DS5C2 series servo driver

User's manual

Wuxi Xinje Electric Co., Ltd.

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XINJE

DS5C2 series drive user's manual

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Basic explanation

- Thank you for purchasing the Xinje DS5C2 series servo drive products.
- This manual primarily provides product information on the DS5C2 series servo drives and the MS6 series servo motors.
- Before using the product, read this manual carefully and connect the wires only after fully understanding its contents.
- Please deliver this manual to the end user.

This manual is suitable for the following users

- Servo system designer
- Installation and wiring worker
- Commissioning and servo debugging workers
- Maintenance and Inspection Worker

How to obtain the manual

- Download the Xinje official website

  Website: www.xinje.com

  Path: Services and Support--Download Center

- Scan the QR code below to view

Declaration of liability

- Although the content of the manual has been carefully verified, errors are inevitable, and we cannot guarantee complete consistency.
- We regularly review the content of the manual and make corrections in subsequent versions. Your valuable feedback is welcome.
- Any changes to the information provided in this manual will not be notified separately; please understand this.

Contact way

If you have any questions about using this product, please contact the agent or office that purchased it, or directly contact Xinje Company.

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- Email: tech@xinje.com
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Safety Precautions

Before using this product, please carefully read this section and operate only after fully understanding its usage, safety precautions, and other relevant information. Ensure proper wiring of the product with strict adherence to safety protocols.

To ensure safe operation, please strictly adhere to the safety labels attached to the equipment. Do not damage or remove these labels.
The instructions are as follows:

	Danger	To prevent electric shock, ensure the power supply is disconnected before installation and wiring, and properly connect the Grounding terminals. Follow the user manual instructions for proper operation. Never fail to connect Protective Earth(PE) terminal.Readthe manual and follow the safety instructions before use.

	High Pressure Warning	This device operates on high-voltage power supply (220V/380V). Do not touch the terminal terminals while powered on or within 15 minutes after power interruption, as this may cause electric shock. The equipment is powered by 220V/380V at high voltage.Please do not touch terminals within 15 minutes after disconnect the power, risk of electric shock.

	High Temperature Warning	Do not touch the radiator after power-on; otherwise, there is a risk of burns. Do not touch the radiator after electrification, risk of scald.

	Indoor location	Install indoors in a location protected from direct sunlight and rain. Please install it indoors without sun and rain.

The safety precautions cover potential issues that may arise during product use. For any remaining matters, please adhere to the basic electrical operating procedures.

Attention to product confirmation
1. Do not install damaged drives, drives missing components, or drives that do not meet the required specifications. 2. Improper use may pose hazards, including the risk of moderate or minor injuries, as well as potential property damage. 3. In accordance with mechanical specifications and the ISO 12100 standard, a risk assessment must be conducted and protective measures implemented before the machine can be put into operation. Users are obligated to understand the remaining risks associated with its operation

Installation Instructions

1. It is strictly forbidden to place near flammable gas,otherwise it will cause fire.
2. This product must not be used in environments containing water vapor, corrosive gases, flammable gases, or other hazardous substances, as it poses risks of electric shock and fire.
3. Do not touch the conductive parts of the product directly, as this may cause unintended operation or malfunction.
4. Improper use may pose hazards, resulting in personal injury or death, severe physical harm, and potentially significant property damage.

Wiring precautions

1. Connect the AC power supply correctly to the drive's dedicated power terminals. Do not connect the drive's output terminals U, V, and W to a three-phase power supply.
2. Connect the Grounding wire correctly; poor Grounding may cause electric shock. Use a cable with the appropriate wire diameter for Grounding (refer to Chapter 3: Servo System Cabling).
3. Please tighten the terminal fixing screws; otherwise, a fire may occur.
4. Before performing wiring operations on the drive, ensure to disconnect all external power supplies.
5. During wiring, ensure that encoder cables and power cables remain loose; avoid tightening them to prevent cable damage.

Operational Instructions

1. After the drive unit is operational, do not touch the rotating parts of the motor as there is a risk of injury.
2. Please test the motor once only; do not connect it to any machinery, as this may cause injury.
3. After connecting the machinery, set the appropriate parameters before operation; otherwise, the machinery may lose control or malfunction.
4. During operation, do not touch the radiator as there is a risk of burns.
5. Do not alter the wiring while the system is energized; this poses a risk of injury.
6. Avoid frequent switching of the power supply; if switching is necessary, do so once every 2 minutes.

Maintenance and Inspection

1. Do not touch the interior of servo drivers or servo motors; doing so may cause electric shock.
2. Do not remove the driver panel during power startup; doing so may cause electric shock.
3. Do not touch the terminal terminals within 15 minutes after the power is turned off; otherwise, residual voltage may cause electric shock.

Wiring precautions:

1. Do not run power lines and control signal lines through the same conduit, nor bundle them together. Maintain a distance of at least 30 cm between power lines and control signal lines.
2. For signal lines and encoder differential feedback lines, use multi-strand twisted pairs or multi-core twisted-pair integrated shielded cables. Regarding wiring length, the maximum length for signal input lines is 3 meters, and for encoder differential feedback lines, it is 20 meters.

Catalogue

CATALOGUE V

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MANUAL UPDATE LOG **545**

►► Confirmation upon product delivery

After the product arrives, please verify its integrity in the following aspects.

Confirm Project	Remarks
Does the delivered product match the ordered model?	Please confirm according to the nameplates of the servo motor and servo unit.
Is the rotating shaft of the servo motor operating smoothly?	It is normal to gently rotate the device with the hand. Motors equipped With brakees will not rotate.
Is there any damaged area?	Conduct a comprehensive visual inspection to check for any damage caused by transportation or other factors.
Is there any loose screw?	Use a screwdriver to check for any loose parts.
Is the motor code consistent?	Check whether the motor codes on drive U3-70 and the motor label match.

If any of the items listed above are inappropriate, please promptly contact the product's agent, office, or the sales department of Xinje Company.

1 Servo system selection

1.1 Servo Driver Selection

1.1.1 Model Name

DS5 C2-2 □P□ - PTA- FS

Name	Product name
DS5	DS5 series

Name	Product type
C	EtherCAT

Name	Product version
2	High performance

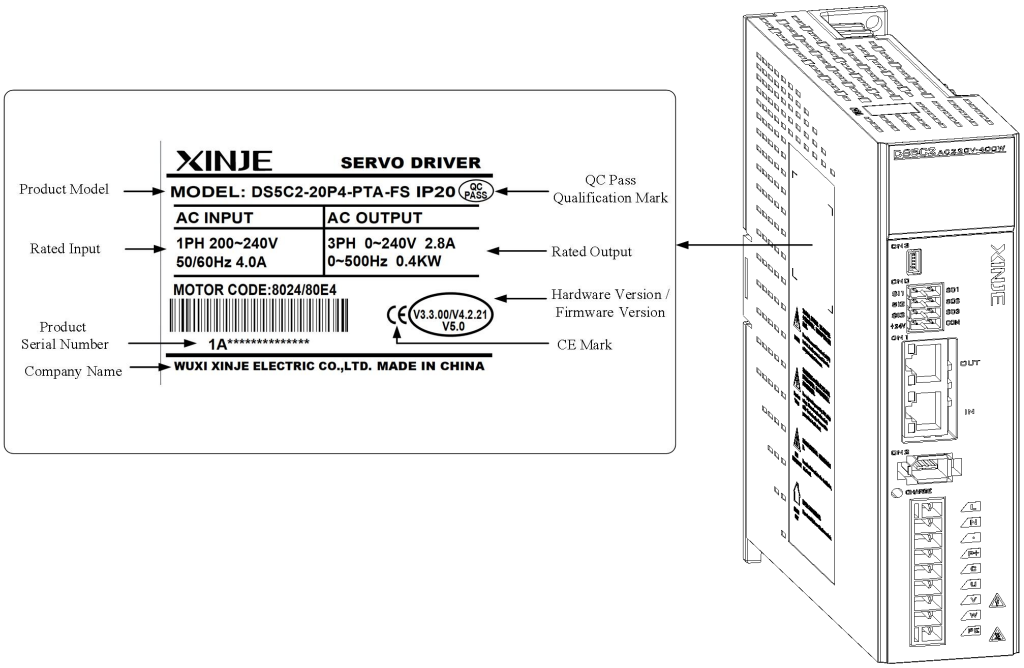
Name	Rated voltage input
2	AC220V
4	AC380V

Name	Optional function
FS	STO
FT	High Protection Type
Empty	Without STO

Name	Encoder type
T	Communication

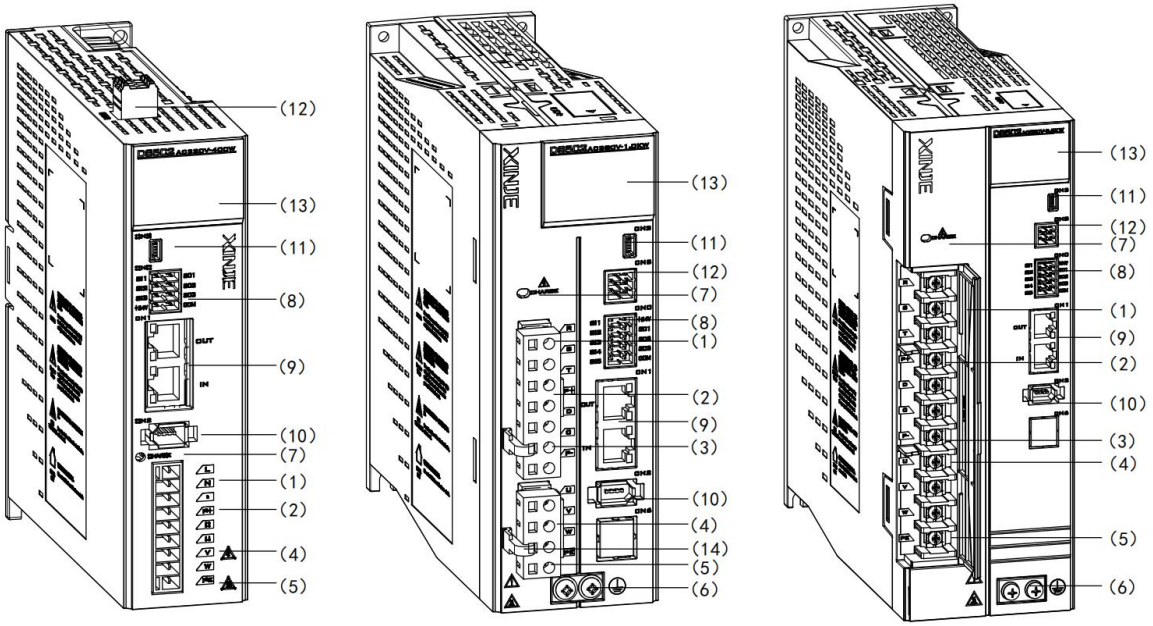
Name	Rated output power	Name	Rated output power
0P1	100W	2P6	2.6kW
0P4	400W	3P0	3kW
0P7	750W	5P5	5.5kW
1P0	1kW	7P5	7.5kW
1P5	1.5kW	15P0	15kW
2P3	2.3kW	22P0	22kW
		2P3	2.3kW

1.1.2 Label Description



1.1.3 Description of each section

- 0.1 kW to 7.5 kW servo driver

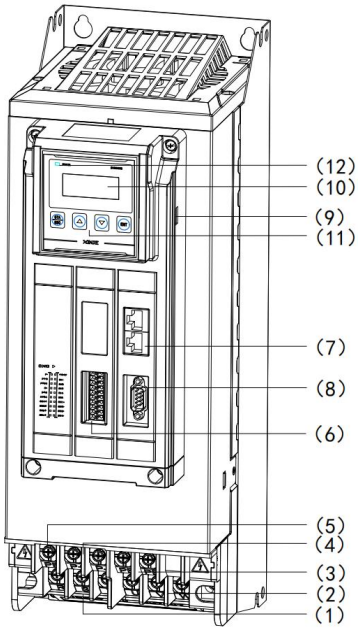


a) Schematic diagram of the driver components for 0.1–0.75 kW b) Schematic diagram of the driver components for 1–3 kW c) Schematic diagram of the driver components for 5.5/7.5 kW

The names of the various components of the 0.1 kW to 7.5 kW servo driver are as follows:

Number	Name	Explanation
(1)	L/N、L1/L2/L3、R/S/T Main circuit power input terminal	Reference drive nameplate rated voltage level: Input main circuit power supply: L/N: Single-phase 220V main circuit power supply; L1/L2/L3: Single-phase/triple-phase main circuit power supply; R/S/T: Three-phase 380V main circuit power supply.
(2)	P+, D, and C brake resistor connection terminals	When using the built-in braking resistor, short-circuit the P+ and D terminals, and disconnect P+ from C. When using an external brake resistor, disconnect the P+ and D shorting wires and connect the brake resistor to the P+ and C terminals.
(3)	P+ and P-busbar terminals	Driver bus terminal.
(4)	U, V, W servo motor power terminals	Connect the servo motor to the U/V/W phases.
(5)	PE motor Grounding terminal	Connect to the motor's Grounding terminal for Grounding.
(6)	⏚Driving Grounding terminal	Connect to external Grounding piles for Grounding treatment. Connect to the power Grounding terminal for Grounding.
(7)	CHARGE busbar voltage indicator light	This indicator shows that the bus capacitor is charged. When the light is on, even if the main circuit power is OFF, the internal capacitor of the servo unit may still retain charge. Therefore, do not touch the power terminals when the light is on to avoid electric shock.
(8)	CN0: Input/Output Control Port	Input/output control signal terminal.
(9)	CN1: EtherCAT communication port	EtherCAT communication network cable interface.
(10)	CN2: Encoder communication port	Connect to the motor encoder terminals.
(11)	CN3: RS232 communication port	RS232 communication interface for connecting with the servo master computer's debugging software.
(12)	CN5: STO Safety Function Terminal	STO functional safety terminals are designed for applications requiring safety functions and for connecting external safety function signals.
(13)	Driver Display Panel	Five 8-digit LED displays for showing the servo's operating status and parameter settings.
(14)	Wiring auxiliary clip	Assistance for installing and wiring Pinterminals.

■ 15 kW servo driver



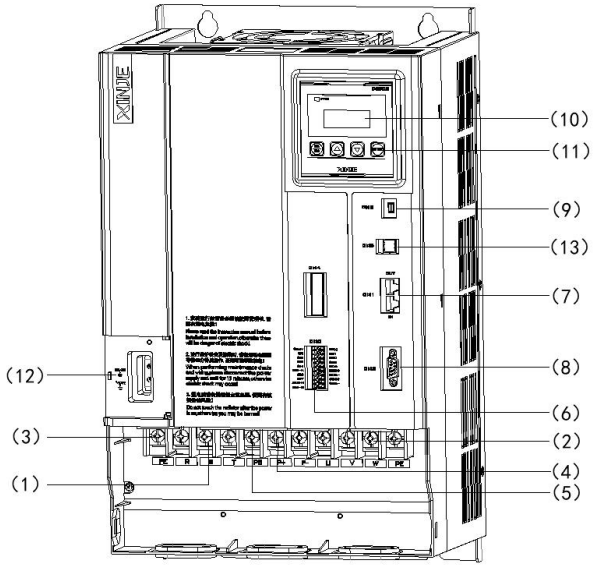
Schematic diagram of the 15 kW drive unit component description

The names of the components of the 15 kW servo driver are as follows:

Number	Name	Explanation
(1)	R/S/T main circuit power input terminal	Reference drive nameplate rated voltage level: Input main circuit power supply: R/S/T: Three-phase 380V main circuit power supply.
(2)	U, V, W servo motor power terminals	Connect the servo motor to the U/V/W phases.
(3)	PE Grounding	Connect to the motor's Grounding terminal for Grounding. Connect to external Grounding piles for Grounding treatment. Connect to the power Grounding terminal for Grounding.
(4)	P+ and P-busbar terminals	Driver bus terminal.
(5)	PB terminal	When using an external braking resistor, connect it to the P+ and PB terminals.
(6)	CN0: Input/Output Control Port	Terminal instruction input signal and other input/output signal ports.
(7)	CN1: EtherCAT communication port	EtherCAT communication network cable interface.
(8)	CN2: Encoder communication port	Connect to the motor encoder terminals.
(9)	CN3: RS232 communication port	RS232 communication interface for connecting with the servo master computer's debugging software.
(10)	Driver Display Panel	Five 8-digit LED displays for showing the servo's operating status and parameter settings.
(11)	Panel Operation Button	Four panel operation buttons for checking the servo's operating status and setting parameters.
(12)	PWR busbar voltage indicator light	This indicator shows that the bus capacitor is charged. When the light is on, even if the main circuit power is

		OFF, the internal capacitor of the servo unit may still retain charge. Therefore, do not touch the power terminals when the light is on to avoid electric shock.

■ 22kW and 32kW servo drivers

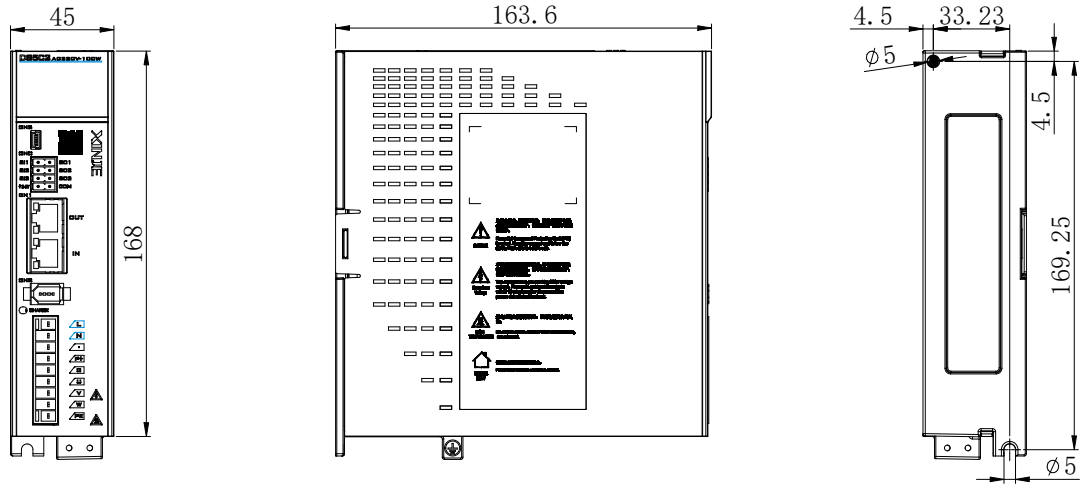


Number	Name	Explanation
(1)	R/S/T main circuit power input terminal	Reference drive nameplate rated voltage level: Input main circuit power supply: R/S/T: Three-phase 380V main circuit power supply.
(2)	U, V, W servo motor power terminals	Connect the servo motor to the U/V/W phases.
(3)	PE Grounding	Connect to the motor's Grounding terminal for Grounding. Connect to external Grounding piles for Grounding treatment. Connect to the power Grounding terminal for Grounding.
(4)	P+ and P-busbar terminals	Driver bus terminal.
(5)	PB terminal	When using an external braking resistor, connect it to the P+ and PB terminals.
(6)	CN0: Input/Output Control Port	Terminal instruction input signal and other input/output signal ports.
(7)	CN1: EtherCAT communication port	EtherCAT communication network cable interface.
(8)	CN2: Encoder communication port	Connect to the motor encoder terminals.
(9)	CN3: RS232 communication port	RS232 communication interface for connecting with the servo master computer's debugging software.
(10)	Driver Display Panel	Five 8-digit LED displays for showing the servo's operating status and parameter settings.

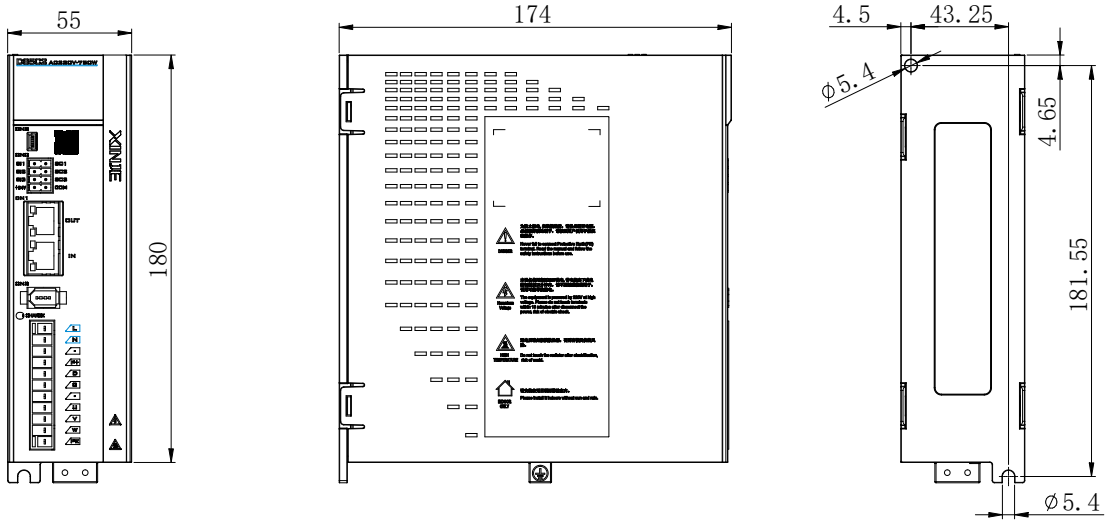
Number	Name	Explanation
(11)	Panel Operation Button	Four panel operation buttons for checking the servo's operating status and setting parameters.
(12)	EMC Grounding, lightning protection Grounding	EMC Grounding: Suppresses electromagnetic interference to ensure proper equipment operation and signal integrity; Lightning protection Grounding: Discharges lightning current to prevent equipment damage and personal injury.
(13)	CN5: STO Safety Function Terminal (Reserved)	STO functional safety terminal, used for safety function applications and external safety signal input. (Not enabled yet)

1.1.4 Service drive dimensions

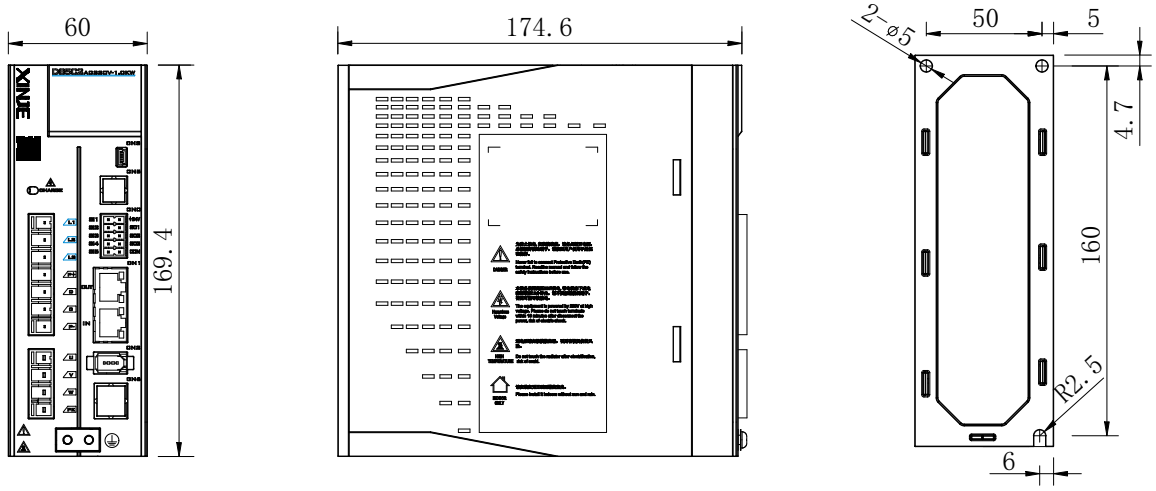
■ DS5C2-20P1/20P4-PTA (-FS) Unit: mm



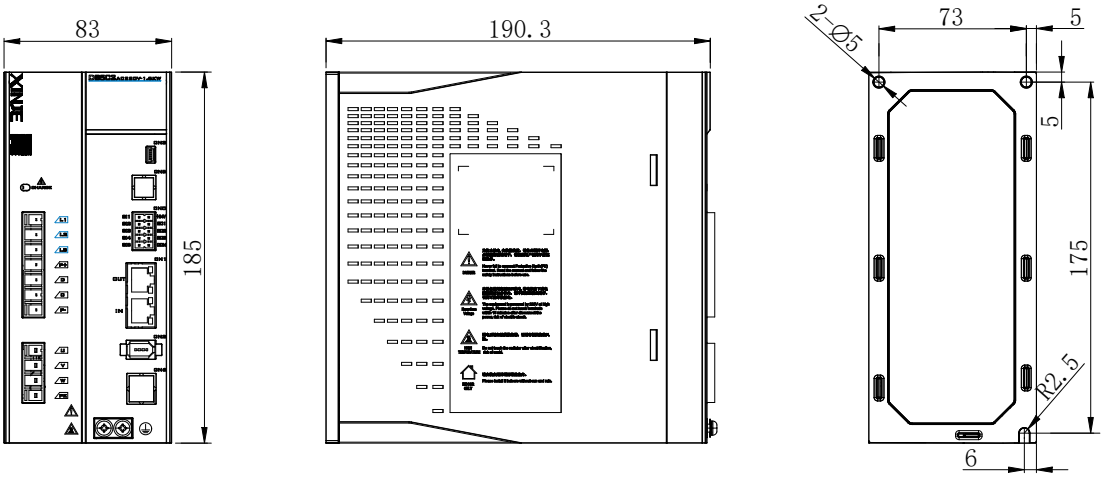
■ DS5C2-20P7-PTA (-FS) Unit: mm



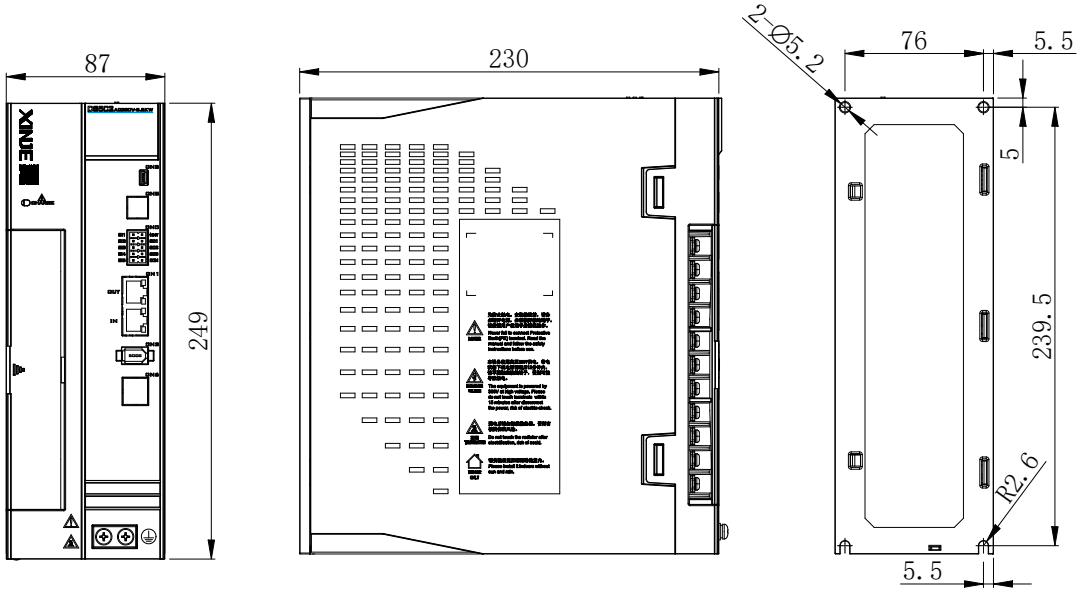
■ DS5C2-21P0/41P0/41P5-PTA (-FS) Unit: mm



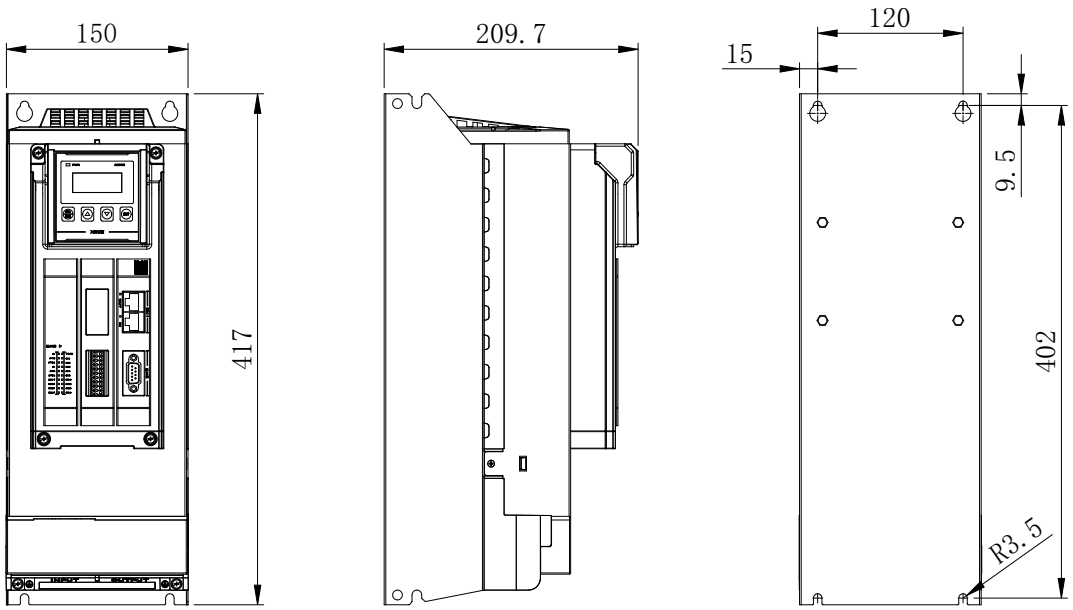
■ DS5C2-21P5/22P3/22P6/42P3/43P0-PTA (-FS) Unit: mm



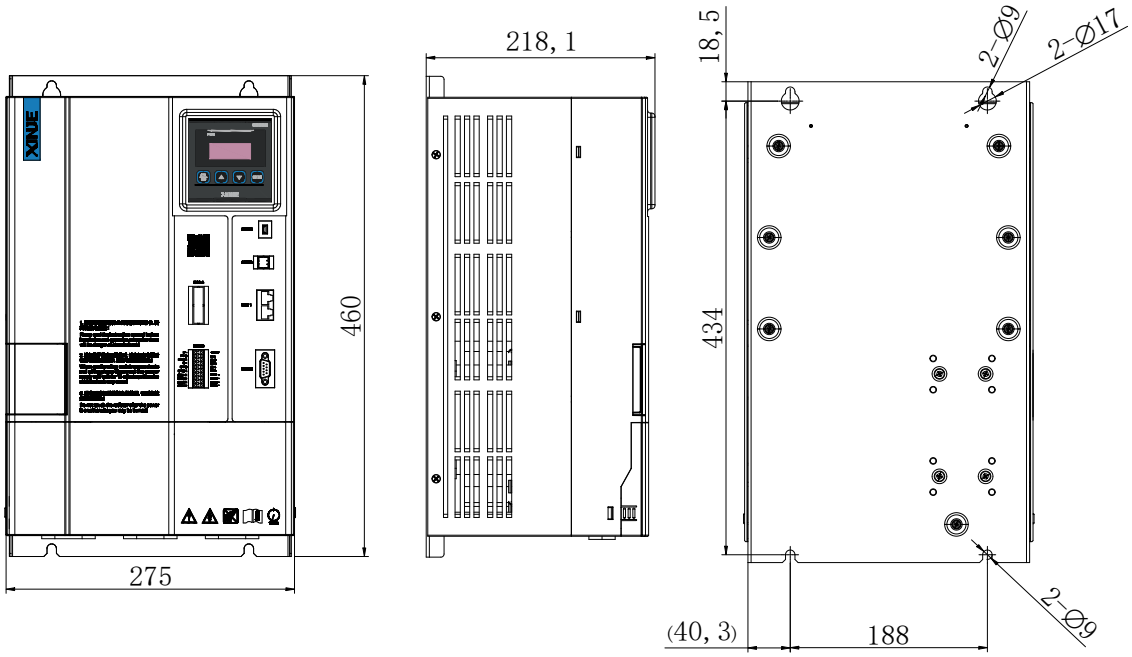
■ DS5C2-45P5/47P5-PTA (-FS) Unit: mm



■ DS5C2-415P0-PTA Unit: mm



■ DS5C2-422P0-PTA, DS5C2-432P0-PTA Unit: mm



1.1.5 Performance requirement

Project		Explanation
Service Unit		DS5C2 series servo driver
Apply encoder		Standard: 19-bit/23-bit communication encoder
Power Input		DS5C2-2□P□-PTA (-FS): Single-phase/Three-phase AC 200–240 V, 50/60 Hz If using a single-phase 220V power supply, connect to L1 and L3; otherwise, parameter memory may be affected during power failure.
		DS5C2-4□P□-PTA (-FS): Three-phase AC 380–440 V, 50/60 Hz
Control method		IGBT PWM control with sine wave current drive method
The product complies with the standards.		EN 61800-5-1:2007/A11:2021
Protection Level		Class I
Connect to the grid system		TN/TT
IP grade		0.1~3kW：IP20
Make use of condition	Operation temperature	-10 to +55°C (No power rating reduction required for temperatures between-10°C and 45°C; a 2% power rating reduction is required for temperatures exceeding 45°C, with a reduction of 2% for each additional degree Celsius increase)
	Storage temperature	-20 ~ +60 ℃

Project		Explanation
	Ambient humidity	Below 90% RH (no condensation)
	Vibration resistance	4.9m/s2
	Above sea level	For heights not exceeding 1000 m; for heights above 1000 m, use at a reduced rate (a 1% reduction per 100 m increase in height).
Build-in function	Safety function	STO Safe Torque shutdown (FS model)
	Dynamic braking	support
	Encoder communication rate	4M
	End-jitter suppression	support
	Bus synchronization cycle	250us、500us、1ms、2ms、4ms、8ms、10ms
Input/Output Signal	Digital input	750W and below: 3 channels Above 1 kW: 5 channels
		0.1~7.5kW： SI1, SI2: High-speed SI inputs with a response time ≤2 μs; SI3, SI4, SI5: Low-speed SI inputs with a response time ≤2 ms. 15~32kW： SI1, SI2, SI3: Low-speed SI inputs with a response time ≤2 ms; SI4, SI5: High-speed SI inputs with a response time ≤2 μs.
		Control voltage: Typical voltage is DC24V; the minimum shall not be lower than DC18V, and the maximum allowable voltage shall not exceed DC28V.
	Numeric output	750W and below: 3 channels Above 1 kW: 4 channels
		7.5 kW and below: SO1, SO2, SO3; response time ≤7 μs; 15 kW and above: SO1, SO2, SO3, SO4; response time ≤7 μs.
		Maximum load current: 400W and below: SO1 DC 500mA (maximum), SO (other) DC 50mA (maximum); 750W and above: SO (full range), DC 50mA (maximum), supports 24VDC with a maximum voltage not exceeding 30VDC;

1.1.6 Electrical specifications

Drive model	Drive power (kW)	Continuous output current (A)	Maximum output current (A)	Power supply input current (A)	Power Supply Voltage	Cooling method
DS5C2-20P1-PTA（-FS)	0.1	0.9	3.15	1.3	Uniphase AC200～240V，50/60Hz	Self-cooling
DS5C2-20P4-PTA（-FS)	0.4	2.8	9.8	4		Self-cooling
DS5C2-20P7-PTA（-FS)	0.75	4.8	16.8	5.5		Air cooling
DS5C2-21P0-PTA（-FS)	1.0	6	18	6 (1PH) 4.4 (3PH)	Single-phase/three-phase AC 200–240 V, 50/60 Hz	Air cooling
DS5C2-21P5-PTA（-FS)	1.5	8	20	7.4 (1PH) 5.1 (3PH)		Air cooling
DS5C2-22P3-PTA（-FS)	2.3	9	18	8 (1PH) 7.4 (3PH)		Air cooling
DS5C2-22P6-PTA（-FS)	2.6	10.5	29.93	8 (1PH) 7.4 (3PH)		Air cooling
DS5C2-41P0-PTA（-FS)	1.0	3.2	9.6	4	Three-phase AC380～440V，50/60Hz	Air cooling
DS5C2-41P5-PTA（-FS)	1.5	5.5	13.75	4		Air cooling
DS5C2-42P3-PTA（-FS)	2.3	8.5	21.25	6.8		Air cooling
DS5C2-43P0-PT	3.0	11	29.7	8		Air cooling

Drive model	Drive power (kW)	Continuous output current (A)	Maximum output current (A)	Power supply input current (A)	Power Supply Voltage	Cooling method
A（-FS)						
DS5C2-45P5-PT A（-FS)	5.5	20	50	16		Air cooling
DS5C2-47P5-PT A（-FS)	7.5	25	62.5	20		Air cooling
DS5C2-415P0-PTA	15	35	87.5	30		Air cooling
DS5C2-422P0-PTA	22	43.5	108.75	35		Air cooling
DS5C2-432P0-PTA	32	62	124	50		Air cooling

1.2 Servo Motor Selection

1.2.1 Model Naming

■ MS6 motor

MS6S – 80 CS 30 B Z 3 – 2 1P0 – S

Display (series)	Inertia
MS6L	Ultra-low inertia
MS6S	Low inertia
MS6G	Medium inertia
MS6H	High inertia

Display	Base no.
25	25 base
40	40 base
60	60 base
80	80 base
100	100 base
110	110 base
130	130 base
180	180 base
200	200 base
265	265 base

Display	Encoder type
CN	Single/multi-turn in one 19-bit magnetic encoder
TH	Multi-turn 23-bit optical encoder

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

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

Display	刹车制动器
–	No brake
Z	With brake

Display	Motor Type
Empty	Standard Type
S	Short Frame Type
F	Air-cooled Motor
Y	Liquid-cooled Motor

Display	Voltage level
0A5	50W
0P1	100W
0P2	200W
0P4	400W
0P7	750W
0P8	850W
1P0	1kW
1P5	1.5kW
1P8	1.8kW
2P3	2.3kW
2P5	2.5kW
2P6	2.6kW
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
30P0	30kW
48P0	48kW

Display	Voltage level
2	220V
4	380V

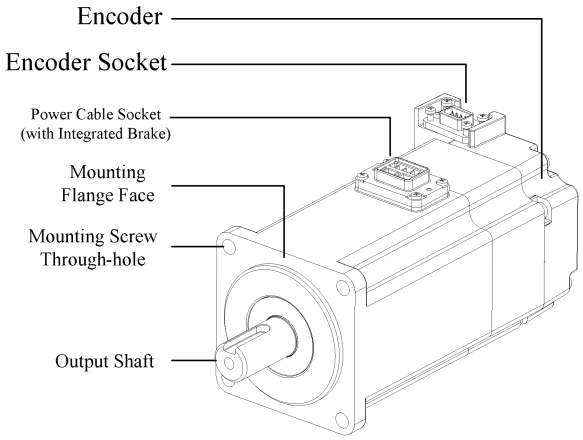
Display	Motor connector
2	Aviation plug
3	Waterproof connector
4	Waterproof connector to amp plug

The DS5C2 series (firmware version <4230) servo driver is compatible with servo motors using CN or TH encoders.

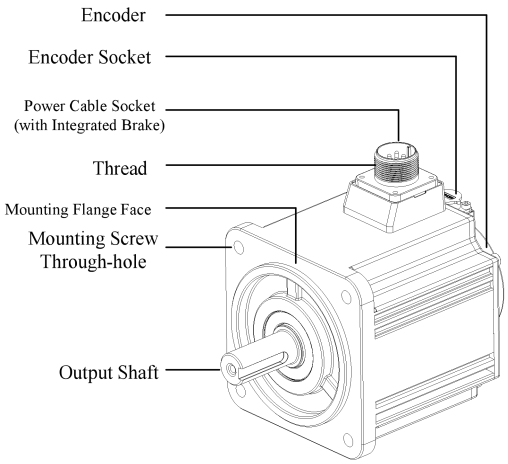
The DS5C2 series servo driver (firmware version ≥4230) is compatible with servo motors using CS, CM, CN, TL, or TH encoders.

1.2.2 Description of each section

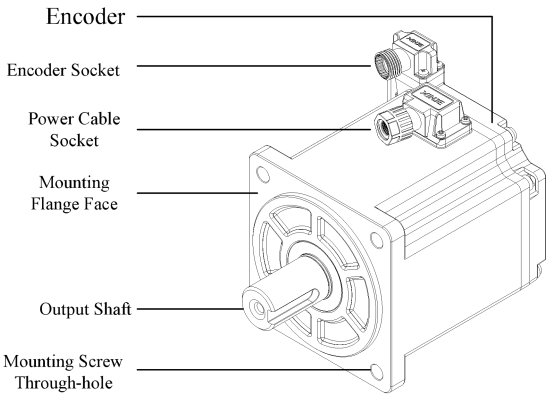
- B3 plug type motor



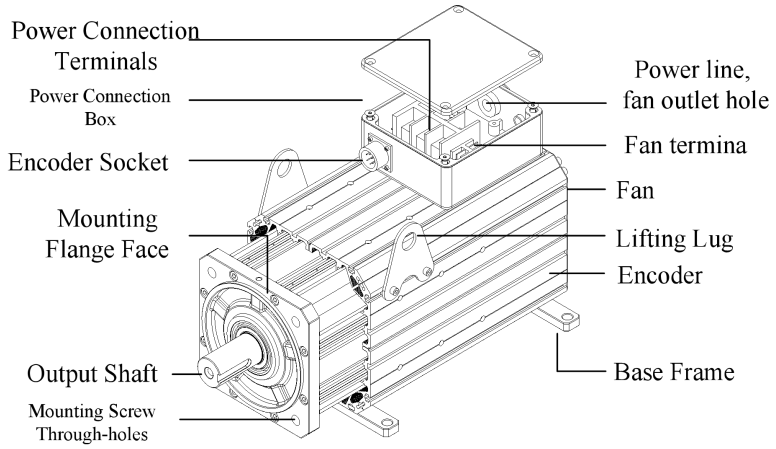
- B2 plug type motor



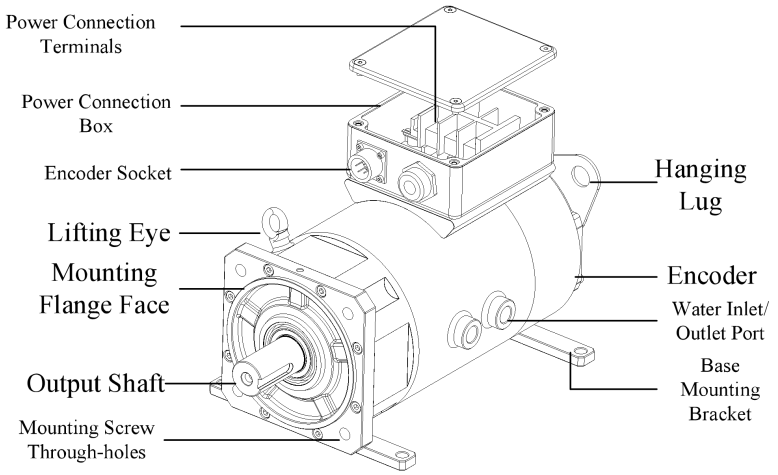
- B4 plug type motor



■ High-power air-cooled motor

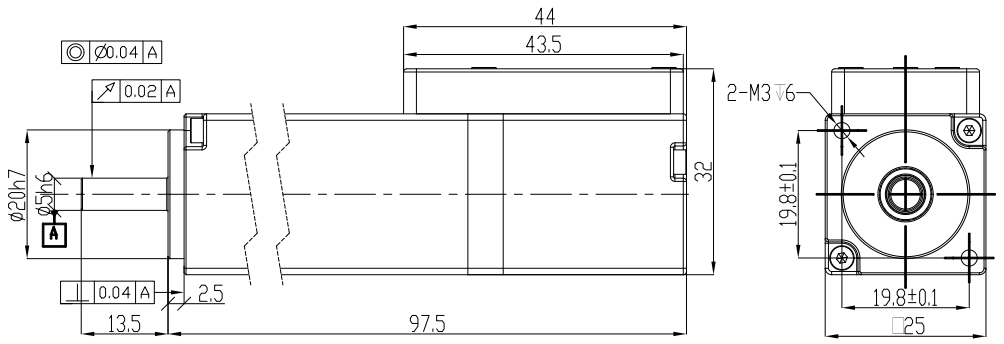


■ High-power liquid-cooled motor



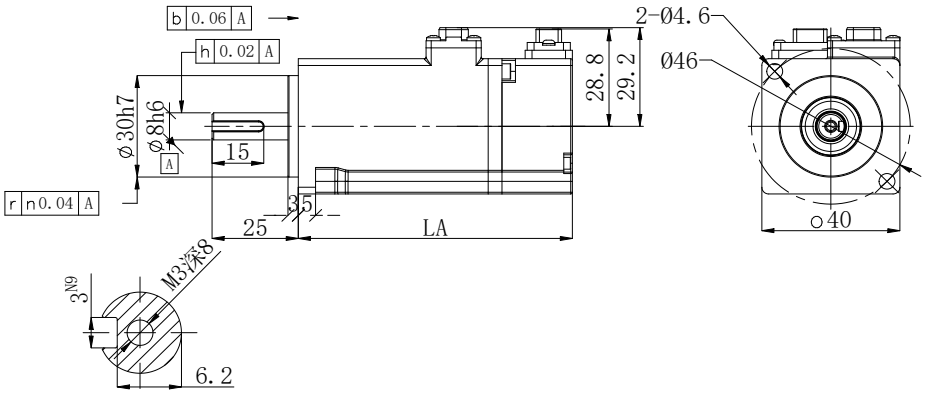
1.2.3 Dimensions of the servo motor

■ Installation dimensions of the 25-machine-base motor Unit: mm



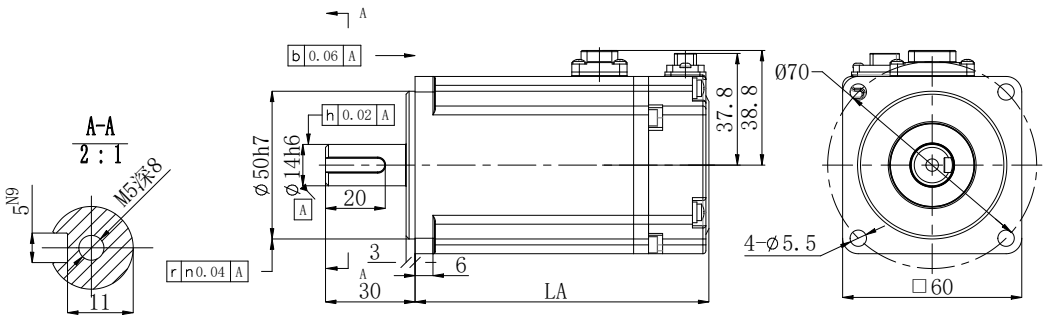
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6S-25CN30B4-20A5	97.5	-	High inertia

■ Installation dimensions of the 40-watt motor base Unit: mm



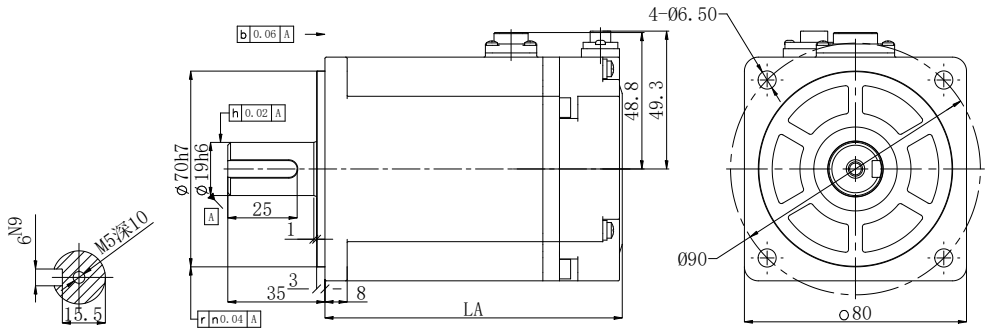
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6H-40CN30B□3-20A5-S	60.8	93.4	High inertia
MS6H-40CN30B□3-20P1-S	77.4	110	
MS6H-40TH30B□3-20A5-S	62.8	95.4	
MS6H-40TH30B□3-20P1-S	79.4	112	

■ Installation dimensions of the 60-watt motor base Unit: mm



Motor Model	LA±1		Inertia Level
	Regular	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	

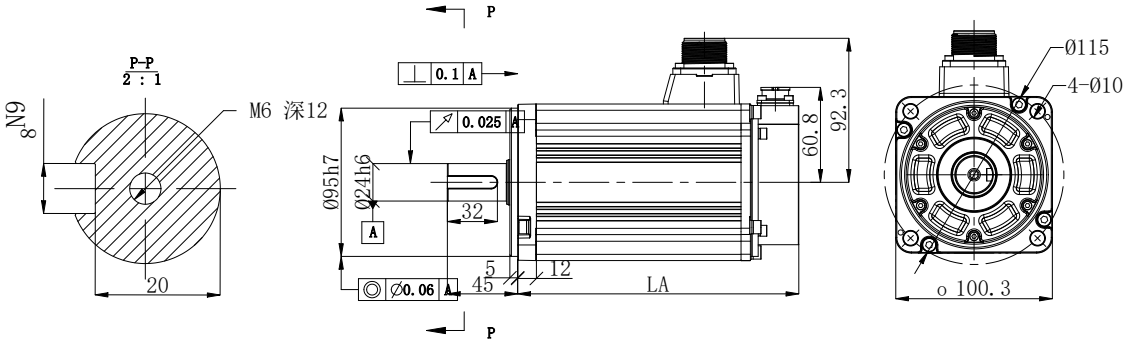
■ Installation dimensions of the 80-watt motor base Unit: mm



Motor Model	LA±1		Inertia Level
	Regular	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	

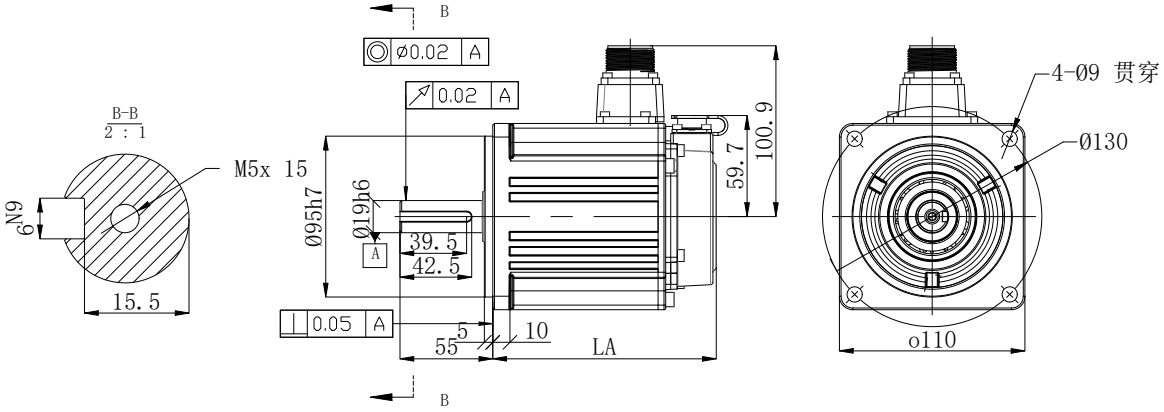
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6H-80TH30B□3-20P7-S	100.3	132.2	
MS6S-80CN30B□3-21P0	117.6	142.6	Low inertia
MS6S-80TH30B□3-21P0	117.6	142.6	
MS6H-80CN30B□3-21P0	134	159	High inertia
MS6H-80CN30B□3-21P0-S	112.5	144.4	
MS6H-80TH30B□3-21P0	134	159	
MS6H-80TH30B□3-21P0-S	123.6	155.5	

■ Installation dimensions for 100-unit base motor Unit: mm



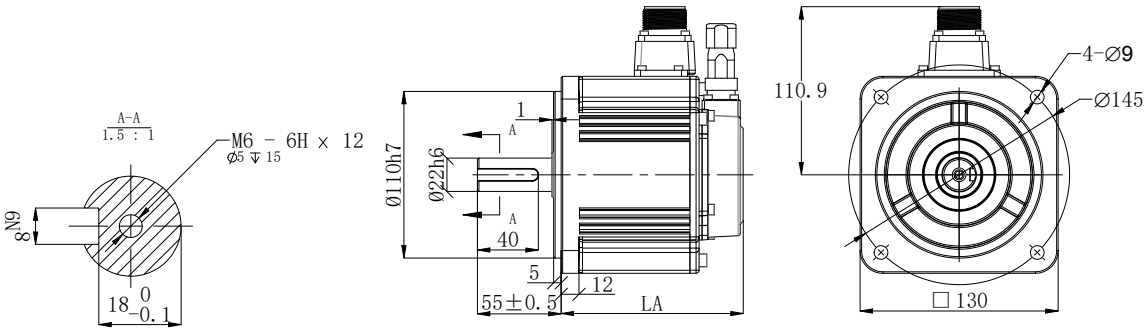
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6L-100CN30B□2-□1P5	180	205	Ultra-low inertia
MS6L-100TH30B□2-□1P5	193	218	
MS6L-100CN30B□2-42P5	228	253	
MS6L-100TH30B□2-42P5	241	266	

■ Installation dimensions of the 110 motor base Unit: mm



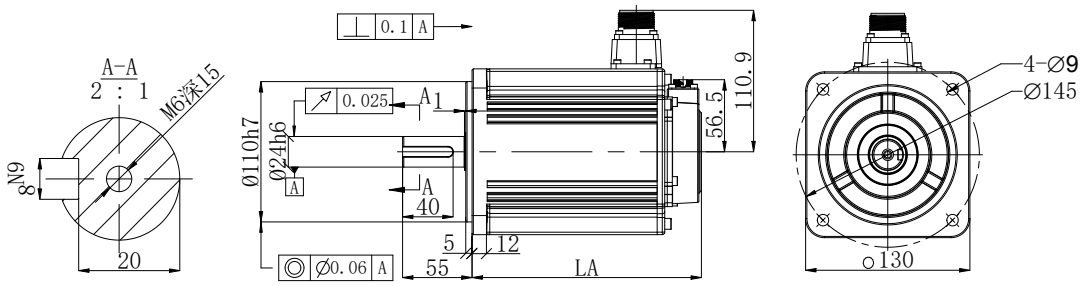
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-110CN30B□2-□1P5	132.5	163.5	Middle Inertia
MS6G-110TH30B□2-□1P5	149	180	
MS6G-110CN30B□2-21P8	132.5	163.5	
MS6G-110TH30B□2-21P8	149	180	

■ Installation dimensions of the 130 motor base Unit: mm

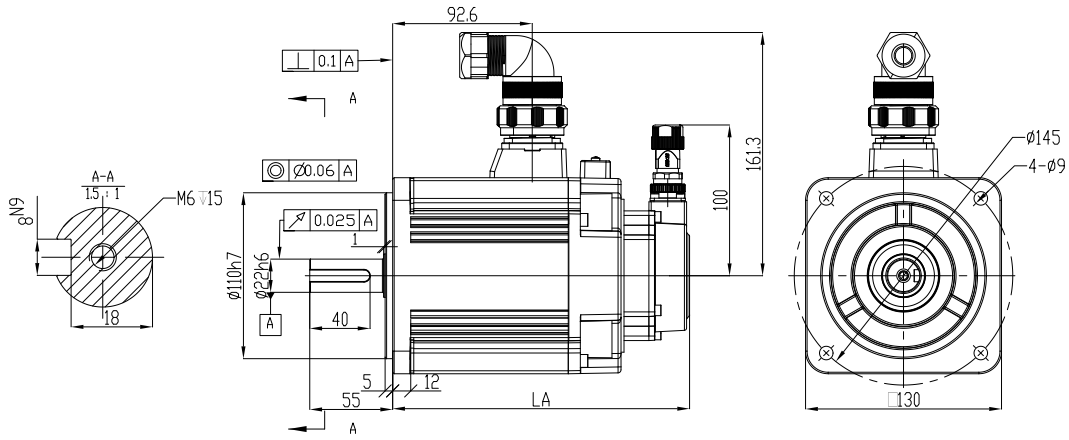


Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-130CN15B□2-□0P8	133.5	162.5	Middle Inertia
MS6G-130TH15B□2-□0P8	150	179	
MS6G-130CN25B□2-□1P0	119.5	148.5	
MS6G-130TH25B□2-□1P0	136	165	
MS6G-130CN20B□2-□1P5	133.5	162.5	
MS6G-130CN15B□2-□1P5	151.5	180.5	
MS6G-130TH20B□2-□1P5	150	179	
MS6G-130TH15B□2-□1P5	168	197	
MS6G-130CN15E□2-□2P3	181.5	210.5	

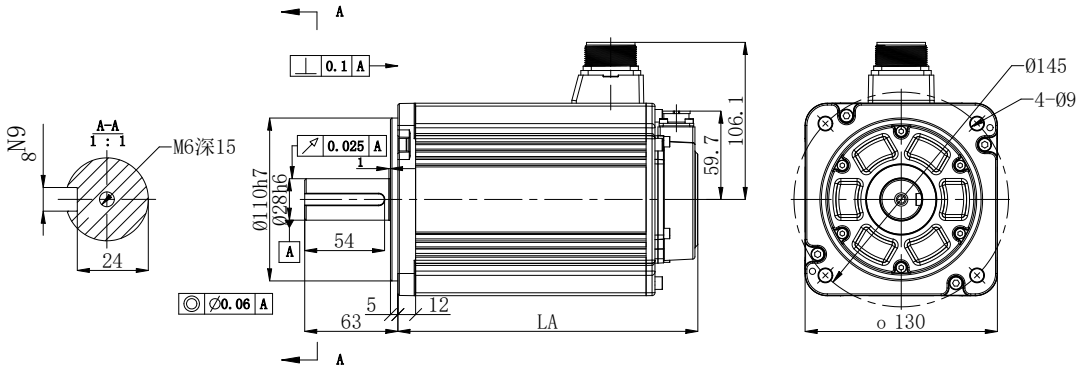
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-130TH15E□2-□2P3	198	227	



Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-130CN15B□2-□2P3	181.5	210.5	Middle Inertia
MS6G-130TH15B□2-□2P3	198	227	

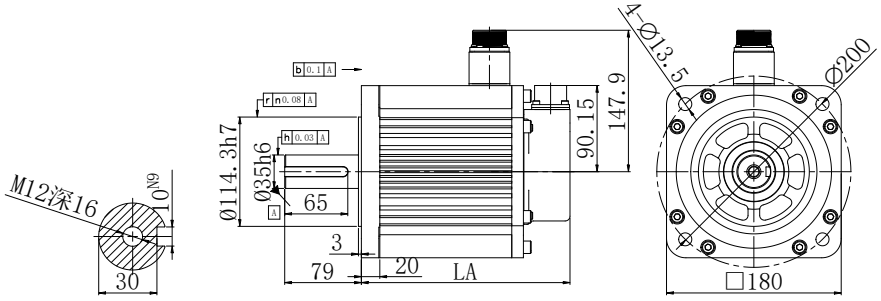


Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-130CN25B□2-22P6	148.5	180.5	Middle Inertia
MS6G-130TH25B□2-22P6	165	197	

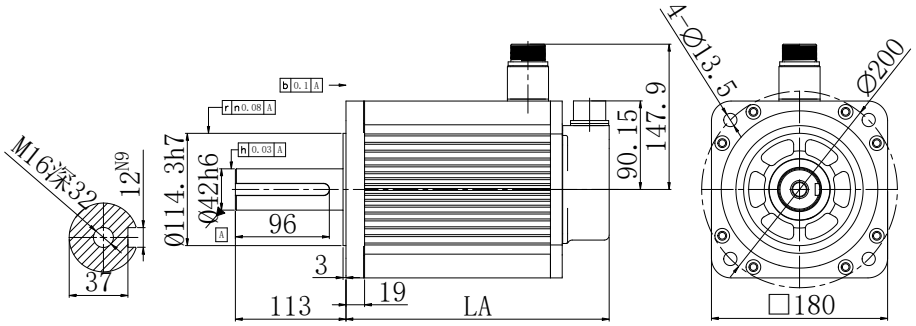


Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6S-130CN30B□2-43P0	202.8	231.8	Low inertia
MS6S-130TH30B□2-43P0	219.3	248.3	
MS6S-130CN30B□2-45P0	257.8	298.5	
MS6S-130TH30B□2-45P0	274.3	315	
MS6S-130CN30B□2-47P0	321.8	362.5	
MS6S-130TH30B□2-47P0	338.3	379	

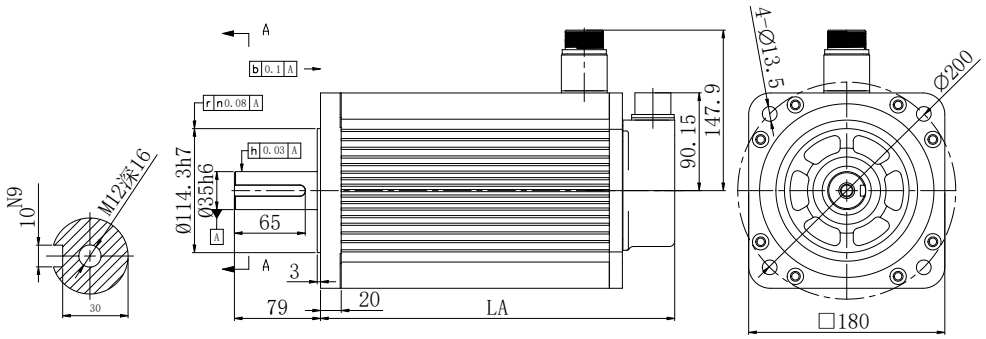
■ Installation dimensions of the 180-watt motor base Unit: mm



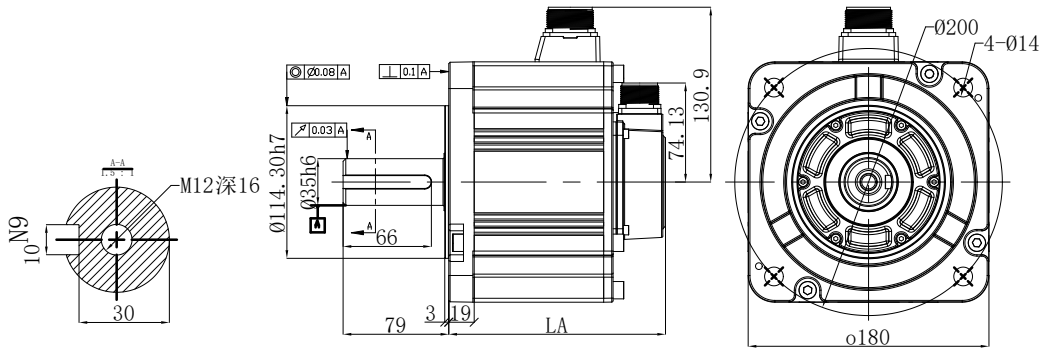
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6H-180CN15B□2-43P0	215	255	High inertia
MS6H-180CN15B□2-44P4	247	287	



Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6H-180CN15B□2-45P5	269	309	High inertia
MS6H-180CN15B□2-47P5	325	365	

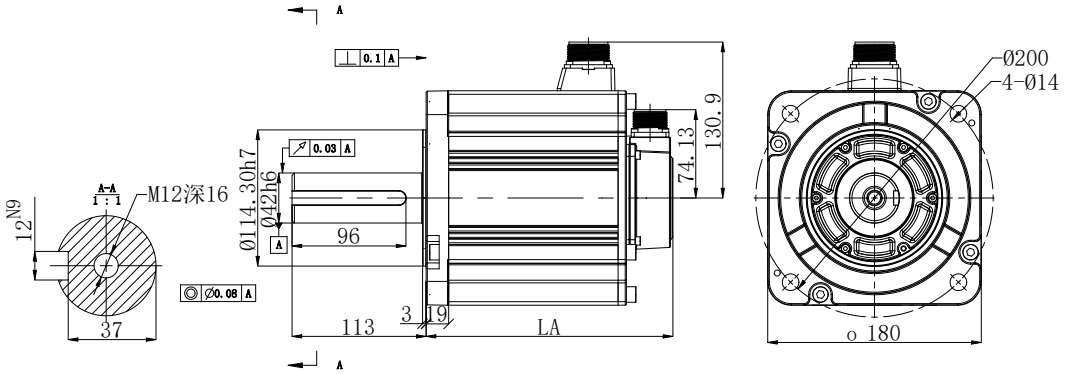


Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6H-180CN15E□2-45P5	269	309	High inertia
MS6H-180CN15E□2-47P5	325	365	



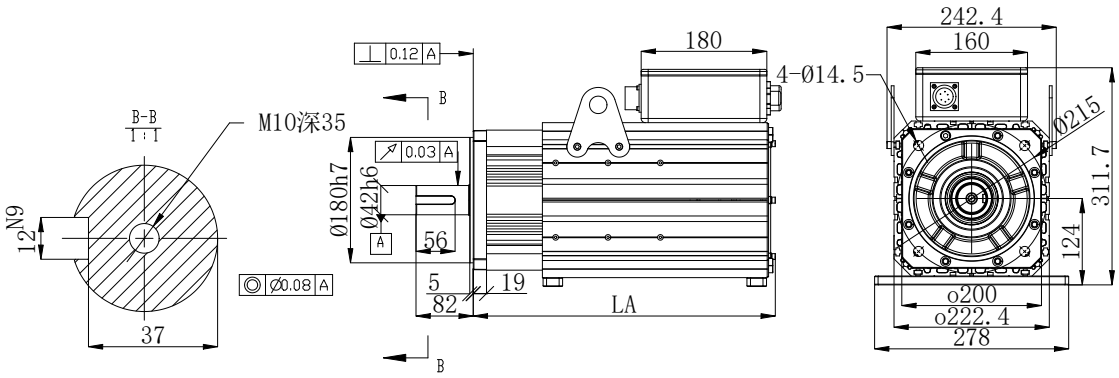
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-180CN15B□2-43P0	162	206.5	Middle Inertia
MS6G-180CN15B□2-44P4	185	229.5	
MS6G-180TH15B□2-43P0	176.5	221	

Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-180TH15B□2-44P4	199.5	244	

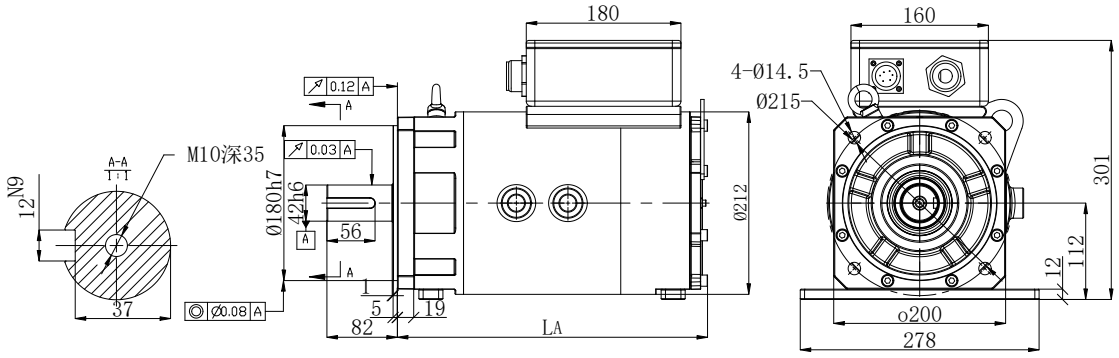


Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-180CN15B□2-45P5	208	252.5	Middle Inertia
MS6G-180CN15B□2-47P5	256	300.5	
MS6G-180TH15B□2-45P5	222.5	267	
MS6G-180TH15B□2-47P5	270.5	315	

■ Installation dimensions for 200-unit base motor Unit: mm

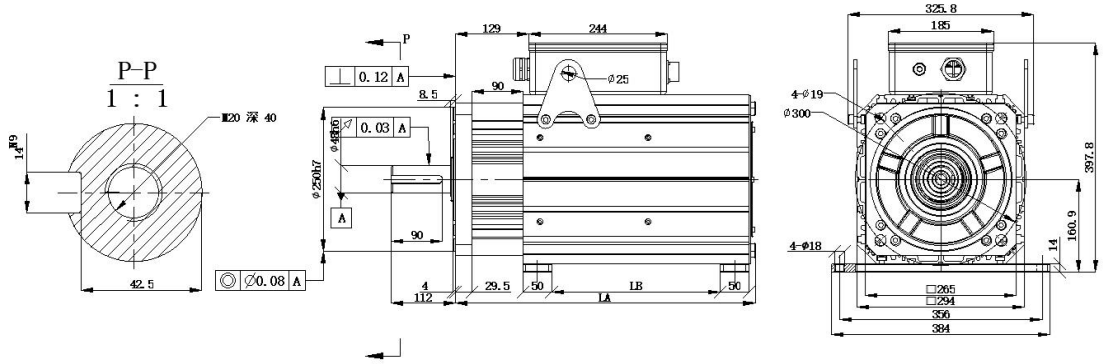


Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-200TH17B□2-413P0-F	433	512	Middle Inertia
MS6G-200TH17B□2-417P0-F	468	545.5	
MS6G-200TH17B□2-421P0-F	503	580.7	
MS6G-200TH17B2-427P0-F	536.4	615.7	



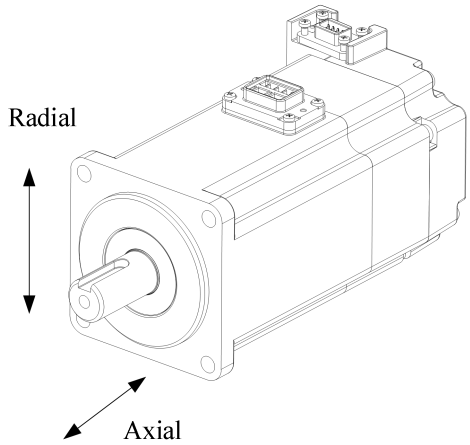
Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-200TH17B2-413P0-Y	361	/	Middle Inertia
MS6G-200TH17B2-417P0-Y	396	/	
MS6G-200TH17B2-421P0-Y	431	/	
MS6G-200TH17B2-427P0-Y	166	/	

■ Installation dimensions of the 265 motor base Unit: mm



Motor Model	LA±1		Inertia Level
	Regular	With brake	
MS6G-265TH17B2-430P0-F	527.5	/	Middle Inertia
MS6G-265TH17B2-448P0-F	577.5	/	

1.2.4 Axial load & Radial loading



seat No	40	60	80	100	110	130	180	200	220	265
Axial loading	54N	74N	147N	196N	147N	196N	400N	640N	686N	1120N
Radial loading	78N	245N	392N	500N	392N	686N	800N	1880N	2254N	3200N

1.3 Cable Selection

1.3.1 Model Naming

■ Encoder cable model

CP – SC T – M - 02

Display	Cable type
CP	Standard Encoder Cable
CPT	High-Flexible Encoder Cable

Display	Connector Type
SP	AMP Connector
SL	15-pin Aviation Connector
SC	10-pin Mini Aviation Connector
SE	B3 Connector, Motor Side (Standard Orientation)
SF	B3 Connector, Motor Side (Reverse Orientation)
ZDL	Straight DB Connector (Drive Side)

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

Display	Battery Case Option
M	Without Battery Case
B	With Battery Case (Frame Size ≥100)
BM	With Battery Case (Frame Size ≤80)

Display	Coupling Type
T	Threaded Push-Pull Type (for Frame 130/180 only)
Empty	Standard Type

■ Power cable model

CP – SC T – M - 02

Display	Cable type
CP	Standard Encoder Cable
CPT	High-Flexible Encoder Cable

Display	Connector Type
SP	AMP Connector
SL	15-pin Aviation Connector
SC	10-pin Mini Aviation Connector
SE	B3 Connector, Motor Side (Standard Orientation)
SF	B3 Connector, Motor Side (Reverse Orientation)
ZDL	Straight DB Connector (Drive Side)

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

Display	Battery Case Option
M	Without Battery Case
B	With Battery Case (Frame Size ≥100)
BM	With Battery Case (Frame Size ≤80)

Display	Coupling Type
T	Threaded Push-Pull Type (for Frame 130/180 only)
Empty	Standard Type

CM T - E 05 A - 03

Name	Cable type
CM	Power cable-no brake
CMB	Power cable-with brake

Name	Cable type
T	High flexibility
G	High flexibility and oil resistance
-	Normal

Name	Motor plug type
E	B3 positive outlet plug
F	B3 reverse outlet plug
L	4-core small aviation plug
XL	4-core medium aviation plug
D	4-core O shape plug

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

Name	Driver side terminal
A/B	Needle terminal (drive side)
T	Thread waterproof (motor side)
-	U-shaped /O-shaped terminal (drive side)

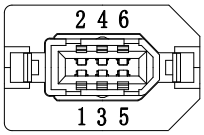
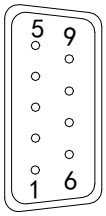
Name	Wire diameter (mm²)
03	0.3
05	0.5
15	1.5
20	2.0
60	6.0

1.3.2 The cable connecting the drive unit to the motor

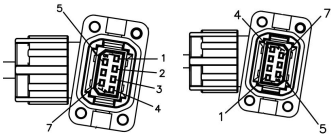
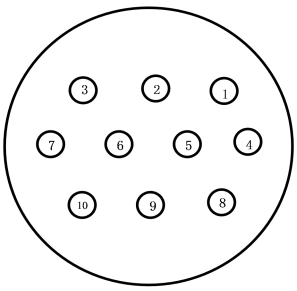
■ Encoder cable interface

(1) Definition of soldering pins for encoder cables on the servo driver side

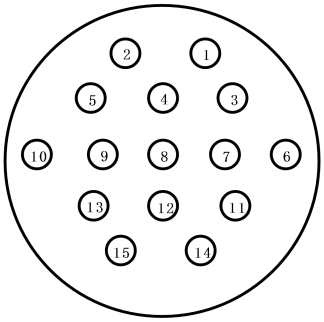
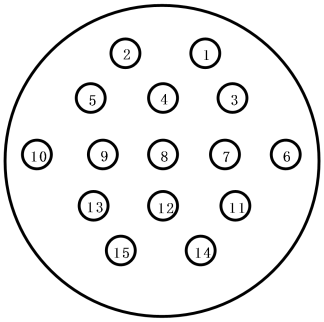
	Interface pin definition

7.5 kw and below 	Number	Definition	Number	Definition
	1	5V	4	/
	2	GND	5	485-A
	3	/	6	485-B
 11 kw and above	Number	Definition	Number	Definition
	1	Temperature transducer -	6	GND
	2	Temperature transducer +	7	/
	3	485-B	8	5v
	4	485-A	9	/
	5	Shield line	-	-

(2) Definition of soldering pins for encoder cables on the motor side

Motor model	Connector pin	Interface pin definition	
MS6-40,60,80 base b3 motor	 Forward line; reverse line (viewpoint)	Number	Definition
		1	5V
		2	GND
		3	Bat+
		4	Bat-
		5	485-A
		6	485-B
		7	Shielding layer
MS6-130 chassis b2 motor		Number	Definition
		1	/
		2	5v
		3	GND
		4	485-A
		5	485-B
		6	Cell +
		7	Cell -
		8	/
		9	/
		10	Shield line

Motor Model	Connector Pin	Interface Pin Definition	
MS6-180 chassis B2 motor		Number	Definition
		1	Shield line
		2	/
		3	485-B

		4	485-A
		5	/
		6	GND
		7	cell -
		8	5V
		9	cell +
		10-15	/
MS6G-200,265 chassis B2 motor		Number	Definition
		1	Shield line
		2	/
		3	485-B
		4	485-A
		5	/
		6	GND
		7	cell -
		8	5V
		9	cell +
		10-13	/
		14	temperature -
		15	temperature +

Battery case instructions:

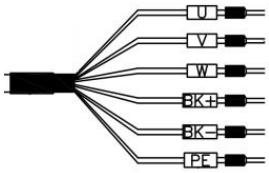
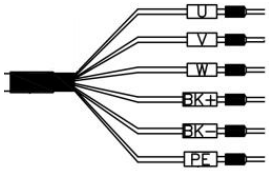
1) The cable defined by the battery+ and battery-pins in the aforementioned encoder is intended for absolute motors; non-absolutely motors do not include these pins on their cables.

2) Only absolute-value motor adaptation cables are equipped with an external battery compartment containing a 3.6V/2.7Ah high-capacity battery with power-off battery replacement functionality, ensuring a service life of ≥2 years. The battery replacement procedure follows Section 7.1.2.

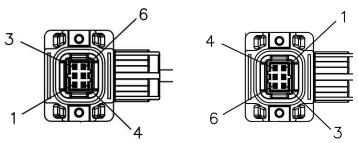
Currently, encoder cables are available in lengths of 2m,3m,5m,8m,10m,12m,16m,20m,25m,30m,35m,40m,45m, and 50m.

Power cable interface

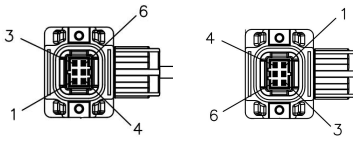
(1) Definition of power line pins on the servo driver side (pin terminals use snap-fit clips for wiring installation)

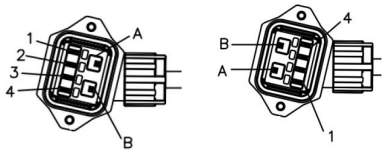
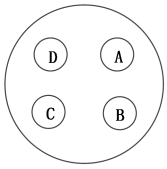
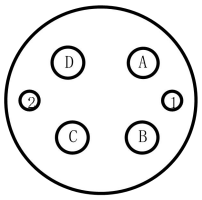
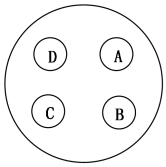
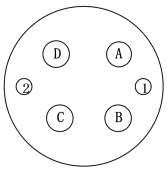
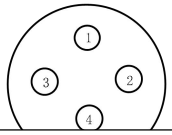
<table>
<tr><th>Motor Model</th><th>Connector appearance</th><th colspan="2">Interface Pin Definition</th></tr>
<tr><td rowspan="7">MS6-40,60,80 base motor</td><td rowspan="7"> 
</td><td>Color</td><td>Definition</td></tr>
<tr><td>Red</td><td>U</td></tr>
<tr><td>White</td><td>V</td></tr>
<tr><td>Black</td><td>W</td></tr>
<tr><td>Yellow-green</td><td>PE</td></tr>
<tr><td>Lan</td><td>BK+</td></tr>
<tr><td>Brown</td><td>BK-</td></tr>
<tr><td rowspan="7">MS6-130 chassis 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>Lan</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="7">MS6-180 Base Motor</td><td rowspan="7"> </td><td>Color</td><td>Definition</td></tr>
<tr><td>Brown/Ruby</td><td>U</td></tr>
<tr><td>Black/Yellow</td><td>V</td></tr>
<tr><td>Lan</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/White</td><td>BK-</td></tr>
<tr><td rowspan="5">MS6-200,265 chassis motors</td><td rowspan="5"> </td><td>Color</td><td>Definition</td></tr>
<tr><td>Red</td><td>U</td></tr>
<tr><td>Huang</td><td>V</td></tr>
<tr><td>Lan</td><td>W</td></tr>
<tr><td>Yellow-green</td><td>PE</td></tr>
</table>

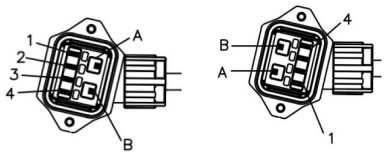
(2) Definition of welding pin for the motor-side power cable

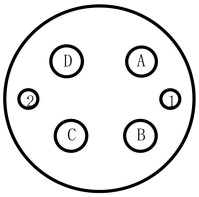
<table>
<tr><th>Motor Model</th><th>Connector Pin</th><th colspan="2">Interface Pin Definition</th></tr>
<tr><td rowspan="8">MS6-40 chassis B3 motor</td><td rowspan="8"> 

Forward line; Reverse line
(Viewpoint)</td><td>Number</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>7</td><td>Shielding</td></tr>
</table>

Motor Model	Connector Pin	Interface Pin Definition	
		Number	Definition
MS6-40 chassis B3 motor	 Forward line; Reverse line (Viewpoint)		layer

Motor Model	Connector Pin	Interface Pin Definition	
		Number	Definition
MS6-60,80 chassis B3 motor	 Forward line; Reverse line Forward line; Reverse line (Viewpoint)	1	U
		2	V
		3	W
		4	PE
		A	BK+
		B	BK-
MS6G-130 base station non-brake-equipped motor		Number	Definition
		A	W
		B	V
		C	U
		D	PE
MS6G-130 Base Brake Motor		Number	Definition
		A	W
		B	V
		C	U
		D	PE
		1	BK+
		2	BK-
MS6G-180 base station non-brake-equipped motor		Number	Definition
		A	PE
		B	W
		C	V
		D	U
MS6G-180 Base Brake Motor		Number	Definition
		A	PE
		B	W
		C	V
		D	U
		1	BK+
		2	BK-
MS6H-180 base station non-brake-equipped motor		Number	Definition
		1	PE
		2	U

Motor Model	Connector Pin	Interface Pin Definition	
MS6-60,80 chassis B3 motor	 Forward line; Reverse line Forward line; Reverse line (Viewpoint)	Number	Definition
		1	U
		3	V
		4	W

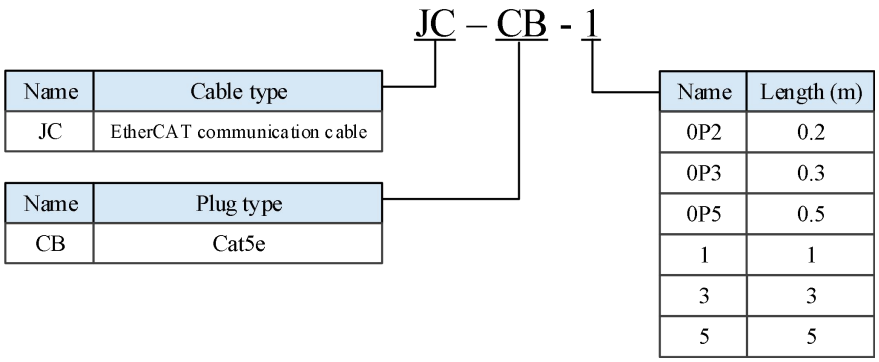
Motor Model	Connector Pin	Interface Pin Definition	
MS6H-180 Base Brake Motor		Number	Definition
		A	U
		B	V
		C	W
		D	PE
		1	BK+
		2	BK-
MS6H-200 and MS655 base motors		Color	Definition
		red	U
		Huang	V
		Lan	W
		Yellow-green	PE

Brake shoe pin description:

The cable with pin definitions including BK+ and BK-is designed for brake-equipped motors; cables for non-brake motors lack these pins and feature empty terminals instead.

Currently, power line cables are available in lengths of 2 meters, 3 meters, 5 meters, 8 meters, 10 meters, 12 meters, 16 meters, 20 meters, 25 meters, 30 meters, 35 meters, 40 meters, 45 meters, and 50 meters.

1.3.3 EtherCAT EtherCAT communication cable model



Name	Cable type
JC	EtherCAT communication cable

Name	Plug type
CB	Cat5e

Name	Length (m)
0P2	0.2
0P3	0.3
0P5	0.5
1	1
3	3
5	5

Currently, EtherCAT bus communication cables are available in lengths of 0.2 meters, 0.3 meters, 0.5 meters, 1 meter, 3 meters, 5 meters, 10 meters, and 20 meters.

1.4 Braking resistor selection

When the servo motor is driven in generator mode, the electrical energy flows back to the servo amplifier side, known as regenerative power. This regenerative power is absorbed by charging the smoothing capacitor in the servo amplifier. Once the maximum chargeable capacity is reached, the excess regenerative power is dissipated through the braking resistor.

The process by which a servo generates renewable electricity is as follows:

- During deceleration operation or during deceleration stop;
- When the vertical axis runs downward;
- When an external load drives the motor to rotate.

Servo driver model	Braking resistor connection terminal
DS5C2-□□P□-PTA	1) Use the built-in braking resistor by short-circuiting terminals P+ and D, and disconnect P+ from terminal C. 2) For drivers with built-in braking resistors rated at 7.5 kW or below, when using an external braking resistor: connect the resistor to terminals P+ and C; disconnect the shorting wires between P+ and D. P0-25 = power value; P0-26 = resistance value. 3) For drivers rated 15 kW or higher using an external braking resistor, connect the resistor to the P+ and PB terminals, where P0-25 represents the power value and P0-26 represents the resistance value.

The table below lists the recommended specifications for external braking resistors for each motor model.

Servo driver model	Built-in braking resistor	Minimum resistance value (Not less than this value)	External braking resistor (Recommended resistance value)	External braking resistor (Recommended power value)
DS5C2-20P1-PTA（-FS)	/	80Ω	80Ω-100Ω	Over 200W
DS5C2-20P4-PTA（-FS)	/			
DS5C2-20P7-PTA（-FS)	80W50Ω	50Ω	50Ω-100Ω	Over 600W
DS5C2-21P0-PTA（-FS)	80W45Ω	35Ω	35Ω-75Ω	Over 800W
DS5C2-21P5-PTA（-FS)	80W50Ω	30Ω	30Ω-50Ω	Over 1000W
DS5C2-22P3-PTA（-FS)	80W50Ω			
DS5C2-22P6-PTA（-FS)	80W50Ω	25Ω	25Ω-50Ω	

DS5C2-41P0-PTA（-FS)	80W100Ω	120Ω	120Ω-150Ω	Over 800W
DS5C2-41P5-PTA（-FS)	80W100Ω	75Ω	75Ω-120Ω	Over 1000W
DS5C2-42P3-PTA（-FS)	80W60Ω	55Ω	55Ω-75Ω	Over 1000W
DS5C2-43P0-PTA（-FS)	80W60Ω	50Ω	50Ω-75Ω	Above 1200W
DS5C2-45P5-PTA（-FS)	/	25Ω	25Ω-65Ω	Over 2000W
DS5C2-47P5-PTA（-FS)	/	22Ω	22Ω-50Ω	Over 2500W
DS5C2-415P0-PTA	/	20Ω	20Ω-45Ω	Over 3000W
DS5C2-422P0-PTA	/	20Ω	20Ω-25Ω	Over 3000W
DS5C2-432P0-PTA	/	20Ω	20Ω-30Ω	Over 5000W

- A smaller resistance value results in faster discharge, but excessively low values may cause the resistor to break down. Therefore, during selection, aim for a value as close as possible to the lower limit—never below it.
- When wiring, use high-temperature resistant and flame-retardant wires, and ensure the surface of the braking resistor does not come into contact with the wires.

1.5 Selection of Peripheral Components

Peripheral components	Compatible device	Explanation
Fuse	All	Used for circuit overcurrent protection: when the current exceeds the rated value for a specified duration, the internal metal wire of the fuse melts, cutting off the circuit to prevent equipment damage or fire.
Circuit breaker		Equipped with overload and short-circuit protection functions, it automatically trips to disconnect the circuit when detecting abnormal currents (such as overcurrent or short circuits), thereby protecting the lines and equipment.
Electromagnetic contactor		The electromagnetic coil controls the on/off state of the main circuit, making it suitable for scenarios requiring frequent motor startups and shutdowns or high-power loads.
EMC filter		Suppress electromagnetic interference (EMI) between the power grid and equipment.
Magnetic ring, magnetic fixture		Utilizes high-frequency impedance characteristics to absorb common-mode noise in cables, thereby suppressing electromagnetic interference (EMI).

Install sufficient branch circuit short-circuit protection devices in accordance with applicable regulations and the provisions of this manual. This product is suitable for circuits with a rated fuse capacity below 5000 A and a maximum voltage of 480 V AC.

Servo driver model	Drive power (kW)	Rated current (A)	Maximum current (A)	Recommended Specification		
				Manufacturer	Model	Rated current (A)
DS5C2-20P1-PTA（-FS)	0.1	0.9	3.15	Bussmann	FWP-5B	5
DS5C2-20P4-PTA（-FS)	0.4	2.8	9.8		FWP-10B	10
DS5C2-20P7-PTA（-FS)	0.75	4.8	16.8		FWP-20B	20
DS5C2-21P0-PTA（-FS)	1.0	6	18		FWP-20B	20

DS5C2-21P5-PTA（-FS)	1.5	8	20		FWP-20B	20
DS5C2-22P3-PTA（-FS)	2.3	9	18		FWP-20B	20
DS5C2-22P6-PTA（-FS)	2.6	10.5	29.93		FWP-20B	20
DS5C2-41P0-PTA（-FS)	1.0	3.2	9.6		FWP-10B	10
DS5C2-41P5-PTA（-FS)	1.5	5.5	13.75		FWP-10B	10
DS5C2-42P3-PTA（-FS)	2.3	8.5	21.25		FWP-15B	15
DS5C2-43P0-PTA（-FS)	3.0	11	29.7		FWP-20B	20
DS5C2-45P5-PTA（-FS)	5.5	20	50		FWP-35B	35
DS5C2-47P5-PTA（-FS)	7.5	25	62.5		FWP-40B	40
DS5C2-415P0-PTA	15	35	87.5		FWP-70B	70
DS5C2-422P0-PTA	22	43.5	108.75		FWP-90B	90
DS5C2-432P0-PTA	32	62	124		FWP-125A	125

1.5.1 Electromagnetic contactor

Servo driver model	Drive power (kW)	Rated current （A)	Maximum current （A)	Recommended Specification		
				Manufacturer	Model	Rated current （A)
DS5C2-20P1-PTA（-FS)	0.1	0.9	3.15	Schneider	LC1 D09	9
DS5C2-20P4-PTA（-FS)	0.4	2.8	9.8		LC1 D09	9
DS5C2-20P7-PTA（-FS)	0.75	4.8	16.8		LC1 D012	12
DS5C2-21P0-PTA（-FS)	1.0	6	18		LC1 D018	18
DS5C2-21P5-PTA（-FS)	1.5	8	20		LC1 D025	25
DS5C2-22P3-PTA（-FS)	2.3	9	18		LC1 D025	25
DS5C2-22P6-PTA（-FS)	2.6	10.5	29.93		LC1 D032	32

Servo driver model	Drive power (kW)	Rated current (A)	Maximum current (A)	Recommended Specification		
				Manufacturer	Model	Rated current (A)
DS5C2-41P0-PTA（-FS)	1.0	3.2	9.6		LC1 D09	9
DS5C2-41P5-PTA（-FS)	1.5	5.5	13.75		LC1 D09	9
DS5C2-42P3-PTA（-FS)	2.3	8.5	21.25		LC1 D012	12
DS5C2-43P0-PTA（-FS)	3.0	11	29.7		LC1 D018	18
DS5C2-45P5-PTA（-FS)	5.5	20	50		LC1 D025	25
DS5C2-47P5-PTA（-FS)	7.5	25	62.5		LC1 D032	32
DS5C2-415P0-PTA	15	35	87.5		LC1 D50A	50
DS5C2-422P0-PTA	22	43.5	108.75		LC1 D65A	65
DS5C2-432P0-PTA	32	62	124		LC1 D95	95

1.5.2 EMC filter

- Shafner

Servo driver model	Drive power (kW)	Rated current (A)	Maximum current (A)	Recommended Specification		
				Manufacturer	Model	Rated current (A)
DS5C2-20P1-PTA（-FS)	0.1	0.9	3.15	Shafner	FN 2090-8-06	8
DS5C2-20P4-PTA（-FS)	0.4	2.8	9.8		FN 2090-10-06	10
DS5C2-20P7-PTA（-FS)	0.75	4.8	16.8		FN 2090-16-06	16
DS5C2-21P0-PTA（-FS)	1.0	6	18		FN3287-16-44-C33-R65	16
DS5C2-21P5-PTA（-FS)	1.5	8	20		FN3287-16-44-C33-R65	16
DS5C2-22P3-PTA（-FS)	2.3	9	18		FN3287-16-44-C33-R65	16
DS5C2-22P6-PTA（-FS)	2.6	10.5	29.93		FN3287-16-44-C33-R65	16

Servo driver model	Drive power (kW)	Rated current (A)	Maximum current (A)	Recommended Specification		
				Manufacturer	Model	Rated current (A)
DS5C2-41P0-PTA（-FS)	1.0	3.2	9.6		FN3287-10-44-C28-R65	10
DS5C2-41P5-PTA（-FS)	1.5	5.5	13.75		FN3287-10-44-C28-R65	10
DS5C2-42P3-PTA（-FS)	2.3	8.5	21.25		FN3287-16-44-C33-R65	16
DS5C2-43P0-PTA（-FS)	3.0	11	29.7		FN3287-16-44-C33-R65	16
DS5C2-45P5-PTA（-FS)	5.5	20	50		FN3287-25-33-C33-R65	25
DS5C2-47P5-PTA（-FS)	7.5	25	62.5		FN3287-40-33-C33-R65	40
DS5C2-415P0-PTA	15	35	87.5		FN3287-50-53-C33-R65	50
DS5C2-422P0-PTA	22	43.5	108.75		FN3287-80-34-C33-R65	80
DS5C2-432P0-PTA	32	62	124		FN3287-100-35-C33-R65	100

- Fiot single-phase AC three-stage filtering / three-phase four-wire three-stage filtering

Servo driver model	Drive power (kW)	Rated current (A)	Maximum current (A)	Recommended Specification		
				Manufacturer	Model	Rated current (A)
DS5C2-20P1-PTA（-FS)	0.1	0.9	3.15	Fiott	FT130-6	6
DS5C2-20P4-PTA（-FS)	0.4	2.8	9.8		FT130-10	10
DS5C2-20P7-PTA（-FS)	0.75	4.8	16.8		FT130-10	10
DS5C2-21P0-PTA（-FS)	1.0	6	18		FT430-20	20
DS5C2-21P5-PTA（-FS)	1.5	8	20		FT430-25	25
DS5C2-22P3-PTA（-FS)	2.3	9	18		FT430-25	25
DS5C2-22P6-PTA（-FS)	2.6	10.5	29.93		FT430-30	30

Servo driver model	Drive power (kW)	Rated current (A)	Maximum current (A)	Recommended Specification		
				Manufacturer	Model	Rated current (A)
DS5C2-41P0-PTA（-FS)	1.0	3.2	9.6		FT430-10	10
DS5C2-41P5-PTA（-FS)	1.5	5.5	13.75		FT430-10	10
DS5C2-42P3-PTA（-FS)	2.3	8.5	21.25		FT430-20	20
DS5C2-43P0-PTA（-FS)	3.0	11	29.7		FT430-20	20
DS5C2-45P5-PTA（-FS)	5.5	20	50		FT430-30	30
DS5C2-47P5-PTA（-FS)	7.5	25	62.5		FT430-40	40
DS5C2-415P0-PTA	15	35	87.5		FT430-50	50
DS5C2-422P0-PTA	22	43.5	108.75		FT430-80	80
DS5C2-432P0-PTA	32	62	124		FT430-100	100

1.5.3 Magnetic ring and magnetic fixture

The magnetic ring is typically installed near the input or output side of the drive, and it is recommended to install it as close as possible to the drive body.

When configured on the input side, its primary function is to eliminate conductive electromagnetic interference in the power lines; when installed on the output side, it effectively suppresses high-frequency radiated interference generated during driver operation while simultaneously reducing parasitic currents in the motor bearings.

To address abnormal leakage currents under specific operating conditions and electromagnetic interference affecting control signal lines, ring-shaped magnetic cores or snap-fit magnetic core assemblies can be employed for targeted solutions. The former is suitable for winding installation, while the latter facilitates rapid deployment on cables.

2 Installation of a servo system

2.1 Installation of the servo driver

2.1.1 Installation site

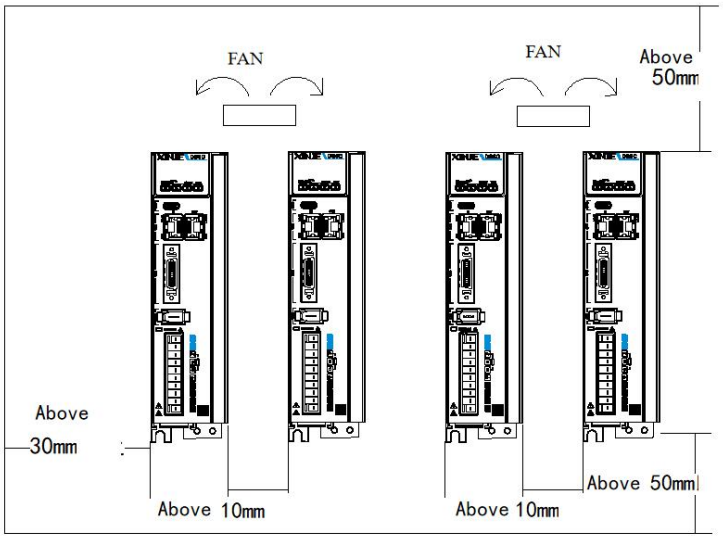
- Install in an enclosure protected from direct sunlight and rain.
- Do not use this product in environments containing corrosive or flammable gases such as hydrogen sulfide, chlorine, ammonia, sulfur, chlorinated gases, acids, alkalis, or salts, or near combustible materials.
- Do not install in environments with high temperatures, humidity, dust, or metal particles.
- Install the drive in a vibration-free location.

2.1.2 Ambient condition

Project	Description
Use ambient temperature	-10 to +55°C (No power rating reduction required for temperatures between-10°C and 45°C; a 2% power rating reduction is required for temperatures exceeding 45°C, with a reduction of 2% for each additional degree Celsius increase)
Environmental humidity	20–90% RH (no condensation)
storage temperature	-20~60°C
storage humidity	20–90% RH (no condensation)
Vibration-resistant	No more than 4.9 m/s²
Above sea level	For heights not exceeding 1000 m; for heights above 1000 m, use the reduced rate (a 1% reduction per 100 m increase in height).

2.1.3 Installation Standard

Please strictly adhere to the installation standards for the control cabinet shown in the figure below, which apply when installing multiple servo drives side-by-side within the control cabinet (hereinafter referred to as "side-by-side installation").
Take drivers of 3 kW or less as an example:



■ When installed side by side

As shown in the figure above, when installing drives side by side inside the cabinet:

- For drivers rated 3 kW or below, ensure a minimum clearance of 10 mm on each lateral side and 50 mm on each longitudinal side.
- The 5.5 kW to 7.5 kW driver requires a clearance of at least 40 mm on each lateral side and over 80 mm on each longitudinal side.
- For 15kW to 32kW drivers, the installation cabinet must be maintained at least 50 mm laterally and 100 mm longitudinally on both sides.

Additionally, to prevent localized overheating of the servo driver's ambient temperature, it is essential to maintain uniform temperature distribution within the control cabinet.

■ Orientation of the servo driver

During installation, orient the front of the servo driver (the actual installation surface for the operator) toward the operator and keep it perpendicular to the wall. For drivers equipped with a braking resistor at the bottom, ensure proper heat dissipation on the installation surface to prevent overheating and fire hazards.

■ Cooling

To ensure effective cooling through fans and natural convection, refer to the figure above and leave sufficient space around the servo driver.

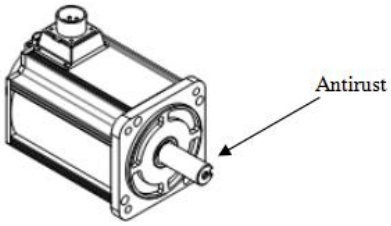
■ Environmental conditions inside the control cabinet

- Service environment temperature for the servo driver: -10 to +55°C (no derating required for temperatures between-10°C and 45°C; derating is required when temperatures exceed 45°C, with a 2% reduction per 1°C increase).

- Humidity: below 90% RH (relative humidity).
- Vibration: 4.9 m/s^2.
- Avoid freezing, condensation, or similar phenomena.

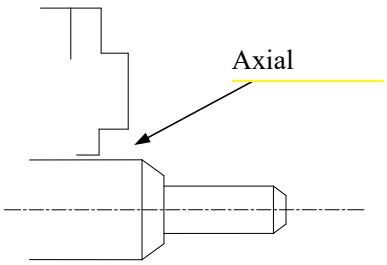
2.2 Installation of a servo motor

MS6 series servo motors can be installed either horizontally or vertically. However, incorrect installation or placement in inappropriate locations may shorten the motor's lifespan or cause unexpected accidents. Please follow the precautions below for proper installation.

pay attention to
1. Apply a rust inhibitor to the shaft end. Before installing the motor, wipe off the inhibitor using a cloth soaked in the diluent. 2. When applying the rust inhibitor, avoid letting the diluent come into contact with other parts of the servo motor. 

2.2.1 Ambient condition

If the installation environment poses a water droplet risk (excluding the motor shaft end), verify that the motor's protection rating meets operational requirements. When the motor shaft section may be exposed to oil splashes, a servo motor equipped with an oil seal must be used.



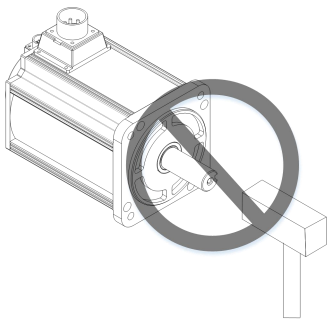
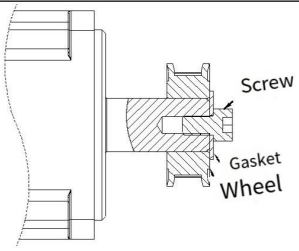
The MS6 series servo motors are designed for indoor use. Please operate them in environments that meet the following installation requirements:

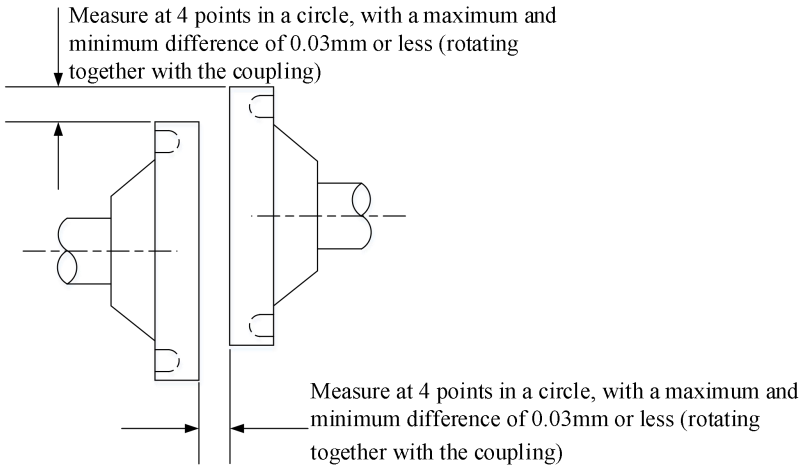
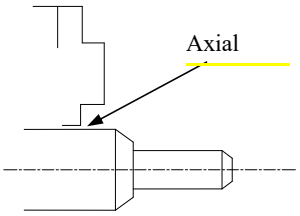
Project	Description
Use ambient temperature	-10°C to 40°C (no freezing)
Environmental humidity	20%~90% RH (no condensation)
storage temperature	-20°C~60°C
storage humidity	20%~90% RH (no condensation)

Vibration resistance (acceleration of vibration)	Radial: 49 m/s²: Axial: 24.5 m/s²
Above sea level	For heights not exceeding 1000 m; for heights above 1000 m, use the reduced rate (a 1% reduction per 100 m increase in height).
Cooling-down method	Air cooling/Liquid cooling/Natural cooling
Levels of protection	IP67 (MS6 series B3 motor, MS6G series B2 motor) IP65 (MS6H series B2 motor) IP54 (for motors with 200 or more stator poles)

- The vibration intensity applied to the servo motor varies depending on the application; please verify the vibration acceleration through actual product testing.
- To achieve the above protection level, ensure the motor and its matching cable are correctly inserted and securely locked.

2.2.2 Installation instructions

Project	Description
Rust prevention	◆ Before installation, wipe off the rust inhibitor from the extended end of the servo motor shaft, then apply the appropriate rust prevention treatment.
Encoder Note	◆ During installation, avoid impacting the shaft end; otherwise, the internal encoder may be damaged.   ◆ When installing the pulley on the servo motor, first verify that all components—including the servo motor, pulley, gasket, and screws—are complete and undamaged, and prepare appropriate tools (e.g., a wrench). Align the pulley's shaft hole with the motor shaft and advance it smoothly to ensure concentricity. Then fit a gasket of suitable specifications onto the motor shaft to compensate for any errors, enhance friction, and prevent loosening. Finally, insert the screws into their holes, securing the gasket firmly against the pulley to ensure reliable fixation. ◆ For servo motor shafts with keyways, install using the screw holes at the shaft

Project	Description
	ends. For shafts without keyways, employ friction coupling or similar methods. ◆ When removing the pulley, use a pulley remover to prevent the bearing from suffering severe impact loads. ◆ To ensure safety, install a protective cover or similar device in the rotating area.
Soothe the mind	◆ When installing the servo motor, ensure it meets the centering accuracy requirements shown in the figure below. Inadequate centering may cause vibration and potentially damage components such as bearings and encoders. During coupling installation, avoid direct impact on the motor shaft to prevent damage to the encoder mounted on the opposite shaft end of the load. 
Installation Direction	◆ The servo motor can be installed either horizontally or vertically.
Oil and Water Countermeasure	If the installation environment poses a water drip risk (excluding the motor shaft end), verify that the motor's protection rating meets operational requirements; when the motor shaft penetration may be exposed to oil splashes, use a servo motor equipped with an oil seal; the oil seal comes with factory-applied lubricating grease and should be replaced after 5,000 hours of normal operation. Operating conditions for servo motors with oil seals: ◆ When in use, ensure the oil level is below the lip of the oil seal. ◆ Use the oil seal when it maintains optimal performance in controlling oil mist splashing. ◆ When installing the servo motor vertically upward, ensure that no oil accumulates on the oil seal lip. 
The stress condition of the cable	◆ Avoid bending or applying tension to electrical wires, especially signal lines with core wires measuring 0.2 mm or 0.3 mm—these are extremely thin. When wiring, never tension them excessively.
Processing of the connector section	For the connector section, please note the following: ◆ When connecting the connector, ensure there are no debris, metal fragments, or other foreign objects inside. ◆ When connecting the connector to the servo motor, always connect it from the main circuit cable side first, ensuring the main cable's Grounding wire is securely connected. Connecting from the encoder cable side first may cause the encoder to

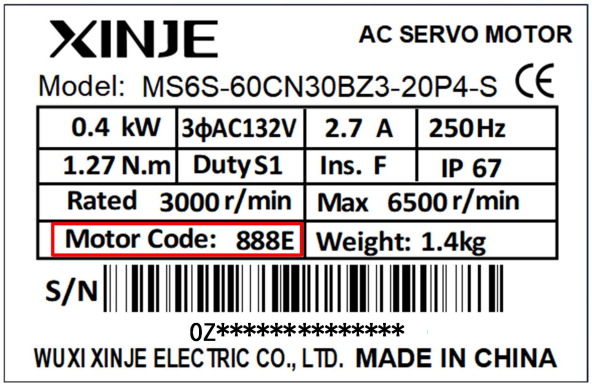
Project	Description
	malfunction due to the potential difference between PE conductors. ◆ When wiring, ensure the pin arrangement is correct. ◆ The connector is made of resin. Avoid applying impact to prevent damage. ◆ When handling the cable while it remains connected, always grip the servo motor housing. Handling only the cable may damage the connector or sever the cable. ◆ When using curved cables, exercise caution during wiring operations to avoid applying stress to the connector. Exerting stress on the connector may cause damage.

2.2.3 Installation site

- Do not operate in environments containing corrosive or flammable gases such as hydrogen sulfide, chlorine, ammonia, sulfur, chlorinated gases, acids, alkalis, or salts.
  Use this product near combustible materials;
- In environments containing grinding fluids, cutting fluids, oil contaminants, or metal dust, select a motor with an oil seal.
- Stay away from heat sources such as STOves;
- Do not use the motor in enclosed environments. Enclosed environments cause the motor to heat up excessively, reducing its service life.

2.2.4 Check the motor code

A servo driver can be paired with motors of similar power ratings, with different motor models identified by the code on their nameplates. Before debugging the servo system, ensure that the motor code U3-70 matches the one indicated on the motor nameplate.



2.3 Installation of servo cable

The servo motors compatible with DS5 series servo drives utilize communication-type encoders. Improper usage or environmental factors may lead to unpredictable effects; therefore, the following precautions must be observed when installing optional power cables and encoder cables.

2.3.1 Optionally select Xinje Cable

Our company's standard cable materials include conventional cables and high-flexibility cables. For motors with a 80 base (including 80 base), the compatible cable connectors are available in aviation-type and AMP-type; for motors above the 80 base, the compatible cable connector is the aviation-type.
When cuSTOmers independently select cables, they must define the actual operating conditions on-site.
For conventional applications, select cables from other manufacturers strictly in accordance with the specifications provided by Xinje (2.3.2 Xinje Cable Specifications). For non-conventional applications, choose cables that exceed Xinje's current specifications based on actual operating conditions.

■ In routine situations, the following points should be noted:

- The pulse command signal cable should be routed to a length of no more than 3 meters.
- The encoder cable should be limited to within 20 meters; for lengths exceeding this, specialized cables are recommended. The cable diameter depends on the actual usage length at the site. Longer cables result in higher resistance, more pronounced voltage attenuation or signal distortion, and may lead to signal loss or failure to detect signals. Therefore, cuSTOm-made specialized cables should generally be used for lengths beyond 20 meters.
- The wire diameter depends on the motor's current rating. Typically, the wire diameter should be set at 1/10 of the motor's maximum current; for example, if the motor's maximum current is 60 A, a 6 mm^2 wire diameter is recommended.
- In case of interference issues, ensure the separation of high-voltage and low-voltage circuits; it is recommended to isolate power lines from encoder and signal lines.
- Ensure proper Grounding of the servo driver and servo motor. The Grounding resistance should not exceed 4 Ω, and the Grounding depth should be greater than 2 meters. It is recommended to use 4×40 mm galvanized steel or 40 mm diameter galvanized steel pipes.
- When cuSTOmers install cables themselves, they should select cable specifications (refer to Section 2.3.2 for Xinje cable specifications). During wiring, ensure reliable soldering to avoid issues such as poor solder joints, bridging, mis-soldering, or missed soldering. After soldering is complete, test the conductivity at both ends of the cable.

■ In unconventional situations, the following precautions should be observed:

1) Applications for cable dragging and bending

- Do not bend or subject the cable to tension. Since the core wire diameter of signal cables is only 0.2 mm or 0.3 mm, they are prone to breaking; exercise caution during use.
- When moving cables, use flexible cables; ordinary cables are prone to damage after prolonged bending.

The built-in cables for low-power motors (below 80-watt motors) are not suitable for cable relocation applications.

- When using a cable protection chain, ensure:

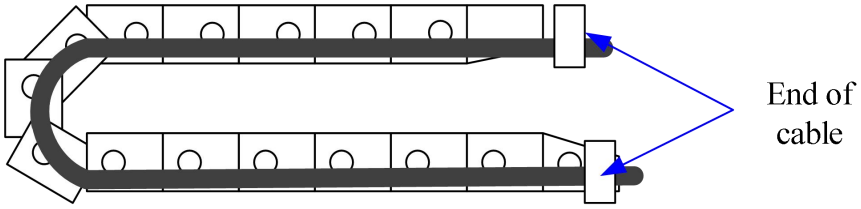
  ① The bending radius of the cable shall be at least 10 times its outer diameter;

  ② Do not secure or bundle the wiring within the cable protection chain; bundling and securing should only be performed at the two immovable ends of the cables on the chain.

  ③ Do not wind or twist the cable;

  ④ The duty cycle within the cable protection chain shall be maintained below 60%.

  ⑤ Do not mix cables with significantly different appearances for wiring; this prevents thick wires from breaking thin ones. If mixing is unavoidable, install a partition device between the cables.



2) Oil-contaminated or humid environments

- It is recommended to use cables with aviation plugs as the optional connector; Ampere interface cables are not advised.
- Existing Ampere interface cables at the site require appropriate protection (e.g., applying glass adhesive or wrapping with insulating cloth).
- Use special cables.

3) Interference-prone or high-current/high-power applications (e.g., welding equipment)

- The motor is properly Groundinged.
- High-current equipment should be Groundinged separately.
- Rational wiring, such as separating power and low-voltage cables.
- Protect the encoder cable with a metal shielding layer or add magnetic rings for interference suppression.

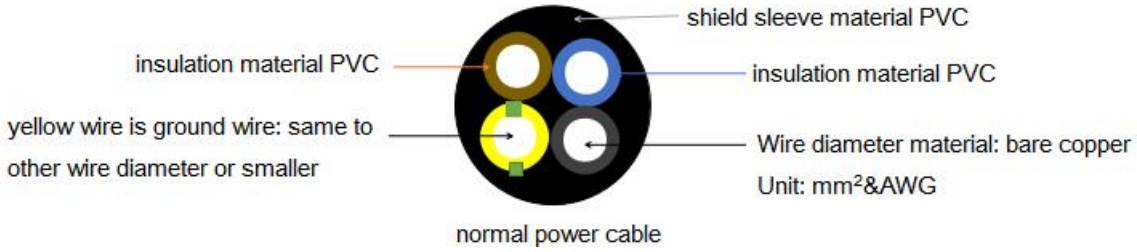
4) Low/High Temperature Environments

- Select cables that meet the usage requirements (special cables).

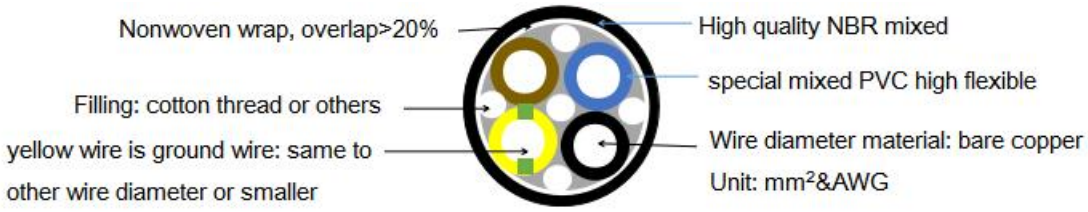
2.3.2 Xinje Cable Specifications

1) Material Composition of Xinje Cable

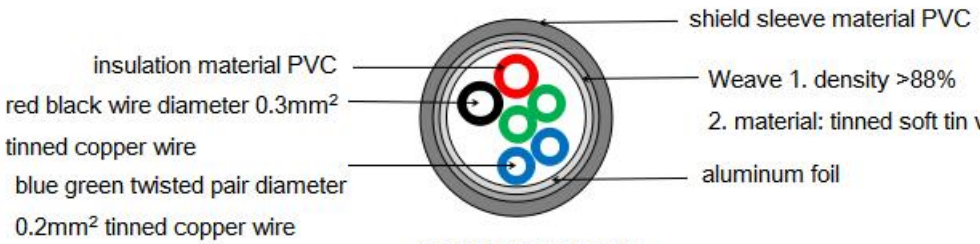
Cross-sectional diagram of cables (encoder cables, power cables), with detailed descriptions of the insulation material, wire diameter, conductor material, and shielding layer material in the internal cross-section view.



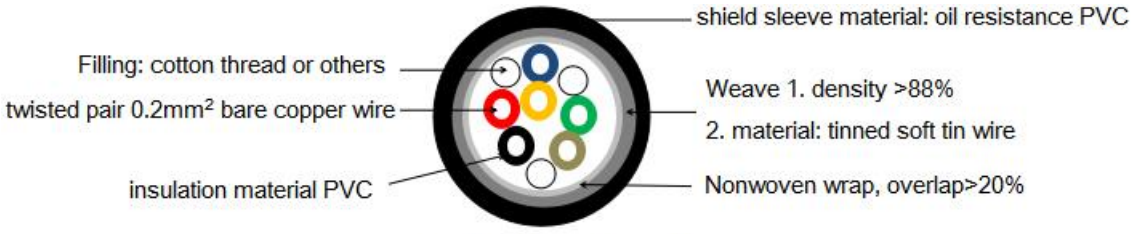
normal power cable



high flexible power cable



normal encoder cable



high flexible encoder cable

2) Wire diameter specifications

Frame size	Encoder wire diameter		Power cable wire diameter		
	Overall wire diameter (standard)	Single Cable Wire diameter	Total wire diameter (mm) (No brake /Brake)	Power cable core Cable diameter (mm²)	Brake cable core wire diameter
40 chassis	6 mm	Below 15 meters: 3P*0.2 mm²	Standard, High Flexibility: 5.2/5.8 mm	4*0.3 mm²	2*0.3 mm²
60,80 machine bases			Standard, High Flexibility: 6.2/6.5 mm	4*0.5 mm²	
100,110,130 machine bases	6.2 mm	15m~30m: 2P*0.2	Standard: 9.4/9.4 mm High flexibility: 9.6/9.6 mm	4*1.5 mm²	

Frame size	Encoder wire diameter		Power cable wire diameter		
	Overall wire diameter (standard)	Single Cable Wire diameter	Total wire diameter (mm) (No brake /Brake)	Power cable core Cable diameter (mm²)	Brake cable core wire diameter
180 chassis, 3 kW 180 chassis, 3 kW		mm²+ 1P*0.34 mm² 30m~50m： 2P*0.2 mm²+ 1P*0.4 mm²	Standard: 9.7/9.8 mm High flexibility: 9.8/9.8 mm	4*2.0 mm²	
180-inch chassis, power above 3 kW 180-inch chassis, power above 3 kW			Standard: 14.5/14.5 mm High flexibility: 15.8/15.8 mm	3*6.0 mm²+ 1*2.5 mm²	
200 machine bases, 13 and 17 kW	7.9 mm		Standard: 14.5 mm High flexibility: 15.5 mm		
200 chassis, 21 kW			Standard: 19.6 mm	4*10.0mm²	
200 chassis, 27 kW			Standard: 20mm	3*12.0mm²+ 1*4 mm²	
265 chassis, 32 kW			Standard: 22mm	4*16.0mm²	
265 chassis, 45 kW			Standard: 29mm	3*30.0mm²+ 1*16 mm²	

For encoder cables of 15 meters or longer, the power lines (5V and GND) must have thicker conductors to prevent voltage attenuation caused by long-distance wiring harnesses, which could impair encoder signal transmission.

3) Cable Technical Specifications

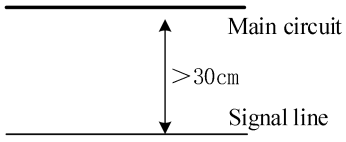
Cable Type	Cable Performance Specifications		Cable installation specifications	
	temperature resistance	withstand voltage	Fixed Installation	Mobile Installation
Regular Cable	-20℃~80℃	2000V/min	≥5*D	/
High flexibility Cable	-20℃~80℃	2000V/min		If the travel distance is ≤2m and R ≥ 7.5*D, then N ≥ 3 million trips; If the travel distance is ≤2 m and R ≥ 10 *D, then N ≥ 5 million trips.
Note: D denotes the finished wire diameter, R denotes the bending radius, and N denotes the number of bending cycles.				

3 Wiring for a servo system

The recommended wiring materials for each interface of the servo driver are listed in the table below:

Driver power	Power cable-Cross-sectional area (mm²)	UVW power cable-cross-sectional area: mm²	Grounding wire⏚-wire diameter mm²	Encoder wire-wire diameter: mm²	Grounding screw specification: mm	Recommended Grounding torque: N·m
100W	2.0	0.3	0.3	0.2 (6 cores)	M3	0.54
200 ~ 750W	2.0	0.5	0.5	0.2 (6 cores)	M3	0.54
1 ~ 2.6kW	2.0	1.5	1.5	0.2 (6 cores)	M4	0.54
3kW	2.0	2.0	2.0	0.2 (6 cores)	M4	0.54
5.5~7.5kW	6.0	6.0	2.5	0.2 (6 cores)	M4	0.54
15kW	6.0	6.0	2.5	0.2 (8 cores)	M4	5.5
22kW	10.0	10.0	10.0	0.2 (8 cores)	M6	5.5
32kW	16.0	16.0	16.0	0.2 (8 cores)	M6	5.5

- Do not run the main circuit cables and signal cables through the same conduit, nor bundle them together. During wiring, maintain a distance of at least 30 cm between the main circuit cables and signal cables.

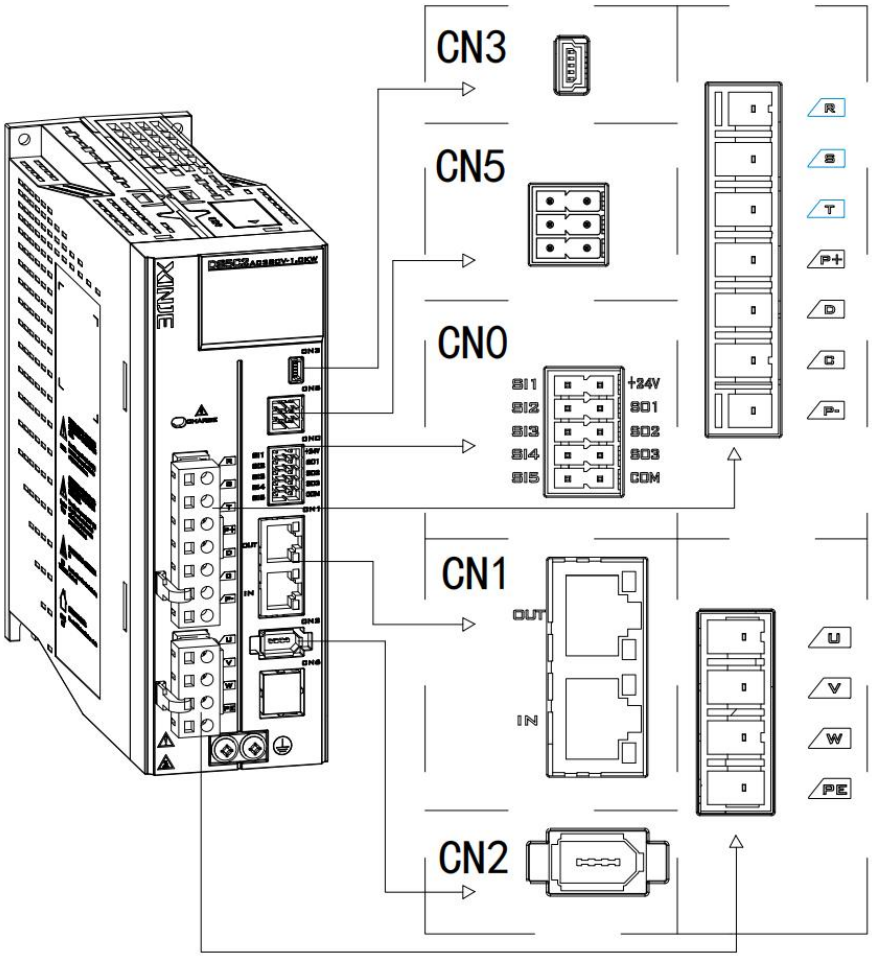


- For signal lines and encoder feedback lines, use multi-strand twisted wires and multi-core twisted shielded cables.
- Regarding wiring length, the maximum length for command input lines is 3 m, while the maximum length for encoder differential feedback lines is 20 m.
- Even when the drive power is disconnected and the panel displays "OFF," the internal capacitors of the servo unit still retain high voltage. Avoid touching the power terminals for at least 10 minutes.

- Avoid frequent power cycling of the driver. When repeated continuous power switching is required, ensure the power switching frequency exceeds 2 cycles per minute. Servo drivers contain large internal capacitors, causing significant charging currents (0.2 seconds) to flow through their internal circuits during power-on. Frequent power switching may degrade the performance of key circuit components and shorten the driver's service life.

3.1 Main circuit wiring

3.1.1 Servo driver terminal layout



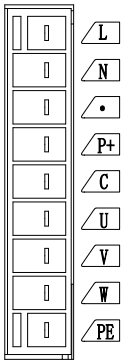
The names of the sections are as follows:

(1): CN3 RS232 port
(2): CN5 STO terminal
(3): CN0 input/output signal lines
(4): CN1 standard RJ45 network port
(5): CN2 Encoder Port
(6): Power supply terminal
(7): Motor terminal block

The terminal layout diagram above depicts the DS5C2-41P0-PTA-FS model. For the actual terminal positions of each power model, refer to Section 1.1.3, "Description of Each Component."

3.1.2 Main circuit terminals and descriptions

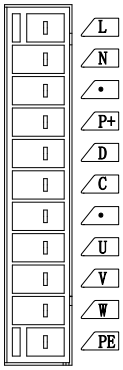
■ DS5C2-20P1/20P4-PTA



In top-down order, the functions of the main circuit terminals are as follows:

Terminal	Function	Rxplain
L、N	Main circuit power supply input terminal	Single-phase AC 200–240 V, 50/60 Hz
●	NC	-
P+、C	Use an external braking resistor	Connect the braking resistor to the P+ and C terminals; P0-25 = Power value, P0-26 = Resistance value
U、V、W、PE	Motor connection terminal	Connected to the motor

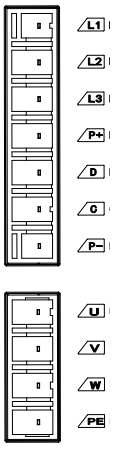
■ DS5C2-20P7-PTA



In top-down order, the functions of the main circuit terminals are as follows:

Terminal	Function	Explanation
L、N	Main circuit power supply input terminal	Single-phase AC 200–240 V, 50/60 Hz
●	NC	-
P+、D、C	Use the built-in braking resistor	Short-circuit the P+ and D terminals; disconnect the P+ and C terminals.
	Use an external braking resistor	Connect the braking resistor to terminals P+ and C, then disconnect the shorting wire between P+ and D. P0-25 = Power value, P0-26 = Resistance value
●	NC	-
U、V、W、PE	Motor connection terminal	Connected to the motor

■ DS5C2-21P0/21P5/22P3/22P6-PTA

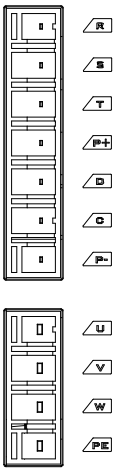


In top-down order, the functions of the main circuit terminals are as follows:

Terminal	Function	Explanation
L1、L2、L3	Main circuit power supply input terminal	Single-phase/three-phase AC 200–240 V, 50/60 Hz (For single-phase power supply, connect to L1/L3; otherwise, parameter memory will be affected during power outage.)
P+、D、C	Use the built-in braking resistor	Short-circuit the P+ and D terminals; disconnect P+ from C.
	Use an external braking resistor	Connect the braking resistor to terminals P+ and C; disconnect the shorting wire between P+ and D; set P0-25 = power value and P0-26 = resistance value.
P+、P-	Busbar terminal	The real-time voltage of the busbar can be measured. Note the danger.

U、V、W、PE	Motor connection terminal	Connected to the motor
⏚	Grounding	The Grounding wire is on the heat sink. Ensure it is properly Groundinged before powering on.

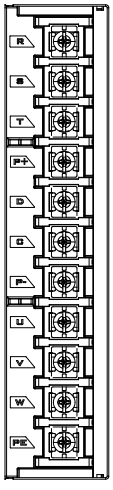
■ DS5C2-41P0/41P5/42P3/43P0-PTA



In top-down order, the functions of the main circuit terminals are as follows:

Terminal	Function	Explanation
R、S、T	Main circuit power supply input terminal	Three-phase AC 380–440 V, 50/60 Hz
P+、D、C	Use the built-in braking resistor	Short-circuit the P+ and D terminals; disconnect P+ from C.
	Use an external braking resistor	Connect the braking resistor to terminals P+ and C; disconnect the shorting wire between P+ and D; set P0-25 = power value and P0-26 = resistance value.
P+、P-	Busbar terminal	The real-time voltage of the busbar can be measured. Note the danger.
U、V、W、PE	Motor connection terminal	Connected to the motor
⏚	Grounding	The Grounding wire is on the heat sink. Ensure it is properly Groundinged before powering on.

■ DS5C2-45P5/47P5-PTA

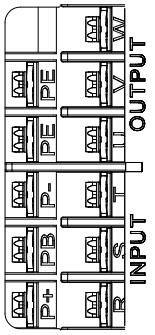


In top-down order, the functions of the main circuit terminals are as follows:

Terminal	Function	Explanation
R、S、T	Main circuit power supply input terminal	Three-phase AC 380–440 V, 50/60 Hz
P+、D、C	Use the built-in braking resistor	Short-circuit the P+ and D terminals; disconnect P+ from C. This model does not have a built-in braking resistor and is not supported.
	Use an external braking resistor	Connect the braking resistor to terminals P+ and C; disconnect the shorting wire between P+ and D; set P0-25 = power value and P0-26 = resistance value.
P+、P-	Busbar terminal	The real-time voltage of the busbar can be measured. Note the danger.
U、V、W、PE	Motor connection terminal	Connected to the motor
⏚	Grounding	The Grounding wire is on the heat sink. Ensure it is properly Groundinged before powering on.

■ DS5C2-415P0-PTA

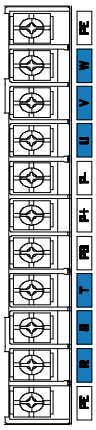
The functions of the main circuit terminals are as follows:



Terminal	Fnction	Explanation
R、S、T	Main circuit power supply input terminal	Three-phase AC 380–440 V, 50/60 Hz
P+、PB	Use an external braking resistor	When using an external braking resistor, connect it to the P+ and PB terminals.
P+、P-	Busbar terminal	The real-time voltage of the busbar can be measured. Note the danger.
U、V、W	Motor connection terminal	Connected to the motor
PE	Grounding	Perform Grounding treatment. Ensure proper Grounding before powering on.

■ DS5C2-422P0/432P0-PTA

The functions of the main circuit terminals are as follows:



Terminal	Function	Explanation
PE	Driver Grounding terminal	-Grounding the drive unit. Ensure proper Grounding before powering on
R、S、T	Main circuit power supply input terminal	Three-phase AC 380–440 V, 50/60 Hz
PB、P+	Use an external braking resistor	When using an external braking resistor, connect it to the P+ and PB terminals.
P+、P-	Busbar terminal	The real-time voltage of the busbar can be measured. Note the danger.
U、V、W	Motor connection terminal	Connected to the motor
PE	Grounding	Perform Grounding treatment. Ensure proper Grounding before powering on.

3.1.3 Description of CN0, CN1, CN2, and CN3 terminals

3.1.3.1 CN0 Terminal Description

■ CN0 terminal specifications (750W and below, 3 input/3 output)

Number	Name	Explanation	Number	Name	Explanation
1	SI1	Input Terminal 1 (High Speed)	5	SO1	Output Terminal 1
2	SI2	Input Terminal 2 (High Speed)	6	SO2	Output Terminal 2
3	SI3	Input terminal 3	7	SO3	Output terminal 3
4	+24V	The collector is connected	8	COM	Output terminal

		in an open circuit.			Grounding

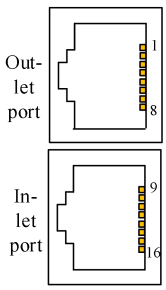
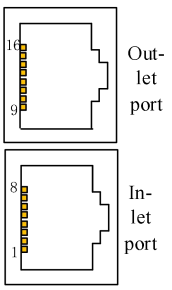
■ CN0 terminal specifications (1–7.5 kW, 5 inputs/3 outputs)

Number	Name	Explanation	Number	Name	Explanation
1	SI1	Input Terminal 1 (High Speed)	6	+24V	Input +24V
2	SI2	Input Terminal 2 (High Speed)	7	SO1	Output Terminal 1
3	SI3	Input terminal 3	8	SO2	Output Terminal 2
4	SI4	Input terminal 4	9	SO3	Output terminal 3
5	SI5	Input terminal 5	10	COM	Output terminal Grounding

■ CN0 terminal specifications (15–32 kW, 5 inputs and 4 outputs)

Number	Name	Explanation	Number	Name	Explanation
1	P-	impulse -	11	+24V	Public terminal of the input port
2	P+5	Pulse +5V	12	SI1	input terminal
3	P+24	Pulse + 24V	13	SI2	input terminal
4	D-	direction -	14	SI3	input terminal
5	D+5	Direction +5v	15	SI4	Input terminal (high-speed)
6	D+24	Direction +24V	16	SI5	Input terminal (high-speed)
7	SO1+	leading-out terminal +	17	SO1-	leading-out terminal -
8	SO2+	leading-out terminal +	18	SO2-	leading-out terminal -
9	SO3+	leading-out terminal +	19	SO3-	leading-out terminal -
10	SO4+	leading-out terminal +	20	SO4-	leading-out terminal -

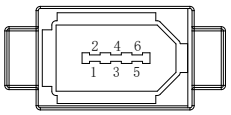
3.1.3.2 CN1 Terminal Description

100~750w,15~32kw	1kw~7.5kw	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	-

3.1.3.3 CN2 Terminal Description

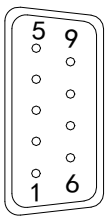
■ 7.5 kW and below

The terminal arrangement on the CN2 driver body side—the encoder socket—is as follows:



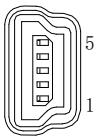
Number	Definition
1	5V
2	GND
5	A
6	B

■ 15–32 kW driver



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

3.1.3.4 CN3 terminal description (RS232 communication)



Drive body side-5-pin trapezoidal interface

Pin number	Name	Explanation
1	TXD	RS232 transmitter
2	RXD	RS232 receiver
3	GND	RS232 signal Grounding

Please use the dedicated cable communication provided by Xinje Company.

RS232 communication operates in full-duplex mode. The TXD pin (pin number 1) on driver 232's communication port must be connected to the RX pin of the USB-to-Serial converter, while the RXD pin (pin number 2) should be connected to the TX pin of the same converter.

The default communication parameters of RS232 are: baud rate 115200 bps; 8-bit data bits; 1-stop bit; parity check.

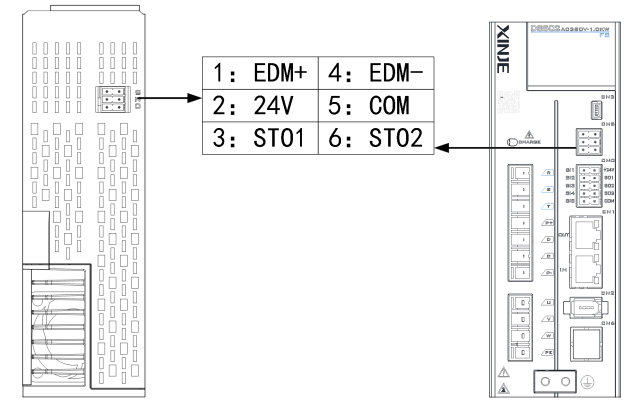
The internal hardware supports a maximum frequency of 250 kHz and does not support hot swapping.

The Modbus station number is set as follows:

Parameter number	Function	Factory settings	Set range	Revise	Take effect
P7-10	Modbus station number configuration	1	1～255	servo OFF	immediately

3.1.3.5 CN5 Terminal Description

The terminal arrangement of Driver CN5 port is as follows (-facing the driver): Safety torque shutdown STO is supported only for models ending with "-FS".



0.1~0.75kW驱动器 STO端子位置　　1kW~7.5KW驱动器 STO端子位置

Number	Name	Explanation	Number	Name	Explanation
1	EDM+	EDM output +	4	EDM-	EDM output -
2	24V	24V output	5	COM	Public Area
3	STO1	STO1 circuit input	6	STO2	STO2 circuit input

To enhance user-friendliness during debugging, a power supply voltage (2:24V) pin has been added. If the STO function is not required, connect terminals STO1 and STO2 to the 24V terminal.

The maximum allowable cable length between the drive and the safety switch is 30 meters.

3.2 Classification and Functions of Signal Terminals

3.2.1 SI incoming signal

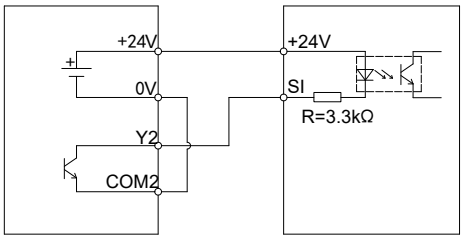
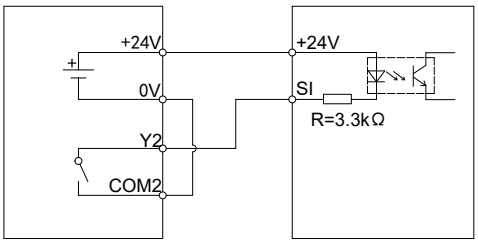
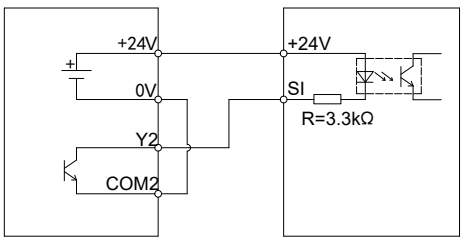
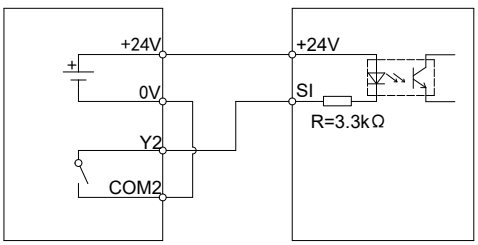
Connect using a relay or a transistor circuit with an open collector. When using a relay, select a low-current relay. Failure to use a low-current relay may result in poor contact.

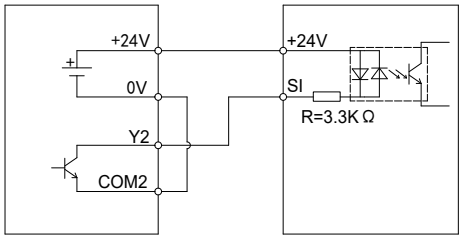
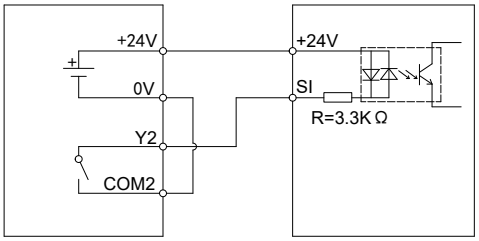
Classify	Input terminal	Function
on-off input	SI1 ~ SI5	Multifunctional input signal terminal

Factory allocation of input terminals

Terminal	SI1	SI2	SI3	SI4	SI5
Function	P-OT/Prohibited forward rotation	N-OT/Prohibition of Inversion	Home Origin Signal	Unassigned	Unassigned

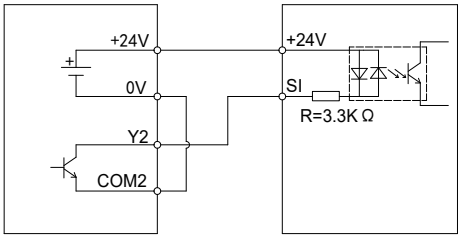
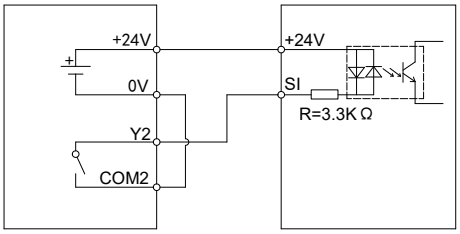
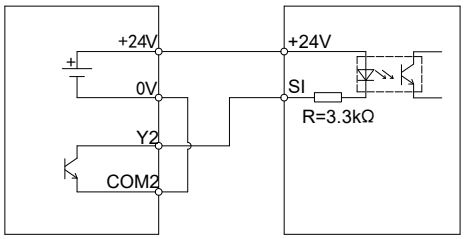
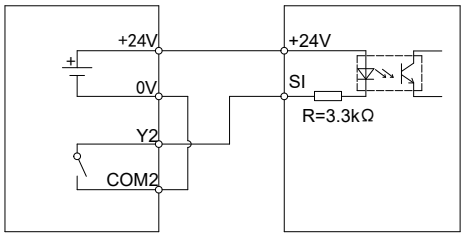
■ 0.1 kW to 7.5 kW servo driver

Open-circuit collector type (750W and below, all SI models)	Relay type (750W and below, all SI models)
Upper device: servo driver 	Upper device: servo driver 
Open-circuit collector type (1 kW to 7.5 kW, SI1/2)	Relay type (1 kW ~ 7.5 kW, SI1/2)
Upper device: servo driver 	Upper device: servo driver 
Open-circuit collector type (1 kW to 7.5 kW, SI3/4/5)	Relay type (1 kW to 7.5 kW, SI3/4/5)

Upper device: servo driver	Upper device: servo driver
	

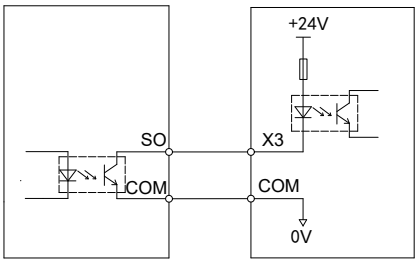
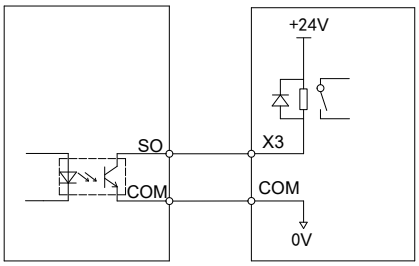
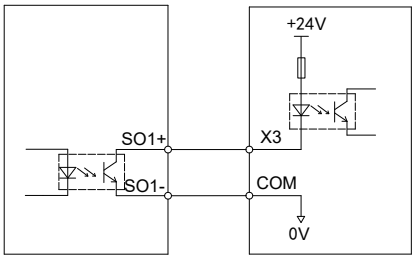
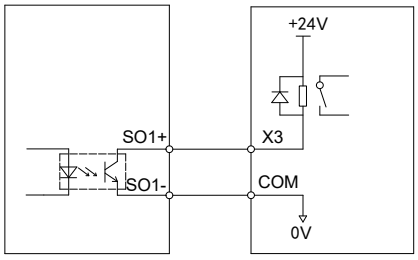
- For drivers rated at 750W or below, SI1 and SI2 are high-speed SI inputs, while SI3 is a low-speed input that supports only the NPN configuration.
- The SI1 and SI2 channels of the 1–7.5 kW driver are high-speed SI inputs with a response time ≤2 μs, supporting only NPN configuration; SI3, SI4, and SI5 channels are low-speed SI inputs with a response time ≤2 ms, supporting both NPN and PNP configurations (all SI1–SI5 channels must use either NPN or PNP configuration simultaneously).
- The typical voltage is DC24V, with a minimum of no less than DC18V and a maximum allowable voltage not exceeding DC28V.

■ 15–32 kW servo driver

Open-circuit collector type (15–32 kW, SI1/2/3)	Relay type (15–32 kW, SI1/2/3)
Upper device: servo driver 	Upper device: servo driver 
Open-circuit collector type (15–32 kW, SI4/5)	**Relay type (15–32 kW, SI4/5)**
Upper device: servo driver Upper device: servo driver 	Upper device: servo driver Upper device: servo driver 

- The 15–32 kW driver features three low-speed SI inputs (SI1, SI2, SI3) with a response time ≤2 ms and supports both NPN and PNP configurations; SI4 and SI5 are two high-speed SI inputs with a response speed ≤2 μs, supporting only the NPN configuration.
- The typical voltage is DC24V, with a minimum of no less than DC18V and a maximum allowable voltage not exceeding DC28V.

Driver SO output circuit

Optocoupler-based upstream device (7.5 kW and below)	Relay-type upper-level device (7.5 kW and below)
Servo driver upper-level device 	Servo driver upper-level device 
Optocoupler-based upstream device (15–32 kW)	**Relay-type upper-level device (15–32 kW)**
Servo driver upper-level device 	Servo driver upper-level device 

- For drivers with power ratings of 7.5 kW or below (SO1, SO2, SO3), only the NPN connection configuration is supported.
- The 15–32 kW drivers SO1, SO2, SO3, and SO4 are labeled with + and-signs. When using the common COM port, SO1-, SO2-, SO3-, and SO4-can be connected together; these ports are NPN type but can also be connected in reverse using a PNP configuration.
- Maximum load current:

  For 400W and below: SO1 DC 500mA (maximum), SO (other) DC 50mA (maximum). Since the current required for dry brake operation is substantial, when directly controlling the brake motor via SO, use terminal SO1 for control and set the brake parameter P5-44 = n.0001.

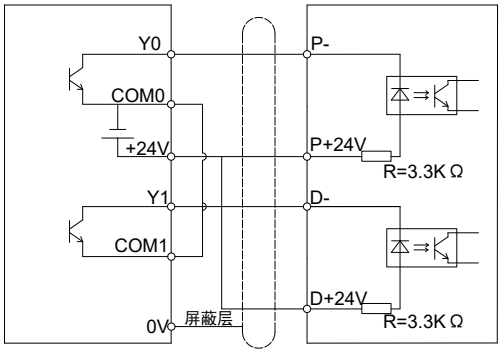
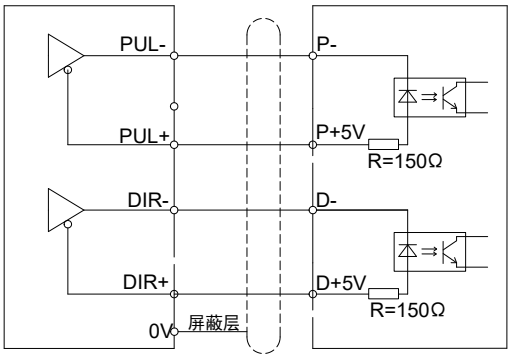
  For 750W and above: SO (all) DC 50mA (maximum), supporting 24VDC with a maximum voltage not exceeding 30VDC. Due to the high current required for brake engagement, use an intermediate relay when controlling the brake motor via SO.

3.2.2 Pulse signal (pulse function supported only for 15–32 kW)

Instruction Format	Select able	Meaning	P- incoming signal	D- incoming signal
P0-10	0	CW/CCW dual-pulse sequence mode	CW	CCW
xxx□	1	AB phase mode (not supported in external	A Xiang	B Xiang

		jog speed mode)		
	2	Pulse + Direction Mode	impulse	direction
The open-circuit collector type (24V voltage) input signal is positive, i.e., P+24V/D+24V. The differential method (5V voltage) uses the input signal P+5V/D+5V.				

