

L1000-L1000s

User Manual

The mind behind the drive



SBT Electric AC Drive SBT L1000/L1000s

L1000 is an electrical AC drive for gearless elevator applications, which can be manufcatured in four different power ranges. This drive has been designed by SBT Electric in 2014. 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.

Chapters

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. Failure diagnosis is also included in this chapter. Please read the manual carefully to tune the drive correctly.



Chapter 1: Initial Settings

♦ Overview

	Descr	Prope	rties		
15	15 11 7.5 5.5			Motor Pov	wer (kW)
3-phase 380V / 50 -60 Hz				Voltage (V)	Input
3-phase 0~380V / 0 ~ 100 Hz				Voltage (V)	Output
31	24	18	14	Current (A)	
6.0	5.7	5.4	5.3	Weight	t (Kg)

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
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	Dimension
Α	205mm
В	287mm
D	215mm
Н	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 L1000 and L1000s models, respectively. In L1000s 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-L1000 I/O block diagram



Figure 1.2 (b): SBT-L1000s 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	ESC	ESC Key	 Returns to the previous display. Moves the cursor one space to the left.
2	RESET	RESET Key	Moves the cursor to the right.Resets the drive to clear a fault situation.
3		RUN Key	Run the motor when the drive is in the LOCAL mode.
4	~	Up Arrow key	Scrolls up to display the next item, select parameter numbers, and increment setting values.
5	\checkmark	Down Arrow Key	Scrolls down to display the previous item, select parameter numbers, and decrements setting values.
6	STOP	STOP Key	Stops drive operation.
7	ENTER	ENTER Key	Enters parameter values and settings.Selects a menu item to move between displays.
8	• R	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]
9	FWD	FWD Light	Lit while the drive runs in the forward direction.
10	REV	REV Light	Lit while the drive runs in the reverse direction.
11	MOD	MOD Light	Lit when the energy injected by the drive is negative.
12	RDY	RDY Light	Lit when the drive is ready to operate.

13	BB	BB Light	Lit when the drive is in the base block status.
14	ALM	ALM Light	Blinks when an alarm occurs.
15	HZ	HZ Light <1>	Lit when the chosen parameter is Hertz.
16	V	Voltage Light <1>	Lit when the chosen parameter is Voltage.
17	А	Current Light <1>	Lit when the chosen parameter is Amper.

<1> By choosing Watt or KiloWatt parameter, V and A Lights turn on. By choosing percent, V and Hz Lights turn on. By choosing millisecond or Second, Hz and A Lights turn on.

Menu structure

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

■ Reference Speed and FWD/REV Command Screen [0000 fvvd]

This is the home screen menu which appears when the panel is just turned on or the escape key is pressed. Upper screen shows the speed reference while the lower one shows the direction of the rotation. If the b1-02 = 0, by pressing the Enter key you can change the motor's moving direction with UP/DWN keys.

■ Output Speed and Current Screen [0000]:

Output speed and current appear in upper and lower screens repectively. By pressing DWN key, output current screen appears.

■ Monitoring (mmon):

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 (Atvn):

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 (PAr):

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 (urfy):

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.

Changing Parameter Values

This example explains changing C1-02 (Deceleration Ramp 1) from 1.50 seconds to 2.50 seconds. The Blinking item has been displayed in gray color.

	Step		Display
1	Turn on the power to the drive. The initial display appears.		FUUd
2	Press or until the Parameter Setting screen (PAr) appears.		PAr
3	Press enter the parameter sub menu.		
4	Press or or to select the C parameter group.		
5	Press ENTER two times.		
6	Press or $C1-02$.		L 1-02
7	Press to view the current setting value (1.50 s). The left most digit blinks.		0 150
8	Press until the desired number is selected. "1" blinks.		0 150
9	Press until the desired number is 02.50.	-	02.50
10	Press ENTER to confirm the change.	+	End
11	The display automatically returns to the screen shown in Step 4.	-	c 1-0 1
12	Press as many times as necessary to return to the initial display.	-	0000 FUUd

♦ Auto-Tunning

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

Auto-Tuning for Induction Motors and Permanent Magnet

This feature automatically sets the motor parameters $E1-\Box\Box$ and $E2-\Box\Box$ for an Induction Motor and Encoder Offset for Permanent Magnet motor.

