LC5E series EtherCAT slave PLC

User manual

Wuxi Xinje Electric Co., Ltd.

Data No. PR02 20240513 1.0

Basic notes

- Thank you for purchasing the Xinjie LC5E-32T4 programmable controller.
- This manual mainly introduces the application of instructions for the LC5E-32T4 programmable controller.
- Before using the product, please read this manual carefully and operate on the premise of fully understanding the contents of the manual.
- For the introduction of software and programming, please refer to the relevant manuals.
- Please deliver this manual to the end user.

User instructions

- Only operators with certain electrical knowledge can carry out wiring and other operations on the product. If there are any unknown cases, please consult our technicians.
- The examples listed in the manual and other technical materials are only for users' understanding and reference, and do not guarantee certain actions.
- When using this product in combination with other products, please confirm whether it complies with relevant specifications and principles.
- When using this product, please confirm whether it meets the requirements and is safe.
- Please set up backup and safety functions by yourself to avoid possible machine failure or loss caused by the failure of this product.

Statement of responsibility

- Although the contents of the manual have been carefully checked, errors are inevitable, and we can't guarantee complete consistency.
- We will often check the contents of the manual and correct them in subsequent versions. We welcome your valuable comments.
- Please understand that the contents described in the manual are subject to change without notice.

Contact method

If you have any questions about the use of this product, please contact the agent and office who purchased the product, or directly contact Xinje company.

- Telephone: 400-885-0136
- Fax: 0510-85111290
- Address: 4th floor, building 7, creative industry park, No. 100, Dicui Road, Wuxi, China
- Post code: 214072
- Website: www.xinje.com

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Catalog

1. Document Guide

1.1 Related manual

Manual Name	Main Content
User Manual for XD and XL Series Programmable Controllers (Basic Instructions)	Introduced the usage of basic instructions for XD and XL series programmable controllers
User Manual for XD and XL Series Programmable Controllers (Positioning Control Chapter)	Introduced the usage of pulse instructions for XD and XL series programmable controllers
User Manual for XD XL XG Series Programmable Controllers (Software Section)	Introduced the use of XPPRO software for XD, XL, and XG series programmable controllers
User Manual for XD and XL Series Programmable Controllers (Hardware Section)	Introduced the hardware wiring of XD and XL series programmable controllers, etc
Ethernet Communication User Manual	Introduced the Ethernet communication methods and usage of XD, XL, and XG series programmable controllers
User Manual for XL Series PLC Expansion Module	Introduced the use of XL series PLC right expansion module
User Manual for XL Series PLC Left Expansion ED Module	Introduced the use of the XL series PLC left expansion module

1.2 Access to manuals

For the manuals listed earlier, users can generally obtain them through the following channels:

Electronic version manual

- Log in to the official website of Xinjie, www.xinje.com, to check and download.

2. Product Overview

2.1 Product introduction

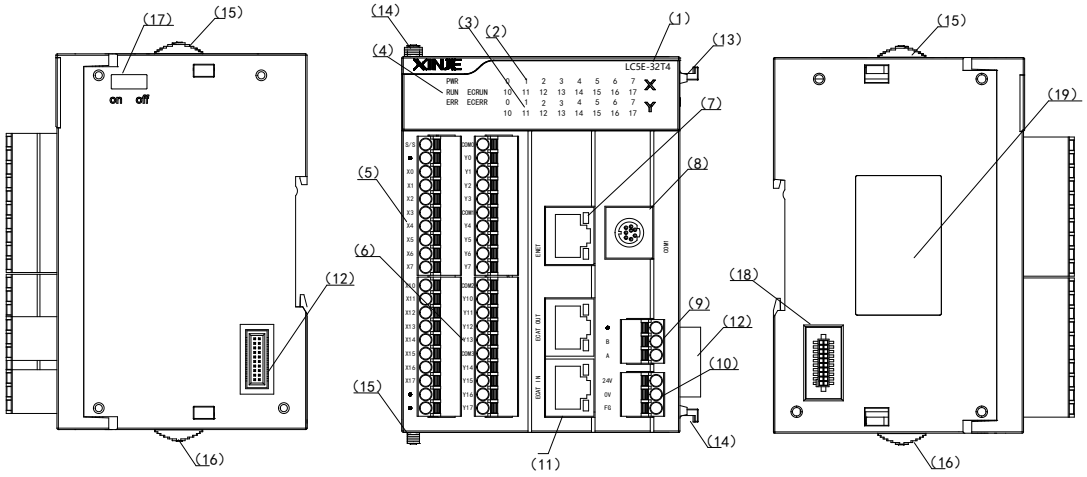
2.1.1 Base unit

LC5E-32T4 is a slim programmable controller that is compatible with all the functions of XL5E series PLC, including expansion, communication, and other functions, on this basis, the EtherCAT slave function has been added, which can be used as an EtherCAT slave to communicate with the master station equipment via EtherCAT. Suitable for scenarios with complex communication networking and high communication requirements, achieving the function of simple networking and fast communication speed.

- IO points 16 inputs 16 outputs
- Input type NPN
- Output type Transistors
- Power source DC24V

For hardware related products, please refer to the User Manual for XD and XL Series Programmable Controllers (Hardware Section).

2.1.1 Structural composition of LC5E-32T4



No.	Interface name	No.	Interface name
(1)	PLC body model	(8)	RS232 communication port (COM1)
(2)	Input tags and indicator lights	(9)	RS485 communication port (COM2)
(3)	Output labels and indicator lights	(10)	Power supply connection terminal
(4)	System indicator PWR: Power indicator light RUN: Running indicator light ERR: Error indicator light ECRUN: Slave station PLC operation indicator light ECERR: Slave PLC fault indicator light	(11)	EtherCAT communication port (IN/OUT)
		(12)	Right expansion module access port
		(13)	Fixed module hook (upper)
		(14)	Fixed module hook (lower)
		(15)	Sliding latch (upper)
		(16)	Sliding latch (lower)
(5)	Input terminal	(17)	None
(6)	Output terminal	(18)	Left expansion module access port
(7)	Ethernet communication port	(19)	Product labeling

2.2 Powerful function

1) Basic function

■ High speed computing

Using a 32-bit CPU, with an Ethernet type instruction processing speed of 0.01~0.03us, a scanning time of 10000 steps and 1ms, and a program capacity of up to 1MB.

■ Rich extensions

Supports 16 different types and models of right expansion modules, and 1 ED expansion module.

■ Multiple communication ports

The basic unit has 3 communication ports and supports 1 RS232, 1 RS485, and 1 RJ45. It can connect various external devices, such as frequency converters, instruments, printers, etc.

■ Abundant capacity of soft components

The maximum resource capacity can reach 8000 points. Non power outage maintenance process S. 1000 power outage maintenance process HS. 70000 points non power-off intermediate relay M. Power off at 12000 points to maintain the intermediate relay HM. Input relay X at 1280 points. Output relay Y at 1280 points. 5000 points non power-off hold timer T. Power off at 2000 points to maintain timer HT. 5000 points non power-off hold counter C. 2000 points power-off hold counter HC. 70000 points non power-off holding data register D. 25000 points of power failure hold data register HD. 8192 point FD.