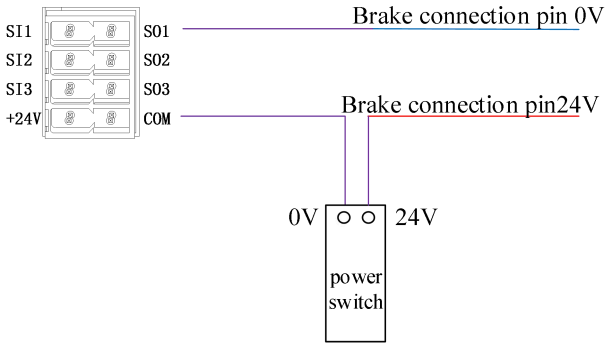
The wiring diagram for the interface circuits of P+D, CW, CCW, and AB phases is as follows:

Open-circuit collector type (24V voltage)	Differential method (5V voltage)
PLC, CNC, microcontroller, and servo drives 	PLC, CNC, microcontroller, and servo drivers 

- The P-/P+24 and D-/D+24 power supply voltages range from 18V to 25V, while the P-/P+5V and D-/D+5V voltages range from 3.3V to 5V. Voltages below 18V/3.3V may result in pulse or directional abnormalities.
- To reduce interference, use twisted-pair shielded cables and keep command signal lines within 3 meters. Connect the shielding layer to the controller's 0V terminal, and ensure proper Grounding of the controller.
- The servo pulse input port is 10 mA conductive.
- If the controller is a Xinje PLC with a rated pulse output current of 50 mA, theoretical calculations indicate that one pulse channel can support up to five servos; however, it is recommended not to exceed three.
- If the pulse frequency of P+D sent by the controller exceeds 100 kHz, a 500Ω/2W pull-up resistor must be connected in parallel at the PLC pulse output terminal, or a 2KΩ/1W pull-up resistor should be connected in parallel at the servo pulse reception terminal.

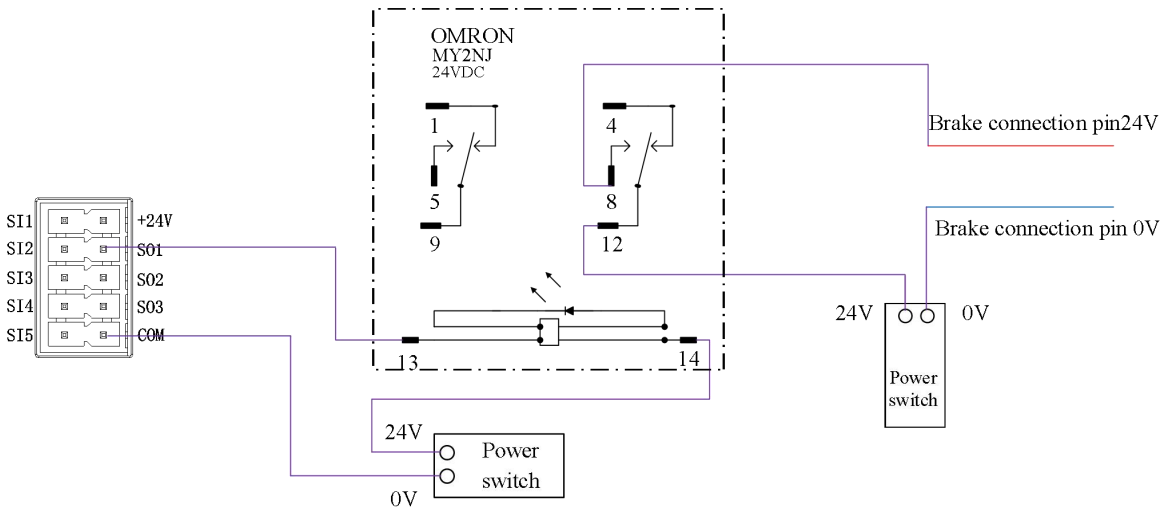
3.3 Power-off brake (brake shoe) wiring

(1) When the drive power is 400 W or lower, it can be directly connected via the SO terminal as shown in the figure below, with parameter P5-44 set to n.0001.



For 400W and lower systems controlling the brake motor via SO, use terminal SO1 for control and set the brake parameter P5-44 to n.0001 to prevent terminal burnout from excessive current or brake failure due to inability to open.

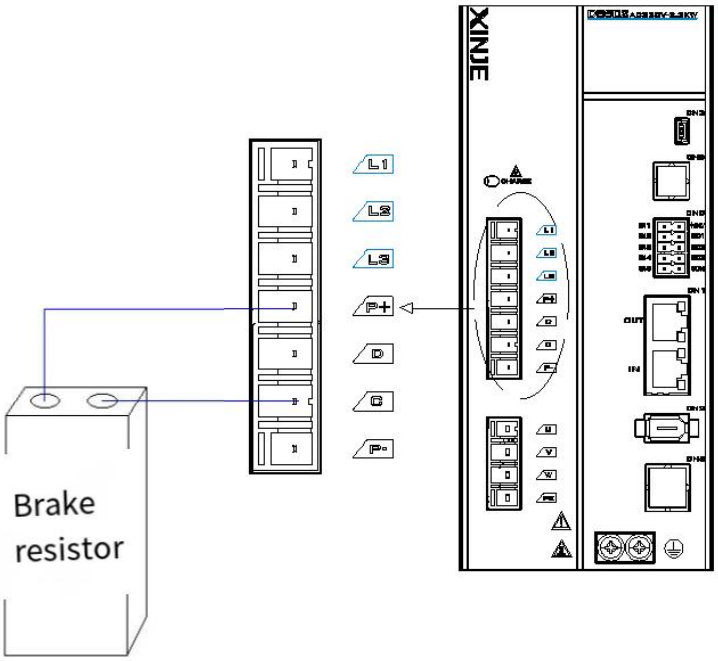
(2) For drives with a power rating of 750 W or higher, an intermediate relay must be used for connection, with parameter P5-44 set to n.000□ (where □ denotes the terminal sequence number of the connected SO port), as shown in the figure below.



For motors rated 750W or higher, the brake current exceeds 400mA; a relay must be used to prevent terminal burnout due to excessive current or brake failure caused by inability to open.

- It is recommended that the SO terminal and the intermediate relay not share the same switching power supply.
- The brake system must not share its power supply switch with other electrical devices to prevent voltage or current reduction caused by operational activities of other equipment, which could lead to unintended brake activation.
- The length of the motor brake cable must fully account for the voltage drop caused by cable resistance, and the operating input voltage for the brake must exceed 21.6 V.
- The power-off brake is designed to maintain braking function and should not be used for emergency braking or equipment shutdown.

3.4 Braking resistor wiring

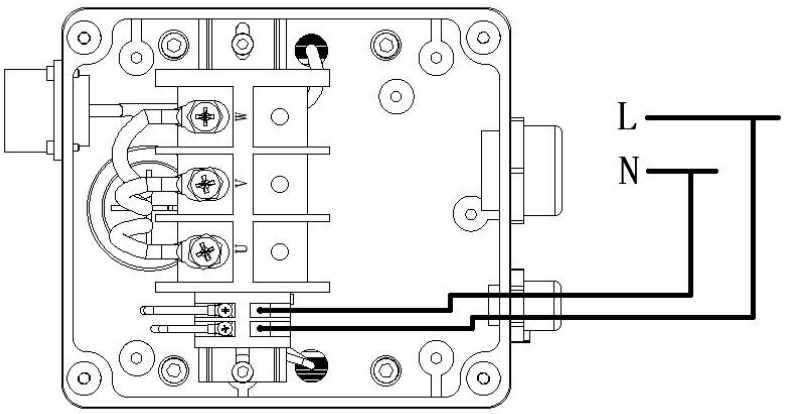


- The unit operates at 0.1–0.4 kW without an integrated braking resistor. When using an external resistor, connect it to terminals P+ and C, where P0-25 represents the power value and P0-26 indicates the resistance value.
- The model operates within a power range of 0.75 kW to 7.5 kW and features an integrated braking resistor. When using an external braking resistor, connect it to terminals P+ and C while disconnecting the shorting strip (wire) between P+ and D. P0-25 represents the power value, and P0-26 indicates the resistance value.
- For drivers rated 15 kW or higher using an external braking resistor, connect the resistor to the P+ and PB terminals, where P0-25 represents the power value and P0-26 represents the resistance value.
- Do not connect the external braking resistor to the P+ and P-terminals of the busbar, as this may cause the motor to explode.
- A smaller resistance value results in faster discharge, but excessively low values may

cause the resistor to break down. Therefore, during selection, aim for a value as close as possible to the lower limit—never below it.

- When wiring, use high-temperature resistant and flame-retardant wires, and ensure the surface of the braking resistor does not come into contact with the wires.

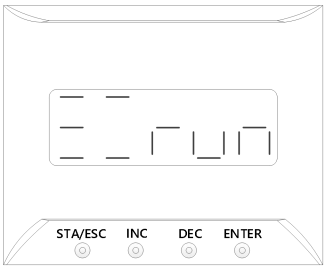
3.5 Wiring for high-power motor fans



- The wiring example for the motor fan shown above illustrates the Xinje Servo 200 chassis motor.
- High-power air-cooled motors rated at 11 kW or above are equipped with fans. The internal motor structure requires connection of both the power supply line and the fan power cable upon factory delivery. The fan's voltage specification should be referenced from the motor-fan wiring markings (220V AC/380V AC).
- Upon factory delivery, the fan lead-out cable is already connected; simply connect the other end directly to the power supply through the fan outlet.

4 Use of the control panel

4.1 Operation Panel Description



Button name	Operation declaration
STA/ESC	Short press: Switch status, return to previous state.
INC	Short press: Display data in ascending order; Long press: Show data in ascending order.
DEC	Short press: Display data in descending order; Long press: Show data decreasing consecutively.
ENTER	Short press: Shift; Long press: Set and view parameters.

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

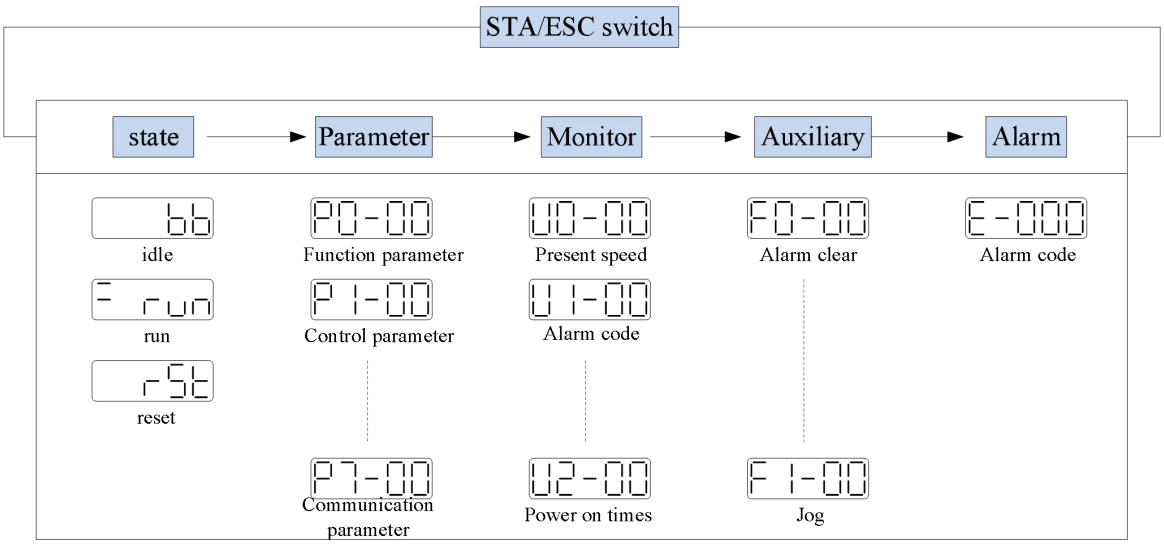
4.2 Panel Status Display Introduction

Panel display	Actual meaning	Panel display	Actual meaning	Panel display	Actual meaning	Panel display	Actual meaning
	A（a）		J（j）		U（u）		6
	B（b）		L（1）		Y（y）		7
	C（c）		N（n）		0		8
	D（d）		O（o）		1		9
	E（e）		P（p）		2		
	F（f）		Q（q）		3		

Panel display	Actual meaning	Panel display	Actual meaning	Panel display	Actual meaning	Panel display	Actual meaning
	G (g)		R (r)		4		
	H (h)		T (t)		5		

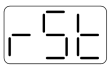
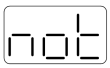
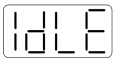
4.2.1 Operation Panel Display

By switching the basic status of the panel controller, users can display operational statuses, set parameters, activate auxiliary functions, and check alarm statuses. Pressing the STA/ESC keys allows sequential switching between states in the order shown below.
Status: bb indicates the servo system is idle; run indicates the servo system is operating; rst indicates the servo system requires a power cycle.



- Parameter settingPx-xx: The first x represents the group number, while the subsequent two x's denote the parameter sequence numbers within that group.
- Monitoring status Ux-xx: The first 'x' represents the group number, while the subsequent two 'x's indicate the parameter sequence numbers within that group.
- Accessibility feature Fx-xx: The first 'x' represents the group number, while the subsequent two 'x's indicate the parameter sequence number within that group.
- Alarm status E-xxx: The first two x characters represent the major alarm category, while the last x character indicates the specific subcategory under that category.

4.2.2 Description of various simplified code display contents

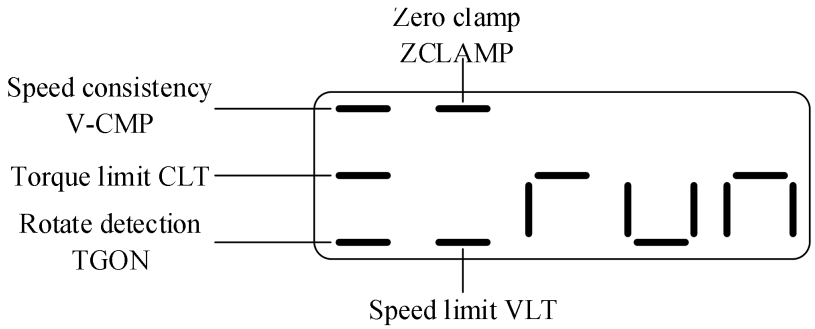
Panel display	Name	Meaning
	In standby mode	Servo off state (the motor is not powered).
	in service	Servo-enabled state (the motor is powered on).
	Power-on prompt	The device requires a reset state; the servo needs to be power-restricted.
	Positive limit detection prompt	Forward drive state is prohibited; P-OT is ON.
	Negative limit detection alert	Reverse the inversion drive state; N-OT is ON.
	Control Mode Prompt	Control Mode 2 is empty. Check the set values of P0-01 and P0-02.
	Communication Status Display	The U5-23 communication status is displayed; refer to Section 4.2.5 "Bus Communication Status Monitoring" for details.
	STO Function Display	Check the 24V input status of the STO terminal to ensure proper connection.
	Err-x Fault Message	Inertia estimation and self-regulation failure alerts: Refer to the corresponding chapter for troubleshooting.

4.2.3 Operation Status Monitoring Description

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

Parameter	Signal name	Factory settings	Applicable mode	Meaning	Revise	Take effect
P8-25	Panel Setting	0	All	0: Normal display; upon power-on, display 'bb' or 'run'. 1: When powered on, the panel displays the value of U0-00 and speed feedback, measured in rpm. 2: When the panel is powered on, the value of U0-07 is displayed; torque feedback is provided in percentage.	At any time	Power off and then power on again

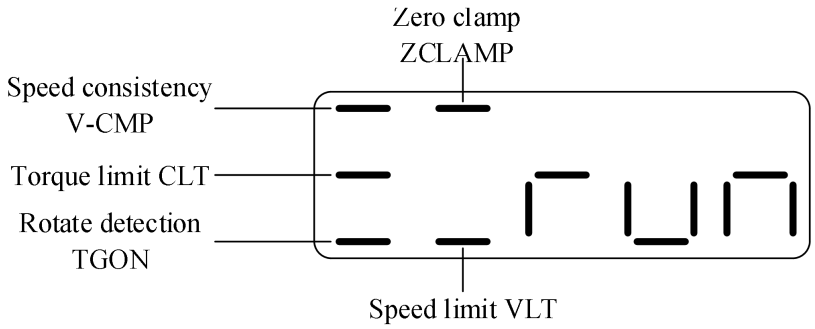
■ When using speed or torque control modes



Number of digits displayed

Bit Data	Display content
P5-39 Same-speed detection (/V-CMP)	The light turns on when the motor's actual speed matches the commanded speed. Same-speed signal detection width: P5-04 (unit: rpm)
P5-42 Torque Limitation (/CLT)	The light turns on when the torque exceeds the set value. Internal forward torque limit: P3-28; Internal reverse torque limit: P3-29
P5-40 Rotation Detection (/TGON)	The light turns 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 Speed Limit (/VLT)	When torque control is active, the light turns on when the speed exceeds the set value. Forward speed limit during torque control: P3-16; Reverse speed limit: P3-17.

■ In position control mode

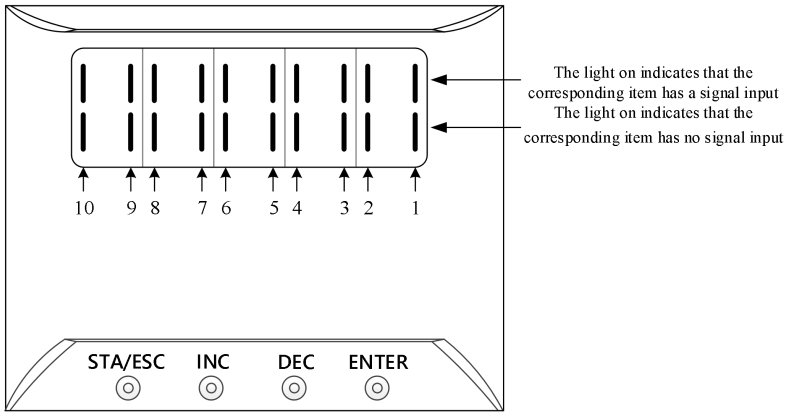


Number of digits displayed

Bit Data	Display content
P5-38 Positioning End (/COIN)	During position control, the light turns on when the specified position matches the actual position. Positioning completion width: P5-00 (unit: command pulse)
P5-46 Near (/NEAR)	During position control, the light turns on when the specified position matches the actual position. Near signal width: P5-06
P5-40 Rotation Detection (/TGON)	The light turns on when the motor speed exceeds the rotation detection speed. Rotation detection speed: P5-03 (unit: rpm)

4.2.4 U-group parameter monitoring

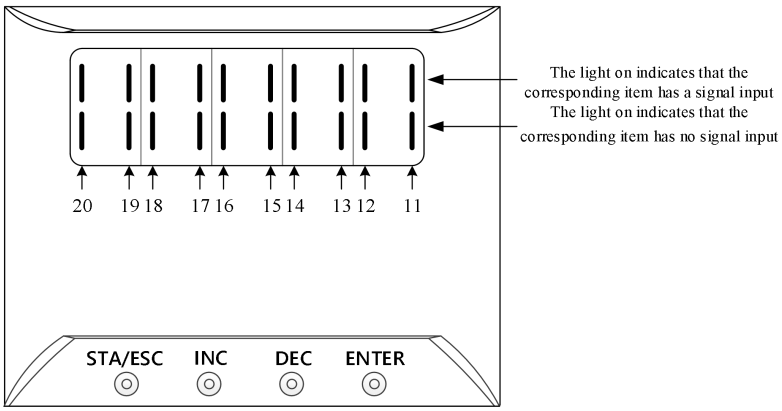
■ State of the U0-21 input signal



■ U0-21 Input Signal 1 Allocation

Segment Display	Explanation	Segment Display	Explanation
1	/S-ON servo enable signal	2	/P-CON proportional motion command
3	/P-OT prohibits forward drive	4	-N/OT: Reverse drive is prohibited
5	/ALM-RST Alert Clear	6	/P/CL forward-side external torque limit
7	-N/CL Reverse Side External Torque Limit	8	/SPD-D Internal Direction Selection Setting
9	/SPD-A Internal Speed Selection Setting	10	/SPD-B Internal Speed Selection Setting
Note: When reading the status via communication, the binary values read from right to left correspond to the /S-ON and /P-CON positions: 0 indicates no input at that position, while 1 indicates input. For example, 0x0001 indicates input at /S-ON, and 0x0201 indicates input at both /S-ON and /SPD-B.			

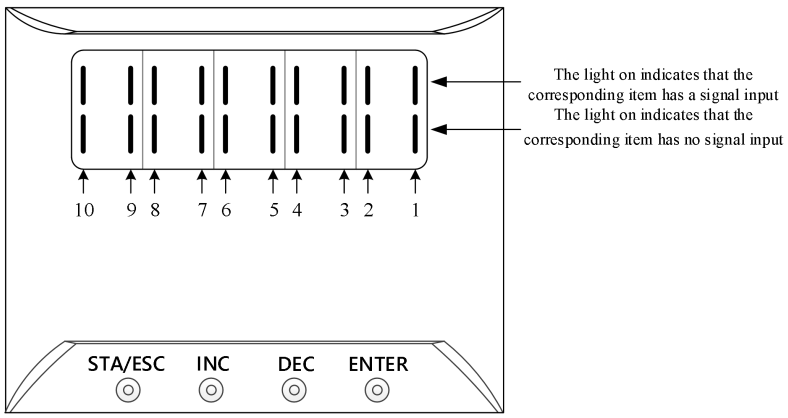
■ State of the U0-22 input signal



■ U0-22 Input Signal 2 Allocation

Segment Display	Explanation	Segment Display	Explanation
11	C/SEL Control Method Selection	12	/ZCLAMP Zero Clamping
13	/INHIBIT instruction pulse prohibition	14	/G-SEL gain switching
15	/CLR Pulse Clear	16	/CHGSTP Step Change
17	Keep	18	Keep
19	Keep	20	Keep
Note: When reading the status via communication, the binary values read from right to left correspond to the /C-SEL and /ZCLAMP positions respectively: 0 indicates no input at that position, while 1 indicates an input. For example, 0x0001 indicates input at /C-SEL, and 0x0009 indicates inputs at both /C-SEL and /G-SEL.			

■ Status of the U0-23 output signal

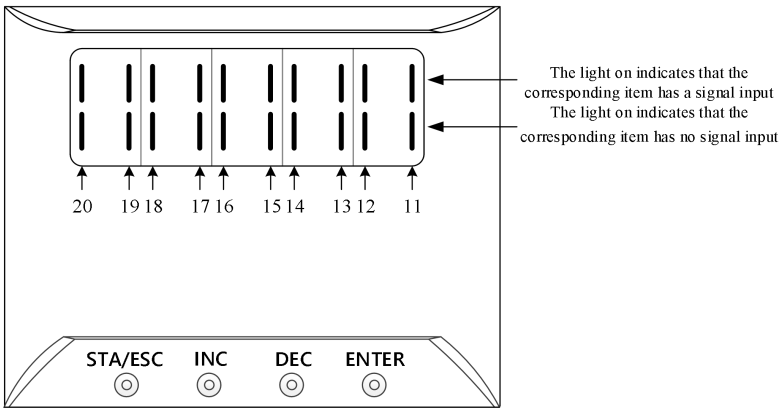


■ U0-23

Segment Display	Explanation	Segment Display	Explanation

Segment Display	Explanation	Segment Display	Explanation
1	Keep Position Completed (/COIN_HD)	2	Positioning End (/COIN)
3	Same-speed detection (/V-CMP)	4	Rotation Detection (/TGON)
5	Ready (/S-RDY)	6	Torque Limitation (/CLT)
7	Speed Limit Detection (/VLT)	8	Brake Interlock (/BK)
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 respectively. A value of 0 indicates no output from that position signal, while 1 indicates an output. For example: 0x0001 indicates an output from /COIN_HD, and 0x0201 indicates outputs from both /COIN_HD and /NEAR.			

■ Status of the U0-24 output signal

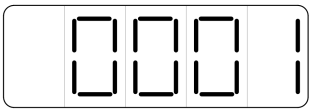
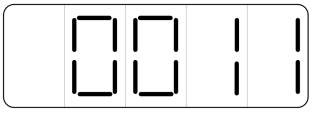
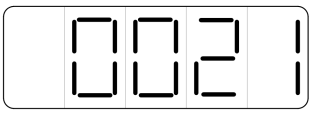
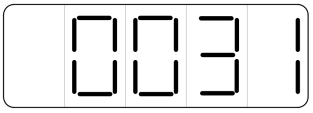
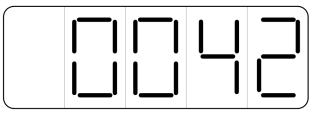


■ U0-24 Output Signal 2 Allocation

Segment Display	Explanation	Segment Display	Explanation
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	Keep	18	Keep
19	Keep	20	Keep
Note: When reading the status via communication, the binary values read from right to left correspond to the /ALM and /V-RDY positions respectively: 0 indicates no input at that position, while 1 indicates an input. For example, 0x0001 indicates output from /ALM, and 0x0011 indicates output from both /ALM and /Z.			

■ U0-88 Motor Code Reading Status

U0-88 Display Status	Meaning

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; use the motor parameters from the driver.
	0021 — Encoder motor parameters read successfully, but the parameter value is 0. Set P0-53 = 1 before use.
	0031 — Encoder motor parameters read successfully, but damaged (CRC verification error); use after setting P0-53=1.
	0042 — Failure to read encoder motor parameters; set P0-53 = 1 before use.

- U4-18 Input Signal Status

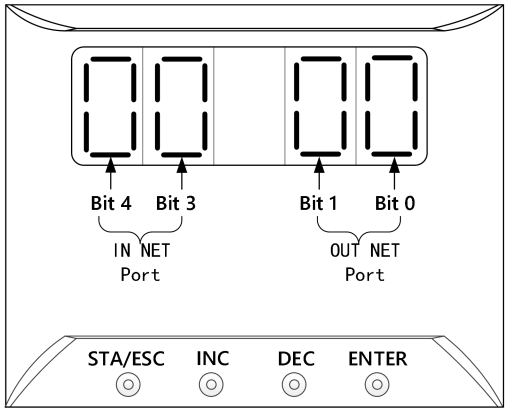
SI1	SI2	SI3	U4-18 display
1	0	0	0x0001
0	1	0	0x0002
1	1	0	0x0003
0	0	1	0x0004
...	...	...	...
Note: U4-18 displays the software active status of SI terminals. This means the terminal's high-level input will only appear on U4-18 after the corresponding terminal's function is configured. For example, if SI1 has no assigned function, even if the hardware sets SI1 to a high level, the 0th bit of U4-18 will not display a 1.			

- U4-19 Output Signal Status

SO1	SO2	SO3	U4-19 displayed
1	0	0	0x0001
0	1	0	0x0002
1	1	0	0x0003
0	0	1	0x0004
...	...	...	...
Note: U4-19 displays the software activation status of the SO terminal, shown by bit position.			

4.2.5 Bus Communication Status Monitoring

- The status of the U5-23 signal



Number of digits	Explanation	Definition	Explanation
Bit0	U5-23.0	OUT Communication Status	1: Normal communication status 0: Abnormal communication status
Bit1	U5-23.1	OUT physical connection	1: Normal physical connection 0: Abnormal physical connection
Bit3	U5-23.3	IN port communication status	1: Normal communication status 0: Abnormal communication status
Bit4	U5-23.4	IN port physical connection	1: Normal physical connection 0: Abnormal physical connection
(1) When the IN port network cable is correctly connected but the OUT port network cable is not properly connected, and communication is normal, U5-23 will display 11 00; (2) When the network cables for the IN and OUT ports are improperly connected and not in a normal communication state, U5-23 will display 00 00. (3) When the IN port network cable and the OUT port network cable are properly connected with normal communication, U5-23 will display 11 11. (4) When the IN port network cable is improperly connected, the OUT port network cable is correctly connected, and communication is normal, U5-23 will display 00 11.			

■ U5-23 Allocation and Description

The DS5C2 series servo drivers lack a network port indicator. The 4230 version and later models include a parameter for communication status monitoring, which was absent in earlier versions of the 4230 series.

4.3 Parameter settings for Group P

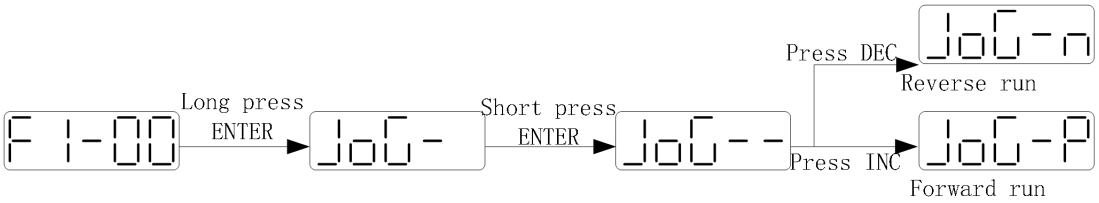
For example, the operational steps when changing the parameter P3-09 value from 2000 to 3000.

Step	Panel display	The button being used	Concrete operations
1	bb	STA/ESC INC DEC ENTER ◎ ◎ ◎ ◎	No action required
2	P0-00	STA/ESC INC DEC ENTER ◎ ◎ ◎ ◎	Press the STA/ESC key to enter parameter setting mode.
3	P3-00	STA/ESC INC DEC ENTER ◎ ◎ ◎ ◎	Press the INC key; one press increases by 1, raising the parameter to 3 and displaying P3-00.
4	P3-00	**STA/ESC INC DEC ENTER** ◎ ◎ ◎ ◎	Shortly press the ENT key; the last zero on the panel will flash.
5	P3-09	STA/ESC INC DEC ENTER ◎ ◎ ◎ ◎	Press the INC key to add to 9
6	P3-09	**STA/ESC INC DEC ENTER** ◎ ◎ ◎ ◎	Hold down the ENT key for an extended period to access the P3-09 internal interface and modify values.
7	3000	**STA/ESC INC DEC ENTER** ◎ ◎ ◎ ◎	Use the INC, DEC, and ENT keys to add, subtract, or shift. After making changes, press and hold ENT to confirm.
8	Operation completed		

When the parameter setting exceeds the permissible range, the driver will not accept the value and will display error E-021 ("Parameter setting exceeded"). This issue typically occurs when the host computer writes parameters to the driver via communication.

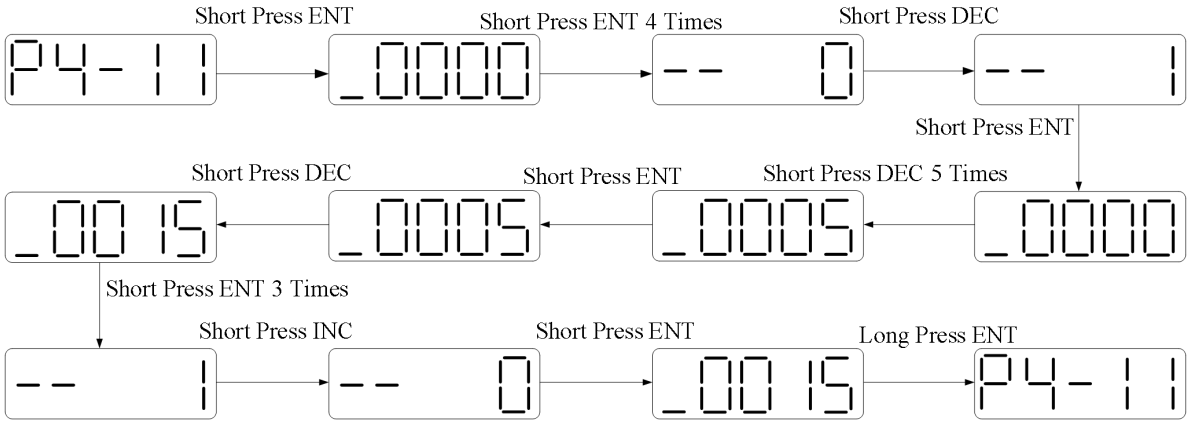
4.3.1 Example of setting P-group parameters for input/output SI and SO

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



4.3.2 Example of negative-value parameter settings for Group P

For example, set parameter P4-11 (high bit of internal position mode pulse count) to-15, corresponding to the operational procedure when the first pulse count is-150000.



4.4 Group F Assistive Function Parameters

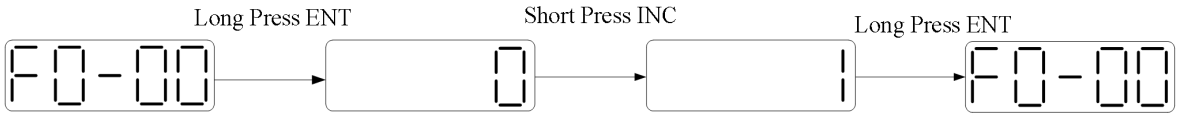
4.4.1 F0 group operation

Function code	Explanation	Function code	Explanation
F0-00	Clear Alert	F0-08	Panel External Instructions for Self-Setting
F0-01	Reset Parameters to Factory Settings	F0-09	Internal panel instructions for automatic adjustment
F0-02	Clear position deviation	F0-10	Panel vibration inhibition 1
F0-04	Clear historical alarm records	F0-11	Panel Vibration Inhibition 2
F0-07	Panel Inertia Identification	F0-12	Panel vibration suppression (fast FFT)

1) Clear Alarm (F0-00)

When a fault occurs, the system automatically enters an alarm state displaying the alarm number; the alarm state is invisible when no fault exists. In the alarm state, writing 1 to F0-00 via the panel allows you to reset the fault.

If a servo alarm occurs due to the servo power supply being OFF, there is no need to clear the alarm.



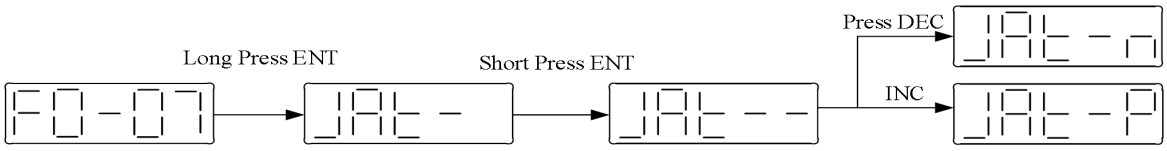
When an alarm occurs, the cause of the alarm should first be eliminated before the alarm is cleared.

2) Panel Inertia Identification (F0-07)

Before performing inertia identification, use the F1-00 point movement function to confirm the servo rotation direction. The initial servo operating direction is determined by INC or DEC at the start of inertia identification.

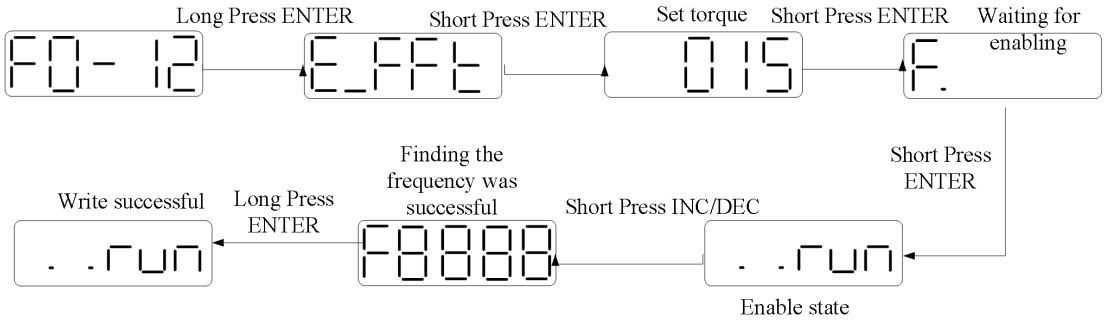
If servo jitter occurs under adaptive default parameters, first switch to the adaptive high-inertia mode (P2-03.3=1) to ensure stable basic servo operation before proceeding with inertia identification.

When the device is in BB mode, enter parameter F0-07 and display:



3) Panel vibration suppression (rapid FFT) (Parameters F0–12)

This function enables mechanical characteristic analysis via parameters F0–12 on the servo control panel, identifying the mechanical resonance frequency to achieve vibration suppression.



4.4.2 F1 group operation

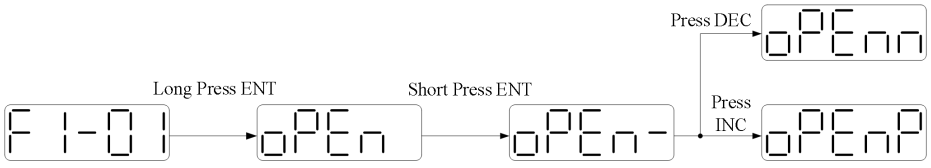
Function code	Explanation	Function code	Explanation
F1-00	Dot Motion	F1-05	Software Enablement
F1-01	pilot run	F1-06	Absolute encoder position reset
F1-02	Current sampling zero calibration	-	-

1) Trial Operation (F1-01)

Before entering the trial operation mode, ensure the motor shaft is not connected to the machinery and that the driver is in the BB idle state.

When connecting the servo driver to a encoder cable or power cable, first enter the test run mode to verify that the encoder terminals or power terminals are correctly connected.

The trial run primarily checks the power lines and encoder feedback circuits to verify proper connections. Following the specified procedures, the motor should operate normally with both forward and reverse rotation. If the motor shaft exhibits vibration or an alarm is triggered, immediately disconnect the power supply and recheck the wiring.



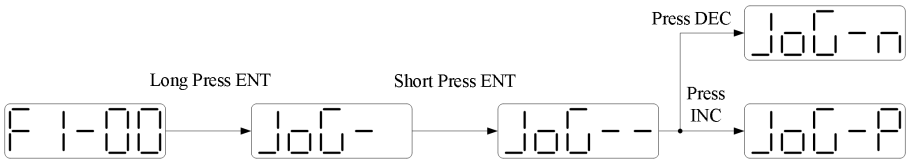
2) Pulse operation (F1-00)

Before entering the intermittent operation mode, first verify that the trial run under an idle motor condition is functioning properly to confirm correct servo wiring.

The dot movement mode requires the driver to be in an idle state!

The dot-movement function operates in speed mode, with P3-09 and P3-10 controlling acceleration and

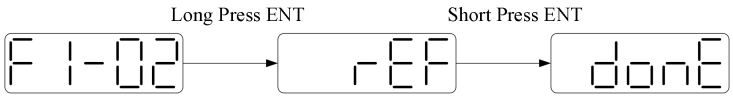
deceleration times!



Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P3-18	JOG jog speed	100	1rpm	0 ~ 1000	servo OFF	immediately

3) Current sampling zero calibration (F1-02)

When the servo driver completes its self-renewal process, or when the motor exhibits unstable operation after an extended period, users are advised to perform automatic current detection offset adjustment.



Press the STA/ESC key to exit this function.

4) Mandatory Enablement (F1-05)

Parameter	Signal name	Setting	Meaning	Revise	Take effect
P0-03	Enable Mode	0	Do not disable	servo OFF	immediately
		1	I/O enabled/S-0N		
		2	Software enablement (F1-05 or communication)		
		3 (Default)	Bus enable (for models supporting the motion bus)		
Set P0-03 to 2. F1-05 = 0: Disables the feature and restores to the bb idle state. F1-05 = 1: Forced enable; the servo is in the RUN operating state.					

The forced enable setting configured via F1-05 becomes invalid after power restoration.

5) Absolute encoder position reset (F1-06)

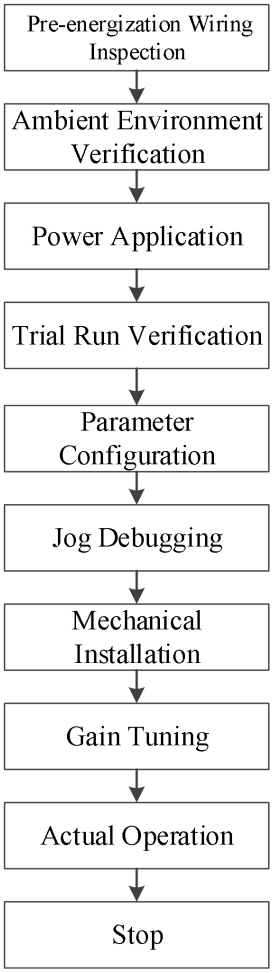
(Only applicable to multi-turn motors) When the servo is in BB mode, perform the absolute encoder turn count reset operation as follows:

By pressing the panel operation key F1-06 and entering 1, the absolute encoder revolution count can be cleared.

By operating the panel to write 3 into F1-06, you can perform zero calibration for the absolute encoder.

5 Debugging and Operation of Servos

5.1 Debugging Flowchart



5.2 Debugging Process Introduction

5.2.1 Wiring inspection

Inspection Direction	Concrete content
Power supply wiring	Single-phase 220V: Connect to power input terminals L, N or L1, L3 Three-phase 220V/Three-phase 380V: Connect to power input terminals L1, L2, and L3
Power line phase sequence	The cables connecting the output terminals U, V, and W of the servo driver to the servo motor are properly connected in the correct phase sequence.
Control Signal	The wiring for SI input signals (refer to 3.2.1), SO output signals (refer to 3.2.2),

Inspection Direction	Concrete content
Wiring	pulse signals (refer to 3.2.3), and other control signal connections is correct.
external signal line	The external signal lines for brake engagement, overtravel protection, and STO have been properly connected as required.
other	The wiring for the external braking resistor is correct (refer to 3.4), and the wiring for the high-power motor fan is correct (refer to 3.5).

5.2.2 Environmental Confirmation

Inspection direction	Concrete content
Wiring inside the electrical cabinet	The electrical cabinet contains no foreign objects; strong and weak electrical circuits are properly separated with reliable wiring. All cables exhibit no loose or missing connections, and the electrical cabinet/driver is reliably Groundinged.
External Installation	There are no high-power interference devices around the drive. When installing the motor, follow the installation requirements specified in the AC servo motor installation and operating manual.

5.2.3 Basic Parameter Confirmation

- Parameter setting

Parameter	Name	Factory Default	Set range	Introduce
P5-44	/BK: Brake Interlock	0000	0~ffff	When driving the brake motor via a servo SO output signal, this parameter must be set. (No setting required for non-brake motors.) ①When set to 0001, the brake control logic is: enable is turned on, the brake opens; enable is turned off, the brake locks. ② When set to 0011, the brake control logic is: enable opens, brake locks; disable closes, brake opens.
P0-05	Selection of rotation direction	0	0~1	Upon factory shipment, the default rotation direction is clockwise when facing the motor flange and counterclockwise when facing it. This parameter can be modified when disabled; any changes require a power cycle to take effect. This parameter modification does not affect the encoder count's positive or negative value.

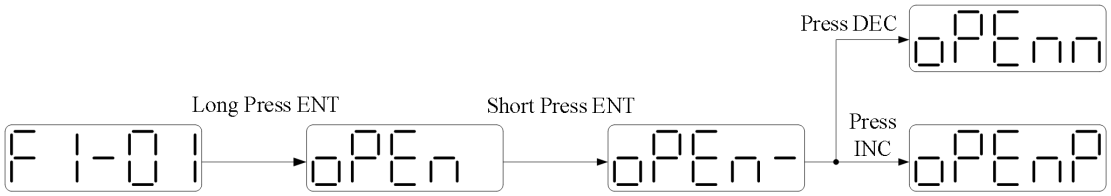
For brake parameters of each motor series, refer to the "AC Servo Motor Installation and Operation Manual".

- Parameter monitoring

Parameter	Name	Remarks
U3-70	Automatically read the motor code from the encoder in the motor parameters	Check whether the parameters in U3-70 match the code following the MOTEL CODE on the motor nameplate.

5.2.4 Pilot run

- Trial Operation Steps



- Trial Operation Instructions and Precautions

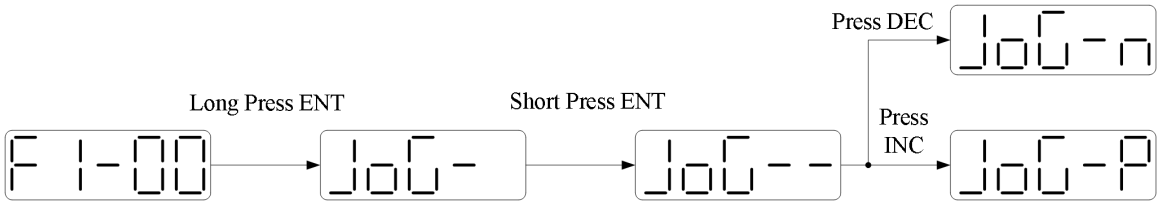
(1) Before entering the trial operation mode, ensure the motor shaft is not connected to any machinery and that the driver is in the BB idle state!

(2) When connecting the servo driver to a non 原厂 encoder cable or power cable, first initiate a trial run mode to verify correct connection of the encoder terminals or power terminals.

(3) During the trial run, primarily inspect the power lines and encoder feedback circuits to verify proper connections. Operate the motor as described below to achieve normal forward and reverse rotation. If the motor shaft exhibits vibration or an alarm is triggered, immediately disconnect the power supply and recheck the wiring.

5.2.5 Dot Motion

- Step-by-step point operation



- Point Operation Instructions and Precautions

Before entering the intermittent operation mode, first verify that the trial run under an idle motor condition is functioning properly to confirm correct servo wiring.

The dot movement mode requires the driver to be in an idle state!

- Dot movement speed setting

The dot-movement function operates in speed mode, with P3-09 and P3-10 controlling acceleration and deceleration durations.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P3-18	JOG jog speed	100	1rpm	0 ~ 1000	servo OFF	immediately

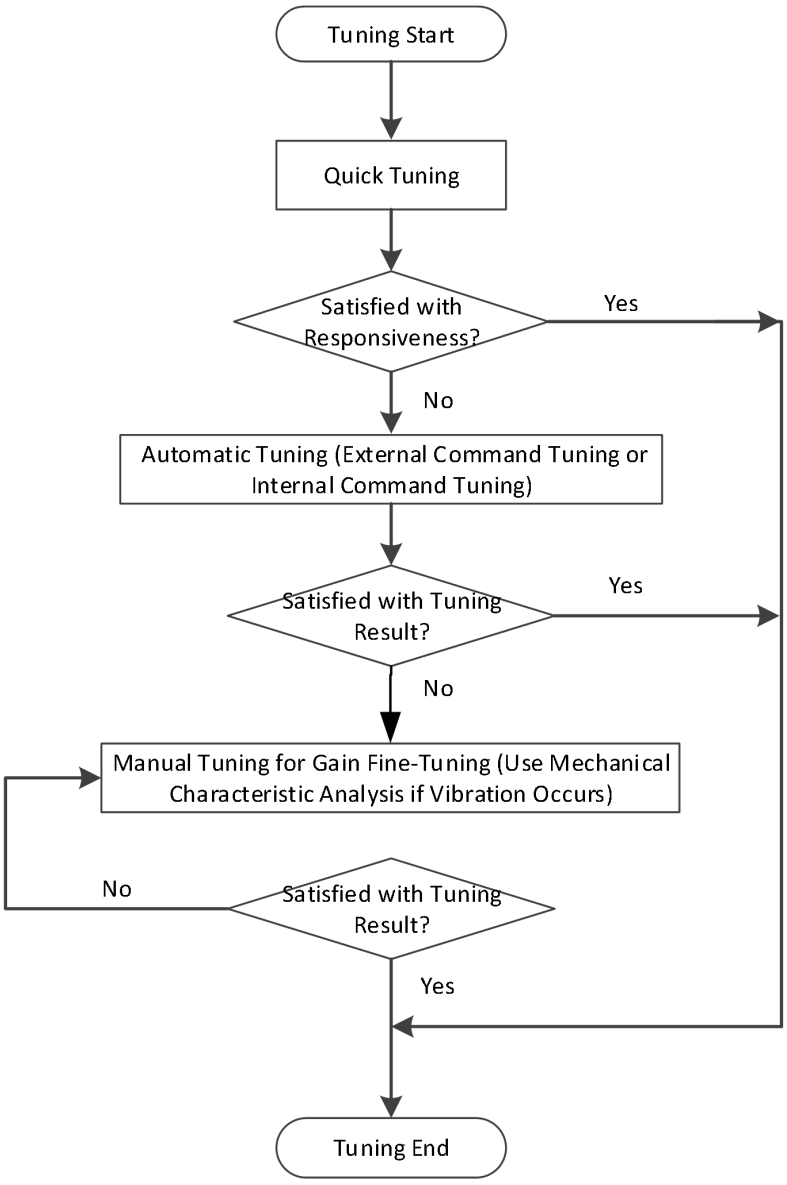
6 Adjustment of servo gain

6.1 Overview of Servo Gain Adjustment

6.1.1 Overview and Process

The servo driver requires a motor that operates as quickly and accurately as possible to execute commands from the host computer or internal settings. To meet this requirement, the servo gain must be properly adjusted.

The factory default servo gain is set to self-tuning mode, but different machines have varying requirements for servo responsiveness. The figure below shows the basic gain adjustment procedure; adjust according to the current machine status and operating conditions.



6.1.2 Differences between several types of adjustments

The adjustment methods are divided into adaptive and self-adjusting types, with their control algorithms and parameters operating independently. Under the self-adjusting mode, three functions are available: rapid adjustment, automatic adjustment, and manual adjustment. These three functions share the same fundamental principle but differ in implementation methods; refer to the corresponding chapters for detailed Explanations.

<table>
<tr><th>Adjustment method</th><th>Classify</th><th>Controlling parameter</th><th>Rigidity</th><th>Responsiveness</th><th>The most relevant control parameters</th></tr>
<tr><td>Self-adaption</td><td>autoadaptation</td><td>P2-01.0=1</td><td>Middle</td><td>150ms level</td><td>P2-05 Adaptive Speed Loop Gain
P2-10 Adaptive Speed Loop Integral
P2-11 Adaptive Position Loop Gain
P2-07 Adaptive Inertia Ratio
P2-08 Adaptive Speed Observer Gain
P2-12 Adaptive Stable Maximum Inertia Ratio</td></tr>
<tr><td rowspan="3">Self-adjustment</td><td>rapid adjustment</td><td rowspan="3">P2-01.0=0 (give tacit consent to)</td><td>Gao</td><td>10–50 ms range</td><td rowspan="3">P0-07 First Inertia Ratio
P1-00 Speed Loop Gain
P1-01 Speed Loop Integral
P1-02 Position Ring Gain
P2-35 Torque command filter time constant 1
P2-49 Model Ring Gain</td></tr>
<tr><td>self-correcting</td><td>Gao</td><td>10 ms level</td></tr>
<tr><td>manual adjustment</td><td>Gao</td><td>etermined by parameters</td></tr>
</table>

6.2 Rotation Inertia Estimation

6.2.1 Summary

Inertia estimation is the function that enables the driver to automatically operate internally (through forward and reverse rotation) while estimating the load's moment of inertia during operation.
The moment of inertia ratio (the ratio of the load's moment of inertia to the motor rotor's moment of inertia) serves as the reference parameter for gain adjustment and must be set to the correct value whenever possible.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-07	First Inertia Ratio	200	%	0 ~ 50000	at any time	immediately

6.2.2 Matters need attention

Where the moment of inertia cannot be determined

- Mechanical systems can only operate in one direction.

Scenarios where inertia estimation is prone to failure

- The load's rotational inertia is too large.
- The operating range is relatively narrow, with a stroke of less than 0.5 revolutions.
- The rotational inertia varies significantly during operation.
- The mechanical rigidity is low, resulting in vibration during the estimation of inertia.

Key points for inertia estimation

- Since rotation is possible in both directions within the specified movement range, confirm the movement range or direction; and ensure the load operates within a safe travel distance.
- If jitter occurs when calculating the assumed inertia using default parameters, it indicates that the current load inertia is too high. Under heavy loads, you can set the initial inertia to approximately twice the current value and run the calculation again.
- The maximum identification limit for the drive's inertia ratio is 500 times (with a parameter upper limit of 50,000). If the estimated inertia ratio equals exactly 50,000, it indicates the ratio has reached the upper limit and cannot be used. Replace the motor with one featuring a larger rotor inertia.

Other Notes

- Inertia switching is not supported; the second inertia ratio is invalid.

6.2.3 Operation Tool

The tools for estimating the load's moment of inertia are the driver panel and the XinJeServo host computer software.

Operation Tool	Restriction Item
Driver Panel	Driver firmware version 4200
XinJeServo Host Computer Software	All versions of the host software support

The driver firmware version can be viewed via U2-07.

6.2.4 Operating steps

1) Inertia estimation step for the drive panel

(1) Parameter Configuration

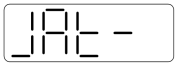
Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P2-15	Inertia configuration stroke	100	0.01 circle	1 ~ 300	at any time	immediately
P2-17	Inertia identification and the maximum speed determined through internal command self-adjustment	0	rpm	0 ~ 65535	at any time	immediately
P2-18	Initial inertia ratio for inertia identification	500	%	1 ~ 20000	at any time	immediately

The recommended P2-17 parameter is 500 rpm or higher; an excessively low command speed may result in inaccurate inertia ratio identification. The default value is one-third of the rated speed, which is calculated automatically based on the motor parameters' rated speed.

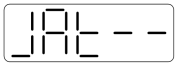
(2) Inertia identification implementation

Before performing inertia identification, use the F1-00 point movement function to confirm the servo rotation direction. The initial servo operating direction is determined by INC or DEC at the start of inertia identification.

The servo enters the BB state and displays parameter F0-07:



Short press the ENTER key to enable the servo; the panel displays:



Short press the INC key for forward operation or the DEC key for reverse operation (choose only one),

and the display will show:

At this point, initiate the operation under the condition P0-05=0 (initial positive direction): a short press on INC first rotates clockwise, then counterclockwise; a short press on DEC first rotates counterclockwise, then clockwise. If inertia identification succeeds, the load inertia ratio is displayed after several forward and reverse rotations and automatically written to P0-07; if identification fails, an error code is displayed. A short press on the STA/ESC key exits the panel's inertia identification operation.

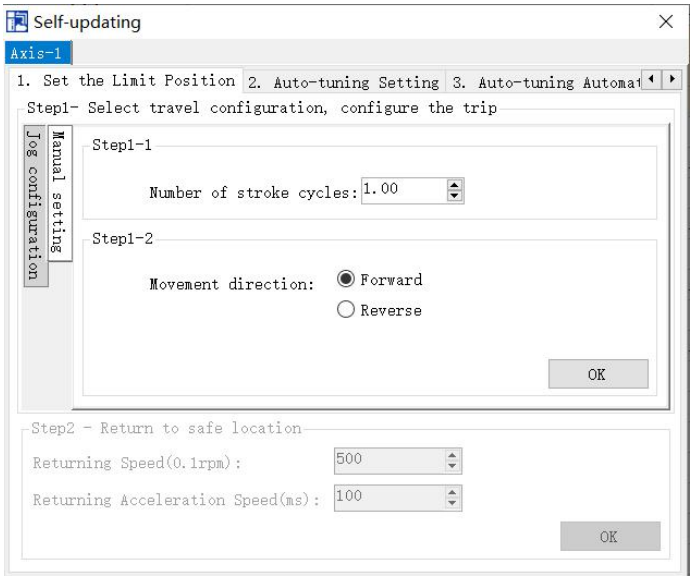
- Panel inertia identification error alarm

Error code	Meaning	Possible causes and solutions
Err-1	Motor torque saturation	① The initial inertia is too small; in adaptive mode, switch to the high-inertia mode (P2-03.3=1); in self-settling mode, adjust the initial inertia ratio P2-18 to twice its current value. ② The maximum speed is excessively high (P2-17), but it should not fall below 500 rpm; an instruction speed that is too low may result in inaccurate inertia ratio identification. ③ The torque limit is too low (P3-28/29).
Err-2	The calculated inertia value has an excessively large numerical 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 target speed may result in inaccurate inertia ratio identification; ② The presumed inertia stroke is too small. It is recommended that the minimum inertia stroke for P2-15 configuration be no less than 50 (0.5 revolution); an insufficient stroke will result in inaccurate determination of the actuation inertia. ③ Excessive institutional friction; ④ Overrun occurred
Err-3	Error in drive internal stroke calculation	① The presumed inertia stroke is too small. It is recommended that the minimum inertia stroke for P2-15 configuration be no less than 50 (0.5 revolution); an insufficient stroke will result in inaccurate determination of the actuation inertia.
Err-4	The location integration feature was used	① During torque-inertia identification, the system should operate in PI control mode; however, it has been switched to P control. Please verify whether the P5-21 proportional action command is enabled. When this function is activated, it automatically switches between P/PI control modes, triggering the Err-4 alarm during inertia reduction execution. ② The load connected to the motor deviates significantly from its inertia, preventing the driver from accurately estimating the inertia. It is recommended to replace the motor with one that matches the inertia requirements, or manually increase P0-07 (when inertia identification is not possible). ③ Empty-shaft estimated inertia. Inertia identification should be performed under load. ④ Incorrect phase sequence of the power lines. Please check the phase sequence and wiring of the power lines.

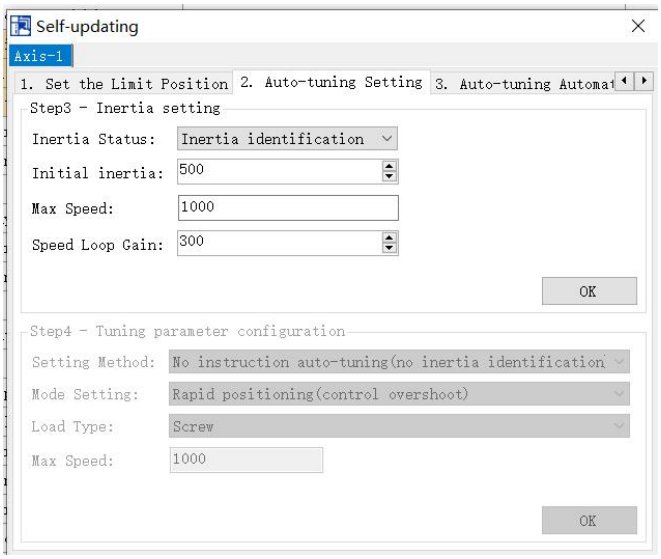
Error code	Meaning	Possible causes and solutions
Err-5	Unrestrained vibration occurs during the inertia identification process.	An un conduct able vibration occurred
Err-6	The drive is not in BB mode.	① The enable function is already activated. The P5-20 can initially be set to 0; ② The driver alarm will be triggered. Press the ESC key to exit the configuration interface and check for any alarms.
Err-7	An alarm was triggered in the driver during the inertia identification process.	The driver features an alarm function. Press the ESC key to exit the calibration interface and check the alarm code. Address the alarm issue before proceeding with inertia estimation.

2) XinJeServo Presumed Inertia Step

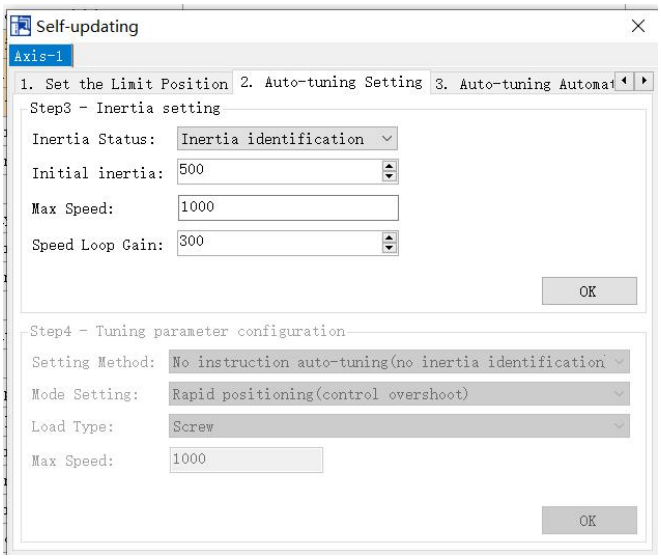
1. On the XinJeServo main menu screen, click [Gain Adjustment];



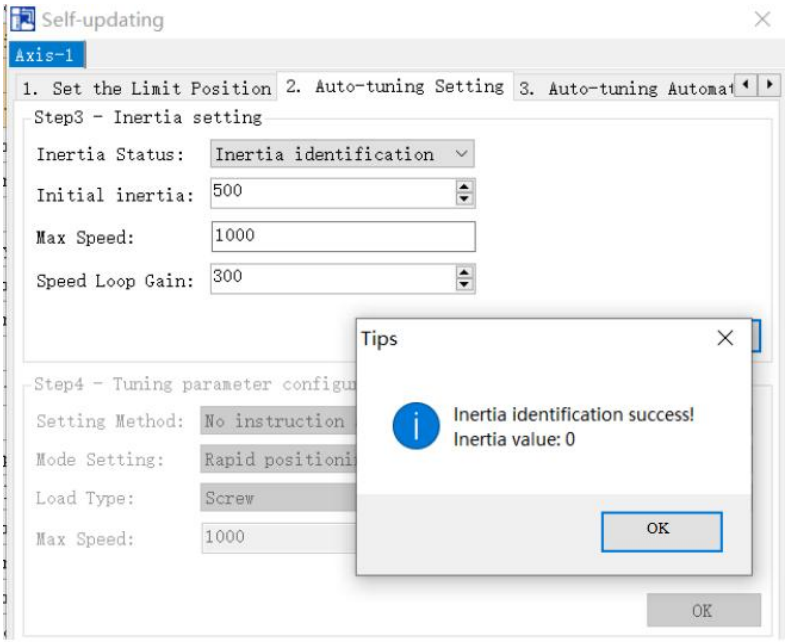
2. Select [Pulse Configuration] or [Manual Setting] to configure the inertia estimation stroke;



3. Settings for the calibration configuration interface;



4. Click [Confirm] to initiate the estimation of inertia.



- If the self-adjustment interface is closed directly at this point, the driver will only configure the inertia ratio parameter.
- For detailed instructions on using the XinJeServo estimated inertia, refer to the XinJeServo help documentation.

6.3 Rapid Adjustment

6.3.1 Summary

To perform rapid adjustment, first set the load moment of inertia. If the moment of inertia does not match, an oscillation alarm will occur. The gain parameters for rapid adjustment operate in self-tuning mode.

6.3.2 Quick adjustment steps

1. Determine the load inertia via the drive panel or the XinJeServo host software, referring to Section 6.2 on rotational inertia estimation;
2. Set the required stiffness 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

6.3.3 The rigidity level corresponds to the gain parameter.

The stiffness rating should be determined based on actual load conditions; a higher P0-04 value corresponds to greater servo gain. If vibration occurs during the increase in stiffness rating, further increases should be avoided. However, after vibration suppression effectively eliminates the vibration, additional increases may be attempted. The following stiffness ratings correspond to recommended loads and 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

While ensuring responsiveness, gain switching is employed to minimize overshoot upon positioning completion, with a rigidity level of P0-04. Seven parameters are associated: P1-00, P1-01, P1-02, P2-35, P1-05, P1-06, P1-07, P2-35, and P2-36, all of which enforce mandatory gain switching activation. P1-14 = 0x00A1.

- P6-00.0 = 2: Rapid positioning mode

Enable the model loop and disturbance observer Dob with rigidity level P0-04, associating five parameters: P1-00, P1-01, P1-02, P2-35, and P2-49. Forcefully bind P2-00.0 and P2-41 of the disturbance observer Dob, along with P2-47.0 and P2-49 of the model loop.

- Rigid hierarchy table for the standard mode (P6-00.0=0)

Rigidity level P0-04	Speed loop gain P1-00	Speed integral 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

Rigidity level P0-04	Speed loop gain P1-00	Speed integral Time constant P1-01	Position loop gain P1-02	Torque command filtering Time constant 1 P2-35
38	8500	94	13600	0
39	9000	88	14400	0
40	9500	84	15200	0
41	10000	80	16000	0

- Rigidity level table for positioning mode (P6-00.0=1)

Rigidity Grade P0-04	Speed loop gain P1-00	Speed loop integral time constant P1-01	Position loop gain P1-02	Second speed loop gain P1-05	The second velocity loop integral time constant P1-06	Second position ring gain P1-07	Torque command filtering time constant: 1/2 P2-35/p2-36
0	15	50000	24	15	51200	40	1326
1	20	39789	32	20	51200	48	995
2	25	31831	40	25	51200	56	796
3	30	26526	48	30	51200	72	663
4	35	22736	56	35	51200	96	568
5	45	17684	72	45	51200	120	442
6	60	13263	96	60	51200	144	332
7	75	10610	120	75	51200	176	265
8	90	8842	144	90	51200	224	221
9	110	7234	176	110	51200	288	181
10	140	5684	224	140	51200	400	142
11	180	4421	288	180	51200	480	111
12	250	3183	400	250	51200	560	80
13	300	2653	480	300	51200	640	66
14	350	2274	560	350	51200	800	57
15	400	1989	640	400	51200	960	50
16	500	1592	800	500	51200	1200	40
17	600	1326	960	600	51200	1440	33
18	750	1061	1200	750	51200	1840	27
19	900	884	1440	900	51200	2240	22
20	1150	692	1840	1150	51200	2720	17
21	1400	568	2240	1400	51200	3360	14
22	1700	468	2720	1700	51200	4000	12
23	2100	379	3360	2100	51200	4480	9
24	2500	318	4000	2500	51200	4960	8
25	2800	284	4480	2800	51200	5440	7
26	3100	257	4960	3100	51200	5920	6
27	3400	234	5440	3400	51200	6400	6
28	3700	215	5920	3700	51200	7200	5
29	4000	199	6400	4000	51200	8000	5

Rigidity Grade P0-04	Speed loop gain P1-00	Speed loop integral time constant P1-01	Position loop gain P1-02	Second speed loop gain P1-05	The second velocity loop integral time constant P1-06	Second position ring gain P1-07	Torque command filtering time constant: 1/2 P2-35/p2-36
30	4500	177	7200	4500	51200	8000	5
31	5000	160	8000	5000	51200	8000	5
32	5500	145	8800	5500	51200	8000	3
33	6000	133	9600	6000	51200	8000	3
34	6500	123	10400	6500	51200	8000	3
35	7000	114	11200	7000	51200	8000	0
36	7500	106	12000	7500	51200	8000	0
37	8000	100	12800	8000	51200	8000	0
38	8500	94	13600	8500	51200	8000	0
39	9000	88	14400	9000	51200	8000	0
40	9500	84	15200	9500	51200	8000	0
41	10000	80	16000	10000	51200	8000	0

- Rapid Location Mode Rigid Level Table (P6-00.0=2)

Rigidity level P0-04	Speed loop gain P1-00	Speed loop integral time constant p1-01	Position loop gain P1-02	Torque command filtering 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

Rigidity level P0-04	Speed loop gain P1-00	Speed loop integral time constant p1-01	Position loop gain P1-02	Torque command filtering time constant p2-35	Model loop gain P2-49
22	864	468	2720	20	2720
23	968	379	3360	20	3360
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	-

6.3.4 Matters need attention

- In the Quick Adjustment Mode, all gain parameters corresponding to the rigidity level can be independently fine-tuned.
- The Quick Adjustment Mode defaults to a rigid level. If the gain does not meet mechanical requirements, adjust it gradually upward or downward.
- To ensure stability, the model loop gain is kept low at low stiffness levels; this parameter can be increased individually when high response performance is required.
- To quickly address vibration issues, adjust the torque command filter P2-35. If ineffective, perform mechanical characteristic analysis and set the corresponding notch parameters (refer to Section 6.7 Vibration Suppression).

6.4 Self-correcting

6.4.1 Summary

Automatic adjustment is divided into internal command self-adjustment and external command self-adjustment.
Automatic adjustment (internal command self-regulation) refers to a function where the servo unit operates automatically (performing reciprocating movements in both forward and reverse directions) without receiving commands from the higher-level device, adjusting its performance based on mechanical characteristics during operation.
Automatic adjustment (external command self-adjustment) is a function that automatically optimizes operations based on commands received from the higher-level device.

The automatic adjustments are as follows:

- Load rotational inertia
- Gain parameters (velocity loop, position loop, model loop gain)
- Filter (notch filter, torque command filter)

6.4.2 Matters need attention

When adjustment is not possible

- Mechanical systems can only operate in one direction.

Scenarios where calibration is prone to failure

- The load's rotational inertia is too large;
- The rotational inertia varies significantly during operation;
- The mechanical rigidity is low, causing vibrations during operation, resulting in failed detection and positioning.
- The operating range is small, within 0.5 circles.

Preparation work before calibration

- Use the location mode;
- The drive is in BB mode;
- The drive has no alarm;
- The number of pulses per servo revolution must be properly matched with the positioning completion width.

6.4.3 Operation tool

Both internal command self-setting and external command self-setting can be executed via the driver panel and the XinJeServo host computer software.

Setpoint Mode	Operation Tool	Restriction Item
Internal command for self-adjustment External command from the tuning process	XinJeServo Host Computer Software	All versions of the host software support
	Driver Panel	The driver firmware requires version 4200 or later.

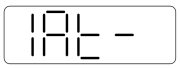
The driver firmware version can be viewed via U2-07.

6.4.4 Internal instructions for the tuning operation steps

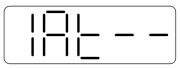
1) Self-adjustment step for the drive panel

1. Perform inertia identification by following Step 6.2.4 of the driver panel inertia estimation procedure during rotational inertia estimation.

2. Enter parameter F0-09 to display 'iat-'.



3. Press and hold the ENTER key; the panel displays "iat--", indicating the servo is enabled.



4. Shortly press INC or DEC; the panel displays "tune" and flashes, entering the adjustment state.

5. The drive automatically sends pulse commands internally for operation; if successfully calibrated, the display shows "done" and flashes.

6. Long-press the STA/ESC key to exit the internal command auto-setting mode.

During the calibration process, briefly pressing STA/ESC at any time will terminate the calibration operation and apply the gain parameters at the time of termination; if calibration fails, the driver must be initialized before attempting calibration again.

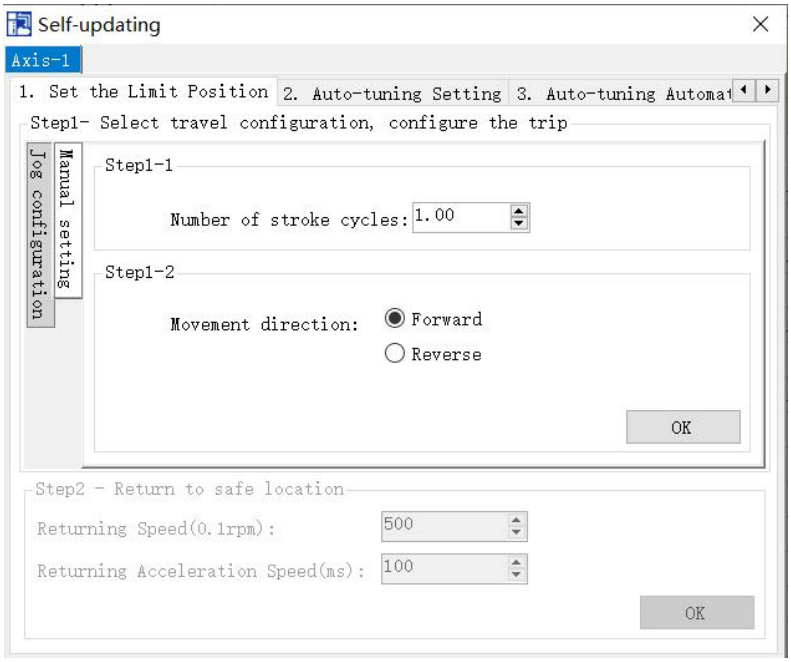
- Self-tuning process panel error alarm

Error code	Meaning	Possible reason
Err-1	Failed to find the optimal gain	The moment of inertia ratio is too large; the mechanism rigidity is too weak.
Err-2	Excessive travel/alarm occurred during the	Ensure the journey does not exceed the

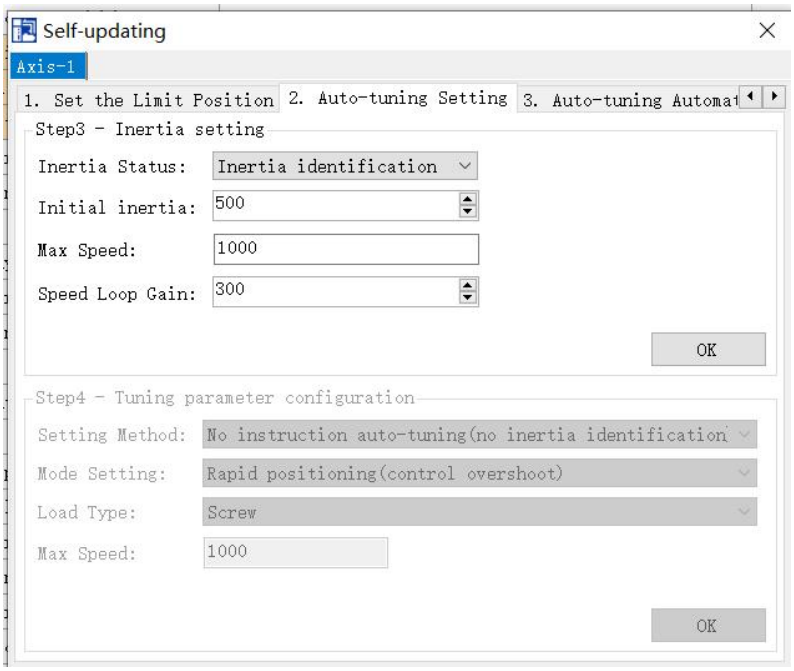
	self-tuning process	limit and no alarms occur before resetting automatically.
Err-6	The drive is not in the "bb" state when performing the operation.	Confirm the current status of the drive
Err-7	An alarm was triggered in the driver during the calibration process.	The drive has an alarm.

2) XinJeServo self-tuning procedure

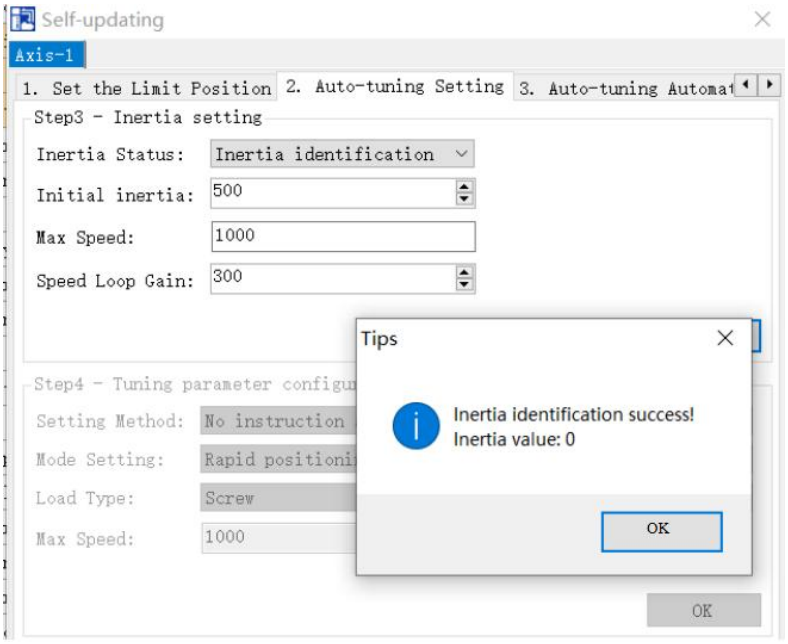
1. On the XinJeServo main menu screen, click [Self-Calibration].
2. Select [Pulse Configuration] or [Manual Setting] to configure the inertia estimation stroke.



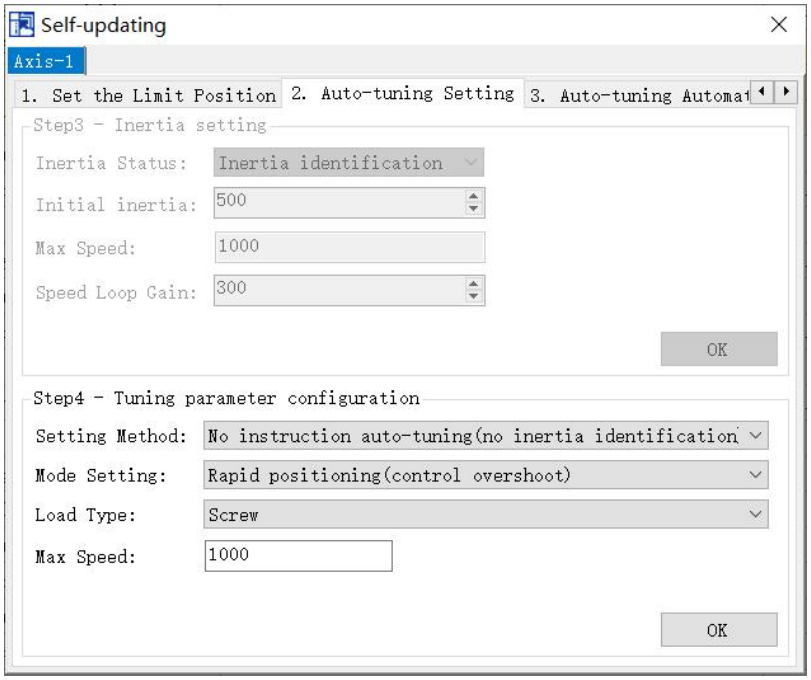
3. Set the configuration interface settings.



4. Click [Confirm] to initiate the estimation of inertia.



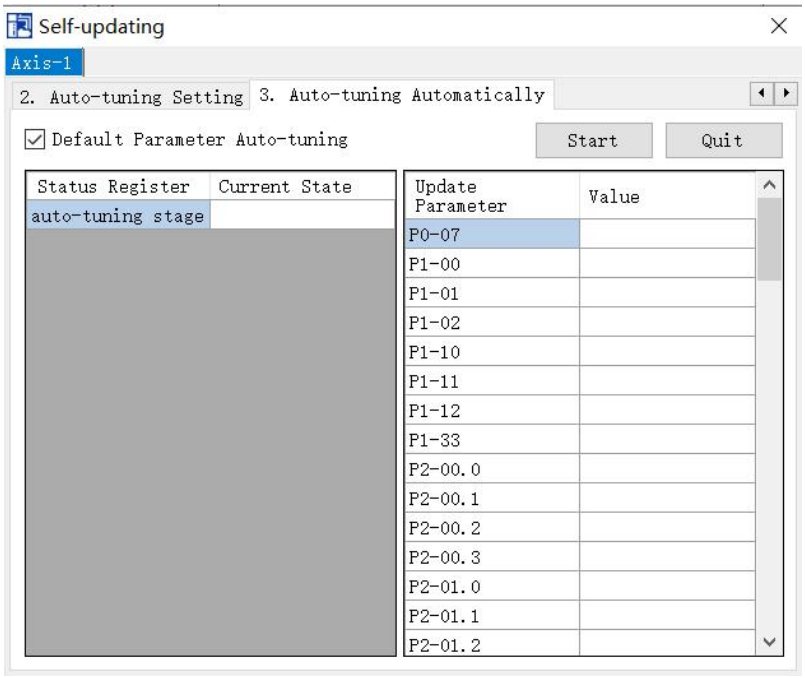
5. Parameter calibration configuration.



Settlement method	Explanation
Soft	Apply a gentle gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.
Quick positioning	Specifically adjusted for positioning applications. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.
Quick positioning (control overshoot)	During purpose-specific positioning, adjustments are made to ensure no overshoot. In addition to gain adjustment, the model loop gain and notch filter are automatically adjusted.

Rigidity level	Explanation
Synchronous belt	Perform adjustments suitable for low-rigidity mechanisms such as synchronous belt drives.
Lead screw	Perform adjustments suitable for highly rigid mechanisms such as ball screw drives. If no corresponding mechanism is available, select this type.
Fixed joint	Perform adjustments suitable for rigid systems and other highly rigid mechanisms.

6. Begin the calibration.



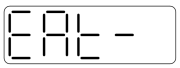
7. Wait for the calibration to complete.

6.4.5 External instructions for the tuning operation steps

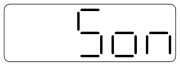
1) Self-adjustment step for the drive panel

1. Perform inertia identification by following Step 6.2.4 of the driver panel inertia estimation procedure during rotational inertia estimation.

2. Enter parameter F0-08 and display Eat- (External Reference Auto-tuning);

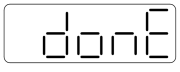


3. Shortly press the ENTER key. If enabling is not activated, the panel displays "Son" and flashes; wait for enabling to occur. If enabling is already activated, skip this step.



4. Enable the servo; the panel displays "tune" with a flashing indicator, entering the calibration state.

5. The upper-level device initiates pulse command transmission for operation; upon successful calibration, the display shows "done" with flashing indicator lights.



6. Long-press the STA/ESC key to exit the external command auto-setting mode.

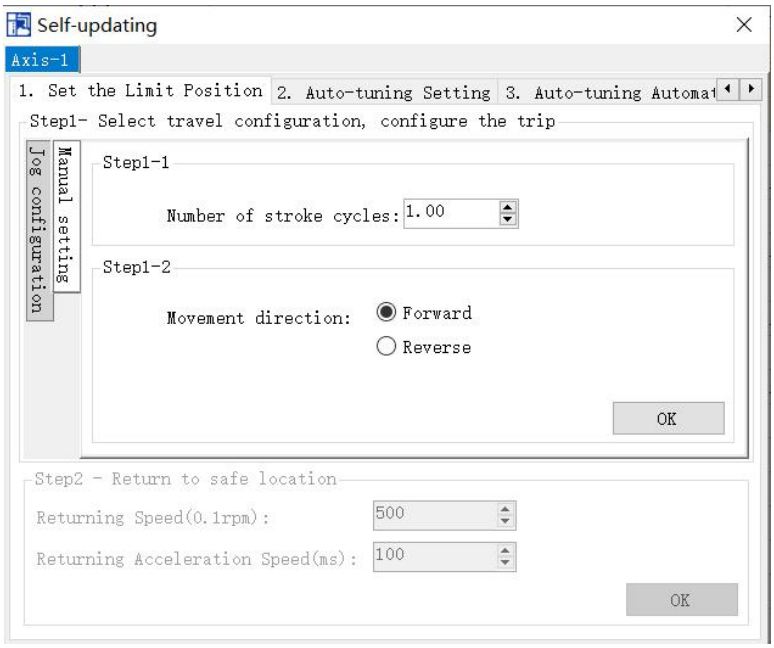
During the calibration process, briefly pressing STA/ESC at any time will terminate the calibration operation and apply the gain parameters at the time of termination.

- Self-tuning process panel error alarm

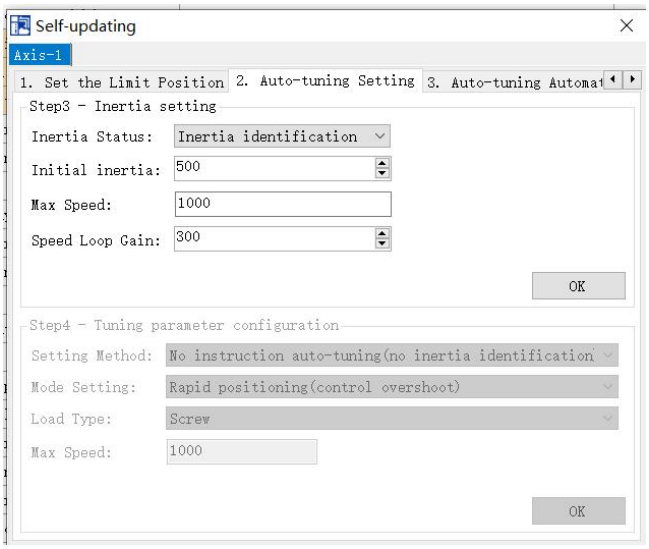
Error code	Meaning	Possible reason
Err-1	Failed to find the optimal gain	The moment of inertia ratio is too large; the mechanism rigidity is too weak.
Err-2	① Overtravel/alarm occurred during the tuning process ② External command setting/Vibration suppression mode: Servo shutdown is enabled during the setting process	Ensure the journey does not exceed the limit and no alarms occur before resetting automatically. Ensure the enabling option is not disabled during the calibration process
Err-3	Current non-position control mode	Auto-adjust in location mode
Err-4	Adaptive feature is not turned off	Change P2-01.0 to 0 before proceeding with self-tuning
Err-7	An alarm was triggered in the driver during the calibration process.	The drive has triggered an alarm.
Err-8	The positioning completion signal is unstable	The instruction interval is too short

2) XinJe Servo self-tuning procedure

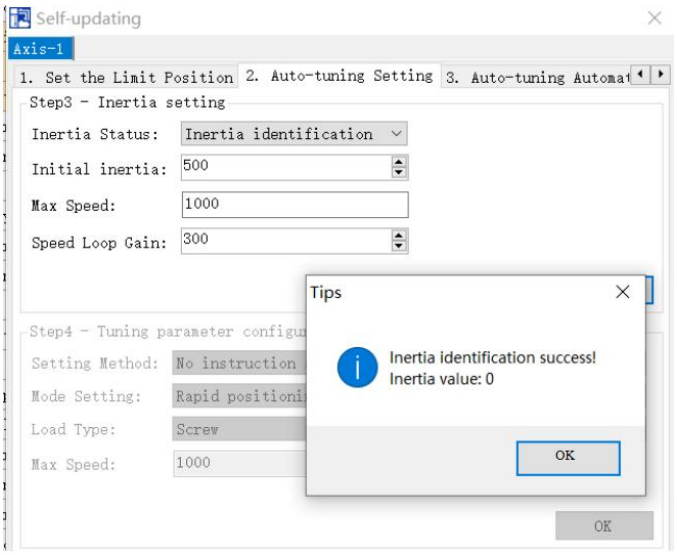
1. On the XinJeServo main menu screen, click [Gain Adjustment];



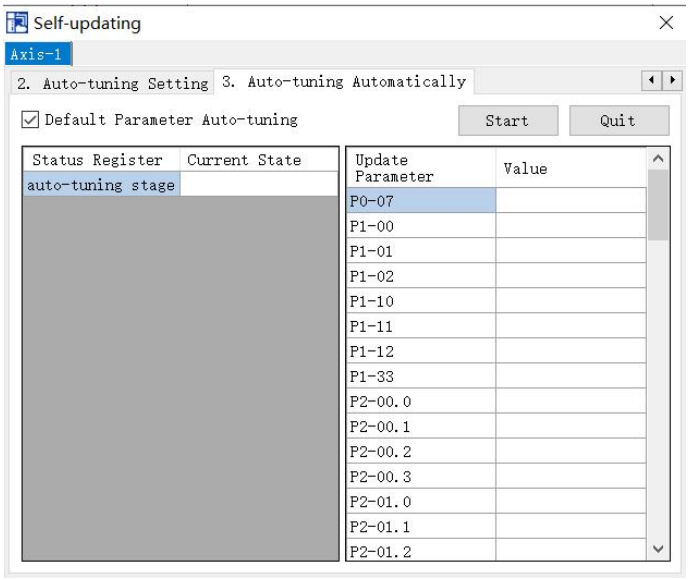
2. Select [Pulse Configuration] or [Manual Setting] to configure the inertia estimation stroke;



3. Settings for the calibration configuration interface;
4. Click [Confirm] to initiate the estimation of inertia;



5. Parameter calibration configuration;

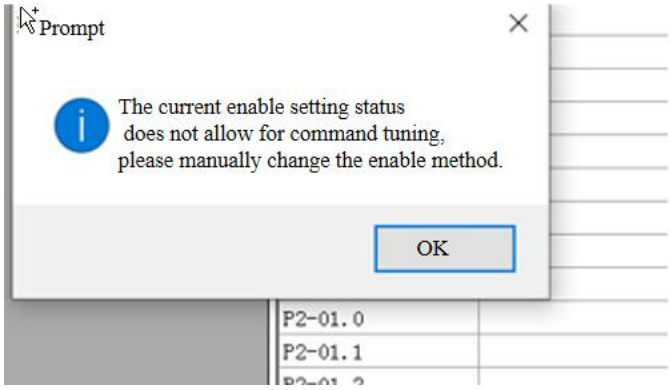


Settlement method	Explanation
Soft	Apply a gentle gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.
Quick positioning	Specifically adjusted for positioning applications. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.
Quick positioning (control overshoot)	During purpose-specific positioning, adjustments are made to ensure no overshoot. In addition to gain adjustment, the model loop gain and notch filter are automatically adjusted.

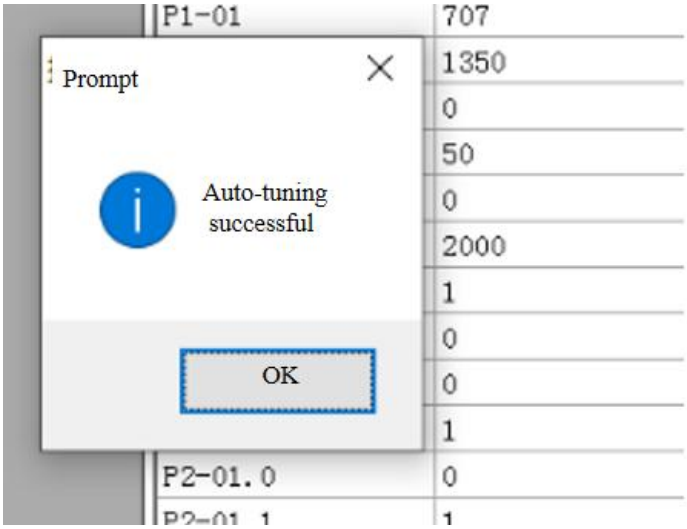
Rigidity level	Explanation
Synchronous belt	Perform adjustments suitable for low-rigidity mechanisms such as synchronous belt drives.
Lead screw	Perform adjustments suitable for highly rigid mechanisms such as ball screw drives. If no corresponding mechanism is available, select this type.
Fixed joint	Perform adjustments suitable for rigid systems and other highly rigid mechanisms.

6. Begin calibration;

7. After enabling the servo, click OK;



8. Once calibration is complete, click OK.



6.4.6 Relevant parameter

The following parameters may be modified during automatic adjustment. Do not make manual changes during the process.

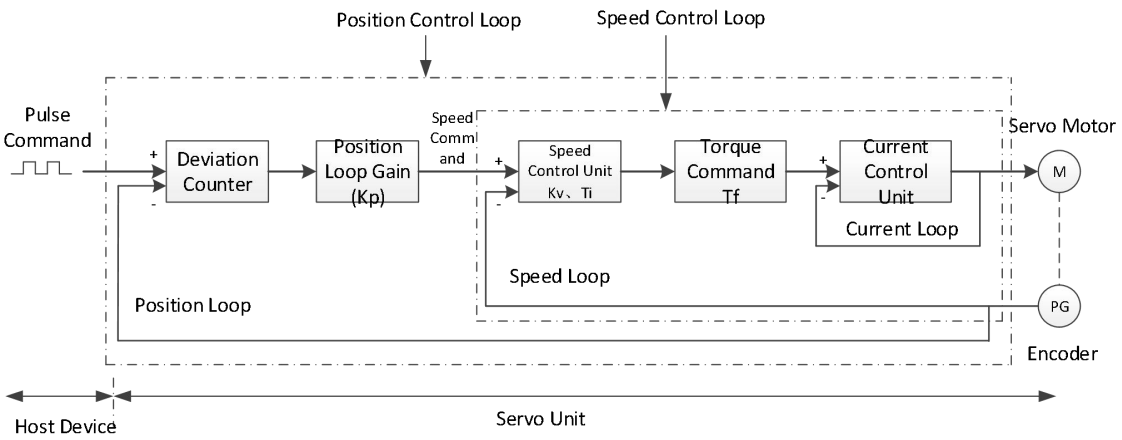
Parameter	Name	Parameter attribute	The impact of the values on gain after calibration is complete.
P0-07	First Inertia Ratio	Gain Performance parameter	Have
P1-00	First speed loop gain		
P1-01	First speed loop integral time constant		
P1-02	First-position ring gain		
P2-00.0	Disturbance Observer Switch		
P2-01.0	Adaptive Mode Switch		
P2-35	Torque command filtering time constant 1		
P2-41	Perturbation Observer Gain		
P2-47.0	Model Loop Switch		

Parameter	Name	Parameter attribute	The impact of the values on gain after calibration is complete.
P2-49	Model Loop Gain		
P2-55	Model speed feedforward gain		
P2-60.0	Active vibration suppression switch		
P2-61	Active vibration suppression frequency		
P2-62	Active vibration suppression gain		
P2-63	Active vibration suppression damping		
P2-64	Active vibration suppression filtering time 1		
P2-65	Active vibration suppression filtering time 2		
P2-66	The second group utilizes active vibration suppression damping.		
P2-67	Second group of active vibration suppression frequencies		
P2-69.0	First notch switch		
P2-69.1	Second wave suppression switch		
P2-71	First notch frequency		
P2-72	First notch bandwidth		
P2-73	First notch attenuation		
P2-74	Second absorption frequency		
P2-75	Second absorption band width		
P2-76	Second waveguide attenuation		
P2-17	Inertia identification and the maximum speed determined through internal command self-adjustment	Settlement Configuration parameter	Not have
P2-86	Set manual mode		
P2-87	Minimum limit for the adjustment movement		
P2-88	Maximum limit for the adjustment movement		
P2-89	Maximum speed of the adjustment movement		
P2-90	Setpoint acceleration and deceleration time		

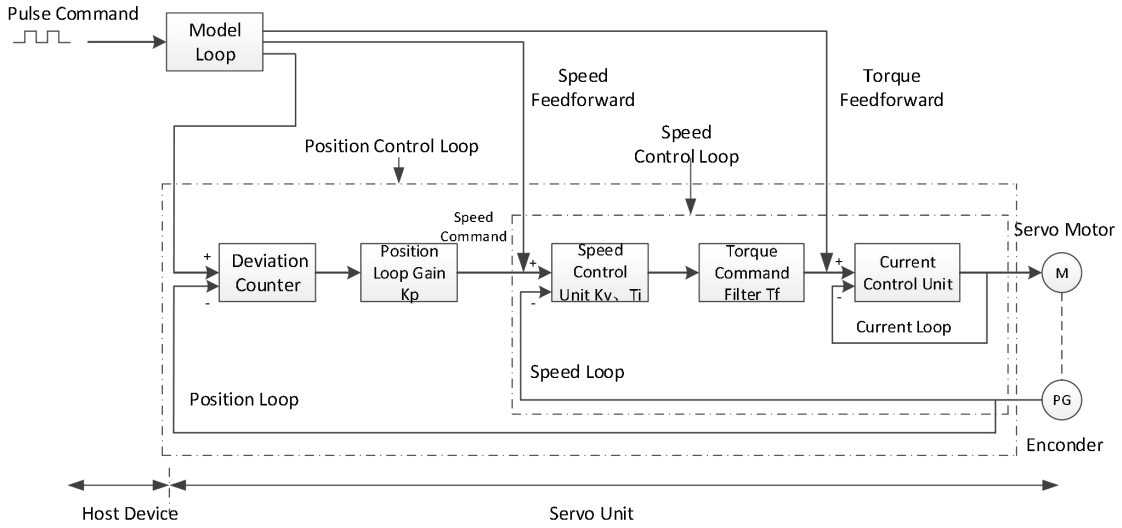
The values P2-60 to P2-63 are automatically adjusted during the self-tuning process and cannot be modified manually by the user; manual modification may risk system instability.

6.5 Manual adjustment

6.5.1 Summary



Position control (close the model loop) control block diagram



Position control (model loop enabled) control block diagram

The servo unit consists of three feedback loops (from inner to outer: current loop, speed loop, and position loop). The innermost 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 rapid gain adjustment fails to achieve the desired effect
- When automatic gain adjustment fails to achieve the desired effect

6.5.2 Example of adjustment steps

In position mode, when the self-tuning selects the soft mode (P2-02.0=1), the model loop function is disabled; in speed mode, the position loop gain becomes invalid.

Improve response time

1. Reduce the torque command filtering time constant (P2-35)
2. Increase the speed loop gain (P1-00)
3. Reduce the integral time parameter of the velocity loop (P1-01)
4. Increase the position loop gain (P1-02)
5. Increase 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 velocity loop (P1-01)
3. Reduce the position loop gain (P1-02)
4. Increase the torque command filtering time constant (P2-35)
5. Reduce the model loop gain (P2-49)

6.5.3 Adjusted gain parameter

The gain parameters that need adjustment are generally:
P1-00 Speed Loop Gain
P1-01 Speed loop integral time constant
P1-02 Position Ring Gain
P2-35 Torque command filtering time constant
P2-49 Model Ring Gain

- Speed Loop Gain

When the speed loop exhibits low responsiveness, it becomes a delay factor for the outer position loop, leading to overshoot or vibration in the speed command. Therefore, within the range where no vibration occurs in the mechanical system, the higher the setpoint value, the more stable and responsive the servo system becomes.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P1-00	Speed Loop Gain	200	0.1Hz	10 ~ 20000	at any time	immediately

- Speed loop integral time constant

To ensure responsiveness even to minimal inputs, the speed loop incorporates an integral element. Since this integral element acts as a delay component in the servo system, an excessive time constant setting may lead to overshoot or prolonged positioning time, thereby reducing responsiveness.

The velocity loop gain and the velocity loop integral time constant approximately satisfy the following relationship:
P1-00 × P1-01 = 636620

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P1-01	Speed loop integral time constant	3300	0.01ms	15 ~ 51200	at any time	immediately

- Position Loop Gain

When the model loop is inactive (P2-47.0=0), the responsiveness of the servo unit's position loop is determined by its gain. A higher position loop gain results in greater responsiveness and shorter positioning time. Generally, the position loop gain should not be set beyond the range of the mechanical system's natural frequencies. Therefore, setting a high position loop gain requires increasing the machine's rigidity and raising its natural frequencies.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P1-02	Position Loop Gain	200	0.1/s	10 ~ 20000	at any time	immediately

- Torque command filtering time constant

When machine vibration is caused by servo drive, adjusting the following torque command filtering time parameter may eliminate the vibration. A smaller value enables better responsive control, though subject to machine constraints. Generally, reduce this parameter when vibration occurs; the recommended adjustment range is 10–150.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P2-35	Torque command filtering time constant 1	66	0.01ms	0 ~ 65535	at any time	immediately
P2-36	Torque command filtering 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 of gain parameters is used, P2-36 takes effect.

- Model Loop Gain

When the model loop is active (P2-47.0=1), the servosystem's responsiveness is determined by the model loop gain. Increasing the model loop gain enhances responsiveness and reduces positioning time. In this case, the servosystem's responsiveness depends solely on this parameter rather than P1-02 (position loop gain). The model loop gain is only effective for the position mode.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P2-49	Model Loop Gain	500	0.1Hz	10 ~ 20000	at any time	immediately

6.6 Self-adaption

6.6.1 Summary

The adaptive function enables stable response through automatic adjustment regardless of machine type or load fluctuations. Servo ON automatically initiates the adjustment process.

6.6.2 Matters need attention

- After the servo unit is installed on the machine, a brief noise may occur during the initial servo startup. This is the sound produced when configuring the automatic notch filter and does not indicate a fault. No noise will be heard during subsequent servo startups.
- When the motor's allowable load moment of inertia is exceeded, vibration may occur. In this case, adjust the adaptive parameters to match the current load moment of inertia.
- In adaptive operations, to ensure safety, perform adaptive functions in a state where emergency stop or shutdown can be initiated at any time.

6.6.3 Operating steps

The factory setting is adaptive and requires no modification of other parameters. The effectiveness of the adaptation is controlled by the following parameters.

Parameter		Meaning	Factory settings	Revise	Take effect
P2-01	n.□□□0	Adaptive Close	n.□□□1	servo bb	Power on again
	n.□□□1	Adaptive Open			

6.6.4 Inertia pattern and related parameters

The adaptive default parameter is set to the low-inertia mode. If the load inertia significantly exceeds the motor's allowable rotational inertia (e.g., 60 times the inertia for a 60 motor), the adaptive high-inertia mode can be activated.

Parameter		Meaning	Factory settings	Revise	Take effect
P2-03	n.0□□□	Adaptive Low-Inertia Mode	n.0□□□	servo bb	Power on again
	n.1□□□	Adaptive High-Inertia Mode			

Parameter	Meaning	Factory settings	Revise	Take effect

Parameter	Meaning	Factory settings	Revise	Take effect
P2-05	Adaptive speed loop gain	400 Note 1	servo bb	immediately
P2-10	Adaptive speed loop integral	500	servo bb	immediately
P2-11	Adaptive Position Loop Gain	100	servo bb	immediately
P2-07	Adaptive Inertia Ratio	0	servo bb	immediately
P2-08	Adaptive Speed Observer Gain	60	servo bb	immediately
P2-12	Adaptive Stable Maximum Inertia Ratio	30	servo bb	immediately
P2-16	Adaptive control of the motor rotor inertia coefficient	100	servo bb	immediately
P2-19	Adaptive control bandwidth	Note 2: 50	servo bb	immediately
P6-05	Adaptive large-inertia mode speed-loop gain	200	servo bb	immediately
P6-07	Adaptive large-inertia mode inertia ratio	50	servo bb	immediately
P6-08	The gain of the adaptive high-inertia mode velocity observer	40	servo bb	immediately
P6-12	Adaptive large-inertia mode stabilizes the maximum inertia ratio	50	servo bb	immediately

- For DS5 series servo drives of 750 W and below, the default value is 400; for other power ratings, the default value is 200.
- For DS5 series servo drives with 400 W or less, the default value is 70; for other power ratings, the default value is 50.

6.6.5 Recommended inertia ratio parameter

Under adaptive default parameters, the system only ensures stable load operation at a specific moment of inertia. If the load inertia is significantly large, certain parameters still require adjustment. The recommended parameters are as follows (all modified parameters were set under the default parameters).

Motor base	Inertia	Parameter
40–90 machine bases	Within 20 times the inertia	Adaptive Low-Inertia Mode (Default Parameter)
	Inertia of 20 to 30 times	Change P2-08=50, P2-12=40
	Inertia of 30 to 40 times	Change P2-08 to 50, P2-12 to 40, and P2-07 to 10.
	Inertia of 40 to 50 times	Change P2-08 to 50, P2-12 to 40, and P2-07 to 30.
	Inertia of 50 to 80 times	Switch to the adaptive high-inertia mode or modify P2-08=40, P2-12=50, P2-07=50
110/130 Engine Base	Within 10 times the inertia	Adaptive Low-Inertia Mode (Default Parameter)
	10 to 15 times	Change P2-08=50, P2-12=40

	the inertia	
	Inertia of 15 to 20 times	Switch to the adaptive high-inertia mode or modify P2-08=40, P2-12=50, P2-07=50
Base with a height of 180 cm or more	Within 5 times the inertia	Adaptive Low-Inertia Mode (Default Parameter)
	5 to 10 times the inertia	Change P2-08=50, P2-12=40
	Inertia of 10 to 20 times	Switch to the adaptive high-inertia mode or modify P2-08=40, P2-12=50, P2-07=50

Parameters with higher inertia can still handle loads with lower inertia; for example, using parameters with 50 times the inertia on a mechanism with 20 times the load inertia will only result in poorer responsiveness.

6.6.6 Adaptive correlation parameter effect

Parameter Small inertia / large inertia	Name	Windows default	Reference angle Section range	Effect
P2-05/P6-05	Speed loop gain in adaptive mode	400/200	200 ~ 400	Reducing the value enhances inertia capacity but decreases responsiveness, significantly impacting responsiveness.
P2-07/P6-07	Load Inertia Ratio in Adaptive Mode	0/50	0 ~ 200	An increase in this parameter can significantly enhance the system's inertia capacity without compromising responsiveness; however, an excessively large value may easily induce oscillations.
P2-08/P6-08	Speed Observer Gain	60/40	30 ~ 60	Reducing P2-08 while increasing P2-12 can significantly enhance the inertia-bearing capacity, but it will reduce responsiveness, with a substantial impact on response performance.
P2-12/P6-12	Adaptive mode stabilizes the maximum inertia ratio	30/50	30 ~ 60	
P2-10	Adaptive Mode Speed Loop Integral Time Coefficient	500	200 or more	Adjust as needed; generally increase
P2-11	Adaptive Mode Position Loop Gain Coefficient	100	50 ~ 200	Adjust as needed: increase response speed and enhance responsiveness; decrease response speed and reduce responsiveness.

Parameter Small inertia / large inertia	Name	Windows default	Reference angle Section range	Effect
P2-16	Adaptive Mode Motor Rotor Inertia Coefficient	100	100 ~ 200	Enhances servo stiffness and improves disturbance resistance, effectively addressing operational jitter.
P2-19	Adaptive control bandwidth	50 ~ 70	40 ~ 80	An increase in magnitude slightly enhances the inertia-bearing capability with minimal impact on responsiveness, serving as an auxiliary parameter.

6.6.7 The adaptive effective time parameter is disabled

When the adaptive function is active (P2-01.0=1), the parameters that become inactive are listed in the table below:

Project	Parameter	Parameter name
Gain Class	P1-00 P1-05	First speed loop gain Second speed loop gain
	P1-01 P1-06	First speed loop integral time constant The second velocity loop integral time constant
	P1-02 P1-07	First-position ring gain Second position ring gain
	P2-49	Model Loop Gain
	P0-07 P0-08	First Inertia Ratio Second Inertia Ratio
	P5-36	-I-SEL Inertia Ratio Switching

6.7 Vibration abatement

6.7.1 Summary

Mechanical systems possess a specific resonant frequency. When the servo gain is increased, sustained vibrations may occur near this mechanical resonant frequency, typically ranging from 400 Hz to 1000 Hz, preventing further gain improvement. Vibration can be eliminated either through automatic detection or manual adjustment of the vibration frequency. Once the vibration is eliminated, the gain may be further increased to enhance responsiveness.

- After performing the vibration suppression operation, the servo responsiveness will change compared to before.
- Before performing vibration suppression operations, correctly set the moment of inertia ratio and gain parameters; otherwise, proper control cannot be achieved.

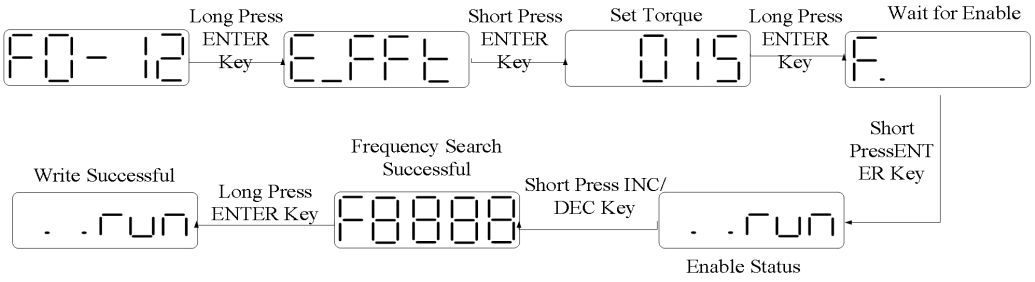
6.7.2 Operation tool

Adjustment method	Operation tool	Control model	Refer to the operational steps	Restriction item
Adaptive Mode	XinJeServo Mechanical Property Analysis	position mode	6.7.4 Vibration Suppression (Host Computer Software)	All versions of the host software support
Self-tuning mode	Panel vibration inhibition operation		6.7.3 Vibration Suppression (Fast FFT)	not have
	XinJeServo Mechanical Property Analysis		6.7.4 Vibration Suppression (Host Computer Software)	All versions of the host software support
Self-tuning/Adaptive Mode	Panel vibration inhibition operation		6.7.3 Vibration Suppression (Fast FFT)	not have

6.7.3 Vibration suppression (fast fft)

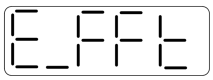
This function enables mechanical characteristic analysis via parameters F0–12 on the servo control panel, identifying the mechanical resonance frequency to achieve vibration suppression.

The complete procedure is shown below:

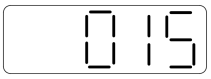


The following explanations the steps:

1. For F0-12, hold down [ENT] to activate the Quick FFT function, displaying "E_FFt";

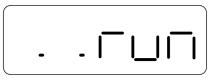


2. Press [ENT] to enter the torque setting interface, where the currently set torque value (i.e., the value of P6-89) will be displayed. Use [▲] and [▼] to adjust the torque command; when increasing the torque value, increment it gradually to avoid excessive equipment vibration.



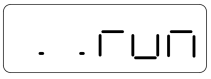
3. After setting the torque command, press and hold [ENT] to enter the "Preparation for Enablement" phase; the interface will display "F.".

4. Press [ENT] to enable the display of "...run";



5. Press [▲] and [▼] to rotate the device in both directions to identify the resonant frequency. During operation, the interface flashes "E_FFt"; if the resonant frequency is found, "Fxxxx" appears on the interface, where "xxxx" represents the resonant frequency. If the search for the functional frequency fails, the interface displays "F----".

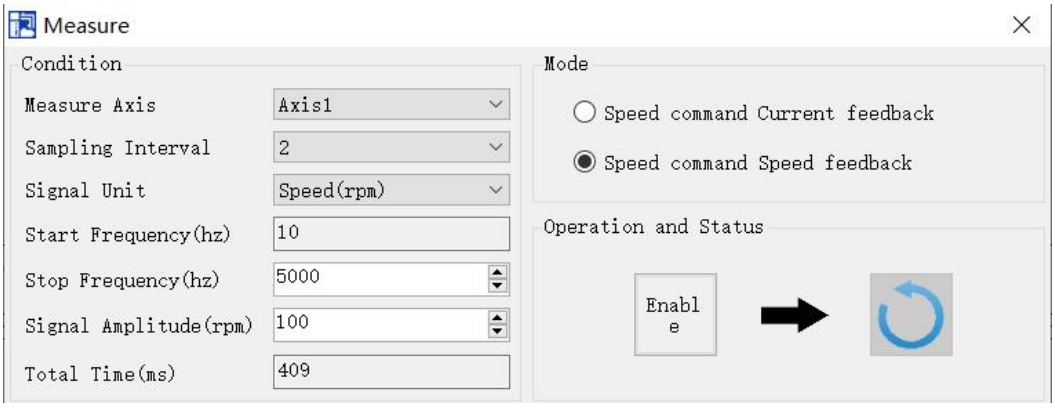
6. Whether the display shows "Fxxxx" or "F----", continue pressing [▲] and [▼] to locate the resonant frequency again. Once identified, hold down [ENT] to set the displayed resonant frequency in the driver's notch filter.



For each step above, press and hold the STA/ESC key to return to the previous operation; tap [STA] to exit any step.

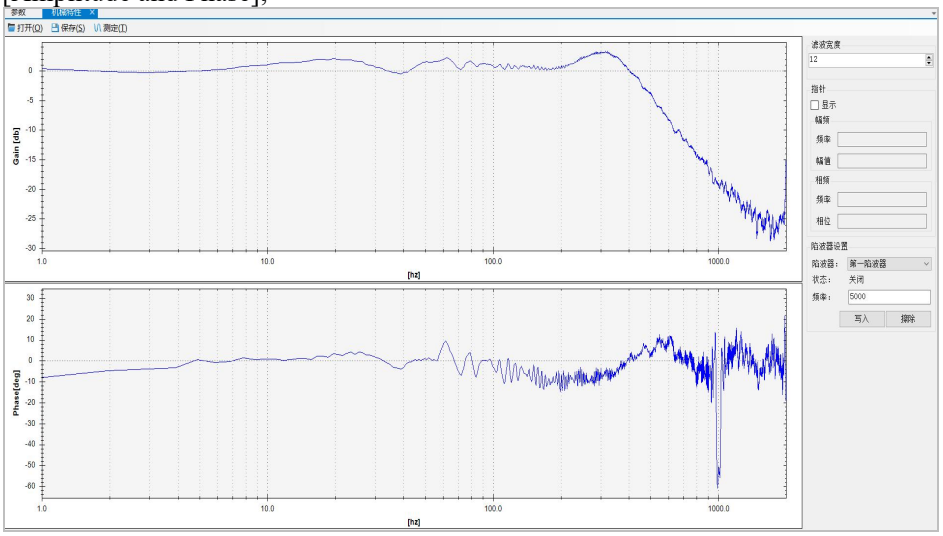
6.7.4 Vibration suppression (host computer software)

1. Open the XinJeServo host software and select Mechanical Properties;
2. Click [Measure];



3. Configure the test conditions, then click [Execute];

4. Select [Amplitude and Phase];



5. Set the filter width (to clearly observe the resonance frequency) and identify the resonance frequency;

6. The band-stop parameters need to be manually configured; for details, refer to Section 6.7.6 "Band-stop Filter".

Taking the figure above as an example, mechanical characteristic analysis reveals a resonance frequency of 328 Hz. The third notch filter can be employed with the following parameter settings:

P2-69=n.1000　P2-77=328

Whether in adaptive or self-tuning mode, using mechanical characteristic analysis constitutes manual notch setting. If multiple resonance points exist, configure the third to fifth notch filters sequentially.

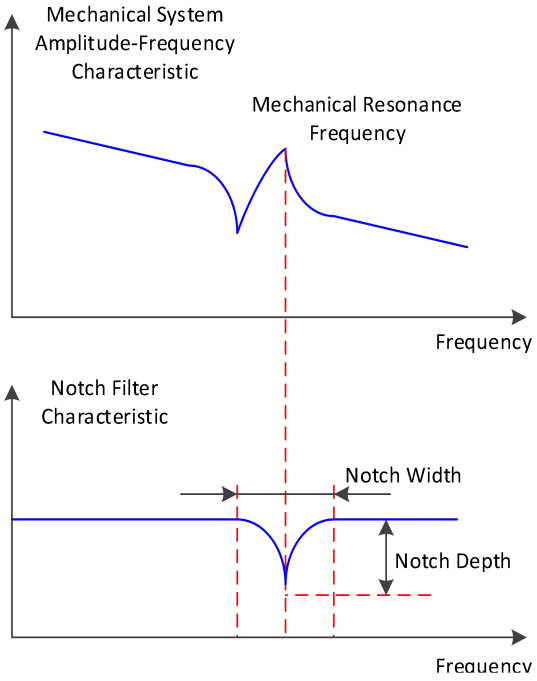
6.7.5 Vibration suppression (manual setting)

When the resonant frequency of the mechanical system is known, vibration can be eliminated by manually setting the vibration frequency.配置 the third to fifth notch filters accordingly. For detailed parameters, refer to Section 6.7.6, "Notch Filters."

6.7.6 Notch filter

The notch filter achieves suppression of mechanical resonance by reducing the gain at specific frequencies. After proper configuration of the notch filter, vibrations can be effectively suppressed, and further increase in servo gain may be attempted.

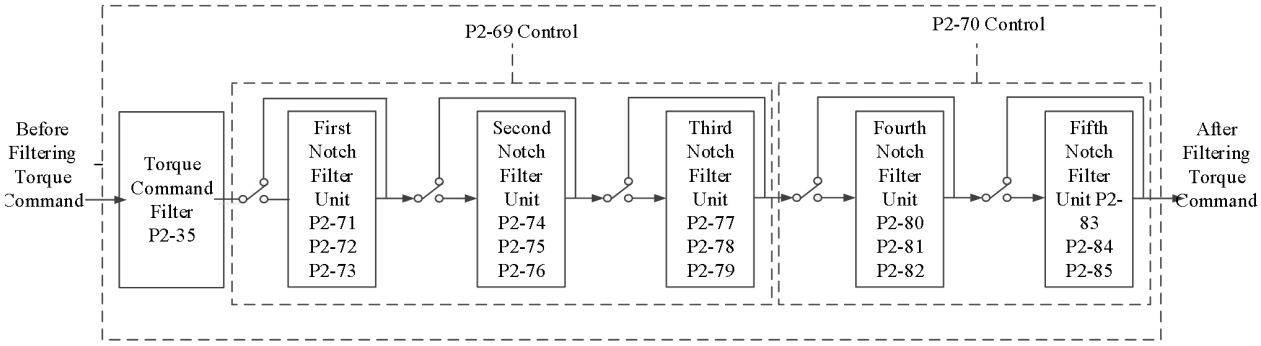
The schematic diagram of the notch filter is shown below:



Slokker Circuit Diagram

The servo driver features five groups of notch filters, each with three parameters: notch frequency, notch attenuation, and notch bandwidth. The first and second notch filters are automatically configured, while the third, fourth, and fifth are manually adjustable.

The torque command filter and the notch filter are connected in series within the system, as shown in the figure below, with the switching of the notch filter controlled by P2-69 and P2-70.



Parameter		Meaning	Factory settings	Revise	Take effect
P2-69	n.□□□0	The first notch filter is turned off.	n.□□□0	at any time	immediately
	n.□□□1	The first notch filter is open			
	n.□□0□	The second notch filter is turned	n.□□0□	at any	immediately

Parameter		Meaning	Factory settings	Revise	Take effect
		off.		time	
	n.□□1□	The second notch filter is open			
	n.0□□□	The third absorber is closed.	n.0□□□	at any time	immediately
	n.1□□□	The third absorber is open			
P2-70	n.□□□0	The fourth absorber is turned off.	n.□□□0	at any time	immediately
	n.□□□1	The fourth absorber is open.			
	n.□□0□	The fifth filter is turned off.	n.□□0□	at any time	immediately
	n.□□1□	The fifth filter is activated.			

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P2-71	First notch frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-72	First notch bandwidth	71	0.01dB	50 ~ 1600	at any time	immediately
P2-73	First notch attenuation	0	0.001Hz	0 ~ 1000	at any time	immediately
P2-74	Second absorption frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-75	Second absorption band width	71	0.01dB	50 ~ 1600	at any time	immediately
P2-76	Second waveguide attenuation	0	0.001Hz	0 ~ 1000	at any time	immediately
P2-77	Third absorption frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-78	Third absorption band bandwidth	71	0.01dB	50 ~ 1600	at any time	immediately
P2-79	Third wave attenuation	0	0.001Hz	0 ~ 1000	at any time	immediately
P2-80	Fourth absorption frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-81	Fourth absorption band bandwidth	71	0.01dB	50 ~ 1600	at any time	immediately
P2-82	Fourth waveguide attenuation	0	0.001Hz	0 ~ 1000	at any time	immediately
P2-83	Fifth absorption frequency	8000	Hz	50 ~ 8000	at any time	immediately
P2-84	Fifth absorption band bandwidth	71	0.01dB	50 ~ 1600	at any time	immediately
P2-85	Fifth wave attenuation	0	0.001Hz	0 ~ 1000	at any time	immediately

- In adaptive mode, the second notch filter is automatically configured when vibration is detected.
- In the automatic tuning mode, when vibration is detected, the second and first notch filters are automatically configured (the second notch filter is prioritized activation when there is only one vibration point).
- Whether in adaptive or self-tuning mode, using mechanical characteristic analysis constitutes manual notch setting; configure the third to fifth notches accordingly.\

6.8 Gain Adjustment Application Feature

6.8.1 Model Loop Control

In the self-tuning mode, in addition to the gain of the speed loop and position loop, there is also the model loop gain, which significantly influences servo responsiveness. When the model loop is disabled, servo responsiveness is determined by the position loop gain; when enabled, it is determined by the model loop gain. The model loop serves as a feedforward function in the driver control loop.
The model loop function is automatically disabled when the self-tuning mode is set to Soft; it is automatically enabled when the self-tuning mode is set to Fast Positioning or Fast Positioning (Control overshoot).

Self-tuning mode

Parameter		Meaning	Factory settings	Revise	Take effect
P2-02	n.□□□1	soft	n.□□□3	at any time	immediately
	n.□□□2	quick positioning			
	n.□□□3	Quick positioning (control overshoot)			

Selection of self-tuning mode:

① Gentle (P2-02.0=1):
This method does not enable model loop gain, operates smoothly, and is suitable for applications with insufficient mechanical rigidity and low response requirements.

② Rapid positioning (P2-02.0=2):
This method offers the fastest response in parameter tuning, but provides no significant suppression of overshoot.

③ Rapid positioning (control overshoot) (P2-02.0=3):
This method features rapid response in parameter tuning and effectively suppresses overshoot.

Loadtype	Explanation
Synchronous Belt	Perform adjustments suitable for low-rigidity mechanisms such as synchronous belt drives.

lead screw	Perform adjustments suitable for highly rigid mechanisms such as ball screw drives. If no corresponding mechanism is available, select this type.
fixed joint	Perform adjustments suitable for rigid systems and other highly rigid mechanisms.

Self-tuning mode	Explanation
soft	Apply a gentle gain adjustment. In addition to gain adjustment, the notch filter is automatically adjusted.
quick positioning	Specifically adjusted for positioning applications. In addition to gain adjustment, it automatically adjusts the model loop gain and notch filter.
quick positioning (Control overshoot)	During purpose-specific positioning, adjustments are made to ensure no overshoot. In addition to gain adjustment, the model loop gain and notch filter are automatically adjusted.

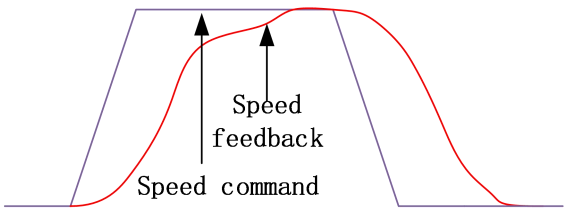
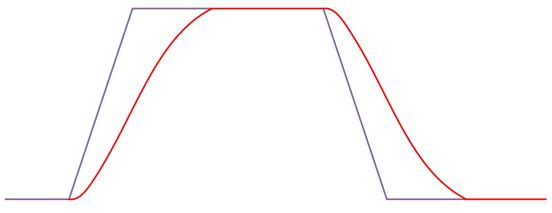
Parameter		Meaning	Factory settings	Revise	Take effect
P2-02	n.□□□1	soft	n.□□□3	at any time	immediately
	n.□□□2	quick positioning			
	n.□□□3	Quick positioning (control overshoot)			

Model Loop Function Switch

Parameter		Meaning	Factory settings	Revise	Take effect
P2-47	n.□□□0	Model loop closed	n.□□□0	at any time	immediately
	n.□□□1	Model loop open			

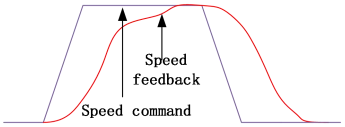
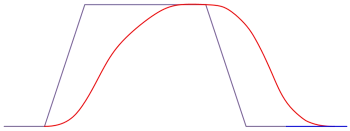
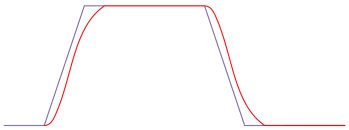
Using the DS5 series servo self-tuning mode as an example with a 750W servo drive operating at 5 times load inertia:

- Model loop function disabled (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: Operation jitter and slow response	Phenomenon: Stable operation and fast response

- Model loop function enabled (Quick Positioning or Quick Positioning (Control overshoot))

Low rigidity, low response	High rigidity, low response	High rigidity, high responsiveness
		
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: Operation jitter and slow response	Phenomenon: Stable operation, slow response	Phenomenon: Stable operation and fast response

The above curve diagram only illustrates the parameter effects and does not represent the actual operational curve.

6.8.2 Torque disturbance observation

The disturbance observer detects and estimates the external disturbance torque acting on the system, compensates for it in the torque command, thereby reducing the impact of external disturbances on the servo system and enhancing its disturbance resistance.

When selecting the Soft Mode in the self-tuning mode, the disturbance observer is automatically disabled while its gain remains unchanged; if Fast Positioning or Fast Positioning (Control overshoot) is selected, the disturbance observer switch is automatically enabled and its gain is set to 85. These parameters require no manual user configuration.

Parameter		Meaning	Factory settings	Revise	Take effect
P2-00	n.□□□0	The disturbance observer is turned off.	n.□□□0	servo bb	immediately
	n.□□□1	The disturbance observer is activated			

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P2-41	Perturbation Observer Gain	85	%	0 ~ 100	at any time	immediately

6.8.3 Gain adjustment parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P1-00	First speed loop gain	<=20P7：300 >=21P0：200	0.1Hz	10~20000	servo bb	immediately
P1-01	First speed loop integral time constant	<=20P7：2122 >=21P0：3183	0.01ms	15~51200	servo bb	immediately
P1-02	First-position ring 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 integration constant	3300	0.01ms	15~51200	servo bb	immediately
P1-07	Second position ring gain	200	0.1/s	10~20000	servo bb	immediately

6.8.4 Gain Switching

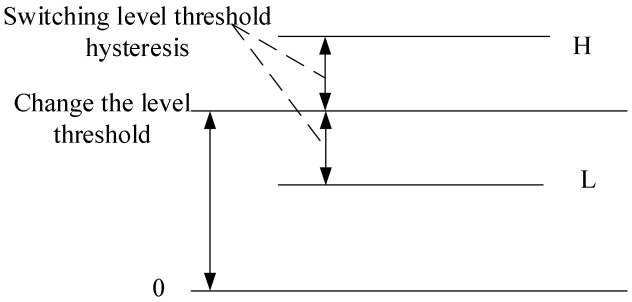
Parameter		Meaning	Factory settings	Unit	Revise	Take effect
P1-14.0	n.□□□X	n.□□□X: Gain switching function switch 0: SI terminal gain switching is effective (gain switching condition parameters are not active) 1: Perform gain switching according to the gain switching conditions 2: Reserved	0	-	at any time	immediately
P1-14.1	n.□□X□	n.□□X□: Gain switching condition selection 0: First gain fixed 1: Switch using the external SI terminal 2: High torque command 3: Speed instruction large				

Parameter		Meaning	Factory settings	Unit	Revise	Take effect
		4: Significant variations in speed commands 5: [retained] 6: Significant positional deviation 7: Position command 8: Positioning completed 9: Actual speed is high A: Position command + actual speed				
P1-15		Gain switching wait time	5	ms	at any time	immediately
P1-16		Gain switching level threshold	50	-	at any time	immediately
P1-17		Hysteresis loop of the gain switching level threshold	30	-	at any time	immediately
P1-18		Position loop gain switching time	3	ms	at any time	immediately

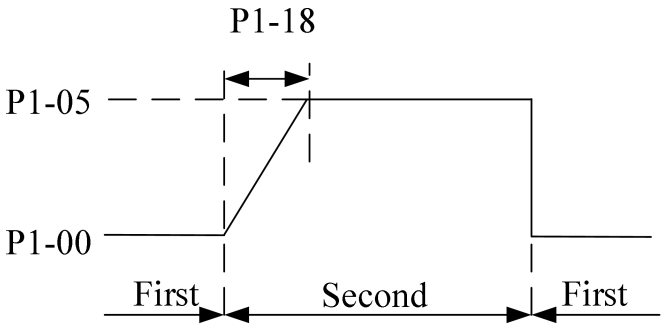
Explanation ：

① Increase the gain switching wait time; this applies only during the process of switching from the second gain back to the first gain.

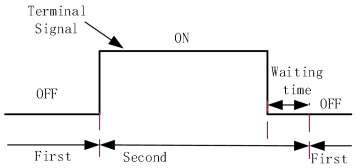
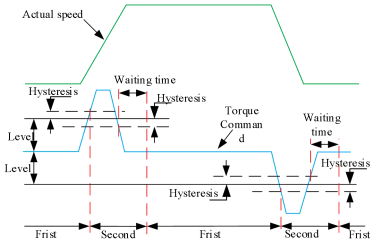
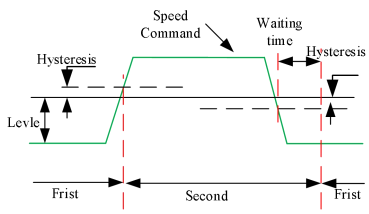
② The definition of the "gain switching level threshold hysteresis loop" is shown in the figure below:

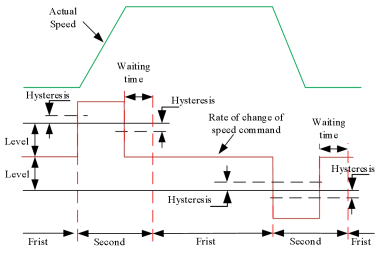
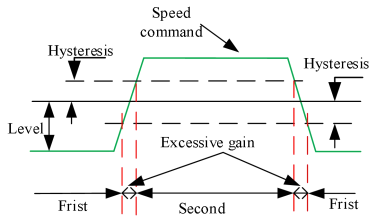


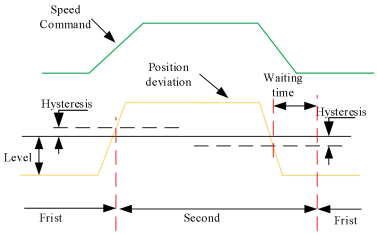
③ Explanation of "Position Gain Switching Time":

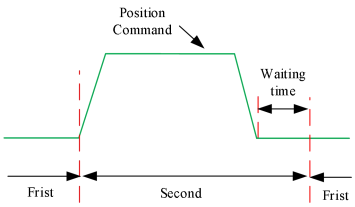
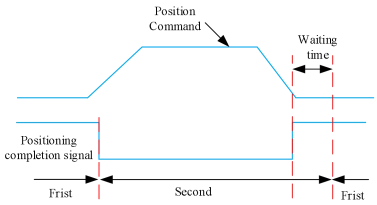


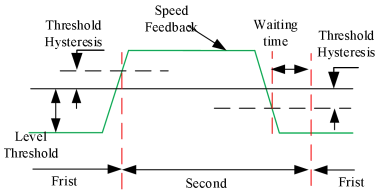
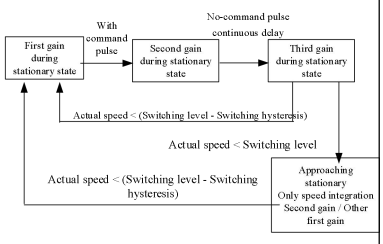
④ Explanation of benefit switching conditions

Gain switching condition settings				Relevant parameter		
P1-14.1	Condition	Schematic diagram	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 the G-SEL signal for gain switching: The G-SEL signal is invalid; the gain for Group 1 is set. The G-SEL signal is valid; Group 2 gain.	valid	of no avail	of no avail
2	torque instruct		During the previous first gain setting, switch to the second gain when the absolute value of the torque command exceeds (level + hysteresis loop) [%]. During the previous second gain setting, when the absolute value of the torque command was below the threshold (level-hysteresis) [%] and the P1-15 condition remained in this state, revert 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 previous first gain setting, switch to the second gain. During the previous second gain setting,	valid	valid	valid

Gain switching condition settings				Relevant parameter		
P1-14.1	Condition	Schematic diagram	Remarks	P1-15 Wait Time	P1-16 Grade Threshold	P1-17 Threshold Hysteresis
			when the absolute value of the speed command was below (level-hysteresis) [rpm] and P1-15 remained in this state, return to the first gain setting.			
4	Rate of change of speed command		When the absolute value of the speed command rate change exceeds (level + hysteresis loop) [10 rpm/s] during the previous first gain setting, switch to the second gain. During the previous second gain setting, when the absolute value of the speed command rate change remains below (level-hysteresis) [10 rpm/s] for the duration specified by P1-15, the system returns to the first gain setting.	valid	valid (10rpm/s)	valid (10rpm/s)
5	Speed command high/low speed thresholds [Not supported]		During the previous first gain setting, when the absolute value of the speed command exceeds (level-hysteresis) [rpm], the system switches to the second gain. The gain gradually adjusts until the absolute value of the speed command reaches (level + hysteresis) [rpm], at which point the gain fully transitions to the second setting.	of no avail	valid (rpm)	valid (rpm)

Gain switching condition settings				Relevant parameter		
P1-14.1	Condition	Schematic diagram	Remarks	P1-15 Wait Time	P1-16 Grade Threshold	P1-17 Threshold Hysteresis
			During the previous second gain phase, the absolute value of the speed command was below (level + hysteresis) [rpm], initiating a return to the first gain level. The gain gradually adjusted until the absolute value reached (level-hysteresis) [rpm], at which point the gain fully returned to its initial state.			
6	position bias		Only effective in location mode (other modes are set to gain 1) When the absolute value of the position deviation exceeds (level + hysteresis loop) [encoder units] during the previous first gain setting, switch to the second gain. During the previous second gain setting, when the absolute value of the position deviation is less than (level-hysteresis loop) [encoder unit], and P1-15 remains in this state throughout the entire duration, the system returns to the first gain setting.	valid	valid Encoder unit	valid Encoder unit

Gain switching condition settings				Relevant parameter		
P1-14.1	Condition	Schematic diagram	Remarks	P1-15 Wait Time	P1-16 Grade Threshold	P1-17 Threshold Hysteresis
7	position instruct		Only effective in location mode (other modes are set to gain 1) During the previous first gain setting, if the position command is not 0, switch to the second gain. During the previous second gain operation, if the position command remains in the 0 state throughout the waiting period P1-15, the system returns to the first gain setting.	valid	no avail	no avail
8	fixed position accomplish		Only effective in location mode (other modes are set to gain 1) If positioning is not completed during the previous first gain, switch to the second gain. During the previous second gain operation, if the positioning completion status remains unchanged throughout the waiting period P1-15, the system returns to the first gain phase. [Note] The detection mode must be configured according to P5-01 to complete the positioning.	valid	no avail	no avail

Gain switching condition settings				Relevant parameter		
P1-14.1	Condition	Schematic diagram	Remarks	P1-15 Wait Time	P1-16 Grade Threshold	P1-17 Threshold Hysteresis
9	reality velocity		Only effective in location mode (other modes are set to gain 1): During the previous first gain setting, if the absolute value of the actual speed exceeded (level + hysteresis loop) [rpm], switch to the second gain setting. During the previous second gain setting, when the absolute value of the relative speed remains below the threshold level (-hysteresis range) [rpm] and P1-15 continues to maintain this condition, revert to the first gain setting.	valid	valid (rpm)	valid (rpm)
A	Position command + Actual speed		Only effective in location mode (other modes are set to gain 1): During the previous first gain setting, if the position command is not 0, switch to the second gain. During the previous second gain application, the position command set to 0 maintained the second gain throughout the waiting period P1-15. When the position command is 0 and the waiting time P1-15 has elapsed, if the absolute value of the actual speed	valid	valid (rpm)	valid (rpm)

Gain switching condition settings				Relevant parameter		
P1-14.1	Condition	Schematic diagram	Remarks	P1-15 Wait Time	P1-16 Grade Threshold	P1-17 Threshold Hysteresis
			is less than [level] [rpm], the speed integration time constant is set to the second speed-loop integration time constant (P1-06); otherwise, it returns to the first gain. If the absolute value of the actual speed is less than [level-hysteresis loop] [rpm], the speed integration also returns to the first speed-loop integration time constant (P1-02).			

6.8.5 Speed loop p-pi mode switching

1) Switching between speed control modes

Parameter		Meaning	Factory settings	Revise	Take effect
P1-26	n.□□□0	0: Do not use mode switching 1: Use the internal torque command as the switching condition 2: Use speed commands as the 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 the 0asr points 1: Keep the velocity 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

Parameter	Meaning	Factory settings	Revise	Take effect
P1-30	Mode Switch-Position Deviation Threshold	0	servo bb	immediately

For power levels up to 22P6, the Asr P/PI mode switching is enabled by default (i.e., P1-26.0 = 1), triggered when the P1-27 torque command exceeds 200%.

2) IP Control Selection

Parameter		Meaning	Factory settings	Revise	Take effect
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 corresponds to PI control; when P1-31=100, it corresponds to IP control.

7 Use of Basic Functions

7.1 Absolute Value System

7.1.1 When load fluctuation occurs

The following reasons can cause load shaking:

- The command is not smooth enough when the load inertia is too large.

Countermeasure: ① Apply position-based smoothing filter P1-25;
② Optimize the commands of the upper-level device to reduce command acceleration;
③ Replace with a motor of greater inertia.

- The servo gain is too low, resulting in insufficient rigidity.

Countermeasure: ① Increase the gain parameter to enhance rigidity and improve disturbance resistance.

- The institution lacks sufficient rigidity, and the equipment is shaking.

Countermeasure: ① Reduce the gain parameter;
② Optimize the commands of the upper-level device to reduce command acceleration.

7.1.2 When vibration occurs

The following reasons can cause machine vibration:

- Vibration caused by inappropriate servo gain

Countermeasure: Reduce gain

- Mechanical resonance point

Countermeasure: Analyze mechanical characteristics or manually set the notch parameters

7.1.3 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

Countermeasure: In the rapid adjustment mode, reduce the rigidity level.
In automatic adjustment mode: Reduce model loop gain P2-49

- Noise generated by mechanical resonance

Countermeasure: Refer to section 6.9.2 for vibration occurrence.

7.1.4 Setting up the absolute value system

A battery unit must be installed to store the position data of the absolute encoder.
Install the battery on the battery cell equipped with the encoder cable containing the battery cell (internal).
When not using the encoder cable with a battery unit, set P0-79 to 1 to operate the multi-turn absolute encoder as an incremental encoder.

Parameter	Signal name	Setting	Meaning	Set range
P0-79	Absolute Encoder setting	0	Use an absolute encoder normally and employ battery-powered position memory.	0~2
		1 (Default)	When used as an incremental encoder, it no longer remembers multi-turn positions.	
		2	Designed for absolute value encoders, this configuration ignores multi-turn overflow alarms but enables recording of overflow occurrences and power-off memory retention.	

After replacing the multi-turn motor, the E-222 alarm will be triggered, automatically resetting the count of overflow cycles; otherwise, severe positional deviation may occur, posing a hazard.

7.1.5 Replace the battery

When replacing the battery, ensure the driver remains properly connected to the motor and the control power supply is powered on. Replacing the battery with the driver and motor's control power off will result in loss of data stored in the encoder.

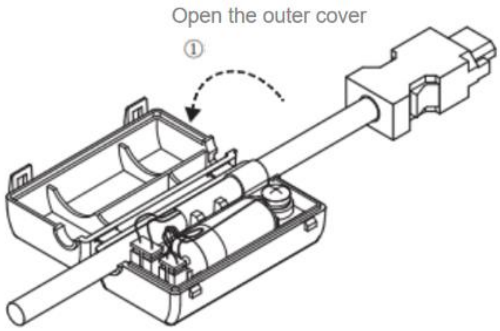
Absolute encoder battery case model (This battery cannot be charged)

- Battery case for standard cable: CP-B-BATT
- Special battery case for tank line: CPT-B-BATT

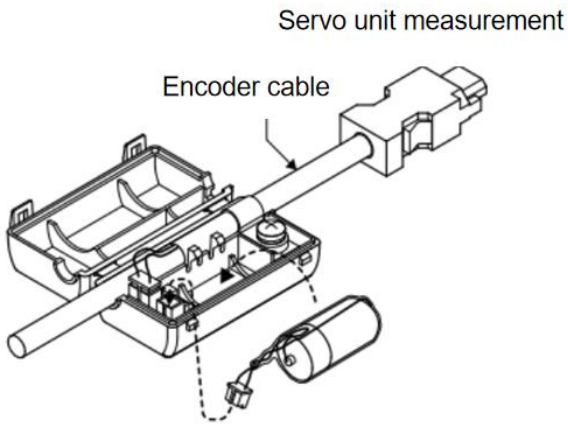
Steps for battery replacement

When using an encoder cable with a battery unit

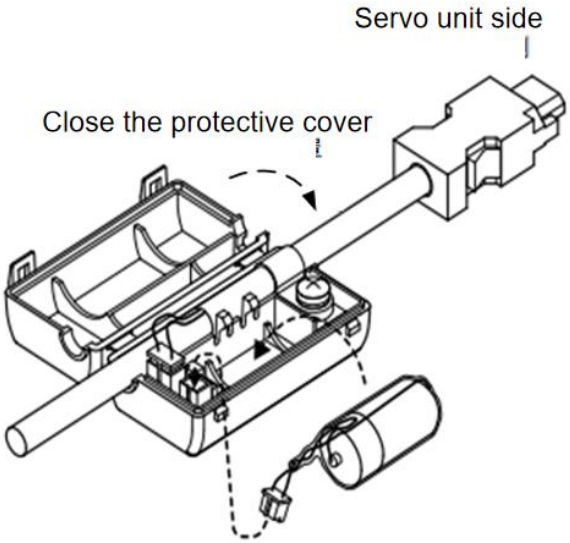
1. Connect only the control power supply to the servo unit;
2. Open the lid of the battery compartment;



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



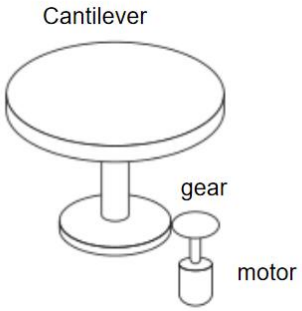
4. Close the box cover of the battery unit;



5. After replacing the battery, clear the alarm (F0-00=1) to eliminate the "Encoder Battery Alert (E-222)" display.
6. Re-power the servo unit;
7. Confirm that the error display disappears and the servo unit operates normally.

7.1.6 Maximum rotation count setting value

The maximum number of rotation cycles can be used for position control of rotating bodies such as turntables.
For example, consider a machine whose rotating table moves only in one direction, as shown below.



Since it can only rotate in one direction, after a certain period of time, the total number of rotations will exceed the maximum count limit of the absolute encoder.

Servo motor series	Resolution ratio (single-loop data)	Serial data with rotation cycles The output range	Operation beyond the time limit
CN	19	-32768~32767	When exceeding the upper limit value of the forward direction (+32767*219): Serial rotation value = 32767 * 219

Servo motor series	Resolution ratio (single-loop data)	Serial data with rotation cycles The output range	Operation beyond the time limit
			When it falls below the lower limit of the reversal direction (-32768*219): Serial rotation value = -32768 * 219

7.1.7 Absolute encoder position calibration

User parameter	Name	Description
F1-06	Set to 1: Absolute encoder clears multi-turn position Set to 3: Absolute encoder zero calibration	
U0-94	Zeroable relative encoder feedback value	
U0-95		
U0-96		
U0-97 (Direction Sign)		0: Encoder zero position in positive direction -1: Encoder zero position in reverse direction

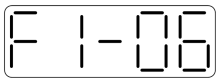
7.1.7.1 Absolute encoder clears multiple turns

The encoder's clearance cycles must be completed in servo BB mode. These cycles can be cleared via the servo panel or SDO communication. Writing 1 to F1-06 sets the current absolute cycle count U0-91 to zero; simultaneously, the multi-cycle counts from position feedback signals U0-57 to U0-60 and U0-94 to U0-97 are also cleared, retaining positions within one cycle.

1) Servo drive panel cleared

The F1-06 allows reading the number of rotations for the absolute encoder position on the panel.
The servo is in BB mode; when parameter F1-06 is entered, the display shows:

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



2) EtherCAT bus communication clearing

In servo BB mode, writing 1 to #0x4106 via EtherCAT bus SDO communication will clear the cycle count.

Write 1 for D0 to clear the circle count.

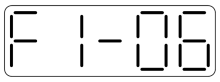
7.1.7.2 Absolute encoder zero point calibration

Absolute encoder zero calibration must be performed in servo BB mode and can only be done via the servo panel. Writing 3 to F1-06 sets the encoder position in the U0-94~97 position feedback signal to 0 (Note: Zero calibration of absolute encoders cannot be performed via SDO communication).

1) Servo drive panel calibration

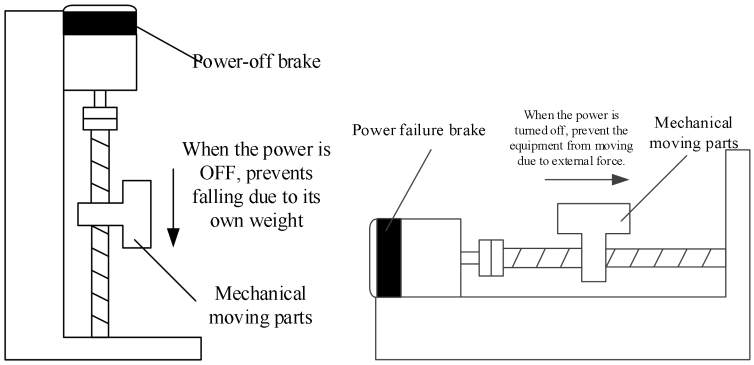
The servo is in BB mode; when parameter F1-06 is entered, the display shows:

Press the [INC] key to reach 3 and hold [ENT] to confirm exit:



7.2 Power-off brake (brake shoe)

When a servo motor controls a vertical load, the purpose of using a "power-loss-brake-equipped servo motor" is to prevent the movable parts from shifting under their own weight or external forces when the system power is switched off.

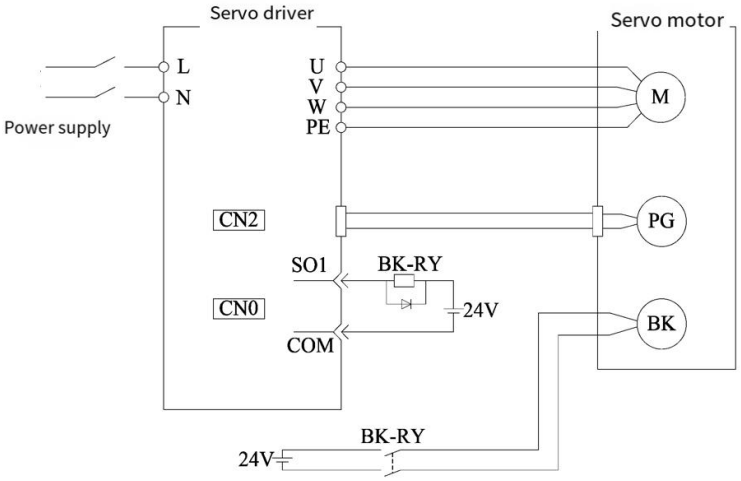


The brake integrated into the servo motor is a fixed, dedicated non-excitation-type brake. It cannot be used for dynamic braking and should only be employed when keeping the servo motor stationary.

- Relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P5-44	Brake Interlock/BK	n.0000	-	n.0000~n.ffff	servo bb	immediately
P5-07	ServoOFF delay time	500	ms	-500~9999	servo bb	immediately
P5-08	Brake command output speed	30	rpm	20 ~ 10000	servo bb	immediately
P5-09	Brake command wait time	500	ms	0 ~ 65535	servo bb	immediately

1) Hardware Connection



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

- The excitation voltage of the power failure brake is 24V.
- If the braking current exceeds 400 mA, use a relay adapter to prevent terminal burnout due to excessive current.

2) Software parameter settings

For servo motors With brakee engagement, configure one SO terminal of the servo driver as the brake output/BK function and specify its valid logic—this requires setting parameter P5-44.

Parameter Setting Status	Servo drive status	Signal/BK terminal output logic	Servo motor status
P5-44=n.000□	servo bb	no avail	The brake power supply has been disconnected, and the motor is in a locked position.
	servo run	valid	The brake power supply is activated, and the motor is in a rotatable position.
P5-44=n.001□	servo run	no avail	The brake power supply has been disconnected, and the motor is in a locked position.
	servo bb	valid	The brake power supply is activated, and the motor is in a rotatable position.

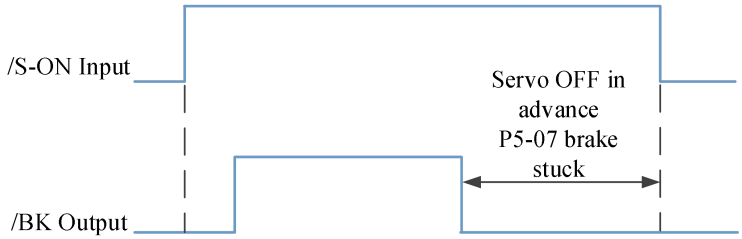
- When the brake signal terminal is used to control the brake, the servo enable ON and brake power are activated, allowing the motor to rotate.
- If the motor fails to rotate during new device debugging, verify whether the brake is released.

3) Timing of servo-driven brake control

(1) Normal brake engagement timing

Due to the delay in brake operation, the mechanism undergoes slight movement under the influence of gravity and other factors. By adjusting the time using parameter P5-07, the brake can be delayed in opening or advanced in closing.

