Just motion control EC Series Drives

User's Manual

V1.42

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Preface

JMC bus driver series products cover R series of Modbus RTU protocol based on RS485 communication network, RC series of CANopen protocol based on CAN communication network and COE (CANopen over) based on EtherCAT communication network The EC series of EtherCAT protocol and other three bus communication modes of digital stepping, hybrid stepping servo, integrated stepping servo, low-voltage servo, high-voltage servo and integrated AC servo are intelligent bus driven products.

The application layer of JMC bus drive series slave station adopts ds402 standard motion control protocol, which supports the control modes of CSP, PP, PV, HM and Pt. Support CW / HW / CCW limit (origin) and two high-speed probe digital input, support brake, in place, alarm digital output. The communication port adopts RJ45 network interface and standard Ethernet communication cable to realize the serial network connection of multi axis slave station. It has the advantages of strong anti-interference ability, high control accuracy and good expansibility. It is the ideal choice of multi axis Industrial Ethernet bus control system!

This manual mainly introduces EC series products:

JMC EC series bus driver refers to the slave driver whose hardware adopts 100Mbps full duplex EtherCAT communication circuit and whose software adopts COE communication protocol and cia402 motion control protocol. EtherCAT is a high-performance Ethernet technology developed by Beckhoff company in Germany, which has high performance, low cost, simple application and flexible topology. It can be applied to the ultra-high speed network at the industrial site level.

This manual will be divided into four parts: hardware, communication, control and routine. The hardware part describes the hardware performance and operation usage of each specific model of product in detail to facilitate users to understand our product; the communication part introduces the EtherCAT protocol in detail to help users understand the protocol and better use our product; the control part is the basic control mode of synchronous cycle position, contour position, contour speed and zero return The operation is introduced in detail to help users quickly get familiar with the operation of our product; the routine part gives an example of programming examples of EtherCAT communication, and provides some communication demos of mainstream brands of controllers. Users can refer to these demos to get started quickly.

report errors

employees shall not be liable for it

In addition, the products and materials mentioned in this manual are for reference only. If the contents are updated, NO further notice will be given.

directory

IHSV-EC Integrated field-bus AC servo motor series

➢ Product introduction

The IHSV-EC integrated field bus AC servo motor product is an EtherCAT integrated field bus AC servo motor. It uses the standard CoE communication protocol and has built-in CIA402 motion control protocol for cycle synchronization position (CSP), cycle synchronization speed (CSV), and cycle synchronization torque (CST), contour position (PP), contour speed (PV), contour torque (PT) and homing (HM) mode; through the optimized PID control algorithm, to achieve full digital control of position, speed, torque, with Compared with the combination of traditional servo drive and servo motor, the cost is lower, the installation is more convenient, the temperature rise of the motor is effectively suppressed, the vibration of the motor is significantly reduced, and the high-speed performance of the motor is greatly enhanced. Comes with 3 digital signal inputs for zero return reference, positive and negative limit input and probe function; comes with 1 digital signal output for in-place output signal and alarm signal selection output; built-in brake control circuit; Current, overvoltage, undervoltage, and position tolerance protection; RJ45 network communication interface, highly integrated design, eliminating encoder, motor power line and signal line, convenient wiring, reducing system complexity; is a cost-effective Very high industrial bus motion control products.

➢ Technical characteristics

✧ · NO lost steps, accurate positioning

✧ · Support standard EtherCAT bus

✧ · CSP / CSV / CST / PP / PV / PT / HM and other modes following the CIA402 motion control protocol, easy to develop

✧ · Built-in CW, CCW, SW three 5V or 24V IO signal input for limit and zero return reference

✧ · Built-in brake circuit, external input 24VDC power supply is eNOugh

✧ · RJ45 standard network connection, the slave stations can be connected by twisted pair network cable

✧ · 100% rated torque drive motor

✧ · Variable current control technology, high current efficiency

✧ · Low vibration, stable operation at low speed

✧ · Built-in acceleration and deceleration control to improve the smoothness of start and stop

✧ · User can customize subdivision

✧ · Compatible with 1000 line and 2500 line encoder

✧ · NO need to adjust general application parameters

✧ · Overcurrent protection, overvoltage protection, undervoltage protection and over-tolerance protection

- ✧ · Strong compatibility, can communicate with mainstream brand PLC controllers, such as: Beckhoff, Panasonic, Omron, Panasonic, Keyence, InNOvance, JMC, etc.

➢ Application

Suitable for various point-to-point control automation equipment and instruments that require large torque, such as: wire stripping machine, marking machine, cutting machine, laser phototypesetting, plotter, CNC machine tool, logistics storage equipment, new energy lithium battery equipment, automatic assembly equipment. The application effect is particularly good in devices that users expect bus control, low NOise and high speed

1 Safety Precautions

The following explanations are for things that must be observed in order to prevent harm to people and damage to property, classified Specially below.

Danger	Indicates great possibility of death or serious injury.
Caution	Indicates possibility of injury or property damage.
	Indicates something that must NOt be done.

1.1 Precaution of receiving and installation

Danger:

1. Please connect motor and drive according to assigned methods in case of damaging machine or fire.
2. Don’t use at places with thick steam, combustible, corrosive gas in case of electrical shocks, damages or fire etc.

1.2 Connection

Danger:

1. Please don’t connect drive power supply to motor output port U,V,W in case of damaging drive and even causing injury or fire.

2. Please confirm if power supply cable is connected with motor output connector, in case of fire caused by sparks.
3. Please select correct power cable and motor power extended cable to avoid fire caused by overcurrent.
4. Please be sure drive case and motor is connected to ground to avoid possible electric shock caused by imperfect earth.

⚠Caution:

1. Please don't bind motor power cable with signal cable, or pass through same tube in case of signal interference.
2. Please use multistrand shielding power cable for signal line and encoder feedback extended cable in order to strength the anti-interference.
3. Please don't touch power supply connector, and confirm discharge indicator light is off before operate again. There is still high voltage inside after drive is powered off.
4. Please confirm all connection is correct before power on.

1.3 Precaution of operation

⚠ Danger:

1. Please make NO-load test before installation to avoid accident.
2. Please don't be operated by people without training in case of injury or damage caused by misoperation.

3. Please don't touch heat sink or inside part of drive while running in case of burn or electric shock.

Caution:

1. Please set drive parameters first, and then do long-term test in case of NOt working properly.
2. Please confirm switches like start, stop, turn off are work well before running the machine.
3. Please don't turn on or off power supply frequently.

1.4 Maintenance & Inspection

:

1、 Don't touch drive or motor inside while running in case of electric shock.

2、 Don't touch power supply or wiring connector of power line in case of electric shock.

3、 Don't change wires while power is on in case of electric shock or injury.

4、 Operation and daily maintenance must be done by trained professionals.

10.Please don't dis-assembly or repair except JMC technicians.

2 Product description

2.1 Technical index

Table 1 IHSV-EC Technical index

<table>
<tr><th colspan="2">IHSV57/60/86-R/RCTechnical index</th><th colspan="7"></th></tr>
<tr><td colspan="2" rowspan="3">Input Power（VDC）</td><td>42 Base</td><td colspan="2">57 Base</td><td colspan="2">60 Base</td><td colspan="2">86 Base</td></tr>
<tr><td>78W</td><td>140W</td><td>180W</td><td>200W</td><td>400W</td><td>440W</td><td>660W</td></tr>
<tr><td>24</td><td colspan="2">36</td><td colspan="2">48</td><td colspan="2">72</td></tr>
<tr><td colspan="2">Communication type</td><td colspan="7">EtherCATProtocol</td></tr>
<tr><td colspan="2">Maximum communication distance</td><td colspan="7">Between slaves 100M</td></tr>
<tr><td colspan="2">Maximum support slave station number</td><td colspan="7">65535</td></tr>
<tr><td colspan="2">Protection</td><td colspan="7">Overload I2t current action value 300% 3S</td></tr>
<tr><td rowspan="5">Environment</td><td>Occasion</td><td colspan="7">Try to avoid dust, oil mist and corrosive gas</td></tr>
<tr><td>Working Temperature</td><td colspan="7">0~+70℃</td></tr>
<tr><td>Storage temperature</td><td colspan="7">-20℃~+80℃</td></tr>
<tr><td>Humidity</td><td colspan="7">40~90%RH</td></tr>
<tr><td>Cooling method</td><td colspan="7">Natural cooling or strong cooling air</td></tr>
</table>

2.2 Naming rules

IHSV57 – 30 - 14 - 36 - EC - XXX

① ② ③ ④ ⑤ ⑥ ⑦

① Series name:IHSV：Integrated AC servo motor

② Motor Base：42：42 Base57：57 Base 60：60 Base 86：86 Base

③ Rated Speed: 30：3000RPM

④ Rated Power: 07 :78W 14 :140W 18 :180W 20 :200W 40 :400W 44 :440W 66 :660W

⑤ Supply Voltage: 24:24VDC36:36VDC 48:48VDC 72:72VDC

⑥ Field-Bus communication：R：RS485 RC：RS485+CAN EC：EtherCAT

⑦ Product design serial number: special function module, the default is the standard model

3 interface and wiring of driver

3.1 Interface definition

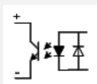
3.1.1Power port

Table 2 Power port

Port	Symbol	Name	Explanation
1	DC+	Power input +	DC power supply
2	GND	Power input ground	

3.1.2 Control signal port（10 pin）

Table 3 Control signal port

Port	Symbol	Name	Explanation
1	COM	Public end	24VDC/GND
2	CW-	Clockwise limit -	
3	HW+	Mechanical origin limit +	Compatible with 5V and 24V
4	CCW+	Counterclockwise limit +	
5	DI3	Probe 1 input	Compatible with 5V and 24V
6	DI4	Probe 2 input	
7	DO0+	Alarm Output +	
8	DO0-	Alarm Output -	
9	DO1+	Output in place +	
10	DO1-	Output in place -	

Remarks: EC series brake power input BK24V, BK0V are located beside the power input

NOte: For the communication port, see "Communication Interface and Wiring" "*Communication Interface and Wiring*" in the communication section (Ctrl + left mouse button or click the text to jump).

3.2 Control signal interface circuit diagram

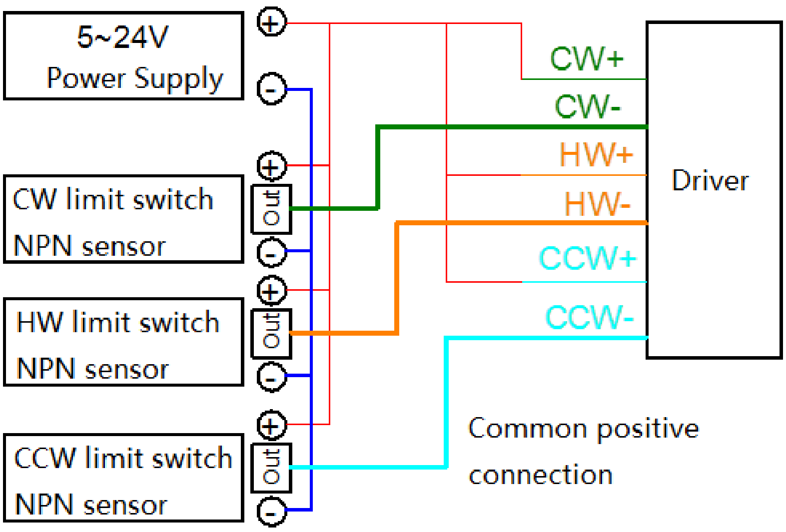


Figure 4 Common positive connection

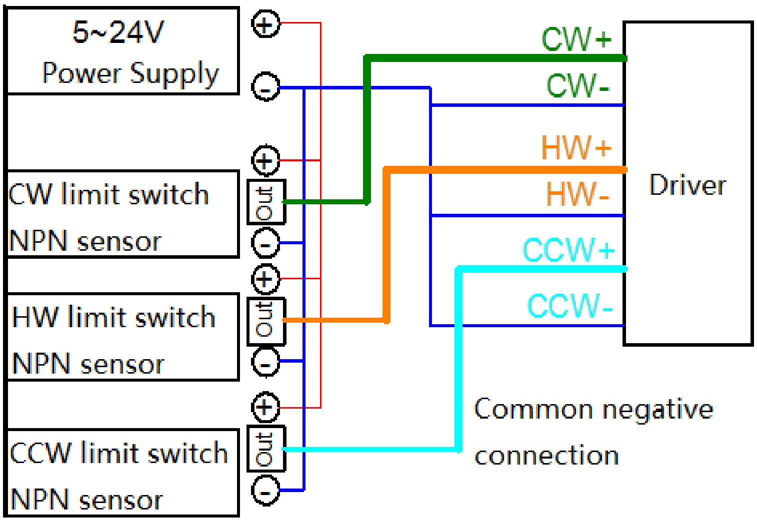


Figure 5 Common negative connection

NOte: The control signal level can be compatible with 5V and 24V.

3.3 Serial interface 232 wiring diagram

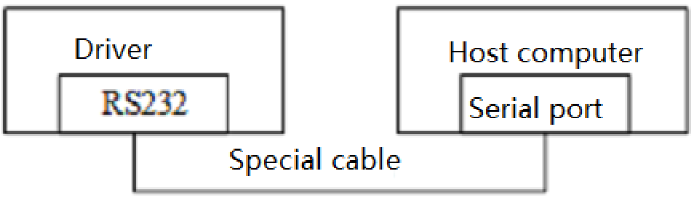


Figure 6 Schematic diagram of parameter debugging wiring

NOte: The cable connecting the IHSV-EC and the PC must be a special cable, the special cable model JMC-RS232-HL340 + JMC-RS232-USB; please confirm before use to avoid damage.

3.4 Typical application wiring diagram

The typical wiring diagram composed of IHSV-EC driver is shown in the figure. The power supply is selected according to the matching motor voltage level.

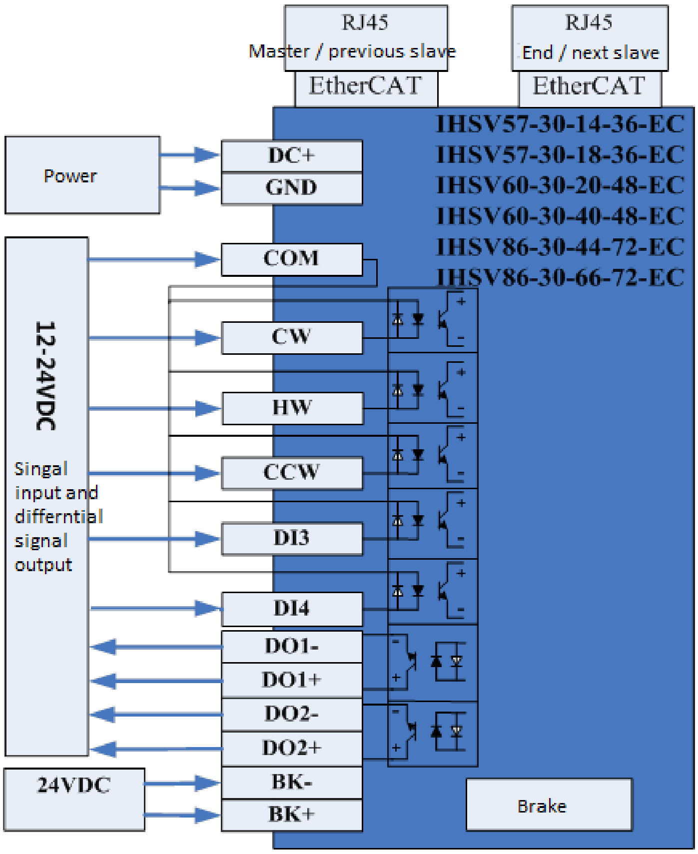


Figure 7 Typical wiring diagram of IHSV-EC

4 Installation instructions and fault alarm

4.1Installation dimensions

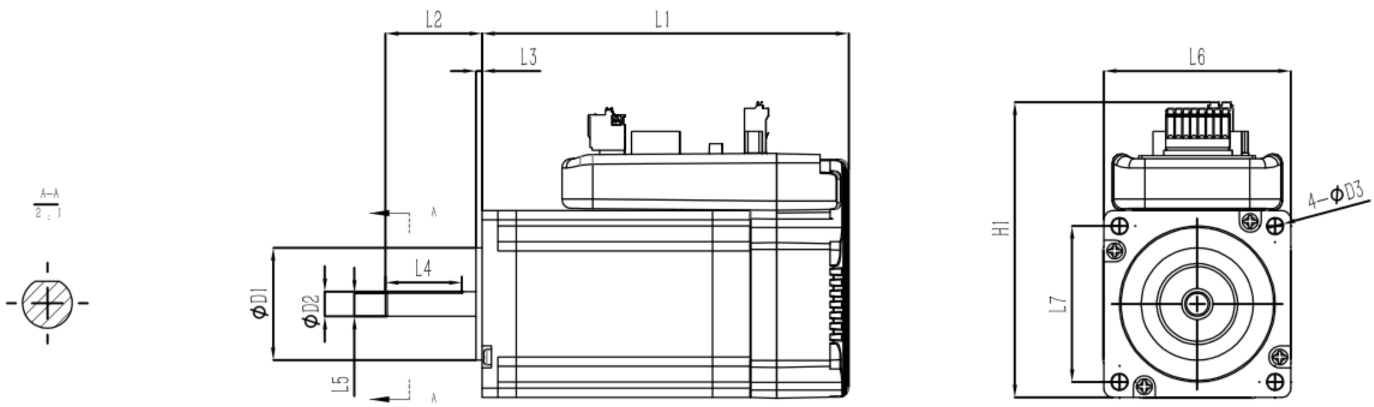


Figure 8 JMC IHSV-EC Integrated motor installation size

Model	L1(mm)	L2(mm)	L6(mm)	L7(mm)	D1 (mm)	D2 (mm)	H1 (mm)
IHSV57-30-14-36-EC	130	33	57	47	38	8	90
IHSV57-30-18-36-EC	150	33	57	47	38	8	90
IHSV60-30-20-48-EC	112	27	60	49.5	50	14	94
IHSV60-30-20-48-EC	142	27	60	49.5	50	14	94
IHSV86-30-44-72-EC	162	38	86	69.5	73	14	121.8
IHSV86-30-66-72-EC	189	38	86	69.5	73	14	121.8

Remarks: The standard 57/60 base motor output shaft is a flat port without key. There are two types of 86 motor output shafts: flat mouth and key; please contact us for the detailed shaft size drawing.

4.2 Installation environment

Using environment will directly affects the normal work and life of product directly, so it must meet the following conditions:

1. Working environment temperature : 0 to 55℃. Work environment humidity : 10% to 90% or less (free from condensation) .
2. Storage environment : -20℃ ~ +85℃ ; Storage humidity : 90% or less (free from condensation) .
3. Vibration : 0.5G or less
4. To prevent rain or damp environment.
5. Avoid exposure in the sun.
6. To prevent oil mist, the erosion of salt.
7. To prevent corrosive liquid, gas, etc.
8. To prevent dust, lint and metal fines.
9. Stay away from the radioactive material and fuel.
10. Reserve space around the drive in the oven for easy loading , unloading and maintenance.
11. Pay attention to the tank in the air flow, if necessary, add outer fan to enhance the air flow, reduce drive environmental temperature for heat dissipation; The long-term working temperature should under 55 ℃.
12. Try to avoid near the vibration source, adding damping device such as vibration absorber or antivibration rubber gasket.
13. If there is electromagnetic interference sources, the power of the drive and control line Louis interference caused by misoperation, NOise filter can be added or used in a variety of effective anti-interference measures in order to ensure the normal operation of the drive (NOise filter can increase the leakage current, need to load an isolation transformer on the drive power input end).

4.3 LED Indicator light

4.3.1 Alarm timing diagram

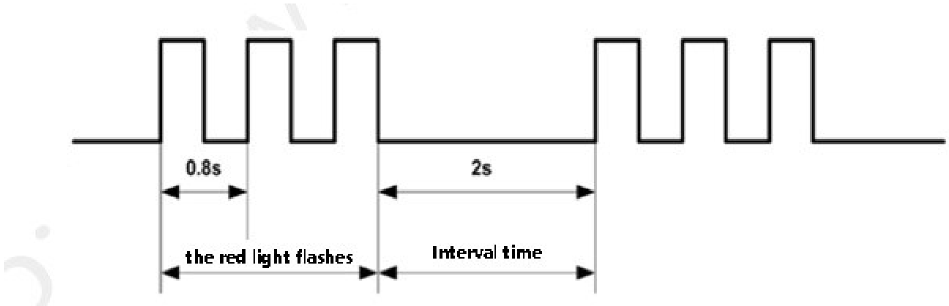


Figure 9 Integrated motor alarm timing of IHSV-EC

4.3.2 flashing times of Signal light

Table 4 Error Alarm

Red light Flashing Times	Alarm description
Red off, green flashing	Drive CAN communication is NOt linked
Red off, green on	The drive is powered on normally
Red flash once, green on	Drive overcurrent
Red flash twice, green on	Drive supply voltage exceeds maximum
Red flash 3 times, green on	Drive supply voltage is below the minimum
Red flash 4 times, green on	Drive position is out of tolerance
Red flash 5 times, green on	Drive communication error
Red flash 6 times, green on	CCW direction limit

Red flash 7 times, green on	CW direction limit
Red flash 8 times, green on	SW direction limit
Red flash 9 times, green on	Drive encoder error
Red flash 10 times, green on	Overload alarm
Red flash 11 times, green on	EEPROM read and write errors
Red flash 12 times, green on	Incorrect electronic gear ratio setting
Red flash 13 times, green on	The host computer needs to be powered on to modify the parameters
Red flash 14 times, green on	Incorrect current range

5 Physical reference

Figure 1 Picture of integrated motor IHSV-EC

6 Use of servo adjustment software

Select JmcServoPcControl servo adjustment software, double-click to open the following figure:

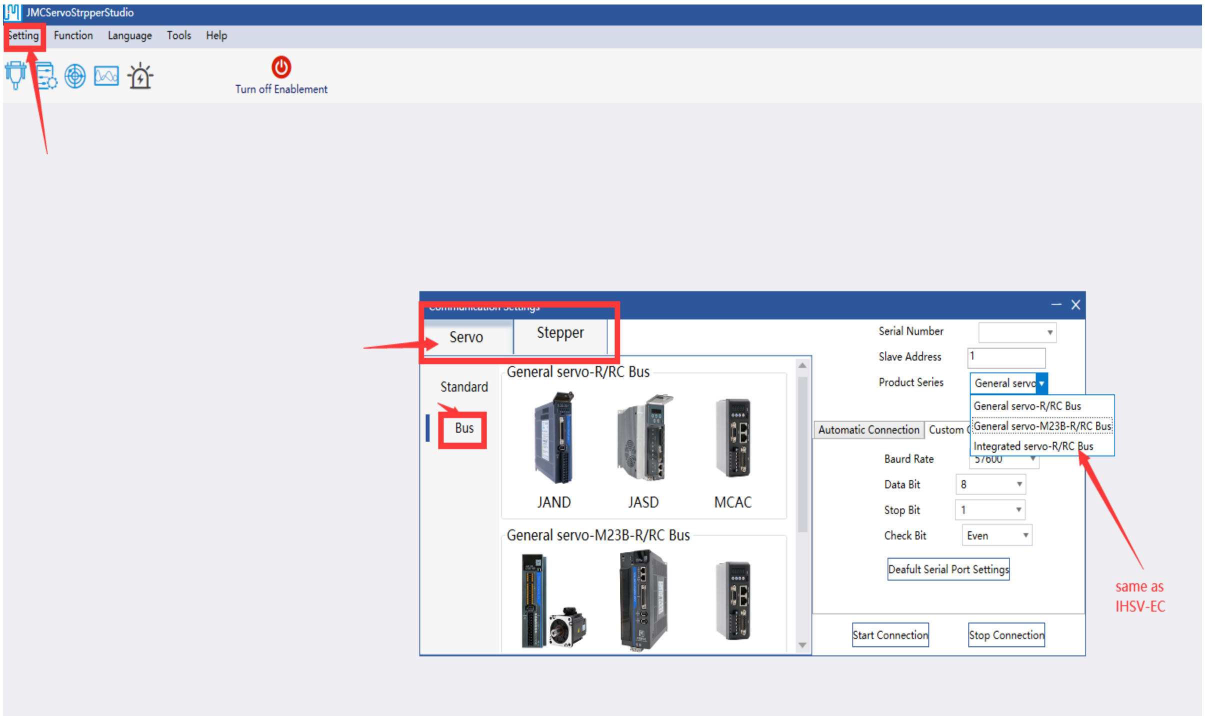
● 

Figure 2 Servo adjustment software

- In the pop-up dialog box, set the corresponding options, click to open, the operation is as follows:
-

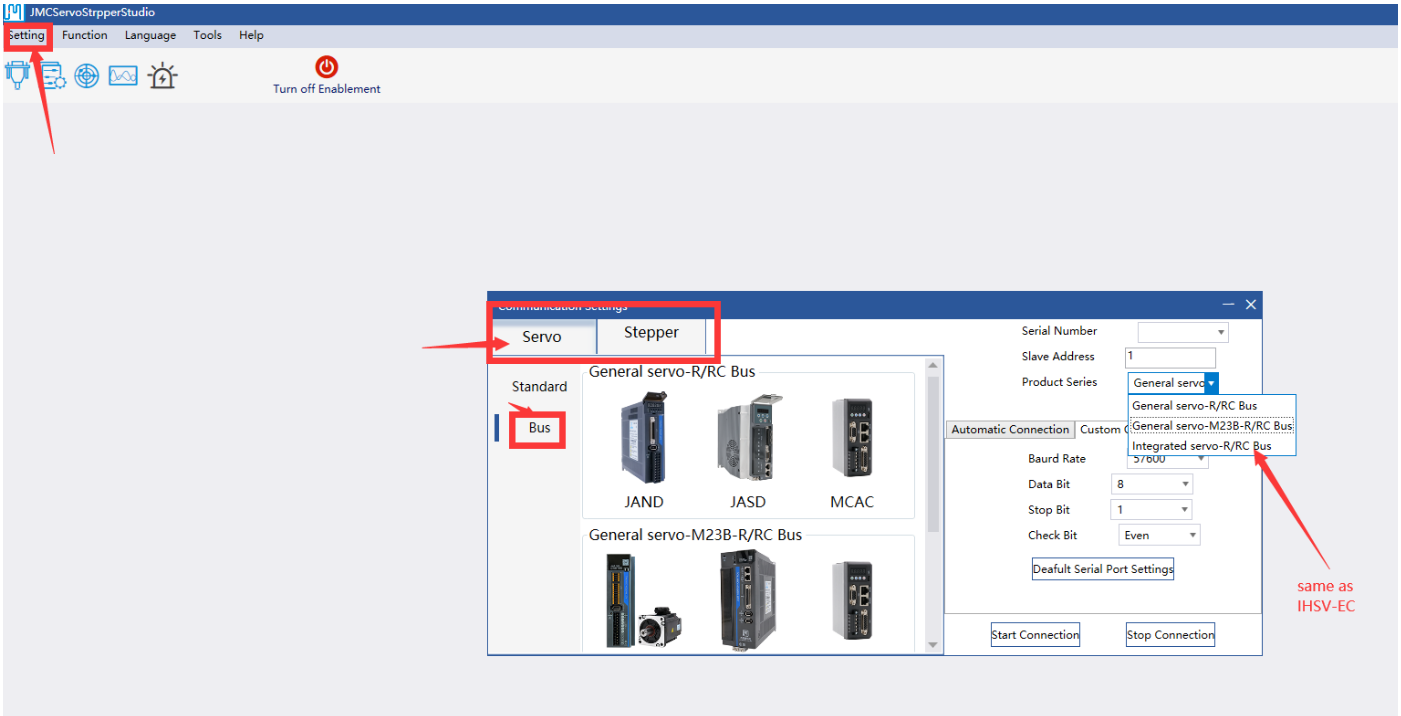


Figure 96 serial port setting of servo debugging software

- After clicking Open, if the communication is successful, the following picture will be displayed:
-

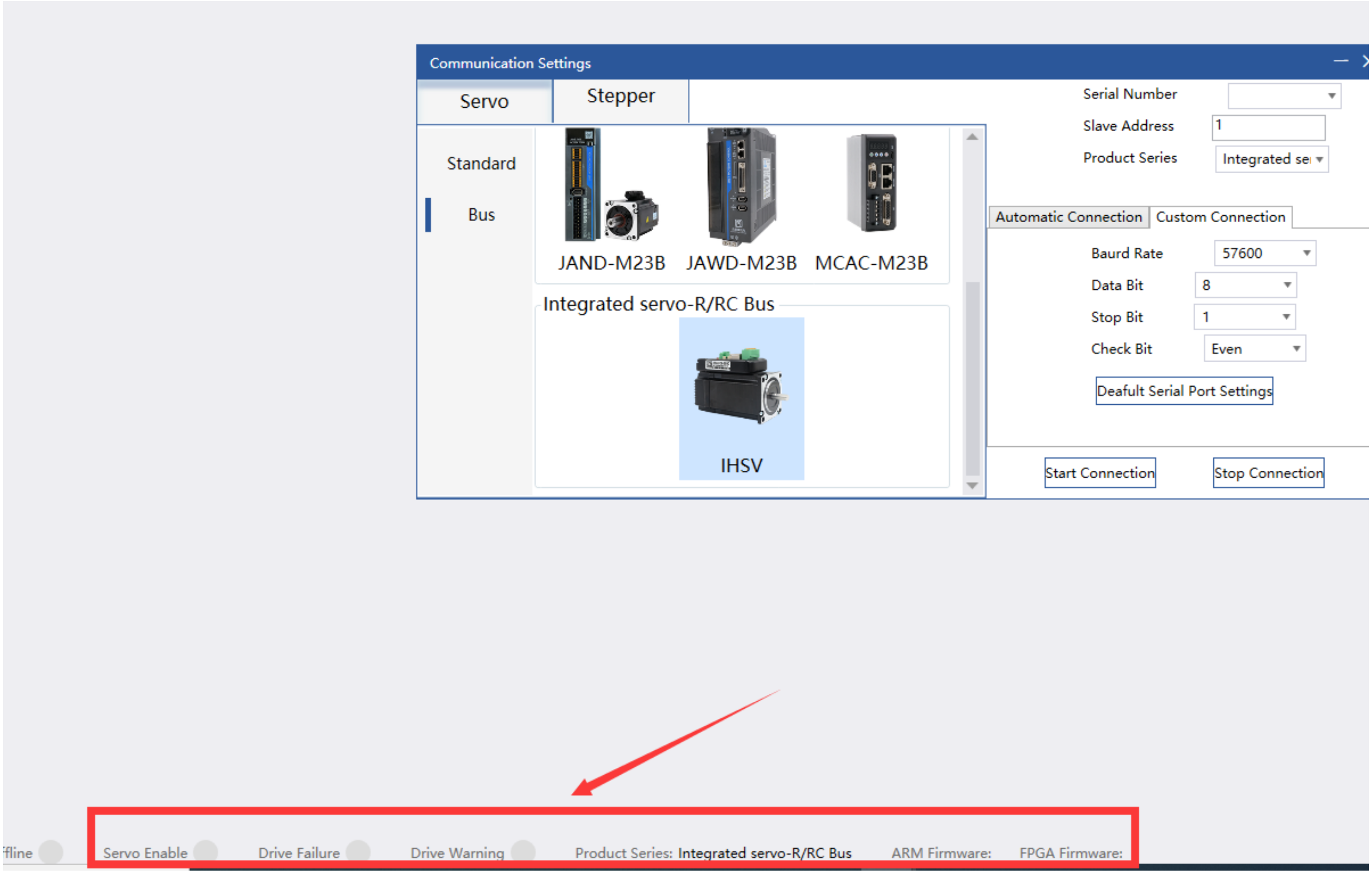


Figure 3　Software communication Successful

NOte: If the connection canNOt be made, please confirm whether the COM port is selected correctly and whether the communication line is connected. After confirming the connection, follow the above steps to reconnect.

Click the option 【Parameter】 on the upper left, and the following window will pop up. At this time, the internal parameters of the drive will be automatically uploaded. After the upload is completed, the customer can change the parameters according to the needs.

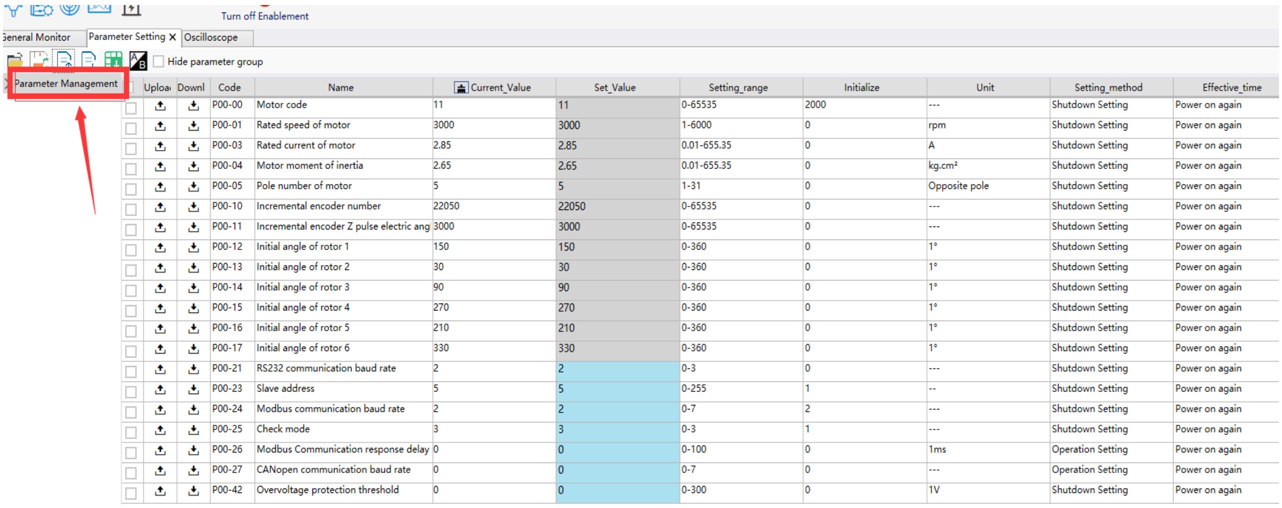


Figure 4Parameter reading completed

NOte: P00-xx are motor and driver parameters, which have been set at the factory and will NOt be provided to customers for modification.

- The parameter settings follow the three steps of Modify → Download → Upload, as shown in the figure below：

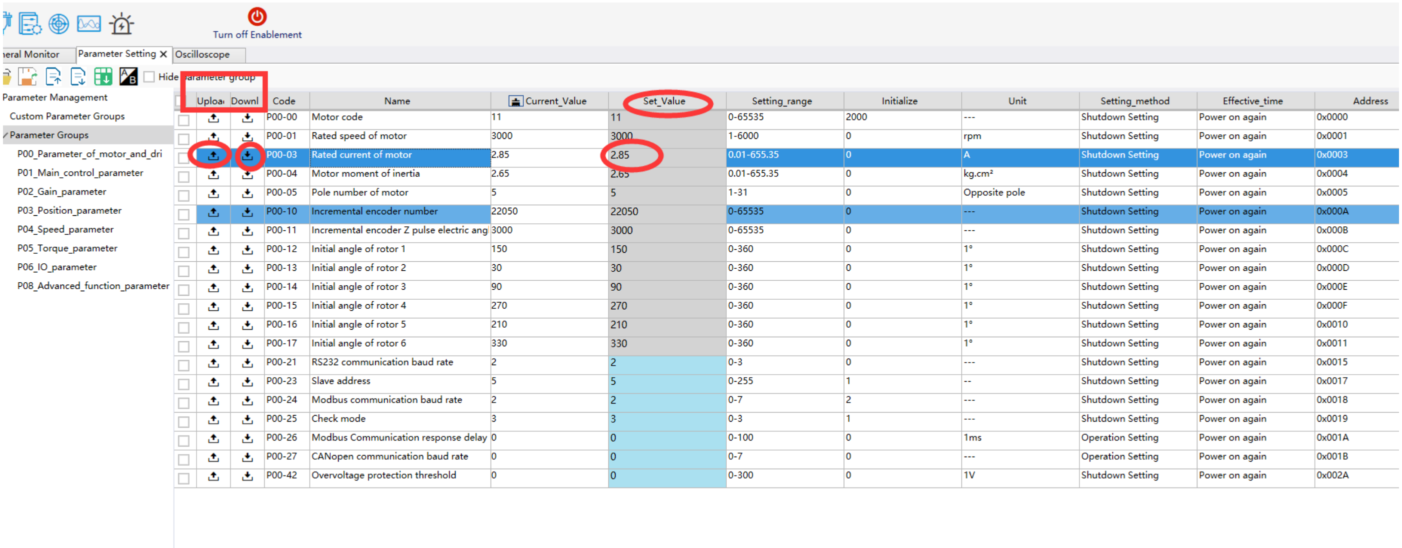


Figure 5Parameter setting process

NOte: After setting the corresponding parameters in the settings, press the download option to download the changed parameters to the drive, and then press the upload option to upload the parameters to the interface to verify whether the parameters have been changed.

7 Gain adjustment by hand

When the automatic gain adjustment does NOt reach the expected effect, you can manually fine-tune the gain to optimize the effect. The servo system consists of three control loops, the basic control block diagram is as follows:

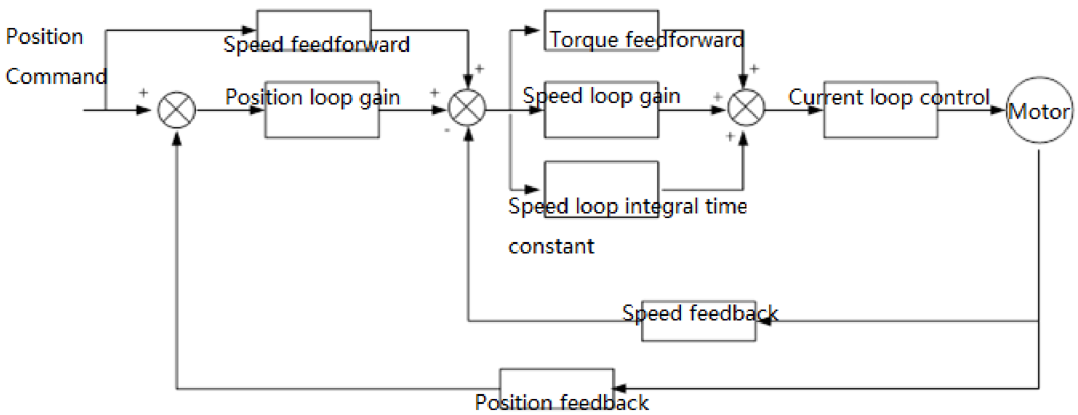


Figure 6 Servo system control block diagram

Gain adjustment needs to follow the order of inner ring and then outer ring, first set the load inertia ratio P01-04, then adjust the speed loop gain, and finally adjust the position loop gain

Speed loop gain: Increase the setting value as much as possible without vibration and NOise, which can improve the speed following performance and speed up the positioning time.

Speed integration constant: The smaller the setting value, the faster the integration speed and the stronger the integration effect. If it is too small, it will easily cause vibration and NOise.

Table 1 Basic gain parameter

Parameter code	Name	Setting range	Default	Description

P01-02	Real-time automatic adjustment mode	0-2	2	0: Manually adjust the rigidity. 1: Standard mode automatically adjusts rigidity. In this mode, the parameters P02-00, P02-01, P02-10, P02-11, P02-13, P02-14, P08-20 will be based on the rigidity level set by P01-03 Automatic setting, manual adjustment of these parameters will have NO effect. To The following parameters are set by the user: P02-03 (speed feedforward gain), P02-04 (speed feedforward leveling Slip constant). 2: The positioning mode automatically adjusts the rigidity. In this mode, this mode Next, the parameters P02-00, P02-01, P02-10, P02-11, P02-13, P02-14, P08-20 will be set according to P01-03 Rigidity level is set automatically, manual adjustment of these parameters will NOt be able to

				effect. The following parameters will be fixed values and canNOt be changed: P02-03 (Speed feedforward gain): 30.0% P02-04 (Speed feedforward smoothing constant): 0.50
P01-03	Real-time automatic adjustment of rigidity settings	0-31	13	Built-in 32 kinds of gain parameters, when P01-02 is set to 1, or 2 time to work. Can be directly called and set according to the actual situation The larger the value, the stronger the rigidity.
P02-00	Position control gain 1	0-3000．0	80.0	▸ The larger the setting value, the higher the

				gain, the greater the rigidity, and the position lags The smaller it is, but the value is too large, the system will oscillate and overshoot. ▸ Gain at rest.
P02-01	Position control gain 2	0-3000.0	80.0	▸ The larger the setting value, the higher the gain, the greater the rigidity, and the position lags The smaller the value, but the larger the value, the more shock and overshoot. ▸ Increase the value as much as possible without vibration. For gain during exercise.
P02-03	Speed feedforward gain	0-100.0	30.0	For the feedforward gain of the speed loop, the larger the parameter value, the smaller the system position tracking error and the faster the response. But if the feedforward gain is too large, it will Make the position loop of the system unstable, and it is easy to produce overshoot and vibration.
P02-04	Speed feedforward Smoothing constant	0-64.00	0	This parameter is used to set the time constant of the speed loop feedforward filter. value The larger, the filtering effect increases, but at the same time the phase lag increases.
P02-10	Speed ratio Gain 1	1-2000.0	40.0	▸ The larger the setting value, the greater the gain and rigidity. Machine and load settings. ▸ Increase the value as much as possible without vibration. ▸ Gain at rest.
P02-11	Speed integral Constant 1	0.1-1000.0	10.0	▸ Integral time constant of speed regulator, the smaller the setting value, the integral The faster the speed, the greater the stiffness. Out of NOise. ▸Under the condition of NO vibration in the system, try to reduce the value of this parameter

P02-12	Pseudo-differential Feed Control System Number 1	0-100.0	100.0	▸When set to 100.0%, the speed loop adopts PI control, and the dynamic response is fast; when set to 0, the integral effect of the speed loop is obvious, Low frequency interference can be filtered, but the dynamic response is slow. ▸By adjusting this coefficient, the speed loop can have better dynamics Response, while increasing the resistance to low-frequency interference.
P02-13	Speed proportional gain 2	1-2000.0	45.0	▸ The larger the setting value, the greater the gain and rigidity. The parameter value is set according to the motor and load conditions. ▸ Increase the value as much as possible without vibration. ▸ Gain during exercise.
P02-14	Speed integral constant 2	0.1-1000.0	1000.0	The integral time constant of the speed regulator. The smaller the setting value, the faster the integral speed and the greater the stiffness. If it is too small, it will easily cause vibration and NOise. ▸Under the condition that the system does NOt oscillate, try to reduce the value of this parameter. ▸ This parameter is for steady state response.
P02-15	Pseudo-differential	0-100.0	100.0	▸When set to 100.0%, the speed loop adopts PI control, and the dynamic response is fast; when set to 0, the integral effect of the speed loop is obvious, which can filter low-frequency interference, but the dynamic response is slow.

	feedforward control coefficient 2			▸By adjusting this coefficient, the speed loop can have better dynamics Response, while increasing the resistance to low-frequency interference.

8 Parameter and Function

8.1 Parameter list

P00-xx: motor and drive's parameter

P01-xx: Main Control parameter

P02-xx: Gain parameter

P03-xx: Position parameter

P04-xx: Speed parameter

P05-xx: Torque parameter

P06-xx: I/O parameter

P08-xx: Advanced Function parameter

Table 65 parameter list

Type	Parameter code	Name	Range	Default	Unit	Set method	Effective time
Motor and driver parameters	P00-00	Motor SN	0-65535	---		Stop & set	Power-On again
	P00-01	Motor rated speed	1-6000	---	rpm	Stop & set	Power-On again
	P00-02	Motor rated torque	0.01-655.35	---	N.M	Stop & set	Power-On again
	P00-03	Motor rated current	0.01-655.35	---	A	Stop & set	Power-On again
	P00-04	Motor rotary inertia	0.01-655.35	---	$kg.cm^2$	Stop & set	Power-On again

	P00-05	Motor pole pairs	1-31	---	Polar logarithm	Stop & set	Power-On again
	P00-10	Incremental encoder PPR	0-65535	---		Stop & set	Power-On again
	P00-11	Incremental encoder Z pulse electrical angle	0-65535	---		Stop & set	Power-On again
	P00-12	Rotor initial angel 1	0-360	---	1°	Stop & set	Power-On again
	P00-13	Rotor initial angel 2	0-360	---	1°	Stop & set	Power-On again
	P00-14	Rotor initial angel 3	0-360	---	1°	Stop & set	Power-On again
	P00-15	Rotor initial angel 4	0-360	---	1°	Stop & set	Power-On again
	P00-16	Rotor initial angel 5	0-360	---	1°	Stop & set	Power-On again
	P00-17	Rotor initial angel 6	0-360	---	1°	Stop & set	Power-On again

	P00-21	RS232 baud rate	0-3	2	---	Stop & set	Power-On again
	P00-23	Slave address	0-255	1	---	Stop & set	Power-On again
	P00-25	Verification method	0-3	1	---	Stop & set	Power-On again
	P00-42	Overvoltage protection threshold	0-300	0	1V	Stop & set	Power-On again
Main control parameters	P01-01	Control mode setup	0-6	0	---	Stop & set	Immediate
	P01-02	Real-time automatic adjustment mode	0-2	1	---	Running & set	Immediate
	P01-03	Real-time automatic adjustment of rigidity settings	0-31	13	---	Running & set	Immediate
	P01-04	Inertia ratio	0-100.00	1	1 time	Running & set	Immediate
	P01-30	Brake-command-servo off, delay time(brake open	0-255	100	1ms	Running & set	Immediate

		delay)					
	P01-31	brake output speed limitation	0-3000	100	1rpm	Running & set	Immediate
	P01-32	Servo OFF brake command waiting time	0-255	100	1ms	Running & set	Immediate
Gain parameters	P02-00	Position control gain 1	0-3000.0	48.0	1/S	Running & set	Immediate
	P02-01	Position control gain 2	0-3000.0	57.0	1/S	Running & set	Immediate
	P02-03	Speed feedforward gain	0-100.0	30.0	1.0%	Running & set	Immediate
	P02-04	Speed feedforward smooth constant	0-64.00	0.5	1ms	Running & set	Immediate
	P02-10	Speed ratio gain 1	1.0-2000.0	27.0	1Hz	Running & set	Immediate
	P02-11	Speed integral constant 1	0.1-1000.0	10.0	1ms	Running & set	Immediate
	P02-12	Fake differential feed-forward control	0-100.0	100.0	1.0%	Running & set	Immediate

		ratio 1					
	P02-13	Speed ratio gain 2	1.0-2000.0	27.0	1Hz	Running & set	Immediate
	P02-14	Speed integral gain 2	0.1-1000.0	1000.0	1ms	Running & set	Immediate
	P02-15	Fake differential feed-forward control ratio 2	0-100.0	100.0	1.0%	Running & set	Immediate
	P02-19	Torque feedforward gain	0-30000	0	1.0%	Running & set	Immediate
	P02-20	Torque feedforward smooth constant	0-64.00	0.8	1ms	Running & set	Immediate
	P02-30	Gain switching mode	0-10	0	---	Running & set	Immediate
	P02-31	Gain switching grade	0-20000	800	---	Running & set	Immediate
	P02-32	Gain switching lag	0-20000	100	---	Running & set	Immediate
	P02-33	Gain switching delay	0-1000.0	10.0	1ms	Running & set	Immediate

	P02-34	Position gain switching time	0-1000.0	10.0	1ms	Running & set	Immediate
	P02-41	Mode switch selection	0-20000	10000	---	Running & set	Immediate
	P02-50	Torque command added value	-100.0-100.0	0	1.0%	Running & set	Immediate
	P02-51	CW torque compensation	-100.0-100.0	0	1.0%	Running & set	Immediate
	P02-52	Reverse torque compensation	-100.0-100.0	0	1.0%	Running & set	Immediate
Positional parameter	P03-00	Source of location command	0-1	0	---	Stop & set	Immediate
	P03-03	Instruction Pulse Inversion	0-1	0	---	Stop & set	Immediate
	P03-04	Position Pulse filtering	0-3	2	---	Running & set	Immediate
	P03-05	Positioning completion criteria	0-2	1	---	Running & set	Immediate
	P03-06	Location complete range	0-65535	30	Encoder Unit	Running & set	Immediate

	P03-09	Number of instruction pulses per turn of motor	0-65535	4000	Pulse	Running & set	Power-On again
	P03-10	Electron Gear 1 molecule	1-65535	4000	---	Running & set	Power-On again
	P03-11	Electronic gear 1 DeNOminator	1-65535	4000	---	Running & set	Power-On again
	P03-15	Excessive position deviation setting	0-65535	0	Command unit *10	Running & set	Immediate
	P03-16	Position Instruction smoothing filter time constant	0-1000.0	0	1ms	Running & set	Immediate
Speed parameter	P04-00	Speed instruction source	0-1	1	---	Stop & set	Immediate
	P04-01	Speed instruction analog counter	0-1	0	---	Stop & set	Immediate
	P04-02	Digital speed given value	-6000—6000	0	1rpm	Running & set	Immediate

	P04-05	Overspeed alarm value	0-6500	6400	1rpm	Running & set	Immediate
	P04-06	Forward speed limit	0-6000	5000	1rpm	Running & set	Immediate
	P04-07	Reverse speed limit	0-6000	-5000	1rpm	Running & set	Immediate
	P04-10	Zero velocity detection value	0-200.0	40	1rpm	Running & set	Immediate
	P04-14	Acceleration time	0-10000	500	1ms/1000rpm	Running & set	Immediate
	P04-15	Deceleration time	0-10000	500		Running & set	Immediate
Torque parameters	P05-10	Internal Forward Torque limit	0-300.0	200.0	1.0%	Running & set	Immediate
	P05-11	Internal reverse torque limit	0-300.0	200.0	1.0%	Running & set	Immediate
I/O	P06-00	Enable the effective level of the input port	0-4	1	---	Running & set	Power-On again
	P06-	Alarm output port	0-1	1	---	Running	Power-On

	20	effective level				& set	again
	P06-22	Effective level of output port	0/1	1	---	Running & set	Power-On again
Advanced function parameters	P08-19	Feedback speed low-pass filter constant	0-25.00	0.8	1ms	Running & set	Immediate
	P08-20	Torque command filter constant	0-25.00	0.84	1ms	Running & set	Immediate
	P08-25	Disturbance torque compensation gain	0-100.0	0	%	Running & set	Immediate
	P08-26	Disturbance torque filtering time constant	0-25.00	0.8	1ms	Running & set	Immediate

8.2 Explanation of parameter

8.2.1 P00-xx P00-xx Motor and driver parameters

Table 2 P00-xx Motor & driver parameter

Parameters Code	Name	Description

P00-00	Motor number	Default set 0: P0-01 to P0-17 is available
P00-01	Rated speed	Set range: 1~6000 rpm; unit：rpm; default value.
P00-02	rated torque	Set range 0.01-655.35 N.m;unit：N.M Default value.
P00-03	Rated current	Set range: 0.01-655.35A,unit：A Default value
P00-04	Rotor inertia	Set range: 0.01-655.35kg.cm^2 ; unit：kg.cm^2 Default value
P00-05	Pole pairs	Set range:1-31 pairs; unit: pairs Default value
P00-10	Incremental encoder lines	Default set
P00-11	incremental encoder Z pulse electric angle	Default set
P00-12	Rotor initial angle 1	Default set
P00-13	Rotor initial angle 2	Default set
P00-14	Rotor initial angle 3	Default set
P00-15	Rotor initial angle 4	Default set
P00-16	Rotor initial angle 5	Default set

P00-17	Rotor initial angle 6	Default set
P00-21	RS232 communication baud rate selection	Set range: 0-3; Choose baud rate to communicate with PC: 0：9600 1：19200 2：57600 3：115200
P00-23	Slave address	Set range: 0-255; Default:1; Set according to device required.
P00-25	Calibration method	Set range: 0-3; Default: 1. 0: NO calibration, 2 stop bit. 1: even calibration, 1 stop bit. 2: odd calibration, 1 stop bit. 3.NO calibration, 1 stop bit.
P00-42	Overvoltage protection threshold	Setting range: 0-300, unit V

8.2.2 P01-xx Main control parameters

Paramete	Name	Description

<table>
<tr><th>rs Code</th><th></th><th></th></tr>
<tr><td>P01-01</td><td>Control mode setting</td><td>Setting range:0-6
0: Position control mode.
1: Speed control mode.
2: Torque control mode
3: Speed, torque control mode. Need to use an external input port in CN1 to switch, set the selected DI port input port function selection to 5 (control mode switching). Control the logic state of the port to switch the control mode
<table>
<tr><td>Port logic</td><td>Control mode</td></tr>
<tr><td>Valid</td><td>Speed mode</td></tr>
<tr><td>Invalid</td><td>Torque mode</td></tr>
</table>
4: Position and speed control mode. Need to use an external input port in CN1 to switch, set the selected DI port input port function selection to 5 (control mode switching). Control the logic state of the port to switch the control mode.
<table>
<tr><td>Port logic</td><td>Control mode</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>Valid</td><td>Position mode</td></tr>
<tr><td>Invalid</td><td>Speed mode</td></tr>
</table>
5 :Position and torque control mode. Need to use an external input port in CN1 to switch, set the selected DI port input port function selection to 5 (control mode switching). Control the logic state of the port to switch the control mode.
<table>
<tr><td>Port logic</td><td>Control mode</td></tr>
<tr><td>Valid</td><td>Position mode</td></tr>
<tr><td>Invalid</td><td>Torque mode</td></tr>
</table>
6 : Fully closed loop
</td></tr>
<tr><td>P01-02</td><td>Real time automatic adjustment mode</td><td>Setting range:0-2
0: Manual adjustment of rigidity
1 : Standard mode automatically adjusts rigidity. In this mode, parameters P02-00, P02-01, P02-10, P02-11, P02-13, P02-14, P08-20 will be set automatically according to the stiffness level set by P01-03, and these parameters can NOt be adjusted by manual. The following parameters are set by the</td></tr>
</table>

		user: P02-03 (speed feedforward gain), P02-04 (speed feedforward smoothing constant). 2 : Positioning mode automatically adjusts rigidity. In this mode, parameters P02-00, P02-01, P02-10, P02-11, P02-13, P02-14, P08-20 will be set automatically according to the rigidity level set by P01-03. and these parameters can NOt be adjusted by manual.. The following parameters will be fixed and canNOt be changed: P02-03 (speed feedforward gain), 30% P02-04 (speed feedforward smoothing constant).0.5
P01-03	Automatically adjust the rigidity setting	Setting range: 0-31 Built-in 32 kinds of gain parameters. It works when P01-02 is set to 1, 2, or 3. It can be called directly according to the actual situation. The larger the set value, the stronger the rigidity.
P01-04	Rotor inertia ratio	Setting range: 0-100, unit: times Set the load inertia ratio to related motor. The setting method is as follows:

		P01-04 = Load inertia / motor inertia This inertia ratio can use the value after AF-J-L automatic inertia recognition, write the recognized value into the parameter
P01-30	Brake command-Servo OFF delay time (brake open delay)	Setting range: 0-255, unit: ms When enabling: The drive will only receive the position command after the time of P01-30 is executed under the enable command is executed. When the enable is off: When the motor is at a static state, after the close enable command is executed, the time after the brake is closed and the motor becomes NOn-energized.
P01-31	Speed limit value of brake command output	Setting range: 0-3000, unit: rpm Motor speed threshold when the brake output is active when the motor is rotating. Less than this threshold, the brake output command is valid, otherwise it will wait for P01-32 time, the brake output command is valid.
P01-32	Servo OFF-brake command waiting time	Setting range: 0-255, unit: ms The maximum waiting time for the brake output

		when the motor is rotating.

8.2.3 P02-xx Gain parameters

Table 3 P02-xx Gain parameters

Parameters Code	Name	Description
P02-00	Position control gain 1	Setting range: 0-3000.0, unit: 1 / S Position loop regulator scale gain. The larger the parameter value set, the higher the gain ratio is, the greater the stiffness is, the smaller the position tracking error will be, and the faster the response. However, too large a parameter can easily cause vibration and overshoot. This parameter is for steady state response.
P02-01	Position control gain 2	Setting range: 0-3000.0, unit: 1 / S Position loop regulator scale gain. The larger the parameter value set, the higher the gain ratio is, the greater the stiffness is, the smaller the position tracking error will be, and the faster the response.

		However, too large a parameter can easily cause vibration and overshoot. This parameter is for dynamic response.
P02-03	Speed feedforward gain	Setting range: 0-100.0, unit: 1.0% The feedforward gain of the speed loop. The larger the parameter value set, the smaller the system position tracking error and the faster the response. However, if the feedforward gain is too large, the position loop of the system will be unstable, which will easily cause overshoot and vibration.
P02-04	Speed feedforward smoothing constant	Setting range: 0-64.00, unit: ms This parameter is used to set the speed loop feedforward filtering time constant. The larger the value set, the larger the filtering effect, but at the same time the phase lag increases.
P02-10	Speed proportional gain 1	Setting range: 1.0-2000.0, unit: Hz The larger the speed proportional gain is, the larger the servo stiffness is and the faster the speed response is. However, if it is too large, it is easy to

		generate vibration and NOise. Under the condition that the system does NOt oscillate, increase this parameter value as much as possible. This parameter is for a static response.
P02-11	Speed integral constant 1	Setting range: 1.0-1000, Unit: ms. Speed regulator integration time constant. The smaller the setting value, the faster the integration speed, the greater the stiffness, and the vibration is too easy to produce NOise if it is too small. When the system does NOt oscillate, reduce this parameter value as much as possible. This parameter is for steady state response.
P02-12	Pseudo-differential feedforward control coefficient 1	Setting range: 0-100.0, unit: 1.0% When set to 100.0%, the speed loop adopts PI control, and the dynamic response is fast; when set to 0, the speed loop integral effect is obvious, which can filter low-frequency interference, but the dynamic response is slow. By adjusting this coefficient, the speed loop can

		have a better dynamic response, and it can increase the resistance to low-frequency interference.
P02-13	speed proportional gain 2	Setting range: 1.0-2000.0, unit: Hz The larger the speed proportional gain is, the larger the servo stiffness is and the faster the speed response is. However, if it is too large, it is easy to generate vibration and NOise. Under the system has NO vibration, increase this parameter value as much as possible. This parameter is for dynamic response.
P02-14	Speed integral constant 2	Setting range: 1.0-1000.0, unit: ms Speed regulator integration time constant. The smaller the setting value, the faster the integration speed, the greater the stiffness is, and the vibration is too easy to produce NOise if it is too small. Under the system has NO vibration, reduce this parameter value as much as possible. This parameter is for dynamic response.
P02-15	Pseudo-differential	Setting range: 0-100.0, unit: 1.0%

	feedforward control coefficient 2	When set to 100.0%, the speed loop PI control, and the dynamic response is fast; when set to 0, the speed loop integral effect is obvious, which can filter low-frequency interference, but the dynamic response is slow. By adjusting this coefficient, the speed loop can have a better dynamic response, and at the same time, it can increase the resistance to low-frequency interference.
P02-19	Torque feedforward gain	Setting range: 0-30000, unit: 1.0% Set the current loop feedforward weighting value. This parameter adds the current loop after weighting the differential of the speed command.
P02-20	Torque feed-forward smoothing constant	Setting range: 0-64.00, unit: ms This parameter is used to set the torque feedforward filtering time constant.
P02-30	Gain switching mode	Setting range: 0-10 The condition to set the 1st and 2nd gain switching mode <table><tr><td>Val</td><td>Switch</td><td>Remark</td></tr></table>

		ue	condition	
		0	fix to the 1st gain	P02-00、P02-10、P02-11、P02-12
		1	fix to the 2nd gain	P02-01、P02-13、P02-14、P02-15
		2	Use DI input switching	Need to set the DI port to 9 (gain switching input) Invalid: first gain Effective: second gain
		3	Big torque command value	When the torque command is greater than the threshold (determined by P02-31 and P02-32), it switches to the second gain. When it is less than the threshold and exceeds the P02-33 delay setting, it switches to the first gain.
		4	Speed command	When the speed command change is greater than the

			changes a lot	threshold (determined by P02-31 and P02-32), it switches to the second gain. When it is less than the threshold and exceeds the P02-33 delay setting, it switches to the first gain.
		5	Big speed command	When the speed command is greater than the threshold (determined by P02-31 and P02-32), it switches to the second gain. When it is less than the threshold and exceeds the P02-33 delay setting, it switches to the first gain.
		6	Large position deviation	When the position deviation is greater than the threshold (determined by P02-31 and P02-32), switch to the

				second gain. When it is less than the threshold and exceeds the P02-33 delay setting, it switches to the first gain.
		7	There is position command	Switch to the second gain when there is a position command. When the position command ends and the P02-33 delay setting is exceeded, it switches to the first gain.
		8	Incomplete positioning	Switch to the second gain when positioning is NOt completed. When the positioning is completed and the P02-33 delay setting is exceeded, it switches to the first gain.
		9	Actual	Switch to the second gain

			speed is big	when the actual speed is greater than the threshold (determined by P02-31 and P02-32). When it is less than the threshold and exceeds the P02-33 delay setting, it switches to the first gain.
		10	With position command + actual speed	Switch to the second gain when there is a position command. When there is NO position command and the actual speed is less than the threshold (determined by P02-31 and P02-32), and when the delay setting of P02-33 is exceeded, it switches to the first gain.
P02-31	Gain switching level	Setting range: 0-20000 Judgment threshold when gain is switched. Torque unit: 1000bit = 25% of rated torque		

		Speed unit: 1000bit = 200 rpm Position unit: 131072bit per revolution
P02-32	Gain switching hysteresis	Setting range: 0-20000 Hysteresis level at gain switching Torque unit: 1000bit = 25% of rated torque Speed unit: 1000bit = 200 rpm Position unit: 131072bit per revolution
P02-33	Gain switching delay	Setting range: 0-1000.0, unit: ms When switching from the second gain to the first gain, the time from when the trigger condition is met to the actual switching.
P02-34	Position gain switching time	Setting range: 0-1000.0, unit: ms Time for position control gain 1 to smoothly switch to position control gain 2
P02-41	Mode switch level	Setting range: 0-20000 Set the threshold for switching. Torque unit: 1000bit = 25% of rated torque Speed unit: 1000bit = 200 rpm Position unit: 131072bit per revolution
P02-50	Torque command	Setting range: -100.0-100, unit: 1.0%

	added value	Valid in position control mode. This value is superimposed on the torque reference value and is used for vertical axis static torque compensation.
P02-51	Forward torque compensation	Setting range: -100.0-100.0, unit: 1.0% Valid in position control mode. For compensating forward static friction
P02-52	Reverse torque compensation	Setting range: -100.0-100.0, unit: 1.0% Valid in position control mode. Used to compensate reverse static friction

8.2.4 P03-xx Position parameters

Table 4 P03-xx Position parameters

Parameters Code	Name	Description
P03-00	Source of position command	0：pulse command 1：Given the number, use it when communicating with control
P03-03	Instruction Pulse Inversion	Used to adjust the direction of the pulse instruction count 0：normal

		1：In The Opposite Direction
P03-04	Position Pulse filter setting	Set range:0-1 Unit:us 0：0.1us。 1：0.4us 2：0.8us。 3：1.6us
P03-05	Positioning completion criteria	0: Output when position deviation is less than P03-06 setting value 1: Output when position is given, and output when position deviation is less than P03-06 setting value 2: Output when position is given (after filtering) , and output when position deviation is less than P03-06 setting value
P03-06	Location complete range	Setting range: 0-65535, unit: encoder unit Used to set the threshold value for positioning completion output. If an incremental encoder motor is used, the number of encoder lines per revolution is calculated by * 4
P03-09	Number of instruction pulses per	Setting range: 0-65535 Absolute encoder motor is effectively used to set

	turn of motor	motor rotation number of instructions pulse. When this parameter is set to 0, P03-10 and P03-11 are valid
P03-10	Electric gear 1 Molecule	Calculation formula of incremental motor electronic gear ratio: $G = \frac{C \times 4}{P} = \frac{\text{Molecule}}{\text{Denominator}}$ C: Encoder line P: No. of input pulse per turn Eg: encoder line 2500; pulse per turn 3200; Electronic gear ratio? $G = \frac{C \times 4}{P} = \frac{2500 \times 4}{3200} = \frac{10000}{3200} = \frac{25}{8}$
P03-11	Electric gear 1 DeNOminator	
P03-15	Position deviation setting is too big	Setting range: 0-65535, Unit: Instruction Unit * 10 set the number of pulse to allow deviation, more than the set value will alarm. EXAMPLE: Setting a value of 20, the drive alerts Al. 501 when the follow deviation exceeds 20 * 10(position deviation is too large)
P03-16	Position Instruction smoothing filter constant	Setting range: 1000, unit: ms Set the time constant of the position command smoothing filter

8.2.5 P04-xx Speed Parameter

Table 5 P04-xx Speed parameter

Parameter code	Name	Description
P04-00	Speed instruction source	0: External Analog Instruction 1: Digital Instruction (Parameter Setting) 2: Digital Instruction (Communication) 3: Internal Multiple instruction sets
P04-01	Speed command analog inversion	Used to adjust the polarity relationship of analog quantity 0: normal 1：Polarity is inversion
P04-02	Digital speed given value	Setting range: -6000 - 6000，Unit: rpm when P04-00 is set to 1, P04-02 is the speed control setting
P04-05	Overspeed alarm value	Setting range: 0-6500, unit: rpm Set the maximum allowable speed value, if it exceeds the set value, AL.420 overspeed alarm
P04-06	Forward speed limit	Set range：0-6000，Unit：rpm

		Limit forward speed of motor
P04-07	Reverse speed limit	Set range：-6000-0，Unit：rpm Limit reverse speed of motor
P04-10	Zero speed detection value	Zero speed detection value Set Zero speed detection threshold, motor speed below the threshold can be output through the output port "zero speed motor output" signal
P04-14	Acceleration time	Set range：0-10000，Unit：1ms/1000rpm Set the acceleration time in speed control
P04-15	Deceleration time	Set range：0-10000，Unit：1ms/1000rpm Set the deceleration time in speed control

8.2.6 P05-xx Torque parameter

Table 6 P05-xx Torque parameter

Parameter code	Name	Description
P05-10	Internal Forward	Setting range: 0-300.0, unit: 1.0%

	Torque limit	limit motor forward output, 100 means 1 times Torque, 300 means 3 times torque when the torque output reaches the limit value, the output signal can be detected through DO port output torque limit
P05-11	Internal reverse torque limit	Setting range： -300.0-0, unit: 1.0% limit motor reverse output, 100 means 1 times Torque, 300 means 3 times torque when the torque output reaches the limit value, the output signal can be detected through the DO port output torque limit

8.2.7 P06-xx I/O Parameter

Table 7 P06-xx I/O parameter

Parameter code	Name	Description
P06-00	Enable output port effective level	Setting range：0-1，Default：1

P06-20	Alarm output port effective level	Setting range：0-1，Default：1
P06-22	In place output port effective level	Setting range：0-1，Default：1

8.2.8 P08-xx Advanced function parameters

Table 8 P08-xx Advanced function parameters

Parameter code	Name	Description
P08-19	Feedback speed low-pass filter constant	Set range：0-25.00，Unit：ms Feedback speed low-pass filter time constant, when the motor running when there is a howling, the value can be set up properly
P08-20	Torque command filter constant	Set range：0-25.00，Unit：ms Torque instruction filter time constant 1, when there is a motor running, the value can be appropriately set to large.
P08-25	Disturbance torque	Set range：0-100.0

	compensation gain	Observed Gain Coefficient of disturbing torque. The larger the value is, the stronger the anti-disturbance Torque is, but the action NOise may also be increased.
P08-26	Disturbance torque filtering time constant	Set range：0-25.00，Unit：ms The bigger the value is, the stronger the filtering effect is, and the action NOise can be suppressed. However, if the disturbance is too large, the phase delay will result and the disturbance torque will be suppressed.

8.3 List of monitoring items

Table 9 List of monitoring items

Display serial number	Display item	Description	Unit
d00.C.PU	Sum of position instruction pulses	This parameter can monitor the number of pulses sent by the user to the servo driver, which can confirm whether there is the pheNOmeNOn of	User unit

		missing pulses	
d01.F.PU	Sum of position feedback pulses	This parameter can monitor the pulse number of servo motor feedback. The unit is consistent with the User Input Instruction Unit	User unit
d02.E.PU	Number of position deviation pulses	This parameter can monitor the pulse number of the position lag in the process of the SERVO system. The unit is consistent with the User Input Instruction Unit	User unit
d03.C.PE	Sum of position given pulses / Gantry motor feedback pulse	This parameter can monitor the number of pulses sent by the user to the servo drive. Unit: When using the absolute value motor, it is calculated as 131072bit per revolution. If an incremental encoder motor is used, the number of encoder lines per revolution is calculated by * 4.	Encoder unit/ User unit
d04.F.PE	Sum of position feedback pulses	This parameter can monitor the pulse number of servo motor feedback.	Encoder unit/

		Unit: 131072 bit per turn when using absolute value motor. Use Incremental encoder motor, then each turn according to encoder line number * 4 calculate.	User unit
d05.E.PE	Position deviation pulse number / Gantry pulse deviation	This parameter can monitor the pulse number of the position lag in the process of the SERVO system. Unit: 131072 bit per turn when using absolute value motor. Use Incremental encoder motor, then each turn according to encoder line number * 4 calculate.	Encoder unit/ User unit
d06.C.Fr	Pulse Command input frequency	This parameter can monitor the input frequency of external pulse instruction	KPPS
d07.C.SP	Speed Control Command		rpm
d08.F.SP	Motor speed	This parameter can monitor the speed of servo motor when it is running	rpm
d09. C.tQ	Torque instruction	This parameter can monitor the Torque	%

		of the servo motor when it is running	
d10. F.tQ	Feedback value of torque	This parameter can monitor the Torque of the servo motor when it is running	%
d11.AG.L	Average torque	This parameter can monitor the average torque of the servo motor in the past 10 seconds	%
d12.PE.L	Peak torque	This parameter can monitor the peak torque of servo motor after power-on	%
d13.oL	Overload rate	This parameter can monitor the servo motor's load occupancy in the past 10 seconds	%
d14.rG	Regeneration load rate	This parameter monitors the load rate of the regeneration resistor	%
d16.I.Io	Input IO status	This parameter can monitor the input port status of CN1. The upper vertical bar represents the high level (photocoupler cut-off), and the lower vertical bar represents the low-level photocoupler conduction). The corresponding relationship with the	Binary

		input port is that the operation panel from right to left 4 vertical bars correspond to DI1-DI4 respectively	
d17.o.Io	Output IO status	This parameter can monitor the output port status of CN1. The upper vertical bar represents the optocoupler conduction, the lower vertical bar represents the optocoupler cutoff, and the corresponding relationship with the output port is the operation panel from right to left.	Binary
d18.AnG	Mechanical angle of motor	This parameter can monitor the mechanical angle of the motor and rotate 1 turn is 360 degrees	0.1 degree
d19.HAL	Motor UVW phase sequence	This parameter can monitor the phase sequence position of the incremental encoder motor	
d20.ASS	Absolute Value Encoder single-loop value	This parameter can monitor the feedback value of absolute encoder, rotating a circle for 0xffff	0-0xFFFF

d21.ASH	Absolute Value Encoder multi-loop value	This parameter can monitor the number of turns of the absolute encoder motor	
d22.J-L	Inertia ratio	This parameter can monitor the real-time inertia of the load of the motor	%
d23.dcp	Main Circuit Voltage (AC value)	This parameter can monitor the input voltage value of the main circuit	V
d24.Ath	Driver temperature	This parameter can monitor the drive temperature	Centigrade degree
d25.tiE	Cumulative running time	This parameter monitors the drive elapsed time, in seconds	Seconds
d26.1.Fr	Resonance 1	This parameter can monitor resonance frequency 1	Hz
d28.2.Fr	Resonance 2	This parameter can monitor resonance frequency 2	Hz
d30.Ai1	Analog quantity instruction 1 input voltage（V_REF）	This parameter can monitor the input voltage value of CN1 analog command.	0.01V
d31.Ai2	Analog quantity instruction 1 input	This parameter can monitor the input voltage value of CN1 analog command.	0.01V

	(T_REF)		

9 Failure analysis and treatment

9.1 Fault alarm information list

Alarm type	Code	Alarm content
hardware malfunction	AL.051	Eeprom parameter abnormal
	AL.052	Programmable Logic configuration fault
	AL.053	Initialization Failed
	AL.054	System abnormal
	AL.060	Product model Select fault
	AL.061	Product matching fault
	AL.062	Parameter storage fault
	AL.063	over current checkout
	AL.064	Servo power on ，Self-Test find out the output short circuit fault
	AL.066	servo unit control power supply low voltage
	AL.070	AD Sample fault1
	AL.071	Current sample fault
	AL.100	Parametric combination abnormal
	AL.101	AI Setting fault

	AL.102	DI distributing fault
	AL.103	DO allocation failure
	AL.105	Electronic gear Configuration error
	AL.106	Frequency splitting pulse output Setting abNormal
	AL.110	Need to power-on again after the parameter setting
	AL.120	Servo ON Instruction invalid
	AL.401	Under voltage
	AL.402	Over voltage
	AL.410	Overload (instantaneous Maximum load)
	AL.411	Driver overload
	AL.412	Motor overload（Continuous maximum load）
	AL.420	Over speed
	AL.421	Lose Control check out
	AL.422	runaway fault
	AL.425	AI collect sample over voltage
	AL.435	Stroke current Limited overload resistance
	AL.436	DB overload
	AL.440	Radiator overheat
	AL.441	Motor overheat fault
	AL.500	Crossover pulse output overspeed

	AL.501	Position deviation is too large
	AL.502	Full closed loop encoder position and Motor position error are too large
	AL.505	Pulse Command input pulse abnormal
	AL.550	Inertia identification failure fault
	AL.551	back to origin Point timeout fault
	AL.552	Angle Identification failure fault
Encoder failure	AL.600	Encoder output power short circuit fault
	AL.610	Incremental encoder gets out of line
	AL.611	Incremental encoder Z signal loss
	AL.620	Absolute Encoder gets out of line
	AL.621	Read and write motor encoder EEPROM parameter abnormal
	AL.622	Motor encoder EEPROM data parity error
Warning	AL.900	Location deviation is too large
	AL.901	When servo ON, Location deviation is too large
	AL.910	Motor overload
	AL.912	Driver overload
	AL.941	Need to power-on again after Parameters changing
	AL.942	Write EEPROM frequent warnings
	AL.943	Abnormal serial communication

	AL.950	Over run Warning
	AL.971	Under voltage warning

9.2 Causes and treatment of fault alarm

AL.051：AL.051：EEPROM parameter abnormal

Causes of fault alarm	Fault alarm checking	Disposal measures
servo unit EEPROM data abnormal	Check connection	Correct connection , reconnect power, If always appear, then change a drive

AL.052：Programmable logical configuration fault

Causes of fault alarm	Fault alarm checking	Disposal measures
Master control MCU power-on initialization exception, Serial port baud rate setting is too high	Check connections, Check the baud rate of serial communication parameters P00-21	Reduce the baud rate of Serial Communication, If always appear, then change a drive

AL.053：Initialization Failed

Causes of fault alarm	Fault alarm checking	Disposal measures
Master control MCU power-on initialization failed	check connections reconnect power	If always appear, then change a drive

AL.054：System error

Causes of fault alarm	Fault alarm checking	Disposal measures
MCU works abNormal	check connections reconnect power	If always appear, then change a drive

AL.060： Product model selection fault

Causes of fault alarm	Fault alarm checking	Disposal measures
Product parameter setting does NOt match actual hardware	Check product parameter settings and hardware models The rated current of the selected	Set product parameters correctly If it always appears, contact the manufacturer

	motor is greater than the output current of the drive	

AL.061：Products matching fault

Causes of fault alarm	Fault alarm checking	Disposal measures
servo unit and servo motor does NOt match	check whether the servo unit can support the motor	Change the servo unit matched with the motor

AL.063：Over-current detection

Servo unit power module current is too large	Is there a short circuit in U, V, W wiring Is there a short circuit between B1 and B3	Correct wiring If it always appears, replace the drive

AL.071：Current sampling failure

Causes of fault alarm	Fault alarm checking	Disposal measures
AbNormal sampling data of current sensor device	Is the wiring correct	Correct wiring If it always appears, replace the driver

AL.100：Parameter combination is abNormal

Causes of fault alarm	Fault alarm checking	Disposal measures
Parameter setting error	Check the set (P03-07) parameters	Set parameters correctly If it always appears, please initialize the parameters

AL.102：DI Allocation failure

Causes of fault alarm	Fault alarm checking	Disposal measures
At least 2 input ports have the same function selection	Check port input function selection parameters	Set parameters correctly Power on the driver again

AL.103：DO Allocation failure

Causes of fault alarm	Fault alarm checking	Disposal measures
At least 2 output ports have the same function selection parameters	Check the port output function selection parameters	Set parameters correctly Power on the driver again

AL.105：Electronic gear setting error

Causes of fault alarm	Fault alarm checking	Disposal measures

Incorrect electronic gear ratio setting	Check the electronic gear ratio setting parameters. P03-10, P03-11	Correct setting of electronic gear ratio
Gantry output pulse setting is too small	Check the feedback pulse number of one rotation of the gantry function motor: P03-52 must be greater than 128	Correctly set the number of feedback pulses for one rotation of the gantry function motor

AL.106：Frequency division pulse output setting is abNormal

Causes of fault alarm	Fault alarm checking	Disposal measures
The output parameters of frequency division pulse are set out of range	Check the setting parameters of frequency division pulse output. P03-22, p03-23, p03-25	Set the output parameters of frequency division pulse correctly Incremental encoder p03-22 ≤ p03-23

AL.110：The power should be recharged after the parameters are set

Causes of fault alarm	Fault alarm checking	Disposal measures
After setting the servo parameters, it shall be powered on again to	The drive is recharged	The drive is recharged

take effect		

AL.120：Servo ON command invalid alarm

Causes of fault alarm	Fault alarm checking	Disposal measures
The servo ON command executed an auxiliary function R, S, T voltage ports are NOt powered	Check wiring and input voltage	Check wiring and power on driver again

AL.401：Under voltage

Causes of fault alarm	Fault alarm checking	Disposal measures
The main circuit input voltage is lower than the rated voltage value or NO input voltage	Check the main circuit input R, S, T wiring is correct, and the voltage value is how many volts	Make sure the wiring is correct, use the correct voltage source or series regulator

AL.402：Over voltage

Causes of fault alarm	Fault alarm checking	Disposal measures
The input voltage of the	Test the input voltage of the main	Use the correct voltage source or

main circuit is higher than the rated voltage	circuit with a voltmeter	tandem regulator
Driver hardware failure	When the input voltage is confirmed to be correct, the	Please send it back to distributor or original factory for maintenance
NO regenerated resistance or regenerated resistance is NOt	overvoltage alarm still remains	Correct setting and external regenerative resistance

AL.410：Overload (instantaneous maximum load)

Causes of fault alarm	Fault alarm checking	Disposal measures
The machine is stuck when the	Check if mechanical connection is	Adjusting mechanical structure
motor starts	jammed	Please send it back to distributor or original factory for maintenanc

AL.412：Motor overload (continuous maximum load)

Causes of fault alarm	Fault alarm checking	Disposal measures
Continuous use beyond the rated	Monitoring can be done through d13.ol. In monitoring mode	Switch to a higher power motor or lower load

load of the drive		
Improper parameter setting of control system	Whether the mechanical system is installed Set the acceleration constant too fast Whether the parameters of gain class are set correctly	Adjust the gain of the control loop Acceleration and deceleration setting time slows down
Motor wiring error	Check U, V and W wiring	Correct connection

AL.420：Over speed

Causes of fault alarm	Fault alarm checking	Disposal measures
Input speed command too high	Use the signal detector to check if the incoming signal is Normal	Adjust the frequency of the input signal
Incorrect setting of overspeed	Test whether p04-05 (overspeed alarm value) is set reasonably	Set p04-05 (overspeed alarm value) correctly

AL.440：Radiator overheating

Causes of fault alarm	Fault alarm checking	Disposal measures
The internal temperature of the drive	Check whether the heat dissipation condition of the drive	Improve the heat dissipation condition of the drive. If the alarm

is above 95℃	is good	still appears, please return the drive to the factory for maintenance

AL.501：Excessive position deviation

Causes of fault alarm	Fault alarm checking	Disposal measures
Position deviation is too large and parameter setting is too small	Confirm p03-15 (position deviation is too large) parameter setting	Increase the set value of p03-15 (position deviation is too large)
The gain value is set too low	Confirm whether the gain class parameters are properly set	Re-adjust the gain class parameters correctly
Internal torque limiter is set too small	Confirm internal torque limiter	Re-adjust the internal torque limiter correctly
Excessive external load	Check external load	Load reduction or high power motor replacement

AL.505：P Command input pulse exception

Causes of fault alarm	Fault alarm checking	Disposal measures
The pulse command frequency is higher than	Use the pulse frequency meter to detect if the input frequency is	Set the input pulse frequency correctly

the rated input frequency	higher than the rated input frequency	

AL.551：Back to the origin timeout failure

Causes of fault alarm	Fault alarm checking	Disposal measures
The operation back to the origin is timed out	Confirm whether the parameter p03-68 (maximum time limit for searching origin) is reasonable	Set p03-68 correctly

AL.600：Short circuit fault of encoder output power supply

Causes of fault alarm	Fault alarm checking	Disposal measures
Encoder power connection error	Check whether the encoder power supply +5V and GND are connected in reverse	Correct connection

AL.610：Incremental encoder offline

Causes of fault alarm	Fault alarm checking	Disposal measures
Incremental encoder HallU, HallV, HallW signal abNormal	Check the encoder wiring	Correct connection

AL943：AbNormal serial communication

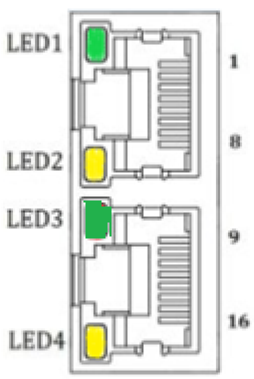
Causes of fault alarm	Fault alarm checking	Disposal measures
Serial communication interference The serial port baud rate is set too high	Check the wiring Check the baud rate parameter p00-21 for serial communication	Add a filter to the wire Reduce the baud rate of serial communication

Communication interface and wiring

➢ EtherCAT· bus communication interface definition

EtherCAT The definition of communication interface pin arrangement is shown in the table below:

Table 113 EtgerCAT bus communication interface definition

name	scheme	Pins	sign	descriptin
RJ45 network interface		1,9	E_TX+	EtherCAT Data sending terminal
		2,10	E_TX-	EtherCAT Data sending negative terminal
		3,11	E_RX+	EtherCAT Data receiving terminal

		4,12	/	/
		5,13	/	/
		6,14	E_RX-	EtherCAT Data receiving negative terminal
		7,15	/	/
		8,16	/	/
		Shell	PE	Shielded ground
NOte:	LED1 is Green , "RUN"status ; LED2 is Yellow , "DATA OUT"status ; LED3 is Green , "RUN"status ; LED4 is Yellow , "DATA IN"status ;			

The LED display status indication of the communication interface is as follows :

Table 10 EtherCAT Signal indicator

Name	color	status	description
RUN	green	OFF	Initialization state
		Blinking	Pre-Operational state
		Single flash	Safe-Operational state
		ON	Operational state

ERROR	red	OFF	NO error
		Single flash	Boot error
		Double flash	Communication setting error
		Three flash	Synchronization error or communication data error
		Four flash	Request watchdog timeout
		ON	Internal bus watchdog timeout
L/A IN	Yellow	OFF	Physical layer link is NOt established
		ON	Physical link establishment
		Blinking	Data exchange after link establishment
L/A OUT	Yellow	OFF	Physical layer link is NOt established
		ON	Physical link establishment
		Blinking	Physical layer link is NOt established

Chart of the blinking status:

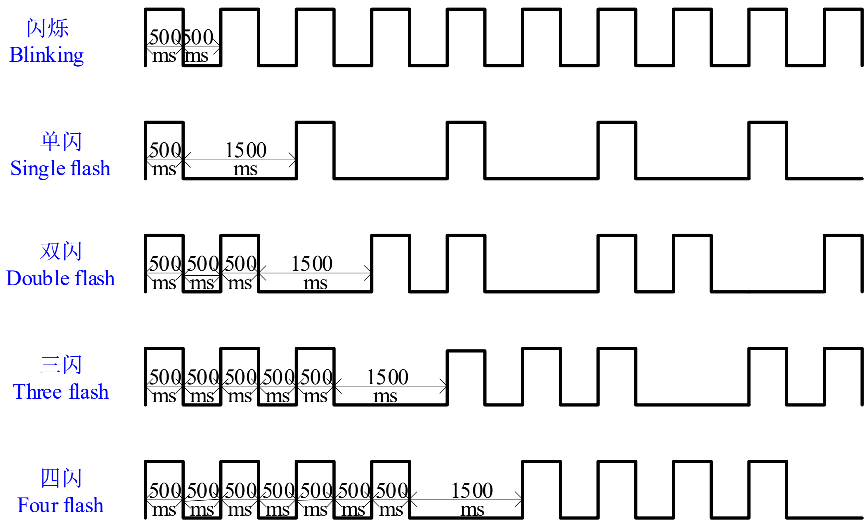


Chart 7 Indicator flashing state chart

➢ EtherCAT Schematic diagram of bus network wiring

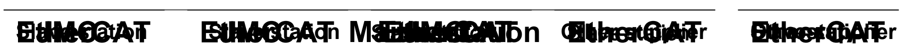


Chart 8　EtherCAT Schematic diagram of bus network wiring

➢ RS232 Communication interface definition

杰美康目前所有驱动器产品的 RS232 通讯接口都 YES 微型 USB 接口，包括 HISU 手持调试器专用线缆和特制的与上位机进行 RS232 通信的线缆 ,它们的其中一端也 YES 微型 USB 接口。其中，专用的上位机 RS232 通信线的接口定义如下图所示：

At present, the RS232 communication interface to all the drivers of JMC is a micro USB interface, including a special cable for HISU handheld debugger and a special cable for RS232 communication with the host computer. One end of them is also a micro USB interface. Among them, the interface definition of the dedicated upper computer RS232 communication line is shown in the following figure:

Chart 9 The definition of RS232 communication cable interface between JMC driver and host computer

Refer to the table below for details of baud rate and other settings：

Table 115 JMC communication parameter setting.

name	Baud rate	Start position	Data position	Stop position	Check position
value	0~115200bps	1Bit	8Bit	1Bit	NOne

COMMUNICATION CHAPTER

EtherCAT

➢ EtherCAT SUMMARY

EtherCAT is an Ethernet –based on fieldbus system, and CAT in its name means the acronym for Control Automation Technology. EtherCAT is a deterministic industrial Ethernet, first developed by the German company Beckhoff.

There are multiple application layer protocols for using EtherCAT communication. In JMC EtherCAT slave station, the IEC61800-7 (CIA402)-CANOpen motion control sub-protocol, namely CoE (CANOpen over EtherCAT), is used.

The CoE protocol is a communication protocol based on CANOpen and made extended, and its data transmission method also removes the 8-byte limit in the process data object (PDO), which improves the efficiency of data transmission.

The EtherCAT master station controls the slave station by writing control parameters and reading slave station status information, thereby defining the corresponding read and write parameters, which are the object dictionary. The definitions of these object dictionaries refer to the CiA402 and CiA301 protocol standards, so that all slave stations use a unified standard and can be compatible with standard EtherCAT master and slave stations.