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

Table 1.2 Types of Auto-Tuning for Induction Motors

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 Unit Parameter		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	Α	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 automatic detection of offset encoder, if the encoder is sin – Cos (ERN1387), the motor must rotate one round before Auto-tune to turn on the Mod light, then perform the Auto-tune operation.

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.	+	DODO FUUa
2.	Press or or until the Auto-Tuning display appears.	-	Atun
3.	Press ENTER to begin setting parameters.	+	
4.	Press ENTER to select the value for T1-01.	-	00
5.	Save the setting by pressing	-	End
6.	The display automatically returns to the display shown in Step 3.	+	E I-0 I

■ 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.	+	F 1-05
2.	Press ENTER to view the default setting.	+	5.3
3.	Press Rest, M and W to enter the motor power nameplate data in kW.	-	5.2
4.	Press ENER to save the setting.	+	End
5.	The display automatically returns to the display in Step 1.	+	F 1-05
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	+	E I-0∃ € I-08

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.	1	Lun 10
2.	Press ORUN to activate Auto-Tuning.	+	Lun 10
3.	Auto-Tuning finishes in approximately five seconds.	+	End

Parameter Settings during Induction Motor Auto-Tuning and Permanet Magnet Motor : T1

■ 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	3,10	3

Setting 3: Stationary Auto-tuning Setting 10: Encoder Offset detection

■ 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 8.25 kW	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 V	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

t 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 60000 ppr	2048 ppr

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	0,2,3,7	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.

Setting 7: PM Closed-Loop vector Control

Use this mode to drive an permanent magnet 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	1

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 SBT-L1000 for tuning acceleration and deceleration ramp. Acceleration ramp parameters always set the ramp or time to accelerate from 0 to the maximum speed (E1-05). Deceleration ramp parameters always set the ramp or time to decelerate from the maximum speed (E1-05) to 0.

In this version (SBT-L1000), 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 C1-04=0, deceleration from leveling speed will be set according to the value set in C1-02.

Note 2: By setting C1-09 to zero, if the motor speed shifts from its nominal speed, the drive immediately applies the brake and coast to stop.

No.	Parameter Name	Application	Setting Range	Default
C1-01	Acceleration Ramp 1	Any speed to any speed		3
C1-02	Deceleration Ramp 1	Any speed to any speed (Except nominal and leveling speed to zero speed)	0.00 to 180.00 s	2
C1-04	Deceleration Ramp 2	Leveling speed to zero speed		4
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	2.00 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		
C2-02	Jerk at Accel end		
C2-03	Jerk at Decel start	0 to 7	3
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-L1000. 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 1: Set the motor parameters (E2- $\Box\Box$) and V/f pattern properly before setting torque compensation parameters.

Note 2: These parameters are not active in the closed-loop control mode for PM motor (A1-02 = 7).

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 0.1 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.
- Increase this setting when motor vibrates in Regenerative mode and leveling speed.
- Decrease this setting when motor vibrates in Motoring mode and leveling speed.
- 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	200.0 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.

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	82
C5-02	Speed Control Loop Integral Time 1	0 to 8191ms	1200ms
C5-03	Speed Control Loop Proportional Gain 2	0 to 255	100
C5-04	Speed Control Loop Integral Time 2	0 to 8191ms	1200ms
C5-13	Speed Control Loop Proportional Gain 3	0 to 255	40
C5-14	Speed Control Loop Integral Time 3	0 to 8191ms	5000ms

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.



