XINJE

DM6C Series Servo Drive

User Manual

WUXI XINJE ELECTRIC CO., LTD.

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XINJE ELECTRIC

DM6C Series Servo Drive

User Manual

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General instructions

- Thank you for purchasing XINJE DM6C Series Servo Drive products.
- This manual primarily introduces product information for the DM6C Series Servo Drives and MS6 Series Servo Motors.
- Before using the product, please read this manual carefully and ensure all wiring is performed under full understanding of the content.
- Please deliver this manual to the end user.

This manual is intended for the following users:

- Servo system designers
- Installation and wiring personnel
- Commissioning and servo debugging personnel
- Maintenance and inspection personnel

Ways to Obtain the Manual

- Electronic version
  Download from XINJE official website:www.xinje.com

Disclaimer

- Although the content of this manual has been carefully reviewed, errors may still occur. We cannot guarantee complete accuracy.
- We regularly review the content of this manual and make corrections in subsequent editions. Your valuable feedback is welcome.
- The content described in this manual is subject to change without prior notice.

Contact information

If you have any questions regarding the use of this product, please contact the distributor or office where you purchased the product, or reach out to XINJE directly.

- General Line：0510-85134136
- Hotline：400-885-0136
- Fax：0510-85111290
- Website：www.xinje.com
- Email：xinje@xinje.com
- Address：No. 816 Jianzhu West Road, Binhu District, Wuxi City, Jiangsu Province

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April 2025

Safety Precautions

Before using this product, be sure to read this section carefully and ensure all operations are performed only after fully understanding the product's usage, safety requirements, and precautions. Exercise extreme caution when connecting the product to power sources.

Potential risks that may arise during product use are primarily outlined in the safety precautions, which are categorized into two levels: Attention and Dangerous. For matters not explicitly covered, please adhere to standard electrical operation procedures.

ATTENTION	Indicates a potential hazard that, if ignored, could result in moderate or minor personal injury, or property damage.
DANGEROUS	Indicates a potentially hazardous situation that, if not avoided, could result in serious injury, death, or significant property damage.

Product Inspection Precautions

1. Do not install drives that are damaged, have missing parts, or do not meet the required model specifications.

Storage and Handling Precautions

1.Do not place or store the product in areas exposed to direct sunlight, where the ambient temperature exceeds the specified storage, where the relative humidity exceeds the specified storage, where there are significant temperature fluctuations, or where condensation occurs.
2.Avoid contact with corrosive or flammable gases, and areas with high levels of dust.
3.Do not place in locations where excessive vibration or impact is directly transmitted to the drive.
4.Never lift or carry the unit by holding the motor cables.

Installation Precautions

1. Never install near flammable gases, as this may cause a fire.
2. Always adhere to the specified installation orientation to prevent drive malfunctions.
3. Never expose the product to moisture, corrosive substances, or flammable gases, as this poses risks of electric shock and fire.
4. Before installation, always disconnect the power supply and verify that the power indicator light is off to prevent electric shock.
5. Do not touch the conductive parts of the product directly, as this may cause malfunction, damage, or electric shock.

Wiring Precautions

1.Please correctly connect the AC power supply to the dedicated power terminals of the drive (L/N or L1/L2/L3 or R/S/T). Do not connect the output terminals U, V, W of the drive to the three-phase power supply.

2.Please properly connect the ground wire. Poor grounding may cause electric shock. Use a 2mm² wire to ground the drive's grounding terminal.

3.Please tighten the terminal screws securely; otherwise, it may cause a fire.

4.Before performing wiring operations on the drive, be sure to disconnect all external power sources.

5.Ensure that the encoder and power cables are in a loose state during wiring. Do not tighten them excessively to avoid cable damage.

Operational Precautions

1.After the drive starts operating, do not touch the rotating parts of the motor to prevent injury.
2.During trial operation, run the motor without load to prevent accidents; otherwise, it may cause personal injury.
3.After connecting to the machinery, set appropriate parameters before operation; otherwise, it may lead to loss of control or malfunction of the machinery.
4.During operation, do not touch the heat sink, as there is a risk of burns.
5.Do not change wiring while the system is energized, as it may cause injury.
6.Do not frequently turn the power on and off. If multiple power cycles are required, limit them to once every 2 minutes. Otherwise, it may damage the drive's charging resistor. Frequent switching may cause the relay to trip before it has released

Maintenance and Inspection

1． Power-on and power-off operations should be performed by qualified personnel.

2.Do not use gasoline, acidic, thinning, or alkaline detergents, as they may damage or discolor the casing.

3.When replacing the drive, transfer the parameters from the original drive to the new one before resuming operation; otherwise, it may cause mechanical damage or even personal injury.

4.Do not change wiring while the system is energized, as it may cause electric shock or injury.

5.Do not remove the servo motor during operation, as it may cause electric shock or injury.

6.Do not touch the interior of the servo drive or servo motor during operation, as it may cause electric shock or injury.

7.Do not touch the terminals within 10 minutes after turning off the power, as residual voltage may cause electric shock or injury.

Wiring Precautions

1. Do not run power lines and control signal lines through the same conduit or bundle them together. Keep wer lines and control signal lines at least 30 cm apart.

2.For signal lines and encoder (PG) feedback lines, use multi-strand twisted pairs and multi-core overall shielded twisted pairs.

3.The maximum length for signal input lines is 3 meters, and for PG feedback lines, it is 20 meters.

4.Ensure wiring is correct and secure; otherwise, it may cause motor 失控 or malfunction, and in severe cases, personal injury.

5.Do not use the drive under poor power conditions or outside the specified voltage range, as it may cause mechanical damage.

6.Take appropriate shielding measures in environments with static electricity, strong electromagnetic fields, radiation, or nearby power lines.

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►►Product Arrival Confirmation

Upon the arrival of the products, please confirm the integrity of the products based on the following aspects:

Confirmation Item	Remarks
Does the arrived product match the ordered model?	Confirm based on the nameplate of the servo motor and servo unit.
Does the rotating shaft of the servo motor move smoothly?	It is normal if it can be turned gently by hand. Motors with brakes will not rotate.
Are there any signs of damage?	Visually inspect the entire exterior for damage caused by transportation, etc.
Are there any loose screws?	Check for loose screws using a screwdriver.
Is the motor code consistent?	Verify that the motor code on the drive (U3-70) matches the code on the motor label.

Do not install any drives that are damaged, have missing parts, or do not meet the required model specifications. If any discrepancies are found, please contact the agent, office, or XINJE's sales department for this product promptly.

1. Servo System Selection

1.1 Servo Drive Selection

1.1.1 Model Nomenclature

- Rectifier Unit

DM6-4 □P□ - R

Show	Product Name
DM 6	DM6 Series All-in-One Servo Drive

Show	Drive Type
R	Rectifier Unit

Show	Rated Input Voltage
4	AC380V

Show	Rated Output Power
110P0	110kW

- Inverter unit

DM6 □-4 □P□ □- M

Show	Product Name
DM 6	DM6 Series All-in-One Servo Drive

Show	Drive type
M	Inverter unit

Show	Single and double axis
S	Single-axis inverter
Empty	Dual-axis inverter

Show	Product Series
C	EtherCAT-based

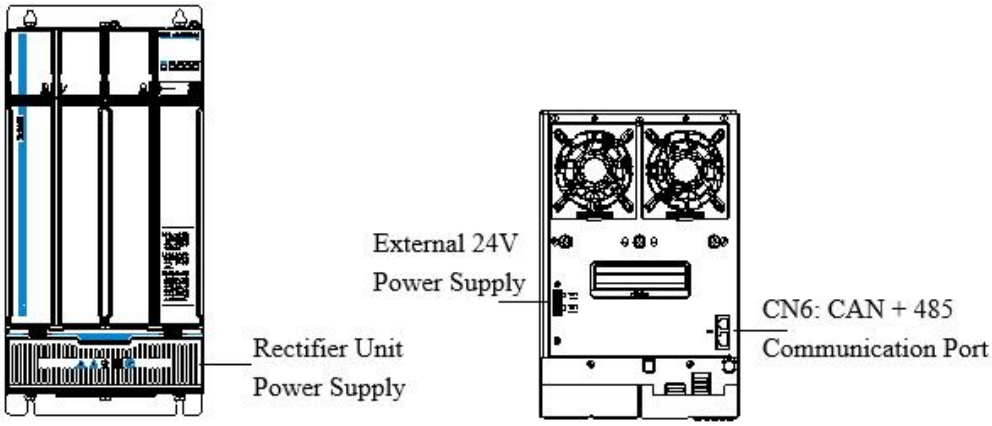
Show	Rated output power
0P4	400W
0P7	750W
3P0	3KW
5P5	5.5KW
7P5	7.5KW
15P0	15KW
45P0	45KW
55P0	55KW
75P0	75KW

Show	Rated Input Voltage
4	AC380V

45kW, 55kW, and 75kW models are only available as single-axis inverter units.

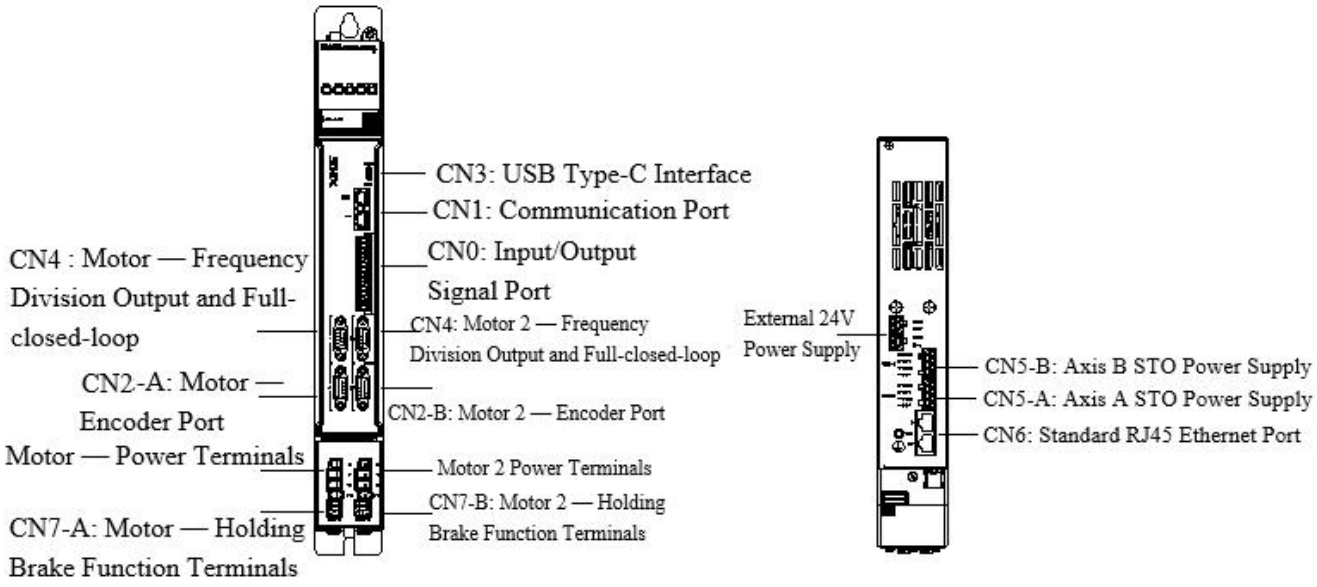
1.1.2 Description of Components

- Rectifier Unit



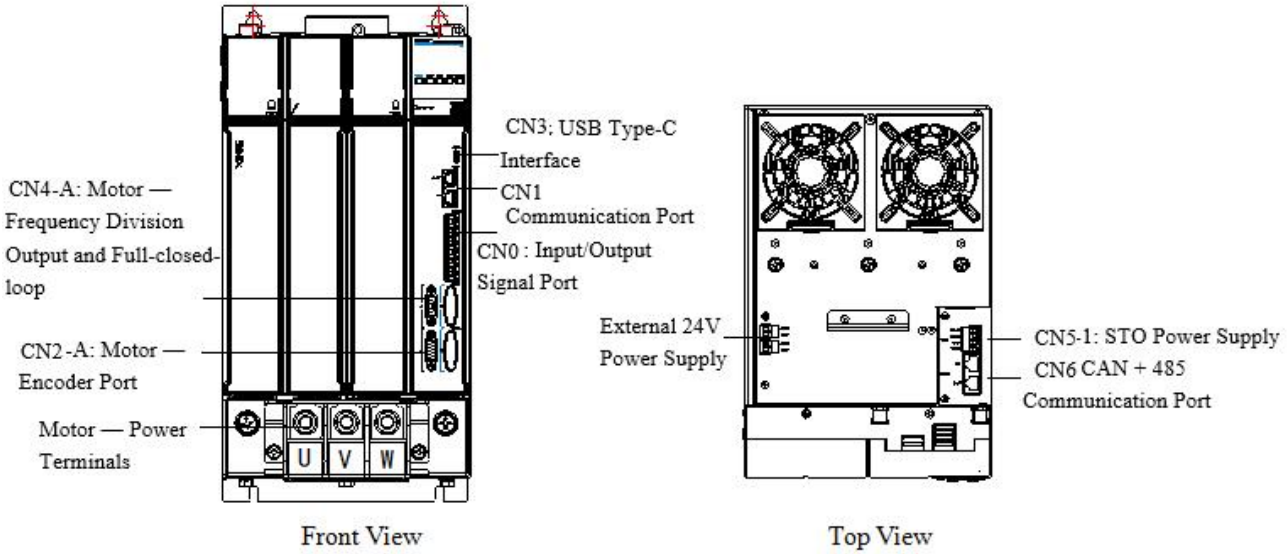
Front View Top View

- Dual-Axis Inverter Unit



Front View Top View

- Single-Axis Inverter Unit



1.1.3 Performance Specifications

Servo Unit		DM6C Series Servo Drive
Compatible Encoder		Standard: 19-bit / 23-bit Communication Encoder
Input Power		DM6-4□P□-R: 3-phase AC380–440V, 50/60 Hz
Control Method		Three-phase full-wave rectification, IPM PWM control, sinusoidal current drive method
Service conditions	Operating Temperature	-10～+40 ℃
	Storage Temperature	-20～+60 ℃
	Ambient Humidity	90% RH or less (non-condensing)
	Vibration Resistance	4.9m/s^2
	Altitude	1000 m or below. For altitudes above 1000 m, please derate the unit (derate by 1% for every 100 m increase).

1.1.4 Electrical Specifications

Drive Model	Drive Power (kW)	Continuous Output Current（A）	Maximum Output Current（A）	Power Supply	Cooling Method
DM6C-40P4-M	0.4kW	2.8	9.8	Supplied by Rectifier Unit	Air-Cooled
DM6C-40P7-M	0.75kW	4.8	16.8	Supplied by Rectifier Unit	Air-Cooled
DM6C-43P0-M	3kW	11	29.7	Supplied by Rectifier Unit	Air-Cooled
DM6C-45P5-M	5.5kW	20	50	Supplied by	Air-Cooled

Drive Model	Drive Power (kW)	Continuous Output Current（A）	Maximum Output Current（A）	Power Supply	Cooling Method
				Rectifier Unit	
DM6C-47P5-M	7.5kW	25	62.5	Supplied by Rectifier Unit	Air-Cooled
DM6C-415P0-M	15kW	37	66.6	Supplied by Rectifier Unit	Air-Cooled
DM6C-445P0S-M	45kW	100	220	Supplied by Rectifier Unit	Air-Cooled
DM6C-455P0S-M	55kW	126	283.5	Supplied by Rectifier Unit	Air-Cooled
DM6C-475P0S-M	75kW	152	273.6	Supplied by Rectifier Unit	Air-Cooled
DM6-4110P0-R	110kW	240	-	Three-Phase AC380～440V，50/60Hz	Air-Cooled

1.2 Servo motor selection

1.2.1 Model naming

- MS6 series motor

MS6S - 80 CS 30 B Z 3 - 2 1P0 - S

Show (Series)	Inertia
MS6L	Ultra-low inertia motor
MS6S	Low inertia motor
MS6G	Medium inertia motor
MS6H	High inertia motor

Show	Frame size
25	Frame 25
40	Frame 40
60	Frame 60
80	Frame 80
100	Frame 100
110	Frame 110
130	Frame 130
180	Frame 180
200	Frame 200

Show	Encoder type
CN	Single and multi-turn integrated 19-bit magnetic encoder
TH	Multi-turn 23-bit optical encoder

Show	Rated speed (rpm)
15	1500
17	1700
20	2000
25	2500
30	3000

Show	Motor shaft specifications
B	With key, with oil seal, with threaded hole
E	Special shaft specifications (length, shaft diameter, etc.)

Show	Brake
-	Without brake
Z	With brake

Show	Motor type
Empty	Standard type
S	Short body type
F	Air-cooled motor
Y	Liquid-cooled motor

Show	Rated output power
0A5	50W
0P1	100W
0P2	200W
0P4	400W
0P7	750W
0P8	850W
1P0	1kW
1P5	1.5kW
2P3	2.3kW
2P5	2.5kW
3P0	3.0kW
4P4	4.4kW
5P0	5.0kW
5P5	5.5kW
7P0	7.0kW
7P5	7.5kW
13P0	13kW
17P0	17kW
21P0	21kW
27P0	27kW
32P0	32kW
45P0	45kW
55P0	55kW
75P0	75kW

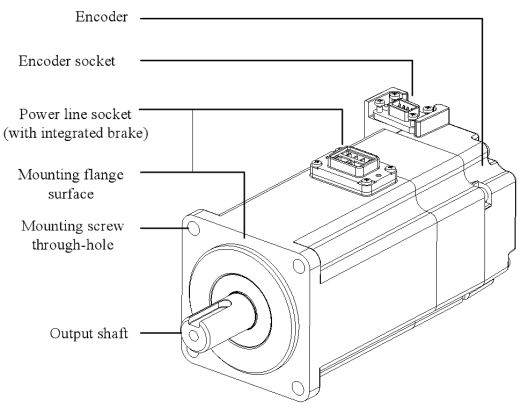
Show	Voltage class
2	220V
4	380V

Show	Motor connector type
2	Aviation plug connector
3	Waterproof connector
4	Waterproof connector to AMP plug

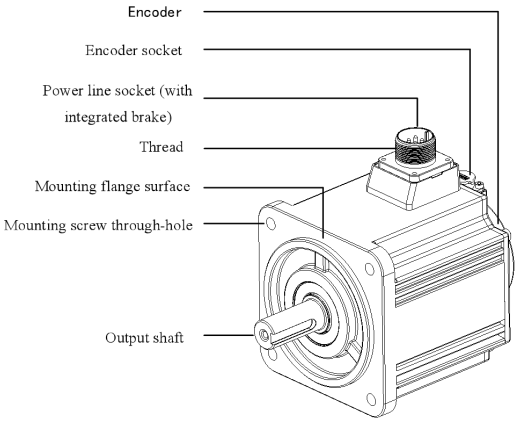
Currently, only CN and TH combinations are available for encoder type selection.

1.2.2 Description of Each Section

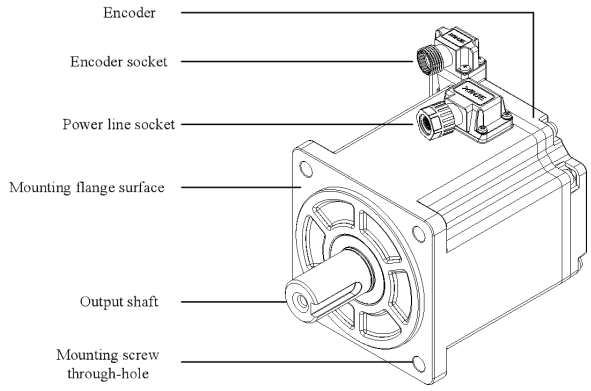
- B2/B3/B4 type motors



B3 motor

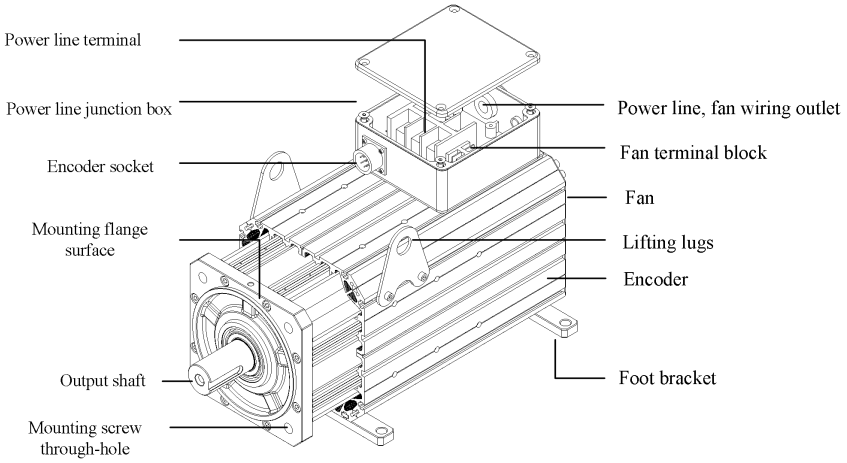


B2 motor

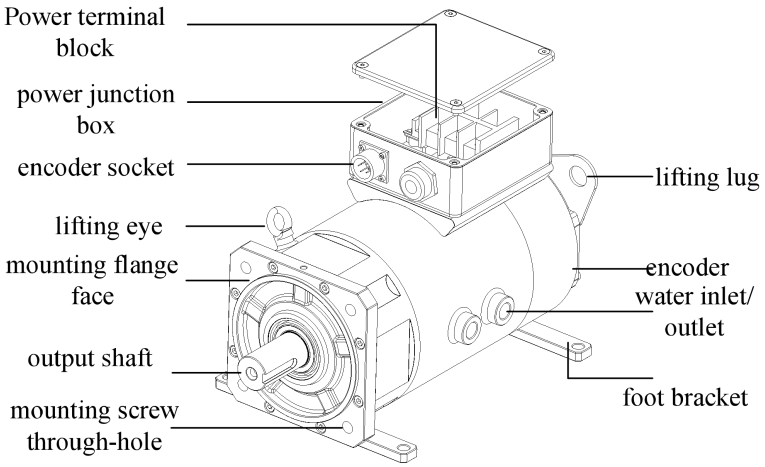


B3 motor

- High-Power Air-Cooled/Liquid-Cooled Motors

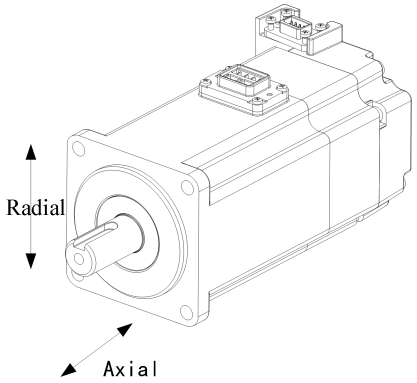


High-power air-cooled motor



high-power liquid-cooled motor

1.2.3 Axial Load and Radial Load Specifications



Frame size	40	60	80	100	110	130	180	200	220	265
Axial Load	54N	74N	147N	196N	147N	196N	400N	640N	686N	1120N
Radial Load	78N	245N	392N	500N	392N	686N	800N	1880N	2254N	3200N

1.3 Cable Selection

1.3.1 model naming

■ Encoder Cable Model Number

CP – SP T – M - 02

Code	Cable type
CP	Standard Encoder Cable
CPT	High-Flex Encoder Cable

Code	Connector Type
SP	AMP Connector
SL	15-pin Aviation Plug
SC	10-pin Compact Aviation Plug
SE	B3 Top Exit Connector (Motor Side)
SF	B3 Bottom Exit Connector (Motor Side)
ZDL	Straight DB Plug (Drive Side)

Code	Length (M)	Code	Length (M)
02	2	12	12
03	3	16	16
05	5	20	20
08	8	25	25
10	10	30	30

Code	Connector Type
M	Without Battery Box
B	With Battery Box (Frame 110 and above)
BM	With Battery Box (Frame 90 and below)

Code	Connector Type
T	Threaded Snap-on Type (For Frame 130/180 only)
Blank	Standard Type

■ Power Cable Model

CM T - E 05 A - 03

Code	Cable Type
CM	Power Cable - Without Brake
CMB	Power Cable - With Brake

Code	Cable Type
T	High-Flex
G	High-Flex & Oil-Resistant
Blank	Standard

Code	Connector Type
E	B3 Top Exit Connector (Motor Side)
F	B3 Bottom Exit Connector (Motor Side)
L	4-pin Compact Aviation Plug
XL	4-pin Medium Aviation Plug
D	4-pin Q-Type Connector

Code	Length (M)	Code	Length (M)
02	2	03	3
05	5	08	8
10	10	12	12
16	16	20	20
25	25	30	30

Code	Terminal (Drive Side)
A/B	Pin Terminal
T	Pin Terminal
Blank	U-Type Terminal / U-Type Terminal

Code	Cross-Section (mm²)	Code	Cross-Section (mm²)
03	0.3	100	10.0
05	0.5	120	12.0
15	1.5	160	16.0
20	2.0	300	30.0
60	6.0		

■ EtherCAT Communication Cable Model Number

JC - CB - 1

Code	Designation
JC	Designation for EtherCAT Communication Cable Set

Code	Designation
CB	Cat 5e Cable

Code	Length (M)
0P2	0.2
0P3	0.3
0P5	0.5
1	1
3	3
5	5

S

Currently available cable lengths are 0.2 m, 0.3 m, 0.5 m, 1 m, 3 m, 5 m, 10 m, and 20 m.

■ CAN&RS485 Communication Cable Model Number

JN - CA - 2

Code	Designation
JN	Designation for CAN485 Communication Cable Set

Code	Designation
CA	Cat 5e Cable

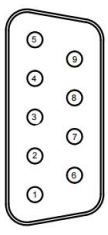
Code	Length (M)
0P3	0.3
2	2

Currently available cable lengths are 0.3 m and 2 m.

1.3.2 Cable Terminal Definitions

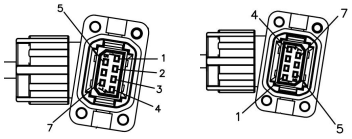
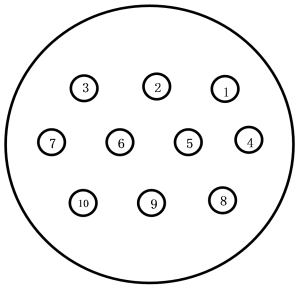
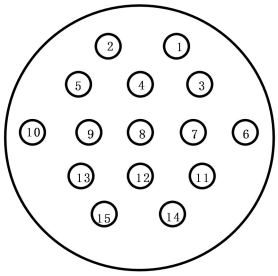
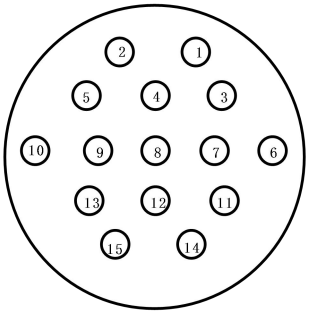
■ Encoder Cable

（1）Servo Motor Side Encoder Cable Pinout



Interface Pinout			
Pin No.	Definition	Pin No.	Definition
1	Temp Sensor -	6	GND
2	Temp Sensor+	7	/
3	485-B	8	+5V
4	485-A	9	/
5	Shield Layer	/	/

（2）Servo Motor Side Encoder Cable Pinout

<table>
<tr><th>Motor Model</th><th>Connector Pin</th><th colspan="2">Interface Pinout</th></tr>
<tr><td rowspan="8">MS6-40、60、80 frame B3 motor</td><td rowspan="8"> 
Front-facing Cable Outlet
Rear-facing Cable Outlet
（Viewing Perspective）</td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>1</td><td>5V</td></tr>
<tr><td>2</td><td>GND</td></tr>
<tr><td>3</td><td>Battery+</td></tr>
<tr><td>4</td><td>Battery-</td></tr>
<tr><td>5</td><td>485-A</td></tr>
<tr><td>6</td><td>485-B</td></tr>
<tr><td>7</td><td>Shield</td></tr>
<tr><td rowspan="11">MS6-130 frame B2 motor</td><td rowspan="11">  </td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>1</td><td>/</td></tr>
<tr><td>2</td><td>5V</td></tr>
<tr><td>3</td><td>GND</td></tr>
<tr><td>4</td><td>485-A</td></tr>
<tr><td>5</td><td>485-B</td></tr>
<tr><td>6</td><td>Battery+</td></tr>
<tr><td>7</td><td>Battery-</td></tr>
<tr><td>8</td><td>/</td></tr>
<tr><td>9</td><td>/</td></tr>
<tr><td>10</td><td>Shield</td></tr>
<tr><td rowspan="11">MS6-180 frame B2 motor</td><td rowspan="11">  </td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>1</td><td>Shield</td></tr>
<tr><td>2</td><td>/</td></tr>
<tr><td>3</td><td>485-B</td></tr>
<tr><td>4</td><td>485-A</td></tr>
<tr><td>5</td><td>/</td></tr>
<tr><td>6</td><td>GND</td></tr>
<tr><td>7</td><td>Battery-</td></tr>
<tr><td>8</td><td>5V</td></tr>
<tr><td>9</td><td>Battery+</td></tr>
<tr><td rowspan="11">200、265 frame motor</td><td rowspan="11">  </td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>1</td><td>Shield</td></tr>
<tr><td>2</td><td>/</td></tr>
<tr><td>3</td><td>485-B</td></tr>
<tr><td>4</td><td>485-A</td></tr>
<tr><td>5</td><td>/</td></tr>
<tr><td>6</td><td>GND</td></tr>
<tr><td>7</td><td>Battery-</td></tr>
<tr><td>8</td><td>5V</td></tr>
<tr><td>9</td><td>Battery+</td></tr>
<tr><td>14</td><td>Temp-</td></tr>
<tr><td>15</td><td>Temp+</td></tr>
</table>

Battery Box Note:

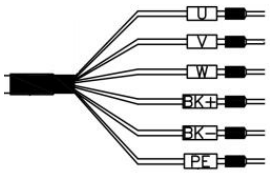
1）The cables for the encoders listed above, which include the Battery+ and Battery- pin definitions, are used for absolute value motors. These pins are not present in the cables for non-absolute value

motors.

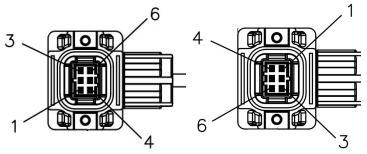
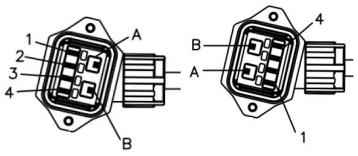
2）Only the absolute value motor is compatible with the external battery box, which features a built-in 3.6V/2.7Ah high-capacity battery and supports battery replacement without power interruption. The battery life is no less than 2 years. For battery replacement methods, refer to Section 5.1.2 "Battery Replacement".

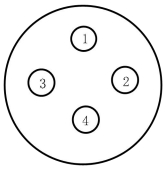
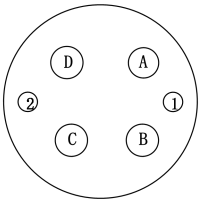
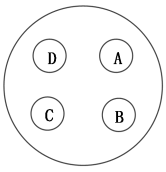
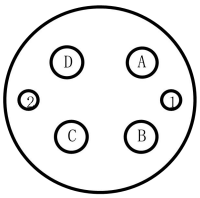
■ Motor Power Cable

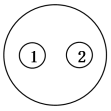
（1）Servo Drive Side Power Cable Pin Definitions

<table>
<tr><th>Motor Model</th><th>Connector Appearance</th><th colspan="2">Interface Pin Definitions</th></tr>
<tr><td rowspan="7">MS6 Series B3 Motor</td><td rowspan="7"> 
</td><td>Color</td><td>Definition</td></tr>
<tr><td>Red</td><td>U</td></tr>
<tr><td>White</td><td>V</td></tr>
<tr><td>Black</td><td>W</td></tr>
<tr><td>Yellow&Green</td><td>PE</td></tr>
<tr><td>Blue</td><td>BK+</td></tr>
<tr><td>Brown</td><td>BK-</td></tr>
<tr><td rowspan="7">MS6 Series 130, 180 Frame B2 Motor</td><td rowspan="7"> </td><td>Color</td><td>Definition</td></tr>
<tr><td>Brown</td><td>U</td></tr>
<tr><td>Black</td><td>V</td></tr>
<tr><td>Blue</td><td>W</td></tr>
<tr><td>Yellow&Green</td><td>PE</td></tr>
<tr><td>Red</td><td>BK+</td></tr>
<tr><td>Black</td><td>BK-</td></tr>
<tr><td rowspan="5">MS6 Series 200 Frame B2 Motor</td><td rowspan="5">200 frame motors have no socket. Note: Connect U, V, W on the drive side and motor side one-to-one.</td><td>Color</td><td>Definition</td></tr>
<tr><td>Red</td><td>U</td></tr>
<tr><td>Yellow</td><td>V</td></tr>
<tr><td>Blue</td><td>W</td></tr>
<tr><td>Yellow&Green</td><td>PE</td></tr>
</table>

（2）Motor Side Power Cable Solder Pin Definitions

<table>
<tr><th>Motor Model</th><th>Connector Pinout</th><th colspan="2">Interface Pin Definitions</th></tr>
<tr><td rowspan="7">MS6-40 Frame B3 Motor</td><td rowspan="7"> 
Front Exit Rear Exit
(User View Angle)</td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>1</td><td>W</td></tr>
<tr><td>2</td><td>V</td></tr>
<tr><td>3</td><td>U</td></tr>
<tr><td>4</td><td>PE</td></tr>
<tr><td>5</td><td>BK+</td></tr>
<tr><td>6</td><td>BK-</td></tr>
<tr><td rowspan="7">MS6-60, 80 Frame B3 Motor</td><td rowspan="7"> 
Front Exit Rear Exit
(User View Angle)</td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>1</td><td>U</td></tr>
<tr><td>2</td><td>V</td></tr>
<tr><td>3</td><td>W</td></tr>
<tr><td>4</td><td>PE</td></tr>
<tr><td>A</td><td>BK+</td></tr>
<tr><td>B</td><td>BK-</td></tr>
</table>

<table>
<tr><th>Motor Model</th><th>Connector Pin</th><th colspan="2">Interface Pin Definition</th></tr>
<tr><td rowspan="5">MS6H-180 Frame Non-brake Motor</td><td rowspan="5">  </td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>1</td><td>PE</td></tr>
<tr><td>2</td><td>U</td></tr>
<tr><td>3</td><td>V</td></tr>
<tr><td>4</td><td>W</td></tr>
<tr><td rowspan="8">MS6H-180 Frame Brake Motor</td><td rowspan="8">  </td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>A</td><td>U</td></tr>
<tr><td>B</td><td>V</td></tr>
<tr><td>C</td><td>W</td></tr>
<tr><td>D</td><td>PE</td></tr>
<tr><td>1</td><td>BK+</td></tr>
<tr><td>2</td><td>BK-</td></tr>
<tr><td rowspan="5">MS6G-130 Frame Non-brake Motor</td><td rowspan="5">  </td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>A</td><td>W</td></tr>
<tr><td>B</td><td>V</td></tr>
<tr><td>C</td><td>U</td></tr>
<tr><td>D</td><td>PE</td></tr>
<tr><td rowspan="8">MS6G-130 Frame Brake Motor</td><td rowspan="8">  </td><td>Pin No.</td><td>Definition</td></tr>
<tr><td>A</td><td>PE</td></tr>
<tr><td>B</td><td>W</td></tr>
<tr><td>C</td><td>V</td></tr>
<tr><td>D</td><td>U</td></tr>
<tr><td>1</td><td>BK+</td></tr>
<tr><td>2</td><td>BK-</td></tr>
<tr><td rowspan="2">200/265 Frame Motor</td><td rowspan="2"> </td><td>Color</td><td>Definition</td></tr>
<tr><td>Red</td><td>U</td></tr>
</table>

Motor Model	Connector Pin	Interface Pin Definition	
		Green	V
		Blue	W
		Yellow&Green	PE
200/265 Frame Brake Motor		Color	Definition
		1	BK+
		2	BK-

Brake Pin Description:

The cable pin definitions above that include BK+ and BK- are used for motors with brakes. Cables for non-brake motors do not have these pins; the terminals are empty.

2. Installation of the Servo System

2.1 Installation of the Servo Drive

2.1.1 Installation Location

- Install the unit inside a control cabinet, protected from direct sunlight and rain.
- Do not use the product in environments near corrosive or flammable gases and materials, such as hydrogen sulfide, chlorine, ammonia, sulfur, oxidizing gases, acids, alkalis, salts, or combustibles请Do not install the unit in environments with high temperature, humidity, dust, or metal dust.
- Install the unit in a location free from vibration.

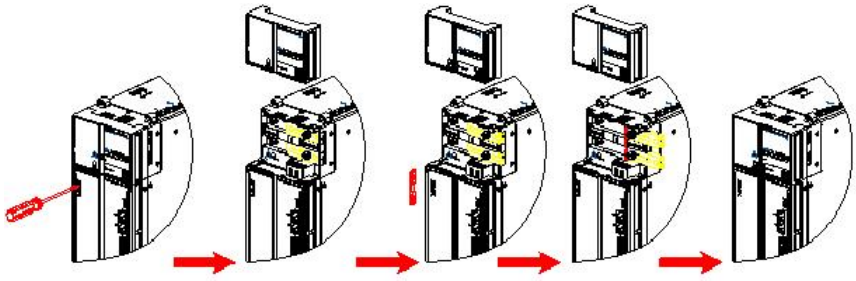
2.1.2 Environmental Conditions

Item	Specification
Operating Ambient Temperature	-10~40℃
Operating Ambient Humidity	20~90%RH（non-condensing）
Storage Temperature	-20~60℃
Storage Humidity	20~90%RH（non-condensing）
Vibration Resistance	4.9 m/s² or less
Altitude	1000 m or below. For altitudes above 1000 m, derate the unit by 1% for every 100 m increase.

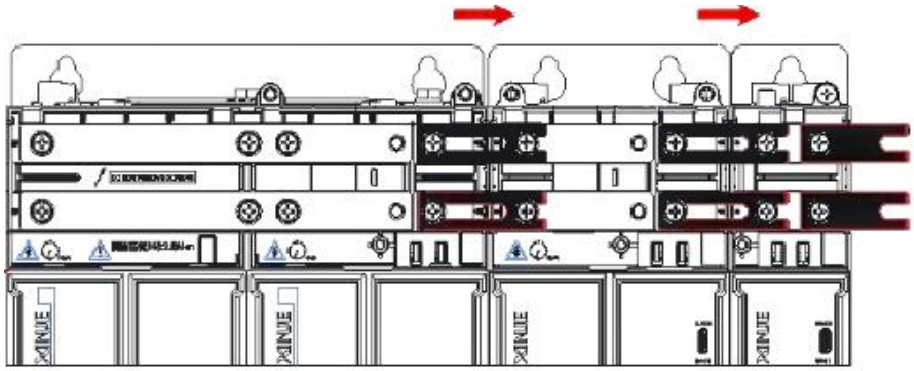
2.1.3 Installation Standard

The installation standard shown in the figure below must be strictly followed. This standard applies when

combining a rectifier module with inverter modules. The combination of multiple inverter modules follows a similar process, extending to the right. Note that the shorting cover plate and the snap-fit cover plate must be installed on the final inverter module



.



Loosen the screws and horizontally lap-connect the copper bar.

■ Servo Drive Orientation

During installation, ensure the front face of the servo drive (the actual mounting surface facing the operator) is oriented toward the operator and perpendicular to the wall.

■ Cooling

Sufficient space must be reserved around the servo drive to allow for effective cooling via the fan and natural convection.

■ Group Installation

A cooling fan should be installed above the servo drive. To prevent localized overheating of the servo drive, maintain a uniform temperature distribution inside the control cabinet.

- Environmental Conditions Inside the Control Cabinet
- Operating ambient temperature: -10°C to 40°C.
- Humidity: 90% RH or less.
- Vibration: 4.9 m/s².
- Avoid conditions leading to freezing or condensation.

- For long-term reliability, use in an ambient temperature below 50°C.

2.2 Servo Motor Installation

MS6 series servo motors can be mounted in either horizontal or vertical orientations. However, incorrect installation or installation in an unsuitable location may shorten the motor's lifespan or cause unexpected accidents. Please ensure proper installation by following the precautions below.

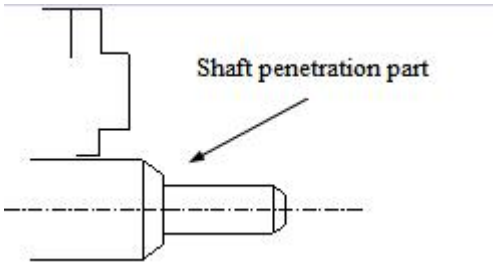
Attention
1. The shaft end is coated with "anti-rust agent." Before installing the motor, wipe off the anti-rust agent with a cloth soaked in "thinner." 2. When wiping off the anti-rust agent, ensure the thinner does not come into contact with other parts of the servo motor.

2.2.1 Installation Location

- Do not use the motor in environments containing corrosive or flammable substances such as hydrogen sulfide, chlorine, ammonia, sulfur, oxidizing gases, acids, alkalis, salts, or near combustible materials.
- In areas exposed to grinding fluid, oil mist, iron dust, or cuttings, select a model equipped with an oil seal.
- Keep the motor away from heat sources such as furnaces.
- Do not use the motor in enclosed environments. Enclosed spaces can cause overheating and reduce the motor's service life.

2.2.2 Environmental Conditions

If there is a risk of water dripping in the equipment installation environment (excluding the motor shaft end), verify whether the motor's ingress protection (IP) rating meets the operational requirements. When the motor shaft penetration area may be exposed to oil splashing, a servo motor equipped with an oil seal must be selected.



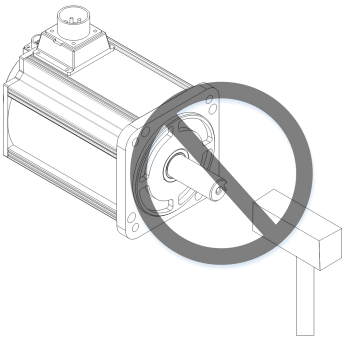
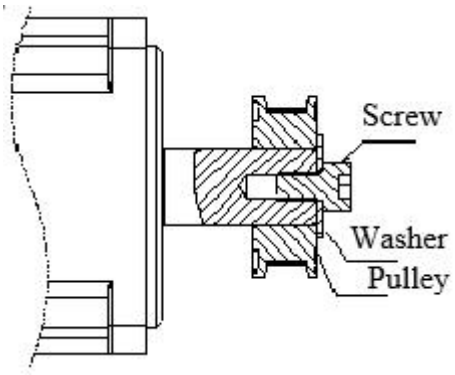
The MS6 series servo motors are designed for indoor use. Operate the motor under the following environmental conditions：

Item	Description
Ambient Temperature	-10℃~40℃(non-freezing)
Ambient Humidity	20%~90%RH(non-condensing)

Item	Description
Storage Temperature	-20℃~60℃
Storage Humidity	20%~90%RH(non-condensing)
Vibration Resistance (Vibration Acceleration)	Radial：49m/s^2 Axial：24.5m/s^2
Altitude	≤ 1000 m. Derate by 1% for every 100 m above 1000 m
Cooling Method	Air-cooled / Liquid-cooled / Natural convection
Protection Rating	IP54 (200-frame and larger motors) IP65 (100-180 frame MS6H series motors) IP67 (80-frame and smaller motors; 100-180 frame non-MS6H series motors)

- The vibration intensity acting on the servo motor varies depending on the application. Always verify the vibration acceleration with the actual product.
- The specified protection ratings are achieved only when the motor and compatible cable are correctly mated and securely locked.

2.2.3 Installation Precautions

Item	Description
Rust Prevention	◆ Before installation, completely wipe off the anti-rust agent from the motor shaft extension and apply appropriate anti-corrosion treatment.
Encoder Caution	◆ Do not impact the shaft extension during installation, as this may damage the internal encoder. 
	 ◆ Before installing a pulley on the servo motor, ensure all components (servo

Item	Description
	motor, pulley, shim, screws, etc.) are complete and undamaged. Prepare suitable tools (e.g., wrenches). ◆Align the pulley's bore with the motor shaft and push it on smoothly to ensure concentricity. ◆Place a shim of the correct specification over the motor shaft to compensate for tolerances, increase friction, and prevent loosening. ◆Finally, insert the screw into the threaded hole and gradually tighten it against the shim and into the pulley to secure the pulley firmly.

2.3 Servo Cable Installation

The MS6 series servo motors utilize communication-type encoders. Improper use or adverse environmental conditions may lead to unpredictable effects. The following points must be observed when installing optional power and encoder cables.

2.3.1 Selecting Xinje Cables

Our standard cable materials include regular and high-flexibility types. For motors of frame size 80 and below, compatible cable connectors are available in aviation plug and AMP types. For motors above frame size 80, the compatible cable connectors are aviation plug type.

For standard applications, strictly adhere to the specifications provided by Xinje (see section 2.3.2 Xinje Cable Specifications) when selecting cables from other manufacturers.

For non-standard applications, select cables from other manufacturers that meet or exceed Xinje's current specifications based on the actual conditions.

Standard Application Considerations:

- Keep the pulse command signal cable length below 3 meters.
- Keep encoder cable lengths within 20 meters. For lengths exceeding 20 meters, special cables are recommended. The encoder cable's cross-sectional area depends on the required length. Longer cables have higher resistance, leading to greater voltage drop or signal distortion, potentially causing lost pulses or undetected signals. Generally, use custom special cables for lengths over 20 meters.
- The power cable's cross-sectional area depends on the motor's current. Typically, select an area equal to 1/10 of the motor's maximum current (e.g., 6 mm² for a 60A motor).
- If interference occurs, separate high-power and low-power cables. It is advised to route power cables separately from encoder and signal cables.
- Ensure proper grounding of the servo drive and motor. Grounding resistance should not exceed 4 Ω, with a grounding depth greater than 2 meters. Use 4x40 galvanized angle steel or a 40mm diameter galvanized steel pipe.
- For customer-made cables, refer to Xinje's specifications (section 2.3.2). Ensure reliable soldering, avoiding cold joints, bridges, wrong connections, or missed spots. Test continuity between both ends after soldering.

Non-Standard Application Considerations:

1）Cable Dragging and Bending:

- Avoid bending cables or subjecting them to tension. Signal cable cores are only 0.2mm or 0.3mm in diameter and break easily. Handle with care.
- Use high-flex cables for moving applications. Standard cables are prone to damage under repeated bending. Integral cables on small motors (below frame size 80) are not suitable for moving applications.

When using cable carriers:

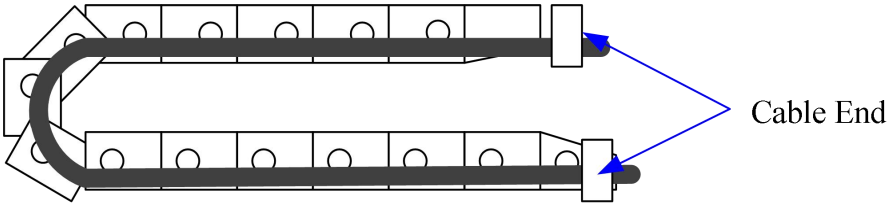
① Maintain a bending radius of at least 10 times the cable's outer diameter；

② Do not clamp or bundle cables inside the carrier; only secure them at the fixed ends outside the carrier.

③ Prevent cables from twisting or tangling.

④ Keep the fill ratio inside the carrier below 60%.

⑤ Do not mix cables with significantly different sizes to prevent crushing thinner cables. If mixing is necessary, use partitions within the carrier.



2）Oily or Humid Environments

- It is recommended to select cables with aviation-style connectors; the use of AMP-style interface cables is discouraged.
- If AMP-style cables are already deployed on-site, appropriate protective measures (such as applying silicone sealant or wrapping with insulating tape) must be implemented.
- Use specially rated cables for these conditions.

3）Environments with Interference or High Current/Power (e.g., Welding Equipment)

- Ensure the motor is correctly grounded.
- Ground high-current equipment separately.
- Employ proper cabling routing, such as separating power and signal cables.
- Shield encoder cables with metal shielding or add ferrite cores to suppress interference.

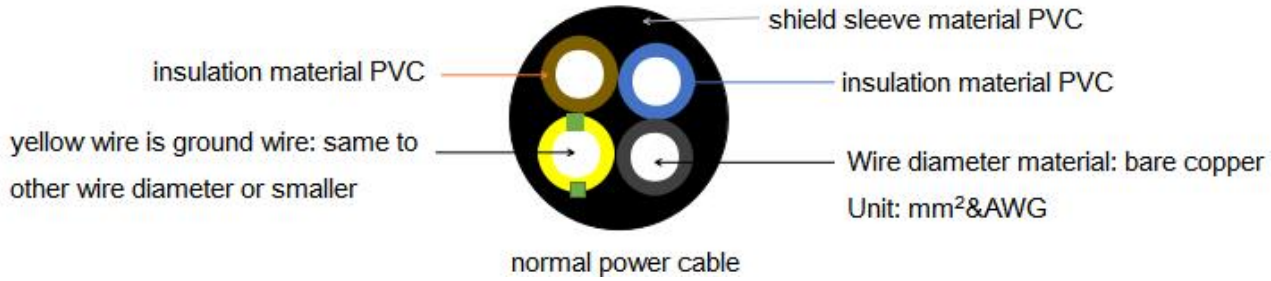
4）Low-Temperature or High-Temperature Environments

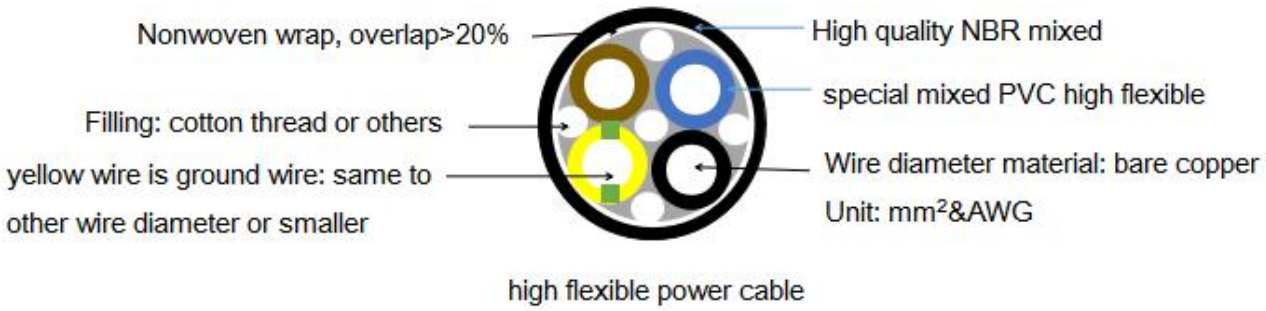
- Select cables (special types) rated for the specific operating temperature conditions.

2.3.2 XINJE Cable Specifications

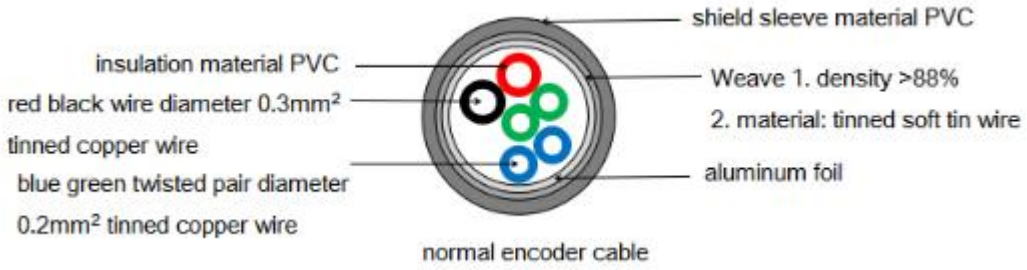
1）XINJE Cable Material Composition

Cross-sectional diagrams of the cables (encoder, power) are provided. These diagrams correspond to descriptions of the sheath material, conductor gauge/size, core material, and shielding layer material.





high flexible power cable



normal encoder cable

high flexible encoder cable

2）Cable Gauge Specifications

Frame Size	Encoder Cable Diameter		Power Cable Diameter		
	Overall Diameter (Standard)	Individual Conductor	Overall Dia. (mm) (Non-brake/Brake)	Power Core Gauge (mm²)	Brake Core Gauge (mm²)
40 Motor Frame	6 mm	15m below：3P*0.2 mm² 15m~30m：2P*0.2 mm²+1P*0.34 mm² 30m~50m：2P*0.2 mm²+1P*0.4 mm²	Standard / High-flex: 5.2/5.8 mm	4*0.3 mm²	2*0.3 mm²
60、80 Motor Frame			Standard / High-flex: 6.2/6.5 mm	4*0.5 mm²	
100、110、130 Motor Frame	6.2 mm		Standard：9.4/9.4mm High-flex: 9.6/9.6 mm	4*1.5 mm²	
180 Motor Frame 3kW			Standard：9.7/9.8 mm High-flex: 9.8/9.8 mm	4*2.0 mm²	
180 Motor Frame 3kW above			Standard：14.5/14.5 mm High-flex:15.8/15.8 mm	3*6.0mm²+1*2.5 mm²	
200 Motor Frame 13、17kW	7.9 mm		Standard：14.5mm High-flex：15.5mm		

200 Motor Frame 21kW			Standard：19.6mm	4*10.0mm²	
200 Motor Frame 27kW			Standard：20mm	3*12.0mm²+ 1*4 mm²	
265 Motor Frame 32kW			Standard：22mm	4*16.0mm²	
265 Motor Frame 45kW			Standard：29mm	3*30.0mm²+ 1*16 mm²	

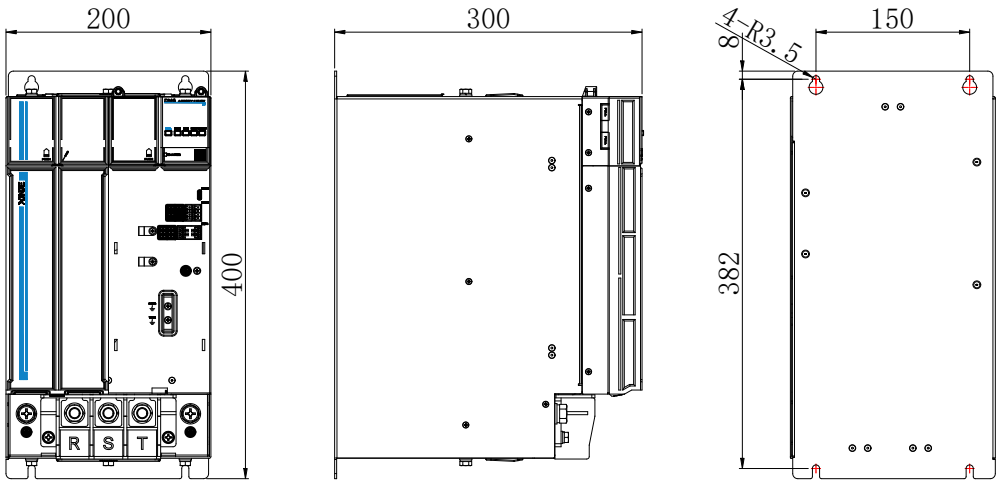
For encoder cables of 15 meters and longer, the power wires (5V and GND) must have an increased gauge to prevent voltage drop over the long distance, which could affect encoder signal transmission.

3）Cable Technical Specifications

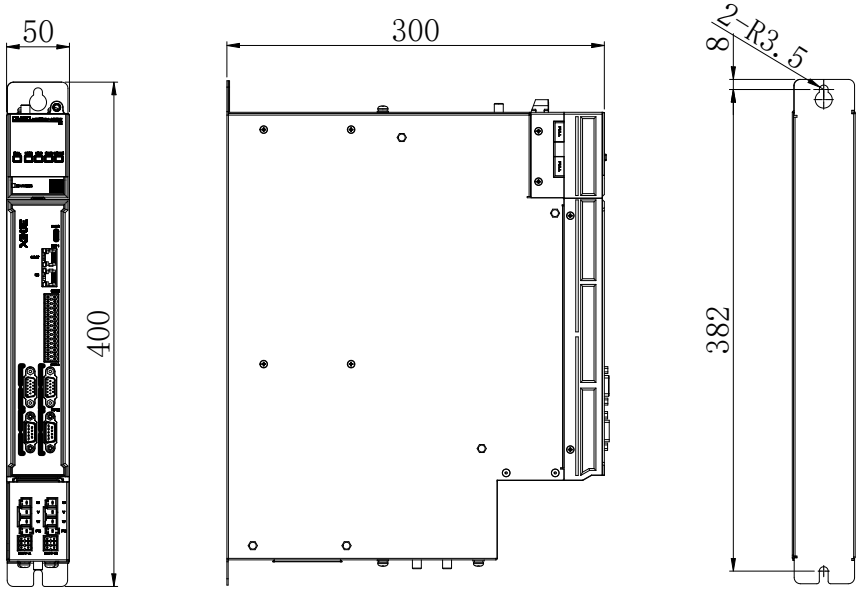
Cable Type	Cable Performance Specifications		Cable Installation Specifications	
	Temperature Rating	Voltage Withstanding	Fixed Installation	Moving Installation
Standard Cable	-20℃~80℃	2000V/min	≥5*D	/
High-Flex Cable	-20℃~80℃	2000V/min		If travel ≤ 2m and R ≥ 7.5 × D, then N ≥ 3 million cycles; If travel ≤ 2m and R ≥ 10 × D, then N ≥ 5 million cycles
Note: D = Finished Cable Diameter, R = Bending Radius, N = Flexing Cycle Life.				

2.4 Servo Drive Outline Dimensions

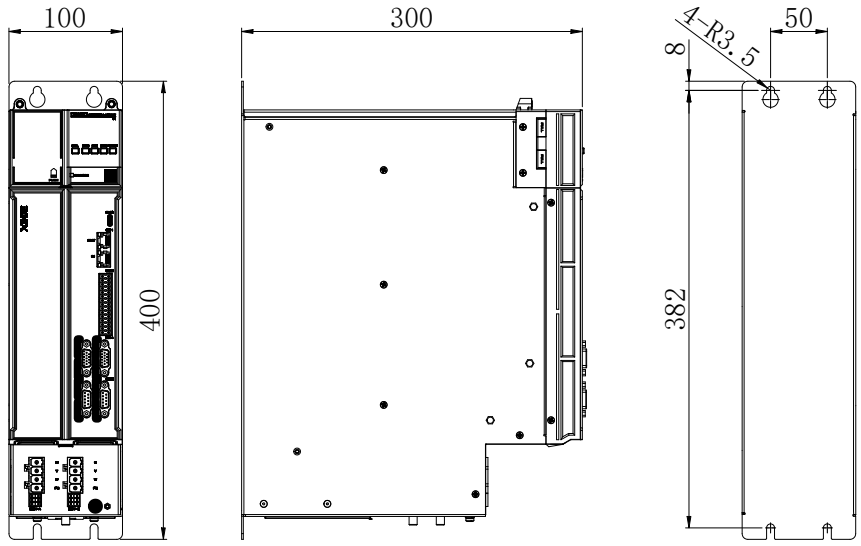
■ DM6-4110P0-R unit：mm



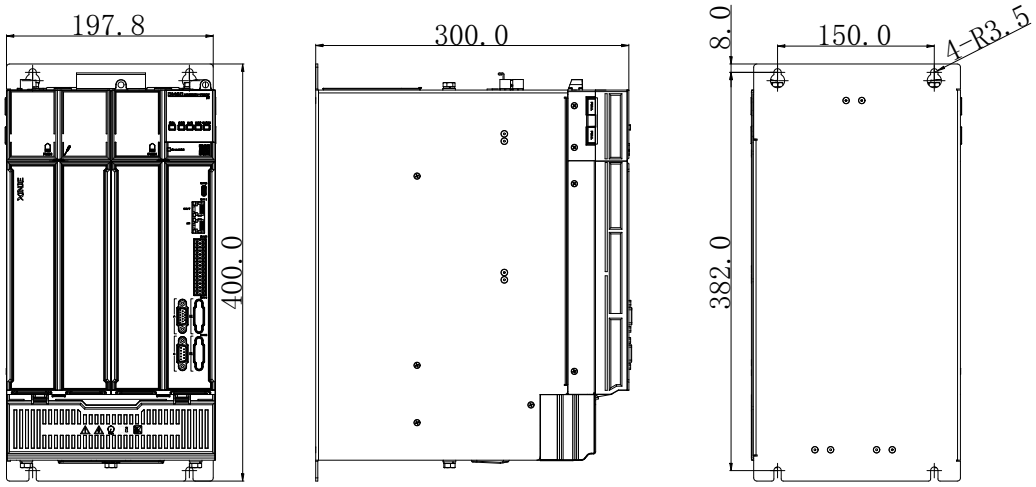
■ DM6C-40P4-M、DM6C-40P7-M、DM6C-43P0-M unit：mm



■ DM6C-45P5-M、DM6C-47P5-M、DM6C-415P0-M unit：mm

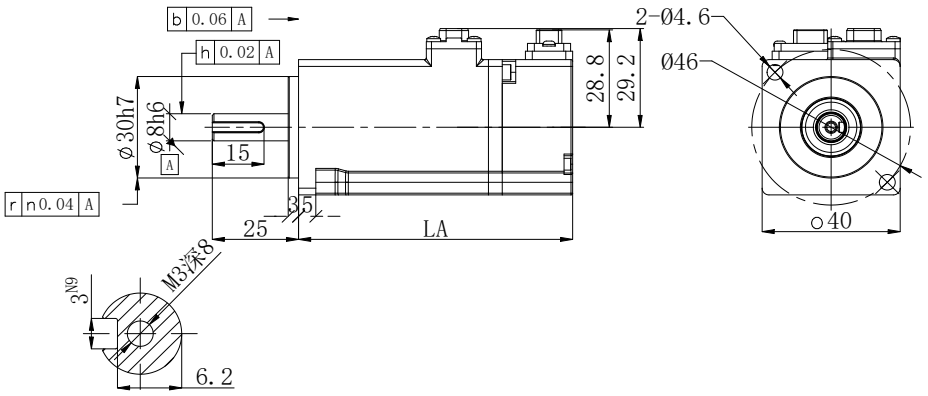


■ DM6C-445P0S-M、DM6C-455P0S-M、DM6C-475P0S-M unit：mm



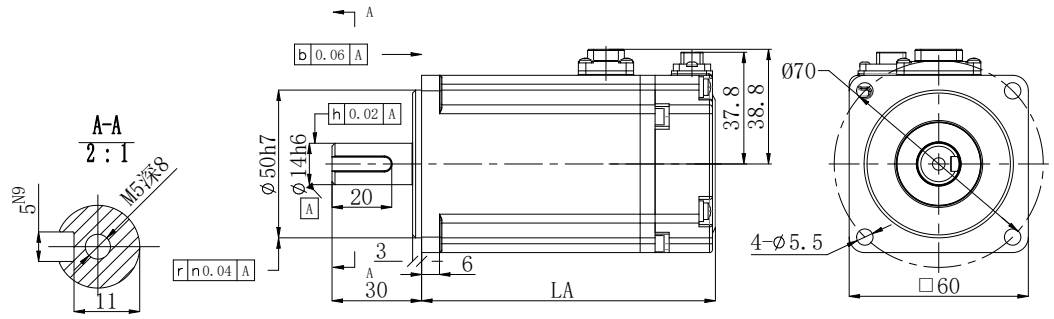
2.5 Outline Dimensions of Servo Motor

■ Mounting Dimensions for 40 Frame Size Motor unit：mm



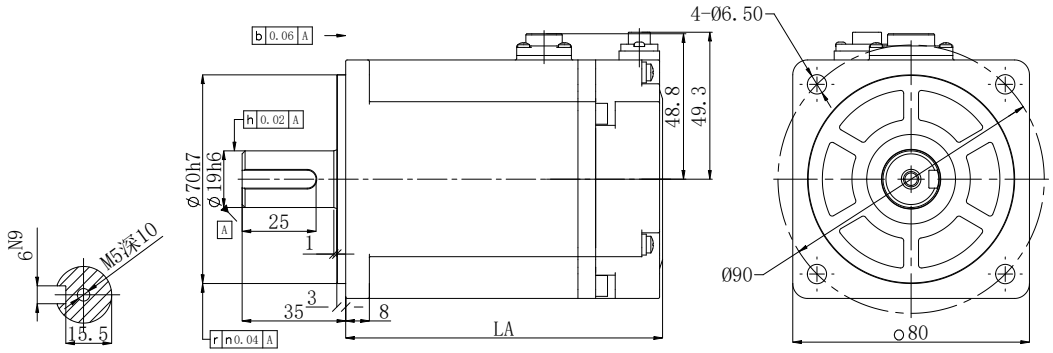
Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6H-40CN30B□3-20A5-S	60.8	93.4	High Inertia
MS6H-40CN30B□3-20P1-S	77.4	110	
MS6H-40TH30B□3-20A5-S	62.8	95.4	
MS6H-40TH30B□3-20P1-S	79.4	112	

■ Mounting Dimensions for 60 Frame Size Motor unit：mm



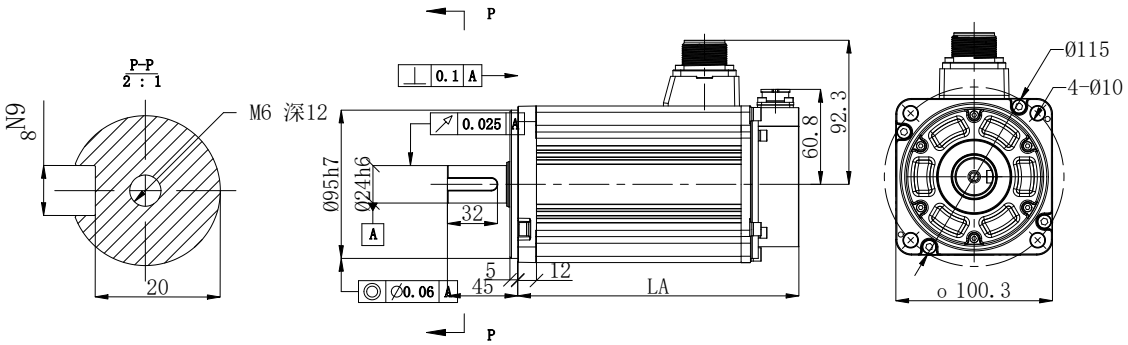
Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6H-60CN30B□3-20P2	76.4	99.15	High Inertia
MS6H-60CN30B□3-20P2-S	66.7	93.5	
MS6S-60CN30B□3-20P4	98.4	121.15	Low Inertia
MS6S-60CN30B□3-20P4-S	88.7	115.5	
MS6S-60TH30B□3-20P4	97.4	121.2	
MS6S-60TH30B□3-20P4-S	97.4	121.2	
MS6H-60CN30B□3-20P4	98.4	121.15	High Inertia
MS6H-60CN30B□3-20P4-S	80.2	106.95	
MS6H-60TH30B□3-20P4	98.4	121.15	
MS6H-60TH30B□3-20P4-S	80.2	106.95	

■ Mounting Dimensions for 80 Frame Size Motor unit：mm



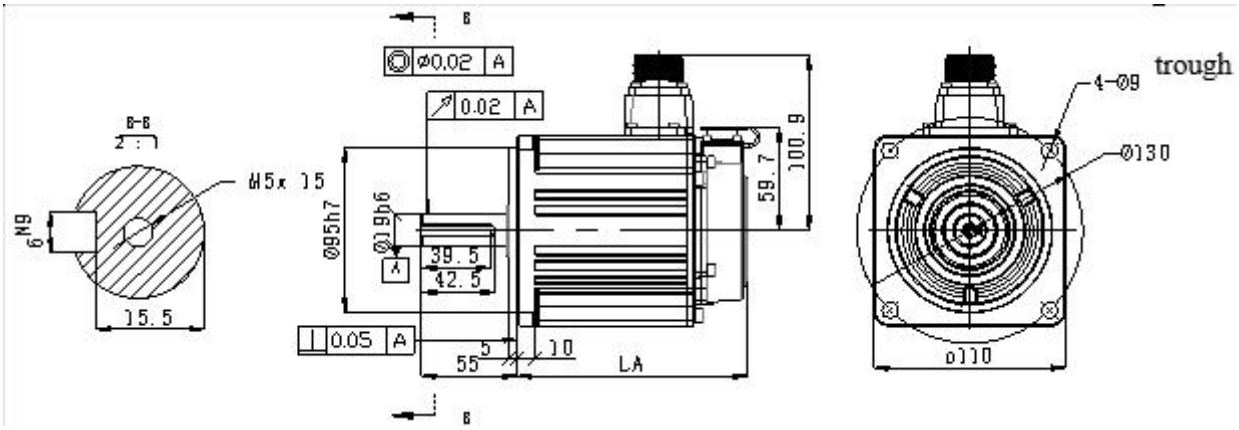
Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6S-80CN30B□3-20P7	107.1	132.1	Low Inertia
MS6S-80CN30B□3-20P7-S	95	126.9	
MS6S-80TH30B□3-20P7	107.1	132.1	
MS6S-80TH30B□3-20P7-S	106.1	138	
MS6H-80CN30B□3-20P7	107.1	132.1	High Inertia
MS6H-80CN30B□3-20P7-S	89.2	121.1	
MS6H-80TH30B□3-20P7	107.1	132.1	
MS6H-80TH30B□3-20P7-S	100.3	132.2	
MS6S-80CN30B□3-21P0	117.6	142.6	Low Inertia
MS6S-80TH30B□3-21P0	117.6	142.6	
MS6H-80CN30B□3-21P0	134	159	High Inertia
MS6H-80CN30B□3-21P0-S	112.5	144.4	
MS6H-80TH30B□3-21P0	134	159	
MS6H-80TH30B□3-21P0-S	123.6	155.5	

■ Mounting Dimensions for 100 Frame Size Motor



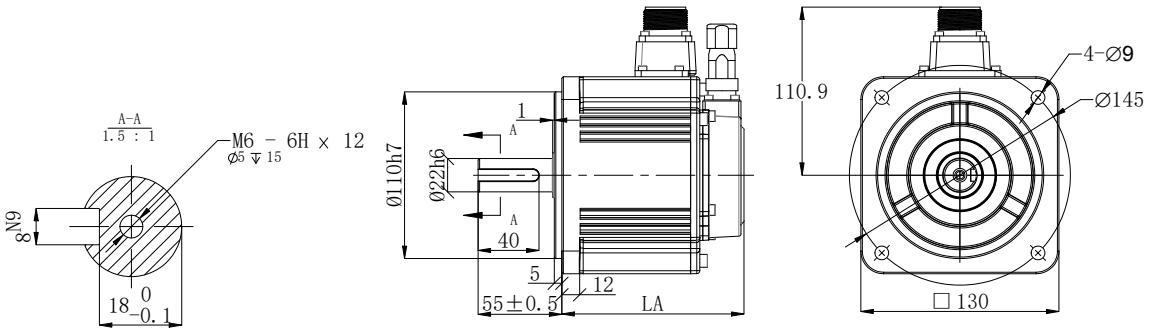
Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6L-100CN30B□2-□1P5	180	205	Ultra-Low Inertia
MS6L-100TH30B□2-□1P5	193	218	
MS6L-100CN30B□2-42P5	228	253	
MS6L-100TH30B□2-42P5	241	266	

■ Mounting Dimensions for 110 Frame Size Motor

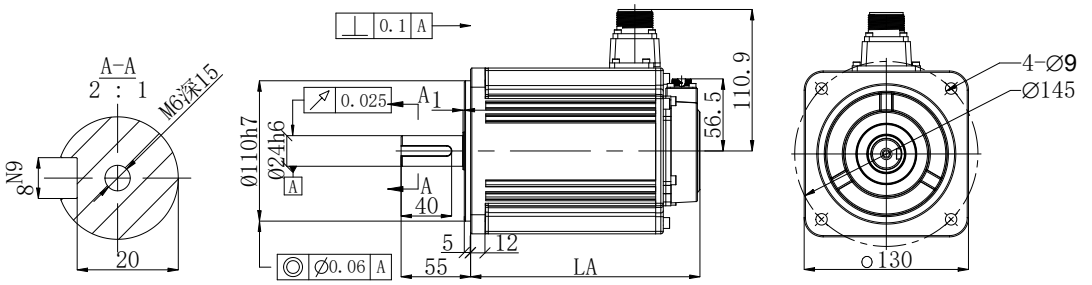


Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6G-110CN30B□2-□1P5	132.5	163.5	Medium Inertia
MS6G-110TH30B□2-□1P5	149	180	

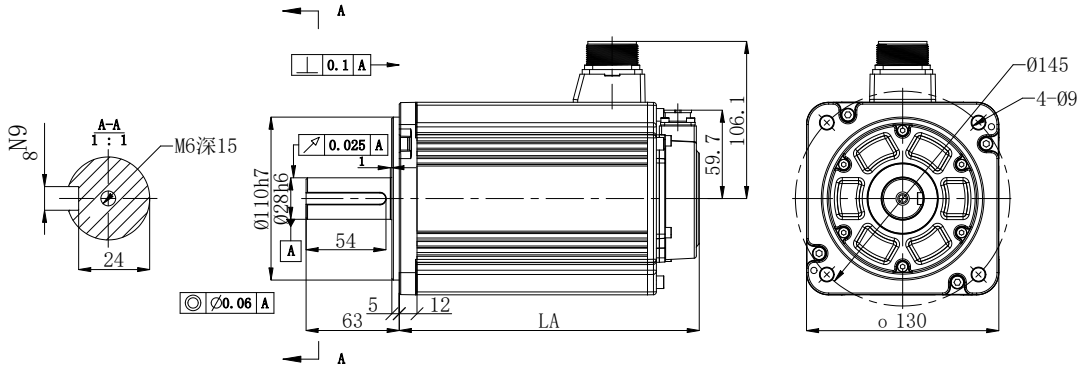
■ Mounting Dimensions for 130 Frame Size Motor unit：mm



Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6G-130CN15B□2-□0P8	133.5	162.5	Medium Inertia
MS6G-130TH15B□2-□0P8	150	179	
MS6G-130CN25B□2-□1P0	119.5	148.5	
MS6G-130TH25B□2-□1P0	136	165	
MS6G-130CN20B□2-□1P5	133.5	162.5	
MS6G-130CN15B□2-□1P5	151.5	180.5	
MS6G-130TH20B□2-□1P5	150	179	
MS6G-130TH15B□2-□1P5	168	197	
MS6G-130CN15E□2-□2P3	181.5	210.5	
MS6G-130TH15E□2-□2P3	198	227	

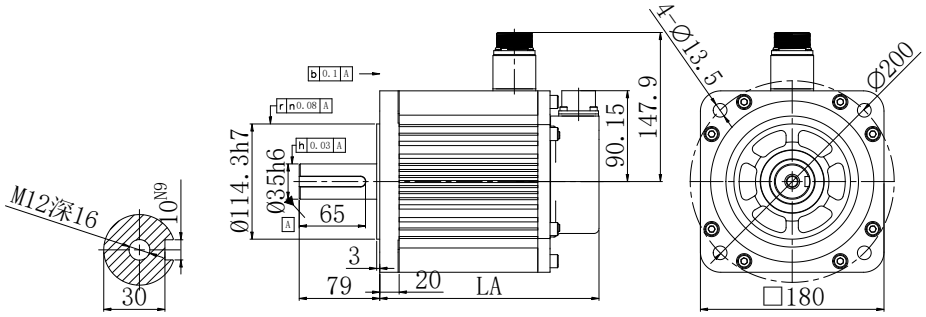


Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6G-130CN15B□2-□2P3	181.5	210.5	Medium Inertia
MS6G-130TH15B□2-□2P3	198	227	

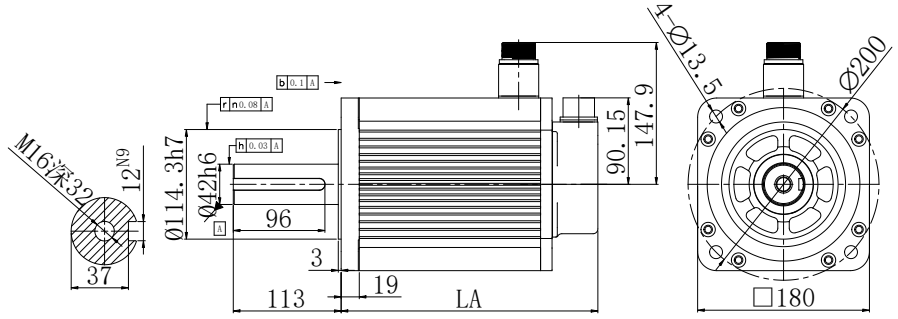


Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6S-130CN30B□2-43P0	202.8	231.8	Low Inertia
MS6S-130TH30B□2-43P0	219.3	248.3	
MS6S-130CN30B□2-45P0	257.8	298.5	
MS6S-130TH30B□2-45P0	274.3	315	
MS6S-130CN30B□2-47P0	321.8	362.5	
MS6S-130TH30B□2-47P0	338.3	379	

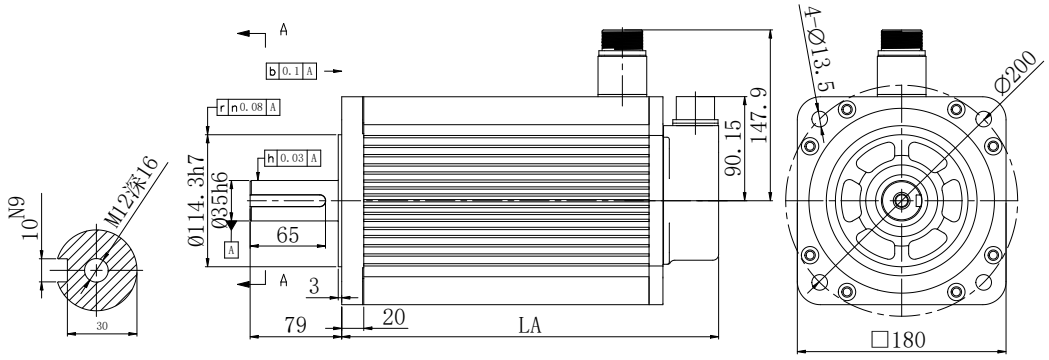
■ Mounting Dimensions for 180 Frame Size Motor unit：mm



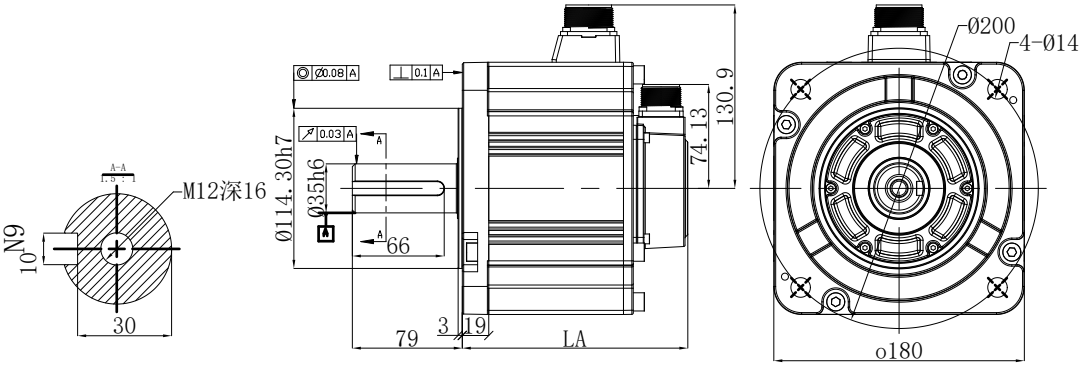
Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6H-180CN15B□2-43P0	215	255	High Inertia
MS6H-180CN15B□2-44P4	247	287	



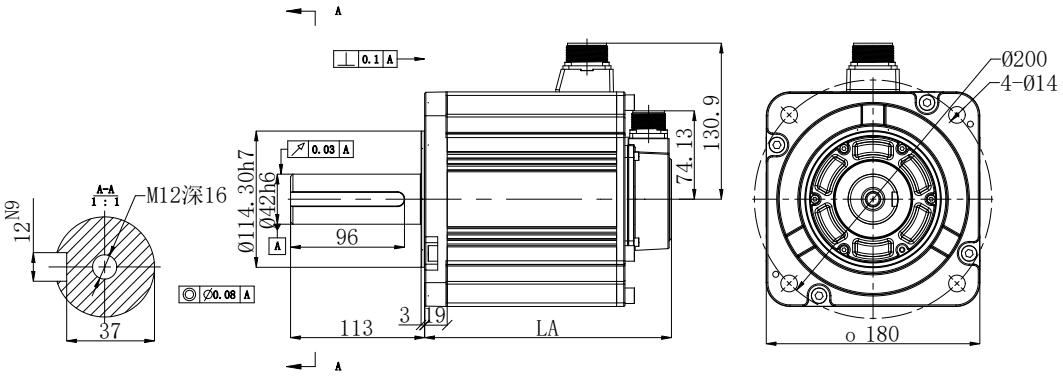
Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6H-180CN15B□2-45P5	269	309	High Inertia
MS6H-180CN15B□2-47P5	325	365	



Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6H-180CN15E□2-45P5	269	309	High Inertia
MS6H-180CN15E□2-47P5	325	365	

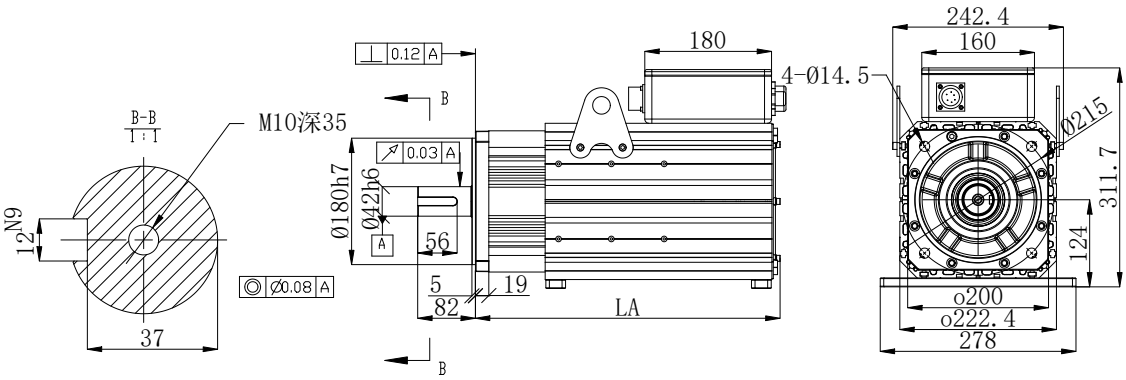


Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6G-180CN15B□2-43P0	162	206.5	Medium Inertia
MS6G-180CN15B□2-44P4	185	229.5	
MS6G-180TH15B□2-43P0	176.5	221	
MS6G-180TH15B□2-44P4	199.5	244	

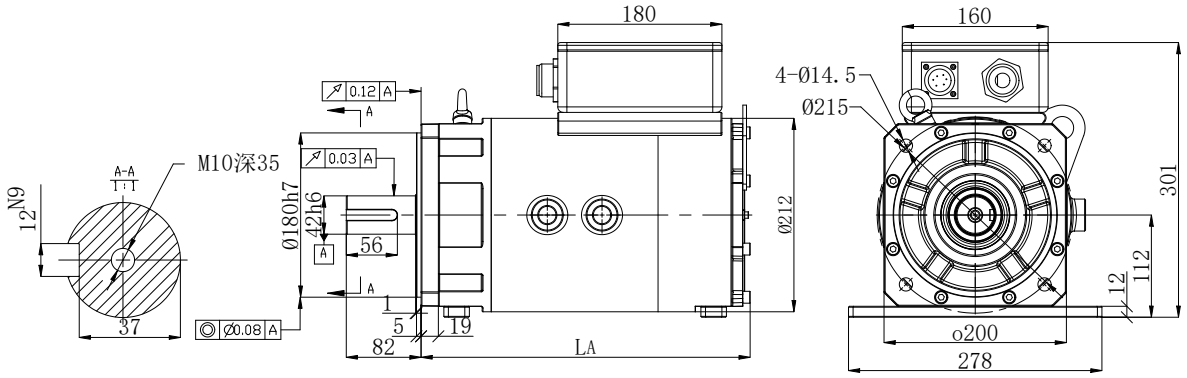


Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6G-180CN15B□2-45P5	208	252.5	Medium Inertia
MS6G-180CN15B□2-47P5	256	300.5	
MS6G-180TH15B□2-45P5	222.5	267	
MS6G-180TH15B□2-47P5	270.5	315	

■ Mounting Dimensions for 100 Frame Size Motor unit：mm



Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6G-200TH17B□2-413P0-F	433	512	Medium Inertia
MS6G-200TH17B□2-417P0-F	468	545.5	
MS6G-200TH17B□2-421P0-F	503	580.7	
MS6G-200TH17B2-427P0-F	536.4	615.7	



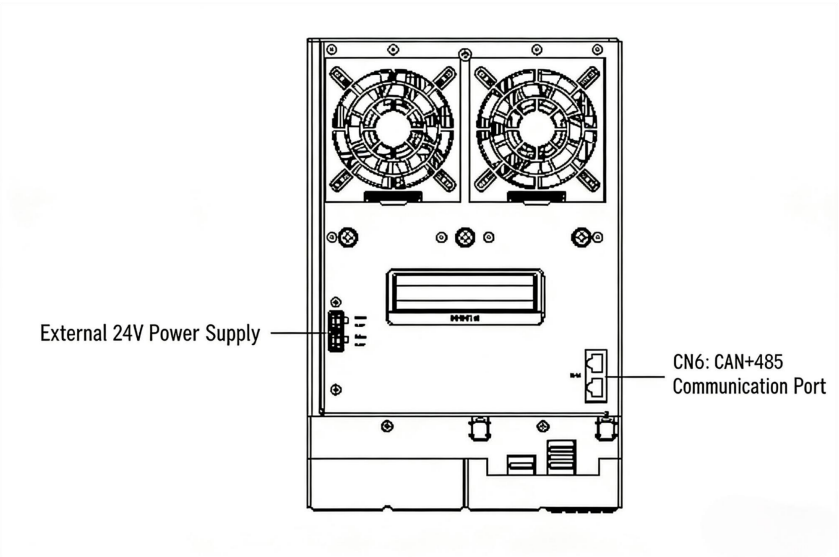
Motor Model	LA±1		Inertia Class
	Standard	With Brake	
MS6G-200TH17B2-413P0-Y	361	/	Medium Inertia
MS6G-200TH17B2-417P0-Y	396	/	
MS6G-200TH17B2-421P0-Y	431	/	
MS6G-200TH17B2-427P0-Y	166	/	

3. Wiring of the Servo System

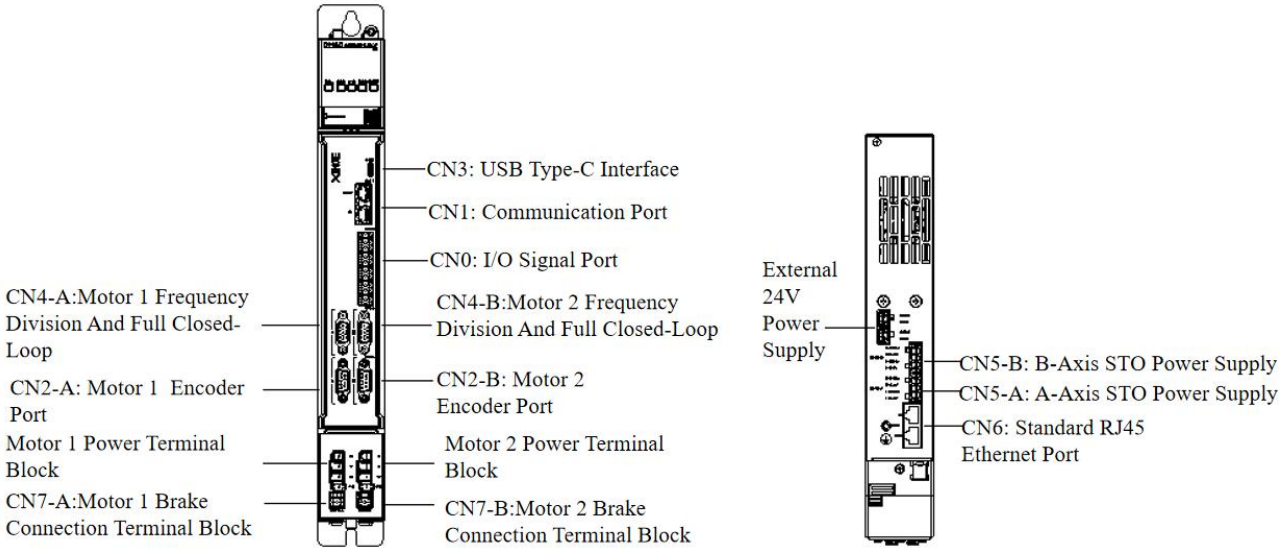
3.1 Main Circuit Wiring

3.1.1 Terminal Arrangement of Servo Driver

- Rectifier unit DM6-4110P0-R



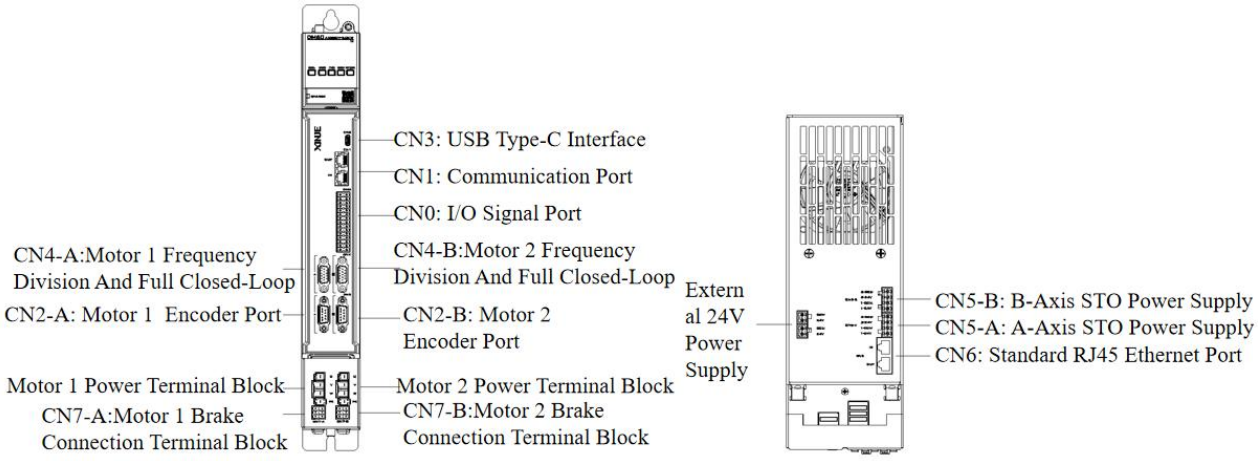
■ DM6C-40P4/40P7/43P0(-S)-M inverter module



First-person perspective, top-down view

First-person perspective, top-down view

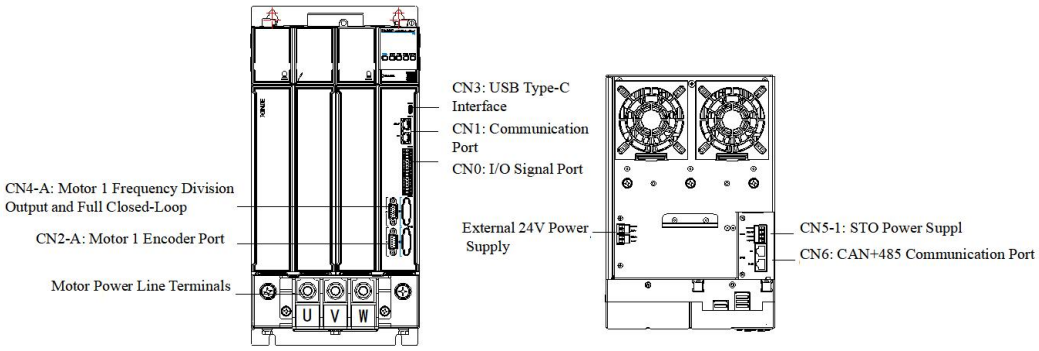
■ DM6C-45P5/47P5/415P0(-S)-M inverter module



First-person perspective, top-down view

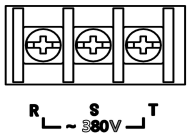
First-person perspective, top-down view

■ DM6C-445P0S/455P0S/475P0S-M Inverter Module



First-person perspective, top-down view

3.1.2 Main Circuit Terminals and Their Descriptions



■ DM6-4110P0-R

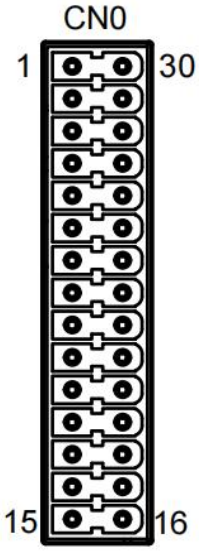
From left to right, the main circuit terminal functions are as follows:

terminal	function	explain
R、S、T	Main circuit power input terminal	Three-phase AC 380-440V,50/60Hz

3.2 Terminal Description

3.2.1 CN0 Terminal Specifications (Input/Output Terminals)

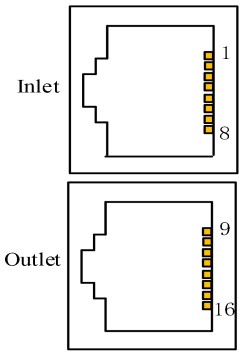
The connector numbers below are in the order from the inverter module panel.



number	name	explain	number	name	explain
1	SI1+	Axis A SI1+ (high-speed)	16	SO4-	Axis B SO4-
2	SI1-	Axis A SI1- (high speed)	17	SO4+	Axis B SO4+
3	SI2+	Axis A SI2+ (high speed)	18	COM	Axis B output terminal ground
4	SI2-	Axis A SI2- (high-speed)	19	SO3	Axis B SO3
5	SI3	Axis A SI3	20	SO2	Axis B SO2
6	SI4	Axis A SI4	21	SO1	Axis B SO1
7	SI5	Axis A SI5	22	+24VI	Axis B Input +24V
8	SI6	Axis A SI6	23	SI6	Axis B SI6
9	+24V	Axis A Input +24V	24	SI5	Axis B SI5
10	SO1	Axis A SO1	25	SI4	Axis B SI4
11	SO2	Axis A SO2	26	SI3	Axis B SI3
12	SO3	Axis A SO3	27	SI2-	Axis B SI2- (high-speed)
13	COM	Axis A output terminal ground	28	SI2+	Axis B SI2+ (high speed)
14	SO4+	Axis A SO4+	29	SI1-	Axis B SI1- (High-speed)
15	SO4-	Axis A SO4-	30	SI1+	Axis B SI1+ (high-speed)

- Input/output terminals: 4 high-speed pulse inputs and 8 standard IO inputs; outputs include 6 standard IO ports and 2 dry contact outputs. Pins 1-4 and 27-30 are dedicated to high-speed pulses (up to 10 Mbit/s), while the remaining pins handle low-speed pulses (up to 10 Kbit/s).
- For inverters rated at 32kW or higher, use single-axis configuration, with only the A-axis terminals (1-15) functional in the driver.

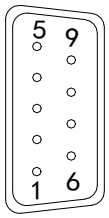
3.2.2 Terminal Specifications for CN1 (EtherCAT Communication)



number	name	number	name
1	TX A+	9	TX B+
2	TX A-	10	TX B-
3	RX A+	11	RX B+
4	-	12	-
5	-	13	-
6	RX A-	14	RX B-
7	-	15	-
8	-	16	-

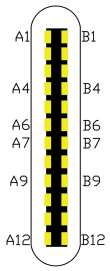
3.2.3 Terminal Specifications for CN2 Encoder

■ The terminal arrangement of the encoder socket on the CN2 driver body is as follows:



order number	definition	order number	definition
1	temperature transducer -	6	GND
2	temperature transducer +	7	
3	485-B	8	+5V
4	485-A	9	
5	shielding layer	/	/

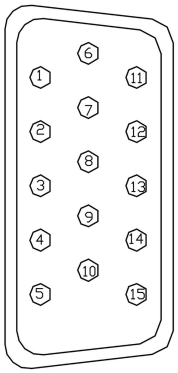
3.2.4 Terminal Specifications for CN3 (USB Type-C Interface)



order number	definition	order number	definition
A1	GND	B1	GND
A4	USB-VBUS	B4	USB-VBUS
A6	USB-D+	B6	USB-D+
A7	USB-D-	B7	USB-D-
A9	USB-VBUS	B9	USB-VBUS
A12	GND	B12	GND

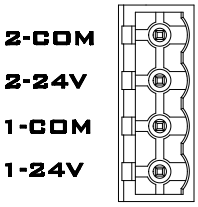
The USB Type-C hardware interface supports dual-sided insertion with a maximum standard transmission distance of 15 meters. Default communication parameters: baud rate 115200bps, 8-bit data, 1-bit stop, and parity check. Hot-swapping is supported.

3.2.5 Terminal Specifications for CN4 (Frequency-Divided Output and Full Closed-Loop Signal Terminals)



number	name	explain	number	name	explain
1	QBH-A+	Fully	9	FPA+	Encoder frequency
2	QBH-A-	Fully	10	FPA-	Encoder frequency
3	GND	grating ruler	11	FPB+	The encoder outputs a
4	QBH-B+	Fully	12	FPB-	Encoder frequency
5	QBH-B-	Full	13	FPZ+	The encoder outputs a
6	QBH-Z+	Fully	14	FPZ-	Encoder frequency
7	QBH-Z-	Full	15	5V	The grating scale is
8	GND	grating ruler	/	/	Idle Pin

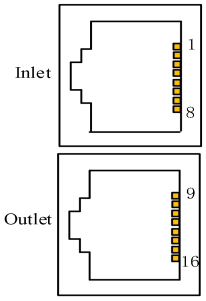
3.2.6 Terminal Specifications for CN5 (STO Signal)



name	explain
2-COM	STO2-COM
2-24V	STO2-24V
1-COM	STO1-COM
1-24V	STO1-24V

External 24V input, voltage range: within 21.6V~26.4V,0.5A.

3.2.7 Terminal Specifications for CN6 (CAN+485 Communication + Station Number Assignment)



number	name	number	name
1	CANH	9	CANH
2	CANL	10	CANL
3	GND	11	GND
4	485-A	12	485-A
5	485-B	13	485-B
6	485GND	14	485GND
7	OUT-TX	15	OUT-TX
8	OUT-RX	16	OUT-RX

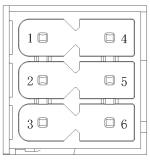
RJ45 male/female connectors compliant with CN6 standard, featuring dual isolated 485 communication channels, dual isolated CAN communication channels, and dual isolated station

number assignment interfaces.

The 485 communication operates at low speed with a baud rate not exceeding 115200 and supports 32 slave stations. By default, CAN communication supports high-speed CAN bus with a maximum baud rate of 1MHz, theoretically supporting a maximum range of 25 meters and 64-axis operation.

To ensure stable communication, a JA-ET terminal resistor can be connected to the CAN communication output port of the last inverter shaft.

3.2.8 Terminal Specifications for CN7 (Brake Terminal)



number	name	number	name
1	/	4	/
2	BK-	5	BK+
3	/	6	/

45kW/55kW/75kW inverter terminals without brake.

3.3 Classification and Function of Signal Terminals

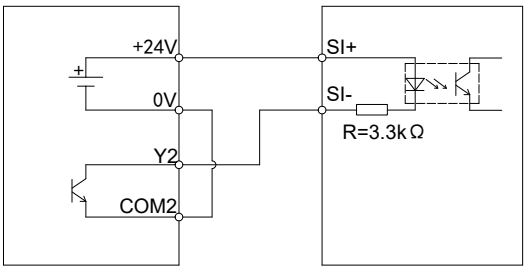
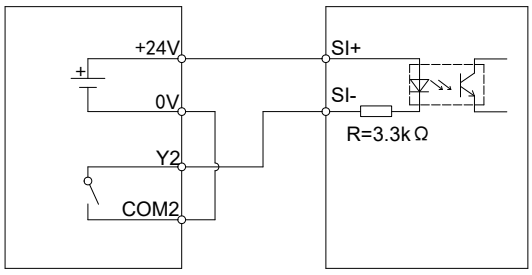
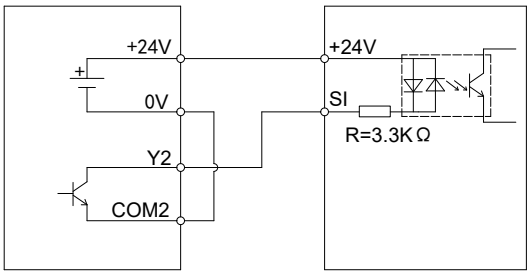
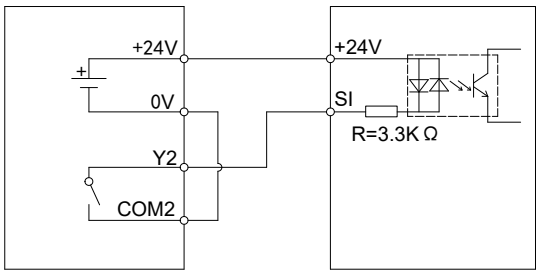
3.3.1 SI input signal

Connect using a relay or a transistor circuit with an open collector. When using a relay, select a low-current relay. If you do not use a low-current relay, poor contact may occur.

classify	input terminal	function
on-off input	SI1 ~ SI6	Multifunctional input signal terminal

The factory allocation of input terminals

terminal	SI1	SI2	SI3	SI4	SI5~SI6
function	S-ON/ enable	ALM-RST/Alarm Reset	P-OT/No forward rotation	N-OT/No reversal	unabsorbed

collector open circuit type (SI1\SI2)	Relay type (SI1\\SI2)
upper device servo driver upper device servo driver 	upper device servo driver upper device servo driver 
collector open circuit type (SI3~SI6)	**Relay type (SI3~SI6)**
upper device servo driver upper device servo driver 	upper device servo driver upper device servo driver 

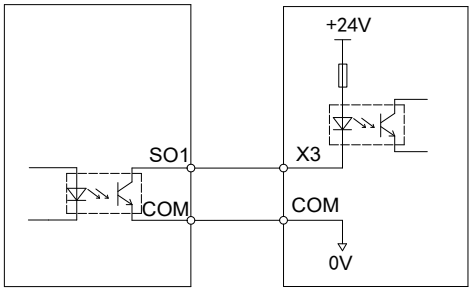
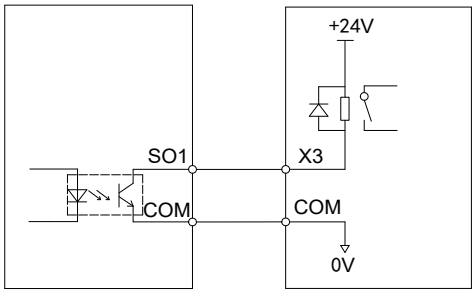
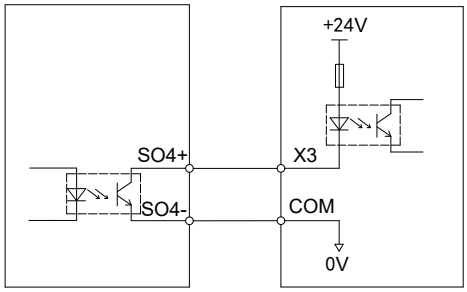
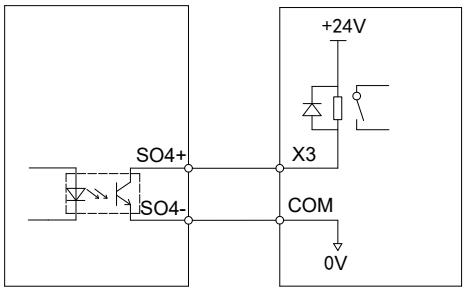
- SI1 and SI2 are high-speed SI inputs with a response time of ≤2μs. They support NPN/PNP and 24VDC, with a recommended minimum voltage of 18V and a maximum of 28V.
- Four-channel low-speed SI inputs (SI3, SI4, SI5, SI6) with a response time of ≤ 2ms, supporting both NPN and PNP configurations.

3.3.2 SO output signal

classify	leading-out terminal	function
optocoupler output	SO1 ~ SO4	multi-function output terminal

The factory allocation of output terminals

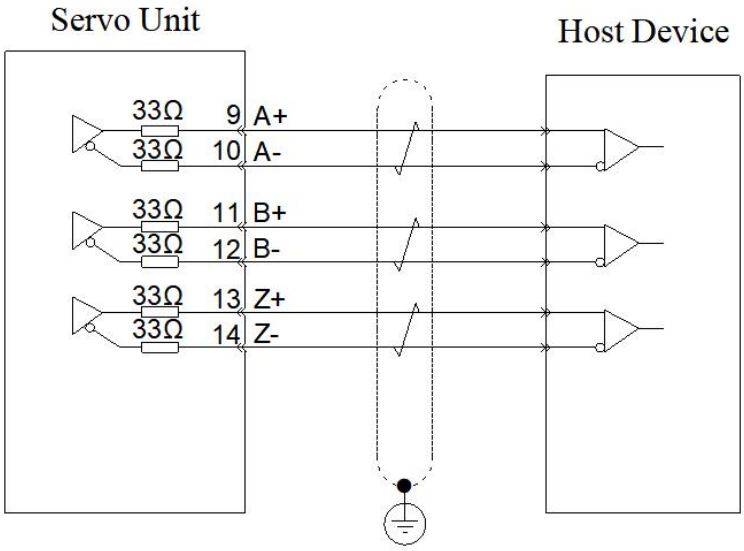
terminal	SO1	SO2	SO3~SO4
function	COIN/Location completed	ALM/ report to the police	unabsorbed

SO1-SO3 type	Relay type (SO1~SO3)
servo driver upper device servo driver upper device 	servo driver upper device servo driver upper device 
SO4 type	**Relay type (SO4)**
servo driver upper device servo driver upper device 	servo driver upper device servo driver upper device 

- SO4+ and SO4-labels;
- Maximum load voltage and current:
  Voltage: DC 30V (maximum)
  Maximum load current: 400W or less: SO1 500mA (maximum), SO2~SO4 50mA (maximum)
  750W and above: SO1 to SO4, 50mA (maximum)
- SO1~SO3 supports NPN connection only, while SO4 provides dry contact output with dual NPN/PNP connection options and low-speed SO output.

3.3.3 Encoder Feedback Output Signal

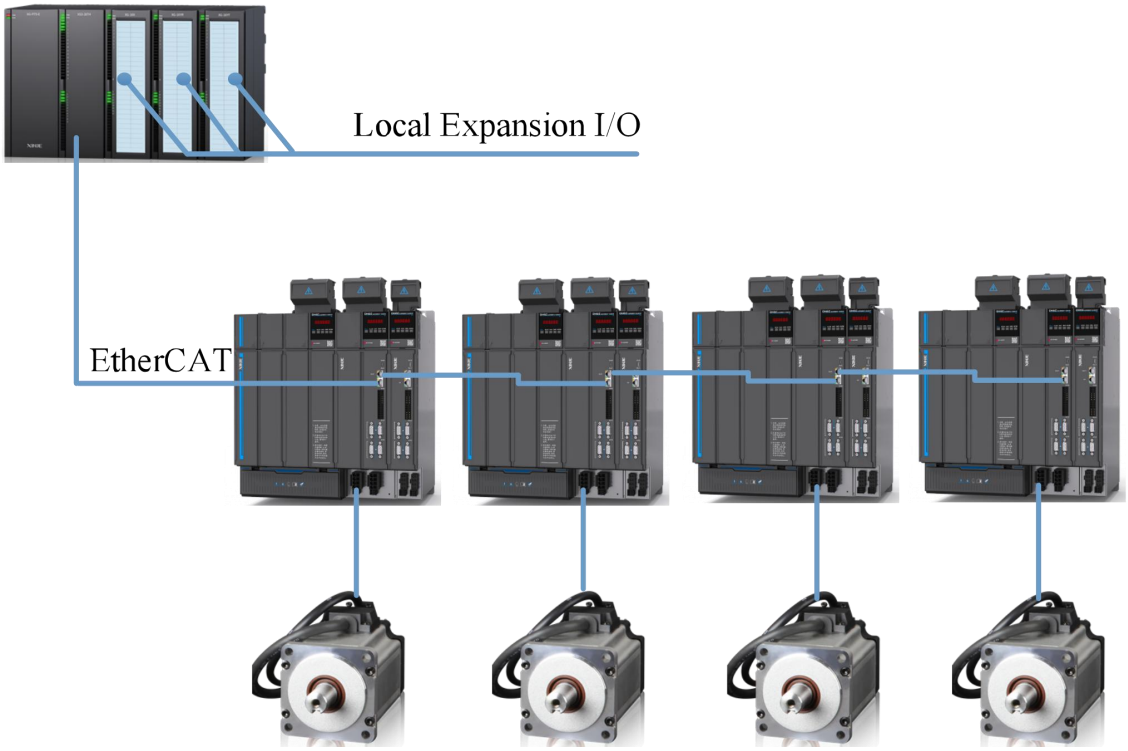
The encoder's frequency division output circuit generates differential signals via a differential driver, providing closed-loop feedback for the host device's position control system. On the host side, differential or optocoupler receiver circuits are used to receive the signals, with a maximum output current of 20mA.



3.4 EtherCAT Communication Connection Description

The EtherCAT motion control system features remarkably simple wiring. EtherCAT enables the replacement of Ethernet's star topology with a streamlined linear configuration. For instance, the Sinovent DM6C series servo motors benefit from EtherCAT's elimination of hubs and switches. Both the XG2 series PLC units and DM6C series servo motors come with built-in EtherCAT communication ports, significantly reducing the need for cables and cable trays. This simplifies wiring design and connector calibration, thereby lowering installation costs.

The EtherCAT bus recommends linear wiring. The wiring method is shown in the figure below:



Among the XG2 series PLCs, only LAN2 port supports EtherCAT communication. The two communication ports of the servo driver follow the 'bottom-in, top-out' principle: LAN2 port must connect to the IN port of the first servo, then the OUT port of the first servo connects to the IN port of the second servo, and so on.

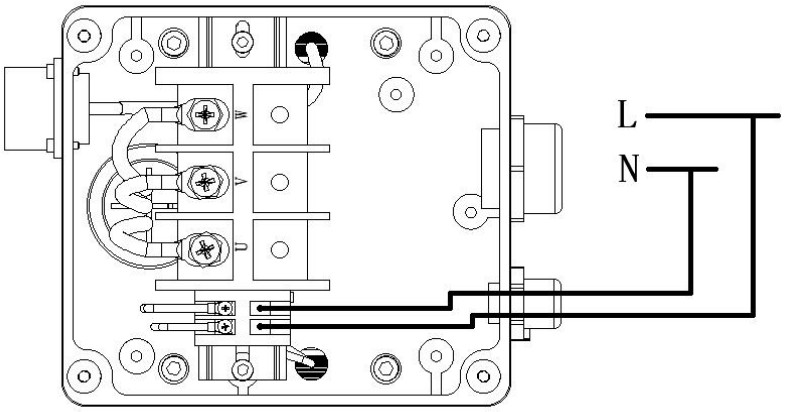
Communication signals are inevitably affected by electromagnetic interference during transmission. We recommend using industrial-grade Category 5e cables, available for purchase from our company.

Bus communication connects physical devices to the diagram.

The bus communication follows the rule of "lower in, upper out."

The definition of Ethernet interface pins is specified in Section 3.2.2 under Terminal Specifications for CN1.

3.5 High-power Motor Fan Wiring

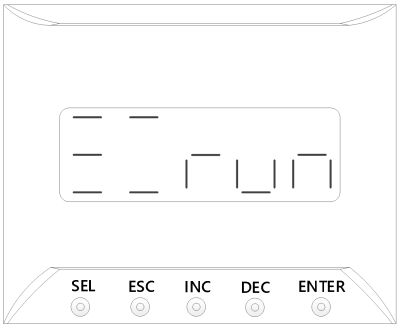


- The diagram above illustrates a wiring example for a motor fan, using the XJ Servo Motor 200 base motor as an example.
- High-power air-cooled motors rated at 11kW or above are equipped with fans. The motor's internal structure must connect to both the power supply and fan power lines during factory installation. Refer to the markings on the motor-fan connection point for the fan's voltage specifications.
- The fan's lead-out wire is pre-connected when the motor leaves the factory, and the other end is directly connected to the power supply through the fan's outlet.

4. Pre-operation of the Servo System

4.1 Basic Operations

4.1.1 Instructions for the Control Panel



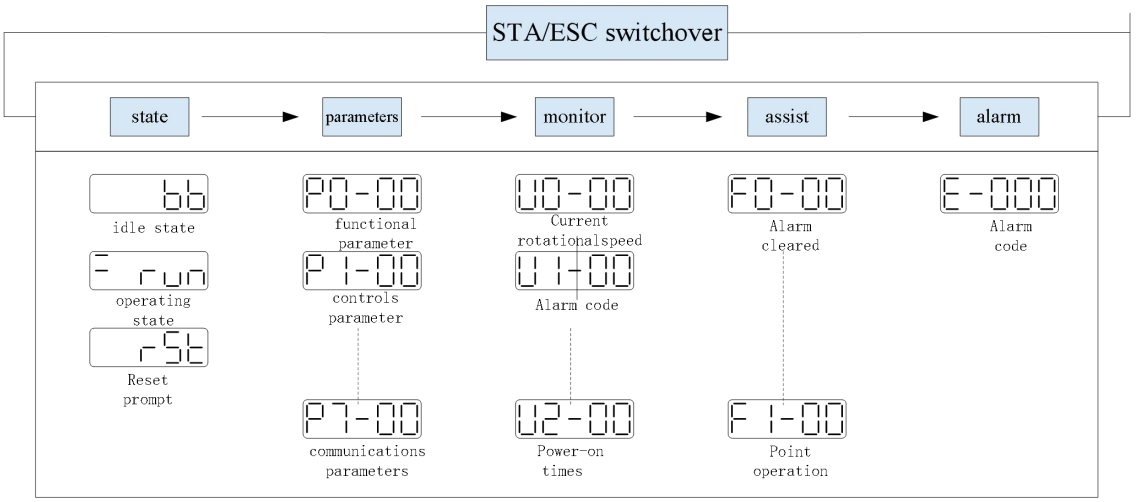
Button name	operation declaration
SEL	Short press: Switch axes, axis numbers appear on the leftmost side
ESC	Short press: Switch or return to the status
INC	Short press: Show data in ascending order. Long press: Show data in ascending order
DEC	Short press: Show data in descending order. Long press: Show data in descending order
ENTER	Short press: Shift; Long press: Set and view parameters

After powering on, the back panel performs a self-check operation, with all display digits and five decimal points illuminated simultaneously for one second.

4.1.2 Key Operations

By switching the basic states of the panel operator, you can display the operating status, set parameters, activate auxiliary functions, and check alarm status. Pressing the ESC key will sequentially switch states in the order shown in the figure below.

Status: bb indicates the servo system is idle; run indicates the servo system is operational; rst indicates the servo system requires a power cycle (the panel status display in this diagram excludes axis numbers).



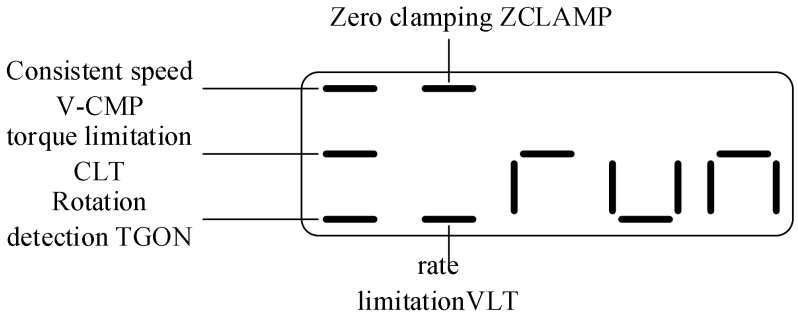
- Parameter configuration Px-xx: The first x denotes the group number, while the subsequent two x's indicate the parameter sequence number within the group.
- Monitoring status Ux-xx: The first x denotes the group number, while the subsequent two x represent the parameter sequence number within the group.
- Auxiliary function Fx-xx: The first 'x' denotes the group number, while the subsequent two 'x' indicate the parameter sequence number within the group.
- Alarm status E-xxx: The first two x's denote the major alarm category, while the last x indicates the subcategory under that category.

4.2 Description of the display status during operation

During power-on, the panel displays according to the P8-25 parameter settings.

parameter	Signal name	factory setting	Applicable mode	meaning	revise	come into force
P8-25	panel display setting	0	own	0: Normal display. Power-up displays 'bb' or 'run'. 1: The panel displays the value of U0-00 and speed feedback in rpm 2: The panel displays the value of U0-07 when powered on, with torque feedback in percentage.	at any time	Power off and power on again

■ When the speed and torque control mode is used

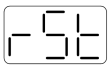
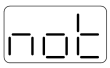
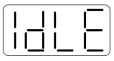


Number of digits

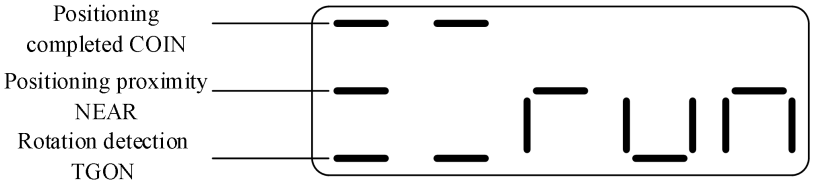
bit data	Show content
P5-39 same speed detection	The light will be on when the motor's actual speed matches the commanded speed. Detection width of synchronous signal: P5-04 (unit: rpm)
P5-42 torque limit	The light turns on when the torque exceeds the set value during speed control. Internal forward torque limit: P3-28 Internal reverse torque limit: P3-29
P5-40 rotation detection	The light will turn on when the motor speed exceeds the rotation detection speed. Rotation detection speed: P5-03 (unit: rpm)
P5-31 Zero Clamping (/ZCLAMP)	The light turns on when the zero-clamping signal activates.
P5-43 velocity limit	The light turns on when the speed exceeds the set value during torque control. Forward speed limit during torque control: P3-16; Reverse speed limit:

	P3-17.

Display content in abbreviated code

Display content in abbreviated code	Show content
	In standby mode Servo off state. (The motor is not powered)
	in service Servo enabled state. (The motor is powered on)
	Reset state required The server needs to be powered on again
	Forbidden forward drive state P-OT ON state. Refer to Section 5.3.2.
	Disable reverse drive state N-OT ON state. Refer to Section 5.3.2.
	Control mode 2 is empty

■ When in position control mode

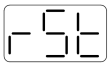
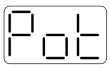
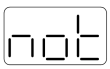
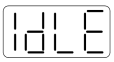


Number of digits

bit data	Show content
P5-38 End of Positioning (/COIN)	When the position is controlled, the light will turn on if the given position matches the actual position. Positioning width: P5-00 (unit: instruction pulse)
P5-36 Near (/NEAR)	When the position is controlled, the light will turn on if the given position matches the actual position. Approach signal width: P5-06
P5-40 rotation detection	The light will turn on when the motor speed exceeds the rotation detection speed. Rotation detection speed: P5-03 (unit: rpm)

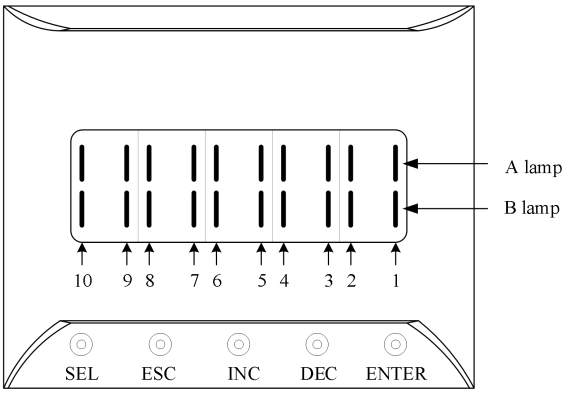
Display content in abbreviated code

Display content in	Show content

abbreviated code	
	In standby mode Servo off state. (The motor is not powered)
	in service Servo enabled state. (The motor is powered on)
	Reset state required The server needs to be powered on again.
	Forbidden forward drive state P-OT ON state. Refer to Section 5.3.2.
	Disable reverse drive state N-OT ON state. Refer to Section 5.3.2.
	Control mode 2 is empty

4.3 UX-XX Monitoring Parameters

■ U0-21 input signal status

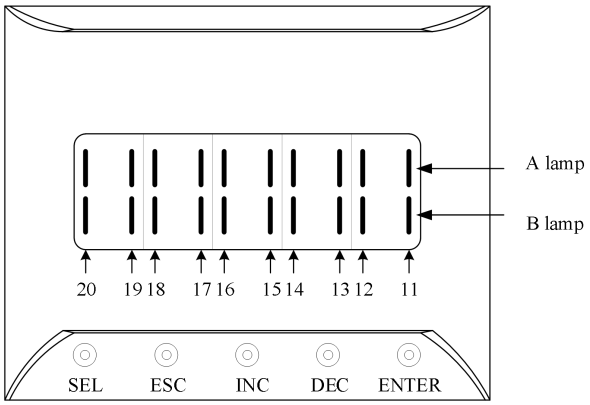


Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal inp

■ U0-21 Input Signal 1 Allocation

block code	explain	block code	explain
1	S-ON servo enable signal	2	P/CON ratio action instruction
3	P-OT prohibition of forward drive	4	N-O-T forbidden inversion drive
5	ALM-RST alarm clearing	6	external torque limit for P-CL forward rotation
7	external torque limit of-N / CL reversal side	8	/SPD-D Internal speed selection
9	/SPD-A Internal Speed Selection	10	/SPD-B internal speed selection
Note: When reading status via communication, the binary values read from right to left correspond to the /S-ON and /P-CON positions. A value of 0 indicates no input at that position, while 1 indicates input. For example: 0x0001 means input at /S-ON, and 0x0201 means input at both /S-ON and /SPD-B.			

■ U0-22 input signal status



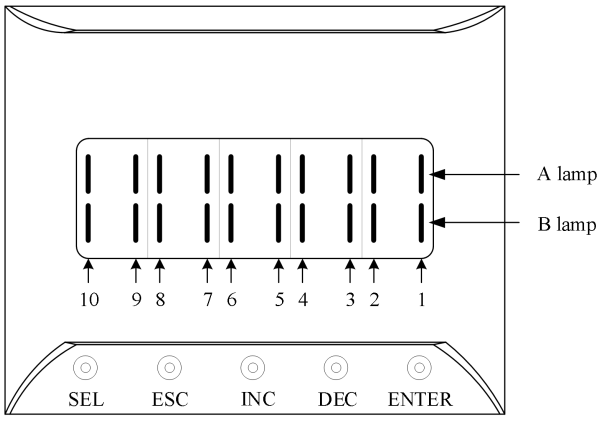
Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal input.

■ U0-22 Input Signal 2 Allocation

block code	explain	block code	explain
11	CSEL mode selection	12	/ZCLAMP zero clamp
13	INHIBIT instruction pulse prohibition	14	G/SEL gain switching
15	CLR pulse clear	16	/CHGSTP step change
17	I-Sel Inertial Switching	18	—
19	—	20	—
Note: When reading status via communication, the binary values read from right to left correspond to the /C-SEL and /ZCLAMP positions. A value of 0 indicates no input at that position, while 1 indicates input. For example: 0x0001 means input at /C-SEL, and 0x0009 indicates input at both /C-SEL and /G-SEL.			

"—" is reserved for display and does not indicate any signal; this status bit remains at 0.

■ U0-23 output signal status

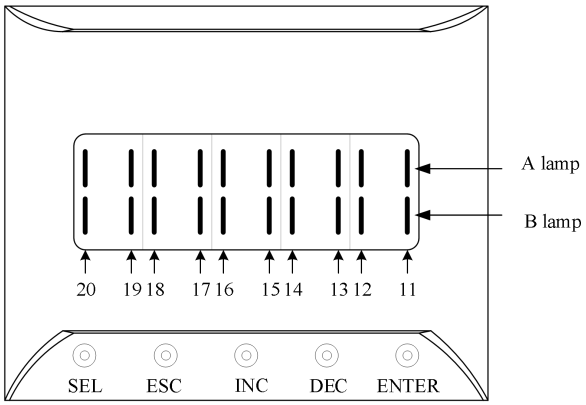


Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal input.

■ U0-23 Output Signal 1 Allocation

block code	explain	block code	explain
1	Keep Location Complete (/COIN_HD)	2	End of Positioning (/COIN)
3	same speed detection	4	rotation detection
5	Ready (S-RDY)	6	torque limit
7	velocity limit detection	8	brake interlock
9	Warning (/WARN)	10	Output Near (/NEAR)
Note: When reading the status via communication, the binary values read from right to left correspond to /COIN_HD and /COIN positions. A value of 0 indicates no output from the signal at that position, while 1 indicates an output. For example: 0x0001 means /COIN_HD has an output, and 0x0201 means both /COIN_HD and /NEAR have outputs.			

■ U0-24 output signal status

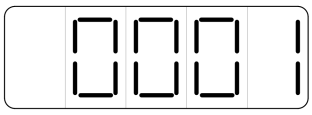
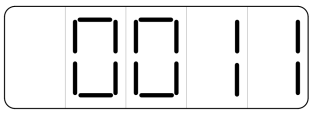
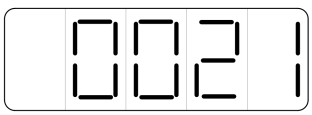
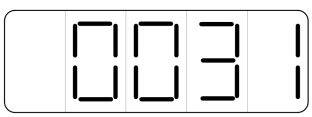


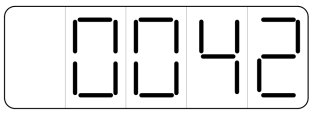
Note: Under positive logic, if light A is on and light B is off, it indicates that there is a signal input. Under negative logic, if light A is on and light B is off, it indicates that there is no signal input.

■ U0-24 output signal distribution

block code	explain	block code	explain
11	report to the police (/ALM)	12	The speed reaches (/V-RDY)
13	Custom Output 1	14	Custom Output 2
15	/Z Xiang	16	/MRUN
17	continue to have	18	continue to have
19	continue to have	20	continue to have
Note: When reading status via communication, the binary value read from right to left corresponds to /ALM and position. A value of 0 indicates no input at that position, while 1 indicates input. For example, 0x0011 means both /ALM and Z phase have output.			

■ U0-88 motor code reading status

U0-88 display status	meaning
	0001 — Encoder motor parameters read successfully, but P0-33 = 0. Use the motor parameters from the encoder.
	0011 — Encoder motor parameters read successfully (P0-33=0). The motor parameters from the driver are now in use.
	0021-Encoder motor parameters detected successfully, but the value is 0. Configure P0-53 before use.
	0031-Encoder motor parameters detected successfully but failed due to CRC error. Use after setting P0-53.

U0-88 display status	meaning
	0042-Failed to read encoder motor parameters. Set P0-53 before use.

■ U4-18 Input Signal Status

SI1	SI2	SI3	U4-18 display
1	0	0	0x0001
0	1	0	0x0002
1	1	0	0x0003
0	0	1	0x0004
...	...	...	...
Note: U4-18 displays the software activation status of SI terminals. The terminal will only appear on U4-18 when its function is set. For example, SI1 has no assigned function, so even if the hardware sets SI1 to high, the 0th bit of U4-18 will not display 1.			

■ U4-19 output signal status

SO1	SO2	SO3	U4-19 shows
1	0	0	0x0001
0	1	0	0x0002
1	1	0	0x0003
0	0	1	0x0004
...	...	...	...
Note: The U4-19 indicator displays the software activation status of the SO terminal, represented by bit positions.			

4.4 FX-XX Auxiliary Function Content

■ F0-XX

Function code	explain	Function code	explain
F0-00	Clear alarm	F0-08	Panel external command auto-adjustment
F0-01	Restore parameters to factory settings	F0-09	panel internal instruction self adjustment
F0-02	Clear positional deviation	F0-10	Panel vibration inhibition 1
F0-04	Clear historical alarm records	F0-11	Panel Vibration Suppression 2
F0-07	panel inertia identification	F0-12	Panel Vibration Suppression (Fast FFT)

1) Clear alarm (parameter F0-00)

When a fault occurs, the system automatically displays the E-XXX alarm status with the alarm number; otherwise, the alarm status is not visible.
In alarm mode, pressing 1 on the panel to write to F0-00 resets the fault.
When an alarm occurs, first identify the cause before clearing it. If the alarm is triggered by a powered-down servo, no clearing is required.

2) Reset parameters to factory defaults (parameter F0-01)

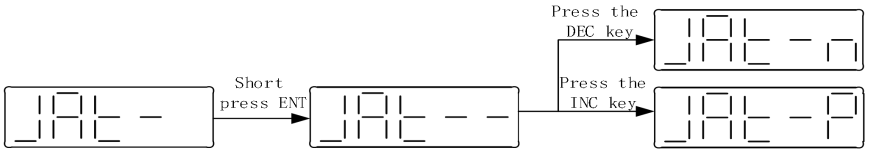
First, turn off the servo, then perform the factory reset as follows:
Set F0-01 to 1 and press ENTER to confirm. The factory reset is complete, so no power-off is required.

3) Clear deviation (parameter F0-02)

Set F0-02=1 to clear the deviation.

4) Panel Inertia Identification (Parameter F0-07)

Before inertial identification, use the F1-00 point movement function to confirm the servo rotation direction. The initial direction of servo operation is determined by INC or DEC when inertial identification begins.
If the servo jitter is under the adaptive default parameters, switch to the adaptive large inertia mode (P2-03.3=1) first to ensure the basic smooth operation of the servo before the inertia identification!
When the device is in BB mode, the parameter F0-07 displays:



For detailed steps, refer to 9.2.4.

5) Panel External Command Self-Adjustment (Parameter F0-08)

For detailed steps, refer to 9.4.5.

6) Panel internal command auto-adjustment (parameter F0-09)

For detailed steps, refer to 9.4.4.

7) Panel vibration suppression (parameters F0-10, F0-11)

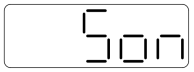
vibration damping mode	show	Modified parameters
pattern 1	vib-1	Changes vibration suppression parameters only
pattern 2	Vib-2	Changes vibration suppression parameters and speed loop gain

The following explains the steps:

1. In self-adjusting mode, select parameter F0-10 to display vib-1 on the panel, or choose F0-11 to show vib-2.

perhaps

2. Press and hold the ENTER key. The Son panel will flash, requiring manual activation.



3. After enabling the servo, the panel displays 'tune' with a flashing indicator, marking the system's entry into the calibration phase.

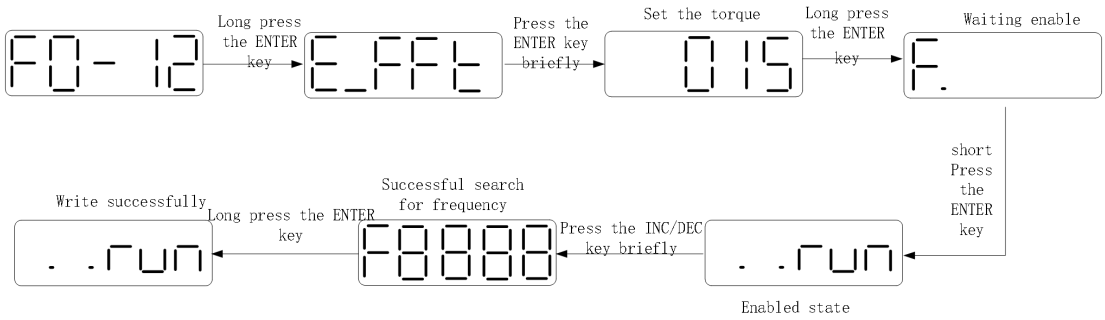
4. The upper device initiates pulse command transmission until the 'done' indicator flashes to confirm vibration suppression completion.

5. Press the STA/ESC keys briefly to exit.

Vibration suppression parameters are automatically written into the first and second notch filters (the second notch filter is prioritized when there is only one vibration point). For details, see Section 8-7-7: Notch Filters.

8) Panel vibration suppression (fast FFT) (parameters F0-12)

The mechanical characteristic analysis can be carried out by F0-12 parameters on the servo operation panel, and the mechanical resonance frequency can be found out to realize the vibration suppression.

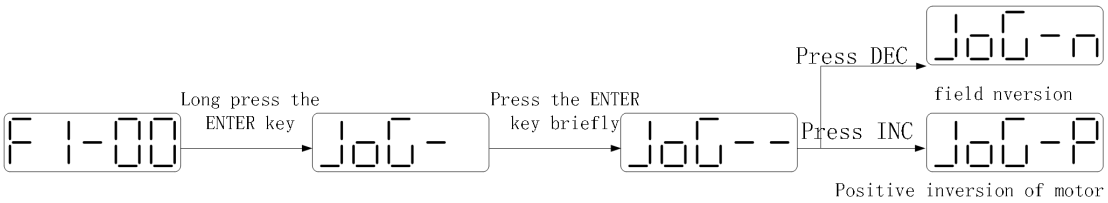


■ F1-XX

Function code	explain	Function code	explain
F1-00	crawl	F1-05	software enablement
F1-01	pilot run	F1-06	Absolute encoder position reset
F1-02	current sampling zeroing	-	-

1) Point operation (Parameter F1-00)

Before entering the stop-and-go mode, ensure the motor shaft is not connected to the machine and the driver is in an idle state!



When performing a point operation, parameters such as gain are involved in the control. You can determine whether the parameter settings are appropriate based on the operational status.

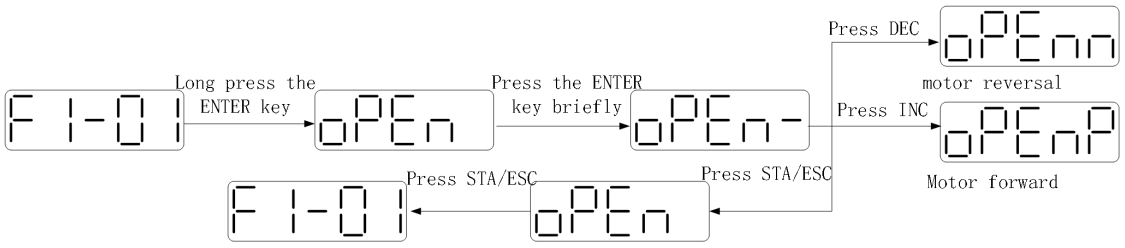
P3-18	JOG speed					
	Set unit	factory setting	Set range	Applicable mode	revise	come into force
	1rpm	100	0~1000	JOG final motion	servo OFF	immediately

2) Trial run (parameter F1-01)

Ensure the motor shaft is not connected to the machine before entering trial mode.

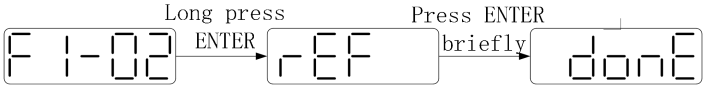
When a servo driver is connected to a non-original encoder or power line, it should first enter trial operation mode to verify the correct connection of the encoder or power terminals.

The trial run checks the power lines and encoder feedback lines to ensure proper connections. Press the button to operate the motor normally in both directions. If the motor shaft shakes or an alarm is triggered, immediately disconnect the power and recheck the wiring.



3) Current sampling zero calibration (parameter F1-02)

When the servo driver completes self-renewal or the motor exhibits prolonged instability, users should perform automatic current detection offset adjustment during the driver's idle state (BB).



Press STATUS/ESC to exit this function. Power on again.

4) Panel Enable (Parameter F1-05)

parameter	Signal name	setting	meaning	revise	come into force
P0-03	enable mode	0	Disable	servo OFF	immediately
		1	I/O enable/S-0N		
		2	Software enablement (F1-05 or communication)		
		3 (Default)	Bus enable (for models with motion bus support)		
Set P0-03 to 2: F1-05 = 0: Disable the enable function and restore to the bb idle state. F1-05 = 1: Forces enable, the servo is in RUN mode.					

Forced enablement will be disabled after power-on.

To enable the device upon power-up and maintain functionality after power-off in normal mode, set P5-20 to n.0010. (P0-03=1 activates)

5) Absolute encoder reset cycles (parameter F1-06)

First, turn off the servo, then perform the absolute encoder reset operation as follows:

① The absolute encoder's circle number can be cleared by writing 1 to F1-06 through the panel operation.

② To clear the loop count, write 1 to the hexadecimal address 0x2106 via Modbus RTU (the servo BB status will be activated; after clearing, write 0 to 0x2106).

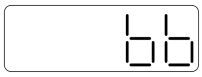
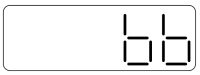
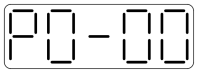
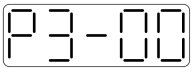
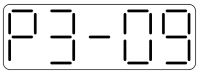
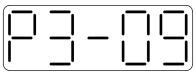
4.5 Fault Alarm Handling

When a fault occurs, the system automatically enters an alarm state and displays the alarm number. In normal operation, the alarm state is not visible. To reset the alarm, write 1 to F0-00 via the panel.
If the servo alarm is triggered due to the OFF status of the servo power supply, no alarm clearing is required.

When an alarm occurs, the cause should be eliminated first, and then the alarm should be removed.

4.6 Panel Button Operations

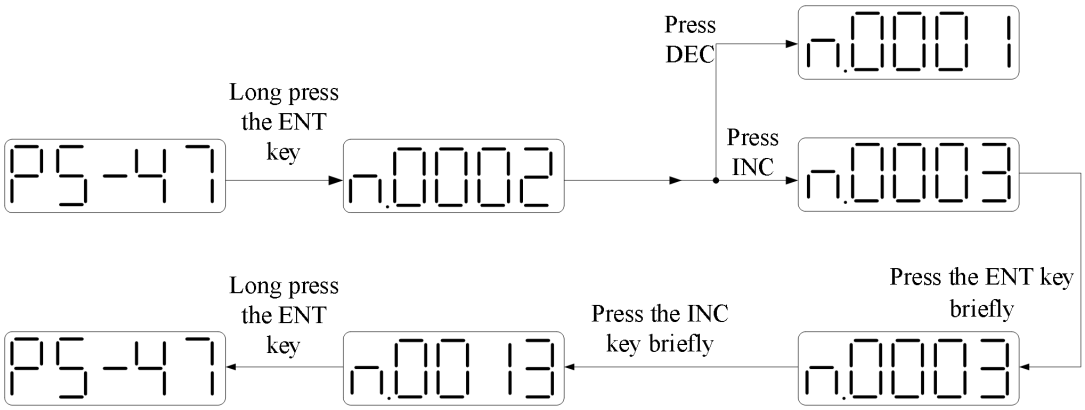
For example, the procedure for adjusting parameter P3-09 from 2000 to 3000.

step	panel display	Keyboard keys	concrete operations
1		AXIS STA/ESC INC DEC ENTER	Switch between axes, with axis numbers displayed on the leftmost side
2		AXIS STA/ESC INC DEC ENTER	No action required
3		AXIS STA/ESC INC DEC ENTER	Press the STA/ESC key to enter the parameter setting function
4		AXIS STA/ESC INC DEC ENTER	Press the INC key to increment by 1. Set the parameter to 3 and display P3-00.
5		AXIS STA/ESC INC DEC ENTER	Press the ENTER key briefly to make the last 0 on the panel flash.
6		AXIS STA/ESC INC DEC ENTER	Press INC to add to 9
7		AXIS STA/ESC INC DEC ENTER	Press and hold the ENTER key to access the P3-09 interface for numerical adjustments.
8		AXIS STA/ESC INC DEC ENTER	Use the INC, DEC, and ENTER keys to add, subtract, or shift. Hold ENTER to confirm after making changes.
9	EO		

When the parameter exceeds the set range, the driver will not accept the value and report E-021 (Parameter Out of Range). This typically occurs when the host computer writes parameters to the driver via communication.

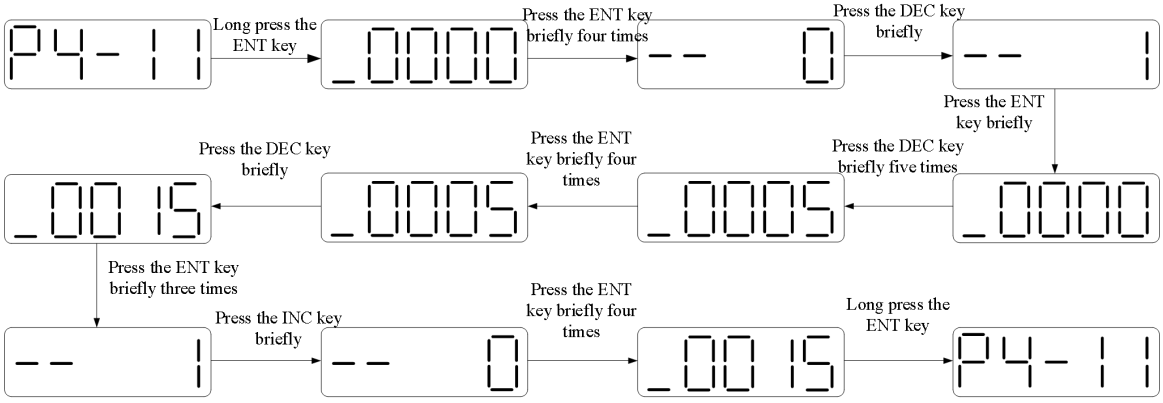
4.6.1 Example of setting SI and SO related P group parameters for input/output

For example, the procedure involves adjusting terminal P5-47 (alarm output terminal) from SO2 to SO3 control, and changing the normally open contact to a normally closed contact.



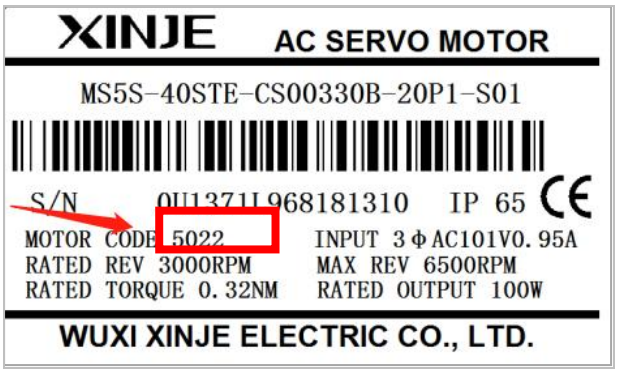
4.6.2 Examples of setting negative values for P-group parameters

For example, set parameter P4-11 (internal position mode pulse count high bit) to-15, meaning the first pulse count is-150000, and follow the corresponding operation steps.



4.7 Change motor code

A servo drive can be paired with motors of similar power ratings, with different models identified by the motor code on the nameplate. Before debugging the servo system, verify that the motor code U3-70 matches the one on the nameplate. If discrepancies are found, contact your agent or technical support.



