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EST60X4 Bus Stepper Driver User Manual

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Revision History

Date	Updated version	Changes
2025.12	V1.0	Initial product release
2026.8	V1.1	Optimized the STO function description in Section 1.4.5

Catalogues

1 Driver Instructions

1.1 Product Introduction

Thank you for choosing the Ritter EST60X4 stepper motor driver. The EST60X4 is a four-axis EtherCAT bus-controlled stepper motor driver that integrates the functionality of an intelligent motion controller. Supports CoE (CANopen over EtherCAT).

1.1.1 Features

1. Supports CoE (CANopen over EtherCAT), compliant with CiA 402 standard
2. Supports CSP, CSV, PP, PV, Homing modes
3. Minimum synchronization cycle: 100us
4. Control methods: open-loop control, closed-loop control
5. Motor type: two-phase, three-phase
6. Brake port: The brake is directly connected. When the brake motor is connected only to control shaft 3 and shaft 4, shaft 1 and shaft 2 have no brake function.
7. Debugging interface: Type-C
8. Five-digit digital tube display for easier monitoring of parameter changes
9. 4 optically isolated digital signal inputs per axis: Supports NPN and PNP inputs, with default functions of negative limit, positive limit, origin input, offline.
10. 1 optically isolated digital signal output per axis: maximum withstand voltage 30V, maximum input or output current 100mA, common cathode connection only.

1.1.2 Electrical characteristics

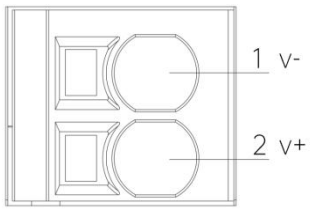
EST60X4 bus product specification list:

Product Model	EST60X4
Output current (A)	0.5 ~ 6 A
Power supply voltage	24~80VDC
Matching motor	Closed loop 60 base and below
Encoder interface	Incremental orthogonal encoder
Encoder resolution	0 ~ 65535
Photoelectric isolated input	16-channel 24V input
Photoelectrically isolated output	4-channel photoelectric isolation output: Alarm, in place and general output
Communication interface	Dual RJ45
Brake interface	The brake is directly connected without the need for additional relay control

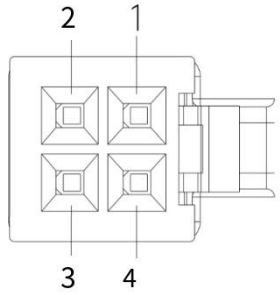
Do not use beyond the specified range.

1.2 Power supply, motor and encoder

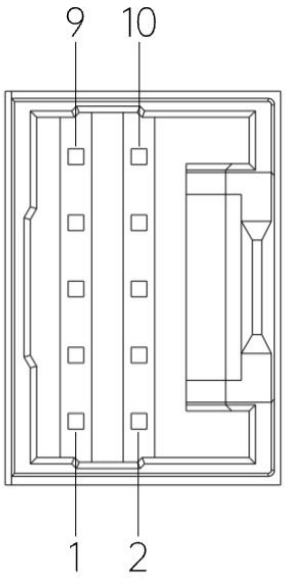
Power terminals:

Illustration example	Pin number	Signal	Name description
	1	V-	Power ground
	2	V+	Power input terminal

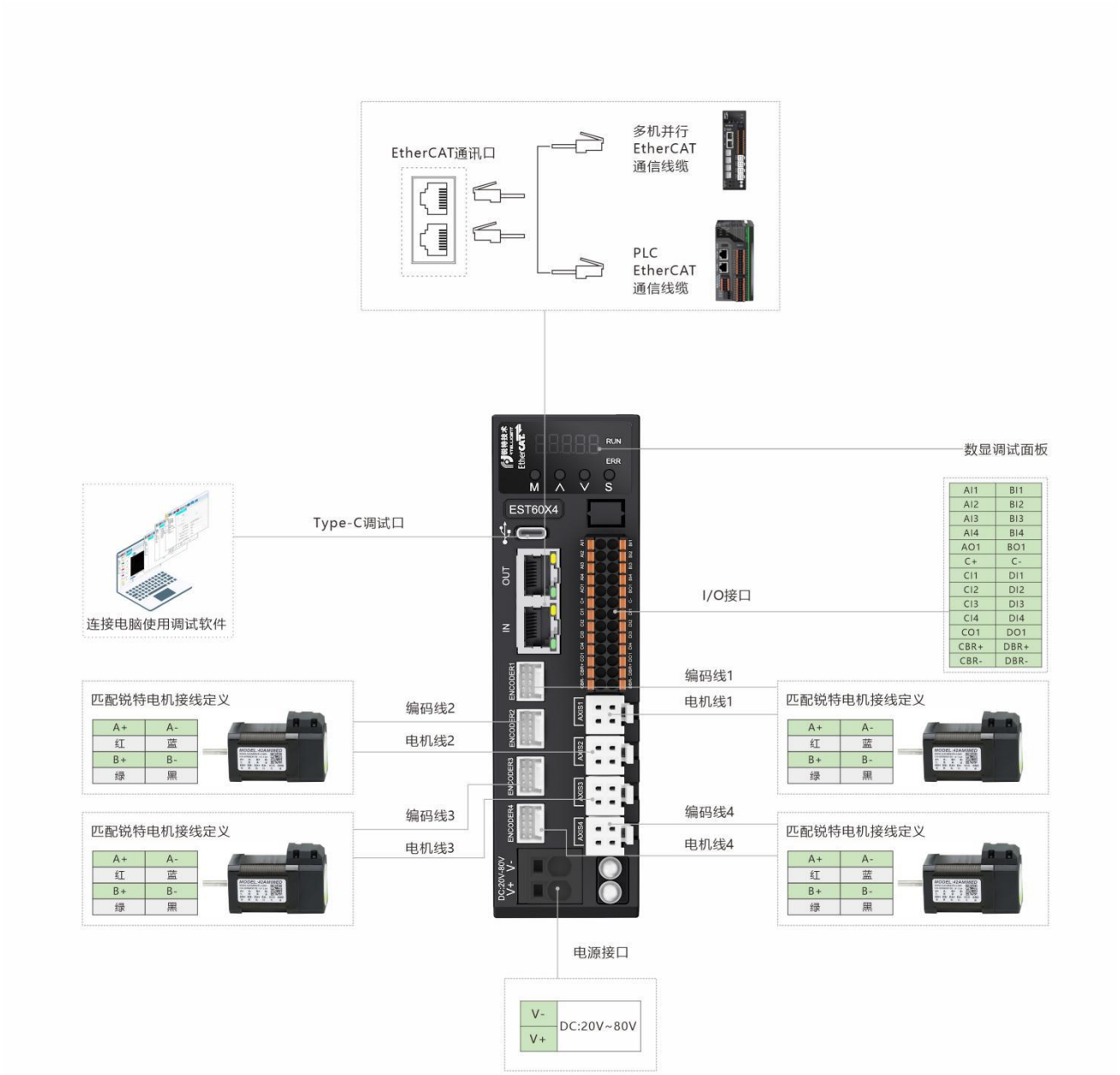
Motor winding terminals:

Illustration example	Pin number	Signal	Name Description
	1	B-	Negative end of phase B of the motor winding
	2	B+	Positive end of phase B of the motor winding
	3	A-	Negative end of phase A of the motor winding
	4	A+	Positive end of Phase A of the motor winding

Encoder terminals:

Illustration example	Pin number	Signal	Name Description
	1	NC	
	2	PE	Shielded ground
	3	EZ+	Encoder Z channel positive input
	4	EZ-	Encoder Z channel negative input
	5	EB+	Encoder B channel positive input
	6	EB-	Encoder B channel negative input
	7	EA+	Encoder A channel positive input
	8	EA-	Encoder A channel negative input
	9	VCC	Encoder 5V power supply
	10	GND	Encoder 5V power ground

1.3 Driver wiring diagram



1.4 Digital input/output ports

The EST60X4 bus stepper driver has 16 digital input ports, 4 digital output ports, and 2 brake direct connection ports.

1.4.1 IO port definition

Functional Classification	Signal Name	Signal Definition	Default Features	Instructions
Axis 1 input port	AI1	Input 1	Axis 1 negative limit	Below 24V; Support co-positive (NPN); Support co-negative (PNP).
	AI2	Input 2	Axis 1 positive limit	
	AI3	Input 3	Axis 1 Origin switch	
	AI4	Input 4	Axis 1 offline	
Shaft 2 input port	BI1	Input 5	Axis 2 negative limit	
	BI2	Input 6	Axis 2 positive limit	
	BI3	Input 7	Axis 2 origin switch	
	BI4	Input 8	Axis 2 offline	
Input port of Axis 3	CI1	Input 9	Axis 3 negative limit	
	CI2	Input 10	Axis 3 positive limit	
	CI3	Input 11	Axis 3 origin switch	
	CI4	Input 12	Axis 3 offline	
Axis 4 input port	DI1	Input 13	Axis 4 negative limit	
	DI2	Input 14	Axis 4 positive limit	
	DI3	Input 15	Axis 4 origin switch	
	DI4	Input 16	Axis 4 offline	

Function Classification	Signal Name	Signal Definition	Default Features	Instructions
Public end	COM+	Public upright pole	---	
	COM-	Common terminal negative	---	
Axis 1 output port	AO1	Axis 1 outputs 1	Alarm output	Below 24V Only co-negative (PNP) is supported
Axis 2 output port	BO1	Axis 2 outputs 1	Alarm output	
Shaft 3 output port	CO1	Axis 3 outputs 1	Alarm output	
Shaft 4 output port	DO1	Axis 4 outputs 1	Alarm output	
Shaft 3 brake interface	CBR+	Axis 3 brake correct		The brake is directly connected, and the internal chopper outputs 24V voltage No additional relay control is required
	CBR-	The brake on axis 3 is negative		
Shaft 4 brake interface	DBR+	Axis 4 brake correct		
	DBR-	Axis 4 brake negative		

1.4.2 Digital input port

The EST60X4 bus stepper driver has 16 input ports.

Take Axis 1 as an example and set the functionality of the input port via 0x2007.

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x2007:01	IN 1 Function	R/W/S	UINT	0 ~ 8	1	---
0x2007:02	IN 2 Function	R/W/S	UINT	0 ~ 8	2	---
0x2007:03	IN 3 Function	R/W/S	UINT	0 ~ 8	3	---
0x2007:04	IN 4 Function	R/W/S	UINT	0 ~ 8	6	---

The following are the values for the input port Settings and the corresponding functions:

value	Features
0	Universal Input Port
1	Negative limit input
2	Positive limit input
3	Origin signal input
4	Clearing faults
5	Emergency stop signal
6	Motor offline
7	Probe 1
8	Probe 2

The status of the input port is read through the 0x60FD object.

Input port polarity is set by the 0x2008 object.

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x2008	Inputs Polarity	R/W/S	UINT	0~0xF	0xF	---

Each Bit defines the polarity of the corresponding port as follows, as Bit 0 defines the polarity of input port 1:

Bit15~bit4	Bit3	Bit2	Bit1	Bit0
---	A4	A3	A2	AI1

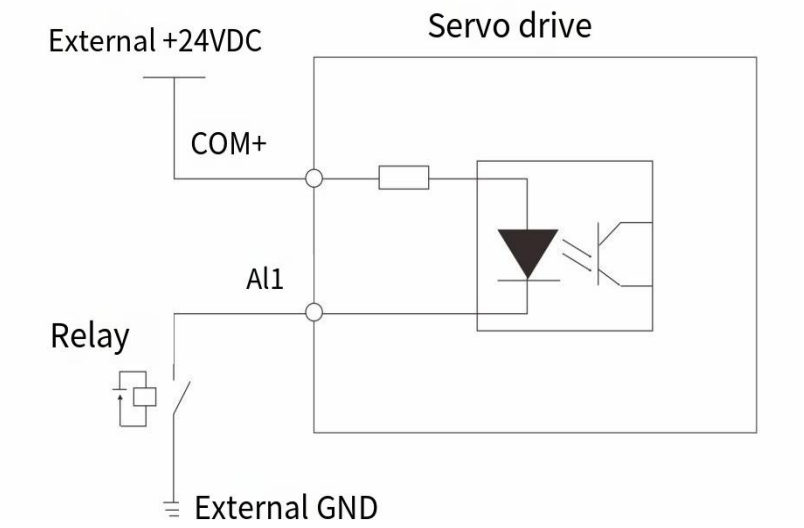
0 -- normally closed, 1 -- normally open

The input port polarity is normally open by default. The default value for 0x2008 is hexadecimal, and the factory default value is F (which is 15 in decimal). To change the polarity of AI1 (negative limit) and AI2 (positive limit) to normally closed, you need to change the corresponding Bit0 and Bit1 to 0.

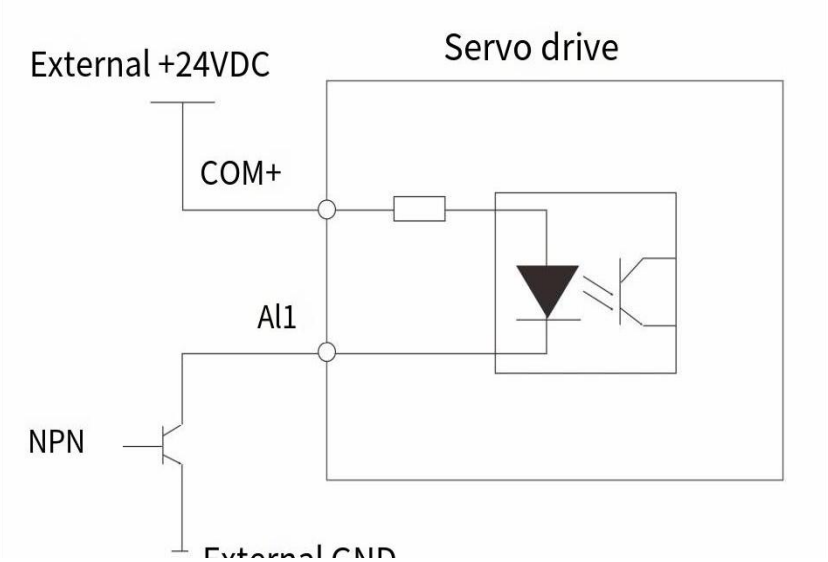
AI1 to DI4 single-ended input terminals:

For example with AI1, the AI1 to DI4 interface circuits are the same.

When the upper device is a relay output:



When the upper device is an open collector output:



Support PNP input

1.4.3 Digital output port

The EST60X4 features four optically isolated output signals with an output current capability of up to 30mA.

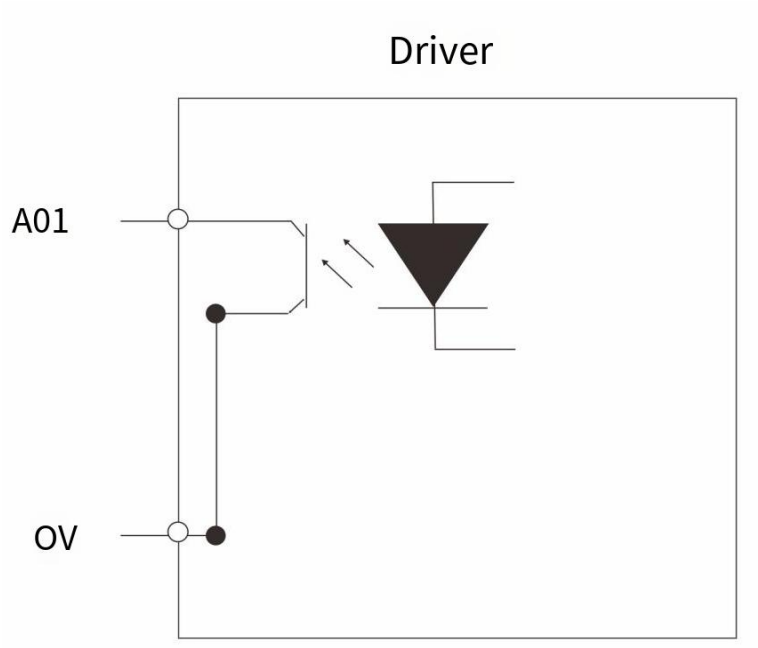
The digital output ports are all normally open by default, and the function of selecting output ports is available through the object dictionary 0x2005, which is used to set the polarity of the output ports.

Axis 1 output port

Object dictionary	Name	Attributes	Type	Range	Default values	Units	Notes
0x2005:01	OUT 1 Function	R/W/S	UINT	0 ~ 3	1	---	Output port function selection: 0 -- Custom output 1 - Alarm output 3 - In-place

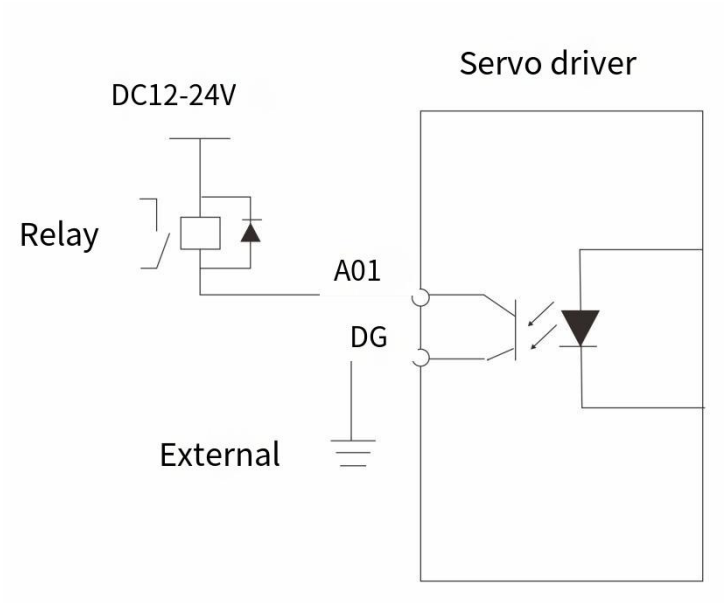
							output
0x2006	OUT Polarity	R/W/S	UINT	0 ~ 3	3	---	Set the normally open and normally closed characteristics of the output port: 0 -- Normally closed 1 - normally open

For example, the AO1 to DO1 interface circuits are the same:

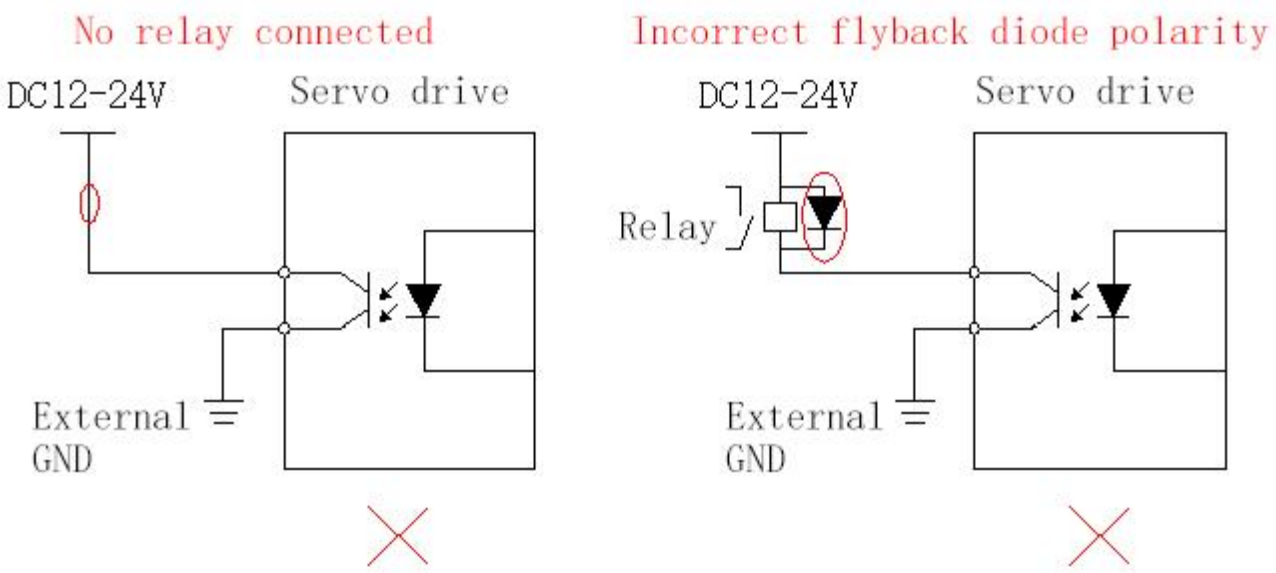


When the upper device is a relay input:

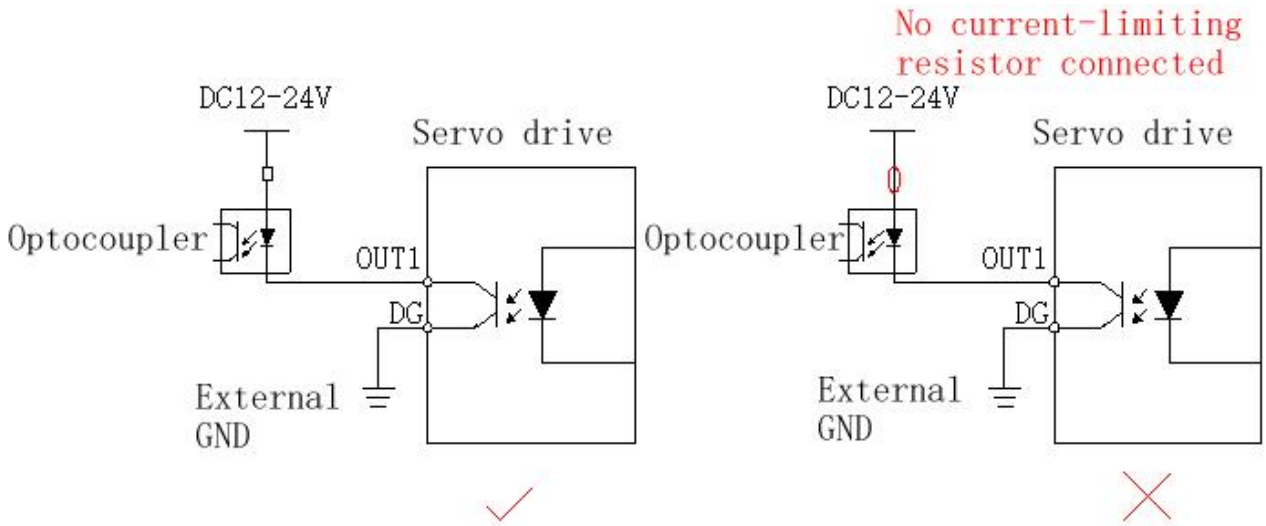
Correct wiring diagram:



Incorrect wiring diagram:

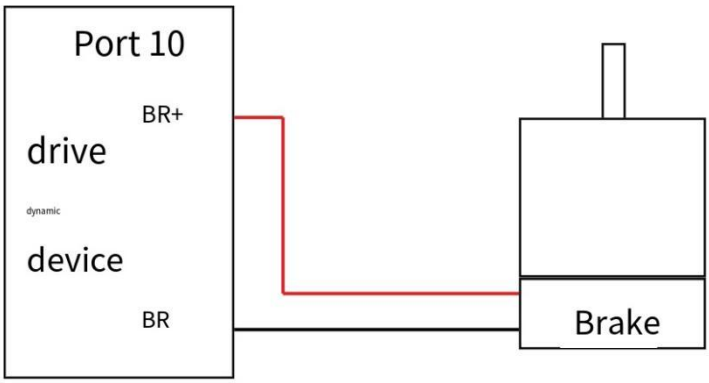


When the upper device is optocoupler input:



1.4.4 Schematic diagram of brake wiring

BR+ at the driver IO port is connected to the positive end of the brake (usually the red wire), and RB- is connected to the negative end of the brake (usually the black wire), as shown in the following figure:

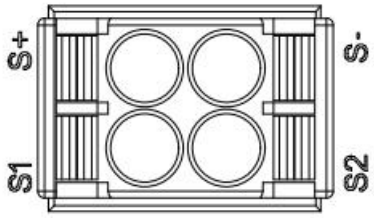


1.4.5 Safety Torque Off (STO) function

1. Overview

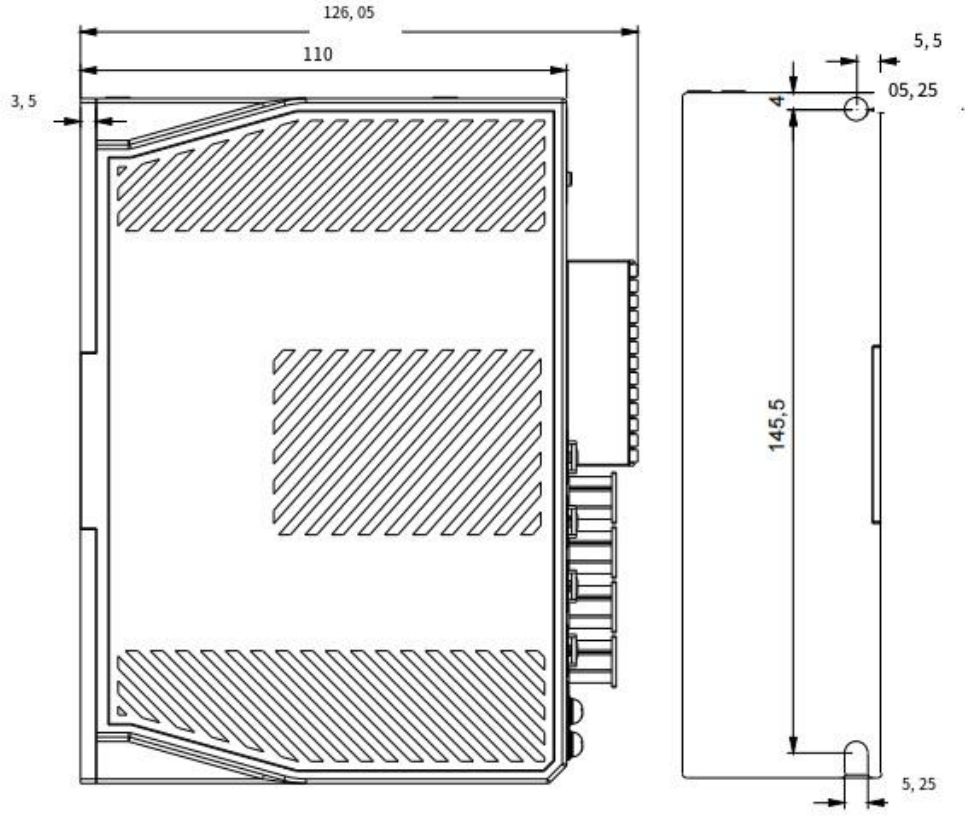
safe Torque off (STO) is a safety feature that uses the input signal from the safety controller to cut off the input current to the motor and stop it. When the STO function is triggered, the driver will turn off the same service ready to finish output signal (S-RDY) and enter a safe state.

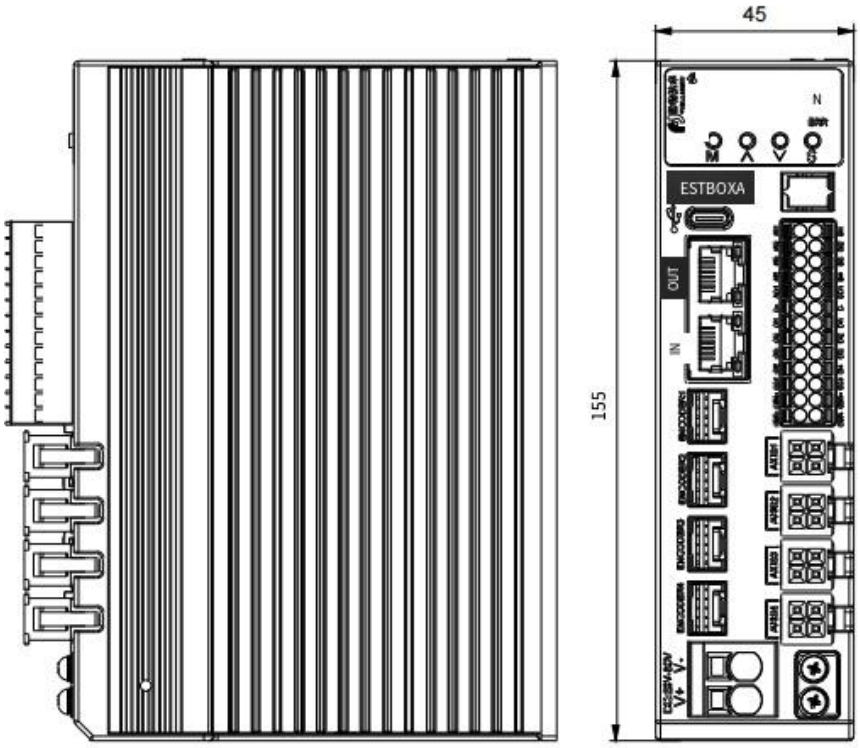
2. STO Wiring Instructions

Diagram Example	Signal Name	Signal Definition	Description
	S+	Internal 15V power supply	Disable STO function: Connect STO to S+; Enable STO function: Connect STO to S-.
	S-	STO reference ground	
	STO1	STO1 control input	
	STO2	STO2 control input	

- Note 1: Only when both the input states of STO1 and STO2 are high (" 1 "or" H ") can the servo driver operate normally. If one of STO1 and STO2 is high and the other is low (" 0 "or" L "), or both are low, the drive will not work.
- Note 2: To use the STO safety torque feature, select the EST60X4-STO model, which is not available on the standard model.

1.5 Mechanical Dimensions




45
155
ESTBOXA
OUT
IN

2 Control Panel

2.1 Panel Overview

2.1.1 Panel Composition Introduction

The driver display panel consists of four buttons and a five-digit LED digital tube display, which is used to display various status information, test run, parameter management and other functions. The four buttons are marked as:

Function Classification	Symbols	Notes	Illustration
Mode/Return/Shift	M	Long press to switch or return, short press to shift	
increase	▲	Switch up to select/increase the value	
reduction	▼	Switch down the selection/decrease the value	
Confirm	S	Confirm the operation	

LED	Status	Description
EtherCAT RUN instructions	Not lit	Initialization State
	Slow flash	Pre-Operational state
	Single flash	Safe-Operational status
	Chang Liang	Operational status
EtherCAT ERR indication	Not lit	No errors
	Slow flash	General Error
	Single flash	Synchronization error
	Double flash	Watchdog error

- Flash: On for 50ms, off for 50ms (10Hz)
- Slow flash: On for 200ms, off for 200ms (2.5Hz)

- Single flash: On for 200ms, off for 1000ms
- Dual flash: On for 200ms, off for 200ms, on for 200ms, off for 1000ms

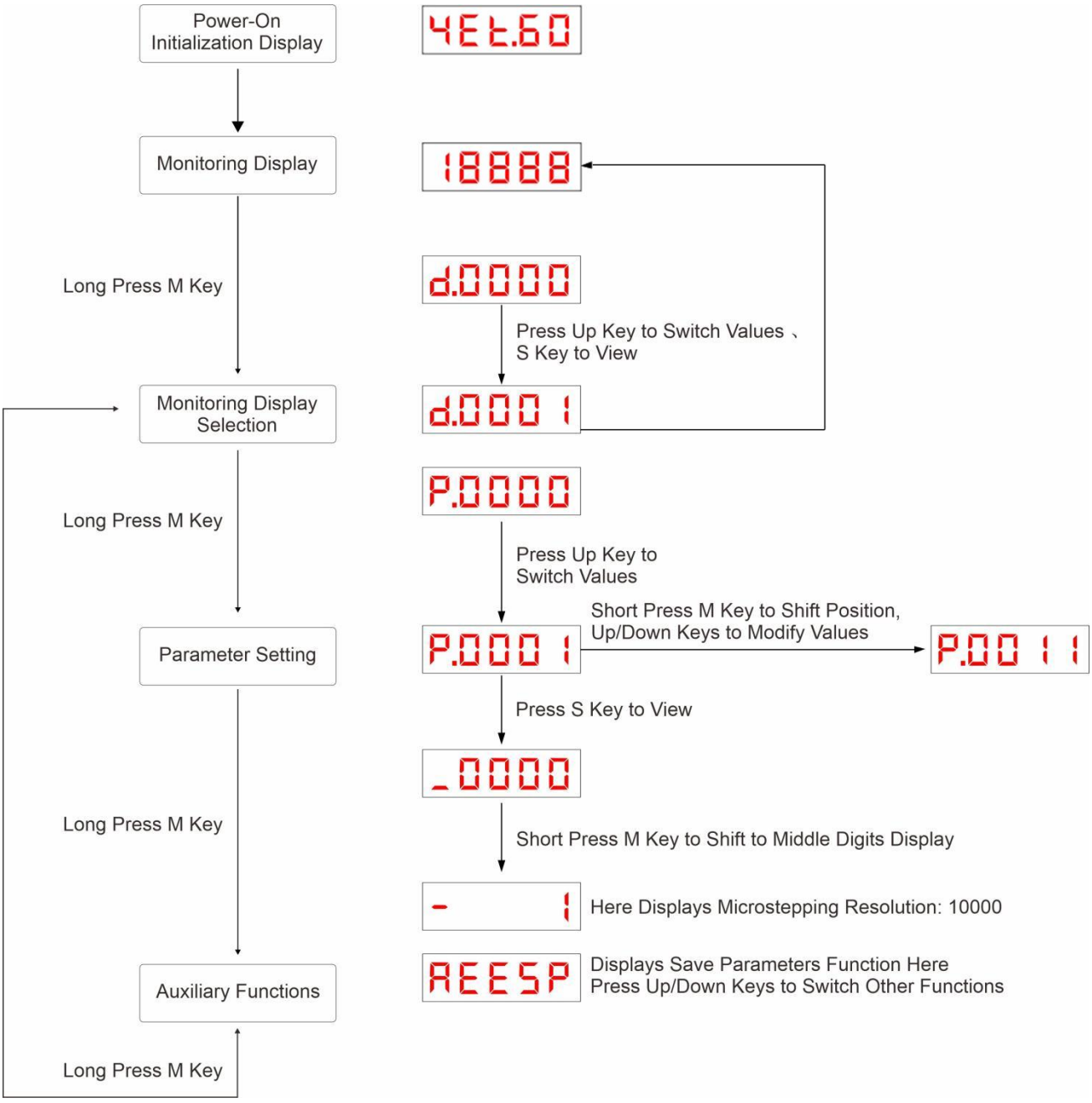
2.1.2 Panel display content

While the driver is running, the LED display can be used for monitoring display, parameter display, function display, parameter management, encoder adjustment, open-loop operation of the driver.

- Monitoring display: Shows the current operating status of the drive
- Parameter display: Show drive control parameter Settings
- Function display: Internal trial operation
- Parameter Management: For managing drive control parameters
- Encoder adjustment, open-loop operation: Vendor reserved functionality

2.1.3 Panel operation

The control panel operation process of the driver is as shown in the following figure:



- Power on, wait for the driver initialization to complete, and the panel display immediately enters monitoring display mode.
- Press and hold the "MODE" key to switch between different display modes/return to the previous menu.
- In the event of a failure, the drive automatically displays the fault monitoring code.

2.1.4 Data display

Instructions for displaying different data lengths and negative numbers:

1. Signed numbers up to 4 digits or unsigned numbers up to 5 digits

Display with a single-page digital tube (5 digits), and for signed numbers, the highest digit of the data "-" indicates a negative sign.