When using a servo motor With brakees, the control signal (/BK) for the brake and the ON/OFF operation timing of the servo SON signal are specified as shown below. Specifically, the servo motor enters the powered-on enabled state before the output/BK signal activates the brake release; it only exits the powered-on state after the output/BK signal locks the brake.



The parameter defined here specifies the duration during which rotation detection TGON is invalid when the motor is stationary.

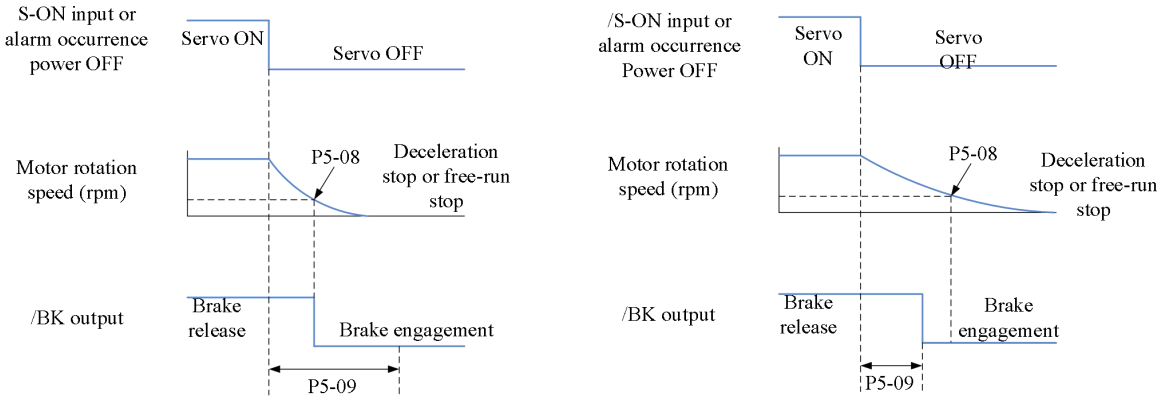
(2) Abnormal brake engagement timing

When an alarm or power outage occurs, the motor rapidly switches to an off-state. During the period when the brake activates due to gravity or inertia, the mechanism may shift. To prevent this, the motor's rotation/BK signal transitions from ON to OFF under the following condition (either condition applies):

① When the servo is turned off and the motor speed falls below the set value of P5-08;

② After the servo is turned off, if the time exceeds the setting value of P5-09.

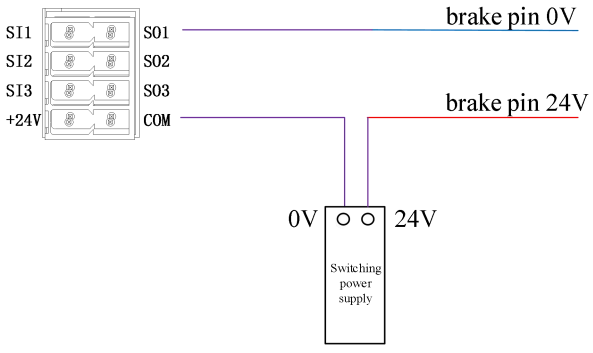
The timeline diagram is as follows:



Since the brake of the servo motor is designed for position holding, it must be activated at the appropriate time when the motor stops. Adjust these user parameters while monitoring the mechanical operation.

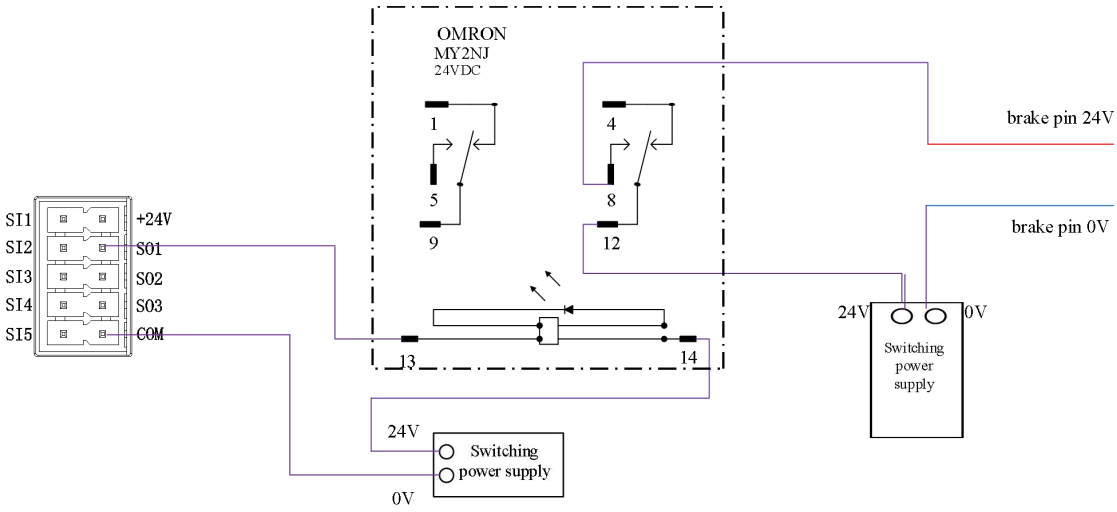
4) Brake connection method

(1) When the drive power is 400 W or lower, it can be directly connected via the SO terminal as shown in the figure below, with parameter P5-44 set to n.0001.



For 400W and lower systems controlling the brake motor via SO, use terminal SO1 for control and set the brake parameter P5-44 to n.0001 to prevent terminal burnout from excessive current or brake failure due to inability to open.

(2) When the drive power reaches 750 W or higher, it must be connected via an intermediate relay as shown in the figure below, with parameter P5-44 set to n.0001.



For motors rated 750W or higher With brakee current exceeding 400mA, a relay adapter must be used to prevent terminal burnout due to excessive current or brake failure caused by inability to open the circuit.

It is recommended that the SO terminal and the intermediate relay not share the same switching power supply.

5) If the brake lever slightly drops after a power outage, the following solution can be applied:

① Appropriately reduce P5-07;
② Set P0-69.2 to 1.

7.3 Parking Method

Servo shutdown is categorized into three methods: Coast to Stop, deceleration shutdown, and dynamic braking (DB) shutdown. The following provides an explanation of these servo shutdown methods.

Stop Method	Coast to Stop	Ramp to Stop	DB stop
Stop Principle	The servo drive is disabled, and the servo motor is not powered; it freely decelerates to zero, with the deceleration time influenced by mechanical inertia and equipment friction.	The servo driver outputs reverse braking torque, causing the motor to decelerate rapidly to zero.	The servo motor operates in short-circuit braking mode.
Stop Characteristics	Advantages: Smooth deceleration with minimal mechanical impact Disadvantages: The deceleration process is relatively slow.	Advantages: Short deceleration time Disadvantages: Presence of mechanical impact	Advantages: Short deceleration time Disadvantages: Presence of mechanical impact

Depending on the specific scenario of servo shutdown, it is categorized into servo OFF shutdown, alarm-induced shutdown, and overtravel shutdown.

The DS5C2 series features dynamic braking (DB) as standard for power outputs ranging from 0.1 to 7.5 kW.

7.3.1 Servo OFF and alarm-induced stop

- Relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-30	stop timeout time	20000	1ms	0 ~ 65535	servo bb	immediately
P0-27	Servo gate enables shutdown mode	0	-	0 ~ 5	servo bb	immediately
P0-29	Alarm stop method	2	-	0 ~ 5	servo bb	immediately

Parameter	Numeric value	Meaning
P0-27	0	Free run stops; after stopping, it remains in free run mode.
	1	Free run stops; after stopping, the DB state is maintained.
	2	The deceleration brake stops; after stopping, the system remains in free-running mode.

	3	Slow down, brake, and stop; maintain the DB state after stopping.
	4	The DB stops and remains in a free-running state after stopping.
	5	The DB stops; its state is maintained after stopping.
P0-29	Enable attribute alarm	
	0	Free run stops; after stopping, it remains in free run mode.
	1	Free run stops; after stopping, the DB state is maintained.
	2/4	The DB stops and remains in a free state after stopping.
	3/5	The DB stops; its state is maintained after stopping.
	Do not enable the attribute alarm	
	0	Free run stops; after stopping, it remains in free run mode.
	1	Free run stops; after stopping, the DB state is maintained.
	2	The deceleration brake stops; after stopping, the system remains in free-running mode.
	3	Slow down, brake, and stop; maintain the DB state after stopping.
	4	The DB stops and remains in a free-running state after stopping.
	5	The DB stops; its state is maintained after stopping.

Explanation ：

1）Servo gate enable shutdown mode (P0-27)

- When P0-27=0, if the servo mode turns off, the motor stops automatically without any alarm.
- When P0-27=1, if the servo mode turns off, the motor will stop freely and maintain the DB state after stopping.
- When P0-27 = 2, if the servo is turned off, the motor will initiate deceleration-based braking until its speed drops below 50 rpm, after which it will stop automatically. Simultaneously, the servo system records the duration of the deceleration phase. If the recorded time exceeds P0-30 while the motor speed has not yet fallen below 50 rpm, alarm E-262 will be triggered.
- When P0-27 = 3, if the servo is turned off, the motor will initiate deceleration-based braking until its speed drops below 50 rpm, after which it transitions to free braking. The servo simultaneously records the duration of the deceleration stop phase. If the recorded time exceeds P0-30 while the motor speed remains above 50 rpm, alarm E-262 is triggered; the system maintains the DB state post-stop.
- When P0-27=4, if the servo mode turns off, the motor DB stops and remains in a free-running state after stopping.
- When P0-27 = 5, if the servo mode turns off, the motor DB stops and maintains its stopped state.

2）Servo alarm parking method (P0-29)

(1) Enable attribute alarm

- When P0-29=0, the motor initiates free parking upon activation of a servo alarm.
- When P0-29=1, if a servo alarm occurs, the motor initiates free parking and remains in DB state after stopping.
- When P0-29=2, if a servo alarm occurs, the motor DB stops and remains in free-running mode after stopping.
- When P0-29=3, if a servo alarm occurs, the motor DB stops and maintains its stopped state thereafter.

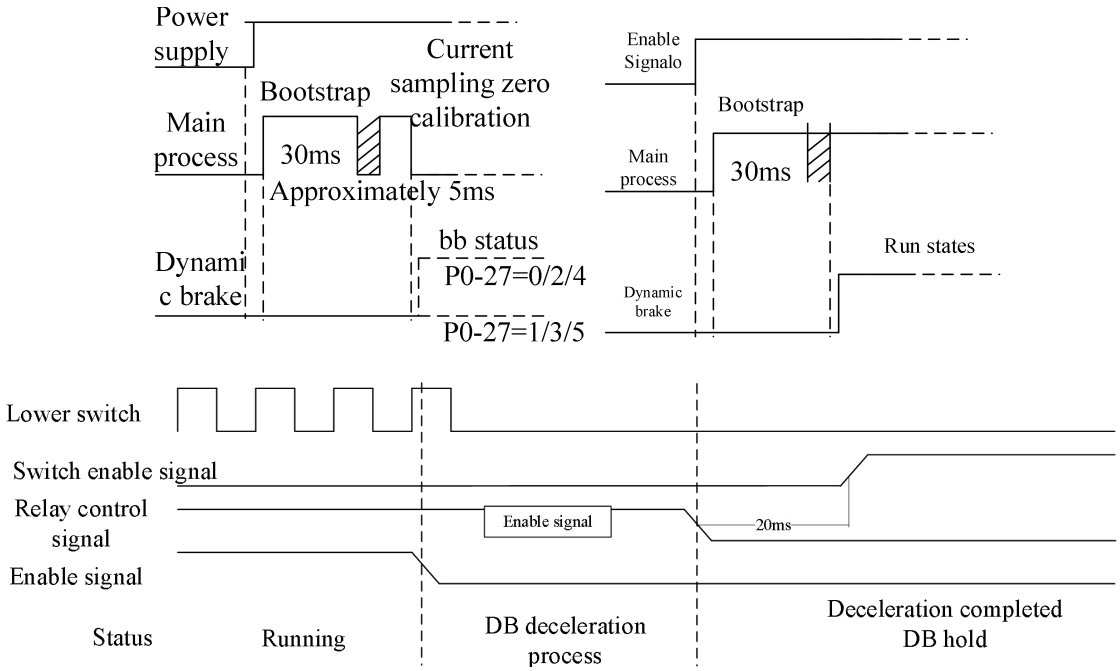
- When P0-29=4, if a servo alarm occurs, the motor DB stops and remains in a free-running state after stopping.
- When P0-29 = 5, if a servo alarm occurs, the motor DB stops and maintains its stopped state thereafter.

(2) Do not enable the attribute alarm

- When P0-29=0, the motor initiates free parking upon activation of a servo alarm.
- When P0-29=1, if a servo alarm occurs, the motor initiates free parking and remains in DB state after stopping.
- When P0-29 equals 2, if a servo alarm occurs, the motor initiates deceleration-based braking until its speed drops below 50 rpm, after which it transitions to free braking. The servo simultaneously tracks the deceleration duration; if this duration exceeds P0-30, the servo proceeds directly to free braking. Since the servo remains in an alarm state during this process, the E-262 alarm will not trigger regardless of P0-29's value. After stopping, the motor continues to operate freely.
- When P0-29 = 3, if a servo alarm occurs, the motor initiates deceleration-based braking until its speed drops below 50 rpm, after which it transitions to free braking. The servo simultaneously records the duration of the deceleration phase. If the recorded time exceeds P0-30 during deceleration, the servo proceeds directly to free braking. Since the servo remains in an alarm state during this process, the E-262 alarm will not be triggered regardless of P0-29's value. After stopping, the system maintains the DB state.
- When P0-29=4, if a servo alarm occurs, the motor DB stops and remains in a free-running state after stopping.
- When P0-29 = 5, if a servo alarm occurs, the motor DB stops and maintains its stopped state thereafter.

3) The servo drive SO terminals are equipped With brakee engagement functionality; the values set for P0-27/P0-29 are invalid, and stop occurs via deceleration mode.

Dynamic Braking (DB) sequence diagram (low level indicates active):



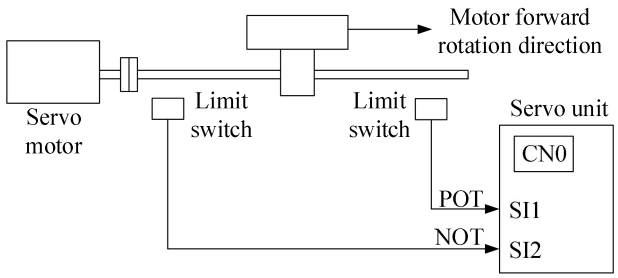
7.3.2 Stop method during over-travel in normal mode

The overtravel prevention function of the servo unit is a safety feature that forces the servo motor to stop upon receiving a signal from the input limit switch when the mechanical moving parts exceed the designed safe movement range.

- Relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-28	Servo Overload stop Mode	2	-	0 ~ 3	servo bb	immediately
P0-30	stop timeout time	20000	1ms	0 ~ 65535	servo bb	immediately
P5-22	Forward rotation is prohibited /P-OT	n.0001	-	0 ~ ff	at any time	immediately
P5-23	Reverse is prohibited /N-OT	n.0002	-	0 ~ ff	at any time	immediately

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



For rotational applications such as conical tables and conveyors, the overtravel prevention function is unnecessary; therefore, no wiring is required for the overtravel prevention input signal.

Parameter setting status	Signal/pot, terminal input status	Overlimit signal (/pot, /not) terminal logic
P5-22/P5-23=n.0000	No external terminal input 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 the reverse limit signal/NOT parameter settings cannot be configured for the same terminal input simultaneously.

Operation direction	Encountering a limit switch	Running state
corotation	Positive limit is valid	Set the servo overtravel stop mode for POT according to P0-28.
	Limit-reversal effective	Call 911 at E-261
reversal	Positive limit is valid	Call 911 at E-261
	Limit-reversal effective	Note: Set the servo overtravel stop mode according to P0-28 for parking.

Parameter	Numeric value	Meaning
P0-28	0	The speed stop 1 is activated; after stopping, the torque in the overtravel direction becomes zero, and the command is accepted.
	1	The system stops automatically; after stopping, the torque in the overtravel direction is zero, and the command is accepted.
	2	The stop 2 mechanism stops; after stopping, no commands are accepted in the overtravel direction.
	3	Call the police (E-260)

- When P0-28=0/2, the motor begins decelerating and stopping upon receiving the over travel stop signal, while the timeout duration during over travel processing also comes into effect.
- During position control, when the motor is stopped using an overtravel signal, positional deviation pulses may occur. To eliminate these positional offset pulses, a clear signal (CLR) must be input. If the servo unit continues to receive these pulses, they will accumulate until the servo unit triggers an alarm.
- During torque control, the servo drive's SO terminal is assigned the brake engagement function and cannot be controlled via the overtravel signal terminals P5-22 or P5-23.
- The servo drive SO terminal is equipped with a brake engagement function, with P0-28 automatically set to 2.

7.3.3 Stop mechanism during bus mode over-travel

Under the bus control modes PP, CSP, PV, CSV, TQ, and CST, depending on the P0-28 settings, the servo unit employs different processing methods upon receiving POT or NOT signals.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-28.0	0: Direct alarm activation using servo-based speed reduction and shutdown method 1: After decelerating and shutting down according to the 605Ah method, an alarm is triggered.	2	-	0~3	○	1|3|4|8|9|10

	2: Do not use overtravel; control is performed by the master station.					

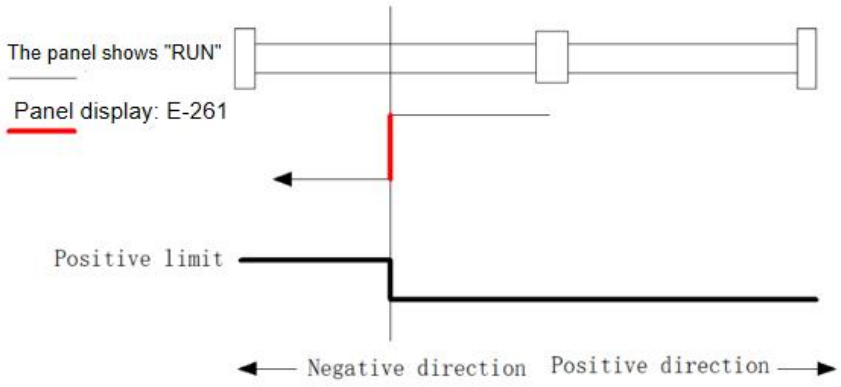
■ The motor is in the disabled state.

- Scenario 1: When the servo is in either enabled (non-moving) or disabled state and touches the reverse limit switch, the panel displays "NOT," cancels the reverse limit signal, and returns to its previous state.
- Scenario 2: When the servo is in either enabled (non-moving) or disabled state and touches the forward limit switch, the panel displays "POT", cancels the forward limit signal, and returns to its previous state.
- Scenario 3: When the servo is either enabled (non-moving) or disabled, and simultaneously triggers both the forward limit switch and the reverse limit switch, the servo will report E-261. If both limit signals are cleared, the panel will return to its previous state; if either limit signal is cleared, the panel will display the other limit signal, and clearing that signal is required for the panel to revert to its original state.

■ The motor is in motion.

1) Accidental contact with the reverse limit switch

Assuming the motor initially moves to the left, if the forward limit switch is accidentally triggered, the servo system will display an E-261 error. If the forward limit switch is first disabled and the alarm is cleared, the shaft returns to its non-enabled state, allowing movement in both directions. However, if the alarm is cleared first and the shaft reverts to the non-enabled state while the POT indicator remains active, the shaft remains restricted by the forward limit switch. In this case, the forward limit signal must be disabled to解除 the forward overtravel restriction.



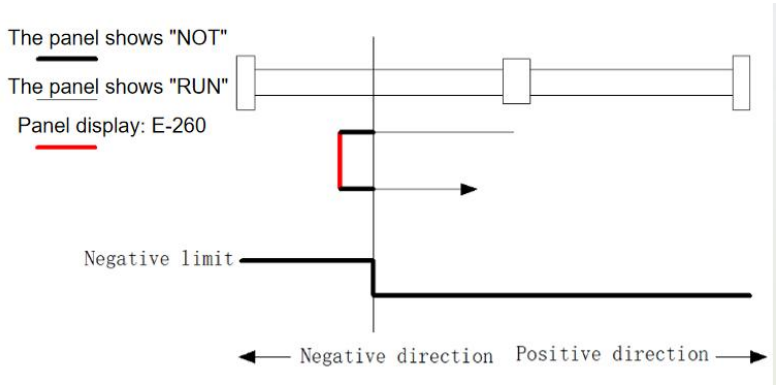
2) Overlimit position state

When P0-28 is set to 1, the servo control reduction stop alarm is triggered.

(1) The initial motion direction is to the left, and no out-of-range signal has been triggered.

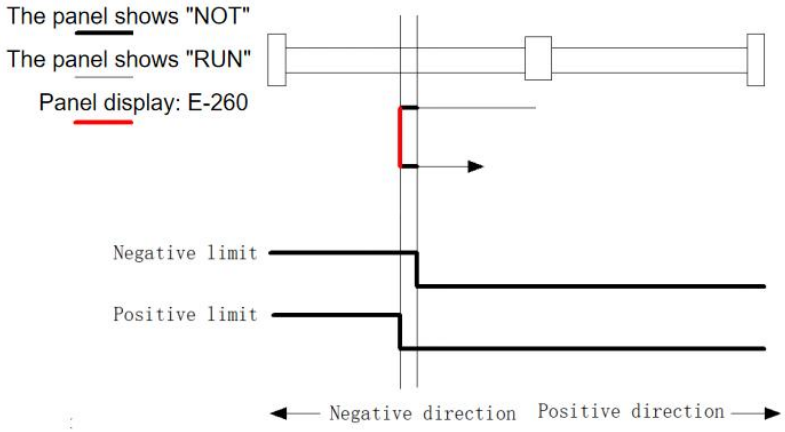
Situation 1: The forward limit switch has not been triggered.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stopping the shaft at the reverse limit switch. The servo will issue an E-260 alarm. The alarm must be cleared before allowing the shaft to move forward; upon contacting the falling edge of the reverse limit switch, the panel will display a change from NOT to RUN, thereby lifting the reverse overtravel restriction.



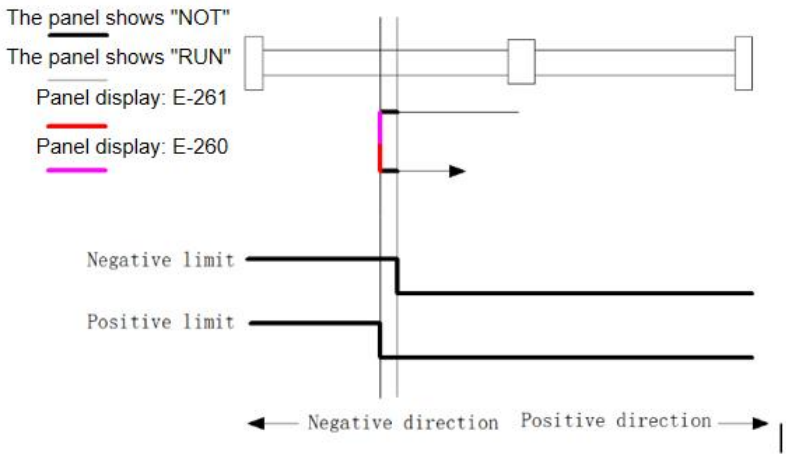
Scenario 2: Before the shaft deceleration stops completely, touch the forward limit switch.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. Before the shaft stops, if the forward limit switch is touched, the servo will issue an E-261 alarm; the forward limit switch must be released to clear this alarm; otherwise, the alarm persists. Subsequently, as the shaft moves forward again and contacts the falling edge of the reverse limit switch, the panel changes from NOT to RUN, thereby lifting the reverse overtravel restriction.



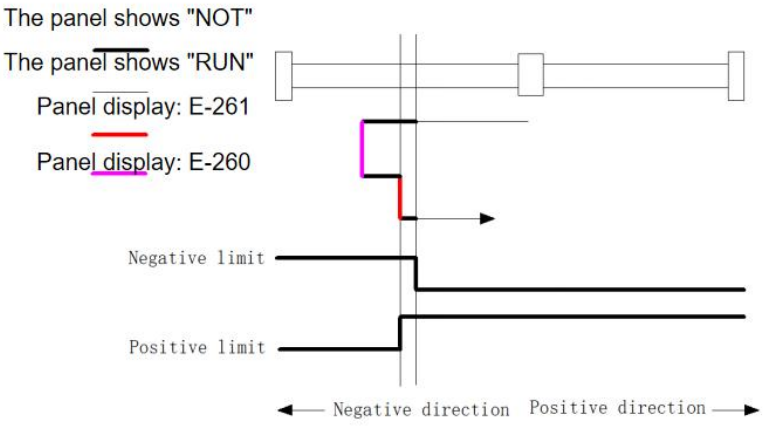
Situation 3: The shaft stops at the negative limit switch and contacts the positive limit switch.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. When the shaft stops at the reverse limit switch, the servo reports E-260; upon contacting the forward limit switch, the servo reports E-261. The forward limit switch must be released to clear the E-261 alarm; otherwise, the alarm remains active. Subsequently, the shaft moves forward and contacts the falling edge of the reverse limit switch, causing the panel display to change from NOT to RUN, thereby lifting the reverse overtravel prohibition.



Scenario 4: During axial forward movement, the device contacts the forward limit switch.

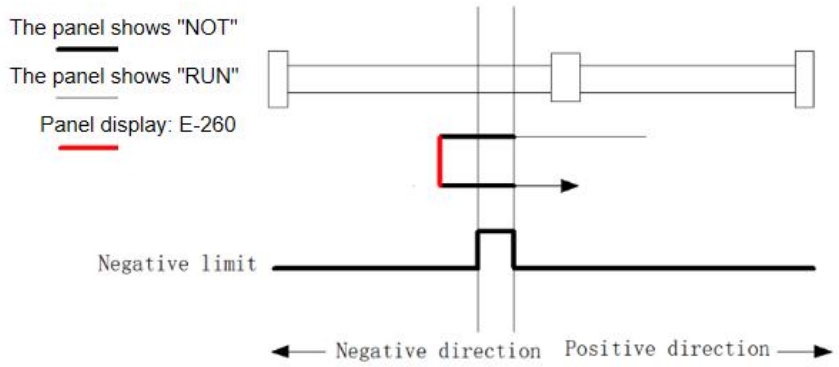
The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. When the shaft stops at the reverse limit switch, the servo reports E-260; after clearing the alarm and allowing the shaft to move forward, it contacts the forward limit switch, prompting the servo to report E-261. The forward limit switch must be released to clear the E-261 alarm; otherwise, the alarm persists. Continuing forward movement causes contact with the falling edge of the reverse limit switch, after which the panel displays a change from NOT to RUN, thereby lifting the reverse overtravel prohibition.



(2) The initial motion direction is to the left, triggering the overshoot signal for overtravel detection.

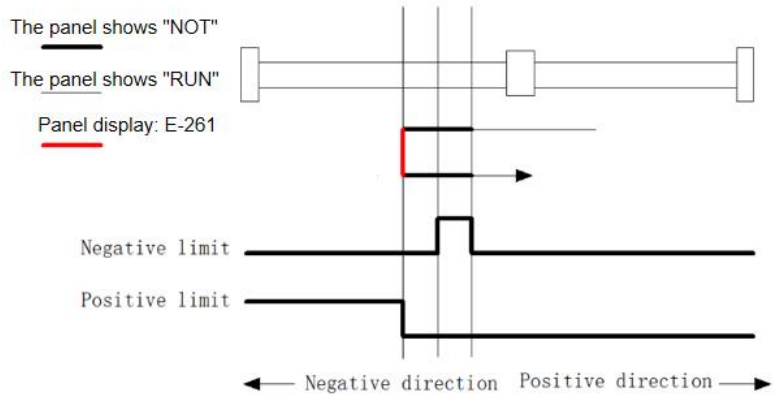
Situation 1: In an offside situation, the forward limit switch has not been triggered.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. However, when the shaft passes beyond the reverse limit switch, its falling edge is detected again, causing the shaft to stop outside the limit position and generating an E-260 alarm from the servo system. The alarm must be cleared for the shaft to resume forward motion; only then will re-contacting both edges of the reverse limit switch trigger a panel display change from NOT back to RUN, thereby lifting the reverse overtravel restriction.



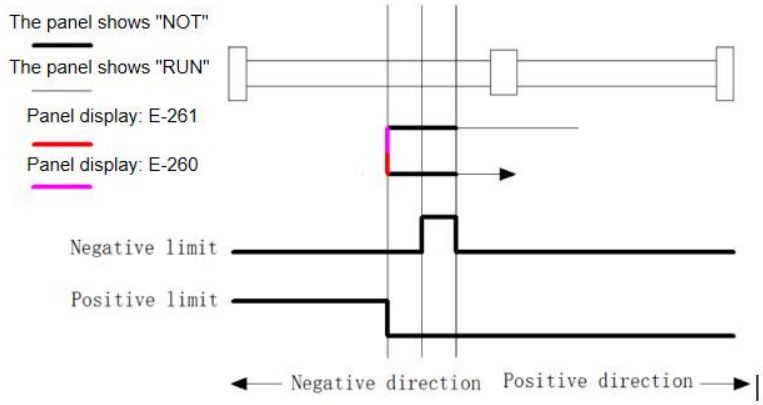
Situation 2: In an offside situation, touch the forward limit switch before the shaft deceleration stop is completed.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering the reverse overtravel deceleration stop. However, since the shaft has already passed through the reverse limit switch, its falling edge is triggered again. Before the shaft stops, it contacts the forward limit switch, causing the servo system to report E-261. To clear this alarm, the forward limit switch must be released; otherwise, the alarm persists. Subsequently, the shaft resumes forward motion and contacts both the rising and falling edges of the reverse limit switch once more. Only then does the panel display change from NOT to RUN, thereby lifting the reverse overtravel prohibition.



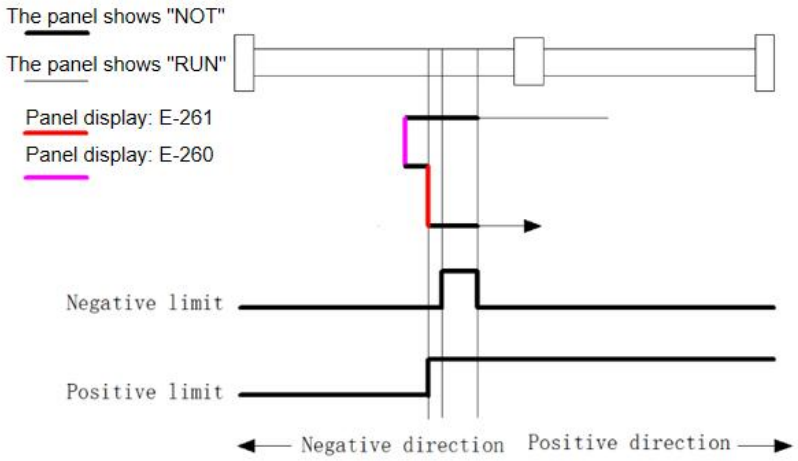
Scenario 3: In an offside situation, upon the shaft stopping, touch the forward limit switch.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering the reverse overtravel deceleration stop. However, when the axis passes beyond the reverse limit switch, its falling edge is triggered again. When the axis stops, the servo reports E-260; at this point, the forward limit switch is contacted, and the servo reports E-261. The forward limit switch must be cleared for the E-261 alarm to be resolved; otherwise, the alarm persists. Subsequently, the axis moves forward again, contacting both the rising and falling edges of the reverse limit switch once more. Only then does the panel display change from NOT to RUN, thereby lifting the reverse overtravel prohibition.



Scenario 4: In an offside situation, during axial forward movement, contact the forward limit switch.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering the reverse overtravel deceleration stop. However, once the shaft passes beyond the reverse limit switch, its falling edge is triggered again. After the shaft stops, the servo reports E-260; clearing this alarm allows the shaft to continue forward motion until it contacts the forward limit switch, at which point the servo reports E-261. The forward limit switch must be cleared for the E-261 alarm to be resolved; otherwise, the alarm persists. Continuing forward movement causes the shaft to contact both the rising and falling edges of the reverse limit switch again, after which the panel changes from NOT to RUN, thereby lifting the reverse overtravel prohibition.



7.4 STO Safe Torque shutdown

7.4.1 STO function overview

STO (Safe Torque Off) function: A safety torque shutdown feature that physically cuts off the motor current via hardware.
The STO safety function terminal (CN5) features a dual-circuit design with two safety signal input channels, STO1 and STO2. Activation of either terminal triggers the STO state, which uses an independent circuit to block the PWM control signal output from the motor current control power module, thereby cutting off the motor current and rendering the motor torque-free.
The primary functions of the safety system or product include the STO function (IEC 61800-5-2), which can request or trigger an STO in the event of a system failure. IEC 61800-5-2 defines STO as a function designed to prevent torque-generated power from supplying electricity to the motor; this function complies with EN 60204-1 stop Category 0. This safety sub-function corresponds to an uncontrolled stop: if the motor is still rotating when the STO function is activated, it will cease rotation due to inertia until complete cessation.

7.4.2 Terminology and abbreviations

Terminology/abbreviations	Description
STO	Safety torque shutdown, compliant with IEC/EN 61800-5-2 safety requirements
SIL	Security and Integrity Level (derived from IEC 61508)
PFH D	Average hourly frequency of hazardous failures
PL	Performance Level (derived from ISO 13849)
Cat.	The categories of the system control safety-related sections are classified as: B, 1, 2, 3, 4
MTTFd	Average Mean Time to Failure (MTTF)
DCavg	Average diagnostic coverage rate (%)
T1	Test and inspection time interval
HFT	Hardware Fault Tolerance
SC	System Capability
MTTR	Average repair time refers to the average total duration required to restore equipment to normal operation after a failure.
MRT	The average repair time refers to the average duration required for technicians to perform physical repairs.
SI	digital input
SO	numeric output
λS	The failure rate of safety faults that cause the system to enter a safe state

λDD	The failure rate of hazardous faults that can be diagnosed by the diagnostic subsystem
λDU	The failure rate of the diagnostic subsystem for detecting hazardous faults that it cannot identify
EDM	External Device Monitoring

7.4.3 Safety standards and specifications

- Safety standards

Security category	Reference standard
Functional Safety	EN 61800-5-2：2017
electromagnetic compatibility EMC	EN IEC 61000-6-4：2019 EN IEC 61000-6-2：2019 EN IEC 61800-3：2023
LVD	EN 61800-5-1：2007/A11:2021

- European Union Directives and Standards

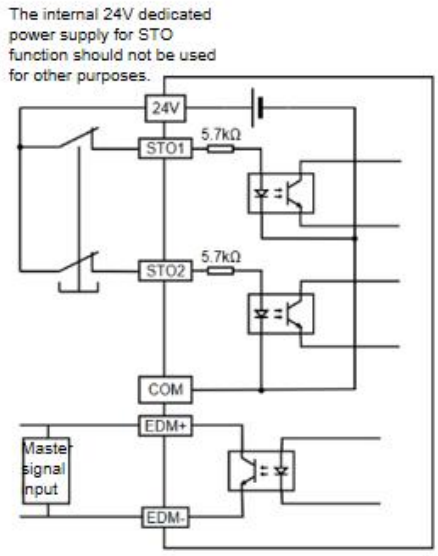
Instruction standard	Reference standard
Low-voltage instruction	EN61800-5-1
Electromagnetic Compatibility Directive	EN 61800-3：2018
Mechanical Instruction	IEC 61800-5-2

- Security parameter

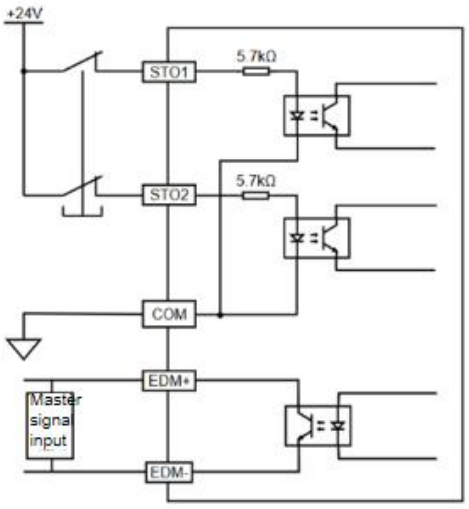
Project	Security parameter
SIL	SIL3，IEC61508 Maximum SIL3, EN IEC62061
PFH D	PFH D ≤1.6x10 -8[1/h] （1.6% of SIL3）
Cat.	3，EN ISO 13849-1
PL	e，EN ISO 13849-1
MTTFd	70.99 years
DCavg	≥90%
T1	20 years

HFT	1
λS	9.4×10-7 /h
λDD	1.59×10-6 /h
λDU	1.61×10-8 /h
MTTR	8h
MRT	8h
Application Mode	High-demand or continuous pattern
Device type	Type B

7.4.4 STO wiring schematic diagram



Internal 24V wiring diagram



External 24V wiring diagram

- Electrical Characteristics of the STO Input Signal

Project	Characteristic	Explanation
voltage range	24V DC（±15%)	-
input currenton	4mA（Typ.)	The input current per STO port under 24V power supply
Logic Level Standard	“L” < 5V，“H” > 15V	L: Low level, H: High level
Digital input impedance	5.7KΩ	-

During wiring, ensure the contact area of the tubular terminal does not exceed 8 mm; install it properly to prevent leakage outside the contact area.

7.4.5 STO operational principle

■ STO detonate by contact

The driver can operate properly only when both STO1 and STO2 terminal input signals are in a valid high-level state. Additionally, during an STO alarm, the current STO status can be determined based on the EDM output signal status, as detailed in the table below:

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	There is output	prohibit

The STO function blocks the PWM signal from reaching the driver's power layer via STO1 and STO2, thereby stoping motor movement. When either or both STO1 and STO2 are set to a low level simultaneously, the PWM signal is interrupted within 30 ms, causing the servo to enter the STO state. At this point:

① PWM control signal is prohibited;

② The servo shall shut down according to the enable/disable shutdown method specified in the P0-29 alarm shutdown procedure;

③ The servo/S-RDY signal output is 0;

④ The panel displays STO.

When both STO1 and STO2 are at low level, the EDM output circuit becomes conductive.

When the STO1 and STO2 statuses are inconsistent and the duration exceeds the P0-88 set time, Alarm E-340: STO statuses are out of sync.

The STO1 and STO2 pins ensure no response to pulses shorter than 1 ms, while ensuring a response to pulses exceeding the value set by P0-89.2~3.

An alarm occurs in the STO state, and the panel displays the alarm information; however, the servo remains in the STO state, with dynamic braking and brake engagement configurations set according to the STO state.

The typical response time for the PWM signal is 30 ms, with a maximum response time of 100 ms.

The EDM signal can detect whether a safety function has been triggered but cannot output a safety signal.

■ STO remove

For the servo to enter the STO safety state, all of the following conditions must be met simultaneously before the safety state can be cleared and normal operation restored:

① Both STO1 and STO2 terminals are at high level;

② Currently in the disabled state;

③ No hazardous faults exist;

After the STO status is lifted, the servo ready output signal/S-RDY is output according to configuration P5-70; dynamic braking is output according to configuration P0-27 or P0-29; and brake engagement is triggered based on the validity of the enable signal/S-ON.

7.4.6 STO-related parameter settings

Parameter	Parameter name	Unit	Scope	Effective time	Function declaration	Give tacit consent to
P0-88	STO Synchronous Detection Configuration	100us	0-1000	immediately	STO Asynchronous Alarm Detection Time	60
P0-89.0~1	STO cushion circuit Abnormal Alarm Detection and Filtering	100us	0-255	immediately	STO cushion circuit Abnormal alarm detection filtering time	32
P0-89.2~3	STO Input Detection and Filtering	100us	10-30	immediately	STO Input Detection and Filtering	12
P0-90.0~1	EDM circuit abnormality alarm	100us	0-255	immediately	EDM circuit abnormality alarm detection and filtering	200

7.4.7 STO function precautions

After the STO function is activated, the motor safely enters a torque-free state, and the servo driver no longer exerts control over it. Therefore, before using the STO function, assess the potential hazards that may persist even after enabling it:

- After enabling the STO function, the servo cannot ensure the motor moves under external forces, such as those acting on a vertical axis.
- The STO function cannot cut off the power supply to the servo unit; the high-voltage section of the driver remains energized, posing continued risks of electric shock or other electrical hazards. When performing maintenance on the servo unit, always disconnect its power supply and related devices.

If the STO function is used to stop an operating servo, the motor will gradually cease operation. If this is unacceptable, the system should employ the correct stop mode instead of using the STO function.

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

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

- Even when the Safe Torque Off (STO) function is activated, a severe hardware failure (e.g., loss of control)—such as the STO logic instructing "CUT control signals and shut down all IGBTs" —may still cause the motor rotor to exhibit an uncontrollable slight rotation. This occurs because the IGBTs themselves are physically damaged by overcurrent or short circuits, rendering them incapable of responding to the logic signal. Such rotation falls under residual risk within the operating range of permanent magnet synchronous motors, which spans from 0° to 180°/2p (where p denotes the number of pole pairs).
- When the STO (Safety Torque Off) function is enabled, perform a periodic STO diagnostic run to verify that the motor has stopped.

7.5 Weak Magnetic Control

7.5.1 Overview of weak magnetic function

For servo-driven permanent magnet synchronous motors, weak magnetic control refers to a control method that operates the motor above its rated speed by reducing the motor's magnetic field, while complying with the inverter's maximum voltage and current limitations. This control technique expands the speed regulation range of permanent magnet synchronous motors.

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

7.5.2 Low magnetic correlation parameter settings

Servo weak magnetic control switch PE-01.3,0 (default): Off – weak magnetic function disabled; 1: On – weak magnetic function enabled.

When enabling the weak magnetic function via servo control, the correct motor parameters—such as back electromotive force coefficient, Ld, and Lq—must be specified. For detailed operating conditions and parameter settings, please consult the original manufacturer's technical support.

Parameter	Parameter name	Unit	Scope	Effective time	Give tacit consent to
PE-01.3	Low-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 for weak magnetic control	%	10-1000	at any time	16
PE-82	Weak magnetic control integrated limit amplifier	%	0-200	at any time	60
PE-83	Voltage Directive 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

8 Basic Mode Usage

8.1 Position control

8.1.1 General Position Mode

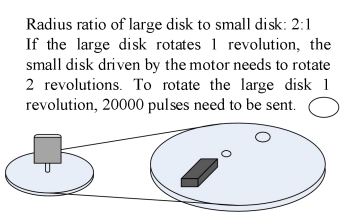
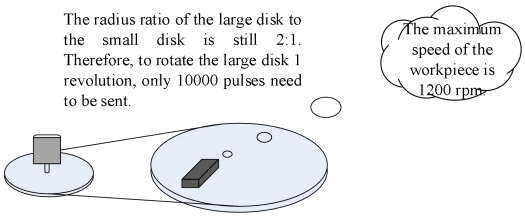
8.1.1.1 Electronic gear ratio

1) Overview

The so-called "electronic gear" function has two primary applications:

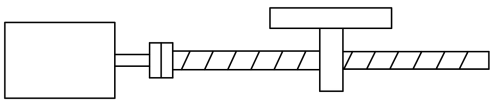
(1) Determine the number of command pulses required for the motor to complete one full rotation, ensuring the motor reaches the desired rotational speed.

The following example uses a 19-bit encoder motor, with the PLC host computer sending pulses at a frequency of 200 kHz:

Set the number of pulses per revolution to 10,000 The electronic gear ratio is set to 524288:10000	Set the number of pulses per revolution to 5000 The electronic gear ratio is set to 524288:5000
	

(2) For precise positioning, specify the physical unit length corresponding to the 1 instruction pulse to facilitate calculations.

As shown in the figure below, if a specified unit pulse corresponds to a workpiece movement of 1 μm, the number of command pulses required for one full rotation of the load axis is 6 mm/1 μm = 6,000 command pulses. With a reduction ratio of 1:1, the pulse count per revolution can be directly set as P0-11 = 6,000 and P0-12 = 0. The host computer then issues 6,000 pulses to move the workpiece by 6 mm (for the specific calculation method, refer to steps 1–6).



Encoder: 524288 (19 bits) Screw pitch: 6 mm

Without changing the electronic gear ratio	Change the electronic gear ratio setting
Without any adjustment, the electronic gear ratio motor rotates one full revolution	By adjusting the electronic gear ratio, the motor requires 6,000 pulses to complete one

generating 524,288 pulses (when P0-11 = 0 and P0-12 = 0). For a motor rotation of one full turn that moves the workpiece by 6 mm, the required number of pulses is 524,288. To move the workpiece by 10 mm, 10/6 × 524,288 = 873,813.333 pulses are needed. However, rounding off the decimal values during pulse transmission introduces measurement errors.	full rotation. For a motor rotation of one full turn that moves the workpiece by 6 mm, the required number of pulses is 6000. To move the workpiece by 10 mm, 10/6 × 6000 = 10000 pulses are needed. Since no decimal fractions are generated during pulse transmission, no errors occur.

- Relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-11	Pulse count per revolution * 1	0	pul	0 ~ 9999	servo OFF	immediately
P0-12	Number of pulses per revolution * 10000	0	pul	0 ~ 9999	servo OFF	immediately
P0-13	Electronic gear ratio (molecular)	1	-	0 ~ 65535	√	immediately
P0-14	Electronic gear ratio (denominator)	1	-	0 ~ 65535	servo OFF	immediately
P0-92	Second set of electronic gear ratios (molecules): low position *1	1	-	1 ~ 9999	○(pattern 5) √(pattern 6)	immediately
P0-93	Second set of electronic gear ratios (molecules): high position * 10000	0	-	0 ~ 65535	○(pattern 5) √(pattern 6)	immediately
P0-94	Second set of electronic gear ratios (denominator) low*1	1	-	1 ~ 9999	servo OFF	immediately
P0-95	Second set of electronic gear ratios (denominator): high position * 10000	0	-	0 ~ 65535	servo OFF	immediately

- P0-11 to P0-14 are parameters related to the electronic gear ratio. P0-11 and P0-12 form one group, while P0-13 and P0-14 form another group. However, the priority of the per-turn pulse count values 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 only become effective 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 take effect.

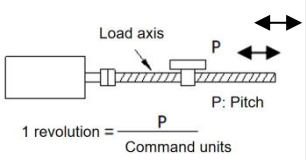
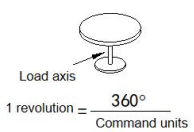
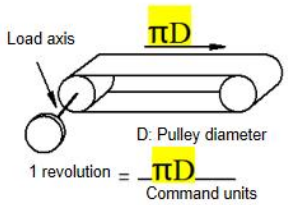
2) Calculation of pulse count per revolution and electronic gear ratio

Step	Content	Explanation
1	Confirm mechanical	Confirm the reduction ratio n:m (where the servo motor

	specifications	rotates m turns while the load shaft rotates n turns), ball screw pitch, pulley diameter, etc.	
2	Confirm encoder pulse count	Confirm the encoder resolution of the servo motor used.	
3	Decision Instruction Unit	Each pulse sent to the decision instruction controller corresponds to the actual operational distance or angle.	
4	Number of instructions required to rotate the load shaft one full revolution	Based on the decision instruction unit, calculate the number of instructions N required for the load shaft to complete one full rotation.	
5	Calculate the pulse count M for one revolution of the computer shaft	The number of command pulses required for the motor shaft to rotate one full revolution is M = N/(m/n).	
6	Set the number of pulses 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: pulses P0-11 to P0-12 (each with a value of 0) have higher priority than the electronic gear ratio; only pulses P0-13 to P0-14 are activated. In special cases where the calculated pulse count per revolution is a decimal value, the electronic gear ratio should be employed.
- When P0-13 and P0-14 exceed the set range, simplify the numerator and denominator of the electronic gear ratio. If the simplified values still fall outside the parameter range, use the second gear ratio set (P0-92–P0-95). The second gear ratio set only becomes effective when P0-11–P0-14 = 0.
- The DS5C2 series servo motor encoders offer resolutions of 524,288 (19-bit) and 8,388,608 (23-bit).
- The instruction unit does not equate to machining accuracy. Refining the instruction unit based on mechanical precision enhances the servo's positioning accuracy. For instance, when using a lead screw with a mechanical precision of 0.01 mm, an instruction unit equivalent to 0.01 mm is more precise than one equivalent to 0.1 mm.

3) Example of Electronic Gear Setting

Step	Name	Ball screw	Cone	Belt + pulley
				
1	Confirm mechanical specifications	Ball screw pitch: 6 mm Mechanical gear ratio: 1:1	1 full rotation angle, 360 degrees	The pulley diameter is 100 mm. Reduction ratio: 1:2

			reduction ratio, 1:3	
2	Confirm encoder pulse count	Encoder resolution: 524288	Encoder resolution: 524288	Encoder resolution: 524288
3	Decision Instruction Unit	1 Instruction unit: 0.001 mm	1 instruction unit: 0.1 degree	1 Instruction unit: 0.02 mm
4	Number of instructions required to rotate the load shaft one full revolution	6mm/0.001mm=6000	360/0.1=3600	314mm/0.02mm=15700
5	Calculate the pulse count M for one revolution of the 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 electronic gear ratio (P0-13/P0-14)/(P0-92~95)	P0-13=524288 P0-14=6000 After division P0-13=32768 P0-14=375	P0-13=524288 P0-14=1200 After division P0-13=32768 P0-14=75	P0-13=524288 P0-14=7850 After division P0-13=262144 P0-14=3925 Convert to the second gear ratio P0-92=2144 P0-93=26 P0-94=3925 P0-95=0

8.1.1.2 Positioning completion signal (/COIN, /COIN_HD)

This signal indicates the completion of servo motor positioning during position control and is used by the command controller to confirm positioning completion.

- Relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P5-00	Positioning completion width	11	Command Unit	0 ~ 65535	at any time	immediately
P5-01	Positioning completion detection mode	0	-	0 ~ 3	at any time	immediately
P5-02	Positioning completion retention time	0	ms	0 ~ 65535	at any time	immediately

Parameter	Signal name	Factory settings	Applicable mode	Meaning	Revise	Take effect
P5-37	/COIN-HD	n.0000	5|6	Complete positioning	at any time	immediately
P5-38	/COIN	n.0001	5|6	Positioning completed	at any time	immediately
For details on hardware wiring, refer to Chapter 3.2.2. If an SO2 output signal is required, set P5-37 and P5-38 to n.0002/0012. Note that each SO terminal can only serve one signal function.						

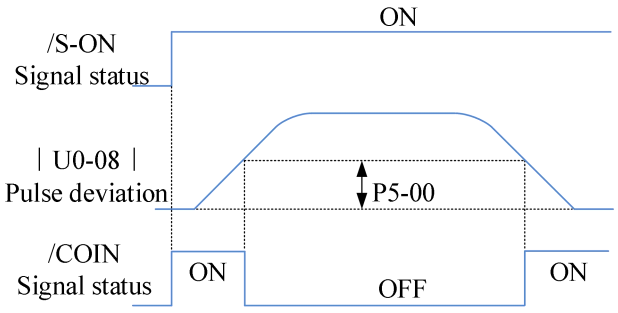
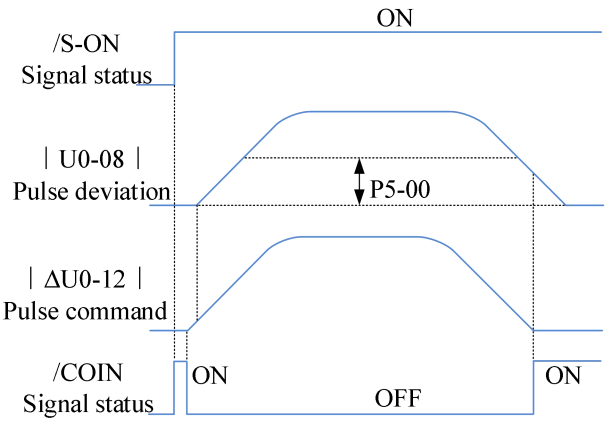
1) Conditions for completing signal output positioning

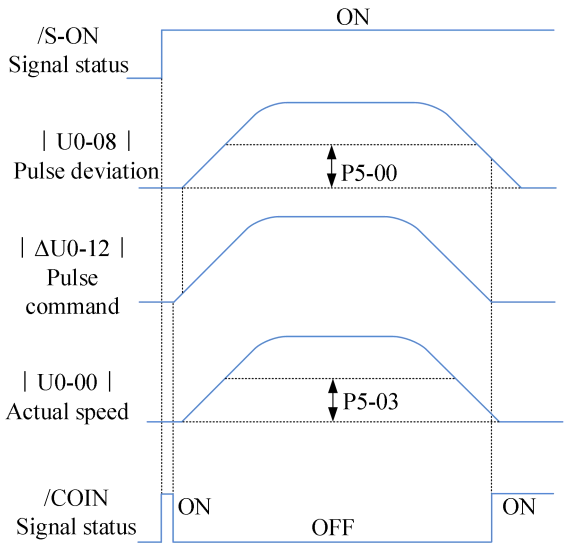
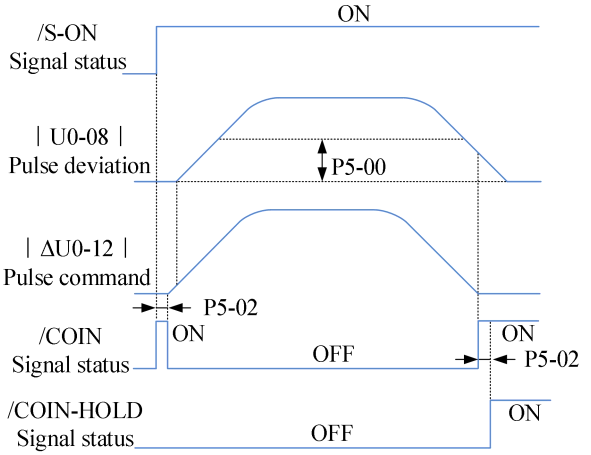
(1)/COIN-HD signal output conditions

The positioning completion hold/COIN-HD signal is only output when the detection mode P5-01 is set to 3 upon completion of positioning. The COIN-HD signal is then output after the /COIN signal remains active for the duration specified by P5-02.

(2)/COIN signal output conditions

According to the positioning completion detection mode configured in P5-01, the positioning completion/COIN signal is output. The following outlines the prerequisites for positioning completion output and its schematic diagram.

P5-01 Settings	Content	Schematic diagram
0	The output COIN signal is generated as long as the absolute value of the deviation remains below P5-00.	
1	After the instruction completes, if the deviation is below P5-00, the COIN signal is output.	

P5-01 Settings	Content	Schematic diagram
2	When the instruction ends and the motor speed is below the rotation detection speed (P5-03), while the absolute deviation value is less than P5-00, the COIN signal is output.	
3	The instruction ends; if the absolute deviation value is below P5-00, the COIN signal is output. If COIN remains active for P5-02 duration, the COIN-HOLD signal is output.	

2) Description of the completed positioning width

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

The table below provides an example:

The time required for a motor to complete one revolution Number of instruction pulses	Positioning completed width P5-00
10000 (default)	11 (Default)
20000	22
5000	6
3000	4
2000	3

The positioning completion width P5-00 varies proportionally with the number of command pulses required for one motor revolution.
The output of the positioning completion signal depends on its width; a smaller width results in a delayed signal output, but this does not affect the motor's actual operating condition.

(2) The positioning completion width can also be set independently; any adjustment to this parameter does not affect the number of command pulses required for one full motor revolution.

8.1.1.3 Locate near signal (/NEAR)

The servo motor is positioned near the positioning completion signal to enable the equipment to prepare for the next action in advance.

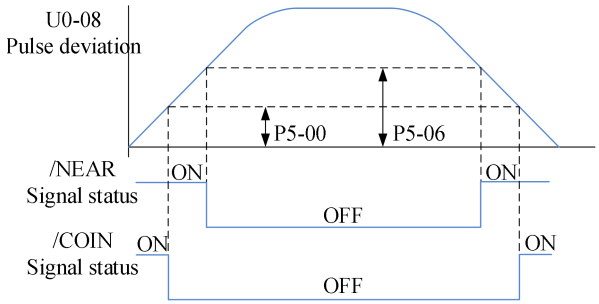
- Relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P5-06	Approach signal output width	50	Command Unit	0 ~ 65535	at any time	immediately

Parameter	Signal name	Factory settings	Applicable mode	Meaning	Revise	Take effect
P5-46	/NEAR	n.0000	5|6	Get Close to Location	at any time	immediately
For details on hardware wiring, refer to Chapter 3.2.2. To locate the proximity from the SO_2 output signal, set P5-46 to n.0002/0012.						

1) Positioning approaches signal output conditions

When the pulse deviation value U0-08 of the servo driver is below the P5-06 set value, the output delivers a near positioning signal (/NEAR).



2) Description of the approach signal output

(1) The approach signal output width P5-06 varies proportionally with changes in the electronic gear ratio, with a factory default value of 50 command units.

The table below provides an example:

The number of command pulses required for a motor to complete one revolution	Approach signal output width P5-06

The signal output width P5-06 varies proportionally with the number of command pulses required for one complete motor revolution.
The output of the positioning completion signal depends on its width; a smaller width results in a

10000 (default)	50 (default)
20000	100
5000	25
3000	15
2000	10

delayed signal output, but this does not affect the motor's actual operating condition.

(2) The approach signal output width can also be set independently; changing it does not affect the number of command pulses required for one full motor revolution.

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

8.1.1.4 Instruction pulse inhibition (/INHIBIT)

Position commands are inhibited, including both internal and external position commands. This function prevents the input of stop command pulses during position control. When the /INHIBIT signal is ON, pulse commands are no longer counted.

- Relevant parameter

Parameter	Signal name	Factory settings	Applicable mode	Meaning	Revise	Take effect
P5-32	/INHIBIT	n.0000	5|6	Instruction Pulse Prohibition	at any time	immediately
The parameter range is n.0000-001A, allocated 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 specifications, refer to Chapter 3.2.1.						

1) Description of INHIBIT terminal validity

Parameter setting status	Signal/INHIBIT terminal input status	Signal/iNHIB T terminal logic
P5-32=n.0000	No external terminal input 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 the INHIBIT terminal signal on the motor operating status

Control model	Motor operating status	
	/INHIBIT terminal logic is valid	Invalid INHIBIT terminal logic
5-Internal Position Control	Pause the current section	The INHIBIT signal changes from ON to OFF, and the process resumes from the pause point.
6-External Position Pulse Control	Pause pulse command reception	The INHIBIT signal transitions from ON to OFF; subsequent pulse commands received after the OFF state continue operation.

8.1.1.5 Deviation Clearing (/CLR)

Position deviation = (position command-position feedback) (encoder unit)

The position deviation cancellation function enables the driver to reset the position deviation to zero when the servo is turned off or a /CLR signal is received.

- Relevant parameter

Parameter	Signal name	Factory settings	Applicable mode	Meaning	Revise	Take effect
P5-34	/CLR	n.0000	All	Pulse Deviation Elimination	at any time	immediately
The parameter range is n.0000-001A, allocated to other input terminals via parameter P5-34. To eliminate signal deviation from SI2, set P5-34 to n.0002/0012. For detailed hardware wiring specifications, refer to Chapter 3.2.1.						

1) /CLR Signal Validity

Parameter Setting Status	Signal/CLR terminal input status	Signal/CLR Terminal Logic
P5-34=n.0000	No external terminal input 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

Send a pulse to the servo and apply the CLR input signal. The servo will latch the current pulse count, update the encoder's current position to the control position feedback, and simultaneously clear all intermediate values in the position loop, speed loop, and current loop.
The /CLR signal uses edge triggering.

3) Additional remarks regarding the pulse position deviation elimination signal

Setting F0-02 to 1 also eliminates pulse position deviation.

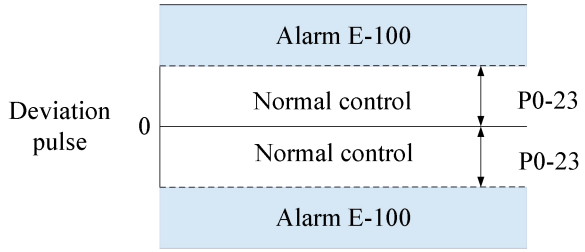
Position Pulse Deviation Setting

The pulse deviation value refers to the difference between the command pulse of the instruction controller (e.g., PLC) and the servo unit's feedback pulse in position mode, measured in 1 command unit, which is determined by the electronic gear ratio.
During position control, an alarm will be triggered when the deviation pulse exceeds a specified threshold value, which is known as the deviation pulse limit.

- relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-23	Pulse deviation limit	2000	0.01 circle	0 ~ 65535	at any time	immediately

When the deviation pulse threshold is 0, the magnitude of the deviation pulse will not be detected.

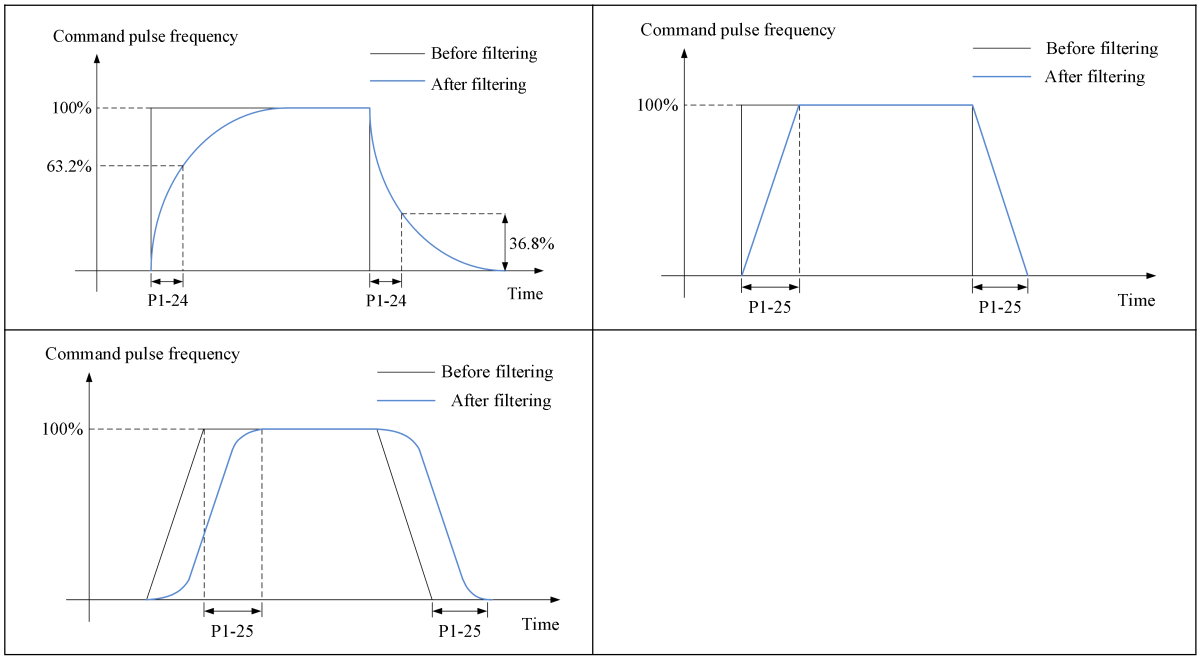


8.1.1.6 Position Directive Filter

- Relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P1-24	Position command acceleration/deceleration filtering time	0	0.1ms	0 ~ 65535	immediately	The servo has not moved.
P1-25	Position command smoothing filter time	0	0.1ms	0 ~ 65535	immediately	The servo has not moved.

Position instruction for acceleration/deceleration filtering	Position Command Smooth Filter



8.1.1.7 Reference Origin

1) Find the reference origin

This function determines the physical zero point of the workbench, serving as the coordinate origin for position control. Users can select either the forward rotation side or the reverse rotation side to identify the reference origin.

2) Functional Settings

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P4-00 n.xx(x	Origin Function	0	-	0 ~ 1	servo OFF	immediately
Note: This feature is applicable to Location Modes 5 and 6. When this parameter is set to 0, the origin-seeking function is disabled; it becomes available only when set to n.001x (set P9-21=0).						

3) Signal Settings

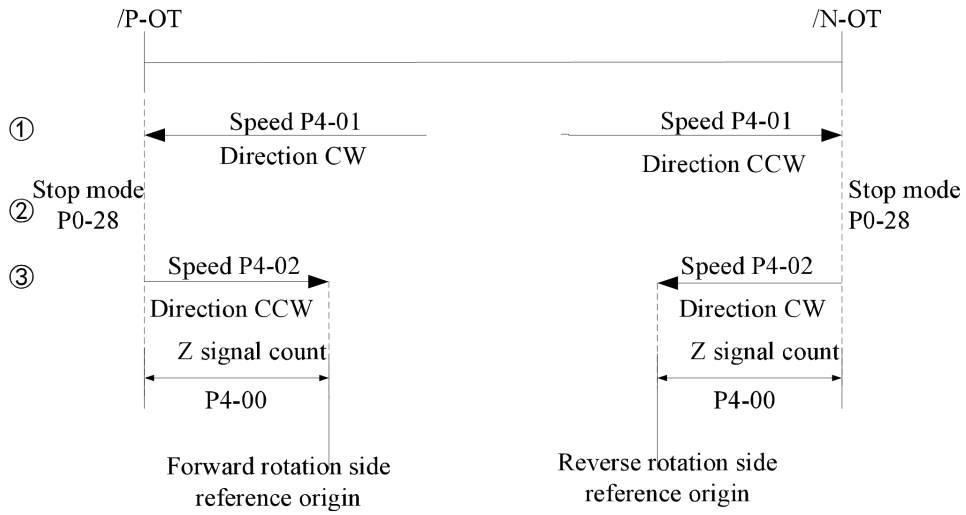
Parameter	Signal name	Factory settings	Meaning	Revise
P5-28	/SPD-A	n.0000	Mode 3: Internal speed selection signal Mode 5: Forward direction to find the origin	The parameter range is 0000–0014, allocated to the input interface via parameters P5–28. When set to 0001, it indicates signal input from terminal SI1.

Parameter	Signal name	Factory settings	Meaning	Revise
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, allocated to the input interface via parameters P5–29. When set to 0001, it indicates signal input from terminal SI1.

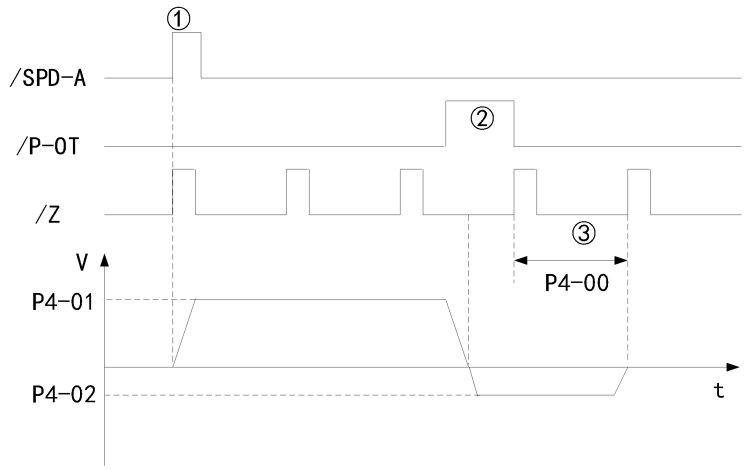
4) Relevant parameter settings

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P4-00 n.xxx□	Z Number of positive signs	2	Individual	0 ~ f	servo OFF	Immediately
P4-01	Speed of collision with the proximity switch	600	rpm	0 ~ 65535	servo OFF	Immediately
P4-02	Reduce the approach switch speed	100	rpm	0 ~ 65535	servo OFF	Immediately
Note: The origin-seeking function is only available for single-turn absolute value motors (multi-turn absolute value motors with P0-79=1 also support this function).						

5) Find the reference origin schematic diagram



The sequence for locating the reference origin for forward rotation is shown below:



The steps are as follows:
(1) Install a limit switch on the forward or reverse rotation side. During the rising edge of the /SPD-A signal, the motor rotates in the forward direction at the speed specified by parameter P4-01 to locate the reference origin for forward rotation.
(2) When the workbench strikes the limit switch, the motor stops according to the P-OT and N-OT stop modes specified in parameter P0-28.
(3) Continue rotating in the direction opposite to the limit switch at the speed specified by parameter P4-02. When the motor reaches the n-th position of the Z-axis signal from the photoelectric encoder, use that position as the coordinate origin, where n is determined by parameter P4-00.

8.1.1.8 New Origin Function

1) Function Description

The return-to-origin function refers to the process where, in position control mode with the servo enabled (set to ON), activating this function causes the servo motor to locate the origin and complete positioning. The identified origin serves as the reference point for subsequent position control operations.
During the return-to-origin operation, all other position commands (including the re-triggered return-to-origin signal) are masked. Upon completion of the return-to-origin, the servo driver becomes responsive to other position commands.
Upon completion of returning to the origin, the servo driver outputs a completion signal. Upon receiving this signal, the host computer can confirm that the return to origin has been completed.

2) Parameter Settings

Parameter	Name	Set range	Meaning	Set time	Entry-into-force time	Default 出厂 setting
P9-11.0	Number of Z phases	0~F	P9-11.0=0: Do not find Z-phase P9-11.0=1: Find one Z-phase P9-11.0=2: Find 2 Z phases	servo OFF	servo ON	0

Parameter	Name	Set range	Meaning	Set time	Entry-into-force time	Default 出厂 setting
			and so on			
P9-11.1	Return to Origin Trigger Method	0~2	P9-11.1=0: Prohibited from returning to the origin P9-11.1=1: Trigger the return to origin via the SI terminal (P5-28) P9-11.1=2: After initial enable upon power-on, immediately return to the starting point	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: Origin Return Mode 2 and so on	servo OFF	servo ON	0
P9-11.3	The deceleration method when encountering an out-of-range signal	0、1	P9-11.3=0: Decelerate according to the acceleration and deceleration times specified in P9-14 P9-11.3=1: Reduce speed immediately	servo OFF	servo ON	0

The P9-11.0 model supports up to 15 Z-phase settings. When P9-11.1=0, the origin return function is disabled; this parameter serves as the enable bit for the origin return function. Origin return modes 1, 3, 5, and 7 correspond respectively to the opposite states of modes 0, 2, 4, and 6.

Parameter	Name	Set range	Unit	Meaning	Setting Time	Take effect Time	Leave the factory Give tacit consent to
P9-12	Return to the original point at high speed	0~3000	rpm	Return to the origin at high speed, identify the deceleration point, and execute the mechanical offset.	servo OFF	servo ON	200

Parameter	Name	Set range	Unit	Meaning	Setting Time	Take effect Time	Leave the factory Give tacit consent to
P9-13	Return to the origin at low speed	0~1000	rpm	Return to the origin at a low speed and locate the origin. The low speed should be sufficiently low to avoid mechanical impact upon stopping.	servo OFF	servo ON	20
P9-14	Time to accelerate and decelerate back to the origin	0~1000	ms	The acceleration and deceleration time here refers to the duration required to reach 1000 rpm from 0 rpm.	servo OFF	servo ON	1000
P9-15	Maximum allowed time to return to the origin	0~12000	10ms	An alarm will be triggered if the total time required for the return-to-origin process exceeds the parameter-set time limit. When P9-15=0, a timeout alarm for the return-to-origin process is issued.	servo OFF	servo ON	0
P9-16	stop-and-return to origin speed threshold	0~1000	rpm	This parameter applies only to origin return modes 6 and 7.	servo OFF	servo ON	2
P9-17	stop-pause type return-to-origin torque threshold	0~300%	%	This parameter applies only to origin return modes 6 and 7. The base value for the percentage is the rated torque.	servo OFF	servo ON	100%
P9-18	stop-pause origin return time threshold	10~1500	ms	This parameter applies only to origin return modes 6 and 7.	servo OFF	servo ON	500
P9-19	Low-order bit of quantum pulse count	-9999~9999	-	Low-order bit of quantum pulse count	servo OFF	servo ON	0
P9-20	High bit of quantitative pulse count	-9999~9999	-	High bit of quantitative pulse count	servo OFF	servo ON	0

Parameter	Name	Set range	Unit	Meaning	Setting Time	Take effect Time	Leave the factory Give tacit consent to
P9-21	New/Old Return to Origin Function Selection	0、1	-	P9-21=0: Return to origin function P9-21=1: Return to origin function	servo OFF	again power on	0
P9-22	End of filtering time for the new origin point	50~10000	ms	When returning to the origin is about to complete, this filtering time is required to wait until the motor has fully stopped before completely exiting the return-to-origin mode. Only after this filtering time will the return-to-origin completion signal be output.	servo OFF	servo ON	500

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

Parameter	Name	Setting Scope	Meaning	Setting Time	Take effect Time	Leave the factory Give tacit consent to
P5-22	Positive overtravel signal POT	0~ffff	Forward limit signal in origin return mode	move setting	immediately Take effect	1
P5-23	Reverse overtravel signal NOT	0~ffff	Reverse limit signal in origin return mode	move setting	immediately Take effect	2

Parameter	Name	Setting Scope	Meaning	Setting Time	Take effect Time	Leave the factory Give tacit consent to
P5-54	Return to the origin to complete the signal	0~ffff	When the return-to-origin action and state are fully completed, a return-to-origin completion signal is issued. Even if another mode is executed after completing the return-to-origin, this signal does not disappear. When the return-to-origin process is restarted, the signal disappears.	move setting	immediately Take effect	0
P5-64	Origin switch signal	0~ffff	The process of returning to the origin requires an origin switch signal.	move setting	immediately Take effect	0
P5-28	The SI terminal initiates a forward return to the origin.	0~ffff	When P9-11.1 equals 1, after assigning terminals to P5-28, the terminals can be used to trigger the forward return to the origin.	move setting	immediately Take effect	0

3) New Return to Origin Mode Selection

Using the new origin restoration function: First set P9-21 to 1, then configure the overtravel switch (POT/NOT) and the origin switch. If using mechanical offset (with P9-19 and P9-20 set), adjust the offset within the travel range to prevent damage to the machinery during origin restoration.
The Z-phase count (P9-11.0) and mechanical offset (P9-19, P9-20) can operate simultaneously. If both the Z-phase count (P9-11.0) and the mechanical offsets (P9-19, P9-20) are non-zero, the servo first determines the Z-phase count (P9-11.0) before executing the mechanical offsets (P9-19, P9-20). If the Z-phase count (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 determining the Z-phase. If the Z-phase count is non-zero but the mechanical offsets are zero, the servo determines the Z-phase (P9-11.0) without executing the mechanical offsets.
There are a total of 8 origin return modes, as follows:
(1) Positive zero return: The deceleration point is the origin switch, where the origin refers to either the origin switch or the motor Z signal (P9-11.2=0).
(2) Reverse zero return: The deceleration point is the origin switch, where the origin refers to either the origin switch or the motor Z signal (P9-11.2=1).
(3) Positive zero return: The deceleration point and origin are defined by the motor's Z-axis signal (P9-11.2=2)
(4) Reverse zero return: The deceleration point and origin are defined by the motor's Z-axis signal

(P9-11.2=3)

(5) Positive return to zero: The deceleration point is the forward overtravel switch, and the origin is either the forward overtravel switch or the motor Z signal (P9-11.2=4).

(6) Reverse zero return: The deceleration point is the reverse overtravel switch, and the origin is either 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 either the mechanical limit position or the motor Z signal (P9-11.2=6).

(8) Reverse zero return: The deceleration point is the mechanical limit position; the origin is either the mechanical limit position or the motor Z signal (P9-11.2=7).

Below is a detailed analysis of each origin-return pattern:

(1) Origin Return Mode 0 – Forward return to zero, with the deceleration point being the origin switch; the origin is either the origin switch or the motor Z signal (P9-11.2=0).

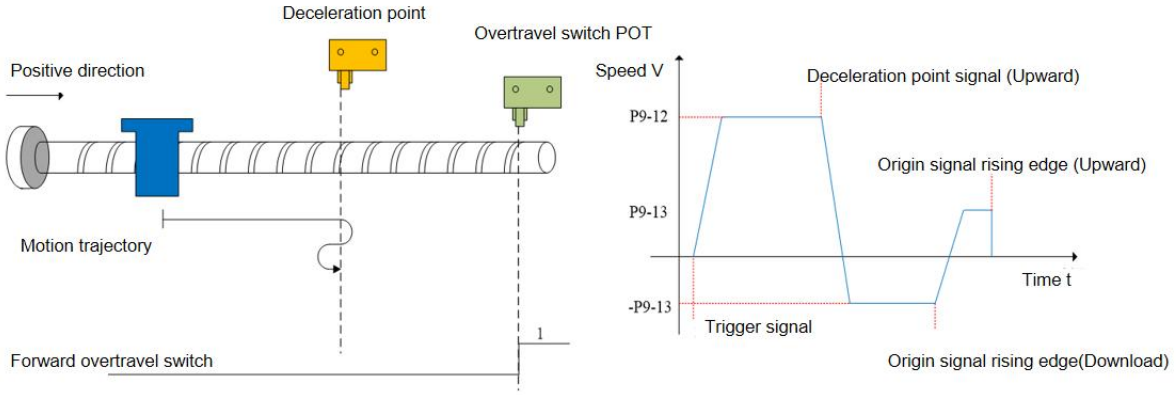
To use this mode, you need to connect the POT, NOT, and origin switches.

1) When the motor starts moving, 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 untriggered throughout the process.

The servo motor first searches for the deceleration point (origin) signal in high speed and forward direction using the P9-12 setting (return-to-origin high-speed speed), until it detects the rising edge of the deceleration point (origin) signal. It then gradually decelerates according to the P9-14 setting (return-to-origin acceleration-deceleration time) until reaching the-P9-13 setting (return-to-origin low-speed speed). Subsequently, the servo motor searches for the deceleration point (origin) signal in reverse direction at low speed using the P9-13 setting; upon detecting the falling edge of the deceleration point (origin) signal, it reverses its movement and continues searching for the rising edge of the deceleration point (origin) signal at low speed using the P9-13 setting. The subsequent return-to-origin operation involves four distinct scenarios:

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

While continuing the low-speed search for the deceleration point (origin) using the P9-13 signal (low-speed speed returning to origin), the system shall immediately cease operation upon detecting the rising edge of the deceleration point (origin) signal.

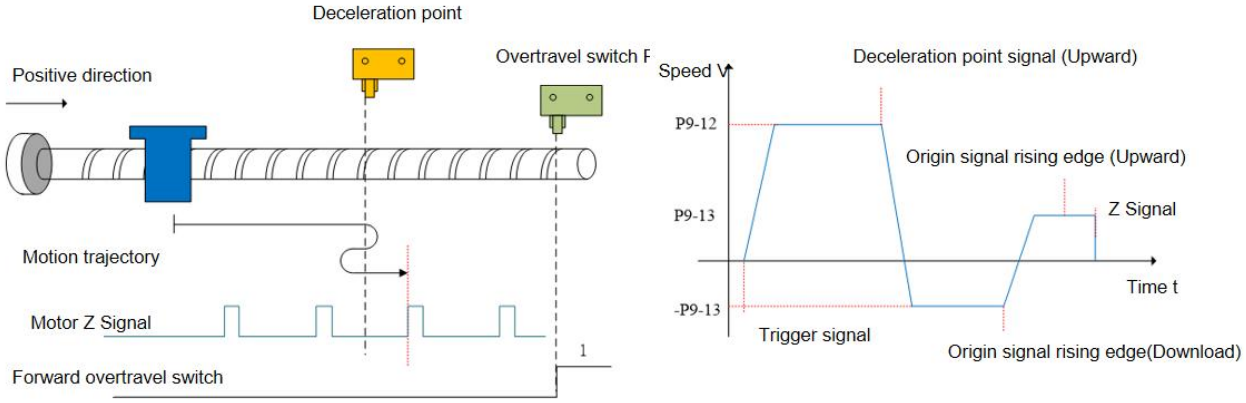


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

During the low-speed search for the deceleration point (origin) signal using P9-13 (return-to-origin low-speed mode), the system immediately stops upon detecting the signal's rising edge. After the motor has completely ceased rotation, it advances a predetermined number of pulses (P9-19 and P9-20) at the speed set by P9-13 (return-to-origin low-speed mode), following the specified mechanical offset direction (positive or negative), before finally stopping the motor.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

Continue the low-speed search for the deceleration point (origin) using P9-13 (low-speed speed returning to origin). While processing the rising edge of the deceleration point (origin) signal, proceed as usual until encountering it; then immediately stop upon detecting the first Z signal.



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

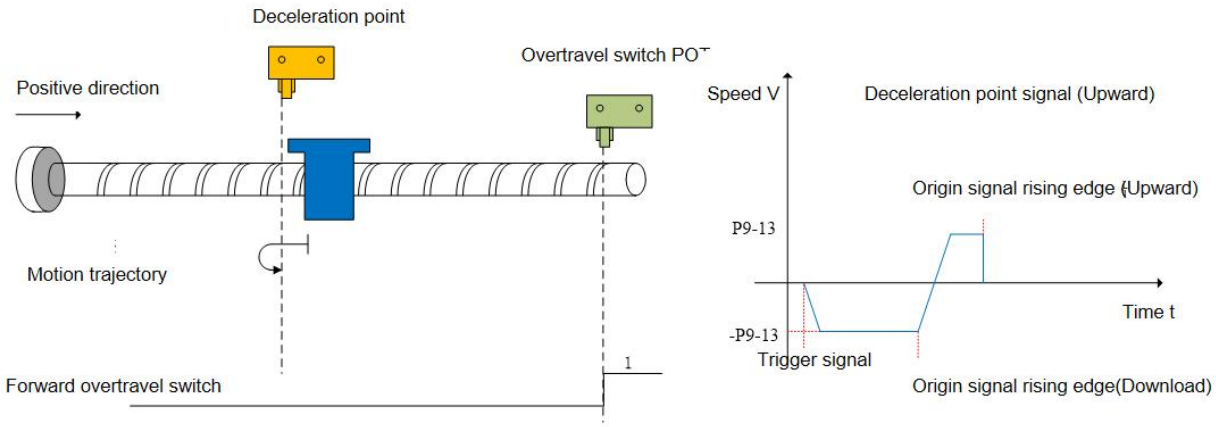
While continuing the low-speed search for the deceleration point (origin) signal's rising edge using P9-13 (return-to-origin low-speed speed), the system proceeds after detecting the signal's rising edge. Upon identifying the first Z-axis signal, the machine stops immediately. After the motor has completely ceased operation, it advances a predetermined number of pulses (P9-19, P9-20) at the speed set by P9-13 (return-to-origin low-speed speed) in the specified direction (positive or negative), then stops.

2) When the motor begins movement, the origin switch (reduction point) signal is valid (signal terminal assigned by P5-64:0 = invalid, 1 = valid), and the forward overtravel switch (P5-22) remains untriggered throughout the process.

The servo motor directly detects the falling edge of the signal indicating the deceleration point (origin) by setting the value to P9-13 (return-to-origin low-speed speed) and performing a low-speed reverse search. Upon detecting this falling edge, it reverses direction (i.e., moves forward) and continues the low-speed search for the rising edge of the deceleration point (origin) signal using P9-13. The subsequent return-to-origin operation proceeds in four distinct scenarios:

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

During forward acceleration or uniform forward motion, the machine shall immediately cease operation upon encountering the rising edge of the deceleration signal (origin point).

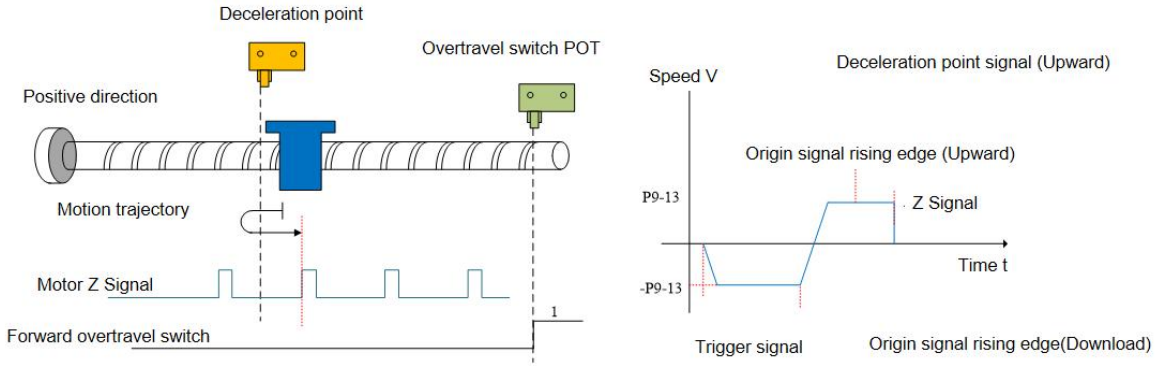


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

During forward acceleration or uniform forward motion, the machine stops immediately upon encountering the rising edge of the origin signal. After complete motor cessation, the motor advances a predetermined number of pulses (P9-19 and P9-20) at the speed set by P9-13 (low-speed return-to-origin speed), following the specified mechanical offset pulse count and direction (positive or negative), before final shutdown.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

During forward acceleration or uniform forward motion, continue operation after encountering the rising edge of the origin signal, then stop immediately upon detecting the first Z signal.



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

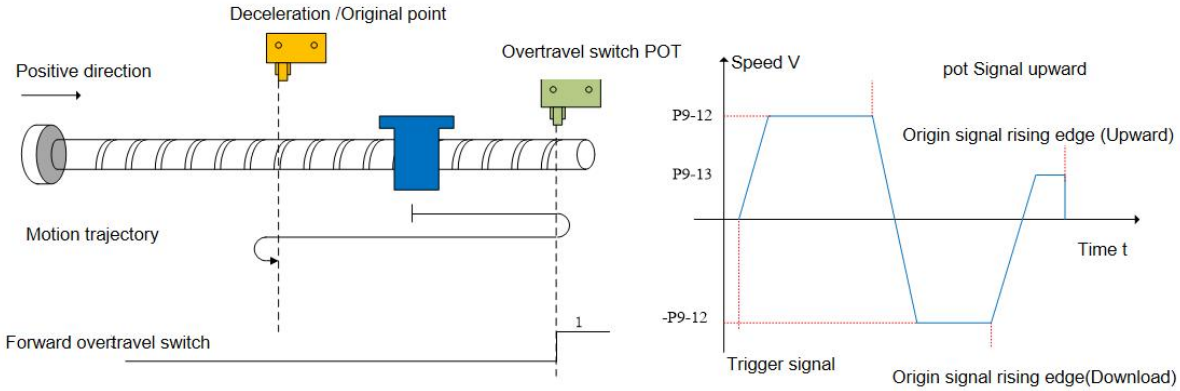
During forward acceleration or uniform forward motion, continue operation after encountering the rising edge of the origin signal, then stop immediately upon detecting the first Z-axis signal. Once the motor has completely ceased, it proceeds at the speed specified in P9-13 (low-speed return-to-origin speed) for a predetermined number of pulses (P9-19, P9-20) and direction (positive or negative), before stopping completely.

3) When the motor starts moving, the origin switch (reduction point) signal is invalid (signal terminal assigned by P5-64:0 = invalid, 1 = valid); during this process, 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 (return-to-origin high-speed speed) setting value. Upon detecting the forward limit 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 value set in P9-14 (return-to-origin acceleration/deceleration time). 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 setting value. The servo motor then performs a forward 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 proceeds under four distinct scenarios:

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



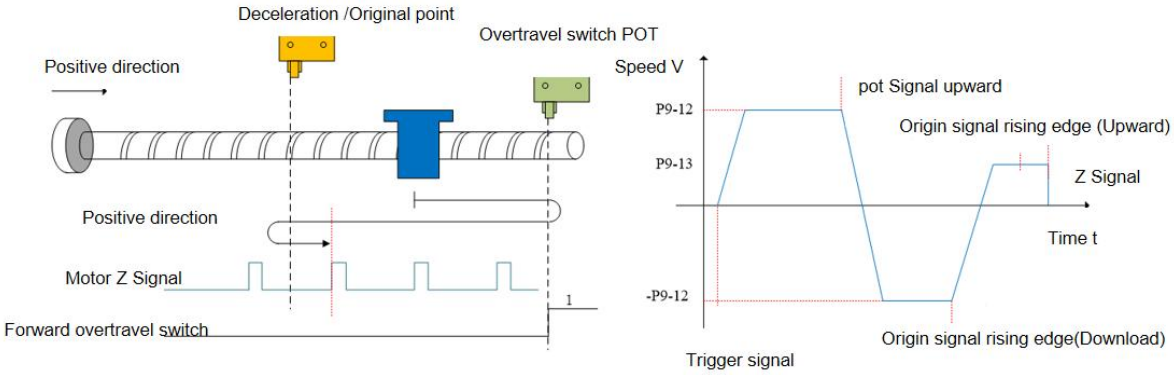
During forward acceleration or uniform forward motion, the machine shall stop immediately upon encountering the rising edge of the origin signal.

② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

During forward acceleration or uniform forward motion, the system immediately stops upon encountering the rising edge of the deceleration point (origin) signal. After the motor has completely ceased rotation, it proceeds for a predetermined number of pulses and in the specified direction (positive or negative) at the speed set by P9-13 (return-to-origin low-speed speed), covering a fixed distance indicated by pulses P9-19 and P9-20, before finally stopping.

③ The number of Z phases is P9-11.0=1, and the mechanical offsets (P9-19, P9-20) are 0:

During forward acceleration or uniform forward motion, continue operation after encountering the rising edge of the deceleration point (origin) signal, then stop immediately upon detecting the first Z signal.



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

During forward acceleration or uniform forward motion, upon encountering the rising edge of the deceleration point (origin) signal, continue operation; then immediately stop when the first Z-axis signal is detected. After the motor has completely ceased rotation, proceed with a fixed-distance pulse run (P9-13-P9-20) at the speed set via P9-13 (returning to the origin at low speed), based on the predetermined number and direction of mechanical offset pulses (positive or negative), before stopping the motor.

(2) Origin Return Mode 1 – Reverse zero return, with the deceleration point being the origin switch; the origin is either the origin switch or the motor Z signal (P9-11.2=1).

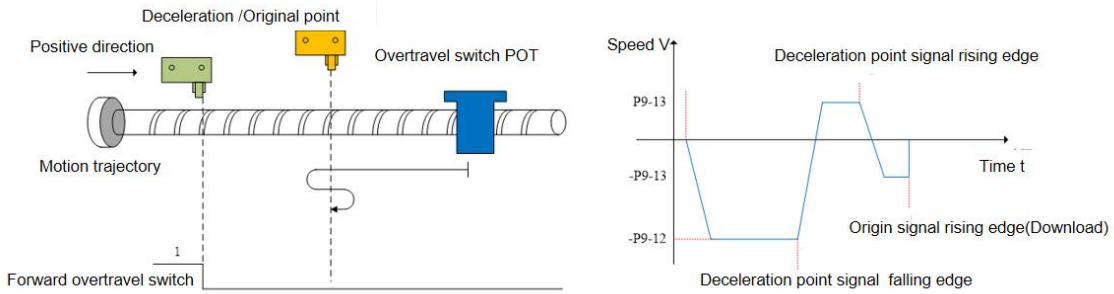
To use this mode, you need to connect the POT, NOT, and origin switches.

1) When the motor starts moving, 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 a high-speed reverse search for the deceleration point signal using the P9-12 (return-to-origin high-speed speed) setting, continuing until it encounters the rising edge of the deceleration point signal. It then gradually accelerates according to the P9-14 (return-to-origin acceleration-deceleration time) until reaching the P9-13 (return-to-origin low-speed speed). Subsequently, the servo motor performs a low-speed forward search for the deceleration point (origin) signal using the P9-13 (return-to-origin low-speed speed) setting; upon encountering the falling edge of this signal, it reverses direction (restores its reverse state) and continues the low-speed search for the rising edge of the deceleration point signal at the P9-13 setting. The subsequent return-to-origin operation involves four distinct scenarios:

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

While continuing the low-speed search for the deceleration point (origin) using the P9-13 signal (low-speed speed returning to origin), the system shall immediately cease operation upon detecting the rising edge of the deceleration point (origin) signal.

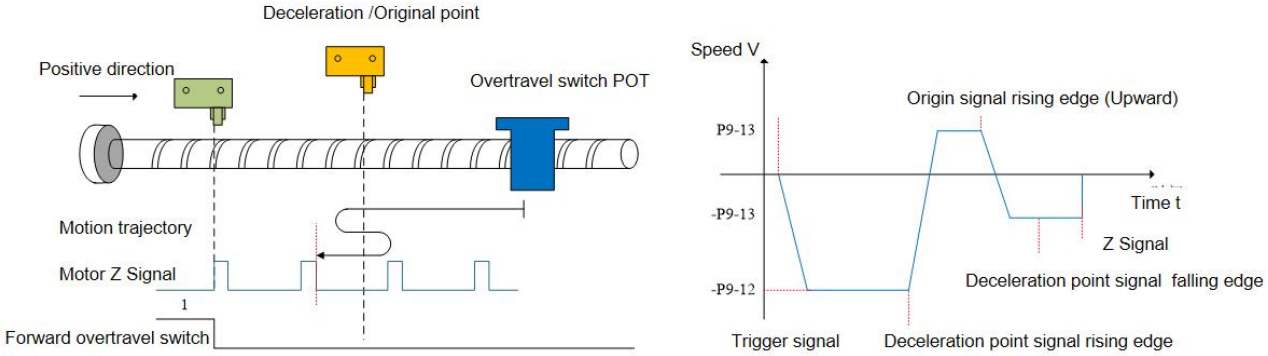


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

During the low-speed search for the deceleration point (origin) signal using the P9-13 command (return to origin at low speed), the system immediately stops upon detecting the signal's rising edge. After the motor has completely ceased rotation, it advances a predetermined number of pulses (P9-19 and P9-20) at the speed set by P9-13 (return to origin at low speed), based on the specified mechanical offset quantity and direction (positive or negative), before finally stopping the motor.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

Continue the low-speed search for the deceleration point (origin) using P9-13 (low-speed speed returning to origin). While processing the rising edge of the deceleration point (origin) signal, proceed as usual until encountering it; then immediately stop upon detecting the first Z signal.



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

During the low-speed search for the deceleration point (origin) using instruction P9-13 (return to origin at low speed), continue executing the signal's rising edge. Upon detecting the deceleration point (origin), proceed immediately; upon identifying the first Z-axis signal, stop the machine completely. After full motor stoppage, execute a predetermined number of pulses and direction (positive or negative) according to the set mechanical offset value, then drive the motor forward at the P9-13 setting speed for fixed pulse intervals (P9-19, P9-20), followed by complete motor shutdown.

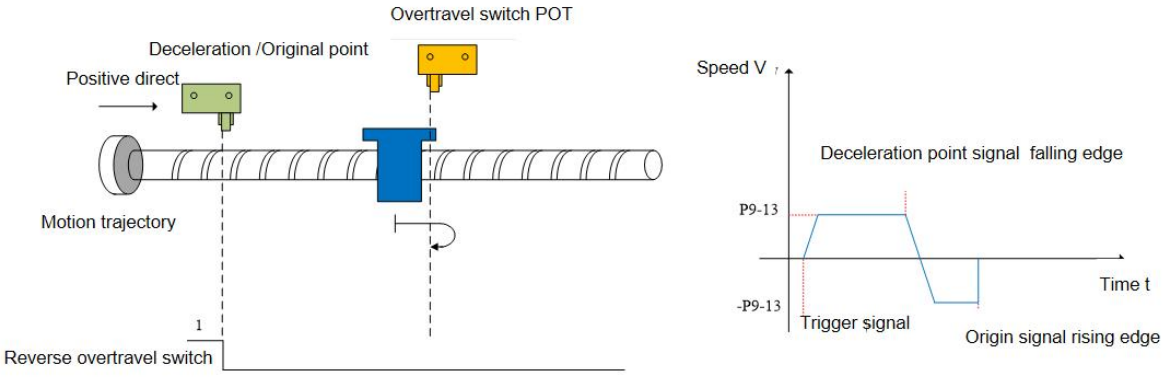
2) When the motor begins movement, the origin switch (reduction point) signal is active (signal terminal assigned by P5-64:0 = inactive, 1 = active), and the reverse overtravel switch (NOT) (P5-23) remains inactive throughout the process.

The servo motor directly detects the falling edge of the signal indicating the deceleration point (origin) by using the P9-13 (return-to-origin low-speed speed) set value for low-speed forward scanning. Upon

detecting this falling edge, it reverses direction (i.e., moves in the opposite direction) and continues scanning the rising edge of the signal for the deceleration point (origin) at the same low speed. The subsequent return-to-origin operation proceeds under four distinct scenarios:

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

During negative acceleration or negative constant-speed operation, the machine shall stop immediately upon encountering the rising edge of the origin signal.

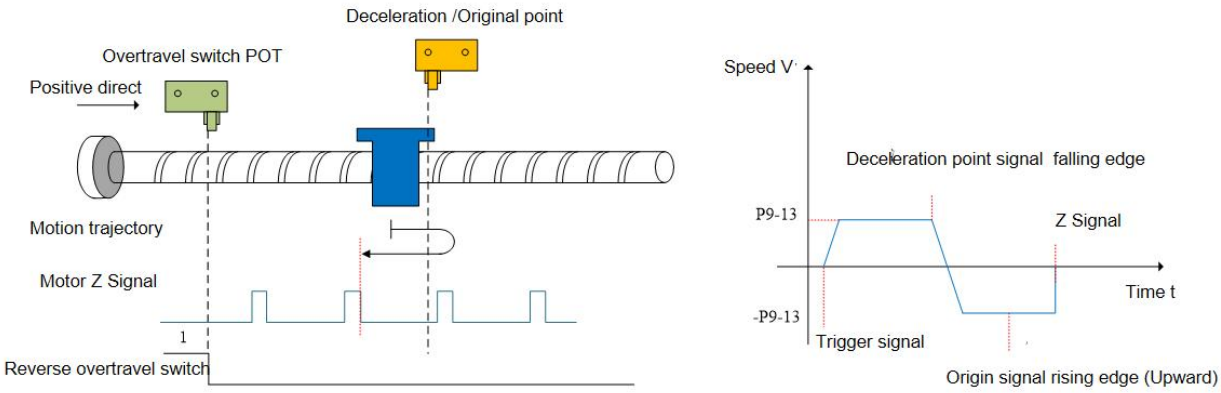


② The number of Z phases P9-11.0 = 0, and the mechanical offsets (P9-19, P9-20) are not zero:

During negative acceleration or negative constant-speed operation, the machine stops immediately upon encountering the rising edge of the origin signal. After complete motor cessation, the motor advances a predetermined number of pulses (P9-19 and P9-20) at the speed set by P9-13 (low-speed return-to-origin speed), following the specified mechanical offset pulse count and direction (positive or negative), before final shutdown.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

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



④ The number of Z phases is P9-11.0=1, and the mechanical offsets (P9-19, P9-20) are non-zero:

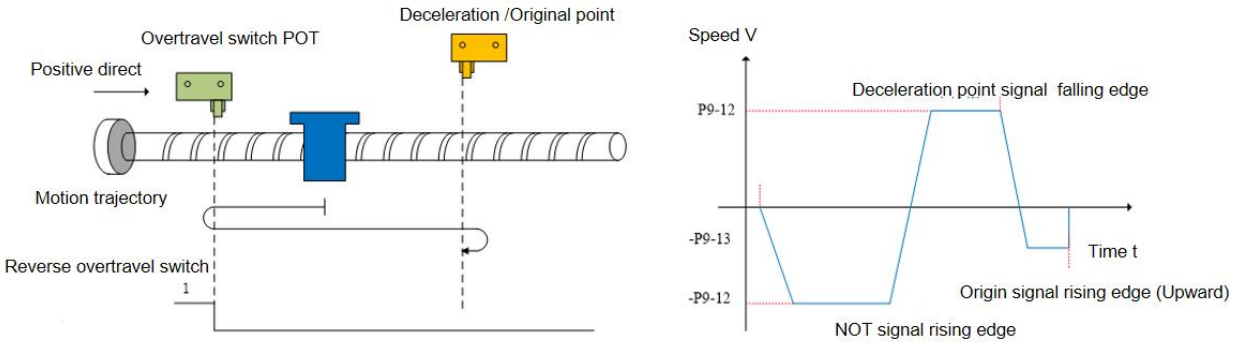
During negative acceleration or negative constant-speed operation, the motor continues running after encountering the rising edge o the deceleration point (origin) signal. Upon detecting the first Z-axis signal, the motor stops immediately. After complete motor cessation, the motor advances a fixed number of pulses (P9-19 and P9-20) at the speed set by P9-13 (return-to-origin low-speed speed), based on the predetermined mechanical offset pulse count and direction (positive or negative), before stopping completely.

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

The servo motor first searches for the deceleration point (origin) signal at high speed in reverse direction using the setting value-P9-12 (return-to-origin high-speed speed). Upon encountering the reverse overshoot switch (NOT), the driver decelerates and reverses direction (i.e., moves forward) based on the value set by P9-14 (return-to-origin acceleration-deceleration time), then immediately searches for the deceleration point (origin) signal's falling edge at high speed in forward direction using P9-12. After detecting this signal's falling edge, the motor decelerates and reverses direction (i.e., moves backward) according to P9-14. Subsequently, the servo motor searches for the deceleration point (origin) signal's rising edge at low speed in reverse direction using-P9-13. The subsequent return-to-origin operation proceeds under four distinct scenarios:

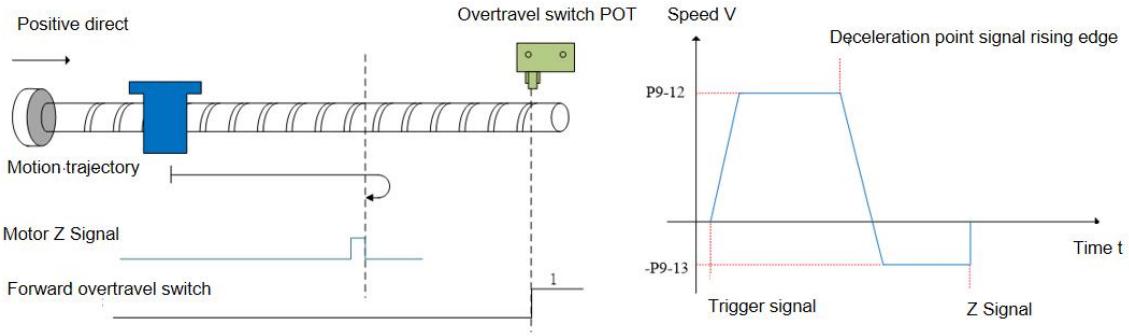
① The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are 0:

During reverse acceleration or constant-speed reversal operation, the machine shall immediately stop upon encountering the rising edge of the origin signal.

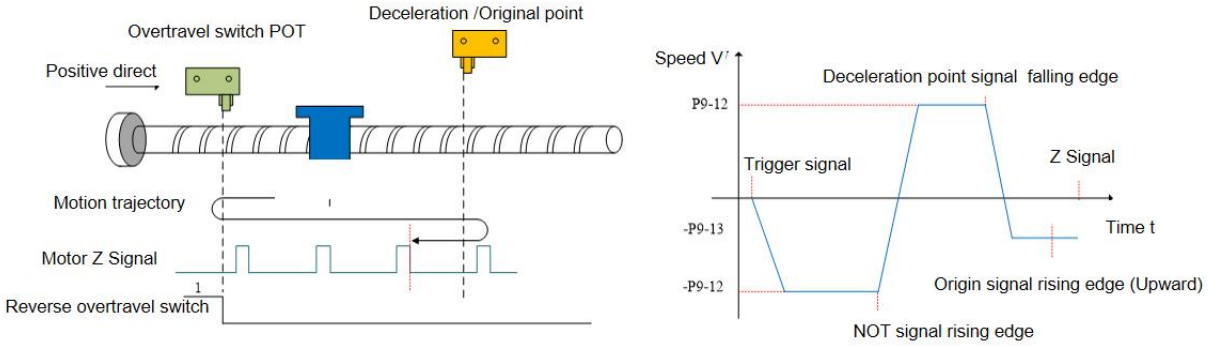


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

During reverse acceleration or constant-speed reversal operation, the machine stops immediately upon encountering the rising edge of the deceleration point (origin) signal. After complete motor cessation, the motor advances a predetermined number of pulses (P9-19 and P9-20) at the speed set via P9-13 (return-to-origin low-speed setting), following the specified mechanical offset quantity and direction (positive or negative), before final shutdown.



③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:



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

④ The number of Z phases is P9-11.0=1, and the mechanical offsets (P9-19, P9-20) are non-zero:

During reverse acceleration or reverse constant-speed operation, continue running after encountering the rising edge of the deceleration point (origin) signal, then immediately stop upon detecting the first Z-axis signal. Once the motor has completely ceased rotation, it proceeds for a predetermined pulse duration at the speed set via P9-13 (returning to the origin at low speed), based on the preset mechanical offset pulse count and direction (positive or negative), before stopping completely.

(3) Origin Return Mode 2 – Forward zero return: The deceleration point and origin are defined by the motor Z signal (P9-11.2=2).

In this mode, the number of motor Z-phase phases is not determined. To use this mode, connect POT and NOT.

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

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

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

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

② The mechanical offset (P9-19, P9-20) is not equal to 0:

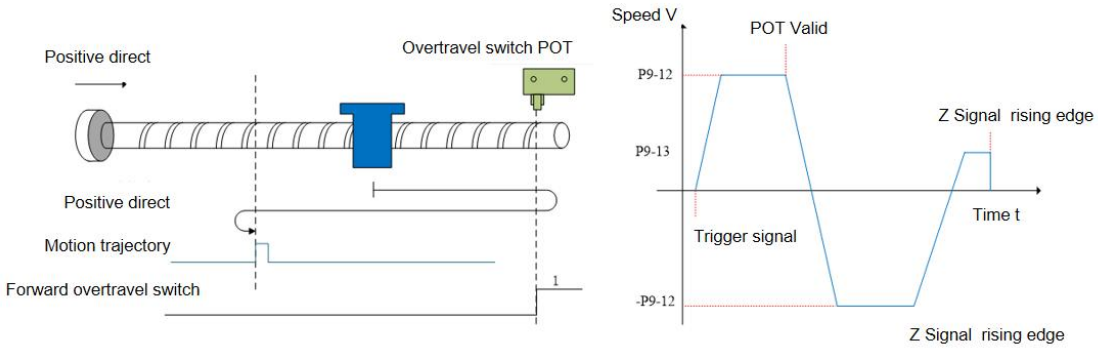
During reverse acceleration or reverse constant-speed operation, the motor stops immediately upon encountering the rising edge on the opposite side of the Z signal. After complete motor cessation, the motor advances a predetermined number of pulses (P9-19 and P9-20) at the speed set by P9-13 (return-to-origin low-speed speed), based on the preset mechanical offset quantity and direction (positive or negative), before stopping definitively.

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

The servo motor first performs a high-speed forward search for the Z signal using the P9-12 (return-to-origin high-speed speed) setting value. Upon encountering the forward overshoot switch, the driver decelerates and reverses direction based on the P9-14 (return-to-origin acceleration-deceleration time), then continues its high-speed reverse search at the same P9-12 setting until reaching the rising edge of the Z signal. Thereafter, it gradually decelerates and reverses back to the forward direction according to the P9-14 setting, followed by a low-speed forward search for the opposite rising edge of the Z signal using the P9-13 (return-to-origin low-speed speed). The subsequent return-to-origin operation proceeds under two distinct scenarios:

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

During forward acceleration or uniform forward motion, 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 equal to 0:

During forward acceleration or constant-speed operation, the motor stops immediately upon encountering the rising edge on the opposite side of the Z signal. After complete motor cessation, the motor advances a predetermined number of pulses according to the set mechanical offset quantity and direction (positive or negative), traveling at the P9-13 speed (low-speed return-to-origin speed) for a fixed distance before stopping again.

(4) Origin Return Mode 3 – Reverse Zero Return: The deceleration point and origin are defined by the motor's Z-axis signal (P9-11.2=3)

In this mode, the number of motor Z-phase phases is not determined. To use this mode, connect POT and NOT.

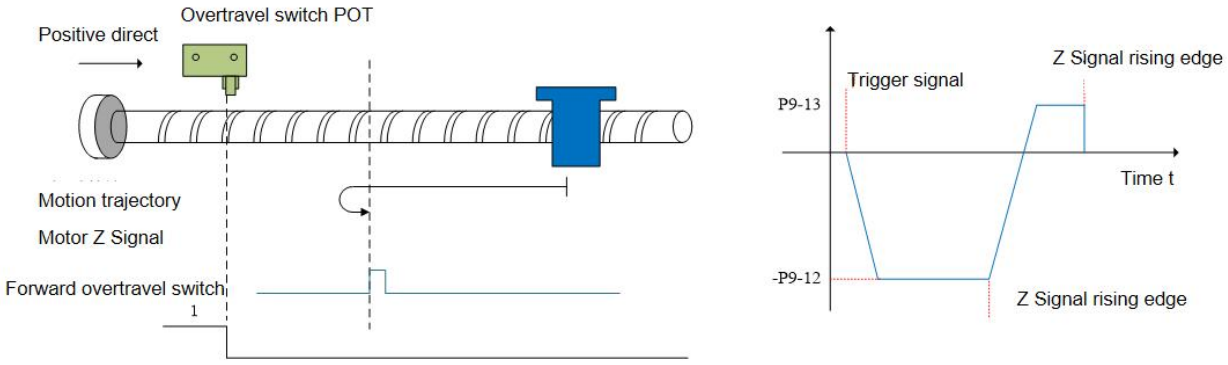
1) When the motor starts moving, the Z signal is either invalid or valid (signal terminal assigned by

P5-64:0 = invalid, 1 = valid), and the reverse overtravel switch (NOT) remains untriggered throughout the entire process.

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

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

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



② The mechanical offset (P9-19, P9-20) is not equal to 0:

During forward acceleration or constant-speed operation, the motor stops immediately upon encountering the rising edge on the opposite side of the Z signal. After complete motor cessation, the motor advances a predetermined number of pulses (P9-19 and P9-20) at the speed set by P9-13 (return-to-origin low-speed setting), following the specified mechanical offset quantity and direction (positive or negative), before stopping definitively.

2) When the motor starts moving, the Z signal is either invalid or valid (signal terminal assigned by P5-64:0 = invalid, 1 = valid); during this process, the reverse overtravel switch (NOT) is triggered.

The servo motor first performs a high-speed reverse search of the Z signal using the P9-12 (return-to-origin high-speed speed) setting value. Upon encountering the reverse overshoot switch, the driver decelerates in reverse according to P9-14 and then resumes high-speed forward search using P9-12 until reaching the rising edge of the Z signal, gradually decelerating back in reverse (i.e., restoring the reverse direction) based on the P9-14 (return-to-origin acceleration-deceleration time) setting value. The servo motor then conducts a low-speed reverse search for the opposite rising edge of the Z signal using P9-13 (return-to-origin low-speed speed). Subsequent return-to-origin actions proceed under two distinct scenarios:

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

During reverse acceleration or reverse 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 equal to 0:

During reverse acceleration or reverse constant-speed operation, the motor stops immediately upon encountering the rising edge on the opposite side of the Z signal. After complete motor cessation, the motor advances a predetermined number of pulses (P9-19 and P9-20) at the speed set by P9-13 (return-to-origin low-speed speed), based on the preset mechanical offset quantity and direction (positive or negative), before stopping definitively.

(5) Origin Return Mode 4 – Forward return to zero, with the deceleration point and origin served by the forward overtravel switch POT (P5-22) (P9-11.2=4)

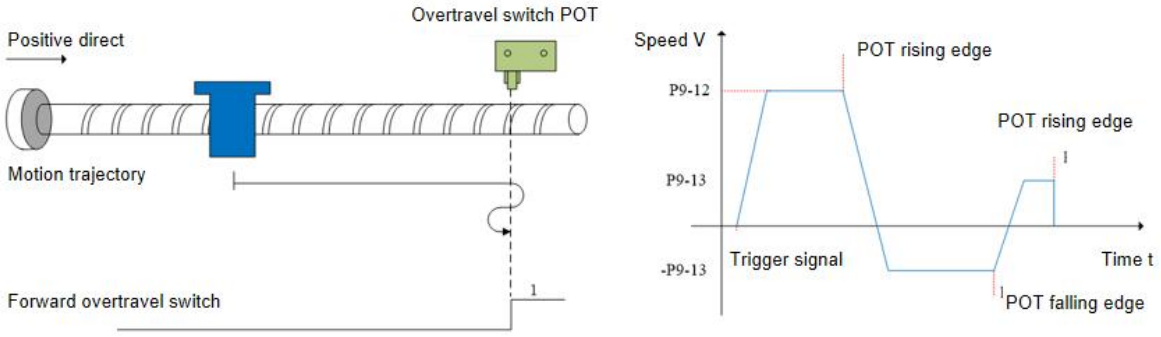
To use this mode, connect NOT and POT.

1) The forward travel switch (POT) is invalid when the motor starts moving.

The servo motor first performs a high-speed forward search for the forward limit switch using the P9-12 (return-to-origin high-speed speed) setting value. Upon detecting the rising edge of the forward limit switch signal, it gradually decelerates and reverses direction according to the P9-14 (return-to-origin acceleration/deceleration time) setting. Then, operating at the low-speed reverse speed specified by P9-13, the servo motor searches for the falling edge of the forward limit switch signal. After identifying this falling edge, the subsequent return-to-origin operation proceeds in one of four scenarios:

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

Reverse the deceleration (i.e., return to forward direction), and use P9-13 (returning to the origin at low speed) to detect the rising edge of the forward overshoot switch signal at low speed. During forward acceleration or constant-speed operation, immediately stop the machine upon encountering the rising edge of the forward overshoot switch signal.

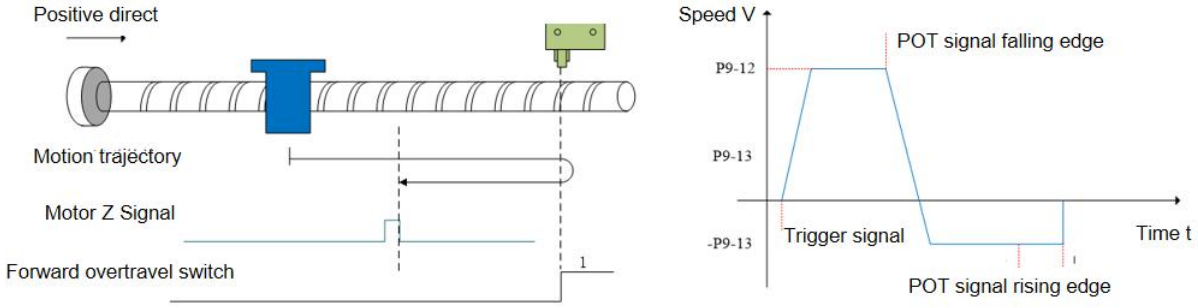


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

Reverse deceleration (i.e., return to forward direction), and using P9-13 (returning to the origin at low speed), perform a low-speed search for the rising edge of the forward travel switch signal. During forward acceleration or constant-speed operation, immediately stop the motor upon encountering the rising edge of the forward travel switch signal. After the motor has completely stopped, proceed with a fixed number of pulses and in the predetermined direction (only negative direction, meaning movement must occur between the origin switch and NOT) according to the set mechanical offset value. Subsequently, the motor moves at the speed specified by P9-13 (returning to the origin at low speed) for a predetermined distance before stopping.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

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



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

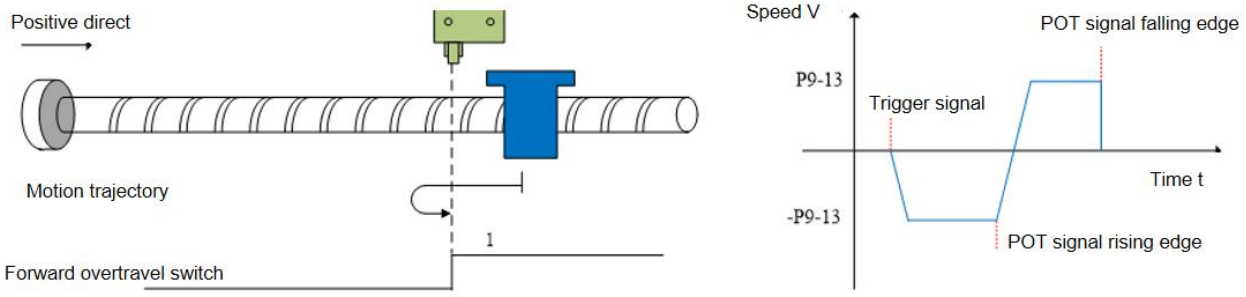
Continue the low-speed reverse operation set according to P9-13 (return to origin at low speed). Upon encountering the rising edge of the first Z signal, stop the motor immediately. After the motor has completely ceased, drive it forward for a predetermined number of pulses and in the specified direction (either negative or positive, but the movement must occur between the origin switch and NOT) based on the preset mechanical offset value. Finally, stop the motor again at the speed defined by P9-13 (return to origin at low speed) for a fixed pulse duration.

2) The forward travel switch (POT) (P5-22) becomes effective when the motor starts moving.

The servo motor directly searches in reverse low speed using the-P9-13 setting value (return-to-origin low-speed speed) for the falling edge of the forward travel switch signal (POT). Upon detecting this falling edge, the subsequent return-to-origin action proceeds according to one of four predefined scenarios:

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

Reverse deceleration (i.e., return to forward motion): Use P9-13 (return to origin at low speed) to perform a low-speed forward search for the POT rising edge. During forward acceleration or constant-speed operation, immediately stop the machine upon encountering the POT rising edge.

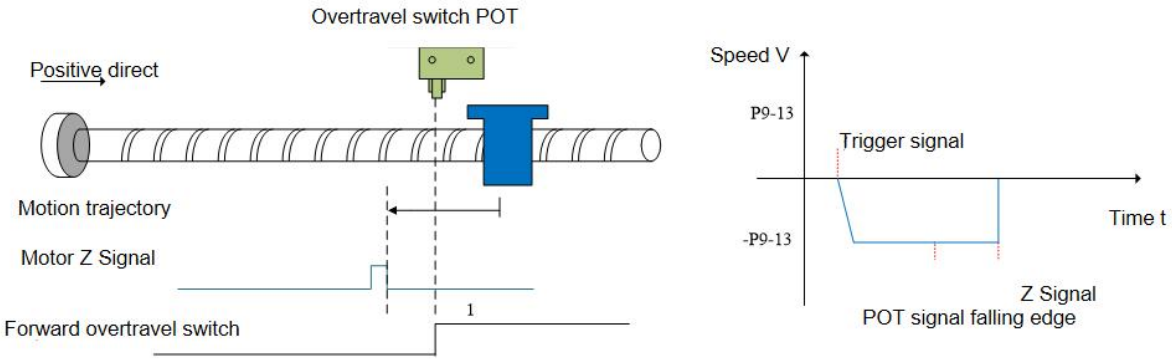


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

Reverse deceleration (i.e., return to forward motion): Using P9-13 (returning to the origin at low speed), perform a low-speed forward search for the POT rising edge. During forward acceleration or constant-speed forward operation, immediately stop the motor upon encountering the POT rising edge. After the motor has completely ceased, proceed according to the preset number and direction of mechanical offset pulses (only in negative direction, i.e., movement must occur between the origin switch and NOT). The motor then travels a fixed distance at the speed set by P9-13 (returning to the origin at low speed) via pulses P9-19 and P9-20 before stopping.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

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



④ The number of Z phases is P9-11.0=1, and the mechanical offsets (P9-19, P9-20) are non-zero:

Continue the low-speed reverse operation set according to P9-13 (return to origin at low speed). Upon encountering the rising edge of the first Z signal, stop the motor immediately. After the motor has completely ceased, execute a series of fixed pulses (P9-19 and P9-20) at the speed specified by P9-13 (return to origin at low speed), following the predetermined mechanical offset pulse count and direction (which may be either negative or positive, but must move between the origin switch and NOT). Finally, stop the motor.

(6) Origin Return Mode 5 – Reverse return to zero, with the deceleration point and origin served as the NOT switch for reverse overtravel (P5-23) (P9-11.2=5)

To use this mode, connect POT and NOT.

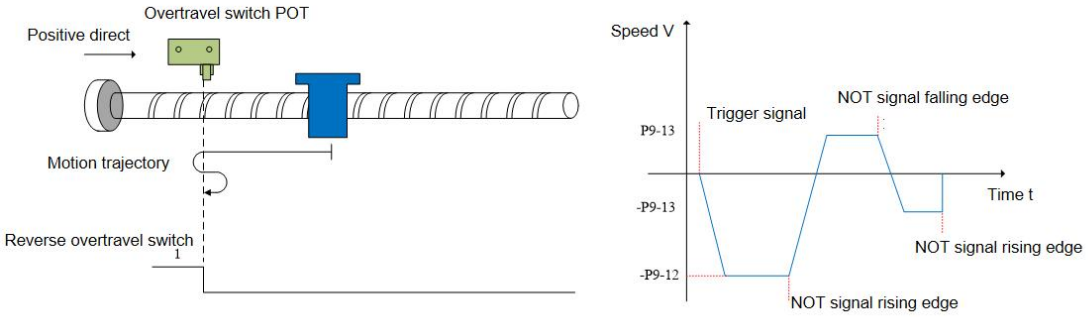
1) The reverse overtravel switch (NOT) is invalid when the motor starts moving.

The servo motor first performs a high-speed reverse search for the reverse overtravel switch (NOT) using the P9-12 setting (return-to-origin high-speed speed). Upon detecting the rising edge of NOT, it gradually decelerates in reverse according to the P9-14 setting (return-to-origin acceleration-deceleration time). Then, the servo motor conducts a low-speed forward search for the falling edge of NOT using the P9-13 setting (return-to-origin low-speed speed). After identifying the falling edge of NOT, the subsequent return-to-origin operation proceeds under four distinct scenarios:

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

Reverse decelerate (i.e., resume reverse motion), then perform a reverse low-speed search for the NOT rising edge using-P9-13 (returning to the original low-speed state). During reverse acceleration or

constant-speed reversal, immediately stop the machine upon encountering the NOT rising edge.

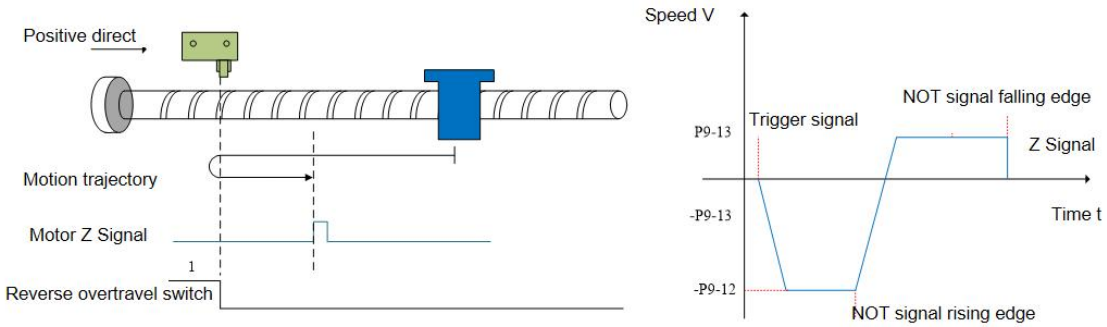


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

Reverse deceleration (i.e., reversal restoration): Using P9-13 (returning to the origin at low speed), perform a reverse low-speed search for the rising edge of the reverse overtravel switch signal (NOT). During reverse acceleration or constant-speed operation, immediately stop upon encountering the NOT rising edge. After the motor has completely ceased rotation, proceed according to the preset number and direction of mechanical offset pulses (only positive direction, meaning movement must occur between the origin switch and POT). The motor then travels a fixed distance at the speed set by P9-13 (returning to the origin at low speed) via pulses P9-19 and P9-20 before stopping.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

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



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

Continue the low-speed forward movement set by P9-13 (returning to the origin at low speed). Upon encountering the rising edge of the first Z signal, stop immediately. After the motor has completely ceased, operate it again at the speed specified by P9-13 (returning to the origin at low speed) for a predetermined number of pulses and in the specified direction (positive or negative, but must move between the origin switch and the POT). Finally, stop the motor.

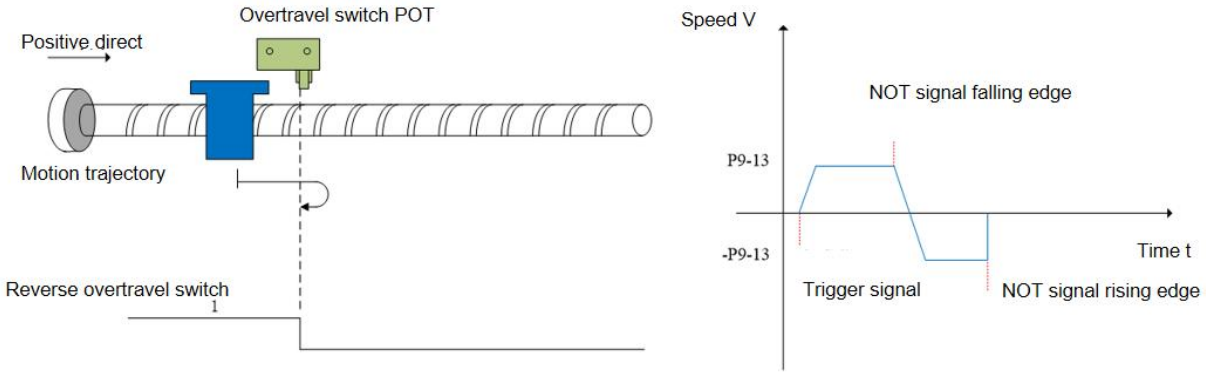
2) The reverse overtravel switch (NOT) (P5-23) becomes effective when the motor starts moving.

The servo motor directly searches for the falling edge of the NOT signal (indicating reverse overtravel) at low speed in the forward direction using the P9-13 setting value (low-speed return to origin). Upon detecting this NOT signal falling edge, the subsequent return-to-origin action proceeds according to one

of four predefined scenarios:

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

Reverse deceleration (i.e., return to reverse mode): Use-P9-13 (return to origin low-speed speed) to perform low-speed reverse scanning for the NOT rising edge. During reverse acceleration or constant-speed reverse operation, immediately stop the machine upon detecting the NOT rising edge.

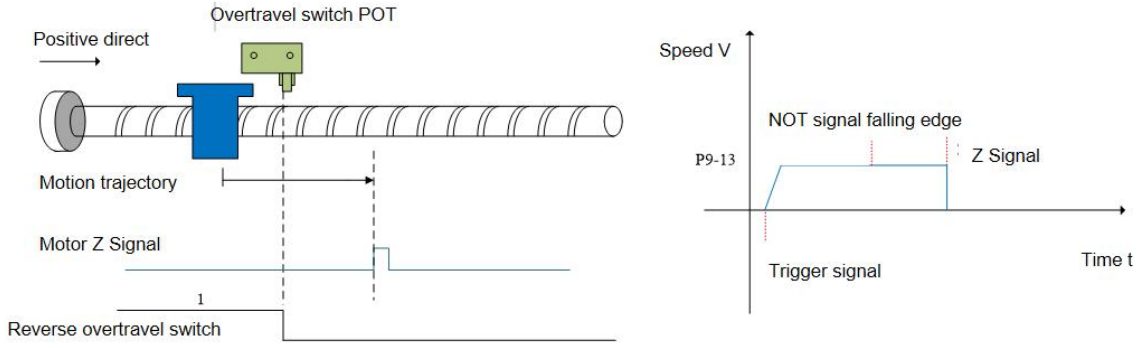


② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

Reverse deceleration (i.e., return to reverse mode): Using P9-13 (returning to the origin at low speed), perform a low-speed reverse search for the NOT rising edge. During reverse acceleration or uniform reverse motion, immediately stop the motor upon encountering the NOT rising edge. After the motor has completely ceased, proceed with a predetermined number and direction of pulses (only positive direction, meaning movement must occur between the origin switch and the POT) at the speed set by P9-13 (returning to the origin at low speed), covering a fixed pulse distance (P9-19, P9-20), after which the motor stops.

③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

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



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

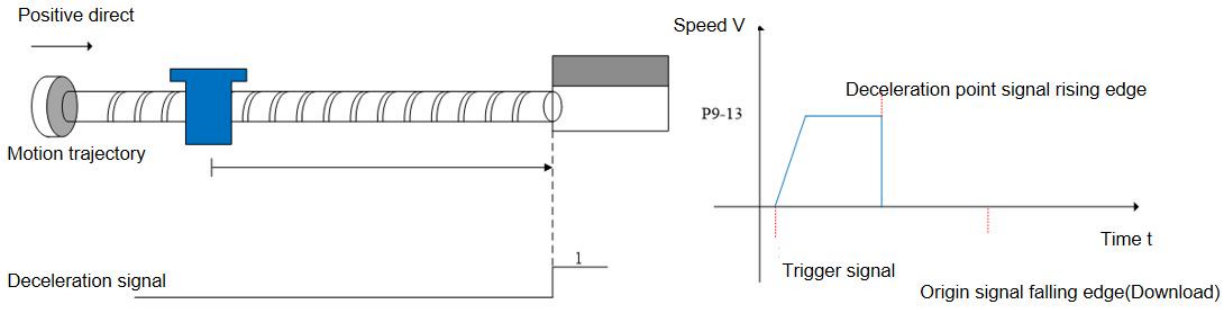
Continue the low-speed forward movement set by P9-13 (returning to the origin at low speed). Upon

encountering the rising edge of the first Z signal, stop immediately. After the motor has completely ceased, operate it again at the speed specified by P9-13 (returning to the origin at low speed) for a predetermined number of pulses and in the specified direction (positive or negative, but must move between the origin switch and the POT). Finally, stop the motor.

(7) Origin Return Mode 6 – Forward return to zero, where the deceleration point and origin correspond to the forward mechanical limit position (P9-11.2=6)

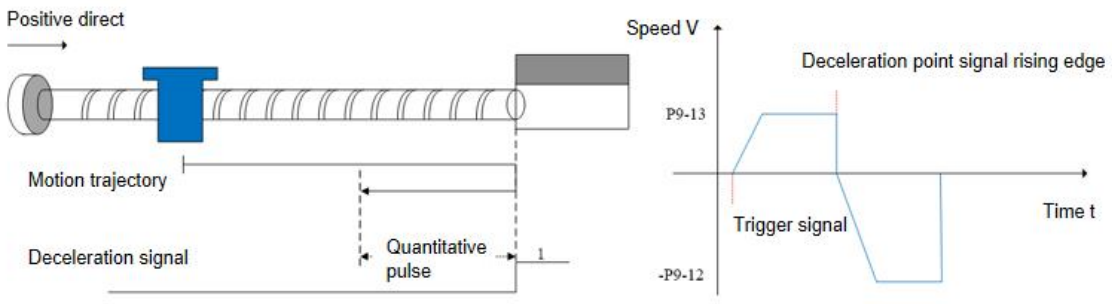
With this mode, there is no need to connect the POT, NOT, or origin switches.
The servo motor first operates forward at low speed using the P9-13 setting (low-speed return to origin). Upon reaching the mechanical limit position, if the absolute torque value reaches the upper limit of P9-17 (stop-type return-to-origin torque threshold) while the absolute speed value remains below the P9-16 setting (stop-type return-to-origin speed threshold), and this condition persists for the duration specified by P9-18 (stop-type return-to-origin time threshold), the system determines that the mechanical limit position has been reached. The subsequent return-to-origin action proceeds according to one of four scenarios:

① If the number of Z-phase positions (P9-11.0) is 0 and the mechanical offset values (P9-19, P9-20) are both 0: stop the machine immediately.



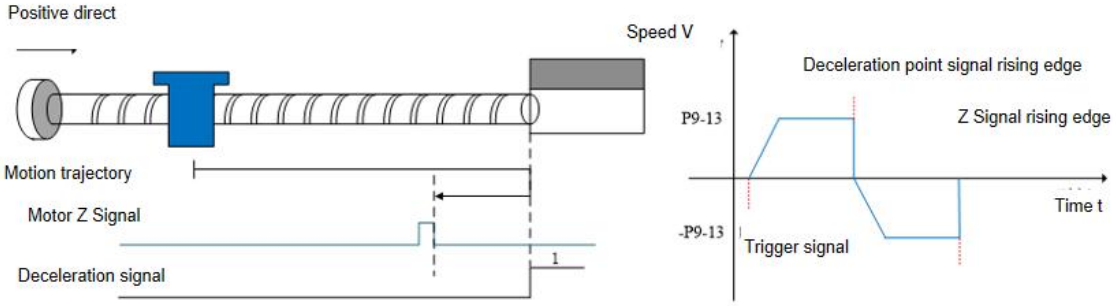
② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

The servo motor stops immediately. After complete cessation, it moves backward for a predetermined number of pulses (P9-19 and P9-20) at the speed set by-P9-13 (low-speed return to origin), then stops completely.



③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

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



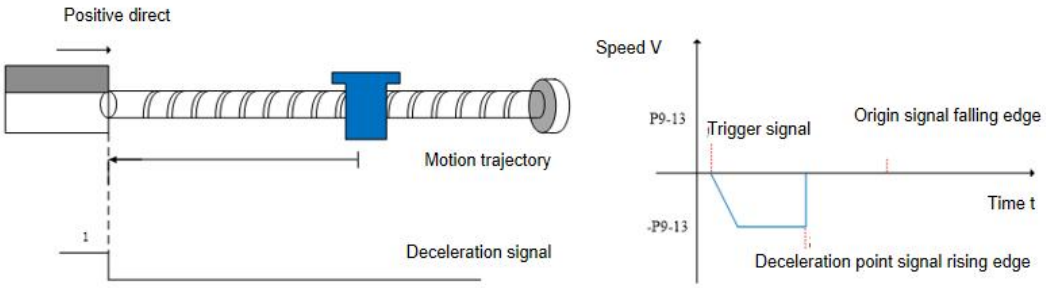
④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

Perform low-speed reverse operation at the setting of-P9-13 (return-to-origin low-speed speed). Upon encountering the rising edge of the first Z signal, stop immediately. After complete cessation, the motor will execute a fixed number of pulses at the speed specified by-P9-13 (return-to-origin low-speed speed), either in forward or reverse direction (within the mechanical limit range), before stopping completely.

(8) Origin Return Mode 7 – Reverse Zero Return: The deceleration point and origin correspond to the reverse mechanical limit positions (P9-11.2=7)

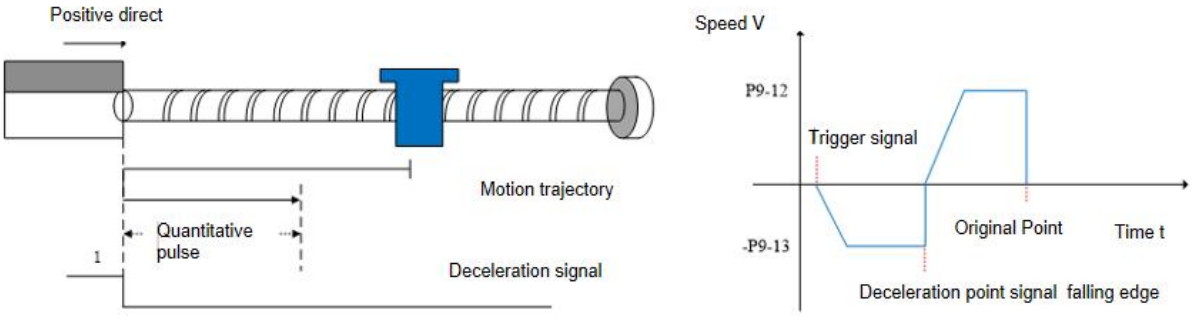
With this mode, there is no need to connect the POT, NOT, or origin switches.
The servo motor first operates in reverse at low speed using the set value-P9-13 (low-speed return to origin). Upon reaching the mechanical limit position, if the absolute torque value reaches P9-17 (stop-type return-to-origin torque threshold) and the absolute speed value remains below P9-16 (stop-type return-to-origin speed threshold), this condition persists for the duration specified by P9-18 (stop-type return-to-origin time threshold), indicating arrival at the mechanical limit position. The subsequent return-to-origin action proceeds according to four distinct scenarios:

① If the number of Z-phase positions (P9-11.0) is 0 and the mechanical offset values (P9-19, P9-20) are both 0: stop the machine immediately.



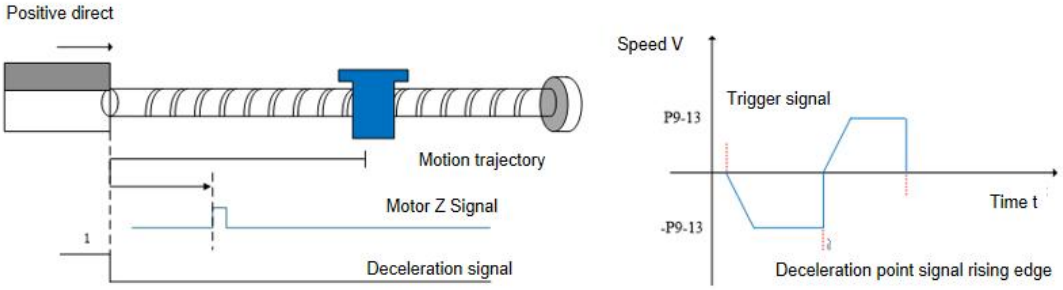
② The number of Z phases (P9-11.0) is 0, and the mechanical offsets (P9-19, P9-20) are non-zero:

The servo motor stops immediately. After complete cessation, it advances forward at the speed set via P9-13 (low-speed return to origin) for a predetermined number of pulses (P9-19, P9-20) based on the preset mechanical offset value, then stops.



③ The number of Z phases (P9-11.0) is 1, and the mechanical offset values (P9-19, P9-20) are 0:

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



④ The number of Z phases (P9-11.0) is 1, and the mechanical offsets (P9-19, P9-20) are non-zero:

The motor operates forward at low speed set by P9-13 (return-to-origin low-speed speed). Upon encountering the rising edge of the first Z-axis signal, it stops immediately. After complete cessation, the motor advances through a predetermined number of pulses (P9-19 and P9-20) at the speed specified by P9-13 (return-to-origin low-speed speed), either in forward or reverse direction (within the mechanical limit range), before stopping completely.

- For return-to-origin modes 6 and 7, once these modes are triggered, the maximum torque during the return-to-origin process is equal to 1.1 times the set value of P9-17 (the touch-stop return-to-origin torque threshold). If both internal forward/reverse torque limits P3-28 and P3-29 are lower than this 1.1-fold set value, the actual torque limit shall be determined by the minimum of P3-28, P3-29, or the set value of P9-17. Similarly, if external forward/reverse torque limits P3-30 and P3-31 are enabled, the effective torque limit will be the smallest value among the internal torque limit, the external torque limit, and 1.1 times the set value of P9-17.
- The torque limit P9-17 (touch-stop origin-recovery torque threshold), set at 1.1 times its value, only becomes effective when both of these origin-recovery modes are activated. If only origin-recovery is enabled and the origin-recovery mode P9-11.2 equals 6 or 7, but the origin-recovery does not occur, the torque limit P9-17 (touch-stop origin-recovery torque threshold), set at 1.1 times its value, remains inactive.

8.1.2 Position control (external pulse position command)

The DS5C2 series supports this feature only in the 15–32 kW power range.

parameter	Essentials	Reference Chapter
P0-01 Control Method Selection	Set to 6: External Pulse Mode	8.1.2.1 External Pulse Position Pattern
P0-10 Pulse Instruction Pattern	Set pulse shape 0：CW/CCW 1：AB 2：P+D	8.1.2.3 Selection of Pulse Instruction Patterns
P0-11 Set the number of pulses per motor revolution *1 P0-12 Sets the number of pulses per motor revolution * 10000 P0-13 Electronic gear ratio (molecule) P0-14 Electronic gear ratio (denominator) P0-92 ~ P0-93:32-bit electronic gear ratio molecule P0-94 ~ P0-95:32-bit electronic gear ratio calculator	The number of command pulses required for the motor to complete one full rotation is set. Both P0-11/P0-12 are valid at 00:00; P0-13/P0-14 take effect thereafter. P0-11 to P0-14 are all zero; P0-92 to P0-95 are valid. 32-bit gear ratio numerator: P0-92*1 + P0-93*10000 32-bit gear ratio: P0-94*1 + P0-95 *10000	8.1.1.1 Electronic Gear Ratio
P0-09 Pulse Instruction Settings	Each device can set the direction of the low-speed pulse command and the filtering time for the low-speed pulse.	8.1.2.5 Selection of the positive direction for pulse commands

8.1.2.1 External Pulse Position Pattern

Parameter	Set value	Meaning	Revise	Take effect
P0-01	6	Use external pulse sequence commands for position control	servo OFF	immediately

8.1.2.2 Pulse Input Specifications

Pulse Specification		Maximum input frequency	voltage specification	Forward current
Low-speed pulse	Open-circuit collector signal	200Kpps	24V	<25mA
	differential wave	500Kpps	3.3~5V	<25mA

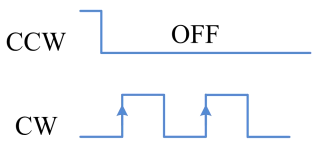
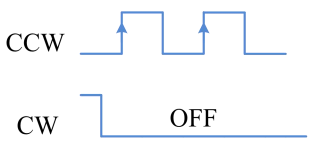
8.1.2.3 Selection of Pulse Instruction Patterns

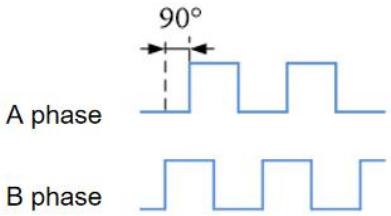
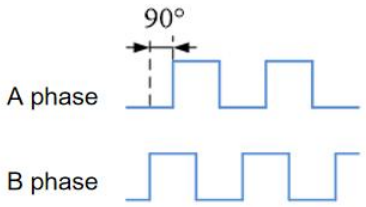
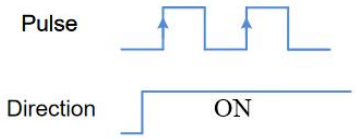
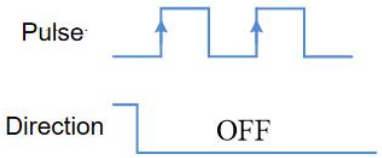
Set the pulse waveform received by the servo driver according to the host computer or other pulse output devices:

- Dual pulses (CW + CCW);
- Phase A and Phase B orthogonal pulses, 4-fold frequency;
- Pulse + direction (positive logic or negative logic).

Parameter	Meaning	Setting	Meaning	Revise	Take effect
P0-10 n.xxx□	Pulse Instruction Format	0	CW、CCW pattern	servo OFF	immediately
		1	AB phase (not supported by the external jog speed mode)		
		2	Pulse + Direction (Default)		
P0-10 n.xx□x	Effective edge of the pulse signal	0	Valid falling edge (default)	servo OFF	immediately
		1	Valid rising edge		

8.1.2.4 The logical form of the instruction pulse

P0-10.0	Corotation	Reversal
0：CW/CCW		

1：AB		
2：P+D		

8.1.2.5 Selection of the positive direction for pulse commands

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-09.0 n.xxx□	Pulse command positive direction	0	-	0/1	servo OFF	Power on again
P0-09.0 alters the counting direction of the servo's internal counter, which determines the motor's rotation direction. Therefore, when operating in external pulse position mode, this parameter can be adjusted if the motor's actual rotation direction differs from the intended one.						

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-09.2 n.x□xx	Pulse command filtering time	2	4.167ns	0~4	servo OFF	Power on again
Pulse filtering time enhances the anti-interference capability of low-speed pulses (within 200 kHz). P0-09.2 = 0: Turn off the noise filter; P0-09.2 = 1~4: Enable the noise filter to remove pulses with a pulse width less than 30 × 4^(n–1) ns.						

8.1.3 Position Control (Internal Position Command)

Parameter	Essentials	Reference chapter
P0-01 Control Method Selection	Set to 5: Internal Position Mode	8.1.3.1 Internal Position Pattern
P4-03 Internal Position Given Pattern P4-04 Number of valid segments P4-10~P4-254: Internal position parameter settings for paragraphs 1 to 35	The control method for the internal positioning mode is specified, including step-changing mode, positioning mode, and adjustment time. Configuration of pulse displacement, velocity, acceleration/deceleration time, and other parameters for each section position	8.1.3.3 Parameter settings for paragraphs 1 to 35
P5-35 Step-change signal/GHGSTP P5-32 Pause current segment signal/INHIBIT P5-31 Skip current section number / Z-CLAMP	Common terminal function assignments	8.1.3.4 Step-change Signal (/CHGSTP) 8.1.1.4 Instruction Pulse Inhibition (/INHIBIT) 8.1.3.5 Skip the current segment signal (/ZCLAMP)
The number of Z-phase signals after the P4-00 leaves the limit switch P4-01 Speed of collision with 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: Find the reference origin on the reverse side in position mode / SPD-B	Internal position return-to origin point setting parameter	8.1.1.8 Reference Origin

8.1.3.1 Internal Location Pattern

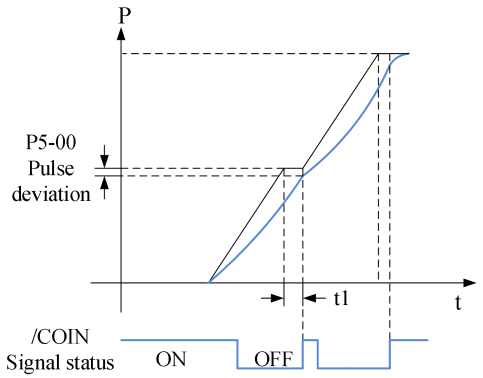
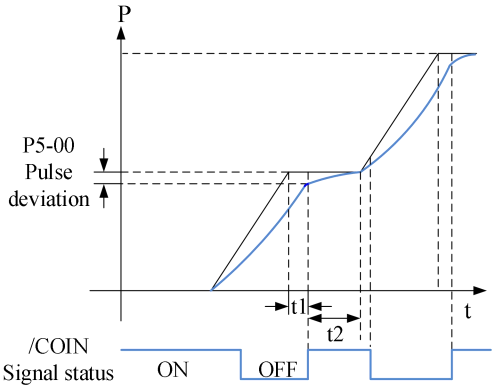
Parameter	Set value	Meaning	Revise	Take effect
P0-01	5	Perform position control using preset values from the servo unit's internal registers.	servo bb	immediately

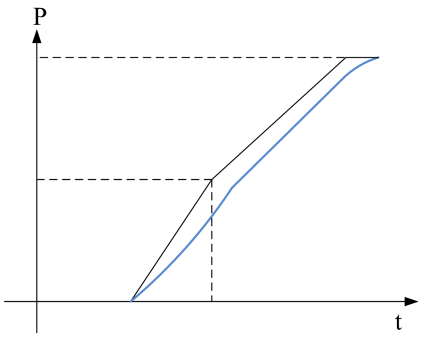
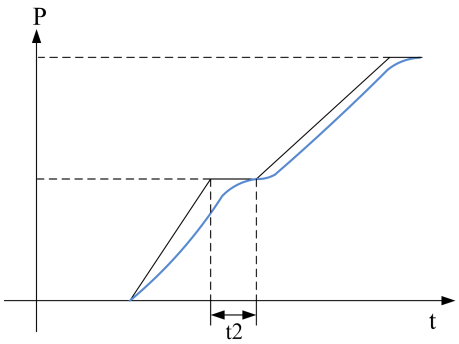
8.1.3.2 Internal Location Mode Settings

Parameter	Parameter function	Unit	Factory settings	Applicable mode	Revise	Take effect
P4-03	Internal Location Mode Settings	—	n.0000	5	servo bb	immediately
	Parameter setting	Functional meaning	Factory settings	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		

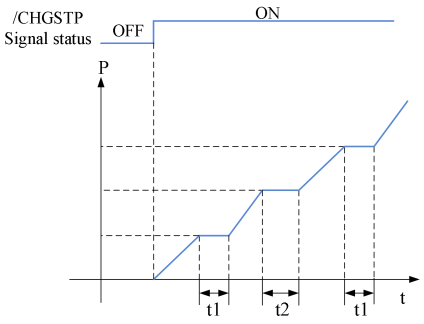
1) Wait Mode

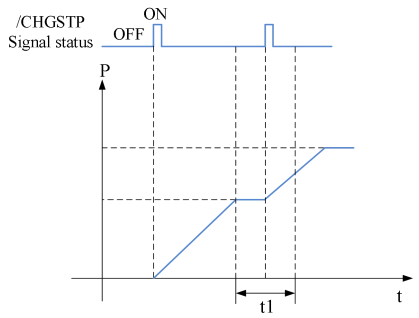
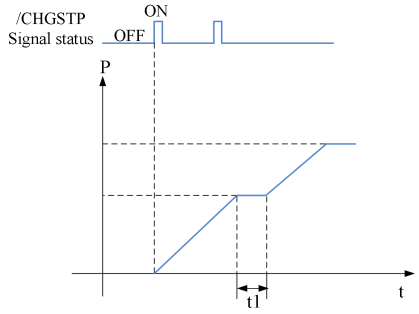
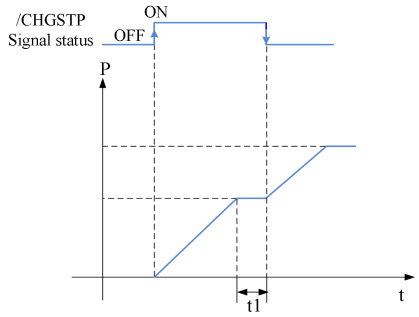
n.x□xx	Meaning
0	Waiting for the positioning to complete
1	Do not wait for positioning to complete
Note: The wait mode determines whether the driver waits for the motor to complete its positioning after issuing a position command when the internal position is specified. This mode applies in all step-changing modes.	

