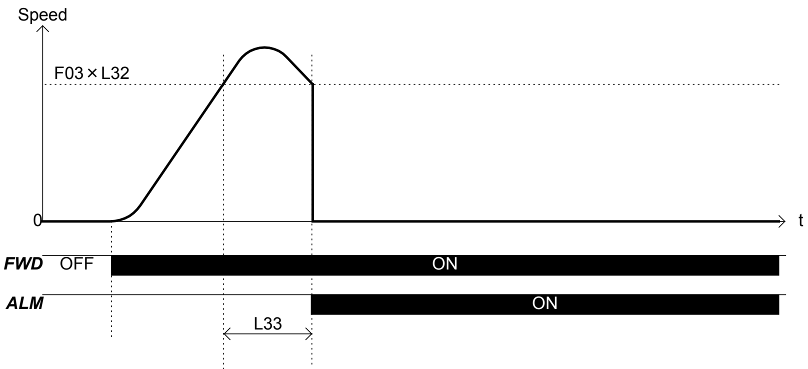
- Data setting range: 50 to 120 (%) (100%: setting value of max speed)

L33	Elevator Parameter (Over speed timer)

Over speed timer (L33) starts when the detection speed exceeds over speed level (L32). After the timer ends, the inverter stops. When the detection speed decreases less than over speed level while the timer works, the timer is reset and the inverter doesn't stop.

- Data setting range: 0.000 to 0.500(s)





L34	Elevator Parameter (Moving distance in creepless operation)

L34 specifies the moving distance of an elevator car in a creepless operation from its start to end.

- Data setting range: 0.0 to 6553.5 (mm)

Creepless operation

If creepless operation is set with the function codes listed below, the inverter receives the landing reference position of the elevator car by an external command, and generates a speed command profile so that the car travels the distance specified by L34 from the reference position to land the car in the correct position.

Accordingly, the creepless operation eliminates the creep required for general elevator control, reducing the landing time duration.

Function code	Name	Data setting range	Unit	Function
E01 to E08	Command assignment to terminals [X1] to [X8]	64: Start creepless operation ***CRPLS***	--	Turning the associated terminal ON starts creepless operation.
L31	Elevator speed	1 to 4000	mm/s	This code specifies the elevator speed relative to the inverter's maximum speed.
L34	Moving distance in creepless operation	0.0 to 6553.5	mm	This code specifies the moving distance of an elevator cage in a creepless operation from its start to end.

Requirements for creepless operation

(1) The elevator system should be equipped with a device that accurately detects the position of an elevator cage, or its equivalent device.

(2) The elevator system should be capable of applying signals issued from the detector (stated in (1) above) to the inverter as a "Start creepless operation" command ***CRPLS*** or be capable of modifying speed commands (except zero speed) to zero speed command.

(3) During deceleration, that is, after the start of deceleration, the signal stated in (2) above can be applied to the inverter.

(4) The moving distance from the start of a creepless operation should be 6553.5 mm or less.

(5) The elevator speed calculated for L31 should be 4000 mm/s or below.

(6) A multistep speed command with S-curve operation should apply for speed control.

Deceleration point programming and moving distance

Creepless operation requires accurately programming the position of a deceleration point. Given below is a programming method using the calculation result of the moving distance from the start of deceleration to a stop.

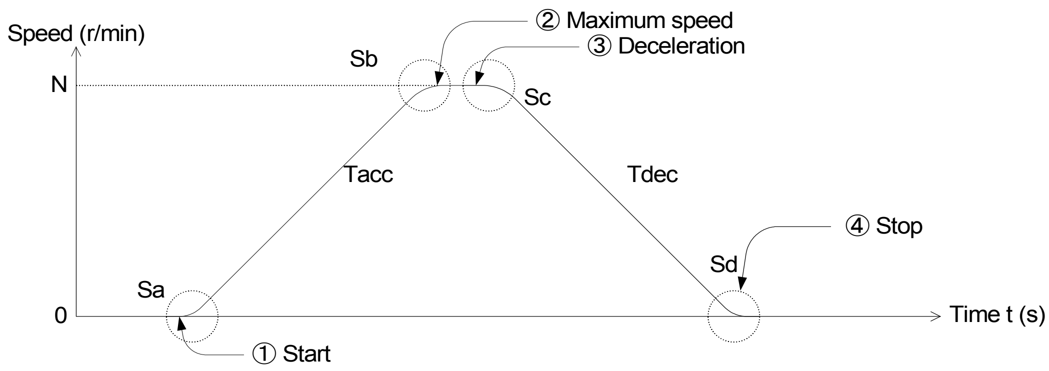
The moving distance from "③ Deceleration" to "④ Stop" in the speed pattern shown below is given by the following equation. Note that N should be equal to or greater than the S-curve zone (N ≥ F03 x (Sc/100 + Sd/100).

$$L = C \times V\max \times Tdec \qquad \textbf{Equation 1}$$

$$C = \frac{1}{2} \times \left(\frac{N}{N\max} \right)^2 + \frac{Sc}{100} \times \left(\frac{N}{N\max} \right) + \left(\frac{Sd^2 - Sc^2}{60} \right) \qquad \textbf{Equation 2}$$

Where

Vmax: Elevator speed (L31) (mm/s)
Nmax: Motor's rated speed (F03) (r/min)
N: Motor speed at the start of deceleration (r/min)
Tdec: Deceleration time specified (s)
Sc, Sd: S-curve zone specified (%)



The elevator cage moves by distance "L" calculated by equations 1 and 2 when the elevator decelerates from speed "N" during deceleration period "Tdec" within S-curve zone from "Sc" to "Sd," provided that no speed error exists in inverter control. The deceleration point, therefore, should be distance "L" or more before the stop position.

Conditions required for starting a creepless operation

When all of the following three conditions are met, a creepless operation starts.

(1) A creepless operation command is entered.

That is,

- The ***CRPLS*** command is turned ON when the ***CRPLS*** is assigned to a terminal.
- Any speed command (except zero speed) is changed to zero speed command when the ***CRPLS*** is not assigned to any terminal.

(2) The reference speed (pre-ramp) is 0.00 r/min.

(3) The remaining moving distance (the internally calculated moving distance from the start of a creepless operation) is nonzero.

Restrictions on creepless operation

(1) The acceleration commanded during a creepless operation will not exceed the specified acceleration.

(2) Do not change the reference speed (pre-ramp) during a creepless operation.

(3) After the end of running (including the end of operation due to the protective function triggered and a coast-to-run command received), turn the ***CRPLS*** command OFF.

(4) In any of the following cases, the creepless operation is forcedly terminated.

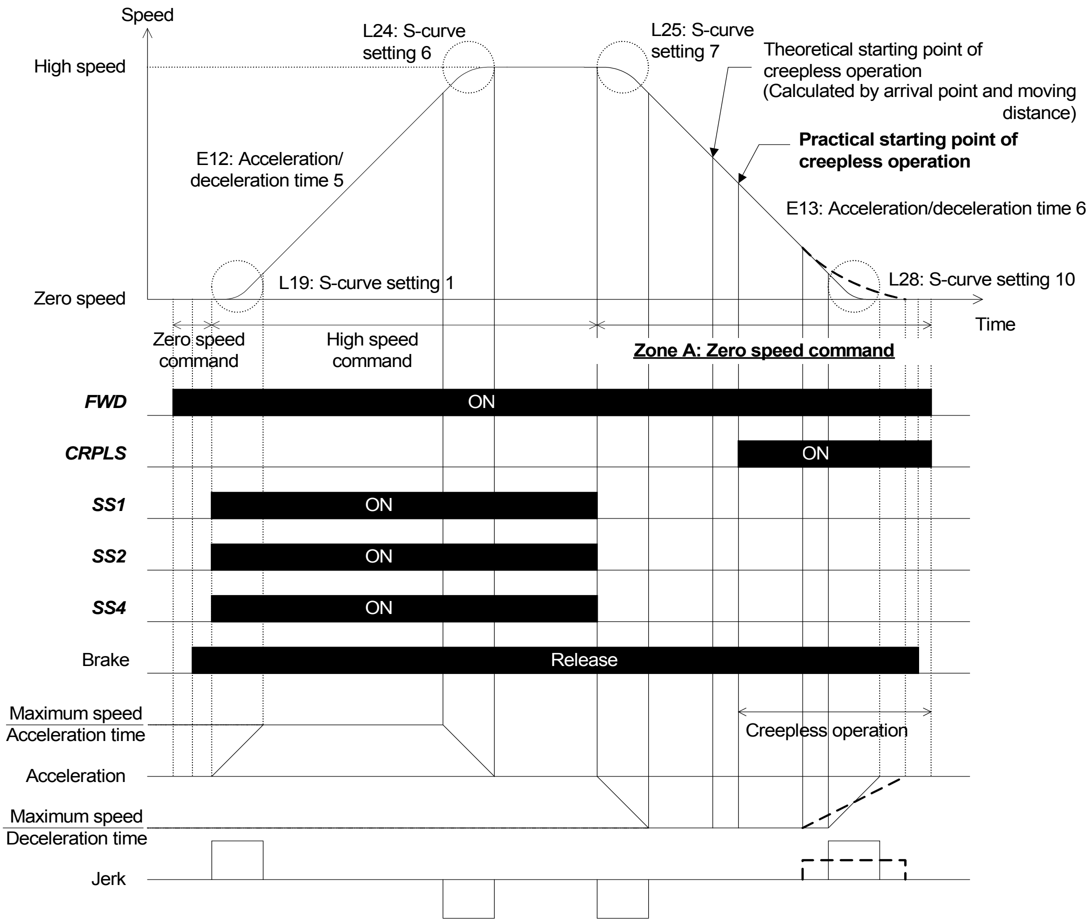
- Such a speed pattern that the speed does not reach 0 after the elevator cage moves the specified moving distance.
- Reference speed (pre-ramp) is nonzero.
- Run command is OFF.

After the forced termination, the inverter continues to run with the speed control not involving a creepless operation. No protective function (trip) works. No further creepless operation takes place until the inverter stops.

Input timing of a creepless operation command

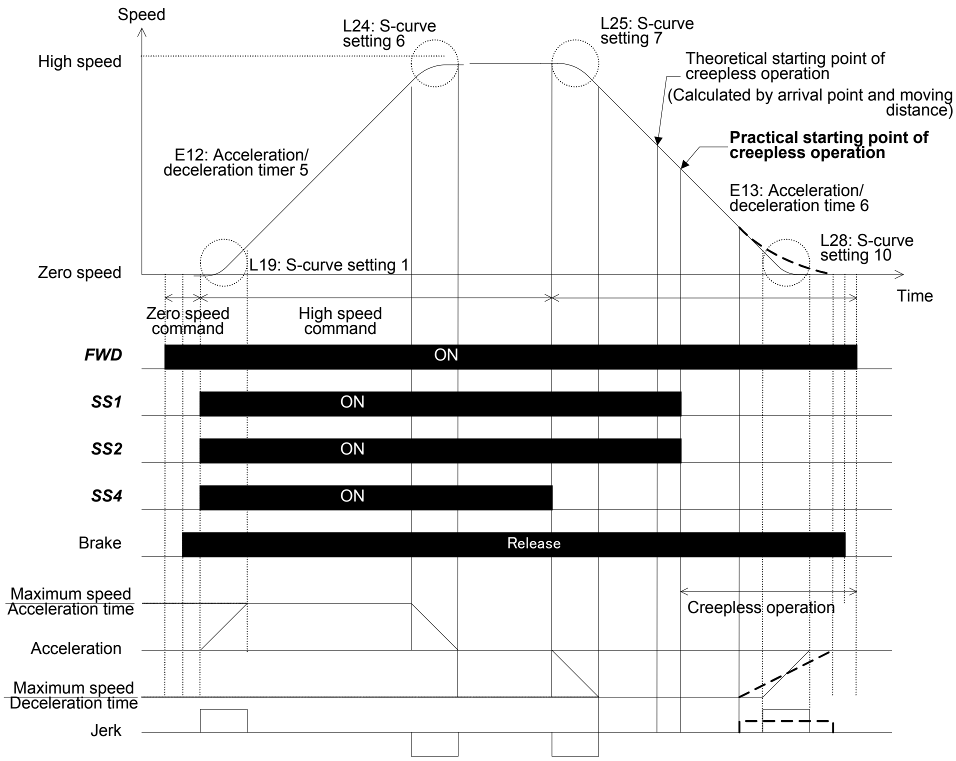
The graph below shows a basic pattern of a creepless operation using the "Start creepless operation" command ***CRPLS***. The ***CRPLS*** command should be given within zone "A" ranging from the end to the start of deceleration.

The following example shows deceleration from high speed to zero speed. The waveforms drawn with broken lines show the speed, acceleration and jerk applied when the ***CRPLS*** command is given earlier than the ones drawn with full lines.



Example of Creepless Operation with ***CRPLS***

The graph below shows a creepless operation applied when no ***CRPLS*** is assigned. Both the creep speed (C07) and zero speed (C04) are set to 0.00 r/min. To prevent any impact to the load, when the speed changes to zero speed from any other speed, the speed control should be programmed so that the acceleration/deceleration time and S-curve zone will not change.



Example of Creepless Operation without ***CRPLS***

<u>Improving the landing position accuracy in a creepless operation</u>

Observing the following rules improves the landing position accuracy (including the repeatability) in a creepless operation.

(1) When using a multistep speed command to change the reference speed (pre-ramp) to zero speed, lessen the number of terminals which should be switched.

Changing the setting of only a single terminal for changing the reference speed (pre-ramp) can suppress the fluctuation of signals issued from the host controller, improving the stopping accuracy. For that purpose, use L11 (Zero speed) to L18 (High speed).

(2) Use the multistep speed command agreement timer (E19) for multistep speed commands.

(3) Specify the filter time constant for reference speed (final) (L09) as small as possible. It is, however, not necessary to specify the value smaller than the factory default.

Increasing the filter time constant makes the actual moving distance to a stop longer than the one specified by L34 (Moving distance in creepless operation). If such is necessary, therefore, increase the L34 data to adjust the landing position. In this case, it is difficult to calculate the moving distance with Equations 1 and 2 given in "Deceleration point programming and moving distance." Tune-up with the actual elevator is required.

(4) Increase the ASR gain.

In a creepless operation, keeping "Reference speed (final) = Detected speed" is ideal. It is, therefore, necessary to increase the ASR gains to the extent that no hunting occurs, by setting L36 to L42.

(5) Widen the S-curve zone at the start of deceleration.

With the same reason as stated in (4) above, to suppress the speed difference at the start of deceleration, it is recommended that the S-curve zone be set to 20% or more to the deceleration sequence.

Notes for accurate landing in a creepless operation

(1) Even if a creepless operation is programmed in accordance with the instructions given on the previous pages, the landing position may not be level with the floor. If it happens, use L34 to adjust the moving distance.

(2) The moving distance accuracy in a creepless operation is not guaranteed since it has a relationship with the elevator speed.

The speed control accuracy is the maximum speed -0.01 to 0.01%. Use the accuracy as a guide in programming the creepless operation.

(3) If it is not possible to accurately set the elevator speed (L31) (e.g., elevator specifications having decimal fractions), any error will be produced between the actual moving distance and internally calculated one. If it happens, use L34 to adjust the moving distance so that the landing position comes to be level.

L36	**ASR (P constant at high speed)**
L37	**ASR (I constant at high speed)**
L38	**ASR (P constant at low speed)**
L39	**ASR (I constant at low speed)**
L40	**ASR (Switching speed 1)**
L41	**ASR (Switching speed 2)**

L36 through L39 specify the P and I constants each at high and low speed of the auto speed regulator (ASR). High and low speeds can be switched according to the ASR switching speeds 1 and 2 (L40 and L41).

For details about the ASR switching speed, refer to the descriptions of L40 and L41.

■ **ASR P constant (L36 and L38)**

The P constant should be specified in proportion to the inertia and machine constants of the load connected to the motor shaft.

If P constant = 1.00, it means that the reference torque comes to be 100% (of the rated torque output of each inverter capacity) when the speed difference (Reference speed (final) - Detected speed) is 100% (equivalent to the maximum speed setting).

- Data setting range: 0.01 to 200.00

Note: Increasing the P constant relative to the inertia makes response from machinery or equipment fast but may cause overshooting or hunting in motor. Further, due to resonance of machinery or overamplified noise, machinery or motor may produce vibration noise.

On the contrary, decreasing the P constant excessively delays response and may cause speed fluctuation in a long cycle, taking time to stabilize the speed.

■ **ASR I constant (L37 and L39)**

The integral constant for the ASR should be specified by the I constant. Since the integration refers to integrating of deviation at the interval of time specified by I constant, setting a small constant shortens the integration interval, making a faster response. On the contrary, setting a large constant lengthens it, having a less effect on the ASR.

To allow overshooting and reach the target speed quickly, specify a small constant.

- Data setting range: 0.001 to 1.000 (s)

Note An integral action refers to a delay component. The integral constant is the gain of the delay component. Making the integral action highly responsive increases the delay component, unstabilizing the control system including the motor and machinery. It takes the form of overshooting or vibration.

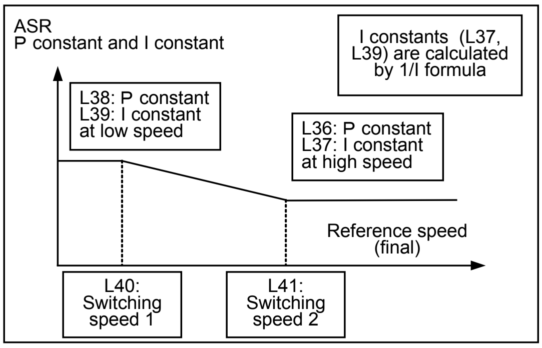
One solution for the resonance of machinery generating abnormal mechanical noise from the motor or gears is to increase the integral constant. If there is a requirement to not delay response from machinery or equipment, examine the machinery causing the resonance and take any necessary measures at the machinery side.

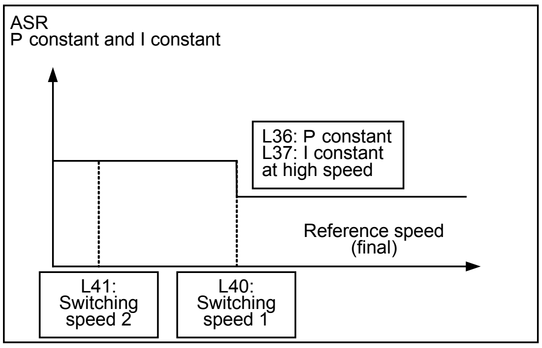
■ASR switching speeds (L40 and L41)

L40 and L41 specify the speed at which the P and I constants to be applied are switched between the ones for high speed (L36 and L37) and the ones for low speed (L38 and L39). The switching pattern samples are shown below.

Note that if L41 ≤ L40, the P and I constants are switched to the ones for high speed when the switching speed specified by L40 is lower than the reference speed (final).

- Data setting range: 0.00 to 6000 (r/min)





L42	ASR (Feed forward gain)

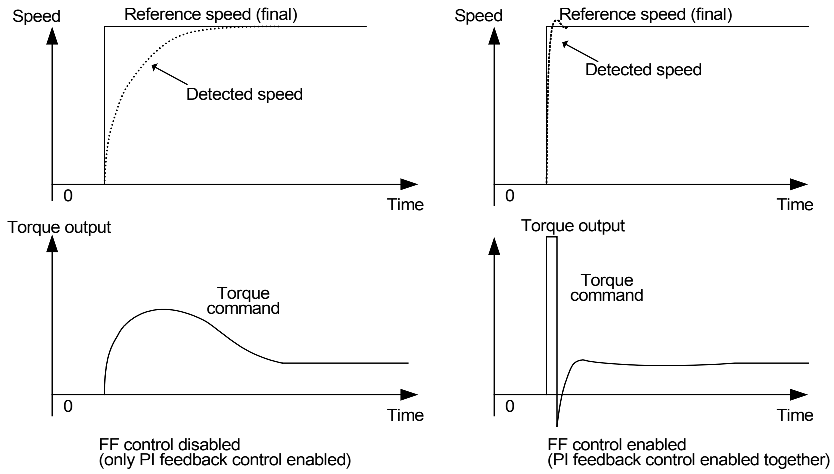
The FRENIC-Lift (LM2A) series of inverters supports the feed forward control that directly adds to reference torque a torque value determined by derivation of the reference speed (final).

- Data setting range: 0.000 to 10.000 (s)

The PI control of the ASR is a feedback control. It monitors the result (detected speed) of the target operation and deals with any deviation from the desired operation (reference speed (pre-ramp)) for correction (for following the reference speed (pre-ramp)). The merit of this control is that it can make corrections even for factors not directly measurable such as not measurable disturbance and uncertainty of the control target. The demerit is that the control makes follow-up corrections after detecting any deviation (reference speed (final) - detected speed) even for foreknown changes.

Since the operation quantity (reference torque) for foreknown factors can be obtained beforehand, adding the quantity to the reference torque directly, the feed forward control can provide a highly responsive control.

When the load inertia is foreknown, the feed forward control is effective. As shown on the next page, the follow-up speed from the detected speed to the reference one is definitely different depending upon whether the feed forward control is disabled or enabled. To get the maximal effect, it is necessary to well balance the feed forward gain (L42) with the P and I constants (L36 to L39) of the ASR.



The effect above can be obtained also by adjusting the P and I constants to speed up the response, but it involves any demerits such as resonance of machinery and vibration noise.

L49	Vibration Suppression Observer (Gain)
L50	Vibration Suppression Observer (Integral time)
L51	Vibration Suppression Observer (Load inertia)

L49 through L51 specify the mechanical inertia for the vibration suppression observer. The observer runs the simulation model inside the inverter, estimates a load torque (that can be a vibration element), and applies it to the reference torque for canceling the load torque. This way the observer quickly attenuates the vibration caused by resonance of machinery.

■ Gain (L49)

L49 specifies the compensation gain for the vibration suppression observer. Setting 0.00 disables the observer.

Usually set the gain within the range from 0.00 to 0.50.

- Data setting range: 0.00 (Disable)
  0.01 to 1.00

■ Integral time (L50)

L50 specifies the integral time of the observer. No change is required except special cases.

- Data setting range: 0.005 to 1.000 (s)

■ Load inertia (L51)

L51 specifies the moment of inertia of the load. After converting the moment of inertia of the motor and traction machine for the motor shaft, use the value.

- Data setting range: 0.01 to 655.35 (kgm^2)

L52	Start Control Mode	F23 (Starting Speed)

L52 specifies the start control mode.

Data for L52	Function
0	Enable speed start mode.
1	Enable torque start mode.

For details, refer to the description of F23.

L54	Torque Bias (Mode)	L58 (Torque Bias, P constant) L59 (Torque Bias, I constant) L60 (Torque Bias, Driving gain) L61 (Torque Bias, Braking gain) L62 (Torque Bias, Digital 1) L63 (Torque Bias, Digital 2) L64 (Torque Bias, Digital 3)

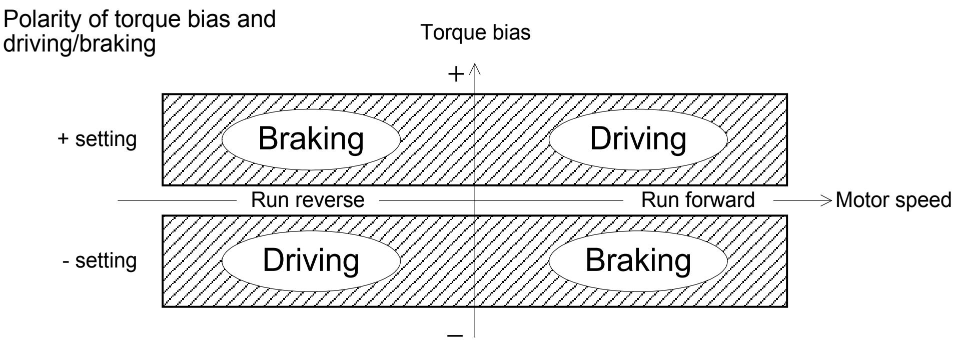
L54 specifies whether to use analog or digital torque bias.

Data for L54	Function
0	Enable analog torque bias.
1	Enable digital torque bias.
2	Enable PI torque bias
3	Enable DCP torque bias

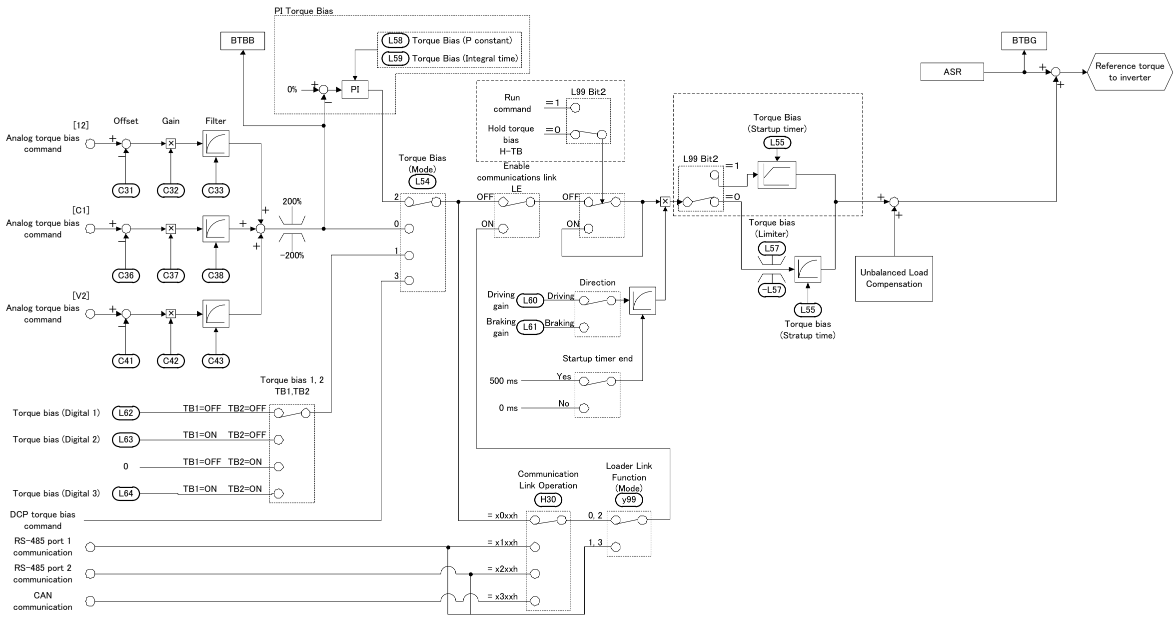
■ Torque Bias (L54)

The torque bias control outputs torque in advance corresponding to the applied load in order to reduce the impact when the brake is released.

A torque bias can be specified either by analog or digital input



In the figure shown above, when viewed from the motor shaft, the counterclockwise rotation means the forward direction, and the clockwise rotation, the reverse direction. A positive torque bias (+) corresponds to forward direction torque.



Block Diagram of Torque Bias Generator

Analog torque bias (L54 = 0)

Setting L54 data to "0" enables torque bias setting with analog input.

When L54 = 0, assigning a reference torque bias to terminals [12] and [V2] (V2 function) (by function codes E61 and E63) allows to input a torque bias with analog voltage input, and assigning it to terminal [V2] (C1 function) (by E62), allows to input a torque bias with analog current input. If no reference torque bias is assigned to any of terminals [12] and [V2], the analog torque bias is 0 (%).

Terminal commands ***TB1*** and ***TB2*** assigned to the general-purpose, programmable input terminals (by function codes E01 to E08, E98 and E99) are ignored.

When an analog torque bias is specified, adjust the gain with L60 (Driving gain) and L61 (Braking gain). If L60 (L61) = 100%, analog input voltage -10 to +10 VDC corresponds to -100 to +100% of the motor rated torque and analog input current 4 to 20 mA corresponds to 0 to 100% of the motor rated torque, assuming that gain and offset of the analog inputs are set to 100% and 0% respectively).

- Balancing

With the elevator being balanced (same load as the counterweight), adjust a torque bias amount to 0% relative to the input voltage of the load sensor. This adjustment should be made when the elevator is stationary with balanced load and the brake applied.

Setting E43 data (LED monitor) to "19" monitors the torque bias balance adjustment value (BTBB) on the LED monitor. For the multi-function keypad, press the SET key in Running mode and select a target monitor item. Adjust the balance by adjusting the analog input offset with C31 ([12]), C36 ([V2] (C1 function)) or C41 ([V2] (V2 function)) so that the monitored data comes to 0 (%). The monitored data shows the ratio to the motor rating torque in percentages.

- Gain adjustment

(1) The gain adjustment should follow the balance adjustment. Before proceeding to the gain adjustment, set analog input with C32 ([12]), C37 ([V2] (C1 function)), or C42 ([V2] (V2 function)) to 100 (%).

(2) According to the table below, determine the initial values of the gains at the driving and braking sides (L60 and L61).

<table>
<tr><th rowspan="2">Motor rotational direction when the elevator lifts up</th><th rowspan="2">When the load increases, the analog voltage/current input (load sensor) will:</th><th rowspan="2">Initial values of L60 and L61 data</th><th colspan="2">Function codes to be set with no load</th></tr>
<tr><th>UP</th><th>DOWN</th></tr>
<tr><td rowspan="2">Forward</td><td>Increase</td><td>+100 (%)</td><td rowspan="2">L61</td><td rowspan="2">L60</td></tr>
<tr><td>Decrease</td><td>-100 (%)</td></tr>
<tr><td rowspan="2">Reverse</td><td>Increase</td><td>-100 (%)</td><td rowspan="2">L60</td><td rowspan="2">L61</td></tr>
<tr><td>Decrease</td><td>+100 (%)</td></tr>
</table>

(3) Setting E43 data (LED monitor) to "20" monitors the torque bias gain adjustment value (BTBG) on the LED monitor. For the multi-function keypad, press the SET key in Running mode and select a target monitor item.