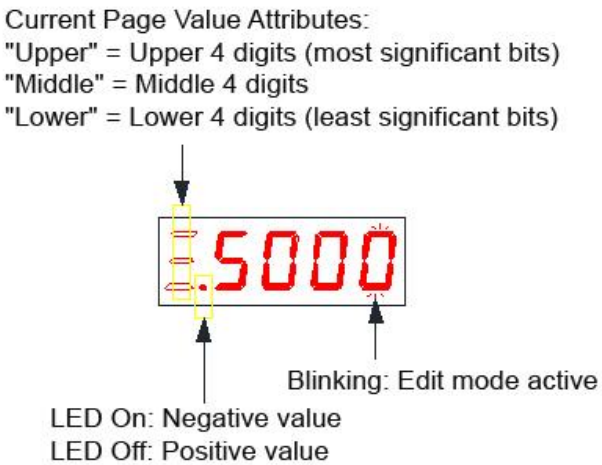
(1) Display example: -6666 is shown as follows:

(2) Show example: 65535 shows as follows:

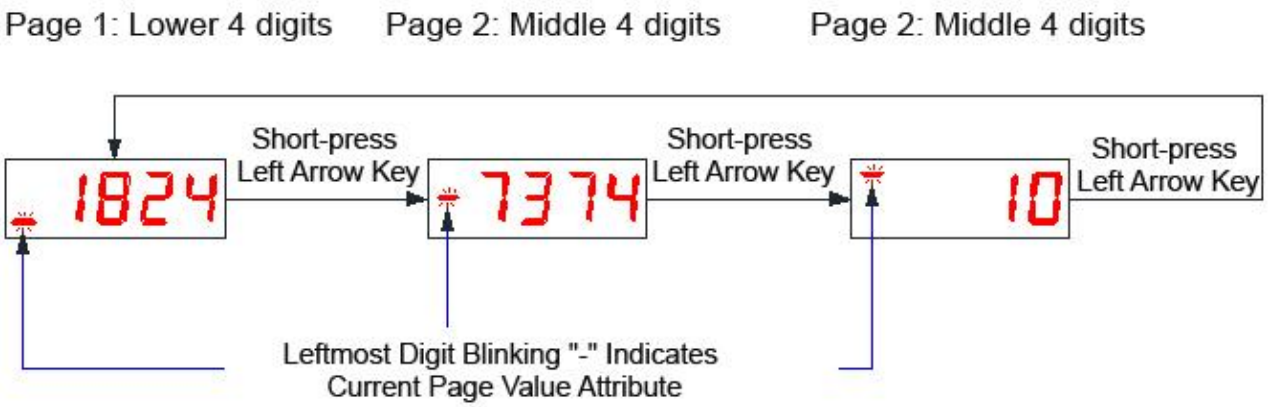
2. A signed number of more than 4 digits or an unsigned number of more than 5 digits

Page by digit from low to high, with every 4 digits on a page, display: current page + current page value, switch to the current page by briefly pressing the shift key.

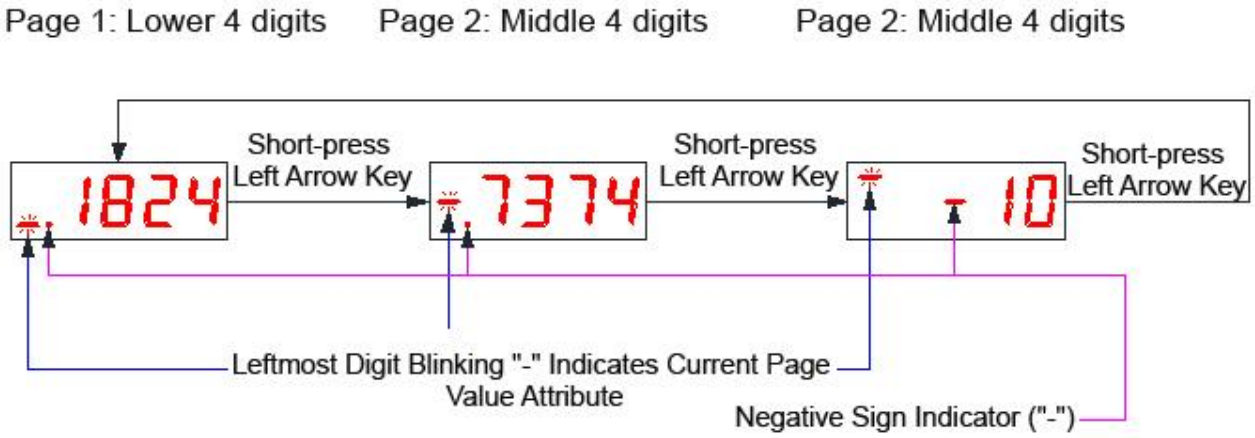
The drive can display up to 12-digit values, requiring 3 pages to represent the "upper 4 digits," "middle 4 digits," and "lower 4 digits" of these values.



(1) Display example: 1073741824 is displayed as follows:

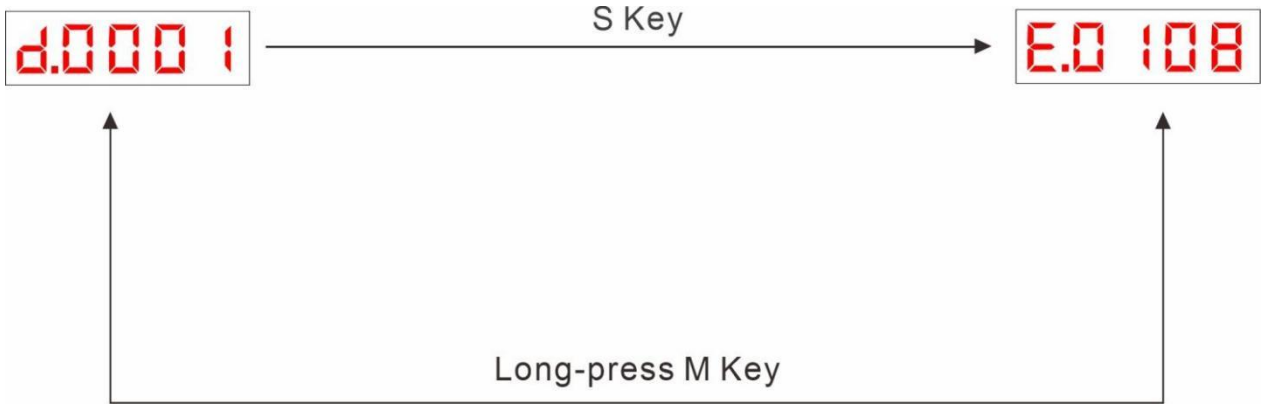


(2) Display example: -1073741824 shows as follows:



2.1.5 Fault display

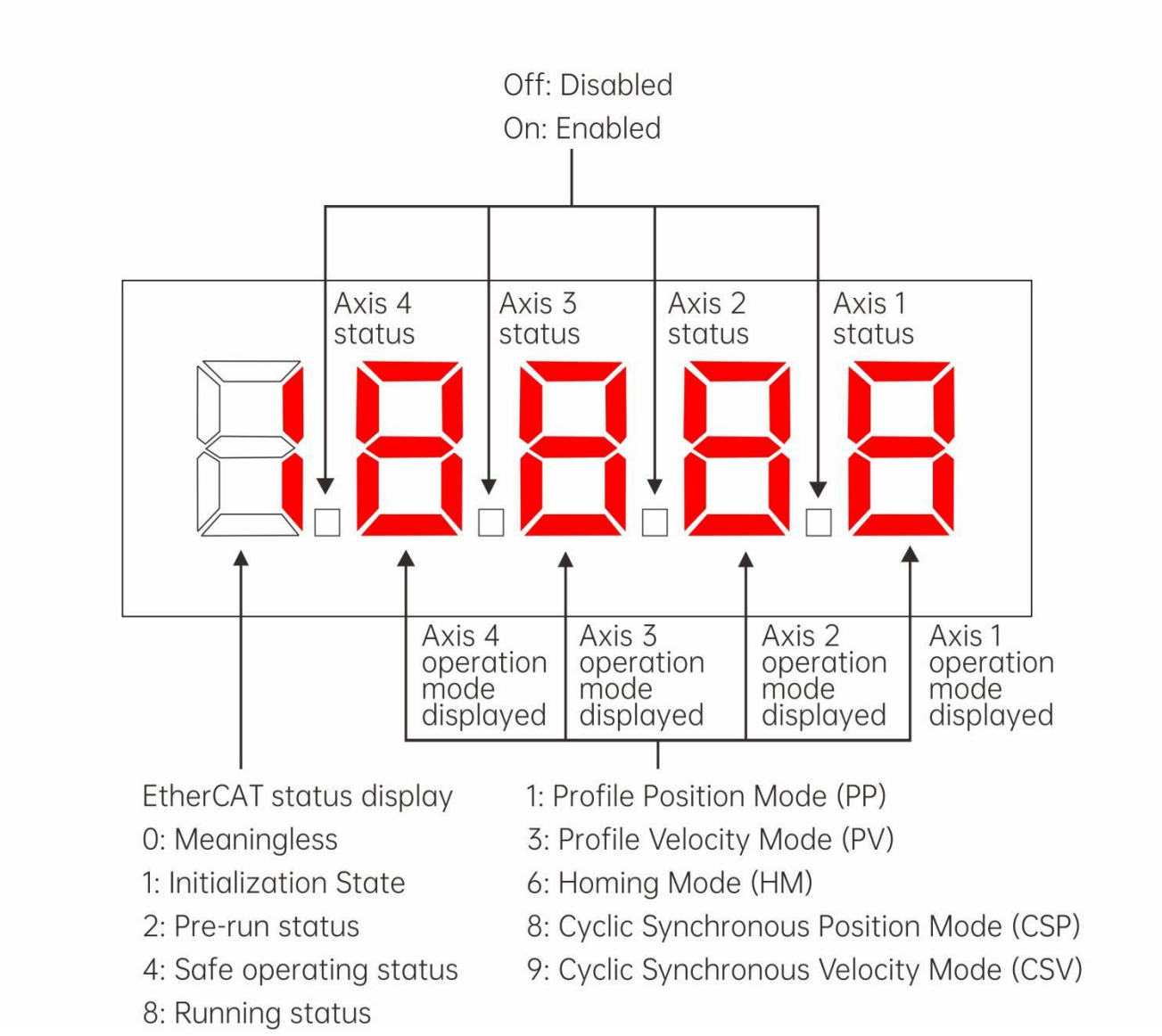
When the driver is reporting an error, the LED panel can display the relevant fault information. If the driver generates multiple fault alarms at the same time, the driver panel will jump in sequence to display each alarm.



◆ For specific fault information, please refer to Section 2.4.1.

2.1.6 Monitoring shows

The monitoring display is used to monitor the operational status of the drive. When the power-on initialization of the drive is completed, the display will show the monitoring values of the object. The monitoring display is described as follows:

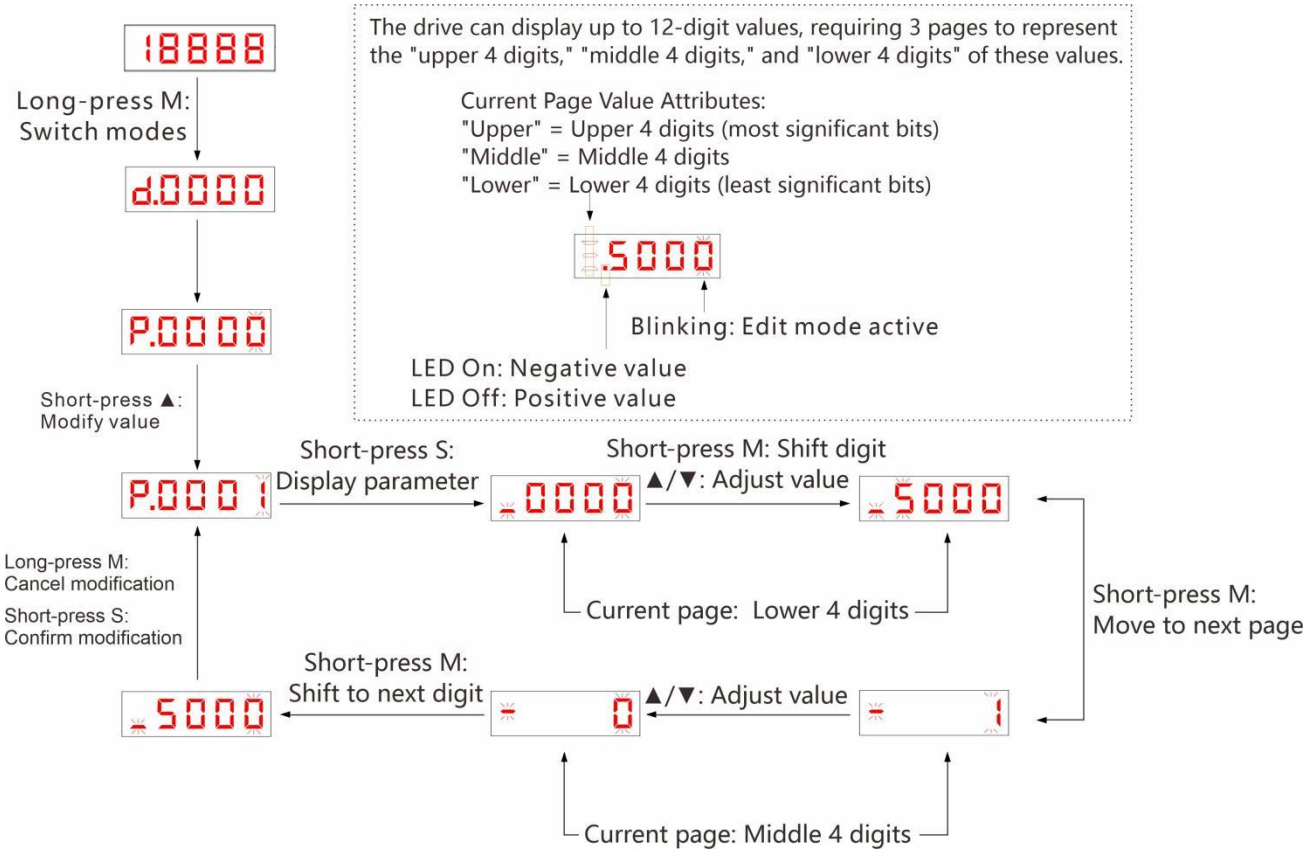


◆ For monitoring values, please refer to Section 2.4.3.

2.2 Parameter Settings

Parameters can be set using the driver's panel. For details of the parameters, see 2.4.3

Take the LED display panel showing the parameter menu as an example and modify driver P.0001 (the number of command pulses for the motor to rotate one full circle) from the default value of 10,000 to 5,000 as an example for operation instructions:



2.3 Auxiliary Functions

2.3.1 Parameter Management

◆ Save parameters: Enter the a.esp interface and press the S key briefly.

◆ To restore factory Settings: Enter the a.esp interface and briefly press the S key.

2.3.2 Soft Reset

◆ Soft Reset: Enter the A.rStC interface and press the S key briefly.

2.3.3 Jog the test operation

With this operation, you can test run the drive as follows:

Long press the M key to switch to the A interface, and press the up/down keys to enter the A.JoG1 page. If the driver is not alarm and not enabled, short press the S key and the LED panel will display the default JOG speed of 100rpm, which can be modified by pressing the key. Then press the S key to confirm, and the driver LED panel will display ready. At this point, you can control the operation of the motor by pressing the up and down keys on the keys

◆ Note: When using this operation, disconnect the bus enable command first. A.og1 is a trial run for axis 1, A.OG2 is a trial run for axis 2, A.OG3 is a trial run for axis 3, A.OG4 is a trial run for axis 4, A.oga is a trial run for four-axis synchronization.

2.4 Numerical address

2.4.1 Fault display value

The error code for each axis is an independent value. If one axis alarms, it will not affect the operating status of the other axis.

The following takes shaft 1 as an example and applies to other drive shafts as well.

If the driver shows E.0007, it indicates that shaft 1 motor has a phase loss error. Corresponding E.0070 is a phase loss alarm for shaft 2, and E.7777 is a phase loss error for shafts 1 to 4.

Parameter Index	Error code 0x603F	Meaning
E.0001	0x3150/0x3151	Internal voltage error
E.0002	0x2211	Overcurrent error
E.0003	0x3210	Overvoltage error
E.0004	0x3220	Under-voltage error
E.0005	0x5441/0x5442/0x5443	Encoder disconnection error
E.0006	---	Parameter storage error
E.0007	0x7122	Motor phase loss error
E.0008	0x8611	Closed-loop out-of-tolerance error
E.0009	---	Encoder phase anomaly error
E.Stop.	0x5445	Emergency stop alarm

Note:

1. When an internal voltage error is triggered, the situation of the drive sampling can be analyzed by reading the value of 0x603F through the host computer/master station;
2. When the encoder disconnection error is triggered, in order to locate the anomaly point more quickly, the encoder disconnection can be analyzed by reading the value of 0x603F on the host computer/master station;

3. When axis 1 triggers the emergency stop alarm, the digital tube shows "E.top." Similarly, if all four axes stop simultaneously, the panel shows "E.S.t.o.p."

2.4.2 Warning shows the value

The warning code for each axis is an independent value. If one axis alarms, it will not affect the operating status of the other axis.

The following takes shaft 1 as an example and applies to other drive shafts as well.

If the driver shows N.0001, it indicates that negative hard limit warning is in effect for shaft 1 motor. Corresponding N.0010 is negative hard limit warning for shaft 2, and n is N.1111. Negative hard limit is in effect for shafts 1 to 4.

Parameter Index	Indicating meaning
n.0001	Hardware negative limit input warning
n.0002	Hardware positive limit input warning
n.0003	Software negative limit warning
n.0004	Software positive limit warning

2.4.3 Monitor display values

The monitoring display is used to monitor the operating status of the EST60X4 drive. When the power-on initialization of the servo drive is completed, the display will show the monitored values of the object. The monitoring display is described as follows:

Monitor Address	Express meaning	Units
d.0000	Drive default state	-
d.0001	Multi-axis fault status analysis	-
d.0002	Shaft 1 motor speed	rpm
d.0003	Shaft 1 pulse command speed	rpm

d.0004	Axis 1 bus voltage	0.01 V
d.0005	Fault code for Axis 1 driver	-
d.0006	Axis 1 status code	-
d.0007	Axis 1CIA402 fault code	-
d.0008	Axis 1 input port status	-
d.0009	Axis 1 output status Status	-
d.0010	Axis 1 position error	Encoder units
d.0011	Current synchronization cycle	us
d.0012	The current ESC register synchronization cycle	us
d.0013	Current DC synchronization flag: 1-DC synchronization in effect; 0-DC synchronization is invalid	-
d.0014	Axis 1 sensor effective status: bit0 negative limit; bit1 positive limit; bit2 origin; 0 invalid /1 valid	-
d.0015	Multi-axis warning status analysis	-
d.0050	PWM interrupt entry GPT0 timer count value	-
d.0051	PWM interrupt entry GPT1 timer count value	-
d.0052	PWM interrupt entry GPT11 timer count value	-
d.0053	PWM interrupt entry GPT12 timer count value	-
d.0054	SYNC0 cycle time	0.1 us
d.0055	The value counted by the GPT0 timer at SYNC0	-
d.0056	The GPT0 timer count at the end of SYNC0	-
d.0057	The GPT0 timer count at the start of PDI	-
d.0058	PDI end value GPD0 timer count value	-
d.0059	SYNC0 interrupts execution time	0.1 us
d.0060	SYNC0 interrupts the execution cycle	0.1 us
d.0061	PDI0 interrupts execution time	0.1 us
d.0062	PDI0 interrupts the execution cycle	0.1 us
d.0063	PWM interrupt execution time	0.1 us
d.0064	PWM interrupts execution cycles	0.1 us
d.0065	GPT11 captures values when SYNC0 is generated	-

d.0066	The GPT12 timer is used to capture the value of the GPT12 timer count when the SYNC0 signal is generated	-
d.0067	SYNC0 synchronizes periodic deviations in real time	0.1 us
d.0068	SYNC0 maximum synchronization deviation	0.1 us
d.0069	GPT0 cycle	0.1 us
d.0070	GPT1 cycle	0.1 us
d.0071	GPT11 cycle	0.1 us
d.0072	GPT12 cycle	0.1 us
d.0073	Synchronous compensation value out-of-limit counter	-
d.0074	ESC configuration register	-
d.0102	Shaft 2 motor speed	rpm
d.0103	Shaft 2 pulse command speed	rpm
d.0104	Shaft 2 drive fault code	-
d.0105	Axis 2 status code	-
d.0106	Shaft 2CIA402 fault code	-
d.0107	Axis 2 input port status	-
d.0108	Axis 2 output status Status	-
d.0109	Axis 2 position error	Encoder units
d.0111	Axis 2 sensor effective status: bit0 negative limit; bit1 positive limit; bit2 origin; 0 invalid /1 valid	-
d.0122	The rotational speed of the motor on axis 3	rpm
d.0123	Axis 3 pulse command speed	rpm
d.0124	Axis 3 driver fault code	-
d.0125	Axis 3 status code	-
d.0126	Axis 3CIA402 fault code	-
d.0127	Axis 3 input port status	-
d.0128	Axis 3 output status Status	-
d.0129	Position error of axis 3	Encoder units
d.0131	Axis 3 sensor effective status: bit0 negative limit; bit1 positive limit; bit2 origin; 0 invalid /1 valid	-

d.0142	Shaft 4 motor speed	rpm
d.0143	Axis 4 pulse command speed	rpm
d.0144	Axis 4 drive fault code	-
d.0145	Axis 4 status code	-
d.0146	Axis 4CIA402 fault code	-
d.0147	Axis 4 input port status	-
d.0148	Axis 4 output status Status	-
d.0149	Axis 4 position error	Encoder units
d.0151	Axis 4 sensor effective status: bit0 negative limit; bit1 positive limit; bit2 origin; 0 invalid /1 valid	-

2.4.4 Parameter setting values

Parameters can be set using the EST60X4 drive panel and modified within the specified range as follows:

Parameter indexing can be categorized by the number of axes: Axis 1 parameter indexing is 0 to 299, axis 2 parameter indexing is 300 to 599, and so on.

This parameter index is consistent with the parameter address of the debugging software

2.4.4.1 Axis 1 Parameter table

Parameter index	Indicating meaning	Scope	Sample default values	Units
P.0000	Axis 1 Peak current	0 ~ 7000	3000	mA
P.0001	Axis 1 Subdivision	0 ~ 51200	10000	Pulse/rev
P.0002	Axis 1 standby time	0 ~ 10000	1000	ms
P.0003	Percentage of standby current for Axis 1	0 ~ 100	50	%
P.0004	AO1 Function	0 ~ 3	1	---
P.0006	Axis 1 outputs polarity	0 ~ 3	3	---
P.0007	AI1 Function	0 ~ 8	1	---

P.0008	AI2 Function	0 ~ 8	2	---
P.0009	AI3 Function	0 ~ 8	3	---
P.0010	AI4 Function	0 ~ 8	6	---
P.0011	Axis 1 input polarity	0 ~ 15	15	---
P.0012	Axis 1 smooths the filtering time	0 ~ 25600	25600	us
P.0013	Shaft 1 lock shaft ramp time	0 ~ 1000	1000	50us
P.0014	Automatic PI enable for Axis 1	0 ~ 1	1	---
P.0015	Axis 1 current loop Kp	200 ~ 10000	1000	---
P.0016	Axis 1 current loop Ki	0 ~ 2000	200	---
P.0017	Axis 1 current loop Kc	0 ~ 1024	256	---
P.0018	Shaft 1 Motor type: 0-two-phase; 1- three-phase	0 ~ 1	0	---
P.0019	Axis 1 self-identifying resistor	0 ~ 65535	1000	mOhm
P.0020	Axis 1 self-identifying inductor	0 ~ 65535	1	mH
P.0021	Axis 1 sets the motor resistance	100 ~ 10000	1000	mOhm
P.0022	Axis 1 sets the motor inductance	1 ~ 10	1	mH
P.0023	Shaft 1 motor counter electromotive force coefficient	0 ~ 1000	256	---
P.0024	Axis 1 motor running direction	0 ~ 1	0	---
P.0025	Axis 1 fault code	0 ~ 65535	0	---
P.0026	Axis 1 status code	0 ~ 65535	0	---
P.0027	Axis 1 Zero address	0 ~ 65535	0	---
P.0028	Axis 1 Control/drive mode	0 ~ 2	1	---
P.0029	Axis 1 encoder resolution	0 ~ 65535	4000	Pulse/rev
P.0030	Axis 1 encoder count	0 ~ 65535	0	Pulse/rev
P.0031	Axis 1 out-of-tolerance	1000 ~ 30000	4000	Pulse/rev

	threshold L			
P.0032	Axis 1 out-of-tolerance threshold H	-	-	
P.0033	Axis 1 Servo mode - Kp	0 ~ 65535	2000	---
P.0034	Axis 1 Servo mode - Ki	0 ~ 65535	0	---
P.0035	Axis 1 Servo mode 1 Kv	0 ~ 1000	100	---
P.0036	Axis 1 Servo mode - Kvff	0 ~ 65535	30	---
P.0037	Axis 1 Servo mode - Kdi	0 ~ 65535	0	---
P.0038	Axis 1 in place output mode	0 ~ 1	0	---
P.0039	Axis 1 positioning error	0 ~ 65535	10	---
P.0040	Axis 1 pulse stop detection time	0 ~ 65535	1000	---
P.0041	Axis 1 Speed low-pass filter frequency 1	0 ~ 65535	200	---
P.0042	Axis 1 Speed low pass filter frequency 2	0 ~ 65535	600	---
P.0043	Axis 1 position loop outputs low-pass filter frequency	0 ~ 65535	2000	---
P.0049	Set speed monitoring for Axis 1	0 ~ 65535	0	RPM
P.0050	Axis 1 feedback speed	0 ~ 65535	0	RPM
P.0051	Axis 1 bus voltage	0 ~ 9999	0	10mv
P.0052	Axis 1DI input status monitoring	0 ~ 65535	0	---
P.0053	Output status of the 1DO port on the axis	0 ~ 65535	0	---
P.0054	Axis 1 Fault detection function enabled	0 ~ 128	128 (0x0080)	---
P.0055	Axis 1 Subdivision mode selection	0 ~ 1	0	---
P.0059	Axis 1DI port digital filter time	0 ~ 65535	5	us
P.0060	EtherCAT slave alias address Settings	0 ~ 65535	1001	---
P.0061	ETherCAT slave alias	0 ~ 1	0	---

	source Settings			
P.0062	Servo driver number	0 ~ 65535	4Et60 (0x12)	---
P.0063	MCU software version number	0 ~ 65535	502	---
P.0064	Hardware version number	0 ~ 65535	500	---
P.0065	Return to zero processing mode selection	0 ~ 65535	0	---
P.0066	The TXCLK transmission delay setting of ECAT	0 ~ 3	0	---
P.0067	The synchronization error alarm threshold allowed by ECAT	0 ~ 65535	0	---
P.0068	Monitor the current ETherCAT slave alias address	0 ~ 65535	0	---
P.0069	Monitor the slave addresses set up by the master station	0 ~ 65535	0	---
P.0070	LED monitors the default index	0 ~ 65535	0	---
P.0090	Save parameters	0 ~ 65535	0	---
P.0091	factory data reset	0 ~ 65535	0	---
P.0100	ECAT port 0 Invalid data frame count	0 ~ 65535	0	---
P.0101	ECAT port 0 receives error counts	0 ~ 65535	0	---
P.0102	ECAT port 1 Invalid data frame count	0 ~ 65535	0	---
P.0103	ECAT port 1 receives error counts	0 ~ 65535	0	---
P.0104	ECAT port 0 forwarding error count	0 ~ 65535	0	---
P.0105	ECAT port 1 forwarding error count	0 ~ 65535	0	---
P.0106	ECAT handles error	0 ~ 65535	0	---

	counts			
P.0107	ECAT MCU and ECAT chip interface PDI communication error count	0 ~ 65535	0	---
P.0108	ECAT port 0 link loss count	0 ~ 65535	0	---
P.0109	Link loss count of ECAT port 1	0 ~ 65535	0	---
P.0123	Overvoltage threshold	50 ~ 90	80	V
P0.124	Under-voltage threshold	0 ~ 20	17	V
P.0128	Debugging - Axis 1 Motion mode	0 ~ 6	0	---
P.0200	Debugging - Shaft 1 emergency stop deceleration	0 ~ 65535	200	r/s^2
P.0203	Debugging - Axis 1 acceleration	0 ~ 10000	100	r/s^2
P.0204	Debugging - Deceleration of Axis 1	0 ~ 10000	100	r/s^2
P.0206	Debugging - Axis 1 positioning running speed	0 ~ 3000	100	rpm
P.0208	Debugging - Axis 1 jog running speed	- 65535 ~ 65535	100	rpm
P.0213	Debugging - Axis 1 positioning stroke	- 65535 ~ 65535	10000	Pulse

2.4.4.2 Axis 2 Parameter table

Parameter index	Indicating meaning	Scope	Sample default values	Units
P.0300	Axis 2 Peak current	0 ~ 7000	3000	mA
P.0301	Axis 2 subdivision	0 ~ 51200	10000	Pulse/rev
P.0302	Axis 2 Standby time	0 ~ 10000	1000	ms
P.0303	Percentage standby	0 ~ 100	50	%

	current for Axis 2			
P.0304	BO1 Function	0 ~ 3	1	---
P.0306	Axis 2 output polarity	0 ~ 3	1	---
P.0307	BI1 Function	0 ~ 8	1	---
P.0308	BI2 Function	0 ~ 8	2	---
P.0309	BI3 Function	0 ~ 8	3	---
P.0310	BI4 Function	0 ~ 8	6	---
P.0311	Axis 2 input polarity	0 ~ 15	15	---
P.0312	The smoothing filtering time of axis 2	0 ~ 25600	25600	us
P.0313	Shaft 2 Lock shaft ramp time	0 ~ 1000	1000	50us
P.0314	Axis 2 Automatic PI enable	0 ~ 1	1	---
P.0315	Axis 2 current loop Kp	200 ~ 10000	1000	---
P.0316	Axis 2 Current loop Ki	0 ~ 2000	200	---
P.0317	Shaft 2 current loop Kc	0 ~ 1024	256	---
P.0318	Shaft 2 Motor type: 0-two-phase; 1- three-phase	0 ~ 1	0	---
P.0319	Axis 2 self-identifying resistor	0 ~ 65535	1000	mOhm
P.0320	Axis 2 self-identifying inductance	0 ~ 65535	1	mH
P.0321	Shaft 2 sets the motor resistance	100 ~ 10000	1000	mOhm
P.0322	Axis 2 sets the motor inductance	1 ~ 10	1	mH
P.0323	Shaft 2 motor counter electromotive force coefficient	0 ~ 1000	256	---
P.0324	Shaft 2 motor running direction	0 ~ 1	0	---
P.0325	Axis 2 fault code	0 ~ 65535	0	---
P.0326	Axis 2 status code	0 ~ 65535	0	---
P.0327	Axis 2 Zero address	0 ~ 65535	0	---
P.0328	Axis 2 Control/drive mode	0 ~ 2	1	---

P.0329	Axis 2 encoder resolution	0 ~ 65535	4000	Pulse/rev
P.0330	Axis 2 encoder count	0 ~ 65535	0	Pulse/rev
P.0331	Axis 2 out-of-tolerance threshold L	1000 ~ 30000	4000	Pulse/rev
P.0332	Axis 2 out-of-tolerance threshold H	-	-	
P.0333	Axis 2 Servo mode - Kp	0 ~ 65535	2000	---
P.0334	Axis 2 Servo Mode 1 Ki	0 ~ 65535	0	---
P.0335	Axis 2 Servo mode 1 Kv	0 ~ 1000	100	---
P.0336	Axis 2 Servo mode 1 Kvff	0 ~ 65535	30	---
P.0337	Axis 2 Servo mode - Kdi	0 ~ 65535	0	---
P.0338	Axis 2 in place output mode	0 ~ 1	0	---
P.0339	Axis 2 positioning error	0 ~ 65535	10	---
P.0340	Axis 2 pulse stop detection time	0 ~ 65535	1000	---
P.0341	Axis 2 Speed low-pass filter frequency 1	0 ~ 65535	200	---
P.0342	Axis 2 Speed low-pass filter frequency 2	0 ~ 65535	600	---
P.0343	Axis 2 position loop outputs low-pass filter frequency	0 ~ 65535	2000	---
P.0349	Axis 2 gives speed monitoring	0 ~ 65535	0	RPM
P.0350	Axis 2 feedback speed	0 ~ 65535	0	RPM
P.0352	Input port status (IO) of Axis 2	0 ~ 65535	0	---
P.0353	Axis 2 Output port status (IO)	0 ~ 65535	0	---
P.0354	Shaft 2 Fault detection is enabled	0 ~ 128	128 (0x0080)	---
P.0355	Axis 2 Subdivision mode selection	0 ~ 65535	0	---
P.0359	Axis 2 input port Digital filter Time (IO)	0 ~ 65535	5	ms
P.0428	Debugging - Axis 2 Motion mode	0 ~ 6	0	---

P.0500	Debugging - Shaft 2 emergency stop deceleration	0 ~ 65535	200	r/s^2
P.0503	Debugging - Axis 2 acceleration	0 ~ 10000	100	r/s^2
P.0504	Debugging - Deceleration of shaft 2	0 ~ 10000	100	r/s^2
P.0506	Debugging - Positioning the running speed of Axis 2	0 ~ 3000	100	rpm
P.0508	Debugging - Shaft 2 jog running speed	- 65535 ~ 65535	100	rpm
P.0513	Debugging - Axis 2 positioning stroke	- 65535 ~ 65535	10000	Pulse