Waiting mode = 0, Adjustment time = 0 ms	Waiting mode = 0, adjustment time> 0 ms
	
After sending a position command, the driver waits for the motor to complete positioning before immediately initiating the next position command. In the diagram, t1 represents the positioning time—the interval between the completion of pulse transmission and the output of the positioning completion signal.	After issuing a position command, the driver waits for the motor to complete positioning before initiating the next position command after the "adjustment time." In the diagram, t1 denotes the positioning time and t2 denotes the adjustment time; in this example, these correspond to parameter P4-16.
Waiting mode = 1, Adjustment time = 0 ms	Waiting mode = 1, adjustment time> 0 ms

 After the driver sends a position command, it immediately proceeds to the next command without waiting for the motor's positioning to complete.	 After issuing a position command, the driver does not wait for the motor to complete positioning but proceeds to issue the next position command only after the "adjustment time." In the figure, t2 represents the adjustment time, which corresponds to parameter P4-16 in this example.

2) Step Change Mode

n.xx□x	Define	
0 Step switching occurs when the signal ON is active, allowing for cyclic operation.		In the figure, t1 = P4-16 and t2 = 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 the execution of a specific segment, the servo will proceed to complete that segment without initiating the next one. 3. In this mode, the step-change signal/CHGSTP is triggered by a high level. 4. During operation, the servo enable function is deactivated, causing the motor to shut down according to the servo OFF shutdown procedure. Upon completion of shutdown, the positioning operation is deemed invalid. 5. After each segment operation is completed, the positioning completion and positioning approach signals remain valid. 6. In this mode, the adjustment time for each section is valid.

n.xx□x	Define	
1 The signal transitions on the rising edge, executed in single steps;		Taking the two segments as an example, in the figure t1 = P4-16. 1. As shown in the figure, under this step-switching mode, the preset adjustment time is ineffective; once the previous sequence of position commands has been executed, the system immediately proceeds to the next command upon receiving a new step-switching signal. 2. In this mode, the step-change signal/CHGSTP is triggered by its rising edge. 3. After each segment operation is completed, the positioning completion and positioning approach signals remain valid. 4. During operation, the servo enable function is deactivated, causing the motor to shut down according to the servo OFF shutdown procedure. Upon completion of shutdown, the positioning operation is deemed invalid. 5. Adjustments made in this mode are invalid.
2 The signal rising edge initiates execution of all tasks sequentially without iteration.		Set two binary examples; in the figure, t1 = P4-16. 1. The /CHGSTP signal before a cycle is completed will not be counted, as shown in the second /CHGSTP signal in the figure. 2. In this mode, the step-change signal/CHGSTP is triggered by its rising edge. 3. After each segment operation is completed, the positioning completion and positioning approach signals remain valid. 4. During operation, the servo enable function is deactivated, causing the motor to shut down according to the servo OFF shutdown procedure. Upon completion of shutdown, the positioning operation is deemed invalid. 5. Adjustments made under this mode are effective.
4 /CHGSTP bilateral trigger		In the figure, t1 = P4-16. 1. The rising edge of /CHGSTP triggers the first segment, while the falling edge triggers the second segment. For the complete execution of the first segment, the /CHGSTP signal remains ON until the end of the first segment. 2. Only in this mode, the number of valid segments for P4-04 is invalid.

<table>
<tr><th>n.xx□x</th><th colspan="2">Define</th></tr>
<tr><td></td><td></td><td>3. After each segment operation is completed, the positioning completion and positioning approach signals remain valid.
4. During operation, the servo enable function is deactivated, causing the motor to shut down according to the servo OFF shutdown procedure. Upon completion of shutdown, the positioning operation is deemed invalid.
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 should not be assigned during operation of this mode.</td></tr>
<tr><td>5
/PREFA
(P5-57)、
/PREFB
(P5-58),
/PREFC
(P5-59):
Terminal selection section numbers, optional from section 1 to section 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 position)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>2 (position of the second paragraph)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>3 (position of the third paragraph)</td></tr>
</table>
1. After each segment operation is completed, the positioning completion and positioning approach signals remain valid.
2. During operation, the servo enable function is deactivated, causing the motor to shut down according to the servo OFF shutdown procedure. Upon completion of shutdown, the positioning operation is deemed invalid.
3. Adjustments made under this mode are effective.
4. The CHGSTP step-change signal is invalid only in this mode.
5. The section number selection terminal can either trigger step switching at the edge or remain in the ON state. This mode supports continuous repeated triggering of a specific section. If the terminal remains ON, the motor will stop upon receiving an overtravel signal; in this case, the terminal must be switched to the OFF state. Otherwise, the motor will continue executing the position section even after the overtravel signal is canceled.</td></tr>
<tr><td>6
/PREFA
(P5-57)、
/PREFB
(P5-58)、
/PREFC
(P5-59)、
/P PREFD
(P5-60)</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 position)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2 (position of the second paragraph)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>3 (position of the 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 (position of the fifth paragraph)</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>n.xx□x</th><th>Define</th></tr>
<tr><td>terminal selection section number, optional from section 1 to 16</td><td>
<table>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>6 (position of the sixth paragraph)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>7 (position of the seventh paragraph)</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 (position of the ninth paragraph)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>10 (position of the tenth paragraph)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>11 (Location of Paragraph 11)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>12 (position of the twelfth paragraph)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>13 (position of the thirteenth paragraph)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>14 (position of paragraph 14)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>15 (position of paragraph 15)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16 (position of paragraph 16)</td></tr>
</table>
Note: The rising edge of the P5-35 step-change signal triggers each position segment (the rising edge is invalid during operation).
1. During operation, the servo enable function is deactivated, causing the motor to shut down according to the servo-off shutdown procedure. Upon completion of shutdown, the positioning command becomes invalid.
2. Adjustments made in this mode are invalid.
3. After each segment operation is completed, the positioning completion and positioning approach signals remain valid.
4. After selecting the segment number, the position segment must be activated only when the rising edge of the P5-35/CHGSTP step-change signal is triggered; triggering during segment operation is invalid.
5. The terminal logic for section number selection is level-sensitive: high input levels are valid, while low input levels are invalid.
</td></tr>
</table>

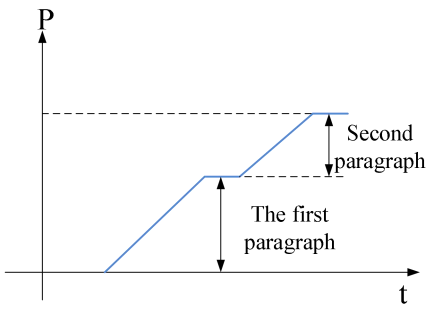
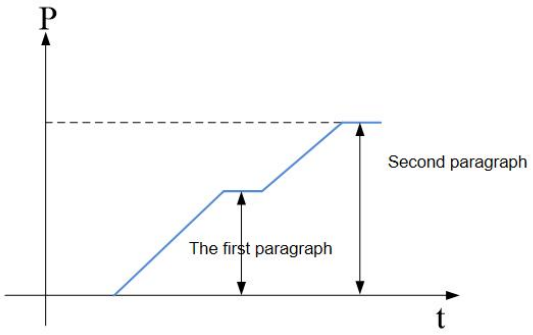
Use the following input signals to switch between internal positions 1-3/1-16.

Parameter	Signal name	Leave the factory Setting	Applicable Mode	Set range	Revise	Take effect
P5-57	Internal Position First Segment Position Selection/PREFA	n.0000	5	The parameter range is 0000–0014, allocated to other input interfaces via	at any time	immediately

				parameters P5–57.		
P5-58	Internal Position Second Segment Position Selection/PREFB	n.0000	5	The parameter range is 0000–0014, allocated to other input interfaces via parameter P5–58.		
P5-59	Internal Position Third Segment Position Selection/PREFC	n.0000	5	The parameter range is 0000–0014, allocated to other input interfaces via parameters P5–59.		
P5-60	Internal Position Section 4 Position Selection/PREFD	n.0000	5	The parameter range is 0000–0014, configured via parameters P5–60 to other input interfaces.		

3) Positioning Mode

n.xxx□	Meaning
0	relative localization
1	Absolute Positioning

0: Relative Positioning	1: Absolute positioning (using the "reference origin" as the zero point for absolute positioning)
	

8.1.3.3 Parameter settings for paragraphs 1 to 35

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P4-10+（n-1)*7	Pulse count (low bit)	0	1 Pulse	-9999 ~ 9999	Edit anytime	immed iately
P4-11+（n-1)*7	Pulse count (high bit)	0	10,000 pulses	-32768 ~ 32767	Edit anytime	immed iately

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P4-12+（n-1)*7	speed	0	0.1rpm	0～65535	Edit anytime	immed iately
P4-13+（n-1)*7	Trapezoidal acceleration time	0	ms	0～65535	Edit anytime	immed iately
P4-14+（n-1)*7	Trapezoidal deceleration time	0	ms	0～65535	Edit anytime	immed iately
P4-15+（n-1)*7	retention parameter	-				
P4-16+（n-1)*7	adjust the time	0	ms	0～65535	Edit anytime	immed iately

Explanation ：

1) Set the pulse count = (high-order bit pulse count) × 10000 + (low-order bit pulse count);
2) In the formula P4-10+ (n-1)*7, n represents the segment number of the internal position, ranging from 1 to 35; parameters for segments 1–12 can be configured via the panel, while parameters for segments 13–35 must be written through communication (RS232 or RS485).
3) In relative positioning mode, if the pulse high level is set to 9999 and the pulse low level is set to 9999, or the pulse high level is set to-9999 and the pulse low level is set to-9999, and P4-03.2 = 1 (indicating no waiting for positioning completion), the system enters infinite pulse mode. Otherwise, the number of pulses emitted is limited.
4) If the speed of any section is set to zero, the system will skip that section during execution and proceed to the next section.
5) In relative positioning mode, if the speed setting for a segment is non-zero but the pulse count is zero, the motor in that segment will not operate during execution. However, its designated waiting mode remains active—meaning it must wait until the adjustment period concludes before proceeding to the next segment.
6) In absolute positioning mode, if the speed setting for a specific section is non-zero but the pulse count is set to zero, the motor will return to the reference origin at the preset speed when executing that section.
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 corresponding waiting mode remains active.
8) In absolute positioning mode, the number of motor rotations is finite and cannot be unlimited.
9) Currently, the position segments in the internal positioning mode support only two velocity types: step velocity and ramp velocity, with no other velocity forms available. When the trapezoidal acceleration time and deceleration time are set to 0, the system operates in step velocity mode; when these times exceed 0, it operates in ramp velocity mode.
10) The trapezoidal acceleration time and trapezoidal deceleration time 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 instruction for that segment will be ignored under step-change modes 0/1/2. Under step-change modes 4/5/6, the motor remains stationary when the position in that segment triggers a step change.

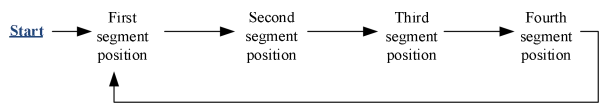
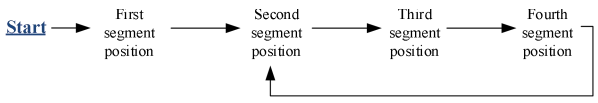
Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
12) The position commands for setting the pulse high and pulse low levels in the internal position segment parameters remain influenced by the electronic gear ratio. The actual number of motor rotations is determined by combining the configured pulse commands with the electronic gear ratio. 13) In absolute positioning mode, the starting position for each step change is determined based on the initial position when the step change is first triggered. In relative positioning mode, the starting position for each step change is determined based on the position at the end of the previous step change. 14) In relative positioning mode, an unlimited number of pulse position segments can be set at position 35. However, when reaching this segment, the motor will continue operating unless a trigger is issued to skip the current segment.						

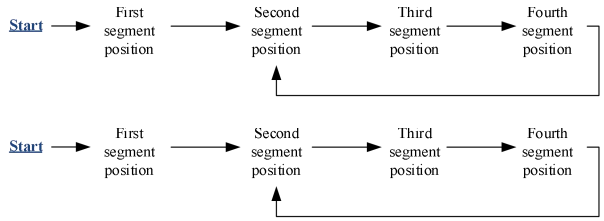
The internal configuration consists of 35 sections. If process requirements necessitate switching between operating sections 1–10 and section 5, this can be configured through the valid section count setting. For example, if parameters are set for all sections 1–10, the valid section count for P4–04 is set to 5, meaning sections 1–5 are valid; if set to 10, sections 1–10 are valid.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P4-04	Number of valid entries	0	-	0 ~ 35	servo bb	immediately

P4-08 sets the starting run segment number after the first round; only the step-switching mode P4-03.1 has valid settings of 0 or 1. The following Explanations the configuration: valid settings are available for segments No.1 through No.8.

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
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	

Step change mode	Set up	Parameter setting	Specific phenomenon
	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 must be triggered by the rising edge.

8.1.3.4 Step change signal (/CHGSTP)

Parameter	Signal name	Setting	Meaning	Modification scope
P5-35	Step change signal/CHGSTP	n.0000	Default: no terminal input assigned. Refer to 8.1.3.2 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 that the signal is input from terminal SI1.

8.1.3.5 Skip the current segment signal (/ZCLAMP)

Parameter	Signal name	Setting	Meaning	Modification scope
P5-31	Skip current section/Z-CLAMP	n.0000	Default unallocated terminal input	The parameter range is 0000–0014, allocated to the input interface via parameters P5–31. When set to 0001, it indicates signal input from terminal SI1.

Under different step-switching modes, skipping the current segment produces different effects, as shown below:

Step change mode P4-03 n.xx□x	Skip the current section	Action
0	/Z-CLAMP	Cancel the current section and proceed to the next one immediately.
1		Cancel the current segment; execute the next segment when the step change signal is activated.
2		Cancel the current section and proceed to the next one immediately.
4		Cancel the current segment; the next segment is executed upon the falling edge of the /CHGSTP step change signal.

Step change mode P4-03 n.xx□x	Skip the current section	Action
5		Cancel the current paragraph. Select another paragraph and apply the corresponding paragraph settings.
6		Current segment canceled; the /CHGSTP step signal's rising edge executes the selected position segment.

8.1.3.6 Exercise Start Signal (/MRUN)

Parameter	Signal name	Factory settings	Meaning	Revise
P5-50	Exercise Start/MRUN	n.0000	Default: no terminal output assigned. This function is only valid in the internal position mode, similar to the positioning completion signal in the external pulse mode; there is an output when the motor is running and none when it stops.	The parameter range is 0000–0014, allocated to the output interface via parameters P5–50. When set to 0001, it indicates signal output from terminal SO1.

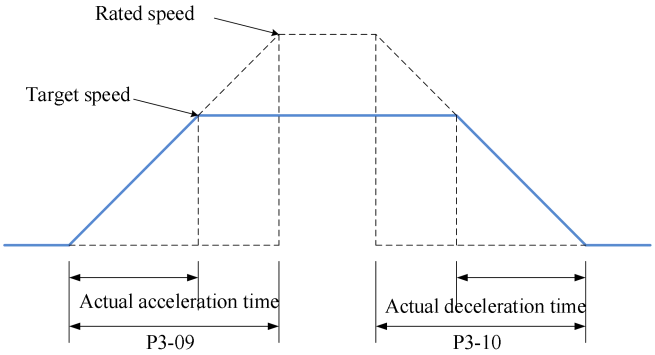
8.2 Control

8.2.1 General Control for Speed Mode

8.2.1.1 Soft Start

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
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

The soft start acceleration/deceleration time applies to modes 3/4/7; smooth speed control is achievable when entering a step-speed command or selecting an internally set speed.
P3-09: Time from the stop state to reaching the rated speed;
P3-10: Time from operating at rated speed to stopping.



8.2.1.2 Zero Clamping Function (/ZCLAMP)

1) Functional Overview

This upper-level device utilizes a "speed command" input and is designed for systems without a "position loop" configuration. It should be activated even when the speed command is non-zero, specifically for stopping the motor while the servo is in a locked state.
When the "Zero Clamping" function is set to "ON", the motor is temporarily positioned at an internal configuration point, where it undergoes clamping within ±1 pulses. Even when rotated by external force, the motor returns to the zero-clamped position.
When using zero clamping, the current speed must be below the zero clamping speed for the function to activate, securing the motor shaft in place. Upon enabling the zero clamping function, the motor switches from speed mode to position mode. In this state, rotating the motor shaft and then releasing it will return it to its original position, whereas rotating the shaft in speed mode will not restore it to its original position due to the absence of position feedback.

2) Input Signal Setting

Parameter	Signal name	Setting	Meaning	Modification scope
P5-31	Zero Clamping/ZCLAMP	n.0000 (default)	Default: No output terminals assigned	The parameter range is 0001–0014, which can be assigned to other input terminals via parameter P5–31.
		n.0002	Input signal via SI2 terminal	

3) Relevant parameter settings

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
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 set to 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 set to ON and the feedback speed falls below P3-13, the system switches to position mode control and locks the position servo. Note: Once the zero-clamping mode is activated, the P3-13 motor will not operate even at specified speeds. The motor reverts to normal operation only when the ZCLAMP input signal is set to OFF.
3	When the ZCLAMP input signal is ON and the set speed falls below P3-13, the system switches to position mode control and locks the motor at that position. If the set speed exceeds P3-13, the motor resumes operation.

8.2.1.3 Speed arrival signal (/V-RDY)

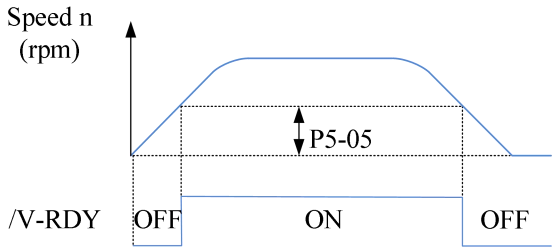
- Relevant parameter

Parameter	Signal name	Factory settings	Applicable mode	Meaning	Revise	Take effect
P5-51	Speed arrival/V-RDY	n.0000	3、4、7	Speed Detection Signal	at any time	immediately

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P5-05	Detection speed reached	1000	rpm	0 ~ 10000	at any time	immediately

1) Speed reaches the signal output condition

When the actual motor speed exceeds the detection speed specified in P5-05, the output speed reaches the signal (/V-RDY).

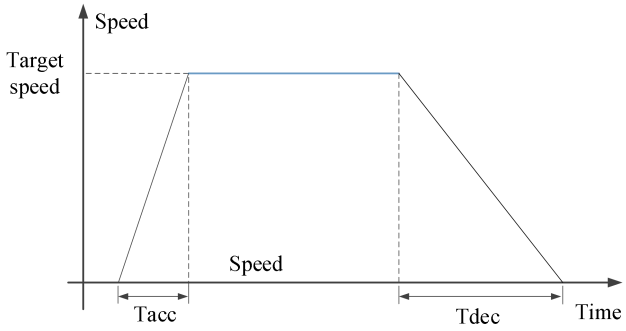


8.2.1.4 Speed Command Filter

- relevant parameter

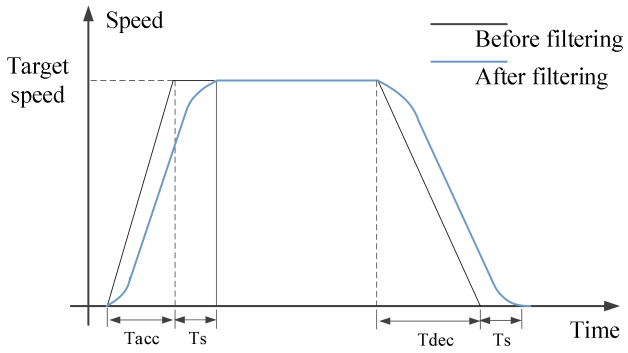
Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P1-23	Speed command filter time constant	0	0.1ms	0 ~ 65535	servo bb	immediately
P3-09	acceleration time	200	1ms	0 ~ 65535	servo bb	immediately
P3-10	deceleration time	200	1ms	0 ~ 65535	servo bb	immediately
P3-11	Sliding average filter time constant	0	0.1ms	0 ~ 65535	servo bb	immediately

First, set P3-09 and P3-10. Plan the acceleration and deceleration times for the speed command.



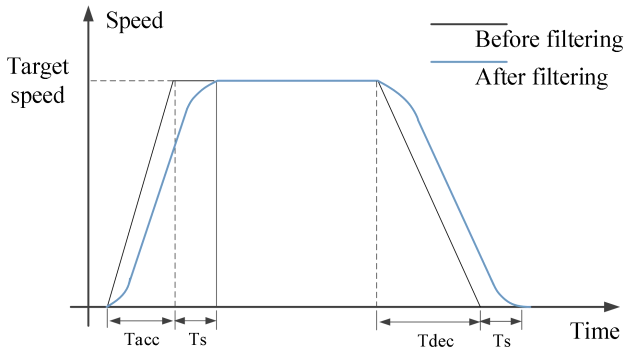
Specifically, the acceleration time Tacc = (target speed / rated speed) × P3-09 [ms], and the deceleration time Tdec = (target speed / rated speed) × P3-10 [ms].

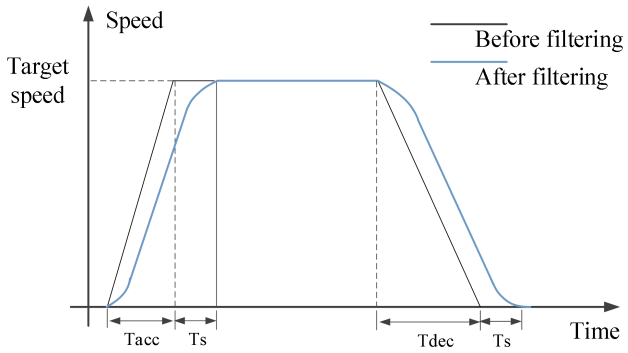
Set an appropriate moving average filter time constant P3-11 (S-type acceleration/deacceleration time constant). Ts = P3-11 × 0.1 [ms].



The sliding average filter time constant must meet the specified requirements: Ts <0.5*Tacc and Ts <0.5*Tdec. Otherwise, an excessively large sliding average filter time will result in increased deceleration times, violating the settings outlined in P3-09 and P3-10.

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





When acceleration and deceleration are applied, the first-order low-pass filter increases the lag of the speed command.

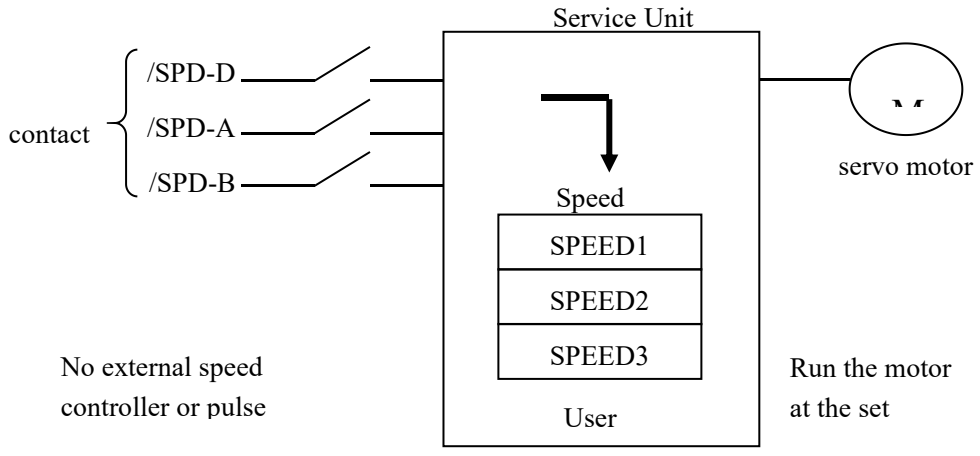
8.2.2 Speed control (internal speed setting)

Parameter	Essentials	Reference chapter
P0-01 Control Method Selection	Set to 3: Internal speed control mode	8.2.2.1 Internal Speed Mode
P3-05 Internal Set Speed 1 P3-06 Internal Set Speed 2 P3-07 Internal Set Speed 3	Internal three-speed speed value setting, unit: rpm	8.2.2.1 Internal Speed Mode
P5-28 Internal Speed Selection/SPD-A P5-29 Internal Speed Selection/SPD-B	The combination of terminals determines the corresponding section speed.	8.2.2.1 Internal Speed Mode
P5-27 Internal Speed Direction Selection/SPD-D	Switch direction; the default is n.0000. By applying a commutation signal through terminal SI2, P5-27 can be set to n.0002.	8.2.2.1 Internal Speed Mode
P3-09 Soft-start acceleration time P3-10 Soft-start deceleration time	Set acceleration and deceleration times in ms	8.2.1.1 Soft Start

8.2.2.1 Internal Speed Mode

Parameter	Set value	Meaning	Revise	Take effect
P0-01	3	Speed Control: Internal speed selection	servo bb	immediately

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



- relevant parameter

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
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 settings	Set range	Revise	Take effect
P5-27	Internal Direction Selection/SPD-D	n.0000	The parameter range is 0000–0014, allocated to other input interfaces via parameters P5–27.	at any time	immediately
P5-28	Internal speed selection/SPD-A	n.0000	The parameter range is 0000–0014, allocated to other input interfaces via parameters P5–28.		
P5-29	Internal speed selection/SPD-B	n.0000	The parameter range is 0000–0014, allocated to other input interfaces via parameters P5–29.		

1) Correlation between operating speed and terminal signals

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<Reversal>	0	0	Internal instruction: 0-speed
	0	1	P3-05：SPEED1
	1	1	P3-06：SPEED2
	1	0	P3-07：SPEED3

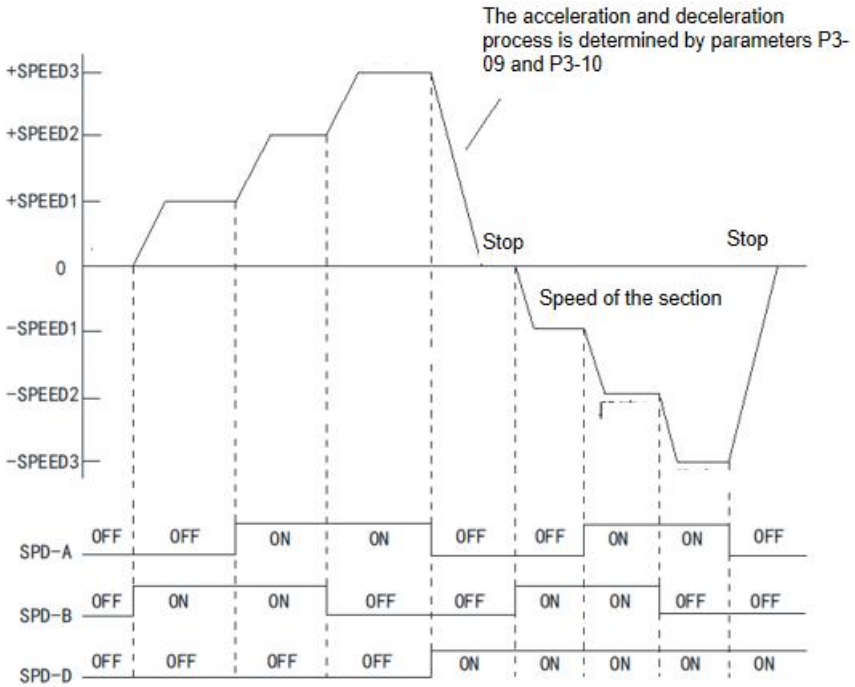
- The SPD-D signal controls direction; the input SI terminals can be modified according to P5-27. The validity of the terminal signal determines the motor direction.
- The combination of the validity of the SPD-A and SPD-B input terminals determines the multi-stage speed.
- In the table above, both 0 and 1 indicate the validity of the signal. The 0 terminal input is invalid, while the 1 terminal input is valid.

2) Terminal Validity Description

The table below uses /SPD-D as an example; the same applies to /SPD-A and /SPD-B signals.

Parameter Setting Status	Signal/SPD-D terminal input status	Signal/SPD-D Terminal Logic
P5-27=n.0000	No external terminal input 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	

3) Operation Example



8.2.3 Speed control (pulse frequency command)

The DS5C2 series supports this feature only in the power range of 15 kW to 32 kW.

Parameter	Essentials	Reference chapter
P0-01 Control Method Selection	Set to 7: External jog speed Mode	8.2.3.1 External jog speed Mode
P0-10 Pulse Instruction Pattern	Set pulse shape 0：CW/CCW 2：P+D	8.1.2.2 Positive Direction and Pulse Shape of Pulse Instructions
P0-15 Command pulse frequency at rated speed	Determine the linear relationship between the pulse frequency and the rotational speed	8.2.3.3 Command pulse frequency at rated speed
P0-16 Speed command pulse filtering time	When the instruction pulse frequency is relatively low, appropriately setting this parameter can reduce speed fluctuations.	8.2.3.4 Speed Command Pulse Filtering Time
P5-71 jog speed Mode Direction Terminal Function Selection	Change pulse direction	8.2.3.5 Direction Selection for Speed Command Pulse

8.2.3.1 External jog speed Mode

Parameter	Set value	Meaning	Revise	Take effect
P0-01	7	Speed Control: Pulse Frequency Speed Command	servo bb	immediately
Function Overview: The speed command is determined by the frequency of the external pulses and is independent of the total number of pulses. The circuit connection and position instructions are identical, allowing selection of CW/CCW modes, AB phases, or a "direction + pulse" pulse configuration.				

8.2.3.2 Pulse Frequency Instruction

The pulse frequency instruction is the same as when using position control (external pulse sequence instruction).

8.2.3.3 Frequency of the command pulse at the rated speed

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect

P0-15	The rated speed corresponds to the pulse frequency.	1000	100Hz	0 ~ 10000	servo bb	immediately
Note: The unit used here is 100 Hz. For example: When the P0-15 parameter is set to 300, the command pulse frequency at the corresponding rated speed is 30 kHz. When the P0-15 parameter is set to 1000, the command pulse frequency at the corresponding rated speed is 100 kHz.						

8.2.3.4 Speed command pulse filtering time

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-16	Speed command pulse filtering time	100	0.01ms	0 ~ 10000	servo bb	immediately
When the instruction pulse frequency is relatively low, appropriately setting this parameter can reduce speed fluctuations.						

8.2.3.5 Direction selection for speed command pulses

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P5-71	jog speed mode direction terminal function selection	0	-	0 ~ 1	servo bb	immediately

8.3 Torque control

Parameter	Essentials	Reference chapter
P0-01 Control Method Selection	Set to 1: Internal torque mode	8.3.1 Torque Control (Internal Setting)
P3-33 Internal Torque Command Given	The given value is the percentage of the rated torque.	8.3.1.1 Internal torque command setting
P3-16 Internal forward speed limit during P3-16 torque control P3-17 Internal reverse speed limit during torque control P3-14 Forward maximum speed limit (MAX speed) P3-15 Reverse maximum speed limit (MAX speed)	Speed limit in torque mode	8.3.1.2 Internal speed limit during torque control
P5-27 Speed Direction Switching/SPD-D	The direction switch defaults to n.0000; if the direction is specified via the SI2 terminal, P5-27 can be set to n.0002.	

8.3.1 Torque control (internally set)

Parameter	Set value	Meaning	Revise	Take effect
P0-01	1	Torque control: Internally set	servo bb	immediately
Function Overview: Uses the internally set torque as the torque command for torque control.				

8.3.1.1 Internal torque command specified

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P3-33	Internal torque command specified	0	1% rated torque	-1000 ~ +1000	at any time	immediately
This parameter is set in units of 1% of the rated torque, with positive and negative values indicating forward and reverse motor rotation respectively. For example: When P3-33 is set to 50, it indicates the motor is rotating forward at 50% of its rated torque. Set P3-33 to-20, indicating the motor operates in reverse at 20% of its rated torque. In addition to controlling the servo direction using torque values, the /SPD-D command can also be used to regulate the direction.						

8.3.1.2 Internal speed limit during torque control

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P3-16	Internal forward speed limit during torque control	Motor rated	rpm	5 ~ 10000	at any time	immediately
P3-17	Internal reverse speed limit during torque control	Motor rated	rpm	5 ~ 10000	at any time	immediately
Note: Even if the set speed for this parameter exceeds the P3-14 speed limit, the actual effective speed limit is only the lower value. (The maximum speed is the smaller of P3-14/P3-15 and P3-16/P3-17.)						

8.3.1.3 Speed Limit Detection (/VLT)

In torque mode, if the absolute value of the servo motor's actual speed exceeds the speed limit, the servo motor's actual speed is considered 受限, and the servo driver may output a VLT signal. Conversely, if neither condition is met, the speed limitation signal is invalid.

Parameter	Signal name	Factory settings	Applicable mode	Meaning	Revise	Take effect
P5-43	/VLT	n.0000	1、2	Speed Limit Detection	at any time	immediately
By default, no terminals are assigned, with parameter values ranging from 0000 to 0014, which are allocated to the output interface via parameter P5-43. When set to 0002, it indicates signal output from the SO2 terminal. The <VLT signal is only effective in torque mode.						

9 EtherCAT bus communication

9.1 Overview of EtherCAT Technology

This section primarily introduces the fundamental concepts, system architecture, communication specifications, and connection requirements of EtherCAT.

9.1.1 EtherCAT Overview

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

The XG2, XDH, or XLH series controllers (master stations) and DS5C2 servo drives (slave stations) comply with the standard EtherCAT protocol, supporting up to 64 slave axes with a 4 ms synchronization cycle, Touch Probe functionality, and multiple control modes including position, speed, and torque. They are widely applicable across various industrial applications.

9.1.2 System Composition (Main Station and Slave Station)

The etherCAT connection architecture is a linear network system that links the master station (FA controller) with multiple slave stations.

The number of nodes that can be connected from the station depends on factors such as the master station's processing or communication cycle, and the number of bytes transmitted.

9.2 EtherCAT Communication Specification

This section primarily covers EtherCAT's frame structure, state machine, ESC, SDO, PDO, SII regions, and communication synchronization modes.

9.2.1 Communication specifications table

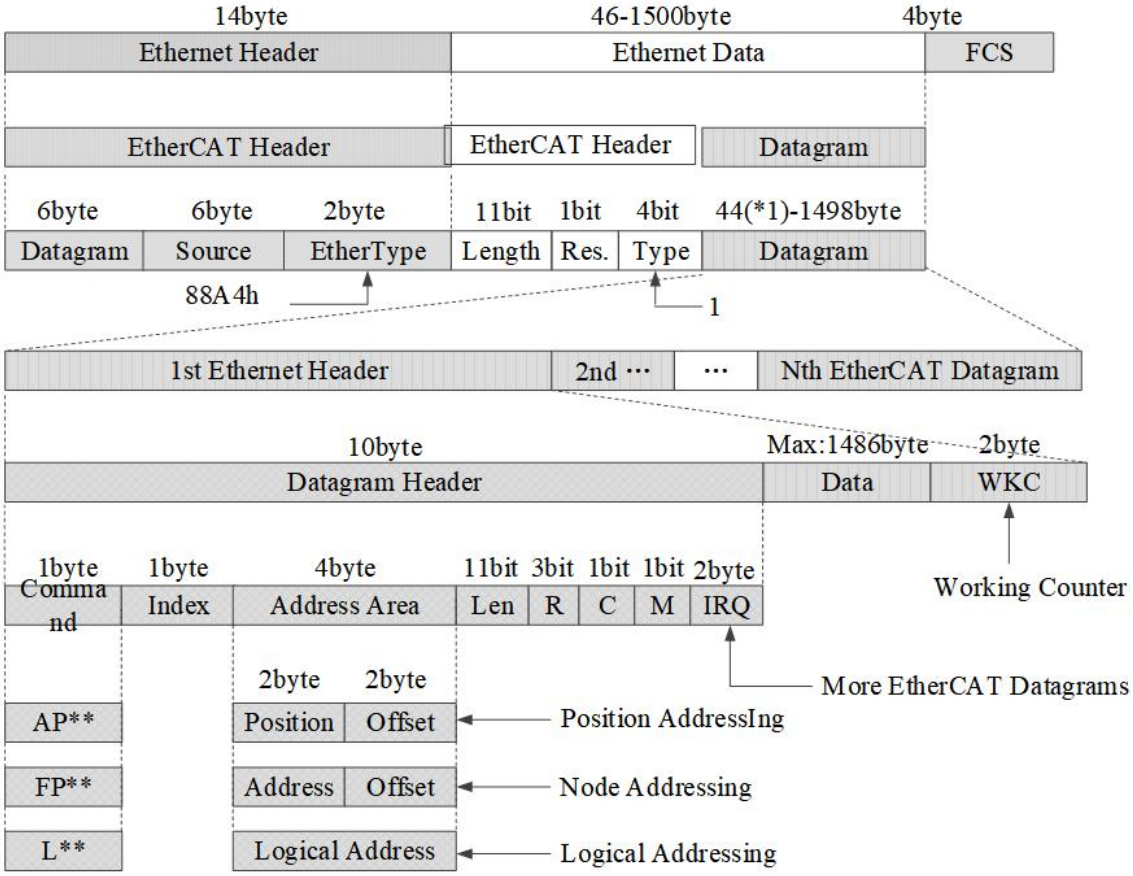
<table>
<tr><th>Project</th><th>Specifications</th></tr>
<tr><td>physical layer</td><td>100BASE-TX（IEEE802.3)</td></tr>
<tr><td>Baud rate</td><td>100 [Mbps] (Full Duplex)</td></tr>
<tr><td>topology</td><td>Line</td></tr>
<tr><td>tie cable</td><td>JC-CB/JC-CA twisted pair cable (shielded twisted pair cable)</td></tr>
<tr><td>Cable length</td><td>The maximum distance between nodes is 50 m.</td></tr>
<tr><td>Communication Port</td><td>2 Port（RJ45)</td></tr>
<tr><td>EtherCAT indicator light (LED)</td><td>[Run] RUN indicator light</td></tr>
<tr><td>Station Alias（ID)</td><td>Range: 0–65535
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 (Periodic synchronous position control mode)</td></tr>
<tr><td>PP</td><td>Profile Position Mode (Profile Position Control 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 (Profile Speed Control Mode)</td></tr>
<tr><td rowspan="2">torque</td><td>Cst</td><td>Cyclic synchronous torque mode (Periodic synchronous torque control mode)</td></tr>
<tr><td>Tq</td><td>Torque Profile Mode (Profile Torque Control Mode)</td></tr>
</table>
</td></tr>
<tr><td>Touch Probe</td><td>Route 2</td></tr>
<tr><td>Synchronized Mode</td><td>DC (concurrent with the SYNCO event)</td></tr>
<tr><td>Cyclic time (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 PDO allocation per site</td><td>TxPDO: 4 [pieces] RxPDO: 4 [pieces]</td></tr>
<tr><td>Maximum byte count for a single PDO station</td><td>TxPDO：32[byte]　　RxPDO：32[byte]</td></tr>
</table>

Email communication interval in PreOP mode	1ms
mail box	SDO requests and SDO information

The meanings of SDO and PDO are Explanationed in Section 9.2.3, State Machine ESM.

9.2.2 Ethercat frame structure

EtherCAT is an industrial communication protocol based on Ethernet that enables real-time control. It simply extends the IEEE 802.3 Ethernet specification without altering its fundamental architecture, allowing it to transmit data directly within standard Ethernet frames.
Since the EtherType in the Ethernet Header is "88A4h", the subsequent Ethernet Data is processed as an EtherCAT frame.
An EtherCAT frame consists of an EtherCAT header and one or more EtherCAT subframes, which are further subdivided. EtherCAT frames with Type=1 in the header alone are processed according to the ESC protocol.



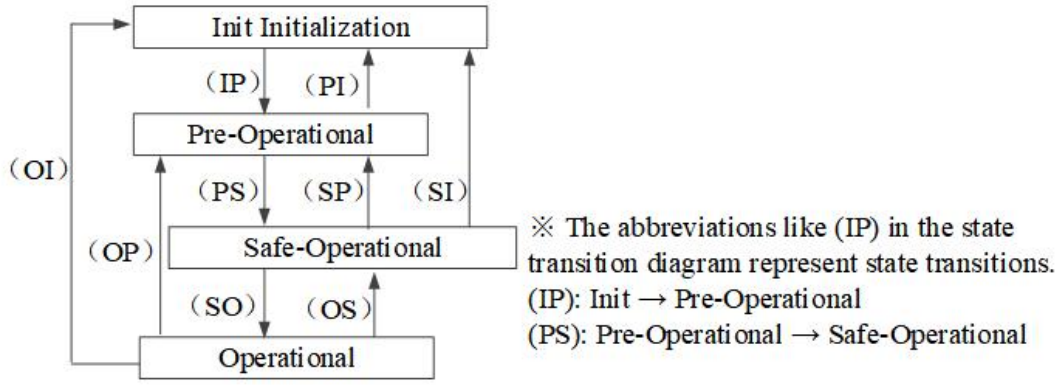
EtherNet/EtherCAT frame structure

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

9.2.3 State machine ESM

ESM stands for EtherCAT State Machine, which coordinates the state relationships between master and slave applications during initialization and operation.
The state change request is executed by the master station, which sends a control request to the application-layer service. The latter generates an application-layer control event in the slave station, which responds to the application-layer control service via its local application-layer state-writing service upon successful or failed completion of the state change request. If the state change fails, the slave station retains its current state and sets an error flag.

The figure below shows the state transition diagram of ESM:



Init: Initial state;
Pre-Operational: Pre-operational status;
Safe-Operational: A safe operating condition;
Operational: Operational status;

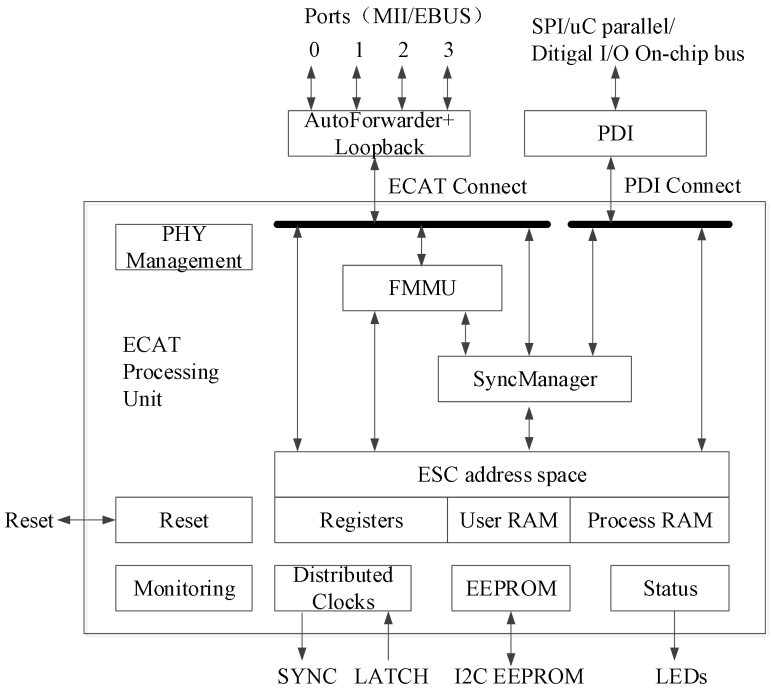
Slave station Status	Actions in each state	Communication Action		
		Send and receive SDO (email) messages	PDO post letters	PDO recipe letters
Initialization State	Communication initialization: SDO and PDO cannot send or receive messages.	-	-	-
Pre-run state	The status of SDO transmission and reception only	Yes	-	-
Safe operating status	The status where only SDO transmits and receives messages, while PDO transmits messages.	Yes	Yes	-
running state	The SDO and PDO can both send and receive messages under this state.	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.
The PDO (Process Data Object) is used to transmit periodic communication data.
The SDO (Service Data Object) is used to transmit non-periodic communication data.
Performing commands or interface operations during an ESM state transition may cause communication errors.

9.2.4 Station controller ESC

9.2.4.1 Principle Overview

ESC stands for EtherCAT Slave Controller. The communication process is entirely handled by the ESC, which features four data transmission and reception ports, each equipped with a TX and RX module. Each port can transmit and receive Ethernet data frames. Data flows through the ESC in a fixed sequence: Port 0 → Port 3 → Port 1 → Port 2 → Port 0. If an ESC detects that a port lacks an external PHY, it automatically closes that port and forwards traffic internally to the next port via a loop.



9.2.4.2 Address space

The DS5C2 series has a physical address space of 8 KB.
The initial 4 KB (0000h–0FFFh) serves as register space, while the additional 4 KB (1000h–1FFFh) is allocated to process data PDO within the RAM domain. For detailed register specifications, refer to the datasheets of IP components (ET1810/ET1811/ET1812).

ESC register byte address	Length (Byte)	Explanation	Initial value *1
Station Controller Information			
0000h	1	type	04h
0001h	1	Revision	02h
0002h~0003h	2	Build	0040h
0004h	1	FMMUs supported	03h
0005h	1	SyncManagers supported	04h
0006h	1	RAM Size	08h
0007h	1	Port Descriptor	0Fh
Station Controller Information			
0008h~0009h	2	ESC Features supported	0184h
Site location			
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			

ESC register byte address	Length （Byte)	Explanation	Initial value *1
0600h~062Fh	3x16	FMMUs[2:0]	-
+0h~3h	4	Logical Start Address	-
+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	-
Distributed Clocks（DC)-SYNC Out Unit			
098Eh	1	SYNCO Status	-
…			
0990h~0993h	4	Start Time Cyclic Operation/Next SYNC0 Pulse	-
…			
09A0h~09A3h	4	SYNC0 Cycle Time	-
…			

9.2.5 SII region （0000h~03Fh)

In the ESC configuration area (EEPROM word addresses 0000h to 0007h), the Configured Station Alias is automatically read from the ESC and written into the ESC registers upon power startup. To reflect the updated values from the SII EEPROM in the ESC registers, a separate power startup is required. Additionally, the initial values of the IP cores (ET1810/ET1811/ET1812) are set. For detailed information, refer to the data sheets of the IP cores (ET1810/ET1811/ET1812).

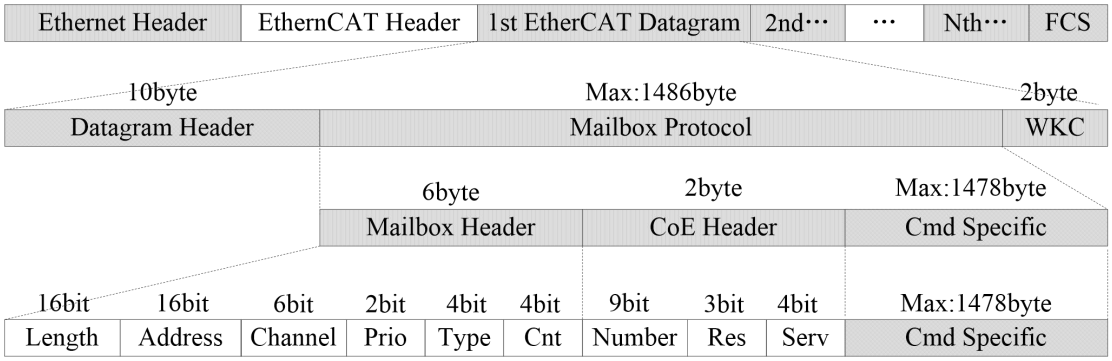
9.2.6 SDO (Service Data Object)

The DS5C2 series supports SDO (Service Data Object). Since SDO data exchange utilizes Mailbox communication, the SDO data refresh rate becomes unstable.

The master station reads and writes data from records in the object dictionary, enabling object configuration and monitoring of various slave states. Responses to read/write operations on the SDO require time. For objects refreshed via PDO, avoid using the SDO for refresh; instead, override the values using PDO.

9.2.6.1 Mailbox frame structure

The frame structure of Mailbox/SDO is shown below. For details, refer to the ETG specification documents (ETG1000-5 and ETG1000-6).



Frame section	List range	Data type	Function
MailBox Header	Length	WORD	Mailbox data length
	Address	WORD	Source site address
	Channel	Unsigned6	（Reserved）
	Prority	Unsigned2	Priority
	Type	Unsigned4	Mailbox mould 00h: Error 01h：（Reserved） 02h: EoE (not corresponding) 03h：CoE 04:00: FoE (not corresponding) 05:00: SoE (not applicable) 06h-0Eh：（Reserved） 0Fh: VoE (not corresponding)
	Cnt	Unsigned3	Mailbox Counter
	Reserved	Unsigned1	（Reserved）
CoE Header	Number	Unsigned9	Reserved
	Reserved	Unsigned3	Reserved
	Service	Unsigned4	Information-based
Cmd specific	Size Indicator	Unsigned1	Data Set Size License
	Transfer Type	Unsigned1	Normal Transfer/Expedited Transfer Option
	Data Set Size	Unsigned2	specified data size
	Complete accessibility	Unsigned1	Selection of object access methods (not specified)
	Command Specfier	Unsigned3	Upload/Download Selection of requirements/responses, etc.

Frame section	List range	Data type	Function
	Index	WORD	Object index
	Sub Index	BYTE	The object's Sub- index
	-	-	The object's data or an Abort message, etc.

9.2.6.2 Mailbox timeout

This servo driver performs the following timeout settings in Mailbox communication.
Mailbox request timeout: 100 ms
The master station sends a request to the slave station (driver). If the WKC value in the transmission data of the request frame is updated, the slave station is considered to have received the request successfully. The process repeats until the WKC is updated; however, if the WKC remains unchanged within the specified time limit, the master station times out.
Mailbox response timeout: 10 seconds
The master station receives responses to requests from slave stations (drives). If the WKC is updated, this is considered a successful response reception. If the response indicating WKC update is not received by the specified time, the master station times out.
The maximum time required for the station (driver) to complete its response.

9.2.6.3 Information during abnormal alarm

1) Alarm Code

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

000h ~ FEFFh is defined according to IEC 61800-7-201.

The ranges FF00h to XXXXXh are defined by the manufacturer, as specified below.

Index	Sub index	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 display the primary alarm number. When no alarm occurs, display 0000h. When an alarm occurs, the alarm (main) number (00h ~ FFh) displays FF**h. example ： ① When a general alarm such as E-030 (overvoltage protection) occurs, 603F = 30d ② Bus-related alarms such as E-850 (TxPDO configuration anomaly protection) and E-851 (RxPDO configuration anomaly protection). 603F = FF55h... 55h = 85d, meaning either the E-850 or E-851 model is involved. As an exception, in the case of E-817 (SyncManager2/3 configuration error), A000h is displayed.				

2) Alarm type (status)

The error register returns the same value as 1001h.

<table>
<tr><th>Index</th><th>Sub index</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">Show the type of alarm (status) occurring in the servo driver.
When no alarm occurs, display 0000h.
Do not display 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 occurrence of an alarm*1</td></tr>
<tr><td>5</td><td>nonsupport</td></tr>
<tr><td>6</td><td>Keep</td></tr>
<tr><td>7</td><td>An alarm with an AL status code not defined occurred*2</td></tr>
</table>
*1: The term "alarm defined by the AL status code" refers to communication-related anomalies in EtherCAT, specifically codes E-800-7, E-810-7, and E-850-7.
*2: The term "alarm with an undefined AL status code" refers to communication-related EtherCAT anomalies (E-880–887) and non-communication-related EtherCAT anomalies.</td></tr>
</table>

9.2.7 PDO (Process Data Object)

The DS5C2 series supports PDO (Process Data Object).
Real-time data transmission based on EtherCAT is achieved through data exchange via PDO (Process Data Object).
PDO includes RxPDO for data transfer from the master station to slave stations, and TxPDO for data transfer from slave stations back to the master station.

	Sender	Receiving party
RxPDO	main station	From Station
TxPDO	From Station	main station

9.2.7.1 PDO Mapping Object

PDO mapping refers to the correspondence between an object dictionary and the corresponding PDO application object.
The table for DS5C2 series PDO mapping supports mapping objects from RxPDO (1600h–1603h) and TxPDO (1A00h–1A03h).

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

TxPDO：32[byte]　　RxPDO：32[byte]

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

Index	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

9.2.7.2 PDO Allocation Object

For PDO data exchange, the table used for PDO mapping must be allocated to SyncManager. The relationship between this mapping table and SyncManager is defined by the PDO allocation object. In the DS5C2 series, the PDO allocation objects can utilize RxPDO (SyncManager2) with 1C12h or TxPDO (SyncManager3) with 1C13h.
The maximum number of application objects that a mapping object can map is as follows:

RxPDO：4 [Table]（1600h～1603h)。

TxPDO：4 [Table]（1A00h～1A03h)。

Usually, mapping one object is sufficient, so the default setting requires no changes.

Example of setting an PDO allocation object:
The assignment of mapping object 1600h to allocation object 1C12h (Sync Manager Channel 2).

Index	Sub	Object contents
1C12h	00h	01h
	01h	1600h
	02h	0000h
	03h	0000h
	04h	0000h

The assignment of mapping object 1A00h to allocation object 1C13h (Sync manager channel 3).

Index	Sub	Object contents

Index	Sub	Object contents
1C13h	00h	01h
	01h	1A00h
	02h	0000h
	03h	0000h
	04h	0000h

9.2.8 Communication Synchronization Mode

The DS5C2 series supports the following synchronization modes.

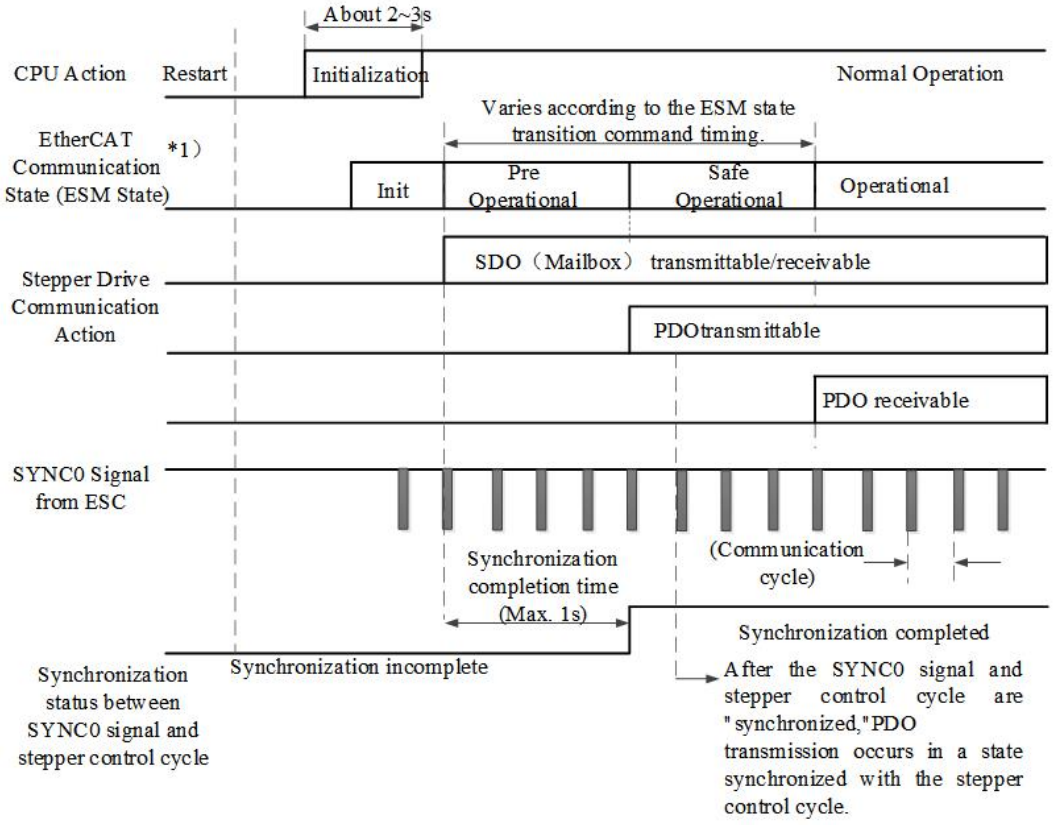
Synchronization Mode	Content	Synchronization method	Feature
DC	SYNC0 event synchronization	Synchronize the time information of other slaves using the time on the first axis as the reference.	high-accuracy Compensation processing is required on the main station side.
SM2	SM2 Event Synchronization	Sync based on the RxPDO's receipt time	No transmission delay compensation; poor accuracy The transmission time must be maintained on the controller side (e.g., through dedicated hardware).
FreeRun	nonsynchronous	nonsynchronous	Simple to handle Poor real-time performance

9.2.8.1 DC (SYNC0 event synchronization)

The DS5C2 series features a 64-bit DC (Distributed Clock) architecture.

The synchronization in EtherCAT communication is performed based on this DC. Substations synchronize using a shared System Time clock with the same reference. The local cycle of a slave begins at the SYNC0 event. Since slave processing (servo processing) starts during the SYNC0 event cycle, it remains consistently synchronized with the SYNC0 event.

During communication initialization, the master station requires transmission delay compensation (offset compensation) as well as periodic deviation compensation. The figure below illustrates the synchronization process of the master station's response to the SYNC0 event triggered by the control power supply and the slave station's processing (servo processing).



9.2.8.2 SM2 (SM2 Event Synchronization)

The station's local cycle begins with the SM2 event.

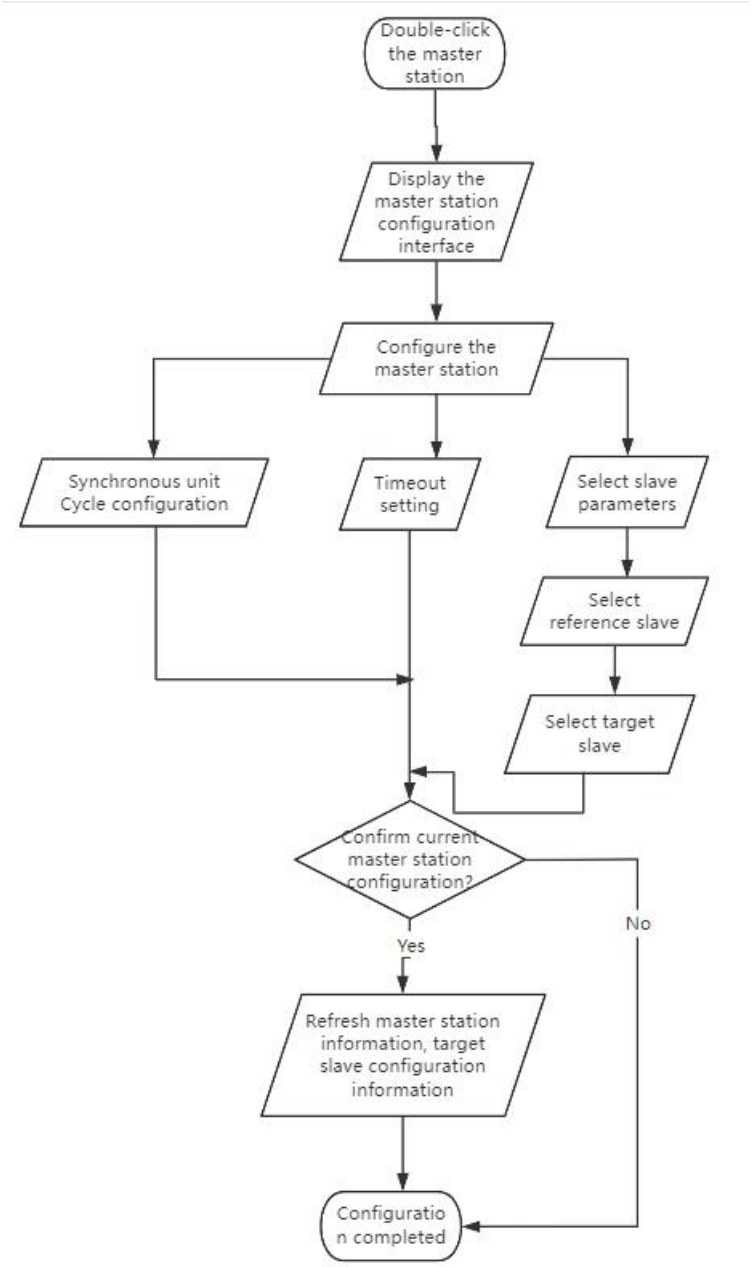
Since the processing at the receiving station begins during the SM2 event cycle, it is always synchronized with the SM2 event.

Since the SM2 event occurs upon completion of message reception by the PDO, it is essential to ensure that the upper-level (main station) side sends messages at the scheduled time. If the variation in message transmission timing is too significant, synchronization may fail or an alarm will be triggered.

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

10 EtherCAT Bus Control Mode

10.1 EtherCAT Operation



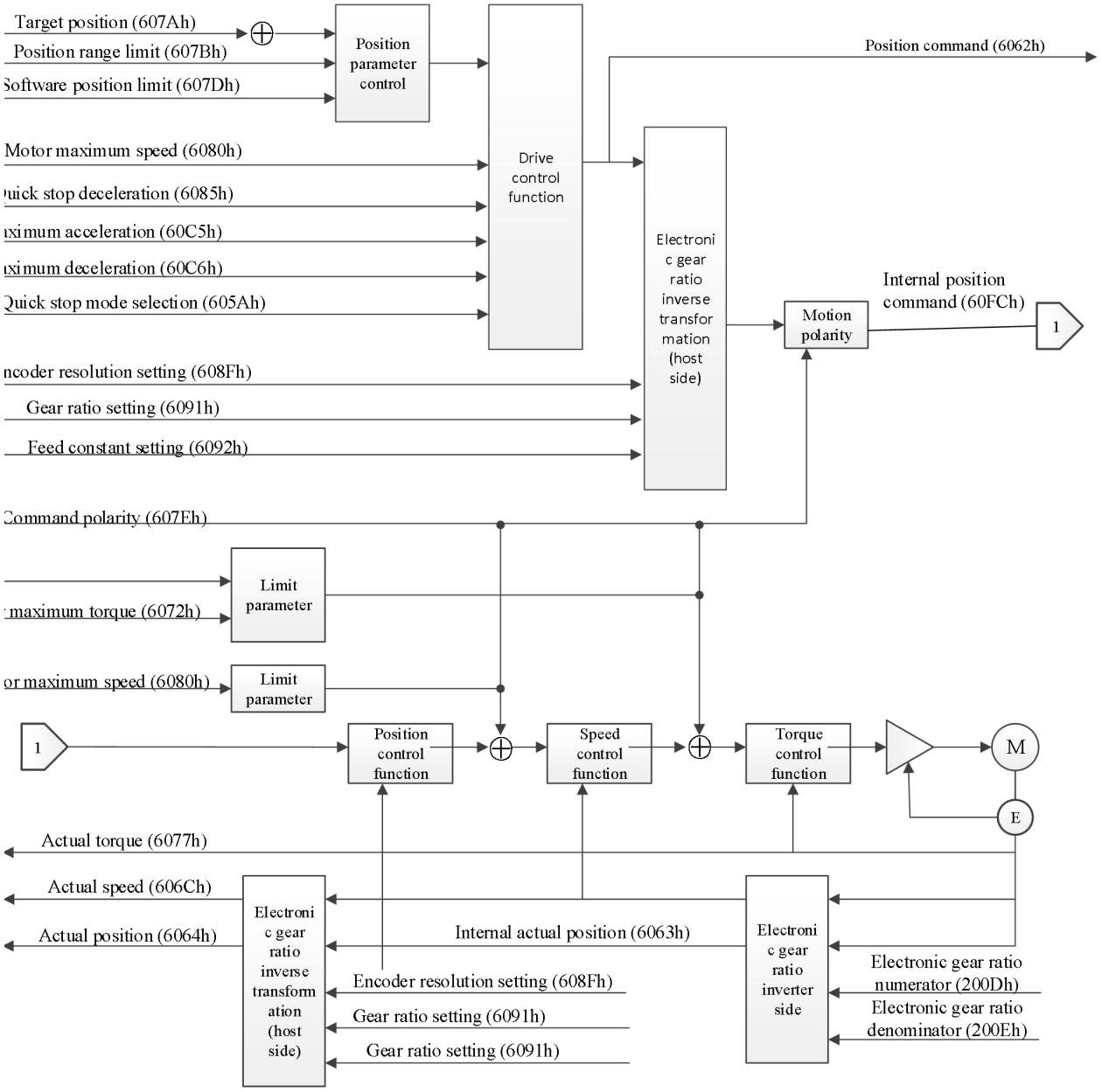
The table below lists the mandatory parameters that must be configured for the CSP, CSV, CST, PP, PV, and TQ modes.

Register	Explanation
RXPDO[0x6040]	Control characters must be added to the PDO configuration and cannot be modified via IO mapping in CSP, CSV, and CST modes; they are governed by the NC module.

RXPDO[0x6060]	The mode control word must be added to the PDO configuration and can be modified via IO mapping in task mode.
RXPDO[0x607A]	The target location, i.e., the location specified by the program, must be added to the PDO configuration.
TXPDO[0x6041]	The status byte must be added to the PDO configuration.
TXPDO[0x6061]	The status code must be added to the 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.

10.2 CSP pattern

CSP (周期同步位置模式): Its trajectory is calculated by the host computer, which periodically sends target positions to the slave stations.



10.2.1 Relevant parameter

1) CSP control mode associated objects (instruction/setting type)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	PDO
6040h	00h	control word	-	0~65535	U16	rw	RxPDO

Other positions share common associated objects.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	PDO
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
607Ah	00h	target location	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Dh	-	Software absolute position limit	-	-	-	-	-
	00h	Represents the 607Dh sub-index number	-	2	U8	ro	NO
	01h	Minimum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
60B1h	00h	jitter	Unit/Unit of instruction	-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	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
605Ah	00h	Quick parking method 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 Response	-	0~2	I16	rw	NO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
		Option Code					
607Dh	-	Software location restriction	-	-	-	-	-
	00h	Represents the 607Dh sub- index number	-	2	U8	ro	NO
	01h	Minimum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	Origin Offset	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Position 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 speed	r(any power-generating or power-driven machine)	1~4294967295	U32	ro	NO
6091h	-	Gear ratio setting	-	-	-	-	-
	00h	Represents	-	2	U8	ro	NO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
		the 6091h sub- index number					
	01h	Motor rotation speed	r(any power-generating or power-driven machine)	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
6092h	-	Feed constant setting	-	-	-	-	-
	00h	Represents the 6092h sub- index number	-	2	U8	ro	NO
	01h	Set the feed value	Command Unit	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
60B8h	00h	Probe Mode	-	0~65535	U16	rw	RxPDO

Control Byte (6040h) <Functions in Control Mode>

Index	Sub index	Name	Unit	Scope	Data type	Pdo	Op-mode
6040h	00h	control word	0~65535	U16	Rw	RxPDO	All

Set the control commands for servo drivers, such as PDS state transitions.

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 corresponding) fr = fault reset r = reserved (not corresponding) fr = fault reset

oms = operation mode specific eo = enable operation

(Control mode dependent bit) qs = quick stop (Control mode dependent bit) qs = quick stop

h = stop ev = enable voltage

h = stop ev = enable voltage

so = switch on

CSP mode does not use the OMS bit.

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

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6041h	00h	Statusword	-	0~65535	U16	ro	TxPDO

Other entities also share common correlation objects for position control.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
6062h	00h	Position Instruction	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
6063h	00h	Internal actual location	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	physical location	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
6065h	00h	Position deviation threshold	Command Unit	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Position reaches the threshold	Command Unit	0~4294967295	U32	rw	RxPDO
6068h	00h	Time until position reaches the threshold	1ms	0~65535	U16	rw	RxPDO
606Ch	00h	Actual motor speed	Unit/Unit of instruction	-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	Represent position deviation (= PERR)	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60FAh	00h	Internal instruction speed (Position ring output)	Unit/Unit of instruction	-2147483648~ 2147483647	I32	ro	TxPDO
60FCh	00h	Internal Location	pulse	-2147483648~ 2147483647	I32	ro	TxPDO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
		Instruction					

Other objects also share common action associations.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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 Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	instruct unit	-2147483648 ~2147483647	I32	ro	TxPDO

Status Byte (6041h) <Functions in Control Mode>

<table>
<tr><th>Index</th><th>Sub index</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 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 corresponding) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
(Control mode dependent bit) ve = voltage enabled
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rtso = ready to switch on</td></tr>
</table>

bit13,12,10（operation mode specific)：

Bit	Name	Value	Definition

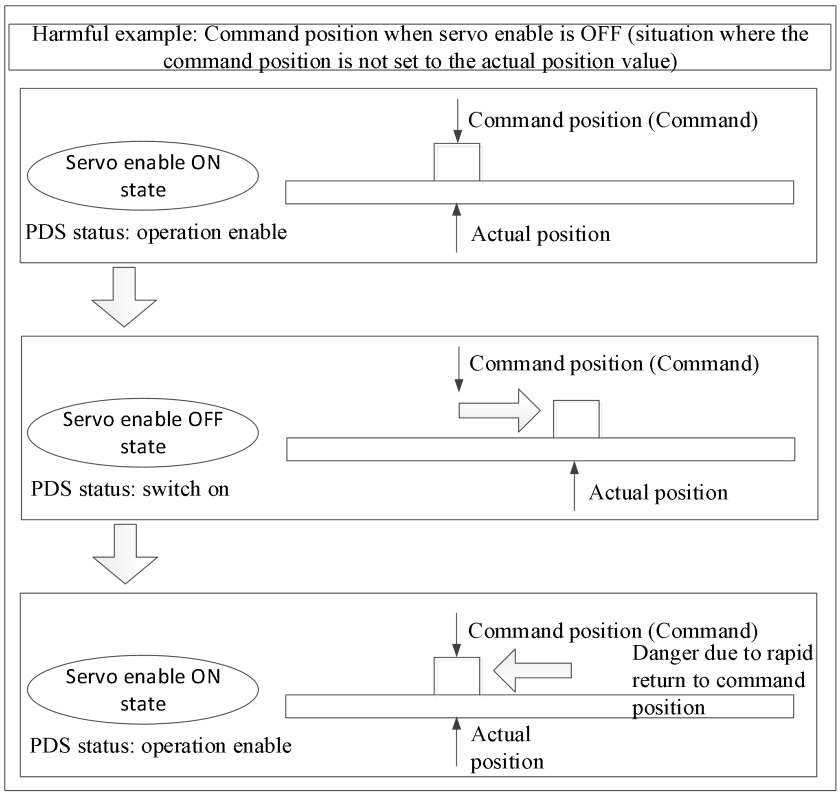
Bit	Name	Value	Definition
10	Keep	-	unused
12	Set Point Confirmation	0	Do not perform actions based on the target location
		1	Perform actions based on the target location
13	Phase Error	0	The value of 60F4h (instruction deviation) = 6062h (position instruction) – 6064h (position feedback) must not exceed the set range of 6065h (excessive position deviation threshold); alternatively, if the value of 60F4h exceeds the set value of 6065h, the time specified in 6066h shall not be executed.
		1	The value of 60F4h (instruction deviation) exceeds the set range for 6065h (excessive position deviation threshold), and the duration has exceeded the time limit specified in 6066h (follow-up error timeout).

The term "perform an action based on the target location" means that if all of the following conditions are met:

- The PDS status indicates that the operation has been initiated.
- Not in a slowdown state (stop, Quickstop, Shutdown, Disable operation, Falut);
- Not in stop stop state.

3) Operations of the CSP control mode

- The cyclic position control mode generates the motion model (track) via the master unit rather than the slave unit.
- The target position is the sum of 607Ah (position given) and 60B0h (position feedforward), interpreted as the absolute position.
- The update (transmission) of the action command should be entered approximately 100 ms after the Operation enabled command is activated.
- 60C2h (Interpolation time period) specifies the update cycle for two objects: 607Ah (position-given) and 60B0h (position feedforward). This value matches the cycle duration of 1C32h-02h (Cycle time). The host device must update the target position using the 60C2h cycle.
- The servo is in disabled state; implement the host processing as follows: 607Ah (position setpoint) + 60B0h (position feedforward) following 6064h (actual position value). If the motor moves due to external forces while the servo is disabled, it becomes hazardous during the next servo activation as the system must return to the target position. Additionally, follow this same tracking procedure when switching from control modes other than CSP to CSP control mode.

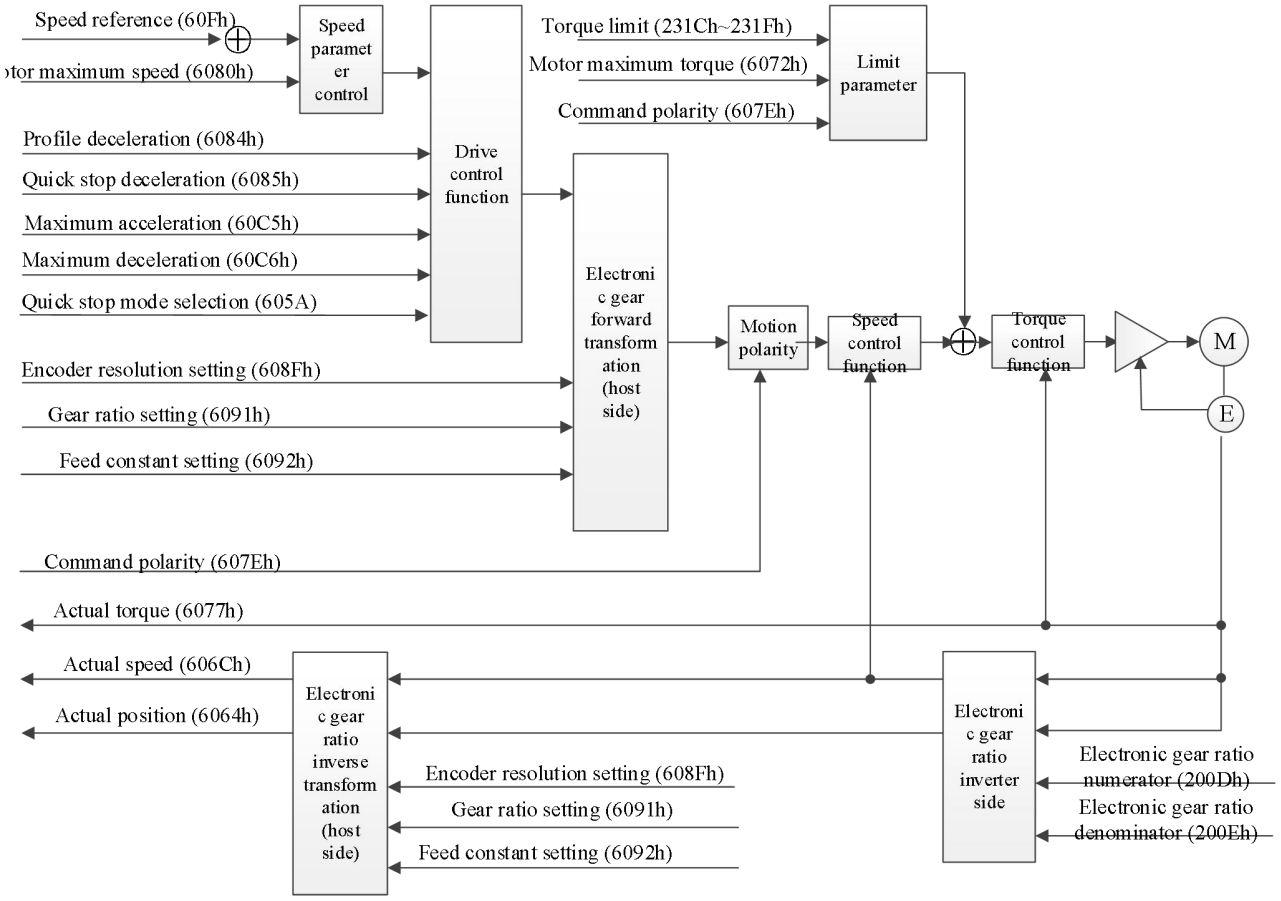


10.2.2 Common Parameters

Register	Explanation	Unit
RXPDO[0x607A]	Given the location, modifications via IO mapping are invalid in CSP mode; they are governed by the NC module.	Command Unit
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
RXPDO[0x6060]	The control mode is CSP (Periodic Synchronous Position Mode); set its value to 8.	-

CSV pattern

The CSV (Periodic Synchronization Speed Mode) allows the motor to operate at a constant speed based on the speed set by the host computer.



10.2.3 Relevant parameter

1) Objects associated with the CSV control mode (instruction/setting type)

Index	Sub index	Name	Unit	Scope	Data type	Accessibil ity	PDo
6040h	00h	control word	-	0~65535	U16	rw	RxPDO

Other objects include those with common speed control associations.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	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	Speed Offset	Unit/Unit of	-2147483648~	I32	rw	RxPDO

			instruction	2147483647			
60B2h	00h	Torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60FFh	00h	Given speed	Unit/Unit of instruction	-2147483648~ 2147483647	I32	rw	RxPDO

There are also other related objects with common actions.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	PDo
605Ah	00h	Quick parking method 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 Response Option Code	-	0~2	I16	rw	NO
607Bh	-	Range location restriction	-	-	-	-	-
	00h	Represents the 607Bh sub- index number	-	2	U8	ro	NO
	01h	Minimum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	Origin Offset	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	PDo
6086h	00h	Position 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 speed	R(any power-generating or power-driven machine)	1~4294967295	U32	ro	NO
6091h	-	Gear ratio setting	-	-	-	-	-
	00h	Represents the 6091h sub- index number	-	2	U8	ro	NO
	01h	Motor rotation speed	r(any power-generating or power-driven machine)	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
6092h	-	Feed constant setting	-	-	-	-	-
	00h	Represents the 6092h sub- index number	-	2	U8	ro	NO
	01h	Set the feed value	Command Unit	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
60B8h	00h	Probe Mode	-	0~65535	U16	rw	RxPDO

Control Byte (6040h)> Functions in CSV Control Mode>

<table>
<tr><th>Index</th><th>Sub index</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 commands for servo drivers, 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 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 corresponding) fr = fault reset
oms = operation mode specific eo = enable operation
(Control mode dependent bit) qs = quick stop
h = stop ev = enable voltage
so = switch on</td></tr>
</table>

CSV format, without using OMS bits.

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

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	PDo
6041h	00h	status word	-	0~65535	U16	ro	TxPDO

There are also other related objects shared for speed control.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	PDo
6063h	00h	Actual internal position feedback	pulse	-2147483648~2147483647	I32	ro	TxPDO
6064h	00h	position feedback	Command Unit	-2147483648~2147483647	I32	ro	TxPDO
606Bh	00h	Speed Instruction	Unit/Unit of instruction	-2147483648~2147483647	I32	ro	TxPDO
606Ch	00h	rate feedback	Unit/Unit of instruction	-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 also related objects with common patterns.

Index	Sub index	Name	Unit	Scope	Data Type	Acce ssibil	Pdo

						ity	
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 Probe 1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO

Status byte (6041h)> Functions of CSV control mode>

<table>
<tr><th>Index</th><th>Sub index</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>r</td><td>follow drive 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 corresponding) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
(Control mode dependent bit) ve = voltage enabled
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rtso = ready to switch on</td></tr>
</table>

bit13,12,10（operation mode specific)：

Bit	Name	Value	Definition
10	Keep	-	unused
12	velocity	0	The action was not executed based on the target speed.
		1	Perform the action at the target speed
13	Keep	-	unused

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

- The PDS status is Operation enabled
- Not in a slowdown procedure (stop, Quickstop, Shutdown, Disable operation, Falut)
- Not in the stop stop state
- Torque limit not triggered

3) Actions for the CSV format mode

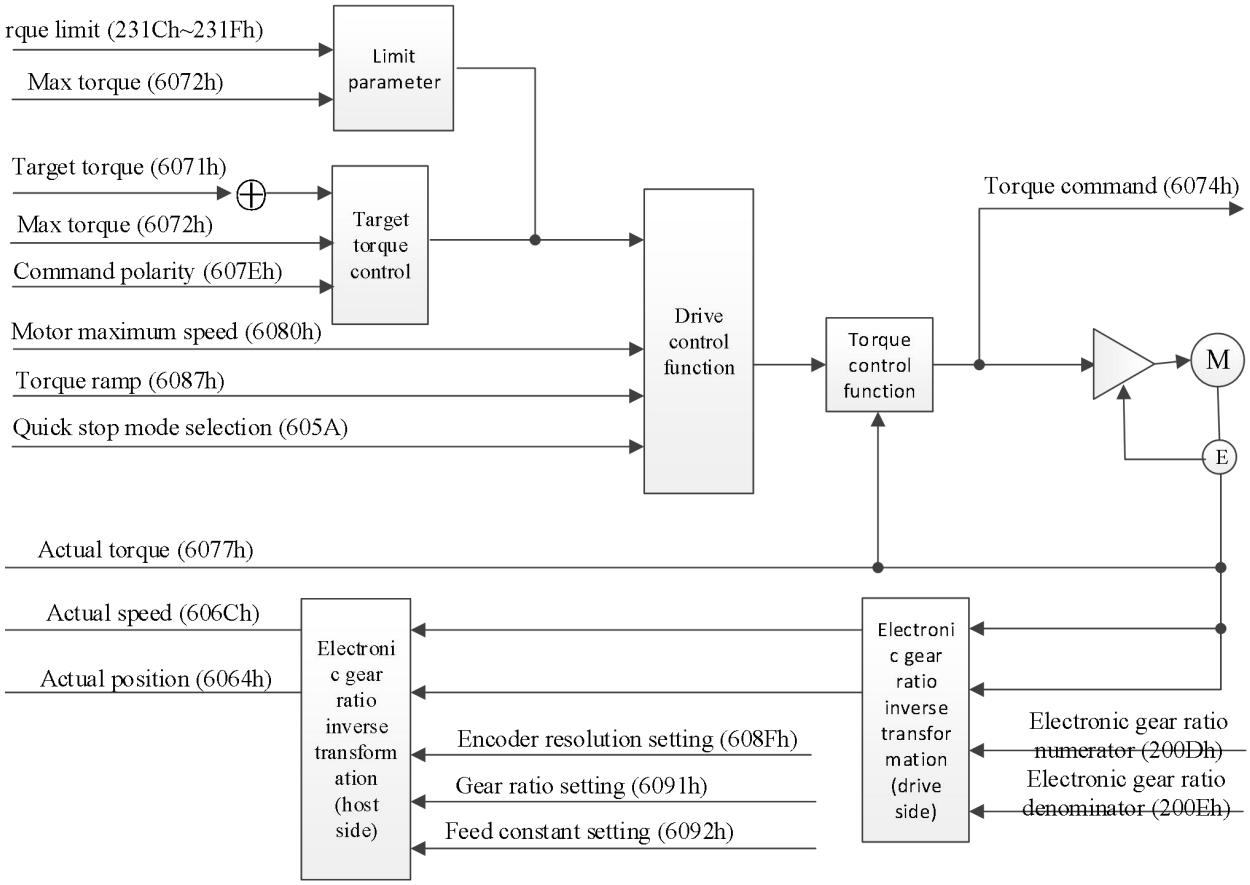
- In the cyclic speed control mode, the motion model (trajectory) is generated not by the slave but by the master.
- The target speed is 60 FFh (target speed).
- The update (transmission) of the action command should be entered approximately 100 ms after enabling the servo operation (via the Operation enabled command).
- 60C2h (Interpolation time period) specifies the cycle duration for updating the two objects 60FFh (target speed) and 60B1h. This value is set to match the cycle time of 1C32h-02h.
- As monitoring information, it provides 606Ch (speed feedback), among others.
- The 60FFh (target speed) value is limited by 6080h (maximum motor speed).

10.2.4 Common Parameters

Register	Explanation	Unit
RXPDO[0x60FF]	Given speed	Unit/Unit of instruction
TXPDO[0x6064]	position feedback	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
RXPDO[0x6080]	The maximum motor speed can be adjusted via the COE-Online online interface to set speed limits.	r/min
RXPDO[0x6060]	The control mode is CSV (Periodic Synchronization Speed Mode); set its value to 9.	-

10.3 CST pattern

The CST (Periodic Synchronous Torque Mode) operates the motor at a constant torque by receiving the torque setting from the host computer.



10.3.1 Relevant parameter

1) Objects associated with the CST control mode (instruction/setting type)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6040h	00h	control word	-	0~65535	U16	rw	RxPDO

Other systems also share common components related to torque control.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6071h	00h	Given torque	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 Slope	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	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
605Ah	00h	Quick parking method 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 Response Option Code	-	0~2	I16	rw	NO
607Bh	-	Range location restriction	-	-	-	-	-
	00h	Represents the 607Bh sub-index number	-	2	U8	ro	NO
	01h	Minimum position range restriction	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
	02h	Maximum position range restriction	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
607Ch	00h	Origin Offset	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction / s^2	0~4294967295	U32	rw	RxPDO
6086h	00h	Position Trajectory Planning Type	-	-32768~32767	I16	rw	RxPDO
608Fh	-	Position Encoder Resolution Setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-	-	2	U8	ro	NO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
		index number					
	01h	Encoder movement distance	pulse	1~4294967295	U32	ro	NO
	02h	Motor rotation speed	r(any power-generating or power-driven machine)	1~4294967295	U32	ro	NO
6091h	-	Gear ratio setting	-	-	-	-	-
	00h	Represents the 6091h sub-index number	-	2	U8	ro	NO
	01h	Motor rotation speed	r(any power-generating or power-driven machine)	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
6092h	-	Feed constant setting	-	-	-	-	-
	00h	Represents the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the feed value	Command Unit	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
60B8h	00h	Probe Mode	-	0~65535	U16	rw	RxPDO

Control Byte (6040h) <Functions in Control Mode>

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
6040h	00h	control word	0~65535	U16	Rw	RxPDO	All

Set the control commands for servo drivers, such as PDS state transitions.
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 corresponding) fr = fault reset r = reserved (not corresponding) fr = fault reset
oms = operation mode specific eo = enable operation
(Control mode dependent bit) qs = quick stop (Control mode

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
		dependent bit) qs = quick stop h = stop ev = enable voltage h = stop ev = enable voltage so = switch on					

CST mode does not use the OMS bit.

2) The object associated with CST moment control (monitoring type)

Index	Sub index	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	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
6063h	00h	Actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
606Ch	00h	rate feedback	Unit/Unit of instruction	-2147483648~ 2147483647	I32	ro	TxPDO
6074h	00h	Torque Command	0.1%	-32768~32767	I16	ro	TxPDO
6075h	00h	Motor rated current	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 also other related objects with common patterns.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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 Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping	instru	-2147483648~	I32	ro	TxPDO

		position of the falling edge of Touch Probe 1	ct unit	2147483647			
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	instruct unit	-2147483648~2147483647	I32	ro	TxPDO

Status Byte (6041h) <Functions of Control Mode>

Index	Sub index	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	Drive following command vaule		r		
7	6	5	4	3	2	1	0
w	sod	qs	ve	f	oe	so	rSTO

r = reserved (not corresponding) w = warning

sod = switch on disabled

oms = operation mode specific qs = quick stop

(Control mode dependent bit) ve = voltage enabled

ila = internal limit active f = fault

oe = operation enabled

rm = remote so = switched on

rtso = ready to switch on

bit13,12,10（operation mode specific)：

Bit	Name	Value	Definition
10	Keep	-	unused
12	torque	0	Do not execute the action based on the target torque
		1	Perform the action based on the target torque
13	Keep	-	unused

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

- The PDS status is Operation enabled
- Not in a slowdown procedure (stop, Quickstop, Shutdown, Disable operation, Falut)
- Not in the stop stop state

3) Actions of the CST mode

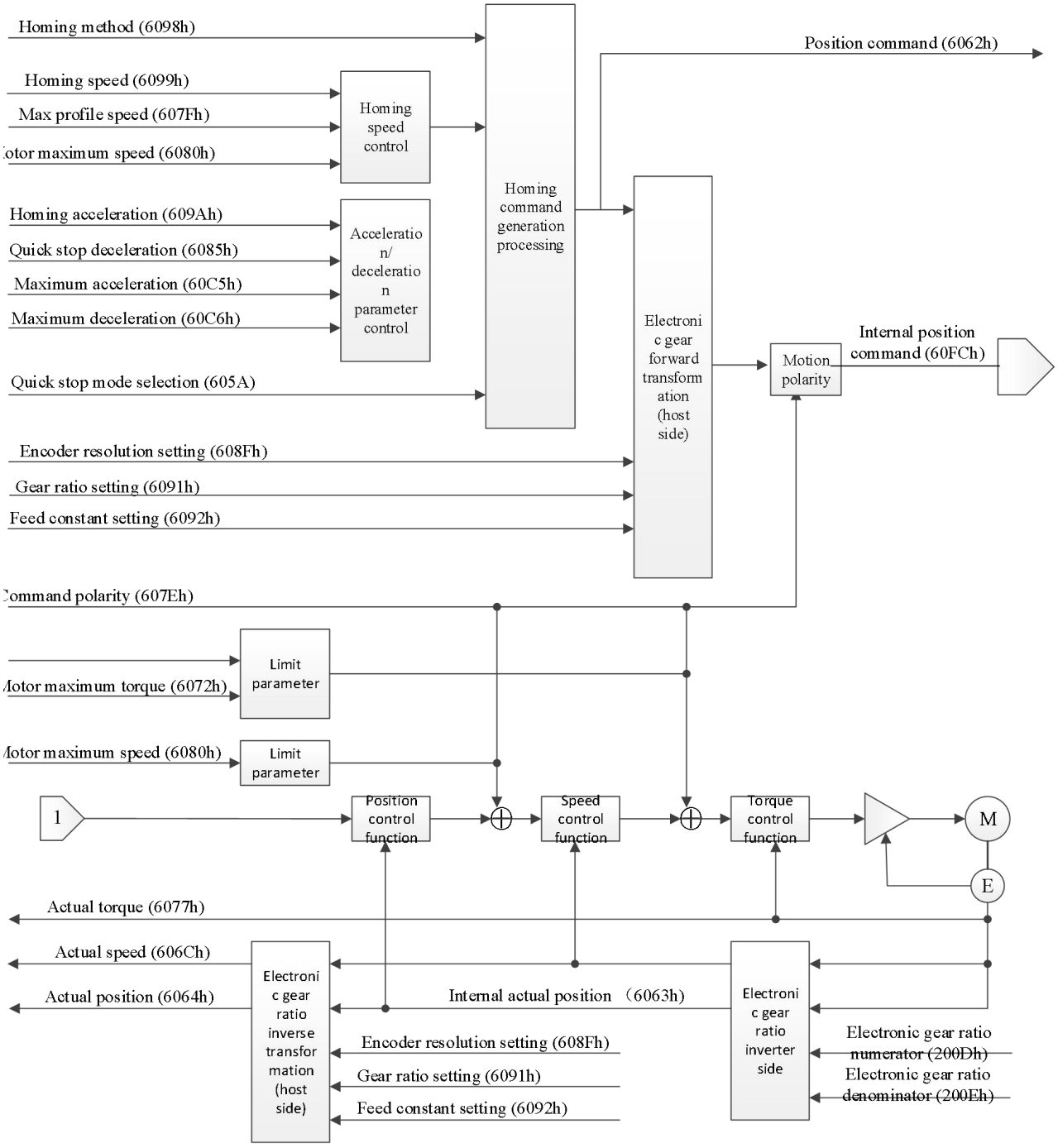
- Cyclic torque control mode: The Profile (track) is generated not on the slave device but on the master device.
- The target torque is 6071 Nm.
- The torque feedforward is 60B2h; feedforward is not supported currently.
- Update the action command (send signal): After the servo is turned on, input it approximately 100 ms later.
- 60C2h (Interpolation time period) specifies the cycle duration for updating the two objects 6071h (torque given) and 60B2h. This value is set to match the cycle time of 1C32h-02h.
- As monitoring information, it provides 6077h (torque feedback), among others.
- The value at 6071h (torque setpoint) is subject to the maximum torque limit at 6072h, the constraints specified in 231Ch (P3-28) and 231Dh (P3-29), as well as the minimum value limitations.
- The speed limit is 6080 h (maximum motor speed).

10.3.2 Common Parameters

Register	Explanation	Unit
RXPDO[0x6071]	Given torque	0.1%
TXPDO[0x6064]	position feedback	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Torque Feedback	0.1%
RXPDO[0x6080]	Maximum motor speed	r/min
RXPDO[0x6060]	The control mode is CST (Periodic Synchronous Torque Mode); set its value to 10.	-

10.4 HM pattern

The HM mode (also known as the origin reset mode) is used to initialize the slave's position. This position control mode specifies the action speed and generates position commands within the servo driver to execute the origin reset operation. When used in incremental mode, the origin reset must be performed before initiating any positioning task after power supply activation.



10.4.1 Relevant parameter

1) hm Control Mode Association Object (Command/Setting Type)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6040h	00h	control word	-	0~65535	U16	rw	RxPDO
6098h	00h	Return to Original Method	-	-128~127	I8	rw	RxPDO
6099h	-	Return to original speed	-	-	-	-	-
	00h	Number of entries	-	2	U8	ro	NO
	01h	Original switching speed	Unit/Unit of instruction	0~4294967295	U32	rw	NO
	02h	The speed of the restoration process	Unit/Unit of instruction	0~4294967295	U32	rw	NO
609Ah	00h	Return to original acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO

Other objects also share common position control associations.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6072h	00h	maximum torque	0.1%	0~65535	U16	rw	RxPDO
607Fh	00h	Maximum Profile velocity	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO
60B1h	00h	Speed Offset	Unit/Unit of instruction	-2147483648~ 2147483647	I32	rw	RxPDO
60B2h	00h	Torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60C5h	00h	maximal acceleration	Unit of instruction / s²	0~4294967295	U32	rw	RxPDO
60C6h	00h	maximum deceleration	Unit of instruction / s²	0~4294967295	U32	rw	RxPDO

There are also other related objects with common actions.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
605Ah	00h	Quick parking method selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO
605Ch	00h	Pause	-	0~1	I16	rw	NO

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
		shutdown method					
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	Failure Response Option Code	-	0~2	I16	rw	NO
607Dh	-	Software absolute position limit	-	-	-	-	-
	00h	Represents the 607Dh sub-index number	-	2	U8	ro	NO
	01h	Minimum position limit	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
	02h	Maximum position limit	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
607Ch	00h	Origin Offset	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Position 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 speed	r(any power-generating or power-driven machine)	1~4294967295	U32	ro	NO
6091h	-	Gear ratio setting	-	-	-	-	-
	00h	Represents the 6091h sub-	-	2	U8	ro	NO

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
		index number					
	01h	Motor rotation speed	r(any power-generating or power-driven machine)	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
6092h	-	Feed constant setting	-	-	-	-	-
	00h	Represents the 6092h sub-index number	-	2	U8	ro	NO
	01h	Set the feed value	Command Unit	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
60B8h	00h	Probe Mode	-	0~65535	U16	rw	RxPDO

Control Byte (6040h) <Functions in HM Control Mode>

<table>
<tr><th>Index</th><th>Sub index</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 commands for servo drivers, 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 colspan="3">4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="2">Fr</td><td colspan="5">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="3">start homing</td></tr>
</table>
r = reserved (not corresponding) fr = fault reset r = reserved (not corresponding) fr = fault reset
oms = operation mode specific eo = enable operation oms = operation mode specific eo = enable operation
(Control mode dependent bit) qs = quick stop (Control mode dependent bit) qs = quick stop
h = stop ev = enable voltage
h = stop ev = enable voltage
so = switch on</td></tr>
</table>

bit9,6-4 （operation mode specific）:

Bit	Name	Value	Definition
4	Return to original	0 -> 1	Initiate the origin reset action
5	(retained)	-	unused
6	(retained)	-	unused

9	(retained)	-	unused

By enabling bit4 (initiating reset) for 6040 hours, obtain the parameters associated with the origin reset position control mode (HM)—including reset method, speed, acceleration/deceleration, etc.—and initiate the action.

Furthermore, even if a new origin reset operation is initiated during the current operation (restarting at bit 4 of 6040h), the new operation will be ignored.

Original method (6098h)

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
6098h	00h	Return to Original Method	-128~127	I8	rw	RxPDO	All

Original Point Setting Method

Value	definition
-2	Reverse collision back to original state
-1	Return to the original state after a frontal collision
0	No original restoration 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 P
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

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
		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	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-Mode
6099h	-	Return to original speed	-	-	-	-	-
		The speed when setting the origin reset position control mode (HM).					
	00h	Number of entries	2	U8	ro	NO	HM
		The number of sub index representing 6099h (original 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 internally processed value 6080h (maximum motor speed) and 2147483647.					
	02h	Speed during search for zero	0~4294967295	U32	rw	NO	HM
		Set the detection action speed to the origin. If the edge of the Switch signal serves as the origin detection position, set the value as small as possible to minimize detection errors. The maximum value is limited by the lower of the internally processed value 6080h (maximum motor speed) and 2147483647.					

Return to original acceleration (609 Ah)

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
609Ah	00h	Return to original acceleration	0~4294967295	U32	rw	RxPDO	All
		Set the acceleration and deceleration values when resetting the origin (hm). The deceleration of origin reset (hm) also applies to this object. When the original operation mode finally stops (the origin position is detected), there is no need to use the settings of this object; the servo lock will cease. If set to 0, internal processing is treated as 1.					

2) hm Control Mode Associated Object (Monitoring Type)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6041h	00h	status word	-	0~65535	U16	ro	TxPDO
60E3h	-	Select restoration method	-	-	-	-	TxPDO
	00h	Indicates the 60E3h sub-	-	1~254	U8	ro	TxPDO

		index number					
	01h	Return to Method 1	-	0~32767	U16	ro	TxPDO
	..	..	..	..	..	..	..
	20h	Return to Original Method 32	-	0~32767	U16	ro	TxPDO

Other entities also share common correlation objects for position control.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
6062h	00h	Position Instruction	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
6063h	00h	Actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
6065h	00h	Position deviation threshold	Command Unit	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout time	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Position reaches the threshold	Command Unit	0~4294967295	U32	rw	RxPDO
6068h	00h	Position to window time	1ms	0~65535	U16	rw	RxPDO
606Ch	00h	rate feedback	Unit/Unit of instruction	-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	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60FAh	00h	Internal instruction speed (Position ring output)	Unit/Unit of instruction	-2147483648~ 2147483647	I32	ro	TxPDO
60FCh	00h	Internal Location Instruction	pulse	-2147483648~ 2147483647	I32	ro	TxPDO

The position feedback for HM after returning to its original position (6064h) is reset to zero.

Other objects also share common action associations.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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 Probe 1	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO

Status Byte (6041h)> Functions in hm Control Mode

<table>
<tr><th>Index</th><th>Sub index</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 rowspan="2">oms</td><td rowspan="2">ila</td><td rowspan="2">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 corresponding) w = warning r = reserved (not corresponding) 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>

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
		rm = remote rtso = ready to switch on			so = switched on		

bit13,12,10（operation mode specific）:

Bit	Name	Value	Definition
10	target reached current state	0	In motion
		1	state of rest
12	homing attained Reduction completed	0	The origin reset action is not complete
		1	The origin reset operation was successfully executed.
13	Return to original error	0	No origin reset anomaly occurred
		1	Abnormal origin reset occurred (the origin reset operation could not be executed properly)

bit13,12,10（operation mode specific）:

Bit13	Bit12	Bit10	Definition
0	0	0	During the origin reset movement
0	0	1	The origin reset operation was interrupted or not started.
0	1	0	The origin reset action has been completed, but the target position has not been reached.
0	1	1	The origin reset maneuver was completed normally.
1	0	0	An abnormal origin reset was detected while the operation was in progress.
1	0	1	Abnormal origin reset detected; stop state

When the bit12 (homing attained) is in the following states, its value is 0:

- When the power is supplied
- When the ESM state transitions from Init to PreOP
- When the origin reset operation begins

When the homing operation (Method 35, Method 37) without motor movement is initiated, the homing attained value is also set to 0. However, this setting period must be extremely brief (approximately 2 ms).

Original method (60E3)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
60E3h	-	Supported Homing method	-	-	-	-	TxPDO
	Return the original method indicating support						
	00h	Number of entries	-	1~254	U8	ro	TxPDO
	Indicates the number of return methods supported by 60E3h (Supported Homing Method).						
	01h	1st supported Homing method	-	0~32767	U16	ro	TxPDO
	Indicates support for the first original method.						

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
	..	..	..	..	..	..	..
	20h	32nd supported Homing method	-	0~32767	U16	ro	TxPDO
	Indicates support for the original method of the 32nd item						

Index	Sub index	bit 15~8	bit 7~0
		Reserved	Supported Homing method: Original 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).

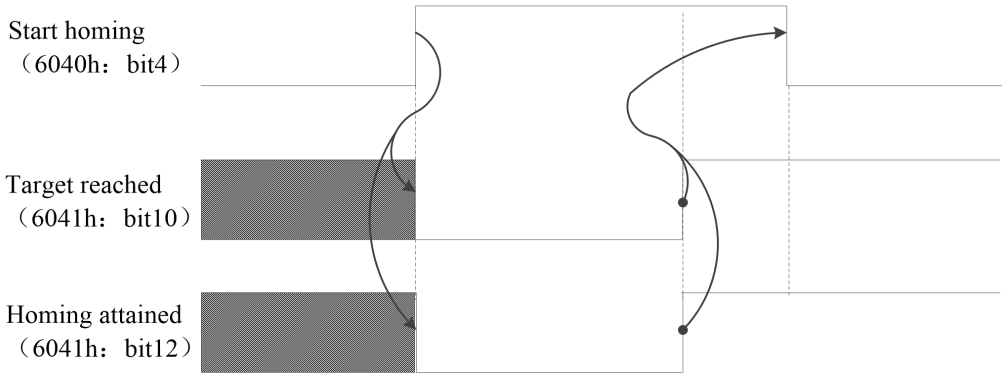
3) Actions of the HM control mode (Homing actions)

When using the incremental mode, perform a homing action to initialize the position information before initiating the standard operation.

- After the origin position is detected, this position serves as the reference for initializing the following objects (predefined settings).
  6062h (position command) = 6064h (position feedback) = 607Ch (return to original offset)
  6063h (actual internal position feedback) = 60FCh (position demand internal value) = 0
- If the origin reset is executed, the position information is initialized (pre-set). Therefore, the data obtained based on the previous position information (such as the Touch probe position) must be retrieved again.
- During the homing action, whether or not the 607Ch (Home offset) is modified, these changes are not reflected in the current homing operation. They will be incorporated during the next homing action (when the position information is initialized upon completion).
- 607Ch is only valid in Origin Return Mode 35 and 37.
- If the edges of the Switch signals (T, NOT, HOME) serve as the origin detection positions, assign each positioning compensation Pin to SI1, SI2, and SI3 respectively. Failure to assign correctly will trigger an origin reset error. (Note: For the DS5C2 series servo, P5-22 is the positive limit setting address with a default value of 1, corresponding to servo terminal SI1; P5-23 is the negative limit NOT setting address with a default value of 2, corresponding to servo terminal SI2; P5-27 is the origin setting address with a default value of 3, corresponding to servo terminal SI3.)
- In the subsequent Method diagrams described, the following terms denote the corresponding meanings.

Index pulse	The Z-bit signal of the encoder
Home switch	The theoretical signal state for near-origin input (ME)
Positive limit	Theoretical signal state of the positive-direction drive prohibition input (POT)
Negative limit	The theoretical signal state of the negative-direction drive prohibition input (NOT)

- Update the action command (send signal); after enabling the servo command (Operation enabled command), input it approximately 100 ms later.
- The following shows the timing of the HM control mode.



- Conditions for Homing Error Occurrence

The conditions under which an homing error (Homing error = 1) occurs are as follows.

Conditions for homing error occurrence	Detailed information
Start outside the enabled operation	Homing cannot be initiated when the PDS status is

	Operation enabled (except for methods 35 and 37).
Start at target speed 0	When the set values for 6099h-01h and 6099h-02h are 0, the Homing function is activated. (The values for method 33 and 34 at 6099h-02h, as well as those for method 35 and 37 at 6099h-01h and 6099h-02h, are excluded from time zero.)
Two limit switches were detected.	During homing startup or the homing operation, two limit switches (Positive/Negative) are detected.
Use the limit switch	In the Method that reverses via the Limit switch, during the decelerated reversal action following the detection of the Limit switch's rising edge, the falling edge of the Limit switch is also detected.
Undistributed Home switch, Limit switch	Unallocated IO terminal

10.4.2 Common parameters

Register	Explanation	Unit
RXPDO[0x6040]	Control word: Modify the control word to return to the origin	-
RXPDO[0x6098]	Return to Origin Method	-
RXPDO[0x609A]	Accelerating back to the origin	Unit of instruction /s²
RXPDO[0x6060]	The control mode is HM mode (i.e., return-to-origin mode). Set its value to 6 when the motor is disabled.	-
SDO[0x6099]	Return to the starting speed and modify it online via COE-Online	Unit/Unit of instruction

Control Byte (6040h)

Set the sequence to (0x06> 0x0F> 0x1F), enable the drive, and start the motor to return to the origin.

10.4.3 Return to origin method

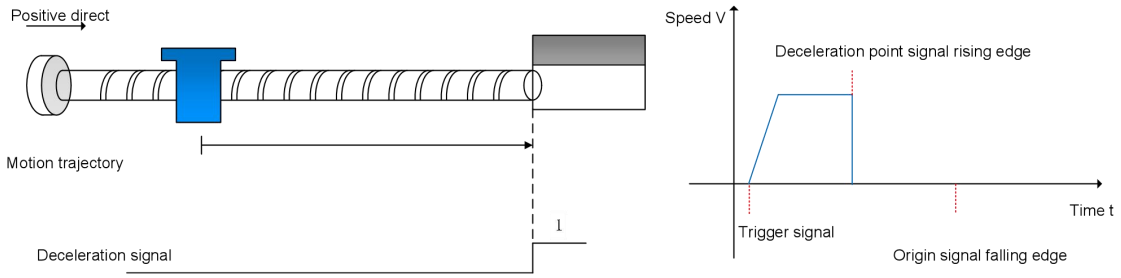
The current Xinje DS5C2 series servo supports the following return-to-origin modes: 1–14,17–30,33,34,35,37, -1, and-2. For slaves from other brands, refer to their respective user manuals for specific return-to-origin specifications.

■ Method-1:

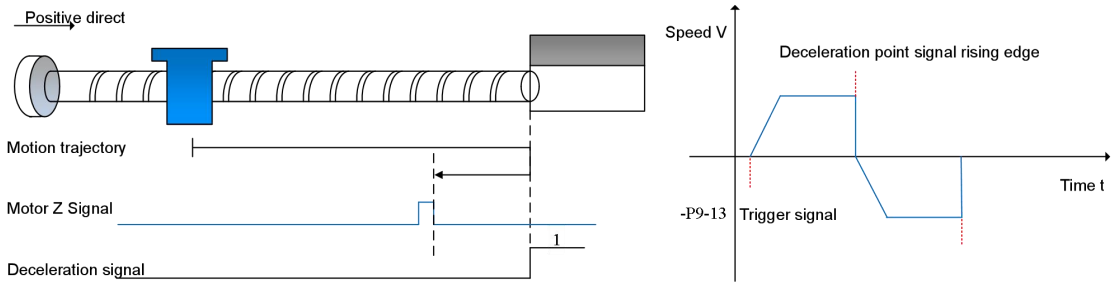
The servo motor first operates in forward low-speed mode at the set value 6099h:02 (low-speed return to origin). Upon reaching the mechanical limit position, if the absolute torque value reaches the upper limit P9-17 (stop-triggered return-to-origin torque threshold) while the absolute speed value remains below the set value P9-16 (stop-triggered return-to-origin speed threshold), and this condition persists for the duration specified by P9-18 (stop-triggered return-to-origin time threshold), the system determines that the mechanical limit position has been reached. Subsequently, two scenarios are considered:

① P7-20 = 0, and the number of quantitative pulses is 0; immediately stop the machine and set this

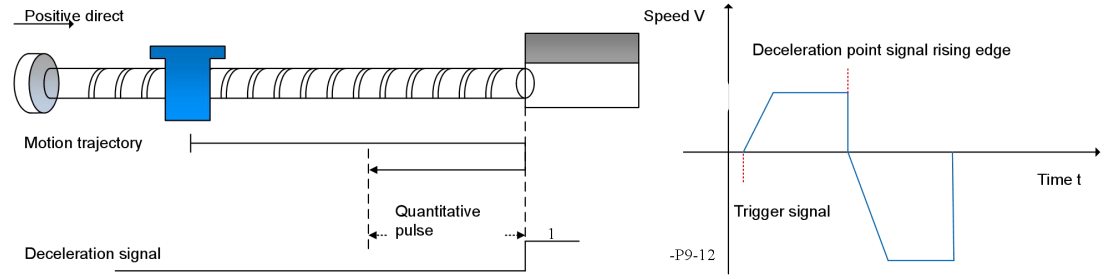
position as the zero point (position reset).



② When P7-20> 0, the number of quantitative pulses is 0; the system operates in reverse at low speed from the set origin point. Upon detecting the rising edge of P7-20 Z signal pulses, the machine stops immediately to calibrate the zero point (position reset).



③ P7-20 = 0, and the number of quantitative pulses is non-zero. First, operate forward at low speed (6099h:02); upon reaching the mechanical point, reverse direction to travel back to the origin at high speed (6099h:01) for the specified pulse duration, then stop the machine and set this position as the zero point (clear Ecat position).



④ When P7-20> 0 (indicating a non-zero number of quantitative pulses), first operate forward at low speed (6099h:02). Upon reaching the mechanical point, reverse at low speed (6099h:02) back to the origin. stop after detecting P7-20 rising edges of Z signals; then stop and proceed at high speed (6099h:01) for the specified pulse duration before stopping again to calibrate the zero point (clearing the Ecat position).

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
P7-20	The HM bus returns to its original state to determine the number of Z phases.	-	1	-9999~9999	○	EtherCAT pattern

The positive and negative values of the P7-20 parameter indicate the direction of zero return: positive values indicate forward origin search, while negative values indicate reverse origin search. The absolute value represents the number of Z-phase searches during zero

return.

■ Method-2:

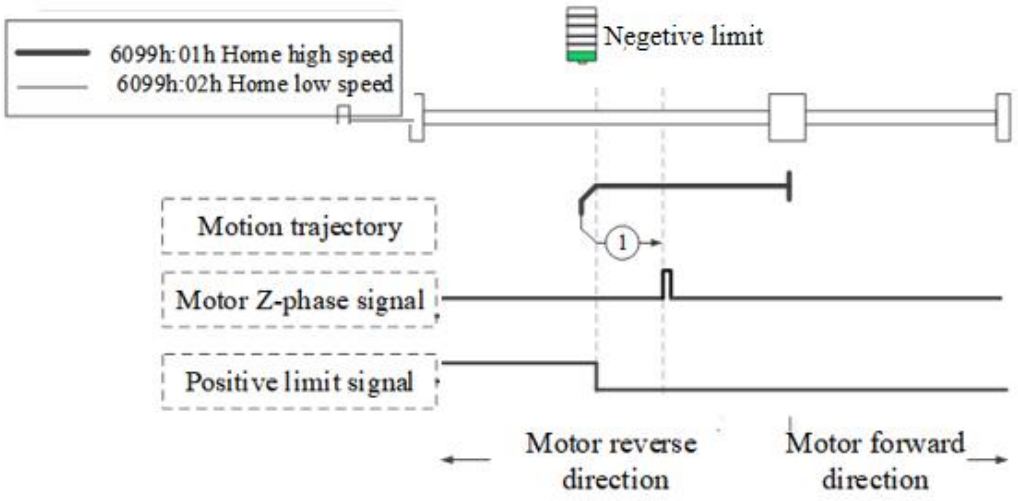
Similar to the previous return-to-origin mode action, but in the opposite direction.

■ Method 1 (6098h=1):

When using Method 1 of this return-to-origin technique, if the reverse limit switch is in a non-triggered state, the initial movement direction is left. The origin position corresponds to the first Z-phase pulse located to the right of the position where the negative limit switch becomes invalid.

Mechanical Origin: Motor Z Signal

Reduction point: Reverse overtravel switch



Use a negative limit switch in conjunction with the motor's Z-axis signal to return to its original position.

● 6098h=1 Action Description:

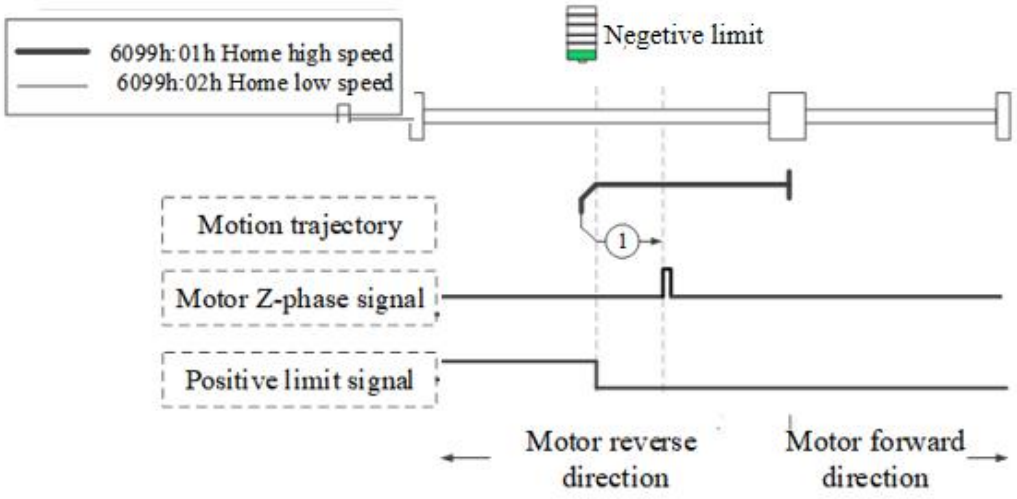
The reverse limit is invalid: When initiating return to origin, start the reverse return at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), decelerate and reverse direction, then proceed with low-speed forward movement at 6099h:02h. After detecting the falling edge of the reverse limit, stop at the first motor Z signal.

■ Method 2 (6098h=2):

When using Method 2, if the forward limit switch has not been triggered, the initial movement direction is to the right. The origin position 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 Signal

Reduction point: Forward overtravel switch



Use a positive limit switch with the motor's Z-axis signal to return to the original position.

- 6098h=2 Action Description:

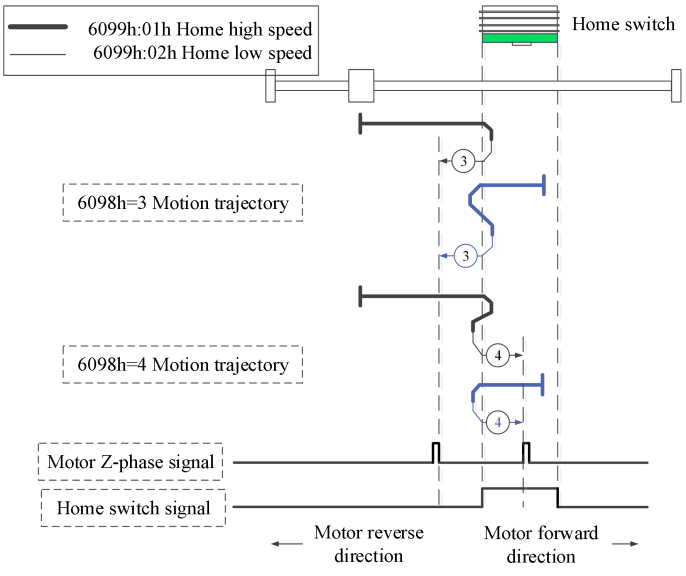
  The forward limit switch is invalid: When initiating return to zero, start the forward return at high speed (6099h:01h). Upon detecting the rising edge of the forward limit switch (POT), decelerate and reverse direction, then proceed with low-speed reverse operation at 6099h:02h. After detecting the falling edge of the forward limit switch, stop the motor upon receiving the first Z signal.

■ Method 3 (6098h=3), Method 4 (6098h=4):

Use Method 3 or 4; the initial direction of movement depends on the state of the origin switch. The origin position is either on the reverse-side side of the origin switch or at the initially detected Z-phase position during forward rotation.

Mechanical Origin: Motor Z Signal

Reduction point: Origin switch



Use the origin switch and the motor Z signal to return to the origin.

- 6098h=3 Action Description:

  ① The origin switch is in an invalid state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, decelerate and reverse direction, then operate in reverse at the original return speed (6099h:02h). Upon detecting the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

  ② The origin switch is in the active state: When initiating return to origin, start the reverse zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, decelerate, then reverse direction again, and continue running in reverse at the original return speed (6099h:02h). After encountering the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

- 6098h=4 Action Description:

  ① The origin switch is in an invalid state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, reverse direction; wait for its falling edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h). After encountering the rising edge of the origin switch, stop the motor upon receiving its first Z-axis signal.

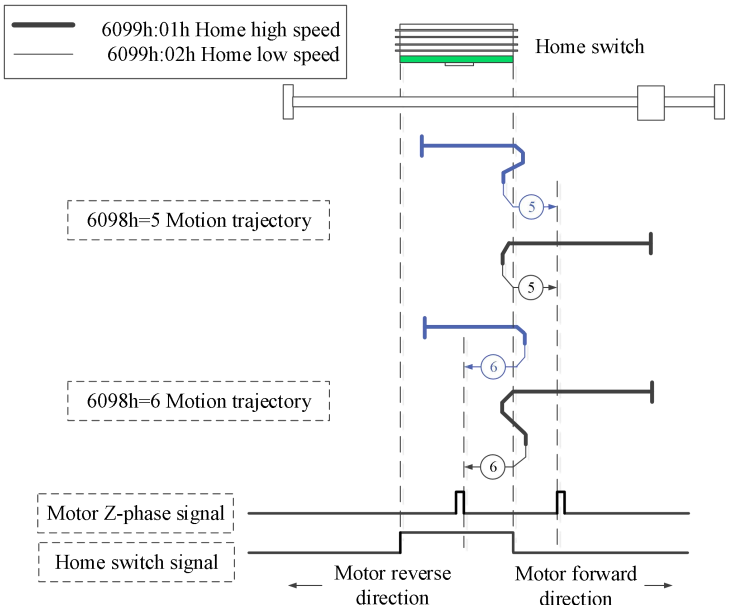
  ② The origin switch is in the active state: When initiating return to origin, start the reverse return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, decelerate and reverse direction, then proceed forward at the return speed of 6099h:02h. After detecting the rising edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

■ Method 5 (6098h=5), Method 6 (6098h=6):

Use Method 5 or 6; the initial direction of movement depends on the state of the origin switch. The origin position is either on the reverse-side side of the origin switch or at the initially detected Z-phase position during forward rotation.

Mechanical Origin: Motor Z Signal

Reduction point: Origin switch



Use the origin switch and the motor Z signal to return to the origin.

- 6098h=5 Action Description:

  ① The origin switch is in an invalid state: During the return to origin, initiate reverse zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, decelerate and reverse direction, then proceed forward at the original return speed (6099h:02h). When the falling edge of the origin switch is detected, stop the motor upon receiving the first Z-axis signal.

  ② The origin switch is in the active state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h). After encountering the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

- 6098h=6 Action Description:

  ① The origin switch is in an invalid state: When initiating return to the origin, start the reverse zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, reverse direction; then locate the falling edge of the origin switch, decelerate, and reverse direction again. Continue running in reverse at the original return speed (6099h:02h). After encountering the rising edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

  ② The origin switch is in the active state: When initiating return to origin, start forward return at high speed (6099h:01h); upon detecting the origin switch's falling edge, decelerate and reverse direction, then operate in reverse at the return speed of 6099h:02h; upon detecting the origin switch's rising edge, stop the motor at the first Z-axis signal.

■ Methods 7–14 (6098h = 7–14):

The models 7–14 all utilize the origin switch and Z-phase signal.
For Modes 7 and 8, the initial motion direction is negative if the origin switch is activated at the start of the movement.
For Modes 9 and 10, the initialization direction is positive if the origin switch is activated at the start of the action.
For Modes 11 and 12, the initialization direction of the action is positive if the origin switch is already

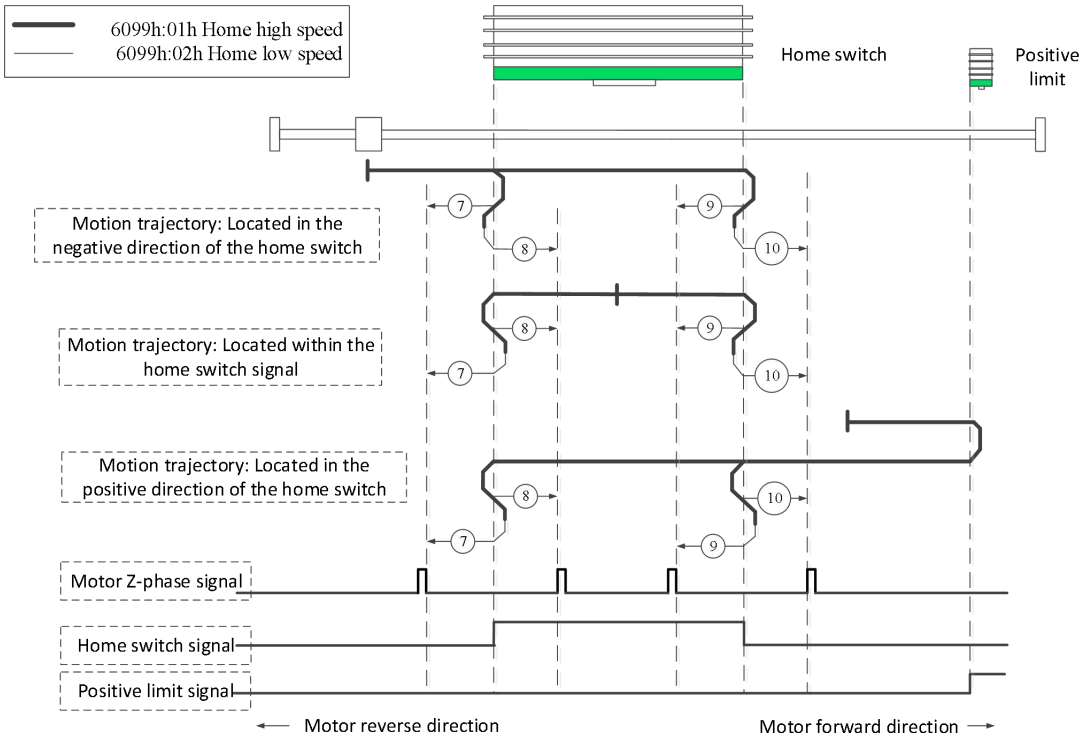
activated at the start of the action.

For Modes 13 and 14, the initialization action direction is negative if the origin switch is already activated at the start of the action.

The final position returning to the origin is the Z-phase signal near the rising or falling edge of the origin switch.

Mechanical Origin: Motor Z Signal

Reduction point: Origin switch



Use the origin switch, forward limit signal, and the motor Z-axis signal to return to its original position.

① Located in the negative direction of the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, decelerate and reverse direction, then proceed in reverse at the return speed of 6099h:02h. When reaching the falling edge of the origin switch, stop the motor upon detecting the first Z-axis signal.

② The origin switch is in the active state: When initiating return to origin, start the reverse zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, decelerate, then reverse direction again, and continue running in reverse at the original return speed (6099h:02h). After encountering the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

③ Operating in the forward direction of the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h). Upon reaching the forward limit, automatically switch direction and continue high-speed operation. After detecting the rising edge of the origin switch, proceed forward until encountering its falling edge—then reverse direction, identify the next rising edge, decelerate, and switch direction again. Return in reverse at the original speed (6099h:02h). Upon detecting the falling edge of the origin switch, stop based on the first motor Z signal.

- 6098h=8 Action Description:

① Positioned in the negative direction relative to the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, reverse direction; identify the falling edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h). When the rising edge of the origin switch is detected, stop the motor upon receiving the first Z-axis signal.

② The origin switch is in the active state: When initiating return to origin, start the reverse return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, decelerate and reverse direction, then proceed forward at the return speed of 6099h:02h. After detecting the rising edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

③ Operating in the forward direction at the origin switch: During initial return, initiate a rapid forward zero-return movement (6099h:01h). Upon reaching the forward limit, automatically reverse direction and maintain high-speed operation. After detecting the rising edge of the origin switch, continue forward until encountering its falling edge—then decelerate and reverse direction, proceeding forward at the original return speed (6099h:02h). Upon detecting the rising edge of the origin switch again, stop the motor upon receiving the first Z-axis signal.

- 6098h=9 Action Description:

① Located in the negative direction of the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, continue forward until reaching its falling edge, then decelerate and reverse direction, operating backward at the return speed of 6099h:02h. After detecting the rising edge of the origin switch, stop when the first motor Z signal is detected.

② The origin switch is in the active state: When initiating return to origin, start forward return at high speed (6099h:01h); upon detecting the origin switch's falling edge, decelerate and reverse direction, then operate in reverse at the return speed of 6099h:02h; upon detecting the origin switch's rising edge, stop the motor at the first Z-axis signal.

③ Operating in the forward direction at the origin switch: During initial return, initiate a rapid forward zero-return movement (6099h:01h). Upon reaching the forward limit, automatically reverse direction for high-speed operation. When the origin switch reaches its rising edge, reverse direction again; then locate the origin switch's falling edge, decelerate, and reverse direction once more. Continue with reverse operation at the original return speed (6099h:02h). After detecting the origin switch's rising edge, stop the motor upon receiving the first Z-axis signal.

- 6098h=10 Action Description:

① Located in the negative direction of the origin switch: During initial return, proceed forward at high speed (6099h:01h) to reach zero. Upon encountering the rising edge of the origin switch, continue forward until reaching its falling edge, then reverse direction and search for the next rising edge. Slow down, reverse again, and resume forward movement at the original return speed (6099h:02h). Upon encountering the falling edge of the origin switch, stop when detecting the first motor Z signal.

② The origin switch is in the active state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h). After encountering the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

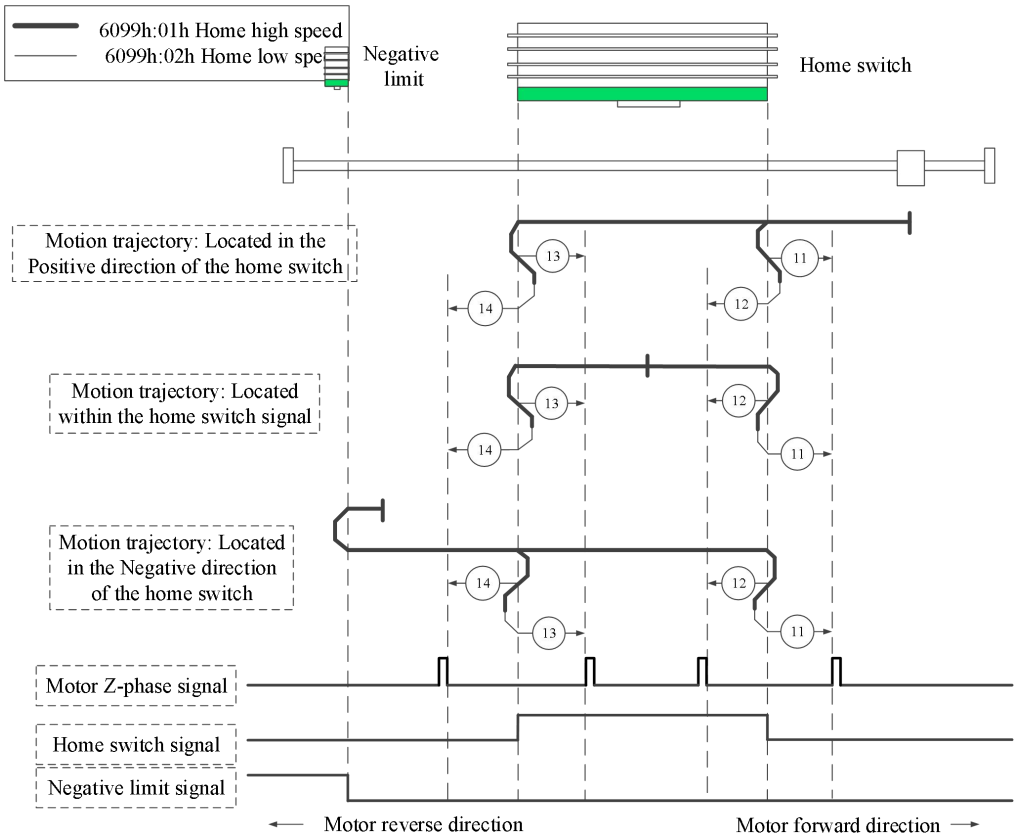
③ When positioned at the origin switch in forward direction: During initial return, initiate a rapid

forward zero-return movement (6099h:01h). Upon reaching the forward limit, automatically reverse direction and continue high-speed operation. After detecting the rising edge of the origin switch, decelerate and reverse direction again, then proceed forward at the original return speed (6099h:02h). Upon detecting the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

① Located in the negative direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, automatically switch direction and continue running at high speed. After detecting the rising edge of the origin switch, proceed forward until encountering its falling edge—then reverse direction, identify the next rising edge, decelerate, and switch direction again. Continue forward at the original return speed (6099h:02h), and upon detecting the falling edge of the origin switch, stop based on the first motor Z signal.

② The origin switch is in the active state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h). After encountering the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

③ When positioned in the forward direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, decelerate and reverse direction, then proceed forward at the return speed of 6099h:02h. Upon reaching the falling edge of the origin switch, stop the motor upon detecting the first Z-axis signal.



Use the origin switch, reverse limit signal, and motor Z-axis signal to return to the original position.

- 6098h=11 Action Description:

① Located in the negative direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, automatically switch direction and continue

running at high speed. After detecting the rising edge of the origin switch, proceed forward until encountering its falling edge—then reverse direction, identify the next rising edge, decelerate, and switch direction again. Continue forward at the original return speed (6099h:02h), and upon detecting the falling edge of the origin switch, stop based on the first motor Z signal.

② The origin switch is in the active state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h). After encountering the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

③ When positioned in the forward direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, decelerate and reverse direction, then proceed forward at the return speed of 6099h:02h. Upon reaching the falling edge of the origin switch, stop the motor upon detecting the first Z-axis signal.

- 6098h=12 Action Description:

  ① Located in the negative direction of the origin switch: During initial return to zero, the system initiates reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and continues running at high speed. After detecting the rising edge of the origin switch, it proceeds forward until encountering its falling edge—at which point it decelerates and reverses direction, operating backward at the original return speed (6099h:02h). Upon detecting the rising edge again, the system stops at the first motor Z signal.

  ② The origin switch is in the active state: When initiating return to origin, start forward return at high speed (6099h:01h); upon detecting the origin switch's falling edge, decelerate and reverse direction, then operate in reverse at the return speed of 6099h:02h; upon detecting the origin switch's rising edge, stop the motor at the first Z-axis signal.

  ③ When positioned in the forward direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, reverse direction; identify the falling edge, decelerate, and reverse direction again. Continue reverse operation at the original return speed (6099h:02h). Upon encountering the rising edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

- 6098h=13 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, the system initiates reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and continues running at high speed. When the origin switch reaches its rising edge, the system reverses direction, waits for the falling edge, decelerates, and reverses again before operating forward at the original return speed (6099h:02h). After encountering the origin switch's rising edge, the system stops at the first motor Z signal.

  ② The origin switch is in the active state: When initiating return to origin, start the reverse return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, decelerate and reverse direction, then proceed forward at the return speed of 6099h:02h. After detecting the rising edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

  ③ When positioned in the forward direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, continue forward until reaching its falling edge, then decelerate and reverse direction. Proceed forward at the

original return speed (6099h:02h). After encountering the rising edge of the origin switch again, stop at the first motor Z signal.

- 6098h=14 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, the system initiates reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and continues running at high speed. After detecting the rising edge of the origin switch, it decelerates and reverses direction, operating backward at the original return speed (6099h:02h). Upon encountering the falling edge of the origin switch, it stops at the first motor Z signal.

  ② The origin switch is in the active state: When initiating return to origin, start the reverse zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, decelerate, then reverse direction again, and continue running in reverse at the original return speed (6099h:02h). After encountering the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

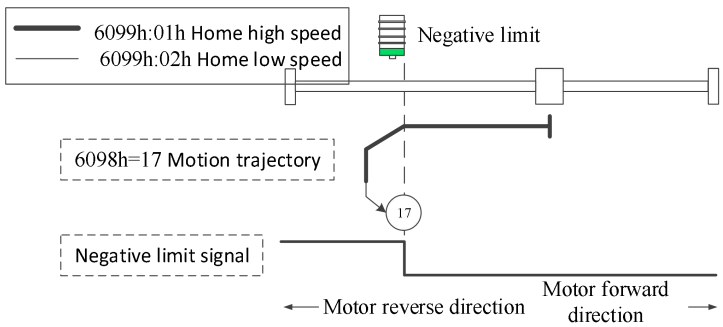
  ③ When positioned in the forward direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, continue forward until encountering its falling edge, then reverse direction. Subsequently, identify the next rising edge of the origin switch, decelerate, and execute another reversal. Operate in reverse at the original return speed (6099h:02h). After detecting the falling edge of the origin switch, stop the motor upon receiving the first Z-axis signal.

■ Method (6098h=17):

This method is similar to Method 1.
The key difference is that the origin detection position is not determined by the motor's Z-axis signal, but rather by the position change of the reverse limit switch (refer to the figure below).
When the reverse limit (NOT) is not assigned, Homing error = 1.

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:

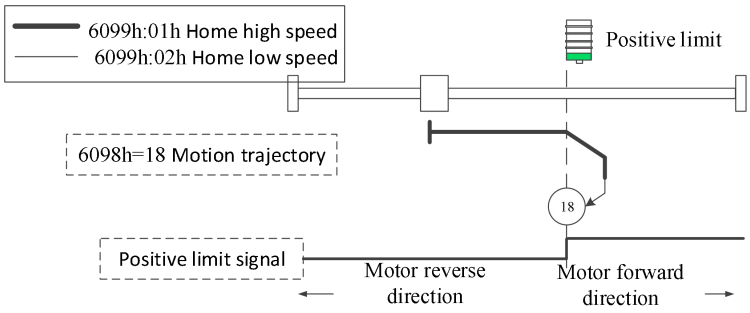
  The reverse limit is invalid: When starting the return process, begin the reverse zero return at high speed (6099h:01h). Upon encountering the rising edge of the reverse limit (NOT), switch direction and decelerate, then proceed with low-speed forward operation at 6099h:02h. stop upon reaching the falling edge of the reverse limit.

■ Method (6098h=18):

This method is similar to Method 2.
The key difference is that the origin detection position is not determined by the motor's Z-axis signal, but rather by the position change of the forward limit switch (refer to the figure below).
When the positive limit switch (POT) is not assigned, Homing error = 1.

Mechanical Origin: Forward Limit Switch

Reduction point: Forward limit switch



Use the forward limit signal to return to the original position.

● 6098h=18 Action Description:

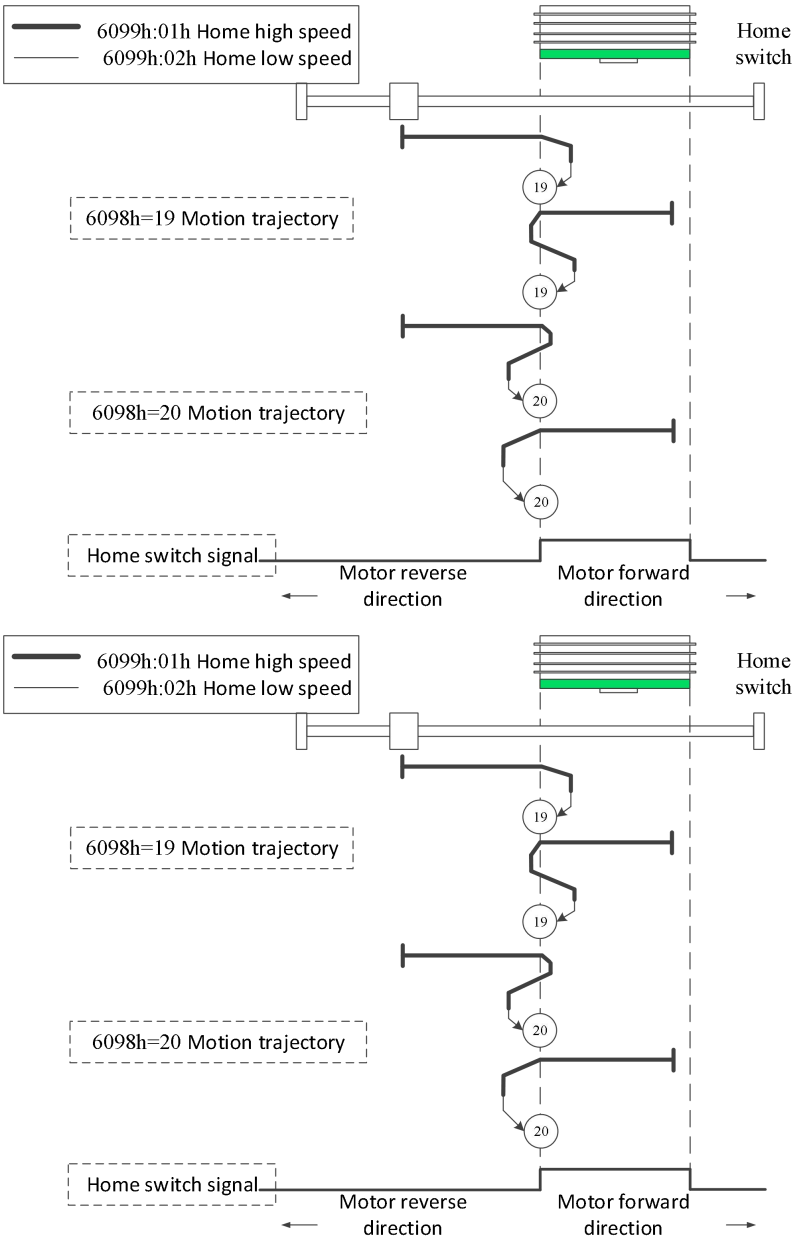
The forward limit switch is invalid: When initiating return to origin, the system starts forward zero return at high speed (6099h:01h). Upon detecting the rising edge of the forward limit switch (POT), it reverses direction and decelerates, then proceeds in reverse at reduced speed (6099h:02h) until reaching the falling edge of the forward limit switch, at which point it stops.

■ Method (6098h=19,6098h=20):

This method is similar to Methods 3 and 4.
The difference is that the origin detection position is not determined by the motor's Z-axis signal, but rather by the position where the origin switch changes (see the figure below).
When HOME is not allocated, Homing error = 1.

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 in an invalid state: During initial return, the system initiates forward zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch signal, it reverses direction and decelerates, then proceeds in reverse at the return speed of 6099h:02h until stopping upon receiving the falling edge of the origin switch signal.

  ② The origin switch is in the active state: When initiating return to origin, start the reverse zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, switch direction; then locate the rising edge and switch direction again. Slow down and continue the reverse operation at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

- 6098h=20 Action Description:

  ① The origin switch is in an invalid state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, reverse direction; locate the

falling edge of the origin switch and reverse direction again, then decelerate. Continue forward operation at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

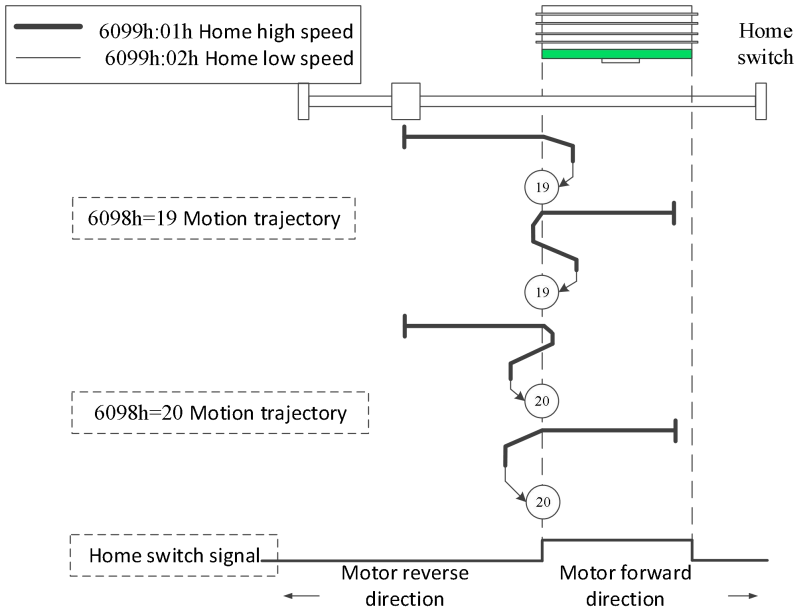
② The origin switch is in the active state: When initiating return to origin, the system begins reverse zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, it switches direction and decelerates, then proceeds forward at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

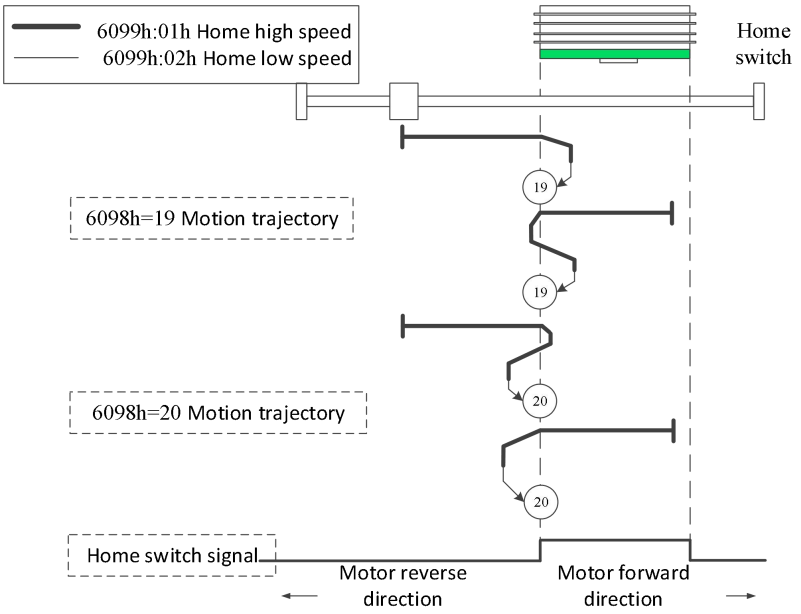
■ Method (6098h=21,6098h=22):

This method is similar to Methods 5 and 6.
The key difference lies in the fact that the origin detection position is not determined by the motor's Z-axis signal, but rather by the position where the origin switch changes.
(See the figure below)
When the origin signal is not assigned, Homing error = 1.

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 in an invalid state: When initiating return to the origin, reverse zeroing begins at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, the system switches direction and decelerates, then proceeds forward at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

  ② The origin switch is in the active state: When initiating return to origin, start forward return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for the rising edge, then reverse again while decelerating. Continue forward operation at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

- 6098h=22 Action Description:

  ① The origin switch is in an invalid state: When initiating return to origin, the system starts reverse zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, it switches direction; then, upon identifying the falling edge, it switches direction again, decelerates, and continues reverse operation at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

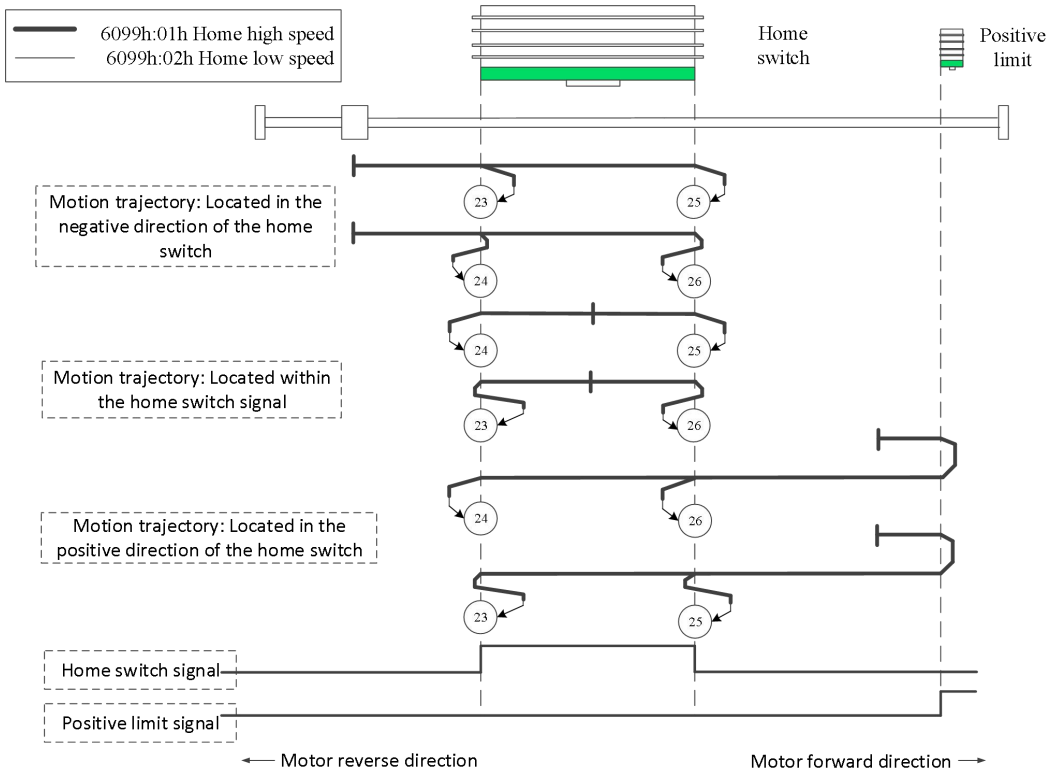
  ② The origin switch is in the active state: When initiating return to origin, the forward return begins at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, the direction is reversed and deceleration occurs, followed by reverse operation at the return speed of 6099h:02h. The machine stops upon detecting the rising edge of the origin switch.