(4) With no load, run the elevator up at a speed of 2 to 10% of the elevator rated speed. Adjust L61 and L60 data in the forward and reverse direction, respectively, so that the monitored data comes to approximately 0 (%) when the speed is stabilized. (The monitored data shows the ratio to the motor rating torque in percentages.)

(5) With no load, run the elevator down at a speed of 2 to 10% of the elevator rated speed. Adjust L60 and L61 data in the forward and reverse direction, respectively, so that the monitored data comes to approximately 0 (%) when the speed is stabilized.

Note For torque bias setting with current input, the input current on terminal [V2] (C1 function) should be within the range from 4 to 20 mA when the elevator is with no load to the maximum load.

Digital torque bias (L54 = 1)

Setting L54 data to "1" enables torque bias setting with digital input.

When L54 = 1, setting "60" or "61" to any general-purpose, programmable input terminal (by function codes E01 to E08, E98 and E99) assigns command ***TB1*** or ***TB2***, respectively. If neither ***TB1*** nor ***TB2*** is assigned, the torque bias is 0 (%).

The table below shows the relationship between the ***TB1***/***TB2*** command settings and the torque bias value. If only either one of those commands is assigned, the unassigned terminal is regarded as OFF. L60 and L61 specify the gains at the driving and braking sides.

When the inverter is running, the reference torque bias should be held at the host controller side. Chattering of a reference torque bias during running will result in vibration.

If it is difficult to hold the reference torque bias at the host controller side, use a torque bias hold command and startup timer described in the description of L55 (Torque bias startup timer).

TB1	***TB2***	Torque bias value
OFF	OFF	Specified by L62 (Data setting range: -200 to 200 (%) with the forward direction torque as +)
ON	OFF	Specified by L63 (Data setting range: -200 to 200 (%) with the forward direction torque as +)
OFF	ON	0 (%) (No torque bias)
ON	ON	Specified by L64 (Data setting range: -200 to 200 (%) with the forward direction torque as +)

PI torque bias (L54 = 2)

Setting L54 data to "2" enables PI torque bias setting with analog input. A torque sensor is used for measuring braking torque, calculate torque bias by making the output of torque sensor become 0V before releasing brake. It is possible to adjust it by the following function codes.

■ Torque Bias (P constant) (L58)

Specify the P constant used in PI torque bias calculation.

- Data setting range: 0.01 to 10.00

■ Torque Bias (I constant) (L59)

Specify the I constant used in PI torque bias calculation.

- Data setting range: 0.00 to 1.00 (s)

DCP torque bias (L54 = 3)

Setting L54 data to "3" enables torque bias command from DCP protocol communication.

L55	Torque Bias (Startup time)

L55 specifies the startup time of the torque bias.

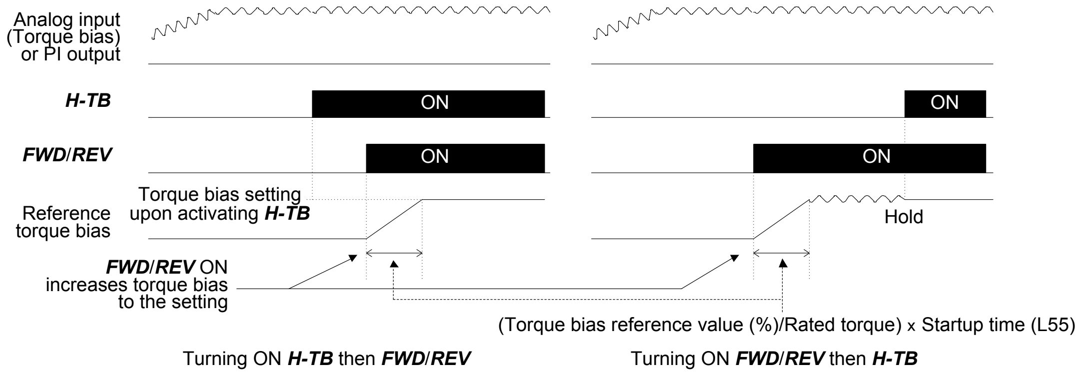
- Data setting range: 0.00 to 1.00 (s)

Terminal command "Hold torque bias" and startup time

Setting "62" to any general-purpose, programmable input terminal (by function codes E01 to E08, E98 and E99) assigns the ***H-TB*** command.

Turning the ***H-TB*** ON holds the reference torque bias; turning it OFF releases the hold.

When a run command ***FWD*** or ***REV*** is turned ON, the inverter increases the reference torque bias value to the specified torque bias in the time length proportional to L55. Note that L55 specifies the time length required from the start of running until the torque changes from 0 to 100% of the motor rated torque. Once the reference torque bias value reaches the specified one, the bias setting applies.



Note: When the PI torque bias (L54=2) is set, it is necessary to turn on the ***FWD*** or ***REV*** earlier than ***H-TB***.

L56	Torque Bias (Reference torque end time) L66 (Unbalanced Load Compensation, Activation time) L67 (Unbalanced Load Compensation, Holding time)

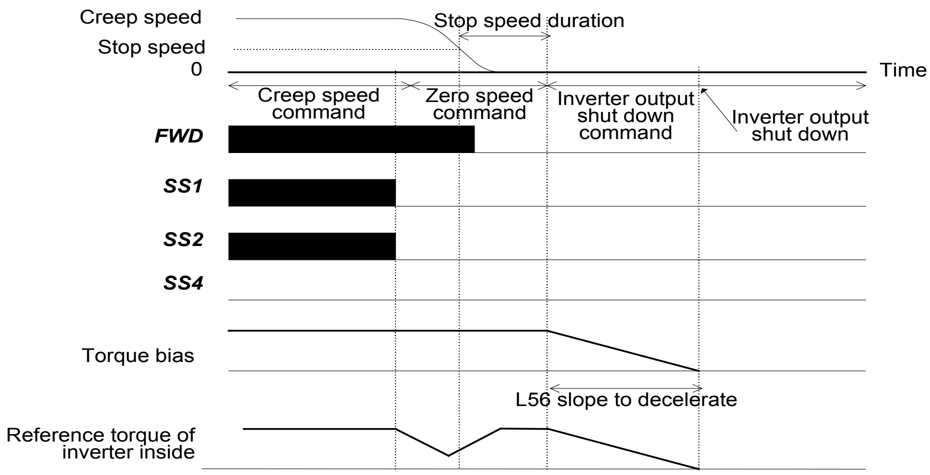
L56 sets up the reference torque end timer in speed control.

- Data setting range: 0.00 (Disable)
  0.01 to 20.00 (s)

In speed control

During the shutdown sequence in speed control, the inverter decreases the reference torque value held internally to 0, taking time proportional to the value set in L56.

Note that L56 sets the time length required to decrease the motor rated rating torque from 100 to 0%.



Reference Torque End Sequence in Speed Control

L57	Torque Bias (Limiter)

L57 specifies the maximum absolute value of a torque bias amount to be used after the driving or braking gain is applied, as a percentage to the rated torque. It limits the torque bias amount for protection against a load sensor defect or other failure.

- Data setting range: 0 to 200 (%)

L58	Torque Bias (P constant)	L54 (Torque Bias, Mode)

L58 specifies the P constant used in PI torque bias.

- Data setting range: 0.01 to 10.00

Refer to the description of function code L54 for details.

L59	Torque Bias (I constant)	L54 (Torque Bias, Mode)

L59 specifies the I constant used in PI torque bias.

- Data setting range: 0.00 to 1.00 (s)

Refer to the description of function code L54 for details.

L60	Torque Bias (Driving gain)	L54 (Torque Bias, Mode)
L61	Torque Bias (Braking gain)	L54 (Torque Bias, Mode)

L60 and L61 specify the gains of torque biases at the driving and braking sides, respectively, as a percentage to the rated torque.

- Data setting range: -1000.0 to 1000.0 (%)

Refer to the description of function code L54 for details.

L62	Torque Bias (Digital 1)	L54 (Torque Bias, Mode)
L63	Torque Bias (Digital 2)	L54 (Torque Bias, Mode)
L64	Torque Bias (Digital 3)	L54 (Torque Bias, Mode)

L62 to L64 specify digital torque bias amounts with the forward rotation direction torque as a positive value.

- Data setting range: -200 to 200 (%)

Refer to the description of function code L54 for details.

L65	Unbalanced Load Compensation (Operation) L66 (Activation timer) L67 (Holding time) L68 (ASR P constant) L69 (ASR I constant) L73 (APR P constant) L74 (APR D constant) L75 (Filter Time Constant for Detected Speed) L76 (ACR P constant) L134 Backlash (Delay Time)

L65 specifies whether to enable or disable the unbalanced load compensation.

Data for L65	Function
0	Disable the unbalanced load compensation.
1	Enable the unbalanced load compensation.
2	Enable the unbalanced load compensation (Backlash correction)

Unbalanced load compensation

This compensation function estimates an unbalanced load and calculates the required torque bias amount inside the inverter.

Setting "67" to any general-purpose, programmable input terminal (by function codes E01 to E08, E98 and E99) assigns the ***UNBL*** command. With the ***UNBL*** being assigned, entering a ***UNBL*** command following a run command starts estimating an unbalanced load. If no ***UNBL*** is assigned, entering a run command starts it.

Just as the torque bias function, this compensation function reduces an impact made when the brake is released even in elevator systems having no load sensors.

The table below lists function codes to be used in unbalanced load compensation.

Function code	Name	Setting required
E01 to E08, E98, and E99	Command assignment to terminals [X1] to [X8] Setting "67" assigns ***UNBL***.	Turn the ***UNBL*** ON to start estimating an unbalanced load (and start L66 and L67 timers). If no ***UNBL*** is assigned, turn a run command ON to start estimating an unbalanced load.
L66	Unbalanced load compensation (Activation timer)	Specifies the maximum time length for estimating an unbalanced load.
L68	Unbalanced load compensation (ASR P constant)	Specifies the ASR P constant used in unbalanced load calculation. If vibration occurs, decrease the constant.
L69	Unbalanced load compensation (ASR I constant)	Specifies the ASR I constant used in unbalanced load calculation. If vibration occurs, increase the constant.
L73	Unbalance load compensation (APR P constant)	Specifies the APR P constant used in unbalanced load calculation
L74	Unbalance load compensation (APR D constant)	Specifies the APR D constant used in unbalanced load calculation
L75	Unbalance load compensation (Filter Time Constant for Detected Speed)	Specifies the Filter time constant for detected speed used in unbalanced load calculation
L76	Unbalance load compensation (ACR P constant)	Specifies the ACR P constant used in unbalanced load calculation

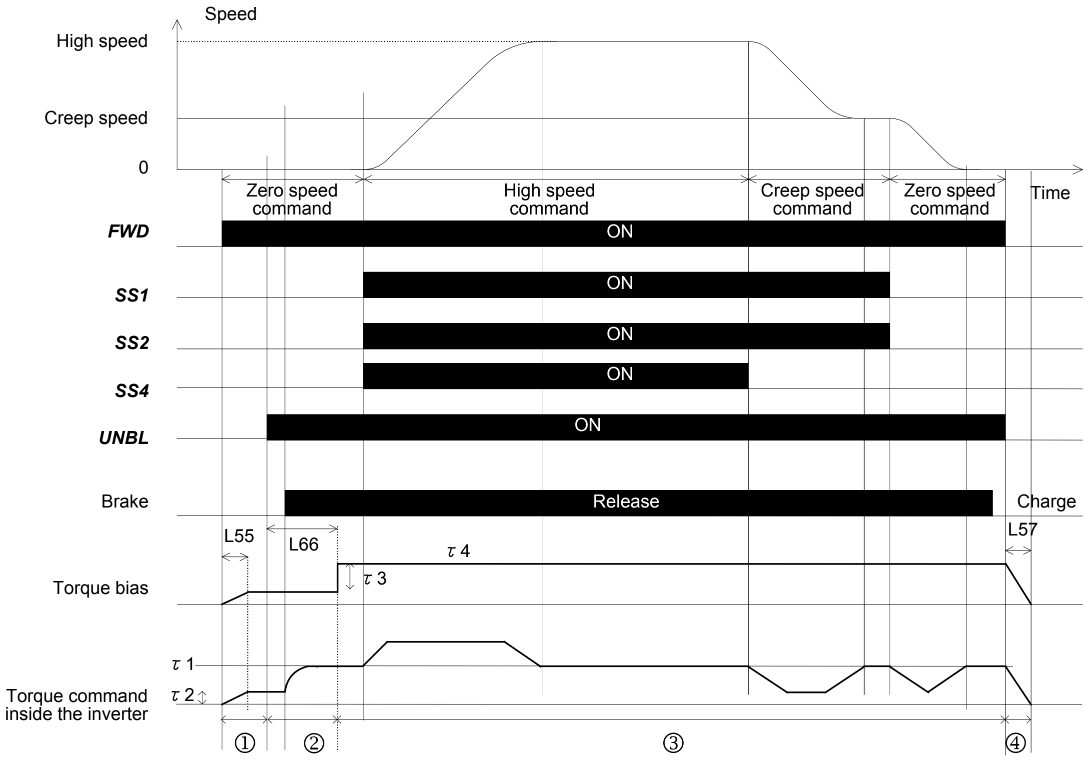
Note When an ***UNBL*** command is assigned to any general-purpose, programmable input terminal, be sure to enter a run command before entry of an ***UNBL*** command. Entry of an ***UNBL*** preceding a run command does not perform unbalanced load compensation.

In speed control

Unbalanced load compensation requires keeping the reference speed (pre-ramp) at 0.00 r/min and releasing the brake during the period from the start of running to the completion of calculation (that is, during the activation timer setting specified by L66).

If the reference speed (pre-ramp) other than 0.00 r/min is entered before the time length specified by L66 elapses, unbalanced load compensation immediately starts.

During the time length (L66) from the start of estimation of an unbalanced load, the inverter holds zero speed with the zero speed control specified when unbalanced load compensation is enabled. After the time length (L66), the current reference torque value inside the inverter will be taken as a torque bias amount. After that, the inverter runs in speed control with the torque bias amount under ASR.



Details

(1) During the period from the entry of a run command to that of an UNBL command, the inverterruns with "User controller's torque bias amount τ2."

(2) During the time length (L66) for the estimation of an unbalanced load, the "Inverter internal reference torque" is equal to "Reference torque at the zero speed hold period in inverter position deviation zero control" plus "User controller's torque bias amount τ2." Finally, the "Inverter internal reference torque" becomes equal to "Load torque τ1."

(3) When the time length (L66) elapses, adding the "Unbalanced load compensation amount τ3" to "User controller's torque bias amount τ2" produces "Torque bias amount τ4." At that point, τ3 = τ1 - τ2. After that, the inverter runs in speed control with the "Torque bias amount τ4" and under normal ASR operation.

(4) During the inverter shutdown sequence, the inverter decreases the reference torque value held by itself to 0, taking time specified by L56, and then shuts itself down.

L66 Unbalanced load compensation (Activation time)

L56 (Torque Bias, Reference torque end time)
L65 (Unbalanced Load Compensation, Operation)

L66 specifies the calculation time duration of unbalanced load compensation after the ***UNBL*** command is turned ON.

- Data setting range: 0.01 to 2.00 (s)

Refer to the descriptions of function codes L56 and L65 for details.

L68 Unbalanced load compensation (ASR P constant)

L68 specifies the ASR(Automatic Speed Regulator) P constant used in unbalanced load calculation.

Set a larger constant than the one specified in normal operation. If vibration occurs, decrease it.

- Data setting range: 0.00 to 200.00

L69 Unbalanced load compensation (ASR I constant)

L69 specifies the ASR I constant used in unbalanced load calculation.

Set a smaller constant than the one specified in normal operation. If vibration occurs, increase it.

- Data setting range: 0.001 to 1.000 (s)

L73 Unbalance load compensation (APR P constant)

L73 specifies the APR (Automatic Position Regulator) P constant used in unbalanced load calculation. If vibration occurs, decrease it.

- Data setting range: 0.00 to 10.00

L74 Unbalance load compensation (APR D constant)

L74 specifies the APR D constant used in unbalanced load calculation.

- Data setting range: 0.0 to 10.0

L75 Unbalance load compensation (Filter Time Constant for Detected Speed)

L75 specifies the filter time constant for detected speed used in unbalanced load calculation.

- Data setting range: 0.000 to 0.100 (s)

L76 Unbalance load compensation (ACR P constant)

L76 specifies the ACR (Automatic Current Regulator) P constant used in unbalanced load calculation. If vibration occurs, decrease it. In case L76 is set to 0.0, L05 setting value is used for ACR P constant during unbalanced load calculation.

- Data setting range: 0.0 (L05 setting value)
  0.1 to 10.0

L80	Brake Control (Mode)
L81	Brake Control (Operation level)
L82	Brake Control (ON delay time)
L83	Brake Control (OFF delay time)
L84	Brake Control (Brake check time)

L80 to L84 allow to perform the settings for brake control signals.

■ Brake control mode (L80)

L80 specifies the ***BRKS*** mode as listed below.

Data for L80	ON conditions	OFF conditions	Hold
1	- A run command is ON. AND - The inverter main circuit (output gate) is kept ON during the ON delay period specified by L82.	- After detection of the stop speed, the OFF delay period specified by L83 has elapsed. OR - The inverter output is shut down.	Except conditions given at left
2	- A run command is ON. AND - Output current ≥ Motor no-load current x L81 (%). AND - The inverter main circuit (output gate) is kept ON during the ON delay period specified by L82.		

■ Operation level (L81)

L81 specifies the output current that turns the ***BRKS*** signal ON when L80 = 2.

- Data setting range: 0 to 200 (%) (Motor no-load current reference)

■ ON delay time (L82)

L82 specifies the delay time from when the ***BRKS*** ON conditions are met until the ***BRKS*** signal is actually turned ON.

- Data setting range: 0.00 to 10.00 (s)

■ OFF delay time (L83)

L83 specifies the delay time from when the ***BRKS*** OFF conditions are met until the ***BRKS*** signal is actually turned OFF.

- Data setting range: 0.00 to 100.00 (s)

■ Brake check time (L84)

L84 specifies the allowable time for the ***BRKE*** signal to turn ON (OFF) after the ***BRKS*** signal is turned ON (OFF). If the ON (OFF) state of the ***BRKE*** signal does not match that of the ***BRKS*** signal within the time specified by L84, the inverter trips with alarm **Er6**. For confirming MC operation, taking use of timer for confirming the condition of ***SW52-2*** and ***CS-MC***.

- Data setting range: 0.00 to 10.00 (s)

Refer to the descriptions of function codes L84 to L86 for details.

Brake control signal *BRKS*

Setting "57" to any of the general-purpose, programmable output terminal (by E20 to E24 and E27) assigns the ***BRKS*** signal to that terminal. The ***BRKS*** signal is available in two modes specified by L80.

The ***BRKS*** signal turns OFF when the time length specified by L83 elapses after the speed (< stop speed) drops below the stop speed, independent of a run command. Adjust the braking timing to match the running pattern.

If the ***BRKS*** signal turns OFF with a run command being ON, the ***BRKS*** signal will no longer turn ON again even the ON conditions are met again. To turn the ***BRKS*** signal ON again, turn the run command OFF once.

Brake confirmation signal *BRKE*

Setting "65" to any of the general-purpose, programmable input terminal (by E01 to E08, E98 and E99) assigns a ***BRKE*** signal to that terminal. This signal is used to confirm whether the actual brake works normally with the ***BRKS*** signal issued from the inverter. Configure an external circuit that turns the signal ON or OFF when the brake is actually released or applied, respectively.

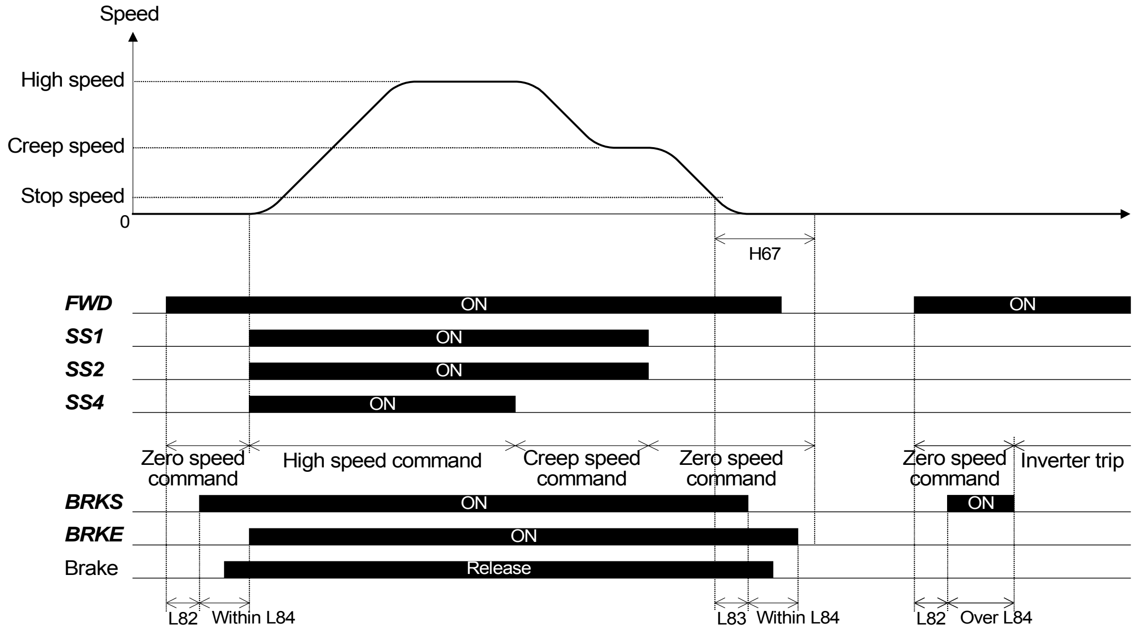
If there is a time lag between the status change of the ***BRKS*** signal and the corresponding change of the ***BRKE*** signal, specify the lag time with L84 (Brake check timer). During the lag time set by L84, even if there is a difference between the output status of the ***BRKS*** signal and input status of the ***BRKE*** signal, the inverter does not trip. If the output status of the ***BRKS*** signal is not identical with the input status of the ***BRKE*** signal after the time set in L84 elapses, the inverter trips with alarm **Er6**. Note that the time lag function does not work unless ***BRKS*** and ***BRKE*** are specified.

Make sure that the total time of the brake check time (L84) and the OFF delay time (L83) is less than the stop speed holding time (H67).

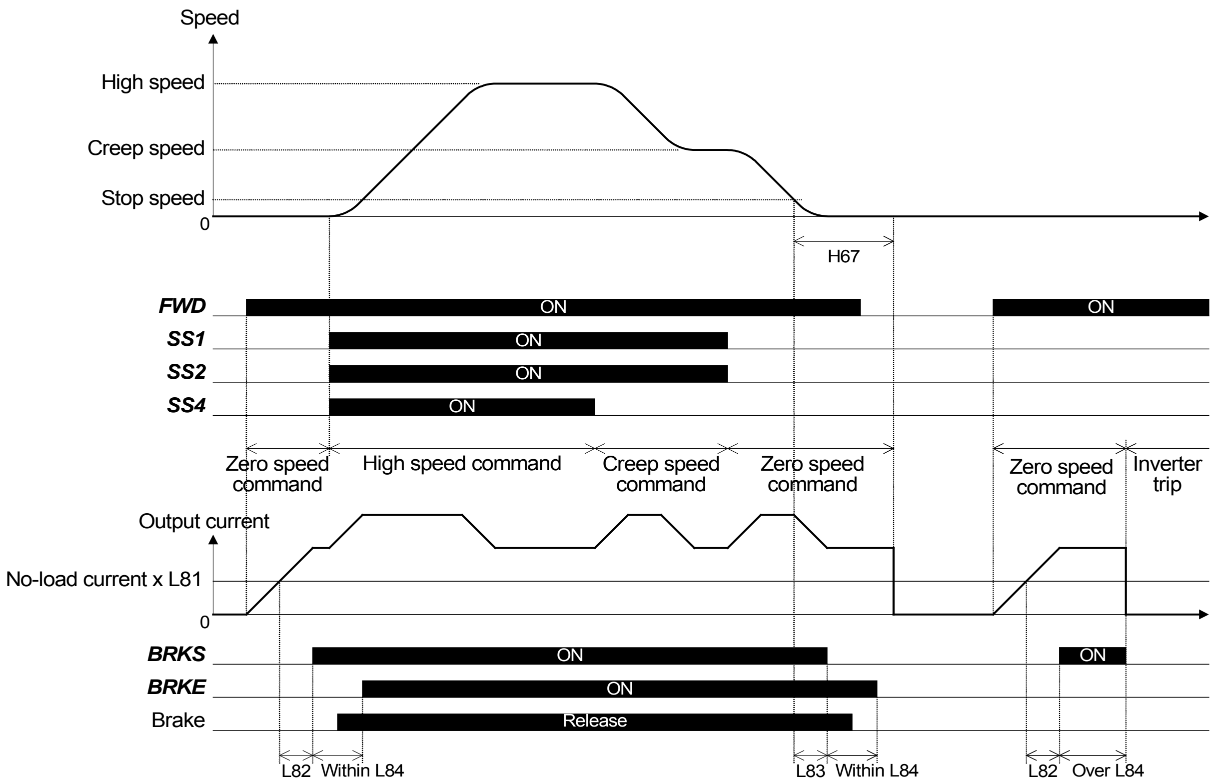
Brake control timing schemes

Given below are brake control timing diagrams when L80 = 1 and 2.

When L80 = 1



When L80 = 2



L85	MC Control (Startup delay time)
L86	**MC Control (MC OFF delay time)**

L85 and L86 specify the ON and OFF timings of the MC control signal ***SW52-2*** or ***SW52-3***.

SW52-2 is assigned to a general-purpose, programmable output terminal by setting "12" in function codes E20 to E24 and E27. ***SW52-3*** is assigned by setting "104" to them. The MC control signal opens or closes the magnetic contactor connected between the inverter and motor.

■ Startup delay time (L85)

L85 specifies the delay time from when the MC control signal ***SW52-2*** turns ON until the main circuit output gate turns ON.

- Data setting range: 0.00 to 10.00 (s)

Note: Even if no ***SW52-2*** is assigned to a general-purpose programmable output terminal, turning a run command ON turns the main circuit output gate ON after the delay time specified by L85 elapses.

■ MC OFF delay time (L86)

L86 specifies the delay time from when the main circuit output gate turns OFF until the MC control signal ***SW52-2*** turns OFF.

- Data setting range: 0.00 to 10.00 (s)

■ MC control *SW52-2*

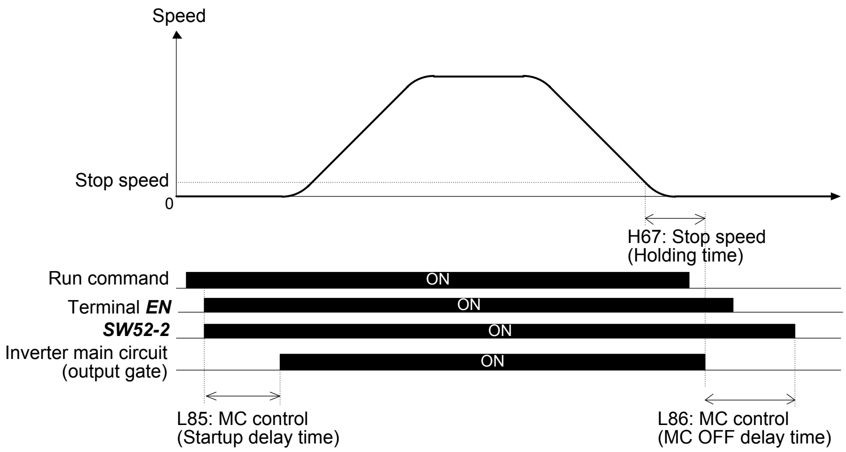
The table below lists the inverter running conditions and triggers required for turning the MC control signal *SW52-2* ON or OFF. The timing diagram is shown on the next page.

SW52-2 ON	***SW52-2*** OFF	Current status retained
(1) When all of the following conditions are met, turning a run command from OFF to ON turns the MC control signal ON. - "Coast-to-stop" ***BX*** OFF - No trip - Terminals [EN1]/[EN2] ON - "Force to decelerate" ***DRS*** OFF (2) Any of the following events with a run command being ON turns the MC control signal ON. - "Coast-to-stop" ***BX*** from ON to OFF. - A trip that occurred is reset. - Terminals [EN1]/[EN2] from OFF to ON	Any of the following events with the MC control signal being ON turns the MC control signal OFF after the MC OFF delay time specified by L86. - Inverter main circuit output gate from ON to OFF - Run command from ON to OFF with the inverter main circuit output gate being OFF - "Coast-to-stop" ***BX*** from OFF to ON - A trip occurs. - Terminals [EN1]/[EN2] from ON to OFF - "Force to decelerate" ***DRS*** from OFF to ON (below the stop speed).	Except the conditions listed at left

* When the conflicting conditions are present, e.g., from ON to OFF conditions and from OFF to ON conditions, the latter event has priority.

* The ***BX*** and [EN1]/[EN2] are in normal logic.

* The "Force to decelerate" state is kept from the entry of a ***DRS*** command until the ***DRS*** is turned ON, and the run command and inverter main circuit output gate are turned OFF.

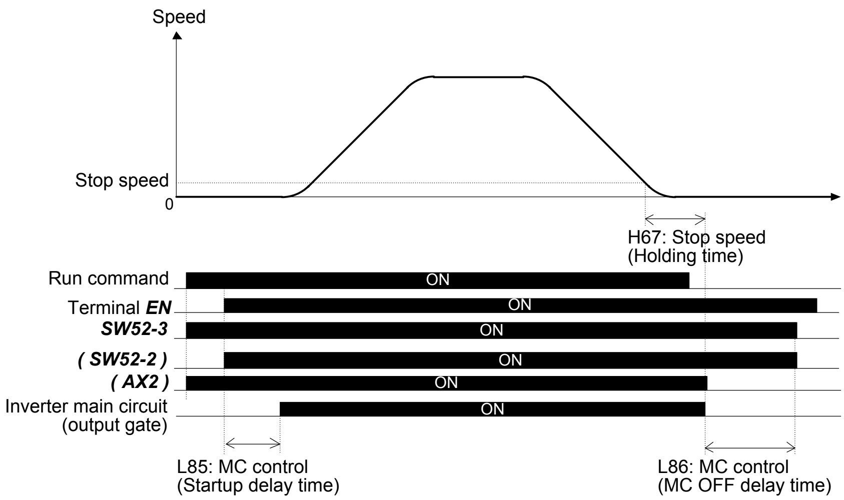


MC Control Signal ***SW52-2*** Timing diagram

■ MC control 2 *SW52-3*

This signal is a logical sum (OR function) of ***SW52-2*** (MC control) and ***AX2*** (Run command activated).