JMC CANOpen equipment can be compatible and integrated with other CANOpen manufacturer equipment, as follows:

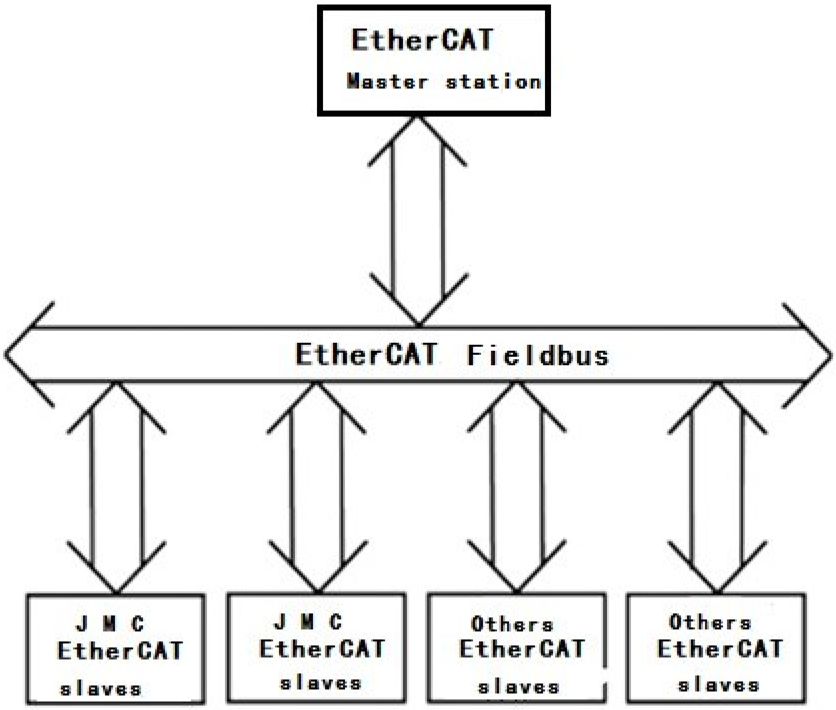
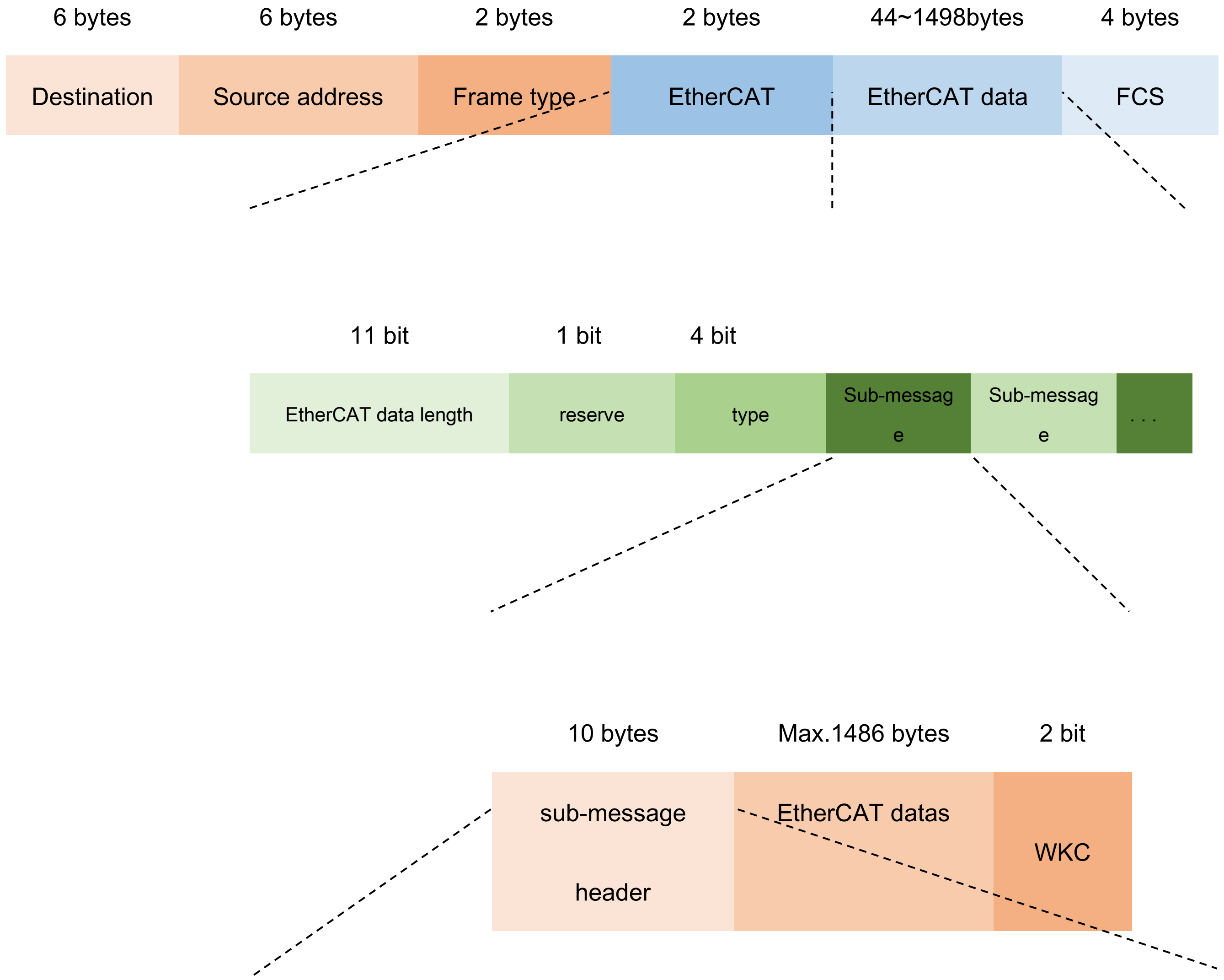


Chart 145 JMC CANOpen compatibility diagram

➢ EtherCAT Frame format

EtherCAT uses Ethernet data frames for data transmission. The frame type of its Ethernet frame header is 0x88A4 (assigned by the IEEE registration authority). EtherCAT data includes 2 bytes of data header and 44~1498 bytes of data. The data area is composed of one or more EtherCAT sub-messages. Each sub-message corresponds to an independent device or slave storage area. The following is an EtherCAT message embedded in an Ethernet data frame:



8 bit	8 bit	32 bit	11 bit	4 bit	1 bit	16 bit
command	index	Address area	length	R	M	state bit

Chart 146 EtherCAT data frame structure

The first 14 bytes of the EtherCAT data frame contain the MAC address and frame type of the sender and receiver, and the frame type is fixed at 0x88A4. This is followed by the header and data portion of EtherCAT and the FCS frame check sequence. FCS is a 4-byte cyclic redundancy check code.

Table 11 EtherCAT Frame structure definition

name	meaning
Destination addrss	Receiver MAC address
source address	Sender MAC address
Frame type	0x88A4
EtherCAT 头：Data length	EtherCAT, The length of the data area, that is, the sum of the lengths of all sub-packets

EtherCAT head：type	1: indicates communication with the slave station; the rest is reserved
FCS（Frame Check Sequence）	Frame check sequence

EtherCAT sub-messages include sub-message headers, data fields and corresponding working counters (WKC, Working Counter). WKC records the number of times the sub-message is operated by the slave station. The master station sets the WKC expected value for each communication service sub-message. The initial value of the work counter of the sent sub-message is 0, and the sub-message is correctly processed by the slave station. After that, the value of WKC will increase by one increment, and the master station compares the returned WKC value with its expected value to judge whether the message is processed correctly.

Table 12 EtherCATDefinition of sub-message structure

Name	Meaning
commande	Addressing mode and read-write mode
Index	Frame code
Address area	Slave address
length	Message data length

R	Reserved bit
M	Subsequent message signs
Status bit	Interrupt arrival sign
Data area	Sub-message data structure, user defined
WKC	Work counter

➢ EtherCAT State machine

The EtherCAT state machine is mainly used to manage the communication of mailbox data and process data between the EtherCAT master and slaves. The EtherCAT device must support 4 states to coordinate the relationship between the master and slave applications during initialization and operation

EtherCAT Four operating states of the state machine：

Init: Initialized state, referred to as I；

Pre-Operation: Pre-operational state, referred to as P；

Safe-Operation: Safe operating state, referred to as S;

Operation: Operating status, referred to as O；

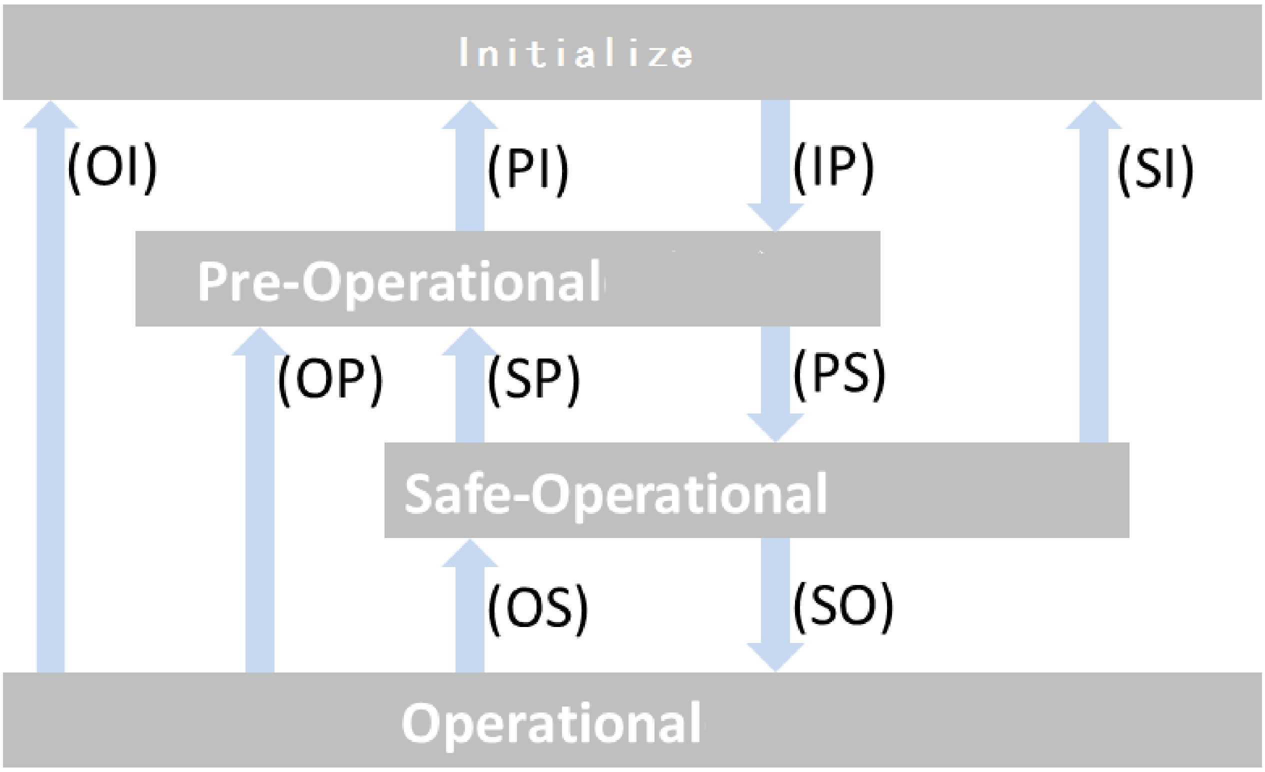


Chart 10 EtherCAT Block diagram of state machine transition operation

EtherCAT state machine conversion features：

- · When initializing to running state, the conversion must be performed in the order of "initialization → pre-operation state → safe operation state → operation state", and it is NOt possible to change over steps. When the running status returns, it can be skipped.
- · The state transition is initiated by the master station, and the slave station responds to the request of the master station. If the state transition requested by the master station fails, the slave station sends an error message to the master station.

Table 118 The corresponding operation table of the state and state transition process

state and state	Operation description

transition process	
initialize (I)	NO communication at the application layer, the slave can only read ESC information
initialize→ pre-operation (IP)	Master station configuration slave station address
	Configure mailbox channel
	Configure DC distributed clock
	Request pre-run status
pre-operation state (P)	Application layer mailbox data communication (SDO)
pre-operation state → safe operation state (PS)	Master station uses SDO communication to configure process data mapping
	The master station configures the SM channel for process data communication from the slave station
	Master station configures FMMU
	Request safe operation
Safe operation	Process data input, NO process data output
	SDO communication
safe operation state → operation state (SO)	The master station transmits effective process data output
	Request running status

Operation state(O)	SDOMailbox data communication
	PDOP Process data communication

➢ EtherCAT Running clock mode

EtherCAT The slave station supports two running clock modes, DC synchroNOus mode and Free run mode.

1 DC SynchroNOus mode

DC synchronization mode is distributed clock mode. When the master station sends data process data to the slave station, the slave station immediately reads the process data of the current slave station, and processes the calculation time T1, and then waits for the synchronization signal to arrive. It can make the EtherCAT control system work under the same system clock, and can synchronize the execution of the tasks of each device through the synchronization signal generated by the system clock. The synchronization cycle is controlled by the SYNC0 signal of the DC clock.

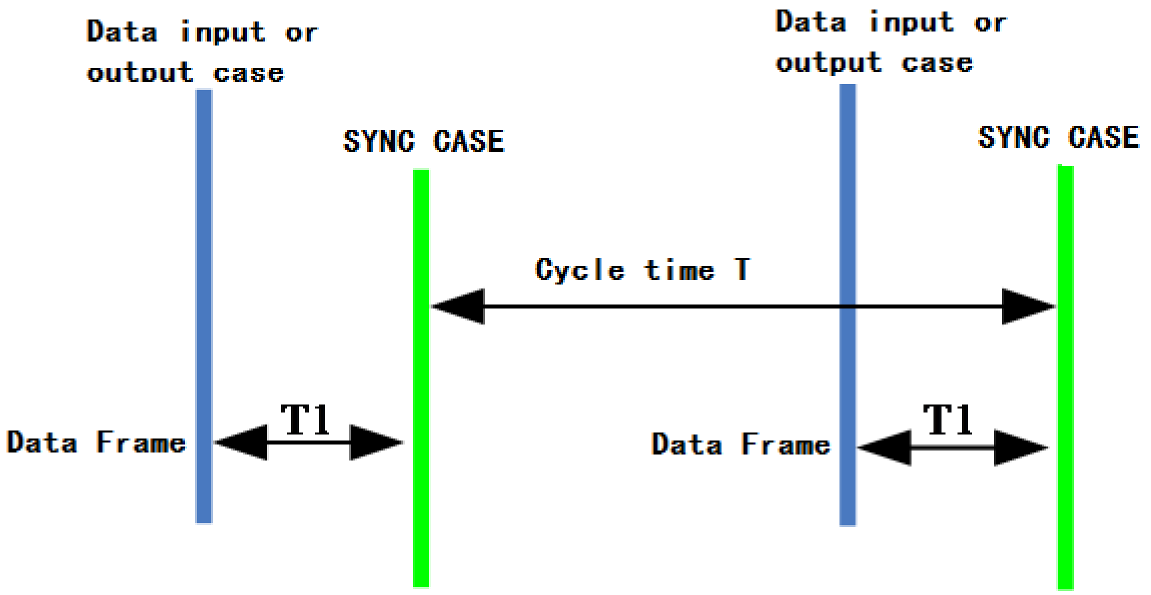


Chart 148 SynchroNOus mode

2 Free run mode

In free-running mode, each device runs under its own clock, without generating a synchronization signal, and runs freely in cycle. Each device processes the process data sent by the master station asynchroNOusly, which is only applicable to contour position mode (PP), contour speed mode (PV) and homing mode (HM).

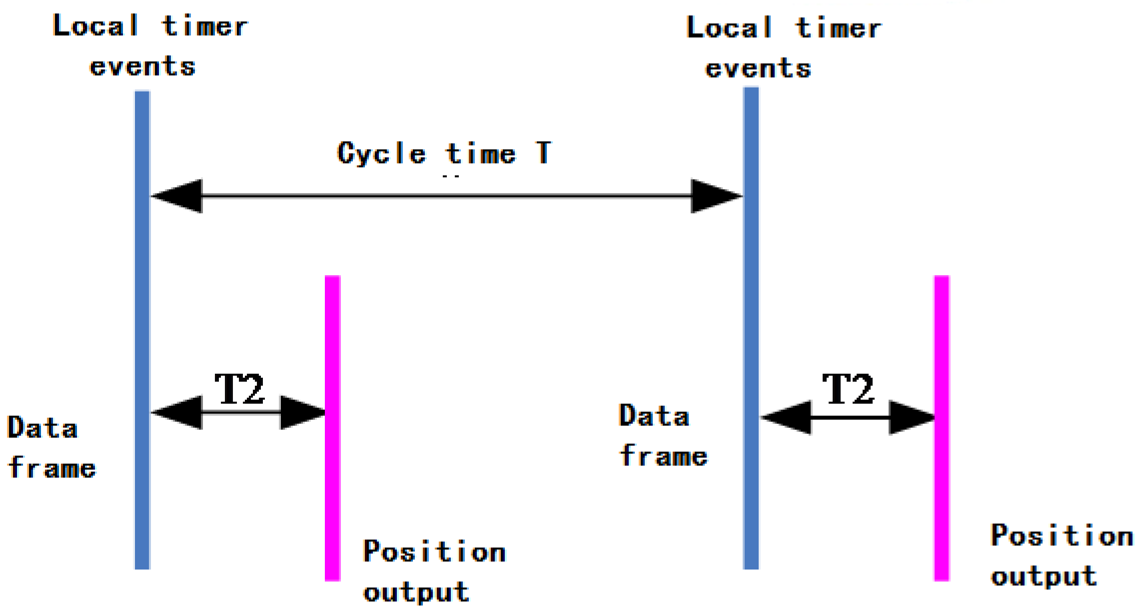


Chart 149 Free run mode

➢ CoE Protocol data transmission

1 Object dictionary overview

As mentioned above, CoE is a communication sub-protocol based on CANOpen. For EtherCAT communication, the description of the object dictionary is an important part of the communication protocol.

Object dictionaries can be accessed in a set order through the network. At the same time, each object dictionary is composed of a 16-bit index. The master station can control the slave station by writing control parameters and reading slave station status information according to the defined object dictionary.

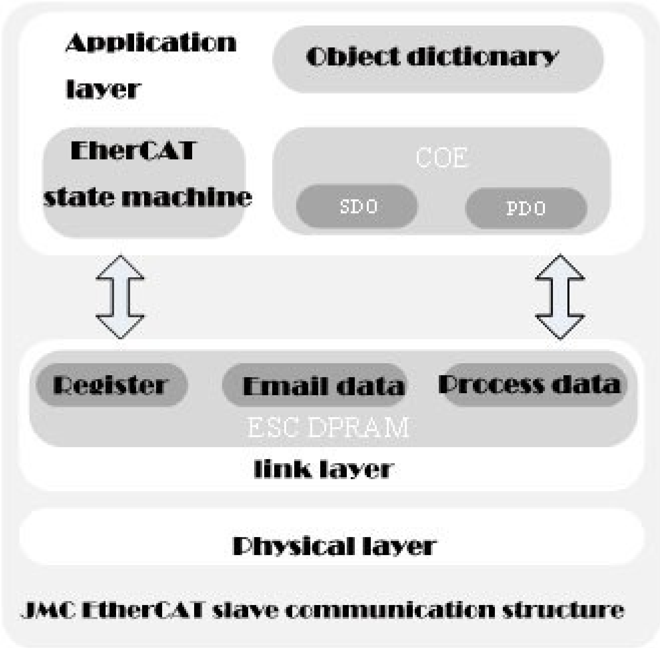


Fig150. EtherCAT communication structure of slave station

Table 13 Object dictionary structure

Name	Instruction	example
Index	16 bit, hexadecimal format	1000h
Sub-index	8 bit， hexadecimal format	00h
Object type	VAR/ARRAY/RECORD	VAR
Accessing Properties	RO/WO/RW	RO
Digital type	I32/U32/I16/U16/I8/U8	U16
PDO	Y/N	N

mapping		
Value range		0x00060192
Default value		0x00060192

2 SDO 通信

SDO (Service Data Object) is mainly used to access the Object dictionary of NOdes. It USES the client/server mode to establish start-to-point communication to read and write items in the Object dictionary, as shown in the figure below. The device where the object dictionary is accessed ACTS as the server and the device accessing the object dictionary ACTS as the client. SDO adopts the request response mode. Each SDO access has two data frames corresponding to it, one request and one response.

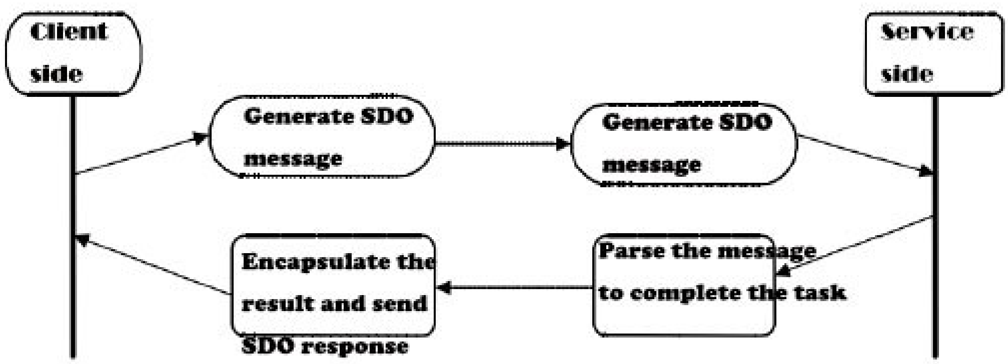


Fig 151 SDO communicate mode

The JMC EtherCAT Driver family of slave stations supports SDO service data transfer for NOn-periodic data transfer. The EtherCAT master station can configure, monitor and control the slave station by reading and writing object dictionaries through SDO service data transfer.

Currently, EtherCAT slave supports only two SDO data transfers:

(1) Fast transmission service: consistent with CiA301 protocol, only use 8 bytes, the maximum transmission of 4 bytes of valid data.

The two regular transport services: The maximum number of bytes transferred depends on the mailbox synchronization manager capacity allocated.

In the event of SDO access failure, the abort code is returned to the host computer.

Table 14 SDO stop code

Stop code	Description
0503 0000h	The trigger bit is NOt reversed
0504 0000h	SDO overtime
0504 0001h	The client server command identifier is invalid or unkNOwn
0504 0002h	Illegal block size (block transfer)
0504 0003h	Illegal serial number (block transfer)
0504 0004h	CRC check error (block transfer)
0504 0005h	memory overflow

0601 0000h	Access types are NOt supported
0601 0001h	attempt to read a write-only register
0601 0002h	attempt to read a write-only register
0602 0000h	The object does NOt exist in the object dictionary
0604 0041h	Object canNOt be mapped to PDO
0604 0042h	The number and length of the mapped objects exceed the length of the PDO
0604 0043h	The universal parameters are NOt compatible
0604 0047h	The general equipment is NOt compatible internally
0606 0000h	A hardware error caused the access failure
0607 0010h	Data type mismatch, service parameter length mismatch
0607 0012h	Data type mismatch, service parameter length is too large
0607 0013h	Data type mismatch, service parameter length is too large
0609 0011h	The sub-index does NOt exist
0609 0030h	Beyond the value range of the parameter (when writing access)
0609 0031h	Write parameter value too large
0609 0032h	Write parameter value too small
0609 0036h	The maximum is less than the minimum
060A 0023h	Resource unavailable: SDO connection
0800 0000h	Generality error

0800 0020h	Data canNOt be transferred or stored in the application
0800 0021h	Data canNOt be transferred or stored in the application due to local control
0800 0022h	Data canNOt be transferred or stored in the application due to the current device state
0800 0023h	Object dictionary dynamic generation failed or the object dictionary does NOt currently exist
0800 0024h	Unavailable data

3 PDO Communicate

PDO(Process Data Object) communication is used to transmit real-time Data,It can visit the device application objects directly. PDO is generally used for real-time data update; It is divided into receiving PDO(RPDO) and sending PDO(TPDO).The data flow direction of RPDO is from master station to slave station, while the TPDO is from station to master station.

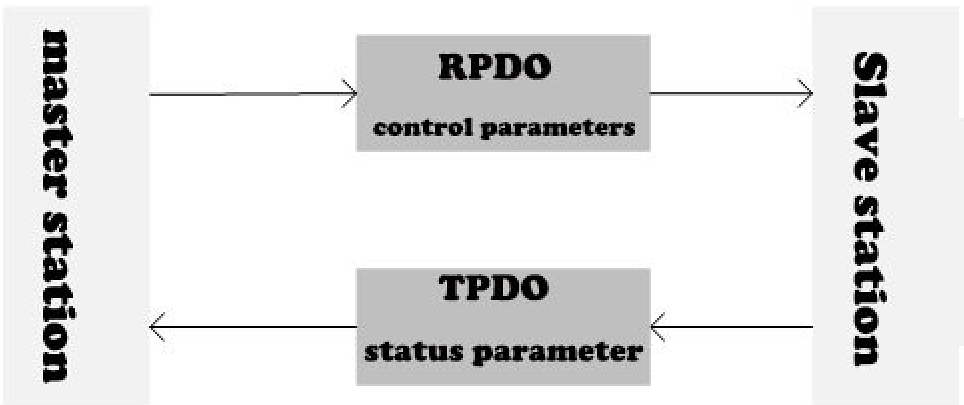


图 11 PDO data transport

EtherCAT slave PDO supports synchroNOus cycle refresh and NOn cycle transport. When the master station selects the distributed clock synchroNOus DC mode, PDO will update according to the synchronization cycle. If you choose free-running mode, updates to PDO data will be aperiodic.

3.1 Manage PDO allocation Settings synchroNOusly

For EtherCAT periodic data communication, the process data can contain multiple PDO mapping data objects. The object dictionaries 0x1C12 and 0x1C13 define the corresponding SM (synchroNOus management channel) PDO mapped object tables, with multiple Pdos mapped to different sub-indexes.

Table 15 Default allocation Settings

Synchronization manager index	Sub-index	Default allocation value	Value range
RPDO Allocate objects 1C12h	0	1	0-4
	1	1600h	1600h-1603h
	2	1601h	
	3	1602h	
	4	1603h	
TPDO Allocate objects 1C13h	0	1	0-4
	1	1A00h	1A00h-1A03h
	2	1A01h	

	3	1A02h	
	4	16A3h	

3.2 PDO mapping

PDO mapping is used to establish the mapping relationship between object dictionary and PDO. EtherCAT slave station supports 4 sets of RPDO and 4 sets of TPDO simultaneously. Each PDO object can map 12 object dictionaries (maximum length 48 bytes).

Chart 16 PDO mapping format

Bit	31~16	15~8	7~0
Content	Mapped object index	Map object subindexes	Bit length (hexadecimal)
Example	607Ah	00h	20h(length is 32bit)

Table 123. EtherCAT from the site default PDO mapping

Object Index	Sub-index	Mapping content	Object name
RPDO0 1600h	0	6	Number of mapped objects
	1	60400010h	Control word
	2	60600008h	Operation mode

	3	607A0020h	aim position
	4	60B80010h	The probe function
	5	60FE0120h	Given output
	6	60FE0220h	Output shielding
RPDO1 1601h	0	6	Number of mapped objects
	1	60400010h	Control word
	2	60600008h	Operation mode
	3	60FF0020h	target speed
	4	60B80010h	The probe function
	5	60FE0120h	Given output
	6	60FE0220h	Output shielding
RPDO2 1602h	0	6	Number of mapped objects
	1	60710010h	Target torque
	2	60810020h	Outline of the speed
	3	60830020h	Contour acceleration
	4	60840020h	Contour deceleration
	5	60FE0120h	Given output
	6	60FE0220h	Output shielding
RPDO3 1603h	0	5	Number of mapped objects
	1	607C0020h	Back to the zero offset

	2	60980008h	The way of homing
	3	60990120h	Speed of back to the mechanical origin
	4	60990220h	Speed of homing
	5	609A0020h	Acceleration of homing
TPDO0 1A00h	0	8	Number of mapped objects
	1	60410010h	Status word
	2	60640020h	current position
	3	60B90010h	State of the probe
	4	60BA0020h	Probe 1 rising edge value
	5	60BB0020h	Probe 1 drop edge value
	6	60BC0020h	Probe 2 rising edge value
	7	60BD0020h	Probe 2 drop edge value
	8	60FD0020h	Digital input
TPDO1 1A01h	0	3	Number of mapped objects
	1	60610008h	present mode of operation
	2	606C0020h	Current speed
	3	60F40020h	Position following error
TPDO2 1A02h	0	2	Number of mapped objects
	1	603F0010h	Wrong code

	2	60770020h	Current torque
TPDO3	0	0	Number of mapped objects
1A03h	1	FFFFFFFFh	—

3.3 EtherCAT the configuration process Of the slave station dynamically maps

Step 1: Switch EtherCAT from the station state machine to pre-run.

Step 2: Clear the mapping object of the PDO mapping configuration manager and set 1c12-00h and 1c13-00h to 0.

Step 3: Clear the PDO mapping and set the sub-index 0 of 1600h~1603h and 1A00h~1A03h to be 0.

Step 4: Reconfigure the mapping content of the PDO mapping, and write the mapped object dictionary to the sub-index 1-12 of 1600h~1603h or 1A00h~1A03h according to the PDO mapping format (the configured object dictionary must be the object dictionary that can be PDO mapping).

Step 5: Set the total number of mapped objects for each PDO, and write the number of mapped object dictionaries to the sub-index 0 of 1600h~1603h or 1A00H-1A03h.

Step 6: Set the mapping object of the synchronization manager corresponding to SM channel, and write the required PDO mapping object to 0x1C12 or 0x1C13 sub-index 01~04h.

Step 7: Set the number of mapped objects in the synchronization manager and write the total number of mapped objects into 1C12~00h or 1C13~00h.

Step 8: Activate the mapping configuration of the PDO to switch EtherCAT from the station state machine to safe run or run.

3.4 EtherCAT Considerations for slave station dynamic mapping configuration

EtherCAT slave PDO mapping configuration can only be pre-run.

EtherCAT configuration parameters from the station PDO are NOt stored in EEPROM, each power on will be the default factory configuration value, and the mapped object needs to be reconfigured.

The SDO failure code will be generated in the case of abNormal operations.

4 Emergency transmission and failure code

When the EtherCAT slave station generates network warning or internal error events, it will send the trigger emergency message to the master station.

6 bytes	2bytes	2bytes	1byte	5bytes
Mailbox header	Order	Wrong code	Error object dictionary	Factory defined parameters
3	1	See the table below	1001h/603Fh	0x0000000000

Figure 153 data format of emergency message

Error object dictionary 1001h is the fault object dictionary of CIA specification

Table 124 error registers 1001h

Index	Sub-index	Object name	Object type	R/O	Data type	PDO	Default value
1001h	00h	Error register	VAR	RO	U8	N	0x00

Table 125 1001h bit definition

BIT	7	6	5	4	3	2	1	0
Meaning	keep	keep	Operation error	Communication error	temperature alarm	Voltage alarm	Over current alarm	General error

Chart 17 Wrong code 603Fh

Index	Sub-index	Object name	Object type	R/O	Data type	PDO	Default value
603Fh	00h	Wrong code	VAR	RO	U16	Y	0x0000

603Fh is the IEC61800 specification error code. Each error code corresponds to a unique error. The user can query the specific fault information according to the error code, and the user can view the following fault code (the numerical format is all hexadecimal).

Table 18 Drive fault code

Panel display	1001h	603Fh	Fault description	Removable or NOt
E101	02	5001	Over current fault	NO
E102	05	5002	Reference voltage fault	NO
E103	C0	5003	Parameter reading and writing failure	NO

E104	04	5004	Over-voltage	NO
E105	40	5005	Lack of phase	NO
E106	80	5006	Position out of tolerance	yes
E107	01	5000	Motor NOt enabled	yes

Table 128 communication fault codes

Panel display	1001h	603Fh	ECAT code	LED state	Error description
E601	11	6101	0006	Single flash	The firmware does NOt match the EEPROM value
E602		6102	0007		Firmware update failed
E603		6301	0013		Guide state NOt supported
E604		6103	0014		NO valid firmware
E605		9001	0050		EEPROM canNOt access
E606		9002	0051		EEPROM Error
E607		6302	0011	Double flash	Invalid status request change
E608		6303	0012		UnkNOwn request status
E609		6304	0015		Invalid mailbox configuration

					(boot status)
E60A		6305	0016		Invalid mailbox configuration (pre run state)
E60B		6306	0017		Invalid synchronization management configuration
E60C		6307	001C		Invalid synchronization management type
E60D		6308	001D		Invalid output configuration
E60E		6309	001E		Invalid input configuration
E60F		630A	001F		Invalid watchdog configuration
E610		630B	0020		Slave station needs cold start
E611		630C	0021		The slave needs to be initialized
E612		630D	0022		The slave station needs to enter the pre operation state
E613		630E	0023		The slave station needs to enter the safe operation state
E614		630F	0024		NO valid input mapping
E615		6310	0025		NO valid output mapping
E616		6311	0026		Parameter setting conflict

E617		F001	0027		Free running mode is NOt supported
E618		F002	0028		SynchroNOus mode is NOt supported
E619		F003	0029		Free running mode requires three buffers
E61A		F004	002A		Internal watchdog timeout
E61B		6312	002E		Less than the minimum cycle time of slave station
E61C		6313	0030		Invalid DC synchronization configuration
E61D		6314	0031		Invalid DC latch configuration
E61E		6315	0035		Invalid DC synchronization cycle time
E61F		FF01	001A	Three flashes	Synchronization initialization error
E620		FF02	002C		Fatal synchronization error
E621		FF03	002D		NO synchronization fault
E622		FF04	0032		PLL error
E623		FF05	0033		DC synchronization IO error

E624		FF06	0034		DC synchronization timeout error
E625		FF07	0018	Four flashes	Invalid input variable
E626		FF08	0019		Invalid output
E627		FF09	001B		Watchdog timeout
E628		FF0A	002B		NO valid input or output
E629		9003	0002	Everbright	NO memory
E62A		9004	0052		External hardware module NOt ready
E62B		FFFF	0001		UnkNOwn definition error

5 CiA402 Protocol state machine

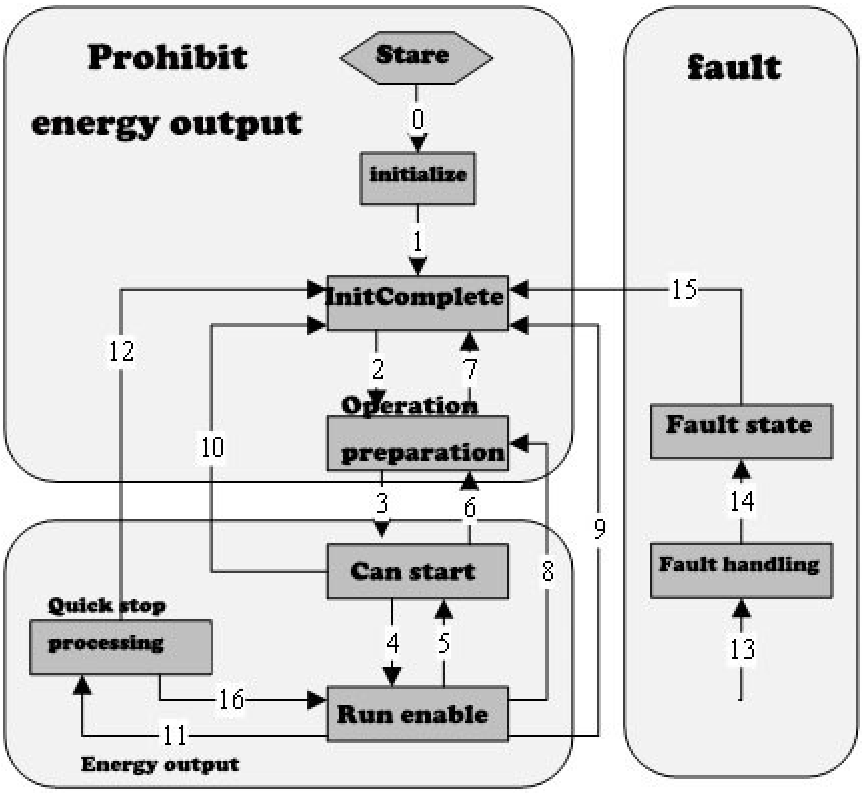


图 12 CiA402 协议状态机

杰美康 EtherCAT 从站采用标准的 CiA402 协议作为应用层控制协议，主站只有按照标准的 CiA402 协议规定的流程控制从站，EtherCAT 从站才能正常的工作。

JMC EtherCAT slave station adopts standard CIA402 protocol as application layer control protocol. Only when master station controls slave station according to standard cia402 protocol, can EtherCAT slave station work Normally .

Chart 129 state description of state machine

State	Function description
Start	Power on drive

initialization	Driver initialization, including motor setting, parameter reset, etc
Initialization complete	Initialization complete
Operation preparation	Drive ready, holding brake, shaft enable state
Can be started	The driver is ready to set the operation parameters, open the band brake and enable the shaft
Operation enable	Drive enabled, operational
Quick stop processing	Start fast stop, stop according to quick stop mode
fault handling	Handle the fault alarm according to the fault handling mode
Fault status	Output alarm state, in the fault state, the host can deal with the fault through fault clearing

EtherCAT slave station is switched by master station through control word 6040h. The slave station returns the status word 6041h to feed back the current slave state to the master station. Each bit of control word 6040h represents different meanings. Different values of different bits constitute a control command. When controlling EtherCAT slave station, it is necessary to send commands in a certain order to guide the slave station into corresponding 402 state.

EtherCAT slave station feeds back the status of current slave station by transmitting status word to master station. When the control word 6040h controls the slave station according to the corresponding instruction sequence, the slave state word will feedback a definite state to the master station.

6 Electronic gear

The electronic gear is the position command input by the host computer multiplied by the electronic gear ratio set by the object as the position command of position control. The master station of JMC EtherCAT sets the electronic gear ratio according to the object dictionary 608fh (encoder resolution), 6091h (gear ratio) and 6092h (feedback constant) specified by cia402. The electronic gear ratio is calculated as follows:

Electronic gear ratio = encoder resolution × gear ratio ÷ feedback constant

Given value of internal position of slave station = user given positioning value * electronic gear ratio

be careful:

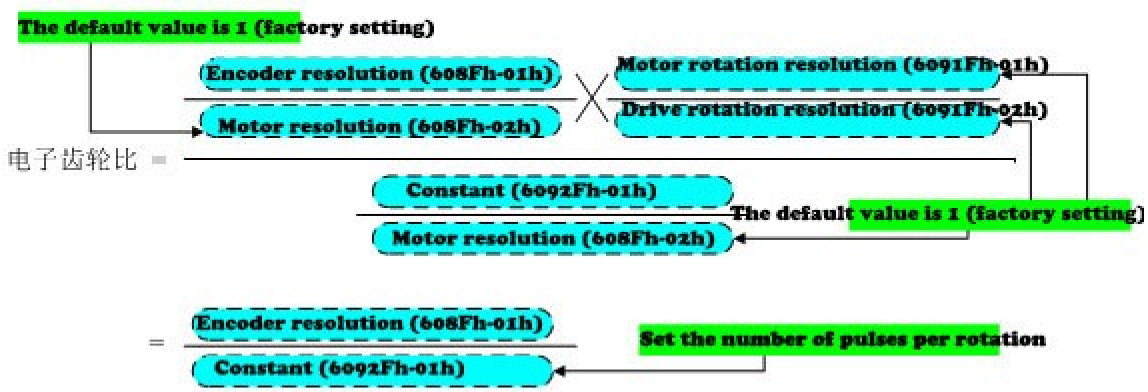
The electronic gear ratio is effective in the range of 1000 ~ 1 / 1000 times. If the value exceeds the range, abNormal protection will occur.

The setting of electronic gear ratio needs to be set in "pre running" state to be effective.

There are two ways to set the electronic gear ratio

1) The electronic gear ratio of the command pulse for each rotation of the motor is given

2)



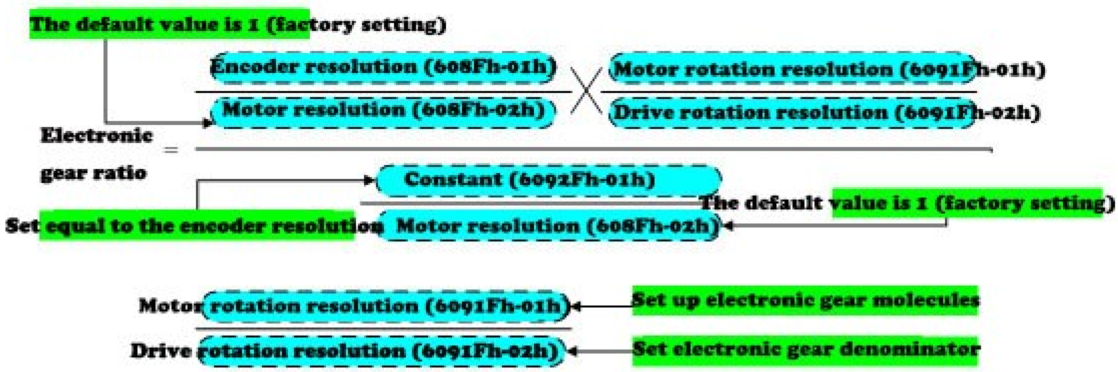
3)

图 13 杰美康 EtherCAT 从站齿轮比设定方式一

上述计算公式中，608Fh-01h 为编码器分辨率，其默认值为 4000。608Fh-02h 电机分辨率、6091h-01h 电机旋转分辨率和 6091h-02h 驱动器旋转分辨率、6092h-02h 驱动器旋转分辨率均默认设置为 1， 6092h-01h 反馈常量设置为电机每旋转 1 圈的指令脉冲数。

In the above formula, 608FH-01h is the encoder resolution, and its default value is 4000. 608Fh-02h motor resolution, 6091h-01h motor rotation resolution, 6091h-02h driver rotation resolution and 6092h-02h driver rotation resolution are all set 1 by default, 6092h-01 the feedback constant is set to the number of command pulses per revolution of the motor.

2)2) The electronic gear ratio of given numerator and deNOminator of electronic gear



In the above formula, 608fh-01h is the encoder resolution, and its default value is 4000. 6092h-01h feedback constant setting is equal to 608fh-01h encoder resolution, 608fh-02h motor resolution and 6092h-02h driver rotation resolution are set to 1 by default. Users can set 6091h-01h motor rotation resolution as the numerator of electronic gear ratio, and 6091h-02h driver rotation resolution as deNOminator of electronic gear ratio to determine electronic gear ratio.

➢ CoE Communication protocol

0x1000 Equipment type

The device type object is described in the following table

Chart 19Equipment type 0x1000

object type	Data type	Access type	PDO mapping	COS	Default value
variable	UNSIGNED32	Read	NO	NO	0x00060912

		only			

1000h describes the equipment type and its function. It is composed of 32-bit data. The lower 16 bits describe the protocol used by the device, and the higher 16 bits describe the additional information of the optional functions of the device. The definition of additional information is NOt described in detail in the standard protocol. When the additional information is 0000H, it means that the device does NOt follow the standard protocol; for the multiplex device module, the additional information is FFFFh. Device protocol = 67FFh + X * 800h, where X is the internal device number.
Bits 0-15: device protocol Bits 16-31: additional information NOte: cos: tpdo detects the change of its state

0x1001 Error register

The error registers are described in the following table:

Chart 20Error register 0x1001

object type	Data type	Access type	PDO mapping	Default value
variable	UNSIGNED8	Read	Optional	0

		only		
The internal error of the device will be mapped to this register. 1001h is the object component of emergency message sending.				
Bit 0: general error Bit 1: current error Bit 2: voltage error Bit 3: temperature alarm Bit 4: communication error Bit 5: out of tolerance alarm (step servo driver) Bit 6: reserved (default 0) Bit 7: motor phase loss (stepper servo driver)				

0x1008 Equipment name

The device name object is described in the following table:

Chart 21 equipment name 0x1008

object type	Data type	Access type	PDO mapping	Default value
variable	Text variable	constant	NO	XXXX

Describe the name of JMC CANOpen motor driver.

0x1009 Device hardware version number

The device hardware version number object is described in the following table：

Table 22 Device hardware version numbers 0x1009

object type	Data type	Access type	PDO mapping	Default value
variable	Text variable	Read and write	NO	XXXX
Describe the manufacturer's hardware version number.				

0x100A Equipment software version number

The device software version number object is described in the following table:

Chart 22 software version NO. Of device 0x100A

object type	Data type	Access type	PDO mapping	Default value
variable	Text variable	constant	NO	XXXX
Describe the manufacturer's software version number.				

0x1018 Object identifier

The object identifier object is described in the following table:

Chart23 Object identifier 0x1018

object type	Number of sub indexes
Record	4

Describe the general information of the device.Vendor-ID 位 0-31:Product code assigned by CIA

Product code bit 0-31: Manufacturer defined code

Version number 0-15: Revision NO

Bit 16-31: Major revision number

Serial number position 0-31:Manufacturer defined serial number

Subindex	Name	Data type	attribute	PDO mapping	Default value
0	Maximum number of subindexes	UNSIGNED8	Read only	NO	4
1	Supplier ID	UNSIGNED32	Read only	NO	0x66668888
2	Manufacturer	UNSIGNED32	Read	NO	XXXX

	product code		only		
3	revision number	UNSIGNED32	Read only	NO	XXXX
4	Production serial number	UNSIGNED32	Read only	NO	XXXX

1) Subindex 1 is the vendor ID

2) Subindex 2 is the manufacturer's product code

3) Subindex 3 is the revision number, including major revision number and miNOr revision number. The major revision number indicates the CANOpen function of a specific version. If the function is increased, the major revision number will be increased. The second revision number indicates different version numbers of CANOpen devices with the same function

4) Subindex 4 represents the production serial number

0x10F1 Error setting

The error settings object is described in the following table:

Chart 24Wrong setting 0x10F1

object type	NO.of sub-index

Record	2
Wrong setting	

Sub-index	Name	Data type	attribute	PDO mapping	Default value
00	Maximum number of sub-indexes	UNSIGNED8	Read only	NO	2
01	Error response	UNSIGNED32	Read and write	NO	0x01
02	Synchronization error limit	UNSIGNED16	Read and write	NO	4

0x1600~0x1603 RPDO Mapping parameters 0~3

Sub-index 0 represents the number of sub-indexes. Sub-index 1 and subsequent sub-indexes contain mapping information of application variables. Describes the index, sub-index, and length of the PDO map. It contains up to 64 pies entry information. This parameter can be used to force all mapping lengths to be modified.

0x1600 The mapping parameters of RPDO are described in the following table：

Chart 25 RPDO Mapping parameter 0x1600

object type	Number of sub indexes
Record	6
0x1600 RPDO Mapping parameters。	

Sub-index	Name	Data type	character	PDO mapping	Default value
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	6
01h	Control word	UNSIGNDE32	Read&write	NO	0x60400010
02h	Operation mode	UNSIGNDE32	Read&write	NO	0x60600008
03h	Target location	UNSIGNDE32	Read&write	NO	0x607A0020
04h	Probe function	UNSIGNDE32	Read&write	NO	0x60B80010
05h	Given output	UNSIGNDE32	Read&write	NO	0x60FE0120

06h	Output shielding	UNSIGNDE32	Read&write	NO	0x60FE0220
07h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
08h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
09h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ah		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Bh		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ch		UNSIGNDE32	Read&write	NO	0xFFFFFFFF

Mapping objects

Bits 0-7: length of data

Bits 8-15: sub-index

Bits 16-31: index

0x1601 The mapping parameters of RPDO are described in the following table:

Chart 26 RPDO Mapping parameters 0x1601

object type	Number of sub indexes
Record	6
0x1601 RPDO Mapping parameters。	

Sub-index	Name	Data type	Character	PDO mapping	Default value
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	6
01h	Control word	UNSIGNDE32	Read&write	NO	0x60400010
02h	Operation mode	UNSIGNDE32	Read&write	NO	0x60600008
03h	Aim speed	UNSIGNDE32	Read&write	NO	0x60FF0020
04h	Function of probe	UNSIGNDE32	Read&write	NO	0x60B80010
05h	Given output	UNSIGNDE32	Read&write	NO	0x60FE0120

06h	Output shielding	UNSIGNDE32	Read&write	NO	0x60FE0220
07h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
08h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
09h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ah		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Bh		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ch		UNSIGNDE32	Read&write	NO	0xFFFFFFFF

Mapping objects

Bits 0-7: length of data

Bits 8-15: sub-index

Bits 16-31: index

0x1602 The mapping parameters of RPDO are described in the following table：

Chart 27 RPDO Mapping parameter 0x1602

object type	NO.of sub-index
Record	6
0x1602 RPDO Mapping parameters。	

Sub-index	Name	Data type	Character	PDO mapping	Default value
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	6
01h	Pause code	UNSIGNDE32	Read&write	NO	0x605D0010
02h	Target torque	UNSIGNDE32	Read&write	NO	0x60710010
03h	Contour velocity	UNSIGNDE32	Read&write	NO	0x60810020
04h	Contour acceleration	UNSIGNDE32	Read&write	NO	0x60830020
05h	Contour deceleration	UNSIGNDE32	Read&write	NO	0x60840020

06h	Given output	UNSIGNDE32	Read&write	NO	0x60FE0120
07h	Output shielding	UNSIGNDE32	Read&write	NO	0x60FE0220
08h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
09h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ah		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Bh		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ch		UNSIGNDE32	Read&write	NO	0xFFFFFFFF

Mapping objects

Bits 0-7: length of data

Bits 8-15: sub-index

Bits 16-31: index

0x1603The mapping parameters of RPDO are described in the following table：

Chart 28 RPDO Mapping parameters 0x1603

object type	NO.of sub-index
record	5
0x1603 RPDO 映射参数	

Sub-index	Name	Data type	Character	PDO mapping	Default value
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	5
01h	Return to zero offset	UNSIGNDE32	Read&write	NO	0x607C0020
02h	reset mode	UNSIGNDE32	Read&write	NO	0x60980008
03h	Speed of return to mechanical origin	UNSIGNDE32	Read&write	NO	0x60990120
04h	Speed of return to origin	UNSIGNDE32	Read&write	NO	0x60990220
05h	Acceleration of	UNSIGNDE3	Read&writ	NO	0x609A0020

	return to zero	2	e		
06h		UNSIGNDE3 2	Read&writ e	NO	0xFFFFFFFF
07h		UNSIGNDE3 2	Read&writ e	NO	0xFFFFFFFF
08h		UNSIGNDE3 2	Read&writ e	NO	0xFFFFFFFF
09h		UNSIGNDE3 2	Read&writ e	NO	0xFFFFFFFF
0Ah		UNSIGNDE3 2	Read&writ e	NO	0xFFFFFFFF
0Bh		UNSIGNDE3 2	Read&writ e	NO	0xFFFFFFFF

Mapping objects

Bits 0-7: length of data

Bits 8-15: sub-index

Bits 16-31: index

0x1A00~0x1A03 TPDO Mapping parameters 0~3

0x1A00 TPDO the mapping parameters are described in the following table：

Chart 29 TPDO mapping parameter 0x1A00

object type	NO.of sub-index
Record	3
0x1A00TPDO mapping parameter。	

Sub-index	Name	Data type	character	PDO mapping	Default value
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	9
01h	Status word	UNSIGNDE32	Read&write	NO	0x60410010
02h	Mode code response	UNSIGNDE32	Read&write	NO	0x60610008
03h	Actual location	UNSIGNDE32	Read&write	NO	0x60640020
04h	Probe status	UNSIGNDE32	Read&write	NO	0x60B90010
05h	Rising edge	UNSIGNDE3	Read&writ	NO	0x60BA0020

	value of probe 1	2	e		
06h	Probe 1 falling edge value	UNSIGNDE32	Read&write	NO	0x60BB0020
07h	Rising edge value of probe 2	UNSIGNDE32	Read&write	NO	0x60BC0020
08h	Rising edge value of probe 2	UNSIGNDE32	Read&write	NO	0x60BD0020
09h	Digital input	UNSIGNDE32	Read&write	NO	0x60FD0010
0Ah		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Bh		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ch		UNSIGNDE32	Read&write	NO	0xFFFFFFFF

Mapping objects

Bits 0-7: length of data

Bits 8-15: sub-index

Bits 16-31: index

0x1A01 TPDO The mapping parameters are described in the following table：

Chart30 TPDO mapping parameter 0x1A01

object type	NO.of sub-index
Record	3
0x1A01TPDO mapping parameter。	

Sub-index	Name	Data type	Character	PDO 映射	Default value
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	3
01h	Mode code response	UNSIGNDE32	Read&write	NO	0x60610008
02h	Actual speed	UNSIGNDE32	Read&write	NO	0x606C0020
03h	Actual error value	UNSIGNDE32	Read&write	NO	0x60F40020
04h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
05h		UNSIGNDE3	Read&writ	NO	0xFFFFFFFF

		2	e		
06h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
07h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
08h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
09h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ah		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Bh		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ch		UNSIGNDE32	Read&write	NO	0xFFFFFFFF

Mapping objects

Bits 0-7: length of data

Bits 8-15: sub-index

Bits 16-31: index

0x1A02 TPDO The mapping parameters are described in the following table：

Chart 31 TPDO Mapping parameters 0x1A02

object type	NO.of sub-index
Record	3
0x1A02 TPDO Mapping parameters。	

Sub-index	Name	Data type	Character	PDO mapping	Default value
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	2
01h	Wrong	UNSIGNDE32	Read&write	NO	0x603F0010
02h	Actual torque	UNSIGNDE32	Read&write	NO	0x60770020
03h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
04h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
05h		UNSIGNDE3	Read&writ	NO	0xFFFFFFFF

		2	e		
06h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
07h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
08h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
09h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ah		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Bh		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ch		UNSIGNDE32	Read&write	NO	0xFFFFFFFF

Mapping objects

Bits 0-7: length of data

Bits 8-15: sub-index

Bits 16-31: index

0x1A03 TPDO mapping parameters are described in the following table：

Chart 32 TPDO Mapping parameters 0x1A03

object type	NO.of sub-index
Record	3
0x1A03 TPDO mapping parameter。	

子索引	Name	Data type	属性	PDO 映射	默认值
00h	Number of mapped objects	UNSIGNDE8	Read&write	NO	0
01h	Mapping object	UNSIGNDE32	Read&write	NO	0xFFFFFFFF
02h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
03h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
04h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
05h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
06h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
07h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
08h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
09h		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ah		UNSIGNDE32	Read&write	NO	0xFFFFFFFF

0Bh		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
0Ch		UNSIGNDE32	Read&write	NO	0xFFFFFFFF
Mapping objects Bits 0-7: length of data Bits 8-15: sub-index Bits 16-31: index					

0x1C00 SynchroNOus management channel

The description of the error setting object is shown in the following table：

Chart 145 synchroNOus management channels 0x1C00

0x1C00 SynchroNOus management channel

The description of the error setting object is shown in the following table：

Chart 145 synchroNOus management channels 0x1C00

Object type	Number of sub-indexes
record	4
SynchroNOusly manage channel types	

Index of the child	Name	The data type	attribute	PDO The PDO mapping	The default value
00	Maximum number of subindexes	UNSIGNED8	read-only	NO	4
01	SM0 communication type	UNSIGNED8	read-only	NO	1
02	SM1 communication type	UNSIGNED8	read-only	NO	2
03	SM2 communication type	UNSIGNED8	read-only	NO	3
04	SM3 communication type	UNSIGNED8	read-only	NO	4

0x1C12 SM2distribution

The description of the error setting object is shown in the following table：

Table 146 SM2 assigns 0x1C12

Object type	Number of sub-indexes
Record	4
Sets the object index assigned by RPDO	

Index of the child	Name	The data type	attribute	PDOThe PDO mapping	The default value
00	Maximum number of subindexes	UNSIGNED8	Read and write	NO	1
01	SM2 assignment 1	UNSIGNED16	Read and write	NO	1600h
02	SM2 assignment 2	UNSIGNED16	Read and write	NO	1601h
03	SM2 assignment 3	UNSIGNED16	Read and	NO	1602h

			write		
04	SM2 assignment 4	UNSIGNED16	Read and write	NO	1603h

0x1C13 SM3apportionment

- The description of the error setting object is shown in the following table
- Table 147 SM3 assigns 0x1C13

Object Type	子索引个数 Number of subindexes
Record	4
Sets the object index assigned by TPDO	

subindex	Name	data type	property	PDO maps	default values

00	Maximum number of subindexes	UNSIGNED8	read-write	NO	1
01	SM3 assignment 1	UNSIGNED16	read-write	NO	1A00h
02	SM3 assignment 2	UNSIGNED16	read-write	NO	1A01h
03	SM3 assignment 3	UNSIGNED16	read-write	NO	1A02h
04	SM3 assignment 4	UNSIGNED16	read-write	NO	1A03h

0x1C32 SM2 Parameter:

- The description of the error setting object is shown in the following table

:

- Table 148 SM2 parameter 0x1C32

Object Type	子索引个数 Number of subindexes
Record	4

SynchroNOusly manage channel types

sub-index	Name	data type	property	PDO mapping	default
00	Maximum number of subindexes	UNSIGNED8	read only	NO	3
01	SynchroNOus type	UNSIGNED8		NO	0
02	Cycle Time	UNSIGNED8	read only	NO	0
03	offset time	UNSIGNED8	read only	NO	0

0x1C33 SM3 Data

- The description of the error setting object is shown in the following table

:

- Table 149 SM3 parameter 0x1C33

Object Type	子索引个数 Number of subindexes
Record	4

SynchroNOusly manage channel types

sub-index	Name	data type	property	PDO mapping	default
00	Maximum number of sub-indexes	UNSIGNED8	read only	NO	3
01	SynchroNOus type	UNSIGNED8		NO	0
02	Cycle Time	UNSIGNED8	read only	NO	0
03	offset time	UNSIGNED8	read only	NO	0

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0x6007 interrupt operation

- The description of the error code object is shown in the following table

:

- Table 150 interrupts operation 0x6007

Object type	data type	property	PDO maps	default values
variable	UNSIGNED16	read-write	YES	1
The DSP error code contains the driver's latest alarm signal.				

0x603F error code

- The description of the error code object is shown in the following table

:

- Table 151 DSP error code 0x603F

Object type	data type	property	PDO	default values

			maps	
variable	UNSIGNED16	Read only	YES	0
The error code contains the driver's latest alarm signal 。				
Each bit of the DSP error code indicates an error state (refer to Appendix C for details)。				

0x6040 control word

- The description of the control word is shown in the following table

:

Table 33 Control word 0x6040

Object type	data type	property	PDO maps	default values
variable	UNSIGNED16	read-write	YES	0
Driver the state and motion of the control word.It is used to enable and disable the power output of the driver, start and stop the motor under different operation modes, clear the wrong a larm, etc.				

- Control the bit definition of a word

:

- Table 153 control bit definitions

Byte	Position	definition	description	Operating limits
LSB	0	Start the	0: invalid 1: valid	
	1	Voltage for a given	0: invalid 1: valid	
	2	A quick stop	0: invalid 1: valid	
	3	Energize the motor	0: invalid 1: valid	
	4	Capture the new target location	0→1: acquisition target position, speed, speed, and execution	PP
		Start back to zero	0→1: start back to zero 1: start back to zero 1→0: end back to zero	HM
	5	Update location NOw	0: NOt immediately updated 1: immediately updated	PP
	6	Absolute/relative position	0: absolute position instruction 1: relative position instruction	PP
	7	Fault reset and	0: invalid 1: valid	

		cleanup		
MSB	8	suspended	0: invalid 1: valid, pause according to 605Dh	
	9	keep	keep	
	10	keep	keep	
	11	keep	keep	
	12	keep	keep	
	13	keep	keep	
	14	keep	keep	
	15	keep	keep	

- Control word state switch command

:

- Table 154 control word state switch commands

transfer command	7Bit 7	3Bit 3	2Bit 2	1Bit 1	0Bit 0	Conversion instructions
关机（抱闸）Shutdown (holding brake)	0	X	1	1	0	0x0006
输出电压(解除抱闸)	0	0	1	1	1	0x00 07

Output voltage (unlocking lock)						
Power on enable	0	1	1	1	1	0x000F
Quick stop	0	X	0	1	X	0x0002
Error reset	0->1	X	X	X	X	0x0080

0x6041 Status word

The description of the status word is shown in the table below：

Table 155 status word 0x6041

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0x0040
The status word can only be read, reflecting the current drive status.				

Status word bit definition：

Table 156 Status Word Bit Definition

byte	Bit	Bit definitio	description	Mode limitation

LSB	0	Ready to start	0 : 1 : 0: invalid 1: valid		—
	1	Can start	0: invalid 1: valid		—
	2	Operating status	0: invalid 1: valid		—
	3	Fault state	0: invalid 1: valid		—
	4	Voltage output	0: invalid 1: valid		—
	5	Quick stop	0: invalid 1: valid		—
	6	NOt operational	0: invalid 1: valid		—
	7	caveat	0: invalid 1: valid		—
MSB	8	Keep	Keep		—
	9	remote control	0: invalid 1: valid		—
	10	Goal reached	0: target position NOt reached 1: target position reached		—
			0	When Bit8=0: the target speed is NOt reached	PV
				When Bit8=1: Decelerate	
			1	When Bit8=0: reaching the target speed	
				When Bit8=1: the speed is 0	
		Reach home position	0	When Bit8=0: the target speed is NOt reached	HM

			When Bit8=1: Decelerate	
			1 When Bit8=0: reaching the target speed When Bit8=1: the speed is 0	
11	Internal software limit trigger	0：Neither the position command NOr position feedback exceeds the limit 1：Position command or position feedback overrun		CSP,PP
12	Follow from the station	0：Slave NOt running position command 1：Slave is executing position command		CSP,CSV,PP,PV
	Zero return completed	0: Zero return NOt completed 1: Zero return completed		HM
13	Following error	0: NO excessive position deviation fault 1: Fault due to excessive position deviation		CSP,CSV,PP,PV
	Zero return error	0: NO error occurs when returning to zero 1: Out-of-tolerance fault occurred during zero return		HM

	14	Keep	keep	—
	15	Keep	keep	—

Status word indicates device status：

Table 157 status word indicates device status

Internal state	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Conversion instruction
initialization	X	0	X	X	0	0	0	0	0x0000
loading finished	X	1	X	X	0	0	0	0	0x0040
Ready for operation	X	0	1	X	0	0	0	1	0x0021
Can start	X	0	1	X	0	0	1	1	0x0023
Run enable	X	0	1	X	0	1	1	1	0x0027
Quick stop is effective	X	0	0	X	0	1	1	1	0x0007
Fault operation	X	0	X	X	1	1	1	1	0x000F
Fault state	X	0	X	X	1	0	0	0	0x0008

0x605A Quick stop code

The quick stop code object description is shown in the table below :

0x605A Table 158 Quick Stop Code 0x605A

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0x0002
The quick stop code determines how to stop at the quick stop command. Only modes 1 and 2 are NOw supported.				

Quick stop code	Perform operation
1	Stop at current deceleration
2	Stop at fast stop speed
3…32767	Stop immediately

0x605B Stop code

The description of the stop code object is shown in the following table :

Table 159 Stop code 0x605B

Object	type of data	Attributes	PDO	Defaults

type			mapping	
variable	UNSIGNED16	Only Read	YES	0x0000
Stop code				
This parameter determines the action to be performed when changing the state machine state (OPERATION ENABLE→READY TO SWITCH ON)。				

Stop code	Perform operation
0	Disabled driver
1	Decelerate at the current deceleration rate; disable the drive
2…32767	Keep

0x605C Enable code

The description of the enabled code objects is shown in the following table：

Table 160 enable code 0x605C

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0x0001

Enable code
This parameter determines the action to be performed when changing the state of the state machine (OPERATION ENABLE→SWITCH ON)

stop code	Perform operation
0	Disabled driver
1	Decrease and then disable the drive at the current deceleration
2…32767	Keep

0x605D Pause code

The description of the pause code object is shown in the following table：

0x605D Table 161 Pause Code 0x605D

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0x0001
The pause code determines how to pause when the pause stop command。				

Pause code	Perform operation
1	Pause at current deceleration
2	Pause at fast stop speed
3…32767	Immediate pause

0x605E Error code

The error code object description is shown in the table below：

Table 162 Error code 0x605E

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0x0002
This code determines the action to be taken when the drive is in error。				

Stop code	Perform operation
-32768…-1	Manufacturer parameters
0	Disabled drive, motor rotates freely
1	Decelerate at the current deceleration
2	Decelerate at a quick stop

	3	Deceleration according to current limit	
	4	Deceleration according to voltage limiting	
	5…32767	keep	

0x6060 Operating mode

The operation mode is described in the following table：

Table 163 Operating modes 0x6060

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0
The operation mode is used to select the corresponding sport mode. The device supports three modes such as speed mode, position mode and homing mode。				

Operating mode	action
1	Contour position mode (PP)
3	Contour speed (PV)
4	Profile torque mode (TQ)

	6	Return to zero mode (HM)	
	8	Cycle SynchroNOus Position Mode (CSP)	
	9	Cycle SynchroNOus Speed Mode (CSV)	
	10	Cycle Synchronized Torque Mode (CST)	

0x6061 Mode code response

The mode code response object description is shown in the following table：

Table 164 Mode code response 0x6061

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0
The mode code response indicates the current operating mode. The return value is related to the corresponding mode state (index 6060h).				

0x6063 Internal location

The internal position object description is shown in the table below：

Table 165 internal position 0x6063

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0
This value is determined by one of the two input values for closed-loop position control。				

0x6064 Actual location

The actual location object description is shown in the table below：

0x6064 Table 166 Actual position 0x6064

UNSIGNED32	Only Read	YES	0

0x6065 Following error

The following error objects are described in the following table：

Table 167 following error 0x6065

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0
This value describes the allowable error range between the actual position value and the target position. If the actual position value exceeds the following error, the following error may occur: the drive is blocked, the target speed canNOt be reached or the closed-loop coefficient is wrong. If the value is 2^32-1, the following control will stop.				

0x6066 Error time

The error time object description is shown in the table below：

Table 168 error time 0x6066

UNSIGNED16	Only Read	YES	0

0x6069 Speed sensor value

The speed sensor value object description is shown in the table below：

Table 169 Speed sensor value 0x6069

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0
Speed sensor value describes the true value of the speed sensor				

0x606A Sensor selection

The sensor selection object is described in the following table：

Table 170 Sensor selection 0x606A

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0
The source of the speed sensor value can be determined by the sensor selection code.				

传感器选择代码 Sensor	description

selection code	
0x0000	The actual speed value is derived from the position encoder
0x0001	The actual speed value is derived from the speed encoder
0x0002…0x7FFF	Keep
0x8000…0xFFFF	factory

0x606C Actual speed

The actual speed object description is shown in the table below：

Table 171 Actual speed 0x606C

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0
The current speed represents the size of the speed at the current moment, in r/min unit. e.g.: If the read index 606C value is 100, it means the current speed is 100rpm.				

0x6071 Target torque

The description of the target torque register is shown in the table below：

Table 172 Target torque 0x6071

register	type of data	access permission	Defaults
6071	UNSIGNED16	RW	0
The unit of this value is ‰. If the input value is 500, the target output torque of the motor is set to 500‰ of the rated torque. Value range: 0~1000.			

0x6072 Torque limit

The description of the torque limit register is shown in the table below：

Table 173 Torque limit 0x6072

register	type of data	access permission	Defaults
6072	UNSIGNED16	RW	0
The unit of this value is ‰. If the input value is 500, the motor torque limit is set to 500‰ of the rated torque. Value range: 0~1000.			

0x6073 Maximum current

The maximum current object description is shown in the table below :

Table 174 Maximum current 0x6073

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0x04B0
This value represents the maximum allowable motor torque current. The unit of this value is ‰.				

0x6074 Torque demand

The torque demand objects are described in the following table :

Table 175 Torque demand 0x6074

Object type	type of data	Attributes	PDO mapping	默 Defaults
variable	UNSIGNED16	Only Read	YES	0
This parameter is the output value of the torque limit function. The unit of this				

value is ‰.

0x6075 Motor rated current

The motor rated current object description is shown in the table below：

Table 176 Motor rated current 0x6075

Object type	type of data	Attributes	PDO mapping	Defaults
				0x00001770
The rated current of the motor depends on the motor nameplate and the unit is mA. Depending on the motor and drive technology, this current can be DC, peak, rms current.				

0x6076 Motor rated

variable	UNSIGNED32	Only Read	YES

torque

The description of motor rated torque object is shown in the following table：

Table 177 Motor rated torque 0x6076

Object	type of data	Attributes	PDO	Defaults

type			mapping	
variable	UNSIGNED32	Only Read	YES	0x00001154
The rated torque of the motor depends on the nameplate of the motor, the unit is mNm, but for linear motors, the unit is mN.				

0x6077 Actual torque

The description of the actual torque register is shown in the table below：

Table 178 Actual torque 0x6077

register	type of data	access permission	Defaults
6077	UNSIGNED16	RW	0
The unit of this value is ‰. If the value is 500, the actual torque of the motor is 500‰ of the rated torque.			

0x6078 Actual current

The actual current object description is shown in the table below：

Table 179 actual current 0x6078

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Only Read	YES	0
The actual current value refers to the instantaneous current of the drive motor. The unit of this value is ‰.				

0x607A target location

The target location object description is shown in the table below：

Table 180 target position 0x607A

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0
The target position is the position where the drive should move in the position mode, and the related parameters are the target speed, acceleration and deceleration. The target position is related to different subdivisions, which can be regarded as calculation or related quantity according to bit 6 of the control word.				

0x607B Position change limitation

The description of the limited object of position change is shown in the following table：

Table 181 Position change limit 0x607B

Object type	type of data	Attributes	PDO mapping	Defaults
ARRAY	UNSIGNED8	Only read	YES	2

Position change limit, including 2 sub indexes, minimum position and maximum position. This parameter limits the range of input values.

Subindex	name	type of data	Attributes	PDO mapping	Defaults
00	Maximum number of sub-indexes	UNSIGNED8	Only read	NO	2
01	Minimum position	INTEGER32	Read and write	YES	0xFFFFFF9C
02	Maximum position	INTEGER32	Read and write	YES	0x00000064

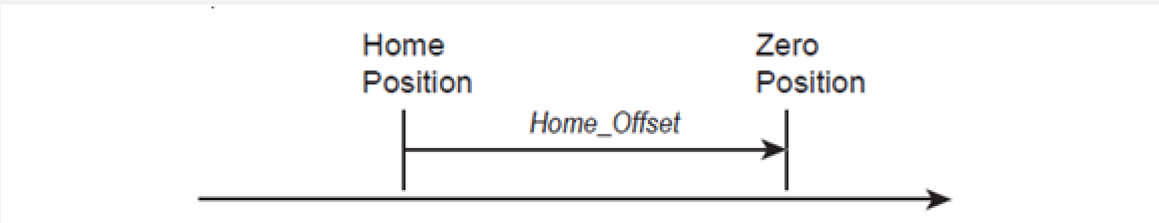
0x607C Zero offset

The zero offset object description is shown in the table below：

Table 182 zero offset 0x607C

Object type	type of data	Attributes	PDO mapping	Defaults	Object type
variable	UNSIGNED32	Only Read	YES	NO	0

Zero offset refers to the offset position of the zero point and the mechanical origin. After finding the mechanical origin, it offsets a certain distance from the mechanical origin to clear all parameters. As shown below:



0x607D Soft position

The description of position soft limit object is shown in the following table：

Table 183 position soft limit 0x607D

Object type	type of data	Attributes	PDO mapping	Defaults

ARRAY	UNSIGNED8	Only read	YES	2

The target position software limit is used to limit the given target position value. When the given target position exceeds the software limit, it will trigger an alarm and stop processing.

Subindex	name	type of data	Attributes	PDO mapping	Defaults
00	Maximum number of sub-indexes	UNSIGNED8		Only read	2
01	Minimum position	INTEGER32		Read and write	0x80000000
02	Maximum position	INTEGER32		Read and write	0x7FFFFFFF

0x607E Polarity selection

The description of polar selection objects is shown in the table below：

Table 184 Polarity selection 0x607E

Object type	type of data	Attributes	PDO mapping	Defaults
ARRAY	UNSIGNED8	Only read	yes	0

Polarity selection is used to control the rotation direction of the position command and speed command when the motor is actually output. At the same time change the selection of positive and negative limit switches. Among them, bit 7 controls the polarity of the position command and bit 6 controls the polarity of the speed command. When the corresponding bit is 1, it is equivalent to the position command value or speed command value * (-1). The feedback position and speed command value have the same polarity as the given value.

0x607F Maximum contour speed

The maximum contour speed object description is shown in the table below ：

Table 185 Maximum contour speed 0x607F

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0x00003840
The maximum contour speed limits the maximum speed of the running path. The unit of this value is the same as the contour speed (0x6081).				

0x6080 Motor speed

The maximum motor speed object description is shown in the table below：

Table 186 Maximum motor speed 0x6080

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only Read	YES	0x00003840
The maximum motor speed limits the speed of the motor in any direction, and its unit is rpm. This parameter is used to protect the motor and can be set according to the motor data sheet.				

0x6081 Contour speed

The outline speed object description is shown in the table below：

Table 187 contour speed 0x6081

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Read andwrite	YES	0
The profile speed is the running speed in PP and PV modes. The maximum				

value of this speed depends on the minimum speed of 0x607F and 0x6080. When the given speed is greater than the maximum value, an alarm will be triggered and the operation will stop. The unit is command/s.

0x6082 Takeoff speed

The description of takeoff speed objects is shown in the table below：

Table 188 take-off speed 0x6082

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Read &write	YES	0
The take-off speed is the speed at which the motor starts directly and will run to the target speed in this speed mode. The unit is command/s.				

0x6083　Contour acceleration

The outline acceleration objects are described in the following table：

Table 189 contour acceleration 0x6083

Object type	type of data	Attributes	PDO mapping	Defaults

variable	UNSIGNED32	Read &write	YES	0
The contour acceleration is the speed acceleration in PP and PV modes. The maximum value of this acceleration depends on the maximum acceleration (0x60C5). When the input acceleration is greater than the maximum acceleration, the input acceleration is limited to the maximum acceleration and a warning is issued. Unit/s2.				

0x6084 Contour deceleration

The deceleration objects are described in the following table：

Table 190 Deceleration 0x6084

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Read &write	YES	0
The contour deceleration is the deceleration in PP and PV modes. The maximum value of this deceleration depends on the maximum deceleration 0x60C6. When the input deceleration is greater than the maximum deceleration, the input deceleration is limited to the maximum deceleration and a warning , The				

unit is the command unit/s2.

0x6085 Quick stop deceleration

The quick stop deceleration objects are described in the following table：

Table 191 Quick stop deceleration 0x6085

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Read &write	YES	0
The quick stop deceleration is the deceleration of the motor when a quick stop is required during the execution of an emergency stop, and its unit is user command/s2.				

0x6086 Movement track type

The description of the motion track type objects is shown in the following table：

Table 192 Motion track type 0x6086

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Read	YES	0

		&write		

The motion track type is used to select the motion track type when the motor performs the action.

value	description
-32768…-1	Manufacturer parameters
0	Linear ramp (trapezoidal trajectory)
1	$\sin^2$ slope
2	Smooth slope
3	Jerk ramp
4…32767	Keep

0x6087 Torque slope

The description of the torque slope register is shown in the table below：

Table 193 Torque slope 0x6087

Register	Type of data	access permission	Defaults
6087	UNSIGNED16	RW	0
The unit of this value is ‰, the parameter describes the rate of change of torque, and the unit is one thousandth of the rated torque per second			

0x6088 Torque change type

The torque change rate object description is shown in the following table：

Table 194 Torque change type 0x6088

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Read &write	YES	0

The torque change type is used to select the type of torque change when the torque change action is performed.

value	description
0x0000	Linear ramp (trapezoidal trajectory)
0x0001	$\sin^2$ slope
0x0002…0x7FFF	Keep
0x8000…0xFFFF	factory

0x608F Encoder resolution

The position encoder resolution object description is shown in the table below：

Table 195 Encoder resolution 0x608F

Object type	Type of data	Attributes	PDO mapping	Defaults
ARRAY	UNSIGNED32	Only read	NO	2

Position encoder resolution is defined as the ratio of encoder resolution to motor resolution.

Subindex	Name	Type of data	Attributes	PDO mapping	Defaults
00	Maximum number of sub-indexes	UNSIGNED8	Read only	NO	2
01	Encoder resolution	UNSIGNED32	Read and write	NO	0x00000FA0
02	Motor resolution	UNSIGNED32	Read and write	NO	0x00000001

0x6091 Gear ratio

The gear ratio objects are described in the table below：

Table 196 Gear ratio 0x6091

Object type	type of data	Attributes	PDO	Defaults

			mapping	
ARRAY	UNSIGNED32	Only read	NO	2

Gear ratio is defined as the ratio of motor resolution to drive subdivision in unit position.

Sub-index	Name	Type of data	Attributes	PDO mapping	Defaults
00	Maximum number of sub-indexes	UNSIGNED8	Read only	NO	2
01	Motor resolution	UNSIGNED32	Read and write	NO	0x00000001
02	Drive segmentation	UNSIGNED32	Read and write	NO	0x00000001

0x6092 Feedback constant

The description of the feedback constant object is shown in the following table：

Table 197 Feedback constant 0x6092

Object type	type of data	Attributes	PDO mapping	Defaults
ARRAY	UNSIGNED32	Only read	NO	2

The feedback constant is the ratio of the feedback amount and drive subdivision within the unit position.

Subindex	Name	type of data	Attributes	PDO mapping	Defaults
00	Maximum number of sub-indexes	UNSIGNED8	Read only	NO	2
01	Amount of feedback	UNSIGNED32	Read and write	NO	0x00000FA0
02	Drive segmentation	UNSIGNED32	Read and write	NO	0x00000001

0x6098 Return to zero

The object description of the zero return mode is shown in the following table：

Table 198 Return to zero mode 0x6098

Object type	type of data	Attributes	PDO mapping	Defaults
variable	INTEGER8	Read and Write	YES	0

The zero return method is that the user selects the corresponding zero return method to perform the zero return according to his own needs.

value	description
-128…-1	factory
0	Do NOt return to zero
1…35	Ways 1 to 35 (see below)
36…127	Keep

0x6099 Return speed

The description of the zero return speed object is shown in the following table：

Table 199 home speed 0x6099

Object type	Subindex	type of data	Attributes	PDO mapping	Defaults
Array	3	UNSIGNED32	Read and write	YES	0
Mechanical origin speed, find the speed of the mechanical origin (limit switch), that is, find the position of the deceleration point. The speed unit is the command unit/s. The zero offset speed is used to find the zero offset speed, and its unit is the command unit/s.					

Subindex	Name	Defaults
0	Maximum number of indexes	2
1	Back to machine origin speed	0
2	Return to zero speed	0

Return to zero acceleration/deceleration

The description of the object of returning to zero acceleration and deceleration is shown in the following table：

Table 200 Return to zero acceleration and deceleration 0x609A

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED16	Read & write	YES	0
The zero return acceleration is the acceleration and deceleration of the slave station motor during zero return, that is, the acceleration and deceleration when it hits the limit.				

0x60B0 Position feedforward

The position feedforward objects are described in the following table：

Table 201 Position feedforward 0x60B0

Object type	type of data	Attributes	PDO mapping	默认值 Defaults
variable	INTEGER32	Read and Write	YES	0
Position feed-forward.				

0x60B1 Speed feed-forward

The speed feed-forward objects are described in the following table：

表 34 速度前馈 0x60B1 Table 202 Speed feedforward 0x60B1

Object type	type of data	Attributes	PDO mapping	Defaults
变量 variable	INTEGER32	读写 Read and Write	YES	0
速度前馈。Speed feed forward.				

0x60B2 Torque feed-forward

The torque feed-forward objects are described in the following table:

Table 203 Torque feedforward 0x60B2

Object type	type of data	Attributes	PDO mapping	Defaults
variable	INTEGER32	Read and Write	YES	0
Torque feedforward.				

0x60B8 Probe function

The probe function object description is shown in the table below：

Table 204 Probe function 0x60B8

Object type	type of data	Attributes	PDO mapping	Defaults
variable	INTEGER16	Read & Write	YES	0
Set probe function				

位 bit	值 value	definition

0	0	Close probe 1
	1	Enable Probe 1
1	0	Trigger the first event
	1	Continuous trigger
3 , 2	00	Probe 1 input trigger
	01	Z phase trigger of position encoder
	10	The probe source is defined by 60D0h-01 (NOt used)
	11	Keep
4	0	Probe 1 does NOt latch on the rising edge
	1	Probe 1 rising edge latch
5	0	Probe 1 falling edge is NOt latched
	1	Probe 1 falling edge latch
6 , 7	-	factory
8	0	Close probe 2
	1	Enable Probe 2
9	0	Trigger the first event
	1	Continuous trigger
11 , 10	00	Probe 1 input trigger
	01	Z phase trigger of position encoder

		10	Probe source is defined by 60D0h-02 (NOt used)	
		11	Keep	
	12	0	Probe 2 does NOt latch on the rising edge	
		1	Probe 2 rising edge latch	
	13	0	Probe 2 falling edge is NOt latched	
		1	Probe 2 falling edge latch	
	14，15	-	factory	

0x60B9 Probe status

The probe status object description is shown in the table below:

Table 205 Probe status 0x60B9

Object type	type of data	Attributes	PDO mapping	Defaults
variable	INTEGER16	读写 Read and Write	YES	0
Probe status.				

位 bit	值 value	定义 definition
0	0	Probe 1 is off
	1	Probe 1 is enabled
1	0	Probe 1 has NO rising edge
	1	Probe 1 has a rising edge
2	0	Probe 1 has NO falling edge
	1	Probe 1 has a falling edge
3-5	0	Keep
6，7	-	factory
8	0	Probe 2 is off
	1	Probe 2 is enabled
9	0	Probe 2 has NO rising edge
	1	Probe 2 has a rising edge
10	0	Probe 2 has NO falling edge
	1	Probe 2 has a falling edge
11-13	0	Keep
14，15	-	factory

0x60BA Probe 1 rising edge value

The probe 1 rising edge value object is described in the following table：

Table 206 Probe 1 Rising Edge Value 0x60BA

Object type	type of data	Attributes	PDO mapping	Defaults
variable	INTEGER32	Read & Write	YES	0
Probe 1 rising edge value.				

0x60BB Probe 1 falling edge value

The probe 1 falling edge value objects are described in the following table：

Table 207 Probe 1 falling edge value 0x60BB

Object type	type of data	Attributes	PDO mapping	默认值 Defaults
variable	INTEGER32	Read and Write	YES	0
Probe 1 falling edge value.				

0x60BC Probe 2 rising edge value

The probe 2 rising edge value object is described in the following table：

Table 208 Probe 2 Rising Edge Value 0x60BC

Object type	type of data	Attributes	PDO mapping	Defaults
variable	INTEGER32	Read &Write	YES	0
Probe 2 rising edge value.				

0x60BD Probe 2 falling edge value

The probe 2 rising edge value object is described in the following table：

Table 209 Probe 2 falling edge value 0x60BD

Object type	type of data	Attributes	PDO mapping	Defaults
variable	INTEGER32	Read & Write	YES	0
Probe 2 falling edge value.				

0x60C2 Interpolation time period

The interpolation time period is described in the following table：

Table 210 Interpolation time period 0x60C2

Object type	type of data	Attributes	PDO mapping	Defaults
ARRAY	UNSIGNED8	Only read	NO	2

The interpolation time period is used for the time-synchronized interpolation position pattern. The unit is 10 to the power of 0080h-02.

Sub-index	name	type of data	Attributes	PDO mapping	Defaults
00	Maximum number of sub-indexes	UNSIGNED8	Read only	NO	2
01	Base of interpolation cycle	UNSIGNED8	Read and write	NO	0x01
02	Interpolation Period Index	INTEGER16	Read and write	NO	0xFD

0x60C5 Acceleration

The maximum acceleration object is described in the following table：

Table 211 Maximum acceleration 0x60C5

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Read and write	YES	0x000186A0
The maximum acceleration is the maximum value of the acceleration in the PP mode, and its unit is the command unit/s2.				

0x60C6 Maximum deceleration

The maximum deceleration object is described in the following table：

Table 212 Maximum deceleration 0x60C6

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Read and write	YES	0x000186A0
The maximum deceleration is the maximum value of the deceleration in PP mode, and its unit is the command unit/s2.				

0x60F4 Actual error value

The actual error value object description is shown in the following table：

Table 213 Actual error value 0x60F4

Object type	type of data	Attributes	PDO PDO mapping	Defaults
variable	UNSIGNED32	Read and write	YES	0
The actual value of the following error.				

0x60FC Internal position reference

The description of the internal position given value object is shown in the following table：

Table 214 Internal position given value 0x60FC

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only read	YES	0
The given value of the internal position.				

0x60FD Digital input

The digital input objects are described in the following table：

Table 215 Digital input 0x60FD

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only read	YES	0

。The index defines the digital input of the device

31 16	15 11	10	9	8 3	2	1	0
factory	keep	Probe 2	Probe 1	keep	Origin switch	Positive limit switch	Negative limit switch

MSB LSB

0x60FE Digital output

The digital output description is shown in the table below：

Table 216 Digital output 0x60FE

Object type	type of data	Attributes	PDO mapping	Defaults

ARRAY	UNSIGNED8	Only read	NO	2

The index defines the digital output of the device.

Sub-index	Name	Type of data	Attributes	PDO PDO mapping	Defaults
00	Maximum number of sub-indexes	UNSIGNED8	Read only	NO	2
01	Output given	UNSIGNED32	Read and write	YES	0x00000000
02	Output shield	UNSIGNED32	Read and write	YES	0x00000000

Sub-index [01] defines the output distribution：

31 … 16	15 … 1	0
factory	keep	Setting the brake

MSB … LSB

Sub-index [02] Select whether to use digital output：

0 – NO output enable；

1 – Output enable；

0x60FF Target speed

The target speed object description is shown in the table below：

Table 217 target speed 0x60FF

Object type	type of data	Attributes	PDO mapping	默认值 Defaults
variable	UNSIGNED32	Only read	YES	0x00000000
The target speed is a given speed command, and its maximum value should NOt be greater than the maximum speed value of the motor. When the given value is greater than the maximum speed value of the motor, an alarm will be triggered and stop.				