5. Setting up basic functions

5.1 Absolute Value System

5.1.1 Setting up the absolute value system

To preserve the absolute encoder's position data, a battery unit must be installed.
Install the battery on the battery unit of the encoder cable with the battery unit (internal).
When not using the battery-powered encoder cable, set P0-79 to 1 to convert the multi-turn absolute encoder into an incremental encoder.

parameter	Signal name	setting	meaning	Set range
P0-79	absolute encoder setting	0	Use an absolute encoder normally and store the position with the battery	0~2
		1 (Default)	As an incremental encoder, it does not store multi-turn positions.	
		2	Use as an absolute encoder, but ignore the multi-turn overflow alarm. Enable recording the number of turns and overflow counts, and retain power loss data.	

If the E-222 alarm is triggered after replacing the multi-turn motor, the system will automatically reset the count of overtrains. Otherwise, severe positional deviation may occur, posing a risk.

5.1.2 Battery Replacement

When replacing the battery, ensure the drive and motor are properly connected and the control power is on. If the control power is off, the data stored in the encoder will be lost.

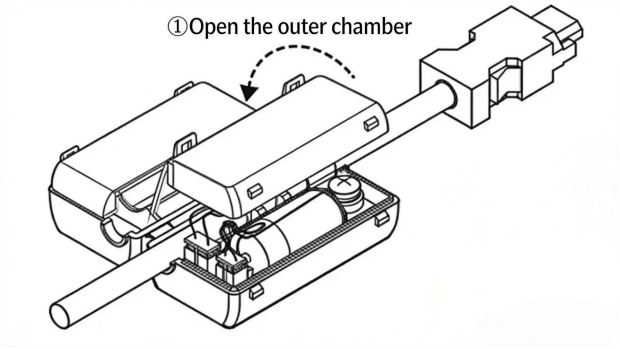
Absolute encoder battery case model (This battery cannot be charged)

- Battery compartment for standard cable: CP-B-BATT
- Tank Chain Line Special Battery Box: CPT-B-BATT

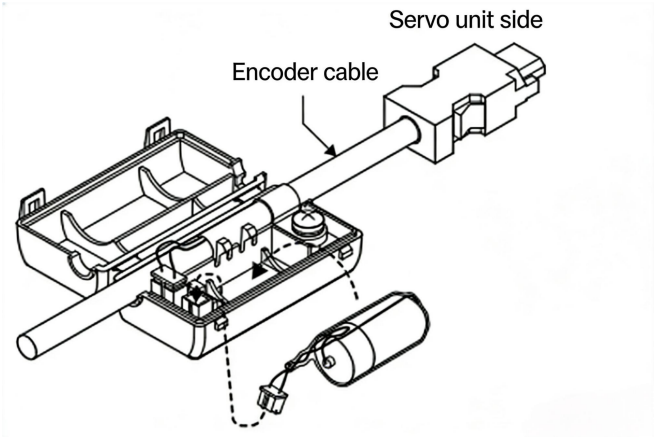
Steps for battery replacement

When using encoder cables with battery units

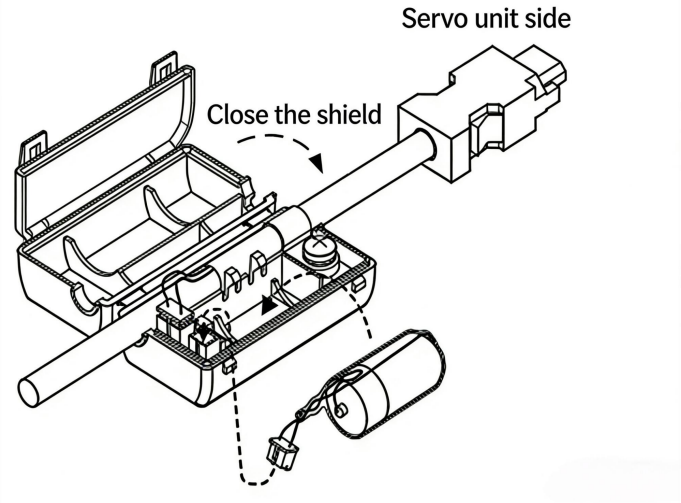
1. Connect only the control power supply to the servo unit;
2. Open the battery compartment cover;



3. Remove the old battery and install a new one.



4. Close the battery compartment cover.

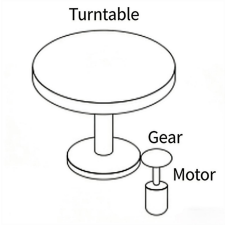


5. After battery replacement, clear the alarm (F0-00=1) to disable the "Encoder Battery Alert (E-222)" display.
6. Reconnect the power supply to the servo unit;
7. The error display has been cleared, and the servo unit is now functioning properly.

5.1.3 Upper limit setting for the number of rotations

The upper limit of the number of rotation can be used for the position control of the rotary table and other rotary bodies.

For example, consider a machine with a rotating table that moves only in one direction, as shown in the figure below.



Because it can only rotate in one direction, after a certain period of time, the number of rotations will always exceed the upper limit of the absolute encoder.

Servo motor series	resolution ratio (One-round data)	Serial data rotation count output range	Operation beyond the limit
CN	19	-32768~32767	When exceeding the upper limit of the forward direction (+32767*219): Rotation serial data=32767*219 When it falls below the lower limit of the reversal direction (-32768*219): Rotation serial data = -32768*219
TH	23		When exceeding the upper limit of the forward direction (+32767*223): Rotation serial data=32767*223 When it falls below the lower limit of the reversal direction (-32768*223): Rotation serial data = -32767*223

5.1.4 Absolute encoder clearing multiple turns

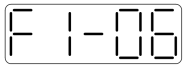
The encoder's clearance cycles must be completed in the servo BB state. Clearance can be performed via the servo panel or Modbus-RTU communication. Writing 1 to F1-06 resets the multi-cycle absolute current count (U0-91) to zero. The multi-cycle position feedback from absolute encoder U0-57~U0-60 and U0-94~97 will also be cleared, retaining positions within one cycle.

This feature is only available for multi-turn absolute motors. It is not available for single-turn absolute motors.

1. Servo drive panel cleared

The servo enters the BB state and displays parameter F1-06:

Press the [INC] key to add to 1 and hold [ENT] to confirm exit:



The F1-06 panel can reset the absolute encoder position count.

2. EtherCAT bus communication clearing

In servo mode, write 1 to #0x4106 via EtherCAT bus communication to clear the loop count.

You can also write to it via the bus SDO:

Enter 1 to clear the circle count.

5.1.5 Zero Point Calibration of Absolute Encoder

User parameters	name
F1-06	Set to 1: Absolute encoder resets to multiple turns Set to 3: Absolute encoder zero calibration
U0-94	Resettable relative encoder feedback value
U0-95	
U0-96	
U0-97	

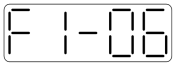
Absolute encoder zero calibration must be performed in servo BB mode and can only be done via the servo panel. When writing 3 to F1-06, the encoder position in the U0-94~97 position feedback will be set to 0.

Absolute encoder zero calibration is not supported via SDO communication.

1. Servo drive panel calibration

The servo enters the BB state and displays parameter F1-06:

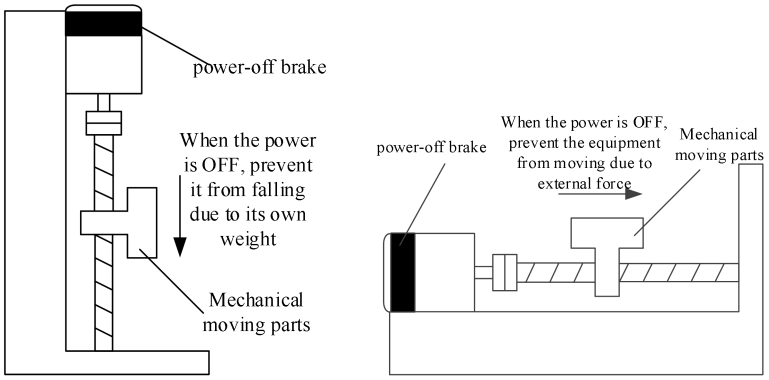
Press the [INC] key to add to 3 and hold [ENT] to confirm exit.



The F1-06 panel calibrates the encoder's current position to zero, while U0-94~97 displays the calibrated position.

5.2 Power failure brake (brake engagement)

The purpose of using "servo motor with power loss brake" is to prevent the movable part from moving under the action of its own weight or external force when the power supply of the system is put in "OFF".



The brake built into the servo motor is a fixed special brake without excitation action. It cannot be used for dynamic braking. It should only be used when the servo motor is kept in a stopped state.

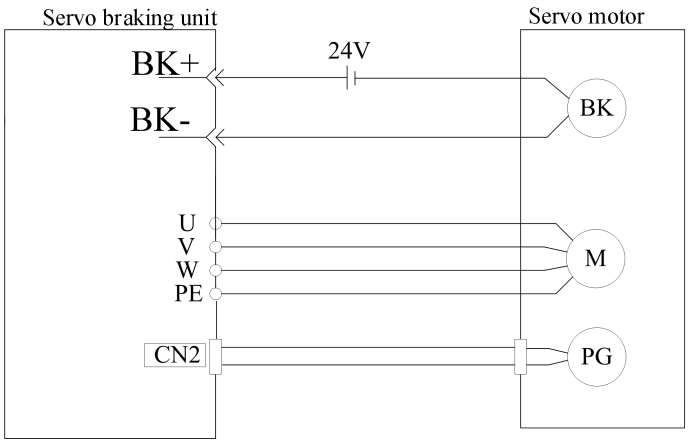
- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P5-44	brake interlock	n.0000	-	0~ffff	servo bb	immediately
P5-07	Servo-off delay time	500	1ms	-500~9999	servo bb	immediately
P5-08	brake command output speed	30	rpm	20 ~ 10000	servo bb	immediately
P5-09	brake command waiting time	500	ms	0 ~ 65535	servo bb	immediately
P0-69.2	Servo control signal source	0	-	0~1	at any time	immediately

The brake signal terminal of the DM6C series servo driver features an external structure, not integrated into the CN0 signal terminal. The brake signal terminal only outputs a signal when parameter P5-44 is set to any value except 0. To avoid interfering with other SO terminal functions, it is recommended to configure it without occupying the S01~SO4 terminals.

1. Hardware connection

The servo unit's sequential output signals "BK" and "Brake Power" form the ON/OFF circuit for the brake. A typical connection example is shown below.



2. Software parameter settings

For servo motors with brake, the brake signal terminal of the servo driver must be activated, meaning parameter P5-44 should be set to a value other than 0.

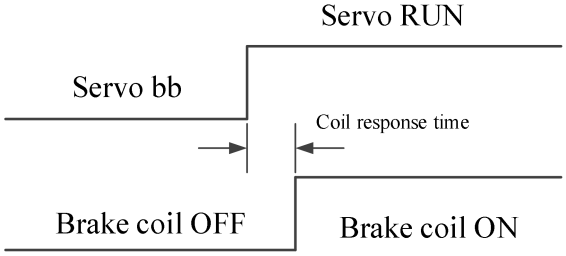
Parameter settings status	Servo drive state	signal/BK terminal output logic	Servo motor status
P5-44=n.000□	servo bb	of no avail	The brake power is disconnected, and the motor is locked in position.
	servo run	valid	The brake power is activated, and the motor is in a rotatable state.
P5-44=n.001□	servo bb	of no avail	The brake power is disconnected, and the motor is locked in position.
	servo run	valid	The brake power is activated, and the motor is in a rotatable state.

- When the brake signal terminal controls the brake, the servo is enabled (ON), the brake power is activated, and the motor is in a rotatable state.
- If the motor fails to rotate during new machine debugging, check whether the brake is released.

3. Timing of Brake Control by Servo Drive

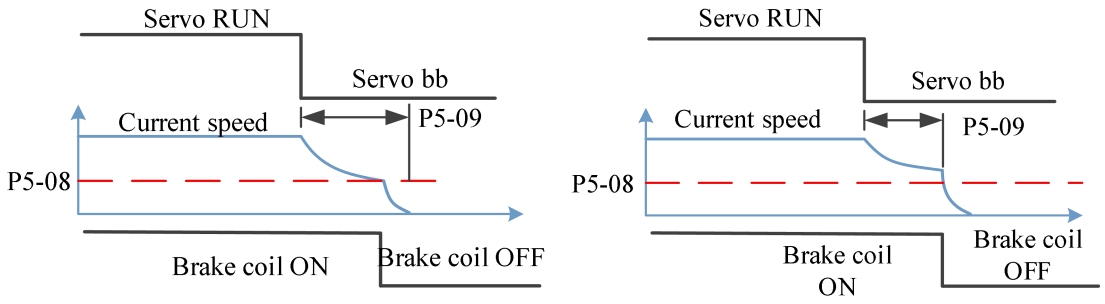
1) Brake timing sequence during normal power-on state

The servo motor activation and brake engagement occur simultaneously, with a response time of 50-60ms between the brake terminal output and the brake coil.



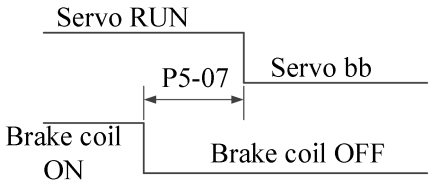
2) The timing of deactivating the enable brake during motion

The direct shutdown enable during operation refers to the motor shaft executing shutdown enable operation directly while maintaining rotational speed (motor speed> 0). After enabling shutdown, the motor decelerates. When the motor decelerates to the preset speed P5-08 within the P5-09 time period, the brake is released. As shown in the left diagram, if the motor has not decelerated below the P5-08 speed by the P5-09 time period, the brake is released directly, as illustrated in the right diagram.



3) The timing sequence for deactivating the enable brake in the stationary state

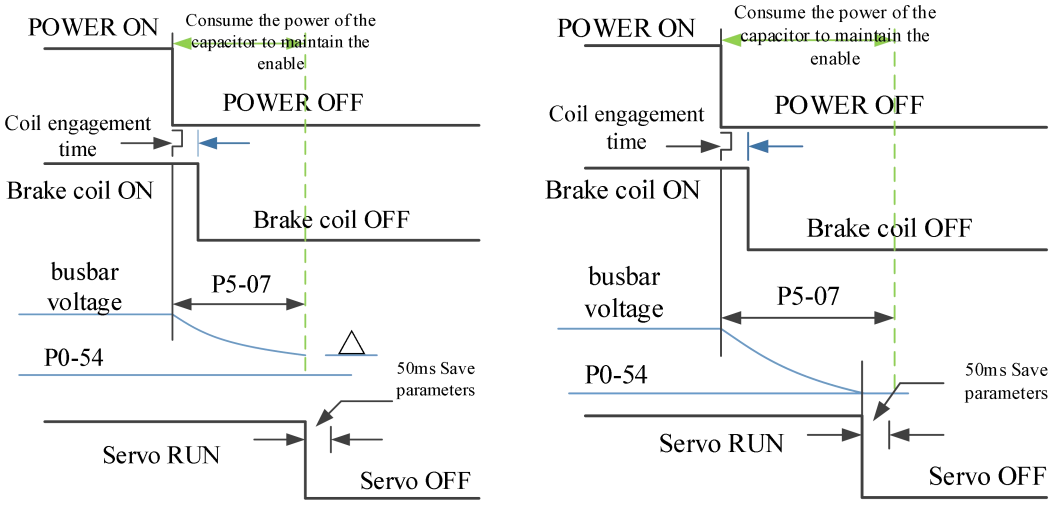
The static state is a special dynamic shutdown mode with zero operating speed. When shutdown operations are performed in this state, the brake will be released P5-07 (absolute value of P5-07) before the shutdown, preventing the system from falling.



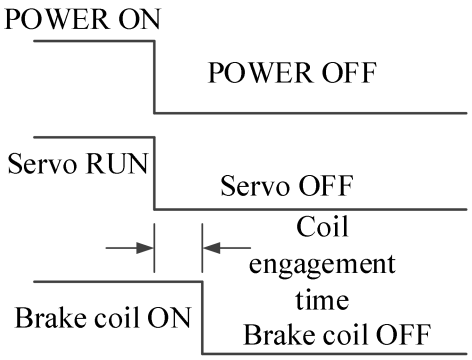
The brake engagement timing reference during alarm (2) and (3).

4) The timing sequence for the brake to engage when power is lost after enabling.

① When P5-07 is set to a negative value, the brake will be immediately released upon signal loss, which consumes the capacitor's stored energy. The release is delayed by the P5-07 time delay.

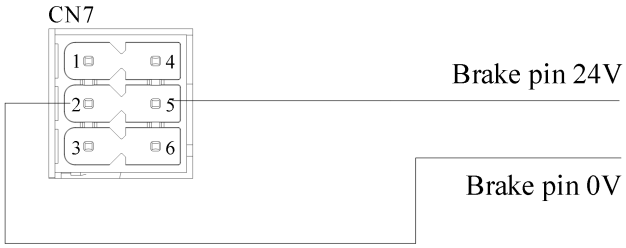


② When P5-07 is set to a positive value, the system will immediately release the brake and disable the enable function upon receiving a drop signal (the P5-07 delay time is not activated in this case).



When P0-69.2=1, the drop signal detected at this time is bus voltage P0-54. When P0-54 reaches the set value (default is 140V), the brake is closed with the set value P5-07. The brake timing is referred to 4).

4. Brake connection method



5. If the brake lever drops slightly after a power outage, try these solutions:

① The value of P5-07 can be set to a negative number.

② Set P0-69.2 directly to 1.

5.3 Parking Methods

Servo shutdown is divided into free shutdown and deceleration shutdown.

shutdown mode	free stop	shut down
shutdown principle	The servo drive is disabled, and the servo motor is not powered, decelerating freely to zero. The deceleration time is affected by mechanical inertia and equipment friction.	The servo driver outputs reverse braking torque, and the motor decelerates rapidly to zero.
shutdown characteristics	Advantages: smooth deceleration, less mechanical impact Disadvantages: Slow deceleration	Advantages: Short deceleration time Disadvantages: Mechanical impact

Depending on the scenarios of servo shutdown, it is classified into three types: servo OFF shutdown, alarm shutdown, and overtravel shutdown.

5.3.1 Servo OFF and Alarm Shutdown

- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P0-30	Stop timeout time	20000	1ms	0 ~ 65535	servo bb	immediately
P5-03	Rotation detection speed	50	rpm	0 ~ 10000	at any time	immediately
P0-27	Servo governor enables shutdown mode	0	-	0/2	servo bb	immediately
P0-29	alarm stop mode	2	-	0/2	servo bb	immediately

parameter	numeric value	meaning
P0-27	0	Free run stops. After stopping, it resumes free run.
	2	The deceleration brake stops, and the system remains in free running state after stopping.
P0-29	Enable the attribute alarm for the envoy.	
	0/2	Free run stops. After stopping, it resumes free run.
	Disable enable attribute alarm	
	0	Free run stops. After stopping, it resumes free run.
	2	The deceleration brake stops, and the system remains in free running state after stopping.

explain ：

1）Servo shutdown mode (P0-27)

① When P0-27=0, if the servo is turned off, the motor will start to stop freely without any alarm;

② When P0-27 equals 2, if the servo is turned off, the motor will decelerate to a stop until its speed drops below P5-03, then it will stop freely. The servo will also time the deceleration phase. If the deceleration time exceeds P0-30 but the motor speed hasn't dropped below P5-03, the E-262 alarm will be triggered.

2）Servo alarm parking mode (P0-29)

(1) Enable the attribute alarm

① When P0-29=0/2, if the servo alarm occurs, the motor will start to rely on free parking;

(2) Disable enable attribute alarm

① When P0-29=0, if the servo alarm occurs, the motor will start to rely on free parking;

② When P0-29 equals 2, if a servo alarm occurs, the motor will initiate deceleration to stop until its speed drops below 50 rpm, then transition to free stop. The servo simultaneously records the deceleration duration. If the recorded time exceeds P0-30 during deceleration, the servo will immediately execute free stop. In this case, regardless of P0-29's value, the E-262 alarm will not be triggered due to the servo's alarm state. After stopping, the system will maintain free-running mode.

3) The servo drive's SO terminal is equipped with a brake engagement function, which automatically applies deceleration mode for parking regardless of whether P0-27/P0-29 equals 0 or 2.

4) Setting P0-27/29=1/3/4/5 for servo drive is meaningless, as all will park in free parking mode.

5.3.2 Parking Method in Normal Mode When Exceeding the Limit

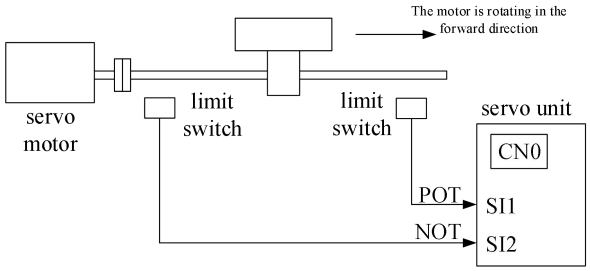
The over travel prevention function of servo unit is a safety function that the servo motor is forced to stop when the movable part of the machine exceeds the designed safe moving range by inputting the signal of limit switch.

- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P0-28	servo overtravel stop mode	2	-	0～3	servo bb	immediately
P0-30	Stop timeout time	20000	1ms	0～65535	servo bb	immediately

P5-22	No forward rotation /P-OT	n.0003	-		at any time	immediately
P5-23	Disable Inversion /N-OT	n.0000	-		at any time	immediately

Be sure to press the connection limit switch as shown in the figure below.



For rotary applications such as conical rollers and conveyors, the overtravel prevention function is unnecessary, and the overtravel prevention input signal does not need to be wired.

Parameter settings status	Signal/POT, terminal input status	Overrun signal (POT, NOT) terminal logic
P5-22/P5-23=n.0000	No external terminal input is required.	of no avail
P5-22/P5-23=n.000□	No signal input at the SI□ terminal	
P5-22/P5-23=n.001□	The SI□ terminal has a signal input.	
P5-22/P5-23=n.0010	No external input terminals required	valid
P5-22/P5-23=n.000□	The SI□ terminal has a signal input.	
P5-22/P5-23=n.001□	No signal input at the SI□ terminal	

The forward limit signal (POT) and reverse limit signal (NOT) cannot be set to the same terminal input simultaneously.

Run direction	limiting	running state
corotation	positive limit is valid	POT, set the servo overtravel stop mode for parking at P0-28
	limit effective	Call E-261
reversal	positive limit is valid	Call E-261
	limit effective	Note: Set the servo overtravel stop mode for parking according to P0-28

parameter	numeric value	meaning
P0-28	0	The stop 1 has stopped. The torque in the overtravel direction is 0. The command is received.
	1	Free stop. After stopping, the torque in the overtravel direction is 0. Receive the command.
	2	The stop 2 has stopped. No commands are received in the overtravel direction after stopping.
	3	Alert (E-260)

- When P0-28=0/2, the motor starts to slow down and stop after receiving the overtravel stop signal, and the timeout time during the overtravel processing also plays a role.
- When the motor is stopped by an overtravel signal during position control, position deviation pulses may occur. To clear these pulses, a CLR signal must be input. If the servo unit still receives these pulses, they will accumulate until the servo unit triggers an alarm.
- During torque control, the servo drive's SO terminal is assigned to the brake function, preventing signal allocation through the overtravel terminals P5-22 and P5-23.
- The servo drive's SO terminal is equipped with a brake engagement function, with P0-28 automatically set to 2.

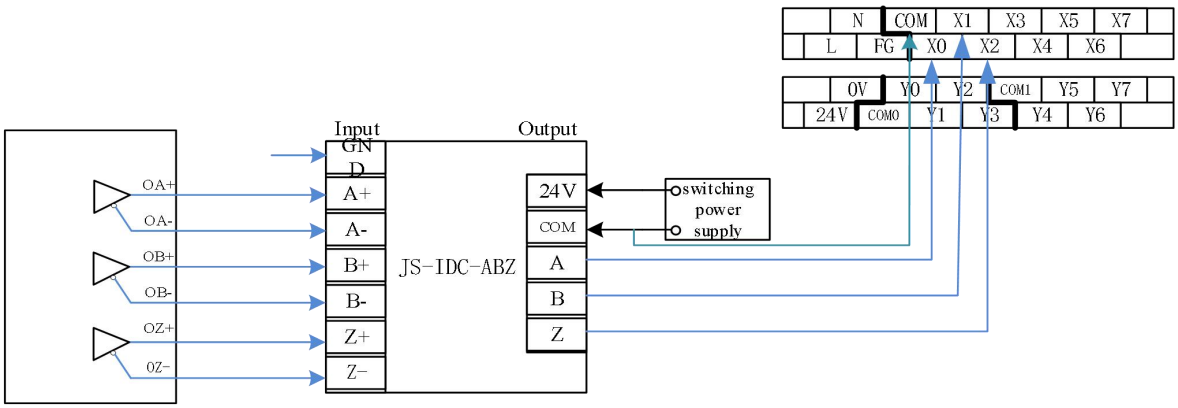
5.4 Encoder ABZ Phase Division Output

The servo drive outputs differential signals through the frequency division output circuit and the differential driver, which provides the position signal for the control of the upper computer device or the pulse signal for the driven servo, thus realizing the following control of the master and slave shafts.

1. Specifications for the encoder's frequency division output

Terminal name	Terminal pin number	terminal function
FPA+	9	A-phase frequency division signal output
FPA-	10	
FPB+	11	B-phase frequency division signal output
FPB-	12	
FPZ+	13	Z-phase frequency division signal output
FPZ-	14	

2. Wiring diagram



3. Parameter Settings

P0-17	frequency division output enable switch					
	set value	function	factory value	Applicable mode	revise	come into force
	0	Disable split output	0	own	servo bb	immediately
	1	Enable split output				
P0-18	Number of feedback pulses per encoder revolution (low bit)					
	Set unit	factory setting	Set range	Applicable mode	revise	come into force
	1	0	0-9999	own	P0-17=0	immediately

P0-19	Number of feedback pulses per encoder revolution (high bit)					
	Set unit	factory setting	Set range	Applicable mode	revise	come into force
	10000	1	0-9999	own	P0-17=0	immediately
P0-20	encoder feedback pulse output frequency division (molecule)					
	Set unit	factory setting	Set range	Applicable mode	revise	come into force
	-	1	0-65535	own	P0-17=0	immediately
P0-21	Encoder feedback pulse output frequency divider (denominator)					
	Set unit	factory setting	Set range	Applicable mode	revise	come into force
	-	1	0-65535	own	P0-17=0	immediately
P5-19	Z phase pulse width					
	Set unit	factory setting	Set range	Applicable mode	revise	come into force
	Ms	2	2-20	own	at any time	immediately

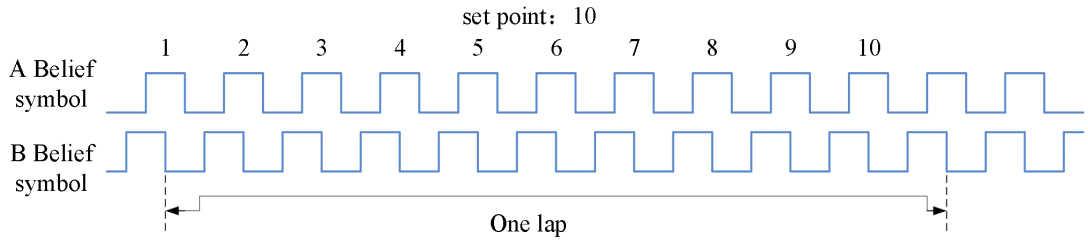
explain ：

(1) Pulse count per revolution: P0-19*10000 + P0-18. Parameters P0-18 to P0-21 are encoder feedback parameters, with P0-18 and P0-19 forming one group and P0-20 and P0-21 another. The feedback pulse count for P0-18 and P0-19 has higher priority than the output pulse frequency divider P0-20 and P0-21. The frequency divider P0-20 and P0-21 only activate when both P0-18 and P0-19 are set to 0.

For example, a magnetic absolute encoder motor (CN) requires 10,000 pulses per revolution. The encoder feedback settings can be configured as P0-18=0000 and P0-19=0001, or alternatively, the encoder feedback division ratio (P0-20/P0-21) can be set. To achieve the required resolution of 10,000/524288 (625/32768) per revolution, the settings should be: P0-18 = P0-19 = 0, P0-20 = 625, and P0-21= 32768.

(2) Encoder feedback is output through port CN0. When using single-phase counting, the motor's rotation count equals the set value. With AB-phase counting, the count becomes four times the set value. We recommend using AB-phase counting for the pulse receiver.

(3) When the feedback pulse count per cycle is 10, the encoder's frequency division pulse outputs two signals: Phase A (PAO) and Phase B (PBO), as shown below:

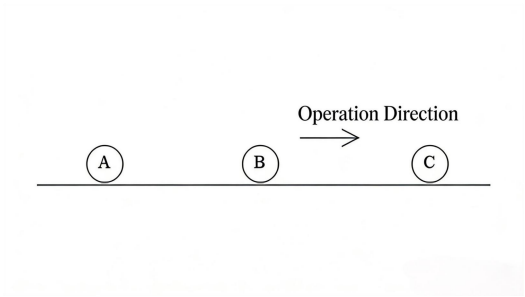


P0-87.0	Encoder Feedback Output Direction Selection					
	set value	function	factory value	Applicable mode	revise	come into force
	0	Phase A leads phase B in forward rotation.	0	own	servo OFF	immediately
	1	Phase B leads phase A in forward rotation.				
P0-87.1	differential feedback output Z phase mode					
	set value	function	factory value	Applicable mode	revise	come into force
	0	Do not output Z-phase pulses	0	own	servo OFF	immediately
	1	output Z phase pulse				

5.5 Full closed-loop input

5.5.1 Overview of the Fully Closed Loop System

The closed-loop system is a system which is installed on the moving machinery by the external position detection device (such as encoder, grating scale, etc.), detects the position of the control object, and gives feedback to the servo unit in real time.

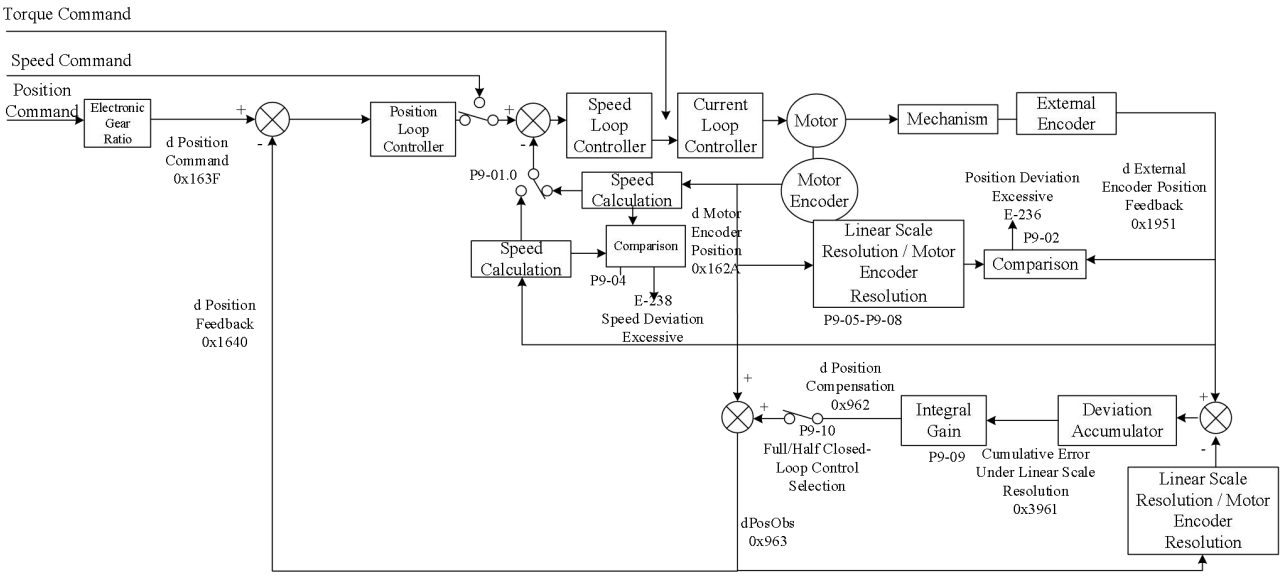


At point A, the host computer issues a pulse command. Assuming the target position is the grating scale's feedback position C, the motor must rotate n full turns to reach this point. If the motor, due to mechanical deviations or other factors, already completes n turns and reaches point B during operation, it will continue running until the grating scale feedback confirms the motor has reached the target position C. This fully closed-loop approach ensures control immunity to external mechanical deviations, thereby enhancing control precision.

5.5.2 Full closed-loop function wiring and implementation logic

The position feedback signal from the external encoder (grating scale) is transmitted to the servo driver via port CN4.

Terminal name	Terminal pin number	terminal function
QBH-A+	1	A-phase frequency division signal output
QBH-A-	2	
QBJ-B+	4	B-phase frequency division signal output
QBH-B-	5	
QBH-Z+	6	Z-phase frequency division signal output
QBH-Z-	7	



5.5.3 Full closed-loop debugging

1. For new motors with idle shaft, perform a stop-and-go trial run to verify system operation under semi-closed-loop control.

When the servo motor is in no-load state, perform trial operation and intermittent operation according to Section 4.4 F1 Group procedures. After verification, set the initial control parameters.

2. Confirm the operation of the semi-closed-loop control when the servo motor is mechanically connected.

After connecting with the related mechanical structure, the load inertia ratio is first presumed. Then, according to the operation of 4.4 F0-07, the servo is instructed by the upper computer device to confirm that the mechanism is correctly connected and running normally.

- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P0-07	first inertia ratio	200	%	0 ~ 50000	at any time	immediately

3. Confirmation of the counting direction of the grating scale

When the motor is disabled, manually operate the machine by monitoring the raw data from the optical grating scale (U4-11/12) and the motor encoder (U0-10/11) to install the grating scale correctly, or adjust the counting direction of the grating scale via P9-00.1.

If U4-11/12 and U0-10/11 increase or decrease in the same direction, use the grating scale value directly. Otherwise, adjust the grating scale installation direction or P9-00.1=1.

parameter	parameter	Functionality	factory	Set range	revise	come

	setting		setting			into force
P9-00.1	n.xx□x	grating scale counting direction	0	The grating caliper reading is positive.	servo bb	Power on again
			1	The grating caliper reading is reversed.		

If the direction setting is incorrect (i.e., P9-02 is not set to 0), the system may trigger Alarm E-236 (Excessive motor-load position deviation) during operation, requiring disabling the enable function and a power cycle. If P9-02 is set to 0, Alarm E-237 (Counting direction reversed) will be triggered, necessitating a power cycle and adjustment of the value.

4. Selection of grating scale type

parameter	parameter setting	Functionality	factory setting	Set range	revise	come into force
P9-00.2	n.x□xx	grating scale type	0	AB phase counter	servo bb	Power on again
			1	Incremental serial communication (not supported)		
			2	Absolute serial communication (not supported)		

5. Confirmation of the number of feedback pulses per circle of the grating scale

Method 1: According to the resolution of the grating scale, the upper computer sends a pulse to make the motor rotate one circle, and the feedback pulse number of the grating scale is calculated at this time, which is recorded as the feedback pulse number of the grating scale per circle.

Method 2: The host computer sends a pulse to rotate the motor one full turn. The system monitors the change in raw data from the U4-11/12 optical grating scale, recording the number of feedback pulses per turn. (This method requires compensation for mechanical errors and cannot be used directly.)

6. Mechanical side grating scale frequency division setting

parameter	meaning	factory setting	unit	Set range	revise	come into force
P9-05	Number of feedback pulses per revolution of the motor encoder / Low	0	PULSE	0 ~ 9999	servo bb	Power on again
P9-06	Number of feedback pulses per revolution of the motor encoder / High	0	PULSE	0 ~ 9999	servo bb	Power on again
P9-07	Feedback pulse count per turn of the grating scale/Low	0	PULSE	0 ~ 9999	servo bb	Power on again

P9-08	Feedback pulse count per high cycle of the grating scale	1	PULSE	0 ~ 9999	servo bb	Power on again

(1) Mechanical side grating scale frequency division:

$$= \frac{\text{Motor encoder feedback pulses per motor revolution}}{\text{Pulses of external quadrature encoder per motor revolutIon}}$$

$$= \frac{\text{P9-08}*10000+\text{P9-07}}{\text{P9-06}*10000+\text{P9-05}}$$

The feedback pulse count per revolution of the motor encoder is calculated as P9-06*10000 + P9-05. When the set value is 0, the encoder resolution is automatically read and configured as the frequency division numerator.

The number of feedback pulses per revolution of the grating scale is calculated as P9-08*10000 + P9-07 + P9-08*10000 + P9-07. The factory default resolution for the grating scale (external encoder) is 10000. Adjust the setting according to the actual resolution of the grating scale.

Enter the complete external grating scale division ratio, and input it after irreducible.

(2) In fully closed-loop mode, it is recommended to set P0-11 and P0-12 to 0 and use the electronic gear ratio of P0-13 and P0-14. P0-11 and P0-12 can also be used if the external grating scale frequency division is correct; otherwise, the E-236 alarm will be triggered.

7. Alarm detection parameter settings

parameter	meaning	factory setting	unit	Set range	revise	come into force
P9-02	Alarm threshold for excessive deviation between motor and load positions	100	PULSE	0 ~ 65535	servo bb	immediately

(1) P9-02: Alarm threshold setting for excessive deviations between motor encoder feedback (position) and full-closed-loop grating scale feedback (load position).
If the value exceeds the preset threshold, the E-236 alarm will be triggered, and the alarm will be cleared upon power restoration. If mechanical errors are confirmed to be significant, causing frequent E-236 alarms, the P9-02 value may be appropriately increased under permissible equipment conditions. When P9-02 is set to 0, no alarm is triggered. However, if the motor encoder signal and the optical grating signal count in opposite directions, the E-237 alarm will occur. This issue can be resolved by restarting the system and adjusting P9-00.1.
(2) To prevent motor runaway or damage caused by external grating scale damage or loose wiring, set P9-02 to an appropriate value.
(3) The P9-02 configuration is determined by the user's location command frequency.

parameter	meaning	factory setting	unit	Set range	revise	come into force

P9-03	Motor-load position deviation clearance setting	0	shut in a pen	0 ~ 65535	servo bb	immediately

(1) When P9-03=n, the motor resets its count to zero after accumulating n full rotations in one direction, clearing the recorded difference between the encoder position feedback and the full-closed-loop grating scale load position feedback.
(2) Setting to 0 means the motor-load position deviation is not cleared; setting a non-zero value clears the deviation after the motor completes n cumulative rotations.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P9-04	Motor-load speed deviation alarm threshold	100	RPM	0 ~ 65535	servo OFF	immediately

P9-04: The motor encoder speed feedback and full-closed-loop grating speed feedback may exhibit deviations. If the actual deviation exceeds the set value, alarm E-238 will be triggered, but this function is only activated when the full-closed-loop speed feedback P9-01.0 is enabled. Setting this parameter to 0 will disable the alarm.

8. The switch for the fully closed-loop control mode

The P9-00.0 can be modified during operation and switches between semi-closed loop and full-closed loop modes via SI terminals, EtherCAT bus, or other methods.

parameter	parameter setting	Functionality	Windows default	Set range	revise	come into force
P9-00.0	n.xxx□	Full closed-loop control mode switch	0	0: Turn off full closed-loop control; 1: Enable full closed-loop control; 2: Select the SI terminal method to activate/deactivate the full closed loop. The SI terminals are assigned by P5-56, and the loop's activation/deactivation is determined by the assigned SI terminal status. 3: Select to enable/disable full closed-loop via ECAT bus: Set both bit24 of 60FEh 01h and 02h to 1 to enable full closed-loop control. If either bit24 of 60FEh 01h or 02h is set to 0 (or all bits are 0), the full closed loop will be disabled.	at any time	immediately

- relevant parameter

parameter	parameter	Functionality	Windows	Set	revise	come into

	setting		default	range		force
P3-18	100	F1-00 point speed	100	0~1000	servo bb	immediately
P5-56	0	SI terminal allocation for full closed loop/semi-closed loop function switching	0	0~ffff	at any time	immediately
P9-09	500	Full closed-loop integration time constant	500	0~65535	servo bb	immediately

(1) Under the fully closed-loop control mode, perform a stop-and-go operation at point F1-00 (P9-00.0=1) to confirm normal system operation. Perform a stop-and-go operation on the servo motor (via the panel F1-00 or using the host computer, gradually increasing the speed while observing for any abnormalities). P3-18 is the speed configured for the closed-loop stop-and-go operation, which only applies in the two stop-and-go modes; other normal control modes are invalid.

(2) Run the servo system to verify the proper operation of the fully closed-loop system. Send commands via PLC or other upper-level devices to monitor the servo unit's performance. Confirm step by step by gradually increasing the speed from low to the target speed.

(3) P9-09: The integral time constant of the full closed-loop system (unit: 0.01ms) is reduced to enhance response speed. This enables the grating scale position feedback to follow positional commands more promptly, resulting in shorter positioning time. When the transmission mechanism between full and half closed-loop systems lacks sufficient rigidity, increasing the integral time constant improves system stability. No gain switching is required when switching between half closed-loop and full closed-loop modes.

5.5.4 All closed-loop function-related parameters

1. Speed feedback selection and servo pulse output mode in full closed-loop control

parameter	Parameter Function	Set unit	factory setting	Applicable mode	revise	come into force
P9-01		-	n.0000	whole	servo bb	Power on again
	parameter setting	Functionality	factory setting	Set Meaning		
	n. □xxx	insignificance				
	n.x□xx	The source of the servo pulse output signal for the full closed-loop control	0	0: Motor encoder ABZ output 1: Raster scale ABZ output		
	n.xx□x	The source of the Z-signal in the zeroing process of the full closed-loop control	0	0: Motor encoder Z phase 1: Z-axis of the grating scale		

	n.xxx□	Selection of speed feedback in full closed-loop control	0	0: Use motor encoder speed 1: Use the grating scale speed

In full closed-loop control, P9-01.0 is usually set to "use motor encoder speed (P9-01.0 = 0)". When only the direct drive servo motor and high resolution grating scale are connected, it is set to "use grating scale speed (P9-01.0= 1)".

2. Monitoring parameters in the full closed-loop mode

In the full closed-loop mode, all encoder data in the original control loop are replaced by the position data from the optical grating (except for the current loop and mechanical angle feedback).

parameter	meaning	data
U4-11	Raw data from the grating scale	U4-12*10000+ U4-11
U4-12		
U4-13	Number of Z-axis grating scales	-
U4-14	grating scale feedback data	U4-15*10000+ U4-14
U4-15		

3. Sampling channel with full closed-loop control

When the grating scale function is enabled, the position control information in position control mode comes from the grating scale feedback position data. When the grating scale speed feedback is enabled, the motor encoder speed feedback information will also be replaced by the grating scale speed feedback data. That is, the grating scale feedback information obtained from the same channel sampling.

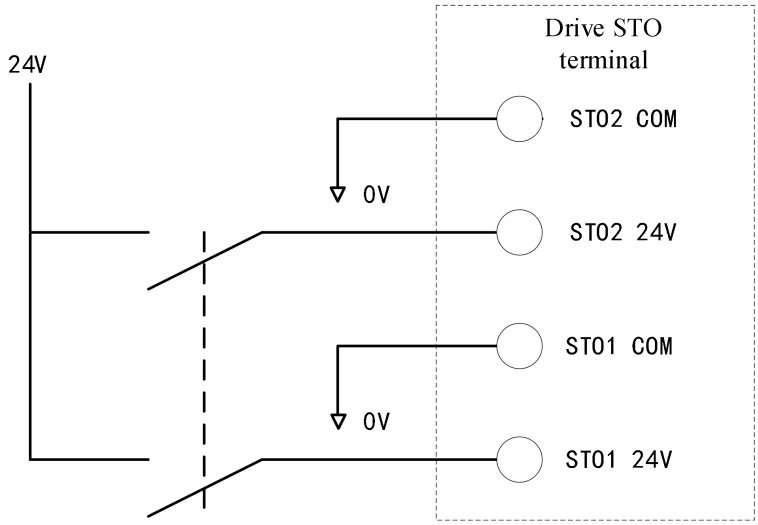
sampling channel	Sampling
1950	The original position information of the grating scale;
1951	Grating differential position feedback (grating resolution)
0953	Grating Differential Position Feedback (Motor Encoder Resolution)
0954	grating speed feedback
0955	Error between position feedback of motor encoder and position feedback of grating scale under resolution of grating scale
3961	The cumulative value of position feedback deviation between grating scale and motor encoder
4960	Total number of grating scale position feedbacks

5.6 STO Safe Torque Shutdown

5.6.1 Overview of STO Function

STO (Safe Torque Off) function: A safety feature that cuts off motor current through hardware. The STO safety terminal (CN5) features a dual-circuit design with two safety signal inputs (STO1 and STO2). When either terminal is triggered, it activates the STO state, isolating the power module that controls motor current. This prevents the power module from outputting PWM control signals, thereby cutting off the motor current and achieving a torque-free state.

5.6.2 STO Wiring Schematic Diagram



5.6.3 Settings for STO-related parameters

parameter	Parameter name	unit	scope	Trigger time	function declaration	give tacit consent to
P0-88	STO Synchronization Detection Configuration	100us	0-1000	immediately	STO asynchronous alarm detection time	60
P0-89.0~1	STO Buffer Circuit Abnormal Alarm Detection and Filtering	100us	0-255	immediately	STO buffer circuit abnormal alarm detection filter time	32
P0-89.2~3	STO input detection and filtering	100us	10-30	immediately	STO input detection and filtering	12

5.6.4 STO Working Principle

■ STO detonate by contact

The driver will operate properly only when both STO1 and STO2 terminal input signals are in a valid high-level state. The status specifications are as follows:

STO1 input	STO2 input	EDM output state	PWM control signal
H	H	no-output	normal
H	L	no-output	prohibit
L	H	no-output	prohibit
L	L	Output	prohibit

When either STO1 or STO2 is at a low level, the servo enters the STO state, at which point:

① PWM control signal is prohibited;

② The servo shuts down according to the shutdown method of enabling and disabling in P0-29 alarm shutdown mode;

③ The servo/S-RDY signal output is 0;

④ The panel displays Sto.

If the STO1 and STO2 statuses are inconsistent and the time exceeds the P0-88 set time, the E-340 alarm will be triggered: STO status is out of sync. The alarm is disabled when the value is 0.

When any of the following occurs:

- When STO1 and STO2 inputs are high, the MCU enable level differs from the PWM enable level.
- Both STO1 and STO2 are low, and PWM_EN is also low.

Alarm E-342: STO input buffer loop malfunction when time exceeds P0-89.0~1. The alarm is disabled when P0 is 0.
The STO1 and STO2 pins must not respond to pulses shorter than 1ms, and must respond to pulses exceeding the threshold set by P0-89.2~3.
When an alarm occurs in the STO state, the panel displays the alert, but the servo remains in STO mode, and the brake configuration is set according to the STO state.

■ STO remove

When both STO1 and STO2 terminals are at high level and the enable signal remains inactive, the STO state is released. The servo ready output signal (S-RDY) is output according to the P5-70 configuration, and the brake is activated based on the validity of the enable signal (S-ON).

5.6.5 Notes on STO Function

When the STO function is activated, the motor will safely enter a torque-free state, and the servo driver will no longer exert control. Therefore, before using the STO function, please assess the

potential risks that may persist after activation.

- When the STO function is enabled, the servo cannot ensure the motor's movement due to external forces, such as vertical-axis motion.
- The STO function cannot disconnect the servo unit's power supply, leaving the driver's high-voltage section energized. This poses risks of electric shock or other hazards. Always disconnect the power supply and related devices before servicing the servo unit.
- Use the external 24V switch power supply to power the function terminal CN5 to provide the STO signal input. The external power supply voltage range is within 22.8V~25.2V,0.5A.

If the STO function stops the running servo, the motor will gradually stop. If this is unacceptable, the system should use the correct stop mode instead of stopping with the STO function.

All cables compatible with STO functionality must be properly protected, routed, and secured. During installation, ensure cables are free from tension or compression. The required cables are listed in the table below:

Cable requirements	explain
kind	Double-shielded or single-shielded twisted pair cable
extreme length	The maximum allowable cable length between the drive and safety switch is 30 meters.
maximum dimensions	0.8mm2（18 AWG）
lower limit	0.3mm2（28 AWG）

5.7 Weak Magnetic Function

5.7.1 Overview of the Weak Magnet Function

The control method of weak magnetic field is to reduce the magnetic field of the motor to make the motor run at the rated speed above the maximum voltage and current limit of the inverter.

When using the weak magnetic function, the motor speed must not exceed its maximum speed to prevent motor failure or personal and property damage.

5.7.2 Settings for weak magnetic correlation parameters

Servo weak magnetic control switch PE-01.3,0 (default): 0 turns off weak magnetic function, 1 turns on weak magnetic function.

To activate the servo's weak magnetic function, ensure proper motor parameters such as back electromotive force coefficient, Ld, and Lq are configured. For specific usage conditions and parameter settings, contact the original manufacturer's technical support.

parameter	Parameter name	unit	scope	Trigger time	give tacit consent to
PE-01.3	weak magnetic control switch	—	0-1	at any time	0
PE-80	weak magnetic control gain Kv	Hz	10-1000	at any time	30
PE-81	The integral time constant Ti of weak magnetic control	%	10-1000	at any time	16
PE-82	weak magnetic control integral limit	%	0-200	at any time	60
PE-83	Voltage command limit threshold	%	50-150	at any time	115
PE-84	IdRef amplitude limiting	%	50-150	at any time	95
PE-85	Main loop voltage smoothing filter time	0.1ms	0-1000	at any time	20

5.8 Position Control

5.8.1 General Positioning Mode

5.8.1.1 Positioning completion signals (/COIN, /COIN_HD)

The signal is used to confirm the completion of the servo motor positioning when the position control is performed.

- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P5-00	Positioning completion width	144	instruction unit	1 ~ 65535	at any time	immediately
P5-01	Complete detection mode	0	-	0 ~ 3	at any time	immediately
P5-02	Location completion time	0	ms	0 ~ 65535	at any time	immediately

paramet er	Signal name	factory setting	Applicable mode	meaning	revise	come into force
P5-37	/COIN-HD	n.0000	5|6	Complete positioning	at any time	imme diatel y
P5-38	/COIN	n.0001	5|6	Complete positioning	at any time	imme diatel y
For details of hardware wiring, refer to Chapter 3.3.2. To output a SO2 signal, set P5-37 and P5-38 to n.0002/0012. Note that each SO terminal can only serve one signal function.						

1) The conditions for outputting the positioning completion signal

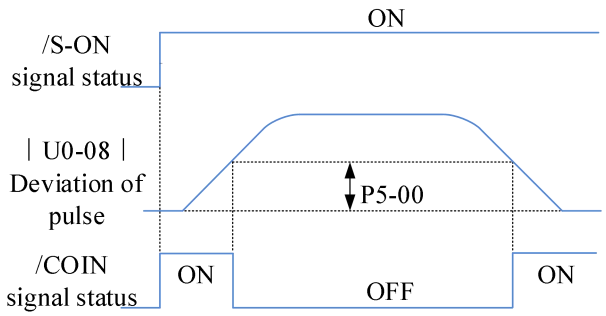
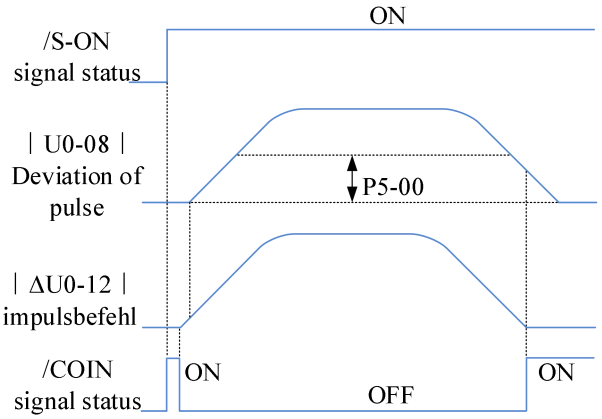
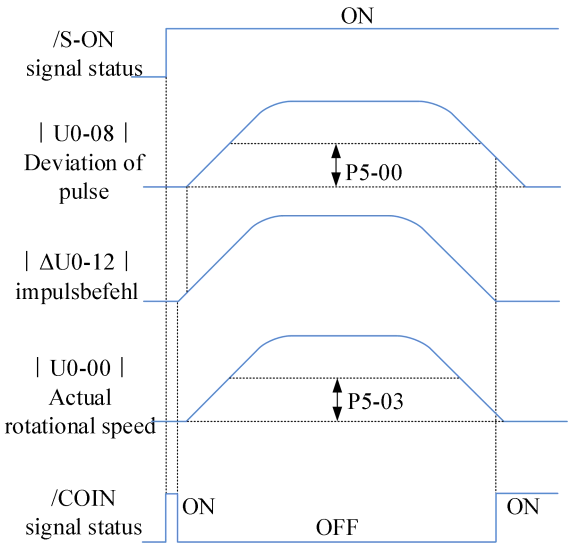
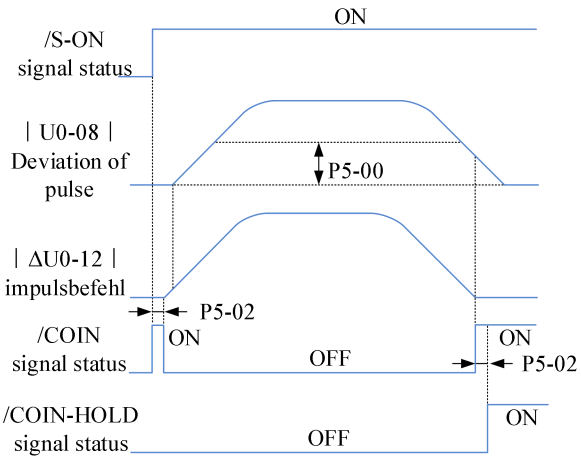
(1) /COIN-HD signal output conditions

The positioning completion hold/COIN-HD signal is only outputted when the detection mode P5-01 is set to 3. The COIN-HD signal is outputted after the /COIN signal is held for P5-02 duration.

(2) /COIN signal output conditions

Based on the positioning completion detection mode configured by P5-01, the system outputs a positioning completion/COIN signal. The following outlines the prerequisites for this output and its schematic diagram.

P5-01 Settings	content	diagrammatic sketch

P5-01 Settings	content	diagrammatic sketch
0	The COIN signal is outputted when the absolute value of deviation stays below P5-00.	
1	After the instruction is completed, if the deviation is below P5-00, the COIN signal is output.	
2	If the command ends and the motor speed is below the rotation detection speed (P5-03), and the absolute deviation is less than P5-00, the COIN signal is output.	
3	When the instruction completes, the system outputs a COIN signal if the absolute deviation value is below P5-00. If the COIN signal remains active for P5-02, it will output a COIN-HOLD signal.	

2) Description of the completed width

(1) The positioning completion width P5-00 varies proportionally with the electronic gear ratio, with a factory default of 11 command units.

The positioning width P5-00 changes proportionally with the number of command pulses required for the motor to complete one revolution.

The output of the positioning completion signal is determined by the width of the signal. The smaller the width, the later the output of the signal, but the signal output does not affect the actual running state of the motor.

(2) The positioning completion width can also be set independently, and its adjustment won't affect the number of command pulses required for the motor to complete one full rotation.

5.8.1.2 Near Positioning Signal (/NEAR)

The servo motor detects signals near the positioning completion signal, enabling the device to prepare for the next action in advance.

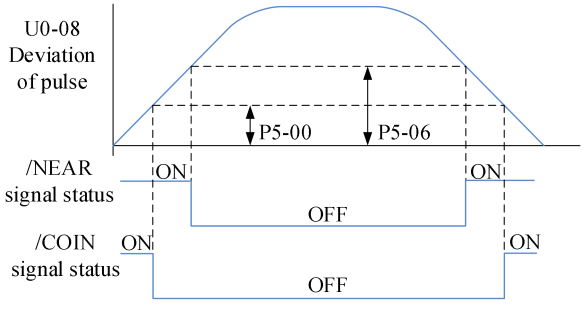
- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P5-06	Approach signal output width	655	instruction unit	0 ~ 65535	at any time	immediately

paramet er	Signal name	factory setting	Applicable mode	meaning	revise	come into force
P5-46	/NEAR	n.0000	5|6	Close proximity	at any time	imme diatel y
For details of hardware wiring, refer to Chapter 3.3.2. To locate the SO2 output signal, set P5-46 to n.0002/0012.						

1) The positioning is close to the signal output condition.

When the pulse deviation U0-08 of the servo driver falls below the P5-06 set value, it outputs a proximity signal (/NEAR).



2) Description of the signal output approach

(1) The signal output width P5-06 varies proportionally with the electronic gear ratio, with a factory default of 655 command units.

The width of the signal output P5-06 is proportional to the number of command pulses required to complete one revolution of the motor.

The output of the positioning completion signal is determined by the width of the signal. The smaller the width, the later the output of the signal, but the signal output does not affect the actual running state of the motor.

(2) The approach signal output width can also be set independently, and its adjustment won't affect the number of command pulses required for the motor to complete one full rotation.

(3) Set this parameter to be wider than the completed positioning width.

5.8.1.3 Instruction Pulse Inhibition (/INHIBIT)

Position command is disabled, including internal and external position commands. The function of stopping pulse input during position control is disabled. When the /INHIBIT signal is ON, pulse commands are no longer counted.

- relevant parameter

parameter	Signal name	factory setting	Applicable mode	meaning	revise	come into force
P5-32	/INHIBIT	n.0000	5|6	instruction pulse prohibition	at any time	immediately
The parameter range is n.0000-001A, which is assigned to other input terminals via parameter P5-32. To disable the signal command pulse input from SI2, set P5-32 to n.0002/0012. For detailed hardware wiring, refer to Chapter 3.3.1.						

1) INHIBIT terminal validity description

Parameter settings status	Signal/INHIBIT terminal input status	signal/inhibit terminal logic
P5-32=n.0000	No external terminal input is required.	of no avail
P5-32=n.000□	No signal input at the SI□ terminal	
P5-32=n.001□	The SI□ terminal has a signal input.	
P5-32=n.0010	No external input terminals required	valid
P5-32=n.000□	The SI□ terminal has a signal input.	
P5-32=n.001□	No signal input at the SI□ terminal	

2) Effect of INHIBIT terminal signal on motor operating status

control model	Motor operating status	
	/INHIBIT terminal logic is valid	The INHIBIT terminal logic is invalid

5-Internal Position Control	Pause the current section	The INHIBIT signal is ON → OFF. Continue running from the pause point.
6-External position pulse control	suspend pulse instruction reception	The INHIBIT signal transitions from ON to OFF. When the signal returns to OFF, the system resumes operation based on the subsequent pulse command.

5.8.1.4 Error Correction (/CLR)

Position deviation = (position command-position feedback) (encoder unit)
The position deviation clearance function allows the drive to reset its position deviation to zero when the servo is turned off or a /CLR signal is received.

- relevant parameter

paramet er	Signal name	factory setting	Applicable mode	meaning	revise	come into force
P5-34	/CLR	n.0000	own	pulse deviation elimination	at any time	immed iately
The parameter range is n.0000-001A, which is assigned to other input terminals via parameter P5-34. To clear signal deviation from SI2, set P5-34 to n.0002/0012. For hardware wiring details, refer to Chapter 3.3.1.						

1) /CLR signal validity

Parameter settings status	Signal/CLR terminal input status	signal/CLR terminal logic
P5-34=n.0000	No external terminal input is required.	of no avail
P5-34=n.000□	No signal input at the SI□ terminal	
P5-34=n.001□	The SI□ terminal has a signal input.	
P5-34=n.0010	No external input terminals required	valid
P5-34=n.000□	The SI□ terminal has a signal input.	
P5-34=n.001□	No signal input at the SI□ terminal	

2) /CLR signal description

When a pulse is sent to the servo, the execution/CLR input signal activates. The servo then latches the current pulse count, updates the encoder's position to the control feedback, and clears all intermediate values in the position loop, speed loop, and current loop.
The /CLR signal uses edge triggering.

3) Other notes on the pulse position deviation clearing signal

The pulse position deviation can be cleared by setting F0-02 to 1.

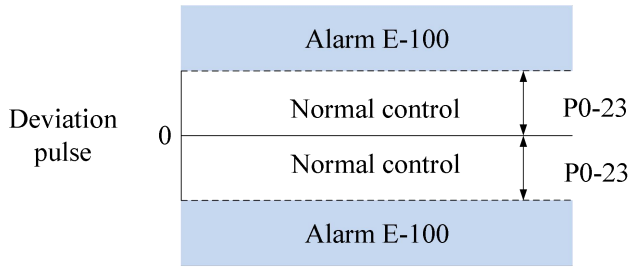
5.8.1.5 Position Pulse Deviation Setting

The pulse deviation value refers to the difference between the command pulse of the instruction controller (such as PLC) and the servo unit feedback pulse in the position mode. Its unit is 1 command unit, which is related to the command unit determined by the electronic gear ratio.
When the position control is in operation, the alarm will be triggered if the deviation pulse exceeds a certain threshold, which is called the deviation pulse limit.

- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P0-23	pulse deviation limit	2000	0.01 turn	0 ~ 65535	at any time	immediately

When the deviation pulse limit is 0, the system will not detect the pulse magnitude.

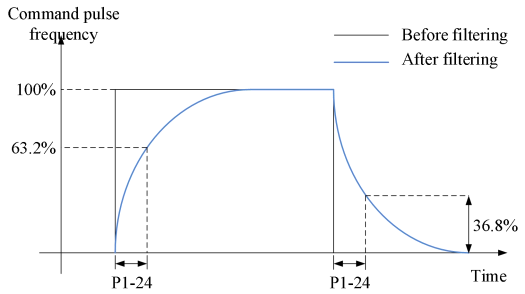
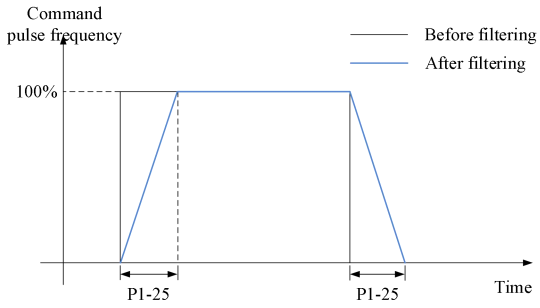
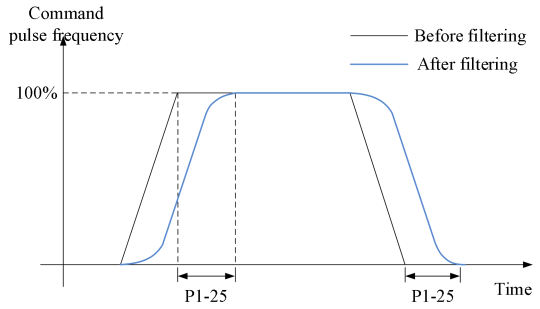


5.8.1.6 Position command filter

- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P1-24	Position command acceleration and deceleration filter time	0	0.1ms	0 ~ 65535	immediately	Servo not activated
P1-25	position command smoothing filter time	0	0.1ms	0 ~ 65535	immediately	Servo not activated

position command acceleration and deceleration filter	position command smoothing filter

position command acceleration and deceleration filter	position command smoothing filter
	
	

5.8.1.7 Reference Origin

1) Find the reference origin

This feature determines the physical zero point of the workbench to serve as the coordinate zero point for point control. Users can select either the forward rotation side or the reverse rotation side as the reference origin.

2) Function Settings

parameter	meaning	factory setting	unit	Set range	revise	come into force
P4-00 n.xx(x	Origin function	0	-	0 ~ 1	servo OFF	immediately
Note: This feature is available for Location Modes 5 and 6. When this parameter is set to 0, the origin-finding function is disabled. The origin-finding function is only available when set to n.001x. (Set P9-21=0)						

3) Signal Settings

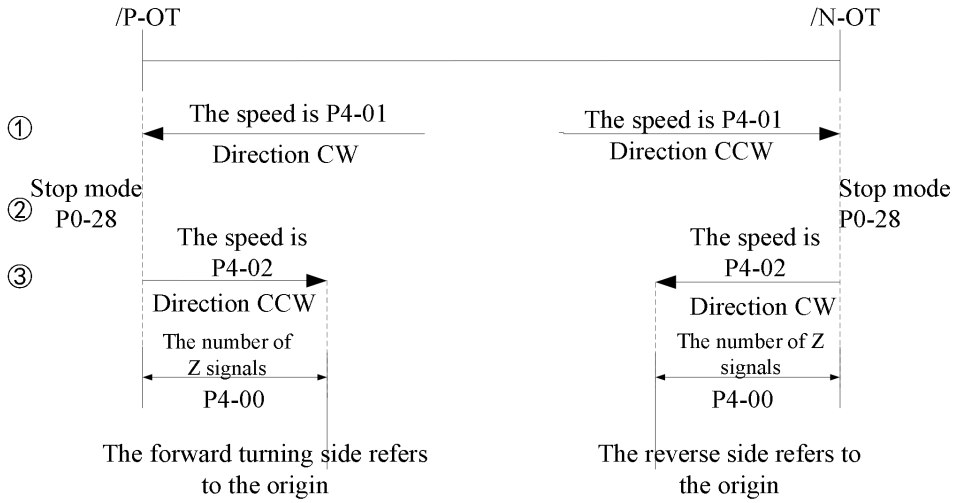
parameter	Signal name	factory setting	meaning	revise
P5-28	/SPD-A	n.0000	Mode 3: Internal speed selection signal Mode 5: Find origin in forward direction	The parameter range is 0000-0014, assigned to the input interface via parameters P5-28. Setting it to 0001 indicates signal

parameter	Signal name	factory setting	meaning	revise
				input from the SI1 terminal.
P5-29	/SPD-B	n.0000	Mode 3: Internal speed selection signal Mode 5: Reverse direction to find the origin	The parameter range is 0000-0014, assigned to the input interface via parameters P5-29. Setting it to 0001 indicates signal input from the SI1 terminal.

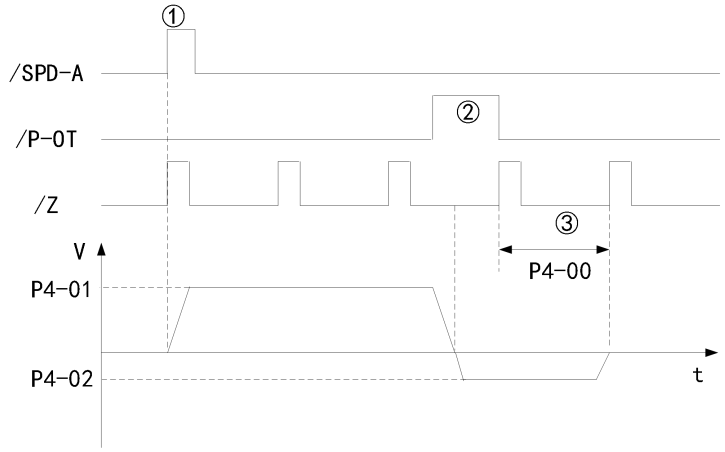
4) Related parameter settings

paramet er	meaning	factory setting	unit	Set range	revise	come into force
P4-00 n.xxx□	Z Sign Count	2	individual	0 ~ f	servo OFF	imme diatel y
P4-01	Collision proximity switch speed	600	rpm	0 ~ 65535	servo OFF	imme diatel y
P4-02	Speed of approaching the proximity switch	100	rpm	0 ~ 65535	servo OFF	imme diatel y
Note: The origin-seeking function is only available for single-turn absolute motors (multi-turn absolute motors can also support this function if P0-79=1).						

5) Find the reference origin schematic diagram



The sequence for aligning the reference origin of forward and reverse rotation is shown below:



The steps are as follows:
(1) Install limit switches on the forward and reverse rotation sides. When the /SPD-A signal rises, the motor rotates in the forward direction at the speed set by parameter P4-01 to locate the reference origin on the forward side.
(2) When the workbench triggers the limit switch, the motor stops according to the P-OT and N-OT settings specified in parameter P0-28.
(3) Rotate the motor in the direction opposite to the limit switch at the speed set by parameter P4-02. When the motor reaches the n-th position of the photoelectric encoder Z, this position is designated as the coordinate zero point, where n is determined by parameter P4-00.

5.8.1.8 New Return to Origin Function

1) Function Description

The return-to-origin function refers to the process where, in position control mode with the servo motor enabled, the system initiates this function. The servo motor then locates the origin to complete positioning, which serves as the reference point for subsequent position control.
During the return-to-origin operation, all other position commands (including the re-triggered return-to-origin signal) are disabled. Once the return-to-origin is completed, the servo driver can respond to other position commands.
After the return to origin is completed, the servo driver outputs a completion signal. Upon receiving this signal, the host computer confirms that the return to origin has been successfully completed.

2) Parameter Settings

parameter	name	Set range	meaning	Set time	entry-into-force time	出厂默认

parameter	name	Set range	meaning	Set time	entry-into-force time	出厂默认
P9-11.0	Z phase count	0~F	P9-11.0=0: Do not find Z phase P9-11.0=1: Find a Z phase P9-11.0=2: Find 2 Z phases and so on	servo OFF	servo ON	0
P9-11.1	trigger at origin	0~2	P9-11.1=0: Do not trigger back to origin P9-11.1=1: Trigger back to origin through SI terminal (P5-28) P9-11.1=2: After the first enable, the system starts back to the origin	servo OFF	servo ON	0
P9-11.2	return to origin mode	0~7	P9-11.2=0: Return to origin mode 0 P9-11.2=1: Return to Origin Mode 1 P9-11.2=2: Return to Origin Mode 2 and so on	servo OFF	servo ON	0
P9-11.3	deceleration mode when over travel signal is detected	0、1	P9-11.3=0: Slow down according to the acceleration and deceleration time set by P9-14 P9-11.3=1: Slow down immediately	servo OFF	servo ON	0

P9-11.0 can set up to 15 Z phases. P9-11.1=0 is equivalent to the return to origin function cannot be used, this parameter can be understood as the enable bit of the return to origin function. Return to origin mode 1, 3, 5, 7 are the opposite of return to origin mode 0, 2, 4, 6.

parameter	name	Set range	unit	meaning	setting time	come into force time	leave the factory give tacit consent to

parameter	name	Set range	unit	meaning	setting time	come into force time	leave the factory give tacit consent to
P9-12	return to the origin high speed velocity	0~3000	rpm	Return to the origin speed, find the deceleration point, and execute the mechanical offset.	servo OFF	servo ON	200
P9-13	Return to the origin at low speed.	0~1000	rpm	Set the speed to a low value to find the origin. The low speed should be low enough to avoid mechanical impact when stopping.	servo OFF	servo ON	20
P9-14	acceleration and deceleration time to return to origin	0~1000	ms	The acceleration and deceleration time here refers to the duration required to reach 1000rpm from 0.	servo OFF	servo ON	1000
P9-15	Maximum time allowed to return to the origin	0~12000	10ms	The system will trigger an alarm if the total time for returning to the origin exceeds the parameter's set time limit. When P9-15 equals zero, the alarm will be triggered for the timeout of returning to the origin.	servo OFF	servo ON	0
P9-16	threshold of stopping and returning to the original speed	0~1000	rpm	This parameter applies only to return-to-origin modes 6 and 7	servo OFF	servo ON	2
P9-17	threshold of stopping torque	0~300%	%	This parameter applies only to return-to-origin modes 6 and 7 The base value of the percentage is the rated torque.	servo OFF	servo ON	100 %
P9-18	touch stop time threshold	10~1500	ms	This parameter applies only to return-to-origin modes 6 and 7	servo OFF	servo ON	500
P9-19	Quantitative pulse count in the lower bit	-9999~9999	-	Quantitative pulse count in the lower bit	servo OFF	servo ON	0

parameter	name	Set range	unit	meaning	setting time	come into force time	leave the factory give tacit consent to
P9-20	Quantitative pulse count high bit	-9999~9999	-	Quantitative pulse count high bit	servo OFF	servo ON	0
P9-21	Select the new or old original point function	0、1	-	P9-21=0: Return to origin function P9-21=1: Reset to origin	servo OFF	again power on	0
P9-22	New origin end filter time	50~10000	ms	This filtering time is required when returning to the origin is about to end, and the return-to-origin mode will not be fully exited until the motor has completely stopped. The return-to-origin completion signal will be output after this filtering time.	servo OFF	servo ON	500

The actual mechanical offset is calculated as P9-19 + P9-20×10000, where P9-19 and P9-20 must share the same sign (either both positive or both negative). This offset represents the absolute position of the servo after returning to the origin.

parameter	name	setting scope	meaning	setting time	come into force time	leave the factory give tacit consent to
P5-22	positive overtravel signal POT	0~ffff	Forward limit signal in return-to-origin mode	move setting	immediately come into force	1
P5-23	Reverse overtravel signal NOT	0~ffff	Reverse Limiting Signal in Origin Return Mode	move setting	immediately come into force	2

parameter	name	setting scope	meaning	setting time	come into force time	leave the factory give tacit consent to
P5-54	return to origin complete signal	0~ffff	The return-to-origin completion signal is output when the return-to-origin action and state are fully completed. Even if another mode is executed after the return-to-origin, the signal does not disappear. When the return-to-origin is restarted, the signal disappears.	move setting	immediately come into force	0
P5-64	Origin switch signal	0~ffff	The process of returning to the origin requires a switch signal at the origin.	move setting	immediately come into force	0
P5-28	SI terminal starts forward to the origin	0~ffff	When P9-11.1=1, after the P5-28 assigns the SI terminal, the terminal can be used to trigger the positive return to the origin	move setting	immediately come into force	0

3) Selecting the new origin mode

To use the reset function, first set P9-21 to 1, then configure the overtravel switch (POT/NOT) and origin switch. If using mechanical offsets (with P9-19 and P9-20 set), adjust the offset within the travel range to prevent mechanical damage during origin reset.

The Z-axis phase count (P9-11.0) and mechanical offset (P9-19, P9-20) can operate simultaneously. If both are non-zero, the servo first detects the Z-axis phase (P9-11.0) before executing the mechanical offset (P9-19, P9-20). If the Z-axis phase (P9-11.0) is zero but the mechanical offsets (P9-19, P9-20) are non-zero, the servo executes the mechanical offsets (P9-19, P9-20) without detecting the Z-axis phase. If the Z-axis phase count is non-zero but the mechanical offsets are zero, the servo detects the Z-axis phase (P9-11.0) but does not execute the mechanical offsets.

There are 8 total return-to-origin patterns, as follows:

(1) Positive return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal (P9-11.2=0)

(2) Reverse return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal (P9-11.2=1)

(3) Positive return to zero, the deceleration point and the origin are the motor Z signal (P9-11.2=2)

(4) Reverse return to zero, the deceleration point and the origin are the motor Z signal (P9-11.2=3)

(5) Positive return to zero, the deceleration point is the positive overtravel switch, the origin is the positive overtravel switch or the motor Z signal (P9-11.2=4)

(6) Reverse return to zero, the deceleration point is the reverse overtravel switch, the origin is the reverse overtravel switch or the motor Z signal (P9-11.2=5)

(7) Positive return to zero, the deceleration point is the mechanical limit position, the origin is the

mechanical limit position or the motor Z signal (P9-11.2=6)

(8) Reverse return to zero, the deceleration point is the mechanical limit position, the origin is the mechanical limit position or the motor Z signal (P9-11.2=7)

The following provides a detailed analysis of each mode of returning to the origin.

(1) Return to origin mode 0-positive return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal (P9-11.2=0)

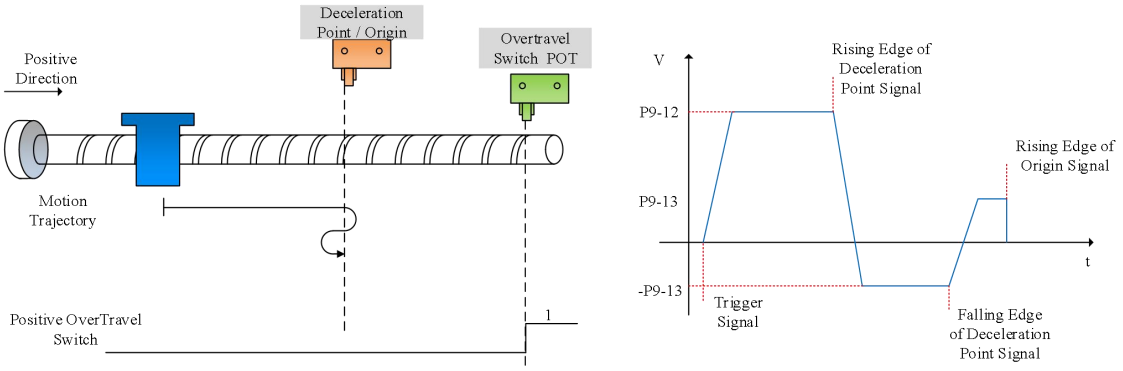
To use this mode, connect the POT, NOT, and origin switches.

1) When the motor starts, the origin switch (reduction point) signal is invalid (signal terminal assigned by P5-64,0=invalid, 1=valid), and the forward overtravel switch (POT, P5-22) remains inactive throughout the process.

The servo motor first initiates high-speed forward search for the deceleration point (origin) signal using the P9-12 (high-speed return-to-origin) setting. Upon detecting the rising edge of the deceleration point (origin) signal, it gradually decelerates to-P9-13 (low-speed return-to-origin) according to the P9-14 (acceleration-deceleration time for origin return) setting. Subsequently, the servo motor reverses direction upon encountering the falling edge of the deceleration point (origin) signal at-P9-13 (low-speed return-to-origin), then continues low-speed search for the deceleration point (origin) signal's rising edge using the P9-13 (low-speed return-to-origin) setting. The subsequent origin return operation involves four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the P9-13 (origin low-speed speed) signal. Upon detecting the signal rising edge of the deceleration point (origin), it immediately halts.

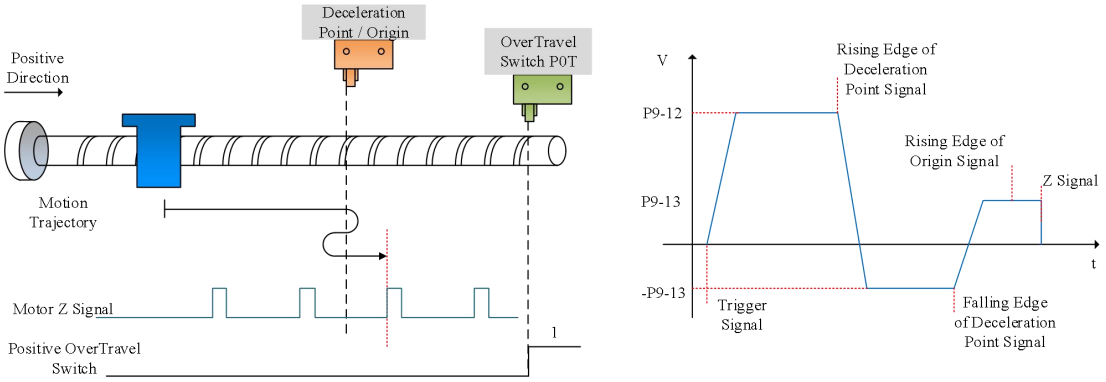


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During the low-speed search for the deceleration point (origin) using P9-13 (returning to origin at low speed), the system immediately halts upon detecting the signal's rising edge. After the motor has fully stopped, it proceeds with a predetermined number of pulses and direction (positive or negative) based on the set mechanical offset. The motor then travels a fixed distance at the speed specified by P9-12 (returning to origin at high speed), followed by a complete shutdown.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the P9-13 (origin low-speed speed). Upon encountering the signal rising edge of the deceleration point (origin), it proceeds to locate the first Z signal and immediately stops.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

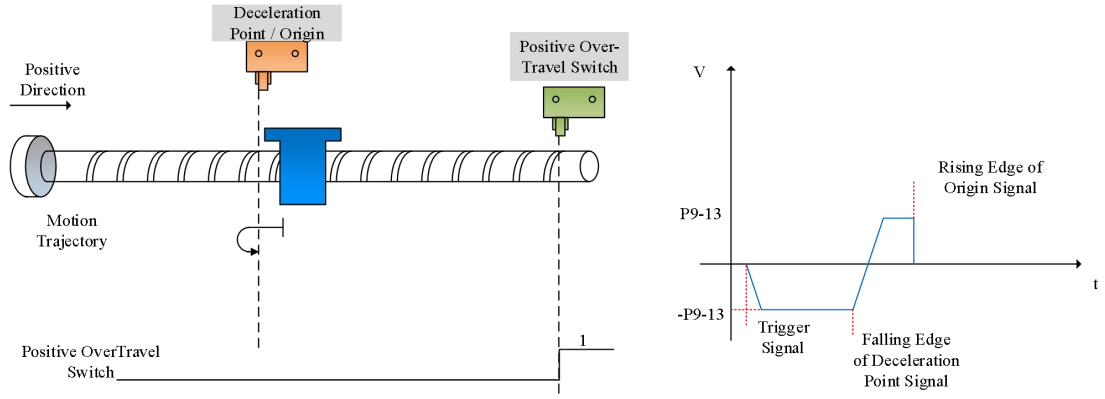
During the low-speed search for the deceleration point (origin) using P9-13 (return to origin at low speed), the system continues operation after detecting the signal's rising edge. Upon identifying the first Z-axis signal, it immediately stops. After the motor has fully ceased, the system then proceeds to execute a fixed pulse sequence (P9-19, P9-20) at the preset mechanical offset pulse count (P9-19, P9-20) and direction (positive or negative). Finally, the motor halts at the speed specified by P9-12 (return to origin at high speed).

2) When the motor starts, the origin switch (reduction point) signal is active (signal terminal assigned by P5-64,0 = inactive, 1 = active), and the forward overtravel switch (P5-22) remains inactive throughout the process:

The servo motor initiates a low-speed reverse search for the deceleration point (origin) by triggering the-P9-13 (origin-low-speed) set value. When the origin signal's falling edge is detected, it reverses direction (to forward) and resumes the low-speed search for the deceleration point (origin) by activating the P9-13 (origin-low-speed) signal. The subsequent return-to-origin operation is categorized into four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During forward acceleration or uniform speed running, the machine will stop immediately when the signal of deceleration point (origin) rises.

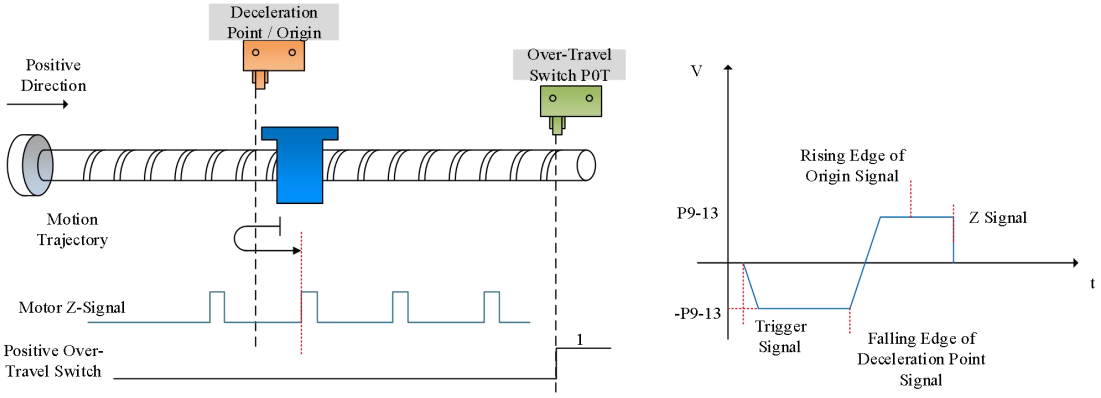


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During forward acceleration or uniform speed operation, the system halts immediately upon encountering the rising edge of the origin signal. After complete motor stoppage, the motor advances a fixed pulse distance (P9-12) at preset speed (high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During forward acceleration or uniform speed running, the machine will continue running after encountering the rising edge of the origin signal, and then stop immediately after finding the first Z signal.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

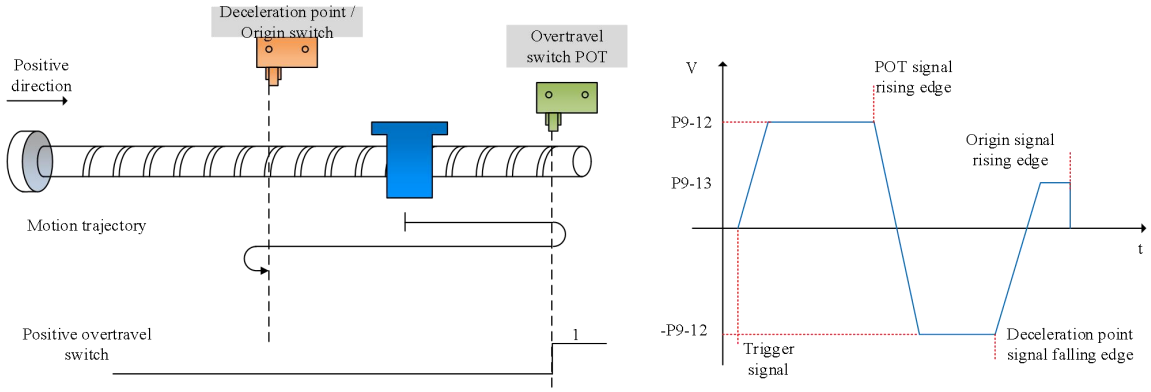
During forward acceleration or constant-speed operation, the motor resumes movement after encountering the rising edge of the origin signal. Upon detecting the first Z-axis signal, it immediately stops. After complete motor shutdown, the system then drives the motor at the preset high-speed speed (P9-12) for a fixed pulse duration (P9-19, P9-20) based on the mechanical offset pulse count (P9-19, P9-20) and direction (positive/negative). The motor then stops after completing this phase.

3) When the motor starts, the origin switch (reduction point) signal is invalid (signal terminal assigned by P5-64,0 = invalid, 1 = valid). During operation, the forward overtravel switch (P5-22) becomes active.

The servo motor first performs a high-speed forward search for the deceleration point signal using the P9-12 (high-speed return-to-origin) setting. Upon detecting the forward overtravel switch (POT) (P5-22), the driver immediately initiates a high-speed reverse search for the deceleration point (origin) signal's falling edge, based on the P9-14 (acceleration/deceleration time to origin) setting. After identifying the deceleration point (origin) signal's falling edge, the motor decelerates and reverses direction (i.e., returns to forward motion) according to the P9-14 (acceleration/deceleration time to origin) setting. The servo motor then performs a low-speed forward search for the deceleration point (origin) signal's rising edge using the P9-13 (low-speed return-to-origin) setting. The subsequent return-to-origin operation involves four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the forward acceleration or forward uniform speed running, the machine will stop immediately when the signal rising edge of the origin is encountered.

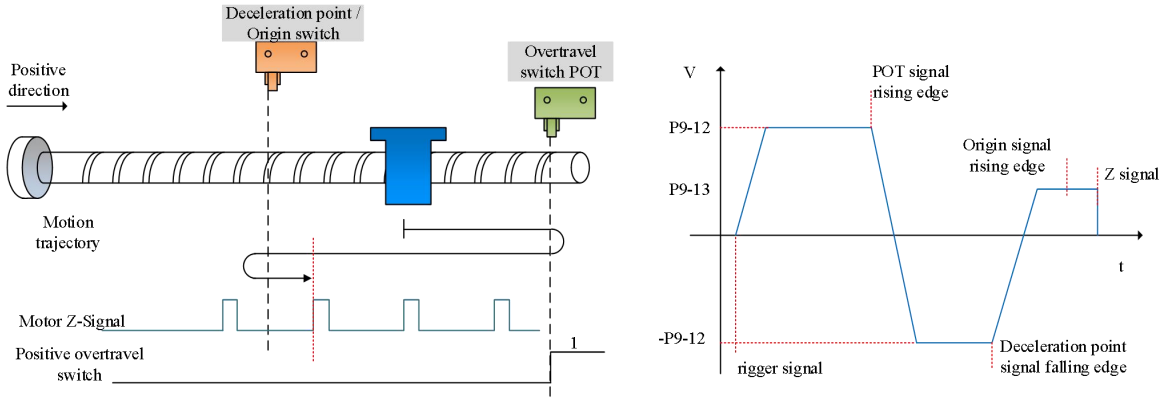


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During forward acceleration or constant-speed operation, the system halts immediately upon detecting the rising edge of the deceleration signal (origin point). After complete motor shutdown, the motor advances a fixed pulse distance (P9-19/P9-20) at preset speed (P9-12, high-speed return to origin) according to the specified mechanical offset pulse count and direction (positive/negative), then stops.

The number of Z phases P9-11.0=1 and the mechanical offset (P9-19, P9-20) is 0:

During forward acceleration or uniform speed operation, the system will continue running after encountering the rising edge of the deceleration point (origin) signal, and immediately stop upon detecting the first Z signal.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

During forward acceleration or constant-speed operation, the system resumes movement after detecting the rising edge of the deceleration signal (origin point). Upon identifying the first Z-axis signal, it immediately halts. After complete motor shutdown, the system then advances the motor at the preset P9-12 speed (returning to origin at high speed) for a fixed pulse duration (P9-19/P9-20), following the specified mechanical offset pulse count and direction (positive/negative). The motor then stops.

(2) Return to origin mode 1--reverse return to zero, the deceleration point is the origin switch, the origin is the origin switch or the motor Z signal (P9-11.2=1)

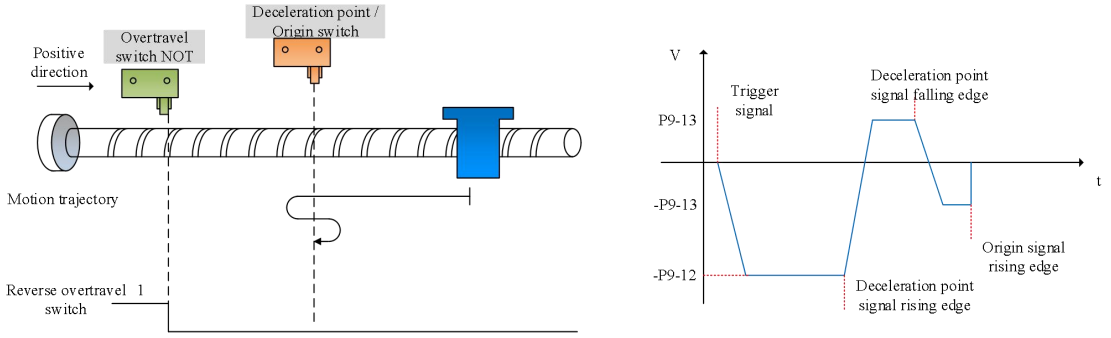
To use this mode, connect the POT, NOT, and origin switches.

1) When the motor starts, the origin switch (reduction point) signal is invalid, and the reverse overtravel switch (NOT) (P5-23) remains inactive throughout the process.

The servo motor first performs high-speed reverse search for the deceleration point signal using the P9-12 (high-speed return-to-origin) setting. It continues until encountering the rising edge of the deceleration point signal. Then, according to the P9-14 (acceleration time for return-to-origin), it gradually accelerates to the P9-13 (low-speed return-to-origin) setting. Subsequently, the servo motor searches forward for the deceleration point (origin) signal at the low-speed forward setting (P9-13) by detecting the falling edge of the deceleration point (origin) signal. Upon encountering the falling edge, it reverses direction (restores reverse motion) and continues low-speed searching for the deceleration point (origin) signal by detecting the rising edge of the P9-13 (low-speed return-to-origin) setting. The subsequent return-to-origin operation involves four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the P9-13 (origin low-speed speed) signal. Upon detecting the signal rising edge of the deceleration point (origin), it immediately halts.

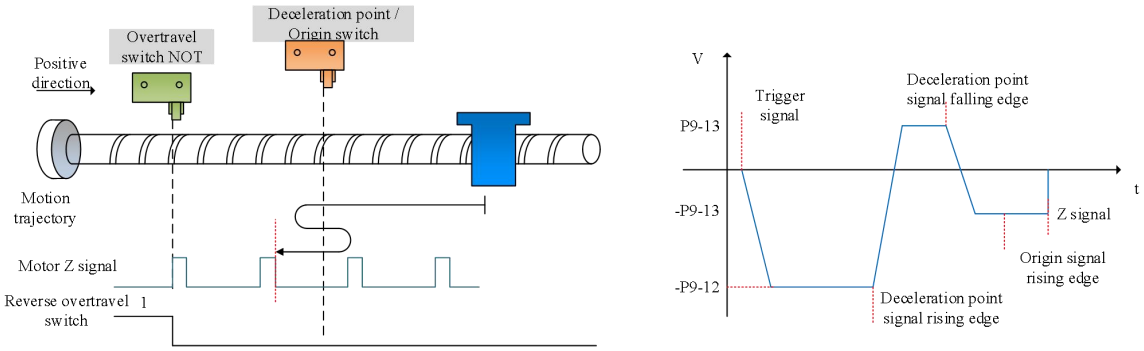


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During the low-speed search for the deceleration point (origin) using P9-13 (return to origin at low speed), the system immediately halts upon detecting the signal's rising edge. After the motor has fully stopped, it executes a set number of pulses (P9-12, return to origin at high speed) according to the preset mechanical offset quantity and direction (positive or negative). The motor then proceeds at the P9-12 speed for a fixed pulse duration (P9-19, P9-20) before stopping completely.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the operation of the signal rising edge, the system continues low-speed search for the deceleration point (origin) using the P9-13 (origin low-speed speed). Upon encountering the signal rising edge of the deceleration point (origin), it proceeds to locate the first Z signal and immediately stops.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

During the operation of the signal rising edge for low-speed search deceleration point (origin) using P9-13 (return to origin at low speed), the system continues running after detecting the deceleration point signal. Upon identifying the first Z-axis positive pulse, it immediately stops. After the motor has fully ceased, the system then executes a set number of pulses (P9-12) at the preset mechanical offset direction (positive or negative), followed by a fixed-distance pulse run (P9-19, P9-20) at the P9-12 (return to origin at high speed) speed before final motor shutdown.

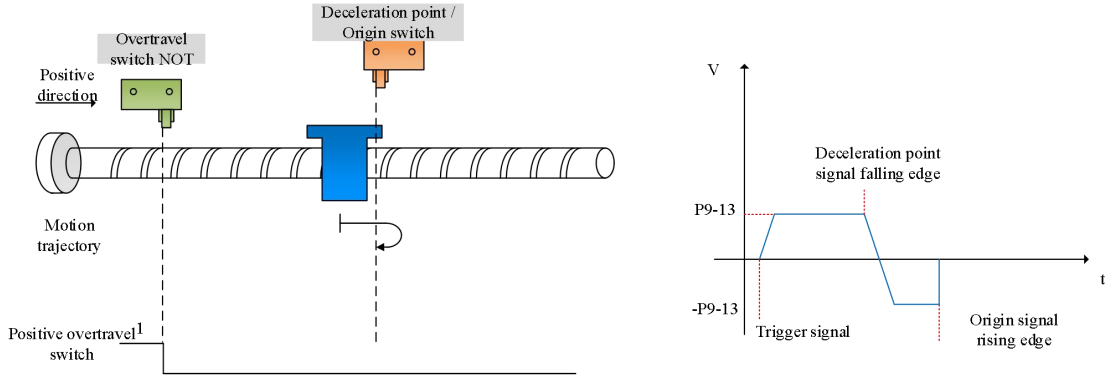
2) When the motor starts, the origin switch (reduction point) signal is active (signal terminal assigned by P5-64,0 = inactive, 1 = active). Throughout the process, the reverse overtravel switch (NOT) (P5-23)

remains inactive.

The servo motor initiates a low-speed forward search for the deceleration point (origin) by triggering the signal's falling edge of P9-13 (return-to-origin low-speed speed). Upon detecting the deceleration point (origin) signal's falling edge, it reverses direction (i.e., negative) and continues the low-speed search for the deceleration point (origin) signal's rising edge using P9-13 (return-to-origin low-speed speed). The subsequent return-to-origin operation is categorized into four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the negative acceleration or negative uniform speed running, the machine will stop immediately when the signal rising edge of the origin is encountered.

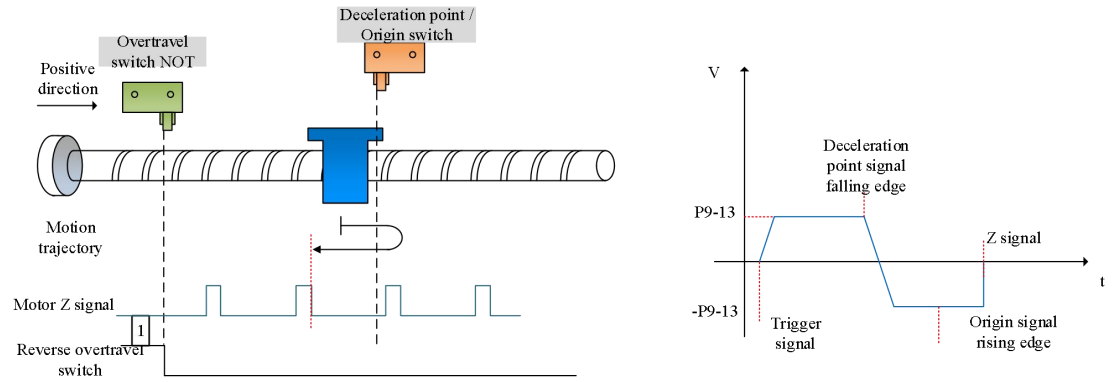


The number of Z phases P9-11.0=0 and the mechanical offset (P9-19, P9-20) is not 0:

During negative acceleration or negative constant-speed operation, the system halts immediately upon encountering the rising edge of the origin signal. After complete motor stoppage, the motor advances a fixed pulse distance (P9-12) at the preset high-speed speed (P9-12) for a predetermined duration, based on the set mechanical offset pulse count and direction (positive or negative), before final shutdown.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the negative acceleration or negative uniform speed operation, the system will continue running after encountering the rising edge of the deceleration point (origin) signal, and immediately stop upon detecting the first Z signal.



The number of Z phases P9-11.0=1 and the mechanical offset (P9-19, P9-20) is not 0:

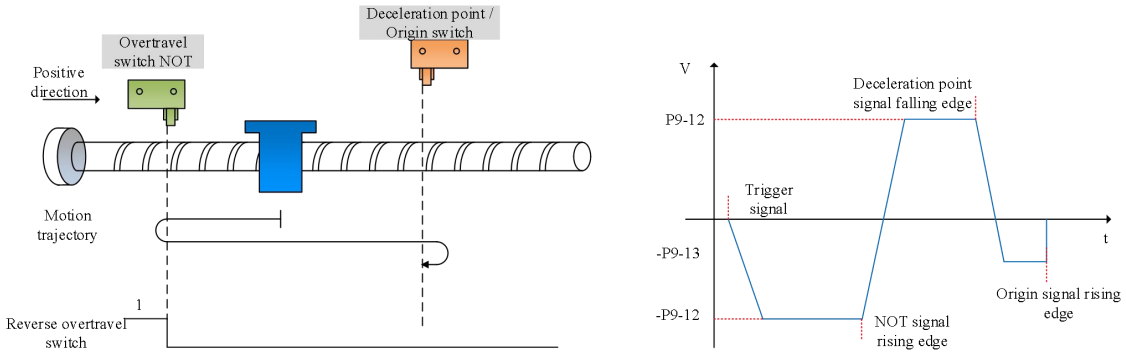
During negative acceleration or negative constant-speed operation, the system resumes movement after detecting the rising edge of the deceleration point (origin) signal. Upon identifying the first Z-axis signal, it immediately halts. After complete motor shutdown, the system then advances the motor at the preset P9-12 speed (returning to origin at high speed) for a fixed pulse duration (P9-19/P9-20), following the specified mechanical offset pulse count and direction (positive/negative). The motor then stops.

3) When the motor starts, the origin switch (reduction point) signal is invalid (signal terminal assigned by P5-64,0=invalid, 1=valid). During operation, the reverse overtravel switch (NOT) is triggered (P5-23).

The servo motor first initiates high-speed reverse search for the deceleration point (origin) signal using the-P9-12 (high-speed return-to-origin) setting. Upon detecting the reverse overtravel switch (NOT), the driver immediately decelerates in reverse (i.e., forward) according to the P9-14 (acceleration/deceleration time for return-to-origin) setting. It then rapidly searches for the deceleration point (origin) signal's falling edge with the-P9-12 (high-speed return-to-origin) setting. When the deceleration point (origin) signal's falling edge is detected, the motor decelerates in reverse (i.e., negative) following the P9-14 (acceleration/deceleration time for return-to-origin) setting. The servo motor subsequently searches for the deceleration point (origin) signal's rising edge with the-P9-13 (low-speed return-to-origin) setting. The subsequent return-to-origin operation involves four scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

During the reverse acceleration or reverse constant speed running, the machine will stop immediately when the signal rising edge of the origin is encountered.

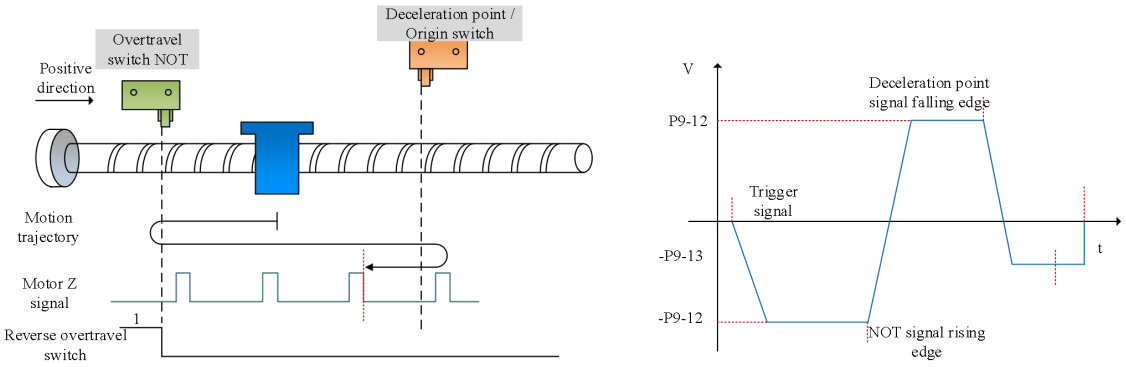


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

During reverse acceleration or constant-speed operation, the system halts immediately upon detecting the rising edge of the deceleration signal (origin point). After complete motor shutdown, the motor advances a fixed pulse distance (P9-19/P9-20) at preset speed (P9-12, high-speed return to origin) according to the specified mechanical offset pulse count and direction (positive/negative), then stops.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

During the reverse acceleration or reverse constant speed operation, the machine will continue running after encountering the rising edge of the origin signal, and then stop immediately upon finding the first Z signal.



The number of Z phases P9-11.0=1 and the mechanical offset (P9-19, P9-20) is not 0:

During reverse acceleration or constant-speed operation, the system resumes movement after detecting the rising edge of the deceleration signal (origin point). Upon identifying the first Z-axis signal, it immediately halts. After complete motor shutdown, the system then advances the motor at the preset P9-12 speed (returning to origin at high speed) for a fixed pulse duration (P9-19/P9-20), following the specified mechanical offset pulse count and direction (positive/negative). The motor then stops.

(3) Return to the origin mode 2-forward return to zero, the deceleration point and the origin are the motor Z signal (P9-11.2=2)

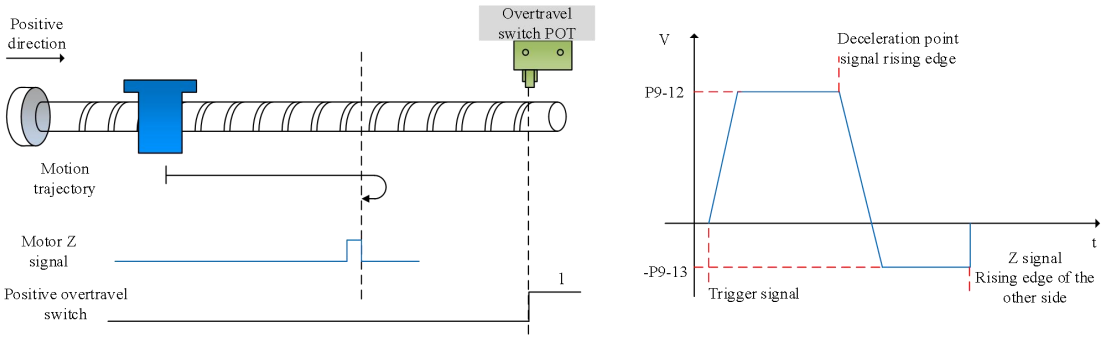
This mode does not count the number of motor Z phases. To use this mode, connect POT and NOT.

1) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by P5-64,0=invalid, 1=valid), and the forward overtravel switch (POT) remains inactive throughout the process.

The servo motor first performs a high-speed forward search for the Z-axis signal using the P9-12 (return-to-origin high-speed speed) setting. Upon detecting the rising edge of the Z-axis signal, it decelerates and reverses direction according to the P9-14 (return-to-origin acceleration-deceleration time) setting, then accelerates to the-P9-13 (return-to-origin low-speed speed) before reversing to perform a low-speed search for the Z-axis signal. The subsequent return-to-origin operation is divided into two scenarios:

① The mechanical offset (P9-19, P9-20) is 0:

During reverse acceleration or reverse constant speed operation, the motor stops immediately upon encountering the rising edge of the Z signal on the opposite side.



② The mechanical offset (P9-19, P9-20) is not zero:

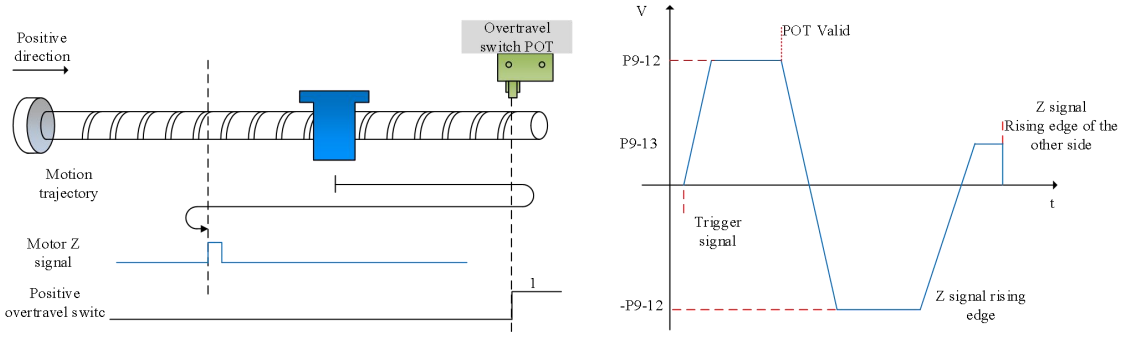
During reverse acceleration or constant-speed operation, the motor halts immediately upon detecting the rising edge of the Z-axis signal on the opposite side. After complete shutdown, the motor advances a fixed distance at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

2) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by P5-64,0=invalid, 1=valid), triggering the forward overtravel switch (POT) (P5-22) during operation.

The servo motor first performs a high-speed forward search for the Z-axis signal using the P9-12 (return-to-origin high-speed speed) setting. Upon encountering the forward overtravel switch, the driver decelerates and reverses direction according to the P9-14 (return-to-origin acceleration/deceleration time) setting, then performs a high-speed reverse search for the Z-axis signal at-P9-12 (return-to-origin high-speed speed). This process continues until the Z-axis signal's rising edge is detected, after which the motor gradually decelerates and reverses (i.e., returns to forward motion) based on the P9-14 (return-to-origin acceleration/deceleration time) setting. The servo motor then performs a low-speed forward search for the Z-axis signal on the opposite side of the rising edge using the P9-13 (return-to-origin low-speed speed) setting. The subsequent return-to-origin action involves two scenarios:

① The mechanical offset (P9-19, P9-20) is 0:

During forward acceleration or uniform speed operation, the machine stops immediately upon encountering the rising edge of the Z signal on the opposite side.



② The mechanical offset (P9-19, P9-20) is not zero:

During forward acceleration or constant-speed operation, the motor halts immediately upon encountering the rising edge of the Z-axis signal from the opposite side. After complete motor stoppage, the motor advances a fixed pulse distance at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

(4) Return to the origin mode 3--reverse back to zero, the deceleration point and the origin are the motor Z signal (P9-11.2=3)

This mode does not count the number of motor Z phases. To use this mode, connect POT and NOT.

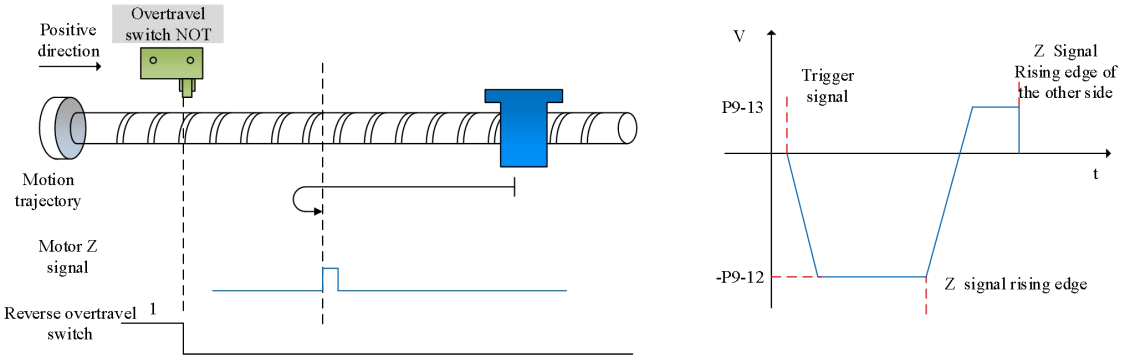
1) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by P5-64:0 =

invalid, 1 = valid), and the reverse overtravel switch (NOT) remains inactive throughout the process.

The servo motor first performs a high-speed reverse search for the Z-axis signal using the P9-12 (return-to-origin high-speed speed) setting. Upon detecting the rising edge of the Z-axis signal, it decelerates in reverse according to the P9-14 (return-to-origin acceleration-deceleration time) setting, then accelerates to the P9-13 (return-to-origin low-speed speed) setting for a forward low-speed search. The subsequent return-to-origin operation is divided into two scenarios:

① The mechanical offset (P9-19, P9-20) is 0:

During the forward acceleration or uniform speed running, the motor stops immediately when encountering the rising edge of the Z signal on the other side.



② The mechanical offset (P9-19, P9-20) is not zero:

During forward acceleration or constant-speed operation, the motor halts immediately upon encountering the rising edge of the Z-axis signal on the opposite side. After complete motor stoppage, the motor advances a fixed pulse distance (P9-19, P9-20) at the preset P9-12 speed (returning to the origin at high speed) based on the predefined mechanical offset pulse count and direction (positive or negative), then stops.

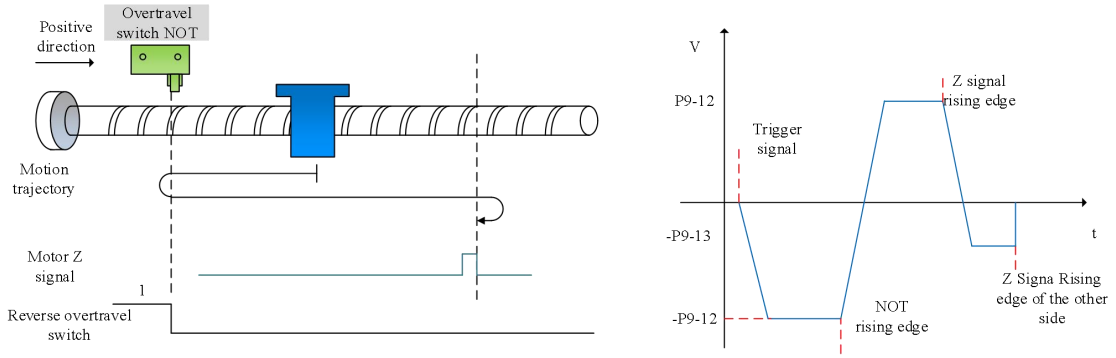
2) When the motor starts, the Z signal is either invalid or valid (signal terminal assigned by P5-64:0 = invalid, 1 = valid). During operation, the NOT switch is triggered.

The servo motor first performs a high-speed reverse search for the Z-axis signal using the P9-12 (high-speed return-to-origin) setting. Upon encountering the reverse overtravel switch, the driver decelerates in reverse according to the P9-14 setting, then resumes high-speed forward search with P9-12 (high-speed return-to-origin) until detecting the Z-axis signal's rising edge. Following the P9-14 (return-to-origin acceleration/deceleration time) setting, it gradually decelerates and reverses (i.e., restores reverse motion). The servo motor then performs a low-speed reverse search for the Z-axis signal's opposite rising edge using P9-13 (low-speed return-to-origin). The subsequent return-to-origin

operation proceeds in two scenarios:

① The mechanical offset (P9-19, P9-20) is 0:

During reverse acceleration or constant speed operation, the machine stops immediately upon encountering the rising edge of the Z signal on the opposite side.



② The mechanical offset (P9-19, P9-20) is not zero:

During reverse acceleration or constant-speed operation, the motor halts immediately upon detecting the rising edge of the Z-axis signal on the opposite side. After complete shutdown, the motor advances a fixed distance at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset pulse count and direction (positive or negative), then stops.

(5) Return to the origin mode 4-forward return to zero, the deceleration point and the origin are the forward overtravel switch POT(P5-22)(P9-11.2=4)

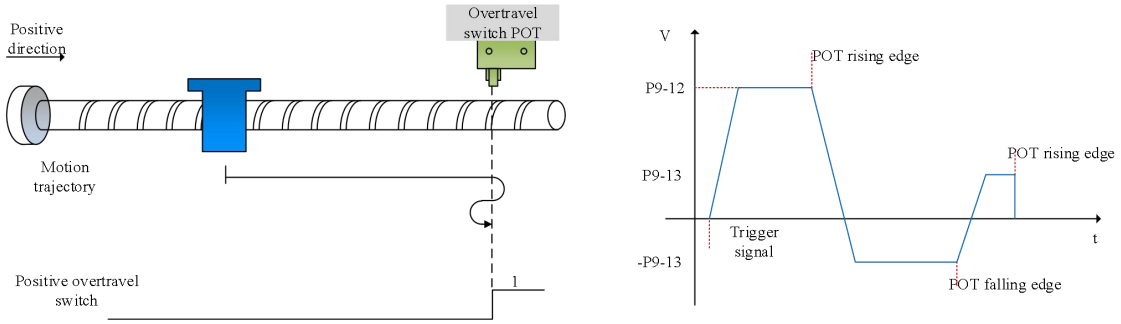
To use this mode, connect NOT and POT.

1) The forward overtravel potentiometer (POT) is invalid when the motor starts moving

The servo motor first performs a high-speed forward search for the forward overtravel switch using the P9-12 (high-speed return-to-origin) setting. Upon detecting the rising edge of the forward overtravel switch signal, it gradually decelerates and reverses direction according to the P9-14 (acceleration-deceleration time for return-to-origin). Then, with the low-speed reverse search for the forward overtravel switch signal initiated by the P9-13 (low-speed return-to-origin) setting, the motor detects the falling edge of the signal. The subsequent return-to-origin operation then proceeds through four distinct scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

Reverse deceleration (i.e., return to forward motion), and use P9-13 (return to origin low-speed) to search for the rising edge of the forward overtravel switch signal at low speed. During forward acceleration or uniform speed operation, immediately stop the machine upon encountering the rising edge of the forward overtravel switch signal.

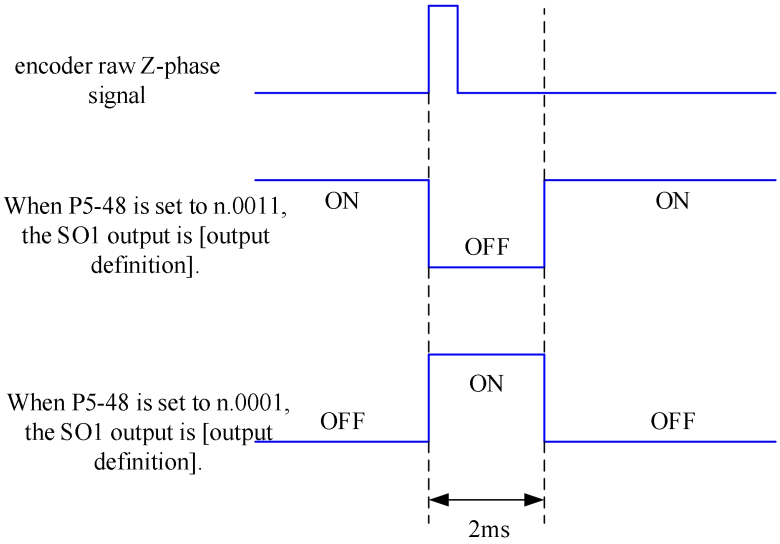


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

Reverse deceleration (i.e., return to forward motion) is initiated using P9-13 (return to origin low-speed speed) to detect the rising edge of the forward overtravel switch signal. During forward acceleration or constant-speed operation, the motor halts immediately upon detecting the signal's rising edge. After complete motor stoppage, the system executes a preset mechanical offset pulse count and direction (strictly negative, i.e., movement between origin switch and NOT) at the P9-12 (return to origin high-speed speed) setting. The motor then proceeds with a fixed pulse sequence before final shutdown.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed reverse operation set at P9-13 (returning to the origin at low speed), then stop immediately upon encountering the first rising edge of the Z signal.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

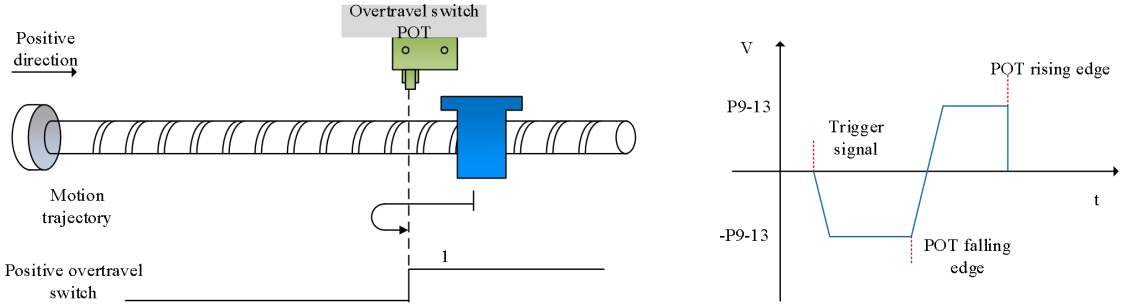
Continue the low-speed reverse operation set by P9-13 (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed number of pulses according to the preset mechanical offset quantity and direction (either negative or positive, but must move between the origin switch and NOT). The motor will then run at the speed set by P9-12 (returning to the origin at high speed) for a predetermined distance before stopping.

2) The forward overtravel switch (POT) (P5-22) activates when the motor starts moving

The servo motor reverses to a low speed state using the-P9-13 (return-to-origin low-speed) set value, detecting the falling edge of the forward overtravel switch signal (POT). Upon encountering this signal, the subsequent return-to-origin operation proceeds through four distinct scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

Reverse deceleration (i.e., return to forward motion) is executed by using P9-13 (return to origin low-speed speed) to detect the rising edge of the POT signal. During forward acceleration or uniform speed operation, the system immediately stops upon detecting the POT rising edge.

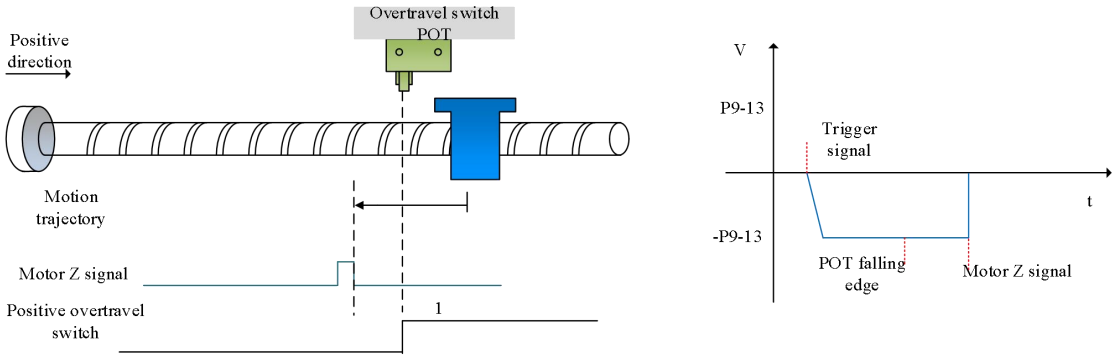


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

Reverse deceleration (i.e., return to forward motion) is executed using P9-13 (return to origin low-speed speed) to detect the rising edge of the POT signal. During forward acceleration or uniform speed operation, the motor halts immediately upon detecting the POT rising edge. After complete motor stoppage, the system then advances the motor at the preset speed (P9-12, return to origin high-speed speed) for a fixed pulse duration (P9-19, P9-20) based on the set mechanical offset pulse count and direction (only negative direction, i.e., movement between the origin switch and NOT). The motor then stops.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed reverse operation set at P9-13 (returning to the origin at low speed), then stop immediately upon encountering the first rising edge of the Z signal.



The number of Z phases P9-11.0=1 and the mechanical offset (P9-19, P9-20) is not 0:

Continue the low-speed reverse operation at the-P9-13 setting (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed pulse sequence (P9-19, P9-20) at the preset mechanical offset pulse count and direction (either negative or positive, but must move between the origin switch and NOT) according to the-P9-12 setting (returning to the origin at high speed), followed by complete motor shutdown.

(6) Return to the origin mode 5-reverse return to zero, the deceleration point and the origin are the reverse overtravel switch NOT(P5-23)(P9-11.2=5)

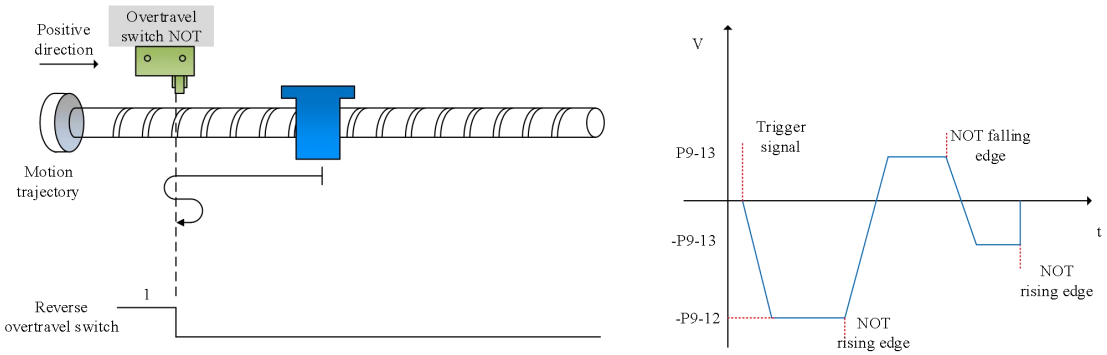
To use this mode, connect POT and NOT.

1) The reverse overtravel switch (NOT) is invalid when the motor starts moving

The servo motor first performs a high-speed reverse search for the NOT switch using the P9-12 (high-speed return-to-origin) setting. Upon detecting the NOT signal's rising edge, it gradually decelerates in reverse according to the P9-14 (acceleration-deceleration time for return-to-origin). Then, the servo motor searches for the NOT signal's falling edge with the low-speed forward movement set by P9-13 (low-speed return-to-origin). After encountering the NOT signal's falling edge, the subsequent return-to-origin operation proceeds through four distinct scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

Reverse deceleration (i.e., reverse recovery), and use-P9-13 (return to origin low-speed) to perform a reverse low-speed search for the NOT rising edge. During reverse acceleration or reverse constant-speed operation, immediately stop the machine upon encountering the NOT rising edge.

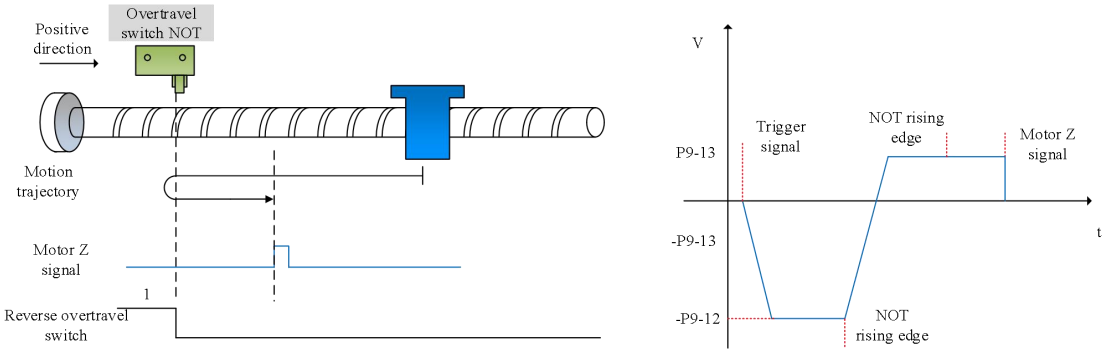


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

The system initiates reverse deceleration (i.e., reverse recovery) by executing the-P9-13 command (returning to the origin at low speed) to detect the NOT signal's rising edge during reverse low-speed operation. Upon detecting the NOT edge during reverse acceleration or constant-speed movement, the motor halts immediately. After complete shutdown, the motor advances a predetermined pulse sequence (P9-19 and P9-20) at the preset speed (P9-12, returning to the origin at high speed) based on the specified mechanical offset quantity and direction (strictly positive, i.e., movement between the origin switch and POT). The motor then stops.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed forward operation set by P9-13, then stop immediately upon encountering the first rising edge of the Z signal.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

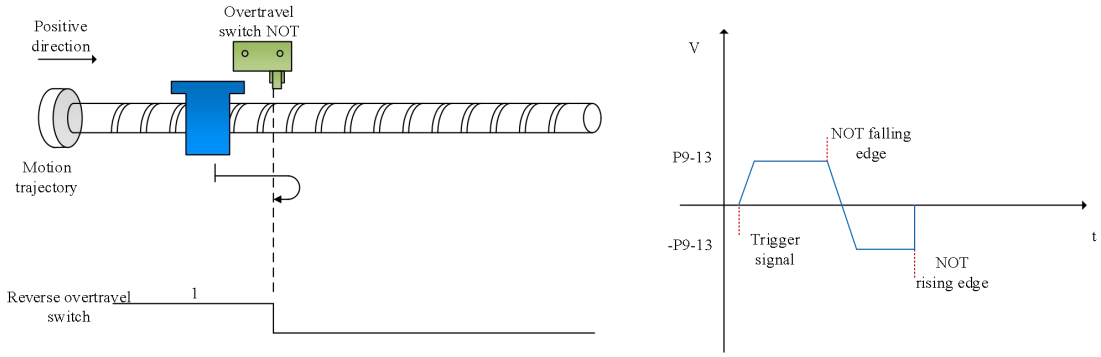
Continue the low-speed forward movement at the P9-13 setting (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed pulse sequence (P9-19, P9-20) at the P9-12 setting (returning to the origin at high speed), following the preset mechanical offset pulse count and direction (positive or negative, but must move between the origin switch and the potentiometer). The motor will then stop.

2) The NOT (P5-23) switch for reverse overtravel activation is effective when the motor starts.

The servo motor directly searches for the NOT signal's falling edge at the low-speed return-to-origin setting (P9-13). Upon detecting this NOT signal, the subsequent return-to-origin operation proceeds through four distinct scenarios:

① The Z-phase count (P9-11.0) is zero, and the mechanical offset (P9-19, P9-20) is zero:

Reverse deceleration (i.e., reverse recovery) involves using-P9-13 (returning to the origin at low speed) to perform a low-speed reverse search for the NOT rising edge. During reverse acceleration or uniform reverse operation, the system must immediately stop upon detecting the NOT rising edge.

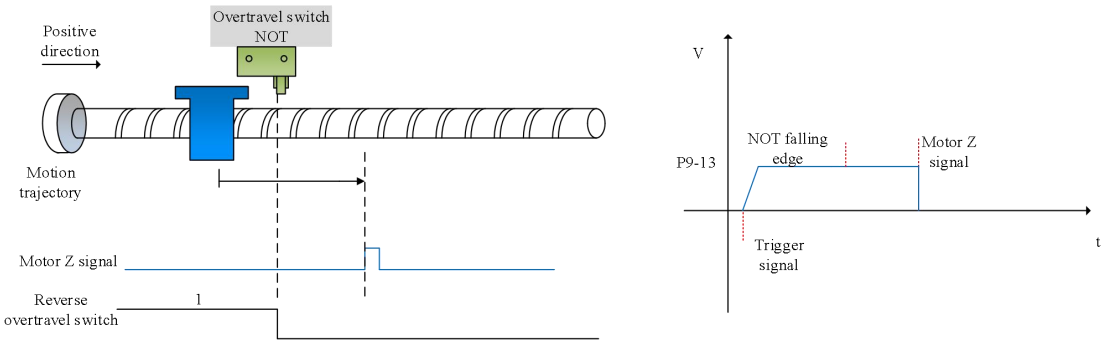


② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

Reverse deceleration (i.e., reverse recovery) involves using P9-13 (returning to the origin at low speed) to search for the NOT rising edge during reverse acceleration or uniform reverse motion. Upon detecting the NOT rising edge, the system immediately stops. After the motor has fully ceased, it proceeds with a predetermined number of pulses and direction (only forward, i.e., movement between the origin switch and POT) according to the set mechanical offset. The motor then travels a fixed distance at the speed set by P9-12 (returning to the origin at high speed) (P9-19, P9-20), after which it stops.

③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Continue the low-speed forward movement set at P9-13 (returning to the origin at low speed), then stop immediately upon encountering the first rising edge of the Z signal.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

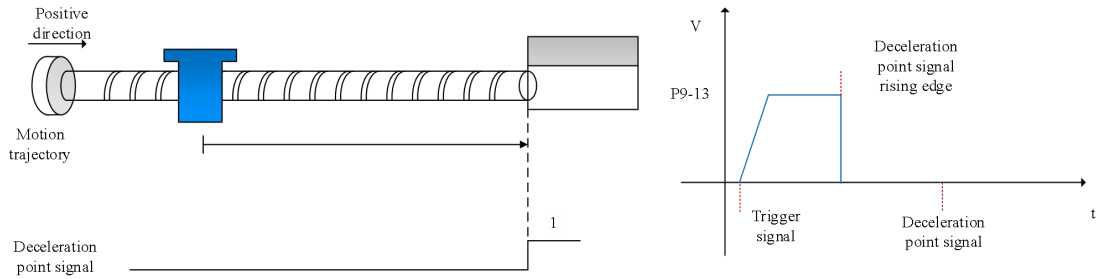
Continue the low-speed forward movement at the P9-13 setting (returning to the origin at low speed). Upon encountering the first rising edge of the Z-axis signal, immediately stop the motor. After complete shutdown, the motor will execute a fixed pulse sequence (P9-19, P9-20) at the P9-12 setting (returning to the origin at high speed), following the preset mechanical offset pulse count and direction (positive or negative, but must move between the origin switch and the potentiometer). The motor will then stop.

(7) Return to the origin mode 6-forward return to zero, the deceleration point and the origin are the forward mechanical limit position (P9-11.2=6)

This mode eliminates the need for POT, NOT, or origin switches.
The servo motor initially operates at low speed in the forward direction with the P9-13 (low-speed

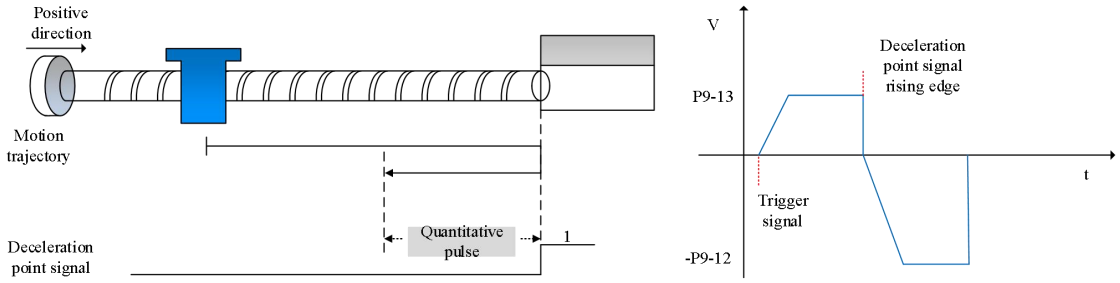
return to origin) setting. Upon reaching the mechanical limit position, if the absolute torque value reaches the P9-17 (touch-stop return-to-origin torque threshold) upper limit while the speed absolute value remains below the P9-16 (touch-stop return-to-origin speed threshold) setting, and this condition persists for the duration specified in the P9-18 (touch-stop return-to-origin time threshold), the system determines the mechanical limit position has been reached. The subsequent return-to-origin action then proceeds through four distinct scenarios:

① If the Z-phase count (P9-11.0) is zero and the mechanical offset (P9-19, P9-20) is zero, the machine should be stopped immediately.



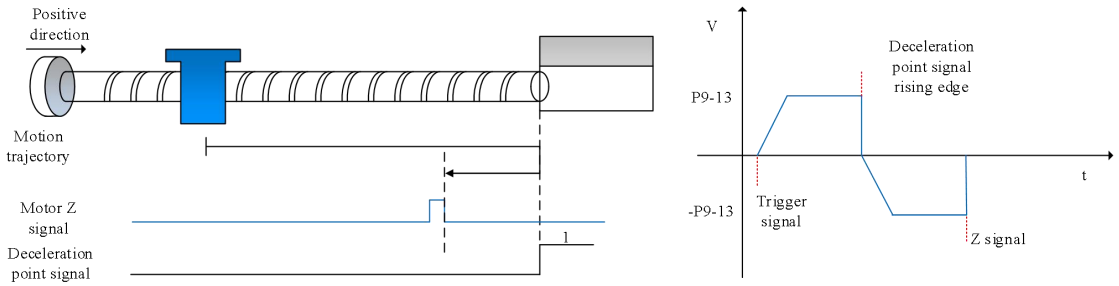
② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

The servo motor halts immediately. After complete stop, it reverses for a fixed pulse duration (P9-19, P9-20) at the-P9-12 speed (returning to the origin at high speed) based on the preset mechanical offset pulse count, then stops.



③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

Perform a low-speed reverse operation at-P9-13 (return to origin low-speed speed), then stop immediately upon encountering the first rising edge of the Z signal.



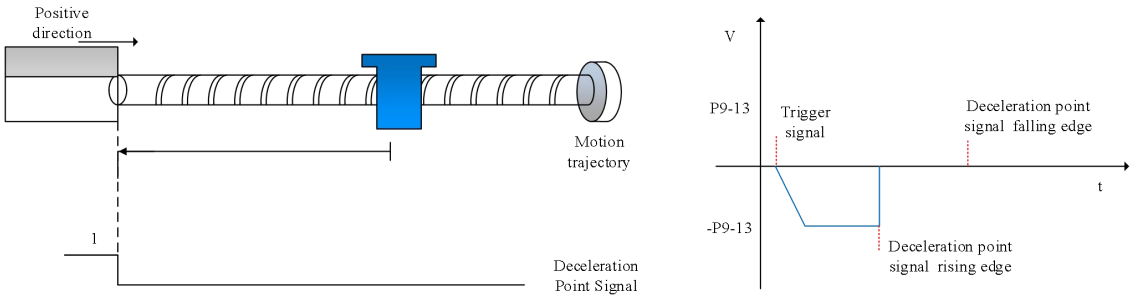
④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

The motor initiates a low-speed reverse run at-P9-13 (returning to the origin at low speed), then halts immediately upon detecting the first rising edge of the Z-axis signal. After complete stoppage, it executes a fixed pulse sequence at-P9-12 (returning to the origin at high speed) based on the preset mechanical offset pulse count. The motor may operate in either positive or negative direction, but must stay within the mechanical limit position range, before final shutdown.

(8) Return to the origin mode 7--reverse return to zero, the deceleration point and the origin are the reverse mechanical limit position (P9-11.2=7)

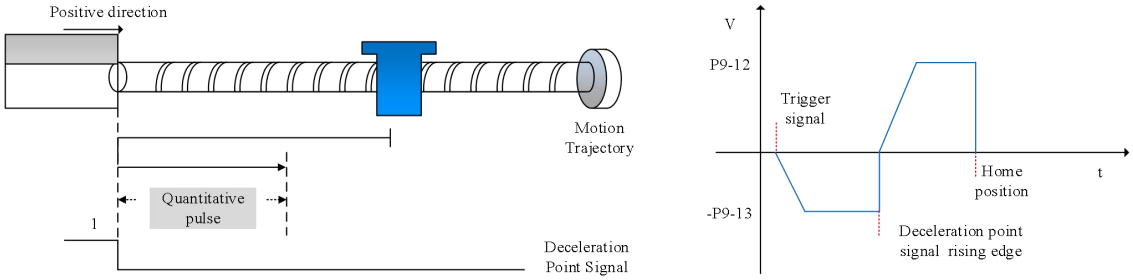
This mode eliminates the need for POT, NOT, or origin switches.
The servo motor initially operates in reverse low speed at the-P9-13 setting (returning to origin at low speed). Upon reaching the mechanical limit position, if the absolute torque value reaches the P9-17 (touch-stop origin return torque threshold) upper limit while the absolute speed value remains below the P9-16 (touch-stop origin return speed threshold) set value, and this state persists for the duration specified by the P9-18 (touch-stop origin return time threshold), the system determines the mechanical limit position has been reached. The subsequent origin return action then proceeds through four scenarios:

① If the Z-phase count (P9-11.0) is zero and the mechanical offset (P9-19, P9-20) is zero, the machine should be stopped immediately.



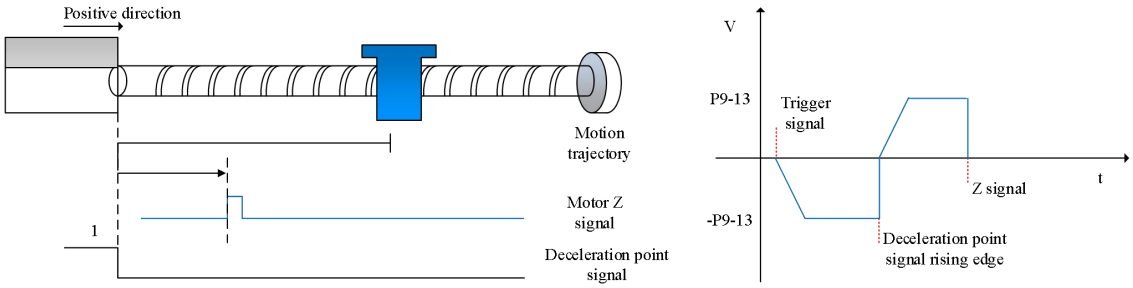
② The Z-phase count (P9-11.0) is zero, while the mechanical offsets (P9-19 and P9-20) are non-zero:

The servo motor halts immediately. After complete stop, it advances forward for a fixed number of pulses (P9-19, P9-20) at the preset speed (P9-12, high-speed return to origin) based on the set mechanical offset, then stops.



③ The Z-phase count (P9-11.0) is 1 with zero mechanical offset (P9-19, P9-20):

The system operates at low speed in forward direction with P9-13 (return to origin low-speed speed) as the setting, and immediately stops upon encountering the first rising edge of the Z signal.



④ The Z-phase count (P9-11.0) equals 1, and the mechanical offsets (P9-19 and P9-20) are non-zero:

The motor operates forward at a low speed set by P9-13 (return-to-origin low-speed setting). Upon detecting the first rising edge of the Z-axis signal, it immediately stops. After complete shutdown, the motor executes a fixed pulse sequence (P9-19, P9-20) at the speed set by P9-12 (return-to-origin high-speed setting), based on the preset mechanical offset pulse count. This sequence may run in either positive or negative direction, but must stay within the mechanical limit position range. The motor then stops.

- For return-to-origin modes 6 and 7, when these modes are activated, the maximum torque during the return-to-origin process is 1.1 times the set value of P9-17 (the threshold for stop-triggered return-to-origin torque). If both internal forward/reverse torque limits P3-28 and P3-29 are lower than 1.1 times P9-17, the torque limit will be set to P3-28 or P3-29. Similarly, if external forward/reverse torque limits P3-30 and P3-31 are enabled, the actual torque limit will be the minimum among the internal torque limit, the external torque limit, and 1.1 times P9-17.
- Only when both of these two return to origin modes are triggered, the torque limit P9-17 (touch stop return to origin torque threshold) set value of 1.1 times is effective. If only the return to origin is enabled and (return to origin mode) P9-11.2=6 or 7 is triggered but the return to origin is not triggered, the torque limit P9-17 (touch stop return to origin torque threshold) set value of 1.1 times is not effective.