The timing diagram is shown on the following figure. Compared with **SW52-2**, even if ***EN*** terminal is OFF or ***BX*** terminal is ON, ***SW52-3*** comes ON and MC can be turned ON in such a condition.



MC Control Signal 2 ***SW52-3*** Timing diagram

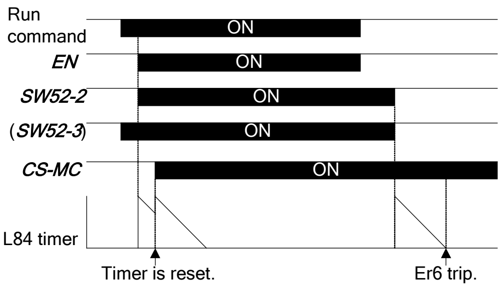
■ MC Operation confirmation

CS-MC is assigned to a general-purpose, programmable input terminal by setting "103" with E01 to E08, E98 and E99. This signal checks that the output side magnetic contactor works correctly. Make the external circuit as if actual MC condition is ON, this input signal CS-MC becomes ON.

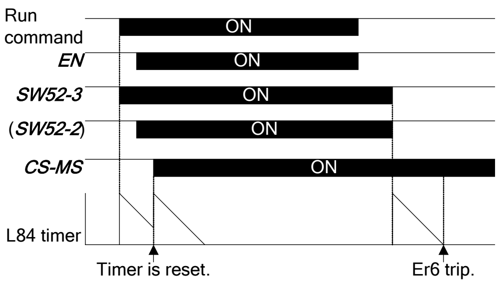
If there is a time lag between the status change of the ***SW52-2*** (***SW52-3***) signal and the corresponding change of the ***CS-MC*** signal, specify the lag time with L84 (Brake check timer). During the lag time set by L84, even if there is a difference between the output status of the ***SW52-2*** signal and input status of the ***CS-MC*** signal, the inverter does not trip. Set L84 in consideration of time from the change of ***SW52-2*** to the change of ***CS-MC***.

When ***SW52-3*** is set instead of ***SW52-2***, it operates according to the state of ***SW52-3*** and ***CS-MC***.

When both ***SW52-2*** and ***SW52-3*** are set, it operates according to the state of ***SW52-2*** and ***CS-MC***.



SW52-2 Timing Scheme



SW52-3 Timing Scheme

Function code of confirmation time for this function and brake check time (L84) are common.

L87	Door Control (Door open starting speed)
L88	Door Control (Door open delay time)
L89	Door Control (Door open period)

L87 to L89 specify the door open parameters relating to the door control signal ***DOPEN*** that is assigned to a general-purpose, programmable output terminal by setting "78" with E20 to E24 and E27.

■ Door open starting speed (L87)

L87 specifies the reference speed (final) below which the door control signal ***DOPEN*** is turned ON. The ***DOPEN*** is turned ON actually after the door open delay time specified by L88 elapses.

- Data setting range: 0.00 to 6000 (r/min)

Data setting range changes depending on the number of poles of motor etc. For details, refer to section 2.2.

■ Door open delay time (L88)

L88 specifies the delay time from when the speed drops below the door open starting speed (L87) until the ***DOPEN*** signal is turned ON.

- Data setting range: 0.0 to 10.0 (s)

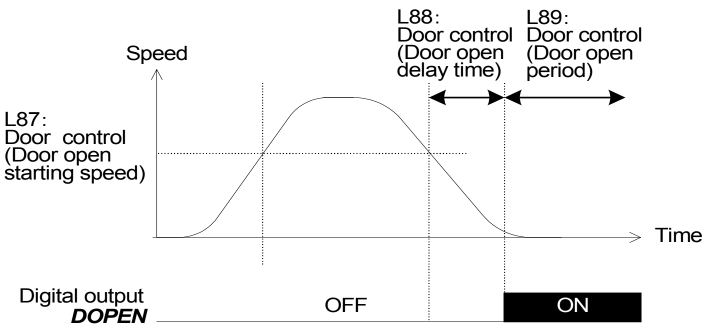
■ Door open period (L89)

L89 specifies the period during which the ***DOPEN*** is kept ON.

- Data setting range: 0.1 to 30.0 (s)

Door control

When the reference speed (final) drops below the door open starting speed (L87) during deceleration and the door open delay time (L88) elapses, the ***DOPEN*** is turned ON and kept ON during the door open period (L89).



Increasing the reference speed (final) above the speed (L87) with the ***DOPEN*** being OFF activates the ***DOPEN*** ON process judgment. If the reference speed (final) does not exceed the speed (L87), the L88 and L89 specifications will be ignored so that the ***DOPEN*** will be kept OFF.

Decreasing the reference speed (final) from the speed exceeding the L87 down to less than the L87 activates the delay timer (L88). After the delay time (L88) elapses, the ***DOPEN*** turns ON during the door open period (L89).

This door control applies to also the battery operation. When the battery operation speed does not reach the door open starting speed (L87), the ***DOPEN*** will be kept OFF.

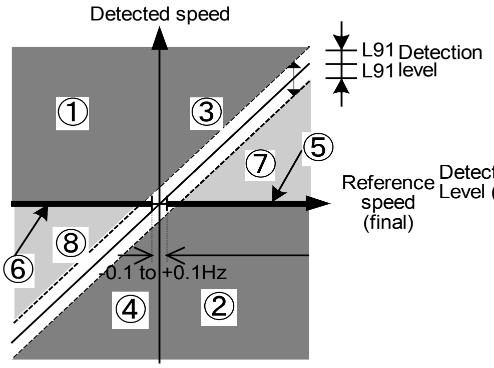
Note: When the L87 = 0.00, the ***DOPEN*** does not work. Operation is different according to L99 bit6.

Refer to the descriptions of function codes L99 bit6 for details.

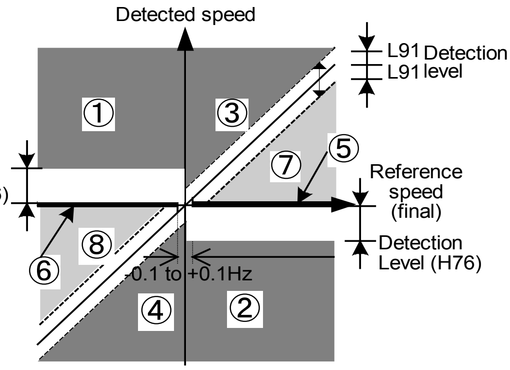
L90	**PG abnormal (operation choice)**	**H76 PG abnormal mode 3(detection range)** **H77 PG abnormal mode 3(detection timer)**
L91	**PG Error Detection (Detection level)**	
L92	**PG Error Detection (Detection time)**	

L90 to L92 specify the PG error detection conditions and the inverter operation in case of error. If the speed error is within a domain specified by L91 during the detection time specified by L92, the inverter regards it as an error and continues running or stops with/without an alarm according to the mode specified by L90.

- Data setting range (L91): 0 to 50 (%)
  (L92): 0.0 to 10.0 (s)



L90 = 0,1,2
Figure 1



L90 = 3
Figure 2

In the above figure, ① through ⑧ represent the following states.

①② : The phases A and B of the PG are reversely connected.

③④ : Excessive speed deviation (|Detected speed| > |Reference speed (final)|)

⑤⑥ : PG wires broken (During zero speed operation, that is, at -0.1 to +0.1 Hz, no PG error can be detected.)

⑦⑧ : Excessive speed deviation (|Reference speed (final)| > |Detected speed|)

If L90 = 0

When the speed is within domains ① through ⑥ in the above graph, the inverter regards it as an error. Independent of the PG error detection, the inverter continues to run.

If a PG abnormal signal ***PG-ABN*** is assigned to any general-purpose, programmable output terminal by setting E20 to E24 and E27 to “76”, the inverter turns the ***PG-ABN*** ON.

If L90 = 1

When the speed is within domains ① through ⑥ in the above graph, the inverter regards it as an error and stops with an excessive speed deviation error (**ErE**).

If L90 = 2

When the speed is within domains ① through ⑧ in the above graph, the inverter regards it as an error and stops with an excessive speed deviation error (**ErE**).

If L90 = 3

When the speed is within domains ① through ⑧ in the above graph, and when the speed is within domains ① or ② in the above graph, the inverter regards it as an error and stops with an excessive speed deviation error (**ErE**).

The content of the previous page is recorded in the following tables.

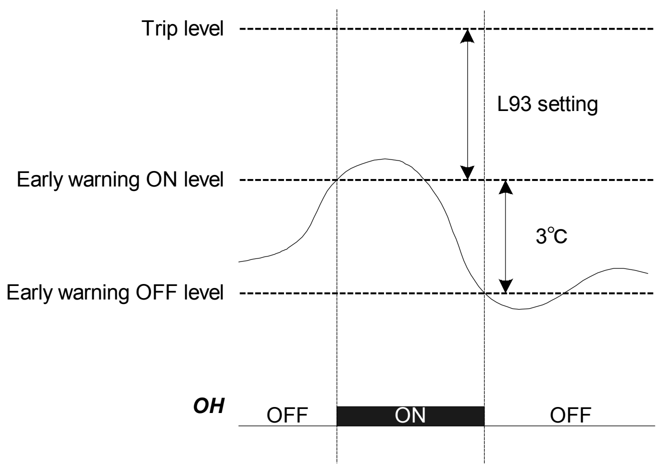
<table>
<tr><th rowspan="2">Data for L90
(PG Error
Detection Mode)</th><th rowspan="2">PG error detection conditions</th><th colspan="3">If a PG error is detected, the inverter:</th></tr>
<tr><th>Outputs
ALM</th><th>Trips with alarm indication</th><th>Outputs
PG-ABN</th></tr>
<tr><td>0</td><td rowspan="2">The speed is <u>within domains ① through ⑥</u> in the above graph during the detection time (L92).</td><td>OFF</td><td>---</td><td>ON</td></tr>
<tr><td>1</td><td rowspan="2">ON</td><td rowspan="2">ErE</td><td rowspan="2">OFF</td></tr>
<tr><td>2</td><td>The speed is <u>within domains ① through ⑧</u> in the above graph during the detection time (L92).</td></tr>
<tr><td>3</td><td>The speed is within domains ① or ② in the below graph during the detection time (H77).
The speed is within domains ① through ① in the below graph during the detection time (L92).</td><td>ON</td><td>ErE</td><td>OFF</td></tr>
</table>

L93 Overheat Early Warning Level

When the temperature reaches the overheat early warning level that is n°C below the trip level, the inverter issues an overheat early warning signal. L93 specifies the n°C. The early warning signal ***OH*** is assigned to a general-purpose, programmable output terminal by setting E20 to E24 and E27 to “28”.

- Data setting range: 1 to 20 (deg)

ON conditions	OFF conditions	Current status retained
When any of the following conditions is met, the ***OH*** signal is turned ON. - The heat sink temperature is higher than "Heat sink overheat trip temperature - L93 setting." - The inverter inside temperature is higher than "Internal overheat trip temperature - L93 setting." - The IGBT junction temperature is higher than "Inverter overload trip temperature - L93 setting."	When all of the following conditions are met, the ***OH*** signal is turned OFF. - The heat sink temperature is lower than "Heat sink overheat trip temperature - L93 setting - 3°C." - The inverter inside temperature is lower than "Internal overheat trip temperature - L93 setting - 3°C." - The IGBT junction temperature is lower than "Inverter overload trip temperature - L93 setting - 3°C."	Except the conditions listed at left



L97 — Magnetic Pole Position Tuning (Voltage)

L97 specifies the amplitude of alternating voltage that is used magnetic pole position tuning (L03=4).

L98 — Protecting operation selection switch

E34 current detection (operation level 1)
E35 current detection1 (timer)

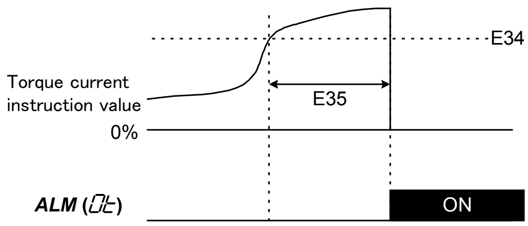
By setting L98 the inverter protecting functions can be enabled/disabled.

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	Not assigned	FAN ON/OFF during battery operation	Not assigned	Calculate ASR with only speed command during ULC	***ENOFF*** signal output mode	Not assigned	Drive continuance alarm	Over torque current protecting operation
Data=0	-	Disable	-	Disable	Disable	-	Disable	Disable
Data=1	-	Enable	-	Enable	Enable	-	Enable	Enable
Default	0	1	0	0	0	0	0	0

Set 0 for the not used functions.

■ Over torque current protecting operation (Bit 0)

The inverter stops when reference torque current of the inverter exceeds the over torque current detection level (E34) and the reference torque current continues longer than the period specified by over torque current detection time (E35). The state is reset after the inverter stops.



In case of vector control with PG for synchronous motor, the motor torque current is approximately proportional to the output current of the motor. But in case of vector control with PG for asynchronous motor the motor torque current is not proportional to the output current of the motor.

■ Drive continuance alarm (Bit 1)

If the function is enabled, the inverter keeps driving the motor for ten seconds when the following alarm happen. This allows to stop safely the elevator when alarm happens.

·**OH2** (External alarm input 2 ***THR2***)

·**OH4** (Motor protection PTC thermistor)

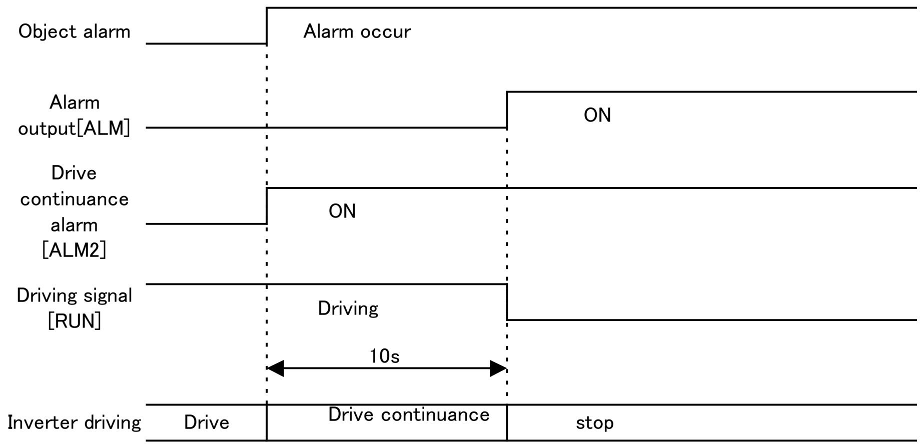
·**OL1** (Motor protection Electronic thermal)

·**OLU** (inverter unit Overload)

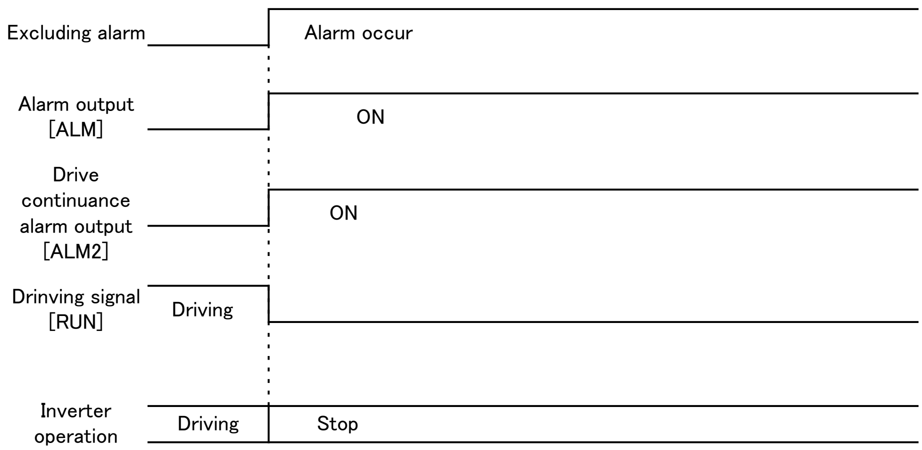
·**Er6** (Reference torque decreasing command error)

When special alarm happens, the inverter keeps driving the motor for ten seconds by drive continuance alarm. After 10 seconds, if the output is shut down, drive continuance alarm will happen and inverter will stop. Drive continuance alarm will be kept until inverter is reset.

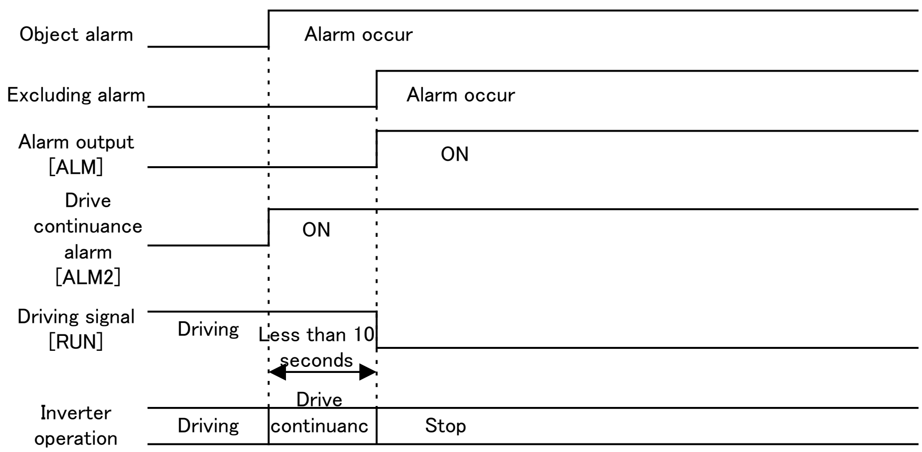
Drive continuance object alarm occurrence



Drive continuance excluded alarm occurence



Both type of alarms occurrence



■ ENOFF signal output mode (Bit 3)

ENOFF output function behavior is selected by Bit 3. Behavior is descrived in below table.

Bit	Definition
0	***ENOFF*** signal means that EN1 and/or EN2 terminals are OFF (not active).
1	***ENOFF*** signal means that EN1 and/or EN2 terminals are OFF (not active) and RUN command is ON.

■ Calculate ASR with only speed command during ULC (Bit 4)

ASR calculation method during ULC is defined by Bit 4. Behavior is descrived in below table.

Bit	Definition
0	Detected speed is used for ASR calculation during unbalanced load compensation.
1	Detected speed is assumed as 0 during unbalanced load compensation. ASR works by using only reference speed from APR.

■ FAN ON/OFF during battery operation (Bit 6)

Normally is not necessary to change this bit.

L99	Control switch	P06 motor unload current L56 torque bias (torque reference finish timer) L57 torque bias (limit) L80 brake control operation selection

By setting L99, operations of inverter can be enabled/disabled.

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	Not assigned	***DOPEN*** function change	S1 bit selection for DCP	Rise direction definition	Short floor operation using s-curve control driving	Initial torque bias and reference torque decreasin g	Magnetic pole position offset	Current confirmation for synchronous motor
Data=0	-	Disable	***SW52-2***	FWD	Disable	Disable	Disable	Disable
Data=1	-	Enable	***SW52-3***	REV	Enable	Enable	Enable	Enable
Default	0	0	0	0	0	0	1	0

■ Current confirmation for synchronous motor (Bit 0)

In case of controlling synchronous motor, the output current is proportional to the output torque. Therefore, theoretically, the output current is 0 before releasing the brake. In this case, even if the output phase is lost, it is impossible to detect it. This function can be used to ensure an output higher than the setting in P06. Please use this function when lift controller uses ID or ID2 as brake release condition in case that the inveter is controlling a synchronous motor.

Tip By using the function, it is possible to confirm the connection between inverter and synchronous motor at stop condition.

⚠WARNING

If this function is used, the recommended value of P06 is less than 5% of the motor rated current.

Otherwise injuries could occur.

■ Magnetic pole position offset (Bit 1)

The tuning result by ***PPT*** is saved (written) or read.

Refer to the explanation of ***PPT*** for details.

■ Initial torque bias and reference torque decreasing (Bit 2)

The following functions can be used, when this function is enabled.

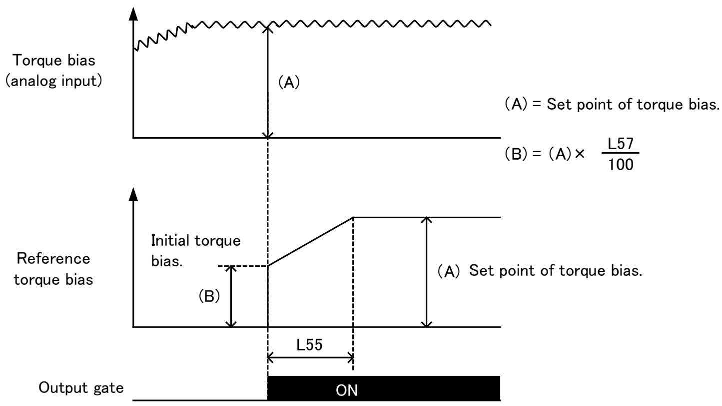
a) Initial torque bias

The operation of initial torque bias is as follows.

- Turning the inverter main circuit (output gate) ON holds a reference torque bias. It is the set point of torque bias. It is indicated as (A).
- Reference torque bias starts at initial torque bias. It is indicated as (B) which is calculated as follows.

$$(B) = (A) \times \frac{L57}{100}$$

- The reference torque bias is increased from (B) to (A). The time is set in function code L55.

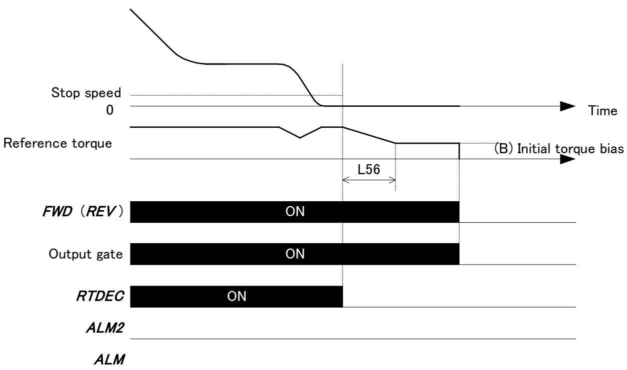


b) Reference torque decreasing

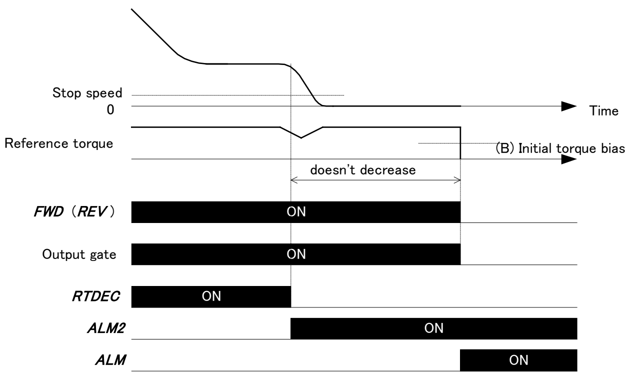
The operation of reference torque decreasing is as follows.

1. ***RTDEC*** is changed from OFF to ON within three seconds after the starting operation.
   Or, when the operation is started, ***RTDEC*** is already ON.
2. When ***RTDEC*** is changed from ON to OFF

When all the above-mentioned are satisfied, the inverter decreases the reference torque to initial torque bias. The time taken to the decrease is L56. In the absolute value, if the reference torque when ***RTDEC*** is turned OFF (A1) is not decreased. When L98 bit1 = 1, drive continuance alarm (***ALM2***) is output and the inverter stops with **Er6**, otherwise, the inverter stops with **Er6** immediatelly. When ***RTDEC*** is changed from ON to OFF while the inverter is stopping, the inverter trips with **Er6**.



Normal operation



Abnormal operation

■ Short floor operation using S curve (Bit 3)

The operation mode of short floor operation can be selected by this function. Even if Mode 2 is selected, when it doesn't meet the requirements of Mode 2, it operates by Mode 1.

Description of Mode 2

When the deceleration instruction to the creep velocity enters while accelerating, it operates. S-curve setting is automatically adjusted and decelerates. The operation conditions of Mode 2 is as follows. When it is not possible to satisfy it, it operates by Mode 1.

·The deceleration instruction to the creep speed (C07) is given while accelerating to Low speed (C09), Middle speed (C10) or High speed (C11) from Zero speed (C04) or STOP.

·S-curve used is 10% or more. (Figure ① to ④)

·The range of acceleration time and deceleration time" used is 1 to 10 seconds. (Figure ⑤,⑥)

·The difference at a set speed of the attainment speed(C09 to C11) and the creep(C07) velocity is rated speed (F03) 10% or more.

·200Hz or less in frequency conversion. rated speed (F03).

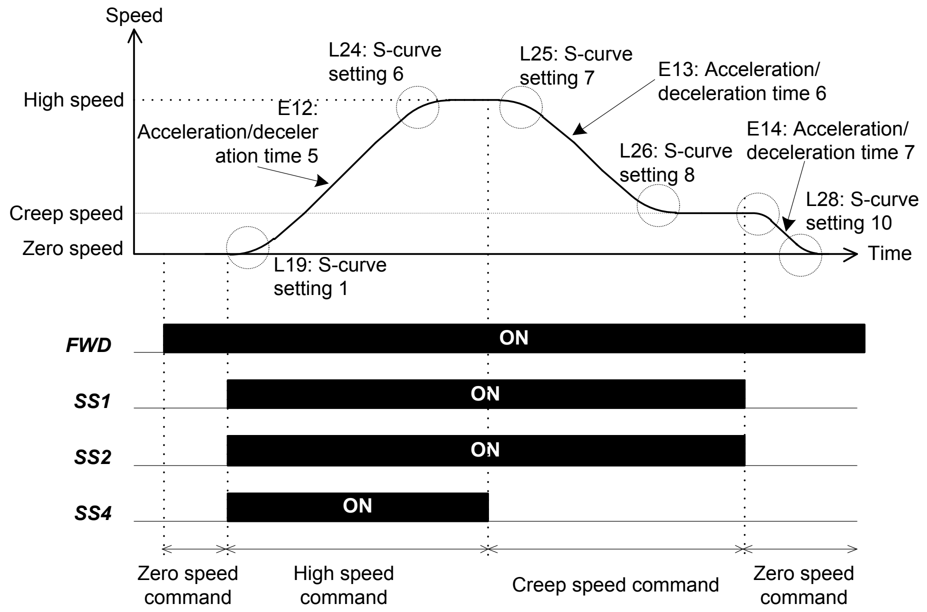
Refer to function code L29 for details of Mode 1.

Note

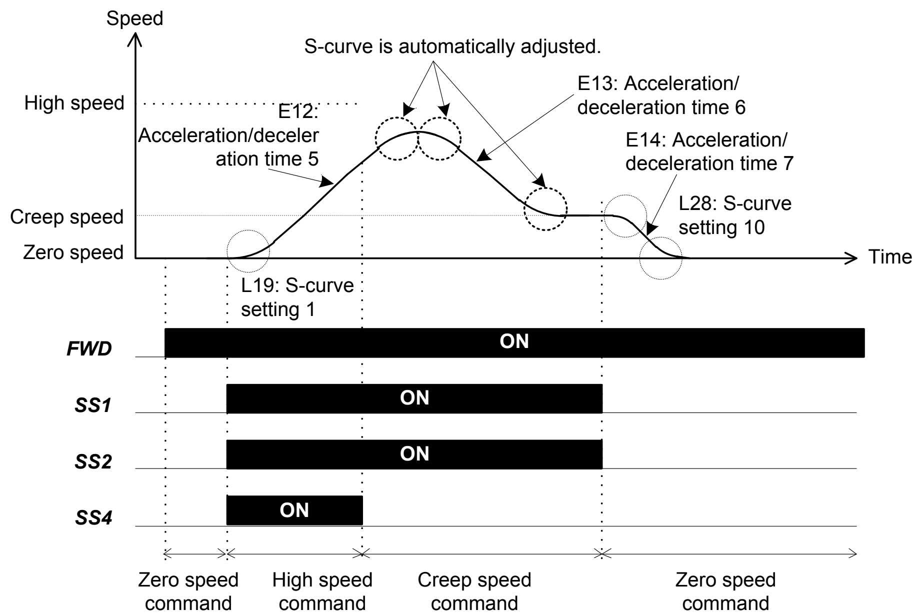
Change speed or neither "Addition and subtraction velocity time" or S-curve when you drive with Mode 2.

The accuracy of the generated speed pattern is not guaranteed. Operate it as you can absorb the error margin by driving in creep speed.

When the instruction to creep velocity is given after acceleration to high speed is completed



When the instruction to creep velocity is given while accelerating to high speed.



■ Rise direction definition for DCP (Bit 4)

This bit specifies the relation between "FWD / REV" and "Upward / Downward" for DCP protocol communication.

L99 bit4 = 0 : FWD = Upward / REV = Downward

L99 bit4 = 1 : FWD = Downward / REV = Upward

■ S1 bit selection for DCP (Bit 5)

This bit specifies the source of S1 bit from either "***SW52-2***" or "***SW52-3***" for DCP protocol communication.