0x6502 Support mode

Support mode object description is shown in the following table：

Table 218 Support Mode 0x6502

Object type	type of data	Attributes	PDO mapping	Defaults
variable	UNSIGNED32	Only read	YES	0x000003AD
This object summarizes the operation modes supported by the device.				
31 16 15 7 6 5 4 3 2 1 0				

Factory	keep	IP	HM	Keep	TQ	PV	VL	PP
MSB								LSB

➢ EtherCAT Object dictionary description

The following is the description of the object dictionary of the XML file of the EtherCAT device:

Table 219 EtherCAT object dictionary description

index	Subindex	Object name	Object type	R/W	type of data	PDO	Defaults
1000h	00h	Equipment type	VAR	RO	U16	N	0x00060192
1001h	00h	Error register	VAR	RO	U8	N	0x00
1008h	00h	Device name	VAR	RO	STRING	N	XXXX
1009h	00h	hardware version	VAR	RO	STRING	N	XXXX
100Ah	00h	Software version	VAR	RO	STRING	N	XXXX
1018h	00h	Equipment Identity	RECAORD	RO	U8	N	4
	01h	Manufacturer ID		RO	U32	N	0x66668888
	02h	Product Code		RO	U32	N	XXXX
	03h	version number		RO	U32	N	XXXX

	04h	serial number		RO	U32	N	XXXX
10F1h	00h	Wrong setting	RECORD	RO	U8	N	2
	01h	Error response		RW	U32	N	0x01
	02h	Synchronization error limit		RW	U16	N	4
1600h	00h	RPDO0	RECORD	RW	U8	N	0Bh
	01h	Control word		RW	U32	N	0x60400010
	02h	Operating mode		RW	U32	N	0x60600008
	03h	target location		RW	U32	N	0x607A0020
	04h	Probe function		RW	U32	N	0x60B80010
	05h	Output given		RW	U32	N	0x60FE0120
	06h	Output shield		RW	U32	N	0x60FE0220
	07h			RW	U32	N	0xFFFFFFFF
	08h			RW	U32	N	0xFFFFFFFF
	09h			RW	U32	N	0xFFFFFFFF
	0Ah			RW	U32	N	0xFFFFFFFF
	0Bh			RW	U32	N	0xFFFFFFFF
	0Ch			RW	U32	N	0xFFFFFFFF
1601h	00h	RPDO1	RECORD	RW	U8	N	0Bh
	01h	Control word		RW	U32	N	0x60400010

	02h	Operating mode		RW	U32	N	0x60600008
	03h	Target speed		RW	U32	N	0x60FF0020
	04h	Probe function		RW	U32	N	0x60B80010
	05h	Output given		RW	U32	N	0x60FE0120
	06h	Output shield		RW	U32	N	0x60FE0220
	07h			RW	U32	N	0xFFFFFFFF
	08h			RW	U32	N	0xFFFFFFFF
	09h			RW	U32	N	0xFFFFFFFF
	0Ah			RW	U32	N	0xFFFFFFFF
	0Bh			RW	U32	N	0xFFFFFFFF
	0Ch			RW	U32	N	0xFFFFFFFF
1602h	00h	RPDO2	RECORD	RW	U8	N	0Bh
	01h	Pause code		RW	U32	N	0x605D0010
	02h	Target torque		RW	U32	N	0x60710010
	03h	Contour speed		RW	U32	N	0x60810020
	04h	Contour acceleration		RW	U32	N	0x60830020
	05h	Contour deceleration		RW	U32	N	0x60840020
	06h	Output given		RW	U32	N	0x60FE0120

	07h	Output shield		RW	U32	N	0x60FE0220
	08h			RW	U32	N	0xFFFFFFFF
	09h			RW	U32	N	0xFFFFFFFF
	0Ah			RW	U32	N	0xFFFFFFFF
	0Bh			RW	U32	N	0xFFFFFFFF
	0Ch			RW	U32	N	0xFFFFFFFF
1603h	00h	RPDO3	RECORD	RW	U8	N	0Bh
	01h	Homing offset		RW	U32	N	0x607C0020
	02h	Return to zero		RW	U32	N	0x60980008
	03h	Back to machine origin speed		RW	U32	N	0x60990120
	04h	Return to zero speed		RW	U32	N	0x60990220
	05h	Return to zero acceleration		RW	U32	N	0x609A0020
	06h			RW	U32	N	0xFFFFFFFF
	07h			RW	U32	N	0xFFFFFFFF
	08h			RW	U32	N	0xFFFFFFFF
	09h			RW	U32	N	0xFFFFFFFF
	0Ah			RW	U32	N	0xFFFFFFFF

	0Bh			RW	U32	N	0xFFFFFFFF
1A00h	00h	TPDO0	RECORD	RW	U8	N	0Bh
	01h	Status word		RW	U32	N	0x60410010
	02h	Mode code response		RW	U32	N	0x60610008
	03h	Actual location		RW	U32	N	0x60640020
	04h	Probe status		RW	U32	N	0x60B90010
	05h	Probe 1 rising edge value		RW	U32	N	0x60BA0020
	06h	Probe 1 falling edge value		RW	U32	N	0x60BB0020
	07h	Probe 2 rising edge value		RW	U32	N	0x60BC0020
	08h	Probe 2 falling edge value		RW	U32	N	0x60BD0020
	09h	Digital input		RW	U32	N	0x60FD0010
	0Ah			RW	U32	N	0xFFFFFFFF
	0Bh			RW	U32	N	0xFFFFFFFF
1A01h	00h	TPDO1	RECORD	RW	U8	N	0Bh

	01h	Mode code response		RW	U32	N	0x60610008
	02h	Actual speed		RW	U32	N	0x606C0020
	03h	Actual error value		RW	U32	N	0x60F40020
	04h			RW	U32	N	0xFFFFFFFF
	05h			RW	U32	N	0xFFFFFFFF
	06h			RW	U32	N	0xFFFFFFFF
	07h			RW	U32	N	0xFFFFFFFF
	08h			RW	U32	N	0xFFFFFFFF
	09h			RW	U32	N	0xFFFFFFFF
	0Ah			RW	U32	N	0xFFFFFFFF
	0Bh			RW	U32	N	0xFFFFFFFF
1A02h	00h	TPDO2	RECORD	RW	U8	N	0Bh
	01h	error code		RW	U32	N	0x603F0010
	02h	Actual torque		RW	U32	N	0x60770020
	03h			RW	U32	N	0xFFFFFFFF
	04h			RW	U32	N	0xFFFFFFFF
	05h			RW	U32	N	0xFFFFFFFF
	06h			RW	U32	N	0xFFFFFFFF

	07h			RW	U32	N	0xFFFFFFFF
	08h			RW	U32	N	0xFFFFFFFF
	09h			RW	U32	N	0xFFFFFFFF
	0Ah			RW	U32	N	0xFFFFFFFF
	0Bh			RW	U32	N	0xFFFFFFFF
1A03h	00h	TPDO3	RECORD	RW	U8	N	0Bh
	01h			RW	U32	N	0xFFFFFFFF
	02h			RW	U32	N	0xFFFFFFFF
	03h			RW	U32	N	0xFFFFFFFF
	04h			RW	U32	N	0xFFFFFFFF
	05h			RW	U32	N	0xFFFFFFFF
	06h			RW	U32	N	0xFFFFFFFF
	07h			RW	U32	N	0xFFFFFFFF
	08h			RW	U32	N	0xFFFFFFFF
	09h			RW	U32	N	0xFFFFFFFF
	0Ah			RW	U32	N	0xFFFFFFFF
	0Bh			RW	U32	N	0xFFFFFFFF
1C00h	00h	SynchroNOus management channel	RECORD	RO	U8	N	4

	01h	SM0 communication type		RO	U8	N	1
	02h	SM1 communication type		RO	U8	N	2
	03h	SM2 communication type		RO	U8	N	3
	04h	SM3 communication type		RO	U8	N	4
1C12h	00h	SM2 distribution	RECORD	RW	U8	N	1
	01h	SM2 allocation 1		RW	U16	N	1600h
	02h	SM2 allocation 2		RW	U16	N	1601h
	03h	SM2 allocation 3		RW	U16	N	1602h
	04h	SM2 distribution 4		RW	U16	N	1603h
1C13h	00h	SM3 distribution	RECORD	RW	U8	N	1
	01h	SM3 allocation 1		RW	U16	N	1A00h

	02h	SM3 allocation 2		RW	U16	N	1A01h
	03h	SM3 allocation 3		RW	U16	N	1A02h
	04h	SM3 allocation 4		RW	U16	N	1A03h
1C32h	00h	SM2 parameters	RECORD	RO	U8	N	3
	01h	Synchronization type			U16	N	0
	02h	period time		RO	U32	N	0
	03h	Offset time		RO	U32	N	0
1C33h	00h	SM3 parameters	RECORD	RO	U8	N	3
	01h	Synchronization type			U16	N	0
	02h	period time		RO	U32	N	0
	03h	Offset time		RO	U32	N	0
6007h	00h	Interrupt operation	VAR	RW	U16	Y	0x0001
603Fh	00h	error code	VAR	RO	U16	Y	0x0000
6040h	00h	Control word	VAR	RW	U16	Y	0x0000
6041h	00h	Status word	VAR	RO	U16	Y	0x0040
605Ah	00h	Quick stop code	VAR	RW	I16	Y	0x0002
605Bh	00h	Stop code	VAR	RW	I16	Y	0x0000

605Ch	00h	Enable code	VAR	RW	I16	Y	0x0001
605Dh	00h	Pause code	VAR	RW	I16	Y	0x0001
605Eh	00h	error code	VAR	RW	I16	Y	0x0002
6060h	00h	Operating mode	VAR	RW	I8	Y	0x00
6061h	00h	Current operating mode	VAR	R0	I8	Y	0x00
6063h	00h	Internal location	VAR	RO	I32	Y	0x00000000
6064h	00h	Actual location	VAR	RO	I32	Y	0x00000000
6065h	00h	Following error	VAR	RW	U32	Y	0x00000FA0
6066h	00h	Error time	VAR	RW	U16	Y	0x0001
6069h	00h	Speed sensor value	VAR	RW	I32	Y	0x00000000
606Ah	00h	Sensor selection	VAR	RW	I16	Y	0x0000
606Ch	00h	Actual speed	VAR	RO	I32	Y	0x00000000
6071h	00h	Target torque	VAR	RW	I16	Y	0x0000
6072h	00h	Torque	VAR	RW	U16	Y	0x05DC
6073h	00h	Maximum current	VAR	RW	U16	Y	0x04B0
6074h	00h	Torque demand	VAR	R0	U16	Y	0x0000

6075h	00h	Motor rated current	VAR	RW	U32	Y	0x00001770
6076h	00h	Motor rated torque	VAR	RW	U32	Y	0x00001154
6077h	00h	Actual torque	VAR	RO	I16	Y	0x0000
6078h	00h	Actual current	VAR	RO	I16	Y	0x0000
607Ah	00h	target location	VAR	RW	I32	Y	0x00000000
607Bh	00h	Position change limitation	ARRAY	RO	U8	N	2
	01h	Minimum position change		RW	I32	Y	0XFFFFFF9C
	02h	Maximum position change		RW	I32	Y	0x00000064
607Ch	00h	Zero offset	VAR	RW	I32	Y	0x00000000
607Dh	00h	Soft position	ARRAY	RO	U8	N	2
	01h	Minimum position		RW	I32	Y	0X80000000
	02h	Maximum position		RW	I32	Y	0x7FFFFFFF

607Eh	00h	Polarity selection	VAR	RW	U8	Y	0x00
607Fh	00h	Maximum contour speed	VAR	RW	U32	Y	0x00003840
6080h	00h	Motor speed	VAR	RW	U32	Y	0x00003840
6081h	00h	Contour speed	VAR	RW	U32	Y	0x00000960
6082h	00h	Takeoff speed	VAR	RW	U32	Y	0x00000000
6083h	00h	Contour acceleration	VAR	RW	U32	Y	0x00000000
6084h	00h	Contour deceleration	VAR	RW	U32	Y	0x00000000
6085h	00h	Quick stop deceleration	VAR	RW	U32	Y	0x00000000
6086h	00h	Movement track type	VAR	RW	I16	Y	0x0000
6087h	00h	Torque change rate	VAR	RW	U32	Y	0x00000000
6088h	00h	Torque change type	VAR	RW	I16	Y	0x0000

608Fh	00h	Encoder resolution	ARRAY	RO	U8	N	2
	01h	Encoder resolution			U32	N	0X00000FA0
	02h	Motor resolution			U32	N	0x00000001
6091h	00h	Gear ratio	ARRAY	RO	U8	N	2
	01h	Motor resolution			U32	N	0X00000001
	02h	Drive segmentation			U32	N	0x00000001
6092h	00h	Feedback constant	ARRAY	RO	U8	N	2
	01h	Amount of feedback			U32	N	0X00000FA0
	02h	Drive segmentation			U32	N	0x00000001
6098h	00h	Return to zero	VAR	RW	I8	Y	0x00
6099h	00h	Return speed	ARRAR	RO	U8	N	2
	01h	Mechanical origin speed		RW	U32	Y	0x00000000

	02h	Zero offset speed		RW	U32	Y	0x00000050
609Ah	00h	Return to zero acceleration	VAR	RW	U32	Y	0x00000000
60B0h	00h	Position feedforward	VAR	RW	I32	Y	0x00000000
60B1h	00h	Speed feedforward	VAR	RW	I32	Y	0x00000000
60B2h	00h	Torque feedforward	VAR	RW	I32	Y	0x00000000
60B8h	00h	Probe function	VAR	RW	U16	Y	0x0000
60B9h	00h	Probe status	VAR	RO	U16	Y	0x0000
60BAh	00h	Probe 1 rising edge value	VAR	RW	I32	Y	0x00000000
60BBh	00h	Probe 1 falling edge value	VAR	RW	I32	Y	0x00000000
60BCh	00h	Probe 2 rising edge value	VAR	RW	I32	Y	0x00000000
60BDh	00h	Probe 1 falling edge value	VAR	RW	I32	Y	0x00000000

60C2h	00h	Interpolation time period	ARRAR	RO	U8	N	2
	01h	Base of interpolation cycle		RW	U8	Y	0x01
	02h	Interpolation Period Index		RW	I8	Y	0xFD
60C5h	00h	Acceleration	VAR	RW	U32	Y	0x000186A0
60C6h	00h	Maximum deceleration	VAR	RW	U32	Y	0x000186A0
60F4h	00h	Actual error value	VAR	RO	I32	Y	0x00000000
60FCh	00h	Internal position reference	VAR	RO	I32	Y	0x00000000
60FDh	00h	Digital input	VAR	RO	U32	Y	0x00000000
60FEh	00h	Digital output	ARRAR	RO	U8	N	2
	01h	Output given		RW	U32	Y	0x00000000
	02h	Output shield		RW	U32	Y	0x00000000
60FFh	00h	Target speed	VAR	RW	I32	Y	0x00000000
6502h	00h	Support mode	VAR	RO	U32	Y	0x000003AD

The above list only lists the object dictionaries used by this series of EtherCAT devices. Users who want to learn more about the object dictionaries can read the ETG documents. Users can download them from the following address: www.ethercat.org.

Control articles

Motion control under EtherCAT communication protocol

The CIA402 protocol standard provides a standard motion control standard for servo drives. Jiemeikang EtherCAT slave supports cycle synchronized position mode (CSP), cycle synchronized speed mode (CSV), cycle synchronized torque mode (CST), contour position Mode (PP), contour speed mode (PV), contour torque mode (PT) and homing mode (HM).

The above several trajectory modes are supported differently in different types of drives. The master station selects by operating the control mode object dictionary 6060h.

Periodic synchroNOus position mode

In the periodic synchroNOus position mode, the master station master completes the position command trajectory planning, and then sends the planned target position 607Ah to the slave driver in a periodic manner. Its position, speed, and torque are completed by the driver.

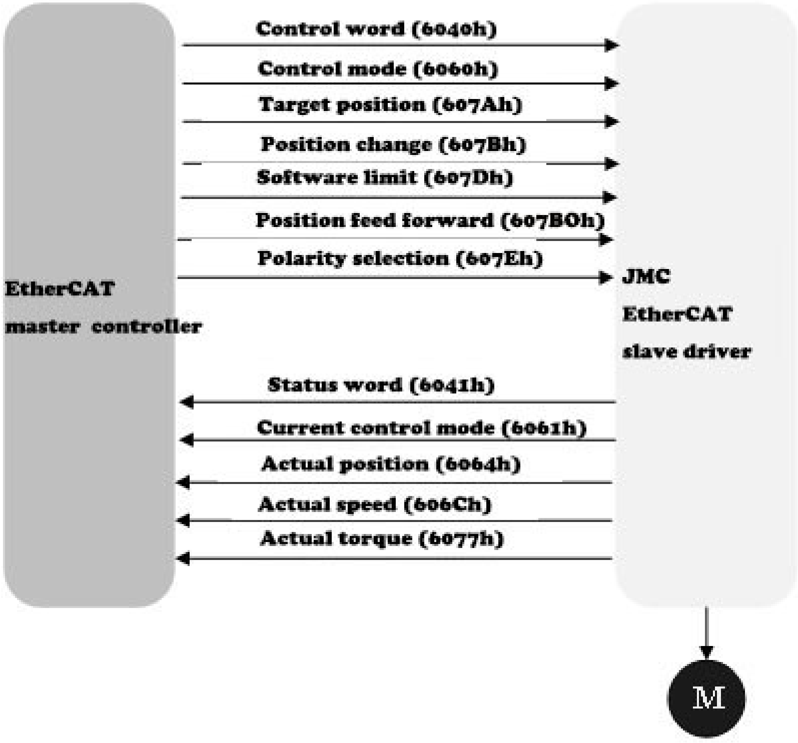


Figure 157 Cycle synchronization position mode control diagram

The motor running speed 606Ch is determined by the given target position 607Ah and the actual position 6064h, and is also related to the electronic gear ratio.

1 Related Object Dictionary Introduction

Table 220 Control word 6040h

index	subindex	Object name	Object name	R/W	type of data	PDO	Defaults
6040h	00h	Control word	VAR	RW	U16	Y	0x0000

Table 221 Control word 6040h bit definition in CSP mode

bit	Bit definition	description
0	start up	0: invalid 1: valid
1	Voltage given	0: invalid 1: valid
2	Quick stop	0: valid 1: invalid
3	Motor power-on enable	0: invalid 1: valid
7	Fault reset clear	0: invalid 1: valid
8	time out	0: invalid 1: valid, pause according to 605Dh setting

Table 222 status word 6041h

index	Subindex	Object name	Object name	R/W	type of data	PDO	Defaults
6041h	00h	Status word	VAR	RO	U16	Y	0x0040

Table 222 Status word 6041h

Bit	Bit definition	Description
10	Goal reached	0: The target position is NOt reached

		1: The target position is reached
11	Internal software limit trigger	0: Neither the position command NOr position feedback exceeds the limit 1: Position command or position feedback overrun
12	Follow from the station	0: Slave NOt running position command 1: Slave is executing position command
13	Following error	0: NO excessive position deviation fault 1: Fault due to excessive position deviation

Table 224 Control mode 6060h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6060h	00h	Control mode	VAR	RW	I8	Y	0x00

Control mode 6060h is used to set the current trajectory mode. In CSP mode, the object dictionary is set to 8.

Table 225 Current control mode 6061h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults

6060h	00h	Control mode	VAR	RO	I8	Y	0x00

The current control mode 6061h is used to display the current track mode. In the CSP mode, the object dictionary setting read value is 8.

Table 226 Target position 607Ah

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
607Ah	00h	target location	VAR	RW	I32	Y	0x00000000

The target position is the value of the absolute position of the slave station given by the master station of the upper computer every synchronization cycle. The slave station follows the absolute position according to the current position, and the unit is the user given instruction.

Table 227 Position change range 607Bh

Index	Subindex	Object name	Object name	R/W	type of data	PDO	Defaults
607Bh	00h	Position change	ARRAY	RO	U8	N	2

		limitation					
	01h	Minimum position change		RW	I32	Y	0XFFFFFF9C
	02h	Maximum position change		RW	I32	Y	0x00000064

The position change range is mainly used to limit the master station trajectory planning to a given position. When the given position is valid within the limit range, a warning will be generated if it exceeds the range. And execute the value within the limited range.

Table 228 Target position software limit 607Dh

Index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
607Dh	00h	Soft limit	ARRAY	RO	U8	N	2
	01h	Minimum position		RW	I32	Y	0X80000000
	02h	Maximum position		RW	I32	Y	0x7FFFFFFF

The target position software limit is used to limit the given target position value. When the given target position exceeds the software limit, it will trigger an alarm and stop processing.

Table 229 Polarity selection 607Eh

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
607Eh	00h	Polarity selection	VAR	RW	U8	Y	0x00

Polarity selection is used to control the rotation direction of the position command and speed command when the motor is actually output. At the same time change the selection of positive and negative limit switches. Among them, bit 7 controls the polarity of the position command and bit 6 controls the polarity of the speed command. When the corresponding bit is 1, it is equivalent to the position command value or speed command value * (-1). The feedback position and speed command value have the same polarity as the given value.

Table 230 Actual position 6064h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6064h	00h	Actual location	VAR	RO	I32	Y	0x00000000

Feedback the current motor position, the feedback unit is the user command unit.

Table 231 Actual speed 606Ch

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
606Ch	00h	Actual speed	VAR	RO	I32	Y	0x00000000

The actual speed feeds back the current motor running speed, and its unit is the command unit/s.

Table 232 Actual torque 6077h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6077h	00h	Actual torque	VAR	RO	I16	Y	0x0000

The actual torque reflects the current torque as a percentage of the rated torque, and the unit is% constant torque output.

Table 233 Maximum motor speed 6080h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6080h	00h	Motor speed	VAR	RW	U32	Y	0x00003840

。The maximum speed of the motor is the characteristic of the motor. When the drive motor reaches this speed after setting, an alarm will be triggered and run at the maximum motor speed.

Table 234 Position feedforward 60B0h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6080h	00h	Motor speed	VAR	RW	U32	Y	0x00003840

Position feed-forward is periodic position compensation. When the position feedforward is NOt 0, the given final position is the sum of 607Ah and 60B0h, and the unit is the user command unit.

2 Recommended configuration of PDO mapping

In the CSP cycle synchronization position mode, PDO mapping is recommended to be configured as follows：

Table 235 PDO mapping recommended configuration-CSP

RPDO	TPDO	Remarks
6040h： Control word	6041h： Status word	required
607Ah： target location	6064h：Actual location	required
6060h： Mode selection	6061h： Current mode display	Optional
60FEh-01h： Digital output	60FDh： Digital input	Optional

3 Application process

Step 1: Check the wiring, including whether the power cord, motor power cord, encoder cord, and communication cord are connected properly, and then power on after confirming that they are correct.

Step 2: When the power is turned on without any error alarm, the slave will switch from the initial state to the pre-operation state.

Step 3: Configure the drive operating parameters (synchronization cycle, electronic gear ratio, polarity selection, current and other parameters) and PDO mapping parameters. After the configuration is completed, the slave state machine will be switched to the operating parameters.

Step 4: In the case of NO abNormality in the previous step, switch the 402 state machine to the running enable state, that is, give the control word 6040h = 000Fh. Under Normal operation, the status word 6041h will be switched to 0027h.

Step 5: Configure the motor operating parameters in CSP mode, such as: operating mode 6060h = 8;

Step 6: The master station of the upper computer calculates the periodic absolute target position 607Ah, and the slave station executes the operation.

Cycle synchronization speed mode (CSV)

In periodic synchroNOus speed mode, the master station of the host computer periodically sends the calculated target speed 60FFh to the slave station, and the slave station internally converts it into the calculation speed of the motor according to the target speed value. And feedback to the master station slave station status information.

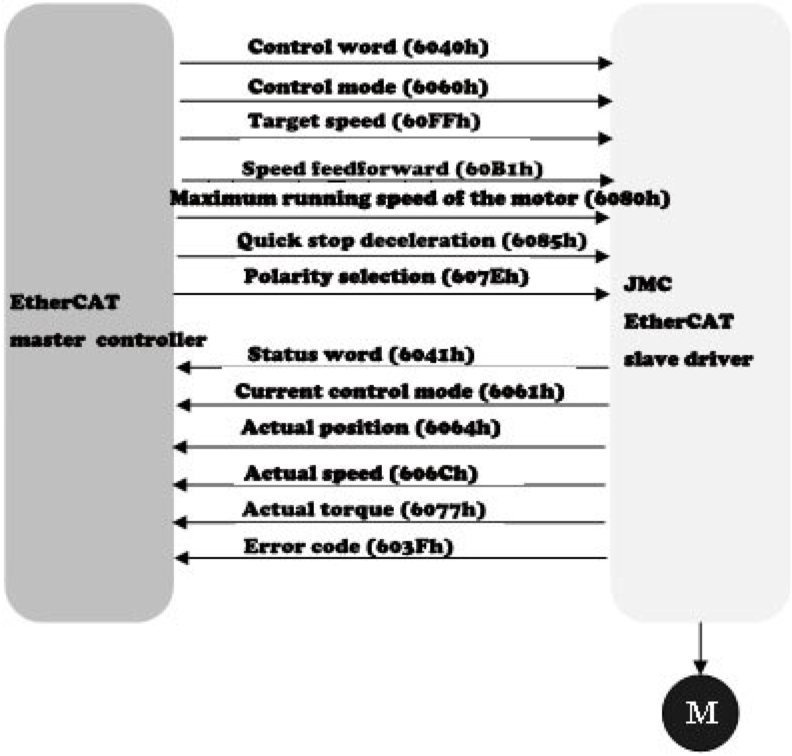


Figure 158 control chart of periodic synchroNOus speed mode

1 Related Object Dictionary Introduction

Table 236 Control word 6040h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6040h	00h	Control word	VAR	RW	U16	Y	0x0000

Bit definition of control word 6040h in CSV mode

Bit	Bit definition	Description
0	start up	0: invalid 1: valid
1	Voltage given	0: invalid 1: valid
2	Quick stop	0: valid 1: invalid
3	Motor power-on enable	0: invalid 1: valid
7	Fault reset clear	0: invalid 1: valid
8	time out	0: invalid 1: valid, pause according to 605Dh setting

Table 238 Status word 6041h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6041h	00h	Status word	VAR	RO	U16	Y	0x0040

Table 239 Bit definition of status word 6041h in CSV mode

Bit	Bit definition	Description
10	Goal reached	0: The target position is NOt reached
12	Follow from the	1: The target position is reached

	station	
13	Following error	0: Slave NOt running position command

Table 240 Control mode 6060h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6060h	00h	Control mode	VAR	RW	I8	Y	0x00

Control mode 6060h is used to set the current track mode. In CSV mode, the object dictionary is set to 9.

Table 241 Current control mode 6061h

index	Sub-index	Object name	对象类型 Object name	R/W	数据类型 type of data	PDO	默认值 Defaults
6061h	00h	Current control mode	VAR	RO	I8	Y	0x00

The current control mode 6061h is used to display the current track mode. In the CSV mode, the object dictionary setting read value is 9.

Table 242 Maximum motor speed 6080h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6080h	00h	Motor speed	VAR	RW	U32	Y	0x00003840

The maximum motor speed is the motor operating characteristics, and its unit is revolutions per minute (RPM). When the given speed is greater than the maximum speed of the motor, it will trigger an alarm and stop running.

Table 243 Quick stop deceleration 6085h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6085h	00h	Quick stop deceleration	VAR	RW	U32	Y	0x00000000

The quick stop deceleration is the deceleration of the motor when a quick stop is required during the execution of an emergency stop, and its unit is user command/s2.

Table 244 Speed feedforward 60B1h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
60B1h	00h	Speed feed-forward	VAR	RW	I32	Y	0x00000000

The speed feed-forward is periodic speed compensation. When the speed feedforward is NOt 0, the given final speed is the sum of 60ffh and 60b1h, and the unit is the user instruction unit / s.

Table 35 Target speed

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
60FFh	00h	Target speed	VAR	RW	I32	Y	0x00000000

The target speed is a given speed command, and its maximum value should NOt be greater than the maximum speed value of the motor. When the given value is greater than the maximum speed value of the motor, an alarm will be triggered and stop.

2 Recommended configuration of PDO mapping

In CSV cycle synchroNOus speed mode, the recommended configuration of PDO mapping is as follows

表 36 PDO 映射建议配置-CSV

Table 246 Recommended PDO mapping configuration-CSV

RPDO	TPDO	Remarks
6040h： Control word	6041h：Status word	required
60FFh： Target speed		required

60B1h: Speed feedforward	6064h：Actual location	Optional
6060h： Mode selection	606Ch： Actual speed	Optional
60FEh-01h：Digital output	6061h：Current mode display	Optional
	60FDh：Digital input	Optional

3 Application process

Step 1: Check the wiring, including whether the power cord, motor power cord, encoder cord, and communication cord are connected properly, and then power on after confirming that they are correct.

Step 2: When the power is turned on without any error alarm, the slave will switch from the initial state to the pre-operation state.

Step 3: Configure the drive operating parameters (synchronization cycle, electronic gear ratio, polarity selection, current and other parameters) and PDO mapping parameters. After the configuration is completed, the slave state machine will be switched to the operating parameters

Step 4: In the case of NO abNormality in the previous step, switch the 402 state machine to the running enable state, that is, give the control word 6040h = 000Fh. Under Normal operation, the status word 6041h will be switched to 0027h.

Step 5: Configure the motor operating parameters in CSV mode, such as: operating mode

6060h = 9;

Step 6: The master station of the host computer calculates the periodic target speed of 60FFh, and the slave station executes the operation.

Contour position mode (PP)

This mode is mainly used for point-to-point trajectory application. The master station of the host computer gives the target position (relative or absolute), target speed, acceleration, deceleration and other parameters. The slave station will generate and execute trajectory planning and execution according to these parameters, and output the status to the master. station.

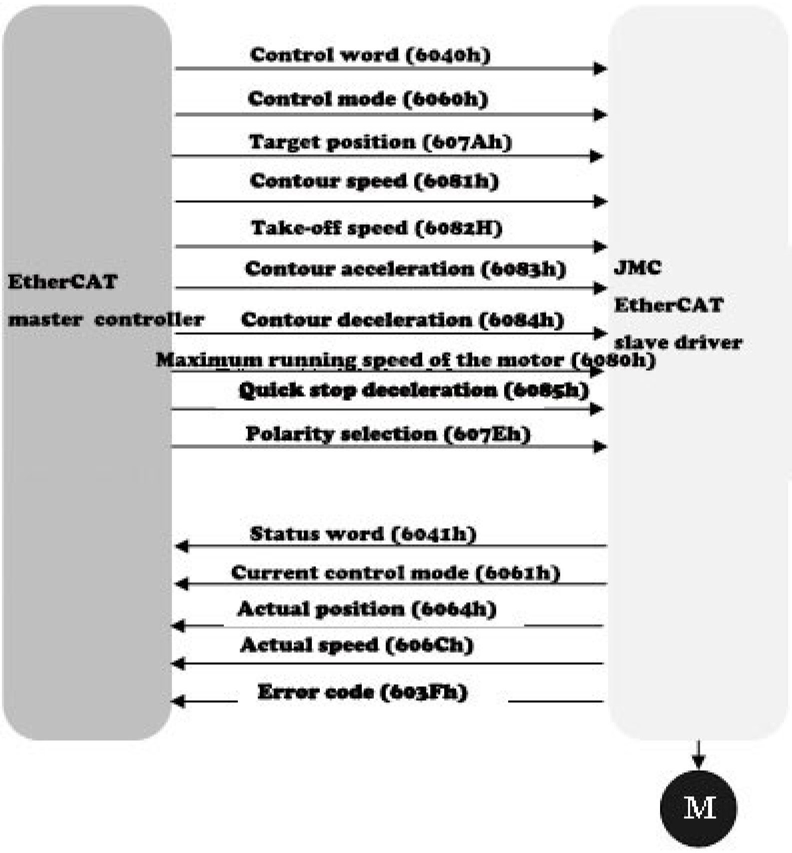


Figure 159 Contour position mode control chart

1 Related Object Dictionary Introduction

Table 247 Control word 6040h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6040h	00h	Control word	VAR	RW	U16	Y	0x0000

Table 248 Bit definition of control word 6040h in PP mode

bit	bit definition	Description
0	start up	0: invalid 1: valid
1	Voltage given	0: invalid 1: valid
2	Quick stop	0: valid 1: invalid
3	Motor power-on enable	0: invalid 1: valid
4	Collect new target location	0→1: The rising edge will collect the target position, speed, acceleration and deceleration, and execute
5	Update location NOw	0: NOn-immediate update 1: immediate update
6	Absolute	0: absolute position command 1: relative position

	position/relative position	command
7	Fault reset clear	0: invalid 1: valid
8	time out	0: invalid 1: valid, pause according to 605Dh setting

Table 249 Status word 6041h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6041h	00h	Status word	VAR	RO	U16	Y	0x0040

Table 250 Bit definition of status word 6041h in PP mode

bit	bit definition	Description
10	Goal reached	0: The target position is NOt reached 1: The target position is reached
11	Internal software limit trigger	0: Neither the position command NOr position feedback exceeds the limit 1: Position command or position feedback overrun

12	Target location update	0: The target position can be updated 1: The target location canNOt be updated
13	Following error	0: NO excessive position deviation fault 1: Fault due to excessive position deviation

6060h Table 251 Control mode 6060h

index	sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6060h	00h	Control mode	VAR	RW	I8	Y	0x00

Control mode 6060h is used to set the current trajectory mode. In PP mode, the object dictionary is set to 1.

6061h Table 252 Current control mode 6061h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6061h	00h	Current control mode	VAR	RO	I8	Y	0x00

The current control mode 6061h is used to display the current track mode. In PP mode, the object dictionary setting read value is 1.

Table 253 Target position 607Ah

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
607Ah	00h	target location	VAR	RW	I32	Y	0x00000000

The target position is the value of the absolute position of the slave station given by the master station of the upper computer every synchronization cycle. The slave station follows the absolute position according to the current position, and the unit is the user given instruction.

Table 254 Contour speed 6081h

index	sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6081h	00h	Contour speed	VAR	RW	U32	Y	0x00000960

Profile speed is the speed of running in PP mode. The maximum value of this speed depends on the minimum speed of 607Fh and 6080h. When the given speed is greater than the maximum value, an alarm will be triggered and the operation will stop. The unit is command/s.

Table 255 Takeoff speed 6082h

Index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6082h	00h	Takeoff speed	VAR	RW	U32	Y	0x00000000

The take-off speed is the speed at which the motor starts directly and will run to the target speed in this speed mode. The unit is command/s.

Table 256 Contour acceleration 6083h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6083h	00h	Contour acceleration	VAR	RW	U32	Y	0x00000000

The contour acceleration is the speed acceleration in PP and PV modes. The maximum value of this acceleration depends on the maximum acceleration 60C5h. When the input acceleration is greater than the maximum acceleration, the input acceleration is limited to the maximum acceleration and a warning is issued. s2.

Table 257 profile deceleration 6084h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults

6084h	00h	Contour deceleration	VAR	RW	U32	Y	0x00000000

The contour deceleration is the deceleration running in PP and PV modes. The maximum value of the deceleration depends on the maximum deceleration of 60c6h. When the input deceleration is greater than the maximum deceleration degree, the input deceleration is limited to the maximum deceleration, and a warning is issued, with the unit of instruction unit / S2.

Table 258 Maximum acceleration table 60C5h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
60C5h	00h	Acceleration	VAR	RW	U32	Y	0x000186A0

The maximum acceleration is the maximum value of the acceleration in the PP mode, and its unit is the command unit/s2.

Table 259 Maximum deceleration 60C6h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
60C6h	00h	Maximum deceleration	VAR	RW	U32	Y	0x000186A0

The maximum deceleration is the maximum value of the deceleration in PP mode, and its unit is the command unit/s2.

2 PP Pattern trajectory curve

In the PP mode, the slave station has 4 trajectory modes. Under the control word bit 5, bit 6, bit 9 three different control word combinations will produce different running tracks, the track running is as follows：

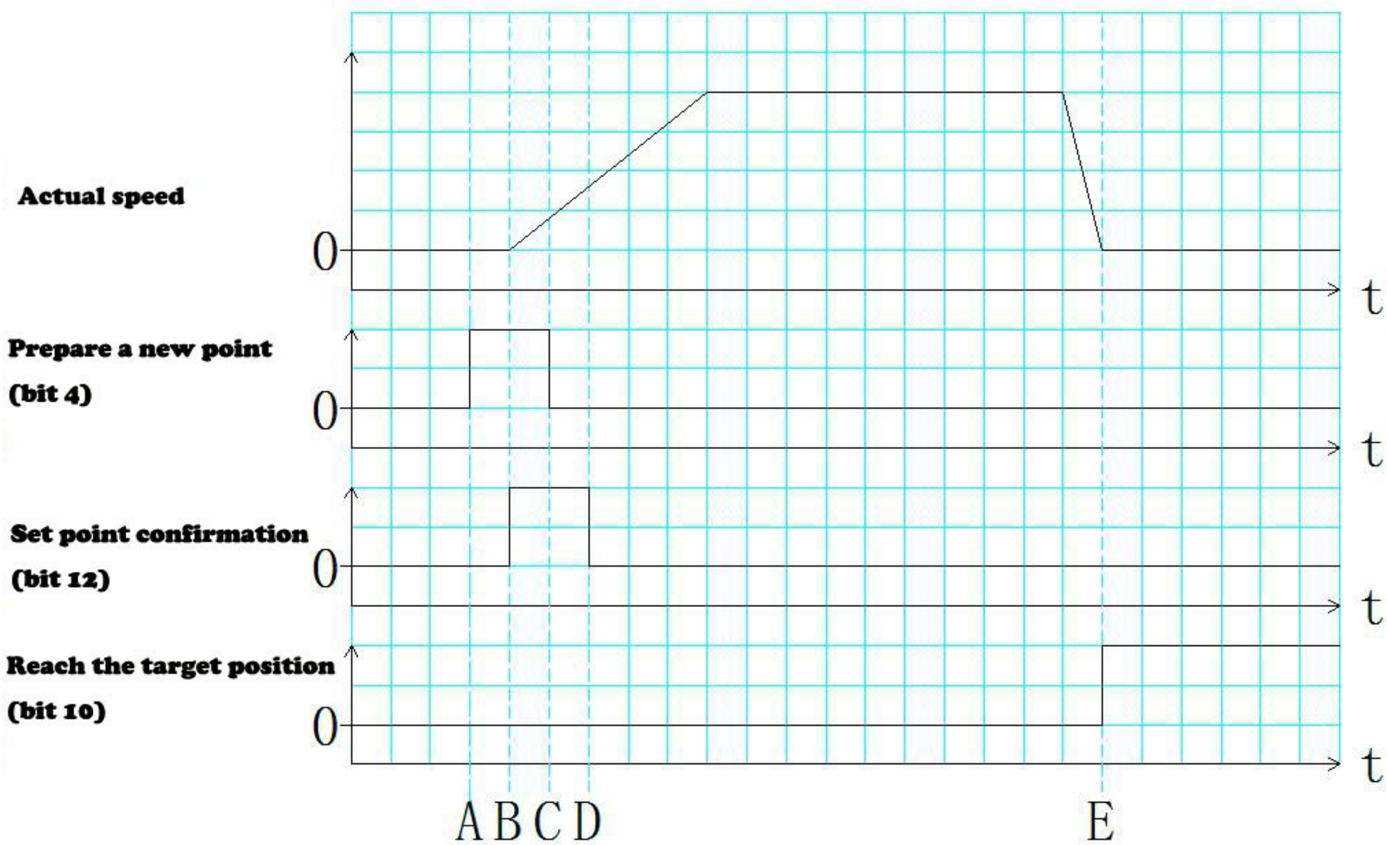


Figure 160 Single point motion

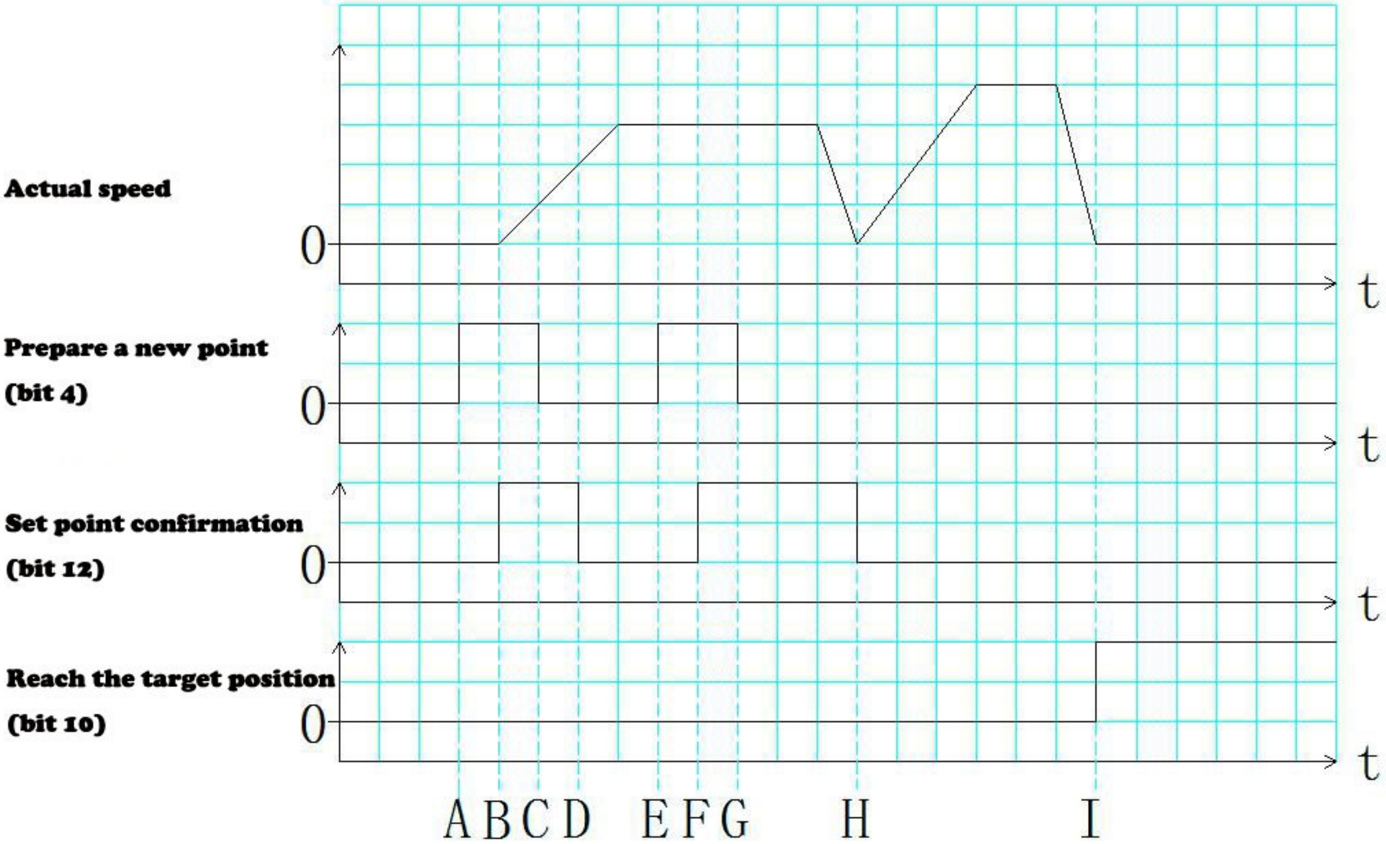


Figure 161 Multi-point motion, stop between positions

In this way, the 9th and 5th bits of the control word are both 0, and the motor will stop during two runs.

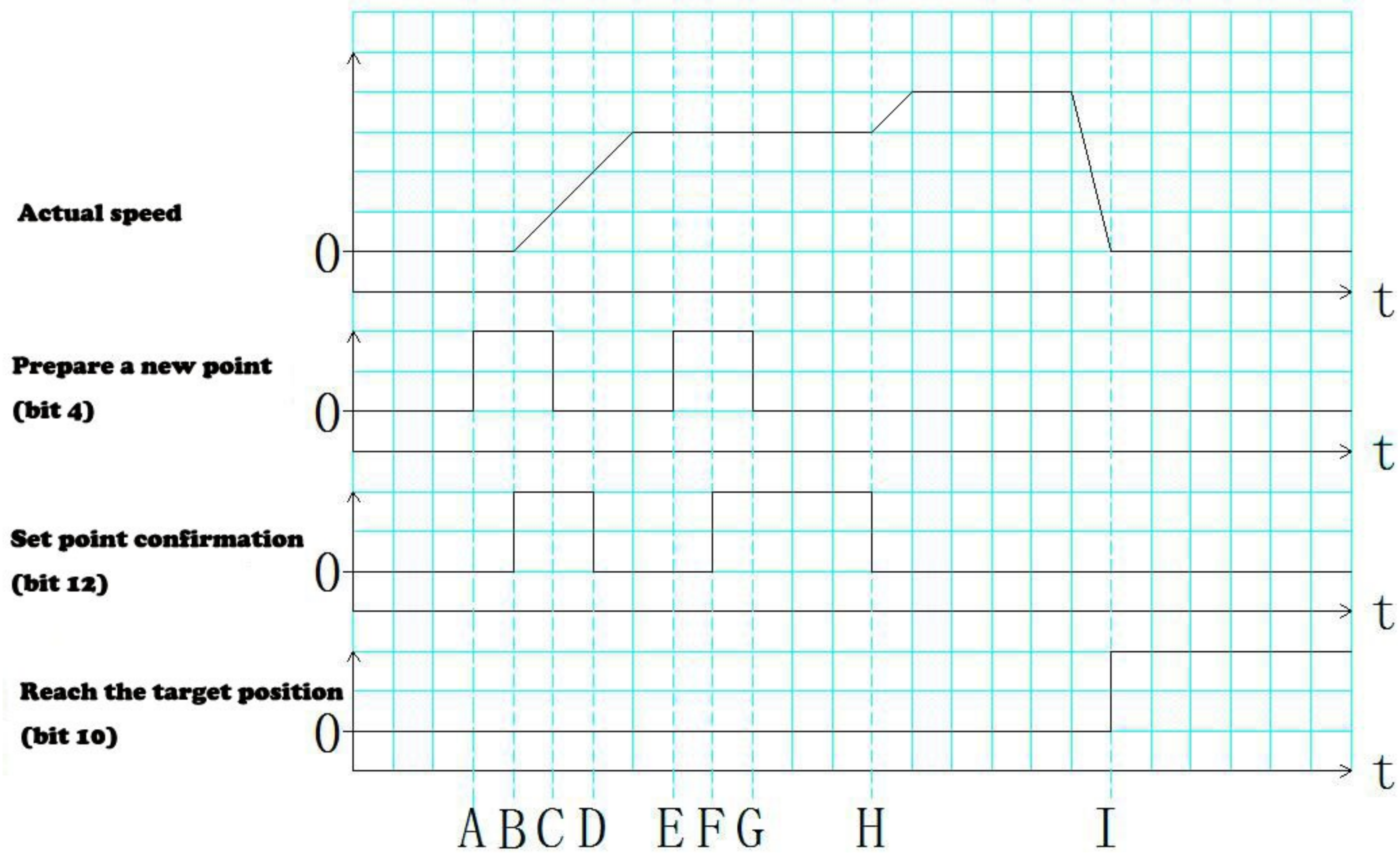


Fig. 162 Multi-point movement without stopping between points

In this way, the 9th bit of the control word is 1, and the 5th bit is 0. The motor runs at the speed of the first point at a constant speed before reaching the first point, and the The motor runs at a speed of several points, during which the motor will NOt stop.

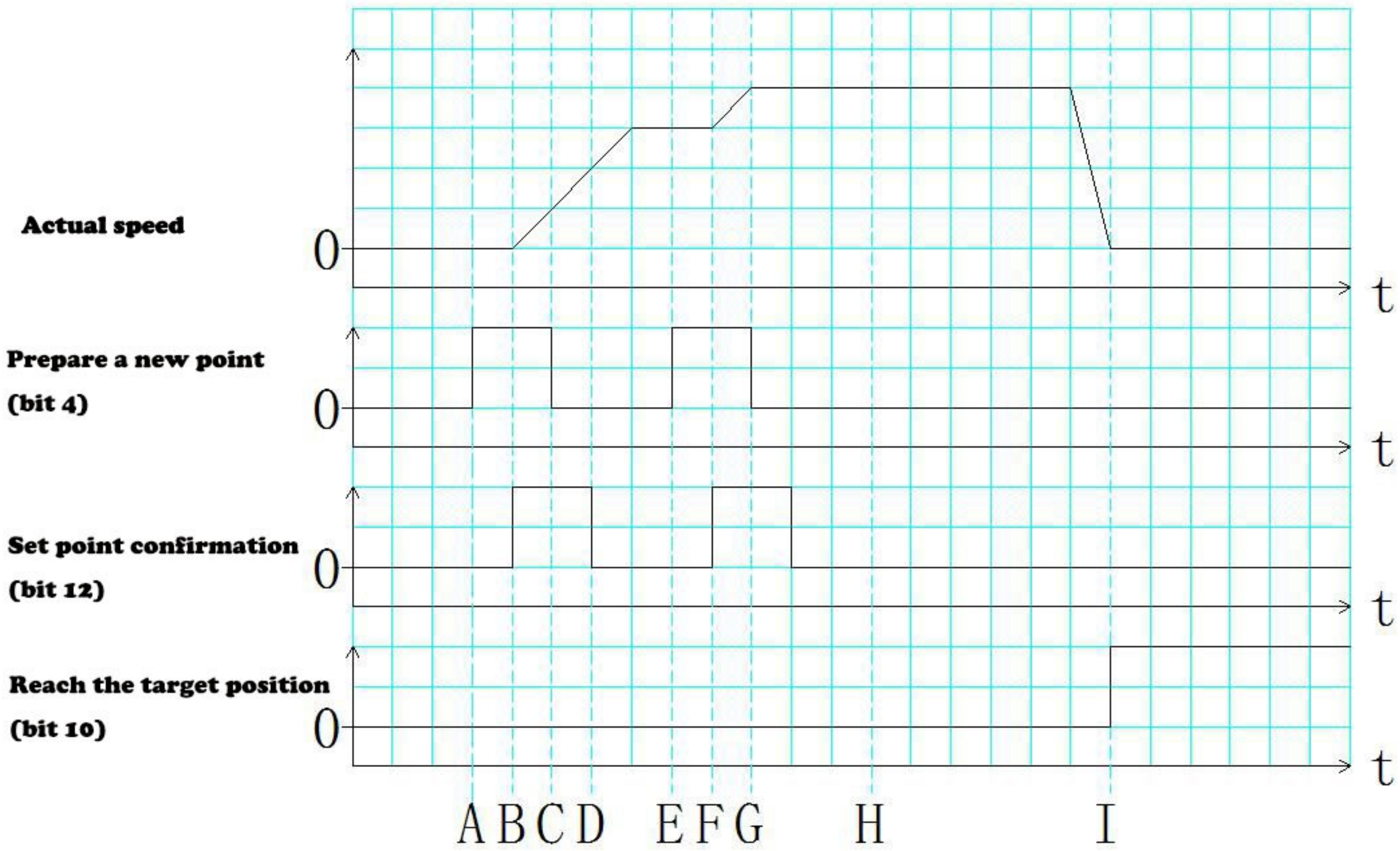


Figure 163 Multi-point motion, after setting the second point, switch directly to the speed of the second point

In this way, the 9th position of the control word is set to 1, and the 5th bit is also set to 1, the motor will directly switch to the second point movement speed, but will NOt complete the first point movement. The running speed of the motor is continuous motion.

3 Recommended configuration of PDO mapping

In PP contour position mode, the recommended configuration for PDO mapping is as follows：

Table 260 Recommended PDO mapping configuration-PP

RPDO	TPDO	Remarks
6040h： Control word	6041h： Status word	required
607Ah：target location		required
6081h: Target speed		required
6083h: Target acceleration		required
6084h: Target deceleration		required
6082h: Takeoff speed	6064h： Actual location	Optional
6060h： Mode selection	606Ch： Actual speed	Optional
60FEh-01h：Digital output	6061h ： Current mode display	Optional
	60FDh：Digital input	Optional

4 Application process

Step 1: Check the wiring, including whether the power cord, motor power cord, encoder cord, and communication cord are connected properly, and then power on after confirming that they are correct.

Step 2: When the power is turned on without any error alarm, the slave will switch from the initial state to the pre-operation state.

Step 3: Configure the drive operating parameters (synchronization cycle, electronic gear ratio, polarity selection, current and other parameters) and PDO mapping parameters. After the configuration is completed, the slave state machine will be switched to the operating parameters.

Step 4: In the case of NO abNormality in the previous step, switch the 402 state machine to the running enable state, that is, give the control word 6040h = 000Fh. Under Normal operation, the status word 6041h will be switched to 0027h.

Step 5: Configure the motor operating parameters in PP mode, such as: operating mode 6060h = 1, target position 607Ah, contour speed 6081h, acceleration 6083h, deceleration 6084h.

Step 6: Send the position acquisition command of control word 6040h, and the slave station executes the operation.

Contour speed mode (PV)

The contour speed mode is mainly used in speed control occasions. The master station of the host computer sets the target speed, acceleration and deceleration.

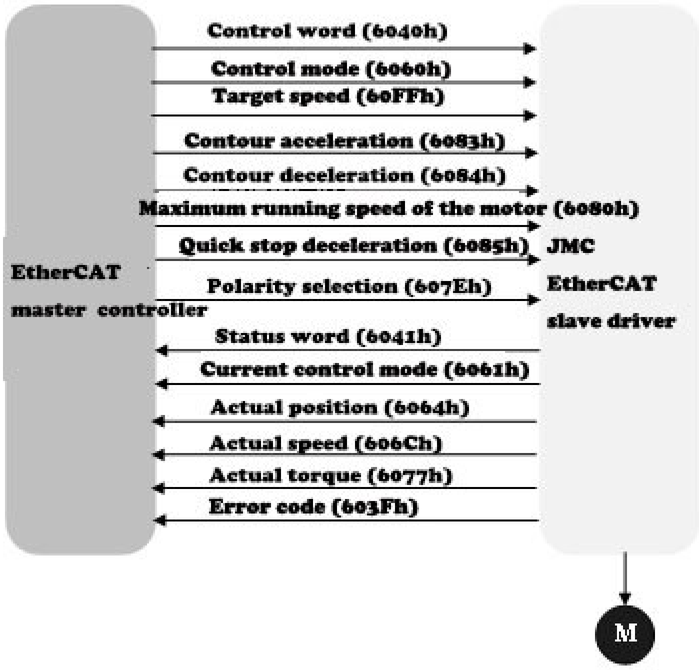


Figure 164 Contour speed mode control diagram

1 Related Object Dictionary Introduction

Table 261 Control word 6040h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6040h	00h	Control word	VAR	RW	U16	Y	0x0000

Table 262 Control word 6040h bit definition in PV mode

位 bit	Bit definition	Description
0	start up	0: invalid 1: valid

1	Voltage given	0: invalid 1: valid
2	Quick stop	0: valid 1: invalid
3	Motor power-on enable	0: invalid 1: valid
7	Fault reset clear	0: invalid 1: valid
8	time out	0: invalid 1: valid, pause according to 605Dh setting

Table 263 Status word 6041h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6041h	00h	Status word	VAR	RO	U16	Y	0x0040

Table 264 Bit definition of status word 6041h in PV mode

bit	位 Bit definition	Description	
10	Goal reached	0	When Bit8=0: the target speed is NOt reached
			When Bit8=1: Decelerate
		1	When Bit8=0: reaching the target speed

			0 When Bit8=1: the speed is 0
12	Follow from the station	0 0: Slave NOt running position command	
		1: Slave is executing position command	
13	Following error	NO excessive position deviation fault	
		1: Fault due to excessive position deviation	

Table 265 Control mode 6060h

Index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6060h	00h	Control mode	VAR	RW	I8	Y	0x00

Control mode 6060h is used to set the current track mode. In PV mode, the object dictionary is set to 3.

Table 266 Current control mode 6061h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6061h	00h	Current control mode	VAR	RO	I8	Y	0x00

The current control mode 6061h is used to display the current track mode. In PV mode, the object dictionary setting read value is 3.

Table 267 Target speed 60FFh

index	Sub-index	Object name	Object name	R/W	Type of data	PDO	Defaults
60FFh	00h	Target speed	VAR	RW	I32	Y	0x00000000

The target speed is the target value that controls the running speed of the motor. After a given running command, the motor will accelerate or decelerate to the target speed according to acceleration and deceleration. The maximum value of this speed value depends on the minimum value of 607Fh and 6080h. When the target speed exceeds the maximum running speed, it will run at the maximum speed and give an alarm. The unit is command/s.

Table 268 Contour acceleration 6083h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6083h	00h	Contour acceleration	VAR	RW	U32	Y	0x00000000

The contour acceleration is the speed acceleration in PP and PV modes. The maximum value of this acceleration depends on the maximum acceleration 60C5h. When the input acceleration is greater than the maximum acceleration, the input acceleration is limited to the maximum acceleration and a warning is issued. s2.

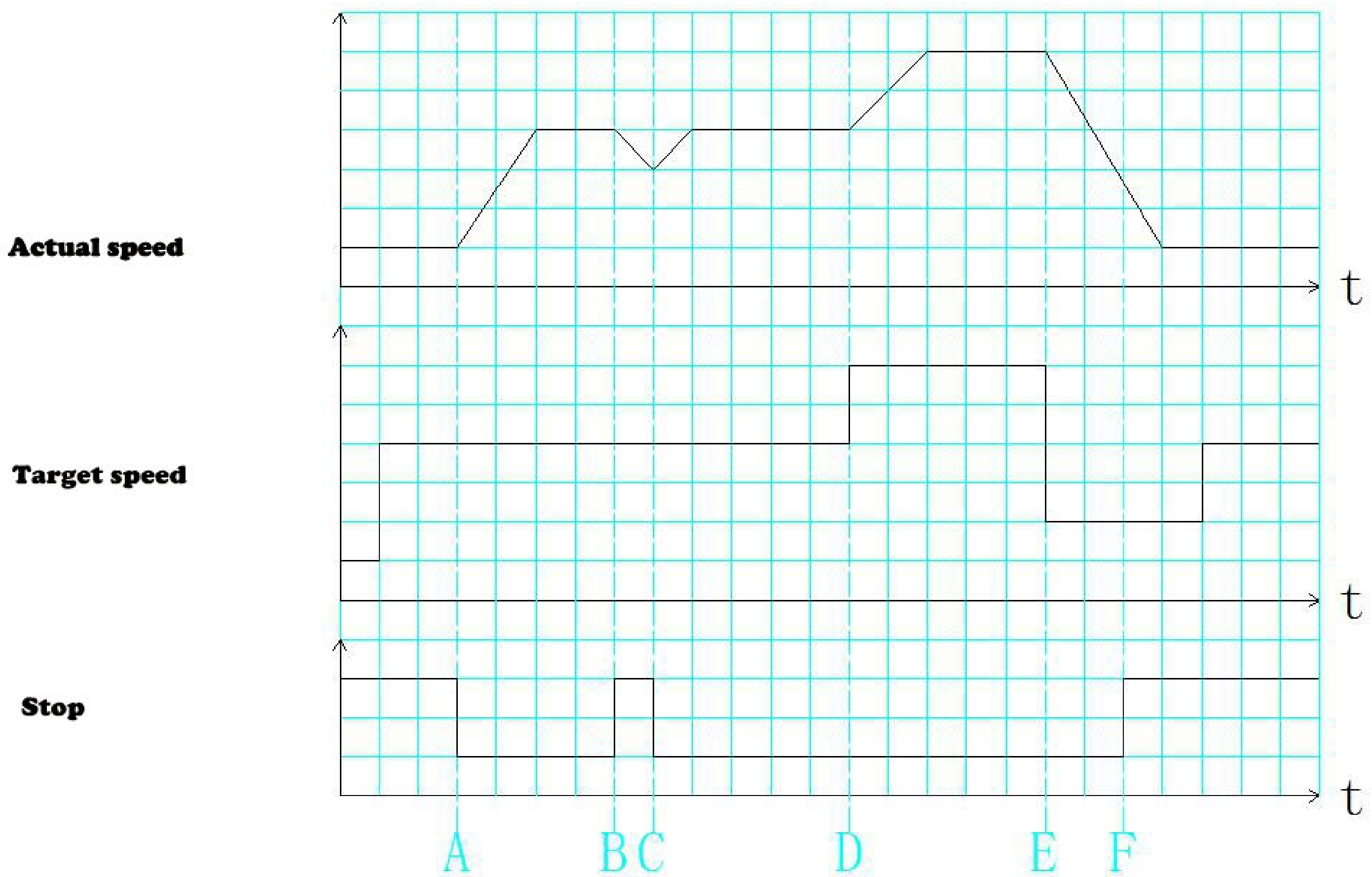
Table 269 Contour deceleration 6084h

index	Sub-index	Object name	Object name	R/W	type of data	PDO	Defaults
6084h	00h	Contour deceleration	VAR	RW	U32	Y	0x00000000

The contour deceleration is the speed deceleration in PP and PV modes. The maximum value of this deceleration depends on the maximum deceleration 60C6h. When the input deceleration is greater than the maximum deceleration, the input deceleration is limited to the maximum deceleration and issued Warning, the unit is command unit/s2.

2 PV Mode trajectory curve

In PV mode, after the target speed, acceleration and deceleration are given, the operation is adjusted in real time according to the given speed value



3 Recommended configuration of PDO mapping

In PV profile velocity mode, the recommended configuration of PDO mapping is as follows:

RPDO	TPDO	Remark
6040h：control word	6041h：Status word	required
60FFh: target speed		required

6083h: Target acceleration		required
6084h: Target deceleration		required
607Fh: Maximum contour velocity	6064h：Actual location	required
6060h：Mode selection	606Ch：Actual speed	required
60FEh-01h：Digital output	6061h：Current mode display	required
	60FDh：Digital input	required

4 application process

Step 1: check the wiring, including power line, motor power line, encoder line and communication line, and power on after confirmation.
Step 2: switch the slave station from initialization state to pre operation state without any error alarm when power on.
Step 3: configure the driver operation parameters (synchronization period, electronic gear ratio, polarity selection, current and other parameters) and PDO mapping parameters, and switch the slave state machine to the operation parameters after the configuration is completed
Step 4: if there is NO abNormality in the previous step, the 402 state machine is switched to the operation enabled state, that is, the control word 6040h = 010fh. Under Normal operation, the status word 6041h will be switched to 0127h.
Step 5: configure the motor operating parameters in PV mode, such as: operation mode 6060h = 3, target speed 60ffh, acceleration 6083h, deceleration 6084h.
Step 6: send the start instruction of control word 6040h = 000fh, and the slave station will execute the operation.

Return to zero mode（HM）

JMC EtherCAT slave station supports the zero-back mode defined by the CiA402 protocol. Users need to set the zero-back mode, zero-back acceleration, zero-back speed, zero-shift speed, zero-shift and other parameters.When the return to zero is completed, the current position will automatically be 0, and the motion position will be run with this point as the reference

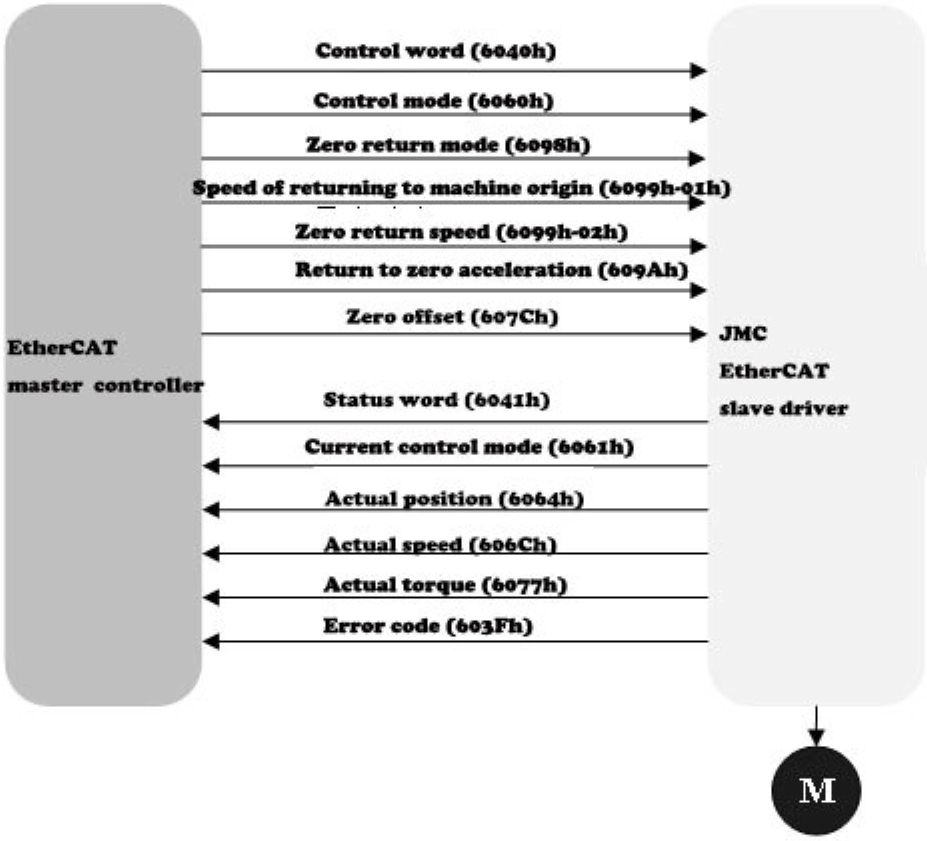


Figure 165 control chart of return to zero mode1

1. **Introduction to the related object dictionary**

Chart 37 Control word 6040h

Index	sub-index	Object name	Object Type	R/W	data type	PDO	default
6040h	00h	control word	VAR	RW	U16	Y	0x0000

Chart 38 Definition of control word 6040h bit in HM mode

Bit	Definition of bit	Description
0	Start	0：Invalid 1：Valid
1	Voltage setting	0：Invalid 1：Valid
2	Quick stop	0：Invalid 1：Valid
3	Motor power on enable	0：Invalid 1：Valid
4	Start return to zero	0→1:Start return to zero 1：Go back to zero 1→0:Return to zero at the end
7	Fault reset clear	0：Invalid 1：Valid
8	Pause	0：Invalid 1：Valid, pause according to 605dh setting

Chart 39 state word 6041h

Index	Sub-index	Object name	Object type	R/W	Data type	PDO	Default value
6041h	00h	Sate word	VAR	RO	U16	Y	0x0040

Chart 273 definition of status word 6041h bit in HM mode

Bit	Bit definition	Description

10	Return to zero position	0	Bit8=0:Return to zero position NOt reached
			Bit8=1:Slow down
		1	Bit8=0:Return to zero position
			Bit8=1:Speed is 0
12	Zero return complete	0：Homing incomplete 1：Homing complete	
13	Return to zero error	0：Zero return without error 1：Over tolerance fault occurred in the process of returning to zero	

Chart 40 control mode 6060h

Index	Sub-index	Object name	Object type	R/W	Data type	PDO	Default value
6060h	00h	Operation mode	VAR	RW	I8	Y	0x00

Control mode 6060h is used to set the current trajectory mode. In HM mode, the object dictionary is set to 6.

Chart 41 Current control mode 6061h

Index	Sub-index	Object name	Object type	R/W	Data type	PDO	Default value
6061h	00h	Operation mode	VAR	RO	I8	Y	0x00

The current control mode 6061h is used to display the current trajectory mode. In HM mode, the read value of the object dictionary is set to 6.

Chart 42 Return to zero offset 607Ch

Index	Sub-index	Object name	Object type	R/W	Data type	PDO	Default value
607Ch	00h	Return to zero acceleration		RW	I32	Y	0x00000000

Return to zero offset is applicable to offset a certain distance after the return to zero mode is completed, and take this point as the zero position. The unit is user instruction.

Chart 43 Return to zero mode 6098h

Index	Sub-index	Object name	Object type	R/W	Data type	PDO	Default value
6098h	00h	Mode of return to zero	VAR	RW	I8	Y	0x00

The return to zero method is that the user selects the corresponding return to zero method according to his own needs.

Chart 44 Speed of return to zero 6099h

Index	Sub-index	Object name	Object type	R/W	Data type	PDO	Default value

6099h	00h	Speed of return to zero	ARRAR	RO	U8	N	2
	01h	Mechanical origin velocity		RW	U32	Y	0x00000000
	02h	Zero offset velocity		RW	U32	Y	0x00000050

Mechanical origin speed, find the speed of mechanical origin (limit switch), that is to find the position of deceleration point. The unit of speed is command unit / s. The zero offset speed is used to find the offset speed of zero position, and its unit is instruction unit / s.

Chart 45 Return to zero acceleration 609Ah

Index	Sub-index	Object name	Object type	R/W	Data type	PDO	Default value
609Ah	00h	Return to zero acceleration	VAR	RW	U32	Y	0x00000000

The return to zero acceleration is the acceleration and deceleration speed of the slave motor in the return to zero, that is, the acceleration and deceleration speed when it reaches the limit.

2 HM Mode trajectory curve

In cia402 protocol, there are 36 kinds of return to zero modes, each of which has a different trajectory curve. Users can choose the return to zero mode by setting the return to zero mode for 6098h according to their own needs.

2.1 Return to zero mode 1

When 6098h = 1, zero return mode 1 is selected :

The CW direction end of CCW direction limit is taken as the reference point, and the first Z signal in CW direction is taken as the zero point.

The motor first moves to the CCW direction at the speed of 6099h-01h returning to the mechanical origin. When the CCW direction limit is effectively activated, it decelerates and stops according to 609ah deceleration, and then reverses to CW direction. When it leaves the CCW direction limit, the first Z signal is the zero point return.

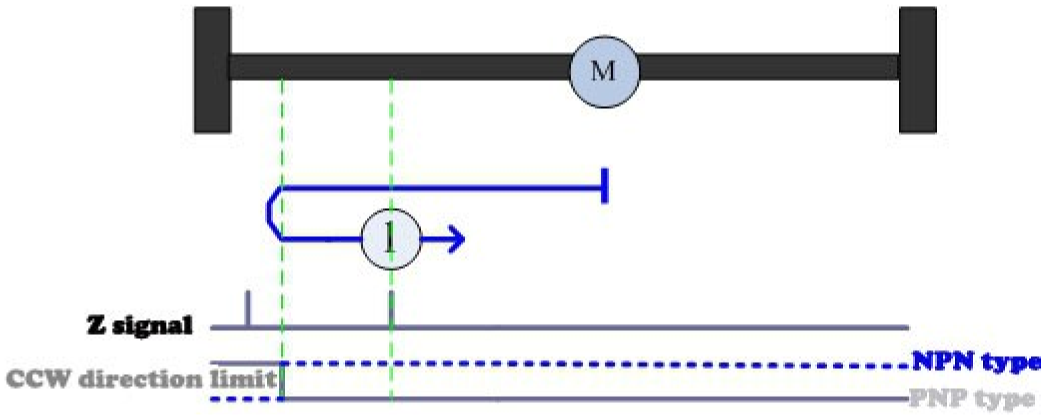


Fig. 166 schematic diagram of jemecon EtherCAT slave station return to zero mode 1

2.2 Return to zero mode 2

When 6098h = 2, zero return mode 2 is selected The CCW direction end of the limit in CW direction is taken as the reference point, and the first Z signal in CCW direction is taken as the zero point. The motor first moves towards CW direction at the speed of 6099h-01h returning to the mechanical origin. When the CW direction limit is effectively activated, it will decelerate and stop at 609ah deceleration, and then move in the CCW direction in reverse direction. When leaving the CW direction limit, the first Z signal is the zero point return.

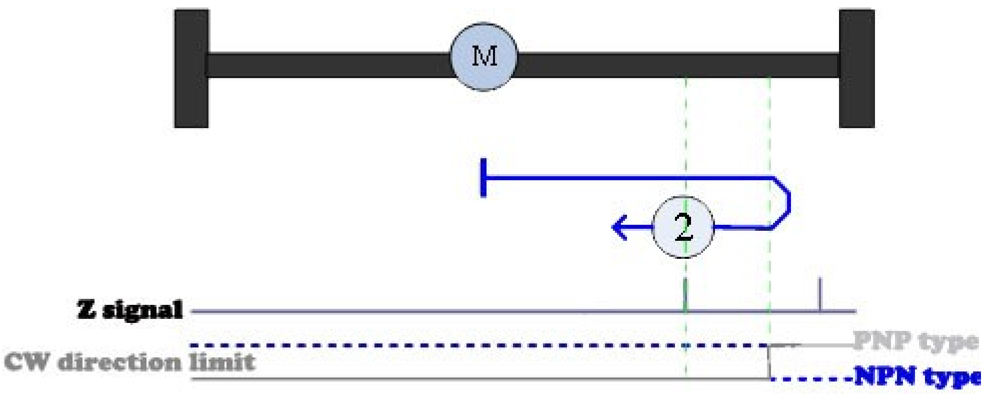


Figure 167 schematic diagram of jemecon EtherCAT slave station return to zero mode II

2.3 Return to zero mode 3

When 6098h = 3, zero return mode 3 is selected

The CCW direction end of HS limit is taken as the reference point, and the first Z signal in CCW direction is taken as the zero point.

The starting position is at the CCW direction side of HS limit: the motor first moves to CW direction at the speed of 6099h-01h returning to the mechanical origin. When the HS limit is effectively activated, it decelerates and stops at 609ah deceleration, and then reverses to CCW direction. After leaving the HS limit, the first Z signal is the zero return point;

The starting position is on the HS limit: the motor runs at a low speed in the CCW direction. When the motor leaves the HS limit, the first Z signal will return to zero;

The starting position is at the CW direction side of HS limit: the motor first moves to CW direction at the speed of 6099h-01h back to the mechanical origin, and when it encounters the CW direction limit, it reverses to the CCW direction. After touching the HS limit, it continues to run in the CCW direction. After leaving the HS limit, the first Z signal is the zero point.

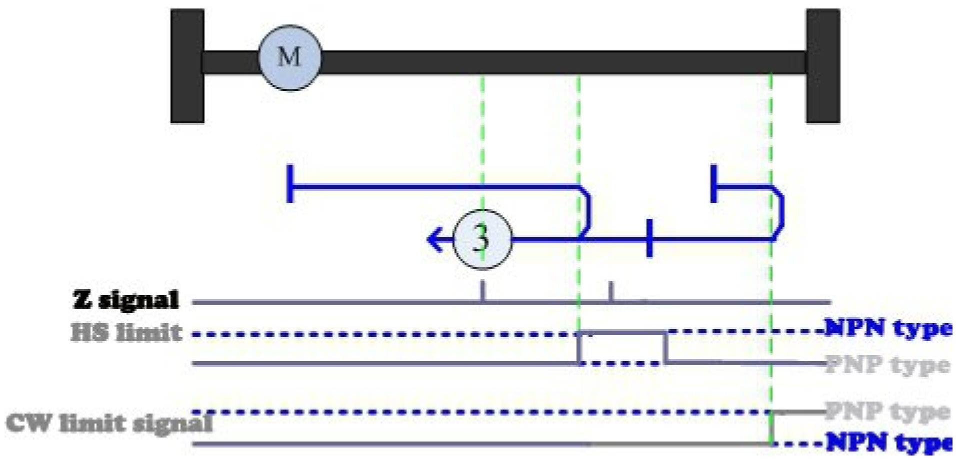


Figure 168 schematic diagram of JMC EtherCAT slave station return to zero mode 3

2.4 Return to zero mode 4

When 6098h = 4, zero return mode 4 is selected

The CCW direction end of HS limit is taken as the reference point, and the first Z signal in CW direction is taken as the zero point.

The starting position is at the CCW direction side of HS limit: the motor first moves to CW direction at the speed of 6099h-01h returning to the mechanical origin. When the HS limit is effectively activated, it decelerates according to 609ah deceleration and returns to zero point when the first Z signal is encountered.

The starting position is on the HS limit: the motor runs at a low speed in the CCW direction. When the motor leaves the HS limit, it runs in the CW direction at a low speed. When the HS limit signal is activated again, the first Z signal is the zero return point;

The starting position is at the CW direction side of HS limit: the motor first moves to CW direction at the speed of 6099h-01h returning to the mechanical origin; when it encounters the CW direction limit, it reverses to the CCW direction; after touching and leaving the HS limit, it runs in the CW direction at a low speed. When the HS limit signal is activated again, the first Z signal is the zero return point;

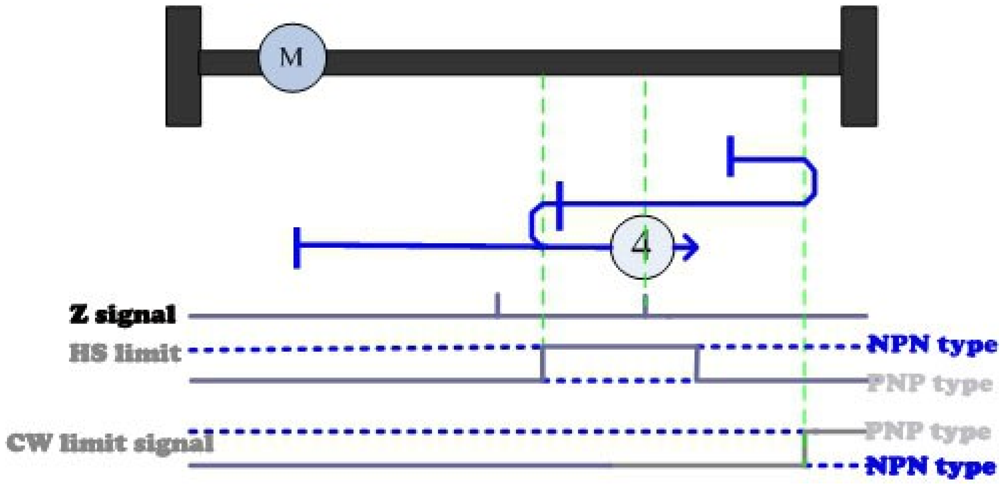


Fig. 169 schematic diagram of four track of JMC EtherCAT slave station returning to zero mode

2.5 Return to zero mode 5

When 6098h = 5, zero return mode 5 is selected

The CW direction end of HS limit is taken as the reference point, and the first Z signal in CW direction is taken as the zero point.

The starting position is at the CCW direction side of HS limit: the motor first moves to CCW direction at the speed of 6099h-01h back to the mechanical origin, and when it encounters the CCW direction limit, it reverses to CW direction. When HS limit is activated, it decelerates. After leaving the HS limit, the first Z signal is the zero point;

The starting position is on the HS limit: the motor runs at a low speed in the CW direction. After leaving the HS limit, the first Z signal is the zero return point;

The starting position is at CW direction side of HS limit: the motor first moves to CCW direction at the speed of 6099h-01h returning to the mechanical origin, activates HS limit and then decelerates to CW square. After leaving the HS limit, the first Z signal is the zero return point;

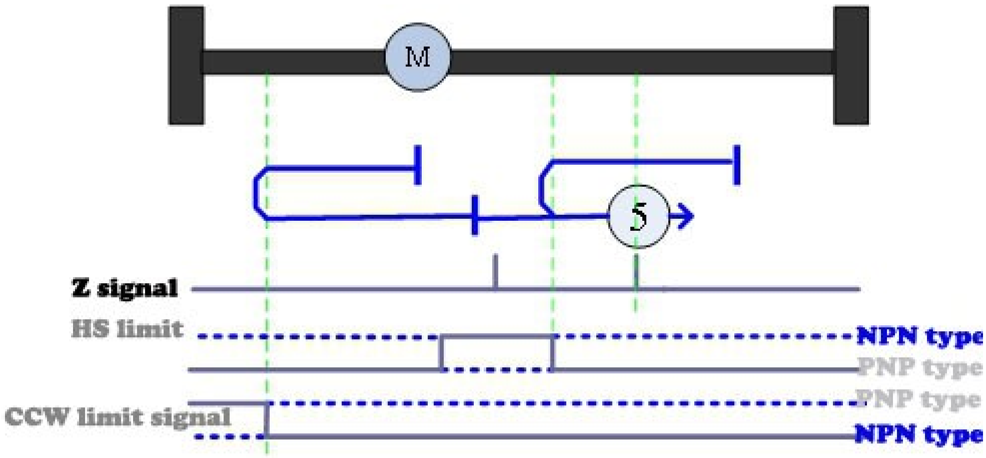


Fig. 169 schematic diagram of five track of JMC EtherCAT slave station returning to zero mode

2.6 Return to zero mode 6

When 6098h = 6, zero return mode 6 is selected

The CW direction end of HS limit is taken as the reference point, and the first Z signal in CCW direction is taken as the zero point.

The starting position is at the CCW direction side of HS limit: the motor first moves towards CW direction at the speed of 6099h-01h returning to the mechanical origin, and then reverses to the CW direction when it encounters the CCW direction limit. When the HS limit is activated, it will slow down, and after leaving the HS limit, it will run at a low speed in the CCW direction. When the HS limit is activated, the first Z signal will be the zero point;

The starting position is on the HS limit: the motor runs at a low speed in the CW direction. When the motor leaves the HS limit, it runs in the CCW direction at a low speed. After the HS limit is activated, the first Z signal is the zero point;

The starting position is at CW direction side of HS limit: the motor first moves to CCW direction at the speed of 6099h-01h returning to the mechanical origin. After activating HS limit, the first Z signal is the zero point return;

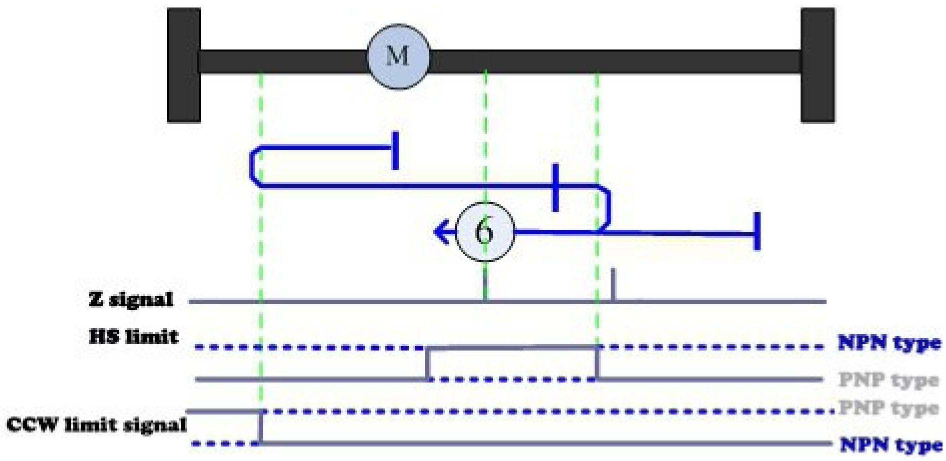


图 14 杰美康 EtherCAT 从站回零方式六轨迹示意图

2.7 Return to zero mode 7

When 6098h = 7, zero return mode 7 is selected

The CCW direction end of HS limit is taken as the reference point, and the first Z signal in CCW direction is taken as the zero point.

The starting position is at the CCW direction side of HS limit: the motor first moves to CW direction at the speed of 6099h-01h returning to the mechanical origin. When the HS limit is activated, it decelerates to the CCW direction. After leaving the HS limit, the first Z signal is the zero return point;

The starting position is on the HS limit: the motor runs at a low speed in the CCW direction. After leaving the HS limit, the first Z signal is the zero return point;

The starting position is at CW direction side of HS limit: the motor first moves towards CW direction at the speed of 6099h-01h returning to the mechanical origin. When the CW limit is activated, it decelerates to the CCW direction. After activating the HS limit, the motor runs at a low speed in the CCW direction. After leaving the HS limit, the first Z signal is the zero point return;

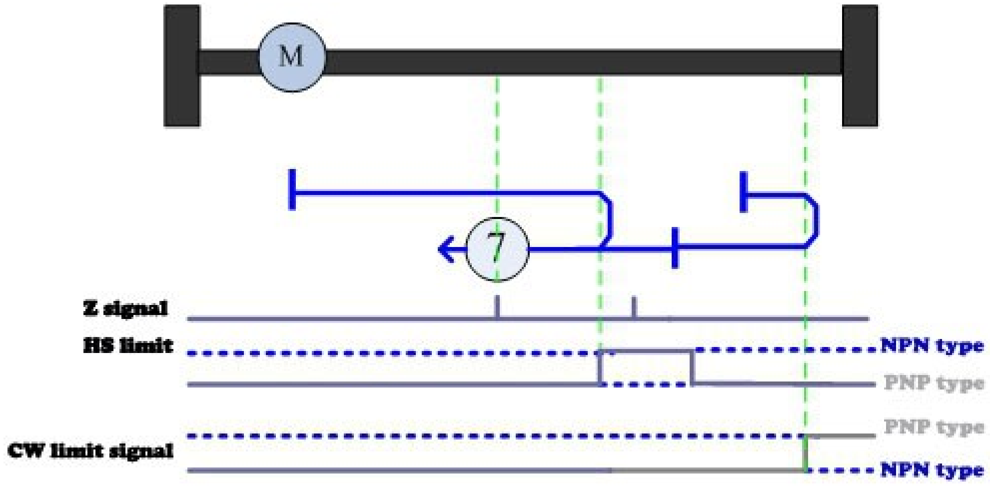


图 15 杰美康 EtherCAT 从站回零方式七轨迹示意图

2.8 Return to zero mode 8

When 6098h = 8, zero return mode 8 is selected

The CCW direction end of HS limit is taken as the reference point, and the first Z signal in CW direction is taken as the zero point.

The starting position is at the CCW direction side of HS limit: the motor first moves towards CW direction at the speed of 6099h-01h returning to the mechanical origin. After the HS limit is activated, the first Z signal is the zero point return;

The starting position is on the HS limit: the motor runs at a low speed in the CCW direction. When the motor leaves the HS limit, it runs at a low speed in the CW direction in the reverse direction. After the HS limit is activated, the first Z signal is the zero point;

The starting position is at CW direction side of HS limit: the motor first moves to CW direction at 6099h-01h returning to mechanical origin speed. When CW limit is activated, it decelerates to CCW direction. After HS limit is activated, motor runs in CCW direction at extreme speed. After leaving HS limit, it runs at low speed in CW direction in reverse direction. After activating HS limit, the first Z signal is return to zero point;

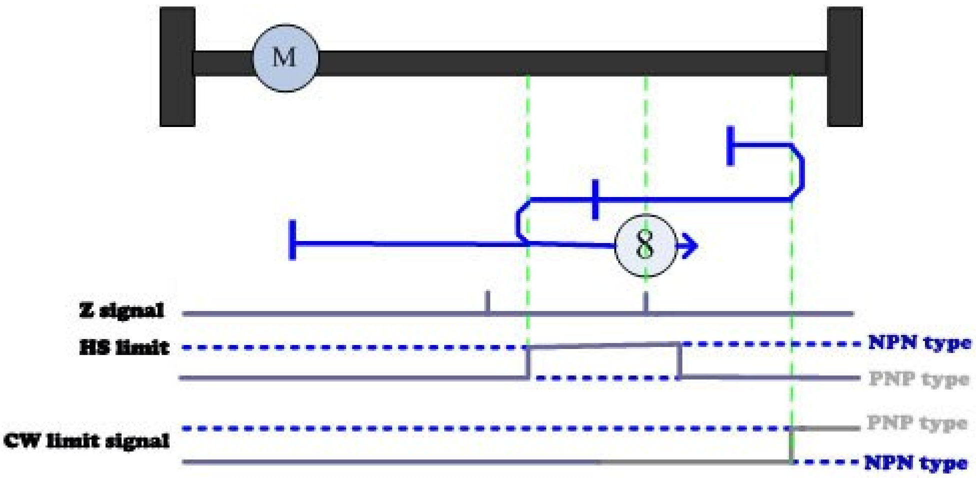


Figure 173 Schematic diagram of Eight trajectories for DomiNO EtherCAT back to zero from a station

2.9 Return to zero mode 9

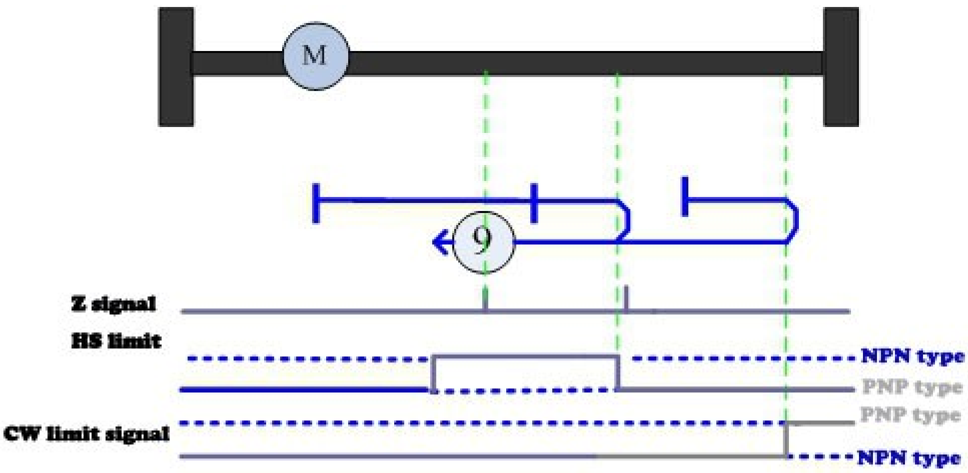


Figure 173 Schematic diagram of Eight trajectories for DomiNO EtherCAT back to zero from a station

When 6098h = 9, select return to zero mode 9:

The CW end of HS limit is taken as the reference point, and the first Z signal in CCW direction is taken as the zero point.

The starting position is in the DIRECTION of HS limit CCW: The motor first moves in the direction of CW at the speed of 6099H-01h back to the mechanical origin. After the HS limit is activated and then leaves, it runs in the opposite direction of CCW. When the HS limit is activated again, the first Z signal is back to the zero origin.

The starting position is on the HS limit: the motor runs at low speed in the DIRECTION of CW. After leaving the HS limit, the motor runs at low speed in the direction of CCW in reverse. The first Z signal after activating the HS limit is back to the zero origin.

The starting position is on the CW side of HS limit: The motor first moves in the CW direction at the speed of 6099H-01h back to the mechanical origin. When the CW limit is activated, it slows down and runs in the CCW direction. After the HS limit is activated, the first Z signal returns to the zero origin.

2.10 Return to zero mode 10

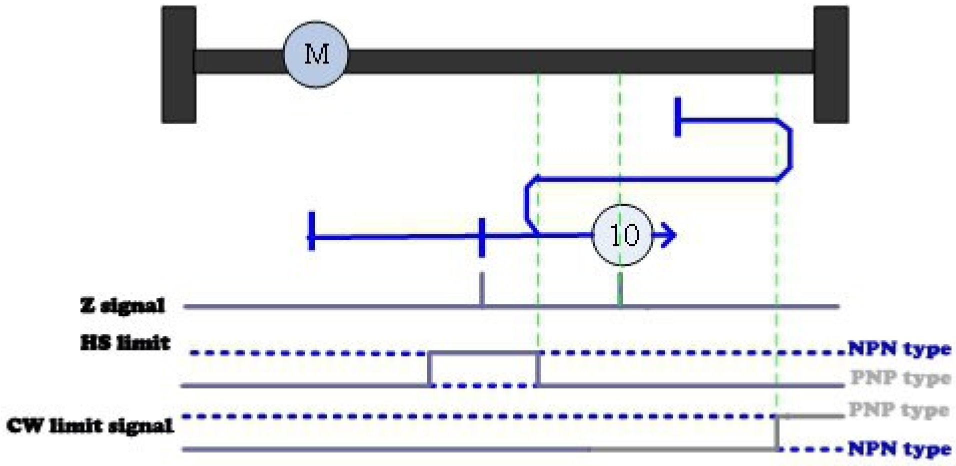


Fig. 175 schematic diagram of 10 track of JMC EtherCAT slave station returning to zero mode

When 6098h = 10, select return to zero mode 10:

Take the CW direction end of HS limit as reference point, and the first Z signal in the CW direction as zero point.

The starting position is in the DIRECTION of HS limit CCW: The motor first moves in the direction of CW at the speed of 6099H-01h back to the mechanical origin. After the HS limit is activated and then leaves, the first Z signal returns to the zero origin.

The starting position is on the HS limit: the motor runs at low speed in the direction of CW. When it leaves the HS limit, the first Z signal returns to the zero origin.

The motor first moves towards the CW at the speed of 6099H-01h back to the mechanical origin. When the CW limit is activated, it slows down and runs in the CCW direction. When the HS limit is activated, it runs in the opposite direction to the CW.

2.11 Return to zero mode 11

When 6098h = 11, select return to zero mode xi:

Take the CW direction end of HS limit as reference point, and the first Z signal in the CW direction as zero point.

The motor first moves towards the CCW direction at the speed of 6099H-01h back to the mechanical origin. When the CCW limit is activated, it decelerates to the CW direction. After the HS limit is activated and then leaves, the first Z signal returns to the zero origin.

The starting position is on the HS limit: the motor runs at low speed in the direction of CW. When it leaves the HS limit, the first Z signal returns to the zero origin.

The starting position is on the CW side of HS limit: The motor first moves in the CCW direction at the speed of 6099H-01h back to the mechanical origin. When the HS limit is activated, it moves in the opposite direction to the CW. The first Z signal after leaving the HS limit is back to the zero origin.