■ 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	20ms

■ 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	1000
C5-20	Speed Control Loop Integral Time during Position Lock	0 to 8191ms	5000ms

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		10 Hz
d1-02	Speed Reference 2		
d1-03	Speed Reference 3		
d1-04	Speed Reference 4	0.00 to E1.04 H	
d1-05	Speed Reference 5	0.00 to E1-04 Hz	0 Hz
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- $\Box\Box$ 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.

Ńo.	Parameter Name	Setting Range	Default
d1-17	JOG Speed	0 to E1-04	0.3Hz

■ d1-18: Speed Reference Selection Mode

This parameter sets the priority of the speed reference inputs.

Note1: 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- $\Box\Box$).

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- \Box =6).

No.	Parameter Name	Setting Range	Default
d1-19	Nominal Speed	0.00 to E1-04	50 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 (H1- $\Box \Box = 9$).

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- \Box =10), this parameter determines the speed during Rescue Operation.

No.	Parameter Name	Setting Range	Default
d1-25	Rescue Operation Speed	0 to E1-04	5.00Hz

■ 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 (H1- $\Box = 8$).

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.

Note: In closed-loop mode, 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.

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	25 V

■ V/f Pattern Settings E1-04 to E1-13



Figure 2.2 Manual V/f curve

♦ E2: Motor Parameters

These parameters contain the motor data. 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	12A

■ 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. This parameter is disable in PM close loop control.

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 to18A	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 13.000 Ω	2 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 15 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- \Box =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, speed levels less than this level will 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 drivers 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 \rightarrow 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 \rightarrow 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. This parameter is disable in close loop control mode.

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. This parameter is disable in close loop control mode.

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. This parameter is disable in close loop control mode.

No.	Parameter Name	Setting Range	Default
S1-02	DC Injection Current at Start	0 to 100%	70%

■ 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. This parameter is disable in close loop control mode.

No.	Parameter Name	Setting Range	Default
S1-03	DC Injection Current at Stop	0 to 100%	80%

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.

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 (A1-02 = 2).

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. Refer to chapter 3 for further information.

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

S3-01: Position Lock Gain at Start

Sets the gain used by the position lock control loop at start. Position Lock at start adjusts the internal tourqe reference value depending on the position deviation in order to hold the car in place when when brake is released. S3-01 sets the gain used to adjust the speed reference during position lock.

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

■ S3-03: Position Lock Gain at Stop

Sets the gain used by the position lock control loop at stop. This is used to hold the car in place whie the brake applies.

Setting S3-03 to a high value will increase the drives ability to hold the car in place but too high of a setting 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 (SBT-L1000) 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	Displays the input terminal status. i i i i i i i i i i S6 (Leveling) S4 (Inspection) S2 (DOWN) S1 (UP) Not Used	
U1-11	Output Terminal Status	Displays the output terminal status.	
U3-01 to U3-08	First to 8th Recent Fault	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.	
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.	

♦Failure Diagnosis

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	LFI	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 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	ОС	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)	ol I	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	οH	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	οu	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.

	n		
Under Voltage 1	ا تا	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	0u2	Control Power Supply Voltage Fault	Control power supply wiring is damaged. Internal circuitry is damaged.
Operator Fault	oPEO3	The same function is assigned to two multi-function inputs.	The same function is assigned to two multi-function inputs.
Cannot Reset	crbb	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	dEu	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 not set correctly.
Encoder Fault	РСон	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:
- A speed reference greater than zero must be provided.
- A speed higher 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-L1000).

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 d1-26 and Higher speed has priority
2	Separate speed inputs, Speed references are set in d1-19 to 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
H1-00	0	Multi-speed Reference 1
H1-00	1	Multi-speed Reference 2
H1-00	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		
Multi-Speed Reference 1	Multi-Speed Reference 2	Multi-Speed Reference 3	Selected Speed
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, d1-25 and d1-26) can be set and selected using four digital inputs.