2.4.4.3 Axis 3 parameter table

Parameter index	Indicating meaning	Scope	Sample default values	"Unit
P.0600	Axis 3 Peak current	0 ~ 7000	3000	mA
P.0601	Axis 3 subdivision	0 ~ 51200	10000	Pulse/rev
P.0602	Axis 3 Standby time	0 ~ 10000	1000	ms
P.0603	Percentage standby current for Axis 3	0 ~ 100	50	%
P.0604	CO1 Function	0 ~ 3	1	---
P.0606	Axis 3 output polarity	0 ~ 3	1	---
P.0607	CI1 Function	0 ~ 8	1	---
P.0608	CI2 Function	0 ~ 8	2	---
P.0609	CI3 Function	0 ~ 8	3	---
P.0610	CI4 Function	0 ~ 8	6	---
P.0611	Axis 3 input polarity	0 ~ 15	15	---
P.0612	Axis 3 smooths the filtering time	0 ~ 25600	25600	us
P.0613	Axle 3 Lock axle ramp time	0 ~ 1000	1000	50us
P.0614	Axis 3 automatic PI	0 ~ 1	1	---

	enable			
P.0615	Axis 3 current loop Kp	200 ~ 10000	1000	---
P.0616	Axis 3 current loop Ki	0 ~ 2000	200	---
P.0617	Axis 3 current loop Kc	0 ~ 1024	256	---
P.0618	Shaft 3 Motor type: 0-two-phase; 1- three-phase	0 ~ 1	0	---
P.0619	Axis 3 self-identifying resistor	0 ~ 65535	1000	mOhm
P.0620	Axis 3 self-identifying inductor	0 ~ 65535	1	mH
P.0621	Axis 3 sets the motor resistance	100 ~ 10000	1000	mOhm
P.0622	Axis 3 sets the motor inductance	1 ~ 10	1	mH
P.0623	Back electromotive force coefficient of shaft 3 motor	0 ~ 1000	256	---
P.0624	Axis 3 running direction	0 ~ 1	0	---
P.0625	Axis 3 fault code	0 ~ 65535	0	---
P.0626	Axis 3 status code	0 ~ 65535	0	---
P.0627	Axis 3 Zero address	0 ~ 65535	0	---
P.0628	Axis 3 Control/drive mode	0 ~ 2	1	---
P.0629	Axis 3 encoder resolution	0 ~ 65535	4000	Pulse/rev
P.0630	Axis 3 encoder counting	0 ~ 65535	0	Pulse/rev
P.0631	Axis 3 out-of-tolerance threshold L	1000 ~ 30000	4000	Pulse/rev
P.0632	Axis 3 out-of-tolerance threshold H	-	-	
P.0633	Axis 3 Servo mode - Kp	0 ~ 65535	2000	---
P.0634	Axis 3 Servo mode 1 Ki	0 ~ 65535	0	---
P.0635	Axis 3 Servo mode 1 Kv	0 ~ 1000	100	---
P.0636	Axis 3 Servo mode - Kvff	0 ~ 65535	30	---
P.0637	Axis 3 Servo mode - Kdi	0 ~ 65535	0	---
P.0638	Axis 3 in place output mode	0 ~ 1	0	---
P.0639	Axis 3 positioning error	0 ~ 65535	10	---
P.0640	Axis 3 pulse stop	0 ~ 65535	1000	---

	detection time			
P.0641	Axis 3 Speed low-pass filter frequency 1	0 ~ 65535	200	---
P.0642	Axis 3 speed low-pass filter frequency 2	0 ~ 65535	600	---
P.0643	The axis 3 position loop outputs the low-pass filter frequency	0 ~ 65535	2000	---
P.0649	Axis 3 given speed monitoring	0 ~ 65535	0	RPM
P.0650	Axis 3 feedback speed	0 ~ 65535	0	RPM
P.0652	Axis 3 Input port status (IO)	0 ~ 65535	0	---
P.0653	Axis 3 output port status (IO)	0 ~ 65535	0	---
P.0654	Axis 3 Fault detection is enabled	0 ~ 128	128 (0x0080)	---
P.0655	Axis 3 subdivision mode selection	0 ~ 65535	0	---
P.0659	Axis 3 input port Digital filter Time (IO)	0 ~ 65535	5	ms
P.0728	Debugging - Axis 3 Motion mode	0 ~ 6	0	---
P.0800	Debugging - Shaft 3 emergency stop deceleration	0 ~ 65535	200	r/s^2
P.0803	Debugging - Axis 3 acceleration	0 ~ 10000	100	r/s^2
P.0804	Debugging - Deceleration of Axis 3	0 ~ 10000	100	r/s^2
P.0806	Debugging - Axis 3 positioning running speed	0 ~ 3000	100	rpm
P.0808	Debugging - Axis 3 point running speed	- 65535 ~ 65535	100	rpm
P.0813	Debugging - Axis 3 positioning stroke	- 65535 ~ 65535	10000	Pulse

2.4.4.4 Axis 4 parameter table

Parameter index	Indicating meaning	Scope	Sample default values	Units
P.0900	Peak current of axis 4	0 ~ 7000	3000	mA
P.0901	Axis 4 subdivision	0 ~ 51200	10000	Pulse/rev
P.0902	Axis 4 Standby time	0 ~ 10000	1000	ms
P.0903	Axis 4 Standby current percentage	0 ~ 100	50	%
P.0904	DO1 Function	0 ~ 3	1	---
P.0906	Axis 4 output polarity	0 ~ 3	1	---
P.0907	DI1 Function	0 ~ 8	1	---
P.0908	DI2 Function	0 ~ 8	2	---
P.0909	DI3 Function	0 ~ 8	3	---
P.0910	DI4 Function	0 ~ 8	6	---
P.0911	Axis 4 input polarity	0 ~ 15	15	---
P.0912	Axis 4 smooths the filtering time	0 ~ 25600	25600	us
P.0913	Axle 4 Lock axle ramp time	0 ~ 1000	1000	50us
P.0914	Axis 4 automatic PI enable	0 ~ 1	1	---
P.0915	Axis 4 current loop Kp	200 ~ 10000	1000	---
P.0916	Axis 4 current loop Ki	0 ~ 2000	200	---
P.0917	Axis 4 current loop Kc	0 ~ 1024	256	---
P.0918	Shaft 4 Motor type: 0-two-phase; 1- three-phase	0 ~ 1	0	---
P.0919	Axis 4 self-identifying resistor	0 ~ 65535	1000	mOhm
P.0920	Axis 4 self-identifying inductor	0 ~ 65535	1	mH
P.0921	Axis 4 sets the motor resistance	100 ~ 10000	1000	mOhm
P.0922	Axis 4 sets the motor inductance	1 ~ 10	1	mH
P.0923	Back electromotive force coefficient of shaft 4	0 ~ 1000	256	---

	motor			
P.0924	Axis 4 specifies running in the positive direction	0 ~ 1	0	---
P.0925	Axis 4 Fault code	0 ~ 65535	0	---
P.0926	Axis 4 status code	0 ~ 65535	0	---
P.0927	Axis 4 Zero address	0 ~ 65535	0	---
P.0928	Axis 4 Control/drive mode	0 ~ 2	1	---
P.0929	Axis 4 encoder resolution	0 ~ 65535	4000	Pulse/rev
P.0930	Axis 4 encoder counting	0 ~ 65535	0	Pulse/rev
P.0931	Axis 4 out-of-tolerance threshold L	1000 ~ 30000	4000	Pulse/rev
P.0932	Axis 4 out-of-tolerance threshold H	-	-	
P.0933	Axis 4 Servo mode - Kp	0 ~ 65535	2000	---
P.0934	Axis 4 Servo mode - Ki	0 ~ 65535	0	---
P.0935	Axis 4 Servo mode one Kv	0 ~ 1000	100	---
P.0936	Axis 4 Servo mode - Kvff	0 ~ 65535	30	---
P.0937	Axis 4 Servo mode - Kdi	0 ~ 65535	0	---
P.0938	Axis 4 in place output mode	0 ~ 1	0	---
P.0939	Axis 4 positioning error	0 ~ 65535	10	---
P.0940	The pulse stop detection time for axis 4	0 ~ 65535	1000	---
P.0941	Axis 4 Speed low-pass filter frequency 1	0 ~ 65535	200	---
P.0942	Axis 4 Speed low pass filter frequency 2	0 ~ 65535	600	---
P.0943	Axis 4 position loop outputs low-pass filter frequency	0 ~ 65535	2000	---
P.0949	Axis 4 given speed monitoring	0 ~ 65535	0	RPM
P.0950	Feedback speed of axis 4	0 ~ 65535	0	RPM
P.0951	Axis 4 bus voltage	0 ~ 9999	0	10mv
P.0952	Axis 4 Input port status (IO)	0 ~ 65535	0	---
P.0953	Axis 4 Output port status	0 ~ 65535	0	---

	(IO)			
P.0954	Axis 4 Fault detection is enabled	0 ~ 128	128 (0x0080)	---
P.0955	Axis 4 subdivision mode selection	0 ~ 65535	0	---
P.0959	Axis 4 input port Digital filter Time (IO)	0 ~ 65535	5	ms
P.1028	Debugging - Axis 2 Motion mode	0 ~ 6	0	---
P.1100	Debugging - Axle 4 emergency stop deceleration	0 ~ 65535	200	r/s^2
P.1103	Debugging - Axis 4 acceleration	0 ~ 10000	100	r/s^2
P.1104	Debugging - Deceleration of axis 4	0 ~ 10000	100	r/s^2
P.1106	Debugging - Axis 4 positioning running speed	0 ~ 3000	100	rpm
P.1108	Debugging - Axis 4 point motion running speed	- 65535 ~ 65535	100	rpm
P.1113	Debugging - Axis 4 positioning stroke	- 65535 ~ 65535	10000	Pulse

3 EtherCAT Communications

3.1 Communications Overview

EtherCAT Communications is an efficient, low-latency real-time industrial Ethernet protocol designed for automation. It supports a variety of network topologies, including linear, star, tree and ring, to accommodate network requirements of different scales. EtherCAT provides precise inter-node synchronization through integrated timestamp and clock synchronization capabilities, suitable for applications with high requirements for precise timing such as multi-axis control and distributed data acquisition. In addition, EtherCAT supports redundancy mechanisms such as dual network cards and ring redundancy to enhance system stability and reliability. For stepper drivers, EtherCAT communication can provide stronger anti-interference capabilities, reduce sensitivity to EMC issues, achieve more precise control and synchronization, and improve overall system performance and stability.

3.2 Communication connection Settings

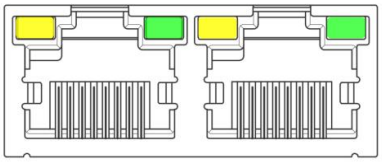
Use a CAT5E (or higher) network cable.

The Ethernet input interface IN is connected to the Ethernet output interface OUT of the previous drive on the controller or bus. The Ethernet output interface OUT is connected to the Ethernet input interface IN of the next drive on the bus. If the drive is the last node on the bus, simply connect the Ethernet input interface IN.

3.2.1 EtherCAT status indicator light

The RJ45 green light is used for the Link status, indicating whether there is a network cable connection.

The yellow light of the RJ45 is for the Activity status, indicating whether there is data communication.



3.2.2 Definition of the EtherCAT communication port

Signal Name		Pin number	Description
Communication signal	TX+	1	EtherCAT data sending + end
	TX-	2	EtherCAT data sender
	RX+	3	EtherCAT data receiving + end
	---	4	---
	---	5	---
	RX-	6	EtherCAT data receiver - end
	---	7	---
	---	8	---

3.2.3 EtherCAT site address

The EST60X4 drive supports two ways to set the slave address: Object dictionary 0x2150 setting the site alias and ESC setting the site alias and selecting through Object dictionary 0x2151.

By default, 0x2151 is 0, and the node address is assigned by the master and saved in the EEPROM.

When a user needs to set a fixed address themselves, 0x2151 should be set to 1, and then the required address value should be written into 0x2150.

0x2151	0x2150	Site Address
0	1001	The master station configures the site alias to the EEPROM address 0x0004 of ESC
1	Set values	Object Dictionary 2150 sets the value to the node address value

4 Object Dictionary

4.1 General Parameters

4.1.1 0x1000 device type

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x1000	Device type	RO	UNSIGNED 32	-	0x00040192	-

Bit 0-15: Device profile number 0x0192: CiA402

Bit 16-31: Additional information 0x0004: Stepper Drive

4.1.2 0x1008 Device name

Show the current drive model name.

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x1008	Device name	RO	Visible string	-	EST60X4	-

4.1.3 0x1009 hardware version

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x1009	Hardware version	RO	Visible string	-	40	-

4.1.4 0x100A software version

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x100A	Software version	RO	Visible string	-	4000	-

4.1.5 0X1010 Save the parameter -- MODBUS address: 90

Subindex of object dictionary 0x1010:01 Writing 1 will save the current parameter.

Note: When saving the parameter, stop the motor first and then save the parameter.

The data structure is as follows:

Object dictionary	Name	"Attribute"	Sub-indexes	Range	Default values	Units
0x1010	Store Parameter	R/W	01	-	0	-

4.1.6 0X1011 Restore factory Settings -- MODBUS address: 91

Object dictionary 0x1011 subindex: 01 Write 1 to restore the drive to factory state.

Note: When restoring to factory Settings, stop the motor first and then restore to factory Settings.

Object Dictionary	Name	Attributes	Sub-indexes	Range	Default value	Units
0x1011	Restore Parameters	R/W	01	-	0	-

4.2 Manufacturer-specific object

The contents of the following object dictionary are based on axis 1 as an example, and the object dictionaries for other drive axes can be obtained through axis offset.

The vendor object address of axis 2 = the vendor object address of axis 1 + 0x800;

The manufacturer object address of axis 4 = the manufacturer object address of axis 3 + 0x800;

For example:

	Axis 1	Axis 2
Peak current	0x2000	0x2800
Target Location	0x607A	0x687A

	Axis 3	Axis 4
Peak current	0x3000	0x3800
Target Location	0x707A	0x787A

4.2.1 0x2000 Peak current -- MODBUS address: 0

Object dictionary	Name	Attributes	Type	Range	Default value	Units
0x2000	Peak Current	R/W/S	UINT	0 ~ 7000	3000	mA

This object is used to set the sinusoidal peak current when the stepper motor operates in an open loop; When matching smaller motors, modify the current before connecting the motor to prevent the motor from burning out due to excessive current.

4.2.2 0x2001 subdivision - MODBUS address: 1

Object dictionary	Name	Attributes	Type	Range	Default values	"Unit
0x2001	Motor Resolution	R/W/S	UINT	0 ~ 65535	10000	Pulse/rev

This object is used to set the number of pulses a stepping motor needs to make one full rotation when it is running in an open-loop manner; In closed-loop mode, the subdivision is the encoder resolution of 0x2020. If you need to modify the subdivision in closed-loop mode, first change 0x2057 to 1 and then modify the value of 0x2001. Do not modify the value of 0x2020 directly, otherwise the closed-loop mode operation will fail.

4.2.3 0x2002 standby time - MODBUS address: 2

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2002	Idle Time	R/W/S	UINT	0 ~ 65535	1000	ms

This object is used to set the time when the stepper motor enters the standby state after it stops running during operation.

4.2.4 0x2003 Standby current percentage -- MODBUS address: 3

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2003	Idle Current Percent	R/W/S	UINT	0 ~ 100	50	%

This object is used to set the percentage of the holding current relative to the operating current set by 0x2000 when the stepper motor stops running and enters standby mode.

4.2.5 0x2005 Output port functionality - MODBUS address: 4

The functions of the output ports on axes 1 to 4

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2005:01	AO1 Function	R/W/S	UINT	0 ~ 3	1	---
0x2805:01	BO1 Function	R/W/S	UINT	0 ~ 3	1	---
0x3005:01	CO1 Function	R/W/S	UINT	0 ~ 3	1	---
0x3805:01	DO1 Function	R/W/S	UINT	0 ~ 3	1	---

The EST60X4 drive contains four output ports, and this object is used to set the functions corresponding to the output ports.

Port functions are defined as follows:

value	Features
0	Custom output
1	Alarm output
3	In-place output

When set to custom output, the status of this port can be controlled by the polarity setting of 0x2006.

4.2.6 0x2006 output port polarity -- MODBUS address: 6

Axis 1 to 4 output port polarity

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2006	AO1 Polarity	R/W/S	UINT	0 ~ 3	1	---
0x2806	BO1 Polarity	R/W/S	UINT	0 ~ 3	1	---
0x3006	CO1 Polarity	R/W/S	UINT	0 ~ 3	1	---

0x3806	DO1 Polarity	R/W/S	UINT	0 ~ 3	1	---

Set the normally open and normally closed characteristics of the output port: Bit0 is set for the polarity of output port 1.

0 -- Normally closed

1 - normally open

Bit15~bit1	Bit0
---	AO1

4.2.7 0x2007 Input port functionality - MODBUS address: 7-10

Axis 1 to 4 input port functionality

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2007:01	AI1 Function	R/W/S	UINT	0 ~ 8	1	---
0x2007:02	AI2 Function	R/W/S	UINT	0 ~ 8	2	---
0x2007:03	AI3 Function	R/W/S	UINT	0 ~ 8	3	---
0x2007:04	AI4 Function	R/W/S	UINT	0 ~ 8	6	---
0x2807:01	BI1 Function	R/W/S	UINT	0 ~ 8	1	---
0x2807:02	BI2 Function	R/W/S	UINT	0 ~ 8	2	---
0x2807:03	BI3 Function	R/W/S	UINT	0 ~ 8	3	---
0x2807:04	BI4 Function	R/W/S	UINT	0 ~ 8	6	---
0x3007:01	CI1 Function	R/W/S	UINT	0 ~ 8	1	---
0x3007:02	CI2 Function	R/W/S	UINT	0 ~ 8	2	---
0x3007:03	CI3 Function	R/W/S	UINT	0 ~ 8	3	---
0x3007:04	CI4 Function	R/W/S	UINT	0 ~ 8	6	---

0x3807:01	DI1 Function	R/W/S	UINT	0 ~ 8	1	---
0x3807:02	DI2 Function	R/W/S	UINT	0 ~ 8	2	---
0x3807:03	DI3 Function	R/W/S	UINT	0 ~ 8	3	---
0x3807:04	DI4 Function	R/W/S	UINT	0 ~ 8	6	---

The EST60X4 contains 16 input ports, and this object is used to set the functions corresponding to the input ports:

value	Features
0	Universal Input Port
1	Negative limit input
2	Positive limit input
3	Origin signal input
4	Clearing faults
5	Emergency stop signal
6	Motor offline
7	Probe 1
8	Probe 2

The input port status of axis 1 is read by the 0x60FD object, and the input port polarity is set by the 0x2008 object.

4.2.8 0x2008 input port polarity -- MODBUS address: 11

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2008	AI1~AI4 Polarity	R/W/S	UINT	0~F	0xF	---
0x2808	BI1~BI4 Polarity	R/W/S	UINT	0~F	0xF	---

0x3008	CI1~CI4 Polarity	R/W/S	UINT	0~F	0xF	---
0x3808	DI1~DI4 Polarity	R/W/S	UINT	0~F	0xF	---

Each bit defines the polarity of the corresponding port. Bit 0 defines the polarity of input port 1:

Bit15~bit4	Bit3	Bit2	Bit1	Bit0
---	Enter 4	Input 3	Input 2	Input 1

0 -- normally closed, 1 -- normally open

4.2.9 0x2009 Filter time -- MODBUS address: 12

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2009	Filter Time	R/W/S	UINT	0 ~ 25600	25600	us

The EST60X4 has a built-in moving average filter, and this object is used to set the time of the moving average filter. The longer the filtering time, the smoother the motor starts and stops, but the greater the motor's response lag.

Lag time = filter time

4.2.10 0x200A lock axle time -- MODBUS address: 13

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x200A	Soft lock Time	R/W/S	UINT	0 ~ 65535	1000	us

When the EST60X4 is enabled, the stepper motor needs to be locked for initial positioning. To reduce jitter during initial positioning, the EST60X4 has built-in ramp lock shaft functionality. This object is used to set the ramp time of the motor locking shaft when the motor is enabled.

Lock shaft time = set value *50us

4.2.11 0x200B current loop parameters -- MODBUS address: 14-17

Object dictionary	Name	Attributes	Type	Range	Default values	Notes
0x200B:01	AutoPI enable	R/W/S	UINT	0 ~ 1	1	The driver is initially positioned while recognizing the motor parameters and automatically calculating the PI gain: 0- Not enabled; 1- Enable
0x200B:02	Iloop_Kp	R/W/S	UINT	100 ~ 65535	1000	When 0x200B:01 is 1, this register cannot be set; When it is 0, the user can set it.
0x200B:03	Iloop_Ki	R/W/S	UINT	0 ~ 10000	200	
0x200B:04	Iloop_Kc	R/W/S	UINT	0 ~ 1024	256	Anti-integral saturation coefficient.

The EST60X4 uses current control to achieve subdivision operation of the stepper motor. The EST60X4 uses an automatic parameter recognition algorithm by default to identify the electrical parameters of the motor and automatically calculate the appropriate current loop PI parameters. When the automatically identified PI parameters do not meet the requirements, the user can set the parameters themselves.

4.2.12 0x200C motor parameters -- MODBUS address: 18-23

Object Dictionary	Name	Attributes	Type	Range	Default values	Notes
0x200C:01	Motor type	R/W/S	UINT	0 ~ 1	0	0 - Two-phase stepper motor 1 - Three-phase stepper motor, reserved function, not available in the current version

0x200C:02	Resistance Auto	R	UINT	100 ~ 65535	1000	When the automatic PI is on, the resistance value of the motor winding is recognized. Unit: mOhm
0x200C:03	Inductance Auto	R	UINT	0 ~ 10	1	When the automatic PI is turned on, the inductance value of the motor winding is recognized. Unit: mH
0x200C:04	Resistance Set	R/W/S	UINT	0 ~ 10000	1000	Motor winding resistance value Unit: mOhm
0x200C:05	Inductance Set	R/W/S	UINT	1 ~ 10	1	Motor winding inductance value Unit: mH
0x200C:06	BEMF coefficient	R/W/S	UINT	0 ~ 1000	256	Back electromotive force coefficient

Servo Mode 1:

When the EST60X4 operates in servo mode 1, the motor parameters themselves do not participate in motor control, and users do not need to set them specifically. The user can determine whether the motor connection is normal by checking the self-identification resistance and inductance values of this object.

Servo Mode 2:

When the EST60X4 operates in servo Mode 2, the closed-loop stepper motor is in FOC control mode. Due to the special structure of the stepper motor, demagnetization control is required for FOC control. The demagnetization control parameters are estimated from the resistance, inductance and back electromotive force coefficient of the motor.

Usually the automatically estimated resistance and inductance can meet the requirements, and the user can also set the resistance to inductance according to the motor parameters provided by the motor manufacturer. The counter electromotive force coefficient can be calculated using the following formula:

0x200C:06 = (rated torque (N.M)/rated current (A)) * 500

4.2.13 0x200D running direction - MODBUS address: 24

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x200D	Invert motor direction	R/W/S	UINT	0 ~ 1	0	---

If the forward direction of the motor is not consistent with the system requirements, the object can reverse the motor's running direction without modifying the motor wiring.

4.2.14 0x200E internal alarm code -- MODBUS address: 25

Object dictionary	Name	"Attribute"	Type	Default values
0x200E	Alarm Code	R	UINT	0

This object shows the current fault code of the drive, with each bit of the object corresponding to an alarm status.

Alarm code	Decimal values	Alarm status
0x0001	1	Internal voltage error
0x0002	2	Overcurrent alarm
0x0004	4	Overvoltage alarm
0x0008	8	Under-voltage alarm
0x0010	16	The encoder end is disconnected
0x0020	32	Parameter storage error
0x0040	64	Motor phase loss
0x0080	128	Closed-loop deviation

0x0400	1024	Emergency stop alarm

When the above fault occurs, after eliminating the fault condition, the fault codes for 0x603F and 0x200E will be cleared by writing 0x80 to the 0x6040 object. (Note that undervoltage and encoder terminal disconnection can be automatically restored by external conditions, while overcurrent and internal voltage errors cannot be cleared by the upper computer alarm)

4.2.15 0x200F internal status code -- MODBUS address: 26

Object dictionary	Name	Attributes	Type	Default values
0x200F	Status Code	R	UINT	0

This object shows the current status code of the drive, with each bit of the object corresponding to a status.

Status code	Decimal values	Status
0x0001	1	Driver enable
0x0002	2	Drive failure
0x0004	4	Arrival signal
0x0008	8	Whether the motor is running or stopped
0x0010	16	Return-to-zero is completed
0x0020	32	Drive ready
Others	Keep	Preserve

4.2.16 0x2010 position reset -- MODBUS address: 27

Object dictionary	Name	Attributes	Type	Scope	Default values	Units

0x2010	Zero Position	R/W	UINT	0 ~ 1	0	---

Setting the object to 01h clears the position value (actual position value) in 0x6064.

Typically used in situations where the motor is moving in one direction all the time, the user needs to stop the motor at the appropriate time, clear the actual position value through this object, and then enable the motor again, otherwise the motor position counter will have a saturation problem.

4.2.17 0x2011 Control mode - MODBUS address: 28

Object dictionary	Name	Attributes	Type	Range	Default value	Units
0x2011	Control mode	R/W/S	UINT	0 ~ 2	1	---

Set the working mode of the stepper motor. (Sync with the driver's firmware, generally no change)

0 - Run in an open loop

1 - Closed loop operation

2 - Closed-loop operation /FOC mode

4.2.18 0x2020 encoder resolution -- MODBUS address: 29

Object dictionary	Name	Attributes	Type	Scope	Default values	Units
0x2020	Encoder Resolution	R/W/S	UINT	0 ~ 65535	4000	Pulse/rev

When the stepper motor operates in a closed-loop mode, you need to set the encoder resolution corresponding to one revolution of the motor. Once this parameter is set, it needs to be saved and then powered on again to take effect.

4.2.19 0x2021 Encoder location -- MODBUS address: 30

Object dictionary	Name	Attributes	Type	Range	Default value	Units
0x2021	Encoder Counter in one rev	R	UINT	0 ~ 65535	0	Pulse/rev

This object reflects the current position of the motor in one circle.

4.2.20 0x2022 position out-of-tolerance alarm threshold -- MODBUS address: 31

Object dictionary	Name	Attributes	Type	Range	Default values	"Unit
0x2022	Position Trae Error Limit	R/W/S	UINT	1000 ~ 30000	4000	Pulse/rev

When the stepper motor operates in closed-loop mode and the position error exceeds this set value, the motor will alarm and disconnect the enable. This parameter takes effect immediately after it is set.

4.2.21 0x2023 Servo Mode 1 control Parameters - MODBUS address: 33-37

Object dictionary	Name	Attributes	Type	Range	Default values	Notes
0x2023:01	PosLoop_Kp	R/W/S	UINT	0 ~ 10000	2000	Proportional gain: Adjusting motor position response rigidity
0x2023:02	PosLoop_Ki	R/W/S	UINT	0 ~ 1000	0	Integral gain, used to eliminate positional errors when the motor is stationary.
0x2023:03	PosLoop_Kd	R/W/S	UINT	0 ~ 10000	100	

0x2023:04	PosLoop_Kvff	R/W/S	UINT	0 ~ 100	30	Speed compensation
0x2023:05	PosLoop_Kdi	R/W/S	UINT	0 ~ 500	0	Used to eliminate low-speed resonances Typically this gain cannot be greater than 200

This object is only effective for closed-loop control of the EST60X4 drive in servo mode 1. Gain is usually set to default.

4.2.22 0x2024 arrival signal -- MODBUS address: 38-40

Object dictionary	Name	Attributes	Type	Range	Default values	Notes
0x2024:01	InPosMode	R/W/S	UINT	0 ~ 10000	0	In place signal determination mode 0 - Detect at all times 1 - Detect after the pulse command stops
0x2024:02	InPosCnt	R/W/S	UINT	0 ~ 1000	10	It is considered in place when the position error is less than the set pulse value and persists for the set time in place.
0x2024:03	InPosTime	R/W/S	UINT	0 ~ 10000	1000	

This object works in the closed-loop mode of the EST60X4 and is used to detect whether the motor is within the set precision range.

4.2.23 0x2025 Servo speed filter - MODBUS address: 41-43

Object dictionary	Name	Attributes	Type	Range	Default values	Notes
0x2025:01	FV1_HZ	R/W/S	UINT	0 ~ 1000	200	Set the filter in

0x2025:02	FV2_HZ	R/W/S	UINT	0 ~ 2000	600	servo mode 2
0x2025:03	FPOUT_HZ	R/W/S	UINT	0 ~ 5000	5000	

This object works in EST60X4 servo mode 2 and is used to set the bandwidth of the speed loop feedback parameter.

FV1_HZ is used to set the bandwidth of the first low-pass filter for the speed feedback filter.

FV2_HZ is used to set the bandwidth of the speed feedback filter's secondary low-pass filter. Typically set FV2HZ = 3* FV1_HZ

FPOUT_HZ is used to set the bandwidth of the FOC speed loop output variable, usually with the default value.

4.2.24 0x2026 Servo Mode 2 control parameters -- MODBUS address: 44-48

Object dictionary	Name	Attributes	Type	Range	Default values	Notes
0x2026:01	PVIA_Kp	R/W/S	UINT	0 ~ 10000	2000	Position-proportional gain: adjusting motor position response rigidity.
0x2026:02	PVIA_Ki	R/W/S	UINT	0 ~ 1000	100	Integral gain, used to eliminate positional errors when the motor is stationary.
0x2026:03	PVIA_Kv1	R/W/S	UINT	0 ~ 10000	200	Speed feedback gain 1
0x2026:04	PVIA_Kv2	R/W/S	UINT	0 ~ 100	30	Speed feedback gain 2
0x2026:05	PVIA_Kvff	R/W/S	UINT	0 ~ 500	0	Speed feedforward gain 1

This object takes effect in the EST60X4 with servo mode 2, using vector control algorithms.

Typically PVIA_Kv1+ PVIA_Kv2 > PVIA_Kvff

4.2.25 0x2043 speed given -- MODBUS address: 49

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2043	Speed Reference	R	UINT	0 ~ 65535	0	RPM

This object reflects the given speed of the current motor.

4.2.26 0x2044 Speed feedback -- MODBUS address: 50

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2044	Speed Feedback	R	UINT	0 ~ 65535	0	RPM

This object reflects the actual speed of the current motor.

4.2.27 0x2048 bus voltage -- MODBUS address: 51

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x2048	Bus Voltage	R	UINT	---	0	10mV

Bus voltage value (V) = object value /100;

4.2.28 0x2049 Input level -- MODBUS address: 52

Object dictionary	Name	Attributes	Type	Range	Default values	Units
0x2049	Input Level	R	UINT	---	0	---

Show the physical level of the current IO input

Bit15~bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
---	IN6	IN5	IN4	IN3	IN2	IN1

0 - No input signal

1 - has an input signal

4.2.29 0x204A output level -- MODBUS address: 53

Object dictionary	Name	Attributes	Type	Range	Default values	"Unit
0x204A	Output Level	R	UINT	---	0	---

Show the physical level of the current output port

Bit15~bit2	Bit1	Bit0
---	OUT2	OUT1

0 -- indicates that there is output at the current output port

1 - indicates no output at the current output port

4.2.30 0x2057 Pulse selection per turn (closed-loop mode) -- MODBUS address: 55

Object dictionary	Name	Attributes	Type	Scope	Default values	Units
0x2057	Number of pulses per revolution selection	R/W/S	UINT	---	0-1	---

0 - the number of pulses per revolution is a value of 0X2020

1 - The number of pulses per revolution is a value of 0X2001

4.2.31 0x2060 Harmonic amplitude of the first resonance point

Object Dictionary	Name	Attributes	Type	Range	Default values	"Unit
0x2060	Amplitude of First Anti-Vibration	R/W/S	UINT	0-1000	0	---

Used to eliminate the vibration at the first resonance point of a two-phase stepping motor. This method offsets resonance by adding a certain amount of harmonics on the basis of the set current. It is necessary to adjust the amplitude and phase of the harmonics to eliminate the vibration.

4.2.32 0x2061 First Resonance point A phase harmonic phase

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x2061	Phase A of First Anti-Vibration	R/W/S	UINT	0-1024	0	---

Adjust the harmonic phase of the A-phase winding

4.2.33 0x2062 First resonance point B phase harmonic phase

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x2062	Phase B of First Anti-Vibration	R/W/S	UINT	0-1024	0	---

Adjust the harmonic phase of the B-phase winding

4.3 CIA402 Object Dictionary

4.3.1 0x603F fault code

Object Dictionary	Name	Attributes	Type	Range	Default values

0x603F	Error Code	RW	UINT	---	0

When a fault occurs, first eliminate the fault condition, then write 0x0080 to the control word 0x6040 and clear 0x603F.

The fault code is as follows:

Error Code	Description
0x3150	Internal voltage error in Phase A circuit
0x3151	Internal voltage error in Phase B circuit
0x2211	Overcurrent error
0x3210	Overvoltage error
0x3220	Under-voltage error
0x5441	Phase A of the encoder is disconnected
0x5442	Phase B of the encoder is disconnected
0x5443	Both encoder AB are disconnected
0x7500	Communication failure
0x7122	Motor error or phase loss fault
0x8611	Tracking error exceeds limit
0x5445	Emergency stop alarm

4.3.2 0x6040 control word

This object is used to control the state of the drive and the motion. It can enable/disable the drive; Starting and stopping the motor; Clearing faults, etc.

Object dictionary	Name	Attributes	Type	Range	Default values
0x6040	Control Word	RW	UINT	---	0

The bits of the control word are defined as follows:

Bit	Description
0	Servo ready (Switch ON)
1	Enable Voltage
2	Quick Stop
3	Enable Operation
4	New Set-Point/Home Start
5	Change Set Immediately
6	Absolute/Relative position
7	Reset Fault
8	Halt
9	Related to the operation mode
10	Retain
11-15	Manufacturer-specific

Detailed combinations of Bit 0-3 and Bit7:

Commands	Control word position				
	Bit7	Bit3	Bit2	Bit1	Bit0
Shutdown	0	x	1	1	0
Switch on	0	0	1	1	1
Switch on + Enable operation	0	1	1	1	1
Disable voltage	0	x	x	0	x
Quick stop	0	x	0	1	x
Disable Operation	0	0	1	1	1
Enable Operation	0	1	1	1	1
Fault reset	0 - > 1	x	x	x	x

Bit4, 5, 6, 8, 9 are defined in their respective relevant modes as follows:

PP mode

Bit	Name	value	Description
4	A new target location	0 - > 1	Switch from 0 to 1 and set a new target position
5	Keep		
6	Absolute/Relative	0	Absolute position mode
		1	Relative position mode
8	Pause	0	The motor waits to complete positioning
		1	Stop running
9	Retain		

PV mode

Bit	Name	value	Description
8	Pause/Run	0	Run the motor to the set speed
		1	The motor slows down to 0 and stops

Return to zero mode

Bit	Name	value	Description
4	Start back to zero	0 - > 1	Start back to zero
8	Pause	0	Controlled by bit4
		1	Stop returning to zero

4.3.3 0x6041 status word

This object sets the probe functionality.

Object Type	Data Type	Access Type	PDO Mapping	Default Value
VAR	UNSIGNED16	RW	Yes	0

Register bits are defined as follows:

Bit	Description
0	Servo Ready To Switch ON
1	Can turn ON (Switch ON)
2	Operation Enabled
3	Fault

4	Voltage Enabled on the main circuit
5	Quick Stop
6	The Switch is Disabled.
7	Warning
8	Keep
9	Remote control
10	Target reach/ Speed Reach
11	Internal Limit Active
12-13	Depending on the mode of operation
14	Manufacturer specific
15	Home find

Bit 9: Remote

Bit9 is used to display whether the control word has been set. This bit indicates Control word has settled.

4.3.4 0x6060 operation mode

Used to set the operation mode.

Object Dictionary	Name	Attributes	Type	Range	Default values
0x6060	Mode of Operation	RW	INTEGER8	---	0

The EST60X4 bus driver supports the following operating modes:

value	Pattern
1	Profile Position Mode (PP)
3	Profile Velocity Mode (PV)
6	Homing Mode (HM)
8	Cyclic Synchronous Position Mode (CSP)
9	Cyclic Synchronous Velocity Mode (CSV)

4.3.5 0x6061 operation mode display

Display the current operation mode, defined as 0x6060.

Object dictionary	Name	Attributes	Type	Range	Default values
0x6061	Mode of Operation Display	R	INTEGER8	---	0

4.3.6 0x6064 Actual location

Show the actual position of the current motor in Pulse

Object Dictionary	Name	Attributes	Type	Range	Default values
0x6064	Position Actual Value	R	INTEGER32	---	0

4.3.7 0x606C actual speed

Show the actual position of the current motor in Pulse/s

Object Dictionary	Name	Attributes	Type	Range	Default values
0x606C	Position Actual Velocity	R	INTEGER32	---	0

4.3.8 0x607A target location

This object sets the target location in PP mode and CSP mode. The unit is Pulse.

Object dictionary	Name	Attributes	Type	Range	Default value
0x607A	Profile Target Position	RW	INTEGER32	---	0

In PP mode, the Bit6 (0x6040.6) of the control word is used to set whether the coordinates are relative or absolute.