L99 bit5 = 0 : S1 bit is the same as the operation of "***SW52-2***"

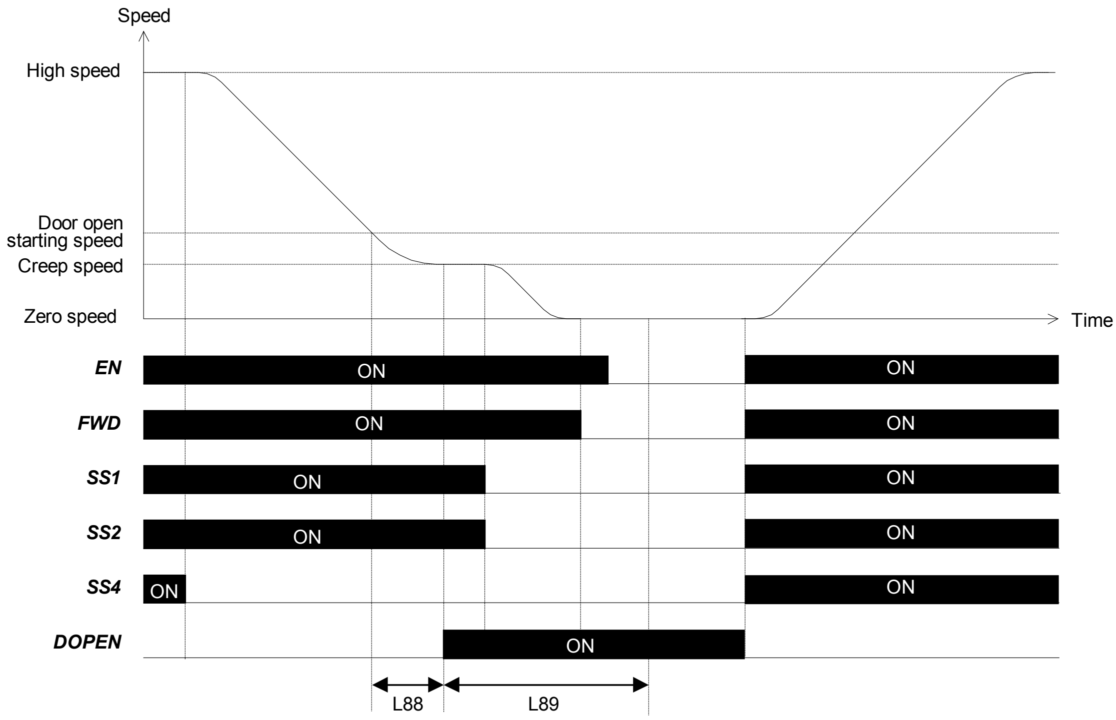
L99 bit5 = 1 : S1 bit is the same as the operation of "***SW52-3***"

■ DOPEN function change (Bit 6)

The function can be switched by L99 bit6.

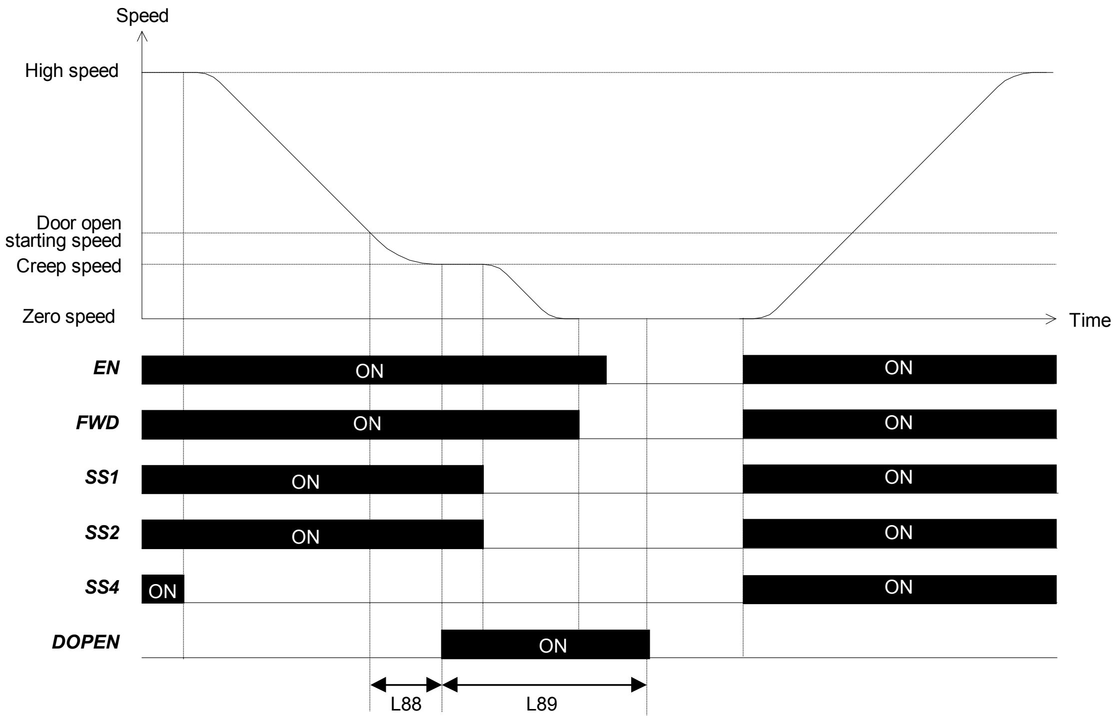
i) When L99 bit6 is 0

After ***DOPEN*** is turned ON, The state of ***DOPEN*** is held until all conditions of ***BX*** terminal ON, ***EN*** terminal OFF, ***DRS*** terminal OFF and alarm are released.



ii) When L99 bit6 is 1

After the timer of L89, ***DOPEN*** is turned off regardless to the state of ***EN*** terminal and ***BX*** terminal. When the terminal ***BX*** is turned on, ***DOPEN*** output signal operates as same as ***EN*** is turned OFF.



L101	**Unlock Safety Gear (Operation)** **E01 to E08 Command Assignment to [X1] to [X8]**
L102	**Unlock Safety Gear (Level)**
L103	**Unlock Safety Gear (Pluse time)**
L104	**Unlock Safety Gear (Rest time)**
L105	**Unlock Safety Gear (Pluse)**
L106	**Unlock Safety Gear (Speed limit)** **F03 Rated Speed**

The aim of "Unlocking safety gear" function is to electrically unlock the car from a safety gear lock. Inverter will generate current pulses in order to force an abrupt reaction of the motor. The abrupt reaction of the motor will unlock the safety gear.

■Unlock Safety Gear Operation (L101)

L101 specifies the operation of unlock safty gear function.

- Data setting range: 0 Disable
  1 Enable

■Unlock Safety Gear Level (L102)

L102 specifies the amplitude of current pulses. This value is a percentage of the inverter's rated current.

- Data setting range: 10 to 200 %

■Unlock Safety Gear Pulse time (L103)

L103 specifies the time that inverter will apply the current of the value set on L102.

- Data setting range: 0.1 to 2.0 s

■Unlock Safety Gear Reset time (L104)

L104 specifies the time between two consecutive pulses.

- Data setting range: 0.1 to 1.0 s

■Unlock Safety Gear Pulse (L105)

L105 specifies the number of pulses that inverter will generate after L101 is enabled and RUN command is given.

- Data setting range: 1 to 5

■Unlock Safety Gear Speed limit (L106)

L106 specifies the maximum speed that the inverter will allow the motor to turn during Unlock safety gear operation.

- Data setting range: 0 to 6000 rpm

<u>Operation procedure</u>

(1) Set function code L101 to "1" or turn ON ***ULSG*** command during stop.
(2) When a run command is set, Unlock safty gear operation stars.
(3) The operation is performed according to preset parameters, and ended automatically.
(4) Turn OFF the run command to finish the operation.
If the run command is given by keypad, it will become OFF automatically.

⚠CAUTION

This function cannot be used unlimited times. If after 2 or 3 trials car is not unlocked, unlock the car by means of mechanic devices (i.e. hoist). An unlimited use of this function can lead an inverter failure.

An accident or physical injury may result.

An damage may result.

L108	Encoder Rotation (Detection speed)

L108 specifies the speed detection threshold for rotation direction indication from the speed measured by the encoder.

- Data setting range: 0.00 to 500.0 mm/s

Refer to the explanation of "***FRUN***" and "***RRUN***".

L109	Travel direction counter (Password setting)
L110	Travel direction counter (Password unlock)
L111	Travel direction counter (Travel limit)
L112	Travel direction counter (Warning level)
L113	Travel direction counter (Partial number of direction changes)
L114	Travel direction counter (Total number of direction changes)
L115	Travel direction counter (Total number of resets)

Travel direction counter function (TDC) provides the information for the maintenance of suspension means (coated ropes or belts).
This function is available only in combination with Multi-function keypad TP-A1-LM2 (option).

■ Travel direction counter (Password setting) (L109)

In this function code a password for TDC must be set. In other words, until password is not defined in L109, TDC function remains disabled.

Data for L109	Action
0000h	No password. Function disabled.
0001h~FFFFh	Password setting range.

As soon as password is defined, L109 returns to default setting value (0000h).

Note: After defining a password TDC function has to be locked. To do so, please turn the power supply of the inverter OFF, wait until keypad is unlit and switch ON again.

■ Travel direction counter (Password unlock) (L110)

After TDC function has been enabled by setting a password in L109, password can be set on this function code to unlock menus 2. Setting, 4. Set PW and 5. TDC Copy.

Data for L111	Action
0000h	No password. Function locked.
0001h~FFFFh	Password setting range.

As soon as password is defined, L110 returns to default setting value (0000h).

Note: After modify TDC function parameters, make sure function is locked again. To do so, please turn the power supply of the inverter OFF, wait until keypad is unlit and switch ON again.

■ Travel direction counter (Travel limit) (L111)

Maximum travel direction changes allowed are set in this function code. When counter L113 reaches this level, in other words when L111=L113, inverter will be blocked by **tCA**.

Data for L111	Action
OFF	Disabled
0.01~10.00 Million direction changes	Maximum number of travel direction changes allowed. Where 0.01 means 10.000 changes and 10.00 means 10.000.000 changes.

■ Travel direction counter (Warning level) (L112)

A warning level can be set in this parameter (**TDCL**). When counter L113 reaches the percentage set in this function code, output function **TDCL** will go to ON state. On the other hand, inverter will indicate the light alarm tCW (L197 bit0).

Data for L112	Action
0%	Disabled
1 1%~90%	Tripping level of TDCL output function and light alarm. Percentage level is refered to L111 limit.

■ Travel direction counter (Partial number of direction changes) (L113)

Partial number of direction changes is shown in this parameter. When running direction is changed from ***FWD*** to ***REV***, or from ***REV*** to ***FWD***, and inverter in enabled (EN terminal ON), L113 counter is increased one unit.

Data for L113	Action
OFF	Disabled
0.01~10.00 Million direction changes	Maximum number of travel direction changes allowed. Where 0.01 means 10.000 changes and 10.00 means 10.000.000 changes.

This parameter can be modified and has to be set to 0.00 when suspension means has been changed. When this parameter is modified (value is changed) reset counter (L115) is increased one unit.

By definition, this parameter cannot be bigger than L111 limit. When L113=L111 inverter will trip with **tCA** alarm, in this case, please change suspension means and reset the counter.

Note After modifying L113 counter, make sure function is locked again. To do so, please turn the power supply of the inverter OFF, wait until keypad is unlit and switch ON again.

In figure 1, a basic time chart of TDC function is shown. In this case, L111 limit is set to 3. As it can be observed, several travels in forward (up) and reverse (down) direction are shown. When direction is changed from up to down, or from down to up, L113 counter increases one unit. At the same time, an output programed with the function ***TDCP*** outputs a pulse. On the other hand, even starting a new travel, if direction is not changed, nothing changes on outputs or counter. In this example L112 is set to 60%. When L113 counter reaches the value 2, which corresponds to the 66.66% of travel limit, an output programed with the function ***TDCL*** changes from OFF to ON. At same time, light alarm for pre warning is shown in the keypad (**tCW**). When L113 counter reaches the value 3, inverter is blocked by the alarm **tCA**. Even forward or reverse are activated, inverter will not allow any other travel until suspension means are changed and L113 counter is reset.

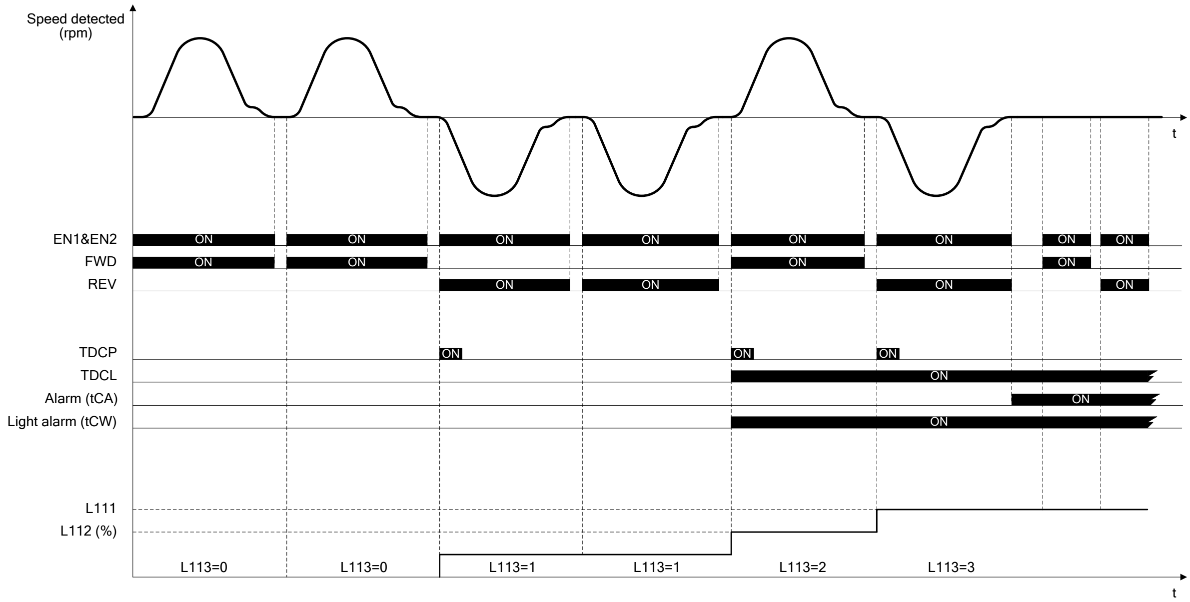


Figure 1. Basic function time chart of TDC function

■ Travel direction counter (Total number of direction changes) (L114)

This is READ ONLY function code. It shows the total number of direction changes. When running direction is changed from ***FWD*** to ***REV*** or from ***REV*** to ***FWD*** this counter is increased. This parameter cannot be modified in order to detect if TDC function is used propertly. In other words, if total number of direction changes, direction changes limit and total number of resets doesn’t match, it means that somebody is manipulating intentionally the inverter in order to avoid changing suspension means. Therefore, by means of this counter, sabotage can be detected.

Monitoring range is from 0.01~10.00 Million direction changes, where 0.01 means 10.000 changes and 10.00 means 10.000.000 changes.

■ Travel direction counter (Total number of resets) (L115)

This is READ ONLY function code. It shows the total number of reset operations. This counter increments one unit each time that parameter L113 is modified.

For additional information about TDC function, refer to related Application Note (AN-Lift2-0004v100EN).

L117	Rescue operation by brake control (Speed limit)
L118	Rescue operation by brake control (Apply time)
L119	Rescue operation by brake control (Speed detection delay time)

When there is a blackout, one possible solution to rescue trapped people in lift car is to perform a rescue operation by brake control. In this case, inverter will control motor’s brake (opening and closing) in order to move the lift by load unbalance (by gravity).

This solution is very useful in case of gearless motors (both synchronous and asynchronous). As gearless motors has no gear box, the system becomes more reversible. Also, it is very useful in case of MRL installations (Machine Room less) where reaching the brake is not easy.

Rescue operation by brake control will move lift car by gravity. In order to keep a safety operation, inverter will monitor lift speed under this operation. This function is not available under Torque Vector Control as motor speed cannot be monitored.

■ Rescue operation by brake control (Speed limit)(L117)

In this parameter, maximum speed allowed during rescue operation by brake control is set. Maximum speed limit is set in mm/s.

As soon as lift reaches speed set in this parameter, ***BRKS*** signal will turn to OFF. While ***RBRK*** input is ON, and lift speed is below this level, ***BRKS*** signal will be ON.

■ Rescue operation by brake control (Apply time) (L118)

When ***BRKS*** signal turns to OFF (brake closes) because lift speed reaches L117 level, lift speed will decrease until 0 mm/s. When lift speed reaches level set on function code L108, timer L118 starts to count. ***BRKS*** will turn ON (brake open) when time set on L118 elapses.

The setting of timer L118 must be lower than the setting of L119 timer, otherwise inverter will trip **rbA** unnecessarily.

■ Rescue operation by brake control (Speed detection delay time) (L119)

When ***BRKS*** signal is ON (brake opened) some detected speed from the motor is expected. If no speed is detected, it can be because motor is not turning (balanced condition or locked condition) or because encoder is broken.

It is understood as no speed detected, no movement, any speed below speed level set on L108. When speed is below L108 timer L119 starts to count. If speed doesn't reach speed level set on L108 when timer L119 elapses, inverter will trip **rbA** alarm.

The setting of timer L118 must be lower than the setting of L119 timer, otherwise inverter will trip **rbA** unnecessarily.

Figure 1 shows a rescue operation by motor brake control when speed limit is not reached. As it can be observed, as soon as ***RBRK*** input function is activated, brake opens. After that motor speed increases because of gravity effect. Speed is below level set in function code L117. Because limit is not reached, ***BRKS*** signal is not going to OFF. ***RBRK*** signal is removed by the controller when floor level is reached.

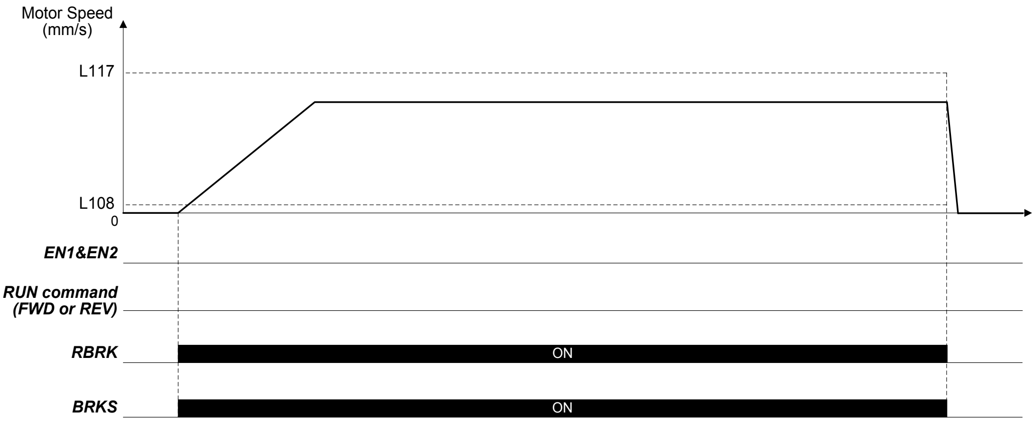


Figure 1. Timing diagram when limit speed is not reached.

Figure 2 shows a rescue operation by motors brake control when L117 speed limit is reached. As it can be observed, as soon as ***RBRK*** input function is activated, brake opens. Motor reaches a certain speed which is over L117 speed limit. At this point ***BRKS*** signal goes to OFF. Inverter waits L118 time to set ***BRKS*** to ON again. ***RBRK*** signal is removed by the controller when floor level is reached.

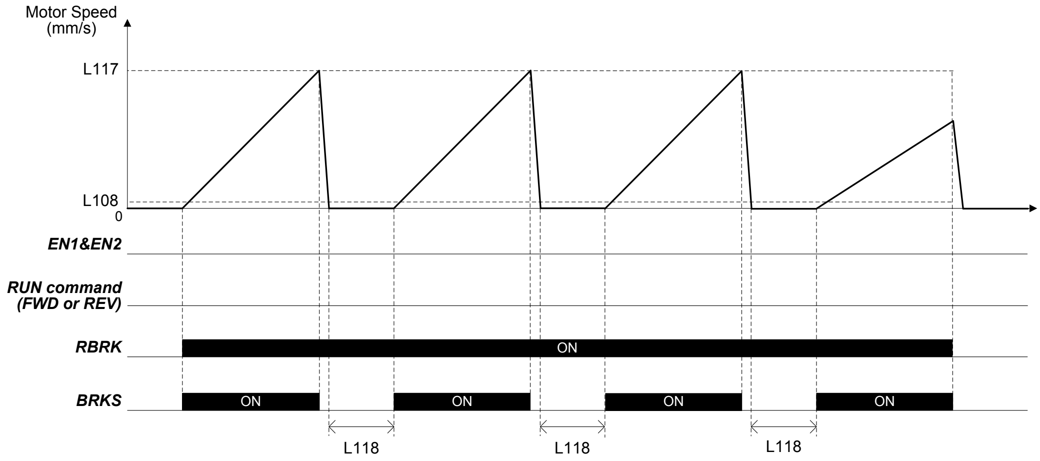


Figure 2. Timing diagram when L117 speed level is reached.

Figure 3 shows a case where inverter is locked by **rbA** alarm. As soon as rescue operation by brake control starts, because speed doesn't reach level set on parameter L108 and time set on L119 elapses, inverter trips **rbA** alarm. When inverter trips an alarm, ***BRKS*** output function goes to OFF immediately.

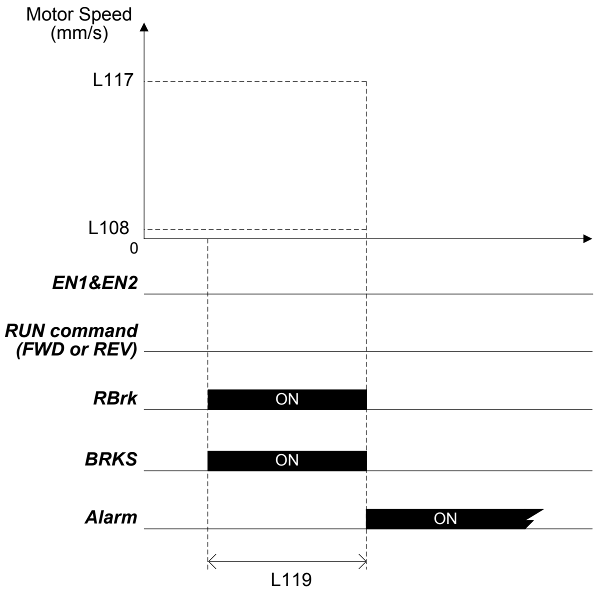


Figure 3. Inverter locked by **rbA** (case 1).

Figure 4 shows a second case where inverter is locked by **rbA** alarm. As soon as rescue operation by brake control starts, motor speed increases because lift car moves by gravity. Therefore speed reaches a value over L108 speed level. Suddenly motor speed decreases to 0.00 mm/s, for example because lift car is locked for any mechanical reason. At this point, because speed is below level set on function code L108, L119 timer starts to count. When L119 time elapses inverter trips **rbA** alarm. When inverter trips an alarm, ***BRKS*** output function goes to OFF immediately.

Even RUN command or *EN1&EN2* are activated during alarm state, as it is happening with standard operation, ***BRKS*** output function will not be activated.

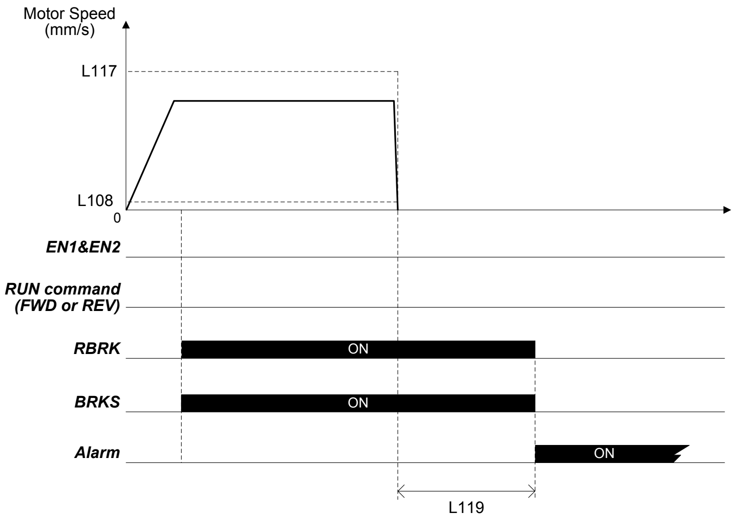


Figure 4. Inverter locked by **rbA** (case 2).

L120	Short circuit control (Control mode)
L121	Short circuit control (Check time)

While motor is stopped motor brakes are closed. If for any reason motor brakes are opened externally (during installation or maintenance for example) motor will turn free in to the loads direction. In case of PMSM, because it has no gearbox, the speed of the lift moving due to gravity can reach quite high speeds. On the other hand, when motor phases are short-circuited, it generates a torque which makes rotating speed slower. Because of this, market trend is to short circuit motor phases when lift is in standstill. Motor phases are short circuited to have an additional safety.

On the other hand, market trend is moving to contactorless solutions. Without contactors the installation (wiring) is easier, there is less maintenance, and acoustic noise is reduced. FRENIC-Lift (LM2A) series has been certified certified according to EN 81-1:1998+A3:2009 and EN81-20:2014 (Clause 5.9.2.5.4 d) and 5.9.3.4.2 d)) to be used without motor contactors. Same contactors that can be removed, nowadays are used to short circuit motor phases when lift is stopped.

An alternative solution when main contactors are removed, can be to use a power relay (or mini contactor) governed by the inverter, in order to short circuit motor phases when lift is stopped. This power relay (or mini contactor) can be directly wired to the dedicated U0, V0 and W0 terminals. Inverter short circuits motor phases when no current is flowing from the inverter to the motor, therefore the relay or contactor doesn't need to be sized according to motor's rated power.

■ Short circuit control (Control mode) (L120)

Behavior of motor phase short circuit can be defined by means of this parameter. Depending on **L120** setting, short circuit will be performed under different conditions.

Data for L120	Action
0 (default setting)	***SCC*** output function will turn ON when RUN command is ON (FWD or REV) and EN terminal is ON. ***SCC*** output function will turn OFF when IGBT's gate drivers are OFF and timer L86 is elapsed.
1	***SCC*** output function will turn OFF only in certain conditions. Conditions are described below: - **Case 1**: Inverter in alarm (***ALM*** output function ON). - **Case 2**: ***RBRK*** input function is ON. It means that rescue by brake control will be performed. - **Case 3**: ***BRKE***, ***BRKE1*** or ***BRKE2*** input functions are ON and ***BRKS*** output function is OFF. It means that somebody opened the brake by "external means". - **Case 4**: ***STBY*** input function is ON. In this case energy will be saved by not keeping energized motor short circuit contacts. In other words, function ***SCC*** will remain ON (no short circuit) always except in above mentioned cases.

Tip

In case of blackout, L86 delay time cannot be ensured. In order to avoid early contact closing, it is recommended to use a normally closed contact with programmable delay at closing. In this case, in order to avoid extra delays, L86 can be set to 0.00s.If the programmable delay is not used, L86 should be set to greater than default setting.

In case of contactorless configuration, L85 timer is not necessary, in this case please set L85=0.00s.

■ Short circuit control (Check time) (L121)

This is the time that inverter will wait to receive short circuit contact feedback (***SCCF*** input function). In case of using ***SCC*** function, to have short circuit contact feedback (***SCCF*** input function) is a must. L121 function code must be set to a time longer than short circuit contact reaction time.

If L121 time elapses and no feedback is received (SCCF remains OFF), inverter will be blocked by alarm SCA.

This timer is only valid when output function ***SCC*** is used.

In below figures, different time charts show the behavior of ***SCC*** and ***SCCF*** functions depending on the setting of function code L120. In case that L120=0 (default setting), ***SCC*** will turn ON and OFF each travel according to below situations shown in each figure.

In figure 1 a standard travel timing sequence is shown.

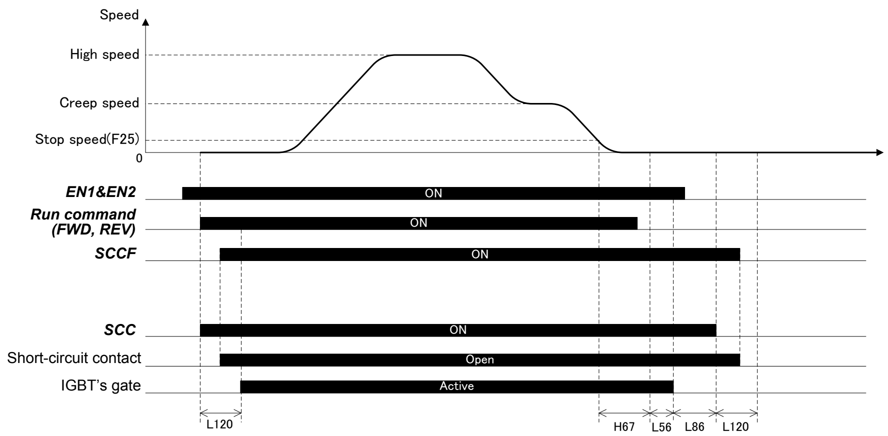


Figure 1. Standard travel timing sequence with feedback contacts.

As it can be observed, as soon as RUN command is ON (***FWD*** or ***REV***) and EN terminals are active,
As it can be observed, as soon as RUN command is ON (***FWD*** or ***REV***) and EN terminals are active,
SCC signal is ON. Therefore from this moment short circuit contact is opened. On the other hand, IGBT's drivers cannot be ON until inverter doesn't receive short circuit contacts feedback (***SCCF***). By means of this, inverter damage can be avoided. As soon as ***SCCF*** signal is received (contact feedback) and timer **L121** is elapsed, inverter can aply voltage at the output as no short circuit is present.