Speed Selection		
Terminal Details		
H1-□□ =6	H1-□□ =6 Nominal Speed	
H1-□□ =9 Revision Speed		
H1-□□ =7 Intermediate Speed		
H1-□□ =8 Leveling Speed		
H1-DD =10 Rescue 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.



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- \Box parameters. Use the C2- \Box 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-L1000. In this version (SBT-L1000), 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



Figure 3.4 Brake Sequence

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

Time Zone	Description
	Up or Down command is issued.
t1	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.
	After the delay time set in S1-10 has passed, the drive outputs current to the motor.
t2	DC Injection Braking or Position Lock begins.
	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.
t3	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.
t4	The drive accelerates up to the selected speed. The speed is kept constant until the leveling speed is
•	selected.
t5	Leveling speed is selected. The drive decelerates to the leveling speed and maintains that speed until the
10	Up or Down command is removed.
t6	The Up or Down signal is cleared. The drive decelerates to zero speed.
	The motor speed reaches the zero speed level (S1-01).
t7	DC Injection Braking or Position Lock is then executed for the time set in S1-05.
••	After the delay time for closing the brake set in S1-07 has passed, the drive clears the "Brake Control".
	The brake applies.
t8	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.
t9	After the delay for the magnetic contactor set in S1-11 has passed, the drive resets the output terminal set
13	for "Output Contactor Control". The Safe Disable Inputs can be cleared and Baseblock can be enabled.

Table 3.1 Time Zones for Brake Sequence

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: Set the drive according to the control mode ■Open loop control (A1-02 = 2)

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 curve manually using (E1-02=3 or E1=02=2) and E1-03. For more information, please refer to E1: V/f pattern in chapter2.

■Close loop control for Induction motor (A1-02 = 3)

If the drive is used to control the Induction motor, the parameters of the speed controllers (C5-) must be carefully adjusted so that the drive can provide smooth and acceptable motion. It should be noted that in order to prevent damage to the engine and elevator system, it is better to set the parameters C5-01, 03, 13, 19 to a minimum and the parameters C5-02, 04, 14, 20 to a maximum of 4000. Then change the parameters according to the engine performance to get the desired movement.

■Close loop control for PM motor (A1-02 = 7)

If the drive is used to control the PM motor, the parameters of the speed controllers (C5-) must be carefully adjusted so that the drive can provide smooth and acceptable motion. It should be noted that in order to prevent damage to the engine and elevator system, it is better to set the parameters C5-01, 03, 13, 19 to a minimum and the parameters C5-02, 04, 14, 20 to a maximum of 4000. Then change the parameters according to the engine performance to get the desired movement.

• 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.

Problem	Control Mode and Possible Cause	Corrective Action	
	Insufficient torque when the brake is released.	 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. 	
Rollback at start	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.	
	Motor starts turning when the brake is not completely released or runs against the brake.	Increase the DC Injection Braking Time at Start using parameter S1-04.	
Shock at start	Acceleration rate is changing too quickly.	Increase C2-01.	
	Starting torque influences the calculated slip.	•Increase Slip Compensation Filter Time Constant (S2-06).	

