

L450U/L450S

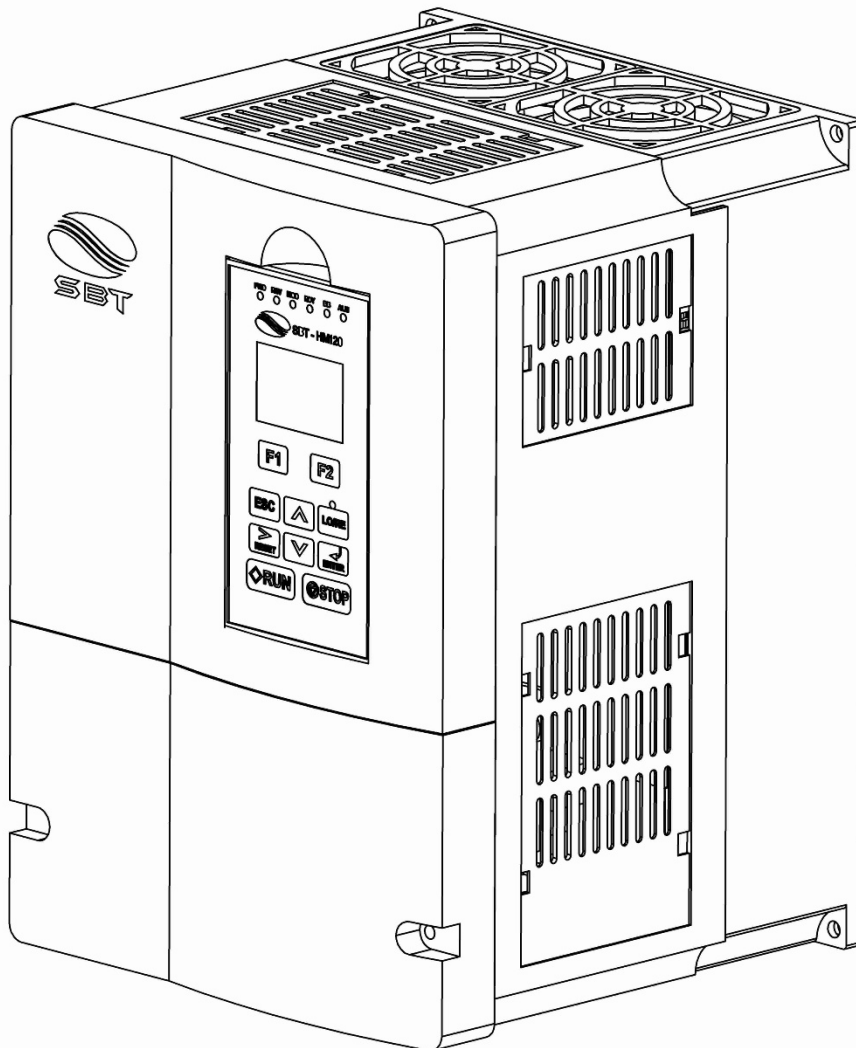
User Manual

The mind
behind
the drive

SBT Electric AC Drive

SBT- L450U / L450S User Manual

SBT-L450 is a general AC drive produced by Sana Barque Tavan company, capable of driving AC motors up to 24A. The drive provides necessary functions to ensure smooth and reliable operation of the motor at various speeds. In this manual, all functions are introduced and explained in detail. The first chapter is dedicated to the initial settings and Auto-tuning, which calculates control parameters required to drive the AC motor. The second chapter explains the drive parameters and features. In the third chapter, procedures required to set the drive for elevator applications are explained. Fault diagnosis is also included in this chapter. Please read the manual carefully to tune the drive correctly.



Chapter 1: Initial Settings

◆ L450U / L450S Overview

Properties		Description			
Motor Power (kW)		5.5	7.5	11	15
Input	Voltage (V)	3-phase 380V / 50 -60 Hz			
Output	Voltage (V)	3-phase 0~380V / 0 ~ 100 Hz			
	Rated Current (A)	14	18	24	31
Weight (Kg)		5.3	5.4	5.7	6.0

◆ Mechanical Installation

■ Dimensions:

The drive dimensions needed for mechanical installation are mentioned in Table 1.1.

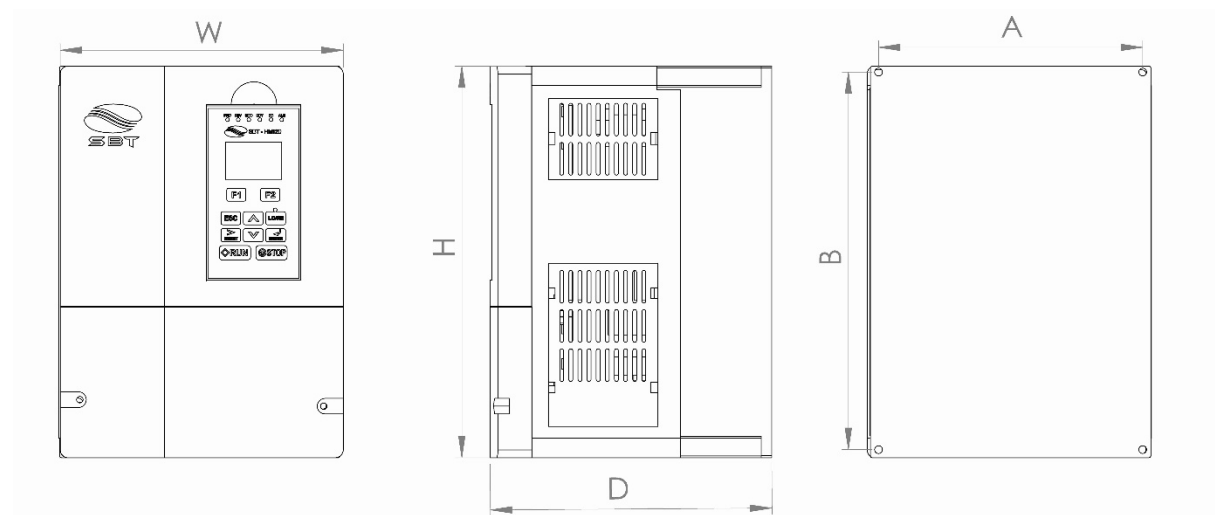


Figure 1.1: Drive box from different views

Table 1.1: Drive dimensions

	Dimension
A	205mm
B	287mm
D	215mm
H	300mm
W	217mm

◆ Standard Connection Diagram

Figures 1.2 (a) and 1.2 (b) show the connection between the power connector and drive control circuits in SBT L450U and L450S models, respectively. In L450S model, the drive can be used in a single phase. It is also possible to set and run the drive via the digital operator without connecting digital I/O wiring. Refer to chapter 2 for further details.