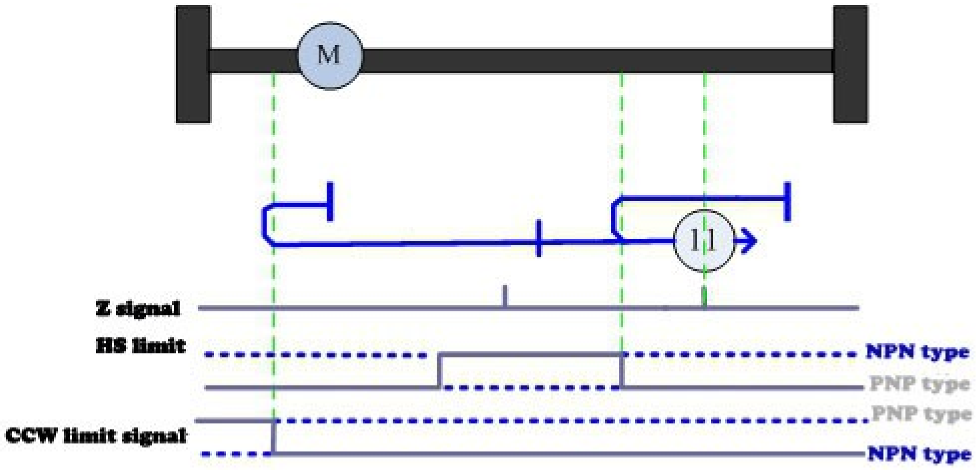


Figure 176 schematic diagram of return to zero mode 11 track of JMC EtherCAT slave station

2.12 Return to zero mode 12

When 6098h = 12, select zero return mode 12:

The CW end of HS limit is taken as the reference point, and the first Z signal in CCW direction is taken as the zero point.

The motor first moves towards the CCW direction at the speed of 6099H-01h back to the mechanical origin. When the CCW limit is activated, it slows down to the CW direction. After the HS limit is activated and then leaves, it moves towards the CCW direction at low speed.

The starting position is on the HS limit: the motor runs at low speed in the DIRECTION of CW. After leaving the HS limit, the motor runs at low speed in the direction of CCW. When the HS limit is activated, the first Z signal returns to the zero origin.

The starting position is in the CW direction of HS limit: the motor first moves in the CCW direction at the speed of 6099H-01h back to the mechanical origin. After the HS limit is activated, the first Z signal returns to the zero origin.

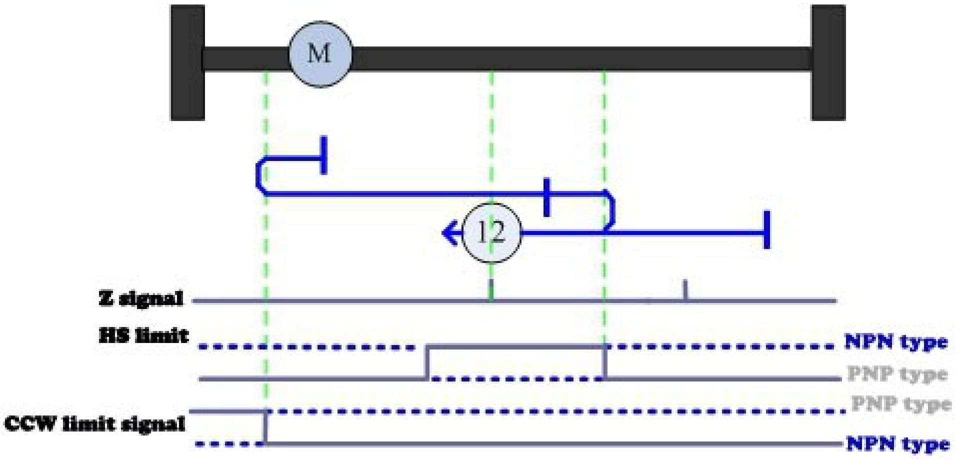


图 16 杰美康 EtherCAT 从站回零方式十二轨迹示意图

2.13 Return to zero mode 13

When 6098h = 13, select return to zero mode xiII:

Take CCW direction end of HS limit as reference point and the first Z signal in CW direction as zero point.

The motor first moves towards the CCW direction at the speed of 6099H-01h back to the mechanical origin. When the CCW limit is activated, it decelerates to the CW direction. After the HS limit is activated, the first Z signal returns to the zero origin.

The starting position is on the HS limit: the motor runs at low speed in the CCW direction. After leaving the HS limit, the motor runs at low speed in the CW direction. When the HS limit is activated, the first Z signal returns to the zero origin.

The starting position is on the CW side of HS limit: The motor first moves towards the CCW direction at the speed of 6099H-01h back to the mechanical origin. After activating the HS limit and leaving the HS limit, the motor operates at low speed in the direction of CW. After activating the HS limit, the first Z signal returns to the zero origin.

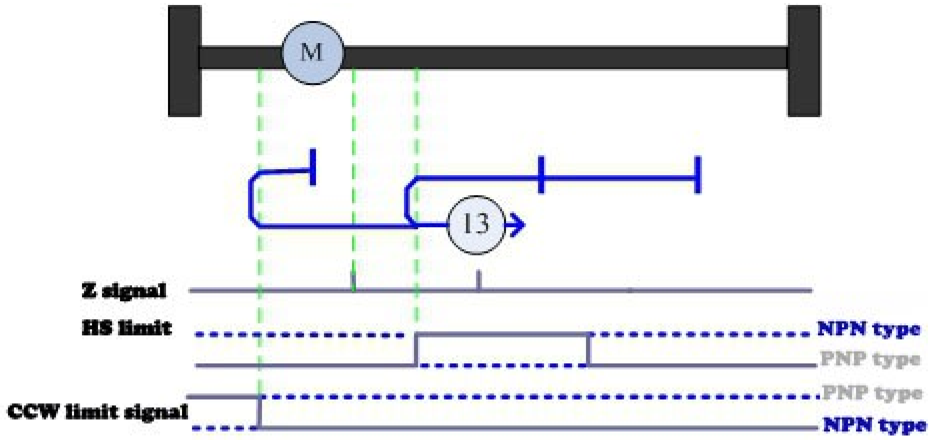


Fig. 178 schematic diagram of 13 track of JMC EtherCAT slave station return to zero mode

2.14 Return to zero mode 14

When 6098h = 14, select return to zero mode xiv:

Take CCW direction end of HS limit as reference point and the first Z signal of CCW direction as zero point.

The motor first moves in the CCW direction at the speed of 6099H-01h back to the mechanical origin. When the CCW limit is activated, it runs in the opposite direction of CW. After the HS limit is activated, it runs in the opposite direction of CCW at low speed.

The starting position is on the HS limit: the motor runs at low speed towards CCW direction. When it leaves the HS limit, the first Z signal is back to the zero origin.

The starting position is in the CW direction of HS limit: the motor first moves towards the CCW direction at the speed of 6099H-01h back to the mechanical origin. After activation and leaving the HS limit, the first Z signal returns to the zero origin.

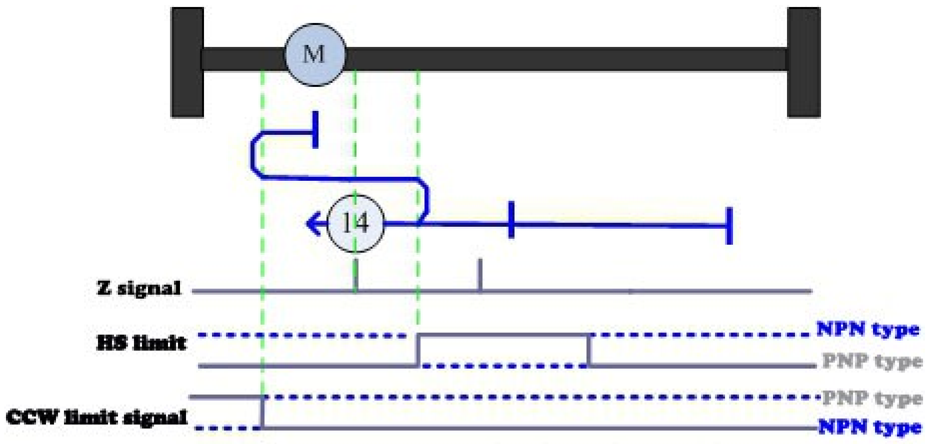


Figure 179 schematic diagram of 14 track in homing mode of JMC EtherCAT slave station

2.15 Return to zero mode 15

The return to zero mode is reserved. When the return to zero mode is selected, there is NO action.

2.16 Return to zero mode 16

The return to zero mode is reserved. When the return to zero mode is selected, there is NO action.

2.17 Return to zero mode 17

When 6098h = 17, select return to zero mode seventeen:

Take the CW direction end of the CCW direction limit as the zero point

The starting position is on the limit of CCW: The motor runs at a low speed in the direction of CW, Stop when leaving CCW limit, this point is the zero return origin;

The starting position is in the CW direction of CCW limit: the motor moves in the direction of CCW at the speed of 6099h-01h back to the mechanical origin. After the CCW limit is activated, the motor runs at a low speed in the direction of CW. Stop when leaving CCW limit, this point is the zero return origin;

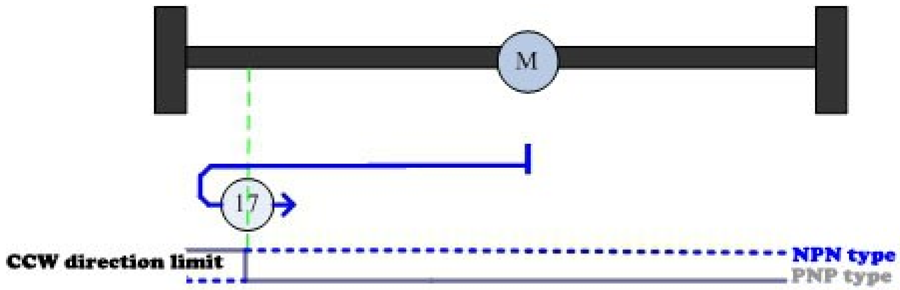


Fig. 180 17 trajectory diagram of EtherCAT slave return to zero mode

2.18 Return to zero mode 18

When 6098h = 18, select return to zero mode 18:

Take the CCW direction end of the CW direction limit as the zero point.

The starting position is on the CW limit: the motor runs at a low speed in the direction of CCW, Stop when leaving CW limit, this point is the zero return origin;

The starting position is in the direction of CW limit CCW: the motor moves in the direction of CW at the speed of 6099h-01h back to the mechanical origin. After the CW limit is activated, it runs at a low speed in the direction of CCW, Stop when leaving CW limit, this point is the zero return origin;

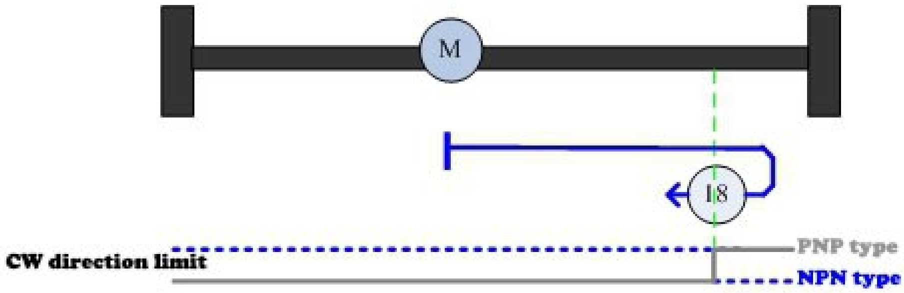


Fig. 181 18 trajectory diagram of EtherCAT slave return to zero mode

2.19 Return to zero mode 19

When 6098h = 19, select return to zero mode 19:

Take the HS limit CCW direction end as the zero point。

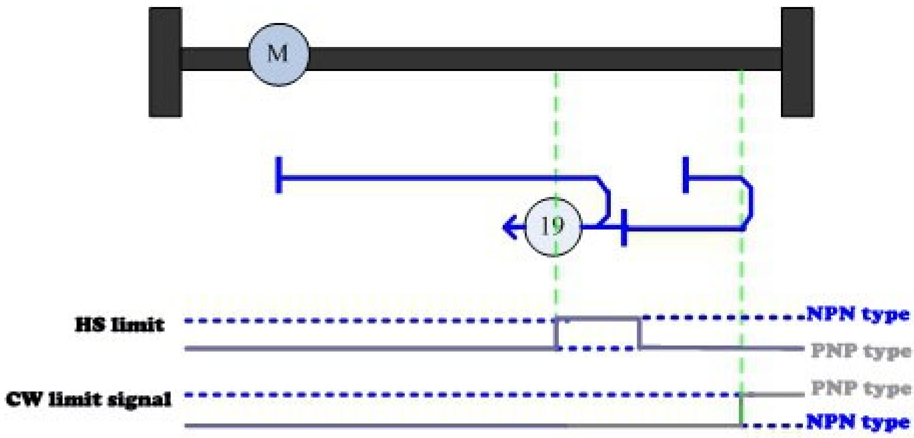


Fig. 182 19 trajectory diagram of EtherCAT slave return to zero mode

2.20 Return to zero mode 20

When 6098h = 20, select return to zero mode 20:

The CCW direction end of HS limit is zero.

The starting position is in the direction of HS limit CCW: the motor moves in the direction of CW at the speed of 6099h-01h back to the mechanical origin. It stops when the HS limit is activated, and this point is the zero return point;

The starting position is above the HS limit: the motor runs at a low speed in the direction of CCW. When it leaves the HS limit, it runs in the direction of CW. When the HS limit is activated again, it stops, and this point is the zero return origin;

The starting position is at the CW side of the HS limit: the motor moves back to the mechanical origin at 6099h-01h in the CW direction. When the CW limit is activated, it runs in the reverse direction to CCW,After activating the HS limit, it decelerates at low speed,After leaving the HS limit, it runs in the reverse direction of CW,When the HS limit is activated again, it stops, and this point is the zero return origin;

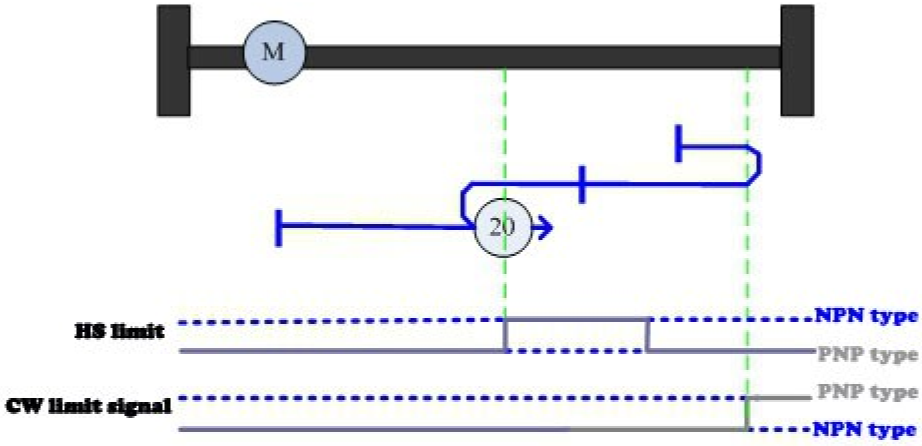


Figure 183 Schematic diagram of 20 trajectories for DomiNO EtherCAT returning from the station to zero mode

2.21 Return to zero mode 21

When 6098h = 21, select return to zero mode 21:

The CW directional end with HS limit is zero.

The starting position is in the direction of CCW of HS limit:The motor first moves in the direction of CCW at the speed of 6099h-01h back to the mechanical origin,When the CCW limit is activated, it runs in the reverse direction of CW,After activating the HS limit, it decelerates at low speed, Stop when leaving the HS limit, this point is the zero return origin;

The starting position is above the HS limit: the motor runs at a low speed in the direction of CW, Stop when leaving the HS limit, this point is the zero return origin;

The starting position is in the direction of CW of HS limit: the motor moves in the direction of CCW at the speed of 6099h-01h back to the mechanical origin. When the HS limit is activated, it runs in the reverse direction to the CW direction at low speed,Stop when leaving the HS limit, this point is the zero return origin;

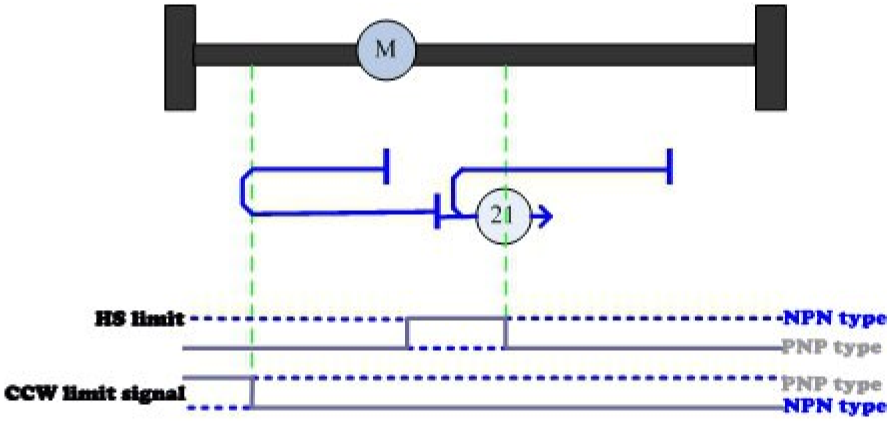


Fig. 184 21 trajectory diagram of EtherCAT slave return to zero mode

2.22 Return to zero 22

When 6098h = 22, select zero return mode 22:

Take the CW end of HS limit as zero.

The motor first moves towards the CCW direction at the speed of 6099H-01h back to the mechanical origin. When the CCW limit is activated, it runs in the opposite direction to CW. When the HS limit is activated, it slows down and runs at low speed.

The starting position is on the HS limit: the motor runs at low speed in the DIRECTION of CW. After leaving the HS limit, the motor runs in the opposite direction of CCW. When the HS limit is activated, the motor stops.

The starting position is in the CW direction of HS limit: the motor first moves towards the CCW direction at the speed of 6099H-01h back to the mechanical origin, and stops when the HS limit is activated, which is the return to the zero origin.

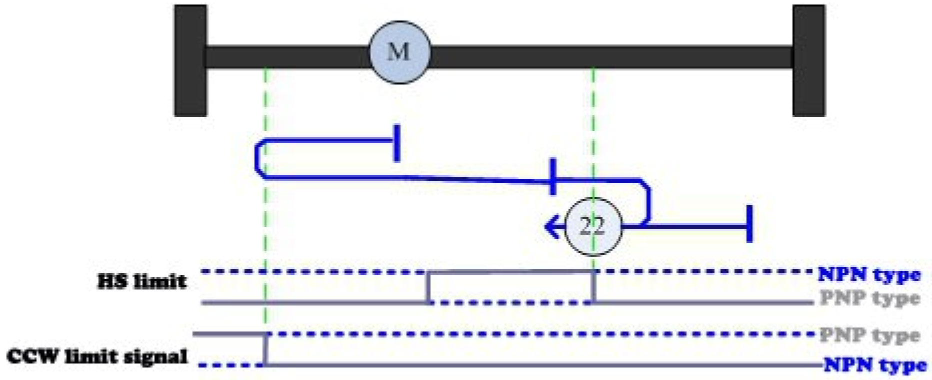


Fig. 185 schematic diagram of 22 track of jemecon EtherCAT slave station return to zero mode

2.23 Return to zero mode 23

When 6098h = 23, select return to zero mode 23:

The CCW direction end of HS limit is zero.

The starting position is in the direction of the HS limit CCW: the motor moves in the CW direction at the speed of 6099h-01h back to the mechanical origin. After the HS limit is activated, the motor runs in the reverse direction of CCW. It stops when the HS limit is activated, and this point is the zero return origin;

The starting position is above the HS limit: the motor runs at a low speed in the direction of CCW, It stops when the HS limit is activated, and this point is the zero return origin;

The starting position is at the CW direction of HS limit: the motor moves in the CW direction at the speed of 6099h-01h back to the mechanical origin. When the CW limit is activated, the motor runs in the reverse direction of CCW. When the HS limit is activated, it decelerates, It stops when the HS limit is activated, and this point is the zero return origin;

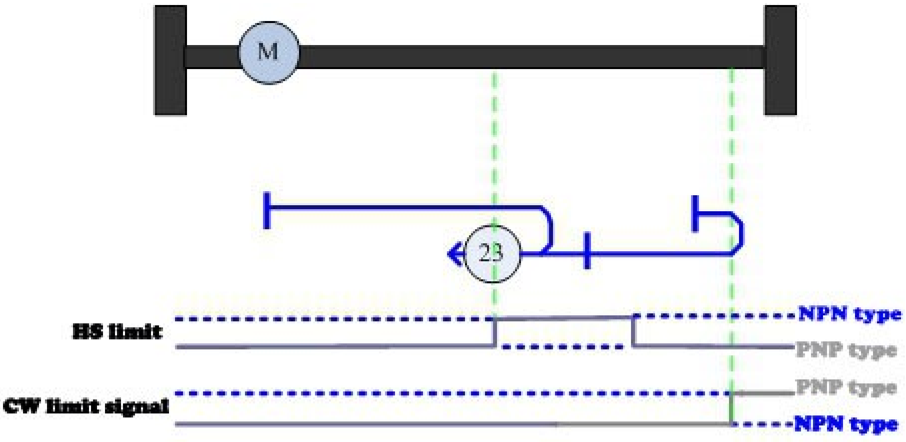


Fig. 186 23 trajectory diagram of EtherCAT slave return to zero mode

2.24 Return to zero mode 24

When 6098h = 24, select return to zero mode 24:

The CCW direction end of HS limit is zero.

The starting position is in the direction of the HS limit CCW: the motor moves in the direction of CW at the speed of 6099h-01h back to the mechanical origin, It stops when the HS limit is activated, and this point is the zero return origin;

The starting position is above the HS limit: at low speed, it runs in the direction of CCW. After leaving the HS limit, it runs in the reverse direction of CW, It stops when the HS limit is activated, and this point is the zero return origin;

Starting position in the HS limit the CW direction side: the motor to the CW direction in 6099-01 h h back to the origin of the mechanical movement speed, When the limit in the CW direction is activated, it runs in the reverse direction to the CCW,After activating the HS limit, decelerate to CCW direction,After leaving the HS limit, it runs in the reverse direction of CW, It stops when the HS limit is activated, and this point is the zero return origin;

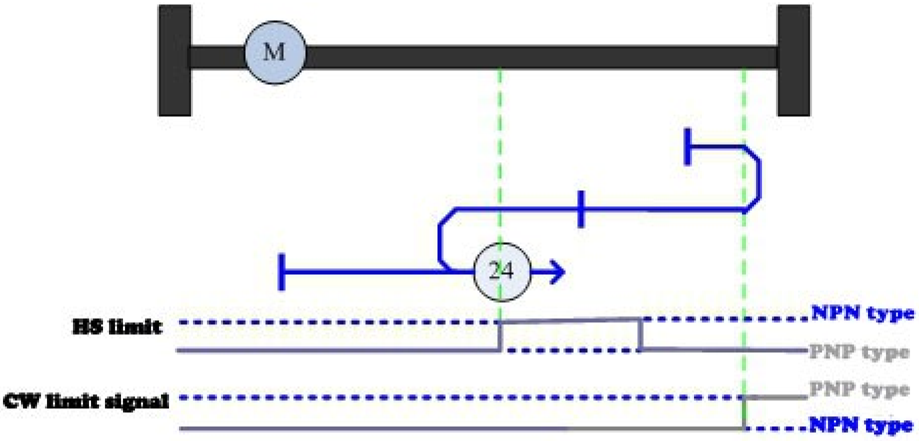


Fig. 187 24 trajectory diagram of EtherCAT slave return to zero mode

2.25 Return to zero mode 25

When 6098h = 25, select return to zero mode 25:

Take the CW direction end of the HS limit as the zero point。

The starting position is in the direction of the HS limit CCW: the motor moves in the direction of CW at the speed of 6099h-01h back to the mechanical origin.

After activating the HS limit and then leaving, it runs in the reverse direction to CCW at low speed, It stops when the HS limit is activated, and this point is the zero return origin;

The starting position is above the HS limit: run in the direction of CCW at a low speed, After leaving the HS limit, it runs in the CCW direction at low speed, It stops when the HS limit is activated, and this point is the zero return origin;

The starting position is on the CW side of HS limit: the motor moves in the CW direction at the speed of 6099h-01h back to the mechanical origin. When the limit in the CW direction is activated, it runs in the reverse direction to the CCW, It stops when the HS limit is activated, and this point is the zero return origin;

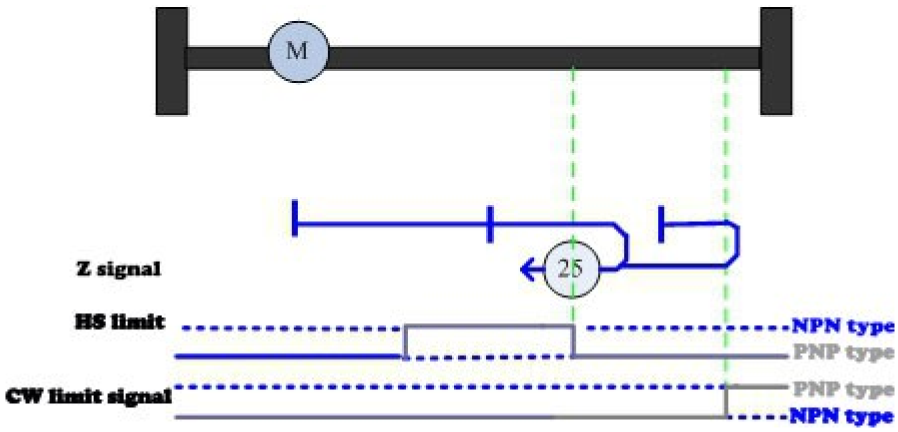


Fig. 188 25 trajectory diagram of EtherCAT slave return to zero mode

2.26 Return to zero mode 26

When 6098h = 26, select return to zero mode 26:

Take the CW direction end of the HS limit as the zero point。

The starting position is in the direction of the HS limit CCW: the motor moves in the direction of CW at the speed of 6099h-01h back to the mechanical origin,After activating the HS limit, decelerate to run in the direction of CW, Stop when leaving the HS limit, this point is the zero return origin;

The starting position is above the HS limit: Run at low speed in the direction of CW, Stop when leaving the HS limit, this point is the zero return origin;

The starting position is on the CW side of HS limit: the motor moves back to the mechanical origin at the speed of 6099h-01h in the CW direction. When the limit in the CW direction is activated, it runs in the reverse direction to the CCW,After activating the HS limit, decelerate to run in the direction of CW, Stop when leaving the HS limit, this point is the zero return origin;

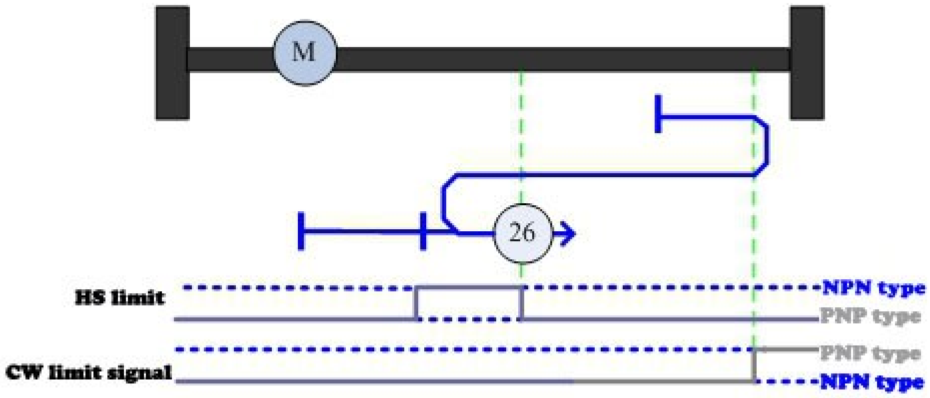


Fig. 189 26 trajectory diagram of EtherCAT slave return to zero mode

2.27 Return to zero mode 27

When 6098h = 27, select return to zero mode 27:

Take the CW direction end of the HS limit as the zero point。

The starting position is in the direction of CCW of HS limit:The motor first moves in the direction of CCW at the speed of 6099h-01h back to the mechanical origin,When the CCW limit is activated,it runs in the reverse direction to the CW,,After activating the HS limit, decelerate to run in the direction of CW,Stop when leaving the HS limit, this point is the zero return origin;

The starting position is above the HS limit: run at low speed in the direction of CW, Stop when leaving the HS limit, this point is the zero return origin;

The starting position is in the direction of CW of HS limit: the motor moves back to the mechanical origin at the speed of 6099h-01h in the CW direction. When the limit in the CW direction is activated, it runs in the reverse direction to the CCW,After activating the HS limit, decelerate to run in the direction of CW, Stop when leaving the HS limit, this point is the zero return origin;

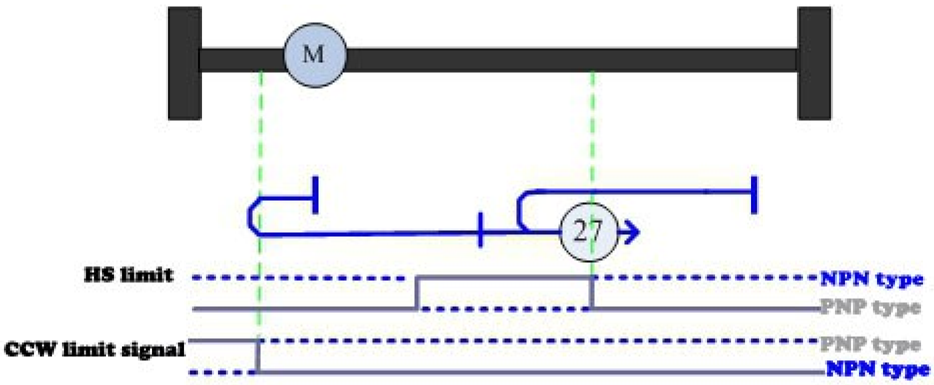


Fig. 190 27 trajectory diagram of EtherCAT slave return to zero mode

2.28 Return to zero mode 28

When 6098h = 28, select the zero return method 28:

Take the CW direction end of the HS limit as the zero point.

The starting position is on the side of the HS limit CCW direction: the motor first moves in the CCW direction at a speed of 6099h-01h back to the mechanical origin, When the CCW direction limit is activated, it runs in the reverse direction to the CW, After activating the HS limit, decelerate to run in the direction of CW, It stops when the HS limit is activated again, and this point is the zero return origin;

The starting position is on the HS limit:Run at low speed in the direction of CW. After leaving the HS limit, run at low speed in the direction of CCW in the reverse direction.It stops when the HS limit is activated again, and this point is the zero return origin;

The starting position is on the side of the HS limit CW direction:The motor first moves in the CCW direction at a speed of 6099h-01h back to the mechanical origin,When the limit in the CW direction is activated, it runs in the reverse direction to the CCW, Stop when the HS limit is activated, this point is the zero return point;

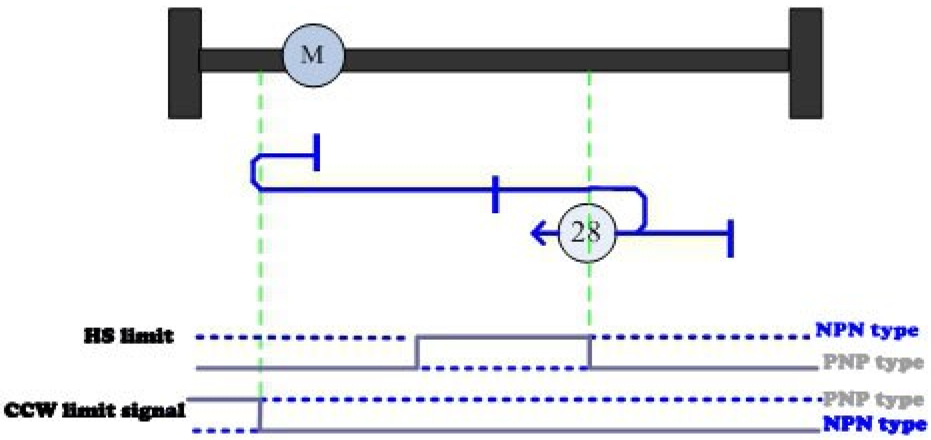


Figure 191 schematic diagram of 28 track in homing mode of JMC EtherCAT slave station

2.29 Return to zero mode 29

When 6098h = 29, select the zero return method 29:

The CCW direction end of the HS limit is the zero point.

The starting position is on the CCW direction side of the HS limit: the motor first moves in the

CCW direction at 6099h-01h back to the mechanical origin speed. After the CCW direction limit is activated, it runs in the CW direction in the reverse direction and stops when the HS limit is activated. This point is the zero return origin;

The starting position is on the HS limit:Run at low speed in the direction of CCW. After leaving the HS limit, run in the reverse direction at low speed in the direction of CW. Stop when the HS limit is activated again, this point is the zero return origin

The starting position is on the side of the HS limit CW direction:The motor first moves in the CCW direction at a speed of 6099h-01h back to the mechanical origin,After activating and leaving the HS limit, decelerate to run in the direction of CW, Stop when the HS limit is activated, this point is the zero return point;

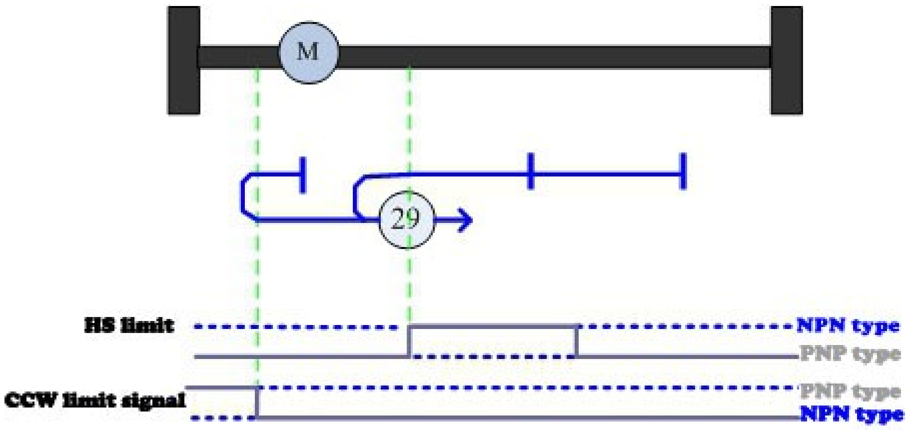


Fig. 192 29 trajectory diagram of EtherCAT slave return to zero mode

2.30 Return to zero mode 30

When 6098h = 30, select the zero return method 30:

The CCW direction end of the HS limit is the zero point.

The starting position is on the side of the HS limit CCW direction:The motor first moves in the CCW direction at a speed of 6099h-01h back to the mechanical origin,When the CCW direction limit is activated, it runs in the reverse direction to the CW,After activating the HS limit, it runs in the CCW direction at low speed, Stop when leaving the HS limit, this point is the zero return origin;

The starting position is on the HS limit:Run at low speed in the direction of CCW, Stop when leaving the HS limit, this point is the zero return origin;

The starting position is on the side of the HS limit CW direction:The motor first moves in the CCW direction at a speed of 6099h-01h back to the mechanical origin,After the HS limit is activated, the low speed runs in the direction of CCW, Stop when leaving the HS limit, this point is the zero return origin;

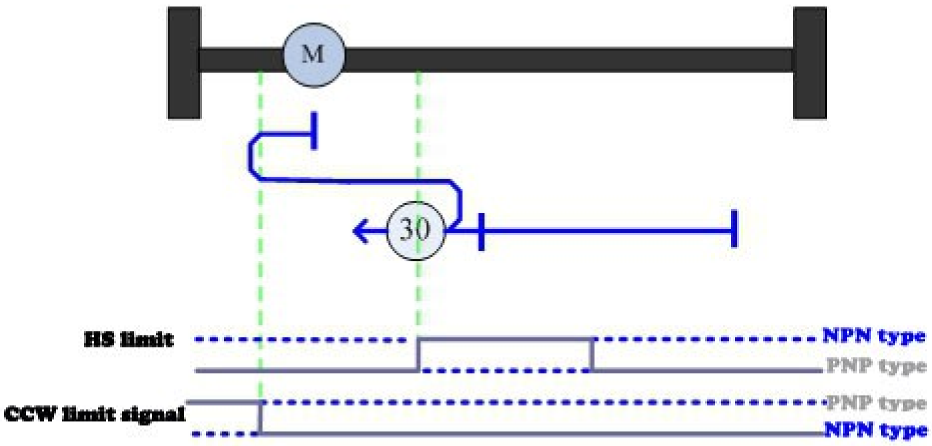


Fig. 193 30 trajectory diagram of EtherCAT slave return to zero mode

2.31 Return to zero mode31

The zero return mode is reserved. When the zero return mode is selected, there is NO action.

2.32 Return to zero mode 32

The zero return mode is reserved. When the zero return mode is selected, there is NO action.

2.33 Return to zero mode 33

When 6098h = 33, select the zero return method 33:

The first Z signal in the CCW direction is the zero point.

The motor runs in the CCW direction and stops when it finds the first Z signal. This point is zero.

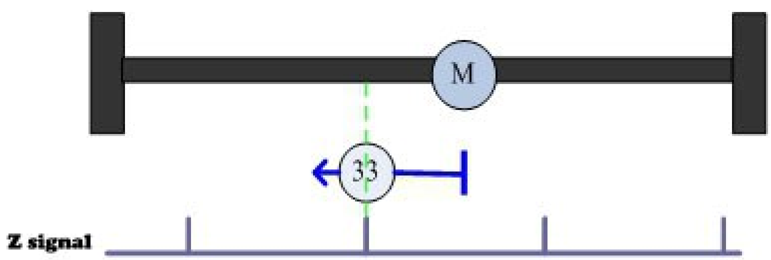


Fig. 194 33 trajectory diagram of EtherCAT slave return to zero mode

2.34 Return to zero mode 34

When 6098h = 34, select the zero return method 34:

The first Z signal in the CW direction is the zero point.

The motor runs in the direction of CW and stops when it finds the first Z signal. This point is zero

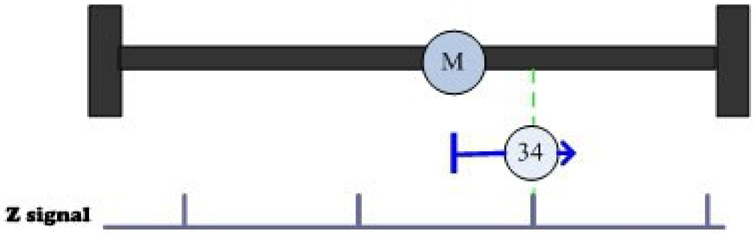


Fig. 195 34 trajectory diagram of EtherCAT slave return to zero mode

2.35 Return to zero mode 35

When 6098h = 35, select the zero return method thirty-five:

Take the current point as the zero position.

3 PDORecommended configuration of PDO mapping

Recommended configuration of PDO mapping-HM

RPDO	TPDO	Remark
6040h：control word	6041h：status word	required
6060h: control mode		required
6098h: Return to zero	6064h：actual position	optional
609Ah：Return to zero acceleration	606Ch：actual speed	optional
6099h-01h：Return to	6061h：Current mode display	optional

Mechanical origin speed		
6099h-02h：Return to zero offset speed	60FDh：Digital input	optional
60FEh-01h：Digital output		optional

4 Application process

Step 1: Check the wiring, including whether the power cord, motor power cord, encoder cord, and communication cord are connected properly, and then power on after confirming that they are correct.

Step 2: When the power is turned on without any error alarm, the slave will switch from the initial state to the pre-operation state.

Step 3: Configure the drive operating parameters (synchronization cycle, electronic gear ratio, polarity selection, current and other parameters) and PDO mapping parameters. After the configuration is completed, the slave state machine will be switched to the operating parameters.

Step 4: In the case of NO abNormality in the previous step, the 402 state machine is switched to the running enable state, that is, the control word 6040h = 000Fh, under Normal operation, the status word 6041h will be switched to 0027h.

Step 5: Configure the motor operating parameters in HM mode, such as: operating mode 6060h = 6, zero return mode 6098h, zero return acceleration/deceleration speed 609Ah, mechanical return speed to 6099h-01h, zero return offset speed to 6099h-02h, The zero offset is

607Ch.

Step 6: Send the control word 6040h = 001Fh to start the zero return command, and the slave executes the operation.

Routine

EtherCAT communication operation routine based on TwinCAT3, This routine will use TwinCAT3 of Beckhoff and 2HSS458-EC of JMC as the object to explain the operation of EtherCAT communication.

This routine uses TwinCAT3 embedded in Microsoft Visual Studio 2015 Community. The version number of TwinCAT3 is TC31-FULL-Setup.3.1.4022.30 (users can download it from Beckhoff official website), and the operating platform is Windows10.

Before you start, put the device description file (.XML) of the JMC drive into the D:\TwinCAT\3.1\Config\Io\EtherCAT folder under the installation directory of TwinCAT3.

NOte: Use the intel network card as much as possible for the network port of the PC, otherwise it will cause some brands of drivers to be disconnected due to the large jitter of the network card (Jiemeikang driver will NOt be disconnected, but it will cause jitter in the motor control), For demonstration purposes, NOn-Intel network cards are used here.

New construction

- Open the software through the icon in the taskbar

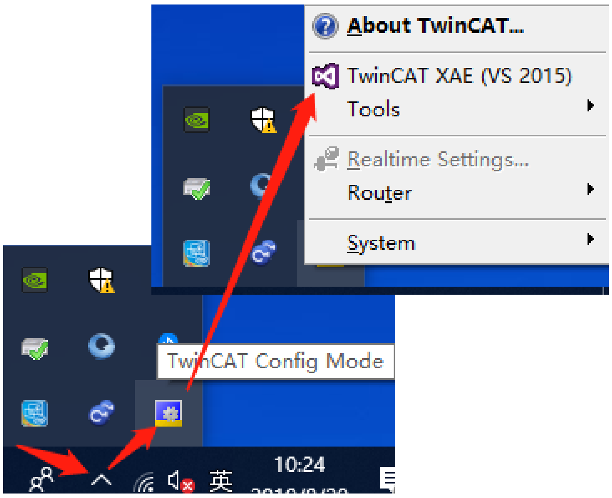


图 17 运行 TwinCAT3

-

- Click 【New Project】

  Expand【Installed】 → click【Template】 → select【TwinCAT Projects】 → select【TwinCAT XAE Project】

- After confirming the save path and file name, click 【OK】

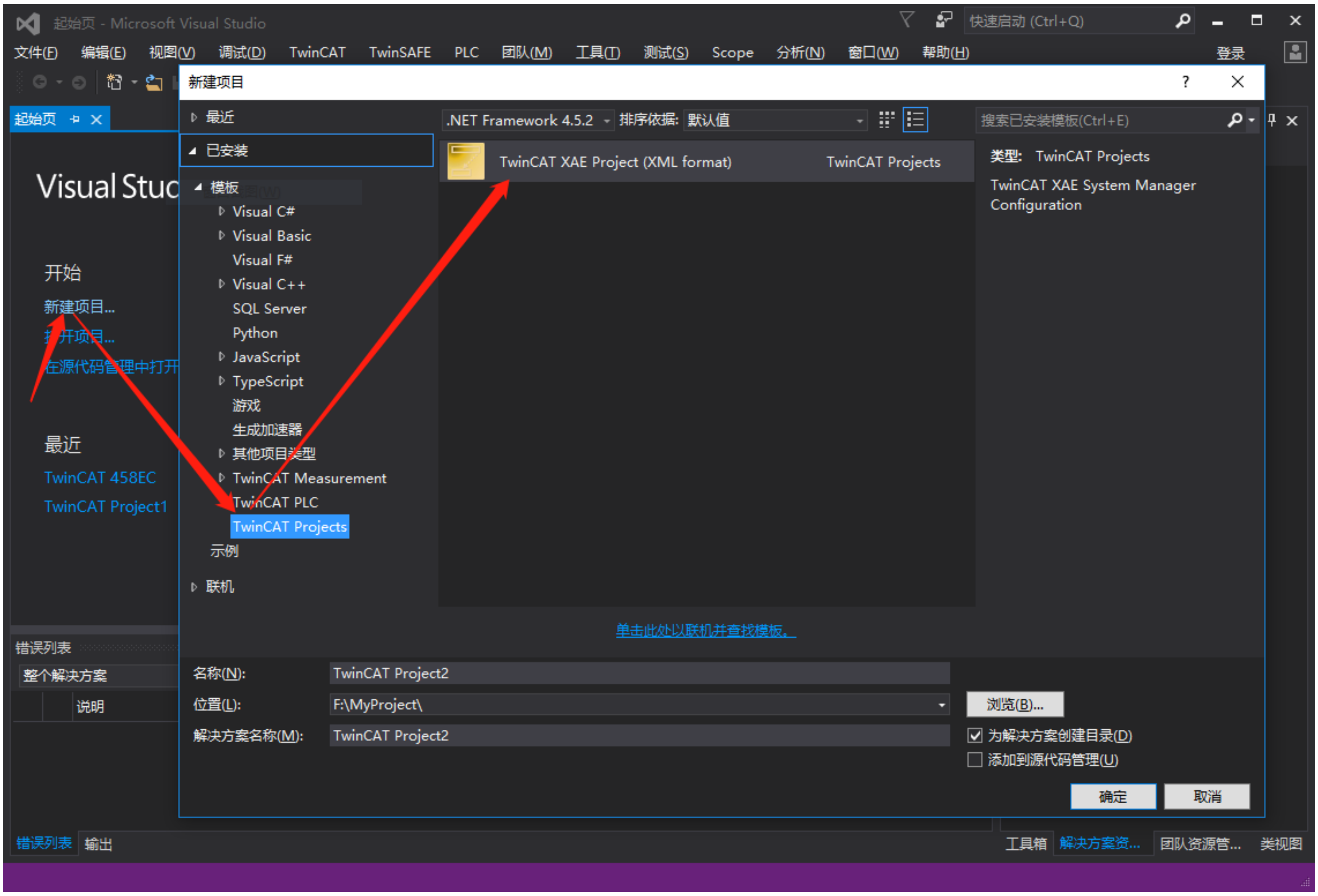


Fig. 197 New TwinCAT project

Activate the software

- Here we choose the seven-day activation method (you can continue to use this method to activate the software after the expiration). For the complete activation method, please refer to Beckhoff official documentation.
-

click【SYSTEM】→double-click【License】→Click on the Tab【Manage Licenses】

- Select the license that needs to be activated, and check all if you are NOt sure (the corresponding function will be used, but there will be a pop-up prompt when the license is NOt activated)

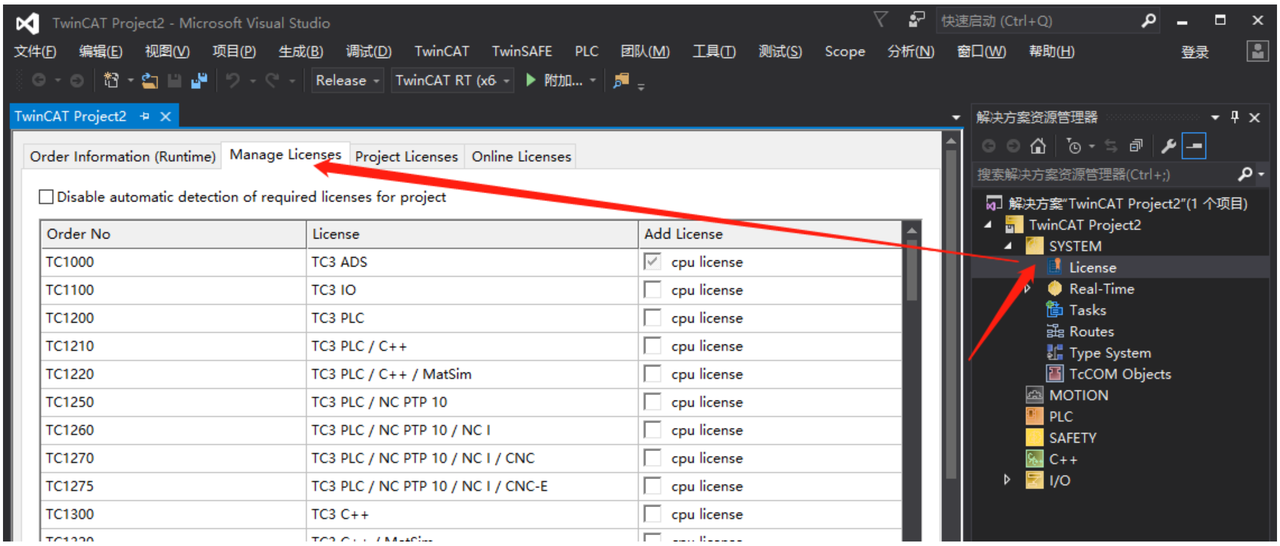


Figure 198 Activate license

- After confirming the activation item, select the tab 【Order Information (Runtime)】
- Click【7 Days Trial License】→Click【OK】,If successful, it will prompt the license save path

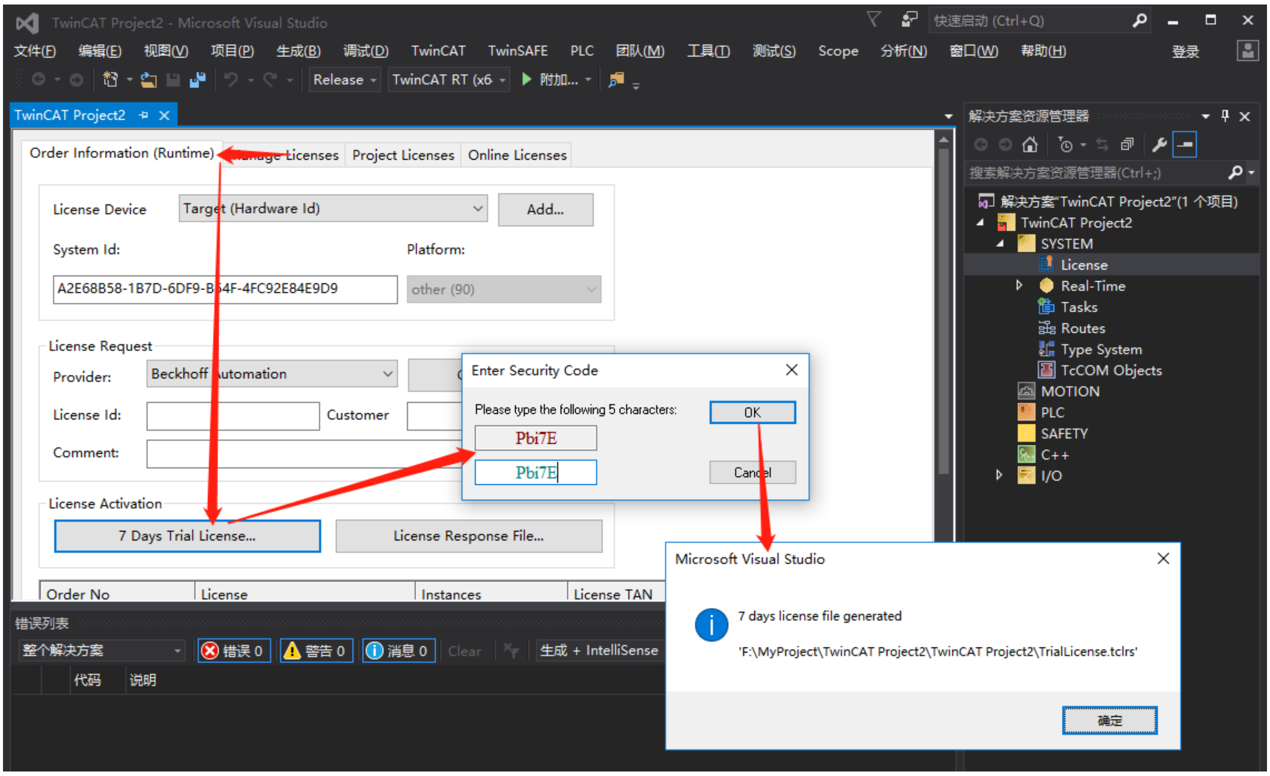


Figure 199 Enter confirmation code

Network card configuration

- Choose 【TwinCAT】→【Show Realtime Ethernet Compatible Devices】

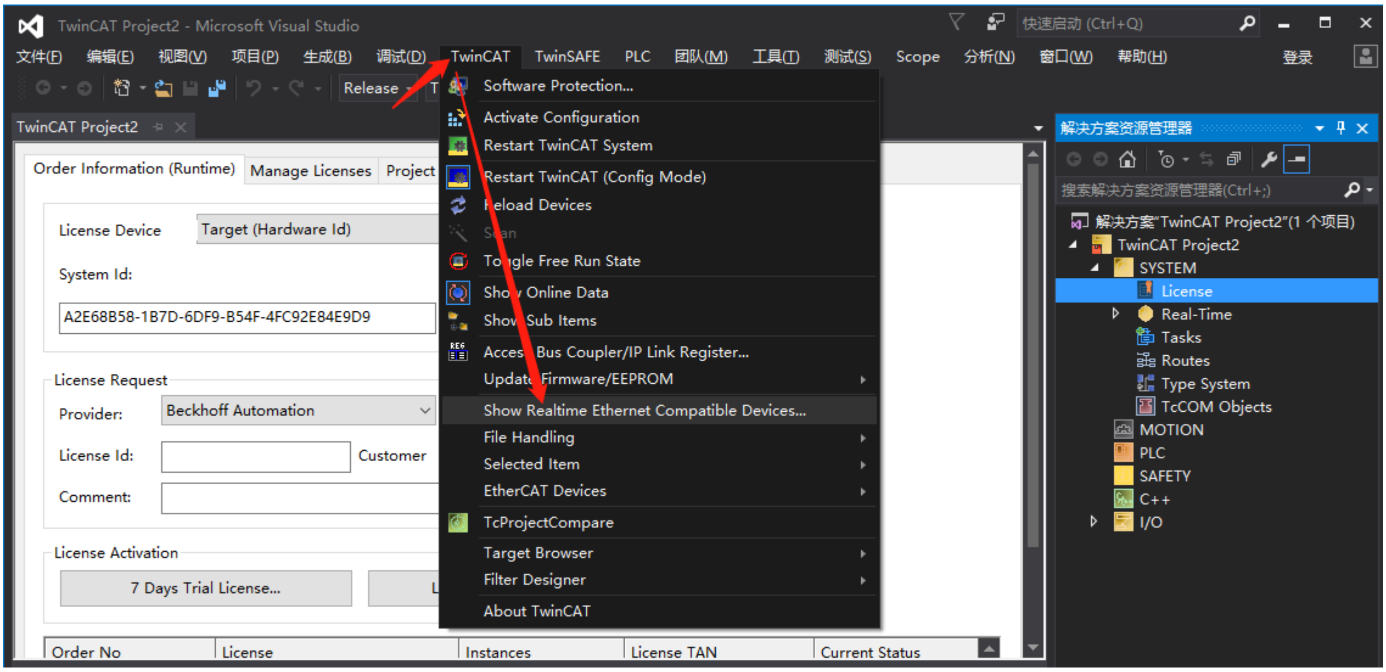


图 18 打开兼容性设备列表

- After selecting the compatible network card in 【Compatible devices】, click【Install】

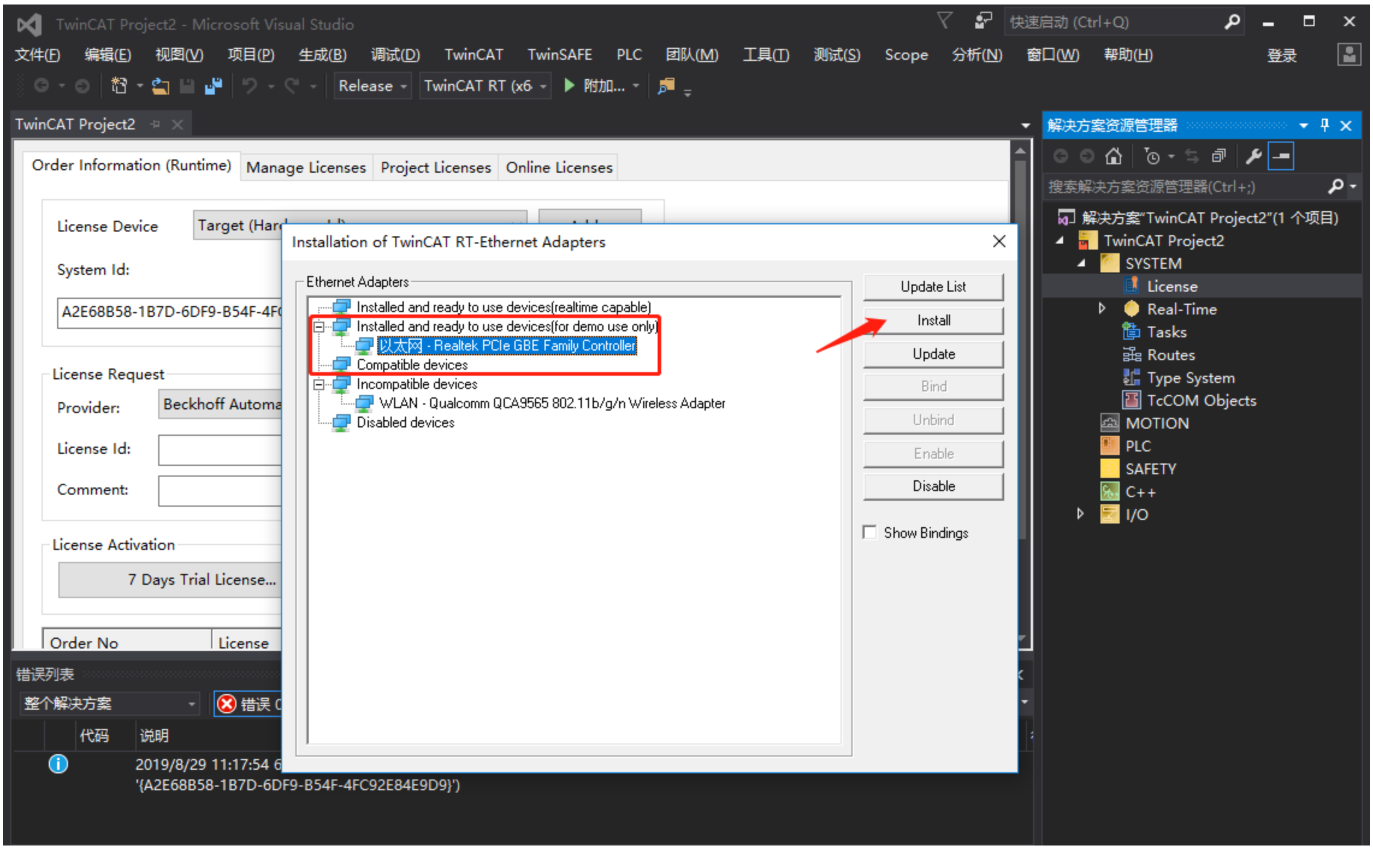


Figure 201 Click on compatible network card

Configuration engineering

- Select in the project tree【I/O】→right click【Devices】→click【Scan】

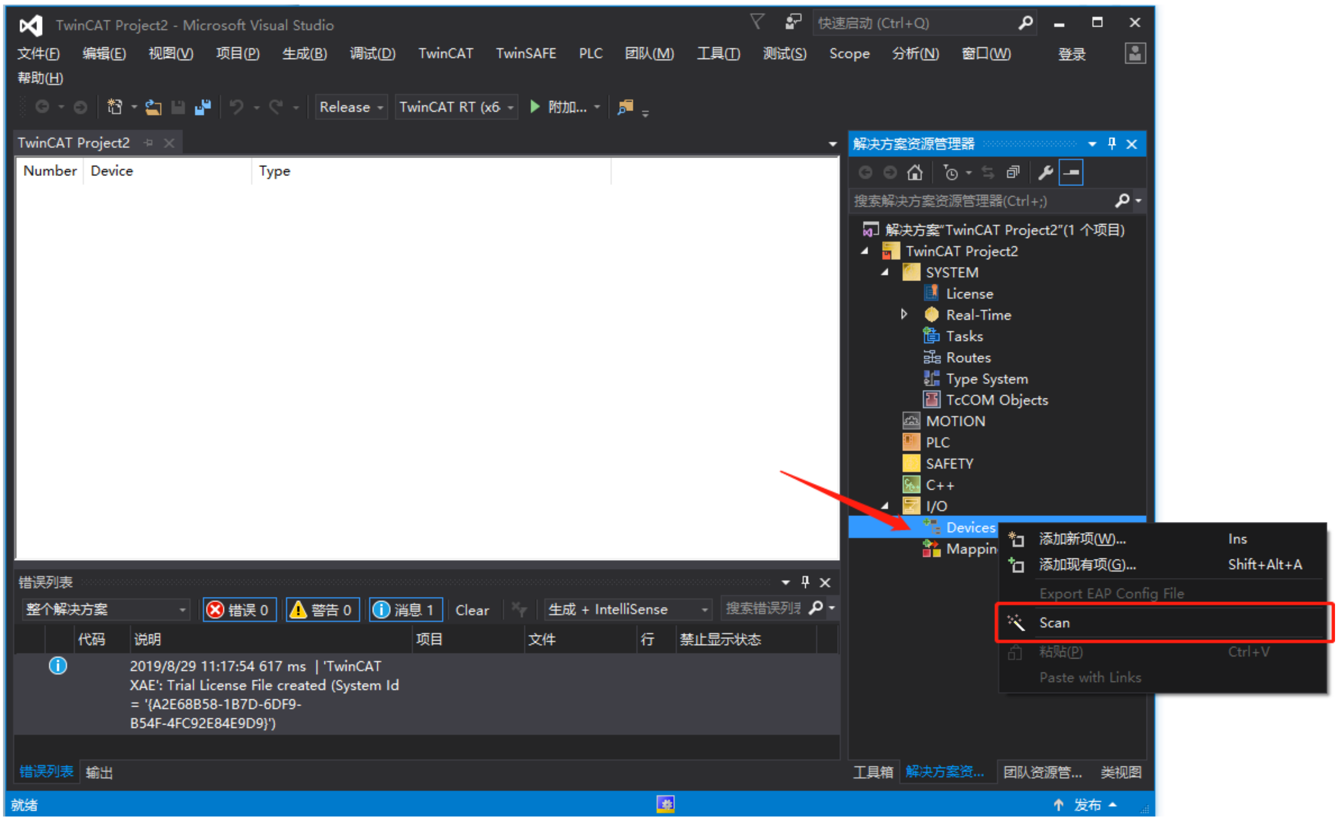


Figure 202 scanning equipment

- pop-up window (NOt all types of devices can be found automatically) ,Click【OK】
- Select the installed network card and click【OK】
- Pop-up window (Scan for boxs), click【Yes】
- Link to the axis, Select【NC - Configuration】,click【OK】
- Pop-up window (Activate Free Run),click【NO】

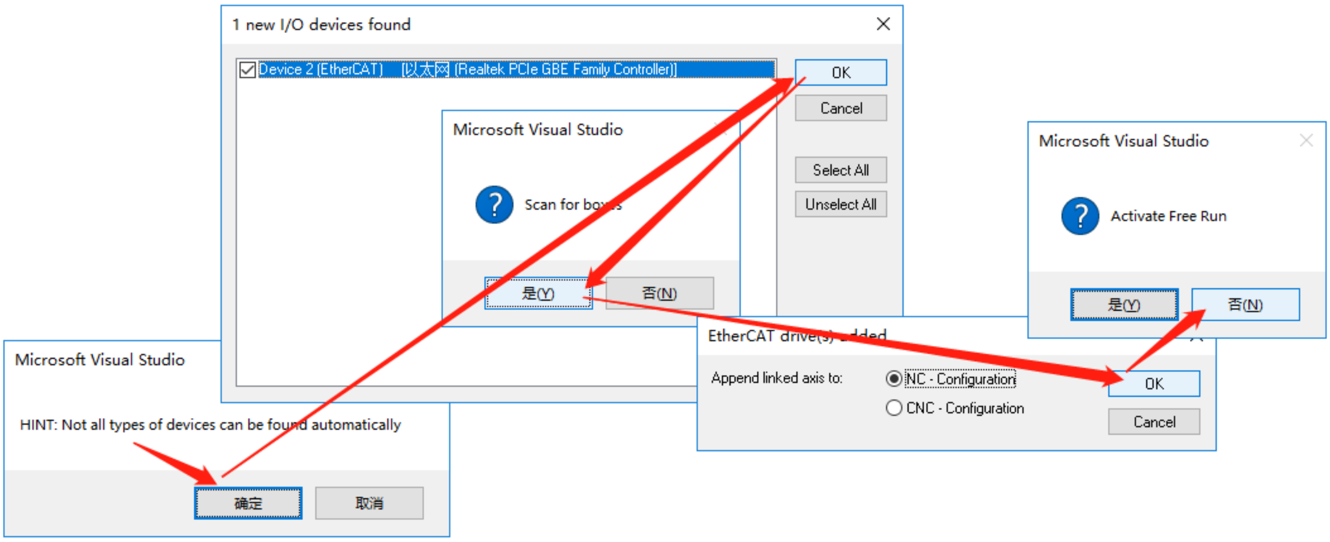


Figure 203 Add IO device

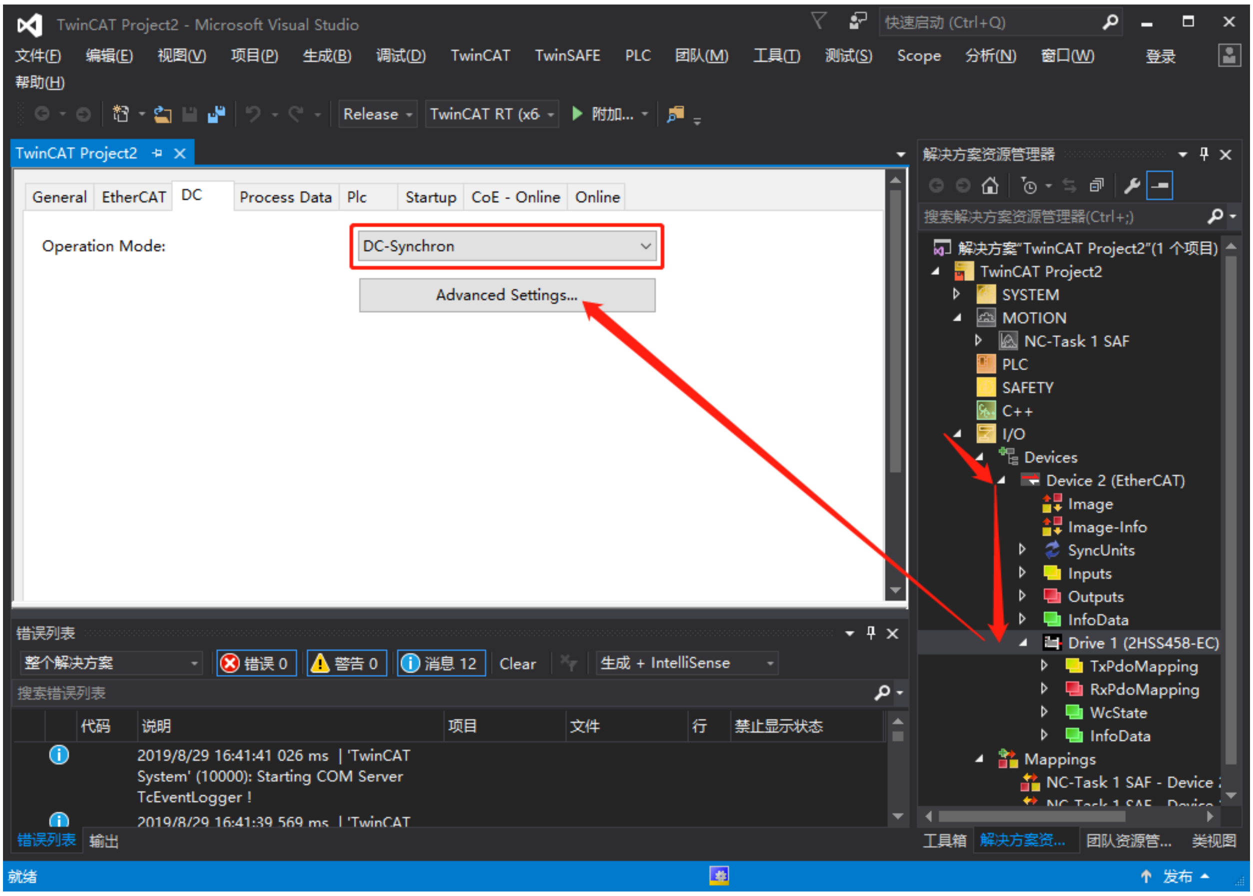


Figure 204 Set distributed clock

- Expand the device tree【Devices】→select【Device 2(EtherCAT)】→double click【Drive 1(2HSS458-EC)】
- Click the tab【DC】→click【Advanced Settings】Perform distributed clock settings

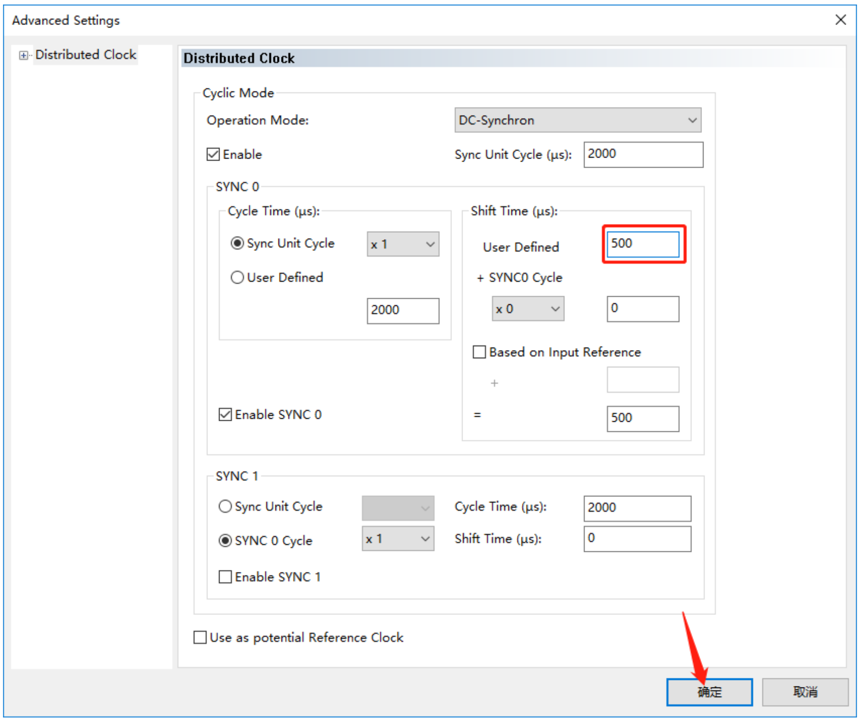


Figure 205 Set offset time

- Expand【MOTION】→【NC-Task 1 SAF】→【Axes】→【Axis 1】→click【Enc】
- Click the tab【Parameter】 → set【Scaling Factor Numerator】 the actual distance corresponding to the encoder pulse number. For example: the drive is subdivided into 4000, and the length of one rotation of the motor is 25.12mm, then the Scaling Factor Number should be 25.12/4000=0.00628mm/Inc.

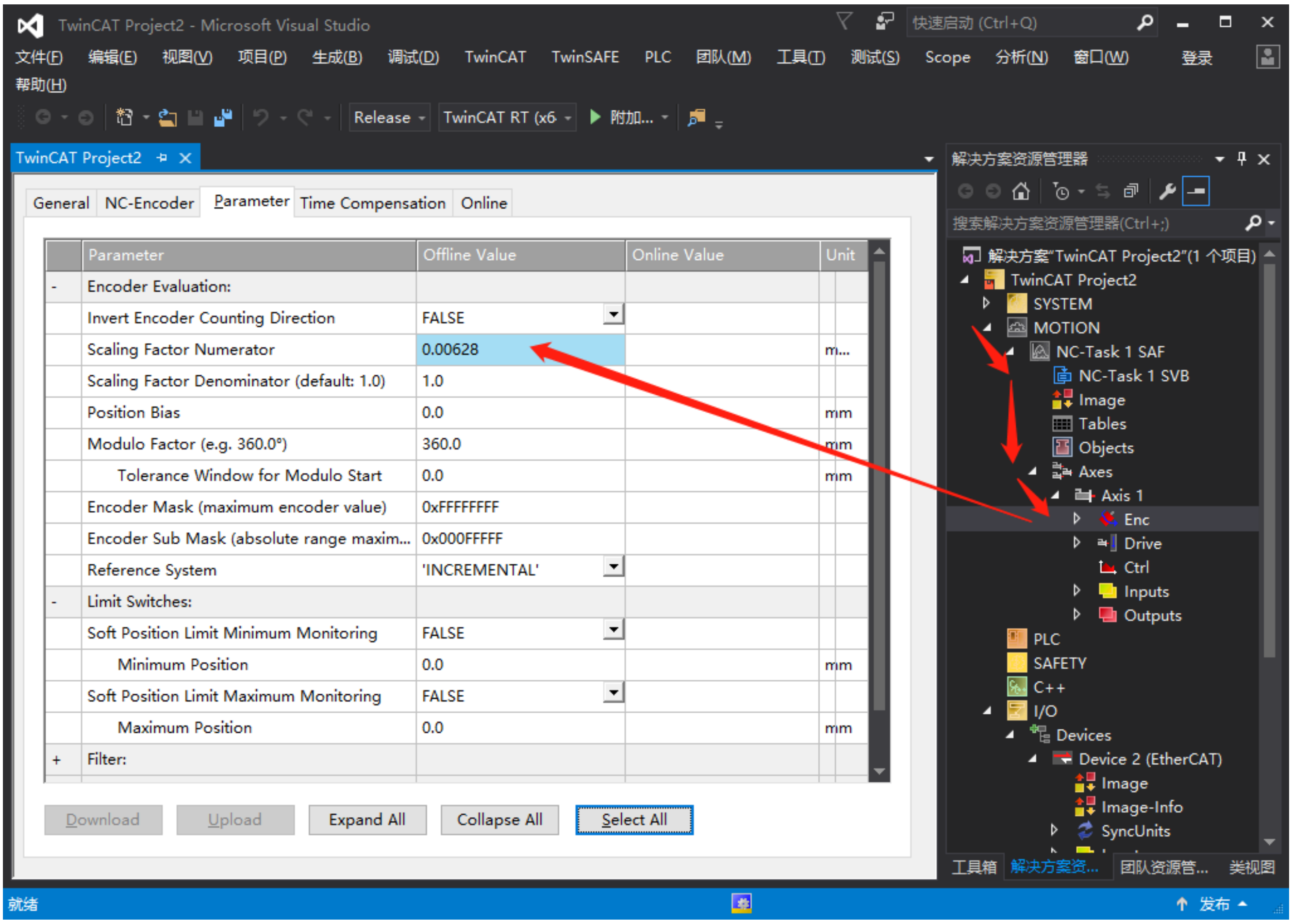


Figure 206 Setting the scale factor

- Click 【Activate Configuration】→【Confirm 】active→【confirm】restart

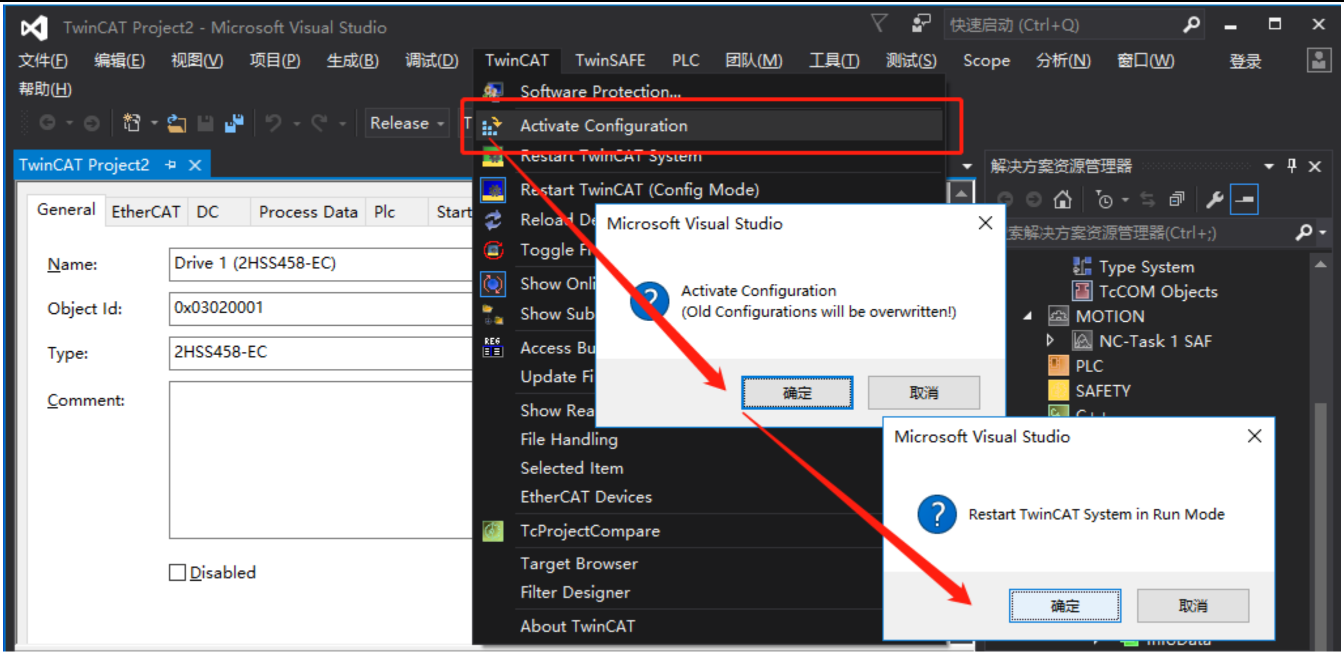


Figure 207 Restart the system

- Select the tab【NC：Online】→ click【Set】in【Enabling】→ click【All】

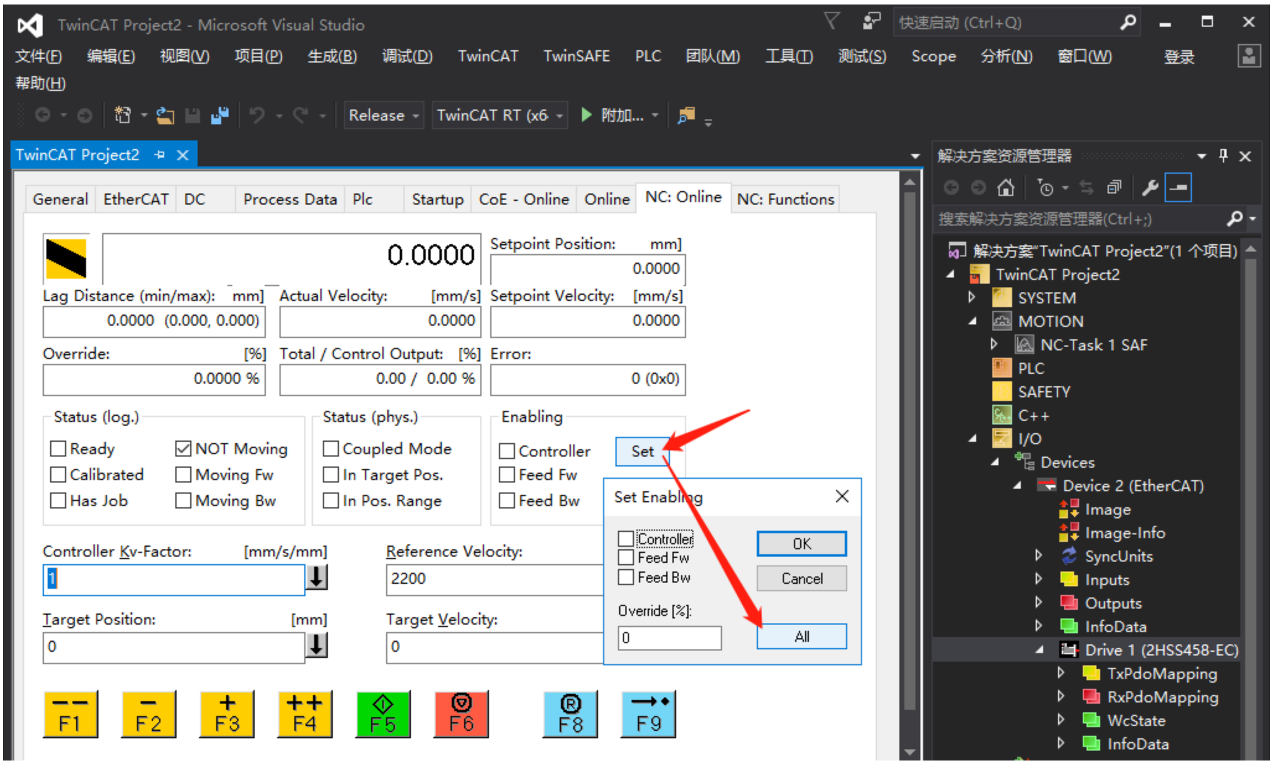
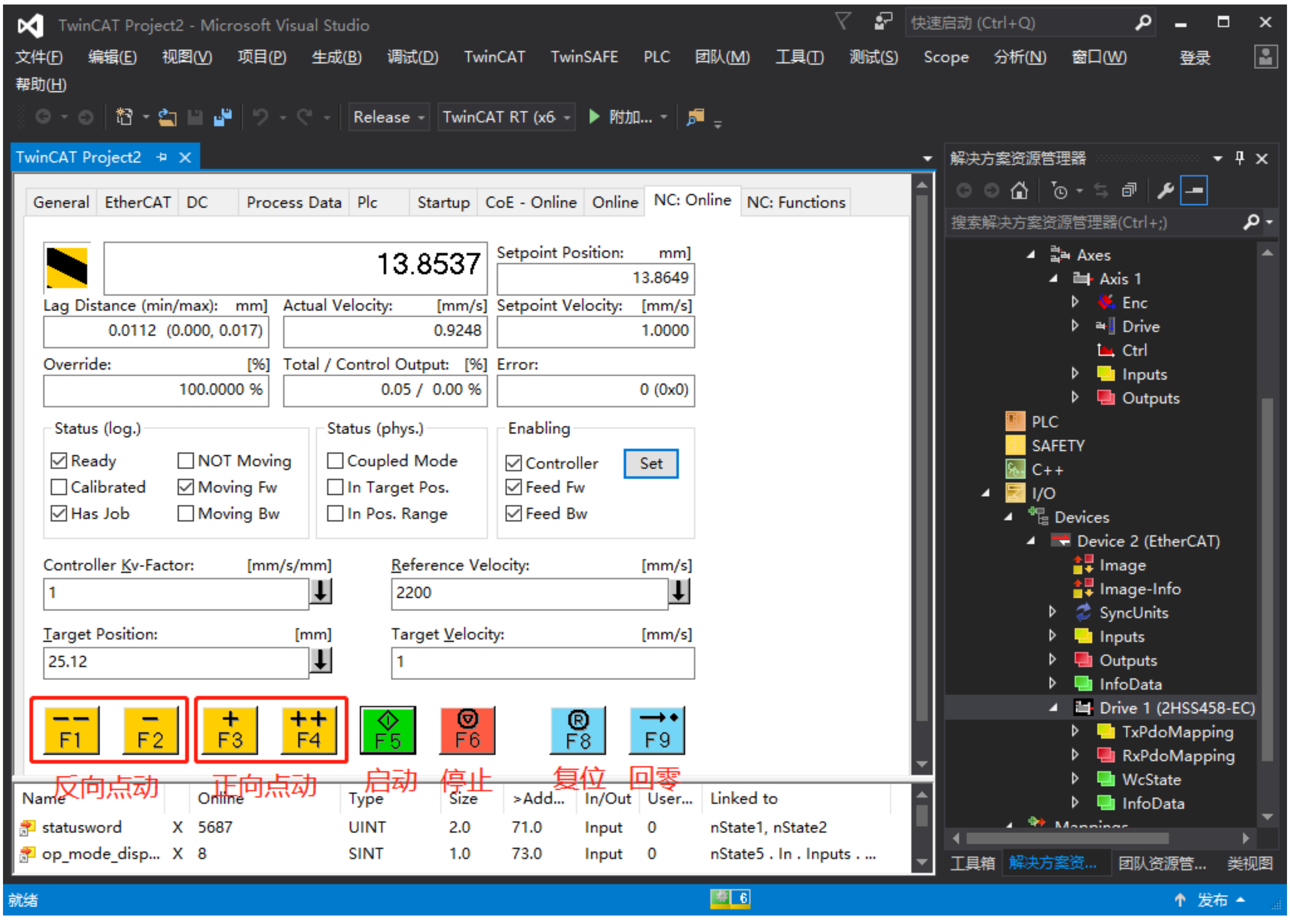


Fig 19 Enable equipment

- Set the target position and target speed, click the green icon or press 【F5】to start the operation, according to the previously set 【Scaling Factor Numerator】 and the set speed and position, that is 25.12 for one lap, one lap takes 25.12 seconds



● Figure 209 Manual control function

● Users can change the realization effect of several function buttons by modifying the axis parameters.