5.8.2 Position Control (Internal Position Commands)

parameter	essentials	Reference chapters
P0-01 Control Mode Selection	Set to 5: Internal Position Mode	5.8.2.1 Internal Positioning Patterns
P4-03 Internal Position Given Mode P4-04 Number of valid segments P4-10~P4-254 Internal Position Parameters for Sections 1 to 35	The control mode of the internal location pattern is given, including the step change mode, the positioning mode and the adjustment time. Configure the pulse displacement, speed, and acceleration/deceleration time for each section	5.8.2.3 Setting of position parameters for paragraphs 1 to 35
P5-35 step signal/GHGSTP P5-32 Pause current segment signal/INHIBIT P5-31 Skip current section number / Z-CLAMP	Common terminal function assignments	5.8.2.4 Step-change signal (/CHGSTP) 5.8.2.5 Skip the current segment （/ZCLAMP）
5.8.2.5 Skip current segment signal (/ZCLAMP)P4-00Number of Z-phase signals after exiting the limit switch. The number of Z-phase signals after the P4-00 signal passes through the limit switch P4-01 The speed of the proximity switch P4-02 Speed of Departure from the Proximity Switch P5-28: Forward rotation side search for reference origin in position mode / SPD-A	P5-29 Reverse-side Reference Origin Search in Position Mode / SPD-B	Reset internal location to origin5.8.1.7 reference origin

5. 8. 2. 1 Internal Location Patterns

parameter	set value	meaning	revise	come into force

P0-01	5	Position control by using preset values of servo unit's internal register	servo bb	immediately

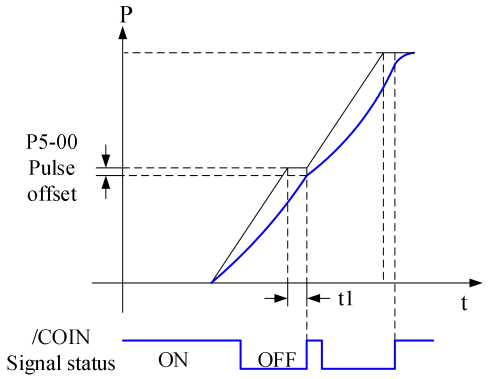
5.8.2.2 Internal Location Mode Settings

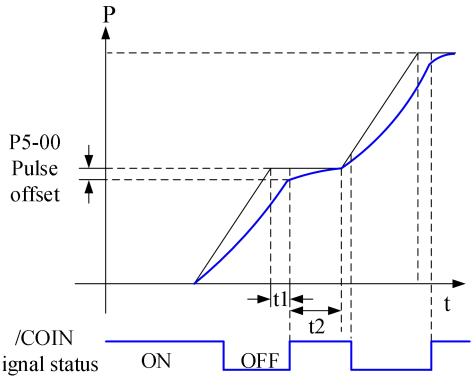
parameter	Parameter Function	Set unit	factory setting	Applicable mode	revise	come into force
P4-03	Internal Location Mode Settings	—	n.0000	5	servo bb	immediately
	parameter setting	Functionality	factory setting	Set range		
	n.□xxx	insignificance				
	n.x□xx	Waiting mode	0	0 ~ 1		
	n.xx□x	step change mode	0	0 ~ 6		
	n.xxx□	positioning mode	0	0 ~ 1		

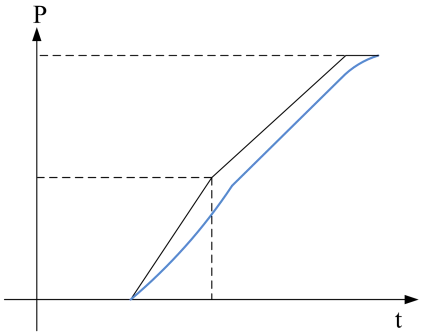
1) Waiting mode

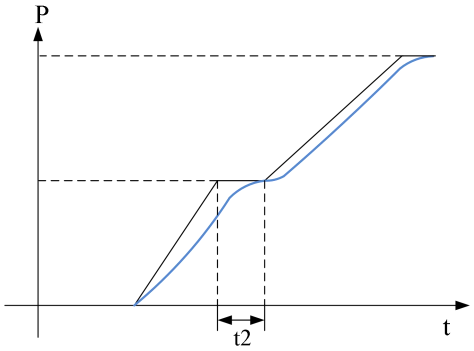
n.x□xx	meaning
0	Waiting for the completion of the location
1	Do not wait for location to complete
Note: The wait mode determines whether the driver waits for the motor to complete positioning after issuing a position command when the internal position is set. This mode applies to all step-change modes.	

Waiting mode: 0, adjustment time: 0ms	Waiting mode=0, adjustment time>0ms

<table>
<tr>
<td> 

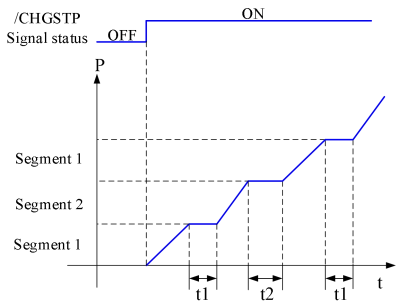
After the driver sends a position command, it will wait for the motor to complete positioning and then immediately start the next position command. In the diagram, t1 represents the positioning time, which is the interval between the completion of pulse transmission and the output of the positioning completion signal.</td>
<td> 

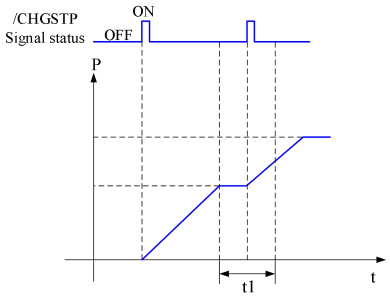
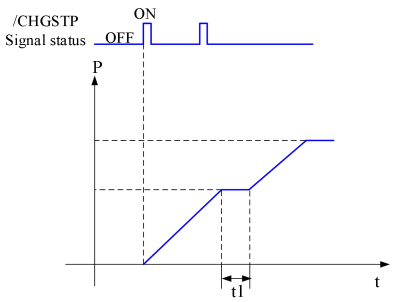
After issuing a position command, the driver waits for the motor to complete positioning before proceeding to the next command after the adjustment period. In the diagram, t1 denotes the positioning time and t2 the adjustment time, with these values corresponding to parameter P4-16 in this example.</td>
</tr>
<tr>
<td>Waiting mode=1, adjustment time=0ms</td>
<td>Waiting mode=1, adjustment time>0ms</td>
</tr>
<tr>
<td> 

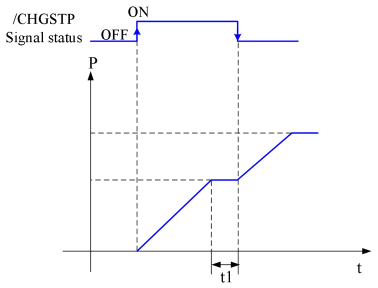
After the driver sends a position command, it proceeds to the next one without waiting for the motor to complete its current position.</td>
<td> 

After the driver issues a position command, it does not wait for the motor to complete positioning but initiates the next command after a 'adjustment time'. In this example, t2 represents the adjustment time, corresponding to parameter P4-16.</td>
</tr>
</table>

2) Step-change mode

<table>
<tr><th>n.xx□x</th><th colspan="2">define</th></tr>
<tr>
<td>0
When signal ON, step is changed and can be recycled;</td>
<td> 
</td>
<td>In the diagram, t1 equals P4-16 and t2 equals P4-23.
1. If the CHGSTP signal remains ON, the servo unit will continuously cycle through the preset position segments.
2. If the /CHGSTP signal is set to OFF during a specific segment, the servo will continue executing that segment without proceeding to the next one.</td>
</tr>
</table>

n.xx□x	define	
		3. In this mode, the step signal/CHGSTP is triggered by high level. 4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the positioning completion was invalid after the shutdown. 5. After each segment operation, the positioning completion and positioning approach signals remain valid. 6. The adjustment time of each paragraph is valid in this mode.
1 The signal changes step by step on the rising edge;		For example, in the two-stage setup, t1 equals P4 minus 16 in the diagram. 1. Note that, as shown in the diagram, the preset adjustment time is ineffective in this step-switching mode. The system will immediately proceed to the next instruction upon receiving a new step-switching signal, once the previous position command has been fully executed. 2. In this mode, the step signal/CHGSTP is triggered by the rising edge. 3. After each segment operation, the positioning completion and positioning approach signals are both valid. 4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the positioning completion was invalid after the shutdown. 5. Adjustments made in this mode are invalid.
2 The signal starts on the rising edge and executes all tasks sequentiall y without looping.		Set two bit positions, where t1 in the diagram equals P4-16. 1. The /CHGSTP signal prior to the completion of a cycle will not be counted, as shown in the second /CHGSTP signal in the figure. 2. In this mode, the step signal/CHGSTP is triggered by the rising edge. 3. After each segment operation, the positioning completion and positioning approach signals are both valid. 4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the

<table>
<tr><th>n.xx□x</th><th colspan="2">define</th></tr>
<tr><td></td><td></td><td>positioning completion was invalid after the shutdown.
5. The adjustment time is valid in this mode.</td></tr>
<tr><td>4
/CHGSTP
bilateral
trigger</td><td> 
</td><td>In the figure, t1 = P4-16.
1. The rising edge of /CHGSTP triggers the first segment, while the falling edge triggers the second segment. To ensure full operation of the first segment, the /CHGSTP signal remains ON until the end of the first segment.
2. In this mode only, the valid segment count of P4-04 is invalid.
3. After each segment operation, the positioning completion and positioning approach signals are both valid.
4. During operation, the servo enable function was disabled, causing the motor to stop in the servo-off shutdown mode. Consequently, the positioning completion was invalid after the shutdown.
5. Adjustments made in this mode are invalid.
6. Before using this step-switching mode, the P5-35 terminals must be properly assigned; step-switching terminals cannot be assigned during operation of this mode.</td></tr>
<tr><td>5
/PREFA
(P5-57)、
Select
terminal
section
numbers
/PREFB
(P5-58) or
/PREFC
(P5-59),
with
options 1
to 3.</td><td colspan="2">
<table>
<tr><th>/PREFC</th><th>/PREFB</th><th>/PREFA</th><th>segment number</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>not have</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1 (first paragraph)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>2 (second paragraph)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>3 (third paragraph)</td></tr>
</table>
1. After each segment runs, the positioning completion and positioning proximity signals are both valid.
2. During operation, the servo enable function was disabled, causing the motor to shut down according to the standard shutdown procedure. Consequently, the positioning operation was invalid after the shutdown.
3. The adjustment time is valid in this mode.
4. The CHGSTP step-change signal is invalid only in this mode.
5. The section number selection terminal can be configured to trigger step switching at the edge or remain ON. This mode supports continuous triggering of a specific section. If the terminal stays ON, the motor will stop upon receiving an overtravel signal. In such cases, the terminal must be switched to OFF to prevent the motor from executing the position section after the overtravel signal is cleared.
</td></tr>
<tr><td>6
/PREFA</td><td colspan="2">
<table>
<tr><th>/PREFD</th><th>/PREFC</th><th>/PREFB</th><th>/PREFA</th><th>segment number</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (first paragraph)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2 (second paragraph)</td></tr>
</table>
</td></tr>
</table>

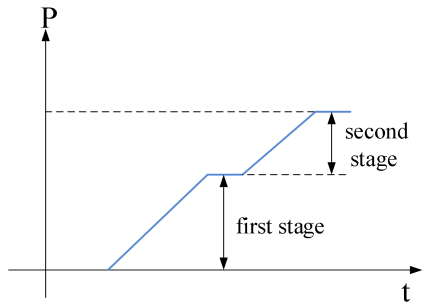
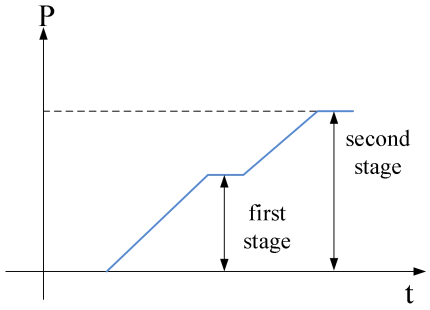
<table>
<tr><th>n.xx□x</th><th>define</th></tr>
<tr><td>(P5-57)、
/PREFB
(P5-58)、
/PREFC
(P5-59)、
Select terminal segment number (P5-60) from 1 to 16</td><td>
<table>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>3 (third paragraph)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>4 (position of the fourth paragraph)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>5 (Paragraph 5)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>6 (position 6)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>7 (Paragraph 7)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>8 (position of the eighth paragraph)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>9 (Paragraph 9)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>10 (Paragraph 10)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>11 (position of the eleventh paragraph)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>12 (Paragraph 12)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>13 (position 13)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>14 (position 14)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>15 (Paragraph 15)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16 (Paragraph 16)</td></tr>
</table>
Note: The P5-35 step-change signal's rising edge triggers each segment position (the rising edge is invalid during operation).
1. During operation, the servo enable function was disabled, causing the motor to shut down according to the standard shutdown procedure. Consequently, the positioning operation was invalid after the shutdown.
2. Adjustments made in this mode are invalid.
3. After each segment operation, the positioning completion and positioning approach signals are both valid.
4. After selecting the section number, the position section must be triggered by the rising edge of the P5-35/CHGSTP step-change signal to activate. Triggering during section operation is invalid.
5. The paragraph number selection terminal logic is level valid. High input is valid, low input is invalid.</td></tr>
</table>

Use the following input signals to switch between internal positions 1-3/1-16.

parameter	Signal name	leave the factory setting	suit pattern	Set range	revise	come into force
P5-57	Internal Position First Paragraph Position Selection/PREFA	n.0000	5	The parameter range is 0000-0014, which is assigned to other input interfaces through parameters P5-57.	at any time	immediately
P5-58	Internal Position Second Section Position Selection/PREFB	n.0000	5	The parameter range is 0000-0014, which is assigned to other input interfaces via parameters P5-58.		

P5-59	Internal Position Third Section Position Selection/PREFC	n.0000	5	The parameter range is 0000-0014, which is assigned to other input interfaces through parameters P5-59.		
P5-60	Internal Position Fourth Section Position Selection/PREFD	n.0000	5	The parameter range is 0000-0014, which is assigned to other input interfaces via parameters P5-60.		

3) Location Mode

n.xxx□	meaning
0	relative localization
1	absolute fix
0: Relative Positioning	1: Absolute Positioning (using the "reference origin" as the zero point for absolute positioning)
	

5.8.2.3 Setting of position parameters for paragraphs 1 to 35

parameter	meaning	factory setting	unit	Set range	revise	come into force
P4-10+（n-1）*7	Pulse count (low bit)	0	1 pulse	-9999 ~ 9999	Edit anytime	immediately
P4-11+（n-1）*7	Pulse count (high bit)	0	10000 pulses	-32768 ~ 32767	Edit anytime	immediately
P4-12+（n-1）*7	speed	0	0.1rpm	0 ~ 65535	Edit anytime	immediately
P4-13+（n-1）*7	trapezoidal acceleration time	0	ms	0 ~ 65535	Edit anytime	immediately
P4-14+（n-1）*7	trapezoidal deceleration time	0	ms	0 ~ 65535	Edit anytime	immediately

parameter	meaning	factory setting	unit	Set range	revise	come into force
P4-15+（n-1）*7	retention parameter	-				
P4-16+（n-1）*7	adjust the time	0	ms	0～65535	Edit anytime	immediately

explain ：

1) Calculate the pulse count as (high bit) × 10000 + (low bit);

2) In the formula P4-10+ (n-1) * 7, n represents the segment number of the internal position, with a range of 1 to 35. Parameters for segments 1 to 12 can be configured via the panel, while those for segments 13 to 35 require parameter writing through communication (RS232 or RS485).

3) In the relative positioning mode, if the pulse high is set to 9999 and the pulse low is set to 9999, or the pulse high is set to-9999 and the pulse low is set to-9999, and P4-03.2=1 (do not wait for positioning completion), then it enters the infinite pulse mode. Otherwise, the number of pulses is limited.

4) If a segment's speed is set to zero, it will be skipped during execution and the next segment will be processed.

5) In the relative positioning mode, if the speed of a segment is set to non-zero but the pulse count is zero, the motor in that segment will not operate during execution. However, the designated waiting mode for that segment remains active, meaning the system will wait until the adjustment period ends before proceeding to the next segment.

6) In absolute positioning mode, if the speed setting for a specific segment is not zero but the pulse count is set to zero, the motor will return to the reference origin at the preset speed when executing that segment.

7) In absolute positioning mode, if the speed settings for two consecutive segments are both non-zero and the pulse count settings are identical, the motor in the latter segment will not operate, but the waiting mode determined for that segment remains valid.

8) In absolute positioning mode, the motor's rotation cycles are limited and cannot be unlimited.

9) At present, there are only two kinds of position segments in the internal position mode, i.e. step speed and ramp speed, and no other speed forms. When the trapezoidal acceleration time and trapezoidal deceleration time are set to 0, it is the step speed form. When the trapezoidal acceleration time and trapezoidal deceleration time are greater than 0, it is the ramp speed form.

10) The trapezoidal acceleration and deceleration times refer to the duration required to reach the rated speed from zero.

11) If the rotational speed in a specified parameter segment is set to 0, the position command for that segment will be ignored under step-change modes 0/1/2. However, under step-change modes 4/5/6, the motor will not rotate when the position in that segment triggers a step change.

12) The position commands for setting the high and low pulse levels in the internal position segment parameters remain influenced by the electronic gear ratio. The actual number of motor rotations must be determined by combining the preset pulse commands with the electronic gear ratio.

13) In absolute positioning mode, the starting position for each step change is based on the initial position when the step change is first triggered. In relative positioning mode, the starting position for each step change is based on the position at the end of the previous step change.

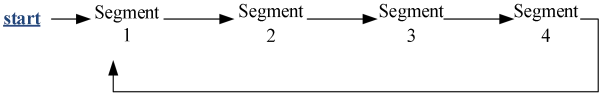
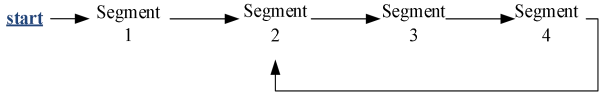
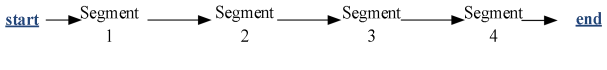
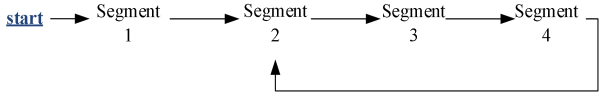
parameter	meaning	factory setting	unit	Set range	revise	come into force
14) In relative positioning mode, the 35-position section allows setting of unlimited pulse segments. However, the motor will continue running until it reaches this position, unless the current segment is skipped.						

The internal location consists of 35 segments. If you need to switch between running 10 segments and 5 segments due to process requirements, you can set the valid segment count. For example, if all segments 1-10 are parameterized, set the valid segment count for P4-04 to 5, meaning segments 1-5 are valid. If set to 10, then segments 1-10 are valid.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P4-04	Number of valid fields	0	-	0 ~ 35	servo bb	immediately

P4-08 sets the starting run section number after the first round, with only the step-change mode P4-03.1 being valid when set to 0 or 1. The following explains the configuration: valid settings are available in sections No.1 through No.8.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P4-08	Internal location pattern starting segment number	1	-	0 ~ 35	servo bb	immediately

step change mode	set up	parameter setting	specific phenomenon
P4-03.1=0	P4-08=0 or P4-08>P4-04	P4-08=8 P4-04=4	
	1≤P4-08≤ P4-04	P4-08=2 P4-04=4	
P4-03.1=1	P4-08=0 or P4-08>P4-04	P4-08=8 P4-04=4	
	1≤P4-08≤ P4-04	P4-08=2 P4-04=4	

When using the skip current segment function, the SI terminal assigned to P5-31 requires a rising edge

trigger.

5.8.2.4 Step-change signal (/CHGSTP)

parameter	Signal name	setting	meaning	Change scope
P5-35	step change signal	n.0000	No terminal input is assigned by default. Refer to Section 5.4.3.2 for the application of step-change signals in the step-change mode table.	Parameter range 0000-0014 The parameter P5-35 is assigned to the input interface. When set to 0001, it indicates the signal input from terminal SI1.

5.8.2.5 Skip current segment signal (/ZCLAMP)

parameter	Signal name	setting	meaning	Change scope
P5-31	Skip current section / Z-CLAMP	n.0000	Default unassigned terminal input	The parameter range is 0000-0014, assigned to the input interface via parameters P5-31. Setting it to 0001 indicates signal input from the SI1 terminal.

The effect of skipping the current section varies depending on the step change mode, as shown below:

step change mode P4-03 n.xx□x	Skip current section	Action
0	/Z-CLAMP	Cancel the current section and proceed to the next one.
1		Cancel the current section and proceed to the next section when the step change signal is triggered.
2		Cancel the current section and proceed to the next one.
4		Cancel the current segment. The next segment will be executed when the /CHGSTP step signal falls.
5		Cancel the current paragraph. Select another paragraph and execute the corresponding paragraph.
6		Cancel the current segment. The /CHGSTP step signal's rising edge executes the selected position segment.

5.8.2.6 Movement Start Signal (/MRUN)

parameter	Signal name	factory setting	meaning	revise
P5-50	Start Movement /MRUN	n.0000	No terminal output is assigned by default. It is only valid in the internal position mode, similar to the positioning completion signal	The parameter range is 0000-0014, assigned to the output interface via parameters P5-50. Setting it to 0001 outputs a signal

			in the external pulse mode. The motor has an output when running and no output when stopped.	from the SO1 terminal.

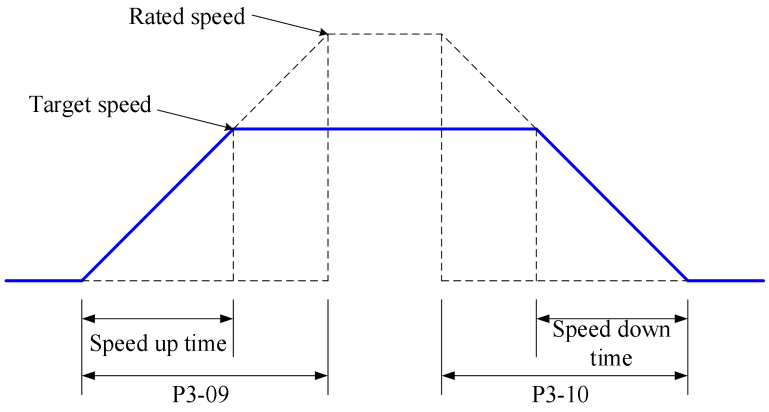
5.9 Speed Control

5.9.1 General Control of Speed Mode

5.9.1.1 Soft Start

parameter	meaning	factory setting	unit	Set range	revise	come into force
P3-09	soft start acceleration time	200	ms	0 ~ 65535	servo bb	immediately
P3-10	soft start deceleration time	200	ms	0 ~ 65535	servo bb	immediately

Soft start acceleration/deceleration time is applicable to mode 3/4/7; when inputting step speed command or selecting internal set speed, smooth speed control can be performed.
P3-09: Time from shutdown to rated speed;
P3-10: Time from rated speed to complete stop.



5.9.1.2 Zero Clamp Function (/ZCLAMP)

1) Function Overview

This function is used for higher-level devices with speed command input in systems without position loop. It activates the motor stop and servo lock when the speed command is non-zero.
When the zero clamping function is set to ON, the internal temporary position loop is activated, causing the motor to clamp within ±1 pulse at this position. Even if external force causes rotation, the motor will return to the zero clamping position.
To activate the zero clamping function, the motor's current speed must be below the clamping threshold to secure the shaft. When this function is enabled, the motor switches from speed control to position control. In position control mode, rotating the shaft and releasing it will return it to its original position. However, in speed control mode, rotation won't reset the shaft to its starting position due to the absence of position feedback.

2) Input signal settings

parameter	Signal name	setting	meaning	Change scope
P5-31	zero clamp	n.0000 (default)	Default unassigned output terminals	The parameter range is 0001-0014, and parameters P5-31 can be assigned to other input terminals.
		n.0002	Input signal via SI2 terminal	

3) Setting of relevant parameters

parameter	meaning	factory setting	unit	Set range	revise	come into force
P3-13	zero clamping speed	10	rpm	0 ~ 300	servo bb	immediately
P3-12	zero clamping mode	0	-	0 ~ 3	servo bb	immediately

P3-12 Settings	content
0	When the ZCLAMP input signal is ON, the forced speed command is 0. Once the actual speed drops below P3-13, the system switches to position mode control and locks the position servo.
1	When the ZCLAMP input signal is ON, the speed command is forcibly set to 0.
2	When the ZCLAMP input signal is ON and the feedback speed drops below P3-13, the system switches to position mode control and locks the position servo. Note: When entering zero-clamping mode, the motor will not operate even if the speed exceeds the P3-13 motor's limit. The motor resumes operation only when the ZCLAMP input signal is turned off.
3	When the ZCLAMP input signal is ON and the set speed is below P3-13, the system switches to position mode control and locks the position servo. If the set speed exceeds P3-13, the motor resumes operation.

5.9.1.3 Speed arrival signal (/V-RDY)

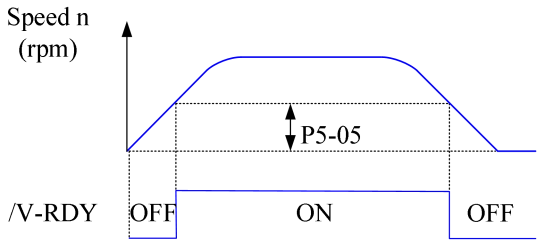
- relevant parameter

parameter	Signal name	factory setting	Applicable mode	meaning	revise	come into force
P5-51	speed of arrival at V-RDY	n.0000	3、4、7	velocity arrival signal	at any time	immediately

parameter	meaning	factory setting	unit	Set range	revise	come into force
P5-05	detection speed	1000	rpm	0 ~ 10000	at any time	immediately

1) The speed reaches the signal output condition.

When the actual motor speed exceeds the detection threshold of P5-05, the speed arrival signal (/V-RDY) is triggered.

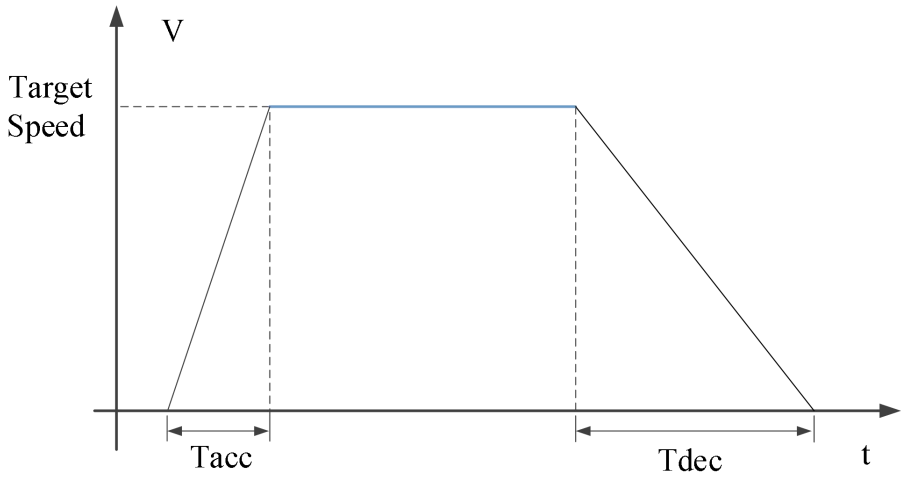


5.9.1.4 Speed command filter

- relevant parameter

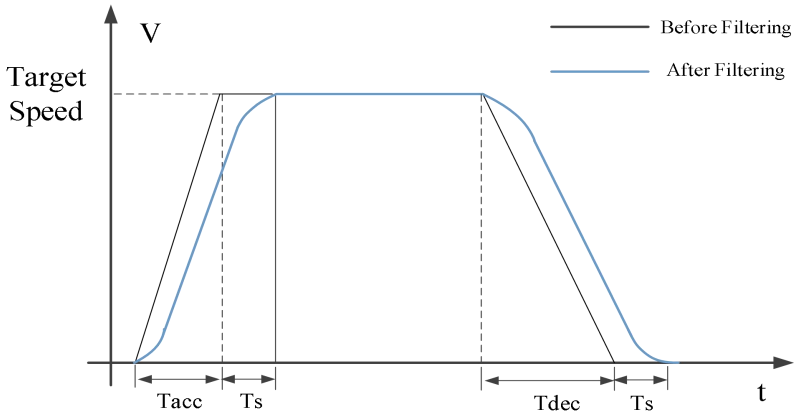
parameter	meaning	factory setting	unit	Set range	revise	come into force
P1-23	velocity command filter time constant	0	0.1ms	0 ~ 65535	servo bb	immediately
P3-09	acceleration time	200	1ms	0 ~ 65535	servo bb	immediately
P3-10	deceleration time	200	1ms	0 ~ 65535	servo bb	immediately
P3-11	Moving average filter time constant	0	0.1ms	0 ~ 65535	servo bb	immediately

Firstly, P3-09 and P3-10 are set. The acceleration and deceleration time of the planning speed command is calculated.



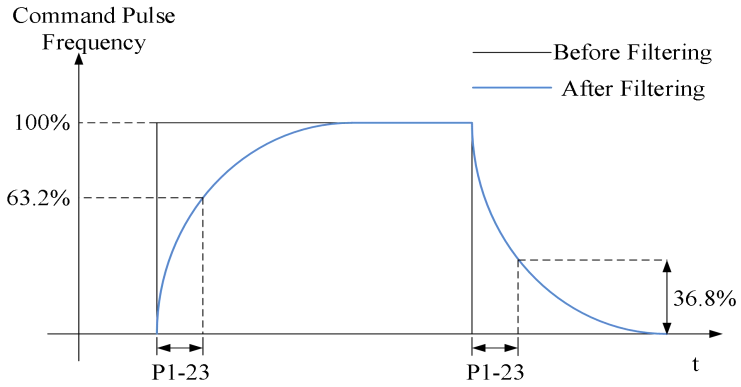
The acceleration time Tacc is calculated as (target speed/ rated speed) × P3-09[ms], and the deceleration time Tdec is calculated as (target speed/ rated speed) × P3-10[ms].

The appropriate time constant P3-11 (S-type acceleration-deceleration time constant) is set as Ts = P3-11*0.1[ms].



The sliding average filter time constant must meet the requirements, Ts<0.5*Tacc and Ts<0.5*Tdec. Otherwise, an excessively large sliding average filter time will result in an increased deceleration time, which does not comply with the settings specified in P3-09 and P3-10.

When P3-09 and P3-10 are set to 0, the sliding average filter time setting converts the speed command into a trapezoidal acceleration/deceleration command. Setting P1-23 (speed command filter time constant) and P1-24 (first-order low-pass filter time constant) produces the following effect:



If the acceleration and deceleration are set, the first-order low-pass filter will increase the lag of the speed command.

5.9.2 Speed Control (Internal Set Speed)

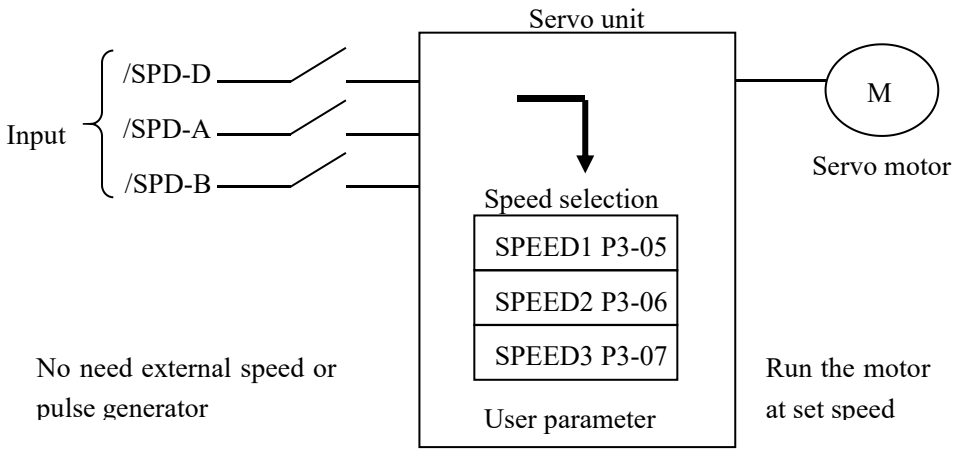
parameter	essentials	Reference chapters
P0-01 Control Mode Selection	Set to 3: Internal speed control mode	5.9.2.1 Internal speed mode
P3-05 Internal setting speed 1 P3-06 Internal setting speed 2 P3-07 Internal setting speed 3	Internal 3-speed speed value setting, in rpm	5.9.2.1 Internal speed mode
P5-28 Internal Speed Selection/SPD-A P5-29 Internal Speed Selection/SPD-B	The combination of terminals determines the corresponding segment speed.	5.9.2.1 Internal speed mode

P5-27 Internal Speed Direction Selection/SPD-D	The default for switching is n.0000. If the commutation is controlled via the SI2 terminal, the P5-27 can be set to n.0002.	5.9.2.1 Internal speed mode
P3-09 Soft-start acceleration time P3-10 Soft-start deceleration time	Set acceleration and deceleration time in milliseconds	5.9.1.1 Soft Start

5.9.2.1 Internal speed mode

parameter	set value	meaning	revise	come into force
P0-01	3	Speed control: Select internal speed	servo bb	immediately

Function Overview: The internal speed selection feature allows users to pre-set three motor speeds via the servo unit's parameters and select the desired speed using external input signals for precise speed control. This eliminates the need for external speed generators or pulse generators.



- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P3-05	Internal set speed 1	0	rpm	-9999 ~ +9999	at any time	immediately
P3-06	Internal set speed 2	0	rpm	-9999 ~ +9999	at any time	immediately
P3-07	Internal set speed 3	0	rpm	-9999 ~ +9999	at any time	immediately

parameter	Signal name	factory setting	Set range	revise	come into force
P5-27	internal direction selection/SPD-D	n.0000	The parameter range is 0000-0014, which is assigned to other input interfaces through	at any time	immediately

parameter	Signal name	factory setting	Set range	revise	come into force
			parameters P5-27.		
P5-28	internal speed selection/SPD-A	n.0000	The parameter range is 0000-0014, which is assigned to other input interfaces through parameters P5-28.		
P5-29	internal speed selection/SPD-B	n.0000	The parameter range is 0000-0014, which is assigned to other input interfaces through parameters P5-29.		

1) The correlation between operating speed and terminal signal

incoming signal			running speed
/SPD-D（P5-27）	/SPD-A（P5-28）	/SPD-B（P5-29）	
0<Forward>	0	0	internal instruction 0 speed
	0	1	P3-05：SPEED1
	1	1	P3-06：SPEED2
	1	0	P3-07：SPEED3
1<Reverse>	0	0	internal instruction 0 speed
	0	1	P3-05：SPEED1
	1	1	P3-06：SPEED2
	1	0	P3-07：SPEED3

- The SPD-D signal controls direction, and the input SI terminal can be adjusted via P5-27. The motor's direction is determined by the signal validity of the terminal.
- The combination of SPD-A and SPD-B input terminals determines the multi-stage speed.
- The 0/1 in the table above indicates the signal validity. A 0 at the terminal means the input is invalid, while a 1 indicates the input is valid.

2) Explanation of terminal validity

The table below uses /SPD-D as an example, with /SPD-A and /SPD-B signals following the same principle.

Parameter settings status	Signal/SPD-D terminal input status	signal / SPD-D terminal logic

P5-27=n.0000	No external terminal input is required.	of no avail
P5-27=n.000□	No signal input at the SI□ terminal	
P5-27=n.001□	The SI terminal has a signal input.	
P5-27=n.0010	No external input terminals required	valid
P5-27=n.000□	The SI terminal has a signal input.	
P5-27=n.001□	No signal input at the SI□ terminal	

5.10 Torque Control

parameter	essentials	Reference chapters
P0-01 Control Mode Selection	Set to 1: Internal torque mode	5.10.1 Internal Torque Mode
P3-33 Internal torque command given	The given value is the percentage of the rated torque.	5.10.1.1 Internal torque command setting
Internal Forward Speed Limitation in P3-16 Torque Control Internal Reverse Speed Limitation in P3-17 Torque Control P3-14 Forward maximum speed limit (MAX speed) P3-15 Reverse maximum speed limit (MAX speed)	Speed Limitation in Torque Mode	5.9.2.1 Internal speed mode
P5-27 Speed Direction Switching/SPD-D	The default direction is n.0000. If the direction is set via the SI2 terminal, P5-27 can be configured as n.0002.	

5.10.1 Torque Control (Internal Settings)

parameter	set value	meaning	revise	come into force
P0-01	1	torque control: internal setting	servo bb	immediately
Function overview: The system uses the internally set torque as the torque command for torque control.				

5.10.1.1 Internal torque command setting

parameter	meaning	factory setting	unit	Set range	revise	come into force
P3-33	internal torque command given	0	1% rated torque	-1000 ~ +1000	at any time	immediately
The parameter is set in 1% of the rated torque, and the positive and negative values correspond to the motor's forward and reverse rotation. For example, setting P3-33 to 50 indicates the motor operates at 50% of its rated torque in forward rotation. Setting P3-33 to-20 enables the motor to reverse at 20% of its rated torque. In addition to controlling the direction with torque, the /SPD-D can also be used for directional control.						

5.10.1.2 Internal speed limit during torque control

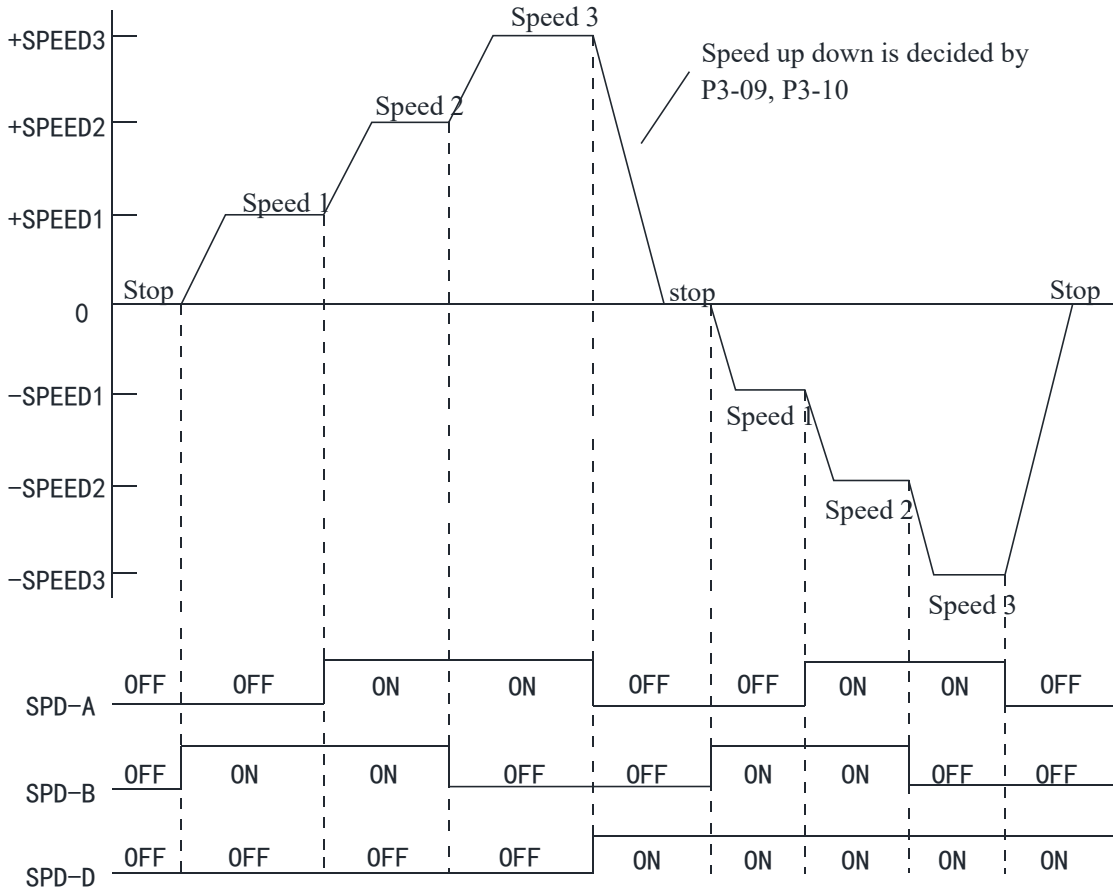
parameter	meaning	factory setting	unit	Set range	revise	come into force
P3-16	Internal Forward Speed Limitation in Torque Control	motor rated	rpm	5 ~ 10000	at any time	immediately
P3-17	Internal Reverse Speed Limitation in Torque Control	motor rated	rpm	5 ~ 10000	at any time	immediately
Note: Even if the set speed of this parameter exceeds the P3-14 speed limit, the actual speed limit applied is the lower value. (The maximum speed is the smaller of P3-14/P3-15 and P3-16/P3-17)						

5.10.1.3 Speed Limit Detection (/VLT)

In torque mode, if the absolute value of the servo motor's actual speed exceeds the speed limit, the system recognizes the speed as restricted and the servo driver outputs a /VLT signal. Conversely, if neither condition is met, the speed restriction signal is invalid.

parameter	Signal name	factory setting	Applicable mode	meaning	revise	come into force
P5-43	/VLT	n.0000	1、2	speed limit detection	at any time	immediately
The default value is unassigned terminals (parameter range: 0000-0014), which are assigned to the output interface via parameter P5-43. Setting it to 0002 enables signal output from the SO2 terminal. The VLT signal is only active in torque mode.						

Run an example



6. EtherCAT bus communication

6.1 Overview of EtherCAT Technology

This section mainly introduces the basic concept, system composition, communication specification and connection description of EtherCAT.

6.1.1 Overview of EtherCAT

EtherCAT, short for Ethernet for Control Automation Technology, is a real-time Ethernet solution developed by Beckhoff Automation GmbH for open communication between master and slave stations. As a mature industrial Ethernet technology, EtherCAT features high performance, low cost, and ease of use.

The XG2, XDH, or XLH series controllers (master stations) and DM6C servo drives (slave stations) comply with the standard EtherCAT protocol, supporting up to 64-axis slave stations with a 4ms synchronization cycle. They feature Touch Probe functionality and multiple control modes including position, speed, and torque, making them widely applicable across various industries.

6.1.2 System Composition (Master Station and Slave Station)

EtherCAT operates as a linear network system connecting a master station (FA controller) with multiple slave stations.
The number of nodes connected from the station depends on the processing or communication period of the master station and the number of bytes transmitted.

6.2 EtherCAT Communication Specifications

This section mainly introduces the frame structure, state machine, ESC, SDO, PDO, SII region, communication synchronization mode and other contents of EtherCAT.

6.2.1 List of Communication Specifications

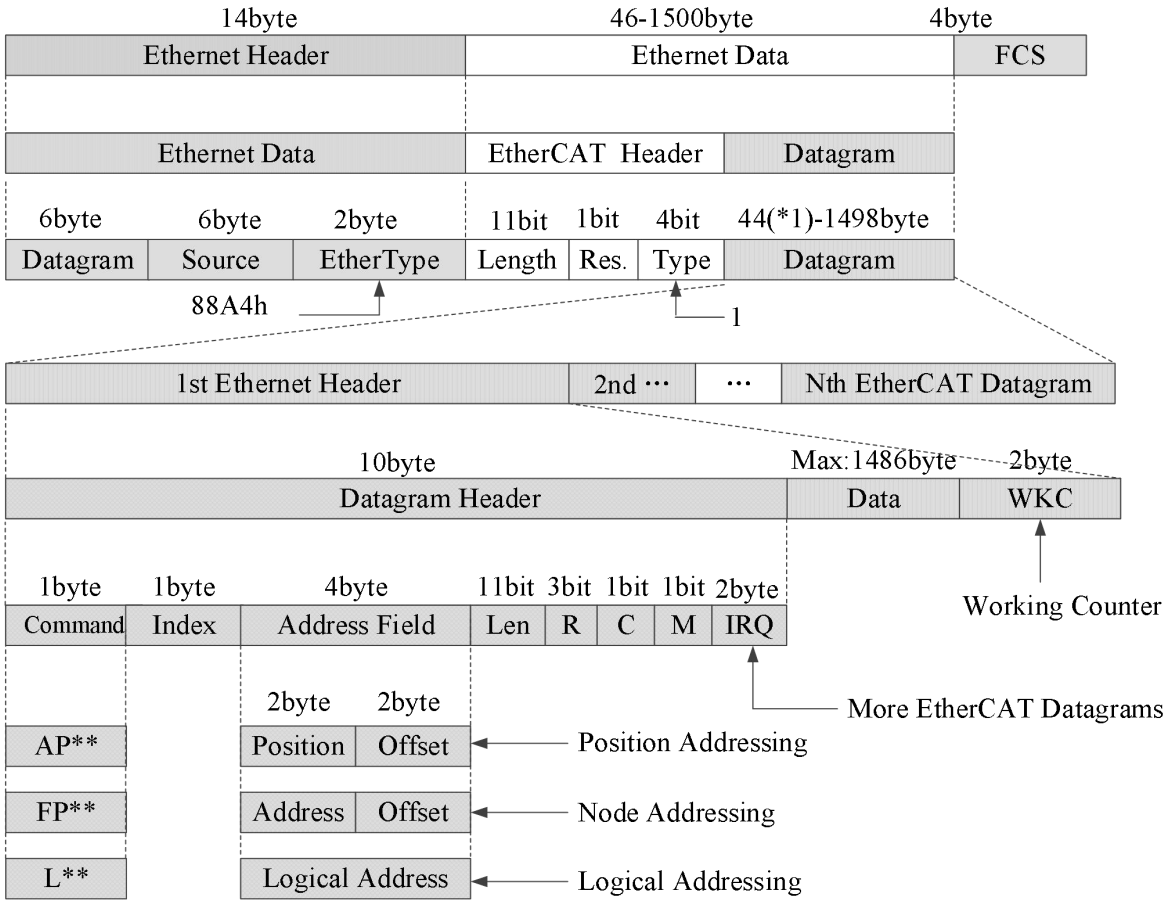
<table>
<tr><th>project</th><th>specifications</th></tr>
<tr><td>physical layer</td><td>100BASE-TX（IEEE802.3）</td></tr>
<tr><td>Baud rate</td><td>100Mbps (full-duplex)</td></tr>
<tr><td>topology</td><td>Line</td></tr>
<tr><td>tie cable</td><td>JC-CB/JC-CA twisted pair cable (shielded twisted pair)</td></tr>
<tr><td>cable length</td><td>The maximum distance between nodes is 50 meters.</td></tr>
<tr><td>communication port</td><td>2 Port（RJ45）</td></tr>
<tr><td>Station Alias（ID）</td><td>Range: 0 to 65535
Set address: 2700h</td></tr>
<tr><td>Explicit Device ID</td><td>nonsupport</td></tr>
<tr><td>Mail Protocol</td><td>COE（CANopen Over EtherCAT）</td></tr>
<tr><td>SyncManager Synchronization Manager</td><td>4</td></tr>
<tr><td>FMMU</td><td>3</td></tr>
<tr><td>Modes of operation control model</td><td>
<table>
<tr><th></th><th colspan="2">control model</th></tr>
<tr><td rowspan="3">position</td><td>Csp</td><td>Cyclic synchronous position mode</td></tr>
<tr><td>PP</td><td>Profile position mode</td></tr>
<tr><td>Hm</td><td>Homing mode (origin reset position control mode)</td></tr>
<tr><td rowspan="2">velocity</td><td>Csv</td><td>Cyclic synchronous speed control mode</td></tr>
<tr><td>Pv</td><td>Profile Velocity Mode</td></tr>
<tr><td rowspan="2">torque</td><td>Cst</td><td>Cyclic synchronous torque mode</td></tr>
<tr><td>Tq</td><td>Torque Profile Mode</td></tr>
</table>
</td></tr>
<tr><td>Touch Probe</td><td>Route 2</td></tr>
<tr><td>concurrent mode</td><td>DC (Synchronous Event)</td></tr>
<tr><td>DC communication cycle</td><td>250,500,1000,2000,4000,8000,10000[μs]</td></tr>
<tr><td>communication object</td><td>SDO[Service Data Object], PDO[Process Data Object]</td></tr>
<tr><td>Maximum number of PDO allocations per single station</td><td>TxPDO: 4 [units] RxPDO: 4 [units]</td></tr>
<tr><td>Maximum byte count for single-site PDO</td><td>TxPDO：32[byte] RxPDO：32[byte]</td></tr>
<tr><td>PreOP mode email communication interval</td><td>1ms</td></tr>
<tr><td>mail box</td><td>SDO requests and SDO information</td></tr>
</table>

The meanings of SDO and PDO are defined in Section 6.2.3, State Machine ESM.

6.2.2 EtherCAT Frame Structure

EtherCAT is an industrial communication protocol based on Ethernet that can be controlled in real time. It is an extension of the IEEE 802.3Ethernet specification without any changes to the basic structure, so it can transfer data in standard Ethernet frames.
Since the Ethernet Header's EtherType is "88A4h", the subsequent Ethernet Data is processed as an EtherCAT frame.
An EtherCAT frame consists of a header and one or more subframes, which are further subdivided.
Only EtherCAT frames with Type=1 header are processed according to the ESC protocol.

EtherNet/EtherCAT frame structure

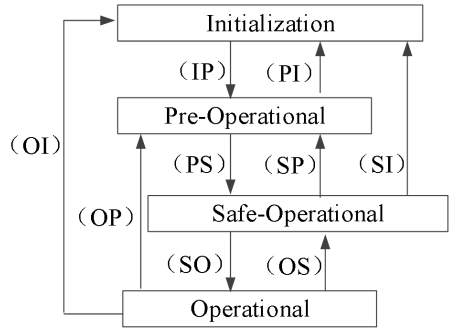


*1: When an Ethernet frame is shorter than 64 bytes, 1 to 32 bytes are appended.
Ethernet header + Ethernet data + FCS

6.2.3 State Machine (ESM)

ESM stands for EtherCAT State Machine, which coordinates the state relationships between master and slave applications during initialization and operation.
The master station initiates a state change request and sends it to the application layer service. The application layer service then generates a control event in the slave station. The slave station responds to the application layer control service via its local application layer status write service, depending on whether the state change request succeeds or fails. If the state change fails, the slave station retains its current state and sets an error flag.

The diagram below illustrates the state transition of ESM:



※In the state transition diagram, abbreviations like (IP) represent state transitions:
（IP）：Init→Pre-Operational （PS）：Pre-Operational→Safe-Operational

Init: Initial state; Init: Initial state;
Pre-Operational: The system is in a state of readiness for operation.
Safe-Operational: A state of safe operation;
Operational: Running status;

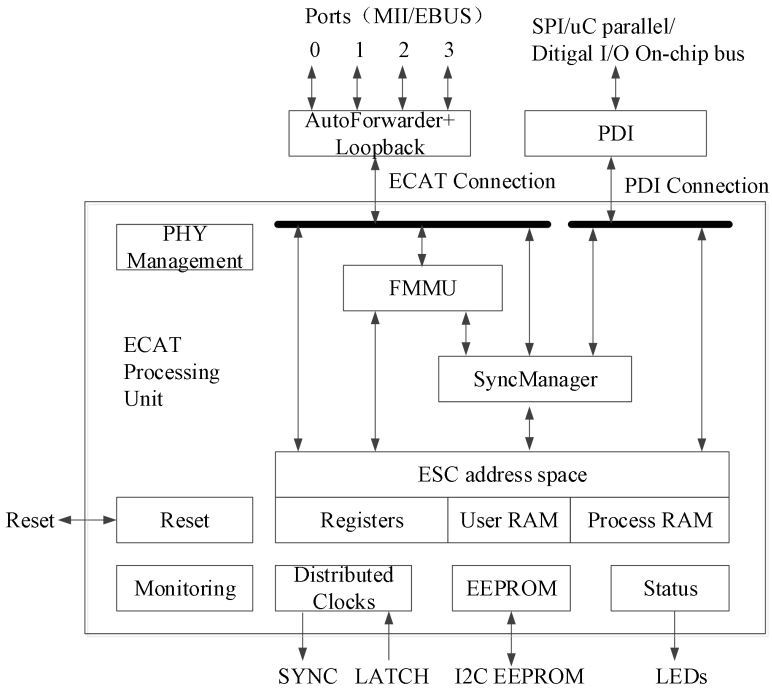
Station status	Actions in each state	Communication action		
		Send and receive emails in SDO	PDO post a letter	PDO collection of letters
initialization state	Communication initialization: SDO and PDO cannot send or receive messages.	-	-	-
Pre-run state	Status of SDO transmission and reception only	Yes	-	-
Safe operating status	The status of SDO only sending and receiving messages, and PDO sending messages	Yes	Yes	-
running state	The state where SDO and PDO can both send and receive messages.	Yes	Yes	Yes

- Access to the ESC register from the master station is independent of the table above and can be performed at any time.
- PDO (Process Data Object) is used to transmit periodic communication data.
- SDO (Service Data Object) is used to transmit non-periodic communication data.
- When the ESM status switches, executing commands or interface operations may trigger communication errors.

6.2.4 Slave Controller (ESC)

6.2.4.1 Overview of the Principle

ESC stands for EtherCAT Slave Controller. It handles all communication processes and features four data ports, each with a TX and RX unit. These ports can transmit Ethernet data frames in a fixed sequence: port 0 → port 3 → port 1 → port 2 → back to port 0. When an ESC detects a port without an external PHY, it automatically closes that port and reroutes the data through an internal loop to the next port.



6.2.4.2 Address Space

The DM6C series features 8Kbyte physical address space.

The first 4Kbyte (0000h ~ 0FFFh) is designated as register space, while the second 4Kbyte (1000h ~ 1FFFh) is allocated as RAM for process data PDO. For register details, refer to the datasheets of IP (ET1810/ET1811/ET1812).

ESC register byte address	length (Byte)	explain	Initial value*1
Information from the station controller			
0000h	1	type	04h
0001h	1	Revision	02h
0002h~0003h	2	Build	0040h
0004h	1	FMMUs supported	03h
0005h	1	SyncManagers supported	04h

ESC register byte address	length (Byte)	explain	Initial value*1
0006h	1	RAM Size	08h
0007h	1	Port Descriptor	0Fh
0008h~0009h	2	ESC Features supported	0184h
Site			
0010h~0011h	2	Configured Station Address	-
0012h~0013h	2	Configured Station Alias	-
...			
data link layer			
...			
0100h~0103h	4	ESC DL Control	-
...			
0110h~0111h	2	ESC DL Status	-
application layer			
0120h~0121h	2	AL Control	-
0130h~0131h	2	AL Status	-
0134h~0135h	2	AL Status Code	-
...			
PDI process data interface			
0140h	1	PDI Control	08h
0141h	1	ESC Configuration	0Ch
0150h	1	PDI Configuration	-
0151h	1	SYNC/LATCH PDI Configuration	66h
0152h~153h	2	Extend PDI Configuration	-
...			
watchdog			
0400h~0401h	2	Watchdog Divider	-
0410h~0411h	2	Watchdog Time PDI	-
0420h~0421h	2	Watchdog Time Process Data	-
0440h~0441h	2	Watchdog Status Process Data	-
0442h	1	Watchdog Counter Process Data	-
0443h	1	Watchdog Counter PDI	-
...			
FMMU			
0600h~062Fh	3x16	FMMUs[2:0]	-
+0h~3h	4	Logical Start Address	-

ESC register byte address	length （Byte）	explain	Initial value*1
+4h~5h	2	Length	-
+6h	1	Logical Start bit	-
+7h	1	Logical Stop bit	-
+8h~9h	2	Physical Start Address	-
+Ah	1	Physical Start bit	-
+Bh	1	Type	-
+Ch	1	Activate	-
+Dh~Fh	3	Reserved	-
...			
Distributed Clocks（DC）-SYNC Out Unit			
0981h	1	Activation	-
...			
0984h	1	Activation Status	-
098Eh	1	SYNCO Status	-
...			
0990h~0993h	4	Start Time Cyclic Operation/Next SYNC0 Pulse	-
...			
09A0h~09A3h	4	SYNC0 Cycle Time	-
...			

6.2.5 SII region (0000h ~ 003Fh)

In the ESC configuration area (EEPROM word address 0000h-0007h), the Configured Station Alias is automatically read and written into the ESC register after the driver power is powered on. To reflect the updated SII EEPROM values in the ESC register, a power restart is required. Additionally, the initial values of the IP cores (ET1810/ET1811/ET1812) are preconfigured. For detailed specifications, please refer to the datasheets of the IP cores (ET1810/ET1811/ET1812).

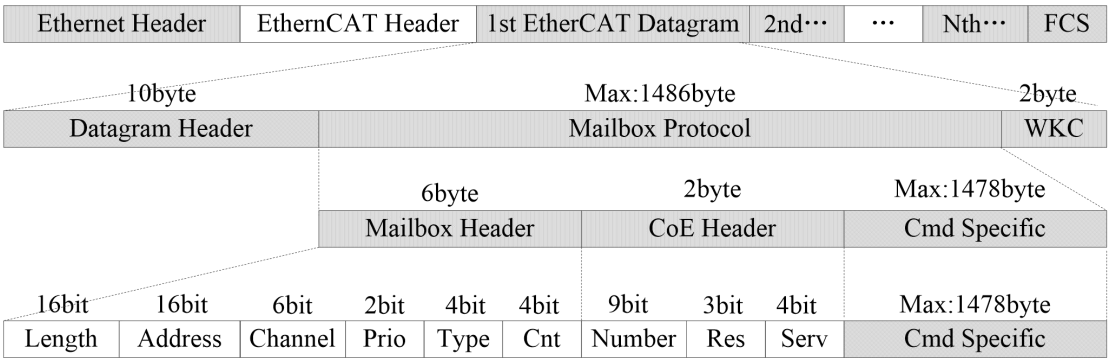
6.2.6 SDO (Service Data Object)

The DM6C series supports SDO (Service Data Objects). Since SDO data exchange uses Mailbox communication, the SDO data refresh time becomes unstable.

The master station accesses object dictionary records for data operations, enabling object configuration and slave status monitoring. SDO read/write operations require time to respond. For PDO-renewed objects, avoid SDO refreshes and instead overwrite with PDO values.

6.2.6.1 Mailbox Frame Structure

The frame structure of Mailbox/SDO is as follows. For details, please refer to the ETG specifications (ETG1000-5 and ETG1000-6).



frame portion	list range	data type	function
MailBox Header	Length	WORD	Mailbox data length
	Address	WORD	Sender's site address
	Channel	Unsigned6	（Reserved）
	Prority	Unsigned2	Priority
	Type	Unsigned4	Mailbox type 00h: Error 01h：（Reserved） 02h: EoE (Not available) 03h：CoE 04h: FoE (Not available) 05h: SoE (Not available) 06h-0Eh：（Reserved） 0Fh: VoE (Not mapped)
	Cnt	Unsigned3	Mailbox Counter
	Reserved	Unsigned1	（Reserved）
CoE Header	Number	Unsigned9	Reserved
	Reserved	Unsigned3	Reserved
	Service	Unsigned4	Informational
Cmd specific	Size Indicator	Unsigned1	Data Set Size License
	Transfer Type	Unsigned1	Normal transfer/Expedited transfer option
	Data Set Size	Unsigned2	Specify data size
	Complete accessibility	Unsigned1	Object access method selection (not applicable)
	Command Specfier	Unsigned3	Upload/Download Request/Response options

frame portion	list range	data type	function
	index of matrix	WORD	Object index
	Sub index of matrix	BYTE	Subindex of the object
			Object data or Abort message, etc.

6.2.6.2 Mailbox timeout

This servo driver performs the following timeout settings in Mailbox communication.
Mailbox request timeout: 100ms
The master station sends a request to the slave station (driver). If the WKC of the transmitted data in the request frame is updated, the slave station is considered to have received the request normally. The master station retries until the WKC is updated. If the WKC remains unchanged after the set time, the master station times out.
Mailbox response timeout: 10s
The master station receives responses from slave stations (drives). If the WKC is updated, it is considered a normal response. If the WKC update response is not received within the set time, the master station times out.
The maximum time required for the response to complete from the station (driver).

6.2.6.3 Information when abnormal alarm occurs

1) Alarm code

The error code returns the same value as 603Fh (Error code).

000h ~ FEFFh is defined according to IEC61800-7-201.

The FF00h ~ FFFFh range is manufacturer-defined, as specified below.

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
603Fh	00h	Error code	0-65535	U16	ro	TxPDO	All
		The alarm number generated by the servo driver: General Alarm 603F displays the complete error code, while bus-related alarms show the main alarm number. Display 0000h when no alarm occurs. When an alarm is triggered, the alarm (main) number (00h ~ FFh) displays FF**h. example ：					

		①When a general alarm (e.g., E-030 overvoltage protection) occurs, 603F = 30d ②Bus-related alarms such as E-850 (TxPDO configuration error protection) and E-851 (RxPDO configuration error protection). 603F = FF55h... 55h=85d, meaning either E-850 or E-851 will be affected As an exception, when E-817 (SyncManager2/3 configuration error) occurs, the system displays A000h.

2) Alarm type (status)

The error register returns the same value as 1001h.

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">1001h</td><td rowspan="2">00h</td><td>Error register</td><td>0-65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Displays the type of alarm (status) occurring in the servo driver.
Display 0000h when no alarm occurs.
Do not show the warning.
<table>
<tr><th>Bit</th><th>content</th></tr>
<tr><td>0</td><td rowspan="4">nonsupport</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td>The AL status code defines the alarm occurrence *1</td></tr>
<tr><td>5</td><td>nonsupport</td></tr>
<tr><td>6</td><td>continue to have</td></tr>
<tr><td>7</td><td>AL status code undefined alarm occurred*2</td></tr>
</table>
*1: The term "AL status code-defined alarm" refers to communication-related anomalies in EtherCAT, specifically E-800~7, E-810~7, and E-850~7.
*2: The term "AL status code undefined alarm" refers to EtherCAT communication-related anomalies (E-880~7) and non-communication-related anomalies.</td></tr>
</table>

6.2.7 PDO (Process Data Object)

The DM6C series supports PDO (Process Data Object).
The real-time data transfer based on EtherCAT is conducted through PDO (Process Data Object) data exchange.
PDO includes RxPDO for data transfer from master to slave and TxPDO for transmission from slave to master.

	Sender	Recipient
RxPDO	main station	slave station
TxPDO	slave station	main station

6.2.7.1 PDO Mapping Objects

PDO mapping refers to the process of mapping from an object dictionary to the application objects of PDO.

The DM6C series PDO mapping table supports mapping objects for RxPDO (1600h ~ 1603h) and

TxPDO (1A00h ~ 1A03h).

The maximum number of application objects a mapping object can map is as follows:

TxPDO：32[byte]　　RxPDO：32[byte]

The following is an example of PDO mapping configuration.
<Example Settings>
The application objects 6040h,6060h,607Ah, and 60B8h are mapped to the target object 1600h (Receive PDO mapping 1: RxPDO_1).

index of matrix	Sub	Object contents	
1600h	00h	04h	
	01h	6040 00 10 h	
	02h	6060 00 08 h	
	03h	607A 00 20 h	
	04h	60B8 00 10 h	
	05h	0000 00 00 h	
	...		
	18h	0000 00 00 h	
6040h	00h	Controlword	U16
6060h	00h	Mode of operation	I8
607Ah	00h	Target Position	I32
60B8h	00h	Touch probe function	U16

6.2.7.2 PDO Allocation Targets

To enable PDO data exchange, the SyncManager must be assigned a PDO mapping table. The relationship between the PDO mapping table and SyncManager is defined in the PDO allocation object. For the DM6C series, the PDO allocation object can utilize RxPDO (SyncManager2) with 1C12h or TxPDO (SyncManager3) with 1C13h.

The maximum number of application objects a mapping object can map is as follows:

RxPDO：4 [Table]（1600h～1603h）。

RxPDO：4 [Table]（1A00h～1A03h）。

Since mapping usually requires only one object, the default setting remains unchanged.

Example of setting PDO allocation objects:

The allocation of mapping object 1600h to allocation object 1C12h (Sync Manager Channel 2).

index of matrix	Sub	Object contents
1C12h	00h	01h
	01h	1600h
	02h	0000h
	03h	0000h
	04h	0000h

The allocation of mapping object 1A00h to allocation object 1C13h (Sync Manager Channel 3).

index of matrix	Sub	Object contents
1C13h	00h	01h
	01h	1A00h
	02h	0000h
	03h	0000h
	04h	0000h

6.2.8 Communication Synchronization Mode

The DM6C series supports the following synchronization modes.

Sync mode	content	Synchronization method	feature
DC	SYNC0 event synchronization	Sync the time information of other slaves with the time on axis 1	high-accuracy Compensation processing is required on the master site side.
SM2	SM2 event synchronization	Synchronize based on the RxPDO's receipt time	No transmission delay compensation, low accuracy The controller must maintain transmission time (e.g., dedicated hardware)
FreeRun	nonsynchronous	nonsynchronous	Simple to handle

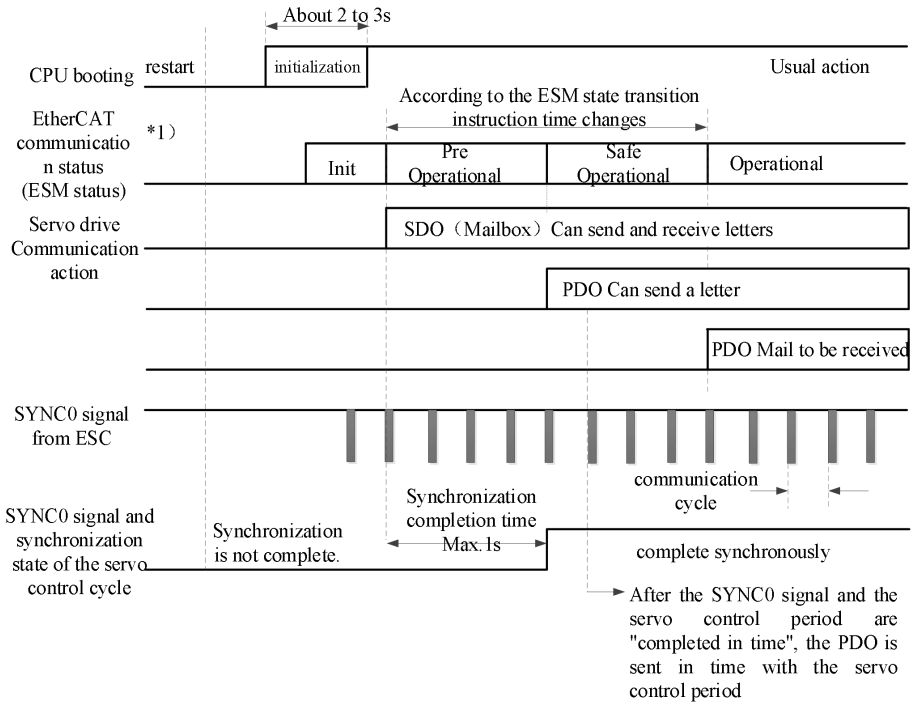
			Poor real-time performance

6.2.8.1 DC (SYNC0 event synchronization)

The DM6C series features a 64-bit DC (Distributed Clock) system.

EtherCAT communication synchronization is based on this DC. The slave node synchronizes via a shared System Time clock. Its local cycle starts at the SYNC0 event. Since slave processing (servo processing) begins at the SYNC0 event cycle, it remains synchronized with the SYNC0 event.

During communication initialization, the master station requires transmission delay compensation (offset compensation) and periodic deviation compensation. The diagram below illustrates the synchronization process from the control power supply's SYNC0 event input to the slave's processing (servo processing).



6.2.8.2 SM2 (SM2 Event Synchronization)

The local period of the station starts from the SM2 event.

Since the processing of the slave station starts at the SM2 event cycle, it is always synchronized with the SM2 event.

Since the SM2 event occurs upon completion of PDO's message reception, it is essential to ensure the master station's scheduled message transmission. Significant deviations in transmission timing may cause synchronization failure or trigger alarms.

If the above issues occur, use DC (SYNC0 event synchronization).

6.2.9 LED indicator lights

The XG2 series features two EtherCAT indicator LEDs: L/A IN and L/A OUT.

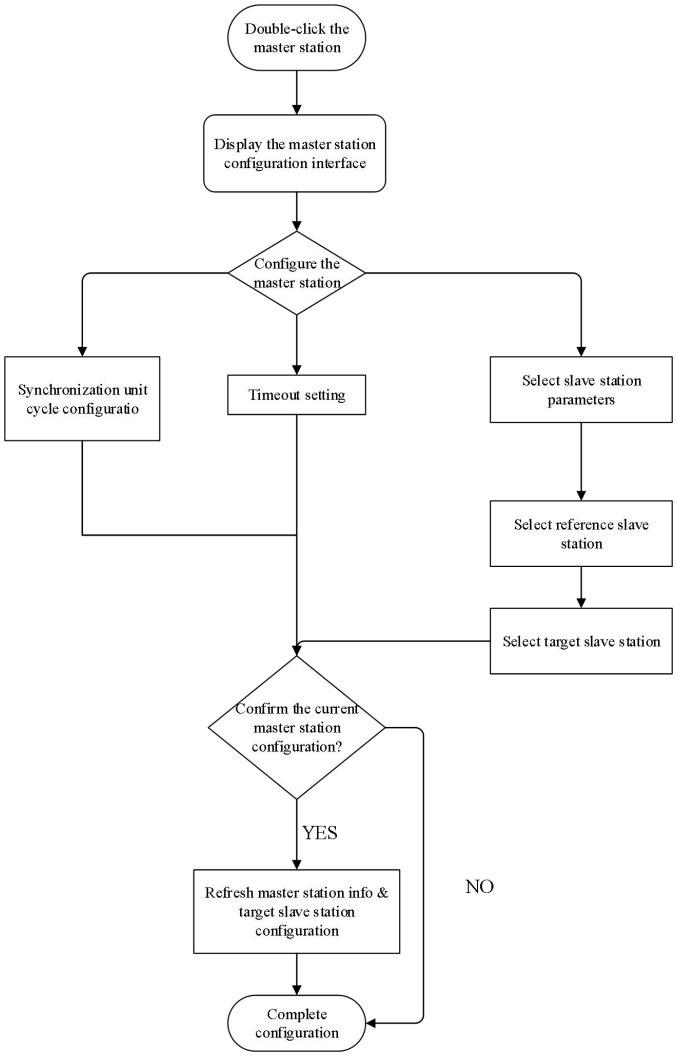
The L/A IN and L/A OUT indicator lights indicate the LINK status and operational status of the physical layer at each port.

The light is green.

LED state	content
OFF dark	Link not established
twinkle	Link setup with data transmission and reception
ON bright	Link established, no data transmission

7. EtherCAT bus control mode

7.1 EtherCAT operation



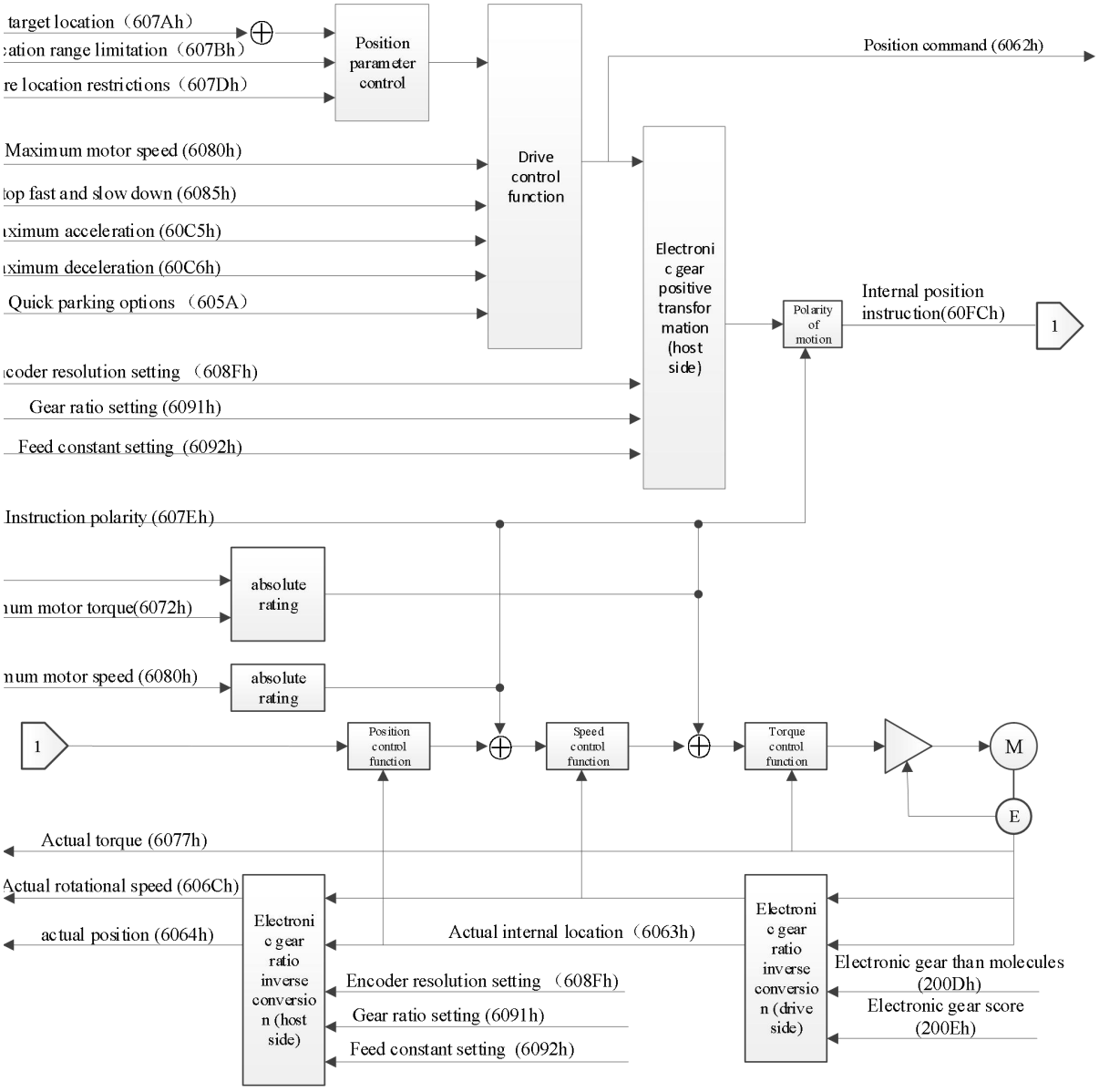
The table below lists the mandatory parameters required for configuration under the CSP, CSV, CST, PP, PV, and TQ modes.

register	explain
RXPDO[0x6040]	Control words must be added to the PDO configuration. They cannot be modified through IO mapping in CSP, CSV, or CST modes and are controlled by the NC module.
RXPDO[0x6060]	Mode control words must be added to the PDO configuration and can be modified via IO mapping in task mode.
RXPDO[0x607A]	The target location, which is the program-specified location, must be added to the PDO configuration.
TXPDO[0x6041]	Status characters must be added to PDO configuration

TXPDO[0x6061]	Status characters must be added to PDO configuration
TXPDO[0x6064]	The actual location must be added to the PDO configuration.
TXPDO[0x606C]	The actual speed must be added to the PDO configuration.

7.2CSP pattern

CSP (Cycle Synchronization Positioning Mode) uses a trajectory calculated by the host computer to periodically send target positions to the slave station.



7.2.1 Relevant parameters

1) CSP control mode associated objects (commands,settings)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO

Other locations control common associated objects.

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
607Ah	00h	target location	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Dh	-	software absolute position limit	-	-	-	-	-
	00h	Indicates the 607Dh sub-index number	-	2	U8	ro	NO
	01h	Minimum position limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
	02h	Maximum location limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Fh	00h	maximum outline velocity	Command unit/s	0~4294967295	U32	rw	RxPDO
60B1h	00h	jitter	Command unit/s	-2147483648~2147483647	I32	rw	RxPDO
60B2h	00h	torque deviation	0.1%	-32768~32767	I16	rw	RxPDO

There are also other related objects with common actions.

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO
605Ah	00h	Quick Stop Mode Selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Pause shutdown method	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and	-	0~2	I16	rw	NO

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO
		effect code					
607Dh	-	Software location restrictions	-	-	-	-	-
	00h	Indicates the 607h sub-index number	-	2	U8	ro	NO
	01h	Minimum position limit	instruction unit	-2147483648 ~2147483647	I32	rw	RxPDO
	02h	Maximum location limit	instruction unit	-2147483648 ~2147483647	I32	rw	RxPDO
607Ch	00h	Origin offset	instruction unit	-2147483648 ~2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quick parking deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Location trajectory planning type	-	-32768~32767	I16	rw	RxPDO
608Fh	-	Position encoder resolution setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-index number	-	2	U8	ro	NO
	01h	Encoder movement amount	pulse	1~4294967295	U32	ro	NO
	02h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO
6091h	-	Gear ratio settings	-	-	-	-	-
	00h	Indicates the 6091h sub-index number	-	2	U8	ro	NO
	01h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO
	02h	rotation number	r (axle)	1~4294967295	U32	rw	NO
6092h	-	Feed constant settings	-	-	-	-	-
	00h	Indicates the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the Feed value	instruction unit	1~4294967295	U32	rw	NO
	02h	Axis rotation number	r (axle)	1~4294967295	U32	rw	NO
60B8h	00h	Probe mode	-	0~65535	U16	rw	RxPDO

Control word (6040h) <cspFunction in control mode>

index of matrix	subindex	name	unit	scope	data type	PDO	Op-mode
6040h	00h	control word	0~65535	U16	Rw	RxPDO	All

Set the control command for the PDS state transition and other servo drivers.
bit information

15	14	13	12	11	10	9	8
R						om	h

7	6	5	4	3	2	1	0
fr	oms			eo	qs	ev	so
	r	r	r				

r = reserved (not mapped) fr = fault reset r = reserved (not mapped) fr = fault reset
oms = operation mode specific eo = enable operation
(The control mode depends on the bit) qs = quick stop (The control mode depends on the bit) qs = quick stop
h = halt ev = enable voltage
h = halt ev = enable voltage
so = switch on

The CSP mode does not utilize the OMS bit.

2) Objects associated with the CSP control mode (monitoring type)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6041h	00h	Statusword	-	0~65535	U16	ro	TxPDO

There are also other objects with common location control.

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
6062h	00h	position instruction	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
6063h	00h	Internal actual location	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	physical location	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
6065h	00h	Excessive position deviation threshold	instruction unit	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Location reaches the threshold	instruction unit	0~4294967295	U32	rw	RxPDO
6068h	00h	Time to reach the position threshold	1ms	0~65535	U16	rw	RxPDO
606Ch	00h	actual speed of motor	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
6074h	00h	internal command torque	0.1%	-32768~32767	I16	ro	TxPDO
6076h	00h	motor rated torque	Mn·m	0~4294967295	U32	ro	TxPDO
6077h	00h	actual torque	0.1%	-32768~32767	I16	ro	TxPDO
60F4h	00h	indicates positional deviation (= PERR)	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60FAh	00h	internal instruction speed Position loop output	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
60FCh	00h	internal location instruction	pulse	-2147483648~ 2147483647	I32	ro	TxPDO

There are also other objects with common action.

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO
603Fh	00h	Error code	-	0~65535	U16	ro	TxPDO
60B9h	00h	Indicates the status of the Touch probe function	-	0~65535	U16	ro	TxPDO
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruct unit	-2147483648 ~2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruct unit	-2147483648 ~2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruct unit	-2147483648 ~2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruct unit	-2147483648 ~2147483647	I32	ro	TxPDO

Status word (6041h) <cspFunction in control mode>

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>status word</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="7">Indicates the status of the servo driver.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="2" rowspan="2">r</td><td colspan="2">oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>Following error</td><td>Drive follow Command value</td><td>r</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>Ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not mapped) w = warning r = reserved
(not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
oms = operation mode specific qs = quick stop
Control mode depends on the bit: ve = voltage enabled
Control mode depends on the bit: ve = voltage enabled
ila = internal limit active f = fault
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rm = remote so = switched on
rtso = ready to switch on</td></tr>
</table>

bit13,12,10（operation mode specific）：

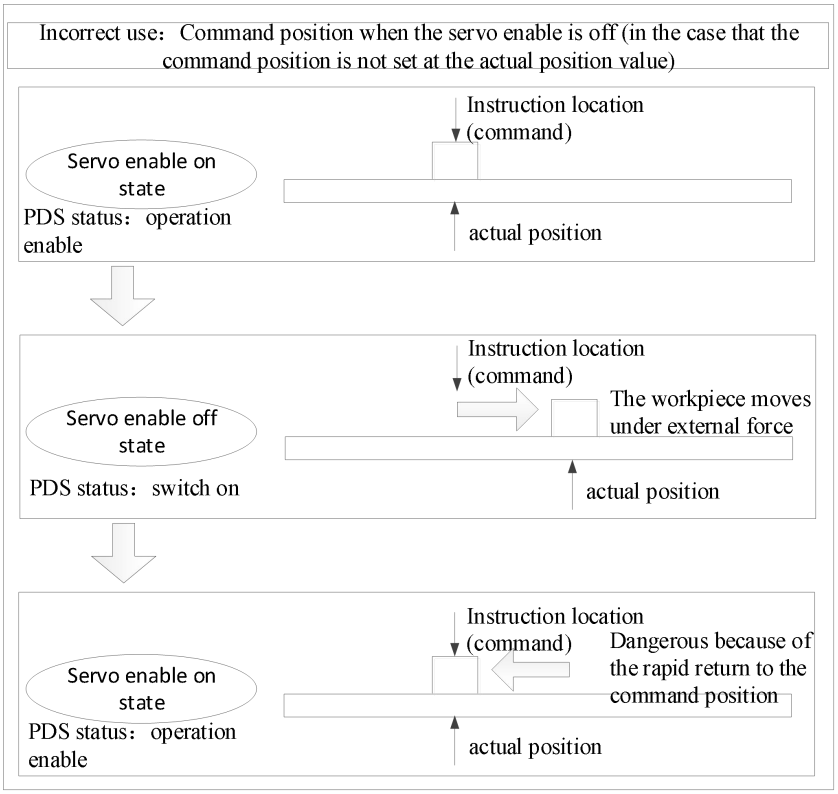
Bit	name	price	definition
10	continue to have	-	unused
12	Confirm settings	0	Do not perform actions based on target location
		1	Perform actions based on target location
13	tracking error	0	60F4h (instruction deviation) = 6062h (position command) − 6064h (position feedback), provided that the result does not exceed 6065h (over-deviation threshold). Alternatively, if 60F4h exceeds 6065h, the system will not proceed to 6066h.
		1	The value of 60F4h (instruction deviation) exceeds the set range of 6065h (excessive position deviation threshold) and has exceeded the time limit of 6066h (follow-up error timeout).

The term "Action based on target location" means that if all the following conditions are met:

- PDS status initiates the operation.
- Not in a halt state (Halt, Quickstop, Shutdown, Disable operation, Falut);
- Not in Halt stop state.

CSP control mode action

- The cyclic position control mode generates the action model (orbit) through the host rather than the slave.
- The target position is the sum of 607Ah (position given) and 60B0h (position feedforward), which should be interpreted as the absolute position.
- The update (send) of the operation command requires approximately 100 milliseconds after the operation enabled command is activated.
- 60C2h (Interpolation time period) is the update cycle for two objects: 607Ah (position given) and 60B0h (position feedforward). This value matches the 1C32h-02h (Cycle time). The host must update the target position using the 60C2h cycle.
- When servo enable is disabled, the host system should implement a control scheme combining 607Ah (position setpoint) + 60B0h (position feedforward) with 6064h (actual position). If the motor moves due to external forces during this disabled state, the subsequent activation of servo enable may trigger dangerous return-to-target-position maneuvers. Additionally, when switching from non-CSP control modes to CSP mode, follow-up processing must be executed.

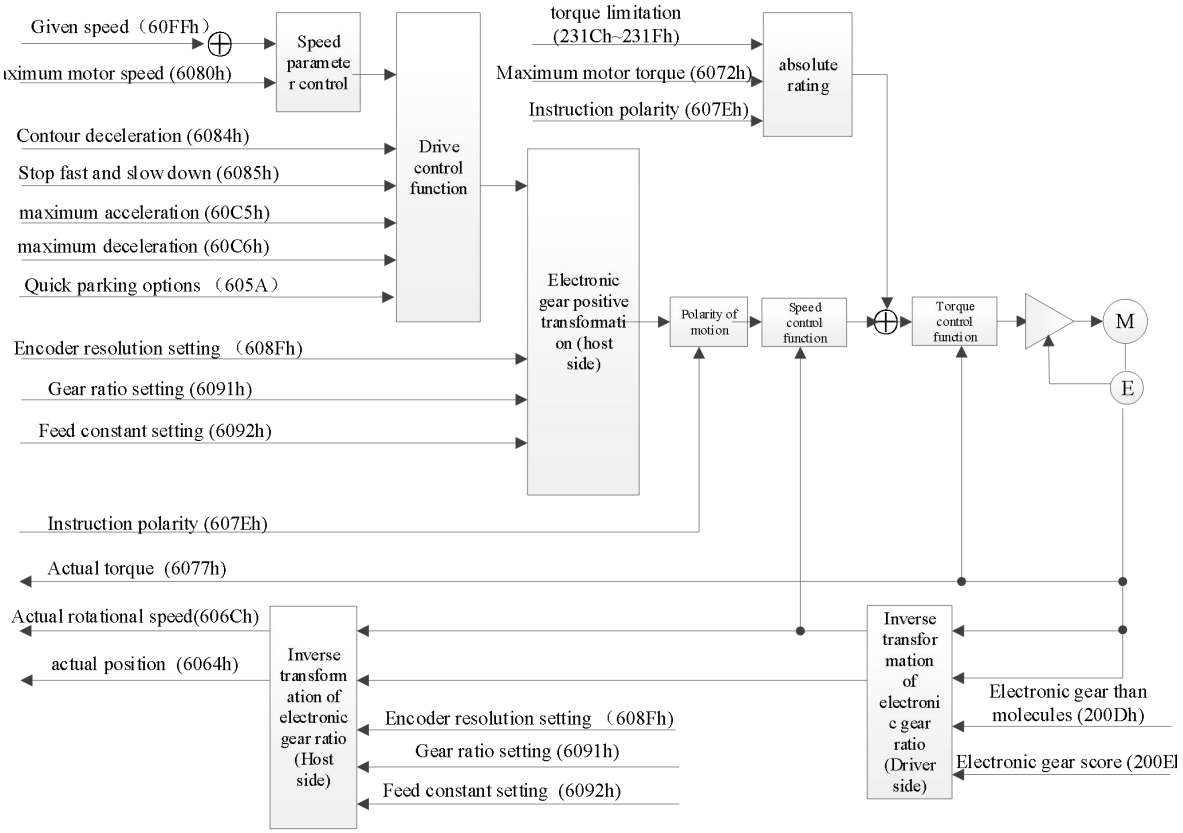


7.2.2 Common Parameters

register	explain	unit
RXPDO[0x607A]	When the position is specified, modifications via IO mapping are invalid in CSP mode, as it is controlled by the NC module.	instruction unit
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
RXPDO[0x6060]	The control mode is CSP (Cycle Synchronization Position Mode). Set its value to 8.	-

7.3CSV pattern

The CSV (Cycle Synchronization Speed Mode) enables the motor to operate at a constant speed by setting the speed through the host computer.



7.3.1 Relevant parameters

1) CSV control mode associated objects (commands,settings)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO
607Fh	00h	maximum outline velocity	Command unit/s	0~4294967295	U32	rw	RxPDO

Other objects with common speed control associations

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
6080h	00h	Maximum	r/min	0~4294967295	U32	rw	RxPDO

		motor speed					
60B1h	00h	velocity offset	Command unit/s	-2147483648~ 2147483647	I32	rw	RxPDO
60B2h	00h	torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60FFh	00h	velocity given	Command unit/s	-2147483648~ 2147483647	I32	rw	RxPDO

Other objects with shared action relationships

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
605Ah	00h	Quick Stop Mode Selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Pause shutdown method	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and effect code	-	0~2	I16	rw	NO
607Bh	-	Location range restrictions	-	-	-	-	-
	00h	Indicates the 607Bh sub-index number	-	2	U8	ro	NO
	01h	Minimum position range limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum location range limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	origin offset	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	command polarity	-	0~255	U8	rw	NO
6085h	00h	quick deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Location trajectory planning type	-	-32768~32767	I16	rw	RxPDO

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
608Fh	-	Position encoder resolution setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-index number	-	2	U8	ro	NO
	01h	Encoder movement distance	pulse	1~4294967295	U32	ro	NO
	02h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO
6091h	-	gear ratio setting	-	-	-	-	-
	00h	Indicates the 6091h sub-index number	-	2	U8	ro	NO
	01h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
6092h	-	Feed constant settings	-	-	-	-	-
	00h	Indicates the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the Feed value	instruction unit	1~4294967295	U32	rw	NO
	02h	Axis rotation number	r（axle）	1~4294967295	U32	rw	NO
60B8h	00h	Probe mode	-	0~65535	U16	rw	RxPDO

Control word (6040h) <csvFunction in control mode>

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6040h</td><td rowspan="2">00h</td><td>control word</td><td>0~65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="6">Set the control command for the PDS state transition and other servo drivers.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="6">r</td><td>oms</td><td>h</td></tr>
<tr><td>7</td><td>6</td><td colspan="2">5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="2">fr</td><td colspan="4">oms</td><td rowspan="2">eo</td><td rowspan="2">qs</td><td rowspan="2">ev</td><td rowspan="2">so</td></tr>
<tr><td>r</td><td colspan="2">r</td><td>r</td></tr>
</table>
r = reserved (not mapped) fr = fault reset r = reserved (not mapped) fr = fault reset
oms = operation mode specific eo = enable operation
(The control mode depends on the bit) qs = quick stop (The control mode depends on the bit) qs = quick stop
h = halt ev = enable voltage
h = halt ev = enable voltage
so = switch on</td></tr>
</table>

CSV mode, does not use OMS bit.

2) CSV control mode associated objects (monitoring type)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6041h	00h	status word	-	0~65535	U16	ro	TxPDO

There are other common objects associated with speed control.

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
6063h	00h	actual internal position feedback	pulse	-2147483648~2147483647	I32	ro	TxPDO
6064h	00h	position feedback	instruction unit	-2147483648~2147483647	I32	ro	TxPDO
606Bh	00h	velocity instruction	Command unit/s	-2147483648~2147483647	I32	ro	TxPDO
606Ch	00h	rate feedback	Command unit/s	-2147483648~2147483647	I32	ro	TxPDO
6074h	00h	torque command	0.1%	-32768~32767	I16	ro	TxPDO

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
6076h	00h	Motor rated torque	Mn·m	0~4294967295	U32	ro	TxPDO
6077h	00h	Torque feedback	0.1%	-32768~32767	I16	ro	TxPDO

There are other objects with common patterns.

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
603Fh	00h	Error code	-	0~65535	U16	ro	TxPDO
60B9h	00h	Indicates the status of the Touch probe function	-	0~65535	U16	ro	TxPDO
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO

Status word (6041h) <csvControl mode functions>

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>status word</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the status of the servo driver.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td rowspan="2">r</td><td rowspan="2">r</td><td rowspan="2">oms</td><td rowspan="2">follow drive command vaule</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>r</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not mapped) w = warning r = reserved (not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop oms =</td></tr>
</table>

		operation mode specific qs = quick stop Control mode dependent bit: ve = voltage enabled Control mode dependent bit: ve = voltage enabled ila = internal limit active f = fault ila = internal limit active f = fault oe = operation enabled rm = remote so = switched on rm = remote so = switched on rtso = ready to switch on

bit13,12,10（operation mode specific）：

Bit	name	price	definition
10	continue to have	-	unused
12	velocity	0	Action not performed at target speed
		1	Perform actions according to target speed
13	continue to have	-	unused

The so-called "action based on target speed" must meet the following conditions:

- The PDS status is Operation enabled
- Not in a hold state (Halt, Quickstop, Shutdown, Disable operation, Falut)
- Not in Halt stop state
- Torque limit not applied

3) Action of the CSV control mode

- In the cyclic speed control mode, the motion model (trajectory) is generated by the master instead of the slave.
- The target speed is 60FFh (target speed)
- The update (send) of the operation command is input approximately 100 ms after the operation enable command is activated.
- 60C2h (Interpolation time period) sets the update cycles for 60FFh (target speed) and 60B1h. This value matches the 1C32h-02h (Cycle time).
- As monitoring data, it provides 606Ch (velocity feedback) and other metrics.
- The 60FFh target speed is limited by the 6080h maximum motor speed.

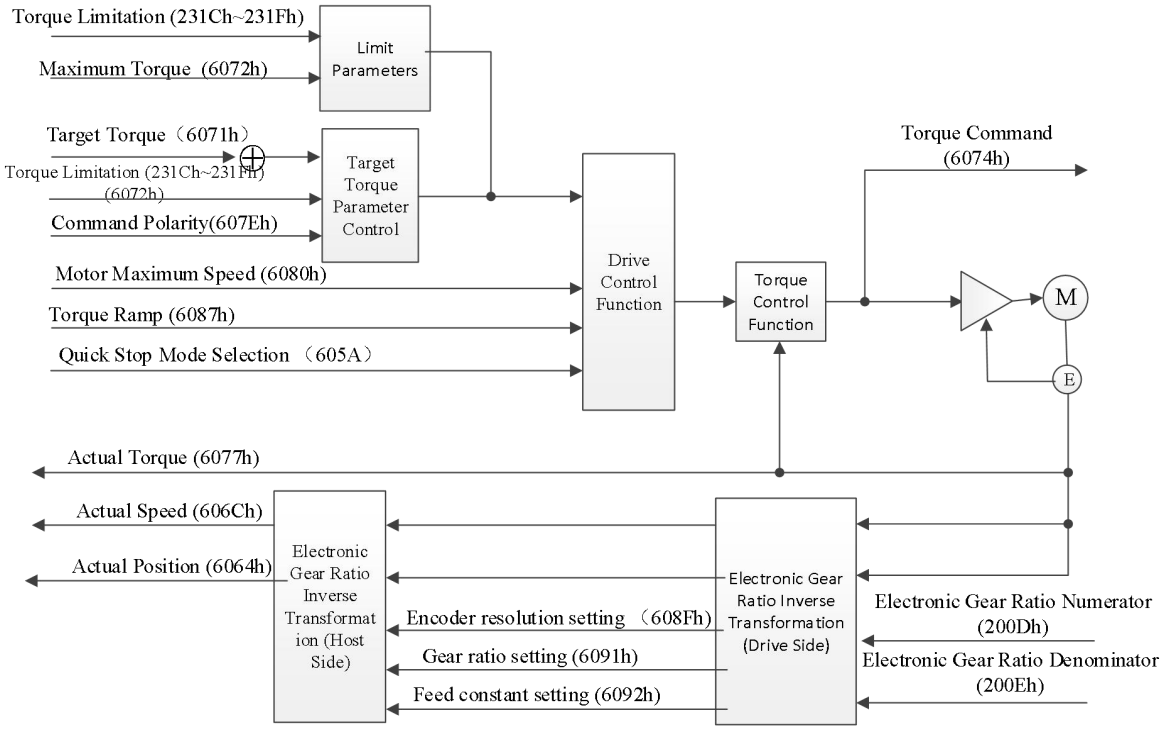
7.3.2 Common Parameters

register	explain	unit
RXPDO[0x60FF]	velocity given	Command unit/s
TXPDO[0x6064]	position feedback	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s

RXPDO[0x6080]	The maximum motor speed can be adjusted via the online COE-Online interface for speed limitation.	r/min
RXPDO[0x6060]	Set to 9	-

7.4CST pattern

The CST (Cycle Synchronous Torque Mode) enables the motor to operate at a constant torque by setting the torque through the host computer.



7.4.1 Relevant parameters

1) Objects associated with the CST control mode (commands and settings)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO

There are other related objects which are common to torque control.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6071h	00h	Torque given	0.1%	-32768~32767	I16	rw	RxPDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
6080h	00h	Maximum motor speed	r/min	0~4294967295	U32	rw	RxPDO
6087h	00h	Torque ramp	0.1%/S	0~4294967295	U32	rw	RxPDO

60B2h	00h	torque offset	0.1%	-32768~32767	I16	rw	RxPDO

There are also other related objects with common actions.

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
605Ah	00h	Quick Stop Mode Selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Suspended shutdown mode	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and effect code	-	0~2	I16	rw	NO
607Bh	-	Location range restriction	-	-	-	-	-
	00h	Indicates the 607Bh sub-index number	-	2	U8	ro	NO
	01h	Minimum position range limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum location range limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	origin offset	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	command polarity	-	0~255	U8	rw	NO
6085h	00h	quick deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Location trajectory planning type	-	-32768~32767	I16	rw	RxPDO

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
608Fh	-	Position encoder resolution setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-index number	-	2	U8	ro	NO
	01h	Encoder movement distance	pulse	1~4294967295	U32	ro	NO
	02h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO
6091h	-	gear ratio setting	-	-	-	-	-
	00h	Indicates the 6091h sub-index number	-	2	U8	ro	NO
	01h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
6092h	-	Feed constant settings	-	-	-	-	-
	00h	Indicates the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the Feed value	instruction unit	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
60B8h	00h	probe mode	-	0~65535	U16	rw	RxPDO

Control word (6040h) <cstFunction in control mode>

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6040h</td><td rowspan="2">00h</td><td>control word</td><td>0~65535</td><td>U16</td><td>Rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="6">Set the control command for the PDS state transition and other servo drivers.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="6">R</td><td>om</td><td>h</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td colspan="2">4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="2">fr</td><td colspan="4">oms</td><td rowspan="2">eo</td><td rowspan="2">qs</td><td rowspan="2">ev</td><td rowspan="2">so</td></tr>
<tr><td>r</td><td>R</td><td colspan="2">r</td></tr>
</table>
r = reserved (not mapped) fr = fault reset r = reserved (not mapped) fr = fault reset
oms = operation mode specific eo = enable operation
(The control mode depends on the bit) qs = quick stop
(The control mode depends on the bit) qs = quick stop
h = halt ev = enable voltage
h = halt ev = enable voltage
so = switch on</td></tr>
</table>

The CST mode does not utilize the OMS bit.

2) CST torque control associated objects (monitoring type)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6041h	00h	status word	-	0~65535	U16	ro	TxPDO
6073h	00h	maximum current	0.1%	0~65535	U16	ro	NO

Other torque control objects (monitoring type)

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
6063h	00h	actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
606Ch	00h	rate feedback	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
6074h	00h	torque command	0.1%	-32768~32767	I16	ro	TxPDO
6075h	00h	Rated current of the motor	1mA	0~4294967295	U32	ro	TxPDO
6076h	00h	motor rated torque	mNm	0~4294967295	U32	ro	TxPDO

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
6077h	00h	torque feedback	0.1%	-32768~32767	I16	ro	TxPDO
6078h	00h	Current actual value	0.1%	-32768~32767	I16	ro	TxPDO

There are other objects with common patterns.

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
603Fh	00h	Error code	-	0~65535	U16	ro	TxPDO
60B9h	00h	Indicates the status of the Touch probe function	-	0~65535	U16	ro	TxPDO
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO

Status word (6041h) <tq Control mode functions>

<table>
<tr><th>index of matrix</th><th>subindex</th><th colspan="2">name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td colspan="2">status word</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="7">Indicates the status of the servo driver.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td rowspan="2">r</td><td colspan="2" rowspan="2">oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>r</td><td>Drive following command vaule</td><td>r</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not mapped) w = warning r = reserved (not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
oms = operation mode specific qs = quick stop
Control mode dependent bit: ve = voltage enabled
Control mode dependent bit: ve = voltage enabled</td></tr>
</table>

		ila = internal limit active	f = fault
		ila = internal limit active	f = fault
		oe = operation enabled	rm = remote
		so = switched on	rtso = ready to switch on
		oe = operation enabled	rm = remote
		so = switched on	rtso = ready to switch on
		oe = operation enabled	rm = remote
		so = switched on	rtso = ready to switch on
		oe = operation enabled	rm = remote
		so = switched on	rtso = ready to switch on

bit13,12,10（operation mode specific）：

Bit	name	Value	Definition
10	continue to have	-	unused
12	torque	0	Do not perform actions based on target torque
		1	Act on target torque
13	continue to have	-	unused

The so-called "action based on target speed" must meet the following conditions:

- The PDS status is Operation enabled
- Not in a hold state (Halt, Quickstop, Shutdown, Disable operation, Falut)
- Not in Halt stop state

3) The action of the CST control mode

- The cyclic torque control mode generates the Profile (track) not on the slave unit but on the master unit.
- The target torque is 6071h
- The torque feedforward is 60B2h. Feedforward is not supported.
- To update the action command (send signal), wait approximately 100ms after the servo is activated before inputting.
- 60C2h (Interpolation time period) sets the update cycles for the 6071h (torque given) and 60B2h objects. This value matches the 1C32h-02h (Cycle time).
- As monitoring data, it provides 6077h (torque feedback) and other parameters.
- The 6071h (torque given) value is subject to the maximum torque limit of 6072h,231Ch (P3-28),231Dh (P3-29), and minimum value restrictions.
- The speed limit is 6080h (maximum motor speed).

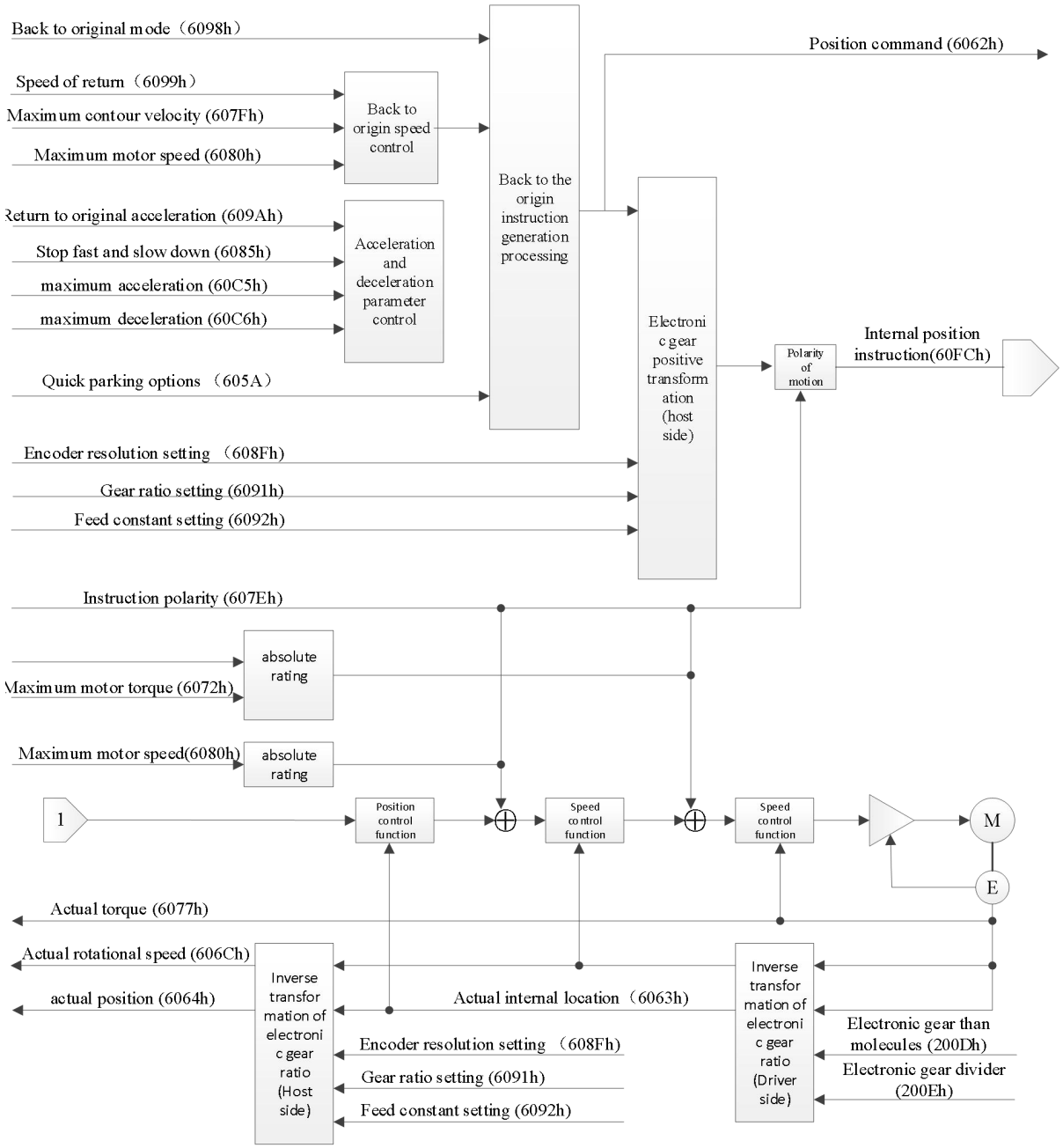
7.4.2 Common Parameters

register	explain	unit
RXPDO[0x6071]	torque given	0.1%
TXPDO[0x6064]	position feedback	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s

TXPDO[0x6077]	torque feedback	0.1%
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6060]	Set to 10	-

7.5HM pattern

The HM mode (origin reset mode) is used to initialize the slave's position. This position control mode generates position commands within the servo driver to perform origin reset actions, specifying the action speed. When used in incremental mode, the origin reset action must be executed before position positioning begins after the control power is activated.



7.5.1 Relevant parameters

1) hm control mode associated objects (commands,settings)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO
6098h	00h	return to origin	-	-128~127	I8	rw	RxPDO
6099h	-	Restore to original speed	-	-	-	-	-
	00h	Number of entries	-	2	U8	ro	NO
	01h	Speed of returning to the original state	Command unit/s	0~4294967295	U32	rw	NO
	02h	reversion velocity	Command unit/s	0~4294967295	U32	rw	NO
609Ah	00h	return to zero acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO

There are other objects with common location control.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
607Fh	00h	maximum outline velocity	Command unit/s	0~4294967295	U32	rw	RxPDO
60B1h	00h	velocity offset	Command unit/s	-2147483648~ 2147483647	I32	rw	RxPDO
60B2h	00h	torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60C5h	00h	maximal acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
60C6h	00h	maximum deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO

There are also other related objects with common actions.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
605Ah	00h	Quick Stop Mode	-	0~7	I16	rw	NO

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
		Selection					
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Suspended shutdown mode	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and effect code	-	0~2	I16	rw	NO
607Dh	-	software absolute position limit	-	-	-	-	-
	00h	Indicates the 607Dh sub-index number	-	2	U8	ro	NO
	01h	Minimum position limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum location limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	origin offset	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	command polarity	-	0~255	U8	rw	NO
6085h	00h	quick deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Location trajectory planning type	-	-32768~32767	I16	rw	RxPDO
608Fh	-	Position encoder resolution setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-index number	-	2	U8	ro	NO

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
	01h	Encoder movement distance	Pulse	1~4294967295	U32	ro	NO
	02h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO
6091h	-	gear ratio setting	-	-	-	-	-
	00h	Indicates the 6091h sub-index number	-	2	U8	ro	NO
	01h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
6092h	-	Feed constant settings	-	-	-	-	-
	00h	Indicates the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the Feed value	instruction unit	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
60B8h	00h	probe mode	-	0~65535	U16	rw	RxPDO

Control word (6040h) <HMFunction in control mode>

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6040h	00h	control word	0~65535	U16	Rw	RxPDO	All
		Set the control command for the PDS state transition and other servo drivers. bit information					

15	14	13	12	11	10	9	8
r						oms	h

		7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 Fr | oms | eo | qs | ev | so R | R | start homing r = reserved (not mapped) fr = fault reset r = reserved (not mapped) fr = fault reset oms = operation mode specific eo = enable operation oms = operation mode specific eo = enable operation (The control mode depends on the bit) qs = quick stop (The control mode depends on the bit) qs = quick stop h = halt ev = enable voltage h = halt ev = enable voltage so = switch on

bit9,6-4（operation mode specific）：

Bit	name	price	definition
4	Go back to original	0 -> 1	Start the origin reset action
5	（ continue to have ）	-	unused
6	（ continue to have ）	-	unused
9	（ continue to have ）	-	unused

After enabling bit4 (initiating reset) for 6040 hours, the system retrieves parameters (reset method, speed, acceleration/deceleration, etc.) associated with the origin reset position control mode (HM), then initiates the operation.

Furthermore, even if a new reset operation is initiated (restarting bit4 at 6040h) during the reset process, the new reset operation will be ignored.

Restore to original (6098h)

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6098h	00h	return to origin	-128~127	I8	rw	RxPDO	All
		origin setting method					

price	definition
-2	back collision
-1	positive collision return
0	No original method specified
1	-Ve LS & Index Pulse
2	+Ve LS & Index Pulse
3	+Ve HS & Index Pulse direction reversal
4	+Ve HS & Index Pulse no direction changed
5	-Ve HS & Index Pulse direction reversal
6	-Ve HS & Index Pulse no direction changed
7	On +Ve HS -Index Ple
8	On +Ve HS +Index Pulse
9	After +Ve HS reverse +Index Pulse
10	After +Ve HS +Index Pulse
11	On -Ve HS -Index Pulse
12	On -Ve HS +Index Pulse
13	After -Ve HS reverse +Index Pulse
14	After -Ve HS +Index Pulse
15	Reserved
16	Reserved
17	Same as 1 without Index pulse
18	Same as 2 without Index pulse
19	Same as 3 without Index pulse
20	Same as 4 without Index pulse
21	Same as 5 without Index pulse
22	Same as 6 without Index pulse
23	Same as 7 without Index pulse
24	Same as 8 without Index pulse
25	Same as 9 without Index pulse
26	Same as 10 without Index pulse
27	Same as 11 without Index pulse
28	Same as 12 without Index pulse
29	Same as 13 without Index pulse
30	Same as 14 without Index pulse
33	On Index Pulse +Ve direction
34	On Index Pulse −Ve direction
35	Current postion = home
37	Current postion = home

Return to original speed (6099h)

index of matrix	son index of matrix	name	scope	data type	accessibility	PDO	Op-mode
6099h	-	return to original speed	-	-	-	-	-
		The speed when the origin reset position control mode (HM) is set.					
	00h	Number of entries	2	U8	ro	NO	HM
		number of subindexes for 6099h (return speed)					
	01h	Speed during search	0~4294967295	U32	rw	NO	HM
		Set the speed of the action triggered by the Switch signal detection. The maximum value is limited by the lower of the two: the internally processed 6080h (maximum motor speed) or 2147483647.					
	02h	Speed during search for zero	0~4294967295	U32	rw	NO	HM
		Set the action speed for origin detection. To minimize detection errors, set the edge of the Switch signal as the origin detection position to the smallest possible value. The maximum value is limited by the lower of the internally processed 6080h (maximum motor speed) and 2147483647.					

Recovery acceleration (609Ah)

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
609Ah	00h	return to zero acceleration	0~4294967295	U32	rw	RxPDO	All
		Set the acceleration and deceleration at the reset of the origin (hm). The deceleration of origin reset (HM) also applies to this object. When the original return method stops (origin position detected), the servo lockout stops without requiring this object's settings. If set to 0, internal processing is treated as 1.					

2) hm control mode associated objects (monitoring type)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6041h	00h	status word	-	0~65535	U16	ro	TxPDO
60E3h	-	Select the return method	-	-	-	-	TxPDO
	00h	Indicates the 60E3h sub-index number	-	1~254	U8	ro	TxPDO
	01h	Restore to Method 1	-	0~32767	U16	ro	TxPDO
	..	..	..	..	..	..	..
	20h	Return to Method 32	-	0~32767	U16	ro	TxPDO

There are also other objects with common location control.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6062h	00h	position instruction	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
6063h	00h	actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
6065h	00h	Excessive position deviation threshold	instruction unit	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout time	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Location reaches the threshold	instruction unit	0~4294967295	U32	rw	RxPDO
6068h	00h	Location to window time	1ms	0~65535	U16	rw	RxPDO
606Ch	00h	rate feedback	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
6074h	00h	torque command	0.1%	-32768~32767	I16	ro	TxPDO
6076h	00h	motor rated torque	Mn·m	0~4294967295	U32	ro	TxPDO
6077h	00h	torque feedback	0.1%	-32768~32767	I16	ro	TxPDO
60F4h	00h	position deviation	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60FAh	00h	internal instruction speed Position loop output	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
60FCh	00h	internal location instruction	pulse	-2147483648~ 2147483647	I32	ro	TxPDO

The position feedback of HM after returning to its original position (6064h) is reset to zero.

There are also other objects with common action.

index of matrix	son index of	name	unit	scope	data type	Accessible inquisitive	PDO

	matrix						
603Fh	00h	Error code	-	0~65535	U16	ro	TxPDO
60B9h	00h	Indicates the status of the Touch probe function	-	0~65535	U16	ro	TxPDO
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO

Status Word (6041h) <Functions in control mode>

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>status word</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the status of the servo driver.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="2" rowspan="2">R</td><td colspan="2">oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>Homing error</td><td>Homing attained</td><td>Target reached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>W</td><td>sod</td><td>Qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not mapped) w = warning r = reserved (not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
oms = operation mode specific qs = quick stop
Control mode dependent bit: ve = voltage enabled
Control mode dependent bit: ve = voltage enabled
ila = internal limit active f = fault
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rm = remote so = switched on</td></tr>
</table>

		rtso = ready to switch on

bit13,12,10（operation mode specific）：

Bit	name	price	definition
10	target reached current state	0	In action
		1	state of rest
12	homing attained Reduction complete	0	Origin reset action not completed
		1	Origin reset action completed normally
13	Return to original error	0	No origin reset exception occurred.
		1	Origin reset error (origin reset operation failed)

bit13,12,10（operation mode specific）：

Bit13	Bit12	Bit10	definition
0	0	0	During the origin reset action
0	0	1	The origin reset action was interrupted or not started
0	1	0	The origin reset action is complete, but the target position is not reached.
0	1	1	The origin reset action was completed normally.
1	0	0	The origin reset anomaly is still active
1	0	1	Origin reset error detected. Stopped.

bit12 (homing attained) is 0 when the state is below this level.

- When the power supply is turned on
- When the ESM state transitions from Init to PreOP
- The origin reset process has begun.

When the motor is not activated during the homing operation (Method 35, Method 37), the homing attained is also set to 0. However, this setting must be maintained for a brief duration (approximately 2 ms).

Restore to original (60E3)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
60E3h	-	Supported Homing method	-	-	-	-	TxPDO
	Supports the original method						
	00h	Number of entries	-	1~254	U8	ro	TxPDO
	Indicates the number of supported homing methods (60E3h).						
	01h	1st supported Homing method	-	0~32767	U16	ro	TxPDO
	Indicates support for the first original method.						
	..	..	..	..	..	..	..

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
	20h	32nd supported Homing method	-	0~32767	U16	ro	TxPDO
	Supports the 32nd way to return to the original state						

index of matrix	subindex	bit 15~8	bit 7~0
		Reserved	Supported homing method
60E3	01h	0	1
	02h	0	2
	03h	0	3
	04h	0	4
	05h	0	5
	06h	0	6
	07h	0	7
	08h	0	8
	09h	0	9
	0Ah	0	10
	0Bh	0	11
	0Ch	0	12
	0Dh	0	13
	0Eh	0	14
	0Fh	0	17
	10h	0	18
	11h	0	19
	12h	0	20
	13h	0	21
	14h	0	22
	15h	0	23
	16h	0	24
	17h	0	25
	18h	0	26
	19h	0	27
	1Ah	0	28
	1Bh	0	29
	1Ch	0	30
	1Dh	0	33
	1Eh	0	34
	1Fh	0	35
	20h	0	37

For the relationship between the value and the restoration method, refer to 6098h (restoration method).

3) The operation of the hm control mode (Homing operation)

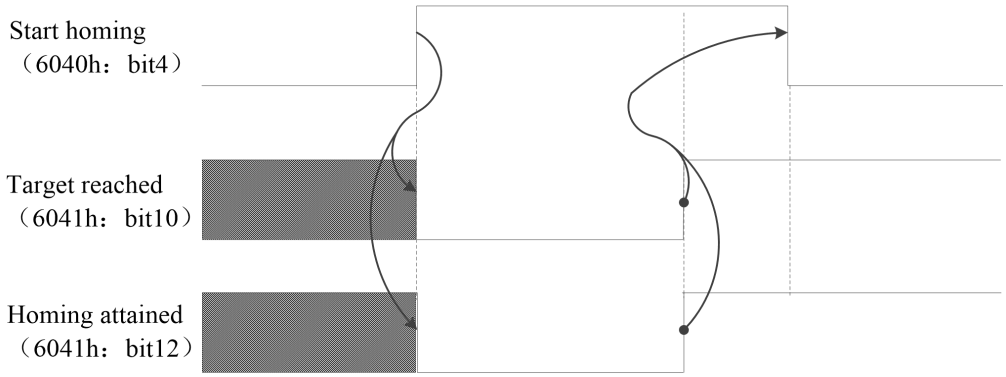
When operating in incremental mode, perform the homing action to initialize the position data prior to

initiating standard operations.

- Once the origin position is detected, it serves as the baseline for initializing the following objects (preset).
  6062h (position command) = 6064h (position feedback) = 607Ch (offset reset)
  6063h (actual internal position feedback) = 60FCh (internal position demand value) = 0
- If the origin reset is executed, the position information is initialized (preset). Therefore, the data obtained based on the previous position information (such as Touch probe position) must be retrieved again.
- The Homing action, whether or not the 607Ch (Home offset) is modified, does not affect the current Homing action. The next Homing action will incorporate this change (with position information initialized upon completion).
- 607Ch is only valid in the mode of returning to the origin 35 and 37.
- When using the edges of Switch signals (T, NOT, HOME) as origin detection points, assign each limit compensation Pin to SI1, SI2, and SI3 respectively. Incorrect assignment will trigger an origin reset error. (Note: For DS5C2 series servos, P5-22 is the positive limit setting address (default 1, corresponding to Servo Terminal SI1); P5-23 is the negative limit NOT setting address (default 2, corresponding to Servo Terminal SI2); P5-27 is the origin setting address (default 3, corresponding to Servo Terminal SI3).)
- In the subsequent Method diagrams, the following terms denote the following meanings.

Index pulse	The Z-bit signal of the encoder
Home switch	The theoretical signal state of the near-origin input (ME)
Positive limit	The theoretical signal state of the positive drive prohibition input (POT)
Negative limit	The theoretical signal state of the NOT input for negative drive

- After updating the action command (send signal) and enabling the servo command (Operation enabled), wait approximately 100 milliseconds before inputting.
- The following shows the timing of the hm control mode.



- Homing error conditions

The following conditions trigger a homing error (Homing error = 1).

Homing error conditions	detailed information
Startup outside of enabled operation	Homing cannot be initiated when PDS is in Operation enabled state (except for method35 and 37).
start at zero target speed	When the set values of 6099h-01h and 6099h-02h are 0, the Homing function is activated. (excluding method33,34's 6099h-02h and method35,37's 6099h-01h and 6099h-02h at 00:00)
Two limit switches detected	During homing startup or operation, the system detects two limit switches (Positive/Negative).

Use the limit switch	In the Method of reversing through the Limit switch, the detection of the Limit switch's falling edge occurs during the deceleration phase of the reversal action after detecting its rising edge.
Unassigned Home switch, Limit switch	unallocated IO port

7.5.2 Common Parameters

register	explain
RXPDO[0x6040]	Control word, modify control word to return to origin
RXPDO[0x6098]	return to origin method
RXPDO[0x609A]	acceleration to origin
RXPDO[0x6060]	Set to 6 when the motor is not enabled
SDO[0x6099]	Restore speed to origin and modify it online through COE-Online

Control word (6040h)

Set the sequence to (0x06>0x0F>0x1F), enable the drive, start the motor, and return to the origin.

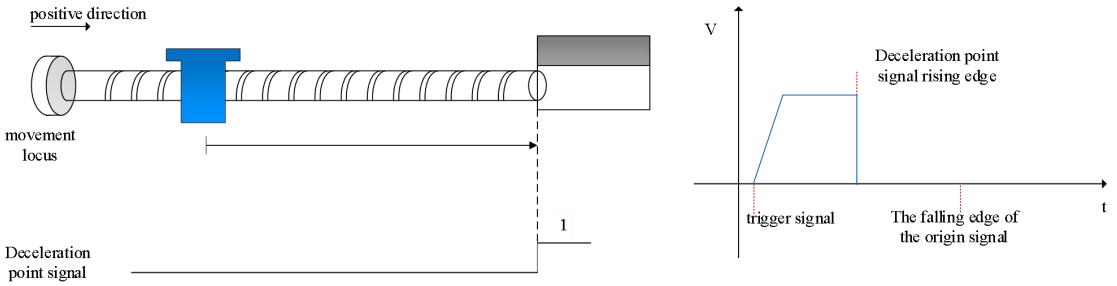
7.5.3 Back to Origin Method

The current Xinye DM6C series servo supports the following return-to-origin modes: 1-14,17~30,33,34,35,37, -1, and-2. For slave units from other brands, the return-to-origin method should be determined according to the specifications in the respective brand's slave manual.

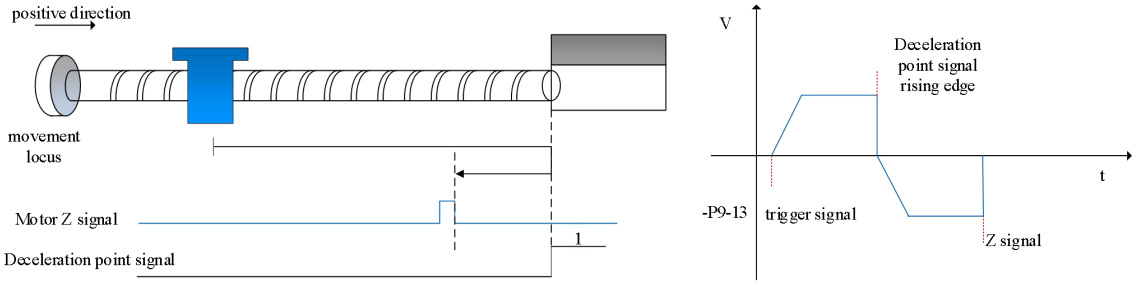
■ Method-1:

The servo motor initially operates in low-speed forward mode at the preset value 6099h:02 (low-speed return to origin). Upon reaching the mechanical limit position, if the absolute torque value reaches the upper limit of P9-17 (touch-stop return-to-origin torque threshold) while the absolute speed value remains below the preset value of P9-16 (touch-stop return-to-origin speed threshold), and this condition persists for the duration specified in P9-18 (touch-stop return-to-origin time threshold), the system will confirm the mechanical limit position has been reached. Subsequently, two scenarios are distinguished:

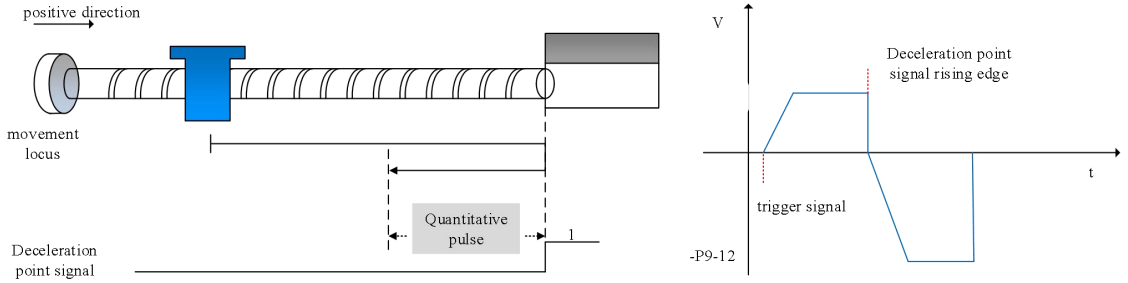
① When P7-20 equals 0 and the count of quantitative pulses is zero, the machine should be stopped immediately, and this position should be set as the zero point (position reset).



② When P7-20 exceeds 0, the system initiates a low-speed reverse run to reset to the origin with zero quantized pulses. Upon detecting P7-20 consecutive rising edges of Z signals, it immediately halts to calibrate the zero point (position reset).



③ P7-20 = 0, and the number of quantized pulses is not zero. First, run forward at low speed (6099h:02). After encountering the mechanical point, reverse and return to the origin at high speed (6099h:01) for the length of the quantized pulse, then stop the machine. Mark this position as the zero point (clear the Ecat position).



④ When P7-20> 0 (indicating non-zero quantized pulses), the system first runs forward at low speed (6099h:02). Upon reaching the mechanical point, it reverses to the origin at preset low speed (6099h:02). After detecting P7-20 Z-signal rising edges, it stops. The system then proceeds to the origin at high speed (6099h:01) for the full quantized pulse duration before stopping, followed by zero calibration (Ecat position reset).

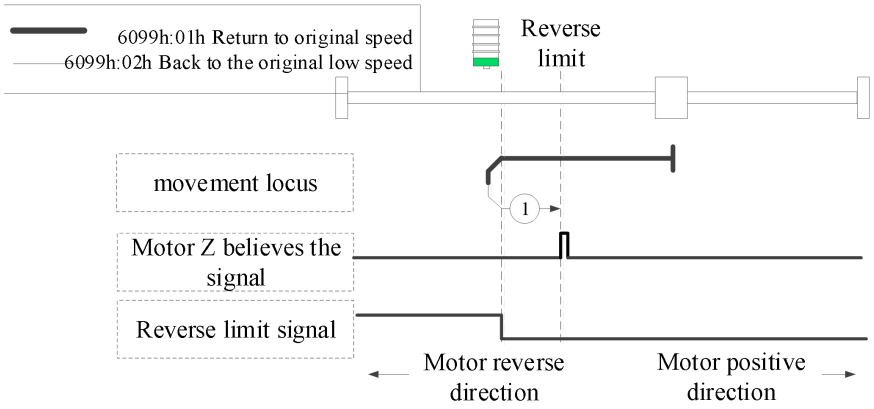
■ Method-2:

Similar to the previous return to original mode action, but in the opposite direction.

■ Method 1 (6098h=1):

When using this return-to-origin method 1, if the reverse limit switch is in the non-trigger state, the initial movement direction is left. The origin position is the first Z-phase pulse to the right of the position where the negative limit switch becomes invalid.

Mechanical origin: Motor Z positive signal
reduction point: reverse overtravel switch



Using a negative limit switch to reset the motor's Z-axis signal

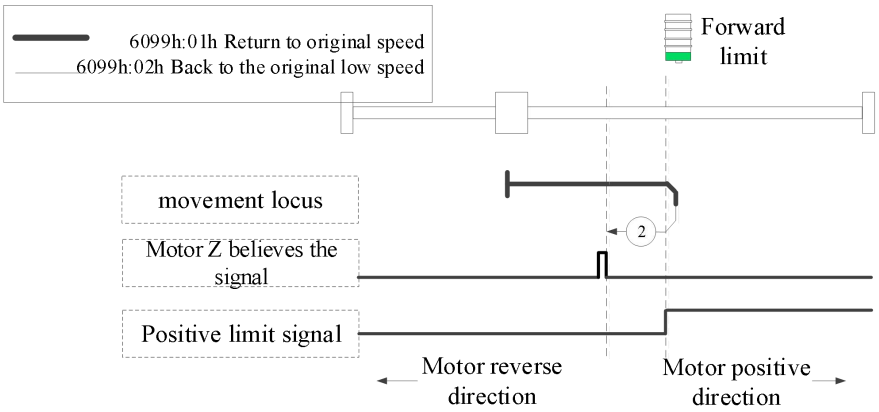
- 6098h=1 Action description:

  The reverse limit is invalid: When starting the return, the system initiates reverse zeroing at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), it decelerates and reverses direction, then proceeds at low-speed forward return (6099h:02h). After detecting the falling edge of the reverse limit, it stops at the first motor Z signal.

  - Method 2 (6098h=2):

    When using Method 2, if the forward limit switch remains inactive, the initial movement direction is to the right. The origin is located at the first Z-phase pulse to the left of the position where the forward limit switch becomes invalid.

    Mechanical origin: Motor Z positive signal
    Reduction point: forward overtravel switch



Using a positive limit switch and the Z-axis signal of the motor to return to the original position

- 6098h=2 Action Description:

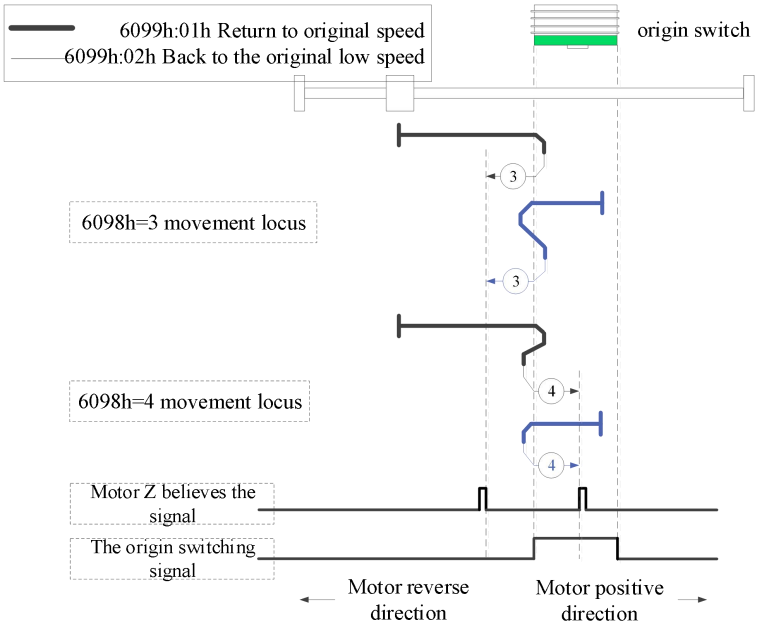
  The forward limit is invalid: When starting the return to zero, the system initiates the forward return at high speed (6099h:01h). Upon encountering the rising edge of the forward limit (POT), it decelerates and reverses direction, then proceeds at the low-speed return speed (6099h:02h). After detecting the falling edge of the forward limit, it stops at the first motor Z signal.

  - Methods 3 and 4 (6098h=3, 6098h=4):

    The initial direction of the movement is determined by the state of the origin switch. The origin

position is either on the reverse side of the origin switch or at the initial detected Z-phase position in the forward direction.

Mechanical origin: Motor Z positive signal
Reduction point: origin switch



Use the origin switch and motor Z signal to return to the origin.

- 6098h=3 Action Description:

① When the origin switch is invalid, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's rising edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's falling edge.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

- 6098h=4 Action Description:

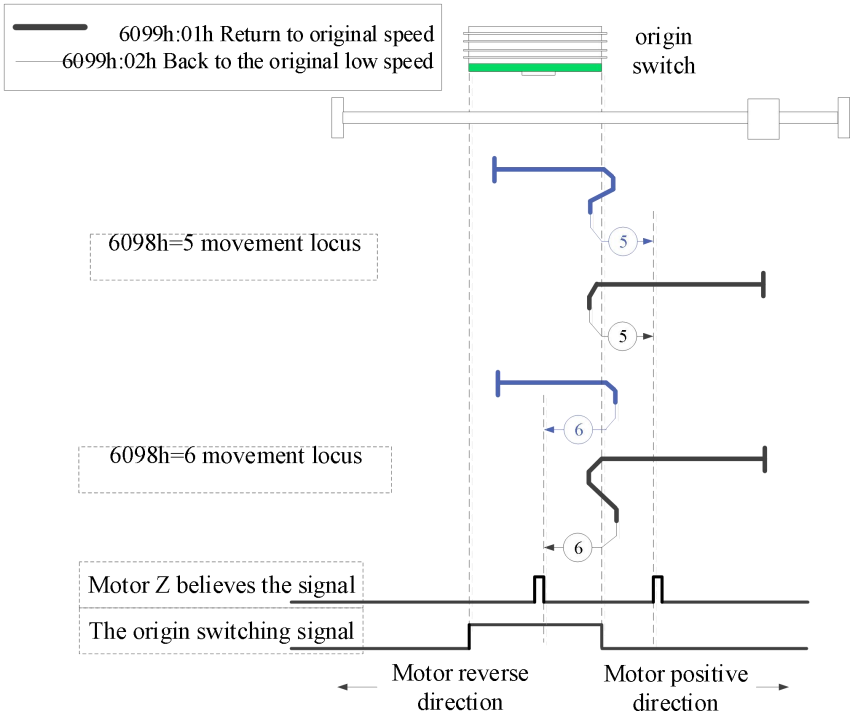
① When the origin switch is inactive, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's rising edge, it reverses direction and waits for the falling edge before decelerating and reversing again. The system then proceeds forward at the original return speed (6099h:02h). When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The first motor Z signal is detected upon the origin switch's rising edge, triggering an immediate shutdown.

■ Methods 5 and 6 (6098h=5, 6098h=6):

Using method 5 or 6, the initial direction of movement is determined by the state of the origin switch. The origin position is either on the reverse side of the origin switch or at the initial detected Z-phase position in the forward direction.

Mechanical origin: Motor Z positive signal
Reduction point: origin switch



Use the origin switch and motor Z signal to return to the origin.

- 6098h=5 Action Description:

① When the origin switch is invalid, the system initiates reverse return at high speed (6099h:01h).

Upon detecting the origin switch's rising edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. After encountering the origin switch's falling edge, it stops at the first motor Z signal.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

- 6098h=6 Action Description:

① When the origin switch is inactive, the system initiates reverse zeroing at high speed (6099h:01h).

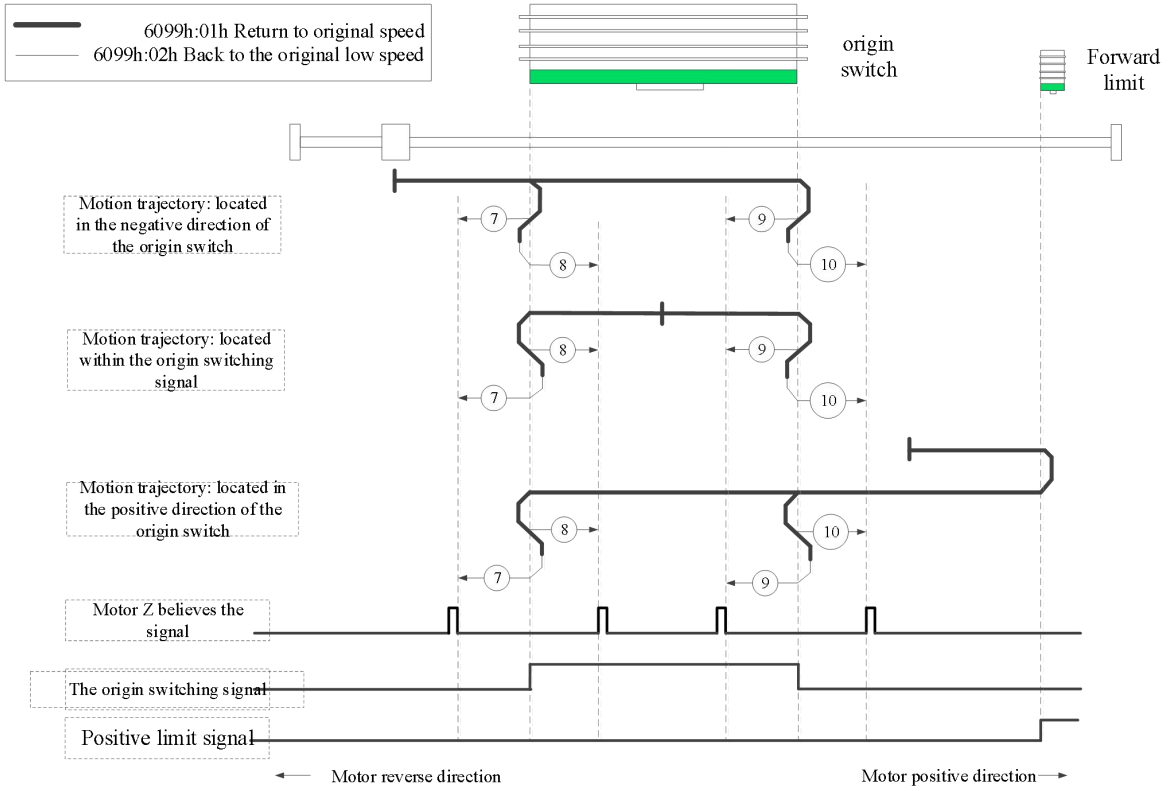
Upon detecting the origin switch's rising edge, it reverses direction and waits for the falling edge to decelerate before reversing again. The system then operates at 6099h:02h speed in reverse mode. When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

■ Method 7~14 (6098h=7~14):

7-14 all use the origin switch and Z signal;
The initial action direction of mode 7 and 8 is negative if the origin switch is activated at the start of the action.
The initialization action direction of mode 9 and 10 is positive if the origin switch is activated at the start of the action.
The initialization action direction of mode 11 and 12 is positive if the origin switch is activated at the start of the action.
The initialization action direction of mode 13 and 14 is negative if the origin switch is activated at the start of the action.
The final position of the returning to the origin is the Z-phase signal near the rising or falling edge of the origin switch.

Mechanical origin: Motor Z positive signal
Reduction point: origin switch



Use the origin switch, forward limit signal, and motor Z-axis signal to return to the origin.

● 6098h=7 Action description:

① When the motor is located at the negative direction of the origin switch, the motor starts to return

to the origin at high speed (6099h:01h) in the positive direction. After encountering the rising edge of the origin switch, the motor decelerates and reverses direction, running in the reverse direction at the speed of 6099h:02h. After encountering the falling edge of the origin switch, the motor stops at the first Z signal.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h).

Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates

a high-speed (6099h:01h) forward reset. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, then reverses to locate the next rising edge. The system decelerates and reverses again, executing a reverse return speed of 6099h:02h. Upon detecting the origin switch's falling edge, it stops at the first motor Z signal.

- 6098h=8 Action Description:

① When the motor is initially in reverse, it first reverses to the neutral position at high speed

(6099h:01h). Upon detecting the rising edge of the origin switch, it reverses direction and decelerates until it detects the falling edge, then reverses again. The motor then resumes forward operation at 6099h:02h speed. When the origin switch rises again, it stops at the first Z-axis signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h).

Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The first motor Z signal is detected upon the origin switch's rising edge, triggering an immediate shutdown.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates

a high-speed (6099h:01h) forward zero return. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, where it decelerates and reverses to maintain the original return speed (6099h:02h) in the forward direction. Upon detecting the origin switch's rising edge again, it stops at the first motor Z signal.

- 6098h=9 Action Description:

① When the origin switch is in the negative position: The system initiates a high-speed (6099h:01h)

positive return to zero. Upon detecting the origin switch's rising edge, it accelerates forward until encountering the falling edge, where deceleration and direction reversal occur. Subsequently, it reverses direction at 6099h:02h speed. After detecting the origin switch's rising edge again, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to

zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a

reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

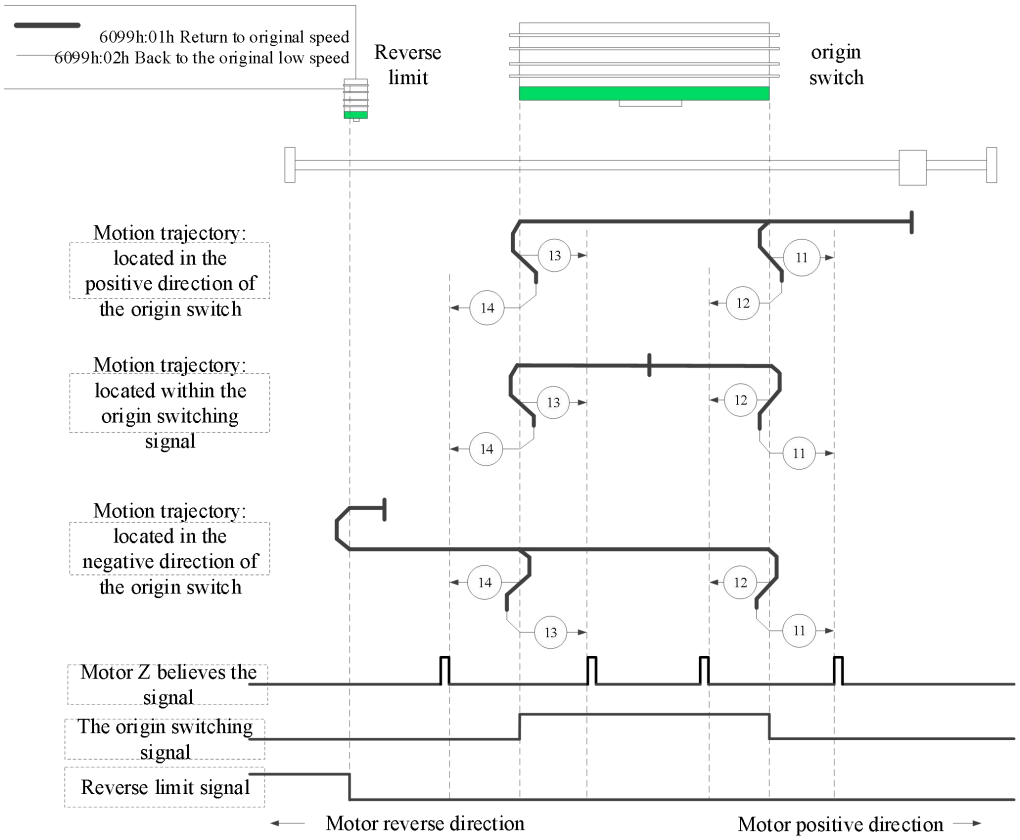
③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) positive return to zero. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it switches direction and searches for the origin switch's falling edge, decelerates, and reverses again. The system then operates in reverse at the original return speed (6099h:02h). Upon detecting the origin switch's rising edge, it stops at the first motor Z signal.

- 6098h=10 Action Description:

① When the origin switch is in the negative position: During initial return, the system initiates a rapid forward reset (6099h:01h). Upon detecting the origin switch's rising edge, it accelerates until encountering the falling edge, then reverses direction. The system then searches for the next rising edge, decelerates, and reverses again. It subsequently returns forward at 6099h:02h speed until the origin switch's falling edge is detected, at which point the first motor Z signal is triggered to halt.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the origin switch is in the forward position: During initial return, the system initiates a rapid forward reset (6099h:01h). Upon reaching the forward limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it decelerates and reverses, then proceeds forward at the reset speed (6099h:02h). When the origin switch's falling edge is detected, it stops at the first motor Z signal.



Use the origin switch, reverse limit signal, and motor Z-axis signal to return to the origin.

- 6098h=11 Action description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, then reverses to locate the next rising edge. The system decelerates and reverses again, then runs forward at the original return speed (6099h:02h). Upon detecting the origin switch's falling edge, it stops at the first motor Z signal.

② When the origin switch is active: The system initiates zero return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then proceeds forward at 6099h:02h speed. When the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the motor starts to return to the origin, it first reverses to zero at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it decelerates and reverses direction, then runs forward at the original return speed (6099h:02h). After detecting the falling edge of the origin switch, it stops at the first Z-axis signal.

- 6098h=12 Action Description:

① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically

reverses direction and maintains high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the origin switch's falling edge, where it decelerates and reverses direction, operating at the original return speed (6099h:02h). The system then stops at the first motor Z signal upon detecting the origin switch's rising edge.

② When the origin switch is active, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it decelerates and reverses direction, executing a reverse return at 6099h:02h. The system then stops at the first motor Z signal upon encountering the origin switch's rising edge.

③ When the motor starts returning to the origin, it first reverses to zero at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, it reverses direction and decelerates until finding the falling edge. It then reverses again, returning to the origin at 6099h:02h. After encountering the rising edge of the origin switch, it stops at the first Z-axis signal.

- 6098h=13 Action description:

① When the origin switch is in the negative position: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and accelerates. After detecting the origin switch's rising edge, it switches direction to locate the falling edge, decelerates, and reverses again. The system then proceeds forward at the original return speed (6099h:02h). When the origin switch's rising edge is detected, it stops at the first motor Z signal.

② When the origin switch is active, the system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The first motor Z signal is detected upon the origin switch's rising edge, triggering an immediate shutdown.

③ When the origin switch is in the forward position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it accelerates forward until encountering the falling edge, then decelerates and reverses direction. The system resumes forward operation at 6099h:02h speed. After detecting the origin switch's rising edge again, it stops at the first motor Z signal.

- 6098h=14 Action Description:

① When the origin switch is in the negative position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and accelerates. After detecting the origin switch's rising edge, it decelerates and reverses, maintaining the original return speed (6099h:02h) until the falling edge. The system then stops at the first motor Z signal.