■ Two programming methods

Supports command language programming and ladder diagram programming. These two types of programming can switch and edit with each other.

■ Rich instruction set

Rich instructions, in addition to basic sequential control, data transmission and comparison, arithmetic operations, data cycling and shifting, it also supports special instructions such as pulse output, high-speed counting, interrupt, PID, etc.

■ Real time clock

Built in clock for time control, using battery to maintain clock information.

■ Ultra thin and compact appearance, easy to install

Featuring an ultra-thin and compact appearance, the guide rail installation is convenient.

2) Enhancements

■ EtherCAT bus

Supports communication as an EtherCAT slave and can communicate with other EtherCAT master devices.

■ Ethernet communication

Equipped with an RJ45 port, supporting TCP/IP protocol, capable of Ethernet based MODBUS-TCP communication and free format communication. Support program upload and download, online monitoring, remote monitoring, and communication with other TCP/IP devices. For specific applications, please refer to the 《Ethernet Communication User Manual》.

■ High speed pulse counting, up to 80KHz

Equipped with a 4-channel two-phase high-speed counter and high-speed counting comparator, it can perform counting in two modes: single-phase and AB phase, with a frequency of up to 80KHz.

- High speed pulse output, up to 100KHz

Equipped with 4 pulse output terminals, Y0-Y3, capable of outputting pulses up to 100KHz.

- Interrupt function

It has interrupt function, divided into external interrupt, timed interrupt, and high-speed counting interrupt, which can meet different interrupt needs.

- Free switching of I/O points

The mapping relationship between input and output points can be freely modified based on IO mapping, and the technology developed for handling terminal damage can achieve normal operation without modifying the program.

- C language editing function block

Using C language to write functional blocks has superior program confidentiality. Meanwhile, due to the introduction of C language's rich operation functions, various functions can be implemented. Saves internal space and improves programming efficiency.

- POU function

Supports POU functionality, including functions (FC), function blocks (FB), and programs, the user can write FC and FB through ladder diagram or C language, and then call them in the program.

- Main body PID function

It has PID control function and can also perform self-tuning control.

- Sequential Function Block Block

In the sequential function block, the sequential execution of instructions can be achieved, especially suitable for pulse output, motion control, module reading and writing functions, simplifying program writing.

- 100 segment high-speed counting interrupt

The high-speed counter has 100 segments of 32-bit preset values, each segment can generate interrupts, with good real-time performance, high reliability, and low cost.

- PWM pulse width modulation

Equipped with PWM pulse width modulation function, it can be used for controlling DC motors.

- Frequency measurement

Support measuring frequency.

- Precise timing

Supports precise timing, with a 32-bit timer of 1ms.

- Online download

Support online download function, truly achieving uninterrupted operation of PLC.

2.3 Expansion unit

Rich expansion modules, LC5E-32T4 supports adding 16 right expansion modules and one left expansion ED module, various types of expansion modules, including analog modules, temperature modules, digital modules, etc.

Please refer to the 《User Manual for XL Series PLC Expansion Module》 and the 《User Manual for XL Series PLC Left Expansion ED Module for the use and introduction of the expansion module》.

2.3.1 Right expansion module

There are various types of expansion modules, including digital expansion modules, analog expansion modules, and temperature control modules.

- Digital expansion module

Input points 8-32. Output points 8-32. Output type: transistor, relay. Power supply: DC24V.

- Analog expansion module

Type: AD, DA, AD/DA. Route: AD4-12, DA2-4. Power supply: DC24V.

- Temperature control module

Type: PT100, thermocouple. Number of channels: 2-6. PID control: built-in, relay. Power supply: DC24V.

When there are more than 5 expansion modules, a terminal resistor XL-ETR needs to be added at the end of the expansion module.

2.3.2 Extended ED module

The left expansion module supports extended communication modules, analog modules, and temperature modules.

- Communication extension

XL-NES-ED, supports RS232 or RS485 (high-speed, supports X-NET bus), two ports cannot be used simultaneously.
XL-COBOX-ED, supports CANopen communication and can serve as a master or slave station.

- Analog input and output

XL-2AD2DA-A-ED, supports input and output in current mode.
XL-2AD2DA-V-ED, supports input and output in voltage mode.
XL-4AD-A-ED, supports current mode input.
XL-4AD-V-ED, supports voltage mode input.
XL-4DA-A-ED, supports current mode output.
XL-4DA-V-ED, supports voltage mode output.

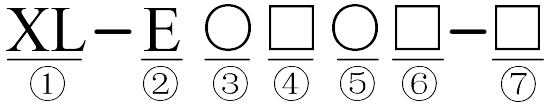
- Analog temperature mixing

XL-2AD2PT-A-ED, supports 2 current input, 2 PT100 temperature inputs.
XL-2AD2PT-V-ED, supports 2 voltage input, 2 PT100 temperature inputs.
XL-2PT2DA-A-ED, supports 2 PT100 temperature input, 2 current outputs.
XL-2PT2DA-V-ED, supports 2 PT100 temperature input, 2 voltage outputs.

2.3.3 Model composition and model table

1)Digital expansion module

■ Naming rule



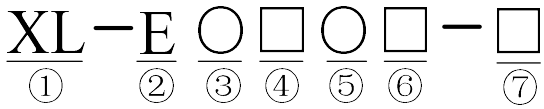
①	Series name	XL:	XL series expansion module
②	Refers to extension modules	E:	Representing extension modules
③	Input channel	8:	8 channels
		16:	16 channels
		32:	32 channels
④	Input point type	X:	Indicates that the input point is an NPN type input
		PX:	Indicates that the input point is a PNP type input
		NPX:	Indicates that the input point is a bipolar inpu
⑤	Output channel	8:	8 channels
		16:	16 channels
		32:	32 channels
⑥	Output form	YT:	Transistor output
		YR:	Relay output
⑦	Interface type	None:	European terminal interface
		A:	Niujiao terminal interface, requires external terminal block

■ Module model list

Model				Input output Total number of points	Input points (DC24V)	Output points (R, T)
Type	Input	Output				
		Relay output	Transistor output			
NPN type	-	XL-E8X8YR	XL-E8X8YT	16 points	8 points	8 points
	XL-E16X	-	-	16 points	16 points	-
	-	XL-E16YR	XL-E16YT	16 points	-	16 points
	-	-	XL-E16YT-A	16 points	-	16 points
	-	-	XL-E16X16YT	32 points	16 points	16 points
	-	-	XL-E16X16YT-A	32 points	16 points	16 points
	XL-E32X	-	-	32 points	32 points	-
	XL-E32X-A	-	-	32 points	32 points	-
	-	-	XL-E32YT	32 points	-	32 points
	-	-	XL-E32YT-A	32 points	-	32 points
PNP type	-	XL-E8PX8YR	XL-E8PX8YT	16 points	8 points	8 points
	XL-E16PX	-	-	16 points	16 points	-
	-	-	XL-E16PX16YT	32 points	16 points	16 points
	-	-	XL-E16PX16YT-A	32 points	16 points	16 points
	-	-	XL-E16PX16PYT	32 points	16 points	16 points
	XL-E32PX	-	-	32 points	32 points	-
	XL-E32PX-A	-	-	32 points	32 points	-
NPN& PNP type	-	XL-E8NPX8YR	XL-E8NPX8YT	16 points	8 points	8 points