■ Method (6098h=23,24,25,26):

This method is similar to the original methods 7, 8, 9, and 10.
The difference is that the origin detection position is not determined by the motor's Z-axis signal, but rather by the position where the origin switch changes (see the figure below).
When the origin signal and forward limit signal are not assigned, Homing error = 1.

Mechanical Origin: Origin Switch

Reduction point: Origin switch



Use the origin switch signal and the forward limit signal to return to the origin.

- 6098h=23 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h); upon encountering the rising edge of the origin switch, decelerate and reverse direction, then proceed in reverse at the return speed of 6099h:02h; stop upon reaching the falling edge of the origin switch.

  ② The origin switch is in the active state: When initiating return to origin, start the reverse zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for its rising edge, decelerate, then reverse again. Continue operating in reverse at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

  ③ Operating in the forward direction of the origin switch: During initial return, initiate a rapid (6099h:01h) forward zero-return motion. Upon reaching the forward limit, automatically reverse direction and continue high-speed operation. After detecting the rising edge of the origin switch, proceed forward until encountering its falling edge—then reverse direction again while identifying the next rising edge, decelerate, and execute another reversal. Subsequently, operate in reverse at the original return speed (6099h:02h), stopping upon reaching the origin switch's falling edge.

- 6098h=24 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, reverse direction; locate the falling edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

  ② The origin switch is in the active state: When initiating return to origin, the system begins reverse zero return at high speed (6099h:01h); upon detecting the falling edge of the origin switch, it decelerates and

reverses direction, then proceeds forward at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

③ Operating in the forward direction at the origin switch: During initial return, initiate a rapid forward zero-return movement (6099h:01h). Upon reaching the forward limit, automatically reverse direction and continue high-speed operation. After detecting the rising edge of the origin switch, proceed forward until encountering its falling edge—then decelerate, reverse direction, and resume forward movement at the original return speed (6099h:02h). stop upon detecting the rising edge of the origin switch again.

- 6098h=25 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, continue forward until reaching its falling edge, then decelerate and reverse direction, operating backward at the return speed of 6099h:02h. stop upon encountering the rising edge of the origin switch.

  ② The origin switch is in the active state: When initiating return to origin, the forward return begins at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, deceleration occurs followed by direction reversal, enabling reverse operation at the return speed of 6099h:02h. The machine stops upon dete cting the rising edge of the origin switch.

  ③ Operating in the forward direction of the origin switch: During initial return, initiate forward zero return at high speed (6099h:01h). Upon reaching the forward limit, automatically switch direction and continue high-speed operation. When the origin switch reaches its rising edge, reverse direction; detect the falling edge, decelerate, and switch direction again. Then operate in reverse at the original return speed (6099h:02h), stopping upon encountering the origin switch's rising edge.

  6098h=26 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, proceed forward at high speed (6099h:01h) to reach zero. Upon encountering the rising edge of the origin switch, continue forward until reaching its falling edge—then reverse direction and search for the next rising edge before decelerating and reversing again. Continue forward at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

  ② The origin switch is in the active state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for its rising edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

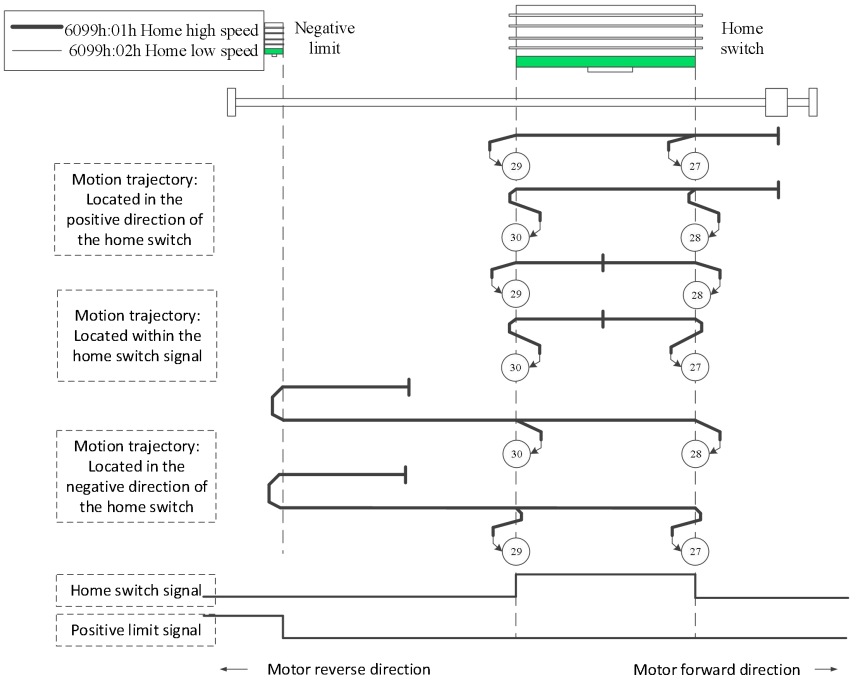
  ③ When positioned at the origin switch in forward direction: During initial return, initiate forward zero return at high speed (6099h:01h). Upon reaching the forward limit, automatically switch direction and continue high-speed operation. After detecting the rising edge of the origin switch, decelerate and reverse direction, then proceed forward at the return speed of 6099h:02h. stop upon detecting the falling edge of the origin switch.

- Method (6098h=27,28,29,30):

  This method is similar to the original methods 11,12,13, and 14.
  The difference is that the origin detection position is not determined by the motor's Z-axis signal, but rather by the position where the origin switch changes (see the figure below).
  When the origin switch and negative limit are not assigned, Homing error = 1.

Mechanical Origin: Origin Switch

Reduction point: Origin switch



Use the origin switch signal and the reverse limit signal to return to the origin.

- 6098h=27 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, the system begins reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and continues running at high speed. After detecting the rising edge of the origin switch, it proceeds forward until encountering its falling edge, at which point it reverses direction, searches for the next rising edge, decelerates, and switches direction again. It then runs forward at the original return speed (6099h:02h) until stopping upon encountering the origin switch's falling edge.

  ② The origin switch is in the active state: When initiating return to origin, start forward zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for its rising edge, decelerate, then reverse again. Continue forward operation at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

  ③ When positioned in the forward direction of the origin switch: During initial return to zero, initiate reverse return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, decelerate and reverse direction, then proceed forward at the return speed of 6099h:02h. stop upon reaching the falling edge of the origin switch.

- 6098h=28 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, the system initiates reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and continues running at high speed. After detecting the rising edge of the origin switch, it proceeds forward until encountering its falling edge—at which point it decelerates, reverses direction, and operates in reverse at the original return speed (6099h:02h), ultimately stopping upon detecting the origin switch's rising edge again.

  ② The origin switch is in the active state: When initiating return to origin, the forward return begins at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, deceleration occurs followed by direction reversal, enabling reverse operation at the return speed of 6099h:02h. The machine stops upon detecting the rising edge of the origin switch.

  ③ When positioned in the forward direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon detecting the rising edge of the origin switch, reverse direction; identify the falling edge, decelerate, and reverse direction again. Continue operating in reverse at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

- 6098h=29 Action Description:

  ① Located in the negative direction of the origin switch: During initial return, the system initiates reverse zero return at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and continues running at high speed. After detecting the rising edge of the origin switch, it reverses direction, waits for the falling edge, decelerates, and reverses again. It then proceeds forward at the original return speed (6099h:02h) until stopping upon encountering the rising edge of the origin switch.

  ② The origin switch is in the active state: When initiating return to origin, the system begins reverse zero return at high speed (6099h:01h); upon detecting the falling edge of the origin switch, it decelerates and reverses direction, then proceeds forward at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

  ③ When positioned in the forward direction of the origin switch: During initial return to zero, initiate reverse zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch,

continue forward until reaching its falling edge, then decelerate and reverse direction. Proceed forward at the original return speed (6099h:02h), stopping upon encountering the rising edge of the origin switch.

- 6098h=30 Action Description:

① Located in the negative direction of the origin switch: During initial return to zero, it begins reverse movement at high speed (6099h:01h). Upon reaching the reverse limit, it automatically switches direction and continues running at high speed. After detecting the rising edge of the origin switch, it decelerates and reverses direction, operating backward at the original return speed (6099h:02h), and stops upon encountering the falling edge of the origin switch.

② The origin switch is in the active state: When initiating return to origin, start the reverse zero return at high speed (6099h:01h). Upon detecting the falling edge of the origin switch, reverse direction; wait for its rising edge, decelerate, then reverse again. Continue operating in reverse at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

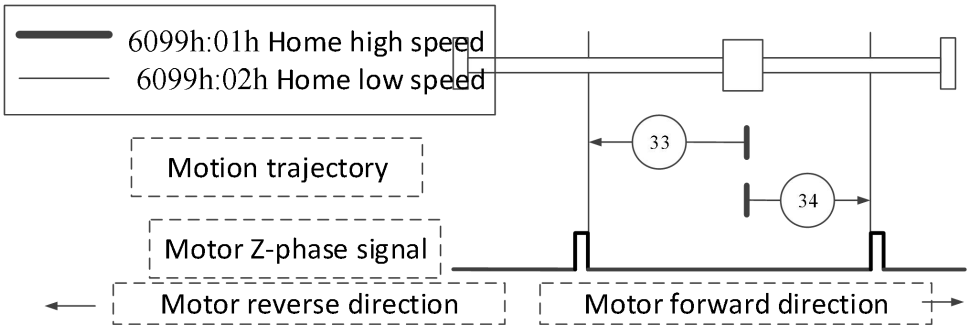
③ When positioned in the forward direction of the origin switch: During initial return, initiate reverse zero return at high speed (6099h:01h). Upon encountering the rising edge of the origin switch, continue forward until reaching its falling edge, then reverse direction. Subsequently, detect the next rising edge of the origin switch, decelerate, and reverse again. Operate in reverse at the original return speed (6099h:02h), stopping upon encountering the falling edge of the origin switch.

- Method (6098h=33,34):

Use Method 33 or 34, with the direction back to the origin being negative or positive, respectively. The original position is located at the Z-axis near the selected direction.

Mechanical Origin: Motor Z Signal

Reduction point: None



The origin is on the Z-positive sign.

- 6098h=33 Action Description:

Upon returning to the original state, run in reverse at the original speed of 6099h:02h until the first motor Z signal triggers a shutdown.

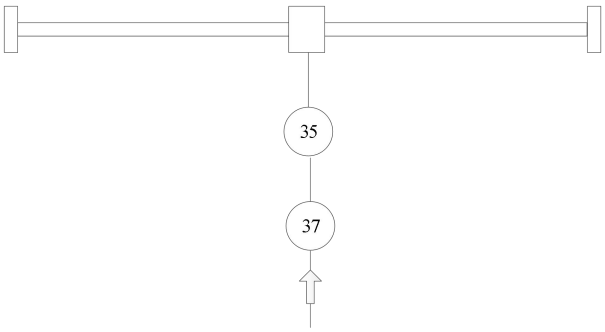
- 6098h=34 Action Description:

Upon returning to the original position, the system operated forward at a speed of 6099h:02h until encountering the first motor Z signal, which triggered a shutdown.

- Method 35 (6098h=35), Method 37 (6098h=37):

In the original 35,37 mode, after triggering the origin reset action, the current position is the origin.

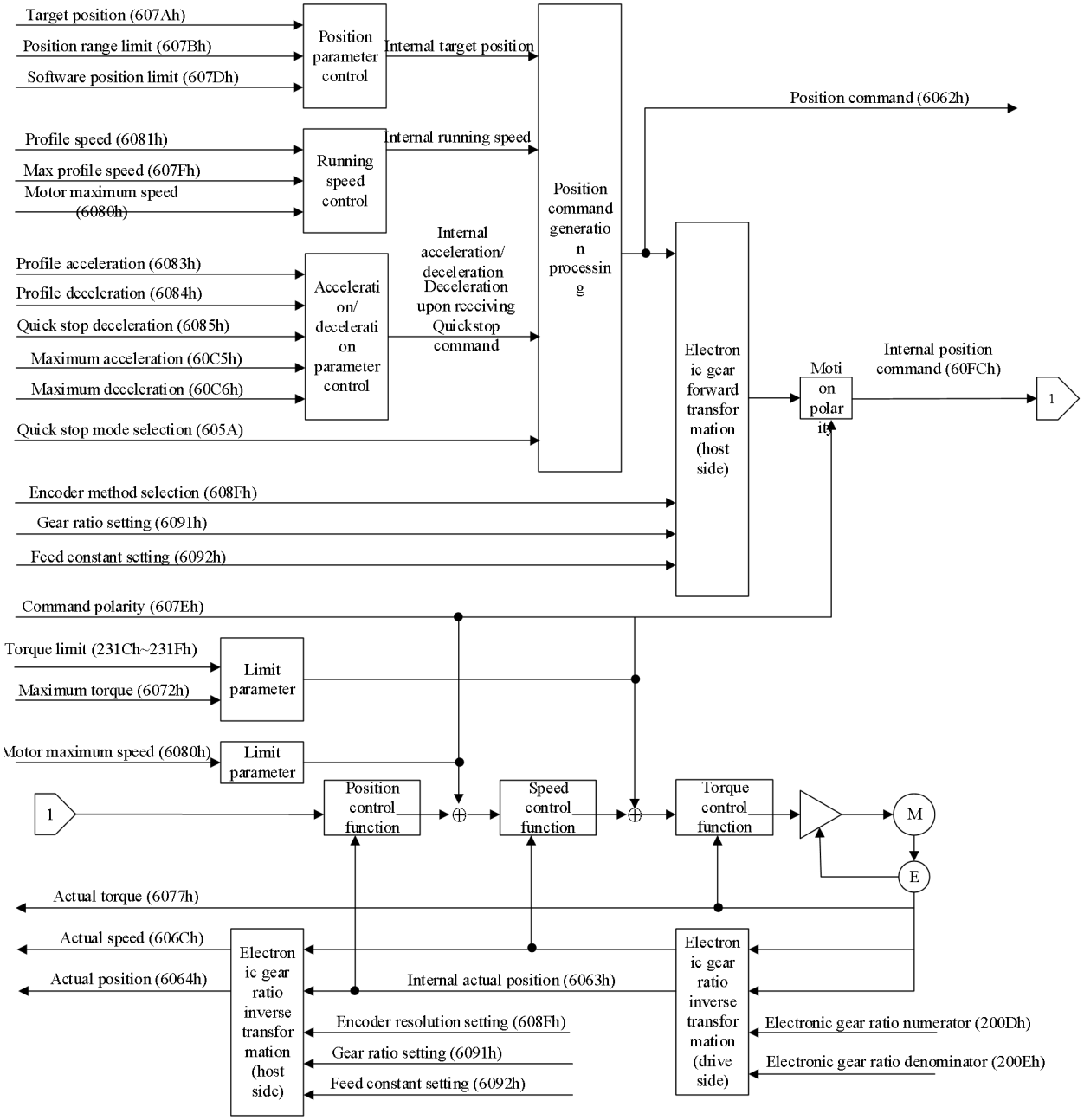
Mechanical Origin: Trigger Position



All restoration methods become effective only after being triggered by the corresponding restoration action command.

10.5 PP pattern

PP (Profile Position Control Mode) is a positioning control method that specifies target position, target speed, acceleration/deceleration, etc., and generates corresponding position commands within the servo driver before execution. This control mode should be used when the communication cycle exceeds 500 μs.



10.5.1 Relevant parameter

1) PP control mode associated objects (instruction/setting type)

Index	Sub index	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	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Dh	-	Software absolute position limit	-	-	-	-	-
	00h	Represents the 607Dh sub- index number	-	2	U8	ro	NO
	01h	Minimum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Fh	00h	Maximum Profile velocity	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO
6081h	00h	Profile run speed	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO
6083h	00h	Outline acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
6084h	00h	Profile deceleration rate	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
60B1h	00h	Speed Offset	Unit/Unit of instruction	-2147483648~ 2147483647	I32	rw	RxPDO
60B2h	00h	Torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60C5h	00h	maximal acceleration	Unit of instruction / s²	0~4294967295	U32	rw	RxPDO
60C6h	00h	maximum deceleration	Unit of instruction / s²	0~4294967295	U3	rw	RxPDO

There are also other related objects with common actions.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
605Ah	00h	Quick parking method selection	-	0~7	I16	rw	NO
605Bh	00h	Close method selection	-	0~1	I16	rw	NO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
605Ch	00h	Pause shutdown method	-	0~1	I16	rw	NO
605Dh	00h	Pause option code	-	1~3	I16	rw	NO
605Eh	00h	Failure Response Option Code	-	0~2	I16	rw	NO
607Dh	-	Software location restriction	-	-	-	-	-
	00h	Represents the 607Dh sub-index number	-	2	U8	ro	NO
	01h	Minimum position limit	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
	02h	Maximum position limit	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
607Ch	00h	Origin Offset	Command Unit	-2147483648~2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Position 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 speed	r(any power-generating or power-driven machine)	1~4294967295	U32	ro	NO
6091h	-	Gear ratio setting	-	-	-	-	-
	00h	Represents the 6091h sub- index number	-	2	U8	ro	NO
	01h	Motor rotation speed	r(any power-generating or power-driven	1~4294967295	U32	rw	NO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
			machine)				
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
6092h	-	Feed constant setting	-	-	-	-	-
	00h	Represents the 6092h sub- index number	-	2	U8	ro	NO
	01h	Set the feed value	Command Unit	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
60B8h	00h	Probe Mode	-	0~65535	U16	rw	RxPDO

Control Byte (6040h) <Functions in Control Mode>

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
6040h	00h	control word	0~65535	U16	rw	RxPDO	All

Set the control commands for servo drivers, such as PDS state transitions.

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 (Enable operation)

Specific operation mode: qs = quick stop – Quick stop

Specific operation mode: qs = quick stop – Quick stop

h = stop: stop ev = enable voltage: Enable voltage h = stop: stop ev = enable voltage: Enable voltage

so = switch on; turn on

bit6-4 (operation mode specific):

Bit	Name	Value	Definition
4	new set-point	0 -> 1	The initiation of positioning actions and setting value updates are triggered. Obtain new position determination tasks (e.g., 607Ah (Target position), 6081h (Profile velocity), etc.).
5	change set immediately	0	Complete the currently executing positioning action. Specifically, during motion execution, if the target position 607A, acceleration 6083, or deceleration 6084 changes, sending control commands will

			not proceed according to the new motion parameters. Instead, the previous motion must be fully executed before issuing new commands to initiate subsequent movements.
		1	Interrogate the current positioning action and immediately initiate the downward positioning action. During the motion, adjust the target position 607A, acceleration 6083, and deceleration 6084. Then send control commands—such as changing the control word from 0x6F (111) to 0x7F (127) (relative mode) or from 0x2F (47) to 0x3F (63) (absolute mode)—and the system will immediately execute based on the new motion parameters.
6	Absolute/Relative	0	607Ah (target position) is treated as an absolute position.
		1	607Ah (target position) is processed as a relative position.

- Do not change acceleration or deceleration during motor operation (*).

  If the speed is adjusted to decrease or increase, set bit 4 (new set-point) from 0 to 1 after the motor stops.

  6083h (Profile acceleration)

  6084h (Profile deceleration)

  60C5h (Maximum acceleration)

  60C6h (Maximum deceleration)
- Under the following conditions, if the set-point (bit4 (new set-point)) is changed from 0 to 1, note that the positioning task will be canceled.

  --6081h (Profile speed) = Key settings when Profile speed is 0.
- When the condition 'stop=1' is detected indicating drive prohibition during deceleration, all positioning tasks are canceled.
- Maintain the PP action for at least 2 ms from initiation until the next PP action begins (the new set-point changes from 0 to 1).

2) PP Control Mode Associated Object (Monitoring Type)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6041h	00h	control word	-	0~65535	U16	ro	TxPDO

Other entities also share common correlation objects for position control.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
6062h	00h	Position Instruction	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
6063h	00h	Actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
6065h	00h	Position deviation threshold	Command Unit	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Position reaches	Command	0~4294967295	U32	rw	RxPDO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
		the threshold	Unit				
6068h	00h	Position to window time	1ms	0~65535	U16	rw	RxPDO
606Ch	00h	rate feedback	Unit/Unit of instruction	-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	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60FAh	00h	Internal instruction speed (Position ring output)	Unit/Unit of instruction	-2147483648~ 2147483647	I32	ro	TxPDO
60FCh	00h	Internal Location Instruction	pulse	-2147483648 ~ 2147483647	I32	ro	TxPDO

Other objects also share common action associations.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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 Probe 1	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO

Status Byte (6041h) <Functions in Control Mode>

Index	Sub index	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
		Following Error	set- point acknowledge		Target Reached		
7	6	5	4	3	2	1	0
w	sod	Qs	ve	f	oe	so	rSTO

r = reserved (not corresponding) 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

bit13,12,10（operation mode specific)：

Bit	Name	Value	Definition
10	target reached	0	stop=0 (normal): Positioning not completed stop=1 (based on the stop time): during shaft deceleration
		1	stop=0 (normal): Positioning completed stop=1 (when stop occurs): The axis stops (axis speed is 0)
12	set-point acknowledge	0	The new setpoint is 0, and the buffer is empty after completing the current target-position action (currently in execution).
		1	The new positioning task loads data into the buffer, which is not empty.
13	following error	0	60F4h（Following error actual value) The value of (= 6062h (Position demand value) – 6064h (Position actual value)) does not exceed the set range of 6065h (Following error window); alternatively, if the value of 60F4h exceeds the set value of 6065h, the time specified in 6066h will not be applied.
		1	60F4h（Following error actual value) The value exceeds the set range of 6065h (Following error window); if it exceeds the set time of 6066h (Following error timeout), continue.

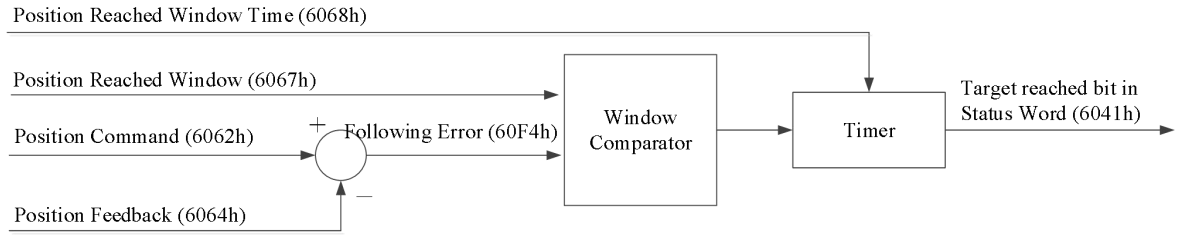
bit10：target reached（Position reached)

When the servo enable is activated (operational active state) and all set-points have generated completion commands, the difference between 6062h (target position value) and 6064h (position feedback) falls within the range defined by 6067h (position arrival threshold). If the time specified in 6068h (position arrival time window) has elapsed, bit 10 of 6041h (status word) changes to 1, indicating target attainment.

Bit	Name	Value	Definition
10	Target reached	0	stop=0 (normal): Positioning not completed stop=1 (based on the stop time): during shaft deceleration
		1	stop=0 (normal): Positioning completed stop=1 (when stop occurs): The axis stops (axis speed is 0)

Location Map

Diagram



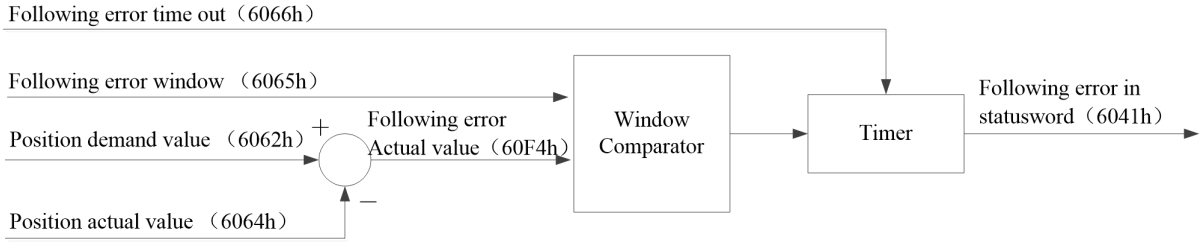
Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
6067h	00h	Position reaches the threshold	Command Unit	0~4294967295	U32	rw	RxPDO	PP
		The difference between 6062h (position command) and 6064h (position feedback) falls within the parameter set value. After the time specified by 6068h (position arrival time window), the bit10 (target reached) of 6041h (status word) is set to 1 as the threshold. If the difference is a value other than the specified parameter setting, bit10 of 6041h is 0.						
6068h	00h	Position arrival time window	1ms	0~65535	U16	rw	RxPDO	PP
		The difference between 6062h (position command) and 6064h (position feedback) represents the duration during which bit 10 ('target reached') of the state word 6041h is set to 1, under conditions within the range defined by 6067h (position arrival threshold).						

bit13: Follow error

When the value of 60F4h (position deviation) exceeds the set range specified by 6065h (excessive position deviation threshold), and if the time set by 6066h (error timeout) continues, bit 13 of 6041h (status word) becomes 1.

Bit	Name	Value	Definition
13	following error Follow-up	0	60F4h (position deviation) The value of (= 6062h (position command) – 6064h (position

Bit	Name	Value	Definition
	Error		feedback)) does not exceed the set range of 6065h (position deviation threshold), or the value of 60F4h exceeds the set value of 6065h without passing through the time set by 6066h.
		1	60F4h (position deviation) The value exceeds the set range of 6065h (for excessive position deviation) or remains beyond the set time of 6066h (error timeout). Continue.



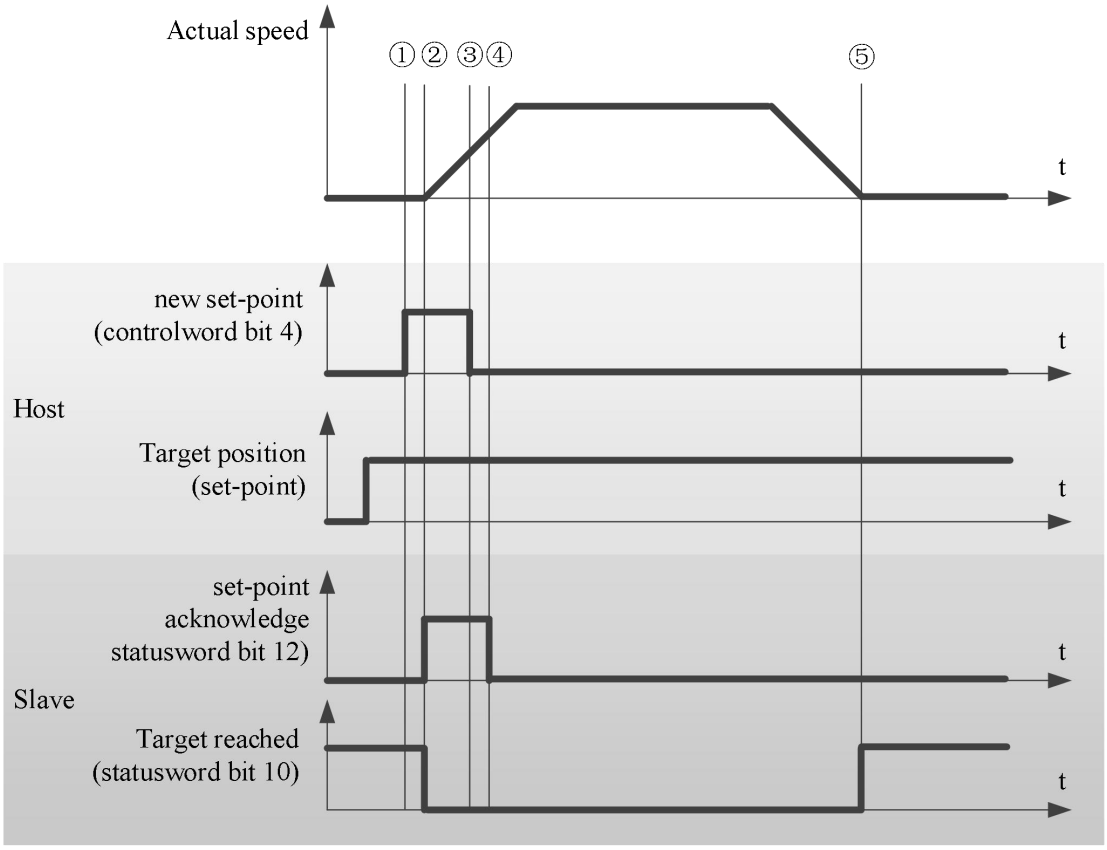
Schematic diagram of the tracking error function

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
6065h	00h	Position deviation threshold	Command Unit	0~4294967295	U32	rw	RxPDO	PP CSP
		The value of 60F4h (Following error actual value) serves as the threshold where bit 13 (following error) of the status word 6041h is set to 1 when its actual value deviates from the specified setting value of this parameter.						
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO	PP CSP
		When the value of 60F4h (position deviation) exceeds the set range of 6065h (overly large position deviation threshold), the current state indicates that the parameter value has surpassed its set limit. If operation continues under these conditions, the threshold for setting bit 13 of 6041h (state word) to 1 should be activated.						

3) Actions of the PP control mode

Example 1: (Basic set-point)

(1) For the master station, after setting the value of 607 Ah (target position), change bit 4 (new set-point) of 6040h (control word) from 0 to 1. At the same time, also set 6081h (profile speed).
The motor does not operate when 6081h (Profile speed) is 0.
(2) From the station, confirm the rising edge (0→1) of bit 4 (new set-point) at 6040h; use 607Ah (target position) as the starting point for positioning. Simultaneously, change bit 12 (set-point acknowledge) in 6041h (status word) from 0 to 1.
(3) At the master station, confirm that bit 12 (set-point acknowledge) at 6041h has changed from 0 to 1, and that bit 4 (new set-point) at 6040h has returned to 0.
(4) From the station, confirm that bit 4 (new set-point) at 6040h is set to 0, and that bit 12 (set-point acknowledge) at 6041h has also been set to 0.
(5) Upon reaching the target location, bit 10 (target reached) at position 6041h changes from 0 to 1.



< Set-point example >

- 6081h (Profile speed) is limited by the lower of 607Fh (maximum Profile speed) and 6080h (maximum motor speed).
- Changing the set values of 607Fh or 6080h during an operation does not reflect in the operation.

Action Example 2: (Action data change without buffering: single set-point)

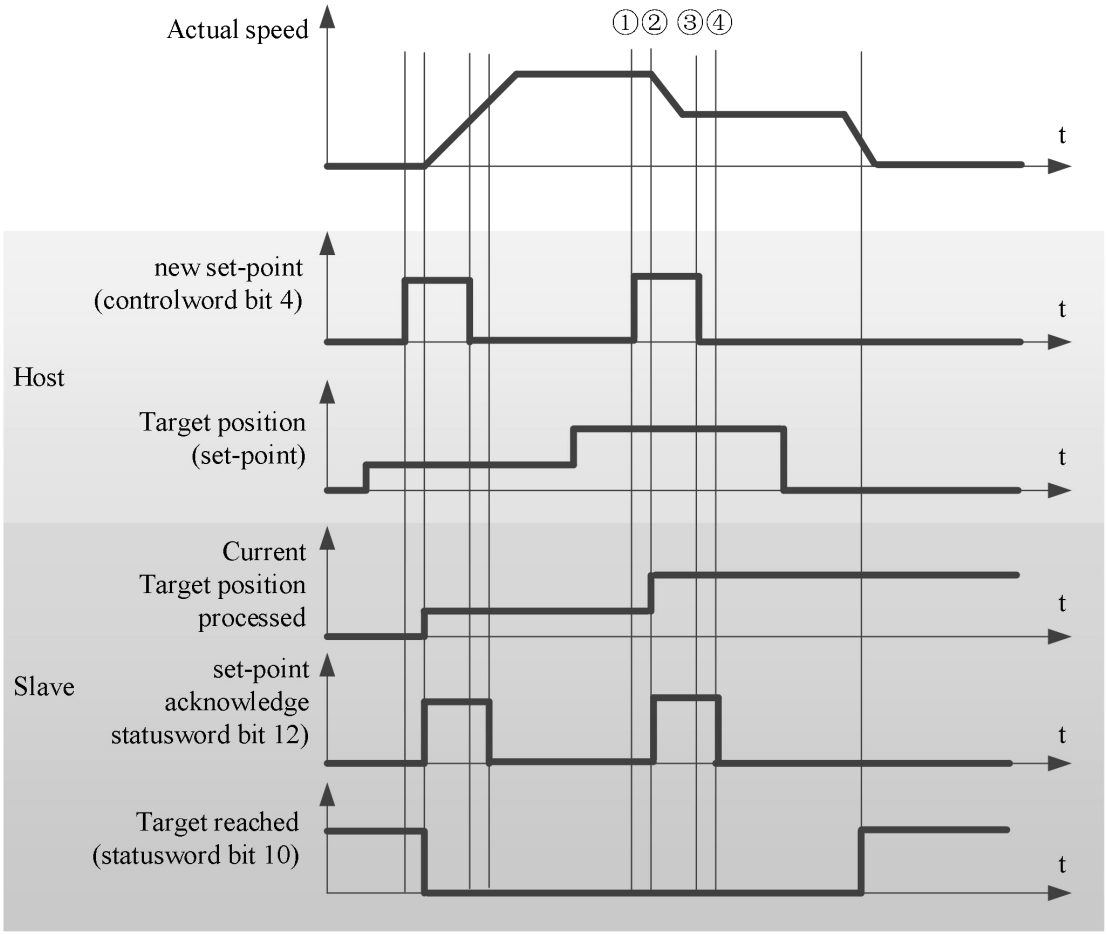
When the bit5 (change set immediately) at 6040h is set to 1, if the change in positioning action data during the current operation has been detected, the current positioning action is interrupted and the next positioning action is initiated immediately.
(1) At the master station, confirm that the bit12 (set-point acknowledge) in 6041h is 0; after modifying the value of 607Ah (target position), set the bit4 (new set-point) in 6040h from 0 to 1.

At this point, do not change the acceleration or deceleration.

(2) From the receiving station, confirm the rising edge (0→1) of bit 4 (new set-point) at 6040h; 607Ah is immediately updated as the new target position. At this point, bit 12 (set-point acknowledge) at 6041h changes from 0 to 1.
(3) At the master station, confirm that bit 12 (set-point acknowledge) at 6041h has changed from 0 to 1, and that bit 4 (new set-point) at 6040h has returned to 0.
(4) From the station, confirm that bit4 (new set-point) at 6040h is 0, and bit12 (set-point acknowledge) at 6041h is 0.

The same steps ((1)–(4)) can be applied to adjust the 6081h (Profile speed).

After modifying 607Ah (target position) and 6081h (profile speed), update both 607Ah and 6081h simultaneously according to the steps (1)–(4) above.



< handshaking procedure for the single set-point method >

10.5.2 Common Parameters

PP Control Mode Associated Object (Command/Setting Category)

Register	Explanation	Unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is PP (Profile Position Control Mode). Set its value to 1.	-
RXPDO[0x607A]	Location Given	Command Unit
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	Maximum internal speed	Unit/Unit of instruction
RXPDO[0x6080]	Maximum motor speed	r/min
RXPDO[0x6081]	Internal speed is set	Unit/Unit of instruction

Register	Explanation	Unit
RXPDO[0x6083]	Internal acceleration	Unit of instruction /s²
RXPDO[0x6084]	Internal deceleration rate	Unit of instruction /s²
RXPDO[0x60C5]	maximal acceleration	Unit of instruction /s²
RXPDO[0x60C6]	maximum deceleration	Unit of instruction /s²
RXPDO[0x6065]	Set the number of follow-up pulse pulses	Command Unit
RXPDO[0x6066]	Follow error timeout time	ms
RXPDO[0x6067]	Position reaches the threshold	Command Unit
RXPDO[0x6068]	Position to window time	ms

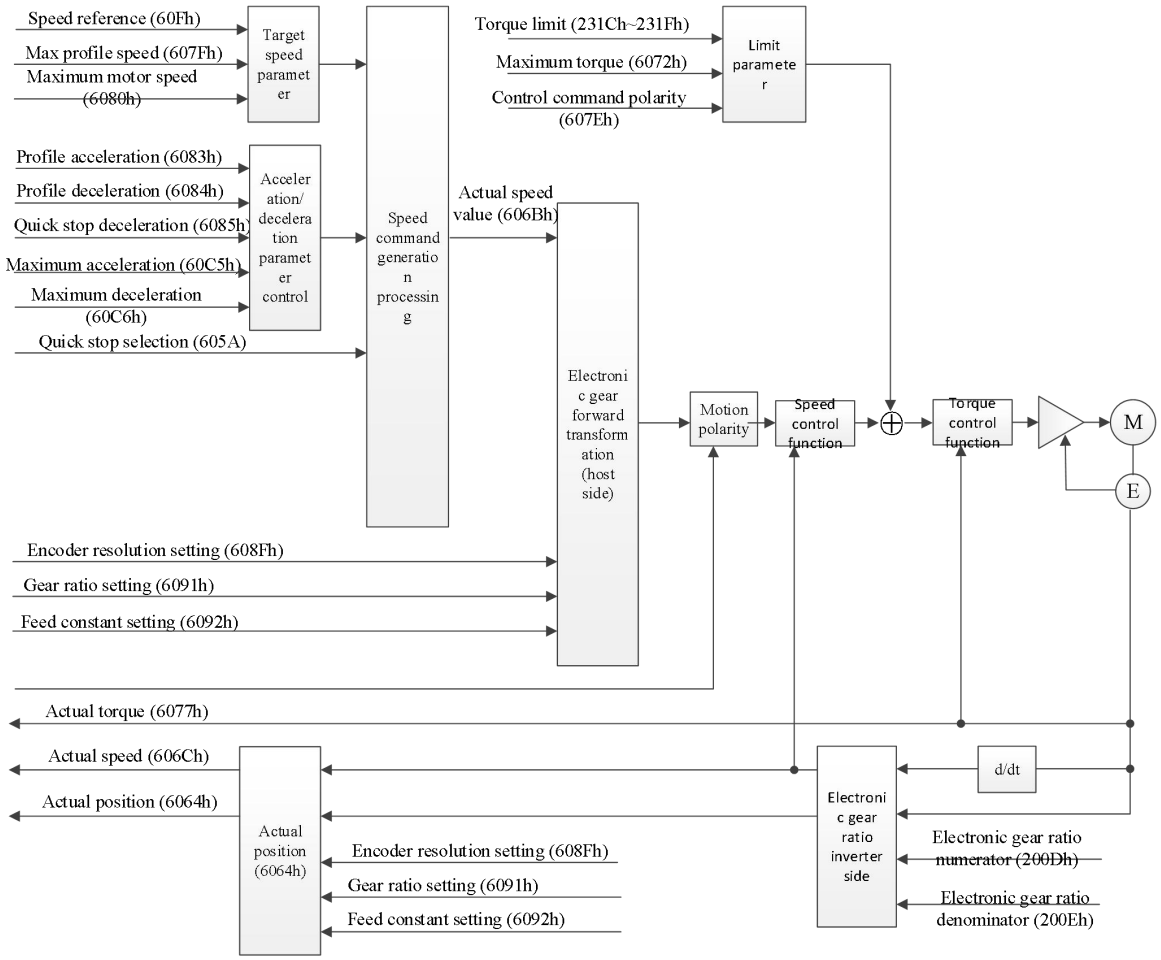
- 6081h (Profile speed) is limited by the lower of 607Fh (maximum internal speed) and 6080h (maximum motor speed).
- Any modification to the set values of 607Fh (maximum internal speed) or 6080h (maximum motor speed) during operation will not be reflected or take effect.

PP Control Mode Associated Object (Command/Monitoring Type)

Register	Explanation	Unit
TXPDO[0x6041]	status word	-
TXPDO[0x6063]	Internal actual location	Command Unit
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Actual Torque	0.1%
TXPDO[0x60F4]	Actual following error value	Command Unit

10.6 PV pattern

The PV (Profile Speed Control Mode) is a speed control mode that specifies target speed, acceleration, and deceleration, generating position commands internally within the servo driver. This control mode should be used when the communication cycle exceeds 500 μs.



10.6.1 Relevant parameter

1) pv control mode associated objects (instruction/setting type)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
6040h	00h	control word	-	0~65535	U16	rw	RxPDO
607Fh	00h	Maximum Profile velocity	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO
6083h	00h	Outline acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO

6084h	00h	Profile deceleration rate	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
60C5h	00h	maximal acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
60C6h	00h	maximum deceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO

There are also objects with common speed control associations.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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	Speed Offset	Unit/Unit of instruction	-2147483648~2147483647	I32	rw	RxPDO
60B2h	00h	Torque offset	0.1%	-32768~32767	I16	rw	RxPDO
60FFh	00h	Target speed	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO

There are also other related objects with common actions.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
605Ah	00h	Quick parking method 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 Response Option Code	-	0~2	I16	rw	NO
607Bh	-	Range	-	-	-	-	-

		location restriction					
	00h	Represents the 607Bh sub- index number	-	2	U8	ro	NO
	01h	Minimum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	Origin Offset	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction /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 speed	r(any power-generating or power-driven machine)	1~4294967295	U32	ro	NO
6091h	-	Motor rotation speed	-	-	-	-	-
	00h	Gear ratio setting	-	2	U8	ro	NO
	01h	Represents the 6091h sub- index number	r(any power-generating or power-driven machine)	1~4294967295	U32	rw	NO
	02h	Motor	r(axle)	1~4294967295	U32	rw	NO

		rotation speed					
6092h	-	Axis rotation angle	-	-	-	-	-
	00h	Feed constant setting	-	2	U8	ro	NO
	01h	Represents the 6092h sub- index number	Command Unit	1~4294967295	U32	rw	NO
	02h	Set the feed value	r(axle)	1~4294967295	U32	rw	NO
60B8h	00h	Axis rotation angle	-	0~65535	U16	rw	RxPDO

Control Byte (6040h) <Functions in PV Control Mode>

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
6040h	00h	control word	0~65535	U16	rw	RxPDO	All

Set the control commands for servo drivers, such as PDS state transitions.

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 corresponding) fr = fault reset r = reserved (not corresponding) fr = fault reset

oms = operation mode specific eo = enable operation

(Control mode dependent bit) qs = quick stop (Control mode dependent bit) qs = quick stop

h = stop ev = enable voltage

h = stop ev = enable voltage

so = switch on

PV mode; OMS bits are not used.

Speed Category

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
607Fh	00h	Max profile velocity Maximum	Unit/Unit of instruction	0~ 4294967295	U32	rw	RxPDO	PP PV HM

		Profile velocity						
		The speed limit values under Profile Position Mode (pp), Origin Reset Position Mode (hm), and Profile Speed Mode (pv). The maximum value is limited by the 6080h internal processing (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 controlling power supply activation, the maximum speed measured from the motor is set. The maximum value is determined by the maximum speed limit read from the motor during internal processing. For tq and CST, the speed is limited by the set value of this object.						

Accelerator and Decelerator Types

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
6083h	00h	Profile acceleration Outline acceleration	Unit of instruction /s²	0~ 4294967295	U32	rw	RxPDO	PP PV
		Set Profile Acceleration. When set to 0, internal processing is treated as 1.						
6084h	00h	Profile deceleration Profile deceleration rate	Unit of instruction /s²	0~ 4294967295	U32	rw	RxPDO	PP PV
		Set Profile Reduction Speed. When set to 0, internal processing is treated as 1.						
60C5h	00h	Max acceleration Maximum acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM
		Set the maximum acceleration. When set to 0, internal processing is treated as 1.						
60C6h	00h	Min deceleration maximum deceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM
		Set the maximum deceleration. When set to 0, internal processing is treated as 1.						

2) pv control mode associated objects (monitoring type)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
6041h	00h	status word	-	0~65535	U16	ro	TxPDO
6065h	00h	Position deviation threshold	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO
6066h	00h	Error timeout	1ms	0~65535	U16	rw	RxPDO
6067h	00h	Speed Threshold	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO
6068h	00h	Time to reach the speed threshold	1ms	0~65535	U16	rw	RxPDO

There are also other related objects shared for speed control.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6063h	00h	Actual internal position feedback	pulse	-2147483648~ 2147483647	I32	ro	TxPDO
6064h	00h	position feedback	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
606Bh	00h	Speed Instruction	Unit/Unit of instruction	-2147483648~ 2147483647	I32	ro	TxPDO
606Ch	00h	rate feedback	Unit/Unit of instruction	-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 also related objects with common patterns.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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 Probe 1	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	Command Unit	-2147483648 ~2147483647	I32	ro	TxPDO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	Command Unit	-2147483648~ 2147483647	I32	ro	TxPDO

Status byte (6041h) <Functions of the control mode>

Index	Sub index	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

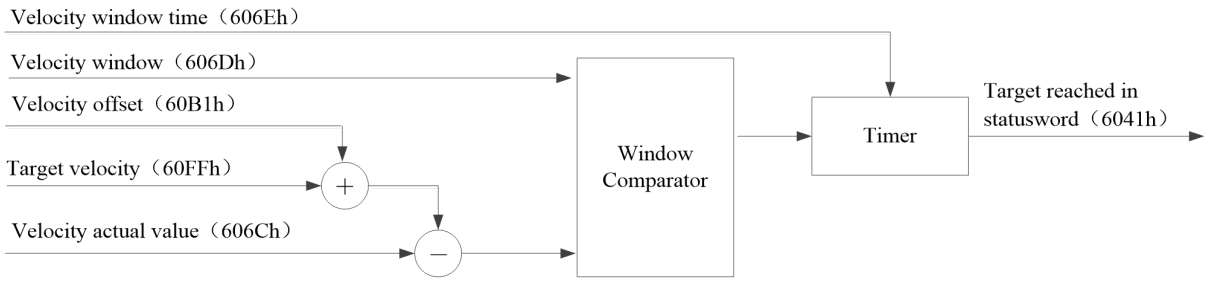
15	14	13	12	11	10	9	8
r		oms		ila	oms	rm	r
		r	speed		Target reached		
7	6	5	4	3	2	1	0
w	sod	qs	ve	f	oe	so	rSTO

r = reserved (not corresponding) w = warning r = reserved (not corresponding) 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

（1)bit10（target reached（Velocity reached)):

The difference between the sum of 60FFh (speed setpoint) and 60B1h (speed offset) and 606Ch (speed feedback) falls within the range defined by 606Dh (speed threshold arrival). If the time specified by 606Eh (speed threshold arrival time) has elapsed, bit 10 of 6041h (state word) becomes 1.

Bit	Name	Value	Definition
10	Target reached	0	stop=0 (normal condition): Speed control not completed stop=1 (based on the stop time): during shaft deceleration
		1	stop=0 (normal condition): Speed control completed stop=1 (when stop occurs): The axis stops (axis speed is 0)



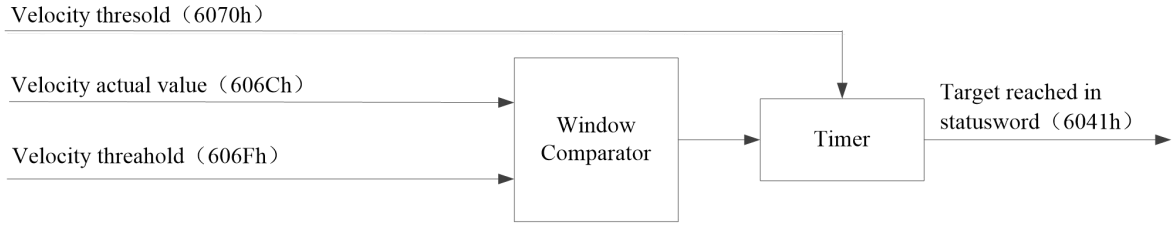
Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
606Dh	00h	Speed reaches the threshold	Command Unit	0~4294967295	U32	rw	RxPDO	PV
		The difference between the sum of 60FFh (speed given) and 60B1h (speed offset) and 606Ch (speed feedback) falls within the set value range of this parameter. After the time duration specified by 606Eh (speed threshold attainment time), the bit10 (target reached) of 6041h is set to 1 as the threshold. If the speed deviation is a value other than the set value of this parameter, the bit10 of 6041h becomes 0.						
606Eh	00h	Time to reach the speed threshold	1ms	0~65535	U16	rw	RxPDO	PV
		The time when the sum of 60FFh (speed setpoint) and 60B1h (speed offset) minus 606Ch (speed feedback) reaches the set value of 606Dh (speed arrival threshold), at which point the bit10 (target reached) of 6041h is set to 1.						

(2)bit12 (speed):

606Ch (velocity feedback) is set according to the value of 606Fh (velocity threshold), and if it exceeds the time value set by 6070h (velocity threshold time), the bit 12 of 6041h becomes 0.

606Ch (Speed Feedback): If the value falls below the set value of 606Fh (Speed Threshold), bit 12 of 6041h becomes 1, indicating the motor has stopped.

Bit	Name	Value	Definition
10	speed	0	During motor operation
		1	The motor is stopped.



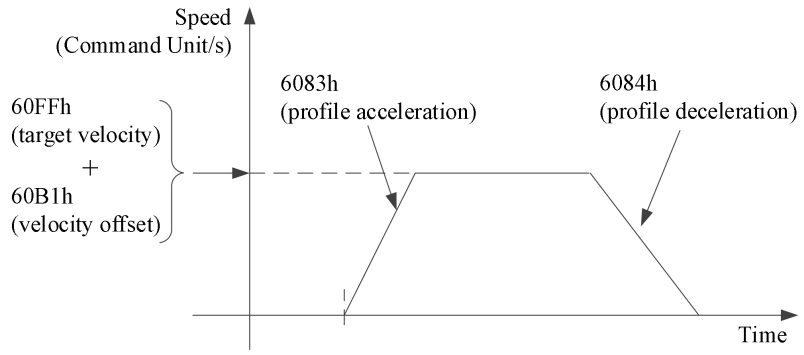
< Speed（functional overview）>

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode

606Fh	00h	Speed Threshold	Command Unit	0~4294967295	U32	rw	RxPDO	PV
		606Ch (Speed Feedback): If the value exceeds this parameter setting, after the time specified by 6070h (Velocity Threshold Time), set the bit 12 (speed) in 6041h (Status Word) to 0 as the threshold. If the speed is below the set value of this parameter, bit 12 of 6041h becomes 1.						
6070h	00h	Speed threshold time	1ms	0~65535	U16	rw	RxPDO	PV
		When the 606Ch (velocity feedback) exceeds the set value of 606Fh (velocity setpoint), determine the time when bit 12 of 6041h becomes 0.						

3) Operation of the PV control mode

- The Profile speed control mode generates speed command values based on the following parameters.
- Speed set (60FFh)
- Speed offset (60B1h)
- Outline acceleration (6083h)
- Profile deceleration rate (6084h)
- The target speed is 60 FFh (Target velocity).
- Velocity offset 60B1h is not supported.
- The update (transmission) of the action command should be performed approximately 100 ms after servo enable is activated.
- As detection information, it provides 606Ch (Velocity Actual Value – speed feedback).



- The 60FFh (fixed speed) is constrained by the 607Fh (maximum internal speed) and the 6080h (maximum motor speed).

10.6.2 Common Parameters

PV Control Mode Association Object (Command/Setting Category)

Register	Explanation	Unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is PV (Profile Speed Control Mode); set its value to 3.	-
RXPDO[0x60FF]	Given speed	Unit/Unit of instruction
RXPDO[0x6072]	maximum torque	0.1%

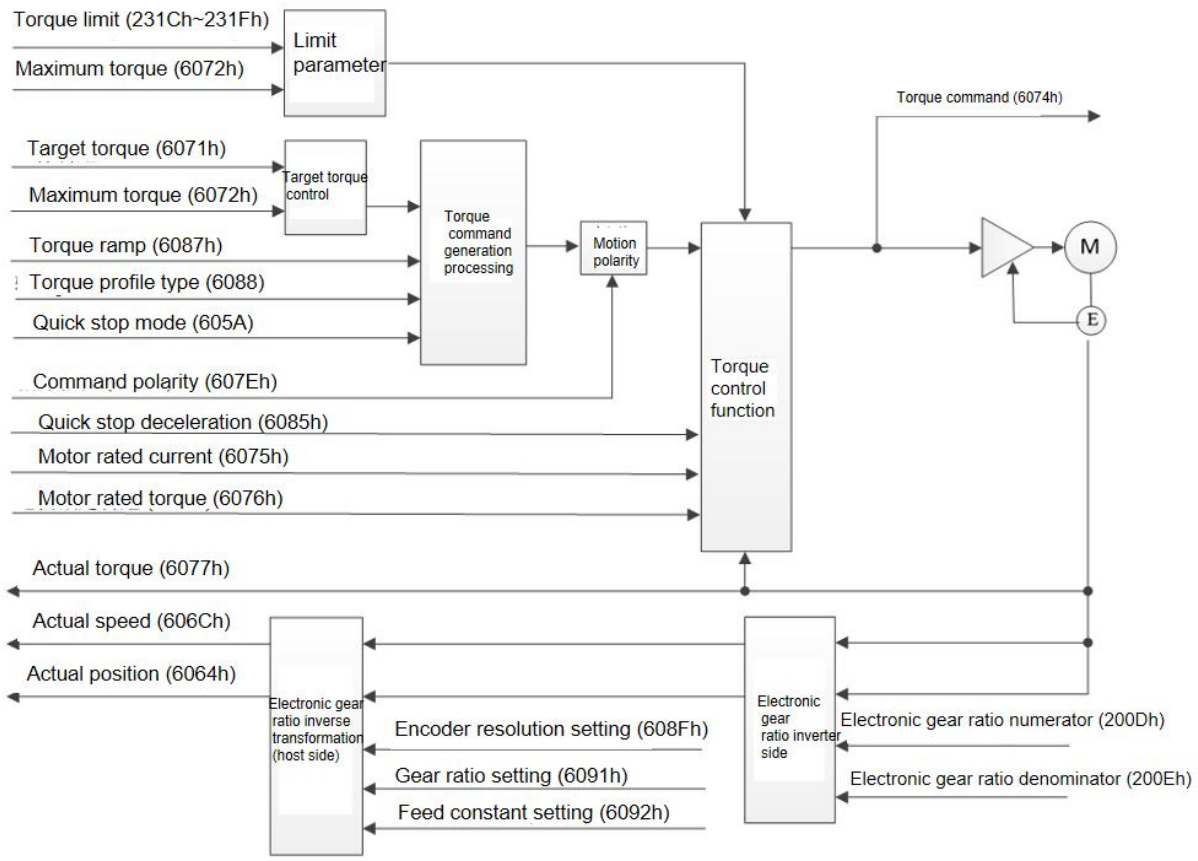
RXPDO[0x607F]	Maximum internal speed	Unit/Unit of instruction
RXPDO[0x6080]	Maximum motor speed	r/min
RXPDO[0x6083]	Internal acceleration	Unit of instruction /s²
RXPDO[0x6084]	Internal deceleration rate	Unit of instruction /s²
RXPDO[0x60C5]	maximal acceleration	Unit of instruction /s²
RXPDO[0x60C6]	maximum deceleration	Unit of instruction /s²
RXPDO[0x606D]	Speed reaches the threshold	Unit/Unit of instruction
RXPDO[0x606E]	Speed timeout	ms
RXPDO[0x606F]	Speed Threshold	Unit/Unit of instruction
RXPDO[0x6070]	Speed threshold time	ms

PV control mode associated objects (instruction,monitoring type)

Register	Explanation	Unit
TXPDO[0x6041]	status word	-
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Actual Torque	0.1%

10.7 TQ pattern

TQ (Profile Torque Control Mode) is a torque control mode that operates based on specified target torques, acceleration/deceleration parameters, and position commands generated internally by the servo driver. This control mode should be used when the communication cycle exceeds 500 μs.



10.7.1 Relevant parameter

1) TQ control mode associated objects (instruction/setting type)

Index	Sub index	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

Other systems also share common components related to torque control.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6071h	00h	Given torque	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 Slope	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	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
605Ah	00h	Quick parking method 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 Response Option Code	-	0~2	I16	rw	NO
607Bh	-	Range location restriction	-	-	-	-	-
	00h	Represents the 607Bh sub- index number	-	2	U8	ro	No
	01h	Minimum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
	02h	Maximum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Ch	00h	Origin Offset	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO
607Eh	00h	Instruction polarity	-	0~255	U8	rw	NO
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO
6086h	00h	Position Trajectory Planning Type	-	-32768~32767	I16	rw	RxPDO
608Fh	-	Position Encoder Resolution Setting	-	-	-	-	-
	00h	Indicates the 608Fh sub-	-	2	U8	ro	NO

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo
		index number					
	01h	Encoder movement distance	pulse	1~4294967295	U32	ro	NO
	02h	Motor rotation speed	r(any power-generating or power-driven machine)	1~4294967295	U32	ro	NO
6091h	-	Gear ratio setting	-	-	-	-	-
	00h	Represents the 6091h sub- index number	-	2	U8	ro	NO
	01h	Motor rotation speed	r(any power-generating or power-driven machine)	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
6092h	-	Feed constant setting	-	-	-	-	-
	00h	Represents the 6092h sub- index number	-	2	U8	ro	NO
	01h	Set the feed value	Command Unit	1~4294967295	U32	rw	NO
	02h	Axis rotation angle	r(axle)	1~4294967295	U32	rw	NO
60B8h	00h	Probe Mode	-	0~65535	U16	rw	RxPDO

Control Byte (6040h)> Functions under TQ Control Mode>

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
6040h	00h	control word	0~65535	U16	rw	RxPDO	All

Set the control commands for servo drivers, such as PDS state transitions.
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 corresponding) fr = fault reset

		oms = operation mode specific eo = enable operation (Control mode dependent bit) qs = quick stop h = stop ev = enable voltage so = switch on

TQ mode does not use the OMS bit.

Torque Category

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
6087h	00h	Torque slope Torque Slope	0.1 %	0~4294967295	U32	rw	RxPDO	tq cst
		Set the parameter value to provide the torque command. The Cyclic Synchronous Torque Mode (CST) is only effective during deceleration and stopping. If set to 0, internal processing operates with 1.						
6088h	00h	Torque profile type Torque Planning Type	-	-32768~32767	I16	rw	RxPDO	tq
		To adjust the torque, select the torque Profile type to be used. 0: Straight slope 1：Not supported						

2) TQ Control Mode Associated Objects (Monitoring Type)

Index	Sub index	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	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
6063h	00h	Actual internal position feedback	pulse	-2147483648~2147483647	I32	ro	TxPDO
6064h	00h	position feedback	Command Unit	-2147483648~2147483647	I32	ro	TxPDO
606Ch	00h	rate feedback	Unit/Unit of instruction	-2147483648~2147483647	I32	ro	TxPDO
6074h	00h	Torque Command	0.1%	-32768~32767	I16	ro	TxPDO
6075h	00h	Motor rated current	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 also other related objects with common patterns.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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 Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO

Status Byte (6041h) <Functions of Control Mode>

<table>
<tr><th>Index</th><th>Sub index</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>r</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 corresponding) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
(Control mode dependent bit) ve = voltage enabled
ila = internal limit active f = fault
oe = operation enabled
rm = remote so = switched on
rtso = ready to switch on</td></tr>
</table>

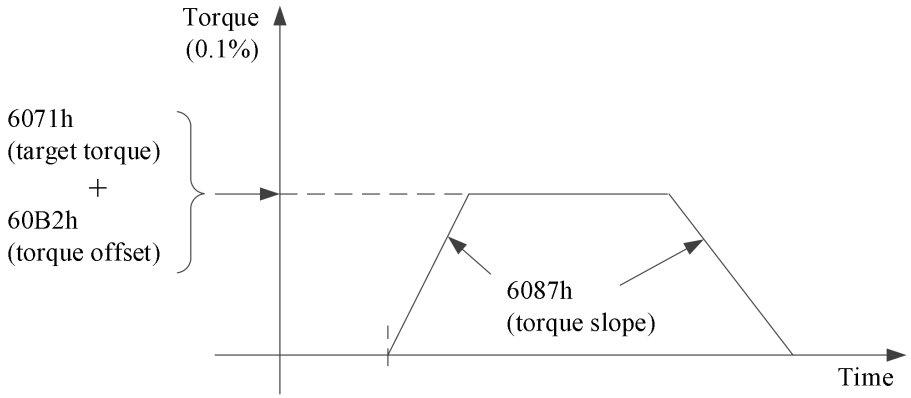
bit13,12,10（operation mode specific）:

Bit	Name	Value	Definition
10	target reached	0	stop=0 (normal condition): 6074h (Torque demand) has not reached the target torque stop=1 (based on the stop time): during shaft deceleration
		1	stop=0 (normal condition): The torque demand (6074h) reaches the

Bit	Name	Value	Definition
			target torque stop=1 (when stop occurs): The axis stops (axis speed is 0)
12	reserved	-	unused
13	reserved	-	unused

3) Actions of the tq control mode

- The Profile Torque Control mode generates torque command values based on the following parameters.
- Target torque specified (6071h)
- Torque offset (60B2h) (not supported)
- Torque slope (6087h)
- Update the action command (send signal): After enabling the servo, input it approximately 100 ms later.
- As monitoring information, it provides 6077h (Torque Actual Value – torque feedback).



- The value of 6071h (Target torque specified) corresponds to 6072h (Maximum torque), 231Ch (P3-28), and 231Dh (P3-29), constrained by the minimum value.
- The speed is limited by 6080 h (maximum motor speed).

10.7.2 Common Parameters

TQ Control Mode Associated Object (Command/Setting Category)

Register	Explanation	Unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is tq (Profile Torque Control Mode); set its value to 4.	-
RXPDO[0x6071]	Given target torque	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 Category)

Register	Explanation	Unit
TXPDO[0x6041]	status word	-

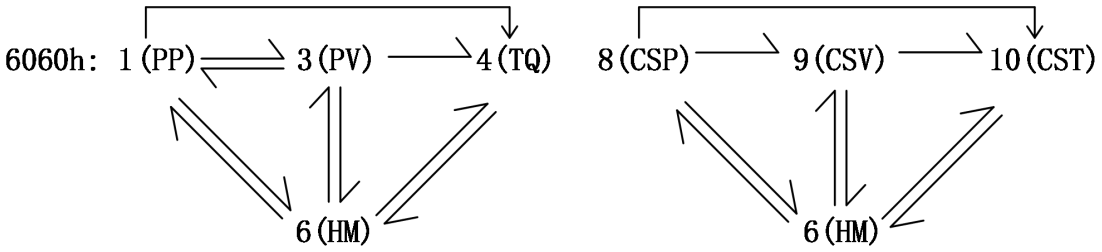
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Actual Torque	0.1%

TQ mode; OMS bits are not used.

10.8 Common Pattern Functionality

10.8.1 Mode interchange function

Supports mode switching during operation with a switching time of 2 ms. When the servo is enabled, it supports switching between position mode and speed mode, position mode and torque mode, and speed mode and torque mode, enabling users to achieve multi-mode switching control in project applications.



10.8.2 Parking method

PDS is a motor deceleration and stop method designed for scenarios such as main power interruption or alarm occurrence when the system is in the Operation-enabled state (servo enable activated).

The deceleration function defined by CoE (CiA402) (selection code) shall be used in combination with the deceleration function on the servo side (DS5C1) (free-run stop, deceleration stop).

PDS Selection Code Overview

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
605Ah	00h	Quick parking method 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 Response Option Code	-	0~2	I16	rw	NO

List of Associated Objects

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
6084h	00h	Profile deceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM CSP CSV

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
		Set Profile Reduction Speed. When set to 0, internal processing is treated as 1.						
6085h	00h	Quick stop deceleration Quickly stop and reduce your speed.	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM CSP CSV
		If the 605Ah (Quick stop Option Code) is "2" or "6", set the deceleration parameter for the motor to stop during Quick stop. The codes 605Dh (stop 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
		Set the parameter value to provide the torque command. The cyclic synchronous torque mode (CST) is only effective during deceleration and stop times.						
609Ah	00h	Homing acceleration	Unit of instruction /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) also applies to this object. At the final stop of each original movement (when the origin position is detected), the set value of this object is not required, and the servo lock stops.						
60C6h	00h	Max deceleration maximal acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP HM CSP
		Set the maximum deceleration. If set to 0, internal processing is performed as an operation with value 1.						

1) Rapid parking mode selection (605Ah)

Set the motor deceleration and stop method when receiving the PDS command "Quick stop".

Index	Sub index	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 motor stops on the servo side (Sequence at Servo-off), transition to Switch on disabled. 1: After the motor stops via 6084h (Profile deceleration), switch to "Switch on disabled". 2: After the motor stops via 6085h (Quick stop Deceleration), switch to Switch On						

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Op-mode
		Disabled. 3: After the motor stops at 60°C for 6 hours (maximum deceleration), switch to "Switch on disabled". 5: After the motor stops via 6084h (Profile deceleration), switch to Quick stop Active. 6: After the motor stops via the 6085h (Quick stop Deceleration) function, switch to Quick stop Active. 7: After the motor stops at 60°C for 6 hours (maximum deceleration), switch to Quick stop Active mode. hm 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switch on disabled. 1: After stopping the 609Ah (Homing acceleration) motor, 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 "Switch on disabled". 5: After the 609Ah (Homing acceleration) motor stops, switch to Quick stop Active mode. 6: After the motor stops via the 6085h (Quick stop Deceleration) function, switch to Quick stop Active. 7: After the motor stops at 60°C for 6 hours (maximum deceleration), switch to Quick stop Active mode. cst, tq 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switch on disabled. 1,2: After the 6087h (Torque slope) motor stops, switch to "Switch on disabled". 3: After the torque 0 motor stops, transition to Switch on disabled. 5.6: After the motor stops via the 6087h (Torque slope) command, switch to Quick stop Active mode. 7: After the torque 0 motor stops, transition to Quick stop Active.						

Example of using the Quick stop command to slow down and stop:

A: If 6040h:bit2 (Controlword: quick stop) changes from 1 to 0, the speed decreases and the movement stops.

During deceleration, the PDS status changes to Quick stop Active.

B: The motor stops when the detected actual speed falls below 10 rpm.

After stopping, the PDS status becomes "Switch on disabled" or "Quick stop active".

2) Power-off option code (605Bh)

Set the motor deceleration and stop method when receiving the PDS commands "Shutdown" and "Disable voltage".

Index	Sub	Name	Unit	Scope	Data	Accessibility	Pdo	Op-mode

	index				Type			
605Bh	00h	Shutdown option code	-	0~1	I8	rw	RxPDO	ALL
		Set the timing for receiving the PDS commands "Shutdown" and "Disable voltage." This varies depending on the control mode definition. Prohibition is set except for the following values. (1) When receiving the PDS command "Shutdown" pp, csp, csv, pv 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Ready to switch on. 1: After the motor stops via 6084h (Profile deceleration), transition to Ready to switch on. hm 0: After the motor stops on the servo side (Sequence at Servo-off), 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 motor stops on the servo side (Sequence at Servo-off), transition to Ready to switch on. 1: After the motor stops via 6087h (Torque slope), transition to Ready to switch on. (2) When receiving the PDS command "Disable voltage" pp, csp, csv, pv 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switch on disabled. 1: After the motor stops via 6084h (Profile deceleration), switch to "Switch on disabled". hm 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switch on disabled. 1: After stopping the 609Ah (Homing acceleration) motor, switch to Switch on disabled. cst, tq 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switch on disabled. 1: After the motor stops via 6087h (Torque slope), switch to "Switch on disabled".						

An example of the deceleration and stop action triggered by the shutdown command:

A: If the PDS command "Shutdown" is received, deceleration and stop will begin.
The PDS status during deceleration remains Operation enabled.
B: The motor stops when the detected actual speed falls below 10 rpm.
After stopping, the PDS status 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	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-mode
605Ch	00h	Disable operation option code	-	0~1	I16	rw	RxPDO	ALL
		Set the timing for receiving the PDS command "Disable operation." This varies depending on the control mode definition. Prohibition is set except for the following values. pp，csp，csv，pv 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switched on. 1: After the motor stops at 6084h (Profile deceleration), transition to Switched on. hm 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switched on. 1: After stopping the 609Ah (Homing acceleration) motor, transition to Switched on. cst，tq 0: After the motor stops on the servo side (Sequence at Servo-off), transition to Switched on. 1: After the motor stops via 6087h (Torque slope), transition to Switched on.						

An example of slowing down and stopping the movement using theDisable operation command.

A: If the PDS command "Disable operation" is received, deceleration and stop will commence.
The PDS status during deceleration remains Operation enabled.
B: The motor stops when the detected actual speed is below 10 r/min.
After stopping, the PDS status bit is switched to On.

4)stop option code（605Dh)

Set the motor deceleration and stop method when bit 8 (stop) of control word 6040h is set to 1.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Op-mode
605Dh	00h	stop option code	-	1~3	I16	rw	NO	ALL
		Set the timing for receiving the PDS command "Disable operation." This varies depending on the control mode definition. Prohibition is set except for the following values. ,Set the timing for the stop action, which varies depending on the control mode definition. Prohibition is set except for the following values.						

		pp, csp, csv, pv 1: After the motor stops via 6084h (Profile deceleration), maintain Operation enabled. 2: After the motor stops via the 6085h (Quick stop Deceleration) function, maintain Operation enabled. 3: After the motor stops at 6072 h (Maximum Torque) and 60C6 h (Maximum Deceleration), maintain Operation enabled. hm 1: After the 609Ah (Homing acceleration) motor stops, maintain Operation enabled. 2: After the motor stops via the 6085h (Quick stop Deceleration) function, maintain Operation enabled. 3: After the motor stops at 6072 h (Maximum Torque) and 60C6 h (Maximum Deceleration), maintain Operation enabled. cst, tq 1,2: After the 6087h (Torque slope) motor stops, maintain Operation enabled. 3: After the torque 0 motor stops, maintain Operation enabled.

An example of the stop function slowing down and stopping movements

A: When 6040h:bit8 (Controlword: stop) changes from 0 to 1, deceleration begins and stops. During deceleration, the PDS status remains Operation enabled.

B: The motor stops when the detected actual speed is below 10 r/min. After stopping, the PDS status remains Operation enabled.

5)Fault reaction option code（605Eh)

Set the motor stop method when an alarm occurs.

Index	Sub index	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 occurrence, which varies depending on the control mode definition. Setting outside the specified range is prohibited. (1) When Err values occur in the ranges of 80.0–80.7, 81.0–81.7, 85.0–85.7, or 88.0–88.7 pp, csp, csv, pv 0: After the servo-side (Sequence at alarm) motor stops, proceed to Fault. 1: After the motor stops via 6084h (Profile deceleration), transition to Fault. 2: After the motor stops via the 6085h (Quick stop Deceleration) function, the system transitions to Fault mode. hm 0: After the servo-side (Sequence at alarm) motor stops, proceed to Fault.						

		1: After the 609Ah (Homing acceleration) motor stops, transition to Fault. 2: After the motor stops via the 6085h (Quick stop Deceleration) function, the system transitions to Fault mode. cst, tq 0: After the servo-side (Sequence at alarm) motor stops, proceed to Fault. 1,2: After the 6087h (Torque slope) motor stops, transition to Fault. (2) When an alarm occurs other than those specified in (1) above 0,1,2: After the servo-side (Sequence at alarm) motor stops, proceed to Fault.

Example of the deceleration and stop action triggered by an alarm

A: If an alarm occurs, deceleration begins and stops. During deceleration, the PDS status is Fault Reaction Active.

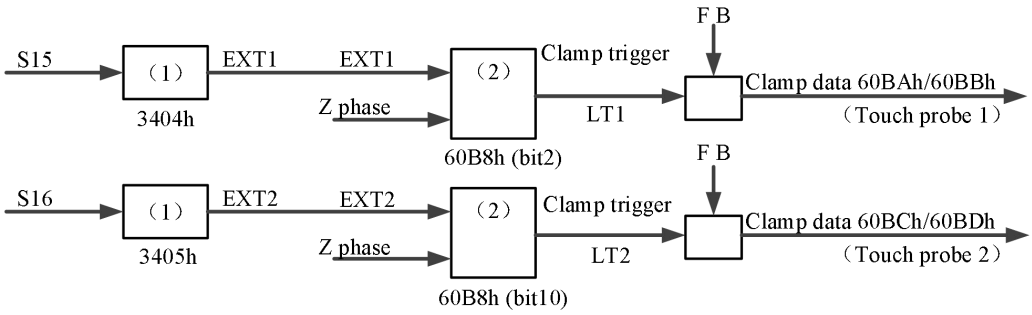
B: The motor stops when the detected actual speed is below 10 r/min. The PDS status after stopping is Fault.

10.8.3 Probe function (position clamping request/unclamping)

The probe function serves as a position latch mechanism. When the trigger conditions (EXT1/EXT2) are met, the function is activated and stores the motor encoder value corresponding to the triggered condition. Depending on the configuration of probe control word 60B8, the function can be triggered either once or multiple times.

- The probe function is not supported in HM mode.
- Currently, only external signals are supported as trigger sources.

1) Composition of the probe function



60B8h: Touch probe function

60BAh: Touch probe pos1 pos value (clamping position for the rising edge of Touch probe 1)

60BBh: Touch probe pos1 negative value (clamping position of the falling edge of Touch probe1)

60BCh: Touch probe pos2 pos value (clamping position for the rising edge of Touch probe2)

60BDh: Negative value of Touch probe pos2 (clamping position of the falling edge of Touch probe2)

If the triggering point coincides with exactly one position during a full motor rotation, the theoretical difference between the two latched probe values should equal the number of pulses generated by the motor encoder over one complete cycle.

It should be noted that there is a delay between the generation of an external trigger signal and the driver's reception of the signal followed by the latch operation. Consequently, the value latched by the probe inevitably deviates from the actual measured value, with the magnitude of this deviation depending on the motor's speed, hardware performance, and software processing.

Key points for using the feature:

Product model	Factory default value		Settings when using the probe function	
	P5-62	P5-63	P5-62 (Terminal)	P5-63 (Terminal)
DS5C2 (7.5 kW and below)	0	0	1 (SI1)	2 (SI2)
DS5C2 (15~32kW)	6	7	6 (P-)	7 (D-)

(1) The clamping trigger signal uses external inputs (EXT1/EXT2). P5-62 and P5-63 are the terminal allocation parameters for Touch Probe 1 and Touch Probe 2 functions, respectively. The default parameters for the driver probe functions are shown in the table above.

60B8h (probe function)			
Bit10	LT2	Bit2	LT1
0	EXT2	0	EXT1
1	Z Xiang	1	Z Xiang

(2) If the Touch probe is applied to an unallocated port, E-883 (abnormal operation protection) occurs.
(3) When the clamping trigger signal is an external input (EXT1/EXT2), acquisition errors 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 shall each exceed 2 ms.
(5) In the following cases, the Touch probe is invalid (canceled). (The value of 60B9h is cleared.)

① The ESM status is Init
② Switching to HM mode

(6) Do not set both rising and falling edges for the same Touch Probe simultaneously. The system cannot guarantee proper operation when both settings are configured concurrently.
(7) It should be noted that there is a delay between the generation of an external trigger signal and the driver's reception of the signal followed by the latch operation. Consequently, the value latched by the probe inevitably deviates from the actual measured value, with the magnitude of this deviation depending on the motor speed, hardware performance, and software processing.

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	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 Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO
60BCh	00h	Indicates the rising edge	instruct	-2147483648~	I32	ro	TxPDO

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo
		clamping position of Touch Probe 2	unit	2147483647			
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO

2) Probe function settings (60B8h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Op-mode
60B8h	00h	Touch probe function	-	0~65535	U16	rw	RxPDO	ALL
		Set the Touch Probe function.						

Description of the corresponding bit

Bit	Value	Annotate	
0	0	Switch off touch probe 1	Touch Probe 1 Execute/stop
	1	Enable touch probe 1	
1	0	Trigger first event	Touch Probe 1 Event Pattern 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 上升沿选择
	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 Descending 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 Execute/stop
	1	Enable touch probe 2	
9	0	Trigger first event	Touch Probe 2 Event Pattern 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 上升沿选择
	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 Descending 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.

3) Probe functional status (60B9h)

Index	Sub index	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.						

Description of the corresponding bit

Bit	Value	Annotate	
0	0	Touch probe 1 is switch off	Touch probe 1 has stopped moving
	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	Status of the rising edge completed by 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 has stopped moving
	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	Status of the rising edge completed by Touch Probe 2
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

4) Obtained clamp position (0x60BA–0x60BD)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	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 Probe 1.						

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 Probe 1.						
60BCh	00h	Touch probe pos2 pos value	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO	ALL
		Indicates the rising edge clamping position of Touch Probe 2.						
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 Probe 2.						

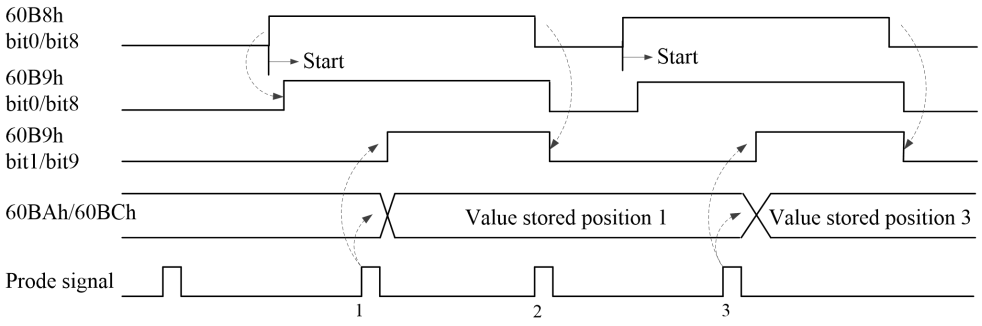
5) Initiation of probe movement

During the transition from "0 (stop)" to "1 (start)" for bit0(bit8) in 60B8h (probe function setting), the system acquires various configuration parameters (bits 1–7 and 9–15 of 60B8h) and initiates the Touch probe operation.
To make changes to various settings effective, return "0 (stop)" at bit 0/8 and then proceed to "1 (start)".
To switch control modes and use the probe function again, set bit0(bit8) to "0 (stop)" and then set it back to "1 (start)".

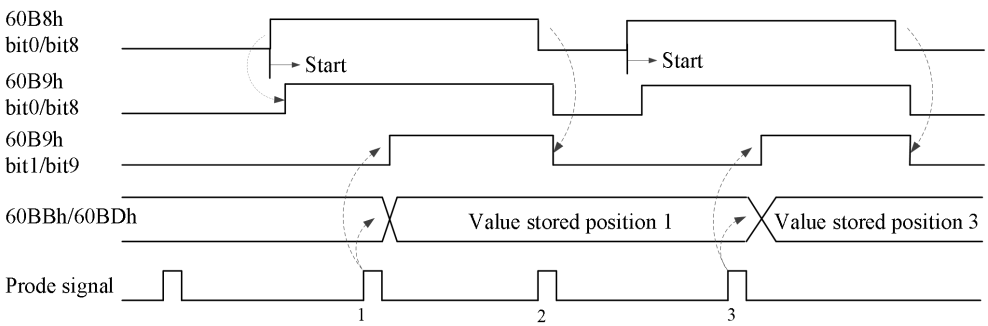
6) Probe Event Pattern

According to bit 1/19 (event mode selection) in the 60B8h probe function settings, you can choose either "0 (Trigger first event mode)" or "1 (Continuous mode)".

(1) <Trigger first event mode> (60B8h: bit1=0 / bit9=0)
After startup, the system operates in a bit-setting mode triggered only by the initial signal. To retrieve data again, the Touch probe must be restarted.



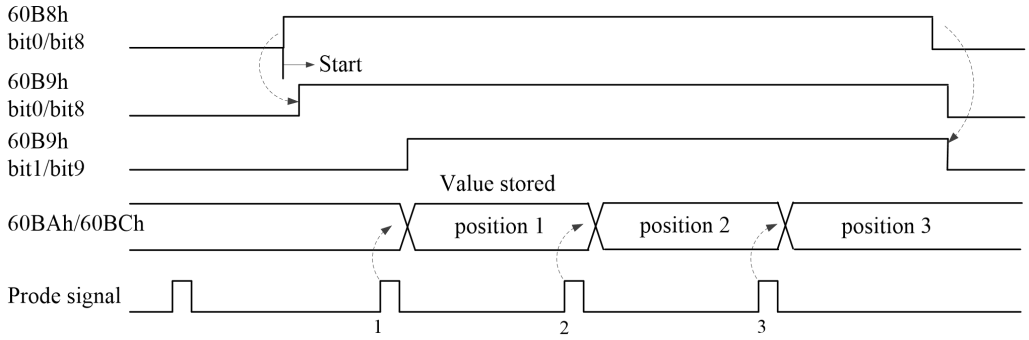
Positive edge case



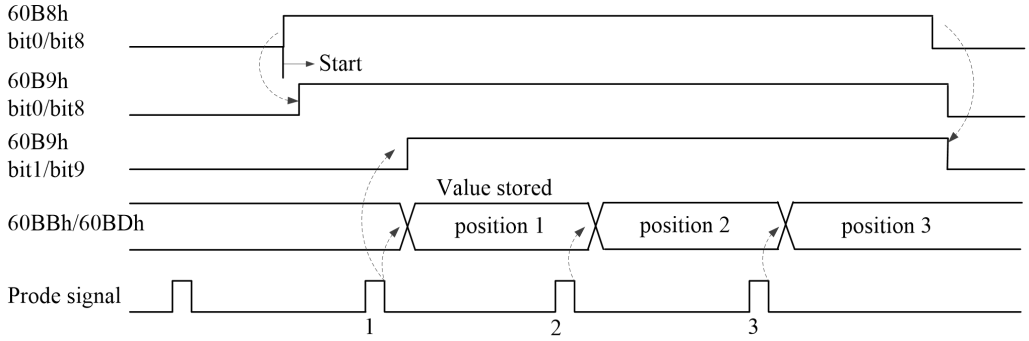
Negative edge case

(2) <Continuous mode> (60B8h: bit1=1 / bit9=1)

After startup, the pattern of triggered signal bit masking is detected each time. The obtained value is retained for the next probe signal.



Positive edge case



Negative edge case

10.8.4 Digital input (60FDh)

The bits of the 60FDh digital input are represented by functional signals assigned through parameters P5-22 (POT setting address), P5-23 (NOT setting address), P5-27 (HOME origin setting address), P5-62 (Probe 1 setting address), P5-63 (Probe 2 setting address), P5-72 (Remote SI Input 1), P5-73 (Remote SI Input 2), P5-74 (Remote SI Input 3), and P5-75 (Remote SI Input 4) of the DS5C2 series servo controller. These signals correspond to the input states of the positive limit switch (POT), negative limit switch (NOT), home switch (HOME), Touch Probe 1 (Probe 1), Touch Probe 2 (Probe 2), Remote Input State 1, Remote Input State 2, Remote Input State 3, and Remote Input State 4, respectively.

Digital input (60FDh)

<table>
<tr><th>Index</th><th>Sub index</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="11">60FDh</td><td rowspan="11">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="7">Represents the theoretical input state of the external input signal.
bit information</td></tr>
<tr><td colspan="7"><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>
</table></td></tr>
</table>

		<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="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 corresponding) pls = positive limit switch r = reserved (not corresponding) pls = positive limit switch nls = negative limit switch (reverse overtravel switch); hs = home switch (origin switch) tp1=Touch probe 1 (Probe 1) tp2=Touch probe 2 (Probe 2) tp1=Touch probe 1 (Probe 1) tp2=Touch probe 2 (Probe 2) ZOSS = 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 State 3 (Remote SI Input State 3) ris4 = Remote Input State 4 (Remote SI Input State 4)

The details for each Bit are as follows:

Numeric value	Description
0	input mode OFF
1	input mode ON

The values of bit0 (reverse overshoot switch), bit1 (forward overshoot 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) on the 60FD (digital input) respectively indicate the signal states of the forward drive limit input, negative drive limit input, near-origin input, probe 1 input, probe 2 input, Z-phase output, remote SI input 1, remote SI input 2, remote SI input 3, and remote SI input 4.

The Z-phase output hold time is modified via driver parameters:

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P5-19	Z-phase output hold time	2	ms	1 ~ 65535	at any time	immediately

The Z-phase output is affected by the EtherCAT communication cycle and its own software processing, resulting in poor consistency.

10.8.5 Digital output (60FEh)

Bit 0 in sub-object word 1 of the 60FEh digital output indicates the zero-crossing Z-phase output status bit, while bit 0 in sub-object word 2 indicates the zero-crossing Z-phase output enable bit. When the Z-phase output enable bit is set to 1, the Z-phase output status bit changes from 0 to 1 upon encoder zero-crossing; after the retention time specified by P5-19, it changes back from 1 to 0. When the Z-phase output enable bit is set to 0, no Z-phase output status is present, and the Z-phase output status bit remains at 0.

Digital output (60FEh)

<table>
<tr><th>Index</th><th>Sub index</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="4">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 representing 60FEh.</td></tr>
<tr><td rowspan="2">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 the 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 State 2)
ros3 = Remote Output State 3 (Remote SO Output State 3)</td></tr>
<tr><td rowspan="2">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">This 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>
<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) roe1 = remote output enable1 (Remote SO Output Enable 1)
roe2 = remote output enable2 (Remote SO Output Enable 2)
Roe3 = Remote Output Enable3 (Remote SO Output Enable 3)</td></tr>
</table>

The details for each Bit are as follows:

Sub index 01h：Physical outputs

Bit	Name	Numeric value	Description
16	Remote SO1 output status bit	0	Remote SO1 status: OFF
		1	Remote SO1 status: ON
17	Remote SO2 output status bit	0	Remote SO2 status: OFF
		1	Remote SO2 status ON
18	Remote SO3 output status bit	0	Remote SO3 status: OFF
		1	Remote SO3 status ON

Sub index 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 ON

In the digital output 60FEh, bits 16,17, and 18 in Sub index 01h (sub-object word 1) represent the remote SO1 output status bits, while bits 16,17, and 18 in Sub index 02h (sub-object word 2) indicate the remote SO1 output enable bit, remote SO2 output enable bit, and remote SO3 output enable bit, respectively.

10.8.6 Location information: Location

1) Initialization time for location information

This servo driver performs initialization (pre-setting) of position information-related objects according to the following timing sequence.

- Initialization sequence (conditions)
  - When the power is supplied
  - When communication is established (ESM state Init → OP migration)
  - When origin reset is completed
  - When performing a complete reset of the absolute multi-turn system
- Initialize object
  - 6062h (Position demand value – Position command)
  - 6063h (Position Actual Internal Value: Feedback on the actual internal position)
  - 6064h (Position actual value feedback)
  - 60FCh (Position demand internal value)

The objective here is to utilize the actual internal position feedback (6063h) representing the motor's position, combined with the subsequent electronic gear functionality that incorporates factors such as Home offset based on polarity change signs, and perform initialization (pre-setting) upon communication establishment.
Additionally, changes to the electronic gear ratio, polarity of the Polarity command, and the Home offset setting values are reflected according to the timing described later in this chapter.

For details on precautions when using absolute encoders, refer to Section 4 of this chapter titled "Initialization of Absolute Encoders".

2) Electronic gear ratio

(1) Functional Description

The electronic gear function multiplies the position command input from the higher-level controller by the electronically set gear ratio specified by the user, thereby generating the position command for the position control unit. By utilizing this function, the rotational or linear displacement of the motor for each command unit can be precisely defined.

(2) Electronic Gear Ratio Setting Method for the DS5C2 Series

Method 1: Set the electronic gear ratio based on the servo internal parameters; refer to Section 8.1.1.1 for the specific configuration method.

Method 2: Set the electronic gear ratio according to the parameters specified in CoE (CiA402):608Fh (Position encoder resolution), 6091h (Gear ratio), and 6092h (Feed constant).

The following primarily Explanations how to set the electronic gear ratio according to the CoE (CiA402) specification.

The relationship between the user-defined unit (instruction unit) and the internal unit (pulse) is calculated using the following equation.

Electronic gear ratio calculation formula:

$$\text{Electronic gear ratio} = \frac{\text{Position encoder resolution} \times \text{Gear ratio}}{\text{Feed constant}}$$

$$\text{Position encoder resolution} = \frac{\text{608F：01（encoderincrements）}}{\text{608F：02（motorrevolutions）}}$$

$$\text{Gear ratio} = \frac{\text{6091：01（Motorrevolutions）}}{\text{6091：02（Shaftrevolutions）}}$$

$$\text{Feed constant} = \frac{\text{6092：01（Feed）}}{\text{6092：02（Shaftrevolutions）}}$$

Position demand value（6062h）×Electronic gear ratio＝Position demand internal value（60FCh）

- The electronic gear ratio is effective within the range of 8,000 to 1/1,000.

If values outside the range saturate within it, E-883 (abnormal operation protection) occurs.

- 608Fh-01h (Encoder increments) are automatically set according to the encoder resolution. The factory value of 6092h-01h (Feed) is determined based on the encoder resolution.
- The setting of the electronic gear ratio is reflected through the following timing sequence.
  - When the power is supplied
  - When communication is established (ESM state Init → OP migration)
  - When origin reset is completed
  - When performing a complete reset of the absolute multi-turn system
- This does not reflect changes to the set values of associated objects, so please note.
  - When initializing position information during the Init⇒Op transition in absolute mode, set the absolute encoder position value ([pulse单位]/electronic gear ratio)

within the range of-231 (-2147483648) to +231-1 (2147483647). Operations outside this range cannot be guaranteed.

- Please confirm the operating range of the absolute encoder and the gear ratio.
- Use the electronic gear ratio settings from the Cia402 protocol whenever possible.

- Relevant parameter

Position encoder resolution (608Fh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Op-Mode
608Fh	-	Position encoder resolution	-	-	-	-	-	-
		The encoder resolution is automatically set.						
	00h	Highest supported sub index	-	2	U8	ro	NO	ALL
		The number of sub index representing 608Fh.						
	01h	Encoder increments	Pulse	1~4294967295	U32	ro	NO	ALL
		Represents the encoder movement distance. 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
		Represents the motor rotation count. The value is fixed to 1.						

This object defines the encoder resolution per full rotation of the motor.

Position encoder resolution = Encoder increments (608Fh-01h) / Motor revolutions (608Fh-02h)

This object is automatically configured based on the information read from the motor connected to the servo driver.

Example: Connection scenario for a 19-bit/r encoder

608Fh-01h（Encoder increments)= 524288

608Fh-02h（Motor revolutions)= 1

Position encoder resolution = 524288 / 1 = 524288

Gear ratio (6091h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Op-mode
6091h	-	Gear ratio	-	-	-	-	-	-
		Set the gear ratio.						
	00h	The highest sub-index supported	-	2	U8	ro	NO	ALL
		The number of sub index 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 gearbox output.
Gear ratio = Motor shaft revolutions (6091h-01h) / Driving shaft revolutions (6091h-02h)

Feed constant（6092h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Op-mode
6092h	-	Feed constant	-	-	-	-	-	-
		Set the feed constant.						
	00h	The highest sub-index supported	-	2	U8	ro	NO	ALL
		The number of sub index for 6092h.						
	01h	Feed	Command Unit	1~4294967295	U32	rw	NO	ALL
		Set the feed rate.						
	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 angular displacement per full rotation of the shaft after gearbox output.

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 specified. The DS5C2 series determines the rotation direction based on the Object Polarity command polarity (607Eh) defined in CoE (CiA402). However, this Object Polarity command polarity (607Eh) varies depending on the rotation direction setting specified by parameter P0-05. For example, when P0-05 is set from 0 to 1, the CiA402 object word 607Eh becomes 0xE0, enabling the driver to execute reverse motion; when P0-05 is set from 1 to 0, the object word 607Eh returns to 0, and the driver resumes the default forward motion.

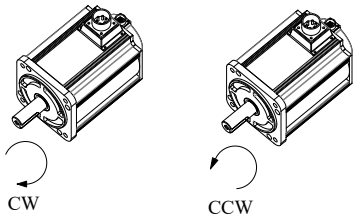
Additionally, the polarity (607Eh) specified by the Object Polarity instruction does not directly replace

parameter P0-05 (rotation direction setting). This applies when transmitting object data between the CoE (CiA402) processing unit and the motor control processing unit, as outlined in the table below.

<table>
<tr><th>Index</th><th>Sub index</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 for transmitting position commands, speed commands, torque commands, as well as position offsets, speed offsets (speed accumulation), and torque offsets (torque accumulation) values from the object to internal processing, and the polarity for transmitting position feedback, speed feedback, and torque feedback values from internal processing back to the object.
Note: For this object, set the position, speed, and torque polarity to all 0 (bit7-5 = all 0) or to 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 for position, speed, and torque are not reversed.</td></tr>
<tr><td>224</td><td>The signs for position, velocity, and torque are reversed.</td></tr>
<tr><td>The above mentioned items</td><td>Not supported (do not set)</td></tr>
</table>
bit7: Position polarity
0: No symbol reversal 1: Symbol reversal
bit6: Speed polarity
0: No symbol reversal 1: Symbol reversal
bit5: Torque polarity
0: No symbol reversal 1: Symbol reversal
bit4-0: Reserved. Set it to 0
Object <Instruction·Setting Class>
·607 Ah (Target position)
·60B0h（Position offset)
·60FFh（Target velocity)
60B1h（Velocity offset)
·6071h (Target torque specified)
·60B2h（Torque offset)
<Monitoring Category>
·6062h (Position demand value – Position command)
·6064h (Position actual value feedback)
·606Bh（Velocity demand value)</td></tr>
</table>

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Op-mode
		·606Ch (Actual velocity value – speed feedback) ·6074h （Torque demand) ·6077h (Torque actual value – torque feedback) ·6078h (Current actual value)						

No symbol reversal: For forward-direction commands, the motor rotates counterclockwise (CCW).
The symbol is reversed: for forward-direction commands, the motor rotates in the CW direction.
The rotation direction of the motor is defined as clockwise (CW) and counterclockwise (CCW) when viewed from the shaft end on the load side.



4) Initialization of an absolute encoder

In position control mode, using an absolute encoder eliminates the need for an origin reset operation (except when the absolute encoder is used as an incremental encoder). After installing the battery, the multi-turn data must be reset upon the device's initial startup.

(1) Absolute data

The data read from the absolute encoder includes built-in single-turn data representing one complete rotation of the motor and multi-turn data that increments with each full rotation. Since the multi-turn data is an electrical count, it requires a battery for backup. Both types of data increase when the motor shaft rotates counterclockwise (CCW). An E-228 alarm is triggered when the multi-turn data overflows (absolute counter overflow protection).

(2) Absolute-to-32-bit data mapping

The servo driver initializes the position information: for a 23-bit encoder, single-turn data occupies 23 bits and multi-turn data occupies 16 bits, resulting in a synthesized position information with a width of 39 bits; however, the value set for the target as position information has a width of 32 bits. Since the 6063h model uses only the lower 32 bits of absolute encoder data for position information setting, the valid bit length of multi-turn data becomes 9 bits (with the upper 7 bits of the 16-bit data being discarded). The 6064h model calculates the position information using the following formula, yielding a result with a 32-bit width. Consequently, the effective bit length of multi-turn data varies according to the electronic gear inverse transformation value.

607Eh (instruction polarity)	Location information (using the motor of a 19-bit encoder as an example)
607Eh = 0 (CCW is the positive direction)	6063h = M*219+S
	6064h = 6063h × Electronic gear inverse transformation value
607Eh = 224 (CW is the positive direction)	6063h = - （M*219 +S)

	6064h = 6063h × Electronic gear inverse transformation value

M: Number of circles S: Single circle position

5) Position range limit (607Bh) Position range limit

The DS5C2 series drives do 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 behavior.

6) Return to original offset (607Ch) Home offset

Set the offset from the mechanical origin. Use this position as the mechanical zero point; if set to 0, the mechanical origin coincides with the mechanical zero point. The origin offset can be a positive or negative value, indicating deviation to the left or right of the mechanical origin.

This object can be updated at any time, but the actual location information must be reflected according to the following time sequence.

- When the power is supplied
- When communication is established (the ESM state transitions from Init to OP migration)
- When origin reset is completed

Use the position under the aforementioned time sequence as the reference to initialize (pre-set) the following objects.

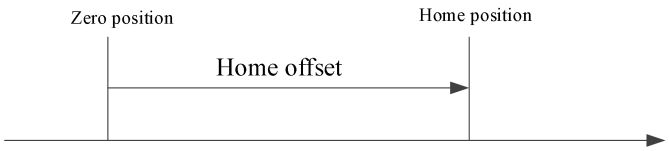
- When the origin position is detected

6063h (Actual internal position feedback) = 60FCh (Position demand internal value) = 0
6062h (Position demand value) = 6064h (Position actual value) = 607Ch (Home offset)

- Initialization (pre-setting) at a time other than when the origin position is detected

6063h (Actual internal position feedback) = 60FCh (Position demand internal value)
6062h (Position demand value) = 6064h (Position actual value)
=6063h (Position Actual Internal Value – Actual Internal Position Feedback) + 607Ch (Home Offset)

The above describes the scenario with an electronic gear ratio of 1:1 and no polarity reversal.



Definition of Origin Offset

Origin Home Position: The position of the index pulse (origin position)
Zero position: In incremental systems, it equals 0 (the position when power is applied, or the position obtained by subtracting the home offset from the position where the index pulse is detected).
The absolute system time = the zero position of the absolute encoder.

10.8.7 Overrun function in bus mode

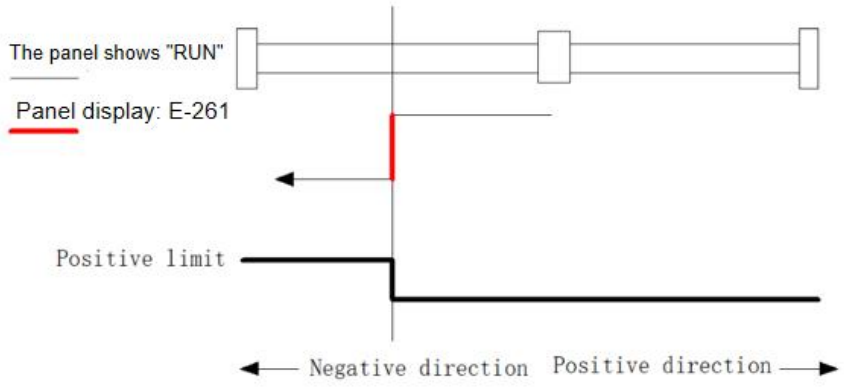
Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P0-28.0	0: Direct alarm activation using servo-based speed reduction and shutdown method 1: After decelerating and shutting down according to the 605Ah method, an alarm is triggered. 2: Do not use overtravel	2	-	0~3	○	1|3|4|8|9|10

1) Prohibited State

- Scenario 1: When the servo is in either enabled (non-moving) or disabled state and touches the reverse limit switch, the panel displays "NOT," cancels the reverse limit signal, and returns to its previous state.
- Scenario 2: When the servo is in either enabled (non-moving) or disabled state and touches the forward limit switch, the panel displays "POT", cancels the forward limit signal, and returns to its previous state.
- Scenario 3: When the servo is either enabled (non-moving) or disabled, and simultaneously triggers both the forward limit switch and the reverse limit switch, the servo will report E-261. If both limit signals are cleared, the panel will return to its previous state; if either limit signal is cleared, the panel will display the other limit signal, and the panel can only return to its previous state after clearing that signal as well.

2) Normal exercise state

（1）The initial movement direction is to the left



The initial movement direction is left; upon contact with the forward limit switch, the servo unit triggers an E-261 error. If the forward limit switch is first disabled and then the alarm is cleared, the axis returns to its inactive state, allowing movement in both directions. However, if the alarm is cleared first and the axis reverts to the inactive state while the panel still displays "POT", the axis remains restricted by the forward limit switch. To solve the forward overtravel prohibition, the forward limit signal must be canceled.

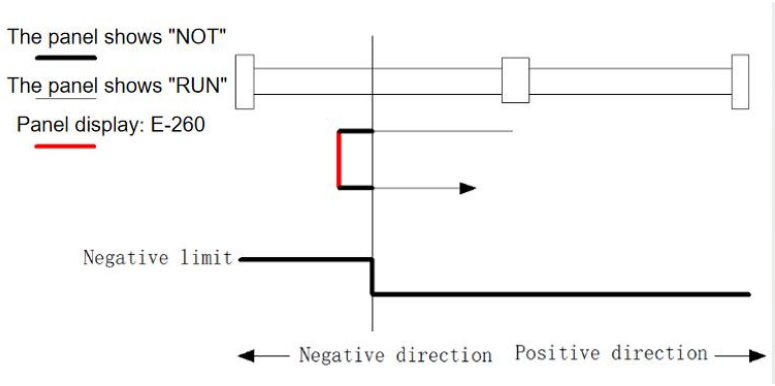
3) Over-travel state

Set P0-28 to 1 (alarm, deceleration, stop)

(1) The initial motion direction is to the left, and no out-of-range signal has been triggered.

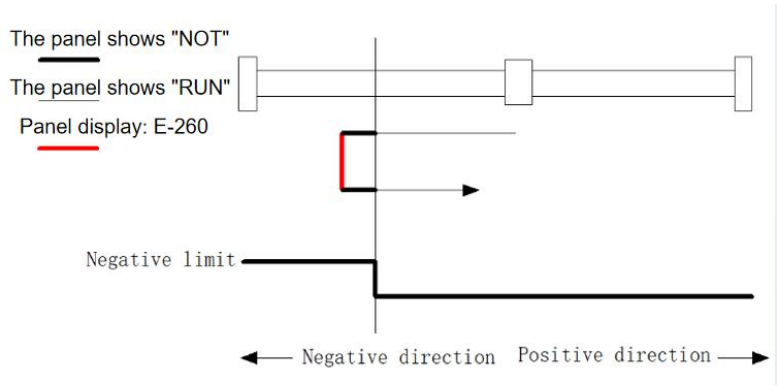
Situation 1: The forward limit switch has not been triggered.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stopping the axis at the reverse limit switch; the servo will report E-260. The alarm must be cleared before allowing the axis to move forward. Contacting the falling edge of the reverse limit switch causes the panel display to change from NOT back to RUN, thereby lifting the reverse overtravel restriction.



Situation 2: Before the shaft deceleration stops completely, touch the forward limit switch.

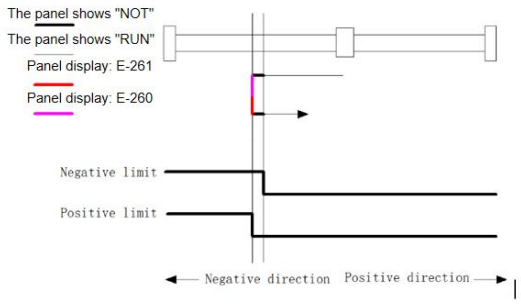
The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. Before the shaft stops, if the forward limit switch is touched, the servo will issue an E-261 alarm; the forward



limit switch must be released to clear this alarm; otherwise, it cannot be cleared. Subsequently, the shaft moves forward again and contacts the falling edge of the reverse limit switch, after which the panel displays a change from NOT to RUN, thereby lifting the reverse overtravel restriction.

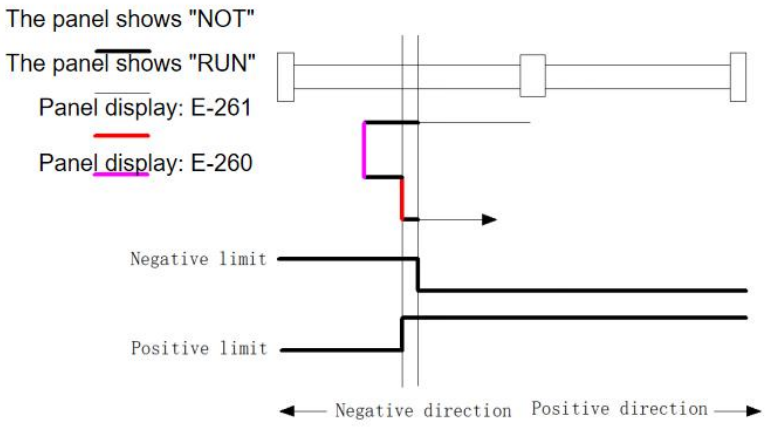
Situation 3: The shaft stops at the negative limit switch and contacts the positive limit switch.

The initial movement direction is left; upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. When the shaft stops at the reverse limit switch, the servo reports E-260. Subsequently, upon contacting the forward limit switch, the servo reports E-261. The forward limit switch must be released to clear the E-261 alarm; otherwise, the alarm remains active. After resuming forward shaft motion and contacting the falling edge of the reverse limit switch, the panel changes from NOT to RUN, thereby lifting the reverse overtravel prohibition.



Scenario 4: During axial forward movement, the device contacts the forward limit switch.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. When the shaft stops at the reverse limit switch, the servo reports E-260; after clearing the alarm and allowing the shaft to move forward, it contacts the forward limit switch, prompting the servo to report E-261. The forward limit switch must be released to clear the E-261 alarm; otherwise, the alarm persists. Continuing forward movement causes contact with the falling edge of the reverse limit switch, after which the panel displays a change from NOT to RUN, thereby lifting the reverse overtravel prohibition.

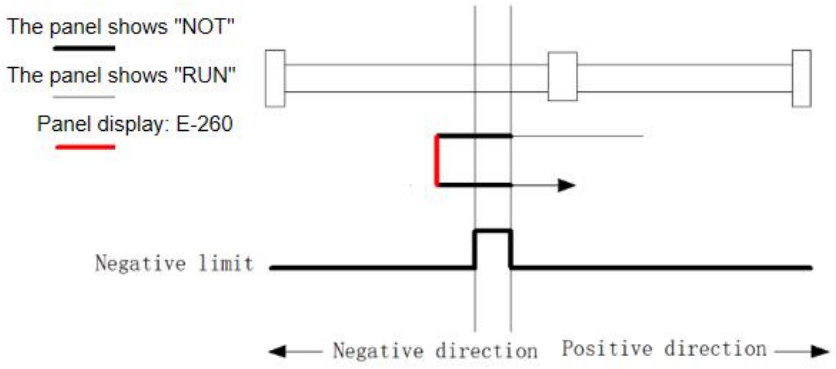


(2) The initial motion direction is to the left, triggering the overshoot signal for overtravel detection.

Situation 1: In an offside situation, the forward limit switch has not been triggered.

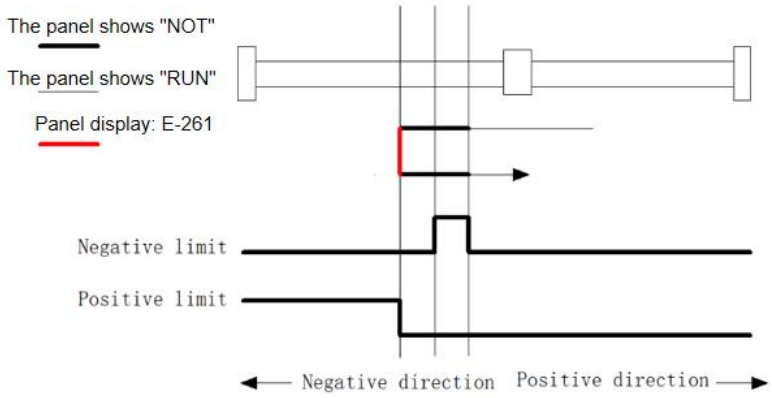
The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering reverse overtravel deceleration and stop. However, when the shaft passes beyond the reverse limit switch, its falling edge is detected again, causing the shaft to stop outside the limit position and triggering an E-260 alarm from the servo system. The alarm must be cleared for the shaft to resume forward movement. Only after re-contacting both the rising and falling

edges of the reverse limit switch will the panel display change back from NOT to RUN, thereby lifting the reverse overtravel restriction.



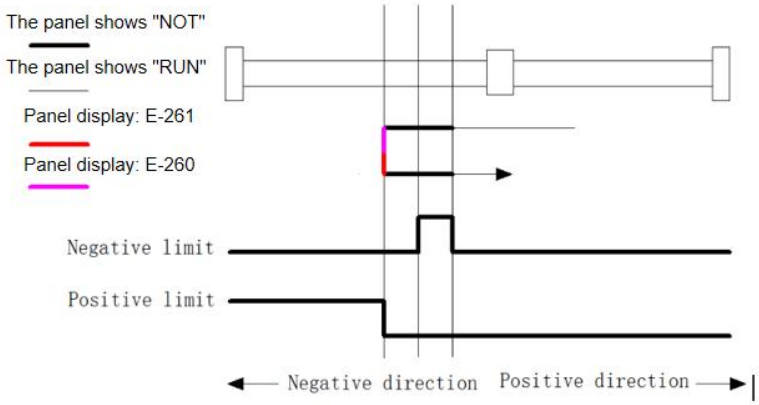
Situation 2: In an offside situation, touch the forward limit switch before the shaft deceleration stop is completed.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering the reverse overtravel deceleration stop. However, once the shaft passes the reverse limit switch, its falling edge is triggered again. Before the shaft stops, if it contacts the forward limit switch, the servo will report E-261; the forward limit switch must be cleared to resolve this alarm. Otherwise, the alarm persists. Subsequently, the shaft resumes forward movement and contacts both the rising and falling edges of the reverse limit switch again. Only then does the panel display change from NOT to RUN, thereby lifting the reverse overtravel prohibition.



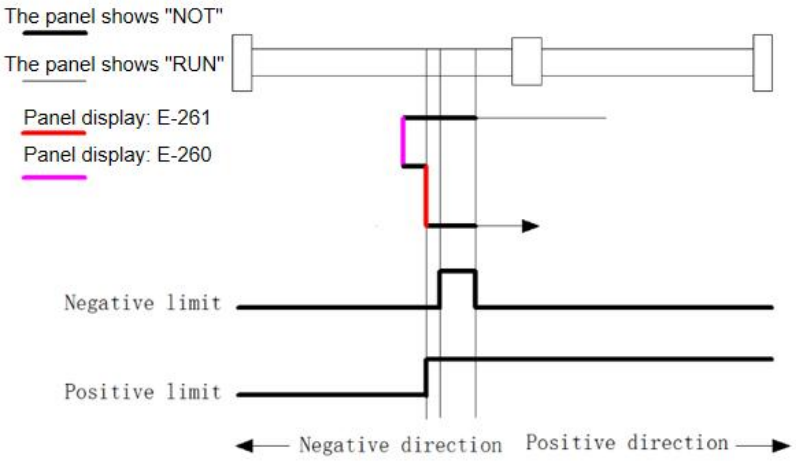
Scenario 3: In an offside situation, when the shaft stops, it touches the forward limit switch.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering the reverse overtravel deceleration stop. However, when the axis passes beyond the reverse limit switch, its falling edge is triggered again. When the axis stops, the servo reports E-260; upon contacting the forward limit switch, the servo reports E-261. The forward limit switch must be released to clear the E-261 alarm; otherwise, the alarm persists. Subsequently, the axis moves forward again, contacting both the rising and falling edges of the reverse limit switch. Only then does the panel display change from NOT to RUN, thereby lifting the reverse overtravel prohibition.



Scenario 4: In an offside situation, during axial forward movement, contact the forward limit switch.

The initial movement direction is left. Upon contacting the rising edge of the reverse limit switch, the panel displays a change from RUN to NOT, triggering the reverse overtravel deceleration stop. However, once the shaft passes the reverse limit switch, its falling edge is triggered again. After the shaft stops, the servo reports E-260; clearing the alarm allows the shaft to continue forward movement until it contacts the forward limit switch, at which point the servo reports E-261. The forward limit switch must be released to clear the E-261 alarm; otherwise, the alarm persists. Continuing forward movement causes the shaft to contact both the rising and falling edges of the reverse limit switch again, after which the panel displays a change from NOT to RUN, thereby lifting the reverse overtravel prohibition.



10.8.8 Remote I/O Function

1) General related parameters

Number	Parameter	Meaning	Give tacit consent to	Setting
1	P5-72	Remote SI Input 1	0	0: Invalid 1: Input a positive signal from SI1 2: Input a positive signal from SI2 3: Input a positive signal from SI3 10: Always set to valid 11: Input the reverse signal from SI1 12: Input the reverse signal from SI2 13: Input the reverse signal from SI3
2	P5-73	Remote SI Input 2	0	0: Invalid 1: Input a positive signal from SI1 2: Input a positive signal from SI2 3: Input a positive signal from SI3 10: Always set to valid 11: Input the reverse signal from SI1 12: Input the reverse signal from SI2 13: Input the reverse signal from SI3
3	P5-74	Remote SI Input 3	0	0: Invalid 1: Input a positive signal from SI1 2: Input a positive signal from SI2 3: Input a positive signal from SI3 10: Always set to valid 11: Input the reverse signal from SI1 12: Input the reverse signal from SI2 13: Input the reverse signal from SI3
4	P5-76	Remote SO Output 1	0	0: Do not output to the terminal 1: Output a positive signal from SO1 2: Send a positive signal for SO2 output 3: Send a positive signal from SO3 output 11: Output the reverse signal from SO1 12: From the SO2 output reverse signal 13: Output the reverse signal from SO3
5	P5-77	Remote SO Output 2	0	0: Do not output to the terminal 1: Output a positive signal from SO1 2: Send a positive signal for SO2 output 3: Send a positive signal from SO3 output 11: Output the reverse signal from SO1

Number	Parameter	Meaning	Give tacit consent to	Setting
				12: From the SO2 output reverse signal 13: Output the reverse signal from SO3
6	P5-78	Remote SO Output 3	0	0: Do not output to the terminal 1: Output a positive signal from SO1 2: Send a positive signal for SO2 output 3: Send a positive signal from SO3 output 11: Output the reverse signal from SO1 12: From the SO2 output reverse signal 13: Output the reverse signal from SO3

2) Remote I/O-related dictionary object

Number	Target	Meaning	Unit	Explanation
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 believes the signal output Bit6~Bit15 retained 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 Bit18: Remote SO Output 3
3	60FEh:02	Bit mask	-	When in use, set the corresponding bits 16–18 to 1.

For detailed information on the 60FDh, please refer to Chapter 10.9.4 Digital Input (60FDh).

For detailed information on the 60FEh, please refer to Chapter 10.9.5 Digital Output (60FEh).

10.8.9 Cascaded alarm function

When this function is enabled, if the terminal signal becomes conductive, the driver will generate an

E-320 alarm. The drivers can be connected in series; by routing the alarm output to the corresponding terminal of the next driver, cascaded alarms can be achieved.

New functional parameter P5-68, with default value set to 0:

Parameter	Meaning	Factory settings	Unit	Set range	Revise	Take effect
P5-68	Terminal emergency alarm function	0	-	00~ff	at any time	immediately

11 Object Dictionary Details

This chapter primarily covers object dictionary area allocation, COE communication area, driver profile area, and related topics.

11.1 Object Dictionary Area Allocation

All objects are configured within the object dictionary of each group using a 16-bit index configuration address represented in 4-digit hexadecimal format.

The object dictionaries specified in CiA402 (CoE: CANopen over EtherCAT) and those for the DS5C2 series are as follows:

The object dictionary specified by cia402		Ds5c2 series object dictionary	
Index	Content	Index	Content
0000h ~ 0FFFh	Data Type Region	0000h ~ 0FFFh	Data Type Region
1000h ~ 1FFFh	COE Communication Area	1000h ~ 1FFFh	COE Communication Area
2000h ~ 5FFFh	Manufacturer CuSTOm Area	2000h ~ 2FFFh	Servo Parameter Region
		3000h ~ 3FFFh	Keep
		4000h ~ 4FFFh	Keep
		5000h ~ 5FFFh	Keep
6000h ~ 9FFFh	Profile region	6000h ~ 6FFFh	Drive Profile Area
		7000h ~ 9FFFh	Keep
A000h ~ FFFFh	Keep	A000h ~ FFFFh	Keep

11.2 COE Communication Region (0x1000-0x1FFF)

11.2.1 Object Overview

1) Device Information Object

Index	Sub index	Name

Index	Sub index	Name
1000h	00h	Device class
1001h	00h	Types of alarms currently occurring
1008h	00h	Device name
1009h	00h	Hardware Version
100Ah	00h	Software release
1018h	-	Factory information
	00h	Sub- index number
	01h	Manufacturer ID
	02h	Product Code
	03h	Version number
	04h	Serial number

2) RxPDO object mapping

Index	Sub index	Name
1600h	-	The mapping object of RxPDO1
	00h	Number of mapping objects supported by RxPDO1
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object
1601h	-	The mapping object of RxPDO2
	00h	Number of mapping objects supported by RxPDO2
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object
1602h	-	The mapping object of RxPDO3
	00h	Number of mapping objects supported by RxPDO3
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object
1603h	-	The mapping object of RxPDO4
	00h	Number of mapping objects supported by RxPDO4

Index	Sub index	Name
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object

3) TxPDO object mapping

Index	Sub index	Name
1A00h	-	TxPDO1-supported mapping objects
	00h	Number of mapping objects supported by TxPDO1
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object
1A01h	-	TxPDO2-supported mapping objects
	00h	Number of mapping objects supported by TxPDO2
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object
1A02h	-	TxPDO3-supported mapping objects
	00h	Number of mapping objects supported by TxPDO3
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object
1A03h	-	TxPDO4-supported mapping objects
	00h	Number of mapping objects supported by TxPDO4
	01h	First mapping object
	02h	The second mapping object
	03h	The third mapping object
	04h	The fourth mapping object

Index	Sub index	Name
	05h	The fifth mapping object
	…	…
	18h	The twenty-fourth mapping object

4) PDO object allocation

Index	Sub index	Name
1C12h	-	RxPDO distribution
	00h	RxPDO allocation amount
	01h	Allocated RxPDO 1
	02h	Allocated RxPDO 2
	03h	The allocated RxPDO 3
	04h	The allocated RxPDO 4
1C13h	-	TxPDO distribution
	00h	TxPDO allocation amount
	01h	allocated TxPDO 1
	02h	allocated TxPDO 2
	03h	allocated TxPDO 3
	04h	allocated TxPDO 4

5) PDO Synchronous Management Channel

Index	Sub index	Name
1C32h	-	Sync Manager 2 Synchronization Channel 2
	00h	Number of sub-object entries
	01h	Sync Mode
	02h	Cycle Time
	03h	Shift time
	04h	Sync modes supported: Set the supported synchronization types
	05h	Minimum cycle time: the minimum value of the communicative cycle that can be set
	06h	Calc and copy time: from SM2 event and SYNC0 event to ESC read completion time
	08h	Command (not supported)
	09h	Delay time (not supported)
	0Ah	Sync0 cycle time When DC SYNC0 (1C32h-01h=02h), the value of ESC register 09A0h is set. Outside of DC SYNC0, it is set to 0.
	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

Index	Sub index	Name
	00h	Number of sub-object entries
	01h	Sync Mode
	02h	Cycle Time
	03h	Shift time
	04h	Sync modes supported: Set the supported synchronization types
	05h	Minimum cycle time: the minimum value of the communicative cycle that can be set
	06h	Calc and copy time: from SM2 event and SYNC0 event to ESC read completion time
	08h	Command (not supported)
	09h	Delay time (not supported)
	0Ah	Sync0 cycle time When DC SYNC0 (1C32h-01h=02h), the value of ESC register 09A0h is set. Outside of DC SYNC0, it is set to 0.
	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

11.2.2 Facility information

This section describes the device information.

<table>
<tr><th>Index</th><th>Sub index</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">1000h</td><td rowspan="2">00h</td><td>Divece type</td><td>0~4294967295</td><td>U32</td><td>ro</td><td>NO</td><td>All</td></tr>
<tr><td colspan="6">Indicates the device category. For a servo driver, the value is fixed at 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">Show the type of alarm (status) occurring in the servo driver.
When no alarm occurs, display 0000h.
Do not display 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 occurrence of an alarm: *1)</td></tr>
<tr><td>5</td><td>nonsupport</td></tr>
<tr><td>6</td><td>Keep</td></tr>
<tr><td>7</td><td>An alarm with an AL status code not defined occurred*2)</td></tr>
</table>
*1) The term "alarm defined by the AL status code" refers to communication-related</td></tr>
</table>

Index	Sub index	Name	Scope	Data Type	Accessibility	Pdo	Op-Mode
		anomalies in EtherCAT, specifically codes E-800-7, E-810-7, and E-850-7. *2) The term "alarm with an undefined AL status code" refers to communication-related EtherCAT anomalies (E-880–887) and non-communication-related EtherCAT anomalies.					
1008h	00h	Manufacturer Device Name	-	-	ro	TxPDO	All
		Indicates the device name.					
1009h	00h	Manufacturer Hardware version	-	-	ro	TxPDO	All
		Indicates the hardware version.					
1018h	00h	Number of entries	0~255	U8	ro	TxPDO	All
		The sub- index number for this object. The value is fixed to 04h.					
	01h	vendor ID	0~4294967295	U32	ro	TxPDO	All
		Represents the manufacturer ID of EtherCAT. The value is fixed to 00000556h.					
	02h	product code	0~4294967295	U32	ro	TxPDO	All
		Indicates the product code. The value is 10305080h.					
	03h	Revision umber	0~4294967295	U32	ro	TxPDO	All
		Indicates the product version number.					
	04h	Divece type	0~4294967295	U32	ro	TxPDO	All
		Represents the product serial number. The value is 00000000h.					

11.2.3 Synchronous Manager Communication Type (1C00h)

The action mode assigned to each SyncManager is configured using the 1C00h object.
For a servo driver, the value is fixed.

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
1C00h	00h	Number of used sync manager channels	0~255	U8	ro	TxPDO	All
		The sub- index number for 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: Not used 1: Mailbox receipt (master station → slave station) 2: Mailbox sending (secondary site → primary site) 3: RxPDO (Master Station → Slave Station) 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: Not used 1: Mailbox receipt (master station → slave station) 2: Mailbox sending (secondary site → primary site) 3: RxPDO (Master Station → Slave Station) 4: TxPDO (slave → master) Since Sync Manager 1 uses Mailbox for sending emails, the value is fixed to 2.					

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
	03h	Communication type sync manager 2	0~4	U8	ro	TxPDO	All
		Set the purpose of Sync Manager 2. 0: Not used 1: Mailbox receipt (master station → slave station) 2: Mailbox sending (secondary site → primary site) 3: RxPDO (Master Station → Slave Station) 4: TxPDO (slave → master) Since Sync Manager 2 uses 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: Not used 1: Mailbox receipt (master station → slave station) 2: Mailbox sending (secondary site → primary site) 3: RxPDO (Master Station → Slave Station) 4: TxPDO (slave → master) Since Sync Manager 2 uses Process Data Output (RxPDO), the value is fixed at 4.					

11.2.4 PDO Mapping

1) PDO allocation object (1C12h ~ 1C13h)

SyncManager determines the tables used for PDO mapping through object configurations from 1C12h to 1C13h.

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
1C12h	00h	Number of assigned PDOs	0~4	U8	rw	NO	All
		The sub- index number of this object.					
	01h	Assigned RxPDO 1	1600h~1603h	U16	rw	NO	All
		Specify the desired RxPDO mapping object.					
	02h	Assigned RxPDO 2	1600h~1603h	U16	rw	NO	All
		Specify the desired RxPDO mapping object.					
	03h	Assigned RxPDO 3	1600h~1603h	U16	rw	NO	All
		Specify the desired RxPDO mapping object.					
	04h	Assigned RxPDO 4	1600~1603	U16	rw	NO	All
		Specify the desired RxPDO mapping object.					
1C13h	00h	Number of assigned PDOs	0~4	U8	rw	NO	All
		The sub- index number for this object. The value is fixed to 04h.					
	01h	Assigned TxPDO 1	1A00h~1A03h	U16	rw	NO	All
		Specify the target TxPDO mapping object.					
	02h	Assigned TxPDO 2	1A00h~1A03h	U16	rw	NO	All
		Specify the target TxPDO mapping object.					
	03h	Assigned TxPDO 3	1A00h~1A03h	U16	rw	NO	All
		Specify the target TxPDO mapping object.					

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
	04h	Assigned TxPDO 4	1A00h~1A03h	U16	rw	NO	All
		Specify the target TxPDO mapping object.					

The Sub- index 01h-04h for 1C12h and 1C13h can only be modified when the ESM status is PreOP and Sub- index 00h equals 0. In all other states, the port code returned is 06010003h.
After the configuration change, specify the number of Sub index using Sub index 00h, and reflect the PDO allocation object settings by converting the ESM status to SafeOP.

2) PDO mapping objects (1600h–1603h,1A00h–1A03h)

As a table used for PDO mapping objects, you can utilize objects defined by RxPDO in ranges 1600h–1603h and by TxPDO in ranges 1A00h–1A03h. Sub index starting from 01h contains information about the mapped application-layer objects.

<table>
<tr><th>Index</th><th>Sub index</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="18">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="6">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="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>Sub- index 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="6">The setting method is the same as that of Sub- index 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="6">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="6">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="6">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="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">16h</td><td>16th receive 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>1601h</td><td>-</td><td colspan="6">The specifications for PDO mapping 2, Sub- indexes, etc., are identical to those of 1600h.</td></tr>
<tr><td>1602h</td><td>-</td><td colspan="6">The specifications for PDO mapping 3, Sub- index, etc., are identical to those of 1600h.</td></tr>
<tr><td>1603h</td><td>-</td><td colspan="6">The specifications for PDO mapping 4, Sub- index, etc., are identical to those of 1600h.</td></tr>
</table>

Do not map duplicate objects. Changes to already duplicated settings are not guaranteed.
For the Sub- index 01h-18h between 16:00 and 16:03, settings can only be modified when the ESM status

is PreOP and Sub- index 00h equals 0. In all other states, an Abort Code (06010003h) is returned.

After the configuration change, specify the number of Sub index 0h using Sub index, and reflect the PDO mapping object settings by converting the ESM status to SafeOP.

<table>
<tr><th>Index</th><th>Sub index</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="18">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">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>Sub- index 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 setting method is the same as that of Sub- index 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">16h</td><td>16th 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, Sub index, etc., are identical to those of 1600h.</td></tr>
<tr><td>1A02h</td><td>-</td><td colspan="6">The specifications for Transmit PDO Mapping 3, Sub index, etc., are identical to those of 1600h.</td></tr>
<tr><td>1A03h</td><td>-</td><td colspan="6">The specifications for Transmit PDO Mapping 4, Sub index, etc., are identical to those of the 1600h.</td></tr>
</table>

Do not map duplicate objects.

No guarantee is provided for changes in previously configured settings.

The Sub- index 01h-18h for the 1A00h-1A03h period can only be modified when the ESM status is PreOP and Sub- index 00h equals 0.

In all other cases, the status returns the Abort Code (06010003h).

After the configuration change, specify the number of Sub index 0h using Sub index, and reflect the PDO mapping object settings by converting the ESM status to SafeOP.

11.2.5 Sync 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	Sub index	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 synchronization mode for Sync Manager 2. 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 cycle (unit: ns). Set one of the following values: 1,000,000 (1 ms), 2,000,000 (2 ms), 4,000,000 (4 ms), 8,000,000 (8 ms), or 10,000,000 (10 ms). Setting any value other than these will trigger E-810 (Synchronization Cycle Setting Abnormal Protection).					
	03h	Shift time	0~4294967295	U32	rw	NO	All
		Offset Time					
	04h	Sync modes supported	0~65535	U16	ro	NO	All
		Set the supported synchronization type. BIT0: FreeRun mode supported 0: Not supported; 1: FreeRun mode is supported This servo driver is set to 1. BIT1: SM synchronization mode support 0: Not supported; 1: SM2 event synchronization supported This servo driver is set to 1. BIT4-2: DC synchronization mode supported 000b: Not supported 001b: Support for the DC sync0 event 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					
1C32	05h	Minimum cycle time	0~4294967295	U32	ro	NO	All

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
		The minimum value of the communicative cycle 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. When the signal is deviated, 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 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 value is a reference and not a guarantee.

Sync Manager 3 (1C33h)

Index	Sub index	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 synchronization mode for Sync Manager 3. 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 cycle (unit: ns). Set one of the following values: 1,000,000 (1 ms), 2,000,000 (2 ms), 4,000,000 (4 ms), 8,000,000 (8 ms), or 10,000,000 (10 ms). Setting any value other than these will trigger E-810 (Synchronization Cycle Setting Abnormal Protection).					
	03h	Shift time	0~4294967295	U32	rw	NO	All
		Offset Time					

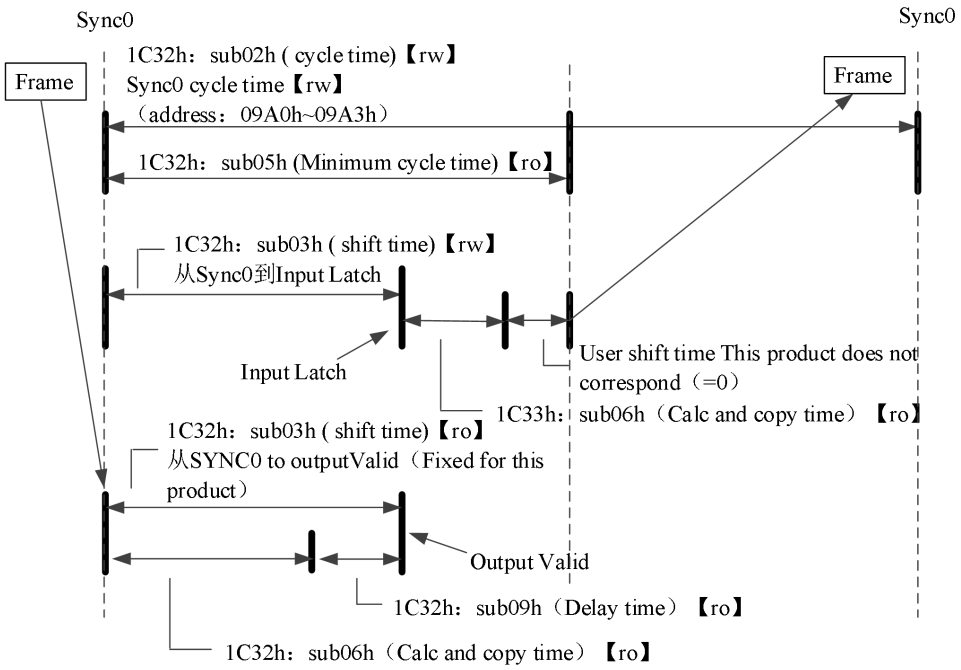
Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
		Sync modes supported	0~65535	U16	ro	NO	All
	04h	Set the supported synchronization type. BIT0: FreeRun mode supported 0: Not supported; 1: FreeRun mode is supported This servo driver is set to 1. BIT1: SM synchronization mode support 0: Not supported; 1: SM2 event synchronization supported This servo driver is set to 1. BIT4-2: DC synchronization mode supported 000b: Not supported 001b: Support for the DC sync0 event 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 communicative cycle 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. When the signal is deviated, 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
		nonsupport					
	20h	Sync error	0~1	BOOL	ro	NO	All
		Sync error					

This setting value is a reference and not a guarantee.

- DC (SYNC0 event synchronization)

Synchronization method	Feature
Use the time on the first axis as the reference Sync time information from other slaves	high-accuracy Compensation processing is required on the main station side.

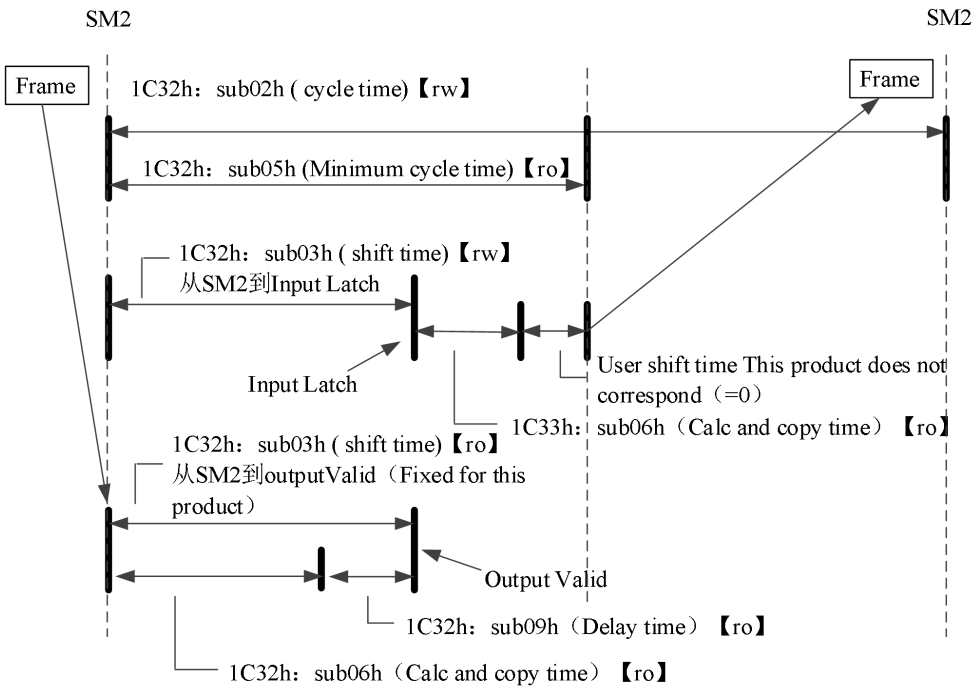
The DC synchronous mode specifications for this servo driver are as follows:



- SM2 (SM2 Event Synchronization)

Synchronization method	Feature
Synchronize with the RxPDO receipt time	Poor compensation accuracy for transmission delay The transmission time must be ensured on the master side (e.g., dedicated hardware).

The SM2 synchronization mode specifications for this servo driver are as follows:


SM2
SM2
Frame
1C32h：sub02h (cycle time)【rw】
Frame
1C32h：sub05h (Minimum cycle time)【ro】
1C32h：sub03h (shift time)【rw】
从SM2到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】
从SM2到outputValid（Fixed for this product）
Output Valid
1C32h：sub09h（Delay time）【ro】
1C32h：sub06h（Calc and copy time）【ro】

11.3 Servo parameter region (0x2000~0x5FFF)

11.3.1 Object Overview

Objects with 2000h to 5FFFh are assigned servo parameters. (For detailed descriptions of servo parameter names, refer to the appendix of this book.)

Index	Sub index	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	Sub index	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	Sub index	Name
3000h	00h	U0-00
3001h	00h	U0-01
3002h	00h	U0-02
...	...	...
3061h	00h	U0-97

Index	Sub index	Name
3100h	00h	U1-00
3101h	00h	U1-01

Index	Sub index	Name
4000h	00h	F0-00

4106h	00h	F1-06

Index	Sub index	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

11.3.2 Object Overview

For example: For parameter P1-04, EtherCAT assigns it the value 2104h.

The P3-10 parameters specify an EtherCAT capacity of 230 Ah.

12–15 bits: The value 2 indicates the servo parameter area.

8–11 bits: 0–F indicates the parameter group number for Group P.

0–7 bits: 00–FF represents the parameter under a specific group in Group P.

11.4 Drive Profile region (0x6000~0x6FFF)

11.4.1 Object Overview

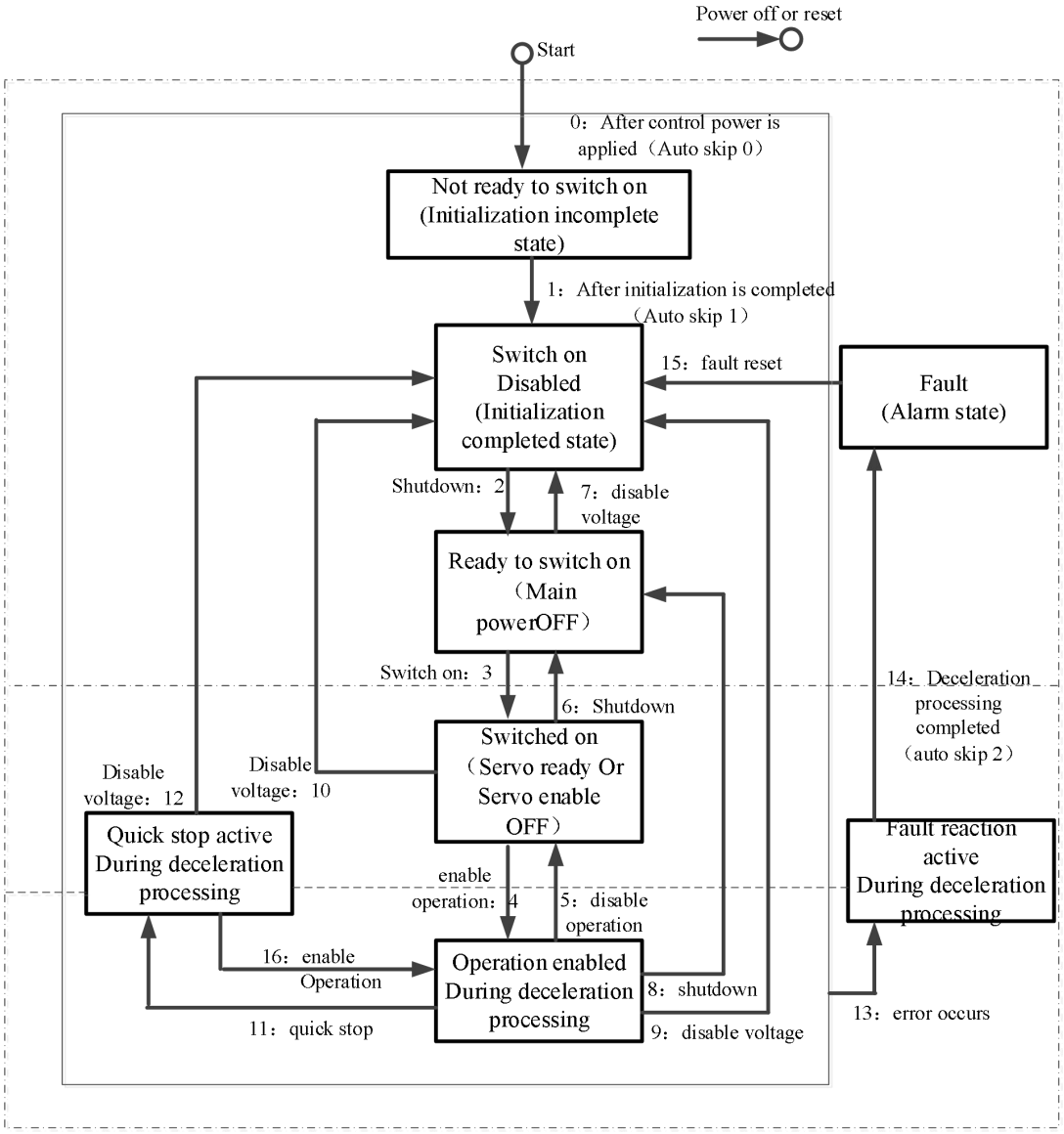
Index	Sub index	Name
603Fh	00h	Abort connection option code
6040h	00h	Control word
6041h	00h	Status word
605Ah	00h	Quick stop option code: Quick stop mode selection
605Bh	00h	Shutdown option code: stop method selection
605Bh	00h	Disable operation option code: Disabling the operation mode selection
605Bh	00h	stop option code: Select pause method
605Eh	00h	Fault reaction option code: Selection of fault reaction method
6060h	00h	Operation modes: Control modes
6061h	00h	Operation modes display: Control mode display
6062h	00h	Position Demand Value Position Instruction
6063h	00h	Actual internal value position; feedback on the actual internal position
6064h	00h	Position actual value Position feedback
6065h	00h	After the error window
6066h	00h	After error timeout
6067h	00h	Position window: Position reaches the threshold
6068h	00h	Position: Window Time; Position: Arrival Window Time
6069h	00h	Actual value of the velocity sensor
606Bh	00h	Velocity Demand Value; Speed Instruction; Speed Instruction
606Ch	00h	Actual velocity value; Speed feedback
606Dh	00h	Velocity window: The speed reaches the threshold.
606Eh	00h	Velocity Window Time: The time required for the speed to reach the target window.
606Fh	00h	Velocity threshold
6070h	00h	Velocity threshold time: Speed threshold time
6071h	00h	Target Torque: Given Torque Value
6072h	00h	Maximum torque
6073h	00h	Max current: Maximum current
6074h	00h	Torque demand: Torque command
6075h	00h	Motor rated current
6076h	00h	Motor rated torque
6077h	00h	Actual torque value – Torque feedback
6078h	00h	Current actual value
6079h	00h	DC link circuit voltage; Bus voltage
607Ah	00h	Target Position: Target Location
607Bh	-	Position range limit

Index	Sub index	Name
	00h	Number of entries
	01h	Min position range limit
	02h	Max position range limit
607Ch	00h	Home Offset: Original Offset
607Dh	-	Software position limit: Absolute software position restriction
	00h	Number of entries
	01h	Min position limit: Minimum position restriction
	02h	Max position limit
607Eh	00h	Polarity instruction polarity
607Fh	00h	Max Profile Velocity: Maximum profile velocity
6080h	00h	Max motor speed: Maximum motor speed
6081h	00h	Profile velocity: The speed at which the profile moves.
6083h	00h	Profile acceleration
6084h	00h	Profile deceleration
6085h	00h	Quick stop-deceleration: Rapid cessation of movement with reduced speed.
6086h	00h	Motion Profile Type: Position Trajectory Planning Type
6087h	00h	Torque slope
6088h	00h	Torque profile type: Torque planning type
608Fh	-	Position encoder resolution
	00h	Number of entries
	01h	Encoder Increment: Encoder increment
	02h	Motor revolutions: Motor rotation
6091h	-	Gear ratio
	00h	Number of entries
	01h	Motor revolutions: Motor rotation
	02h	Shaft revolutions: Axis rotation
6092h	-	Constant Feed Rate Constant
	00h	Number of entries
	01h	Feed
	02h	Shaft revolutions: Axis rotation
6098h	00h	Homing method: Original method
6099h	-	Homing speed: Return speed
	00h	Number of entries
	01h	Speed during search for switch: The speed at which the switch returns to its original state
	02h	Speed during the zero restoration process search
609Ah	00h	Homing acceleration: Original acceleration
60A3h	00h	Profile jerk use: Profile sharp movement application
60A4h	-	Profile jerk: A sudden change in the profile shape.
	00h	Number of entries
	01h	Profile jerk1: Rapid Profile movement 1
	02h	Profile jerk2: Profile sharp movement 2
60B0h	00h	Position offset: Position feedforward

Index	Sub index	Name
60B1h	00h	Velocity offset: Speed feedforward
60B2h	00h	Torque offset; Torque feedforward
60B8h	00h	Touch probe function
60B9h	00h	Touch probe status: Probe status
60BAh	00h	Touch probe pos1 pos value: Positive value for touch probe pos1
60BBh	00h	Touch probe pos1 negative value
60BCh	00h	Touch probe pos2 pos value: Positive value for touch probe pos2
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: Original method
	00h	Number of entries
	01h	First supported Homing method: Original method 1
	..	..
	20h	32nd supported Homing method – Return method 32
60F2h	00h	Positioning option code
60F4h	00h	Actual error value: Follow the error
60FAh	00h	Control Effort: The control mechanism
60FCh	00h	Position Demand Internal Value
60FDh	00h	Digital inputs; Digital inputs
60FEh	-	Digital outputs Digital outputs
	00h	Number of entries
	01h	Physical outputs: Physical outputs
	02	Bit mask
60FFh	00h	Target speed: Target velocity
6502h	00h	Supported drive modes

11.4.2 PDS (Power Drive Systems) specifications

Based on user commands or abnormal detection events, the state transitions of the PDS associated with the servo driver's power control are defined as shown in the figure below.



In the STO state, PDS is in the Switch on disabled state.

After migrating to Operation enabled, increase the time to above 100 ms and enter the action command.

The table below shows PDS state transition events (transition conditions) and the actions performed during transitions.

The PDS migration proceeds concurrently with the handshake process, with state transitions confirmed via the 6041h Statusword before transmitting the next migration command.

PDS conversion		Event	Movement
0	Auto skip 0	Automatic migration occurs after power supply or application layer reset.	Automatic migration occurs after power supply is restored or after application layer

PDS conversion		Event	Movement
			reset.
1	Auto skip 1	Auto-transform after initialization is complete.	Communication has been established.
2	Shut down	The scenario where a shutdown command is received in a non-STO state.	Nothing special.
3	Switch on	When the power supply is in the ON state, it receives a Switch on command.	Nothing special.
4	Enable operation	The scenario where the Receive Enable operation instruction is received.	The drive function is effective. Additionally, all previous set-point data have been cleared.
5	Disable operation	The scenario where the Disabling Operation command is received.	The drive driver is invalid.
6	Shutdown	The scenario where a shutdown command is received while the power supply is in the ON state. The detected power supply is in the OFF state.	Nothing special.
7	Disable voltage	The scenario where the reception disability voltage command is received. The scenario where the Quick stop command is received. The ESM state refers to the scenario where the system transitions to the Init state during PreOP, SafeOP, or OP phases. The situation in the STO state.	Nothing special.
8	Shutdown	This refers to the scenario where the power supply is in the ON state and receives a shutdown command.	The drive function is invalid
9	Disable voltage	The scenario where the reception disability voltage command is received. The situation in the STO state.	The drive function is invalid
10	Disable voltage	The scenario where the reception disability voltage command is received. The scenario where the Quick stop command is received. The ESM state refers to the scenario where the system transitions to the Init state during PreOP, SafeOP, or OP phases. The situation in the STO state.	Nothing special.
11	Quick stop	The scenario where the Quick stop command is received.	Execute the Quick stop function.
12	Disable voltage	The Quick stop occurs when the selected code is set to 1, 2, or 3, and the Quick stop action has been completed. This occurs when the Quick stop selection code is set to values 5, 6, or 7, and after the Quick stop	The drive function is disabled.

PDS conversion		Event	Movement
		action is completed, upon receiving the Disable Voltage command. The detected power supply is in the OFF state. The situation in the STO state.	
13	Error occurs	This situation involves the detection of abnormalities.	Execute the Fault Reaction function.
14	Auto skip 2	After the anomaly detection and reduction processing is completed, the system will automatically migrate.	The drive function is invalid
15	Fault reset	The scenario where the fault reset instruction is received after the cause of the exception has been resolved.	When no fault factors exist, reset the fault status.
16	Enable operation	The Quick stop selection code corresponds to the settings of 5, 6, or 7, and it is triggered when the Enable operation command is received.	Optimize the driving function.