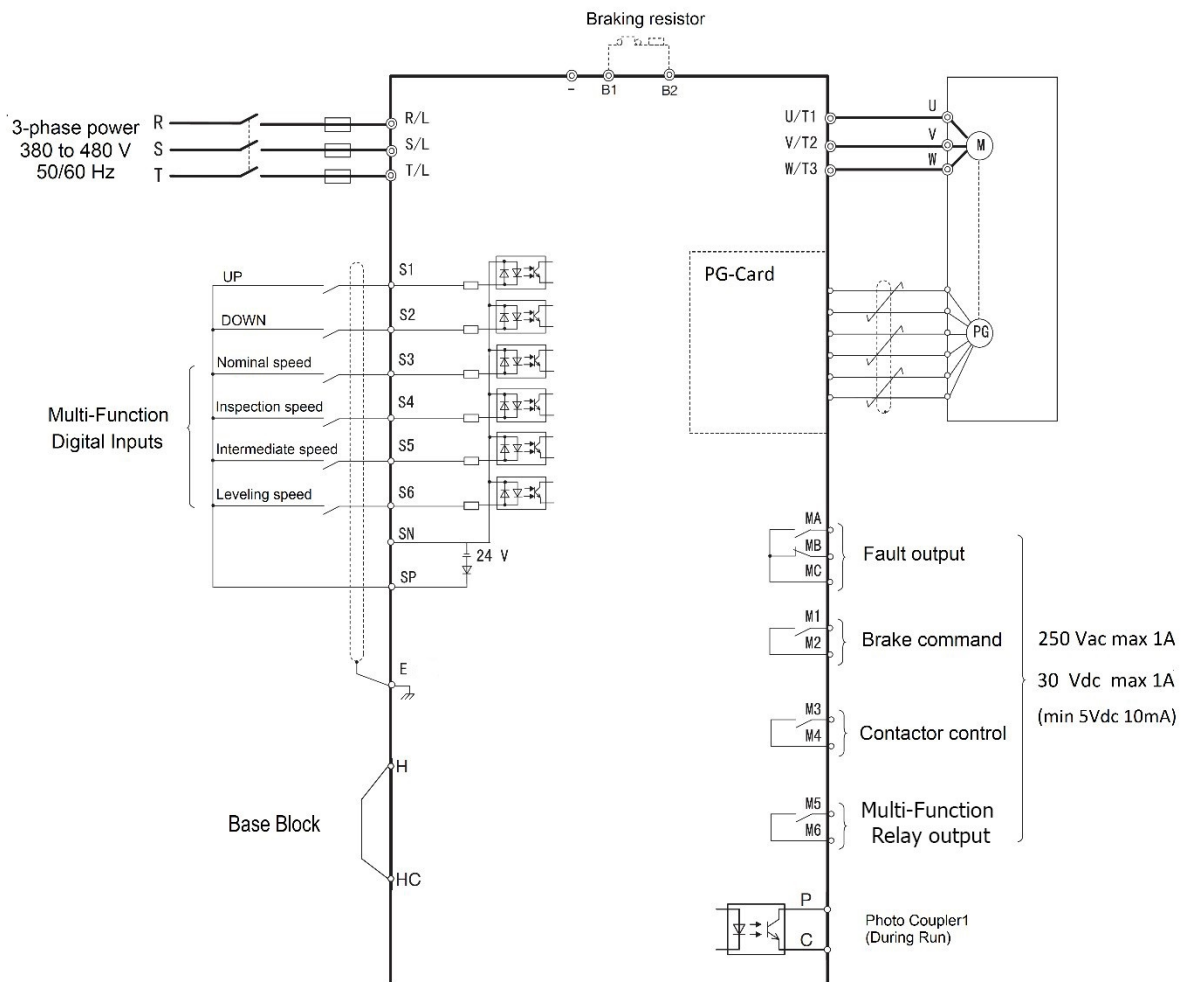


Figure 1.2 (a): SBT-L450U I/O block diagram

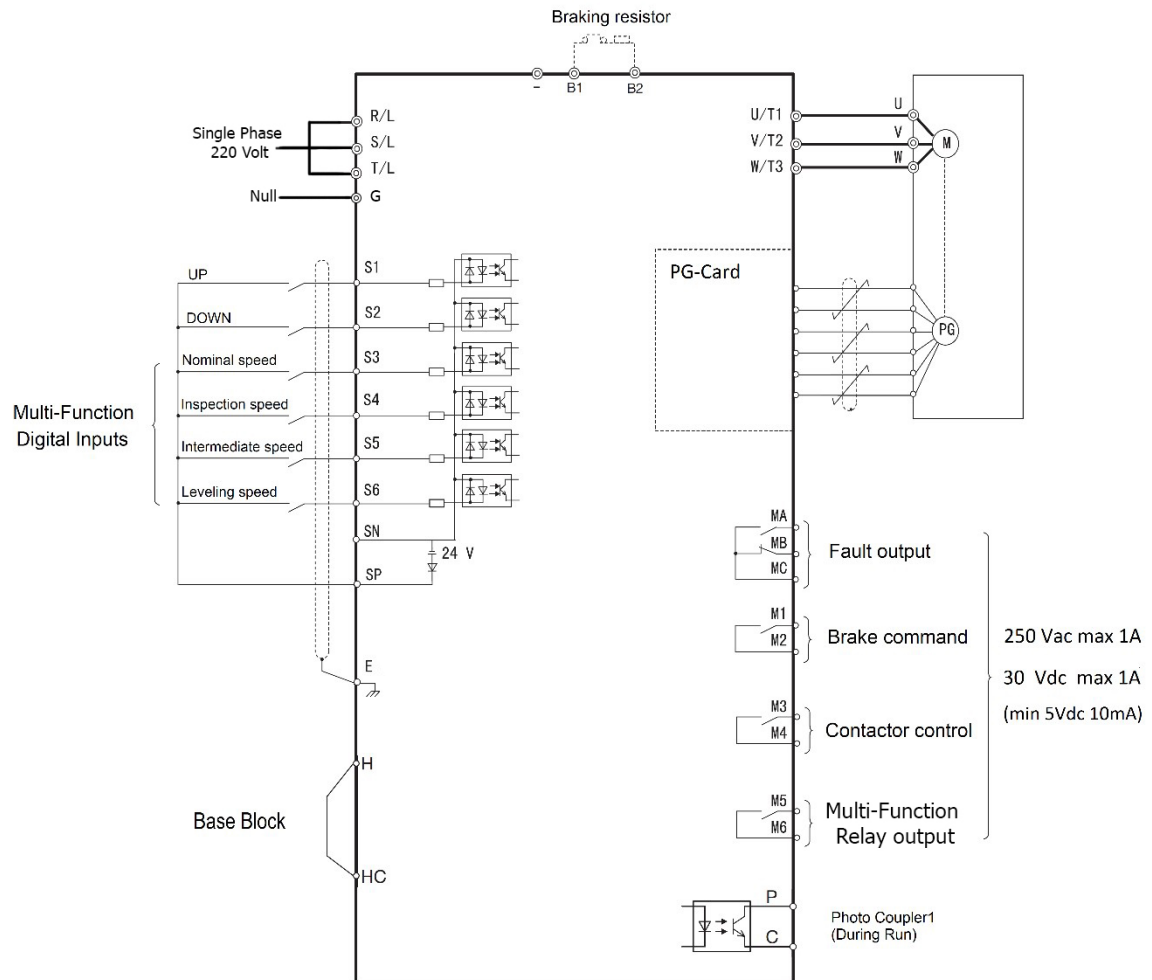


Figure 2.2 (b): SBT-L450S I/O block diagram

◆ Digital Operator

Use the digital operator to enter Run and Stop commands, edit parameters, and display data including fault and alarm information.

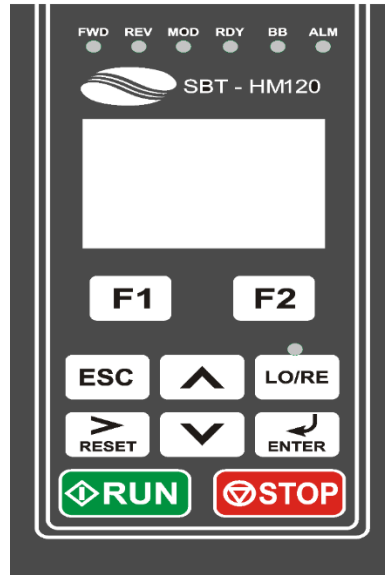


Figure 1.3: Keys and displays on the Digital Operator

No.	Display	Name	Function
1	F1 F2	Function Key (F1, F2)	Functions assigned to F1 and F2 vary depending on the currently displayed menu. The name of each function appears in the lower half of the display window.
2	ESC	ESC Key	<ul style="list-style-type: none"> Returns to the previous display. Moves the cursor one space to the left.
3	RESET	RESET Key	<ul style="list-style-type: none"> Moves the cursor to the right. Resets the drive to clear a fault situation.
4	RUN	RUN Key	Run the motor when the drive is in the LOCAL mode.
5	Up Arrow	Up Arrow key	Scrolls up to display the next item, select parameter numbers, and increment setting values.
6	Down Arrow	Down Arrow Key	Scrolls down to display the previous item, select parameter numbers, and decrements setting values.
7	STOP	STOP Key	Stops drive operation.
8	ENTER	ENTER Key	<ul style="list-style-type: none"> Enters parameter values and settings. Selects a menu item to move between displays.
9	LO/RE	LO/RE Selection Key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE) for the Run command and speed reference. The LED is on when the drive is in the LOCAL mode (operation from keypad). [Not available in SBT-L450]
10	LO/RE	LO/RE Light	Lit while the operator is selected to run the drive (LOCAL mode). This feature is not available in this version.
11	FWD	FWD Light	Lit while the drive runs in the forward direction.
12	REV	REV Light	Lit while the drive runs in the reverse direction.
13	MOD	MOD Light	Lit when the energy injected by the drive is negative.
14	RDY	RDY Light	Lit when the drive is ready to operate.
15	BB	BB Light	Lit when the drive is in the base block status.
16	ALM	ALM Light	Blinks when an alarm occurs.

◆ LCD Display

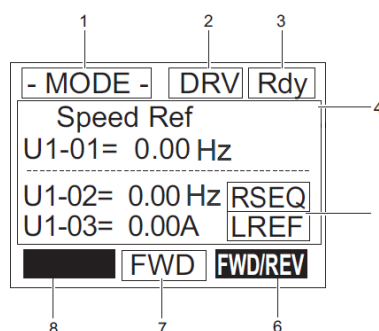


Figure 1.4: Panel monitoring menu

No.	Name	Display	Content
1	Operation Mode Menus	MODE	Displayed when in the main menu.
		MONITOR	Displayed when in Monitor Mode.
		VERIFY	Indicates the Modified Parameters Menu.
		PRMSET	Displayed when in Parameter Setting Mode.
		A.TUNE	Displayed during Auto-Tuning.
2	Mode Display Area	DRV	Displayed when in Drive Mode.
		PRG	Displayed when in Programming Mode.
3	Ready	Rdy	It indicates the drive is ready to run.
4	Data Display	-	Displays specific data and operation data.
6	Function Key 1 (F1)	HELP	Pressing displays the Help menu.
		←	Pressing scrolls the cursor to the left.
		HOME	Pressing returns to the top menu (Monitor Menu).
		ESC	Pressing returns to the previous display.
7	FWD/REV	FWD	During Up command
		REV	During Down command
8	Function Key 2 (F2)	FWD/REV	Pressing switches between Up and Down when the Up/Down command is set using the digital operator.
		DATA	Pressing scrolls to the next display.
		→	Pressing scrolls the cursor to the right.
		RESET	Pressing resets the existing drive fault or error.

◆ Menu structure

The drive panel has four display screens that cover user-accessible drive features. Hereafter, these menus are explained:

■ Monitoring:

Monitor parameters let the user view various aspects of drive performance using the digital operator display. The values are updated online according to the drive condition.

■ Auto-tuning

Based on the required motor parameters shown in this menu, the drive is capable of calculating necessary control parameters to run the motor efficiently.

■ Setting


In the setting menu, the user can edit and verify parameter settings. The number of accessible parameters is based on the control method set in A1-02.

■ Modified Parameters

The parameters which have been modified and changed since the startup of the panel are shown in this menu. If the driver turns off or the panel resets, the list will be cleared.

◆ Auto-Tuning

The drive offers Auto-Tuning for induction motors. The type of Auto-Tuning used differs further based on the control mode and other operating conditions.

 **Note:** The drive will only show Auto-Tuning parameters that are valid for the control mode which has been set in A1-02.

■ Auto-Tuning for Induction Motors

This feature automatically sets the motor parameters E1-□□ and E2-□□ for an induction motor.

Table 1.2 Types of Auto-Tuning for Induction Motors


Type	Setting	Requirements and Benefits	V/f (0)	OL(2)	CLV (3)	CLVPM (7)
Stationary Auto-tuning	T1-01=3	• Automatically calculates motor parameters needed for open-loop and V/f control.	Yes	Yes	Yes	No
Encoder Offset Calculation	T1-01=10	Automatically calculates Encoder offset.	No	No	No	Yes


Table 1.3 lists the data that must be entered for Auto-Tuning. Make sure this data is available before starting Auto-Tuning. The necessary information is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer.


Table 1.3 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T1-01)	
			3 Stationary	10 Encoder offset calculation
Motor Rated Power	T1-02	kW	Yes	Yes
Motor Rated Voltage	T1-03	Vac	Yes	Yes
Motor Rated Current	T1-04	A	Yes	Yes
Motor Rated Frequency	T1-05	Hz	Yes	Yes
Number of Motor Poles	T1-06	-	Yes	Yes
Motor Rated Speed	T1-07	rpm	Yes	Yes
Encoder resolution	T1-08	PPR	No	Yes

■ Basic Auto-Tuning Preparations and Precautions

 **WARNING!** Electrical Shock Hazard. Do not touch the motor during Auto-Tuning. Lethal voltages may be present on the motor case. Failure to comply may result in serious injury from electrical shock.

 **WARNING!** Electrical Shock Hazard. When executing Stationary Auto-Tuning for motor data, the motor does not rotate, however, power is applied. Do not touch the motor until Auto-Tuning is completed. Failure to comply may result in death or serious injury from electrical shock.

 **Note:** In the automatic calculation of encoder offset, although the test is in static mode, the mechanical brake must be in open condition and if the motor is connected to a load, it must be adjusted to be balanced on both sides. (Do not move to the desired position by opening the brakes)

- When using a motor contactor, make sure it remains closed during the Auto-Tuning process.
- Ensure Base_Block signal is ON when performing Auto-Tuning.
- Ensure the motor is securely mounted and bolted in place prior to Auto-Tuning.
- To cancel Auto-Tuning, press the STOP key on the digital operator.

- Make sure motor nameplate data is readily available before Auto-Tuning the drive. Auto-Tuning requires the user to input data from the motor nameplate or motor test report.

◆ Auto-Tuning Operation Example

■ Selecting the Type of Auto-Tuning

The example below shows how to select the type of Auto-Tuning.

Step		Display/ Result
1.	Turn on the power to the drive. The initial display appears.	→ <div> - MODE - DRV Rdy Speed Ref (OPR) U1-01= 0.00% U1-02= 0.00% RSEQ U1-03= 0.00A LREF FWD FWD/REV </div>
2.	Press or until the Auto-Tuning display appears.	→ <div> - MODE - PRG Auto-Tuning AUTO HELP FWD DATA </div>
3.	Press to begin setting parameters.	→ <div> - A.TUNE - PRG Tuning Mode T1-01= 0 +0+ Standard Tuning ESC FWD DATA </div>
4.	Press to select the value for T1-01.	→ <div> - A.TUNE - PRG Tuning Mode T1-01= 0 +0+ Standard Tuning "0" ← FWD → </div>
5.	Save the setting by pressing	→ <div> Entry Accepted </div>
6.	The display automatically returns to the display shown in Step 3.	→ <div> - A.TUNE - PRG Tuning Mode T1-01= 0 +0+ Standard Tuning ESC FWD DATA </div>

■ Enter Data from the Motor Nameplate



After selecting the type of Auto-Tuning, enter the data required from the motor nameplate.

Step		Display/ Result
1.	Press to access the motor output power parameter T1-02.	→ <div> - A.TUNE - PRG Mtr Rated Power T1-02= 3.70kW (0.00 ~ 650.00) "3.70kW" ESC FWD DATA </div>
2.	Press to view the default setting.	→ <div> - A.TUNE - PRG Mtr Rated Power T1-02= 0.3.70kW (0.00 ~ 650.00) "3.70kW" ← FWD → </div>
3.	Press , , , and to enter the motor power nameplate data in kW.	→ <div> - A.TUNE - PRG Mtr Rated Power T1-02= 004.00kW (0.00 ~ 650.00) "3.70kW" ← FWD → </div>
4.	Press to save the setting.	→ <div> Entry Accepted </div>

5.	The display automatically returns to the display in Step 1.	→	<div> -A.TUNE - PRG Mtr Rated Power T1-02= 4.00kW (0.00 ~ 650.00) "3.70kW" ESC FWD DATA </div>
6.	Repeat Steps 1 through 5 to set the following parameters: • T1-03, Motor Rated Voltage • T1-04, Motor Rated Current • T1-05, Motor Base Frequency • T1-06, Number of Motor Poles • T1-07, Motor Base Speed • T1-08, Encoder Resolution	→	<div> -A.TUNE - PRG Mtr Rated Power T1-02= 4.00kW (0.00 ~ 650.00) "3.70kW" ESC FWD DATA </div> <div> ↓ </div> <div> -A.TUNE - PRG Rated Speed T1-07= 1450RPM (0 ~ 24000) "1450RPM" ESC FWD DATA </div>

■ Starting Auto-Tuning

⚠ WARNING! Electrical Shock Hazard. High voltage will be supplied to the motor when Stationary Auto-Tuning is performed even with the motor stopped, which could result in death or serious injury. Do not touch the motor until Auto-Tuning has been completed.