In CSP mode, this target position is always in absolute position mode.

4.3.9 0x607C zero offset

This object is used to set the offset of the zero sensor from position 0. The unit is Pulse.

Object dictionary	Name	Attributes	Type	Range	Default values
0x607C	Home Offset	RW	INTEGER32	---	0

4.3.10 0x6081 trajectory speed

This object is used to set the maximum speed for the trapezoidal acceleration and deceleration command in PP mode. The unit is Pulse/s

Object dictionary	Name	Attributes	Type	Range	Default values
0x6081	Profile Velocity	RW	INTEGER32	---	10000

4.3.11 0x6083 Trajectory acceleration

This object is used to set the acceleration of trapezoidal acceleration and deceleration commands in PP mode and PV mode, with the unit being Pulse/s^2

Object Dictionary	Name	Attributes	Type	Range	Default value
0x6083	Profile Acceleration	RW	INTEGER32	---	100000

4.3.12 0x6084 trajectory deceleration

This object is used to set the deceleration of the trapezoidal acceleration/deceleration command in PP mode, PV mode, with the unit of Pulse/s^2

Object Dictionary	Name	Attributes	Type	Range	Default values
0x6084	Profile Deceleration	RW	INTEGER32	---	100000

4.3.13 0x6085 quickly stop the deceleration

This object is used to set the deceleration when the motor stops in PP mode, PV mode, HOME mode when it encounters sensors such as limit and zero. The unit is Pulse/s.

Object dictionary	Name	Attributes	Type	Range	Default values
0x6085	Quickstop Deceleration	RW	INTEGER32	---	500000

4.3.14 0x6098 Return-to-zero method

This object is used to set the method for the motor to return to zero.

Object Dictionary	Name	Attributes	Type	Range	Default values
0x6098	Homing Method	RW	INTEGER8	1 ~ 35	17

Describe the reference return-to-zero mode in detail.

4.3.15 0x6099 return-to-zero speed

This object sets the speed at which the motor returns to zero.

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x6099:01	Homing Velocity (fast)	R/W/S	UNSIGNED32	---	10000	Pulse/s
0x6099:02	Homing Velocity (slow)	R/W/S	UNSIGNED32	---	2000	Pulse/s

4.3.16 0x609A return to zero acceleration

This object is used to set the acceleration and deceleration of the position curve when the motor returns to zero. The unit is Pulse/s^2.

Object dictionary	Name	Attributes	Type	Range	Default values
0x609A	Homing Acceleration	RW	UNSIGNED32	---	100000

4.3.17 0x60B8 probe function Settings

This object sets the probe function.

Object Dictionary	Name	Attributes	Type	Scope	Default values
0x60B8	Touch Probe Function	RW	UNSIGNED16	0 ~ 65535	0

Register bits are defined as follows:

Bit	Value	Definition
0	0	Probe 1 Prohibited
	1	Probe 1 is enabled
1		Retain
2		Preserve
3		Preserve
4	0	The rising edge latch of Probe 1 is prohibited
	1	Enable Probe 1 rising edge latching
5	0	Prohibit Probe 1 falling edge latching
	1	Enable Probe 1 falling edge latching
6		Retain
7		Preserve
8	0	Probe 2 Prohibited
	1	Probe 2 enabled

9		Retain
10		Preserve
11		Preserve
12	0	Prohibit Probe 2 rising edge latching
	1	Enable Probe 2 rising edge latching
13	0	Prohibit Probe 2 fall edge latching
	1	Enable Probe 2 fall edge latching
14		Retain
15		Reserve

Positive positions are locked at the rising edge moment, and negative positions are locked at the falling edge moment.

4.3.18 0x60B9 probe status

This object defines the functional status of the probe.

Object Dictionary	Name	Attributes	Type	Range	Default values
0x60B9	Touch Probe Status	R	UNSIGNED16	0 ~ 65535	0

Status bits are defined as follows:

Bit	Value	Definition
0	0	Probe 1 Prohibited
	1	Probe 1 is enabled
1	0	Probe 1 rising edge latch: None
	1	Probe 1 rising edge latch: Yes
2	0	Probe 1 falling edge latching: None
	1	Probe 1 falling edge latch: Yes
3-7	0	Retained
8	0	Probe 2 Prohibited
	1	Probe 2 enabled
9	0	Probe 2 rising edge latch: None
	1	Probe 2 rising edge latch: Yes
10	0	Probe 2 falling edge latching: None

	1	Probe 2 falling edge latch: Yes
11-15	0	Reserve

4.3.19 0x60BA probe 1 positive latch value

This object holds the position where the rising edge of Probe 1 is latched.

Object dictionary	Name	Attributes	Type	Range	Default values
0x60BA	Touch Probe 1 Positive Value	R	UNSIGNED32	0 ~ 65535	0

4.3.20 0x60BB probe 1 negative latch value

This object holds the position where Probe 1 is latched along the falling edge.

Object dictionary	Name	Attributes	Type	Range	Default values
0x60BB	Touch Probe 1 Negative Value	R	UNSIGNED32	0 ~ 65535	0

4.3.21 0x60BC probe 2 positive latch value

This object holds the position where the rising edge of Probe 2 is latched.

Object dictionary	Name	Attributes	Type	Range	Default values
0x60BC	Touch Probe 2 Positive Value	R	UNSIGNED32	0 ~ 65535	0

4.3.22 0x60BD probe 2 negative latch value

This object holds the position where Probe 2 is latched along the falling edge.

Object	Name	Attributes	Type	Range	Default

Dictionary					values
0x60BD	Touch Probe 2 Negative Value	RO	UNSIGNED32	0 ~ 65535	0

4.3.23 0x60FD input port logical state

This object monitors the input port of the drive.

Object Dictionary	Name	Attributes	Type	Range	Default values
0x60FD	Digital Inputs	RO	UNSIGNED32	0 ~ 65535	0

Bit0	CW negative limit	0 -- invalid 1 - The limit takes effect
Bit1	CCW positive limit	
Bit2	HOME Origin signal	0 -- zero invalid 1 - zero is valid
Bit3~ Bit15	Keep	
Bit16	IN1	Physical state of the input port 0 - The input signal is invalid 1 - The input signal is valid
Bit17	IN2	
Bit18	IN3	
Bit19	IN4	
Bit20	IN5	
Bit21	IN6	
Bit22~Bit31	Keep	

4.3.24 0x60FE output port logical state

This object controls the digital output signal

Object	Name	Attributes	Type	Range	Default	Units

Dictionary					value	
0x60FE:01	physical outputs	R/W	UNSIGNED32	---	0	
0x60FE:02	bit mask	R/W	UNSIGNED32	---	0	

Physical outputs:

Bit 0 to 15 are reserved functions.

Bit 16-17 is used to control OUT1-out2.

Bits 18 to 31 are reserved

0 and 1 correspond to output off and on

Bit mask:

Bits 0 to 15 are reserved functions.

Bit 16-17 is used to enable OUT1-out2.

Bits 18 to 31 are reserved

0 and 1 control whether the output port is enabled.0 - not enabled, 1 - enabled

4.3.25 0x60FF PV mode speed Settings

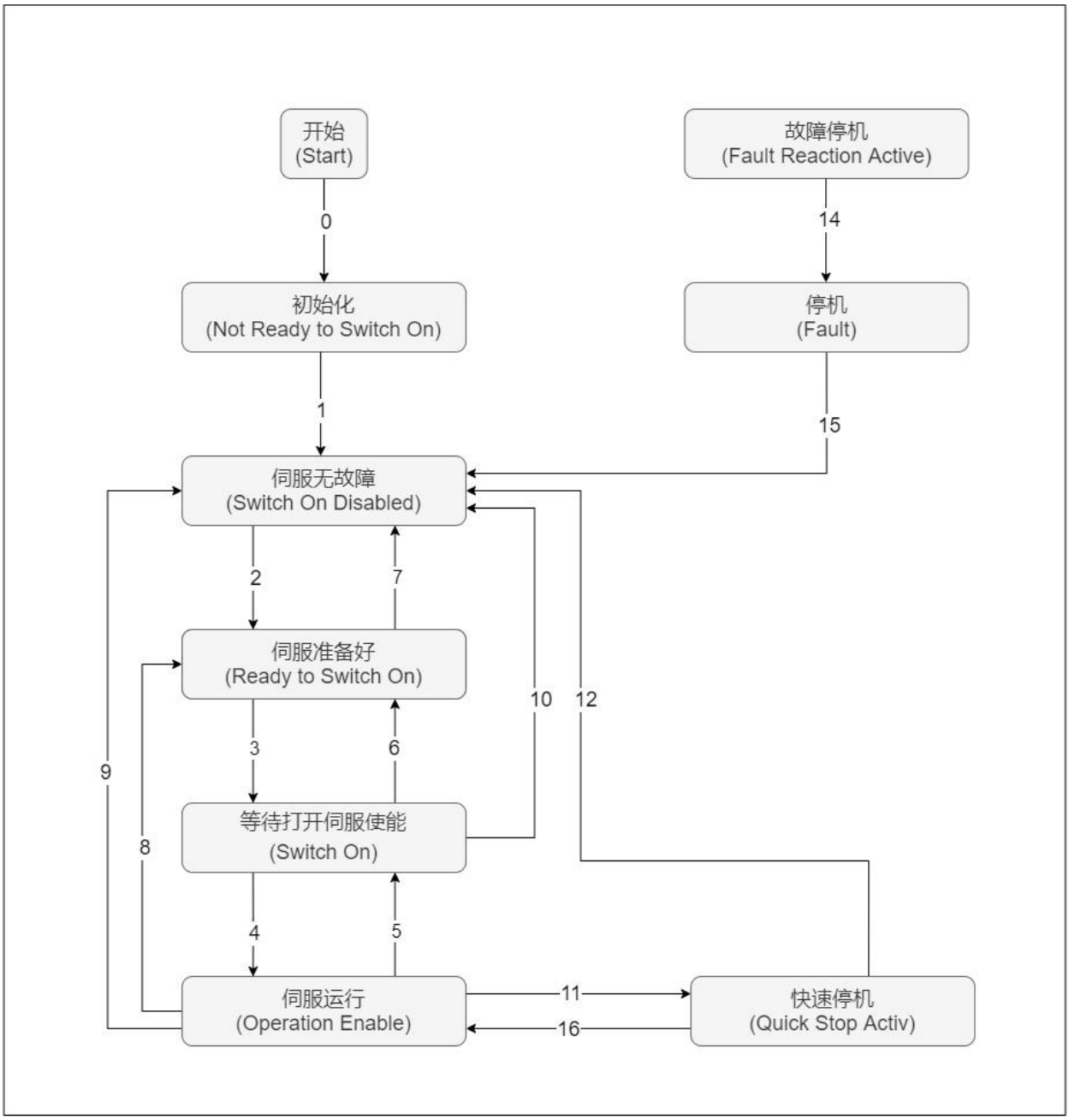
This object sets the speed in PV mode in units of Pulse/s

Object Dictionary	Name	Attributes	Type	Range	Default values	Units
0x60FE:01	physical outputs	R/W	UNSIGNED32	---	0	
0x60FE:02	bit mask	R/W	UNSIGNED32	---	0	

This object is 32-bit signed data, with positive and negative values representing the two directions in which the motor is running.

4.4 Servo status Settings

The servo drive must be booted in accordance with the process specified in the standard CiA402 protocol before it can operate in the specified state.



Initialization	Drive initialization and internal self-check have been completed The parameters of the drive cannot be set, nor can the drive function be
Servo without fault	Servo driver no faults or errors have been ruled out Drive parameters can be set
Servo ready	The servo drive is ready The driver parameters can be set
Wait for the servo to be	The servo driver waits to turn on the servo enable Driver parameters can be set
Servo running	The driver is running normally, a certain servo operation mode has been enabled, the motor is powered on, and the motor rotates when the
Quick shutdown	The quick shutdown function is activated and the drive is performing the quick shutdown function
Downtime Due to failure	The drive has failed and is in the process of performing a failure shutdown.
Fault	The fault shutdown is completed, all drive functions are disabled, and drive parameters are allowed to be changed in order to troubleshoot.

Control commands and status switching:

CiA402 status switch		Control word 6040h	Status word 6041h Bit0 to Bit9
0	Power on → Initialize	Natural transition, no control instructions required	0x0000
1	Initialization → Servo no fault	Natural transition, no control instructions required	0x0250
2	Servo no fault → Servo ready	0x0006	0x0231
3	The server is ready → Wait to enable the server	0x0007	0x0233
4	Wait to enable the servo → run the servo	0x000F	0x0237
5	Servo run → Wait to enable the servo	0x007	0x0233
6	Wait to enable the server → The server is ready	0x006	0x0231
7	Servo ready → servo no fault	0x0000	0x0250
8	Servo running → Servo ready	0x0006	0x0231
9	Servo running → servo without fault	0x0000	0x0250
10	Wait to enable the servo → servo no fault	0x0000	0x0250
11	Servo run → Quick stop	0x0002	0x217
12	Quick shutdown → No servo failure	A natural transition after the shutdown is completed, no control instructions required	0x0250
13	→ Downtime due to faults	In any state other than "Fault", the servo drive will automatically switch to the fault stop state upon failure without command control	0x021F
14	Failure shutdown → Failure	After the fault is done for you, a natural transition is needed without control instructions	0x0218
15	Fault → Servo no fault	0x80	0x0250
16	Quick stop → servo run	Once the shutdown is complete, send 0x0F	0x0237

4.4.1 Control word 6040h

Index	Name	Control word					Data structure	VAR	Data types	Uint16
6040h	Data range	0～65535	Factory Settings	0	Accessibility	RW	Related Patterns	ALL	Can it be mapped	RPDO

Set control instructions:

Bit	Name		Description
0	Servo operation can be enabled	Switch on	0: Ineffective, 1: effective
1	Connect the main circuit power	Enable voltage	0: Invalid, 1: Valid
2	Quick shutdown	Quick stop	0: Ineffective, 1: effective
3	Servo running	Enable operation	0: invalid, 1: valid
4～6	Operation mode related	Operation mode specific	Related to servo operation mode
7	Fault Reset	Fault reset	Perform the fault reset function for resettable faults and warnings Bit7 rising edge is effective; Bit7 remains at 1, and all other control instructions are invalid
8	Pause	Halt	For the pause methods in each mode, please refer to the object dictionary 605Dh
9	Run Mode related	Operation mode specific	Related to each servo operation mode
10	Retain	ReveR5L EtherCAT	Undefined
11～15	Manufacturer Custom	Manufacturer-specific	Manufacturer's Own

It is meaningless to assign each Bit of the control word separately; it must be combined with other bits that do not constitute a certain control instruction.

Bit0 to Bit3 and Bit7 have the same meaning in each servo mode, and commands must be sent in sequence to direct the servo driver to the desired state according to the CiA402 state machine switching process, with each command corresponding to a

determined state;

Bit4 to Bit6 are associated with each servo mode, see the control instructions for different modes;

Bit9 does not define functions.

4.4.2 Status word 6041h

Index 6041h	Name	Status words					Data structure	VAR	Data types	Uint16
	Data range	0～65535	Factory Settings	0	Accessibility	RO	Related Patterns	ALL	Can it be mapped	TPDO

Reflecting the current operating status of the servo drive:

Bit	Name		Description
0	Servo ready	Ready to switch on	0: Ineffective, 1: effective
1	Servo operation can be enabled	Switch on	0: Ineffective, 1: effective
2	Servo running	Operation enabled	0: Ineffective, 1: effective
3	Malfunctioning	Fault	0: Invalid, 1: valid
4	The main circuit is powered on	Voltage enabled	0: ineffective, 1: effective
5	Quick shutdown	Quick stop	0: Ineffective, 1: effective
6	The servo is not running	Switch on disabled	0: Ineffective, 1: effective

7	Warnings	Waming	0: Ineffective, 1: effective
8	Manufacturer Custom	Manufacturer specific	Undefined functionality
9	Remote control	Remote	0: Invalid, 1: Valid (Control word takes effect)
10	Target reached	Target reach	0: Ineffective, 1: effective
11	Internal restrictions are valid	Internal limit active	0: Invalid, 1: valid
12~13	Operation mode related	Operation limit active	Related to each servo operation mode
14	Manufacturer Custom	Manufacturer specific	Undefined functionality
15	Retained	---	---

Display values (binary values)	Description
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Start (Switch on)
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x0xx 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

Bit0 to Bit9 have the same meaning in each servo mode. After the control word 6040h sends commands in sequence, the servo feeds back a definite state.

Bit12 to Bit13 are associated with each servo mode (see control instructions for different modes)

Bit10, Bit11, and Bit15 have the same meaning in each servo mode and indicate the state of the servo after it executes a certain servo mode.

4.5 Servo mode Settings

4.5.1 Introduction to Servo Mode

---	Name	Supports servo operation mode					Data structures	---	Data types	---
	Data Range	-	Factory Settings	---	Accessibility	---	Related Patterns	-	Can it be mapped	---

Reflect the servo operating mode supported by the drive:

	Description	Support or not (0: no support, 1: Support)
0	Contour Position Mode (PP)	1
1	Variable frequency speed control mode (VL)	0
2	Contour speed mode (PV)	1
3	Contour torque mode (PT)	0
4	NA	0
5	Return to Zero Mode (HM	1
6	Interpolation mode (IP)	0
7	Periodic Synchronous Position Mode (CSP)	1
8	Periodic Synchronous Velocity Pattern (CSV)	1
9	Periodic Synchronous torque Mode (CST)	0
10～31	NA	0

Index 6060h	Name	Mode selection					Data structure	VAR	Data types	Int16
	Data	0～10	Factory	8	Accessi	RW	Related	ALL	Can it be	RPDO

	range		Settings		bility		Patterns		mapped	

Select the servo running mode:

Settings	Servo mode
0/2/5	NA
1	Contour position pattern (PP)
3	Contour velocity Mode (PV)
4	Contour torque mode (PT)
6	Return to zero mode (HM)
7	Interpolation mode (IP)
8	Periodic Synchronous Position Mode (CSP)
9	Periodic Synchronous Speed Mode (CSV
10	Periodic Synchronous torque Mode (CST)

Index	Name	Running Mode shows				Data structure	VAR	Data types	Int16
6061h	Data range	0~10	Factory Settings	0	Accessi bility	RO	Related Patterns	ALL	Can it be mapped	TPDO

Swear the current operating mode of the servo drive:

Set values	Servo mode
0/2/5	NA
1	Contour position pattern (PP)
3	Contour velocity Mode (PV)
4	Contour torque mode (PT)
6	Return to zero mode (HM)
7	Interpolation mode (IP)
8	Periodic Synchronous Position Mode (CSP)
9	Periodic Synchronous Velocity Pattern (CSV)

10	Periodic Synchronous torque Mode (CST)

4.5.2 Mode switching

Notes for using the servo operation status switching mode:

(1) When the servo driver is in any state and switches to other modes from contour position mode or periodic synchronous position mode, unexecuted position instructions will be discarded.

(2) When switching from other modes to run in periodic synchronous mode, wait at least 5ms before sending instructions; otherwise, instruction loss or error will occur.

4.6 Periodic Synchronous Location Mode (CSP)

In periodic synchronous position mode, the host computer executes position instruction planning and then sends the planned target position 607Ah to the servo driver in a periodic synchronous manner. Position and speed control are accomplished within the servo driver.

4.6.1 Related objects

Control word 6040h		
position	Name	Description
0	Servo ready (Switch On)	The motor is enabled when Bit0 to Bit3 values are all 1
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
7	Reset Fault	0: No effect 1: Reset the drive failure

Status word 6041h		
position	Name	Description
10	Target Arrival Target Reached	0: Target position not reached 1: Target position arrived
11	The internal position of the software exceeds the limit Internal Limit Active	0: Position instructions and position feedback are not out of limit 1: Position command or position feedback is out of limit
12	The slave follows the instruction Driver Follow the Command	0: The slave does not follow the command 1: The slave station follows the instructions
13	Follow error Following Error	0: No position deviation faults 1: A position deviation fault occurs
15	Retain	---

4.6.2 Suggested Configuration

RPDO	TPDO	Instructions
6040h: Control Word	6041h: Status Word	Must
607Ah: Target Position	6064h: Position Actual Value	Must
6060h: Modes of Operation	6061h: Modes of Operation Display	Optional
	603Fh: Error Code	Optional
	60FDh: Digital Inputs	Optional

4.7 Periodic Synchronous Speed Mode (CSV)

In periodic synchronous speed mode, the host computer sends the planned target speed of 60FFh to the servo driver in a periodic synchronous manner, and the speed control is done within the servo driver.

4.7.1 Related objects

Control word 6040h		
position	Name	Description
0	Servo ready (Switch On)	The motor is enabled when Bit0 to Bit3 values are all 1
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
7	Reset Fault	0: No effect 1: Reset drive failure

Status word 6041h		
position	Name	Description
10	Target Arrival Target Reached	0: Target speed not reached 1: Target speed reached
11	The software's internal position exceeds the limit Internal Limit Active	0: Neither the position command nor the position feedback exceeded the limit 1: Position command or position feedback is out of limit
12	The slave follows the instruction Driver Follow the Command	0: The slave does not follow the command 1: The slave follows the instruction
15	Keep	---

4.7.2 Suggested Configuration

RPDO	TPDO	Instructions
6040h: Control Word	6041h: Status Word	Must
6060h: Modes of Operation	6061h: Modes of Operation Display	Optional
60FFh: Target Velocity		Must
	6064h: Position Actual Value	Optional
	606Ch: Velocity Actual Value	Optional
	603Fh: Error Code	Optional
	60FDh: Digital Inputs	Optional

4.8 Contour Position Mode (PP)

Contour position Mode is mainly used for point-to-point positioning applications. In this mode, the host computer gives the target position (absolute or relative), the speed, acceleration, and deceleration of the position curve. The trajectory generator inside the servo generates the target position curve instructions according to the Settings, and the driver completes the position and speed control internally.

4.8.1 Related objects

Control word 6040h		
position	Name	Description
0	Servo ready (Switch On)	The motor is enabled when Bit0 to Bit3 values are all 1
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	

4	New Set-Point	This is the rising edge from 0 to 1 indicating the pre-triggered new target position 607Ah, contour velocity 6081h, acceleration 6083h, deceleration 6084h given
5	Change Set Immediately	0: Not updated immediately 1: Update immediately
6	Absolute/Relative position	0: The target position is an absolute position instruction 1: Target position is relative position instruction
7	Reset Fault	0: No effect 1: Reset drive failure
8	Pause Halt	0: The server is set from Bit0 to Bit3 1: Pause the servo at 605Dh

Status word 6041h		
position	Name	Description
10	Target Arrival Target Reached	0: Target position not reached 1: Target position arrived
11	The internal position of the software exceeds the limit Internal Limit Active	0: Position instructions and position feedback are not out of limit 1: Position command or position feedback exceeds the limit
12	Target position update Set-Point Acknowledge	0: The slave did not follow the instruction 1: The slave follows the instruction
13	Follow error Following Error	0: No position deviation faults 1: A position deviation fault occurs
15	Retain	---

4.8.2 Position curve generator

1. Update now

(1) The host computer first updates other properties that modify the displacement command as needed (acceleration time 6083h, deceleration time 6084h, contour speed 6081h, target displacement 607Ah).

(2) The host computer sets bit4 of 6040h from 0 to 1, indicating that the slave station has a new displacement command that needs to be enabled.

(3) After receiving the rising edge of bit4 of 6040h, the slave station makes a judgment on whether it can receive the new displacement instruction:

If the initial state of bit5 of 6040 is 0 and bit12 of 6041h is 0 at this time, it indicates that the slave station can receive the new displacement instruction ①; After the slave receives the new displacement instruction, set the bit12 of 6041 from 0 to 1, indicating that the new displacement instruction ① has been received, and the slave is currently in a state where it cannot continue to receive the new displacement instruction.

In the immediate update mode, once a new displacement command is received (the biyt12 of 6041h changes from 0 to 1), the servo immediately executes the displacement command.

(4) The host computer can release the displacement command data and set the bit4 of the control word 6040h from 1 to 0 only after receiving the status word 6041h from the slave station, indicating no new position command at present. Since the bit4 of 6040h is valid along the change, this operation does not interrupt the displacement instruction being executed.

(5) When the slave station detects that the bit4 of the control word 6040h changes from 1 to 0, it can set the bit12 of the status word 6041h from 1 to 0, indicating that the slave station is ready to receive the new displacement instructions.

◆ In the immediate update mode, bit12 of 6041h is always reset to zero when bit4 of control word 6040h is detected by the slave station to change from 1 to 0.

◆ In the immediate update mode, during the execution of the current displacement instruction ①, a new displacement instruction ② is received, and the unexecuted displacement instructions in ① are not discarded. For relative position instructions, after the positioning of the second displacement instruction is completed, the total displacement increment = 607Ah of the target position increment of ① + 607Ah of the target position increment of ②. For absolute position instructions, After the second displacement instruction is located, the user's absolute position = the target position of ② 607Ah.

2. Not an immediate update

(1) The host computer first updates other properties that modify the displacement command as needed (acceleration time 6083h, deceleration time 6084h, contour speed 6081h, target displacement 607Ah).

(2) The host computer sets bit4 of 6040h from 0 to 1, indicating that the slave station has a new displacement command that needs to be enabled.

(3) After receiving the rising edge of bit4 of 6040h, the slave station makes a judgment on whether it can receive the new displacement instruction:

If the initial state of bit5 of 6040 is 0 and bit12 of 6041h is 0 at this time, it indicates that the slave station can receive the new displacement instruction ①; After the slave receives the new displacement instruction, set the bit12 of 6041 from 0 to 1, indicating that the new displacement instruction ① has been received, and the slave is currently in a state where it cannot continue to receive the new displacement instruction.

(4) The host computer can release the displacement instruction data and set the bit4 of the control word 6040h from 1 to 0, indicating that there are no new position instructions at present. Since the bit4 of 6040h is valid along the change, this operation does not interrupt the displacement instruction being executed.

(5) When the slave station detects that the bit4 of the control word 6040 changes from 1 to 0, after the current segment positioning is completed, it releases the bit12 of 6041, indicating that the slave station is ready to receive new displacement instructions. In non-immediate update mode, the servo cannot receive new displacement instructions while the current segment is running. Once the current segment positioning is completed, the servo can receive new displacement instructions. Once received (bit12 of 6041 changes from 0 to 1), the servo immediately executes the displacement instructions.

4.8.3 Suggested configuration

RPDO	TPDO	Instructions
6040h: Control Word	6041h: Status Word	Must
607Ah: Target Position	6064h: Position Actual Value	Must
6060h: Modes of Operation	6061h: Modes of Operation Display	Optional
6081h: Profile Velocity		Must
6083h: Profile Acceleration		Optional
6084h: Profile Deceleration		Optional

4.9 Contour Velocity Mode (PV)

In this mode, the upper computer sends the target speed, acceleration and deceleration to the servo driver, and the speed adjustment is executed internally by the servo.

4.9.1 Related objects

Control word 6040h		
position	Name	Description
0	Servo ready (Switch On)	The motor is enabled when Bit0 to Bit3 values are all 1
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
7	Reset Fault	0: No effect 1: Reset drive failure
8	Pause Halt	0: The server is set from Bit0 to Bit3 1: Set the servo to pause at 605Dh

Status word 6041h		
position	Name	Description
10	Target Arrival Target Reached	0: Target speed not reached 1: Target speed reached
11	The software's internal position exceeds the limit Internal Limit Active	0: Position instructions and position feedback are not out of limit 1: Position command or position feedback is out of limit
15	Retain	---

4.9.2 Suggested Configuration

RPDO	TPDO	Instructions
6040h: Control Word	6041h: Status Word	Must
6060h: Modes of Operation	6061h: Modes of Operation Display	Optional
60FFh: Target Velocity		Must
6083h: Profile Acceleration	6064h: Position Actual Value	Optional
6084h: Profile Deceleration	606Ch: Velocity Actual Value	Optional
	603Fh: Error Code	Optional
	60FDh: Digital Inputs	Optional

4.10 Origin Regression Mode (HM)

The origin regression mode is used to find the mechanical origin and to determine the positional relationship between the mechanical origin and the mechanical zero point.

- Mechanical origin: A fixed position on a machine that corresponds to a definite origin switch or motor Z signal.
- Mechanical zero point: The absolute zero position on a machine.

After the origin return to zero is completed, the motor stops at the mechanical origin. By setting 607Ch, the relationship between the mechanical origin and the mechanical zero point can be defined:

Mechanical origin = mechanical zero point + 607Ch (origin offset)

When 607Ch = 0, the mechanical origin coincides with the mechanical zero point.

4.10.1 Relevant objects

Control word 6040h		
position	Name	Description
0	Servo ready (Switch On)	The motor is enabled when Bit0 to Bit3 values are all 1
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
4	Home Start	0 -> 1: Start to zero 1: Return-to-zero 1 -> 0: End to zero
7	Reset Fault	0: No effect 1: Reset the drive failure
8	Pause Halt	0: The servo decides whether to start back to zero by setting Bit4 1: Pause the servo by setting 605Dh

Status word 6041h		
position	Name	Description
10	Target Arrival Target Reached	0: Target position not reached 1: Target position arrived
11	The internal position of the software exceeds the limit Internal Limit Active	0: Position instructions and position feedback are not out of limit 1: Position command or position feedback is out of limit
12	Return to zero Homing Attained	0: Failed to return to zero 1: Successful return-to-zero, this flag bit is valid after the servo is in the return-to-zero mode running state (target reach signal) is set

13	Return to zero error Homing Error	0: No error occurred when returning to zero 1: Error occurred when resetting to zero
15	Keep	---

4.10.2 Suggested Configuration

RPDO	TPDO	Instructions
6040h: Control Word	6041h: Status Word	Must
6060h: Modes of Operation	6061h: Modes of Operation Display	Optional
6098h: Homing Method		Optional
6099-01h: Speed during search for switch signal Speed		Optional
6099-02h: Speed during search for zero Signal	603Fh: Error Code	Optional
609Ah: Homing acceleration	60FDh: Digital Inputs	Optional

4.11 Return-to-zero method

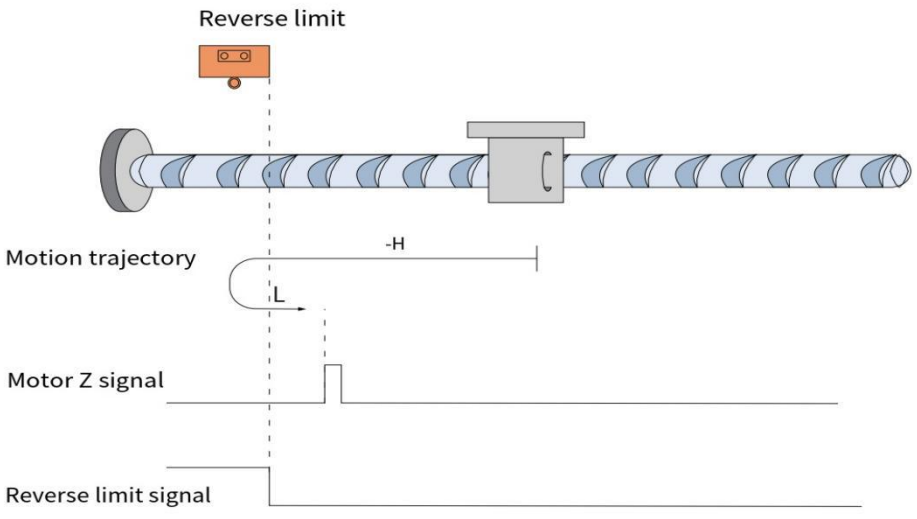
The EST60X4 drive supports 1 to 35 return-to-origin methods, which are defined and the return-to-origin process as follows:

4.11.1 Method 1 (6098=1)

Origin: Z signal

Deceleration point: Reverse limit signal (NOT)

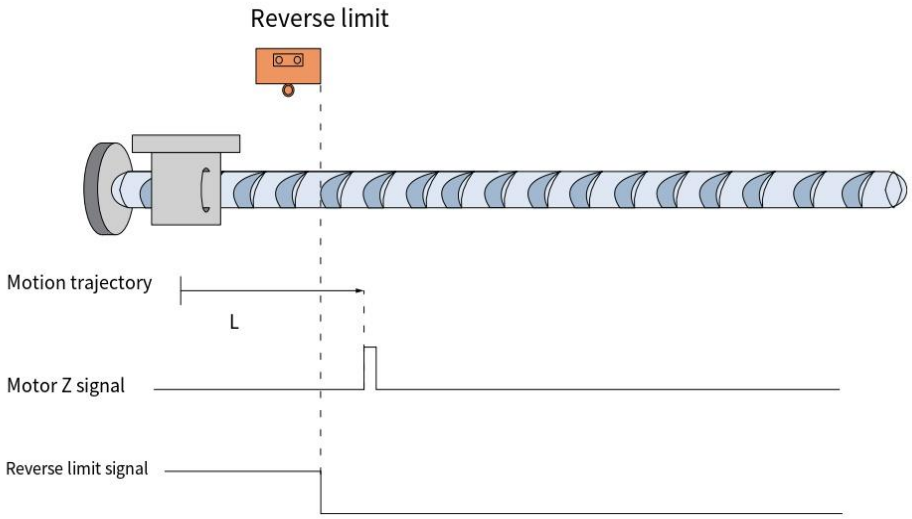
- **The reverse limit signal is nvalid when starting back to zero**



In the figure, "H" represents high speed 6099.01 and "L" represents low speed 6099.02.

Start to return to zero when NOT=OFF, start to return to zero at reverse high speed, decelerate and reverse after encountering the NOT rising edge, run forward at low speed, stop at the first Z signal after encountering the NOT falling edge.

- **The reverse limit signal is effective when starting back to zero**



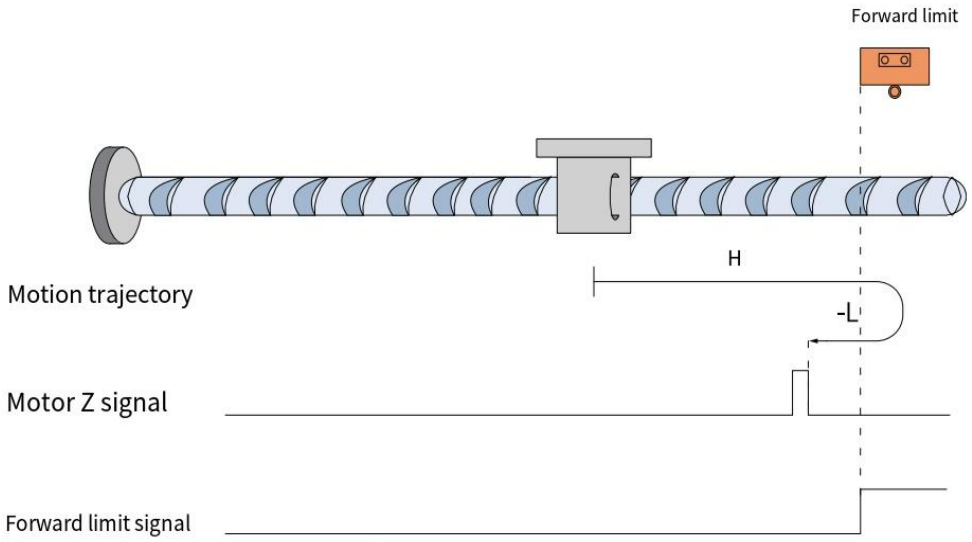
Start the return to zero when NOT=ON, directly return to zero at a low forward speed, and stop at the first Z signal after the NOT falling edge.