② When the origin switch is active: The system initiates reverse zeroing at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and searches for the rising edge, then decelerates before reversing again. It then operates at 6099h:02h speed in reverse mode. When

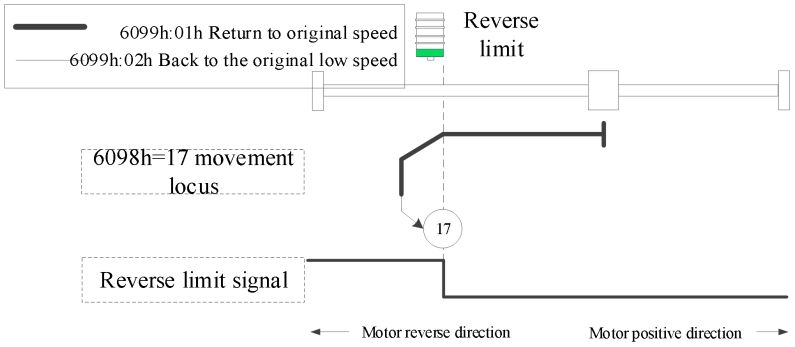
the origin switch's falling edge is detected, it stops at the first motor Z signal.

③ When the origin switch is in the forward position: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the origin switch's rising edge, it advances until encountering the falling edge, then reverses direction. The system then searches for the origin switch's rising edge, decelerates, and reverses again. It returns to the origin at 6099h:02h speed. After detecting the origin switch's falling edge, it stops at the first motor Z signal.

■ Method (6098h=17):

This method is similar to method 1.
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position change of the reverse limit switch (see figure below).
Homing error = 1 when the reverse limit (NOT) is not allocated.

Mechanical origin: reverse limit switch
reduction point: reverse limit switch



Use the reverse limit signal to return to the original position.

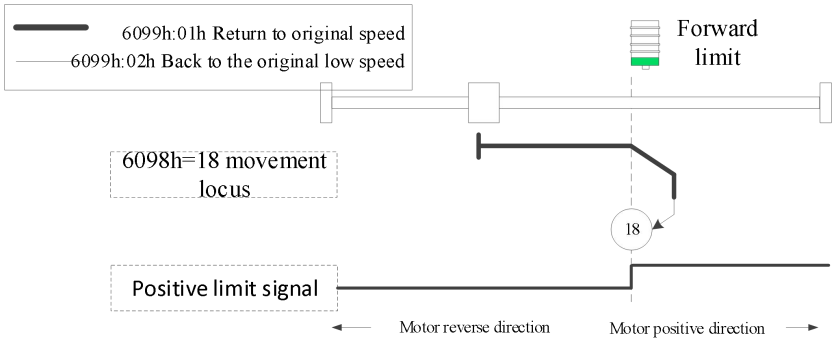
● 6098h=17 Action description:

The reverse limit is invalid: When starting the return, the system initiates reverse zeroing at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), it reverses direction and decelerates, then proceeds at the low-speed return speed (6099h:02h) in the forward direction. The system stops when the falling edge of the reverse limit is detected.

■ Method (6098h=18):

This method is similar to Method 2.
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position change of the forward limit switch. (Refer to the diagram below)
Homing error = 1 when the positive limit (POT) is not allocated.

Mechanical origin: forward limit switch
Deceleration point: forward limit switch



Use the forward limit signal to return to the original position.

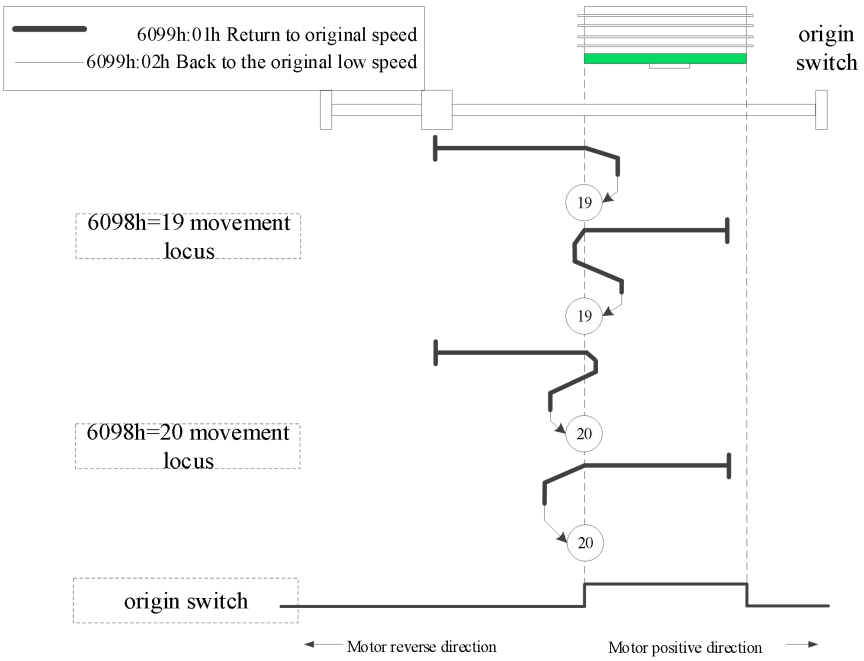
- 6098h=18 Action Description:

  When the forward limit is invalid, the system initiates a high-speed (6099h:01h) return to zero. Upon detecting the rising edge of the forward limit (POT), it reverses direction and decelerates, then proceeds at a reduced speed (6099h:02h) in reverse mode until the falling edge of the forward limit is detected, at which point it stops.

  ■ Methods 19 and 20 (6098h=19,6098h=20):

  This method is similar to the original method 3,4.
  The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch change. (Refer to the figure below)
  Homing error = 1 when HOME is not allocated.

  Mechanical Origin: Origin Switch
  Reduction point: origin switch



Use the origin switch signal to return to the origin.

- 6098h=19 Action description:

  ① The origin switch is invalid: When starting the return, the forward return begins at high speed

(6099h:01h). After encountering the rising edge of the origin switch, the direction is reversed and decelerated, then the return proceeds in reverse at 6099h:02h. The machine stops upon the falling edge of the origin switch signal.

② The origin switch is in the active state: When starting the return to the origin, the reverse return to zero begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then the direction is reversed again, decelerating, and running in reverse at the return speed of 6099h:02h. After encountering the falling edge of the origin switch, the machine stops.

- 6098h=20 Action Description:

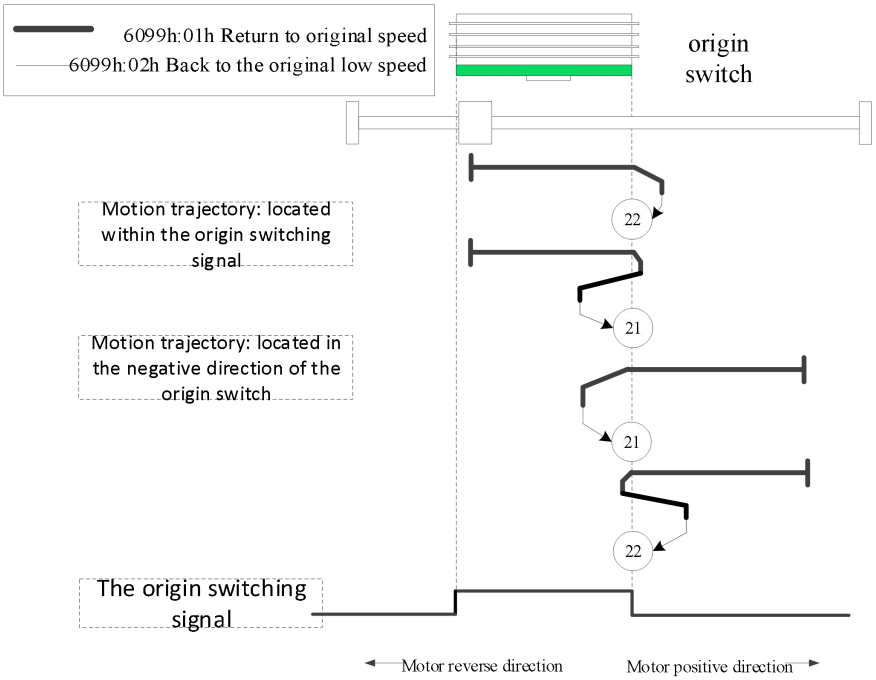
① The origin switch is invalid: When starting the return, the forward return begins at high speed (6099h:01h). After encountering the rising edge of the origin switch, the direction is reversed to find the falling edge of the origin switch, then the direction is reversed again, and the speed is reduced. The return proceeds forward at the speed of 6099h:02h until the origin switch's rising edge is encountered, at which point the machine stops.

② When the origin switch is active, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it reverses direction and decelerates, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

- Methods 21 and 22 (6098h=21,6098h=22):

This method is similar to the original method 5,6.
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch's transition.
(See the figure below)
Homing error = 1 when the origin signal is not assigned.

Mechanical Origin: Origin Switch
Reduction point: origin switch



Use the origin switch signal to return to the origin.

- 6098h=21 Action description:

  ① The origin switch is invalid: When starting the return, reverse the return speed at high speed (6099h:01h). After encountering the rising edge of the origin switch, reverse the direction and slow down. Then, run forward at the return speed of 6099h:02h. After encountering the falling edge of the origin switch, stop.

  ② When the origin switch is in the active state, the system initiates the return to the origin at high speed (6099h:01h) for a forward return to zero. Upon encountering the falling edge of the origin switch, it reverses direction and searches for the rising edge of the origin switch, then reverses again while decelerating. The system then proceeds forward at the return speed of 6099h:02h until it stops upon encountering the falling edge of the origin switch.

- 6098h=22 Action description:

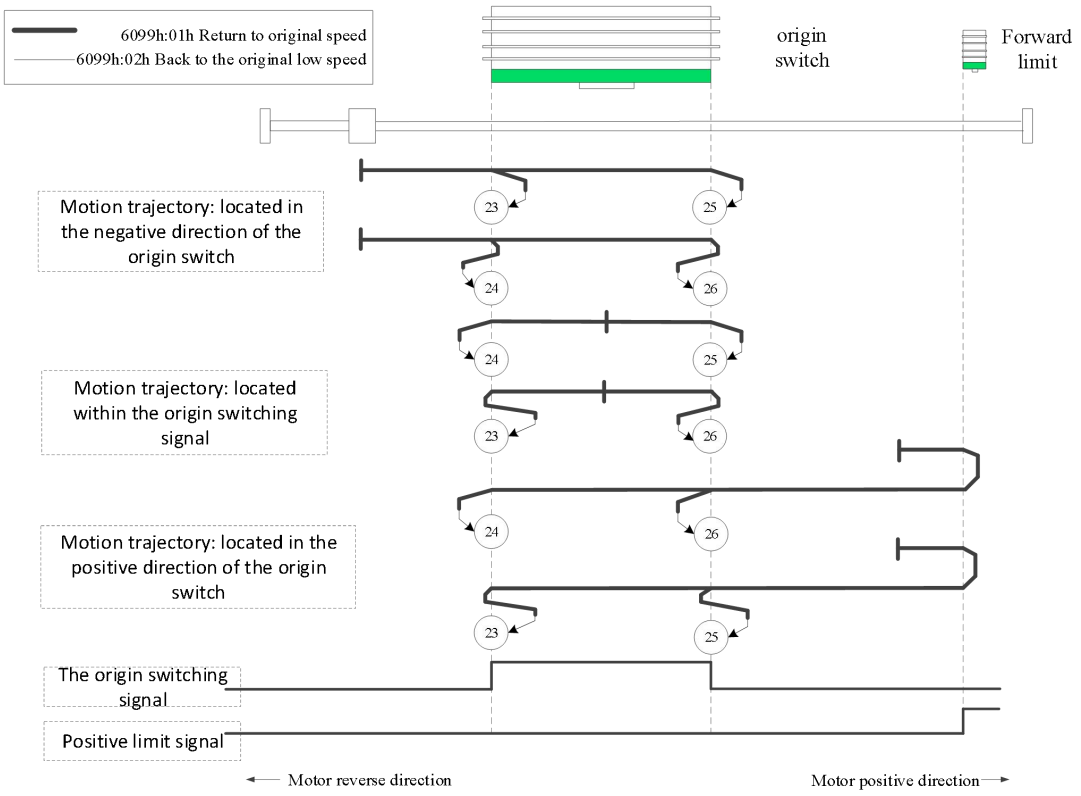
  ① The origin switch is invalid: When starting the return, reverse the return speed to 6099h:01h. After encountering the rising edge of the origin switch, reverse direction and find the falling edge of the origin switch, reverse direction again, slow down, reverse the return speed to 6099h:02h, stop after encountering the rising edge of the origin switch.

  ② When the origin switch is in the active state, the system initiates a high-speed (6099h:01h) forward return to zero. Upon detecting the origin switch's falling edge, it reverses direction and decelerates, then proceeds backward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

- Method 23-26 (6098h=23,24,25,26):

This method is similar to the back-to-origin methods 7, 8, 9, 10.
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch change. (Refer to the figure below)
Homing error = 1 if the origin signal and forward limit signal are not assigned.

Mechanical Origin: Origin Switch
Reduction point: origin switch



Use the origin switch signal and forward limit signal to return to the origin.

- 6098h=23 Action Description:

① The original point switch is located in the negative direction: when starting to return to the origin, it starts with high speed (6099h:01h) to return to zero in the positive direction. After encountering the rising edge of the original point switch, it decelerates and changes direction, running in reverse with the original point switch speed of 6099h:02h. After encountering the falling edge of the original point switch, it stops.

② The origin switch is in the active state: When starting the return to the origin, the system begins the reverse return at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, it switches direction and searches for the rising edge of the origin switch. The system then decelerates and switches direction again, running in reverse at the return speed of 6099h:02h. It stops the machine upon encountering the falling edge of the origin switch.

③ When positioned at the origin switch's positive direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the positive limit, it automatically reverses to

high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, then reverses to locate the next rising edge. The system decelerates, reverses again, and executes a reverse return at 6099h:02h speed. It stops upon reaching the origin switch's falling edge.

- 6098h=24 Action Description:

① The system is located at the negative direction of the origin switch. When starting to return to the origin, it starts to return to zero in the positive direction at high speed (6099h:01h). After encountering the rising edge of the origin switch, it changes direction, searches for the falling edge of the origin switch, decelerates, changes direction again, and runs in the positive direction at the return speed of 6099h:02h. After encountering the rising edge of the origin switch, it stops.

② When the origin switch is in the active state, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

③ When positioned at the origin switch's positive direction, the system initiates a high-speed (6099h:01h) return to zero. Upon reaching the positive limit, it automatically reverses to high-speed operation. After detecting the origin switch's rising edge, it continues forward until encountering the falling edge, where it decelerates and reverses direction. The system then maintains the original return speed (6099h:02h) in the forward direction until stopping at the origin switch's rising edge.

- 6098h=25 Action Description:

① The original point switch is located in the negative direction: when starting to return to the origin, it begins the positive return at high speed (6099h:01h). After encountering the rising edge of the original point switch, it continues forward until it meets the falling edge, then decelerates and reverses direction, running backward at the original point switch's return speed (6099h:02h). Upon encountering the rising edge of the original point switch again, the machine stops.

② When the origin switch is in the active state, the system initiates the return process at high speed (6099h:01h) for a forward return to zero. Upon detecting the falling edge of the origin switch, it decelerates and reverses direction, then proceeds at the reduced speed (6099h:02h) for a reverse return. The system halts upon detecting the rising edge of the origin switch.

③ When the original point switch is in the forward direction: During initial return, the system initiates a high-speed (6099h:01h) forward reset. Upon reaching the forward limit, it automatically reverses to high-speed operation. After detecting the rising edge of the original point switch, it switches direction to locate the falling edge, decelerates, and reverses again. The system then returns to the original point at a reduced speed (6099h:02h) and stops upon encountering the rising edge of the original point switch.

- 6098h=26 Action description:

① When the system initiates return to origin, it first performs a high-speed (6099h:01h) forward

return to zero. Upon detecting the rising edge of the origin switch, it continues forward until encountering the falling edge, at which point it reverses direction. The system then searches for the next rising edge of the origin switch, decelerates, and reverses again. It subsequently returns to origin at the speed of 6099h:02h, and stops upon reaching the falling edge of the origin switch.

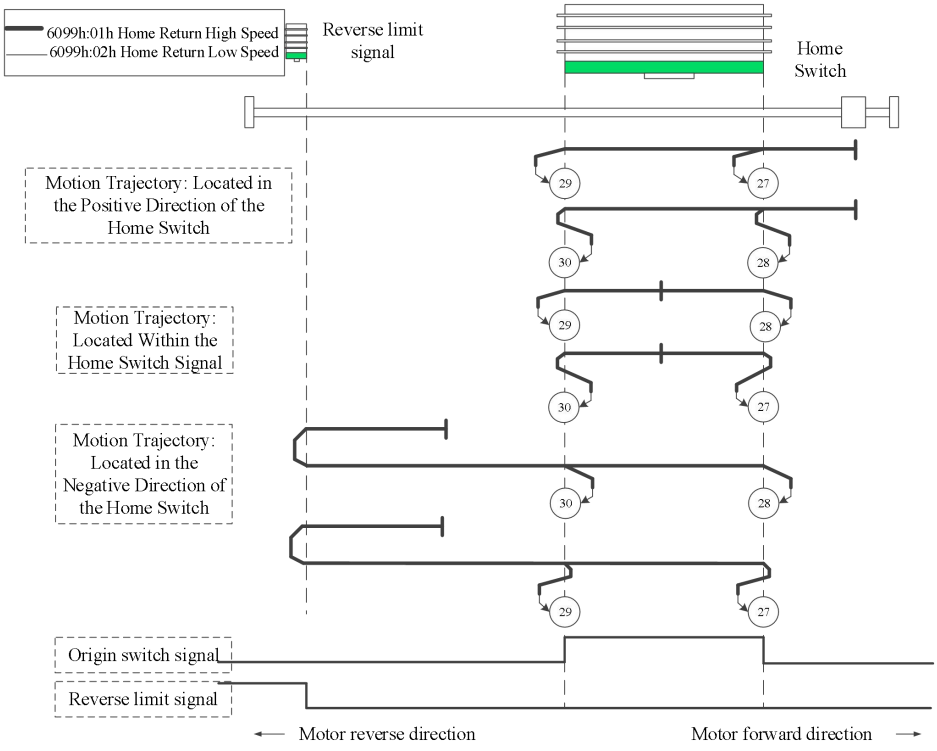
② The origin switch is in the active state: When starting the return to the origin, the forward return begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return proceeds forward at the speed of 6099h:02h until the origin switch's falling edge is encountered, at which point the machine stops.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reaches the positive limit, then automatically reverses direction and runs at high speed. After the original point switch rises, the system decelerates and reverses direction, and runs forward at the original speed (6099h:02h).

■ Methods 27-30 (6098h=27,28,29,30):

This method is similar to the original method 11,12,13,14.
The key difference is that the origin detection position is determined not by the motor's Z-axis signal, but by the position of the origin switch change. (Refer to the figure below)
Homing error = 1 when the origin switch and negative limit are not allocated.

Mechanical Origin: Origin Switch
Reduction point: origin switch



Use the origin switch signal and reverse limit signal to return to the origin.

- 6098h=27 Action Description:

  ① When positioned at the negative direction of the origin switch: During initial return, the system initiates reverse zeroing at high speed (6099h:01h). Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the rising edge of the origin switch, it continues forward until encountering the falling edge, at which point it reverses direction again. The system then decelerates, searches for the next rising edge of the origin switch, and reverses direction once more. It then proceeds forward at the original return speed (6099h:02h) until stopping upon detecting the falling edge of the origin switch.

  ② The origin switch is in the active state: When starting the return to the origin, the forward return begins at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, the direction is reversed to search for the rising edge of the origin switch, then decelerate and reverse again. The return proceeds forward at the speed of 6099h:02h until the origin switch's falling edge is encountered, at which point the machine stops.

  ③ When the system starts to return to the origin, it first reverses to zero at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, it decelerates and reverses direction, then runs forward at the original return speed (6099h:02h). The system stops when the falling edge of the origin switch is detected.

- 6098h=28 Action Description:

  ① When positioned at the negative direction of the origin switch, the system initiates a high-speed (6099h:01h) reverse return to zero. Upon reaching the reverse limit, it automatically reverses direction and maintains high-speed operation. After detecting the rising edge of the origin switch, it continues forward until encountering the falling edge, where it decelerates and reverses direction again, now operating at the original return speed (6099h:02h). The system then stops upon detecting the rising edge of the origin switch.

  ② When the origin switch is in the active state, the system initiates the return process at high speed (6099h:01h) for a forward return to zero. Upon detecting the falling edge of the origin switch, it decelerates and reverses direction, then proceeds at the reduced speed (6099h:02h) for a reverse return. The system halts upon detecting the rising edge of the origin switch.

  ③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reverses to return to zero. After encountering the rising edge of the original point switch, it changes direction, searches for the falling edge of the original point switch, decelerates, and changes direction again. The system then runs in reverse at the original speed of 6099h:02h until it stops upon encountering the rising edge of the original point switch.

- 6098h=29 Action description:

  ① When the system initiates return to the origin, it first reverses at high speed (6099h:01h) until

encountering the reverse limit. Upon reaching the origin switch's rising edge, it reverses again to seek the falling edge, decelerates, and reverses once more. The system then proceeds forward at the original return speed (6099h:02h) until stopping at the origin switch's rising edge.

② When the origin switch is in the active state, the system initiates reverse return at high speed (6099h:01h). Upon detecting the origin switch's falling edge, it decelerates and reverses direction, then proceeds forward at 6099h:02h. The system halts when the origin switch's rising edge is detected.

③ When the original point switch is in the positive direction, the system starts to return to the original position at high speed (6099h:01h) and reverses to return to zero. After encountering the rising edge of the original point switch, it continues forward until it meets the falling edge of the original point switch, then decelerates and changes direction. The system runs forward at the original return speed (6099h:02h) and stops after encountering the rising edge of the original point switch.

- 6098h=30 Action Description:

① The system is located at the negative direction of the origin switch. When starting to return to the origin, it starts to reverse to zero at high speed (6099h:01h). After encountering the reverse limit, it automatically changes direction and runs at high speed. After encountering the rising edge of the origin switch, it decelerates and changes direction, and runs in reverse at the speed of 6099h:02h. After encountering the falling edge of the origin switch, it stops.

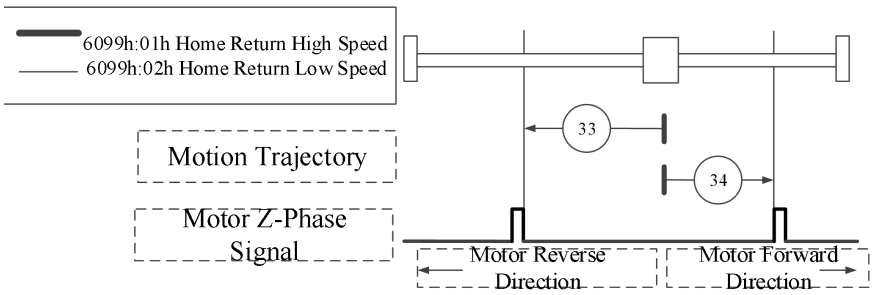
② The origin switch is in the active state: When starting the return to the origin, the system begins the reverse return at high speed (6099h:01h). Upon encountering the falling edge of the origin switch, it switches direction and searches for the rising edge of the origin switch. The system then decelerates and switches direction again, running in reverse at the return speed of 6099h:02h. It stops the machine upon encountering the falling edge of the origin switch.

③ When the original point switch is in the forward direction: During initial return, the system reverses to zero at high speed (6099h:01h). Upon detecting the rising edge of the original point switch, it advances until encountering the falling edge, then reverses direction. The system searches for the next rising edge, decelerates, and reverses again. It then returns to the original point switch at the speed of 6099h:02h, stopping when the falling edge is detected.

- Methods 33 and 34 (6098h=33,34):

Use method 33 or 34, where the direction to the origin is negative or positive, respectively. The original position is near the Z axis in the selected direction.

Mechanical origin: Motor Z positive signal
Deceleration point: None



The origin is on the Z-axis.

- 6098h=33 Action description:

  During the initial reset, the system operates in reverse at 6099h:02h speed, stopping at the first motor Z signal.

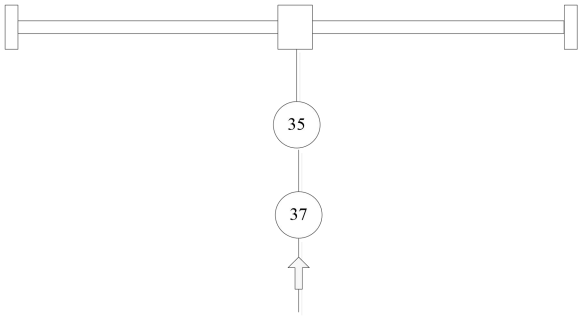
- 6098h=34 Action description:

  During the initial return phase, the system operated forward at 6099h:02h speed until encountering the first motor Z signal, which triggered a shutdown.

  - Methods 35 (6098h=35) and 37 (6098h=37):

    In modes 35 and 37, the current position is reset to the origin after triggering the origin reset action.

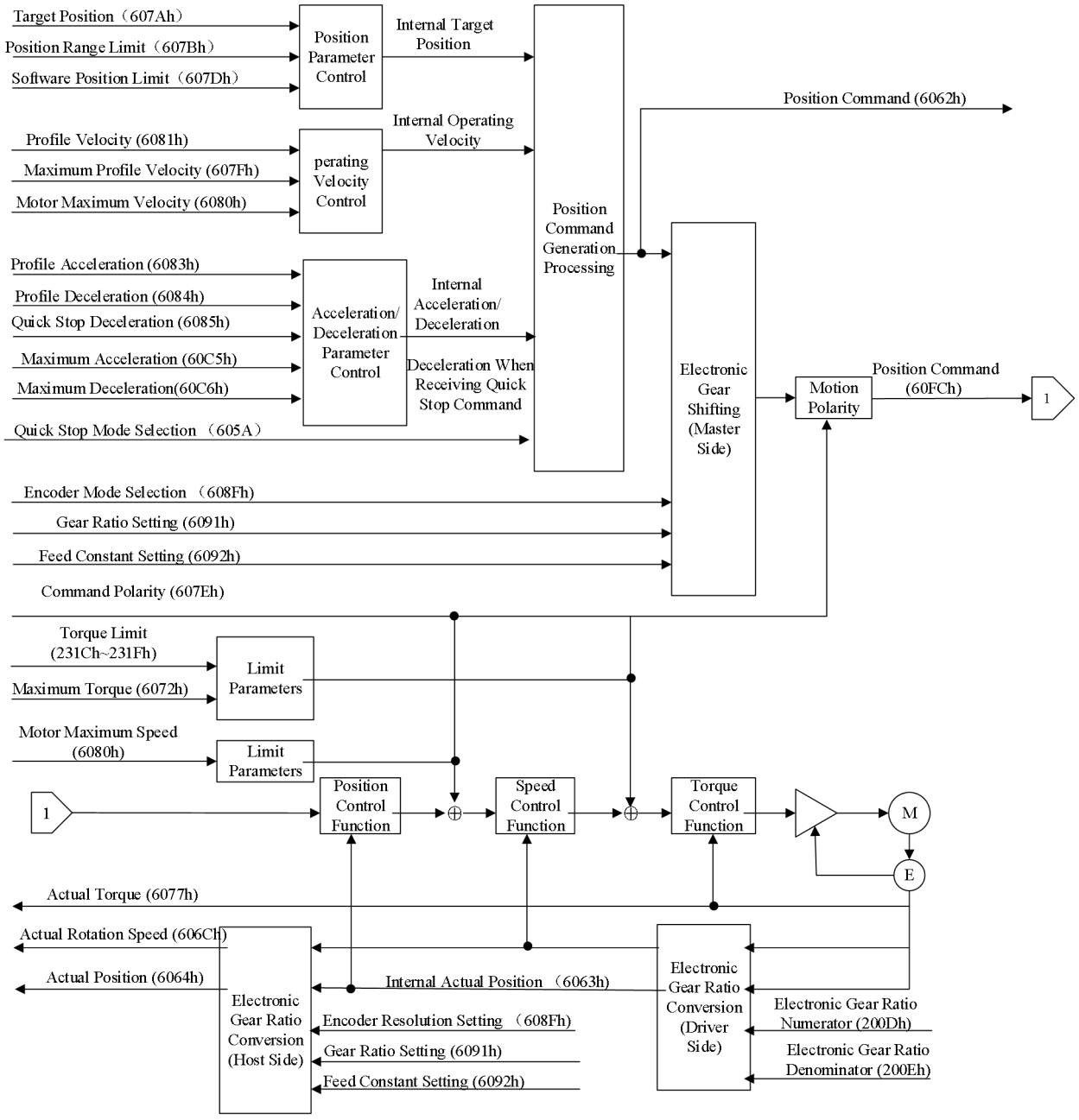
    Mechanical origin: Trigger position



All revert methods require the revert action command to trigger before taking effect.

7.6 PP pattern

PP (Profile Positioning Mode) is a positioning control method that specifies target position, target speed, and acceleration/deceleration. The servo driver generates position commands and executes them accordingly. This mode should be used when the communication cycle exceeds 500μs.



7.6.1 Relevant parameters

1) PP control mode associated objects (commands,settings)

index of matrix	son index of matrix	name	unit	scope	data type	accessibility	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
607Ah	00h	target location	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Dh	-	software absolute position limit	-	-	-	-	-
	00h	Indicates the 607Dh sub-index number	-	2	U8	ro	NO
	01h	minimum position limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
	02h	Maximum location limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Fh	00h	maximum outline velocity	Command unit/s	0~4294967295	U32	rw	RxPDO
6081h	00h	Contour speed	Command unit/s	0~4294967295	U32	rw	RxPDO
6083h	00h	contour acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
6084h	00h	contour deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
60B1h	00h	velocity offset	Command unit/s	-2147483648~2147483647	I32	rw	RxPDO
60B2h	00h	torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60C5h	00h	maximal acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
60C6h	00h	maximum deceleration	instruction units/s²	0~4294967295	U3	rw	RxPDO

There are also other related objects with common actions.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
605Ah	00h	Quick Stop Mode Selection	-	0~7	I16	rw	NO

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Suspended shutdown mode	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and effect code	-	0~2	I16	rw	NO
607Dh	-	Software location restrictions	-	-	-	-	-
	00h	Indicates the 607h sub-index number	-	2	U8	ro	NO
	01h	Minimum position limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
	02h	Maximum location limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Ch	00h	origin offset	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Eh	00h	command polarity	-	0~255	U8	rw	NO
6085h	00h	quick deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Location trajectory planning type	-	-32768~32767	I16	rw	RxPDO
608Fh	-	Position encoder resolution setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-index number	-	2	U8	ro	NO
	01h	Encoder movement distance	pulse	1~4294967295	U32	ro	NO
	02h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6091h	-	gear ratio setting	-	-	-	-	-
	00h	Indicates the 6091h sub-index number	-	2	U8	ro	NO
	01h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
6092h	-	Feed constant settings	-	-	-	-	-
	00h	Indicates the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the Feed value	instruction unit	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
60B8h	00h	probe mode	-	0~65535	U16	rw	RxPDO

Control word (6040h) <ppFunction in control mode>

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6040h	00h	control word	0~65535	U16	rw	RxPDO	All

Set the control command for PDS state transition and other servo drivers.

bit information

15	14	13	12	11	10	9	8
r						om	h
7	6	5		4	3	2	1	0
fr	oms				eo	qs	ev	so
	abs/rel	Change set immediately		New set-point				

r = reserved (not mapped) fr = fault reset

r = reserved (not mapped) fr = fault reset

oms = operation mode specific eo = enable operation

Specific operation mode: QS = Quick Stop

Specific operation mode: QS = Quick Stop

h = halt (stop) ev = enable voltage (enable voltage)

		h = halt (stop) ev = enable voltage (enable voltage) so = switch on

bit6-4（operation mode specific）：

Bit	name	price	definition
4	new set-point	0 -> 1	Trigger for starting the positioning action and updating the set value. Acquire new position determination tasks (607Ah (Target position), 6081h (Profile velocity), etc.).
5	change set immediately	0	Complete the current positioning action. If the target position 607A, acceleration 6083, and deceleration 6084 are changed during movement, the control command will not execute according to the new motion parameters. The previous motion must be completed before sending a new command to execute the new motion.
		1	Immediately halt the current positioning action and initiate the downward positioning action. During motion, adjust target position 607A, acceleration 6083, and deceleration 6084. Then send control commands—such as changing control word 0x6F (111) to 0x7F (127) (relative mode) or 0x2F (47) to 0x3F (63) (absolute mode)—and the system will immediately execute the new motion parameters.
6	Absolute/Relative	0	607Ah (target position) is processed as an absolute position.
		1	607Ah (target location) as relative position processing.

- Do not change acceleration or deceleration during motor operation (*).
  If the acceleration/deceleration mode is changed, set bit4 (new set-point) from 0 to 1 after the motor stops.
  6083h (Profile acceleration)
  6084h (Profile deceleration)
  60C5h (Maximum Acceleration)
  60C6h (Maximum deceleration)
- If you execute the set-point (bit4 (new set-point) changes from 0 to 1) under the following conditions, note that the positioning task will be canceled.
  Key configuration points for--6081h (Profile speed) when set to 0.
- When the system detects a drive prohibition during deceleration (halt=1), all positioning tasks are canceled.
- Maintain the PP action for at least 2ms between initiating one PP action and the next (when the new set-point transitions from 0 to 1).

2) PP control mode associated objects (monitoring type)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6041h	00h	control word	-	0~65535	U16	ro	TxPDO

There are also other objects with common location control.

index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO
6062h	00h	position instruction	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
6063h	00h	actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
6065h	00h	Excessive threshold for positional deviation	instruction unit	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Location reaches the threshold	instruction unit	0~4294967295	U32	rw	RxPDO
6068h	00h	Location to window time	1ms	0~65535	U16	rw	RxPDO
606Ch	00h	rate feedback	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
6074h	00h	torque command	0.1%	-32768~32767	I16	ro	TxPDO
6076h	00h	Motor rated torque	Mn·m	0~4294967295	U32	ro	TxPDO
6077h	00h	Torque feedback	0.1%	-32768~32767	I16	ro	TxPDO
60F4h	00h	position deviation	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60FAh	00h	internal instruction speed (Position loop output)	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
60FCh	00h	internal location instruction	pulse	-2147483648 ~ 2147483647	I32	ro	TxPDO

There are also other objects with common action.

index of matrix	subindex	name	unit	scope	data type	Accessible inquisitive	PDO
603Fh	00h	Error code	-	0~65535	U16	ro	TxPDO

60B9h	00h	Indicates the status of the Touch probe function	-	0~65535	U16	ro	TxPDO
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruction unit	-2147483648~2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruction unit	-2147483648~2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruction unit	-2147483648~2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruction unit	-2147483648~2147483647	I32	ro	TxPDO

Status word (6041h) <ppFunction in control mode>

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>status word</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="7">Indicates the status of the servo driver.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="2" rowspan="2">r</td><td colspan="2">oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>Following Error</td><td>set- point acknowledge</td><td>Target Reached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>Qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not mapped) w = warning r = reserved (not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
oms = operation mode specific qs = quick stop
Control mode depends on the bit: ve = voltage enabled
Control mode depends on the bit: ve = voltage enabled
ila = internal limit active f = fault
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rm = remote so = switched on
rtso = ready to switch on</td></tr>
</table>

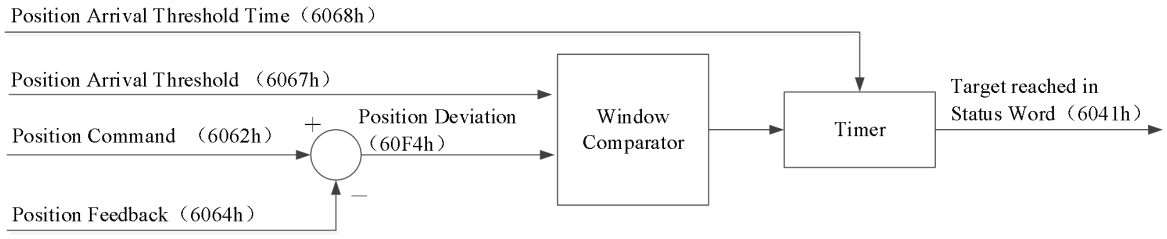
bit13,12,10（operation mode specific）：

Bit	name	price	definition
10	target reached	0	halt=0 (normal): Positioning not completed halt=1 (when halt stops): Axis deceleration
		1	halt=0 (normal): Positioning complete halt=1 (when halt stops): axis stops (axis speed is 0)
12	set-point acknowledge	0	setpoint is 0, and the buffer is empty after the current target position action is completed (in progress).
		1	The new positioning task is loaded into the buffer, which is not empty.
13	following error	0	60F4h（Following error actual value） If the value of (6062h (Position demand value) -6064h (Position actual value)) does not exceed the 6065h (Following error window) setting range, or if the 60F4h value exceeds the 6065h setting value, the 6066h time setting will not be applied.
		1	60F4h（Following error actual value） The value exceeds the set range of 6065h (Following error window). After 6066h (Following error time out), continue.

bit10：target reached（Position reached）

When the servo enable is active (operation valid) and all set-points have generated completion commands, the difference between 6062h (target position value) and 6064h (position feedback) must remain within the range defined by 6067h (position arrival threshold). If the time specified in 6068h (position arrival time window) has elapsed, the bit10 (target achieved) in 6041h (state word) will be set to 1.

Bit	name	price	definition
10	Target reached	0	halt=0 (normal): Positioning not completed halt=1 (when halt stops): Axis deceleration
		1	halt=0 (normal): Positioning complete halt=1 (when halt stops): axis stops (axis speed is 0)



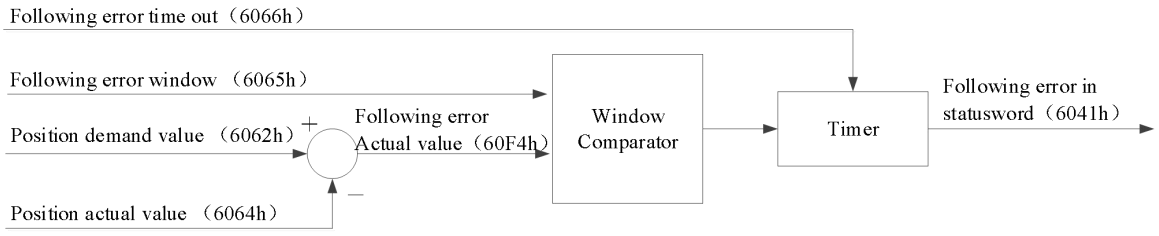
Location to Destination Diagram

index of matrix	subindex	name	unit	scope	data type	Accessible inquisitive	PDO	OP-mode
6067h	00h	Location reaches the threshold	instruction unit	0~4294967295	U32	rw	RxPDO	PP
		The difference between 6062h (position command) and 6064h (position feedback) must stay within the parameter's set range. When the 6068h (position arrival time window) time period is reached, set the bit10 (target achieved) of 6041h (status word) to 1 as the threshold. If the difference is not set by this parameter, bit10 of 6041h is 0.						
6068h	00h	Location arrival time window	1ms	0~65535	U16	rw	RxPDO	PP
		The difference between 6062h (position command) and 6064h (position feedback) indicates the duration during which the bit10 (target reached) in 6041h (state word) is set to 1, within the range defined by 6067h (position threshold).						

bit13: Follow error

When the 60F4h (position deviation) value exceeds the 6065h (over-deviation threshold) range, and the 6066h (error timeout) time limit is exceeded, the bit13 of the 6041h (status word) becomes 1.

Bit	name	price	definition
13	following error Follow error	0	60F4h (Position Deviation) The value of (6062h (position command) -6064h (position feedback)) must not exceed the set range of 6065h (position deviation threshold). Alternatively, if the value of 60F4h exceeds the set value of 6065h, the time setting of 6066h will not be applied.
		1	60F4h (Position Deviation) The value exceeds the set range of 6065h (position deviation threshold) and remains beyond the 6066h (error timeout) time limit. Continue



Schematic diagram of the follow-error function

index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO	OP-mode

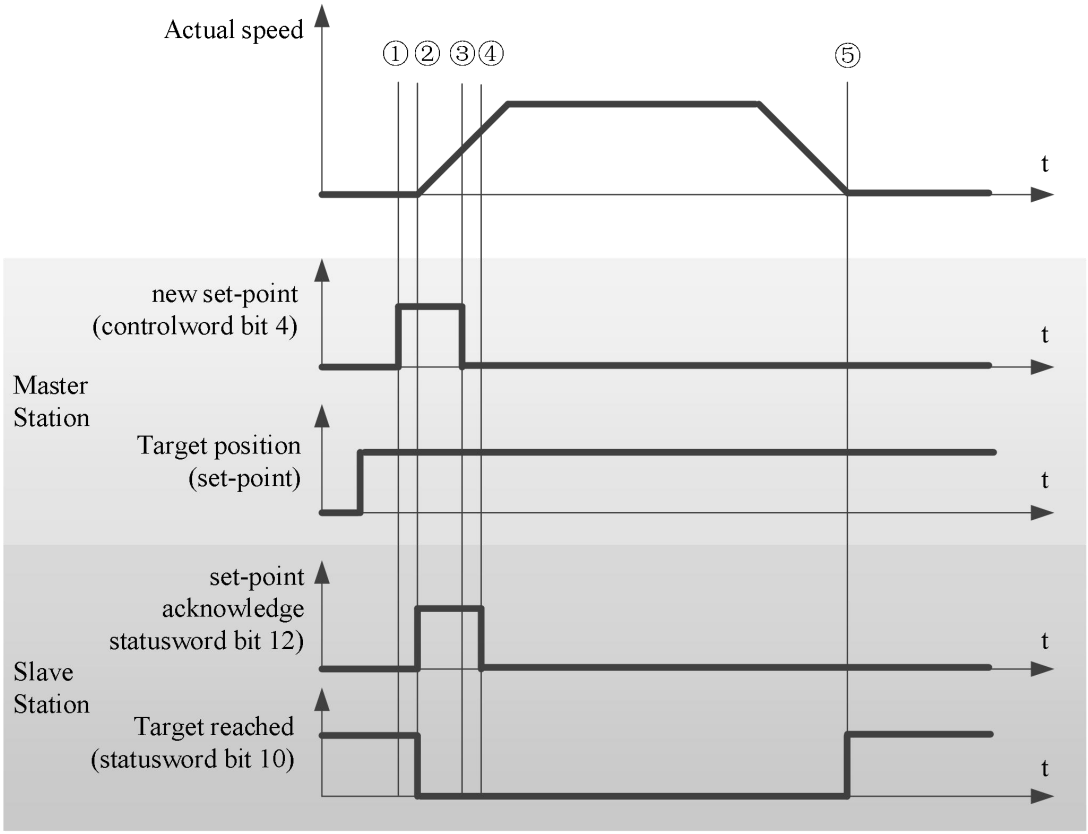
6065h	00h	Excessive threshold for positional deviation	instruction unit	0~4294967295	U32	rw	RxPDO	PP CSP
		When the value of 60F4h (Following error actual value) deviates from the preset value, the threshold is set to 6041h (state word) bit13 (following error) with a value of 1.						
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO	PP CSP
		When the 60F4h (position deviation) value exceeds the 6065h (over-deviation threshold) range, the system will set this parameter above its preset value. If the process continues, the 13th bit of the 6041h (status word) will be set to 1 as the threshold.						

3) The action of the PP control mode

Example 1: (Basic set-point)

(1) On the master station, after setting the value of 607Ah (target position), change bit4 (new set-point) of 6040h (control word) from 0 to 1. At this point, also set 6081h (profile speed).
The motor remains inactive when the contour speed (6081h) reaches zero.

(2) The slave node detects the rising edge (0→1) of bit4 (new set-point) at 6040h, with 607Ah (target position) as the starting point for positioning. Simultaneously, it updates bit12 (set-point acknowledge) in 6041h (status word) from 0 to 1.
(3) The master station confirms that the bit12 (set-point acknowledge) at 6041h has transitioned from 0 to 1, and the bit4 (new set-point) at 6040h has reset to 0.
(4) At the slave station, verify that bit4 (new set-point) of 6040h is set to 0, and bit12 (set-point acknowledge) of 6041h is also set to 0.
(5) When the target position is reached, bit10 (target reached) of 6041h changes from 0 to 1.



< Set-point example >

- The 6081h (profile speed) is limited by the lower of 607Fh (maximum profile speed) and 6080h (maximum motor speed).
- Changes to the 607Fh or 6080h settings in the action will not be reflected.

Example 2: (Action data change without buffer: single set-point)

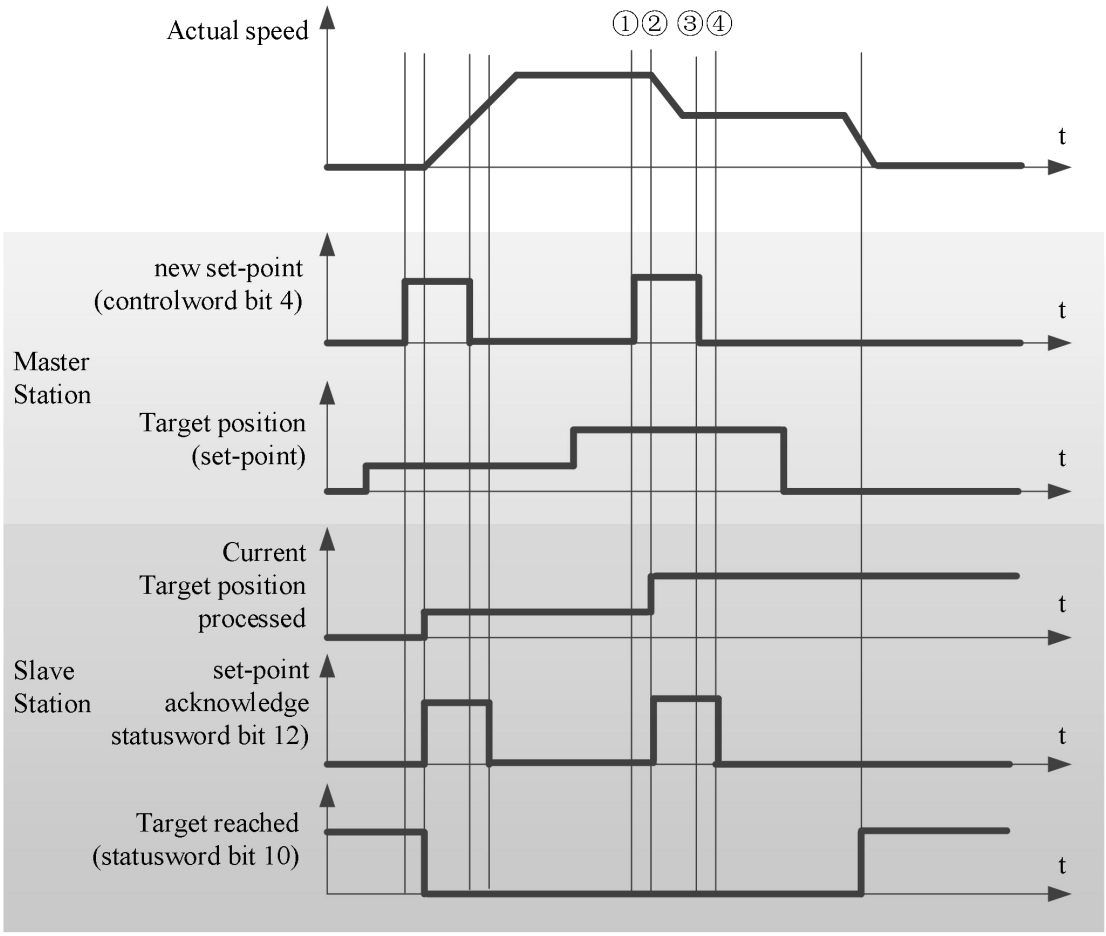
When the bit5 (change set immediately) of 6040h is set to 1, if the change in positioning action data during the current action has been detected, the current positioning action will be interrupted and the next positioning action will be initiated immediately.
(1) At the master station, verify that bit12 (set-point acknowledge) of 6041h is 0. After modifying the value of 607Ah (target position), set bit4 (new set-point) of 6040h from 0 to 1.

Do not change the acceleration or deceleration at this time.

(2) The slave node detects the rising edge (0→1) of bit4 (new set-point) at 6040h, and immediately updates 607Ah as the new target position. Simultaneously, bit12 (set-point acknowledge) at 6041h transitions from 0 to 1.
(3) The master station confirms that the bit12 (set-point acknowledge) at 6041h has transitioned from 0 to 1, and the bit4 (new set-point) at 6040h has reset to 0.
(4) At the slave station, verify that bit4 (new set-point) of 6040h is 0 and bit12 (set-point acknowledge) of 6041h is 0.

The same procedure (1)–(4) can adjust the contour speed (6081h).

After modifying 607Ah (target position) and 6081h (profile speed), update both 607Ah and 6081h simultaneously according to steps (1) to (4) above.



< handshaking procedure for the single set-point method >

7.6.2 Common Parameters

PP control mode associated objects (commands,settings)

register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	Set to 1	-
RXPDO[0x607A]	Position given	instruction unit
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	maximum internal velocity	Command unit/s
RXPDO[0x6081]	internal speed given	Command unit/s
RXPDO[0x6083]	internal acceleration	instruction units/s²
RXPDO[0x6084]	internal deceleration	instruction units/s²

register	explain	unit
RXPDO[0x60C5]	maximal acceleration	instruction units/s²
RXPDO[0x60C6]	maximum deceleration	instruction units/s²
RXPDO[0x6065]	Set the number of trailing pulse counts	instruction unit
RXPDO[0x6066]	Follow error timeout time	ms
RXPDO[0x6067]	Location reaches the threshold	instruction unit
RXPDO[0x6068]	Location to window time	ms

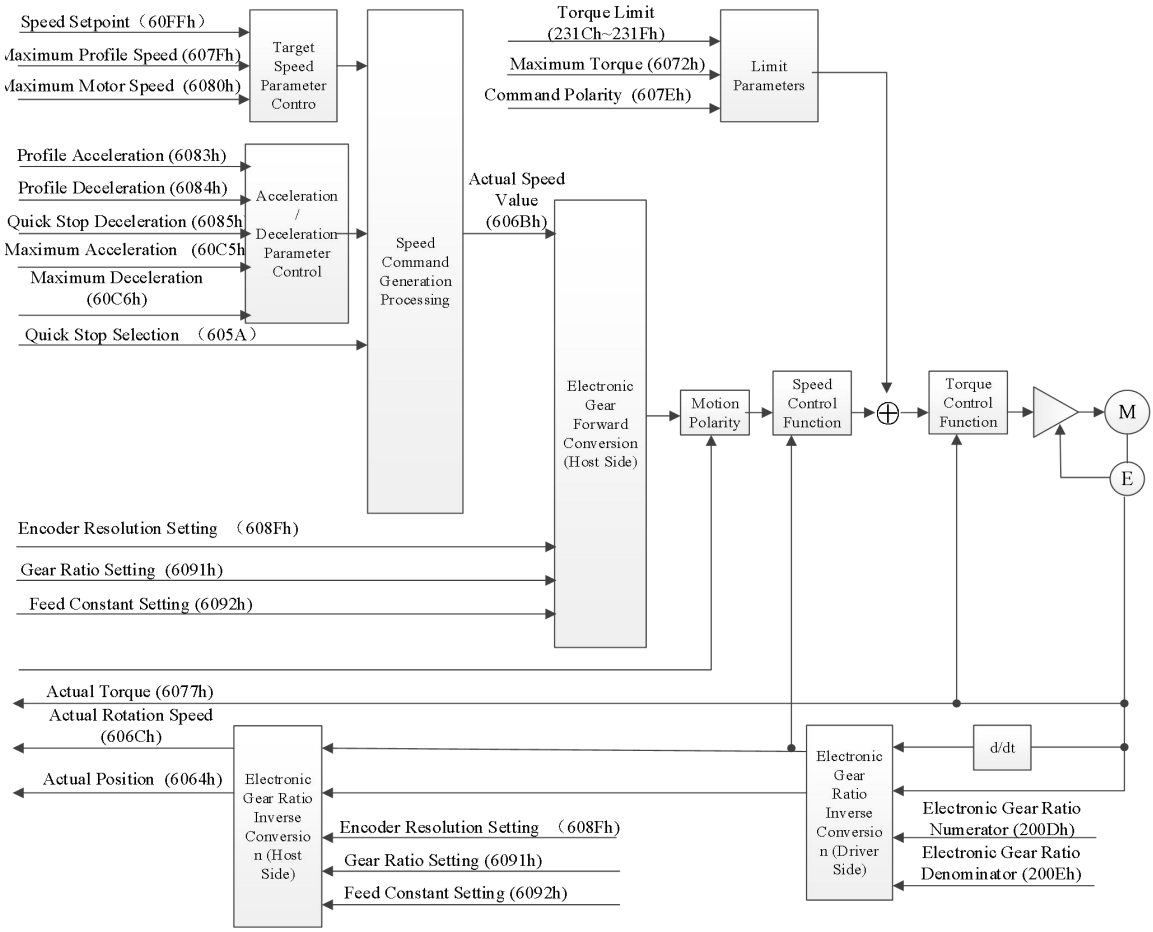
- The 6081h (contour velocity) is limited by the 607Fh (maximum internal velocity).
- When modifying the 607Fh (maximum internal speed) setting in the action, the change will not be reflected in the action.

PP control mode associated objects (commands,monitoring type)

register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6063]	Internal actual location	instruction unit
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%
TXPDO[0x60F4]	actual following error	instruction unit

7.7PV pattern

PV (Profile speed control mode) is a speed control mode that sets target speed, acceleration, and deceleration, and generates position commands internally in the servo driver. This control mode should be used with a communication cycle of 500 μs or longer.



7.7.1 Relevant parameters

1) PV control mode associated objects (commands,settings)

index of matrix	subindex	name	unit	scope	data type	Accessible inquisitive	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO
607Fh	00h	maximum outline velocity	Command unit/s	0~4294967295	U32	rw	RxPDO
6083h	00h	Outline acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO

6084h	00h	Contour deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
60C5h	00h	maximal acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
60C6h	00h	maximum deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO

There are other objects with common association of speed control.

index of matrix	subindex	name	unit	scope	data type	Accessible inquisitive	PDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
6080h	00h	Maximum motor speed	r/min	0~4294967295	U32	rw	RxPDO
60B1h	00h	velocity offset	Command unit/s	-2147483648~2147483647	I32	rw	RxPDO
60B2h	00h	torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60FFh	00h	target speed	Command unit/s	0~4294967295	U32	rw	RxPDO

There are also other related objects with common actions.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
605Ah	00h	Quick Stop Mode Selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Suspended shutdown mode	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and effect code	-	0~2	I16	rw	NO

607Bh	-	Location range restriction	-	-	-	-	-
	00h	Indicates the 607Bh sub-index number	-	2	U8	ro	NO
	01h	Minimum position range limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
	02h	Maximum location range limit	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Ch	00h	origin offset	instruction unit	-2147483648~2147483647	I32	rw	RxPDO
607Eh	00h	command polarity	-	0~255	U8	rw	NO
6085h	00h	quick deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
608Fh	-	Position encoder resolution setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-index number	-	2	U8	ro	NO
	01h	Encoder movement distance	pulse	1~4294967295	U32	ro	NO
	02h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO
6091h	-	motor rotation number	-	-	-	-	-
	00h	gear ratio setting	-	2	U8	ro	NO
	01h	Indicates the 6091h sub-index number	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO

	02h	motor rotation number	r (axle)	1~4294967295	U32	rw	NO
6092h	-	rotation number	-	-	-	-	-
	00h	Feed constant settings	-	2	U8	ro	NO
	01h	Indicates the 6092h sub-index number	instruction unit	1~4294967295	U32	rw	NO
	02h	Set the Feed value	r (axle)	1~4294967295	U32	rw	NO
60B8h	00h	rotation number	-	0~65535	U16	rw	RxPDO

Control Word (6040h) <Functions in PV Control Mode>

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6040h	00h	control word	0~65535	U16	rw	RxPDO	All

Set the control command for PDS state transition and other servo drivers.

bit information

15	14	13	12	11	10	9	8
r						om	h
7	6	5		4	3	2	1	0
fr	oms				eo	qs	ev	so
	r	r		r				

r = reserved (not mapped) fr = fault reset r = reserved (not mapped) fr = fault reset

oms = operation mode specific eo = enable operation

(The control mode depends on the bit) qs = quick stop (The control mode depends on the bit) qs = quick stop

h = halt ev = enable voltage

h = halt ev = enable voltage

so = switch on

In PV mode, the OMS bit is not used.

Speed class

index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO	OP-mode

607Fh	00h	Max profile velocity maximum outline velocity	Command unit/s	0~ 4294967295	U32	rw	RxPDO	PP PV HM
		Speed limits for Profile position mode (pp), zero position reset mode (hm), and Profile speed mode (pv). The maximum value is limited by the internal processing using 6080h (maximum motor speed).						
6080h	00h	Max motor speed maximum motor speed	r/min	0~ 4294967295	U32	rw	RxPDO	PV TQ CSV CST
		Set the motor's maximum speed. When the power supply is controlled, the maximum speed read from the motor is set. The maximum value is limited by the maximum speed read from the motor. When using tq or CST, the speed is limited by the set value of this object.						

acceleration and deceleration class

index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO	OP-mode
6083h	00h	Profile acceleration contour acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO	PP PV
		Set Profile acceleration. Set to 0, internal processing is treated as 1.						
6084h	00h	Profile deceleration contour deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO	PP PV
		Set Profile deceleration. Set to 0, internal processing is treated as 1.						
60C5h	00h	Max acceleration maximum acceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO	PP PV HM
		Set maximum acceleration. Set to 0, internal processing is treated as 1.						
60C6h	00h	Min deceleration maximum deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO	PP PV HM
		Set maximum deceleration. Set to 0, internal processing is treated as 1.						

2) PV control mode associated objects (monitoring type)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6041h	00h	status word	-	0~65535	U16	ro	TxPDO
6065h	00h	Excessive threshold for positional deviation	Command unit/s	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Speed threshold	Command unit/s	0~4294967295	U32	rw	RxPDO
6068h	00h	Time to reach the speed threshold	1ms	0~65535	U16	rw	RxPDO

There are other common objects associated with speed control.

index of matrix	subindex	name	unit	scope	data type	Accessible inquisitive	PDO
6063h	00h	actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
606Bh	00h	velocity instruction	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
606Ch	00h	rate feedback	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
6074h	00h	torque command	0.1%	-32768~32767	I16	ro	TxPDO
6076h	00h	motor rated torque	Mn·m	0~4294967295	U32	ro	TxPDO
6077h	00h	torque feedback	0.1%	-32768~32767	I16	ro	TxPDO

There are other objects with common patterns.

index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO
603Fh	00h	Error code	-	0~65535	U16	ro	TxPDO
60B9h	00h	Indicates the status of the Touch probe	-	0~65535	U16	ro	TxPDO

index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO
		function					
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruction unit	-2147483648 ~2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruction unit	-2147483648~ 2147483647	I32	ro	TxPDO

Status word (6041h) <pvControl mode functions>

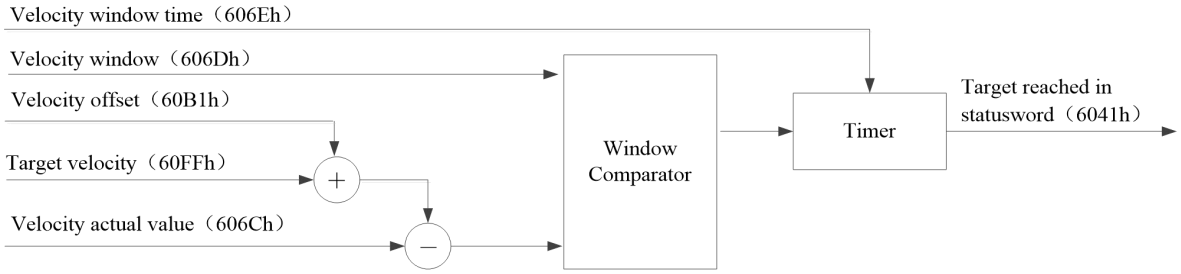
<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>status word</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the status of the servo driver.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="2" rowspan="2">r</td><td colspan="2">oms</td><td rowspan="2">ila</td><td>oms</td><td rowspan="2">rm</td><td rowspan="2">r</td></tr>
<tr><td>r</td><td>speed</td><td>Target reached</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not mapped) w = warning r = reserved (not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
oms = operation mode specific qs = quick stop
Control mode dependent bit: ve = voltage enabled
Control mode dependent bit: ve = voltage enabled
ila = internal limit active f = fault
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on</td></tr>
</table>

		rm = remote rtso = ready to switch on	so = switched on

(1) bit10 (target reached (Velocity reached)):

The difference between the combined values of 60FFh (speed given) and 60B1h (speed offset) and 606Ch (speed feedback) falls within the range set by 606Dh (speed threshold). If the time specified by 606Eh (speed threshold time) has elapsed, bit10 of 6041h (state word) becomes 1.

Bit	name	Value	Definition
10	Target reached	0	halt=0 (normal): Speed control not completed halt=1 (when halt stops): Axis deceleration
		1	halt=0 (normal): speed control completed halt=1 (when halt stops): axis stops (axis speed is 0)



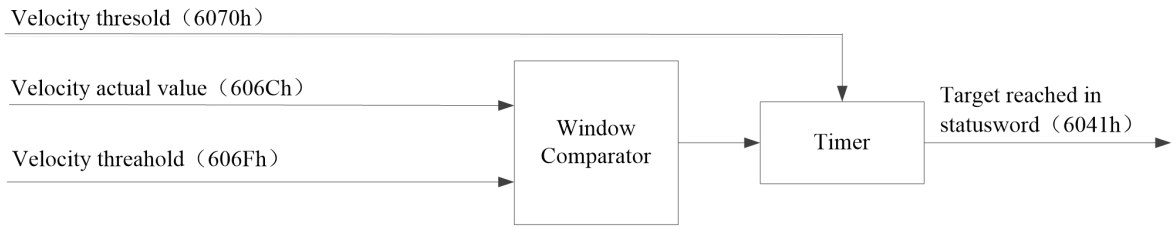
index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO	OP-mode
606Dh	00h	Speed reaches the threshold	instruction unit	0~4294967295	U32	rw	RxPDO	PV
		The combined value of 60FFh (speed given) and 60B1h (speed offset) minus 606Ch (speed feedback) must stay within the parameter's set range. After the 606Eh (speed threshold time) period, set bit10 (target reached) to 1 at 6041h as the threshold. If the speed deviation exceeds the set value of this parameter, bit10 of 6041h will be set to 0.						
606Eh	00h	Time to reach the speed threshold	1ms	0~65535	U16	rw	RxPDO	PV
		The time when the combined value of 60FFh (speed given) and 60B1h (speed offset) minus 606Ch (speed feedback) reaches the set value of 606Dh (speed arrival threshold), the bit10 (target reached) of 6041h is set to 1.						

(2) bit12 (speed):

The 606Ch (velocity feedback) is set according to the 606Fh (velocity threshold) value. If the value exceeds the 6070h (velocity threshold time) threshold, the bit12 of 6041h is set to 0.

If 606Ch (speed feedback) is lower than the set value of 606Fh (speed threshold), bit12 of 6041h becomes 1, indicating the motor stops.

Bit	name	price	definition
10	speed	0	Motor in motion
		1	Motor is stopped



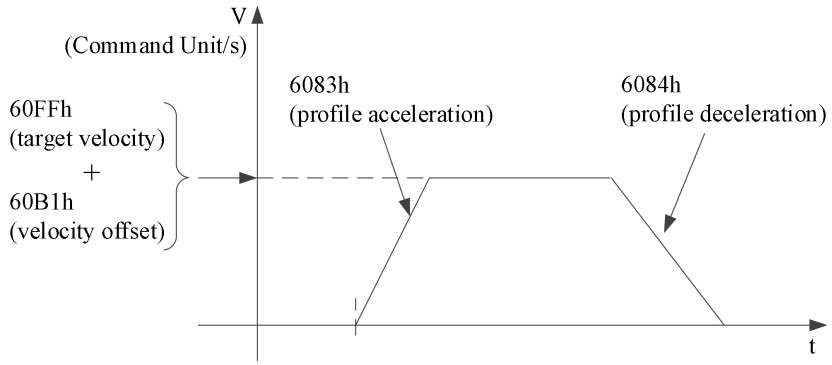
< Speed（functional overview）>

index of matrix	son index of matrix	name	unit	scope	data type	Accessible inquisitive	PDO	OP-mode
606Fh	00h	Speed threshold	instruction unit	0~4294967295	U32	rw	RxPDO	PV
		When 606Ch (velocity feedback) exceeds the preset threshold, after the 6070h (velocity threshold time) period, the bit12 (speed) in 6041h (status word) is reset to 0. If the speed is below the set value of this parameter, bit12 of 6041h is set to 1.						
6070h	00h	Speed threshold time	1ms	0~65535	U16	rw	RxPDO	PV
		When 606Ch (velocity feedback) exceeds the set value of 606Fh (velocity setpoint), the time when bit12 of 6041h is reset to 0 is determined.						

3) The action of the PV control mode

The Profile speed control mode generates speed command values based on the following parameters.

- Fixed speed (60FFh)
- Speed offset (60B1h)
- Outline acceleration (6083h)
- Contour deceleration (6084h)
- The target speed is 60FFh (Target velocity).
- Velocity offset 60B1h is not supported.
- The update (send) of the action command requires approximately 100ms after the servo enable is activated before input.
- As detection data, it provides 606Ch (Velocity actual value speed feedback) and other parameters.



- The 60FFh (speed given) is limited by the 607Fh (maximum internal speed) and 6080h (maximum motor speed).

7.7.2 Common Parameters

pv control mode associated objects (commands,settings)

register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is PV (Profile Velocity Control mode). Set its value to 3.	-
RXPDO[0x60FF]	velocity given	Command unit/s
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	maximum internal velocity	Command unit/s
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6083]	internal acceleration	instruction units/s²
RXPDO[0x6084]	internal deceleration	instruction units/s²
RXPDO[0x60C5]	maximal acceleration	instruction units/s²
RXPDO[0x60C6]	maximum deceleration	instruction units/s²
RXPDO[0x606D]	Speed reaches the threshold	Command unit/s
RXPDO[0x606E]	Speed limit exceeded	ms
RXPDO[0x606F]	Speed threshold	Command unit/s
RXPDO[0x6070]	Speed threshold time	ms

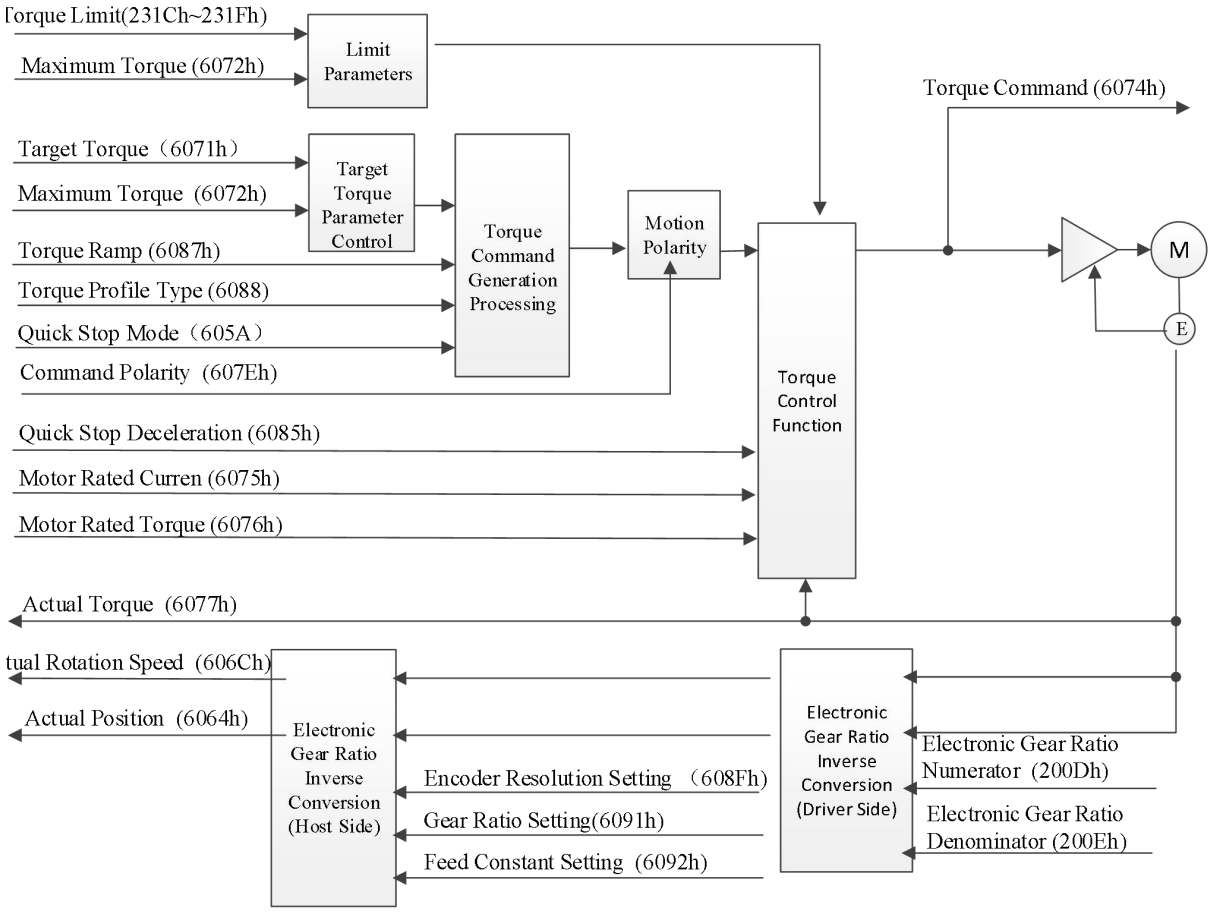
pv control mode associated objects (command,monitoring type)

register	explain	unit

TXPDO[0x6041]	status word	-
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%

7.8TQ pattern

TQ (Profile Torque Control Mode) is a torque control method that generates position commands within the servo driver to achieve target torque and acceleration/deceleration. This mode should be used when the communication cycle exceeds 500 μs.



7.8.1 Relevant parameters

1) TQ control mode associated objects (commands,settings)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO
6088h	00h	Torque planning type	-	-32768~32767	I16	rw	RxPDO

There are other related objects which are common to torque control.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6071h	00h	Torque given	0.1%	-3276~32767	I16	rw	RxPDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
6080h	00h	Maximum motor speed	r/min	0~4294967295	U32	rw	RxPDO
6087h	00h	Torque ramp	0.1%/S	0~4294967295	U32	rw	RxPDO
60B2h	00h	torque offset	0.1%	-32768~32767	I16	rw	RxPDO

There are also other related objects with common actions.

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
605Ah	00h	Quick Stop Mode Selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Suspended shutdown mode	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and effect code	-	0~2	I16	rw	NO
607Bh	-	Location range restriction	-	-	-	-	-
	00h	Indicates the 607Bh sub-index number	-	2	U8	ro	No
	01h	Minimum position range limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum location range limit	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	origin offset	instruction unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	command polarity	-	0~255	U8	rw	NO
6085h	00h	quick deceleration	instruction units/s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Location trajectory planning type	-	-32768~32767	I16	rw	RxPDO
608Fh	-	Position encoder resolution setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-index number	-	2	U8	ro	NO

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
	01h	Encoder movement distance	pulse	1~4294967295	U32	ro	NO
	02h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO
6091h	-	gear ratio setting	-	-	-	-	-
	00h	Indicates the 6091h sub-index number	-	2	U8	ro	NO
	01h	motor rotation number	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
6092h	-	Feed constant settings	-	-	-	-	-
	00h	Indicates the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the Feed value	instruction unit	1~4294967295	U32	rw	NO
	02h	rotation number	r（axle）	1~4294967295	U32	rw	NO
60B8h	00h	probe mode	-	0~65535	U16	rw	RxPDO

Control word (6040h) <Functions in TQ control mode>

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6040h	00h	control word	0~65535	U16	rw	RxPDO	All

Set the control command for PDS state transition and other servo drivers.

bit information

15	14	13	12	11	10	9	8
R						om	h

		7 6 5 4 3 2 1 0 fr oms eo qs ev so r r r r = reserved (not mapped) fr = fault reset r = reserved (not mapped) fr = fault reset oms = operation mode specific eo = enable operation (The control mode depends on the bit) qs = quick stop (The control mode depends on the bit) qs = quick stop h = halt ev = enable voltage h = halt ev = enable voltage so = switch on

TQ mode does not use the OMS bit.

torque class

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO	OP-mode
6087h	00h	Torque slope torque ramp	0.1 %	0~4294967295	U32	rw	RxPDO	tq cst
		The parameter value is set to give the torque command. The cyclic synchronous torque mode (CST) is only active during deceleration and stopping phases. If set to 0, internal processing uses 1.						
6088h	00h	Torque profile type Torque planning type	-	-32768~32767	I16	rw	RxPDO	tq
		Set the torque Profile type to change torque. 0: Straight slope 1：Not supported						

2) TQ control mode associated objects (monitoring type)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
6041h	00h	status word	-	0~65535	U16	ro	TxPDO
6073h	00h	maximum current	0.1%	0~65535	U16	ro	NO

Other torque control objects with common associations (monitoring type)

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
6063h	00h	actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position	instruction	-2147483648~	I32	ro	TxPDO

		feedback	unit	2147483647			
606Ch	00h	rate feedback	Command unit/s	-2147483648~ 2147483647	I32	ro	TxPDO
6074h	00h	torque command	0.1%	-32768~32767	I16	ro	TxPDO
6075h	00h	Rated current of the motor	1mA	0~4294967295	U32	ro	TxPDO
6076h	00h	motor rated torque	mNm	0~4294967295	U32	ro	TxPDO
6077h	00h	torque feedback	0.1%	-32768~32767	I16	ro	TxPDO
6078h	00h	Current actual value	0.1%	-32768~32767	I16	ro	TxPDO

There are other objects with common patterns.

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO
603Fh	00h	Error code	-	0~65535	U16	ro	TxPDO
60B9h	00h	Indicates the status of the Touch probe function	-	0~65535	U16	ro	TxPDO
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO

Status word (6041h) <tq Control mode functions>

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6041h	00h	status word	0~65535	U16	ro	TxPDO	All

		Indicates the status of the servo driver. bit information

15	14	13	12	11	10	9	8
r		oms		ila	oms	rm	r
		r	r		target reached		
7	6	5	4	3	2	1	0
w	sod	qs	ve	f	oe	so	rsto

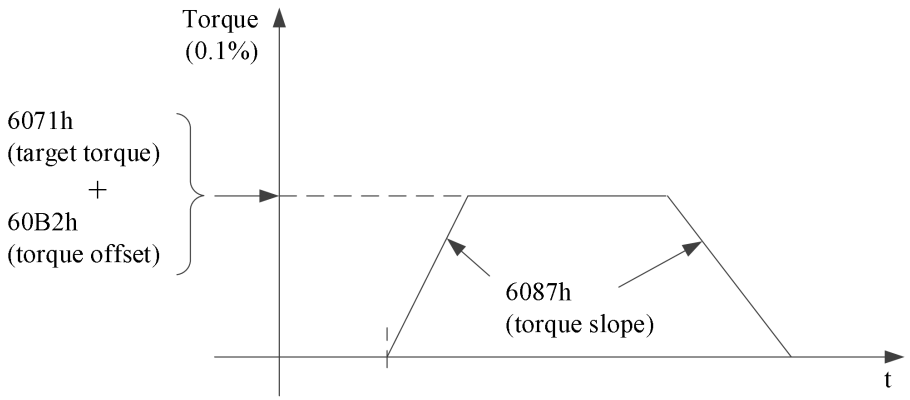
r = reserved (not mapped) w = warning r = reserved (not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
oms = operation mode specific qs = quick stop
Control mode dependent bit: ve = voltage enabled
Control mode dependent bit: ve = voltage enabled
ila = internal limit active f = fault
ila = internal limit active f = fault
oe = operation enabled rm = remote
oe = operation enabled rm = remote
so = switched on rtso = ready to switch on
so = switched on rtso = ready to switch on

bit13,12,10（operation mode specific）：

Bit	name	price	definition
10	target reached	0	halt=0 (normal mode): 6074h (Torque demand) has not reached the target torque halt=1 (when halt stops): during shaft deceleration
		1	halt=0 (normal mode): 6074h (Torque demand) reaches target torque halt=1 (when halt stops): axis stops (axis speed is 0)
12	reserved	-	unused
13	reserved	-	unused

3) The action of the tq control mode

- The Profile torque control mode generates torque command values based on the following parameters.
- Target torque is set (6071h)
- Torque offset (60B2h) (not supported)
- Torque slope (6087h)
- Update the action command (send). After enabling the servo, wait approximately 100ms before entering it.
- As monitoring data, it provides 6077h (Torque actual value, torque feedback) and other parameters.



- The target torque (6071h) is set to the maximum torque (6072h), 231Ch (P3-28), and 231Dh (P3-29), with a minimum value limit.
- The speed is limited by the 6080h (Maximum Motor Speed).

7.8.2 Common Parameters

tq control mode associated objects (commands,settings)

register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is tq (Profile Torque Control Mode). Set its value to 4.	-
RXPDO[0x6071]	target torque given	0.1%
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6087]	Set torque slope	0.1%/S
RXPDO[0x6088]	Set the torque Profile type to be used	-

tq control mode associated objects (command,monitoring type)

register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%

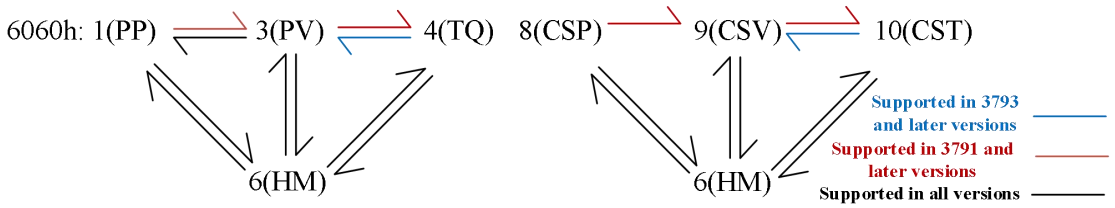
TQ mode, without using OMS bits.

By changing control word 6040 (6→15), the slave can be enabled.

7.9 Common Modes and Functions

7.9.1 Mode Switching Function

This model supports mode switching during operation with a switching time of 2ms. When the servo is enabled, it allows switching between position mode and speed mode, position mode and torque mode, or speed mode and torque mode, enabling users to achieve multi-mode switching control in engineering projects.



7.9.2 Parking Methods

PDS is a motor deceleration stop method that activates when the system is in Operation-enabled mode (servo enable), designed to handle scenarios such as main power interruption or alarm activation.
The deceleration function (selection code) defined by CoE (CiA402) will be combined with the servo (DS5C1) side deceleration function (free run stop, deceleration stop).

PDS selection code list

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO
605Ah	00h	Quick Stop Mode Selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Pause shutdown method	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	failure mode and effect code	-	0~2	I16	rw	NO

List of associated objects

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO	OP-mode
6084h	00h	Profile deceleration	instruction units/s²	0~ 4294967295	U32	rw	RxPDO	PP PV HM

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO	OP-mode
								CSP CSV
		Set Profile deceleration. Set to 0, internal processing is treated as 1.						
6085h	00h	Quick stop deceleration quick deceleration	instruction units/s²	0~ 4294967295	U32	rw	RxPDO	PP PV HM CSP CSV
		If the 605Ah (Quick stop option code) is '2' or '6', set the motor deceleration parameters for Quick stop operation. The codes 605Dh (Halt option code) and 605Eh (Fault reaction option code) are also used when the value is 2.						
6087h	00h	Torque slope	0.1%	0~ 4294967295	U32	rw	RxPDO	TQ CST
		The parameter value is set to give the torque command. The cyclic synchronous torque mode (CST) is only effective during deceleration and stopping phases.						
609Ah	00h	Homing acceleration	instruction units/s²	0~ 4294967295	U32	rw	RxPDO	HM
		Set the acceleration and deceleration values for the origin reset position control mode (HM). The deceleration function of the Origin Reset Position Control Mode (HM) is also applied to this object. When the original method reaches its final stop (i.e., when the origin position is detected), the servo lock stops without using the preset value of this object.						
60C6h	00h	Max deceleration maximal acceleration	instruction units/s²	0~ 4294967295	U32	rw	RxPDO	PP HM CSP
		Set maximum deceleration. If set to 0, internal processing is treated as an 1 operation.						

1) Quick parking mode selection (605Ah)

Set the motor deceleration stop method for the PDS command "Quick Stop" during reception.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO	OP-mode
605Ah	00h	Quick stop option code	-	0~7	I16	rw	NO	ALL
		pp, csp, csv, pv 0: After the servo-side motor stops (Sequence at Servo-off), transition to Switch						

		on disabled. 1: After the motor stops at 6084h (Profile deceleration), switch to 'Switch on disabled'. 2: After the motor stops via 6085h (Quick stop deceleration), switch to 'Switch on disabled'. 3: After the motor stops at 60°C for 6 hours (maximum deceleration), switch to the 'Switch on disabled' mode. 5: After the motor stops at 6084h (Profile deceleration), switch to Quick Stop Active mode. 6: After the motor stops via 6085h (Quick stop deceleration), switch to Quick stop active. 7: After the motor stops at 60°C6h (maximum deceleration), switch to Quick Stop Active mode. hm 0: After the servo-side motor stops (Sequence at Servo-off), transition to Switch on disabled. 1: After the 609Ah (Homing acceleration) motor stops, the system switches to Switch on disabled mode. 2: After the motor stops via 6085h (Quick stop deceleration), switch to 'Switch on disabled'. 3: After the motor stops at 60°C for 6 hours (maximum deceleration), switch to the 'Switch on disabled' mode. 5: After the 609Ah (Homing acceleration) motor stops, the system switches to Quick Stop Active mode. 6: After the motor stops via 6085h (Quick stop deceleration), switch to Quick stop active. 7: After the motor stops at 60°C6h (maximum deceleration), switch to Quick Stop Active mode. cst, tq 0: After the motor stops at the Servo-off sequence, transition to Switch on disabled. 1,2: After the motor stops at 6087h (Torque slope), switch to 'Switch on disabled'. 3: After the torque 0 motor stops, switch to 'Switch on disabled'. 5,6: After the motor stops at 6087h (Torque slope), the system switches to Quick Stop Active mode. 7: After the torque 0 motor stops, switch to Quick Stop Active.

Example of using the Quick Stop command to slow down and stop:

A: When bit2 (Control word: quick stop) transitions from 1 to 0 at 6040Hz, the system initiates deceleration and stops.

During deceleration, the PDS status transitions to Quick Stop Active.

B: The motor stops when the detected speed falls below 10 r/min.

After stopping, the PDS status becomes either Switch on disabled or Quick stop active.

2) Power-off option code (605Bh)

Set the motor deceleration and stop method when receiving PDS commands "Shutdown" and "Disable voltage".

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO	OP-mode
605Bh	00h	Shutdown option code	-	0~1	I8	rw	RxPDO	ALL
		Sets the timing for receiving PDS commands "Shutdown" and "Disable voltage", which varies according to the control mode definition. Prohibited except for the following values. (1) When the PDS command "Shutdown" is received pp, csp, csv, pv 0: After the servo-side motor (Sequence at Servo-off) stops, transition to Ready to switch on. 1: After the motor stops at 6084h (Profile deceleration), transition to Ready to switch on. hm 0: After the servo-side motor (Sequence at Servo-off) stops, transition to Ready to switch on. 1: After the 609Ah (Homing acceleration) motor stops, transition to Ready to switch on. cst, tq 0: After the servo-side motor (Sequence at Servo-off) stops, transition to Ready to switch on. 1: After the motor stops at 6087h (Torque slope), transition to Ready to switch on. (2) When the PDS command "Disable voltage" is received pp, csp, csv, pv 0: After the motor stops at the Servo-off sequence, transition to Switch on disabled. 1: After the motor stops at 6084h (Profile deceleration), switch to 'Switch on disabled'. hm 0: After the motor stops at the Servo-off sequence, transition to Switch on disabled. 1: After the 609Ah (Homing acceleration) motor stops, the system switches to Switch on disabled mode. cst, tq 0: After the motor stops at the Servo-off sequence, transition to Switch on disabled. 1: After the motor stops at 6087h (Torque slope), switch to the 'Switch on disabled' state.					

Example of deceleration stop action triggered by shutdown command:

A: If the PDS command "Shutdown" is received, the system will begin to slow down and stop.
The PDS status remains Operation enabled during deceleration.
B: The motor stops when the detected actual speed is below 10 r/min.
The PDS status after stopping is Ready to switch on.

3）Disable operation option code（605Ch）

Set the motor deceleration and stop method when receiving the PDS command "Disable operation".

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO	OP-mode
605Ch	00h	Disable operation option code	-	0~1	I8	rw	RxPDO	ALL
		Sets the timing for receiving the PDS command "Disable operation". The timing varies depending on the control mode. Prohibited except for the following values. pp, csp, csv, pv 0: After the motor stops at the Servo-off sequence, transition to Switched on. 1: After the motor stops at 6084h (Profile deceleration), the system transitions to the Switched on state. hm 0: After the motor stops at the Servo-off sequence, transition to Switched on. 1: After the 609Ah (Homing acceleration) motor stops, the system transitions to the Switched on state. cst, tq 0: After the motor stops at the Servo-off sequence, transition to Switched on. 1: After the motor stops at 6087h (Torque slope), switch to Switched on.						

An example of stopping the deceleration action using the Disable operation command.
A: When the PDS command "Disable operation" is received, the system initiates deceleration and stops.
The PDS status remains Operation enabled during deceleration.
B: The motor will stop when the detected speed drops below 10 r/min.
The PDS status bit is switched on after stopping.

4）Halt option code（605Dh）

When bit8 (Halt) of control word 6040h is set to 1, the motor deceleration stop method is activated.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO	OP-mode
605Dh	00h	Halt option code	-	1~3	I16	rw	NO	ALL

		Sets the timing for receiving the PDS command "Disable operation". The timing varies depending on the control mode. Prohibited except for the following values. Set the timing for the Halt action, which varies depending on the control mode definition. Prohibited except for the following values. pp, csp, csv, pv 1: After the motor stops at 6084h (Profile deceleration), keep Operation enabled. 2: After the motor stops via 6085h (Quick stop deceleration), keep Operation enabled. 3: After the motor stops at 6072h (Maximum Torque) and 60C6h (Maximum Deceleration), the Operation enabled state remains. hm 1: After the 609Ah (Homing acceleration) motor stops, the system remains in Operation enabled mode. 2: After the motor stops via 6085h (Quick stop deceleration), keep Operation enabled. 3: After the motor stops at 6072h (maximum torque) and 60C6h (maximum deceleration), the Operation enabled state remains. cst, tq 1,2: After the motor stops at 6087h (Torque slope), keep Operation enabled. 3: After the torque 0 motor stops, keep Operation enabled.

Example of stopping motion with Halt function

A: When 6040h:bit8 (Controlword: halt) transitions from 0 to 1, the system initiates deceleration and halts. The PDS state during deceleration remains Operation enabled.

B: The motor will stop when the detected actual speed falls below 10 r/min. The PDS status remains Operation enabled after stopping.

5) Fault reaction option code (605Eh)

Set the method of motor stop when alarm occurs.

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO	OP-mode
605Eh	00h	Fault reaction option code	-	0~2	I16	rw	NO	ALL
		Set the timing for alarm triggers, which varies by control mode. Do not set beyond the specified value. (1) When Err80.0 ~ 80.7, 81.0 ~ 81.7, 85.0 ~ 85.7, or 88.0 ~ 88.7 occurs pp, csp, csv, pv						

		0: After the servo-side (Sequence at alarm) motor stops, the system transitions to Fault mode. 1: After the motor stops at 6084h (Profile deceleration), the system transitions to Fault mode. 2: After the motor stops via 6085h (Quick stop deceleration), the system transitions to Fault mode. hm 0: After the servo-side (Sequence at alarm) motor stops, the system transitions to Fault mode. 1: After the 609Ah (Homing acceleration) motor stops, the system transitions to Fault mode. 2: After the motor stops via 6085h (Quick stop deceleration), the system transitions to Fault mode. cst，tq 0: After the servo-side (Sequence at alarm) motor stops, the system transitions to Fault mode. 1,2: After the motor stops at 6087h (Torque slope), the system transitions to Fault mode. (2) When an alarm occurs that is not specified in the above (1) section: 0,1,2: After the servo-side (Sequence at alarm) motor stops, transition to Fault.

Example of the action of deceleration and stopping according to the alarm

A: If an alarm is triggered, the system will begin decelerating and eventually stopping. During deceleration, the PDS status remains 'Fault reaction active'.

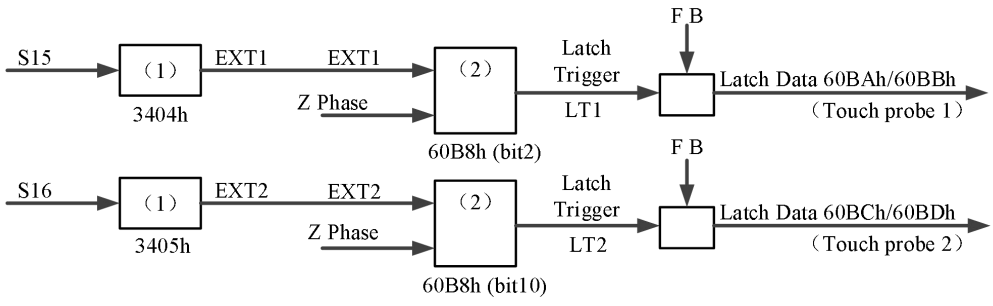
B: The motor will stop when the detected speed is below 10 r/min. The PDS status will be set to Fault after stopping.

7.9.3 Probe Function (Position Clamping Request/Release)

The probe function is a position latch function. When the trigger condition (EXT1/EXT2) is met, the probe function is activated and the motor encoder value at the trigger point is latched. Depending on the setting of the probe control word 60B8, single or multiple triggers can be achieved.

- Probe function is not supported in hm mode.
- Only external signals can be used as trigger sources.

1) The composition of probe functions



60B8h: Touch probe function

60BAh: Touch probe position 1 (the rising edge clamping position of Touch probe1)
60BBh: Touch probe 1's falling edge clamping position
60BCh: Touch probe 2's rising edge clamping position
60BDh: Touch probe 2's falling edge clamping position
If the trigger position is at the same point of the motor rotation, the difference between the two latch probe values should be the number of pulses emitted by the motor encoder in one cycle.
It should be noted that there is a certain time from the generation of the external trigger signal to the driver receiving the signal and executing the latch operation. Therefore, the value latched by the probe will inevitably have an error compared to the actual value. The magnitude of this error is related to the motor's speed, hardware performance, and software processing.

Function usage notes:

(1) The clamping trigger signal uses external inputs (EXT1/EXT2), with P5-62 and P5-63 designated for Touch Probe1 and Touch Probe2 respectively. The default driver probe parameters are listed in the table below.

product model	出厂默认值		Probe function settings	
	P5-62	P5-63	P5-62 (Terminal)	P5-63 (Terminal)
DM6C	0	0	1（SI1）	2（SI2）

60B8h (probe function)			
Bit10	LT2	Bit2	LT1
0	EXT2	0	EXT1
1	Z Xiang	1	Z Xiang

(2) If the Touch probe is executed on an unallocated port, E-883 (abnormal operation protection) will be triggered.
(3) When the clamping trigger signal is an external input (EXT1/EXT2), acquisition errors may occur. Keep the speed near the clamping signal input as low as possible.
(4) The ON and OFF durations of the clamping trigger signal input must each exceed 2ms.
(5) The touch probe is invalid (canceled) in the following cases. (The value of 60B9h is cleared).

① ESM status is Init

② Switching to HM mode

(6) Do not set both rising and falling edges for the same Touch Probe. This may cause the device to fail to respond when both edges are configured simultaneously.
(7) It should be noted that there is a certain time from the generation of the external trigger signal to the driver receiving the signal and performing the latch operation. Therefore, the value latched by the probe will inevitably have an error compared to the actual value, and the magnitude of this error is related to the motor's speed, hardware performance, and software processing.

2) Probe-related objects

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO
60B8h	00h	Probe function settings	-	0~65535	U16	rw	RxPDO
60B9h	00h	Indicates the status of the Touch probe function	-	0~65535	U16	ro	TxPDO
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the falling edge clamping position of Touch probe1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO

3) Probe function settings (60B8h)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO	OP-mode
60B8h	00h	Touch probe function	-	0~65535	U16	rw	RxPDO	ALL
		Set up the Touch probe function.						

corresponding bit description

bit	price	annotate	
0	0	Switch off touch probe 1	Touch Probe 1 Run/Stop
	1	Enable touch probe 1	
1	0	Trigger first event	Touch Probe 1 event mode selection
	1	Continuous	
2	0	Trigger with touch probe 1 input	Touch Probe 1 Trigger selection (external input/Z phase)
	1	Trigger with zero impulse signal of position encoder	
3	-	Reserved	unused
4	0	Switch off sampling at positive edge of touch probe 1	Touch Probe 1 rising edge selection
	1	Enable sampling at positive edge of touch probe 1	
5	0	Switch off sampling at negative edge of touch probe 1	Touch Probe 1 falling edge selection
	1	Enable sampling at negative edge of touch probe 1	
6-7	-	Not Supported	unused
8	0	Switch off touch probe 2	Touch Probe 2

bit	price	annotate	
	1	Enable touch probe 2	Run/Stop
9	0	Trigger first event	Touch Probe 2 event mode selection
	1	Continuous	
10	0	Trigger with touch probe 2 input	Touch Probe 2 Trigger selection (external input/Z phase)
	1	Trigger with zero impulse signal of position encoder	
11	-	Reserved	unused
12	0	Switch off sampling at positive edge of touch probe 2	Touch Probe 2 rising edge selection
	1	Enable sampling at positive edge of touch probe 2	
13	0	Switch off sampling at negative edge of touch probe 2	Touch Probe 2 falling edge selection
	1	Enable sampling at negative edge of touch probe 2	
14-15	-	Not Supported	unused

Do not set both rising and falling edges under the same probe.

4) Probe function status (60B9h)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO	OP-mode
60B9h	00h	Touch probe status	-	0~65535	U16	ro	TxPDO	ALL
		Indicates the status of the Touch probe function.						

corresponding bit description

bit	price	annotate	
0	0	Touch probe 1 is switch off	Touch Probe 1 action stopped
	1	Touch probe 1 is enabled	Touch Probe 1 is in action
1	0	Touch probe 1 no positive edge value stored	The rising edge of Touch Probe 1 is incomplete
	1	Touch probe 1 positive edge value stored	Completion status of the rising edge on Touch Probe 1
2	0	Touch probe 1 no negative edge value stored	The falling edge of Touch Probe 1 is incomplete
	1	Touch probe 1 negative edge value stored	Completion status of the falling edge on Touch Probe 1
3-5	-	Reserved	unused
6-7	-	Not Supported	unused
8	0	Touch probe 2 is switch off	Touch Probe 2 action stopped
	1	Touch probe 2 is enabled	Touch Probe 2 is in action
9	0	Touch probe 2 no positive edge value stored	The rising edge of Touch Probe 2 is incomplete
	1	Touch probe 2 positive edge value stored	Completion status of the rising edge on Touch Probe 2

bit	price	annotate	
10	0	Touch probe 2 no negative edge value stored	The falling edge of Touch Probe 2 is incomplete
	1	Touch probe 2 negative edge value stored	Completion status of the falling edge on Touch Probe 2
11-13	-	Reserved	unused
14-15	-	Not Supported	unused

5) Obtained clamp positions (0x60BA~0x60BD)

index of matrix	son index of matrix	name	unit	scope	data type	Available inquisitive	PDO	OP-mode
60BAh	00h	Touch probe pos1 pos value	instruct unit	-2147483648~2147483647	I32	ro	TxPDO	ALL
		Indicates the rising edge clamping position of Touch probe1.						
60BBh	00h	Touch probe pos1 neg value	instruct unit	-2147483648~2147483647	I32	ro	TxPDO	ALL
		Indicates the clamping position of the falling edge of Touch probe1.						
60BCh	00h	Touch probe pos2 pos value	instruct unit	-2147483648~2147483647	I32	ro	TxPDO	ALL
		Indicates the rising edge clamping position of Touch probe2.						
60BDh	00h	Touch probe pos2 neg value	instruct unit	-2147483648~2147483647	I32	ro	TxPDO	ALL
		Indicates the clamping position of the falling edge of Touch probe2.						

6) Start of probe action

During the transition from '0 (stop) to 1 (start)' for bit0/8 (Touch probe execution/stop) in 60B8h (probe function setting), the system acquires various configuration parameters (60B8h: bit1-7 and bit9-15) and initiates the Touch probe operation.
To activate changes in various settings, set bit0 and bit8 to "0 (stop)" and then switch to "1 (start)".
To switch control mode and use the probe function, set bit0 and bit8 to 0 (stop) and then to 1 (start).

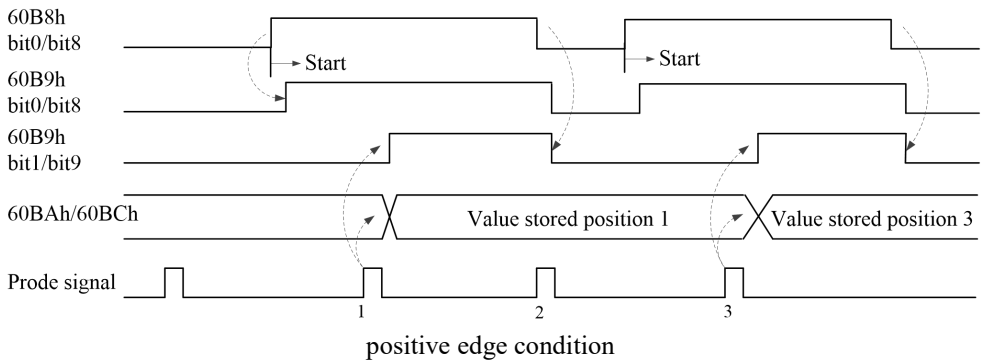
7) Event pattern of probe

Based on the bit1 and bit9 (event mode selection) of 60B8h (probe function setting), you can select either "0 (Trigger first event mode)" or "1 (Continuous mode)".

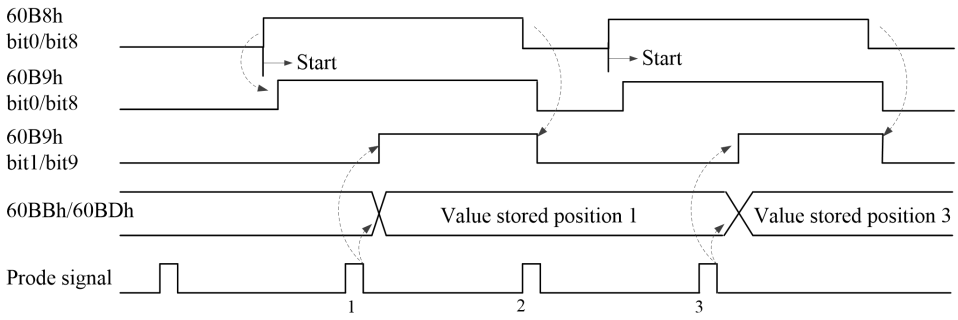
(1) <Trigger first event mode> (60B8h: bit1=0 / bit9=0)

After startup, the mode is set only by the first trigger signal. To retrieve it again, you must restart the

Touch probe.



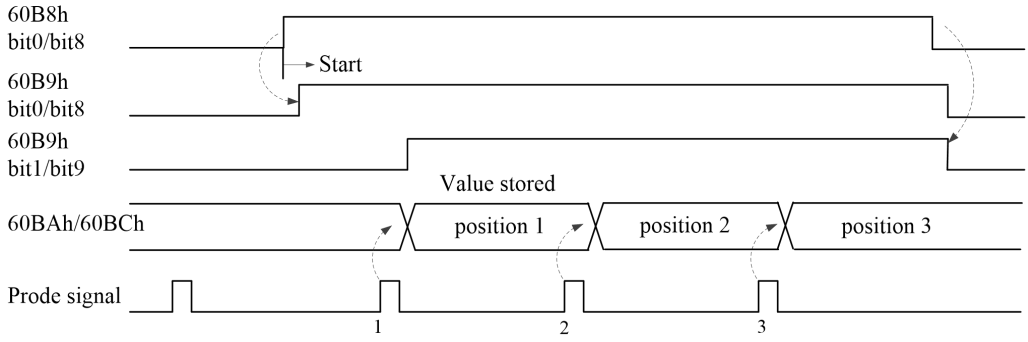
positive edge condition



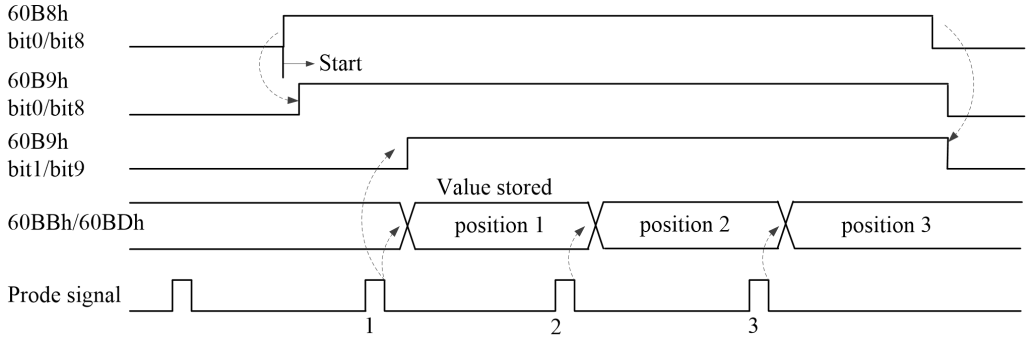
Negative edge condition

(2) <Continuous mode> (60B8h: bit1=1 / bit9=1)

After startup, this mode triggers the bit set signal each time. The obtained value is retained until the next Probe signal.



positive edge condition



Negative edge condition

7.9.4 Digital Input (60FDh)

The 60FDh digital input's bits are assigned functional signals through parameters P5-22 (POT setting address), P5-23 (NOT setting address), P5-27 (HOME origin setting address), P5-62 (Probe 1 setting address), and P5-63 (Probe 2 setting address) of the DM6C series servo, representing the input states of the positive limit switch (POT), negative limit switch (NOT), home switch (HOME), Touch probe 1, and Touch probe 2 respectively.

Digital input (60FDh)

<table>
<tr><th>index of matrix</th><th>son
index of matrix</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">60FDh</td><td rowspan="2">00h</td><td>Digital inputs</td><td>0~4294967295</td><td>U32</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">It represents the theoretical input state of the external input signal.
bit information
<table>
<tr><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td></tr>
<tr><td colspan="8">r</td></tr>
<tr><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td></tr>
<tr><td colspan="4">r</td><td>ris4</td><td>ris3</td><td>ris2</td><td>ris1</td></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="8">r</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="2">r</td><td>Zos</td><td>tp2</td><td>tp1</td><td>hs</td><td>pls</td><td>nls</td></tr>
</table>
r = reserved (not mapped)
pls= positive limit switch (positive limit switch)
nls = Negative Limit Switch (NLS)
hs=home switch (origin switch)
tp1=Touch Probe 1
tp2=Touch probe 2 (Probe 2)
zos: zero impulse signal output (Z-phase output)
ris1= remote input state1 (Remote SI Input State 1)
ris2= remote input state2 (Remote SI Input State 2)
ris3= remote input state3 (Remote SI Input State 3)
ris4= remote input state4 (Remote SI Input State 4)</td></tr>
</table>

Details of each Bit are as follows:

numeric value	description
0	input mode OFF
1	input mode ON

The 60FD's digital input configuration specifies: bit0 (reverse overtravel switch), bit1 (forward overtravel switch), bit2 (origin switch), bit3 (probe 1), bit4 (probe 2), bit5 (Z-phase output), bit16 (remote SI input 1), bit17 (remote SI input 2), bit18 (remote SI input 3), and bit19 (remote SI input 4) as signal states for positive drive limit, negative drive limit, near-origin input, probe 1 input, probe 2 input, Z-phase output, and remote SI inputs 1-4 respectively.

The Z-phase output hold time is adjusted via driver parameters.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P5-19	Z phase output hold time	2	ms	1 ~ 65535	at any time	immediately

The output of Z phase is affected by the EtherCAT communication cycle and its own software processing, resulting in poor consistency.

7.9.5 Digital Output (60FEh)

In digital output 60FEh, bit0 in sub-object word 1 indicates the zero-crossing Z-phase output status bit, while bit0 in sub-object word 2 indicates the zero-crossing Z-phase output enable bit. When the encoder crosses zero, setting the Z-phase output enable bit to 1 causes the Z-phase output status bit to transition from 0 to 1. After the hold time specified by P5-19, the Z-phase output status bit returns to 0. If the Z-phase output enable bit is set to 0, no Z-phase output status is generated, and the Z-phase output status bit remains at 0.

Digital output (60FEh)

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="10">60FEh</td><td>00h</td><td>Number of entries</td><td>2</td><td>U8</td><td>ro</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">The number of sub-indexes with 60FEh.</td></tr>
<tr><td rowspan="9">01h</td><td>Physical outputs</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="7">Indicates the output status of an external output signal.
bit information
<table>
<tr><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td></tr>
<tr><td colspan="8">r</td></tr>
<tr><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td></tr>
<tr><td colspan="5">r</td><td>ros3</td><td>ros2</td><td>ros1</td></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="8">r</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="8">r</td></tr>
</table>
r = reserved (not mapped)
ros1= remote output state1 (Remote SO Output State 1)
ros2= Remote Output State 2 (Remote SO Output Status 2)
ros3 = Remote Output State 3 (Remote SO Output Status 3)</td></tr>
<tr><td rowspan="9">60FEh</td><td rowspan="9">02h</td><td>Bit mask</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="7">It indicates the function of the output host for setting external output signals.
bit information
<table>
<tr><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td></tr>
<tr><td colspan="8">r</td></tr>
<tr><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td></tr>
<tr><td colspan="5">r</td><td>roe3</td><td>roe2</td><td>roe1</td></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
</table></td></tr>
</table>

		r 7 6 5 4 3 2 1 0 r r = reserved (not mapped) roe1= remote output enable1 (Remote SO Output Enable 1) roe2= remote output enable2 (Remote SO Output Enable 2) roe3 = Remote Output Enable 3

Details of each Bit are as follows:

Subindex 01h：Physical outputs

bit	name	numeric value	description
16	Remote SO1 output status bit	0	Remote SO1 status is OFF
		1	Remote SO1 status ON
17	Remote SO2 output status bit	0	Remote SO2 status is OFF
		1	Remote SO2 status ON
18	Remote SO3 output status bit	0	Remote SO3 status OFF
		1	Remote SO3 status ON

Subindex 02h：Bit mask

bit	name	numeric value	description
16	Remote SO1 output enable bit	0	Remote SO1 output enabled OFF
		1	Remote SO1 output enabled ON
17	Remote SO2 output enable bit	0	Remote SO2 output enabled OFF
		1	Remote SO2 output enabled ON
18	Remote SO3 output enable bit	0	Remote SO3 output enabled OFF
		1	Remote SO3 output enabled

In digital output 60FEh, Subindex 01h (subobject word 1) has bits 16,17, and 18 representing the remote SO1 output status bits, while Subindex 02h (subobject word 2) contains bits 16,17, and 18 indicating the remote SO1, SO2, and SO3 output enable bits respectively.

7.9.6 Location Information

1) The initialization time for location information

This servo driver initializes the position-related object under the following timing sequence.

- Initialization sequence (conditions)
  - When the power supply is turned on
  - Communication establishment (ESM state Init→OP migration)
  - When the origin reset is completed
  - When the absolute multi-turn reset is performed
- Initialize object
  - 6062h (Position demand value)
  - 6063h (Position Actual Internal Value feedback)
  - 6064h (Position Actual Value Position Feedback)
  - 60FCh (Position Demand Internal Value)

The system utilizes actual internal position feedback (6063h) from the motor's feedback mechanism. The electronic gear function subsequently adjusts Home offset based on polarity change signals, with all parameters preconfigured during initial communication setup.
Furthermore, adjustments to electronic gear ratios, polarity settings (Polarity command), and home offset values are implemented according to the timing sequence detailed in the latter part of this chapter.

For details on using absolute encoders, refer to Section 4 'Initialization of Absolute Encoders' in this chapter.

2) Electronic gear ratio

(1) Function Description

The electronic gear multiplies the position command from the upper input with the electronic gear ratio set by the object, which functions as the position command of the position control unit. By using this function, the motor rotation or movement amount of each command unit can be set arbitrarily.

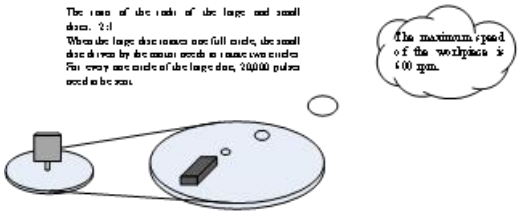
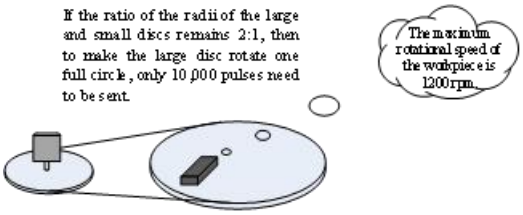
(2) Method of setting electronic gear ratio of DM6C series

Method 1: Set the electronic gear ratio according to the internal parameters of the servo.

The so-called "electronic gear" function has two main applications:

(1) Determine the number of command pulses required for the motor to complete one full rotation, ensuring the motor reaches the target speed.

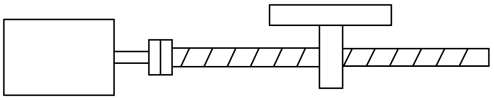
The following example uses a 19-bit encoder motor, with the PLC host computer sending pulses at 200kHz.

Set the pulse count per revolution to 10000 The electronic gear ratio is set to 524288:10000	Set the pulse count per revolution to 5000 The electronic gear ratio is set to 524288:5000
	

(2) In the precise positioning, the physical unit length corresponding to the 1 instruction pulse is set to

facilitate calculation.

As shown in the figure, if a unit pulse is designated to move the workpiece by 1μm, the load axis requires 6000 command pulses (6mm/1μm) to complete one full rotation. For a 1:1 reduction ratio, the system can directly set the pulse count per revolution as P0-11=6000 and P0-12=0. The host computer then issues 6000 pulses to move the workpiece by 6mm (refer to steps 1-6 for detailed calculation).



Encoder: 524288 (19 bits) Screw pitch: 6mm

Do not change the electronic gear ratio	Change the electronic gear ratio
Without adjustment, the electronic gear ratio motor completes 524,288 pulses per rotation (P0-11=0, P0-12=0). For a motor rotation of 1 full turn moving the workpiece by 6mm, 524288 pulses are required. To move the workpiece by 10mm, 10/6×524288=873813.333 pulses are needed. However, rounding down the actual pulse count during transmission causes measurement errors.	By adjusting the electronic gear ratio, the motor requires 6000 pulses to complete one full rotation. For a motor with a 6000-pulse-per-turn capacity, a 6mm workpiece movement requires 6000 pulses. When moving the workpiece 10mm, the required pulses increase to 10000 (10/6×6000). Since actual pulse transmission avoids decimal precision, this eliminates measurement errors.

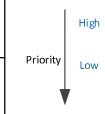
- relevant parameter

parameter	meaning	factory setting	unit	Set range	revise	come into force
P0-11	Pulses per revolution*1	0	pul	0～9999	servo OFF	immediately
P0-12	Pulses per revolution × 10000	0	pul	0～9999	servo OFF	immediately
P0-13	electronic gear ratio	1	-	0～65535	servo OFF	immediately
P0-14	Electronic gear ratio (denominator)	1	-	0～65535	servo OFF	immediately
P0-92	Second set of electronic gear ratios (molecule) low position*1	1	-	1～9999	○（pattern 5） √（pattern	immediately

parameter	meaning	factory setting	unit	Set range	revise	come into force
					6))	
P0-93	Second set of electronic gear ratios (molecule) high position*10000	0	-	1 ~ 65535	○ (pattern 5) √ (pattern 6)	immediately
P0-94	Second set of electronic gear ratios (denominator) lower bit*1	1	-	1 ~ 9999	servo OFF	immediately
P0-95	Second set of electronic gear ratios (denominator) high*10000	0	-	1 ~ 65535	servo OFF	immediately

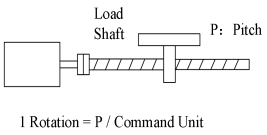
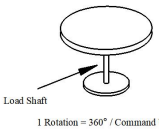
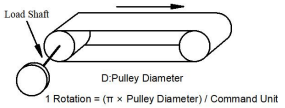
- The parameters P0-11 to P0-14 are all related to the electronic gear ratio. P0-11 and P0-12 form one group, while P0-13 and P0-14 form another. However, the priority of the pulse count per revolution for P0-11 and P0-12 is higher than that of the electronic gear ratio P0-13 and P0-14. The electronic gear ratio P0-13 and P0-14 will only be activated when both P0-11 and P0-12 are set to 0.
- When P0-11, P0-12, P0-13, and P0-14 are all set to 0, P0-92, P0-93, P0-94, and P0-95 will be activated.

Calculation of Pulse Count per Revolution and Electronic Gear Ratio

step	content	explain
1	Confirm the mechanical specifications	Verify the reduction ratio n:m (where the servo motor rotates m turns and the load shaft rotates n turns), ball screw pitch, pulley diameter, etc.
2	Verify encoder pulse count	Confirm the encoder resolution of the servo motor used.
3	decision unit	One pulse of the decision command controller corresponds to the actual running distance or angle.
4	Instruction count for one rotation of the load shaft	Calculate the command quantity N for one full rotation of the load shaft based on the decision unit.
5	Pulse Count M for One Revolution of Computer Shaft	The number of command pulses for a full rotation of the motor shaft is M = N/(m/n).
6	Set the pulse count per revolution (P0-11/P0-12) or the electronic gear ratio (P0-13/P0-14) / (P0-92~95)	P0-11=M%10000 P0-12=M/10000 $\frac{P0-13}{P0-14}=\frac{Encoder\ Resolution}{M}=\frac{Encoder\ Resolution\times m}{N\times n}$ 

- In Step 6, the pulse count per revolution determines the activation priority. When the pulse count per revolution exceeds the electronic gear ratio, the system activates P0-13~P0-14 only if P0-11~P0-12 are all zero. In special cases where the calculated pulse count per revolution is a decimal value, the electronic gear ratio should be considered.
- When P0-13 and P0-14 exceed the preset range, reduce the electronic gear ratio's numerator and denominator. If the ratio still exceeds the parameters after reduction, activate the second gear ratio set (P0-92 ~ P0-95). The second gear ratio only takes effect when P0-11 ~ 14=0.
- The DM6C series servo motor encoders offer resolution options of 524288 (19-bit) and 8388608 (23-bit).
- The command unit does not equate to machining precision. Refining the command unit based on mechanical precision can enhance the servo's positioning accuracy. For example, when using a lead screw, the mechanical precision can reach 0.01mm. In this case, a 0.01mm command unit is more precise than a 0.1mm command unit.

Example of setting electronic gear

step	name	ball screw	circular truncated cone	belt and pulley
				
1	Confirm the mechanical specifications	Ball screw pitch 6mm Mechanical gear ratio: 1:1	1 rotation per 360 degrees, 1:3 reduction ratio	The pulley diameter is 100mm. Reduction ratio: 1:2
2	Verify encoder pulse count	Encoder resolution: 131072	Encoder resolution: 131072	Encoder resolution: 131072
3	decision unit	1 instruction unit: 0.001mm	1 instruction unit: 0.1 degree	1 instruction unit: 0.02mm
4	Instruction count for one rotation of the load shaft	6mm/0.001mm=6000	360/0.1=3600	314mm/0.02mm=15700
5	Pulse Count M for One Revolution of Computer Shaft	M =6000/(1/1)=6000	M=3600/(3/1)=1200	M=15700/(2/1)=7850
6	Set the number of pulses per cycle P0-11/P0-12	P0-11=6000 P0-12=0	P0-11=1200 P0-12=0	P0-11=7850 P0-12=0

	set the gear ratio (P0-13/P0-14)/(P0-92~95)	P0-13=131072 P0-14=6000 After reduction P0-13=8192 P0-14=375	P0-13=131072 P0-14=1200 After reduction P0-13=8192 P0-14=75	P0-13=131072 P0-14=7850 After reduction P0-13=65536 P0-14=3925 Convert to second gear ratio P0-92=5536 P0-93=6 P0-94=3925 P0-95=0

Method 2: Set the electronic gear ratio according to the CoE (CiA402) specifications for Object 608Fh (Position Encoder Resolution), 6091h (Gear Ratio), and 6092h (Feed Constant).

The following section details the configuration of electronic gear ratios based on CoE (CiA402) standards.

The relationship between user-defined units (instruction units) and internal units (pulses) is calculated using the following equation.

Formula for calculating electronic gear ratios:

$$\text{Electronic gear ratio} = \frac{\text{Position encoder resolution} \times \text{Gear ratio}}{\text{Feed constant}}$$

$$\text{Position encoder resolution} = \frac{\text{608F: 01 (encoderincrements)}}{\text{608F: 02 (motorrevolutions)}}$$

$$\text{Gear ratio} = \frac{\text{6091: 01 (Motorrevolutions)}}{\text{6091: 02 (Shaftrevolutions)}}$$

$$\text{Feed constant} = \frac{\text{6092: 01 (Feed)}}{\text{6092: 02 (Shaftrevolutions)}}$$

Position demand value (6062h) ×Electronic gear ratio=Position demand internal value (60FCh)

- The electronic gear ratio is effective in the range of 8000 to 1/1000.

If a value outside the range saturates within the range, E-883 (abnormal operation protection) occurs.

- 608Fh-01h (Encoder increments) is automatically set according to the encoder resolution. The factory default value of 6092h-01h (Feed) is also determined by the encoder resolution.
- The setting of electronic gear ratio is reflected by the following timing.
  - When the power supply is turned on
  - Communication establishment (ESM state Init→OP migration)
  - When the origin reset is completed
  - When the absolute multi-turn reset is performed
- This does not reflect changes in the set values of associated objects. Please note.
  - For absolute mode initialization of position information during Init⇒Op, the absolute encoder position value (pulse/unit) or electronic gear ratio must be set within the range of-2^31 (-2147483648) to +2^31-1 (2147483647). Operations outside this range cannot be guaranteed.

- Check the position range and gear ratio of the absolute encoder.
- Use the electronic gear ratio setting in Cia402 protocol as much as possible.

- relevant parameter

Position encoder resolution (608Fh)

index of matrix	subindex	name	unit	scope	data type	Available inquisitive	PDO	OP-mode
608Fh	-	Position encoder resolution	-	-	-	-	-	-
		The encoder resolution is automatically set.						
	00h	Highest sub-index supported	-	2	U8	ro	NO	ALL
		The number of subindexes for 608Fh.						
	01h	Encoder increments	Pulse	1~4294967295	U32	ro	NO	ALL
		Represents the encoder movement amount. The value is automatically set by the encoder resolution.						
	02h	Motor revolutions	r（any power-generating or power-driven machine）	1~4294967295	U32	ro	NO	ALL
		Indicates the motor rotation count. The value is fixed to 1.						

This object defines the encoder resolution per motor rotation.
Position encoder resolution = Encoder increments (608Fh-01h) / Motor revolutions (608Fh-02h)

This object is automatically set based on the information read from the motor connected to the servo driver.
Example: 17-bit/r encoder connection scenario

608Fh-01h（Encoder increments）= 130172

608Fh-02h（Motor revolutions）= 1

Position encoder resolution = 131072 / 1 = 131072

Gear ratio (6091h)

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO	OP-mode
6091h	-	Gear ratio	-	-	-	-	-	-
		Set the gear ratio.						
	00h	Highest sub-index supported	-	2	U8	ro	NO	ALL
		The number of subindexes for 6091h.						
	01h	Motor revolutions	Pulse	1~4294967295	U32	rw	NO	ALL
		Set the motor rotation speed.						
	02h	Shaft revolutions	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO	ALL
		Set the axis rotation number.						

This object defines the motor speed and the shaft speed after the gearbox output.
Gear ratio = Motor shaft revolutions (6091h-01h) / Driving shaft revolutions (6091h-02h)

Feed constant（6092h）

index of matrix	subindex	name	unit	scope	data type	accessibility	PDO	OP-mode
6092h	-	Feed constant	-	-	-	-	-	-
		Set the feed constant.						
	00h	Highest sub-index supported	-	2	U8	ro	NO	ALL
		The number of subindexes for 6092h.						
	01h	Feed	command unit	1~4294967295	U32	rw	NO	ALL
		Set the feed amount.						
	02h	Shaft revolutions	r（any power-generating or power-driven machine）	1~4294967295	U32	rw	NO	ALL
		Set the axis rotation number.						

This object represents the action amount of the gear box output shaft per rotation.

Feed constant =Feed（6092h-01h）/ Driving shaft revolutions（6092h-02h）

3) Instruction polarity (607Eh)Polarity

For position, speed, torque commands and their offsets, the polarity (motor rotation direction) can be set. The DS5C2 series executes rotation direction setting according to the object polarity command (607Eh) specified in CoE (CiA402). However, the object polarity command (607Eh) in CoE (CiA402) changes with the rotation direction set by parameter P0-05. For example, when P0-05 is set to 1, the object word 607Eh in CiA402 becomes 0xE0, allowing the driver to perform reverse motion. When P0-05 is set to 0, the object word 607Eh becomes 0, and the driver returns to the default forward motion.

Furthermore, the object polarity instruction (607Eh) does not directly replace parameter P0-05 (rotation direction setting). This applies when the CoE (CiA402) processing unit and motor control unit exchange object data as specified in the table below.

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>unit</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>OP-mode</th></tr>
<tr><td rowspan="2">607Eh</td><td rowspan="2">00h</td><td>Polarity instruction polarity</td><td>-</td><td>0~255</td><td>U8</td><td>rw</td><td>NO</td><td>ALL</td></tr>
<tr><td colspan="7">Set the polarity of the position command, speed command, torque command, position offset, speed offset (speed addition), torque offset (torque addition) values from the object to the internal processing, and set the polarity of the position feedback, speed feedback, torque feedback values from the internal processing to the object.
Note: For this object, set the position, speed, and torque polarity to 0 (bit7-5=all 0) or 224 (bit7-5=all 1).
Actions under other settings cannot be guaranteed.
<table>
<tr><th>set value</th><th>content</th></tr>
<tr><td>0</td><td>The signs of position, speed, and torque are not reversed</td></tr>
<tr><td>224</td><td>The signs of position, speed, and torque are reversed</td></tr>
<tr><td>Above</td><td>Not supported (do not set)</td></tr>
</table>
bit7: Position polarity
0: No reversal 1: Reversal
bit6: speed polarity
0: No reversal 1: Reversal
bit5: Torque polarity
0: No reversal 1: Reversal
bit4-0: Reserved. Set to 0

Object <Directive·Setting Class>

·607Ah (Target position)

·60B0h（Position offset）

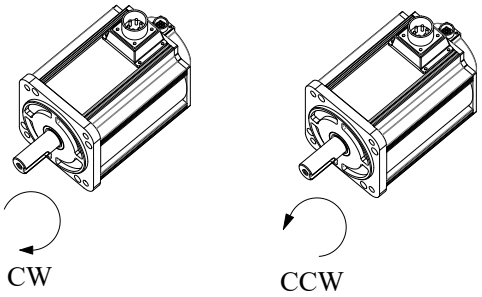
·60FFh（Target velocity）</td></tr>
</table>

		·60B1h（Velocity offset） ·6071h (Target torque set) ·60B2h（Torque offset） <Monitoring Category> ·6062h (Position demand value) ·6064h (Position Actual Value Position Feedback) ·606Bh（Velocity demand value） ·606Ch (Velocity actual value speed feedback) ·6074h（Torque demand） ·6077h (Torque actual value) ·6078h (Current actual value)

No symbol reversal: The motor rotates counterclockwise (CCW) when the command is in the forward direction.

The symbol is reversed: the motor rotates clockwise (CW) when the command is in the forward direction.

The rotation direction of the motor is defined as clockwise (CW) and counterclockwise (CCW) when viewed from the load-side shaft end.



4) Initialization of absolute encoders

In position control mode, absolute encoders require no origin reset (except when used as incremental encoders). After battery installation, the multi-turn data must be reset during the initial startup of the device.

(1) Absolute data

The absolute encoder reads two types of data: single-turn data representing the motor's internal rotation count per full revolution, and multi-turn data that increments with each rotation. The multi-turn data, being an electrical count, requires battery backup. Both data types accumulate when the motor rotates counterclockwise from the shaft end. An E-228 alarm (absolute encoder overflow protection) is triggered when multi-turn data overflows.

(2) Mapping absolute data to 32-bit data

The servo driver initializes position data. For a 23-bit encoder, single-turn data occupies 23 bits while multi-turn data requires 16 bits, resulting in a synthesized position signal with 39-bit width. However, the target value for position information is set to 32-bit width. The 6063h model exclusively uses the lower 32 bits of absolute encoder data for position setting, reducing the valid bit length of multi-turn data to 9 bits (eliminating the upper 7 bits of the 16-bit encoding). The 6064h model calculates position information using the following formula, yielding a 32-bit width. Consequently, the valid bit length of multi-turn data varies according to the electronic gear inverse transformation value.

607Eh (instruction polarity)	position information
0 (CCW is positive)	6063h=M*217 +S
	6064h= (6063h × inverse transform value of electronic gear) + 607Ch
224 scenario (CW is positive direction)	6063h= - (M*217 +S)
	6064h= (6063h × inverse electronic gear value) -607Ch

M: Multiple loops data
S: Single loop data

5) Position range limit (607Bh)

The DM6C series driver does not support wrap-around.
The infinite rotation mode operates internally as 607Bh-01h=80000000h and 607Bh-02h=7FFFFFFFh. Modifying this object does not affect the rotation.

6) Return to original offset (607Ch) Home offset

Set the offset from the mechanical origin to the mechanical zero point. If set to 0, the mechanical origin will coincide with the mechanical zero point. The origin offset can be set to a positive or negative number, indicating a left or right deviation from the mechanical origin.

The DM6C series driver does not support this parameter, so the modification is invalid. The following describes the effects when this parameter is valid.

This object can be updated at any time, but the actual location information must be reflected through the following time sequence.

- When the power supply is turned on
- When communication is established (ESM status is Init→OP migration)
- When the origin reset is completed

Use the position under the specified time sequence as the reference to initialize the following objects.

- When the origin position is detected

6063h (Actual internal position feedback) = 60FCh (Position demand internal value) = 0
6062h (Position demand value) = 6064h (Position actual value) = 607Ch (Home offset)

- Initialization (preset) at a time other than when the origin position is detected

6063h (Actual internal position feedback) = 60FCh (Required internal position value)
6062h (Position demand value) = 6064h (Position actual value)
=6063h (Position actual internal value) + 607Ch (Home offset)

The above describes the situation of the electronic gear ratio 1:1 and the non-polar reversal.

Home offset definition

Home position: The index pulse position (origin position)
Zero position: In incremental systems, it equals 0 (either the position when power is applied, or the position obtained by subtracting the Home offset from the index pulse detected in the HM).
Absolute system time = absolute encoder zero point position.

7.9.7 Overrun function in bus mode

parameter	meaning	leave the factory setting	unit	setting scope	revise	come into force
P0-28.0	0: Direct alarm activation with servo-based deceleration and shutdown; 1: Alarm triggered upon deceleration shutdown in 605Ah mode; 2: Do not use over-range	2	-	0~3	○	1|3|4|8|9|10

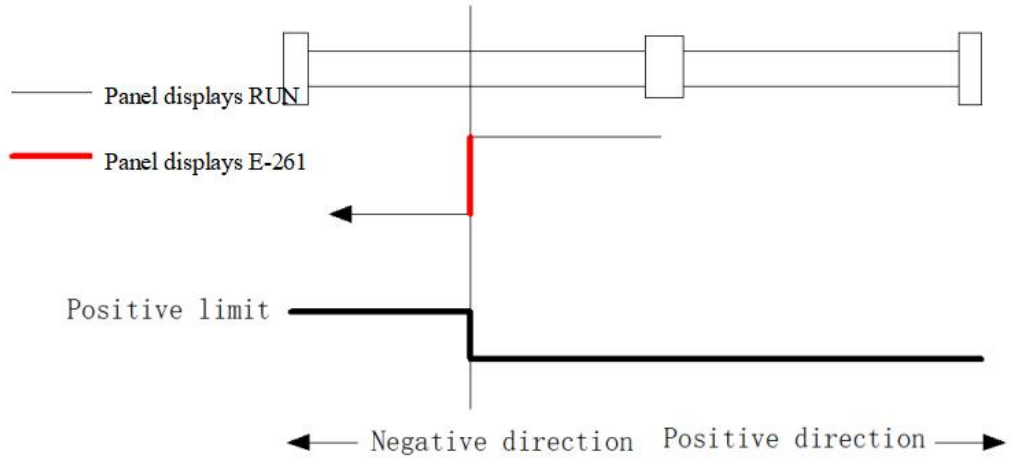
1) Prohibited status

- Scenario 1: When the servo is either enabled (non-moving) or disabled, and the reverse limit switch is triggered, the panel displays 'NOT' to cancel the reverse limit signal, after which it returns to its previous state.
- Scenario 2: When the servo is either enabled (non-moving) or disabled, and the forward limit switch is triggered, the panel displays POT. The forward limit signal is canceled, and the panel returns to its previous state.
- Scenario 3: When the servo is either enabled (non-moving) or disabled, and both the forward and reverse limit switches are activated, the servo will trigger an E-261 error. If both limit signals are cleared, the panel will revert to its previous state. If only one limit signal is cleared, the panel will display the remaining signal. To restore the previous state, the remaining limit signal must also be cleared.

2) Normal motion state

(1) Initial movement direction: left

The initial movement direction is left. When the forward limit switch is triggered, the servo will display E-261. If the forward limit switch is disabled first and the alarm is cleared afterward, the axis returns to its non-enabled state, allowing both forward and reverse movement. However, if the alarm is cleared first and the axis reverts to its non-enabled state while the panel still shows POT, the axis remains restricted by the forward limit switch. To remove the forward overtravel prohibition, the forward limit signal must be disabled.



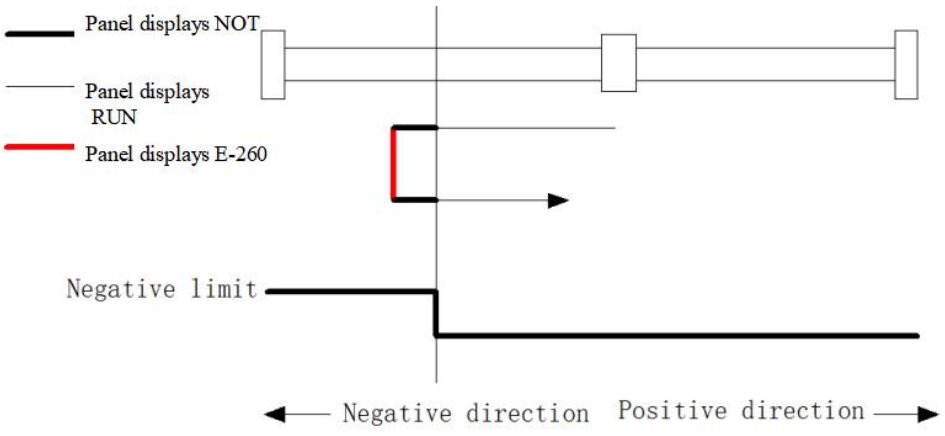
3) Overtravel state

Set P0-28 to 1 (alarm, deceleration, and stop)

(1) The initial movement direction is left, and the out-of-range signal has not triggered an out-of-position condition.

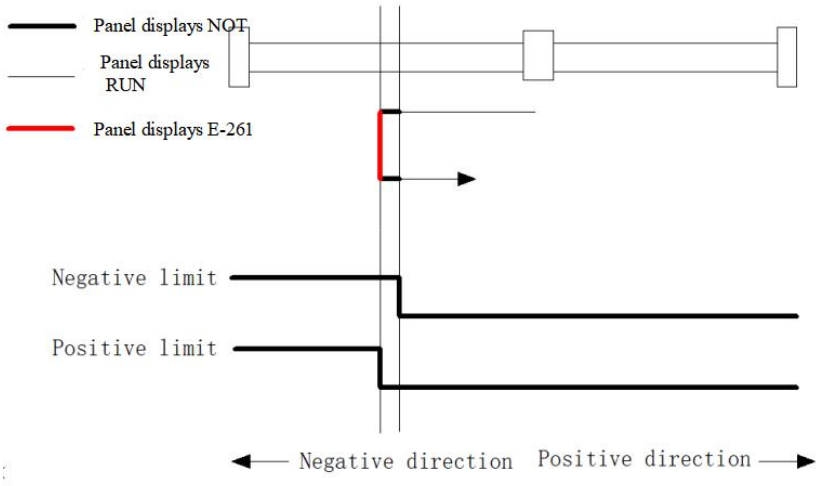
Scenario 1: The forward limit switch was not activated

The initial movement starts leftward. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering reverse overtravel deceleration and stopping the shaft at the switch. The servo then triggers E-260. To resolve this, clear the alarm and allow the shaft to move forward. Upon detecting the falling edge of the reverse limit switch, the panel will switch back to RUN, thereby lifting the reverse overtravel restriction.



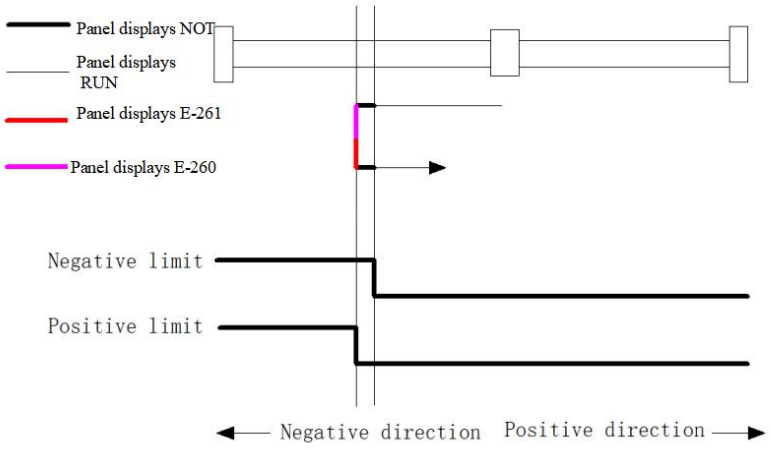
Scenario 2: Before the shaft deceleration stops, the forward limit switch is triggered.

The initial movement starts leftward. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. Before the shaft stops, if the forward limit switch is triggered, the servo will display E-261. To clear the E-261 alarm, the forward limit switch must be released; otherwise, the alarm remains. Subsequently, the shaft resumes forward movement. Upon detecting the falling edge of the reverse limit switch, the panel switches from NOT to RUN, thereby lifting the reverse overtravel prohibition.



Scenario 3: The shaft stops at the negative limit switch and triggers the positive limit switch.

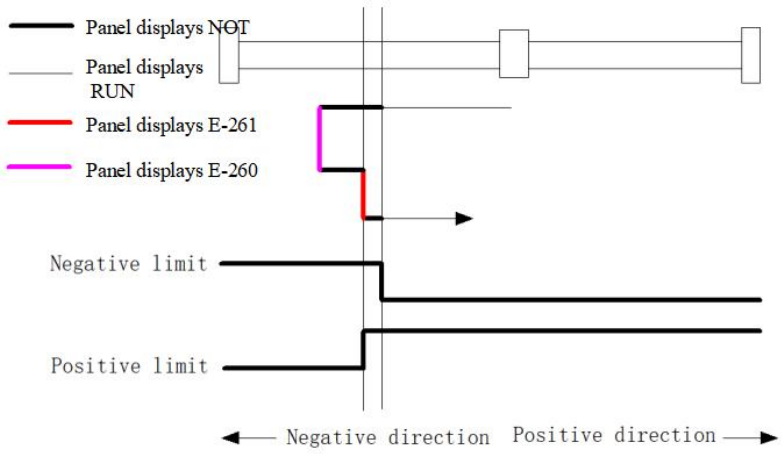
The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. If the shaft stops at the reverse limit switch, the servo will report E-260. Upon detecting the forward limit switch, the servo will report E-261. To clear the E-261 alarm, the forward limit switch must be released; otherwise, the alarm cannot be cleared. Subsequently, the shaft moves forward and detects the falling edge of the reverse limit switch. The panel then changes from NOT to RUN, lifting the reverse overtravel prohibition.



Scenario 4: During forward axial movement, the forward limit switch is triggered.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. If the shaft stops at the reverse limit switch, the servo will report E-260. After clearing the alarm and allowing the shaft to move forward, the panel detects the forward limit switch. The servo then reports E-261. To clear the E-261 alarm, the forward limit switch must be released; otherwise, the alarm will persist. Continuing

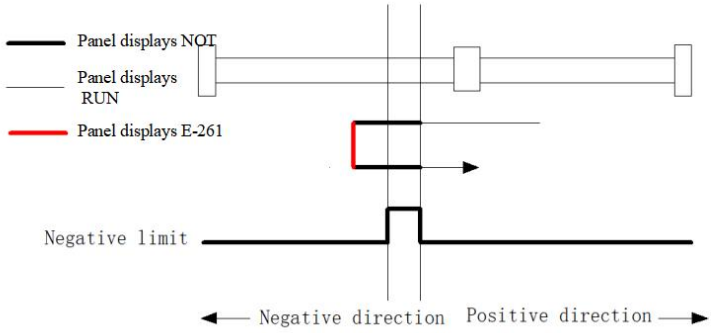
forward movement causes the panel to detect the falling edge of the reverse limit switch, changing from NOT to RUN, thereby lifting the reverse overtravel prohibition.



(2) The initial movement direction is left, triggering the overtravel signal for out-of-range detection.

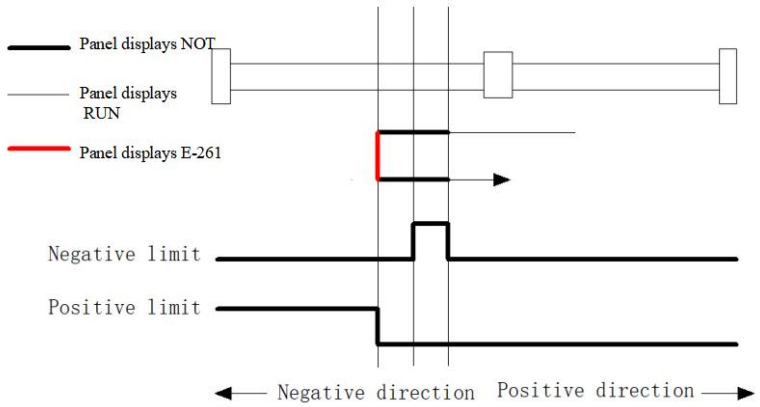
Scenario 1: When offside occurs, the forward limit switch remains unactivated.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, if the shaft exceeds the limit switch, the falling edge of the reverse limit switch is triggered again, causing the shaft to stop outside the limit. The servo will then report E-260. To resume normal shaft movement, the alarm must be cleared. Upon re-detected edges of the reverse limit switch (rising/falling), the panel will return to RUN, thereby lifting the reverse overtravel prohibition.



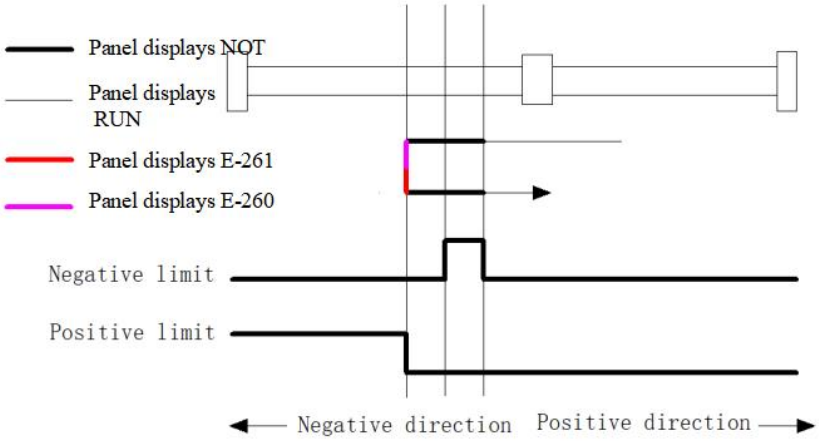
Scenario 2: When offside occurs, the forward limit switch must be triggered before the shaft deceleration stops completely.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, the shaft passes through the reverse limit switch, which then triggers its falling edge. Before the shaft stops, it touches the forward limit switch. The servo will display E-261, requiring the forward limit switch to be canceled to clear the E-261 alarm. Otherwise, the alarm cannot be cleared. The shaft then resumes forward movement, touching both the rising and falling edges of the reverse limit switch again. Only then does the panel change from NOT to RUN, lifting the reverse overtravel prohibition.



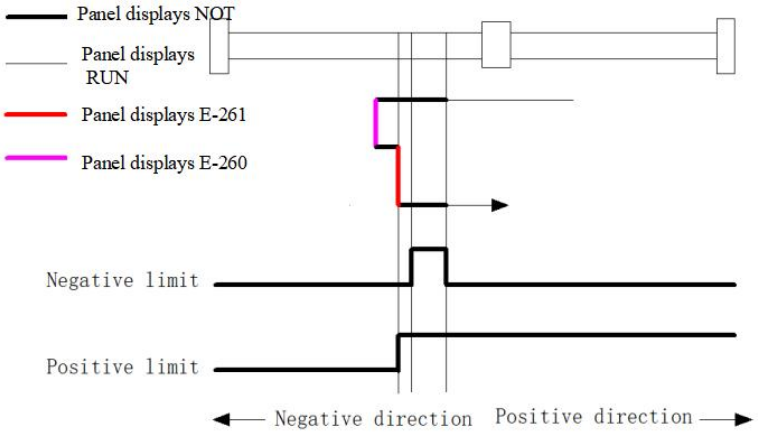
Scenario 3: When in an offside position, the shaft stops and touches the forward limit switch.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, as the shaft passes the reverse limit switch, the falling edge of the reverse limit switch is triggered. Upon shaft stoppage, the servo triggers E-260. At this point, the forward limit switch is activated, causing the servo to report E-261. To clear the E-261 alarm, the forward limit switch must be deactivated; otherwise, the alarm persists. The shaft then resumes forward movement, triggering the rising and falling edges of the reverse limit switch again. Only then does the panel change from NOT to RUN, lifting the reverse overtravel prohibition.