2)Analog quantity and temperature expansion module

■ Naming rules



①	Series name	XL:	XL series expansion module
②	Refers to extension modules	E:	Representing extension modules
③	Input channel	1:	1 channel
		2:	2 channels
		4:	4 channels
		8:	8 channels
④	Analog input	AD:	Indicates analog voltage and current input
		PT3:	Indicates the input of a 3-wire PT100 temperature sensor
		TC:	Indicates the input of the thermocouple temperature sensor
		WT:	Indicating pressure measurement
⑤	Output channel	2:	2 channels
		4:	4 channels
⑥	Analog output	DA:	Indicates analog voltage and current output
⑦	Analog quantity type	A:	Indicates current mode
		V:	Indicates voltage mode
		P:	Indicating PID adjustment function
		D:	Hardware version differentiation (Only applicable to WT modules)
		S:	Indicating a resolution of 1/65536 (16 Bit)

■ Module model list

Model		Description
Analog input and output	XL-E4AD	4-channel analog input, supporting two modes of current and voltage
	XL-E4AD2DA	4 analog inputs , 2 analog outputs
	XL-E4DA	4-channel analog output, supporting two modes of current and voltage
	XL-E8AD-A	8-channel analog input, supporting current mode
	XL-E8AD-V	8-channel analog input, supporting voltage mode
	XL-E8AD-A-S	8-channel analog input, supporting current mode, 16 bit resolution
	XL-E8AD-A-S	8-channel analog input, supporting current mode, 16 bit resolution
Temperature measurement	XL-E4PT3-P	4-way PT100 temperature measurement with built-in PID adjustment
	XL-E4TC-P	4-way thermocouple temperature measurement with built-in PID adjustment
Weigh	XL-E1WT-D	1-channel pressure measurement, -20~20mV, 23 bit conversion accuracy
	XL-E2WT-D	2-way pressure measurement, -20~20mV, 23 bit conversion accuracy
	XL-E4WT-D	4-way pressure measurement, -20~20mV, 23 bit conversion accuracy

3)Left Extended ED Module

■ Naming rules

XL－2AD①2DA②2PT③NES④－A⑤－ED⑥

①	Analog input	2AD:	Two analog inputs
②	Analog output	2DA:	2-channel analog output
③	Temperature measurement	2PT:	2-way platinum thermistor input
④	Communication	NES:	RS232 or RS485 communication
⑤	Analog quantity type	A: V:	Both input and output are in current mode Both input and output are in voltage mode
⑥	Extension flag	ED:	Left Extended ED Module Flag

■ Module model list

Model		Description
Analog input	XL-4AD-A-ED	4-channel analog current input
	XL-4AD-V-ED	4-channel analog voltage input
Analog output	XL-4DA-A-ED	4-channel analog current output
	XL-4DA-V-ED	4-channel analog voltage outputs
Analog input and output	XL-2AD2DA-A-ED	2-channel analog current input, 2-channel analog current outputs
	XL-2AD2DA-V-ED	2-channel analog voltage input, 2-channel analog voltage outputs
Analog temperature mixing	XL-2AD2PT-A-ED	2-channel analog current input, 2-channel PT100 temperature inputs
	XL-2AD2PT-V-ED	2-channel analog voltage input, 2-channel PT100 temperature inputs
	XL-2PT2DA-A-ED	2-channel PT100 temperature input, 2-channel analog current outputs
	XL-2PT2DA-V-ED	2-channel PT100 temperature input, 2-channel analog voltage outputs
Communication	XL-NES-ED	Expand 1 RS232 and 1 RS485 communication port, but cannot be used simultaneously
	XL-COBOX-ED	Supports CANopen communication and can serve as a master or slave station

3. Application Description of Functional Instructions

3.1 Basic instructions

3.1.1 Introduction to Basic Instructions

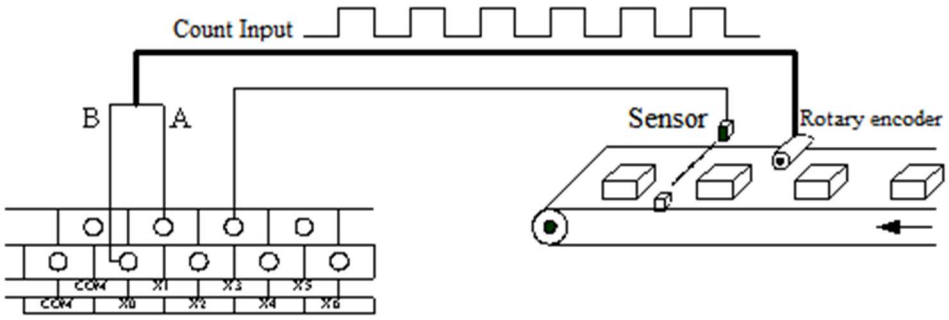
The LC5E-32T4 programmable controller provides users with sufficient basic instructions, it can meet basic functions such as sequence control, data transmission and comparison, arithmetic operations, logic control, data cycling and shifting, etc, it also has commands such as interrupts, high-speed counter specific comparison commands, high-speed pulse output commands, precise timing, PID control, etc.

This PLC can achieve the function of writing function blocks using C language, The edited function block can be called freely in the program, and the edited function block can be called freely in the program, with good confidentiality and strong applicability, while also reducing the workload of programming. And it has the function of indirect addressing, which can be achieved by adding offset suffixes (such as X3 [D100], M10 [D100], D0 [D100]) after the coil and data register. When D100=9, X3 [D100] represents X14, M10 [D100] represents M19, and D0 [D100] represents D9.

3.1.2 High speed counting

LC5E-32T4 supports 4-way high-speed counting, with a maximum of 80KHZ for single-phase and 50KHZ for AB phase.

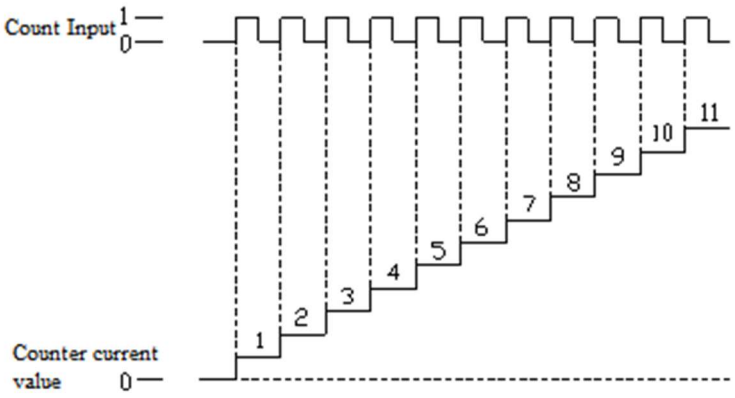
1) The input is in NPN mode, please choose an encoder with DC24V NPN collector open circuit output (OC).



2) There are two counting modes, namely single-phase incremental mode and AB phase mode.

■ Incremental mode

In this mode, the input pulse signal is counted, and the count value increases with the rising edge of each pulse signal.