At stopping, ***SCC*** is not OFF until IGBT's drivers are OFF and time L86 has elapsed. By means of this, inverter ensures that when short circuit is applied, IGBT's drivers are OFF, and brake is closed. brake is closed, no regenerated energy can flow from the motor.

In figure 2, an emergency stop timing sequence is shown.

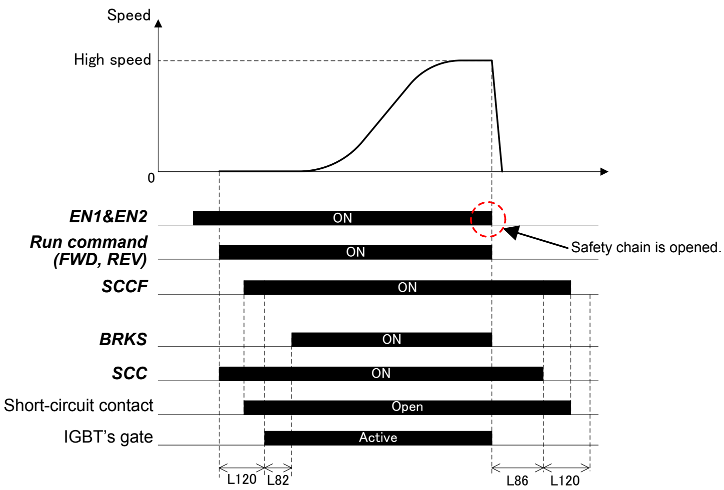


Figure 2. Emergency stop timing sequence.

In figure 3, a starting sequence with feedback contacts timing problem is shown.

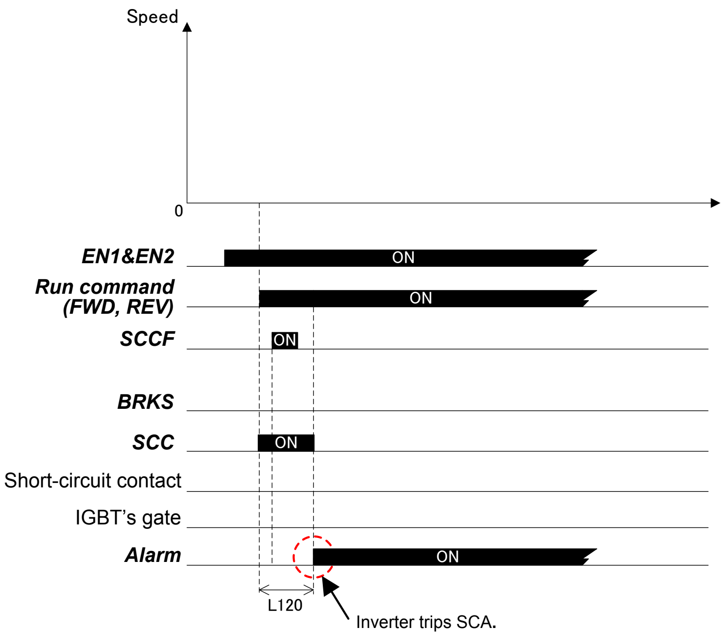


Figure 3. Starting sequence with feedback contacts timing problem (**SCA** alarm).

As it can be observed, inverter waits L121 time in order to receive ***SCCF*** signal (contact feedback). When L121 time finished, no feedback is received from shor circuit contacts, therefore inverter trips SCA alarm. At same time, because constant feedback is not received, IGBT's drivers are not activated and ***SCC*** output signal goes to OFF state.

In figure 4, a stopping sequence with feedback contacts timing problem is shown.

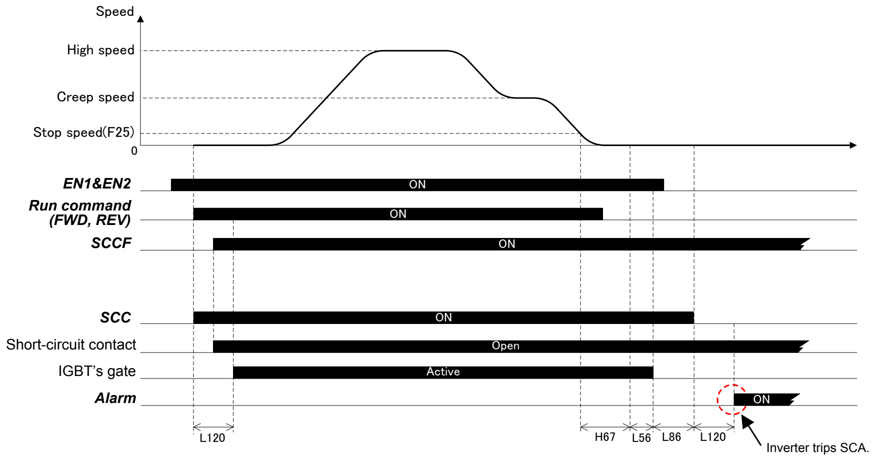


Figure 4. Stopping sequence with feedback contact timing problem (**SCA** alarm)

After time L121 has elapsed, because ***SCCF*** input (feedback) has not changed its status, **SCA** alarm is issued.

In figure 5, a feedback problem during normal travel is shown.

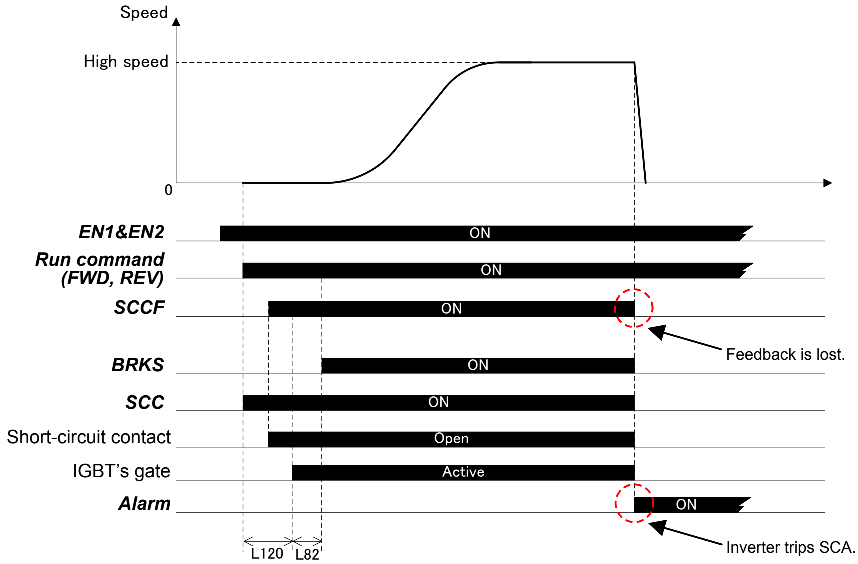


Figure 5. Feedback problem during normal travel (**SCA** alarm).

As it can be observed, during motion no timer is considered, in other words, if feedback is lost (***SCCF*** input signal) inverter trips immediately with **SCA** alarm and output circuit is switched OFF. This is in order to avoid as fast as possible any possible damage on the inverter's output circuit.

In case that L120=1, ***SCC*** will turn ON and OFF under certain conditions as it is explained above. Figures 6, 7, 8 and 9 show the sequence in these cases.

<u>Case 1:</u> Inverter in alarm (***ALM*** output function ON)

Figure 6 shows the case when any alarm (except **SCA**) is issued). As it can be observed, inverter waits anyway the time L86 after IGBT's gates are OFF. By means of this delay time, short circuit contacts will be closed when brake is applied and no current is flowing.

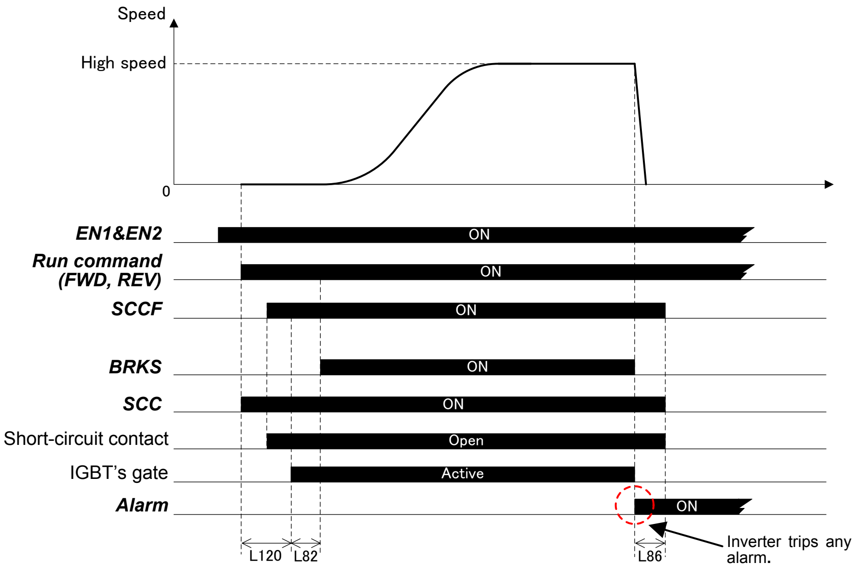


Figure 6. Inverter in alarm (***ALM*** output function ON)

<u>Case 2:</u> ***RBRK*** input function is ON

Figure 7 shows the case of rescue operation by brake control. In this case, motor phases short circuit is performed in order to avoid that motor accelerates too fast.

As it can be observed, as soon as rescue operation by brake control starts (***RBRK*** is ON) function ***SCC*** turns to OFF (short circuit is applied). Contacts feedback is received after the mechanical delay of the power relay (or mini contactor). Brake will not be opened before timer L82 has elapsed. This is in order to avoid that motor brake opens when short circuit is not done, in other words, it avoids that contacts closed while motor is already generating energy. For a similar reason, when rescue operation by brake control finishes (***RBRK*** is OFF) SCC will not be turned ON until timer L86 is elapsed. By means of this short circuit will be open when motors brake is already applied (motor is not generating anymore).

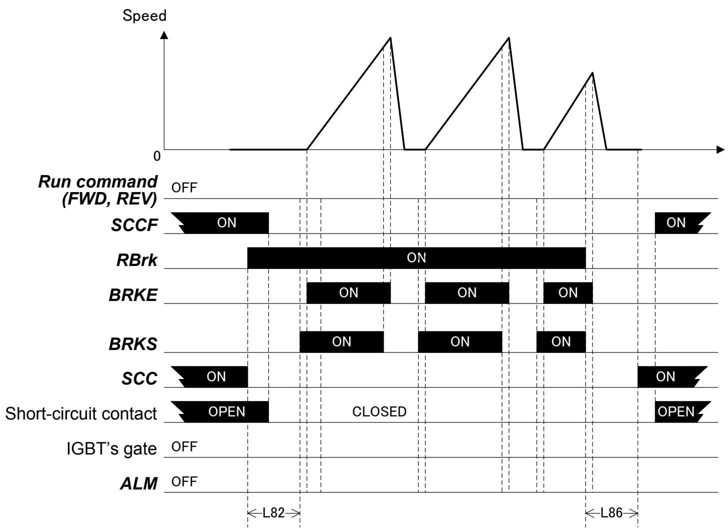


Figure 7. Rescue operation by brake control

<u>Case 3:</u> ***BRKE***, ***BRKE1*** or ***BRKE2*** input functions are ON and ***BRKS*** output function is OFF

Figure 8 shows the case when brake is controlled by external means. This is detected because ***BRKS*** signal is not ON but ***BRKE*** feedback signal is received. This basically means that somebody opened the brake by external means. In this case, short circuit will be applied as well in order to avoid that motor accelerates fast as brake will be opened.

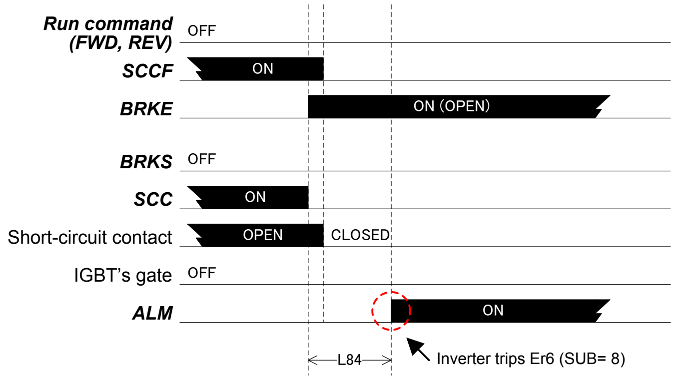


Figure 8. Brake opened by external means.

Case 4: ***STBY*** input function is ON

Figure 9 shows the case when stand-by mode function (***STBY***) is enabled. In this case energy will be saved by not keeping energized motor short circuit conactor.

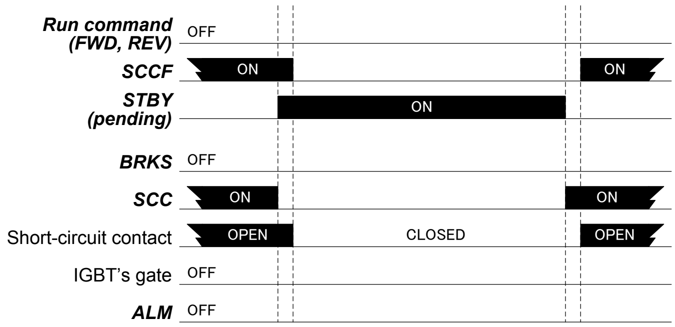


Figure 9. ***STBY*** function enabled.

L122	Deliverance Operation (Input power detection level)
L123	**Deliverance Operation (Direction Calculation Setup)**
L124	**Deliverance Operation (Direction Calculation Delay Timer)**

This function calculates the best direction to perform the movement (FWD or REV), when a vertical load with a counterweight has to be moved and the requirements about the input power are very restrictive (i.e., supplying the inverter by means of a UPS system or batteries).

■Input power detection level (L122)

On this parameter input power detection level is set. This level is used to decide to which direction run the motor.

- Data setting range: 1 to 200 %

■Direction Calculation Setup (L123)

L123 is a byte parameter. Depending on setting of bit 0, 1 and 2, behavior of deliverance operation is decided.

bit	Bit setting description
bit0 Activation	0: Function disabled. If ***BATRY*** input function is enabled, inverter will behave as current FRENIC-Lift during rescue mode. In other words, motor will turn ***FWD*** or ***REV*** depending on input terminal activation.
	1: Function enabled. If ***BATRY*** input is activated, motor will turn in different directions depending on the setting of ***bit1***, ***bit2***, **L123** and **L124**.
bit1 Input power level reached criteria	0: Cancel deliverance operation If during calculation, it is detected that in both directions (FWD and REV), level 121 is reached, deliverance operation is stopped. In other words, inverter will not try to run the motor to any direction
	1: Take the direction with the highest output frequency. In this case, the selected direction will be the one with the highest output frequency when the Input power detection level is reached.
bit2 Directions test criteria	0: Move in ***FWD*** direction Regardless of input terminal activation (RUN command), deliverance operation will turn the motor always in ***FWD*** direction. If level 121 is not reached, deliverance operation will be finished when RUN command is removed.
	1: Move in ***FWD*** and ***REV*** direction Regardless of input terminal activation (RUN command), deliverance operation will turn the motor always in ***FWD*** direction. After few seconds motor will be stopped and ***REV*** direction will be tested. Deliverance operation will be finished in the direction of the RUN command with the lowest input power consumption.

■Direction Calculation Delay Timer (L124)

Calculation of deliverance operation will start after the time set on L124 is elapsed.
- Data setting range: 0.00 to 1.00 s

L125 UPS/batteries minimum operation level

Minimum battery operation level can be defined in this function code. If batteries or UPS are not supplying enough voltage on the DC link to perform battery operation, inverter will be locked by **LV** alarm. By means of this level, battery operation is aborted if DC link voltage is not enough to perform battery operation.

If DC link voltage is above L125 level, rescue operation can be performed (is allowed). If DC link voltage is below or equal to L125 level, rescue operation cannot be performed, inverter will trip **LV** as soon as RUN command (***FWD*** or ***REV***) is given; even ***BATRY*** function is activated in any input.

In figure 1, a rescue operation sequence when DC link voltage is above L125 level is shown.

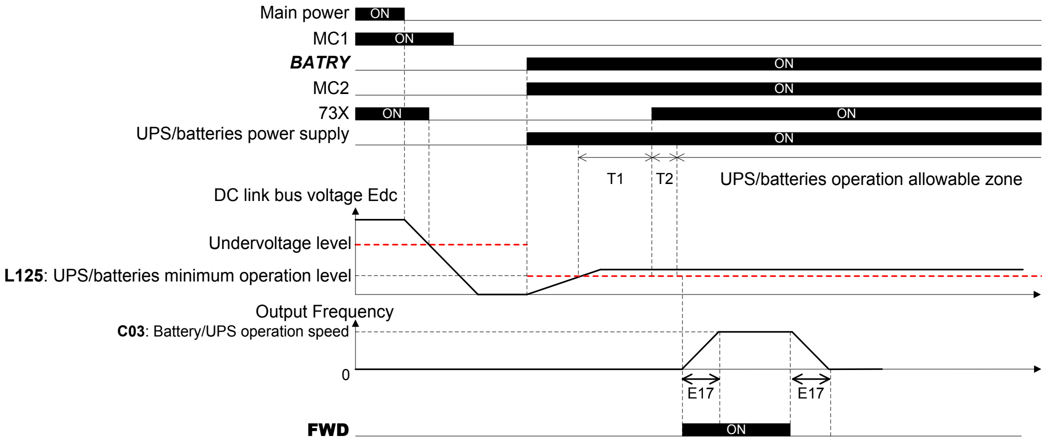


Figure 1. Rescue operation sequence when DC link voltage > L125

As it can be observed Main supply is disconnected for any reason. At this point power supply is changed from mains to batteries (or UPS) by means of MC1 and MC2. MC1 links mains supply to the inverter, MC2 links batteries (or UPS) supply to the inverter. When MC2 is closed voltage increases on DC Link. This voltage reaches L125 level. When inverter and controller are ready to perform rescue operation it starts because DC link voltage level is over L125.

In figure 2, a rescue operation sequence when DC link voltage is below L125 level is shown.

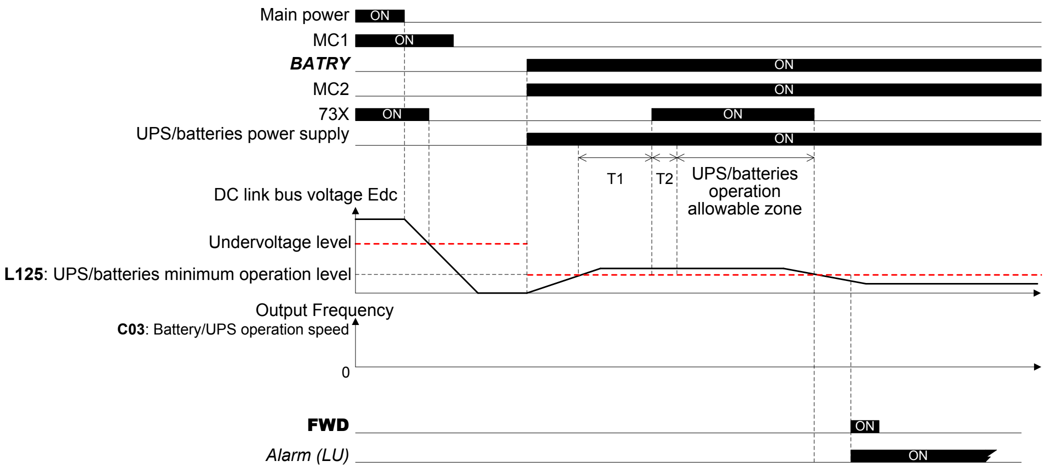


Figure 2. Rescue operation sequence when DC link voltage < L125

As it can be observed Main supply is disconnected for any reason. At this point power supply is changed from mains to batteries (or UPS) by means of MC1 and MC2. When MC2 is closed voltage increases on DC Link. This voltage reaches L125 level but after few minutes it goes below for any reason. When inverter and controller are ready to perform rescue operation it cannot starts as DC link voltage level is below L125. At this point inverter trips with **LV** alarm.

L130	Sheave diameter (Ds)
L131	**Encoder diameter (De)**
L132	**Theta compensation band**
L133	**Theta compensation gain lower limiter**

FRENIC-Lift (LM2A) series includes the motor control “Vector control with peripheral PG (Synchronous motor)”. FRENIC-Lift is able to control PMS motors with incremental encoder even encoder is not installed in the centre of the shaft.

■ Sheave diameter (Ds) (L130)

Set the motor sheave diameter (in mm) in this parameter.

■ Encoder diameter (De) (L131)

Set the encoder sheave diameter.

■ Theta compensation band (L132)

Theta compensation band is used for a better accuracy on Vector control with peripheral PG (Synchronous motor). Please, don’t modify this parameter, default setting is the optimal value.

■ Theta compensation gain lower limiter (L133)

Theta compensation gain lower limit is used for a better accuracy on Vector control with peripheral PG (Synchronous motor). Please, don’t modify this parameter, default setting is the optimal value.

For additional information about “Vector control with peripheral PG (Synchronous motor)”, refer to related Application Note (AN-Lift2-0005v100EN).

L134	Backlash (Delay Time)	L65 Unbalanced Load Compensation (Operation)

Car position is held as backlash position when value of L134 has passed after BRKS switched ON to OFF.

- Data setting range: 0.00 to 10.00

L135	Encorder Electronic name plate (EEPROM bank number)

L136	Encorder Electronic name plate (Mode)

Absolute encoders with EnDat or Hiperface serial communication have a free memory area on internal EEPROM.
This free memory area can be used by the inverter to save (write) data related to motor parameters function codes. On the other hand, inverter can upload (read) this information from the encoder.
The function codes which can be read/write on the encoder are shown in table below.

Func. codes	Name
P01	Motor poles
P02	Motor capacity
P03	Motor rated current
P06	Motor no-load current
P07	Motor %R1
P08	Motor %X
F04	Base speed
F05	Rated voltage
F11	Electric thermal – level
F12	Electric thermal – time constant
L02	Encoder pulse rate
L04	PP offset
L05	ACR – P
L97	PP tuning – Alternating voltage

■Encorder Electronic name plate (EEPROM bank number) (L135)

L135 is EEPROM bank number. Please check with encoder manufacturer.

- Data setting range: 0 to 255

■Encorder Electronic name plate (Mode) (L136)

L101 specifies the operation of Encorder Electronic name plate.

- Data setting range: 0: Disable
  1: Read
  2: Write

To change the L136 data, it is necessary to press the STOP + ⌃ / ⌄ keys (simultaneous keying).

L143	Load cell function (Overload mode selection)

L144	Load cell function (Timer)

L145	Load cell function (LC1 detection level)

L146	Load cell function (LCF detection level)

L147	Load cell function (LCO detection level)

In case of very reversible lift installations with synchronous motor, detected torque can be used to estimate the load inside car, in other words, torque is proportional to the load. On the other hand, nowadays lift manufacturers are installing load cells on the lifts in order to detect load inside car. As it is stated in EN 81-1:1998+A3:2009 *14.2.5 Load control* movement of the lift has to be prevented in case of overload. Load cell is a device which increases the cost of the lift, and needs to be adjusted. By means of load cell function, installation of load cell can be avoided in certain cases.

This function is not available under Torque Vector control. This function detects the load inside the car during zero speed at starting.

■ Load cell function (Overload mode selection) (L143)

Load cell function can operate in a different ways when Overload (LCO) level is detected.

Data for L143	Action
0 (Default setting)	When overload is detected (according to setting on L144 and L147) ***LCO*** output function is activated. Inverter doesn't stop operation. It is a decision of the controller to stop or not the lift.
1	When overload is detected (according to setting on L144 and L147) LCO ouput function is activated. After closing the brake, inverter stops and trips with ***LCO*** alarm.

■ Load cell function (Timer) (L144)

In order to detect torque at zero speed, brake has to be opened and some time is needed to stabilize motor's current. This time is defined in L144 function code.

■ Load cell function (LC1 detection level) (L145)

Torque level set on this parameter will be understood as, torque needed to keep zero speed when one person (or a certain level of load) is inside the car.

In order to set L145 correctly, please check torque at zero speed when one person is inside car (or certain amount of load that wants to be detected) after rollback is compensated.

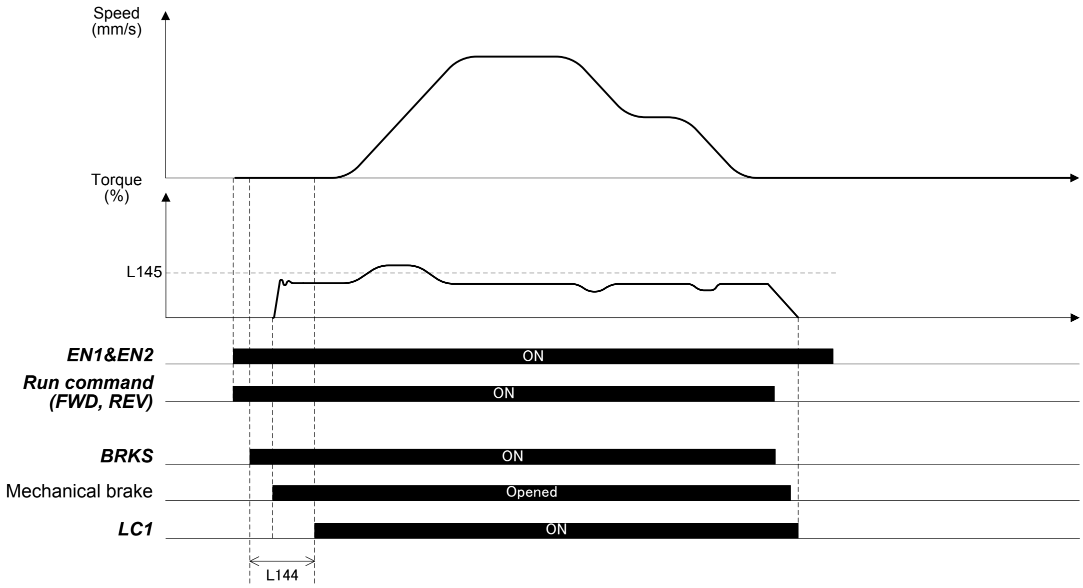


Figure 1. Level detection 1 (***LC1***)

As it can be observed, as soon as ***BRKS*** signal goes to ON, L144 timer starts to count. On the other hand, as soon as mechanical brake opens torque (output current) increases but some time is needed to stabilize torque at zero speed. When L144 timer is elapsed, because torque is below L145 level, output function ***LC1*** is going to ON state. This is understood as one person inside the car (or similar situation). ***LC1*** is kept to ON until current (torque) is completely removed from the motor. When current is removed from the motor it is understood that travel is finished. ***LC1*** signal will go to OFF when travel is finished.

■ Load cell function (LCF detection level) (L146)

Torque level set on this parameter will be understood as, torque needed to keep zero speed when car is full.

In order to set L146 correctly, please check torque at zero speed when full load is inside car after rollback is compensated.

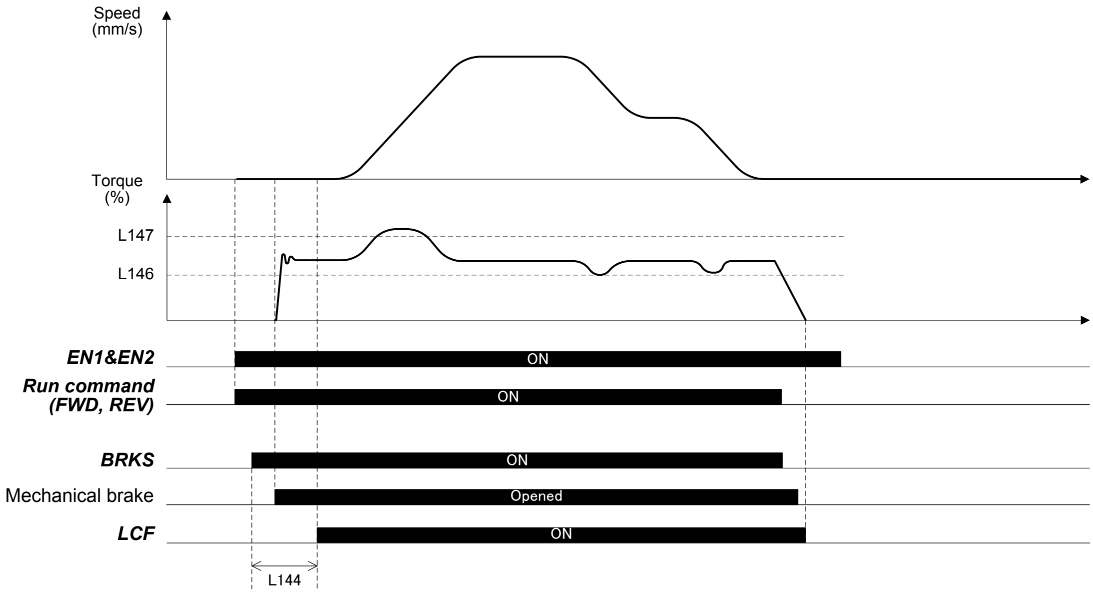


Figure 2. Full load detection level (***LCF***)

As it can be observed, as soon as ***BRKS*** signal goes to ON, L144 timer starts to count. On the other hand, as soon as mechanical brake opens torque (output current) increases but some time is needed to stabilize torque at zero speed. When L144 timer is elapsed, because torque is between levels L146 and L147, output function ***LCF*** is going to ON state. This is understood as full load inside the car. ***LCF*** is kept to ON until current (torque) is completely removed from the motor. When current is removed from the motor it is understood that travel is finished. ***LCF*** signal will go to OFF when travel is finished.

■ Load cell function (LCO detection level) (L147)

Torque level set on this parameter will be understood as, torque needed to keep zero speed when car is in overload.

In order to set L147 correctly, please check torque at zero speed when maximum load allowed is inside car after rollback is compensated.