Scenario 4: When in an offside position, contact the forward limit switch during axial forward movement.

The initial movement direction is left. When the panel detects the rising edge of the reverse limit switch, it changes from RUN to NOT, triggering the reverse overtravel deceleration stop. However, the shaft crosses the reverse limit switch, which then triggers its falling edge. Upon shaft stoppage, the servo reports E-260. After clearing the alarm and allowing the shaft to move forward, it contacts the forward limit switch. The servo then reports E-261, requiring the forward limit switch to be canceled to clear the E-261 alarm. Otherwise, the alarm persists. Continuing forward movement causes the shaft to contact the reverse limit switch again, triggering both rising and falling edges. The panel then changes from NOT to RUN, lifting the reverse overtravel prohibition.



7.9.8 Remote I/O Function

- General Parameters

order number	parameter	meaning	give tacit consent to	setting
1	P5-72	Remote SI Input 1	0	0: Invalid 1: Input positive signal from SI1 2: Input positive signal from SI2 3: Input positive signal from SI3 10: Always set to valid 11: Input the inverse signal from SI1 12: Input the inverse signal from SI2 13: Input the inverse signal from SI3
2	P5-73	Remote SI Input 2	0	0: Invalid 1: Input positive signal from SI1 2: Input positive signal from SI2 3: Input positive signal from SI3 10: Always set to valid 11: Input the inverse signal from SI1 12: Input the inverse signal from SI2 13: Input the inverse signal from SI3
3	P5-74	Remote SI Input 3	0	0: Invalid 1: Input positive signal from SI1 2: Input positive signal from SI2 3: Input positive signal from SI3 10: Always set to valid 11: Input the inverse signal from SI1 12: Input the inverse signal from SI2 13: Input the inverse signal from SI3
4	P5-75	Remote SI Input 4	0	0: Invalid 1: Input positive signal from SI1

order number	parameter	meaning	give tacit consent to	setting
				2: Input positive signal from SI2 3: Input positive signal from SI3 10: Always set to valid 11: Input the inverse signal from SI1 12: Input the inverse signal from SI2 13: Input the inverse signal from SI3
5	P5-76	Remote SO Output 1	0	0: Do not output to terminal 1: Output positive signal from SO1 2: Send a positive signal for SO2 output 3: Send positive signal from SO3 11: Output the inverse signal from SO1 12: From SO2 output reverse signal 13: Output the reverse signal from SO3
6	P5-77	Remote SO Output 2	0	0: Do not output to terminal 1: Output positive signal from SO1 2: Send a positive signal for SO2 output 3: Send positive signal from SO3 11: Output the inverse signal from SO1 12: From SO2 output reverse signal 13: Output the reverse signal from SO3
7	P5-78	Remote SO Output 3	0	0: Do not output to terminal 1: Output positive signal from SO1 2: Send a positive signal for SO2 output 3: Send positive signal from SO3 11: Output the inverse signal from SO1 12: From SO2 output reverse signal 13: Output the reverse signal from SO3

- remote I/O related dictionary object

order number	target	meaning	unit	explain
1	60FDh	Digital inputs	-	Bit0: N-OT signal Bit1: P-OT signal Bit2: SPDD signal Bit3: Probe 1 signal Bit4: Probe 2 signal Bit5: Z Sign Output Keep Bit6~Bit15 Bit16: Remote SI Input 1 Bit17: Remote SI Input 2 Bit18: Remote SI Input 3
2	60FEh:01	Physical outputs	-	Bit0~Bit15 reserved Bit16: Remote SO output 1 Bit17: Remote SO Output 2

order number	target	meaning	unit	explain
				Bit18: Remote SO Output 3
3	60Feh:02	Bit mask	-	When using, set the corresponding positions 1 to 18 of Bit16~Bit18

For details on 60FDh, please refer to Section 7.9.4 Digital Input (60FDh).

For details on 60FEh, please refer to Section 7.9.5 Digital Output (60FEh).

7.9.9 Cascading Alarm Function

The DM6C supports an external terminal emergency alarm function. When this function is enabled, the driver will generate an alarm E-320 if the terminal signal is active. The driver can be used in series by connecting the alarm output to the corresponding function terminal of the next driver, enabling cascaded alarms.

Add new function parameter P5-68, which is set to 0 by default:

parameter	meaning	factory setting	unit	Set range	revise	come into force
P5-68	Terminal emergency alarm function	0	-	00~ff	at any time	immediately

8. Object Dictionary Details

This chapter mainly introduces object dictionary area allocation, COE communication area, driver profile area and so on.

8.1 Object Dictionary Area Allocation

All objects are configured in the object dictionary of each group through a 16-bit index configuration address represented by a 4-digit hexadecimal.
The object dictionaries for CoE (CANopen over EtherCAT) specified in CiA402 and the DM6C series are defined as follows:

CiA402 object dictionary		Object Dictionary of DM6C Series	
index of matrix	content	index of matrix	content
0000h ~ 0FFFh	Data Type Area	0000h ~ 0FFFh	Data Type Area
1000h ~ 1FFFh	COE communication area	1000h ~ 1FFFh	COE communication area
2000h ~ 5FFFh	Manufacturer Custom Region	2000h ~ 2FFFh	servo parameter area
		3000h ~ 3FFFh	continue to have
		4000h ~ 4FFFh	continue to have
		5000h ~ 5FFFh	continue to have
6000h ~ 9FFFh	Profile region	6000h ~ 6FFFh	Drive Profile Area
		7000h ~ 9FFFh	continue to have
A000h ~ FFFFh	continue to have	A000h ~ FFFFh	continue to have

8.2 COE Communication Region (0x1000-0x1FFF)

8.2.1 List of objects

1) Device information object

index of matrix	subindex	name
1000h	00h	device class
1001h	00h	Types of alarms that are currently occurring
1008h	00h	device name
1009h	00h	Hardware version
100Ah	00h	software release
1018h	-	Factory information
	00h	subindex number
	01h	manufacturer ID
	02h	Product code
	03h	version number
	04h	serial number

2) RxPDO object mapping

index of matrix	subindex	name
1600h	-	RxPDO1 mapping object
	00h	The number of mapping objects supported by RxPDO1
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object
1601h	-	RxPDO2 mapping object
	00h	The number of mapping objects supported by RxPDO2
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object
1602h	-	RxPDO3 mapping object

index of matrix	subindex	name
	00h	The number of mapping objects supported by RxPDO3
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object
1603h	-	RxPDO4 mapping object
	00h	The number of mapping objects supported by RxPDO4
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object

3) TxPDO object mapping

index of matrix	subindex	name
1A00h	-	TxPDO1-supported mapping objects
	00h	Number of mapped objects supported by TxPDO1
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object
1A01h	-	TxPDO2-supported mapping objects
	00h	The number of mapping objects supported by TxPDO2
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object
1A02h	-	TxPDO3-supported mapping objects
	00h	The number of mapping objects supported by TxPDO3

index of matrix	subindex	name
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object
1A03h	-	TxPDO4-supported mapping objects
	00h	The number of mapping objects supported by TxPDO4
	01h	First mapping object
	02h	Second mapping object
	03h	Third mapping object
	04h	The fourth mapping object
	05h	Fifth mapping object
	...	...
	18h	The twenty-fourth mapping object

4) PDO object allocation

index of matrix	subindex	name
1C12h	-	RxPDO distribution
	00h	RxPDO allocation
	01h	Assigned RxPDO 1
	02h	Assigned RxPDO 2
	03h	Assigned RxPDO 3
	04h	Assigned RxPDO 4
1C13h	-	TxPDO distribution
	00h	TxPDO allocation count
	01h	Assigned TxPDO 1
	02h	Assigned TxPDO 2
	03h	Assigned TxPDO 3
	04h	Assigned TxPDO 4

5) PDO synchronous management channel

index of matrix	subindex	name
1C32h	-	Sync Manager 2 Synchronization Channel 2
	00h	Number of sub-objects
	01h	Sync mode
	02h	Cycle time
	03h	Shift time
	04h	Sync modes supported: Set supported sync types

index of matrix	subindex	name
	05h	Minimum cycle time: The minimum value of the communication cycle that can be set
	06h	Calculate and copy the time from SM2 event, SYNC0 event to ESC read completion time
	08h	Command (not supported)
	09h	Delay time (not supported)
	0Ah	Sync0 cycle time The value in register 09A0h of the ESC is set when DC SYNC0 (1C32h-01h=02h). It is set to 0 otherwise.
	0Bh	Cycle time is too short (not supported)
	0Ch	SM event missed (not supported)
	0Dh	Shift time is too short (not supported)
	0Eh	RxPDO toggle failed (not supported)
	20h	Sync error
1C33h	-	Sync Manager 3 Synchronization Channel 3
	00h	Number of sub-objects
	01h	Sync mode
	02h	Cycle time
	03h	Shift time
	04h	Sync modes supported: Set supported sync types
	05h	Minimum cycle time: The minimum value of the communication cycle that can be set
	06h	Calculate and copy the time from SM2 event, SYNC0 event to ESC read completion time
	08h	Command (not supported)
	09h	Delay time (not supported)
	0Ah	Sync0 cycle time The value in register 09A0h of the ESC is set when DC SYNC0 (1C32h-01h=02h). It is set to 0 otherwise.
	0Bh	Cycle time is too short (not supported)
	0Ch	SM event missed (not supported)
	0Dh	Shift time is too short (not supported)
	0Eh	RxPDO toggle failed (not supported)
	20h	Sync error

8.2.2 Equipment Information

This section describes the device information.

index of matrix	son index of matrix	name	scope	data type	Available inquisitive	PDO	Op-mode
1000h	00h	Divece type	0~4294967295	U32	ro	NO	All

<table>
<tr><th>index of matrix</th><th>son index of matrix</th><th>name</th><th>scope</th><th>data type</th><th>Available inquisitive</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td></td><td></td><td colspan="6">Indicates the device type. For a servo driver, the value is fixed to 04020192h.</td></tr>
<tr><td rowspan="2">1001h</td><td rowspan="2">00h</td><td>error register</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Displays the type of alarm (status) occurring in the servo driver.
Display 0000h when no alarm occurs.
Do not show the warning.
<table>
<tr><th>Bit</th><th>content</th></tr>
<tr><td>0</td><td rowspan="4">nonsupport</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td>AL status code defines the alarm occurrence*1)</td></tr>
<tr><td>5</td><td>nonsupport</td></tr>
<tr><td>6</td><td>continue to have</td></tr>
<tr><td>7</td><td>AL status code undefined alarm occurred*2)</td></tr>
</table>
*1) The term "AL status code alarm" refers to communication-related anomalies in EtherCAT, specifically codes E-800~7, E-810~7, and E-850~7.
*2) The term "AL status code undefined alarm" refers to EtherCAT communication-related anomalies (E-880~7) and non-communication-related anomalies.</td></tr>
<tr><td rowspan="2">1008h</td><td rowspan="2">00h</td><td>Manufacturer Device Name</td><td>-</td><td>-</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Displays the device name.</td></tr>
<tr><td rowspan="2">1009h</td><td rowspan="2">00h</td><td>Manufacturer Hardware version</td><td>-</td><td>-</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the hardware version.</td></tr>
<tr><td rowspan="10">1018h</td><td rowspan="2">00h</td><td>Number of entries</td><td>0~255</td><td>U8</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the sub-index number of this object. The value is fixed to 04h.</td></tr>
<tr><td rowspan="2">01h</td><td>vendor ID</td><td>0~4294967295</td><td>U32</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">The manufacturer ID of EtherCAT. The value is fixed to 00000556h.</td></tr>
<tr><td rowspan="2">02h</td><td>product code</td><td>0~4294967295</td><td>U32</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the product code. The value is 10305080h.</td></tr>
<tr><td rowspan="2">03h</td><td>Revision umber</td><td>0~4294967295</td><td>U32</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the product version number.</td></tr>
<tr><td rowspan="2">04h</td><td>Divece type</td><td>0~4294967295</td><td>U32</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the product serial number. The value is 00000000h.</td></tr>
</table>

8.2.3 Synchronization Manager Communication Type (1C00h)

The action mode assigned to each SyncManager is configured via the 1C00h object.
The value is fixed for the servo driver.

index of matrix	subindex	name	scope	data type	Available inquisitive	PDO	Op-mode

index of matrix	subindex	name	scope	data type	Available inquisitive	PDO	Op-mode
1C00h	00h	Number of used sync manager channels	0~255	U8	ro	TxPDO	All
		Indicates the sub-index number of this object. The value is fixed to 04h.					
	01h	Communication type sync manager 0	0~4	U8	ro	TxPDO	All
		Set the purpose of Sync Manager 0. 0: Unused 1: Mailbox incoming (master → slave) 2: Mailbox sending (slave to master) 3: RxPDO (master → slave) 4: TxPDO (slave→master) Since Sync Manager0 uses Mailbox for receiving messages, the value is fixed to 1.					
	02h	Communication type sync manager 1	0~4	U8	ro	TxPDO	All
		Set the purpose of Sync Manager 1. 0: Unused 1: Mailbox incoming (master → slave) 2: Mailbox sending (slave to master) 3: RxPDO (master → slave) 4: TxPDO (slave→master) Since Sync Manager1 uses Mailbox for sending emails, the value is fixed at 2.					
	03h	Communication type sync manager 2	0~4	U8	ro	TxPDO	All
		Set the purpose of Sync Manager 2. 0: Unused 1: Mailbox incoming (master → slave) 2: Mailbox sending (slave to master) 3: RxPDO (master → slave) 4: TxPDO (slave→master) Since Sync Manager2 employs Process Data Output (RxPDO), the value is fixed at 3.					
	04h	Communication type sync manager 3	0~4	U8	ro	TxPDO	All
		Set the purpose of Sync Manager 3. 0: Unused 1: Mailbox incoming (master → slave)					

index of matrix	subindex	name	scope	data type	Available inquisitive	PDO	Op-mode
		2: Mailbox sending (slave to master) 3: RxPDO (master → slave) 4: TxPDO (slave→master) Since Sync Manager2 employs Process Data Output (RxPDO), the value is fixed at 4.					

8.2.4 PDO Mapping

1) PDO allocation object (1C12h ~ 1C13h)

SyncManager assigns PDO mapping tables through object configuration from 1C12h to 1C13h.

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
1C12h	00h	Number of assigned PDOs	0~4	U8	rw	NO	All
		Indicates the sub-index number of this object.					
	01h	Assigned RxPDO 1	1600h~1603h	U16	rw	NO	All
		Specify the RxPDO mapping object to use.					
	02h	Assigned RxPDO 2	1600h~1603h	U16	rw	NO	All
		Specify the RxPDO mapping object to use.					
	03h	Assigned RxPDO 3	1600h~1603h	U16	rw	NO	All
		Specify the RxPDO mapping object to use.					
	04h	Assigned RxPDO 4	1600~1603	U16	rw	NO	All
		Specify the RxPDO mapping object to use.					
1C13h	00h	Number of assigned PDOs	0~4	U8	rw	NO	All
		Indicates the sub-index number of this object. The value is fixed to 04h.					
	01h	Assigned TxPDO 1	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					
	02h	Assigned TxPDO 2	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					
	03h	Assigned TxPDO 3	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					
	04h	Assigned TxPDO 4	1A00h~1A03h	U16	rw	NO	All
		Specify the TxPDO mapping object.					

The 1C12h and 1C13h sub-index 01h-04h can only be modified when the ESM status is PreOP and sub-index 00h=0. In all other states, the port code (06010003h) is returned.
After the configuration change, the Sub index number using Sub index 00h is set, and the PDO allocation object configuration is reflected by converting the ESM status to SafeOP.

2) PDO mapping objects (1600h ~ 1603h,1A00h ~ 1A03h)

The table for PDO mapping can use objects from 1600h to 1603h for RxPDO and from 1A00h to 1A03h for TxPDO. Sub-index 01h onward indicates information about the mapped application layer objects.

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="20">1600h</td><td rowspan="2">00h</td><td>Number of entries</td><td>0~4294967295</td><td>U8</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">Indicates the sub-index number of this object.</td></tr>
<tr><td rowspan="2">01h</td><td>1st receive PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">Set the first mapping object.<table><tr><td>bit</td><td>31 ...16</td><td>15 ....8</td><td>7 ....0</td></tr><tr><td></td><td>Index number</td><td>Subindex number</td><td>bit length</td></tr></table></td></tr>
<tr><td rowspan="2">02h</td><td>2nd receive PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">The method is the same as for Subindex 01h.</td></tr>
<tr><td rowspan="2">03h</td><td>3rd receive PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td rowspan="2">04h</td><td>4th receive PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td rowspan="2">05h</td><td>5th receive PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td rowspan="2">06h</td><td>6th receive PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td>...</td><td colspan="7">...</td></tr>
<tr><td rowspan="2">18h</td><td>24th receive PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="7">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td>1601h</td><td>-</td><td colspan="7">The specifications for PDO mapping 2, Sub-index, and other components are identical to those of 1600h.</td></tr>
<tr><td>1602h</td><td>-</td><td colspan="7">The specifications for PDO mapping 3, Sub-index, and other components are identical to those of 1600h.</td></tr>
<tr><td>1603h</td><td>-</td><td colspan="7">The specifications for PDO mapping 4, Sub-index, and other components are identical to those of 1600h.</td></tr>
</table>

Do not map duplicate objects. Changes to duplicate settings are not guaranteed.
The Sub-index 01h-18h (1600h-1603h) can only be modified when the ESM status is PreOP and

Sub-index 00h=0. In all other states, the system returns the Abort Code (06010003h).
After the configuration change, the Sub index number using Sub index 0h is set, and the PDO mapping object configuration is reflected by converting the ESM status to SafeOP.

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="20">1A00h</td><td rowspan="2">00h</td><td>Number of entries</td><td>0~4294967295</td><td>U8</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the sub-index number of this object.</td></tr>
<tr><td rowspan="2">01h</td><td>1st transmit PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">Set the object for the first mapping.
<table><tr><td>bit</td><td>31 ...16</td><td>15 ....8</td><td>7 ... 0</td></tr><tr><td></td><td>Index number</td><td>Subindex number</td><td>bit length</td></tr></table></td></tr>
<tr><td rowspan="2">02h</td><td>2nd transmit PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">The method is the same as for Subindex 01h.</td></tr>
<tr><td rowspan="2">03h</td><td>3rd transmit PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td rowspan="2">04h</td><td>4th transmit PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td rowspan="2">05h</td><td>5th transmit PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td rowspan="2">06h</td><td>6th transmit PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td>...</td><td colspan="6">...</td></tr>
<tr><td rowspan="2">18h</td><td>24th transmit PDO mapped</td><td>0~4294967295</td><td>U32</td><td>rw</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">The setting method is the same as that of Sub-index 01h.</td></tr>
<tr><td>1A01h</td><td>-</td><td colspan="6">The specifications for Transmit PDO mapping 2, Subindex, and other parameters are identical to those of 1600h.</td></tr>
<tr><td>1A02h</td><td>-</td><td colspan="6">The specifications for Transmit PDO mapping 3, Subindex, and other parameters are identical to those of 1600h.</td></tr>
<tr><td>1A03h</td><td>-</td><td colspan="6">The specifications for Transmit PDO mapping 4, Subindex, and other parameters are identical to those of 1600h.</td></tr>
</table>

Do not map duplicate objects.
No guarantee is provided for changes in the already repeated settings.
The Sub-index 01h-18h (1A00h-1A03h) can only be modified when the ESM status is PreOP and Sub-index 00h=0.
Otherwise, the system returns an Abort Code (06010003h).
After the configuration change, the Sub index number using Sub index 0h is set, and the PDO mapping object configuration is reflected by converting the ESM status to SafeOP.

8.2.5 Synchronous Manager 2/3 (1C32h,1C33h)

The configuration of Sync Manager 2 is executed according to 1C32h (Sync Manager 2 synchronization).
The configuration of Sync Manager 3 is executed according to 1C33h (Sync Manager 3 synchronization).

Sync Manager 2 (1C32h)

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
1C32	00h	Number of entries	0~20h	U8	ro	NO	All
		The Sub index number for this object. The value is fixed to 20h.					
	01h	Sync mode	0-65535	U16	rw	NO	All
		Set the Sync Manager 2 synchronization mode. 00h：FreeRun（not synchronized） 01h：SM2（synchronized with SM 2 Event） 02h：DC SYNC0（synchronized with Sync0 Event）					
	02h	Cycle time	0~4294967295	U32	rw	NO	All
		Set the Sync Manager period (in ns). Select one of the following values: 1,000,000 (1ms), 2,000,000 (2ms), 4,000,000 (4ms), 8,000,000 (8ms), or 10,000,000 (10ms). Setting any other value will trigger E-810 (Synchronization Cycle Setting Error Protection).					
	03h	Shift time	0~4294967295	U32	rw	NO	All
		offset time					
	04h	Sync modes supported	0~65535	U16	ro	NO	All
		Set supported sync types. BIT0: FreeRun mode is supported 0: Not supported; 1: FreeRun mode is supported This servo driver is set to 1. BIT1: SM synchronization mode supports 0: Not supported; 1: SM2 event synchronization is supported This servo driver is set to 1. BIT4-2: DC synchronization mode is supported 000b: Not supported 001b: DC sync0 event support This servo driver is set to 001b. BIT6-5: Output offset support 00b: Not supported 01b: Local clock offset support This servo driver is set to 00b.					

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
		BIT15-7：Reserved					
1C32	05h	Minimum cycle time	0~4294967295	U32	ro	NO	All
		The minimum value of the communication period that can be set.					
	06h	Calc and copy time	0~4294967295	U32	ro	NO	All
		From the SM2 event and SYNC0 event to the ESC read completion time. If the signal is off, this time can also be extended.					
	08h	Command	0~65535	U16	ro	NO	All
		nonsupport					
	09h	Delay time	0~4294967295	U32	ro	NO	All
		nonsupport					
	0Ah	Sync0 cycle time	0~4294967295	U16	ro	NO	All
		When DC SYNC0 (1C32h-01h=02h), the value in the ESC register 09A0h is set. Set to 0 when DC SYNC0 is not active.					
	0Bh	Cycle time too small	0~65535	U16	ro	NO	All
		nonsupport					
	0Ch	SM-event missed	0~65535	U16	ro	NO	All
		nonsupport					
	0Dh	Shift time too short	0~65535	U16	ro	NO	All
		nonsupport					
	0Eh	RxPDO toggle failed	0~65535	U16	rw	NO	All
		nonsupport					
	20h	Sync error	0~1	BOOL	ro	NO	All
		Sync error					

This setting is a reference value and not a guarantee.

Sync Manager 3 (1C33h)

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
1C33h	00h	Number of entries	0~20h	U8	ro	NO	All
		The Sub index number for this object. The value is fixed to 20h.					
	01h	Sync mode	0~65535	U16	rw	NO	All
		Set the Sync Manager 3 synchronization mode. 00h：FreeRun（not synchronized） 01h：SM2（synchronized with SM 2 Event）					

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
		02h：DC SYNC0（synchronized with Sync0 Event）					
	02h	Cycle time	0~4294967295	U32	rw	NO	All
		Set the Sync Manager period (in ns). Select one of the following values: 1,000,000 (1ms), 2,000,000 (2ms), 4,000,000 (4ms), 8,000,000 (8ms), or 10,000,000 (10ms). Setting any other value will trigger E-810 (Synchronization Cycle Setting Error Protection).					
	03h	Shift time	0~4294967295	U32	rw	NO	All
		offset time					
	04h	Sync modes supported	0~65535	U16	ro	NO	All
		Set supported sync types. BIT0: FreeRun mode supports 0: Not supported; 1: FreeRun mode is supported This servo driver is set to 1. BIT1: SM synchronization mode supports 0: Not supported; 1: SM2 event synchronization is supported This servo driver is set to 1. BIT4-2: DC synchronization mode is supported 000b: Not supported 001b: DC sync0 event support This servo driver is set to 001b. BIT6-5: Output offset support 00b: Not supported 01b: Local clock offset support This servo driver is set to 00b. BIT15-7：Reserved					
1C33h	05h	Minimum cycle time	0~4294967295	U32	ro	NO	All
		The minimum value of the communication period that can be set.					
	06h	Calc and copy time	0~4294967295	U32	ro	NO	All
		From the SM2 event and SYNC0 event to the completion of ESC reading. If the signal is off, this time can also be extended.					
	08h	Command	0~65535	U16	ro	NO	All
		nonsupport					
	09h	Delay time	0~4294967295	U32	ro	NO	All
		nonsupport					
	0Ah	Sync0 cycle time	0~4294967295	U16	ro	NO	All
		The same value as 1C32h-0Ah.					
	0Bh	Cycle time too small	0~65535	U16	ro	NO	All
		nonsupport					
	0Ch	SM-event missed	0~65535	U16	ro	NO	All
		nonsupport					
	0Dh	Shift time too short	0~65535	U16	ro	NO	All
		nonsupport					
	0Eh	RxPDO toggle failed	0~65535	U16	rw	NO	All

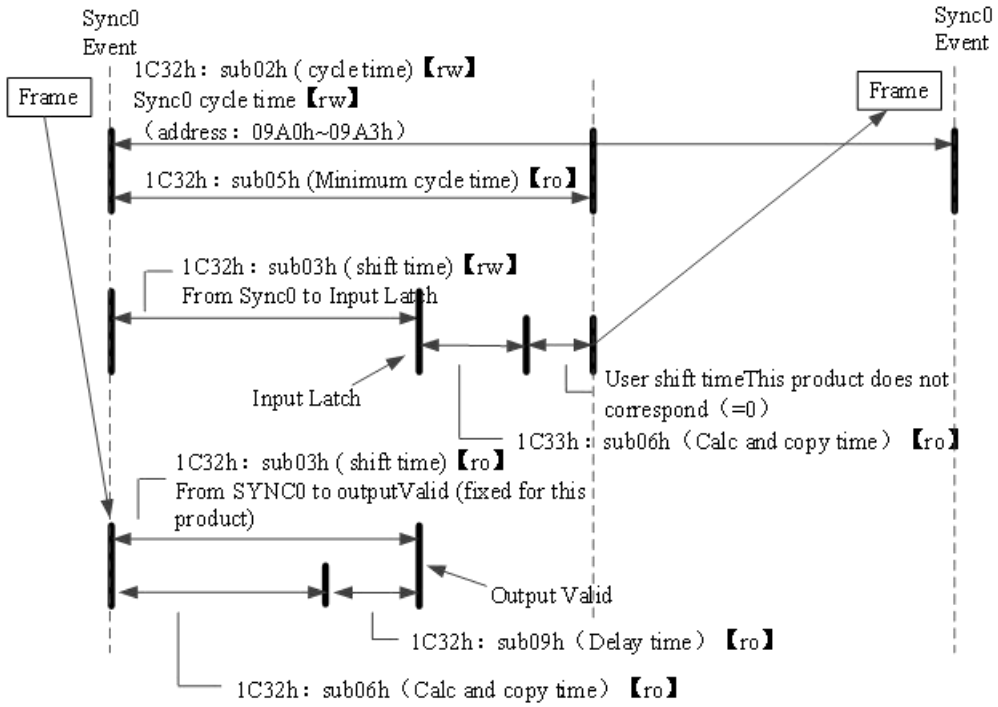
index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
		nonsupport					
	20h	Sync error	0~1	BOOL	ro	NO	All
		Sync error					

This setting is a reference value and not a guarantee.

- DC (SYNC0 event synchronization)

Synchronization method	feature
Use the time on the first axis as the reference. Synchronize time information from other slaves	high-accuracy Compensation processing is required on the master site side.

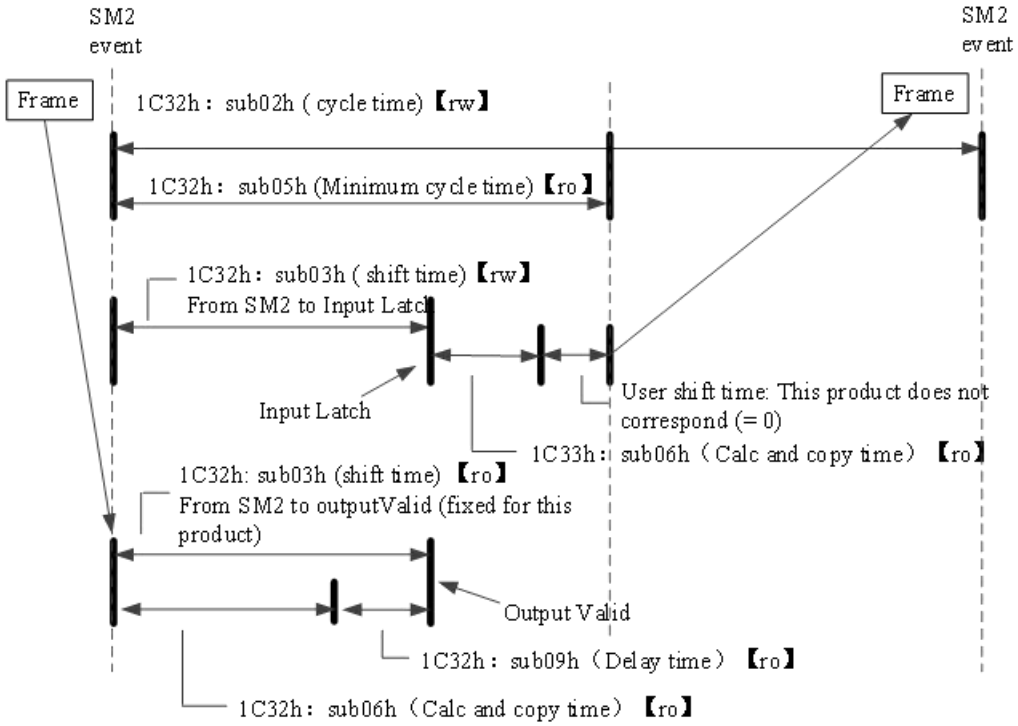
The DC synchronous mode specifications for this servo driver are as follows:



- SM2 (SM2 Event Synchronization)

Synchronization method	feature
Synchronize with RxPDO's receipt time	The compensation accuracy for transmission delay is poor. The transmission time must be confirmed on the master side (e.g., dedicated hardware).

The SM2 synchronous mode specifications for this servo driver are as follows:


SM2
event
SM2
event
Frame
1C32h：sub02h（cycle time）【rw】
Frame
1C32h：sub05h (Minimum cycle time)【ro】
1C32h：sub03h（shift time）【rw】
From SM2 to Input Latch
Input Latch
User shift time: This product does not correspond (= 0)
1C33h：sub06h（Calc and copy time）【ro】
1C32h: sub03h (shift time) 【ro】
From SM2 to outputValid (fixed for this product)
Output Valid
1C32h：sub09h（Delay time）【ro】
1C32h：sub06h（Calc and copy time）【ro】

8.3 Servo Parameter Area (0x2000~0x5FFF)

8.3.1 List of objects

Objects with 2000h to 5FFFh are assigned servo parameters. (For detailed names of servo parameters, refer to the appendix of this book.)

index of matrix	subindex	name
2000h	00h	P0-00
2001h	00h	P0-01
2002h	00h	P0-02
2003h	00h	P0-03
...	...	...
205Fh	00h	P0-95
2100h	00h	P1-00
2101h	00h	P1-01
2102h	00h	P1-02
2103h	00h	P1-03
...	...	...
214Ah	00h	P1-74
2200h	00h	P2-00
2201h	00h	P2-01
2202h	00h	P2-02
2203h	00h	P2-03
...	...	...
2263h	00h	P2-99
2300h	00h	P3-00
2301h	00h	P3-01
2302h	00h	P3-02
2303h	00h	P3-03
...	...	...
232Eh	00h	P3-46

index of matrix	subindex	name
2500h	00h	P5-00
2501h	00h	P5-01
2502h	00h	P5-02
2503h	00h	P5-03
...	...	...
2547h	00h	P5-71
2700h	00h	P7-00
2701h	00h	P7-01
2702h	00h	P7-02
2703h	00h	P7-03
...	...	...
2715h	00h	P7-21
2800h	00h	P8-00
2801h	00h	P8-01
2802h	00h	P8-02
2803h	00h	P8-03
...	...	...
281Ah	00h	P8-26

index of matrix	subindex	name
3000h	00h	U0-00
3001h	00h	U0-01
3002h	00h	U0-02
...	...	...
3061h	00h	U0-97

index of matrix	subindex	name
3100h	00h	U1-00
3101h	00h	U1-01

index of matrix	subindex	name

4000h	00h	F0-00
4106h	00h	F1-06

index of matrix	subindex	name	unit	data area	data type	sign	PDO
5000h	00h	Encode Single Position Encoder single-turn position	-	-2147483648 ~ 2147483647	I32	ro	TxPDO
5001h	00h	Encode MultRevolutions Encoder multi-turn position	-	-2147483648~ 2147483647	I32	ro	TxPDO
5002h	00h	ModeSwitch Deceleration time Mode switch deceleration time	-	0~65535	U16	rw	RxPDO

8.3.2 Object Overview

For example, the P1-04 parameter is assigned the EtherCAT code 2104h.

The P3-10 parameters specify an EtherCAT capacity of 230Ah.

12-15 bits: 2 indicates the servo parameter area. 12-15 bits: 2 indicates the servo parameter area.

8-11 bits: 0-F indicates the parameter group number in Group P. 8-11 bits: 0-F indicates the parameter group number in Group P.

0-7 bits: 00-FF indicates the parameter under a specific group in the P group. 0-7 bits: 00-FF indicates the parameter under a specific group in the P group.

8.4 Profile region (0x6000~0x6FFF)

8.4.1 List of objects

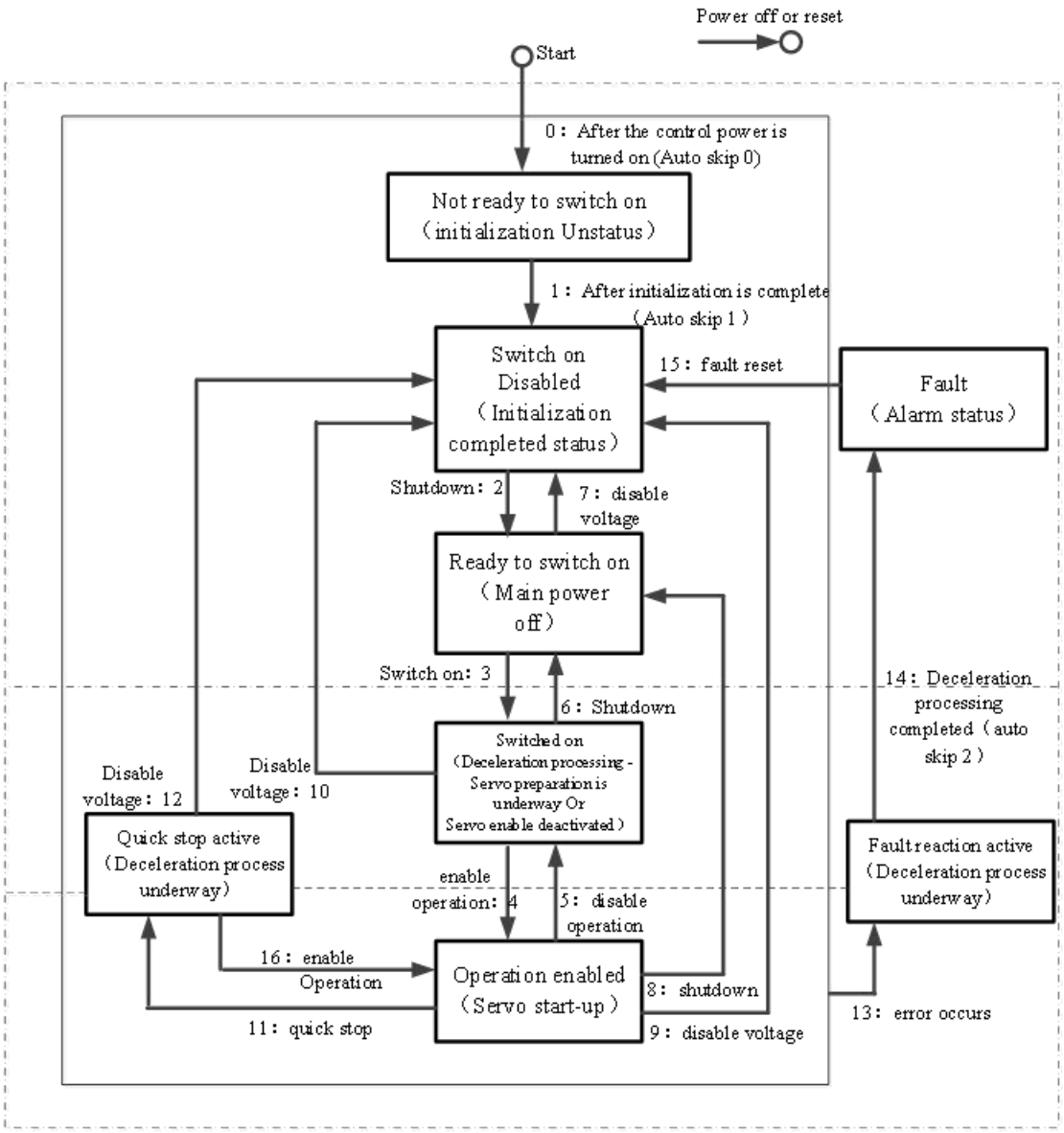
index of matrix	subindex	name
603Fh	00h	Abort connection option code
6040h	00h	Control word
6041h	00h	Status word
605Ah	00h	Quick stop option code
605Bh	00h	Shutdown option code
605Bh	00h	Disable operation option code
605Bh	00h	Halt option code
605Eh	00h	Fault reaction option code
6060h	00h	Mode of operation
6061h	00h	Control mode display
6062h	00h	Position demand value
6063h	00h	Actual internal value position feedback
6064h	00h	Position actual value position feedback
6065h	00h	Following error window
6066h	00h	Error timeout
6067h	00h	Position window position reaches the threshold
6068h	00h	Position window time: The time when the position arrives at the window.
6069h	00h	Actual value of the velocity sensor
606Bh	00h	Velocity demand value; speed instruction
606Ch	00h	Actual velocity value; speed feedback
606Dh	00h	Velocity window: Speed reaches the threshold
606Eh	00h	Velocity window time: The time it takes for a speed to reach a certain threshold.
606Fh	00h	Velocity threshold
6070h	00h	Velocity threshold time
6071h	00h	target torque
6072h	00h	Maximum torque
6073h	00h	Max current
6074h	00h	torque demand
6075h	00h	Rated current of the motor
6076h	00h	Rated torque of the motor
6077h	00h	torque feedback
6078h	00h	Current actual value
6079h	00h	DC link circuit voltage; bus voltage
607Ah	00h	Target position
607Bh	-	Position range limit
	00h	Number of entries
	01h	Min position range limit
	02h	Max position range limit

index of matrix	subindex	name
607Ch	00h	Home offset
607Dh	-	Software position limit: Absolute position limit for software.
	00h	Number of entries
	01h	Minimum position limit
	02h	Maximum position limit
606Eh	00h	Polarity instruction polarity
607Fh	00h	Maximum Profile Velocity
6080h	00h	Maximum motor speed
6081h	00h	Profile velocity
6083h	00h	Profile acceleration
6084h	00h	Profile deceleration
6085h	00h	Quick stop deceleration
6086h	00h	Motion profile type: Position trajectory planning type
6087h	00h	Torque slope
6088h	00h	Torque profile type
608Fh	-	Position encoder resolution
	00h	Number of entries
	01h	Encoder increment
	02h	Motor revolutions
6091h	-	Gear ratio
	00h	Number of entries
	01h	Motor revolutions
	02h	Shaft revolutions
6092h	-	Constant Feed Constant
	00h	Number of entries
	01h	Feed
	02h	Shaft revolutions
6098h	00h	Homing method Return to origin method
6099h	-	Homing speeds; return to original speed
	00h	Number of entries
	01h	Speed during search for switch
	02h	Speed during the zero return process
609Ah	00h	homing acceleration
60A3h	00h	Profile jerk use
60A4h	-	profile jerk
	00h	Number of entries
	01h	Profile jerk1 Profile jerk1
	02h	Profile jerk2 Profile jerk2
60B0h	00h	Position offset feedforward
60B1h	00h	velocity offset speed feedforward
60B2h	00h	Torque offset feedforward
60B8h	00h	touch probe function
60B9h	00h	Touch probe status
60BAh	00h	Touch probe pos1 positive value
60BBh	00h	Touch probe pos1 negative value

index of matrix	subindex	name
60BCh	00h	Touch probe pos2 positive value
60BDh	00h	Touch probe pos2 negative value
60C2h	-	Interpolation time period
	00h	Number of entries
	01h	Interpolation time period value
	02h	Interpolation time index
60C5h	00h	Maximum acceleration
60C6h	00h	Maximum deceleration
60E3h	-	Supported Homing method
	00h	Number of entries
	01h	1st supported Homing method Return to origin method 1
	..	..
	20h	32nd supported Homing method 32
60F2h	00h	Positioning option code
60F4h	00h	Follow error actual value
60FAh	00h	control effect
60FCh	00h	Position Demand Internal Value
60FDh	00h	Digital inputs
60FEh	-	Digital outputs
	00h	Number of entries
	01h	Physical outputs
	02	bit mask
60FFh	00h	Target velocity
6502h	00h	Supported drive modes

8.4.2 PDS (Power Drive Systems) Specifications

The PDS status transition of the servo driver's power control is defined as shown in the figure below, based on user commands or abnormal detection.



After migrating to Operation enabled, increase the time to over 100ms and enter the action command. The table below outlines the PDS state transition events (transition conditions) and the actions during the transition.

During PDS migration, the system performs state transition while establishing the handshake (using 6041h: Statusword to confirm the state change before sending the next migration command).

PDS change		event	movement
0	Auto skip 0	Automatic migration after power-on or application layer reset.	Automatic migration after power-on or application layer reset.
1	Auto skip 1	Auto-transform after initialization.	Communication is established.
2	Shut down	The shutdown command is received.	No special.
3	Switch on	When the power supply is ON, it receives the Switch on command.	No special.
4	Enable operation	The Enable operation command is accepted.	The drive function is active. All previous set point data has been cleared.
5	Disable operation	Enable the Disable operation command.	The drive function is invalid.

PDS change		event	movement
6	Shutdown	When the power supply is ON, the system receives a shutdown command. The power supply is detected to be in the OFF state.	No special.
7	Disable voltage	Disable the voltage command. The scenario of receiving the Quick Stop command. The ESM state is the scenario where the system transitions to Init during PreOP, SafeOP, or OP.	No special.
8	Shutdown	The power supply is in the ON state when receiving a Shutdown command.	The drive function is invalid
9	Disable voltage	Disable the voltage command.	The drive function is invalid
10	Disable voltage	Disable the voltage command. The scenario of receiving the Quick Stop command. The ESM state refers to the scenario where the system transitions to the Init state during PreOP, SafeOP, or OP phases.	No special.
11	Quick stop	The situation where the Quick Stop command is received.	Run the Quick Stop function.
12	Disable voltage	When the Quick stop selection code is set to 1, 2, or 3, and the Quick stop action is completed. The Quick stop function is triggered when the selected code is 5, 6, or 7, and upon completion of the Quick stop action, upon receiving the Disable voltage command. The power supply is detected to be in the OFF state.	The drive function is disabled.
13	Error occurs	Abnormal detection.	Execute the Fault reaction function.
14	Auto skip 2	After the exception detection and reduction processing is completed, the system will automatically migrate.	The drive function is invalid
15	Fault reset	When the fault causes are resolved, the system receives a fault reset command.	No Fault condition exists. Reset the Fault status.
16	Enable operation	The Quick Stop function activates when the selected code is 5, 6, or 7, upon receiving the Enable operation command.	Drive function is effective.

8.4.3 Control Word (6040h)

The PDS status transition and commands for the slave device (servo driver) are configured via the 6040h control word.

	subindex	name	scope	data type	accessibility	PDO	Op-mode

<table>
<tr><td>index of matrix</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">6040h</td><td rowspan="2">00h</td><td>Controlword</td><td>0~65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="6">Set control commands for servo drives, such as PDS state transitions.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="6">R</td><td>oms</td><td>h</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>fr</td><td colspan="3">R</td><td>eo</td><td>qs</td><td>ev</td><td>so</td></tr>
</table>
r = reserved (not mapped) fr = fault reset r = reserved (not mapped) fr = fault reset
oms = operation mode specific eo = enable operation
(The control mode depends on the bit) qs = quick stop (The control mode depends on the bit) qs = quick stop
h = halt ev = enable voltage
h = halt ev = enable voltage
so = switch on</td></tr>
</table>

Command	bits of the controlword					PDS change
	bit7	bit3	bit2	bit1	bit0	
	Fault reset	Enable operation	quick stop	Enable voltage	Switch on	
Shutdown	0	-	1	1	0	2，6，8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3+4
Enable operation	0	1	1	1	1	4，16
Disable voltage	0	-	-	0	-	7，9，10，12
Quick stop	0	-	0	1	-	7，10，11
Disable operation	0	0	1	1	1	5
Fault reset	0->1	-	-	-	-	13

The bit logic of the quick stop instruction is valid when it is 0.
Please note to perform other bit logic and reverse operations.

When bit8 (halt) is set to 1, the motor will be decelerated and paused via the 605Dh (Halt selection code).
After pausing, you must disable the restart action.

bit9,6-4（operation mode specific）：

This describes the changes in the OMS bit inherent to the control mode (Op-mode). (For details, refer to the relevant section for each control mode.)

Op-mode	Bit9	Bit6	Bit5	Bit4
pp	change on set-point	absolute /elative	change set immediately	new set-point
pv	-	-	-	-
tq	-	-	-	-
hm	-	-	-	start homing
csp	-	-	-	-
csv	-	-	-	-
cst	-	-	-	-

8.4.4 Status Word (6041h)

The PDS status transition and commands for the slave device (servo driver) are configured via the 6040h control word.

<table>
<tr><th>index of matrix</th><th>subindex</th><th>name</th><th>scope</th><th>data type</th><th>accessibility</th><th>PDO</th><th>Op-mode</th></tr>
<tr><td rowspan="2">6041h</td><td rowspan="2">00h</td><td>Statusword</td><td>0~65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the status of the servo driver.
bit information
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="2">r</td><td colspan="2">oms</td><td>ila</td><td>oms</td><td>rm</td><td>r</td></tr>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>w</td><td>sod</td><td>qs</td><td>ve</td><td>f</td><td>oe</td><td>so</td><td>rsto</td></tr>
</table>
r = reserved (not mapped) w = warning r = reserved (not mapped) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop oms = operation mode specific qs = quick stop
Control mode dependent bit: ve = voltage enabled Control mode dependent bit: ve = voltage enabled
ila = internal limit active f = fault ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on rm = remote so = switched on
rtso = ready to switch on</td></tr>
</table>

bit6,5,3-0 (switch on disabled/quick stop/fault/operation enabled/switched on/ready to switch on): This bit indicates the PDS status. The following lists the states and their corresponding bits.

StatusWord	PDS State	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Incomplete initialization status
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization completed

StatusWord	PDS State	
xxxx xxxx x01x 0001 b	Ready to switch on	Initialization completion status
xxxx xxxx x01x 0011 b	Switched on	Servo enable off / Servo ready
xxxx xxxx x01x 0111 b	Operation enabled	Enable servo
xxxx xxxx x00x 0111 b	Quick stop active	Stop now
xxxx xxxx x0xx 1111 b	Fault reaction active	Abnormal (Alarm) Detection
xxxx xxxx x0xx 1000 b	Fault	Abnormal (Alarm) Status

When bit4 (voltage enabled) is set to 1, the power supply voltage is applied to PDS.
The bit5 (quick stop) signal: A value of 0 indicates the PDS has received a quick stop request. The logic of the quick stop bit is active when the bit is at 0. Note that other bit logic operations and their inverse actions should be executed accordingly.
When bit7 (warning) is set to 1, it indicates an ongoing warning. During this state, the PDS status remains unchanged and the motor continues to operate.
When bit9 (remote) is 0 (local), it indicates the 6040 (Controlword) is unresponsive. When bit9 (remote) is 1, it means the 6040 (Controlword) is responsive. The ESM status is set to 1 when transitioning to PreOP or higher states.
bits 13,12, and 10 (operation mode specific): These indicate the OMS bit variations inherent to the control mode. (For details, refer to the relevant sections for each control mode.)

Op-mode	bit13	bit12	Bit10
pp	following error	set-point acknowledge	target reached
pv	-	speed	target reached
tq	-	-	target reached
hm	homing error	homing attained	target reached
csp	following error	drive follows command value	-
csv	-	drive follows command value	-
cst	-	drive follows command value	-

bit11 (internal limit active): The internal limit is triggered when the bit11 (internal limit active) in the 6041h status word becomes 1.
bits 15 and 14 (reserved): These bits remain unused (fixed at 0).

8.5 Control Mode Settings

8.5.1 Supported driving modes (6502h)

The servo driver can confirm the supported control mode according to 6502h.

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6502h	00h	Supported drive modes	0~4294967295	U32	ro	TxPDO	All

Indicates the supported control mode (Mode of operation).
A value of 1 indicates the supported mode.
bit information

31...16			15...10			9	8
r			r			cst	csv
0			0			1	1
7	6	5	4	3	2	1	0
csp	r	hm	r	tq	pv	r	pp
1	0	1	0	1	1	0	1

bit	Mode of operation	abbreviation	corresponding
0	Profile position mode	pp	YES
2	Profile Velocity Mode	pv	YES
3	Torque Profile Mode	tq	YES
5	Homing mode (origin reset position mode)	hm	YES
7	Cyclic synchronous position mode	csp	YES
8	Cyclic synchronous speed control mode	csv	YES
9	Cyclic synchronous torque mode	cst	YES

8.5.2 Control Mode (6060h)

The control mode is set through 6060h (control mode).

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
6060h	00h	Mode of operation	-128~127	I8	rw	RxPDO	All

Set the control mode of servo driver.
Non-corresponding control mode is disabled.

bit	Mode of operation	abbreviation	corresponding
-128~ -1	Reserved	-	-
0	No mode changed/No mode assigned No control mode change / No control mode assignment	-	-
1	Profile position mode	pp	YES
3	Profile Velocity Mode	pv	YES
4	Torque Profile Mode	tq	YES
6	Homing mode (origin reset position mode)	hm	YES
8	Cyclic synchronous position mode	csp	YES
9	Cyclic synchronous speed control mode	csv	YES
10	Cyclic synchronous torque mode	cst	YES
11~127	Reserved	-	-

The 6060h (Modes of operation) control mode defaults to 0 (No mode change/no mode assigned). After power-on, always set the appropriate control mode value. If both 6060h and 6061h settings are 0, migrating the PDS status to Operation enabled will trigger E-881 (Control mode setting exception protection).
If no control mode is set for 6060h, the E-881 (Control Mode Setting Abnormal Protection) will be triggered.
When the initial state 6060h=0 (No mode assigned) is converted to a supported control mode (pp, pv, tq, hm, CSP, CSV, CST), resetting 6060h=0 again as 'No mode changed' will prevent the control mode switch from being executed (the previous control mode will be maintained).

8.5.3 Current Control Mode (6061h)

The servo driver's internal control mode is confirmed via the 6061h (Modes of operation display). After configuring 6060h (Modes of operation), verify through testing whether the target action is feasible.

index of matrix	son index of matrix	name	scope	data type	accessibility	PDO	Op-mode
6061h	00h	Mode of operation display	-128~127	I8	ro	TxPDO	All

Indicates the current control mode.

bit	Mode of operation	abbreviation	corresponding
-128~-1	Reserved	-	-
0	No mode changed/No mode assigned No control mode change / No control mode	-	-

		assignment		
		1	Profile position mode	pp	YES
		3	Profile Velocity Mode	pv	YES
		4	Torque Profile Mode	tq	YES
		6	Homing mode (origin reset position mode)	hm	YES
		8	Cyclic synchronous position mode Cycle Synchronization Position Control Mode	csp	YES
		9	Cyclic synchronous velocity mode (Cycle synchronization speed control mode)	csv	YES
		10	Cyclic synchronous torque mode	cst	YES
		11~127	Reserved	-	-

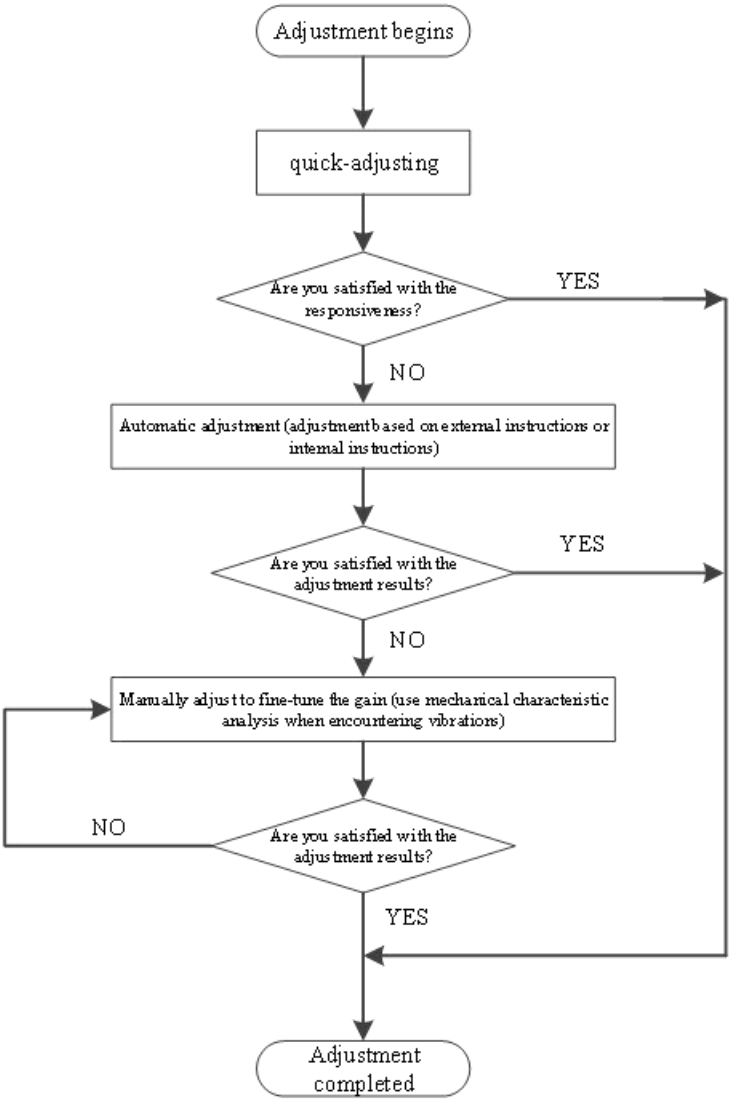
9. Adjustment of servo gain

9.1 Overview of Servo Gain Adjustment

9.1.1 Overview and Process

Servo driver needs to drive the motor as fast and accurate as possible to follow the command from the upper computer or the internal setting. In order to meet this requirement, the servo gain must be adjusted properly.

The following is the basic workflow for gain adjustment. Adjust according to the current machine status and operating conditions.



9.1.2 Differences between several adjustments

The adjustment methods are divided into adaptive and self-adjusting, with their control algorithms and parameters being independent. The self-adjusting mode includes three functions: fast adjustment, automatic adjustment, and manual adjustment. These three functions share the same core principle but differ in implementation methods. For details, refer to the corresponding sections.

<table>
<tr><th>Adjustment method</th><th>classify</th><th>controlling parameter</th><th>rigidity</th><th>reactive mode</th><th>The main relevant control parameters</th></tr>
<tr><td>self-adaption</td><td>autoadaptation</td><td>P2-01.0=1</td><td>centre</td><td>150ms level</td><td>P2-05 Adaptive Speed Loop Gain
P2-10 adaptive speed loop integration
P2-11 adaptive position loop gain
P2-07 Adaptive Inertia Ratio
Gain of P2-08 adaptive velocity observer
P2-12 Adaptive Stability and Maximum Inertia Ratio</td></tr>
<tr><td rowspan="3">self-tuning</td><td>rapid adjustment</td><td rowspan="3">P2-01.0=0</td><td>Gao</td><td>10-50ms</td><td rowspan="3">P0-07 First Inertia Ratio
P1-00 speed loop gain
P1-01 Velocity loop integral
P1-02 position loop gain
P2-35 torque command filter time constant 1
P2-49 model loop gain</td></tr>
<tr><td>self-correcting</td><td>Gao</td><td>10ms level</td></tr>
<tr><td>hand regulation</td><td>Gao</td><td>parameterized</td></tr>
</table>

9.2 Estimation of Rotational Inertia

9.2.1 Overview

The rotational inertia estimation is the function of driving the internal automatic operation (through forward and reverse rotation) of the driver to estimate the rotational inertia of the load during operation.
The ratio of the load inertia to the motor inertia is the reference parameter for the gain adjustment, and it must be set to the correct value.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P0-07	first inertia ratio	200	%	0 ~ 50000	at any time	immediately

9.2.2 Notes

Cases where the inertia cannot be inferred

- Mechanical system can only run in one direction.

Inertial estimation is prone to failure in certain situations

- The load has too large rotational inertia.
- The operating range is narrow, with a stroke of less than 0.5 turns.
- The moment of inertia changes greatly in the running process.
- The mechanical rigidity is low, and the vibration is produced when the inertia is presumed.

Inertial estimation considerations

- The device can rotate in both directions within the set range. Check the movement range or direction, and ensure the load operates within the safe travel distance.
- If the system runs with jitter when the default parameters are used to estimate inertia, it indicates that the current load inertia is too large. You can also set the initial inertia to about twice the current value and run the process again under a higher load.
- The maximum recognition limit for the drive's inertia ratio is 500x (parameter upper limit: 50000). If the estimated inertia ratio is exactly 50000, it means the limit has been reached and the drive cannot be used. Replace the motor with a rotor that has a higher inertia ratio.

Other notes

- Inertia switching is not supported. The second inertia ratio is invalid.

9.2.3 Operating Tools

The tool to deduce the load moment of inertia is the driver panel and XinJeServo upper computer software.

Tools	Restriction
drive panel	The driver firmware requires version 4200 or later
XinJeServo Host Computer Software	All versions of the host software support

The driver firmware version is displayed in U2-07.

9.2.4 Operating Procedures

1. Step of estimating the inertia of the drive panel

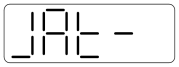
1. Parameter configuration

parameter	meaning	factory setting	unit	Set range	revise	come into force
P2-15	inertia configuration stroke	100	0.01 turn	1 ~ 300	at any time	immediately
P2-17	Inertia Identification and Self-adjusting Maximum Speed of Internal Command	0	rpm	0 ~ 65535	at any time	immediately
P2-18	Initial inertia ratio for inertia identification	500	%	1 ~ 20000	at any time	immediately

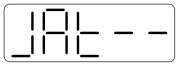
The recommended operating speed for P2-17 is 500rpm or higher. If the command speed is too low, the inertia ratio may be misidentified.

2. Inertia identification execution

Before inertial identification, use the F1-00 point movement function to confirm the servo rotation direction. The initial direction of servo operation is determined by INC or DEC when inertial identification begins.
If the servo jitter is under the adaptive default parameters, switch to the adaptive large inertia mode (P2-03.3=1) first to ensure the basic smooth operation of the servo before the inertia identification!
The servo enters the F0-07 parameter display in BB mode:



Press and hold the ENTER key to enable the servo. The panel displays:



Press the INC key to run forward or the DEC key to run backward (choose one). The display will

show:

When the system initiates under P0-05=0 (initial positive direction), a short press of INC first triggers forward rotation followed by reverse rotation, while a short press of DEC reverses first then forwards. Upon successful inertia identification, the system displays the load-inertia ratio after several forward/reverse cycles and automatically writes it to P0-07. If the identification fails, an error code is displayed. Pressing the STA/ESC keys briefly terminates the panel's inertia identification operation.

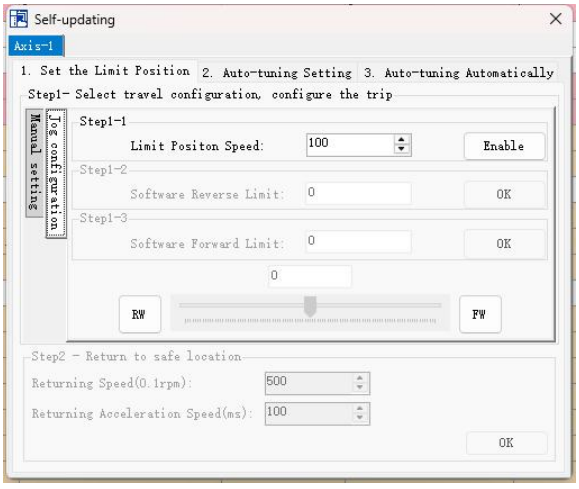
- Panel inertia identification error alarm

error code	meaning	Possible reasons and solutions
Err-1	motor torque saturation	① The initial inertia is too small; in the adaptive mode, switch to the large inertia mode P2-03.3=1; in the self-adjusting mode, the initial inertia of inertia identification is P2-18, and adjust to the current 2 times. ② The maximum speed is too high (P2-17), but it is recommended not to drop below 500 rpm, as an excessively low speed would result in inaccurate inertia ratio identification. ③ The torque limit is too small (P3-28/29).
Err-2	The calculated inertia value has a large error	① The maximum speed limit is too low (P2-17), but it is recommended not to set it below 500 rpm, as an excessively low command speed may result in inaccurate inertia ratio identification. ②The presumed inertia travel is too small. It is recommended that the minimum P2-15 inertia travel should not be less than 50 (0.5 circle). Too small travel will result in inaccurate identification of the pushed inertia. ③ The friction of the mechanism is too big; ④The overtravel has occurred.
Err-3	Internal travel calculation error in the drive	①The presumed inertia travel is too small. It is recommended that the minimum P2-15 inertia travel should not be less than 50 (0.5 circle). Too small travel will result in inaccurate identification of the push-out inertia.
Err-4	Location integration feature used	①During torque-inertia identification, the system should operate in PI control mode. The configuration was mistakenly changed to P control. Please verify whether the P5-21 proportional action command is enabled. When this function is activated, it will automatically switch to P/PI control, which may trigger the Err-4

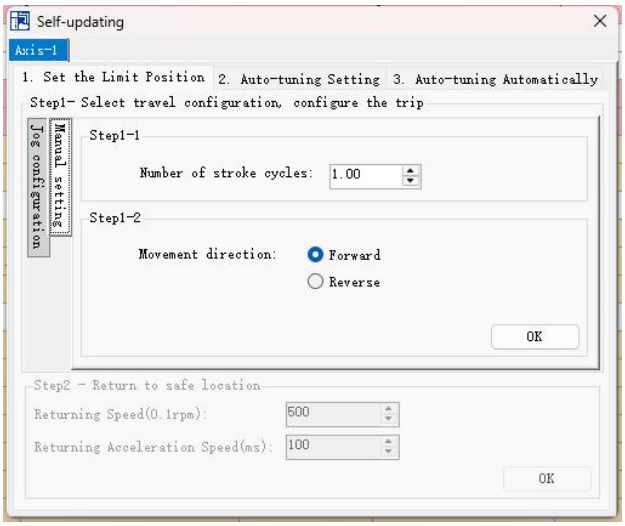
error code	meaning	Possible reasons and solutions
		alarm during inertia push execution. ② The motor's load and inertia are significantly mismatched, preventing the driver from accurately estimating inertia. Consider replacing the motor with one that matches the inertia requirements, or manually increase P0-07 (though this won't enable inertia identification). ③ The inertia of the shaft is estimated. The inertia identification should be carried out under load. ④ Power line phase sequence is incorrect. Check the power line phase sequence and wiring.
Err-5	Unrestrained Vibration in Inertial Identification Process	Unhandleable vibration occurred
Err-6	The drive is not in bb mode	① The enable function is activated. P5-20 can be initially set to 0. ② The driver alarm will appear. Press ESC to exit the setting interface and check for alarms.
Err-7	The driver alarm occurs during the inertia identification process	The driver triggers an alarm. Press ESC to exit the configuration interface and check the alarm code. Resolve the alarm before proceeding with inertia estimation.

2. XinJeServo Presumed Inertia Step

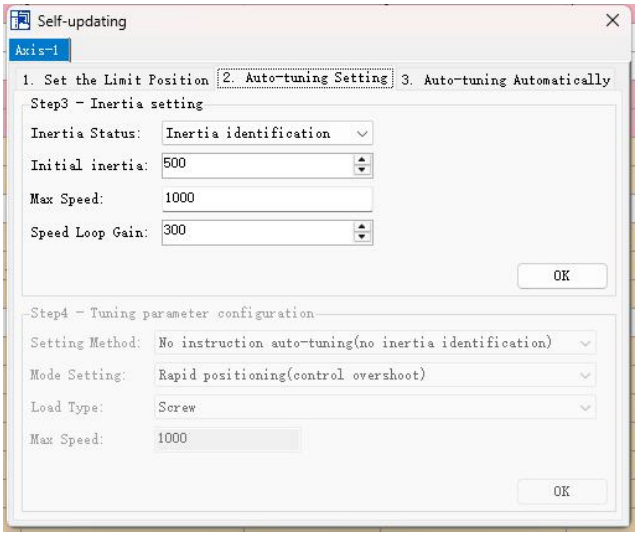
1. On the XinJeServo main menu screen, select [Self-Adjust].



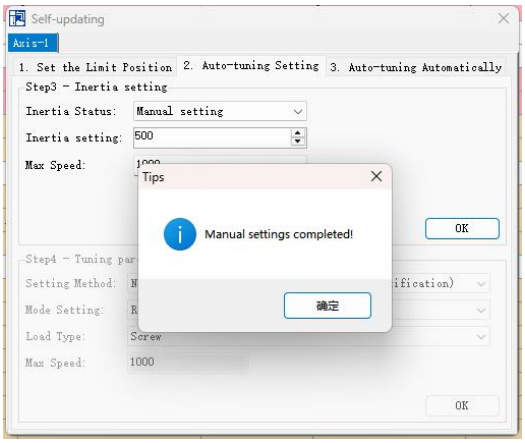
2. Select [Point Motion Configuration] or [Manual Setting] to configure the inertia estimation travel.



3. Set the configuration interface.



4. Click [Confirm] to start the inertia calculation.



- If the self-adjustment interface is closed directly, the driver will only configure the inertia ratio parameter.
- For detailed instructions on using XinJeServo's estimated inertia, refer to the XinJeServo help documentation.

9.3 Quick Adjustment

9.3.1 Overview

To perform quick adjustment, set the load inertia first. If the inertia is mismatched, an oscillation alarm will occur. The gain parameters for quick adjustment are in self-tuning mode.

9.3.2 Quick adjustment steps

1. Estimate the load inertia using either the driver panel or XinJeServo's host software, as specified in Section 9.2 for rotational inertia estimation.
2. Disable adaptive mode and set P2-01.0 to 0;
3. Set the required rigidity level P0-04.

P2-01.0 is the rightmost digit of the P2-01 parameter, as shown below:

P2-01=n. 0 0 1 0
↳ P2-01.0

9.3.3 The gain parameters corresponding to the rigid level

The rigidity level should be set based on actual load conditions. A higher P0-04 value indicates greater servo gain. If vibration occurs during the increase of rigidity level, further increases should be avoided. However, if vibration is eliminated through vibration suppression, additional increases may be attempted. The following recommended rigidity levels for specific loads are provided for reference only.

Supports three rigid level types selected via P6-00.0:

- P6-00.0 = 0: Standard mode [Default]

Rigidity level P0-04, associated with four parameters: P1-00, P1-01, P1-02, and P2-35.

- P6-00.0 = 1: Positioning mode, also known as soft mode

By implementing gain switching while maintaining responsiveness, the system achieves minimal overshoot at positioning completion. The rigid level P0-04 involves seven parameters: P1-00, P1-01, P1-02, P2-35, P1-05, P1-06, and P1-07, with P1-14 set to 0x00A1 to enforce mandatory gain switching.

- P6-00.0 = 2: Quick positioning mode

Enable the model loop and disturbance observer Dob, with rigidity level P0-04 and five parameters: P1-00, P1-01, P1-02, P2-35, and P2-49. Force binding for P2-00.0 and P2-41 in the disturbance observer Dob, and P2-47.0 and P2-49 in the model loop.

■ Standard rigid grade table (P6-00.0=0)

rigidity class P0-04	speed loop gain P1-00	integral of velocity time constant P1-01	position loop gain P1-02	torque command filtering Time constant 1 P2-35
0	15	50000	24	1326
1	20	39789	32	995
2	25	31831	40	796
3	30	26526	48	663
4	35	22736	56	568
5	45	17684	72	442
6	60	13263	96	332
7	75	10610	120	265
8	90	8842	144	221
9	110	7234	176	181
10	140	5684	224	142
11	180	4421	288	111
12	250	3183	400	80
13	300	2653	480	66
14	350	2274	560	57
15	400	1989	640	50
16	500	1592	800	40
17	600	1326	960	33
18	750	1061	1200	27
19	900	884	1440	22
20	1150	692	1840	17
21	1400	568	2240	14
22	1700	468	2720	12
23	2100	379	3360	9
24	2500	318	4000	8
25	2800	284	4480	7
26	3100	257	4960	6
27	3400	234	5440	6
28	3700	215	5920	5
29	4000	199	6400	5
30	4500	177	7200	5
31	5000	159	8000	5
32	5500	145	8800	3
33	6000	133	9600	3
34	6500	123	10400	3
35	7000	114	11200	0
36	7500	106	12000	0
37	8000	100	12800	0
38	8500	94	13600	0
39	9000	88	14400	0

rigidity class P0-04	speed loop gain P1-00	integral of velocity time constant P1-01	position loop gain P1-02	torque command filtering Time constant 1 P2-35
40	9500	84	15200	0
41	10000	80	16000	0

■ Rigid grade table for positioning mode (P6-00.0=1)

rigidity grade P0-04	speed loop gain P1-00	integral of velocity time constant P1-01	position loop gain P1-02	Filtering time constant of torque command 1/2 P2-35/P2-36	second speed loop gain P1-05	second speed loop integral time constant P1-06	second position loop gain P1-07
0	15	50000	24	1326	15	51200	40
1	20	39789	32	995	20	51200	48
2	25	31831	40	796	25	51200	56
3	30	26526	48	663	30	51200	72
4	35	22736	56	568	35	51200	96
5	45	17684	72	442	45	51200	120
6	60	13263	96	332	60	51200	144
7	75	10610	120	265	75	51200	176
8	90	8842	144	221	90	51200	224
9	110	7234	176	181	110	51200	288
10	140	5684	224	142	140	51200	400
11	180	4421	288	111	180	51200	480
12	250	3183	400	80	250	51200	560
13	300	2653	480	66	300	51200	640
14	350	2274	560	57	350	51200	800
15	400	1989	640	50	400	51200	960
16	500	1592	800	40	500	51200	1200
17	600	1326	960	33	600	51200	1440
18	750	1061	1200	27	750	51200	1840
19	900	884	1440	22	900	51200	2240
20	1150	692	1840	17	1150	51200	2720
21	1400	568	2240	14	1400	51200	3360
22	1700	468	2720	12	1700	51200	4000
23	2100	379	3360	9	2100	51200	4480
24	2500	318	4000	8	2500	51200	4960
25	2800	284	4480	7	2800	51200	5440
26	3100	257	4960	6	3100	51200	5920
27	3400	234	5440	6	3400	51200	6400
28	3700	215	5920	5	3700	51200	7200
29	4000	199	6400	5	4000	51200	8000
30	4500	177	7200	5	4500	51200	8000
31	5000	160	8000	5	5000	51200	8000

rigidity grade P0-04	speed loop gain P1-00	integral of velocity time constant P1-01	position loop gain P1-02	Filtering time constant of torque command 1/2 P2-35/P2-36	second speed loop gain P1-05	second speed loop integral time constant P1-06	second position loop gain P1-07
32	5500	145	8800	3	5500	51200	8000
33	6000	133	9600	3	6000	51200	8000
34	6500	123	10400	3	6500	51200	8000
35	7000	114	11200	0	7000	51200	8000
36	7500	106	12000	0	7500	51200	8000
37	8000	100	12800	0	8000	51200	8000
38	8500	94	13600	0	8500	51200	8000
39	9000	88	14400	0	9000	51200	8000
40	9500	84	15200	0	9500	51200	8000
41	10000	80	16000	0	10000	51200	8000

■ Quick Location Mode Rigid Grade Table (P6-00.0=2)

rigidity class P0-04	speed loop gain P1-00	Integral Time Constant P1-01 for Velocity Loop	position loop gain P1-02	Torque command filter time constant P2-35	model loop gain P2-49
0	71	50000	24	20	24
1	80	39789	32	20	32
2	89	31831	40	20	40
3	100	26526	48	20	48
4	112	22736	56	20	56
5	125	17684	72	20	72
6	140	13263	96	20	96
7	157	10610	120	20	120
8	176	8842	144	20	144
9	198	7234	176	20	176
10	221	5684	224	20	224
11	248	4421	288	20	288
12	278	3183	400	20	400
13	311	2653	480	20	480
14	349	2274	560	20	560
15	390	1989	640	20	640
16	437	1592	800	20	800
17	490	1326	960	20	960
18	549	1061	1200	20	1200
19	615	884	1440	20	1440
20	689	692	1840	20	1840
21	771	568	2240	20	2240
22	864	468	2720	20	2720
23	968	379	3360	20	3360

rigidity class P0-04	speed loop gain P1-00	Integral Time Constant P1-01 for Velocity Loop	position loop gain P1-02	Torque command filter time constant P2-35	model loop gain P2-49
24	1084	318	4000	8	4000
25	1214	284	4480	7	4480
26	1360	257	4960	6	4960
27	1523	234	5440	6	5440
28	1705	215	5920	5	5920
29	1910	199	6400	5	6400
30	2139	177	7200	5	7200
31	2396	160	8000	5	8000
32	2684	145	8800	3	-
33	3006	133	9600	3	-
34	3367	211	10400	3	-
35	3771	189	11200	0	-
36	4223	168	12000	0	-
37	4730	150	12800	0	-
38	5298	134	13600	0	-
39	5934	107	14400	0	-
40	6646	95	15200	0	-
41	6646	95	16000	0	-

9.3.4 Notes

- The gain parameters corresponding to the rigid level can be adjusted independently in the fast adjustment mode.
- The Quick Adjustment mode defaults to a rigid level. If the gain does not meet mechanical requirements, adjust it gradually.
- In order to ensure stability, the model ring gain is given small in low rigidity level, and the value of this parameter can be increased separately when high response is required.
- To quickly address vibration issues, adjust the torque command filter P2-35. If ineffective, perform mechanical characteristic analysis and set the relevant notch parameters (refer to Section 9.7 Vibration Suppression).

9.4 Automatic Adjustment

9.4.1 Overview

Automatic adjustment is divided into internal instruction self-adjustment and external instruction self-adjustment.
Automatic adjustment (internal command self-adjustment) is a function where the servo unit automatically operates (forward and reverse reciprocating motion) without commands from the upper device, adjusting according to mechanical characteristics during operation.
Automatic adjustment (external command self-adjustment) is a function that automatically optimizes the operation based on commands from the higher-level device.

Auto-adjustments are as follows:

- load moment of inertia
- Gain parameters (velocity loop, position loop, model loop gain)
- Filter (notch filter, torque command filter)

9.4.2 Notes

When adjustments cannot be made

- Mechanical system can only run in one direction.

Conditions in which adjustments are likely to fail

- The load has too large rotational inertia;
- The moment of inertia changes greatly in the running process;
- The low mechanical rigidity causes vibration during operation, and the detection and positioning fail.
- The running distance is small, within 0.5 circles.

Preparation work before setting

- Use location mode;
- The drive is in BB mode.
- The drive has no alarm.
- The coordination between the number of pulses per revolution and the width of the completed positioning is reasonable.

9.4.3 Operating Tools

Both internal and external command self-adjustment can be performed through the driver panel and XinJeServo upper computer software.

set mode	Tools	Restriction

internal instruction self adjustment external command auto setting	XinJeServo Host Computer Software	All versions of the host software support
	drive panel	All DM6C driver inverter modules support

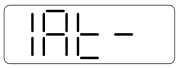
The driver firmware version is displayed in U2-07.

9.4.4 Internal instructions for self-adjustment operation steps

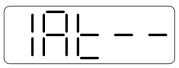
1. Self-adjustment steps for the drive panel

1. Perform inertia identification by following the driver panel estimation procedure in step 9.2.4 of rotational inertia estimation.

2. Enter the parameter F0-09 to display 'iat-'.



3. Press and hold the ENTER key, the panel will display 'iat--', indicating the servo is now enabled.



4. Press and hold INC or DEC to activate the adjustment mode, where the panel displays 'tune' with a flashing indicator.

5. The driver automatically sends pulse commands internally. If the setup is successful, it displays 'done' and flashes.

6. Press and hold the STA/ESC keys to exit the internal command auto-adjustment.

During the calibration process, a short press of STA/ESC will terminate the operation and revert to the original gain settings. If calibration fails, always reinitialize the driver before attempting it again.

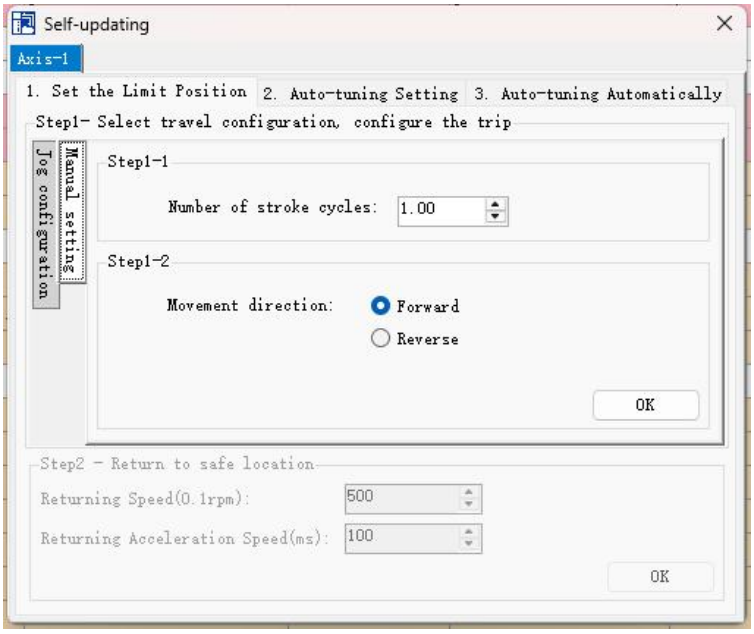
- Self-tuning process panel error alarm

error code	meaning	Possible reasons
Err-1	Failed to find the optimal gain	The inertia ratio is too large; the mechanism is too weak
Err-2	Excessive range/alarm during self-tuning	Ensure the trip has no over-trip or alarm before resetting
Err-6	The drive is not in the "bb" state when the operation is performed.	Check the current status of the drive
Err-7	The driver generates an alarm during the	The drive has an alarm

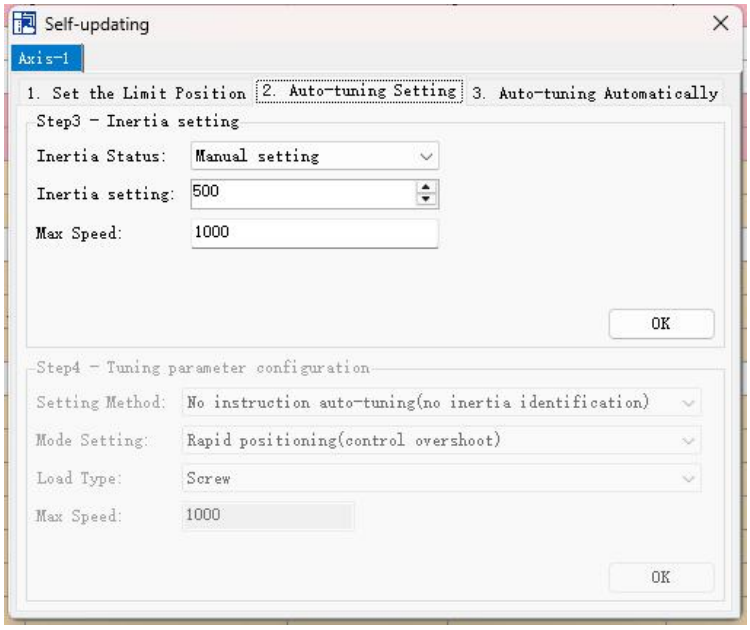
	calibration process.	

2. XinJeServo self-tuning procedure

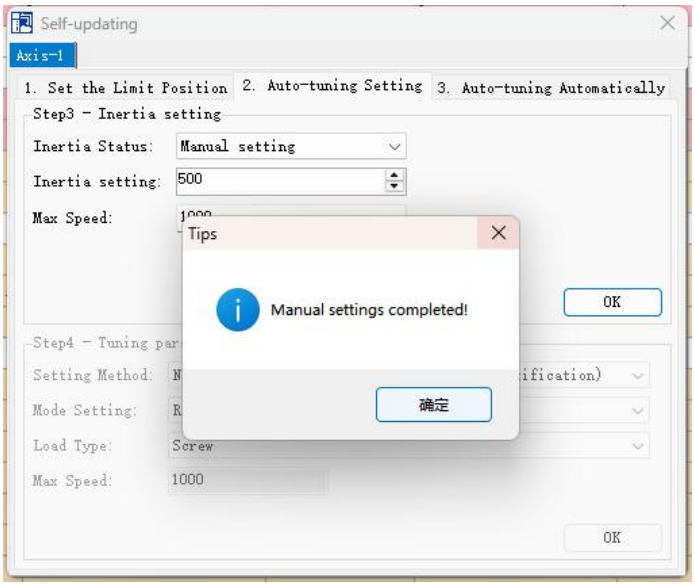
1. On the XinJeServo main menu screen, select [Self-Adjust].
2. Select [Point Motion Configuration] or [Manual Setting] to configure the inertia estimation travel.



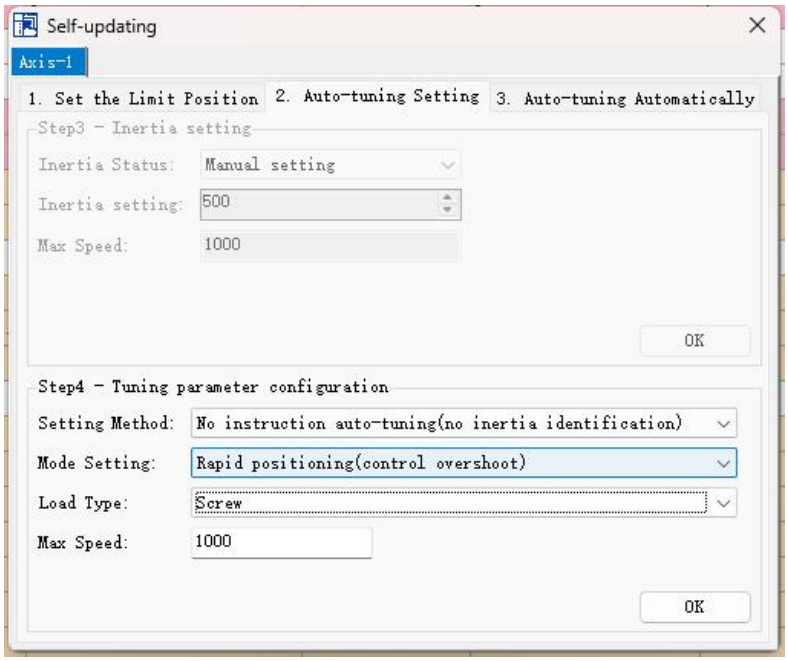
3. Set the configuration interface.



4. Click [Confirm] to start the inertia calculation.



5. Setting parameters.

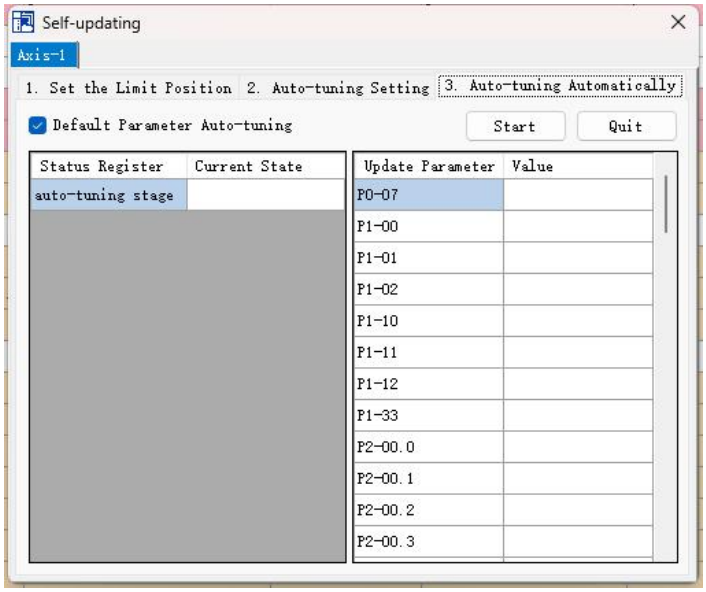


adjustment method	explain
soft	Apply a soft gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.
quick positioning	Adjusts for positioning purposes. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.
quick	In the purpose of positioning, the adjustment focuses on avoiding overshoot. In

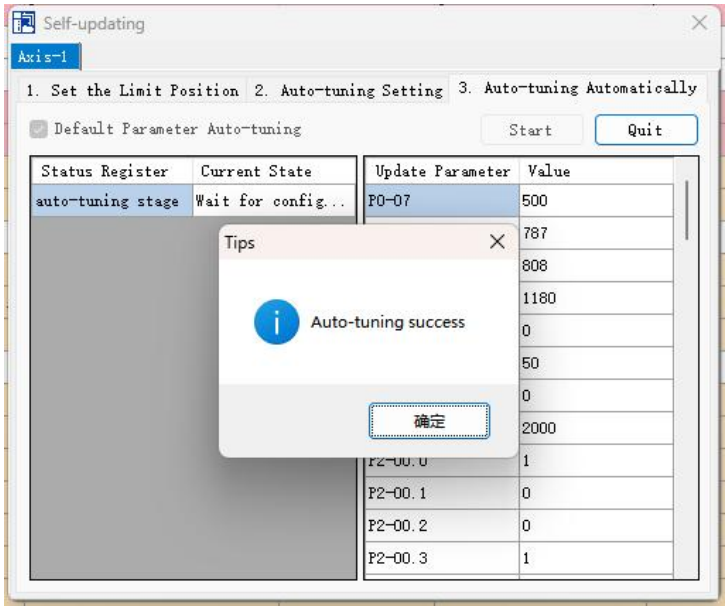
positioning (overshoot control)	addition to gain adjustment, the model loop gain and notch filter are automatically adjusted.

rigidity class	explain
locking-in range on synchronization	The adjustment is suitable for the lower rigidity mechanism such as the synchronous belt mechanism.
lead screw	Adjust for high-rigidity mechanisms such as ball screw mechanisms. Select this type if no corresponding mechanism is available.
fixed joint	The adjustment is suitable for rigid body system and other rigid mechanism.

6. Start the adjustment.



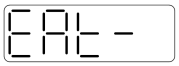
7. Wait for the adjustment to complete.



9.4.5 External Command Self-Adjustment Operation Steps

1. Self-adjustment steps for the drive panel

1. Perform inertia identification by following the driver panel estimation procedure in step 9.2.4 of rotational inertia estimation.
2. When entering parameter F0-08, the system displays Eat- (External Reference Auto-tuning);



3. Press and hold the ENTER key. If the enable function is not enabled, the panel will display 'Son' and flash, then wait for the enable function to activate. If the enable function is already enabled, skip this step.

4. Activate the servo, the panel displays 'tune' with a flashing indicator, and the system enters the calibration phase.

5. The upper device initiates pulse command transmission. Upon successful calibration, it displays 'done' with a flashing indicator.

6. Press and hold the STA/ESC keys to exit the external command auto-adjustment.

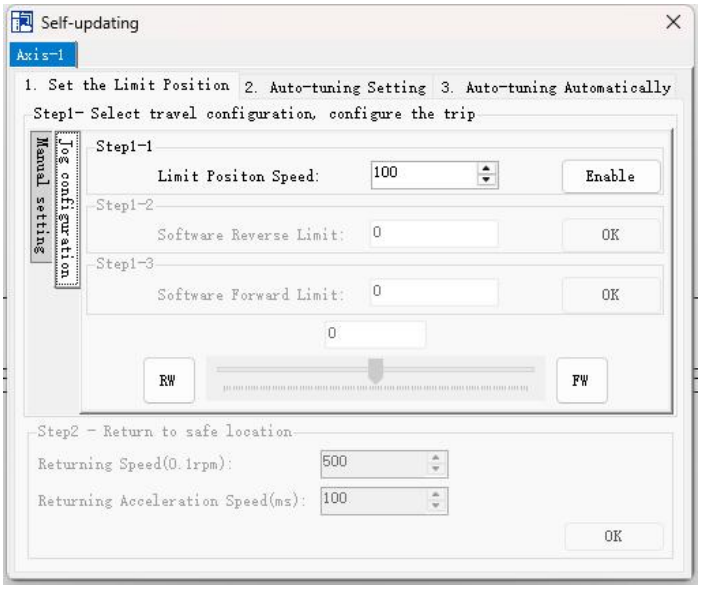
During the calibration process, a short press of STA/ESC will terminate the operation and revert to the original gain settings.

- Self-tuning process panel error alarm

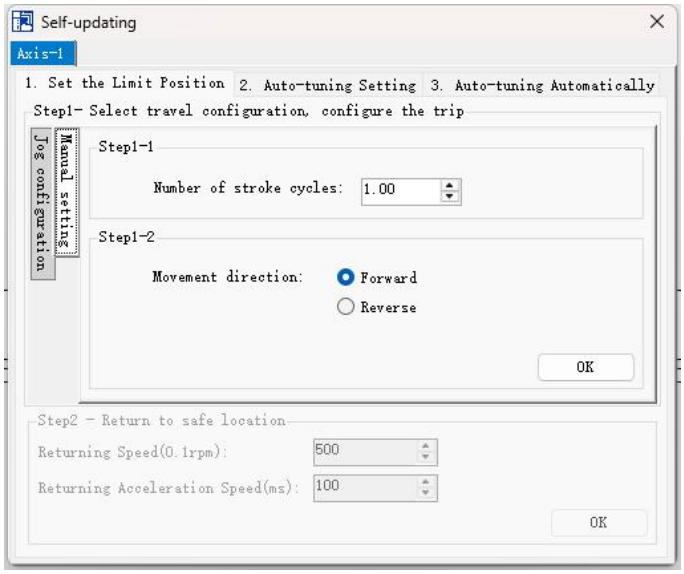
error code	meaning	Possible reasons
Err-1	Failed to find the optimal gain	The inertia ratio is too large; the mechanism is too weak
Err-2	① During the self-adjustment process, an over-range or alarm occurred. ② External command setting/vibration suppression mode: Servo is enabled during the setting process	Ensure the trip has no over-trip or alarm before resetting Confirm that enabling is not disabled during the setup process
Err-3	Current non-position control mode	Set the location mode to auto-adjust
Err-4	Adaptive feature is not turned off	Set P2-01.0 to 0 before performing self-tuning
Err-7	The driver generates an alarm during the calibration process.	The drive has an alarm.
Err-8	The positioning signal is unstable	The command interval is too short

2. XinJeServo self-tuning procedure

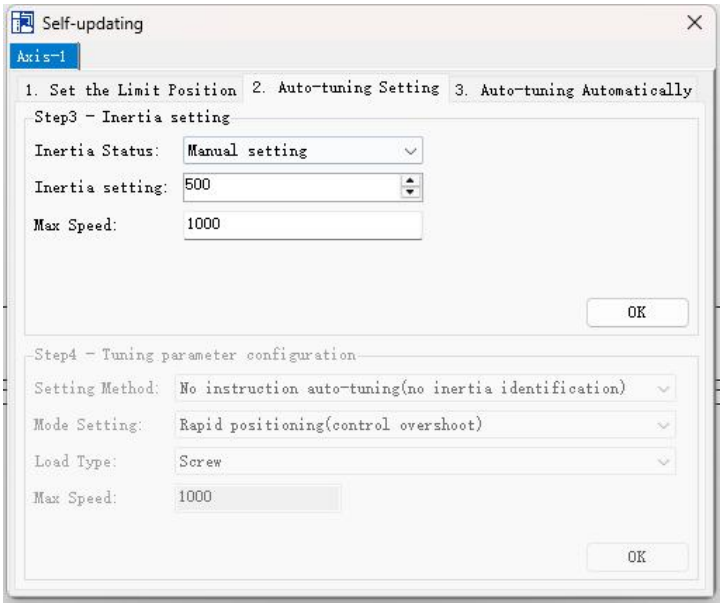
1. In the XinJeServo main menu, select [Self-Adjust].



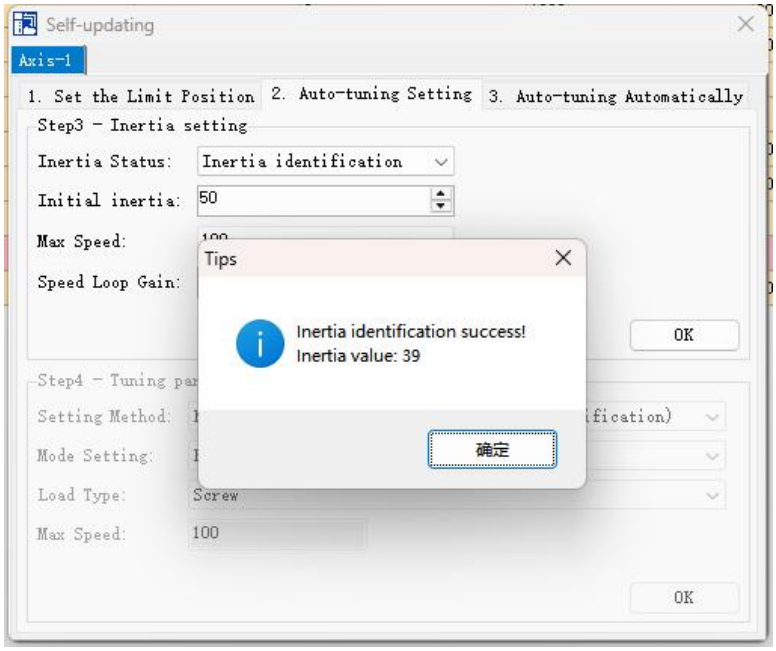
2. Select [Point Motion Configuration] or [Manual Setting] to configure the inertia estimation travel.



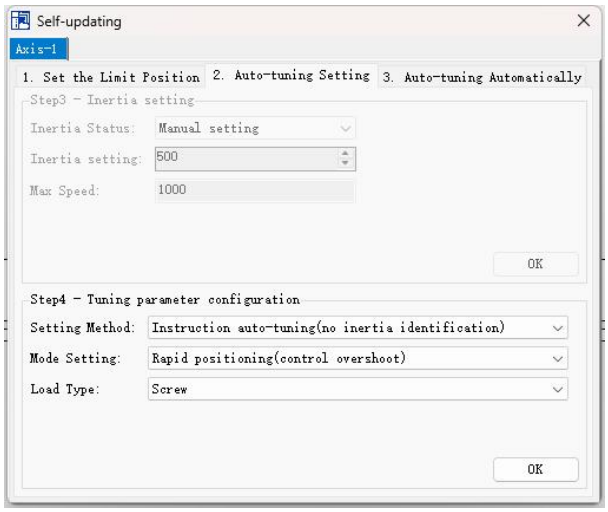
3. Set the configuration interface;



4. Click [Confirm] to start calculating the presumed inertia;



5. Set the parameters;

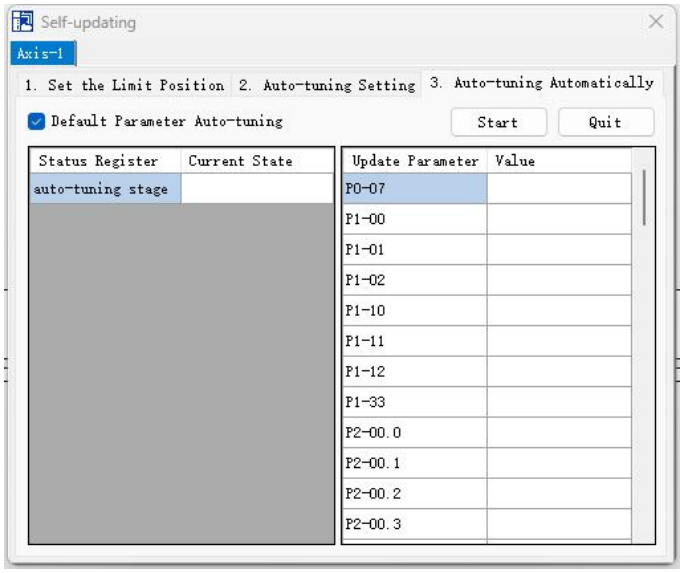


adjustment method	explain
soft	Apply a soft gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.
quick positioning	Adjusts for positioning purposes. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.
quick positioning (overshoot control)	In the purpose of positioning, the adjustment focuses on avoiding overshoot. In addition to gain adjustment, the model loop gain and notch filter are automatically adjusted.

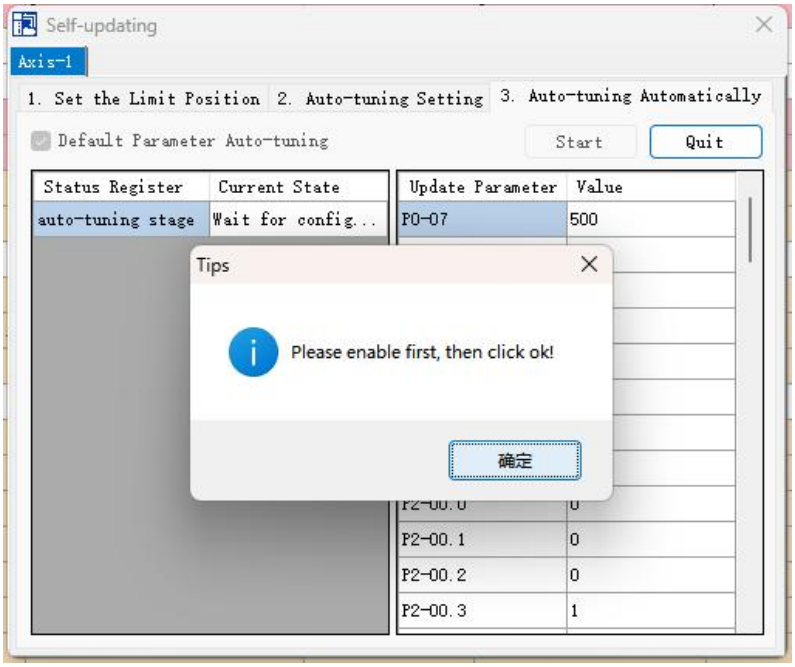
rigidity class	explain
locking-in range on	Adjustment for the lower rigidity mechanism such as synchronous belt mechanism

synchronization	
lead screw	Adjust for high-rigidity mechanisms such as ball screw mechanisms. If no corresponding mechanism is available, select this type.
fixed joint	Adjustment Suitable for Rigid System and Other Rigid Mechanism

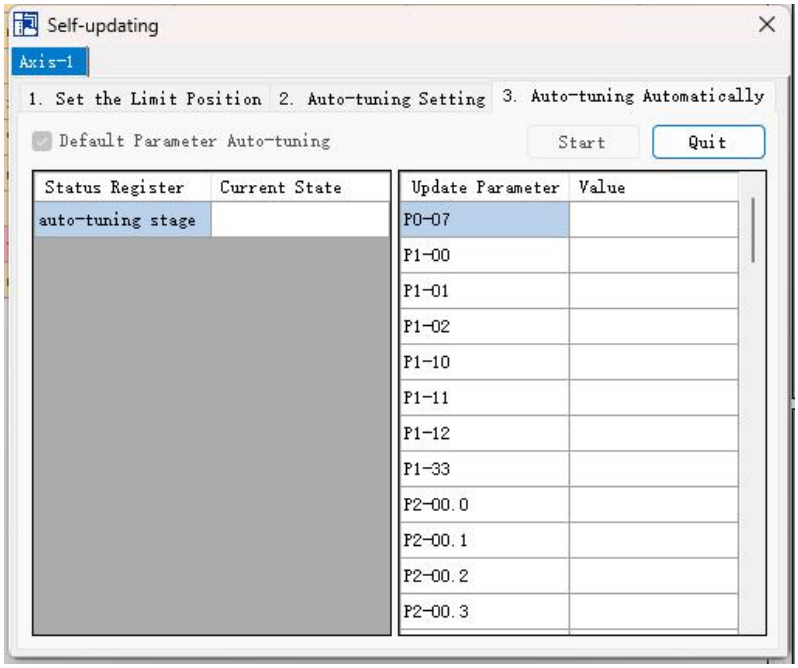
6. Start the adjustment process;



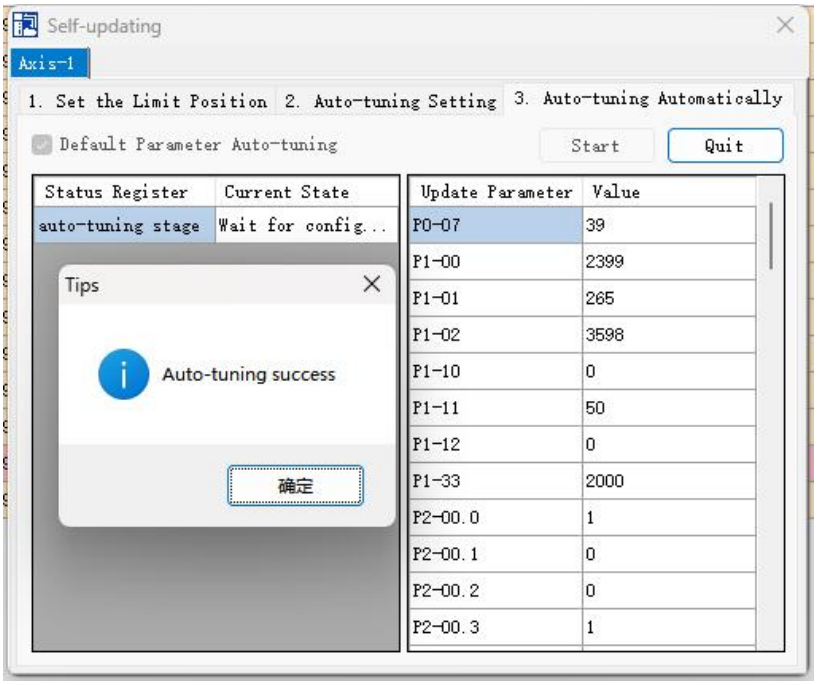
7. After enabling the servo, click OK.



8. The upper device initiates pulse command transmission and awaits the completion of calibration.



9. Complete the adjustment and click OK.



9.4.6 Relevant parameters

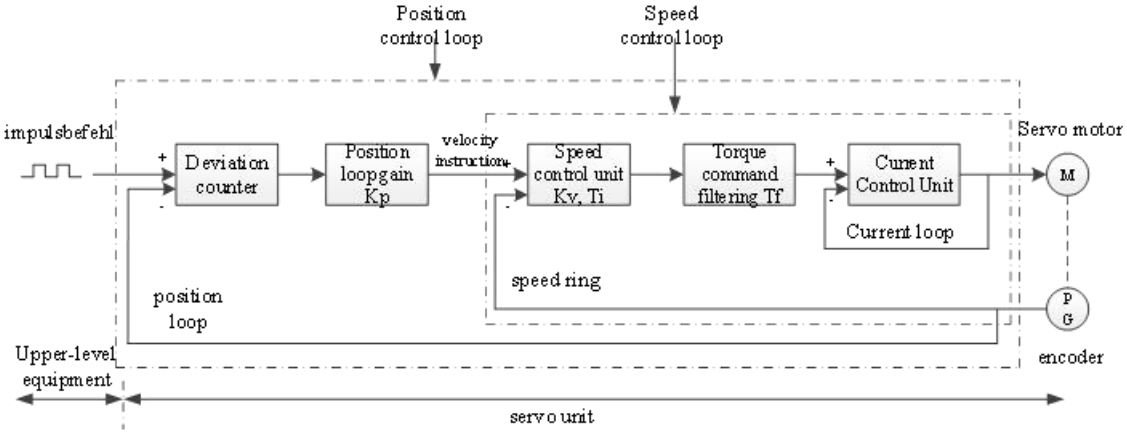
The following parameters may be modified during automatic adjustment. Do not change them manually.

parameter	name	parameter attribute	The effect of the numerical value on the gain after the adjustment is finished
P0-07	first inertia ratio	gain performance parameter	have
P1-00	first speed loop gain		
P1-01	first speed loop integral time constant		
P1-02	first position loop gain		
P2-00.0	perturbation observer switch		
P2-01.0	adaptive mode switch		
P2-35	Torque command filter time constant 1		
P2-41	perturbation observer gain		
P2-47.0	model loop switch		
P2-49	model loop gain		
P2-55	model speed feedforward gain		
P2-60.0	active vibration suppression switch		
P2-61	active vibration damping frequency		
P2-62	active vibration damping gain		
P2-63	active vibration damping		
P2-64	Active vibration suppression filter time 1		
P2-65	Active vibration suppression filtering time 2		
P2-66	The second group uses active vibration damping and damping techniques.		
P2-67	The second group has an active vibration suppression frequency.		
P2-69.0	first notch switch		
P2-69.1	second notch switch		
P2-71	first notch frequency		
P2-72	first notch attenuation		
P2-73	first notch bandwidth		
P2-74	second notch frequency		
P2-75	second notch attenuation		
P2-76	second notch bandwidth		
P2-17	Inertia Identification and Self-adjusting Maximum Speed of Internal Command	set configuration parameter	not have
P2-86	fixed point motion mode		
P2-87	minimum limit of set motion		
P2-88	Maximum limit of the set motion		
P2-89	maximum speed of the set motion		
P2-90	set acceleration and deceleration time		

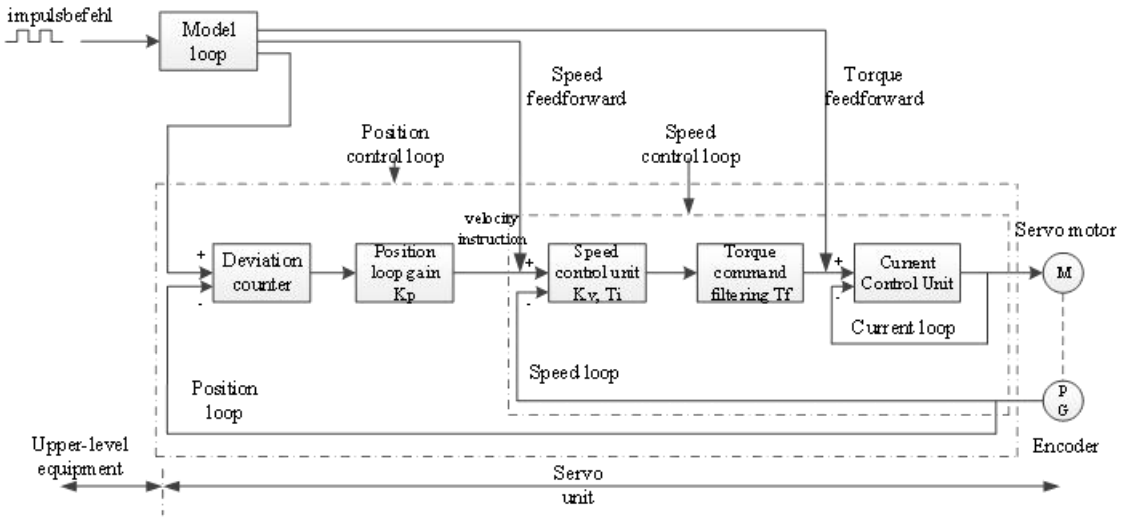
P2-60 ~ P2-63 are automatically adjusted during the self-tuning process and cannot be modified manually by users, as manual adjustments may cause system instability.

9.5 Manual adjustment

9.5.1 Overview



Position control (model loop off) control block diagram



Position control (enable model loop) control block diagram

The servo unit consists of three feedback loops (from inner to outer: current loop, speed loop, position loop). The inner loop requires higher responsiveness. Failure to adhere to this principle may result in reduced responsiveness or vibration. The current loop parameters are fixed values that ensure adequate responsiveness, eliminating the need for user adjustment.

Use manual adjustment in the following situations:

- When the desired effect cannot be achieved through rapid gain adjustment
- When automatic gain adjustment fails to achieve the desired effect

9.5.2 Example of adjustment steps

If the self-adjustment is selected in the gentle mode (P2-02.0=1) in the position mode, the model loop function is turned off; the position loop gain is invalid in the speed mode.

Improve response time

1. Decrease the torque command filter time constant (P2-35)
2. Boost the speed loop gain (P1-00)
3. Reduce the integral time parameter of the speed loop (P1-01)
4. Enhance the position loop gain (P1-02)
5. Improving the model loop gain (P2-49)

Reduce response, prevent vibration and overshoot

1. Reduce the speed loop gain (P1-00)
2. Increase the integral time constant of the speed loop (P1-01)
3. Reduce the position loop gain (P1-02)
4. Increase the torque command filter time constant (P2-35)
5. Reduce the model loop gain (P2-49)

9.5.3 Adjusted gain parameters

The gain parameters to be adjusted are generally:
P1-00 Speed loop gain
P1-01 Integral Time Constant of Speed Loop
P1-02 Position loop gain
P2-35 Torque command filter time constant
P2-49 model loop gain

- speed loop gain

When the speed loop is slow, it will be a delay element of the outer position loop, and the overshoot or the vibration of the speed command will occur. Therefore, in the range that the mechanical system does not vibrate, the larger the set value is, the more stable and responsive the servo system is.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P1-00	speed loop gain	300	0.1Hz	10 ~ 20000	at any time	immediately

- integral time constant of velocity loop

In order to make the servo system respond to the small input, the speed loop contains an integral element. Because the integral element is a delay element for the servo system, when the time constant is set too large, overshoot will occur or the positioning time will be prolonged, and the responsiveness will be reduced.
The speed loop gain and the speed loop integral time constant satisfy the following relation:

P1-00 × P1-01 = 636620

parameter	meaning	factory setting	unit	Set range	revise	come into force
P1-01	integral time constant of velocity loop	2653	0.01ms	15 ~ 51200	at any time	immediately

- position loop gain

When the model loop is invalid (P2-47.0=0), the responsiveness of the servo unit's position loop is determined by the position loop gain. The higher the position loop gain, the more responsive it is, and the shorter the positioning time. Generally, the position loop gain should not be increased beyond the range of the natural frequencies of the mechanical system. Therefore, to set a higher position loop gain, the rigidity of the machine must be increased, and the natural frequencies of the machine must be raised.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P1-02	position loop gain	480	0.1/s	10 ~ 20000	at any time	immediately

- torque command filter time constant

If the machine vibrates due to servo drive, adjusting the torque command filter time parameter may eliminate the vibration. A smaller value enables better responsiveness, but it is limited by the machine's condition. When vibration occurs, reduce this parameter. The recommended adjustment range is 10 to 150.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P2-35	Torque command filter time constant 1	66	0.01ms	0 ~ 65535	at any time	immediately
P2-36	Torque command filter time constant 2	100	0.01ms	0 ~ 65535	at any time	immediately

When the first set of gain parameters is used, P2-35 takes effect; when the second set is used, P2-36 takes effect.

- model loop gain

When the model loop is active (P2-47.0=1), the responsiveness of the servo system is determined by the model loop gain. If the model loop gain is increased, the responsiveness increases and the positioning time is reduced. In this case, the responsiveness of the servo system depends on this parameter, not P1-02 (position loop gain). The model loop gain is only effective for the position mode.

parameter	meaning	factory setting	unit	Set range	revise	come into force
P2-49	model loop gain	480	0.1Hz	10 ~ 20000	at any time	immediately

9.6 Adaptive adjustments

9.6.1 Overview

Adaptive function is the function that can get stable response by automatic adjustment no matter the machine type and load fluctuation.

9.6.2 Notes

- When the servo unit is installed on the machine, it may emit a brief sound during initial startup. This is due to the automatic notch filter setup, not a malfunction. The sound will not occur during subsequent startups.
- The motor may vibrate when operating beyond its allowable load inertia. Adjust the adaptive parameters to match the current load inertia.
- To ensure safety in adaptive operations, enable adaptive functions with emergency stop or shutdown capabilities available at any time.

9.6.3 Operating Procedures

Factory settings are adaptive and effective without modifying other parameters. The adaptive effect is controlled by the following parameters.

parameter		meaning	factory setting	revise	come into force
P2-01	n.□□□0	adaptive shutdown	n.□□□0	servo bb	Power on again
	n.□□□1	Open automatically			

9.6.4 Inertial Mode and Related Parameters

The adaptive default setting is set to low inertia mode. If the load inertia significantly exceeds the motor's allowable load inertia (e.g., 60 times the inertia of a 60 motor), you can activate the adaptive high inertia mode.

parameter		meaning	factory setting	revise	come into force
P2-03	n.0□□□	adaptive small inertia mode	n.0□□□	servo bb	Power on again
	n.1□□□	adaptive large inertia mode			

parameter	meaning	factory setting	revise	come into force
P2-05	adaptive speed loop gain	400	servo bb	Power on again
P2-10	adaptive velocity loop integration	500	servo bb	Power on again
P2-11	adaptive position loop gain	100	servo bb	Power on again
P2-07	adaptive inertia ratio	0	servo bb	Power on again
P2-08	Gain of adaptive velocity observer	60	servo bb	Power on again
P2-12	adaptive stability maximum inertia ratio	30	servo bb	Power on again
P2-16	Adaptive control of motor rotor inertia coefficient	100	servo bb	Power on again
P2-19	adaptive control bandwidth	50	Change anytime	Instantly effective
P6-05	Gain of adaptive large inertia mode speed loop	200	servo bb	Power on again
P6-07	adaptive large inertia mode inertia ratio	50	servo bb	Power on again
P6-08	Gain of adaptive large inertia mode speed observer	40	servo bb	Power on again
P6-12	Adaptive Large Inertia Mode Stabilization with Maximum Inertia Ratio	50	servo bb	Power on again

9.6.5 Recommended Inertia Ratio Parameters

Adaptive default parameters only ensure stable operation of the load under a certain moment of inertia. If the load has a large moment of inertia, some parameters still need to be adjusted. The recommended parameters are as follows (all modified parameters are based on the default settings).

motor base	inertia	parameter
40～90 engine base	Within 20 times the inertia	Adaptive small inertia mode (default)
	20 to 30 times the inertia	Change P2-08 to 50 and P2-12 to 40
	30 to 40 times the inertia	Change P2-08 to 50, P2-12 to 40, and P2-07 to 10
	40 to 50 times the inertia	Change P2-08 to 50, P2-12 to 40, and P2-07 to 30
	50 to 80 times the inertia	Switch to adaptive high-inertia mode or adjust P2-08=40, P2-12=50, P2-07=50
110/130 Engine	Within 10 times the inertia	Adaptive small inertia mode (default)

motor base	inertia	parameter
Base	10 to 15 times the inertia	Change P2-08 to 50 and P2-12 to 40
	15 to 20 times the inertia	Switch to adaptive high-inertia mode or adjust P2-08=40, P2-12=50, P2-07=50
180 and above base	Within 5 times the inertia	Adaptive small inertia mode (default)
	5 to 10 times the inertia	Change P2-08 to 50 and P2-12 to 40
	10 to 20 times the inertia	Switch to adaptive high-inertia mode or adjust P2-08=40, P2-12=50, P2-07=50

The parameters with large inertia can still carry the load with small inertia, for example, the parameters with 50 times inertia are used in the mechanism with 20 times load inertia, but the responsiveness will be worse.

9.6.6 Effects of adaptive correlation parameters

parameter small inertia / large inertia	name	Windows default	Reference tilt Section range	effect
P2-05/P6-05	Gain of Velocity Loop in Adaptive Mode	400/200	200 ~ 400	Reducing the value improves inertia capacity but decreases responsiveness, significantly affecting responsiveness.
P2-07/P6-07	Load Inertia Ratio in Adaptive Mode	0/50	0 ~ 200	The increase of the inertia capacity can be greatly improved, and the response is not affected, but the excessive increase is easy to produce oscillation.
P2-08/P6-08	velocity observer gain	60/40	30 ~ 60	Reducing P2-08 while increasing P2-12 can significantly enhance the inertia carrying capacity, but it will reduce responsiveness, which has a significant impact on responsiveness.
P2-12/P6-12	Adaptive Mode Stabilization with Maximum Inertia Ratio	30/50	30 ~ 60	
P2-10	Adaptive mode speed loop integral time coefficient	500	200 or more	Adjust as needed, usually increase
P2-11	Adaptive mode position loop gain coefficient	100	50 ~ 200	Adjust as needed to increase response speed and decrease response time

parameter small inertia / large inertia	name	Windows default	Reference tilt Section range	effect
P2-16	Inertia Coefficient of Rotor in Adaptive Mode Motor	100	100 ~ 200	Increase the servo rigidity and enhance the anti-disturbance capability to solve the operation jitter.
P2-19	adaptive control bandwidth	50 ~ 70	40 ~ 80	Increasing the magnitude slightly enhances the inertia capacity with minimal impact on responsiveness, serving as an auxiliary parameter.

9.6.7 Adaptive parameters that become invalid when their validity period expires

The parameters that become invalid when the adaptive function is effective (P2-01.0=1) are shown in the following table:

project	parameter	Parameter name
gain class	P1-00	first speed loop gain
	P1-05	second speed loop gain
	P1-01	first speed loop integral time constant
	P1-06	second speed loop integral time constant
	P1-02	first position loop gain
	P1-07	second position loop gain
	P2-49	model loop gain
	P0-07	first inertia ratio
	P0-08	second moment of inertia ratio
	P5-36	I-Sel Inertial Ratio Switching

9.7 Vibration Suppression

9.7.1 Overview

Mechanical system has a certain resonance frequency, when the servo gain is increased, it may produce continuous vibration near the mechanical resonance frequency, generally in 400Hz~1000Hz, which leads to the gain can not be increased further, the vibration can be eliminated by automatic detection or manual setting of vibration frequency, after the vibration is eliminated, if the response is needed to be increased, the gain can be increased further.

- After the vibration suppression operation, the servo responsiveness will change.
- Before performing vibration suppression, set the moment of inertia ratio and gain parameters correctly. Otherwise, the control will not function properly.

9.7.2 Operating Tools

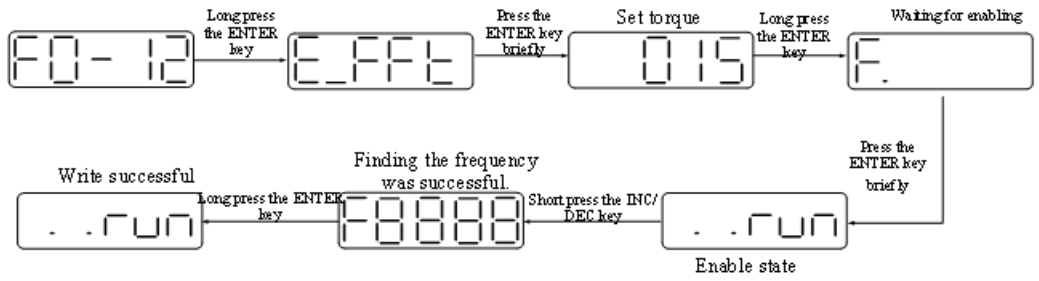
Adjustment method	Tools	control model	Refer to the operation steps	Restriction
adaptive mode	Mechanical Characteristic Analysis of XinJeServo	In position mode	9.7.4 Vibration Suppression (Host Computer Software)	All versions of the host software support
self-tuning mode	Panel vibration inhibition operation		9.7.3 Vibration Suppression (Panel)	not have
	Mechanical Characteristic Analysis of XinJeServo		9.7.4 Vibration Suppression (Host Computer Software)	All versions of the host software support
self-tuning/adaptive mode	Panel vibration inhibition operation		9.7.6 Vibration Suppression (easyFFT)	not have

The driver firmware version is displayed in U2-07.

9.7.3 Vibration Suppression (Fast FFT)

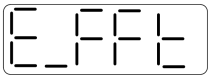
The mechanical characteristic analysis can be carried out by F0-12 parameters on the servo operation panel, and the mechanical resonance frequency can be found out to realize the vibration suppression.

The complete process is shown below:

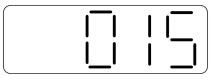


The following explains the steps:

1. Press and hold [ENT] on the F0-12 panel to activate the Quick FFT mode, displaying "E_FFt".

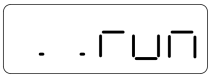


2. Press [ENT] to access the torque setting interface, where the current torque value (P6-89) is displayed. To adjust the torque command, press [▲] or [▼] for increment or decrement. When increasing the torque command, it is recommended to do so incrementally to prevent severe equipment vibration.



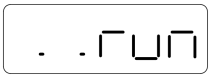
3. After setting the torque command, press and hold [ENT] to enter the 'Preparation for Enablement' phase, where the interface displays 'F.'.

4. Press [ENT] to enable and display "...run";



5. Press [▲] and [▼] to rotate the device in both directions to identify the resonant frequency. During operation, the interface will flash "E_FFt". If the resonant frequency is detected, the interface will display "Fxxxx", where "xxxx" represents the resonant frequency. If the search fails, the interface will show "F----".

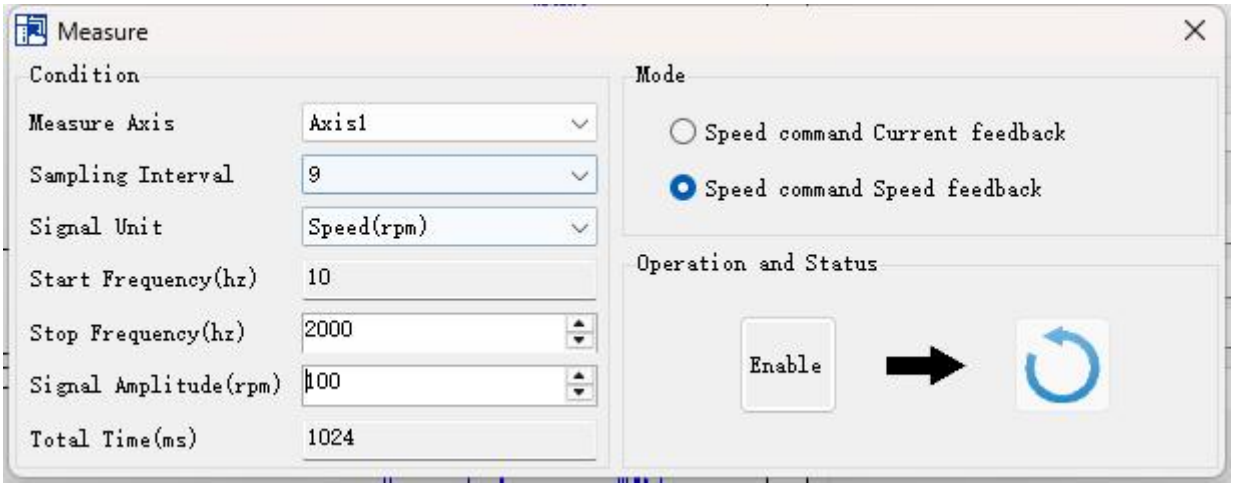
6. Whether displaying "Fxxxx" or "F----", continue pressing [▲] and [▼] to locate the resonant frequency. Once identified, hold [ENT] to transfer the displayed frequency to the driver's notch filter.



Press the STA/ESC keys to return to the previous step. Press [STA] to exit.

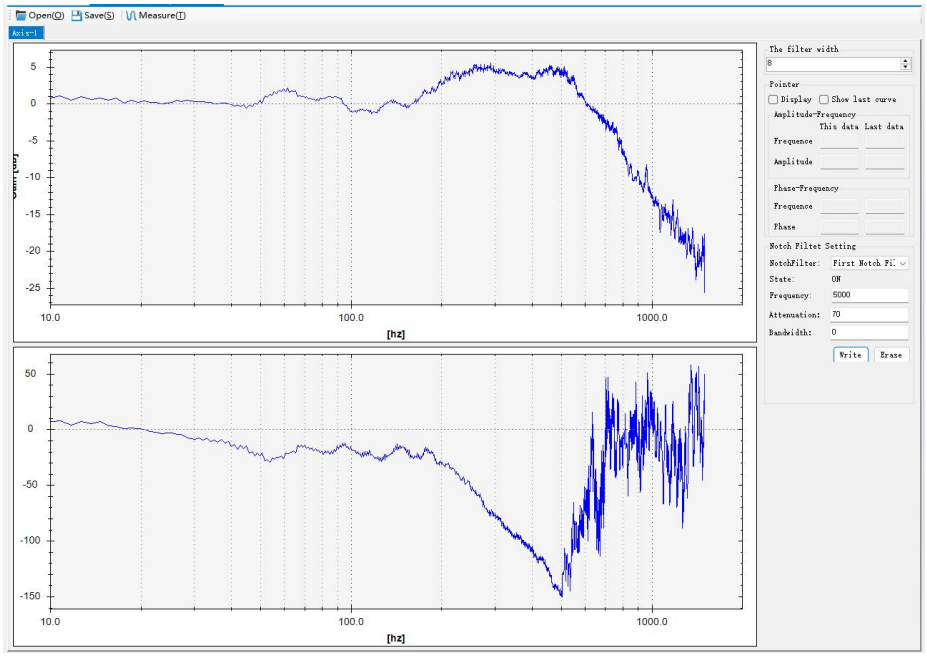
9.7.4 Vibration Suppression (Host Computer Software)

1. Launch the XinJeServo host software and select the mechanical properties.
2. Click [Measure];



3. Configure test conditions, then click [Execute];

4. Select [Amplitude and Phase];



5. Set the filter width (to clearly identify the resonance frequency) and determine the resonance frequency.

6. The band-stop filter parameters require manual configuration. For details, refer to Section 9.7.6 on band-stop filters.

As shown in the figure above, mechanical analysis indicates a resonance frequency of 328Hz. The third notch filter can be used with the following parameters:

P2-69=n.1000 P2-77=328

Whether in adaptive or self-tuning mode, mechanical characteristic analysis is equivalent to manual notch setting. If multiple resonance points exist, configure the third to fifth notchers sequentially.

9.7.5 Vibration Suppression (Manual Settings)

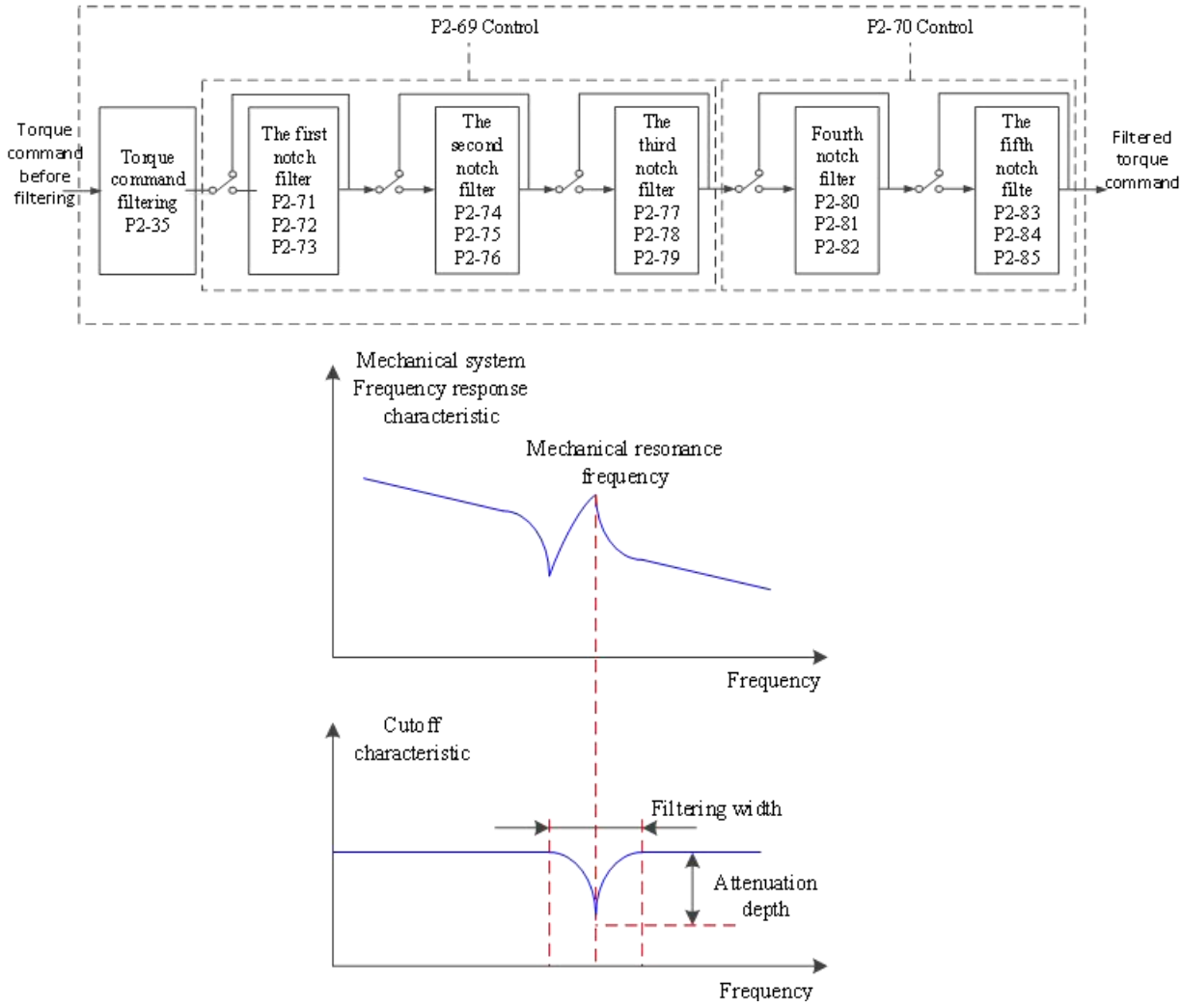
To eliminate vibration by manually setting the vibration frequency when the resonance frequency of the

mechanical system is known, configure the third to fifth notch filters. For related parameters, see 9.7.6 Notch Filters.

9.7.6 Bandpass Filter

The mechanical resonance can be suppressed by reducing the gain at a specific frequency. After the proper setting of the notch, the vibration can be effectively suppressed, and the servo gain can be increased.

The schematic diagram of the notch filter is shown below:



Principle diagram of a notch filter

The servo driver has 5 groups of notch filter, each group has 3 parameters, namely notch frequency, notch attenuation, notch bandwidth. The first and second notch filter are automatically set, the third, fourth and fifth are manually set.

The torque command filter and notch filter are in series in the system, as shown in the figure below, where the switch of the notch filter is controlled by P2-69 and P2-70.

parameter	meaning	factory setting	revise	come into force

parameter		meaning	factory setting	revise	come into force
P2-69	n.□□□0	first notch is off	n.□□□0	at any time	immediately
	n.□□□1	The first notch is opened			
	n.□□0□	second choke is off	n.□□0□	at any time	immediately
	n.□□1□	The second choke is open			
	n.0□□□	third choke is off	n.0□□□	at any time	immediately
	n.1□□□	The third choke is open			
P2-70	n.□□□0	fourth notch is off	n.□□□0	at any time	immediately
	n.□□□1	The fourth notch is opened.			
	n.□□0□	Fifth notch is closed	n.□□0□	at any time	immediately
	n.□□1□	The fifth notch is opened.			

parameter	meaning	factory setting	unit	Set range	revise	come into force
P2-71	first notch frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-72	first notch attenuation	71	0.1dB	50 ~ 1600	at any time	immediately
P2-73	first notch bandwidth	0	Hz	0 ~ 1000	at any time	immediately
P2-74	second notch frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-75	second notch attenuation	71	0.1dB	50 ~ 1600	at any time	immediately
P2-76	second notch bandwidth	0	Hz	0 ~ 1000	at any time	immediately
P2-77	third notch frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-78	third stoppage attenuation	71	0.1dB	50 ~ 1600	at any time	immediately
P2-79	third stopband	0	Hz	0 ~ 1000	at any time	immediately
P2-80	fourth notch frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-81	fourth notch attenuation	71	0.1dB	50 ~ 1600	at any time	immediately

parameter	meaning	factory setting	unit	Set range	revise	come into force
P2-82	fourth notch bandwidth	0	Hz	0 ~ 1000	at any time	immediately
P2-83	fifth notch frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-84	fifth notch attenuation	71	0.1dB	50 ~ 1600	at any time	immediately
P2-85	fifth notch bandwidth	0	Hz	0 ~ 1000	at any time	immediately

- The second notch filter is automatically configured when the vibration is detected in adaptive mode.
- In the auto-tuning mode, the system automatically configures the second and first notch filters upon detecting vibration, with the second filter being prioritized when a single vibration point is detected.
- Whether in adaptive or self-tuning mode, if mechanical characteristic analysis is used, it is considered manual notch setting. Configure the third to fifth notchers.

9.8 Gain adjustment application function

9.8.1 Model Ring Control

In self-tuning mode, the system incorporates model loop gain alongside speed and position loop gains, with the model loop gain being particularly influential on servo responsiveness. When the model loop is disabled, the position loop gain governs the servo response, whereas when enabled, the model loop gain takes over. Functioning as a feedforward mechanism in the driver control loop, the model loop's specific role is detailed in Section 9.5: Manual Adjustment.
The model loop function automatically turns off when the auto-tuning mode is set to Soft, and turns on when the auto-tuning mode is set to Fast Positioning or Fast Positioning (Control Overshoot).

self-tuning mode

parameter		meaning	factory setting	revise	come into force
P2-02	n.□□□1	soft	n.□□□3	at any time	immediately
	n.□□□2	quick positioning			
	n.□□□3	Quick positioning (overshoot control)			

Selection of self-tuning mode:
P2-02.0=1: Softness
The method does not open the model loop gain, and the operation is soft, which is suitable for the occasions of insufficient mechanical rigidity and low responsiveness.
P2-02.0=2: Fast positioning
The response of the parameters is the fastest, but the overshoot is not suppressed.

③ Fast positioning (control overshoot) (P2-02.0=3):

The method has the advantage of fast response and can suppress overshoot.

loadtype	explain
locking-in range on synchronization	The adjustment is suitable for the lower rigidity mechanism such as the synchronous belt mechanism.
lead screw	Adjust for high-rigidity mechanisms such as ball screw mechanisms. Select this type if no corresponding mechanism is available.
fixed joint	The adjustment is suitable for rigid body system and other rigid mechanism.

self-tuning mode	explain
soft	Apply a soft gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.
quick	Adjusts for positioning purposes. In addition to gain adjustment, it automatically

positioning	adjusts the model loop gain and notch filter.
quick positioning (overshoot control)	In the purpose of positioning, the adjustment focuses on avoiding overshoot. In addition to gain adjustment, the model loop gain and notch filter are automatically adjusted.

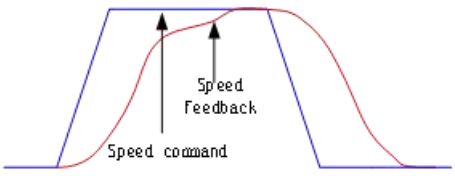
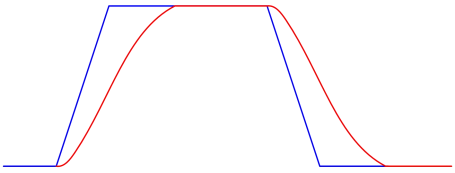
parameter		meaning	factory setting	revise	come into force
P2-02	n.□□□1	soft	n.□□□3	at any time	immediately
	n.□□□2	quick positioning			
	n.□□□3	Quick positioning (overshoot control)			

model loop function switch

parameter		meaning	factory setting	revise	come into force
P2-47	n.□□□0	Model loop closed	n.□□□0	at any time	immediately
	n.□□□1	Model loop open			

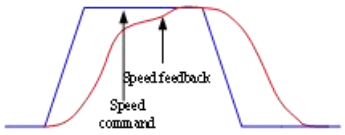
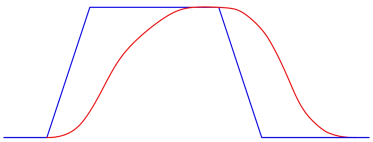
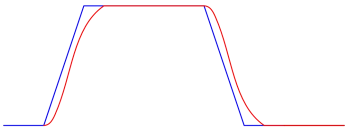
Using the DM6C series servo self-tuning mode as an example, with a 750W servo system operating at five times the load inertia:

- Model loop function off (soft mode)

low rigidity, low response	high rigidity, medium response
	
Load inertia ratio P0-07:500%	
Speed loop gain P1-00:200	Speed loop gain P1-00:800
Speed loop integral P1-01:3300	Speed loop integral P1-01:825
Position loop gain P1-02:200	Position loop gain P1-02:700
Phenomenon: Run jitter and slow response	Phenomenon: Running smoothly and responding quickly

- Enable model loop function (Quick Positioning or Quick Positioning (Control Overshoot))

low rigidity, low response	high rigidity, low response	high rigidity, high response

		
Load inertia ratio P0-07:500%		
Speed loop gain P1-00:200	Speed loop gain P1-00:800	Speed loop gain P1-00:800
Speed loop integral P1-01:3300	Speed loop integral P1-01:825	Speed loop integral P1-01:825
Position loop gain P1-02:200	Position loop gain P1-02:700	Position loop gain P1-02:700
Model loop gain P2-49:300	Model loop gain P2-49:300	Model loop gain P2-49:4000
Phenomenon: Run jitter and slow response	Phenomenon: The system runs smoothly but responds slowly	Phenomenon: Smooth operation and fast response

The above curve diagram only shows the parameter effect and does not represent the actual running curve.

9.8.2 Torque disturbance observation

The disturbance observer detects and estimates the external disturbance torque of the system, and compensates the torque command, which can reduce the influence of external disturbance on the servo and improve the disturbance resistance.