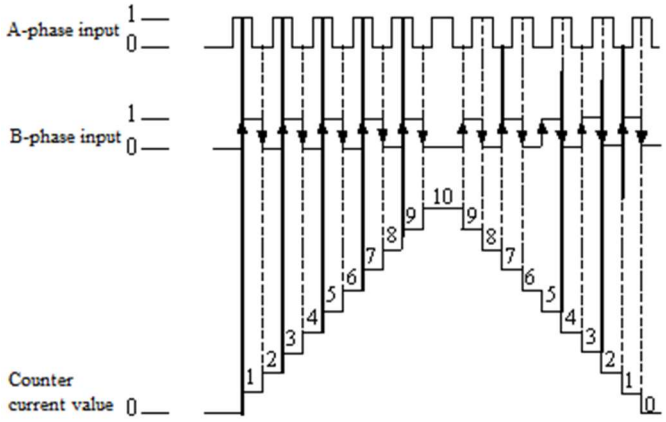


■ AB phase mode

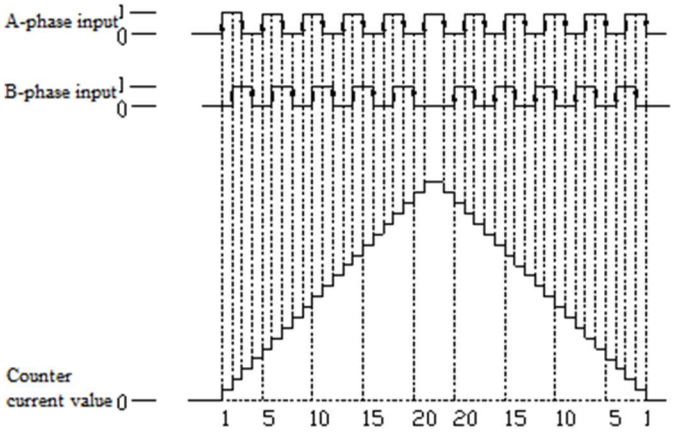
In this mode, the high-speed counting value is incremented or decremented based on the pulse signal (phase A and phase B) with a phase difference of 90 °, according to the number of harmonics, it can be divided into two modes: second harmonic and fourth harmonic, but its default counting mode is fourth harmonic mode.

Double frequency counting mode and quadruple frequency counting mode are as follows:

■ Double frequency



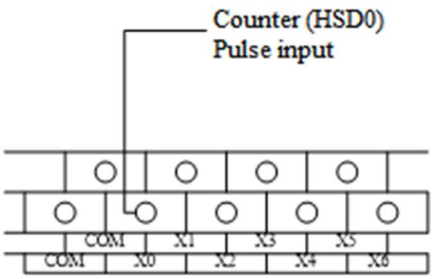
■ Quadruple frequency



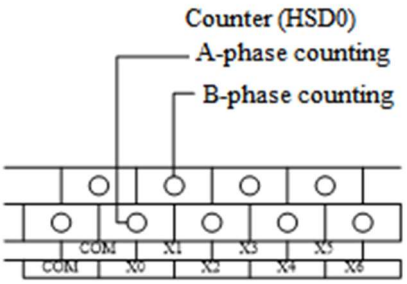
3) The counting range of the high-speed counter is K-2147483648~K+2147483647. When the count value exceeds this range, overflow or underflow occurs.

The so-called overflow occurs when the count value jumps from K+2147483647 to K-2147483648 and continues counting. When an underflow occurs, the count value jumps from K-2147483648 to K+2147483647 and continues counting.

4) High speed counter input terminal wiring



Incremental mode



AB phase mode

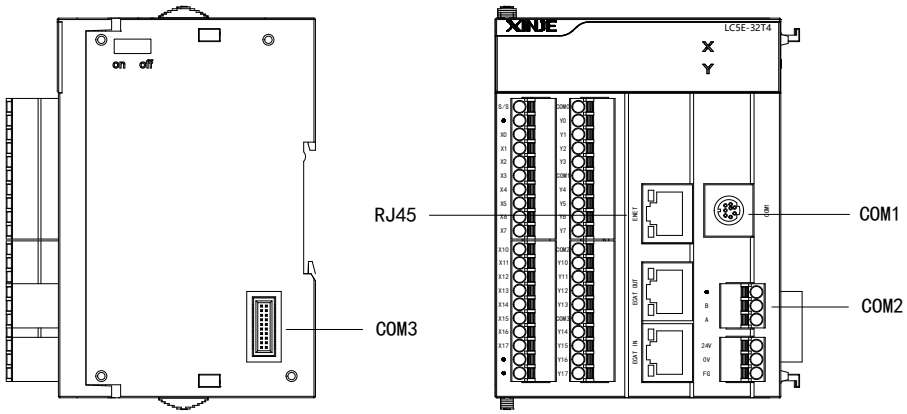
3.1.3 Serial communication

The LC5E-32T4 programmable controller can support multiple serial communication protocols, supports Modbus RTU, Modbus ASCII, and free format communication, suitable for a wider range of applications, it can communicate with devices such as printers, instruments, and scanners.

When modifying the communication parameters of the communication port, the PLC needs to be powered off and then back on for the parameters to take effect. Set the delay waiting time before adding communication to Modbus communication. As a slave, when the host communication command is too frequent and the slave PLC cannot respond in time, the slave will reject the host command until the executing communication command is completed.

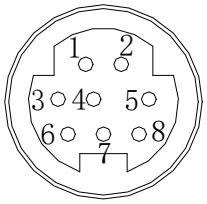
1) Communication port

The LC5E-32T4 body comes with 1 RS232, 1 RS485 communication port, and an RJ45 network port, which can be extended to a serial port.



■ RS232 communication port

The RS232 communication port (COM1) has the following pin definitions:

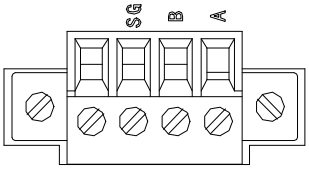


4: RxD
5: TxD
8: GND

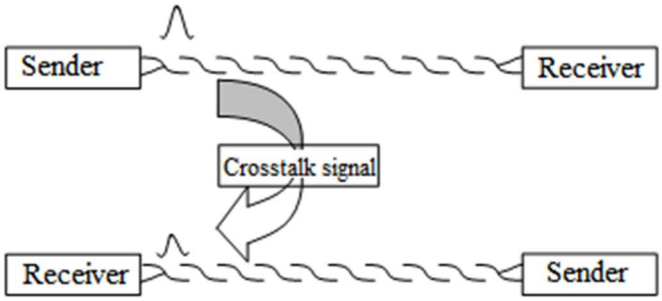
Mini Din 8-core socket (hole)

■ RS485 communication port (COM2)

The RS485 communication port pins are terminals A and B, A is the "RS485+" signal, and B is the "RS485-" signal, among them, SG is the signal ground terminal, and the port diagram is as follows:



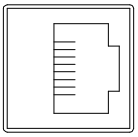
When using RS485 communication, please use twisted pair (as shown below), if conditions permit, shielded twisted pair cables can be used and grounded at a single end. If there is no reliable ground, they can also be suspended.