Step			Display/Result
1.	After entering the data listed on the motor nameplate, press  to confirm.	→	<div> -A.TUNE - DRV Auto-Tuning 0.00 Hz/ 0.00A Tuning Ready ? Press RUN key ESC FWD </div>
2.	Press  to activate Auto-Tuning.	→	<div> -A.TUNE - DRV Rdy Tune Proceeding X.XX Hz/ X.XXA <<<<<< >>>>>> FWD </div>
3.	Auto-Tuning finishes in approximately five seconds.	→	<div> -MODE - DRV End Tune Successful FWD RESET </div>

◆ Parameter Settings during Induction Motor Auto-Tuning: T1

The T1-□□ parameters are used to set the Auto-Tuning input data for induction motor tuning.

■ T1-01: Auto-Tuning Mode Selection

Sets the type of Auto-Tuning to be used.

No.	Parameter Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	3	3

Setting 3: Stationary Auto-tuning

■ T1-02: Motor Rated Power

It sets the motor rated power according to the motor nameplate value.

No.	Parameter Name	Setting Range	Default
T1-02	Motor Rated Power	0 to 10	5.3 kW

■ T1-03: Motor Rated Voltage

It sets the motor rated voltage according to the motor nameplate value.

No.	Parameter Name	Setting Range	Default
T1-03	Motor Rated Voltage	0 to 380	380 V

■ T1-04: Motor Rated Current

It sets the motor rated current according to the motor nameplate value. Enter the current at the motor base speed.

No.	Parameter Name	Setting Range	Default
T1-04	Motor Rated Current	2 to 24 A	12 A

■ T1-05: Motor Base Frequency

It sets the motor rated frequency according to the motor nameplate value.

No.	Parameter Name	Setting Range	Default
T1-05	Motor Base Frequency	0 to 50 Hz	50 Hz

■ T1-06: Number of Motor Poles

It sets the number of motor poles according to the motor nameplate value.

No.	Parameter Name	Setting Range	Default
T1-06	Number of Motor Poles	2 to 48	4

■ T1-07: Motor Base Speed

It sets the motor rated speed according to the motor nameplate value.

No.	Parameter Name	Setting Range	Default
T1-07	Motor Base Speed	300 to 3000 rpm	1380 rpm

■ T1-08: Encoder resolution (pulses per revolution)

It sets the number of pulses from the PG encoder. Set the actual number of pulses for one full motor rotation.

No.	Parameter Name	Setting Range	Default
T1-08	Encoder number of Pulses Per Revolution	0 to 30000 ppr	2048

Chapter 2: Parameter Details

A: Initialization

The initialization group contains parameters associated with the initial setup of the drive. Parameters involving the initialization and control method are located in this group.

■ A1-02: Control Method Selection

Selects the Control Method (also referred to as the control mode) that the drive uses to operate the motor.

No.	Parameter Name	Setting range	Default
A1-02	Control Method Selection	0,2,3	2

Setting 0: V/f Control for Induction Motors

Use this mode for simple speed control. This method sets the output voltage based on the motor voltage-frequency curve.

Setting 2: Open-Loop Control

Use this mode for general applications that require more precise speed control and quicker torque response than V/f.

Setting 3: Closed-Loop Control

Use this mode to drive an induction motor with encoder feedback. This mode offers high-performance control down to 0 rpm motor speed.

■ A1-03: Factory Reset

Resets parameters back to their default values.

No.	Parameter Name	Setting range	Default
A1-03	Factory Reset	0,1	0

Setting 0: No Function

Setting 1: Factory Reset

b: Application

◆ b1: Operation Mode Selection

■ b1-02: Up/Down Command Selection

Determines the Up/Down command source in the REMOTE mode. Wire the motor so the elevator goes up when an Up command is issued.

No.	Parameter Name	Setting Range	Default
b1-02	Up/Down Command Selection	0 to 1	1

Setting 0: Operator

Allows the user to enter Up/Down commands from the digital operator. Use this setting when performing a test run only. In this mode, the speed reference is determined by d1-01.

Setting 1: Control Circuit Terminal

Up/Down commands are issued from the control circuit terminals. This is the standard setting used in most elevator applications.

■ b1-08: Up/Down Command Selection while in Programming Mode

As a safety precaution, the drive will not normally respond to a Up/Down command input when the digital operator is being used to adjust a parameter in the Programming Mode (Verify Menu, Setup Mode, and Auto-Tuning Mode). If required by the application, set b1-08 to allow the drive to run while in the Programming Mode.

No.	Parameter Name	Setting Range	Default
b1-08	Up/Down Command Selection while in Programming Mode	0 to 2	0

Setting 0: Disabled

A Up/Down command is not accepted while the digital operator is in the Programming Mode.

Setting 1: Enabled

A Up/Down command is accepted in any digital operator mode.

Setting 2: Prohibit programming during run

It is not possible to enter the Programming Mode as long as the drive output is active. The Programming Mode cannot be displayed during Run.

■ b3-01: Detection light load direction

Enable or disable light load experiment

No.	Parameter Name	Setting Range	Default
b3-01	Detection light load direction	0, 1	1

Setting 0: Disable

If this parameter is set to 0, the drive will move in the direction that has been issued from the control center, while the drive itself is in rescue mode and the light load orientation detection test no longer will be performed by the drive in this situation.

Setting 1: Enable

If this parameter is set to 1, the driver will perform a light load direction test in rescue mode. Any direction command issued from the control center will be ignored by the driver.

C: Tuning

C parameters are used to set the acceleration and deceleration characteristics, as well as jerk. Other parameters in this group cover setting for torque compensation and PI controller in closed-loop control.


◆ C1: Acceleration and Deceleration Ramps


■ C1-01 to C1-04 and C1-09: Accel, Decel Ramps 1 and 2 and Fast Stop Ramp


Five parameters can be set in the drive for tuning acceleration and deceleration ramp. Acceleration ramp parameters always set the ramp or time to accelerate from 0 to the maximum speed. Deceleration ramp parameters always set the ramp or time to decelerate from the maximum speed to 0.

In this version (SBT-L450U), C1-01 is used for acceleration time. C1-02 is used when the motor decelerates from any speed to any other speed (except nominal and leveling speed to zero speed). C1-

04 is used when the motor decelerates from leveling speed to zero speed. C1-09 determines the deceleration ramp from nominal speed to zero speed.

 **Note 1:** If C1-02=0, drive coast to stop

 **Note 2:** If C1-04=0, deceleration from leveling speed will be set according to the value set in C1-02.

 **Note 3:** By setting C1-09 to zero, if the motor speed shifts from its nominal speed, the drive immediately applies the brake and coasts to stop.

No.	Parameter Name	Application	Setting Range	Default
C1-01	Acceleration Ramp 1	Any speed to any speed	0.00 to 180.00 s	4
C1-02	Deceleration Ramp 1	Any speed to any speed (Except nominal and leveling speed to zero speed)		2
C1-04	Deceleration Ramp 2	Leveling speed to zero speed		2
C1-09	Fast Stop Ramp	Nominal speed to zero speed		0

■ C1-15: Inspection Deceleration Ramp

Sets the deceleration ramp during Inspection Run. If this parameter is set to 0s, the drive coasts to stop.

No.	Parameter Name	Setting Range	Default
C1-15	Inspection Deceleration Ramp	0.00 to 2.00 s	0.00 s

◆ C2: Jerk Settings

Jerk settings set the transition between acceleration rates. Adjust them to smooth out jerks or shocks that occur when the speed is changing.

■ C2-01 to C2-05: Jerk Settings

C2-01 through C2-05 set separate jerks for each section of the acceleration or deceleration.

No.	Parameter Name	Setting Range	Default
C2-01	Jerk at Accel start	0 to 7	4
C2-02	Jerk at Accel end		
C2-03	Jerk at Decel start		
C2-04	Jerk at Decel end		
C2-05	Jerk at leveling speed		

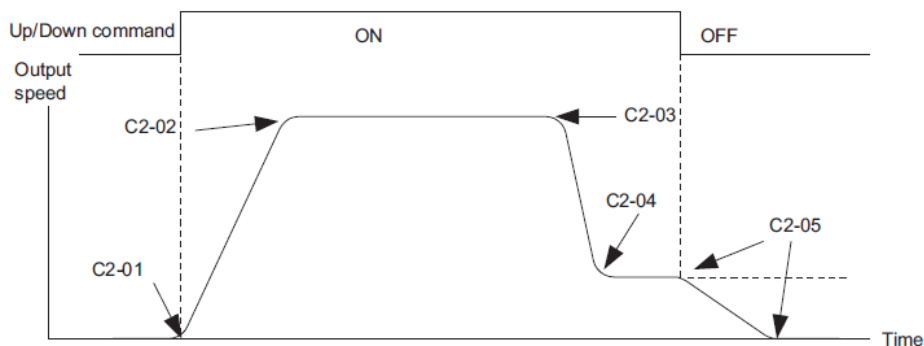


Figure 2.1: Jerk Settings


The transition time between accelerating and decelerating ramps is expressed by discrete numbers in SBT-L450U. Eight S-curve settings are available, and are expressed as below:

- 0: No S Curve
- 1: Very low
- 2: Low
- 3: Intermediate 1
- 4: Intermediate 2
- 5: Intermediate 3
- 6: High
- 7: Very high

Adjusting low numbers leads to shock while high numbers slow the operation. The optimum operation can be obtained by setting these parameters to 3 or 4.

◆ C4: Torque Compensation

The torque compensation function compensates for insufficient torque production at start-up or when a load is applied.

 **Note:** Set the motor parameters (E2-□□) and V/f pattern properly before setting torque compensation parameters.

■ C4-01: Torque Compensation Gain

Sets the gain for the torque compensation function.

No.	Parameter Name	Setting Range	Default
C4-01	Torque Compensation Gain	0.00 to 5.00	1.5

Adjustment

Although this parameter rarely needs to be changed, it may be necessary to adjust the torque compensation gain in small steps of 0.05 in the following situations:

- Increase this setting when using a long motor cable, or when the starting torque is not high enough to accelerate the motor.
- Decrease this setting when motor oscillation occurs.

Adjust C4-01 so that the output current does not exceed the drive rated current.

■ C4-02: Torque Compensation Primary Delay Time

It Sets the delay time used for applying torque compensation.

No.	Parameter Name	Setting Range	Default
C4-02	Torque Compensation Primary Delay Time	0.0 to 2000.0 ms	600.0 ms

Adjustment

Although C4-02 rarely needs to be changed, adjustments may be necessary in the following situations:

- Increase this setting if the motor vibrates.
- Decrease this setting if the motor responds too slowly to changes in the load.

◆ C5: Speed Control Loop

These parameters are accessible only in the closed-loop control mode (A1-02=3).

The Speed control Loop Controls the motor speed in CLV and CLV/PM control modes. It adjusts torque reference in order to minimize the difference between speed reference and actual motor speed.

The speed control block diagram has been shown in fig2.2.

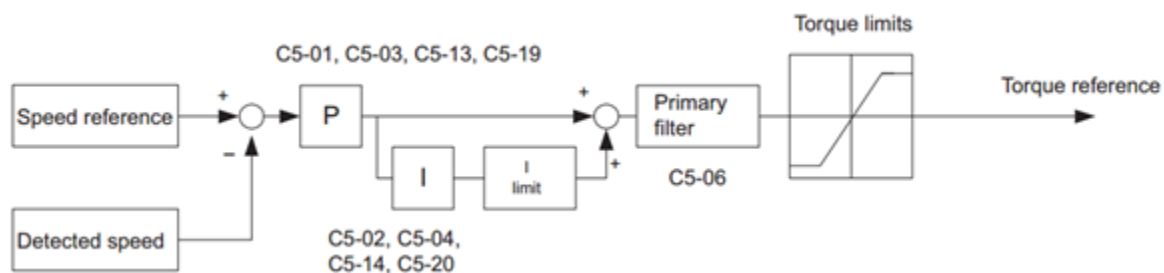


Figure 2.2: Speed Control Block Diagram

■ **C5-01, C5-03, C5-13 / C5-02, C5-04, C5-14: Speed Control Loop Proportional Gain 1, 2, 3 / Speed Control Loop Integral Time 1, 2, 3**

These parameters can be used to adjust the responsiveness of the Speed Control Loop.