4.11.2 Method 2 (6098=2)

Origin: Z signal

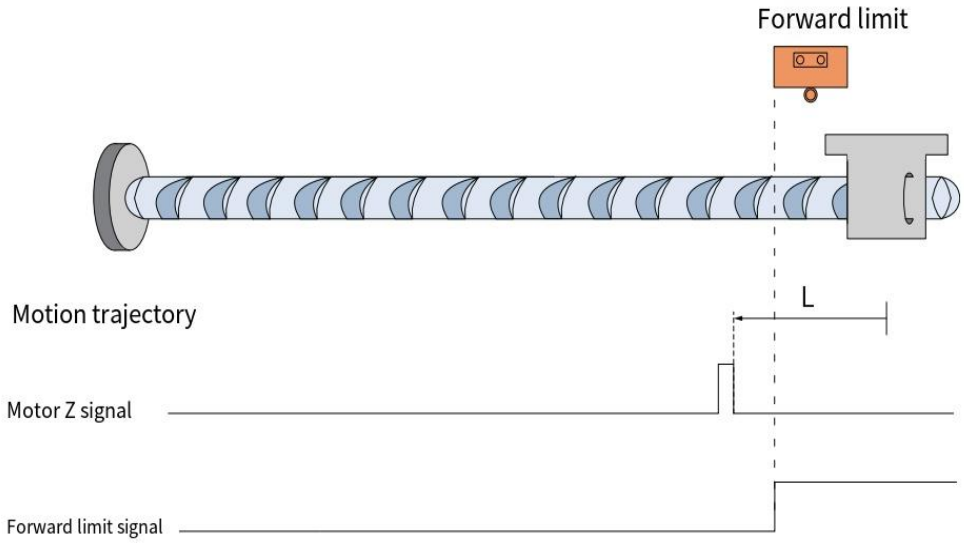
Deceleration point: Forward limit signal (POT)

- **The forward limit signal is invalid when starting back to zero**



Start the return to zero when POT=OFF, start the return to zero at high forward speed after encountering the rising edge of POT, decelerate, reverse, run at low reverse speed
, stop at the first Z signal after encountering the falling edge of POT.

- **The forward limit signal is effective when starting back to zero**



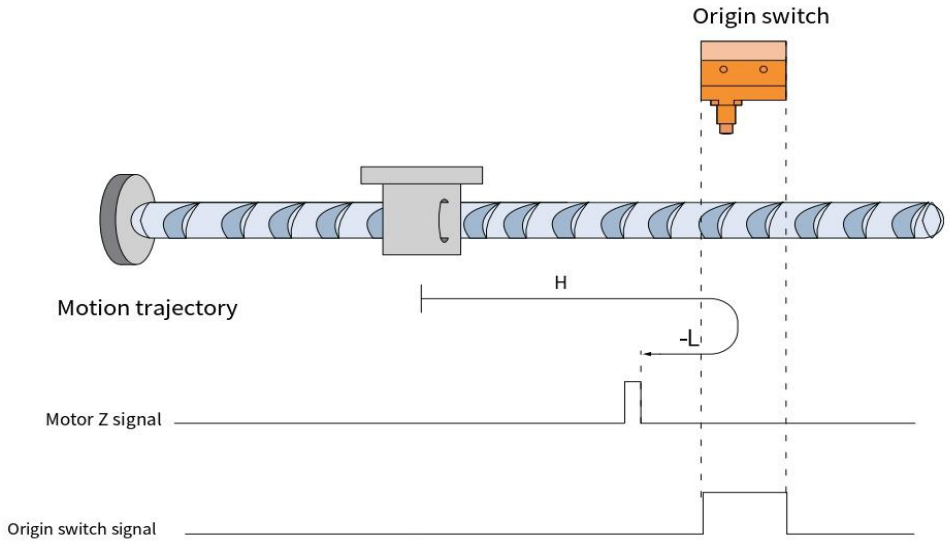
Start the return to zero when POT=ON, directly reverse the low speed return to zero, and stop when the first Z signal after the POT falling edge is encountered.

4.11.3 Method 3 (6098=3)

Origin: Z signal

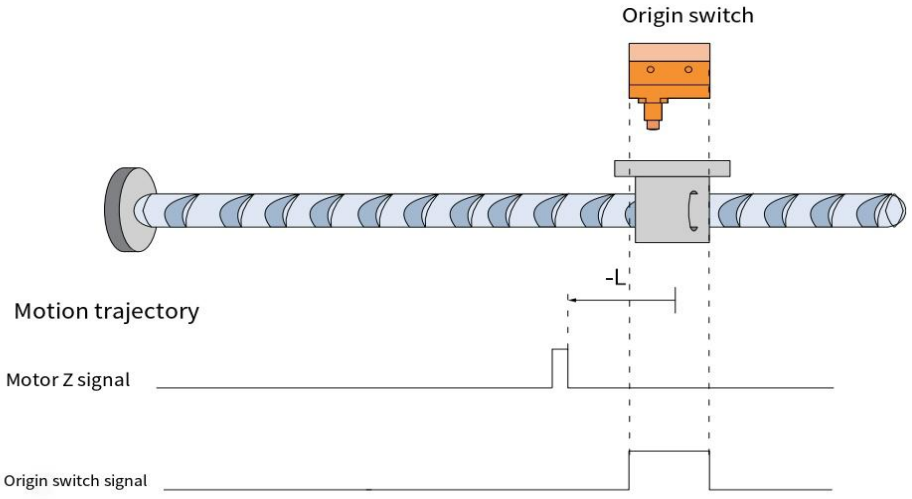
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero**



Start the return to zero when HOME=OFF, start the return to zero at high forward speed, decelerate and reverse when encountering the rising edge of HOME, run the reverse low speed, stop when encountering the first Z signal after the falling edge of HOME.

- **The origin switch signal is effective when starting back to zero**



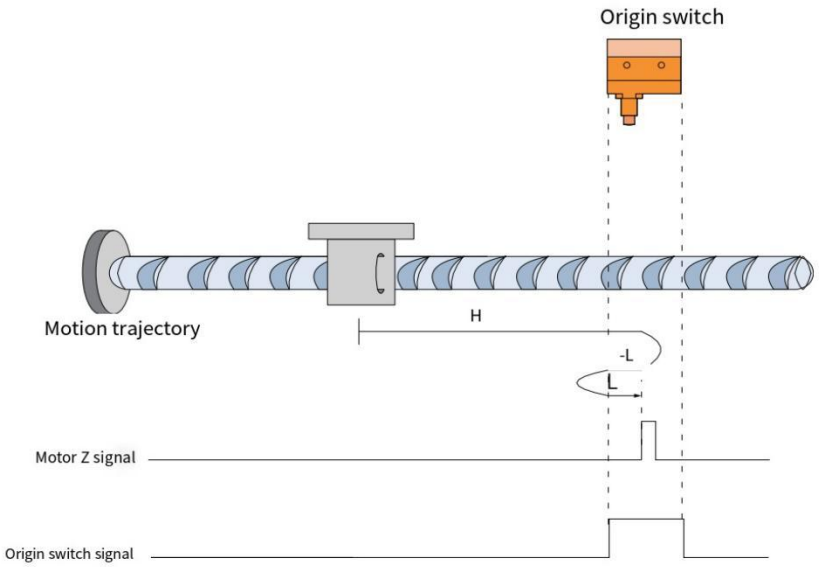
Start the return to zero when HOME=ON, start the return to zero at reverse low speed, and stop at the first Z signal after the HOME falling edge.

4.11.4 Method 4 (6098=4)

Origin: Z signal

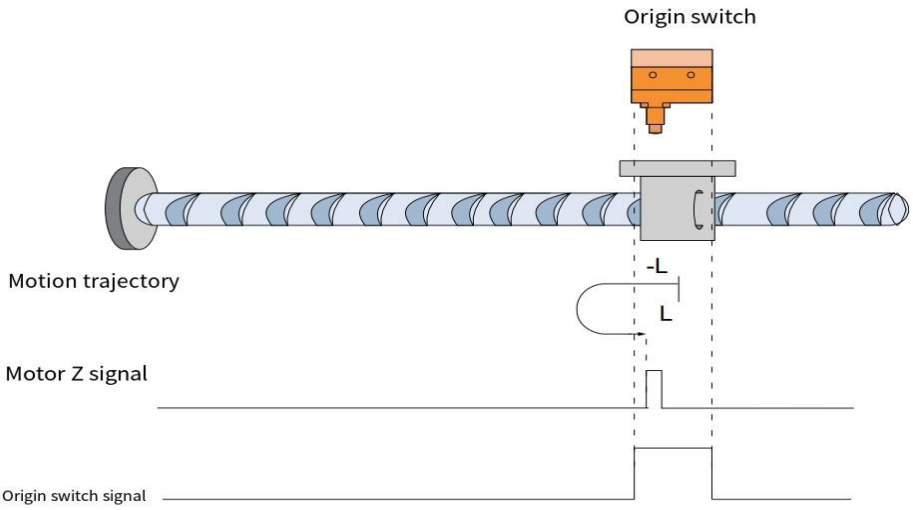
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero**



Start the return to zero when HOME=OFF, start the return to zero at high forward speed, after encountering the rising edge of HOME, decelerate and reverse, run at low reverse speed, after encountering the falling edge of HOME, decelerate and reverse, run at low forward speed, stop at the first Z signal after encountering the rising edge of HOME.

- **The origin switch signal is effective when starting back to zero**



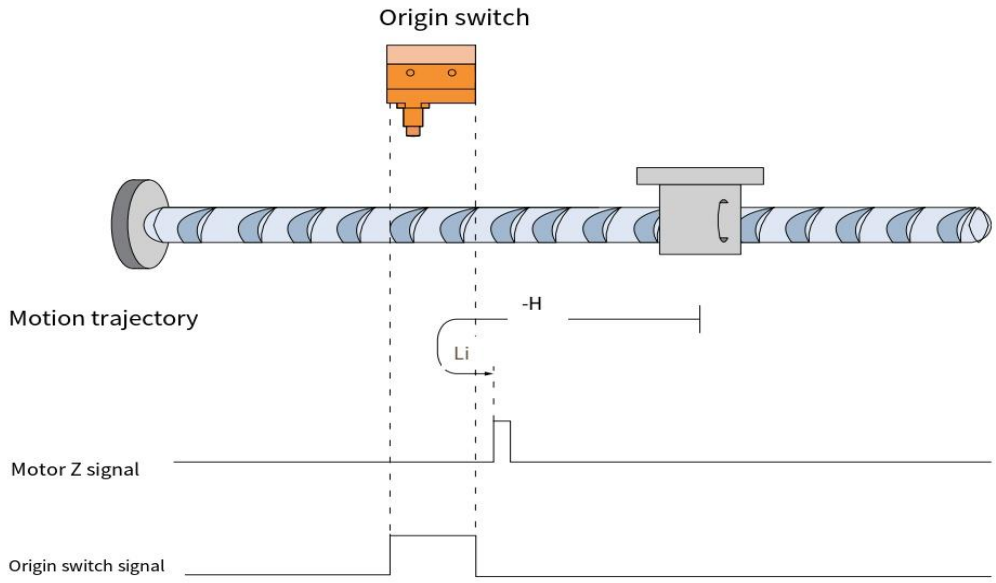
Start to return to zero when HOME=ON, start to return to zero at reverse low speed, after encountering the NOT falling edge, decelerate and reverse, run forward low speed, stop at the first Z signal after encountering the HOME rising edge.

4.11.5 Method 5 (6098=5)

Origin: Z signal

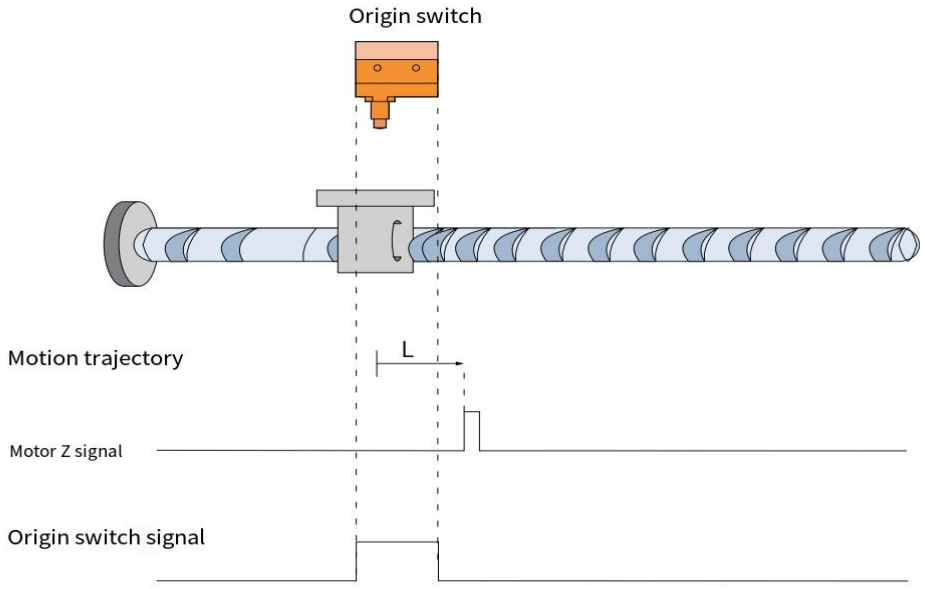
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero**



When HOME=OFF, it starts to return to zero. It begins to return to zero at high speed in the reverse direction. After encountering the rising edge of HOME, it decelerates in the reverse direction and runs at low speed in the forward direction. It stops at the first Z signal after encountering the falling edge of HOME.

- **The origin switch signal is effective when starting back to zero**



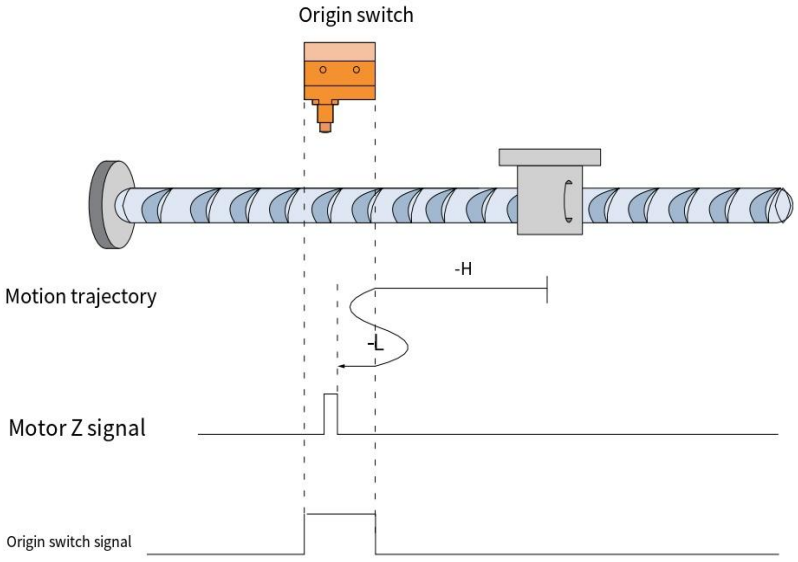
Start returning to zero when HOME=ON, start returning to zero at a forward low speed, stop at the first Z signal after the HOME falling edge.

4.11.6 Method 6 (6098=6)

Origin: Z signal

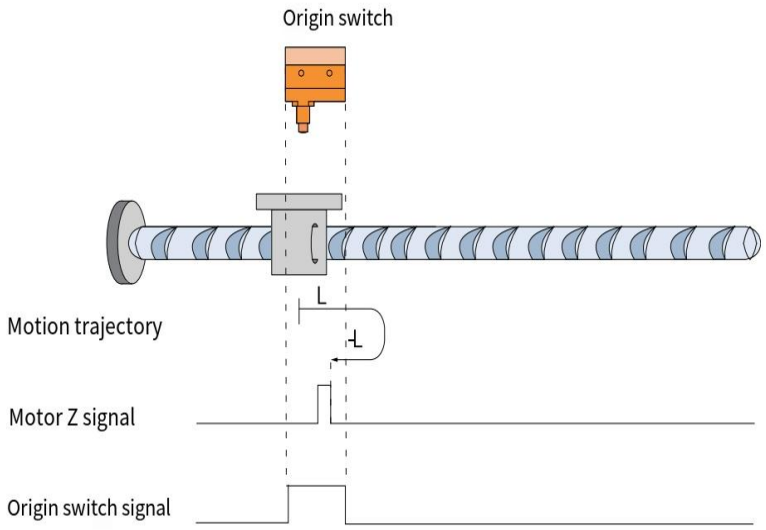
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero**



Start the return to zero when HOME=OFF, start the return to zero at reverse high speed, after encountering the rising edge of HOME, decelerate and reverse, run forward low speed, after encountering the falling edge of HOME, decelerate and reverse, run backward low speed, stop at the first Z signal after encountering the rising edge of HOME.

- **The origin switch signal is effective when starting back to zero**



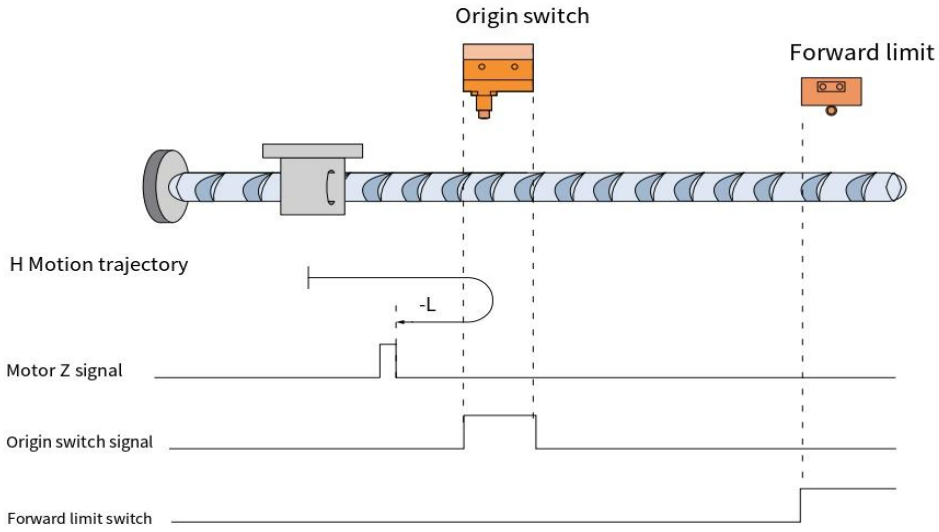
When HOME=ON, it begins to return to zero. It starts to return to zero at a forward low speed. After encountering the HOME falling edge, it decelerates and reverses. It runs in the reverse low speed and stops at the first Z signal after encountering the HOME rising edge.

4.11.7 Method 7 (6098=7)

Origin: Z signal

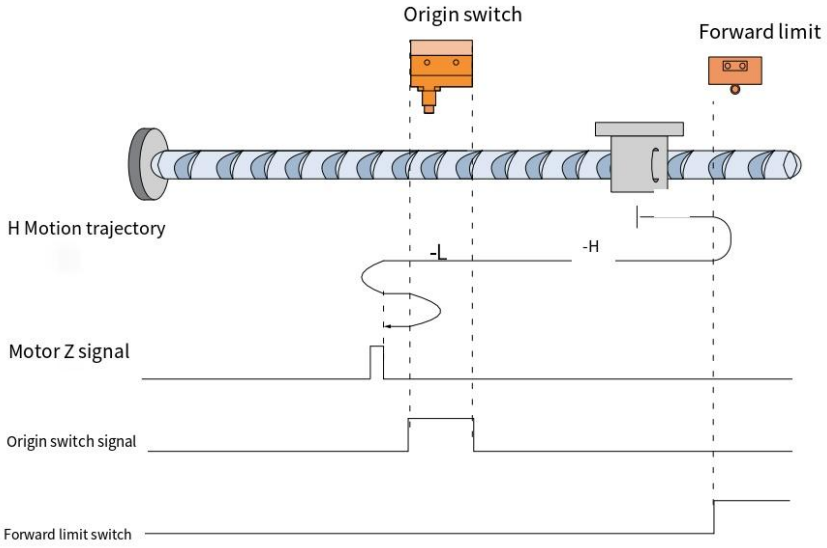
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the forward limit switch is not encountered**



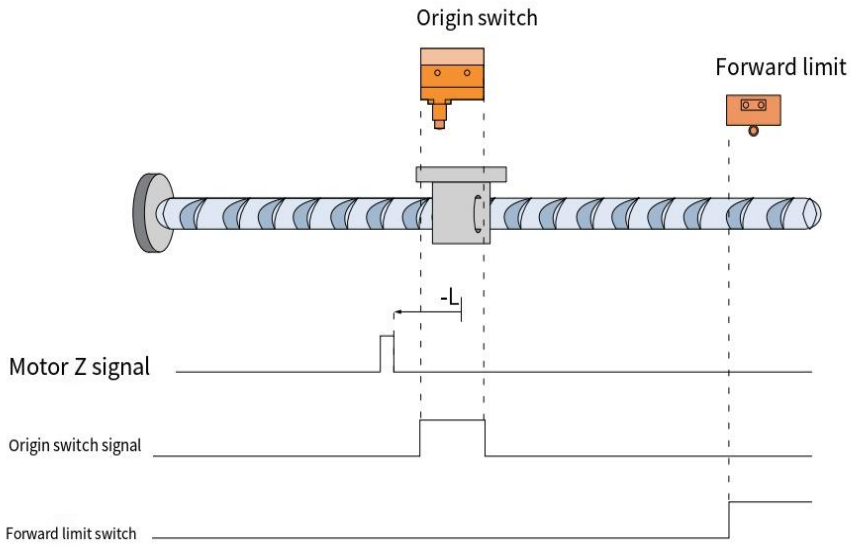
When HOME=OFF, POT=OFF, the return to zero begins at high forward speed. After encountering the rising edge of HOME, decelerate and reverse, reverse and run at low speed, stop when encountering the first Z signal on the falling edge of HOME.

- **When starting to return to zero, the origin switch signal is invalid when encountering the forward limit switch**



When HOME=OFF and POT=OFF, it starts to return to zero at high speed in the forward direction. After encountering the rising edge of POT, it automatically runs at high speed in the reverse direction. When encountering the rising edge of HOME, it runs at low speed in the reverse direction. When encountering the falling edge of HOME, it decelerates and runs in the reverse direction at low speed. When encountering the rising edge of HOME, it decelerates and runs in the reverse direction at low speed. The first Z signal after the HOME falling edge stops.

- **The origin switch signal is effective when starting back to zero**



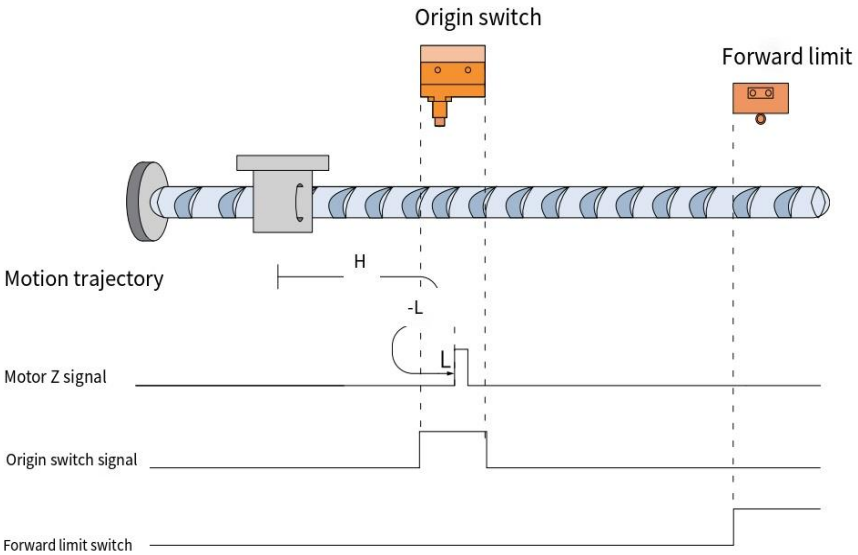
When HOME=ON, POT=OFF , the return to zero begins at reverse low speed and stops at the first Z signal after the HOME falling edge.

4.11.8 Method 8 (6098=8)

Origin: Z signal

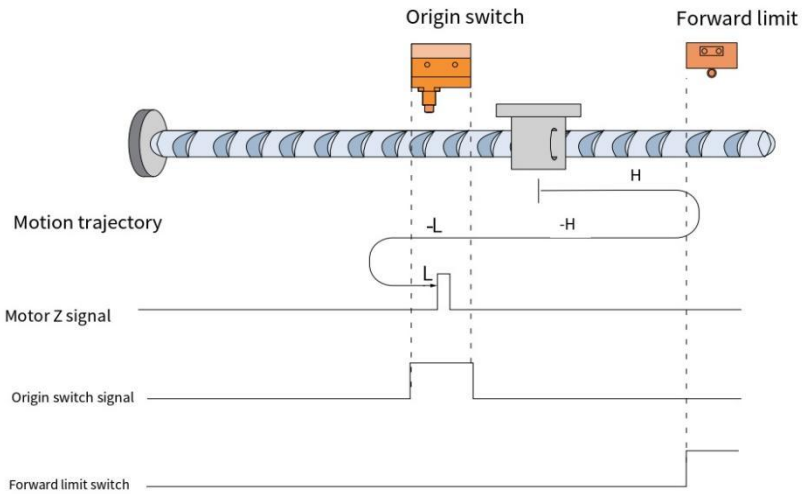
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the forward limit switch is not encountered**



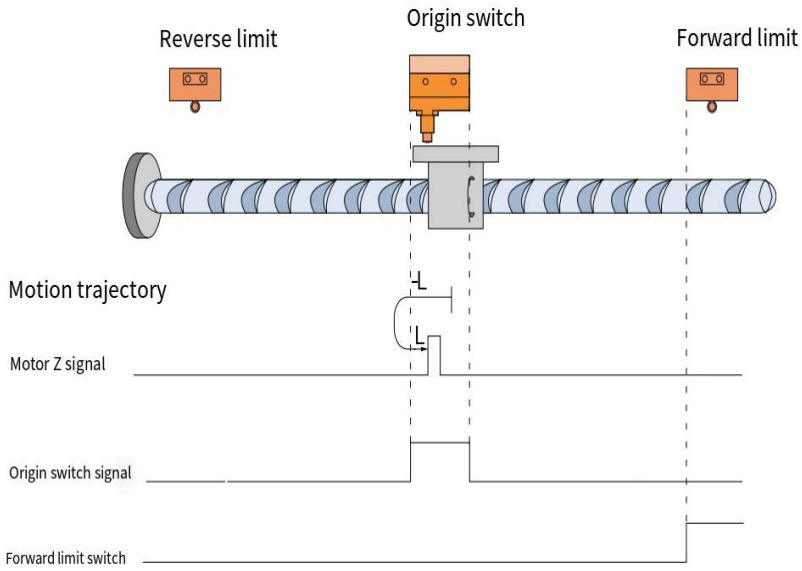
When HOME=OFF, POT=OFF, the return to zero begins at high forward speed. After encountering the rising edge of HOME, decelerate and reverse, reverse and run at low speed. After encountering the falling edge of HOME, decelerate and reverse, forward and run at low speed. Stop at the first Z signal after encountering the rising edge of HOME.

- **When starting back to zero, the origin switch signal is invalid and the forward limit switch is encountered**



When HOME=OFF, POT=OFF, it begins to return to zero. It starts to return to zero at high forward speed. After encountering the rising edge of POT, it automatically runs in reverse high speed. After encountering the rising edge of HOME, it runs in reverse low speed. After encountering the falling edge of HOME, it decelerates in reverse and runs in forward low speed. Stops at the first Z signal after encountering the rising edge of HOME.

- **The origin switch signal is effective when starting back to zero**



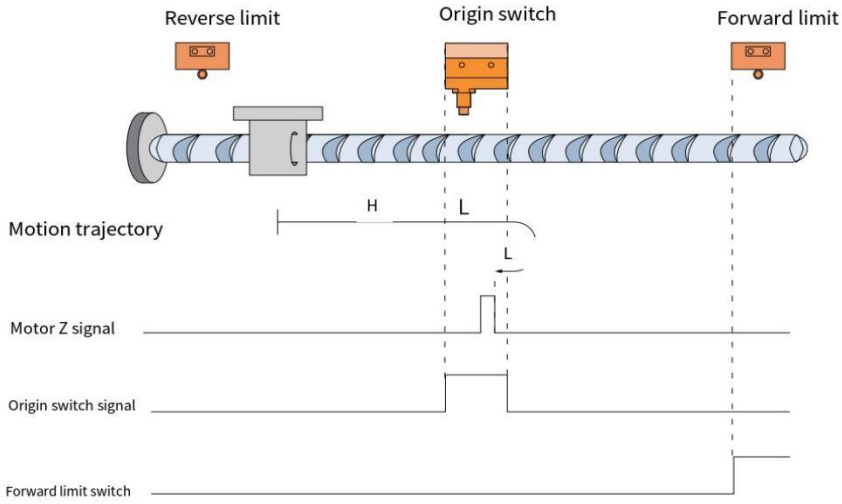
When HOME=ON, POT=OFF, start the return to zero, start the return to zero at reverse low speed, after encountering the HOME falling edge, decelerate and reverse, run forward low speed, stop at the first Z signal after encountering the HOME rising edge.

4.11.9 Method 9 (6098=9)

Origin: Z signal

Deceleration point: Origin signal (HOME)

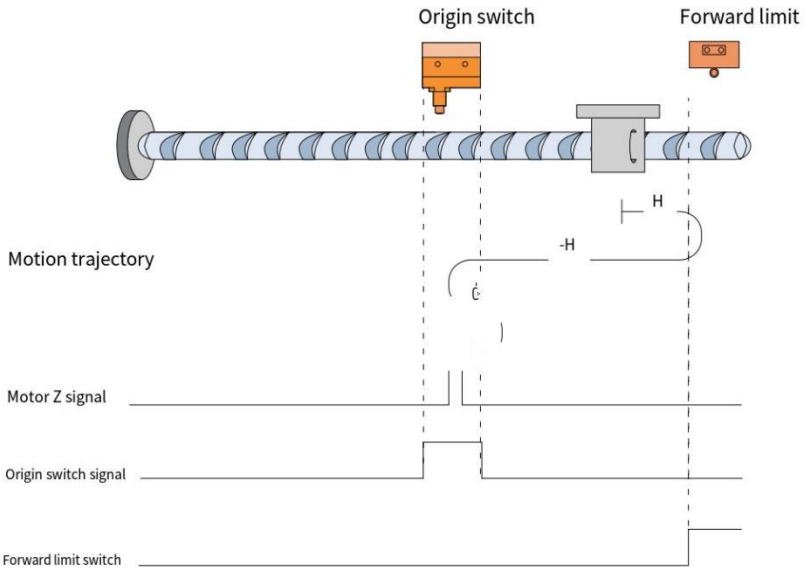
- **The origin switch signal is invalid when starting back to zero, and the forward limit switch is not encountered**



When HOME=OFF and POT=OFF, it starts to return to zero. It begins to return to zero at high speed in the forward direction. After encountering the rising edge of HOME, it runs at low

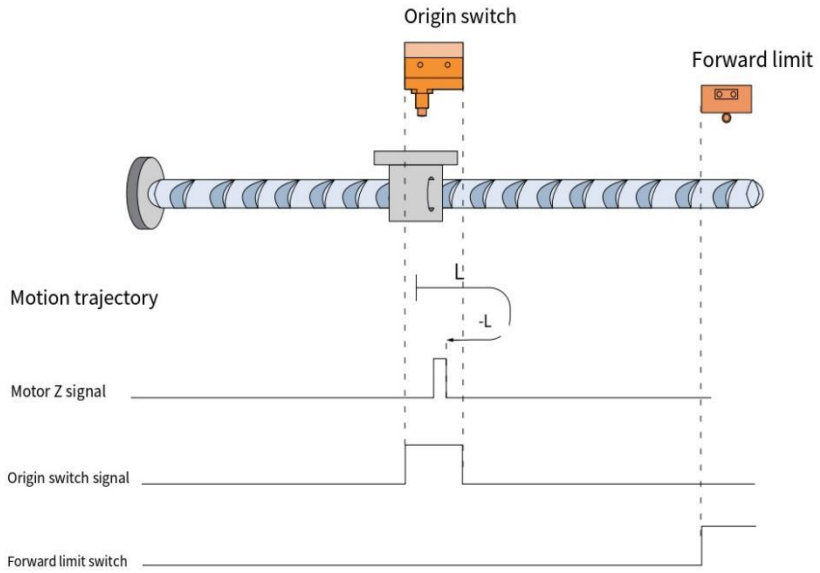
speed in the forward direction. After encountering the falling edge of HOME, it decelerates in the reverse direction and runs at low speed in the reverse direction. The machine stops at the first Z signal after encountering the rising edge of HOME.

- **When starting back to zero, the origin switch signal is invalid and the forward limit switch is encountered**



When HOME=OFF, POT=OFF, it begins to return to zero. It starts to return to zero at high forward speed. After encountering the rising edge of POT, it automatically runs at high reverse speed. After encountering the rising edge of HOME, it decelerates and reverses, runs at low forward speed. After encountering the falling edge of HOME, it decelerates and reverses, runs at low reverse speed. Stops at the first Z signal after encountering the rising edge of HOME.

- **The origin switch signal is effective when starting back to zero**



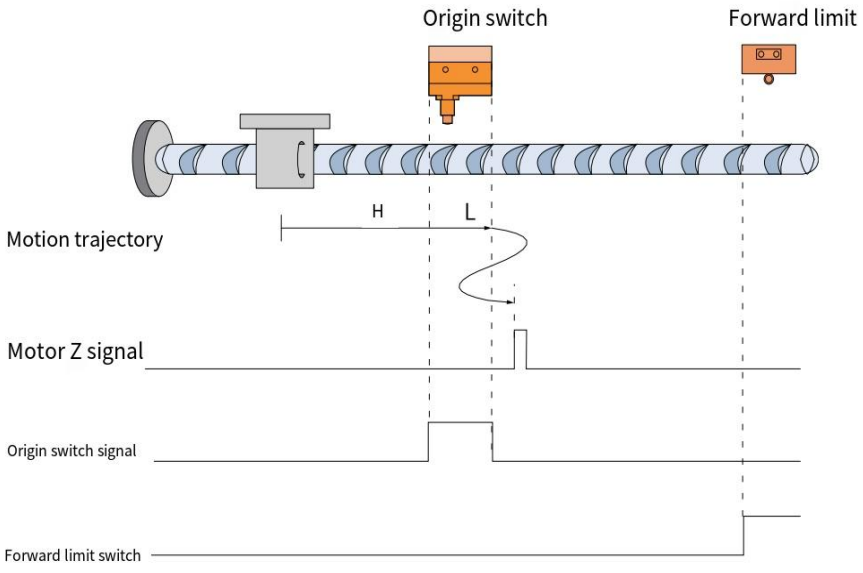
When HOME=ON, POT=OFF, start the return to zero, start the return to zero at the forward low speed, after encountering the HOME falling edge, decelerate and reverse, run the reverse low speed, stop at the first Z signal after encountering the HOME rising edge.