■ Ethernet port (RJ45 port)

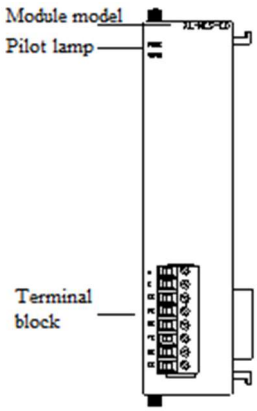
The RJ45 port is unique to Ethernet PLCs and supports Ethernet communication using TCP/IP protocol, this port has the characteristics of being faster and more stable than USB communication, reflected in better real-time monitoring of PLC data and faster downloading of programs. The wiring method used in Ethernet communication itself also has significant advantages over RS485 and USB, in situations where multiple PLCs communicate, users only need to use a switch to communicate with any PLC on site.

In addition to being used in the LAN, Ethernet also supports remote search, monitoring operation, upload and download functions of PLC through the Internet, and communication with other TCP IP devices in the network.



■ Left expansion ED port (COM3)

The left expansion ED port is extended to RS232 and RS485 ports through an external ED board, the current ED board model is XL-NES-ED (Can be extended to one RS232 port and one RS485 port, but both cannot communicate at the same time).



The names of each section are as follows:

Name		Function
Power indicator light		When the ED module has power supply, this indicator light is on
Communication indicator light		When the communication port of the ED module is communicating normally, this indicator light will light up
Terminal block	A	RS485 communication 485+terminals
	B	RS485 communication 485-terminals
	SG	Ground
	FG	Ground terminal
	None	Empty terminal
	TX	RS232 communication data transmission terminal
	RX	RS232 communication data receiving terminal
	SG	Ground

- Communication parameters

Parameter	Explanation
Station number	Modbus station numbers 1-254
Baud rate	300bps~9Mbps
Data bits	8
Stop bit	1, 1.5, 2
Parity	None (No parity), Odd (Odd parity), Even (Even parity), Empty, Mask

Default parameters for communication port: station number 1, baud rate 19200bps, 8 data bits, 1 stop bit, even parity.

There are multiple ways to set PLC communication port parameters:

There are two ways to set Modbus communication parameters: (1) Set parameters through programming software, (2) Set parameters using the configuration tool XINJEConfiguration.

The free format communication parameters can be set through programming software.

The X-NET communication parameters can be set through the configuration tool XINJEConfiguration. The X-NET communication function can be found in the X-NET Bus User Manual.

For the A and B ports on the PLC body, baud rates above 1Mbps are only applicable to X-NET communication mode. During modbus communication, the A and B terminals on the body cannot reach 1M.

- Overview of Modbus communication function

PLC supports master and slave stations when using Modbus communication.

◆ Main station form

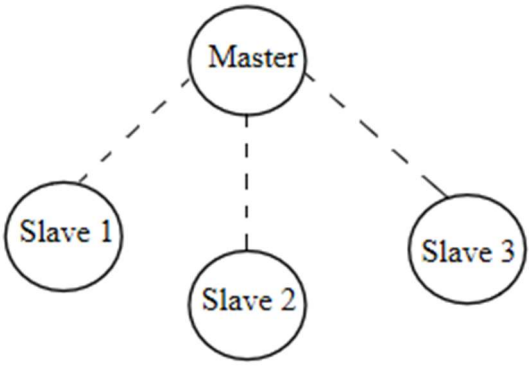
When the programmable controller serves as the master station device, it can communicate with other slave devices using the Modbus RTU or Modbus ASCII protocol through Modbus commands. Exchange data with other devices. Example: The Xinjie XD3 series PLC can control the frequency converter through communication.

◆ Slave station form

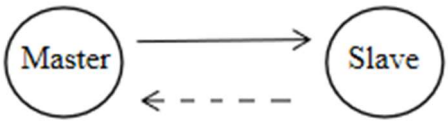
When a programmable controller is used as a slave device, it can only respond to the requirements of other master stations.

◆ The concept of master-slave

In the RS485 network, at a certain moment, there can be one master and multiple slaves (as shown in the figure below), where the master station can perform read and write operations on any of the slaves, direct data exchange between slave stations is not allowed. The master station needs to write a communication program to read and write to one of the slave stations. The slave station doesn't need to write a communication program, only needs to respond to the read and write of the master station. (Wiring method: All 485+connected together, all 485- connected together)



In the RS232 network (as shown below), only one-on-one communication is allowed, and there is only one master and one slave at a certain time.



The reason why there are dashed arrows in the figure (including in the RS485 network) is because theoretically, in two networks, as long as each PLC doesn't send data, any PLC in the network can be used as the master station, and the other PLCs can be used as the slave stations. However, due to the lack of a unified clock reference between multiple PLCs, it is easy for multiple PLCs to send data at the same time, which can lead to communication conflicts and failures. Therefore, it is not recommended to use this method.

- For the A and B ports on the PLC body, baud rates above 1Mbps are only applicable to X-NET communication mode. During modbus communication, the A and B terminals on the body cannot reach 1M.
- For the application of basic instructions, high-speed counting, modbus communication, etc., please refer to the 《User Manual for XD and XL Series Programmable Controllers (Basic Instructions)》. This includes the application of basic instructions, communication instructions, PID instructions, and special instructions such as pulse width modulation.

3.2 Pulse function

LC5E supports 4 pulse outputs, with a maximum pulse output of 100KHz, by using different instruction programming methods, it is possible to perform unidirectional pulse output without acceleration/deceleration, unidirectional pulse output with acceleration/deceleration, and multi segment, forward and reverse output, etc. The output frequency can reach up to 100KHz. The pulse output port is Y0-Y3. When the pulse output terminal is not used as a pulse output, it can be used as a regular Y terminal or as a directional terminal.

When using the pulse output function, LC5E-32T4 needs to configure pulse data, user parameter blocks, and system parameter blocks separately. Please refer to the relevant instructions for application and parameter configuration **《User Manual for XD and XL Series Programmable Controllers (Positioning Control Chapter)》**. This includes the use of pulse instructions and case studies.

- ※1: PLC can output pulses ranging from 100KHz to 200KHz, but it cannot guarantee that all servos operate normally. Please connect a resistor of approximately 500 Ω between the output end and the 24V power supply.
- ※2: When using positioning commands, the pulse direction terminal can be freely defined in all output terminals except for the pulse output terminal. It is recommended to use the transistor output point on the PLC body.
- ※3: The response time of the pulse output port transistor is below 0.5us, and the response time of the other output transistors is below 0.2ms.
- ※4: Pulse requires the configuration of pulse output terminals and pulse direction terminals. It is recommended to distinguish the pulse direction terminals corresponding to all pulse output terminals, otherwise it may cause problems such as pulse commutation failure.

3.3 Ethernet function

The LC5E series PLC supports Ethernet communication. Before conducting Ethernet communication, it is necessary to first understand several basic concepts of Ethernet communication, such as IP address allocation, PC network address and settings, etc. It can communicate with clients, servers, and other devices, supporting modbus TCP, free format TCP, and UDP communication.