11.4.3 Control Byte (6040h)

Commands for PDS state transitions and control of the slave unit (servo driver) are configured via the 6040h control word.

<table>
<tr><th>Index</th><th>Sub index</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>Controlword</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 commands for servo drivers, 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 corresponding) fr = fault reset
oms = operation mode specific eo = enable operation
(Control mode dependent bit)
qs = quick stop (Control mode dependent bit) h = stop
ev = enable voltage h = stop
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 set to 0.
Please note to perform other bit logic operations and their inverses.

bit8 (stop): When set to 1, the motor is slowed down and paused via the 605Dh (stop selection code). After pausing, disable the restart feature.

bit9,6-4（operation mode specific)：

The following describes the changes to the OMS bits inherent to the control mode (Op-mode). (For details, refer to the chapter on the corresponding objects 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	-	-	-	-

11.4.4 Status byte (6041h)

Commands for PDS state transitions and control of the slave unit (servo driver) are configured via the 6040h control word.

<table>
<tr><th>Index</th><th>Sub index</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="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">r</td><td colspan="3">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 corresponding) w = warning
sod = switch on disabled
oms = operation mode specific qs = quick stop
(Control mode dependent bit)
ve = voltage enabled
ila = internal limit active f = fault
ioe = operation enabled
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 statuses and their corresponding bits.

StatusWord	PDS State	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Initialization incomplete status
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization completion status
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	Servo enable enabled

StatusWord	PDS State	
xxxx xxxx x00x 0111 b	Quick stop active	stop immediately
xxxx xxxx x0xx 1111 b	Fault reaction active	Abnormality (Alarm) Detection
xxxx xxxx x0xx 1000 b	Fault	Abnormal (Alarm) Status

bit4 (voltage enabled): When set to 1, the power supply voltage is applied to PDS.
Bit 5 (Quick stop): A value of 0 indicates that the PDS has received a quick stop request. The quick stop logic is active when bit 5 is at 0. Note that other bit logic states trigger opposite actions.
bit7 (warning): When set to 1, it indicates a warning is occurring. During the warning, the PDS status remains unchanged and the motor continues operating.
bit9 (remote): When set to 0 (local), it indicates that the 6040 (Controlword) is unprocessable. When set to 1 (remote), it indicates that the 6040 (Controlword) is processable. The ESM status becomes 1 when transitioning to PreOP or higher states.
bit13,12,10 (operation mode specific): These bits indicate the changes in OMS bits inherent to each control mode. (For details, refer to the chapter on the corresponding control modes.)

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 primary cause of the internal limit is when the bit11 (internal limit active) in Statusword 6041h becomes 1.
bit15,14 (reserved): These bits are unused (fixed at 0).

11.5 Control Mode Setting

11.5.1 Supported drive modes (6502h)

This servo driver can identify the supported control modes based on the 6502h specification.

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Op-mode
6502h	00h	Supported drive modes	0~4294967295	U32	ro	TxPDO	All

The control mode indicating support (Mode of operation).
A value of 1 indicates the supported mode in this 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 (Profile Position Control Mode)	pp	YES
2	Profile Velocity Mode (Profile Velocity Control Mode)	pv	YES
3	Torque Profile Mode (Profile Torque Control Mode)	tq	YES
5	Homing mode (origin reset position mode)	hm	YES
7	Cyclic synchronous position mode (Cycle Synchronization Position Control Mode)	csp	YES
8	Cyclic synchronous velocity mode (Cycle Synchronization Speed Control Mode)	csv	YES
9	Cyclic synchronous torque mode (Cycle-synchronous torque control mode)	cst	YES

11.5.2 Control Mode (6060h)

The control mode is set via 6060h (Control Mode).

<table>
<tr><th>Index</th><th>Sub index</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="11">6060h</td><td rowspan="11">00h</td><td>Mode of operation</td><td>-128~127</td><td>I8</td><td>rw</td><td>RxPDO</td><td>All</td></tr>
<tr><td colspan="6">Set the control mode for the servo driver.
The non-corresponding control mode setting is prohibited.
<table>
<tr><th>Bit</th><th>Mode of operation</th><th>Abbreviation</th><th>Corresponding</th></tr>
<tr><td>-128~ -1</td><td>Reserved</td><td>-</td><td>-</td></tr>
<tr><td>0</td><td>No mode changed/No mode assigned</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>Profile Position Mode (Profile Position Control Mode)</td><td>pp</td><td>YES</td></tr>
<tr><td>3</td><td>Profile Velocity Mode (Profile Velocity Control Mode)</td><td>pv</td><td>YES</td></tr>
<tr><td>4</td><td>Torque Profile Mode (Profile Torque Control Mode)</td><td>tq</td><td>YES</td></tr>
<tr><td>6</td><td>Homing mode (origin reset position mode)</td><td>hm</td><td>YES</td></tr>
<tr><td>8</td><td>Cyclic synchronous position mode (Periodic synchronous position control mode)</td><td>csp</td><td>YES</td></tr>
<tr><td>9</td><td>Cyclic synchronous speed control mode</td><td>csv</td><td>YES</td></tr>
<tr><td>10</td><td>Cyclic synchronous torque mode (Periodic synchronous torque control mode)</td><td>cst</td><td>YES</td></tr>
<tr><td>11~127</td><td>Reserved</td><td>-</td><td>-</td></tr>
</table></td></tr>
</table>

Since the 6060h (Modes of Operation control mode) has a default value of 0 (No mode change/no mode assigned), the appropriate control mode must be configured after power-on. When both the 6060h and 6061h settings are set to 0, migrating the PDS status to Operation enabled will trigger E-881 (Control Mode Configuration Abnormal Protection).

If no corresponding control mode is set for 6060h, E-881 (Control Mode Setting Abnormal Protection) will occur.

In the initial state, 6060h=0 (No mode assigned). After switching to a supported control mode (pp, pv, tq, hm, CSP, CSV, CST), resetting 6060h=0 again is treated as "No mode changed," and the control mode switch cannot be executed (the previous control mode remains unchanged).

11.5.3 Current control mode (6061h)

The confirmation of the control mode inside the servo driver is performed according to 6061h (Modes of Operation Display). After setting 6060h (Modes of Operation), verify whether the specified action can be executed by detecting its feasibility.

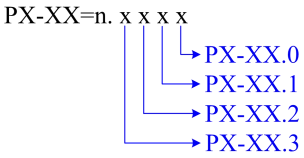
<table>
<tr><th>Index</th><th>Sub index</th><th>Name</th><th>Scope</th><th>Data Type</th><th>Accessibility</th><th>Pdo</th><th>Op-mode</th></tr>
<tr><td rowspan="12">6061h</td><td rowspan="12">00h</td><td colspan="2">Mode of operation display</td><td>-128~127</td><td>I8</td><td>ro</td><td>TxPDO</td><td>All</td></tr>
<tr><td colspan="7">Represent the current control mode.
<table>
<tr><th>Bit</th><th>Mode of operation</th><th>Abbreviation</th><th>Corresponding</th></tr>
<tr><td>-128~-1</td><td>Reserved</td><td>-</td><td>-</td></tr>
<tr><td>0</td><td>No mode changed/No mode assigned (No control mode change / No control mode assignment)</td><td>-</td><td>-</td></tr>
<tr><td>1</td><td>Profile Position Mode (Profile Position Control Mode)</td><td>pp</td><td>YES</td></tr>
<tr><td>3</td><td>Profile Velocity Mode (Profile Velocity Control Mode)</td><td>pv</td><td>YES</td></tr>
<tr><td>4</td><td>Torque Profile Mode (Profile Torque Control Mode)</td><td>tq</td><td>YES</td></tr>
<tr><td>6</td><td>Homing mode (origin reset position mode)</td><td>hm</td><td>YES</td></tr>
<tr><td>8</td><td>Cyclic synchronous position mode (Cycle Synchronization Position Control Mode)</td><td>csp</td><td>YES</td></tr>
<tr><td>9</td><td>Cyclic synchronous velocity mode (Cycle Synchronization Speed Control Mode)</td><td>csv</td><td>YES</td></tr>
<tr><td>10</td><td>Cyclic synchronous torque mode (Cycle-synchronous torque control mode)</td><td>cst</td><td>YES</td></tr>
<tr><td>11~127</td><td>Reserved</td><td>-</td><td>-</td></tr>
</table></td></tr>
</table>

12 Parameter List

12.1 Servo Parameter Table

12.1.1 Group P functional parameters

Modification and effective timing: "○" indicates modification during servo OFF, with immediate effect;
"√" indicates that 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 it can be changed at any time and takes effect when the motor is not rotating.
"▲" indicates that it can be modified at any time, but requires a power cycle to take effect.
For parameters set in hexadecimal format, prefix "n." before the value indicates that the current setting is a hexadecimal number.
Parameter composition:



1) Parameter P0 group

Parameter	Functional description	Unit	Factory Default	Setting Scope	Effective Time	Applicable Mode
P0-00	Driver type 0: General Type 1: EtherCAT type	-	1	0 ~ 1	●	All
P0-01	P0-00=0: Standard general type 1: Internal Torque Mode 3: Internal Speed Mode 5: Internal Position Pattern 6: External Pulse Position Pattern (Supports only 15–32 kW) 7: External jog speed Mode (Supports only 15–32 kW) P0-00=1: EtheCat type 1: Profile Position Control Mode (PP) 3: Profile Velocity Control Mode (PV) 4: Profile Torque Control Mode (TQ) 6: Origin Return Pattern (HM) 8: Cycle Synchronization Position Control Mode (CSP) 9: Cycle Synchronization Speed Control Mode (CSV)	-	0	1 ~ 10	○	All

Parameter	Functional description	Unit	Factory Default	Setting Scope	Effective Time	Applicable Mode
	10: Cycle Synchronous Torque Control Mode (CST)					
P0-02	Control Mode 2 (description as above) When the C-SEL signal is active, the servo system switches to the mode selected by P0-02 for operation.	-	0	1 ~ 10	○	All
P0-03	Enable mode: 0: Disabled 1: IO/SON input signal 2: Software Enablement (Panel/Modbus): Write value 1 to panel F1-05 3: Bus Enable	-	3	0~3	○	All
P0-04	Rigidity Level	-	<=20P7: 13 >=21P0: 11	0~41	△	All
P0-05	Selection of rotation direction	-	0	0~1	●	All
P0-07	First Inertia Ratio	1%	200	0~50000	√	All
P0-09.0	Input pulse command in positive direction 0: Forward pulse count 1: Reverse pulse counting	-	0	0~1	●	6、7
P0-09.2	Input pulse instruction filtering time	-	F	0~F	●	6、7
P0-10.0 xxx□	0：CW/CCW 1: AB (External pulse velocity mode not supported) 2：P+D	-	2	0~2	○	6、7
P0-11	Set the number of pulses per cycle to the lower bit × 1	-	0	0~9999	○	5、6
P0-12	Set the number of pulses per cycle to high value × 10000	-	0	0~65535	○	5、6
P0-13	Electronic Gear Molecular	-	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

Parameter	Functional description	Unit	Factory Default	Setting Scope	Effective Time	Applicable Mode
P0-23	Pulse deviation limit	0.01 circle	2000	0~65535	√	5、6
P0-24	0: Cumulative discharge time 1: Average Power Mode 1 2: Average Power Mode 2 (Imperfect, not recommended)	-	0	0~2	○	All
P0-25	Discharge resistor power value	W	Related to the drive power	0~65535	○	All
P0-26	Discharge resistor resistance value	Ω		1~500	○	All
P0-27	Servo gate enables shutdown mode 0: stop freely and maintain free operation after stopping 1: stop freely and maintain the DB state after stopping 2: Reduce speed and stop; maintain free-running state after stopping 3: Reduce speed and stop; maintain DB status after stopping 4: DB stops; after stopping, it remains in a free-running state. 5: DB stops; maintain the DB state after stopping	-	0	0~5	○	All
P0-28	Normal mode Overrun stop mode (P0-28.0) 0: Slow down and stop 1 1: Free stop 2: Slow down and stop 2 3: Alarm stopped Overload alarm shielding switch (P0-28.1) 0: Do not block overtime alerts 1: Suppress out-of-range alarm	-	2	0~3	○	All
	EC Bus Overrun stop Mode (P0-28.0) 0: Direct alarm activation using servo-based speed reduction and shutdown method 1: After decelerating and shutting down according to the 605Ah method, an alarm is triggered. 2: Do not use overtravel	-	2	0~3	○	1|3|4|8|9|10
P0-29	Servo alarm stop mode 0: stop freely and maintain free operation after stopping 1: stop freely and maintain the DB state	-	2	0~5	○	All

Parameter	Functional description	Unit	Factory Default	Setting Scope	Effective Time	Applicable Mode
	after stopping 2: DB/Slow down and stop; maintain free running state after stopping 3: DB/Slow stop; maintain DB status after stopping 4: DB stops; after stopping, it remains in a free-running state. 5: DB stops; maintain the DB state after stopping					
P0-30	stop timeout time	1ms	20000	0~65535	○	All
P0-31	stop time of the reduction	1ms	25	0~5000	○	All
P0-33	Motor Code Setting	-	0000	0~65535	●	All
P0-42	Maximum zero current	AD	100	0~500	○	All
P0-53	Automatic reading of motor parameters; alarm suppression switch 0: Do not block alarms 1: Mask the alert for missing valid motor parameters	-	0	0/1	●	All
P0-55	Open-loop rotation speed	-	0	-6000~6000	○	All
P0-56	Number of encoder communication attempts	-	10	1~65535	○	All
P0-63.0	Selection of encoder speed measurement algorithms 0: K-type speed measurement (default) 1: Speed measurement method 1, S method (To be used with P0-63.1) 2: Speed measurement method 2, P method (To be used with P0-63.2) 3: Speed measurement method 3, T method (parameter configuration P0-76,%)	-	0	0~3	○	All
P0-63.1	Number of right shifts for the original position difference in the S method	-	0	0~f	○	All
P0-63.2~3	The total length L of the speed measurement section in Method P	-	0	4~17	○	All
P0-68.0~P0-68.1 xx□□	Number of consecutive error alarms during encoding data update sequences	-	0x05	0x01~0xFF	●	All
P0-68.2~P0-68.3 □□xx	E-241 alarm filtering frequency	-	0	0~0xFF	●	All

Parameter	Functional description	Unit	Factory Default	Setting Scope	Effective Time	Applicable Mode
P0-69	Fan switch (P0-69.0) 0: Turn on the fan when the temperature exceeds 45°C; turn off the fan when the temperature is below 42°C (hysteresis range: 3°C). 1: Turn on the fan when enabled; turn off the fan when disabled Large motor thermocouple wire break alarm shielding switch (P0-69.1) 0: Do not block the thermocouple wire break alarm 1: Mask the thermocouple wire break alarm	-	1	0/1	√	All
P0-70	Pulse command deviation limit value	0.01 circle	200	0~65535	√	8
P0-71	Bus CSP Position Interpolation Mode Selection 0: Advanced Interpolation 1: Normal interpolation	-	1	0~1	√	8
P0-72	Bus Sync0 offset time After setting the parameters, the changes will take effect only after the host computer reactivates them. You can observe the modification effects via U5-19.	[%]	0	0~60	√	All
P0-74	Stall alarm time	1ms	By device model	0-65535	√	All
P0-75	Stall alarm speed	1rpm	50	5~9999	√	All
P0-76	The tracking coefficient R of the T method	[%]	20	1~1000	√	All
P0-79	Absolute Encoder Settings 0: Used as an absolute encoder 1: Used as an incremental encoder 2: When used as an absolute encoder, ignore the multi-turn overflow alarm.	-	1	0~2	●	All
P0-80	Motor thermal power protection method 0: Current Protection 1: Average thermal power protection 2: Analog thermal power protection	-	2	0~2	●	All
P0-88	STO status asynchronous alarm detection time	0.1ms	60	0~1000	√	All
P0-89.0~1	STO Buffer Circuit Abnormal Alarm Detection and Filtering Time	0.1ms	10	0~255	√	All
P0-89.2~3	STO Input Detection and Filtering	0.1ms	12	10~30	√	All

Parameter	Functional description	Unit	Factory Default	Setting Scope	Effective Time	Applicable Mode
P0-90.0~1	EDM circuit abnormality alarm detection and filtering	0.1ms	200	0~255	√	All
P0-92 ~ P0-93	32-bit electronic gear ratio molecule P0-11 to P0-14 are valid when set to 0. P0-92*1 + P0-93 *10000	-	1	1~9999	○(pattern 5) √(pattern 6)	5、6
			1	0~65535		
P0-94 ~ P0-95	32-bit electronic gear ratio resolver P0-11 to P0-14 are valid when set to 0. P0-94*1 + P0-95 *10000	-	1	1~9999	○	5、6
			1	0~65535		

2) Parameter P1 group

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
P1-00	First speed loop gain	0.1Hz	Model-related	10~20000	√	All
P1-01	First speed loop integral time constant	0.01ms	Model-related	15~51200	√	All
P1-02	First-position ring gain	0.1/s	Model-related	10~20000	√	All
P1-05	Second speed loop gain	0.1Hz	Model-related	10~20000	√	1|3|5|6|7|
P1-06	The second velocity loop integral time constant	0.01ms	Model-related	15~51200	√	1|3|5|6|7|
P1-07	Second position ring gain	0.1/s	200	10~20000	√	1|3|5|6|7|
P1-10	Speed 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	√	All
P1-15	Gain switching wait time	-	5	0~1000	√	All
P1-16	Gain switching level threshold	-	50	0~20000	√	All
P1-17	Gain switching level hysteresis loop	-	30	0~20000	√	All
P1-18	Position loop gain switching time	-	3	0~1000	√	All
P1-19.0	Gap Compensation Function Direction 0: Positive direction 1: Opposite direction	-	0	0~1	√	All
P1-19.1	Gap Compensation Function Switch 0: Close 1: Enable	-	0	0~1	√	All
P1-20	Gap Compensation Quantity	0.1Pref	0	0~65535	√	All
P1-21	Gap Compensation Filter Time	0.01ms	0	0~65535	√	All
P1-23	Speed command filter time parameter	0.1ms	0	0~65535	○	3

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
P1-24	Position command acceleration/deceleration filtering time	0.1ms	0	0~65535	△	5|6
P1-25	Position command smoothing filter time parameter	0.1ms	0	0~65535	△	5|6
P1-26.0	Condition for switching speed control mode [P-PI changing-over] 0: Do not use mode switching 1: Use the internal torque command as the switching condition 2: Use speed commands as the switching condition 3: Use acceleration as the switching condition 4: Use position deviation as the switching condition	-	<=22P6：1 Others：0	0~4	△	All
P1-26.1	Speed control mode switching: Integral hold selection 0: Clear the 积分 of 0 Asr 1: Keep the points unchanged and do not accumulate them	-	1	0~1	△	All
P1-27	Mode Switch – Torque Command Threshold	%	200	0~800	△	All
P1-28	Mode Switch-Speed Command Threshold	rpm	0	0~10000	△	All
P1-29	Mode Switch-Acceleration Threshold	rpm/s	0	0~30000	△	All
P1-30	Mode Switch-Position Deviation Threshold	Command Unit	0	0~10000	△	All
P1-31	I-P control switching threshold	%	100	0~100	△	All
P1-74	Encoder zero position offset detection cycle	-	1000	0~65535	√	All
P1-75.0~1	Encoder zero position offset detection threshold	-	0A	0~500	√	All
P1-75.2~3	Number of filtering cycles for electrical angle deviation detection	-	06	0~500	√	1|2|3|4|5|6|7

3) Parameter P2 group

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable Mode
P2-00.0	Disturbance Observer Switch 0: Close 1: Open	-	0	0~1	○	All
P2-00.1	Speed Observer Selection 0: Close 1：EhVobs 2：Vobs	-	0	0~2	○	All
P2-00.3	Electrical angle compensation switch 0: Close 1: Open	-	0	0~1	○	All
P2-01.0	Adaptive Mode Switch 0: Close 1: Open	-	0	0~1	●	All
P2-01.1	Adaptive Level 0: High Response 1: Low noise	-	By device model	0~1	●	All
P2-02.0	Self-tuning mode 1: Soft 2: Rapid Localization 3: Rapid positioning and overshoot control	-	3	1~3	√	All
P2-02.2	Load type (valid only during self-tuning) 1: Synchronous Belt 2: Screw rod 3: Rigid Connection	-	2	1~3	√	All
P2-03.2	Speed Loop IP Control Enablement 0: Close 1: Open	-	0	0~1	●	All
P2-03.3	Adaptive Load Type 0: Low Inertia Mode 1: High Inertia Mode	-	0	0~1	√	All
P2-05	Adaptive Mode Speed Loop Gain (Standard)	0.1Hz	200	1~65535	○	All
P2-07	Adaptive Mode Inertia Ratio (Standard)	%	0	0~10000	○	All
P2-08	Adaptive Mode Speed Observer Gain (Standard)	Hz	40	10~1000	○	All
P2-12	Maximum Inertia Ratio of Adaptive Mode (Standard)	-	30	1~10000	○	All
P2-15	Inertia identification and self-adjustment of the maximum travel for internal commands	0.01r	100	1~3000	√	All
P2-17	Inertia identification and the maximum speed determined through internal command self-adjustment	-	0	0~65535	√	All
P2-18	Initial inertia ratio for inertia identification	%	500	1~20000	√	All
P2-19	Adaptive Mode Bandwidth	%	50	1~100	○	All
P2-31	Dead zone compensation time	0.01ms	15	0~65535	√	All

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable Mode
P2-35	Torque command filtering time constant 1	0.01ms	66	0~65535	√	All
P2-36	Torque command filtering time constant 2	0.01ms	100	0~65535	√	All
P2-39	Perturbation Observer Gain 1	-	10	10~1000	√	All
P2-40	Perturbation Observer Gain 2	-	100	10~1000	√	All
P2-41	Disturbance torque compensation coefficient (Non-adaptive mode is effective)	%	85	0~100	√	All
P2-42	Cut-off frequency of the disturbance torque low-pass filter	0.1Hz	0	-1000~1000	√	All
P2-43	Inertia coefficient of the disturbance observer	%	100	1~1000	√	All
P2-47.0	Model Loop Switch 0: Close 1: Open	-	0	0~f	√	All
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 suppression of self-tuning switch 0: Do not configure active vibration suppression after self-tuning 1: Active vibration suppression configured after self-tuning	-	1	0~1	√	3|4|5|6|7
P2-61	Active vibration suppression frequency	0.1Hz	10000	10~20000	√	All
P2-62	Active vibration suppression gain	%	100	1~1000	√	All
P2-63	Active vibration suppression damping	%	100	0~300	√	All
P2-64	Active vibration suppression frequency 1	-	0	-10000~10000	√	All
P2-65	Active vibration suppression frequency 2	-	0	-10000~10000	√	All
P2-69.0	Sloshing wave filter 1 switch	-	0	0~1	√	All
P2-69.1	Sloshing wave filter 2 switch	-	0	0~1	√	All
P2-69.3	Sloshing wave filter 3 switch	-	0	0~1	√	All
P2-70.0	Sloshing wave filter 4 switch	-	0	0~1	√	All
P2-70.1	Sloshing wave filter 5 switch	-	0	0~1	√	All
P2-71	First notch frequency	Hz	8000	50~8000	√	All
P2-72	First notch bandwidth	0.01dB	71	50~1000	√	All
P2-73	First notch attenuation	0.001Hz	0	0~1000	√	All
P2-74	Second absorption frequency	Hz	8000	50~8000	√	All
P2-75	Second absorption band width	0.01dB	71	50~1000	√	All
P2-76	Second waveguide attenuation	0.001Hz	0	0~1000	√	All
P2-77	Third absorption frequency	Hz	8000	50~8000	√	All
P2-78	Third absorption band bandwidth	0.01dB	71	50~1000	√	All
P2-79	Third wave attenuation	0.001Hz	0	0~1000	√	All
P2-80	Fourth absorption frequency	Hz	8000	50~8000	√	All
P2-81	Fourth absorption band bandwidth	0.01dB	71	50~1000	√	All

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable Mode
P2-82	Fourth waveguide attenuation	0.001Hz	0	0~1000	√	All
P2-83	Fifth absorption frequency	Hz	8000	50~8000	√	All
P2-84	Fifth absorption band bandwidth	0.01dB	71	50~1000	√	All
P2-85	Fifth wave attenuation	0.001Hz	0	0~1000	√	All

4) Speed control parameter Group P3

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable Mode
P3-05	Preset 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	0	0~65535	○	3|4|7
P3-10	deceleration time	ms	0	0~65535	○	3|4|7
P3-12	Zero-speed clamping mode	-	0	0~3	○	3|4|7
P3-13	Zero-speed clamping speed	rpm	10	0~300	○	3|4|7
P3-14	Positive maximum speed command limit	rpm	4000	0~10000	○	All
P3-15	Reverse maximum speed instruction limit	rpm	4000	0~10000	○	All
P3-16	Internal forward speed limit during torque control	rpm	2000	5~10000	√	1|2
P3-17	Internal reverse speed limit during torque control	rpm	2000	5~10000	√	1|2
P3-18	Click speed	rpm	100	0~1000	○	All
P3-19	Positive warning speed	rpm	3000	0~10000	○	All
P3-20	Reverse warning speed	rpm	3000	0~10000	○	All
P3-21	Positive alarm speed	rpm	4000	0~10000	○	All
P3-22	Reverse alarm speed	rpm	4000	0~10000	○	All
P3-28	Internal forward rotation torque limit	%	By device model	0~Motor overload factor	√	All
P3-29	Internal reverse rotation torque limit	%	By device model	0~Motor overload factor	√	All
P3-30	External forward rotation torque limit	%	By device model	0~Motor overload factor	√	All
P3-31	External reverse rotation torque limit	%	By device model	0~Motor overload factor	√	All
P3-33	Preset torque	%	0	-1000~1000	√	1
P3-37	Torque mode switching delay	ms	40	0~9999	√	1|2
P3-38	Prevention and control of positive rotation torque limitation	%	By device model	0~Motor overload factor	√	All
P3-39	Prevention and control of reverse rotation torque limitation	%	By device model	0~Motor overload factor	√	All
P3-40.0	F friction compensation switch	-	0	0~1	√	All
P3-40.1	Selection of the friction compensation speed source	-	0	0~2	√	All
P3-45	Friction Compensation Speed Threshold	0.1rpm	20	0~200	√	All
P3-46	Dynamic braking delay enable	ms	10	0~50	√	All

5) Internal position parameter group P4

Parameter	Name	Unit	Factory Default	Set range	Effective Time	Applicable Mode
P4-00.0	Z Number of positive signs The number of Z signals processed after releasing the limit switch (Note: stop when the n+1th Z signal arrives).	individual	2	0~f	○	5|6
P4-00.1	Enable/Disable the Origin Search feature 0: Not enabled 1: 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	Speed of collision with the proximity switch	rpm	600	0~65535	○	5|6
P4-02	The speed of approaching the proximity switch	rpm	100	0~65535	○	5|6
P4-03.0	Set the positioning mode based on the given internal location pattern 0: Relative Positioning 1: Absolute Positioning	-	0	0~1	○	5
P4-03.1	Set the step mode based on the internal position given pattern 0: Switch steps when the signal is ON; can be repeated cyclically 1: Signal rising edge step change, executed in single step 2: Initiated by the signal rising edge, executes all operations sequentially without looping. 3: Communication setting segment number 4: /CHSTP bilateral edge trigger 5: Select the section number for terminals/PREFA (P5-57), /PREFB (P5-58), or /PREFC (P5-59); options include sections 1–3. 6: Terminal/PREFA (P5-57), /PREFB (P5-58), /PREFC (P5-59), /PREFD (P5-60) – Terminal selection section numbers, optional from section 1 to 16.	-	0	0~5	○	5
P4-03.2	Internal location: Given pattern set to wait mode 0: Waiting for positioning to complete 1: Do not wait for positioning to complete	-	0	0~1	○	5
P4-04	Number of valid entries	-	0	0~35	○	5
P4-10P4-11	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

Parameter	Name	Unit	Factory Default	Set range	Effective Time	Applicable Mode
P4-10+ (n-1)*7 ~ P4-16+ (n-1)*7	Pulse parameters for paragraphs 1 to 35 (n indicates the position segment number)	-	-	-	√	5

- Set pulse count = pulse count (high bit) × 10000 + pulse count (low bit);
- There are 35 paragraphs in total; parameters for paragraphs 1–12 can be set via the panel, while those for paragraphs 13–35 require parameter writing through communication (RS232 and RS485).

6) Signal parameter settings Group P5

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable mode
P5-00	Positioning completion width/COIN	Command Unit	11	1~65535	√	5|6
P5-01	Positioning completion detection mode	-	0	0~3	√	5|6
P5-02	Positioning completion retention time	ms	0	0~65535	√	5|6
P5-03	Rotation detection speed	rpm	50	0~10000	√	All
P5-04	Same-speed detection speed	rpm	50	0~10000	√	All
P5-05	Detection speed reached	rpm	1000	0~10000	√	All
P5-06	Position close to the output width	Command Unit	50	0~65535	√	5|6
P5-07	ServoOFF delay time	ms	500	0~65535 Before 3760 -500-9999 (3760 and later)	○	All
P5-08	Brake command output speed	rpm	30	20~10000	○	All
P5-09	Brake command wait time	ms	500	0~65535	○	All
P5-10	CuSTOm Output 1 Trigger Condition	-	0	0~ffff	√	All
P5-11	Value to compare with the trigger condition for CuSTOm Output 1	With Trigger The conditions are related.	0	-9999~9999	√	All
P5-12	Select CuSTOm Output 1 method	-	0	0~3	√	All
P5-13	Set cuSTOm output 1 hysteresis loop	With Trigger The conditions are related.	0	0~65535	√	All
P5-14	CuSTOm Output 2 Trigger Condition	-	0	0~ffff	√	All
P5-15	Value to compare with the trigger condition for Set and	With Trigger	0	-9999~9999	√	All

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable mode
	CuSTOm Output 2	The conditions are related.				
P5-16	Select CuSTOm Output 2 method	-	0	0~3	√	All
P5-17	Set cuSTOm output 2 hysteresis loop	With Trigger The conditions are related.	0	0~65535	√	All
P5-18	IO filter time factor	-	1	0~10000	√	All
P5-19	Z-phase output hold time	ms	2	1~65535	√	All
P5-20.0~1	In non-EtherCAT mode (P0-00=0): /S-ON: Servo signal enabled 00: Set the signal to always "invalid". 01: Input a positive signal from terminal SI1. 02: Input a positive signal from the SI2 terminal. 03: Apply a positive signal to the SI3 terminal. 04: Input a positive signal from the SI4 terminal. 10: Set the signal to always "valid". 11: Input the reverse signal from terminal SI1. 12: Input the reverse signal from terminal SI2. 13: Input the reverse signal from terminal SI3. 14: Input the reverse signal from the SI4 terminal.	-	00	0~ff	√	1|3|5
P5-20.2	SI terminal filtering time	ms	0	0~f	√	All
P5-21.0~1	/P-CON proportional motion command	-	00	0~ff	√	All
P5-21.2	SI terminal filtering time	ms	0	0~f	√	All
P5-22.0~1	In non-EtherCAT mode: /P-OT: Forward drive is prohibited In EtherCAT mode: Control Mode 6 (Zero Return Mode), POT prohibition signal	-	01	0~ff	√	All
P5-22.2	SI terminal filtering time	ms	0	0~f	√	All
P5-23.0~1	In non-EtherCAT mode: -N/OT: Reverse drive is prohibited In EtherCAT mode: Control Mode 6 (Zero Return Mode), NOT prohibition signal	-	02	0~ff	√	All
P5-23.2	SI terminal filtering time	ms	0	0~f	√	All

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable mode
P5-24.0~1	/ALM-RST: Alert Clear	-	0	0~ff	√	All
P5-24.2	SI terminal filtering time	ms	0	0~f	√	All
P5-25.0~1	/P-CL: Forward-side external torque limit	-	00	0~ff	√	All
P5-25.2	SI terminal filtering time	ms	0	0~f	√	All
P5-26.0~1	-N/CL: External torque limit on the reverse side	-	00	0~ff	√	All
P5-26.2	SI terminal filtering time	ms	0	0~f	√	All
P5-27.0~1	In non-EtherCAT mode: /SPD-D: Internal speed direction selection in EtherCAT mode: Control Mode 6 (Zero Return Mode), Home Origin Signal	-	03	0~ff	√	1|2|3|4|7
P5-27.2	SI terminal filtering time	ms	0	0~f	√	1|2|3|4|7
P5-28.0~1	In non-EtherCAT mode: Speed Mode: /SPD-A: Internal set speed selection New original mode: /SPD-A: Trigger the original action Original mode: /SPD-A: Forward direction to find the origin	-	00	0~ff	√	3|5
P5-28.2	SI terminal filtering time	ms	0	0~f	√	3|5
P5-29.0~1	In non-EtherCAT mode: Speed Mode: /SPD-B: Internal speed selection setting Original mode: /SPD-B: Reverse direction to find the origin	-	00	0~ff	√	3|5
P5-29.2	SI terminal filtering time	ms	0	0~f	√	3|5
P5-30.0~1	/C-SEL: Control method selection	-	00	0~ff	√	All
P5-30.2	SI terminal filtering time	ms	0	0~f	√	All
P5-31.0~1	In internal speed mode/external jog speed mode: /ZCLAMP: Zero Clamping Internal location mode: -Z-CLAMP: Skip the current segment number	-	00	0~ff	√	Zero clamping: 3|7 Skip current section: 5
P5-31.2	SI terminal filtering time	ms	0	0~f	√	3
P5-32.0~1	/INHIBIT: Instruction pulse prohibition	-	00	0~ff	√	5
P5-32.2	SI terminal filtering time	ms	0	0~f	√	5
P5-33.0~1	/G-SEL: Gain Switching	-	00	0~ff	√	All
P5-33.2	SI terminal filtering time	ms	0	0~f	√	All
P5-34.0~1	/CLR: Pulse Offset Clear	-	00	0~ff	√	5|6
P5-34.2	SI terminal filtering time	ms	0	0~f	√	5|6
P5-35.0~1	/CHGSTP: Internal position pattern step signal	-	00	0~ff	√	5

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable mode
P5-35.2	SI terminal filtering time	ms	0	0~f	√	5
P5-36.0~1	-I-SEL: Inertia Ratio Switching	-	00	0~ff	√	All
P5-36.2	SI terminal filtering time	ms	0	0~f	√	All
P5-37	/COIN_HD: Positioning completed and maintained 00: Do not output to terminals 01: Send a positive signal from the SO1 terminal 02: Send a positive signal from the SO2 terminal 03: Send a positive signal from the 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
P5-38	/COIN: Positioning completed	-	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	√	All
P5-41	/S-RDY: Ready	-	0000	0~ffff	√	All
P5-42	/CLT: Torque Limit	-	0000	0~ffff	√	All
P5-43	/VLT: Speed limit detection	-	0000	0~ffff	√	1|2
P5-44	/BK: Brake Interlock	-	0000	0~ffff	○	All
P5-45	/WARN： warn	-	0000	0~ffff	√	All
P5-46	/NEAR： be close to	-	0000	0~ffff	√	5|6
P5-47	/ALM： report to the police	-	0002	0~ffff	√	All
P5-48	/Z: Encoder Z signal output	-	0000	0~ffff	√	All
P5-50	/MRUN: Internal position mode movement start signal	-	0000	0~ffff	√	5
P5-51	/V-RDY: Speed reached	-	0000	0~ffff	√	3|4|7
P5-52	/USER1: CuSTOm Output 1	-	0000	0~ffff	√	All
P5-53	/USER2: CuSTOm Output 2	-	0000	0~ffff	√	All
P5-57	/PREFA: Internal position selection signal A	-	0	※1	√	5
P5-58	/P PREFB: Internal position selection signal B	-	0	※1	√	5
P5-59	/P PREFC: Internal position selection signal C	-	0	※1	√	5
P5-60	/P PREFD: Internal position selection signal D	-	0	※1	√	5
P5-61.0~1	/TRAJ-START: Signal triggering the start of exercise	-	00	0~ff	√	5
P5-62	Probe Function 1	-	7.5 kW and below: 0; 15 kW and above: 6	0~ff	○	EtherCAT pattern
P5-63	Probe Function 2	-	7.5 kW and	0~ff	○	EtherCAT pattern

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable mode
			below: 0; 15KW：7			
P5-68.0~1	Terminal emergency alarm function	-	00	0~ff	√	All
P5-68.2	SI terminal filtering time	ms	0	0~f	√	All
P5-70	/SRDY: Output condition selection 0: After the drive unit initialization is complete, this terminal becomes conductive 1: This terminal will conduct only after enabling.	-	0	0~1	√	All
P5-71	jog speed mode direction terminal function selection	-	0	0~1	√	7
P5-72	Remote SI Input 1	-	0	0~ff	√	EtherCAT pattern
P5-73	Remote SI Input 2	-	0	0~ff	√	EtherCAT pattern
P5-74	Remote SI Input 3	-	0	0~ff	√	EtherCAT pattern
P5-76	Remote SO Output 1	-	0	0~ff	√	EtherCAT pattern
P5-77	Remote SO Output 2	-	0	0~ff	√	EtherCAT pattern
P5-78	Remote SO Output 3	-	0	0~ff	√	EtherCAT pattern

Table 1 Input Signal Allocation

Input terminal parameters	Servo Model	Set range
P5-20~P5-36 P5-57~P5-59 P5-72~P5-74	DS5C2 series	n.0000~n.0005 n.0010~n.0015

Table 2: Output Signal Allocation

Output terminal parameters	Servo Model	Set range
P5-37~P5-53 P5-76~P5-78	DS5C2 series	n.0000~n.0004 n.0010~n.0014

7) Signal parameter settings Group P6 (some parameters retained)

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable mode
P6-00	Rigid Setting Mode 0: Standard Mode 1: Positioning Mode 2: Quick Location Mode	-	0	0~2	○	All
P6-05	Adaptive mode speed loop gain (high inertia)	0.1Hz	200	1~65535	○	1|3|5|6|7
P6-07	Adaptive mode inertia ratio (high inertia)	%	50	0~10000	○	1|3|5|6|7
P6-08	Adaptive Mode Speed Observer Gain (High Inertia)	Hz	40	10~1000	○	1|3|5|6|7

Parameter	Name	Unit	Factory Default	Set range	Effective time	Applicable mode
P6-12	Adaptive mode maximum inertia ratio (large inertia)	-	50	1~10000	○	1|3|5|6|7

8) P7 group communication parameter settings (485 communication not supported currently)

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
P7-00	From station number	-	0	0~100	○	EtherCAT pattern
P7-10	RS232 station number	-	1	0~100	√	1|3|5
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	Baud rate	09	0~16	√	1|3|5

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
	13：3M 14：4M 15：5M 16：6M					
P7-11.2	RS232 stop bit 0: 2 digits 2nd place	stop bit	2	0~2	√	1|3|5
P7-11.3	RS232 parity bit 0: No verification 1:odd 2: Parity Check	check bit	2	0~2	√	1|3|5
P7-20	The HM bus returns to its original state to determine the number of Z phases.	-	1	-9999~9999	○	EtherCAT pattern
P7-21	Filtering time after zero return	ScanA period	400	1~65535	○	EtherCAT pattern

9) Parameter P8 group

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
P8-17	sampling interval	-	25	1~65535	▲	1|3|5
P8-25	Panel Selection	-	0	0~2	▲	1|3|5

10) Parameter P9 group

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
P9-16	stop and return to the origin speed threshold	rpm	2	0~1000	○	EtherCAT pattern
P9-17	stop-pause return-to-origin torque threshold	%	100	0~300	○	EtherCAT pattern
P9-18	Time threshold for stopping and returning to the origin	ms	500	10~1500	○	EtherCAT pattern
P9-19	Low-order quantized pulse count	-	0	-9999~9999	○	EtherCAT pattern
P9-20	High bit of quantitative pulse count	-	0	-9999~9999	○	EtherCAT pattern

11) Parameter PE group

Parameter	Functional description	Unit	Factory Default	Set range	Effective time	Scope of application
PE-01.3	Low-magnetic control switch	—	0	0-1	√	All
PE-80	Weak magnetic control gain Kv	Hz	30	10-1000	√	All
PE-81	The integral time constant Ti for weak magnetic control	%	16	10-1000	√	All
PE-82	Weak magnetic control integrated limit amplifier	%	60	0-200	√	All
PE-83	Voltage Directive Limit Threshold	%	115	50-150	√	All
PE-84	IdRef amplitude limiting	%	95	50-150	√	All
PE-85	Main loop voltage smoothing filter time	0.1ms	20	0-1000	√	All

12.2.2 Group F Functional Parameters

Function code	Explanation
F0-00	Clear Alert
F0-01	Recovery factory settings
F0-02	Clear position deviation
F1-00	Dot Motion
F1-01	Pilot run
F1-02	Current sampling zero calibration
F1-05	Panel Enable
F1-06	Absolute encoder clearance circle count

12.2.3 Group U Monitoring Parameters

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		(-65536 ~ 65535)*10000	
U0-10	Encoder feedback value	(0000 ~ 9999)*1	Encoder pulse
U0-11		(0000 ~ 65535)*10000	
U0-12	Input instruction 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
U0-21	Input signal state 1		
U0-22	Input Signal Status 2		
U0-23	Output signal status 1		
U0-24	Output Signal Status 2		
U0-25	Input pulse frequency	(0000 ~ 9999)*1	Hz
U0-26		(0000 ~ 65535)*10000	
U0-41	Instantaneous output power		1W
U0-42	Average output power		1W
U0-43	Instantaneous thermal power		1W

Monitoring number	Content	Unit
U0-44	Average thermal power	1W
U0-49	Position Feedforward	1 Instruction Unit
U0-50	Speed Feedforward	rpm
U0-51	Torque feedforward	% specified
U0-52	Instantaneous bus capacitor power	1W
U0-53	Average busbar capacitive power	1W
U0-55	Instantaneous braking discharge power	1W
U0-56	Average 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 (Direction Sign)		
U0-89	Position Instruction End Flag	
U0-91	Number of turns for the absolute value motor	
U0-94	Calibrate the absolute value encoder position for the lower 32 bits	Encoder position
U0-95		
U0-96	Calibrate the absolute value encoder position using 32 bits	Encoder position
U0-97 (Direction Sign)		
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	The U-phase current at the time of the alarm occurrence	0.01A
U1-03	The V-phase current at the time of the alarm occurrence	0.01A
U1-04	The bus voltage at the time of the alarm occurrence	V
U1-05	The IGBT temperature at the time of the alarm occurrence	0.1℃
U1-06	Torque current at the time of the alarm occurrence	0.01A
U1-07	The excitation current at the time of the alarm occurrence	A
U1-08	Position deviation at the time of the alarm occurrence	command pulse
U1-09	The speed value at the time of the alarm occurrence	rpm
U1-10	The time in seconds when the alarm was triggered (16-bit lower value), accumulated from the first power-on	s
U1-11	The time in seconds when the alarm was triggered (16-bit integer), accumulated from the first power-on	s
U1-12	The number of runtime errors is calculated since the last power-on.	
U1-13	The number of operation warnings is calculated from the last power-on.	
U1-14	Total historical alarm count	
U1-15	Total historical warning count	

Monitoring number	Content	Unit
U1-16	The most recent second alarm code	
U1-17	The latest third alarm code	
U1-18	The latest fourth alarm code	
U1-19	The latest 5th alarm code	
U1-20	The latest 6th alarm code	
U1-21	The latest 7th alarm code	
U1-22	The latest alarm code is the 8th one.	
U1-23	The latest 9th alarm code	
U1-24	The latest 10th alarm code	
U1-25	The most recent 11th alarm code	
U1-26	The most recent 12th alarm code	
U1-27	The most recent 13th alarm code	
U1-28	The most recent 14th alarm code	
U1-29	The most recent 15th alarm code	
U1-30	The most recent 16th alarm code	
U1-31	The most recent 17th alarm code	
U1-32~U1-47	Recent warning codes 2 through 17	

U2-XX：

Monitoring number	Content		Unit
U2-00	Power-on frequency		-
U2-01	series		-
U2-02	Model (low 16 bits)		-
U2-03	Model (16-bit height)		-
U2-04	Manufacturing date: Year		-
U2-05	Production date: Month		-
U2-06	Production date: Day		-
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	Current runtime (starting from the last power-on)		hour
U2-13	Current runtime (starting from the last power-on)		minute
U2-14	Current runtime (starting 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 activation)		1W
U2-17	Average bus capacitor filtering power (average power during the power-on period starting from the first power-on)		1W
U2-18	Total number of motor rotations	(0000～9999)*1	Circle
U2-19		(0000～9999)*10000	Circle
U2-20	Device serial number: 16-bit (not supported)		
U2-21	Device serial number: 16-digit (not supported)		
U2-22	Firmware generation date: Year		
U2-23	Firmware generation date: Month/Day		

Monitoring number	Content	Unit
U2-24	Firmware generation time: hours/minutes	
U2-33	The highest busbar voltage in history	V
U2-34	Torque current at the moment of the highest bus voltage in history	0.01A
U2-35	The longest duration in history for the maximum bus voltage	hour
U2-36	The longest duration in history for the maximum bus voltage	minute
U2-37	The longest duration in history for the maximum bus voltage	second
U2-38	The motor code from the most recent connection	
U2-39	The motor code from the most recent second connection	
U2-40	The motor code for the most recent third connection	
U2-41	Running time of the motor code during the most recent connection	hour
U2-42	Running time of the motor code during the most recent second connection	hour
U2-43	Running time of the motor code for the most recent third connection	hour

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	-
U3-70	Automatically read the motor code from the encoder in the motor parameters (related only to the motor code)	-

U4-XX:

Monitoring number	Content	Unit
U4-10	Resonant frequency detected by fast FFT	Hz
U4-16	Accumulated value of continuous overload operation under thermal power protection	-
U4-17	Accumulated value of instantaneous overload operations under thermal power protection	-
U4-18	SI terminal active status	-
U4-19	SO terminal active status	-

U5-XX:

Monitoring number	Content	Unit
U5-00	Sync0 cycle time	us
U5-05	Port0 RX error count (Stop when reaching 255)	
U5-07	Port1 RX error count (Stop when reaching 255)	
U5-12	Port0 Link loss count (Stop when reaching 255)	
U5-13	Port1 Link loss count (Stop when reaching 255)	
U5-19	Synchronization Offset Time	us

12.2 Object Dictionary Table of Contents

12.2.1 Object Dictionary Area Allocation

All objects are configured within the object dictionary of each group using a 16-bit index address represented in four-digit hexadecimal format.

The object dictionaries specified in CiA402 (CoE: CANopen over EtherCAT) and those for the DS5C2 series are as follows:

The object dictionary specified by CiA402		DS5C2 Series Object Dictionary	
Index	Content	Index	Content
0000h~0FFFh	Data Type Region	0000h~0FFFh	Data Type Region
1000h~1FFFh	COE Communication Area	1000h~1FFFh	COE Communication Area
2000h~5FFFh	Manufacturer CuSTOm Area	2000h~2FFFh	Servo Parameter Region
		3000h~3FFFh	Keep
		4000h~4FFFh	Keep
		5000h~5FFFh	Keep
6000h~9FFFh	Profile region	6000h~6FFFh	Drive Profile Area
		7000h~9FFFh	Keep
A000h~FFFFh	Keep	A000h~FFFFh	Keep

12.2.2 COE Communication Region (0x1000–0x1FFF)

Index	Sub index	Name	Unit	Data Scope	Data Type	Sign	Pdo
1000h	00h	Device type	-	0~429496795	U32	RO	NO
1001h	00h	Error register: Type of alarm occurring	-	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	-	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 Enter the number of mapping objects supported by RxPDO1	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The third mapping object	-	0~4294967295	U32	RW	NO

Index	Sub index	Name	Unit	Data Scope	Data Type	Sign	Pdo
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1601h	00h	2nd RxPDO mapping Number of mapping objects supported by RxPDO2	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The 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 Number of mapping objects supported by RxPDO3	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The 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 Number of mapping objects supported by RxPDO4	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The 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 mapping objects supported by the output TxPDO1	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The 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 mapping objects supported by TxPDO2	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The third mapping object	-	0~4294967295	U32	RW	NO
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1A02h	00h	3rd TxPDO mapping Number of mapping objects supported by TxPDO3	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The third mapping object	-	0~4294967295	U32	RW	NO

Index	Sub index	Name	Unit	Data Scope	Data Type	Sign	Pdo
	...	...	-	0~4294967295	U32	RW	NO
	18h	The twenty-fourth mapping object	-	0~4294967295	U32	RW	NO
1A03h	00h	4th TxPDO mapping Number of mapping objects supported by TxPDO3	-	0~24	U8	RW	NO
	01h	First mapping object	-	0~4294967295	U32	RW	NO
	02h	The second mapping object	-	0~4294967295	U32	RW	NO
	03h	The 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 001	-	0~4	U8	RO	NO
	02h	Sub Index 002	-	0~4	U8	RO	NO
	03h	Sub Index 003	-	0~4	U8	RO	NO
	04h	Sub Index 004	-	0~4	U8	RO	NO
1C12h	00h	RxPDO handles the allocation of RxPDO resources. RxPDO handles the allocation of RxPDO resources.	-	0~4	U8	RW	NO
	01h	Sub- index 1	-	1600h~1603h	U16	RW	NO
	02h	Sub- index 2	-	1600h~1603h	U16	RW	NO
	03h	Sub- index 3	-	1600h~1603h	U16	RW	NO
	04h	Sub- index 4	-	1600h~1603h	U16	RW	NO
1C13h	00h	TxPDO assigns TxPDO allocation	-	0~4	U8	RW	NO
	01h	Sub- index 1	-	1A00h~1A03h	U16	RW	NO
	02h	Sub- index 2	-	1A00h~1A03h	U16	RW	NO
	03h	Sub- index 3	-	1A00h~1A03h	U16	RW	NO
	04h	Sub- index 4	-	1A00h~1A03h	U16	RW	NO
1C32h	00h	Sync manager 2 synchronization Synchronous Management Channel 2	-	0~20h	U8	RO	NO
	01h	Number of sub-object entries	-	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 synchronization types	ns	0~4294967295	U32	RO	NO
	06h	Minimum cycle time The minimum value of the communicative cycle that can be set	ns	0~4294967295	U32	RO	NO
	08h	Calc and copy time From the SM2 event and SYNC0 event to the 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

Index	Sub index	Name	Unit	Data Scope	Data Type	Sign	Pdo
	0Bh	Sync0 cycle time When DC SYNC0 (1C32h-01h=02h), the value of ESC register 09A0h is set. For all other DC SYNC0 values, the setting remains 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 Synchronous Management Channel 3	-	0~20h	U8	RO	NO
	01h	Number of sub-object entries	-	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 synchronization types	ns	0~4294967295	U32	RO	NO
	06h	Minimum cycle time The minimum value of the communicative cycle that can be set	ns	0~4294967295	U32	RO	NO
	08h	Calc and copy time From the SM2 event and SYNC0 event to the 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 When DC SYNC0 (1C32h-01h=02h), the value of the ESC register 09A0h is set. Outside of DC SYNC0, it 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

12.2.3 Servo Parameter Region

Index	Sub index	Name
2000h	00h	P0-00
2001h	00h	P0-01
2002h	00h	P0-02
2003h	00h	P0-03
...	...	...
205Fh	00h	P0-95

Index	Sub index	Name
2500h	00h	P5-00
2501h	00h	P5-01
2502h	00h	P5-02
2503h	00h	P5-03
...	...	...
2547h	00h	P5-71

Index	Sub index	Name
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	Sub index	Name
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

12.2.4 Drive Profile Region (0x6000~0x6FFF)

Error code (603Fh)

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Applicable mode
603Fh	00h	Error code	0~65535	U16	ro	TxPDO	ALL
		Display the alarm number occurring in the servo driver; general alarms show the complete error code, while bus-related alarms display the main number.					

Control Byte (6040h)

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Applicable mode
6040h	00h	Controlword	0~65535	U16	rw	RxPDO	ALL
		Set the control commands for servo drivers, such as PDS state transitions.					

The bit information for 6040h:

Bit	Name		Explanation
0	switch on	Server Preparation	-
1	enable voltage	Connect the main circuit power supply	-
2	quick stop	Quick shutdown	The logic is valid at 0. Note that other bit logic operations and their inverses apply.
3	enable operation	Servo Operation	-

Bit	Name		Explanation
4	operation mode specific	Control Mode Dependency Bit	PP：new set-point HM：start homing In other modes: This position is undefined
5	operation mode specific	Control Mode Dependency Bit	PP：change set immediately In other modes: This position is undefined
6	operation mode specific	Control Mode Dependency Bit	PP：absolute /elative In other modes: This position is undefined
7	fault reset	Failure Reset	-
8	stop	suspend	When bit8=1, the motor deceleration pause is executed via 605Dh (stop selection code). After the pause, the enable function must be turned off to restart the operation.
9	operation mode specific	Control Mode Dependency Bit	PP：change on set-point In other modes: This position is undefined
10~15	Reserved	Keep	-

Description of bit0–3 and bit7 in 6040h:

Order	The 6040h bit					PDS change
	bit7	bit3	bit2	bit1	bit0	
	Failure Reset	Servo Operation	Quick shutdown	Connect the main circuit power supply	Server Preparation	
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

Status byte (6041h)

commands such as PDS status transitions and those controlling the slave device are configured via the 6040h control word.

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Applicable mode
6041h	00h	Statusword Status Word	0~65535	U16	ro	TxPDO	ALL

The bit information for 6041h:

Bit	Name		Explanation
0	ready to switch on	Main circuit power off state	-
1	switched on	Server standby state	-
2	operation enabled	Servo Operation	-
3	fault	hitch	-
4	voltage enabled	Main circuit power supply status	1: Indicates the power supply voltage applied to the PDS
5	quick stop	Quick shutdown	0: Indicates that the PDS has received a quick stop request. The quick stop bit logic is valid when set to 0. Note that other bit logic operations and their inverse actions apply.
6	switch on disabled	The servo cannot operate.	-
7	warning	warn	1: Indicates that a warning is occurring. During the warning, the PDS status remains unchanged, and the motor continues to operate.
8	reserved	Keep	-
9	remote	telecontrol	0: Indicates that 6040h is in an unprocessable state. 1: Indicates that 6040h is in a processable state. The ESM status becomes 1 when transitioning to PreOP or higher.
10	operation mode specific	Control Mode Dependency Bit	PP、PV、TQ、HM：target reached In other modes: This position is undefined
11	internal limit active	The software internal location exceeds the limit	The positional deviation exceeds the P5-00 positioning completion width threshold.
12	operation mode specific	Control Mode Dependency Bit	PP：set-point acknowledge PV：speed HM：homing attained CSP、CSV、CST：drive follows command value TQ: This field is undefined

Bit	Name		Explanation
13	operation mode specific	Control Mode Dependency Bit	PP：following error HM：homing error CSP：following error In other modes: This position is undefined
14~15	reserved	Keep	The value is set to 0

Explanation of bits 6–5 and bits 3–0 in 6041h:

6041h	PDS Status Description	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Initialization incomplete status
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization completion status
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	Servo enable enabled
xxxx xxxx x00x 0111 b	Quick stop active	stop immediately
xxxx xxxx x0xx 1111 b	Fault reaction active	Abnormality (Alarm) Detection
xxxx xxxx x0xx 1000 b	Fault	Abnormal (Alarm) Status

Quick shutdown mode selection (605Ah)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
605Ah	00h	Quick stop option code Quick shutdown method selection	-	0~7	I16	rw	NO	ALL

Value information for 605Ah:

Current control mode	Value	Active Deceleration	PDS Status after Stop
pp，csp，csv，pv pattern	0	Coast to Stop of the servo-side	Switch on disabled
	1	6084h	
	2	6085h	
	3	60C6h	
	5	6084h	Quick stop active
	6	6085h	
	7	60C6h	
hm pattern	0	Coast to Stop of the servo-side	Switch on disabled
	1	609Ah	
	2	6085h	
	3	60C6h	
	5	609Ah	Quick stop active

Current control mode	Value	Active Deceleration	PDS Status after Stop
	6	6085h	
	7	60C6h	
cst，tq pattern	0	Coast to Stop of the servo-side	Switch on disabled
	1、2	6087h	
	3	Torque set to 0	
	5、6	6087h	Quick stop active
	7	Torque set to 0	

Example of using the Quick stop command to slow down and stop:
A: If 6040h:bit2 (Controlword: quick stop) changes from 1 to 0, the speed decreases and the stop occurs. During deceleration, the PDS status changes to Quick stop Active.
B: The motor stops when the detected actual speed falls below 10 rpm.
After stopping, the PDS status becomes "Switch on disabled" or transitions to "Quick stop active".

Shut-down mode selection (605Bh)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
605Bh	00h	Shutdown option code Shut-down method selection	-	0~1	I8	rw	RxPDO	ALL

Value information for 605Bh:

(1) When receiving the PDS command "Shutdown"

Current control mode	Value	Active Deceleration	PDS Status after Stop
pp，csp，csv，pv pattern	0	Coast to Stop of the servo-side	Ready to switch on
	1	6084h	
hm pattern	0	Coast to Stop of the servo-side	
	1	609Ah	
cst，tq pattern	0	Coast to Stop of the servo-side	
	1	6087h	

(2) When receiving the PDS command "Disable voltage"

Current control mode	Value	Active Deceleration	PDS Status after Stop
pp，csp，csv，pv pattern	0	Coast to Stop of the servo-side	Switch on disabled
	1	6084h	

hm pattern	0	Coast to Stop of the servo-side	
	1	609Ah	
cst，tq pattern	0	Coast to Stop of the servo-side	
	1	6087h	

An example of the deceleration and stop action triggered by the shutdown command:
A: If the PDS command "Shutdown" is received, the system will begin decelerating and stopping.
The PDS status during deceleration remains Operation enabled.
B: The motor stops when the detected actual speed falls below 10 rpm.
After stopping, the PDS status is Ready to switch on.

Servo OFF shutdown method selection (605Ch)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable Mode
605Ch	00h	Servo-off shutdown method	-	0~1	I16	rw	RxPDO	ALL

Value information for 605Ch:

Current control mode	Value	Active Deceleration	PDS Status after Stop
pp，csp，csv，pv pattern	0	Coast to Stop of the servo-side	Switched on
	1	6084h	
hm pattern	0	Coast to Stop of the servo-side	
	1	609Ah	
cst，tq pattern	0	Coast to Stop of the servo-side	
	1	6087h	

An example of slowing down and stopping the movement using theDisable operation command.
A: If the PDS command "Disable operation" is received, the system will begin decelerating and stopping.
The PDS status during deceleration remains Operation enabled.
B: The motor stops when the detected actual speed is below 10 r/min.
After stopping, the PDS status bit is switched to On.

Select shutdown pause method (605Dh)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
605Dh	00h	Select a pause shutdown method	-	1~3	I16	rw	NO	ALL

Value information for 605Dh:

Current control mode	Value	Active Deceleration	PDS Status after Stop
pp，csp，csv，pv pattern	1	6084h	Operation enabled
	2	6085h	

	3	6072h、60C6h	
hm pattern	1	609Ah	
	2	6085h	
	3	6072h、60C6h	
cst，tq pattern	1、2	6087h	
	3	Torque set to 0	

An example of the stop function slowing down and stopping movements

A: When 6040h:bit8 (Controlword: stop) changes from 0 to 1, deceleration begins and stops. During deceleration, the PDS status remains Operation enabled.

B: The motor stops when the detected actual speed is below 10 r/min. After stopping, the PDS status remains Operation enabled.

Alarm shutdown method selection (605Eh)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
605Eh	00h	Fault reaction option code Selection of Alarm shutdown method	-	0~2	I16	rw	NO	ALL

Value information for 605Eh:

(1) When an EtherCAT communication correlation anomaly alarm occurs (E-800–E-899):

Current control mode	Value	Active Deceleration	PDS Status after Stop
pp，csp，csv，pv pattern	0	Coast to Stop of the servo-side	Fault
	1	6084h	
	2	6085h	
hm pattern	0	Coast to Stop of the servo-side	
	1	609Ah	
	2	6085h	
cst，tq pattern	0	Coast to Stop of the servo-side	
	1、2	6087h	

(2) When an unrelated EtherCAT communication anomaly alarm occurs (excluding E-800 to E-899):

Current control mode	Value	Active Deceleration	PDS Status after Stop
pp，csp，csv，pv hm，cst，tq	0、2、3	Coast to Stop of the servo-side	Fault

Example of the deceleration and stop action triggered by an alarm

A: If an alarm occurs, deceleration begins and stops. During deceleration, the PDS status is Fault Reaction Active.

B: The motor stops when the detected actual speed is below 10 r/min. The PDS status after stopping is Fault.

Control mode setting (6060h)

The control mode is set via 6060h.

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Applicable mode
6060h	00h	Mode of operation Control Mode Setting	-128~127	I8	rw	RxPDO	All

Bit information for 6060h:

Bit	Definition		Abbreviation	Corresponding
0	No mode changed/No mode assigned	No control mode change / No control mode assigned	-	-
1	Profile position mode	Corner Position Control Mode	pp	YES
3	Profile velocity mode	Profile Speed Control Mode	pv	YES
4	Torque profile mode	Profile Torque Control Mode	tq	YES
6	Homing mode	Origin Reset Position Pattern	hm	YES
8	Cyclic synchronous position mode	Periodic Synchronization Position Control Mode	csp	YES
9	Cyclic synchronous velocity mode	Periodic Synchronization Speed Control Mode	csv	YES
10	Cyclic synchronous torque mode	Periodic Synchronous Torque Control Mode	cst	YES
11~127	-	Keep	-	-

Since 6060h defaults to (No mode change/no mode assigned), the control mode value must be configured after power-on. When both the setting value of 6060h and 6061h are set to 0, migrating the PDS status to Operation enabled will trigger E-881 (control mode setting exception protection).

In the initial state (6060h), after transitioning from 0 to one of the supported control modes (pp, pv, tq, hm, CSP, CSV, CST), resetting 6060h back to 0 will retain the previous control mode as "No mode changed," preventing any control mode switching from being executed.

Control mode display (6061h)

The confirmation of the control mode inside the servo driver is performed according to 6061h. After setting 6060h, verify whether this target action can be executed by performing a detection.

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Applicable mode
6061h	00h	Mode of operation display Control Mode Display	-128~127	I8	ro	TxPDO	All

The bit information for 6061h:

Bit	Definition		Abbreviation	Corresponding
-128~-1	-	Keep	-	-
0	No mode changed/No mode assigned	No control mode change / No control mode assigned	-	-
1	Profile position mode	Corner Position Control Mode	pp	YES
3	Profile velocity mode	Profile Speed Control Mode	pv	YES
4	Torque profile mode	Profile Torque Control Mode	tq	YES
6	Homing mode	Origin Reset Position Pattern	hm	YES
8	Cyclic synchronous position mode	Periodic Synchronization Position Control Mode	csp	YES
9	Cyclic synchronous velocity mode	Periodic Synchronization Speed Control Mode	csv	YES
10	Cyclic synchronous torque mode	Periodic Synchronous Torque Control Mode	cst	YES
11~127	-	Keep	-	-

Position Instruction (6062h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6062h	00h	Position demand value [PUU] Position Instruction	Command Unit	-2147483648~2147483647	I32	ro	TxPDO	PP CSP HM

Internal actual position feedback (6063h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6063h	00h	Position actual internal value Internal actual position feedback	instruct unit	-2147483648~2147483647	I32	ro	TxPDO	ALL

Position Feedback (6064h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6064h	00h	Position actual value position feedback	Command Unit	-2147483648~2147483647	I32	ro	TxPDO	ALL

Excessive position deviation threshold (6065h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6065h	00h	Following error window Position deviation threshold	Command Unit	0~ 4294967295	U32	rw	RxPDO	PP CSP
		When the difference between position command 6062h and position feedback 6064h exceeds 6065h, and the time reaches 6066h, bit 13 of 6041h is set to 1.						

Too large position deviation timeout time (6066h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6066h	00h	Following error time out Too large position deviation timeout time	1ms	0~65535	U16	rw	RxPDO	PP CSP
		When the difference between position command 6062h and position feedback 6064h exceeds 6065h, and the time reaches 6066h, bit 13 of 6041h is set to 1.						

Position reaches the threshold (6067h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable mode
6067h	00h	Position windows Position reaches the threshold	Command Unit	0~4294967295	U32	rw	RxPDO	PP
		When the difference between position command 6062h and position feedback 6064h falls within the set range of 6067h, and when the time reaches 6068h, bit 10 of 6041h is set to 1.						

Position command arrival threshold time (6068h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6068h	00h	Position window Time until position reaches the threshold	1ms	0~65535	U16	rw	RxPDO	PP
		When the difference between position command 6062h and position feedback 6064h falls within the set range of 6067h, and when the time reaches 6068h, bit 10 of 6041h is set to 1.						

Speed Instruction (606Bh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
606Bh	00h	Velocity Demand Value Speed Instruction	Unit/Unit of instruction	-2147483648~2147483647	I32	RO	TxPDO	PV CSV

Speed Feedback (606Ch)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
606Ch	00h	Actual velocity value; Speed feedback	Unit/Unit of instruction	-2147483648~2147483647	I32	ro	TxPDO	ALL

The speed reaches the threshold (606Dh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
606Dh	00h	Velocity window Speed reaches the threshold	instruct unit	0~4294967295	U32	rw	RxPDO	PV
		When the difference between the speed command 606Bh and the speed feedback 606Ch falls within the set range of 606Dh, and the time reaches 606Eh, the bit 10 of 6041h is set to 1.						

Time to reach the speed threshold (606Eh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
606Eh	00h	Velocity window time Time to reach the speed threshold	1ms	0~65535	U16	rw	RxPDO	PV
		When the difference between the speed command 606Bh and the speed feedback 606Ch falls within the set range of 606Dh, and the time reaches 606Eh, the bit 10 of 6041h is set to 1.						

Speed threshold (606Fh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
606Fh	00h	Velocity threshold Speed Threshold	Command Unit	0~4294967295	U32	rw	RxPDO	PV
		When the value of speed feedback 606Ch exceeds the set value of 606Fh and reaches						

		6070h, the threshold where bit12 is set to 0 at 6041h is triggered. If the speed is below the set value of this parameter, bit 12 of 6041h becomes 1.

Speed threshold time (6070h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6070h	00h	Velocity threshold time: Time for the velocity threshold to be reached	1ms	0~65535	U16	rw	RxPDO	PV
		When the 606Ch exceeds the set value of 606Fh, determine the time when bit12 of 6041h becomes 0.						

Target torque (6071 h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable Mode
6071h	00h	Target torque Target Torque	0.1%	-3276~32767	I16	rw	RxPDO	TQ

Maximum torque (6072 h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
6072h	00h	Max torque maximum torque	0.1%	0~65535	U16	rw	RxPDO	ALL

Maximum current (6073h)

Index	Sub	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable
6073h	00h	Max current maximum current	0.1%	0~65535	U16	ro	NO	ALL

Torque command (6074h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6074h	00h	Torque demand value Torque Command	0.1%	-32768~32767	I16	ro	TxPDO	ALL

Motor rated torque (6076 h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6076h	00h	Motor rated torque Motor rated torque	Mn·m	0 – 4294967295	U32	RO	TxPDO	ALL

Torque feedback (6077h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6077h	00h	Actual torque value – Torque feedback	0.1%	-32768~32767	I16	ro	TxPDO	ALL

Current Feedback (6078h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6078h	00h	Current actual value: Current feedback	0.10%	-32768~32767	I16	RO	TxPDO	ALL

Busbar voltage (6079h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6079h	00h	DC link circuit voltage busbar voltage	mV	0~4294967295	U32	RO	TxPDO	ALL

Target position (607Ah)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
607Ah	00h	Target position target location	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO	PP CSP HM

Range location restriction (607Bh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable mode
607Bh	01h	Minimum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO	ALL
	02h	Maximum position range restriction	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO	ALL

This parameter modification is ineffective.

Origin offset (607Ch)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
607Ch	00h	Home Offset Origin Offset	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO	NO

Soft limit (607Dh)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable Mode
607Dh	01h	Minimum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO	NO
	02h	Maximum position limit	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO	NO

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
607Eh	00h	Polarity instruction polarity	-	0~255	U8	rw	NO	ALL

Command polarity (607Eh)

Bit information for 607Eh:

Bit	Name	Value	Annotate	Annotate
0-4	Keep	0	-	For retention, set to 0
5	Torque polarity	0	No symbol reversal	0: No symbol inversion 1: Symbols are reversed
		1	The symbol is reversed	
6	Speed polarity	0	No symbol reversal	0: No symbol inversion 1: Symbols are reversed
		1	The symbol is reversed	
7	Position polarity	0	No symbol reversal	0: No symbol inversion 1: Symbols are reversed
		1	The symbol is reversed	

The position, speed, and torque polarity must be identical—either all bits 7–5 are set to 0 or all bits 7–5 are set to 1.

Maximum Profile speed (607Fh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable mode
607Fh	00h	Max profile velocity Maximum Profile velocity	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO	PP PV HM
		The speed limit value under pp, hm, and pv. The maximum value is limited by the 6080h through internal processing.						

Maximum motor speed (6080 h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
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 controlling power supply activation, the maximum speed measured from the motor is set. The maximum value is determined by the maximum speed limit read from the motor during internal processing. For tq and CST, the speed is limited by the set value of this object.

Profile run speed (6081h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable Mode
6081h	00h	Profile velocity Profile run speed	Unit/Unit of instruction	0~4294967295	U32	rw	RxPDO	PP

Outline acceleration (6083h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6083h	00h	Profile acceleration Outline acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV
		Set Profile Acceleration. When set to 0, internal processing is treated as 1.						

Profile deceleration rate (6084h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6084h	00h	Profile deceleration Profile deceleration rate	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM CSP CSV
		Set Profile Reduction Speed. When set to 0, internal processing is treated as 1.						

Quick parking deceleration (6085h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
6085h	00h	Quickly stop and reduce your speed.	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM CSP CSV

Motor rated current (6075A)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6075h	00h	Motor rated current Motor rated current	1mA	0 ~4294967295	U32	RO	TxPDO	PP PV HM CSP CSV

Location Trajectory Planning Type (6086h)

Index	Sub index	Name	Unit	Scope	Data type	Access ibility	Pdo	Appli cable mode
6086h	00h	Motion profile type Position Trajectory Planning Type	-	-32768~32767	I16	rw	RxPDO	HM

Parameter 0: Step type; Parameter 1: Slope type.

This parameter applies only to the HM mode. In PP and PV modes, it specifies the slope type used internally for trajectory planning.

In CSP and CSV modes, this parameter is not required as trajectory planning is completed entirely at the master station.

Torque slope (6087h)

Index	Sub index	Name	Unit	Scope	Data Type	Access ibility	Pdo	Appli cable mode
6087h	00h	Torque slope Torque Slope	0.1%	0~4294967295	U32	rw	RxPDO	TQ CST
		,Set the parameter value to provide the torque command. ,In CST mode, this applies only during deceleration and stop times.						

Torque planning type (6088h)

Index	Sub index	Name	Unit	Scope	Data type	Access ibility	Pdo	Appli cable mode
6088h	00h	Torque profile type Torque Planning Type	-	0~65535	I16	rw	RxPDO	TQ

This parameter: 0: Step type; 1: Slope type.

In TQ mode, the torque planning directly uses the ramp type; modifying this parameter has no effect.

Electronic gear ratio (6091h)

Index	Sub index	Name	Unit	Scope	Data Type	Access ibility	Pdo	Appli cable Mode

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6091h	01h	Motor revolutions Motor rotation speed	Transfer (motor)	1~4294967295	U32	rw	NO	ALL
	02h	Shaft revolutions Set axis rotation count	Axis	1~4294967295	U32	rw	NO	ALL

This object defines the motor speed and the shaft speed after gearbox output.
Gear ratio = 6091h-01h/ 6091h-02h

Encoder frequency division ratio (6092h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable mode
6092h	01h	Feed	Command Unit	1~4294967295	U32	rw	NO	ALL
		Set the feed rate.						
	02h	Shaft revolutions	Axis	1~4294967295	U32	rw	NO	ALL
		Set the axis rotation number.						

This object represents the angular displacement per full rotation of the shaft after gearbox output.
Feed constant =6092h-01h/ 6092h-02h

Original method (6098h)

Index	Sub index	Name	Scope	Data type	Accessibility	Pdo	Applicable mode
6098h	00h	Homing method Return to Original Method	-128~127	I8	rw	RxPDO	All

Value information for 6098h:

Value	Definition
-2	Find the reverse limit
-1	Find the positive limit
0	No original restoration method specified
1	The reverse zero return mechanism uses the reverse limit switch as the deceleration point and the motor's Z signal as the origin. The system must first detect the falling edge of the reverse limit signal before reaching the Z signal.
2	The forward return to zero is triggered by the forward limit switch, with the origin defined by the motor's Z signal. The system must first detect the falling edge of the forward limit signal before proceeding.
3	The process returns to zero in the forward direction, with the deceleration point being the origin switch and the origin serving as the motor's Z signal. Before encountering the Z signal, one must first detect the falling edge on the same side of the origin switch.

Value	Definition
4	The process returns to zero in the forward direction, with the deceleration point being the origin switch and the origin serving as the motor's Z signal. Before encountering the Z signal, the system must first detect the rising edge on the same side of the origin switch.
5	The reverse zero return process uses the origin switch as the deceleration point, with the origin defined by the motor's Z signal. Before detecting the Z signal, the system must first identify the falling edge on the same side of the origin switch.
6	The reverse zero return process uses the origin switch as the deceleration point, with the origin defined by the motor's Z signal. Before detecting the Z signal, the system must first identify the rising edge on the same side of the origin switch.
7	The process returns to zero in the forward direction, with the deceleration point being the origin switch and the origin serving as the motor's Z signal. Before encountering the Z signal, one must first detect the falling edge on the same side of the origin switch.
8	The process returns to zero in the forward direction, with the deceleration point being the origin switch and the origin serving as the motor's Z signal. Before encountering the Z signal, the system must first detect the rising edge on the same side of the origin switch.
9	The process returns to zero in the forward direction, with the deceleration point being the origin switch and the origin serving as the motor's Z signal. Before encountering the Z signal, one must first detect the rising edge on the opposite side of the origin switch.
10	The process returns to zero in the forward direction, with the deceleration point being the origin switch and the origin serving as the motor's Z signal. Before encountering the Z signal, one must first detect the falling edge on the opposite side of the origin switch.
11	The reverse zero return process uses the origin switch as the deceleration point, with the origin defined by the motor's Z signal. Before detecting the Z signal, the system must first identify the falling edge on the same side of the origin switch.
12	The reverse zero return process uses the origin switch as the deceleration point, with the origin defined by the motor's Z signal. Before detecting the Z signal, the system must first identify the rising edge on the same side of the origin switch.
13	The reverse zero return process uses the origin switch as the deceleration point. The origin is defined by the Z signal from the motor on the opposite side of the origin switch. Before detecting the Z signal, the system must first identify the rising edge on the opposite side of the origin switch.
14	The reverse zero return process uses the origin switch as the deceleration point. The origin is defined by the Z signal from the motor on the opposite side of the origin switch. Before detecting the Z signal, one must first identify the falling edge on the opposite side of the origin switch.
15	insignificance
16	insignificance
17	Return to the original action as in step 1, but use the reverse limit position as the origin.
18	Perform the original action as in step 2, but use the positive limit position as the origin.
19	Return to the original action as in step 3, but use the origin switch as the origin point.
20	Perform the same original action as step 4, but use the origin switch as the origin point.
21	Perform the same original action as step 5, but use the origin switch as the origin point.
22	Return to the original action as in step 6, but use the origin switch as the origin point.
23	Return to the original action as in step 7, but use the origin switch as the origin point.
24	Perform the same original action as step 8, but use the origin switch as the origin point.
25	Return to the original action as in step 9, but use the origin switch as the origin point.

Value	Definition
26	The return-to-origin action is the same as action 10, but the origin is the origin switch.
27	Return to the original action as in step 11, but use the origin switch as the origin point.
28	The return-to-origin action is the same as 12, but the origin is at the origin switch.
29	Return to the original action as in step 13, but use the origin switch as the origin point.
30	Return to the original action as in step 14, but use the origin switch as the origin point.
31	insignificance
32	insignificance
33	Reverse return to the origin, with the origin at the Z-axis signal of the motor.
34	Return to the original position, with the origin at the Z-axis signal of the motor.
35	Use the current location as the origin
37	Use the current location as the origin.

Return to original speed (6099h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable Mode
6099h	01h	Speed during search Search for the deceleration point signal speed	Unit/Unit of instruction	0~4294967295	U32	rw	NO	HM
	02h	Speed during search for zero Search for the origin signal speed	Unit/Unit of instruction	0~4294967295	U32	rw	NO	HM
		If the edge of the Switch signal serves as the origin detection position, set the value as small as possible to minimize detection errors.						

The speeds of 6099-01h and 6099-02h are limited by the minimum value between 6080h and 607Fh.

Return to original acceleration (609 Ah)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
609Ah	00h	Homing acceleration Return to original acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	HM
		·Set the acceleration and deceleration values for HM mode. ·When the process reaches its final stop in the original sequence (upon detecting the origin position), the set value of this object is not required, and the servo lock stops.						

Position Feedforward (60B0h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60B0h	00h	Position offset Position Feedforward	Command Unit	-2147483648~ 2147483647	I32	rw	RxPDO	ALL
		This parameter is used for position loop control. Since the underlying servo algorithm does not support feedforward control, this parameter is not currently required; modifying it will not affect the performance.						

Speed Feedforward (60B1h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60B1h	00h	Velocity offset Speed Feedforward	Unit/Unit of instruction	-2147483648~ 2147483647	I32	rw	RxPDO	ALL
		This parameter is used for speed loop control of the drive. Since the underlying servo algorithm does not support feedforward control, this parameter is temporarily unused; modifying it will not affect the performance.						

Torque feedforward (60B2h)

Index	Sub index	Name	Unit	Data area	Data Type	Accessibility	Pdo	Applicable Mode
60B2h	00h	Torque offset Torque feedforward	0.1%	-2147483648~ 2147483647	I32	rw	RxPDO	ALL
		This parameter is used for the drive current loop control. Since the underlying servo algorithm does not support feedforward control, this parameter is not used for now; modifying it will not affect the performance.						

Probe Function (60B8h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable Mode
60B8h	00h	Touch probe function Probe Function	-	0~65535	U16	rw	RxPDO	ALL

The bit information of 60B8h:

Bit	Value	Annotate	
0	0	Probe 1 is disabled	Probe 1 enabled
	1	Probe 1 enabled	
1	0	Single Trigger	Probe 1 Trigger Mode Selection
	1	Continuous Trigger	
2	0	External input signal	Probe 1 Trigger Method Selection
	1	Z positive sign (not supported)	
3	-	-	-

Bit	Value	Annotate	
4	0	The rising edge is not latched	Probe 1 rising edge selection
	1	rising edge latch	
5	0	Downfall edge without latch	Probe 1 falling edge selection
	1	Downfall latch	
6-7	-	-	-
8	0	Probe 2 is not enabled	Probe 2 enabled
	1	Probe 2 enabled	
9	0	Single Trigger	Probe 2 Trigger Mode Selection
	1	Continuous Trigger	
10	0	External input signal	Probe 2 Trigger Method Selection
	1	Z positive sign (not supported)	
11	-	-	-
12	0	The rising edge is not latched	Probe 2 rising edge selection
	1	rising edge latch	
13	0	Downfall edge without latch	Probe 2 falling edge selection
	1	Downfall latch	
14-15	-	-	-

- The Z-phase trigger mode is not supported currently; only external signals can serve as the trigger source.
- Do not set both rising and falling edges under the same probe.

Probe status (60B9h)

Index	Sub index	Name	Unit	Scope	Data type	Accessibility	Pdo	Applicable mode
60B9h	00h	Touch probe status Probe Status	-	0~65535	U16	ro	TxPDO	ALL

The bit information of 60B9h:

Bit	Value	Annotate	
0	0	Probe 1 not executed	Probe 1 Status
	1	Probe 1 is running	
1	0	The rising edge of Probe 1 has not completed latching.	Probe 1 rising edge latch state
	1	The rising edge latch of Probe 1 has been completed.	
2	0	The rising edge of Probe 1 is not locked.	Probe 1 rising edge latch state
	1	The rising edge latch of Probe 1 has been completed.	
3-7	-	-	-
8	0	Probe 2 was not executed	Probe 2 Execution Status
	1	Probe 2 is running	
9	0	The rising edge of Probe 2 has not completed latching.	Probe 2 rising edge latch state
	1	The rising edge latch of Probe 2 is complete	
10	0	The rising edge of Probe 2 is not locked.	Probe 2 rising edge latch state
	1	The rising edge latch of Probe 2 is complete	
11-15	-	-	-

The position value locked by the rising edge of Probe 1 (60BAh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60BAh	00h	Probe pos1 pos value: The position value where Probe 1's rising edge is locked.	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO	ALL

The position value locked by the falling edge of Probe 1 (60BBh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60BBh	00h	Touch probe pos1 neg value The position value locked by the falling edge of Probe 1	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO	ALL

The position value locked by the rising edge of Probe 2 (60BCh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60BCh	00h	Touch probe pos2 pos value The position value locked by the rising edge of Probe 2	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO	ALL

The position value locked by the falling edge of Probe 2 (60BDh)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60BDh	00h	Touch probe pos2 neg value The position value where Probe 2 descends and locks	instruct unit	-2147483648~ 2147483647	I32	ro	TxPDO	ALL

Maximum acceleration (60°C, 5 hours)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60C5h	00h	Max acceleration maximal acceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM
		Set the maximum acceleration. When set to 0, internal processing is treated as 1.						

Minimum acceleration (60°C, 6 hours)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60C6h	00h	Min deceleration maximum deceleration	Unit of instruction /s²	0~4294967295	U32	rw	RxPDO	PP PV HM
		Set the maximum deceleration. When set to 0, internal processing is treated as 1.						

Positive torque limit (60E0h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60E0h	00h	Positive torque limited Positive torque limit	0.1%	0~65535	U16	rw	RxPDO	ALL

Reverse torque limit (60E1h)

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
60E1h	00h	Negtive torque limited Reverse Torque Limit	0.1%	0~65535	U16	rw	RxPDO	ALL

Position deviation (60F4h)

Index	Sub index	Name	Unit	Data area	Data Type	Accessibility	Pdo	Applicable Mode
60F4h	00h	Following error actual value position deviation	Command Unit	-2147483648 ~2147483647	I32	RO	TxPDO	PP CSP HM

Internal instruction speed (60 FAh)

Index	Sub index	Name	Unit	Data area	Data Type	Accessibility	Pdo	Applicable Mode
60FAh	00h	Control effort Internal instruction speed (position output)	Unit/Unit of instruction	-2147483648~ 2147483647	I32	RO	TxPDO	ALL

Internal instruction location (60FCh)

Index	Sub index	Name	Unit	Data area	Data Type	Accessibility	Pdo	Applicable Mode
60FCh	00h	Position demand value Internal instruction location	Command Unit	-2147483648~ 2147483647	I32	RO	TxPDO	PP CSP HM

Digital input (60FDh)

Index	Sub index	Name	Unit	Data area	Data Type	Accessibility	Pdo	Applicable Mode
60FDh	00h	Digital inputs: Digital input	-	0~4294967295	U32	ro	TxPDO	ALL

The bit information of 60FDh:

Bit	Name	Value	Annotate
0	negative limit switch Reverse Overtravel Switch	0	No reverse overtravel switch signal detected
		1	Reverse overtravel switch signal detected
1	positive limit switch Positive overtravel switch	0	No positive overshoot switch signal was detected.
		1	Positive overshoot switch signal detected
2	home switch Origin Switch	0	No origin switch signal detected
		1	The origin switch signal has been detected.
3	EXT1 Probe 1	0	No input signal for Probe 1 was detected.
		1	The input signal of Probe 1 has been detected.
4	EXT1 Probe 2	0	No input signal for Probe 2 was detected.
		1	The input signal of Probe 2 has been detected.
5	Z Positive Signal Output	0	No Z-phase output signal detected
		1	Z-phase output signal detected
6-15	Reserve Reservation	-	-
16	Remote SI Input 1	0	No remote SI1 input signal detected
		1	Remote SI1 input signal detected
17	Remote SI Input 2	0	No remote SI2 input signal detected
		1	Remote SI2 input signal detected
18	Remote SI Input 3	0	No remote SI3 input signal detected
		1	Remote SI3 input signal detected
19-31	REServed	-	-

Digital output (60FEh)

Index	Sub index	Name	Unit	Data area	Data Type	Accessibility	Pdo	Applicable Mode
60FEh	-	Digital outputs Digital outputs	-	-	-	-	-	-
	01h	Physical outputs Output of the external output signal	-	-	-	-	-	-
	02h	The Bit Mask sets the output operation host function for external output signals.	-	-	-	-	-	-

The bit information for 60FEh:

Index	Bit	Name	Value	Annotate
01h	0-15	REServed	-	-
	16	Remote SO1 output status	0	No remote SO1 output signal detected
			1	Remote SO1 output signal detected

Index	Bit	Name	Value	Annotate
	17	Remote SO2 output status	0	No remote SO2 output signal detected
			1	Remote SO2 output signal detected
	18	Remote SO3 output status	0	No remote SO3 output signal detected
			1	Remote SO3 output signal detected
02h	0-15	REServed	-	-
	16	Enable remote SO1 output	0	Close remote SO1 output
			1	Enable remote SO1 output
	17	Enable remote SO2 output	0	Close remote SO2 output
			1	Enable remote SO2 output
	18	Enable remote SO3 output	0	Close remote SO3 output
			1	Enable remote SO3 output

Target speed (60 FFh)

Index	Sub index	Name	Unit	Data area	Data Type	Accessibility	Pdo	Applicable Mode
60FFh	00h	Target velocity Target speed	Unit/Unit of instruction	-4294967296~4294967295	U32	RW	RxPDO	PV

Supported drive modes (6502h)

This servo driver can identify the supported control modes based on the 6502h specification.

Index	Sub index	Name	Unit	Scope	Data Type	Accessibility	Pdo	Applicable Mode
6502h	00h	Supported drive modes Supported drive modes	-	-2147483648 ~2147483647	I32	ro	TxPDO	ALL

The bit information for 6502h:

Bit	Definition		Abbreviation	Corresponding
0	Profile position mode	Corner Position Control Mode	pp	YES
2	Profile velocity mode	Profile Speed Control Mode	pv	YES
3	Torque profile mode	Profile Torque Control Mode	tq	YES
5	Homing mode	Origin Reset Position Pattern	hm	YES
7	Cyclic synchronous position mode	Periodic Synchronization Position Control Mode	csp	YES
8	Cyclic synchronous velocity mode	Periodic Synchronization Speed Control Mode	csv	YES
9	Cyclic synchronous torque mode	Periodic Synchronous Torque Control Mode	cst	YES
10~31	-	Keep	-	-

12.3 Terminology List

The abbreviated form of a name	Full name	Description
EtherCAT	Ethernet for Control Automation Technology	Utilize the communication functionality 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	Corner Position Control Mode
pv	Profile velocity	Profile Speed Control Mode
tq	Torque profile	Profile 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	Service data object for transmitting non-periodic communication data
PDO	Process Data Object	Process data object used to transmit periodic communication data
TxPDO	-	PDO from the slave station to the master station
RxPDO	-	PDO transmitted from the master station to the slave station
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 an Ethernet controller into electrical or optical signals.
PDI	Process Data Interface or Physical Device Interface	Process Data Interface
EEPROM	Electrically Erasable Programmable Read Only Memory	Programmable read-only memory, a non-volatile memory used to store ESC configurations and device descriptions. Connected to the ESI interface.
ESI	EtherCAT Slave Information, stored in ESI EEPROM（formerly known as SII)	The etherCAT level information is stored in the ESI EEPROM (formerly known as SII).

In TQ mode, the torque planning directly uses the ramp type; modifying this parameter has no effect.

13 Police Alarm Analysis

13.1 EtherCAT Communication Association Abnormal Alert

Alarm code	Cause of error		Solution
E-800	The incorrect ESM requirement requires exception handling.	Accept conversion requests from states that cannot be transformed from the current state: Init→Safeop Init→OP PreOP→OP Error occurred: The ESM status remains in its current state (Init, PreOP, or SafeOP) during these states, and transitions to SafeOP during the OP phase. ESC register AL Status Code: 0011h After switching the EC bus mode to normal mode, if the EtherCAT master station continues to be used for connection, it can only request the PREOP status; otherwise, an E-800 error will occur.	1. Confirm the state transition requirements of the upper-level device. 2. ① When using the EC bus mode, set P0-00 to 1; ② Check whether the master station's PDO configuration is correct.
E-801	undefined ESM requirement for exception protection	Accept state transition requirements except for the following: 1：Request Init State 2：Request Pre-Operational State 3：Request Bootstrap State 4：Reauest Safe-operational State 8：Request Operational State Error occurred: The ESM status remains in its current state (Init, PreOP, or SafeOP) during these states, and transitions to SafeOP during the OP phase. ESC register AL Status Code: 0012h	Confirm the status transition requirements of the upper-level device. The alarm can be cleared using the servo panel F0-00=1.
E-802	The guidance state requires exception	Accept the following state transition requirements:	Confirm the status transition requirements of the upper-level device.

Alarm code	Cause of error		Solution
	protection	3：Request Bootstrap State Error occurred: ESM status: Init ESC register AL Status Code: 0013h	The alarm can be cleared using the servo panel F0-00=1.
E-803	PLL incomplete exception protection	One second after synchronization processing, the phase combination between communication and servo (PLL locking) remains incomplete. ESM status after error: PreOP ESC register AL Status Code: 002Dh	Confirm the DC settings and verify that propagation delay compensation and deviation compensation are correct. Set the servo panel F0-00 to 1 to clear the alarm.
E-804	PDO watchdog exception protection	During POCO communication (SafeOP or OP state), the bit 10 of time 0220 (AL Event Request) is not set to ON via the ESC register addresses 0400 (Watchdog Divider) and 0420 (Watchdog Time Process Data). Error occurred: ESM status: Safe OP ESC register AL Status Code: 001Bh PDO communication connection lost	1. Verify whether the transmission time of the PDO from the upper device is fixed (i.e., uninterrupted); 2. Confirm that the PDO watchdog's detection delay value is excessively large; 3. Check for any issues with the EtherCAT communication cable wiring and excessive noise on the cable. Replace it with a high-quality network cable. 4. Reconnect the communication cables; leave the network cables suspended and separate them from the power lines. 5. Discontinue operation of welding machines and other interference-producing equipment to eliminate interference issues; 6. Cross-test to identify the fault point; The alarm can be cleared using the servo panel F0-00=1.
E-806	PLL Abnormal Protection	The ESM state occurs when, under SafeOP or OP conditions, the phase (PLL lock) of communication and servo signals is out of sync. ESM status after error: SafeOP ESC register AL Status Code: 0032h	Confirm the DC settings and verify that propagation delay compensation and deviation compensation are correct. The alarm can be cleared using the servo panel setting F0-00=1, or the system can be reset by

Alarm code	Cause of error		Solution
			disconnecting the control power supply.
E-807	Simultaneous Signal Anomaly Protection	After the synchronous processing is completed, determine whether the SYNC0 or IRQ interrupt handling exceeds the preset threshold. ESM status after error: SafeOP ESC register AL Status Code: 002Ch	Confirm the DC settings and verify that propagation delay compensation and deviation compensation are correct. The alarm can be cleared using the servo panel setting F0-00=1, or the system can be reset by disconnecting the control power supply.
E-810	Sync period setting exception protection	Set an unsupported synchronization cycle: The synchronization period setting value is outside the range of 250,500,1000,2000,4000,8000, or 10000 μs. After an error occurs, the ESM status is PreOP. ESC register AL Status Code: 0035h	Set the synchronization period correctly The alarm can be cleared via the servo panel F0-00=1.
E-811	Set email notification for exception protection	Error in the SM0/1 setting value for the email: The email sending and receiving areas overlap with SM2/3, and the addresses of these areas are odd numbers. The starting email address is outside the range of SyncManager0: 1000h–10FFh and SyncManager1: 1200h–12FFh. Incorrect setting of SyncManager0/1 length (ESC registers: 0802h,0803h/080Ah, 080Bh): SyncManager0: outside the range of 32 to 256 bytes SyncManager1: outside the range of 40 to 256 bytes When the Control Register (ESC register: 0804h/080Ch) of SyncManager0/1 is improperly configured: Set all bits except 100110b to 0804h: bit5-0 Set all bits except 100110b to 080Ch: bit5-0 Error occurred: ESM status: Init ESC register AL Status Code: 0016h	Set SyncManager correctly according to the ESI file description The alarm can be cleared via the servo panel F0-00=1.
E-814	PDO watchdog setting for abnormal protection	Invalid PDO watchdog configuration. The PDO watchdog is triggered (SyncManager: bit 6 of register 0804h is set to 1). The configured timeout values for the PDO watchdog (registers 0400h and 0402h) do not meet the requirement of "communication cycle	Set the watchdog timeout value correctly The alarm can be cleared via the servo panel F0-00=1.

Alarm code	Cause of error		Solution
		× 2". ESM status after error: PreOP ESC register AL Status Code: 001Fh	
E-815	DC setting for abnormal protection	An error in the DC configuration. The bit 2-0 of the ESC register 0981h (Activation) is set to a value other than the following. bit2-0=000b； bit2-0=011b ESM status after error: PreOP ESC register AL Status Code: 0030h	Confirm the DC settings The alarm can be cleared via the servo panel F0-00=1.
E-816	SM Event Pattern Setting Abnormal Protection	An unsupported SM time mode is set; the 1C32/1C33-01 chip sets values other than 00,01, or 02. The bit 2-0 of ESC register 0981 is set to 000b, and only the SM2 values 1C32h-01h and 1C33h-01h are enabled. ESM status after error: PreOP ESC register AL Status Code: 0028h	Confirm that the settings for 1C32h-01h and 1C33h-01h are identical and their values correspond to any of 00h,01h, or 02h. The alarm can be cleared via the servo panel F0-00=1.
E-817	SyncManager 2/3 exception protection setup	SM2/3 is set to an incorrect value The physical address configuration for SM2/3 is incorrect (ESC register: 0810h/0818h): the transmit/receive area overlaps with SM2/3, the starting address is odd, and the end address falls outside the valid range. SM2/3 length settings (ESC register: 0812h/081A) differ from those of RxPDO and TxPDO. The control registers (ESC registers: 0814h/081Ch) of SM2/3 are improperly set. Set all bits except 100110b to bit5-0 ESM status after error: PreOP ESC register AL Status Code: 001Dh/001Eh	Set SyncManager2/3 correctly according to the ESI file description The alarm can be cleared via the servo panel F0-00=1.
E-850	TxPDO allocation exception protection	The data size mapped by TxPDO exceeds 32 bytes. ESM status after error: PreOP ESC register AL Status Code: 0024h	Ensure the data size set for the TxPDO mapping is within 32 bytes. The alarm can be cleared via the servo panel F0-00=1.
E-851	RxPDO allocation exception	The data size mapped by RxPDO exceeds 32 bytes ESM status after error: PreOP	Ensure the data size setting for the RxPDO mapping is within 32 bytes

Alarm code	Cause of error		Solution
	protection	ESC register AL Status Code: 0025h	The alarm can be cleared via the servo panel F0-00=1.
E-881	Abnormal protection for control mode setting	When the set value of 6060h is 0 and the set value of 6061h is 0, the PDS status is converted to "Operation enabled". The control mode corresponding to 6060h is not set. Error occurred: ESM status remains unchanged ESC register AL Status Code: 0000h	Confirm the set value for 6060h The alarm can be cleared via the servo panel F0-00=1.
E-882	During the operation, ESM requires exception protection.	When the PDS status is "Operation enabled" or "Quick stop active", a command to convert from another ESM status is received. ESM status after error: Based on the status transition requirements from the host computer ESC register AL Status Code: 0000h	Confirm the status transition requirements from the upper-level device The alarm can be cleared via the servo panel F0-00=1.
E-883	Abnormal movement detection and protection	When the input signals EXT1/EXT2 are not assigned, select the external triggering scenario via the Touch Probe function. Before calculating the electronic gear ratio, when the signless value of either the denominator or numerator exceeds 31 bits; The calculation process for electronic gear ratios when the denominator or numerator has a non-signature value exceeding 64 bits; For the final calculation result of electronic gear ratios, when either the denominator or numerator has a non-signature value exceeding 32 bits, or when the ratio falls outside the range of 8000 to 1/1000; Error occurred: ESM status: stopped in the current ESM status ESC register AL Status Code: 0000h	Check whether the functional terminal assignments for the probe (P5-62/P5-63) are correct; Check whether the electronic gear ratio setting is correct; The alarm can be cleared via the servo panel F0-00=1.
E-899	The program cannot access the bus peripheral correctly.	An abnormal bus EEPROM data load or hardware failure causing the bus-specific chip to malfunction will result in E-899.	EEPROM of the update bus Contact the agent or the manufacturer's after-sales service.

13.2 EtherCAT Communication Unrelated Abnormal Alarm

13.2.1 Overview of Standard Alarm Parameters

History record: "√" indicates that historical alarms can be recorded; "○" indicates no recording.
vable column: "√" indicates an alarm that can be cleared; "○" indicates one that cannot be cleared.

Alarm Code		Confirm Code	Explanation	Attribute			Servo status when an alarm occurs.
Major category	Subd			History record	Can be deleted	Does clearing an alarm require a power cycle to take effect?	
EEEE	1	EEEE1	Communication error between the panel and the CPU	○	○	deny	servo run
	2	EEEE2			○	deny	servo run
	3	EEEE3			○	deny	servo run
	4	EEEE4			○	deny	servo run
01	0	E-010	The firmware version does not match	○	○	yes	servo run
	3	E-013	FPGA loading error	○	○	yes	servo run
	5	E-015	Program execution error	○	○	yes	servo run
	6	E-016	hard error	○	○	deny	servo run
	7	E-017	Processor operation timed out	○	○	yes	servo run
	9	E-019	System password incorrect	○	○	yes	servo run
02	0	E-020	Parameter loading error	○	○	yes	servo run
	1	E-021	Parameter range exceeded	√	√	deny	servo run
	2	E-022	Parameter conflict	○	√	deny	servo run
	3	E-023	Incorrect sampling channel	○	○	yes	servo

Alarm Code		Confirm Code	Explanation	Attribute			Servo status when an alarm occurs.
Major category	Subd			History record	Can be deleted	Does clearing an alarm require a power cycle to take effect?	
			configuration				run
	4	E-024	Parameter lost	√	√	deny	servo run
	5	E-025	Erasing FLASH error	√	√	deny	servo run
	6	E-026	Initialization FLASH error	√	√	deny	servo run
	8	E-028	EEPROM write error	√	√	deny	servo run
	9	E-029	Frequent EEPROM write alarm	√	√	deny	servo run
03	0	E-030	Busbar voltage overvoltage	√	√	deny	servo off
04	0	E-040	Busbar voltage is too low. ① Low grid voltage	√	√	deny	servo run
			Busbar voltage is too low. ② Power failure of the drive causes bus voltage undervoltage	○	√	deny	servo off
	1	E-041	The drive has lost power.	○	√	deny	servo run
	3	E-043	Busbar voltage charging failed	√	√	yes	servo off
	4	E-044	Three-phase voltage input with one phase missing	√	√	deny	servo off
06	0	E-060	The module temperature is too high.	√	√	deny	servo run
	1	E-061	Motor overheating alarm	√	√	deny	servo run
	3	E-063	Thermistor wire break alarm	√	√	deny	servo run
08	0	E-080	Excess speed alarm	√	√	deny	servo off
	2	E-082	Encoder zero position deviation protection 1	√	√	deny	servo off
	3	E-083	Speed command exceeded limit	√	√	deny	servo off

Alarm Code		Confirm Code	Explanation	Attribute			Servo status when an alarm occurs.
Major category	Subd			History record	Can be deleted	Does clearing an alarm require a power cycle to take effect?	
09	2	E-092	Analog Tref calibration zero exceedance	√	√	deny	servo run
	3	E-093	Analog signal Vref zero calibration exceeds the limit	√	√	deny	servo run
10	0	E-100	The positional deviation is too large.	√	√	deny	servo run
	1	E-101	Sudden mutation in the position command deviation	√	√	deny	servo run
11	0	E-110	A short circuit in the external UVW was detected during self-check.	√	√	deny	servo off
	2	E-112	U-phase current overcurrent protection	√	√	deny	servo off
	3	E-113	V-phase current overcurrent protection	√	√	deny	servo off
	5	E-115	U-phase short-circuit protection (only 22–32 kW)	√	√	deny	servo off
	6	E-116	V-phase short-circuit protection (only 22–32 kW)	√	√	deny	servo off
	7	E-117	Phase-to-phase short-circuit protection (only for 22–32 kW)	√	√	deny	servo off
13	0	E-150	Power cable disconnected	√	√	deny	servo off
16	1	E-161	The drive is overloaded with thermal power.	√	√	deny	servo run
	5	E-165	Flow Prevention and Alarm	√	√	deny	servo run
20	0	E-200	Braking resistor overload	√	√	deny	servo run
22	0	E-220	Absolute servo encoder communication error	√	√	deny	servo off
	1	E-221	Too many CRC errors in encoder communication	√	√	deny	servo off
	2	E-222	Absolute value servo encoder battery low-voltage alarm	√	√	deny	servo off
	3	E-223	Absolute value servo encoder	√	√	deny	servo

Alarm Code		Confirm Code	Explanation	Attribute			Servo status when an alarm occurs.
Major category	Subd			History record	Can be deleted	Does clearing an alarm require a power cycle to take effect?	
			itself has a data access alarm.				off
	6	E-226	TAMA optical fiber has been used for temperature alarm detection.	√	√	deny	servo off
	7	E-227	Error in the multi-turn signal data of the Shanghai Electric encoder	√	√	deny	servo off
	8	E-228	Absolute value servo encoder value overflow	√	√	deny	servo off
	9	E-229	Encoder electrical angle deviation protection	√	√	deny	servo off
24	0	E-240	Time-series error in encoder position data acquisition	√	√	deny	servo off
	1	E-241	The encoder response data is corrupted.	√	√	deny	servo off
25	0	E-250	Return to Origin Error Alarm	√	√	deny	servo off
26	0	E-260	Excess travel alarm	√	√	deny	servo run
	1	E-261	Out-of-range signal connection error	√	√	deny	servo run
	2	E-262	Control stop timeout	√	√	deny	servo off
	4	E-264	Excessive vibration	√	√	deny	servo run
	5	E-265	The motor is vibrating excessively.	√	√	deny	servo run
28	0	E-280	Failed to access motor parameters	√	√	deny	servo off
	1	E-281	An error occurred while writing data to the encoder EEPROM.	√	○	deny	servo off
31	0	E-310	The motor power is mismatched.	√	○	yes	servo off
	1	E-311	Motor code lost	√	○	yes	servo off
	1	E-312	The motor parameters have been	√	○	yes	servo

Alarm Code		Confirm Code	Explanation	Attribute			Servo status when an alarm occurs.
Major category	Subd			History record	Can be deleted	Does clearing an alarm require a power cycle to take effect?	
			corrupted during reading.				off
	3	E-313	The encoder software version is mismatched	√	○	yes	servo off
	4	E-314	The encoder software version is not supported	√	○	yes	servo off
	5	E-315	Cannot read the motor parameters	√	○	yes	servo off
	6	E-316	The motor code read differs from the set code.	√	○	yes	servo off
32	0	E-320	External terminal emergency alarm	√	√	deny	servo run
34	0	E-340	STO states are out of sync	√	√	deny	servo off
	2	E-342	STO buffer circuit abnormal alarm	√	√	deny	servo off
	3	E-343	EDM circuit error	√	√	deny	servo off

13.2.2 Analysis of Common Alarm Types

The DS5 alarm code format is E-XX□, where "XX" indicates the major category of the alarm, and "□" specifies the exact sub-category within that major category.

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
EEEE	1	EEEE1	Communication error between the panel and the CPU	① Significant fluctuations in power supply voltage; low voltage causes panel refresh failure. ② The panel program is corrupted.	① Ensure stable power supply and maintain consistent voltage levels; ② After power interruption and restart, if the alarm persists, contact the authorized dealer or manufacturer.
	2	EEEE2			
	3	EEEE3			
	4	EEEE4		① Significant fluctuations in power supply voltage; low	① Ensure stable power supply and maintain consistent voltage levels; ② After power interruption and restart, if the alarm persists, contact the authorized dealer or manufacturer.

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
				voltage causes panel refresh failure. ② The panel program is corrupted. ③ Communication enters a infinite loop	③ Remove the communication terminals and then run to confirm.
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 Device damage	Contact the agent or manufacturer
	4	E-014	FPGA access error	The program is corrupted. ② Hardware damage ③ Excessive intensity of external interference	Contact the agent or manufacturer
	5	E-015	Program execution error	The program is corrupted.	Contact the agent or manufacturer
	7	E-017	Processor operation timed out	The program is corrupted.	Contact the agent or manufacturer
	9	E-019	System password incorrect	The program is corrupted.	Contact the agent or manufacturer
02	0	E-020	Parameter loading error	Parameter self-check failed	Powering on again will restore the parameters to their default settings. If the issue persists, contact your agent or manufacturer.
	1	E-021	Parameter range exceeded	The set value is outside 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 In the P0-01=4 mode, setting P3-00 to 1 will trigger an alarm.
	3	E-023	Incorrect sampling channel configuration	Incorrect configuration of cuSTOm output trigger channel or data monitoring channel	Check if the configuration parameters are correct
	4	E-024	Parameter lost	The grid voltage is too low.	① For a single-phase 220V power supply, connect L1 and L3; ② Immediately powering on after a power outage will trigger an alarm E-024;

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					③ Reset parameters
	5	E-025	Erasing FLASH error	Parameter save failed during power outage	Contact the agent or manufacturer
	6	E-026	Initialization FLASH error	The FLASH chip has unstable power supply.	Contact the agent or manufacturer
	8	E-028	EEPROM write error	Unstable voltage 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 normal voltage range for a 220V driver is 200V–240V, and for a 380V driver, it is 360V–420V. If significant voltage fluctuations are observed, use the appropriate voltage source and regulator.
				The load's rotational inertia is too large (resulting in insufficient braking capability).	① Connect the external braking resistor (220V: discharge starts at U0-05=392, ends at U0-05=377; 380V: discharge starts at U0-05=750, ends at U0-05=720). ② Increase the acceleration and deceleration time; ③ Reduce load inertia; ④ Reduce the start-stop frequency; ⑤ Replace with a higher-power driver and motor
				The braking resistor is damaged or has an excessively high resistance value.	Check the braking resistor and replace it with an external resistor of appropriate resistance value.
				The acceleration and deceleration times are too short.	Prolong acceleration and deceleration times
				Hardware failure in the driver's internal sampling circuit	Use the AC range of the multimeter to measure the input voltage of the servo LN (R/S/T); the normal value is 220V ±10%. If the reading exceeds 220V ±10% (380V ±10%), check the supply voltage. If the supply voltage is normal, the servo BB is in operation; monitor U0-05. If the voltage measured by the multimeter multiplied by 1.414 is less than U0-05 (within a 10V error margin), the servo driver is faulty and

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					requires return for repair.
04	0	E-040	The busbar voltage U0-05 is below the preset threshold. 220V-powered machine (U0-05 ≤ 150V) 380V power supply machine (U0-05 ≤ 300V)	An alarm is triggered during normal power-up due to excessively low grid voltage.	① Check the grid voltage fluctuations. The normal voltage range for a 220V driver is 200V–240V; if significant voltage fluctuations occur, use a voltage regulator. ② Replace with a transformer of larger capacity
				Sudden power outage occurred	Power on again after the voltage stabilizes.
				Hardware failure in the driver's internal sampling circuit	Use the AC range of the multimeter to measure the input voltage of the servo LN (R/S/T); the normal value is 220V ±10%. If the reading is <220V ±10% (380V ±10%), check the supply voltage. If the supply voltage is normal, the servo BB is in operational status; monitor U0-05. If the voltage measured by the multimeter ×1.414> U0-05 (within an error margin of 10V), the servo driver is faulty and must be returned for repair.
	1	E-041	The drive has lost power.	The drive power supply is disconnected	Check the power supply
	3	E-043	Busbar voltage charging failed	An alarm is triggered during normal power-up due to excessively low grid voltage.	An alarm is triggered during normal power-up due to excessively low grid voltage.
				Hardware damage	When powering on the drive, check for any relay engagement sound.
	4	E-044	Three-phase voltage input with one phase missing	Three-phase input power supply is missing one phase.	Check the power supply
06	0	E-060	The module temperature is too high. (alarm when module temperature U0-06 ≥ 95°C) U0-06 ≥ 70°C Warning)	Running under heavy load for an extended period	Reconsider the motor capacity and monitor the U0-02 torque during operation to determine if it remains above 100 for an extended period. If so, consider using a higher-capacity motor or reducing the load.
				The ambient temperature is too high.	① Enhance ventilation measures to reduce ambient temperature; ② Check whether the fan rotates

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					during servo enable; module temperature U0-06 ≥ 45°C, and the fan is activated
				Fan damaged	Replace the fan
	1	E-061	Motor overheating	An alarm is triggered when the motor temperature exceeds 140°C.	① Check whether the motor fan is abnormal; ② Contact the manufacturer's technical support
	3	E-063	Thermocouple wire break alarm	The thermocouple in the motor with a power of 11 kW or higher has broken. ② Alarm for incorrect activation of motors below 11 kW due to wire breakage detection	Check the connection of the external thermocouple; Shielded thermocouple wire 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.	The motor code does not match	Check whether the motor code (the number following MOTOR CODE) on drive U3-00 matches that on the motor tag. If they do not match, adjust them to match and power on again.
				UVW wiring error	Check the UVW wiring of the motor; ensure proper phase sequence connection.
				The motor speed is too high.	① The maximum speed limit value P3-21/P3-22 has been reduced; ② Check whether any external force is causing the motor to rotate too rapidly, whether the pulse input frequency is excessively high, or whether the electronic gear ratio is too large.
				Encoder failure	① Check the encoder cable or replace the encoder cable; 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 whether the value of U0-10 changes normally—one direction increases while the other decreases (displayed in a 0–9999 cycle).
				parameter setting	An alarm is triggered when the actual speed exceeds the P3-21/P3-22 value.
	2	E-082	Encoder zero	① UVW phase	① Check whether the three-phase

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
			position deviation protection 1	sequence phase shift ② Motor encoder zero position deviation	power lines are connected in the UVW phase sequence. ② Check the encoder zero position; please contact the manufacturer's technical support.
	3	E-083	Speed command exceeded limit	The speed command in position mode exceeds the set value of 1.3*P3-21/P3-22.	① Check the set values for P3-21/P3-22; ② Abnormal position command;
10	0	E-100	The positional deviation is too large.	During position control, the difference between the set position and the actual position exceeds the limit value.	① Check whether the motor is running in blocked condition; ② Reduce the position-given speed; ③ Increase the deviation pulse limit value P0-23
	1	E-101	Position Directive Mutation	The position difference in the cycle period is too large.	① Check whether the position command is correctly specified, and confirm if any specification error has caused an excessive change in the position command. ② Verify whether the excessive electronic gear ratio setting causes abrupt changes in position commands; ③ Ensure that the target position matches the position feedback before mode switching or when servo activation occurs.
11	0	E-110	A short circuit in the external UVW was detected during self-check.	No motor code found	Check whether the motor code (the number following MOTOR CODE) on drive U3-00 matches that on the motor tag. If they do not match, adjust them to match and power on again.
				Wrong U, V, and W wiring	Check the motor's UVW wiring, ensuring it is connected in the correct phase sequence (brown U, black V, blue W).
				The UVW driver output is short-circuited or the motor is faulty.	① Check whether the UVW phase-to-phase resistance of the motor is balanced; if the resistance values are unbalanced, replace the motor. ② Check for a short circuit between the UVW and PE terminals of the motor; if present, replace the motor. ③ Measure the UVW output on the

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					driver side using a multimeter (in diode mode): use the black probe (P+) and red probe to measure UVW; use the red probe (P-) and black probe to measure UVW. If any of the six voltage drop values is 0, replace the driver.
				The load section is experiencing a stall.	It is recommended to operate the motor with an empty shaft to eliminate load issues.
				Instant alarm during high-speed start/stop	Increase acceleration and deceleration times
				Encoder Problem	① Check the encoder cable or replace the encoder cable; 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 whether the value of U0-10 changes normally—one direction increases while the other decreases (displayed in a 0–9999 cycle).
	2	E-112	U-phase current overcurrent protection	Wrong U, V, and W wiring	Check the motor's UVW wiring, ensuring it is connected in the correct phase sequence (brown U, black V, blue W).
				The UVW driver output is short-circuited or the motor is faulty.	① Measure the UVW phase-to-phase resistance of the motor to ensure balance. If the resistance values are unbalanced, replace the motor. ② Check for a short circuit between the UVW and PE terminals of the motor; if present, replace the motor. ③ Measure the UVW output on the driver side using a multimeter (in diode mode): use the black probe (P+) and red probe to measure UVW; use the red probe (P-) and black probe to measure UVW. If any of the six voltage drop values is 0, replace the driver.
				The load section is experiencing a stall.	It is recommended to operate the motor with an empty shaft to eliminate load issues.

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
				Instant alarm during high-speed start/stop	Increase acceleration and deceleration times
				Encoder Problem	① Check the encoder cable or replace the encoder cable; ② Set the servo driver to the BB mode and adjust it to U0-10. Slowly rotate the motor shaft manually to verify whether the value of U0-10 changes normally—one direction increases while the other decreases (displayed in a 0–9999 cycle).
	3	E-113	V-phase current overcurrent protection	Wrong U, V, and W wiring	Check the motor's UVW wiring, ensuring it is connected in the correct phase sequence (brown U, black V, blue W).
				The UVW driver output is short-circuited or the motor is faulty.	① Measure the UVW phase-to-phase resistance of the motor to ensure balance. If the resistance values are unbalanced, replace the motor. ② Check for a short circuit between the UVW and PE terminals of the motor; if present, replace the motor. ③ Measure the UVW output on the driver side using a multimeter (in diode mode): use the black probe (P+) and red probe to measure UVW; use the red probe (P-) and black probe to measure UVW. If any of the six voltage drop values is 0, replace the driver.
				The load section is experiencing a stall.	It is recommended to operate the motor with an empty shaft to eliminate load issues.
				Instant alarm during high-speed start/stop	Increase acceleration and deceleration times
				Encoder Problem	① Check the encoder cable or replace the encoder cable; ② Set the servo driver to the BB mode and adjust it to U0-10. Slowly rotate the motor shaft manually to verify whether the value of U0-10 changes normally—one direction increases while the other decreases (displayed in

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					a 0–9999 cycle).
11	567	E-115 E-116 E-117	U/V/W phase short-circuit protection (only 22–32 kW)	No motor code found	Check whether the motor code (the number following MOTOR CODE) on drive U3-00 matches that on the motor tag. If they do not match, adjust them to match and then power on again.
				Wrong U, V, and W wiring	Check the UVW wiring of the motor; ensure it is connected according to the correct phase sequence.
				The UVW driver output is short-circuited or the motor is faulty.	① Check whether the UVW phase-to-phase resistance of the motor is balanced; if the resistance values are unbalanced, replace the motor. ② Check for a short circuit between the UVW and PE terminals of the motor; if present, replace the motor. ③ Measure the UVW output on the driver side using a multimeter (in diode mode): connect the black probe to P+ and the red probe to measure UVW; connect the red probe to P-and the black probe to measure UVW. If any of the six voltage drop values is 0, replace the driver.
				The load section is experiencing a stall.	It is recommended to run the motor with its shaft idle to eliminate load issues.
				Instant alarm during high-speed start/stop	Increase acceleration and deceleration times
				Encoder Problem	① Check the encoder cable or replace the encoder cable; ② Set the servo driver to the BB mode and adjust it to U0-10. Slowly rotate the motor shaft manually to verify whether the value of U0-10 changes normally—one direction increases while the other decreases (displayed in a 0–9999 cycle).
15	0	E-150	Power cable disconnected	The drive unit/cable/motor experiences a break in any one of the U/V/W three-phase power	Disconnect the drive power supply and check the power line connections. It is recommended to use a multimeter to test the conductivity. After resolving the issue, power on the device again.

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
				lines.	
16	1	E-161	The drive is overloaded with thermal power.	The motor code does not match	Check whether the motor code (the number following MOTOR CODE) on drive U3-00 matches that on the motor tag. If they do not match, adjust them to match and power on again.
				The motor is overloaded, with its actual operating torque exceeding the rated torque and running continuously for an extended period. (Check the actual operating torque on monitor U0-02: if the motor operates normally without seizing or vibration, a sustained value above 100 on U0-02 indicates improper motor selection.)	Increase the capacity of the drive and motor. Extend the acceleration and deceleration time while reducing the load. Monitor U0-00 to check for overspeed operation.
				The mechanism experiences collision, sudden weight increase, or distortion.	Eliminate mechanical distortion factors. Reduce the load.
				The motor operates when the brake is not released.	Measure the voltage at the brake caliper terminal to determine whether the brake is open. Determine the brake control method; it is recommended to use the servo BK brake signal for control. If servo control is not employed, careful attention must be paid to the timing between brake release and motor operation.
				There are wiring errors in the encoder and power lines, or there are broken wires or loose connectors with shortened pins.	Check the wiring of the U, V, and W power lines to ensure there is no incorrect phase sequence. Use a multimeter to check whether all encoder wires are properly connected and check for any breaks.

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					Check for any looseness at the connector, monitor the machine's vibration, and inspect the connector for pin shrinkage, poor soldering, or damage.
				In multi-machine wiring, the motor wire was mistakenly connected to another shaft, resulting in incorrect wiring.	Check the servo wiring and ensure the motor wires and encoder wires are correctly connected to their respective shafts.
				Improper gain adjustment causes motor vibration, back-and-forth oscillation, and abnormal noise during operation.	Re-adjust the gain parameter
				Hardware failure of the drive or motor	On-site servo cross-test results indicate either motor shaft misalignment or motor failure: during trial operation of F1-01 and spot movement test of F1-00, the motors fail to rotate at constant speed. Replace the drive or motor, and return the faulty unit to the manufacturer for repair.
	5	E-165	Flow Prevention and Alarm If the current motor output torque exceeds the torque limit P3-38/39, and the duration reaches P0-74 (in ms) while the rotational speed is below P0-75 (1 rpm), an alarm will be triggered.	① The machinery experiences impact, sudden weight increase, or distortion; ② When the motor brake is not released, the motor operates; ③ The parameter settings are unreasonable.	① Eliminate mechanical distortion factors. Reduce the load; ② Measure the voltage at the brake caliper terminal to confirm the brake is released; Determine the brake control method; it is recommended to use the servo BK brake signal for control. If servo control is not employed, careful attention must be paid to the timing between brake release and motor operation. ③ Monitor the actual output torque range of U0-02 and verify whether the torque limit value is properly set.
20	0	E-200	Braking resistor	The grid voltage	Improve the input voltage

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
			overload	exhibits significant fluctuations, resulting in excessively high voltage levels.	
				The braking resistor is oversized.	Replace with a higher-power brake resistor
				The acceleration and deceleration times are too short.	Prolong acceleration and deceleration times
				Hardware damage	Use the AC range of the multimeter to measure the input voltage of the servo LN (R/S/T); the normal value is 220V ±10%. If the reading exceeds 220V ±10% (380V ±10%), check the supply voltage. If the supply voltage is normal, the servo BB is in operation; monitor U0-05. If the voltage measured by the multimeter multiplied by 1.414 is less than U0-05 (within a 10V error margin), the servo driver is faulty and requires return for repair.
22	0	E-220	Absolute servo encoder communication error	Motor mismatch error	Check if the motor is properly matched
				The encoder cable is not connected or has poor contact.	Check if the value of U0-54 increases rapidly; if so, determine that the encoder circuit is disconnected. Disconnect the drive power supply and check the encoder cable connections for any loose wires. It is recommended to use a multimeter to test the conductivity. After resolving the issue, power on the device again. ① Hot-plugging is strictly prohibited. ② For applications requiring tank chains, use dedicated cables.
				The received encoder data is incorrect, and the number of errors exceeds the value in the encoder error retry count register P0-56.	Check whether the value of U0-54 has increased and whether the value of U0-79 is increasing; if so, determine that the encoder is experiencing interference. Do not route encoder wires through the same conduit as high-voltage circuits; install a filter on the power input side of the servo driver; fit magnetic

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					ferrules onto encoder wires; avoid using equipment with significant interference such as welding machines.
	1	E-221	Too many CRC errors in encoder communication	The encoder is subject to interference.	Use genuine Xinje cable. If non-genuine encoder cables are used, verify that they employ twisted-pair shielded cables; separate high-voltage and low-voltage wiring, and prohibit bundling of power cables with encoder cables. Ensure proper Grounding of servo motors and drivers; install magnetic ferrules on encoder cables. Shut down welding machines and other equipment that generate significant interference to identify the source of interference; isolate the interference source.
	2	E-222	Absolute servo encoder battery low-voltage alarm (this alarm can be masked)	The battery voltage in the encoder line battery box is below 3V.	Replace the battery while keeping the servo driver power on to avoid encoder position errors. Battery specifications: Industrial 5 battery, 3.6V (model CP-B-BATT).
				Power-on alert for the encoder position loss alarm on the new device	① The motor's absolute position memory during power failure relies on the battery connected to the encoder cable. If the encoder cable and motor are disconnected and power is lost, the motor's current position will be lost, triggering Alarm 222. This alarm can be cleared by setting F0-00=1, after which normal operation resumes. ② Using P0-79 can disable this alarm. When P0-79 is set to 1, the motor operates as an incremental motor—no multi-turn counting occurs, and power disconnection does not retain the current position.
	3	E-223	Absolute value servo encoder itself has a data access alarm.	The multi-turn absolute value motor does not use encoder cables with built-in battery boxes.	① Use the encoder cable equipped with a battery compartment; or replace the normally used encoder cable and perform cross-testing.
				Encoder failure or unstable encoder power	② The encoder itself is faulty and requires replacement of the servo

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
				supply	motor.
	6	E-226	TAMA optical fiber has been used for temperature alarm detection.	① The encoder temperature is too high; ② The P0-77 encoder alarm temperature setting is too low;	① Measure the current encoder temperature and dissipate heat from encoders with excessively high temperatures; ② Adjust the alarm temperature threshold for the P0-77 encoder; ③ P0-77 = 0 shielding;
	7	E-227	Error in the multi-turn signal data of the Shanghai Electric encoder	This is usually an issue with the encoder itself or an unstable power supply to the encoder.	① Check whether the encoder cable is functioning properly and replace the operational encoder cable; ② Replace the motor.
	8	E-228	Absolute value servo encoder value overflow	The absolute encoder rotates more than 32,767 turns in the forward direction or more than 32,768 turns in the reverse direction.	① Set F1-06 to 1 and clear the absolute encoder's multi-turn count; ② For applications requiring recording multi-turn absolute positions, set P0-79=2 to disable this alarm; for applications without such requirement, set P0-79=1.
	9	E-229	Encoder electrical angle deviation protection	① Incorrect phase sequence of the motor power lines; ② Encoder zero position offset	① Check whether the three-phase sequence of the dynamic line is connected according to the UVW phase sequence. ② Check the encoder zero position; contact the manufacturer's technical support.
24	0	E-240	Time-series error in encoder position data acquisition	① Communication anomaly between the servo driver and encoder; ② The encoder signal is interfered with; ③ Encoder malfunction	① Restart the drive; ② Check the wiring arrangement of the transmission cables to ensure separate routing for high-voltage and low-voltage circuits; ③ Separate power supply for high-current equipment; ④ Good Grounding
	1	E-241	The encoder response data is corrupted.	① Incorrect encoder data received; ② The encoder signal is interfered with; ③ Encoder malfunction	① Check the wiring arrangement of the transmission cables to ensure separate routing for high-voltage and low-voltage circuits; ② Separate power supply for high-current equipment; ③ Good Grounding
25	0	E-250	Return to Origin	① If P9-15 is not zero,	① Increase P9-15;

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
			Error Alarm	the total time required to return to the origin exceeds the time set for P9-15; ② Incorrect original function parameter settings for the new version	② Ensure that the direction of the mechanical displacement (P9-19, P9-20) is opposite to the direction of returning to the origin; ③ Check whether there is any issue with the origin signal; ④ Check the original function parameter settings upon return
26	0	E-260	Excess travel alarm	An out-of-range signal was detected, and the out-of-range processing mode is configured to trigger an alarm.	If you do not want an immediate alarm to be triggered when exceeding the limit, you can change the signal processing method for exceeding the limit.
	1	E-261	Out-of-range signal connection error	When the motor is rotating forward, it encounters a reverse overtravel signal. ② When the motor reverses, it encounters a forward overtravel signal.	Check the connection of over-limit signals and the allocation of over-limit terminals
	2	E-262	Control stop timeout	① Excessive inertia ② The stop timeout duration is too short	① Reduce inertia or use a brake motor; ② Increase the stop timeout time P0-30;
	4	E-264	Excessive vibration	① Oscillation caused by external forces ② Large load inertia combined with incorrect load inertia ratio settings or insufficient gain results in oscillation during positioning.	① Identify the source of external forces and check for any issues with the mechanical installation; ② Increase the servo gain to enhance disturbance resistance; ③ Analysis of the data acquisition speed curve; When the first three peaks and troughs of the pulse command reach a convergent state (where 0.8 × |first peak| ≤ |second peak| ≤ 0.8 × |third peak|), the drive should not trigger an alarm; in such cases, the relevant thresholds can be adjusted. When the three first peak speed values after the completion of the pulse command consecutively reach or exceed 300 rpm three times, the drive alarm is triggered. The issue should be

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					resolved using Method ① or Method ② as described above. ④ Contact the manufacturer's technical support
	5	E-265	The motor is vibrating excessively.	The machinery is vibrating.	Check the motor installation
28	0	E-280	Failed to read motor parameters	① Motor mismatch; ② The encoder wires are not connected, incorrectly connected, or loose.	① The driver and motor are matched by professionals and can be used together. ② Check the connection status of the encoder wires, measure their continuity, or replace the encoder wires for inspection. ③ Check whether the driver and motor are functioning properly. This can be verified by replacing them with new components. If the issue is identified as a problem with the driver or the motor itself, the unit should be returned to the manufacturer for inspection.
	1	E-281	An error occurred while writing data to the encoder EEPROM.	Failed to write to EEPROM	This product cannot have motor parameters manually configured at the factory. Upon power-on, the driver automatically reads the motor code; if the read fails, an alarm is triggered. Only after professionals confirm that the driver and motor are compatible and can be used together should the motor parameters be updated using a self-renewing tool. After successful writing, set P0-53 to 1 (to suppress the automatic reading alarm) and correctly configure the P0-33 motor code.
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; after connection, it will read automatically and function normally.
	1	E-311	When reading the motor code automatically, the motor parameters read are 0, and the driver P0-33 =	Motor code not set	This product cannot have motor parameters manually configured at the factory. Upon power-on, the driver automatically reads the motor code; if the read fails, an alarm is triggered. Only after professionals confirm that

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
			0.		the driver and motor are compatible and can be used together should the motor parameters be updated using a self-renewing tool. After successful writing, set P0-53 to 1 (to suppress the automatic reading alarm) and correctly configure the P0-33 motor code.
	2	E-312	The motor parameters have been corrupted during reading.	The parameter CRC check failed	This product cannot have motor parameters manually configured at the factory. Upon power-on, the driver automatically reads the motor code; if the read fails, an alarm is triggered. Only after professionals confirm that the driver and motor are compatible and can be used together should the motor parameters be updated using a self-renewing tool. After successful writing, set P0-53 to 1 (to suppress the automatic reading alarm) and correctly configure the P0-33 motor code.
	3	E-313	The encoder software version is mismatched	The encoder software version is mismatched	① Update the driver firmware to achieve optimal performance based on the current motor parameters; ② The product cannot have its motor parameters manually set upon leaving the factory. After power-on, the driver automatically reads the motor code; if the read fails, an alarm is triggered. Only after professionals confirm that the driver and motor are compatible and can be used together should the motor parameters be updated using the self-update tool. Upon successful update, set P0-53 to 1 (to disable the automatic motor parameter read alarm) and correctly configure the P0-33 motor code. At this point, the motor parameters are stored in the driver and the system functions normally, although this may affect certain performance characteristics.
	4	E-314	The motor code does not match the software	The encoder hardware version is higher than the driver firmware	Contact the manufacturer's technical support to update the driver firmware.

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
			version.	version.	
	5	E-315	When reading the motor code automatically, the motor parameters read are 0, and the driver P0-33 = 0.	The motor code read is 0	This product cannot have motor parameters manually configured at the factory. Upon power-on, the driver automatically reads the motor code; if the read fails, an alarm is triggered. Only after professionals confirm that the driver and motor are compatible and can be used together should the motor parameters be updated using a self-renewing tool. After successful writing, set P0-53 to 1 (to suppress the automatic reading alarm) and correctly configure the P0-33 motor code.
	6	E-316	Automatic code reading error	The automatically read motor code does not match the P0-33 setting.	Check the U3-70 and the motor housingnameplate for the MOTOR CODE. If the two values differ, contact the manufacturer's technical support. The motor parameters cannot be manually set before the product leaves the factory; upon power-on, the driver will automatically read the motor code. If the read fails, an alarm will be triggered. Only after professionals confirm that the driver and motor are compatible and can be used together should the motor parameters be updated using the self-update tool. After successful writing, set P0-53 to 1 (to disable the automatic motor parameter read alarm) and correctly configure the P0-33 motor code.
32	0	E-320	Driver cascade alarm	Terminal emergency alarm function	Check whether alarm output signals from other drives are connected to the SI input terminals of the drive; prioritize handling this alarm. Correctly set parameter P5-68.
34	0	E-340	STO states are out of sync	The input states of STO1 and STO2 are inconsistent.	① Ensure that STO1 and STO2 are disconnected simultaneously; ② If a specific STO channel remains in a high-level state after disconnecting the 24V power supply, contact the

Major category	Subd	Confirm Code	Explanation	Possible reason	Solution
					original manufacturer's technical support.
	2	E-342	STO buffer circuit abnormal alarm	STO buffer circuit malfunction	Please contact the original manufacturer's technical support.
	3	E-343	EDM circuit error	EDM output signal error	Please contact the original manufacturer's technical support.

13.3 Abnormal (Alarm) Read

000h ~ FEFFh is defined according to IEC 61800-7-201.

The range FF00h to XXXXXh can be cuSTOmized by the user as follows.
The lower 8 bits of the defined value (FF00h to FFFFFh) represent the primary code for alarm numbers indicating servo abnormalities (alarms), as shown in the table below. (The secondary code of the alarm number is not read.)
Additionally, the primary code of the alarm number is represented in hexadecimal format.

Index	Sub index	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 primary alarm number. When no alarm occurs, display 0000h. When an alarm occurs, the alarm (main) number (00h ~ FFh) displays FF**h. example ： ①When a general alarm such as E-030 (overvoltage protection) occurs, 603F = 30d ② Bus-related alarms such as E-850 (TxPDO configuration anomaly protection) and E-851 (RxPDO configuration anomaly protection). 603F = FF55h... 55h = 85d, meaning either the E-850 or E-851 model is involved. As an exception, in the case of E-817 (SyncManager2/3 configuration error), A000h is displayed.				

Secondly, alarms can also be read via SDO read commands. The corresponding object dictionary for U1-00 is 0x3100, with the following command:

Read the value from register D0 in the slave object dictionary (address 0x3100) corresponding to station number 0: the value contained in 00 (current alarm code). (For detailed usage instructions, refer to the user manual of the XDH/XLH/XG2 series programmable controllers [Advanced Motion Control Section].)

13.4 Clear exception (alarm)

Reset method for the EtherCAT-associated protective function with an adjustable exception (alarm) threshold

The following methods ①, ②, ③, and ④ can all be used to reset the abnormal (alarm) status to zero.

Additionally, for protection functions not related to EtherCAT, refer to the Basic Functional Specifications section of the technical documentation.

Method ①: Set bit 4 (Error Ind Ack) of AL Control to "1".

Subsequently, bit 7 of 6040h (Controlword) is set from 0 to 1 (发送 Fault reset command), completing the exception (alarm) reset.

After the exception (alarm) reset is completed, the PDS status transitions from Fault to Switch on disabled.

Method ②: The servo driver automatically performs exception (alarm) reset (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 the OFF state to the ON state.

After the exception (alarm) reset is completed, the PDS status migrates from Fault to Switch on Disabled.

Method ④: Clear the alarm by writing a command via SDO. The corresponding object dictionary for F0-00 is 0x4000. The command is as follows:

When an alarm occurs, write 1 to D0 to clear the alarm. (For specific usage instructions, refer to the User Manual of the XDH/XLH/XG2 series programmable controllers [Advanced Motion Control Section].)

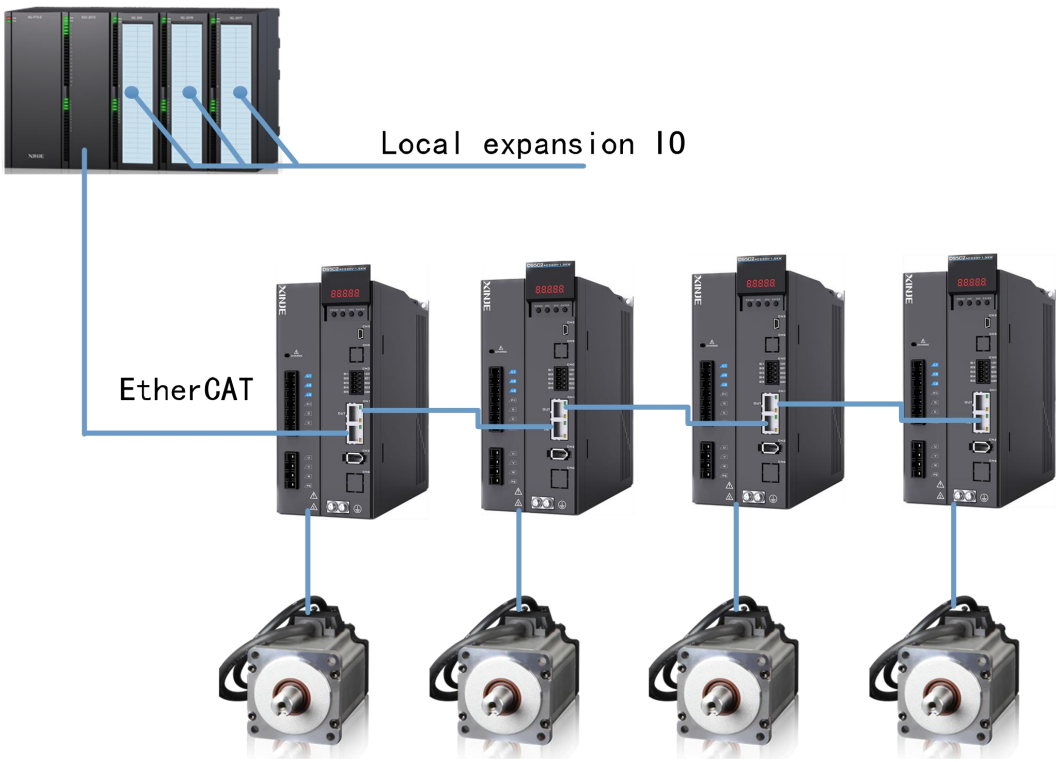
14 Communication Case Study

14.1 Xinje XG2/XDH and Xinje DS5C2 Servo EtherCAT Communication Example

14.1.1 System configuration

Name	Model/specification	Quantity	Remarks
Motion Control Software	Xinje PLC Programming Tool Software	1	
Xinje Servo	DS5C2-41P0-PTA	1	
Ethernet cable	JC-CB-3	Several	For connecting the computer to the servo

14.1.2 System topology

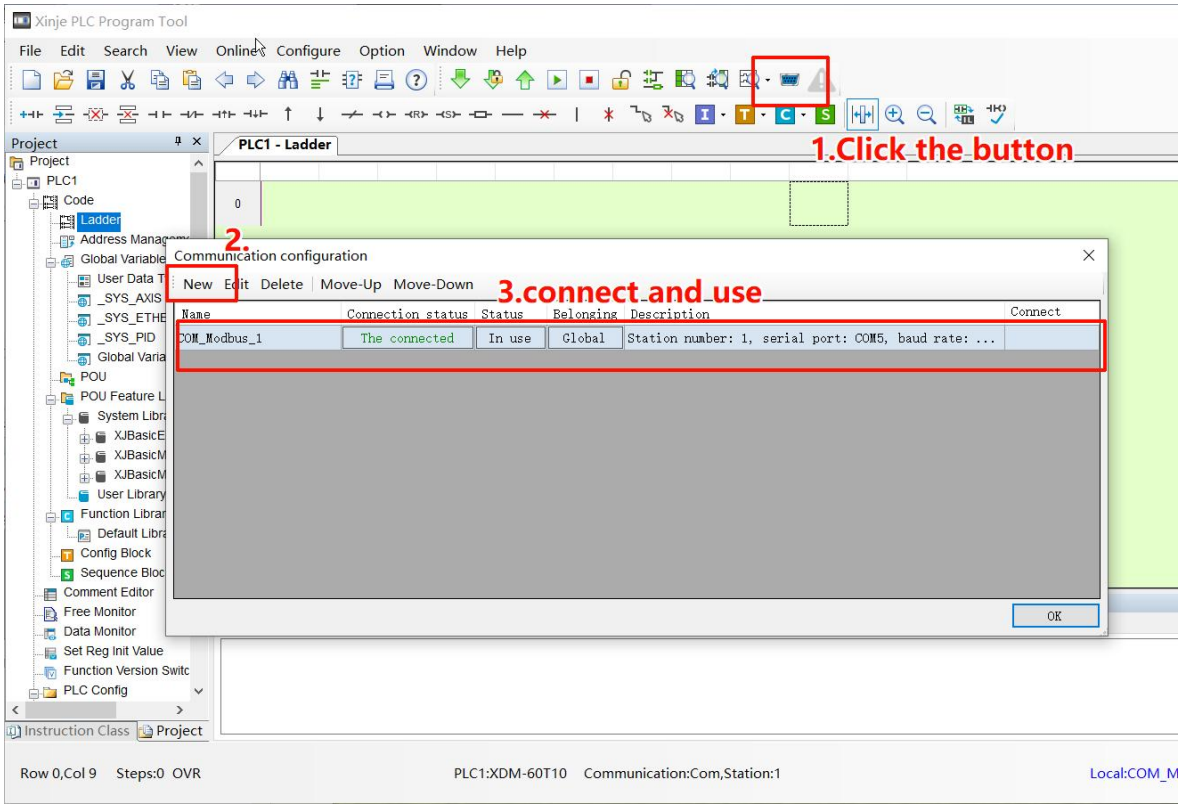


The DS5C2 driver's network port wiring follows the bottom-in, top-out standard: the main station's network cable is connected to the IN port of the first driver; from the OUT port of the first driver, another network cable is routed to the IN port of the second driver, and so on.

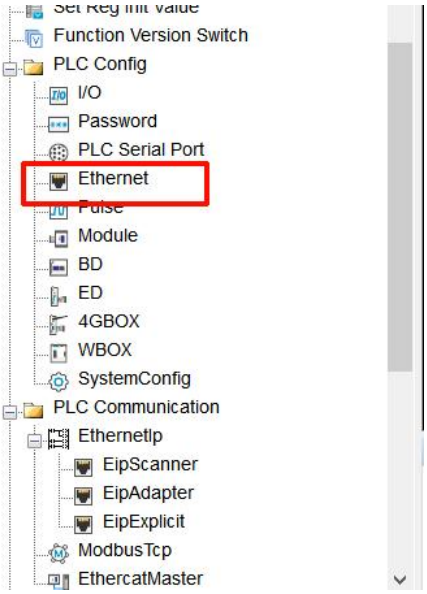
14.1.3 Debugging Steps

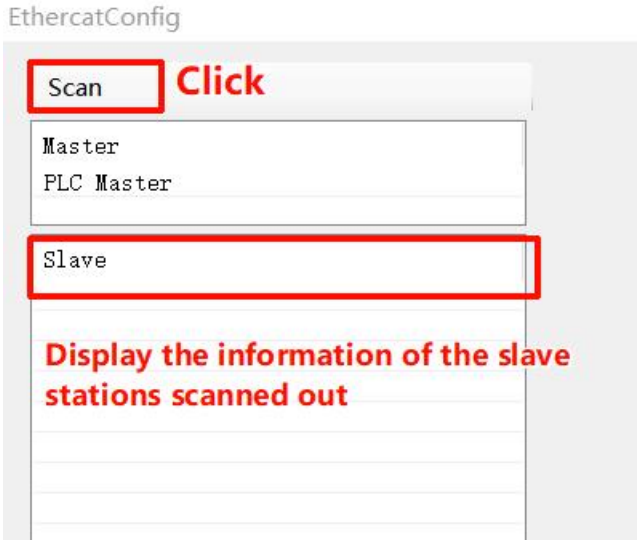
Debug each EtherCAT bus control mode, using the H movement as an example (the H movement is the default in PLC programming software versions 3.7.14 and above, with SFD811 set to 1).

1、 linkage PLC。



2. Configure EtherCAT.





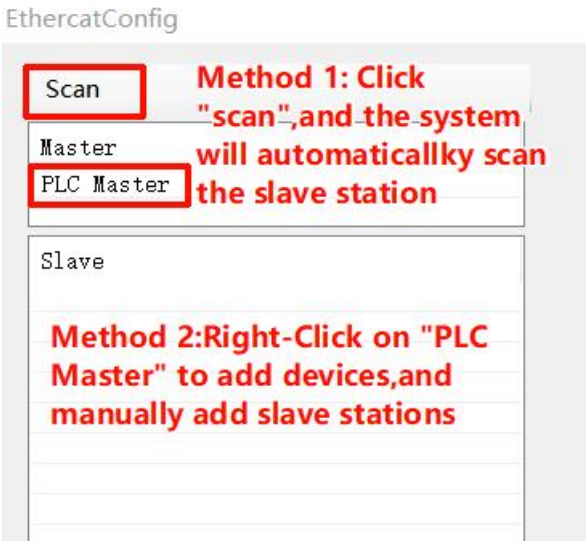
3. In [Expert Engineering Data], confirm the PDOs to be configured for this mode.

1) Example of CSP Mode Operation

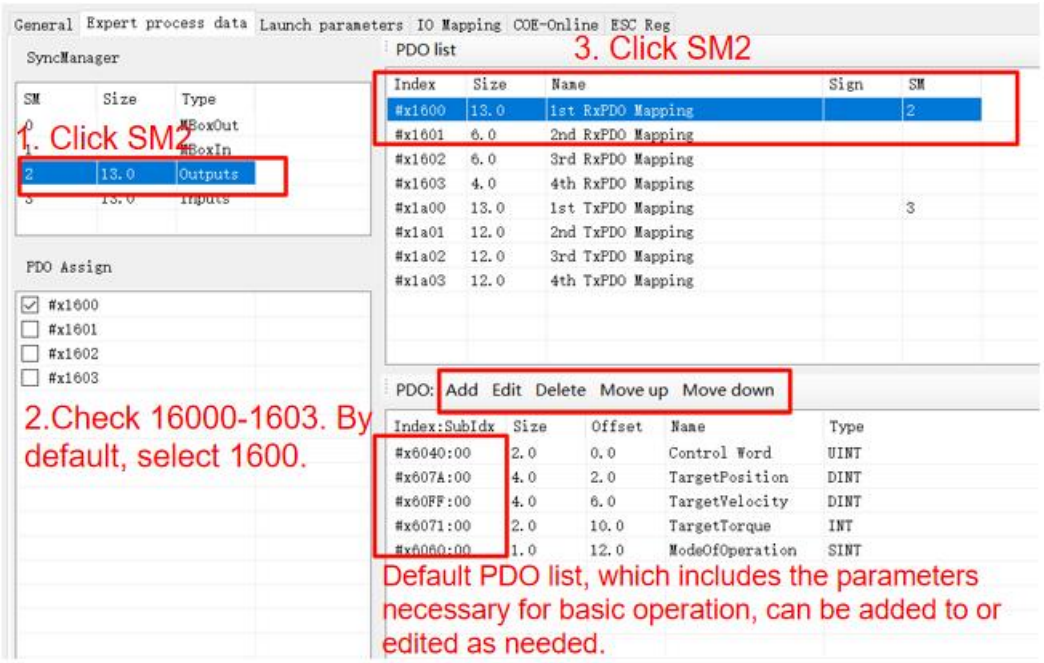
CSP Control Mode Association Object

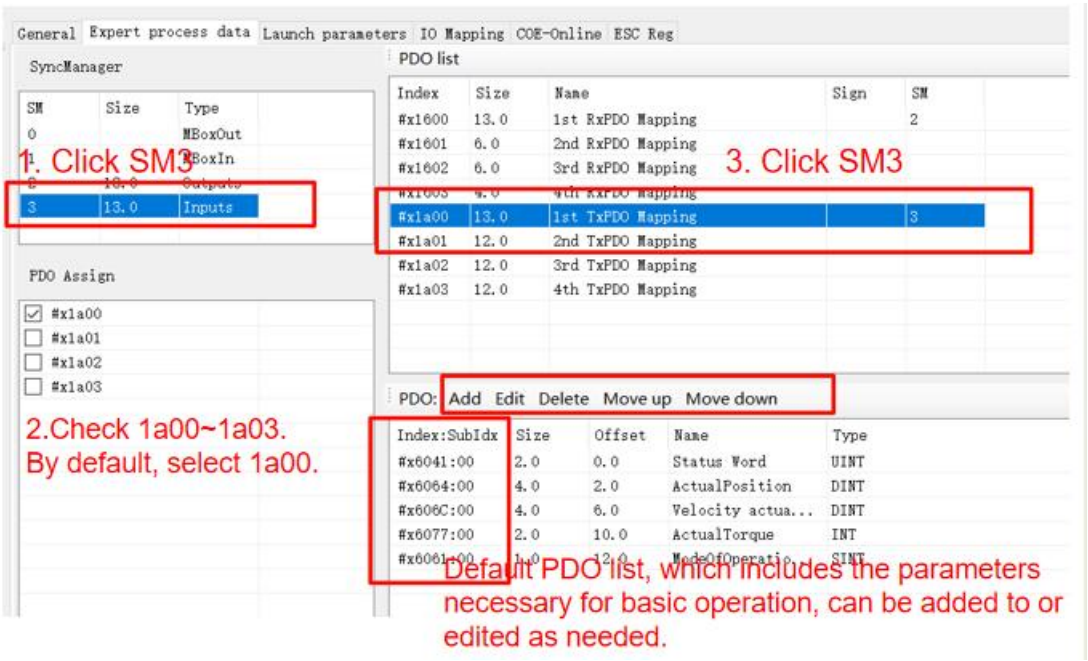
Register	Explanation	Unit
RXPDO[0x607A]	Given the location, modifications via IO mapping are invalid in CSP mode; they are governed by the NC module.	Command Unit
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
RXPDO[0x6060]	The control mode is CSP (Periodic Synchronous Position Mode); set its value to 8.	-

① On the EtherCAT interface, select [Scan] or [Add Device] for slaves; use the default configuration on the [General] interface.