No.	Parameter Name	Setting Range	Default
C5-01	Speed Control Loop Proportional Gain 1	0 to 255	2
C5-02	Speed Control Loop Integral Time 1	0 to 8191ms	1000ms
C5-03	Speed Control Loop Proportional Gain 2	0 to 255	15
C5-04	Speed Control Loop Integral Time 2	0 to 8191ms	1000ms
C5-13	Speed Control Loop Proportional Gain 3	0 to 255	15
C5-14	Speed Control Loop Integral Time 3	0 to 8191ms	1000ms

It is important to change the coefficients of the speed controllers properly in order to drive the motor in a soft and smooth way. The accelerating procedure of P and I coefficients for start and stop modes are shown in Fig. 2-3, (a) and (b) respectively.

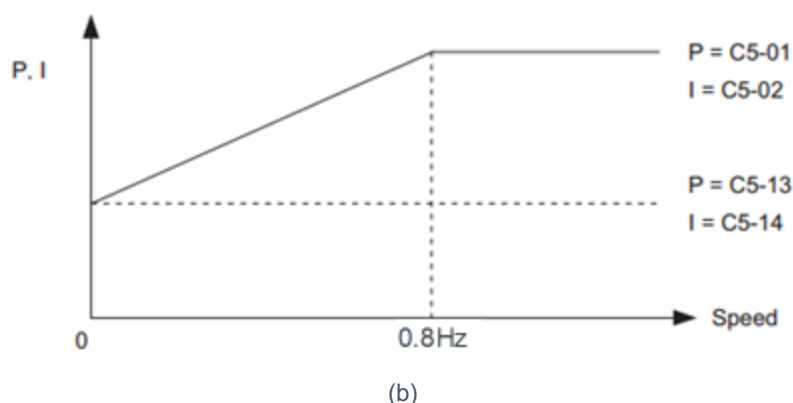
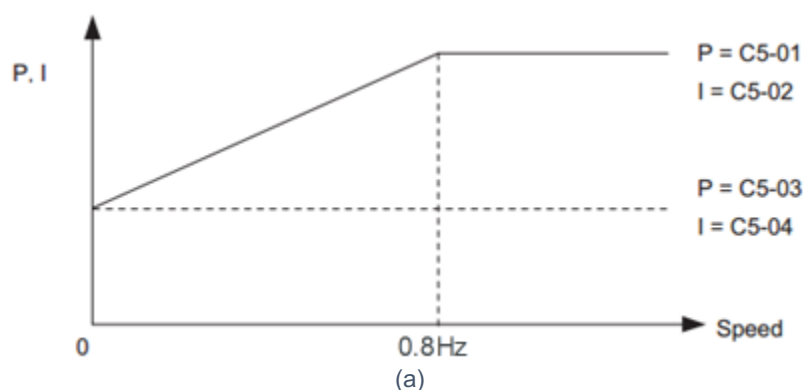


Figure 2.3 Settings at Low and High Speed during Acceleration

■ **C5-06: Speed Control Loop Primary Delay Time Constant**

This parameter sets the filter time constant for the time from the speed loop to the torque command output. Increase this setting gradually in increments of 0.01 for loads with low rigidity, or when oscillation is a problem. The excessive increase of this parameter will cause problems.

No.	Parameter Name	Setting Range	Default
C5-06	Speed Control Loop Primary Delay Time Constant	0 to 500ms	30ms

■ C5-19, C5-20: Speed Control Loop P Gain Time, I Time during Position Lock

These two parameters are used to adjust the responsiveness of Speed Control Loop during Position Lock. Incorrect adjustment causes a rollback after the brake releases or motor oscillation.

No.	Parameter Name	Setting Range	Default
C5-19	Speed Control Loop Proportional Gain Time during Position Lock	0 to 255	3
C5-20	Speed Control Loop Integral Time during Position Lock	0 to 8191ms	300ms

d: Reference Settings

The d family parameters determine the speed of the elevator including the speed reference.

◆ d1: Speed Reference

The parameters of this family adjust the reference speed of the drive in different conditions.

■ d1-01 to d1-08: Speed References 1 to 8

The drive lets the user switch between 8 preset frequency references during run by using the digital input terminals.

No.	Parameter Name	Setting Range	Default
d1-01	Speed Reference 1	0.00 to E1-04 Hz	10 Hz
d1-02	Speed Reference 2		0 Hz
d1-03	Speed Reference 3		
d1-04	Speed Reference 4		
d1-05	Speed Reference 5		
d1-06	Speed Reference 6		
d1-07	Speed Reference 7		
d1-08	Speed Reference 8		

Multi-Step Speed Selection

To use several speed references for a multi-step speed sequence, set the H1-□□ parameters to 0,1,2.

Reference	Multi-step Speed 1 H1-□□=0	Multi-step Speed 2 H1-□□=1	Multi-step Speed 3 H1-□□=2
Frequency Reference 1	OFF	OFF	OFF
Frequency Reference 2	ON	OFF	OFF
Frequency Reference 3	OFF	ON	OFF
Frequency Reference 4	ON	ON	OFF
Frequency Reference 5	OFF	OFF	ON
Frequency Reference 6	ON	OFF	ON
Frequency Reference 7	OFF	ON	ON
Frequency Reference 8	ON	ON	ON

■ d1-17: JOG Speed Selection

This parameter adjusts the speed that is related to JOG.

No.	Parameter Name	Setting Range	Default
d1-17	JOG Speed	0 to E1-04	0Hz

■ d1-18: Speed Reference Selection Mode

This parameter sets the priority of the speed reference inputs.

NOTICE: Always turn off the RUN command before changing the setting of parameters d1-18 (Speed Reference Selection Mode), d1-01 (Speed Reference Selection). If the RUN command is on, when changing any of these settings, the motor may unexpectedly start running and could result in injury.

No.	Parameter Name	Setting Range	Default
d1-18	Speed Reference Selection Mode	0 to 2	1

Setting 0: Use multi-speed references d1-01 to d1-08

These parameters set speed references 1 through 8. Each of these speed reference values can be selected using digital inputs programmed for multi-speed selection(H1-□□).

Setting 1: High-speed reference has priority

Four different speed parameters (d1-19, d1-20, d1-24, d1-26) can be programmed. If any of these speed parameters and leveling speed, activated at the same time, speed parameters have priorities over leveling speed parameter.

Setting 2: Low-speed reference has priority

Four different speed parameters (d1-19, d1-20, d1-24, d1-26) can be programmed. If any of these speed parameters and leveling speed, activated at the same time, the leveling speed has priority over speed parameters.

■ d1-19: Nominal Speed

Sets the nominal speed, and it is used as the motor reference speed when a digital command for the Nominal input terminal is issued(H1-□□=6).

No.	Parameter Name	Setting Range	Default
d1-19	Nominal Speed	0.00 to E1-04	47 Hz

■ d1-20: Intermediate Speed

Sets intermediate speed.

No.	Parameter Name	Setting Range	Default
d1-20	Intermediate Speed	0.00 to 50.00 Hz	30.00 Hz

■ d1-24: Inspection Operation Speed

It sets the inspection speed, and it is used as the motor reference speed when a digital command for the Inspection input terminal is issued.

No.	Parameter Name	Setting Range	Default
d1-24	Inspection Operation Speed	0.00 to 50.00 Hz	15.00 Hz

■ d1-25: Rescue Operation Speed

While digital input has been set to rescue mode (H1-□□=10), this parameter determines the speed during Rescue Operation.

No.	Parameter Name	Setting Range	Default
d1-25	Rescue Operation Speed	0 to E1-04	5Hz

■ d1-26: Leveling Speed

It sets the Leveling speed, and it is used as the motor reference speed when a digital command for the Leveling input terminal is issued.

No.	Parameter Name	Setting Range	Default
d1-26	Leveling Speed	0.00 to 50.00 Hz	5.00 Hz

E: Motor Parameters

E parameters cover V/f pattern and motor data settings.

NOTICE: In closed-loop mode (A1-02=3), only frequency and nominal voltage (E1-04, E1-05) are Customizable, which after the auto-tuning, they will be adjusted by the drive automatically.

◆ E1: V/f Pattern

■ E1-02: V/f Mode

No.	Parameter Name	Setting Range	Default
E1-02	V/f Mode	0 to 3	3

Setting 0: Normal V/f

In this mode, the drive uses V/f curve based on Maximum Voltage (E1-05) and Maximum frequency (E1-04). In all reference speeds, this ratio is kept constant.

Setting 1: Torque Compensation

In this mode, the torque is increased to prevent motor stall under heavy loads.

Setting 2: Manual Curve

In this mode, the user can adjust the voltage-speed curve by setting parameters E1-05 through E1-13. Be careful to set these parameters correctly, otherwise, the motor will show unexpected behavior or overload fault will occur due to the saturation of the motor magnetic core.

Setting 3: Boost Manual Curve (Recommended)

In this mode, the voltage-speed curve is set according to parameters E1-05 through E1-13, and starting torque is increased to prevent motor stall under heavy loads. Besides, voltage offset could be added to all points in the curve by using E1-03. The voltages-speed curve will be according to Fig. 2.2. Use this option when the motor is under heavy loads, or high starting torque is required.

■ E1-03: Voltage Offset

No.	Parameter Name	Setting Range	Default
E1-03	Voltage Offset	0V to 50V	0V

The voltage-speed curve set by parameters E1-05 through E1-13 could be further modified by adding a constant voltage. The amount of added voltage could be set in E1-03. If the motor stalls, increase voltage offset to increase the torque. Note that E1-03 is used when E1-02 is set to 3 or 1.

■ V/f Pattern Settings E1-04 to E1-13

No.	Parameter Name	Setting Range	Default
E1-04	Maximum Output Frequency	0 to 50Hz	50 Hz
E1-05	Maximum Voltage	0.0 to 380.0 V	380.0 V
E1-06	Voltage at 16/32 Max Frequency	0.0 to 380.0 V	167V
E1-07	Voltage at 12/32 Max Frequency	0.0 to 380.0 V	121 V
E1-08	Voltage at 10/32 Max Frequency	0.0 to 380.0 V	92 V
E1-09	Voltage at 8/32 Max Frequency	0.0 to 380.0 V	75 V
E1-10	Voltage at 6/32 Max Frequency	0.0 to 380.0 V	55 V
E1-11	Voltage at 5/32 Max Frequency	0.0 to 380.0 V	45 V
E1-12	Voltage at 4/32 Max Frequency	0.0 to 380.0 V	35 V
E1-13	Voltage at 3/32 Max Frequency	0.0 to 380.0 V	25V

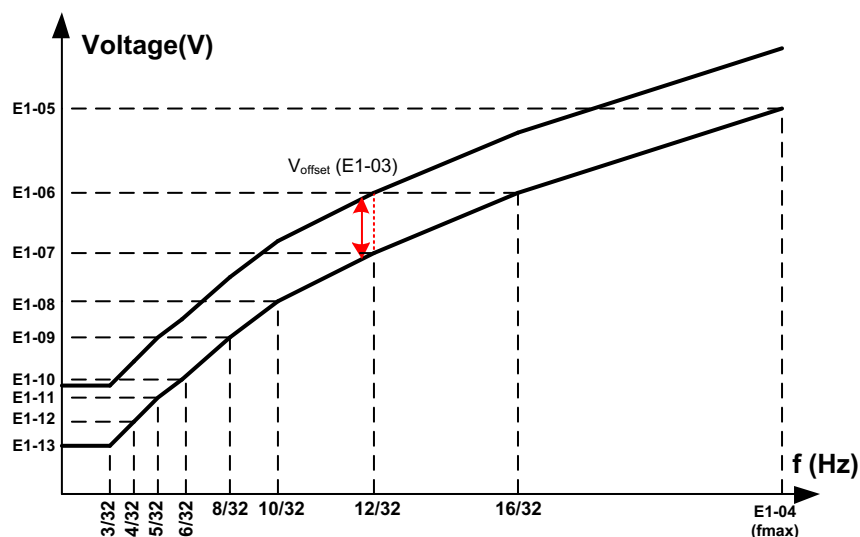


Figure 2.2 Manual V/f curve

◆ E2: Motor Parameters

These parameters contain the motor data for induction motors. They are set automatically when Auto-Tuning is performed.