3.3.1 Ethernet overview

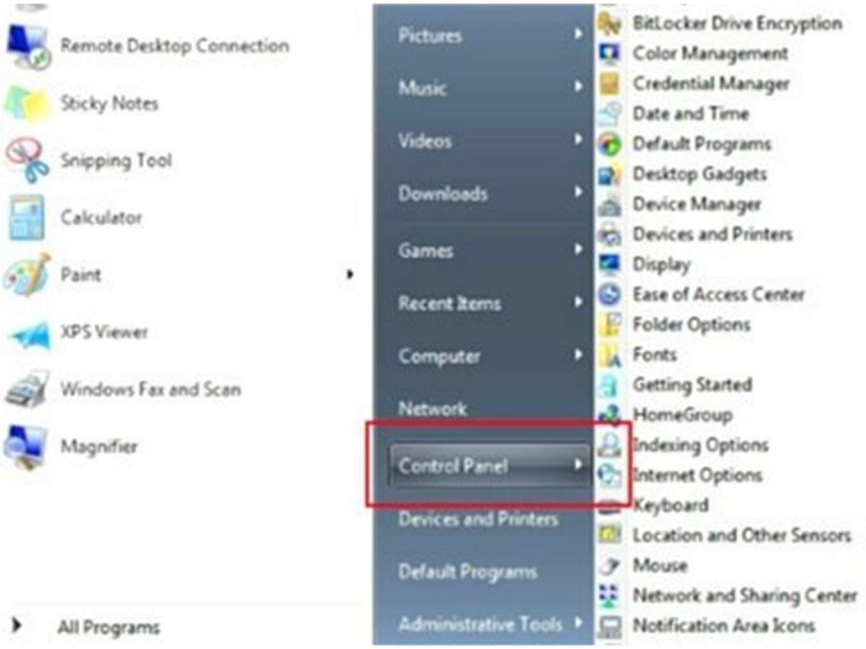
1) Assign IP address

If the programming device (such as PC) uses a network card to connect to the factory LAN (or the Internet), the programming device and PLC must be in the same subnet. The combination of IP address and subnet mask can specify the subnet of the device.
The network ID is the first part of an IP address, which consists of the first three octets (For example, if the IP address is 211.154.184.16, 211.154.184 represents the network ID), and it determines the IP network in which the user is located. The value of the subnet mask is usually 255.255.255.0. However, due to your computer being in the factory LAN, the subnet mask may have different values (e.g. 255.255.254.0) to set a unique subnet. The subnet mask defines the boundaries of an IP subnet by performing a logical AND operation with the device IP address.

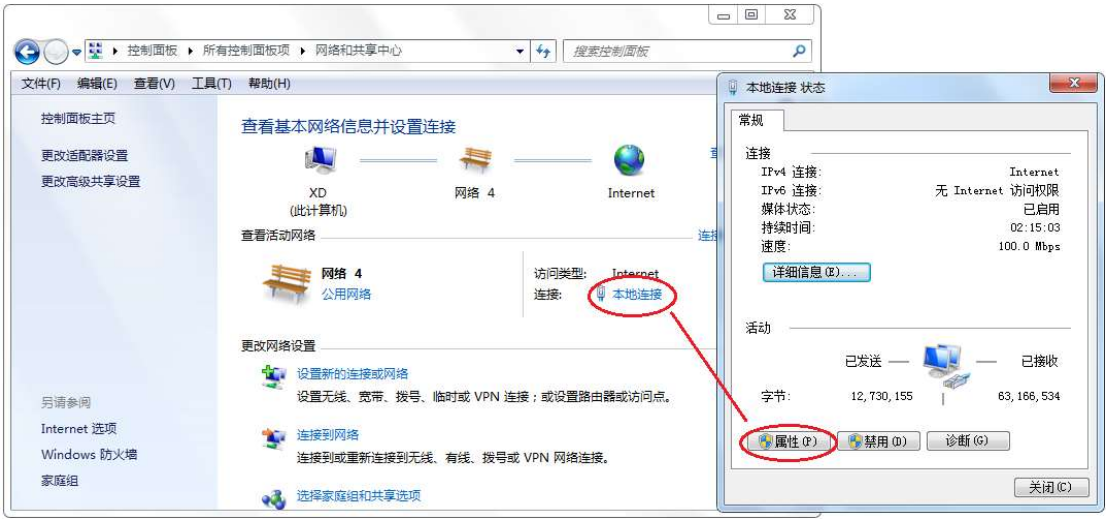
2) Set PC network address information

■ If you are using the WIN7 operating system, you can assign or check the IP address of the programming device by following these steps:

1. Open Control Panel - Network and Sharing Center:

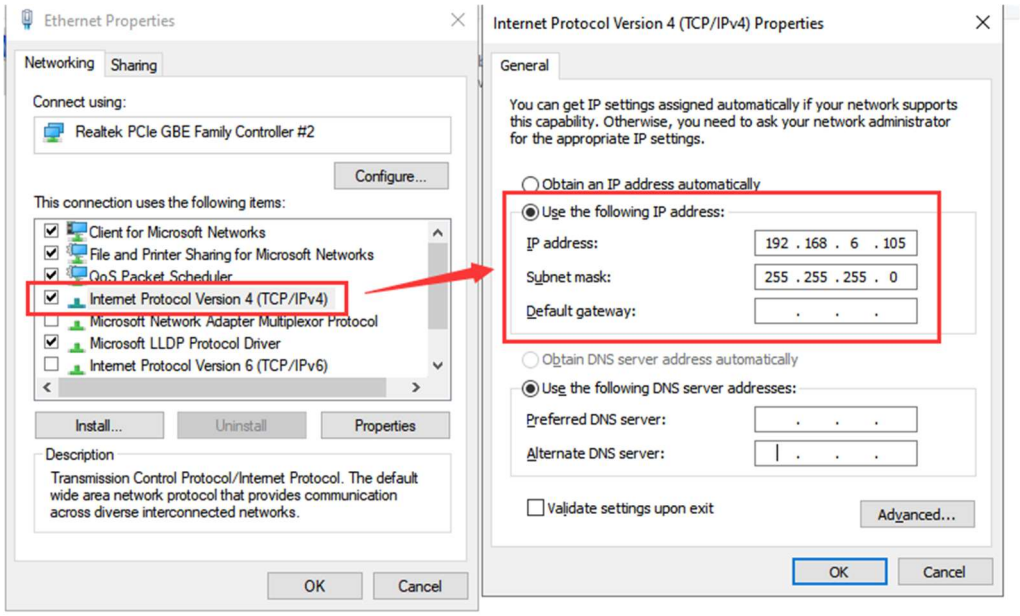


2. Click on "Local Connection" to view the properties:



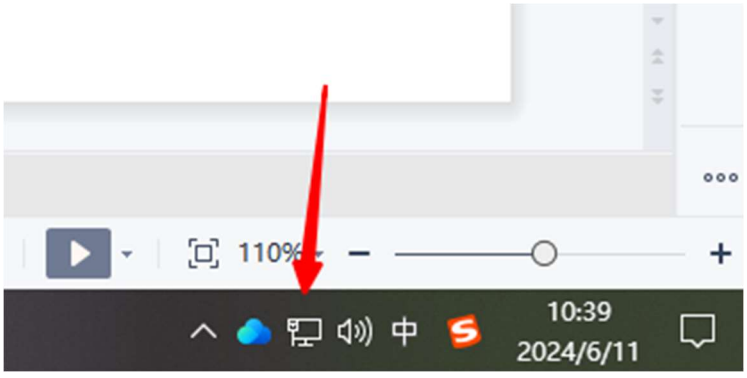
3. Set the IP address of the PC to be on the same subnet as the PLC.