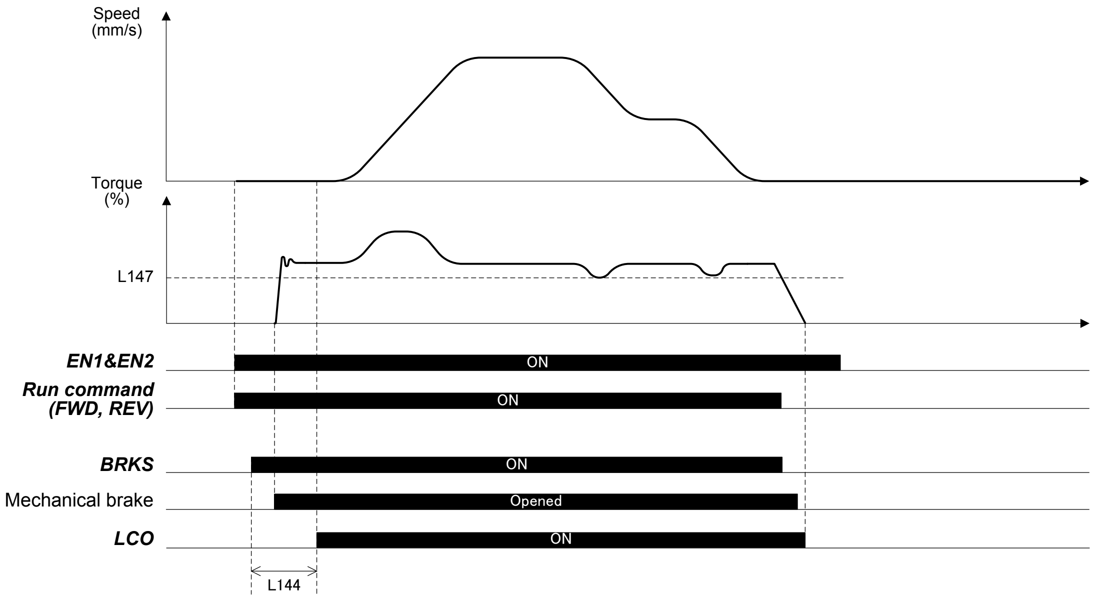


Figure 3. Overload detection level (***LCO***)

As it can be observed, as soon as ***BRKS*** signal goes to ON, L144 timer starts to count. On the other hand, as soon as mechanical brake opens torque (output current) increases but some time is needed to stabilize torque at zero speed. When L144 timer is elapsed, because torque is over L147 level, output function ***LCO*** is going to ON state. This is understood as full load inside the car. ***LCO*** is kept to ON until current (torque) is completely removed from the motor. When current is removed from the motor it is understood that travel is finished. ***LCO*** signal will go to OFF when travel is finished.

On the other hand, because of a faster reaction, an inverter alarm can be selected. When inverter is in alarm mode, it disables output circuit (current) and brake is applied. This behavior can be set on function code L143.On figure 4, overload detection with **LCO** alarm is shown

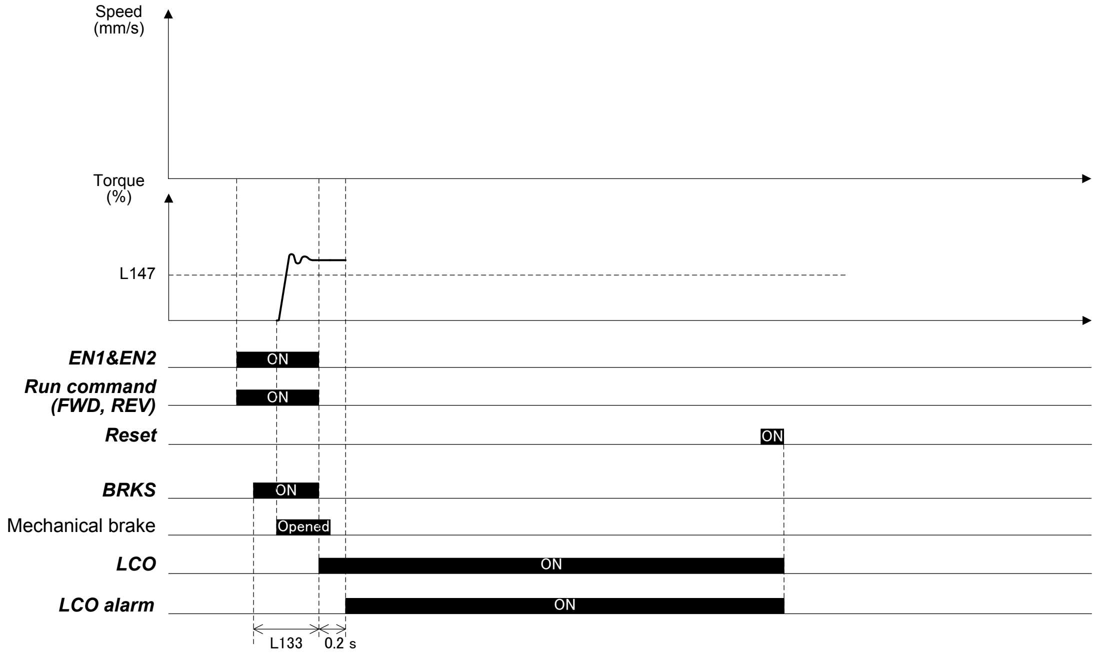


Figure 4. Overload detection with **LCO** alarm (L132=1)

As it can be observed, as soon as ***BRKS*** signal goes to ON, L144 timer starts to count. On the other hand, as soon as mechanical brake opens torque (output current) increases but some time is needed to stabilize torque at zero speed. When L144 timer is elapsed, because torque is over L147 level, output function ***LCO*** is going to ON state. After 0.2 s, in order to make sure brake is closed before current is removed, ***LCO*** alarm is issued.

L197	Warning selection switch

Set L197 bits according to Light Alarm setting.

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Warning code	-	-	-	-	-	-	-	tCW
Warning function	-	-	-	-	-	-	-	TDC lifetime early warning
Data=0	-	-	-	-	-	-	-	Disable
Data=1	-	-	-	-	-	-	-	Enable
Default	-	-	-	-	-	-	-	0

■ TDC Lifetime early warning (Bit 0)

When L197 Bit 0 is set to 1 TDC ligth alarm function is enabled. Light alarm level is set by function code L112.

For additional information please refer to TDC function (L109~L115).

L198	Operation setting switch 1

Set L198 bits according to inverter operation.

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	Short detection cancel	Ground fault detection cancel	-	-	-	-	Masked parameters depending on set control mode	Carrier frequency fixed
Data=0	Enable	Enable	-	-	-	-	Disable	Disable
Data=1	Cancel	Cancel	-	-	-	-	Enable	Enable
Default	0	0	0	0	0	0	0	0

■ Carrier frequency fixed (Bit 0)

It is possible to fix the carrier frequency to 16 kHz for the whole speed range in order to reduce driving noise.

Refer to the description of function code F26.

■ Masked parameters depending on set control mode (Bit 1)

It is available to mask unused function codes according to each control mode.

■ Ground fault detection cancel (Bit 6)

■ Short detection cancel (Bit 7)

Normally it is not necessary to change these bits.

L201	Pulse output (OPC-PR/PS/PSH) (AB pulse output rate)
L202	Pulse output (OPC-PR/PS/PSH) (AB pulse output order)
L203	Pulse output (OPC-PR/PS/PSH) (Z pulse output)
L205	Pulse output (OPC-PR/PS/PSH) (AB pulse output hysteresis)
L209	Pulse output (OPC-PR/PS/PSH) (Number of ST bits)

For details, refer to the instruction manual of the corresponding option card.

2.3.9 K codes (Keypad functions)

K01	LCD monitor (Language selection)

K01 specifies the language to display on the multi-function keypad as follows:

Data for K01	Language	Data for K01	Language
0	Japanese	9	Greek
1	English	10	Turkish
2	German	11	Polish
3	French	12	Czech
4	Spanish	13	Swedish
5	Italian	14	Portuguese
6	Chinese	15	Dutch
8	Russian	100	User-customizable

Note If the langue for touch panel which connect with inverter is not belong to above range, English will be indicated.

K02	LCD monitor (Backlight off time)

K02 specifies the backlight OFF time of the LCD on the keypad.

When no keypad operation is performed during the time specified by K02, the backlight goes OFF.

-Data setting range: 1 to 30 (min.), OFF

Data for K02	Function
OFF	Always turn the backlight OFF
1 to 30 (min.)	Turn the backlight OFF automatically after no keypad operation is performed during the backlight OFF time.

The backlight OFF time can be configured easily in Programming mode as follows.

PRG > 1(Start-up) > 3(Disp Setting) > 9(Lighting time)

K03 K04	LCD monitor (Backlight brightness control) (Contrast control)

These function codes control the backlight brightness and contrast.

-Data setting range: 0 to 10

■Backlight brightness control (K03)

Data for K03	0, 1, 2, • • • • • • • • • • • • • • • 8, 9, 10
0	Dark ←→ Light

■Contrast control (K04)

Data for K04	0, 1, 2, • • • • • • • • • • • • • • • 8, 9, 10
0	Dark ←→ Light

📖The backlight brightness and contrast can be controlled easily in Programming mode as follows.

PRG > 1(Start-up) > 3(Disp Setting) > 10(Brightness)

PRG > 1(Start-up) > 3(Disp Setting) > 11(LCD Contrast)

K08 LCD Monitor Status Display/Hide Selection

K08 selects whether to display or hide the status messages to be monitored on the LCD monitor on the keypad.

-Data setting range: 0, 1

Data for K08	Function
0	Hide status messages
1	Display status messages (factory default)

<LCD on the keypad>

Status messages
Capacitor lifetime being measured
Undervoltage
No input to EN
Input to BX
During auto resetting for alarm
During drive continuance alarm
During standby mode
Load factor being measured
During rescue operation by brake control
During battery operation

K15 Sub monitor (Display type)

K15 specifies the LCD monitor display mode to be applied when the inverter using the multi-function keypad is in Running mode.

Data for K15	Function
0	Running status, rotational direction and operation guide
1	Bar charts for reference speed (final), output current and reference torque

K16 K17 — Sub Monitor 1 (Display item selection) / Sub Monitor 2 (Display item selection)

K16 and K17 specify the monitoring item to be displayed on the sub monitor 1 and 2.

-Data setting range: 1 to 30

Data	Function (Item to be displayed)	LCD indicator	Unit	Description
1	Reference speed (final)	Spd	selected by C21	-
3	Reference speed (pre-ramp)	S.Spd	selected by C21	-
4	Motor speed	Sync	r/min	-
6	Elevator speed	Lift	m/min	-
9	Elevator speed (mm/s)	Lift	mm/s	-
13	Output current	Iout	A	Inverter output current expressed in RMS (A)
14	Output voltage	Vout	V	Inverter output voltage expressed in RMS (V)
18	Calculated torque	TRQ	%	Reference torque (%) based on the motor rated torque *1
19	Input power	PWR	kW	Inverter's input power (kW)
28	Reference torque	TRQC	%	Torque in % based on the motor rated torque being at 100%
29	Torque bias balance (Offset) adjustment (BTBB)	BTBB	%	Used to adjust the analog torque bias balance
30	Torque bias gain adjustment (BTBG)	BTBG	%	Used to adjust the analog torque bias gain

*1 In vector control with PG, this item shows the reference torque.

The monitor items of sub monitors 1 and 2 can be selected easily in Programming mode as follows.

PRG > 1(Start-up) > 3(Disp Setting) > 4(Sub Monitor 1)

PRG > 1(Start-up) > 3(Disp Setting) > 5(Sub Monitor 2)

K20 K21 K22	Bar Chart 1 (Display item selection) Bar Chart 2 (Display item selection) Bar Chart 3 (Display item selection)

These function codes specify the items to be displayed in bar graphs 1 to 3 on the LCD monitor.

-Data setting range: 1 to 30

Data	Monitor item	LCD indicator	Definition of monitor amount 100%
1	Reference speed (Final)	Spd	Rated Speed (F03)
13	Output current	Iout	Twice the inverter rated current
14	Output voltage	Vout	200 V class: 250 V 400 V class: 500 V
18	Calculated torque	TRQ	Twice the rated motor torque
19	Input power	PWR	The inverter rated capacity
28	Reference torque	TRQC	Twice the rated motor torque
29	Torque bias balance adjustment (Offset) (BTBB)	BTBB	Twice the rated motor torque
30	Torque bias gain adjustment (BTBG)	BTBG	Twice the rated motor torque

The monitor items for bar charts 1 to 3 can be selected easily in Programming mode as follows.

PRG > 1(Start-up) > 3(Disp Setting) > 6(Bar Chart 1)
PRG > 1(Start-up) > 3(Disp Setting) > 7(Bar Chart 2)
PRG > 1(Start-up) > 3(Disp Setting) > 8(Bar Chart 3)

K23	Traveling direction selection

K23 specifies the relation between “FWD / REV” and “Upward / Downward” for keypad displaying.

Data for K23	moving FWD	moving REV
0	⬆ Upward	⬇ Downward
1	⬇ Downward	⬆ Upward

K91 K92	Shortcut Key Function for ⟨ in Running Mode Shortcut Key Function for ⟩ in Running Mode

These function codes define "jump-to" menus on the ⟨ and ⟩ keys as a shortcut key. Pressing the shortcut keys ⟨ or ⟩ in Running mode jumps the screen to the previously defined menu.

Assigning frequently-used menus to the shortcut keys allows a single touch of the shortcut key to open the target menu screen.

-Data setting range: 0 (Disable), 11 to 99

Example: Data 1 1

Sub menu # (second digit)
Menu # (first digit)

Data for K91, K92	Jump to:	
	Menu	Sub menu
0	-- (Disable)	--
11	Start-up	Language
12		App select
13		Disp setting
21	Function Codes	Data Set
22		Data Check
23		Changed Data
24		Data Copy
25		Initialize
31	INV Info	Op Monitor
32		I/O Check
33		Maintenance
34		Unit Info
35		Travel counter
41	Alarm Info	Alarm History
51	User Config	Select Q. Setup
61	Tools	CLogic Monitor
62		Load Factor
63		COM Debug

Chapter 3

OPERATION USING “TP-A1-LM2”

This chapter describes how to operate FRENIC-Lift (LM2A) using with optional multi-function keypad “TP-A1-LM2”.

Contents

3.1 LCD monitor, keys and LED indicators on the keypad

The keypad "TP-A1-LM2" allows you to run and stop the motor, monitor the running status, specify the function code data, and monitor I/O signal states, maintenance information, and alarm information.

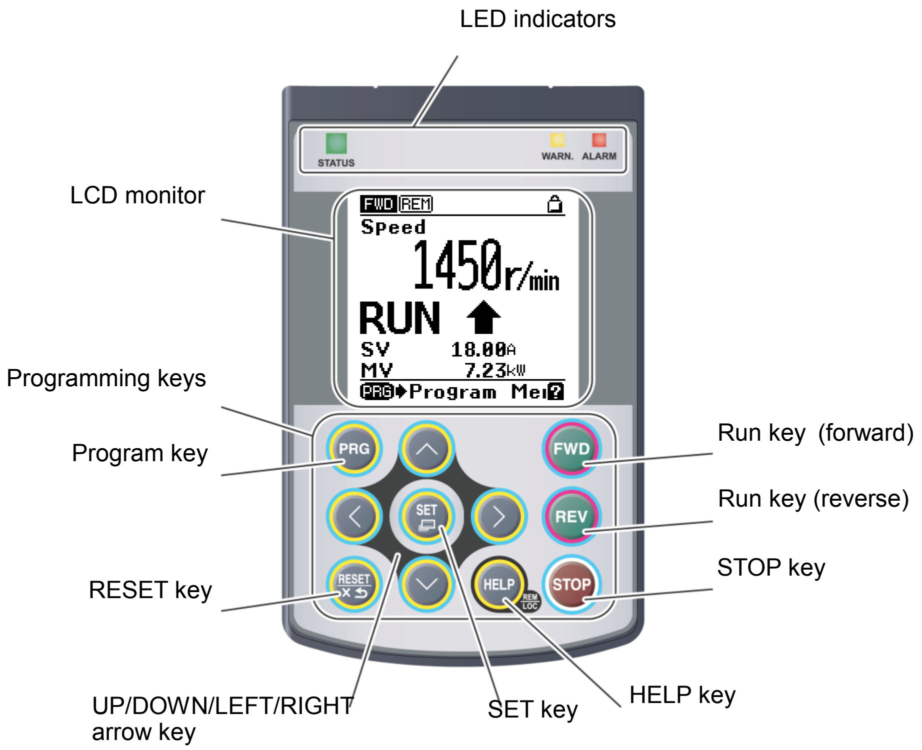


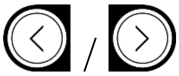
Figure 3.1 Names and Functions of Keypad Components

LED indicators:	These indicators show the current running status of the inverter.	Refer to Table 3.1.
LCD monitor:	This monitor shows the following various information about the inverter according to the operation modes.	Refer to Figure 3.2 and Table 3.3 and Table 3.4.
Keys:	These keys are used to perform various inverter operations.	Refer to Table 3.2.

Table 3.1 Indication of LED Indicators

LED Indicators	Indication	
STATUS (Green)	Shows the inverter running state.	
	Flashing	No run command input (Inverter stopped)
	ON	Run command input
WARN. (Yellow)	Shows the warning state (light alarm).	
	OFF	No light alarm has occurred.
	Flashing /ON	A light alarm has occurred. But inverter can continue running.
ALARM (Red)	Shows the alarm state (heavy alarm).	
	OFF	No heavy alarm has occurred.
	Flashing	A heavy alarm has occurred. Inverter shuts off its output.

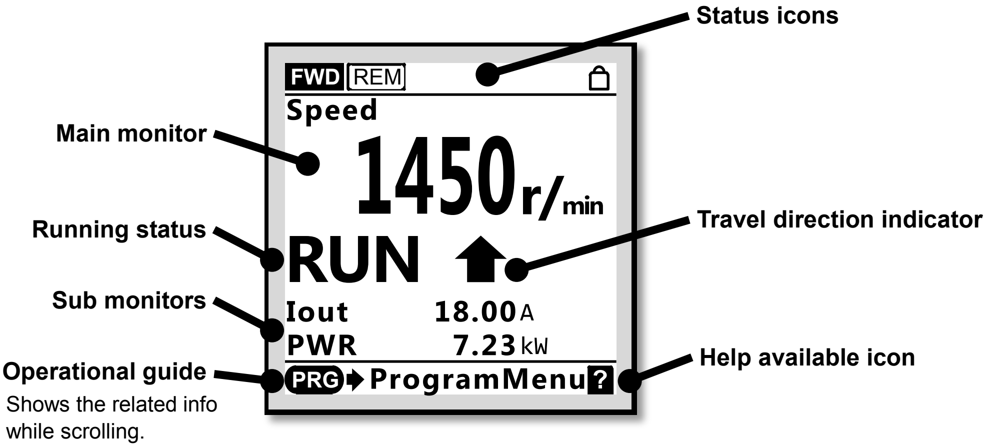
Table 3.2 Overview of Keypad Functions

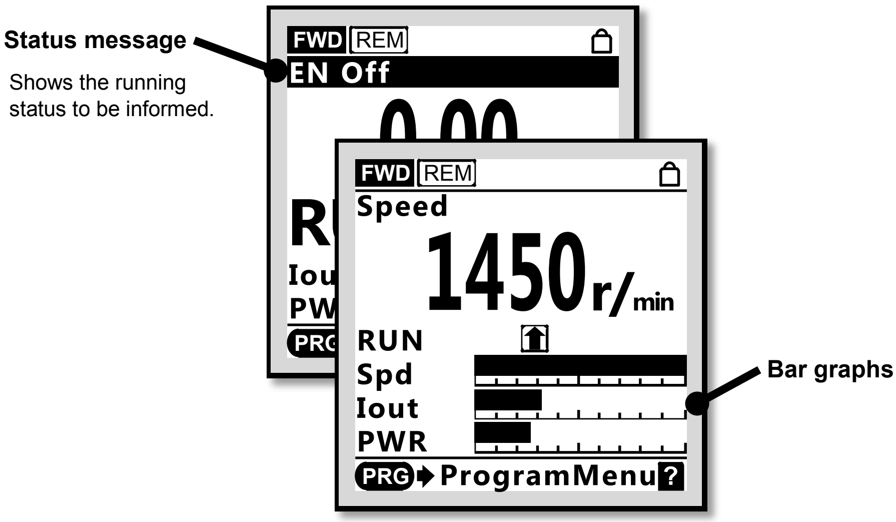
Keys	Functions
	This key switches the operation modes between Running mode/Alarm mode and Programming mode.
	Reset key which works as follows according to the operation modes. ■ In Running mode: This key cancels the screen transition. ■ In Programming mode: This key discards the settings being configured and cancels the screen transition. ■ In Alarm mode: This key resets the alarm states and switches to Programming mode.
	UP/DOWN key which works as follows according to the operation modes. ■ In Running mode: These keys switch to the digital reference speed (when local mode). ■ In Programming mode: These keys select menu items, change data, and scroll the screen. ■ In Alarm mode: These keys display multiple alarms and alarm history.
	These keys move the cursor to the digit of data to be modified, shift the setting item, and switch the screen.
	Set key which works as follows according to the operation modes. ■ In Running mode: Pressing this key switches to the selection screen of the LCD monitor content. ■ In Programming mode: Pressing this key establishes the selected items and data being changed. ■ In Alarm mode: Pressing this key switches to the alarm detailed information screen.
	Pressing this key calls up the HELP screen according to the current display state. Holding it down for 2 seconds toggles between the remote and local modes.
	Pressing this key starts running the motor in the forward rotation (when local mode).
	Pressing this key starts running the motor in the reverse rotation (when local mode).
	Pressing this key stops the motor (when local mode).

■ LCD Monitor

The LCD monitor shows various information of the inverter according to the operation modes.

< Screen example in Running mode >





< Screen example in Alarm mode >

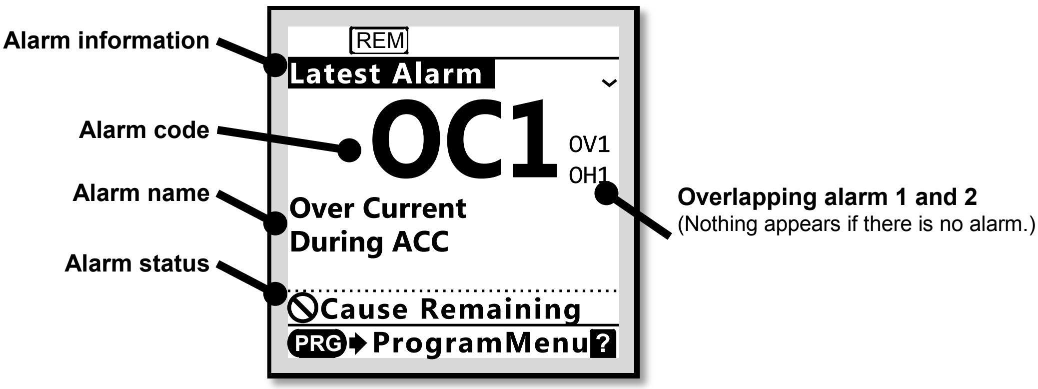


Figure 3.2 Main items displayed on the LCD monitor

Table 3.3 Icons on the LCD Monitor

Status icons that show the running status, run command sources and various icons		
FWD	Running status (rotation direction)	Running forward
REV		Running reverse
REM	Run command source	External terminals
COM		Communications link
LOC		Keypad in local mode
🔒	Password protection state	Locked with password 1 (Function code data change is prohibited.)
🔓		Lock being released (Password being canceled temporally)
⇧	Travel direction (Appears during Programming mode and Alarm mode.)	Traveling upward
⇩		Traveling downward
Running status		
STOP	Running status	No run command entered or inverter stopped
RUN		Run command entered or during inverter output
Travel direction indicator		
⬆	Travel direction (Appears during Running mode.)	Traveling upward
⬇		Traveling downward

Table 3.4 Status messages on the LCD Monitor

Status messages	Appearance condition
Low Supply Volt	Run command is turned ON at low supply voltage.
EN Off	Run command is turned ON when [EN1] and/or [EN2] are being released.
BX Active	Run command is turned ON when ***BX*** command is being turned ON.
AutoReset ALM	Inverter is trying / waiting to reset the alarm automatically.
Pre-Alarm	Inverter is detecting pre-alarm by overheat.
Standby	Inverter is in standby mode by means of ***STBY*** command.
Unlocking SG	Inverter is trying to unlock safety gear by means of ***ULSG*** command.
Rescue by BRKS	Inverter is releasing brakes for emergency rescue operation by means of ***RBRK*** command.
Battery Op.	Inverter is operating as battery mode by means of ***BATRY*** command.
DC-Cap. Measure	Inverter is measuring its main capacitor lifetime before turning power OFF.
L.Factor Measure	Inverter is measuring load factor of the applying system.

Note LCD has temperature characteristics. The low temperature slows down the LCD response; the high temperature makes the screen contrast high so that contrast adjustment may be needed.

3.2 Overview of Operation Modes

The keypad has the following three operation modes:

■ Running mode : After powered ON, the inverter automatically enters this mode.

This mode allows you to specify the reference speed, and run/stop the motor with the FWD / REV / STOP keys during local mode.

It is also possible to monitor the running status in real time.

■ Programming mode : This mode allows you to configure function code data and check a variety of information relating to the inverter status and maintenance.

■ Alarm mode : If an alarm condition arises, the inverter automatically enters Alarm mode. In this mode, you can view the corresponding alarm code* and its related information on the LCD monitor.

* Alarm code: Indicates the cause of the alarm condition.

Figure 3.3 shows the status transition of the inverter between these three operation modes. If the inverter is turned ON, it automatically enters Running mode, making it possible to start or stop the motor.

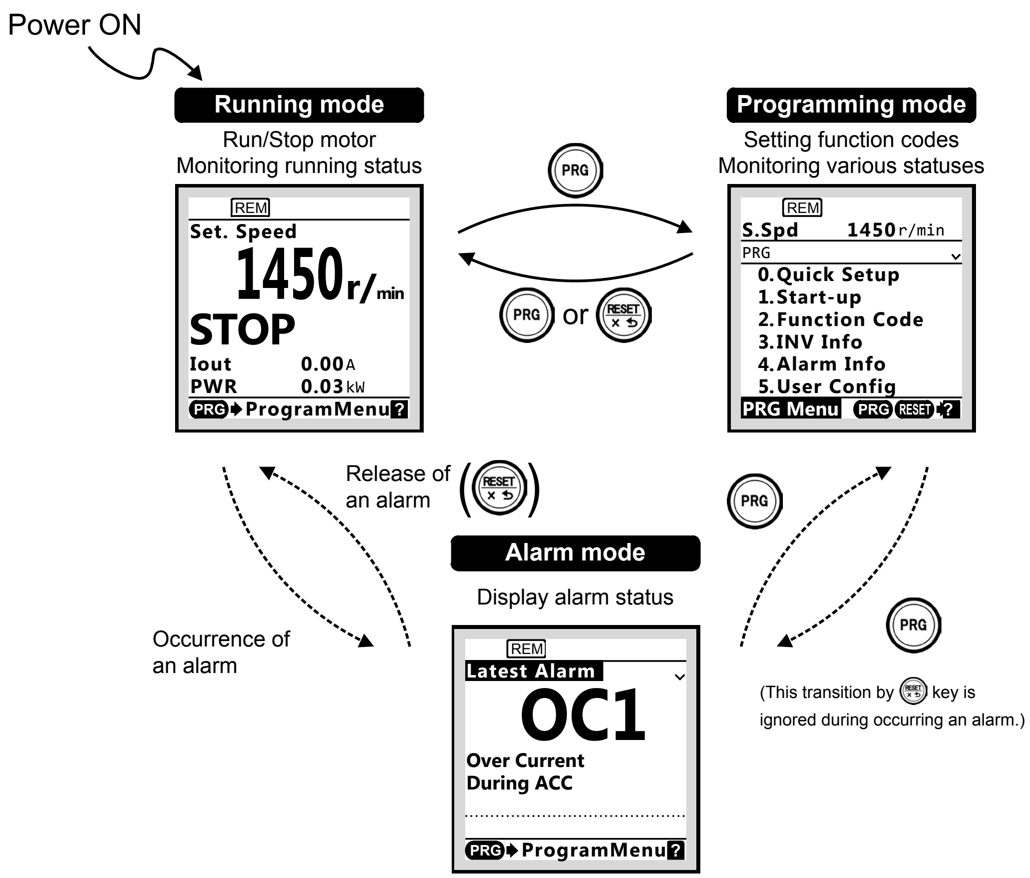


Figure 3.3 Screens Transition between each operation Modes

3.3 Running Mode

When the inverter is turned on, it automatically enters Running mode in which you can:

(1) Monitor the running status (e.g., reference speed and output current),
(2) Switch between remote and local modes,
(3) Configure the reference speed (pre-ramp), and
(4) Run/stop the motor.

3.3.1 Monitoring the running status

In Running mode, the nine items listed below can be monitored. Immediately after the inverter is turned on, the monitor item specified by function code K10 is displayed. Press the SET key to switch between monitor items.

Table 3.5 Monitoring Items (Selectable anytime)

Monitor #	Monitor Items	Sub-monitor	Unit	Meaning of displayed value	Function code data for E43
0	Speed monitor	Function code E48 specifies what to be displayed on the main monitor.			0
	Reference speed (final)	Spd	*1	Reference speed (final) command to the Automatic speed regulator (ASR)	(E48 = 0)
	Reference speed (pre-ramp)	S.Spd	*1	Reference speed being set	(E48 = 2)
	Motor speed	Sync	r/min	Motor rotation speed	(E48 = 3)
	Elevator speed	Lift	m/min	Elevator speed in m/min	(E48 = 5)
	Elevator speed 2	Lift	mm/s	Elevator speed in mm/s	(E48 = 8)
13	Output current	Iout	A	Current output from the inverter in RMS	3
14	Output voltage	Vout	V	Voltage output from the inverter in RMS	4
18	Calculated torque	TRQ	%	Calculated motor output torque in % *2	8
19	Input power	PWR	kW	Input power to the inverter	9
28	Reference torque	TRQC	%	Motor output torque in %	18
29	Torque bias balance adjustment value	BTBB	%	Used to adjust the analog torque bias balance	19
30	Torque bias gain adjustment value	BTBG	%	Used to adjust the analog torque bias gain	20

*1 Function code C21 provides a choice of speed units – Hz, r/min, m/min, and mm/s.