Table 3.2 Drive problems and corrective actions

		•If the problem exists, increase the Slip		
		Compensation Delay Time (S2-05) in steps of		
		Junzance Torque Detection Delay Time (C4.02)		
		•Increase Torque Detection Detay Time (C4-02)		
Shock at start		• If the problem still exists decrease Torque		
	Starting torque is too much	Detection Gain (C4-01) Note that decreasing		
	Surting torque is too much.	C4-01 may result in motor stall and over-current		
		fault. In this case, increase acceleration time		
		(C1-01).		
		Change S1-00 in steps of 0.1, and see its		
	The starting speed is not optimized.	influence on shock.		
		 Increase the Delay Time to Close the Brake 		
	Brake is applied too early causing the motor to run against the	(S1-07). If necessary, also increase the DC		
	brake	Injection Braking Time at Stop S1-05.		
Shock at stop	blake.	•If the problem still exists, increase zero speed at		
onock at stop		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	Increase DC injection at stop (S1-03).		
	efficiently.	. Increase the Teneve Compensation Deley Time		
lork occurs due to	Too fast torque or slip compensation.	• Increase the Torque Compensation Delay Time $(C4, 02)$		
overshoot when the motor reaches top		• Increase the Slin Compensation Delay Time		
		(S2-06).		
speed.	The acceleration rate changes too quickly when reaching the	Decrease the Jerk at the End of Acceleration.		
-	selected speed.	Increase C2-02.		
	Not enough torque at low speed.	If (E1-02=0), change it to 1 or 3.		
		If E2-02=1, Increase E1-03.		
Motor stops shortly		If $E2-02=2/3$, Increase (E1-10 to E1-13).		
(undershoot) when		Alternatively, you may increase E1-03.		
the leveling speed is	Tee much align commenceation	Adjust the motor data, especially motor rated $(S_2, 0_1)$ correctly.		
reached.	100 much sup compensation.	speed (32-01) correctly.		
		Decrease the Jerk at the End of Deceleration		
	The deceleration rate changes too quickly when reaching	Increase C2-04.		
	leveling speed.			
		Increase the Torque Compensation Delay Time		
Motor or machine	Torque compensation responds too quickly.	(C4-02).		
vibrates at high		Set the rated speed according to the motor		
speed or top speed.	Rated speed is not set correctly	nameplate.		
	The output voltage is too high.	Set E2-02 to 2or 3 and decrease E1-10 to E1-13.		
Motor or machina	Torque compensation is responding too quickly.	Increase the Torque Compensation Delay Time		
vibrates in the low		(C4-02).		
or medium speed	The value for the motor slip is set incorrectly.	Check the Motor Slip value in parameter E2-02.		
range.	The slip fluctuation is high.	Increase the Slip Compensation Filter Time (S2- 06) in steps of 50ms		
-	Ytheretic and a starting and a start	Increase C4 01		
	vibration occurs only in regenerative mode.	mercase C4-01.		

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

Problem	Control Mode and Possible Cause	Corrective Action
Pollback at start		-Increase the parameter value of S3-01.
Konback at start	Incorrect adjustment of DC-injector control controllers	-Increase the C5-19
		- decrease the C5-20
Motor sound before	Incorrect adjustment of DC-injector control controllers	-Reduce the C5-19
start		- decrease the C5-20
	Motor starts when the brake is not released completely	-Increase the time of DC Injection (S1-04)
Shock at start	Time of the accelerate is very low	-Increase the C2-01
Shock at start	Incorrect adjustment of speed controllers	-Increase the C5-03
	incorrect adjustment of speed controllers	- decrease the C5-04
Motor Vibrate at	Incorrect adjustment of speed controllers	-Increase the C5-04
start	incorrect adjustment of speed controllers.	- decrease the C5-03
		-Increase the C5-02
vibrate in nominal	Incorrect adjustment of speed controllers.	- decrease the C5-01
speed		
Shock at stop	Mechanical brake operates very early and stops the motor middle of the move.	Increase the delay of mechanical brake operation (S1-07). If necessary increase the DC injection time(S1-05)

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

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	Incorrect adjustment of DC-injector control controllers	-Reduce the C5-19 - decrease the C5-20
start	Incorrect Encoder Offset	- Tune again drive with Auto tune
	Motor starts when the brake is not released completely	-Increase the time of DC Injection (S1-04)
Shock at start	Time of the accelerate is very low	-Increase the C2-01
Onock at Start	Incorrect adjustment of speed controllers	-Increase the C5-03 - decrease the C5-04
Motor Vibrate at	Incorrect adjustment of speed controllers.	-Increase the C5-04 - decrease the C5-03
start	Incorrect Encoder Offset	- Tune again drive with Auto tune
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 middle of the move.	Increase the delay of mechanical brake operation (S1-07). If necessary increase the DC injection time(S1-05)
	Incorrect Encoder Offset	- Tune again drive with Auto tune