■ E2-01: Motor Rated Current

Used to protect the motor and calculate drive control parameters. Set E2-01 to the full load amps (FLA) stamped on the motor nameplate. If Auto-Tuning completes successfully, the value entered to T1-04 will automatically be saved to E2-01.

No.	Parameter Name	Setting Range	Default
E2-01	Motor Rated Current	2 to 18A	14A

■ E2-02: Motor Rated Slip

Sets the motor rated slip in Hz to protect the motor and calculate drive control parameters. This value is automatically set during Auto-Tuning.

No.	Parameter Name	Setting Range	Default
E2-02	Motor Rated Slip	0.00 to 20.00 Hz	4 Hz

■ E2-03: Motor No-Load Current

Sets the no-load current for the motor in amperes when operating at the rated frequency. The drive sets E2-03 during the Auto-Tuning process. Please note that if this parameter is set to 0, output phase loss fault detection will be disabled.

No.	Parameter Name	Setting Range	Default
E2-03	Motor No-Load Current	0 to 18A	4A

■ E2-04: Number of Motor Poles

Sets the number of motor poles to E2-04. If Auto-Tuning completes successfully, the value entered to T1-06 will automatically be saved to E2-04.

No.	Parameter Name	Setting Range	Default
E2-03	Number of motor poles	2 to 48	4

■ E2-05: Motor Line-to-Line Resistance

Sets the line-to-line resistance of the motor stator winding. If Auto-Tuning completes successfully, this value is automatically calculated. Enter this value as line-to-line and not for each motor phase.

No.	Parameter Name	Setting Range	Default
E2-05	Motor Line-to-Line Resistance	0.000 to 5.000 Ω	2.7 Ω

■ E2-11: Motor Rated Power

Sets the motor rated power in kW. If Auto-Tuning completes successfully, the value entered to T1-02 will automatically be saved to E2-11.

No.	Parameter Name	Setting Range	Default
E2-11	Motor Rated Power	0.00 to 8.25 kW	5.5 kW

H: Terminal Functions

H parameters are used to assign functions to the external terminals.

◆ H1: Multi-Function Digital Inputs

■ H1-03 to H1-06: Functions for Terminals S3 to S6

These parameters assign functions to the multi-function digital inputs. The various functions and settings are listed in the table below.

No.	Parameter Name	Setting Range	Default
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	0 to 14	6
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	0 to 14	9
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	0 to 14	7
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	0 to 14	8

Setting	Function
0	Multi-Speed Reference 1
1	Multi-Speed Reference 2
2	Multi-Speed Reference 3
6	Nominal Speed
7	Intermediate Speed
8	Leveling Speed
9	Inspection Operation
11	Baseblock Command (N.O.)
12	Baseblock Command (N.C.)
13	Fault Reset
14	External Fault

Setting 0 to 2: Multi-Step Speed Reference 1 to 3

By setting three of the digital inputs to 1 to 3, 8 reference speeds set at d1-01 through d1-08 can be accessed. Refer to d1: Frequency Reference for more details.

Setting 6: Nominal Speed

Closing a terminal set for “Nominal speed” makes the drive run at the speed reference set to d1-19. Conditions change, however, according to the speed selection mode set in d1-18.

Setting 7: Intermediate Speed

Closing a terminal set for “Intermediate speed” makes the drive run at the speed reference set to d1-20. Conditions change, however, according to the speed selection mode set in d1-18.

Setting 8: Leveling Speed

Closing a terminal set for “Leveling speed” makes the drive run at the speed reference set to d1-26. Conditions change, however, according to the speed selection mode set in d1-18.

Setting 9: Inspection Operation

It causes the drive to operate at the speed reference set in the d1-24 parameter. To use Inspection Run, the terminal must be configured before the Up/Down command issued.

Setting 10: Rescue Operation


Closing a terminal set for “Rescue operation” makes the drive run at d1-25 conditions.

Setting 11, 12: Baseblock Command (N.O., N.C.)

When the driver receives a baseblock command, the output transistors stop switching and the motor coasts to stop.

Setting 13: Fault Reset

When the drive detects a fault condition, the fault output contactor closes, the drive output shuts off, and the motor coasts to stop. After disabling the Run command, clear the fault either by pressing the RESET key on the digital operator or closing a digital input configured as a Fault Reset (H1-□□=13).

 **Note:** Disable the Run command prior to resetting a fault. Otherwise, "cannot reset fault" will appear on the digital operator.

Setting 14: External Fault

The External fault command stops the drive when problems occur with external devices. To use the External fault command, set one of the multi-function digital inputs to 14. The digital operator will display EF.

◆ H2: Multi-Function Digital Outputs

■ H2-03: Terminals M5-M6 Function Selection

No.	Parameter Name	Setting Range	Default
H2-03	Multi-Function relay function	0 to 6	0

Setting	Function
0	During Run
1	Speed Agree
2	Drive Ready
3	Baseblock command(NO)
4	Fault
5	Reverse
6	Baseblock command(NC)

Setting 0: During Run

This relay is absorbed during the run

Setting 1: Speed Agree

If the drive output frequency is lower than the set value in parameter L4-01, the relay is absorbed.

Setting 2: Drive Ready

If the driver is without errors, the relay is absorbed.

Setting 3: Baseblock command(NO)

When the baseblock is disabled, the relay is absorbed.

Setting 4: Fault

When a fault occurs, the relay is absorbed.

Setting 5: Reverse

When the motor moves in the Reverse direction, the relay is absorbed.

Setting 6: Baseblock command(NC)

When the Baseblock is enabled, the relay is absorbed.

L: Protection Functions

◆ L1: Motor Protection

■ L1-02: Motor Overload Protection Time

It Sets the time that the drive will subsequently shut down due to the motor overload (oL1) when the motor is running with excessive current. Enter the time the motor can withstand operating at 150% current. This parameter rarely requires adjustment.

No.	Parameter Name	Setting Range	Default
L1-02	Motor Overload Protection Time	6 s to 90 s	60 s

■ L1-08: oL1 Current Level

It Sets the current level for motor overload detection. This parameter should be set as a percentage of the motor rated current (E2-01).

No.	Parameter Name	Setting Range	Default
L1-08	oL1 Current Level	100% to 150%	150%

◆ L4: Speed Detection

■ L4-01: Speed Agreement Detection Level

Determine the speed at which, lower speed levels cause Speed Agree relay to be absorbed.

No.	Parameter Name	Setting Range	Default
L4-01	Speed Agree	0 to 50Hz	2

◆ L5: Automatic Fault Reset

When an error occurs in the driver, these parameters can be used to clear the faults automatically and let the driver continue in its normal operation.

■ L5-01: Number of Auto Reset Attempts

If L5-01 is set to 0, the drive fault must be reset manually. Otherwise, the drive tries to automatically reset the fault and continues operation.

DANGER! In some applications, it is not safe to clear a fault automatically. Automatic fault restart function should not be enabled in such applications.

No.	Parameter Name	Setting Range	Default
L5-01	Number of Auto Reset Attempts	0 to 1	0

o: Operator Related Settings

◆ o3: Copy Function

These parameters are used to adjust and control the Copy function of the digital operator. The Copy function, stores parameter settings into the memory of the digital operator to facilitate the transfer of those stored settings to other drives with the same model, capacity, and control mode setting.

■ o3-01 Copy Function Selection


Instructs the drive to Read, Write, or Verify parameter settings.

No.	Parameter Name	Setting Range	Default
o3-01	Copy Function Selection	0 to 3	0

Setting 0: Copy Select (no function)

Setting 1: INV → OP READ

Copies all parameters from the drive to the digital operator.

 **Note:** The copy protection for the digital operator is enabled by default. Set o3-02 to 1 to unlock copy protection.

Setting 2: OP → INV WRITE

Copies all parameters from the digital operator to the drive.

Setting 3: OP ↔ INV VERIFY

Parameters in the drive are compared with the parameter settings saved on the digital operator to see if they match.

■ o3-02 Copy Allowed Selection

It allows and restricts the use of the Copy function.

No.	Parameter Name	Setting Range	Default
o3-02	Copy Allowed Selection	0 or 1	0

Setting 0: Disabled

Setting 1: Enabled

S: Elevator Parameters

This section describes various functions needed to operate an elevator application: braking sequence and slip compensation.

◆ S1: Brake Sequence

■ S1-00: Zero Speed Level at Start

Determines the frequency to begin acceleration after DC Injection.

No.	Parameter Name	Setting Range	Default
S1-00	Zero Speed Level at Start	0.00 to 10.00	0.2

■ S1-01: Zero Speed Level at Stop

Determines the frequency to begin applying DC Injection when the drive is ramping to stop.

No.	Parameter Name	Setting Range	Default
S1-01	Zero Speed Level at Stop	0.00 to 10.00	0.2

■ S1-02: DC Injection Current at Start

Determines the amount of current to use for DC Injection at the start. Set as a percentage of the motor rated current.

No.	Parameter Name	Setting Range	Default
S1-02	DC Injection Current at Start	0 to 100%	100%

■ S1-03: DC Injection Current at Stop

Determines the amount of current to use for DC Injection at the stop. Set as a percentage of the motor rated current.

No.	Parameter Name	Setting Range	Default
S1-03	DC Injection Current at Stop	0 to 100%	100%

■ S1-04: DC Injection / Position Lock Time at Start

Determines how long the drive should perform DC Injection at the start. During this time, the drive allows motor flux to develop, which is essential for applying torque quickly once the brake is released. A setting of 0.00 disables S1-04.

No.	Parameter Name	Setting Range	Default
S1-04	DC Injection Time at Start	0.00 to 10.00 s	0.40 s

■ S1-05: DC Injection / Position Lock Time at Stop

Determines how long the drive should perform DC Injection at the stop. A setting of 0.00 disables S1-05.

No.	Parameter Name	Setting Range	Default
S1-05	DC Injection Time at Stop	0.00 to 10.00 s	0.60 s

■ S1-06: Brake Release Delay Time

Determines the time that must pass after an Up/Down command is entered before the output terminal set for "Brake control" is triggered. Adjusting this delay time can help when there is not enough time to develop the appropriate amount of motor flux. Be sure to also increase the time S1-04 when setting S1-06 to relatively long delay time.

No.	Parameter Name	Setting Range	Default
S1-06	Brake Release Delay Time	0.00 to 10.00s	0.20 s

■ S1-07: Brake Close Delay Time

Determines the time that must pass after zero speed is reached before the output terminal set for "Brake control" is released.

No.	Parameter Name	Setting Range	Default
S1-07	Brake Close Delay Time	0.00 to 10.00s	0.30 s

■ S1-10: Run Command Delay Time

Sets the time the drive waits after receiving an Up/Down command before starting operation. The time set should give the motor contactor enough time to close.

No.	Parameter Name	Setting Range	Default
S1-10	Run Command Delay Time	0.00 to 1.00 s	0.20s

■ S1-11: Output Contactor Open Delay Time

Determines the time that must pass for an output terminal set for "Output contactor control" to be released after the drive has stopped and drive output has been shut off.

No.	Parameter Name	Setting Range	Default
S1-11	Output Contactor Open Delay Time	0.00 to 1.00 s	0.20 s

■ S1-12: Motor Contactor Control During Auto-Tuning Selection

Determines the state of the output contactor control command during Auto-Tuning. If S1-12 is set to 1, the motor contactor will be closed during auto-tuning.

No.	Parameter Name	Setting Range	Default
S1-12	Motor Contactor Control during Auto-Tuning	0 to 1	0

Setting 0: Disabled

Setting 1: Enabled

◆ S2: Slip Compensation for Elevators

The slip compensation function automatically adjusts the speed reference for leveling operation depending on the load measured at a constant speed. S2 parameters tune the slip compensation function to improve the landing accuracy. Slip Compensation requires that the drive be set for Open-Loop Control.