4.11.10 Method 10 (6098=10)

Origin: Z signal

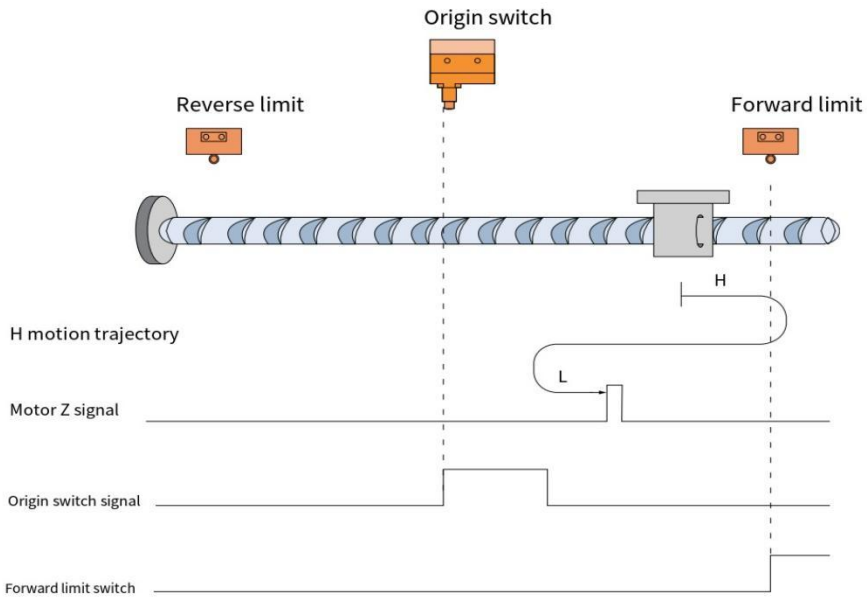
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the forward limit switch is not encountered**



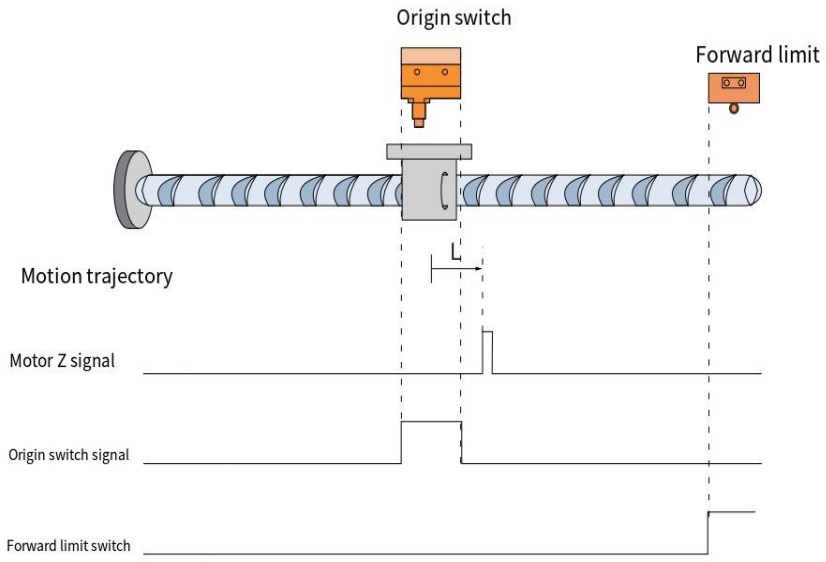
When HOME=OFF, POT=OFF, the return to zero begins at high forward speed. After encountering the rising edge of HOME, run forward at low speed. After encountering the falling edge of HOME, decelerate and reverse, run reverse at low speed. After encountering the rising edge of HOME, decelerate and reverse, run forward at low speed. Stop at the first Z signal after encountering the falling edge of HOME.

- **When starting back to zero, the origin switch signal is invalid and the forward limit switch is encountered**



When HOME=OFF, POT=OFF, it begins to return to zero. It starts to return to zero at high forward speed. After encountering the rising edge of POT, it automatically runs at high reverse speed. After encountering the rising edge of HOME, it decelerates in reverse and runs at low forward speed. It stops at the first Z signal after encountering the falling edge of HOME.

- **The origin switch signal is effective when starting back to zero**



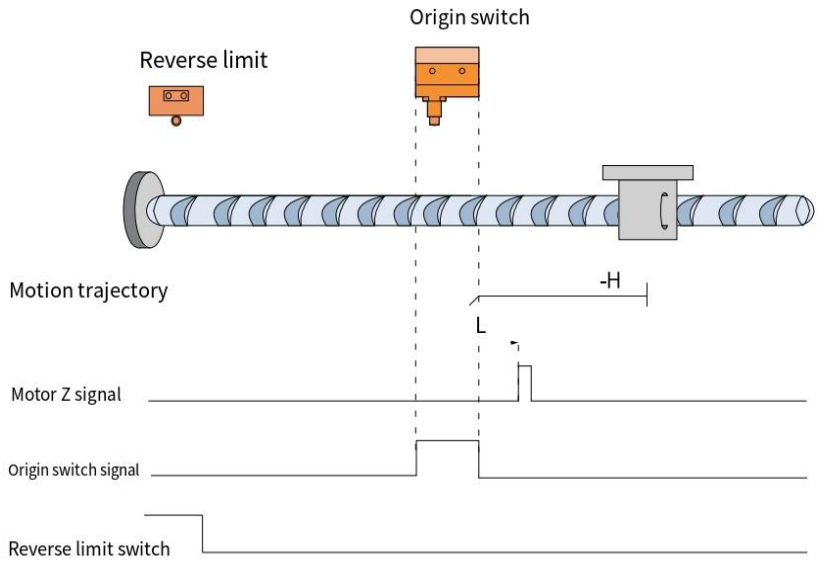
When HOME=ON, POT=OFF, it begins to return to zero. It starts to return to zero at a forward low speed and stops at the first Z signal after the HOME falling edge.

4.11.11 Method 11 (6098=11)

Origin: Z signal

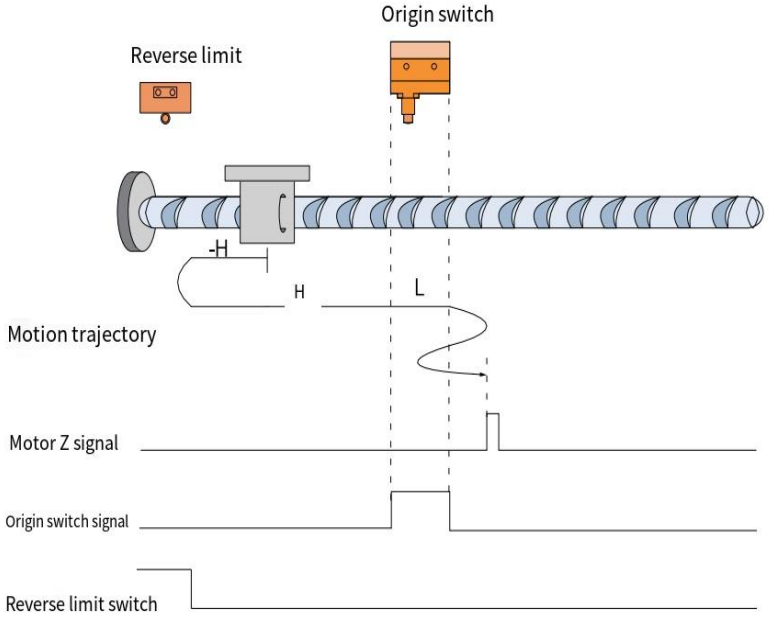
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered**



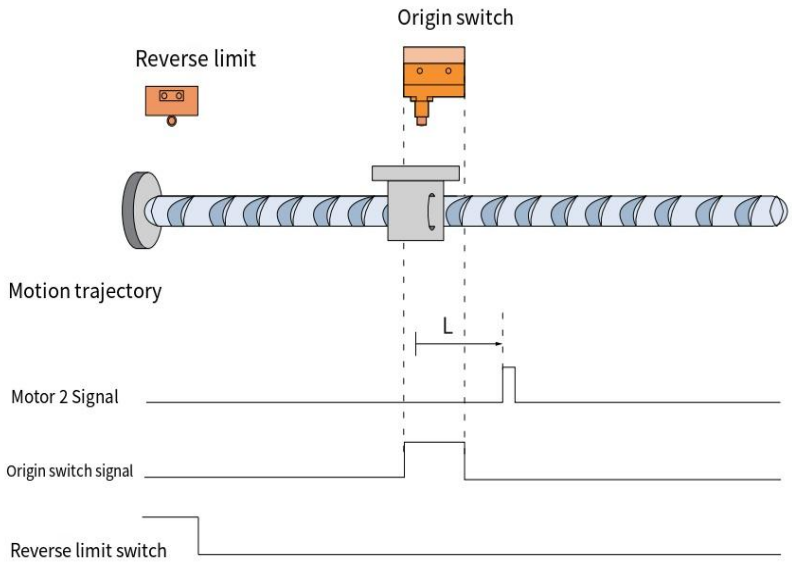
When HOME=OFF, NOT=OFF, start the return to zero, start the return to zero at reverse high speed, after encountering the rising edge of HOME, decelerate and reverse, run forward at low speed, stop when encountering the first Z signal of the falling edge of HOME.

- **When starting the return to zero, the origin switch signal is invalid and the reverse limit switch is encountered**



When HOME=OFF and NOT=OFF, start to return to zero with reverse high speed. After encountering the NOT rising edge, immediately run forward high speed. After encountering the HOME rising edge, run forward low speed. After encountering the HOME falling edge, decelerate and reverse, run reverse low speed. After encountering the HOME rising edge, decelerate and reverse, run forward low speed. The first Z signal after encountering the HOME falling edge stops.

- **The origin switch signal is effective when starting back to zero**



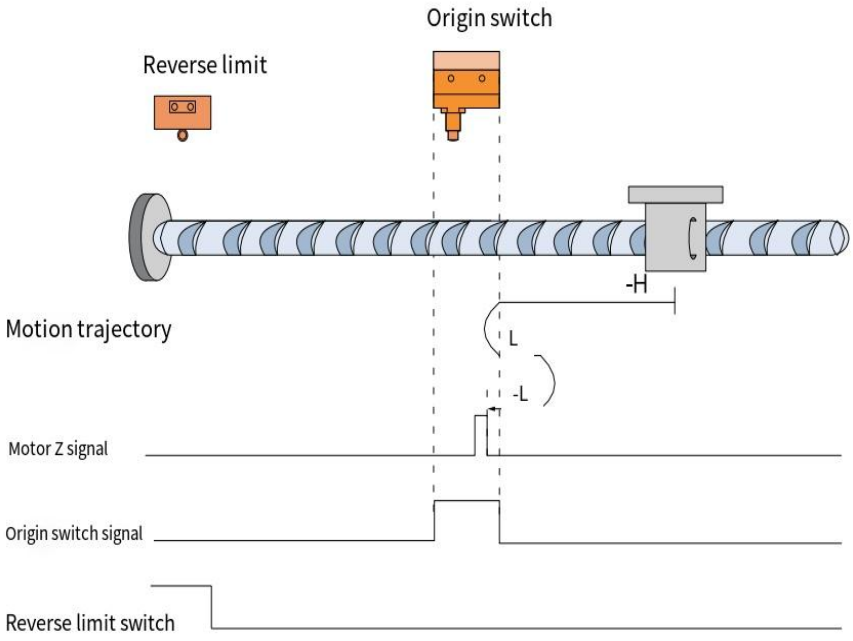
When HOME=ON, NOT=OFF, it begins to return to zero. It starts to return to zero at a forward low speed and stops at the first Z signal after the HOME falling edge.

4.11.12 Method 12 (6098=12)

Origin: Z signal

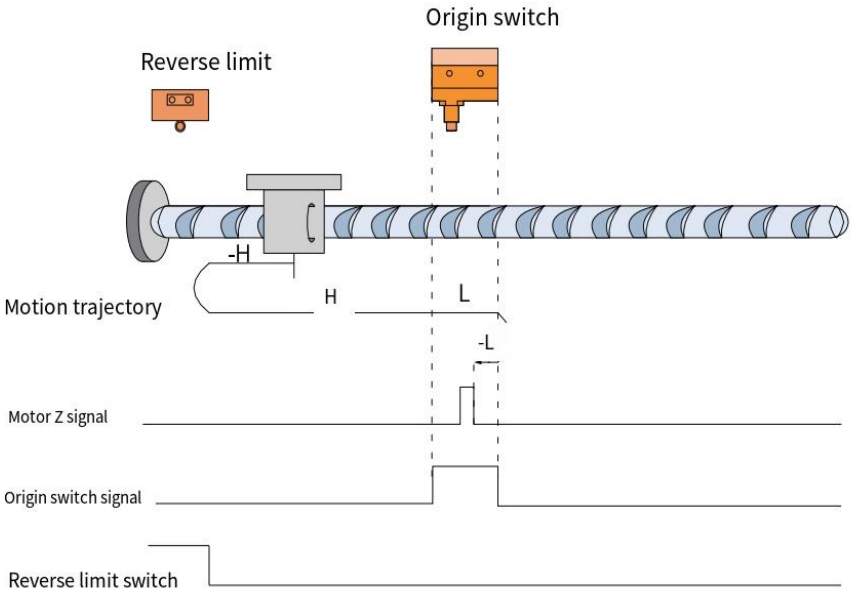
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered**



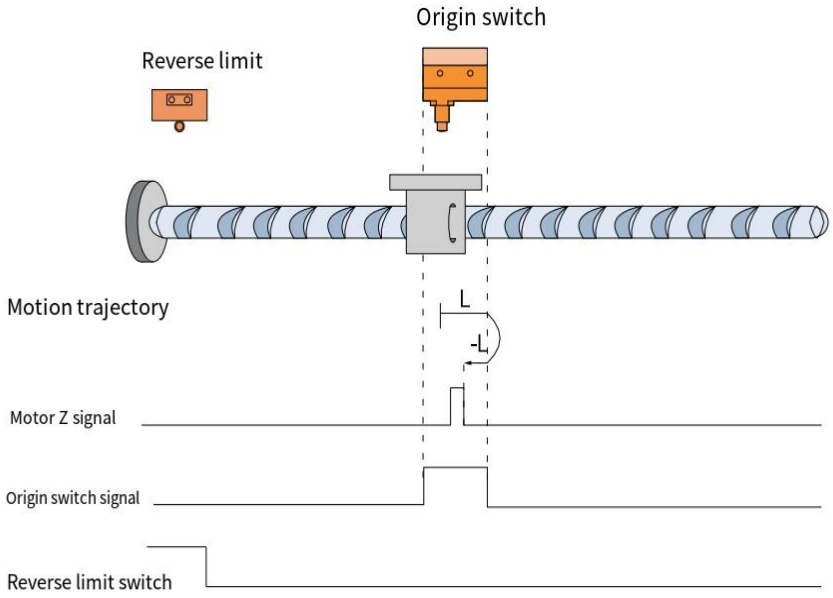
When HOME=OFF, NOT=OFF, start the return to zero at reverse high speed, decelerate and reverse after encountering the rising edge of HOME, run forward at low speed after encountering the falling edge of HOME, decelerate and reverse, run backward at low speed, stop at the first Z signal after encountering the rising edge of HOME.

- **When starting back to zero, the origin switch signal is invalid and the reverse limit switch is encountered**



When HOME=OFF and NOT=OFF, start to return to zero with reverse high speed. After encountering the NOT rising edge, immediately run forward high speed. After encountering the HOME rising edge, run forward low speed. After encountering the HOME falling edge, decelerate and reverse, run reverse low speed. Stop with the first Z signal after encountering the HOME rising edge.

- **The origin switch signal is effective when starting back to zero**



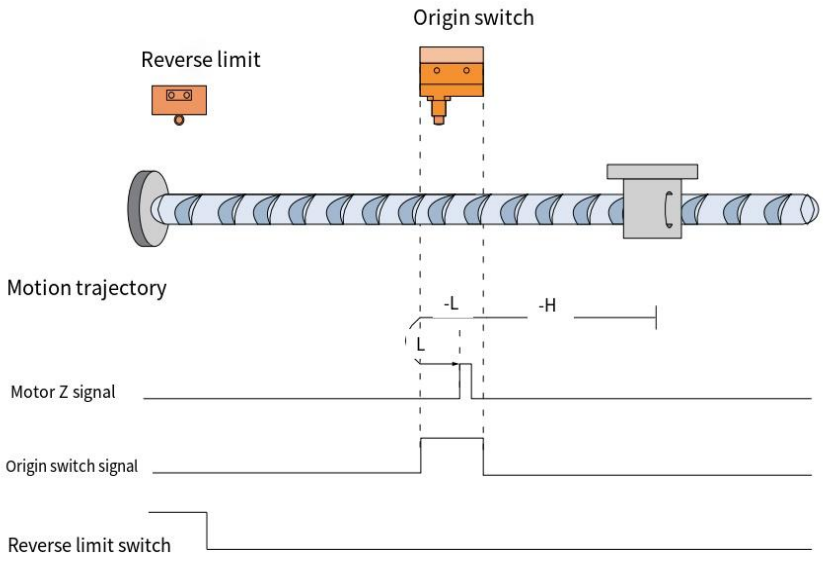
When HOME=ON and NOT=OFF, start the return to zero, start the return to zero at the forward low speed, after encountering the HOME falling edge, decelerate and reverse, run the reverse low speed, stop at the first Z signal after encountering the HOME rising edge.

4.11.13 Method 13 (6098=13)

Origin: Z signal

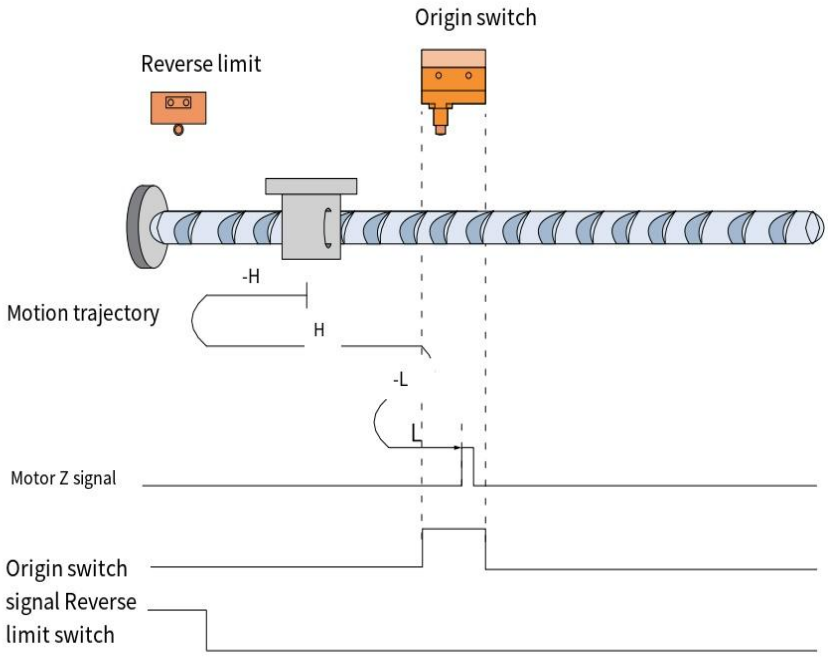
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered**



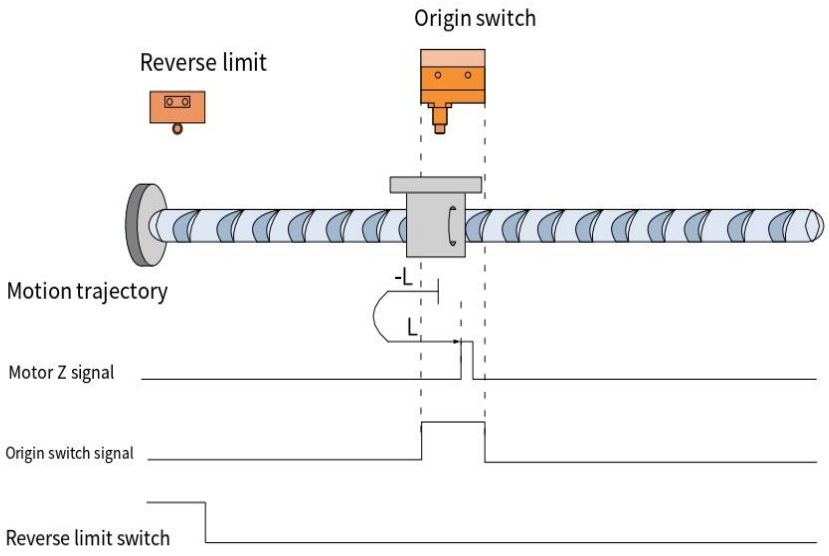
Return to zero when HOME=OFF, NOT=OFF, return to zero at reverse high speed, run at reverse low speed after encountering the HOME rising edge, decelerate reverse when encountering the HOME falling edge, run at forward low speed, stop at the first Z signal after encountering the HOME rising edge.

- **When starting the return to zero, the origin switch signal is invalid and the reverse limit switch is encountered**



When HOME=OFF and NOT=OFF, it starts to return to zero and begins to return to zero at reverse high speed. After encountering the NOT rising edge, it immediately runs forward at high speed. When encountering the HOME rising edge, it decelerates and reverses, and runs backward at low speed. When encountering the HOME falling edge, it decelerates and reverses, and runs forward at low speed. The first Z signal after encountering the HOME rising edge stops the machine.

- **The origin switch signal is effective when starting back to zero**



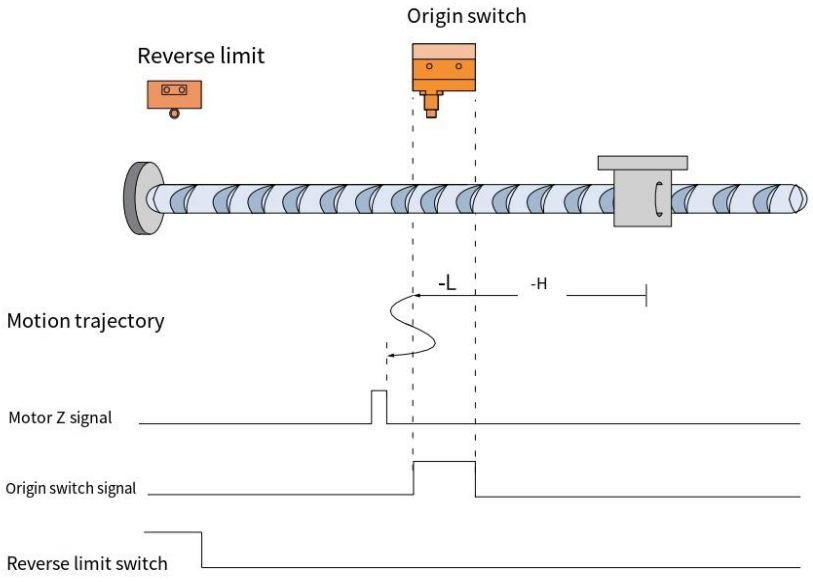
When HOME=ON, NOT=OFF, start to return to zero, start to return to zero at reverse low speed, after encountering the falling edge of HOME, decelerate and reverse, run forward low speed, stop at the first Z signal after encountering the rising edge of HOME.

4.11.14 Method 14 (6098=14)

Origin: Z signal

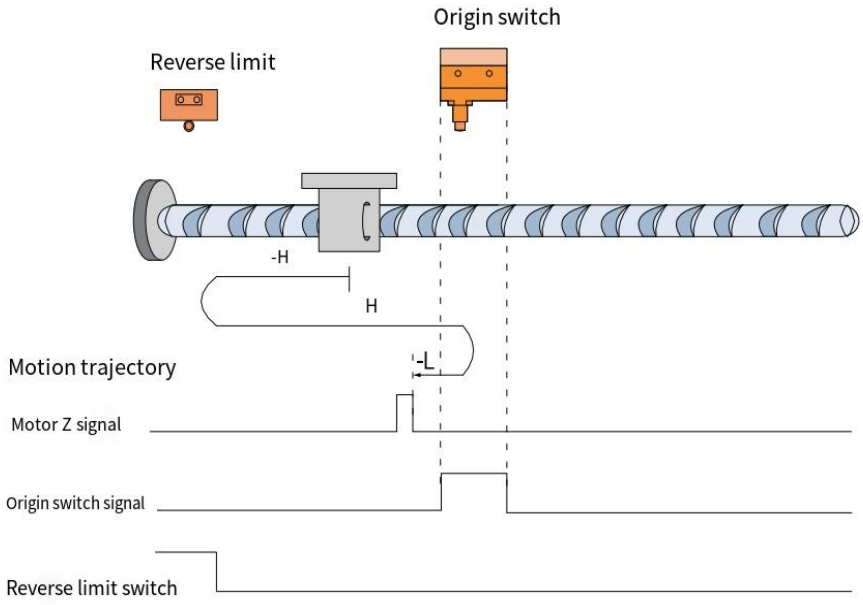
Deceleration point: Origin signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered**



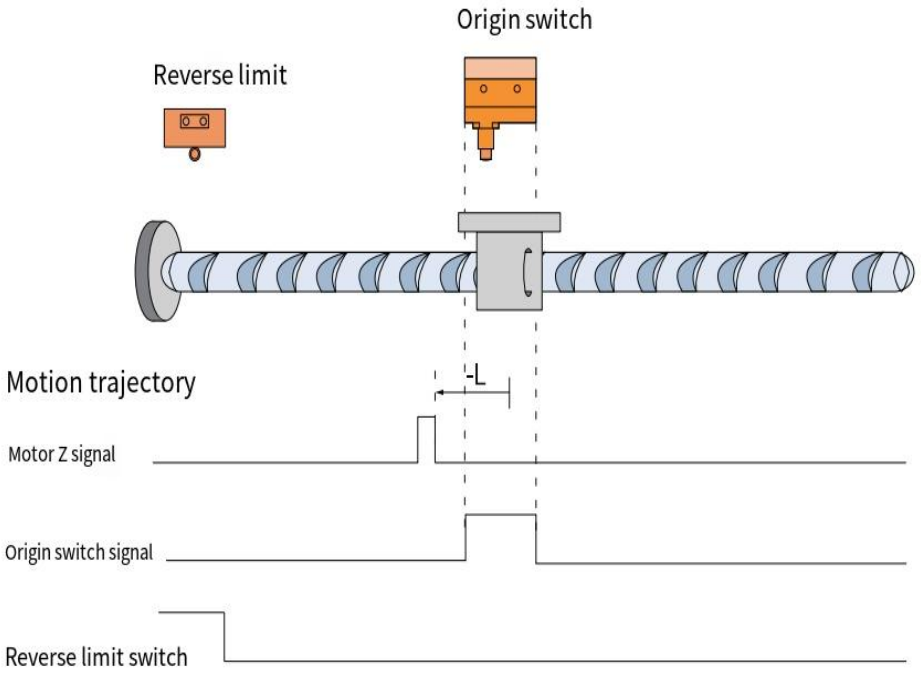
Return to zero when HOME=OFF, NOT=OFF, start to return to zero at reverse high speed after encountering the HOME rising edge, reverse low speed after encountering the HOME falling edge, decelerate reverse, forward low speed after encountering the HOME rising edge, decelerate reverse, reverse low speed after encountering the HOME falling edge, stop at the first Z signal after encountering the home falling edge

- **The origin switch signal is invalid when starting back to zero and encountering the reverse limit switch**



When HOME=OFF, NOT=OFF, start the return to zero, start the return to zero at reverse high speed, after encountering the NOT rising edge, immediately run forward high speed, after encountering the HOME rising edge, decelerate and reverse, run reverse low speed, stop at the first Z signal after encountering the HOME falling edge.

- **The origin switch signal is effective when starting back to zero**



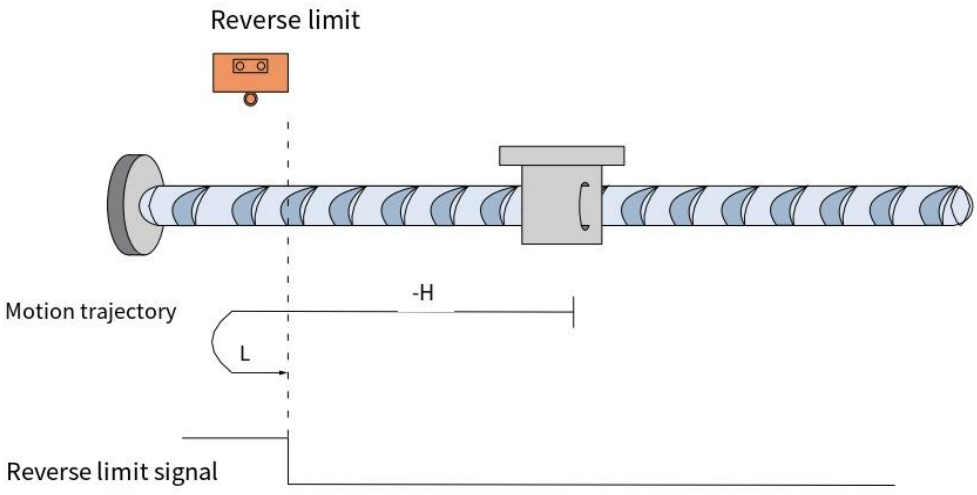
Start the return to zero when HOME=ON, NOT=OFF, start the return to zero at reverse low speed, and stop at the first Z signal after the HOME falling edge.

4.11.15 Method 17 (6098=17)

Origin: Reverse limit Signal (NOT)

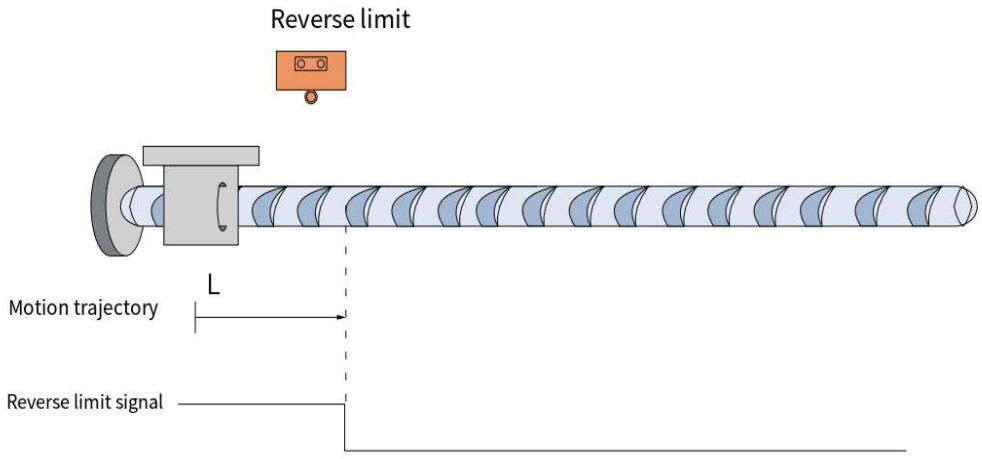
Deceleration point: Reverse limit signal (NOT)

- **The reverse limit signal is invalid when starting back to zero**



When NOT=OFF, it starts to return to zero, then returns to zero at high speed in the reverse direction. After encountering the rising edge of NOT, it decelerates in the reverse direction and runs at a low speed in the forward direction. It stops when encountering the falling edge of NOT.

- **The reverse limit signal is effective when starting to return to zero**



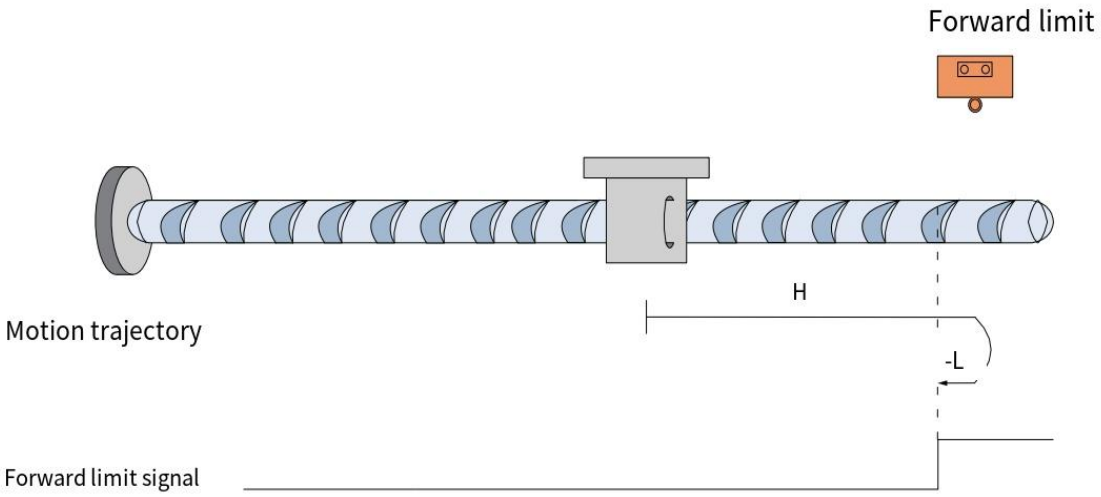
Start the return to zero when NOT=ON, start the return to zero at a forward low speed, and stop when the NOT falling edge is encountered.

4.11.16 Method 18 (6098=18)

Origin: Forward Limit Signal (POT)

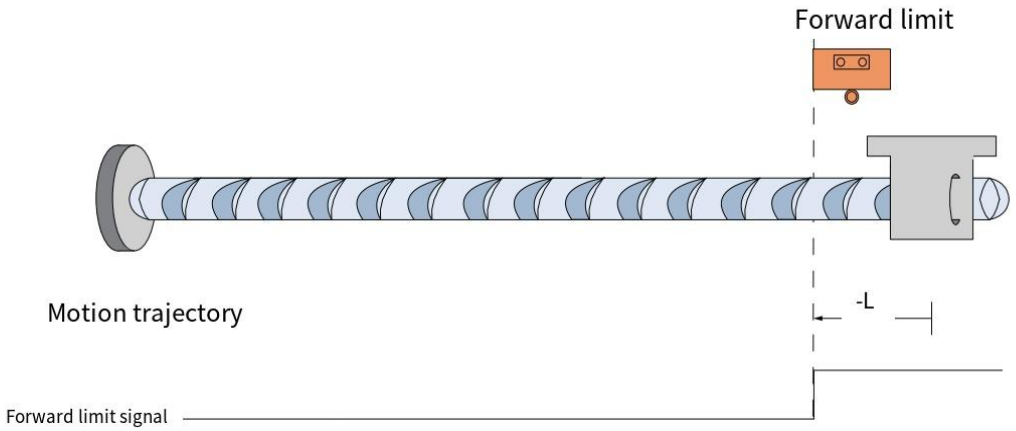
Deceleration point: Forward limit signal (POT)

- **The forward limit signal is invalid when starting back to zero**



Start the return to zero when POT=OFF, start the return to zero at high forward speed, decelerate and reverse after encountering the rising edge of POT, run the reverse at low speed, stop after encountering the falling edge of POT.