● Expand【Motion】→Select【NC-Task 1 SAF】→【Axes】→click【Axis1】→Click the tab 【Parameter】

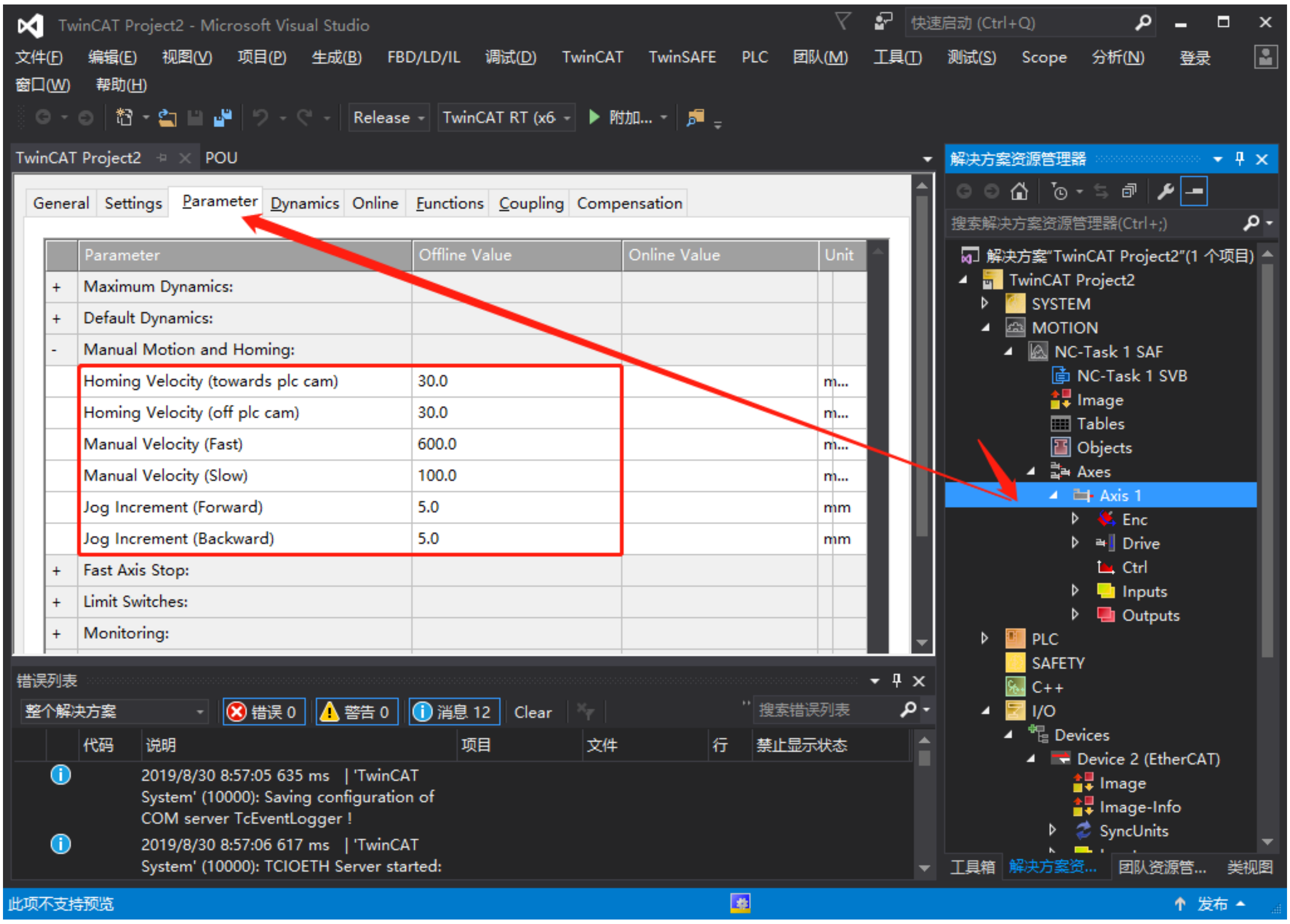


Figure 210 Setting manual control parameters

PLC program creation

- Before starting, click【TwinCAT】→【Restart TwinCAT(Config Mode)】→【OK】→【NO】

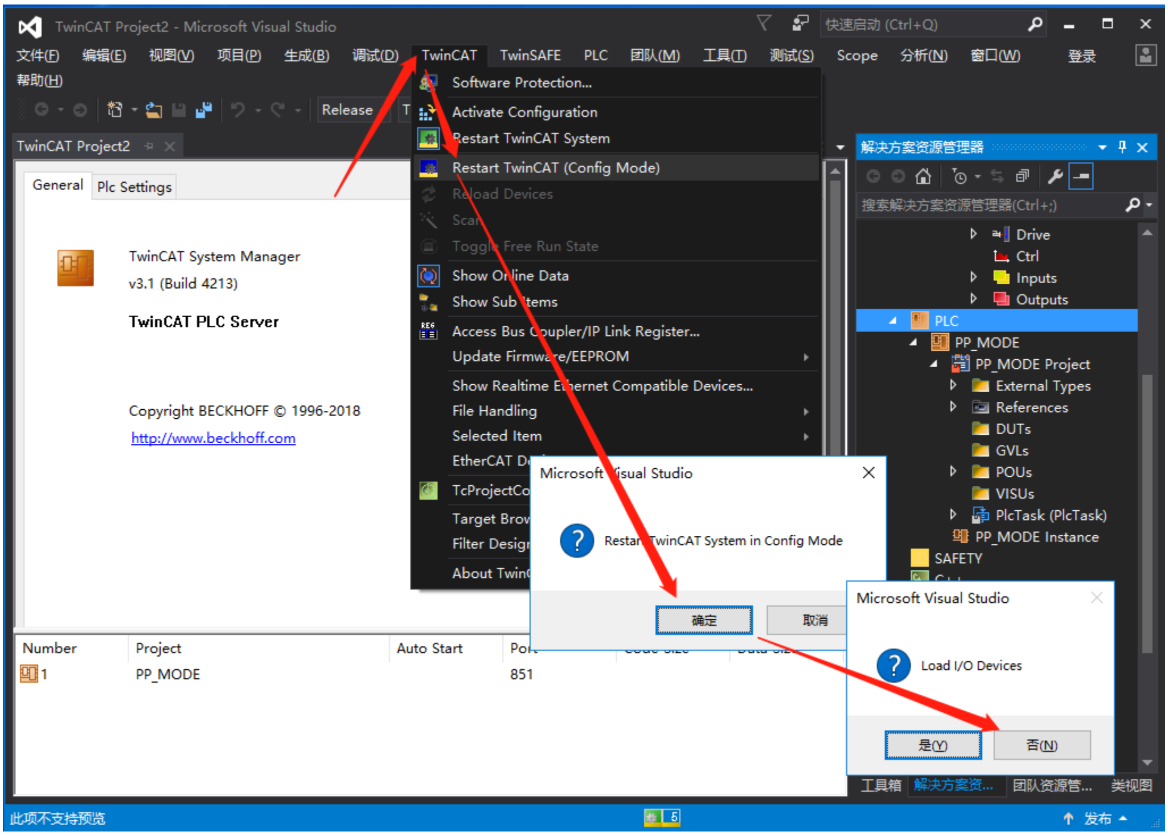


Figure 211 Enter configuration mode

Right mouse button【PLC】→click【Add new item】

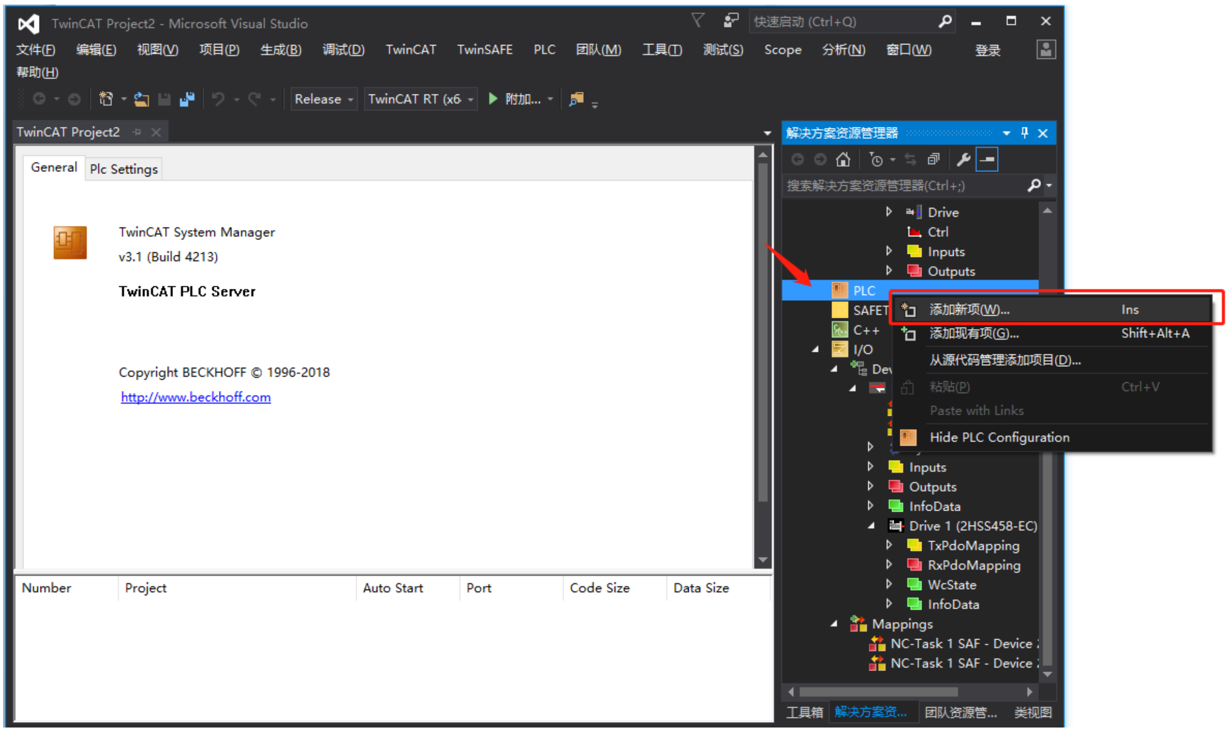


Figure 211 Enter configuration mode

Right mouse button【PLC】→click【Add new item】

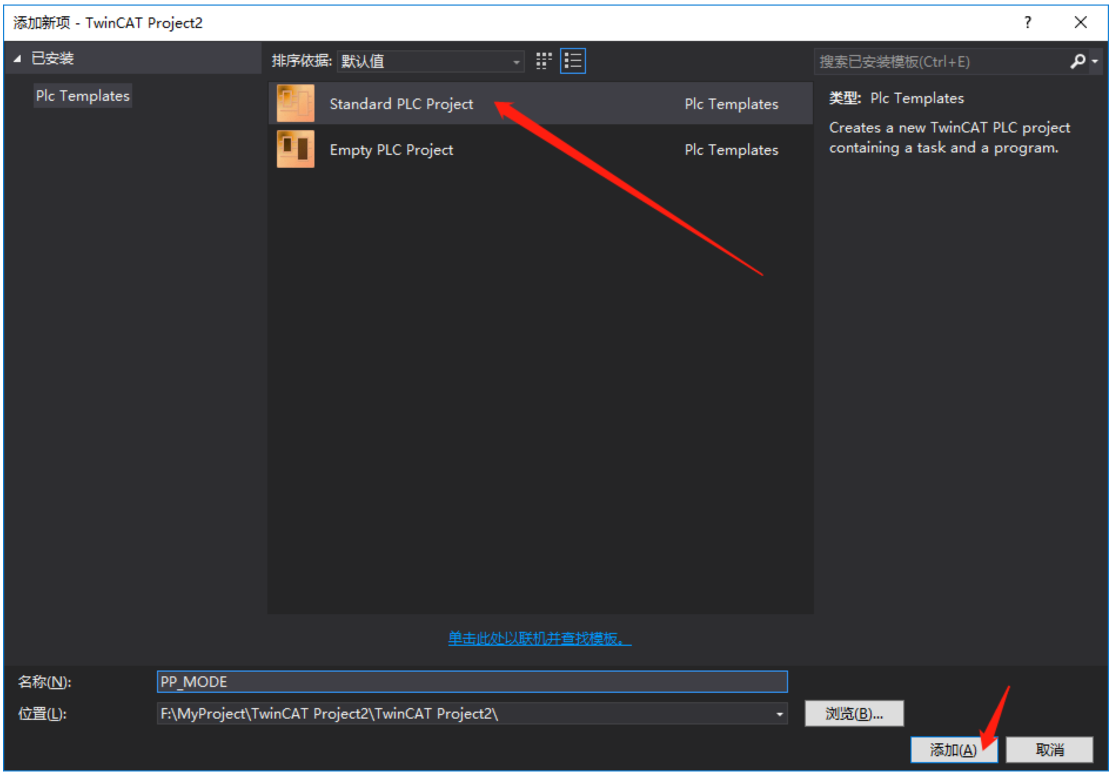


Figure 212 Add PLC project

- Expand the PLC tree, right-click【POUs】→【Add】→click【POU】
- This example uses ladder diagram programming as an example, set 【Name】, 【Type】 and 【Implementation Language】, click 【Open】

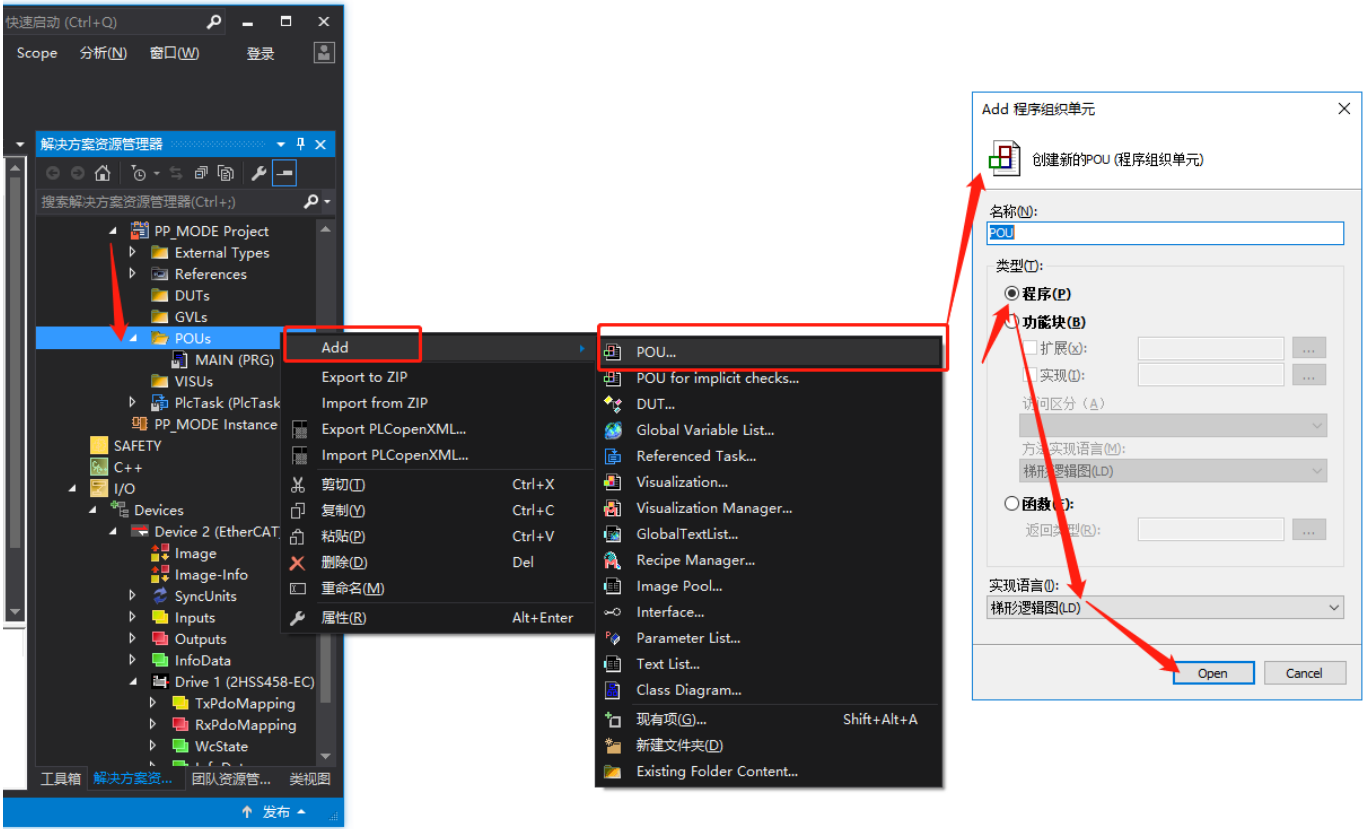


Figure 214 Add POU program

- To add PLC tasks (POUs) to be run, right-click, select 【Add】 → click【Existing Item】

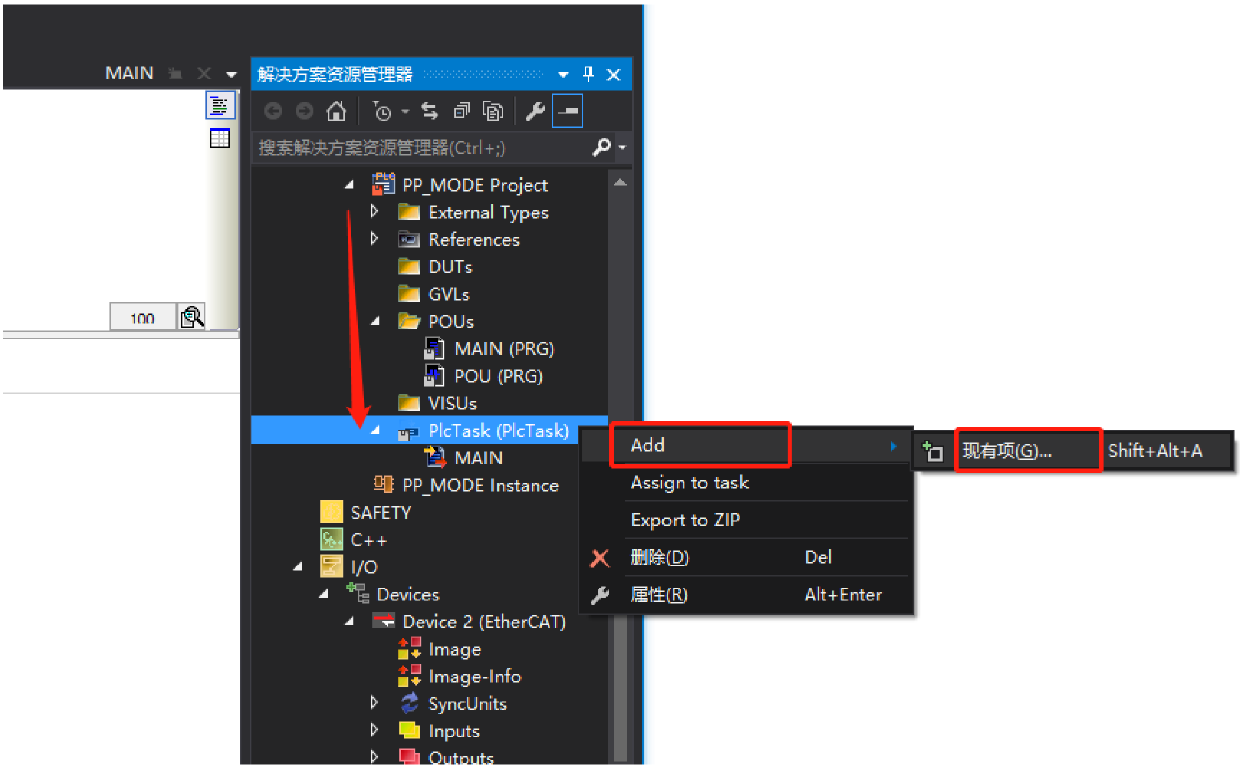


Fig 20 add PLC task

- Click 【Category】 → 【Programs】 → select the required program files under the POUs in the current project → click【OK】

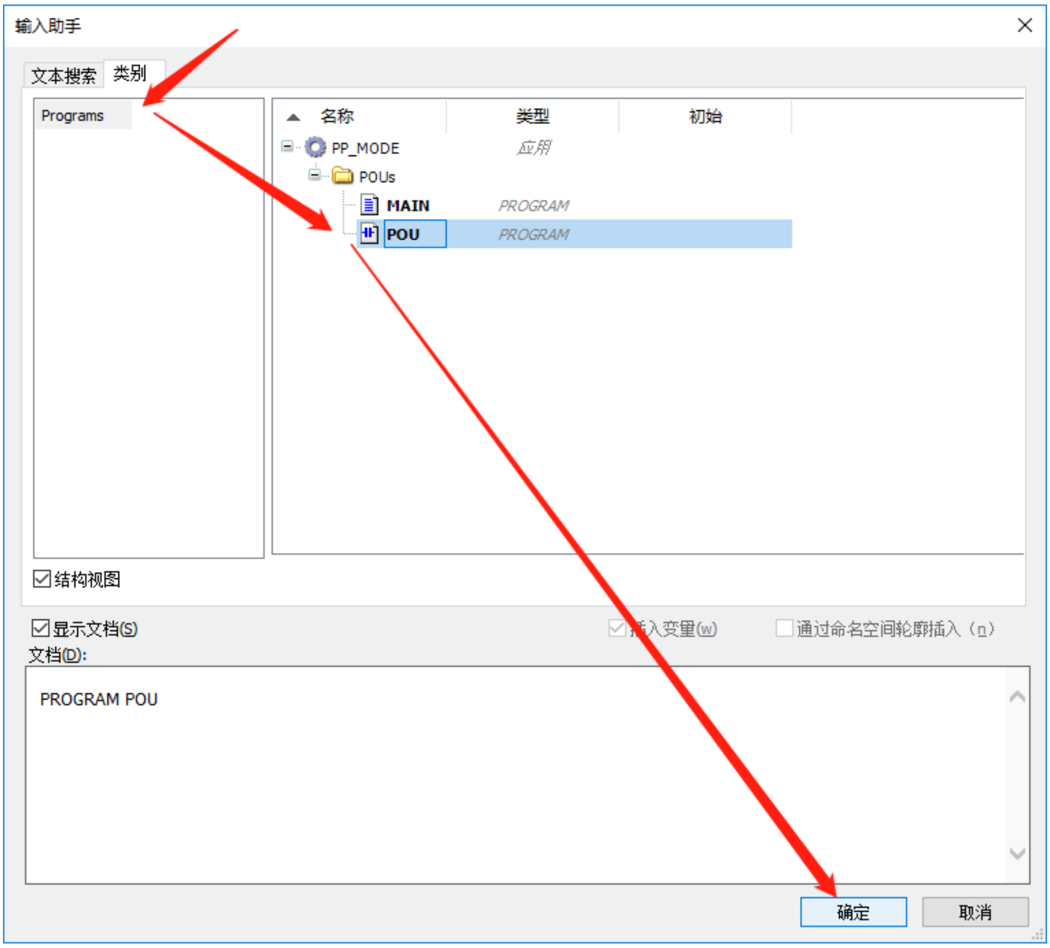
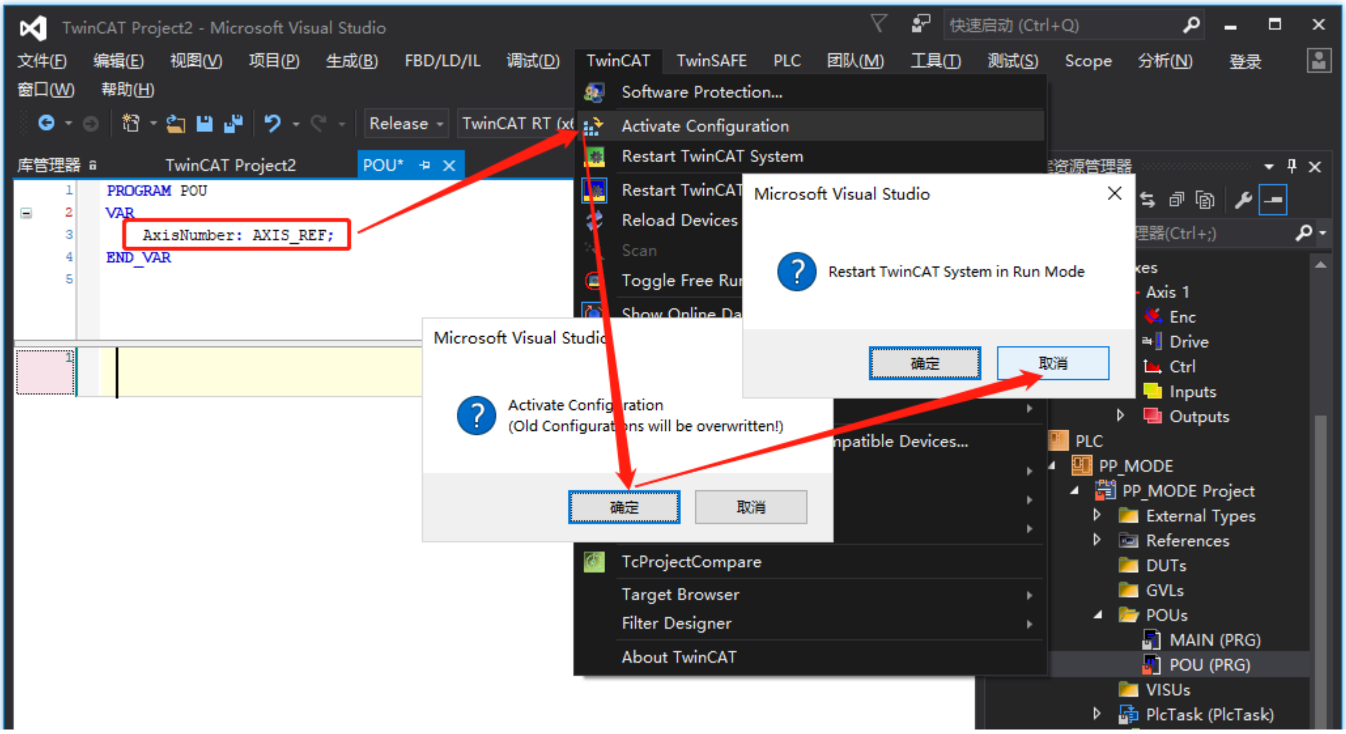


Figure 216 Select PLC task

- We need to first create the AXIS_REF variable (users can also set the variable as an array of global variables to facilitate the configuration of multiple axes), and click 【Activate Configuration】 to activate the configuration → 【OK】→【Cancel】



- Figure 217 creates the axis variable
- Then link the created variable to the corresponding axis
- Expand【Motion】→【NC-Task 1 SAF】→【Axes】→ click【Axis1】→ click the tab【Setting】
- Click 【Link To PLC】→ select the created variable → click 【OK】

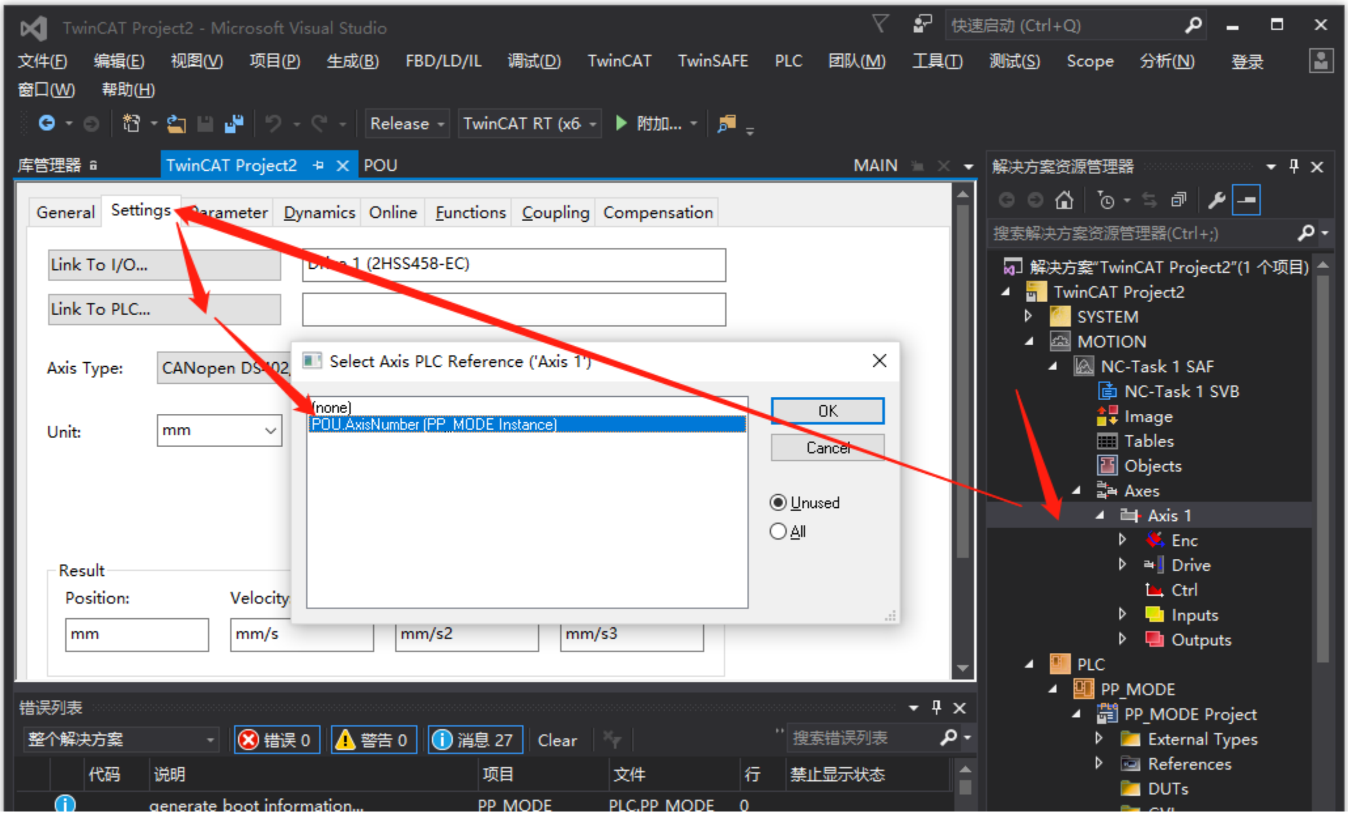


Figure 218. Link axis variables1 Control method I

- Because we will use the official motion control library, we need to add it to the project first.
- Right click【References】→click【Add library】

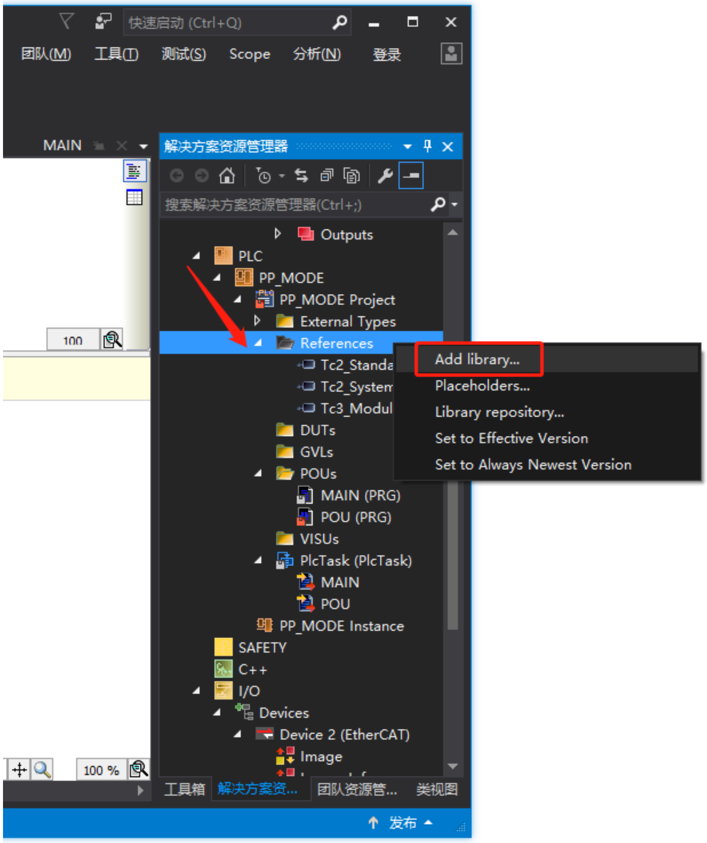


Figure 219 Add library

- Selcet【Motion】→【PTP】→【Tc2_MC2】(Added according to specific needs)

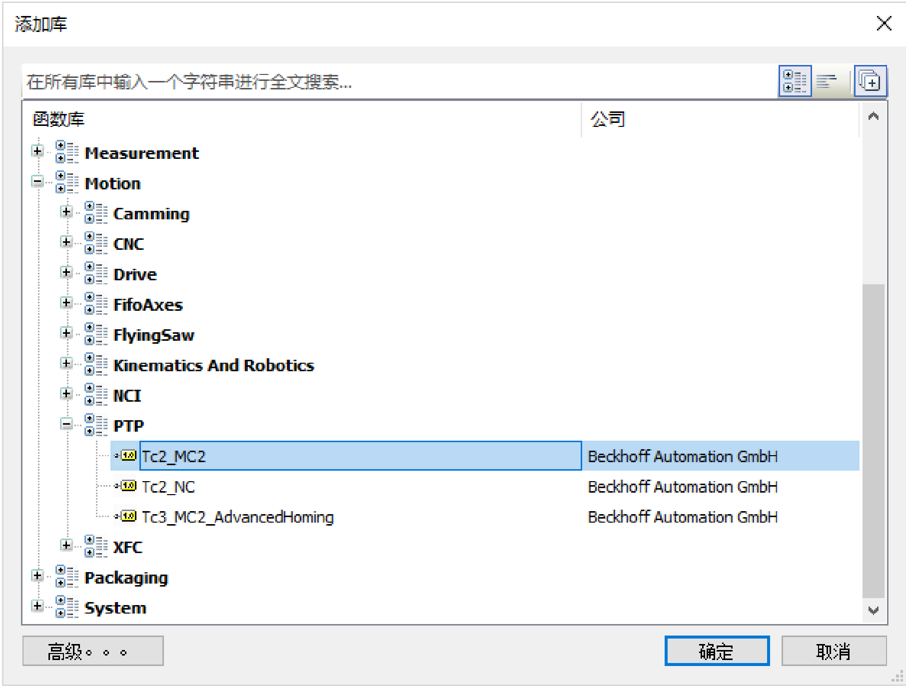


Figure 220 Select control motion library

- Click the created program in 【POUs】, in the program section, right-click and select Insert Operation Block

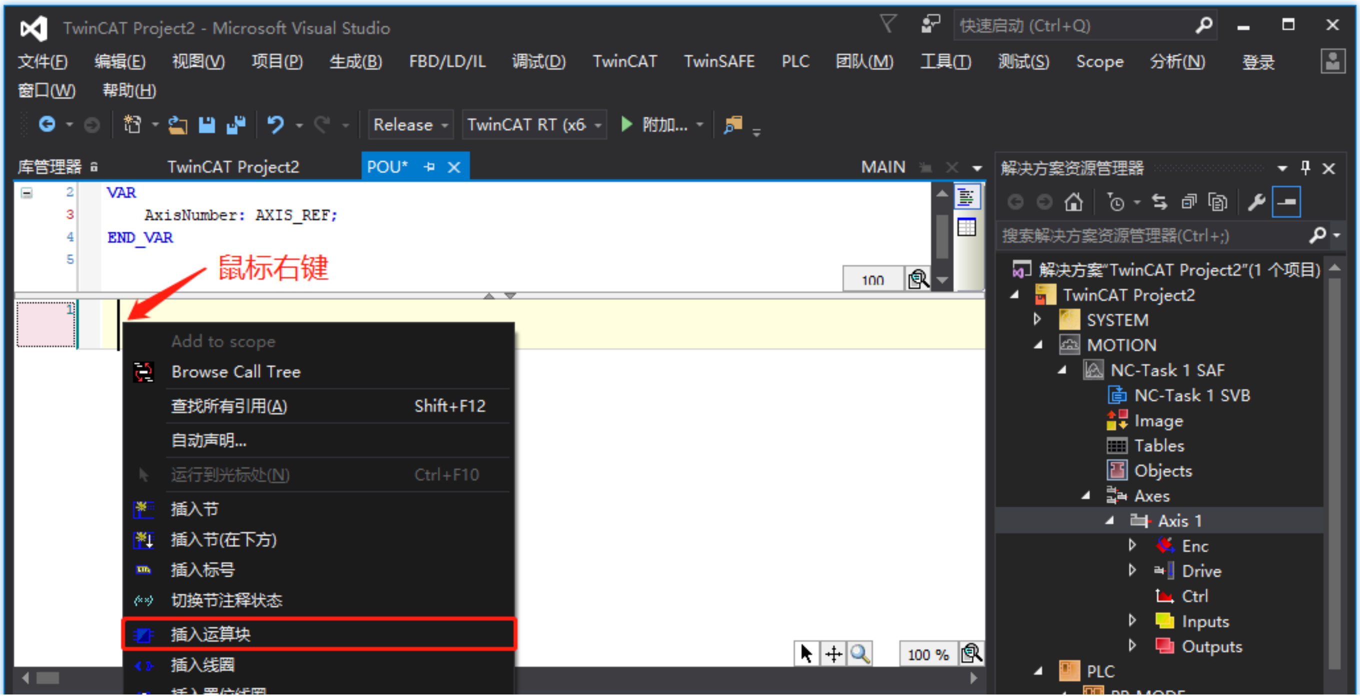


Fig. 221 Insert operation block

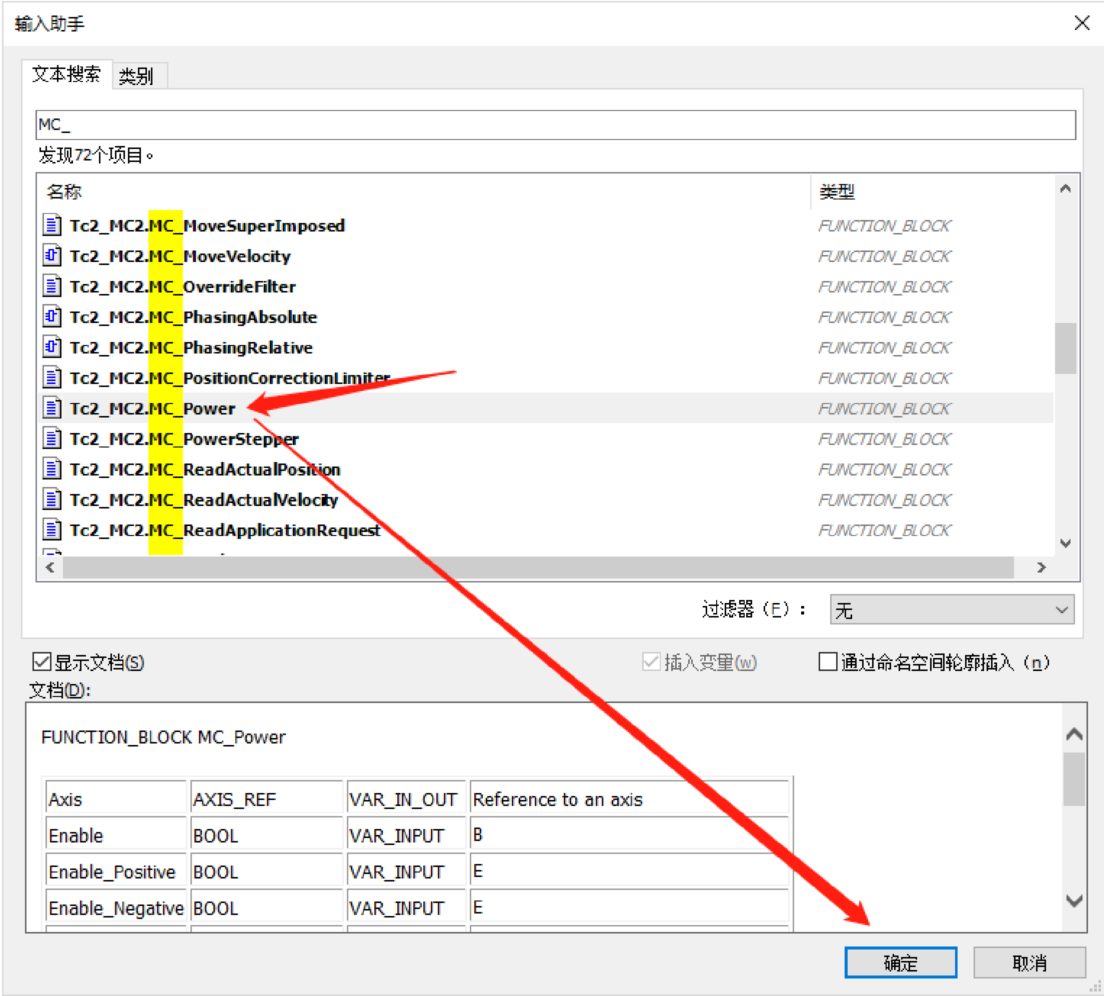
- Find the corresponding function block and click 【OK】 (MC_Power is used to send the enable command)
- 

Fig 21 Select function block

- The following are the routines of the function block of point control. When using, you can go to 【I/O】→【Devices】→【Device 2(EtherCAT)】→tab 【NC : Online】to view the real-time feedback data

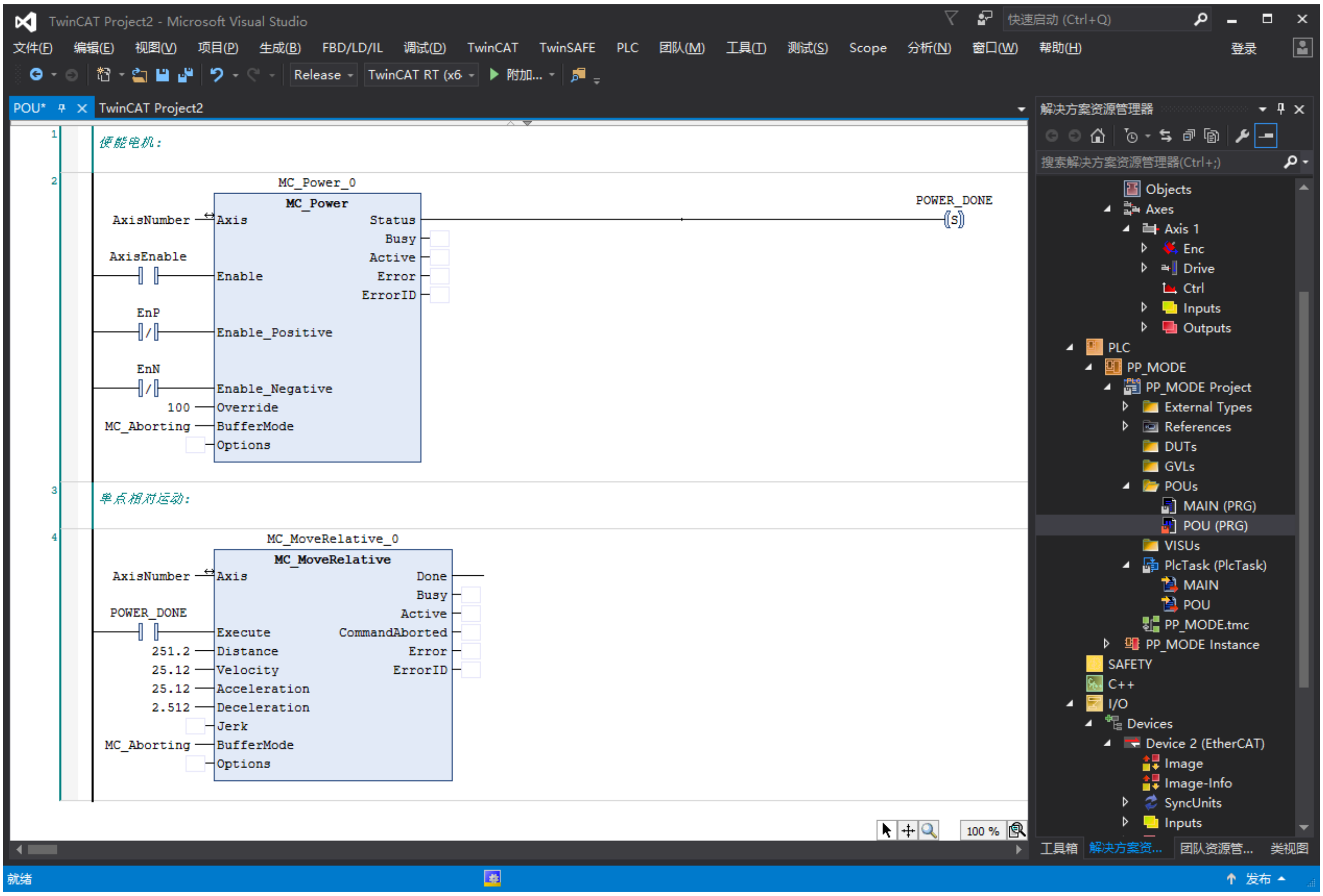


Figure 223 Point control routine

Tip: Because Beckhoff has many function blocks, the usage is similar, so I will NOt repeat them here. For details, please refer to the official help document:

https://infosys.beckhoff.com/english.php?content=../content/1033/tcplclib_tc2_standard/9007199329144587.html&id=

2 Control method · II

The second method is to NOt use the functions in the Beckhoff motion control library, but directly modify the PDO mapping data to achieve motion control. This method is slightly different from the engineering setting process of method one. The following will start after completing the configuration of the motor shaft.

- Right-click the mouse to select the program "POU(PRG)" written in 【POUs】and select 【Remove】.

NOte: Select 【Remove】 instead of 【Delete】, if you select【Delete】, the POU program file will be deleted completely

- Select the corresponding POU program task in【PlcTask(PlcTask)】, and then right-click→【Delete】→OK

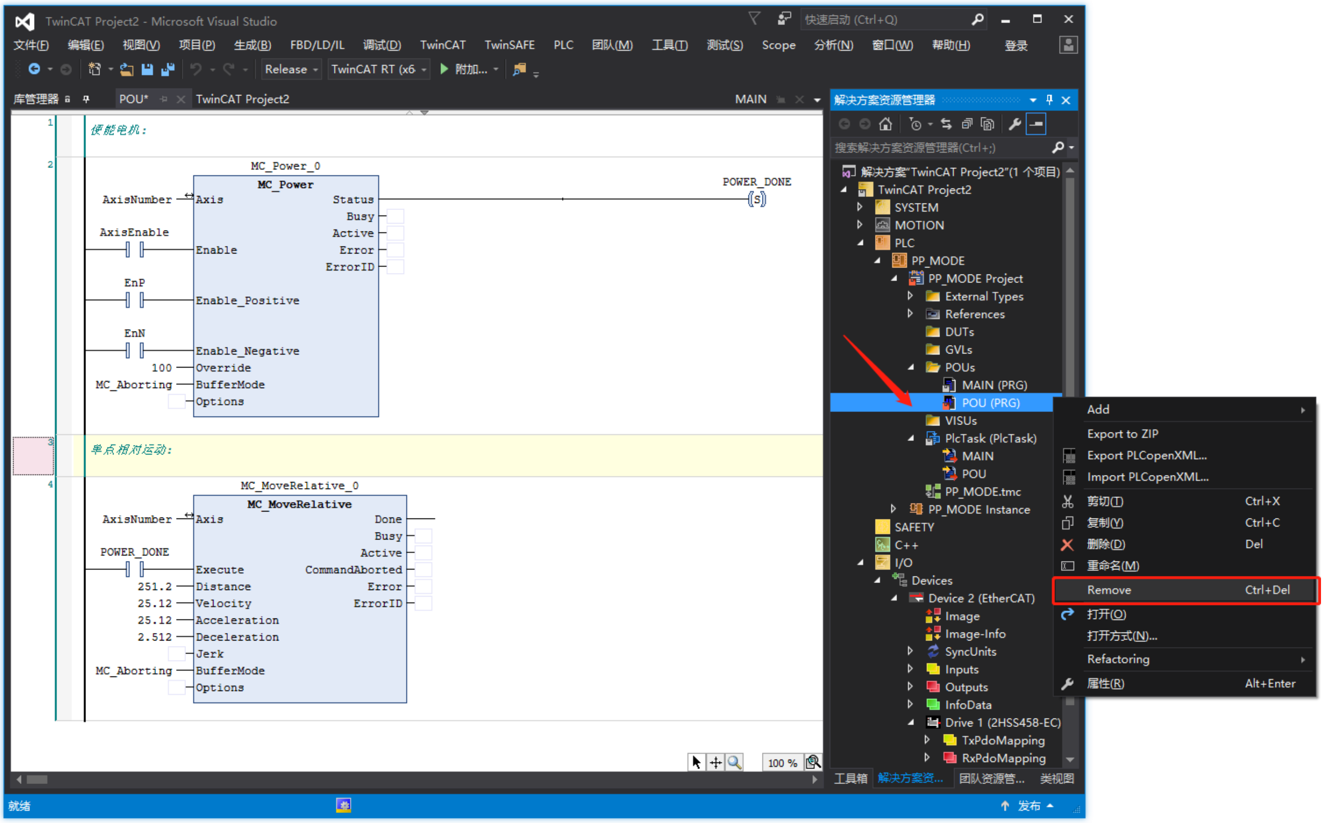


Figure 224 Removes the POU

- Next, create a new POU program and add it to the PLC task, please follow the previous operation

NOte: After creating a new POU program, you need to re-create a new variable linked to the corresponding axis number. Therefore, it is NOt difficult to find that the variable for linking is best set as a global variable to avoid the need to repeatedly link the motor shaft.

- Open the PLC tree →right key【GVLs】→【Add】→【Global Variable List】
- Set the name of the variable list, click【Open】

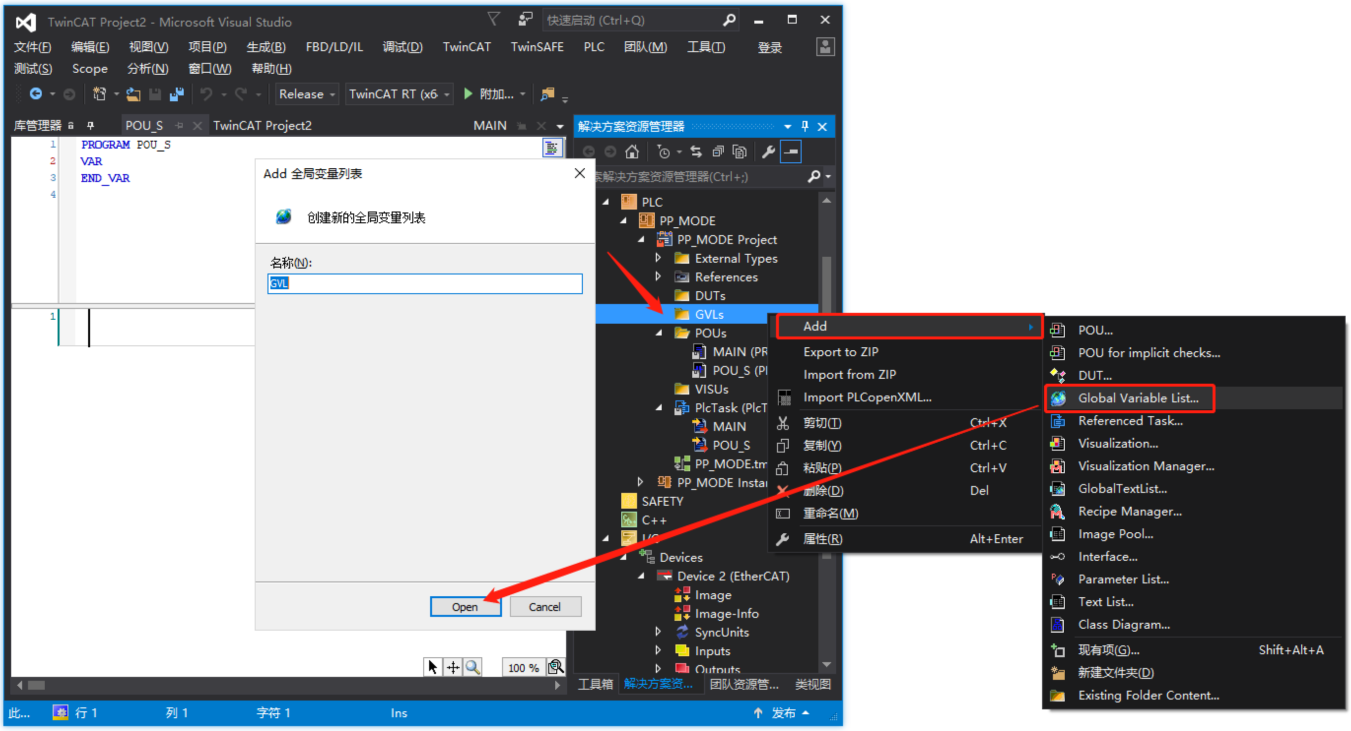


Figure 225 Add global variable list

- In order to add multiple axes in the future, set the axis parameters to an array of AXIS_REF type, and then click 【Activate Configuration】 to activate the configuration, and operate as before

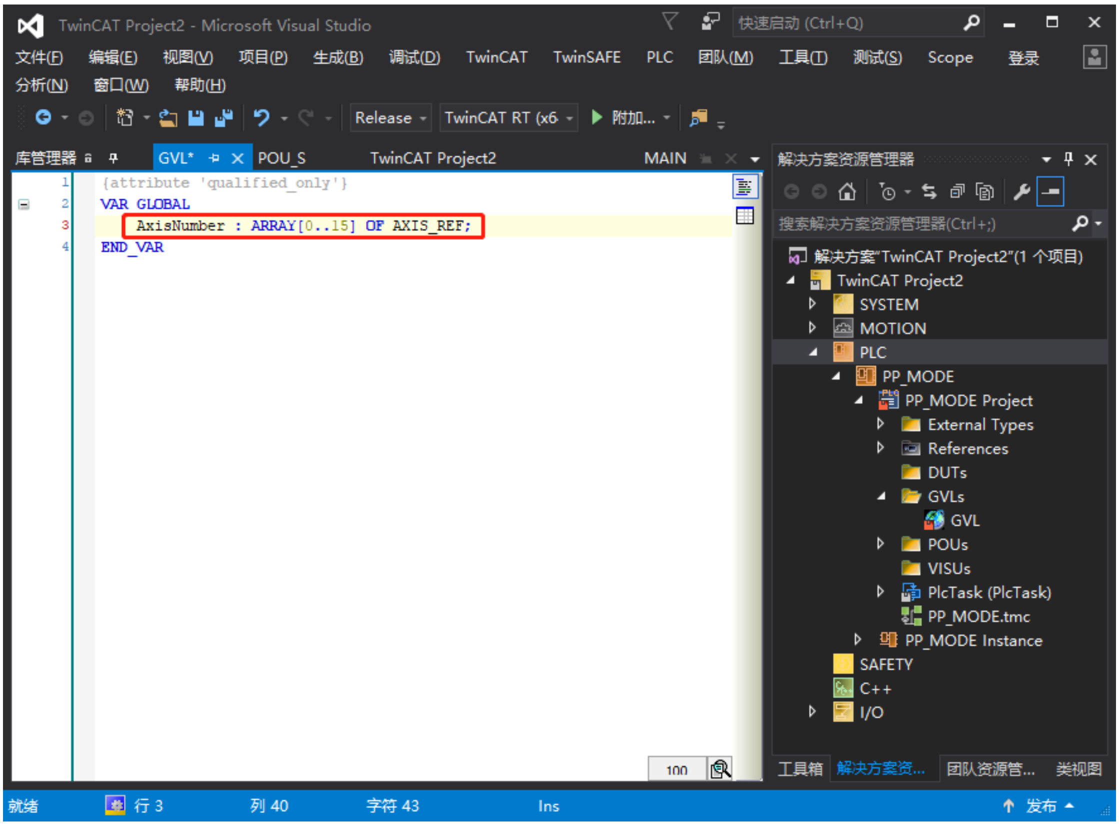


Figure 226 Add axis parameter group

- Select an address in the array to link to the axis, here select GVL.AxisNumber[0]

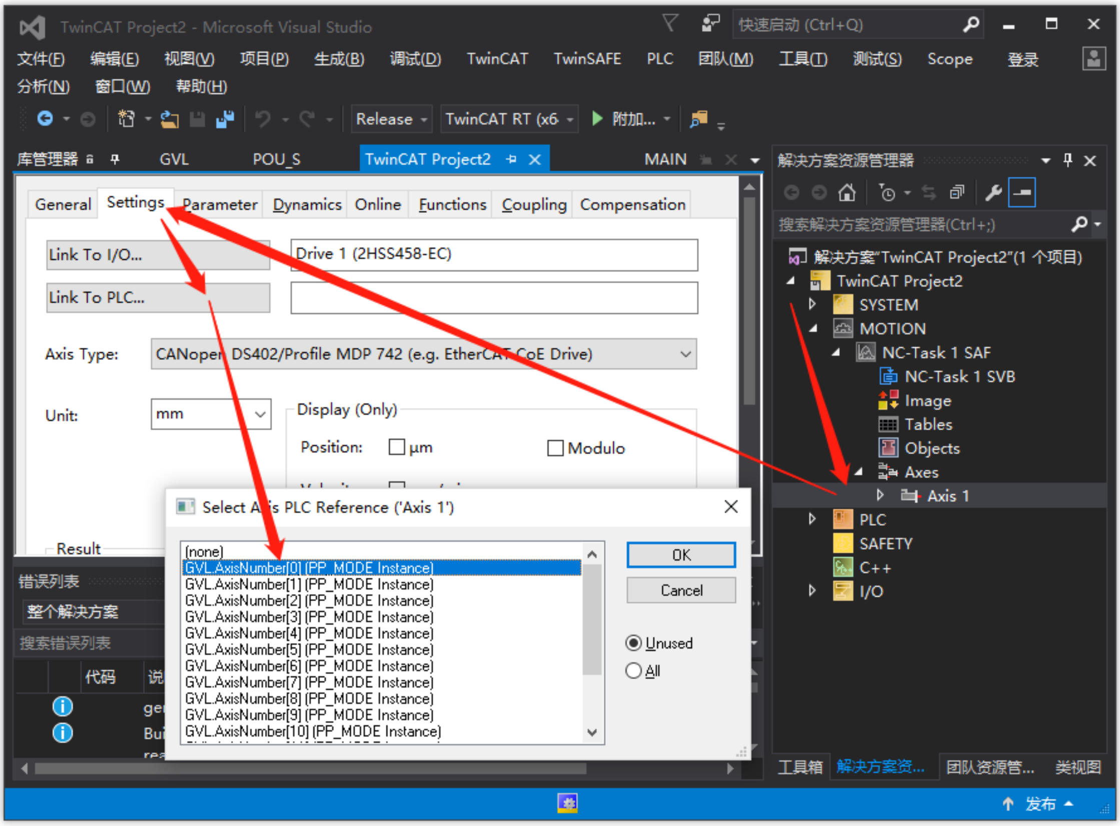


Figure 227 Link to corresponding axis number

- Then we need to configure the PDO mapping, open【I/O】→【Devices】→【Device 2(EtherCAT)】→【Drive 1】→Click the tab【Process Data】→Select one of the PDO indexes

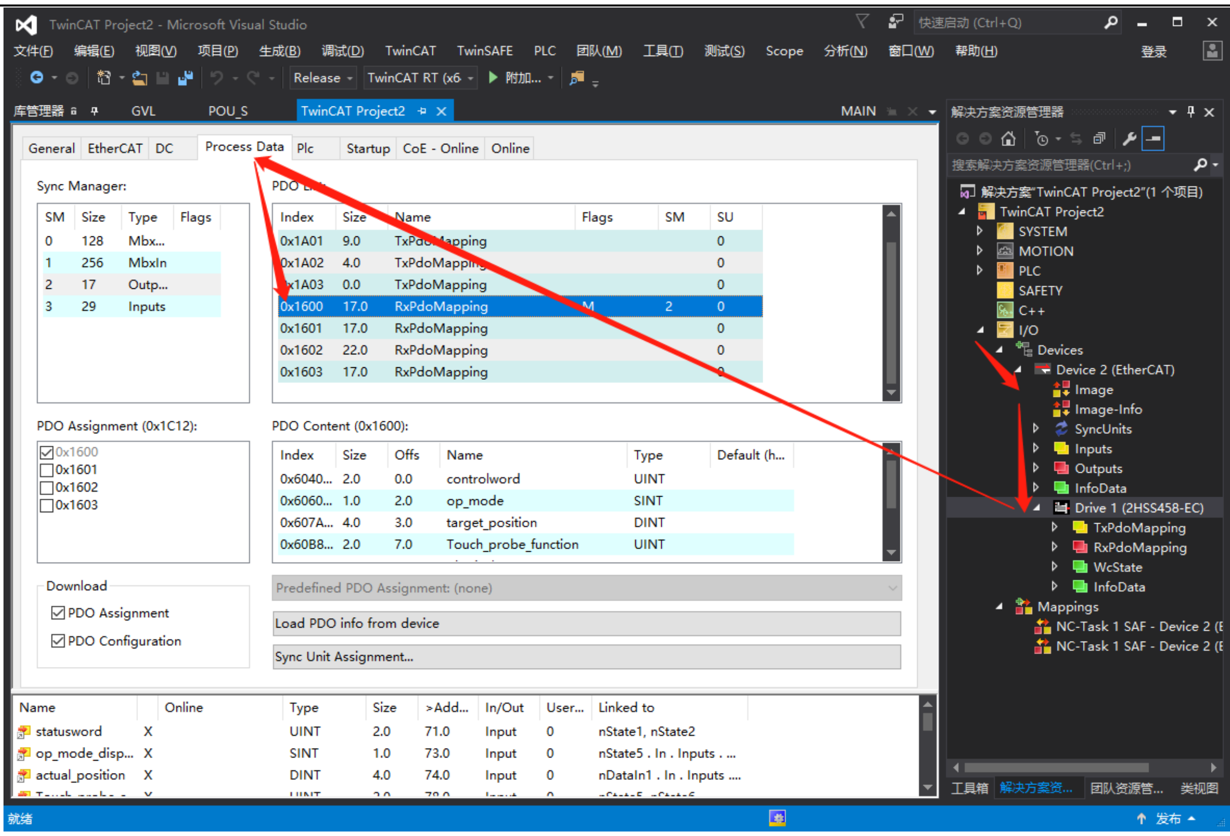


Figure 228 Modify PDO

- Delete【Delete】to remove the unnecessary object index, and insert【Insert】the required object index

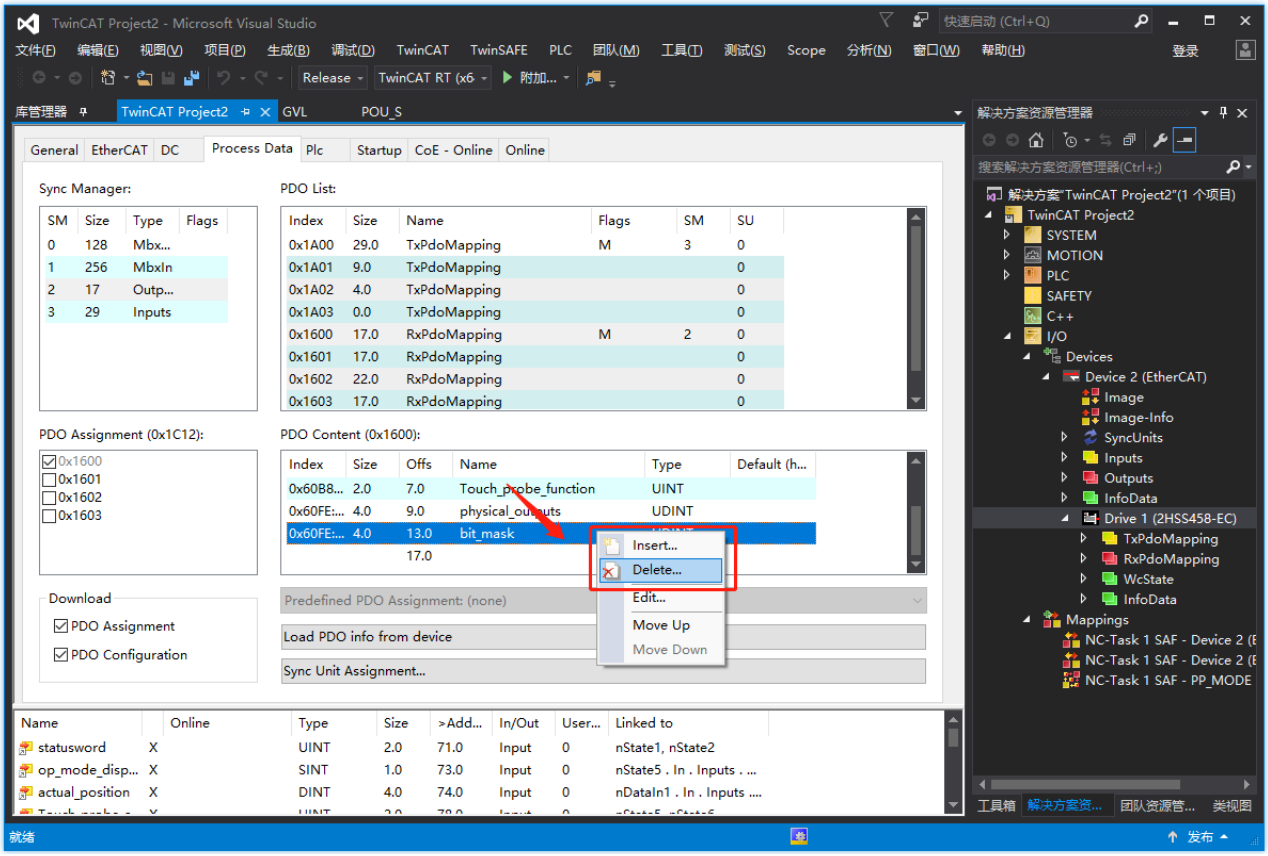


Figure 229 Modify PDO index

- Here we add the commonly used ones to the PDO mapping

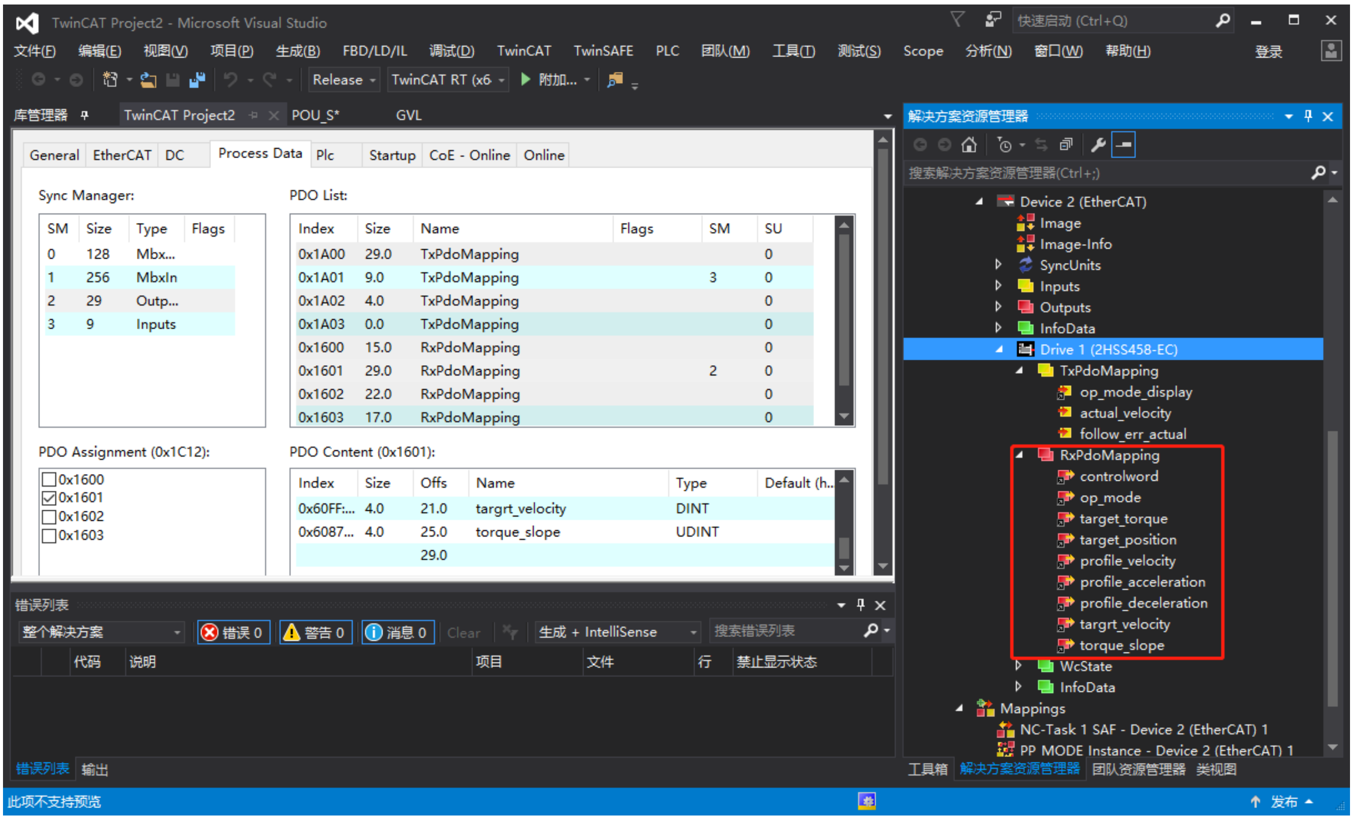


Fig 22 RxPDOMapping

- Then we add the corresponding output variable to the created POU program variable list, and click【Activate Configuration】] to activate the configuration

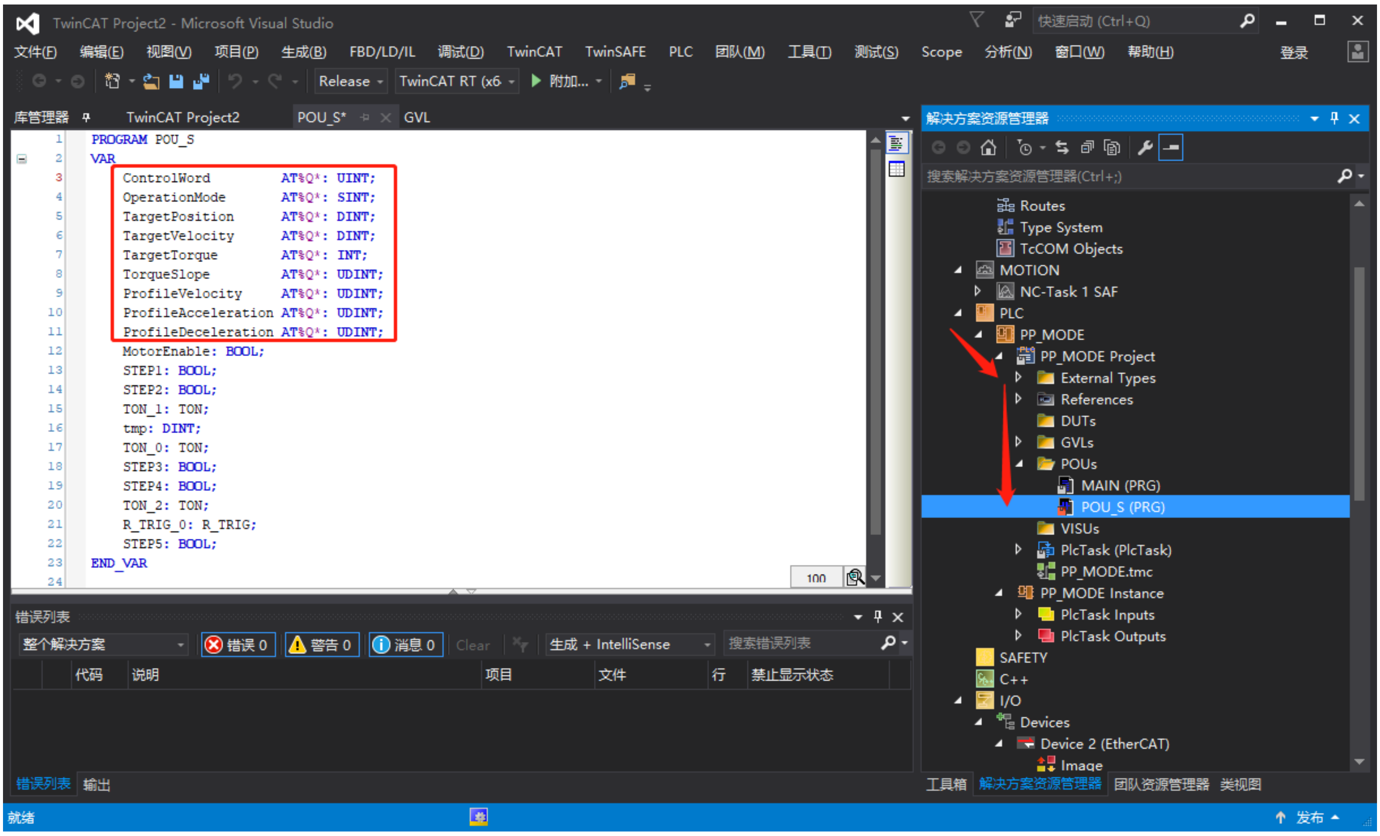


Figure 231 Add output variable

- Then we need to link the PDO mapped variables to the PLC program variables
- Open 【I/O】→【Devices】→【Device 2(EtherCAT)】→【Drive 1】→【RxPdoMapping】→Click on one of the PDO indexes→click【Linked to】→Select the corresponding PLC output variable→click【OK】

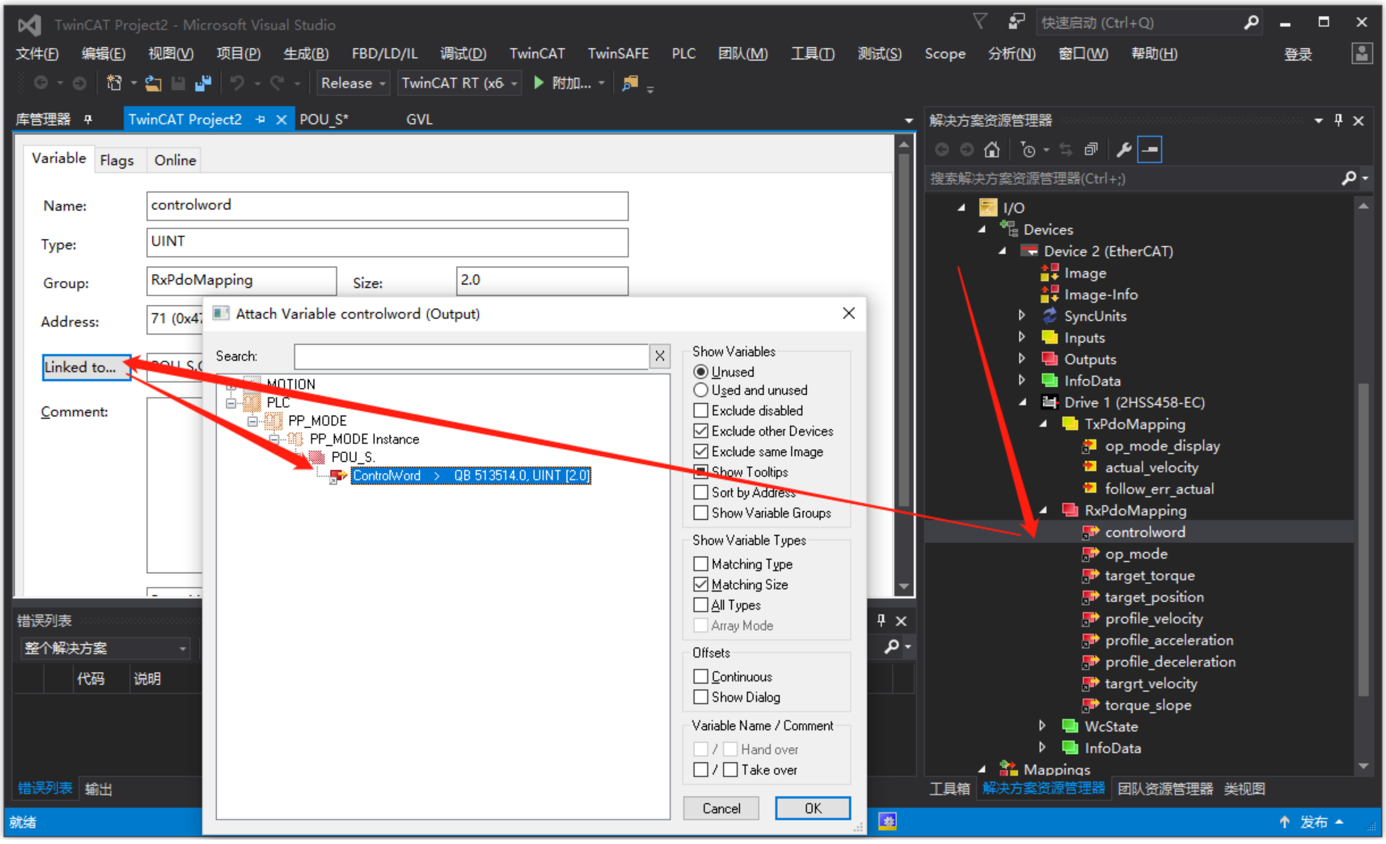


Figure 232 Link to output variable

- Link the required PDO mapping variables, write the program, and then click 【Activate Configuration】 to activate the configuration → 【OK】 to activate → 【OK】 to enter the operating mode

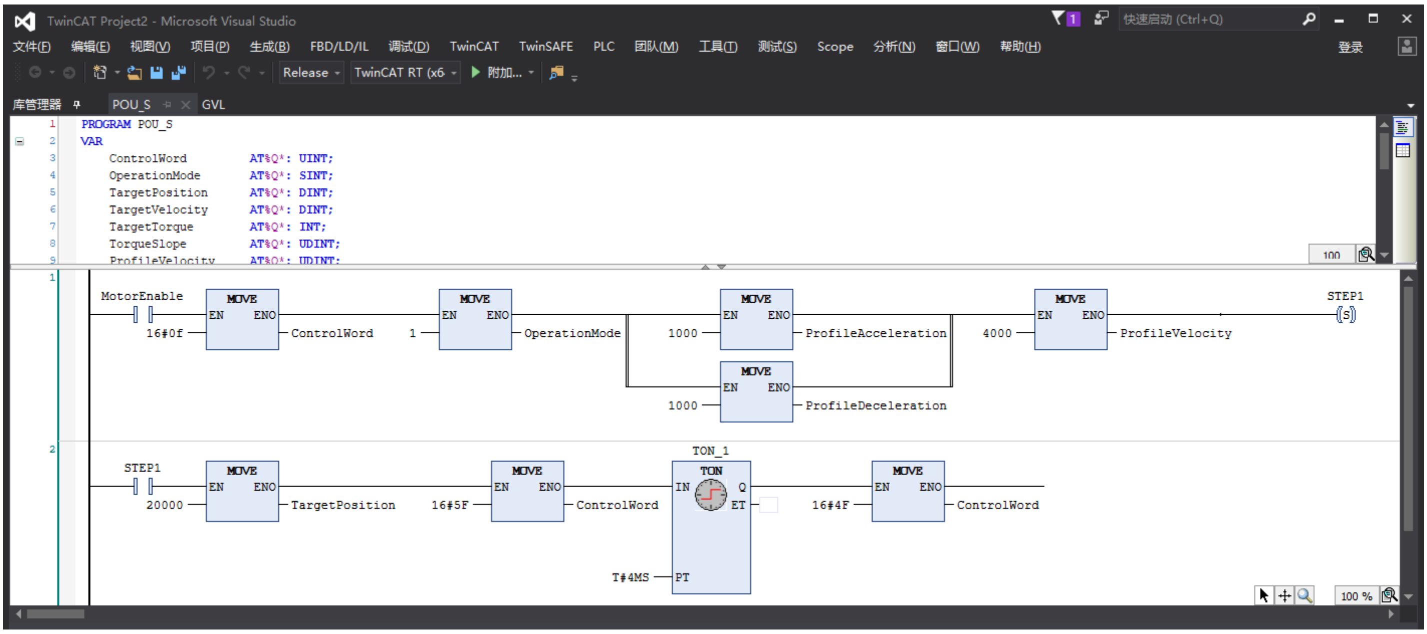


Fig. 233 Enter running mode

- Click [PLC] → select 【Login to】→ continue to download【YES】

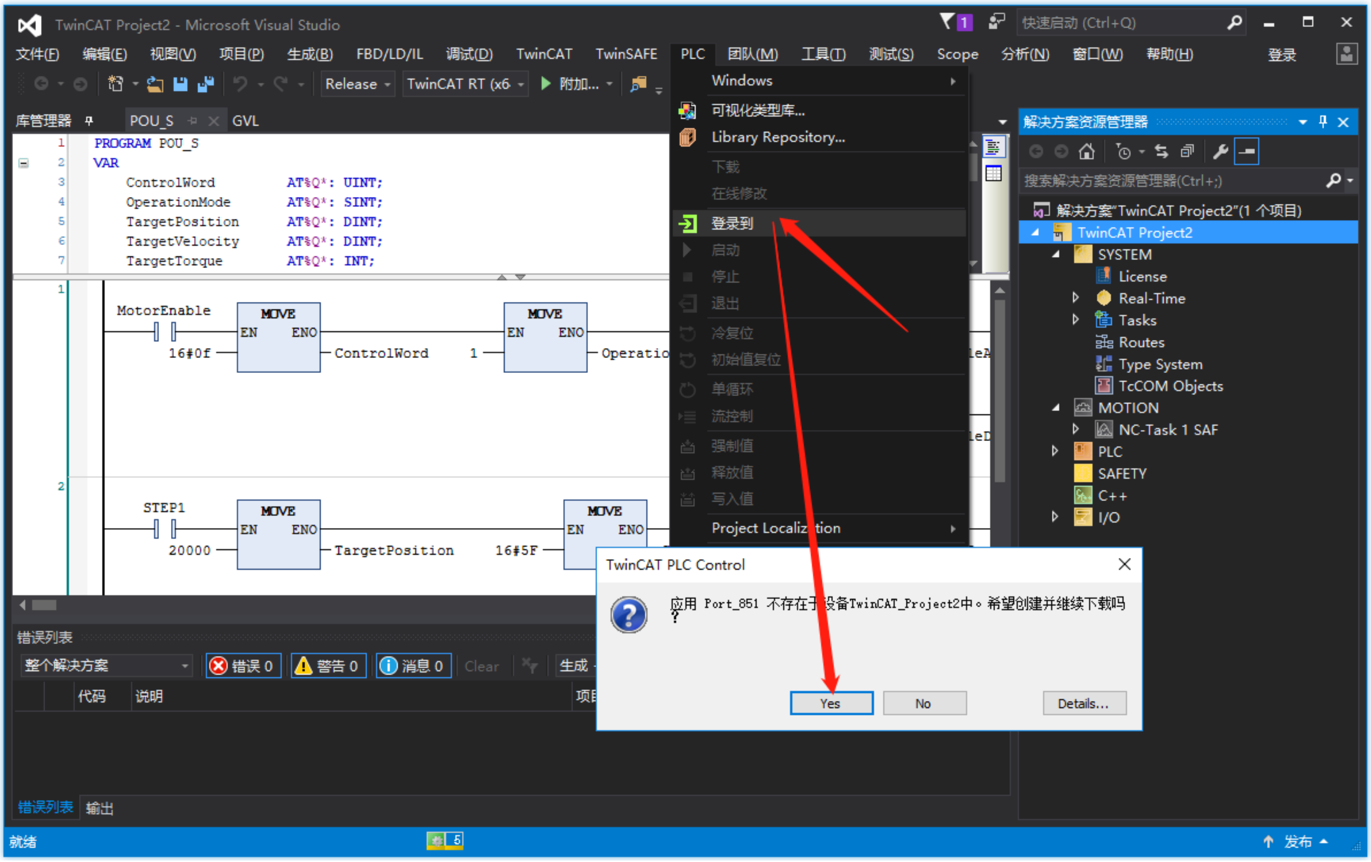


Figure 234 Confirm to continue downloading

- click【PLC】→select【start】

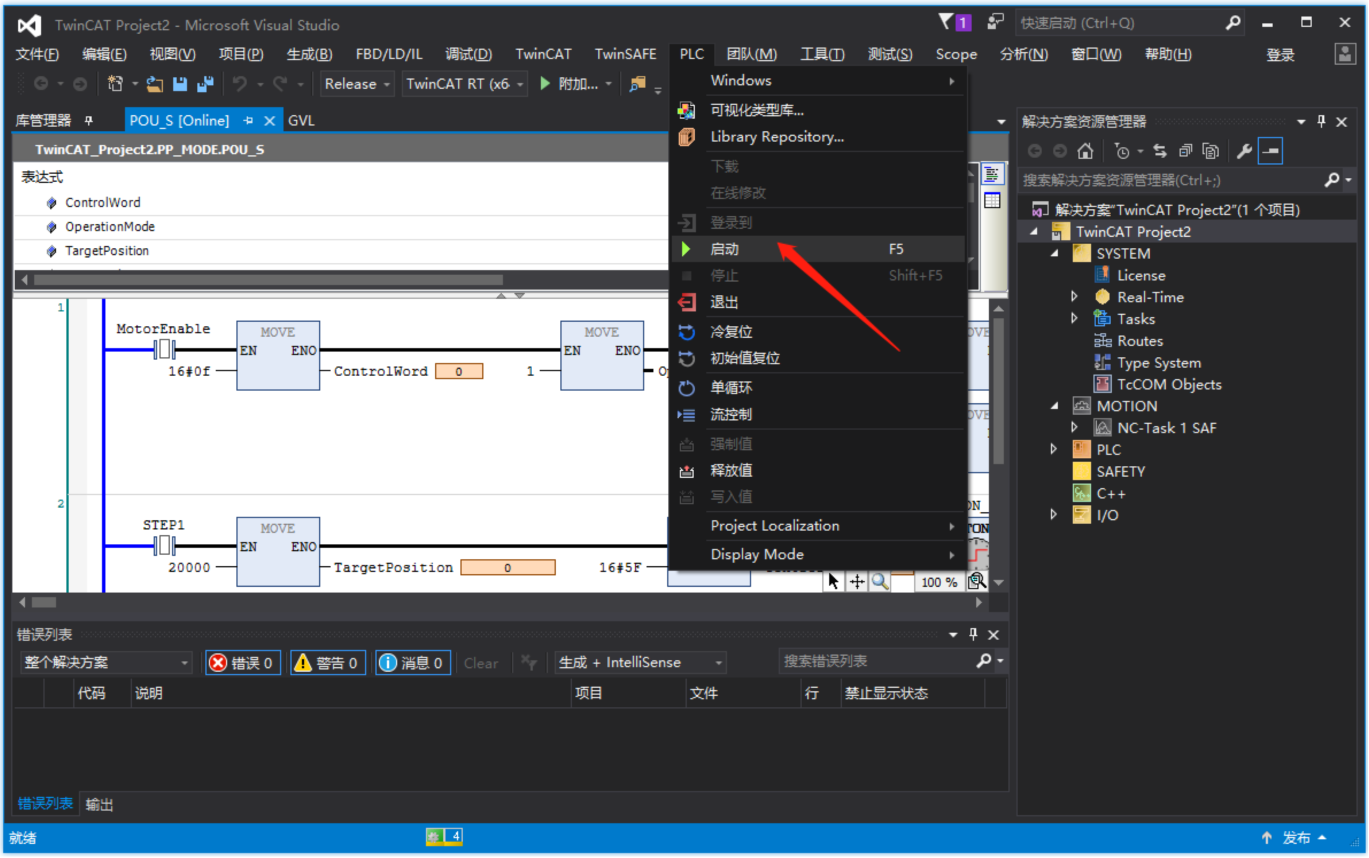


Fig. 235 Start PLC

- Then, the user can start to run the written program

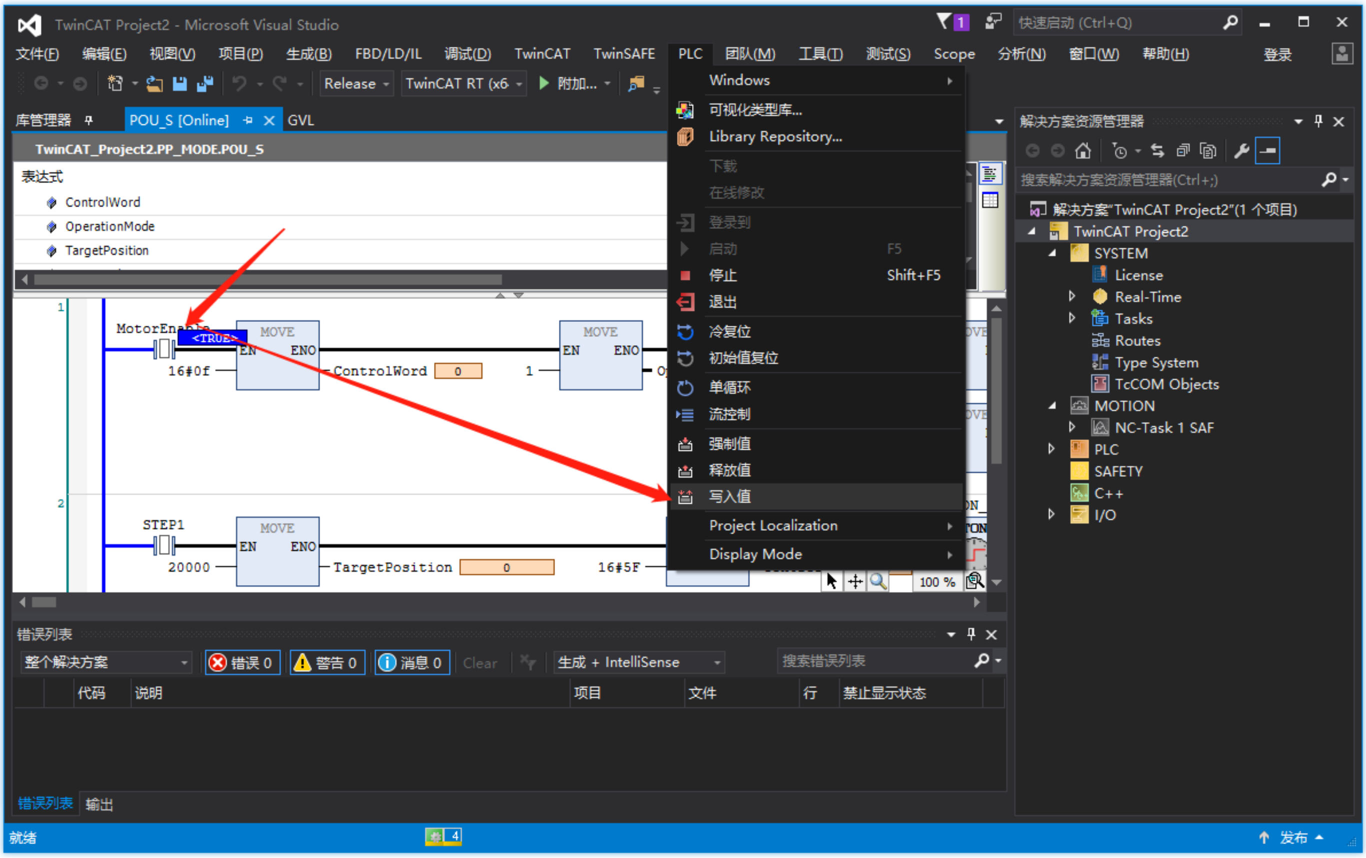


Figure 236 Running the program

EtherCAT communication operation routine based on INOvance controller

This routine will use the AM600 controller of Incheon and the 2DM542-EC of Jiemeikang Electromechanical as an object to explain the operation of EtherCAT communication.