The default IP address of the PLC is 192.168.6.6, so the IP address of the PC needs to be set to an address with the same network ID (such as 192.168.6.105), and the subnet mask needs to be set to 255.255.255.0. The default gateway can be left blank. In this way, the PC can be connected to the PLC. As shown in the following figure:

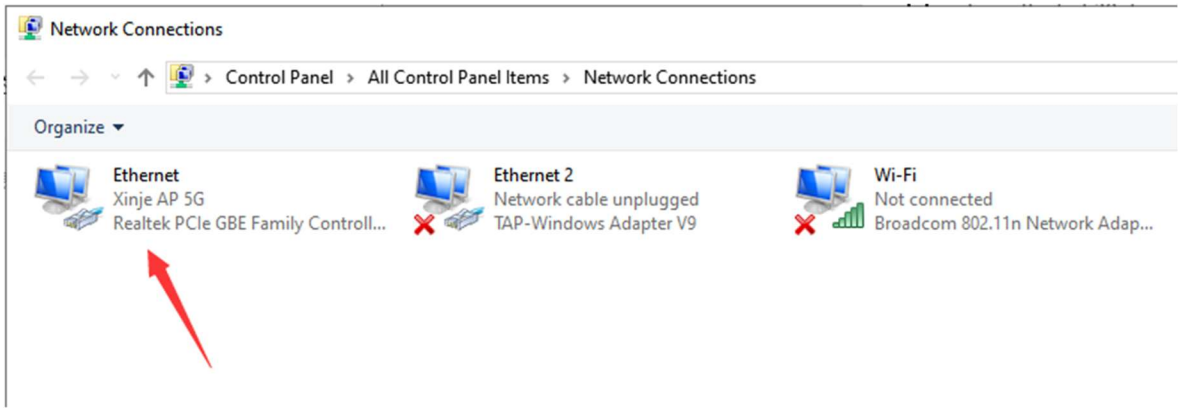


■ If you are using the WIN10 operating system, you can assign or check the IP address of the programming device by following these steps:

1. Right click on the small computer icon in the bottom right corner of the computer, as shown in the following figure:

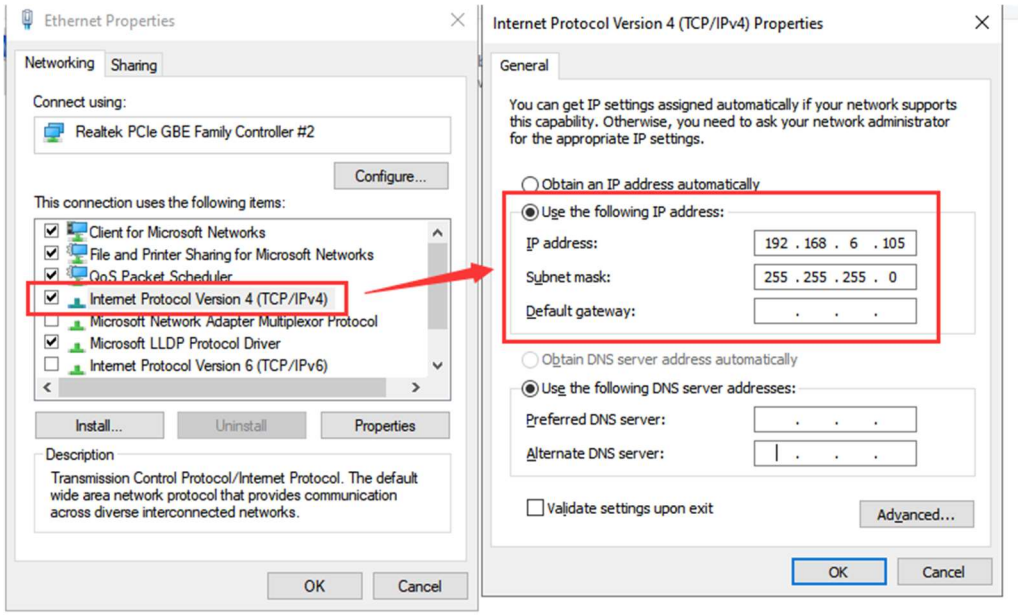


2. Open "Network and Internet Settings", select the corresponding network card, right-click to open Properties:



3. Set the IP address of the PC to be on the same subnet as the PLC.

The default IP address of the PLC is 192.168.6.6, so the IP address of the PC needs to be set to an address with the same network ID(such as 192.168.6.105), and the subnet mask needs to be set to 255.255.255.0. The default gateway can be left blank. In this way, the PC can be connected to the PLC. As shown in the following figure:



3.3.2 TCP IP protocol

TCP/IP protocol is a commonly used Ethernet communication protocol, which adopts a more open approach compared to the open interconnect model ISO. It has been recognized by the US Department of Defense and widely used in practical engineering. The TCP/IP protocol can be used on various channels and underlying protocols, such as T1, X.25, and RS232 serial interfaces. More precisely, TCP/IP protocol is a protocol group that includes TCP protocol, IP protocol, UDP protocol, ICMP protocol, and other protocols.

1) Port number

In Ethernet, communication based on TCP or UDP protocols must use port numbers to communicate with upper layer applications, ranging from 0 to 65535, some port numbers correspond to default functions, such as port 80 for browsing web services, port 21 for FTP services, port 502 for MODBUS TCP communication, and so on.

2) UDP protocol

UDP is a user data protocol that uses a simple connectionless transmission model with minimal protocol

overhead. There is no handshake mechanism in the UDP protocol, so the reliability of the protocol is only equivalent to the underlying network. Unable to ensure protection for sending and replying to messages. For data integrity, UDP also provides checksums and typically addresses different functions with different port numbers.

UDP multicast is the Internet Group Management Protocol, abbreviated as IGMP. Multicast transmission is the implementation of point-to-point network connections between the sender and each receiver, used in a typical master-slave mode, it effectively solves the problem of single point transmission and multi-point reception, and can greatly save network bandwidth and reduce network load.

3) TCP protocol

■ The basic principles of TCP

The TCP protocol is the Transport Control Protocol, which is a connection oriented and reliable transport layer protocol. Connection oriented refers to a normal TCP transmission that requires the establishment of specific virtual circuit connections between the TCP client and TCP server. To transmit data through TCP, a connection must be established between the two hosts.

Between applications running on hosts communicating via Ethernet, TCP provides reliable, orderly, and error checking message sending capabilities. TCP can ensure that the content and order of all bytes received and sent are exactly the same. The TCP protocol creates a connection between the active device (i.e. the device initiating the connection) and the passive device (i.e. the device receiving the connection). **After the connection is established, either party can initiate data transmission.**

The TCP protocol is a "streaming" protocol, which means that there is no end flag in the message, and all received messages are considered part of the data stream. For example, the client device sends three messages to the server, each containing 20 bytes. The server only sees a 60 byte "stream" received (Assuming the server performs a receive operation after receiving three messages).