- **The forward limit signal is effective when starting to return to zero**



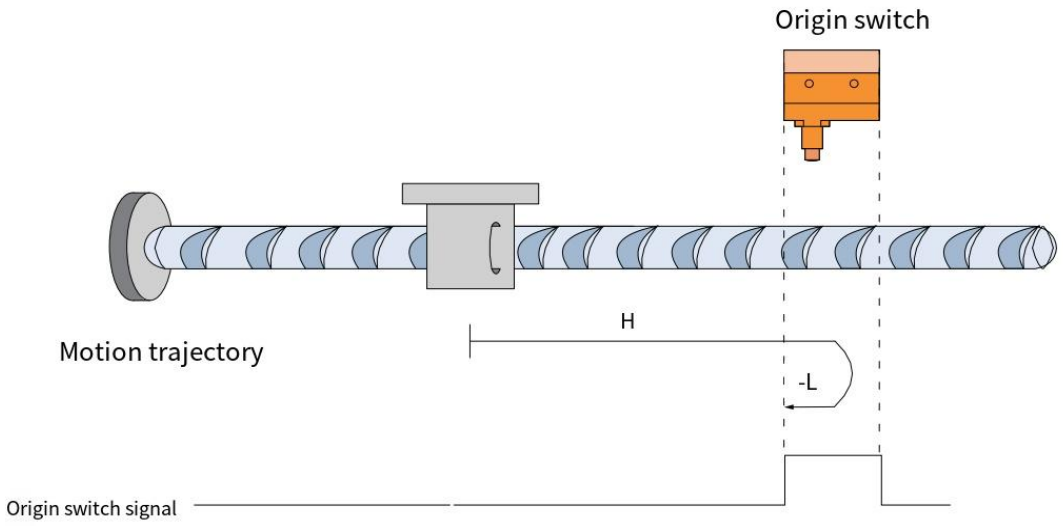
It begins to return to zero when POT=ON, starts to return to zero at reverse low speed, and stops when it encounters the POT falling edge.

4.11.17 Method 19 (6098=19)

Origin: Origin Switch Signal (HOME)

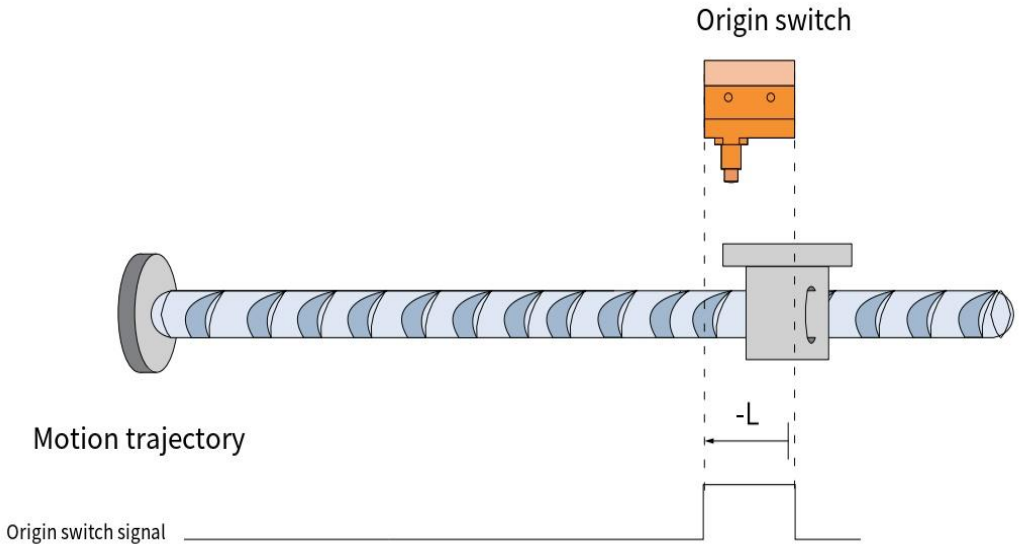
Deceleration point: Origin switch signal (HOME)

- **The origin switch signal is invalid when starting back to zero**



Start the return to zero when HOME=OFF, start the return to zero at high forward speed, decelerate and reverse after encountering the rising edge of HOME, run the reverse low speed, stop after encountering the falling edge of HOME.

- **The origin switch signal is valid when return-to-zero starts**



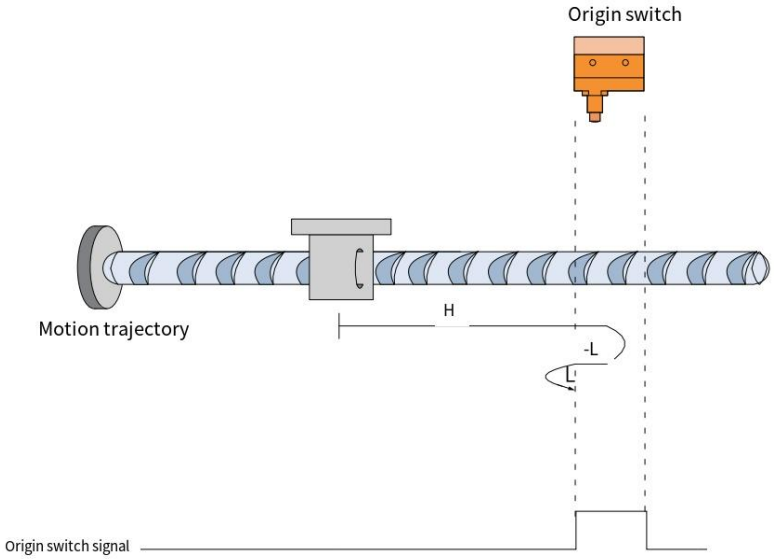
When HOME=ON, it starts to return to zero. It begins to return to zero at a reverse low speed and stops when it encounters the falling edge of HOME.

4.11.18 Method 20 (6098=20)

Origin: Origin Switch Signal (HOME)

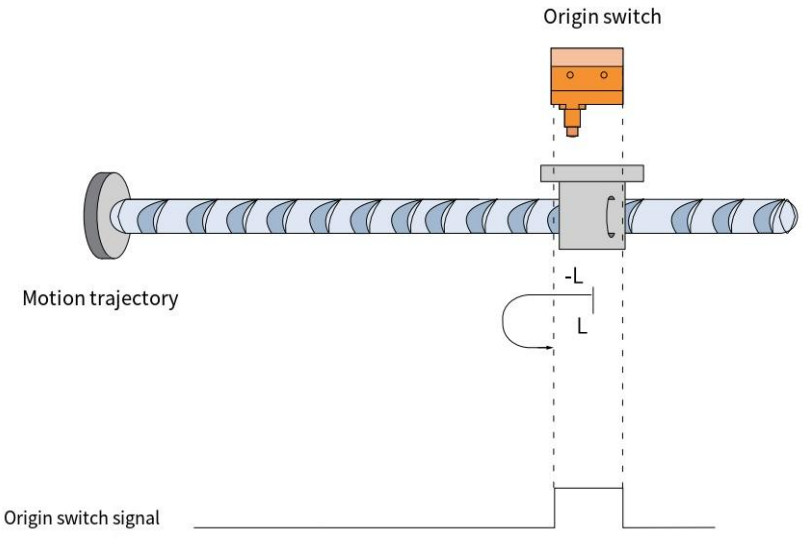
Deceleration point: Origin switch signal (HOME)

- **The origin signal switch is invalid when starting back to zero**



Start the return to zero when HOME=OFF, start the return to zero at high forward speed, after encountering the rising edge of HOME, decelerate and reverse, run at low reverse speed, after encountering the falling edge of HOME, decelerate and reverse, run at low forward speed, stop when encountering the rising edge of HOME again.

- **The origin signal switch is effective when return-to-zero starts**



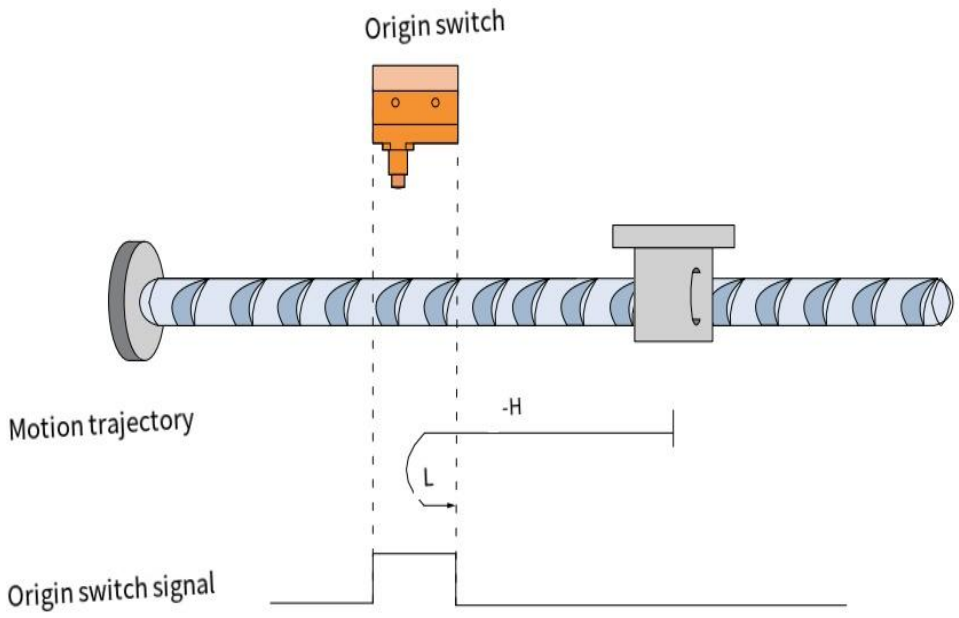
Start the return to zero when HOME=ON, start the return to zero at reverse low speed, decelerate and reverse when encountering the HOME falling edge, run forward at low speed, stop when encountering the HOME rising edge.

4.11.19 Method 21 (6098=21)

Origin: Origin Switch Signal (HOME)

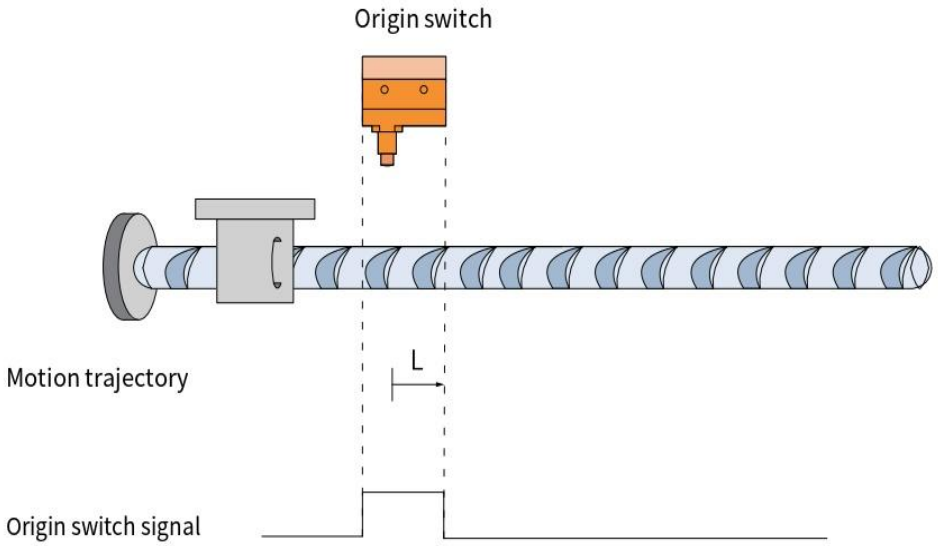
Deceleration point: Origin switch signal (HOME)

- **The origin signal switch is invalid when starting back to zero**



Start the return to zero when HOME=OFF, start the return to zero at high speed in the reverse direction, decelerate in the reverse direction after encountering the rising edge of HOME, run forward at low speed, stop when encountering the falling edge of HOME.

- **The origin switch signal is effective when return-to-zero starts**



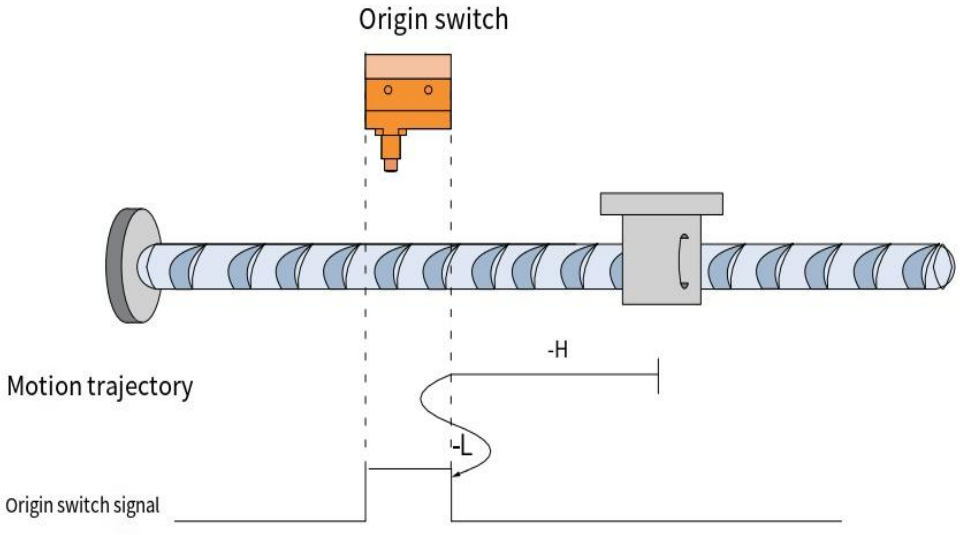
It begins to return to zero when HOME=ON, starts to return to zero at a forward low speed, and stops when it encounters the falling edge of HOME.

4.11.20 Method 22 (6098=22)

Origin: Origin switch signal (HOME)

Deceleration point: Origin switch signal (HOME)

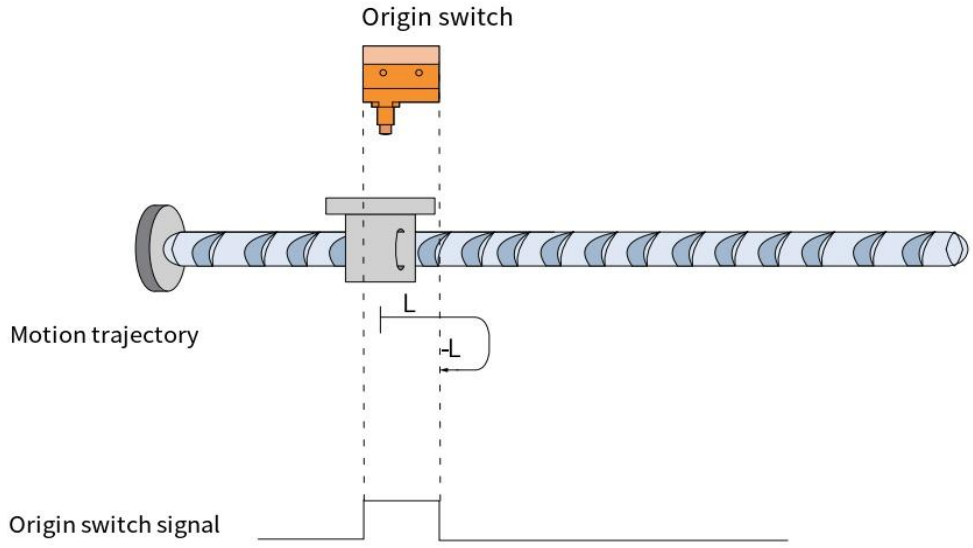
- **The origin switch signal is invalid when starting back to zero**



Start the return to zero when HOME=OFF, start the return to zero at reverse high speed, after encountering the rising edge of HOME, decelerate and reverse, run forward at low speed,

after encountering the falling edge of HOME, decelerate and reverse, run backward at low speed, stop when encountering the rising edge of HOME again.

- **The origin switch signal is valid when starting to return to zero**



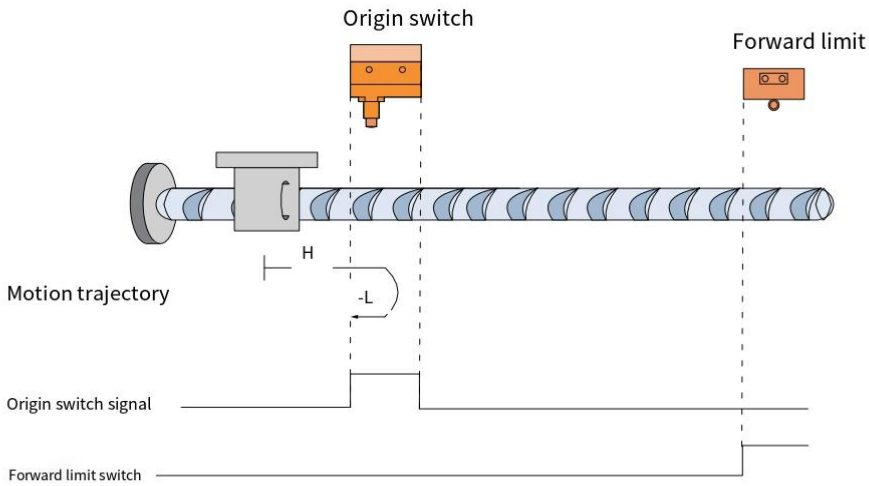
When HOME=ON, it begins to return to zero. It starts to return to zero at a forward low speed. After encountering the HOME falling edge, it decelerates and reverses. It runs in the reverse low speed and stops when encountering the HOME rising edge.

4.11.21 Method 23 (6098=23)

Origin: Origin Switch Signal (HOME)

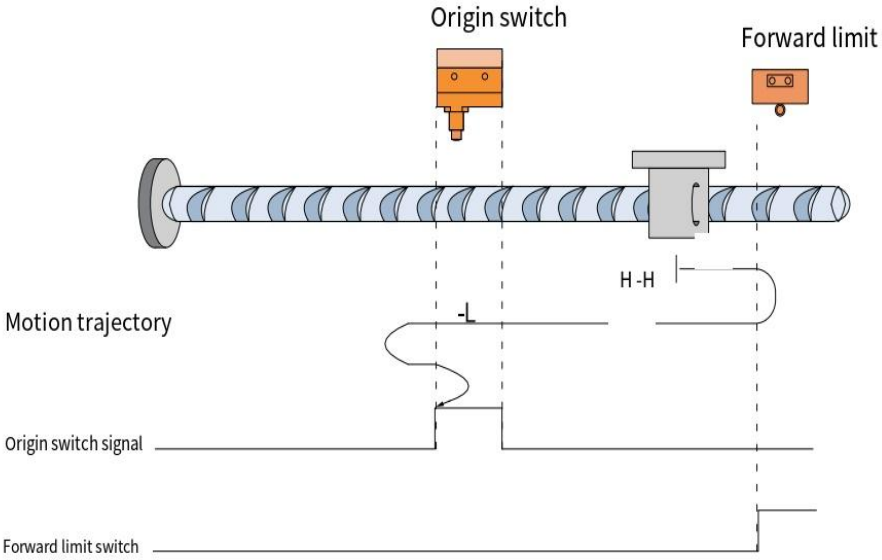
Deceleration point: Origin switch signal (HOME)

- **When starting back to zero, the origin switch signal is invalid and the forward limit switch is not encountered.**



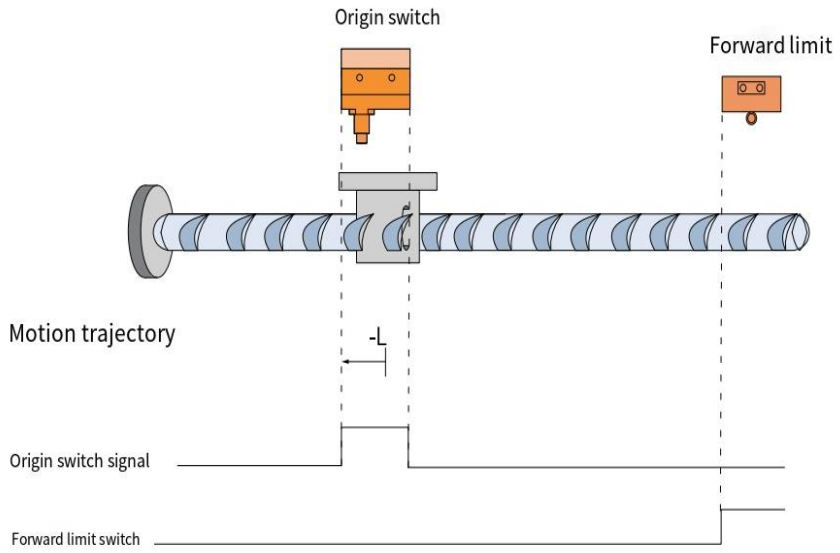
When HOME=OFF, POT=OFF, start the return to zero, start the return to zero at high forward speed, after encountering the rising edge of HOME, decelerate and reverse, reverse and run at low speed, stop when encountering the falling edge of HOME.

- **When starting to return to zero, the origin switch signal is invalid when encountering the forward limit switch.**



When HOME=OFF, POT=OFF, start to return to zero, start to return to zero at high forward speed, after encountering the rising edge of POT, immediately reverse high speed, after encountering the rising edge of HOME, reverse low speed, after encountering the falling edge of HOME, decelerate reverse, forward low speed, after encountering the rising edge of HOME, decelerate reverse, reverse low speed, Stop when you encounter the HOME falling edge again.

- **The origin switch signal is effective when starting back to zero.**



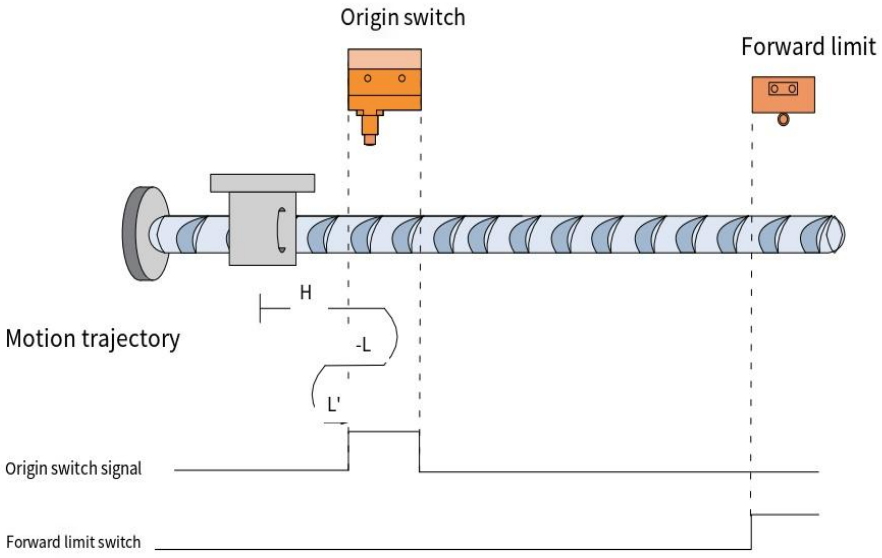
It begins to return to zero when HOME=ON, POT=OFF, starts to return to zero at reverse low speed, and stops when it encounters the falling edge of HOME.

4.11.22 Method 24 (6098=24)

Origin: Origin switch signal (HOME)

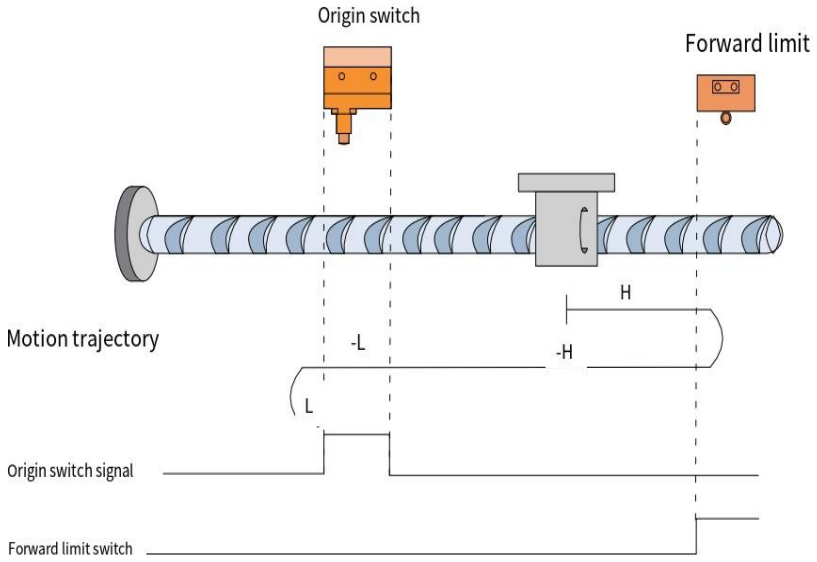
Deceleration point: Origin switch signal (HOME)

- **When starting back to zero, the origin switch signal is invalid and the forward limit switch is not encountered.**



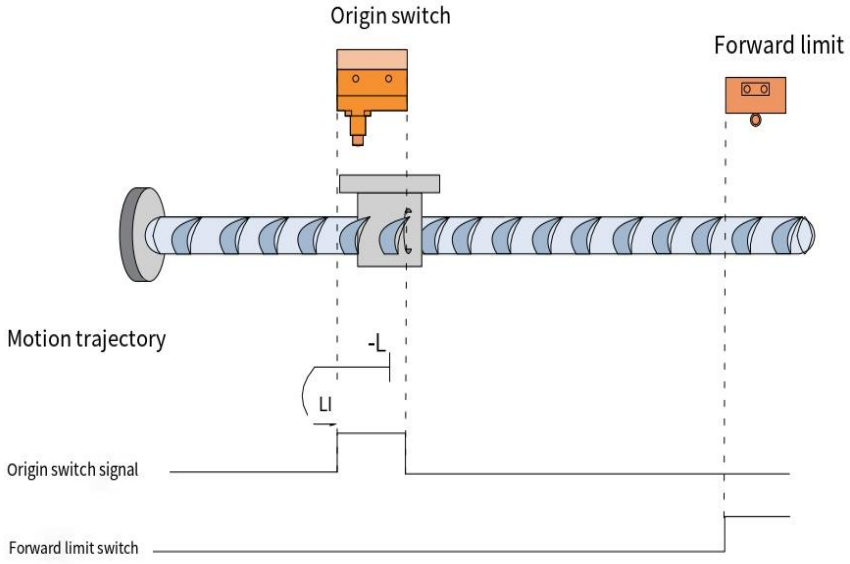
When HOME=OFF, POT=OFF, start the return to zero, start the return to zero at high forward speed, after encountering the rising edge of HOME, decelerate and reverse, run at low reverse speed, after encountering the falling edge of HOME, decelerate and reverse, run at low forward speed, stop after encountering the rising edge of HOME again.

- **When starting the return to zero, the origin switch signal is invalid and the forward limit switch is encountered.**



When HOME=OFF, POT=OFF, start to return to zero, start to return to zero at high forward speed, after encountering the rising edge of POT, automatically reverse high speed, after encountering the rising edge of HOME, reverse low speed, after encountering the falling edge of HOME, decelerate and reverse, forward low speed, stop when encountering the rising edge of HOME.

- **The origin switch signal is valid when starting to return to zero.**



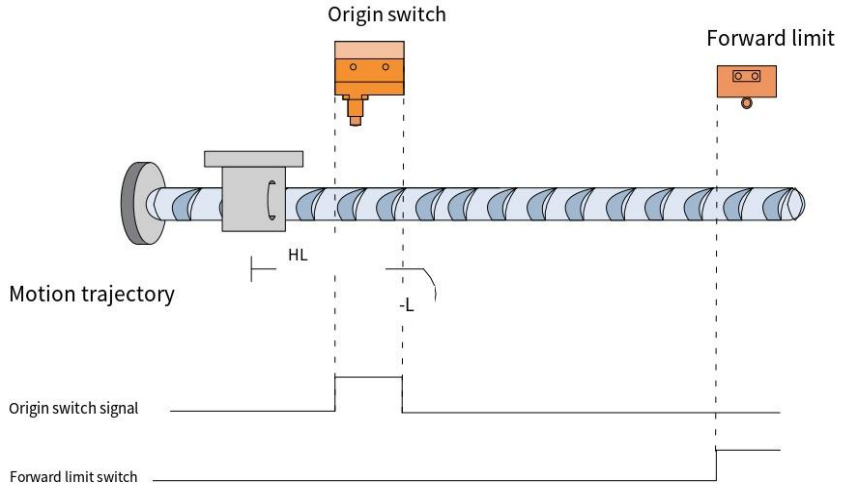
When HOME=ON, POT=OFF, start the return to zero, start the return to zero at reverse low speed, after encountering the HOME falling edge, decelerate and reverse, run forward low speed, stop when encountering the HOME rising edge.

4.11.23 Method 25 (6098=25)

Origin: Origin Switch Signal (HOME)

Deceleration point: Origin switch signal (HOME)

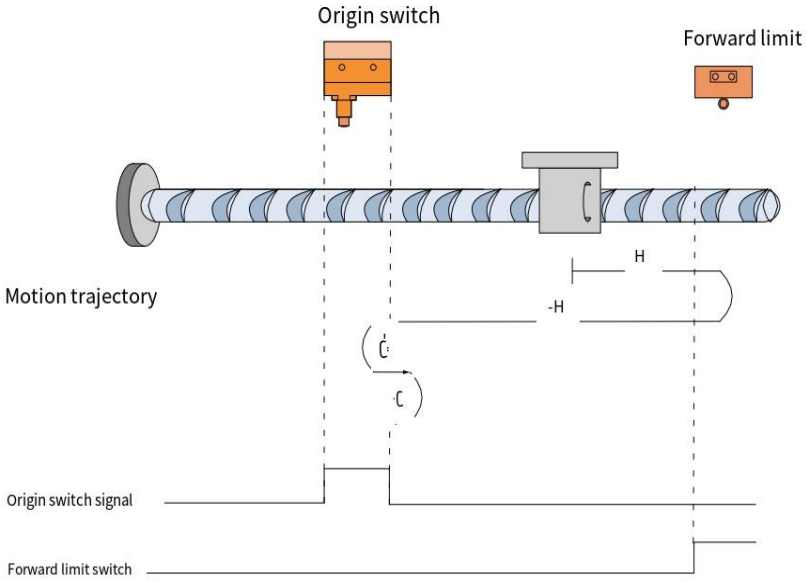
- **When starting back to zero, the origin switch signal is invalid and the forward limit switch is not encountered.**



When HOME=OFF, POT=OFF, the return to zero begins at high forward speed, when encountering the rising edge of HOME, the forward low speed runs, when encountering the

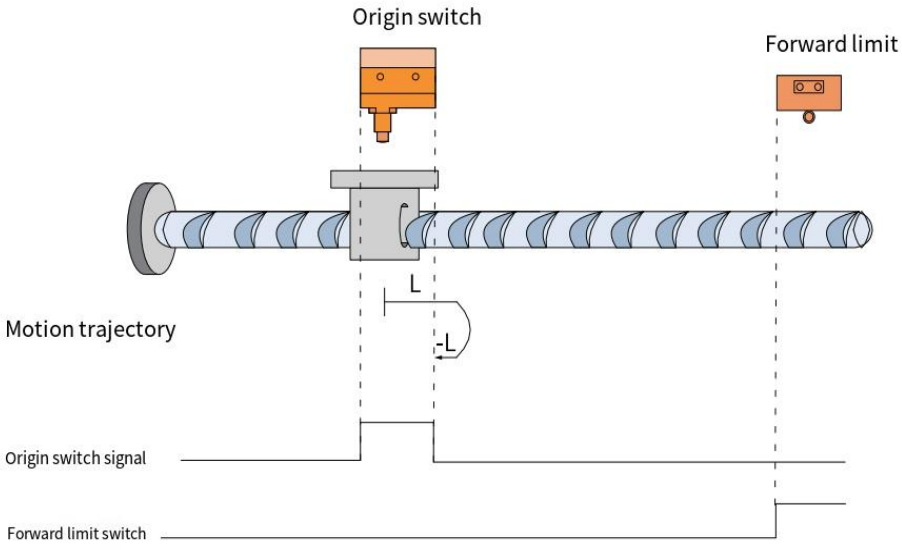
falling edge of HOME, the deceleration reverses, the reverse low speed runs, when encountering the rising edge of HOME stops.

- **When starting to return to zero, the origin switch signal is invalid and the forward limit switch is encountered.**



When HOME=OFF, POT=OFF, start to return to zero, start to return to zero at high forward speed, when encountering the rising edge of POT, automatically reverse high speed, when encountering the rising edge of HOME, decelerate and reverse, forward low speed, when encountering the falling edge of HOME, decelerate and reverse, reverse low speed, stop when encountering the rising edge of HOME again.

- **The origin switch signal is valid at the start of the zero return.**



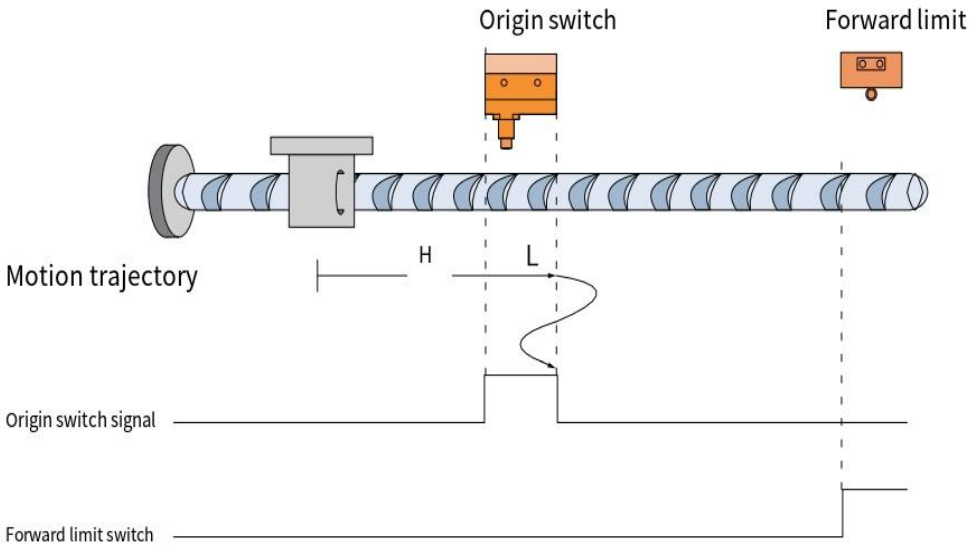
When HOME=ON and POT=OFF, it starts to return to zero. It begins to return to zero at a forward low speed. After encountering the falling edge of HOME, it decelerates and reverses. It runs at a reverse low speed and stops when it encounters the rising edge of HOME.