Add slave device description file

- Open programming software INOProShop→Tools→Device Library

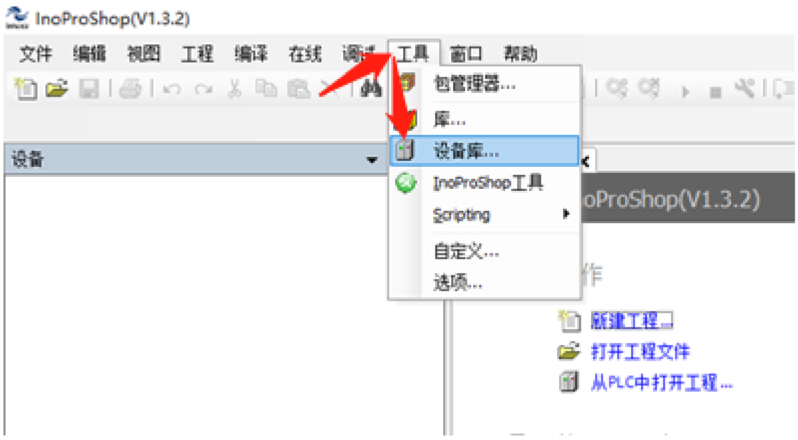


Figure 237 Open the device library

- Installation→Install slave device description file

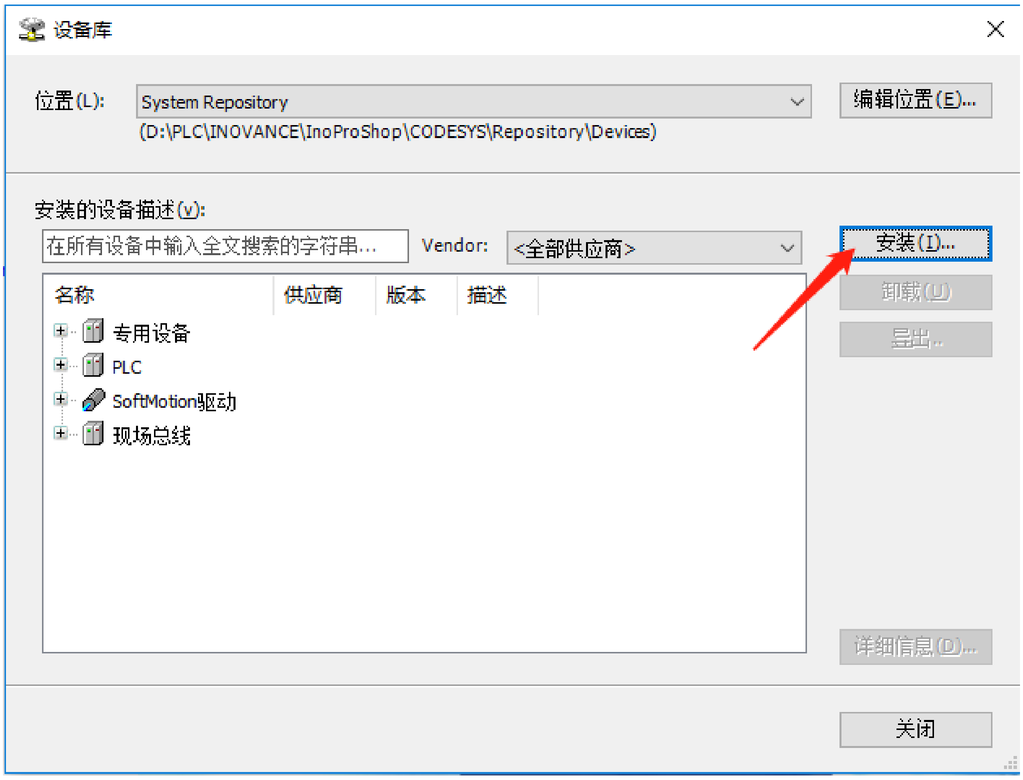


Figure 238 Install device description file

- Select XML file→Open

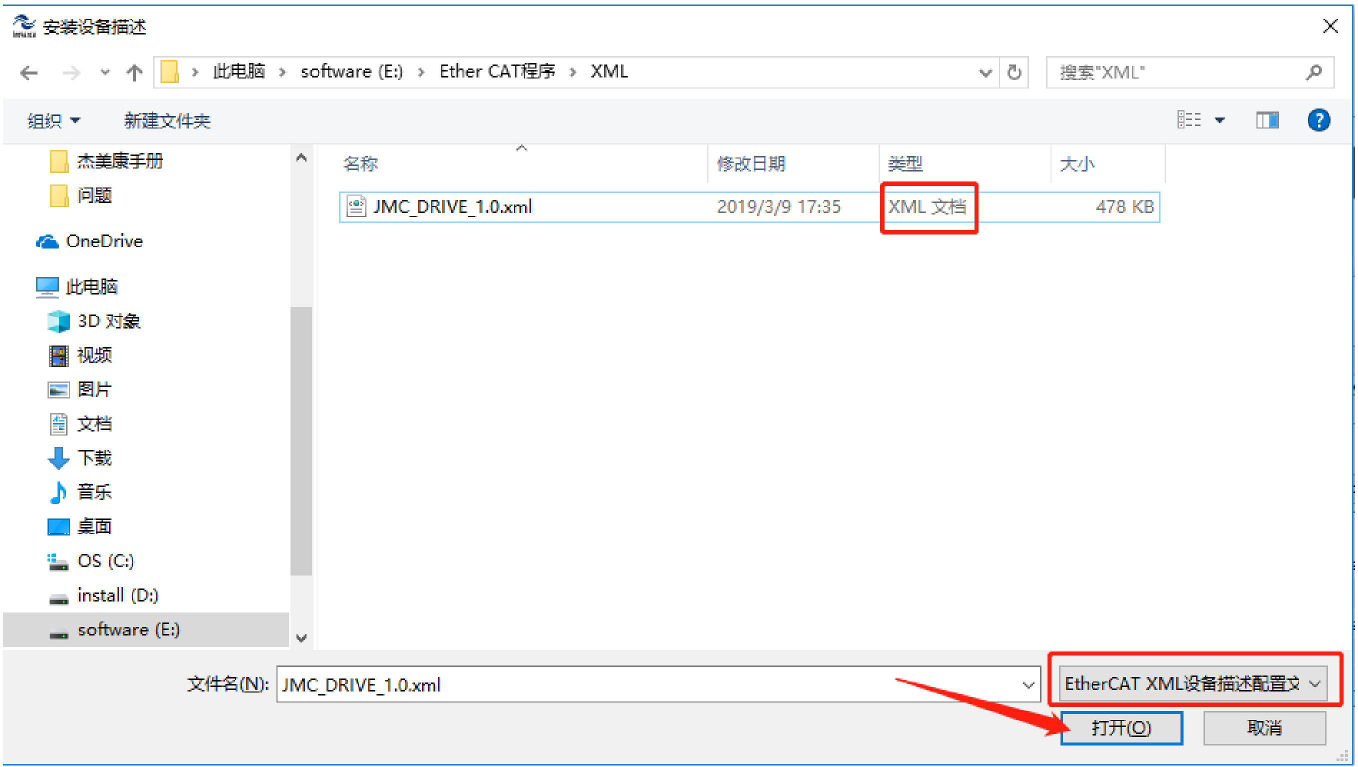


Figure 239 Select XML file

- After successful opening, the "Uninstall" button will NO longer be dim

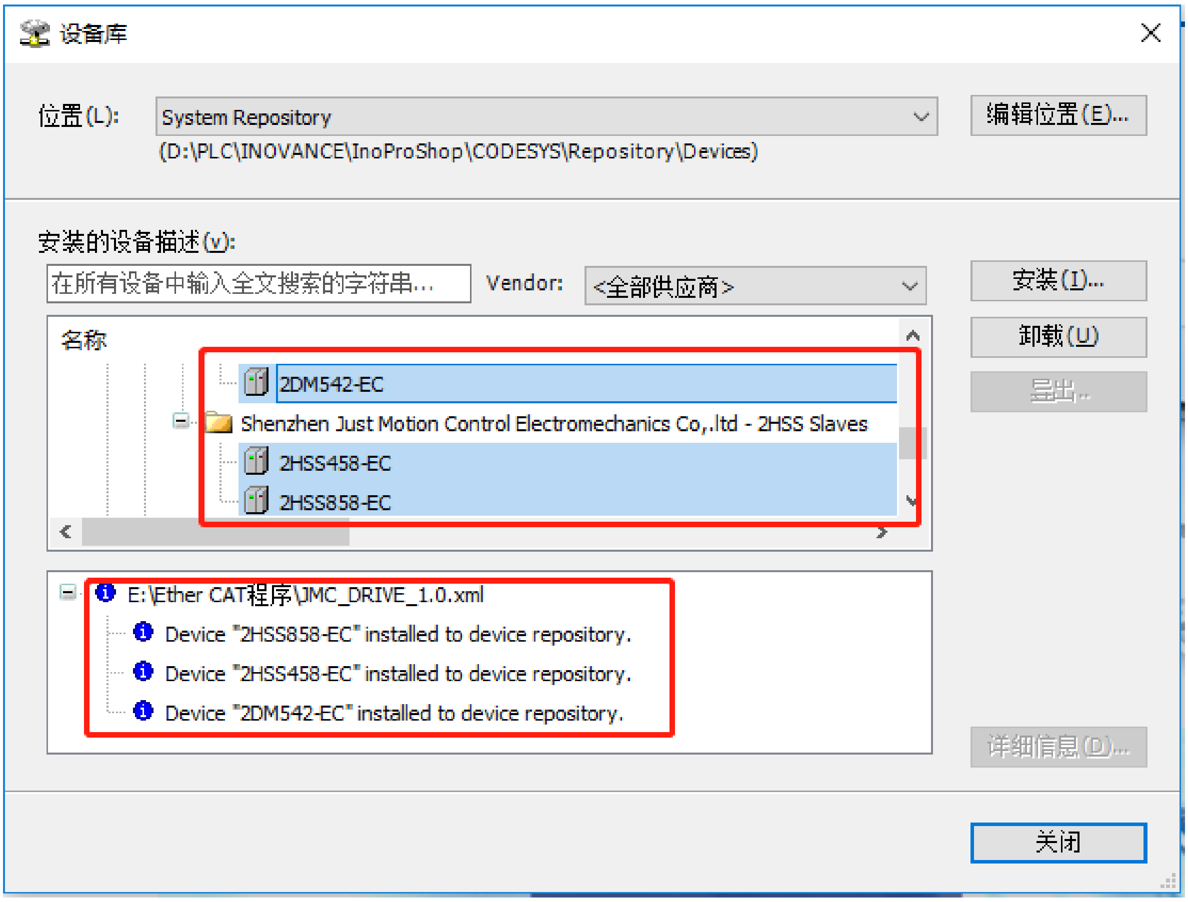


Figure 240 Successful installation

Create a project

- Click New Project

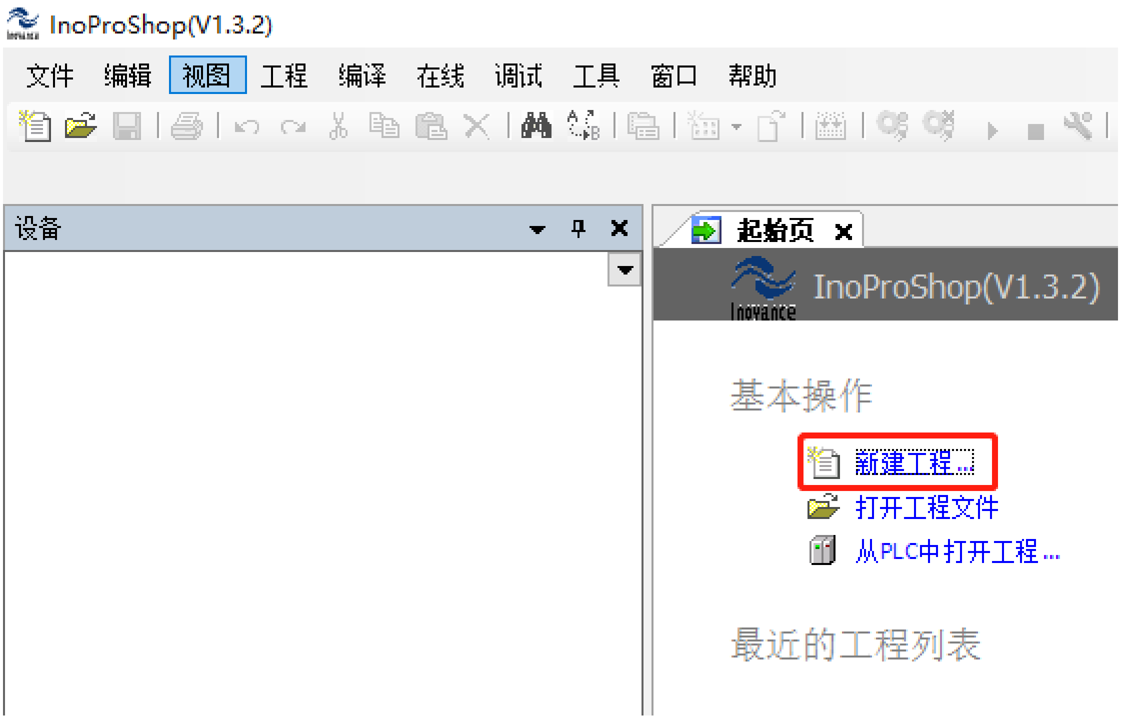


Figure 241 New INOProShop project

- Select "Standard Project" and determine the location and name of the EtherCAT project

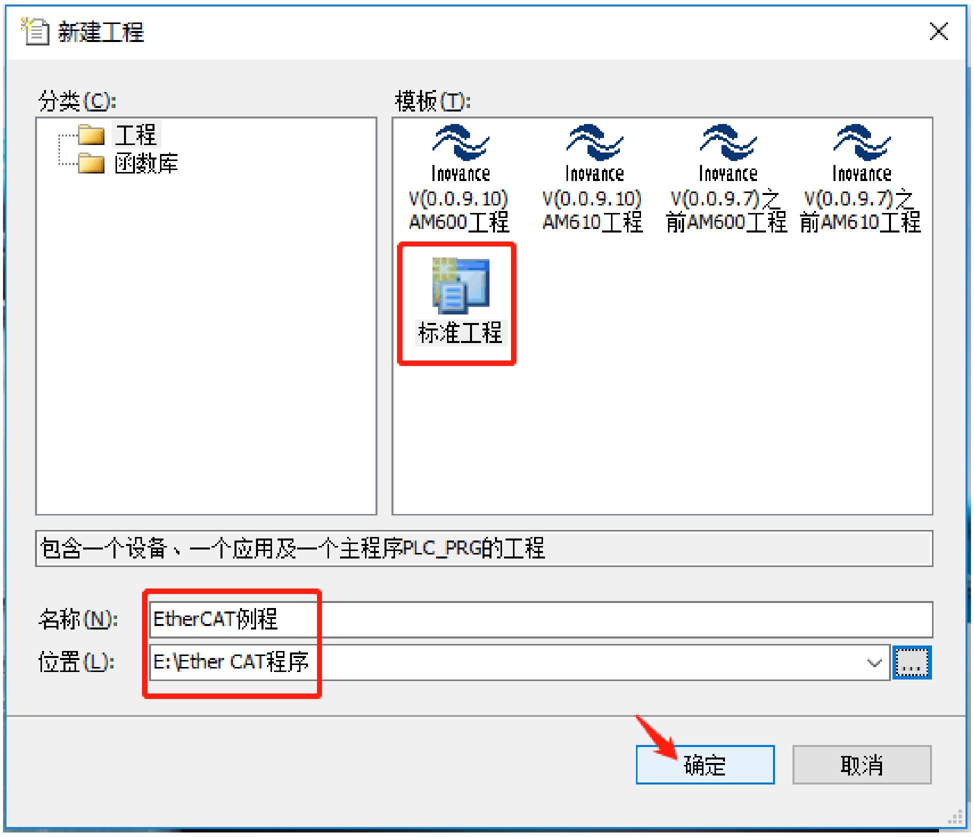


Figure 242 New standard project

- Select the device and programming language used, click OK
-

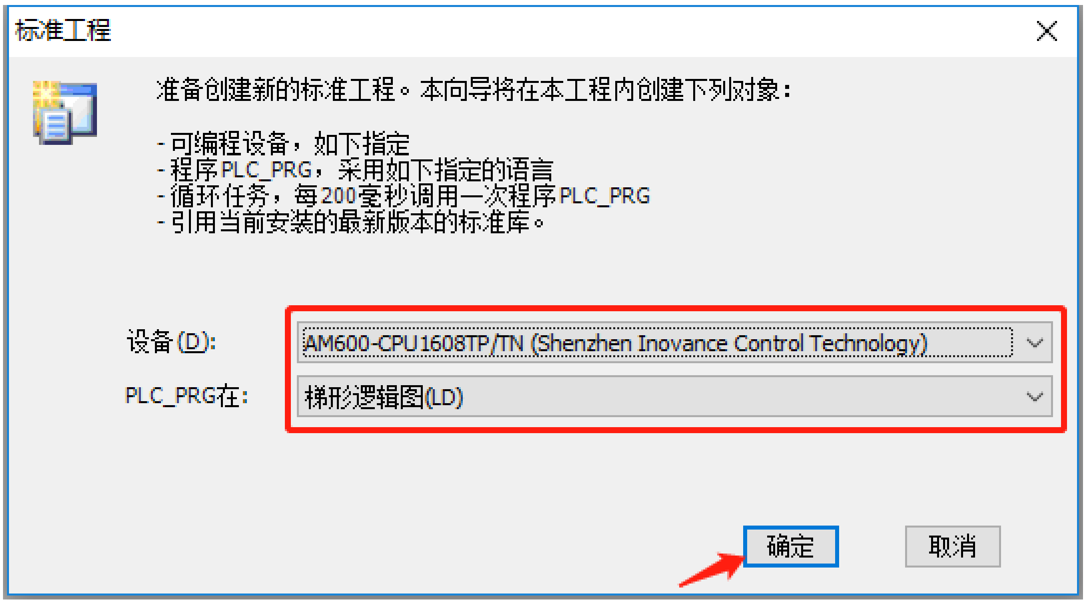


Figure 243 Determining the device and programming language

Add device

- Double-click Network Configuration→click PLC→check EtherCAT master

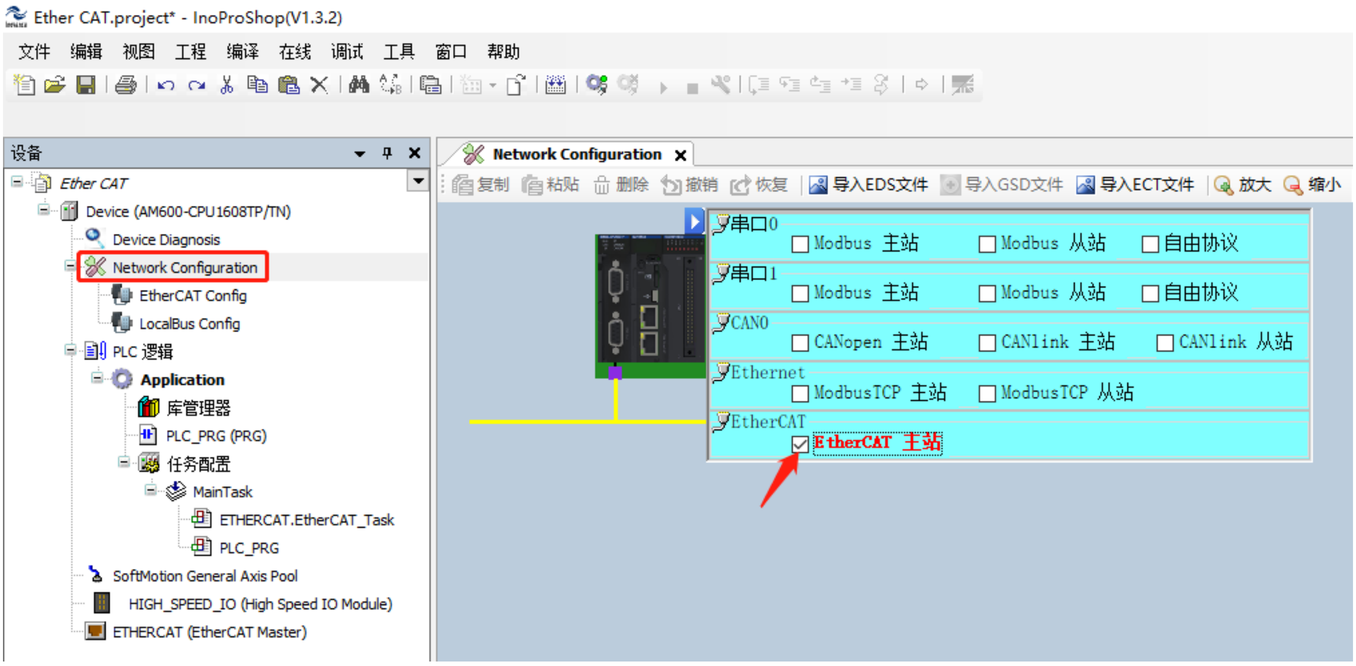


Figure 244 Add EtherCAT master

- Find ‘’ShenZhen Just motion comtrol” under the network device list on the right, double-click the slave station to be added.
-

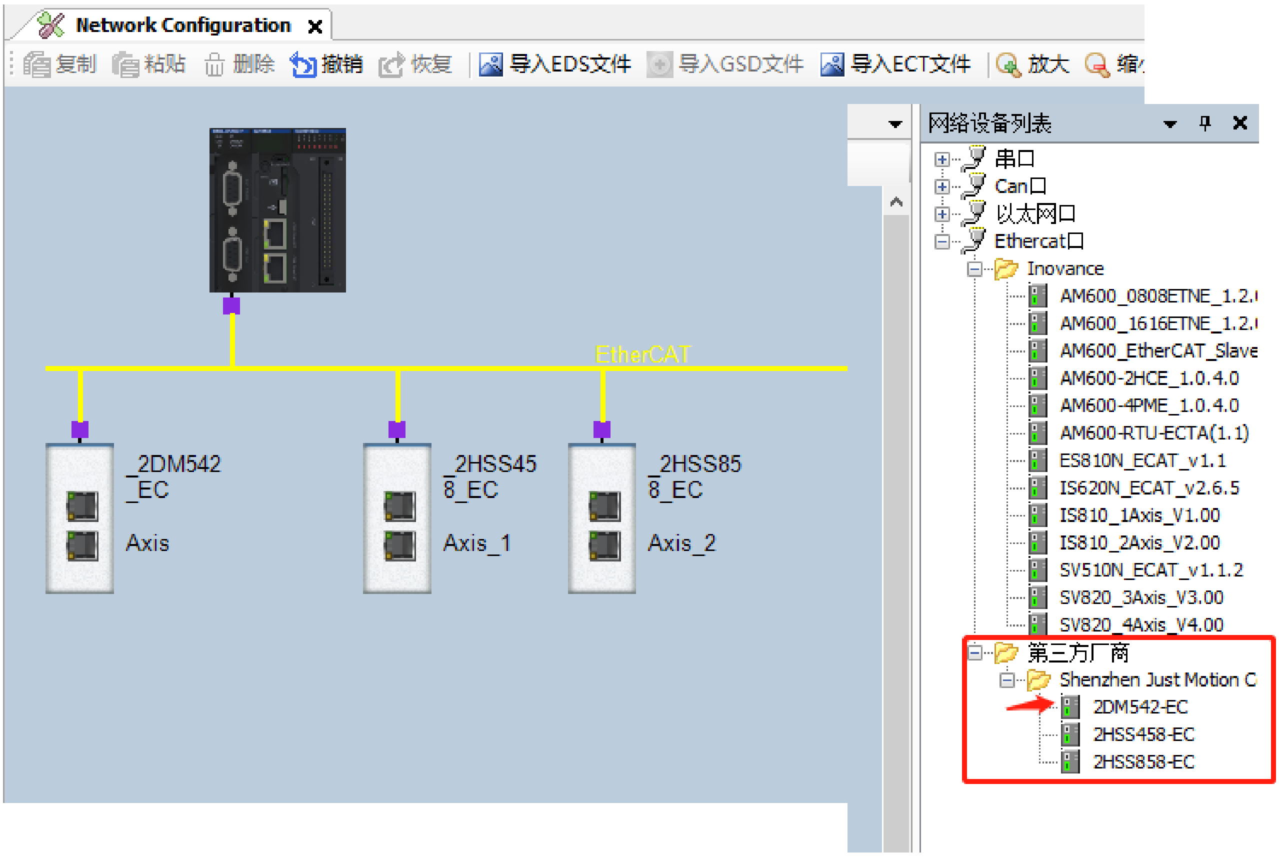


Figure 245 Add slave device

- Find the added slave station under the left device → right click to add CIA 402AIXS

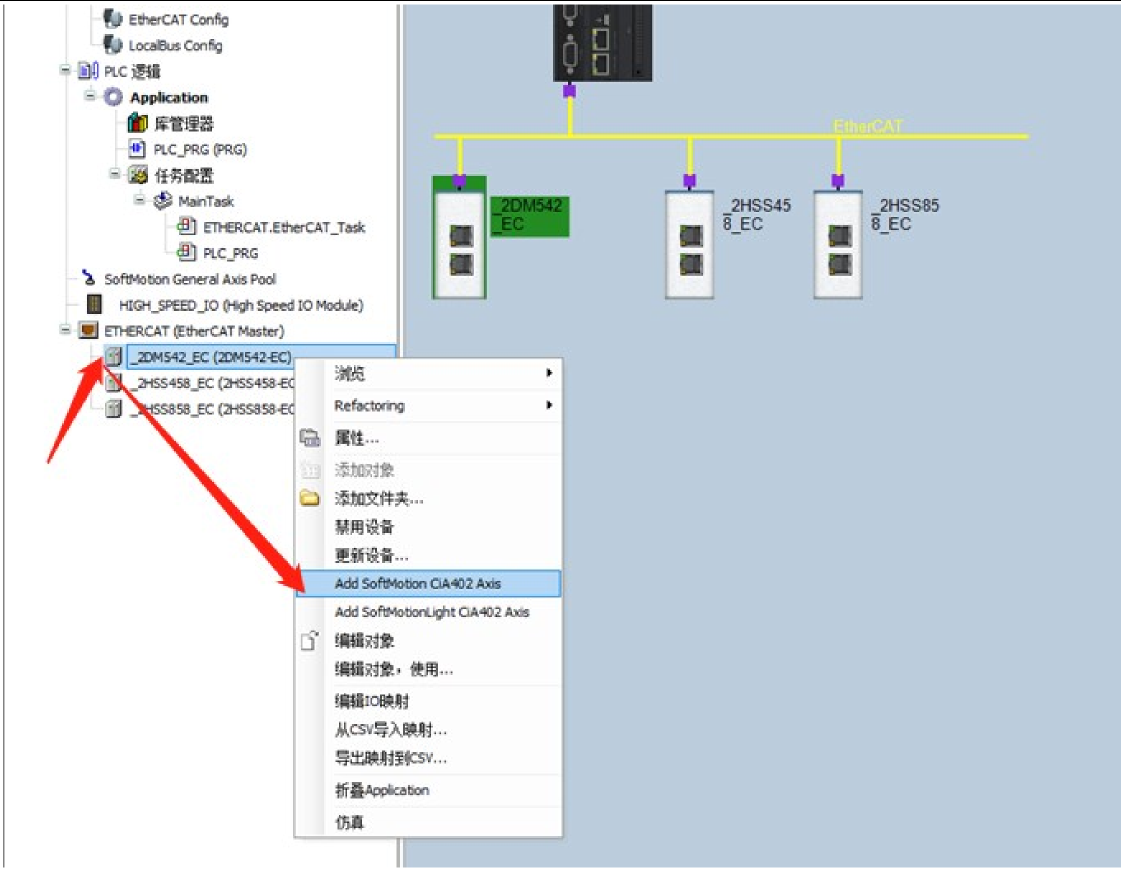


Figure 246 Add 402 axis

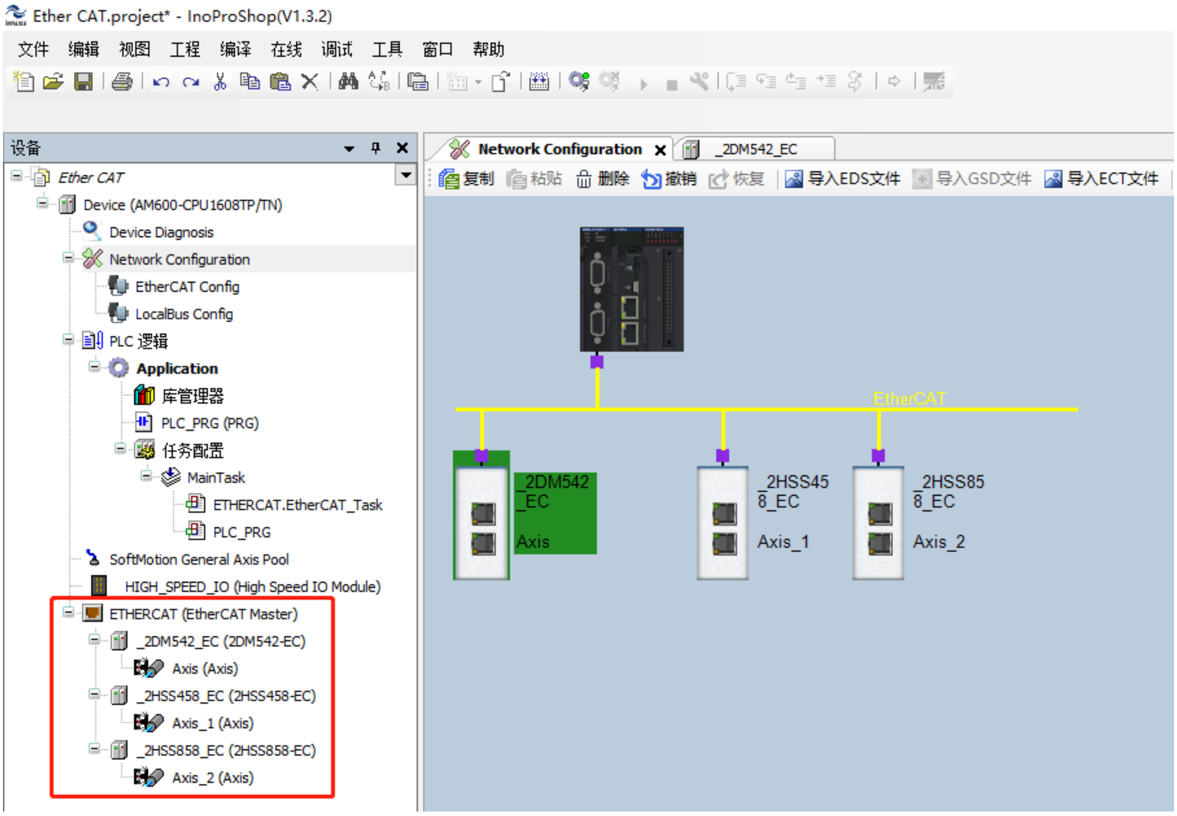


Figure 247 402 axis added

Parameter setting

- Double-click 2DM542-EC → check to enable expert settings under overview

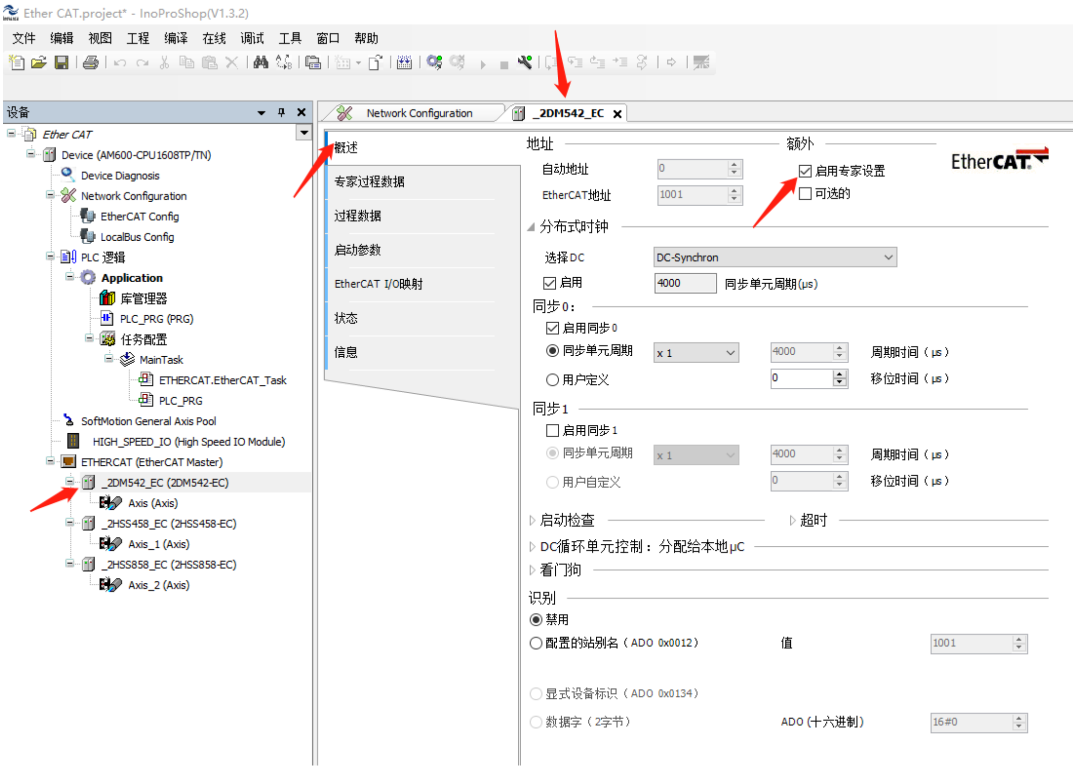


Figure 248 Enable expert settings

- Check PDO allocation and PDO configuration under expert process data

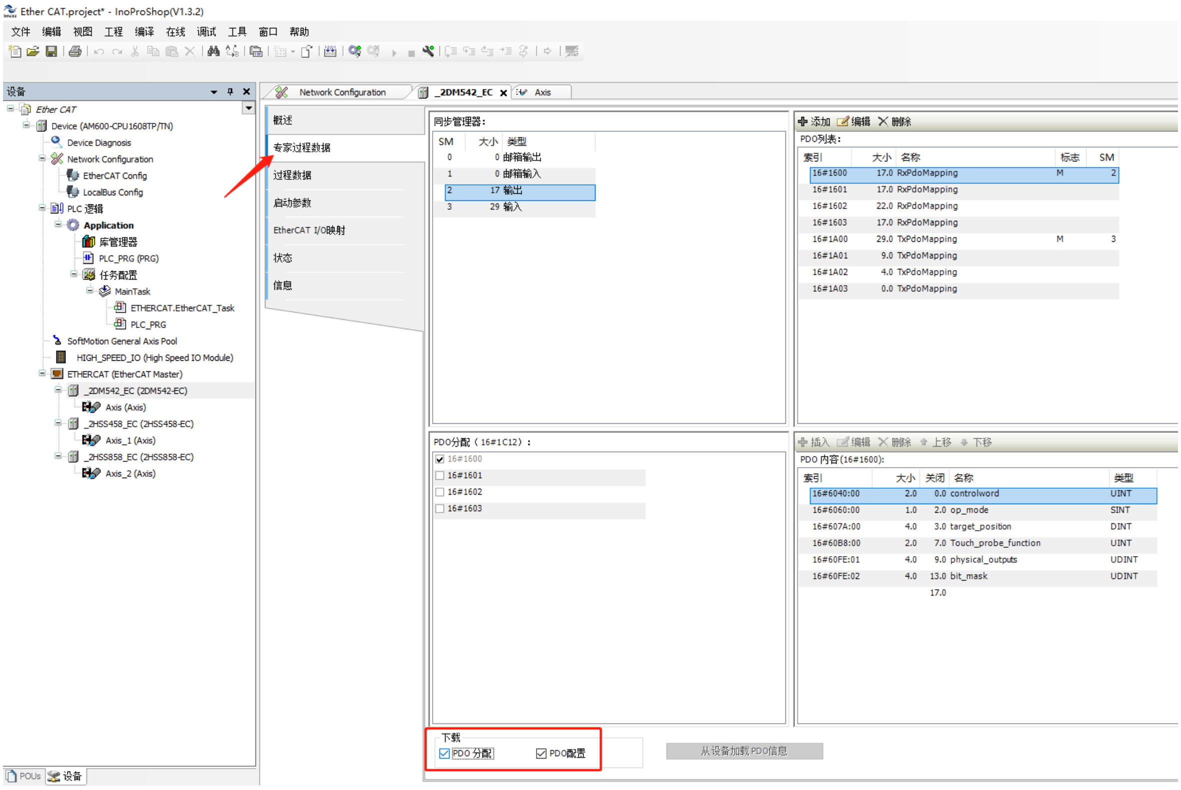


Figure 249 Check PDO configuration

- Double-click Axis→Under the unit conversion, find the number of pulses of one revolution of the motor, and modify it to 16#FA0 (subject to modification according to the drive).

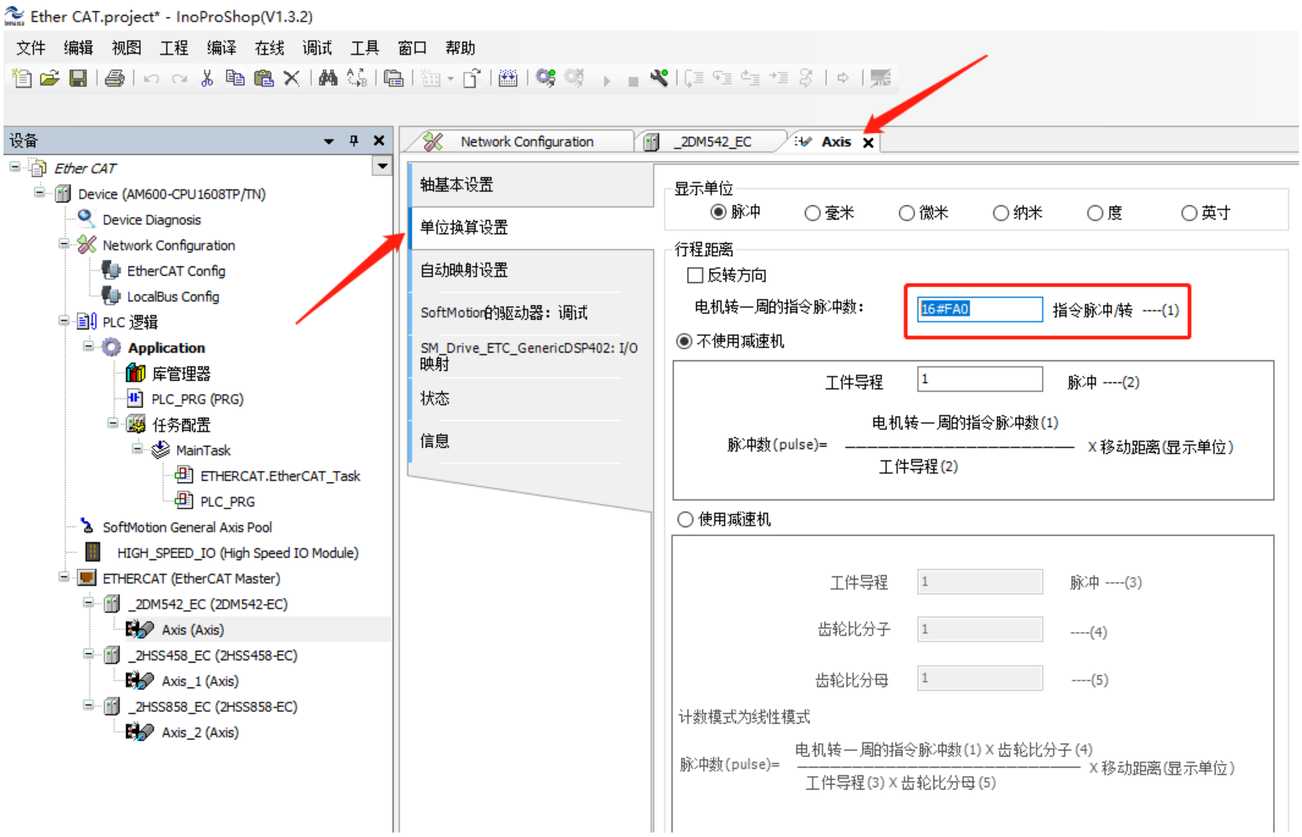


Figure 250 Setting the number of pulses for one revolution of the motor

Add zero return parameter

- Startup parameter→click to add

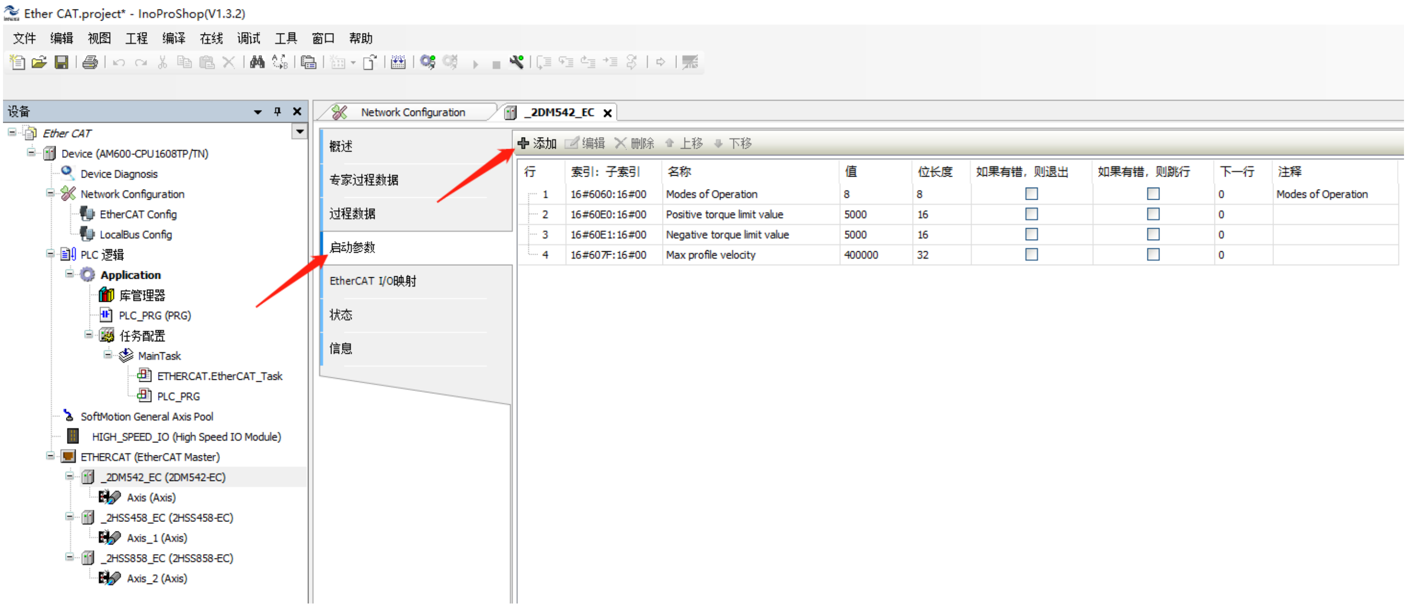
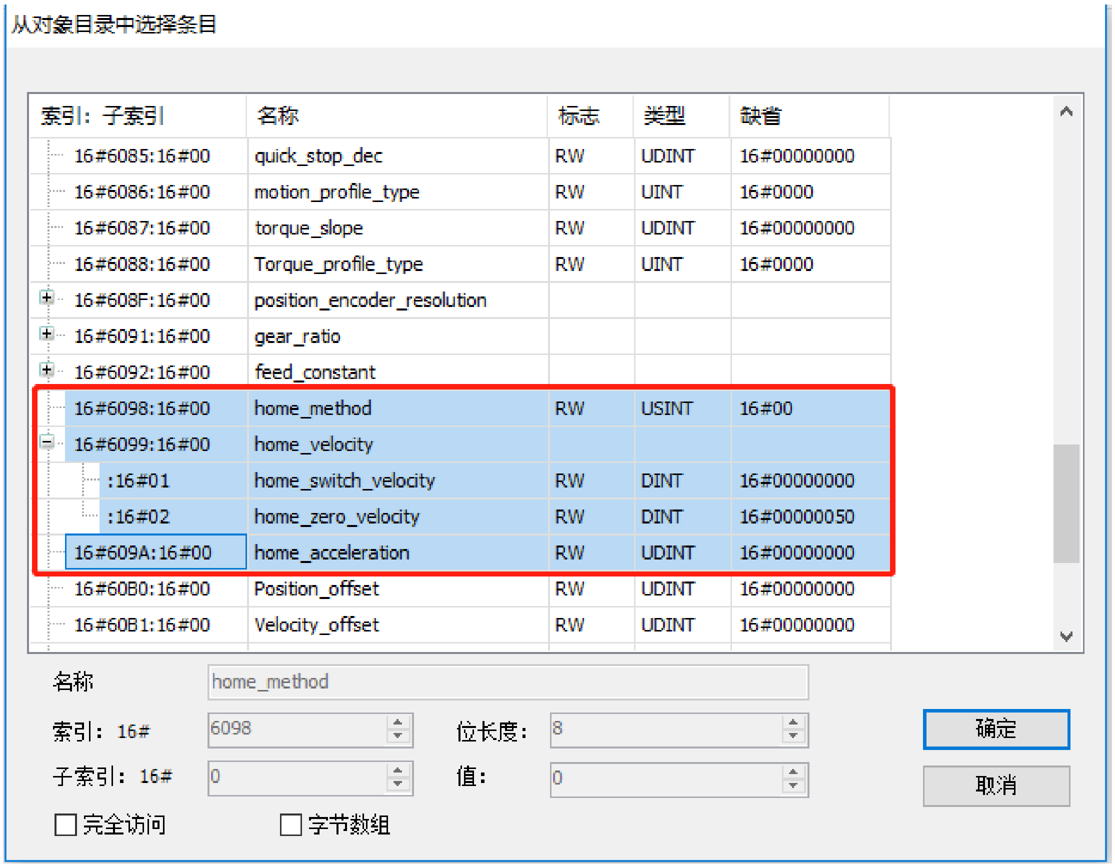


Figure 251 Add startup parameters

- Find 6098 (zero return method), 6099 01 (zero return speed), 6099 02 (zero return slow speed), 609A (zero return acceleration/deceleration) in the object catalog



索引：子索引	名称	标志	类型	缺省
16#6085:16#00	quick_stop_dec	RW	UDINT	16#00000000
16#6086:16#00	motion_profile_type	RW	UINT	16#0000
16#6087:16#00	torque_slope	RW	UDINT	16#00000000
16#6088:16#00	Torque_profile_type	RW	UINT	16#0000
16#608F:16#00	position_encoder_resolution			
16#6091:16#00	gear_ratio			
16#6092:16#00	feed_constant			
16#6098:16#00	home_method	RW	USINT	16#00
16#6099:16#00	home_velocity			
:16#01	home_switch_velocity	RW	DINT	16#00000000
:16#02	home_zero_velocity	RW	DINT	16#00000050
16#609A:16#00	home_acceleration	RW	UDINT	16#00000000
16#60B0:16#00	Position_offset	RW	UDINT	16#00000000
16#60B1:16#00	Velocity_offset	RW	UDINT	16#00000000

Figure 252 Selection object dictionary

Set the zero return parameter

16#6098 (zero return method): select the appropriate zero return method, and the track map of the zero return method can be found in the Jiemeikang EtherCAT protocol manual.

16#6099[01] (Return speed to zero): 4000 speed is 1rps

16#6099[02] (slow return speed): 100 speed is 0.025rps

16#609A (zero return acceleration/deceleration): 40000 speed is 10rps

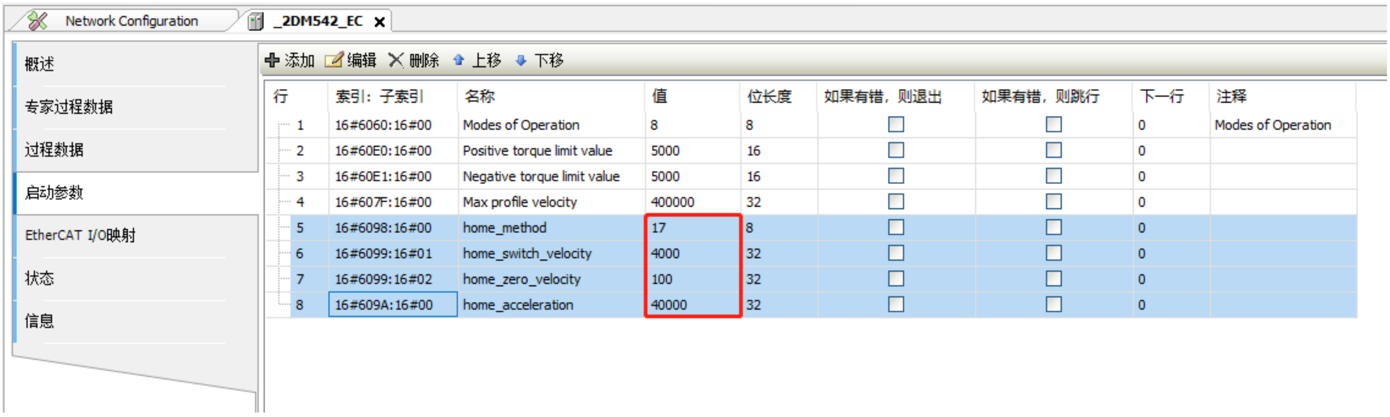


Figure 253 Setting the zero return parameter

Programming

1 New program organization unit

- Right click Application→Add Object→Program Organization Unit→Name, Type, Language
-

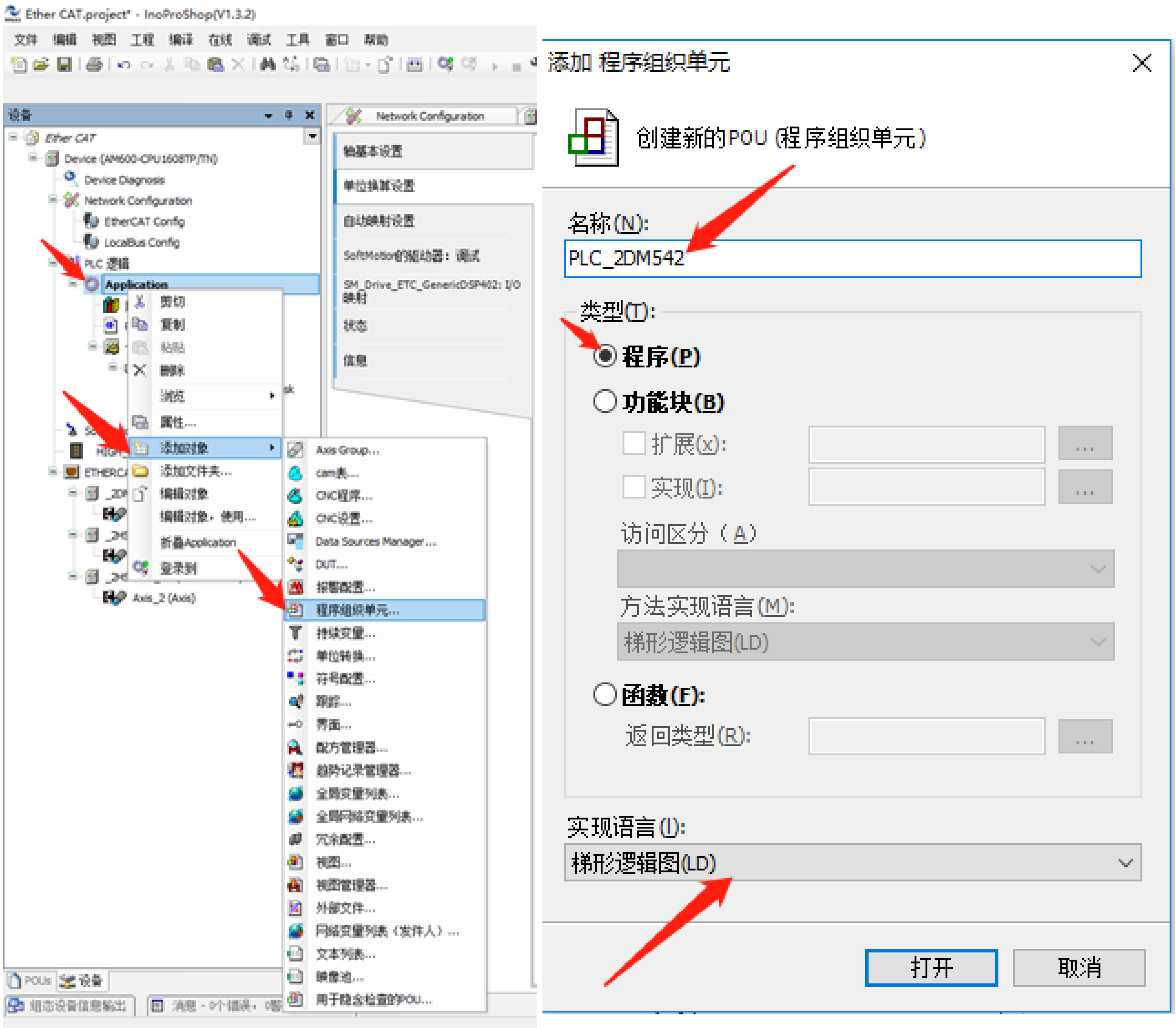


Figure 254 Create POU

2 Add motion control instructions

Click Insert Operation Block to open the input assistant to add motion instructions. (For specific instruction application, please refer to "AM600 Series Programmable Logic Controller Programming Manual (Motion Control)")

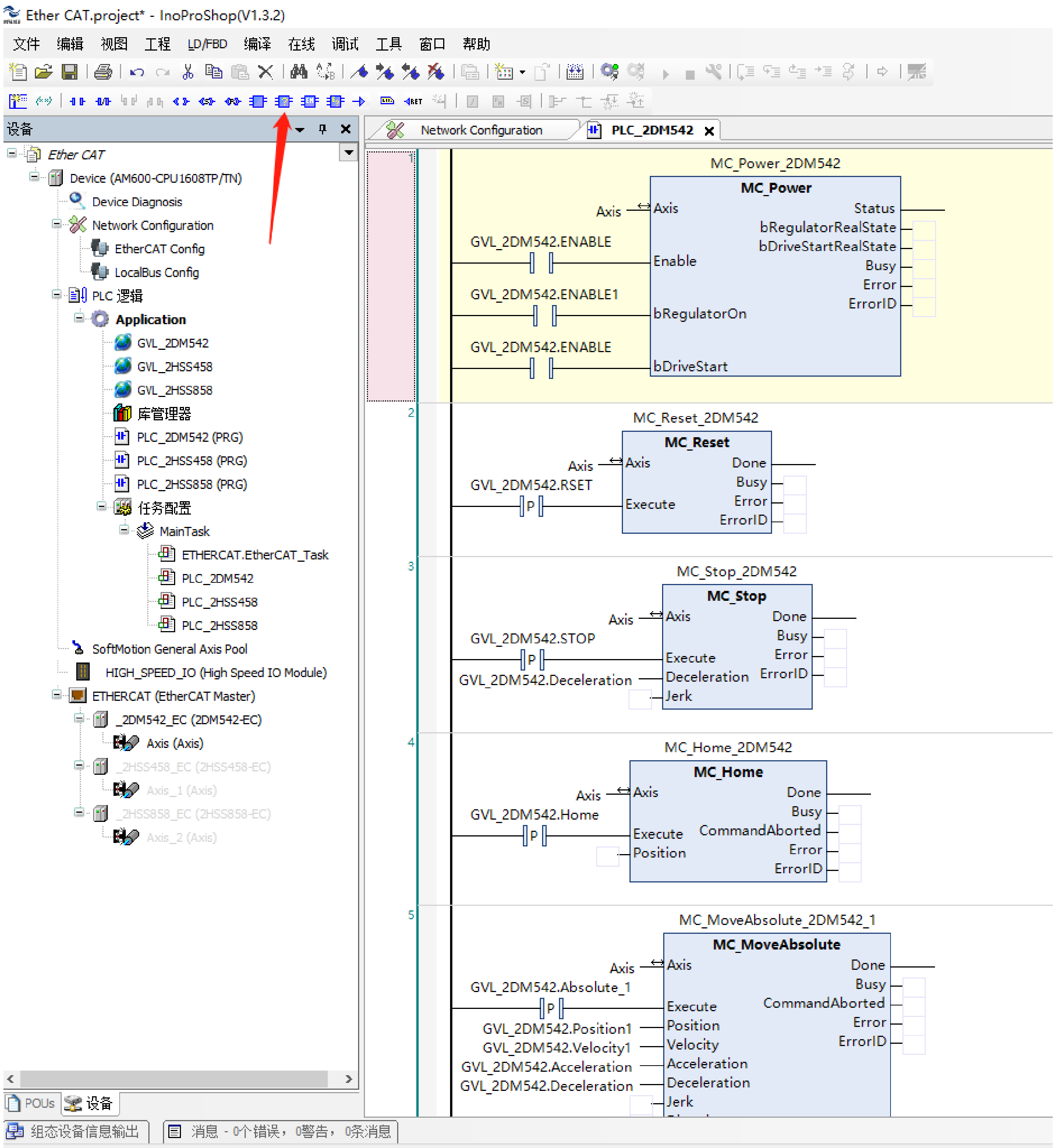


Figure 255 Motion control module

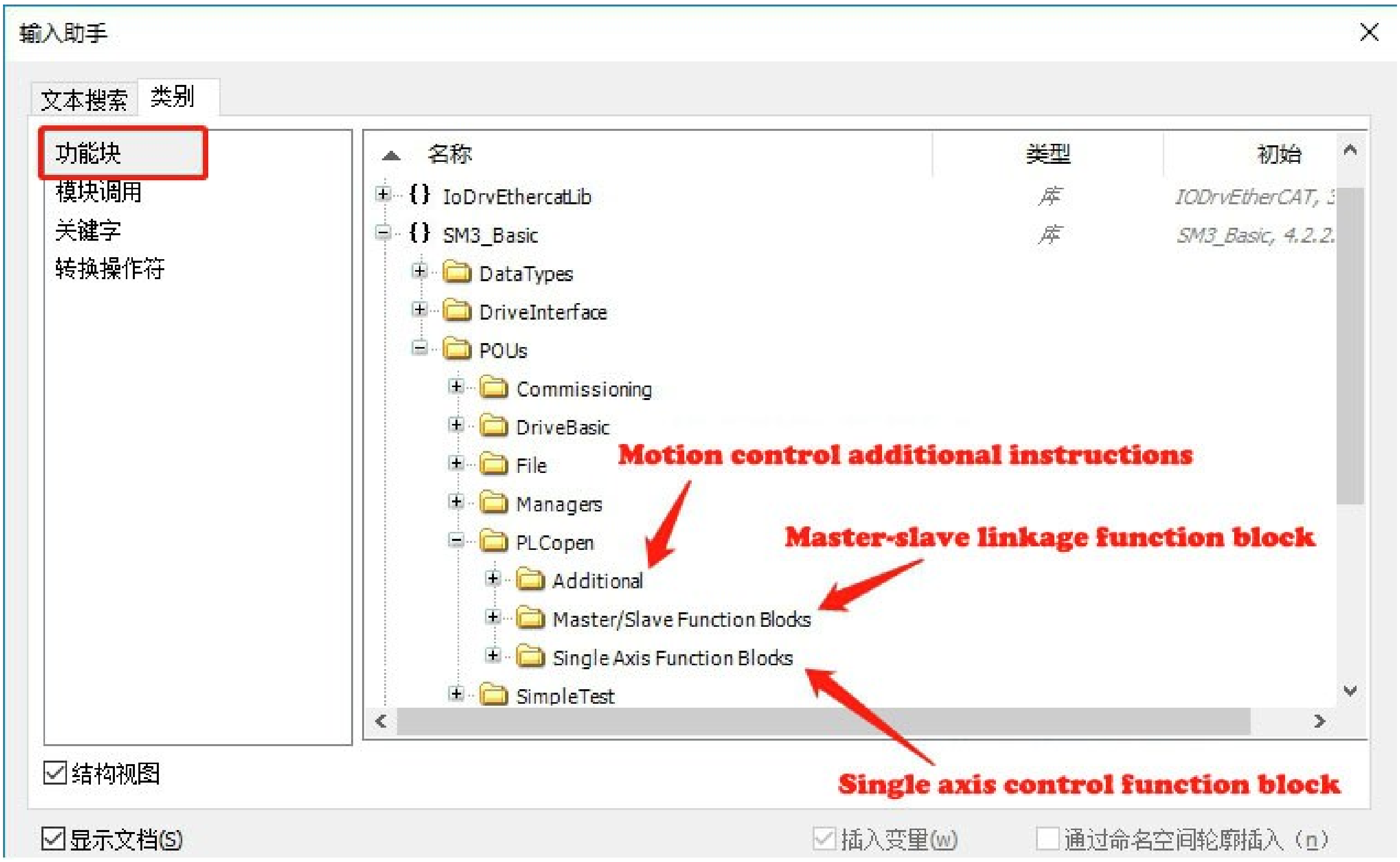
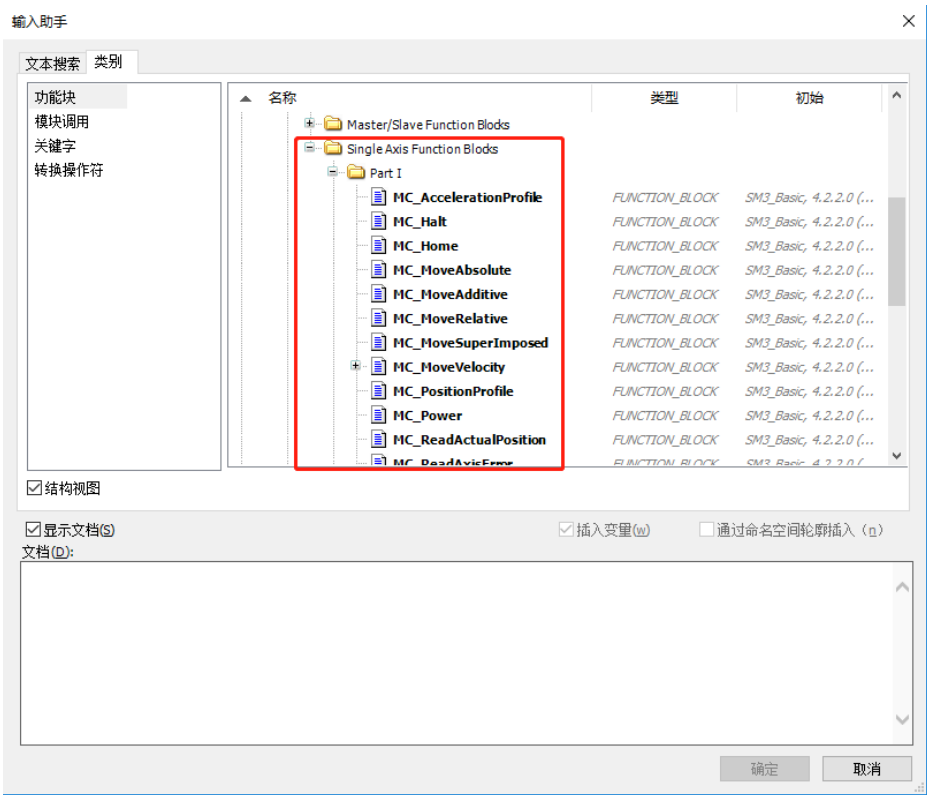


Figure 256 Function block

- The routine used is to control single-axis instructions



3 Add task configuration

- Double-click MainTask→Add Call

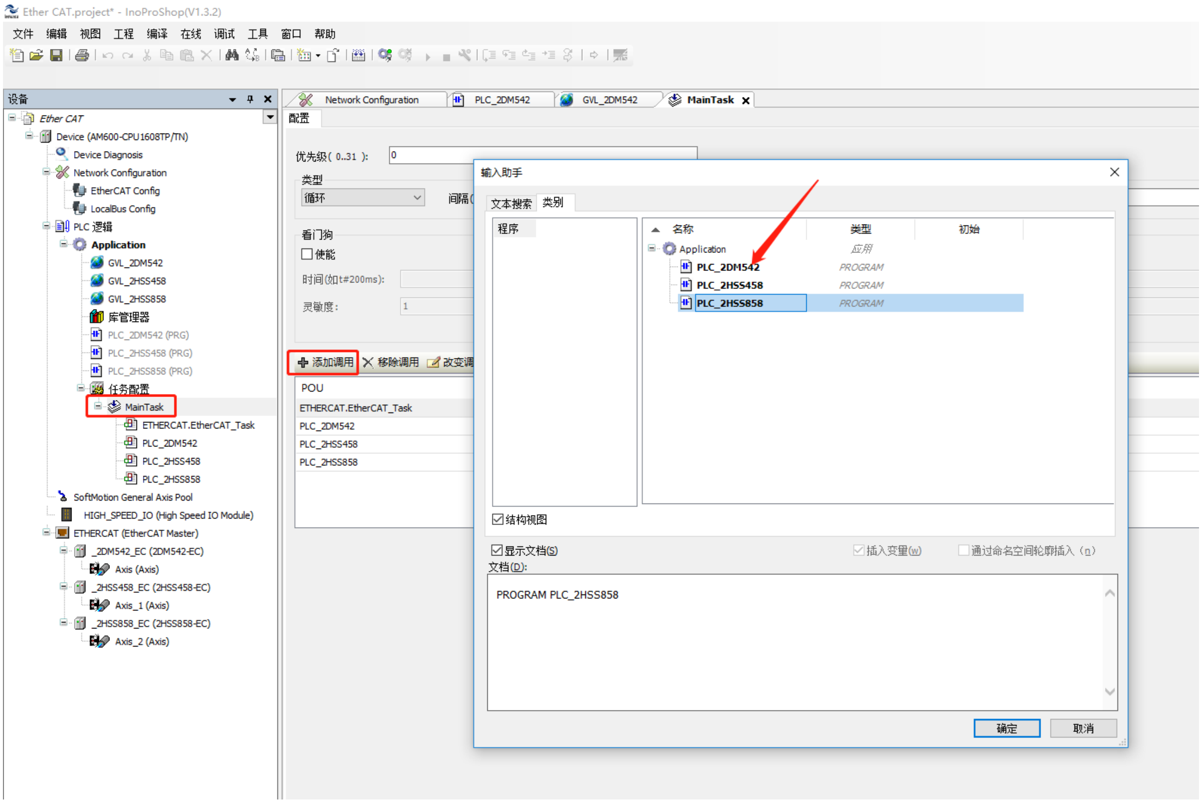


Figure 258 Add task configuration

4 Login to download and debug the program

- Scan the master device

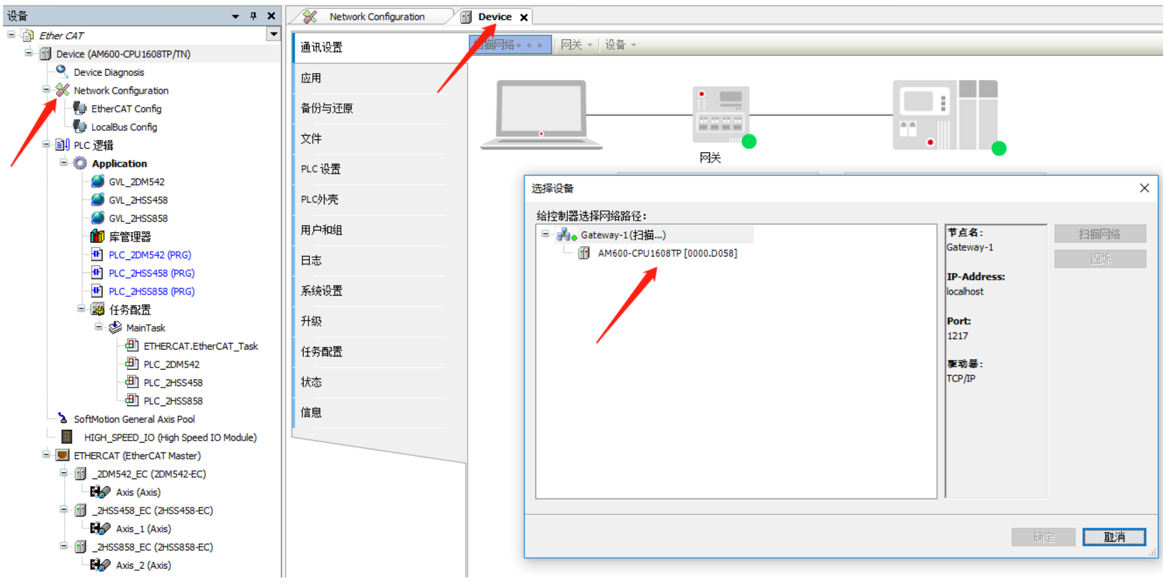
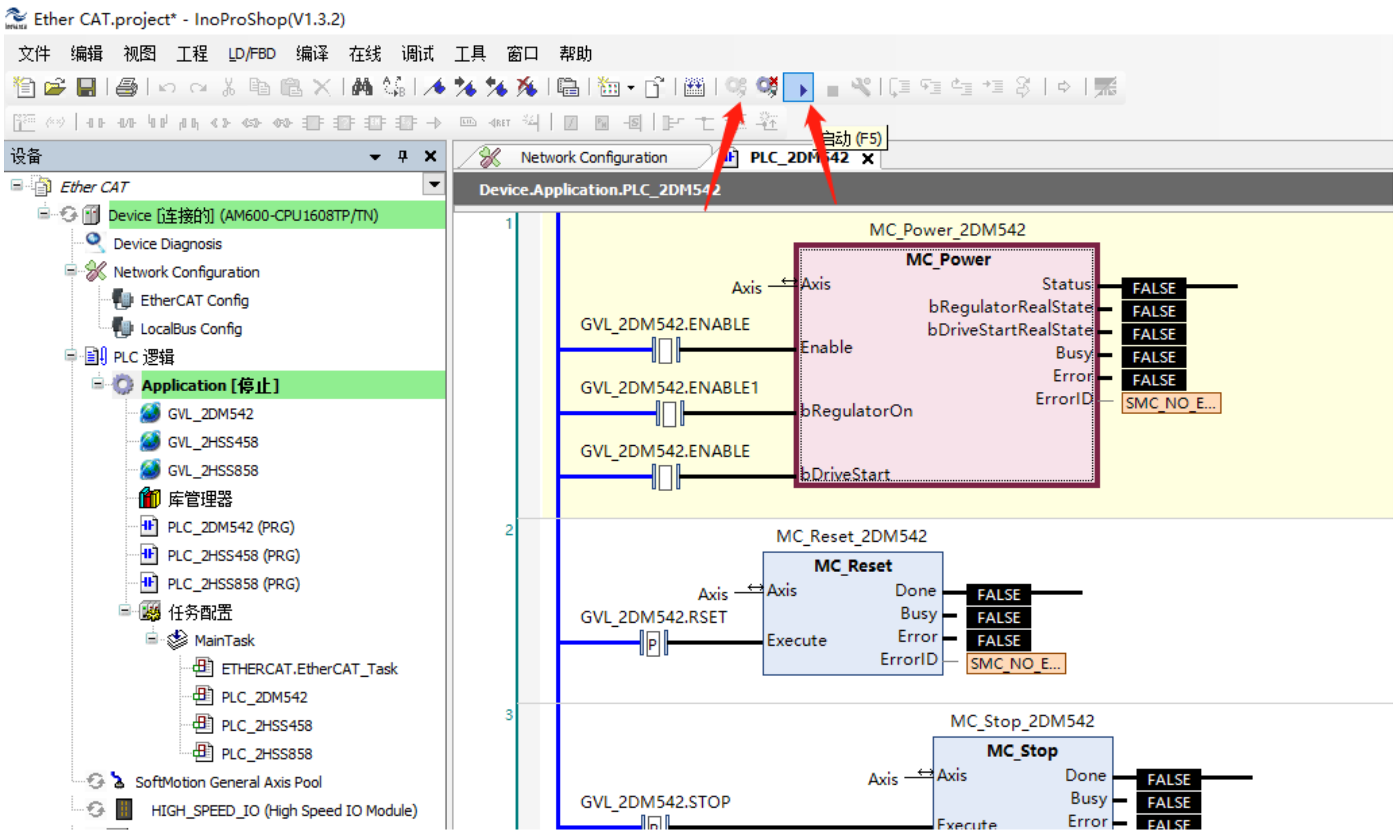


Figure 259 Scanning the master device

- Login→Start



- Figure 260 Log in to the device

- The connection status between the slave station and the master station

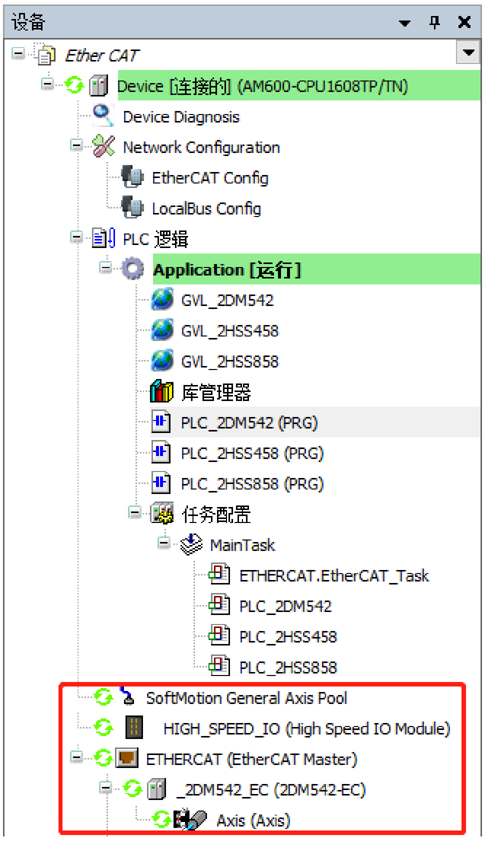


Figure 261 Master-slave connection status

5 Enable device

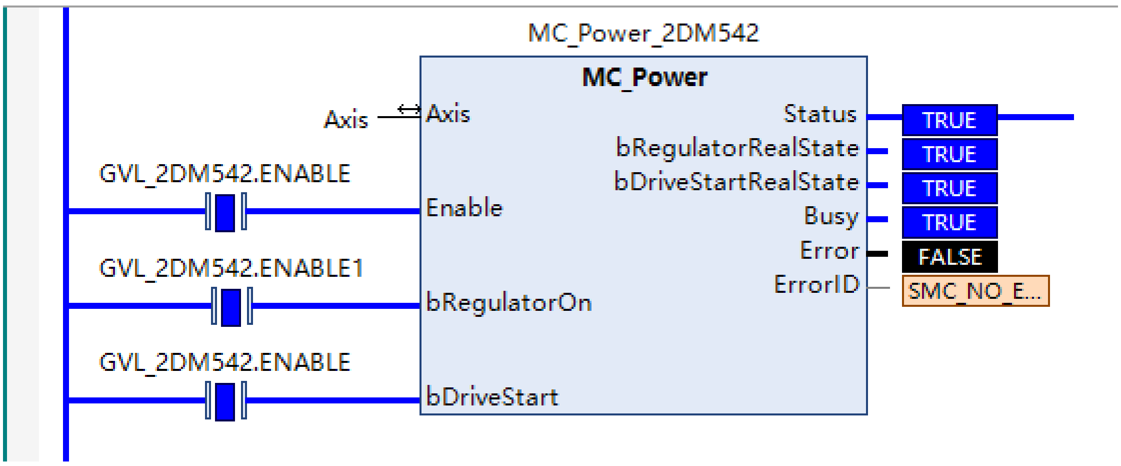
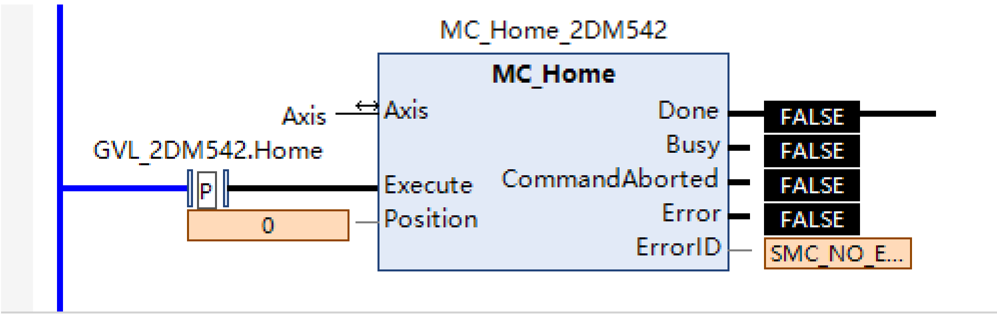


Figure 262 Enabling device

6 Back to zero mode



7 Position mode

- Absolute positioning

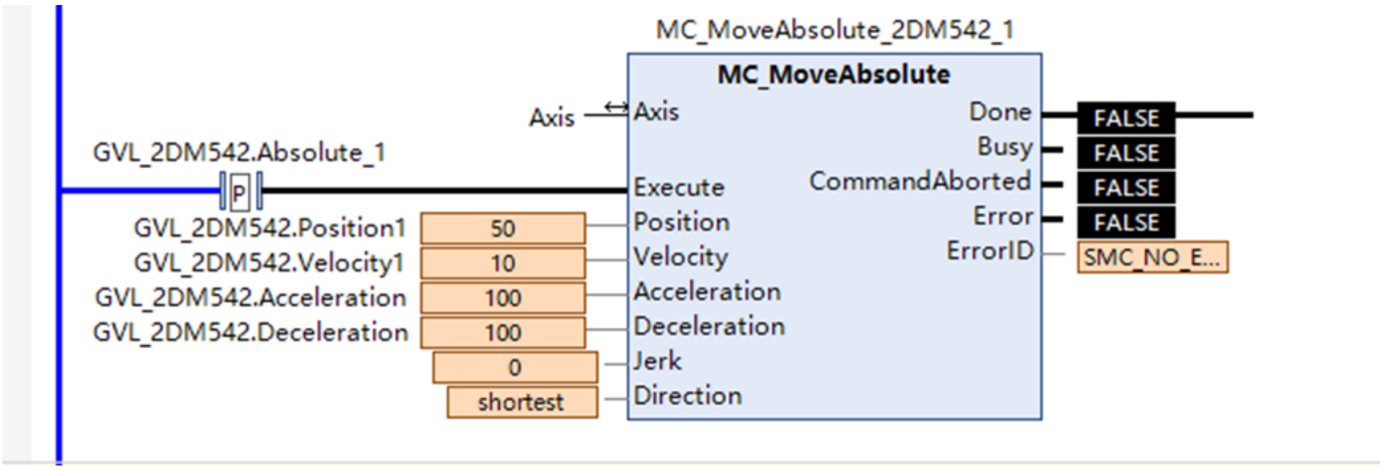
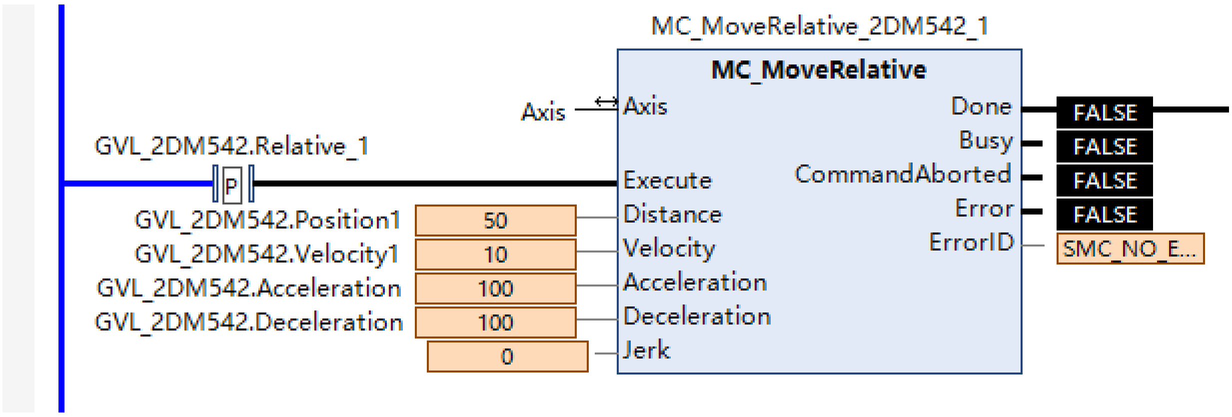


Figure 264 Position mode

- Relative positioning
-



- Figure 23 Relative positioning

8 speed mode

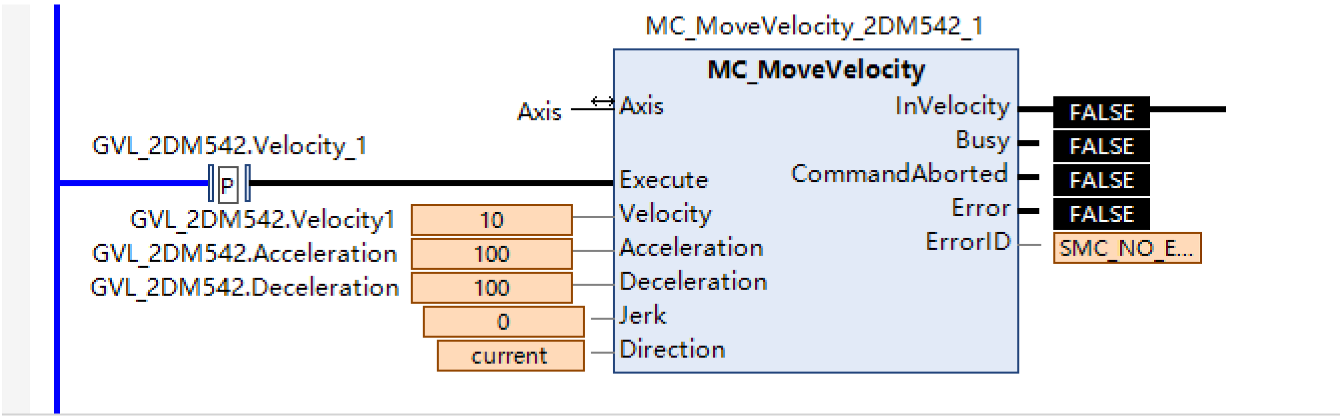


Figure 24 Speed mode

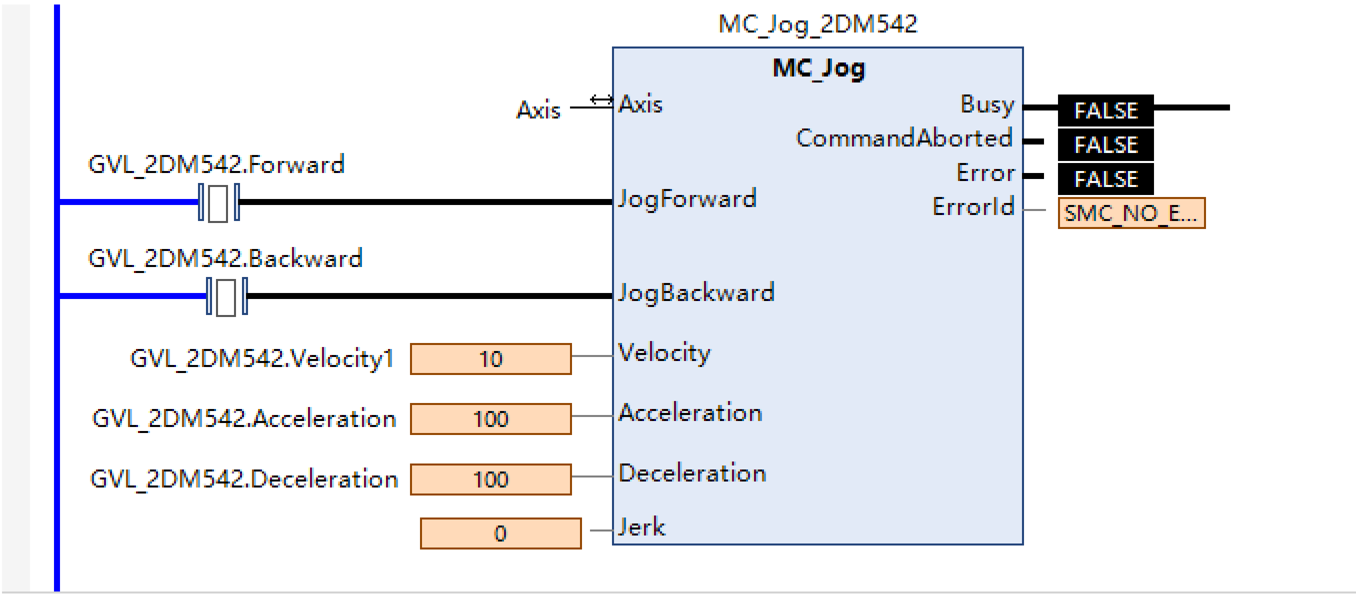


Figure 25 JOG mode

9 Alarm reset

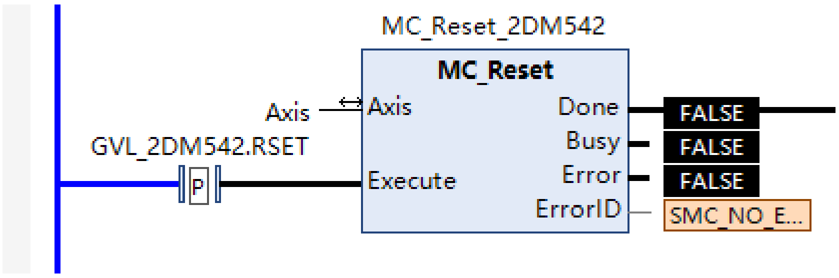


Figure 26 alarm reset

10 Stop the device

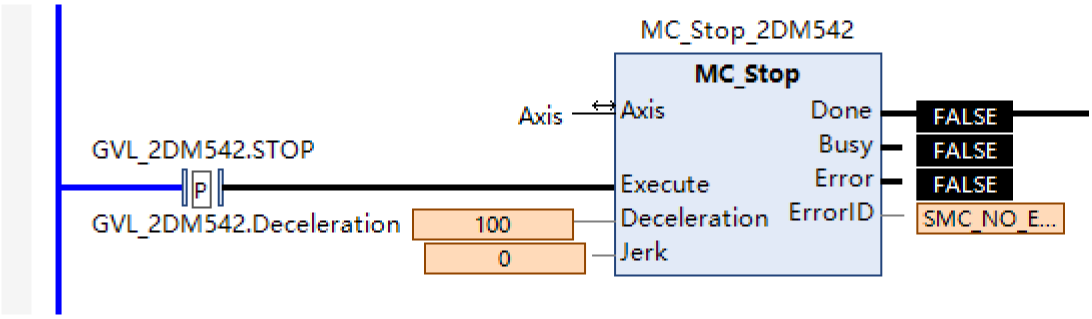


Figure 269 Stop device

EtherCAT communication operation routine based on Omron controller

Install device description file

Open Omron programming software Sysmac Studio→New Project→Create

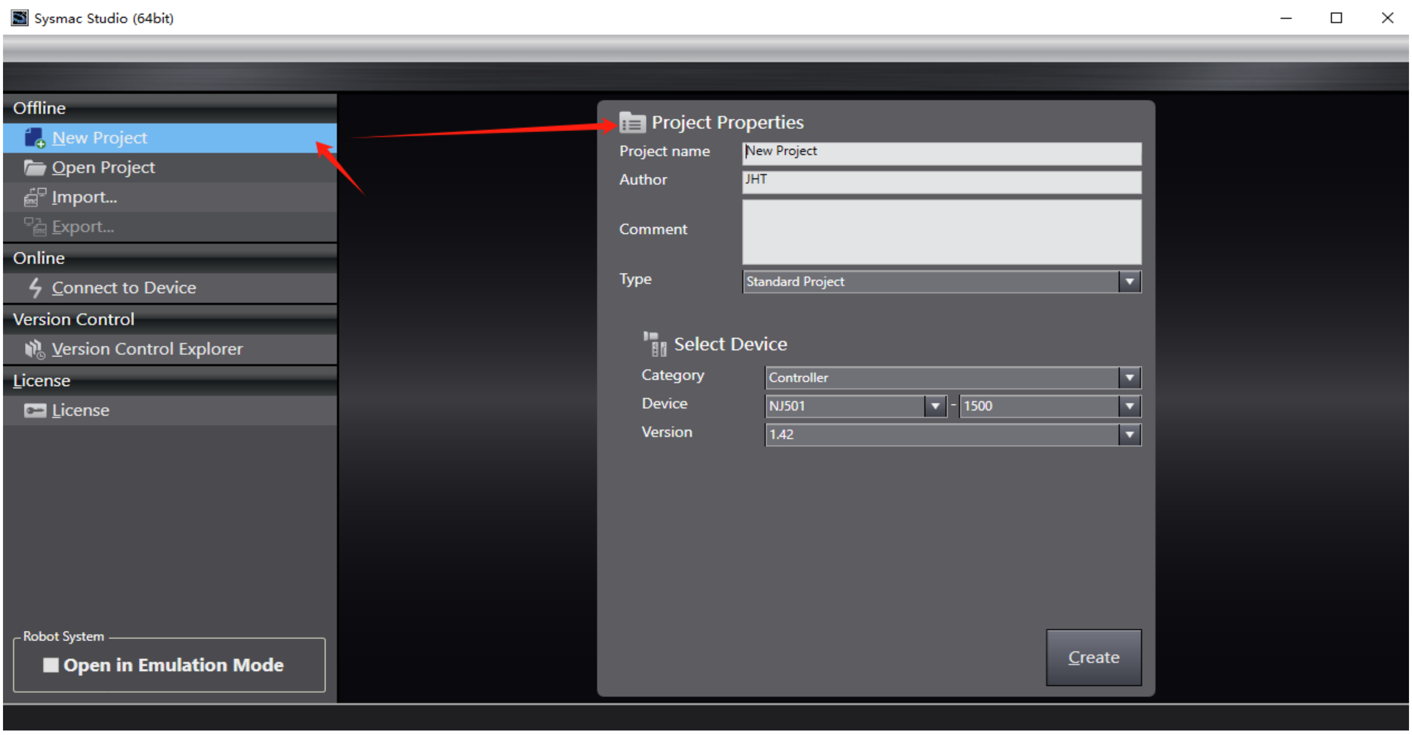


Figure 270 New Sysmac project

- Double-click EtherCAT in the configuration and settings → right-click the main device → click to display the ESI library