■ S2-01: Motor Rated Speed

Sets the rated speed of the motor.

No.	Parameter Name	Setting Range	Default
S2-01	Motor Rated Speed	300 to 3000 rpm	1380 rpm

■ S2-02/S2-03: Slip Compensation Gain in Motoring Mode / Regenerative Mode

Slip compensation for leveling speed can be set separately for motoring and regenerative states to help improve the accuracy of leveling.

No.	Parameter Name	Setting Range	Default
S2-02	Slip Compensation Gain in Motoring Mode	0.0 to 4.0	1
S2-03	Slip Compensation Gain in Regenerative Mode	0.0 to 4.0	0.5

■ S2-06: Slip Compensation Torque Detection Filter Time Constant

Sets the filter time constant applied to the torque signal used for the slip compensation value calculation.

No.	Parameter Name	Setting Range	Default
S2-06	Slip Compensation Torque Detection Filter Time Constant	0 to 2000 ms	2000 ms

◆ S3: Start/Stop Optimization

This parameter is enabled in closed-loop control mode(A1-02=3)

■ S3-01: Position Lock Gain at Start

It Sets the gain used by the Position Lock control loop at the start. It is used to hold the motor in place while the brake released.

The excessive increase of this parameter causes oscillation at the start moment.

No.	Parameter Name	Setting Range	Default
S3-01	Position Lock Gain at Start	0 to 100	3

■ S3-03: Position Lock Gain at Stop

It Sets the gain used by the Position Lock control loop at the stop. This is used to hold the motor in place while the brake applies.

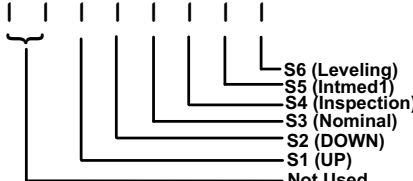
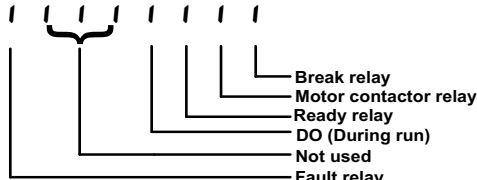
Setting S3-03 to a high value will increase the ability of the drive to hold the motor in place, but an excessive increase of this parameter can result in motor oscillation.

No.	Parameter Name	Setting Range	Default
S3-03	Position Lock Gain at Stop	0 to 100	3

U: Monitoring Parameters

Monitor parameters let the user view various aspects of drive performance using the digital operator display. The monitor parameters available in this version are indicated in table 2.1.

Table 2.1: Monitoring parameters

No.	Name	Description
U1-01	Speed Reference	Monitors the speed reference.
U1-02	Output Speed	Monitors the output speed.
U1-03	Output Current	Displays the output current.
U1-05	Speed feedback	Display the motor speed feedback.
U1-06	Output Voltage Reference	Displays the output voltage.
U1-07	DC Bus Voltage	Displays the DC bus voltage.
U1-08	Output Power	Displays the output power (this value is calculated internally).
U1-10	Input Terminal Status	<p>Displays the input terminal status.</p> 
U1-11	Output Terminal Status	<p>Displays the output terminal status.</p> 
U3-01 to U3-08	First to 8th Recent Fault	<p>Displays the first to the eighth most recent faults. After eight faults have occurred in the drive, data for the oldest fault is deleted. The most recent fault appears in U3-01, with the next most recent fault appearing in U3-02. The data is moved to the next monitor parameter every time a fault occurs.</p>
U4-08	Heatsink Temperature	Displays the heatsink temperature
U6-01	Motor Secondary Current (Iq)	Displays the value of the motor secondary current (Iq).
U6-02	Motor Excitation Current (Id)	Displays the value calculated for the motor excitation current (Id).
U6-05	Output Voltage Reference (Vq)	Output voltage reference (Vq) for the q-axis.
U6-06	Output Voltage reference (Vd)	Output voltage reference (Vd) for the d-axis.

◆ Fault Detection

Faults are detected for drive protection, and cause the drive to stop while triggering the fault output terminal MA-MB MC. Remove the cause of the fault and manually clear the fault before attempting to run the drive again.

Fault Name	symbol	Description	Cause
Memory Data Error	Err	EEPROM write error	-The power supply was switched off while parameters were being saved to the drive.
External Fault	EF	External Fault at multi-function	-An external device has tripped a fault function. -I/O wiring is incorrect. -Incorrect multi-function contact input setting
Output Phase Loss	LF	Phase loss on the output side of the drive.	-The output cable is disconnected. -The motor winding is damaged. -The output terminal is loose. -An output transistor is damaged. -The no-load current (E2-03) is set too high. -The Motor contactor is not set up correctly.
Short-circuit	SC	Drive current exceeded short-circuit detection level (maximum allowable current)	-Accel/decel ramp is too short. -The current level increased due to a momentary power loss or while attempting to perform a fault reset. -The encoder and drive phase sequence are not the same. (Interchange A, B of the encoder)
Overcurrent	OC	Drive current exceeded overcurrent detection level	-The Load is too heavy. -Accel/decel ramp is too short. -The current level increased due to a momentary power loss or while attempting to perform a fault reset.
Overload (oL1)	oL1	Drive current exceeded motor overload detection level	-The Load is too heavy. -Accel/decel ramp is too short.
Overload (oL2)	oL2	Drive current has been 2 times greater than the current value sets in E2-01 parameter	-The Load is too heavy. - The motor current is set incorrectly
Over Temperature	oH	The temperature of the heatsink exceeded the overheat detection level	-The surrounding temperature is too high. -the Load is too heavy. -The internal cooling fan is stopped.
Over Voltage	ov	Voltage in the DC bus has exceeded the overvoltage detection level.	-The Deceleration ramp is too short and regenerative energy is flowing from the motor into the drive. -Fast acceleration ramp causes the motor to overshoot the speed reference. -Drive input power voltage is too high. -The braking resistor is not connected, or wiring is wrong. -The braking resistance ohm is higher than standard values.

Under Voltage 1	Uv1	Voltage in the DC bus fell below the under-voltage detection level	-Input power phase loss. -One of the drive input power wiring terminals is loose. -There is a problem with the voltage from the drive input power. -The power has been interrupted.
Under Voltage 2	Uv2	Control Power Supply Voltage Fault	Control power supply wiring is damaged. Internal circuitry is damaged.
Operator Fault	oP03	The same function is assigned to two multi-function inputs.	The same function is assigned to two multi-function inputs.
Cannot Reset	crSt	When the error wants to be reset, the Up / down command has not been removed yet.	When the error wants to be reset, the Up / down command has not been removed yet.
Excessive Speed Deviation	dEv	The difference between the motor speed feedback and the reference speed is too high.	- The mechanical brake is not released. - The slope of the family c1 is too low. - Controller coefficients in c5 are set incorrectly.
Motor over speed	oS	Motor speed is too large	- Adjusted speeds are not set correctly. - Encoder signal direction is not the same with drive direction(change A and B) -UVW wires do not close correctly(Change U with V)
Encoder Fault	PGoH	encoder card is not connected correctly or encoder is not working correctly.	The encoder card is not matched with encoder or there is a problem in encoder cable or encoder card is not connected correctly or encoder is damaged.
Encoder card	oFc4	Encoder card is not working correctly	Encoder card is Not appropriate for this drive or encoder card is damaged.

Chapter 3: Tuning the drive for elevator application

In this chapter, the procedures required to set the drive for elevator application are explained. First, conditions under which the drive starts and stops running are mentioned. Then, the procedure for setting the drive will be explained in 9 consecutive steps.

■ Travel Start and Stop

Travel Start

To start the elevator in the up or down direction, the following conditions must be fulfilled:

- Drive is in ready condition.
- A speed greater than zero should be selected by the digital operator or the digital inputs.
- The Safe Disable signals at terminal H must be closed (drive output enabled).
- An Up or Down Signal must be set at the source specified in b1-02.

Travel Stop

The drive stops under the following conditions:

- The Up or Down command is removed.
- d1-18 is set to 1 or 2 and the Up/Down or all speed signals (S3 to S6) are removed.
- d1-18 is set to zero and the Up/Down is removed.
- A fault occurs. The drive coasts to stop in this condition.
- The Safe Disable inputs are opened or a Base Block signal is enabled. In this case, the brake is applied immediately and the drive output shuts off.

To tune the drive for the elevator applications, the procedure indicated below is recommended:

◆ Step 1: Up/Down Command Source Selection

The input source for the Up and Down command can be selected using parameter b1-02. The digital operator could be used for the test purpose. Depending on the elevator main controller, digital inputs or Modbus communication could be used as the source of Up/Down command. (Modbus communication is not available in SBT-L450).

b1-02	Up/Down Source	Up/Down command input
0	Operator Keypad	RUN and STOP keys on the operator
1	Digital Inputs	Terminal S1: Run in the Up direction Terminal S2: Run in the Down direction

◆ Step 2: Speed Selection Using Digital Inputs (b1-01 = 0)

Use parameter d1-18 to determine different travel speeds selected by the digital inputs.

d1-18	Speed Selection
0	Multi-speed inputs 1, Speed references are set in d1-01 to d1-08
1 (default)	Separate speed inputs, Speed references are set in d1-19 to d1-24 and d1-26, and Higher speed has priority
2	Separate speed inputs, Speed references are set in d1-19 to d1-24 and d1-26, and Leveling speed has priority

■ Multi-Speed Inputs (d1-18 = 0)

Multi-speed inputs could be used by assigning Multi-speed references to digital inputs as shown in the table below:

Parameter Number	Set value	Details
H1-□□	0	Multi-speed Reference 1
H1-□□	1	Multi-speed Reference 2
H1-□□	2	Multi-speed Reference 3

Different speed reference settings can be selected by combining the three digital inputs as shown in the table below.

Digital Inputs			Selected Speed
Multi-Speed Reference 1	Multi-Speed Reference 2	Multi-Speed Reference 3	
0	0	0	Speed Reference 1 (d1-01)
1	0	0	Speed Reference 1 (d1-02)
0	1	0	Speed Reference 1 (d1-03)
1	1	0	Speed Reference 1 (d1-04)
0	0	1	Speed Reference 1 (d1-05)
1	0	1	Speed Reference 1 (d1-06)
0	1	1	Speed Reference 1 (d1-07)
1	1	1	Speed Reference 1 (d1-08)

■ Separate Speed Inputs (d1-18=1 or 2)

Four different speed settings (defined in parameters d1-19, d1-20, d1-24, and d1-26) can be set and selected using four digital inputs.

Speed Selection	
Terminal	Details
H1-□□ =6	Nominal Speed
H1-□□ =9	Revision Speed
H1-□□ =7	Intermediate Speed
H1-□□ =8	Leveling Speed

Higher Speed has Priority (d1-18 = 1) (Default)

The higher speed has priority over the leveling speed. The leveling signal is disregarded as long as any other speed selection input is active. The drive decelerates to the leveling speed (d1-26) when the selected speed reference signal is removed.

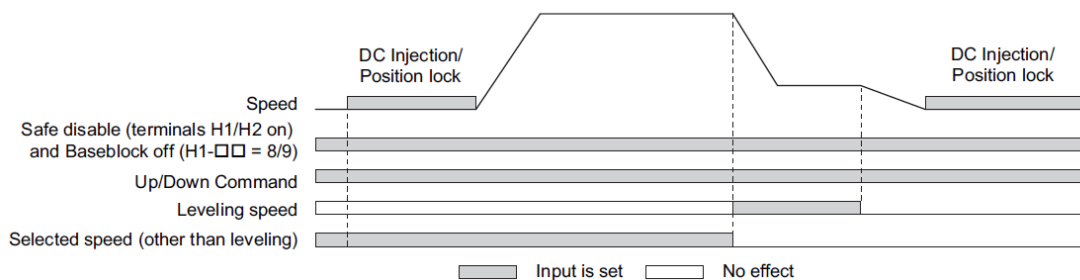


Figure 3.1 elevator ride sequence when d1-18=1

Leveling Speed has Priority (d1-18 = 2)

The leveling signal has priority over other speed references. The drive decelerates to the leveling speed (d1-26) when the leveling speed selection input is activated. The drive stops when either the leveling input or the Up/Down command is released.