4.11.24 Method 26 (6098=26)

Origin: Origin Switch Signal (HOME)

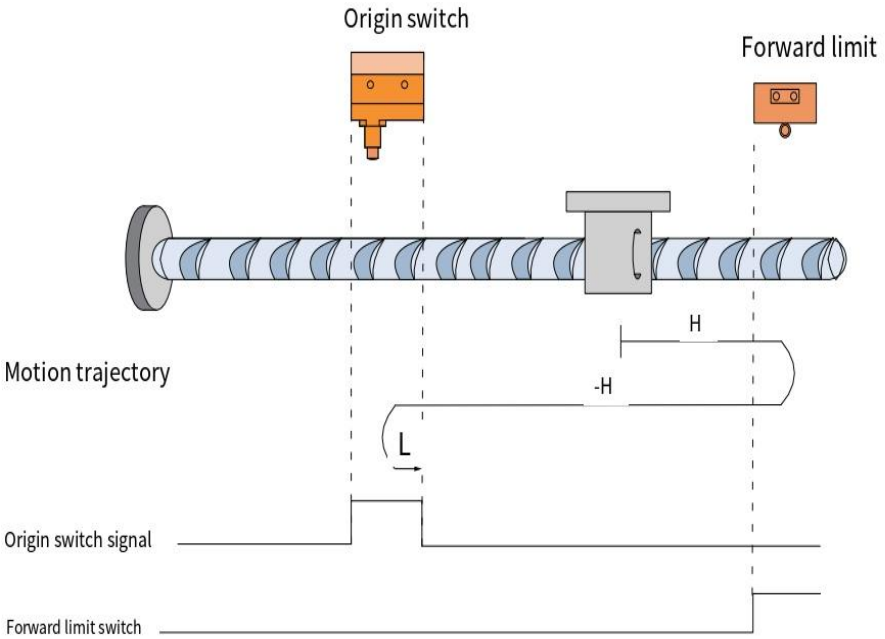
Deceleration point: Origin switch signal (HOME)

- **When starting back to zero, the origin switch signal is invalid and the forward limit switch is not encountered.**



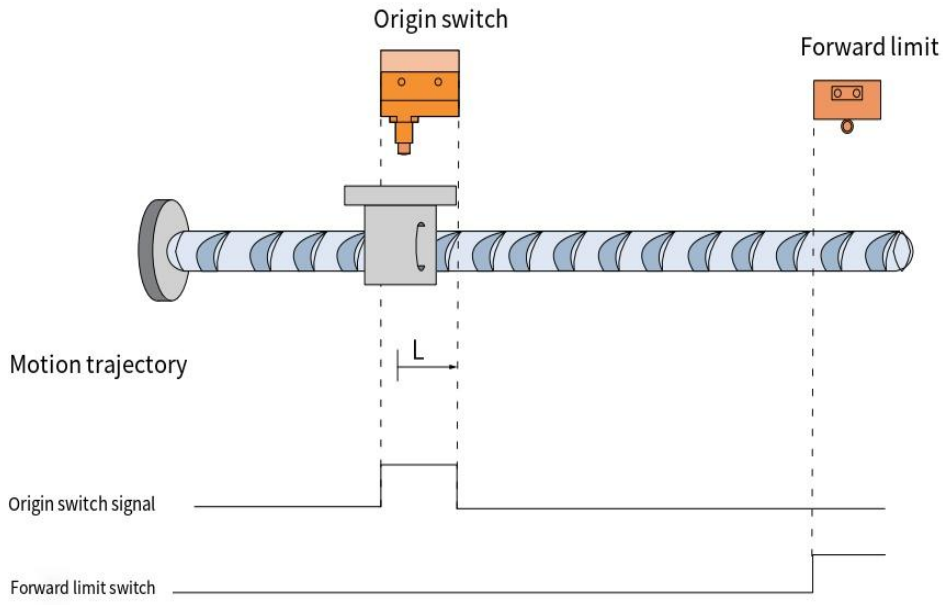
When HOME=OFF, POT=OFF, start the return to zero, start the return to zero at high forward speed, after encountering the rising edge of HOME, run forward at low speed, after encountering the falling edge of HOME, decelerate and reverse, run reverse at low speed, after encountering the rising edge of HOME, decelerate and reverse, run forward at low speed again, stop after encountering the falling edge of HOME.

- **The origin switch signal is invalid when starting the return to zero, and it encounters the forward limit switch.**



When HOME=OFF, POT=OFF, it begins to return to zero. It starts to return to zero at high forward speed. After encountering the rising edge of POT, it automatically runs at high reverse speed. After encountering the rising edge of HOME, it decelerates in reverse and runs at low forward speed. When encountering the falling edge of HOME, it stops.

- **The origin switch signal is valid when return-to-zero starts.**



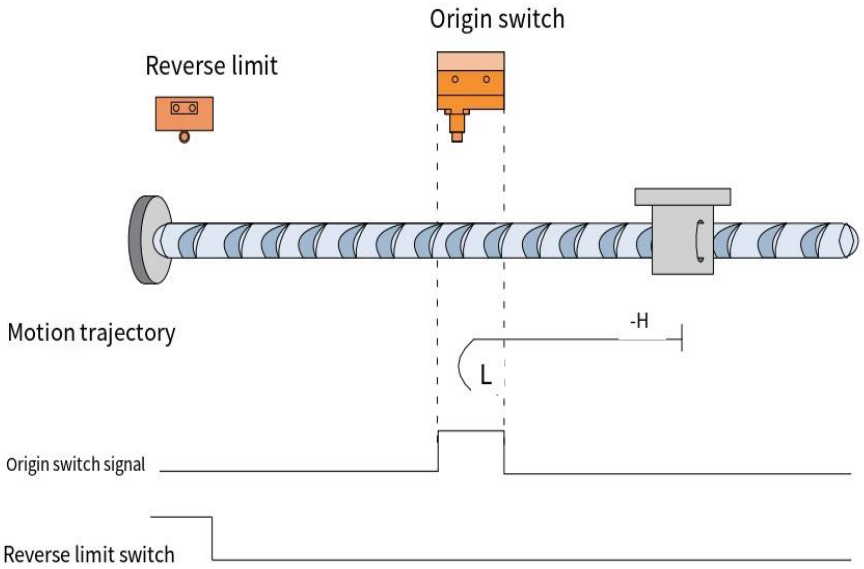
When HOME=ON, POT=OFF, it begins to return to zero. It starts to return to zero at a forward low speed and stops when it encounters the HOME falling edge.

4.11.25 Method 27 (6098=27)

Origin: Origin Switch Signal (HOME)

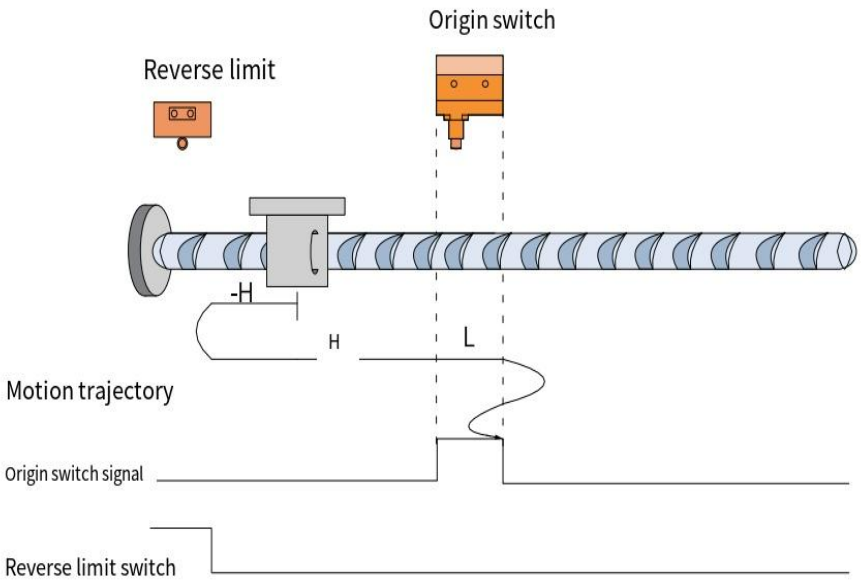
Deceleration point: Origin switch signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered.**



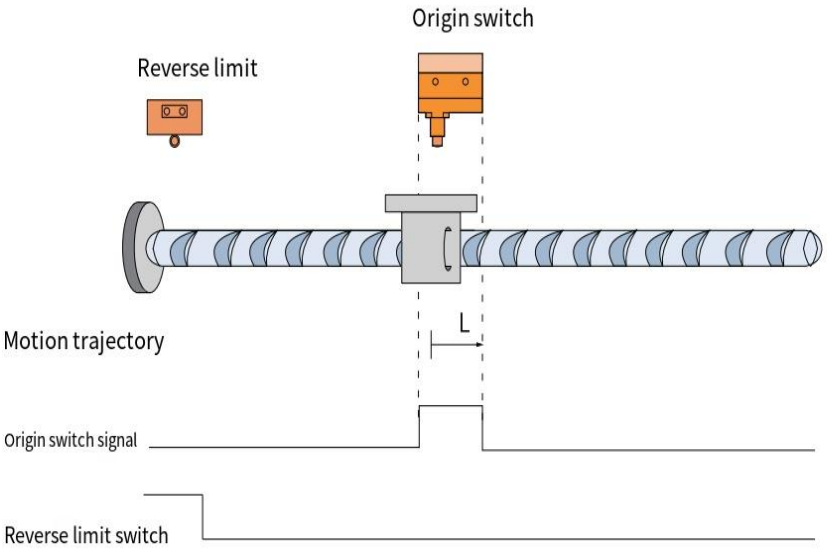
Return to zero when HOME=OFF, NOT=OFF, start to return to zero at reverse high speed, decelerate and reverse when encountering the rising edge of HOME, run forward at low speed, stop when encountering the falling edge of HOME.

- **When starting the return to zero, the origin switch signal is invalid and the reverse limit switch is encountered.**



When HOME=OFF and NOT=OFF, it starts to return to zero and begins to return to zero at high speed in the reverse direction. After encountering the NOT rising edge, it automatically runs at high speed in the forward direction. When encountering the HOME rising edge, it runs at low speed in the forward direction. When encountering the HOME falling edge, it decelerates and runs in the reverse direction at low speed. When encountering the HOME rising edge, it decelerates and runs in the reverse direction at low speed. Stop when you encounter the HOME falling edge again.

- **The origin switch signal is effective when starting back to zero.**



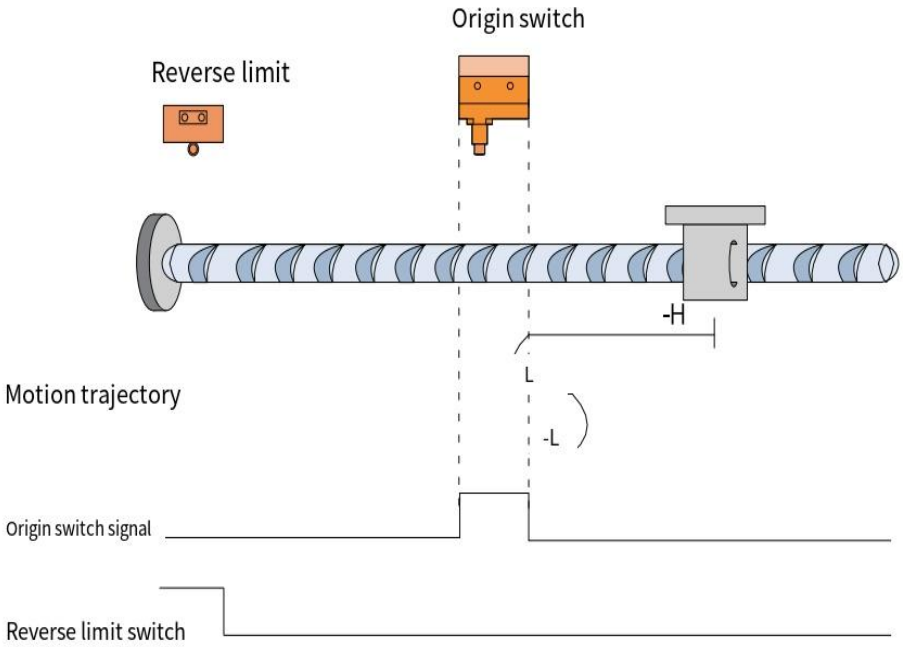
It begins to return to zero when HOME=ON and NOT=OFF. It starts to return to zero at a forward low speed and stops when it encounters the HOME falling edge.

4.11.26 Method 28 (6098=28)

Origin: Origin Switch Signal (HOME)

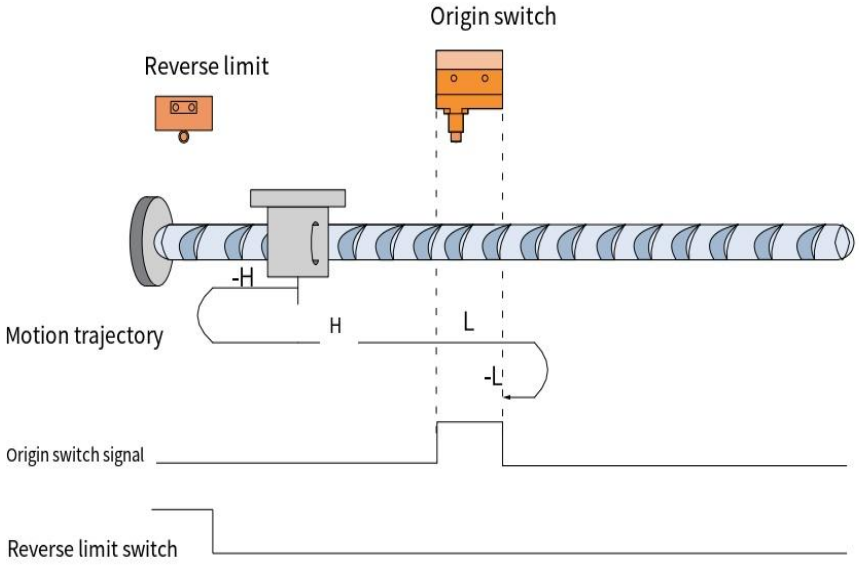
Deceleration point: Origin switch signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered.**



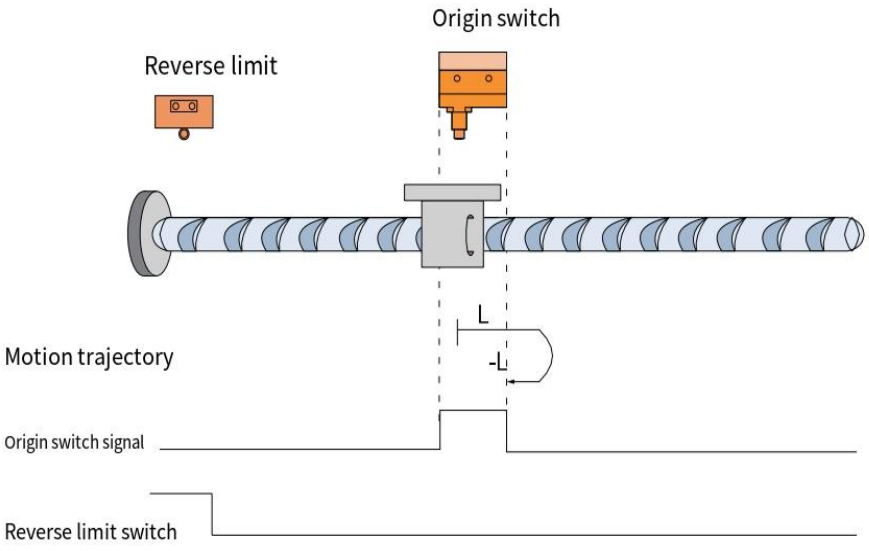
Return to zero when HOME=OFF, NOT=OFF, start to return to zero at reverse high speed, after encountering the rising edge of HOME, decelerate and reverse, run forward at low speed, after encountering the falling edge of HOME, decelerate and reverse, run backward at low speed, stop when encountering the rising edge of HOME again.

- **When starting the return to zero, the origin switch signal is invalid and the reverse limit switch is encountered.**



When HOME=OFF, NOT=OFF, start to return to zero, start to return to zero at reverse high speed, when encountering the NOT rising edge, automatically run forward high speed, when encountering the HOME rising edge, run forward low speed, when encountering the HOME falling edge, decelerate and reverse, run reverse low speed, when encountering the HOME rising edge, stop.

- **The origin switch signal is valid when starting to return to zero.**



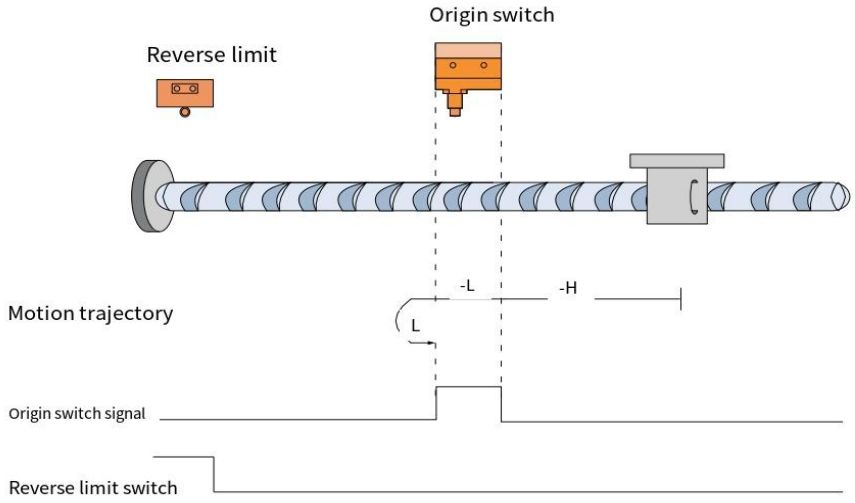
When HOME=ON and NOT=OFF, start the return to zero, start the return to zero at the forward low speed, after encountering the HOME falling edge, decelerate and reverse, run the reverse low speed, stop when encountering the HOME rising edge.

4.11.27 Method 29 (6098=29)

Origin: Origin Switch Signal (HOME)

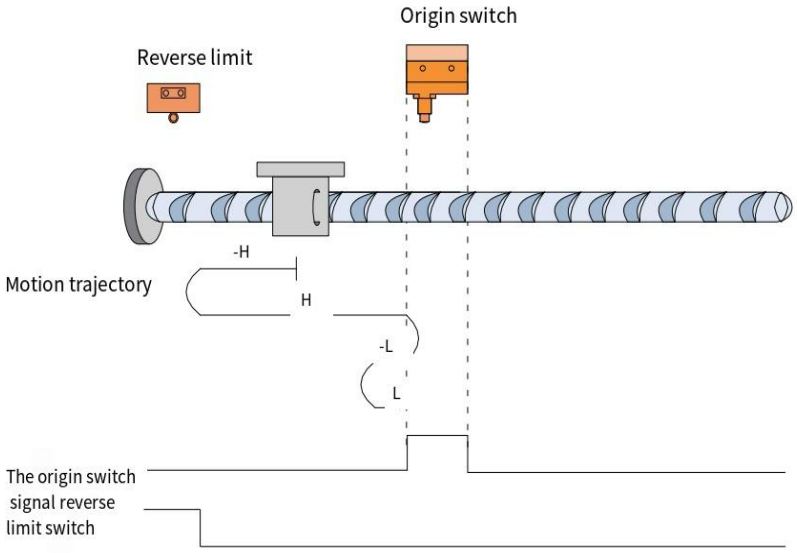
Deceleration point: Origin switch signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered.**



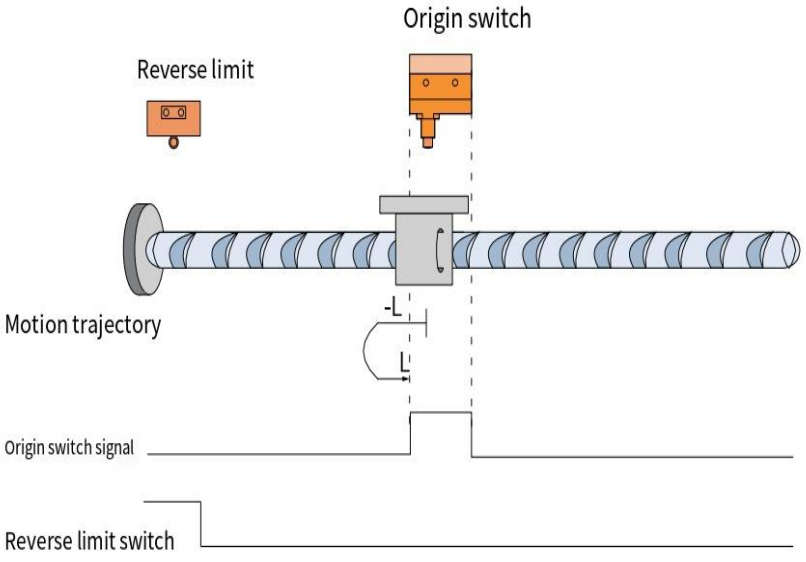
When HOME=OFF and NOT=OFF, it starts to return to zero. It begins to return to zero at high speed in the reverse direction. After encountering the rising edge of HOME, it runs at low speed in the reverse direction. After encountering the falling edge of HOME, it decelerates in the reverse direction and runs at low speed in the forward direction. It stops when it encounters the rising edge of HOME.

- **The origin switch signal is invalid when starting the return to zero and encountering the reverse limit switch.**



When HOME=OFF and NOT=OFF, start to return to zero with reverse high speed. When encountering the NOT rising edge, automatically run forward high speed. When encountering the HOME rising edge, decelerate and reverse, run backward low speed. When encountering the HOME falling edge, decelerate and reverse, run forward low speed. When encountering the HOME rising edge again, stop.

- **The origin switch signal is valid at the start of the return to zero.**



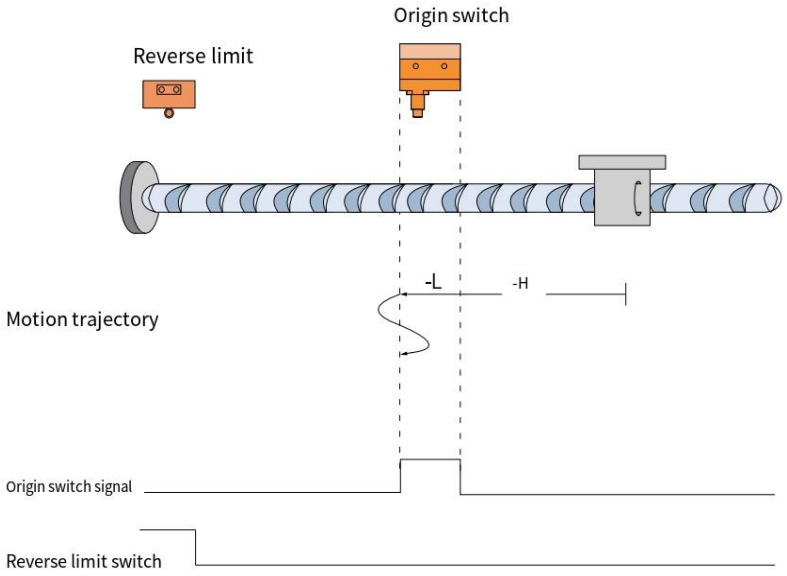
When HOME=ON and NOT=OFF, start the return to zero, start the return to zero at the forward low speed, after encountering the HOME falling edge, decelerate and reverse, run the reverse low speed, stop when encountering the HOME rising edge.

4.11.28 Method 30 (6098=30)

Origin: Origin Switch Signal (HOME)

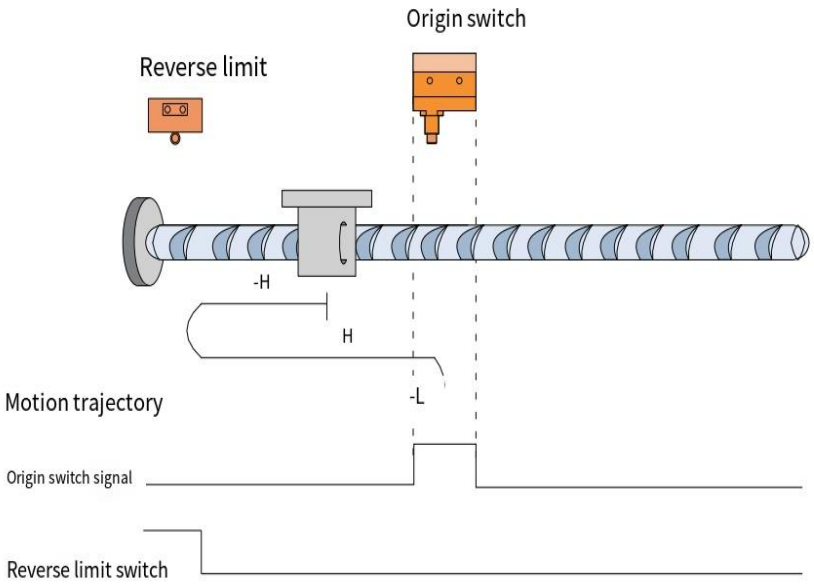
Deceleration point: Origin switch signal (HOME)

- **The origin switch signal is invalid when starting back to zero, and the reverse limit switch is not encountered.**



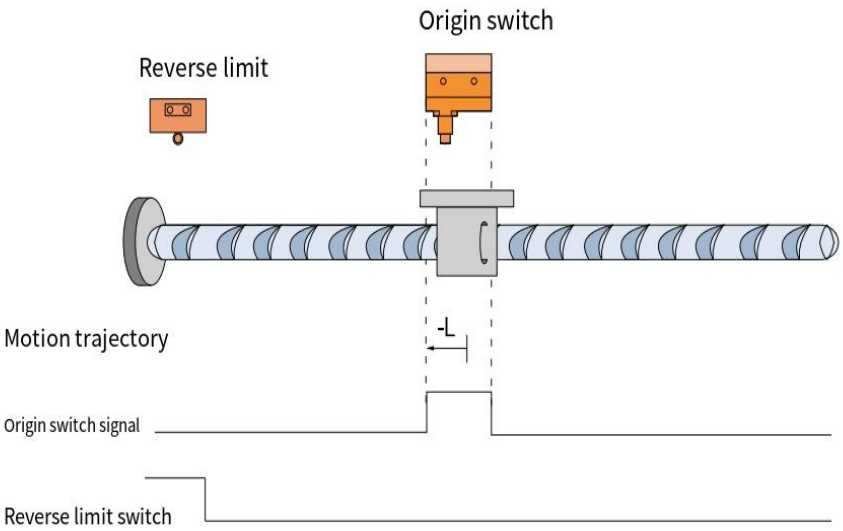
When HOME=OFF, NOT=OFF, start to return to zero with reverse high speed, after encountering the rising edge of HOME, run in reverse low speed, after encountering the falling edge of HOME, decelerate and reverse, run in forward low speed, after encountering the rising edge of HOME, stop.

- **The origin switch signal is invalid when starting the return to zero and encountering the reverse limit switch.**



When HOME=OFF, NOT=OFF, it begins to return to zero. It starts to return to zero at reverse high speed. After encountering the NOT rising edge, it automatically runs forward high speed. After encountering the HOME rising edge, it decelerates and stops.

- **The origin switch signal is effective at the start of the return to zero.**

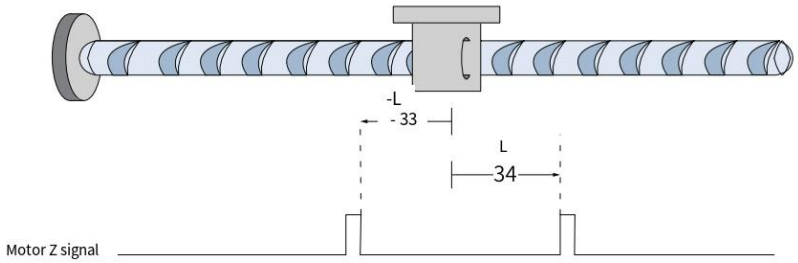


Return to zero when HOME=ON, NOT=OFF, start to zero at reverse low speed, and decelerate to stop when the HOME falling edge is encountered.

4.11.29 Method 33/34 (6098=33/34)

Origin: Z signal

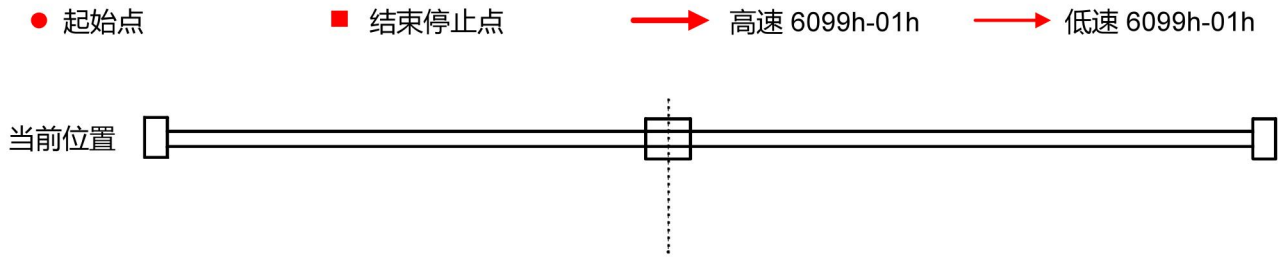
Deceleration point: None



Return-to-zero Method 33: Run in reverse at a low speed and stop at the first Z signal encountered.

Return-to-zero Method 34: Run forward at low speed and stop the first Z signal encountered.

4.11.30 Method 35 (6098=35)



Return-to-zero Method 35, with the current position as the mechanical origin.

4.11.31 Method 36/37 (6098=36/37)

Return to zero mode 36, 37 is the torque return to zero mode, which does not require an external limit signal and determines whether the mechanical hard limit is reached by detecting the torque output inside the motor. The relevant zeroing parameters are as follows:

Index	Name	Flags	Value	Unit
2030:0	Home expansion parameters	RW P	> 6 <	
2030:01	Torque Home MaxTorque output(%)	RW P	0x0032 (50)	
2030:02	Torque Home Detect Limit(%)	RW P	0x0014 (20)	
2030:03	Torque Home speed limit(RPM)	RW P	0x003C (60)	
2030:04	Torque Home Hold Time(50us)	RW P	0x00C8 (200)	
2030:05	Torque Mode speed_Kp	RW P	0x01F4 (500)	
2030:06	Torque Mode speed_Ki	RW P	0x03E8 (1000)	

203:01 Defines the maximum torque output during the torque return-to-zero process, setting a percentage of current for 0x2000.

At 203:02, define the torque for determining whether the motor is at the mechanical limit during the torque return to zero process, and set the percentage of the current at 0x2000.

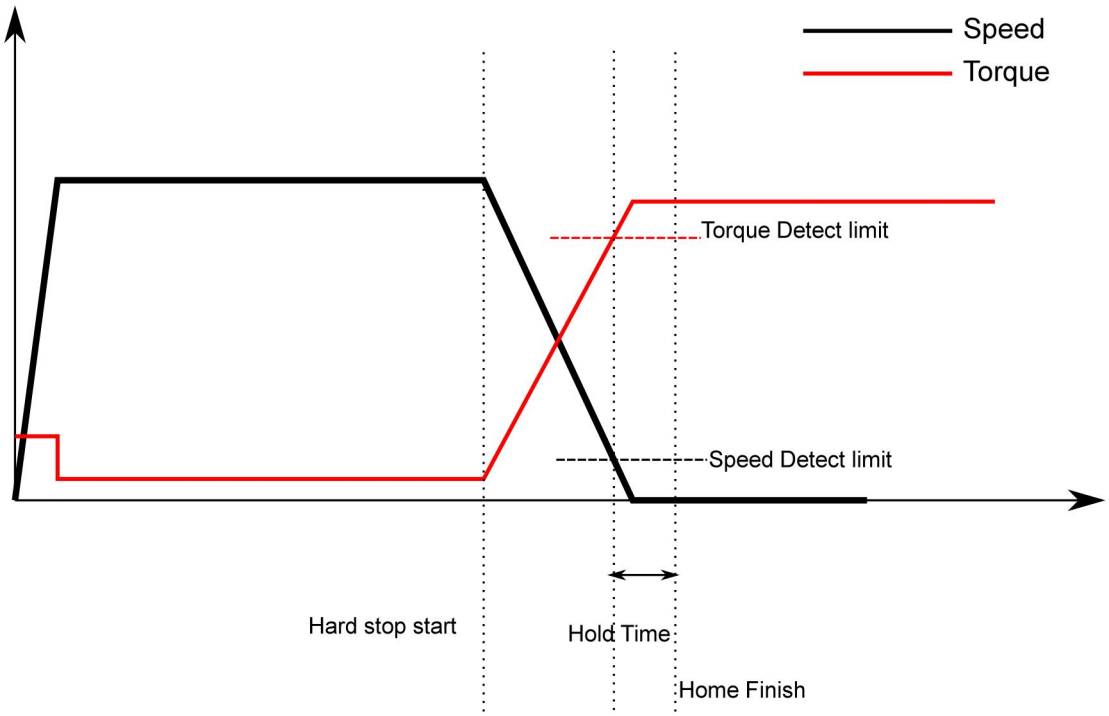
203:03 Define the speed limit for turning off whether the motor is at the mechanical limit during torque return-to-zero.

203:04 Define the holding time of whether the motor is at the mechanical limit during torque return-to-zero.

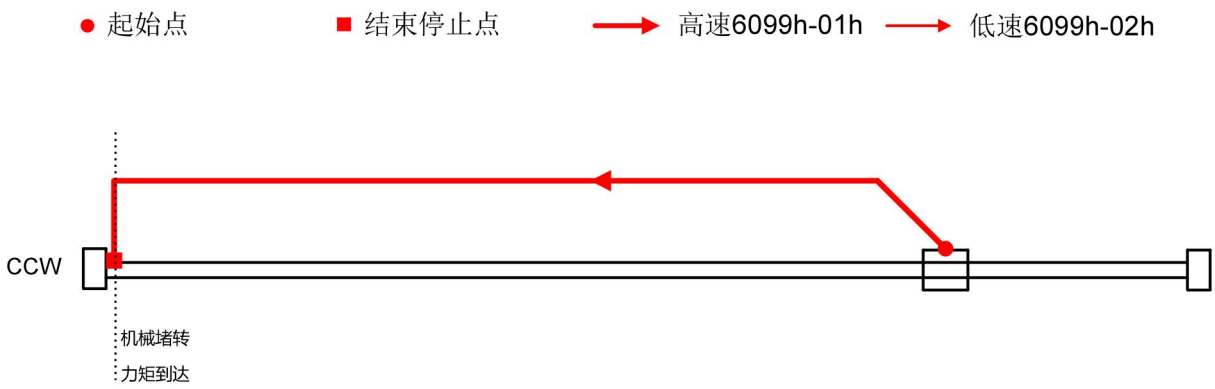
203:05 Define the proportional gain of the speed loop during torque return to zero.

2030:06 Define the integral gain of the velocity loop in the process of torque return to zero.

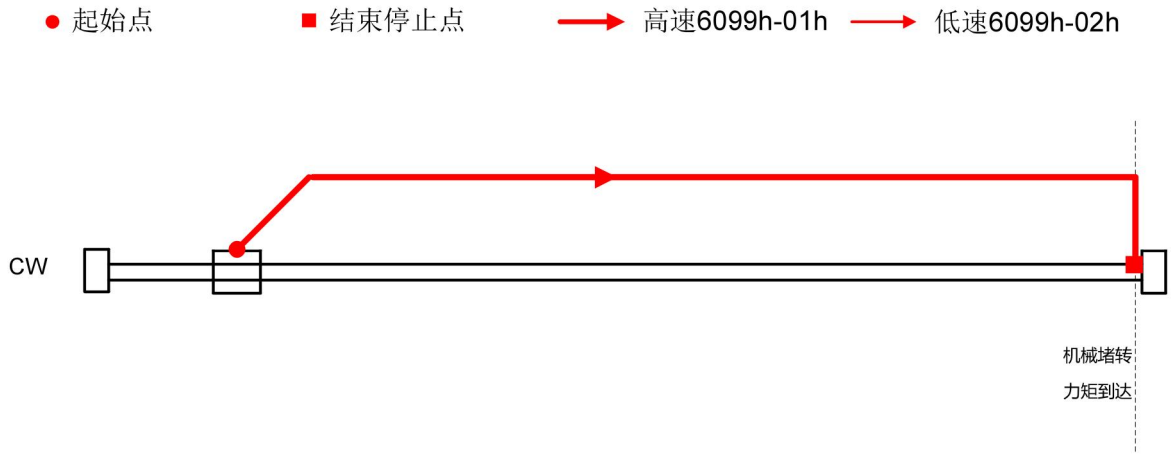
The relevant definitions are as follows:



Return-to-zero method 36: The motor returns to zero at high speed in the direction of the CCW forward rotation. When it hits the limit stop, the return-to-zero is completed.



Method 37: The motor returns to zero at high speed in the direction of CW reverse rotation. After hitting the limit and blocking the rotor, the return to zero is completed.



Service and Support

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