Table 3 4 Drive	problems and	corrective	actions	(closed-loon
Table J.4 Dilve	problems and	COLLECTIVE	actions	(Closeu-loop

Step 9: Landing Accuracy adjustments (A1-02=2)

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	E1-05	Maximum Voltage	V	380
A1-03	Reset Factory	-	0	E1-06	Voltage at 16/32 Max Speed	V	167
b1-02	Up/Down Command Selection	-	1	E1-07	Voltage at 12/32 Max Speed	V	121
b1-08	Up/Down Command Selection while in Programming Mode	-	1	E1-08	Voltage at 10/32 Max Speed	V	92
C1-01	Acceleration Ramp 1	s	3	E1-09	Voltage at 8/32 Max Speed	V	75
C1-02	Deceleration Ramp 1	S	2	E1-10	Voltage at 6/32 Max Speed	V	52
C1-04	Deceleration Ramp 2	s	4	E1-11	Voltage at 5/32 Max Speed	V	40
C1-09	Fast Stop Ramp	s	0	E1-12	Voltage at 4/32 Max Speed	V	35
C1-15	Inspection Deceleration Ramp	s	2	E1-13	Voltage at 3/32 Max Speed	V	20
C2-01	Jerk at Accel Start	-	3	E2-01	Motor Rated Current	А	12
C2-02	Jerk at Accel End	-	3	E2-02	Motor Rated Slip	Hz	4
C2-03	Jerk at Decel Start	-	3	E2-03	Motor No-load current	А	4
C2-04	Jerk at Decel End	-	3	E2-04	Number of Motor Poles	-	4
C2-05	Jerk below Leveling Speed	-	3	E2-05	Motor Line to Line Resistance	Ω	2
C4-01	Torque Compensation Gain	-	1.5	E2-11	Motor Rated Power	kW	5.3
C1-02	Torque Compensation	me	200	H1_03	Multi-Function Digital Input		6
04-02	Primary Delay time	1115	200	111-05	Terminal S3 Function Selection	-	0
C5-01	Speed Control Loop	_	82	H1-04	Multi-Function Digital Input	_	q
03-01	Proportional Gain 1		02	111-04	Terminal S4 Function Selection	-	5
C5-02	Speed Control Loop Integral Time 1	ms	1200	H1-05	Multi-Function Digital Input Terminal S5 Function Selection	-	7
C5-03	Speed Control Loop Proportional Gain 2	-	100	H1-06	Multi-Function Digital Input Terminal S6 Function Selection	-	8
C5-04	Speed Control Loop Integral Time 2	ms	1200	L1-02	Motor Overload Protection Time	s	60
C5-13	Speed Control Loop Proportional Gain 3	-	40	L1-08	oL1 Current Level	%	150
C5-14	Speed Control Loop Integral Time 3	ms	5000	L4-01	Speed Agree	Hz	2
C5-19	Speed Control Loop Proportional Gain Time during Position Lock	-	100	L5-01	Number of Auto Reset Attempts	-	0
C5-20	Speed Control Loop Integral Time during Position Lock	ms	5000	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
d1-17	JOG Speed	Hz	0.3	S1-07	Brake Close Delay Time	S	0.3
d1-18	Speed Reference Selection Mode	-	1	S1-10	Run Command Delay Time	S	0.2
d1-19	Nominal Speed	Hz	50	S1-11	Output Contactor Open Delay Time	S	0.2
d1-20	Intermediate Speed 1	Hz	0	S1-12	Motor Contactor Control During Auto-Tuning	-	0
d1-24	Inspection Operation Speed	Hz	15	S2-01	Motor Rated Speed	rpm	1380
d1-25	Rescue Operation Speed	Hz	2	S2-02	Slip Compensation Gain in Motoring Mode	-	1
d1-26	Leveling Speed	Hz	5	S2-03	Slip Compensation Gain in Regenerative Mode	-	0.5
E1-02	V/f Mode	-	3	S2-06	Slip Compensation Torque Detection Filter Time Constant	S	2000