*2 In vector control with PG, this item shows the reference torque.

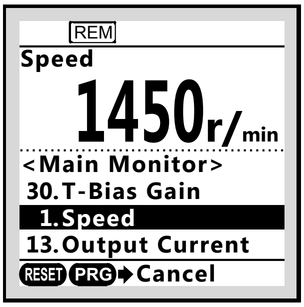


Figure 3.4 Switching main monitor item (display example)

3.3.2 Remote and Local modes

The inverter is available in either remote or local mode.

In remote mode, which applies to normal operation, the inverter is driven under the control of the data setting stored in the inverter. In local mode, which applies to maintenance operation, it is separated from the control system and is driven manually under the control by the keypad.

Holding down the HELP key on the keypad for 2 seconds or more, toggles between remote and local modes. Additionally, local mode is not kept after turning power on again. In other words, the inverter starts up as remote mode always.

Tip: The current mode can be checked by the status icons. The REM / COM is displayed in remote mode and the LOC is displayed in local mode.

Switching from remote to local mode automatically inherits the reference speed (pre-ramp) used in remote mode. If the motor is running at the time of the switching from remote to local, the run command will be automatically kept ON. If, however, there is a discrepancy between the settings used in remote mode and ones made on the keypad (e.g., switching from the reverse rotation in remote mode to the forward rotation only in local mode), the inverter automatically stops.

3.3.3 Setting up reference speed (pre-ramp)

In local mode, you can set up the desired reference speed (pre-ramp) in displayed units with ∧ / ∨ keys on the keypad.

(1) Switch the keypad to Running mode. This is because in Programming or Alarm mode, the ∧ / ∨ keys are disabled to set the reference speed (pre-ramp).

(2) Press the ∧ / ∨ key to display the current reference speed (pre-ramp). The lowest digit will blink.

(3) To change the reference speed (pre-ramp), press the ∧ / ∨ key again. The new setting can be saved into the inverter's internal memory.

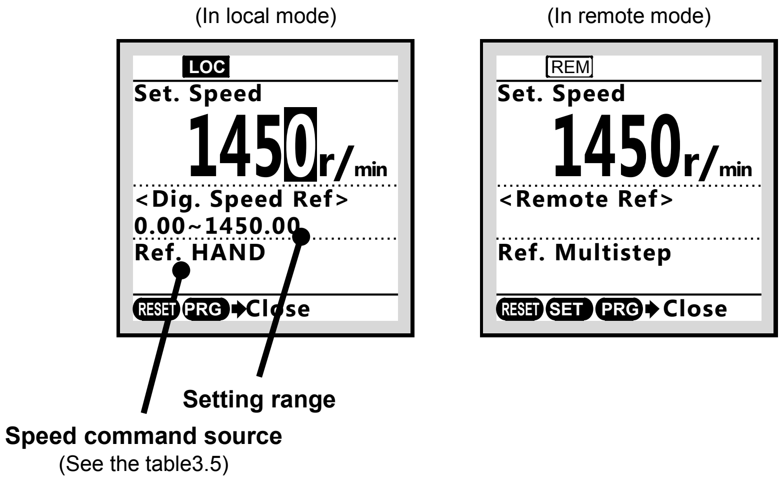


Figure 3.5 Setting up reference speed (display example)

Tip:

- The reference frequency will be saved either automatically by turning the main power OFF.
- When you start specifying the reference speed (pre-ramp) or any other parameter with the ∧ / ∨ key, the least significant digit on the display blinks; that is, the cursor lies in the least significant digit. Holding down the ∧ / ∨ key changes data in the least significant digit and generates a carry, while the cursor remains in the least significant digit.

  Using the < / > key moves the cursor (blinking) between digits, making change to the large value easily.

Table 3.6 Available Speed command sources

Symbol	Command source	Symbol	Command source
HAND	Keypad	Multistep	Multistep speed command
AnlgNR	Analog speed command (Not reversible)	Anlg_R	Analog speed command (Reversible)
RS485 Ch1	Via RS485 communications link (port 1: Keypad port)	RS485 Ch2	Via RS-485 communications link (port 2: Terminal block)
Loader	Via FRENIC Loader software	CAN	Via CAN communications link
Jogging	Jogging operation		

3.3.4 Running/stopping the motor

In local mode, pressing the FWD / REV key starts running the motor in the forward or reverse direction and pressing the STOP key decelerates the motor to stop. The FWD / REV key is enabled only in Running and Programming mode.

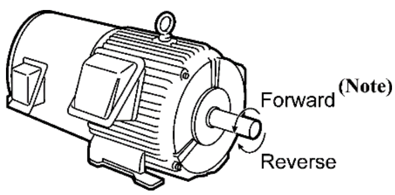


Figure 3.6 Rotational direction of motor

Note) The rotational direction of IEC-compliant motor is opposite to the one shown here.

Chap. 3 OPERATION USING "TP-A1-LM2"

3.4 Programming Mode

Programming mode allows the setting and confirmation of function codes, and monitoring of maintenance-related and input/output (I/O) terminal information, as well as other functions. A menu format is used to enable simple function selection. The menu transition for programming mode is shown below.

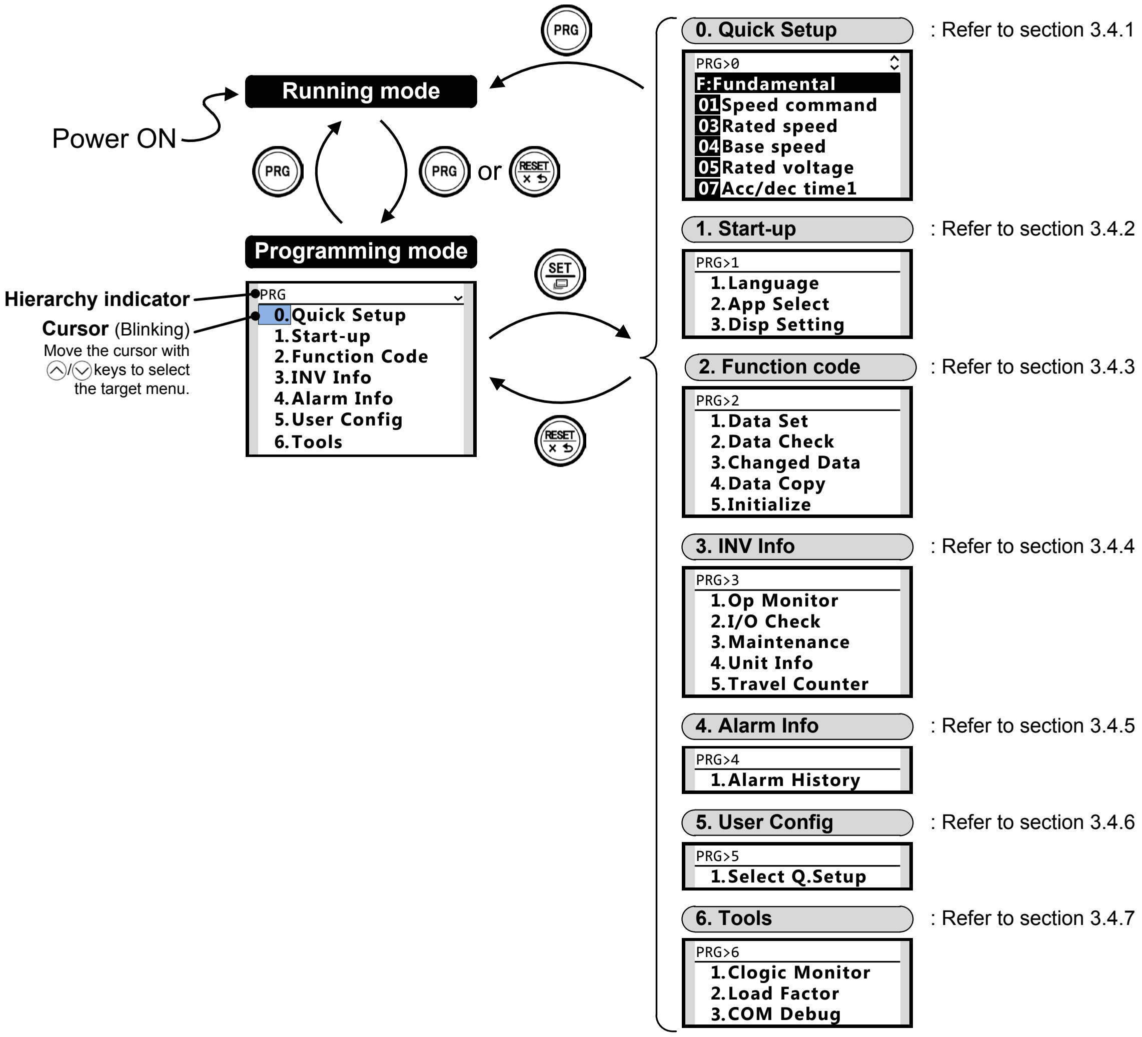


Figure 3.7 Menus transition in Programming mode

■ Hierarchy indicator

The hierarchical structure for each screen is indicated in order to let you know where you are. For example, if you see "Alarm history" screen, this indicator shows as PRG>4>1.

Additionally, this indicator might show page number, function code number, alarm code, or etc. with corresponding to each situations.

Table 3.7 Menus available in Programming mode

Main Menu	Sub-Menu		Hierarchy indicator	Principal Functions
0. Quick Setup: Shows only frequently used function codes.				
	—	—	PRG>0	
1. Start-up: Sets functions for initial settings.				
	1	Language	PRG>1>1	Sets language to be displayed on LCD monitor.
	2	Select application	PRG>1>2	Allows individual initialization of function codes that are grouped by application.
	3	Display settings	PRG>1>3	Selects content to be displayed on LCD screen.
2. Function Code: Setting screens related to function codes, such as setting/copying function code data.				
	1	Set data	PRG>2>1	Allows function code data to be displayed/changed.
	2	Confirm data	PRG>2>2	Allows confirmation of function code settings.
	3	Confirm revised data	PRG>2>3	Allows confirmation of function code changes from factory-default settings.
	4	Copy data	PRG>2>4	Reads, writes and verifies function code data between the inverter and the keypad.
	5	Initialize data	PRG>2>5	Restores function code data values to factory-default settings.
3. INV Information: Allows monitoring of inverter operational status.				
	1	Operation monitor	PRG>3>1	Displays operational information.
	2	I/O checking	PRG>3>2	Displays external interface information.
	3	Maintenance information	PRG>3>3	Displays cumulative run time and other information used during maintenance.
	4	Unit information	PRG>3>4	Allows confirmation of inverter type, serial number and ROM version.
	5	Travel direction counter	PRG>3>5	Allows confirmation and setting of travel direction counter. This function provides the information for replacing wire/rope.
4. Alarm Information: Displays alarm information.				
	1	Alarm history	PRG>4>1	Lists alarm history (newest + 3 previous). Also this allows you to view the detail information on the running status at the time when alarm occurred.
5. User Configure: Allows any settings to be made.				
	1	Quick setup selection	PRG>5>1	Allows function codes to be added to or deleted from the "Quick Setup".
6. Tools: Various functions				
	1	Customizable logic monitor	PRG>6>1	Previews status of each step in customizable logic.
	2	Load Factor Measurement	PRG>6>2	Allows measurement of the operational status of the maximum output current and average output current.
	3	Communication Debugging	PRG>6>3	Allows monitoring and setting of function codes for communication (S, M, W, X, Z, and etc.)

3.4.1 Quick Setup

PRG > 0

Menu number 0, "Quick Setup" shows only those function codes predetermined to have a high usage frequency.

Menu number 5, "User Config" can be used to add or delete function codes from the Quick Setup.

3.4.2 Start-up

PRG > 1

Menu number 1, "Start-up" allows display of information needed on startup: the language displayed on the LCD monitor and inverter operational status.

3.4.2.1 Set Display Language: “Language”

PRG > 1 > 1 > K01

Allows setting of the keypad display language (15 languages + user customizable language).
This setting is same as function code K01.

Available languages might change according to software version of TP-A1-LM2.

3.4.2.2 Select application: “App Select”

PRG > 1 > 2 > H03

Allows individual initialization of function codes that are grouped by application.
This setting is same as function code H03.

Refer to "0 Data Initialization" for details.

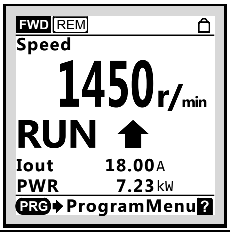
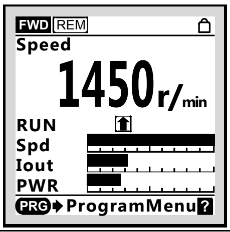
3.4.2.3 Display settings: “Disp Setting”

PRG > 1 > 3 > 1 > K15 to PRG > 1 > 3 > 13 > K92

Allows setting the keypad display content and behavior.

Follow the settings below to display output frequency, current, torque and other necessary information on the keypad's main monitor and sub-monitors.

Table 3.8 Items available in display settings

Sub-Menu		Functions	Function Code
1	Screen selection	Selects sub-monitor display (numerical display/bar graph)  	K15
2	Main monitor	Set main monitor display item.	E43
3	Select speed monitor	Set speed monitor item that corresponding to E43 = 0.	E48
4	Sub-monitor 1	Set sub-monitor 1 display item.	K16
5	Sub-monitor 2	Set sub-monitor 2 display item.	K17
6	Bar graph 1	Set bar graph 1 display item.	K20
7	Bar graph 2	Set bar graph 2 display item.	K21
8	Bar graph 3	Set bar graph 3 display item.	K22
9	Backlight OFF time	Set backlight blackout time.	K02
10	Brightness control	Set backlight brightness.	K03
11	Contrast	Set contrast.	K04
12	Shortcut <	Set shortcut destination for < / > key (jump directly to registered menu screen from Running mode screen).	K91
13	Shortcut >		K92

3.4.3 Function Codes

PRG > 2

Function code data settings and changes, including copying and initializing data, can be made via programming mode menu number 2, "Function Code".

3.4.3.1 Setting up function code data: "Data Set"

PRG > 2 > 1

This section explains how to set function code data.

The examples below show how to change "F03: Rated speed" from 1450 r/min to 1800 r/min.

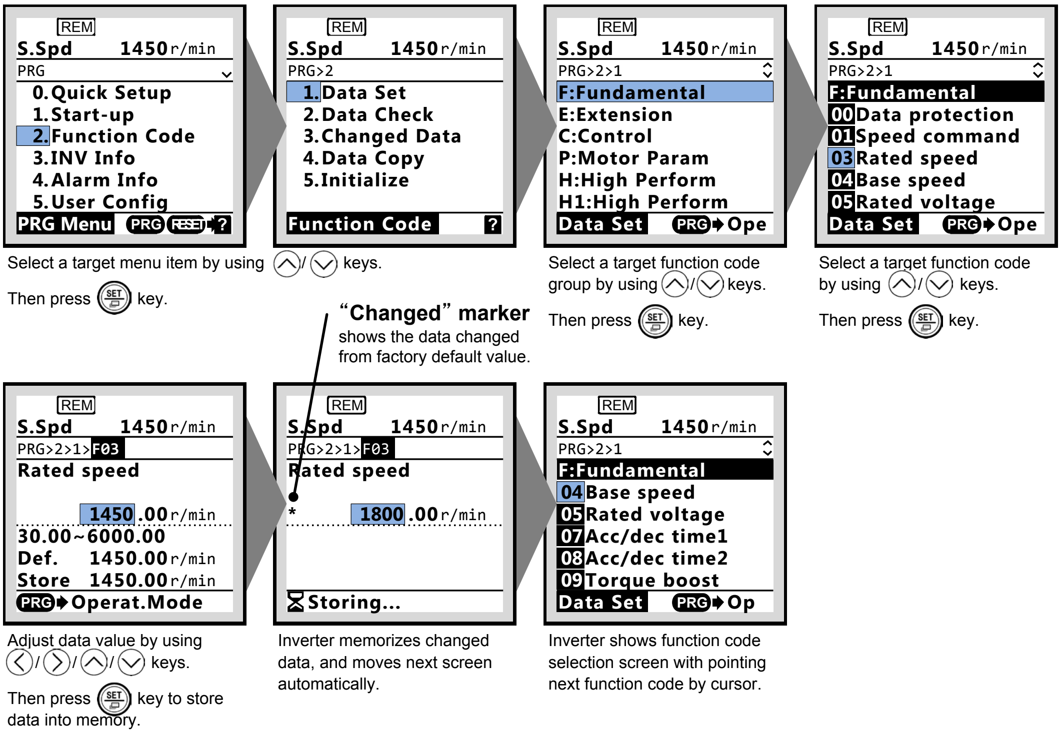


Figure 3.8 Screen transition example for setting function code

■ Double-key operation

Some important function codes (for example, H03: Initialization) require double-key operation to prevent misoperation.

In order to change their data, press STOP key and ∧ key to increase, or STOP key and ∨ key to decrease.

■ Changing function code data while running

Data for some function codes can be changed when the inverter is running; others cannot. Furthermore, for some function codes, changing the data will cause those values to be reflected immediately without storing in inverter operation; for other function codes, they will not be reflected.

For details on function codes, refer to the "2.2 Function Code Table" in Chapter 2.

3.4.3.2 Checking function code data: “Data Check”

PRG > 2 > 2

Function codes and function code data can be checked at the same time. Also, function codes that have been changed from their factory default values are indicate by an asterisk (*). Selecting the function code and pressing key allows you to edit or change the displayed function code data.

The Screen transition in this screen is almost same as in 3.4.3.1. However, the function code list screen is as shown below.

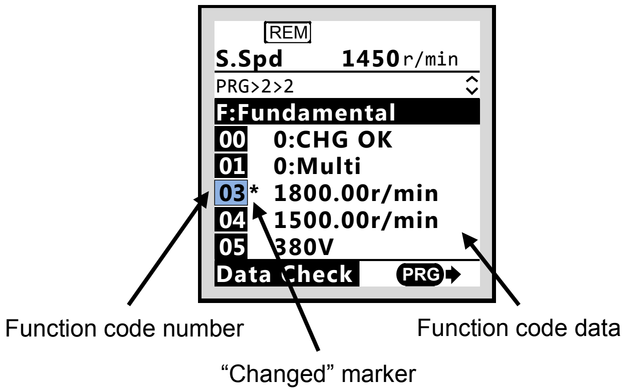


Figure 3.9 Checking function code data (display example)

3.4.3.3 Checking changed function code data: Changed Data”

PRG > 2 > 3

Only function codes that have been changed from their factory default values are shown. Selecting the function code and pressing key allows you to refer to or change the displayed function code data.

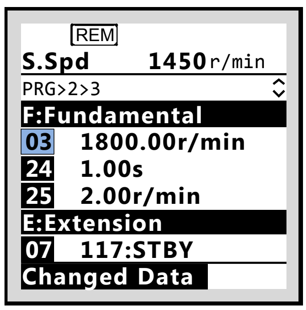


Figure 3.10 Checking changed function code data (display example)

3.4.3.4 Copying function code data: Data Copy”

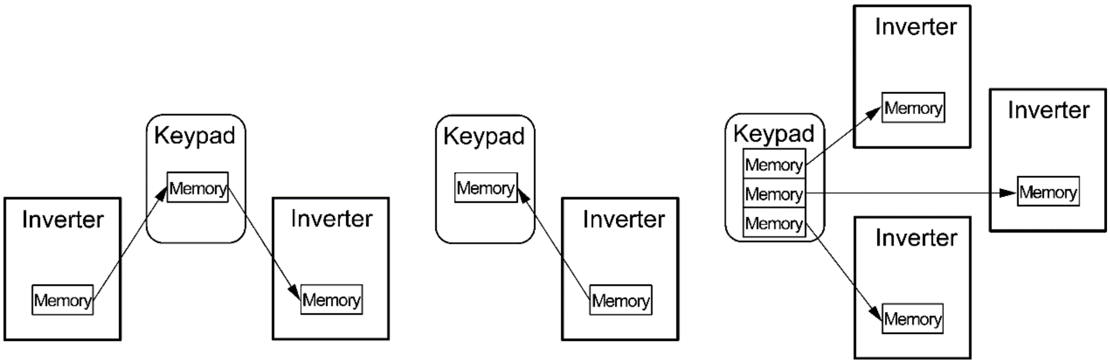
PRG > 2 > 4

This menu provides “Read”, “Write”, “Verify”, and “Check” operation, enabling the following applications. The keypad can hold three sets of function code data in its internal memory to use for three different inverters.

(a) Reading function code data already configured in an inverter and then writing that function code data altogether into another inverter.

(b) Copying the function code data saved in the inverter memory into the keypad memory for backup.

(c) Saving function code data in the keypad as master data for data management; that is, saving more than one set of function code data in the keypad and writing a set of data suited to the machinery into the target inverter.



(a) Copy (b) Backup (c) Data management

The following functions can be made to sub-menu numbers 1 to 5.

Table 3.9 Operations available in copying function code data

Sub-Menu No	Sub-Menu	Description
1	I.Write: Write data with verification after initialization	Performs inverter initialization, data writing, and verifying automatically.
2	Read: Read data	Reads out function code data from the inverter memory and stores it into the keypad memory.
3	Write: Write data	Writes the data held in the selected area of the keypad memory into the target inverter memory.
4	Verify: Verify data	Verifies the data held in the keypad memory against that in the inverter memory.
5	Check: Check copied data in the keypad	Shows the model info (type) and function code data of three sets of data stored in the keypad memory.

The example below shows screen transition in the case of "I.Write" operation.
"Read", "Write", and "Verify" operations are similar.

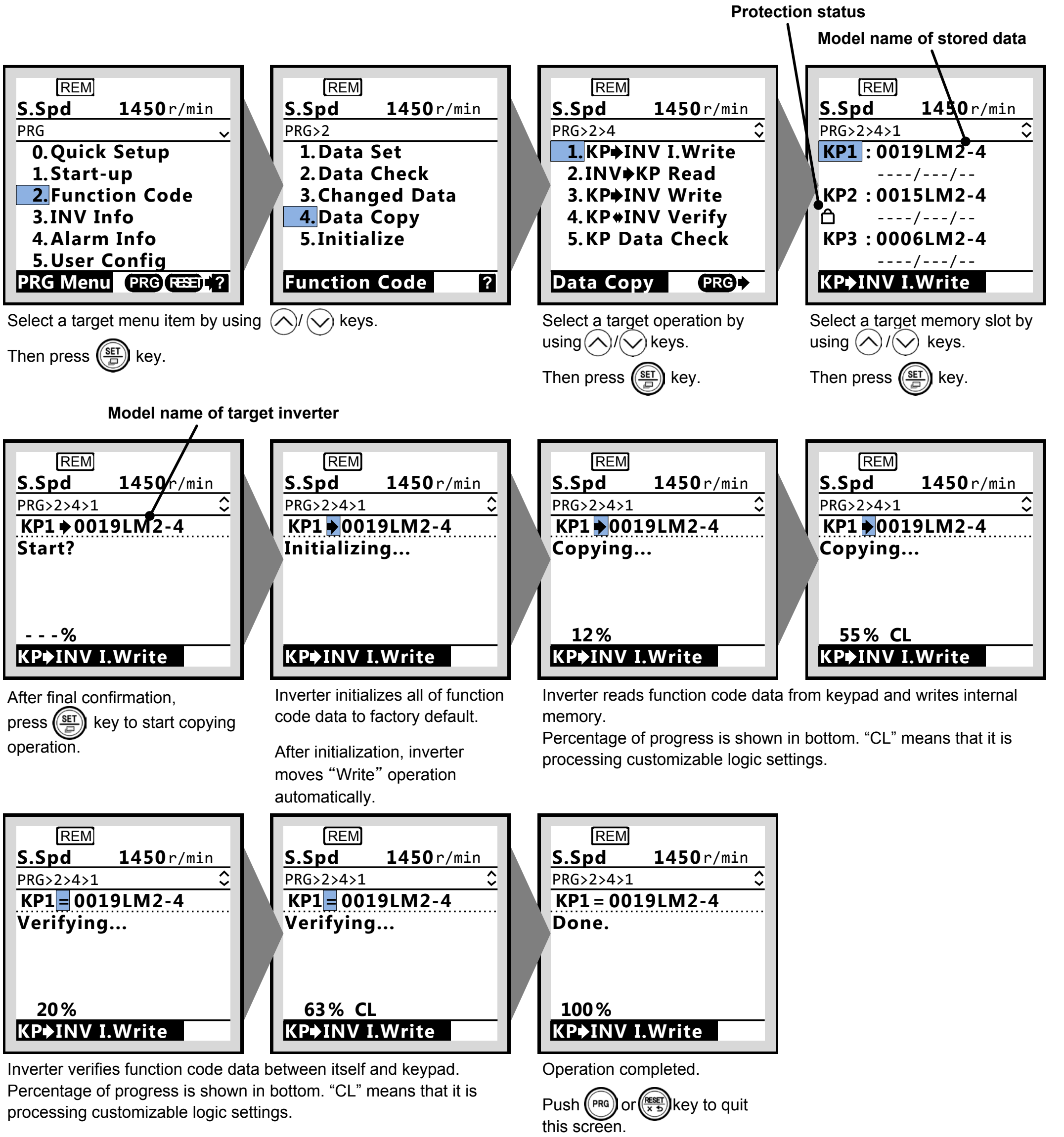


Figure 3.11 Screen transition example for copying function code data

In "Check" operation, function code data stored in keypad can be check on the screen as below.

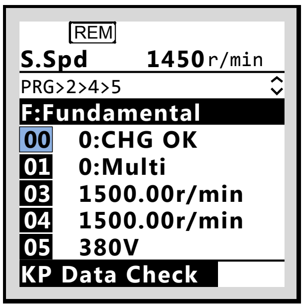


Figure 3.12 Checking function code data stored in keypad (display example)

■ Overwritten protection for copied data

It allows protecting function code data stored in keypad for each memory slots.

In order to protect data, move to the screen for selecting target memory slot at "Read" operation (PRG > 2 .> 4 > 2), and move cursor to target memory slot that you want to protect.

Holding down the key on the keypad for 5 seconds or more in above situation, toggles between protected and un-protected state for each memory slots individually.

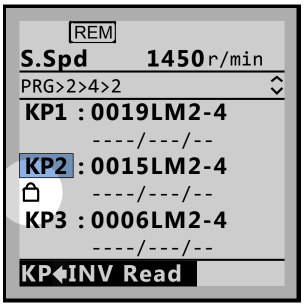
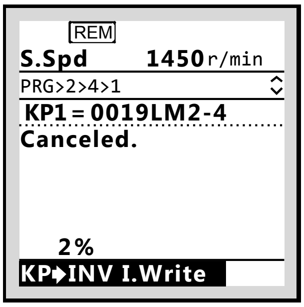


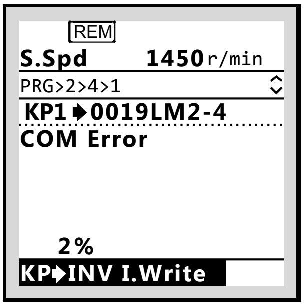
Figure 3.13 Overwritten protected status (display example)

■ Error messages



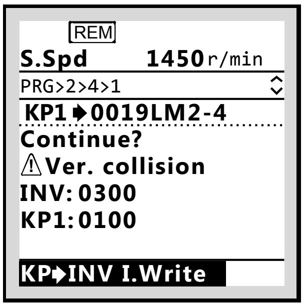
Pressing PRG key or RESET key during each operations cancel the operation, and "Canceled" is shown on the screen, and the operation is terminated forcibly.

In the case of "Read" operation, the data stored in the selected memory slot is cleared if cancelled.



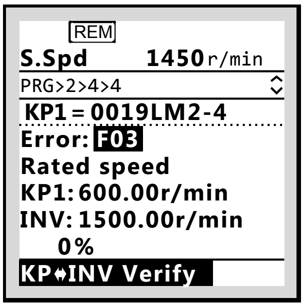
If a communication error occurs between keypad and inverter during each operations, the error screen will be displayed.

Try again after checking connections between keypad and inverter.



The function codes stored in the keypad are not compatible with the inverter function codes. Software versions may be non-standard or incompatible. Please contact us.

It can be continued by pressing SET key. In this case, it might cause problems because the operation is processed forcibly.



<Only "Verify" operation>

If there is a mismatch in the function code data between inverter and keypad, the mismatched function code data is displayed on the screen, and verification stops temporally.

Pressing SET key again continues verification with the next function code data.

Note

If an error screen is displayed, press the PRG key or the RESET key to release.
After resetting, the screen returns to programming mode.

3.4.3.5 Initialize function code data: "Initialize"

PRG > 2 > 5

This returns function code data to the values in the factory default settings or sets function code data for certain application system. Changing the data requires double-key operation (the STOP key and the ⌃ key or the STOP key and the ⌄ key). The following types of initialization are available.

Table 3.10 Initialization types

Initialization type		Function
0	Manually set values	Does not initialize.
1	Initialize values to factory default values (vector control for IM)	Initialize all function code data to settings suited for vector control for IM. (initializes to factory default values).
2	System-specific initialization (vector control for PMSM)	Initialize all function code data to settings suited for vector control for PMSM.
3	System-specific initialization (open loop control for IM)	Initialize all function code data to settings suited for open loop control for IM.
11	Limited initialization (initialization except for communication function codes)	Initialize function codes except communication settings.
12	Limited initialization (initialization for customizable logic)	Initialize function codes for customizable logic U/U1 codes.

3.4.4 Inverter Information: "INV Info"

PRG > 3

Menu number 3, "INV Info" allows display of various information of the inverter: Current operation status, i/o status, and maintenance data.