Selecting the Soft Mode in self-tuning mode automatically turns off the disturbance observer without changing its gain. If you select Fast Tracking or Fast Tracking (Control Overshoot), the disturbance observer is automatically enabled with its gain set to 85. These parameters require no manual adjustment.

parameter		meaning	factory setting	revise	come into force
P2-00	n.□□□0	disruptive observer shutdown	n.□□□0	servo bb	immediately
	n.□□□1	Enable the disturbance observer			

parameter	meaning	factory setting	unit	Set range	revise	come into force
P2-41	perturbation observer gain	85	%	0 ~ 100	at any time	immediately

9.8.3 Gain adjustment parameters

parameter	meaning	factory setting	unit	Set range	revise	come into force
P1-00	first speed loop gain	<=20P7：300	0.1Hz	10~20000	servo bb	immediately

parameter	meaning	factory setting	unit	Set range	revise	come into force
		>=21P0：200				
P1-01	first speed loop integral time constant	<=20P7：2122 >=21P0：3183	0.01ms	15~51200	servo bb	immediately
P1-02	first position loop gain	<=20P7：300 >=21P0：200	0.1/s	10~20000	servo bb	immediately
P1-05	second speed loop gain	200	0.1Hz	10~20000	servo bb	immediately
P1-06	second speed loop integral constant	3300	0.01ms	15~51200	servo bb	immediately
P1-07	second position loop gain	200	0.1/s	10~20000	servo bb	immediately

9.8.4 Gain Switching

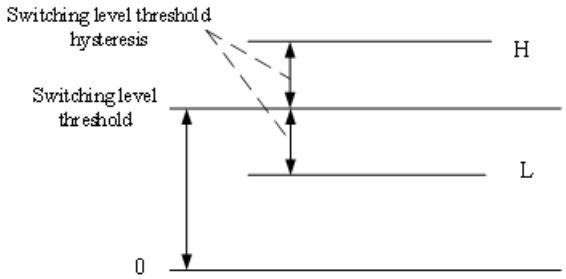
parameter		meaning	factory setting	revise	come into force
P1-14	n.□□□0	0: SI terminal gain switching is active (gain switching condition parameters are not active) 1: Perform gain switching according to the gain switching conditions 2: Reserve	0	servo bb	immediately
	n.□□□1	n.□□X□: Gain switch condition selection 0: The first gain is fixed 1: Switch using external SI terminals 2: The torque command is large. 3: Speed command is large 4: Speed commands vary significantly 5: Speed command high-low threshold (not supported) 6: Large positional deviation 7: Position command 8: Location completed 9: Actual speed is high A: Position command + actual speed			
P1-15		gain switching delay	5	servo bb	immediately

P1-16	gain switching level threshold	50	servo bb	immediately
P1-17	Hysteresis Loop of Gain Switching Level Threshold	30	servo bb	immediately
P1-18	position loop gain switching time	2	servo bb	immediately

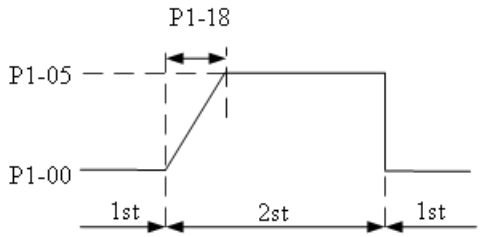
explain ：

① Gain switch wait time, only during the process of switching from the second gain to the first gain

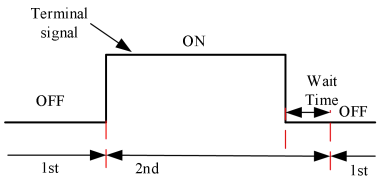
② The definition of "gain switching level threshold hysteresis" is illustrated in the figure below:

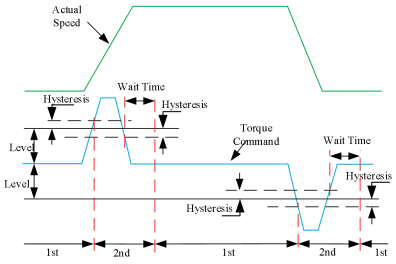
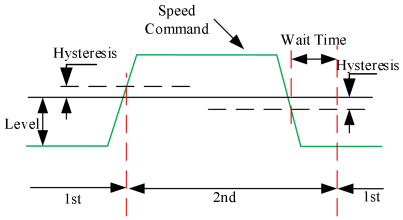


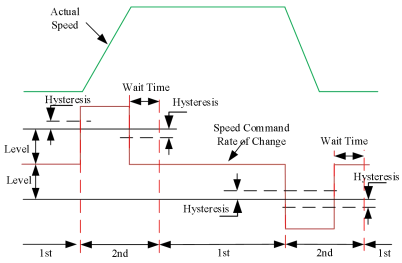
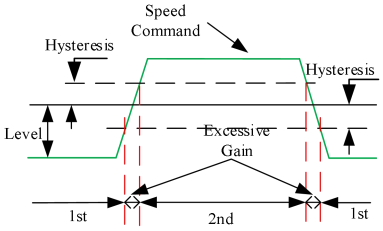
③ "Position gain switching time" explanation:

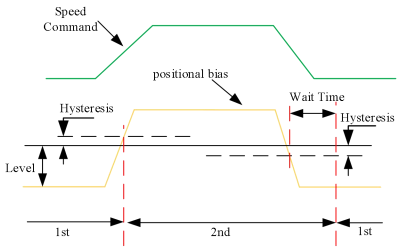
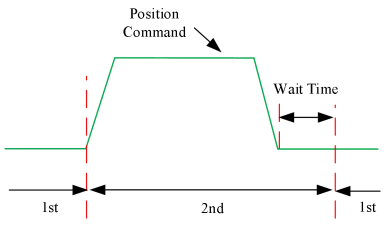


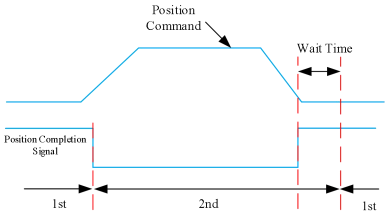
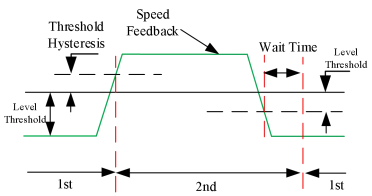
④ Explanation of the gain switching conditions

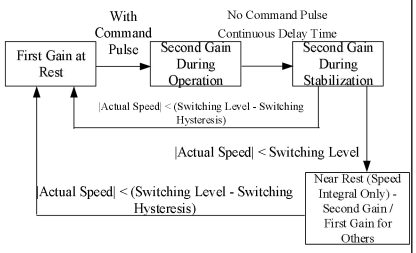
gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
0	first gain fixed	-	-	of no avail	of no avail	of no avail
1	terminal changing-over		Use G-SEL signals for gain switching: G-SEL signal invalid, gain of group 1 G-SEL signal is valid, gain for the second group	valid	of no avail	of no avail

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
2	torque instruct		When the absolute value of the torque command exceeds (level + hysteresis) [%] during the first gain phase, the system switches to the second gain. When the absolute value of the torque command during the last second gain cycle was below the threshold of [level-hysteresis], and the P1-15 sensor maintained this condition, the system reverted to the first gain setting.	valid	valid (%)	valid (%)
3	velocity instruct		When the absolute value of the speed command exceeds (level + hysteresis) [rpm] during the first gain phase, the system switches to the second gain. When the absolute value of the speed command during the last second gain period was below (level-hysteresis) [rpm], and P1-15 remained in this state, the system returned to the first gain setting.	valid	valid	valid

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
4	rate of change of speed command		When the absolute value of the speed command rate change exceeds (level + hysteresis) [10 rpm/s] during the first gain adjustment, the system switches to the second gain. When the absolute value of the speed command rate change during the last 2nd gain period is below (level-hysteresis) [10 rpm/s], and P1-15 remains in this state, the system returns to the first gain setting.	valid	valid (10rpm/s)	valid (10rpm/s)
5	Speed command high-low threshold [not supported]		When the absolute value of the speed command exceeds (level-hysteresis) [rpm] during the first gain phase, the system switches to the second gain phase. The gain gradually adjusts until the absolute value reaches (level + hysteresis) [rpm], at which point the gain fully transitions to the second level. During the second gain phase, when the absolute value of the speed command falls below (level + hysteresis) [rpm], the	of no avail	valid (rpm)	valid (rpm)

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
			system initiates the first gain phase. The gain value then gradually adjusts until the absolute value reaches (level-hysteresis) [rpm], at which point the gain fully returns to the first setting.			
6	position bias		Only in location mode (other modes fixed at gain 1) When the absolute value of positional deviation exceeds (level + hysteresis) [encoder units] during the first gain adjustment, switch to the second gain. When the absolute value of positional deviation during the last second gain cycle was below (level-hysteresis) [encoder units], and the P1-15 state remained in this condition, the system reverted to the first gain setting.	valid	valid Encoder unit	valid Encoder unit
7	position instruct		Only in location mode (other modes fixed at gain 1) When the first gain is applied, if the position command is not zero, switch to the second	valid	of no avail	of no avail

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
			gain. During the second gain phase, if the position command remains at zero for the entire waiting period P1-15, the system will revert to the first gain state.			
8	fixed position accomplish		Only in location mode (other modes fixed at gain 1) If the positioning is not completed during the first gain, switch to the second gain. If the positioning completion status remains unchanged during the waiting period P1-15 during the second gain phase, the system will revert to the first gain phase. [Note] Set the positioning mode for detection completion according to P5-01	valid	of no avail	of no avail
9	reality velocity		Only in location mode (other modes fixed at gain 1): When the absolute value of the actual speed exceeds (level + hysteresis) [rpm] during the first gain adjustment, the system switches to the second gain. During the last second	valid	valid (rpm)	valid (rpm)

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
			gain cycle, when the absolute value of the relative speed remains below the threshold (level-hysteresis) [rpm] and P1-15 maintains this condition, the system returns to the first gain setting.			
A	position command + actual speed		Only in location mode (other modes fixed at gain 1): When the first gain is applied, if the position command is not zero, switch to the second gain. During the second gain phase, the system maintains the second gain setting when the position command is 0 for the duration of P1-15. When the position command is 0 and the waiting time P1-15 is reached, if the absolute value of the actual speed is below (hysteresis level) [rpm], the speed integral time constant is fixed at the second speed loop integral time constant (P1-06), and the system returns to the first gain setting. If the actual speed's	valid	valid (rpm)	valid (rpm)

gain switching condition setting				relevant parameter		
P1-14.1	condition	diagrammatic sketch	remarks	P1-15 wait time	P1-16 grade threshold	P1-17 threshold hysteresis
			absolute value falls below (hysteresis level) [rpm], the speed integral also resets to the first speed loop integral time constant (P1-02).			

9.8.5 Speed Loop P-PI Mode Switching

1) Speed control mode switching

parameter		meaning	factory setting	revise	come into force
P1-26	n.□□□0	0: Do not use mode switching 1: Use internal torque command as switching condition 2: Use speed command as switching condition 3: Use acceleration as the switching condition 4: Use position deviation as the switching condition	<=22P6：1 Others：0	servo bb	immediately
	n.□□0□	0: Clear 0asr points 1: Keep the speed loop integral constant without accumulation	1		
P1-27		Mode switch-torque command threshold	200	servo bb	immediately
P1-28		Mode switch-speed command threshold	0	servo bb	immediately
P1-29		Mode switch-Acceleration threshold	0	servo bb	immediately
P1-30		Mode switch-Position deviation threshold	0	servo bb	immediately

For power stages up to 22P6, the Asr P/PI mode switching is enabled by default (i.e., P1-26.0 = 1), with the switch initiated when the torque command from P1-27 exceeds 200%.

2) IP control selection

parameter	meaning	factory setting	revise	come into force

P2-03	n.□0□□	0: PI control 1: IP control	0	servo bb	Power on again
P1-31		I-P control switching threshold	100	servo bb	Power on again

When P1-31=0, the speed loop is equivalent to PI control; when P1-31=100, the speed loop is equivalent to IP control.

9.9 Gain adjustment related

9.9.1 When load shaking occurs

The following reasons may cause load wobbling:

- Insufficiently smooth command under excessive load inertia

Countermeasures: ① Use position instruction smoothing filter P1-25;

② Optimize the command of the upper device to reduce the command acceleration;

③ Replace the motor with larger inertia.

- The servo gain is too low, resulting in insufficient rigidity.

Countermeasures: ① Increase the gain parameter and rigidity to enhance the anti-disturbance ability.

- The mechanism is too stiff, and the equipment is shaking.

Countermeasures: ① Reduce the gain parameter;

② Optimize the instruction of the upper device to reduce the instruction acceleration.

9.9.2 When vibration occurs

The following reasons may cause machine vibration:

- Vibration caused by improper servo gain

Countermeasures: Reduce the gain

- mechanical resonance point

Countermeasures: Mechanical characteristic analysis or manual setting of notch parameters

9.9.3 When noise occurs

In adaptive mode:

- caused by inappropriate servo gain

Countermeasure: Reduce the adaptive control bandwidth (P2-19).

In self-tuning mode:

- caused by inappropriate servo gain

Countermeasures: In the mode of rapid adjustment, the rigid level should be reduced.

Auto-adjust mode: Reduce model loop gain P2-49

- noise produced by mechanical resonance

Solution: Refer to Section 9.7 'Vibration Suppression' and apply vibration treatment.

10. Police report analysis

10.1 EtherCAT Communication Abnormal Alarm

Alarm code	cause of error		resolvent
E-800	Incorrect ESM request for exception protection	Accept conversion requests from states that cannot be converted from the current state: Init→Safeop Init→OP PreOP→OP Error status of ESM: Stays in the current state (Init, PreOP, SafeOP) when it occurs, and transitions to SafeOP during operation. ESC register AL Status Code: 0011h	Confirm the state transition requirements of the upper device. To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-801	ESM requirements are not defined for exception protection	Accept state transition requests except those specified below: 1：Request Init State 2：Request Pre-Operational State 3：Request Bootstrap State 4：Reauest Safe-operational State 8：Request Operational State Error status of ESM: Stays in the current state (Init, PreOP, SafeOP) when it occurs, and transitions to SafeOP during operation. ESC register AL Status Code: 0012h	Confirm the state transition requirements of the upper device. To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-802	The guidance state requires exception protection.	Accept the following state transition requirements: 3：Request Bootstrap State	Confirm the state transition requirements of the upper device.

Alarm code	cause of error		resolvent
		Error status of ESM: Init ESC register AL Status Code: 0013h	To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-803	PLL incomplete exception protection	After 1 second of synchronization, the phase combination between communication and servo (PLL lock) still cannot be completed. Error status of ESM: PreOP ESC register AL Status Code: 002Dh	Verify the DC settings and ensure propagation delay compensation and deviation compensation are correct. To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-804	PDO watchdog exception protection	During PDO communication (SafeOP or OP state), the bit10 of time 0220 (AL Event Request) is not ON when setting the ESC register addresses 0400 (Watchdog Divider) and 0420 (Watchdog Time Process Data). Error status: Safe OP ESC register AL Status Code: 001Bh PDO communication connection lost	1. Verify if the PDO's transmission time from the upper device is fixed or interrupted; 2. The PDO watchdog detected an excessively large delay value; 3. Check for wiring issues in the EtherCAT communication cable and excessive noise on the cable. Replace with a high-quality network cable. 4. Reconnect the communication cables, leaving the network cable unconnected and separated from the power line. 5. Before restarting the equipment, ensure all welding machine-related interference devices are turned off. To eliminate interference; 6. Cross-test to identify the fault point; To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-806	PLL exception protection	The ESM state occurs when the phase (PLL lock) between communication and servo fails to synchronize during SafeOP or OP states.	Verify the DC settings and ensure propagation delay compensation and deviation compensation are correct.

Alarm code	cause of error		resolvent
		Error status of ESM: SafeOP ESC register AL Status Code: 0032h	You can clear the alarm or reset the system by disconnecting the power supply through the servo panel F0-00=1.
E-807	simultaneous signal abnormality protection	After the synchronization process completes, the SYNC0 or IRQ interrupt handler is triggered when the value exceeds the preset threshold. Error status of ESM: SafeOP ESC register AL Status Code: 002Ch	Verify the DC settings and ensure propagation delay compensation and deviation compensation are correct. You can clear the alarm or reset the system by disconnecting the power supply through the servo panel F0-00=1.
E-810	Synchronization period setting exception protection	Unsupported sync cycles: The synchronization period setting is outside 500us, 1ms, 2ms, and 4ms. Error status of ESM: PreOP ESC register AL Status Code: 0035h	Set the synchronization period correctly To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-811	Set up email exception protection	Incorrect SM0/1 settings in the email: The email sending/receiving area overlaps with SM2/3, and the sending/receiving area address is odd. The starting address of the mailbox is outside the range of SyncManager0: 1000h~10FFh and SyncManager1: 1200h~12FFh. Incorrect SyncManager0/1 length (ESC registers: 0802h,0803h/080Ah, 080Bh) setting: SyncManager0: out of range (32~256 bytes) SyncManager1: out of range (40-256 bytes) Incorrect configuration of SyncManager0/1's Control Register (ESC register: 0804h/080Ch): Set 100110b to 0804h: bit5-0 Set 100110b to 080Ch: bit5-0 Error status of ESM: Init ESC register AL Status Code: 0016h	Set SyncManager correctly according to the ESI file description To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-814	PDO watchdog setting	PDO watchdog configuration is incorrect.	Set the watchdog timeout correctly

Alarm code	cause of error		resolvent
	exception protection	The PDO watchdog is active (SyncManager: bit6 of register 0804h is 1). The timeout thresholds detected by the PDO watchdog (registers 0400h and 0402h) do not meet the requirement of 'communication cycle * 2'. Error status of ESM: PreOP ESC register AL Status Code: 001Fh	To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-815	DC setting abnormal protection	The DC setting error. The bit2-0 of the ESC register 0981h (Activation) must be set to any value except those specified below. bit2-0=000b；bit2-0=011b Error status of ESM: PreOP ESC register AL Status Code: 0030h	Confirm DC settings To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-816	SM event pattern setting exception protection	The unsupported SM time mode is set. The 1C32/1C33-01 chip sets values other than 00,01, or 02. The bit2-0 of the ESC register 0981 is set to 000b, and only the SM2 configurations 1C32h-01h and 1C33h-01h are enabled. Error status of ESM: PreOP ESC register AL Status Code: 0028h	Confirm that the settings for 1C32h-01h and 1C33h-01h are identical and the values are 00h,01h, or 02h. To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-817	SyncManager 2/3 setting exception protection	SM2/3 is set to an incorrect value Incorrect physical address configuration for SM2/3 (ESC register: 0810h/0818h): The transmission/reception area overlaps with SM2/3, the starting address is odd, and the destination address is out of range. SM2/3 length configuration (ESC register: 0812h/081A) differs from RxPDO and TxPDO The control register (ESC register: 0814h/081Ch) of SM2/3 is improperly configured. Set all bits from 5 to 0 except 100110b Error status of ESM: PreOP ESC register AL Status Code: 001Dh/001Eh	Set SyncManager2/3 correctly according to the ESI file description To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-850	TxPDO	The data size mapped by TxPDO	Ensure the TxPDO mapping

Alarm code	cause of error		resolvent
	allocation exception protection	exceeds 24 bytes Error status of ESM: PreOP ESC register AL Status Code: 0024h	data size is set to 24 bytes or less To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-851	RxPDO allocation exception protection	The RxPDO mapping exceeds 24 bytes Error status of ESM: PreOP ESC register AL Status Code: 0025h	Confirm the RxPDO mapping data size is set to 24 bytes or less To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-881	Control mode setting exception protection	When both the 6060h and 6061h settings are set to 0, the PDS status transitions to 'Operation enabled'. The control mode corresponding to 6060h is not set. Error after ESM status: Stopped at the current ESM status ESC register AL Status Code: 0000h	Confirm the 6060h setting To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-882	ESM requires exception protection during operation	When the PDS status is either 'Operation enabled' or 'Quick stop active', it receives commands to transition to other ESM states. ESM status after error: Based on the status transition request from the host computer ESC register AL Status Code: 0000h	Verify the status transition request from the parent device To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.
E-883	Abnormal movement protection	When the input signals EXT1/EXT2 are not assigned, the external trigger is selected via the Touch probe function. The calculation results of electronic gear ratio are outside the range of 1/1000 to 1000 times; The calculation process of electronic gear ratio, when the denominator or numerator has no sign and exceeds 64 bits; The final calculation result of electronic gear ratio, where the denominator or numerator without sign exceeds 32 bits; Error after ESM status: Stop in the	To clear the servo alarm, either set SM2013+20* (N-1) or configure F0-00=1 on the servo panel.

Alarm code	cause of error		resolvent
		current ESM status ESC register AL Status Code: 0000h	

10.2 EtherCAT Communication Non-Related Abnormal Alarm

The DM6C alarm code follows the E-XX□ format, where 'XX' indicates the alarm's category and' □' specifies the exact subcategory.

big class	small class	confirm code	explain	Possible reasons	resolvent
EEEE	1	EEEE1	Panel communication error with CPU	The power supply voltage fluctuates significantly, and the low voltage causes the panel to fail to refresh. The panel program is damaged. ③ Communication enters a dead loop	①Stable power supply, ensure the stability of power supply voltage; ②If the alarm persists after power-off and power-on, contact the authorized dealer or manufacturer. ③Unplug the communication terminal and run the program to confirm.
	2	EEEE2			
	3	EEEE3			
	4	EEEE4			
01	0	E-010	The firmware version does not match	The downloaded firmware version is incorrect	Contact the agent or manufacturer
	3	E-013	FPGA loading error	The program is corrupted. ② The device is damaged.	Contact the agent or manufacturer
	4	E-014	FPGA access error	The program is corrupted. ② Hardware damage ③ The intensity of external interference is too high.	Contact the agent or manufacturer
	5	E-015	Program error	Program error	Contact the agent or manufacturer
	7	E-017	Processor operation timed out	Program error	Contact the agent or manufacturer
	9	E-019	Incorrect system password	Program error	Contact the agent or manufacturer

big class	small class	confirm code	explain	Possible reasons	resolvent
02	0	E-020	Parameter loading error	Parameter self-check failed	Powering on again will restore the default settings. If the issue persists, contact your agent or manufacturer.
	1	E-021	Parameter range exceeded	The value is not within the specified range	Check parameters and reset
	2	E-022	Parameter conflict	TREF or VREF function settings conflict	① Check whether the parameter settings meet the requirements; ② When P0-01 equals 4, setting P3-00 to 1 will trigger an alarm.
	3	E-023	Sampling channel configuration error	The custom output trigger channel or data monitoring channel is misconfigured	Check if the settings are correct
	4	E-024	Parameter lost	The grid voltage is too low.	① For single-phase 220V power supply, connect L1 and L3; ② If power is restored immediately after a power outage, the E-024 alarm will be triggered; Reset parameters
	5	E-025	erase FLASH error	Parameter save failed during power loss	Contact the agent or manufacturer
	6	E-026	FLASH initialization error	Unstable power supply for FLASH chip	Contact the agent or manufacturer
	8	E-028	EEPROM write error	Voltage instability or chip malfunction	Contact the agent or manufacturer
03	0	E-030	The busbar voltage U0-05 exceeds the preset threshold. 220V power supply machine (U0-05≥402V) 380V power supply machine (U0-05≥780V)	The grid voltage is too high.	Check the power grid voltage fluctuations. The 220V driver operates within 200V-240V, while the 380V driver requires 360V-420V. For significant voltage variations, use the correct voltage source and regulator.
				Excessive load moment of inertia (insufficient braking capacity)	① Increase the acceleration and deceleration time; ② Reduce the load inertia; ③ Reduce the start-stop

big class	small class	confirm code	explain	Possible reasons	resolvent
					frequency; ④Replace with a higher power driver and motor
				The acceleration and deceleration time is too short	extend acceleration and deceleration time
				Hardware fault of the internal sampling circuit of the drive	Use the AC range of a multimeter to measure the input voltage of the servo LN (R/S/T). The normal value is 220V ±10%. If the measured value exceeds 220V ±10% (380V ±10%), check the supply voltage. If the supply voltage is normal, the servo is in BB status. Monitor U0-05. If the voltage measured by the multimeter (1.414 times the measured value) is less than U0-05 (within 10V error), the servo driver is faulty and needs to be returned for repair.
04	0	E-040	The busbar voltage U0-05 is lower than the preset threshold. 220V power supply machine (U0-05≤150V) 380V power supply machine (U0-05≤300V)	Alarm for low grid voltage during normal power-on	① Monitor power grid fluctuations. The 220V driver operates within a normal voltage range of 200V to 240V. If significant voltage fluctuations occur, a voltage stabilizer is recommended. ②Replace the transformer with a larger capacity
				Instant power outage	Wait for the voltage to stabilize before powering on again
				Hardware fault of the internal sampling circuit of the drive	Use the AC range of a multimeter to measure the input voltage of the servo LN (R/S/T). The normal value is 220V ±10%. If

big class	small class	confirm code	explain	Possible reasons	resolvent
					the measured value is <220V ± 10% (380V ±10%), check the supply voltage. If the supply voltage is normal, the servo is in BB status. Monitor U0-05. If the multimeter reading is 1.414 times the U0-05 voltage (within 10V error), the servo driver is faulty and must be returned for repair.
	1	E-041	Power failure of the drive	The drive power is disconnected.	Check the power supply
	3	E-043	Busbar voltage charging failed	Alarm for low grid voltage during normal power-on	Alarm for low grid voltage during normal power-on
				Hardware damage	When powering on the drive, check for any relay engagement sound.
06	0	E-060	The module temperature is too high. Alarm for module temperature U0-06 ≥ 90℃ U0-06≥ 70℃ Warning)	Long-term operation under heavy load	Re-evaluate the motor capacity and monitor the U0-02 torque during operation to check if it remains above 100 for extended periods. If so, consider using a higher-capacity motor or reducing the load.
				The ambient temperature is too high.	①Enhance ventilation measures to lower ambient temperature; ② Check if the fan rotates during servo enable; if module temperature U0-06 reaches or exceeds 45 ℃ , the fan will activate
				Fan damage	Replace the fan
	1	E-061	motor overheating	Alarm when motor temperature exceeds 140℃	① Check if the motor fan is functioning properly; ② Contact the manufacturer for technical support.

big class	small class	confirm code	explain	Possible reasons	resolvent
	3	E-063	thermocouple breakage alarm	Thermocouple break in motor with power of 11kW or above ② Alarm for incorrect activation of motor below 11kW due to detected wire breakage	Check the external thermocouple connection. Shielded thermocouple break alarm: P0-69.1=1
08	0	E-080	Over-speed (actual speed ≥ P3-21/P3-22) The maximum forward speed is P3-21, and the maximum reverse speed is P3-22.	Motor code does not match	Check if the motor code (the number after MOTOR CODE) on the U3-00 drive and the motor label match. If they do not, adjust them to match and power on again.
				UVW wiring error	Check the UVW wiring of the motor and connect it according to the phase sequence.
				The motor is running too fast.	① The maximum speed limit P3-21/P3-22 is reduced; ② Check if any external force causes the motor to rotate too fast, if the pulse input frequency is too high, or if the electronic gear ratio is excessive.
				encoder fault	① Check the encoder wire or replace the encoder wire; ② Set the servo driver to the bb mode and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify the normal value change of U0-10, which should show an increasing value in one direction and a decreasing value in the other (displaying a 0-9999 cycle).
				parameter setting	An alarm will be triggered if the actual speed exceeds the P3-21/P3-22 ratio.

big class	small class	confirm code	explain	Possible reasons	resolvent
	2	E-082	Encoder zero position deviation protection 1	① UVW phase sequence misalignment ② Zero position deviation of the motor encoder	①Check whether the three-phase power lines are connected in the UVW sequence. ② Check the encoder zero position. Contact the manufacturer's technical support.
	3	E-083	speed command exceeded	Speed command in position mode exceeds the set value of 1.3*P3-21/P3-22	① Check the set values of P3-21/P3-22; ② Position command is abnormal;
09	2	E-092	The analog signal Tref has exceeded the zero calibration limit.	Error in analog calibration zeroing operation	Set the zero point without applying analog voltage
	3	E-093	The analog signal Vref calibration zero exceeds the limit.	Error in analog calibration zeroing operation	Set the zero point without applying analog voltage
10	0	E-100	Excessive positional deviation	When position control is active, the difference between the given position and the actual position exceeds the limit.	① Observe whether the motor is locked; ② reduce the position given speed; ③ Increase the pulse limit value P0-23
	1	E-101	position command mutation	The position command deviation at every 1/6 synchronization cycle exceeds the limit set by P0-70.	①Check the modification procedure; ② Set the appropriate P0-70 value
11	0	E-110	During self-check, an external UVW	No motor code found	Check if the motor code (the number after MOTOR CODE) on the U3-00 drive and the motor

big class	small class	confirm code	explain	Possible reasons	resolvent
			short circuit was detected (the 15KW model lacks E-110 alarm protection, while the 3KW model supports it).		label match. If they do not, adjust them to match and power on again.
				U, V, W wiring error	Check the motor's UVW wiring and ensure it is connected in the correct phase sequence (brown U, black V, blue W).
				The driver's UVW output is short-circuited or the motor is faulty.	① Check if the UVW phase resistance of the motor is balanced. Replace the motor if the resistance is unbalanced. ② Check for short circuits between the motor's UVW and PE terminals. Replace the motor if a short circuit is detected. ③ Measure the driver-side UVW output using a multimeter (diode mode): connect the black probe to P+ and the red probe to UVW; or use the reverse probes (red to P-, black to UVW). Replace the driver if any of the six voltage drop values is zero.
				The load part is stuck in place.	Run the motor with the shaft idle to troubleshoot the load issue
				Instant alarm for high-speed start/stop	Increase acceleration and deceleration time
				encoder problem	① Check the encoder wire or replace the encoder wire; ② Set the servo driver to the bb mode and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify the normal value change of U0-10, which should show an increasing value in one direction and a decreasing value in the other (displaying a 0-9999 cycle).

big class	small class	confirm code	explain	Possible reasons	resolvent
11	2 3 4	E-112 E-113 E-114	U/V/W phase current overcurrent protection	U, V, W wiring error	Check the UVW wiring of the motor, ensuring correct phase sequence (brown U, black V, blue W).
				The driver UVW output is short-circuited or the motor is faulty.	① Check if the UVW phase resistance of the motor is balanced. If unbalanced, replace the motor. ② Check for short circuits between the motor's UVW and PE terminals. Replace the motor if a short circuit is detected. ③ Measure the driver-side UVW output using a multimeter (diode mode): connect the black probe to P+ and the red probe to P-. If any of the 6 voltage drop values is 0, replace the driver.
				The load part is stuck in place.	Run the motor with the shaft idle to troubleshoot the load issue
				Instant alarm for high-speed start/stop	Increase acceleration and deceleration time
				encoder problem	① Check the encoder wire or replace the encoder wire; ② Set the servo driver to the bb state and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify normal value changes in U0-10, with one direction increasing and the other decreasing (displaying a 0-9999 cycle).
11	5 6 7	E-115 E-116 E-117	U/V/W phase short circuit protection	No motor code found	Check if the motor code (the number after MOTOR CODE) on the U3-00 drive and the motor label match. If they do not, adjust them to match and power on again.

big class	small class	confirm code	explain	Possible reasons	resolvent
				U, V, W wiring error	Check the motor's UVW wiring and ensure it is connected in the correct phase sequence (brown U, black V, blue W).
				The driver's UVW output is short-circuited or the motor is faulty.	① Check if the UVW phase resistance of the motor is balanced. Replace the motor if the resistance is unbalanced. ② Check for short circuits between the motor's UVW and PE terminals. Replace the motor if a short circuit is detected. ③ Measure the driver-side UVW output using a multimeter (diode mode): connect the black probe to P+ and the red probe to UVW; or use the reverse probes (red to P-, black to UVW). Replace the driver if any of the six voltage drop values is zero.
				The load part is stuck in place.	Run the motor with the shaft idle to troubleshoot the load issue
				Instant alarm for high-speed start/stop	Increase acceleration and deceleration time
				encoder problem	① Check the encoder wire or replace the encoder wire; ② Set the servo driver to the bb mode and adjust the driver to U0-10. Slowly rotate the motor shaft by hand to verify the normal value change of U0-10, which should show an increasing value in one direction and a decreasing value in the other (displaying a 0-9999 cycle).
13	0	E-150	Power line break	The drive unit, cable, or motor experiences a broken power line in any	Unplug the driver's power supply and check the power line connection. It is recommended to

big class	small class	confirm code	explain	Possible reasons	resolvent
				of the U/V/W three-phase system.	use a multimeter to test the conduction. After troubleshooting, power the device again.
16	1	E-161	overload of the thermal power of the drive	Motor code does not match	Check if the motor code (the number after MOTOR CODE) on the U3-00 drive and the motor label match. If they do not, adjust them to match and power on again.
				The motor is overloaded, with actual operating torque exceeding the rated torque and sustained continuous operation. (Monitor U0-02 for actual operating torque. If the motor operates normally without stalling or vibration, and U0-02 remains consistently above 100, this indicates improper motor selection.)	Increase the capacity of the drive and motor. Extend the acceleration and deceleration time, and reduce the load. Monitor U0-00 to check for overspeed operation.
				The machine is hit, the machine suddenly becomes heavy, or the machine twists.	Eliminate mechanical distortion and reduce load
				The motor activates when the brake is not released.	Measure the voltage of the brake terminal to determine the opening of the brake. The braking control method should be determined, and it is recommended to use the servo BK brake signal for control. If servo control is not used, the timing between brake opening and motor operation must be carefully considered.
				The encoder and power lines are miswired, or there are broken wires or	Check the wiring of the U, V, and W power lines to ensure correct phase sequence.

big class	small class	confirm code	explain	Possible reasons	resolvent
				loose connectors with pin shrinkage.	Use a multimeter to check if all encoder wires are properly connected and if any are broken. Check for loose connectors, machine vibrations, and any pin shrinkage, poor soldering, or damage to the connectors.
				In multi-machine wiring, the motor wire was mistakenly connected to another shaft, resulting in incorrect wiring.	Check the servo wiring and connect the motor and encoder cables to their respective shafts.
16	1	E-161	overload of the thermal power of the drive	Gain adjustment issues cause motor vibration, back-and-forth movement, and abnormal noise.	re-adjust the gain parameter
				Hardware failure in the drive or motor	On-site servo cross-test indicates either motor shaft misalignment or motor shaft idle, causing F1-01 trial run and F1-00 stop-motion to fail in achieving uniform rotation. Replace the faulty drive or motor, and return the defective unit to the manufacturer for repair.
	5	E-165	Anti-rotation alarm If the motor's output torque exceeds the forward/reverse torque limit, and the duration reaches P0-74 (in milliseconds) while the speed remains below P0-75 (1 rpm), an alarm will be triggered.	① the machine is impacted, the machine suddenly becomes heavy, the machine twists; ② The motor operates when the brake is not released; ③ The parameter setting is unreasonable.	① eliminate the mechanical distortion factors and reduce the load; ② Measure the voltage at the brake terminal to confirm the brake is released; The braking control mode should be determined, and it is recommended to use the servo BK brake signal for control. If servo control is not used, the timing between brake opening and motor operation must be carefully considered.

big class	small class	confirm code	explain	Possible reasons	resolvent
					③ Monitor the actual output torque range of U0-02 and verify the proper configuration of the torque limit value for P3-38/39.
22	0	E-220	Absolute value servo encoder communication error	Motor mismatch	Check if the motor matches correctly
				The encoder wire is not connected or has poor contact.	Check if the U0-54 value rises rapidly. If so, the encoder circuit is likely disconnected. Unplug the drive power and check the encoder cable connections for loose wires. Test the continuity with a multimeter. After troubleshooting, power on the device again. ① Hot swapping is strictly prohibited. ② For tank chains, use dedicated cables.
				The received encoder data is incorrect, and the number of errors exceeds the value in the P0-56 register for encoder error retries.	Check if the value of U0-54 increases and the value of U0-79 rises. If so, the encoder is likely to be interfered with. Do not route encoder wires through the same conduit as high-voltage circuits. Install a power filter on the servo driver's input side. Use magnetic ferrite cores for encoder wiring. Avoid welding machines and other high-interference equipment.
	1	E-221	Too many CRC errors in encoder communication	The received encoder data is incorrect, and the number of errors exceeds the value in the P0-56 register for encoder error retries.	The encoder is jammed. Isolate the jamming source.
	2	E-222	Absolute servo encoder battery low voltage	The battery voltage in the encoder line battery box is below 2.75V.	To prevent encoder position errors, replace the battery while keeping the servo drive powered

big class	small class	confirm code	explain	Possible reasons	resolvent
			alarm (this alarm can be disabled)		on. Battery specifications: AA battery, 3.6V (model CP-B-BATT). CPT-B-BATT)
				Power-on alarm for the new device	① The absolute position memory of the motor during power failure relies on the battery in the encoder cable. If the encoder cable and motor are disconnected and power supply is lost, the current position of the motor will be lost, triggering alarm 222. To restore normal operation, simply clear this alarm by setting F0-00=1. ②Using P0-79 can disable this alarm. When P0-79 is set to 1, the motor operates as an incremental type, stops multi-turn counting, and the current position is not remembered during power-off.
	3	E-223	Absolute value servo encoder data access alarm	The multi-turn absolute value motor does not use encoder cables with battery boxes.	①Use the encoder cable with its built-in battery compartment; ② Power off and power on again (ensure the driver panel is fully extinguished). If the alarm persists, contact the agent or manufacturer.
				The encoder is faulty or the power supply is unstable.	
	7	E-227	The multi-turn signal data of the Shanghai Electric encoder is incorrect.	The issue is usually with the encoder itself or its unstable power supply.	This alarm may occur when the encoder cable is disconnected during a battery-free state.
	8	E-228	Absolute value servo encoder value overflow	The motor runs in one direction, and the encoder data value is	① Set F1-06 to 1 and reset the absolute encoder's multi-turn

big class	small class	confirm code	explain	Possible reasons	resolvent
				too large, causing overflow.	count; ② P0-79=2 can block the alarm.
24	0	E-240	Timing error in reading encoder position data	① The number of consecutive errors in encoder data update timing exceeds the value in P0-68 ②CPU timer fluctuates	① Restart the drive; ② Check the wiring arrangement of the transmission cables to ensure the separation of high-voltage and low-voltage circuits; ③ The high-current equipment is supplied separately; ④ Good grounding
	1	E-241	The encoder responds with corrupted data.	The received encoder data is incorrect, and the number of errors exceeds the value in the P0-56 register for encoder error retries.	① Check the wiring arrangement of the transmission cables to ensure the separation of high-voltage and low-voltage circuits; ② The high-current equipment is supplied separately; ③ Good grounding
26	0	E-260	overtravel alarm	An out-of-range signal was detected, and the out-of-range processing mode is configured to trigger an alarm.	To avoid immediate alarm when exceeding the limit, you can modify the signal processing method.
	1	E-261	Out-of-range signal connection error	① When the motor is running forward, it encounters a reverse overtravel signal. ② When the motor reverses, it encounters a forward overtravel signal.	Check the overtravel signal connection and terminal allocation.

big class	small class	confirm code	explain	Possible reasons	resolvent
	2	E-262	Control stop timeout	① The inertia is too large. The timeout for stopping is too short ③ The brake torque is set too low.	① Reduce inertia or use brake motor; ② Increase the stop timeout time P0-30; ③ Increase the braking torque P3-32
	4	E-264	Excessive vibration	oscillation caused by external force ② Large load inertia and incorrect load inertia ratio or too small gain lead to oscillation during positioning	① Check the source of external forces and inspect the mechanical installation for any issues; ② Increase the servo gain to improve the anti-disturbance ability; ③ the analysis of the collection speed curve; When the first three peaks and troughs of the pulse command are in a convergent state (0.8*|first peak|>|second peak| and 0.8*|second peak|>|third peak|), the driver should not trigger an alarm. In such cases, the relevant thresholds can be adjusted. If the three peak speed values of the pulse command are not less than 300rpm for three times, the drive alarm will be triggered. ④Contact the manufacturer for technical support.
	5	E-265	The motor is running excessively.	The machine is vibrating.	Check the motor installation.
28	0	E-280	Failed to read motor parameters	Failed to read EEPROM	Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter

big class	small class	confirm code	explain	Possible reasons	resolvent
					alarm) and configuring P0-33 as the motor code.
	1	E-281	An error occurred while writing data to the encoder EEPROM.	Failed to write to EEPROM	Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.
	2	E-282	Station number assignment timeout	The cable for station number assignment is broken.	① Check if there are any issues with the connection between the rectifier module and the inverter module; ② Contact the manufacturer for technical support.
	3	E-283	The rectifier module is overheated.	Long-term operation under heavy load	Re-evaluate the motor capacity and monitor the U0-02 torque during operation to check if it remains above 100 for extended periods. If so, consider using a higher-capacity motor or reducing the load.
				The ambient temperature is too high.	①Enhance ventilation measures to lower ambient temperature; ② Check if the fan rotates during servo enable; if module temperature U0-06 reaches or exceeds 45 ℃ , the fan will activate
				Fan damage	Replace the fan
	5	E-285	rectifier module P-overcurrent	Breakdown of P-end Protected Discharge Tube	Contact the manufacturer's technical support
31	0	E-310	The drive and motor power are mismatched	For example, a 750W drive with a 200W motor	Match the correct motor and driver, and set the P0-33 motor code correctly before use.
	1	E-311	The motor parameters read	Motor code not set	Once the driver and motor are professionally matched and

big class	small class	confirm code	explain	Possible reasons	resolvent
			during automatic motor code reading are 0, and the driver P0-33=0		compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.
	2	E-312	The motor parameters have been corrupted.	CRC check failed	Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.
	3	E-313	The encoder software version is not compatible	The encoder software version is not compatible	① Update the driver firmware to optimize the motor's performance with current parameters; ② By setting P0-53=1 (to disable automatic motor parameter readout alarm) and configuring P0-33 motor code correctly, the motor parameters will be stored in the driver for normal operation, though this may affect certain performance characteristics.
	4	E-314	The motor code does not match the software version	The encoder hardware version is higher than the driver firmware version	Contact technical support to update the driver firmware
	5	E-315	The motor parameters read during automatic motor code reading are 0, and the driver P0-33=0	The motor code is 0	Once the driver and motor are professionally matched and compatible, the system can be activated by setting P0-53=1 (to disable the motor parameter alarm) and configuring P0-33 as the motor code.
	6	E-316	Auto-code reading error	The motor code read automatically does not match the one set in P0-33.	Check the MOTOR CODE on the U3-70 and motor housing nameplates. ①If two values match, update the P0-33 motor code or set P0-33 to 0 to automatically retrieve the motor code;

big class	small class	confirm code	explain	Possible reasons	resolvent
					②If the values differ, contact the manufacturer's technical support
34	0	E-340	STO status inconsistency	The input states of STO1 and STO2 are inconsistent, and the time exceeds the P0-88 setting.	① Ensure simultaneous disconnection of STO1 and STO2; ②If a STO circuit remains high after disconnecting the 24V power supply, contact the manufacturer's technical support.
	2	E-342	STO buffer circuit error	STO buffer circuit malfunction	Check if the 24V power supply for STO1 and STO2 is stable. If stable, contact the manufacturer's technical support.
40	0	E-400	Connection error from the station	Communication timeout between rectifier unit and inverter module	

10.3 Abnormal (Alarm) Readout

000h ~ FEFFh is defined according to IEC61800-7-201.

The FF00h ~ FFFFh range can be customized by users as specified below.

The lower 8 bits of the defined value (FF00h ~ FFFFh) represent the primary code for alarm numbers indicating servo system abnormalities (alarms). (The secondary code of the alarm number is not read.) In addition, the main code of the alarm number is expressed by 16-ary number.

index of matrix	subindex	name	scope	data type	accessibility	PDO	Op-mode
603Fh	00h	Error code	0~65535	U16	ro	TxPDO	All
		The alarm number generated by the servo driver: General Alarm 603F displays the complete error code, while bus-related alarms show the main alarm number. Display 0000h when no alarm occurs. When an alarm is triggered, the alarm (main) number (00h ~ FFh) displays FF**h. example ： ①When a general alarm (e.g., E-030 overvoltage protection) occurs, 603F = 30d ②Bus-related alarms such as E-850 (TxPDO configuration error protection) and E-851 (RxPDO configuration error protection). 603F = FF55h... 55h=85d, meaning either E-850 or E-851 will be affected As an exception, when E-817 (SyncManager2/3 configuration error) occurs, the system displays A000h.					

Alternatively, alarms can be read via SDO read commands. The U1-00 object dictionary corresponds to 0x3100, with the following command:

Read the value from the slave object dictionary 0x3100 (station number 0) in register D0, using the code 00 (current alarm code). (See the user manual for the XDH/XLH/XG2 series programmable controllers, 'Advanced Motion Control' section, for detailed instructions.)

10.4 Reset Alarm

Reset method for EtherCAT-associated protection functions with alarm reset capability

Methods ①, ②, ③, and ④ can all reset the alarm.

For protection functions not related to EtherCAT, please refer to the Basic Function Specifications section in the technical documentation.

Method ①: Set bit4 (Error Ind Ack) of AL Control to "1".

Subsequently, the bit7 of 6040h (Controlword) is set from 0 to 1 (sending a Fault reset command), thereby completing the reset of the fault alarm.
After the exception (alarm) reset is completed, the PDS status transitions from Fault to Switch on disabled.

Method ②: The servo driver automatically resets the alarm (panel F0-00) via the host computer software.
After the exception (alarm) reset is completed, the PDS status transitions from Fault to Switch on disabled.

Method ③: The external alarm reset input (A-CLR) of the servo driver transitions from OFF to ON.

After the exception (alarm) reset is completed, the PDS status transitions from Fault to Switch on disabled.

Method ④: Clear the alarm by writing a command via SDO. The object dictionary corresponding to F0-00 is 0x3000. The command is as follows:

When an alarm occurs, write 1 to D0 to clear the alarm. (For detailed instructions, refer to the User Manual for XDH/XLH/XG2 Series Programmable Controllers [Advanced Motion Control Section])

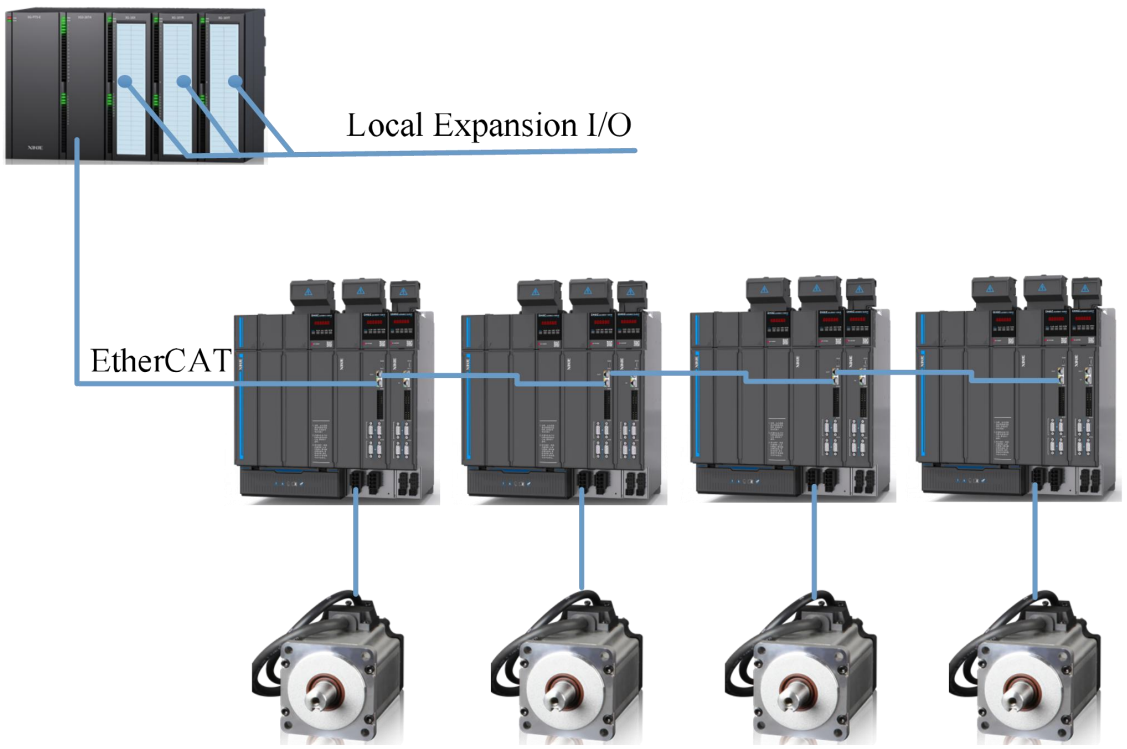
11. Communication Cases

11.1 XJX XG2/XDH and XJX DM6C Servo EtherCAT Communication Example

11.1.1 System Configuration

name	Model/Specification	quantity	remarks
motion control software	Xinjie PLC Programming Tool Software	1	
Servo of XJ	DM6-4110P0-R	1	
parvicostellae	JC-CA-3	a surname	Connects the computer to the servo

11.1.2 System Topology

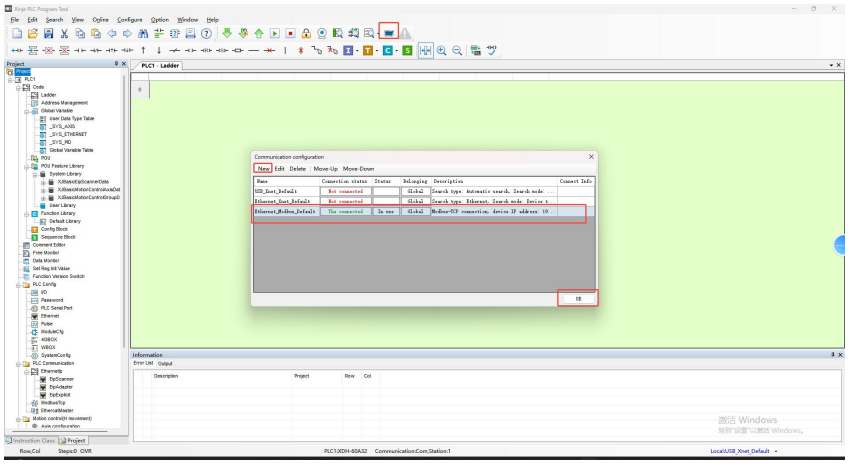


The DM6C driver's EtherCAT network port wiring follows a bottom-up standard: the master station's network cable connects to the first driver's IN port, while the first driver's OUT port cable connects to the second driver's IN port, and so on.

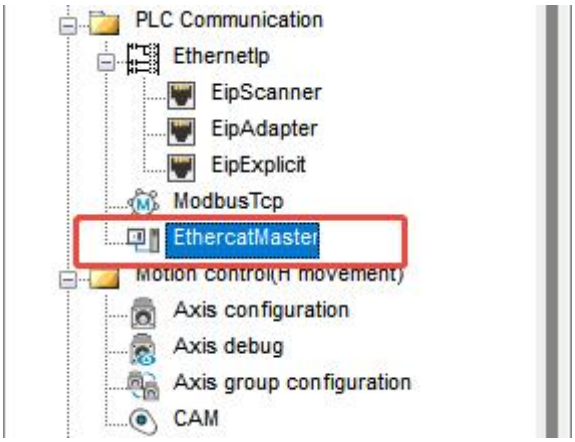
11.1.3 Debugging Steps

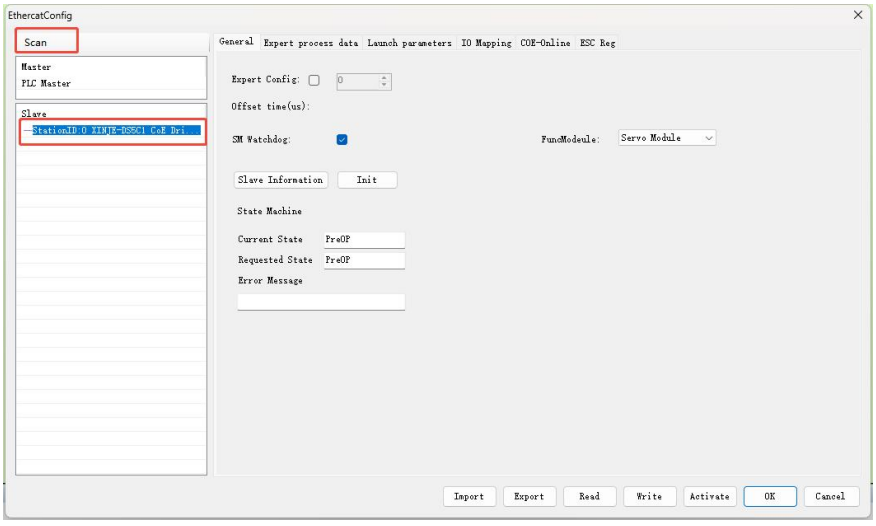
Using H motion as an example, debug each EtherCAT bus control mode (the default in PLC programming software version 3.7.14 and above is H motion, with SFD811=1).

1、 linkage PLC。



2. Configure Ethercat.





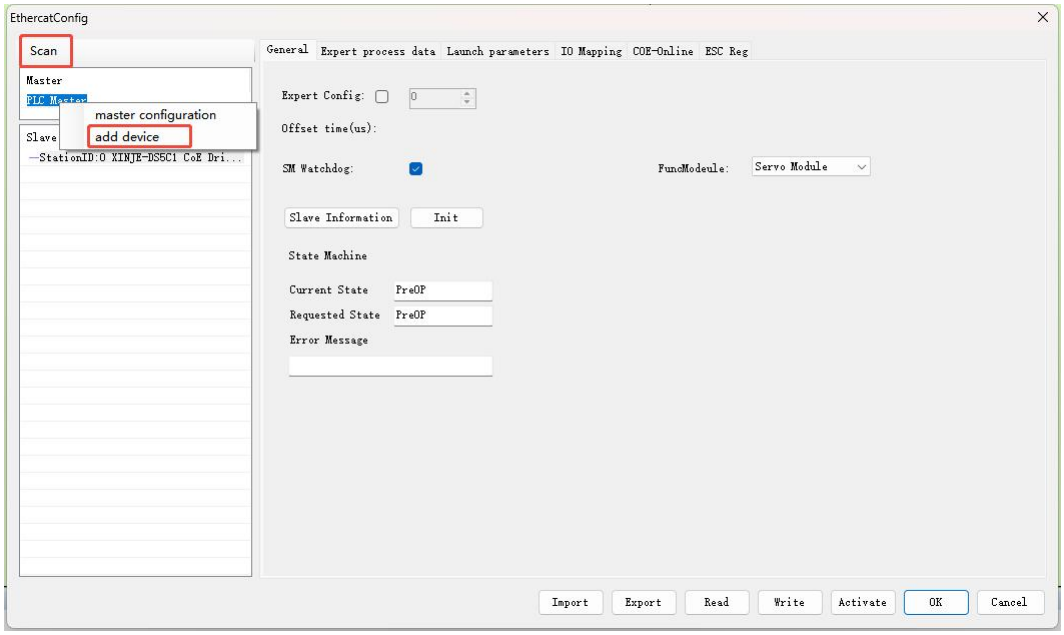
3. Confirm the PDO to be configured in this mode in Expert Engineering Data.

1) Example of CSP mode operation

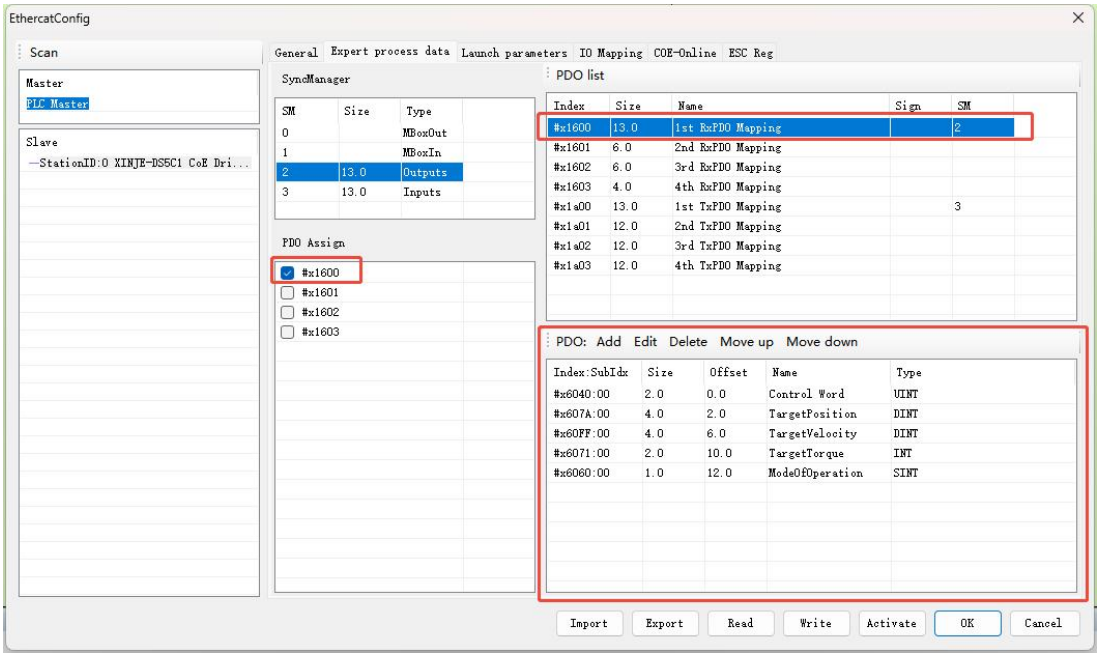
CSP control mode associated object

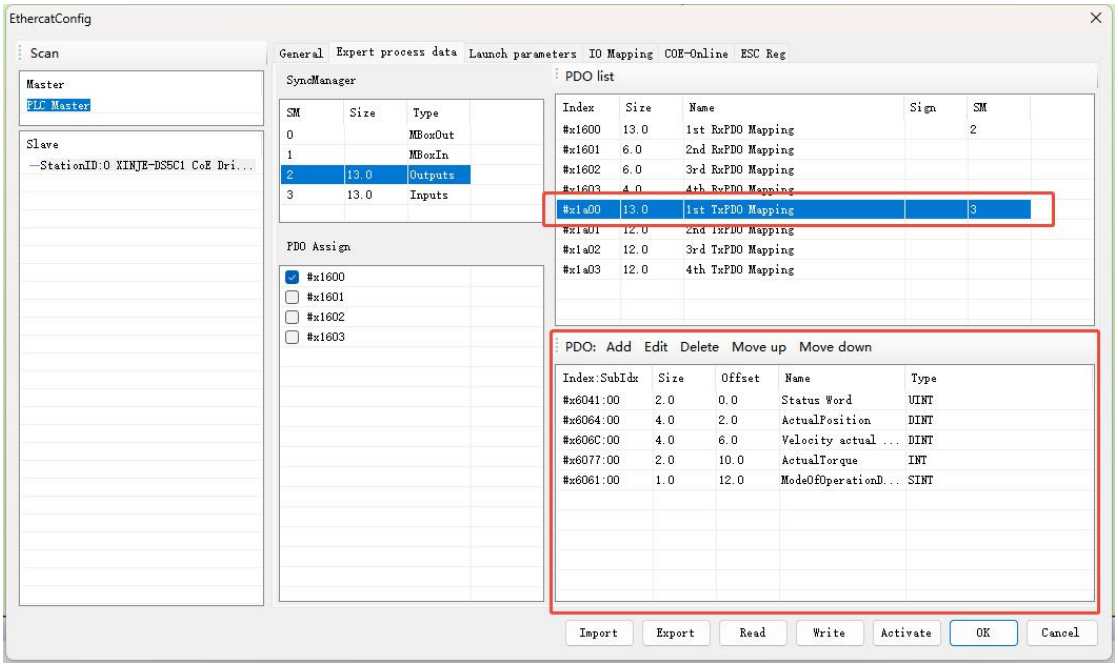
register	explain	unit
RXPDO[0x607A]	When the position is specified, modifications via IO mapping are invalid in CSP mode, as it is controlled by the NC module.	instruction unit
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
RXPDO[0x6060]	The control mode is CSP (Cycle Synchronization Position Mode). Set its value to 8.	-

① On the EtherCAT interface, select [Scan] or [Add Device] for slave devices, and use the default configuration in the [General] interface.

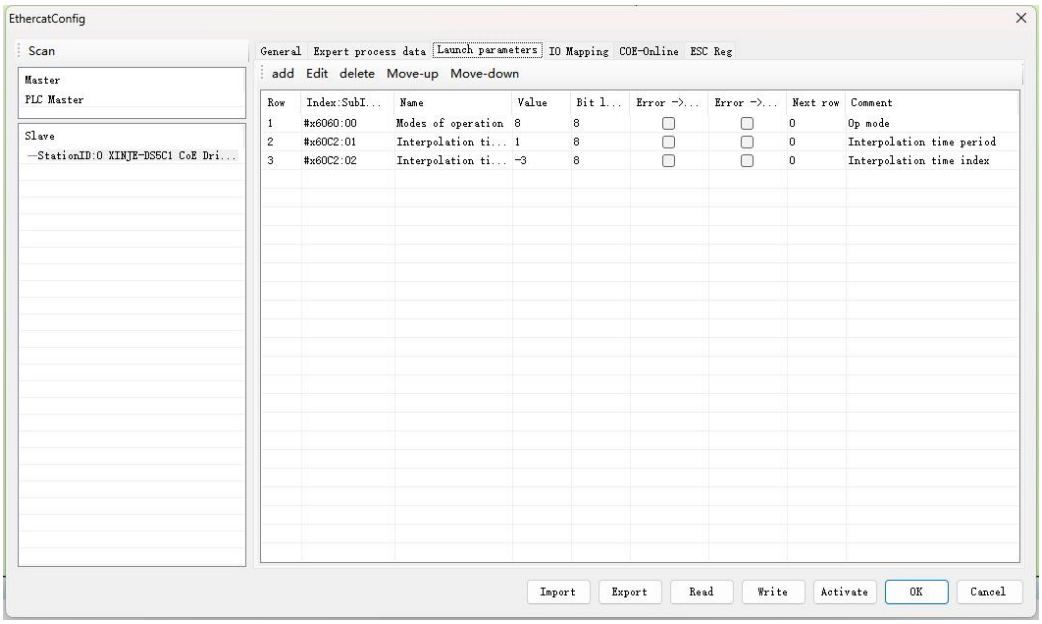


② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00. (The default configuration meets CSP's basic requirements. Additional PDO parameters can be added if needed.)





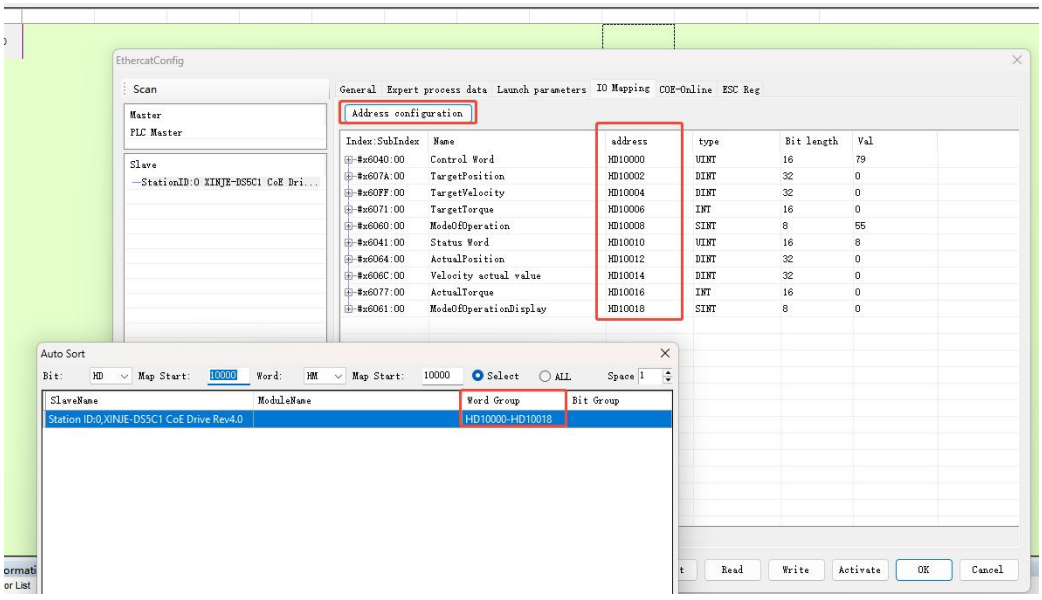
③ Verify that the 6060h value in [Start Parameters] is set to 8.



The startup parameters include three default configurations: 6060h (slave mode, default value 8 for CSP mode); 60C2-1 and 60C2-2 (synchronization unit period), where 60C2-1 specifies the period value and 60C2-2 its unit. For example, the default synchronization unit period is 100×10^{-5} seconds (1000 microseconds). This parameter automatically adjusts to the master station's synchronization period configuration, eliminating manual modification.

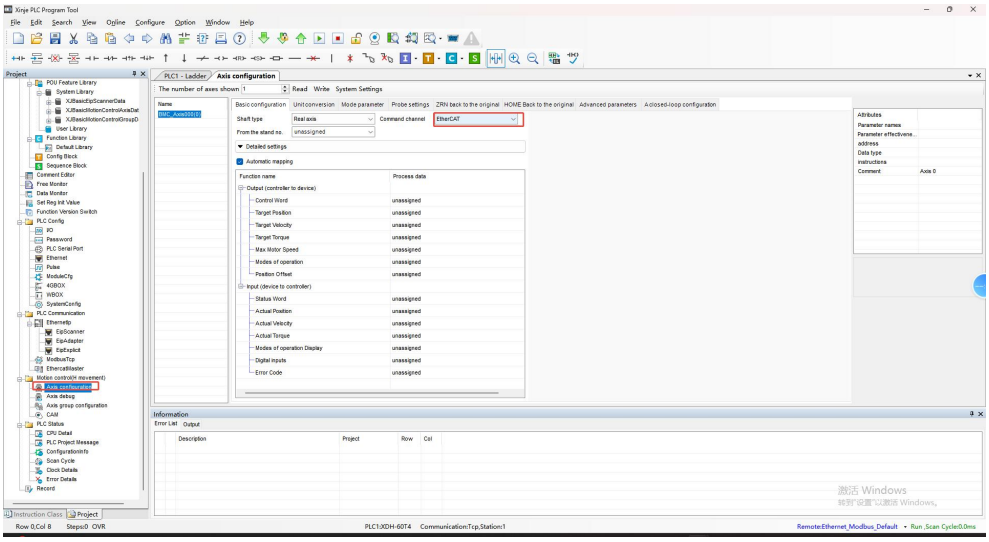
④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.

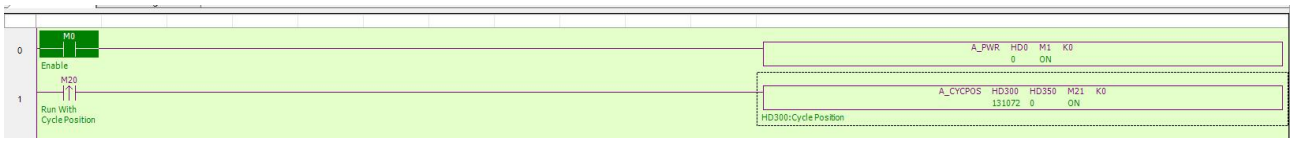


⑥ Upon activation, the station state machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ Verify that the instruction channel (SFD8001+300*N) in the axis configuration parameters is set to Ethercat (with the register value set to 0).



⑧ In the CSP mode, the current position can be monitored via HD10002 (607Ah mapping), the actual motor position via HD10012 (6064h mapping), and the actual speed via HD10014 (606Ch mapping).



PLC1-FreeMOnitor1

Moni-Window | Add | Edit | Delete | Delete All | Upword | Downword | Top | Bottom

Name	Monitor value	type	Map-Addres...	Comment
M0	ON	BIT	Bit	Enable
M20	OFF	BIT	Bit	Run With Cycle Position
HD300	131072	LREAL	QWord	Cycle Position
HD10002	131072	DINT	DWord	Station 1D:0,#x607A:0,Target position
HD10008	8	INT	SWord	Station 1D:0,#x6060:0.Modes of operation
HD10012	131072	DINT	DWord	Station 1O:0.#x6064:0.Position actual value
HD10004	0	DINT	DWord	Station 1D:0,#x60FF:0,Target velocity
SFD811	1	INT	SWord	Motion control function: 0-simple type; 1-introductory and practical type;

- When the M20 is switched from OFF to ON, it performs periodic position control on the designated axis of HD300. Upon successful execution, the M21 is set to ON, indicating the axis has entered periodic control mode. The axis is then controlled by periodically assigning values to HD300.
- Before triggering the instruction, ensure the HD300 value matches the current position; otherwise, a step will occur.
- Periodic position control requires writing the target position value into the register periodically. The position change should not be too large to avoid the shaft's flyout caused by a significant difference between the given period position and the previous one.

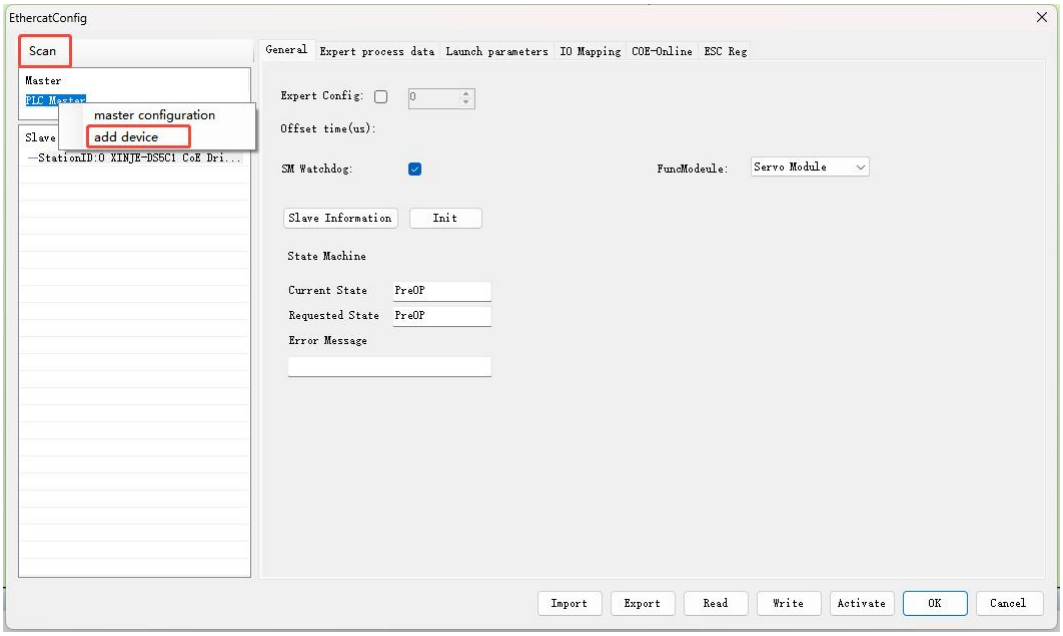
2) CSV mode operation example

CSV control mode associated object

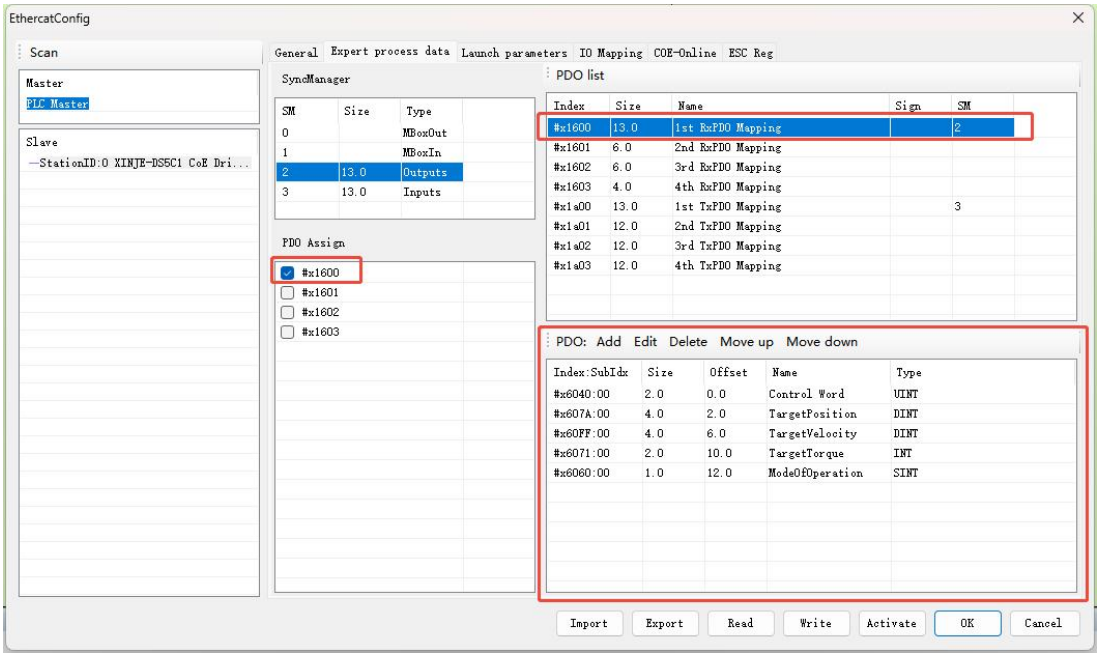
register	explain	unit

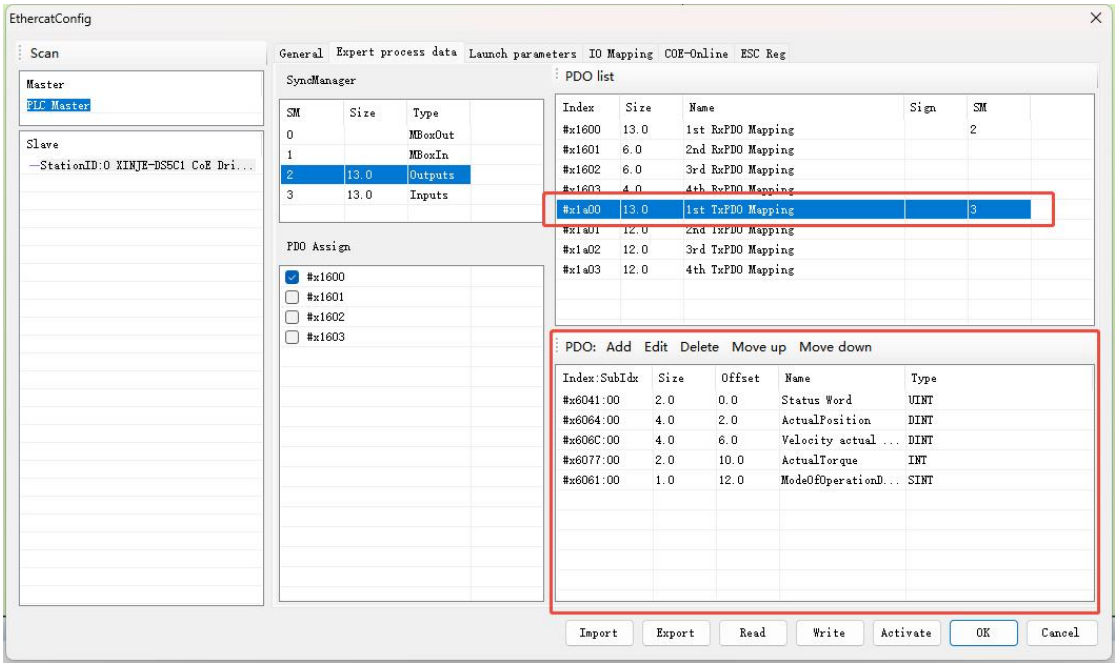
RXPDO[0x60FF]	velocity given	Command unit/s
TXPDO[0x6064]	position feedback	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
RXPDO[0x6080]	The maximum motor speed can be adjusted via the online COE-Online interface.	r/min
RXPDO[0x6060]	The control mode is CSV (periodic synchronization speed mode). Set its value to 9.	-

① On the Ethercat interface, select [Scan] or [Add Device] for slave devices, and use the default configuration on the [General] interface.

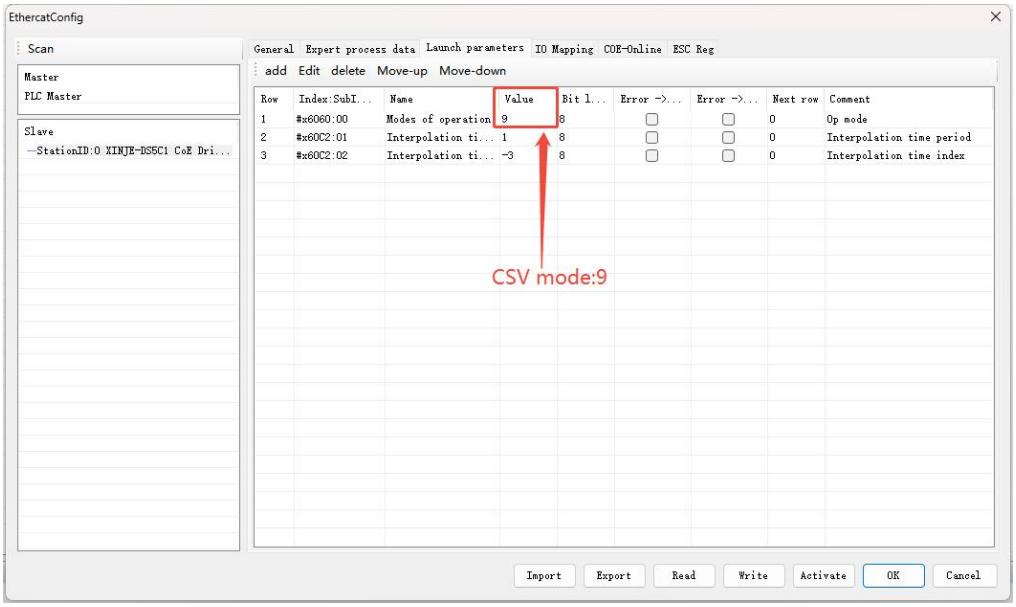


② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00. (The default configuration meets basic CSV requirements. Additional PDO parameters can be added if needed.)



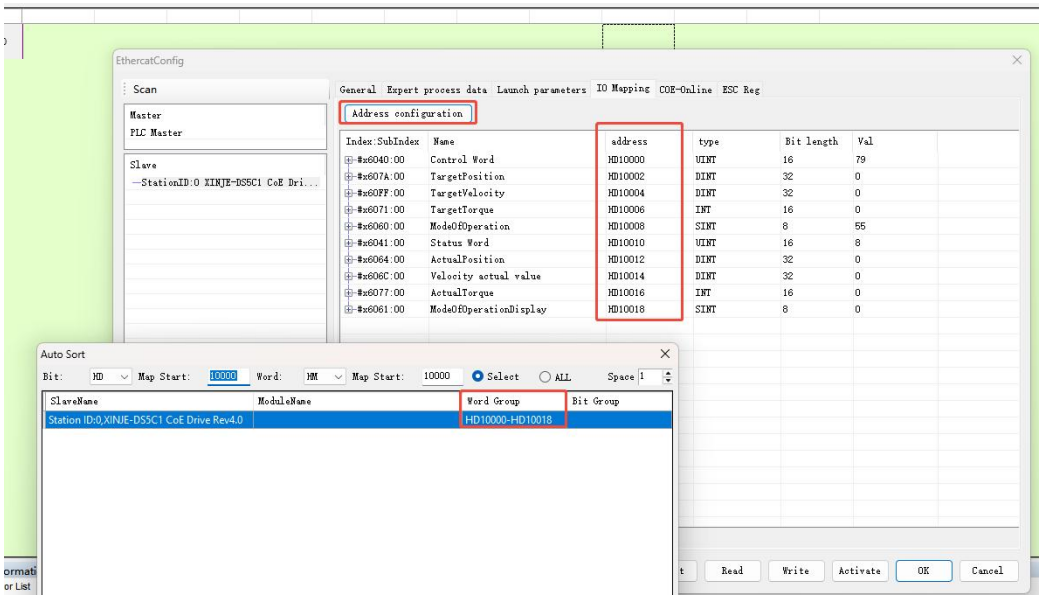


③ Verify that the 6060h value in [Start Parameters] is 9.



④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station status machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit/receive signals. After switching to OP, the maximum motor speed (6080h) can be adjusted via COE-Online.

⑦ When the enable bit is set to ON, HD10000 (mapped to 6040h) will transition from 6 to 7 and then to 15, indicating the slave enable state. This can be achieved by assigning a value to HD10004 (mapped to 60FFh) as the target speed in CSV mode. Real-time speed interpolation can be implemented by modifying HD1004 during I9900 interrupts.

⑧ In CSV mode, the system monitors the current speed via HD10004 (60FFh mapping), the actual motor position via HD10012 (6064h mapping), and the actual speed via HD10014 (606Ch mapping).

PLC1-FreeMOnitor1

Moni-Window | Add | Edit | Delete | Delete All | Upword | Downword | Top | Bottom

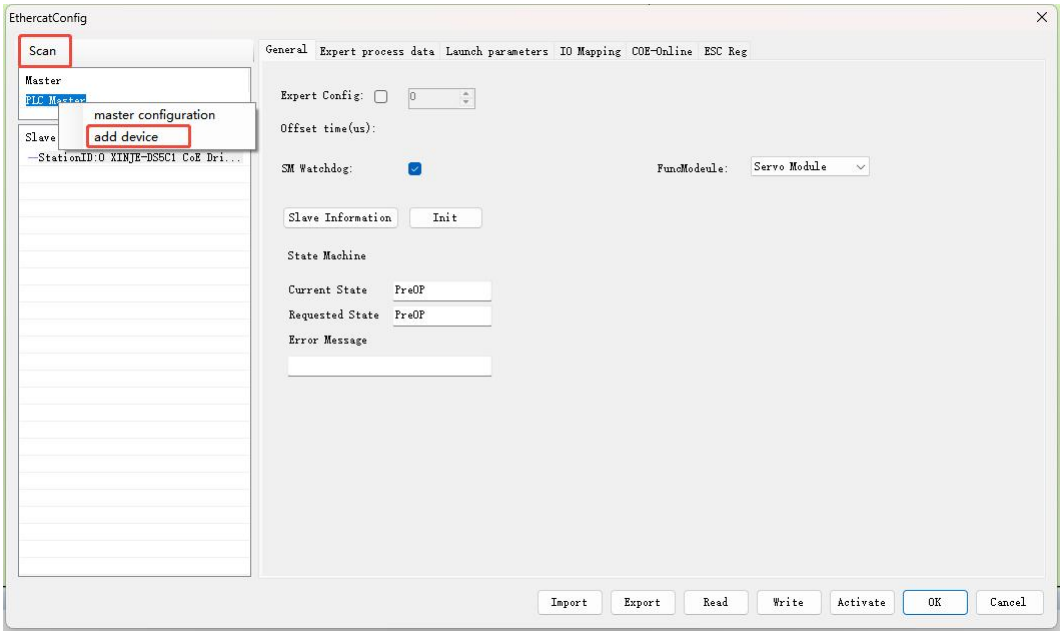
Name	Monitor value	type	Map-Addres...	Comment
M0	ON	BIT	Bit	Enable
M30	OFF	BIT	Bit	Run With Cycle Velocity
HD400	131072	LREAL	QWord	Cycle Velocity
HD10002	43691646	DINT	DWord	Station 1D:0, #x607A:0, Target position
HD10004	131072	DINT	DWord	Station 1D:0, #x60FF:0, Target velocity
HD10008	9	INT	SWord	Station 1D:0, #x6060:0. Modes of operation
HD10014	130722	DINT	DWord	Station 1D:0, #x606C:0. Velocity actual value
HD10012	43691122	DINT	DWord	Station 1D:0. #x6064:0 Position actual value

3) Example of operating the CST mode

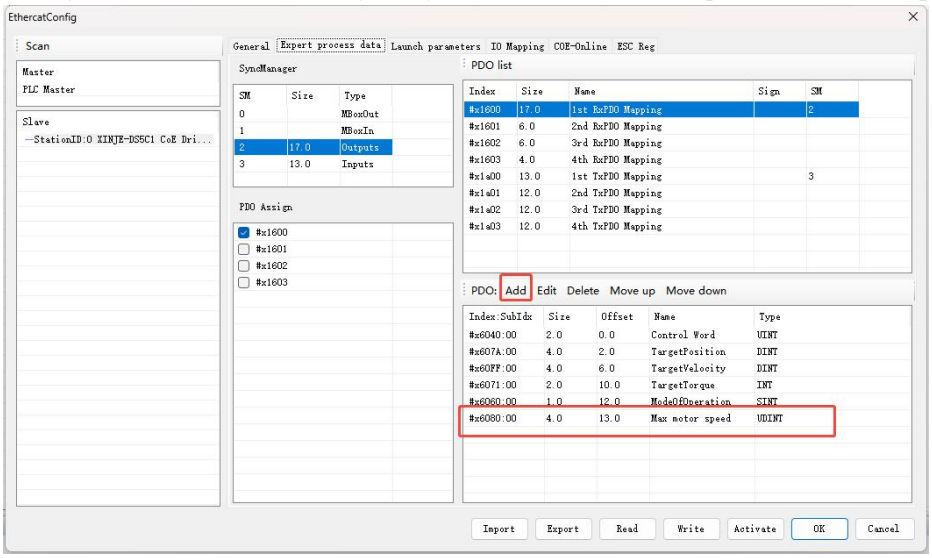
CST control mode associated object

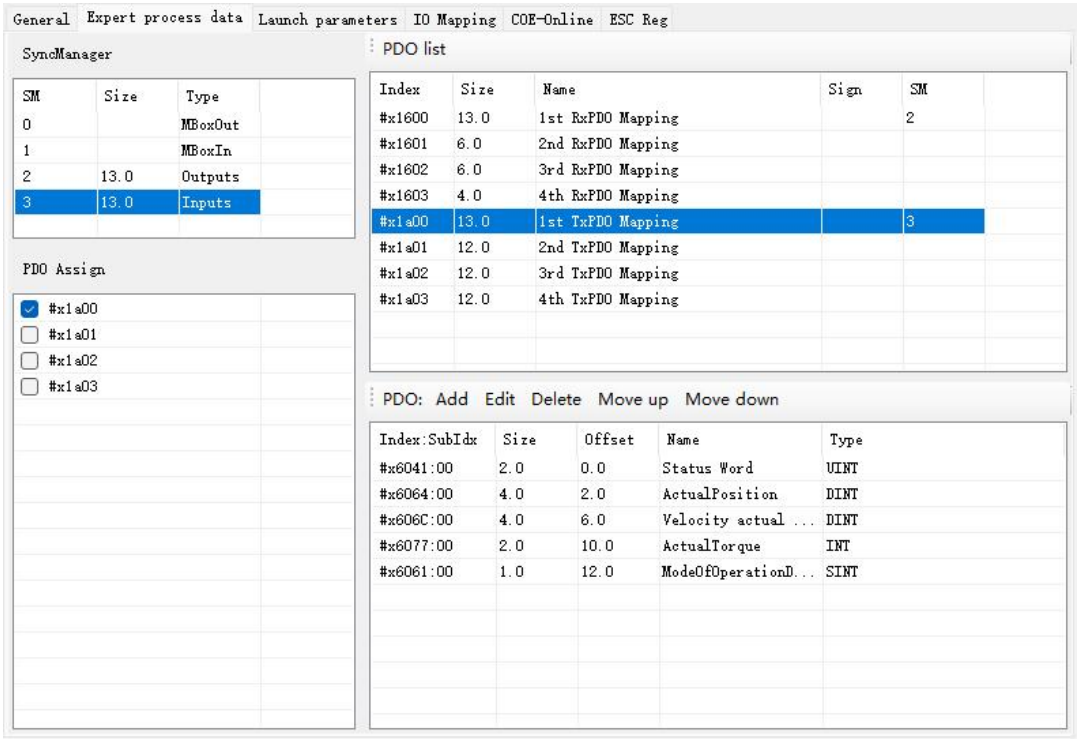
register	explain	unit
RXPDO[0x6071]	torque given	0.1%
TXPDO[0x6064]	position feedback	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	torque feedback	0.1%
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6060]	The control mode is CST (Cycle Synchronous Torque Mode). Set its value to 10.	-

① On the Ethercat interface, select [Scan] or [Add] slave station, and use the default configuration on the [General] interface.

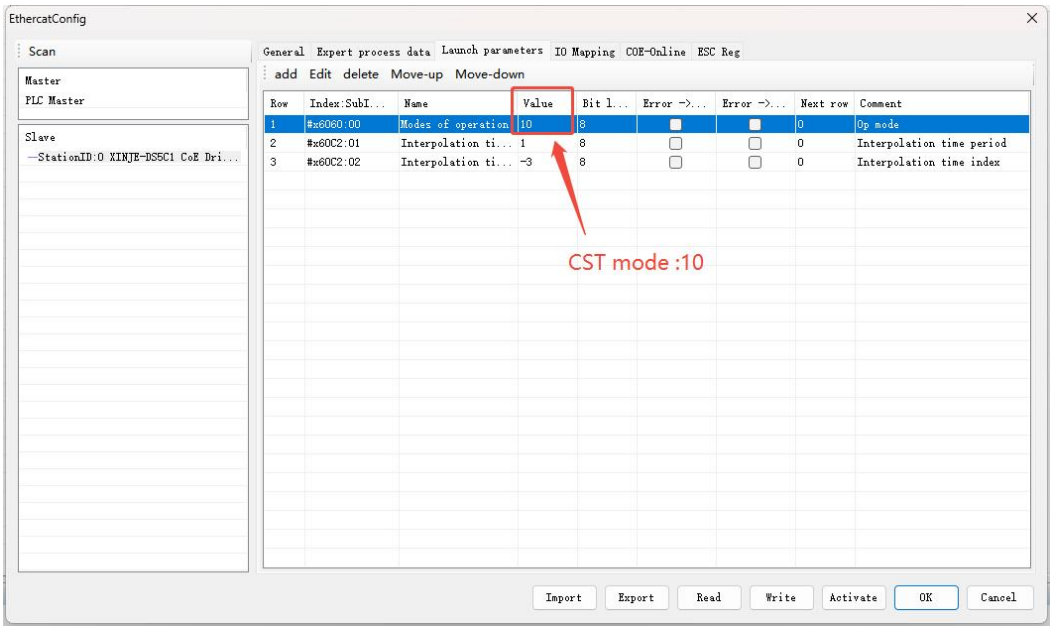


② In the [Expert Process Data] → [PDO Allocation] section, select 1600 and 1A00. The default configuration meets CST's basic requirements. Additional PDO parameters can be added if needed for example, adding 6080h to 1600 allows adjusting the motor's maximum speed to control torque.



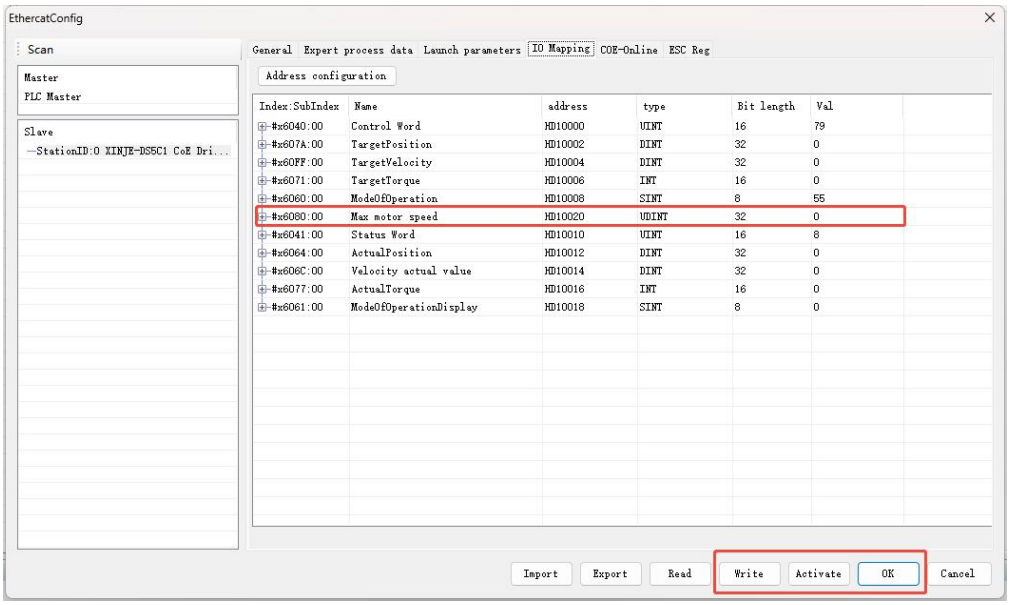


③ Verify that the 6060h value in [Start Parameters] is set to 10.



④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

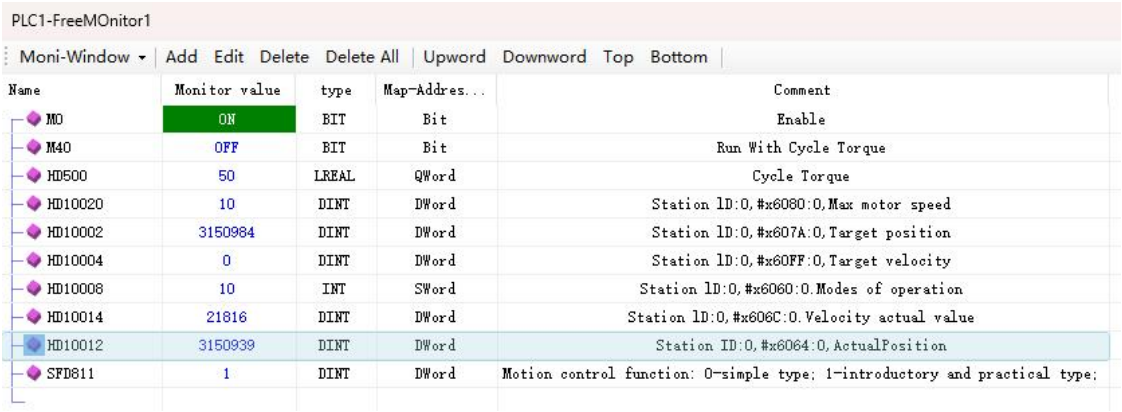
⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station state machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ When the enable bit is set to ON, HD10000 (mapped to 6040h) will transition from 6 to 7 and then to 15, indicating the slave enable state. This can be achieved by assigning a value to HD10006 (mapped to 6071h) as the specified torque in CST mode.

⑧ In CST mode, the system monitors the current torque via HD10006 (mapping to 6071h), the actual position via HD10012 (mapping to 6064h), the actual speed via HD10014 (mapping to 606Ch), and the actual torque via HD10016 (mapping to 6077h). The maximum motor speed can be restricted at 6080h (Note: After adding the speed limit parameter, ensure the speed remains within the appropriate range during operation).



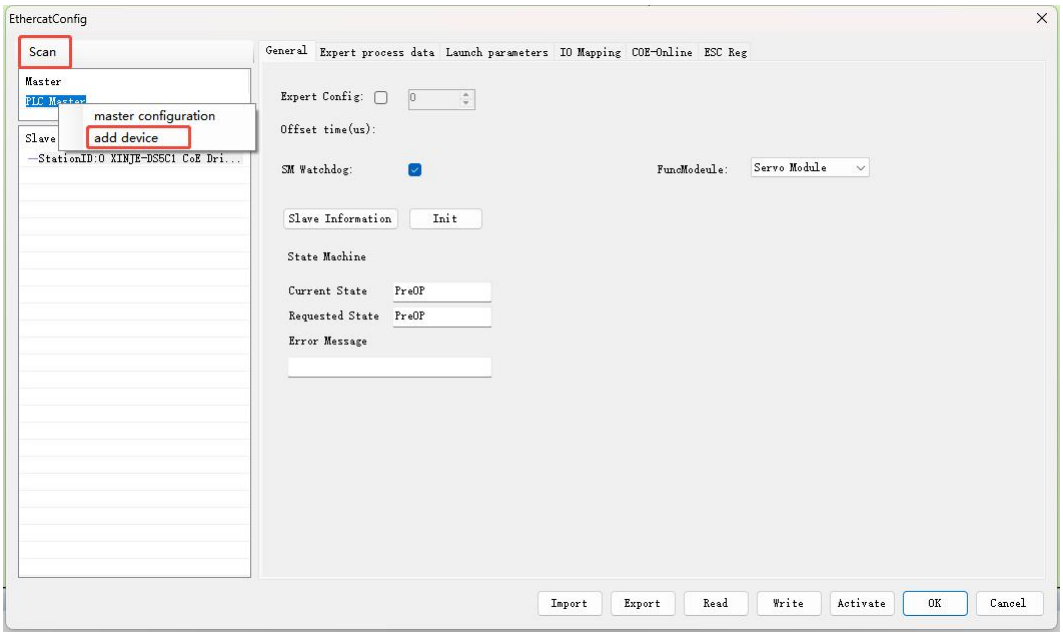
4) Examples of HM mode operations

HM control mode associated object

register	explain	unit
RXPDO[0x6040]	Control word, modify control word to return to origin	-
RXPDO[0x6098]	return to origin method	-
RXPDO[0x609A]	acceleration to origin	instruction units/s²
RXPDO[0x6060]	The control mode is HM mode (return to origin mode). Set its value to 6 when the motor is not enabled.	-
SDO[0x6099]	Restore speed to origin and modify it online through COE-Online	Command unit/s

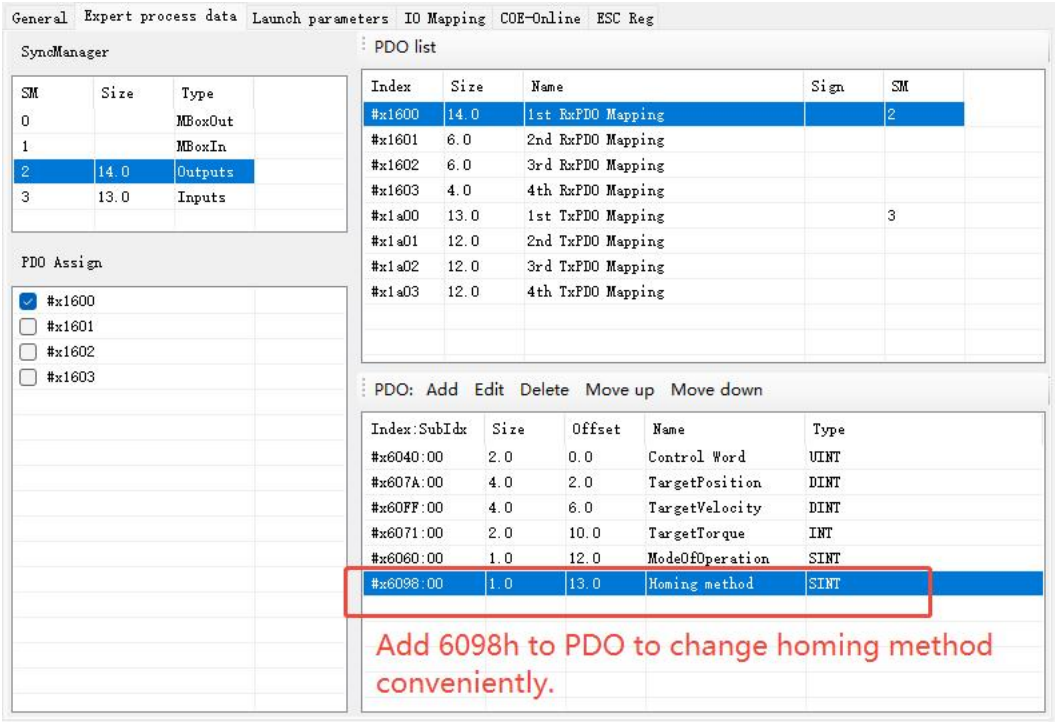
① Perform terminal assignment. P5-22 is the positive limit setting address, with default value 1 corresponding to servo terminal SI1; P5-23 is the negative limit NOT setting address, default value 2 corresponding to servo terminal SI2; P5-27 is the origin setting address, default value 3 corresponding to servo terminal SI3.

② On the Ethercat interface, select [Scan] or [Add Device] for slave devices, and use the default configuration on the [General] interface.

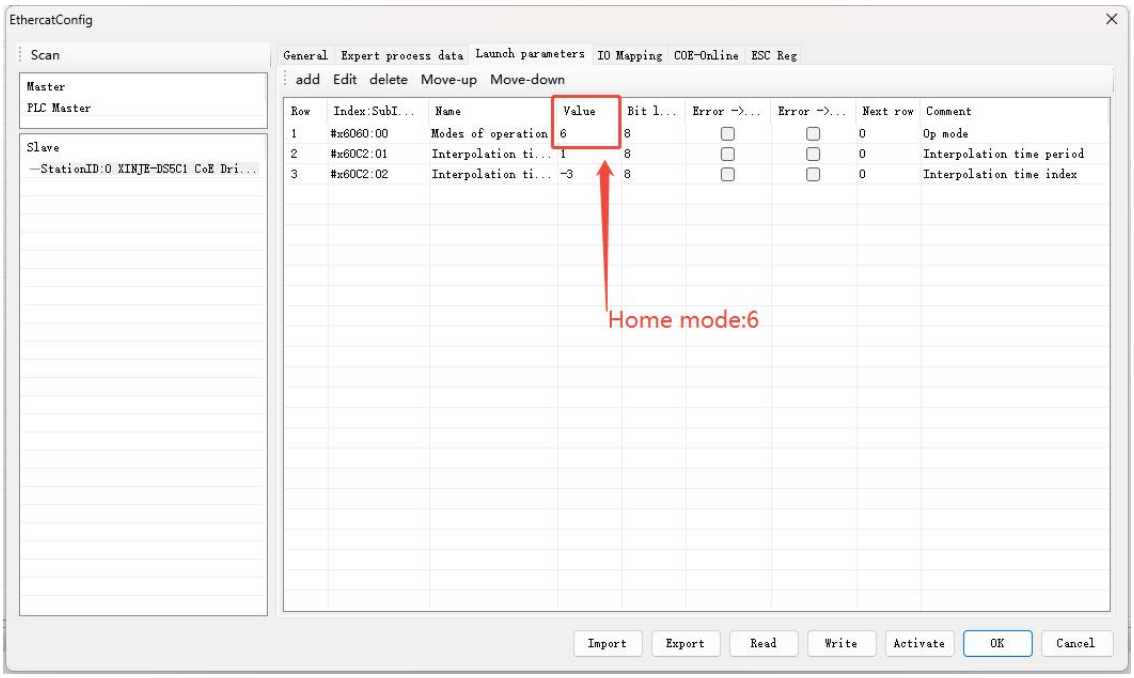


② In [Expert Process Data] → [PDO Allocation], select 1600 and 1A00, then add 6098h to 1600.

③

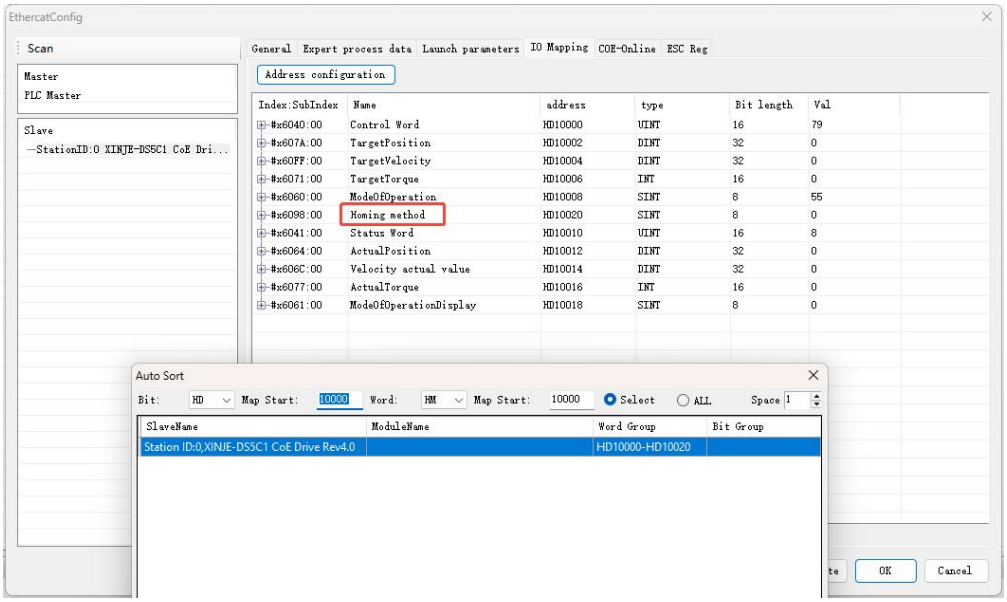


④ Verify that the 6060h value in [Start Parameters] is 6.



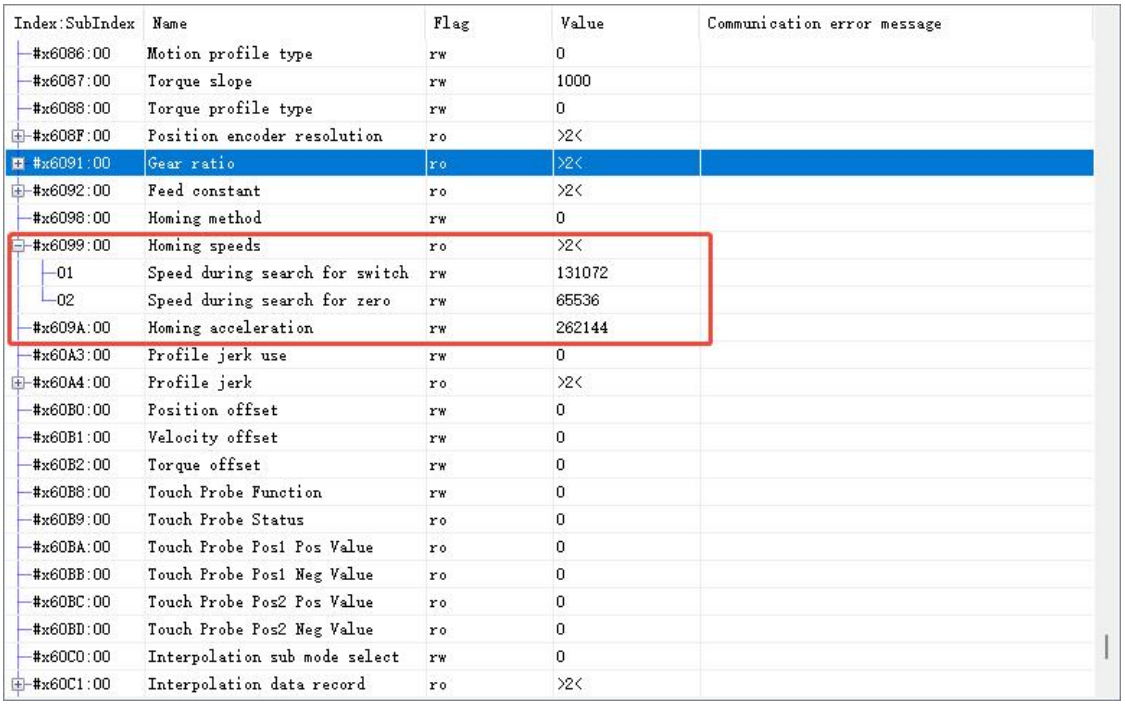
⑤[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

⑥ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑦ Upon activation, the slave status machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑧ After the system transitions to OP mode, the original speed and acceleration values can be adjusted via COE-Online.



⑨ Set the origin return mode (6098h).

This setting ranges from-2 to 37 (currently supports-2 to 14,17 to 30,33,34,35, and 37).

⑩ After enabling the ON state, HD10000 (6040h mapping) will transition from 6→7→15 to indicate the slave enable status, then reset to 15→31 to return to the origin. During this reset process, if the

origin signal is triggered, the system will decelerate and stop according to the predefined reset procedure. To initiate another reset, first change 6040h to 15, then execute the HD10000 (6040h mapping) 15→31 sequence.

5) Examples of PP Mode operations

PP control mode associated objects (commands,settings)

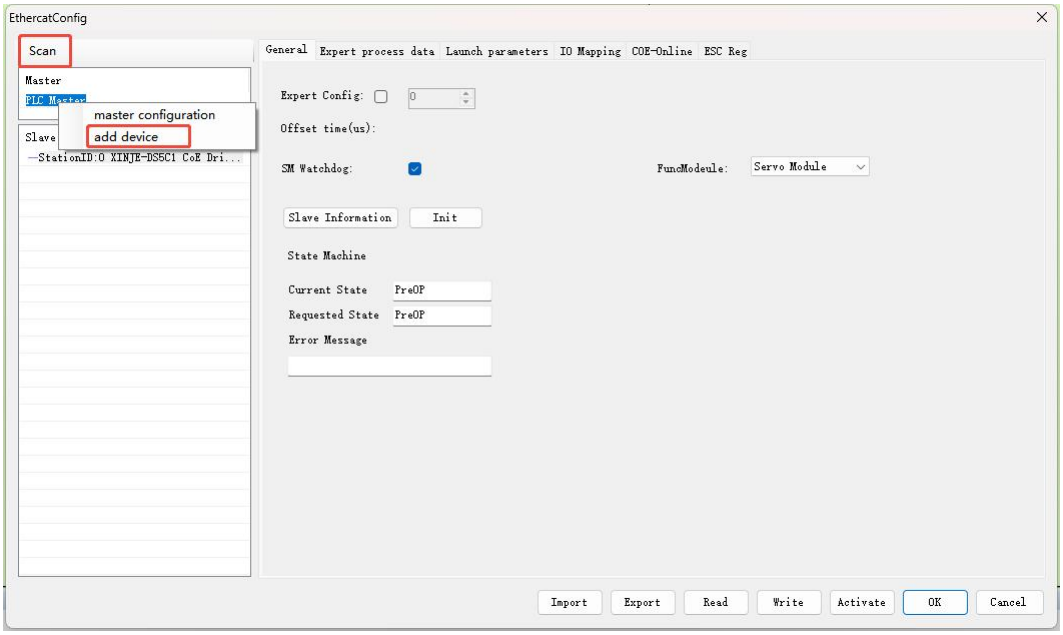
register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is PP (Profile Position Control Mode). Set its value to 1.	-
RXPDO[0x607A]	Position given	instruction unit
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	maximum internal velocity	Command unit/s
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6081]	internal speed given	Command unit/s
RXPDO[0x6083]	internal acceleration	instruction units/s²
RXPDO[0x6084]	internal deceleration	instruction units/s²
RXPDO[0x60C5]	maximal acceleration	instruction units/s²
RXPDO[0x60C6]	maximum deceleration	instruction units/s²
RXPDO[0x6065]	Set the number of trailing pulse counts	instruction unit
RXPDO[0x6066]	Follow-up error timeout time	ms
RXPDO[0x6067]	Location reaches the threshold	instruction unit
RXPDO[0x6068]	Location to window time	ms

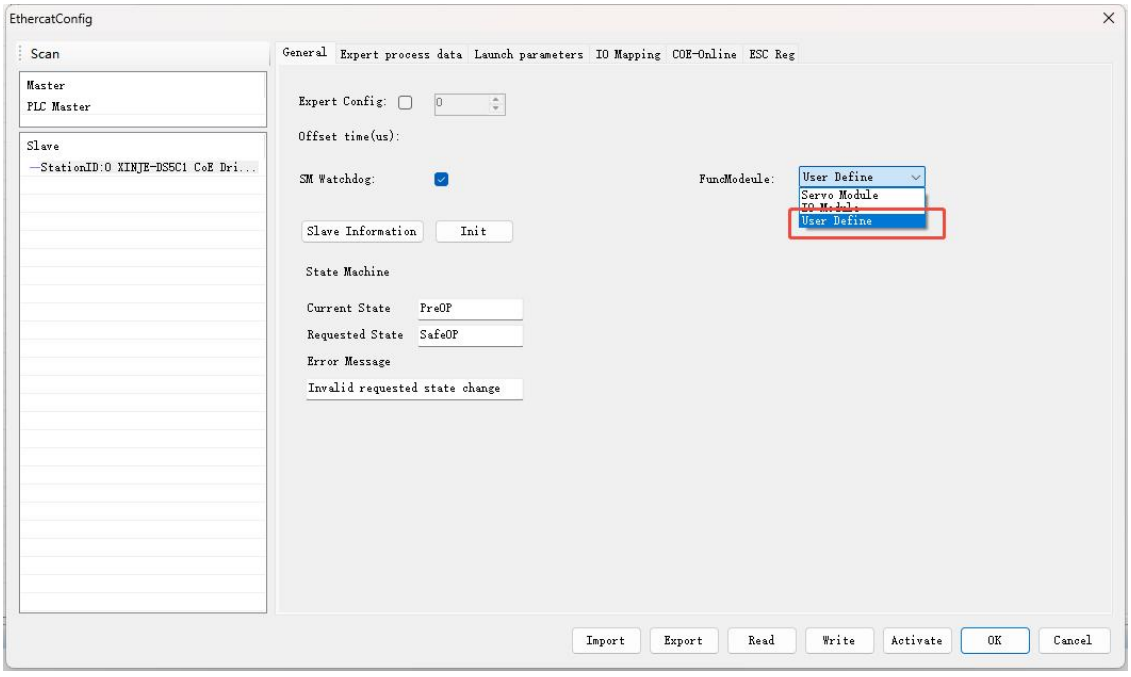
- The 6081h (profile speed) is limited by the lower of 607Fh (maximum internal speed) and 6080h (maximum motor speed).
- If you modify the set values of 607Fh (maximum internal speed) or 6080h (maximum motor speed) during operation, these changes will not be reflected in the action and will not take effect.

PP control mode associated objects (commands,monitoring type)

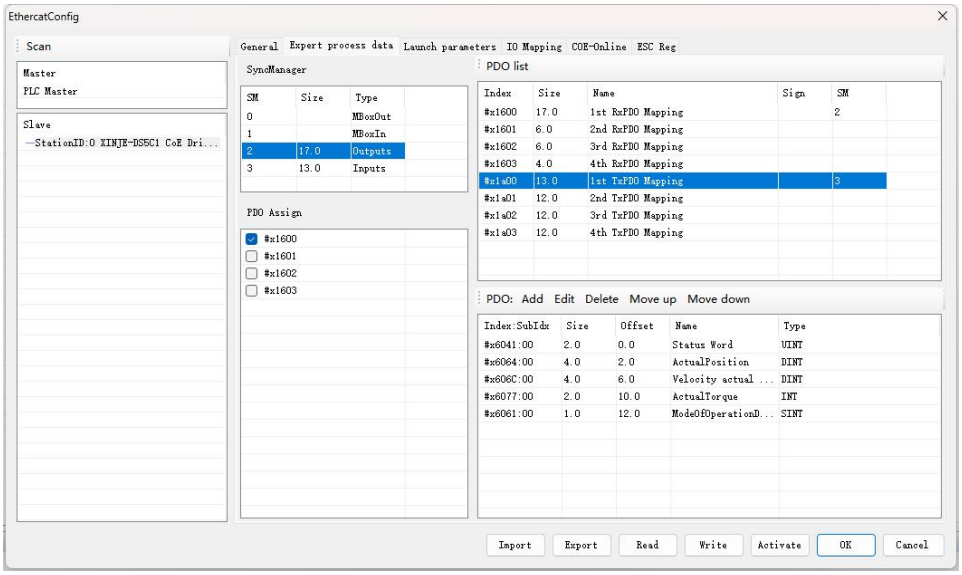
register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6063]	Internal actual location	instruction unit
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%
TXPDO[0x60F4]	actual following error	instruction unit

① In the EtherCAT interface, select the [Scan] or [Add Device] slave node, then choose User Defined as the [Common] interface function block.

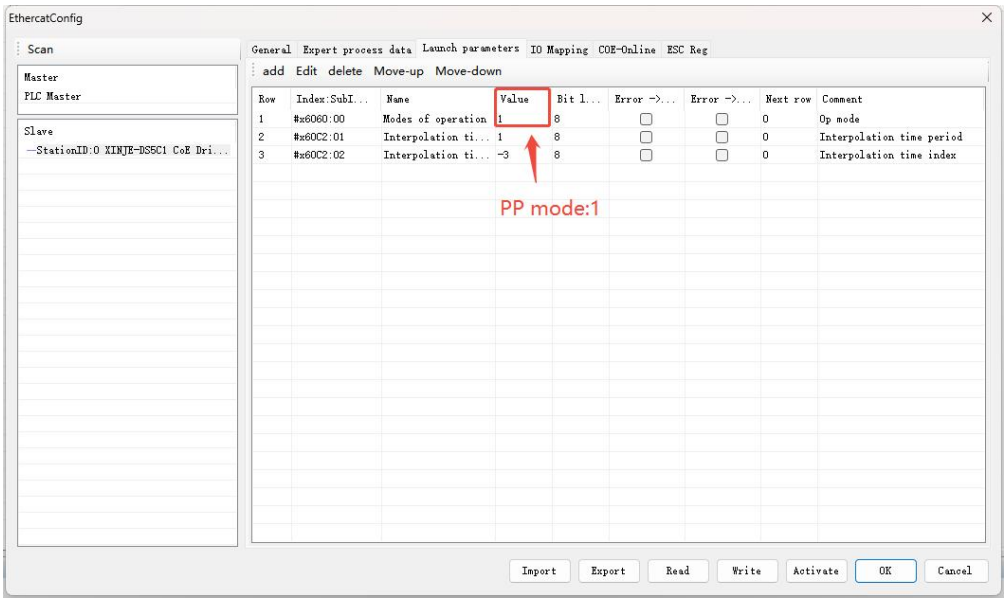




② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00 to add PDO parameters linked to the mode (each parameter cannot exceed 32 bytes).

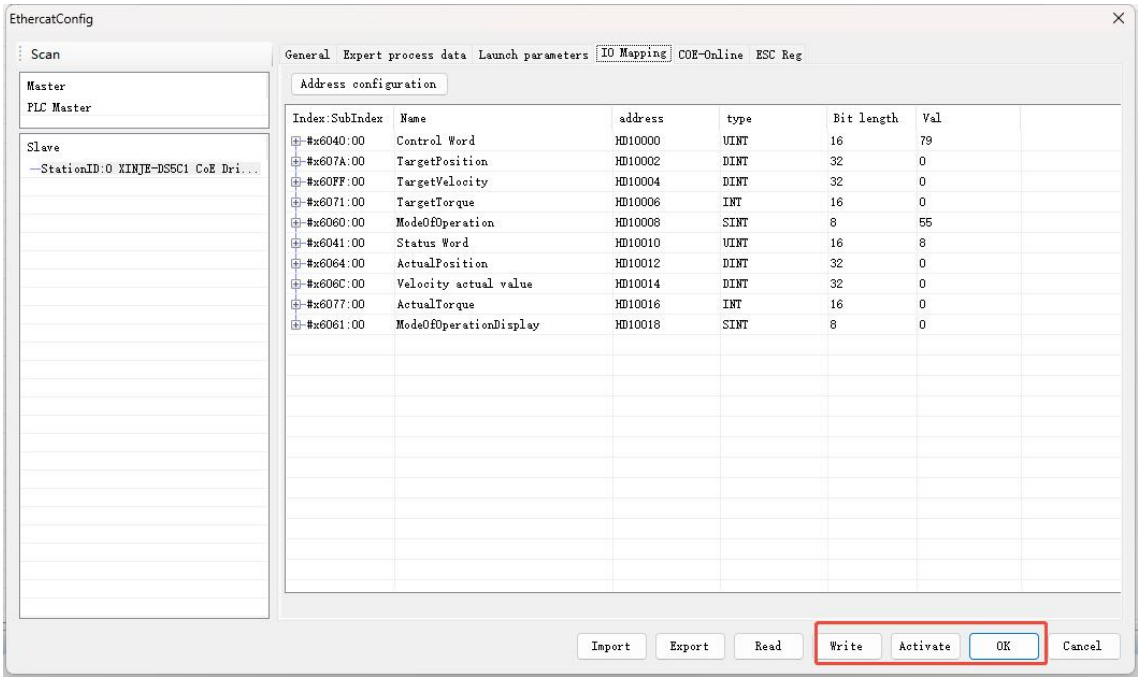


③ Verify that the 6060h value in [Start Parameters] is set to 1.



④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station state machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ Modify control word 6040h (absolute mode: 6→15→31; relative mode: 6→79→95) to enable the slave, then set parameters like target position, target speed, and acceleration/deceleration to control the motor.

⑧ In PP mode, I/O mapping addresses can be configured and monitored. For example, the control word of Axis 1 can be modified via HD10000 (mapping to 6040h) to enable or disable the motor, while the current position of Axis 1 can be monitored through HD10002 (mapping to 607Ah).

6) Example of operating the PV mode

pv control mode associated objects (commands,settings)

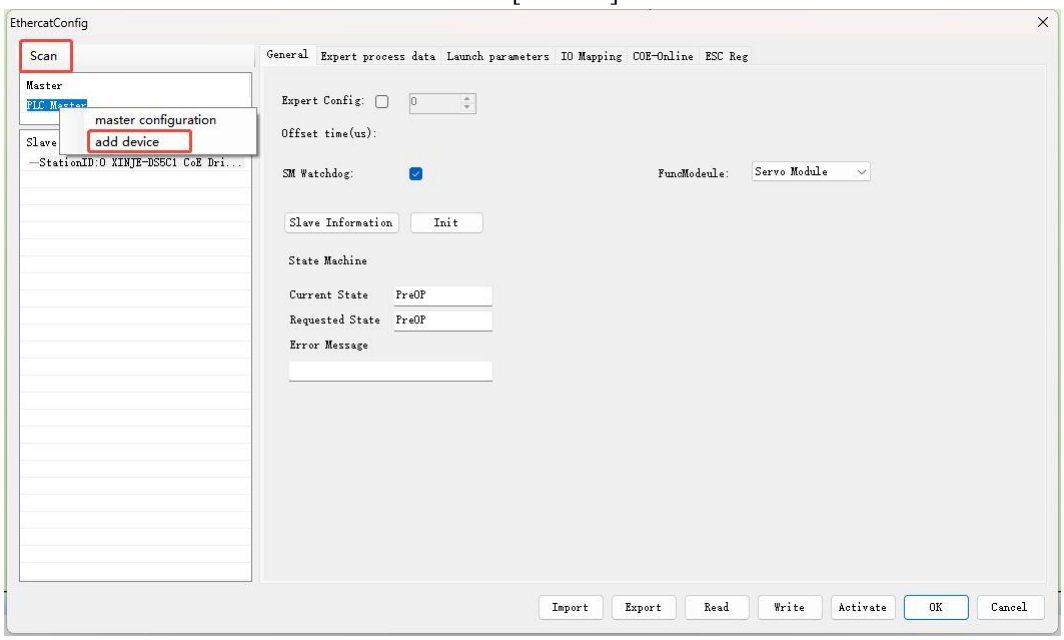
register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is PV (Profile Velocity Control mode). Set its value to 3.	-
RXPDO[0x60FF]	velocity given	Command unit/s
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	maximum internal velocity	Command unit/s
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6083]	internal acceleration	instruction units/s^2
RXPDO[0x6084]	internal deceleration	instruction

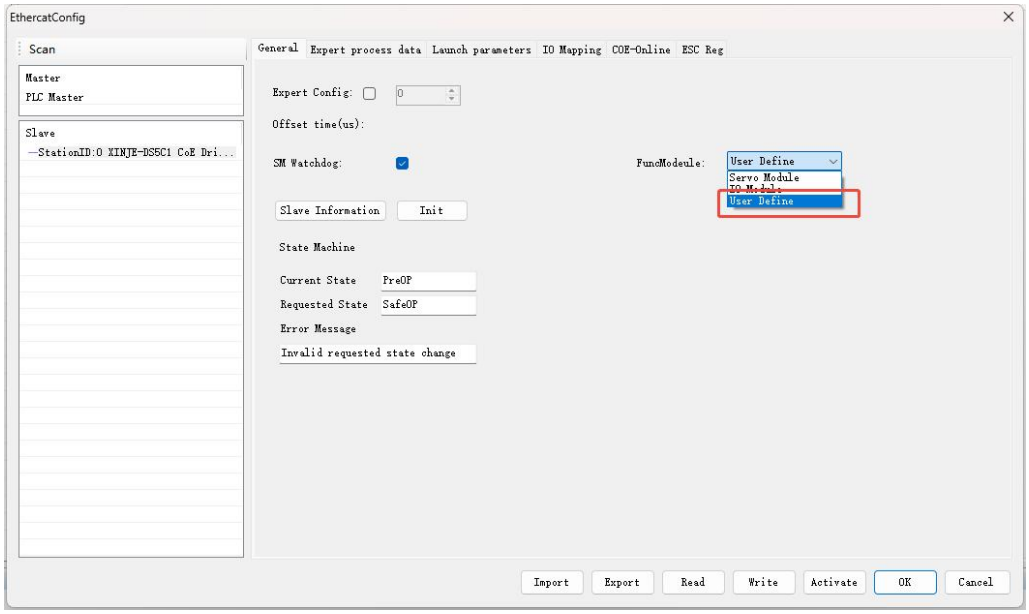
		units/s²
RXPDO[0x60C5]	maximal acceleration	instruction units/s²
RXPDO[0x60C6]	maximum deceleration	instruction units/s²
RXPDO[0x606D]	Speed reaches the threshold	Command unit/s
RXPDO[0x606E]	Speed limit exceeded	ms
RXPDO[0x606F]	Speed threshold	Command unit/s
RXPDO[0x6070]	Speed threshold time	ms

pv control mode associated objects (command,monitoring type)

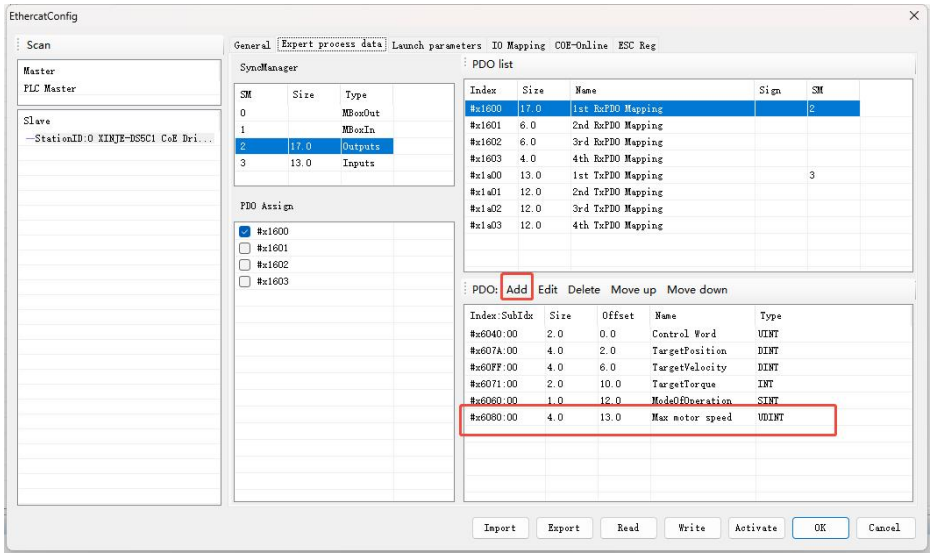
register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s
TXPDO[0x6077]	actual torque	0.1%

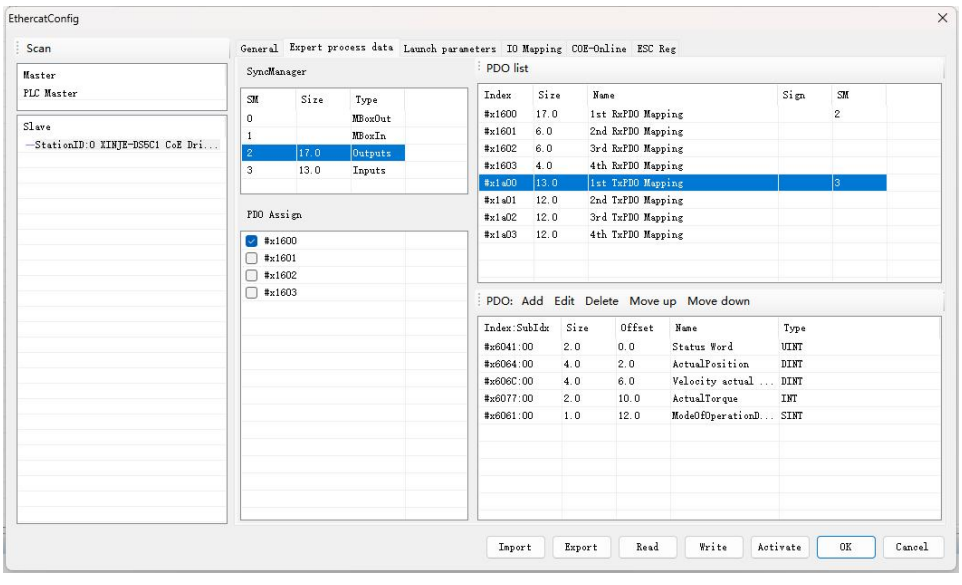
① On the EtherCAT interface, select the slave device from the [Scan] or [Add Device] menu, then choose User Defined as the function block in the [General] interface.



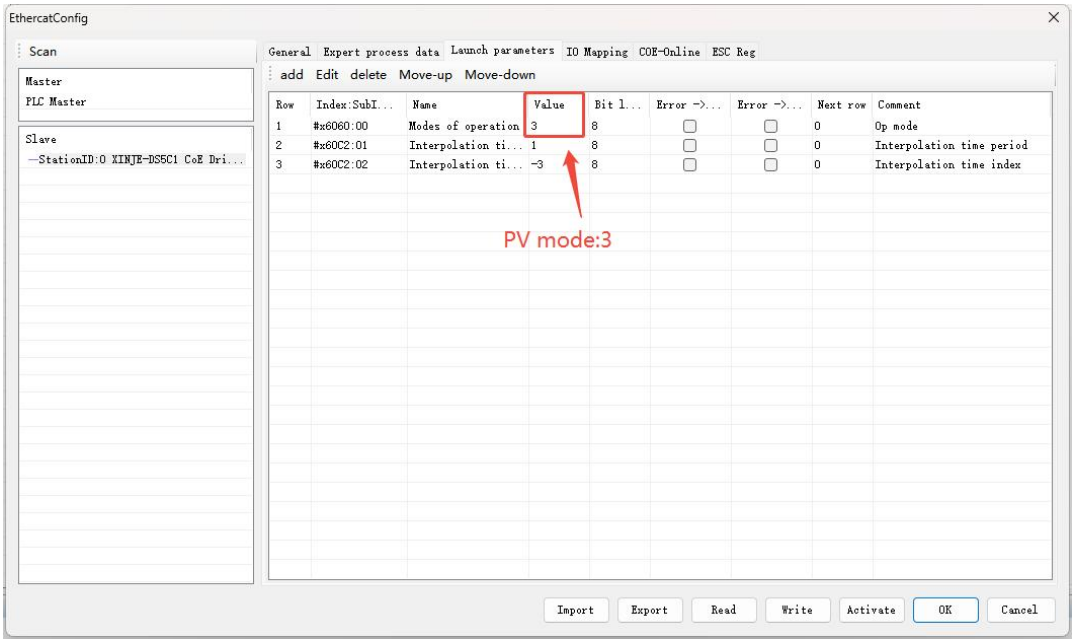


② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00 to add PDO parameters linked to the mode (each parameter cannot exceed 32 bytes).



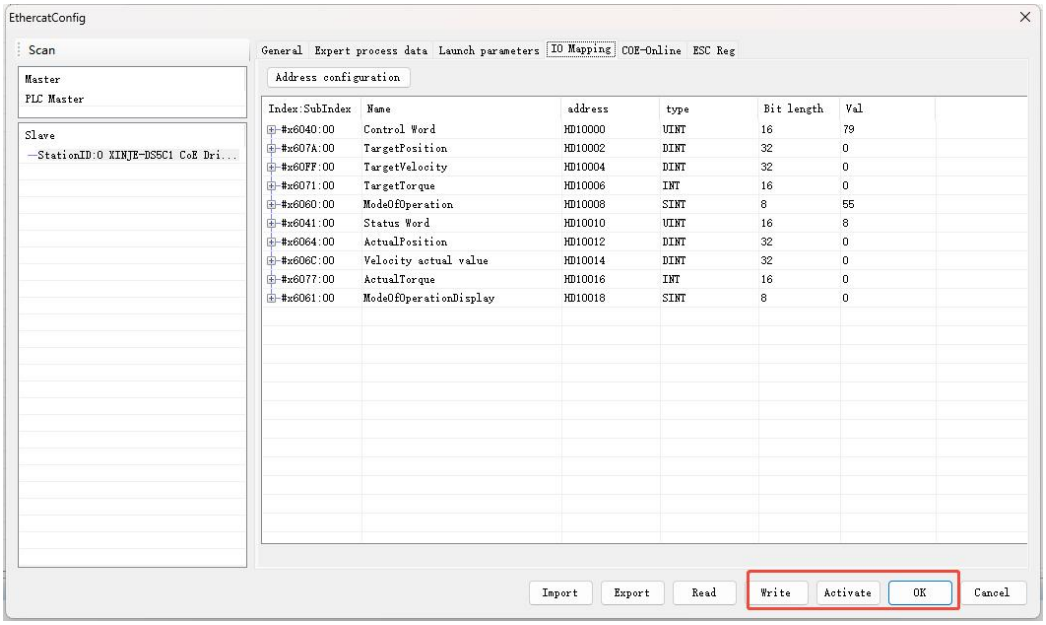


③ Verify that the 6060h value in [Start Parameters] is set to 3.



④[IO mapping]The starting address can be customized.

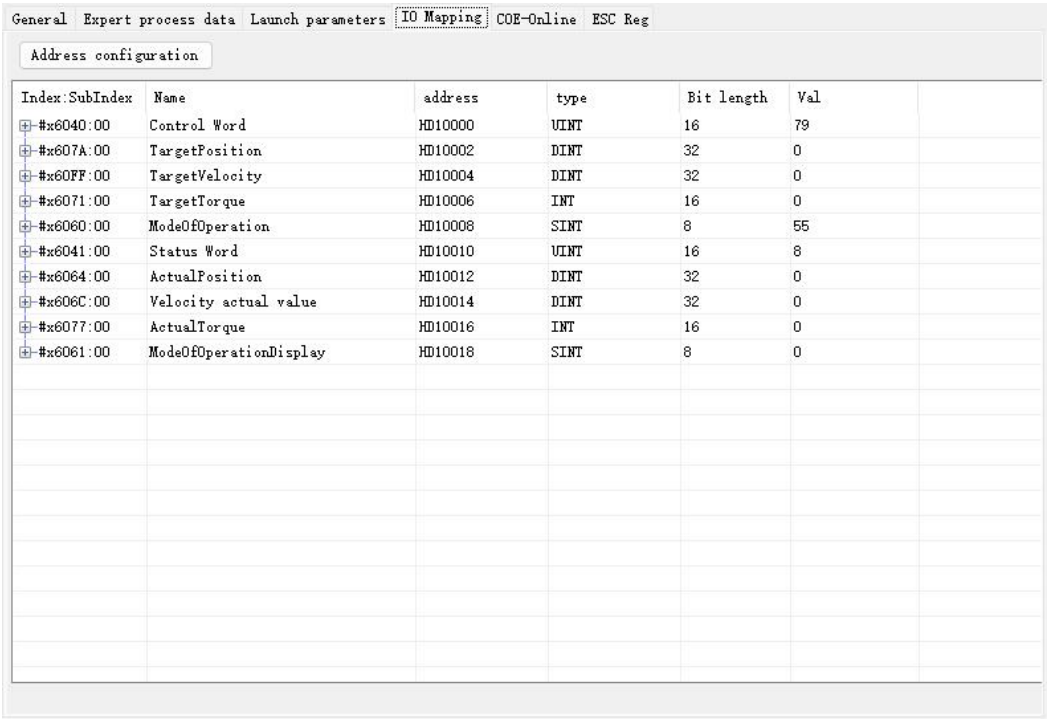
⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station state machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ Modify control word 6040 (6 → 15) to enable the slave, then set target speed, acceleration/deceleration and other parameters to control the motor.

⑧ In PV mode, I/O mapping addresses can be configured and monitored. For example, the control word of Axis 1 can be modified via HD10000 (mapping to 6040h) to enable or disable the motor, while the actual position of the motor on Axis 1 can be monitored through HD10012 (mapping to 6064h), and the current speed can be tracked via HD10014 (mapping to 606Ch).



Index:SubIndex	Name	address	type	Bit length	Val
#x6040:00	Control Word	HD10000	UINT	16	79
#x607A:00	TargetPosition	HD10002	DINT	32	0
#x60FF:00	TargetVelocity	HD10004	DINT	32	0
#x6071:00	TargetTorque	HD10006	INT	16	0
#x6060:00	ModeOfOperation	HD10008	SINT	8	55
#x6041:00	Status Word	HD10010	UINT	16	8
#x6064:00	ActualPosition	HD10012	DINT	32	0
#x606C:00	Velocity actual value	HD10014	DINT	32	0
#x6077:00	ActualTorque	HD10016	INT	16	0
#x6061:00	ModeOfOperationDisplay	HD10018	SINT	8	0

7) TQ Mode Operation Example

tq control mode associated objects (commands,settings)

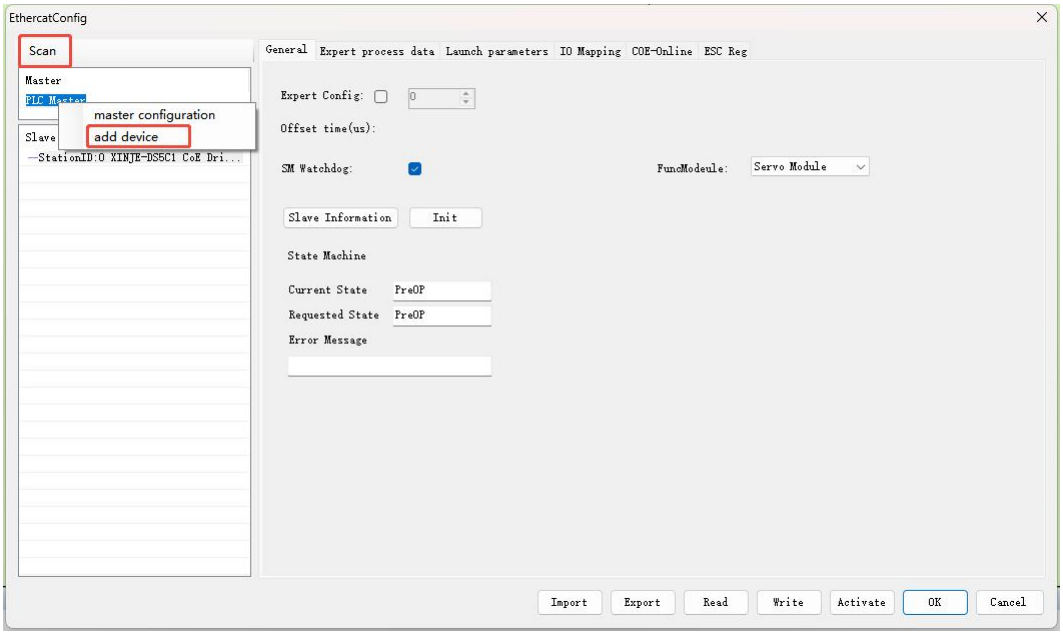
register	explain	unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is tq (Profile Torque Control Mode). Set its value to 4.	-
RXPDO[0x6071]	target torque given	0.1%
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x6080]	maximum motor speed	r/min
RXPDO[0x6087]	Set torque slope	0.1%/S
RXPDO[0x6088]	Set the torque Profile type to be used	-

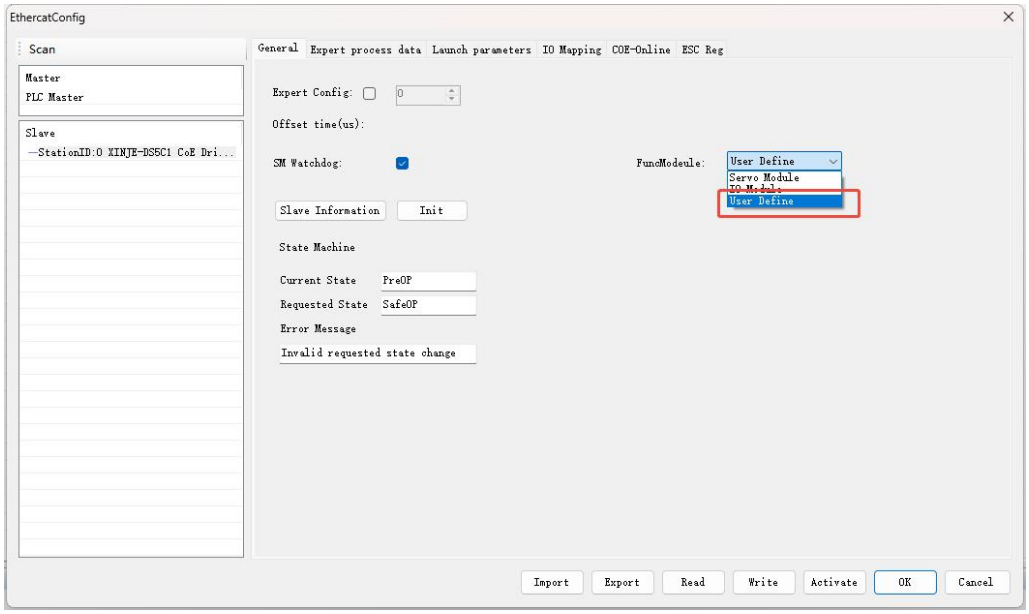
tq control mode associated objects (command,monitoring type)

register	explain	unit
TXPDO[0x6041]	status word	-
TXPDO[0x6064]	Position feedback (actual motor position)	instruction unit
TXPDO[0x606C]	rate feedback	Command unit/s

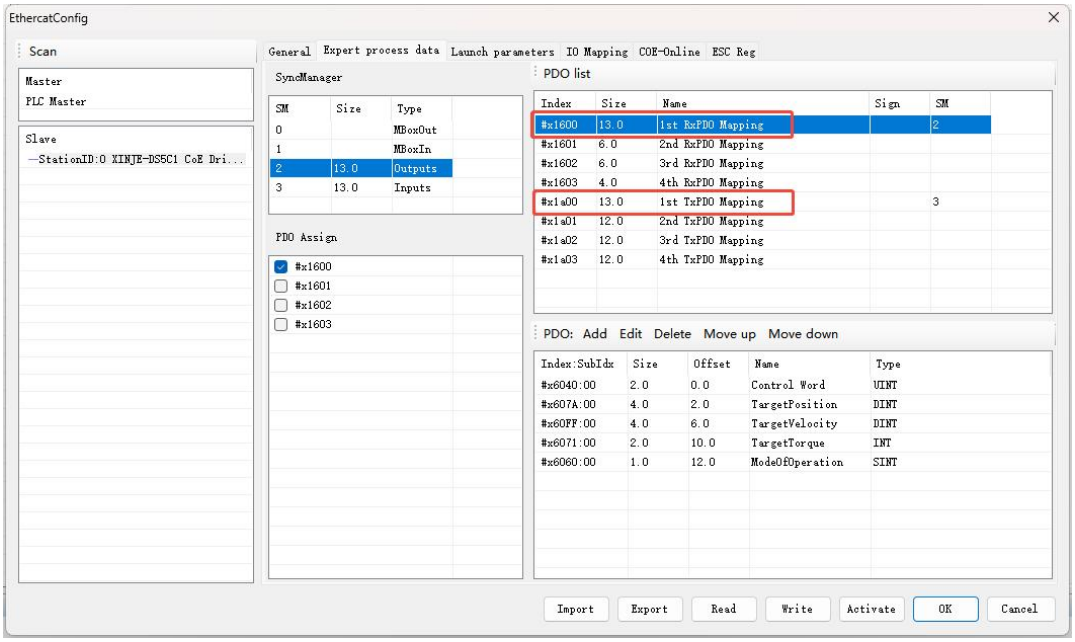
TXPDO[0x6077]	actual torque	0.1%

① On the EtherCAT interface, select the slave device from the [Scan] or [Add Device] menu, then choose User Defined as the function block in the [General] interface.

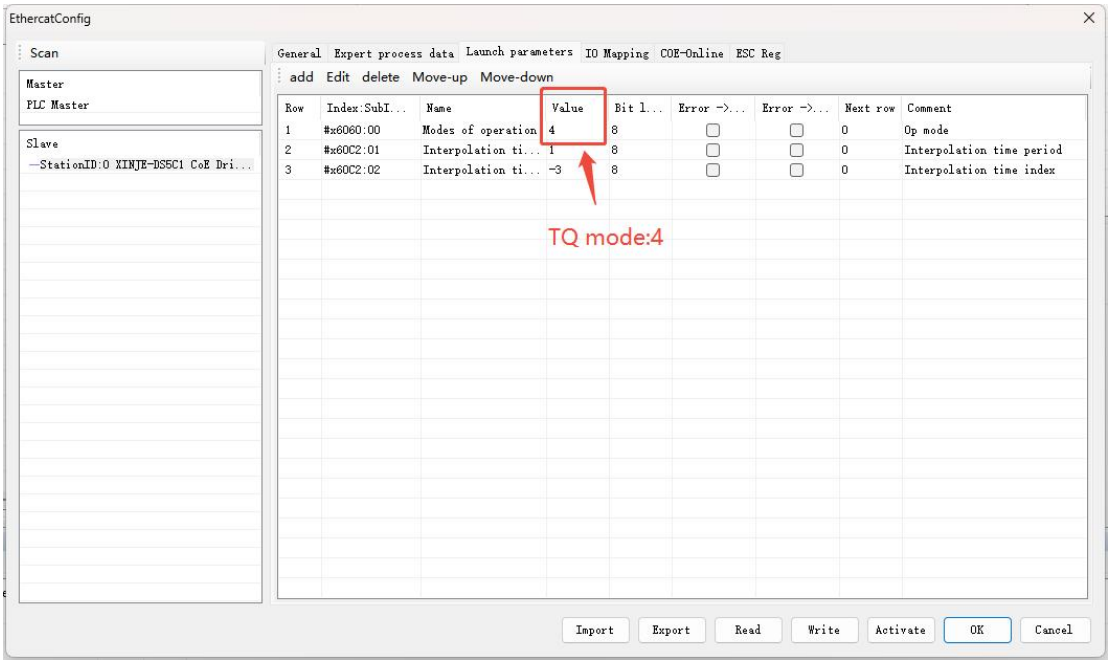




② In [Expert Process Data] → [PDO Allocation], check 1600 and 1A00 to add PDO parameters linked to the mode (each parameter cannot exceed 32 bytes).