E1-03	Voltage Offset	V	0	S3-01	Position Lock at start	-	3
E1-04	Maximum Output Frequency	Hz	50	S3-02	Position lock at stop	-	3
T1-01	Auto-Tuning Mode Selection	-	3	T1-05	Motor Base Frequency	Hz	50
T1-02	Motor Rated Power	kW	5.5	T1-06	Number of Motor Poles	-	4
T1-03	Motor Rated Voltage	V	380	T1-07	Motor Base Speed	rpm	1380
T1-04	Motor Rated Current	A	12				

Monitoring Parameters

U1-01	Speed Reference	Hz	-
U1-02	Output Speed	Hz	-
U1-03	Output Current	Hz	-
U1-06	Output Voltage Reference	V	-
U1-07	DC Bus Voltage	V	-
U1-08	Output Power	kW	-
U1-10	Input Terminal Status	-	1
U1-11	Output Terminal Status	-	-
U3-01 to U3-08	Fault History 1 to 8	-	-
U4-08	Heatsink Temperature	Co	-
U6-01 Motor Secondary Current (Α	-
U6-02	Motor Excitation Current (Id)	Α	-
U6-05	Output Voltage Reference (Vq)	V	-
U6-06	Output Voltage reference (Vd)	V	-



Appendix 2: Encoder cards guide

SBT-B1 Incremental Encoder Card

The SBT-B1 encoder card allows the user to connect a pulse (incremental) encoder to capture feedback from the motor speed for use in the drive. The feedback taken from the motor speed control is used to control the closed loop of the induction motor and the PM motor.

This card is able to connect the pulse encoder (incremental) with two different voltage 5 and 12 volts. Also, this card has the ability to connect the encoder in two differential and single-way forms to the drive.



* Connection Diagram



Figure 1 shows the encoder connections of the SBT-B1 model.

Figure 1 . SBT-B1 encoder card connection

SBT-E2 Sin-Cos Encoder Card

The SBT-E2 encoder card allows the user to connect a sinusoidal encoder to capture feedback from the motor speed for use in the drive. Speed feedback is used to accurately control motor speed in PM motor control.



* Connection Diagram



Figure 2 shows the encoder connections of the SBT-E2 model.

Figure 2 . SBT-E2 encoder card connection

SBT-F2 Sin-Cos Encoder Card

The SBT-F2 encoder card allows the user to connect the encoder to the EnDat protocol to get feedback from the motor speed for use in the drive. Speed feedback is used to accurately control motor speed in PM motor control.



* Connection Diagram



Figure 3 shows the encoder connections of the SBT-F2 model.

Figure 3 . SBT-F2 encoder card connection

*Appendix 3

Encoder card installation cautions

Warning 1 : Be careful when connecting the power supply to the encoder.

Warning 2 : Avoid disconnecting the encoder card when the drive is on.

Warning 3 : Avoid connecting the encoder card when the drive is on.

Warning 4 : Make sure the shield wire is connected to the encoder card.

Appendix 4

Encoder card faults

Fault Name	symbol	Description	Cause
Excessive Speed Deviation dEu Encoder Fault PGoH Encoder card OFC4		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 not set correctly.
		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 is not working correctly	Encoder card is Not appropriate for this drive or encoder card is damaged.
Over Speed	O5	The motor speed feedback exceeded the 60Hz	 Check the E1-04 parameter. Check the drive speed parameter.

The mind behind the drive



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