Travel direction counter function is also provided in this menu.

3.4.4.1 Check Operational Status: "Op Monitor"

PRG > 3 > 1

This allows to check the inverter's operational status. This can be used when confirming operational status during maintenance or on test runs.

Table 3.11 Display items in "Op Monitor"

Page No.	Category	Code	Details
1	Reference speed (pre-ramp)	Fref	Reference speed (pre-ramp) currently specified [Hz]
	Reference speed (final)	Fout1	Reference speed (final) commanded to the Automatic Speed Regulator (ASR) [Hz]
	Output frequency	Fout2	Frequency being output [Hz]
	Motor rotational speed	SyncSp	Detected speed [r/min]
	Elevator speed	LiftSp	Detected speed [mm/s]
2	Output current	Iout	Output current value [A]
	Output voltage	Vout	Output voltage value [V]
	Calculated torque	Torque	Calculated torque [%] based on the motor rated torque being at 100%. *1
	Power consumption	Power	Power consumption [kW]

Page No.	Category	Code	Details
3	Output status	FWD	Rotating forward
		REV	Rotating reverse
		EXT	Inverter applies DC voltage to the motor
		INT	Inverter stops output
	Ramp status	Acc	During acceleration
		Dec	During deceleration
		Const	During constant speed
		<Blank>	Stopped
	Motor type	IM	Induction motor (asynchronous motor)
		PMSM	Permanent magnet synchronous motor
	Selected control mode	PG-IM	Vector control with PG for IM
		PG-PM	Vector control with PG for PMSM
		TV	Torque vector (open loop) control for IM
	Running status	PG/Hz	■ : Enable vector control
		TrqLimit	■ : During torque limitation
		LowVolt	■ : During low supply voltage
4	Operational status	FAR	■ : Frequency attained
		FDT	■ : Frequency detection
		RDY	■ : Ready to run
		FAN	■ : Cooling fan operating
		TRY	■ : Trying automatic resetting alarm
		OH	■ : Overheat early warning
		LIFE	■ : Lifetime warning
		ID	■ : Current detection
		ID2	■ : Current detection 2
5	Reference torque	TRQC	Value [%] based on the motor rated torque being at 100%.
	Reference torque current	TRQI	Value [%] based on the motor rated current being at 100%.
	Reference torque bias	TRQB	Value [%] based on the motor rated torque being at 100%.
	Electronic thermal for motor	OLM	Value [%] based on the electronic thermal overload protection being at 100%.
	Detected motor temperature	NTC	Detected motor temperature [℃]
6	CAN status	CAN Sta	Operational status
		CAN Bus	Error status
		CAN STM	State machine status
7, 8	Acceleration/Deceleration distance calculation Page 7: Acceleration distance Page 8: Deceleration distance	SpInit	Initial speed (before acceleration/deceleration) [mm/s]
		SpTrgt	Target speed (after acceleration/deceleration) [mm/s]
		Dist.	Calculated distance which takes during acc/dec [mm]
		Acc	Maximum acceleration rate [mm/s^2]
		Jerk1	1^{st} jerk [mm/s^3]
		Jerk2	2^{nd} jerk [mm/s^3]

*1: In vector control with PG, this item shows the reference torque.

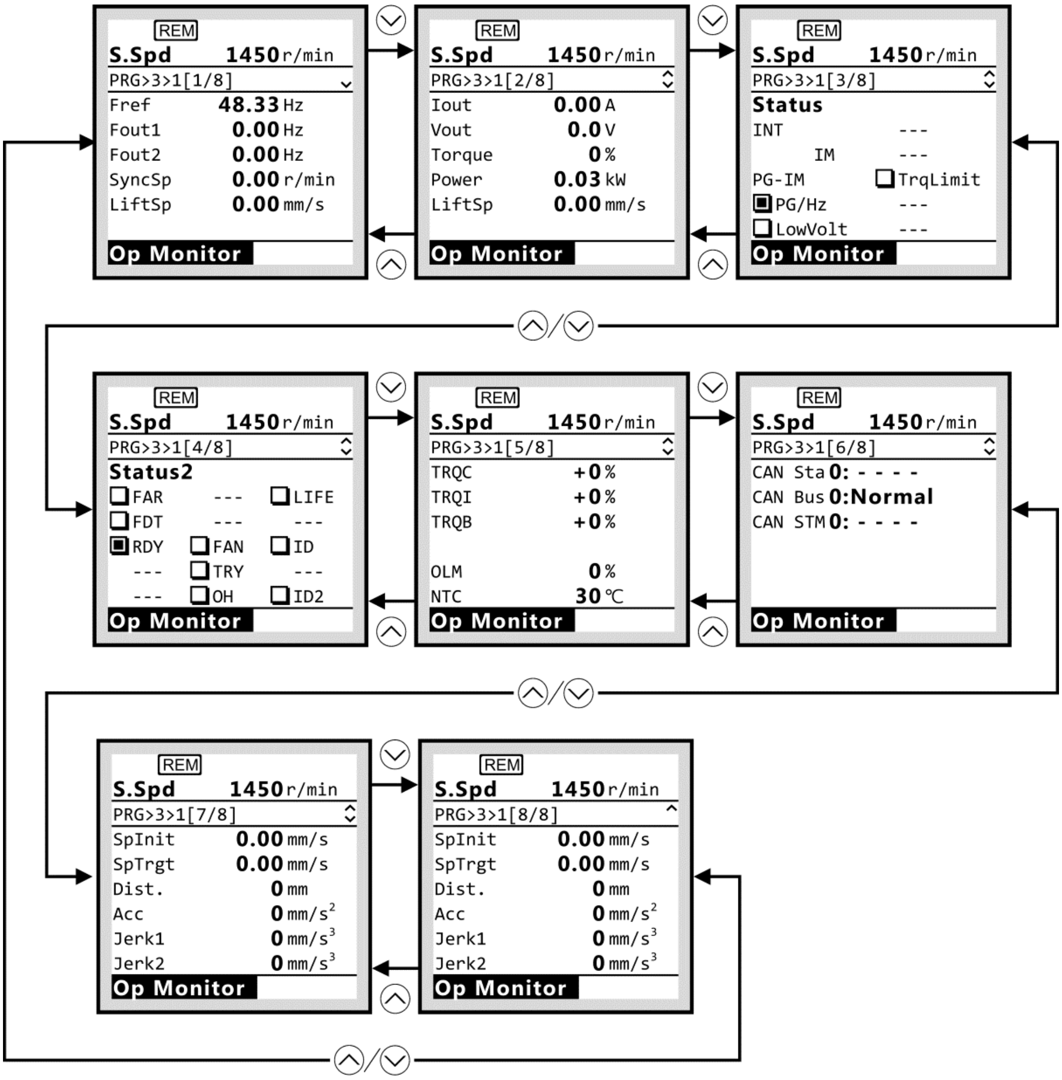


Figure 3.14 Screen transition for “Op Monitor” (display example)

3.4.4.2 Check Status of Input/Output Signal Status: "I/O Check"

PRG > 3 > 2

This allows confirmation of the inverter's digital input/output signal and analog input/output signal. This can be used when confirming operational status during maintenance or on test runs.

Table 3.12 Display items in "I/O Check"

Page No.	Category	Category Details	Symbol	Details
1	Di	Control circuit terminal input signal (terminal input)	FWD, REV, X1-X8, EN1, EN2	ON/OFF information on control circuit's terminal input (Reversal on short-circuit, no reversal when open)
2	Di: Link	Communications port input signal	FWD, REV, X1-X8, XF, XR, RST	Input information on communication-specific function code S06 (Reversal on 1, no reversal on 0)
3	Do	Output signal	Y1-Y2, Y3A-Y5A, 30ABC	Output signal information
4	Ai/Ao	Analog input signal	12	Terminal 12 input voltage
			C1	Terminal C1 input current
			V2	Terminal V2 input voltage
			PTC	Terminal PTC input voltage
			FM1-Vo	Terminal FMA output voltage, output current
5	Theta	Phase angle	θe	Output electrical angle [deg-el]
			θre	Magnetic pole position detection angle [deg-mech] (Only displayed with PMPG option)
			θm	Detected mechanical angle[deg-mech]
			PPb	Magnetic pole position detection signal in binary (Only displayed with PMPG option)
6	Pulse	Encoder pulse	P2	Encoder pulse rate for A/B phase [kPulse/s]
			Z2	Encoder pulse rate for Z phase [Pulse/s]

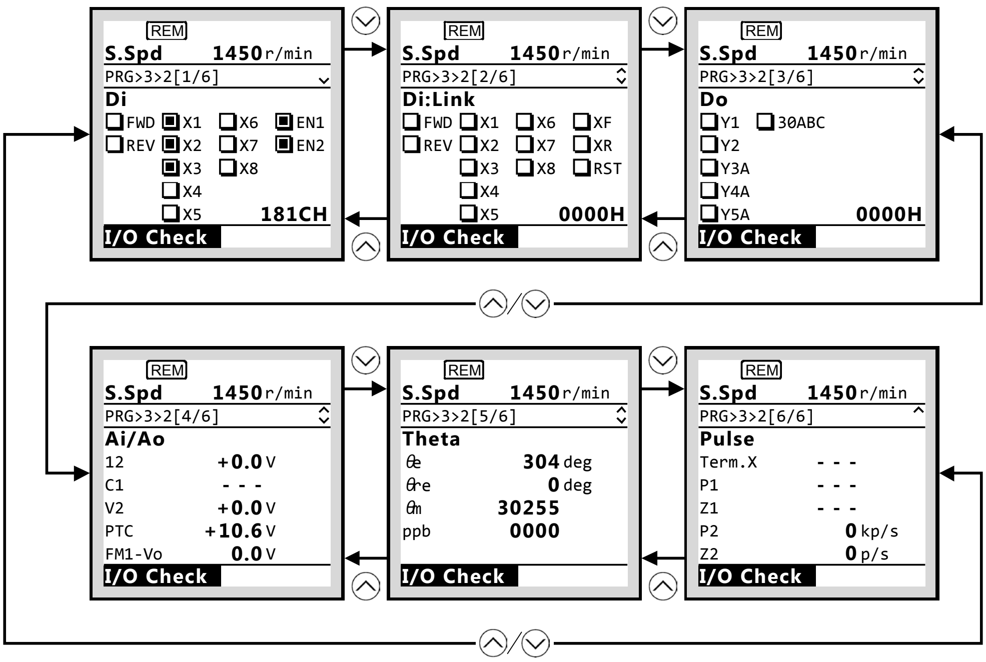


Figure 3.15 Screen transition for "I/O Check" (display example)

3.4.4.3 View Maintenance Information: “Maintenance”

PRG > 3 > 3

Displays information needed for inverter maintenance.

Table 3.13 Display items in “Maintenance”

Page No.	Category	Code	Details
1	Cumulative run time	Time	Shows cumulative time inverter’s main power has been on. Reverts to 0 after exceeding 65,535 hours and begins counting up again.
	DC link bus voltage	Edc	Shows DC link bus voltage of inverter’s main circuit.
	Maximum effective current value	Imax	Shows as the effective value the maximum inverter output current each hour.
	Cumulative power level	Wh	Shows cumulative power level. Reverts to 0 after passing 1,000,000 kWh.
2	Number of starting motor (gate-on)	G-On	Accumulates and shows the number of motor operations (the number of times the inverter run command has been ON). The number 1.00 means 10000.
	Number of power up	P-On	Shows the total amount of number the inverter has been turned power on. The number 1.00 means 10000.
	Powered life of cooling fan	EneT	Shows the total amount of time the cooling fan has been in operation. Time when the cooling fan ON-OFF control (function code H06) is enabled and the cooling fan is off is not counted.
	Target life of cooling fan	Life	Shows the cooling fan’s remaining service life. Remaining life is calculated by subtracting elapsed time from the service life (five years).
3	Capacity of main circuit capacitor	Cap	Current capacity of main circuit capacitor is shown, using capacity at time of shipment as 100%.
	Life of electrolytic capacitor on PCB (Powered life)	EneT	Shows as cumulative run time the product of the cumulative amount of time during which a voltage has been applied to the electrolytic capacitor on the PCB times a coefficient to account for ambient temperature conditions.
	Target life of electrolytic capacitor on PCB	Life	Shows the remaining life of the electrolytic capacitor on the PCB. Remaining life is calculated by subtracting elapsed time from the service life (five years).
4	Cumulative motor run time	EneT	Shows the motor’s cumulative run time. Reverts to 0 after exceeding 99,990 hours and begins counting up again.
	Number of startups	EneN	Accumulates and shows the number of motor operations (the number of times the inverter run command has been ON). Reverts to 0 after exceeding 65,535 times and begins counting up again.
5	Interior temperature (Real-time value)	Int	Shows the current temperature inside the inverter.
	Maximum interior temperature	Int(max)	Shows the maximum temperature inside the inverter in one-hour increments.
	Heat sink temperature (Real-time value)	Fin	Shows the current temperature of the heat sink inside the inverter.
	Maximum heat sink temperature	Fin(max)	Shows the current temperature of the heat sink inside the inverter.

Page No.	Category	Code	Details
6	RS-485 error (Communications port 1)	Ch1	Shows the cumulative number of times an error has arisen at RS-485 (communications port 1) and the code for the most recent error.
	RS-485 error (Communications port 2)	Ch2	Shows the cumulative number of times an error has arisen at RS-485 (communications port 2) and the code for the most recent error.
	Option error (A-port)	OpA	Shows the cumulative number of times an error has arisen in communications option installed in the A-port and the code for the most recent error.
	Option error (B-port)	OpB	Not supported.
	Option error (C-port)	OpC	Shows the cumulative number of times an error has arisen in communications option installed in the C-port and the code for the most recent error.
7	CAN communication error	SD Er	Shows the cumulative number of times a transmitting error has arisen at CAN communication.
		RD Er	Shows the cumulative number of times a receiving error has arisen at CAN communication.
8	Inverter ROM version	Main	Shows the inverter ROM version as four digits.
	Keypad ROM version	KP	Shows the keypad ROM version as four digits.
	Option (A-port) ROM version	OpA	Shows the ROM version as four digits of the option installed in A-port.
	Option (B-port) ROM version	OpB	Not supported.
	Option (C-port) ROM version	OpC	Shows the ROM version as four digits of the option installed in C-port.
9	Option (A-port) Type	OpA	Shows the type name of the option installed in A-port.
	Option (B-port) Type	OpB	Not supported.
	Option (C-port) Type	OpC	Shows the type name of the option installed in C-port.

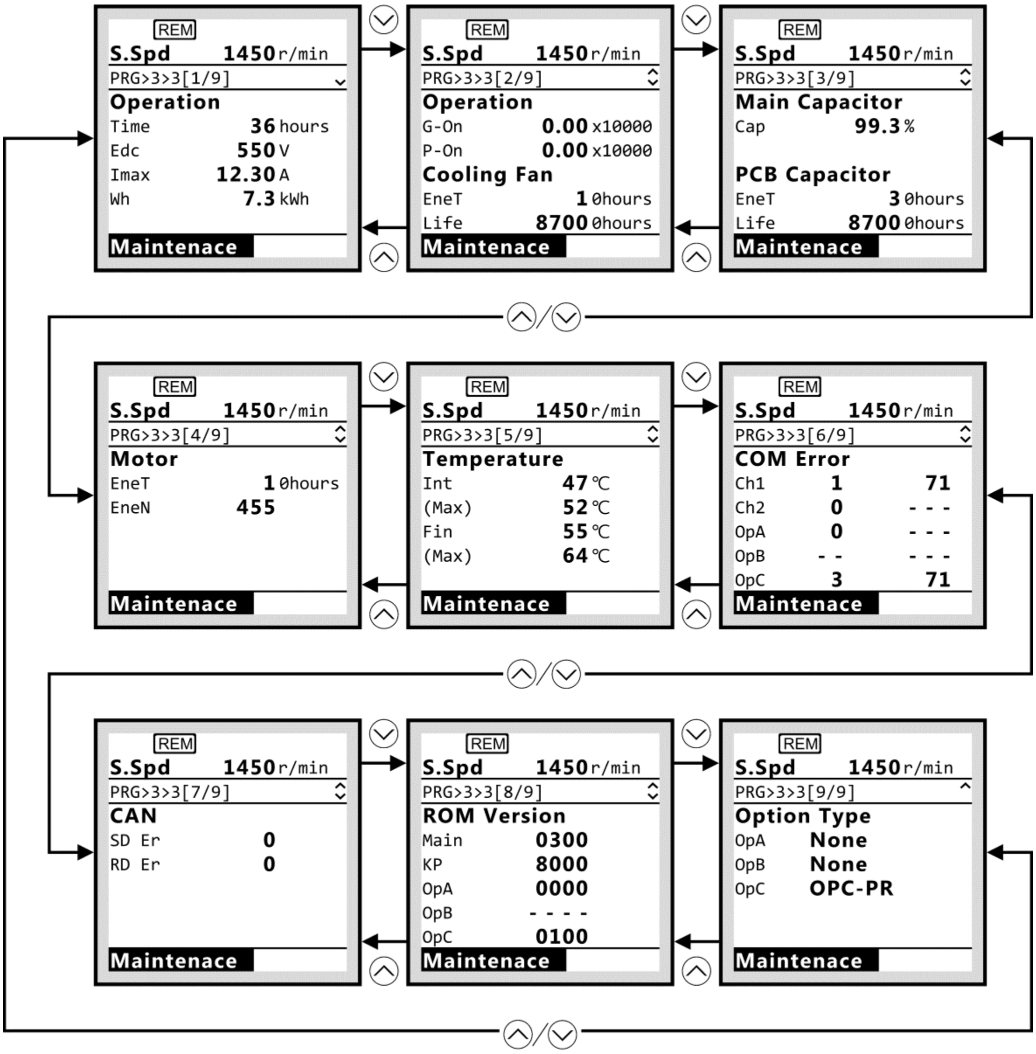


Figure 3.16 Screen transition for "Maintenance" (display example)

3.4.4.4 View Unit Information: "Unit Info"

PRG > 3 > 4

Shows inverter type, serial number and ROM version.

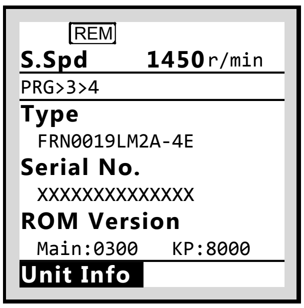


Figure 3.17 Unit information screen (display example)

3.4.4.5 Check/Set travel direction counter function: “Travel Counter”

PRG > 3 > 5

This allows to check and set the travel direction counter (TDC) function.

For additional information about TDC function, refer to related Application Note (AN-Lift2-0004v100EN).

3.4.5 Alarm Information: “Alarm Info”

PRG > 4

3.4.5.1 Check Alarm History: “Alarm History”

PRG > 4 > 1

For the most recent alarm and the past three, shows alarm codes indicating the types of protective functions operated, the number of consecutive alarms, and the various inverter status at the time the alarm was triggered.

Table 3.14 Display items in “Alarm History”

Page No.	Category	Symbol	Details
1	Alarm name	—	Name of alarm
	Main alarm	Main	Triggered alarm code and alarm sub-code which means detailed causes of alarm. For detail about alarm sub-code, please contact us.
	Overlapping alarm 1	O.lap1	Simultaneously triggered alarm code (No. 1) and alarm sub-code. (If no alarm, shows " --- ")
	Overlapping alarm 2	O.lap2	Simultaneously triggered alarm code (No. 2) (If no alarm, shows " --- ")
2	Reference speed (pre-ramp)	Fref	Reference speed (pre-ramp) currently specified [Hz]
	Reference speed (final)	Fout1	Reference speed (final) commanded to the Automatic Speed Regulator (ASR) [Hz]
	Speed	Speed	Detected speed [Hz]
	Output current	Iout	Output current [A]
	Output voltage	Vout	Output voltage [V]
	Magnetic pole position offset angle	PP.Ofs	Magnetic pole position offset angle [deg] at that time.
3	Calculated torque	Torque	Calculated torque [%]
	Reference torque	TRQC	Value [%] based on the motor rated torque being at 100%.
	Reference torque current	TRQI	Value [%] based on the motor rated current being at 100%.
4	Cumulative run time	Time	Shows cumulative time inverter’s main power has been on. Reverts to 0 after exceeding 655,350 hours and begins counting up again.
	Number of startups	EneN	Accumulates and shows the number of motor operations (the number of times the inverter run command has been ON). Reverts to 0 after exceeding 6,553,500 times and begins counting up again.
	DC link bus voltage	Edc	Shows DC link bus voltage of inverter’s main circuit.
	Interior temperature	T.Int	Shows the interior temperature.
	Heat sink temperature	T.Fin	Shows the heat sink temperature.
	Power consumption	Power	Power consumption (only the most recent alarm history stored.)

Page No.	Category	Symbol	Details
5	Output status	FWD	Rotating forward
		REV	Rotating reverse
		EXT	Inverter applies DC voltage to the motor
		INT	Inverter stops output
	Ramp status	Acc	During acceleration
		Dec	During deceleration
		Const	During constant speed
		<Blank>	Stopped
	Motor type	IM	Induction motor (asynchronous motor)
		PMSM	Permanent magnet synchronous motor
	Selected control mode	PG-IM	Vector control with PG for IM
		PG-PM	Vector control with PG for PMSM
		TV	Torque vector (open loop) control for IM
	Running status	PG/Hz	▣ : Enable vector control
		TrqLimit	▣ : During torque limitation
		LowVolt	▣ : During low supply voltage
6	Operational status	FAR	▣ : Frequency attained
	Frequency detection	FDT	▣ : Frequency detection
	Run preparation	RDY	▣ : Ready to run
	Recovering power after momentary power failure	FAN	▣ : Cooling fan operating
	Motor overload	TRY	▣ : Trying automatic resetting alarm
	Fan operating	OH	▣ : Overheat early warning
	Retrying	LIFE	▣ : Lifetime warning
	Heat sink overheat early warning	ID	▣ : Current detection
	Lifetime alarm	ID2	▣ : Current detection 2
	Overload prevention controlled	OLP	Overload prevention controlled
	Current detection	ID	Current detection
7	Di: Control circuit terminal input signal (terminal input)	FWD, REV, X1-X8, EN1, EN2	ON/OFF information on control circuit's terminal input (Reversal on short-circuit, no reversal when open)
8	Di Link: Communications port input signal	FWD, REV, X1-X8, XF, XR, RST	Input information on communication-specific function code S06 (Reversal on 1, no reversal on 0)
9	Do: Output signal	Y1-Y2, Y3A-Y5A, 30ABC	Output signal information

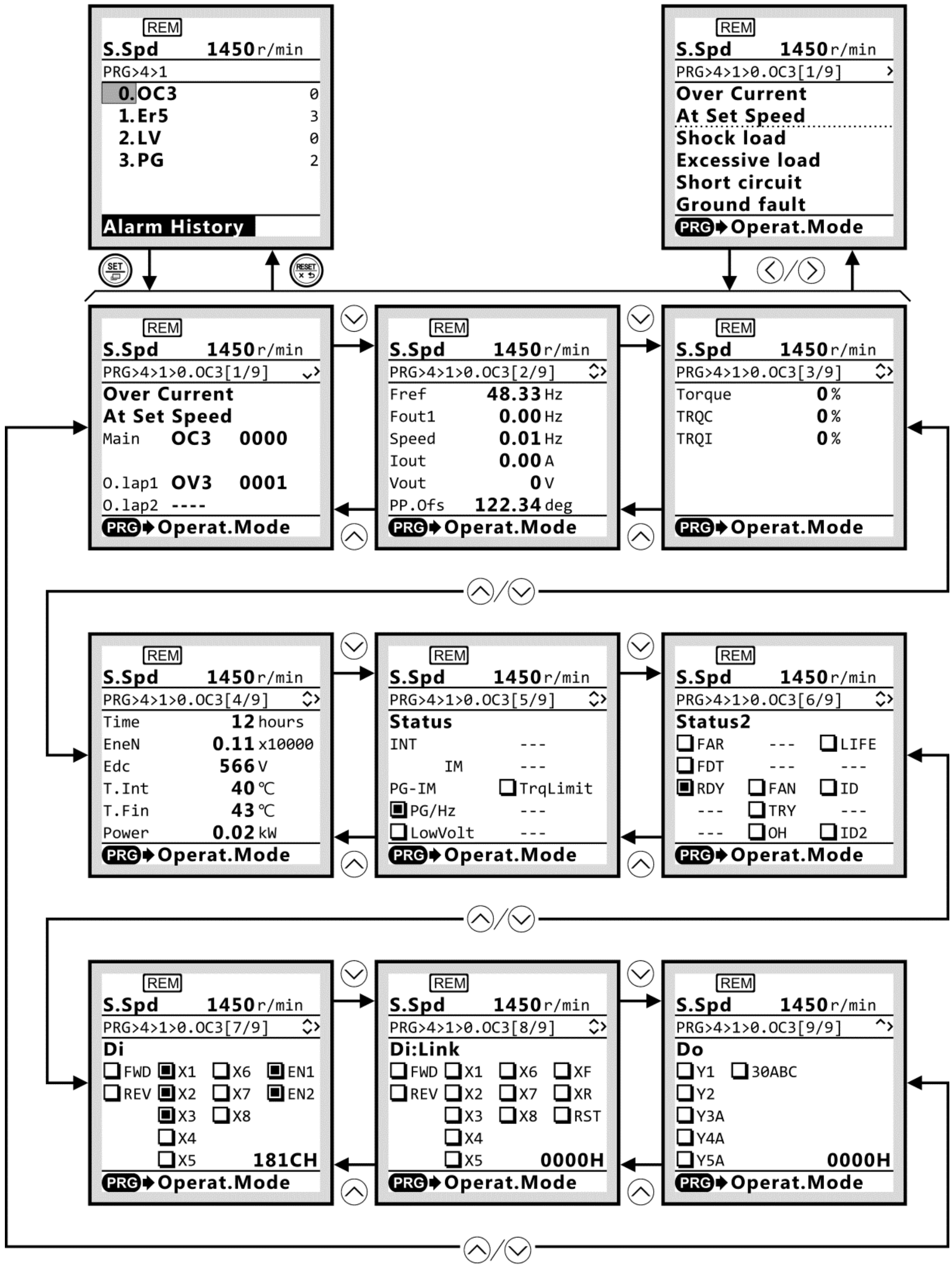


Figure 3.18 Screen transition for “Alarm History” (display example)

3.4.6 User Configuration: “User Config”

PRG > 5

3.4.6.1 Quick setup

PRG > 5 > 1

From programming mode menu number 5, “User Config” function codes can be added to or deleted from the Quick Setup. Target function codes can be added or deleted by selecting them.

3.4.7 Tools

PRG > 6

3.4.7.1 Monitor Customizable Logic: “CLogic Monitor”

PRG > 6 > 1

Customizable logic can be previewed graphically in each function block.

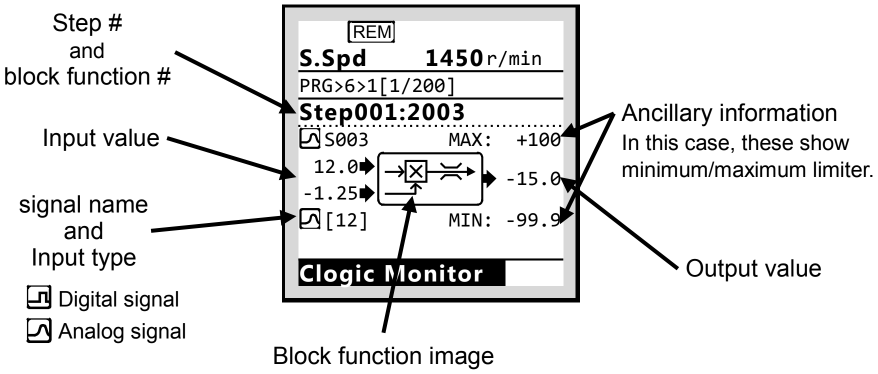


Figure 3.19 Customizable logic monitor (display example)

3.4.7.2 Load Factor Measurement: “Load Factor”

PRG > 6 > 2

This function enables measurement of the maximum output current, average output current and average braking power. Measurement modes are indicated in the table below.

Measurement Mode	Details
Mode for measuring for a fixed period of time	Mode for setting a measurement period and taking measurements for a set period of time
Mode for measuring from run to stop	Mode for taking measurements from the beginning to the end of a run

Note If in the mode to measure the interval from run to stop, entering this mode while running will take measurements during the period until stopping. If entering this mode while stopped, measurements will be taken from the next run until the stop.

Tip During load factor measurement, the PRG key transitions into running mode. The RESET key moves to the measurement mode selection screen. In this case, load factor measurement will be continued.

3.4.7.3 Communication Debug: “COM Debug”

PRG > 6 > 3

Communication-specific function codes (S, M, W, W1, W2, W3, X, Z) can be monitored and set.

3.5 Alarm Mode

If an abnormal condition arises, the protective function is invoked and issues an alarm, then the inverter automatically enters Alarm mode. At the same time, an alarm code appears on the LCD monitor.

3.5.1 Releasing the alarm and switching to Running mode

Remove the cause of the alarm and press the RESET key to release the alarm and return to Running mode. The alarm can be removed using the RESET key only when the alarm code is displayed.

3.5.2 Displaying the alarm history

It is possible to display 4 alarm codes (newest + past 3 alarms) in addition to the one currently displayed. Previous alarm codes can be displayed by pressing the ∧ / ∨ key while the current alarm code is displayed.

3.5.3 Displaying the status of inverter at the time of alarm

When the alarm code is displayed, you may check various running status information (output frequency and output current, etc.) by pressing the SET key.

Further, you can view various information items about the running status of the inverter using the ∧ / ∨ key. The information displayed is the same as for Menu #4 "Alarm Information" in Programming mode. Refer to Section 3.4.5.1, "Confirm Alarm History."

Pressing the PRG key while the running status information is displayed returns to the alarm code display.

FRENIC-Lift

Reference Manual

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The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the FRENIC-Lift (LM2) series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

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