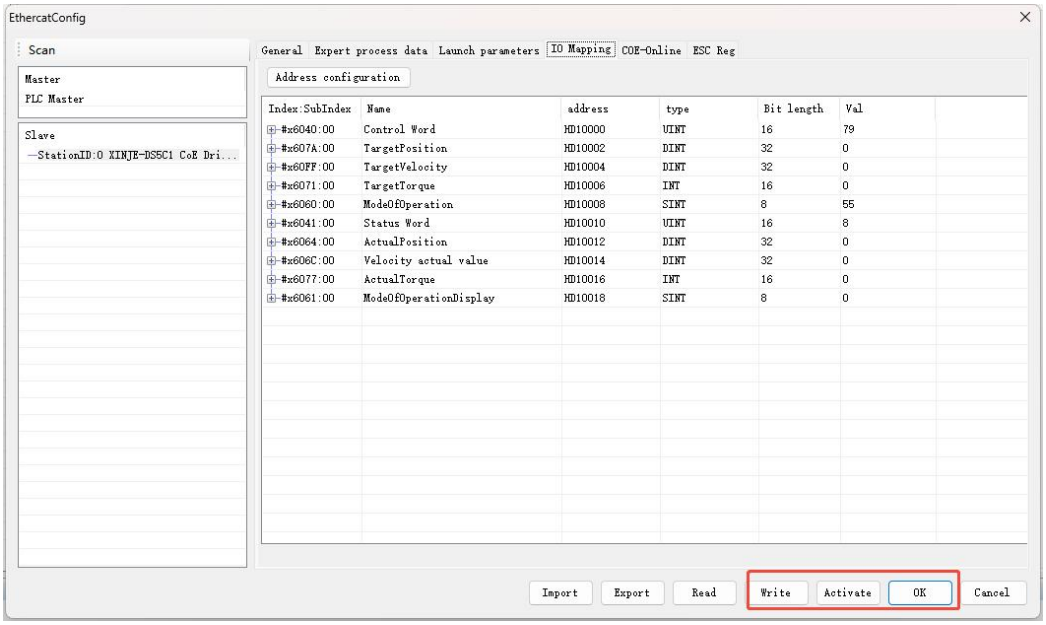


③ Verify that the 6060h value in [Start Parameters] is set to 4.



④[IO mapping]The starting address can be customized.

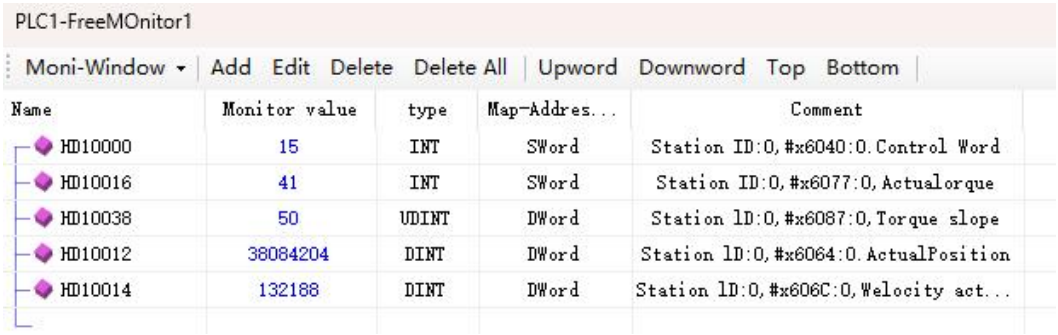
⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after activation and saving.



⑥ Upon activation, the station state machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ Modify control word 6040 (6→15) to enable the slave, and set parameters like target torque and torque slope to control the motor.

⑧ In tq mode, I/O mapping addresses can be configured and monitored. For example, the control word of Axis 1 can be modified via HD10000 (mapping to 6040h) to enable or disable the motor, the actual torque of Axis 1 can be monitored through HD10016 (mapping to 6077h), and the torque slope of Axis 1 can be set via HD10038 (mapping to 6087h).



8) Probe function demonstration (using the Xinjie DS5C1-20P4-PTA servo as an example; the DM6C operation method is identical to the DS5C1)

Probe function associated object

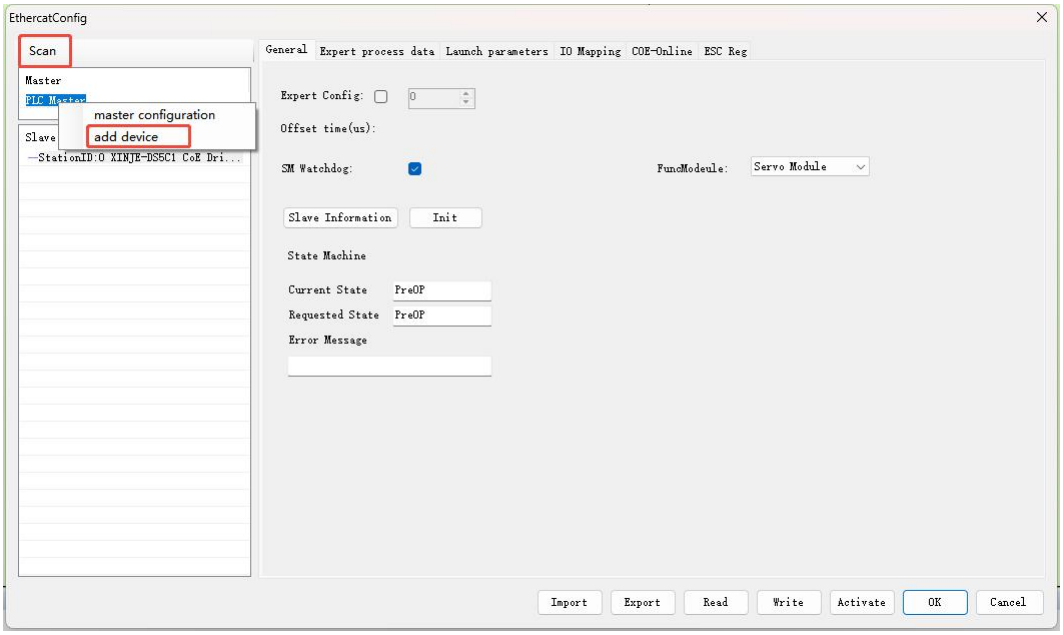
index of matrix	subindex	name	unit
60B8h	00h	Probe function settings	-
60B9h	00h	Indicates the status of the Touch probe function	-
60BAh	00h	Indicates the rising edge clamping position of Touch probe1	instruction unit

60BBh	00h	Indicates the clamping position of the falling edge of Touch probe1	instruction unit
60BCh	00h	Indicates the rising edge clamping position of Touch probe2	instruction unit
60BDh	00h	Indicates the falling edge clamping position of Touch probe2	instruction unit

① External wiring and probe terminal allocation: P5-62 and P5-63 are designated for probe functions.

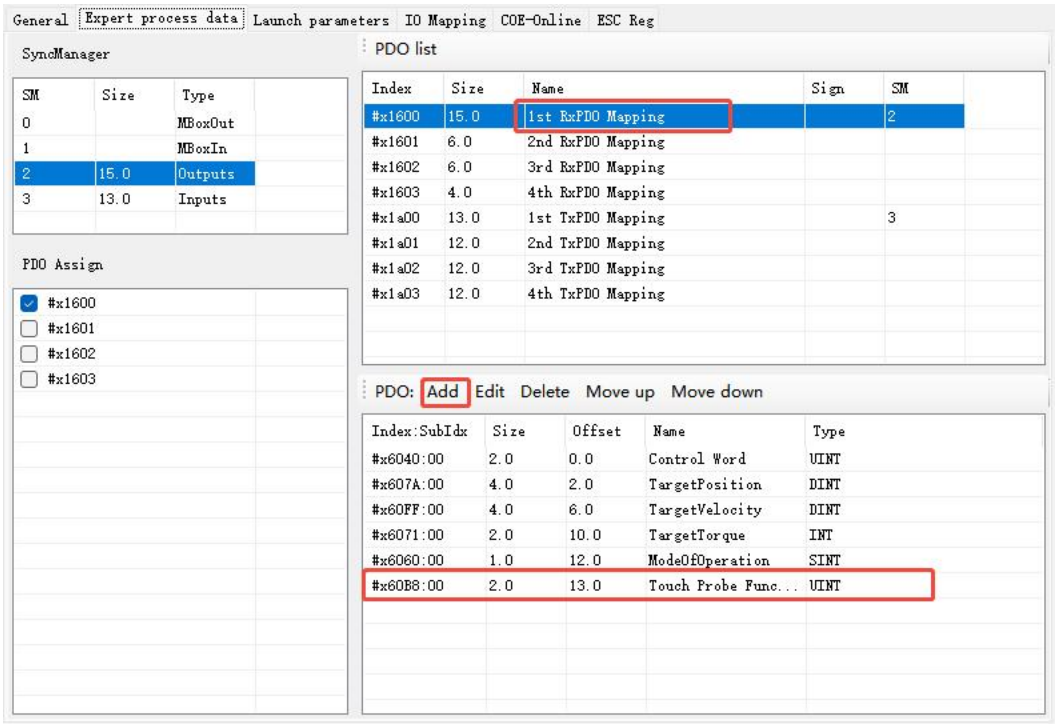
Probe 1 is exclusively assigned to SI1, while Probe 2 is exclusively assigned to SI2. When SI1 is allocated, P5-62 is programmed with 1; when SI2 is allocated, P5-63 is programmed with 2.

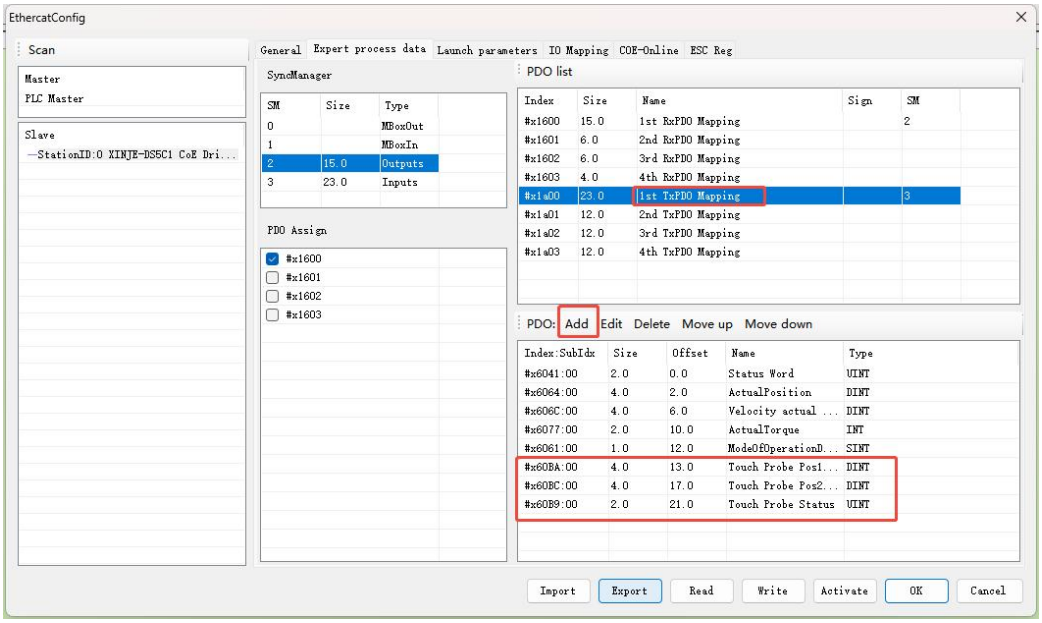
② On the Ethercat interface, select [Scan] or [Add Device] for slave devices, and use the default configuration on the [General] interface.



③ When a level signal on driver SI1 or SI2 undergoes a transition, the probe function is activated, and the probe value is locked in the corresponding COE object address 0X60BA~0X60BD. To retrieve the probe value, the corresponding probe value object (0X60BA-0X60BD) must be added to TxPDO for data acquisition.

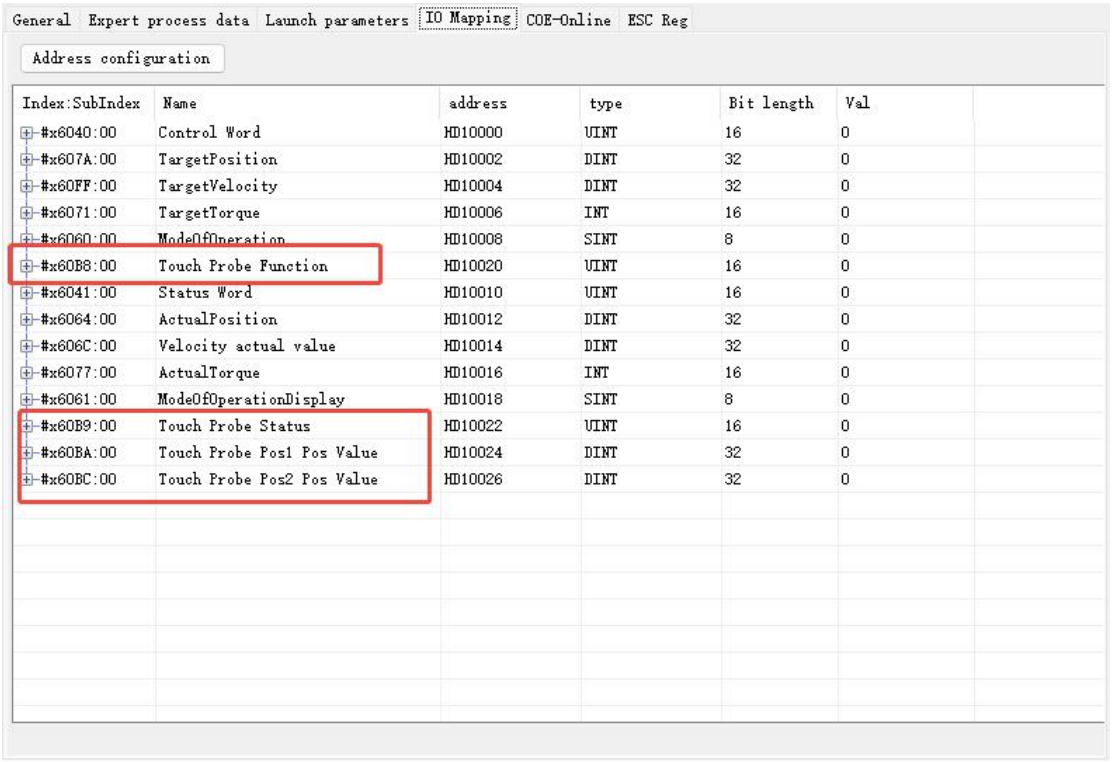
In the [Expert Process Data] → [PDO Allocation] section, select 1600 and 1A00. For 1600, add 60B8h; for 1A00, add 60BAh and 60BCh (this example uses the rising edges of two probes. For falling edges, add 60BBh and 60BDh).





④[IO Mapping]The default starting address is HD10000, which can be adjusted as needed.

⑤ After completing parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect after successful activation.

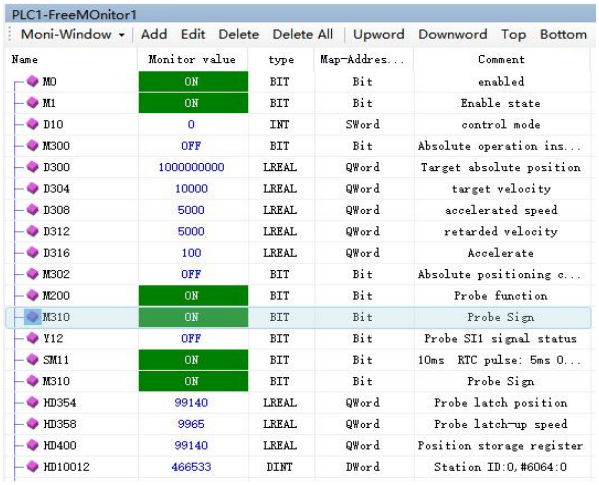


Index:SubIndex	Name	address	type	Bit length	Val
#x6040:00	Control Word	MD10000	UINT	16	0
#x607A:00	TargetPosition	MD10002	DINT	32	0
#x60FF:00	TargetVelocity	MD10004	DINT	32	0
#x6071:00	TargetTorque	MD10006	INT	16	0
#x6060:00	ModeOfOperation	MD10008	SINT	8	0
#x60B8:00	Touch Probe Function	MD10020	UINT	16	0
#x6041:00	Status Word	MD10010	UINT	16	0
#x6064:00	ActualPosition	MD10012	DINT	32	0
#x606C:00	Velocity actual value	MD10014	DINT	32	0
#x6077:00	ActualTorque	MD10016	INT	16	0
#x6061:00	ModeOfOperationDisplay	MD10018	SINT	8	0
#x60B9:00	Touch Probe Status	MD10022	UINT	16	0
#x60BA:00	Touch Probe Pos1 Pos Value	MD10024	DINT	32	0
#x60BC:00	Touch Probe Pos2 Pos Value	MD10026	DINT	32	0

⑥ Upon activation, the station state machine (SD8021) transitions from 1→2→4→8, where 8 indicates the OP state, enabling both SDO and PDO to transmit and receive signals.

⑦ After enabling the slave station, the probe function can be activated by modifying the HD10024 (mapping 60B8h).

⑧ After enabling the probe function, the following parameters can be monitored: the rising edge bit value of Probe 1 via HD10022 (60BAh mapping), the rising edge bit value of Probe 2 via HD10024 (60BCh mapping), the current probe status via HD10026 (60B9h mapping), the motor's actual position via HD10012 (6064h), and the actual speed via HD10014 (606Ch mapping).


PLC1-FreeMOnitor1

Moni-Window | Add | Edit | Delete | Delete All | Upword | Downword | Top | Bottom

Name	Monitor value	type	Map-Addres...	Comment
M0	ON	BIT	Bit	enabled
M1	ON	BIT	Bit	Enable state
D10	0	INT	SWord	control mode
M300	OFF	BIT	Bit	Absolute operation ins...
D300	1000000000	LREAL	QWord	Target absolute position
D304	10000	LREAL	QWord	target velocity
D308	5000	LREAL	QWord	accelerated speed
D312	5000	LREAL	QWord	retarded velocity
D316	100	LREAL	QWord	Accelerate
M302	OFF	BIT	Bit	Absolute positioning c...
M200	ON	BIT	Bit	Probe function
M310	ON	BIT	Bit	Probe Sign
Y12	OFF	BIT	Bit	Probe SI1 signal status
SM11	ON	BIT	Bit	10ms RTC pulse: 5ms O...
M310	ON	BIT	Bit	Probe Sign
HD354	99140	LREAL	QWord	Probe latch position
HD358	9965	LREAL	QWord	Probe latch-up speed
HD400	99140	LREAL	QWord	Position storage register
HD10012	466533	DINT	DWord	Station ID:0,#6064:0

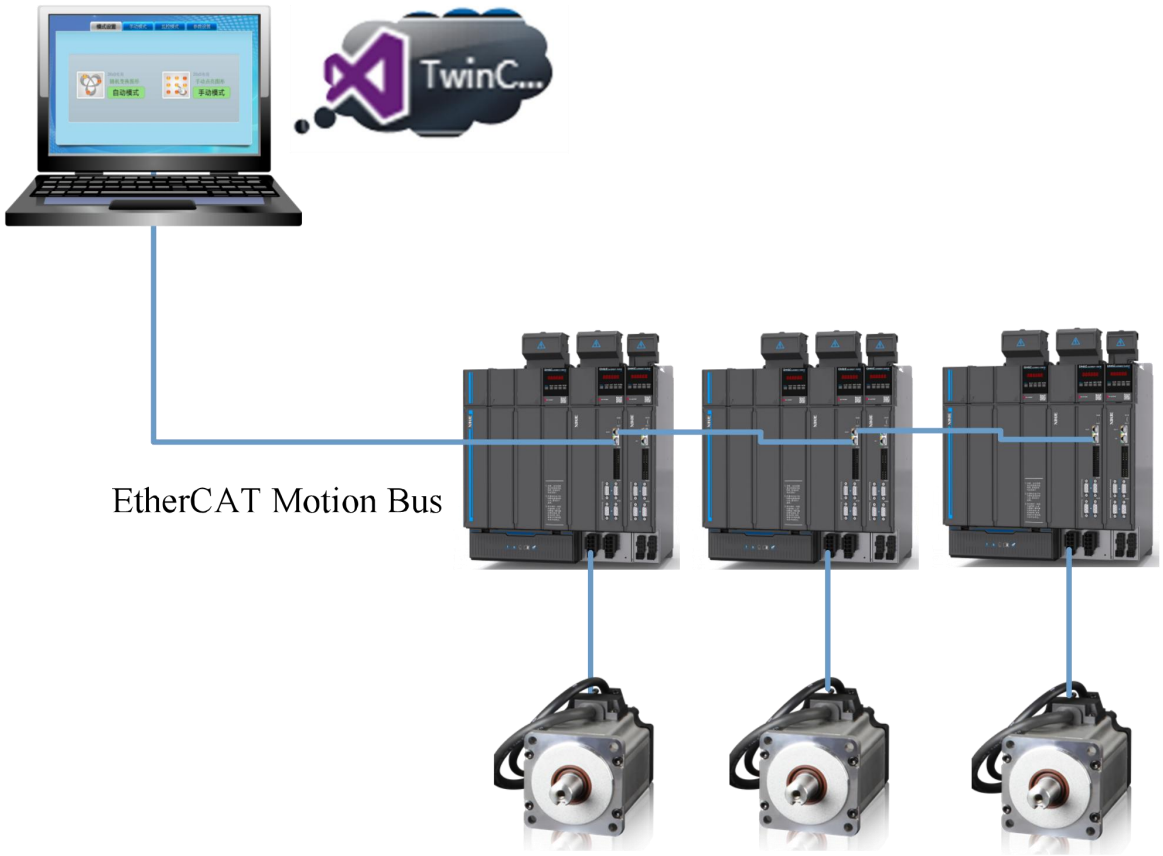
11.2 Communication between Beckhoff TWINCAT and XJINJI DM6C Servo EtherCAT

This example demonstrates how to implement EtherCAT motion control by using Beckhoff TWINCAT control software as the master station and XINJE servo as the slave station.

11.2.1 System Configuration

name	Model/Specification	quantity	remarks
motion control software	TWINCAT XAE（VS 2013）	1	The application version used in this example: TC31-FULL-Setup.3.14022.27
Servo of XJ	DM6C-45P5-R	1	
parvicostellae	JC-CA-3	a surname	Connects the computer to the servo

11.2.2 System Topology



The two communication ports of the DM6C series servo drive follow the principle of "bottom in, top out". That is, the master station must connect to the port below the CN1 port of the first servo, and then the port above the first servo connects to the port below the second servo, and so on.

11.2.3 Debugging Steps

Add XML file

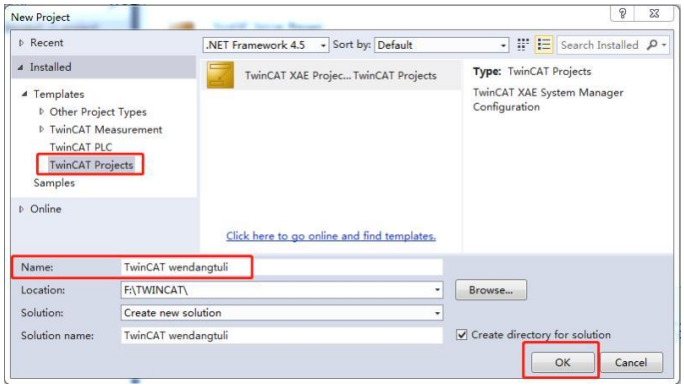
Before starting the software, copy the DM6C servo device description XML file to the Twincat installation directory, which is the default path C:\\TwinCAT\\3.1\\Config\\Io\\EtherCAT.

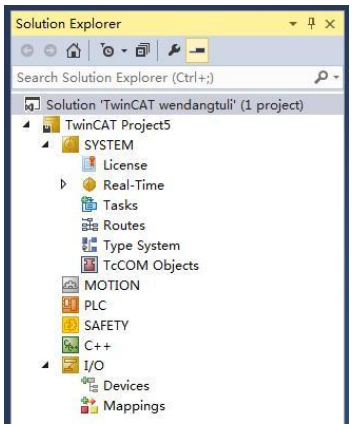
2) New project

Double-click to open TwinCAT XAE (VS 2013) and create a new project:

(1) Execute FILE—NEW—Project;

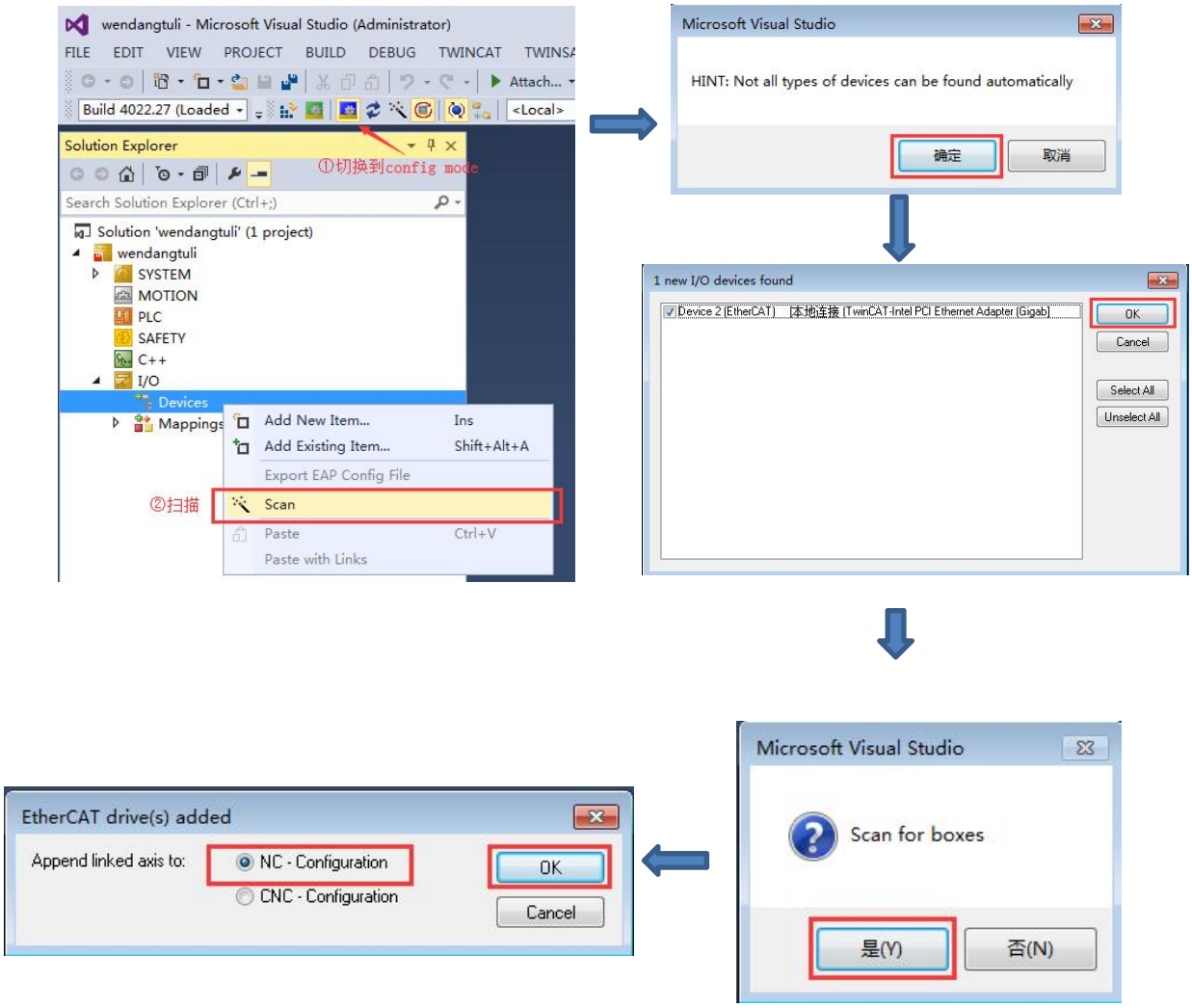
(2) Select the TwinCAT Project, enter the project name and save path, then click OK. The Property Explorer will appear in the Engineering panel.





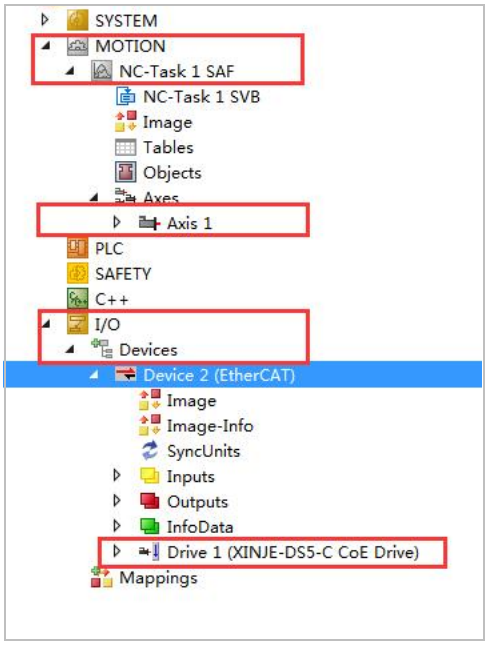
3) Hardware scan

If the controller isn't in config mode, click the icon to sv it to config mode, then right-click Device and select Scan to scan the Ethercat slave.



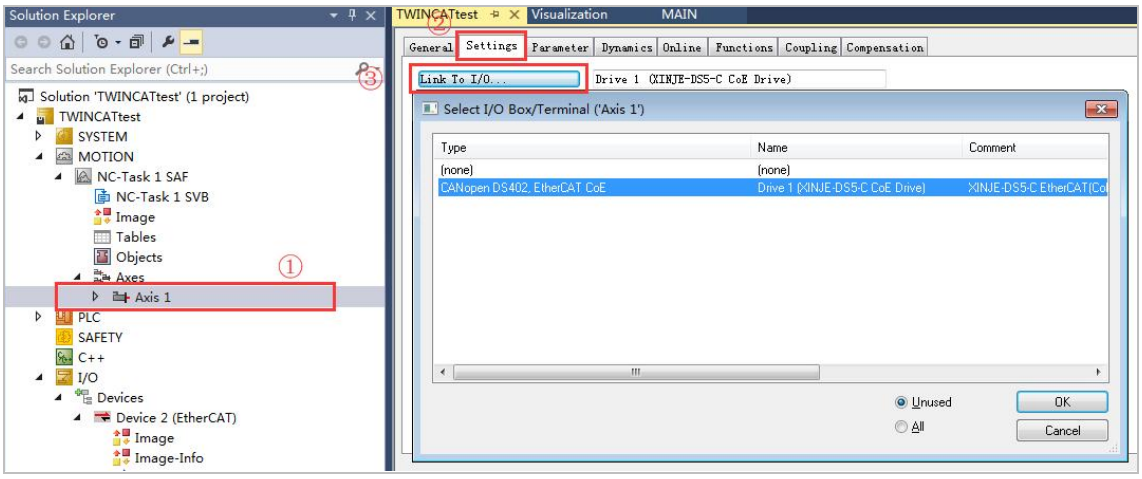
Scan to the end and automatically add to NC mode.

After the scan is complete, you can see an NC axis (Axis1) in Motion, corresponding to the motor connected to the servo, and the scanned driver DM6C in Device.



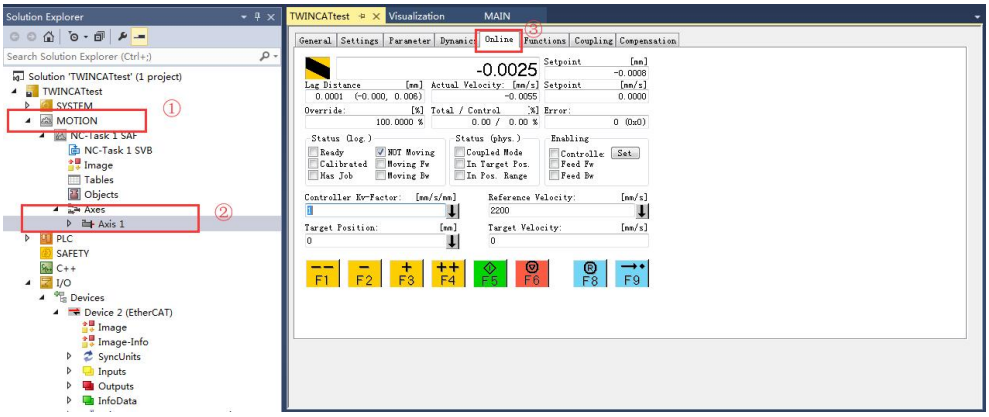
4) Link NC axis and physical axis

You can select the physical axis linked to the NC axis through Axis1-Settings-Link. This link is automatically added during hardware scanning, or you can manually add the axis by right-clicking the Axis and selecting Append axis to manually link the NC axis to the physical axis. The window displays the corresponding relationship between the NC axis and the physical axis.



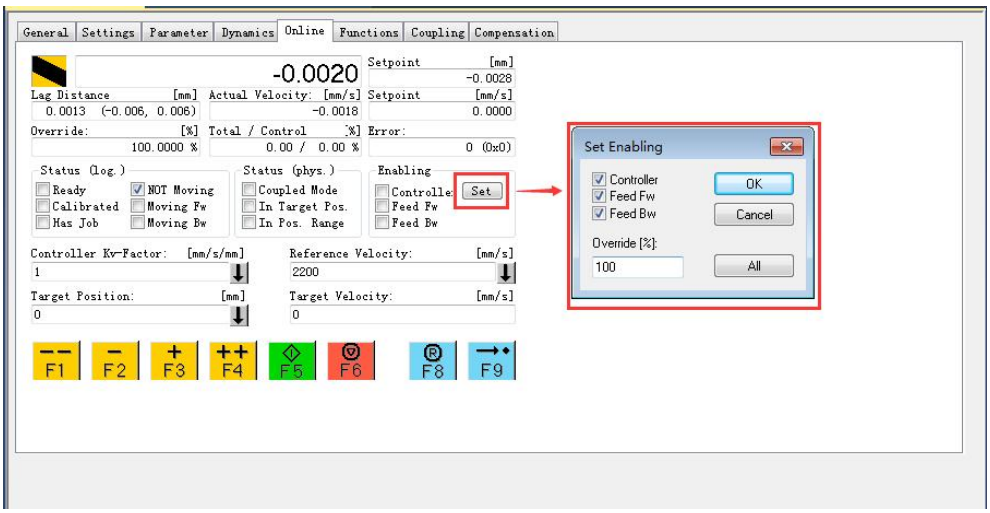
5) Debugging through the NC-Online interface

(1) Click the icon to activate configuration, switch TwinCAT to run mode, then sequentially select MOTION-Axis1-Online to debug the servo axis.

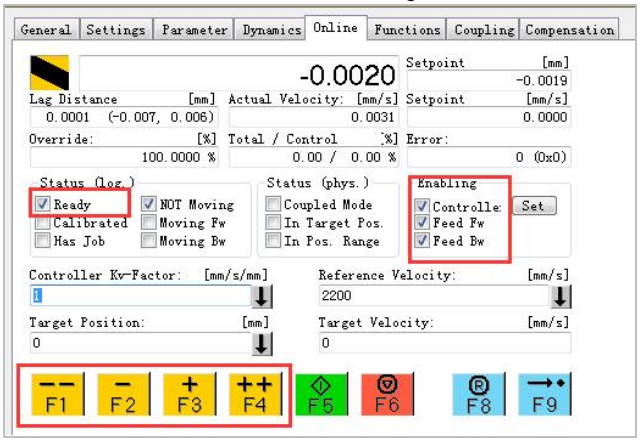


If the current position of the axis is not visible in the Online tab, verify that the motor model has been correctly added and the configuration activated.

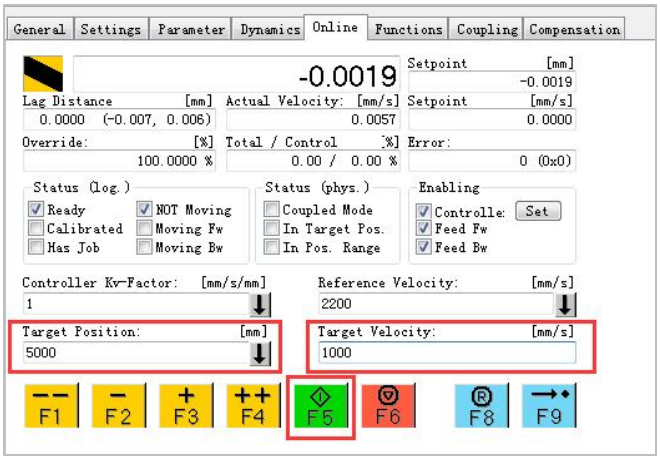
(2) Click Set, manually select Controller, Feed Fw, and Feed Bw, then configure the Override (speed ratio). After clicking OK, or simply select ALL to enable all axes, the system will automatically set the speed ratio to 100%.



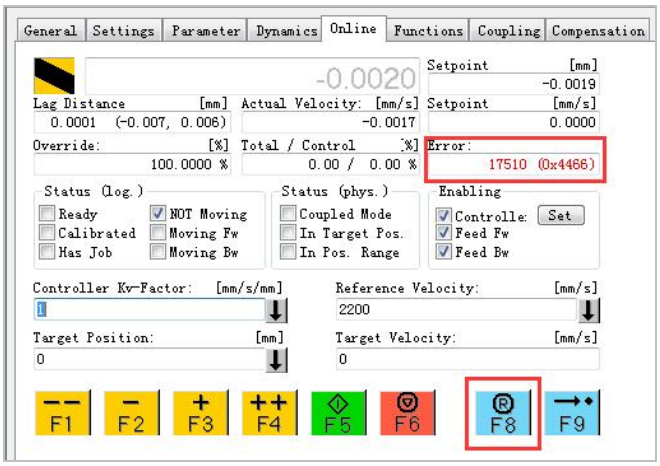
(3) If the Ready status is checked, the motor is enabled. You can then use F1 to F4 to perform point movements on the axis. The point speed is set in the Manual Velocity tab under Parameter, with default speeds of 100mm/s and 600mm/s for slow and fast point movements, respectively.



(4) After setting the Target Position and Target Velocity, press F5 to activate position control. The motor will move to the target position as programmed. This is an absolute position control system, and you can use F6 to pause during the process.



(5) When NC error occurs, the Error message displays error codes. To reset the error, press F8; otherwise, the axis will stop moving. F9 is the origin reset button. Pressing F9 resets the axis position to 99999... and moves slowly. However, the origin signal requires external hardware input, which cannot be captured in the Online window. Therefore, F9 is generally not used for origin reset; instead, it is implemented through programming in the program.

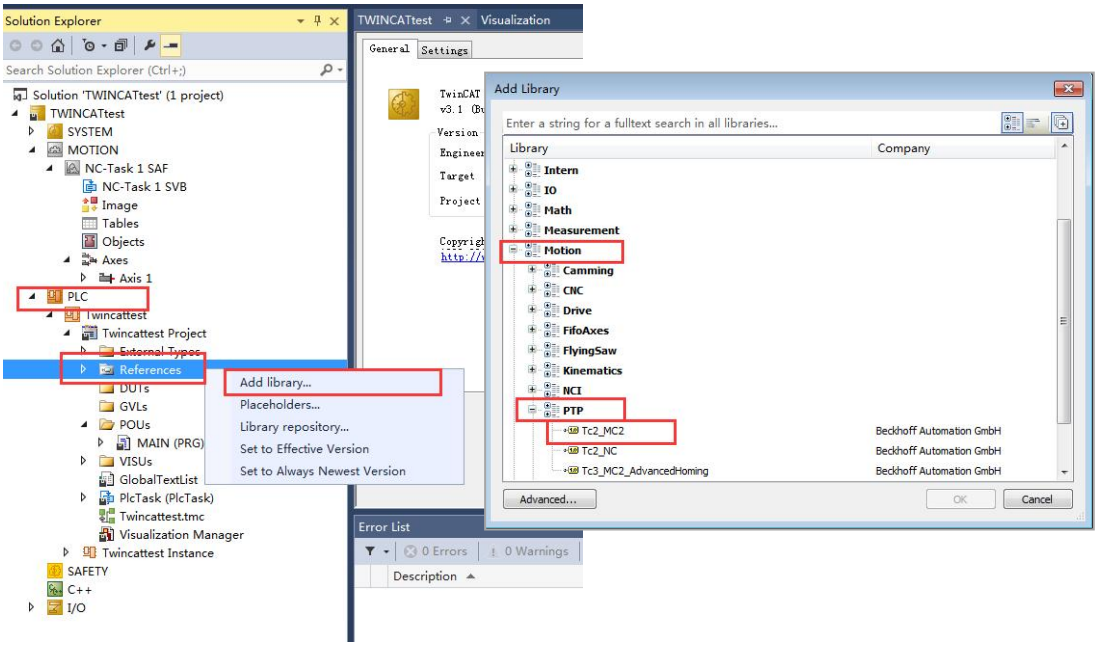


For more single-axis debugging features, refer to the TC3 Training Manual V1.1.0.

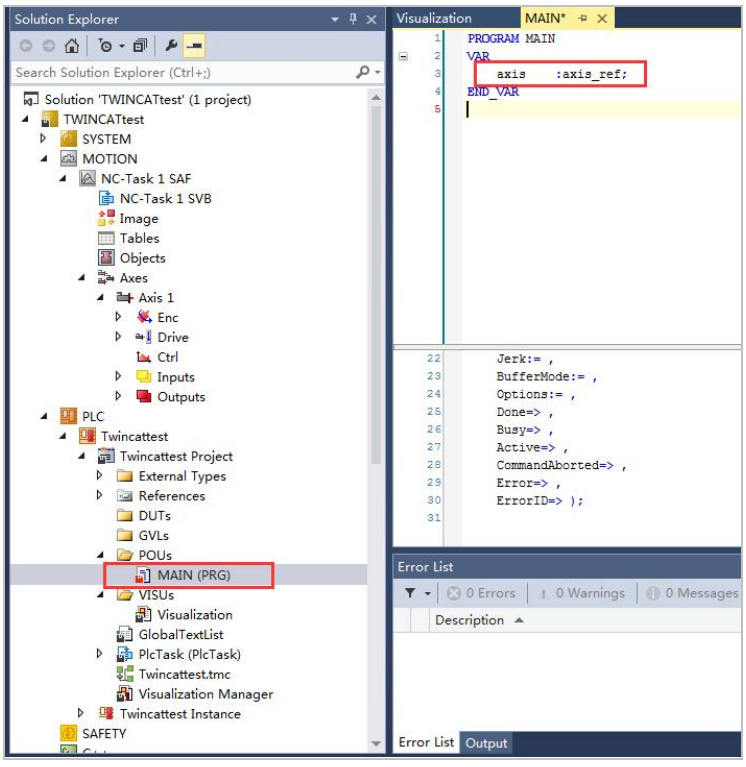
6) Control the DM6C servo motor via PLC Control programming

Add motion control library files and axis type variables

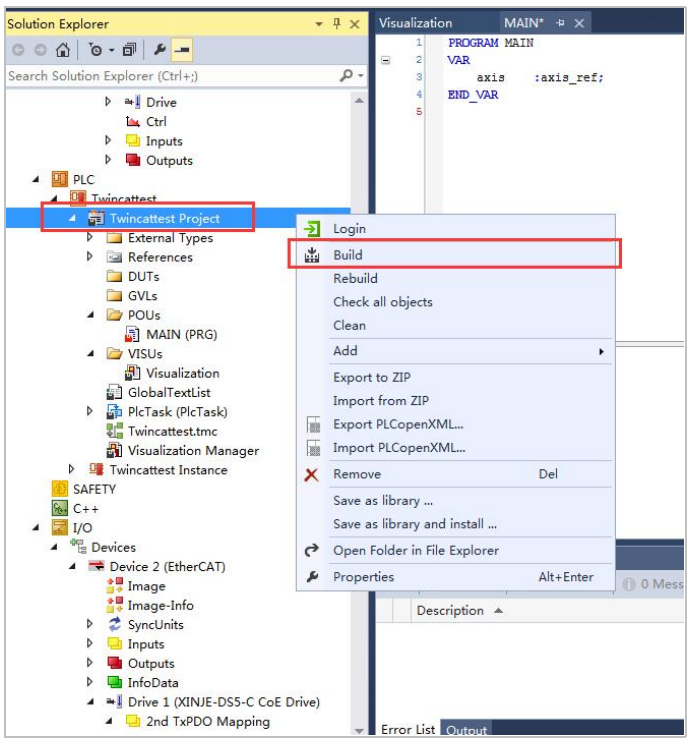
Create a new project in PLC, expand it, locate References at the bottom, right-click and select Add Library. In the dialog box that appears, locate Motion--PTP--TC2-MC2 and add it. This completes the library file addition for the PLC.



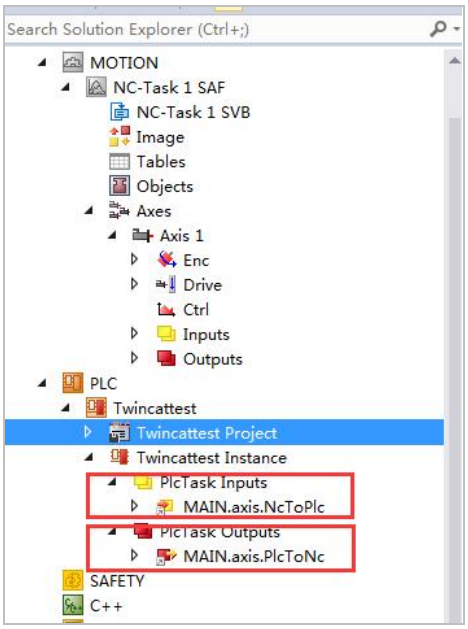
In the main program of POU, a variable of Axis_ref type is created. Axis_ref is a structure designed for data exchange between NC and PLC, and it contains other structures internally. This variable is referred to as the axis variable.



After writing the program, compile it to check for errors. In this example, the project is named Twincattest. Find the Twincattest Project, right-click it, select Build, and click.

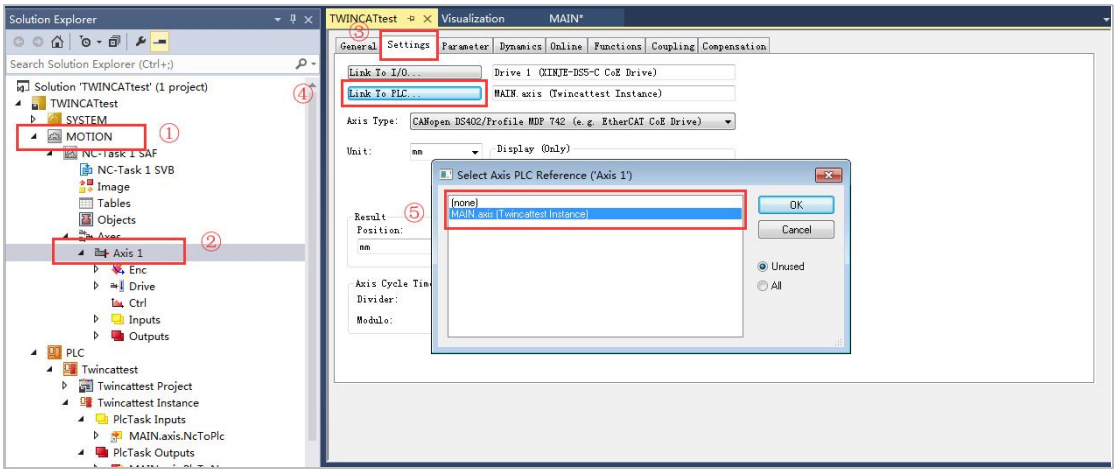


After successful compilation, the corresponding variables will appear in the Instanc directory of the project. Once Build completes, you can bind two variables under PlcTask Inputs and PlcTask Outputs in the Twincattest instance.



(2) Variable Linking between NC and PLC

In Motion, expand the Axes menu, locate the newly created NC axis Axis1, and double-click it. In the right-side interface, navigate to the Settings tab and select 'Link to PLC' to connect Axis1 to the corresponding PLC. This connection enables data exchange between the NC and PLC.

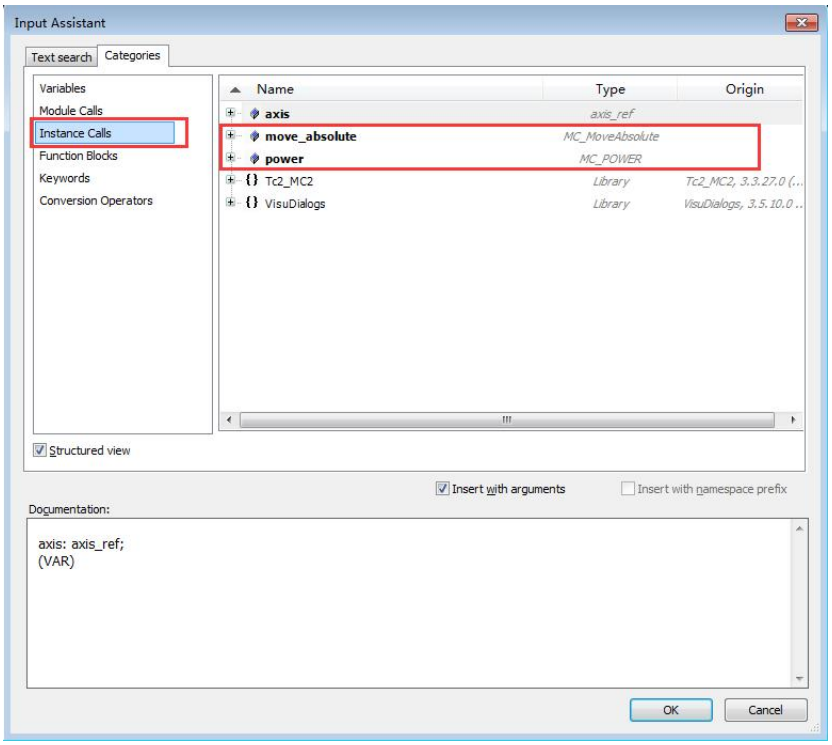


(3) Call the function block to control the axis movement

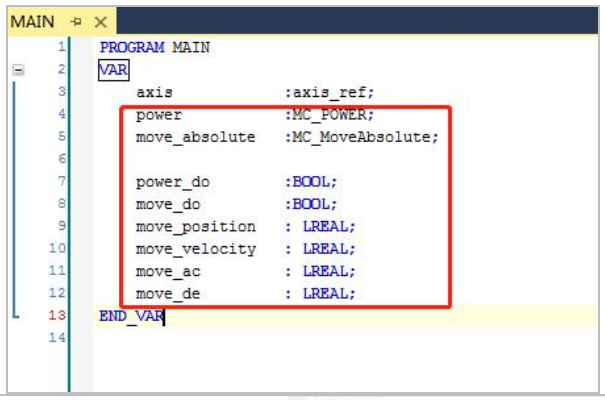
In the POU-MAIN (PRG) interface, declare two function blocks: MC_POWER and MC_MoveAbsolute. MC_POWER controls axis enablement, while MC_MoveAbsolute manages absolute position movement.

```
PROGRAM MAIN
VAR
    axis            :axis_ref;
    power           :MC_POWER;
    move_absolute   :MC_MoveAbsolute;
```

Press F2 in the program editor window, then select power and move_absolute from the Categories—Instance Calls section to invoke the defined function blocks in the program.



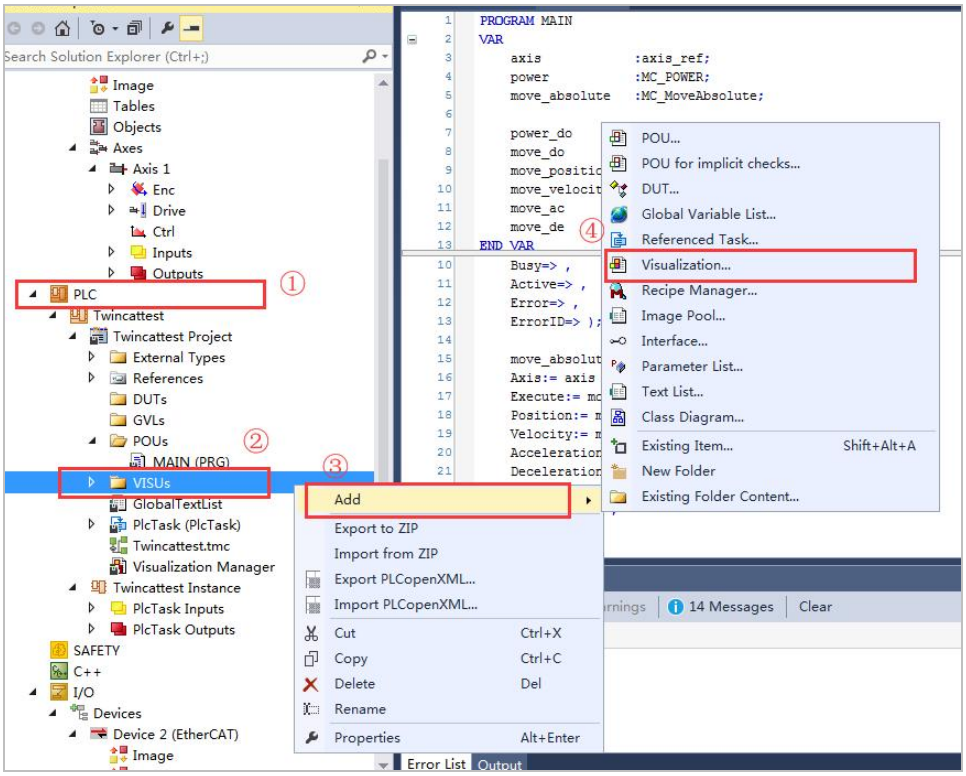
Complete the parameter settings in the function block: Enable indicates the enable bit, with Enable_Positive permitting forward rotation and Enable_Negative allowing reverse rotation. The variables include: Overide (speed ratio), Axis (corresponding axis), Position (target location), Velocity (positioning speed), Acceleration (acceleration), and Deceleration (deceleration). Two boolean variables, power_do and move_do, are declared as trigger bits for the enable and absolute position motion functions. A Lreal-type variable is defined to store absolute position data, velocity, and acceleration/deceleration values.



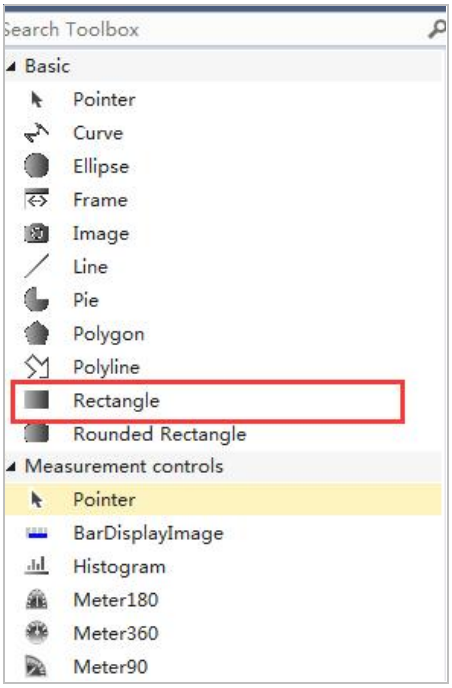

```
move_absolute(
Axis:= axis ,
Execute:= move_do ,
Position:= move_position,
Velocity:= move_velocity,
Acceleration:= move_ac,
Deceleration:= move_de,
Jerk:= ,
BufferMode:= ,
Options:= ,
Done=> ,
Busy=> ,
Active=> ,
```

```
power(
  Axis:= axis,
  Enable:= power_do,
  Enable_Positive:=TRUE ,
  Enable_Negative:=TRUE ,
  Override:= ,
  BufferMode:= ,
  Options:= ,
  Status=> ,
  Busy=> ,
  Active=> ,
  Error=> ,
  ErrorID=> );
```

Locate the VISU component beneath the PLC, right-click it, select Add from the context menu, then choose Add Visualization from the new menu to create a visualization interface.

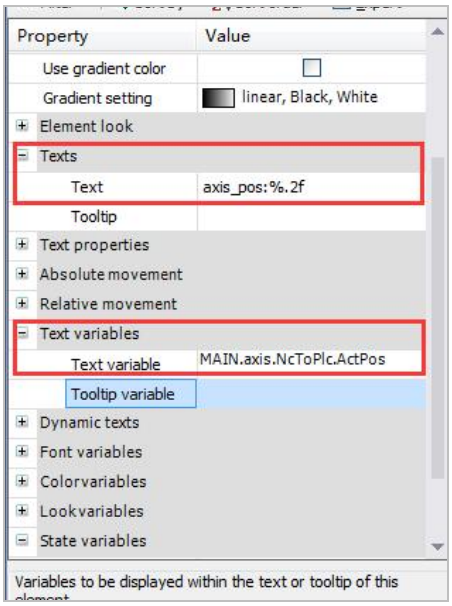


In the toolbar of the Visu interface, select the rectangle box and drag out a control. Double-click the rectangle box control to set it.

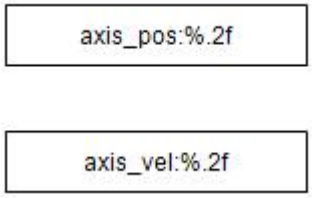


Double-click the control, and under the Properties tab on the right, make the following settings: Texts — Text input axis_pos:%2f,%2f represents the floating-point data type to display the values of associated variables (i.e., the variables pointed to by Text variables — Text variable) with only two

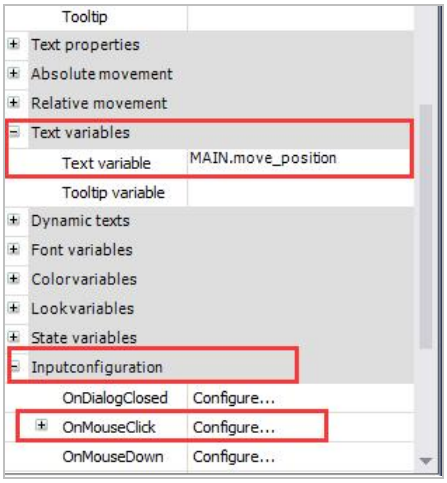
decimal places retained. Text variables — Text variable to input MAIN.axis.NcToPlc. ActPos, indicating the actual position of the control on the axis variable.

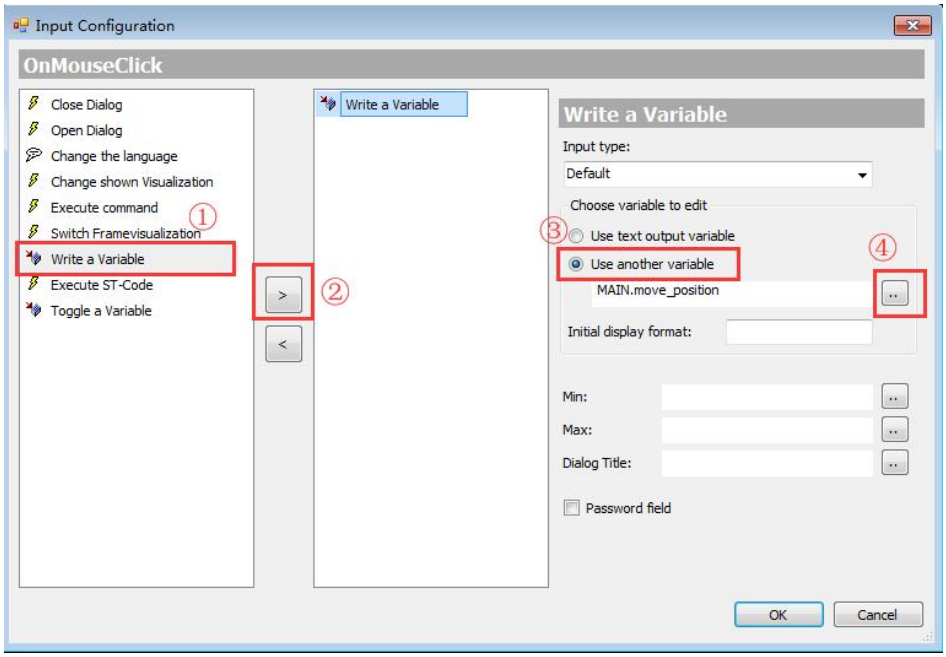


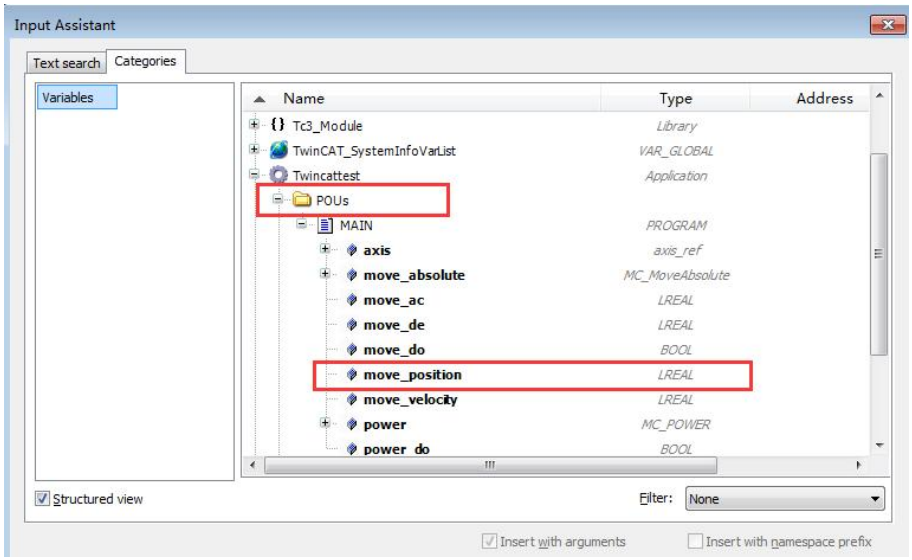
Create another control to indicate the current speed of the shaft, Text variable input MAIN.axis.NcToPlc. ActVelo.



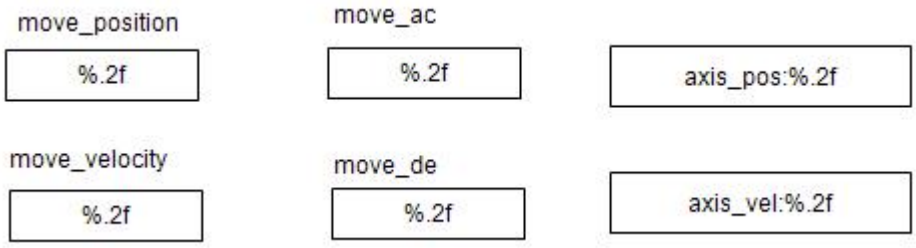
Add a rectangle control to input the target position value of absolute position movement. The specific operation is as follows: Create a rectangle control, input the MAIN.move_position (a real type variable added in the program) into the Text variable, click Inputconfiguration — OnMouseClick, select Write a Variable in the pop-up interface, click> to add the function, and choose Use another variable to point to the variable MAIN.move_position on the right.



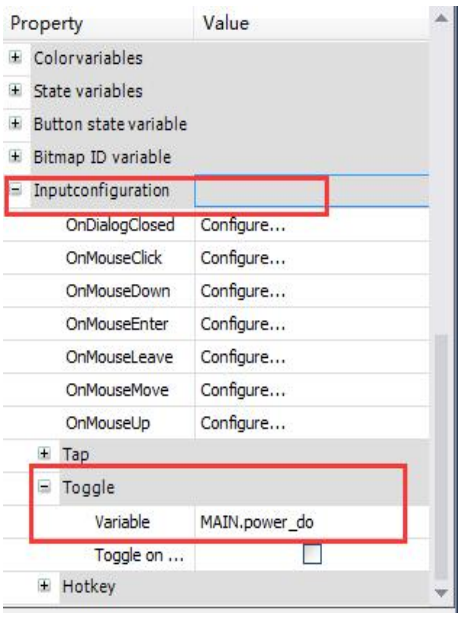


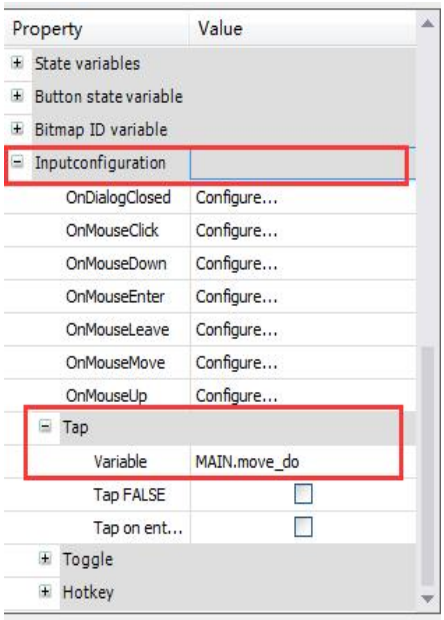


The same method is used to create the control of velocity, acceleration and deceleration of absolute position motion.

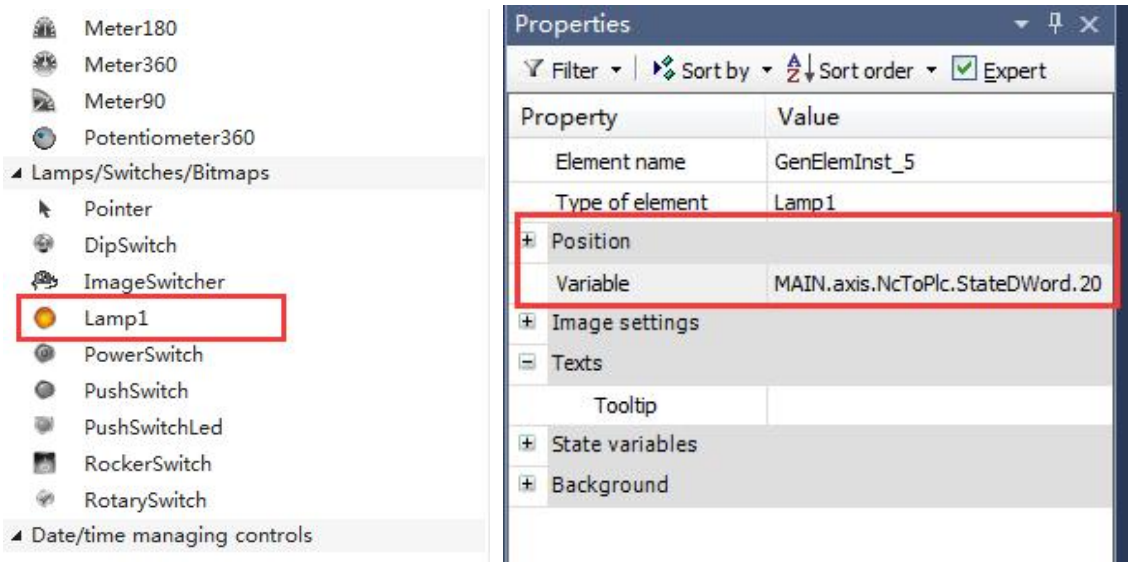


Create two button controls to manage enabling and axis movement. For the enabling control, input MAIN.power_do in the Inputconfiguration — Toggle (toggle button) — Variable section. One click sets it to 1, another click sets it to 0. For the axis movement trigger control, input MAIN.move_do in the Inputconfiguration — Tap (instant button) — Variable section. It sets to 1 only when clicked and to 0 when released.

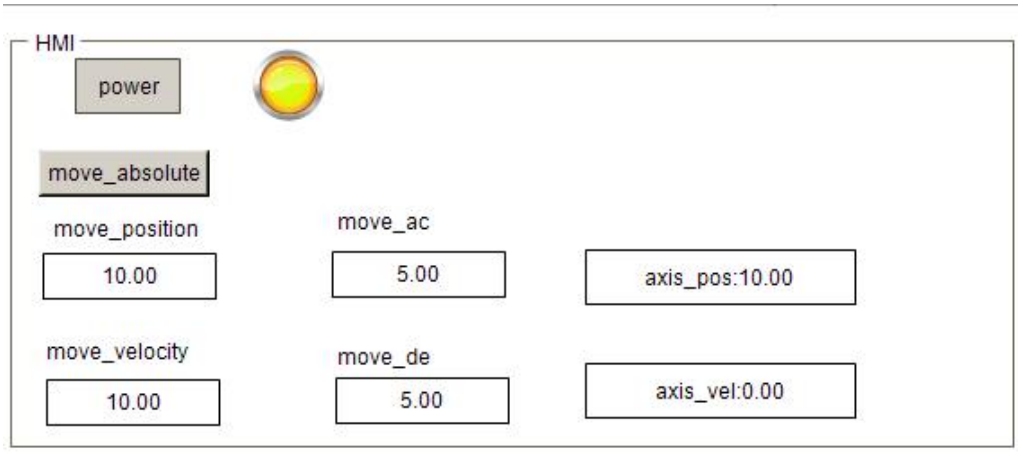




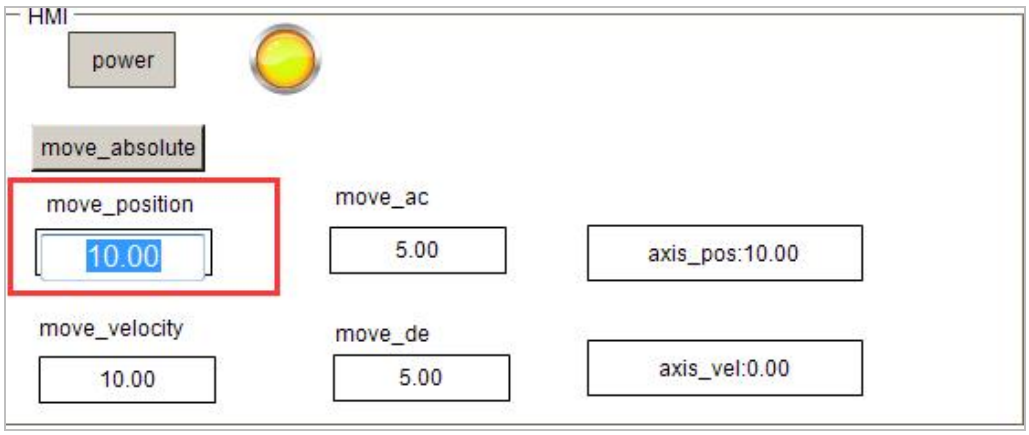
Create an indicator light control to show whether the Power function block is enabled successfully. First, drag an LED icon from the Toolbox on the right, and then bind Position--Variable to MAIN.axis.NcToPlc.StateDWord.20 variable, where StateDWord.20 indicates the enable status of the axis variable.



After writing the program, activate it by clicking Login to run. Then, click the Run button to view the values of specified variables in the visual interface.



Click input controls like move_position to modify variable values in real time.



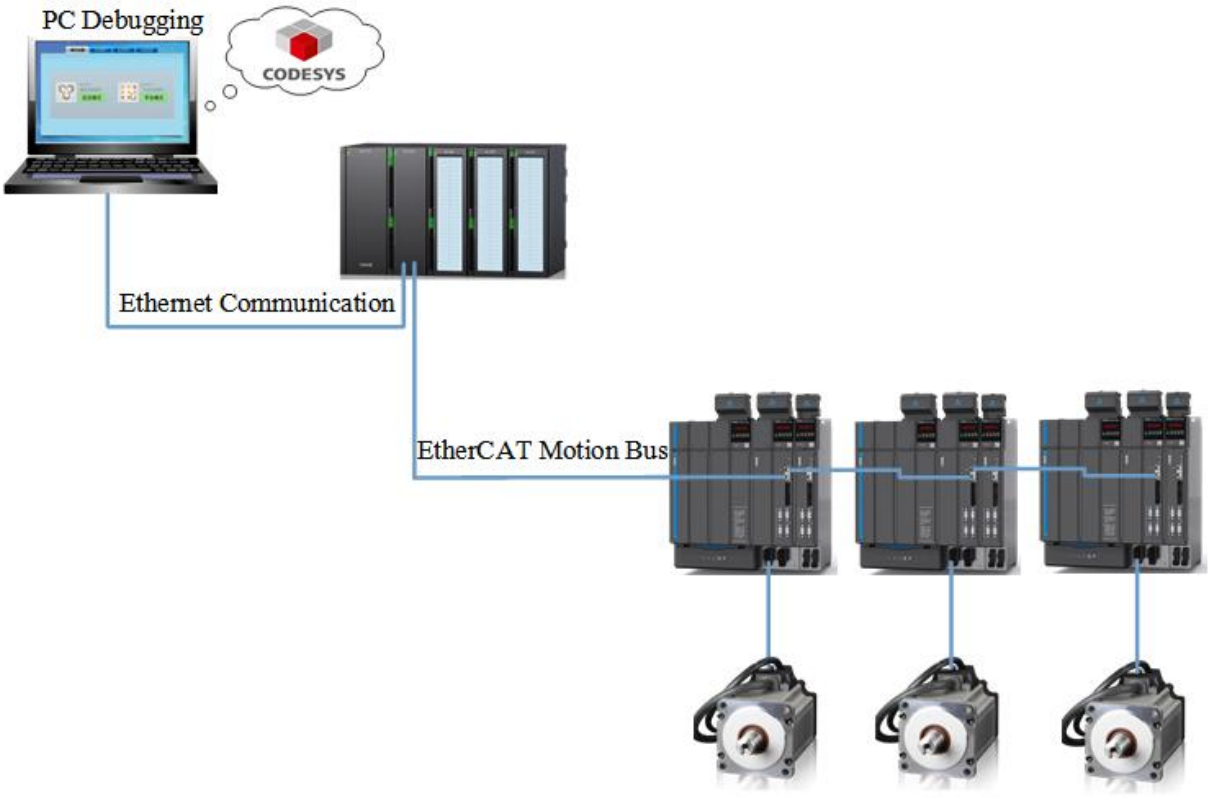
11.3 CODESYS and Xinjie DM6C Servo EtherCAT Communication Example

This case demonstrates how EtherCAT motion control is implemented using CODESYS motion control software as the master station (with the XG3 series PLC serving as a hardware platform) and the DM6C series servo as the slave station.

11.3.1 System Configuration

name	Model/Specification	quantity	remarks
motion control software	CODESYS	1	Software version: V3.5 SP13 Patch 1
hardware control platform	XS3 series PLC	1	
Servo of XJ	DM6C-45P5-R	3	
parvicostellae	JC-CA-3	a surname	Connects the computer to the servo

11.3.2 System Topology



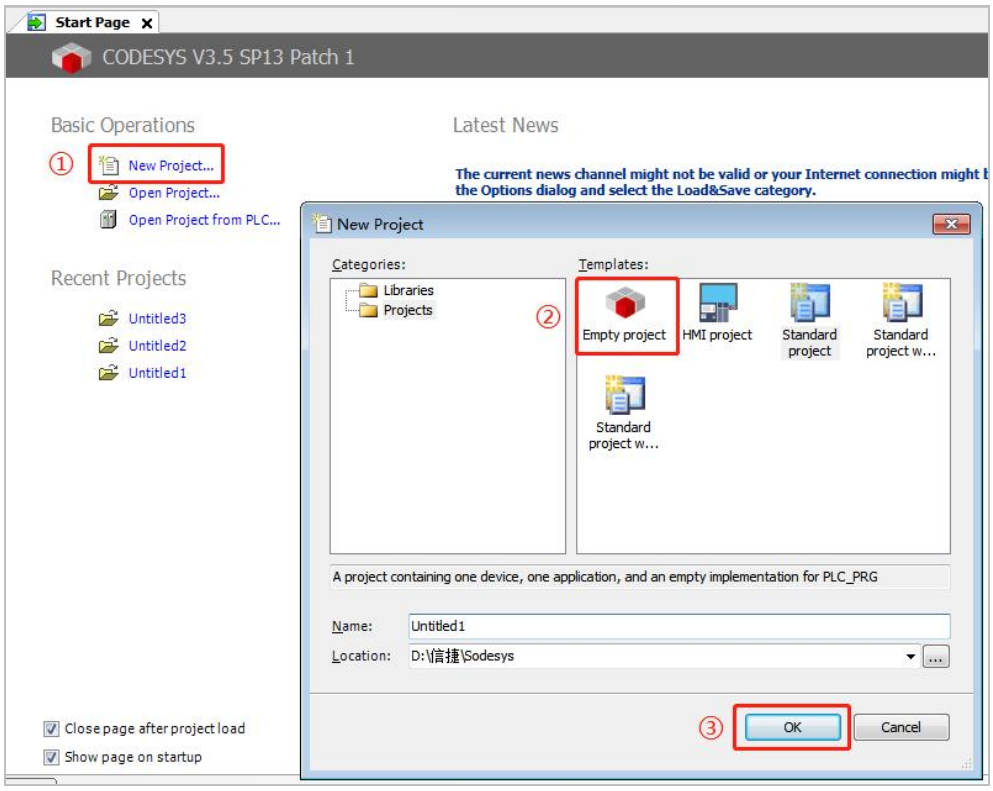
This is a control system developed by CODESYS based on traditional hard PLC. In this solution, the PLC development system typically runs on a standard PC, while the traditional hard PLC serves merely as a hardware platform. The real-time kernel of the software PLC is installed within the hard PLC, and the system programs developed by the development system are downloaded into the hard PLC. The control system diagram is shown in the figure above.

The XS series PLC features dual network ports: the upper Ethernet/IP port connects to the CODESYS host computer, while the lower EtherCAT port interfaces with the XINJE DM6C series servo for EtherCAT communication. The DM6C series servo drives require the 'lower-in, upper-out' principle for their communication ports.

11.3.3 Debugging Steps

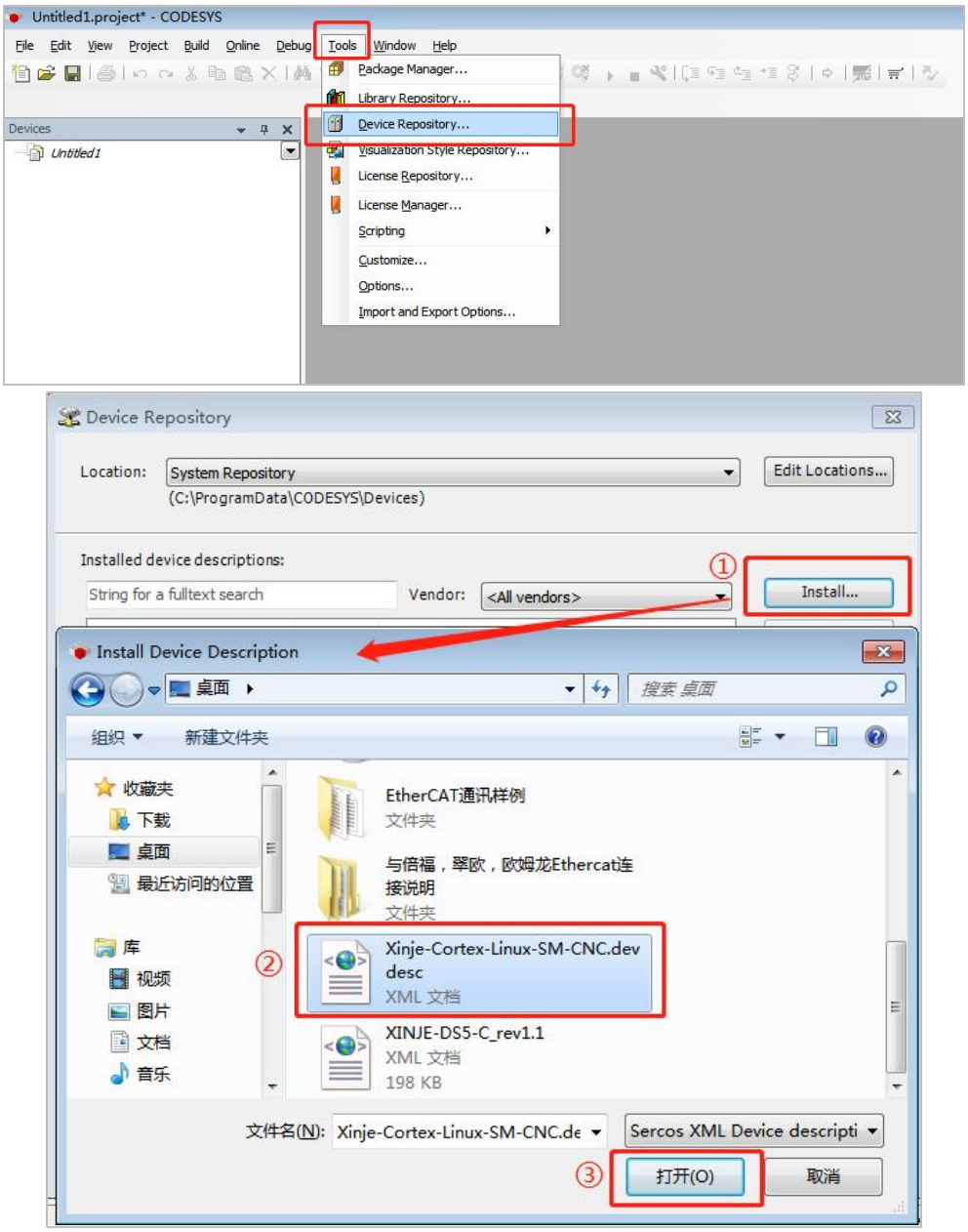
1) New construction projects

Double -click to launch Codesys. Select the New Project command to create a blank project. Enter the project name and save path, then click OK.

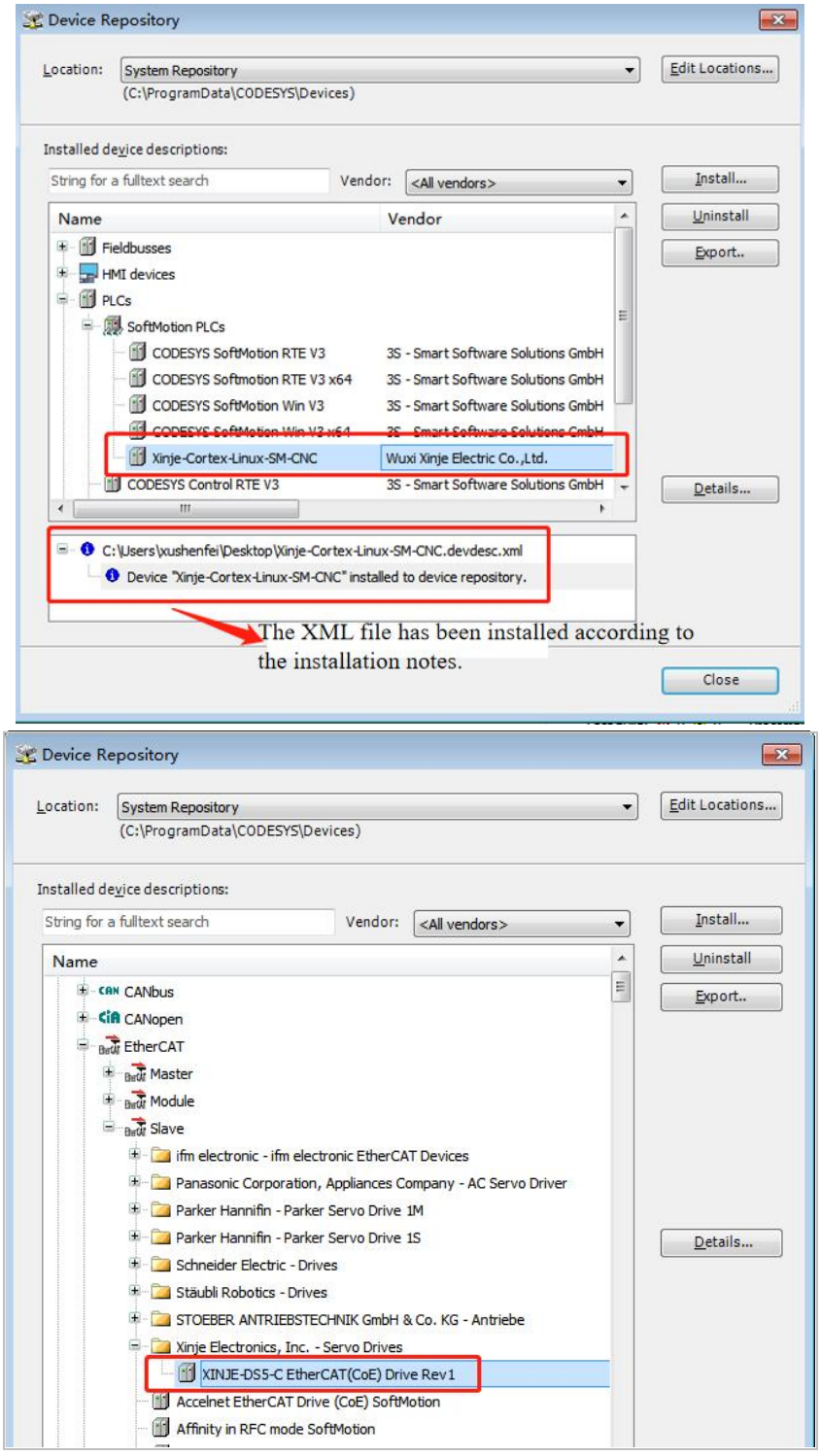


2) Add XML file

Open the Tools Device Repository and add the XML files for both the master and slave devices. First, add the master device's XML file. Click Tools--Device Repository, then click Install in the dialog box. Locate the XML file by selecting its path, and click Open after selection.

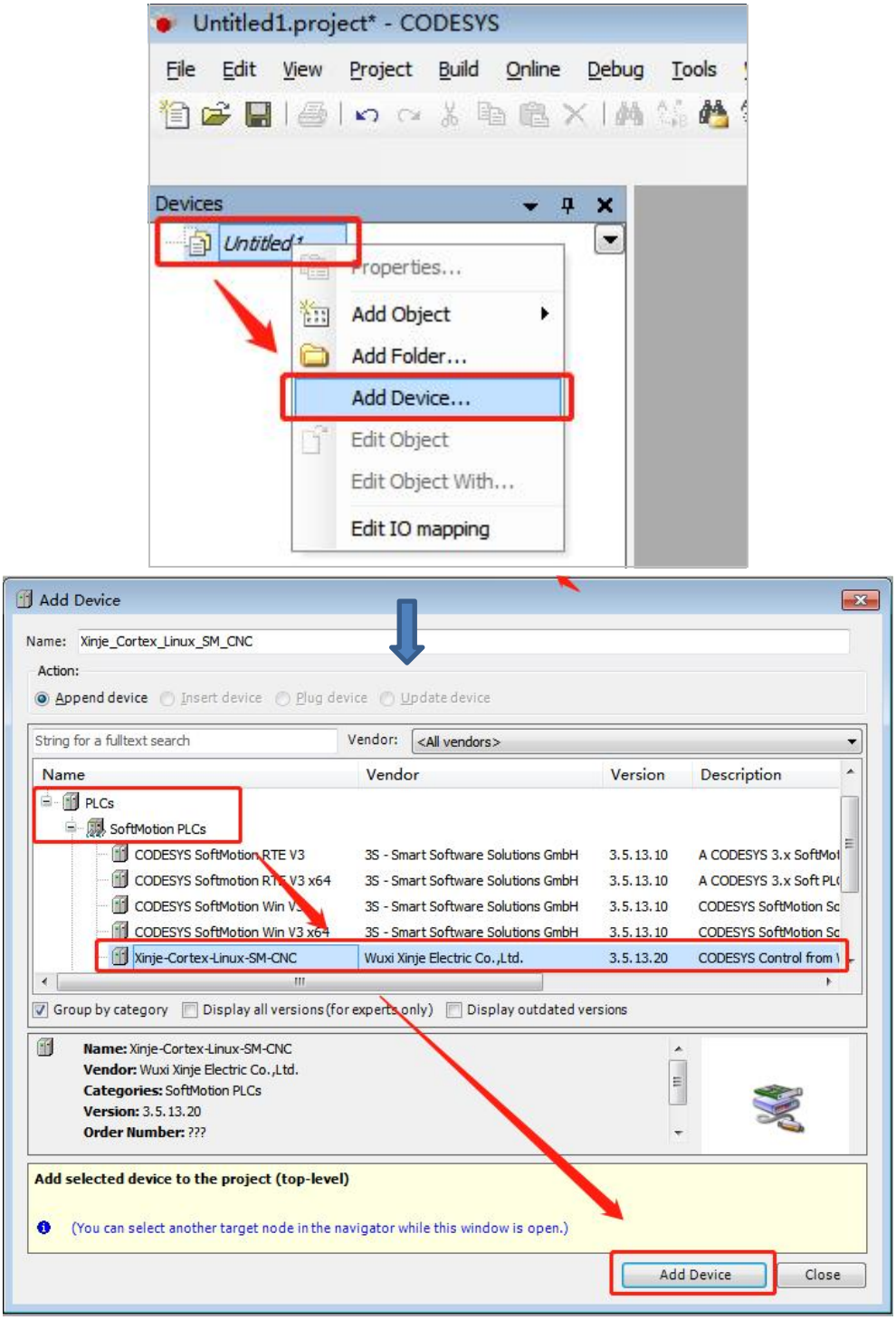


The installation is complete upon opening, as shown in the figure below. Similarly, install the slave XML file (XINJE-DS5-C_rev1.1) using the same method.

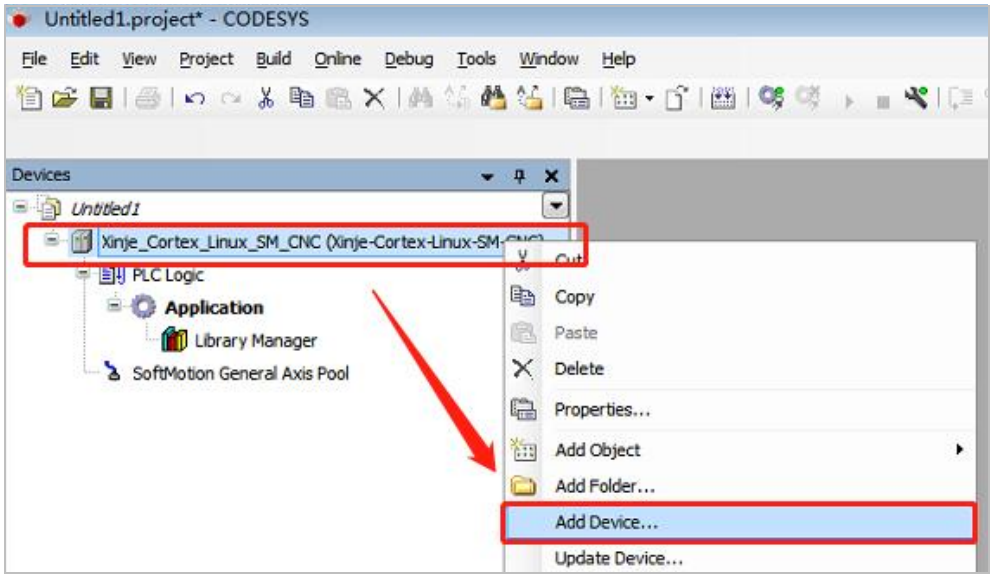


3) Add primary site equipment

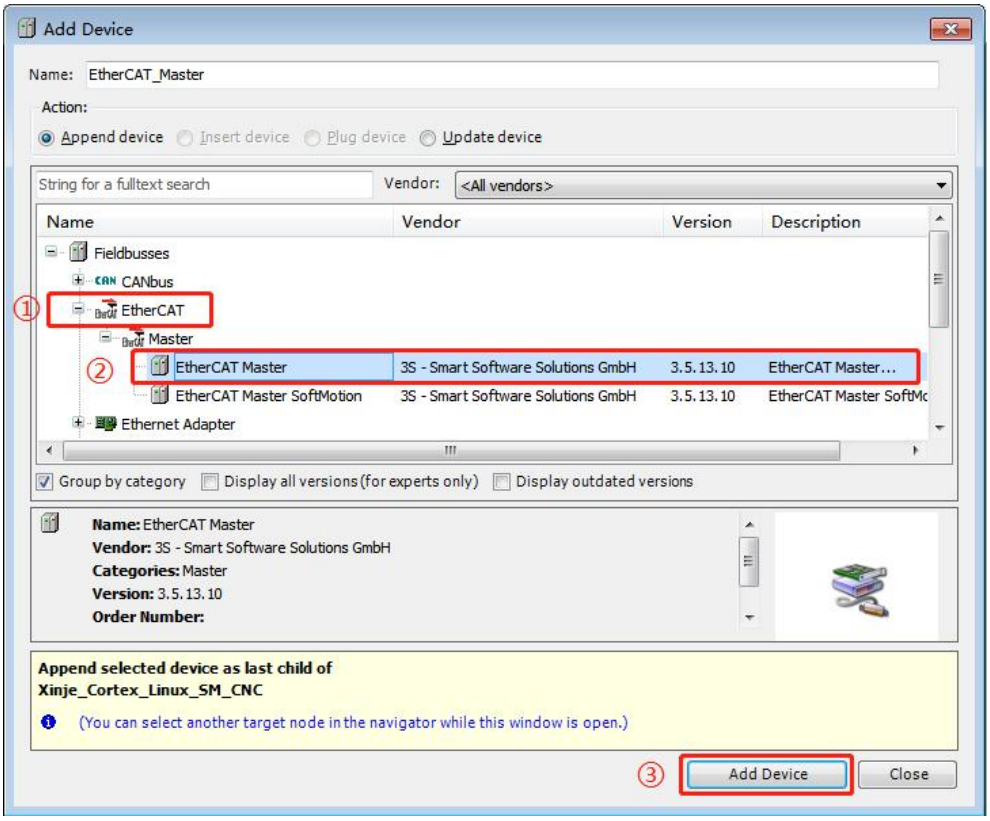
Right-click the Untitled file, select Add Device, then choose PLCs--SoftMotion PLCs--Xinje – Cortex-Linux-SM-CNC in the dialog box, and finally add the PLC.



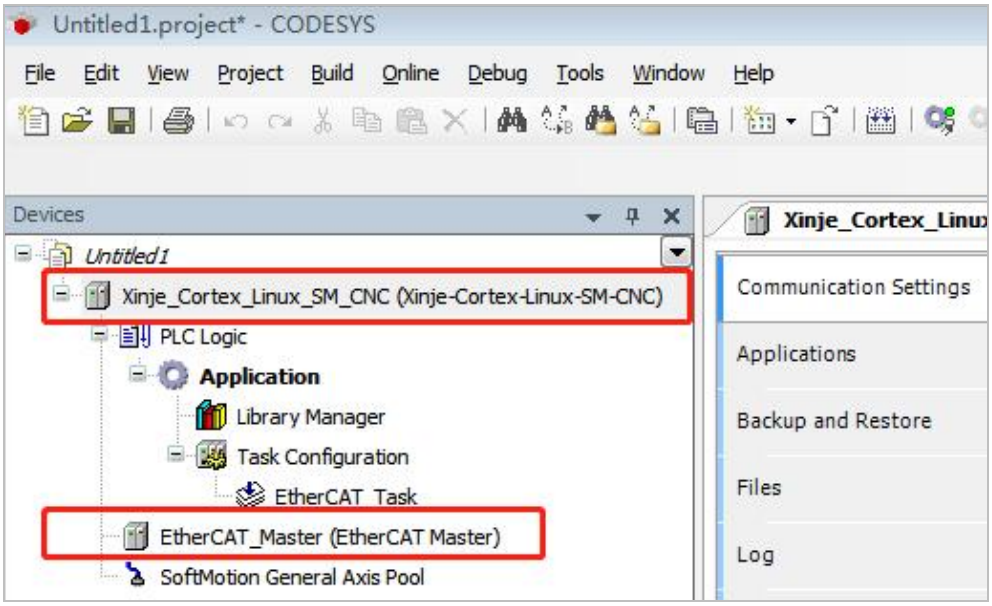
After installing the PLC, the Device Manager will appear on the right side of the interface. Select Xinje –Cortex-Linux-SM-CNC, right-click it, and click Add Device to add the device.



In the Add Device dialog box, select EtherCAT—Master—EtherCAT Master, then click Add Device to complete the process.



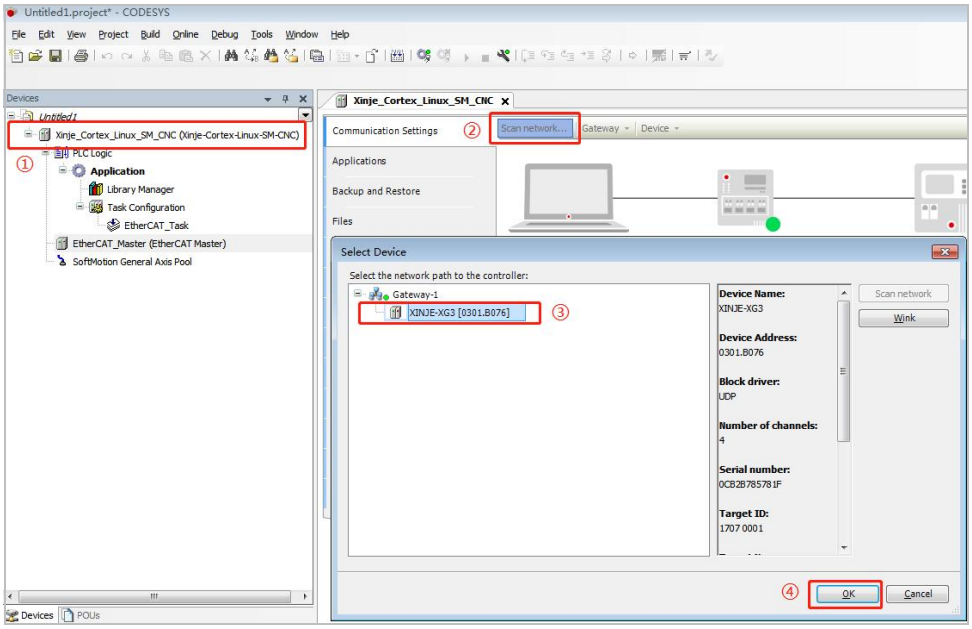
Device setup is complete, as shown below:



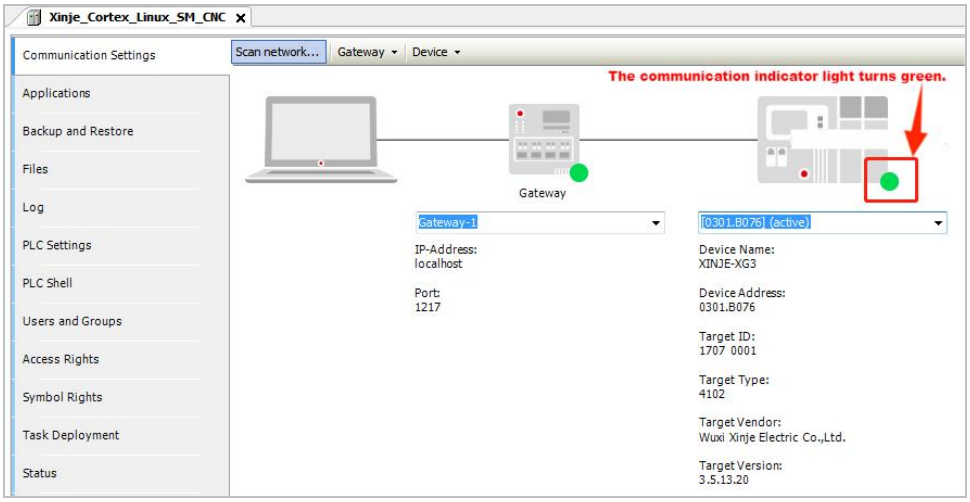
4) Gateway communication settings

Double-click Xinje _Cortex_Linux_SM_CNC, then select 'Scan Network' in the Communication Settings tab to search for PLCs on the same network segment. Once found, click OK. The PLC shown below has the device name XINJE-XG3.

To establish an Ethernet connection, the PC's IP address must be within the same subnet as the PLC's. Therefore, verify the PC's IP address configuration before proceeding.

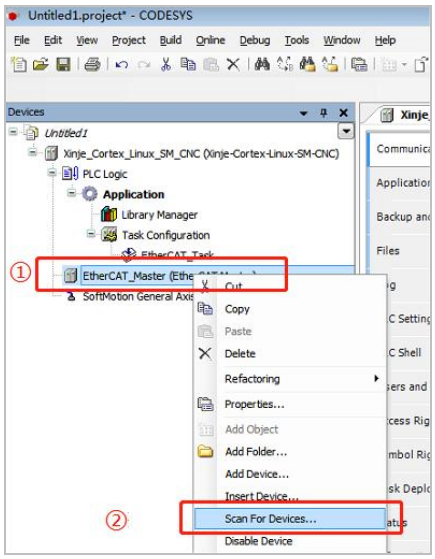


After successful communication, the result is shown below:

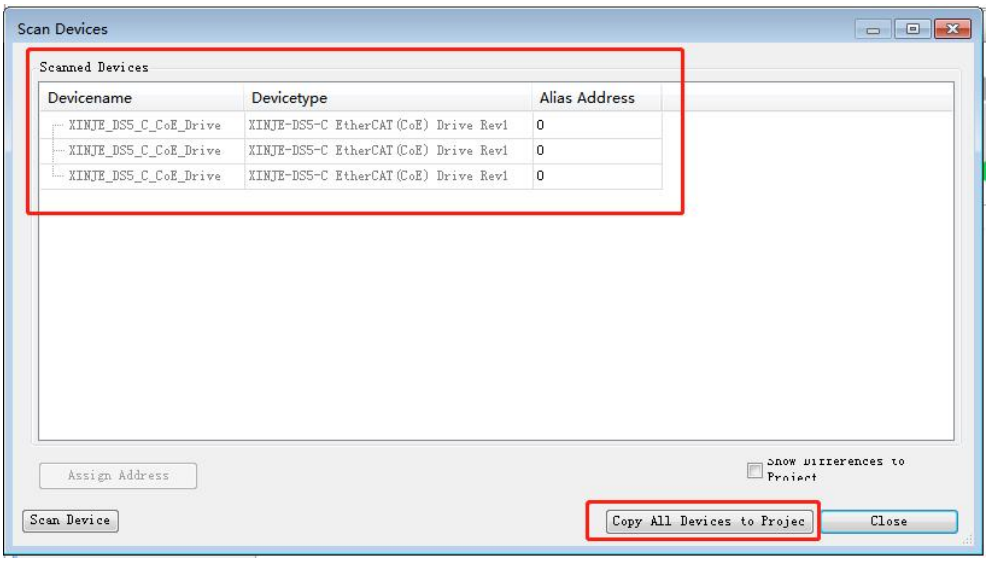


5) Scan the slave device

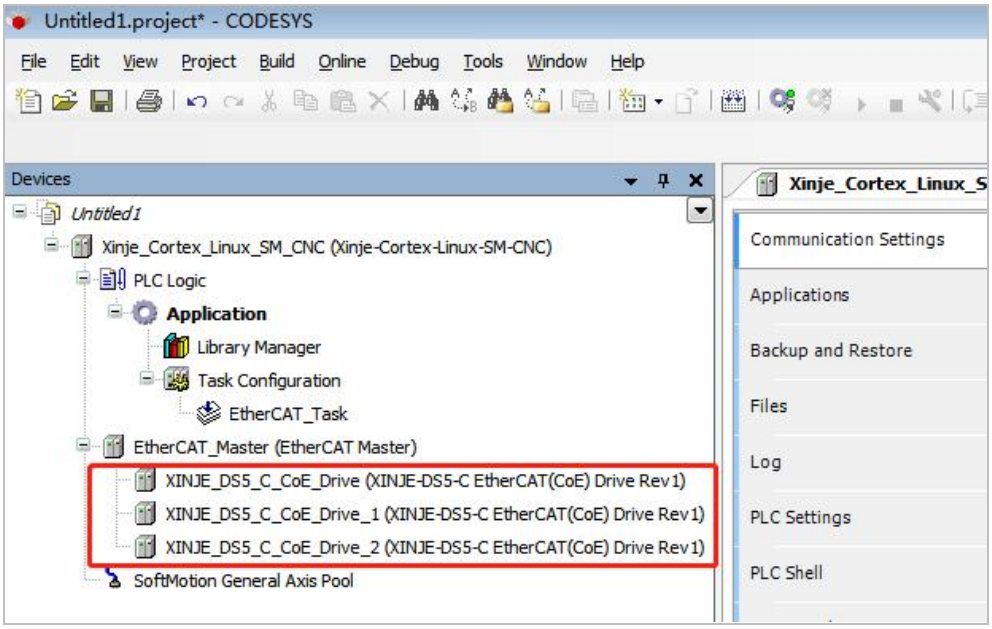
In the Device tab, right-click EtherCAT_Master and select Scan For Devices to scan EtherCAT slave devices.



In this example, three DM6C-series servos are connected. The scan results are shown below. Click 'Copy All to Project' to add all scanned slaves to the project.

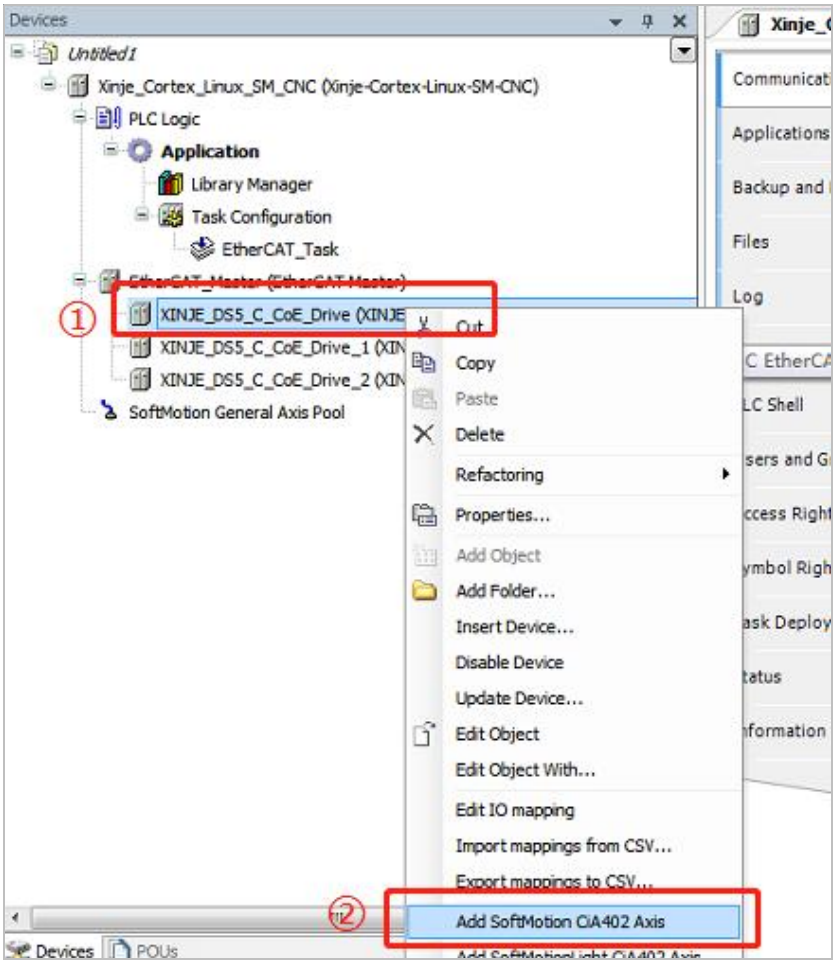


After the station device is successfully added, the 'Devices' column will appear as shown in the figure below.

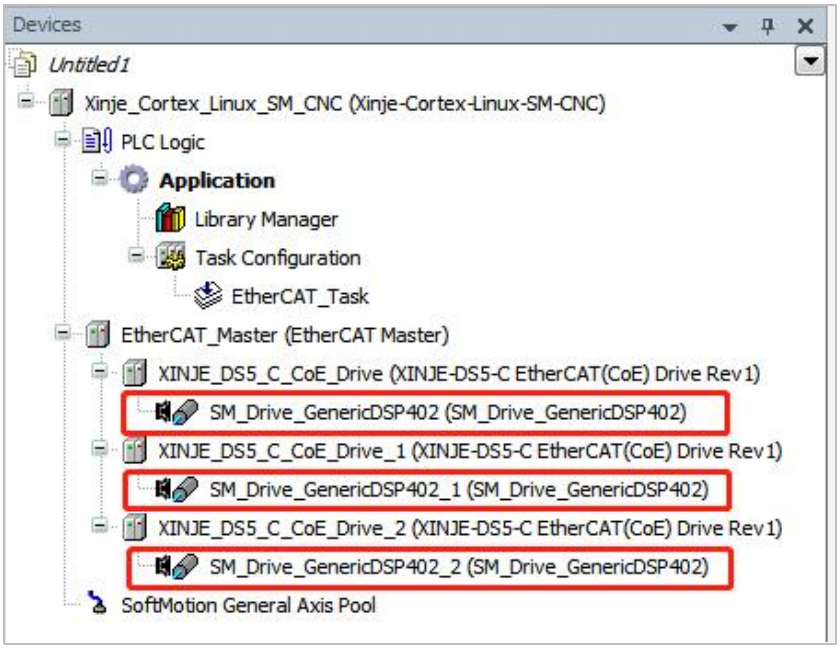


6) Add motion control axis

Right-click the XINJE_DS5_C_CoE_Drive device and select Add SoftMotion CiA 402 Axis.

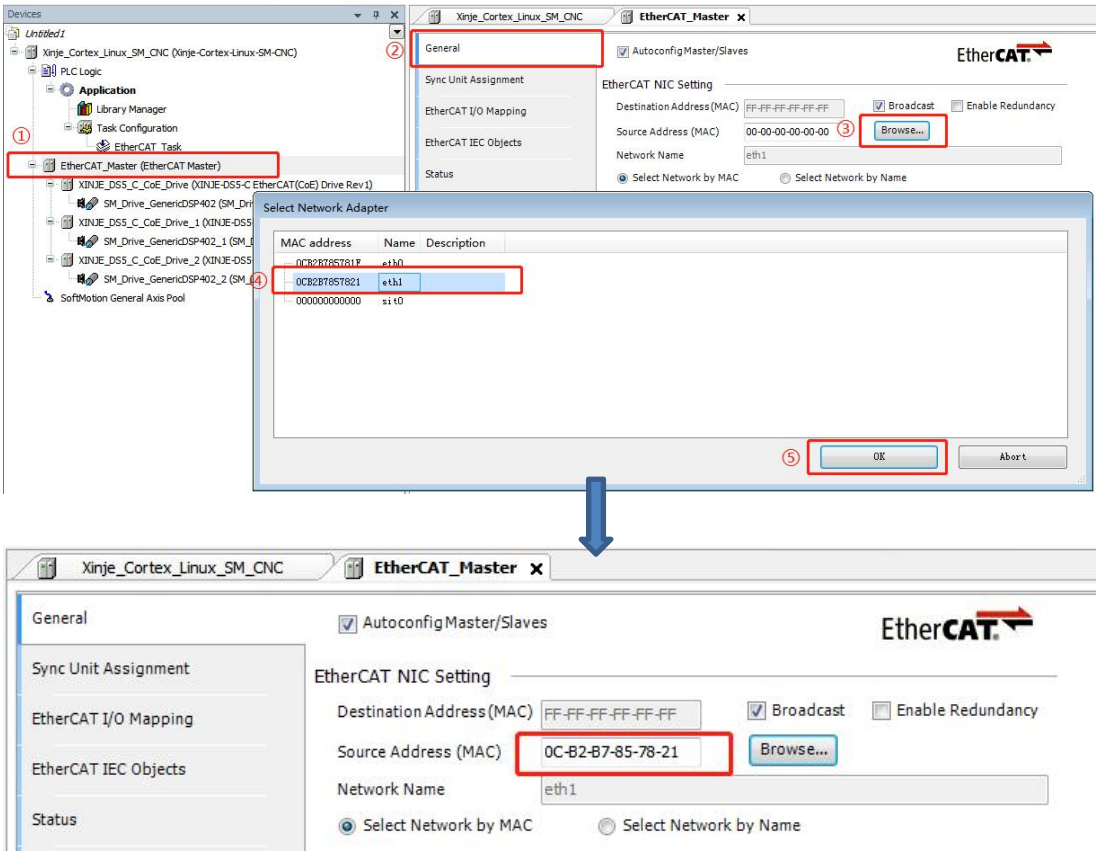


Similarly, add an axis to each slave station. After completion, the result is shown in the figure below.



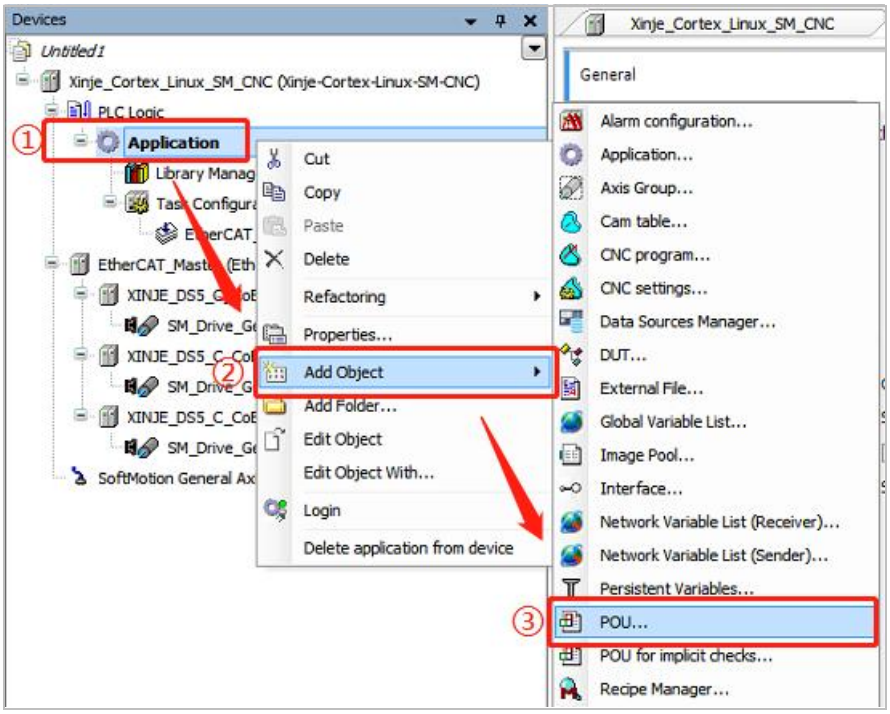
7) Source address selection for the master station equipment

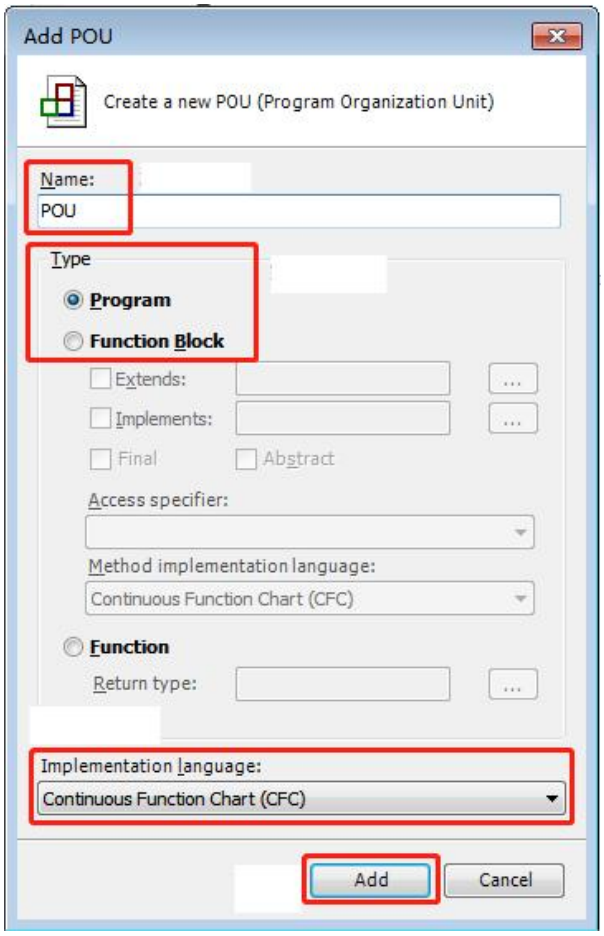
Double-click "EtherCAT_Master", then select Browse... in the General tab. Choose the target MAC address and click OK to finalize the source address selection.



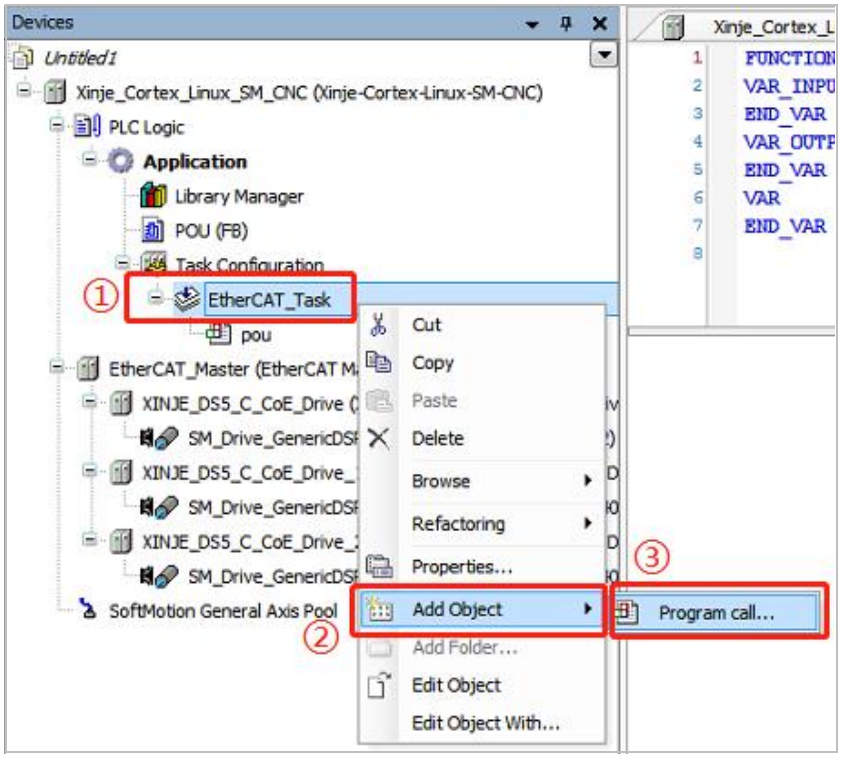
8) Write a program

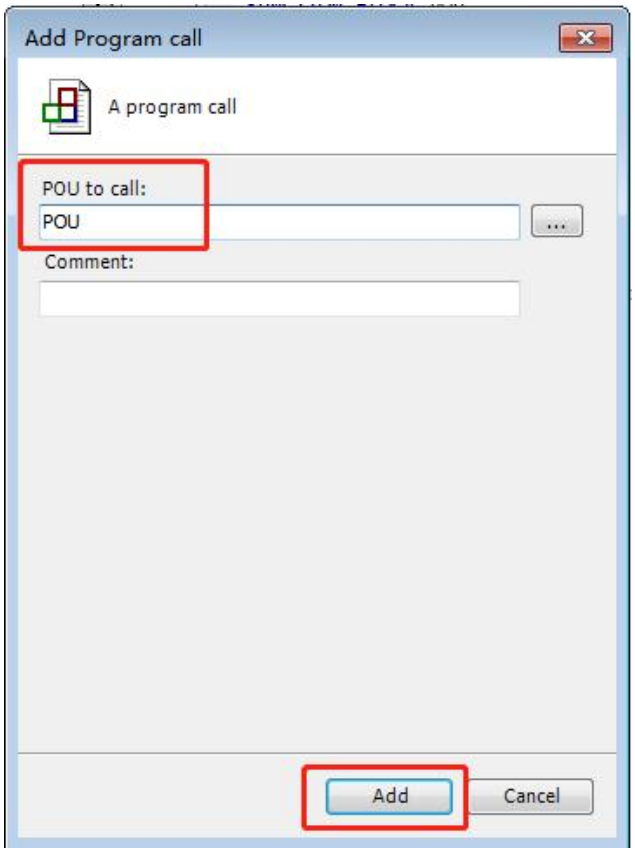
Add POU. Right-click Application in the Devices column, then select Add Object--POU... Select a name for the POU and choose the programming method, then click Add. In this example, select Continuous Function Diagram (CFC) for programming.





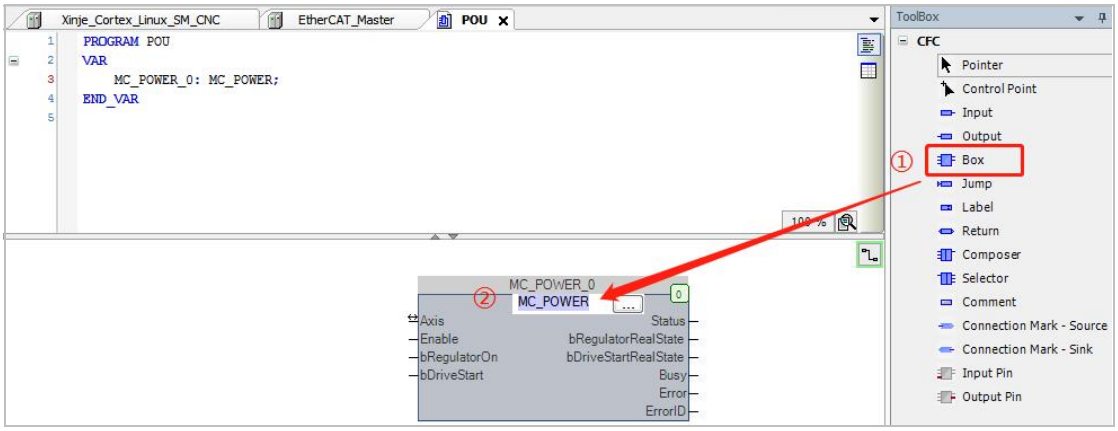
Double-click the added POU to program it in the POU interface. Note: The POU must be added to the task, as the subsequent compilation command only compiles programs included in the task. If the created POU is not added to the task, the compilation command will not perform syntax checking on the POU. Right-click EtherCAT(Task), select Add object--Program call, enter 'POU' in the Add Program call dialog box, and click Add to complete the addition.



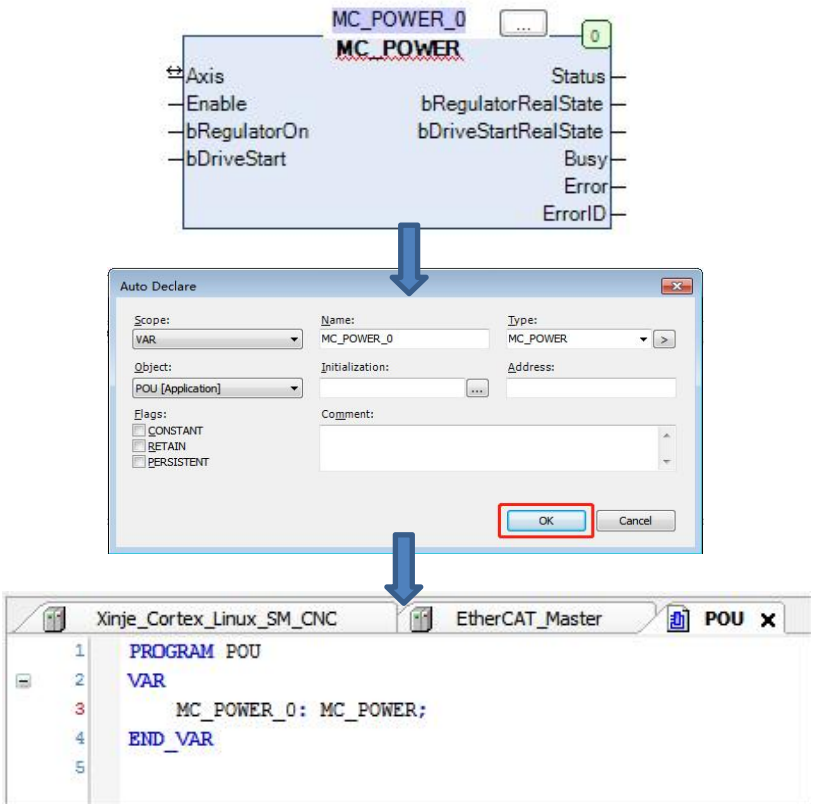


Call function block

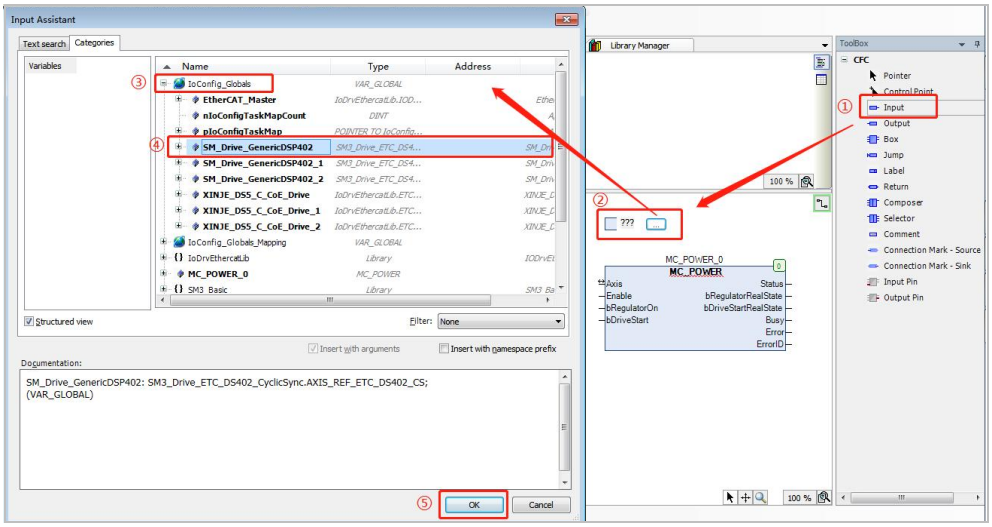
In the POU interface, call the MC_POWER function block to enable the axis. Select the Box in the toolbar, drag it into the programming interface, and enter MC_POWER.



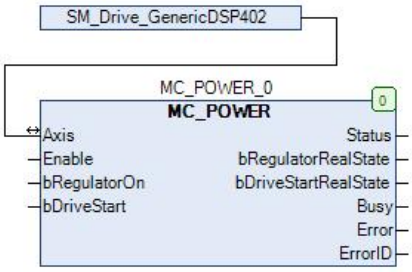
Link this function block to the first slave axis variable. As shown in the diagram, enter MC_POWER_0, and the programming interface will automatically generate the required variables.



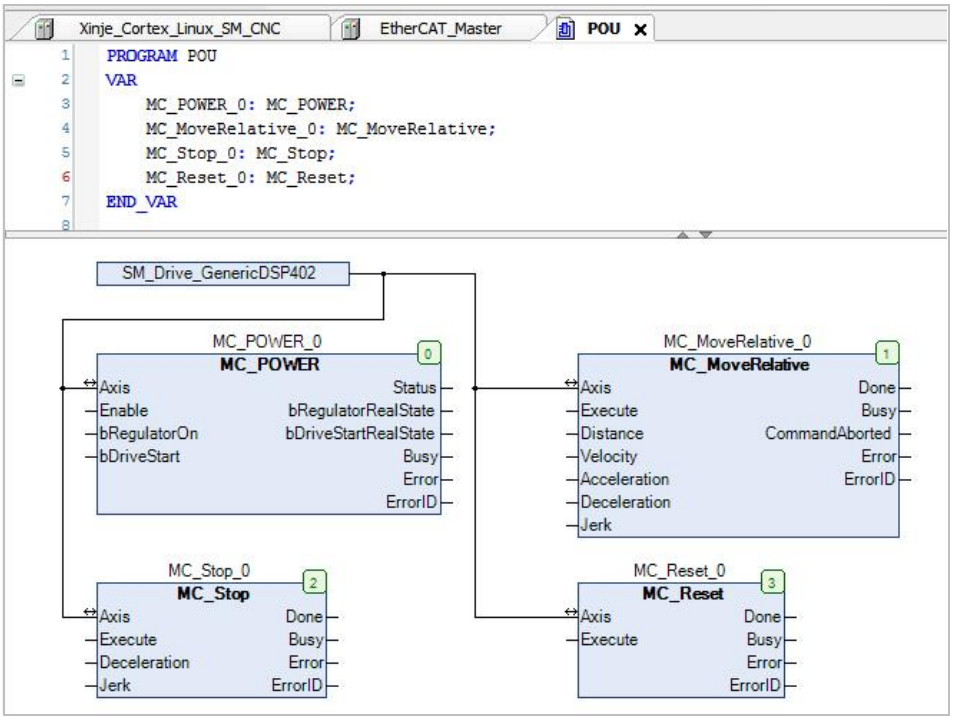
Add "Input" and link this function block to the first slave axis. Select Input from the toolbar, drag it into the programming interface, double-click the control, and click to open the Input Assistant dialog. In the dialog, select IoConfig_Globals--SM_Drive_GenericDSP402, then click OK.



Connect the added input function block to the enabled function block with a wire.



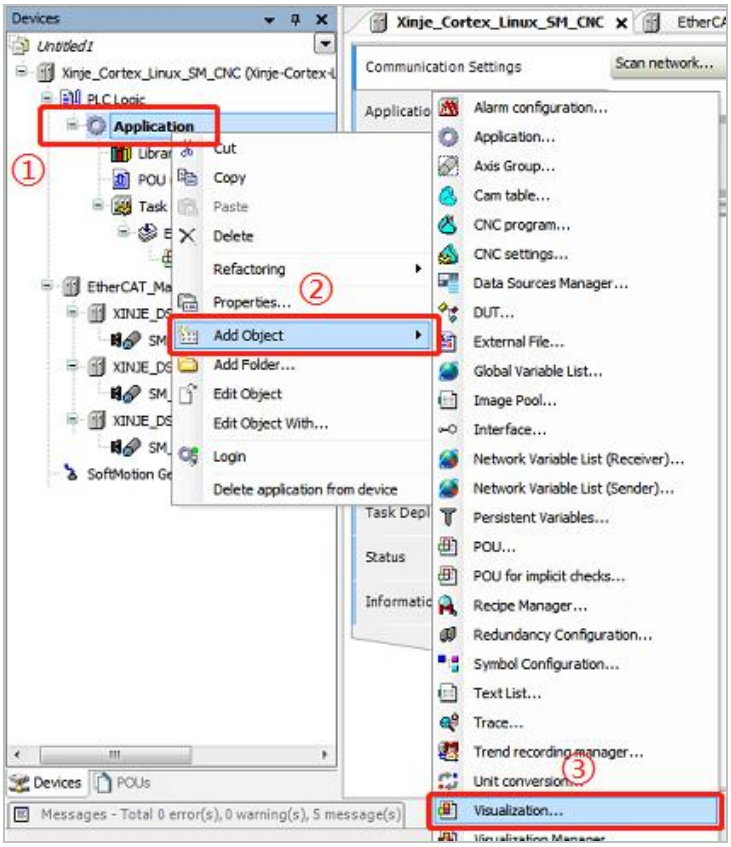
Similarly, add the relative movement function block MC_MoveRelative, stop function block MC_Stop, and reset function block MC_Reset. The program is shown in the figure below.

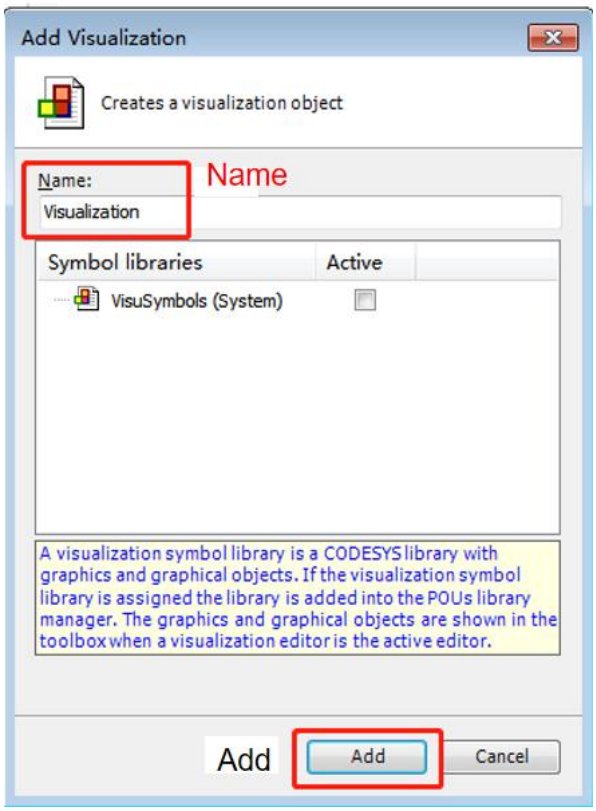


9) Create a view

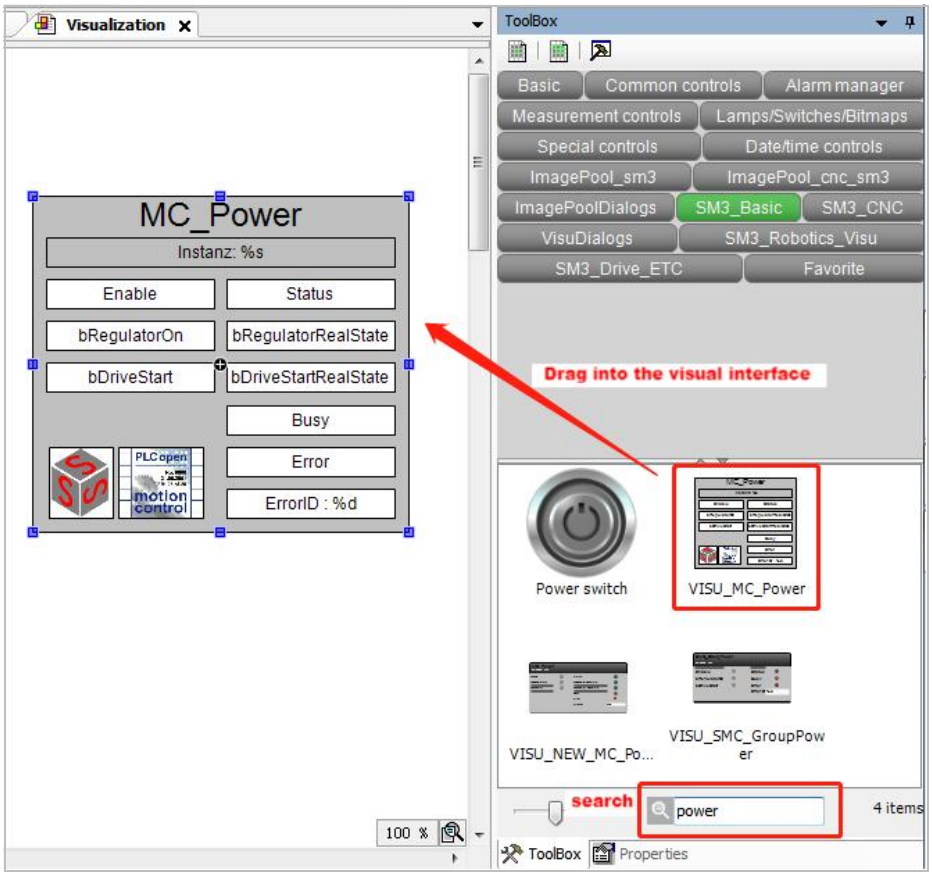
Add a view. Right-click Application in the Devices column, then select Add Object—Visualization...

Name the view and select a programming method, then click Add.

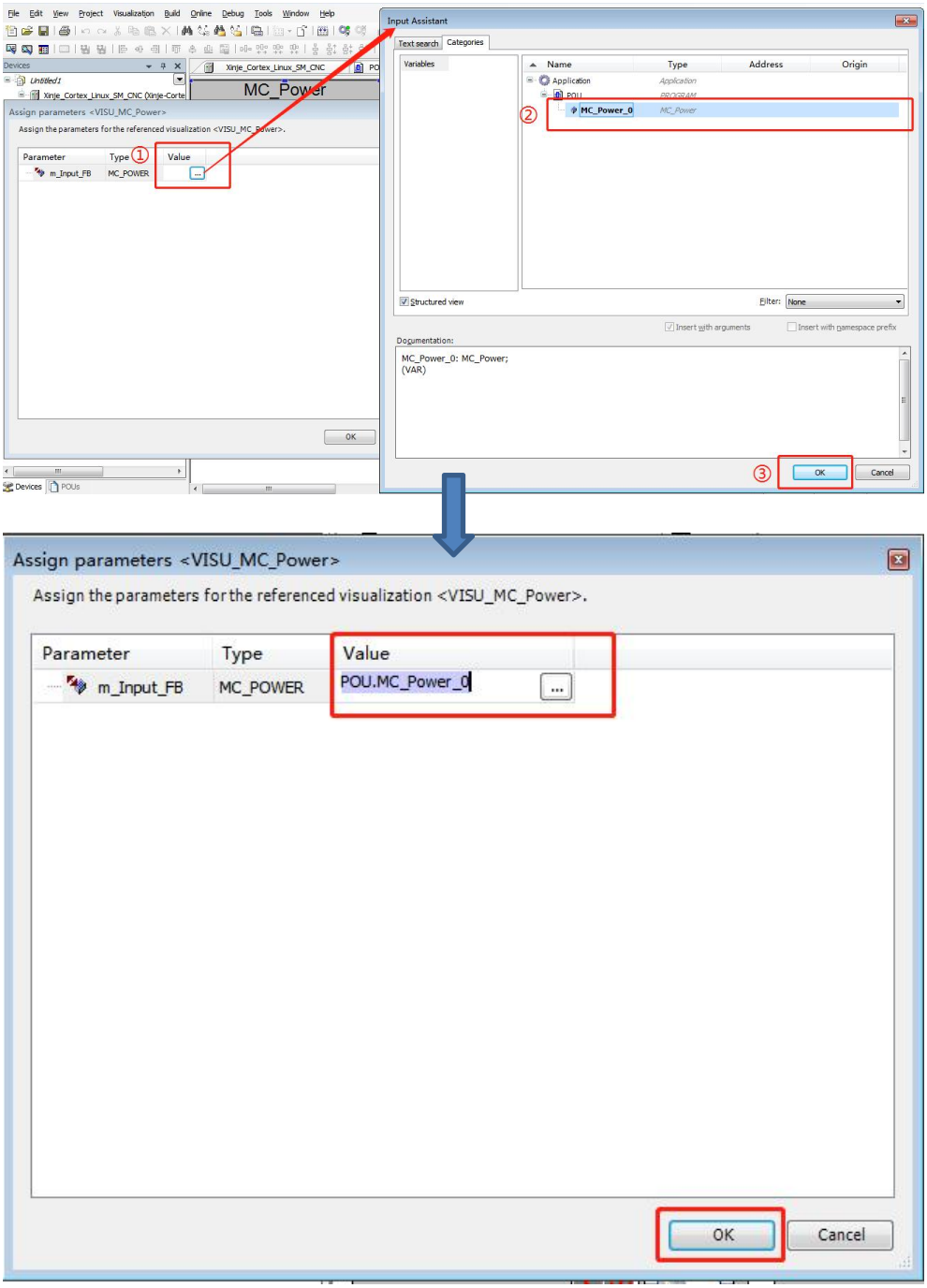




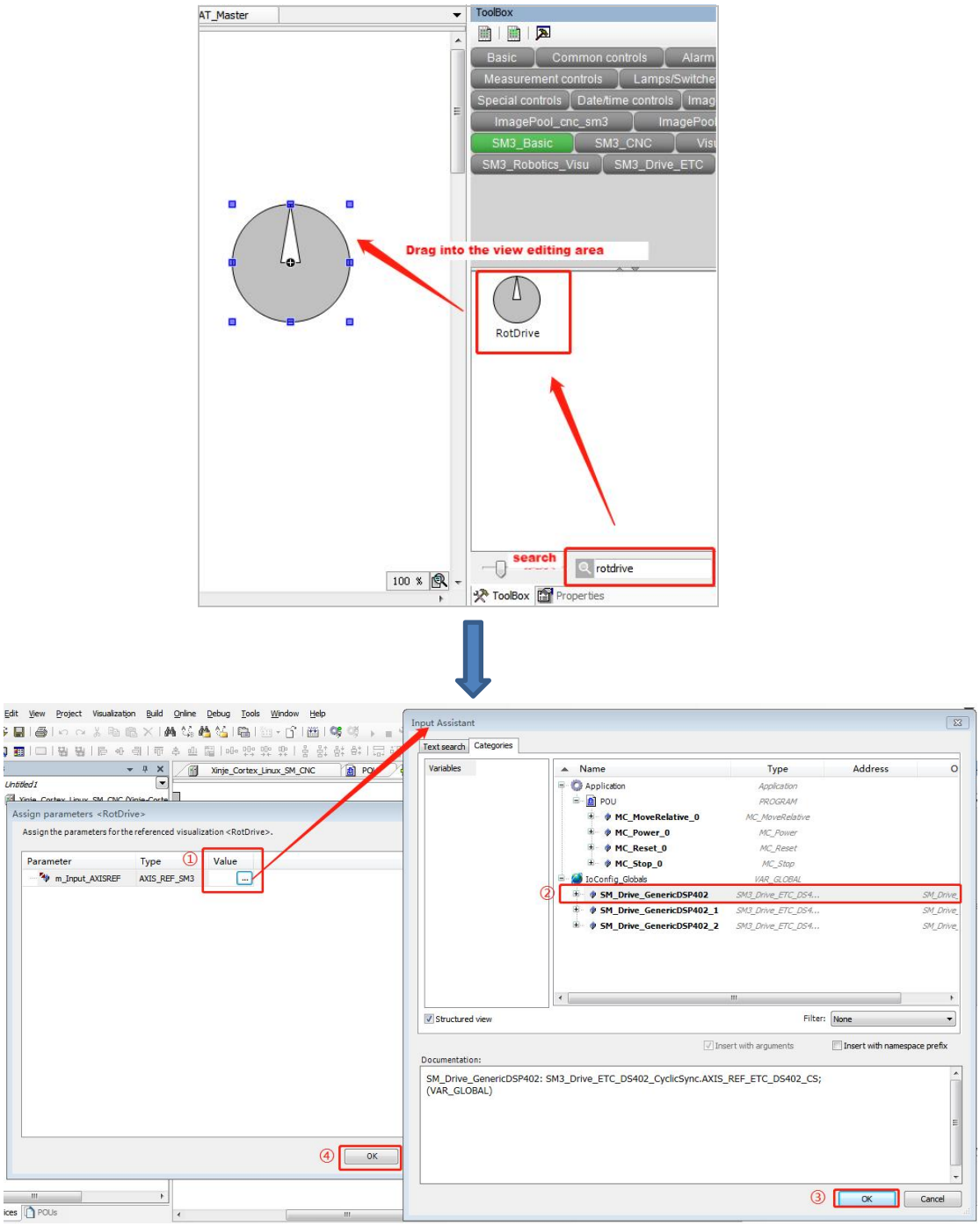
Double-click Visualization in the Devices section to add the desired view to the view interface. For example, search for power in the toolbar to drag the view control for enabling functions into the view.