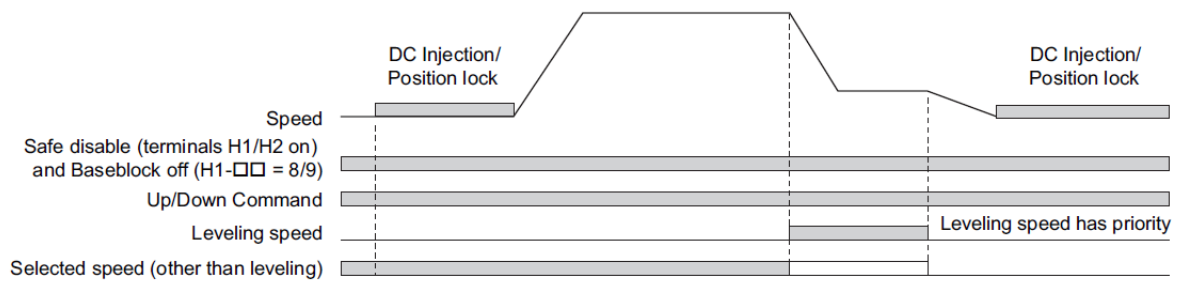


Figure 3.2 elevator ride sequence when d1-18=2

◆ Step 3: Accel/Decel Ramp and Jerk Settings

Acceleration and deceleration ramps are set using the C1-□□ parameters. Use the C2-□□ parameters to adjust the jerk at the start of acceleration or deceleration.

The default values set by the drive are recommended. Setting highly fast rates for acceleration and deceleration ramps could result in over-current and over-voltage fault, respectively. Acceleration ramp parameters always set the time to accelerate from 0 to the maximum speed. Deceleration ramp parameters always set the time to decelerate from the maximum speed to 0. C1-01, C1-02, and C1-04 are the default active accel/decel settings in SBT-L450U. In this version (SBT-L450U), C1-01 is used for all accelerations. C1-02 is used when the motor decelerates from any speed to any other speed (except nominal and leveling speed to zero speed). C1-04 is used when the motor decelerates from leveling speed to zero speed. C1-09 is used when the motor decelerates from nominal speed to zero speed. If C1-04=0, the leveling deceleration ramp will be according to the value set in C1-02. Refer to the C parameters family part in chapter 2 for further details.

Figure 3.3 explains how accel/decel ride and jerk settings can be used to adjust the ride profile.

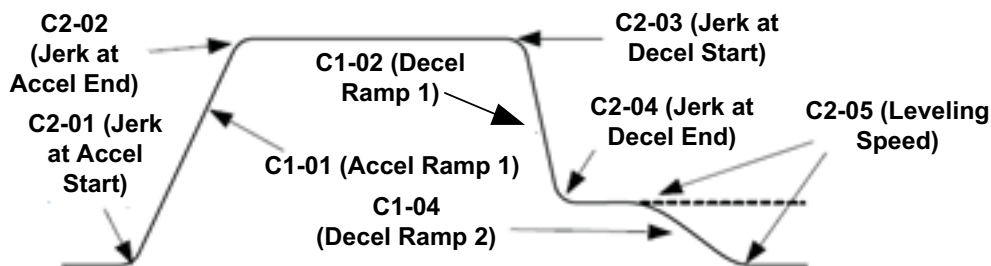


Figure 3.3 accel/decel ride and jerk settings

◆ Step 4: Brake Sequence

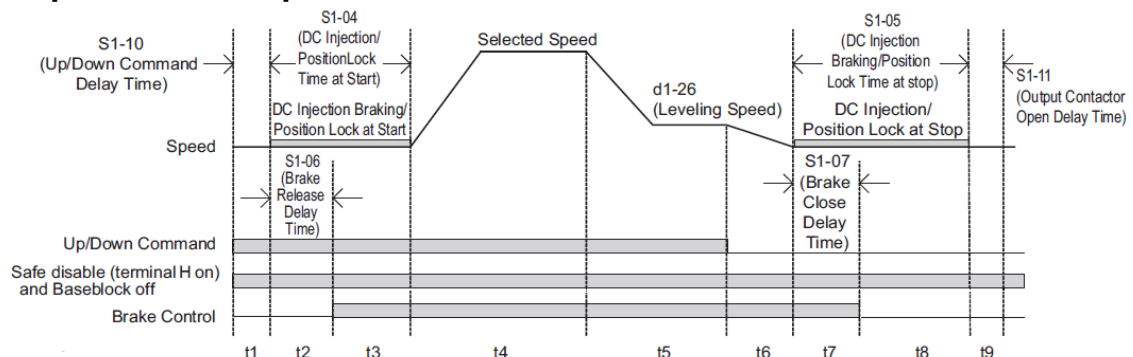


Figure 3.4 Brake Sequence

Figure 3.4 is divided into time zones. Table 3.1 explains the sequence in each time zone.

Table 3.1 Time Zones for Brake Sequence

Time Zone	Description
t1	Up or Down command is issued.
	Safe Disable terminals H-HC must be set.
	Speed reference must be selected by input terminals.
	If the motor contactor feedback signal is not used, then the driver waits for the operation start delay time set in S1-10 to pass, then it proceeds to the next step.
t2	After the delay time set in S1-10 has passed, the drive outputs current to the motor.
	DC Injection Braking or Position Lock begins.
t3	After the brake release delay time set in S1-06 has passed, the drive sets the “Brake Control” output in order to release the brake.
t4	DC Injection Braking or Position Lock will continue until the time S1-04 has elapsed. Avoid setting S1-06 greater than S1-04 since the motor could be driven against the applied brake.
t5	The drive accelerates up to the selected speed. The speed is kept constant until the leveling speed is selected.
t6	Leveling speed is selected. The drive decelerates to the leveling speed and maintains that speed until the Up or Down command is removed.
t7	The Up or Down signal is cleared. The drive decelerates to zero speed.
	The motor speed reaches the zero speed level (S1-01).
	DC Injection Braking or Position Lock is then executed for the time set in S1-05.
t8	After the delay time for closing the brake set in S1-07 has passed, the drive clears the “Brake Control”. The brake applies.
t9	The drive continues DC Injection or Position Lock until the time set in S1-05 has passed. When S1-05 has passed, the drive output is shut off.
t10	After the delay for the magnetic contactor set in S1-11 has passed, the drive resets the output terminal set for “Output Contactor Control”. The Safe Disable Inputs can be cleared and Baseblock can be enabled.

◆ Step 5: Control Method Selection

The control method should be determined based on the requirements and available equipment. For more landing accuracy, Open-loop control is recommended when PG is not available. If PG is used, V/f with PG provides more accurate speed control.

◆ Step 6: Motor parameters

If all motor parameters are available, E1 and E2 parameter groups should be set manually. E1-04, E1-05, E2-01, E2-02, E2-03, E2-04, E2-05 are the necessary parameters for the normal operation of the drive. If the resistance value of the motor is unknown, perform auto-tuning using the Auto-tuning section of the panel. The auto-tuning procedure is explained in chapter 1. Note that the “output phase loss” fault is based on the no-load current of the motor (E2-03), and if starting current is less than 25% of no-load current, the drive will trip and show “output phase loss” fault. To disable this fault, the no-load current could be set zero.

◆ Step 7: V/f Mode Selection

Determine which V/f curve is more suitable for the motor. Normal V/f curve is the most energy-efficient method, however, the starting torque is not high enough to accelerate the motor. Using boost manual curve with predefined values (E1-02=3) is highly recommended for elevator applications. Torque boost option (E1-02=1) is an alternative option for motors with heavy loads. Experts can set V/F curve manually using (E1-02=3 or E1-02=2) and E1-03. For more information, please refer to E1: V/F pattern in chapter 2.

◆ Step 8: Adjustments for Elevator Ride Comfort

This section explains the adjustment of drive settings used to eliminate problems with vibration and rollback. Perform the steps presented in this section after the Basic Application Setup procedure is completed.

The following table describes the most common problems encountered when riding an elevator with an induction motor and propose the related solutions for these problems. Before taking any action, make sure the startup procedures have been performed as previously described.

Table 3.2 Drive problems and corrective actions

Problem	Control Mode and Possible Cause	Corrective Action
Rollback at start	Insufficient torque when the brake is released.	<ul style="list-style-type: none"> • Increase the DC Injection Braking Current at Start using parameter S1-02. • Increase Torque Detection Gain (C4-01) in steps of 0.2. • Increase starting frequency (S1-00). • Increase Voltage offset (E1-03) in steps of 5V.
	DC Injection and brake timing are not optimized.	Set the time for DC Injection Braking at Start (S1-04) as short as possible, and make sure that brake releases completely before the motor starts to turn.
	Motor torque is not fully established when the brake is released.	Lengthen the Brake Release Delay Time (S1-06) and the time for DC Injection Braking / Position Lock at Start (S1-04).
	Motor contactor closes too late.	Make sure that the contactors are closed before the Up/Down command is issued.
Shock at start	Motor starts rotating when the brake is not completely released or runs against the brake.	Increase the DC Injection Braking Time at Start using parameter S1-04.
	Acceleration rate is changing too quickly.	Increase C2-01.
	Starting torque influences the calculated slip.	<ul style="list-style-type: none"> • Increase Slip Compensation Filter Time Constant (S2-06). • If the problem exists, increase the Slip Compensation Delay Time (S2-05) in steps of 50ms.
	Starting torque is too much.	<ul style="list-style-type: none"> • Increase Torque Detection Delay Time (C4-02) in steps of 50ms. • If the problem still exists, decrease Torque Detection Gain (C4-01). Note that decreasing C4-01 may result in motor stall and over-current fault. In this case, increase acceleration time (C1-01).
	The starting speed is not optimized.	Change S1-00 in steps of 0.1, and see its influence on shock.
Shock at stop	Brake is applied too early, causing the motor to run against the brake.	<ul style="list-style-type: none"> • Increase the Delay Time to Close the Brake (S1-07). If necessary, also increase the DC Injection Braking Time at Stop S1-05. • If the problem still exists, increase zero speed at stop (S1-01).
	Motor contactor is released before the brake is fully applied.	Check the motor contactor sequence. (S1-11)
	DC injection is not powerful enough to stop the motor efficiently.	Increase DC injection at stop (S1-03).
Jerk occurs due to overshoot when the motor reaches top speed.	Too fast torque or slip compensation.	<ul style="list-style-type: none"> • Increase the Torque Compensation Delay Time (C4-02). • Increase the Slip Compensation Delay Time (S2-06).
	The acceleration rate changes too quickly when reaching the selected speed.	Decrease the Jerk at the End of Acceleration. Increase C2-02.
Motor stops shortly (undershoot) when the leveling speed is reached.	Not enough torque at low speed.	If (E1-02=0), change it to 1 or 3. If E2-02=1, Increase E1-03. If E2-02=2/3, Increase (E1-10 to E1-13). Alternatively, you may increase E1-03.
	Too much slip compensation.	Adjust the motor data, especially motor rated speed (S2-01) correctly.
	The deceleration rate changes too quickly when reaching leveling speed.	Decrease the Jerk at the End of Deceleration. Increase C2-04.
Motor or machine vibrates at high speed or top speed.	Torque compensation responds too quickly.	Increase the Torque Compensation Delay Time (C4-02).
	Rated speed is not set correctly	Set the rated speed according to the motor nameplate.
Motor or machine vibrates in the low or medium speed range.	The output voltage is too high.	Set E2-02 to 2 or 3 and decrease E1-10 to E1-13.
	Torque compensation is responding too quickly.	Increase the Torque Compensation Delay Time (C4-02).
	The value for the motor slip is set incorrectly.	Check the Motor Slip value in parameter E2-02.
	The slip fluctuation is high.	Increase the Slip Compensation Filter Time (S2-06) in steps of 50ms.
	Vibration occurs only in regenerative mode.	Increase C4-01.