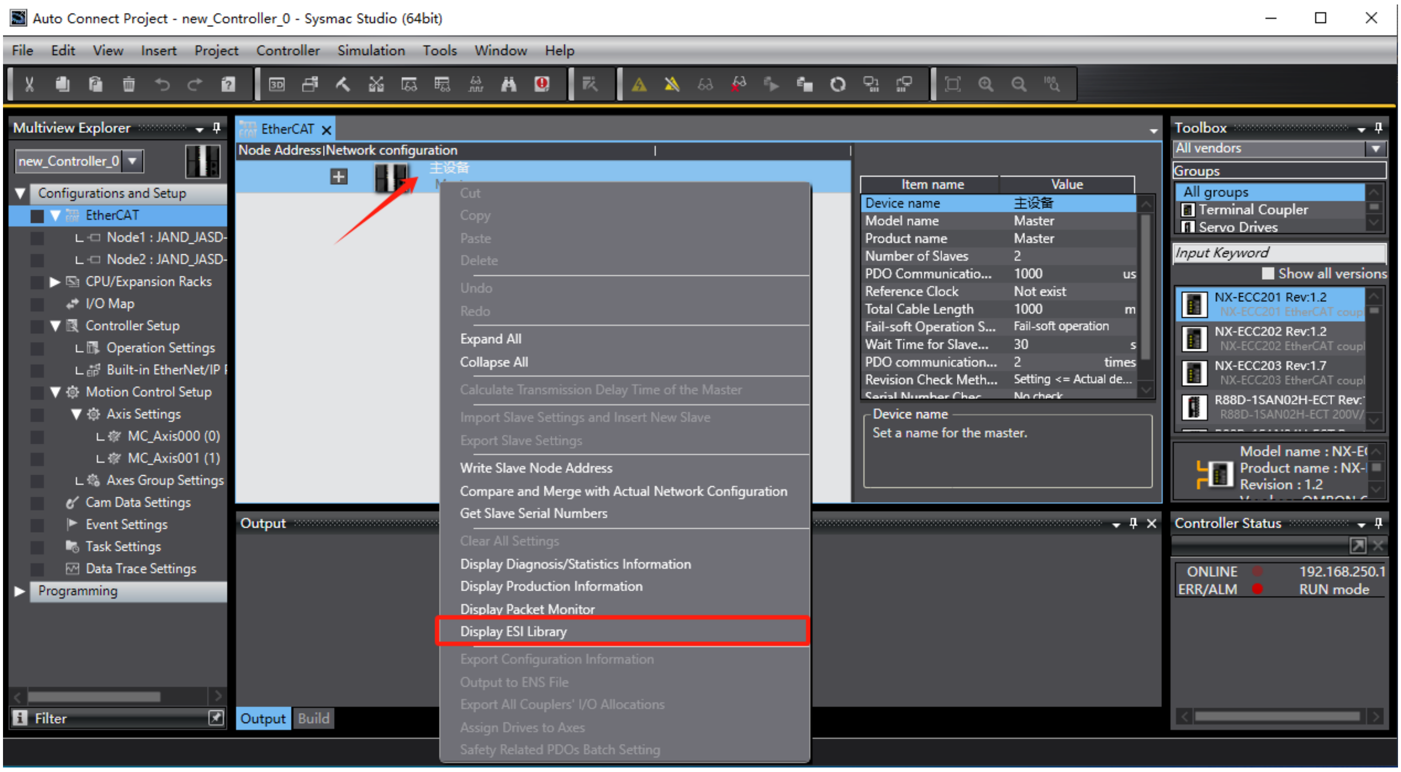
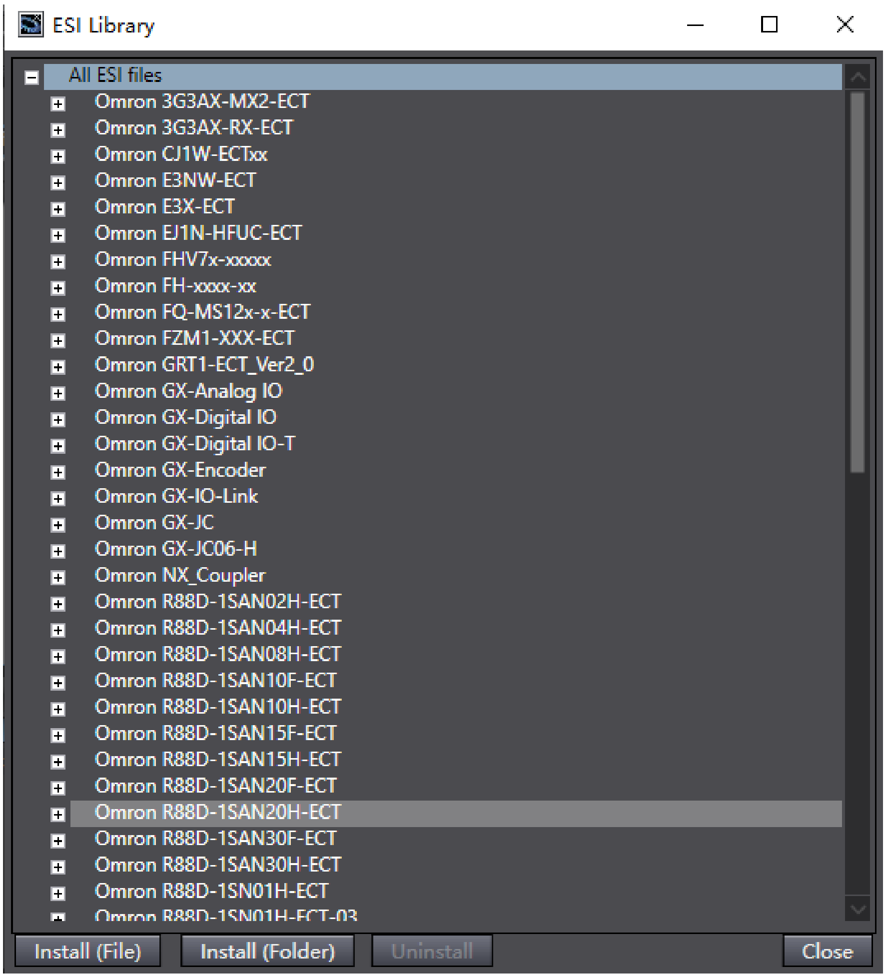


Figure 271 Open the ESI library

- Click on "This Folder"


ESI Library
All ESI files
Omron 3G3AX-MX2-ECT
Omron 3G3AX-RX-ECT
Omron CJ1W-ECTxx
Omron E3NW-ECT
Omron E3X-ECT
Omron EJ1N-HFUC-ECT
Omron FHV7x-xxxxx
Omron FH-xxxx-xx
Omron FQ-MS12x-x-ECT
Omron FZM1-XXX-ECT
Omron GRT1-ECT_Ver2_0
Omron GX-Analog IO
Omron GX-Digital IO
Omron GX-Digital IO-T
Omron GX-Encoder
Omron GX-IO-Link
Omron GX-JC
Omron GX-JC06-H
Omron NX_Coupler
Omron R88D-1SAN02H-ECT
Omron R88D-1SAN04H-ECT
Omron R88D-1SAN08H-ECT
Omron R88D-1SAN10F-ECT
Omron R88D-1SAN10H-ECT
Omron R88D-1SAN15F-ECT
Omron R88D-1SAN15H-ECT
Omron R88D-1SAN20F-ECT
Omron R88D-1SAN20H-ECT
Omron R88D-1SAN30F-ECT
Omron R88D-1SAN30H-ECT
Omron R88D-1SN01H-ECT
Install (File)
Install (Folder)
Uninstall
Close

- Put the device description file of JMC ECAT series into this folder → then close Omron programming software

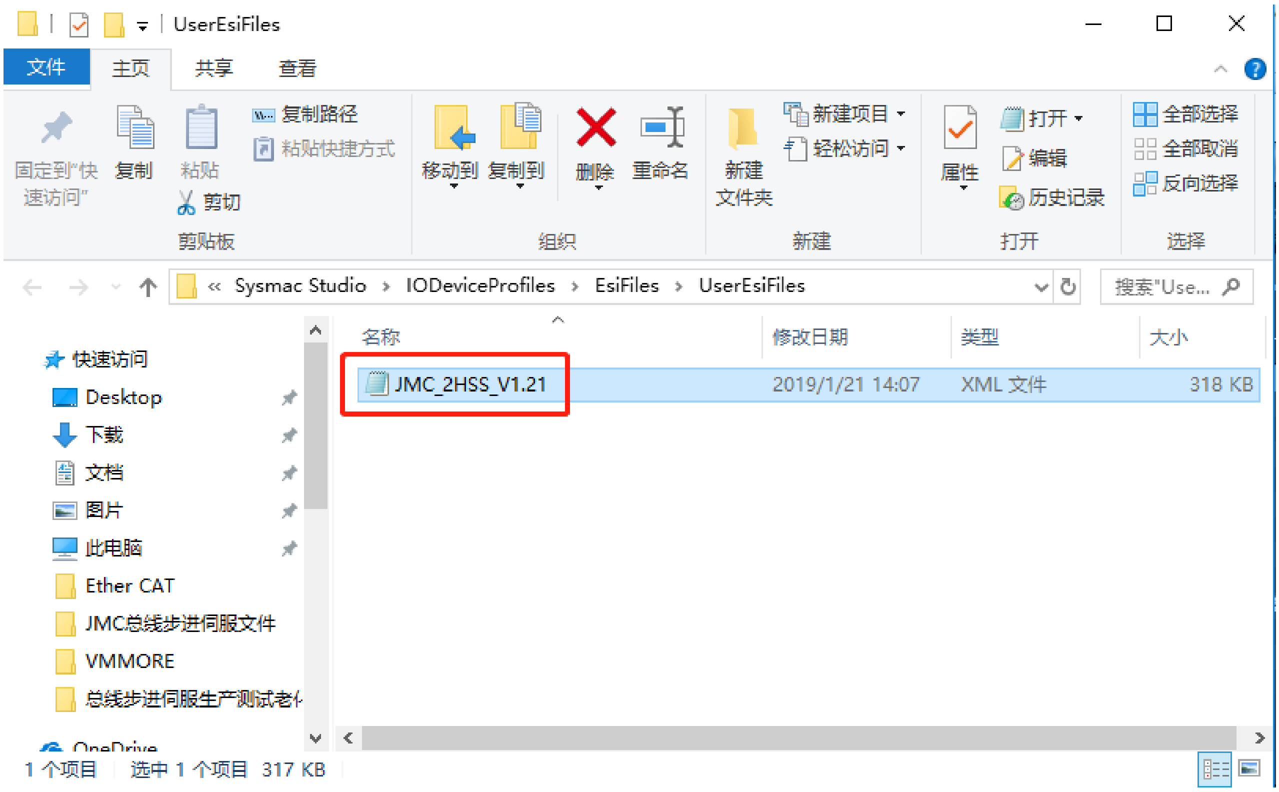


Figure 273 Select XML file

Set computer connection properties

- The PC and the controller are directly connected via Ethernet, and the computer TCP/IP properties need to be set
- Open the Network and Sharing Center→Properties

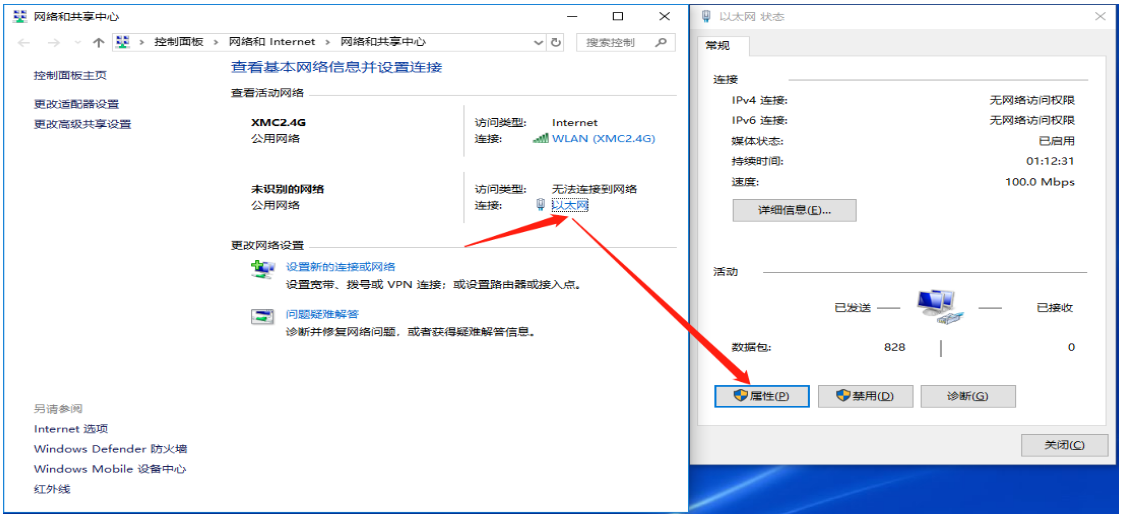


Figure 274 Configure TCP/IP

- Double-click the Internet protocol version 4 → set the IP address according to the controller

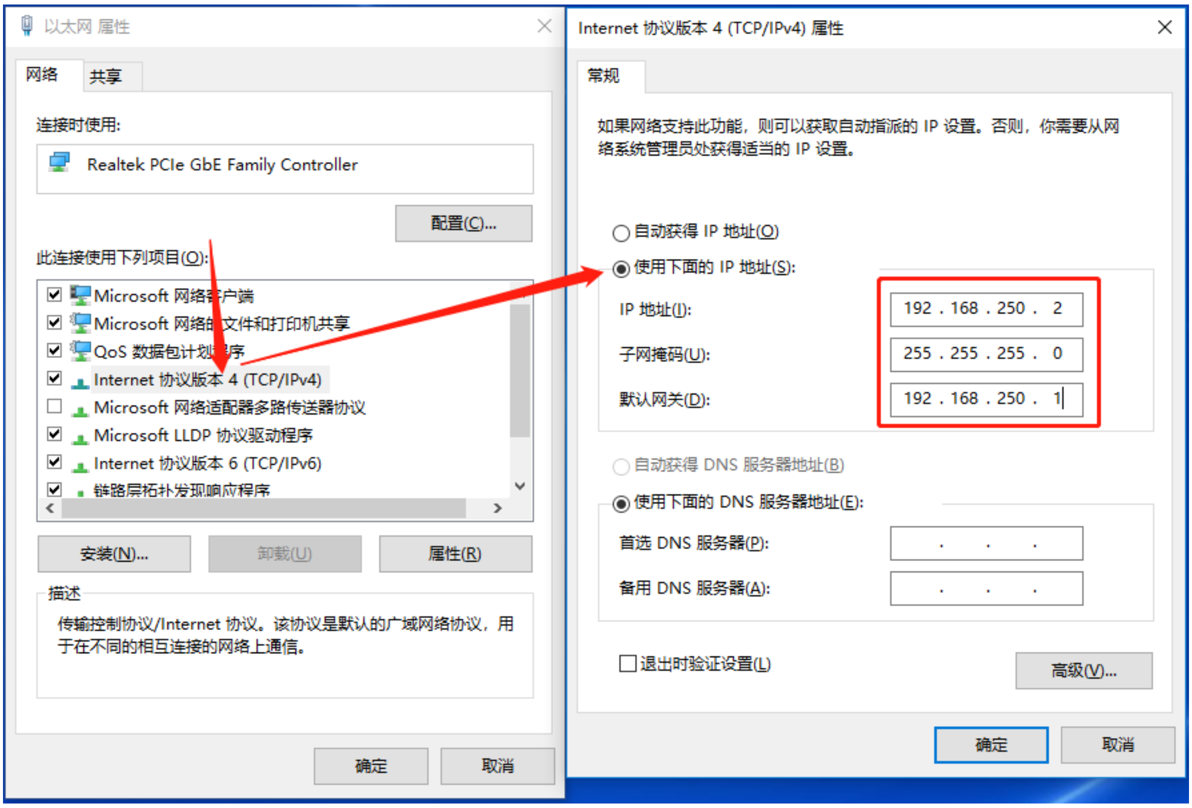


Figure 275 Set IP address

Omron software configuration

1.Open project

- Open Omron programming software→Open project→Open the ECAT routine just created

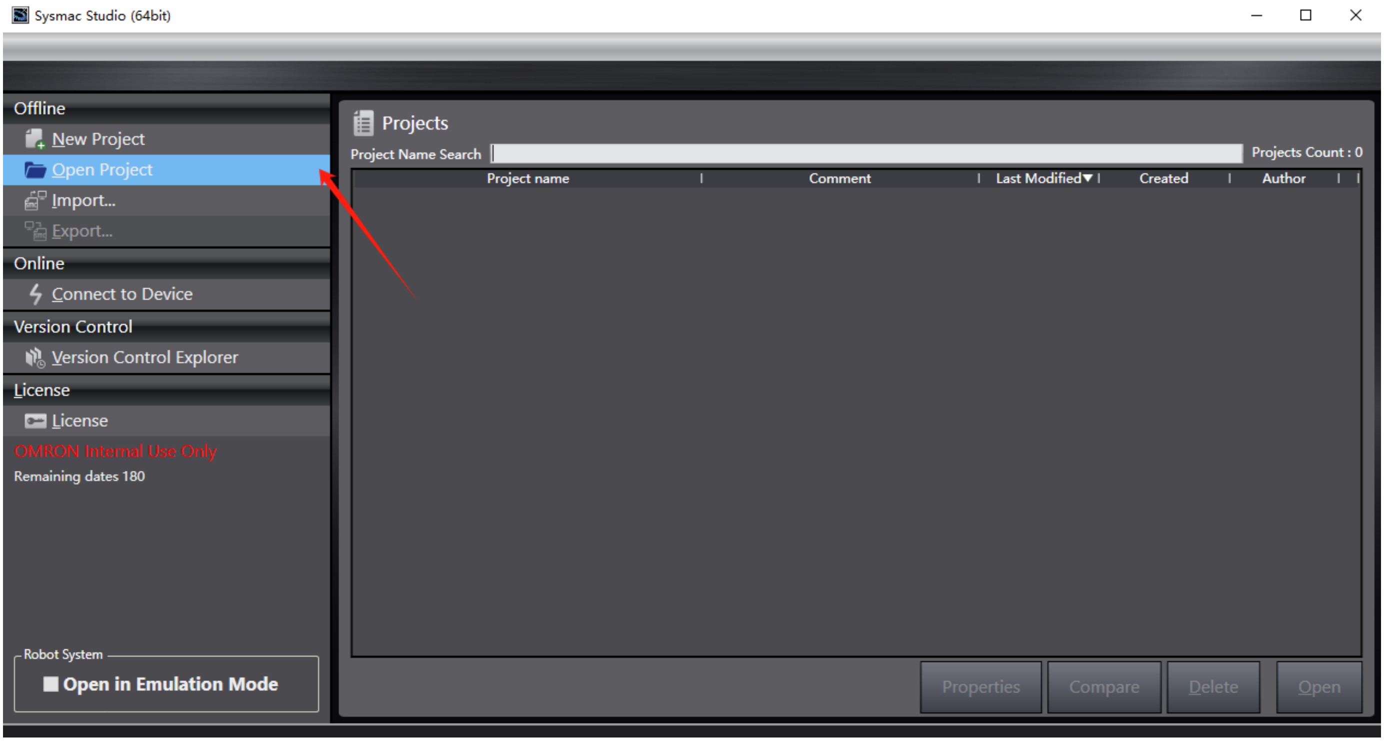


Figure 276 Open project

2 Communication settings

- Controller→Communication Settings

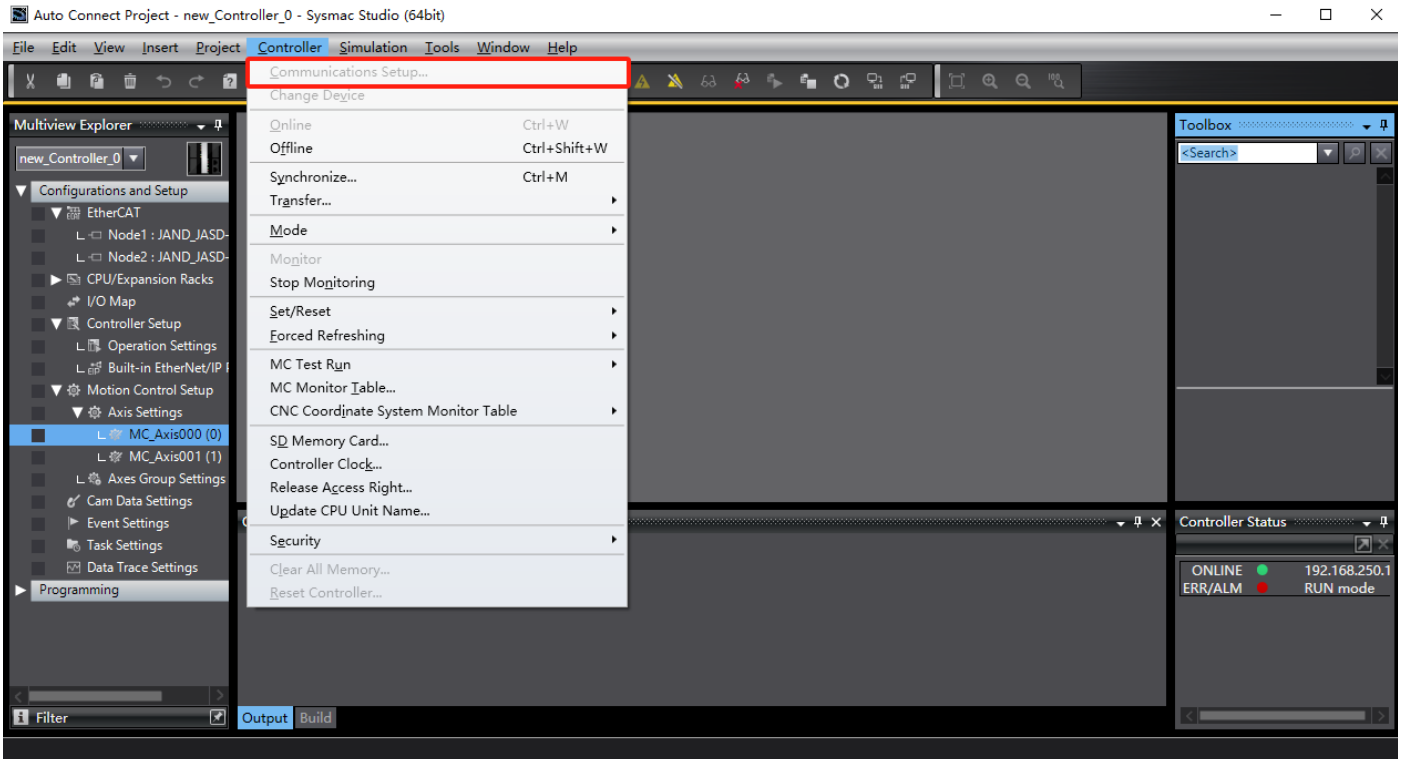


Figure 277 Communication settings

- Select Ethernet communication

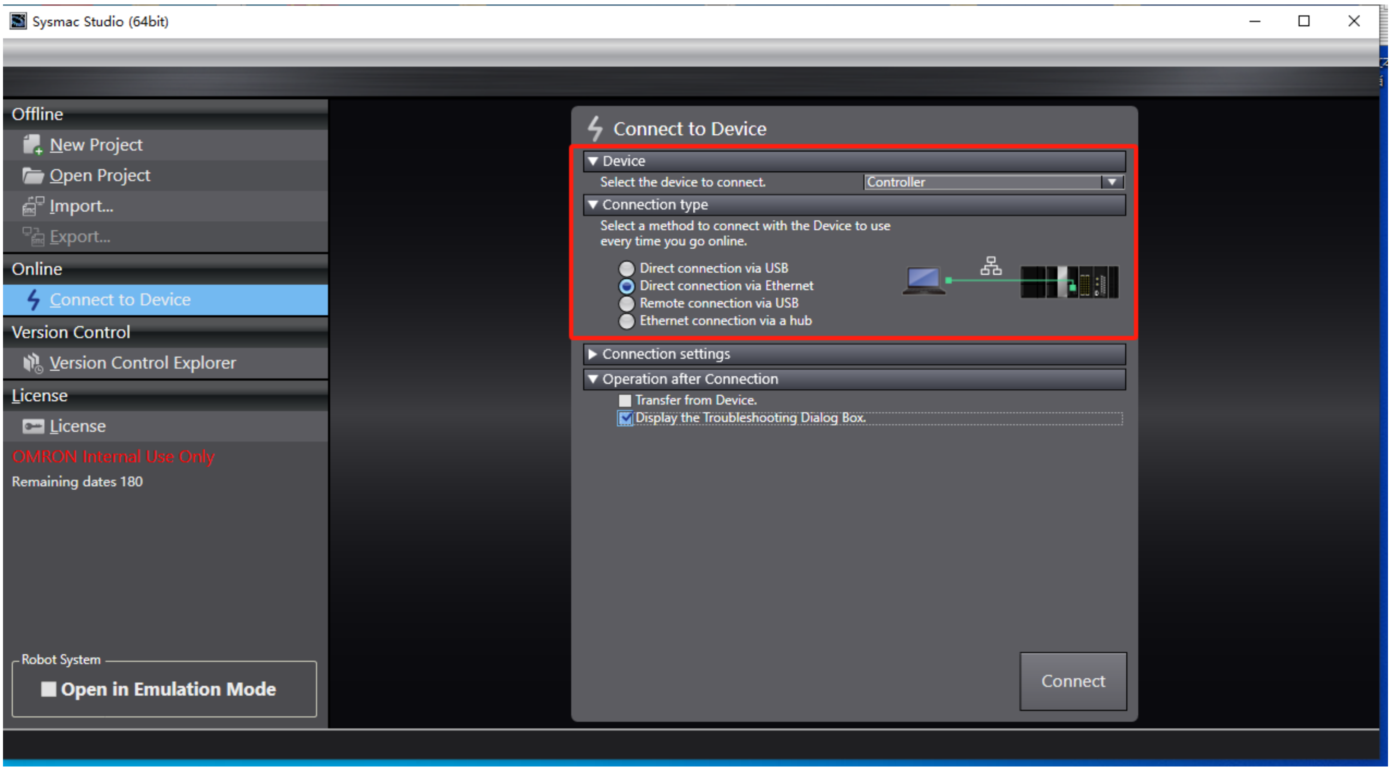


Figure 278 Select Ethernet communication

3 Scanning equipment

- Online→Double-click EtherCAT in the configuration and settings→Right-click on the main device→Compare and merge with the physical network configuration

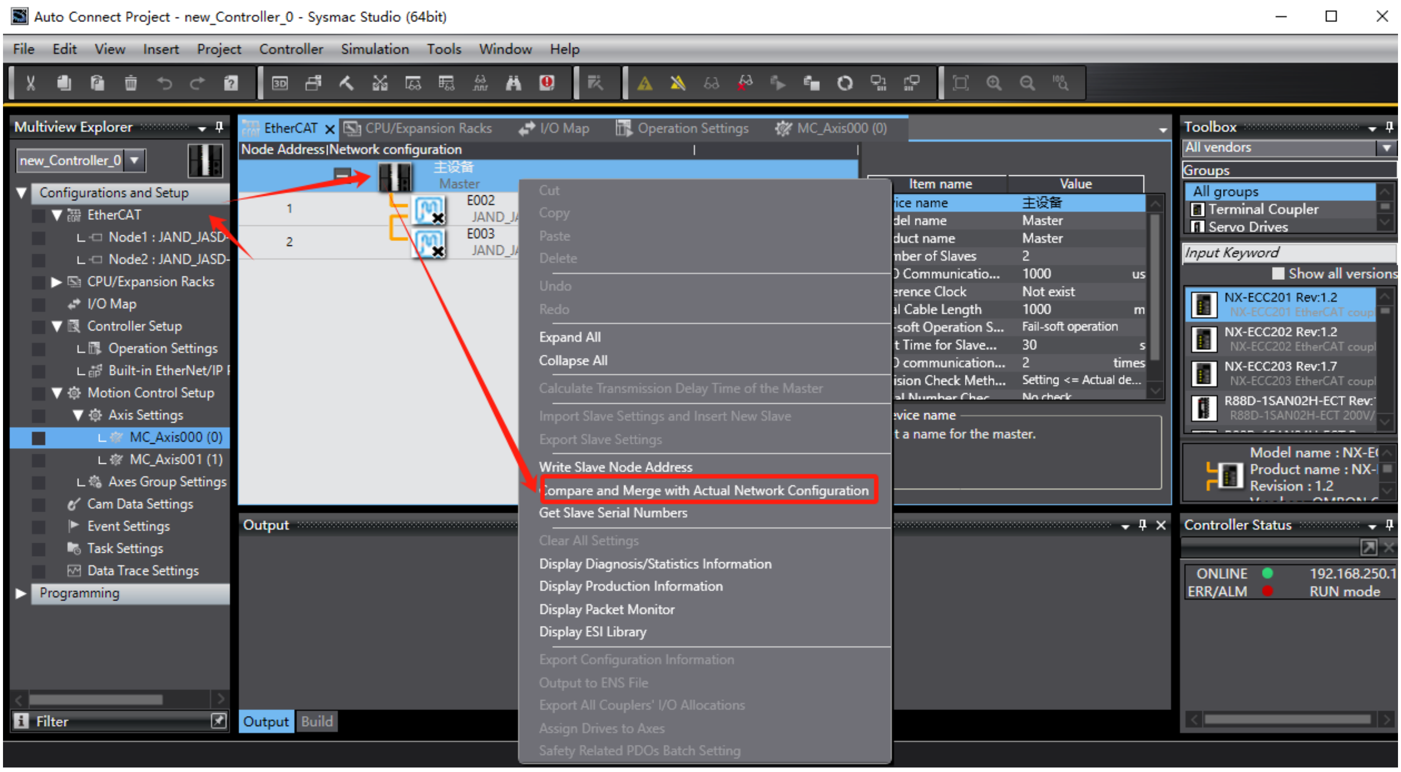


Figure 279 Comparison and merge with physical network configuration

- Apply physical network configuration

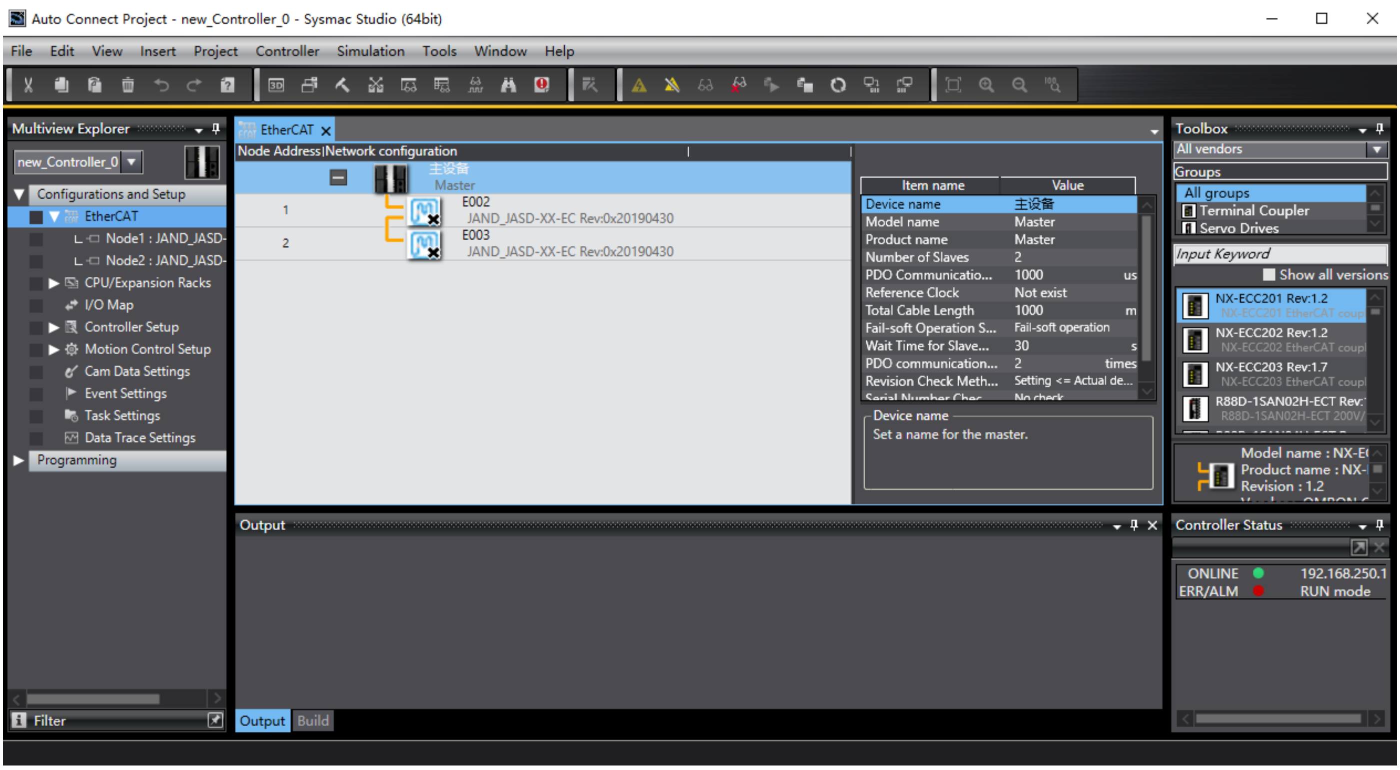


Figure 280 Applied physical network configuration

4 Axis parameter setting

Offline→Motion control axis→Axis setting→Add→Motion control axis

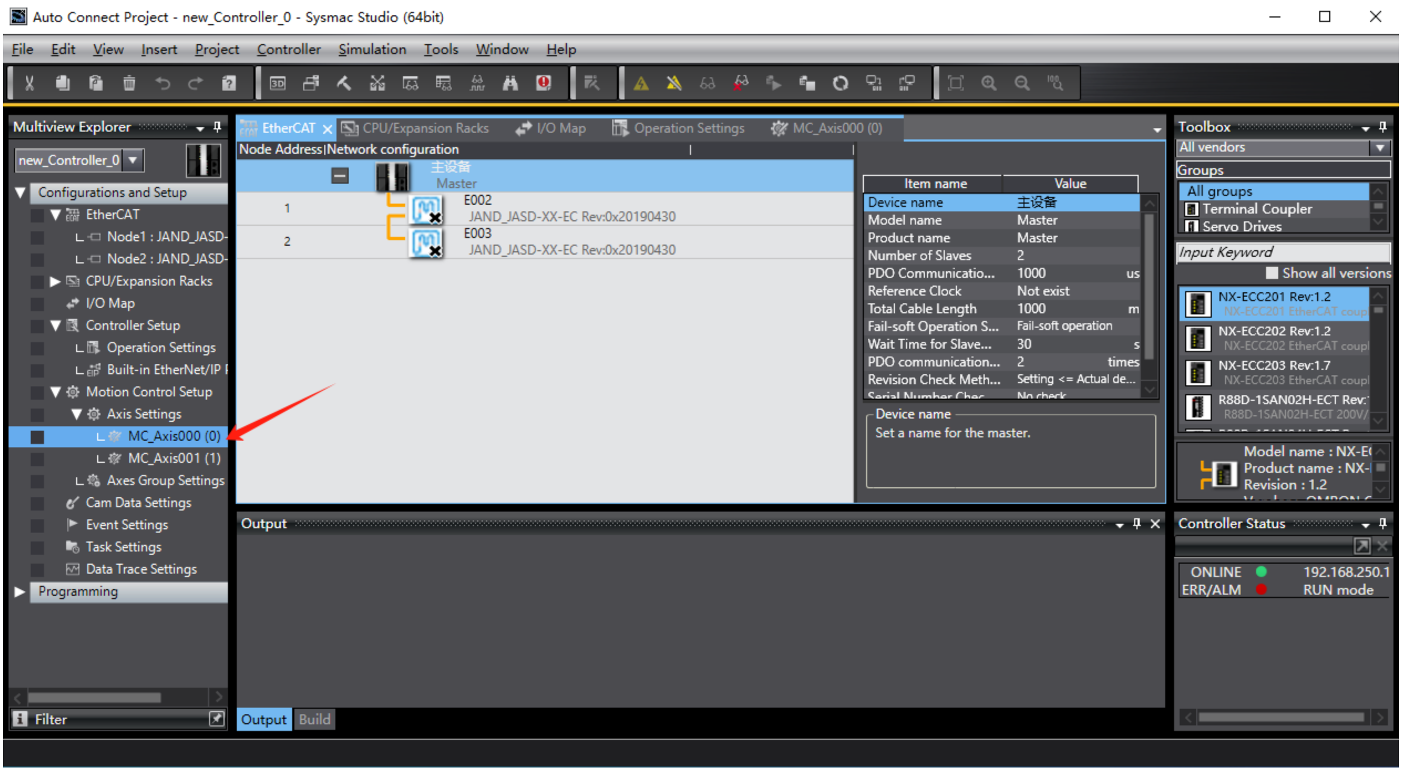


Figure 283 Add motion control axis

5 Axis assignment

double click MC_Axis000 → axis basic setting

axis number: JMC driver's communication axis number axis using: the axis is used

axis type: servo axis

output equipment 1: the relevant driver’s name

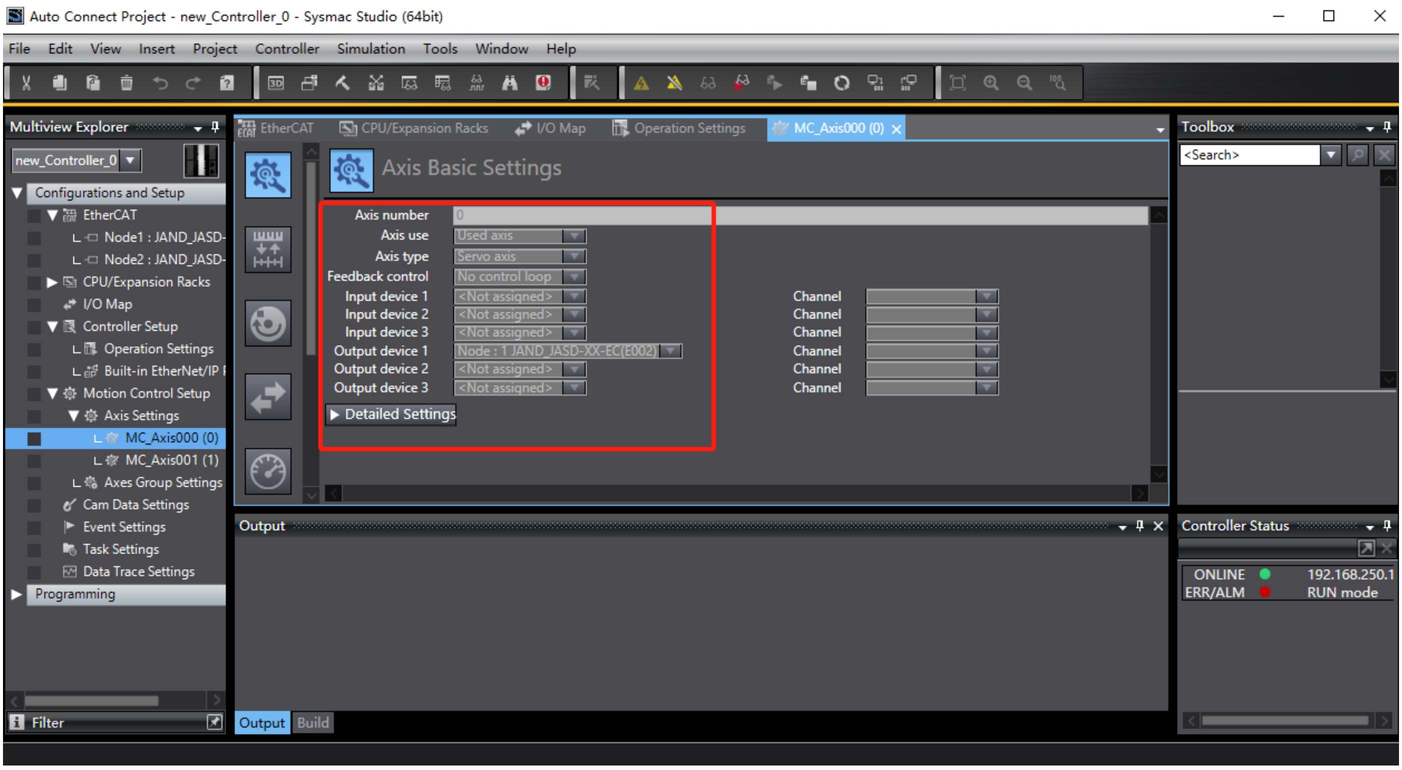


Figure 284 axis assignment

6 Detailed setting

Pay attention to the object name and index number in the PDO allocation mapping process. If the mapping is NOt assigned correctly, an error will occur.

NOte: 60FD must be mapped according to bits, and must be mapped in accordance with the following figure.

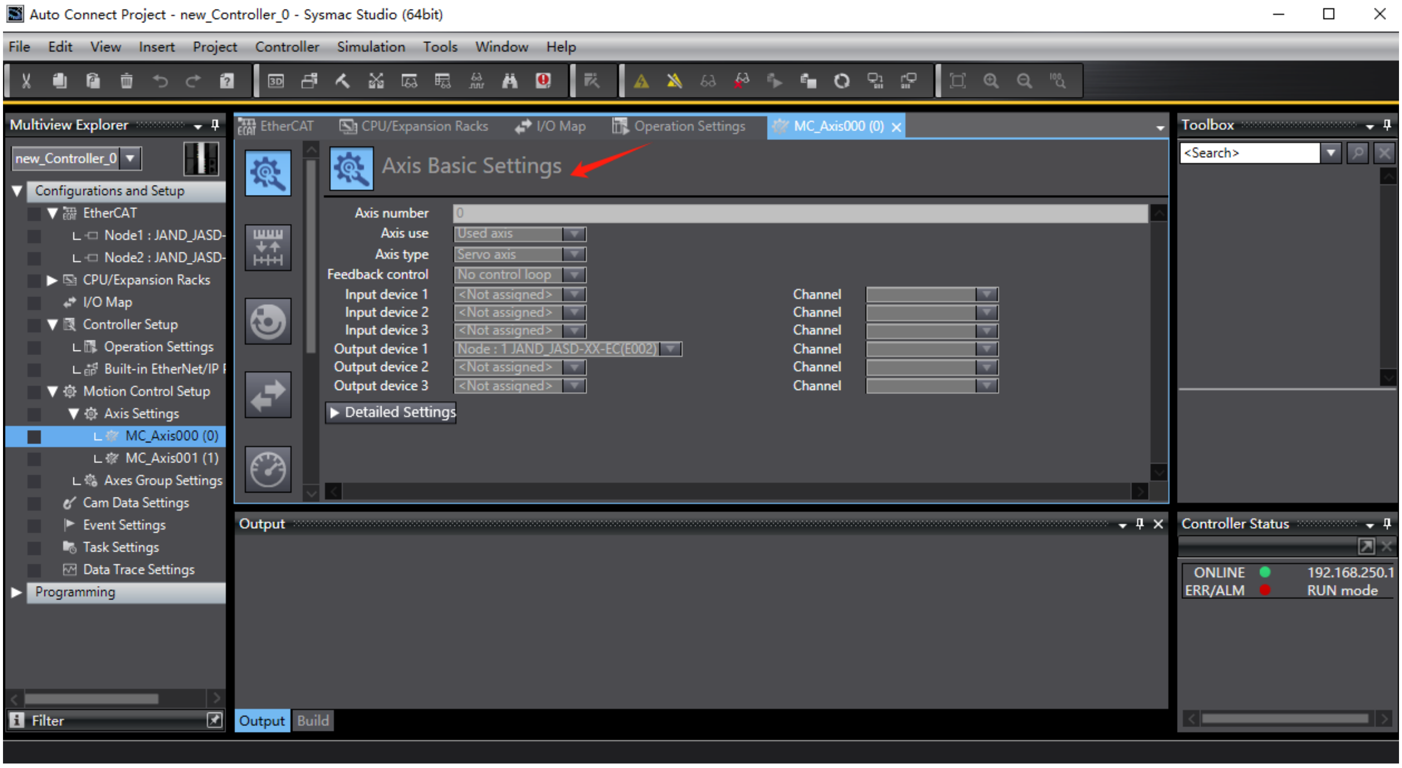


Fig 27 Axis basic setting

7 Unit conversion settings

- Set the number of command pulses for one revolution of the motor according to the actual motor resolution

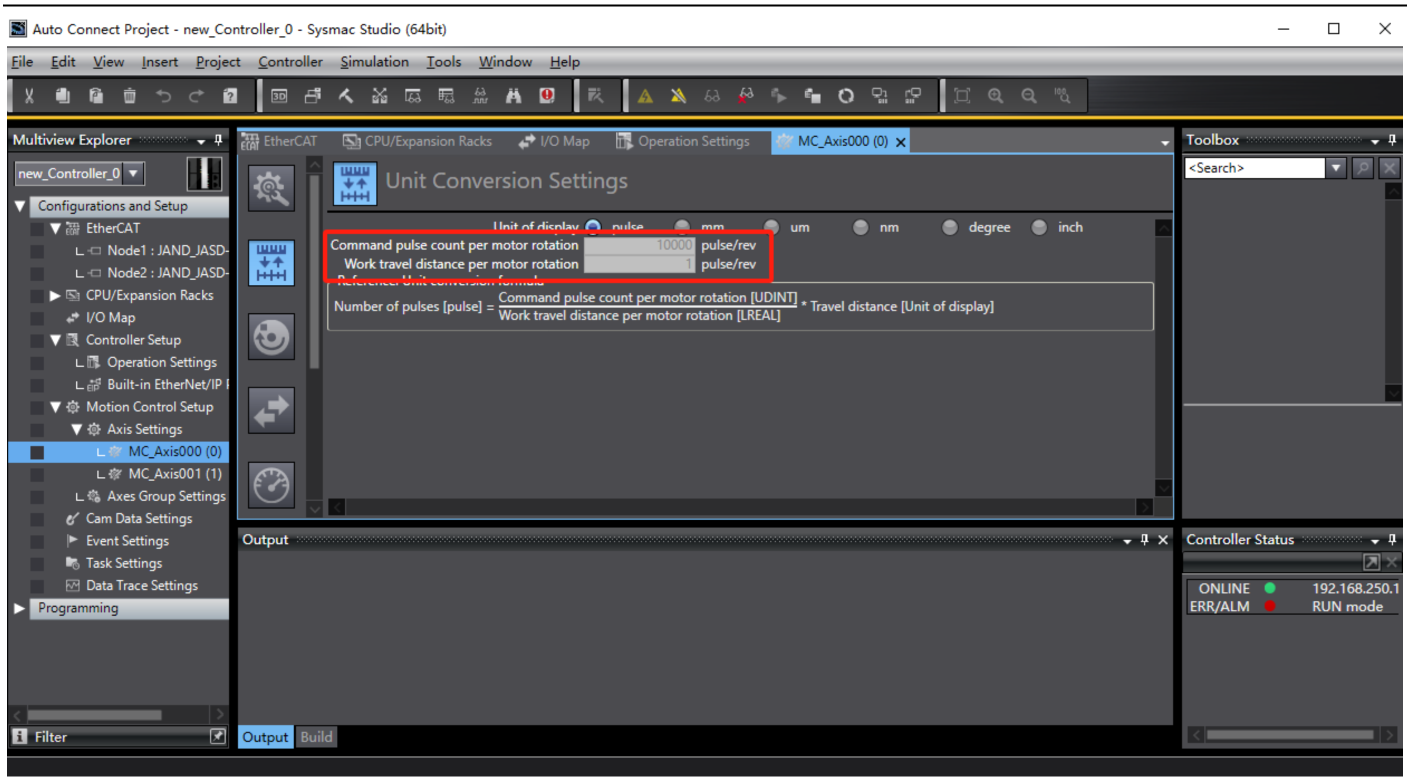


Fig 286 Unit conversion settings

8 Origin return setting

According to the actual mechanical conditions, select the appropriate homing method, speed, acceleration negative limit input.

NOte: Only one external origin input and Z-phase input can be selected, and they canNOt be used at the same time.

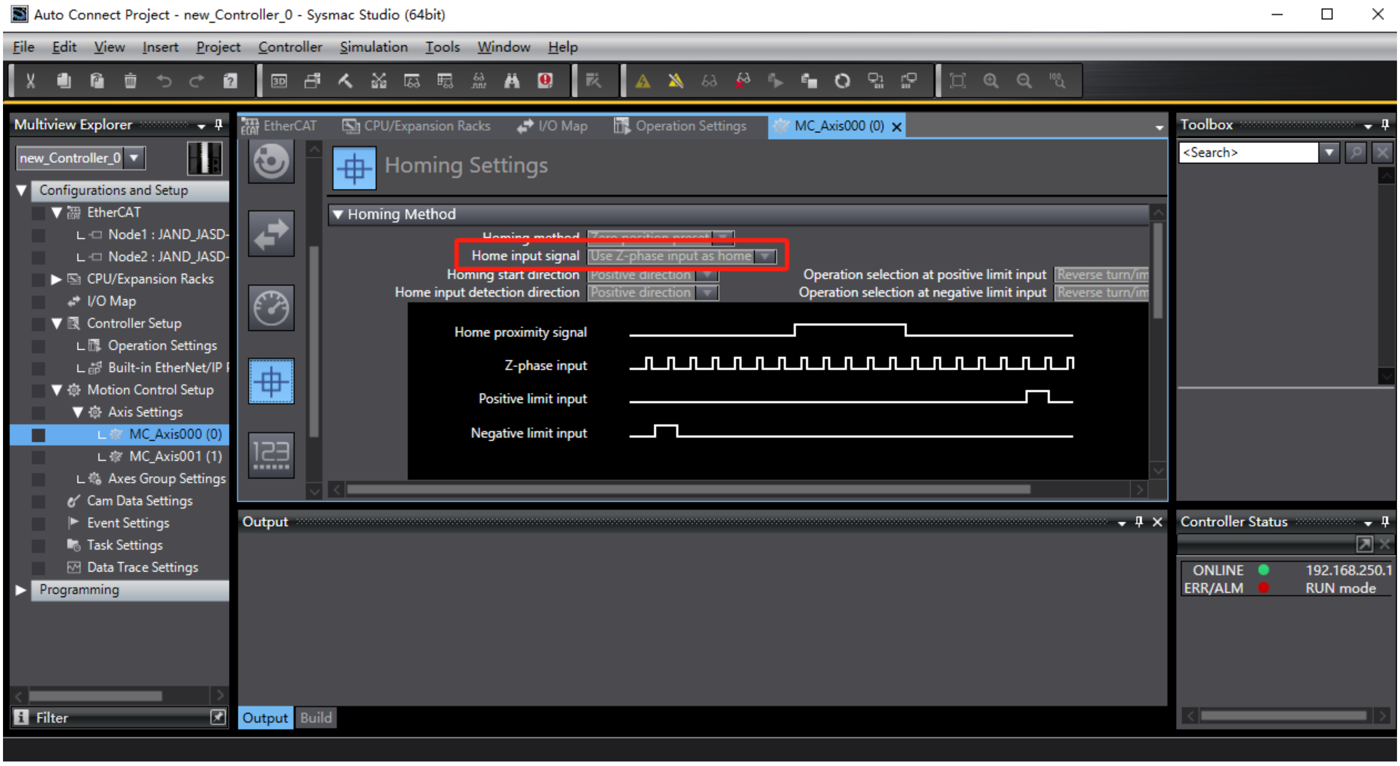


Figure 287 Origin return setting

Program control

After the above configuration is completed, we can control the motor operation through the PLC program, and we can judge whether it can be enabled by the status bit MC_Axis000.DrvStatus.Ready. To avoid the PLC running first, the communication has NOt been configured, which eventually canNOt be enabled.

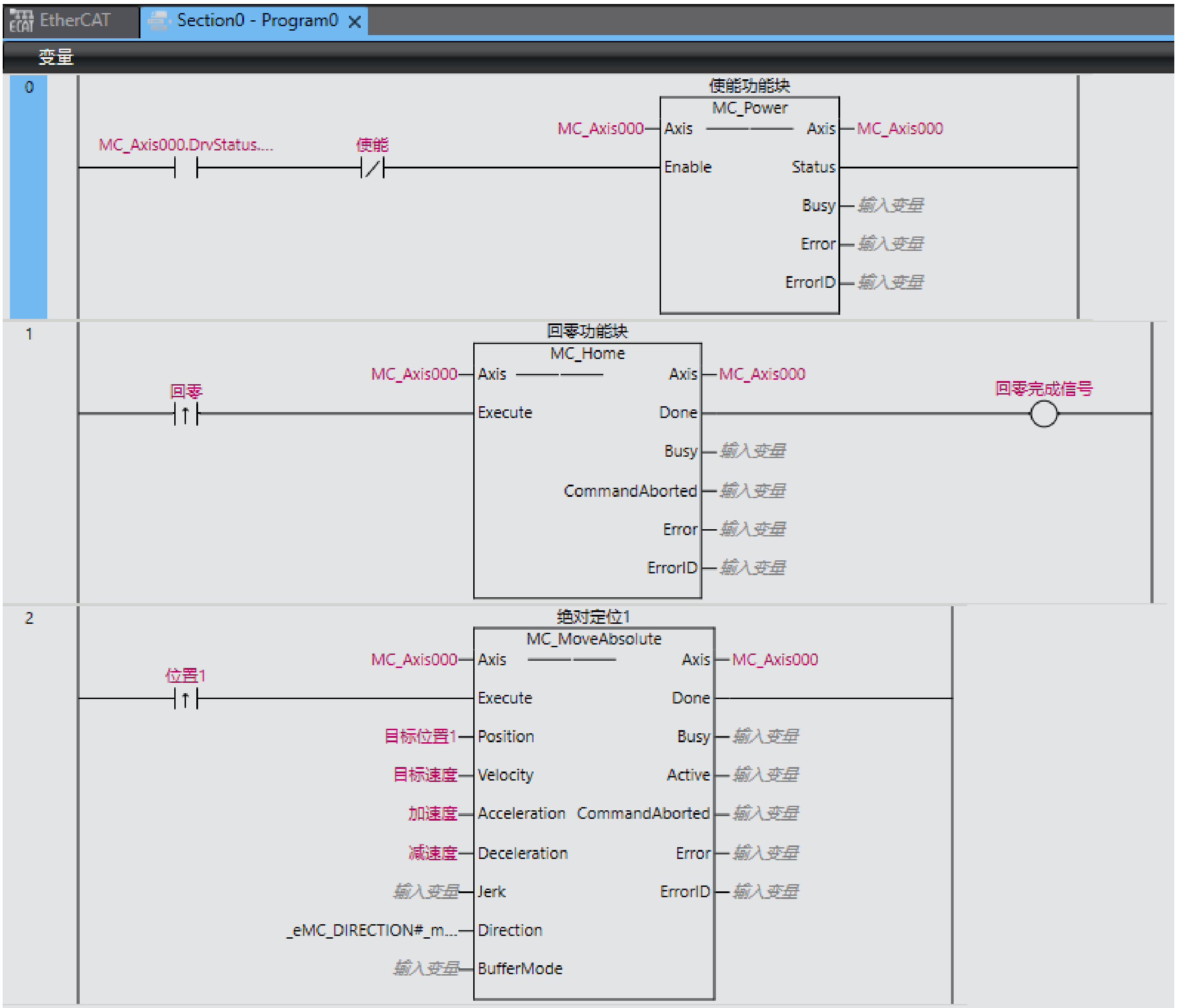


Figure 288 Program control

on-line running

After all configuration and programming are completed, switch to online status.

Use the synchronization function to compare the difference between the controller program and the current program, and then decide whether to download.

You can also download the current program directly, or upload the program in the controller.

EtherCAT communication operation example based on CoDeSys

Install device description file

- Open programming software (use CODESYS here)→Tool→Device→Install

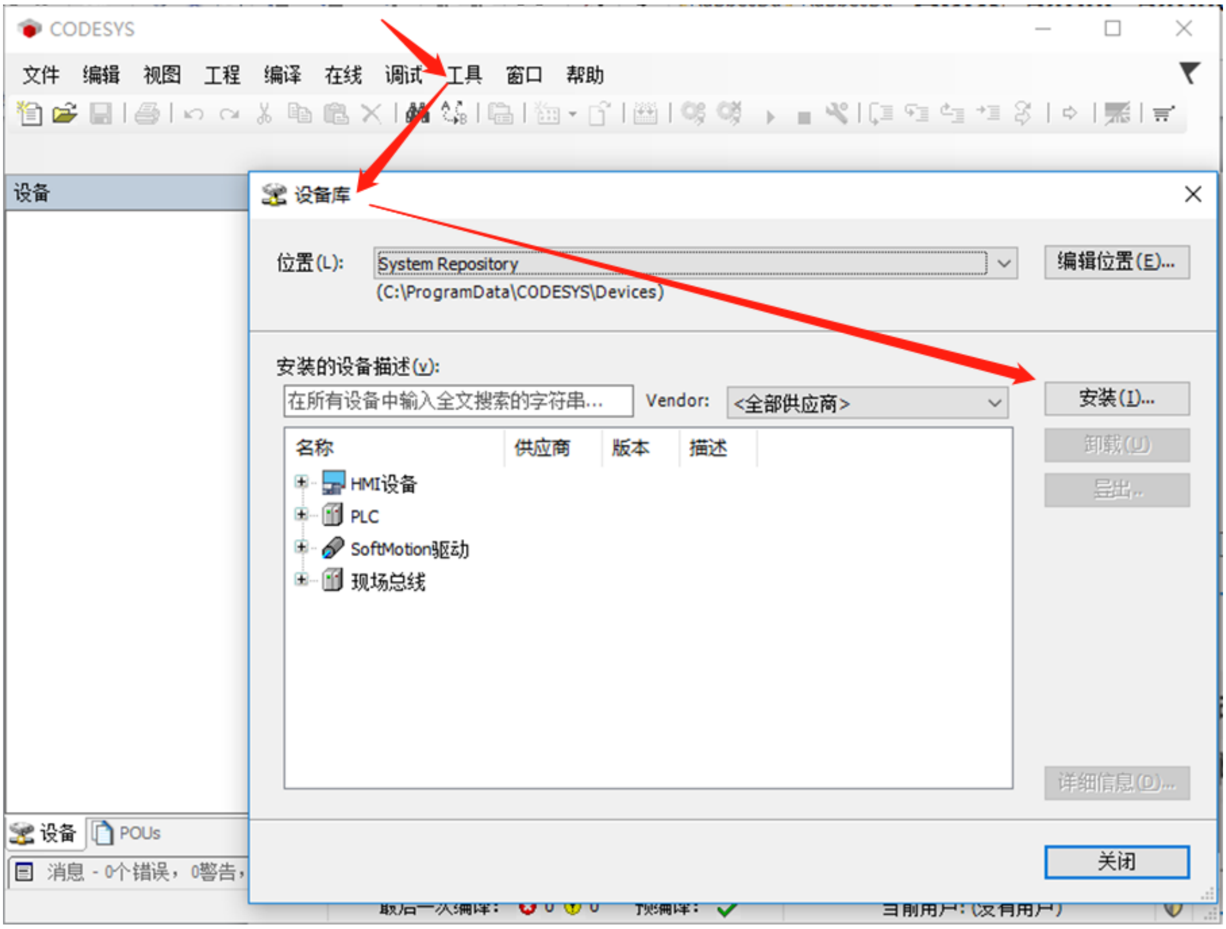


Figure 289 Install device description file

- Install the master station and slave station device description files separately

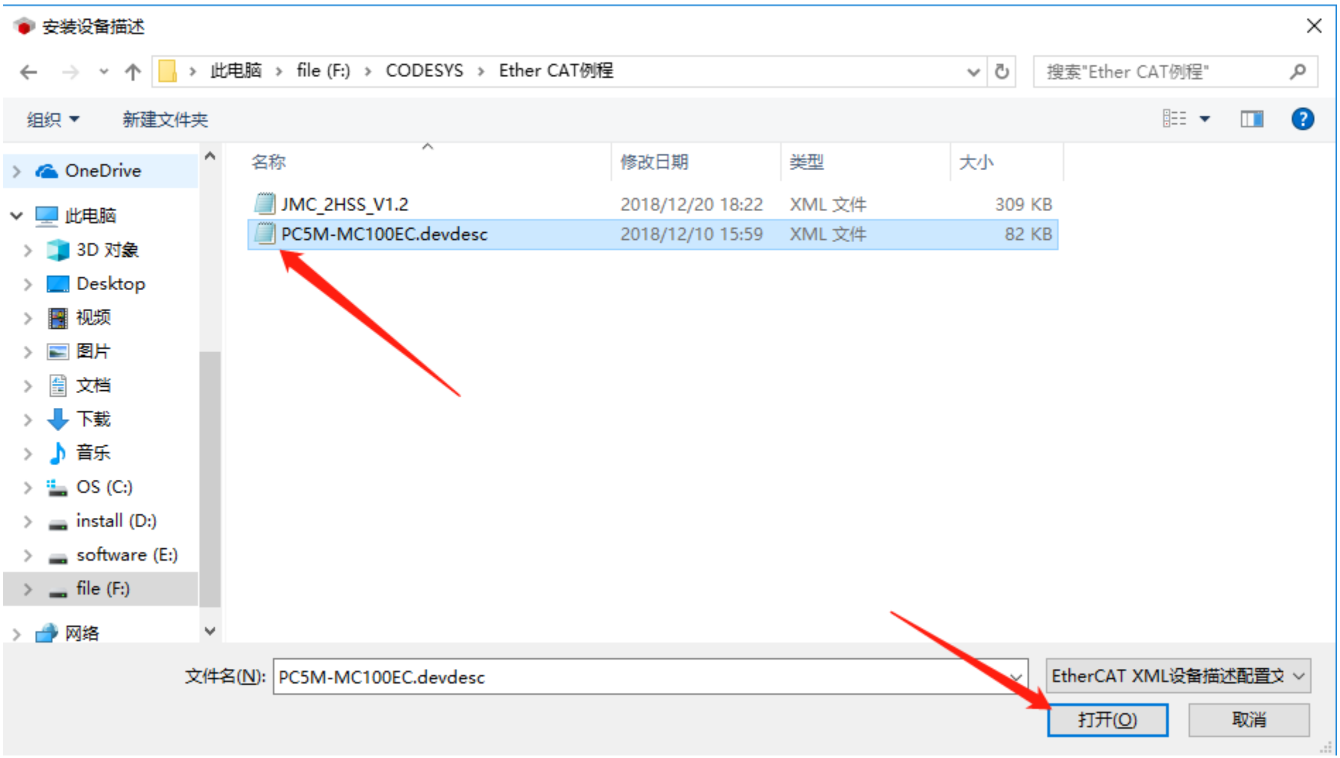


Figure 290 · Install the master station and slave station device description files separately

- Waiting it’s installed automatically

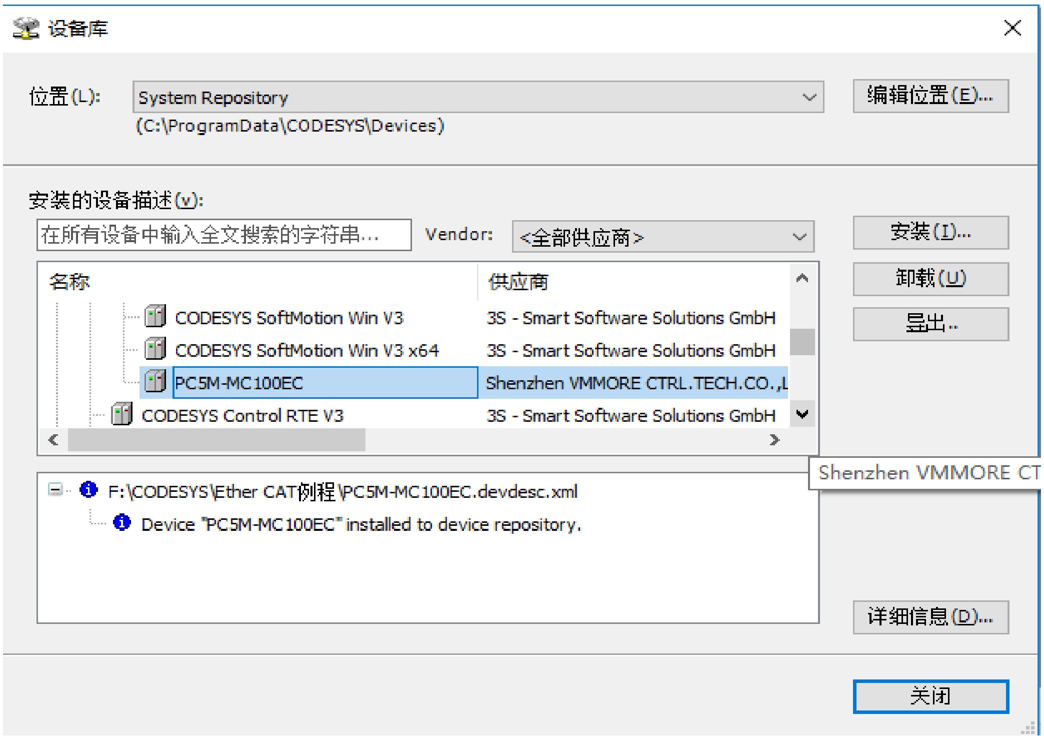


Figure 291 install automatically

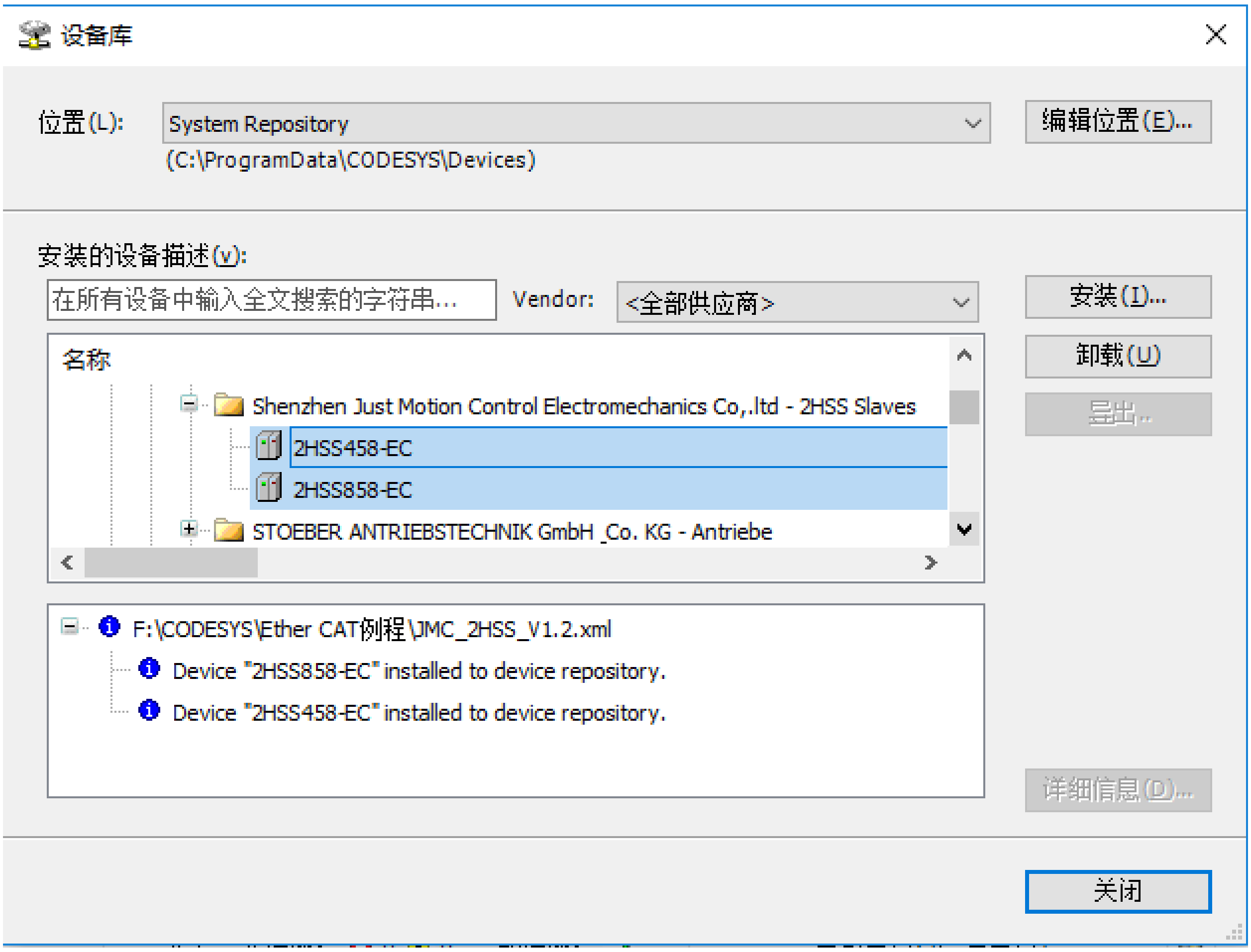


Figure 292 after installing

Create a project

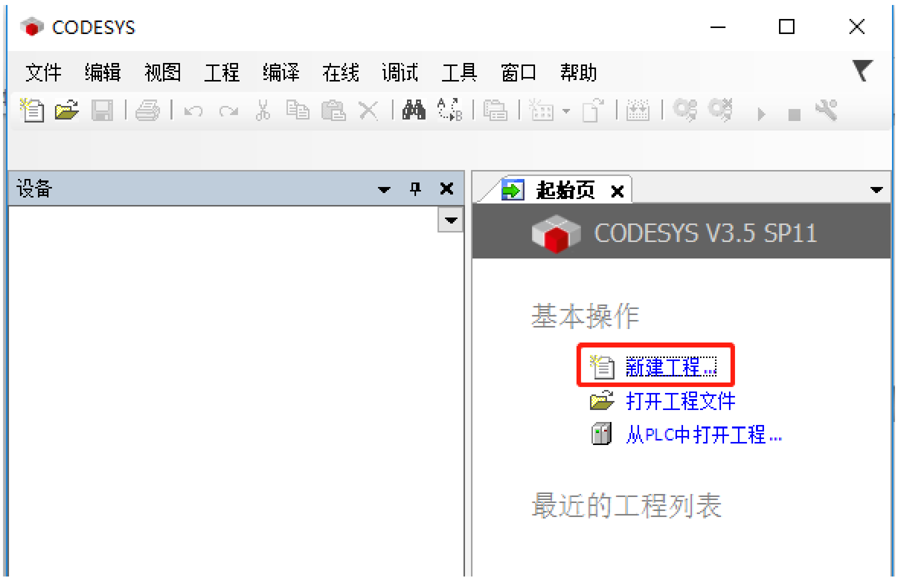


Fig 28 Create CODESYS project

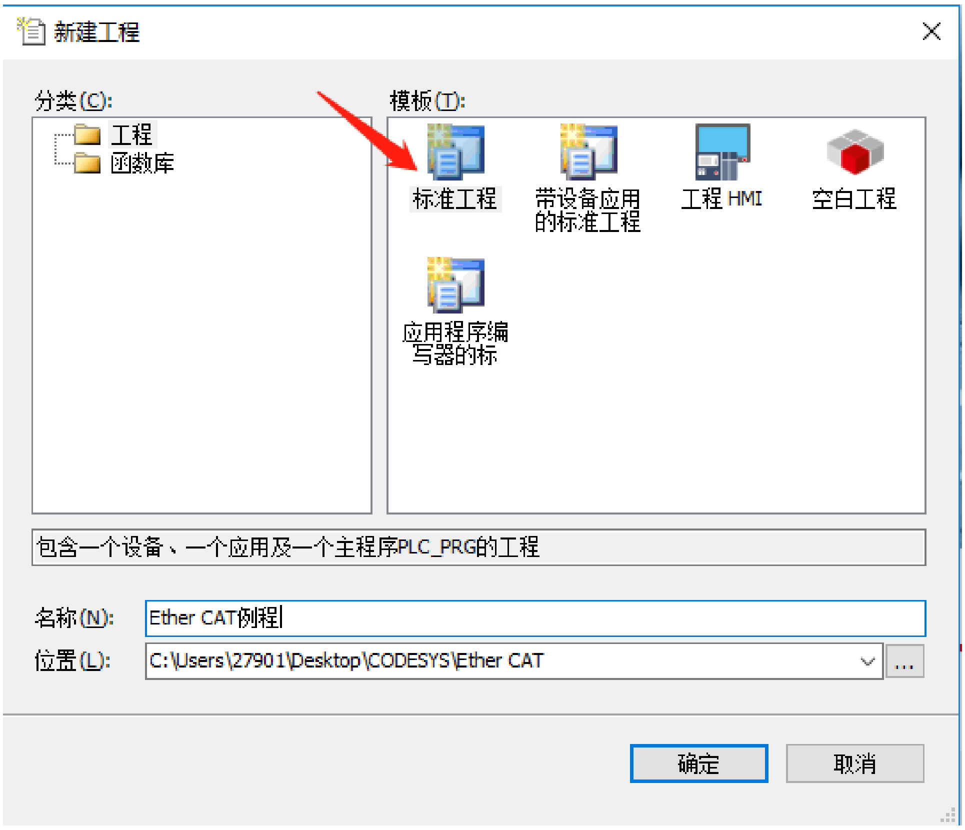


Figure 294 create a standard project

- select device and programming language

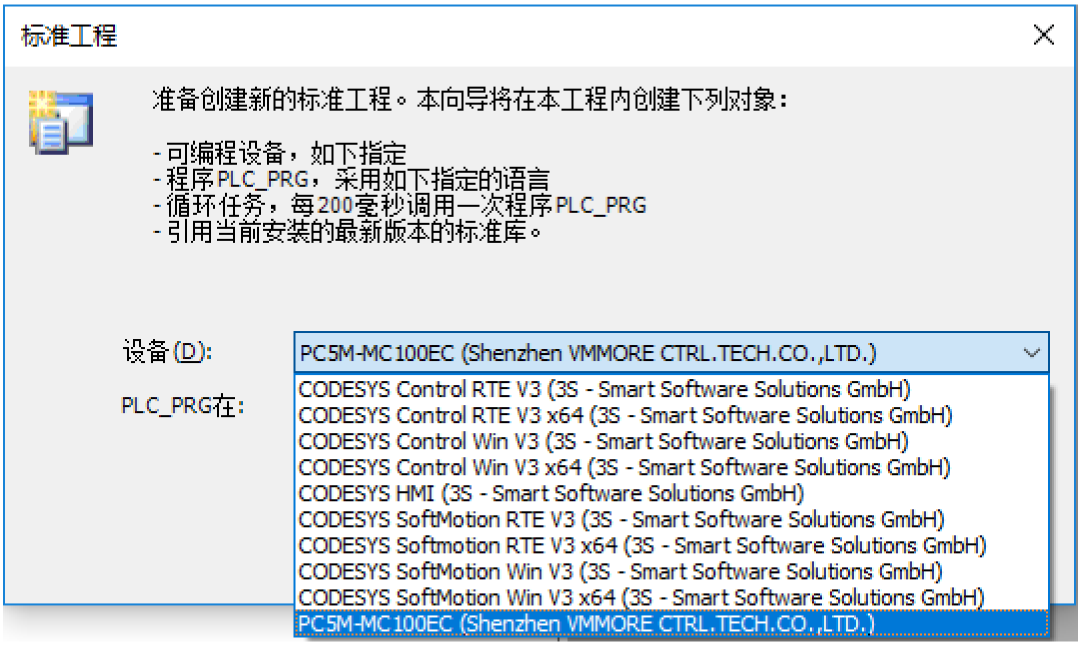


Figure 295 select device

Add device

- Device (PC5M-MC100EC) right click → add device → select EtherCAT_Master_SoftMotion → add device → close

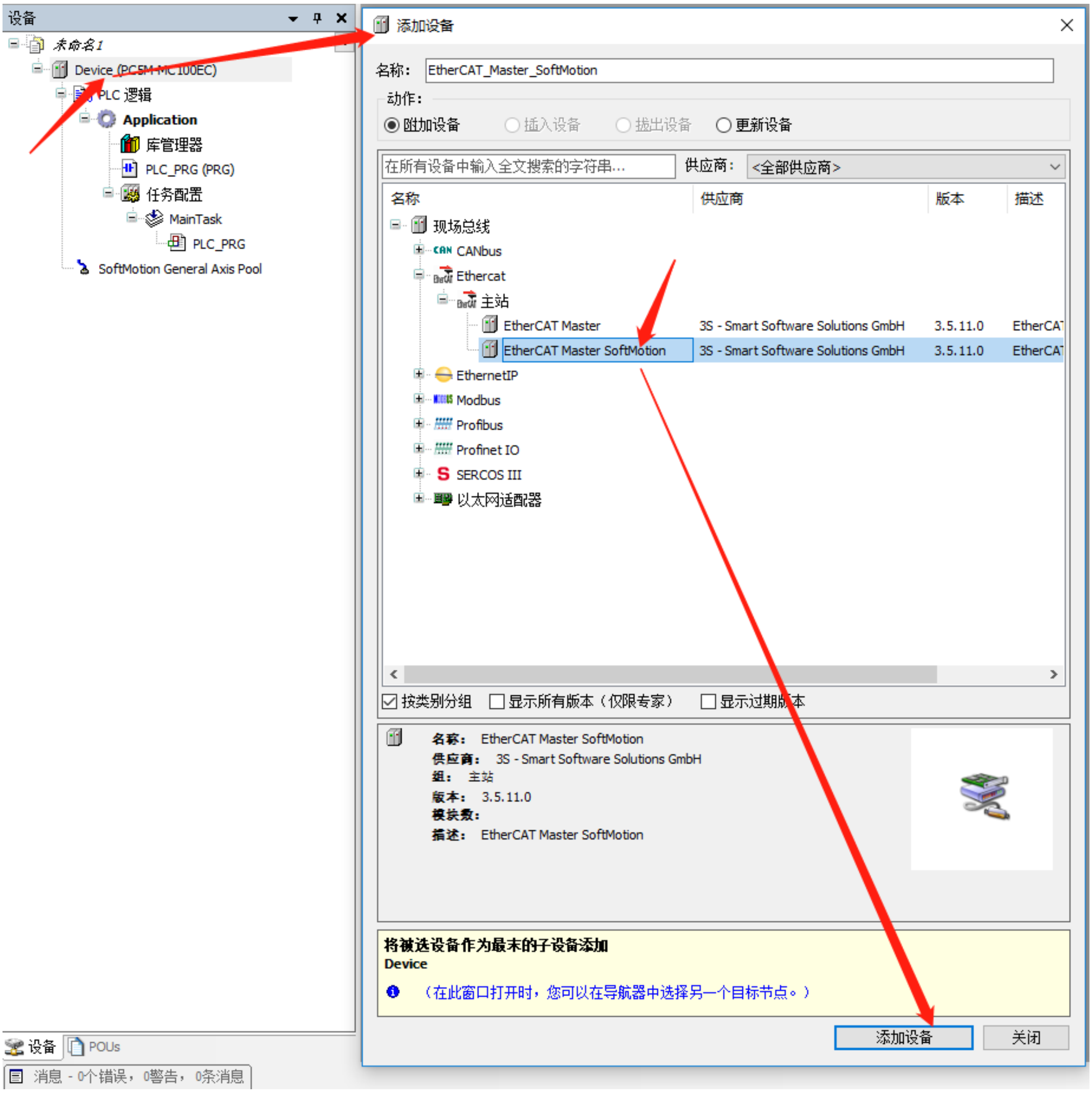


Figure 296 add device

- Right click of EtherCAT_Master_SoftMotion → add device → select 2HSS458_EC → add device → close

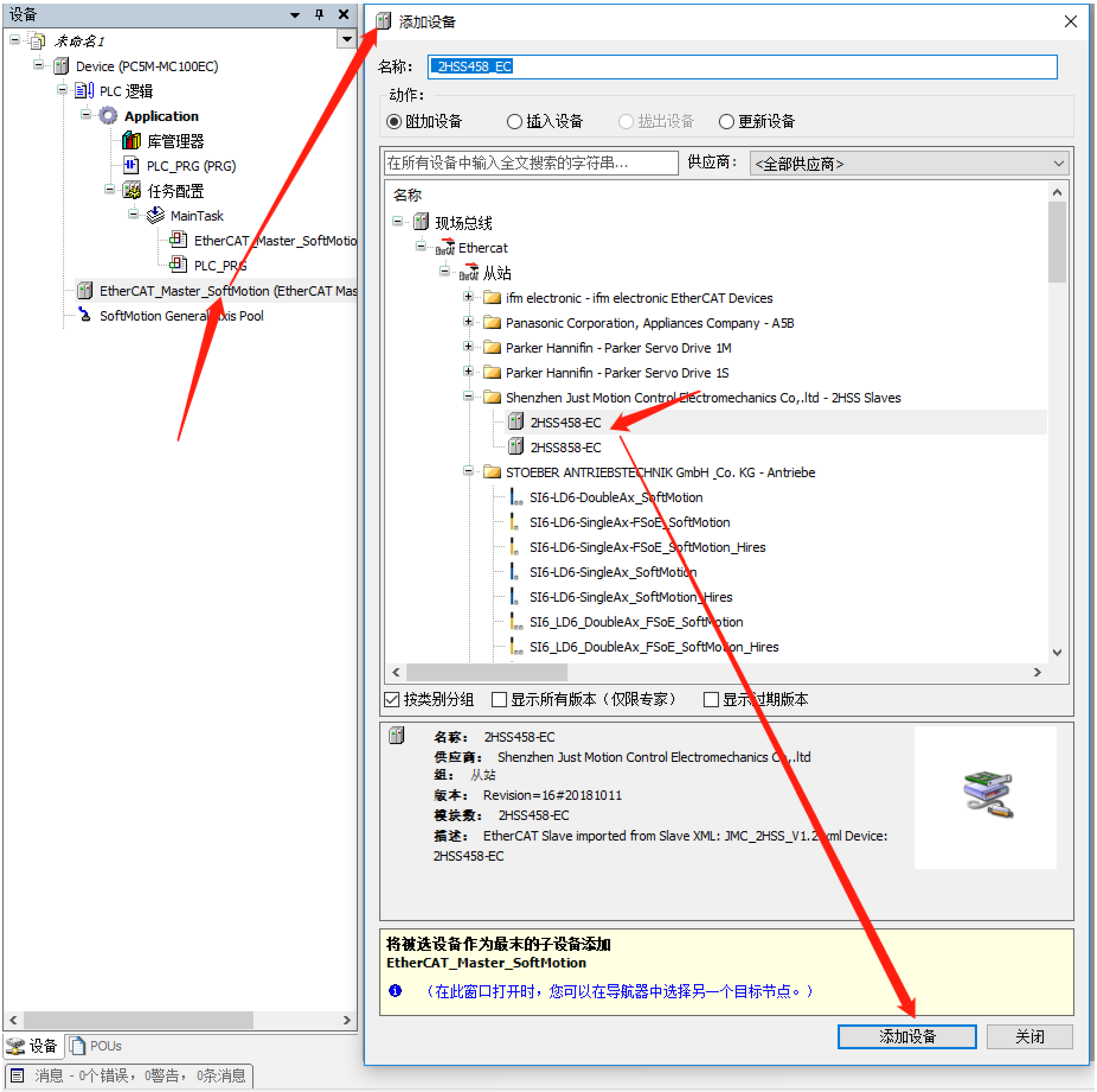


Figure 297 select device

- 2HSS458_EC right-click → add CiA402 axis of SoftMotion

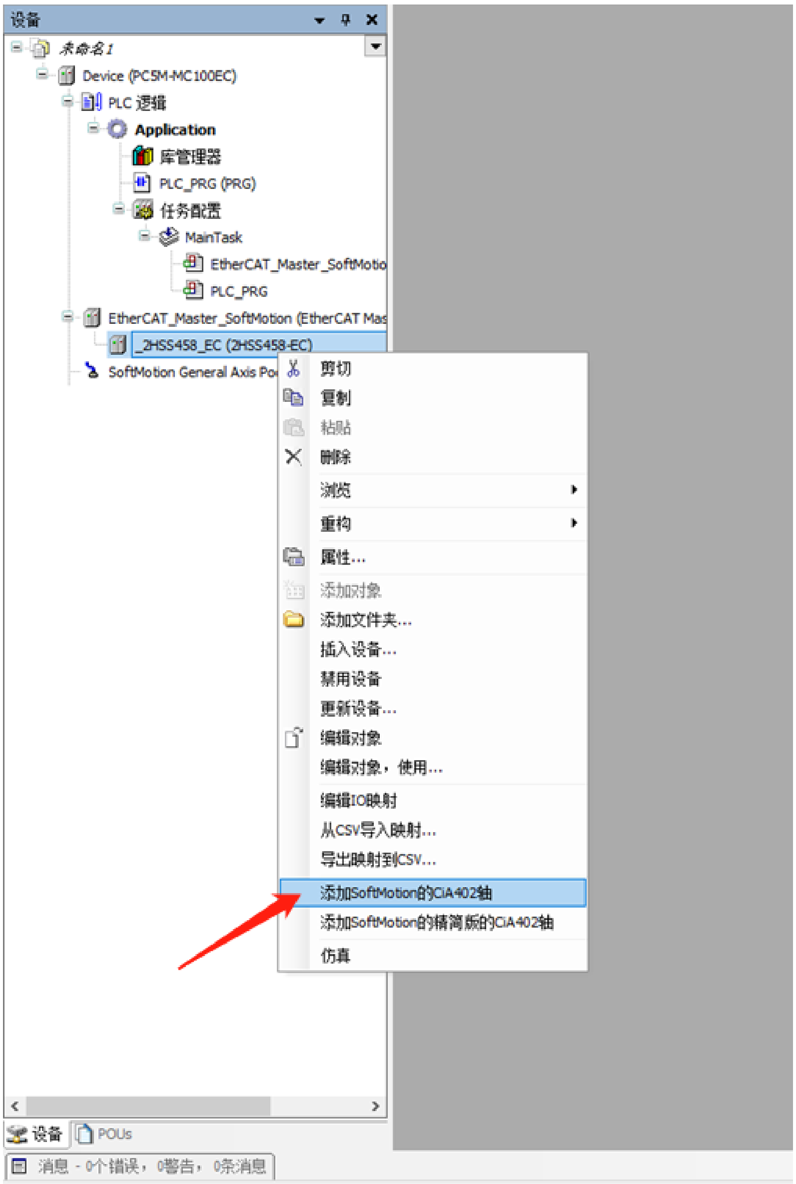


Figure 298 add CiA402 axis of SoftMotion

Parameter setting

Double-click 2HSS458_EC→Enable expert settings→Expert process data

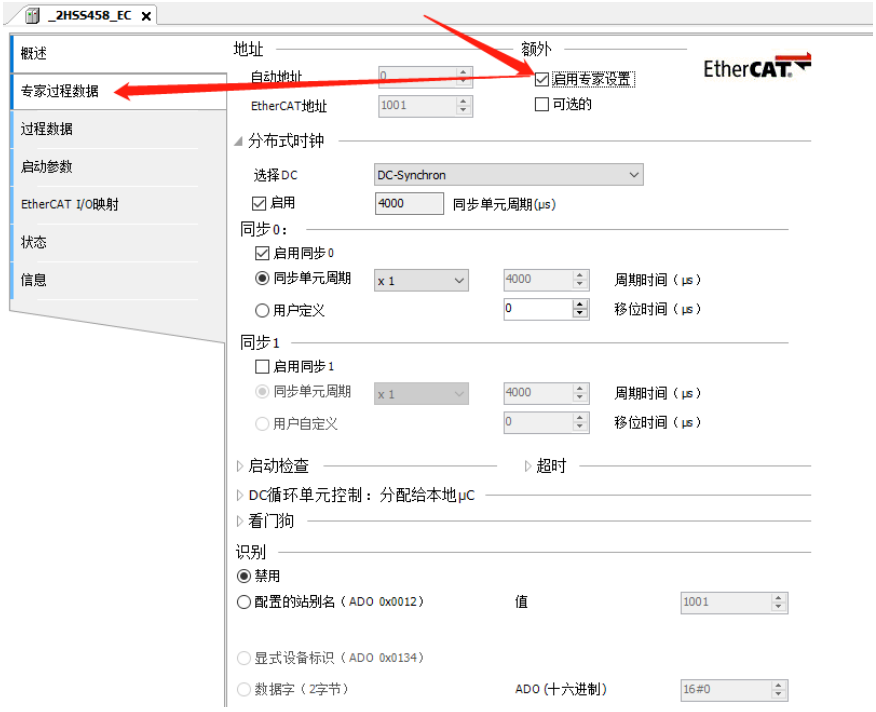


Figure 299 Enable expert settings

- Check the PDO allocation and PDO configuration in the download

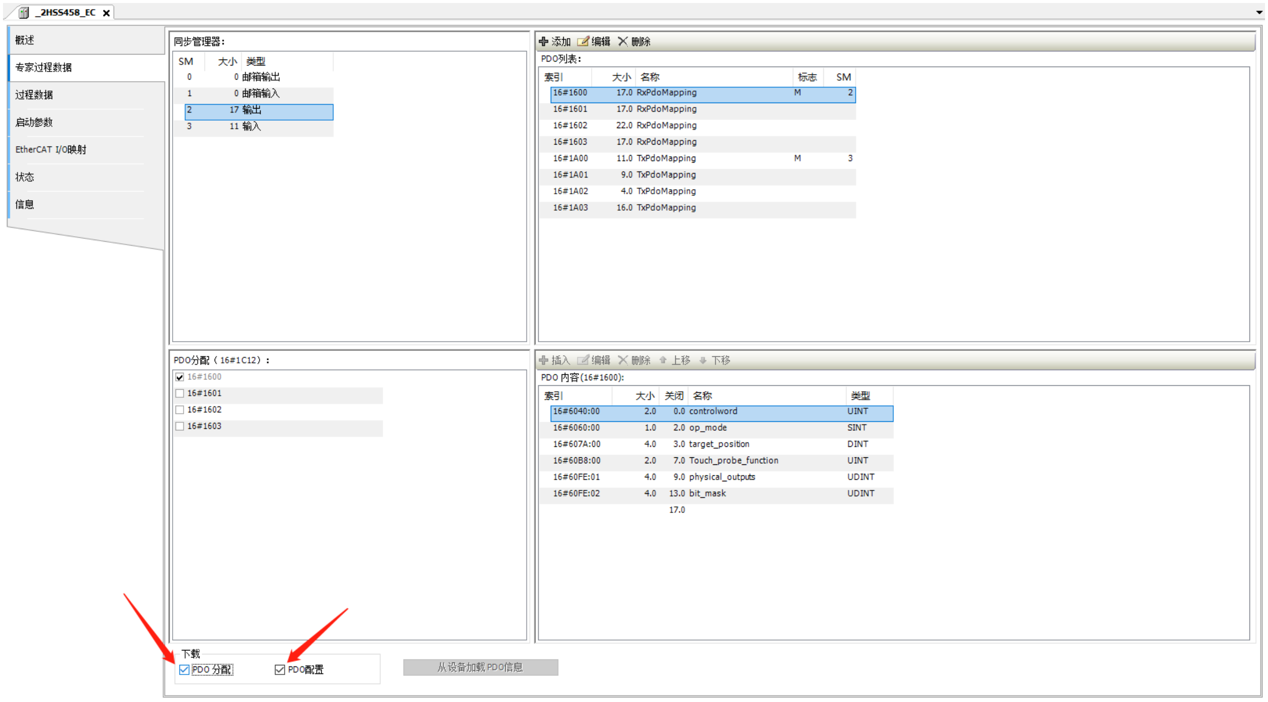


Figure 300 Expert process data

Double-click SM_Drive_GenericDSP402 → SoftMotion: Zoom/Map → Change 16#10000 to 16#FA0

●

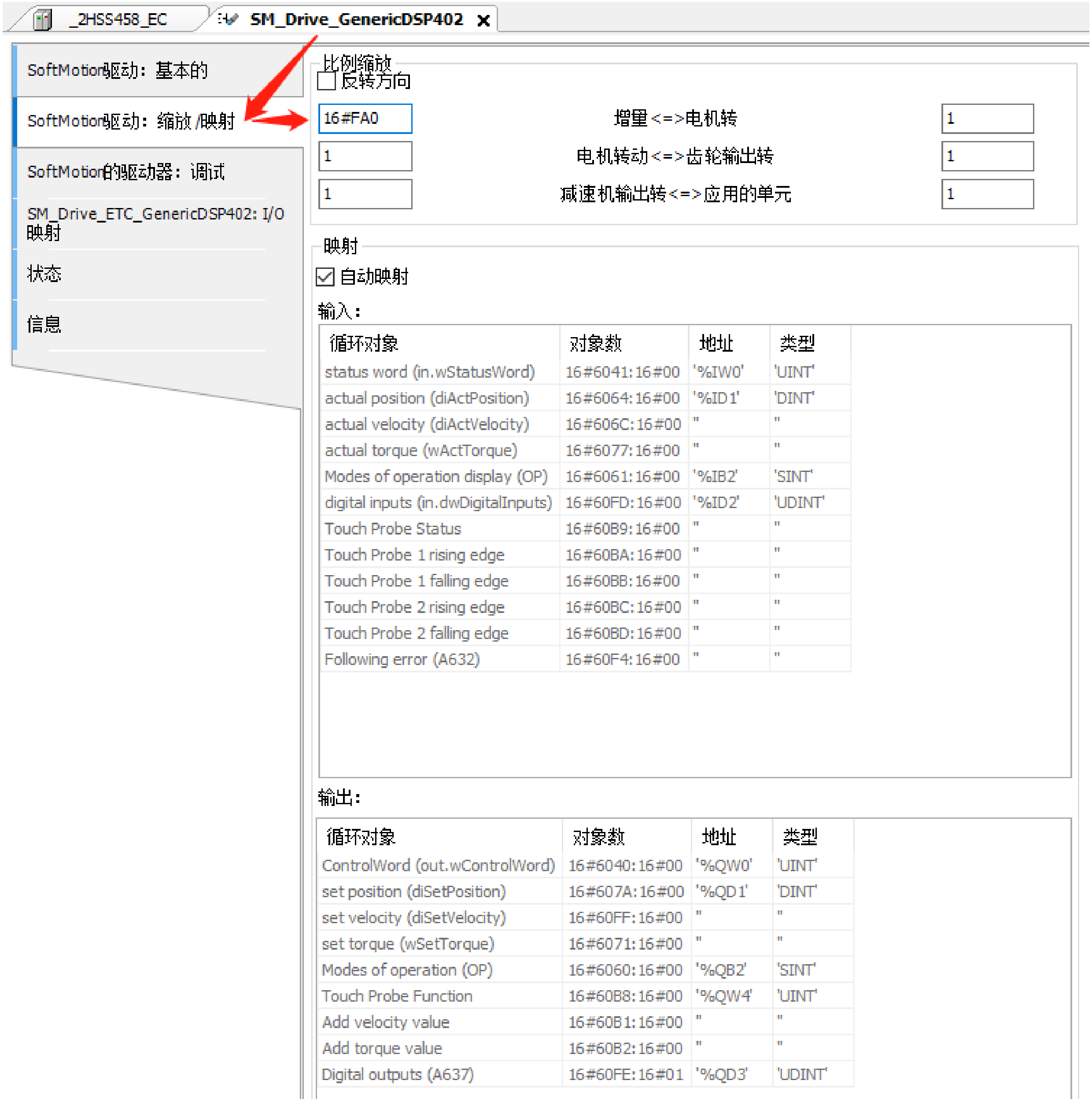


Figure 301 zoom/map

Programming

1 Set homing parameter

- Double-click 2HSS458_EC→Startup parameter→Add

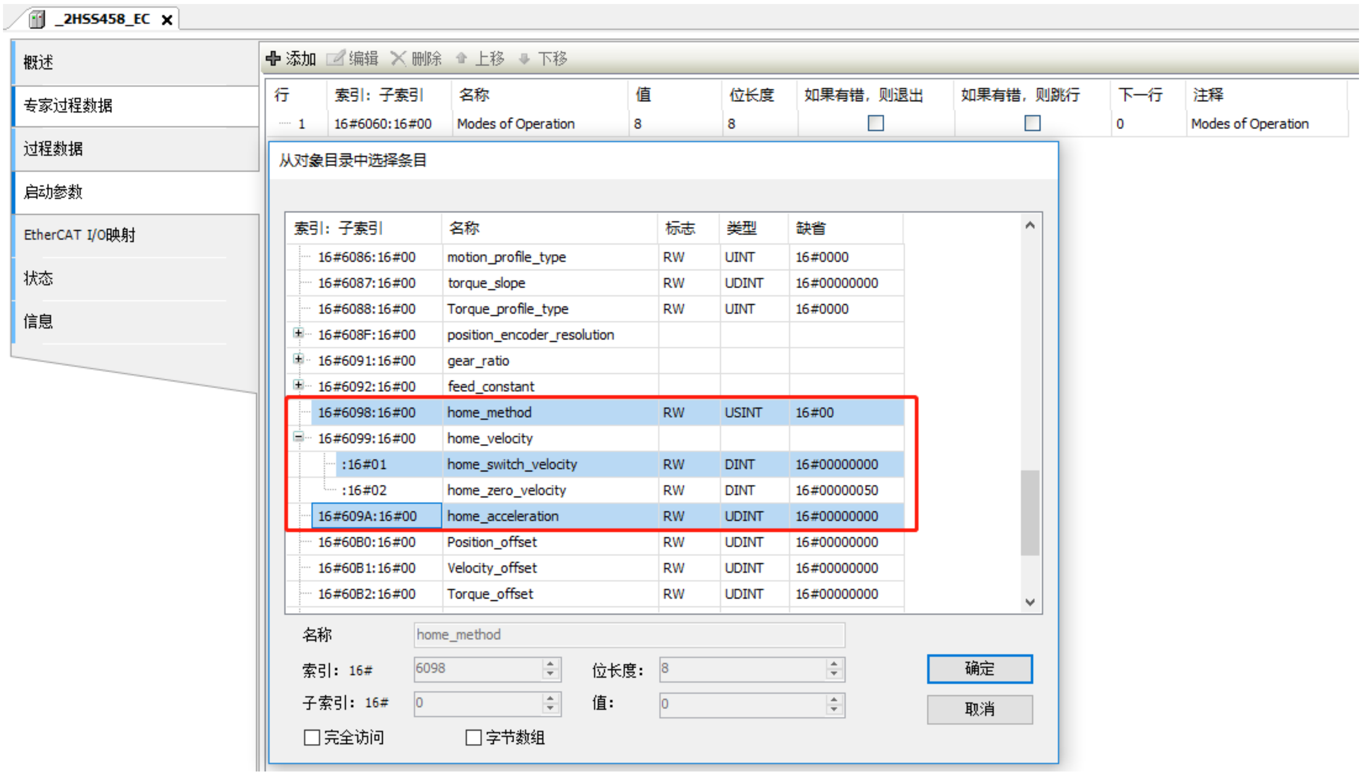


Fig 29 Add start parameter

Figure 303 Add object dictionary index

Add 60986099 [01], 609a → confirm

16#6098： homing type

16#6099 01： homing speed

16#609A： homing acc/dec velocity

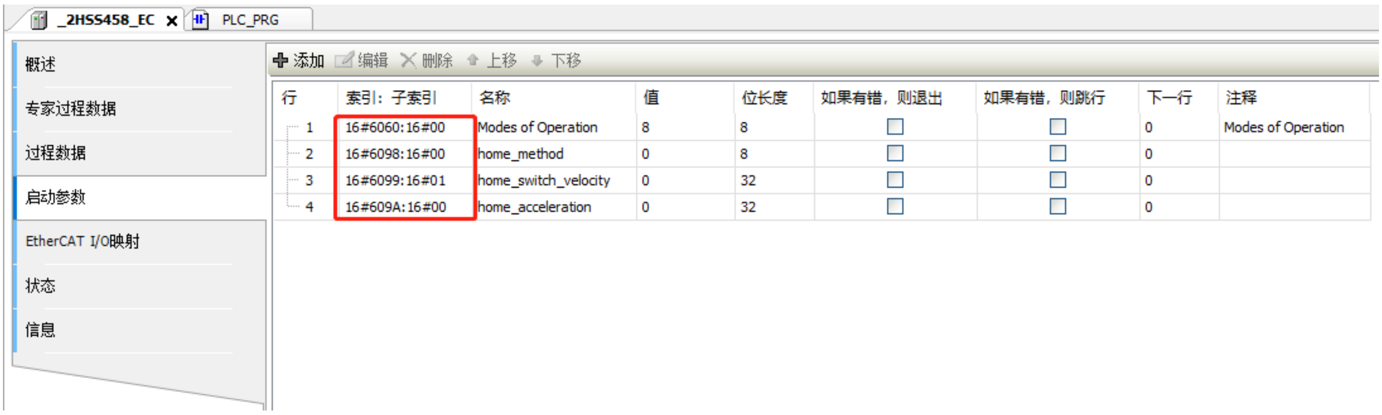


Figure 304 After adding the index

Eg：

16#6098=1， select homing type 1

16#6099 01=4000 speed is 1rps

16#609A=40000 acc/dec velicty is 10rps

Because SoftMotion: scaling/mapping is 16#FA0=4000, so the motor needs 4000 pulses for one revolution

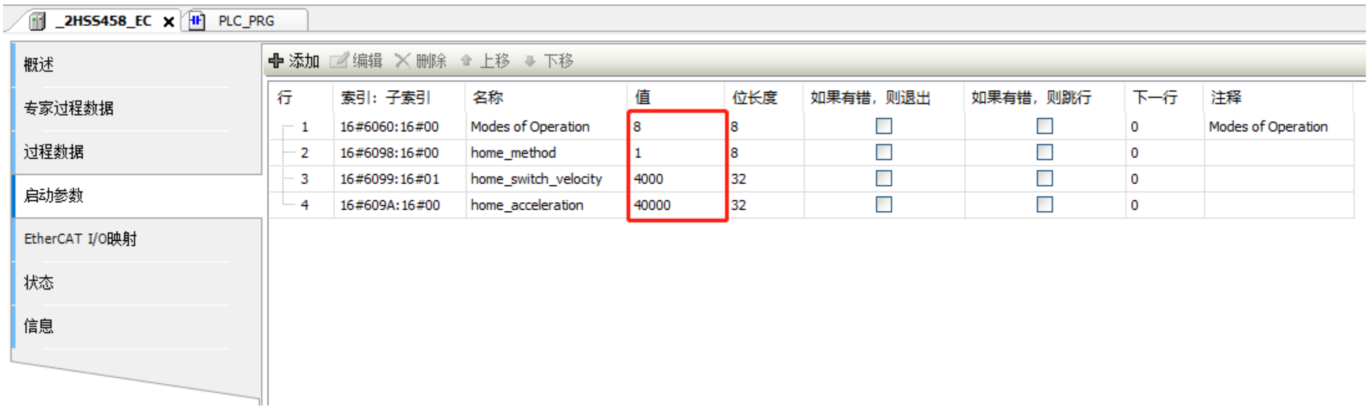


Figure 30 Modify the value of an object

2 Homing procedure

MC_Power：Axis enable command

MC_Home：Axis home command

Execute the axis enable function first, and then execute the axis home function to start the zero return and the motor runs. After reaching the corresponding limit switch, the motor stops and the position is cleared to 0.