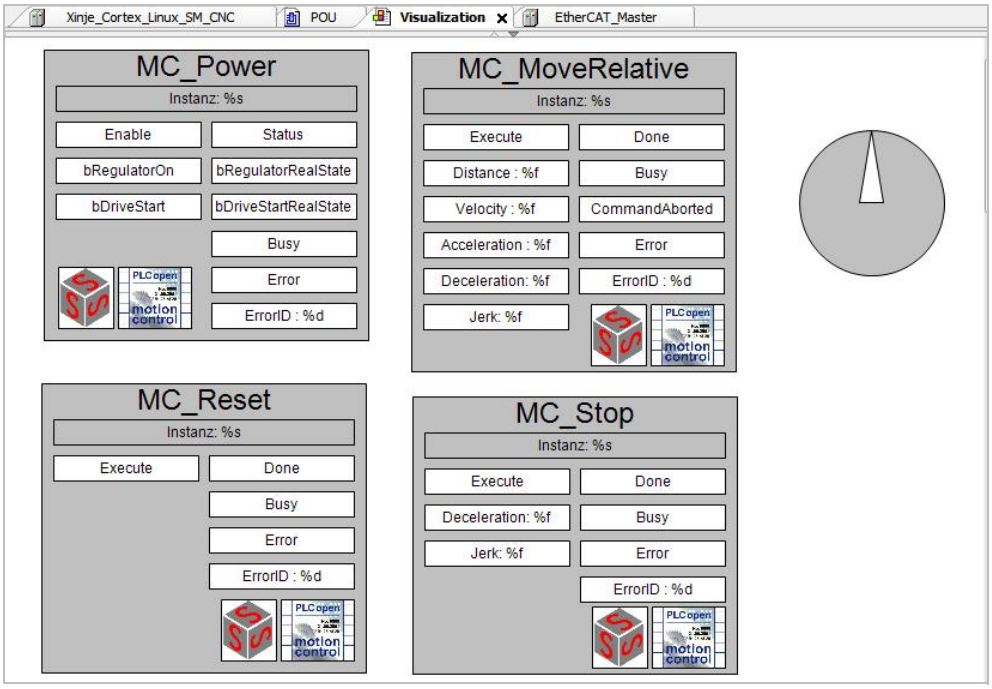
When dragging a control into the view editing area, a dialog box titled "Assign parameters <VISU_MC_Power>" will automatically appear. Link the view control to the declared variable in this dialog. Double-click the "Value" field, select the declared variable in the new dialog, and click OK. The linked variable name will then appear in the "Value" field. Click OK again to complete the variable link. Repeat the same steps for other view controls.



Add a view simulating the motor's rotation and link it to the motor shaft. Add and link it as above.


AT_Master
ToolBox
Basic
Common controls
Alarm
Measurement controls
Lamps/Switche
Special controls
Date/time controls
Imag
ImagePool_cnc_sm3
ImagePool
SM3_Basic
SM3_CNC
SM3_Robotics_Visu
SM3_Drive_ETC
Drag into the view editing area
RotDrive
search
rotdrive
100 %
ToolBox
Properties
Edit View Project Visualization Build Online Debug Tools Window Help
Assign parameters <RotDrive>
Assign the parameters for the referenced visualization <RotDrive>.
Parameter
Type
Value
m_Input_AXISREF
AXIS_REF_SM3
OK
Input Assistant
Text search
Categories
Variables
Name
Type
Address
Application
POU
MC_MoveRelative_0
MC_Power_0
MC_Reset_0
MC_Stop_0
IoConfig_Globals
SM_Drive_GenericDSP402
SM_Drive_GenericDSP402_1
SM_Drive_GenericDSP402_2
Structured view
Filter:
None
Insert with arguments
Insert with namespace prefix
Documentation:
SM_Drive_GenericDSP402: SM3_Drive_ETC_DS402_CyclicSync.AXIS_REF_ETC_DS402_CS;
(VAR_GLOBAL)
OK
Cancel

The completed view is shown below:



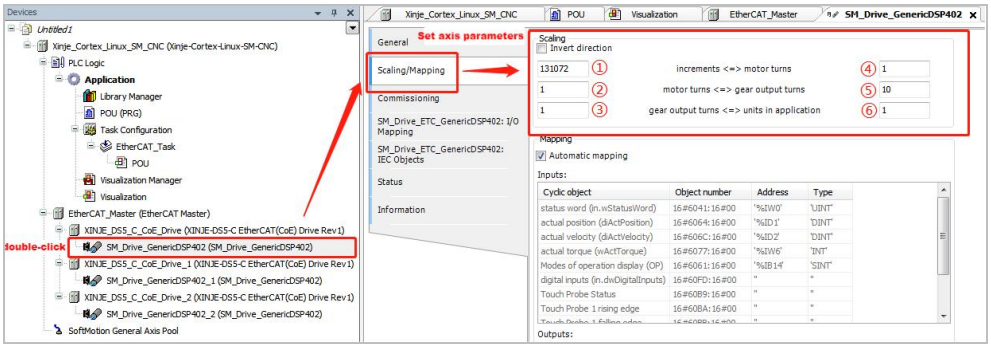
10) Online control

Axis parameter settings. Double-click Axis 1 to configure axis parameters in the Scaling/Mapping tab.

① To set encoder precision, enter 131072 for this example, as a 17-bit encoder is connected.

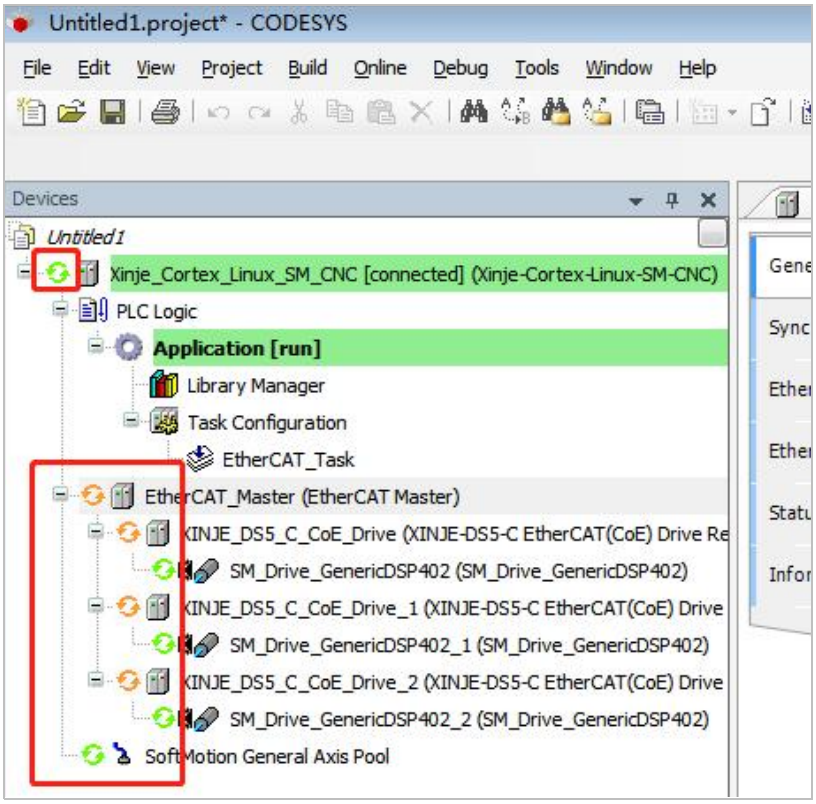
The relationship between setting and output: Coefficient = (④*⑤*⑥)/(②*③)

Example: When the input-output relationship coefficient is 10 and the Distance setting in the MC_MoveRelative function block is 100, the calculation 100/10×131072 yields 131070, meaning the motor will complete 10 full rotations over 131072 pulses. Setting the Velocity to 10 results in 10/10×131072=131072, operating at 131072 pulses per second. For Acceleration (1000), the calculation 1000/10×131072=13107200 indicates an acceleration of 13107200 m/s², with deceleration settings following the same logic.

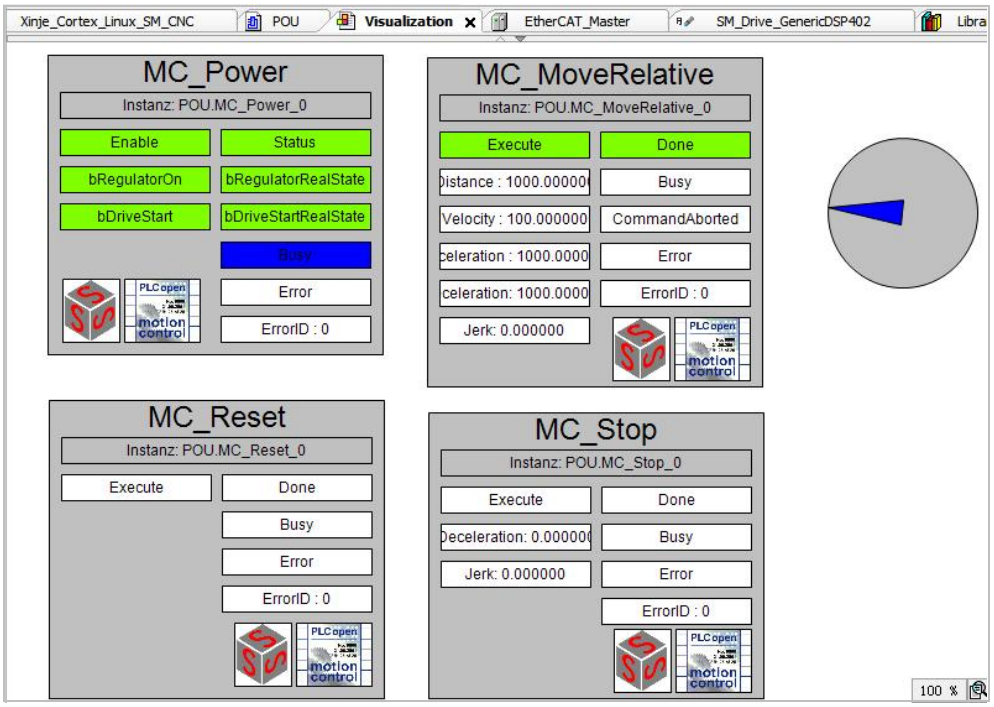


After completing parameter configuration, compile the program for syntax check. Once the program passes the check without errors, you can log in and run it. Logging in establishes a connection

between the application and the target device, enabling online operation. To ensure proper login, the device's communication settings must be correctly configured, and the application must be free of compilation errors. Follow the sequence of compiling, logging in, and running. The normal operational state is illustrated in the figure below.



In this view, you can configure parameters such as the motor's travel distance and speed. To activate the motor, sequentially select bDriveStart, bRegulatorOn, and Enable from the MC_Power function block. Finally, click Execute in the MC_MoveRelative function block to initiate the relative position movement.


Xinje_Cortex_Linux_SM_CNC
POU
Visualization
EtherCAT_Master
SM_Drive_GenericDSP402
Libra
MC_Power
Instanz: POU.MC_Power_0
Enable
Status
bRegulatorOn
bRegulatorRealState
bDriveStart
bDriveStartRealState
Busy
Error
ErrorID : 0
MC_MoveRelative
Instanz: POU.MC_MoveRelative_0
Execute
Done
Busy
CommandAborted
Error
ErrorID : 0
Jerk: 0.000000
MC_Reset
Instanz: POU.MC_Reset_0
Execute
Done
Busy
Error
ErrorID : 0
MC_Stop
Instanz: POU.MC_Stop_0
Execute
Done
Busy
Error
ErrorID : 0
Jerk: 0.000000
100 %

11.4 OMRON and XJIN DM6C Servo EtherCAT Communication Example

This example demonstrates how OMRON PLC serves as the EtherCAT master station while XINJE servo acts as the slave station to implement EtherCAT motion control.

11.4.1 System Configuration

name	Model/Specification	quantity	remarks
upper monitor	Sysmac Studio	1	Omron upper-level computer software
controller	OMRON NJ501-1500 series	1	
Servo of XJ	DM6C-45P5-R	1	
parvicostellae	JC-CA-3	a surname	For connecting computers to PLCs and PLCs to servo systems

11.4.2 System Topology

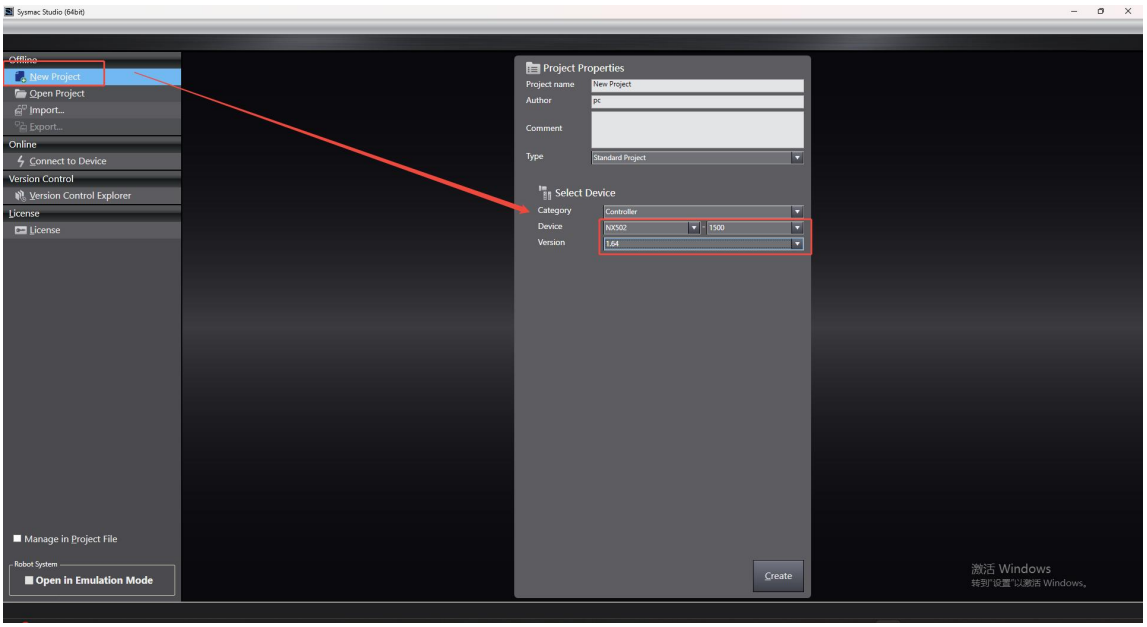
The NJ501 CPU module features two network ports: the red port (Ethernet/IP) connects to OMRON's Sysmac Studio host computer for PLC monitoring and data writing, while the yellow port (EtherCAT) interfaces with XINJE DM6C series servos to enable EtherCAT communication.

Each network port has three indicator lights: RUN, ERROR, and ACT. When the network cable is correctly connected, RUN should light up, and ACT remains normally lit. ACT will flash when communication is established and data is exchanged. ERROR will not light up unless there is an exception.

11.4.3 Debugging Steps

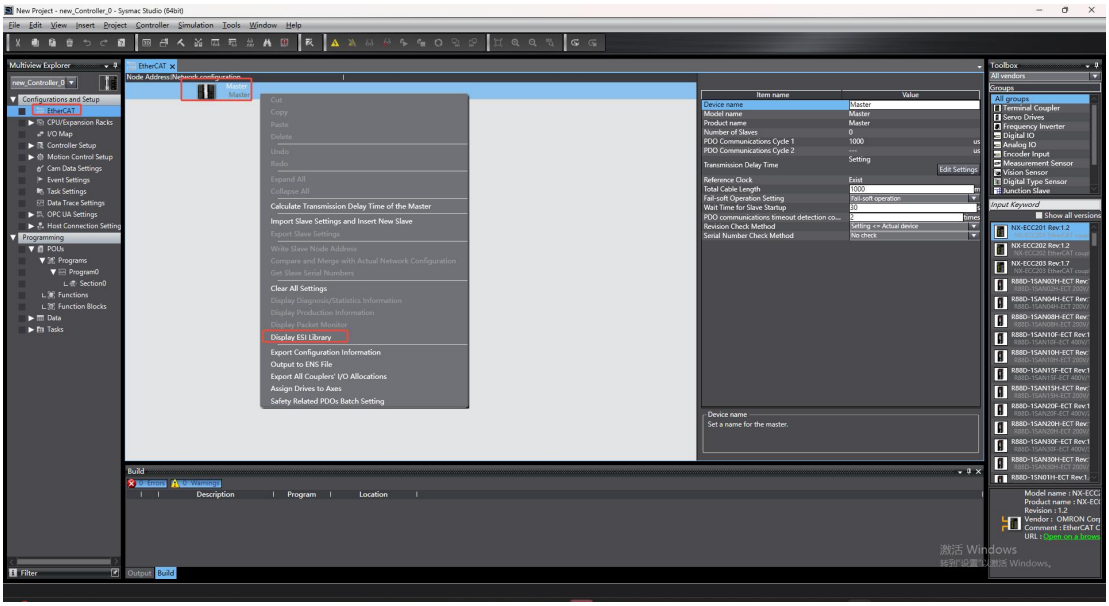
1) New construction projects

Open the OMRON host software Sysmac Studio. For first-time users, select 'New Project' and choose the model: NJ501-1500, version 1.02 in the project properties interface. Click 'Create' to generate the programming interface.

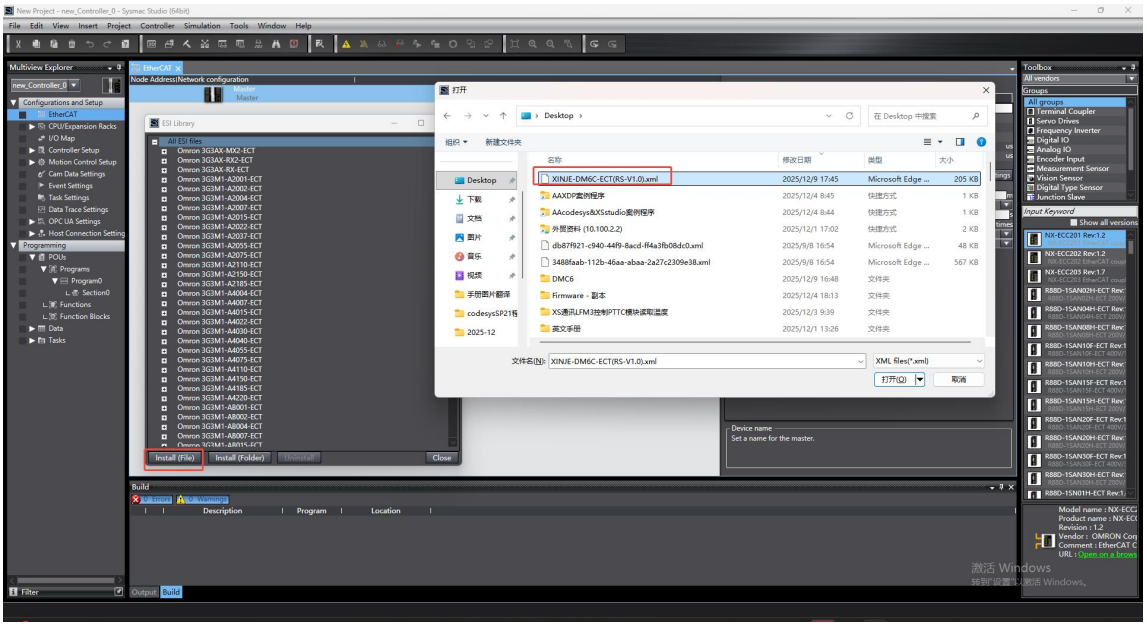


2) Add XML file

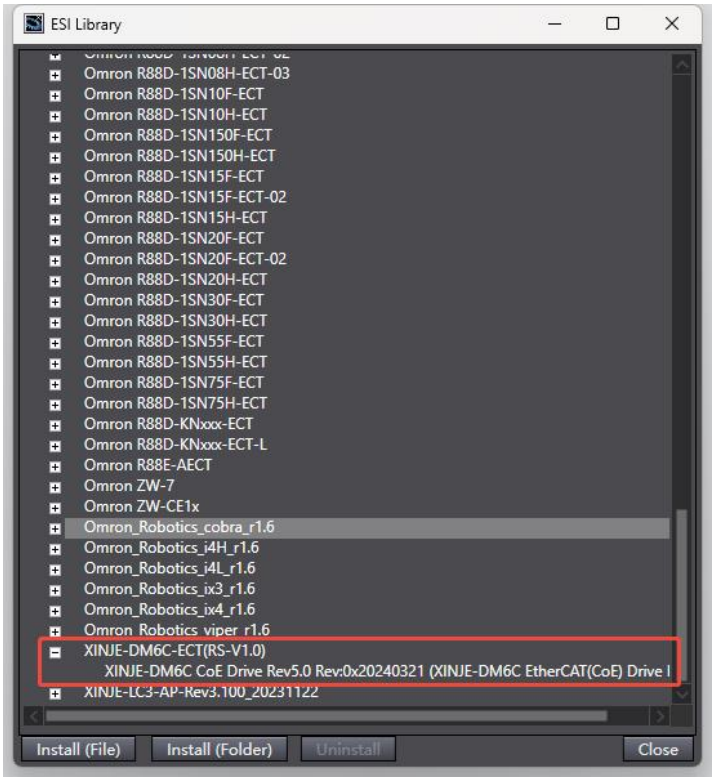
Double-click "EtherCAT" on the main interface to open the EtherCAT configuration interface. For first-time users, add an XML file to the library. Right-click the "Main Device" and select "Show ESI Library".



Next, add the DM6C XML file to the ESI library that appears. Select 'This folder' to display the file storage path, then place the 'XINJE-DM6C-rev1.1' XML file in the specified folder.

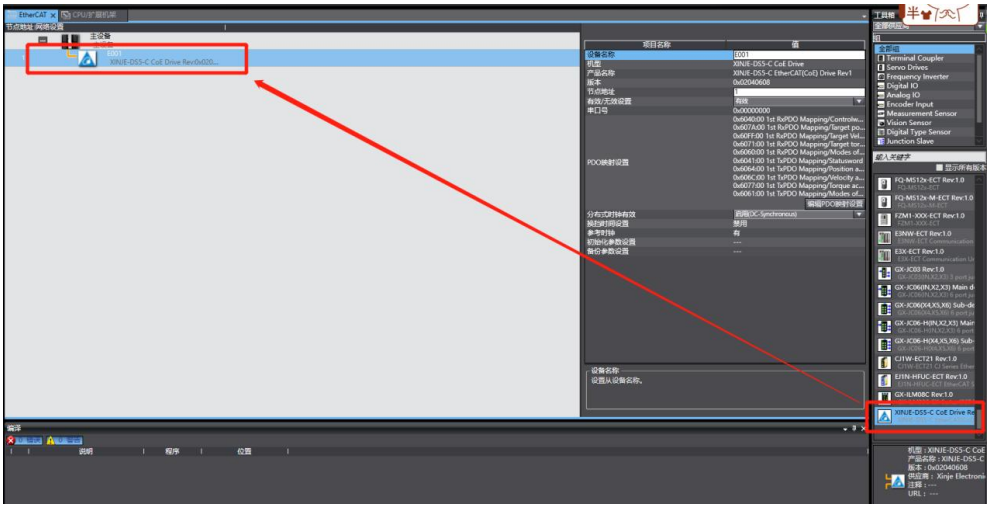


Finally, close Sysmac Studio and restart the software. When you revisit the ESI library, you'll find the XINJE-DM6C slave description file already included.



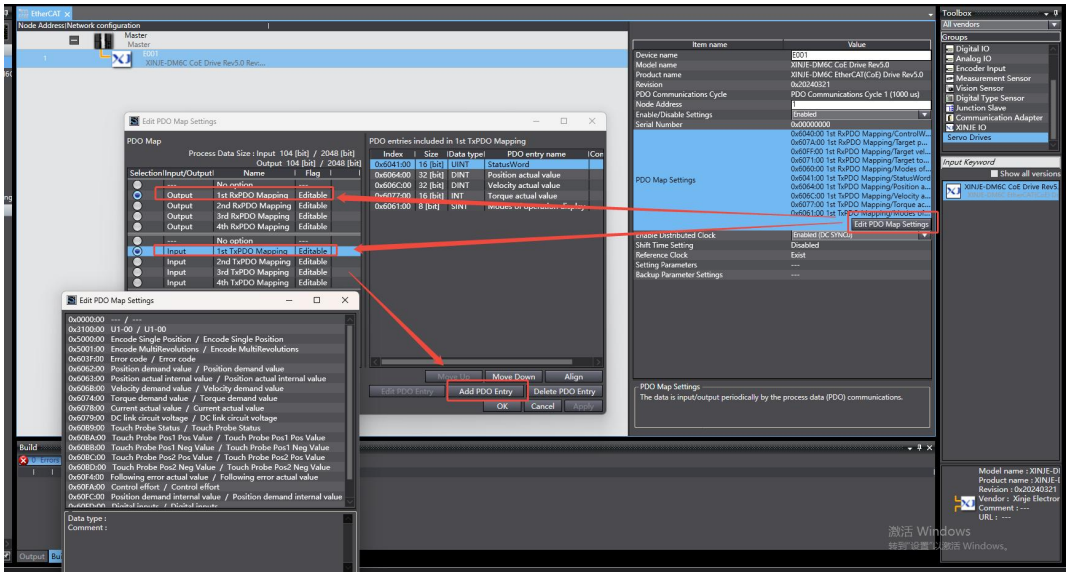
3) Add device

On the right side of the interface, locate "XINJE-DS5C CoE Drive Rev" and double-click to add it to the main device node.

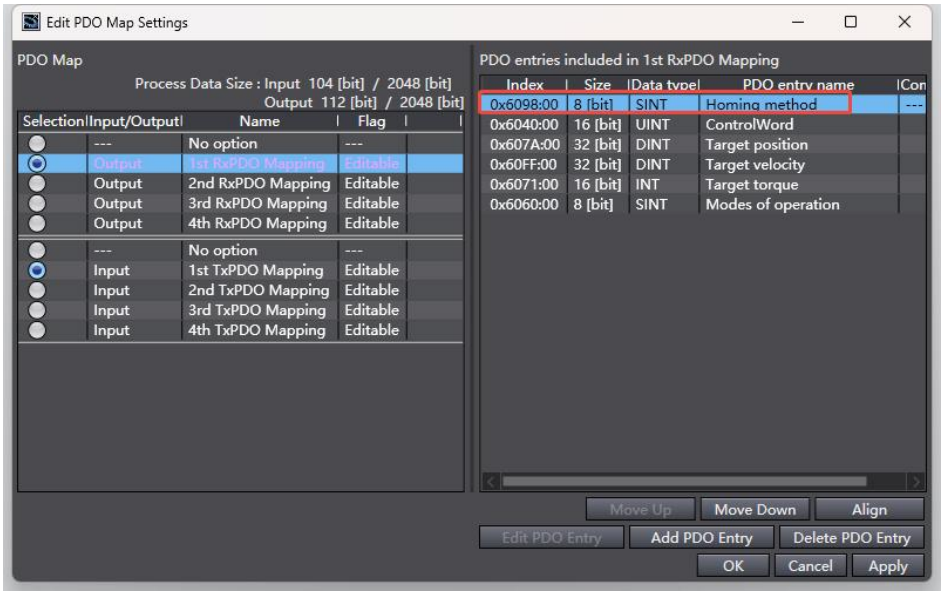


After adding a node, the cursor will highlight its PDO configuration. Select 'Edit PDO Mapping Settings' to view the current output PDO Mapping on the left and PDO entries on the right, where you can add or remove PDOs as needed. To add a PDO, select 'Add PDO Entry' to display available PDO

objects. After selecting one, click 'OK' and then 'Apply' to complete the addition.

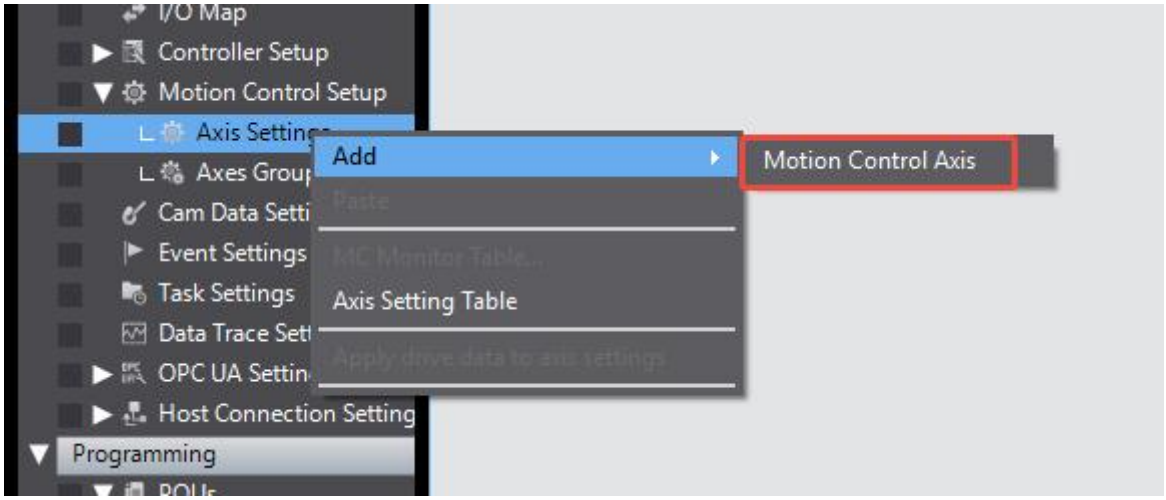


After adding, it will look like this:



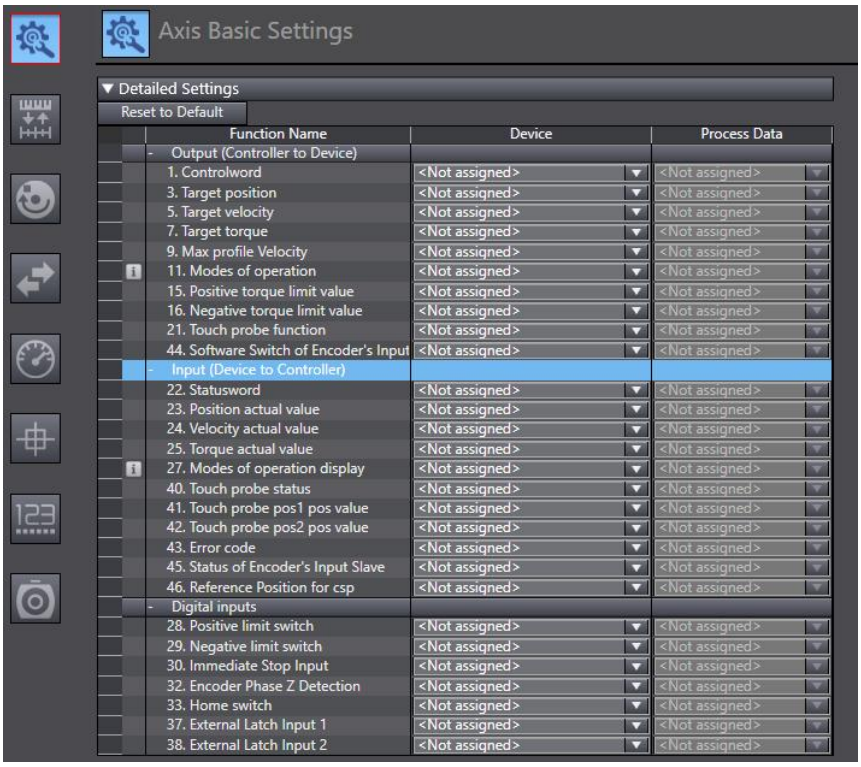
4) Setting of motion control axis

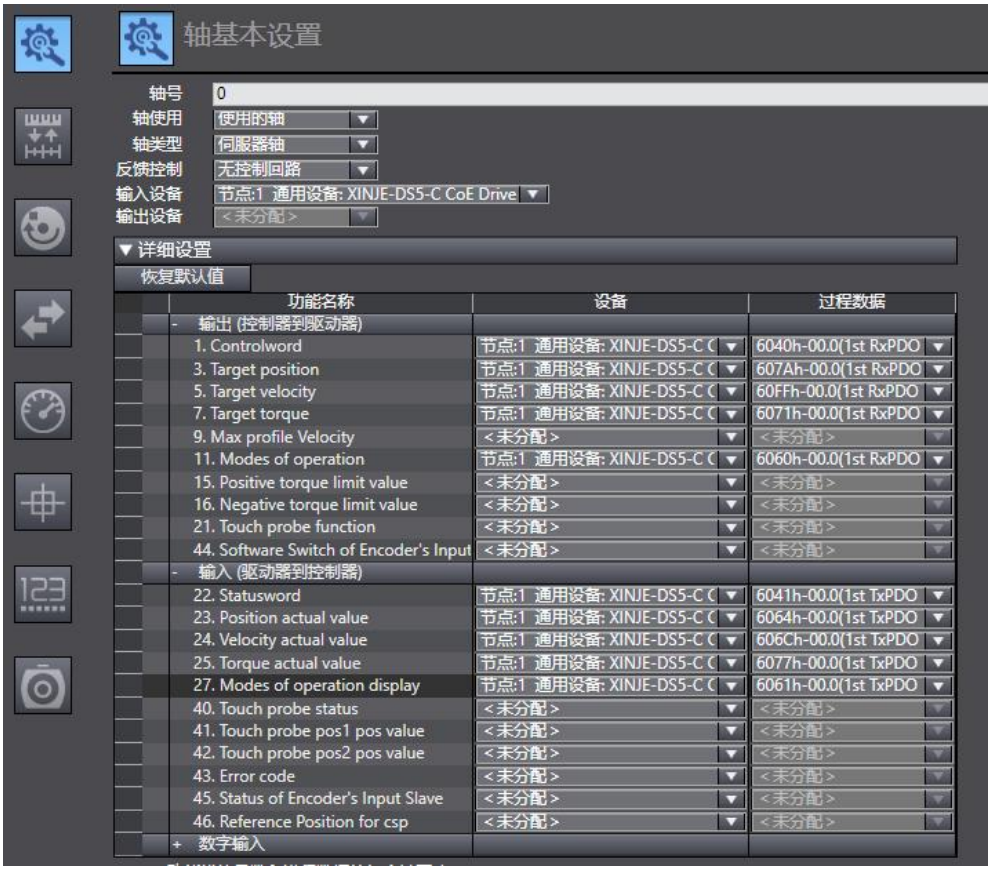
Double-click "Motion Control Settings", right-click "Axis Settings", and select "Add — Motion Control Axis".



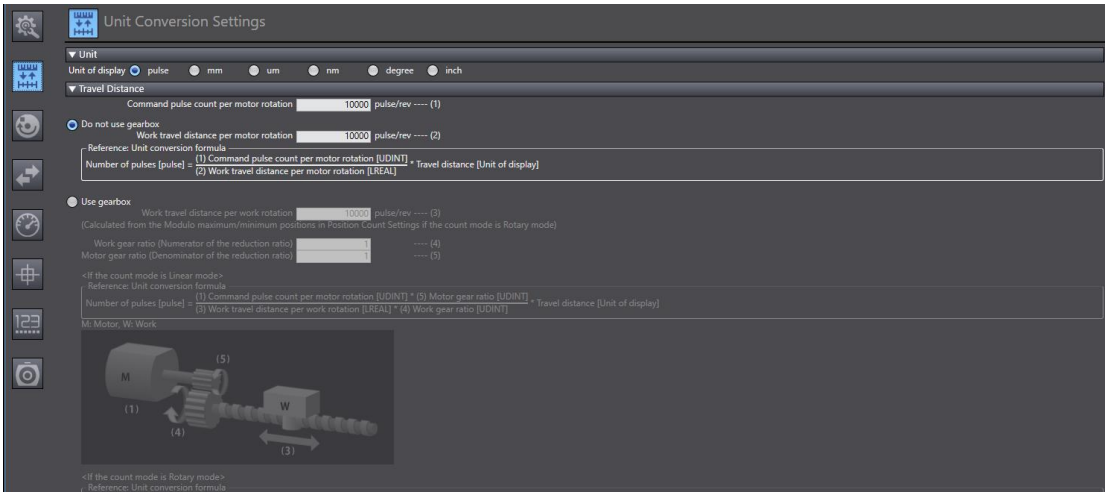
Double-click "MC_Axis000" to open the axis configuration interface. The interface is divided into multiple sub-interfaces. In the "Basic Axis Settings" interface, select "Axis Type-Servo Axis" and choose "Input Device: Node 1: DS5C".

Click Detailed Settings to expand the configuration module. The function names must match the PDO mapping entries on the device. Add them manually here. Omissions or errors will affect the parameter's subsequent use.



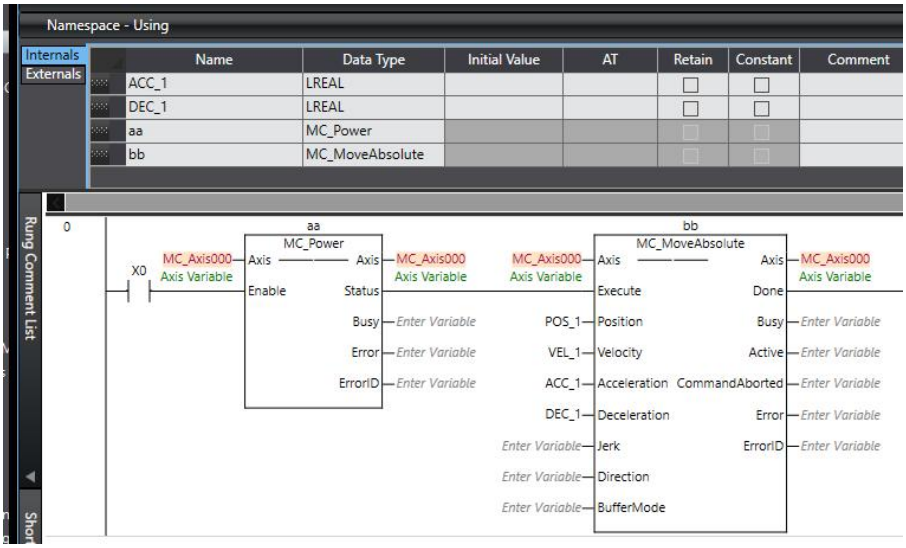


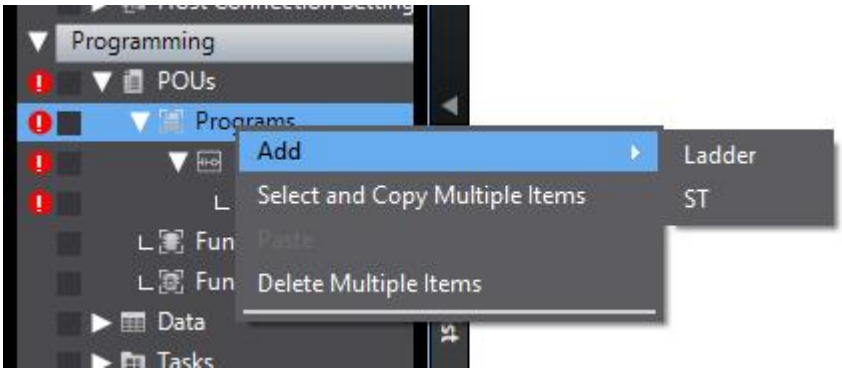
In the "Unit Conversion Settings", the "Number of command pulses per motor revolution" field should specify the motor encoder's bit count. For example, if using a 17-bit encoder, change it to 131072. The "Working stroke per motor revolution" refers to the motor's equivalent travel per rotation. Here, modify it to 131072 with a default gear ratio of 1:1.



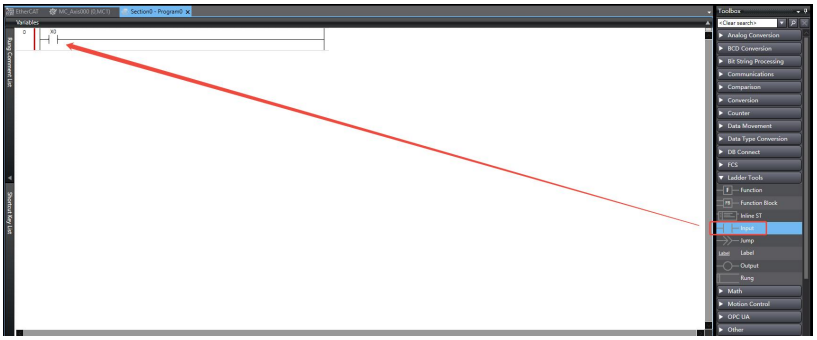
5) Write a program for "round trip motion"

Programming Interface Guide: Select 'Programming — POU — Program — Program0 — Section0' in sequence. Double-click 'Section0' to open the programming interface. By default, Program0 is set to ladder diagram programming. To switch to ST programming, right-click 'Program — Add — ST'. The 'Toolbox' section allows you to add various ladder diagram elements.

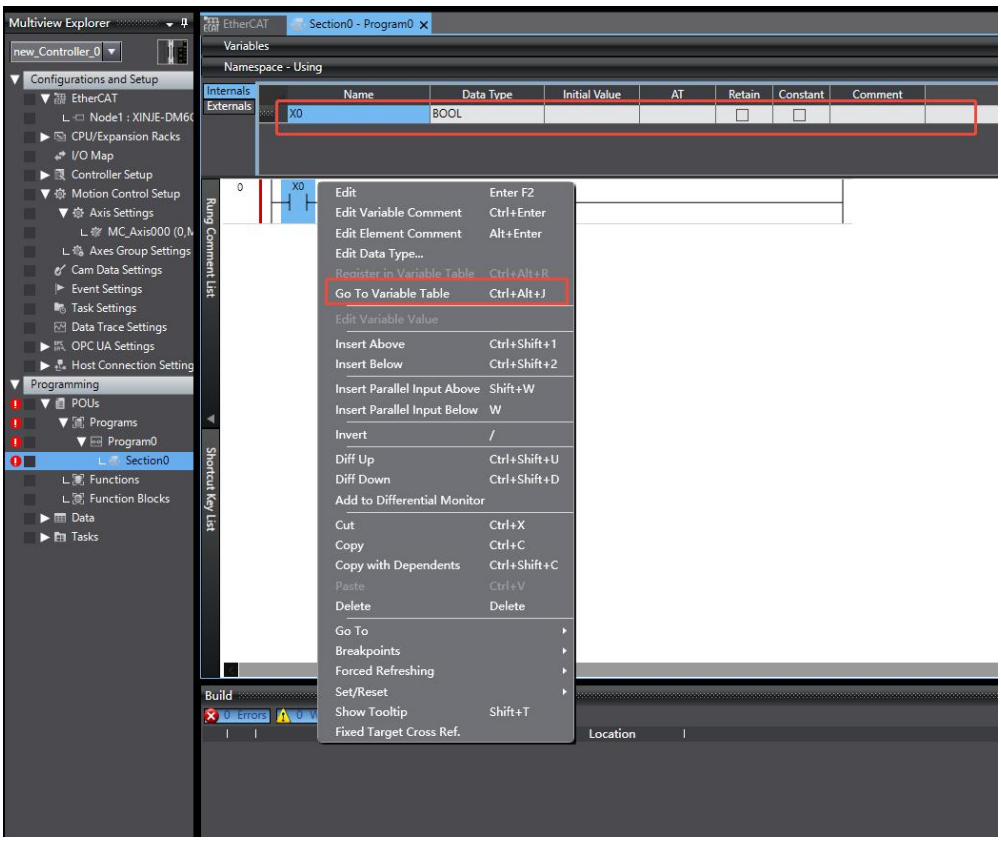




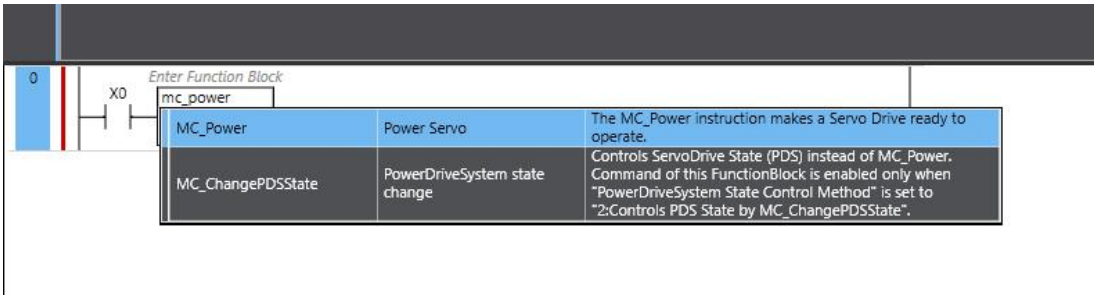
Select a "junction" and drag it directly into a ladder diagram node.



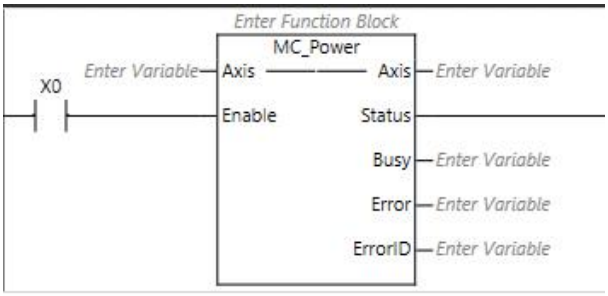
Click "Enter Variable" to enter a variable name. A new variable will be created if you enter a new name, or you can select an existing variable. New variables are listed in the variable table. Right-click variable X0 and select "Go to Variable Table" to expand it. The variable table allows you to create variables of various data types for use or view all defined variables.



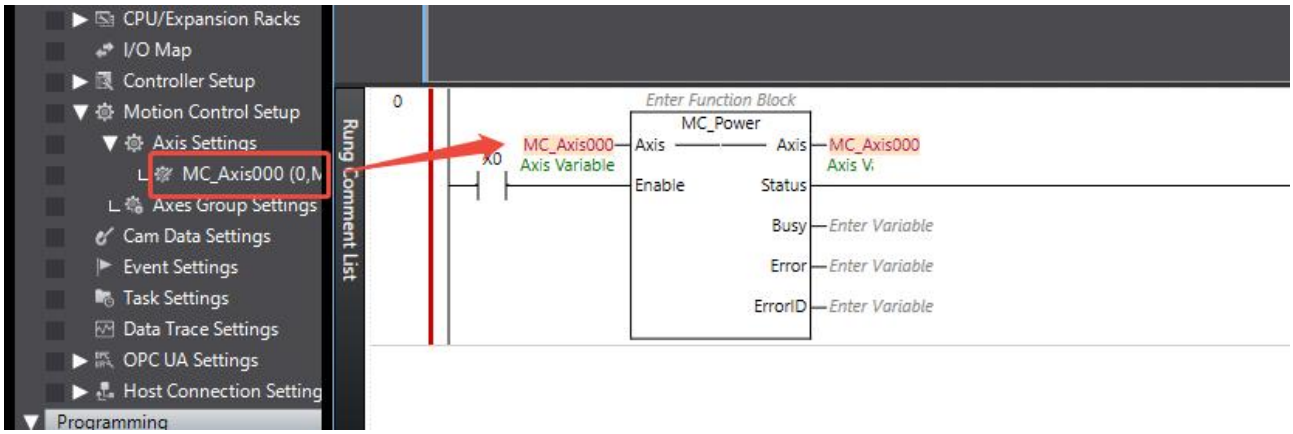
Add a "Function Block" in the same way in the ladder diagram.



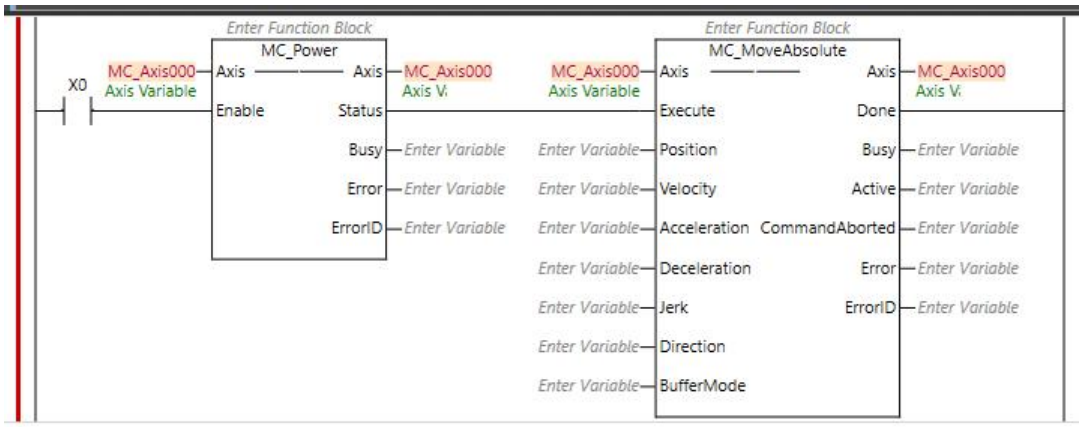
Enter a function block name to call its parameters. For example, enter "MC_Power" to declare this function block as MC_Power.



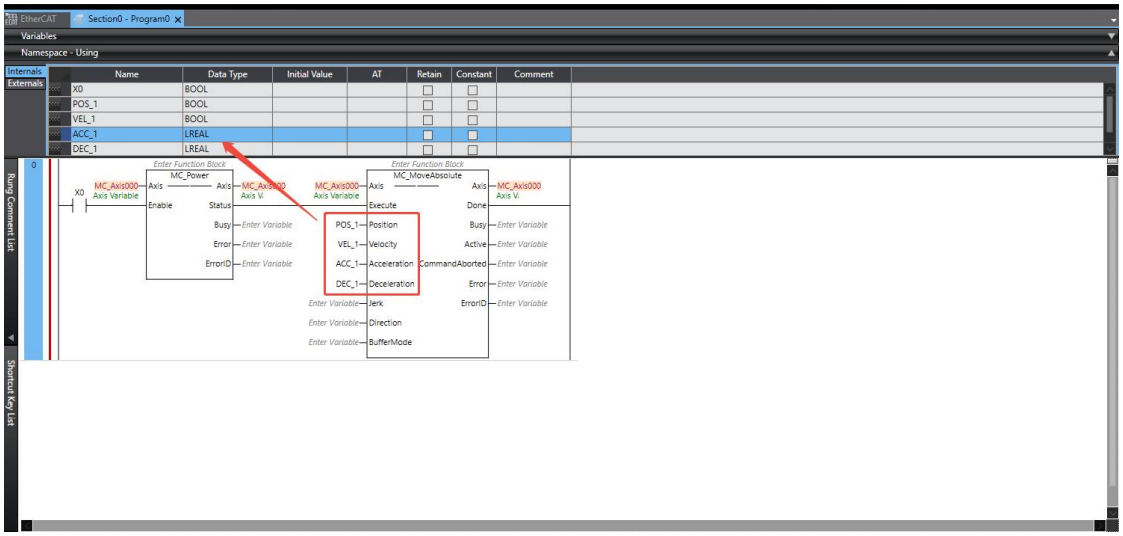
The Axis function block connects to the variable. Inputting MC_Axis000 indicates the axis 'MC_Axis000' is applied to the function block.



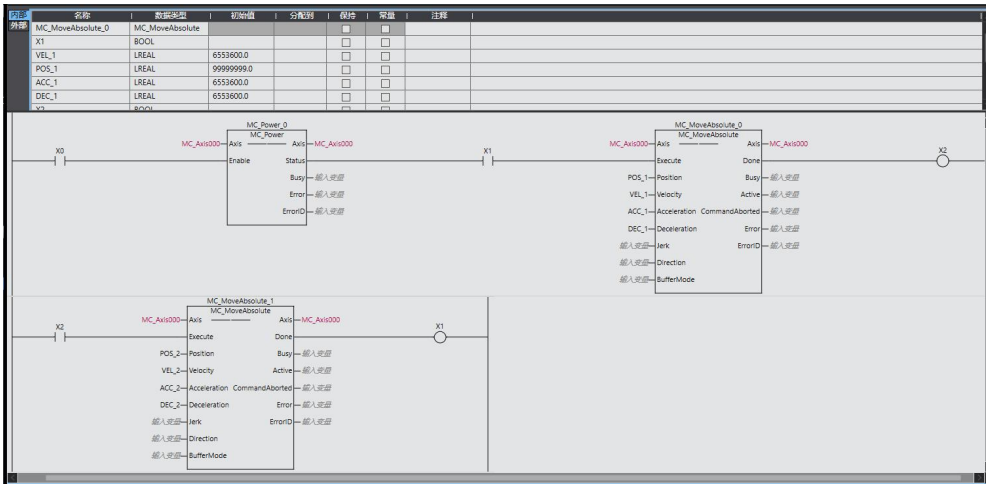
Add the function block "MC_MoveAbsolute" in the same manner, and define the variables "Pos_1", "Vel_1", "Acc_1", and "Dec_1" for the pins "Position", "Velocity", "Acceleration", and "Deceleration".



The defined variables can be assigned initial values in the variable table, which take effect during PLC operation.

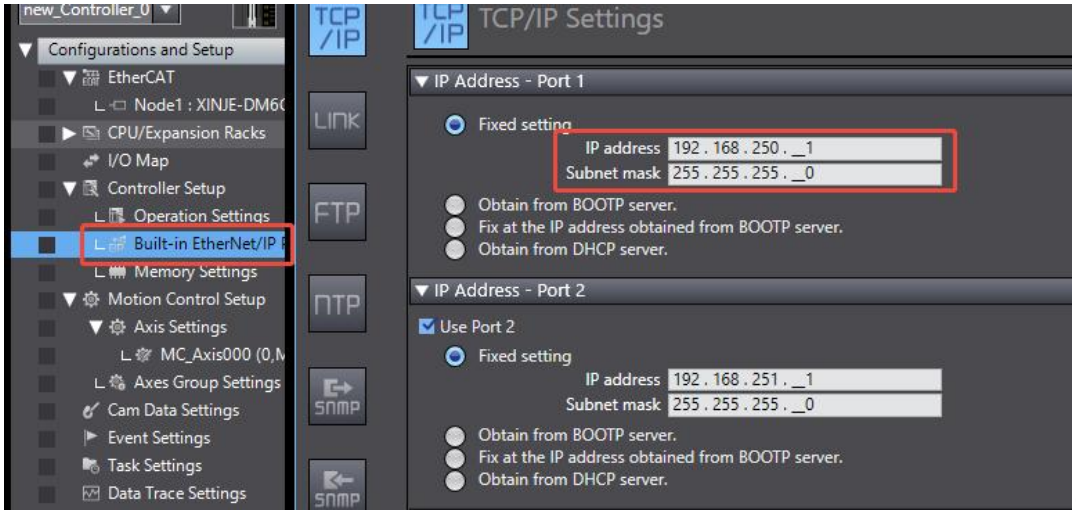


The same way to write the complete return motion ladder program.

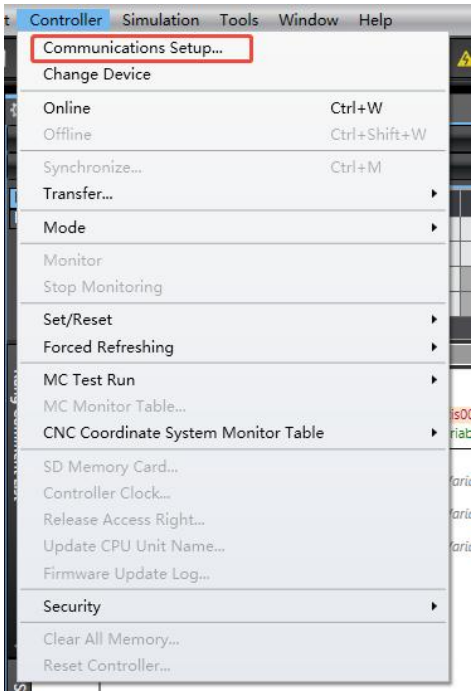


6) Gateway communication settings

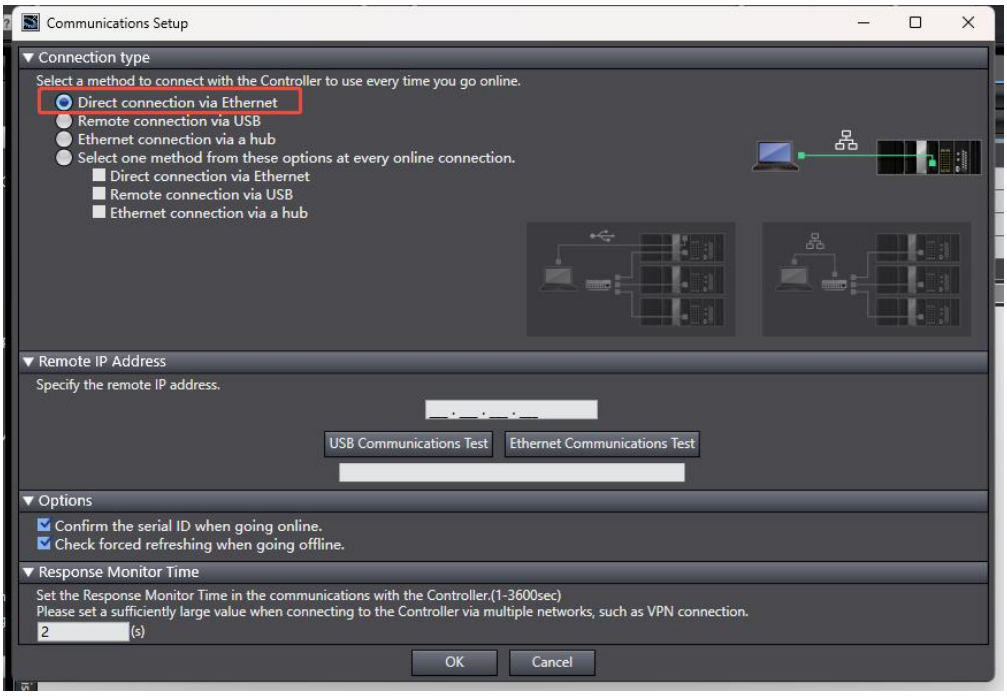
First, check the PLC's IP address: In the multi-view browser, select "Controller Settings-Built-in Ethernet/IP Port Settings" to access the "TCP/IP Settings" interface on the right. The configuration interface displays the fixed IP address assigned to the current project. For a new program, the default IP address is 192.168.250.1.



Communication configuration path: "Controller ⟶ Communication Settings".

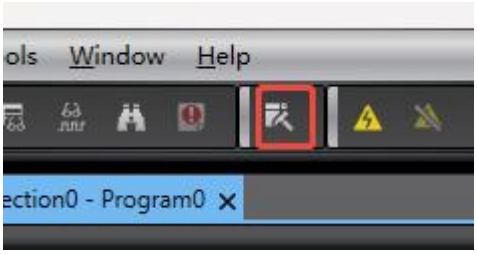


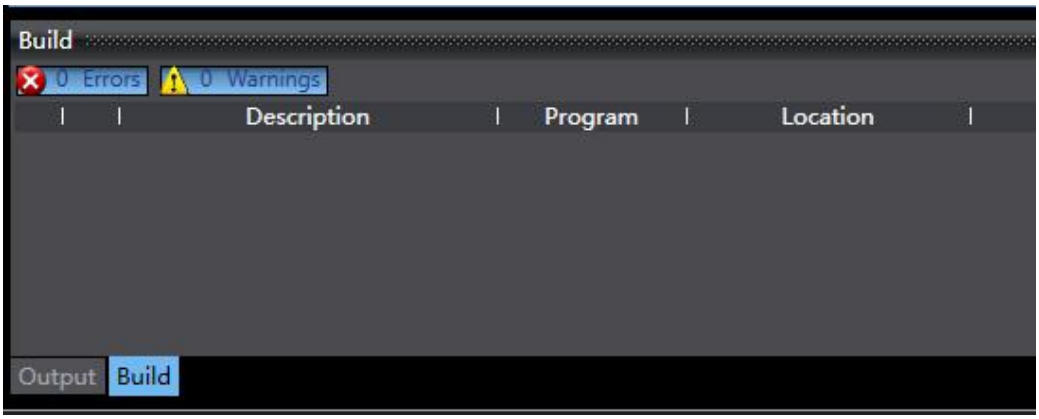
To establish an Ethernet connection, ensure the PC's IP address is either auto-allocated or within the PLC's IP address range. Before proceeding, verify that the PC's IP configuration meets the specified requirements.



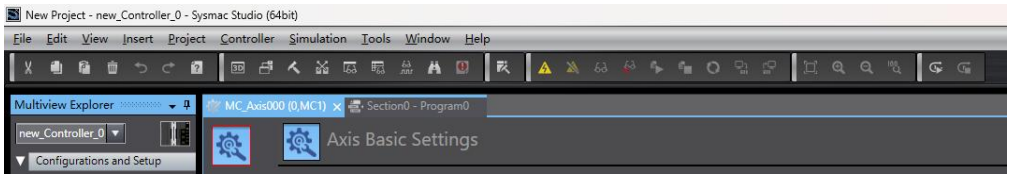
7) Compile and prepare for connection

Find the "Compile Controller" in the toolbar to compile the project. If errors occur, check the cause.

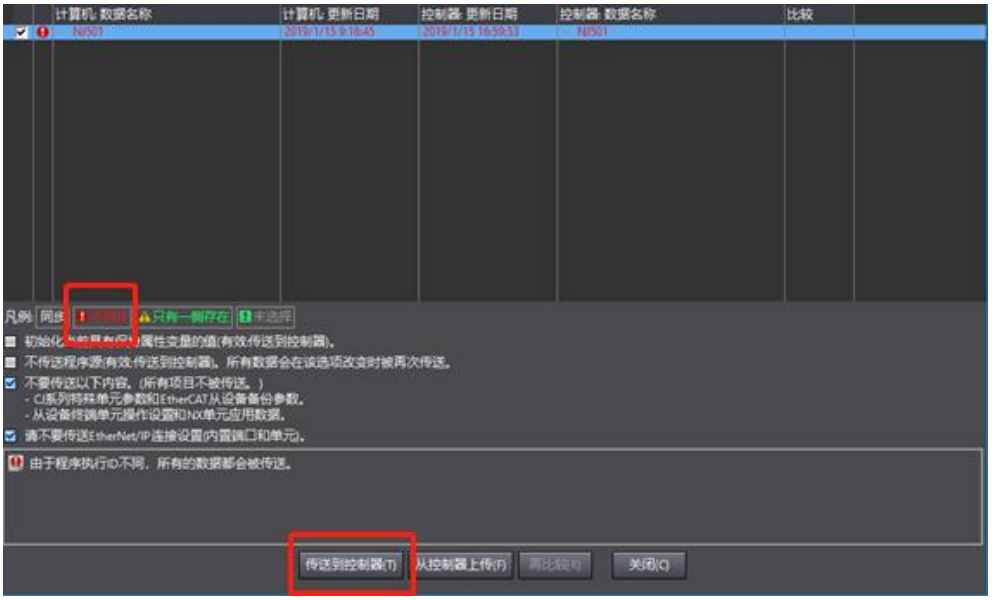


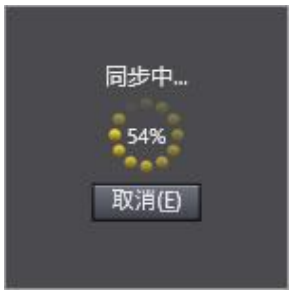


After compilation, find and click "Online" in the toolbar. If the pop-up "Connection to controller failed" appears, check the communication configuration. Once online, the host computer switches to online status.



Select Synchronize in the toolbar. A comparison window will compare the local project with the project in the controller. If the local project and the project in the controller are different, it will display Unsynchronized. Click Transfer to Controller to download the local project and overwrite the original project in the controller.

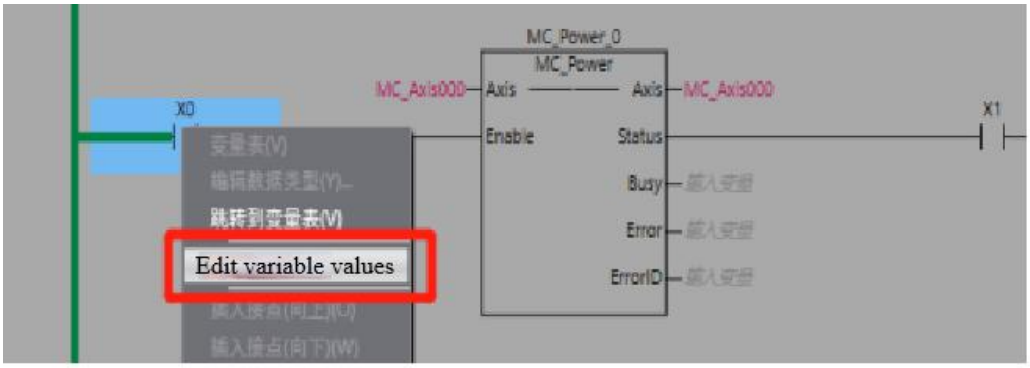


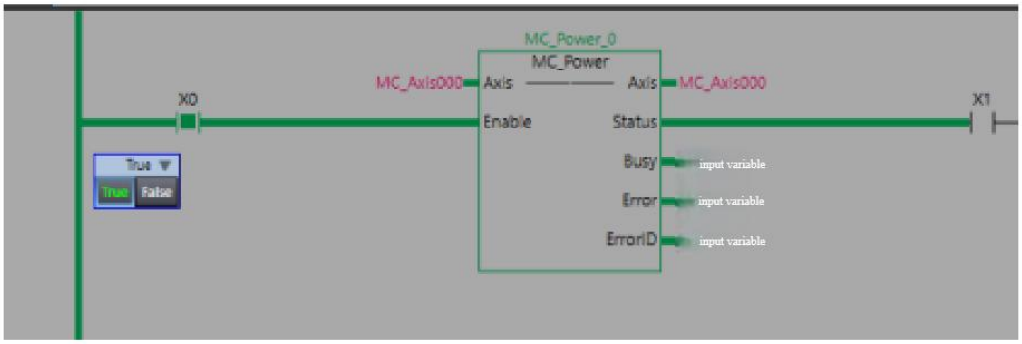


After synchronization, click "Compare Again" to check the synchronization status of entries between the local project and the controller project. Subsequent modifications will highlight entries differing from the controller project during synchronization.

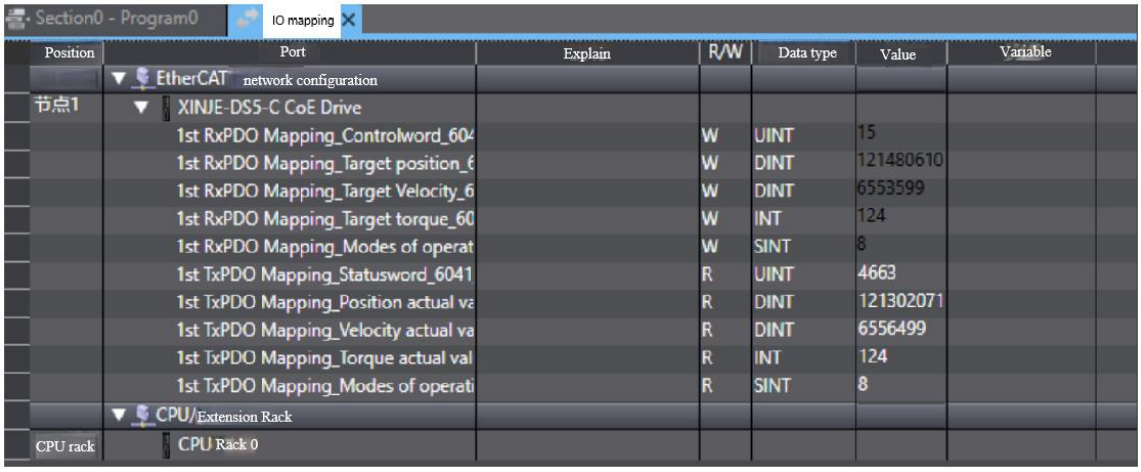
8) Online control

Right-click the variable "X0" in the "Section0" interface, select "Edit Variable Value", and switch the Boolean to "True". The function block "MC_Power" will activate, enabling the servo. Repeat the same operation to set the variable "X1" to "True", enabling the program's reciprocating motion.

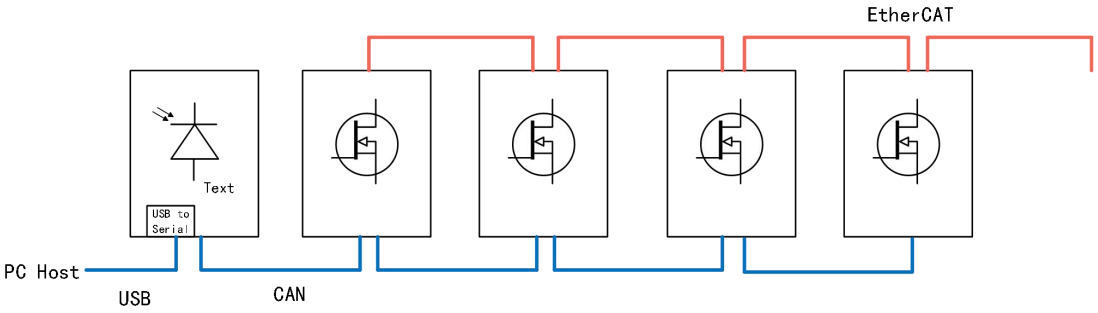




PDO object data can be monitored for real-time changes through "IO mapping".



12. Case of DM6C whole machine connection



CAN network diagram

The DM6C multi-functional servo is a dual-power supply model. During operation, first connect to the CAN communication network, then power the 24V and STO ports. Wait until the rectifier and inverter modules display "P-OFF" before applying 380V power. For power-off operations, first disconnect the 380V high-voltage power, then the 24V power. The rectifier and inverter modules require CAN communication to function properly.

Note that the rectifier module's CAN communication network port must connect to the downstream port, which has a built-in terminal resistor. For the inverter module, the network port should be oriented with the top inlet and bottom outlet when viewed from above.

To support the dual-power configuration, the inverter module must activate overcurrent and short-circuit protection upon detecting the rectifier module's enable completion. These protections are deactivated when the rectifier module's enable is turned off and the bus voltage drops below 400V, preventing false alarms caused by current sampling in the inverter module during power-off conditions.

- rectifier module

  The upper panel displays a '....' initialization effect lasting approximately 6 seconds, with one dot blinking per second. During this state, the rectifier module performs initialization and waits for the inverter module to fully start.

  The panel then displays the 'CAN' status, indicating that CAN communication is attempting to establish a connection. If it remains stuck in this state, it means the CAN communication cable is disconnected. At this point, U4-13 equals 0.

  The panel then displays "CAN--", indicating active CAN communication. At this point, U4-13 equals 1.

  When the alarm is not active, the panel will display 'P-OFF' indicating successful CAN communication connection, but the 380V AC power remains disconnected. At this point, U4-13 equals 3.

  Note: Alarm codes have the highest priority. When an alarm occurs, the panel displays the alarm code first.

- inverter module

  The rear panel displays a '------' effect after power-on. The inverter module's initialization panel shows the same display as the DS5C2.

After initialization, the panel displays a 'CAN' waiting status, indicating the inverter module is awaiting CAN communication. If it remains stuck in this state, it suggests the CAN communication cable is disconnected. At this point, P7-14 equals 0.

The panel then displays "CAN--", indicating active CAN communication. At this point, P7-14 equals 1.

When the alarm is not active, the panel will display 'P-OFF', indicating that CAN communication has been successfully established but the rectifier module remains disabled. At this point, P7-14 equals 3.

Note: Alarm codes have the highest priority and are displayed first on the panel when an alarm occurs.

Appendix

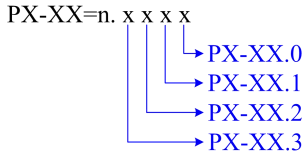
Appendix 1. List of driver parameters

Appendix 1.1 Functional parameters of the inverter module P group in the driver

Modification and effective time: "○" indicates modification during servo OFF, effective immediately.
√ indicates changes can be made at any time and take effect immediately.
● indicates that the changes require a power cycle to take effect.
The "▵" indicates that the setting can be changed at any time and takes effect when the motor is not rotating.

"▲" means it can be modified at any time and requires a power cycle to take effect.

For hexadecimal parameters, add the prefix "n." before the value to indicate that the current value is a hexadecimal number.
Parameter composition:



(1) Parameter P0 group

P0-XX	functional description	unit	factory value	setting scope	come into force opportunity	suit pattern
P0-00	Drive type 0: General Type 1: EtherCAT type	-	1	0 ~ 1	○	own
P0-01	P0-00=0: General type 1: Internal torque mode 3: Internal speed mode 5: Internal Position Pattern P0-00=1: EtherCAT type 1: Profile Position Control Mode (PP) 3: Profile Velocity Control Mode (PV) 4: Torque Control Mode (TQ) 6: Origin Regression Mode (HM) 8: Cycle Synchronization Position Control Mode (CSP) 9: Cycle Synchronization Speed Control Mode (CSV) 10: Cycle Synchronization Torque	-	0	1 ~ 10	○	own

P0-XX	functional description	unit	factory value	setting scope	come into force opportunity	suit pattern
	Control Mode (CST)					
P0-02	Control Mode 2 (as described above) When the C-SEL signal is active, the servo system will operate in the mode selected by P0-02.	-	0	1 ~ 10	○	own
P0-03	Enable mode: 0: Disable 1: IO /SON input signal 2: Software enable (Panel/Modbus) Panel F1-05 writes 1; Modbus writes 1 to register 0x2105. Writing 0 cancels enable 3: Bus enable	-	3	0~3	○	own
P0-04	rigidity class	-	13	0~41	△	own
P0-05	Rotation direction selection	-	0	0~1	●	own
P0-07	first inertia ratio	1%	200	0~50000	√	own
P0-09.0	Input pulse instruction in positive direction 0: Positive pulse count 1: Counting reverse pulses	-	0	0~1	●	6、7
P0-09.2	Input pulse instruction filter time	-	F	0~F	●	6、7
P0-09.3	Input pulse instruction filtering pre-assignment	-	0	0~7	●	6、7
P-10.0 xxx□	0：CW/CCW 1：AB 2：P+D	-	2	0~2	○	6、7
P0-11	Set the number of pulses per cycle in the lower bit ×1	-	0	0~9999	○	5、6
P0-12	Set the number of pulses per cycle to 10,000	-	0	0~65535	○	5、6
P0-13	electronic gear molecule	-	1	1~65535	√	5、6
P0-14	electronic gear denominator	-	1	1~65535	○	5、6
P0-15	Pulse frequency corresponding to the rated speed of the speed mode	100Hz	1000	0~10000	○	7
P0-16	Speed command pulse filtering time	0.01ms	100	0~10000	○	7
P0-23	pulse deviation limit	0.01 turn	2000	0~65535	√	5、6
P0-24	0: Cumulative discharge time 1: Average Power Mode 1 2: Average Power Mode 2	-	0	0~1	○	own
P0-25	Power value of the discharge resistor	W	drive power dependent	0~65535	○	own
P0-26	Resistance value of the discharge resistor	Ω		1~500	○	own
P0-27	Servo governor enables shutdown mode 0: Free stop, maintain free running state after stopping 2: Slow down and stop. After stopping, keep running freely.	-	0	0~5	○	own
P0-28	Servo overtravel stop mode	-	0	0~3	○	own

P0-XX	functional description	unit	factory value	setting scope	come into force opportunity	suit pattern
	(P0-28.0) 0: Slow down and stop 1 1: Inertial stop 2: Slow down and stop 2 3: Alarm stopped Overtravel alarm shield switch (P0-28.1) 0: Do not block overtime alerts 1: Disable overtravel alarm					
	EC bus over-run stop mode (P0-28.0) 0: Direct alarm, use servo deceleration and stop mode 1: Alarm after deceleration and shutdown in 605Ah mode 2: Do not use over-range	-	0	0~3	○	1|3|4|8|9|10
P0-29	servo alarm stop mode 0: Inertial operation stopped 2: Slow down and stop	-	0	0、2	○	own
P0-30	Stop timeout time	1ms	20000	0~65535	○	own
P0-31	stop time	1ms	25	0~5000	○	own
P0-33	motor code setting	-		0~65535	●	own
P0-53	Automatic reading of motor parameters; alarm shielding switch 0: Do not block alarms 1: Block the alarm for unreadable valid motor parameters	-	0	0/1	●	own
P0-55	open loop rotational speed	-	0	-6000~6000	○	own
P0-56	Number of encoder communication attempts	-	10	1~65535	○	own
P0-68.0~P0-68.1 xx□□	Number of consecutive errors in the alarm sequence when updating encoded data		0x05	0x01~0xFF	●	own
P0-68.2~P0-68.3 □□xx	E-241 alarm filtering frequency	-	0	0~0xFF	●	own
P0-69	**Fan switch (P0-69.0)** 0: Turn on the fan when temperature exceeds 45°C, and turn it off when it drops below 42 ° C (with a hysteresis of 3°C) 1: Turn on the fan when enabled, and turn it off when disabled **The Alarm Shield Switch of the Large Motor Thermocouple Wire Break (P0-69.1)** 0: Do not block the thermocouple break alarm 1: Disable thermocouple wire break alarm	-	1	0/1	√	own

P0-XX	functional description	unit	factory value	setting scope	come into force opportunity	suit pattern
P0-70	pulse instruction deviation limit	0.01 turn	200	0~65535	√	8
P0-74	Stall alarm time	1ms	0	0-65535	√	own
P0-75	Stall alarm speed	1rpm	50	5~9999	√	own
P0-79	Absolute encoder battery low voltage alarm switch 0: Used as an absolute encoder 1: Used as an incremental encoder 2: Use as an absolute encoder, ignoring multi-turn overflow alarm	-	1	0~2	●	own
P0-80	Protection method for the thermal power of the motor 0: Current protection 1: average thermal power protection 2: Simulation of thermal power protection	-	2	0~2	●	own
P0-92 ~ P0-93	32-bit electronic gear ratio molecule P0-11 ~ P0-14 is valid when 0. P0-92*1 + P0-93 *10000	-	1 1	1~9999 1~65535	○ (pattern 5) √ (pattern 6)	5、6
P0-94 ~ P0-95	32-bit electronic gear ratio P0-11 ~ P0-14 is valid when 0. P0-94*1 + P0-95 *10000	-	1 1	1~9999 1~65535	○ (pattern 5) √ (pattern 6)	5、6

(2) Parameter P1 group

P1-XX	functional description	unit	factory value	setting scope	come into force opportunity	suit pattern
P1-00	first speed loop gain	0.1Hz	300	10~20000	√	own
P1-01	first speed loop integral time constant	0.01ms	2653	15~51200	√	own
P1-02	first position loop gain	0.1/s	480	10~20000	√	own
P1-10	velocity feedforward gain	1%	0	0~300	√	5|6|7
P1-11	Speed feedforward filtering time	0.01ms	50	0~10000	√	5|6|7
P1-14	Gain Switching Mode Settings	-	0	0~0x00A2	√	own
P1-15	gain switching delay	ms	5	0~1000	√	own
P1-16	gain switching level threshold	-	50	0~20000	√	own
P1-17	gain switching hysteresis	-	30	0~20000	√	own
P1-18	position loop gain switching	ms	3	0~1000	√	own

P1-XX	functional description	unit	factory value	setting scope	come into force opportunity	suit pattern
	time					
P1-22	Selection of speed command filter 0: First-order low-pass filter 1: Moving Average Filter	-	0	0~1	○	3|4|7
P1-23	Speed command filter time parameter	0.1ms	0	0~65535	○	3|4|7
P1-24	Position command acceleration/deceleration filter time	0.1ms	0	0~65535	△	5|6
P1-25	position command smoothing filter time parameter	0.1ms	0	0~65535	△	5|6
P1-74	Encoder zero-bit offset detection cycle	-	1000	0~65535	√	own
P1-75	Encoder zero-bit offset detection threshold	-	10	0~255	√	own

(3) Parameter P2 group

P2-XX	name	unit	factory value	setting scope	come into force opportunity	suit pattern
P2-00.0	perturbation observer switch 0: Close 1: Open	-	0	0~1	○	own
P2-01.0	adaptive mode switch 0: Close 1: Open	-	0	0~1	●	own
P2-01.1	adaptive grade 0: High response 1: Low noise	-	By device model	0~1	●	own
P2-02.0	self-tuning mode Soft 2: Quick location 3: Quick positioning and overshoot control	-	3	1~3	√	own
P2-02.2	Load type (valid only during self-tuning) 1: Synchronous Belt 2: Screw 3: Rigid Connection	-	2	1~3	√	own
P2-03.3	adaptive load type 0: Small inertia mode 1: Large Inertia Mode	-	0	0~1	●	own
P2-05	Adaptive mode speed loop gain (standard)	0.1Hz	400	1~65535	○	own
P2-07	inertial ratio of adaptive mode (standard)	%	0	0~10000	○	own
P2-08	Gain of adaptive mode velocity observer (standard)	Hz	60	10~1000	○	own
P2-12	Maximum Inertia Ratio (Standard) for Adaptive Mode	-	30	1~10000	○	own

P2-XX	name	unit	factory value	setting scope	come into force opportunity	suit pattern
P2-15	Inertia Identification and Self-adjusting Maximum Stroke of Internal Command	0.01r	100	1~3000	√	own
P2-17	Inertia Identification and Self-adjusting Maximum Speed of Internal Command	-	0	0~65535	√	own
P2-18	Initial inertia ratio for inertia identification	%	500	1~20000	√	own
P2-19	adaptive mode bandwidth	%	50	1~100	○	own
P2-35	Torque command filter time constant 1	0.01ms	66	0~65535	√	own
P2-36	Torque command filter time constant 2	0.01ms	100	0~65535	√	own
P2-41	disturbance torque compensation coefficient (Non-adaptive mode is active)	%	85	0~100	√	own
P2-47.0	model loop switch 0: Close 1: Open	-	0	0~f	√	own
P2-49	model loop gain	0.1Hz	480	10~20000	√	3|4|5|6|7
P2-60.0	active vibration suppression switch 0: Close 1: Open	-	0	0~1	√	3|4|5|6|7
P2-60.1	active self-adjusting switch 0: Do not configure active vibration suppression during self-tuning 1: Configuration of active vibration suppression after self-tuning	-	1	0~1	√	3|4|5|6|7
P2-61	active vibration damping frequency	0.1Hz	1000	10~20000	√	own
P2-62	active vibration damping gain	%	100	1~1000	√	own
P2-63	active vibration damping	%	100	0~300	√	own
P2-64	Active vibration suppression frequency 1	-	0	-5000~5000	√	own
P2-65	Active vibration suppression frequency 2	-	0	-5000~5000	√	own
P2-69.0	Shackling filter 1 switch	-	0	0~1	√	own
P2-69.1	Shackling filter 2 switch	-	0	0~1	√	own
P2-69.3	Shackling filter 3 switch	-	0	0~1	√	own
P2-70.0	Shackling filter 4 switch	-	0	0~1	√	own
P2-70.1	Shackling filter 5 switch	-	0	0~1	√	own
P2-71	first notch frequency	Hz	8000	50~8000	√	own
P2-72	first notch attenuation	0.1dB	71	50~1600	√	own
P2-73	first notch bandwidth	Hz	0	0~1000	√	own
P2-74	second notch frequency	Hz	8000	50~8000	√	own
P2-75	second notch attenuation	0.1dB	71	50~1600	√	own
P2-76	second notch bandwidth	Hz	0	0~1000	√	own

P2-XX	name	unit	factory value	setting scope	come into force opportunity	suit pattern
P2-77	third notch frequency	Hz	8000	50~8000	√	own
P2-78	third stoppage attenuation	0.1dB	71	50~1600	√	own
P2-79	third notch bandwidth	Hz	0	0~1000	√	own
P2-80	fourth notch frequency	Hz	8000	50~8000	√	own
P2-81	fourth notch attenuation	0.1dB	71	50~1600	√	own
P2-82	fourth notch bandwidth	Hz	0	0~1000	√	own
P2-83	fifth notch frequency	Hz	8000	50~8000	√	own
P2-84	fifth notch attenuation	0.1dB	71	50~1600	√	own
P2-85	fifth notch bandwidth	Hz	0	0~1000	√	own

(4) Speed control parameter group P3

P3-XX	name	unit	factory value	setting scope	come into force opportunity	suit pattern
P3-05	Default speed 1	rpm	0	-9999~9999	√	3
P3-06	Preset Speed 2	rpm	0	-9999~9999	√	3
P3-07	Preset Speed 3	rpm	0	-9999~9999	√	3
P3-09	acceleration time	ms	200	0~65535	○	3|4|7
P3-10	deceleration time	ms	200	0~65535	○	3|4|7
P3-12	zero speed clamping mode	-	0	0~3	○	3|4|7
P3-13	zero speed clamp speed	rpm	10	0~300	○	3|4|7
P3-14	positive maximum speed limit	rpm	4000	0~10000	○	own
P3-15	reverse maximum speed limit	rpm	4000	0~10000	○	own
P3-16	Internal Forward Speed Limitation in Torque Control	rpm	2000	5~10000	√	1|2
P3-17	Internal Reverse Speed Limitation in Torque Control	rpm	2000	5~10000	√	1|2
P3-18	point velocity	rpm	100	0~1000	○	own
P3-19	positive warning speed	rpm	3000	0~10000	○	own
P3-20	reverse warning speed	rpm	3000	0~10000	○	own
P3-21	positive alarm speed	rpm	4000	0~10000	○	own
P3-22	Reverse alarm speed	rpm	4000	0~10000	○	own
P3-28	internal forward torque limit	%	By device model	0~Motor overload multiple	√	own
P3-29	internal reverse torque limit	%	By device model	0~Motor overload multiple	√	own
P3-30	external forward torque limit	%	By device model	0~Motor overload multiple	√	own
P3-31	external reverse torque limit	%	By device model	0~Motor overload multiple	√	own
P3-32	brake torque	1%	100	0~1000	√	own
P3-33	preset torque	%	0	-1000~1000	√	1
P3-38	Anti-reverse rotation and forward rotation torque limit	%	By device model	0~Motor overload multiple	√	own
P3-39	Anti-reverse rotation torque limit	%	By device	0~Motor	√	own

P3-XX	name	unit	factory value	setting scope	come into force opportunity	suit pattern
			model	overload multiple		
P3-45	friction compensation speed threshold	0.1rpm	20	0~200	√	1|2

(5) Internal position parameter group P4

P4-XX	name	unit	factory value	Set range	come into force opportunity	suit pattern
P4-00.0	Z Number of positive signs The number of Z signals after exiting the limit switch (Note: Stop when the n+1th Z signal arrives)	individual	2	0~f	○	5|6
P4-00.1	Enable or disable the origin search function 0: Not enabled Enable	-	0	0~1	○	5|6
P4-00.2	return to zero overtravel prohibition 0: Not prohibited 1: Prohibited	-	0	0~1	○	5|6
P4-01	velocity of collision with proximity switch	rpm	600	0~65535	○	5|6
P4-02	Speed of approaching the proximity switch	rpm	100	0~65535	○	5|6
P4-03.0	Set the positioning mode for the given internal location pattern 0: Relative Positioning 1: Absolute Positioning	-	0	0~1	○	5
P4-03.1	Set the step mode for the given internal location pattern 0: Switch steps when signal ON, can loop 1: Step by step on the rising edge of the signal 2: Start with the rising edge of the signal, execute all sequentially, no loop 3: Communication setting section number 4: /CHSTP bilateral trigger 5: Select section numbers for terminals/PREFA (P5-57), /PREFB (P5-58), and /PREFC (P5-59), with options 1 to 3. 6: Select section numbers for terminals/PREFA (P5-57), /PREFB (P5-58), /PREFC (P5-59), and /PREFD (P5-60), with options from 1 to 16.	-	0	0~6	○	5
P4-03.2	Internal location given pattern set to wait mode 0: Waiting for location to complete 1: Do not wait for positioning to	-	0	0~1	○	5

P4-XX	name	unit	factory value	Set range	come into force opportunity	suit pattern
	complete					
P4-04	Number of valid fields	-	0	0~35	○	5
P4-10～P4-11	first pulse	1pul	0	-327689999~327679999	√	5
P4-12	First paragraph speed	0.1rpm	0	0~65535	√	5
P4-13	First acceleration time	1ms	0	0~65535	√	5
P4-14	First deceleration time	1ms	0	0~65535	√	5
P4-16	adjust the time	1ms	0	0~65535	√	5
P4-10+(n-1)*7～P4-16+(n-1)*7	Pulse parameters for paragraphs 1 to 35 (n indicates the position segment number)	-	-	-	√	5
Note: 1) Set pulse count = (high bit pulse count) × 10000 + (low bit pulse count); 2) The system consists of 35 sections in total. Parameters for sections 1-12 can be configured via the control panel, while those for sections 13-35 require parameter writing through RS232 and RS485 communication interfaces.						

(6) Signal parameter settings for Group P5

P5-XX	name	unit	factory value	Set range	come into force opportunity	Applicable mode
P5-00	Complete Width/COIN	instruction unit	144	1~65535	√	5|6
P5-01	Complete detection mode	-	0	0~3	√	5|6
P5-02	Location completion time	ms	0	0~65535	√	5|6
P5-03	Rotation detection speed	rpm	50	0~10000	√	own
P5-04	same speed detection speed	rpm	50	0~10000	√	own
P5-05	detection speed	rpm	1000	0~10000	√	own
P5-06	Positioning close to the output width	instruction unit	655	1~65535	√	5|6
P5-07	Servo-off delay time	ms	500	-500~9999	○	own
P5-08	brake command output speed	rpm	30	20~10000	○	own
P5-09	brake command waiting time	ms	500	0~65535	○	own
P5-10	Custom output 1 trigger condition	-	0	0~ffff	√	own
P5-11	Value to compare with the trigger condition for Custom Output 1	Related to trigger conditions	0	-9999~9999	√	own
P5-12	Select Custom Output 1	-	0	0~3	√	own
P5-13	Set custom output 1 hysteresis	Related to trigger conditions	0	0~65535	√	own
P5-14	Custom Output 2 Trigger Condition	-	0	0~ffff	√	own
P5-15	Set the value to compare with the trigger condition of custom output 2	Related to trigger conditions	0	-9999~9999	√	own
P5-16	Select Custom Output 2	-	0	0~3	√	own
P5-17	Set custom output 2 hysteresis	Related to	0	0~65535	√	own

P5-XX	name	unit	factory value	Set range	come into force opportunity	Applicable mode
		trigger conditions				
P5-18	IO filter time multiplier	-	1	0~10000	√	own
P5-19	Z phase output hold time	ms	2	1~65535	√	own
P5-20.0~1	/S-ON: Servo signal 00: Set the signal to always "invalid" 01: Input positive signal from SI1 terminal 02: Input positive signal from SI2 terminal 03: Input positive signal from SI3 terminal 04: Input positive signal from SI4 terminal 10: Set the signal to always "active" 11: Input the reverse signal from terminal SI1 12: Input the reverse signal from the SI2 terminal 13: Input the reverse signal from the SI3 terminal 14: Input the reverse signal from the SI4 terminal	-	00	0~ff	√	own
P5-20.2	SI terminal filter time	ms	0	0~f	√	own
P5-21.0~1	P/CON ratio action instruction	-	00	0~ff	√	own
P5-21.2	SI terminal filter time	ms	0	0~f	√	own
P5-22.0~1	**In non-EtherCAT mode:** /P-OT: Forward drive is prohibited **EtherCAT mode:** Control mode 6 (return-to-zero mode), POT disabled	-	01	0~ff	√	own
P5-22.2	SI terminal filter time	ms	0	0~f	√	own
P5-23.0~1	**In non-EtherCAT mode:** -N/OT: Reverse drive is prohibited **EtherCAT mode:** Control Mode 6 (Reset Mode), NOT prohibition signal	-	02	0~ff	√	own
P5-23.2	SI terminal filter time	ms	0	0~f	√	own
P5-24.0~1	/ALM-RST: Alert Clear	-	0	0~ff	√	own
P5-24.2	SI terminal filter time	ms	0	0~f	√	own
P5-25.0~1	P-CL: Positive side external torque limit	-	00	0~ff	√	own
P5-25.2	SI terminal filter time	ms	0	0~f	√	own
P5-26.0~1	-N/CL: Reverse-side external torque limit	-	00	0~ff	√	own
P5-26.2	SI terminal filter time	ms	0	0~f	√	own
P5-27.0~1	**In non-EtherCAT mode:** **/SPD-D: Internal speed direction selection in EtherCAT mode:**	-	03	0~ff	√	1|2|3|4|7

P5-XX	name	unit	factory value	Set range	come into force opportunity	Applicable mode
	Control Mode 6 (Reset Mode), Home Origin Signal					
P5-27.2	SI terminal filter time	ms	0	0~f	√	1|2|3|4|7
P5-28.0~1	In non-EtherCAT mode: Speed mode: /SPD-A: Internal speed selection New original mode: /SPD-A: Trigger the original action Back to original mode: /SPD-A: Find the origin in forward direction	-	00	0~ff	√	3|5
P5-28.2	SI terminal filter time	ms	0	0~f	√	3|5
P5-29.0~1	In non-EtherCAT mode: Speed mode: /SPD-B: Internal speed selection Back to original mode: /SPD-B: Reverse direction to find the origin	-	00	0~ff	√	3|5
P5-29.2	SI terminal filter time	ms	0	0~f	√	3|5
P5-30.0~1	C-SEL: Control mode selection	-	00	0~ff	√	own
P5-30.2	SI terminal filter time	ms	0	0~f	√	own
P5-31.0~1	/ZCLAMP: Zero clamp	-	00	0~ff	√	3
P5-31.2	SI terminal filter time	ms	0	0~f	√	3
P5-32.0~1	INHIBIT: Inhibit instruction pulse	-	00	0~ff	√	5|6|7
P5-32.2	SI terminal filter time	ms	0	0~f	√	5|6|7
P5-33.0~1	G/SEL: gain switching	-	00	0~ff	√	own
P5-33.2	SI terminal filter time	ms	0	0~f	√	own
P5-34.0~1	/CLR: Pulse offset clear	-	00	0~ff	√	5|6
P5-34.2	SI terminal filter time	ms	0	0~f	√	5|6
P5-35.0~1	/CHGSTP: internal position pattern step signal	-	00	0~ff	√	5
P5-35.2	SI terminal filter time	ms	0	0~f	√	5
P5-36.0~1	I-SEL: Inertial Switching	-	00	0~ff	√	own
P5-36.2	SI terminal filter time	ms	0	0~f	√	own
P5-37	/COIN_HD: Positioning completed 00: No output to terminal 01: Positive signal output from SO1 terminal 02: Positive signal output from SO2 terminal 03: Positive signal output from SO3 terminal 11: Output the reverse signal from the SO1 terminal 12: Output the reverse signal from the SO2 terminal 13: Output the reverse signal from the SO3 terminal	-	0000	0~ffff	√	5|6

P5-XX	name	unit	factory value	Set range	come into force opportunity	Applicable mode
P5-38	/COIN: End of positioning	-	0001	0~ffff	√	5|6
P5-39	V-CMP: same speed detection	-	0000	0~ffff	√	3|4|7
P5-40	/TGON: Rotation Detection	-	0000	0~ffff	√	own
P5-41	/S-RDY: Ready	-	0000	0~ffff	√	own
P5-42	torque limit	-	0000	0~ffff	√	own
P5-43	VLT: Velocity Limit Detection	-	0000	0~ffff	√	1|2
P5-44	/BK: Brake interlock	-	0000	0~ffff	○	own
P5-45	/WARN： warn	-	0000	0~ffff	√	own
P5-46	/NEAR： be close to	-	0000	0~ffff	√	5|6
P5-47	/ALM： report to the police	-	0002	0~ffff	√	own
P5-48	/Z: Encoder Z positive signal output	-	0000	0~ffff	√	own
P5-50	/MRUN: Internal Position Pattern Movement Start Signal	-	0000	0~ffff	√	5
P5-51	V-RDY: Velocity reached	-	0000	0~ffff	√	3|4|7
P5-52	/USER1: Custom Output 1	-	0000	0~ffff	√	own
P5-53	/USER2: Custom Output 2	-	0000	0~ffff	√	own
P5-55	Interrupt the fixed-length output signal	-	0000	0~ffff	√	own
P5-56	/FCLOSE: Full closed switch	-	0000	0~ffff	√	5|6|8
P5-57	/PREFA: Internal Position Selection Signal A	-	0	0~ffff	√	5
P5-58	/PREFB: Internal Position Selection Signal B	-	0	0~ffff	√	5
P5-59	/PREFC: Internal Position Selection Signal C	-	0	0~ffff	√	5
P5-60	/PREFD: Internal position selection signal D	-	0	0~ffff	√	5
P5-61.0~1	/TRAJ-START: Trigger signal for the start of the exercise	-	00	0~ff	√	5
P5-62	Probe Function 1	—	0	0005	○	EtherCAT pattern
P5-63	Probe Function 2	—	0	0006	○	EtherCAT pattern
P5-70	/SRDY: Output condition selection 0: The terminal is activated after the driver initialization is complete 1: This terminal will conduct only after enabling	-	0	0~1	√	own
P5-71	Function Selection of Pulse Velocity Mode Direction Terminal	-	0	0~1	√	7

(7) Signal parameter settings for P6 group (some parameters retained)

P6-XX	name	unit	factory value	Set range	Trigger time	Applicable mode

P6-05	Adaptive Mode Speed Loop Gain (Large Inertia)	0.1Hz	200	1~65535	○	1|2|3|4|5|6|7
P6-07	inertia ratio of adaptive mode (large inertia)	%	50	0~10000	○	1|2|3|4|5|6|7
P6-08	Gain of adaptive mode velocity observer (large inertia)	Hz	40	10~1000	○	1|2|3|4|5|6|7
P6-12	Maximum Inertia Ratio (MIR) of Adaptive Mode	-	50	1~10000	○	1|2|3|4|5|6|7

(8) Communication parameter settings for Group P7

parameter	functional description		unit	leave the factory Windows default	short-cut process scope	come into force opportunity	Applicable mode
P7-00	RS485 station number		-	0	0~100	○	own
P7-01.0~1	RS485 baud rate		Baud rate	06	0~16	○	own
	00：300 01：600 02：1200 03：2400 04：4800 05：9600 06：19200 07：38400 08：57600 09：115200 0A：192000 0B：256000	0C：288000 0D：384000 0E：512000 0F：576000 10：768000 11：1M 12：2M 13：3M 14：4M 15：5M 16：6M					

parameter	functional description	unit
P7-01.2	RS485 stop bit 0:2 bits 2:1 position	stop bit
P7-01.3	RS485 parity bit 0-No validation 1-odd parity 2 parity	check bit
P7-02	RS485 communication protocol 1-Modbus RTU protocol 2-Xnet bus protocol 3-Read the Xnet bus torque	-
P7-03	Xnet synchronous sampling time	1ms
P7-04	Xnet slave data	-
P7-05	Number of Xnet slaves	-
P7-06	Number of retry attempts for communication timeout	Next
P7-07	bus instruction refresh period	1us
P7-08	Position deviation compensation threshold	-

parameter	functional description	unit
P7-09	Number of times for positional deviation compensation	-

P7-XX	name	unit	factory value	Set range	Trigger time
P7-10	RS232 station number (the factory default value will be updated once after power-on based on the inverter module's location)	-	1	0~100	○
P7-11.0~1	RS232 baud rate 00：300 01：600 02：1200 03：2400 04：4800 05：9600 06：19200 07：38400 08：57600 09：115200 0A：192000 0B：256000 0C：288000 0D：384000 0E：512000 0F：576000 10：768000 11：1M 12：2M 13：3M 14：4M 15：5M 16：6M	Baud rate	09	0~16	○
P7-11.2	RS232 stop bit 0:2 bits 2:1 position	stop bit	2	0~2	○
P7-11.3	RS232 parity bit 0: No validation 1: Odd parity 2: Parity check	check bit	2	0~2	○

(9) Parameter P8 group

P8-XX	name	unit	factory value	Set range	Trigger time	Applicable mode
P8-25	Panel selection	-	0	0~2	▲	own

(10) Full closed-loop parameter P9 group

P9-XX	name	Windows default	Parameter range	Trigger time	remarks

P9-XX	name	Windows default	Parameter range	Trigger time	remarks
P9-00.0	Full closed-loop control mode switch	0	0~3	√	0: Turn off full closed-loop control; 1: Enable full closed-loop control; 2: Select the SI terminal method to enable/disable the full closed-loop system; 3: Select the ECAT bus method to enable/disable the full closed-loop system;
P9-00.1	grating scale counting direction	0	0，1	●	0: Use the grating scale directly 1: Use after reversing the grating scale count value
P9-00.2	grating scale type	0	0~2	●	0: AB phase counter 1: Incremental serial communication (not supported) 2: Absolute serial communication (not supported)
P9-01.0	Selection of speed feedback in full closed-loop control	0	0，1	●	0: Use motor encoder speed; 1: Use the grating speed.
P9-01.1	Z Sign source	0	0，1	●	0: Motor encoder Z phase 1: Z-axis grating scale (not supported in new return original mode)
P9-01.2	servo pulse output	0	0，1	●	0: Motor encoder ABZ output 1: Raster scale ABZ output
P9-02	Alarm threshold for excessive deviation between motor and load positions	100	0~65535	○	The resolution of the grating scale is taken as the standard
P9-03	Motor-load position deviation clearance setting	0	0~65535	○	0: Motor-load position difference not cleared n: The motor clears the load-position deviation after rotating n full turns.
P9-04	Motor-load speed deviation alarm threshold	100	0~65535	○	Alarm off when RPM is 0
P9-05	The number of feedback pulses per revolution of	0	0~9999	●	When the set value is 0, set the encoder resolution to the fractional numerator (P9-06*10000+ P9-05).

P9-XX	name	Windows default	Parameter range	Trigger time	remarks
	the motor encoder is low.				
P9-06	The motor encoder provides a high number of feedback pulses per revolution.	0	0~9999	●	P9-06*10000+ P9-05
P9-07	The number of feedback pulses per turn of the grating scale is low.	0	0~9999	●	When the set value is 0, P9-08*10000+ P9-07 sets 10000 as the frequency divider denominator.
P9-08	High number of feedback pulses per turn of the grating scale	1	0~9999	●	P9-08*10000+ P9-07
P9-09	Full closed-loop integration time constant	500	0~65535	○	0.01ms

Appendix 1.2 Functional parameters of the F-group inverter module of the drive

Function code	explain
F0-00	Clear alarm
F0-01	Restore factory settings
F0-02	Clear positional deviation
F1-00	crawl
F1-01	pilot run
F1-02	current sampling zeroing
F1-05	Enable panel
F1-06	Absolute encoder clearance circle count

Appendix 1.3 Inverter module U group monitoring parameters of the driver

U0-XX:

monitoring number	content		unit
U0-00	Current speed of the servo motor		Rpm
U0-01	Input speed command		Rpm
U0-02	torque command		% specified
U0-03	mechanical angle		1°
U0-04	electric degress		1°
U0-05	busbar voltage		V
U0-06	IPM temperature		0.1℃
U0-07	torque feedback		% specified
U0-08	pulse deviation value	(-9999～9999) *1	command pulse
U0-09		(-32768～32767) *10000	
U0-10	encoder feedback value	0000～9999	encoder pulse
U0-11		(0000～65535) *10000	
U0-12	Input command pulse count	(-9999～9999) *1	command pulse
U0-13		(-32768～32767) *10000	
U0-14	position feedback	(-9999～9999) *1	command pulse
U0-15		(-32768～32767) *10000	
U0-18	torque current		0.01A
U0-19	V-REF value for analog input		0.001V
U0-20	T-REF value for analog input		0.001V
U0-21	Input signal state 1		
U0-22	Input Signal State 2		
U0-23	Output Signal State 1		
U0-24	Output Signal State 2		
U0-25	input pulse frequency	(0000～9999) *1	Hz
U0-26		(0000～9999) *10000	

monitoring number	content	unit
U0-41	instantaneous output power	1W
U0-42	average output power	1W
U0-43	instantaneous thermal power	1W
U0-44	mean thermal power	1W
U0-49	position feedforward	1 instruction unit
U0-50	velocity feedforward	rpm
U0-51	torque feedforward	% specified
U0-52	Instantaneous bus capacitive power	1W
U0-53	Average bus capacitor power	1W
U0-55	instantaneous regenerative braking discharge power	1W
U0-56	average regenerative braking discharge power	1W
U0-57	The absolute encoder's current position feedback is 32 bits low	Encoder position
U0-58		
U0-59	The absolute encoder's current position feedback is 32 bits high	Encoder position
U0-60		
U0-89	position instruction end flag	
U0-91	Number of turns in a multi-turn absolute value motor	
U0-98	Temperature of high-power motors	0.1℃

U1-XX：

monitoring number	content	unit
U1-00	Current alarm code	
U1-01	Current warning code	
U1-02	U-phase current at the time of alarm	0.01A
U1-03	V-phase current at the time of alarm	0.01A
U1-04	bus voltage at the time of alarm	V
U1-05	IGBT temperature at the time of alarm	0.1℃
U1-06	torque current at the time of alarm	0.01A
U1-07	excitation current at the time of alarm	A
U1-08	Location deviation at the time of the alarm	command pulse
U1-09	Speed value at the time of alarm	rpm
U1-10	The time in seconds when the alarm was triggered (16-bit lower 16-bit). The count starts from the first power-on.	s
U1-11	The time in seconds when the alarm was triggered (16-bit high). The count starts from the first power-on.	s
U1-12	The number of runtime errors is calculated after this power-on	
U1-13	The number of operation warnings is calculated after this power-on.	
U1-14	Total historical alarm count	
U1-15	Total historical warnings	
U1-16	The second alarm code recently	
U1-17	The third alarm code recently	
U1-18	The 4th alarm code recently	
U1-19	The 5th alarm code recently	
U1-20	The 6th alarm code recently	

monitoring number	content	unit
U1-21	The 7th alarm code recently	
U1-22	The 8th alarm code recently	
U1-23	The 9th alarm code recently	
U1-24	The 10th alarm code recently	
U1-25	The 11th alarm code recently	
U1-26	The 12th alarm code recently	
U1-27	The 13th alarm code recently	
U1-28	The 14th alarm code recently	
U1-29	The 15th alarm code recently	
U1-30	The 16th alarm code recently	
U1-31	The 17th alarm code recently	
U1-32~U1-47	Recent warning codes 2 through 17	

U2-XX：

monitoring number	content		unit
U2-00	Power-up count		-
U2-01	series		-
U2-02	Model (16-bit)		-
U2-03	Model (16-bit)		-
U2-04	Production date: Year		-
U2-05	Production date: Month		-
U2-06	Production date:		-
U2-07	firmware version		-
U2-08	Hardware version		-
U2-09	Total runtime (from the first power-on)		hour
U2-10	Total runtime (from the first power-on)		minute
U2-11	Total runtime (from the first power-on)		second
U2-12	Run time (from the last power-on)		hour
U2-13	Run time (from the last power-on)		minute
U2-14	Run time (from the last power-on)		second
U2-15	Average output power (the average power during the enabling process from the first enable)		1W
U2-16	Average heating power (the average power during the enabling process from the first enabling)		1W
U2-17	Average bus capacitor filter power (the average power during the power-on period from the first power-on)		1W
U2-18	Total number of turns of the motor	(0000～9999) *1	shut in a pen
U2-19		(0000～9999) *10000	shut in a pen
U2-20	Device serial number: 16 bits lower		
U2-21	Device serial number: 16-digit		
U2-22	Firmware generation date: Year		
U2-23	Firmware generation date: Month/Day		
U2-24	Firmware generation time: hours/minutes		

U3-XX：

monitoring number	content	unit

U3-00	Motor code for automatic reading (including thermal power parameters)	-
U3-01	Motor version	-
U3-02	Encoder version	-
U3-68	Cumulative number of communication timeouts for rectification and inversion processes	-
U3-70	Automatically reads the motor code from the encoder in motor parameters (only related to the motor code)	-

U4-XX：

monitoring number	content	unit
U4-10	Resonant Frequency Detected by Fast FFT	Hz
U4-11	Raw data from the grating scale	1. Grating scale feedback pulse
U4-12	Raw data from the grating scale	1. Grating scale feedback pulse
U4-13	The original Z-phase number of the grating scale	-
U4-16	accumulated value of continuous overload operation for thermal power protection	-
U4-17	accumulated instantaneous overload operation value of thermal power protection	-

Appendix 1.4 Rectifier module P group function parameters of the driver

Modification and effective time: "○" indicates modification during servo OFF, effective immediately.

√ indicates changes can be made at any time and take effect immediately.

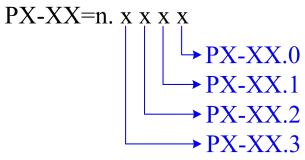
● indicates that the changes require a power cycle to take effect.

The "△" indicates that the setting can be changed at any time and takes effect when the motor is not rotating.

"▲" means it can be modified at any time and requires a power cycle to take effect.

For hexadecimal parameters, add the prefix "n." before the value to indicate that the current value is a hexadecimal number.

Parameter composition:



parameter	functional description	unit	factory value	setting scope	come into force opportunity	suit scope
P0-01	Busbar under-voltage warning threshold After rectifier startup, measure the bus voltage	V	350	0~1000	√	1|2|3|4|5|6|7|8|9|10
P0-02	Busbar overvoltage warning threshold	V	700	0~1000	√	1|2|3|4|5|6|7|8|9|10
P0-03	Busbar under-voltage alarm threshold After rectifier startup, measure the bus voltage	V	300	0~1000	√	1|2|3|4|5|6|7|8|9|10
P0-04	The busbar voltage exceeds the P0-04 set value and remains above it for the duration of P0-05, triggering alarm E-030.	V	780	0~1000	√	1|2|3|4|5|6|7|8|9|10
P0-05	Bus voltage filtering time constant	0.1ms	20	0~1000	√	1|2|3|4|5|6|7|8|9|10
P0-06	Busbar overvoltage immediate alarm threshold	V	780	0~1000	√	1|2|3|4|5|6|7|8|9|10

parameter	functional description	unit	factory value	setting scope	come into force opportunity	suit scope
	If the bus voltage exceeds the set value, an alarm is triggered immediately.					
P0-07	Fan switch 0: Mode 1: Fan on when temperature exceeds 45°C, off when below 42°C (hysteresis 3°C) 1: Mode 2: The fan runs continuously after enabling	-	1	0、1	√	1|2|3|4|5|6|7|8|9|10
P0-08.0	Enter the phase loss protection switch 0: Not protected 1: Protection	-	1	0、1	√	1|2|3|4|5|6|7|8|9|10
P0-08.1	Overvoltage protection switch 0: Not protected 1: Protection	-	1	0、1	√	1|2|3|4|5|6|7|8|9|10
P0-08.2	Enter the three-phase unbalanced protection switch. 0: Not protected 1: Protection	-	1	0、1	√	1|2|3|4|5|6|7|8|9|10
P0-09	Communication Abnormal Protection of Rectifier and Inverter Module 0: Not protected 1: Protection	-	1	0、1	√	1|2|3|4|5|6|7|8|9|10
P0-10	Rectification and Inversion Communication Timeout Time	10ms	500	100~2000	√	1|2|3|4|5|6|7|8|9|10
P0-14	0: Disable 1: Auto-enable, parallel inverter auto soft start 2: Software enables soft start without parallel inverters, with F1-05=1 activation	-	1	0~2	√	1|2|3|4|5|6|7|8|9|10
P0-16	The signal source for the station is lost. 0: AC signal 1: Bus voltage threshold	-	0	0、1	√	1|2|3|4|5|6|7|8|9|10
P0-17	Voltage threshold for power failure from the station	V	250	0~500	○	1|2|3|4|5|6|7|8|9|10

parameter	functional description	unit	factory value	setting scope	come into force opportunity	suit scope
P5-18	IO filter time multiplier The filtering time of the SI terminal is the same as that of the data terminal.	-	1	0~10000	√	1|2|3|4|5|6|7|8|9|10
P7-00	RS485 station number	-	1	0~100	○	1|2|3|4|5|6|7|8|9|10
P7-01.0~1	RS485 baud rate 00：300 01：600 02：1200 03：2400 04：4800 05：9600 06：19200 07：38400 08：57600 09：115200 0A：192000 0B：256000 0C：288000 0D：384000 0E：512000 0F：576000 10：768000	bit/s	06	0~16	○	1|2|3|4|5|6|7|8|9|10

parameter	functional description	unit	factory value	setting scope	come into force opportunity	suit scope
	11：1M 12：2M 13：3M 14：4M 15：5M 16：6M					
P7-01.2	RS485 stop bit 0:2 bits 2:1 position	bit	2	0~2	○	1|2|3|4|5|6|7|8|9|10
P7-01.3	RS485 parity bit 0: No validation 1: Odd parity 2: Parity check	-	2	0~2	○	1|2|3|4|5|6|7|8|9|10
P7-02	RS485 communication protocol 1: Modbus RTU protocol 2: Xnet bus protocol	-	1	1~255	○	1|2|3|4|5|6|7|8|9|10
P7-03	Xnet synchronous sampling time	1ms	9	1~500	○	10
P7-04	Xnet slave data	-	15	1~500	○	10
P7-05	Number of Xnet slaves	-	10	1~256	○	10
P7-06	Number of retry attempts for communication timeout	Next time	10	1~500	○	10
P7-07	bus instruction refresh period	1us	3000	1~65535	○	10
P7-08	Position deviation compensation threshold	-	0	0	√	10
P7-09	Number of times for positional deviation compensation	-	0	0	√	10
P7-10	RS232 station number	-	1	0~100	√	1|2|3|4|5|6|7|8|9|10
P7-11.0	RS232 baud rate	bit/s	06	0~16	√	1|2|3|4|5|6|7|8|9|10

parameter	functional description	unit	factory value	setting scope	come into force opportunity	suit scope
~1	00：300 01：600 02：1200 03：2400 04：4800 05：9600 06：19200 07：38400 08：57600 09：115200 0A：192000 0B：256000 0C：288000 0D：384000 0E：512000 0F：576000 10：768000 11：1M 12：2M 13：3M 14：4M					

parameter	functional description	unit	factory value	setting scope	come into force opportunity	suit scope
	15：5M 16：6M					
P7-11.2	RS232 stop bit 0:2 bits 2:1 position	bit	2	0、2	√	1|2|3|4|5|6|7|8|9|10
P7-11.3	RS232 parity bit 0: No validation 1: Odd parity 2: Parity check	-	2	0~2	√	1|2|3|4|5|6|7|8|9|10
P8-00	Sampling Channel 1	-	0203	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-01	Sampling Channel 2	-	0205	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-02	Sampling Channel 3	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-03	Sampling Channel 4	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-04	Sampling Channel 5	-	0301	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-05	Sampling Channel 6	-	0302	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-06	Sampling Channel 7	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-07	Sampling Channel 8	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-08	Sampling Channel 9	-	1634	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-09	Sampling channel 10	-	4452	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-10	Sampling Channel 11	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-11	Sampling channel 12	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-12	Sampling channel 13	-	0502	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-13	Sampling channel 14	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10

parameter	functional description	unit	factory value	setting scope	come into force opportunity	suit scope
P8-14	Sampling channel 15	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-15	Sampling channel 16	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-16	sampling configuration 1: Manual sampling 2: Auto Sampling 3: Trigger Sampling 4: Enable sampling 5: Signal Sampling 6: Incorrect sampling 7: Positional sampling 8: Enable sampling	-	1	0~8	√	1|2|3|4|5|6|7|8|9|10
P8-17	sampling interval	-	36	1~65535	√	1|2|3|4|5|6|7|8|9|10
P8-18	dwell time	-	1024	0~65535	√	1|2|3|4|5|6|7|8|9|10
P8-19	trigger channel	-	0	0~ffff	√	1|2|3|4|5|6|7|8|9|10
P8-20	Trigger threshold is 16 bits lower	-	0	0~65535	√	1|2|3|4|5|6|7|8|9|10
P8-21	Trigger threshold is 16 bits higher	-	0	0~65535	√	1|2|3|4|5|6|7|8|9|10
P8-22	trigger slope	-	0	0~65535	√	1|2|3|4|5|6|7|8|9|10
P8-23	Sampling ratio	%	100	0~100	√	1|2|3|4|5|6|7|8|9|10
P8-25	Display content settings directly on the panel when powered on 0: Power-up display bb 1: The power supply shows the speed feedback of U0-00 2: Power-on display shows U0-07 torque feedback	-	0	0~2	▲	1|2|3|4|5|6|7|8|9|10

Appendix 1.5 Function parameters of the U group of the driver rectifier module

U0-XX	functional description	unit
U0-00	busbar voltage	V

U0-XX	functional description	unit
U0-01	rectifier temperature	℃
U0-02	Enter the RMS value of the RS voltage	V
U0-03	Enter the RMS value of the ST voltage	V
U0-04	Enter the RMS value of the TR voltage	V
U0-05	Enter the RS phase	°
U0-06	Enter ST phase	°
U0-07	Enter TR phase	°
U0-08	Enter the three-phase imbalance degree.	%
U0-09	Enter the harmonic content of the RS voltage.	%
U0-10	Enter the ST voltage harmonic content percentage	%
U0-11	Enter the harmonic content of the TR voltage.	%
U0-12	Mean value of the RS voltage sampling channels	-
U0-13	Mean value of ST voltage sampling channels	-
U0-14	Mean value of TR voltage sampling channels	-
U1-00	Current alarm code	-
U1-01	Current warning code	-
U1-02	SR voltage at alarm	V
U1-03	ST voltage at the time of alarm	V
U1-04	SR voltage at alarm	V
U1-05	SR Phase at Alarm Occurrence	°
U1-06	ST Phase at Alarm Occurrence	°
U1-07	TR Phase at Alarm Occurrence	°
U1-08	bus voltage at the time of alarm	V
U1-09	Rectifier temperature at the time of alarm	℃
U1-10	The time in seconds when the alarm was triggered (16-bit lower 16-bit). This is the cumulative count since the first power-on.	s
U1-11	The time in seconds when the alarm was triggered (16-bit high). This is the cumulative count since the first power-on.	s
U1-12	The number of runtime errors is calculated after this power-on	-
U1-13	The number of operation warnings is calculated after this power-on.	-
U1-14	Total historical alarm count	-
U1-15	Total historical warnings	-
U1-16	The first alarm code recently	-
U1-17	The second alarm code recently	-
U1-18	The third alarm code recently	-

U0-XX	functional description	unit
U1-19	The 4th alarm code recently	-
U1-20	The 5th alarm code recently	-
U1-21	The 6th alarm code recently	-
U1-22	The 7th alarm code recently	-
U1-23	The 8th alarm code recently	-
U1-24	The 9th alarm code recently	-
U1-25	The 10th alarm code recently	-
U1-26	The 11th alarm code recently	-
U1-27	The 12th alarm code recently	-
U1-28	The 13th alarm code recently	-
U1-29	The 14th alarm code recently	-
U1-30	The 15th alarm code recently	-
U1-31	The 16th alarm code recently	-
U1-32	First recent warning code	-
U1-33	Second recent warning code	-
U1-34	The third warning code recently	-
U1-35	The 4th warning code recently	-
U1-36	The 5th warning code recently	-
U1-37	The 6th warning code recently	-
U1-38	The 7th warning code recently	-
U1-39	The 8th warning code recently	-
U1-40	The 9th warning code recently	-
U1-41	The 10th recent warning code	-
U1-42	The 11th recent warning code	-
U1-43	The 12th recent warning code	-
U1-44	The 13th recent warning code	-
U1-45	The 14th recent warning code	-
U1-46	The 15th warning code	-
U1-47	The 16th warning code	-
U2-00	Power-up count	-
U2-01	series	-
U2-02	Model (16-bit)	-
U2-03	Model (16-bit)	-
U2-04	Production date: Year	-
U2-05	Production date: Month	-
U2-06	Production date:	-
U2-07	firmware version	-
U2-08	Hardware version	-
U2-09	Total runtime (from the first power-on)	hour hour
U2-10	Total runtime (from the first power-on)	minute minute

U0-XX	functional description	unit
U2-11	Total runtime (from the first power-on)	second second
U2-12	Run time (from the last power-on)	hour hour
U2-13	Run time (from the last power-on)	minute minute
U2-14	Run time (from the last power-on)	second second
U2-15	average output power	-
U2-16	mean thermal power	-
U2-17	average capacitive power	-
U2-18	The motor's total operating position is at the lower level (x1).	-
U2-19	The motor's total operating position is at the high level x10000.	-
U2-20	Low bit of the drive serial number	-
U2-21	High bit of the drive serial number	-
U2-22	Firmware production date: Year	-
U2-23	Firmware production date: Month Day	-
U2-24	Firmware production date: hour and minute	-
U2-25	ModelLow	-
U2-26	ModelHigh	-
U2-27	Monitoring register	-
U2-28	ModelIndex	-
U2-29	Panel version	-
U2-30	FPGA firmware version number	-
U4-00	SI1 input edge change calculation value	-
U4-01	SI2 input edge change calculation value	-
U4-02	SI3 input edge change calculation value	-
U4-03	SI4 input edge change calculation value	-
U4-04	SI5 input edge change calculation value	-
U4-05	SI6 input edge change calculation value	-
U4-06	SI7 input edge change calculation value	-
U4-07	SI8 input edge change calculation value	-
U4-08	SI9 input edge change calculation value	-
U4-09	SI10 input edge change calculation value	-
U4-10	Resonant Frequency Detected by Fast FFT	Hz
U4-12	Number of CAN slave devices	-
U4-13	CAN slave status	-

Appendix 1.6 Rectifier module F group function parameters of the driver

F0-XX	functional description	unit
F0-00	Clear alarm	-

F0-01	Restore factory settings	-

Appendix 2. List of object dictionaries

object dictionary area allocation

All objects are configured in the object dictionary of each group through a 16-bit index address represented by a 4-digit hexadecimal.

The object dictionaries for CoE (CANopen over EtherCAT) specified in CiA402 and the DM6C series are defined as follows:

CiA402 object dictionary		Object Dictionary of DM6C Series	
index of matrix	content	index of matrix	content
0000h ~ 0FFFh	Data Type Area	0000h ~ 0FFFh	Data Type Area
1000h ~ 1FFFh	COE communication area	1000h ~ 1FFFh	COE communication area
2000h ~ 5FFFh	Manufacturer Custom Region	2000h ~ 2FFFh	servo parameter area
		3000h ~ 3FFFh	continue to have
		4000h ~ 4FFFh	continue to have
		5000h ~ 5FFFh	continue to have
6000h ~ 9FFFh	Profile region	6000h ~ 6FFFh	Drive Profile Area
		7000h ~ 9FFFh	continue to have
A000h ~ FFFFh	continue to have	A000h ~ FFFFh	continue to have

Appendix 2.1 COE Communication Range (0x1000-0x1FFF)

index of matrix	subindex	name	unit	data area	data type	sign	PDO
1000h	00h	device type	-	0~429496795	U32	RO	NO
1001h	00h	error register type of alarm	-	0~65535	U16	RO	NO
1008h	00h	Device name	-	-	-	RO	NO
1009h	00h	Hardware version	-	-	-	RO	NO
100Ah	00h	Software version	-	-	-	RO	NO
1018h	00h	Identity factory information	-	-	-	RO	-
	01h	vendor ID Supplier ID	-	0~255	U8	RO	NO
	02h	product code	-	0~429496795	U32	RO	NO
	03h	Revision Version Number	-	0~429496795	U32	RO	NO
	04h	Serial number	-	0~429496795	U32	RO	NO
1600h	00h	1st RxPDO mapping	-	0~24	U8	RW	NO

index of matrix	subindex	name	unit	data area	data type	sign	PDO
		Enter the number of mapping objects supported by RxPDO1					
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1601h	00h	2nd RxPDO mapping The number of mapping objects supported by RxPDO2	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1602h	00h	3rd RxPDO mapping The number of mapping objects supported by RxPDO3	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1603h	00h	4th RxPDO mapping The number of mapping objects supported by RxPDO4	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1A00h	00h	1st TxPDO mapping Number of objects supported by TxPDO1	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1A01h	00h	2nd TxPDO mapping Number of mapped objects supported by TxPDO2	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO

index of matrix	subindex	name	unit	data area	data type	sign	PDO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1A02h	00h	3rd TxPDO mapping Number of mapped objects supported by TxPDO3	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1A03h	00h	4th TxPDO mapping Number of mapped objects supported by TxPDO3	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	Second mapping object	-	0~4294967295	U32	RW	NO
	03h	Third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1C00h	00h	Sync mangager communication type Communication type	-	0~255	U8	RO	NO
	01h	Sub index of matrix 001	-	0~4	U8	RO	NO
	02h	Sub index of matrix 002	-	0~4	U8	RO	NO
	03h	Sub index of matrix 003	-	0~4	U8	RO	NO
	04h	Sub index of matrix 004	-	0~4	U8	RO	NO
1C12h	00h	RxPDO assigns the RxPDO allocation.	-	0~4	U8	RW	NO
	01h	Subindex 1	-	1600h~1603h	U16	RW	NO
	02h	Subindex 2	-	1600h~1603h	U16	RW	NO
	03h	Subindex 3	-	1600h~1603h	U16	RW	NO
	04h	Subindex 4	-	1600h~1603h	U16	RW	NO
1C13h	00h	TxPDO assigns the TxPDO allocation.	-	0~4	U8	RW	NO
	01h	Subindex 1	-	1A00h~1A03h	U16	RW	NO
	02h	Subindex 2	-	1A00h~1A03h	U16	RW	NO
	03h	Subindex 3	-	1A00h~1A03h	U16	RW	NO
	04h	Subindex 4	-	1A00h~1A03h	U16	RW	NO
1C32h	00h	Sync manager 2 synchronization Sync Management Channel 2	-	0~20h	U8	RO	NO
	01h	Number of sub-objects	-	0~65535	U16	RW	NO
	02h	Sync mode	ns	0~4294967295	U32	RW	NO
	03h	Cycle time	ns	0~4294967295	U32	RW	NO
	04h	Shift time	-	0~65535	U16	RO	NO
	05h	Sync modes supported Set supported sync types	ns	0~4294967295	U32	RO	NO

index of matrix	subindex	name	unit	data area	data type	sign	PDO
	06h	Minimum cycle time Minimum communication cycle	ns	0~4294967295	U32	RO	NO
	08h	Calc and copy time From SM2 event and SYNC0 event to ESC read completion time	ns	0~65535	U16	RO	NO
	09h	Command (not supported)	ns	0~4294967295	U32	RO	NO
	0Ah	Delay time (not supported)	-	0~4294967295	U32	RO	NO
	0Bh	Sync0 cycle time The value in register 09A0h of the ESC is set to DC SYNC0 (1C32h-01h=02h). For other DC SYNC0 values, the value is set to 0.	-	0~65535	U16	RO	NO
	0Ch	Cycle time is too short (not supported)	-	0~65535	U16	RO	NO
	0Dh	SM event missed (not supported)	-	0~65535	U16	RO	NO
	0Eh	Shift time is too short (not supported)	-	0~65535	U16	RW	NO
	20h	RxPDO toggle failed (not supported)	-	0~1	BOOL	RO	NO
1C33h	00h	Sync manager 3 synchronization Sync Management Channel 3	-	0~20h	U8	RO	NO
	01h	Number of sub-objects	-	0~65535	U16	RW	NO
	02h	Sync mode	ns	0~4294967295	U32	RW	NO
	03h	Cycle time	ns	0~4294967295	U32	RW	NO
	04h	Shift time	-	0~65535	U16	RO	NO
	05h	Sync modes supported Set supported sync types	ns	0~4294967295	U32	RO	NO
	06h	Minimum cycle time Minimum communication cycle	ns	0~4294967295	U32	RO	NO
	08h	Calc and copy time From SM2 event and SYNC0 event to ESC read completion time	ns	0~65535	U16	RO	NO
	09h	Command (not supported)	ns	0~4294967295	U32	RO	NO
	0Ah	Delay time (not supported)	-	0~4294967295	U32	RO	NO
	0Bh	Sync0 cycle time The value in register 09A0h of the ESC is set to DC SYNC0 (1C32h-01h=02h). For other DC SYNC0 values, the value is set to 0.	-	0~65535	U16	RO	NO
	0Ch	Cycle time is too short (not supported)	-	0~65535	U16	RO	NO
	0Dh	SM event missed (not supported)	-	0~65535	U16	RO	NO
	0Eh	Shift time is too short (not supported)	-	0~65535	U16	RW	NO
	20h	RxPDO toggle failed (not supported)	-	0~1	BOOL	RO	NO

Appendix 2.2 Servo parameter range

index of matrix	subindex	name
2000h	00h	P0-00
2001h	00h	P0-01
2002h	00h	P0-02
2003h	00h	P0-03
...	...	...
205Fh	00h	P0-95
2100h	00h	P1-00
2101h	00h	P1-01
2102h	00h	P1-02
2103h	00h	P1-03
...	...	...
214Ah	00h	P1-74
2200h	00h	P2-00
2201h	00h	P2-01
2202h	00h	P2-02
2203h	00h	P2-03
...	...	...
2263h	00h	P2-99
2300h	00h	P3-00
2301h	00h	P3-01
index of matrix	subindex	name
2302h	00h	P3-02
2303h	00h	P3-03
...	...	...
232Eh	00h	P3-46

index of matrix	subindex	name
2500h	00h	P5-00
2501h	00h	P5-01
2502h	00h	P5-02
2503h	00h	P5-03
...	...	...
2547h	00h	P5-71
2700h	00h	P7-00
2701h	00h	P7-01
2702h	00h	P7-02
2703h	00h	P7-03
...	...	...
2715h	00h	P7-21
2800h	00h	P8-00
2801h	00h	P8-01
2802h	00h	P8-02
2803h	00h	P8-03
...	...	...
281Ah	00h	P8-26

Appendix 2.3 Profile region (0x6000~0x6FFF)

index of matrix	son index of matrix	name	unit	data area	data type	sign	PDO
6007h	00h	Abort connection option code	-	0~3	I16	RW	NO
603Fh	00h	Error Code	-	0~65535	U16	RO	TxPDO
6040h	00h	Control word	-	0~65535	U16	RW	RxPDO
6041h	00h	Status word	-	0~65535	U16	RO	TxPDO
605Ah	00h	Quickstop option code Quick shutdown mode selection	-	0~7	I16	RW	NO

index of matrix	son index of matrix	name	unit	data area	data type	sign	PDO
605Bh	00h	Shutdown option code Shut-down option code	-	0~1	I16	RW	NO
605Ch	00h	Disable the operation option code to pause the shutdown mode selection	-	0~1	I16	RW	NO
605Dh	00h	Halt option code Pause option code	-	1~3	I16	RW	NO
605Eh	00h	Fault reaction option code failure mode and effect code	-	0~2	I16	RW	NO
6060h	00h	Modes of operation mode control word	-	-128~127	I8	RW	RxPDO
6061h	00h	Modes of operation display Mode control word display	-	-128~127	I8	RO	TxPDO
6062h	00h	Position demand value [PUU] Position instruction	instruct unit	-2147483648~2147483647	I32	RO	TxPDO
6063h	00h	Actual internal position feedback	1 encoder unit	-2147483648~2147483647	I32	RO	TxPDO
6064h	00h	Position actual value position feedback	instruct unit	-2147483648~2147483647	I32	RO	TxPDO
6065h	00h	Following error window Excessive position deviation threshold	instruct unit	0~4294967295	U32	RW	RxPDO
6066h	00h	Following error time out Error timeout	1ms	0~65535	U16	RW	RxPDO
6067h	00h	Position windows Location reaches the threshold	instruct unit	0~4294967295	U32	RW	RxPDO
6068h	00h	Position window Time to reach the position threshold	1ms	0~65535	U16	RW	RxPDO
606Bh	00h	Velocity demand value velocity instruction	instruct unit /s	-2147483648~2147483647	I32	RO	TxPDO
606Ch	00h	Actual velocity value; speed feedback	instruct unit /s	-2147483648~2147483647	I32	RO	TxPDO
606Dh	00h	Velocity window Speed reaches the threshold	instruct unit	0~4294967295	U32	RW	RxPDO
606Eh	00h	Velocity window time speed to window time	1ms	0~65535	U16	RW	RxPDO
606Fh	00h	Velocity threshold	instruct unit	0~4294967295	U32	RW	RxPDO
6070h	00h	Velocity threshold time Speed threshold time	1ms	0~65535	U16	RW	RxPDO
6071h	00h	target torque	0.10%	-32768~32767	I16	RW	RxPDO
6072h	00h	Maximum torque	0.10%	0~65535	U16	RW	RxPDO
6073h	00h	Maximum current	0.10%	0~65535	U16	RO	NO
6074h	00h	Torque demand value	0.10%	-32768~32767	I16	RO	TxPDO

index of matrix	son index of matrix	name	unit	data area	data type	sign	PDO
		torque command					
6075h	00h	Motor rated current Rated current of the motor	1mA	0~4294967295	U32	RO	TxPDO
6076h	00h	Motor rated torque motor rated torque	Mn·m	0~4294967295	U32	RO	TxPDO
6077h	00h	Actual torque value | Torque feedback	0.10%	-32768~32767	I16	RO	TxPDO
6078h	00h	Current actual value Current actual value	0.10%	-32768~32767	I16	RO	TxPDO
6079h	00h	DC link circuit voltage busbar voltage	mV	0~4294967295	U32	RO	TxPDO
607Ah	00h	Target position	instruct unit	-2147483648~2147483647	I32	RW	RxPDO
607Bh	Position range limit						-
	00h	Number of entries Number of subindexes	-	2	U8	RO	NO
	01h	Min position range limit Minimum position range limit	instruct unit	-2147483648~2147483647	I32	RW	RxPDO
	02h	Max position range limit Maximum location range limit	instruct unit	-2147483648~2147483647	I32	RW	RxPDO
607Ch		Home Offset Origin Offset	instruct unit	-2147483648~2147483647	I32	RW	RxPDO
607Dh	Software absolute position limit						-
	00h	Number of entries Number of subindexes	-	2	U8	RO	NO
	01h	Min position limit Minimum position limit	instruct unit	-2147483648~2147483647	I32	RW	RxPDO
	02h	Max position limit Maximum location limit	instruct unit	-2147483648~2147483647	I32	RW	RxPDO
607Eh	00h	Polarity instruction polarity	-	0~255	U8	RW	NO
607Fh	00h	Max Profile velocity maximum outline velocity	instruct unit /s	0~4294967295	U32	RW	RxPDO
6080h	00h	Max motor speed maximum motor speed	r/min	0~4294967295	U32	RW	RxPDO
6081h	00h	Profile velocity Contour speed	instruct unit /s	0~4294967295	U32	RW	RxPDO
6082h	00h	End velocity	Command unit/s	0~4294967295	U32	RW	RxPDO
6083h	00h	Profile acceleration contour acceleration	instruction units/s²	0~4294967295	U32	RW	RxPDO
6084h	00h	Profile deceleration contour deceleration	instruction units/s²	0~4294967295	U32	RW	RxPDO
6085h	00h	Quick stop deceleration rapid deceleration	instruction units/s²	0~4294967295	U32	RW	RxPDO
6086h	00h	Motion profile type Location trajectory	-	-32768~32767	I16	RW	RxPDO

index of matrix	son index of matrix	name	unit	data area	data type	sign	PDO
		planning type					
6087h	00h	Torque slope	0.1%/S	0~4294967295	U32	RW	RxPDO
6088h	00h	Torque profile type Torque planning type	-	0-65535	I16	RW	RxPDO
608Fh	-	Position encoder resolution Position encoder resolution	-	-	-	-	-
	00h	Number of entries subindex	-	2	U8	RO	NO
	01h	Sub index of matrix 001	pulse	1~4294967295	U32	RO	NO
	02h	Sub index of matrix 002	r (any power-generating or power-driven machine)	1~4294967295	U32	RO	NO
6091h	-	gear ratio setting	-	-	-	-	-
	00h	Indicates the 6091h sub-index number	-	2	U8	RO	NO
	01h	motor rotation number	r (any power-generating or power-driven machine)	1~4294967295	U32	RW	NO
	02h	rotation number	r (axle)	1~4294967295	U32	RW	NO
6092h	-	Feed constant settings	-	-	-	-	-
	00h	Indicates the 6092h sub-index number	-	2	U8	RO	NO
	01h	Set the Feed value	instruct unit	1~4294967295	U32	RW	NO
	02h	rotation number	r (axle)	1~4294967295	U32	RW	NO
6093h	00h	Position factor	No supported				
6098h	00h	homing method	-	-128~127	I8	RW	RxPDO
6099h	homing speed						-
	00h	Number of entries	-	2	U8	RO	NO
	01h	Sub index of matrix 001	Command unit/s	0~4294967295	U32	RW	RxPDO
	02h	Sub index of matrix 002	Command unit/s	0~4294967295	U32	RW	RxPDO
609Ah	00h	Homing acceleration return to zero acceleration	-	0~4294967295	U32	RW	RxPDO
60A3h	-	Profile jerk use	Not supported				
60A4h	00h	Profile jerk					
	01h	Sub index of matrix 001					
	02h	Sub index of matrix 002					
60B0h	00h	Position offset	Not supported				
60B1h	00h	Velocity offset					
60B2h	00h	Torque offset					
60B8h	00h	Touch probe function probe function	-	0~65535	U16	RW	RxPDO

index of matrix	son index of matrix	name	unit	data area	data type	sign	PDO
60B9h	00h	Touch probe status probe state	-	0~65535	U16	RO	TxPDO
60BAh	00h	Touch probe pos1 pos value Probe 1 rising edge position value	instruct unit	-2147483648~2147483647	I32	RO	TxPDO
60BBh	00h	Touch probe pos1 neg value Probe 1 rising edge position value	instruct unit	-2147483648~2147483647	I32	RO	TxPDO
60BCh	00h	Touch probe pos2 pos value Probe 2 rising edge position value	instruct unit	-2147483648~2147483647	I32	RO	TxPDO
60BDh	00h	Touch probe pos2 neg value Probe 2 rising edge position value	instruct unit	-2147483648~2147483647	I32	RO	TxPDO
60C0h		Interpolation sub mode select	No supported				
60C1h	-	Interpolation data record					
	00h	Number of entries					
	01h	Sub index of matrix 001					
	02h	Sub index of matrix 002					
60C2h	-	Interpolation time period	-	-	-	-	-
	00h	Number of entries	-	2	U8	RO	TxPDO
	01h	Sub index of matrix 001	-	0~4294967295	U32	RW	TxPDO
	02h	Sub index of matrix 002	-	0~4294967295	U32	RW	TxPDO
60C5h	-	Max acceleration maximal acceleration	instruction units/s²	0~4294967295	U32	RW	RxPDO
60C6h	-	Max deceleration maximum deceleration	instruction units/s²	0~4294967295	U32	RW	RxPDO
60E0h	00h	Positive torque limited positive torque limit	No supported				
60E1h	00h	Negtive torque limited reverse torque limit	No supported				
60E3h	Supported Homing method						TxPDO
	00h	Number of entries Number of subindexes	-	1~254	U8	RO	TxPDO
	01h	1st supported Homing method Original method 1 supported	-	0~32767	U16	RO	TxPDO
	..	..	..	..	..	..	..
	20h	32nd supported Homing method The restore method supports 32 restore methods	-	0~32767	U16	RO	TxPDO
60F2h	00h	Positioning option code	-	0~32767	U16	RW	RxPDO

index of matrix	son index of matrix	name	unit	data area	data type	sign	PDO
		Location options code					
60F4h	00h	Position deviation of the actual value of the error	instruct unit	-2147483648~2147483647	I32	RO	TxPDO
60FAh	00h	After the error, the actual value of the internal instruction speed	Command unit/s	-2147483648~2147483647	I32	RO	TxPDO
60FCh	00h	Position demand value position instruction	pulse	-2147483648~2147483647	I32	RO	TxPDO
60FDh	00h	Digital inputs	Digital inputs				
60FEh	-	Digital outputs	No supported				
	00h	Number of entries					
	01h	Physical outputs					
	02h	Bit mask					
60FFh	00h	Target velocity	Command unit/s	0~4294967295	U32	RW	RxPDO
6502h	00h	Supported drive modes Supported drive mode	-	0~4294967295	U32	RO	TxPDO

- The object dictionaries 607Bh (Position Range Limited) and 607Dh (Softward Position Limited) have default values: Min range limited: -2147483648; Max range limited: 2147483647.

This parameter modification does not work.

- 6086h (Motion Profile Type)

Parameter 0: Step type 1: Slope type

This parameter applies only to HM mode. It is the slope type used directly in the trajectory planning of PP and PV modes.

In CSP and CSV modes, this parameter is unnecessary, as trajectory planning is handled by the master station.

- 6088h (Torque profile type)

Parameter 0: Step type 1: Slope type

Appendix 3. Glossary

the abbreviated form of a name	full name	description
EtherCAT	Ethernet for Control Automation Technology	The Communication Function of Ethernet for Automation Control Technology
COE	CANopen Over EtherCAT	CAN Application Protocol Based on EtherCAT
FMMU	Fieldbus Memory Management Unit	fieldbus memory management unit
SM	Sync Manager	Sync Manager
pp	Profile position	Internal Location Control Mode
pv	Profile velocity	Internal speed control mode
tq	Torque profile	internal torque control mode
csp	Cyclic synchronous position mode	cyclic position control mode
hm	Homing mode	origin reset position control mode
csv	Cyclic synchronous velocity mode	cyclic speed control mode
cst	Cyclic synchronous torque mode	cyclic torque control mode
DC	Distributed Clock	distributed clock
SDO	Service Data Object	A service data object for transmitting non-periodic communication data
PDO	Process Data Object	Process data object for transmitting periodic communication data
TxPDO	-	PDO from slave to master
RxPDO	-	PDO from master to slave
ESM	EtherCAT State Machine	EtherCAT state machine
ESC	EtherCAT Salve Controller	station controller
PHY	Physical layer device that converts data from the Ethernet controller to electric or optical signals.	A physical layer device that converts data from Ethernet controllers into electrical or optical signals.
PDI	Process Data Interface or Physical Device Interface	process data interface
EEPROM	Electrically Erasable Programmable Read Only Memory	A programmable read-only memory for non-volatile storage of ESC configuration and device descriptions. Connected to the ESI interface.
ESI	EtherCAT Slave Information, stored in ESI EEPROM（formerly known as SII）	EtherCAT data is stored in the ESI EEPROM (formerly known as SII).

Manual update log

Information about the revision of the data is recorded together with the data number in the lower right corner of the cover of the data.

order number	Document ID	chapters and sections	Update content
1	SM6 01 20250407 1.0	-	The first edition of the manual was published.
2	SM6 01 20250416 1.0.1	-	Change the content of section 1.1.4.
3	SM6 01 20250612 1.1	-	1、New models (45/55/75kW) with detailed specifications, performance parameters, electrical standards, and dimensional diagrams. 2、Update servo motor model, parts description, and shaft radial load specifications. 3. The instructions for optimizing motor installation and environmental conditions.

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WUXI XINJE ELECTRIC CO., LTD.

Address: No.816, West Jianzhu Road, Binhu District, Wuxi City, Jiangsu Province

Tel: 0510-85134136 Fax: 0510-85111290

Website: www.xinje.com Email: xinje@xinje.com

National technical service hotline: 400-885-0136