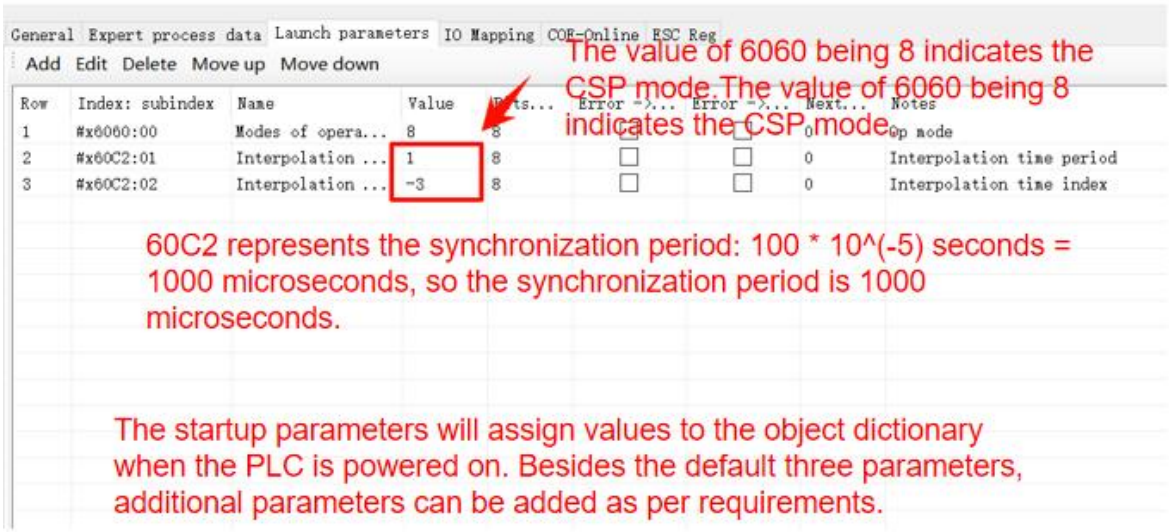


② In [Expert Process Data] → [PDO Allocation], check boxes 1600 and 1A00. (The default configuration meets the basic requirements for CSP usage; additional PDO parameters can be added as needed.)





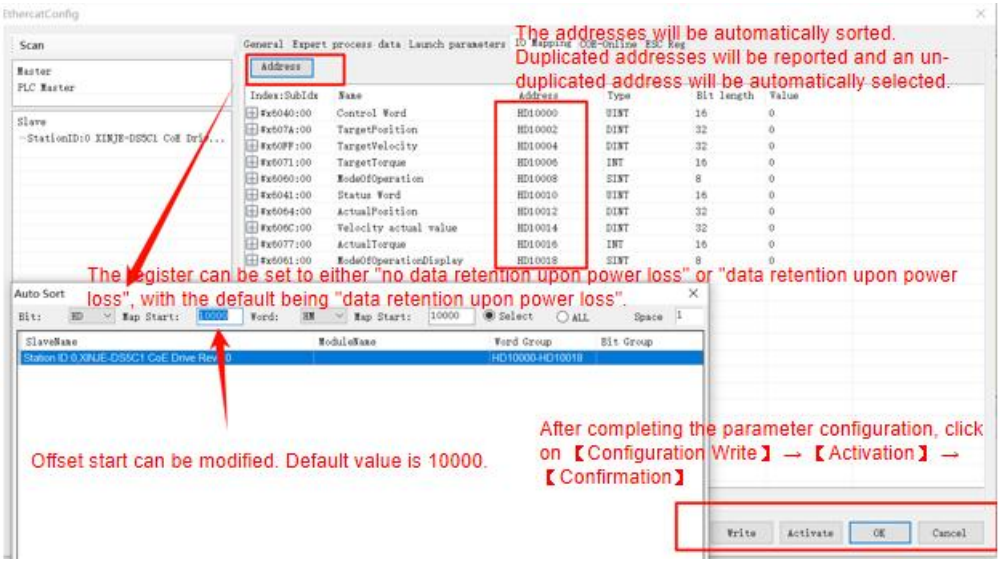
③ Confirm that the 6060h value in [Startup Parameters] is set to 8.



The startup parameters include three default configurations: 6060h represents the slave operation mode, with a default value of 8 (CSP mode); 60C2-1 and 60C2-2 denote the synchronization unit cycle, where 60C2-1 specifies the cycle value and 60C2-2 indicates the unit of measurement. For example, the default synchronization unit cycle is 100×10^{-5} s, equivalent to 1000 μs. This parameter automatically adjusts according to the synchronization cycle configured by the master station, eliminating the need for manual modification.

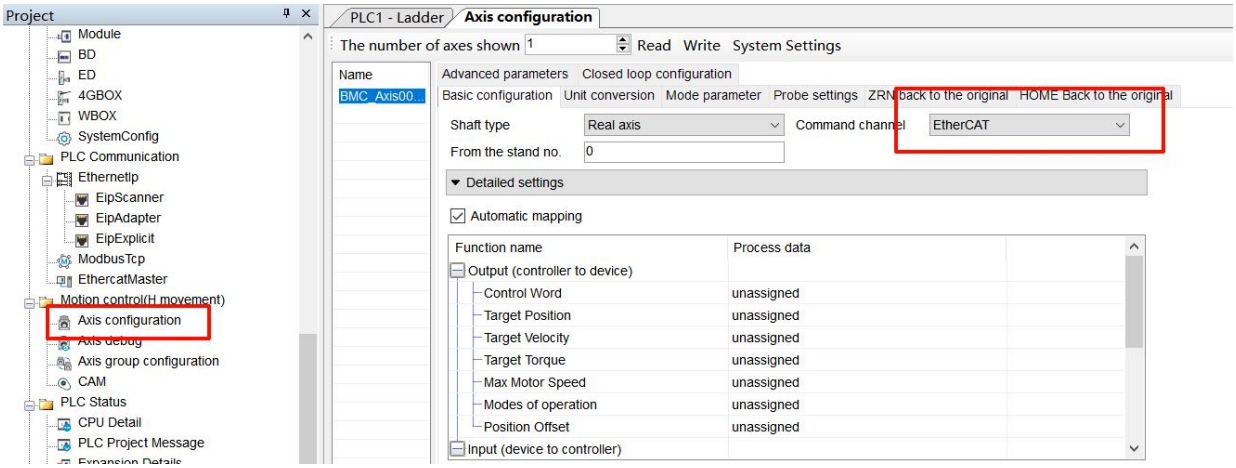
④[IO Mapping]The default starting address is HD10000; it can be modified as needed.

⑤ After completing the parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect once activation and saving are successful.

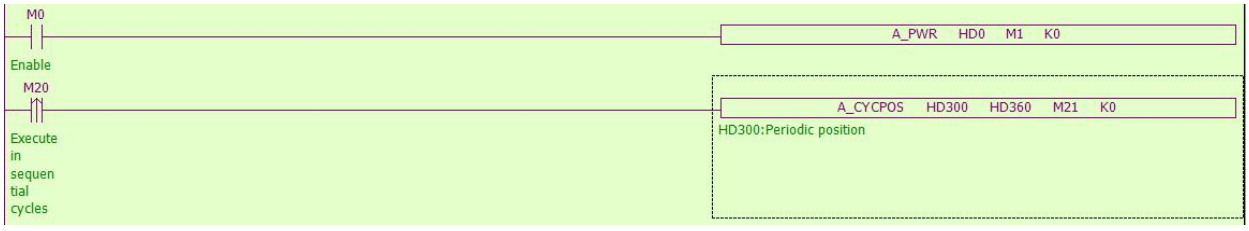


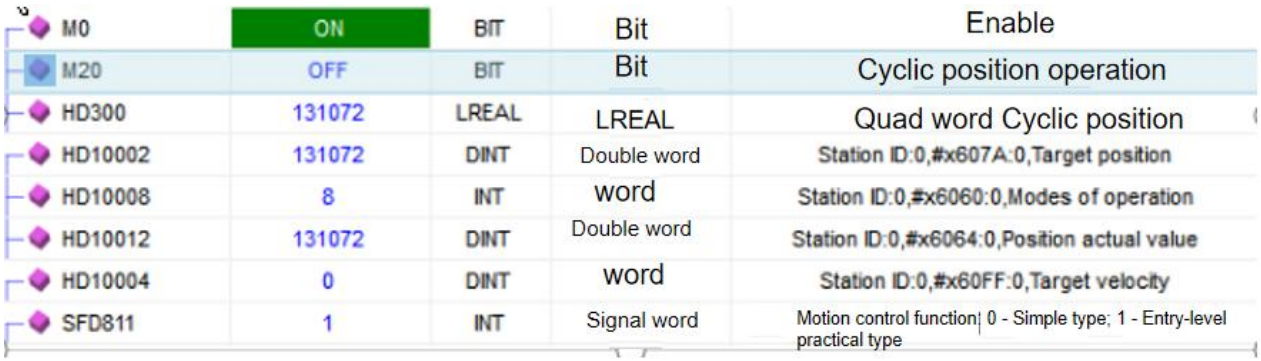
⑥ After activation is completed, the station state machine (SD8021) transitions from state 1 to 2, then to 4, and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception.

⑦ Ensure 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 real-time speed via HD10014 (606Ch mapping).





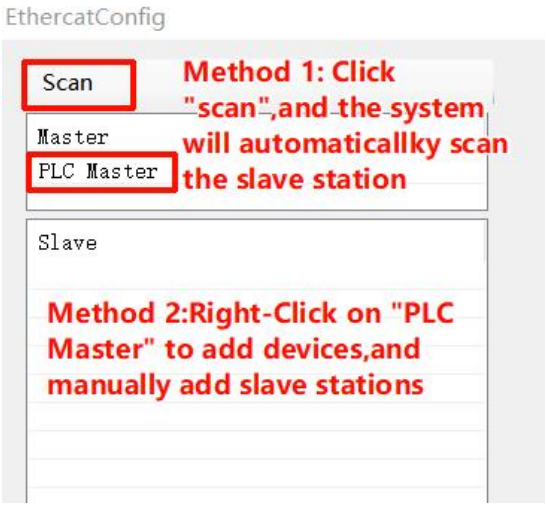
- When the M20 switches from OFF to ON, it performs periodic position control on the axis designated by HD300. Upon successful execution, setting M21 to ON indicates that the axis is in periodic control mode, achieving axis control through periodic parameter assignment to HD300.
- Before triggering the instruction, ensure the HD300 value matches the current position; otherwise, a step will occur.
- Periodic position control requires periodically writing the target position value into the register. Position variations should not be excessive to prevent shaft overspeeding caused by a significant difference between the current and previous periodic positions.

2) CSV mode operation example

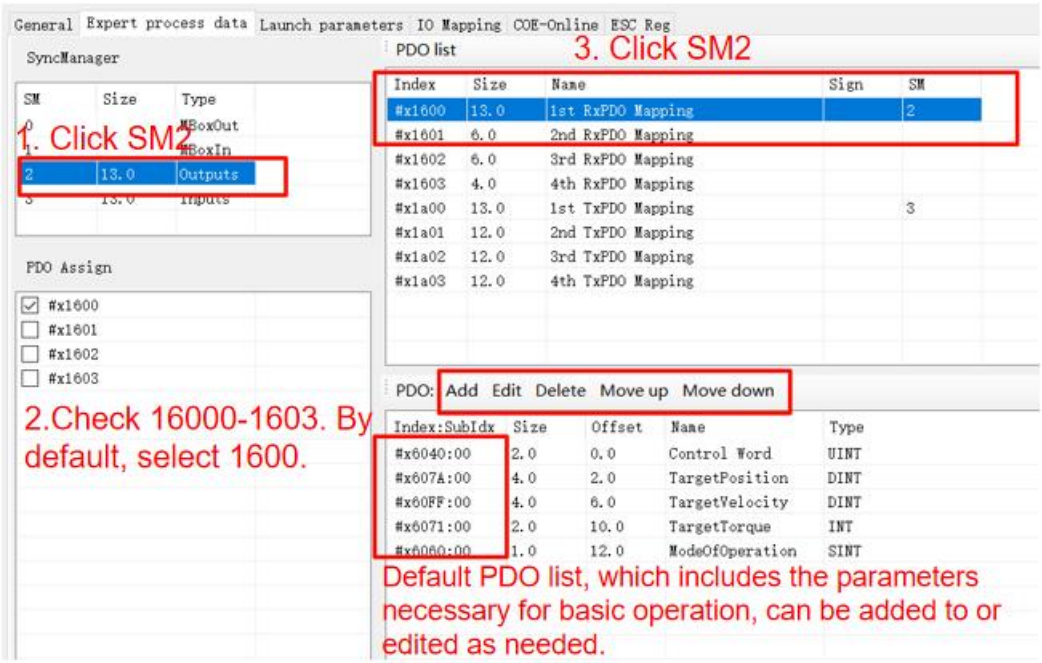
CSV Control Mode Associated Object

Register	Explanation	Unit
RXPDO[0x60FF]	Given speed	Unit/Unit of instruction
TXPDO[0x6064]	position feedback	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
RXPDO[0x6080]	The maximum motor speed can be adjusted via the COE-Online online interface to set a speed limit.	r/min
RXPDO[0x6060]	The control mode is CSV (Periodic Synchronization Speed Mode); set its value to 9	-

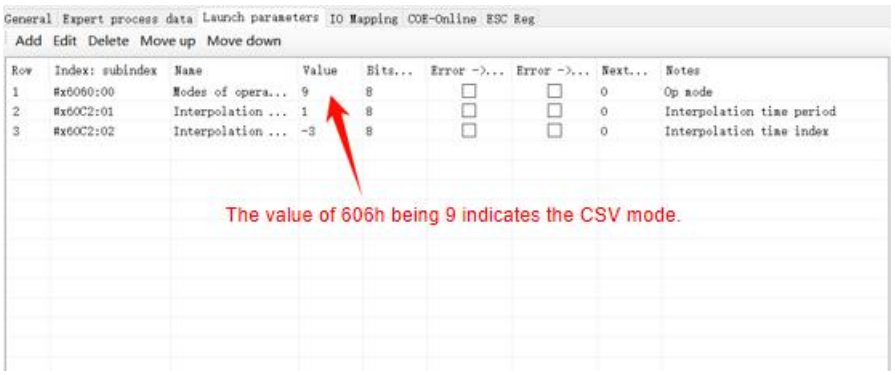
① On the Ethercat interface, select [Scan] or [Add Device] for the slave device; on the [General] interface, use the default configuration.



② In [Expert Process Data]→[PDO Allocation], check boxes 1600 and 1A00. (The default configuration meets basic CSV requirements; additional PDO parameters can be added as needed.)

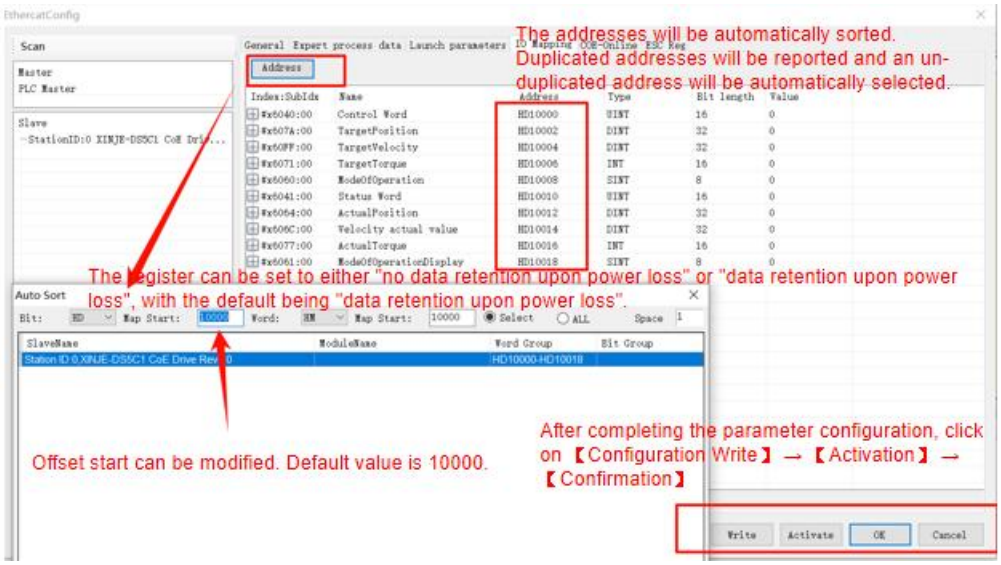


③ Confirm that the 6060h value in [Startup Parameters] is set to 9.



④ [IO Mapping]The default starting address is HD10000; it can be modified as needed.

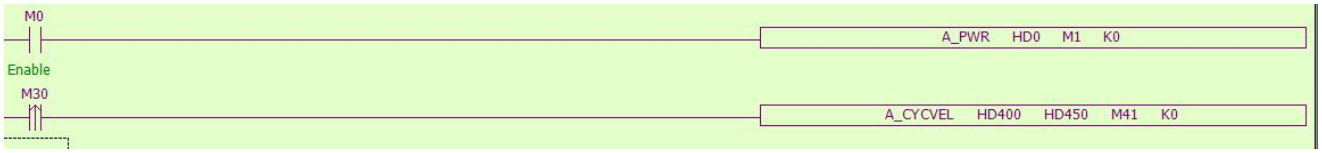
⑤ After completing the parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect once activation and saving are successful.



⑥ After activation is complete, the station state machine (SD8021) transitions from state 1 to 2, then to 4, and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception. Once the state switches to OP, the maximum motor speed (6080 h) can be adjusted via COE-Online.

⑦ After setting the enable flag to ON, HD10000 (mapped to 6040h) transitions from state 6 to 7 and then to 15, indicating the slave enable status. This can be achieved by assigning a value to HD10004 (mapped to 60FFh) as the specified speed in CSV mode; real-time speed interpolation can be implemented by modifying HD1004 during I9900 interrupts.

In CSV mode, the current speed can be monitored via HD10004 (60FFh mapping), the actual motor position via HD10012 (6064h mapping), and the actual speed via HD10014 (606Ch mapping).



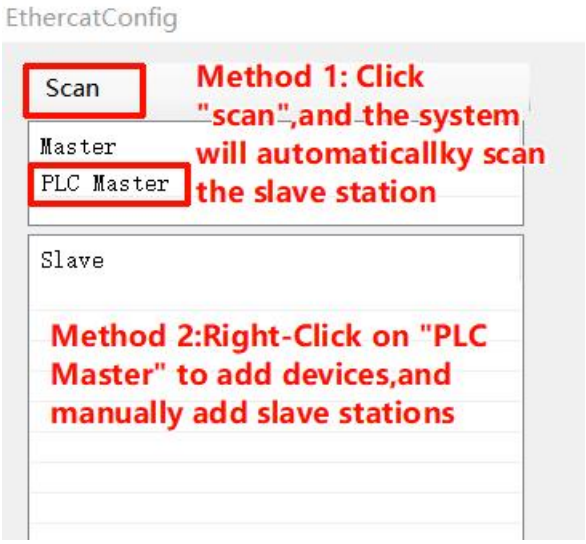
M0	ON	BIT	Bit	Enable
M20	OFF	BIT	Bit	Cyclic position operation
HD300	131072	LREAL	LREAL	Quad word Cyclic position
HD10002	131072	DINT	Double word	Station ID:0,#x607A:0,Target position
HD10008	8	INT	word	Station ID:0,#x6060:0,Modes of operation
HD10012	131072	DINT	Double word	Station ID:0,#x6064:0,Position actual value
HD10004	0	DINT	word	Station ID:0,#x60FF:0,Target velocity
SFD811	1	INT	Signal word	Motion control function| 0 - Simple type; 1 - Entry-level practical type

3) CST Mode Operation Example

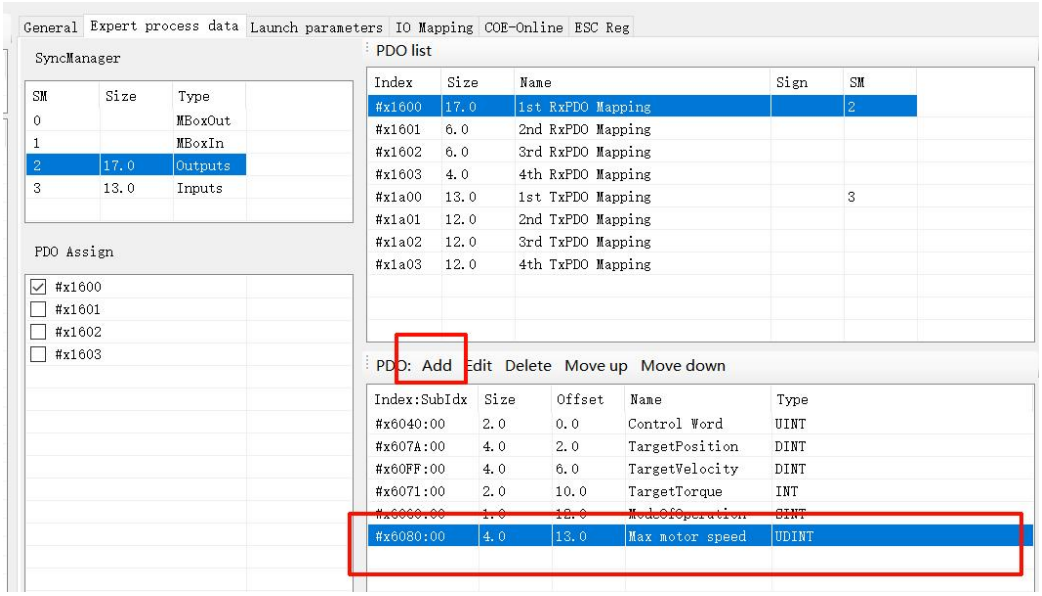
CST Control Mode Associated Object

Register	Explanation	Unit
RXPDO[0x6071]	Given torque	0.1%
TXPDO[0x6064]	position feedback	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Torque Feedback	0.1%
RXPDO[0x6080]	Maximum motor speed	r/min
RXPDO[0x6060]	The control mode is CST (Periodic Synchronous Torque Mode); set its value to 10.	-

① On the Ethercat interface, select [Scan] or [Add Slave]; on the [General] interface, use the default configuration.



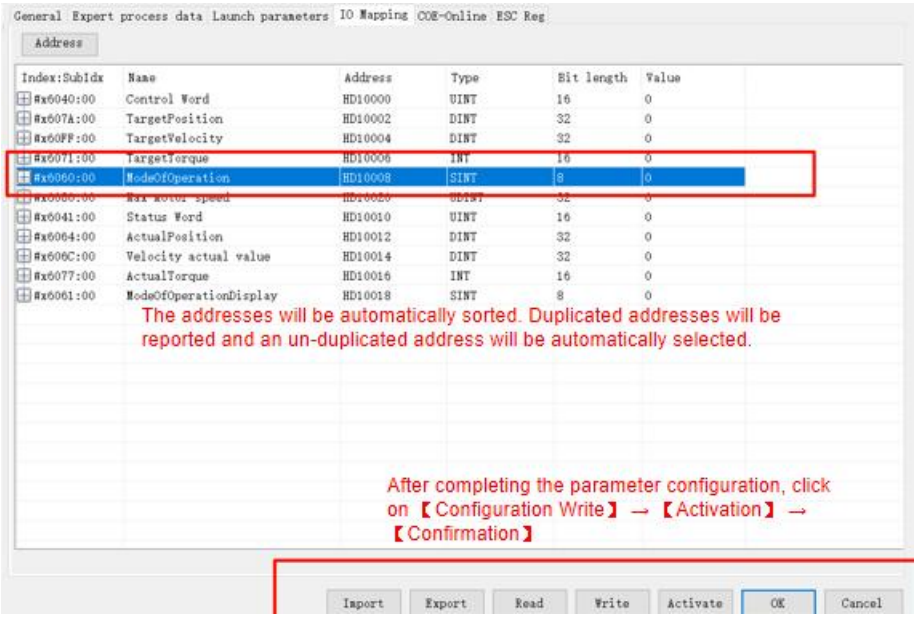
② [Expert Process Data] → In [PDO Allocation], select 1600 and 1A00; the default configuration meets the basic requirements for CST operation. Additional PDO parameters can be added as needed—for example, include 6080h in 1600 to adjust the maximum motor speed and control torque.



③ Confirm that the 6060h value in [Startup Parameters] is set to 10.

④ [IO Mapping]The default starting address is HD10000; it can be modified as needed.

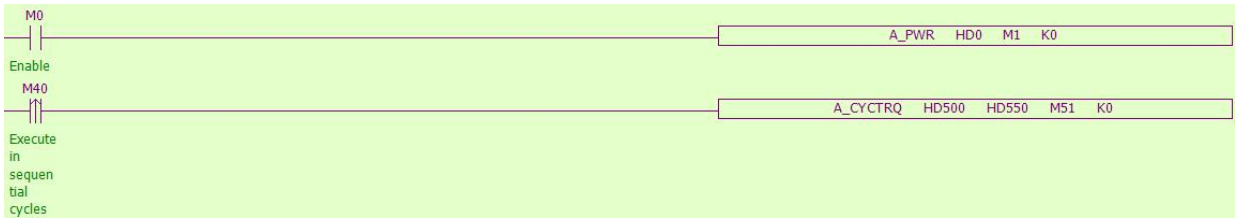
⑤ After completing the parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect once activation and saving are successful.



⑥ After activation is completed, the station state machine (SD8021) transitions from state 1 to 2, then to 4, and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception.

⑦ After enabling the ON setting, HD10000 (mapped to 6040h) will transition from state 6 to 7 and then to 15, indicating the slave enable status. This can be achieved by assigning a specific torque value to HD10006 (mapped to 6071h) in CST mode.

⑧ In CST mode, the current torque can be monitored via HD10006 (map 6071h), the actual position via HD10012 (map 6064h), the actual speed via HD10014 (map 606Ch), and the actual torque via HD10016 (map 6077h). The maximum motor speed can be restricted using parameter 6080h (Note: After adding the speed limit parameter, ensure the speed remains within the appropriate range during operation).



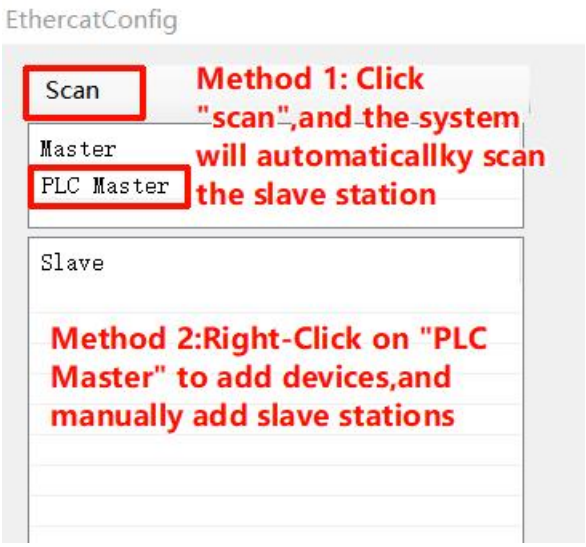
4) HM Mode Operation Example

HM Control Mode Associated Object

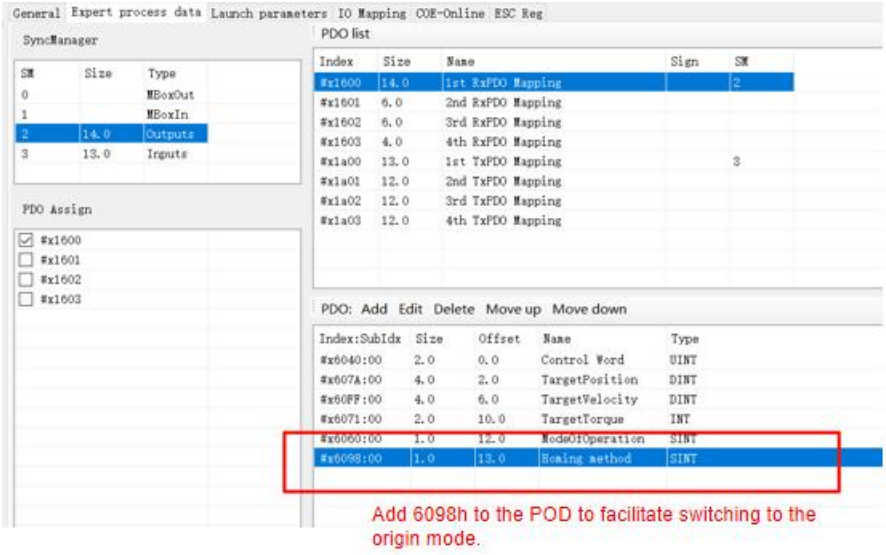
Register	Explanation	Unit
RXPDO[0x6040]	Control word: Modify the control word to return to the origin	-
RXPDO[0x6098]	Return to Origin Method	-
RXPDO[0x609A]	Accelerating back to the origin	Unit of instruction /s²
RXPDO[0x6060]	The control mode is HM mode (i.e., return-to-origin mode). Set its value to 6 when the motor is disabled.	-
SDO[0x6099]	Return to the starting speed and modify it online via COE-Online	Unit/Unit of instruction

① Perform terminal assignment. P5-22 is the positive limit setting address, with a default value of 1, corresponding to servo terminal SI1; P5-23 is the negative limit NOT setting address, with a default value of 2, corresponding to servo terminal SI2; P5-27 is the origin setting address, with a default value of 3, corresponding to servo terminal SI3.

② On the Ethercat interface, select [Scan] or [Add Device] for slaves; on the [General] interface, use the default configuration.



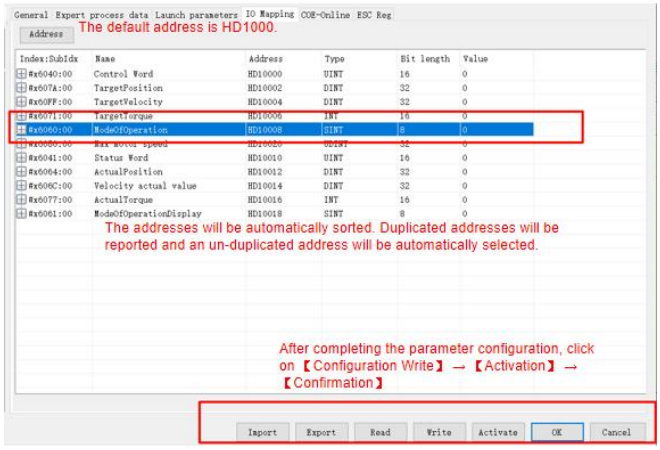
③ In [Expert Process Data]→[PDO Allocation], check both 1600 and 1A00, and add 6098h to 1600.



④ Ensure that the 6060h value in [Startup Parameters] is set to 6.

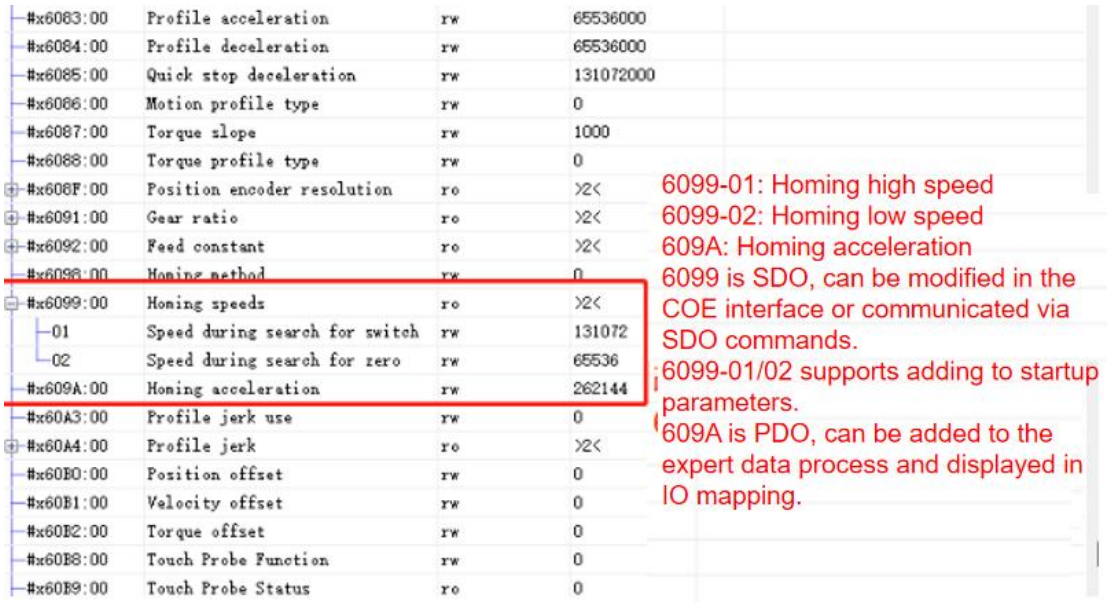
⑤ [IO Mapping]The default starting address is HD10000; it can be modified as needed.

⑥ After completing the parameter configuration, click [Configure and Write] → [Activate] → [Confirm]. The parameters will take effect after successful activation and saving.



⑦ Upon completion of activation, the station state machine (SD8021) transitions from state 1 to 2, then to 4 and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception.

⑧ After switching to the OP state, the speed and acceleration back to the origin can be adjusted via COE-Online.



⑨ Set the origin restoration method (6098h).

This setting ranges from-2 to 37 (currently supported values: -2 to 14,17 to 30,33,34,35,37).

⑩ After setting the enable flag to ON, HD10000 (the 6040h mapping) transitions from state 6 to 7 and then to 15, indicating the slave enable status; subsequently, it switches back from state 15 to 31 to return to its original position. During this return process, if the origin signal is triggered, the device decelerates and stops according to the corresponding return procedure. To repeat the return operation, first set 6040h to state 15, then switch HD10000 (the 6040h mapping) from state 15 to 31.

5) PP Mode Operation Example

PP Control Mode Associated Object (Command/Setting Category)

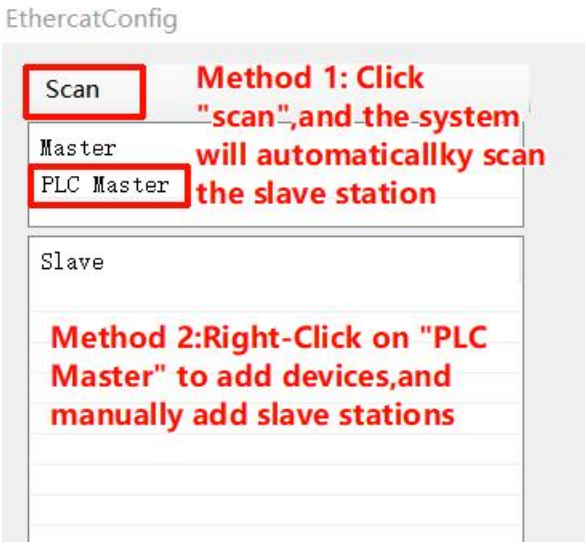
Register	Explanation	Unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is PP (Profile Position Control Mode). Set its value to 1.	-
RXPDO[0x607A]	Location Given	Command Unit
RXPDO[0x6072]	maximum torque	0.1%
RXPDO[0x607F]	Maximum internal speed	Unit/Unit of instruction
RXPDO[0x6080]	Maximum motor speed	r/min
RXPDO[0x6081]	Internal speed is set	Unit/Unit of instruction
RXPDO[0x6083]	Internal acceleration	Unit of instruction /s²
RXPDO[0x6084]	Internal deceleration rate	Unit of instruction /s²
RXPDO[0x60C5]	maximal acceleration	Unit of instruction /s²
RXPDO[0x60C6]	maximum deceleration	Unit of instruction /s²
RXPDO[0x6065]	Set the number of follow-up pulse pulses	Command Unit
RXPDO[0x6066]	Follow error timeout time	ms
RXPDO[0x6067]	Position reaches the threshold	Command Unit
RXPDO[0x6068]	Position to window time	ms

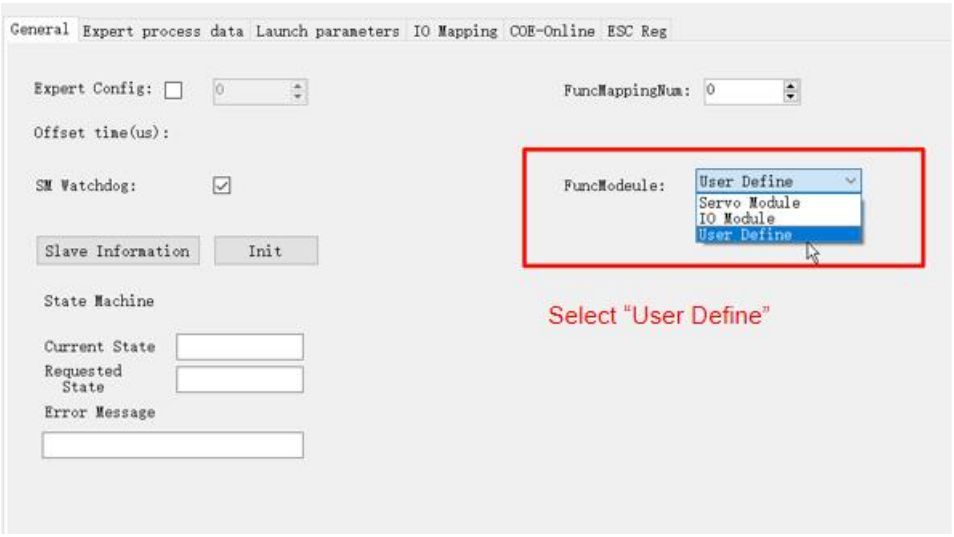
- 6081h (Profile speed) is limited by the lower of 607Fh (maximum internal speed) and 6080h (maximum motor speed).
- Any modification to the set values of 607Fh (maximum internal speed) or 6080h (maximum motor speed) during operation will not be reflected or take effect.

PP Control Mode Associated Object (Command/Monitoring Type)

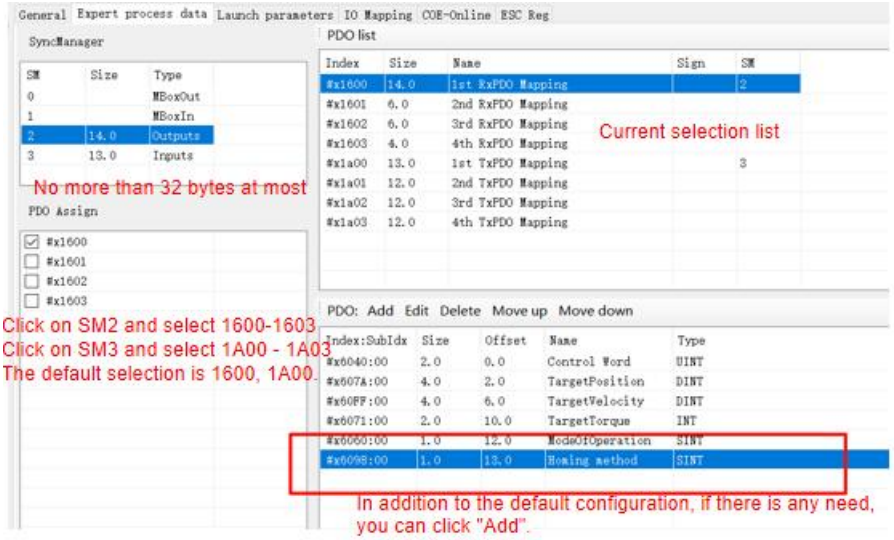
Register	Explanation	Unit
TXPDO[0x6041]	status word	-
TXPDO[0x6063]	Internal actual location	Command Unit
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Actual Torque	0.1%
TXPDO[0x60F4]	Actual following error value	Command Unit

① On the EtherCAT interface, select [Scan] or [Add Device] for the slave device, and choose User Defined as the function block in the [General] interface.'

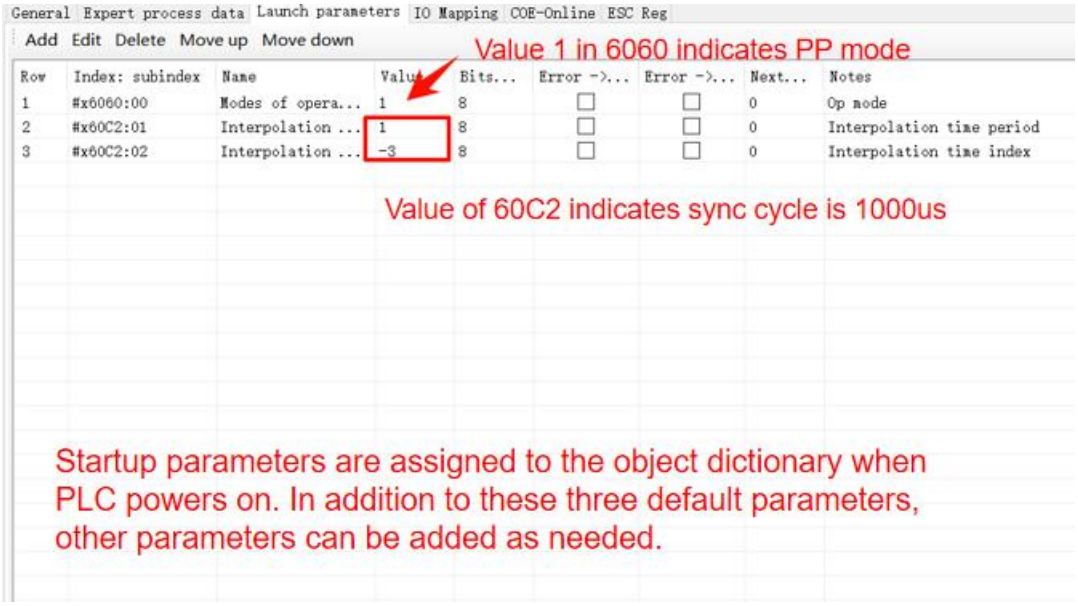




② In [Expert Process Data] → [PDO Allocation], check boxes 1600 and 1A00 to add PDO parameters associated with the mode (each parameter cannot exceed 32 bytes).

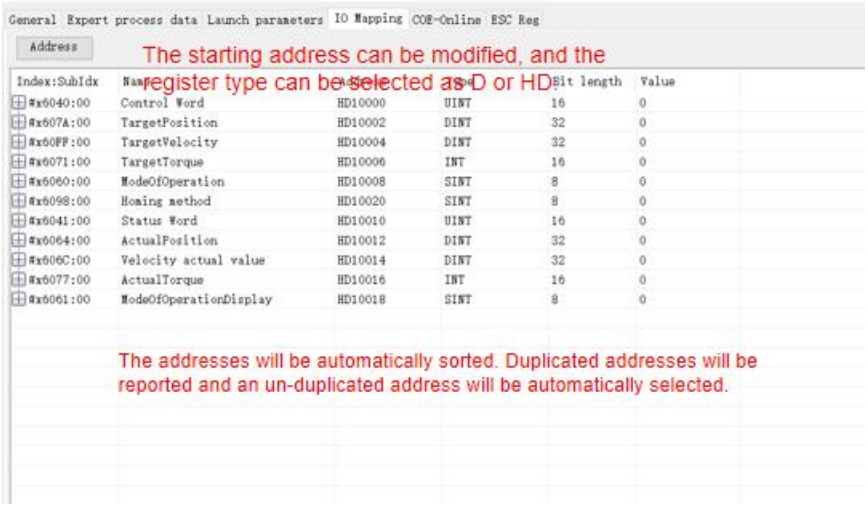


③ Ensure that the 6060h value in [Startup Parameters] is set to 1.



④ [IO Mapping]The default starting address is HD10000; it can be modified as needed.

⑤ After completing the parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect once activation and saving are successful.

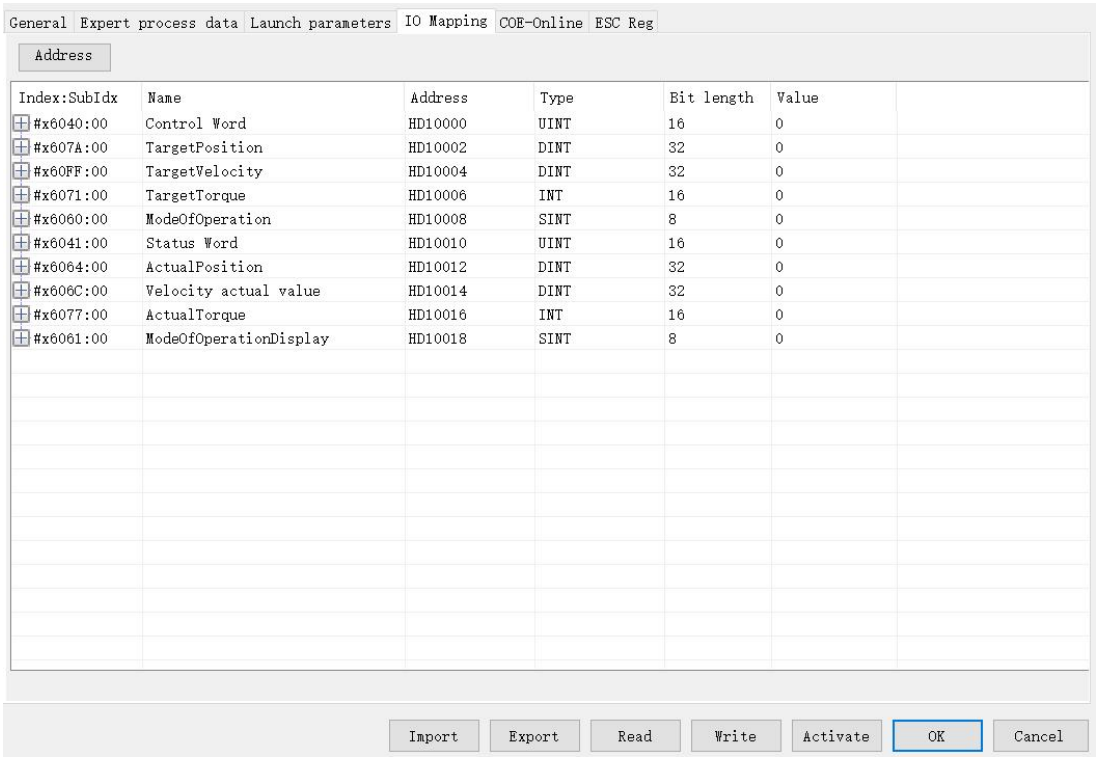


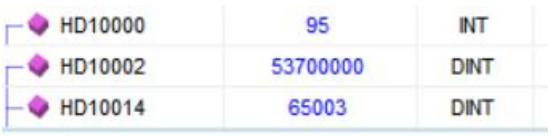
⑥ After activation is completed, the station state machine (SD8021) transitions from state 1 to 2, then to 4, and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception.

⑦ Modify control word 6040h (Absolute mode: 6→15→31; Relative mode: 6→79→95) to enable the slave unit, enabling motor movement by setting parameters such as target position, target speed, and acceleration/deceleration.

⑧ In PP mode, monitoring data can be configured via I/O mapping addresses. For example, the control word of Axis 1 can be modified using HD10000 (6040h mapping) to enable or disable the motor, while

the current position of Axis 1 can be monitored using HD10002 (607Ah mapping).





6) Example of PV Mode Operation

PV Control Mode Association Object (Command/Setting Category)

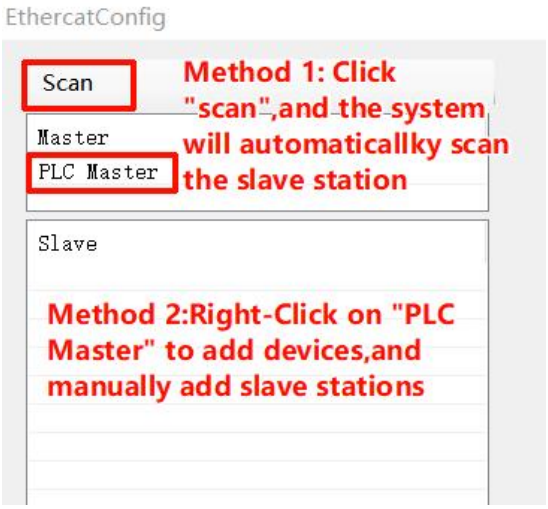
Register	Explanation	Unit
RXPDO[0x6040]	Control word	-
RXPDO[0x6060]	The control mode is PV (Profile Speed Control Mode); set its value to 3.	-
RXPDO[0x60FF]	Given speed	Unit/Unit of instruction
RXPDO[0x6072]	Maximum torque	0.1%
RXPDO[0x607F]	Maximum internal speed	Unit/Unit of instruction
RXPDO[0x6080]	Maximum motor speed	r/min
RXPDO[0x6083]	Internal acceleration	Unit of instruction /s²
RXPDO[0x6084]	Internal deceleration rate	Unit of instruction /s²
RXPDO[0x60C5]	Maximal acceleration	Unit of instruction /s²

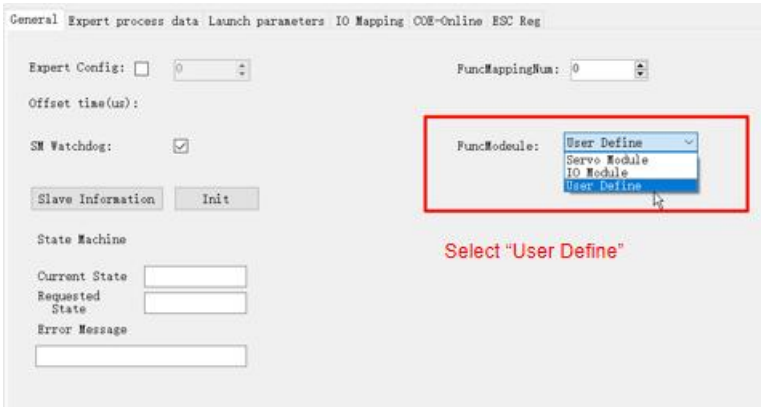
RXPDO[0x60C6]	Maximum deceleration	Unit of instruction /s²
RXPDO[0x606D]	Speed reaches the threshold	Unit/Unit of instruction
RXPDO[0x606E]	Speed timeout	ms
RXPDO[0x606F]	Speed Threshold	Unit/Unit of instruction
RXPDO[0x6070]	Speed threshold time	ms

PV control mode associated objects (instruction,monitoring type)

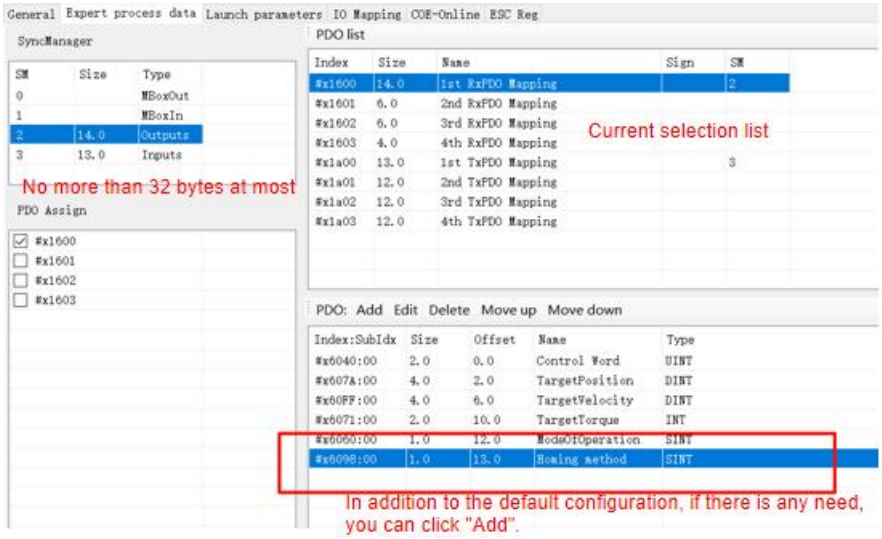
Register	Explanation	Unit
TXPDO[0x6041]	Status word	-
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Actual Torque	0.1%

① On the EtherCAT interface, select [Scan] or [Add Device] for the slave device, and choose User Defined as the function block in the [General] interface.

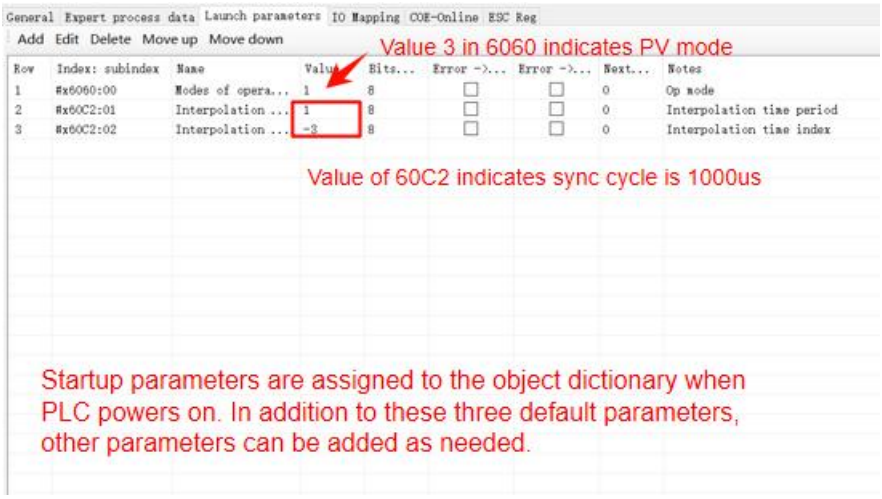




② In [Expert Process Data] → [PDO Allocation], check boxes 1600 and 1A00 to add PDO parameters associated with the mode (each parameter cannot exceed 32 bytes).

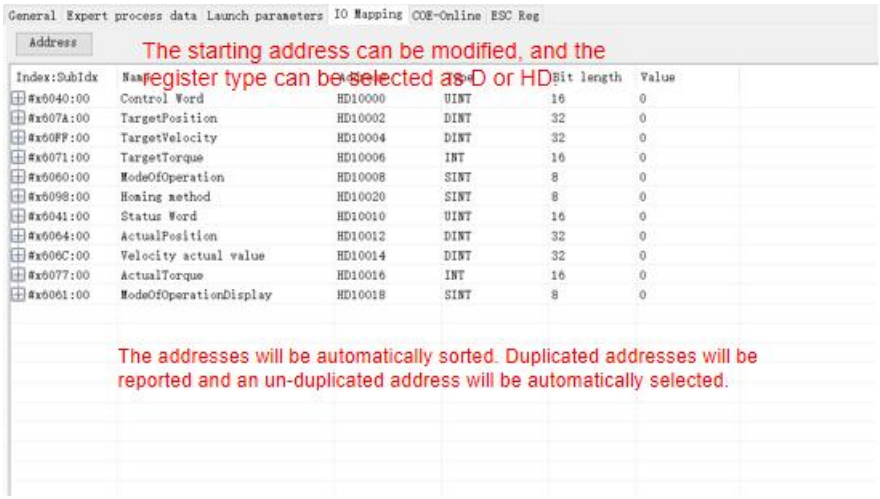


③ Ensure that the 6060h value in [Startup Parameters] is set to 3.



④ [IO Mapping] The starting address can be cuSTOmized.

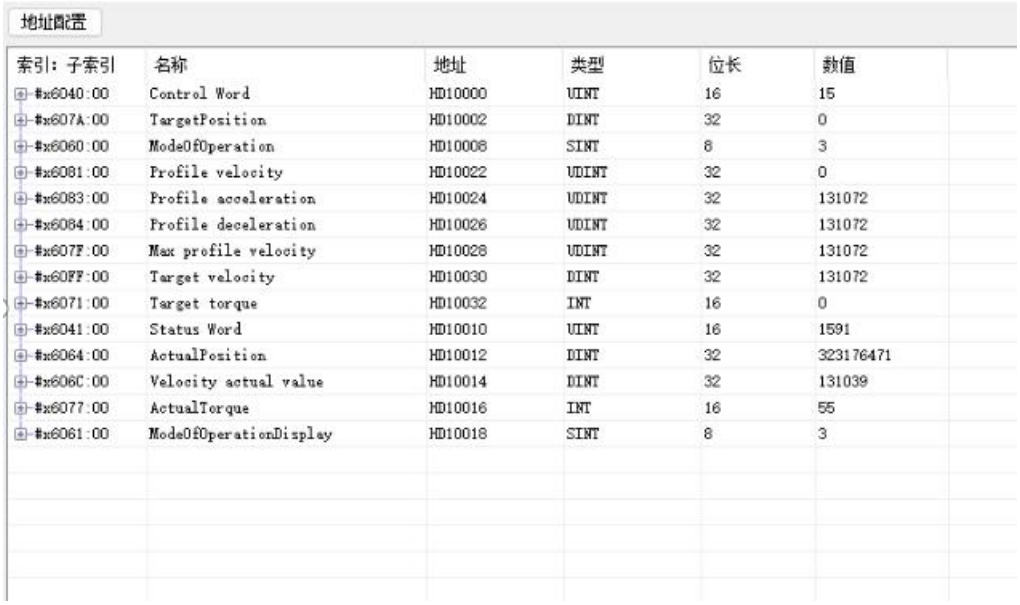
⑤ After completing the parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect once activation and saving are successful.



⑥ After activation is completed, the station state machine (SD8021) transitions from state 1 to 2, then to 4, and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception.

⑦ Modify control word 6040 (6→15) to enable the slave unit, and drive the motor by setting parameters such as target speed and acceleration/deceleration.

⑧ In PV mode, monitoring data can be configured via I/O mapping addresses. For example, the control word of Axis 1 can be modified using HD10000 (mapping to 6040h) to enable or disable the motor; the actual position of the motor on Axis 1 can be monitored via HD10012 (mapping to 6064h), and its current speed can be monitored via HD10014 (mapping to 606Ch).



HD10000	15	INT
HD10012	315360395	DINT
HD10014	130324	DINT

7) TQ Mode Operation Example

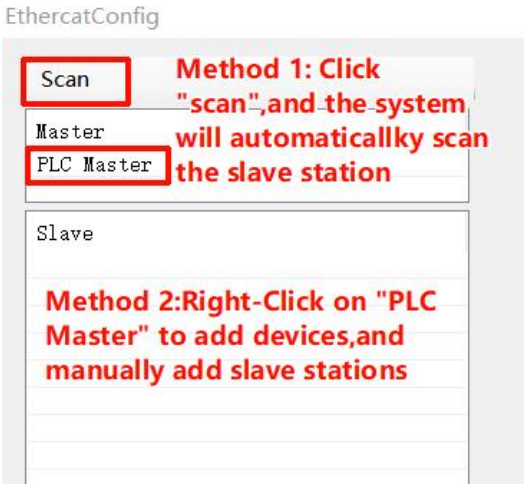
TQ Control Mode Associated Object (Command/Setting Category)

Register	Explanation	Unit
RXPDO[0x6040]	control word	-
RXPDO[0x6060]	The control mode is tq (Profile Torque Control Mode); set its value to 4.	-
RXPDO[0x6071]	Given target torque	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	-

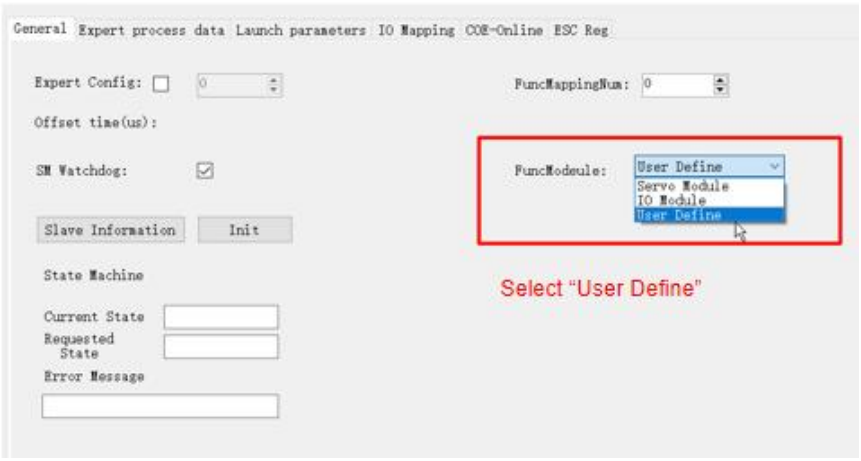
TQ Control Mode Associated Objects (Command/Monitoring Category)

Register	Explanation	Unit
TXPDO[0x6041]	status word	-
TXPDO[0x6064]	Position feedback (actual motor position)	Command Unit
TXPDO[0x606C]	rate feedback	Unit/Unit of instruction
TXPDO[0x6077]	Actual Torque	0.1%

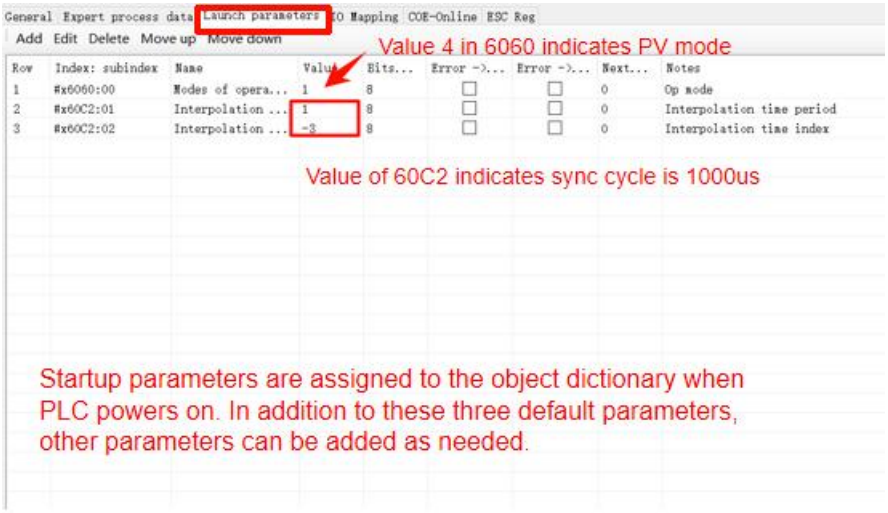
① On the EtherCAT interface, select [Scan] or [Add Device] for the slave device, and choose User Defined as the function block in the [General] interface.



② In [Expert Process Data]→[PDO Allocation], check boxes 1600 and 1A00 to add PDO parameters associated with the mode (each parameter cannot exceed 32 bytes).

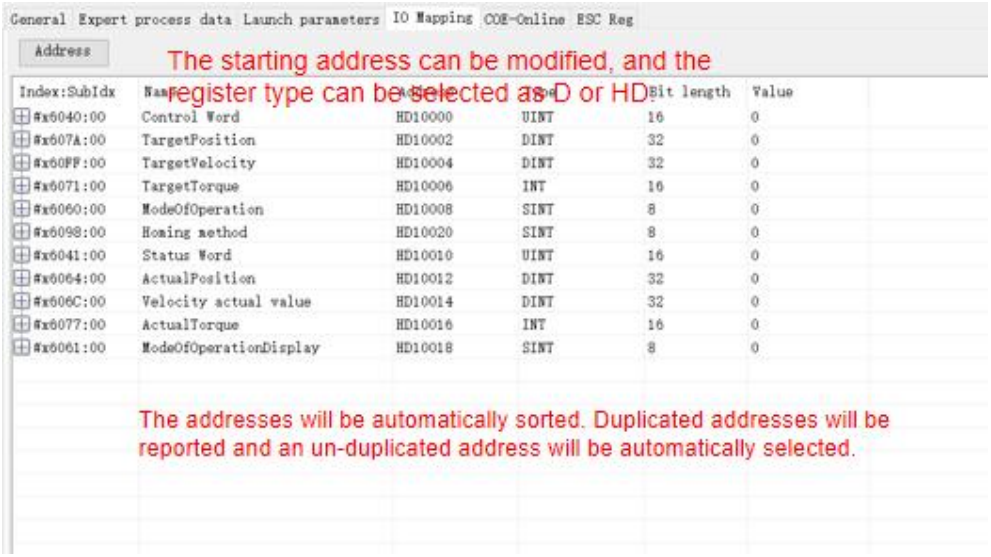


③ Confirm that the 6060h value in [Startup Parameters] is set to 4.



④ [IO Mapping] The starting address can be cuSTOmized.

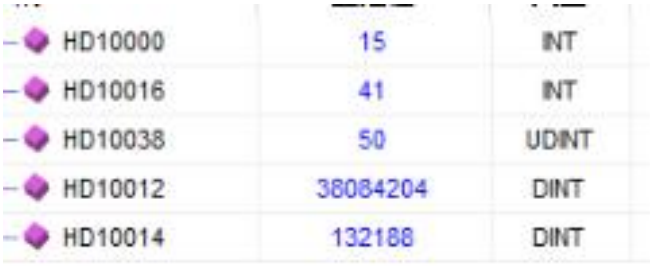
⑤ After completing the parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect once activation and saving are successful.



⑥ After activation is completed, the station state machine (SD8021) transitions from state 1 to 2, then to 4, and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception.

⑦ Modify control word 6040 (from 6 to 15) to enable the slave device, and drive the motor by setting parameters such as target torque and torque rate.

⑧ In tq mode, monitoring data can be configured via I/O mapping addresses. For example, the control word of Axis 1 can be modified using HD10000 (mapping to 6040h) to enable or disable the motor; the actual torque of the motor on Axis 1 can be monitored using HD10016 (mapping to 6077h); and the torque slope of Axis 1 can be set using HD10038 (mapping to 6087h).



8) Probe functionality example (using the Xinje DS5C1-20P4-PTA servo as an example; the operation method for DS5C2 is identical to that of DS5C1)

Probe Function Association Object

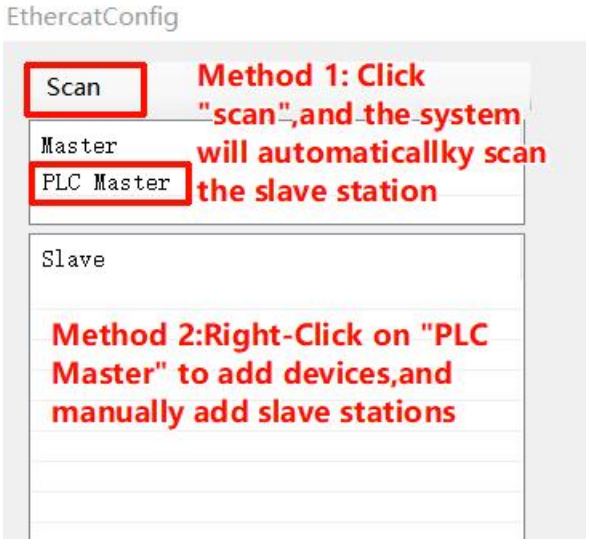
Index	Sub index	Name	Unit
60B8h	00h	Probe Function Settings	-
60B9h	00h	Indicates the status of the touch probe function	-
60BAh	00h	Indicates the rising edge clamping position of Touch Probe 1	Command Unit

60BBh	00h	Indicates the clamping position of the falling edge of Touch Probe 1	Command Unit
60BCh	00h	Indicates the rising edge clamping position of Touch Probe 2	Command Unit
60BDh	00h	Indicates the clamping position of the falling edge of Touch Probe 2	Command Unit

① External wiring and probe terminal assignment: P5-62 and P5-63 are designated for probe function terminals. Probe 1 can only be assigned to SI1, while Probe 2 can only be assigned to SI2. When assigning SI1, write '1' into P5-62; when assigning SI2, write '2' into P5-63.

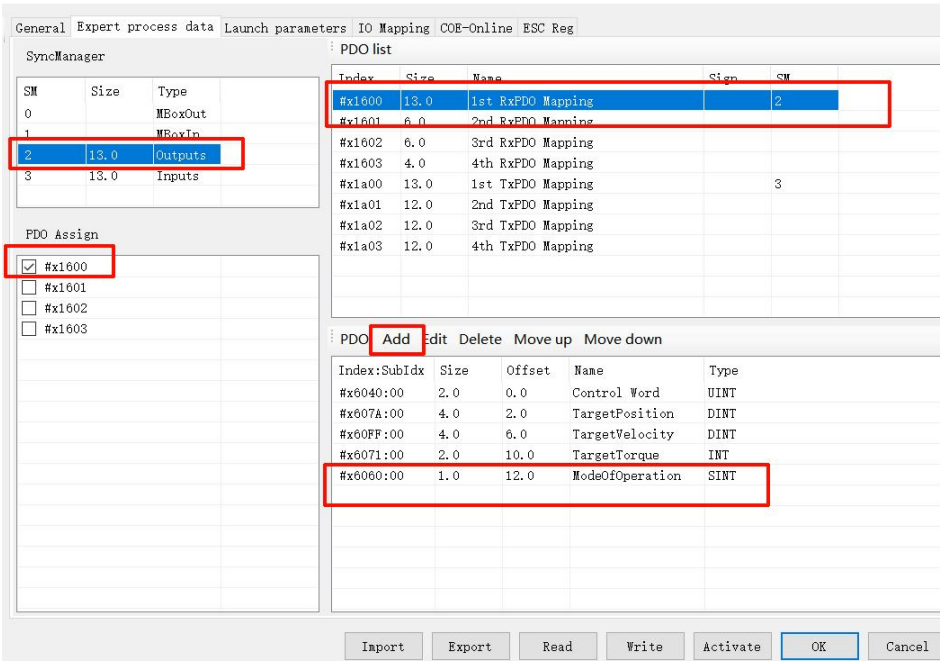
Product model	Factory default value		Settings when using the probe function	
	P5-62	P5-63	P5-62 (Terminal)	P5-63 (Terminal)
DS5C2 (7.5 kW and below)	0	0	1 (SI1)	2 (SI2)
DS5C2 (15~32kW)	6	7	6 (P-)	7 (D-)

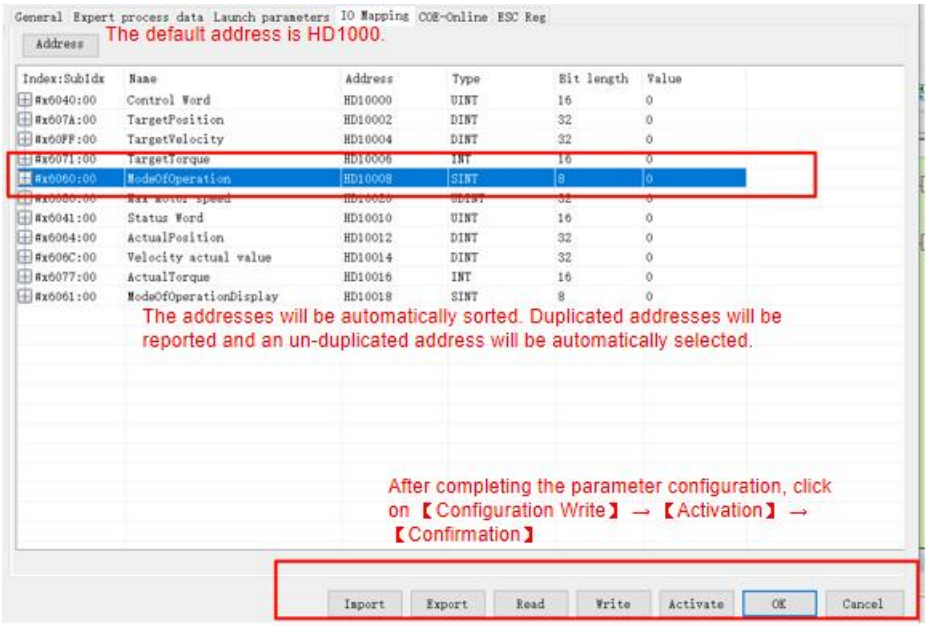
② On the Ethercat interface, select [Scan] or [Add Device] for slaves; on the [General] interface, use the default configuration.



③ When a level signal connected to 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 read the probe value, the corresponding probe value object (0X60BA–0X60BD) must be added to TxPDO for data acquisition.

[Expert Process Data]→ In [PDO Allocation], select 1600 and 1A00; add 60B8h to 1600, and add 60BAh and 60BCh to 1A00 (this example uses the rising edges of the two probe signals; for falling edges, add 60BBh and 60BDh).





④[IO Mapping]The default starting address is HD10000; it can be modified as needed.

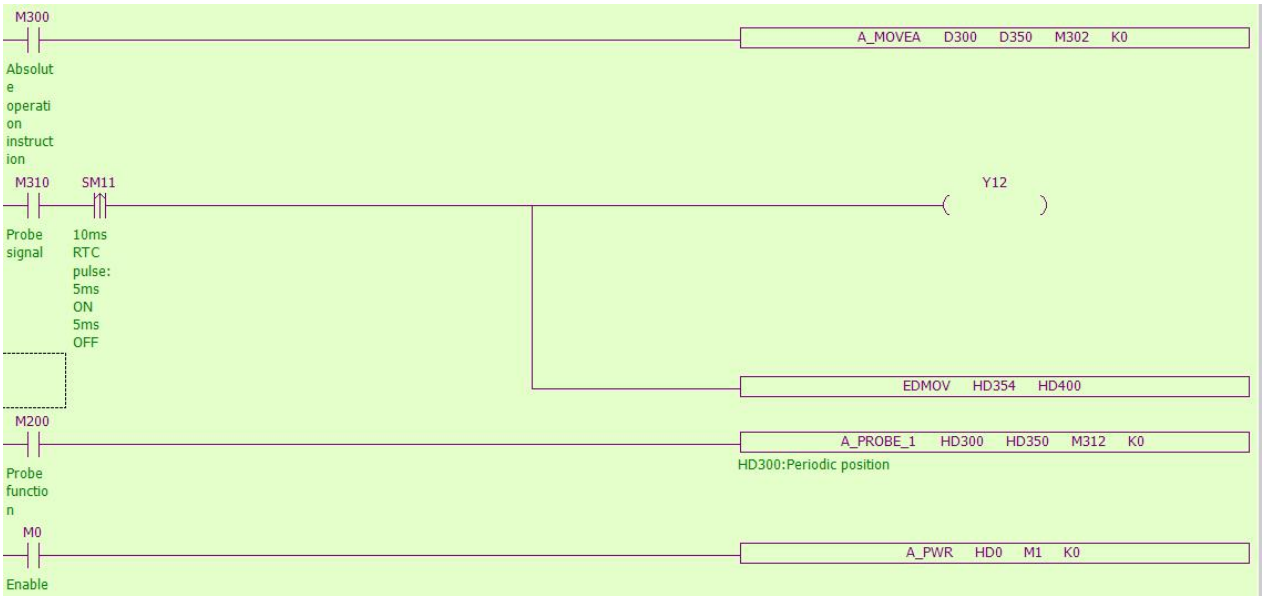
⑤ After completing the parameter configuration, click [Configure and Write] → [Activate] → [OK]. The parameters will take effect upon successful activation.

#x6040:00	Control Word	HD10000	UINT	16	6
#x607A:00	TargetPosition	HD10002	DINT	32	-4
#x60FF:00	TargetVelocity	HD10004	DINT	32	0
#x6071:00	TargetTorque	HD10006	INT	16	0
#x6060:00	ModesOfOperation	HD10008	SINT	8	8
#x60B8:00	Touch Probe Function	HD10020	UINT	16	0
#x6041:00	Status Word	HD10010	UINT	16	561
#x6064:00	ActualPosition	HD10012	DINT	32	-4
#x606C:00	Velocity actual value	HD10014	DINT	32	15
#x6077:00	ActualTorque	HD10016	INT	16	0
#x6061:00	ModesOfOperationDisplay	HD10018	SINT	8	8
#x60BA:00	Touch Probe Pos1 Pos Value	HD10022	DINT	32	0
#x60BC:00	Touch Probe Pos2 Pos Value	HD10024	DINT	32	0
#x60B9:00	Touch Probe Status	HD10026	UINT	16	0
#x60BB:00	Touch Probe Pos1 Neg Value	HD10028	DINT	32	0
#x60BD:00	Touch Probe Pos2 Neg Value	HD10030	DINT	32	0

⑥ After activation is completed, the station state machine (SD8021) transitions from state 1 to 2, then to 4, and finally to 8, where state 8 indicates the OP state. At this point, both SDO and PDO can perform data transmission and reception.

⑦ After enabling the slave device, the probe function can be activated by modifying the HD10024 mapping (specifically, the 60B8h mapping).

⑧ After enabling the probe function, the rising edge bit values of Probe 1 can be monitored via HD10022 (60BAh mapping), those 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).



M0	ON	BIT	Bit	Enable
M1	ON	BIT	Bit	Enable status
D10	0	UINT	Single word	Control mode
M300	OFF	BIT	Bit	Absolute move command
D300	1000000000	LREAL	Quad word	Target absolute position
D304	10000	LREAL	Quad word	Target velocity
D308	5000	LREAL	Quad word	Acceleration
D312	5000	LREAL	Quad word	Deceleration
D316	100	LREAL	Quad word	Jerk
M302	OFF	BIT	Bit	Absolute positioning completed status
M200	ON	BIT	Bit	Probe function
M310	ON	BIT	Bit	Probe signal
Y12	OFF	BIT	Bit	Probe S11 signal status
SM11	ON	BIT	Bit	10ms clock pulse: 5ms ON 5ms OFF
M310	ON	BIT	Bit	Probe signal
HD354	99140	LREAL	Quad word	Probe latched position
HD358	9965	LREAL	Quad word	Probe latched velocity
HD400	99140	LREAL	Quad word	Position storage register
HD10012	466533	DINT	Double word	Station ID:0,#x6064:0,Actual position

14.2 Befei TwinCAT and Xinje DS5C2 Servo EtherCAT Communication Example

This example demonstrates how the Beckhoff TWINCAT control software functions as the EtherCAT master station while the XINJE servo acts as the slave station, enabling EtherCAT motion control.

14.2.1 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
Xinje Servo	DS5C2-41P0-PTA	1	
Ethernet cable	JC-CA-3	Several	For connecting the computer to the servo

14.2.2 System topology

The two communication ports of the Xinje DS5C2 series servo drives adhere to the "bottom-in, top-out" principle: the master station must connect to the port below CN1 of the first servo, then the port above the first servo connects to the port below the second servo, and so on.

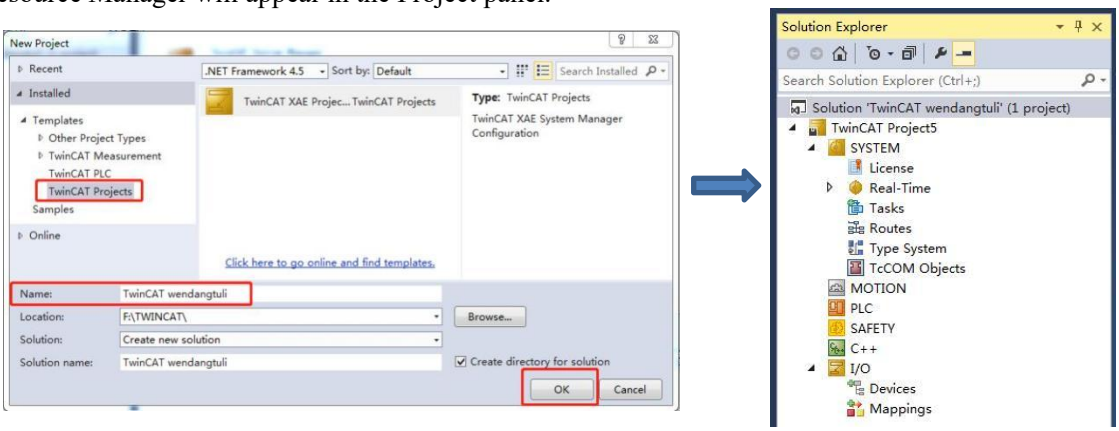
14.2.3 Debugging Steps

1) Add an XML file

Before launching the software, copy the DS5C2 servo device description XML file to Twincat's installation directory—the default path is C:\TwinCAT\3.1\Config\Io\EtherCAT.

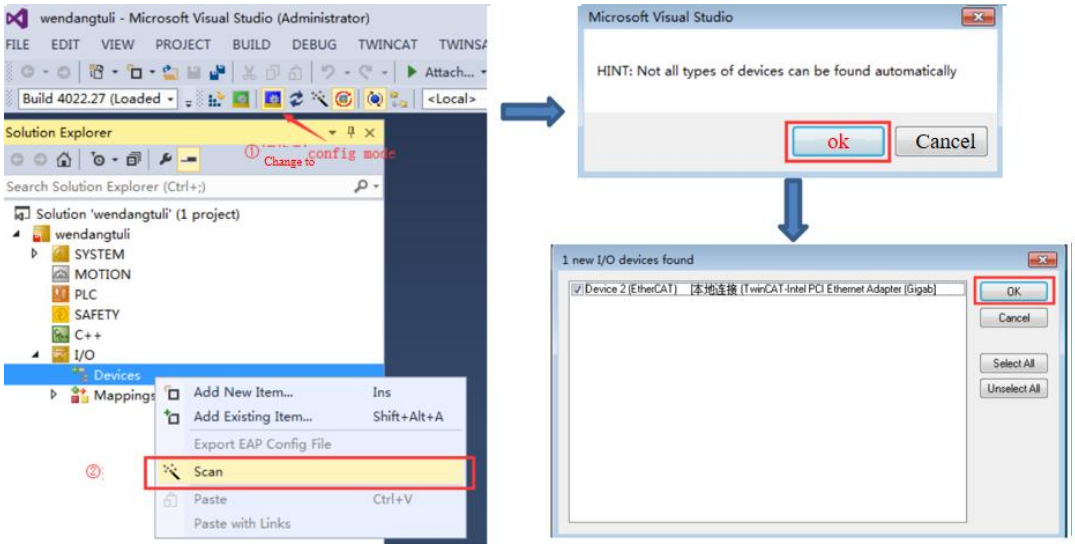
2) New Project

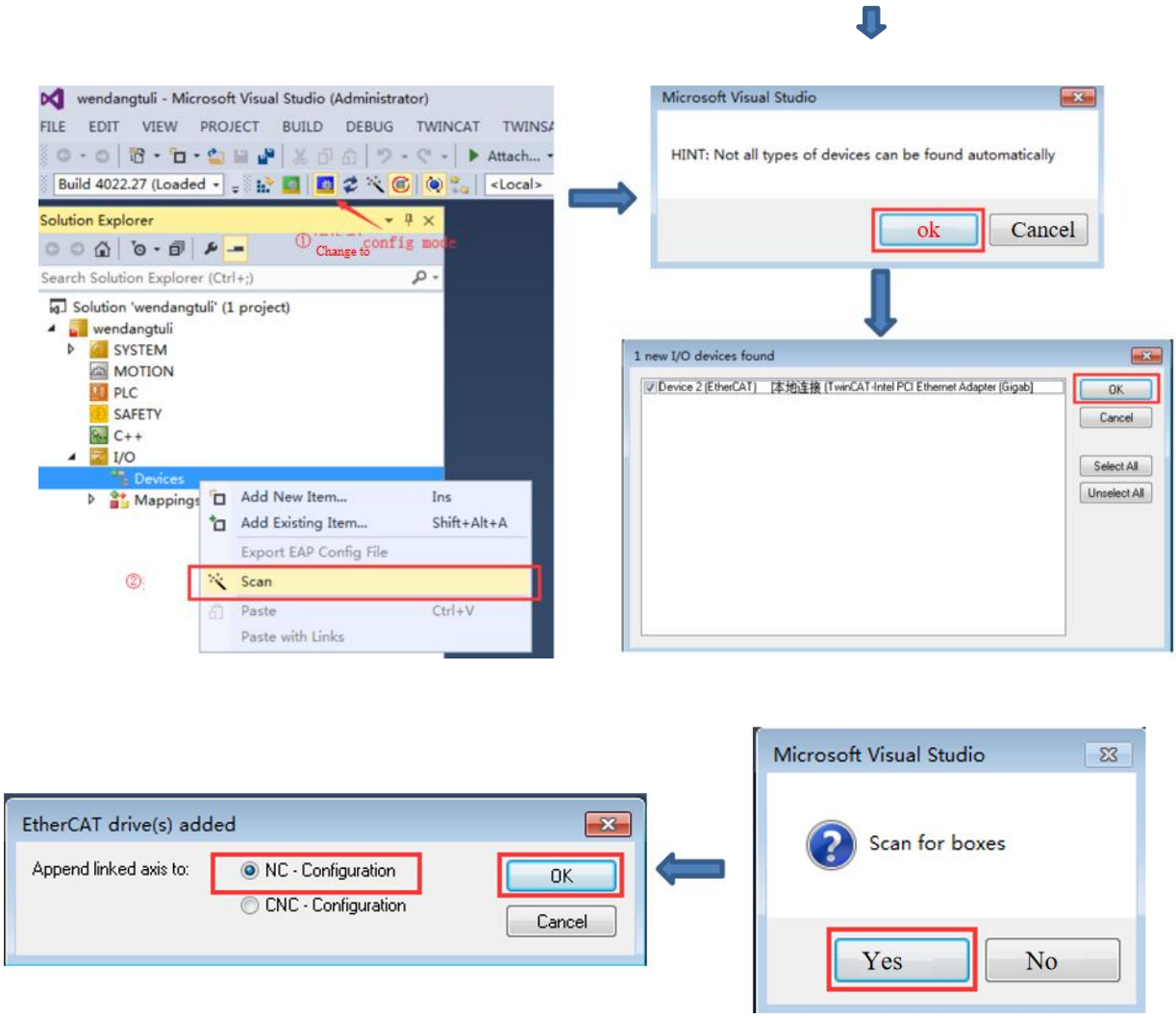
Double-click to open the TwinCAT XAE (VS 2013) software and create a new project:
(1) Execute FILE—NEW—Project;
(2) Select the TwinCAT Project, enter the project name and save path, then click OK. The Attribute Resource Manager will appear in the Project panel.



3) Hardware Scan

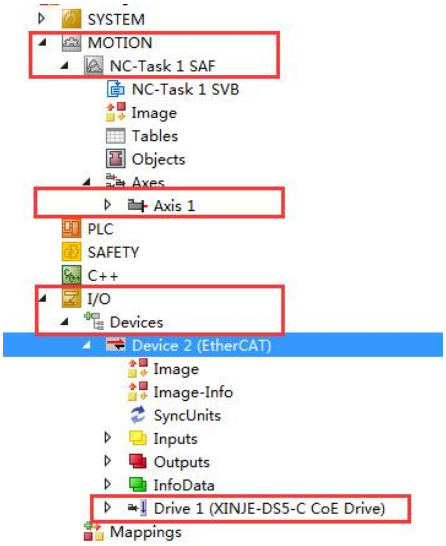
If the controller is not in config mode, click this icon to switch it to config mode first, then right-click the Device and select Scan to scan the Ethercat slave.





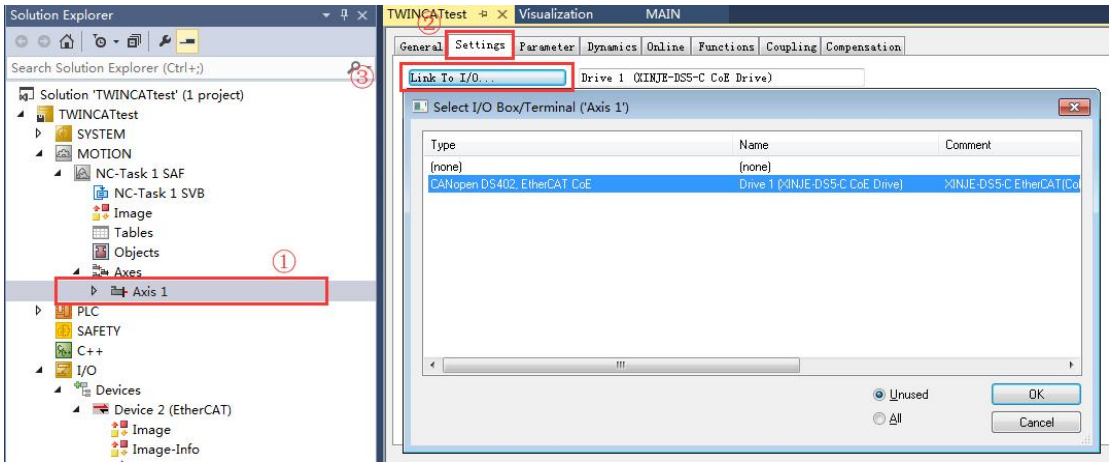
Scan until the end and automatically add to NC mode.

After completion of the scan, an NC axis Axis1 corresponding to the servo-connected motor can be observed in Motion, while the scanned driver DS5C2 is visible in Device.



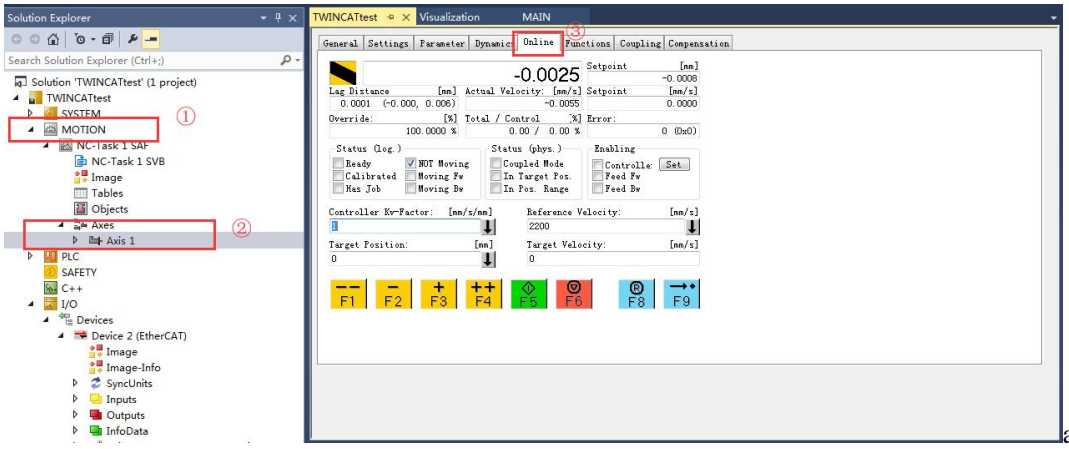
4) Link NC axis and physical axis

You can select the physical axis associated with the NC axis through Axis1-Settings-Link. This link is automatically added during hardware scanning, or you can manually right-click the axis and select Append axis to link the NC axis to a physical axis. The window displays the correspondence between the NC axis and the physical axis.



5) Debugging via the NC-Online interface

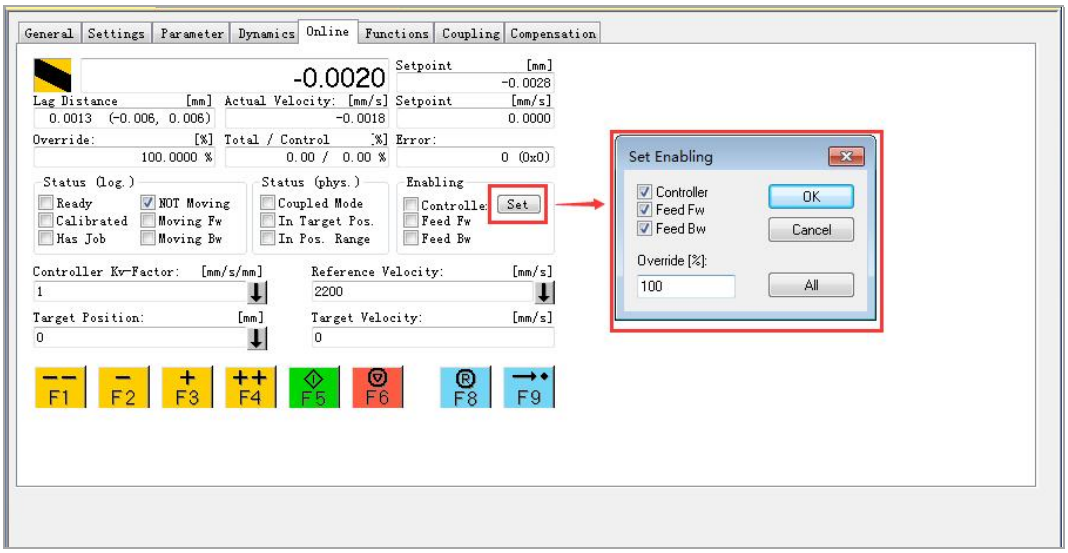
(1) Click the icon to activate configuration, switch TwinCAT to the run mode, then sequentially select Motion-Axis1-Online to debug the servo



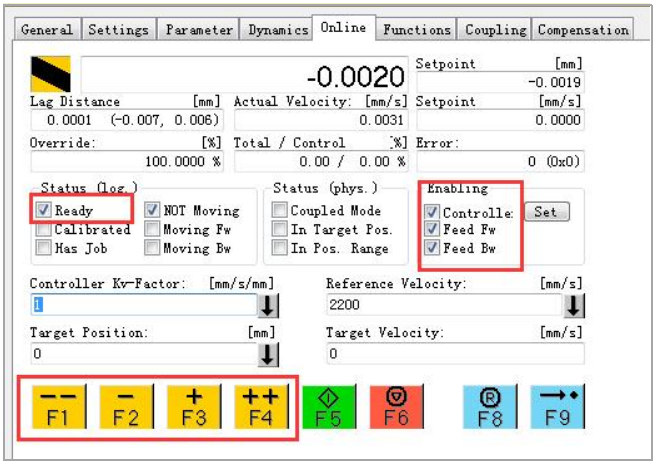
axis.

If the current axis position is not visible on the Online tab, verify that the motor model has been correctly added and that the configuration activation procedures have been completed properly.

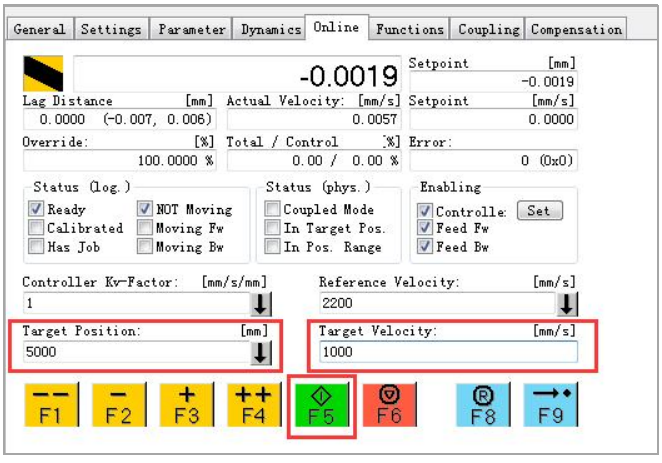
(2) Click Set, manually check Controller, Feed Fw, and Feed Bw, and configure theOverride (speed ratio), then click OK; alternatively, directly click ALL to enable all axes, setting the speed ratio automatically to 100%.



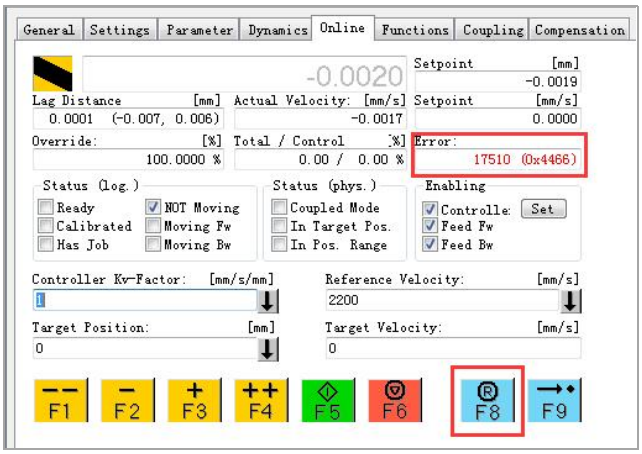
(3) If the Ready status is checked, it indicates that the motor is enabled. At this point, the shaft can be operated via F1–F4 for spot movements. The spot movement speed is set in the Manual Velocity field of the Parameter tab, with default values of 100 mm/s for slow spot movements and 600 mm/s for fast spot movements.



(4) After setting the Target Position and Target Velocity, press F5 to activate position control; the motor will move to the specified target position. This is absolute positioning, and you can use F6 to pause during the process.



(5) When an NC error occurs, the Error message displays the corresponding error code. To reset the error, press F8; otherwise, the axis cannot continue its operation. F9 is the origin-seeking button: pressing it sets the axis position to 99999... and initiates slow movement. However, the origin signal requires external hardware input and cannot be captured in the Online window. Therefore, F9 is generally not used for origin restoration; instead, this function is implemented through programming within the system.

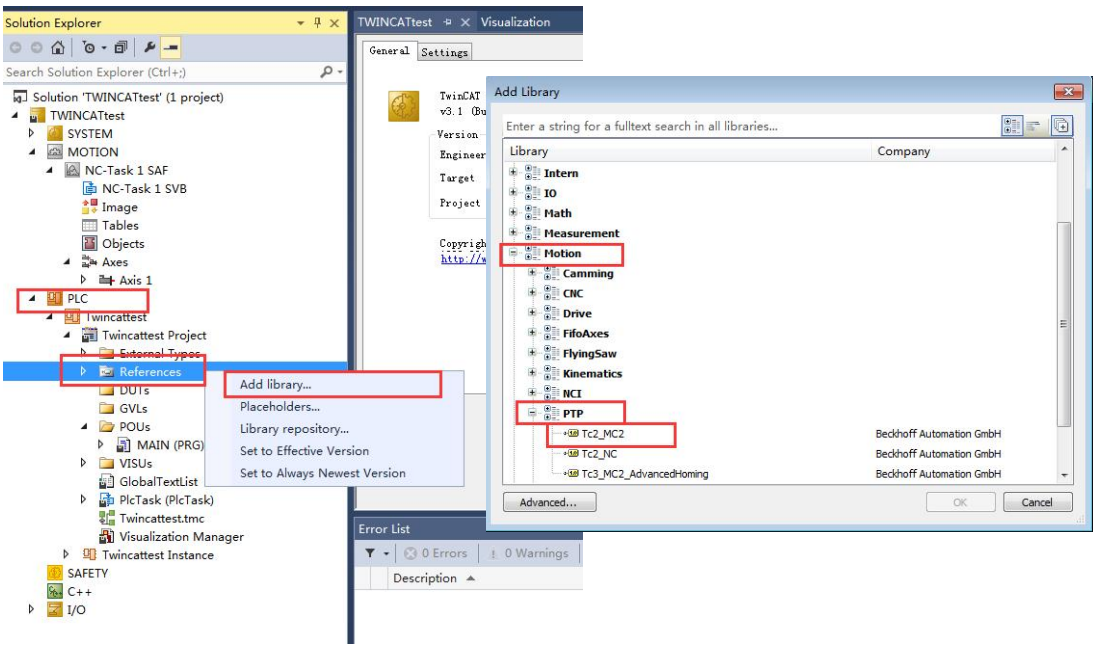


For more single-axis debugging features, refer to the "TC3 Training Manual V1.1.0".

6) Control the DS5C2 servo motor via PLC control programming

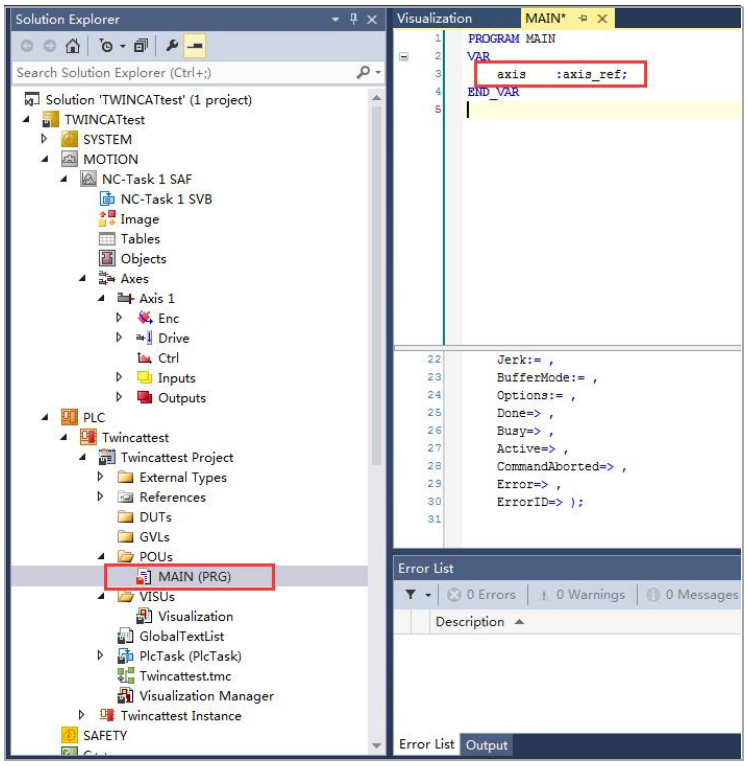
(1) Add the motion control library file and axis type variables

Create a new project in the PLC, expand it, locate the References section below, right-click and select Add Library. In the dialog box that appears, navigate to Motion--PTP--TC2-MC2 and choose Add. This completes the addition of a library file to the PLC.

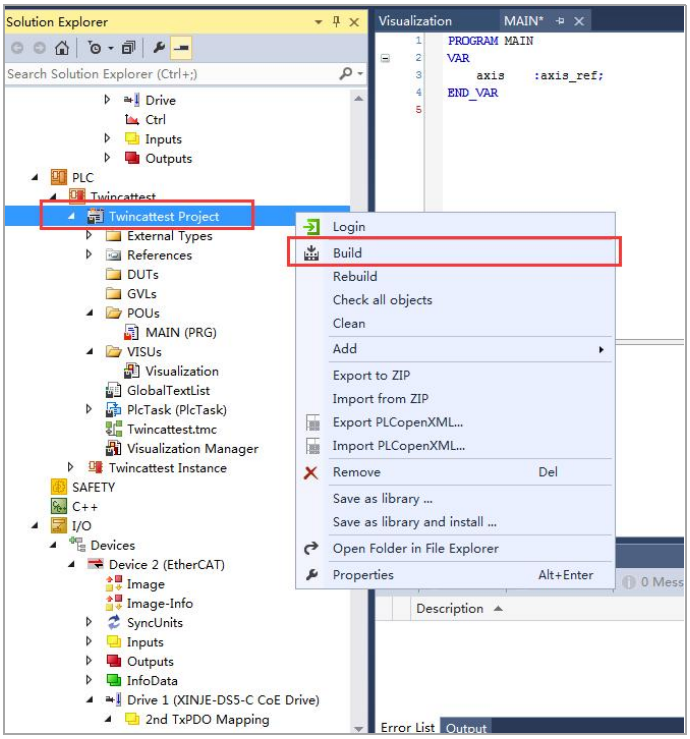


In the main program of the POU, create a variable of the Axis_ref type. Axis_ref is a structure primarily

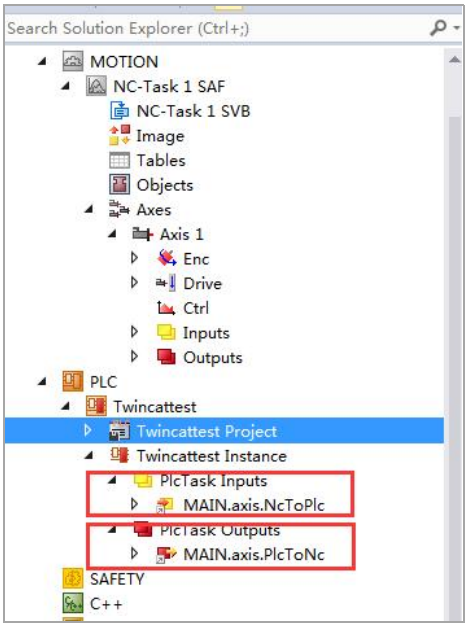
used for data exchange between NC and PLC, and it also contains other internal structures. We refer to this Axis_ref type variable as the axis variable.



After completing the program, compile it to check for errors. In this example, the project is named Twincattest; locate the Twincattest Project, right-click it, select Build, and click OK.

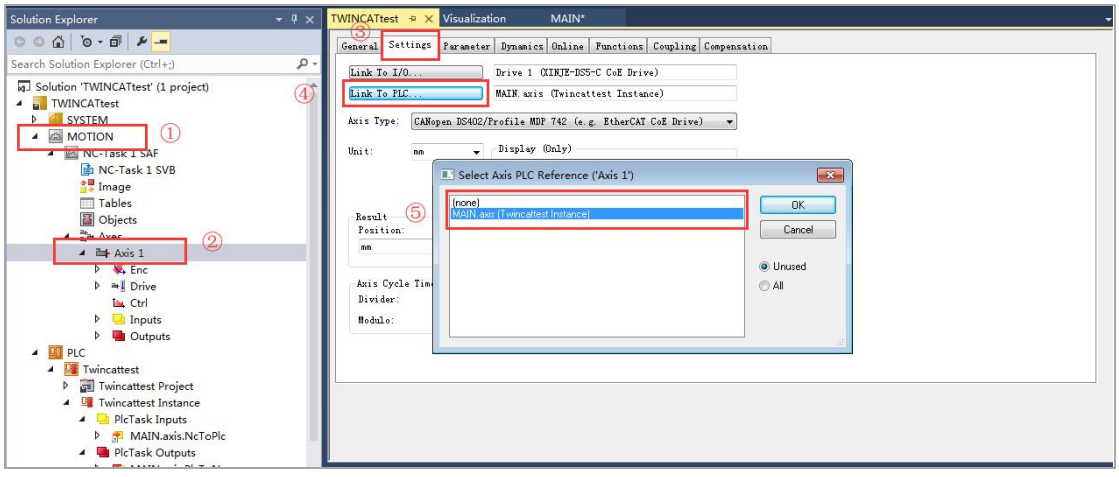


After successful compilation, the corresponding variables will appear in the Instanc directory of the project. Upon successful Build compilation, you can observe two variables bound under PlcTask Inputs and PlcTask Outputs respectively within the Twincattest instance.



(2) Variable linking between NC and PLC

In Motion, expand the Axis section, locate the created NC axis Axis1, and double-click it. In the right-side interface, find the 'Link to PLC' option under the Settings tab, then connect Axis1 to the corresponding PLC. This connection enables data exchange between the NC and PLC.

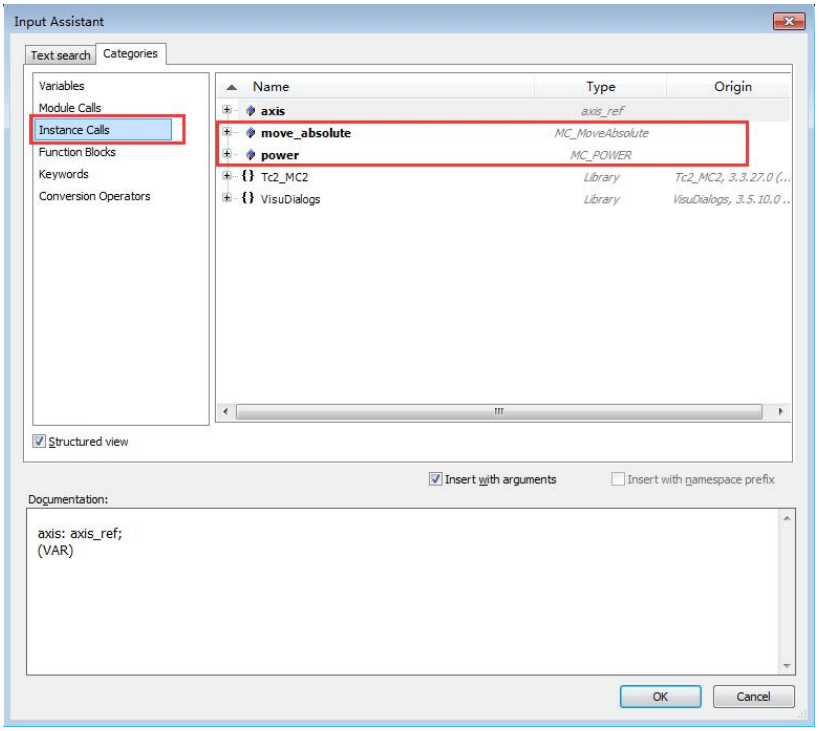


(3) Call the function block to control axis movement

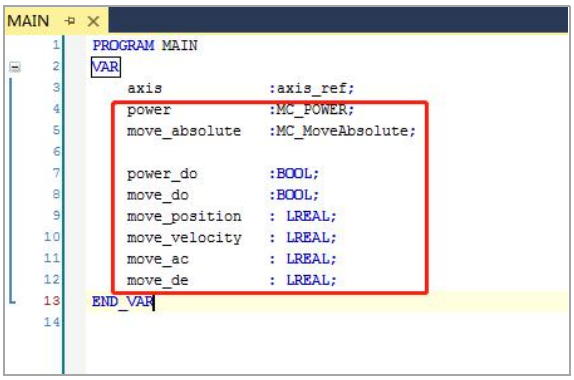
In the POUs-MAIN (PRG) interface, declare an MC_power function block and an MC_MoveAbsolute function block. The MC_power block controls axis enablement, while the MC_MoveAbsolute block controls absolute position movement of the axis.

```
PROGRAM MAIN
VAR
    axis            :axis_ref;
    power           :MC_POWER;
    move_absolute   :MC_MoveAbsolute;
```

In the program editing window, press F2, then select power and move_absolute from Categories → Instance Calls to invoke the defined function block in the program.



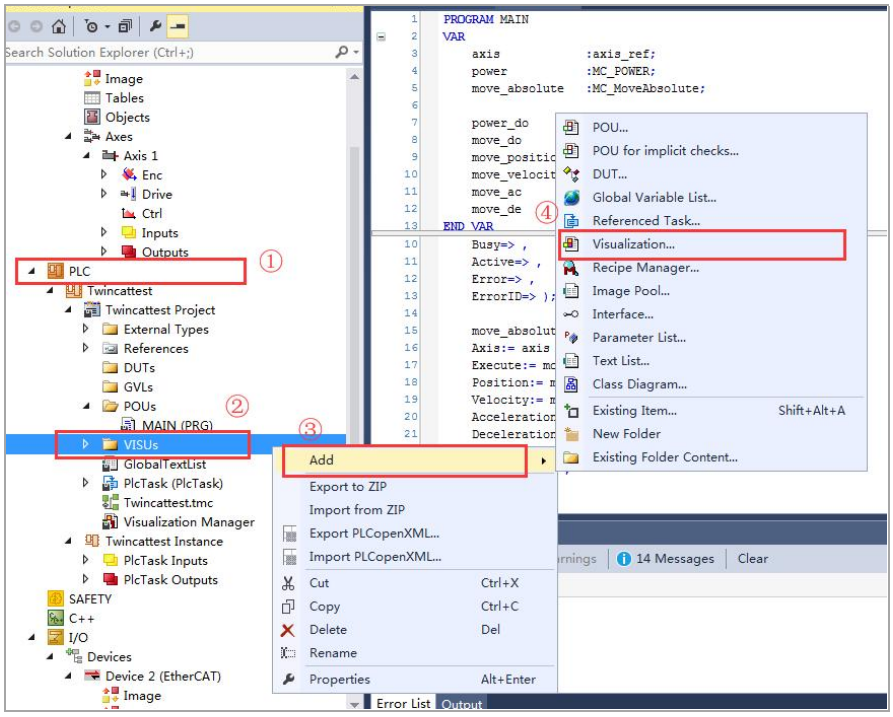
Complete the parameters in the function block: Enable indicates the enabling bit; Enable_Positive allows forward rotation, while Enable_Negative allows reverse rotation; Overwrite specifies the speed ratio; Axis denotes the corresponding axis; Position indicates the positioning location; Velocity represents the positioning speed; Acceleration denotes acceleration; and Deceleration denotes deceleration. Additionally, declare two boolean variables, power_do and move_do, as trigger bits for the enabling and absolute position motion function blocks, respectively. Also declare a real-type variable to store the absolute position, velocity, and acceleration values for the absolute position motion.



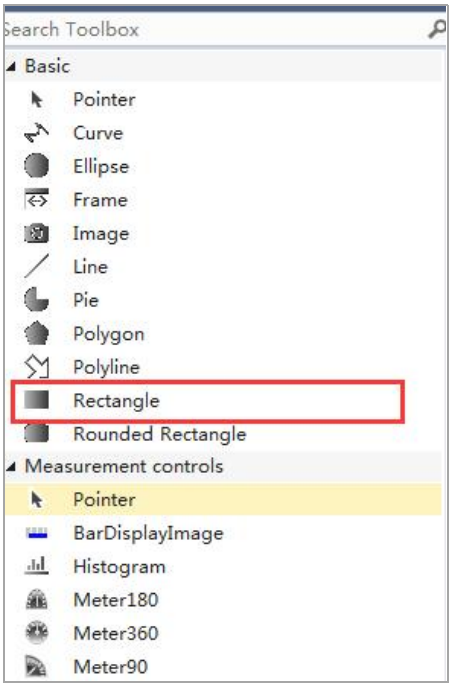
```
move_absolute(
Axis:= axis ,
Execute:= move_do ,
Position:= move_position,
Velocity:= move_velocity,
Acceleration:= move_ac,
Deceleration:= move_de,
Jerk:= ,
BufferMode:= ,
Options:= ,
Done=> ,
Busy=> ,
Active=> ,
```

```
power(
Axis:= axis,
Enable:= power_do,
Enable_Positive:=TRUE ,
Enable_Negative:=TRUE ,
Override:= ,
BufferMode:= ,
Options:= ,
Status=> ,
Busy=> ,
Active=> ,
Error=> ,
ErrorID=> );
```

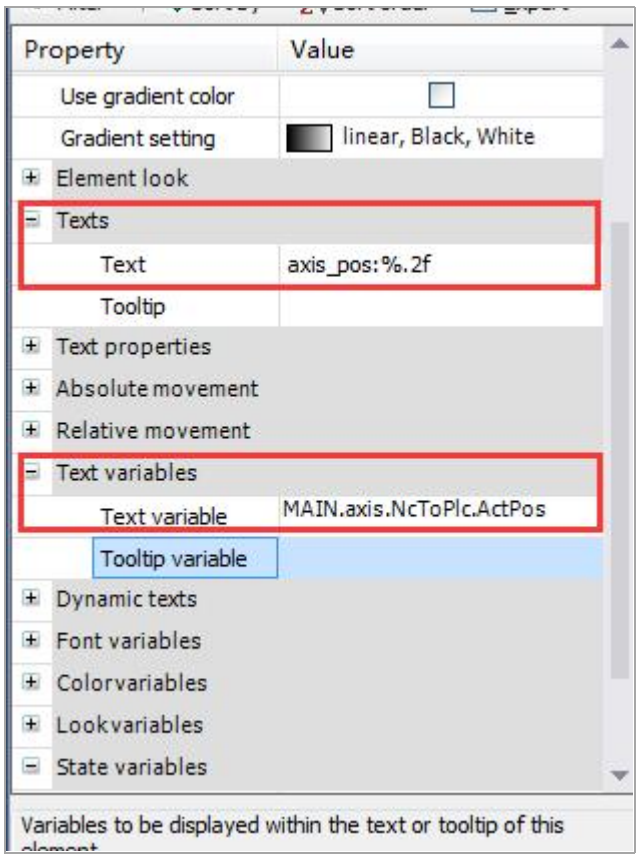
Right-click on VISU below the PLC, select Add from the pop-up menu, then choose Add Visualization from the new menu to create a visualization interface.



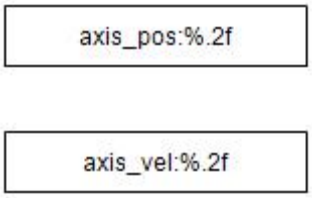
In the toolbar of the added Visu interface, select the rectangular box and drag out a control. Double-click the rectangular box control to configure it.



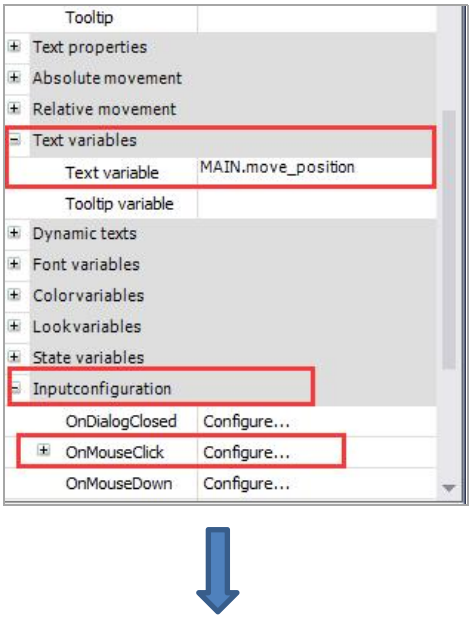
Double-click the control and, under the Properties tab on the right, make the following settings: Text → Text Input Axis Pos:%2f. The%2f indicates that the floating-point data type displays the value of the associated variable (i.e., the variable pointed to by the Text Variable) with only two decimal places retained. Text Variables → Text Variable Input MAIN_axis.NcToPlc.ActPos specifies the actual position of this control on the axis variable.

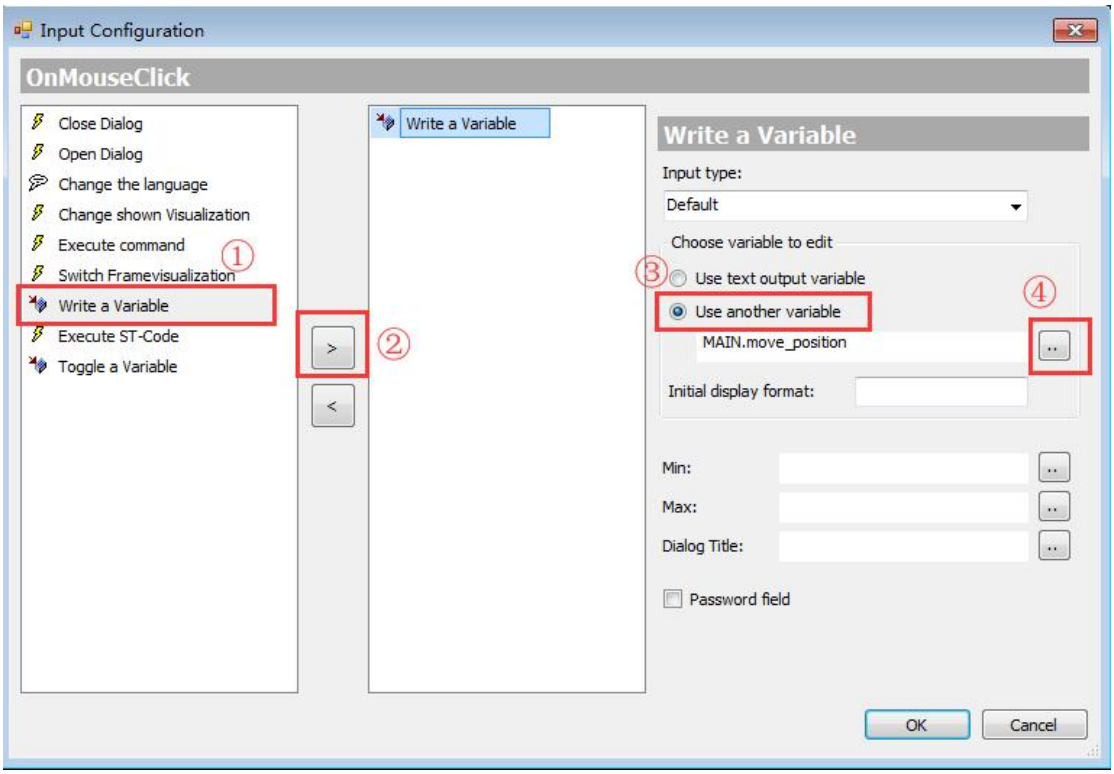


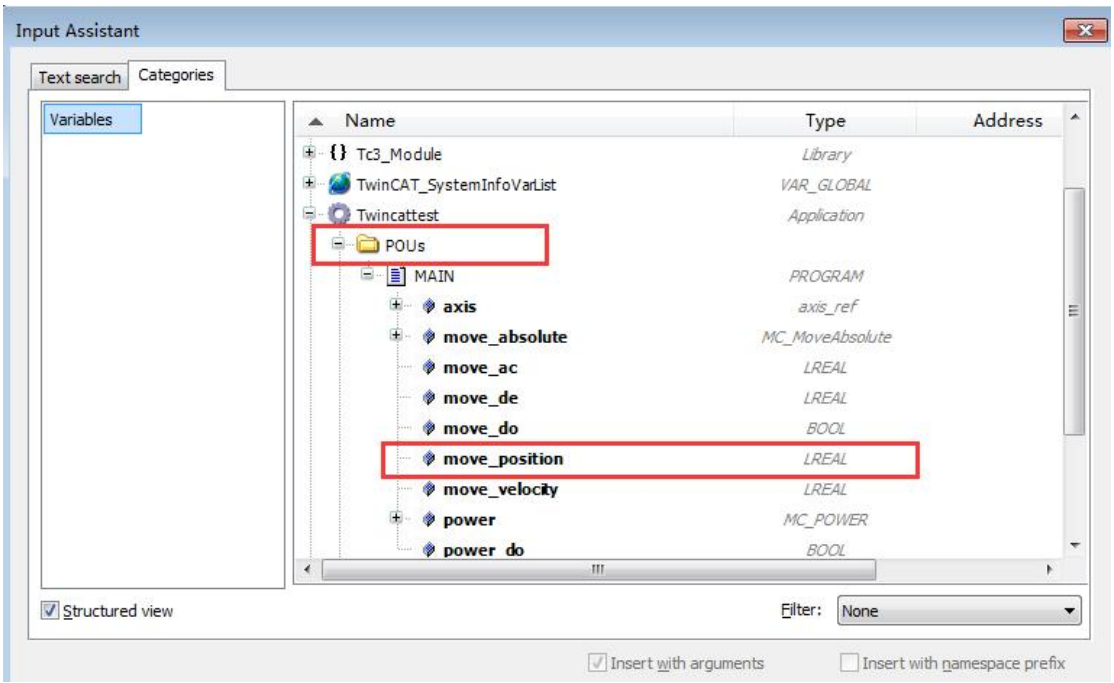
Add another control to display the current axis speed; the Text variable should be set toMAIN.axis.NcToPlc.ActVelo.



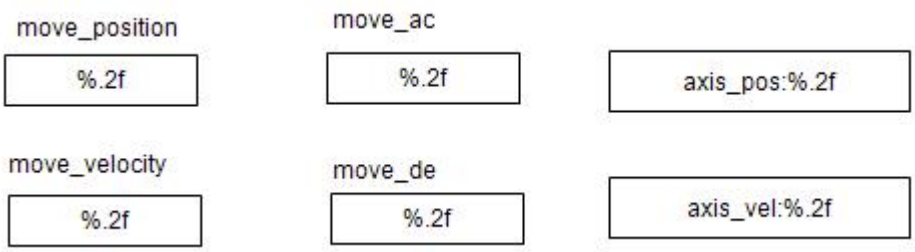
Add a rectangle control to input the target position value for absolute position movement. The steps are as follows: Create a rectangle control and use Text Variable to display MAIN.move_position (a real-type variable added in the program). Click InputConfiguration → OnMouseClick, select Write a Variable in the pop-up interface, click> Add Function, and choose Use another variable pointing to MAIN.move_position on the right side.



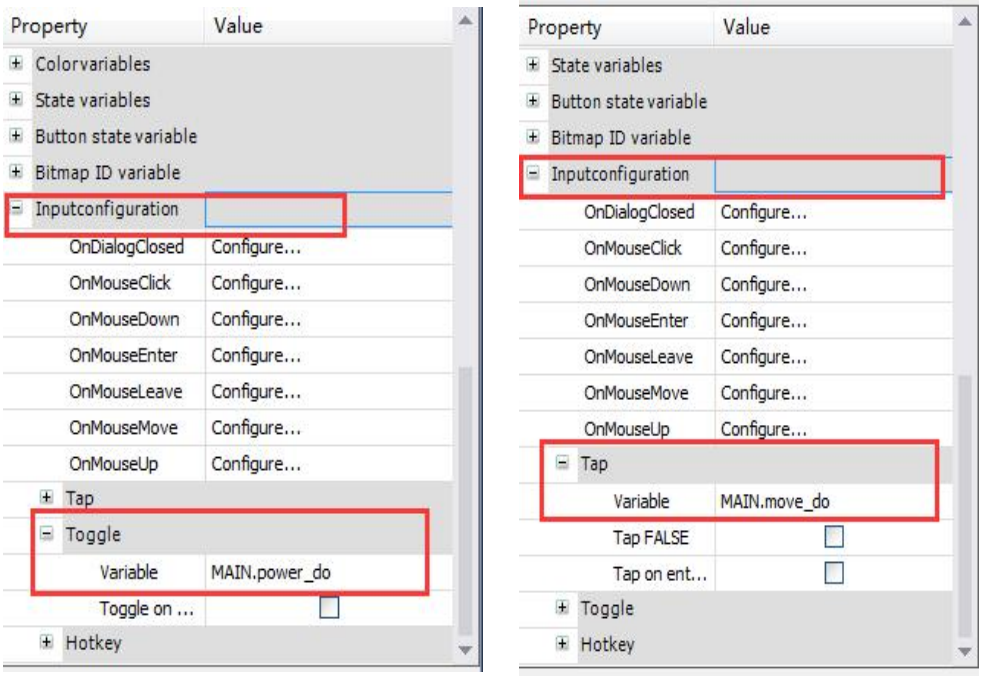




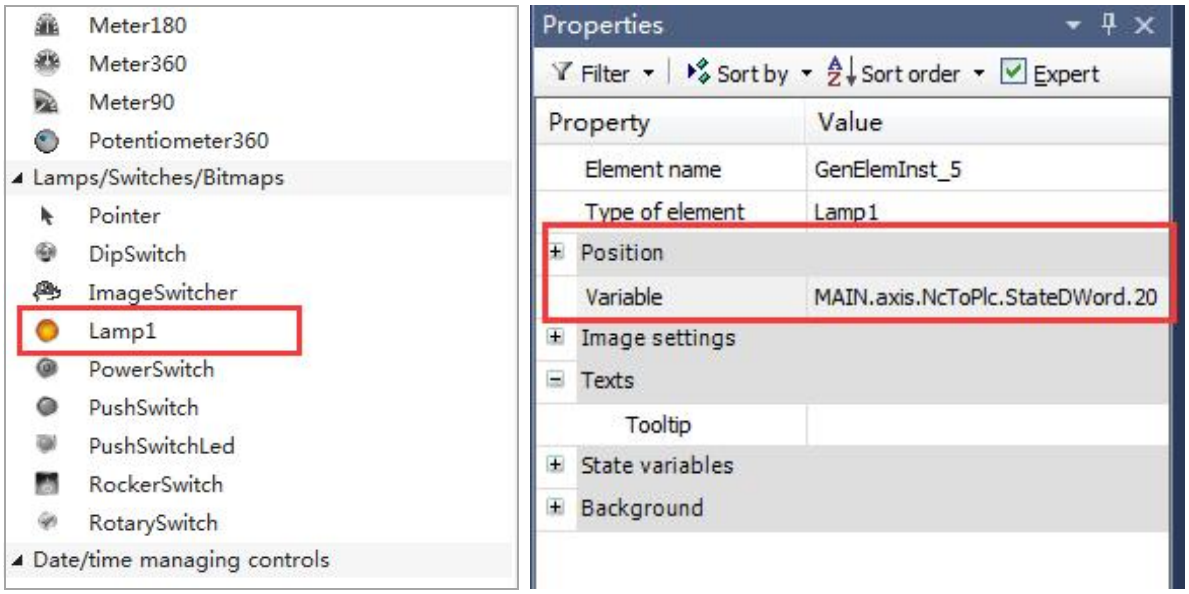
Use the same method to recreate the controls for velocity, acceleration, and deceleration in absolute position motion.



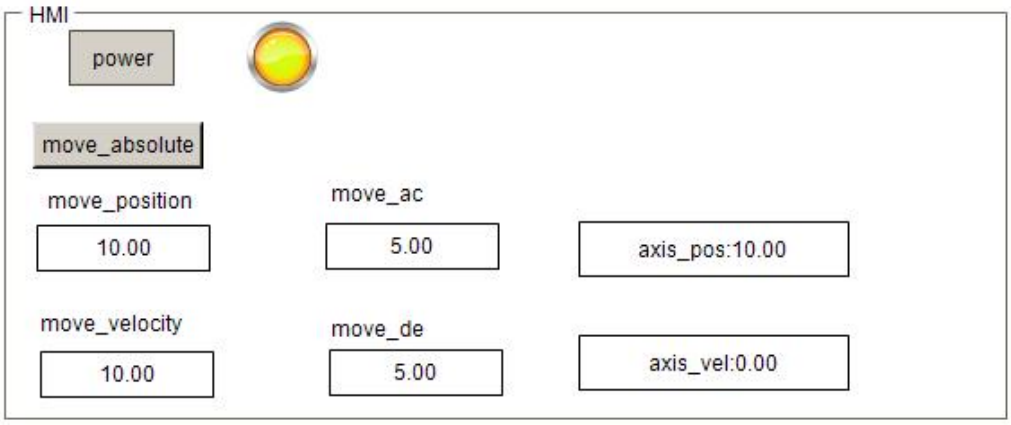
Create two button controls to manage enabling and axis movement. For the enabling control, enter MAIN.power_do in the Inputconfiguration →Toggle (Toggle Button) →Variable field; a single click sets it to 1, while a second click sets it to 0. For the axis movement trigger control, enter MAIN.move_do in the Inputconfiguration →Tap (Tap Button) →Variable field; it sets to 1 only upon clicking and returns to 0 when released.



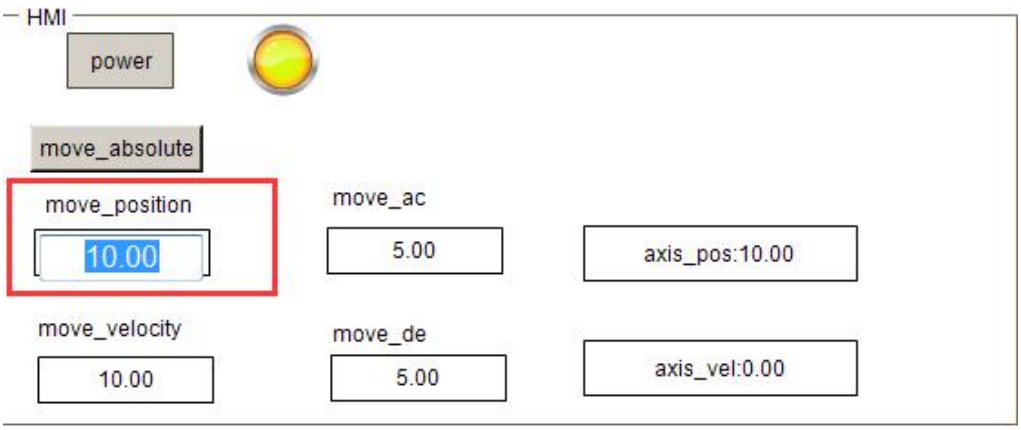
Create an indicator control to display whether the Power function block has been successfully enabled. First, drag an LED icon from the toolbox on the right, then bind Position—Variable to the variable MAIN.axis.NcToPlc StateDWord.20; here, StateDWord.20 represents the enabling status of the axis variable.



After writing the program, activate it by clicking "Login" to launch the program. Then click the Run button to view the values of specified variables in the visual interface.



Click input-type controls such as move_position to modify variable values in real time.



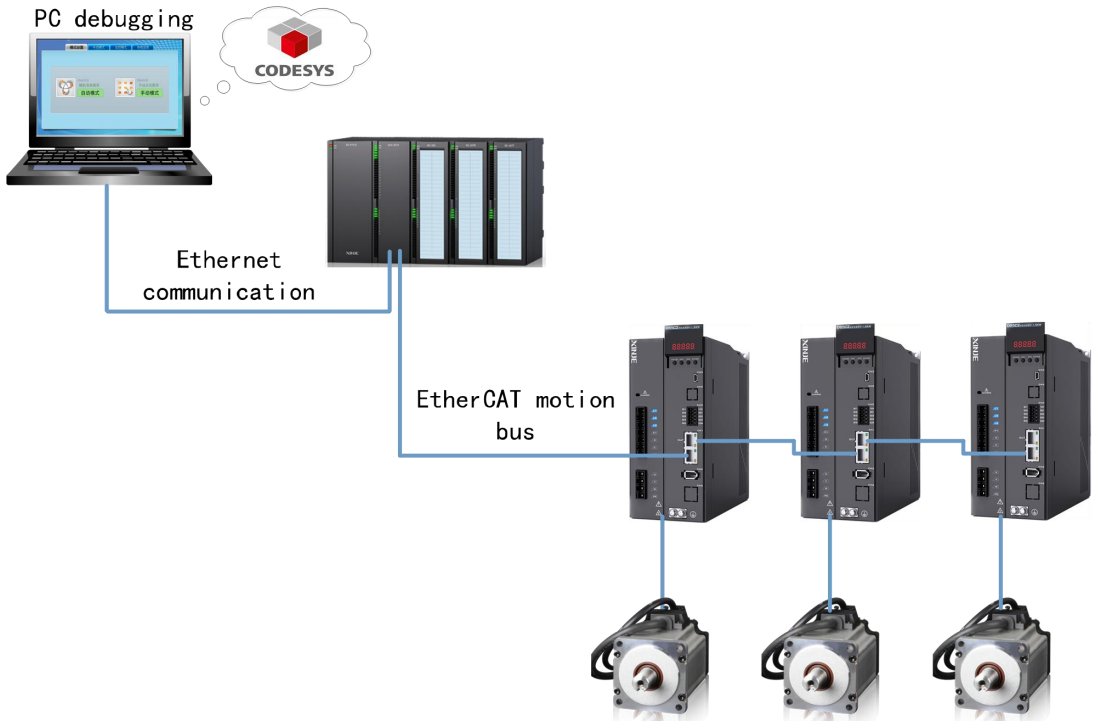
14.3 SYS and Xinje DS5C2 servo EtherCAT communication example

This example demonstrates how the CODESYS motion control software implements EtherCAT motion control when used as the EtherCAT master station (with the Xinje XS3 series PLC serving solely as a hardware platform) and the Xinje DS5C2 series servo motors functioning as slave stations.

14.3.1 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	
Xinje Servo	DS5C2-41P0-PTA	3	
Ethernet cable	JC-CA-3	Several	For connecting the computer to the servo

14.3.2 System topology



This is a control system developed by CODESYS based on traditional hard PLCs. In this solution, the PLC development system typically runs on a standard PC, while the traditional hard PLC serves merely as a hardware platform that hosts the real-time core of the software PLC. The system programs written by the development system are then downloaded onto the hard PLC. The control system diagram is shown

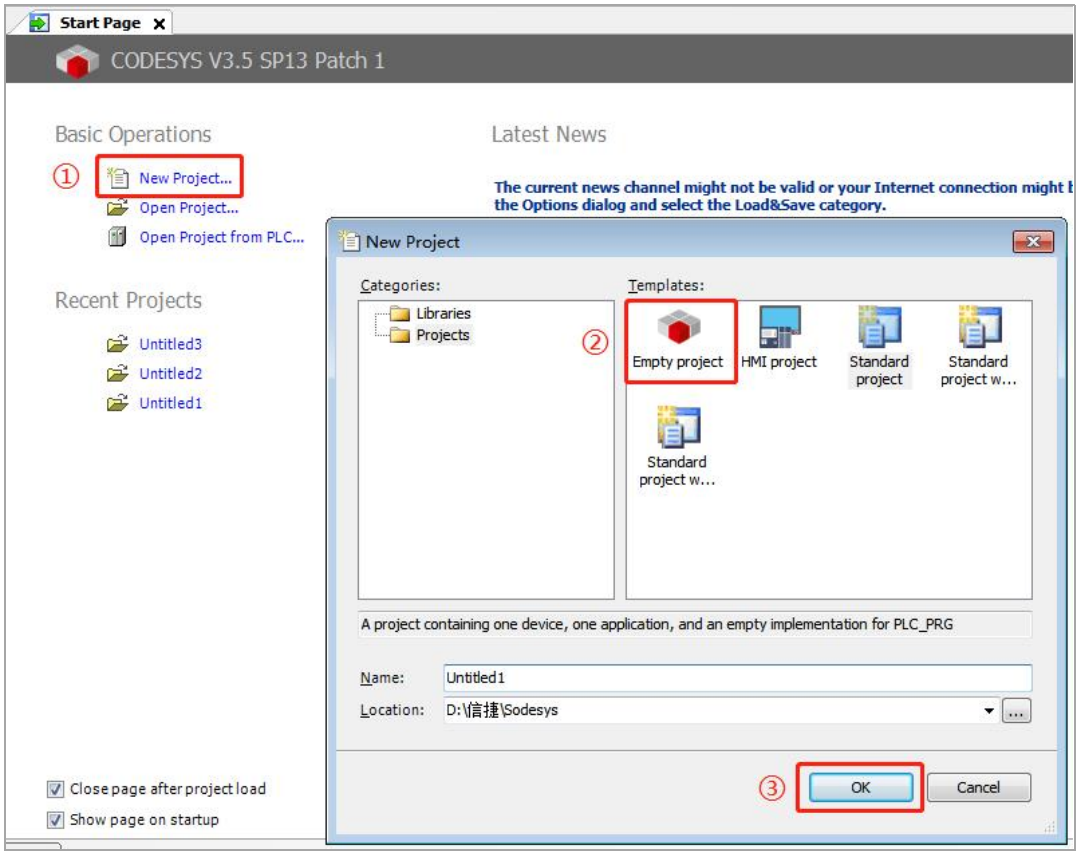
above.

The XS3 series PLC features two network ports: the upper port supports Ethernet/IP for connecting to the CODESYS host computer, while the lower port serves as an EtherCAT interface for interfacing with XINJE DS5C2 series servo drives via EtherCAT communication. The two communication ports of the XINJE DS5C2 series servo drives must adhere to the "lower-in, upper-out" principle.

14.3.3 Debugging Steps

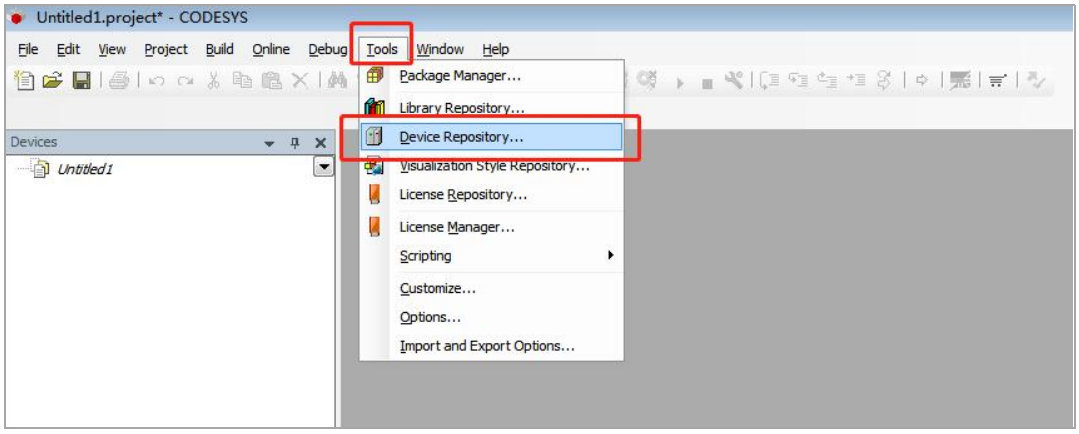
1) New Project

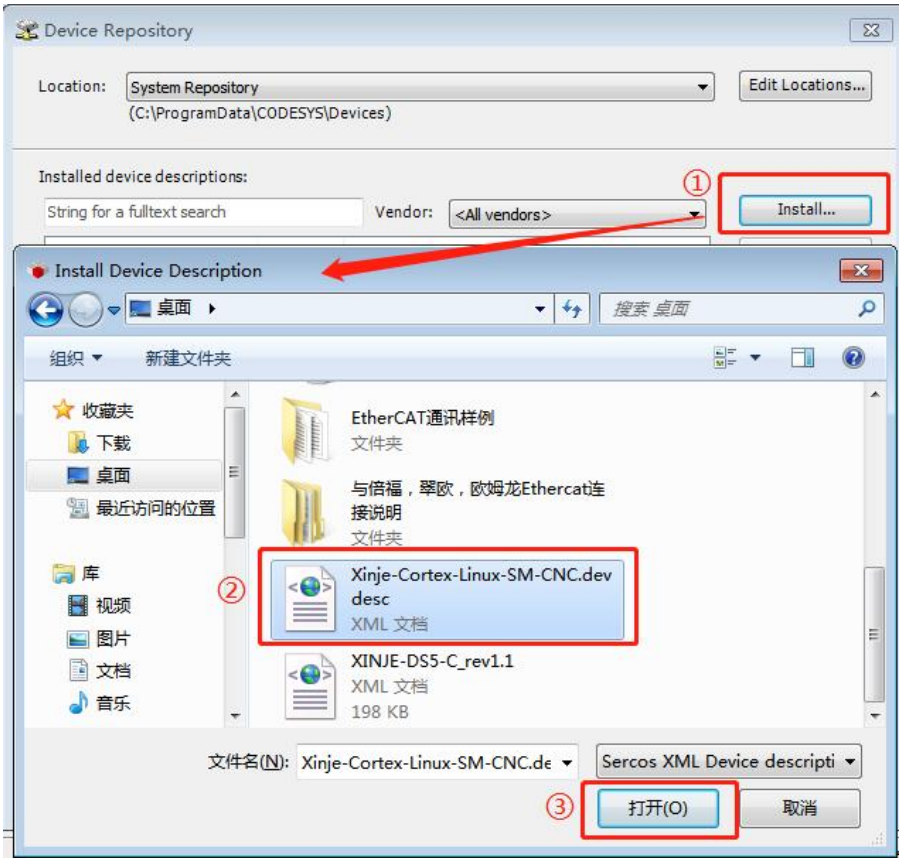
Double -click to launch Codesys. Select the New Project command to create a blank project, enter the project name and save path, then click OK.



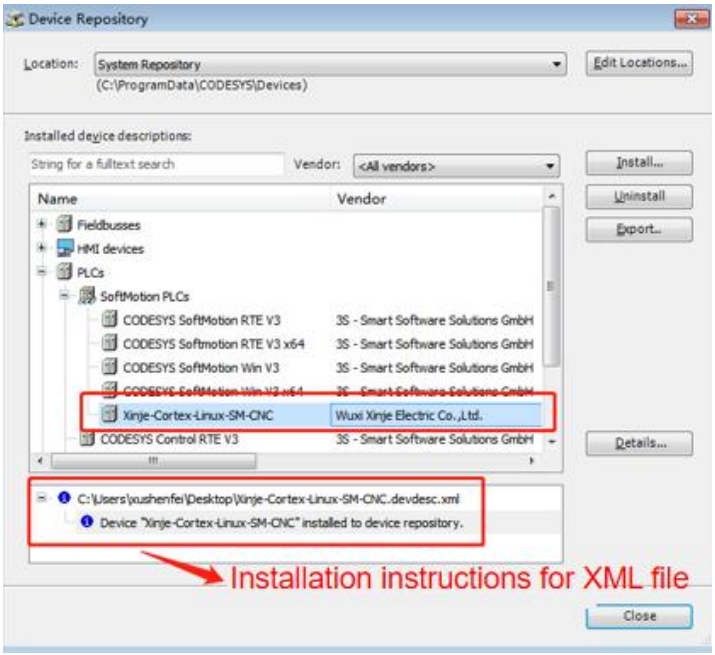
2) Add an XML file

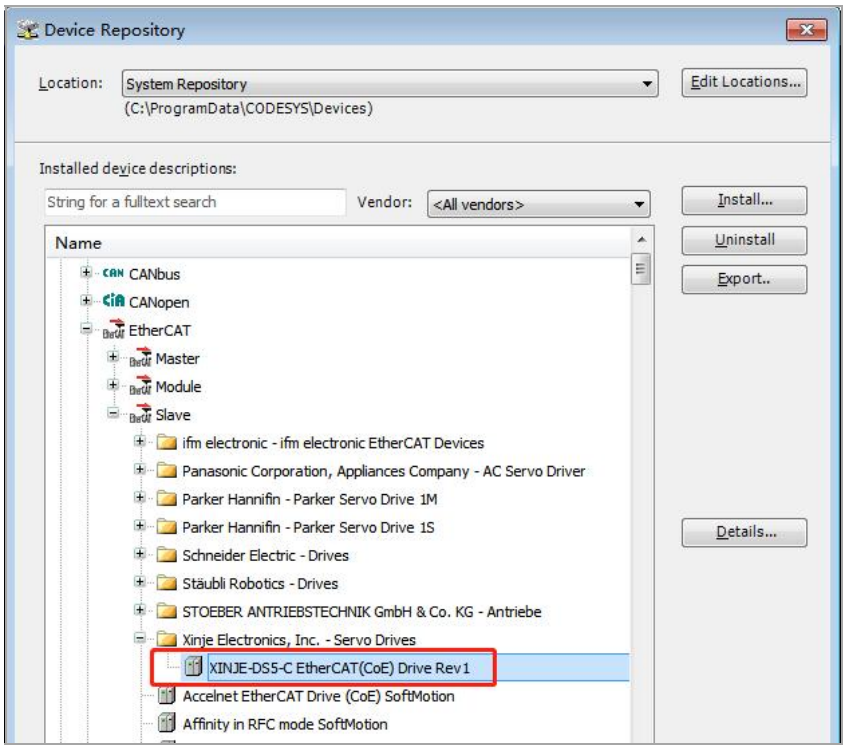
Open the Tool Device Repository and add the XML files for both the master station device and the slave station device. First, add the XML file for the master station device. Follow these steps: click Tools → Device Repository, then in the dialog box that appears, click Install; select the path containing the XML file, locate the file, and click Open.





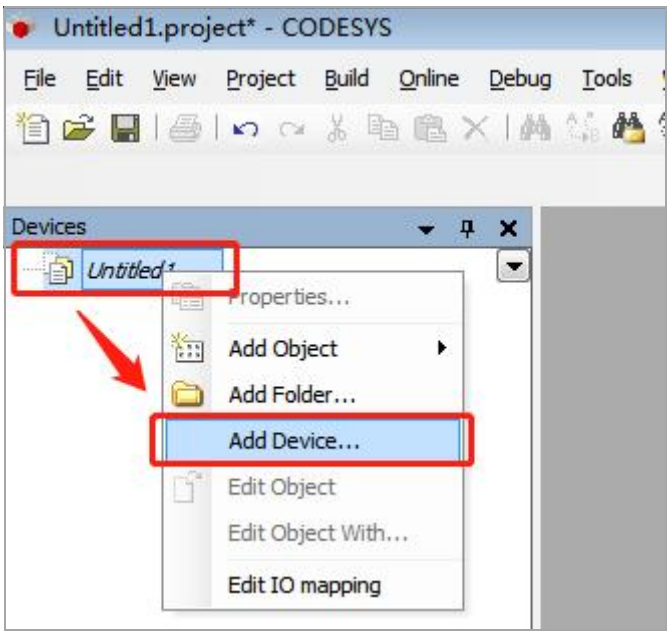
The installation is complete upon opening, as shown in the figure below. Similarly, install the slave XML file (XINJE-DS5-C_rev1.1) using the same method.