Table 3.3 Drive problems and corrective actions (closed-loop)

Problem	Control Mode and Possible Cause	Corrective Action
Rollback at start	Incorrect adjustment of DC-injector control controllers	-Increase the parameter value of S3-01. -Increase the C5-19 -Decrease the C5-20
Motor sound before start	Incorrect adjustment of DC-injector control controllers	- Decrease the C5-19 - Increase the C5-20
Shock at start	Motor starts when the brake is not released completely	-Increase the time of DC Injection (S1-04)
	Time of the accelerate is very low	-Increase the C5-01
	Incorrect adjustment of speed controllers	-Increase the C5-03 - decrease the C5-04
Motor Vibrate at start	Incorrect adjustment of speed controllers.	-Increase the C5-04 - decrease the C5-03
Vibrate in nominal speed	Incorrect adjustment of speed controllers.	-Increase the C5-02 - decrease the C5-01
Shock at stop	Mechanical brake operates very early and stops the motor in the middle of rotation.	Increase the delay of mechanical brake operation(S1-07). If necessary increase the DC injection time(S1-05)

◆ Step 9: Landing Accuracy adjustments

The aim of this test is to achieve the same stopping position in both cases, cabin with half-load (no-slip influences) and without load(maximum slip influences). While in the half-load case, only one test is enough, the other one should be repeated until the stopping accuracy in both cases is reached to the same level. After adjusting these settings, the cabinet can be moved exactly to the desired floor by moving the magnets or adjusting the slope of the inverter.

In this method, we will compare the landing position in two different cases: half-load and empty cabin. When there is half load inside the cabin, it should have a balanced condition; in this case, the slip influences should be almost zero.

First, choose one floor, and put **half-load** in the cabin. Then, call the lift to come to the floor where you are measuring in **down** direction (coming from an upper floor) and measure (note) the distance where the lift has stopped (from the floor level).

If the cabin is above the floor level, the distance is positive (Ex. +4mm); if the cabin is below the floor level, the distance is negative (Ex. -13mm). Repeat the test (still with **half load**) calling the lift to come to the floor where you are waiting in **up** direction (coming from a lower floor) and measure (note) the distance where the lift has stopped (from the floor level).

Now remove the load (**empty cabin**) and measure the stopping position when the cabin is going **down** (coming from the upper floor). So, we are checking the slip in the driving condition.

Compare the position with the case measured with **half load**:

- If the cabin landing position is higher in the case without a load, it means that the slip is not enough. We need to increase slip when the cabin is empty (with more slip the lift will go faster than without load in driving condition); in this case increase S2-02 (slip compensation in motoring mode) by 10% and measure again.

- If the cabin landing position is higher in the case with half load, it means that the slip is too much. We need to decrease slip when the cabin is empty (with less slip the lift will go slower without a load in driving condition); in this case, decrease S2-02 (slip compensation driving gain) by 10% and measure again.

- If the cabin landing position is the same in both cases, there is no need to change slip compensation driving gains. Slip frequency is correctly adjusted in driving conditions.

Measure the stopping position when the cabin is going **up** (coming from a lower floor). So, we are checking the slip in the braking condition. Compare the position with the one measured with **half load**:

- If the cabin landing position is higher in the case without a load, it means that the slip is not enough. We need to increase slip when the cabin is empty (with more slip the lift will go slower without a load in braking condition); in this case increase S2-03 (slip compensation braking gain) by 10% and measure again.

- If the cabin landing position is higher in the case with half load, it means that the slip is too much. We need to decrease slip when the cabin is empty (with less slip the lift will go faster without a load in braking condition); in this case decrease S2-03 (slip compensation braking gain) by 10% and measure again.
- If the stop distance in both cases is equal, there is no need to change slip compensation braking gains. Slip frequency is correctly adjusted in braking conditions.

Appendix A: Parameters Table

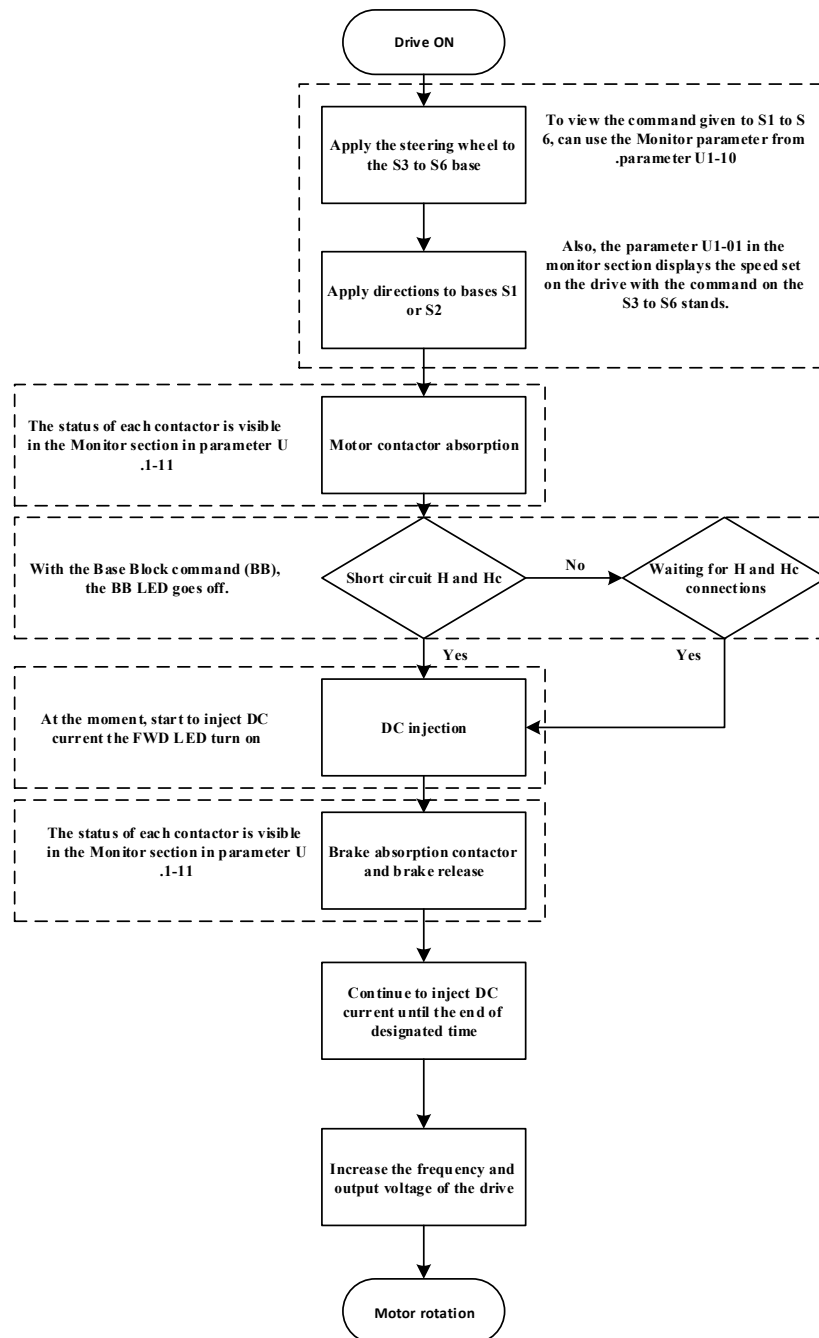
◆ Setting Parameters

No.	Name	Unit	Default value	No.	Name	Unit	Default Value
A1-02	Control Method Selection	-	2	E1-12	Voltage at 4/32 Max Speed	V	35
A1-03	Reset Factory	-	0	E1-13	Voltage at 3/32 Max Speed	V	20
b1-02	Up/Down Command Selection	-	1	E2-01	Motor Rated Current	A	12
b1-08	Up/Down Command Selection while in Programming Mode	-	1	E2-02	Motor Rated Slip	Hz	4
C1-01	Acceleration Ramp 1	s	4	E2-03	Motor No-load current	A	4
C1-02	Deceleration Ramp 1	s	2	E2-04	Number of Motor Poles	-	4
C1-04	Deceleration Ramp 2	s	2	E2-05	Motor Line to Line Resistance	Ω	2
C1-09	Fast Stop Ramp	s	0	E2-11	Motor Rated Power	kW	5.3
C1-15	Inspection Deceleration Ramp	s	2	H1-03	Multi-Function Digital Input Terminal S3 Function Selection	-	6
C2-01	Jerk at Accel Start	-	3	H1-04	Multi-Function Digital Input Terminal S4 Function Selection	-	9
C2-02	Jerk at Accel End	-	3	H1-05	Multi-Function Digital Input Terminal S5 Function Selection	-	7
C2-03	Jerk at Decel Start	-	3	H1-06	Multi-Function Digital Input Terminal S6 Function Selection	-	8
C2-04	Jerk at Decel End	-	3	L1-02	Motor Overload Protection Time	s	60
C2-05	Jerk below Leveling Speed	-	3	L1-08	oL1 Current Level	%	150
C4-01	Torque Compensation Gain	-	1.5	L5-01	Number of Auto Reset Attempts	-	0
C4-02	Torque Compensation Primary Delay time	ms	200	o3-01	Copy Function Selection	-	0
d1-01	Speed Reference 1	Hz	10	o3-02	Copy Allowed Selection	-	0
d1-02	Speed Reference 2	Hz	0	S1-00	Zero Speed Level at Start	Hz	1
d1-03	Speed Reference 3	Hz	0	S1-01	Zero Speed Level at Stop	Hz	0.5
d1-04	Speed Reference 4	Hz	0	S1-02	DC Injection Current at Start	%	70
d1-05	Speed Reference 5	Hz	0	S1-03	DC Injection Current at Stop	%	80
d1-06	Speed Reference 6	Hz	0	S1-04	DC Injection/Position Lock Time at Start	s	0.4
d1-07	Speed Reference 7	Hz	0	S1-05	DC Injection/Position Lock Time at Stop	s	0.6
d1-08	Speed Reference 8	Hz	0	S1-06	Brake Release Delay Time	s	0.2
d1-18	Speed Reference Selection Mode	-	1	S1-07	Brake Close Delay Time	s	0.3
d1-19	Nominal Speed	Hz	50	S1-10	Run Command Delay Time	s	0.2
d1-20	Intermediate Speed 1	Hz	30	S1-11	Output Contactor Open Delay Time	s	0.2
d1-24	Inspection Operation Speed	Hz	15	S1-12	Motor Contactor Control During Auto-Tuning	-	0
d1-26	Leveling Speed	Hz	5	S2-01	Motor Rated Speed	rpm	1380
E1-02	V/f Mode	-	3	S2-02	Slip Compensation Gain in Motoring Mode	-	1
E1-03	Voltage Offset	V	0	S2-03	Slip Compensation Gain in Regenerative Mode	-	0.5
E1-04	Maximum Output Frequency	Hz	50	S2-06	Slip Compensation Torque Detection Filter Time Constant	s	2000
E1-05	Maximum Voltage	V	380	T1-01	Auto-Tuning Mode Selection	-	3
E1-06	Voltage at 16/32 Max Speed	V	167	T1-02	Motor Rated Power	kW	5.5
E1-07	Voltage at 12/32 Max Speed	V	121	T1-03	Motor Rated Voltage	V	380
E1-08	Voltage at 10/32 Max Speed	V	92	T1-04	Motor Rated Current	A	12
E1-09	Voltage at 8/32 Max Speed	V	75	T1-05	Motor Base Frequency	Hz	50
E1-10	Voltage at 6/32 Max Speed	V	52	T1-06	Number of Motor Poles	-	4
E1-11	Voltage at 5/32 Max Speed	V	40	T1-07	Motor Base Speed	rpm	1380

◆ Monitoring Parameters

U1-01	Speed Reference	Hz	-
U1-02	Output Speed	Hz	-
U1-03	Output Current	Hz	-
U1-05	Speed Feedback	Hz	-
U1-06	Output Voltage Reference	V	-
U1-07	DC Bus Voltage	V	-
U1-08	Output Power	kW	-
U1-10	Input Terminal Status	-	-
U1-11	Output Terminal Status	-	-
U3-01 to U3-08	Fault History 1 to 8	-	-
U6-01	Motor Secondary Current (Iq)	A	-
U6-02	Motor Excitation Current (Id)	A	-
U6-05	Output Voltage Reference (Vq)	V	-
U6-06	Output Voltage reference (Vd)	V	-
U8-02	Heatsink Temperature	C°	-

Appendix 1: Drive Operation Flowchart



The mind behind the drive



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