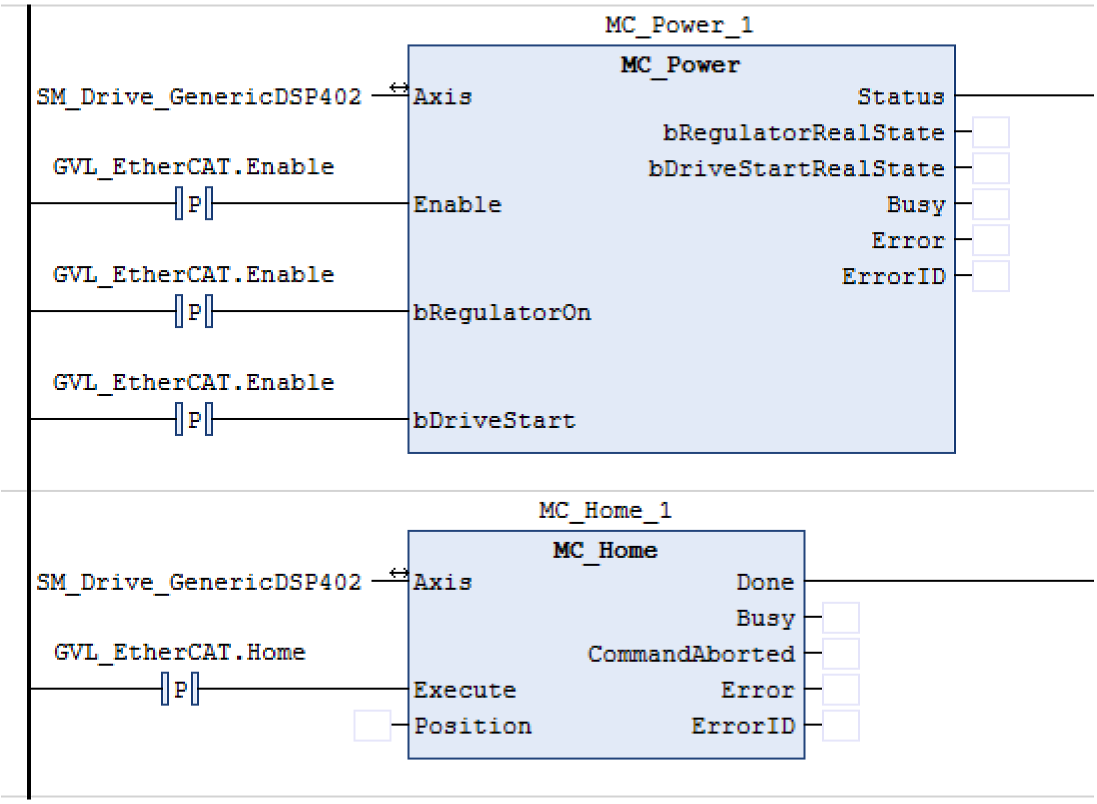


Figure 306 Homing procedure

Position mode

MC_MoveAbsolute：Axis absolute positioning control instruction

Position：Absolute position of movement (unit: number of motor revolutions)

Velocity：Operating speed (unit: rps)

Acceleration：Acceleration rate (unit: rps)

Deceleration：Deceleration rate (unit: rps)

MC_MoveRelative：Axis relative positioning control instruction

Distance：Relative motion position (unit: number of motor revolutions)

Velocity：Operating speed (unit: rps)

Acceleration：Acceleration rate (unit: rps)

Deceleration：Deceleration rate (unit: rps)

Execute the axis enable function first, and then execute the position function, the motor runs, and the motor stops after reaching the given position

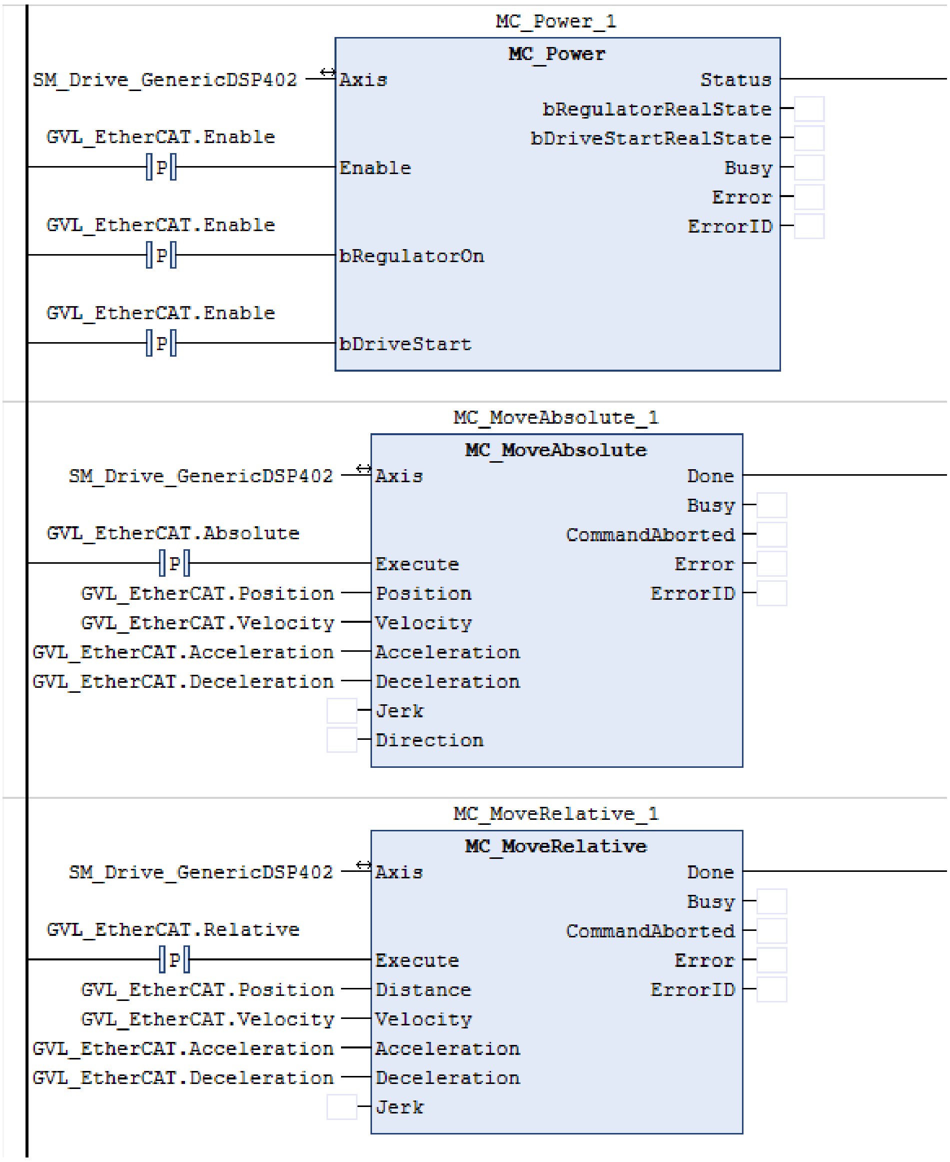


Fig 31 Position mode

Speed mode

MC_MoveVelocity：Axis speed control instruction

Velocity：running speed

Acceleration：acceleration speed

Deceleration：deceleration speed

MC_Jog：Jog mode

JogForward：CW rotation

JogBackward：CCW rotation

Velocity：running speed（Unit：rps）

Acceleration：acceleration speed （Unit：rps）

Deceleration：deceleration speed （Unit：rps）

MC_Stop：Axis stop command

Deceleration：deceleration speed（Unit：rps）

speed control

Execute the axis enable function block first, then execute the speed function block, the motor runs, execute the axis stop function block, the motor stops

Jog control

Execute the axis enable function block first

Set JogForward to TRUE, the motor runs in the CW direction, and set JogForward to FALSE, the motor stops.

When JogBackward is set to TRUE, the motor runs in the CCW direction, and if JogBackward is set to FALSE, the motor stops.

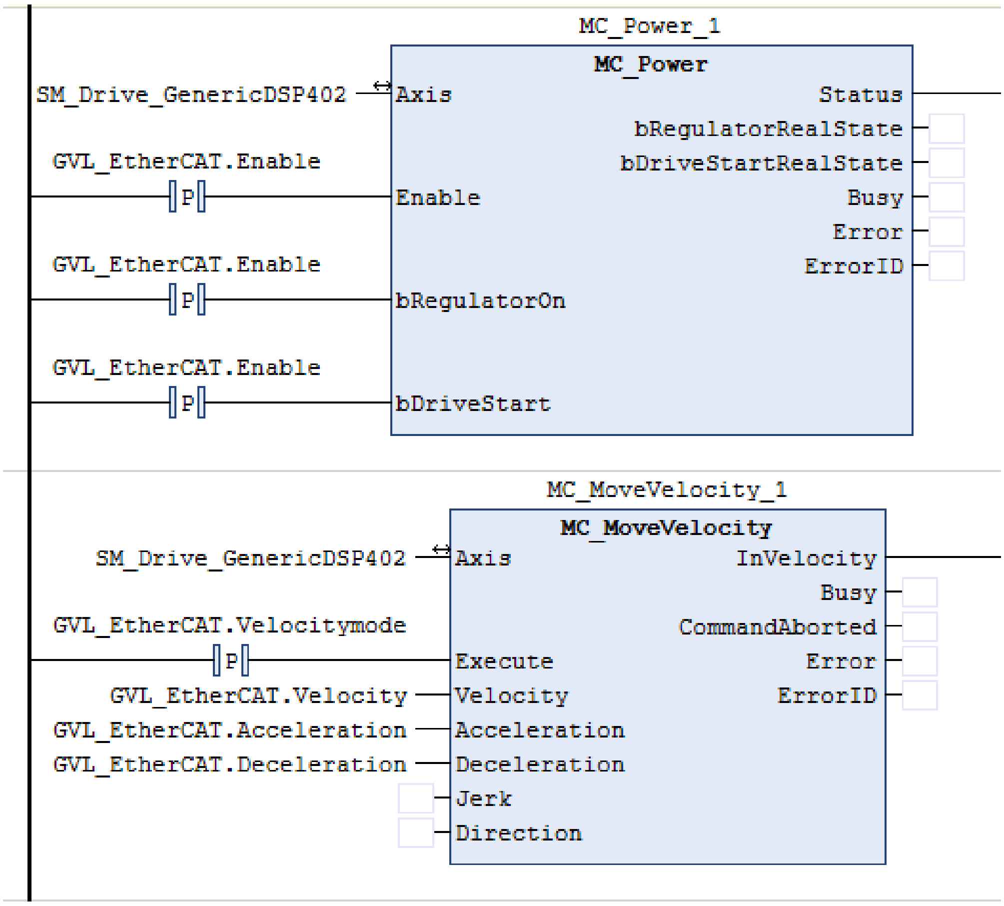


Fig 308 Speed mode

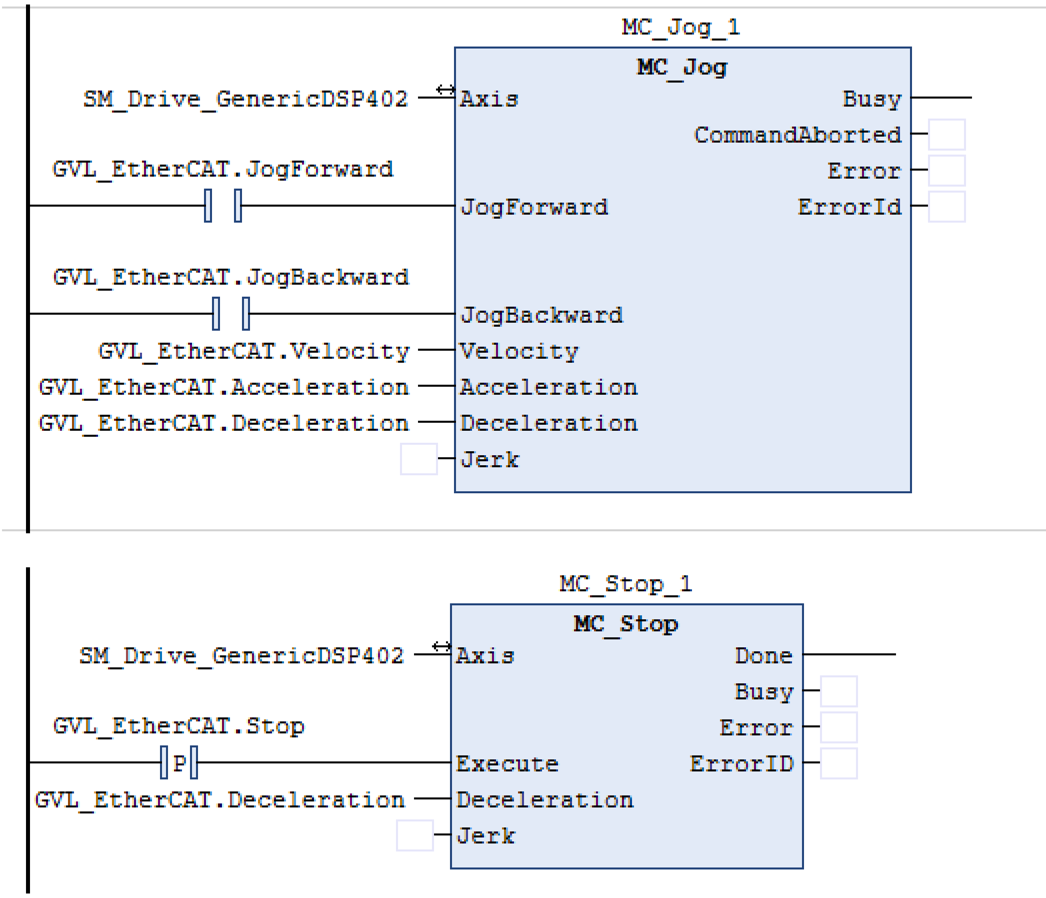


Fig 32 JOG mode

The position, speed, acceleration and deceleration used by the function blocks in the program can be set in global variables.

_2HSS458_EC | PLC_PRG | GVL_EtherCAT

```
{attribute 'qualified_only'}
VAR_GLOBAL
    Enable : BOOL :=FALSE;
    Home : BOOL :=FALSE;
    Absolute : BOOL :=FALSE;
    Absolute1 : BOOL :=FALSE;
    Relative : BOOL :=FALSE;
    Velocitymode : BOOL :=FALSE;
    JogForward : BOOL :=FALSE;
    JogBackward : BOOL :=FALSE;
    Reset : BOOL :=FALSE;
    Stop : BOOL :=FALSE;

    Position : LREAL :=50;
    Position1 : LREAL :=0;
    Distance : LREAL :=50;
    Velocity : LREAL :=10;
    Acceleration: LREAL :=100;
    Deceleration: LREAL :=100;
    ReadPosition : LREAL;
    ReadVelocity : LREAL;
END_VAR
```

Fig 310 Set global variables

EtherCAT communication operation routine based on Panasonic controller

New Project

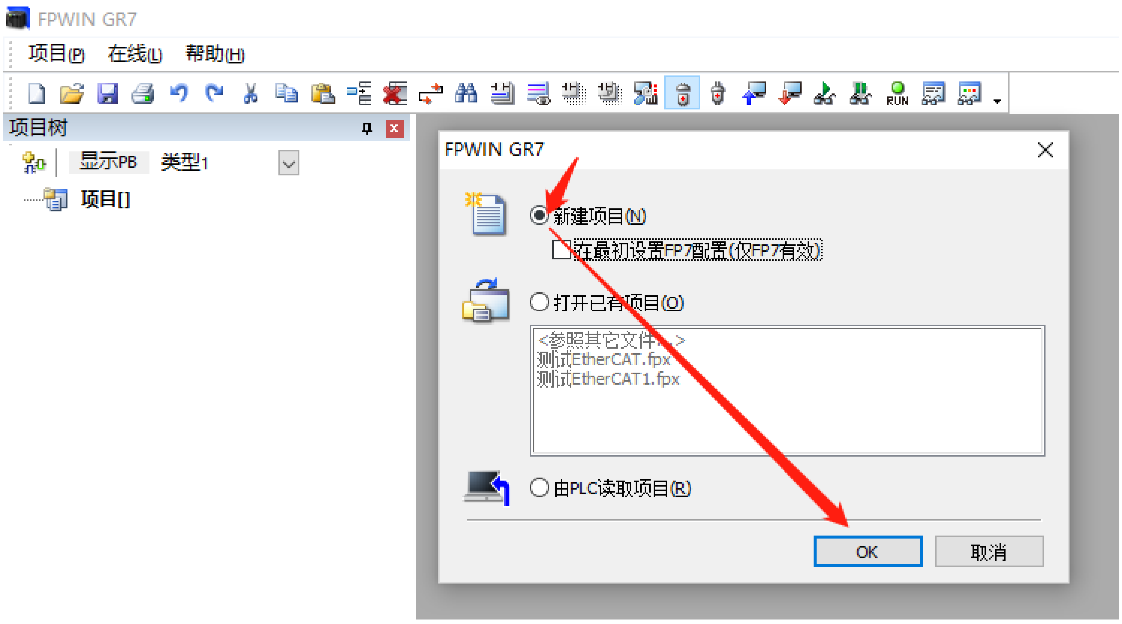


Fig 311 New FPWIN project

- Open the software FPWIN GR7→Project→New→Select CPU Unit and Motion Control Unit→OK

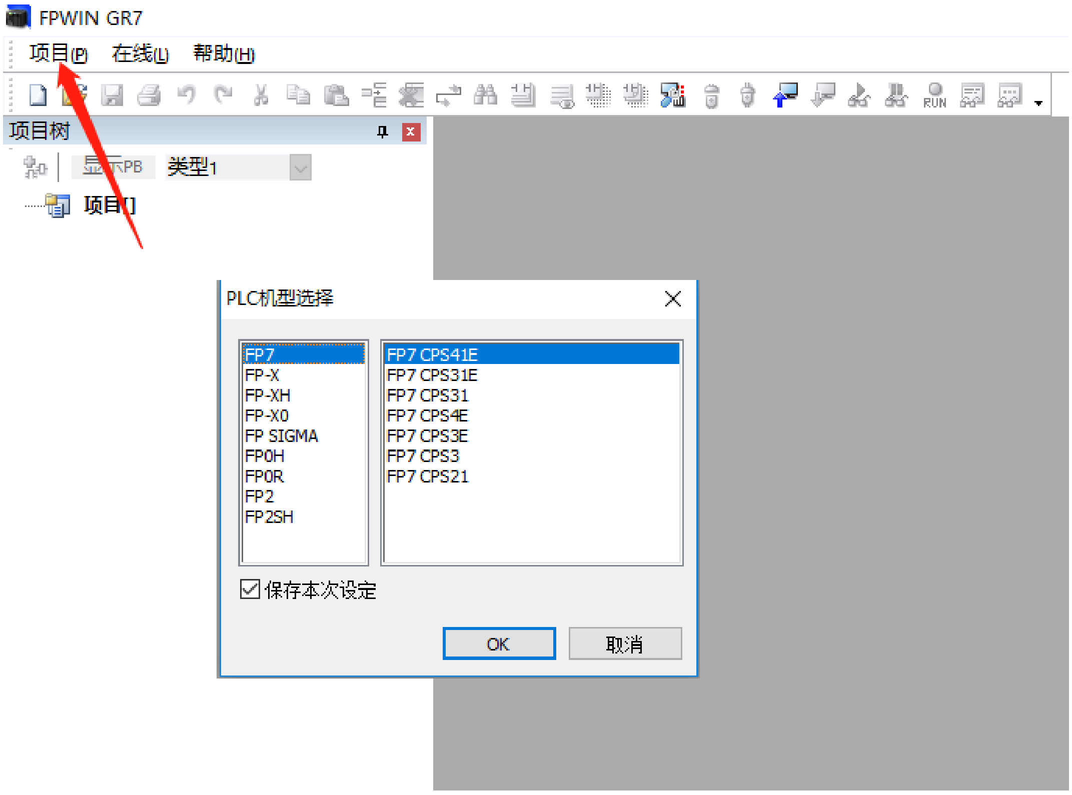


Fig 33 Select CPU unit and motion control unit

- Configure I/O mapping

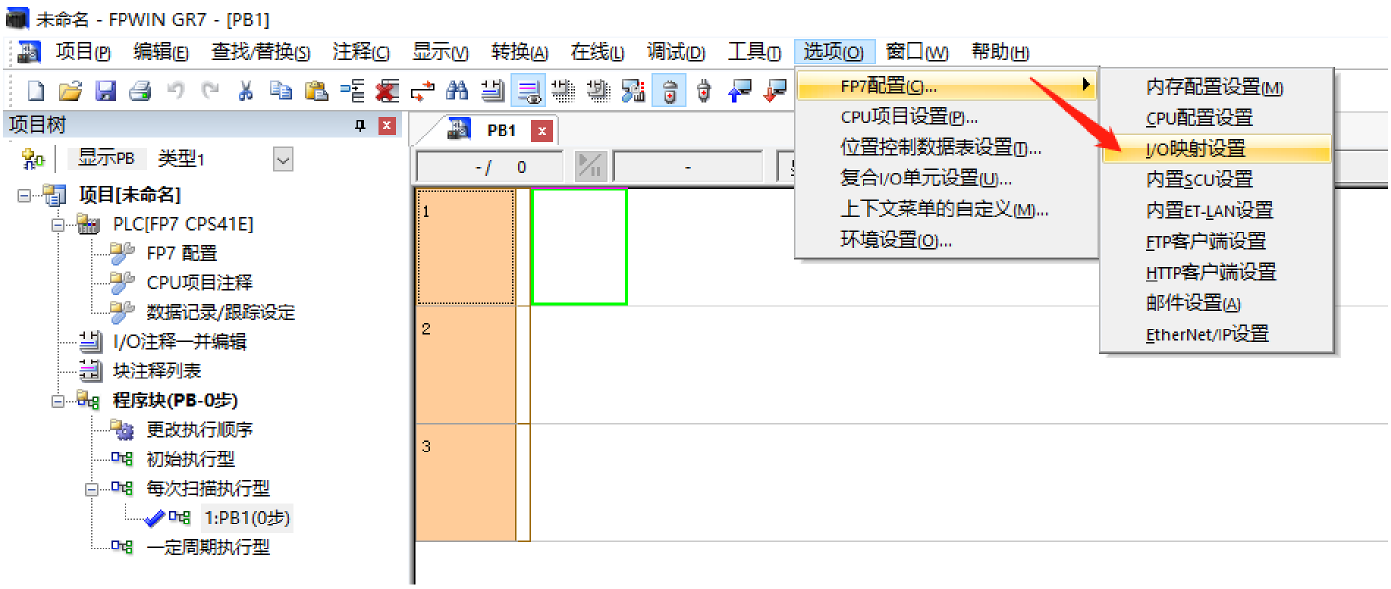


Fig 34 Configure I/O mapping

- Double-click the "Product Number" of slot NO. 0 → enter the unit selection, select the unit type and unit name

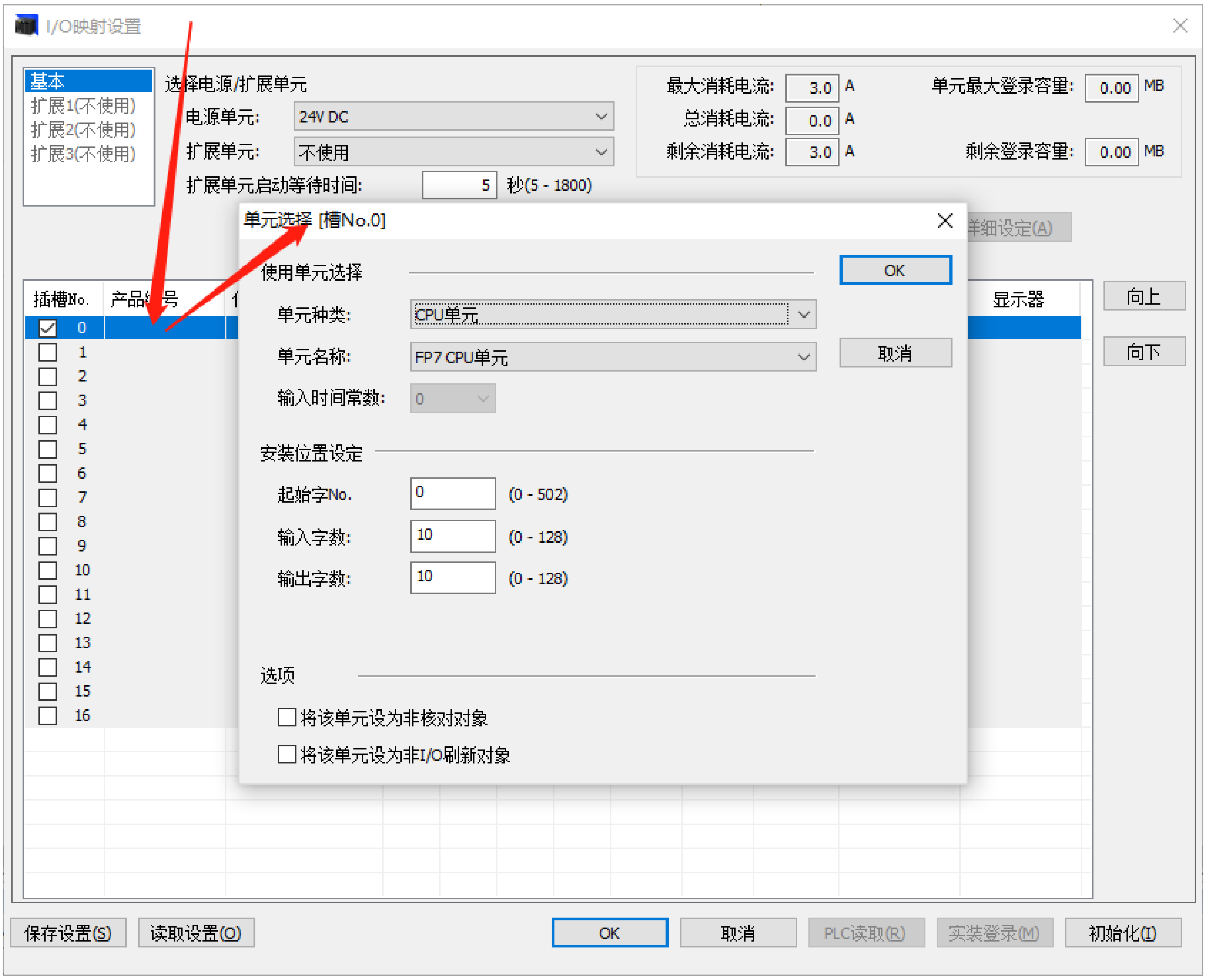


Figure 314 selecting unit type and unit name - slot NO.0

- · Slot NO. 1 "Product Number" → enter the unit selection, select the unit type and unit name

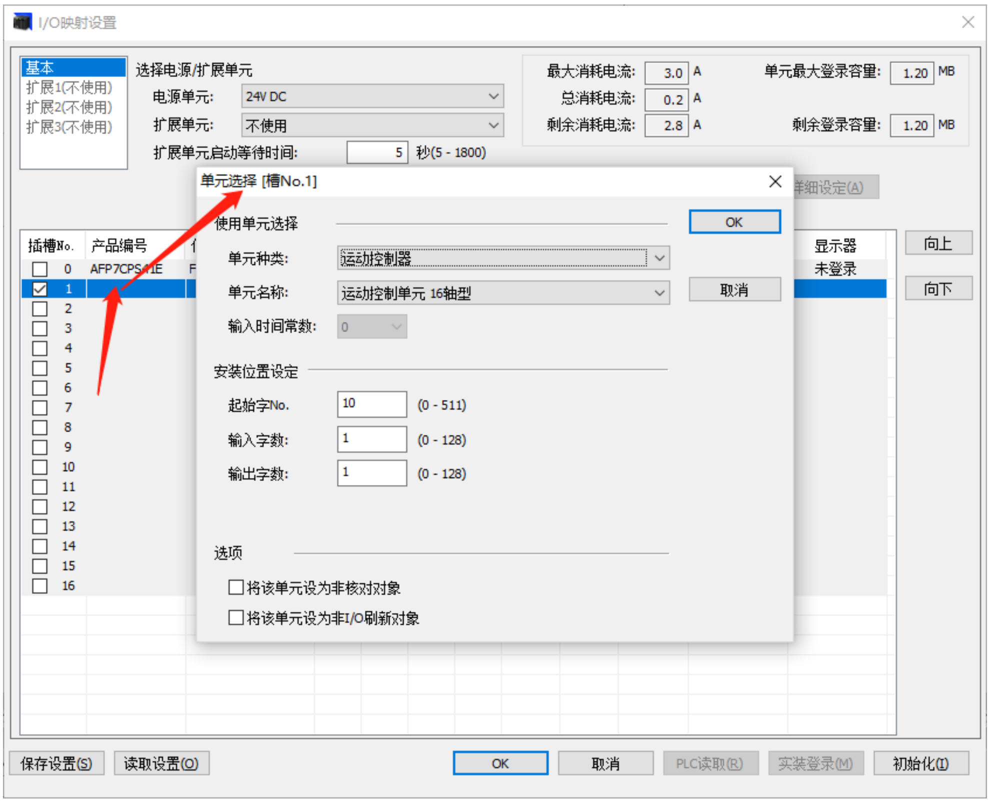


Fig 315.Select the unit type and unit name-Slot NO. 1

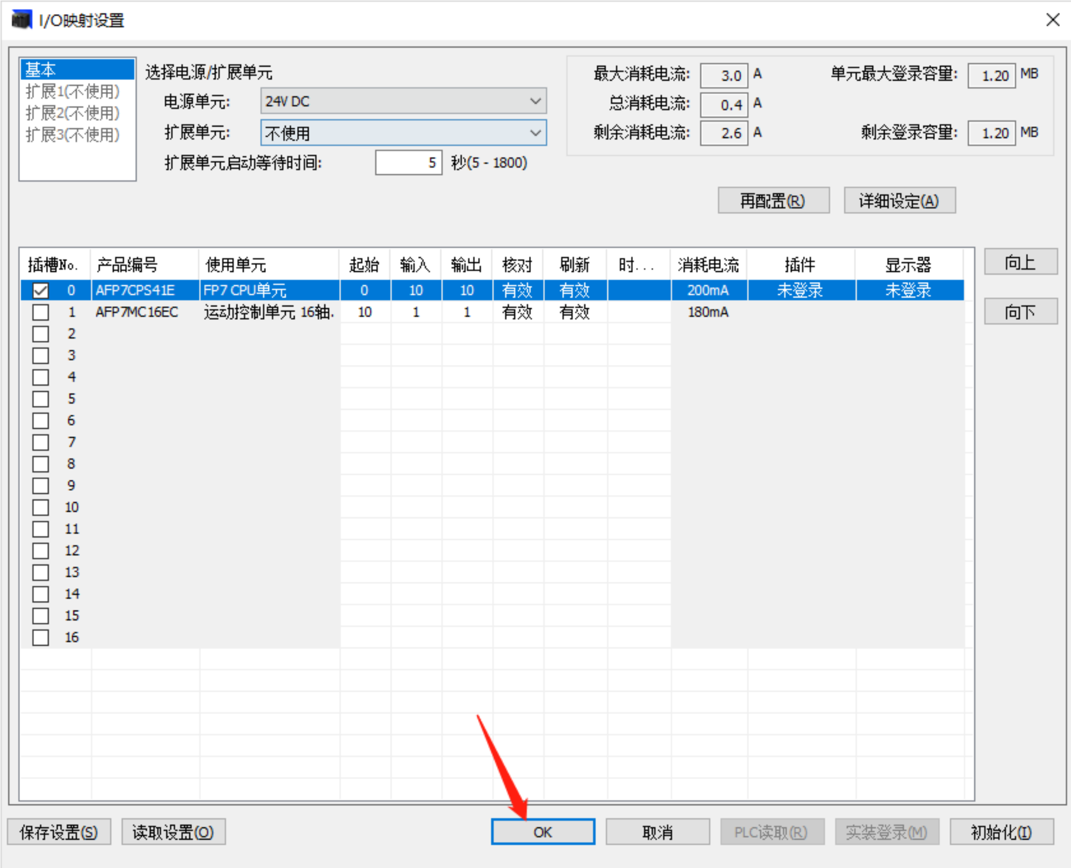


Fig 35 Select complete

Use CMI software to set the parameters of the axis

1 New Project

- Open the software ,Control Motion Integrator→new create

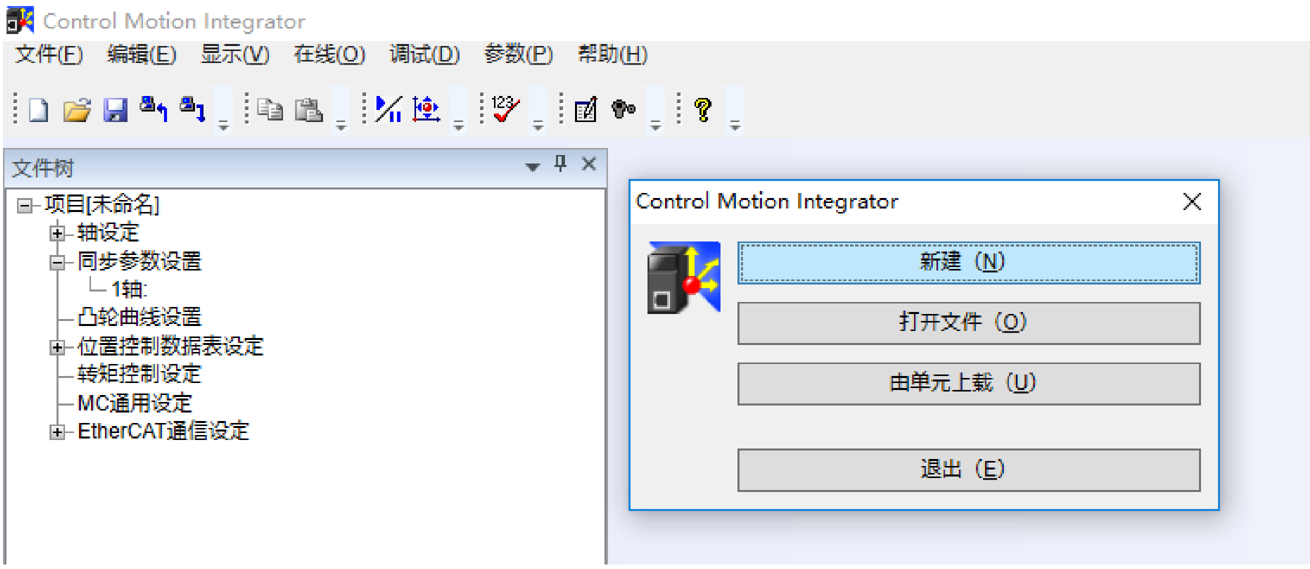


Fig 36 Create New CMI project

- Select the motion control unit (must be consistent with the FPWIN GR7 software I/O mapped motion control unit) → rotate to select the actual number of axes used → confirm
-

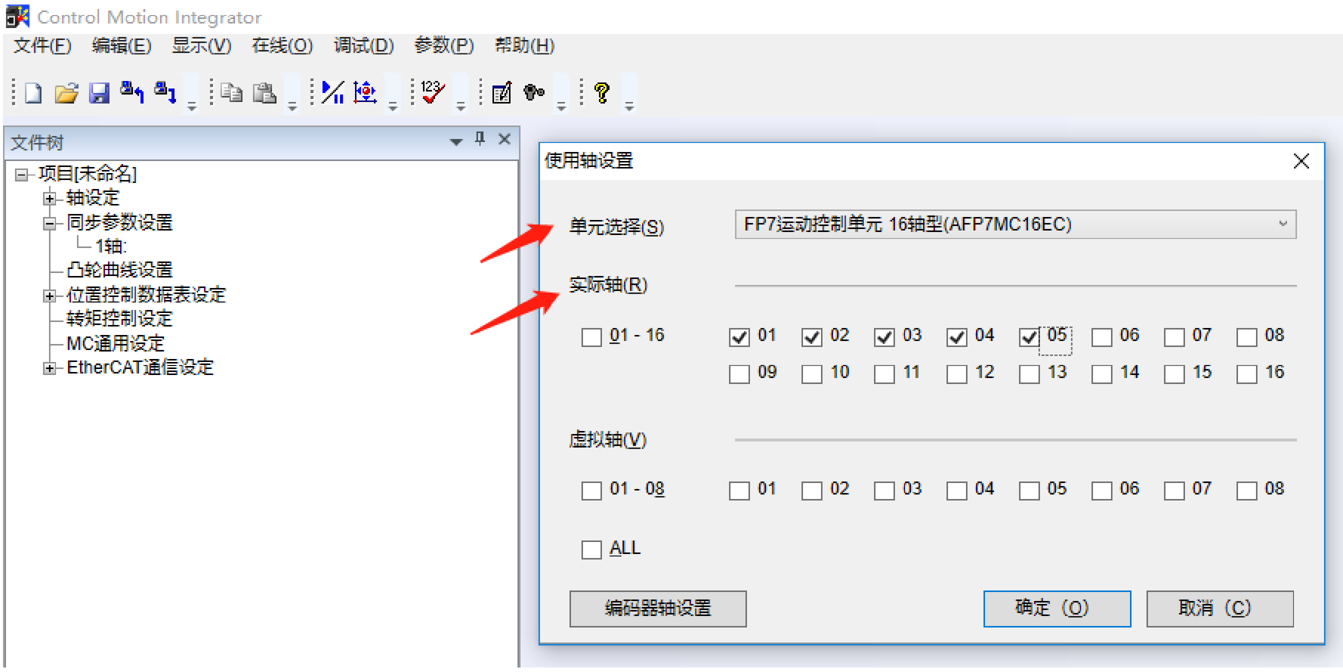


Fig 37 Select Motion Control Unit

- Whether the axis should be interpolated; if necessary, please add the axis to the interpolation group, if NOt, directly confirm
-

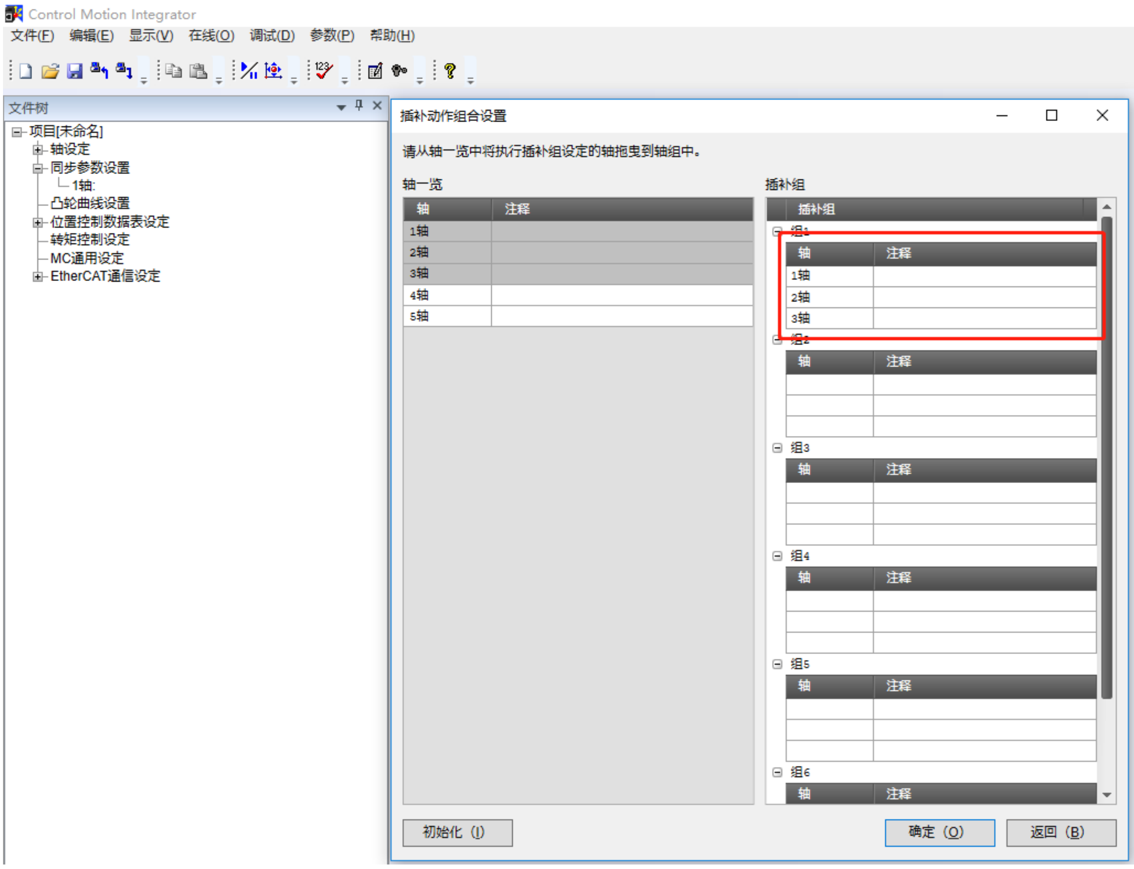


Fig 38 Interpolation group

2 Add ESI file

- Double-click EtherCAT communication settings

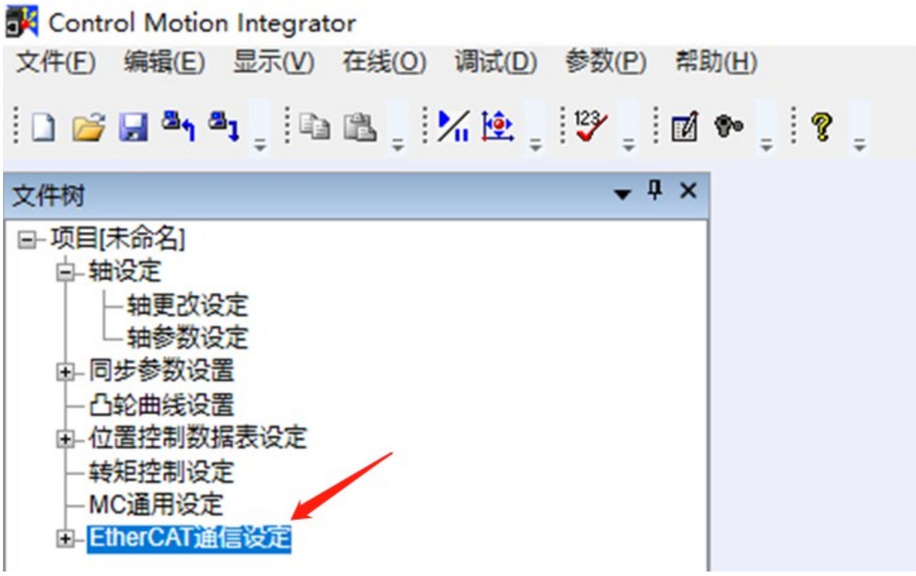


Fig 39 EtherCATCommunication settings

- Enter into EtherCAT Configurator→Press the file →ESI manage

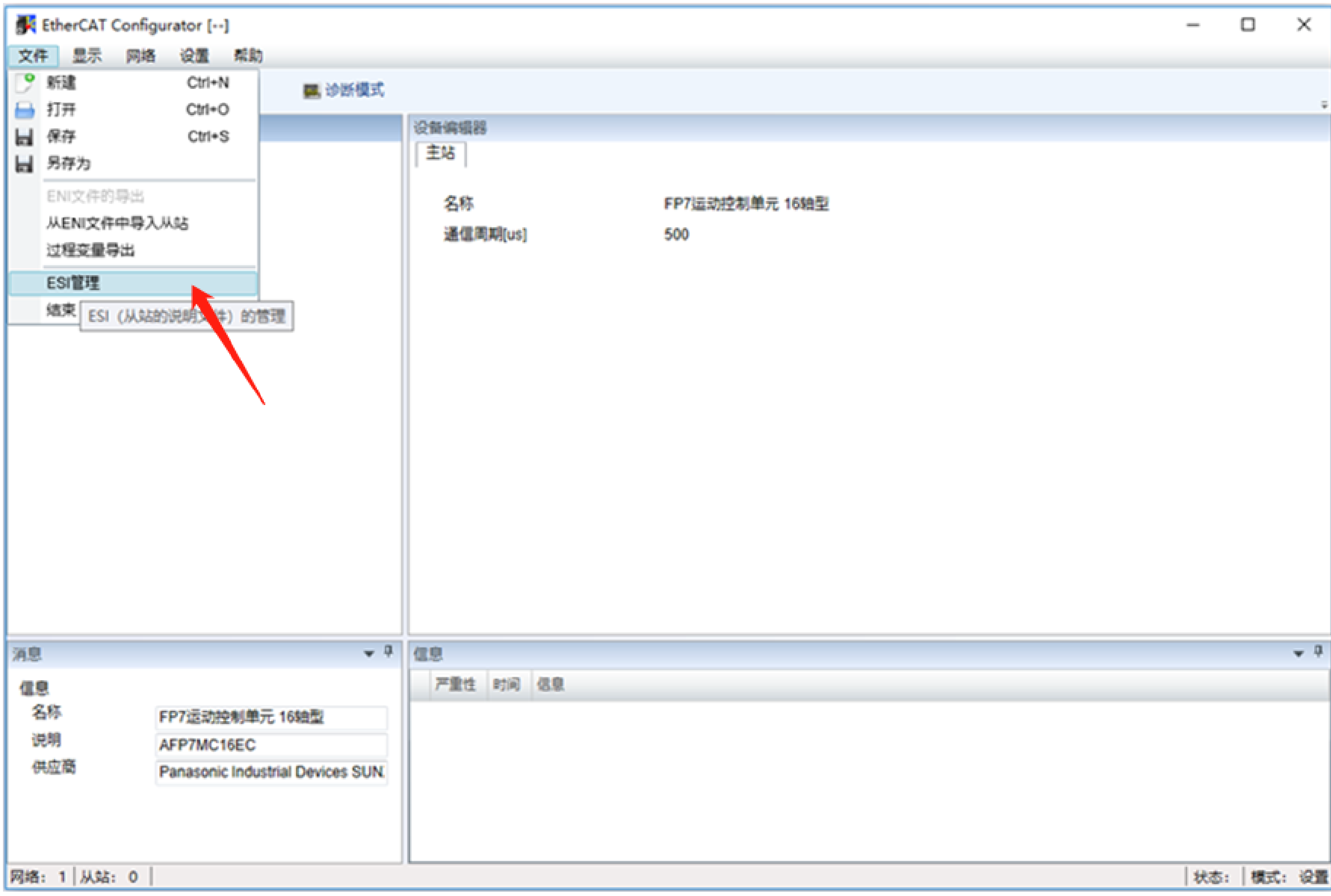


Fig 40 ESI manage

- Click the file to add

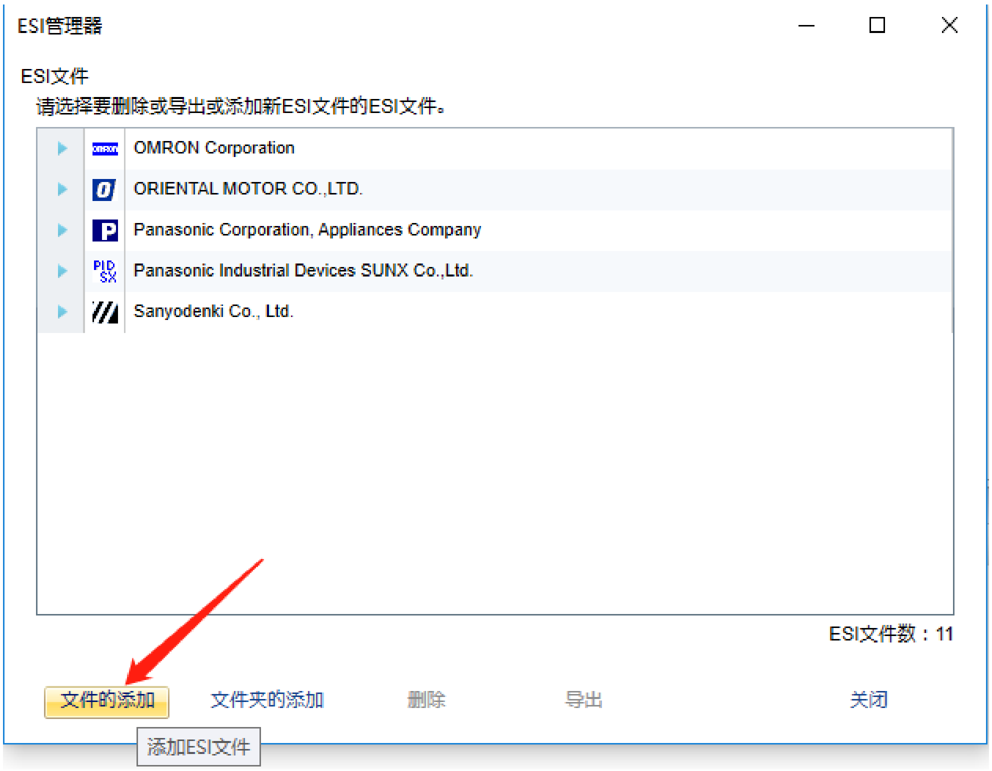


Fig 41 add ESI

Add ESI file→

Open

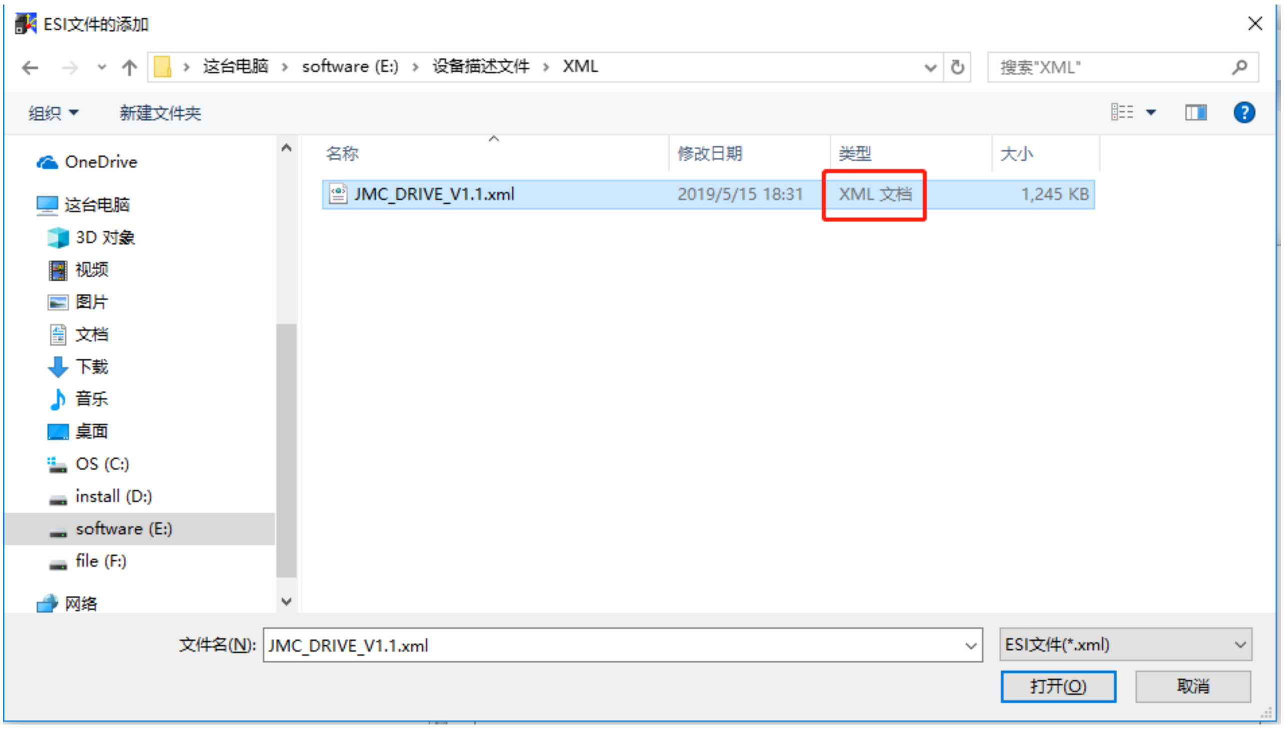


Fig 42 Open XML file

- Add successfully

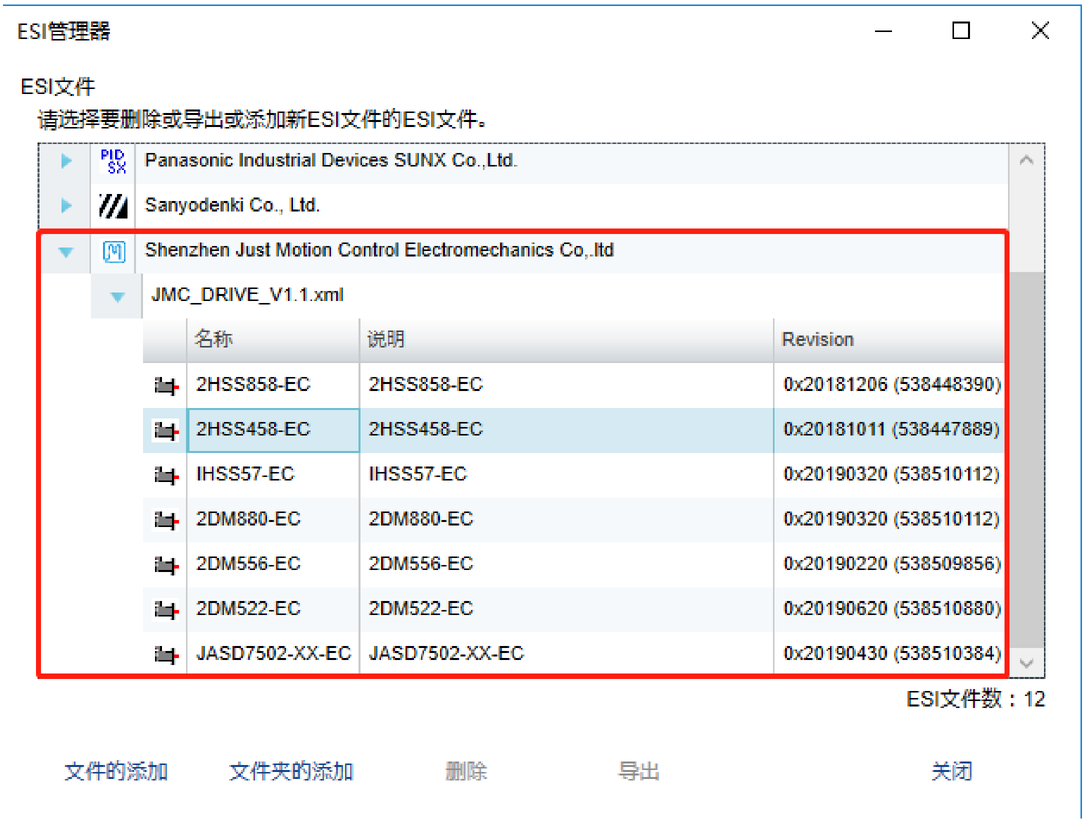


Fig 43 add XML succeed

3 Add Slave

Add slaves, you can manually add, you can also scan to add. Scan to add, add directly click EtherCAT network scan.

- Add manually: Click Add from the slave → select the axis model, the number of axes → OK

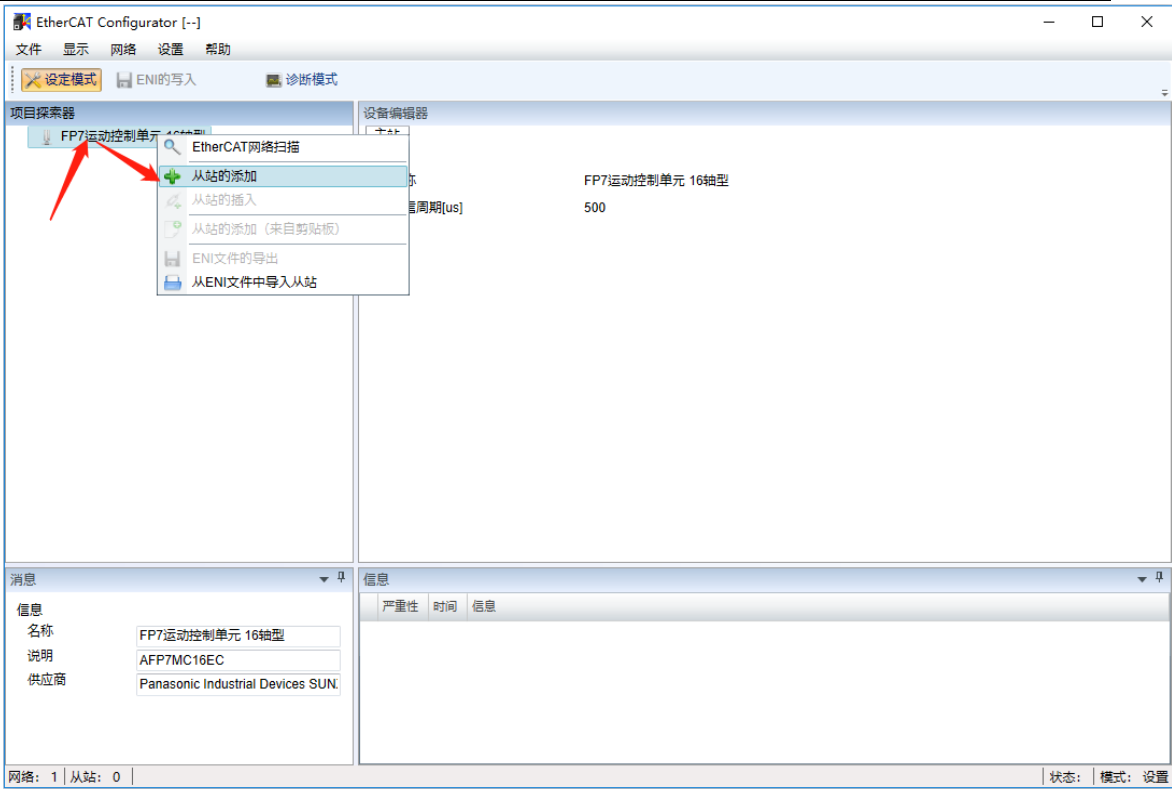


Fig 44 Select shaft model

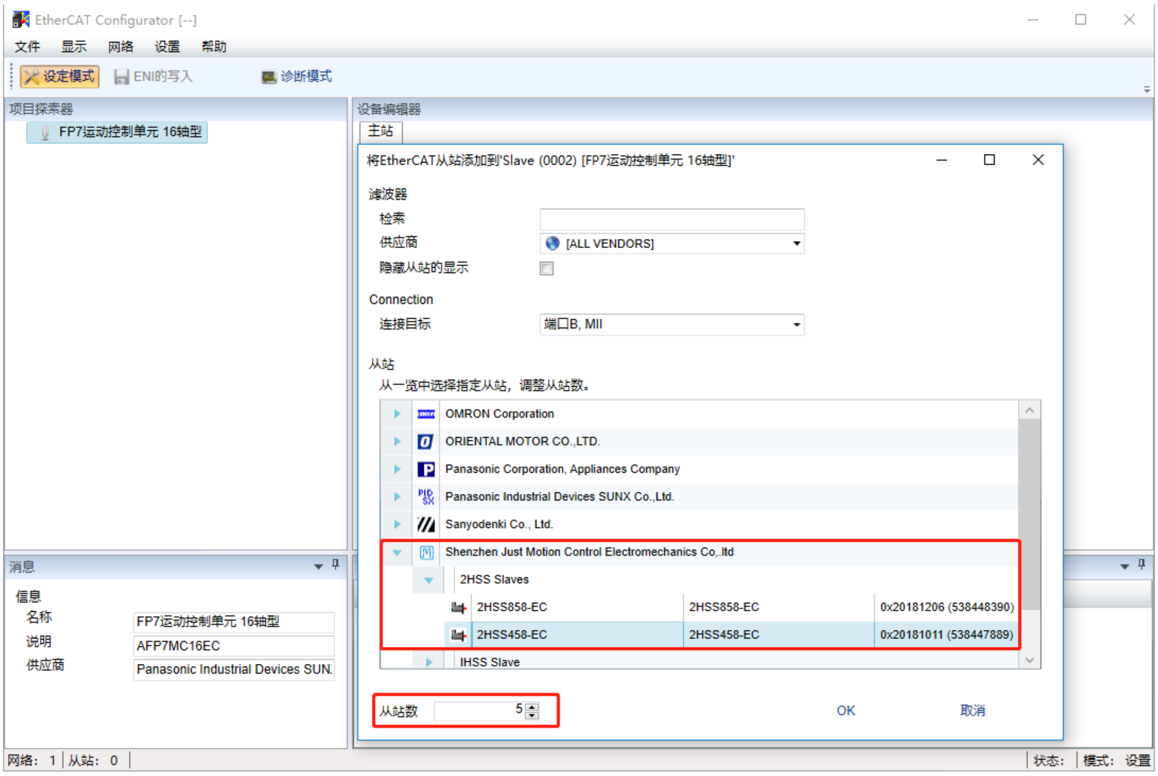


Fig 45 Set the number of slaves

- Add completed

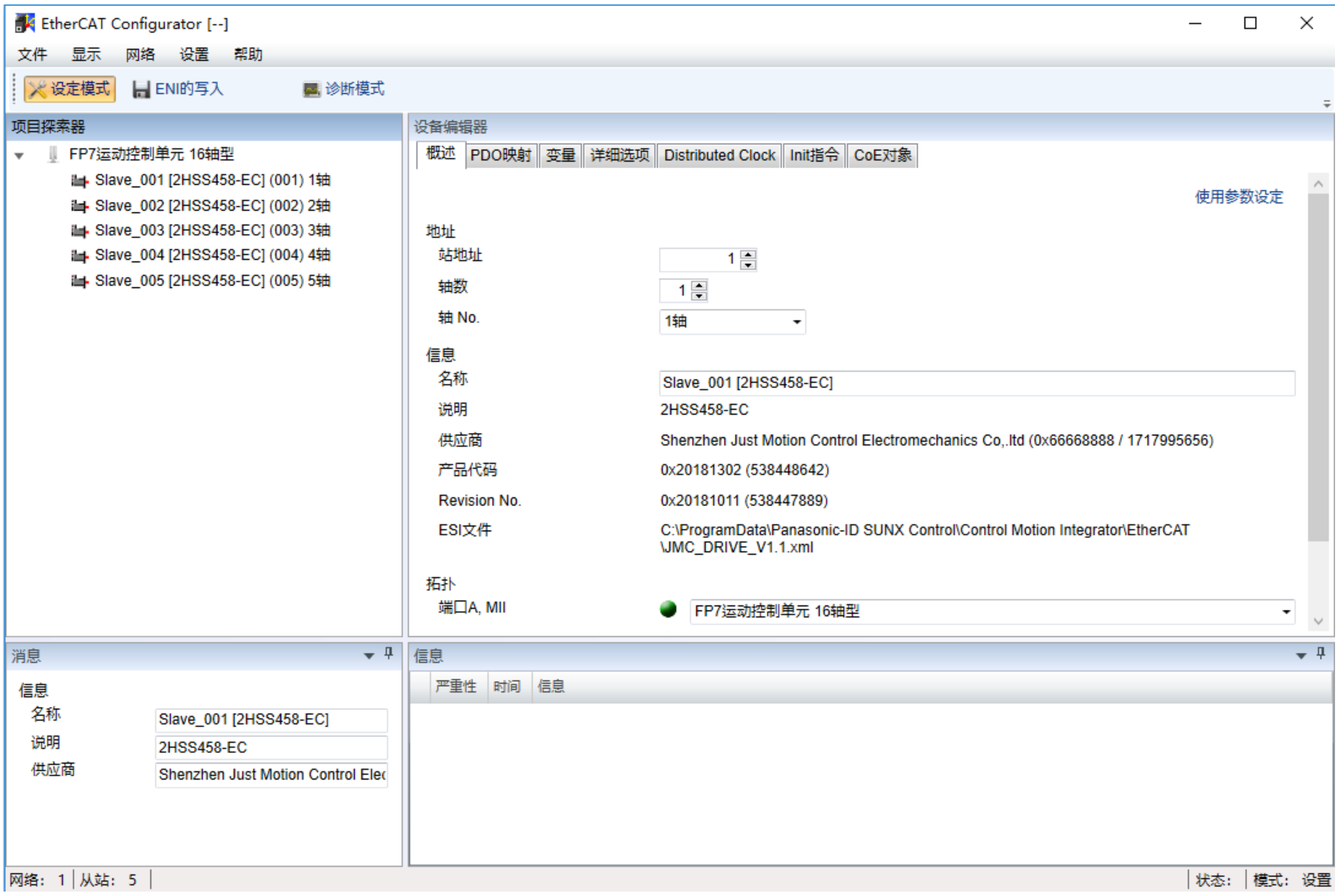


Fig 46 Add completed

4 Setting of axis parameters

- Double-click the axis parameter setting in the file tree

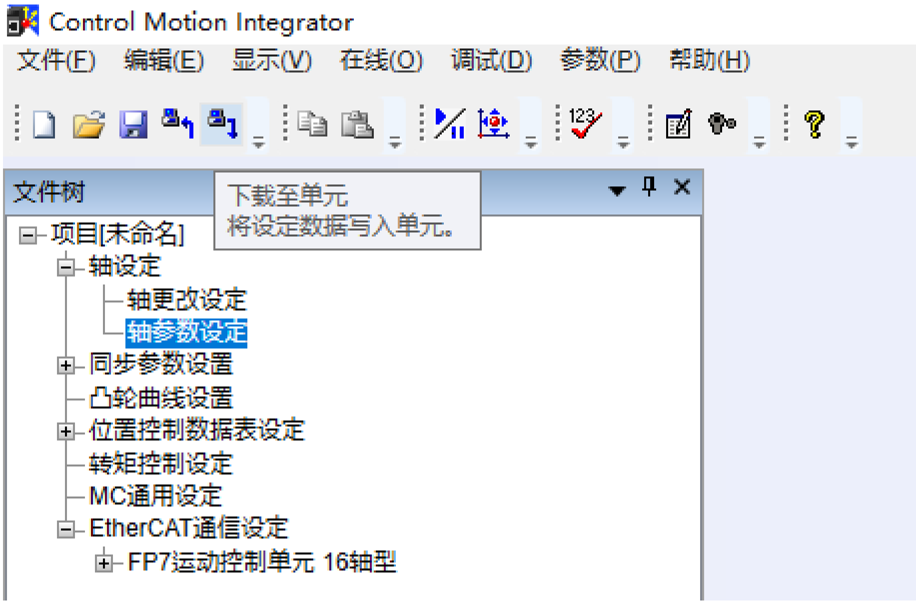
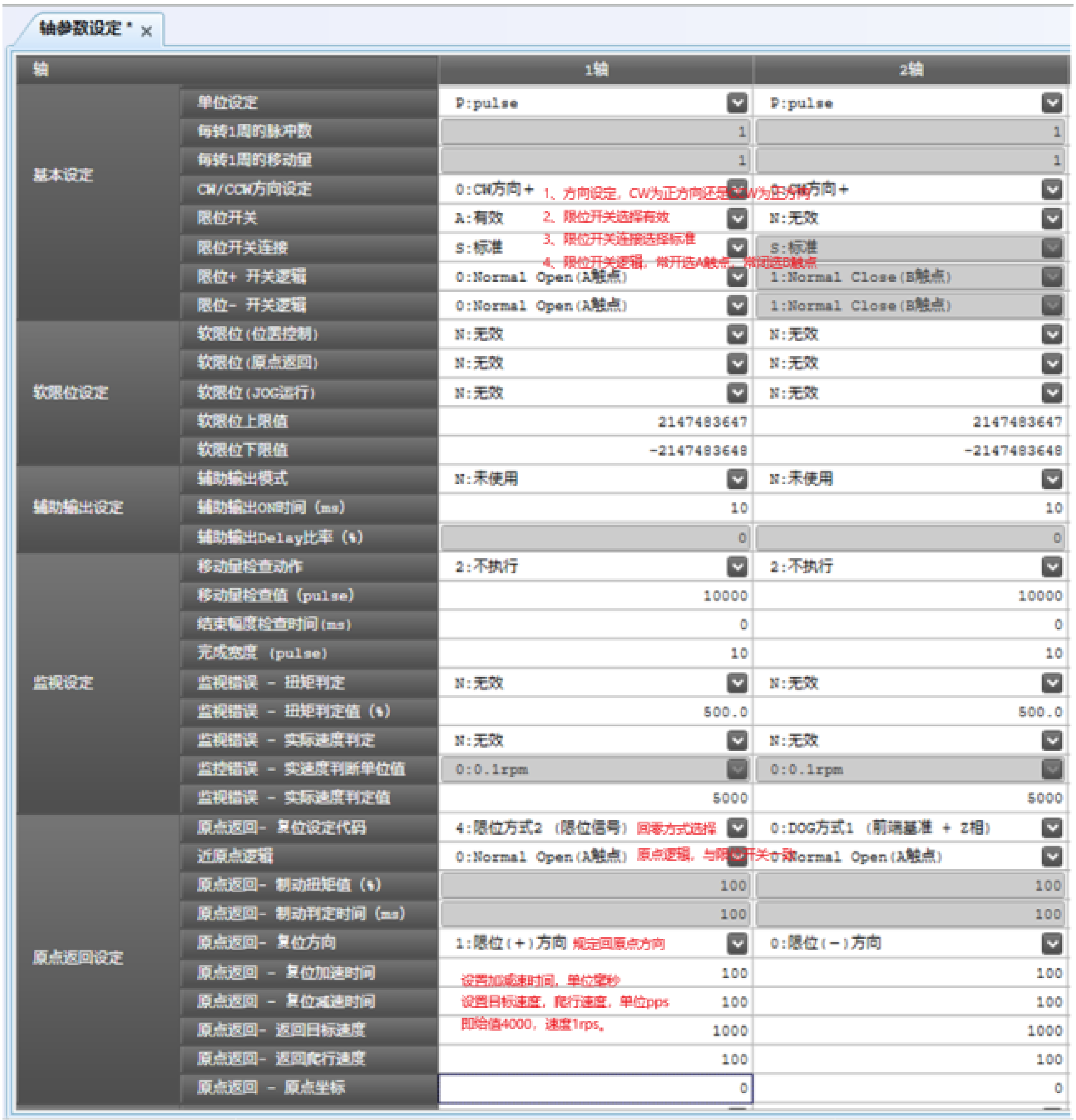


Fig 47 Axis parameter setting

Only a few simple parameters of axis 1 are set below, which can operate Normally .

For parameter setting, please refer to Chapter 5.2 of FP7 Motion Control Unit User Manual.

Please refer to Chapter 11 of FP7 Motion Control Unit User Manual for the origin return method.


轴参数设定 *

轴		1轴	2轴
基本设定	单位设定	P:pulse	P:pulse
	每转1周的脉冲数	1	1
	每转1周的移动量	1	1
	CW/CCW方向设定	0:CW方向+	0:CW方向+
	限位开关	A:有效	N:无效
	限位开关连接	S:标准	S:标准
	限位+ 开关逻辑	0:Normal Open(A触点)	1:Normal Close(B触点)
	限位- 开关逻辑	0:Normal Open(A触点)	1:Normal Close(B触点)
软限位设定	软限位(位置控制)	N:无效	N:无效
	软限位(原点返回)	N:无效	N:无效
	软限位(JOG运行)	N:无效	N:无效
	软限位上限值	2147483647	2147483647
	软限位下限值	-2147483648	-2147483648
辅助输出设定	辅助输出模式	N:未使用	N:未使用
	辅助输出ON时间 (ms)	10	10
	辅助输出Delay比率 (%)	0	0
监视设定	移动量检查动作	2:不执行	2:不执行
	移动量检查值 (pulse)	10000	10000
	结束幅度检查时间(ms)	0	0
	完成宽度 (pulse)	10	10
	监视错误 - 扭矩判定	N:无效	N:无效
	监视错误 - 扭矩判定值 (%)	500.0	500.0
	监视错误 - 实际速度判定	N:无效	N:无效
	监控错误 - 实速度判断单位值	0:0.1rpm	0:0.1rpm
	监视错误 - 实际速度判定值	5000	5000
原点返回设定	原点返回- 复位设定代码	4:限位方式2 (限位信号)	0:DOG方式1 (前端基准 + Z相)
	近原点逻辑	0:Normal Open(A触点)	0:Normal Open(A触点)
	原点返回- 制动扭矩值 (%)	100	100
	原点返回- 制动判定时间 (ms)	100	100
	原点返回- 复位方向	1:限位(+)方向	0:限位(-)方向
	原点返回 - 复位加速时间	100	100
	原点返回 - 复位减速时间	100	100
	原点返回- 返回目标速度	1000	1000
	原点返回- 返回爬行速度	100	100
	原点返回 - 原点坐标	0	0

Fig 48 Setting example

5 Position parameter setting

- Double-click the position control setting in the file tree

Because our unit is set to pulse, the drive subdivision defaults to 4000, that is, the value 4000 is one lap, and 200000 is 50 laps. For operation mode and control method, please refer to Chapter 5.3 of FP7 Motion Control Unit User Manual

轴参数设定 * 位置控制 *

数据表No.	运行模式	控制方式	1st轴(1)移动量	加减速方式	加速时间 (ms)	减速时间 (ms)	目标速度	停顿时间(ms)	辅助输出
1	E: 结束点	A: 绝对值	200000	L: 直线	100	100	1000	0	0
2	E: 结束点	A: 绝对值	0	L: 直线	100	100	1000	0	0
3	E: 结束点	I: 增量	200000	L: 直线	100	100	1000	0	0
4	E: 结束点	I: 增量	-200000	L: 直线	100	100	1000	0	0
5	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
6	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
7	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
8	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
9	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
10	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
11	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
12	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
13	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
14	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
15	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
16	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
17	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
18	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
19	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
20	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
21	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
22	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
23	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
24	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
25	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
26	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
27	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
28	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
29	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
30	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
31	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
32	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
33	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
34	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
35	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
36	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0
37	E: 结束点	I: 增量	0	L: 直线	100	100	1000	0	0

1轴 2轴 3轴 4轴 5轴

Fig 49 Position parameter setting

6 Download parameters

- Click to download to the unit

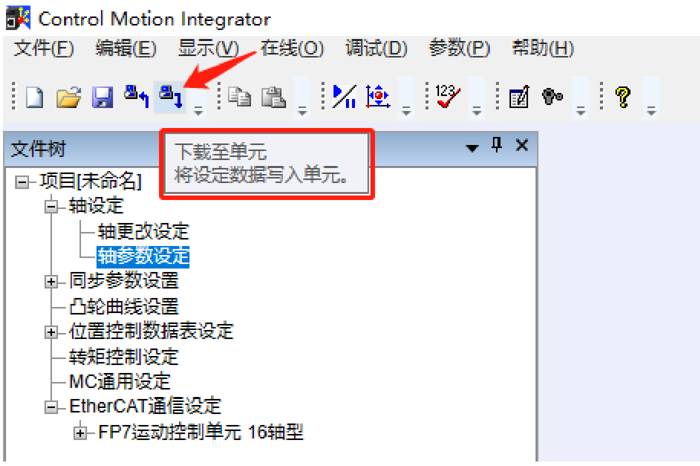


Fig 50 Download parameters

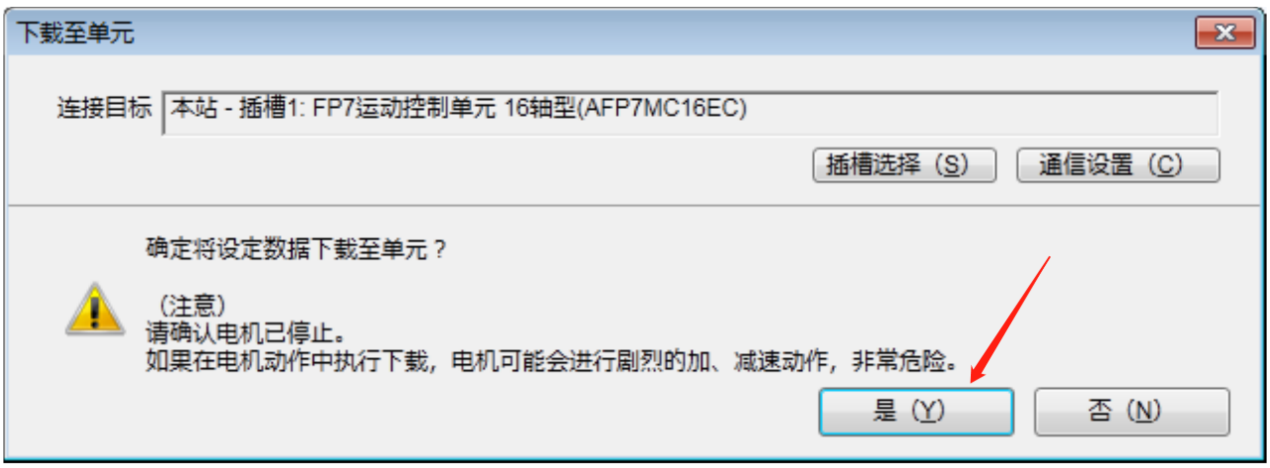


Fig 45 Download to Unit

For specific programming code, refer to Panasonic's official "FP7 Motion Control Unit User Manual", which has detailed tutorials.

Contact us

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