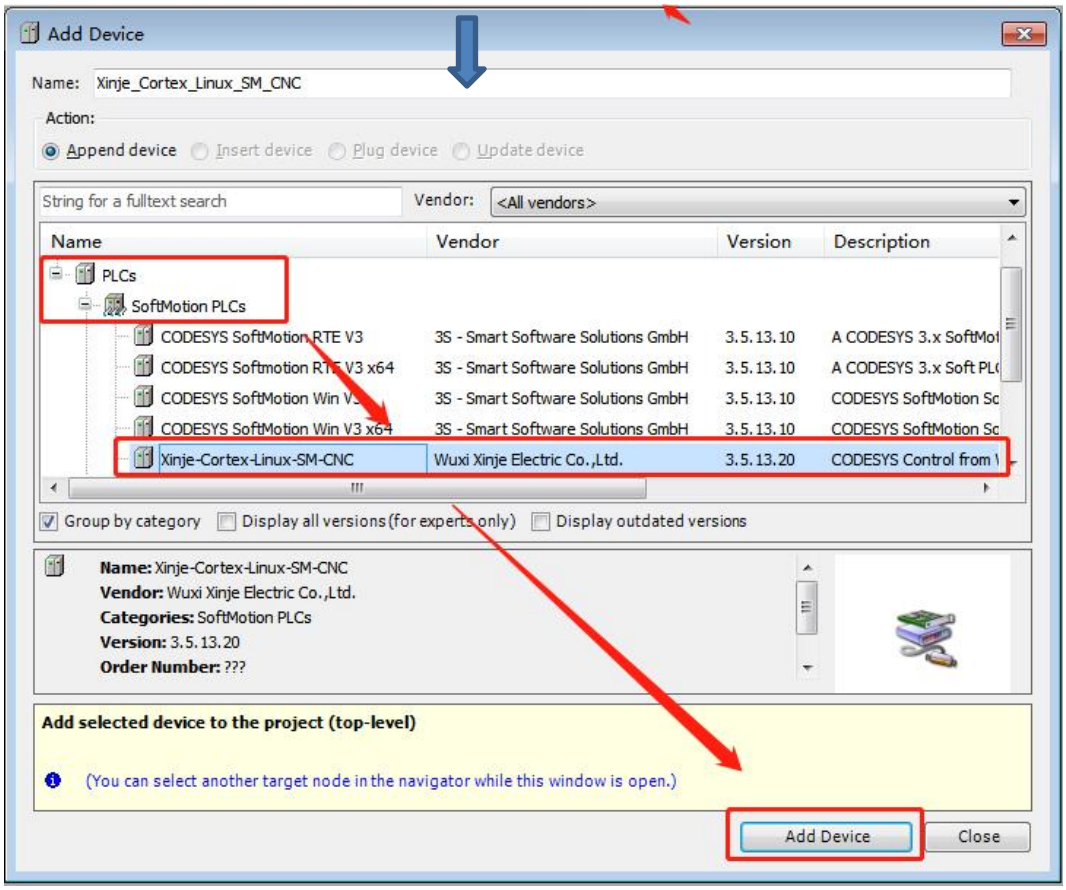




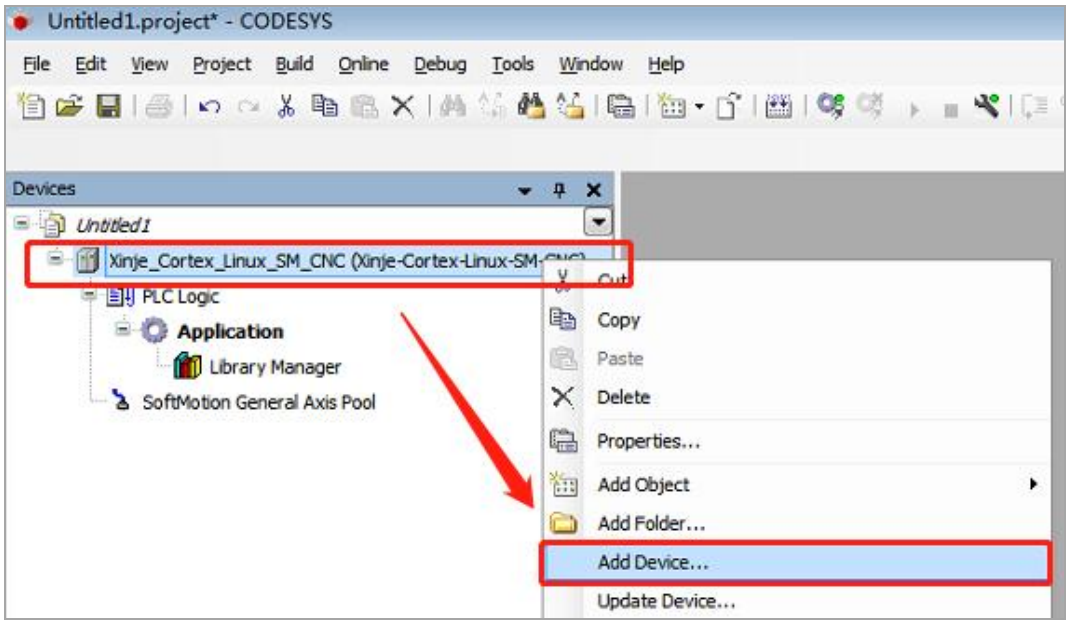
3) Add the main station equipment

Right-click "Untitled", select "Add Device" to add a device. In the "Add Device" dialog box, choose "PLCs--SoftMotion PLCs--Xinje–Cortex-Linux-SM-CNC", and finally click "Add Device" to install the PLC.

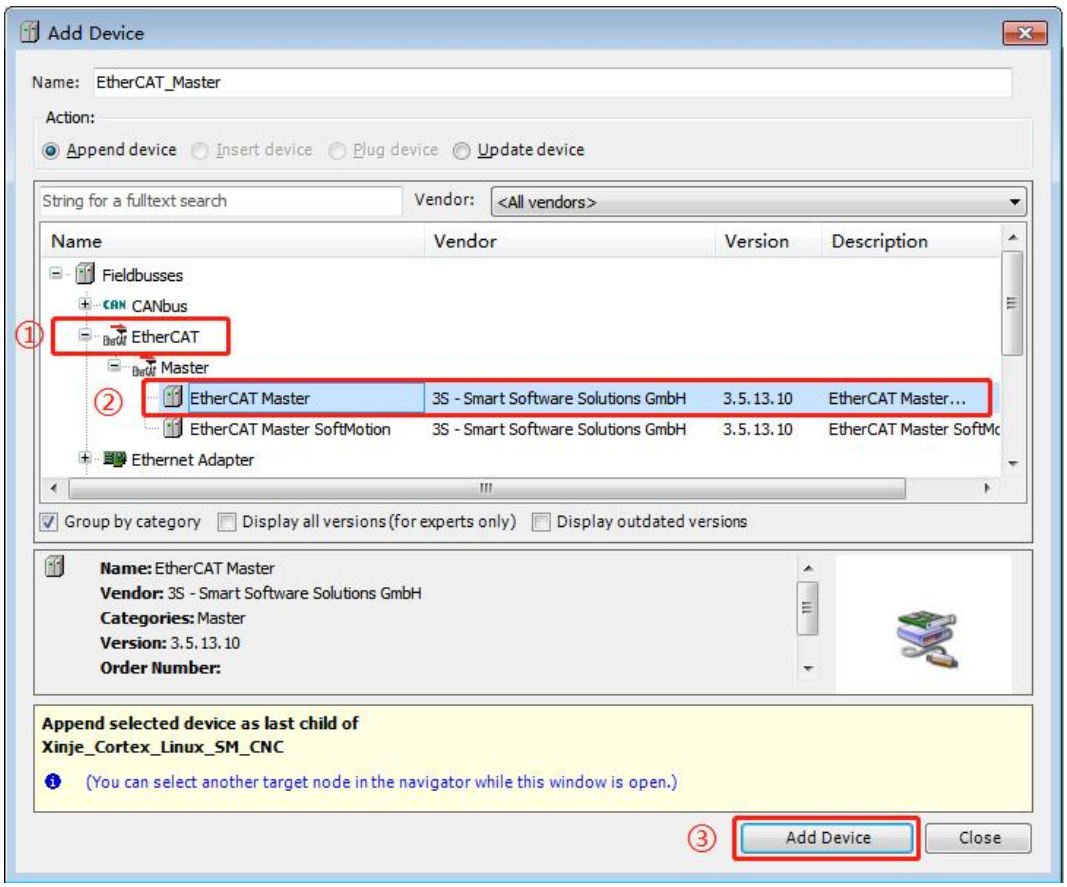




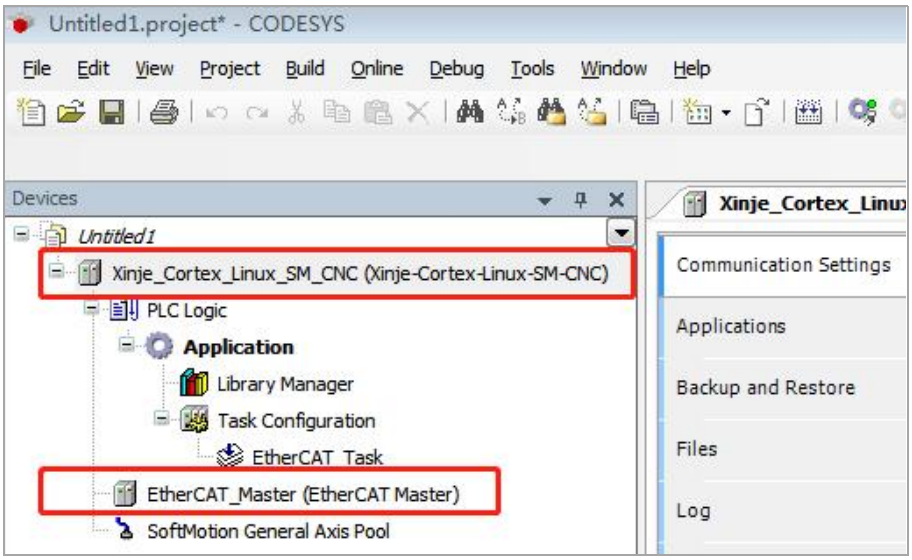
After adding the PLC, the Device Manager appears on the right side of the interface. Select Xinje –Cortex-Linux-SM-CNC, right-click, and click Add Device to add the device.



In the "Add Device" dialog box, select "EtherCAT—Master—EtherCAT Master," then click Add Device to complete the process.



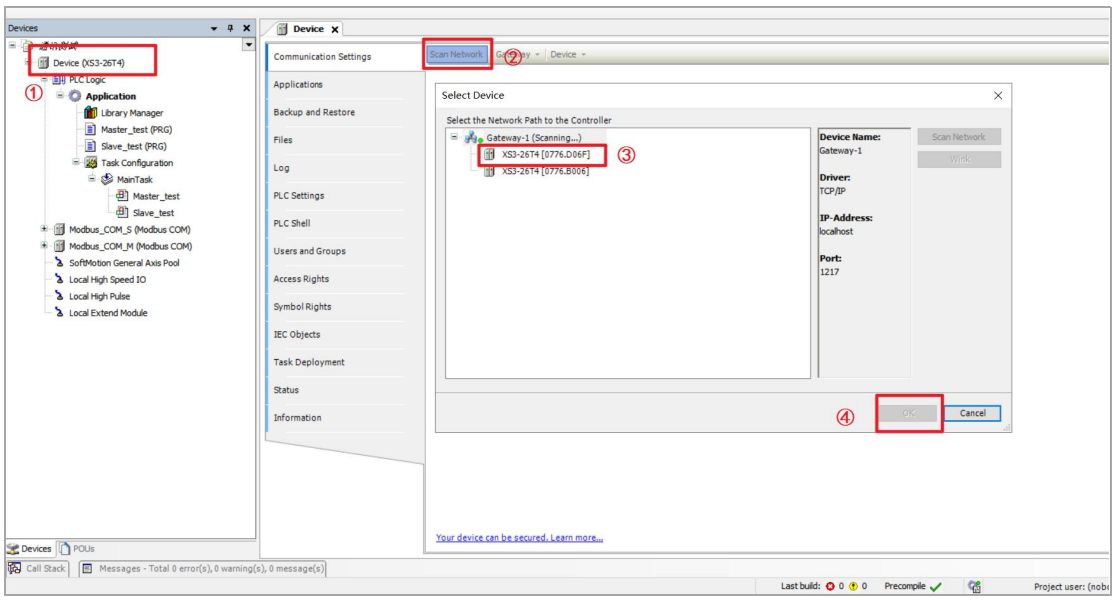
Device addition completed, as shown below:



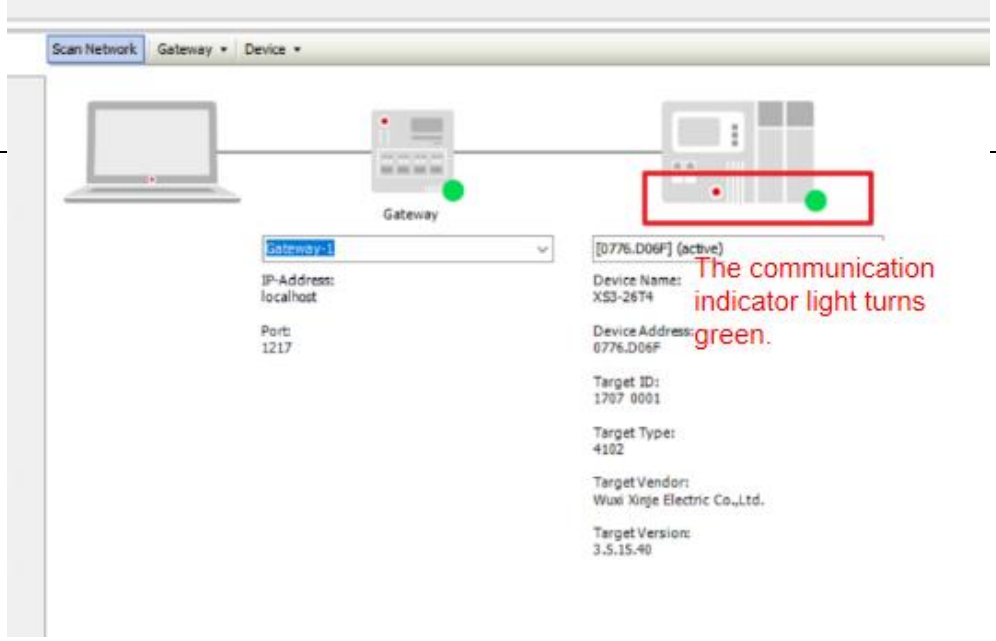
4) Gateway Communication Settings

Double-click Xinje_Cortex_Linux_SM_CNC, then select Scan Network in the Communication Settings tab to search for PLCs within the same network segment. After finding one, click OK. As shown in the figure below, the PLC's device name is XINJE-XS3.

For an Ethernet connection, the IP address of the connected device (PC) must reside in the same network segment as that of the PLC. Therefore, verify that the PC's IP configuration meets the required specifications before establishing the connection.

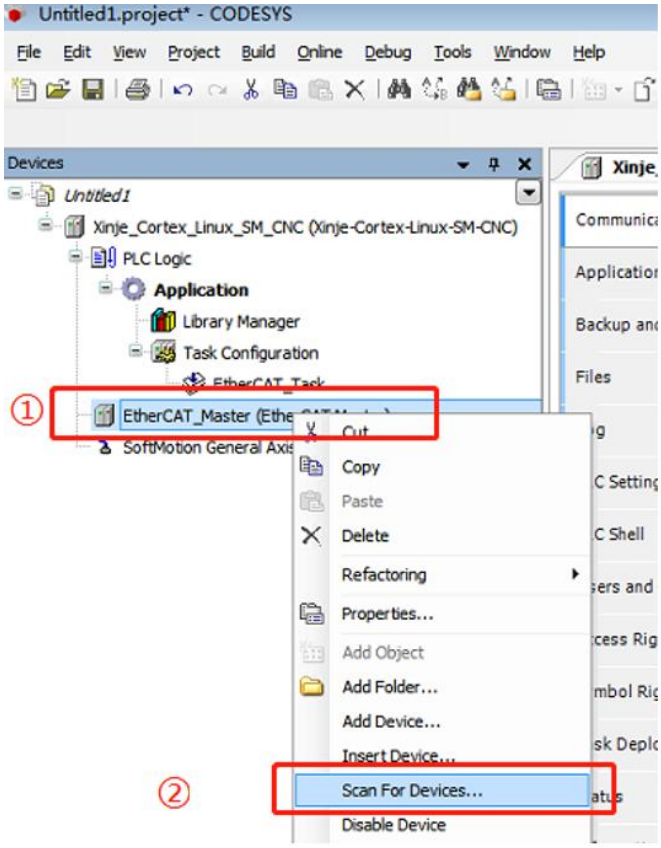


After successful communication, the result is shown below:

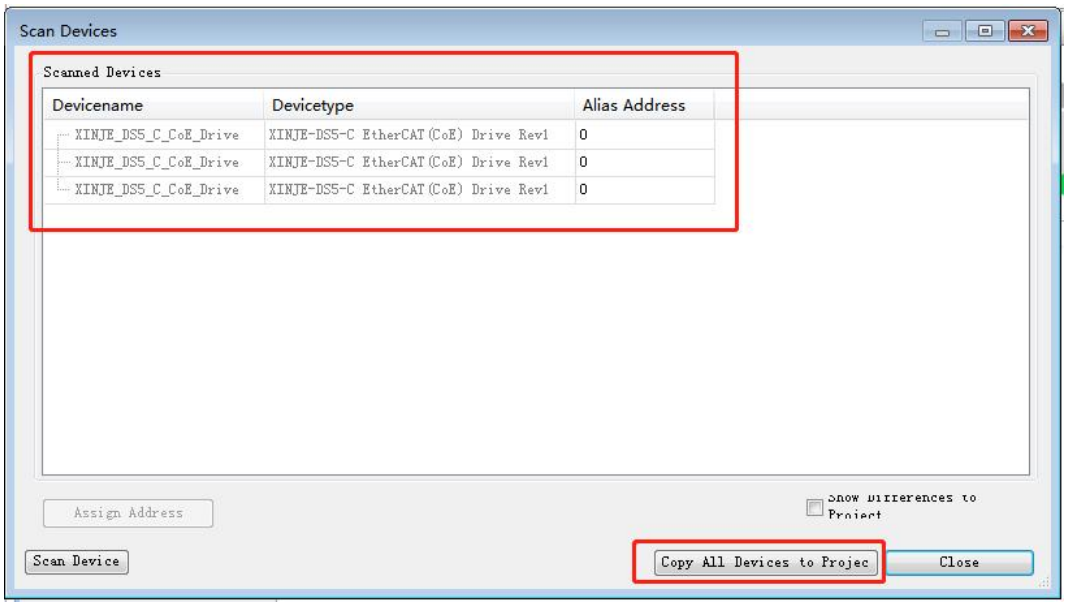


5) Scan the slave device

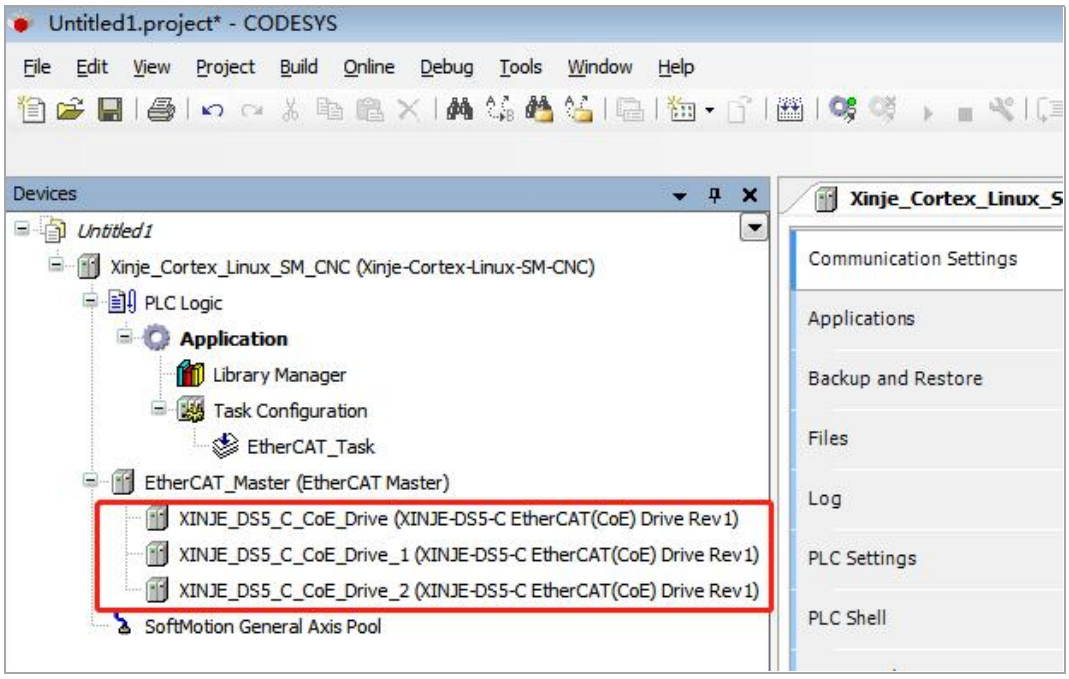
In the Device section, right-click EtherCAT MASTER and select Scan For Devices to scan the EtherCAT slave devices.



In this example, three DS5C2-series servos are connected. The scan results are shown below. Click "Copy All to Project" to add all scanned slaves to the project.

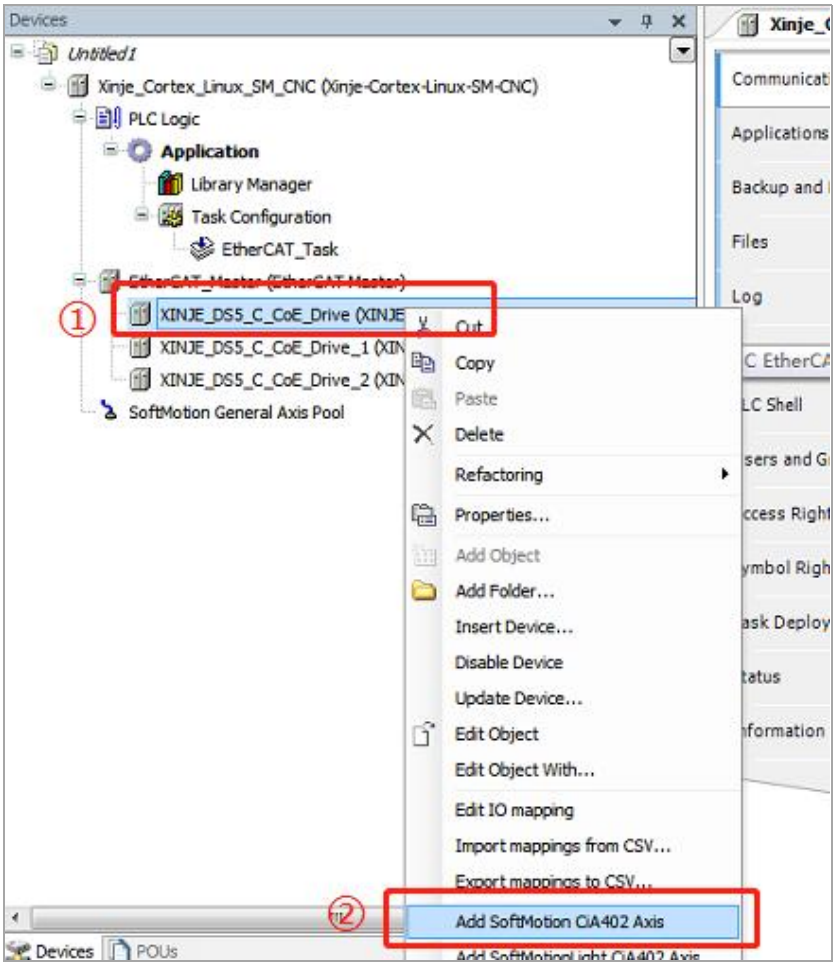


After successfully adding the station device, the "Devices" section appears as shown below.

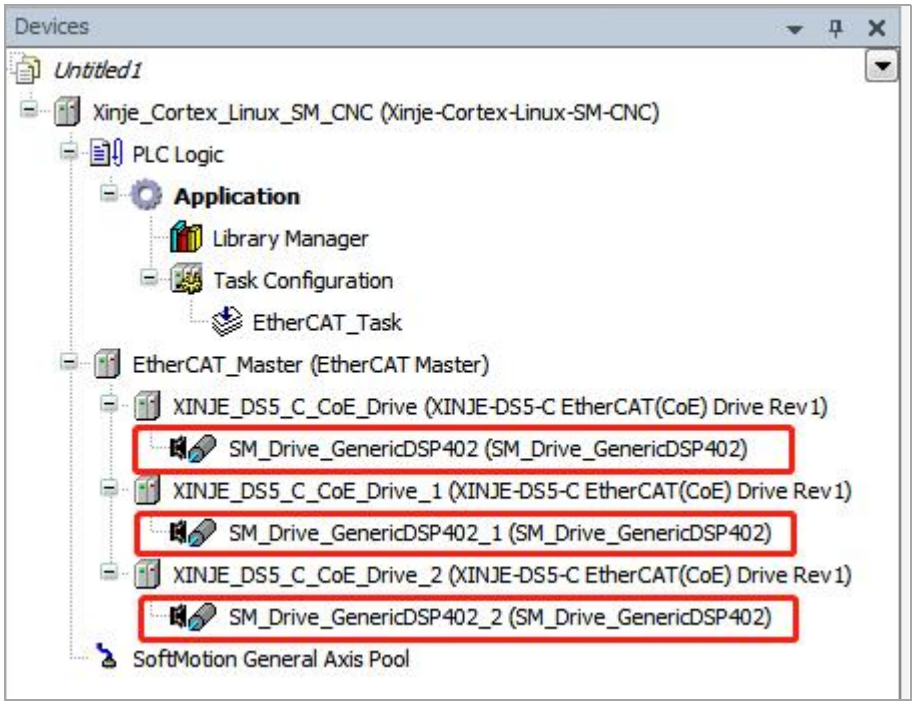


6) Add a motion control axis

Select the axis device XINJE_DS5_C_CoE_Drive, right-click it, and click Add SoftMotion CiA 402 Axis.

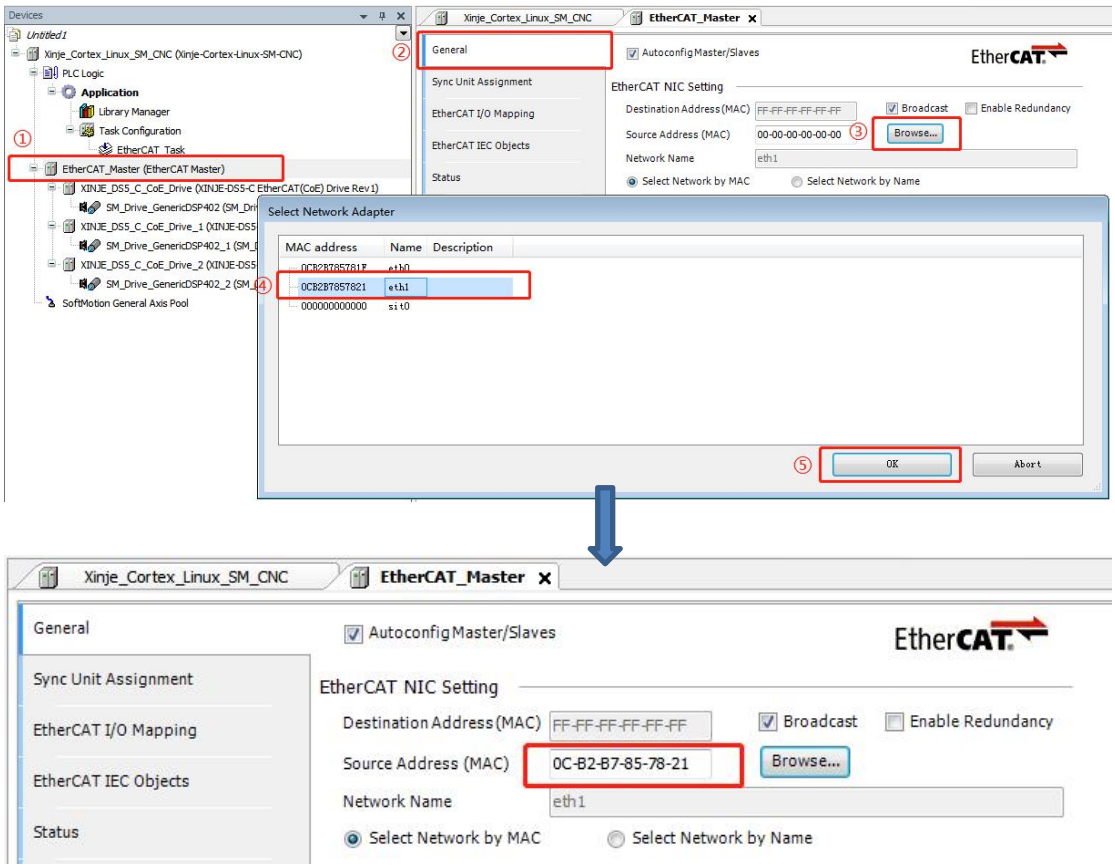


Similarly, add an axis for each slave station; after completion, the result is shown in the figure below:



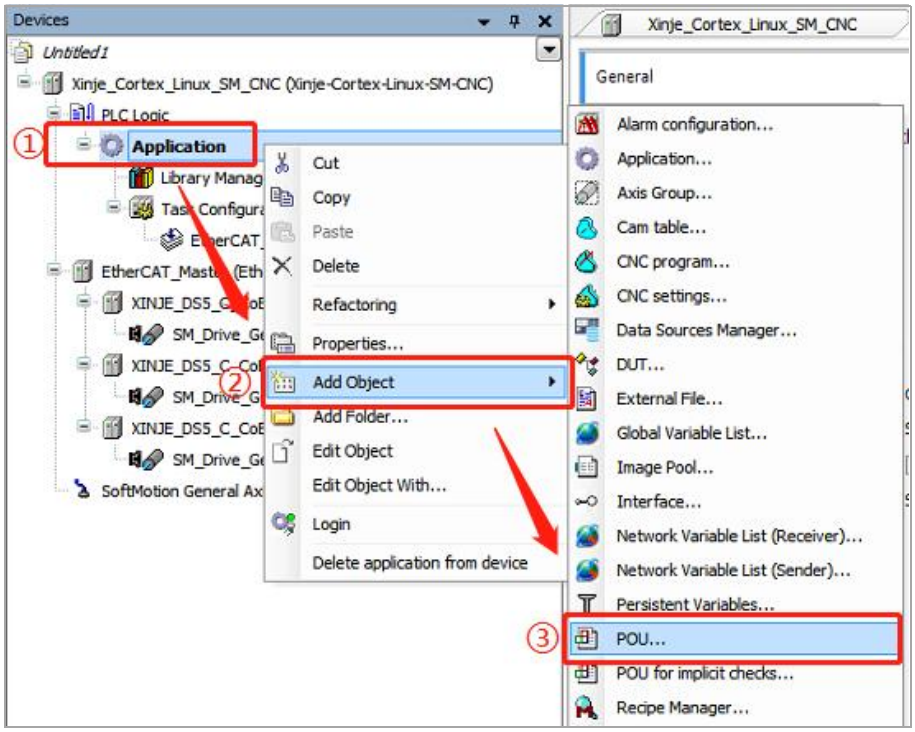
7) Source address selection for the master station equipment

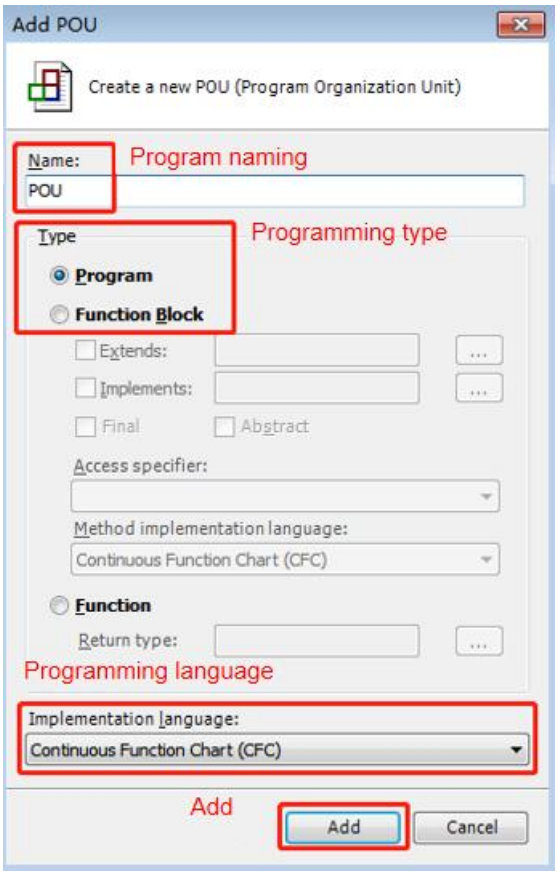
Double-click "EtherCAT_Master", then in the General tab, click Browse..., select the desired MAC address, and click OK to complete the source address selection.



8) Write a program

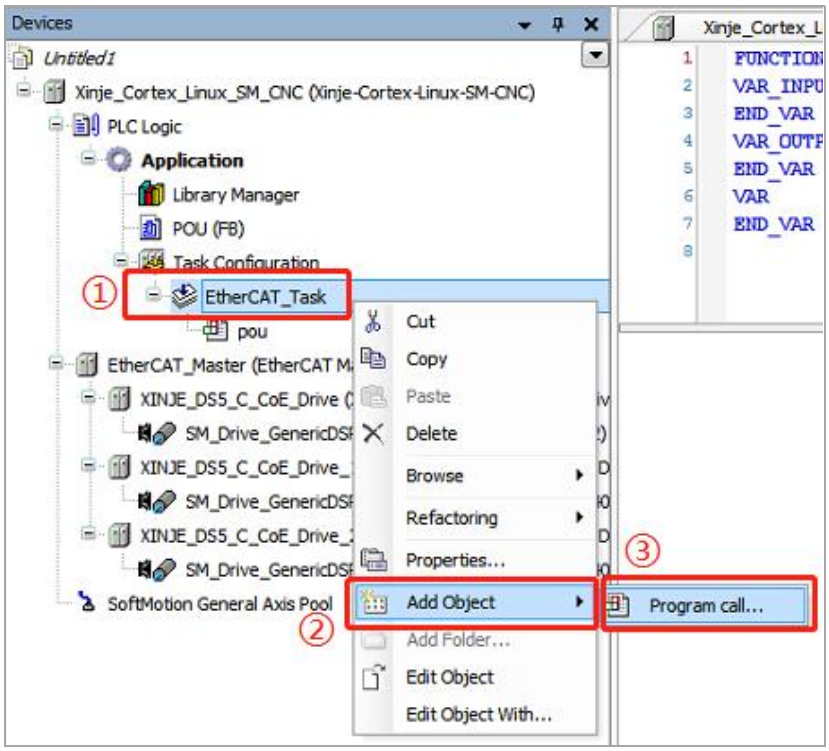
Add a POU. In the Devices section, right-click the Application, then select Add Object → POU... Name the added POU, choose the programming method, and click Add. In this example, programming is performed using the Continuous Function Diagram (CFC) format.

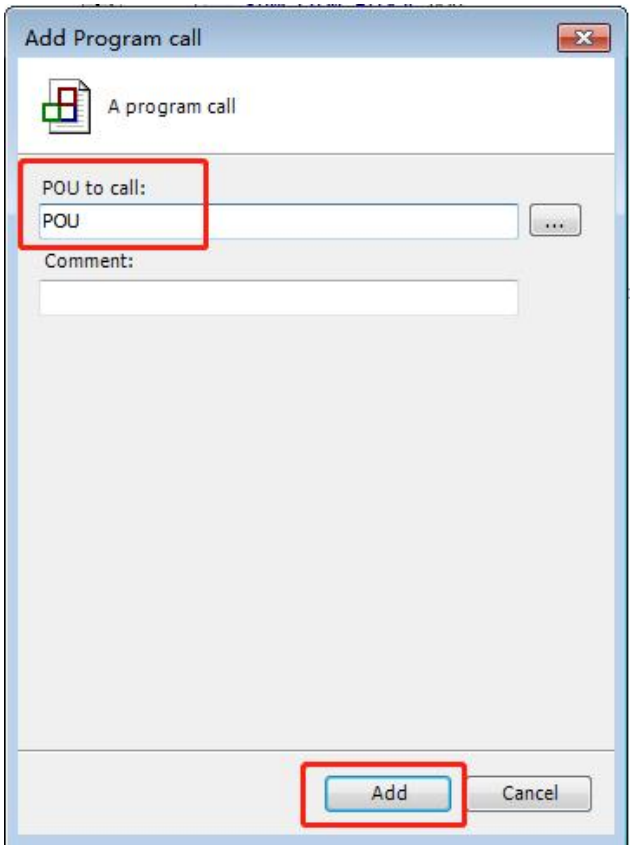




Double-click the added POU to start programming in the POU interface. Note: The POU must be included in the task, as subsequent compilation commands will only compile programs added to the task. If the created POU is not included in the task, the compilation command will not perform syntax checking

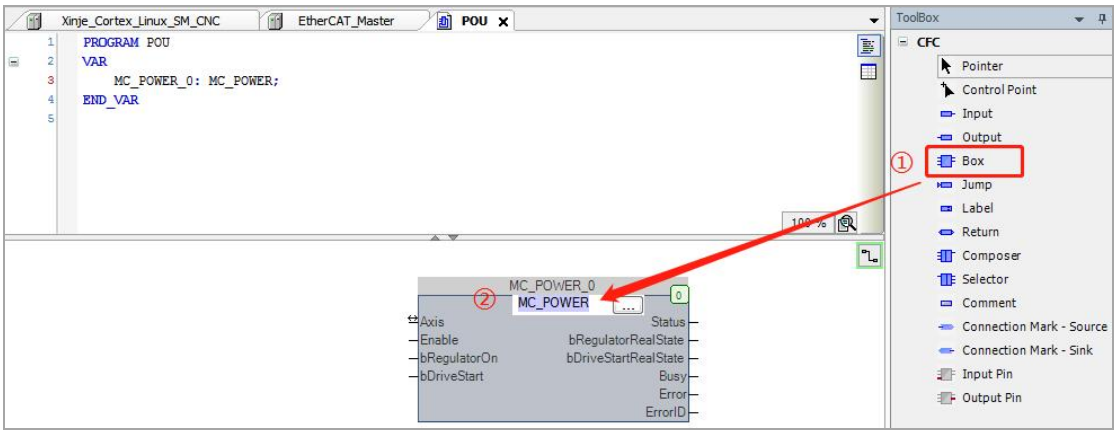
on it. Right-click EtherCAT(Task, select Add Object → Program Call, enter "POU" in the Add Program Call dialog box, and finally click Add to complete the addition.



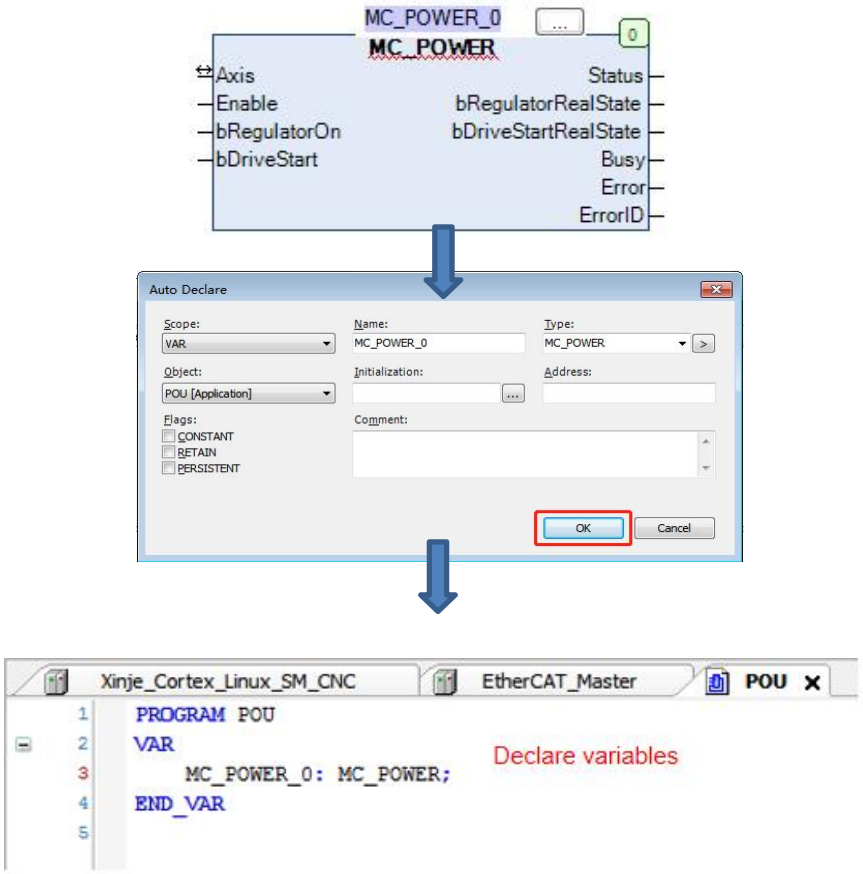


Call the function block

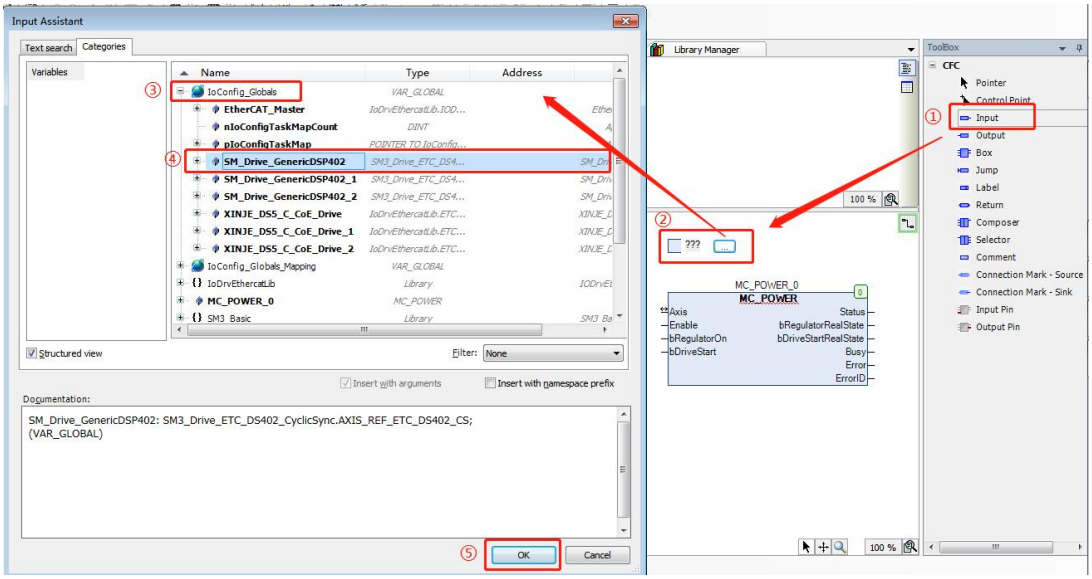
In the POU interface, call the MC_POWER function block to enable the axis. Select the Box from the toolbar, drag it into the programming interface, and enter MC_power.



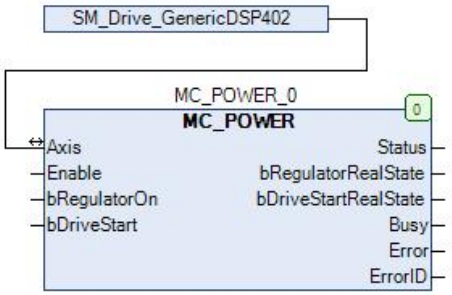
Link this function block to the variable of the first slave axis. As shown in the figure, enter MC_POWER_0, and the programming interface will automatically generate the required variables.



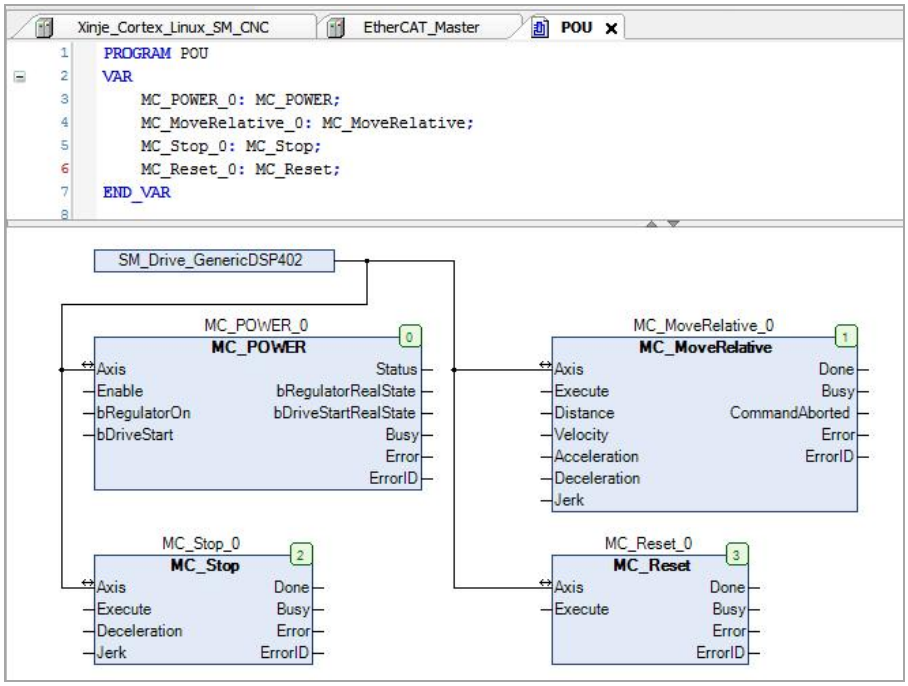
Add the "Input" component and link it to the first slave axis. Select the Input control from the toolbar, drag it into the programming interface, double-click the control, then click to open the Input Assistant dialog box. In this dialog, choose IoConfig_G globals--SM_DriveGenericDSP402, and finally click OK.



Connect the added input function block to the enabled function block with wires.

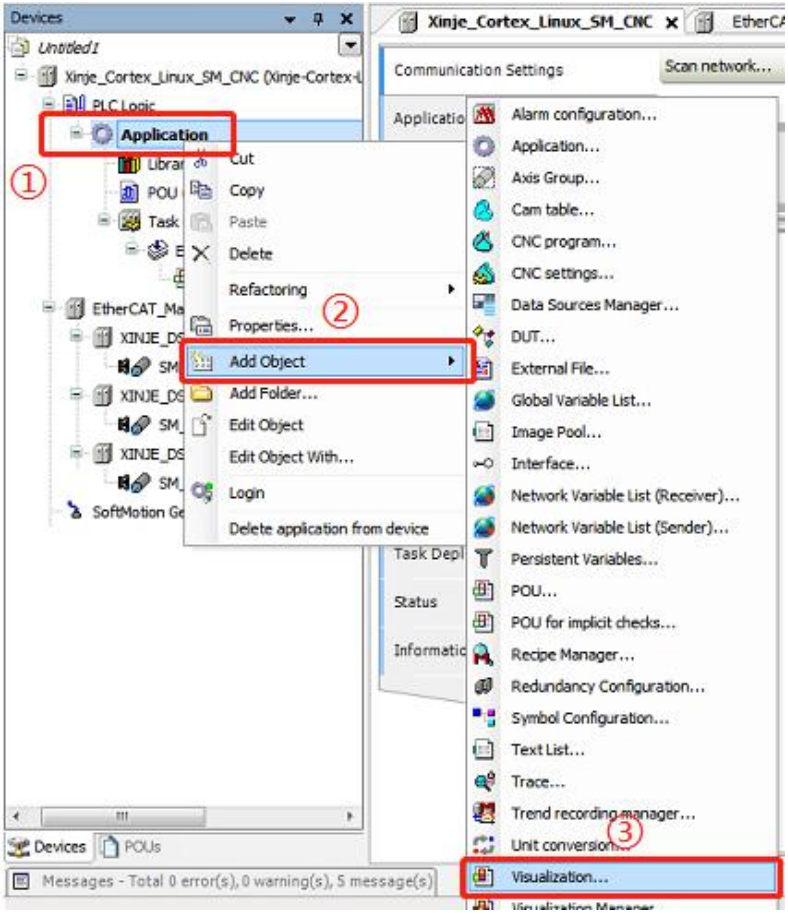


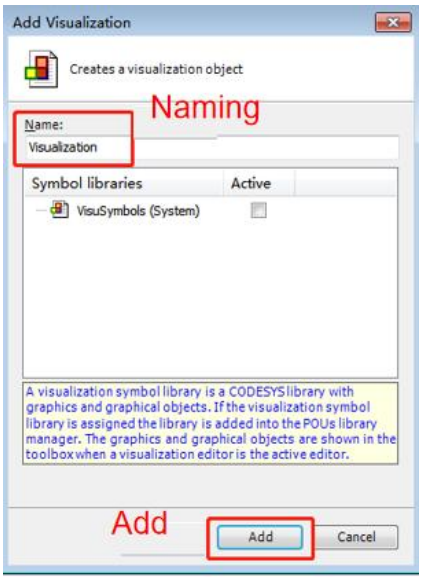
Similarly, continue adding the relative movement function block MC_MoveRelative; stop function block MC_stop; reset function block MC_Reset. The program is shown below.



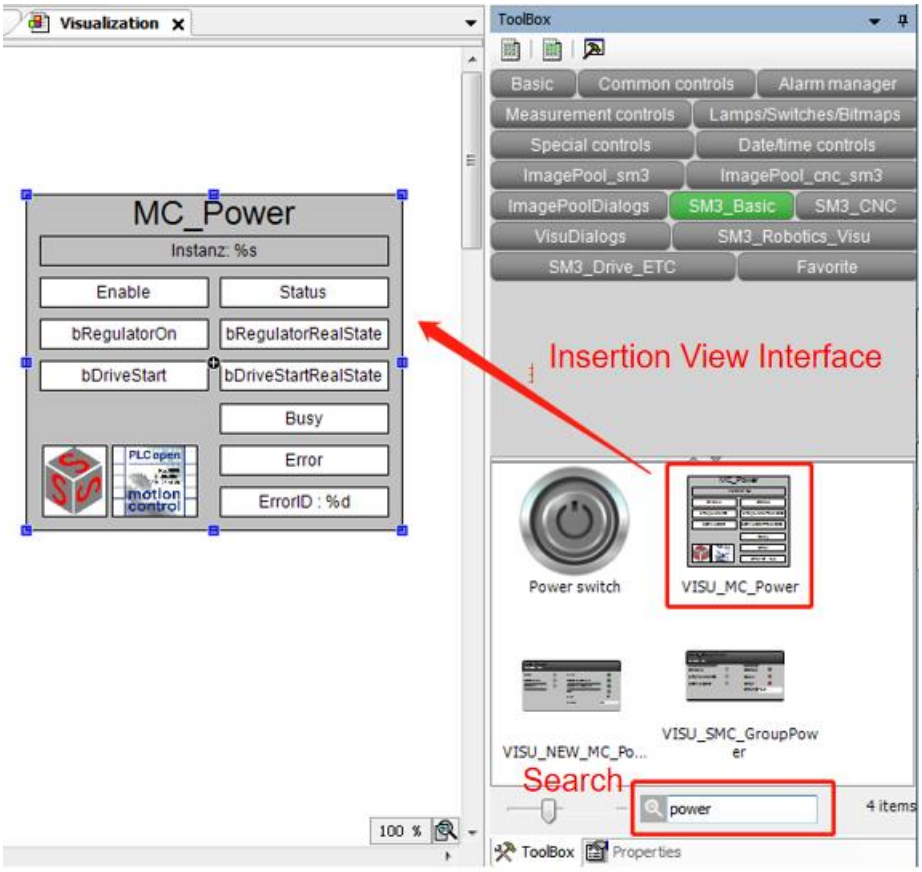
9) Create View

Add a view. In the Devices section, right-click Application and select Add Object—Visualization... Name the added view, choose the programming method, then click Add.



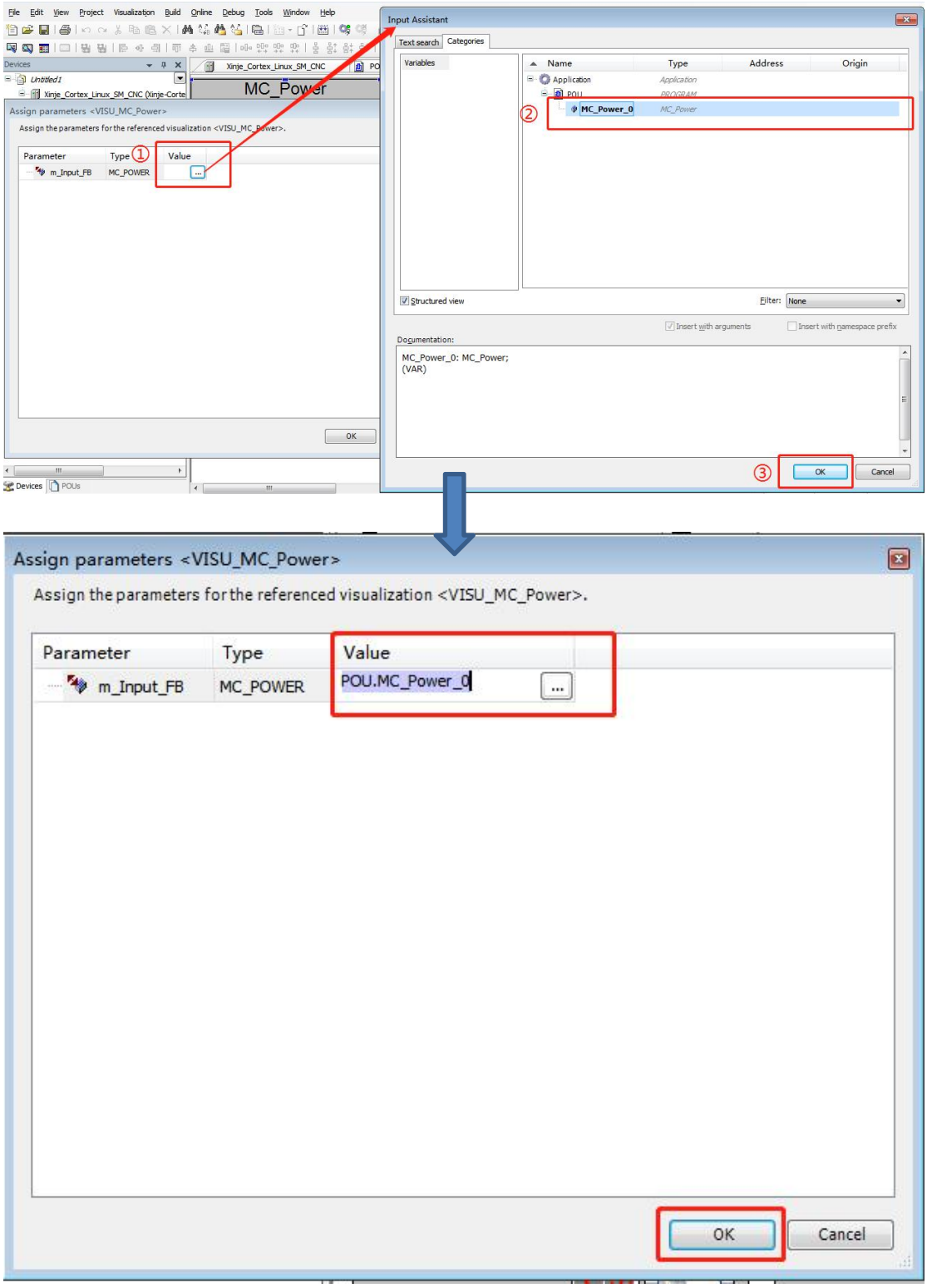


Double-click Visualization in the Devices section to add the desired view to the view interface. For example, search for power in the toolbar and drag the corresponding view control into the view area.

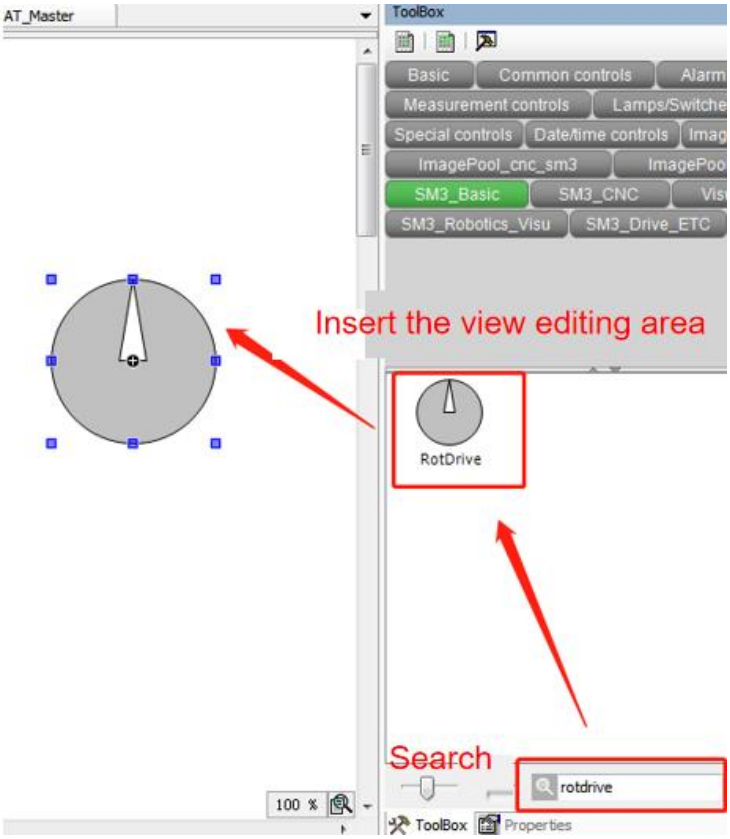


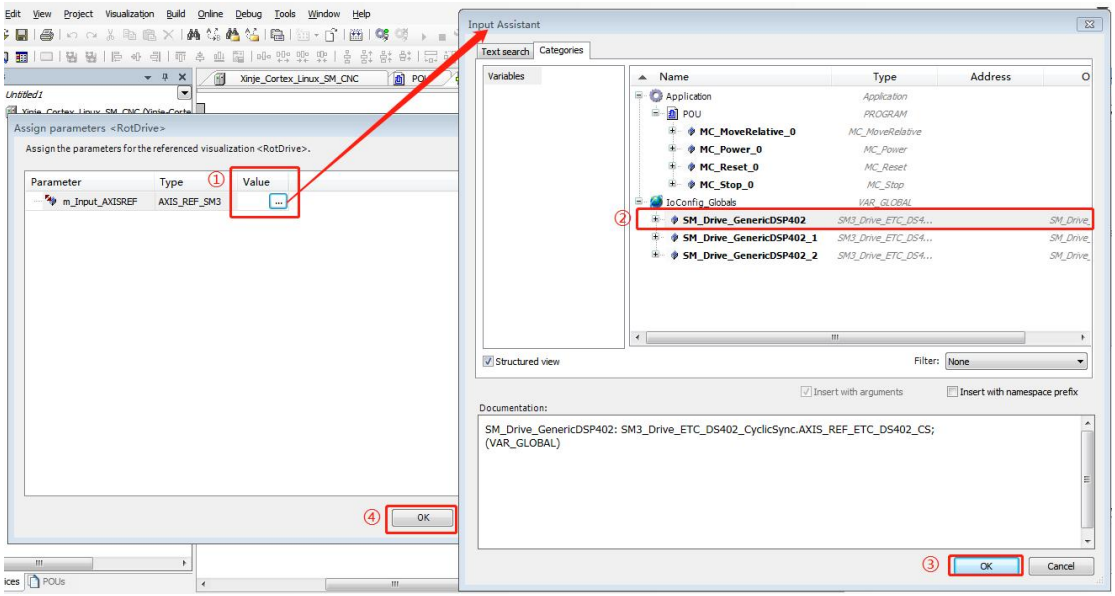
When dragging a control into the view editing area, the dialog box "Assign parameters <VISU_MC_Power>" appears automatically. At this point, [...] link the view control to the corresponding declared variable. Double-click the "Value" field, select and click it; in the newly opened

dialog box, choose the declared variable and click OK. The linked variable name will then appear in the "Value" field. Click OK again to complete the linking. Repeat the same procedure for other view controls.

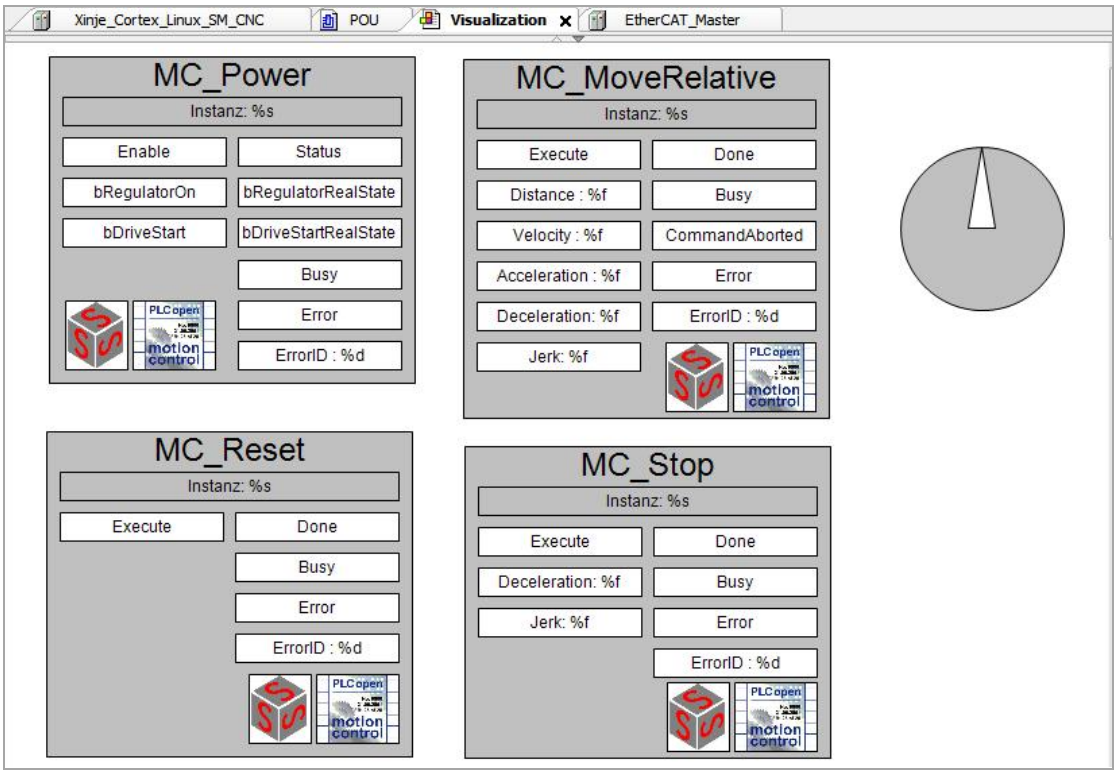


Add a view showing the simulated motor rotation and link this view to the motor shaft. The addition and linking methods are the same as above.



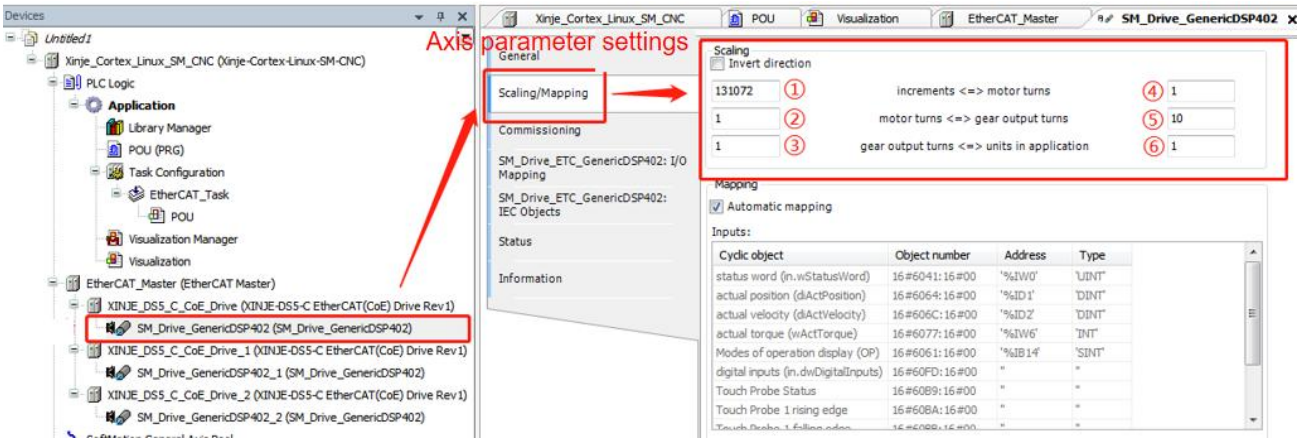


The completed view is shown below:

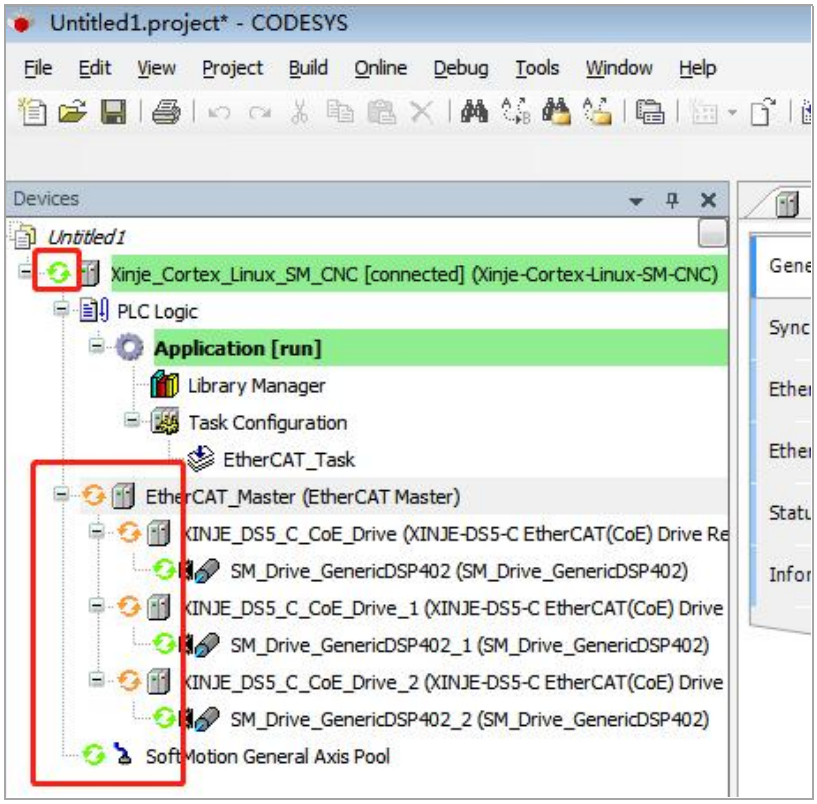


10) Online Control

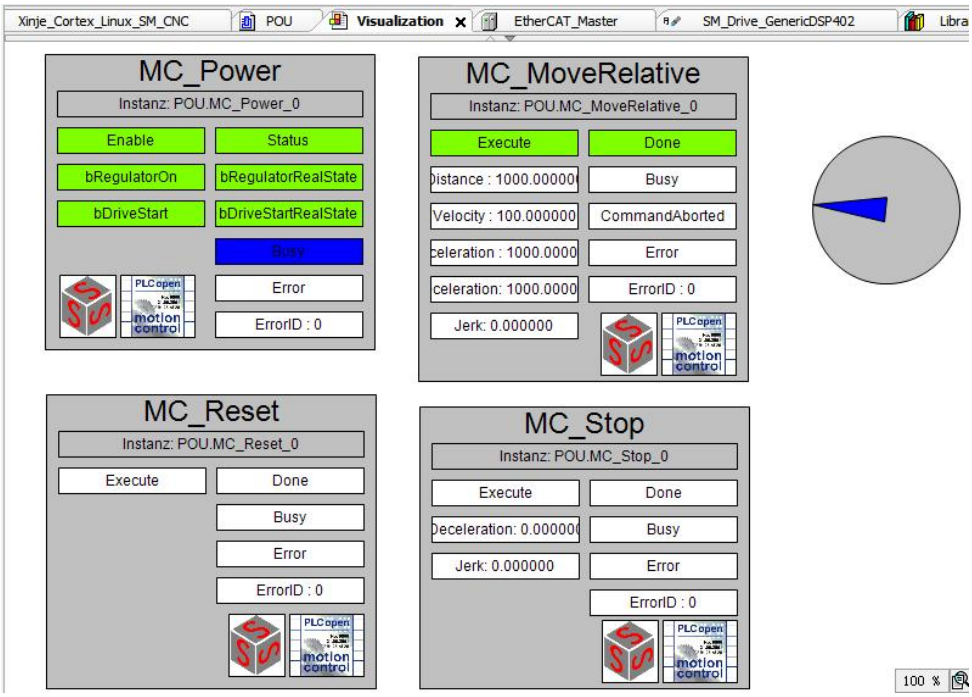
Axis parameter settings. Double-click Axis 1 and configure the axis parameters in the Scaling/Mapping tab. ① To set encoder precision: since a 19-bit encoder is connected in this example, enter 524288.
The relationship between setting and output: Coefficient = (④*⑤*⑥)/(②*③)
For example: When the input-output relationship coefficient is 10 and the Distance setting in the MC_MoveRelative function block is 100, the calculation yields 100/10 × 524288 = 5242880, indicating a set operating distance of 5242880 pulses, equivalent to 10 full rotations of the motor. Setting the Velocity value to 10 results in 10/10 × 524288 = 524288, meaning the motor operates at 524288 pulses per second. Setting the Acceleration value to 1000 produces 1000/10 × 524288 = 52428800, representing an acceleration of 52428800 m/s²; the deceleration setting follows the same logic.



After completing the parameter configuration, compile the program for syntax checking. Once no errors are detected during the check, the program can be launched and run. The login process establishes a connection between the application and the target device, putting it into an online state. Proper login requires correctly configured device communication settings and a compilation error-free application. Follow the sequence of compilation, login, and execution; the normal operational state is illustrated below.



At this point, you can configure parameters such as the distance and speed the motor needs to travel in the view. Click in sequence on bDriveStart—bRegulatorOn—Enable within the MC_Power function block to activate the motor properly. Finally, click Execute in the MC_MoveRelative function block to initiate relative position movement.



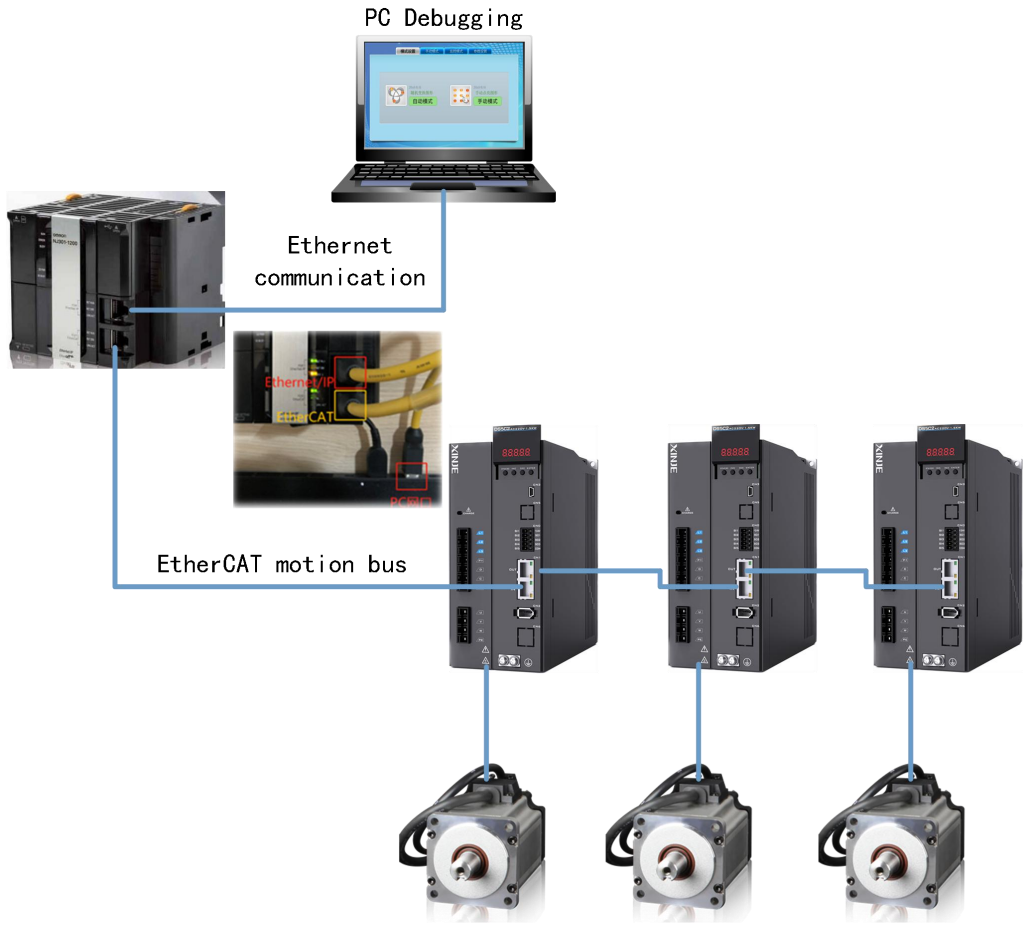
14.4 OMRON and Xinje DS5C2 Servo EtherCAT Communication Example

This example demonstrates how EtherCAT motion control is implemented when the OMRON-brand PLC serves as the EtherCAT master station and the XINJE servo as the slave station.

14.4.1 System configuration

Name	Model/Specification	quantity	remarks
upper monitor	Sysmac Studio	1	Omron upper-level computer software
controller	OMRON NJ501-1500 series	1	
Xinje Servo	DS5C2-41P0-PTA	1	
Ethernet cable	JC-CA-3	Several	For connections between computers and PLCs, as well as between PLCs and servos

14.4.2 System topology



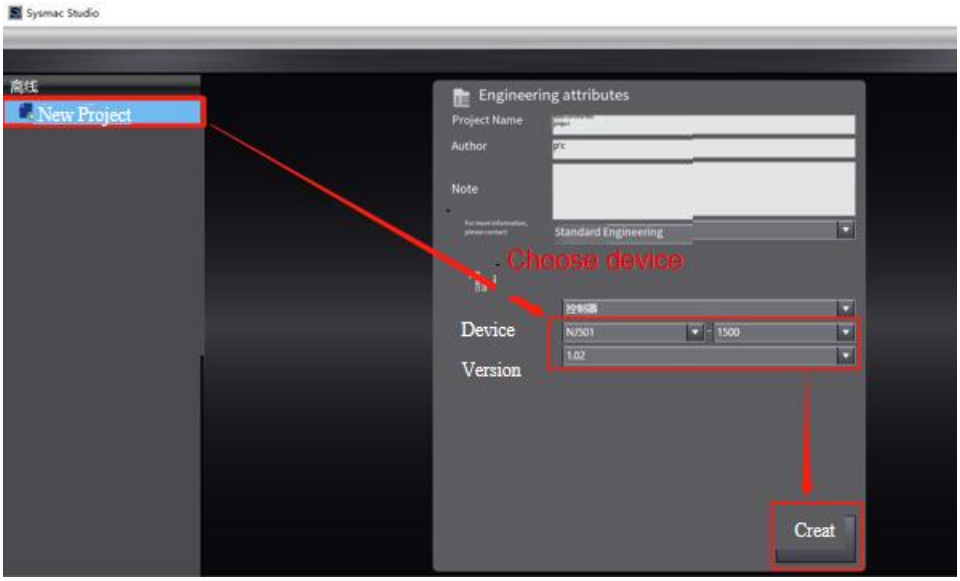
The NJ501 CPU module features two network ports: the red port (labeled Ethernet/IP) is used to connect to the OMRON host computer Sysmac Studio for monitoring and writing operations on the PLC, while the yellow port (labeled EtherCAT) connects to the XINJE DS5C2 series servo drives for EtherCAT communication.

Each network port features three indicator lights: RUN, ERROR, and ACT. When the network cable is properly connected, the RUN light turns on, and the ACT light remains on continuously. Once communication is established and data is exchanged between ports, the ACT light flashes. The ERROR light does not illuminate unless an exception occurs.

14.4.3 Debugging Steps

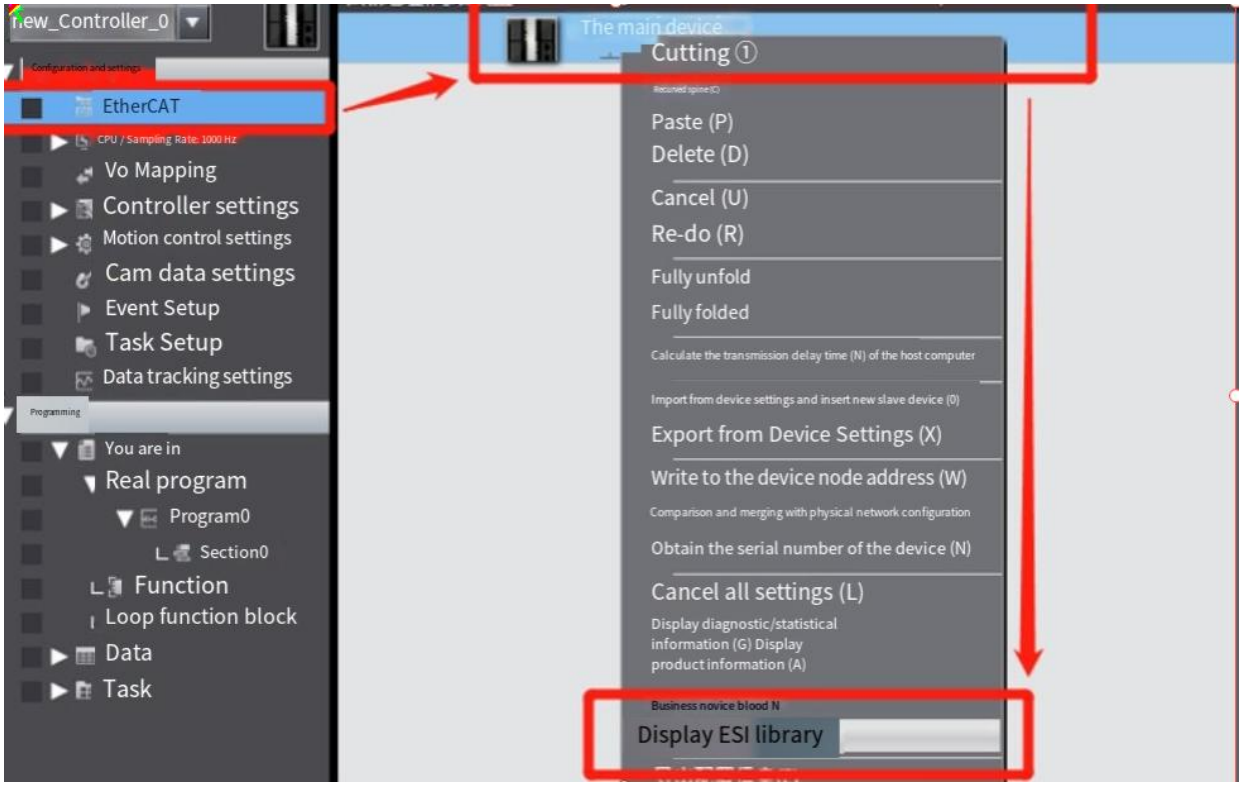
1) New Project

Open the OMRON host software Sysmac Studio. For first-time use, select "New Project," then choose the model NJ501-1500 with version 1.02 in the project properties interface, and click "Create" to generate the programming interface.

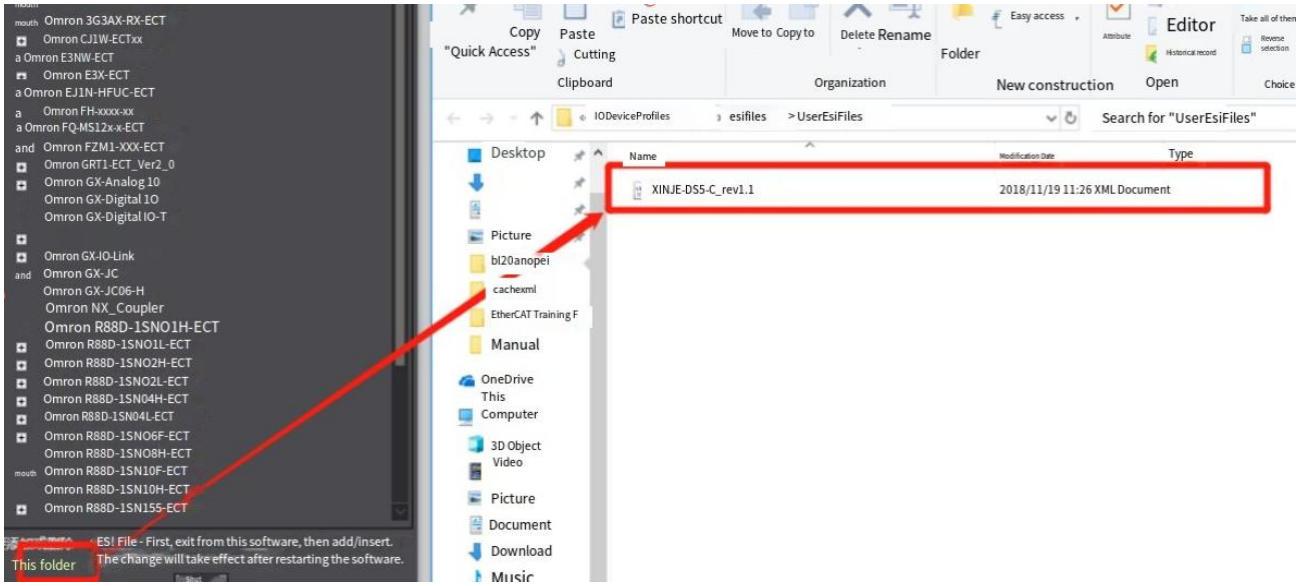


2) Add an XML file

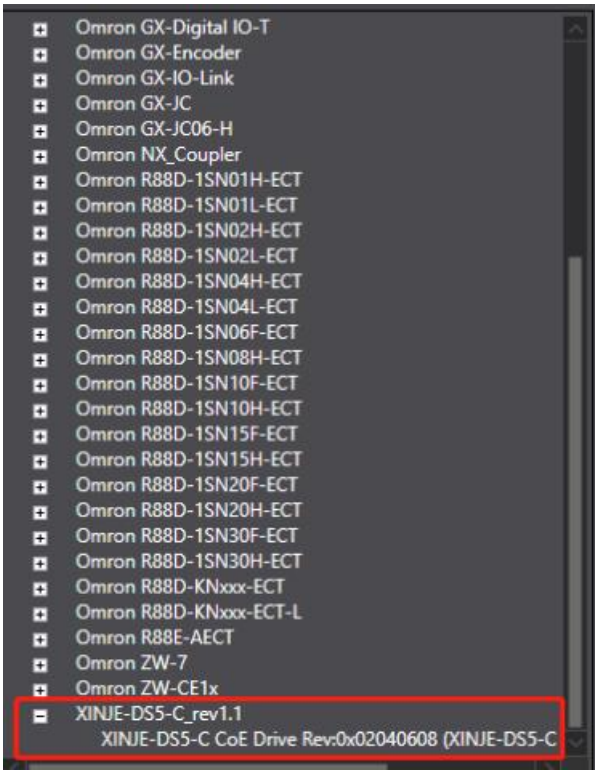
Double-click "EtherCAT" on the main interface to open the EtherCAT configuration interface. For first-time use, add an XML file to the library. Right-click the "Main Device" and select "Show ESI Library".



Next, add the DS5C2 XML file to the pop-up ESI library. Select "This Folder," which displays the file storage path; place the "XINJE-DS5C2-rev1.1" XML file in this folder.

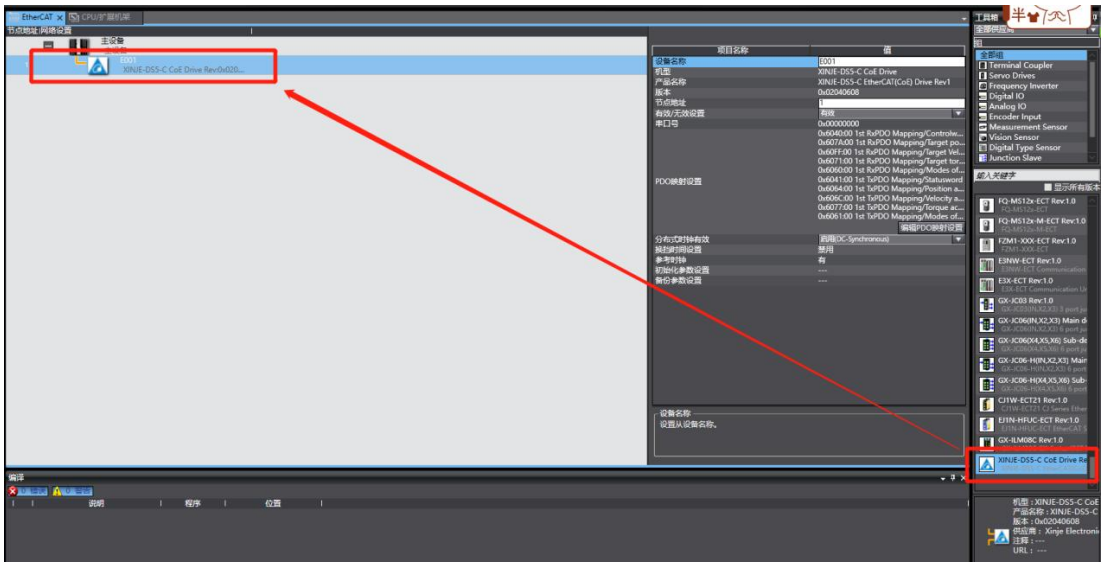


Finally, close Sysmac Studio and restart the software. Then browse the "ESI Library" again; the XINJE-DS5C2 slave description file is already present in the library.

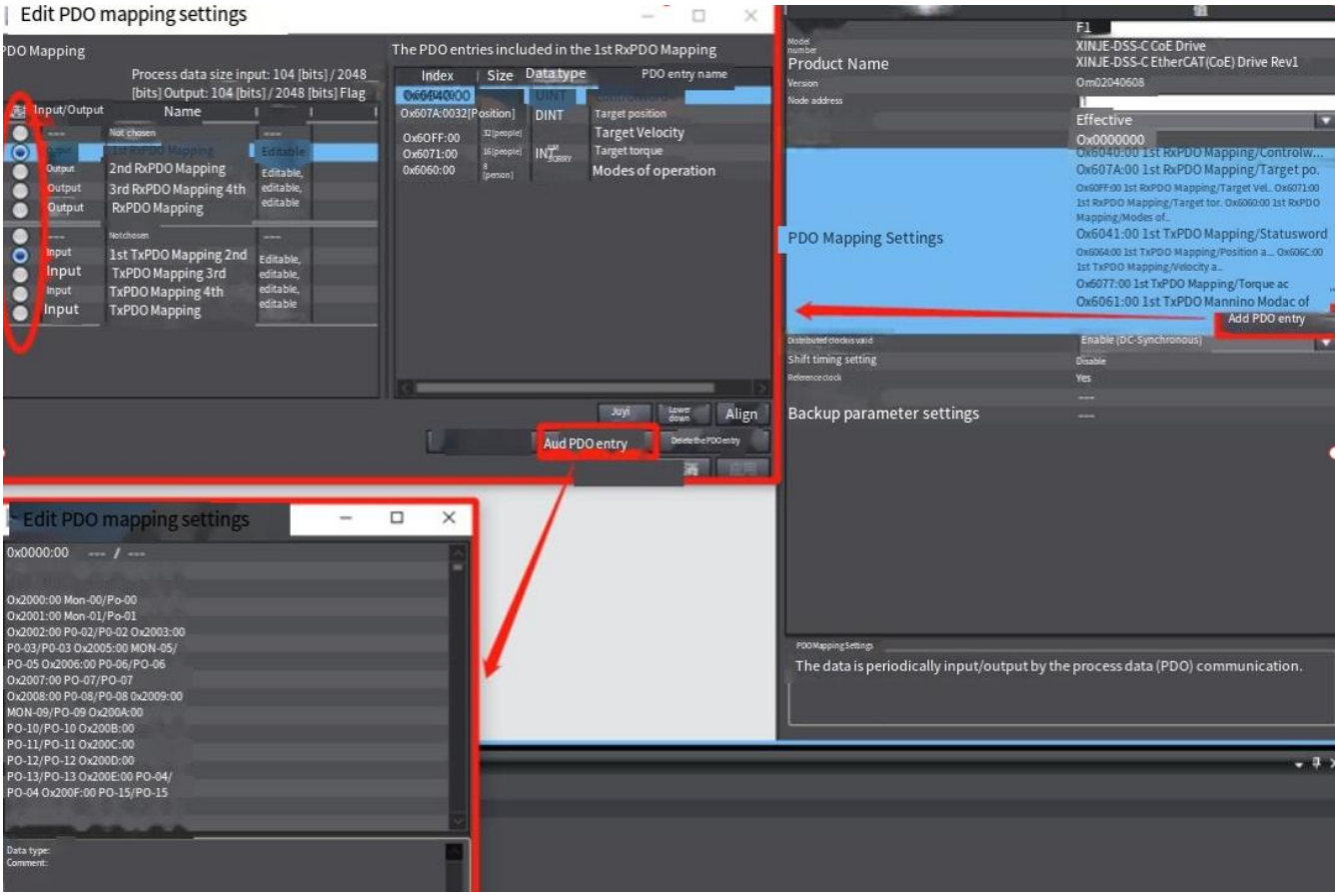


3) Add device

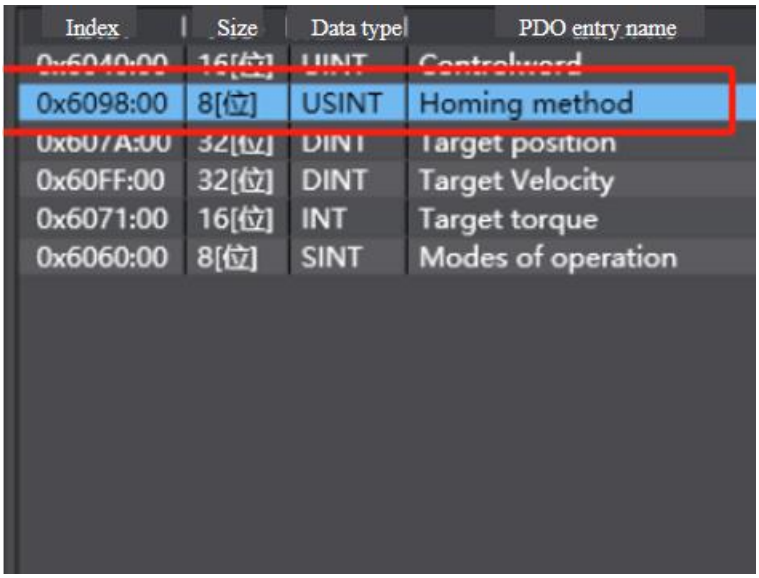
On the right side of the interface, locate "XINJE-DS5C2 CoE Drive Rev" and double-click to add it as a node under the main device.



After adding a node, selecting the node with the cursor displays its current PDO configuration. Choose "Edit PDO Mapping Settings" —the left side of the dialog shows the current output PDO Mapping while the right side displays PDO entries, allowing you to add or remove PDOs as needed. To add a PDO, select "Add PDO Entry"; the dialog displays available PDO objects. After selecting one, click "OK" and then "Apply" to complete the addition.



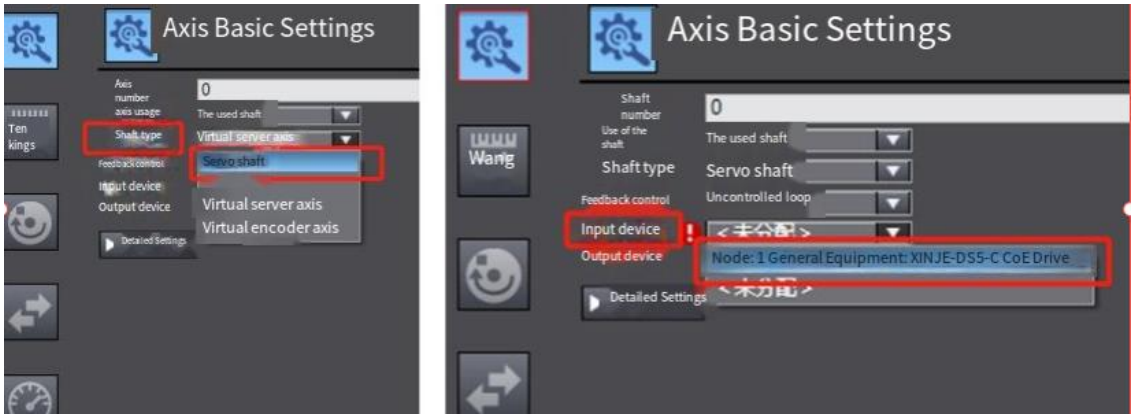
After adding, it appears as shown below:



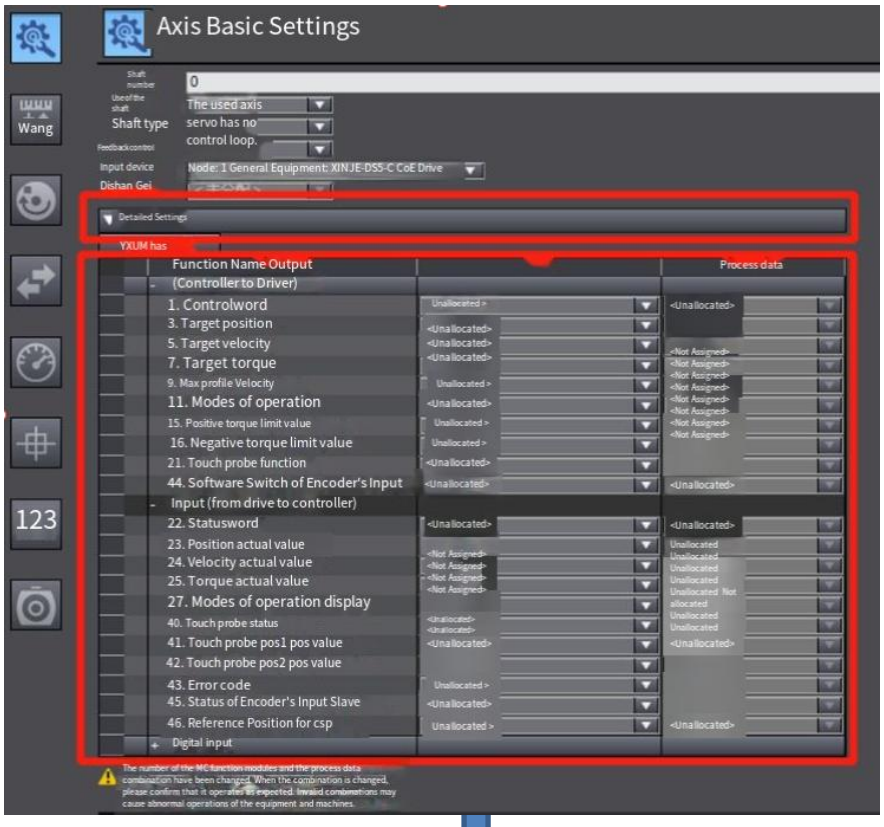
4) Motion Control Axis Settings

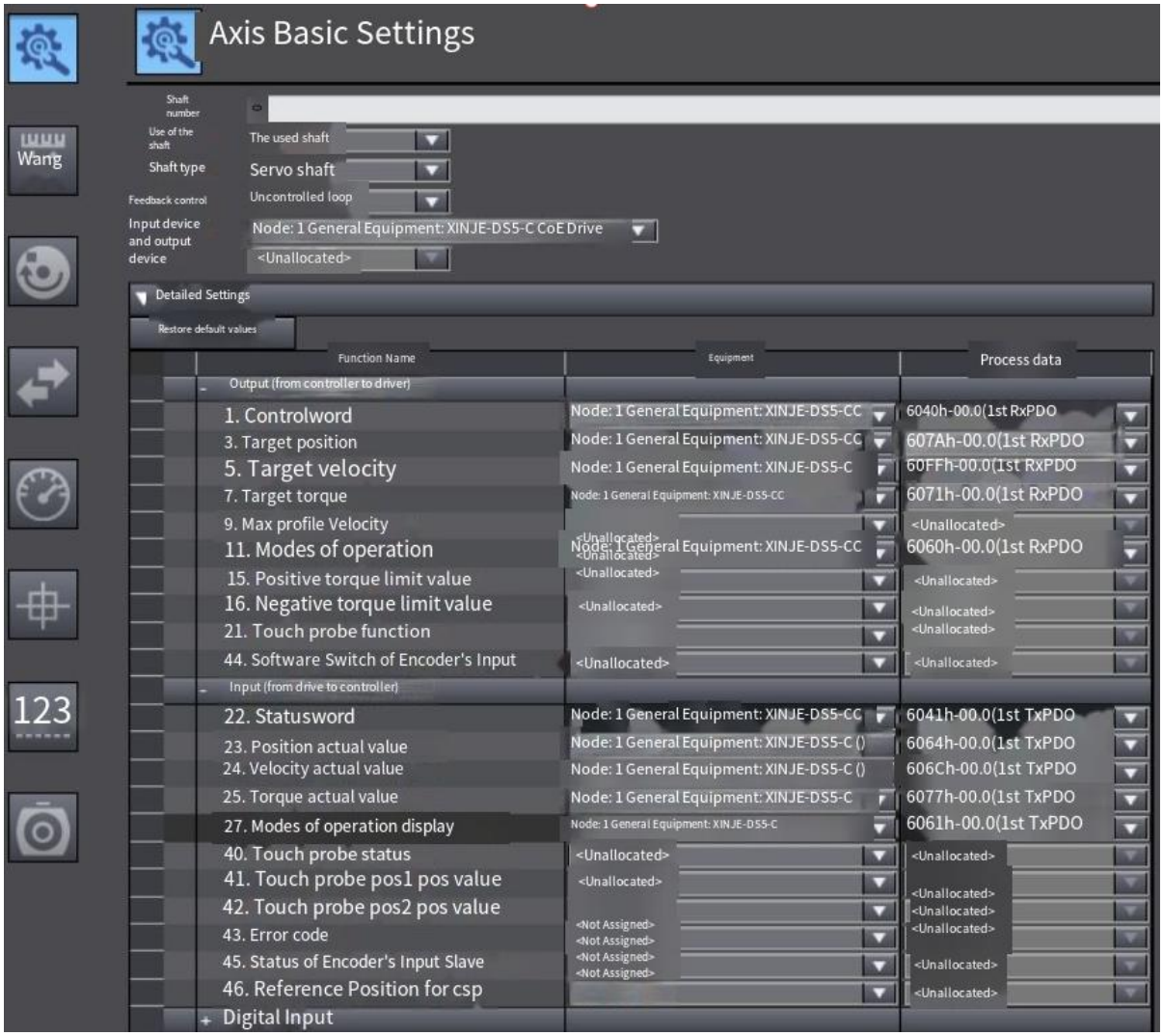
Double-click "Motion Control Settings", right-click "Axis Settings", and select "Add – Motion Control Axis".

Double-click "MC_Axis000" to open the axis configuration interface, which consists of multiple sub-interfaces. In the "Basic Axis Settings" interface, select "Axis Type – Server Axis" and choose "Input Device" as "Node 1: DS5C2".

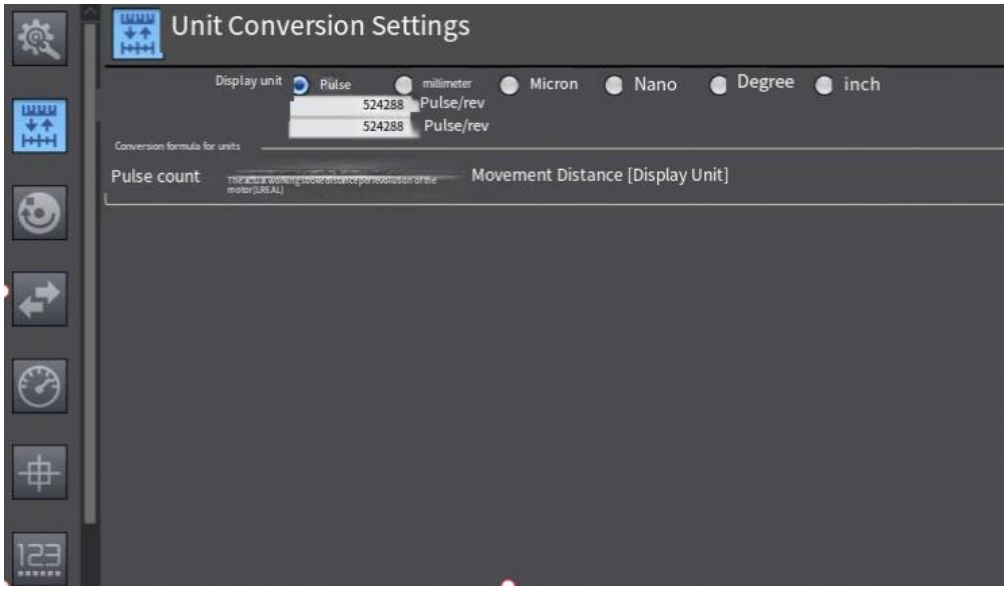


Click "Detailed Settings" to expand the configuration module. The function names must correspond one-to-one with the PDO mapping entries on the device. These entries must be added manually; missing or incorrect additions will affect the subsequent use of these parameters.



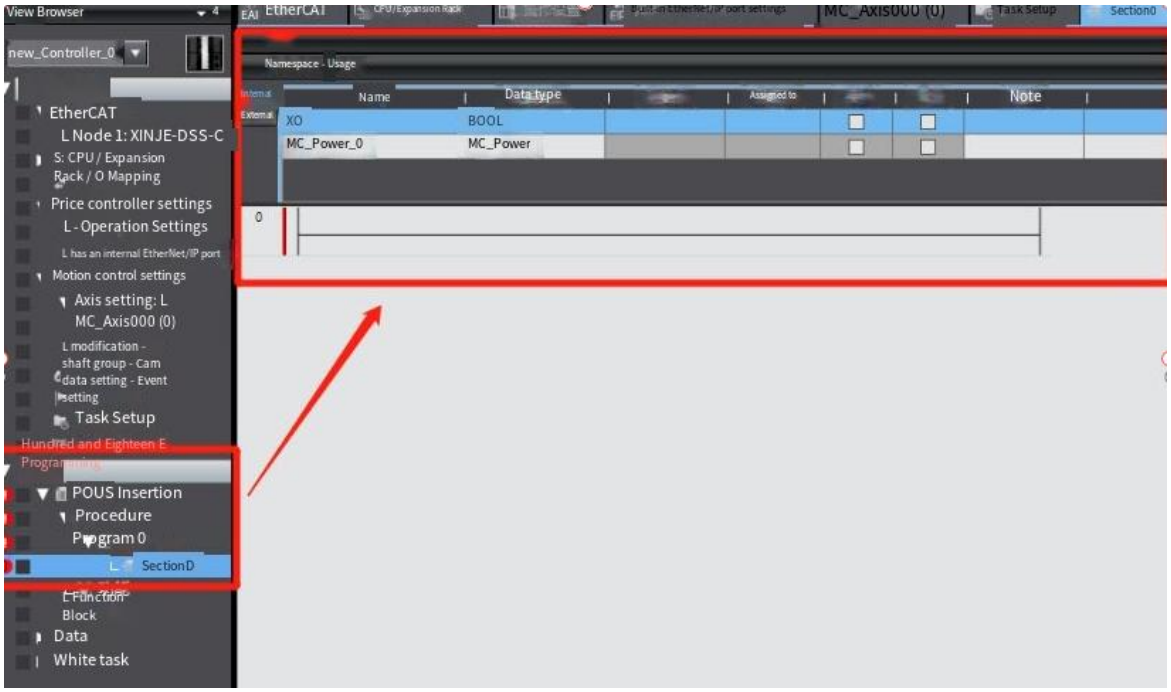


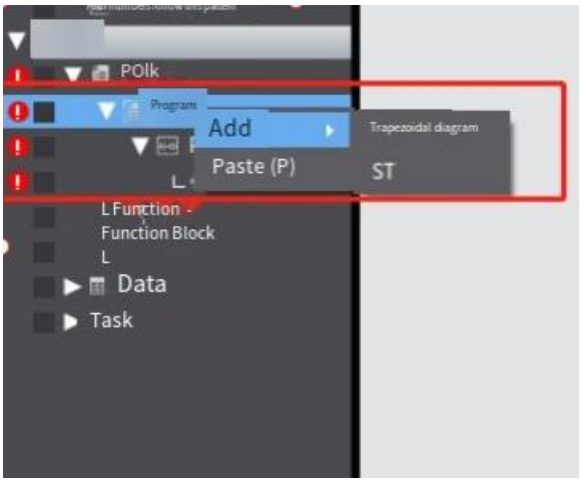
In the "Unit Conversion Settings," the "Number of command pulses per motor revolution" should correctly specify the motor encoder's line count. For example, if a 19-bit encoder is used, this value should be set to 524288. The "Working stroke per motor revolution" represents the equivalent travel per motor rotation; in this example, it is set to 524288 with a default gear ratio of 1:1.



5) Write a program for "round-trip motion"

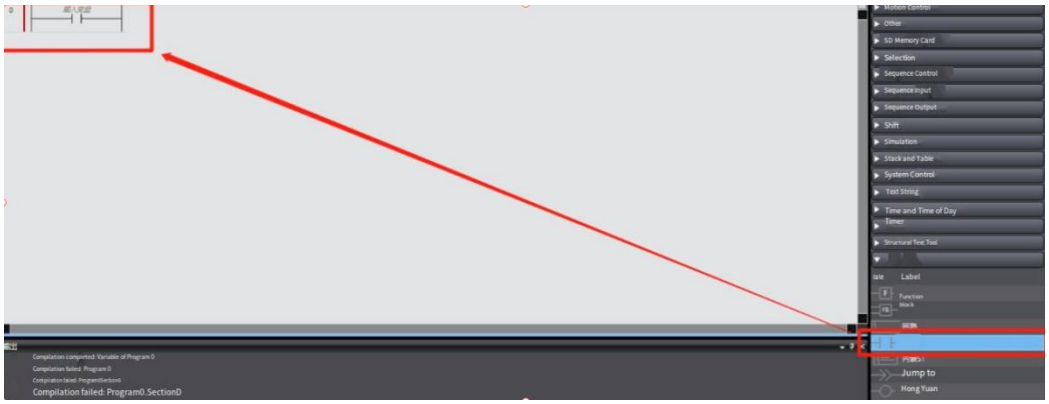
Programming Interface Instructions: Select in sequence "Programming → POUs → Program → Program0 → Section0", then double-click "Section0" to open the programming interface. By default, Program0 supports ladder diagram programming; for ST programming, right-click "Program → Add → ST". The "Toolbox" section allows you to add various ladder diagram elements.



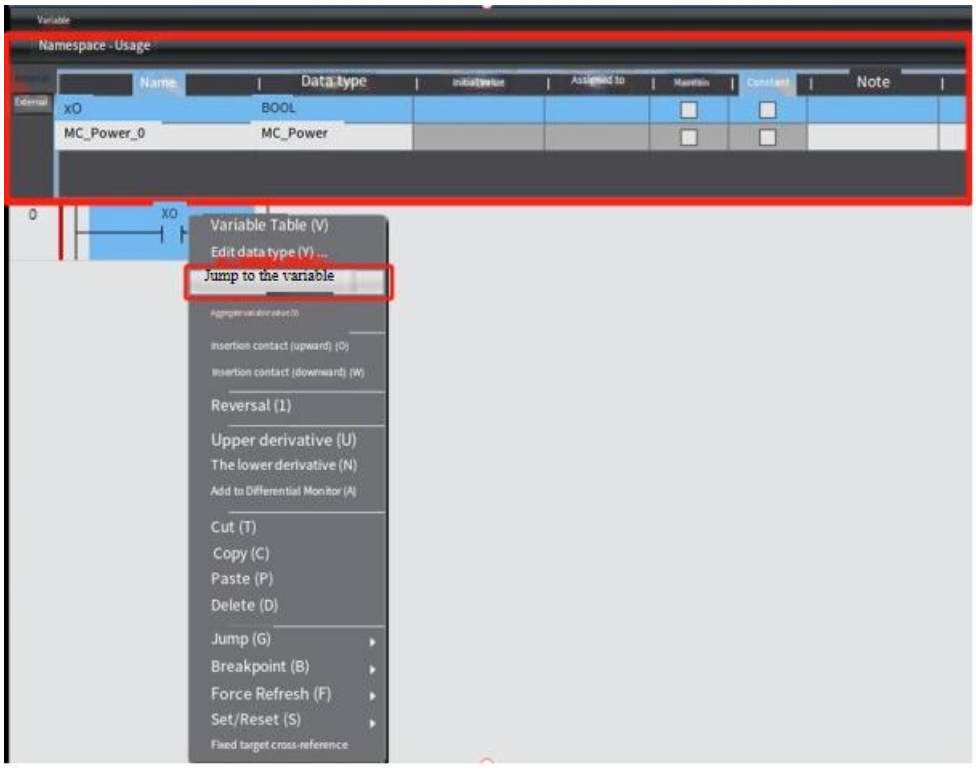

POIk
Program
Add
Paste (P)
Trapezoidal diagram
ST
L Function
Function Block
L
Data
Task

Search
Data Movement
Data Type Conversion
FCS
Math
Motion Control
Other
SD Memory Card
Selection
Sequence Control
Sequence Input
Sequence Output
Shift
Simulation
Stack and Table
System Control
Text String
Time and Time of Day
Timer
Structural Text Tool
Label
Label
Function
Function block
Loop
Contact point
Embedded ST
Line due to

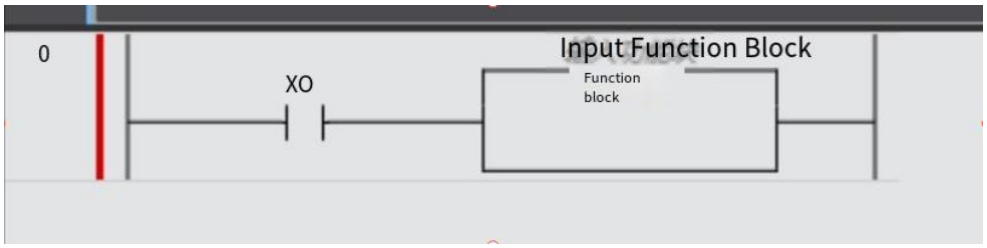
Select the "point" and drag it directly into the trapezoidal diagram node.



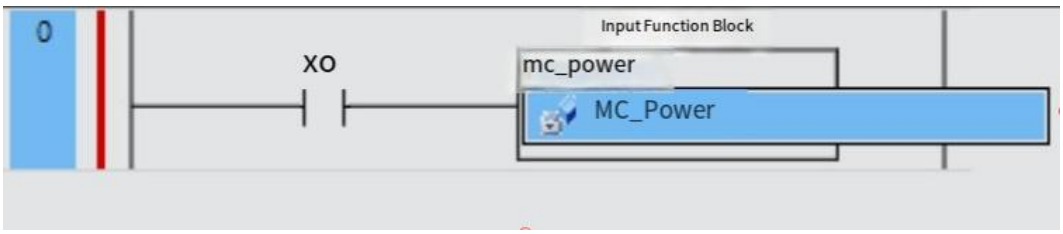
Click "Enter Variable" to enter the variable name. For a new variable name, a new variable will be created; for an existing variable, you can directly select it and fill in the value. New variables are listed in the Variable Table—right-click variable X0 and select "Go to Variable Table" to expand it. The Variable Table allows you to create variables of various data types for use or view all predefined variables.

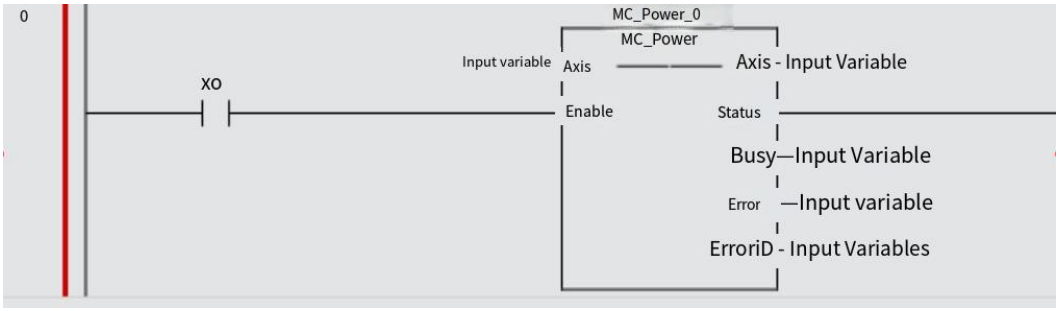


Add a "function block" in the ladder diagram using the same method.

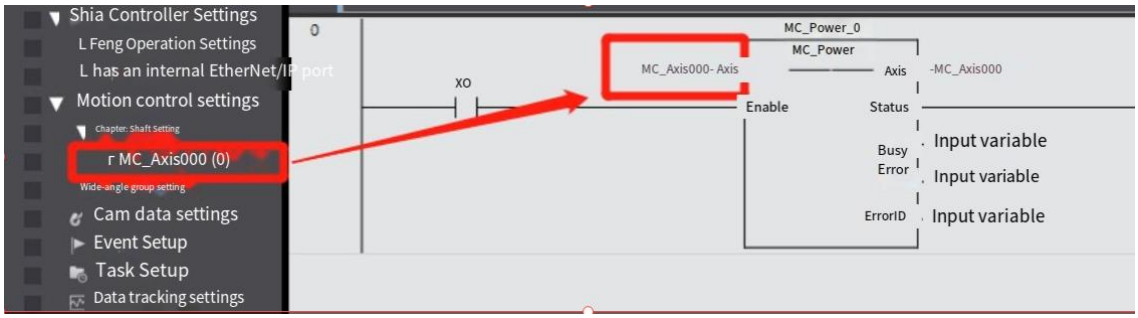


Enter a function block name to call its parameters. For example, enter "MC_Power" to declare this function block as MC_Power.

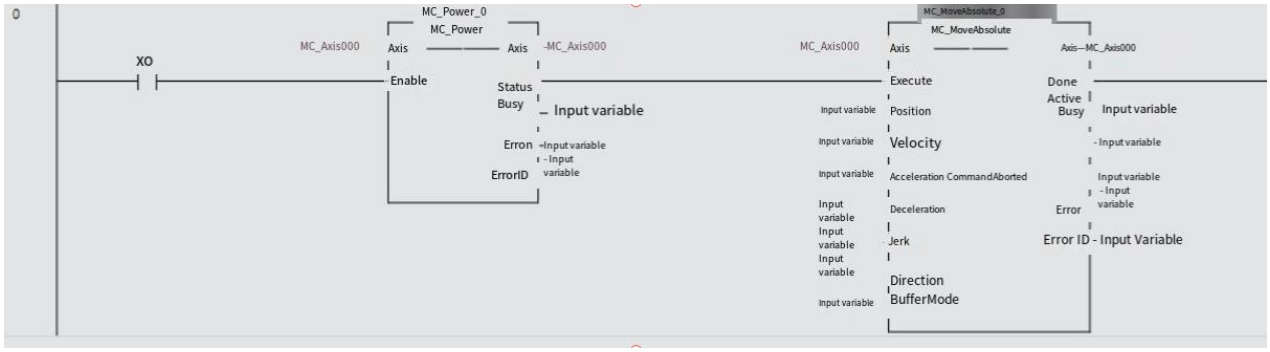




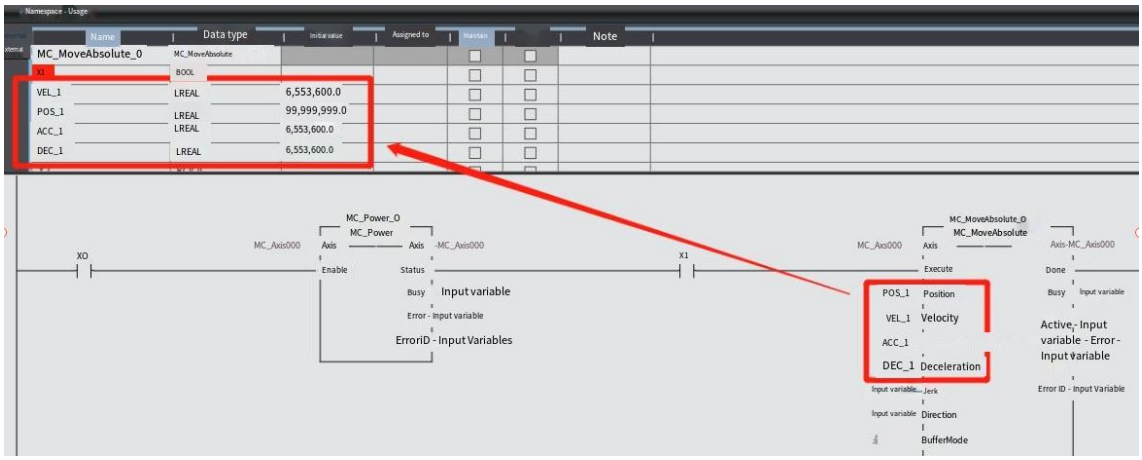
The Axis pin of the function block connects to a variable; inputting MC_Axis000 indicates that the function block is applied to axis "MC_Axis000".



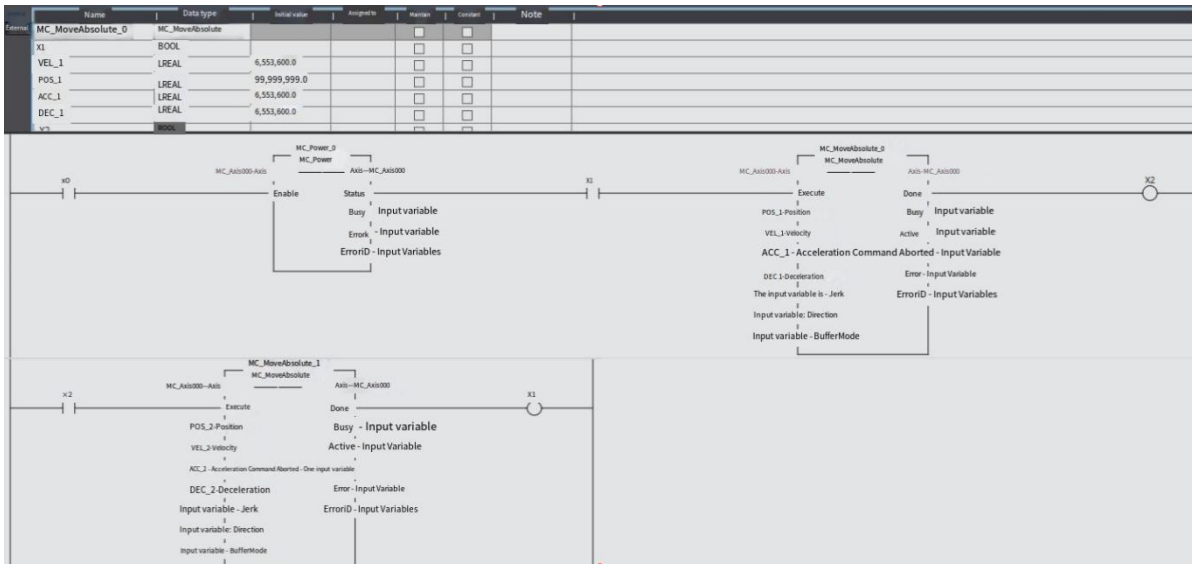
Add the function block "MC_MoveAbsolute" in the same manner, and define the variable names "Pos_1", "Vel_1", "Acc_1", and "Dec_1" for the pins "Position", "Velocity", "Acceleration", and "Deceleration".



The defined variables can be assigned initial values in the variable table, and these initial values take effect during PLC operation.

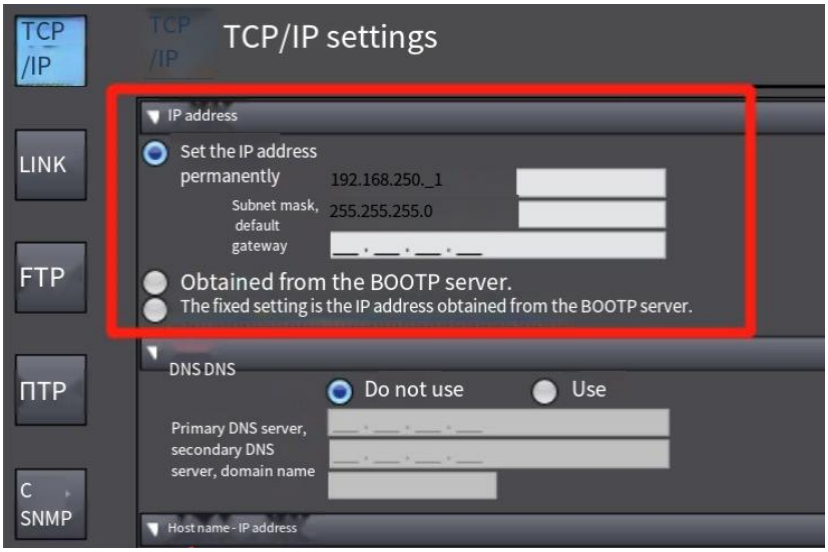


Write the complete program for a round-trip motion trapezoidal trajectory using the same approach.

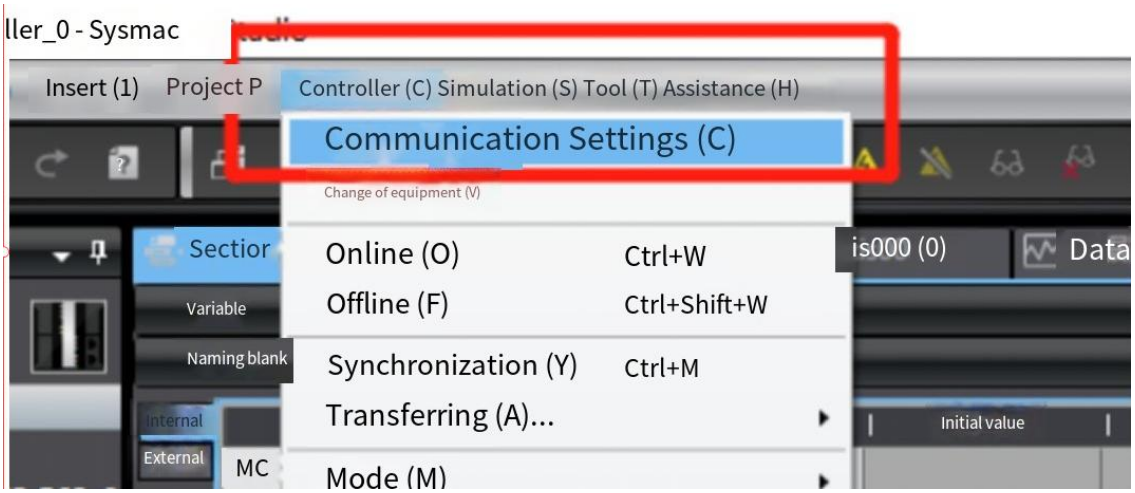


6) Gateway Communication Settings

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. This configuration interface displays the fixed IP address assigned by the current project. For a newly created program, the default IP address is 192.168.250.1.

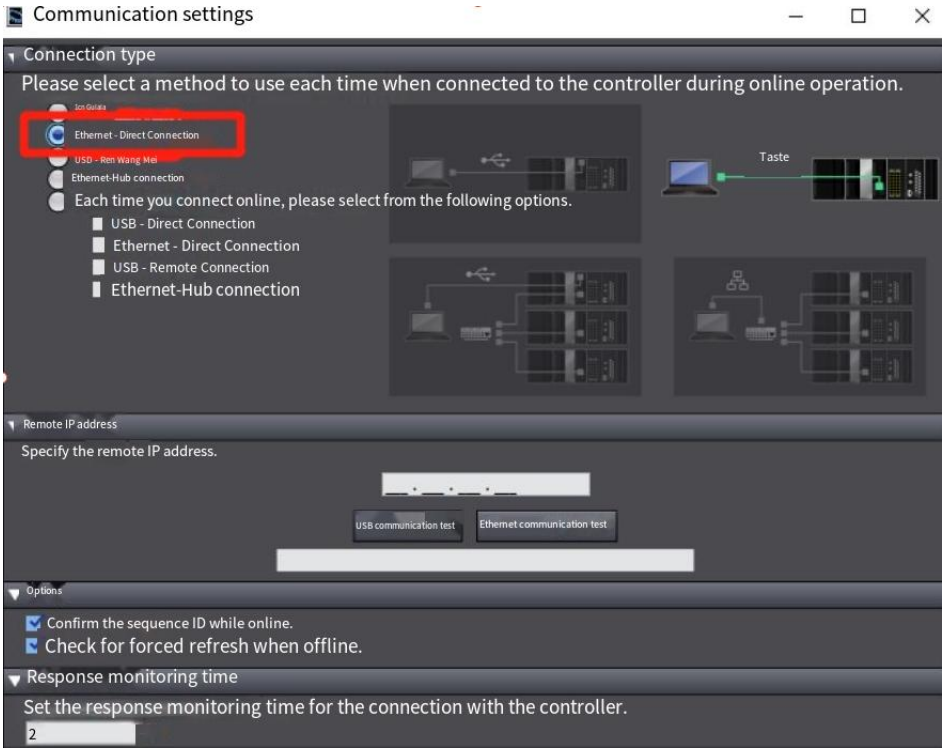


Communication configuration path: "Controller – Communication Settings".



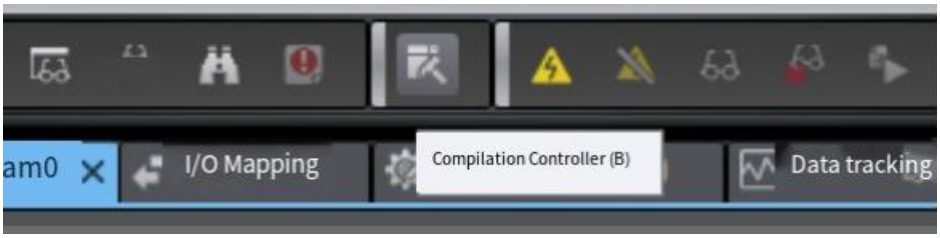
In the "Communication Settings" interface, select "Ethernet – Direct Connection," then click "OK" to close the interface.

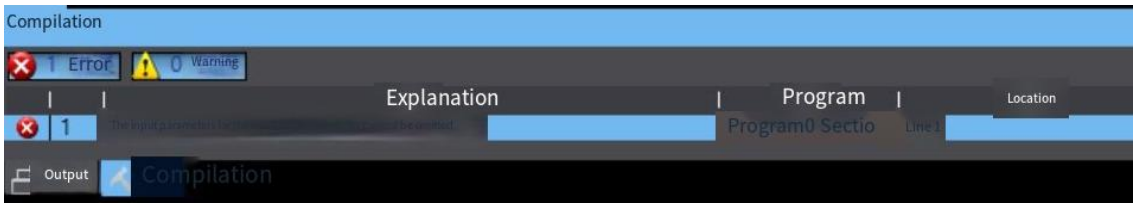
The Ethernet connection requires the device (PC) IP address to be automatically obtained or within the PLC's IP address range. Therefore, verify that the PC's IP configuration meets the requirements before establishing the connection.

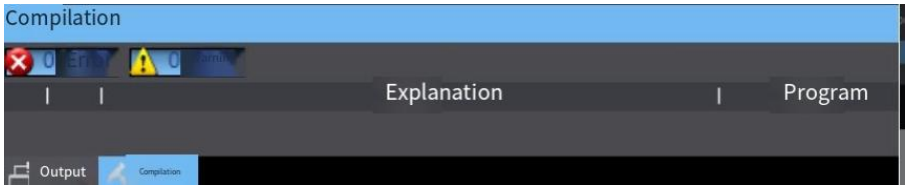


7) Compiler and connection preparation

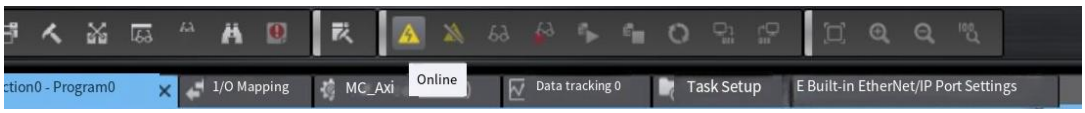
Find the "Compile Controller" in the toolbar and compile the project. If errors occur, check their causes.

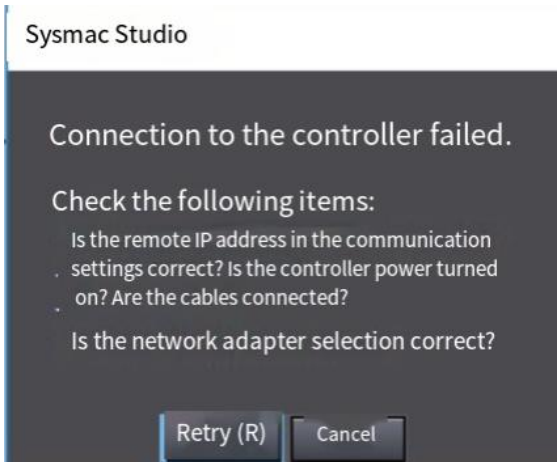


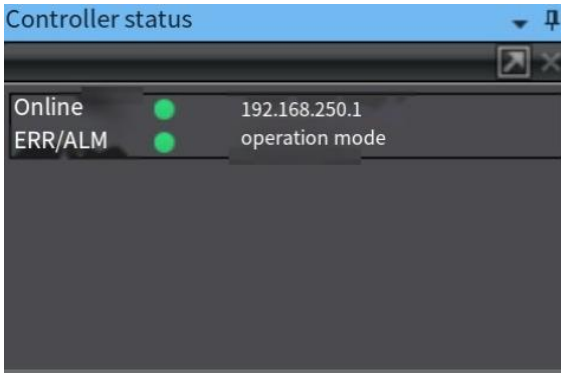




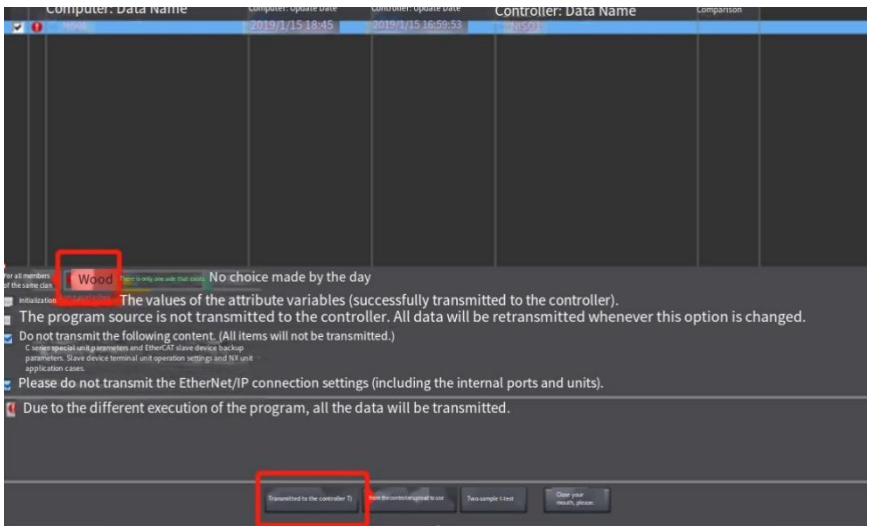
After compilation is successful, locate and click "Online" in the toolbar. If a pop-up message "Connection to controller failed" appears, verify that the communication configuration is correct. Once online, the host computer switches to the online state.

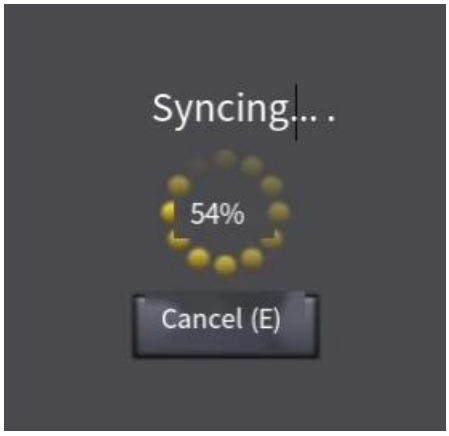




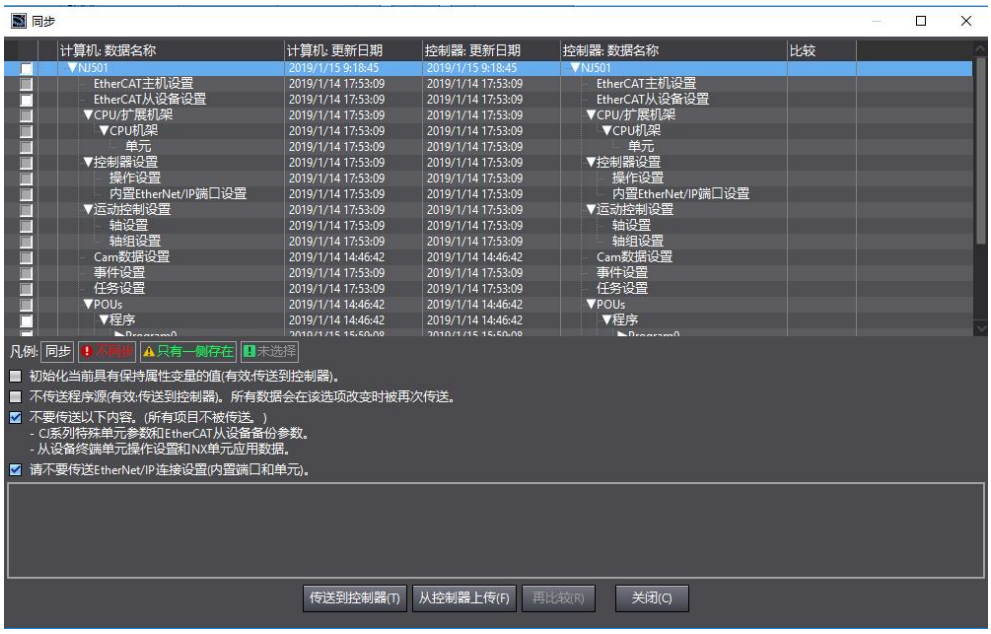


Select "Sync" from the toolbar. A dialog window will compare the local project with the project in the controller. If the projects differ, it will display "Not Synchronized." Click "Transfer to Controller" to download the local project and overwrite the existing project in the controller.



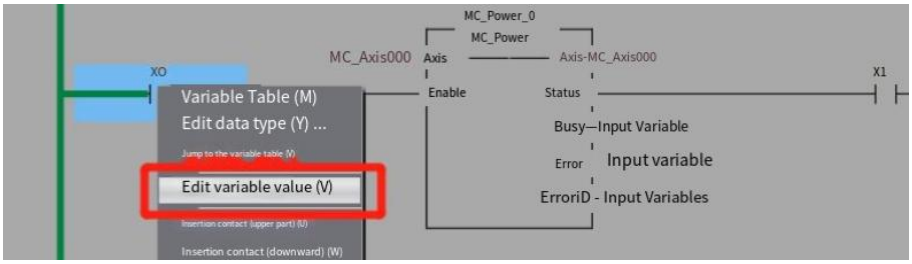


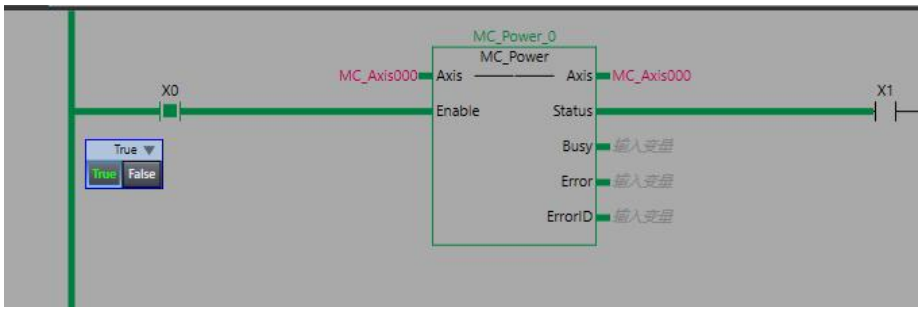
After synchronization is complete, click "Compare Again" to check the synchronization status of entries between the local project and the controller project. When the modified project is synchronized again, entries differing from those in the controller project will be highlighted in detail.



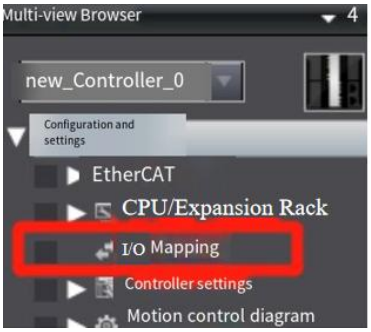
8) Online Control

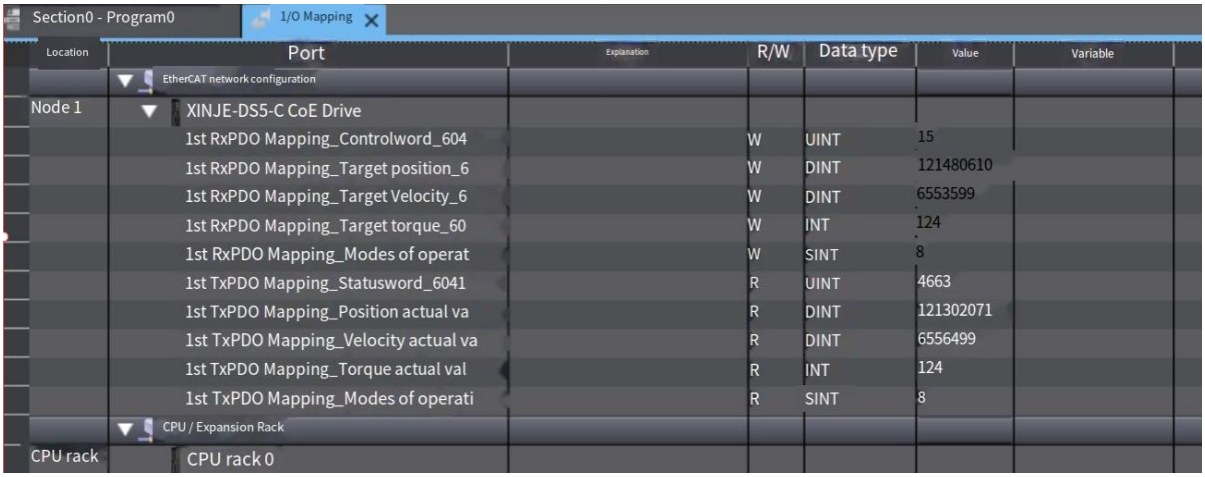
In the "Section0" interface, right-click the variable "X0" and select "Edit Variable Value" to set its BOOL value to "True". This activates the "MC_Power" function block and enables the servo motor. Repeat the same procedure to set variable "X1" to "True", enabling the program's reciprocating motion.





PDO object data can monitor real-time changes through "IO Mapping".





Appendix

Appendix 1 Certification and Standard Requirements

CE Mark Overview

- The "CE mark" is a certification symbol used in European commercial trade (production, import, and sale) to indicate that a product complies with safety (LVD), electromagnetic compatibility (EMC), and other relevant directives.
- The CE mark indicates that the manufacturer declares the product fully complies with the fundamental requirements of the European Union's laws and regulations concerning safety, health, environmental protection, and consumer protection (known as "Directives" or "Regulations").
- All products covered by the CE Directive must bear this marking before entering the EU market, regardless of their place of production worldwide.

The product complies with the directive table and relevant standards.

Certification name	Command name		Meet a criterion
CE attestation	EMC instruct	2014/30/EU	EN IEC 61000-6-4:2019 EN IEC 61000-6-2:2019 EN IEC 61800-3:2023
	LVD instruct	2014/35/EU	EN 61800-5-1:2007/A11:2021

Appendix 1.1 EU Directives and Compliance Standards Applicable to This Product

(1) Complies with EMC directives and standards

This product complies with the requirements of EMC Directive 2014/30/EU, has been tested in accordance with EN IEC 61800-3, and passed the testing.
The EMC standard is a technical specification system designed to ensure that electronic equipment operates stably in electromagnetic environments without interfering with other devices. Its core requirements are divided into two aspects:
① Electromagnetic Interference (EMI): Controls the electromagnetic disturbance energy emitted externally by the device itself.
② Electromagnetic Compatibility (EMS): The equipment must possess the capability to resist external electromagnetic interference.

(2) Complies with the LVD low-voltage directive and standards

This product complies with the requirements of Directive 2014/35/EU when operating within its applicable scope. Tested in accordance with EN 61800-5-1:2007/A11:2021, it meets the fundamental safety requirements for all electrical equipment across a wide voltage range of 50 V to 1000 V AC and 75 V to 1500 V DC. Its primary objective is to protect personnel, liveSTOck, and property from risks such as electric shocks, fires, and mechanical hazards associated with the use of electrical equipment.

(3) Description of Key Safety and EMC Characteristics

1. Security Section (derived from LVD):

1) Installation Requirements:
The operation must be performed by a certified electrician; reliable Grounding (PE) is mandatory; torque requirements apply to the power terminals.
2) Installation Environment and Protective Requirements
For installation site requirements, please refer to Section 2.1.1 "Installation Site" on page 34.
For installation environment requirements, please refer to Section 2.1.2 Environmental Conditions on page 34.
For installation standards, refer to Section 2.1.3 on page 34.
3) Requirements for protective devices
To comply with the EU safety standard EN 61800-5-1, ensure that a circuit breaker and fuse are installed on the drive's power input side to prevent hazardous accidents caused by internal short circuits.

For specification requirements of circuit breakers and fuses (保险 wires), refer to Section 1.5 "Selection of Peripheral Components" on page 30.
4) Warning Sign
High-pressure and burn warnings are indicated; please refer to the safety precautions in the preface of this manual or the warning information on the drive housing.

2. EMC section (derived from the EMC Directive):

To ensure compliance with EMC directives and standards, an EMC filter must be installed on the drive input side, and a recommended shielded cable should be selected for the output. Additionally, the filter must be reliably Groundinged, and shielded cables (for motor power lines and encoder lines) must be used. The shielding layer must be terminated at 360° to a Groundinged metal clamp/EMC connector; the encoder line must be separated from the power line, and the cabinet must be properly Groundinged.
For filter selection requirements, refer to Chapter 1.5 "Peripheral Component Selection" on page 30.

Appendix 1.2 Information on the Manufacturer and the EU Authorized Representative

(1) Manufacturer Information

Name: Wuxi Xinje Electric Co., Ltd.
Address: No.816, Jianzhu West Road, Binhu District, Wuxi City, Jiangsu Province 214026

(2) Information about the German branch

Name: XINJE ELECTRONIC GMBH.

Address: Koblenzer Str. 71,56626 Andernach, Germany
Contact Number: Ms.Lili-Iven Phone: 015234531220

Manual Update Log

Information regarding the revision of the materials is recorded together with the material number in the lower right corner of the cover.

Number	File number	Chapters and sections	Update content
1	SC5 15 20230518 1.0	-	The first edition of the manual has been released.
2	SC5 15 20230719 1.0.1	-	1. Amend the content of Chapters 1.3.1, 1.3.3, and 1.4; 2. Amend the contents of 3.1.3.1, 3.1.3.2, 5.3, 5.4.1.1, 5.4.1.9, 5.6.1.2, 7.9.3, and Appendix 3; 3. Modify the parameter range for P0-93, P0-95, and U0; 4. Modify the applicable modes for P5-31 to P5-32.
3	SC5 15 20231007 1.0.2	-	1、Add features of Version 4210; 2、The cable pin definition has been revised to reflect the solder wire perspective. 3. Correction of other manual errors.
4	SC5 15 20240103 1.1	-	1. Add 5.5 kW and 7.5 kW models; 2. Add usage instructions for the optional STO feature; 3. Correction of other manual errors.
5	SC5 15 20240323 1.1.1	-	1. Revise the Stop description in Chapter 5.3.1; 2. Update the chapter on 11.1 Bus Communication Cases; 3. Other manual errors have been revised.
6	SC5 15 20240520 1.2	-	1. Add the 15 kW model.
7	SC5 15 20240716 1.2.1	-	1. Amend the wire diameter specifications in section 2.3.2; 2. Amend Sections 5.2, 5.3, 7.7, 7.9.6, and Appendix 1.1; 3. Other manual errors have been revised.
8	SC5 15 20250115 1.2.2	-	1. Optimized documentation for absolute encoders; 2. Modified default values for some parameters; 3. Other manual errors have been revised.
9	SC5 15 20250609 1.3	-	1. Added 32 kW-related drawings, parameters, and terminal descriptions; 2. Optimize the layout of Chapters 1–2; 3. Added new motor sizes for newly commissioned units; 4. Optimize cable diameter specifications;

Number	File number	Chapters and sections	Update content
			5. Optimized layout for the operation panel, with added step-by-step instructions for P-group parameter settings; 6. Optimization of the sequence diagram for HM's return-to-origin movement; 7. Added E-115/116/117 alarm; 8. Other revisions to manual errors.
10	SC5 15 20250925 1.3.1	-	Amend the content of Chapters 1.5.1 and 1.5.3.
11	SC5 15 20251111 1.3.2	-	Amend the content of Chapters 1.1.6, 1.4, 1.5, and 5.7.
12	SC5 15 20251227 2.0	-	1、Recommended selection of additional peripheral components; 2、Reorder the chapter sequence in the manual, split 部分内容 from existing chapters and merge it into new chapters, and add a new chapter on debugging and operation. 3、Added STO certification specifications and CE certification declaration; 4、Other manual revisions were incorrect;