■ The basic concept of sockets

A socket is the cornerstone of communication and the basic operating unit for network communication that supports the TCP/IP protocol. It is an abstract representation of endpoints in the process of network communication, containing five types of information necessary for network communication: the protocol used for connection, the IP address of the local host, the protocol port of the local process, the IP address of the remote host, and the protocol port of the remote process.

When the application layer communicates data through the transport layer, TCP encounters the problem of providing concurrent services to multiple application processes simultaneously. Multiple TCP connections or application processes may need to transmit data through the same TCP protocol port. In order to distinguish between different application processes and connections, many computer operating systems provide socket interfaces for applications to interact with the TCP/IP protocol. The application layer can distinguish communication from different application processes or network connections through socket interfaces with the transport layer, achieving concurrent services for data transmission.

■ Establishing a socket connection

Establishing a socket connection requires at least one pair of sockets, one running on the client side (also known as a TCP client) called ClientSocket, and the other running on the server side (also known as a TCP server) called ServerSocket.

The connection process between sockets is divided into three steps: server listening, client request, and connection confirmation.

Server listening: The server socket doesn't locate the specific client socket, but is in a waiting state for connection, monitoring the network status in real-time, and waiting for the client's connection request.

Client request: Refers to a connection request made by the client's socket, with the target being the server's socket. For this, the client's socket must first describe the socket of the server it wants to connect to, indicate the address and port number of the server socket, and then make a connection request to the server socket.

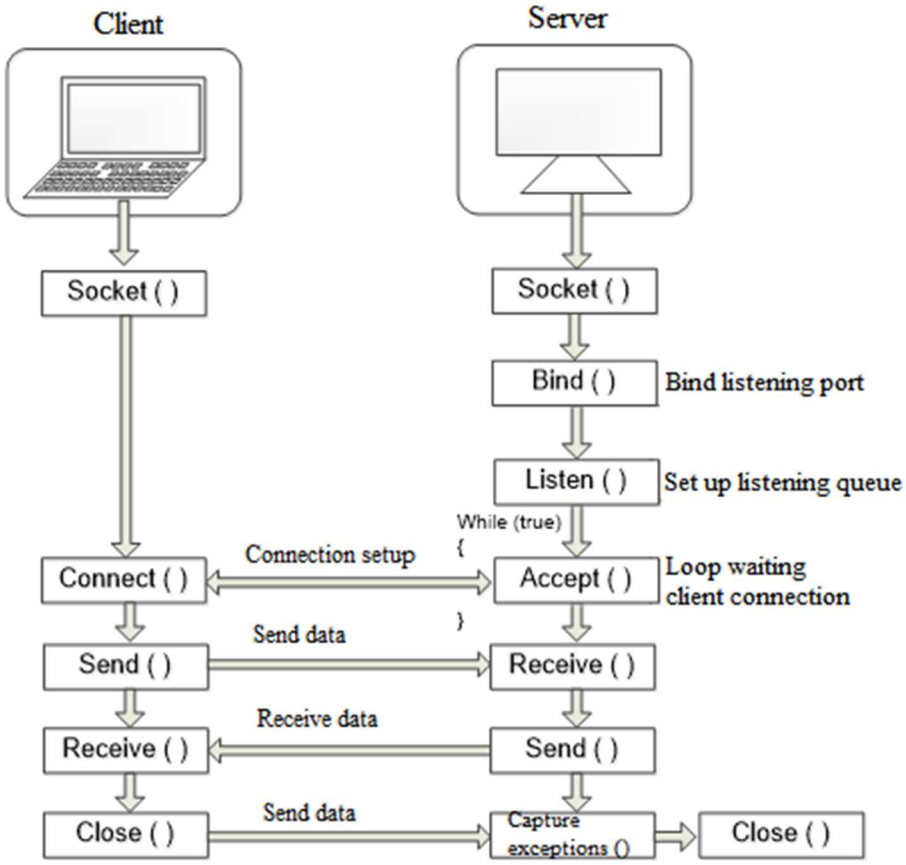
Connection confirmation: When the server socket detects or receives a connection request from the client socket, it responds to the request from the client socket, establishes a new thread, and sends the description of the server socket to the client. Once the client confirms this description, both parties officially establish the connection. The server socket continues to be in a listening state and continues to receive connection requests from other client sockets.

When creating a socket connection, you can specify the transport layer protocol to use. The socket can support different transport layer protocols (TCP or UDP), and when using the TCP protocol for connection, the socket connection is a TCP connection.

TCP communication diagram:

In the following figure, the socket on the server is in a listening state. The client makes a connection request to the server, and the server receives the connection request and sends a reply confirmation message to the client. After the client receives it, it sends a confirmation message to the server. After completing resource allocation, a TCP connection is established, and this process is called a "triple handshake".

After the connection is established, the client and server conduct data transmission and reception. After the data transmission and reception are completed, both the client and server can initiate a connection closure request. After four waves, the TCP connection is closed and all data transmission and reception are interrupted.



Please refer to the specific communication command configuration and application cases for reference《Ethernet Communication User Manual》.

4. EtherCAT communication

4.1 Overview

4.1.1 EtherCAT overview

EtherCAT, Ethernet for Control Automation Technology, developed by Beckhoff Automation GmbH, is a real-time Ethernet used for open network communication between master and slave stations. EtherCAT, as a mature industrial Ethernet technology, has the characteristics of high performance, low cost, and easy use.
The LC5E-32T controller (slave station) complies with the standard EtherCAT protocol. It can communicate with XDH, XLH, and other third-party devices through EtherCAT to achieve data transmission.

4.1.2 System composition (master station, slave station composition)

The connection form of EtherCAT is a network system that connects the main station (FA controller) and multiple slave stations in a linear manner. The number of nodes that a slave can connect to depends on the processing or communication cycle of the master station, the number of bytes transmitted, etc.

4.1.3 Communication specifications

Project	Specifications
Physical layer	100BASE-TX(IEEE802.3)
Baud rate	100[mBbps] (Full duplex)
Topology	Line
Connects cables	JC-CA twisted pair (Shielded twisted pair)
Cable length	The maximum length between nodes is 100m
Communication port	2 Port(RJ45)
EtherCAT Indicators (LED)	[Run] RUN Indicator [L/A IN] Port0 Link/Activity Indicator (Green) [L/A OUT] Port1 Link/Activity Indicator (Green)
Station Alias (ID)	Setting range: 0-65535 Set address: 2700h
Explicit Device ID	Not supported
Mailbox protocol	COE(CANopen Over EtherCAT)
SyncManager	4
FMMU	3
Touch Probe	4
Synchronous mode	DC (SYNCO event contemporaneous) SM (SM event synchronization)
Communication object	PDO [Process Data Object]
Maximum allocation of single station PDO	TxPDO: 16 [pieces] RxPDO: 16[pieces]
Maximum Bytes of Single Station PDO	TxPDO: 100[byte] RxPDO: 100[byte]
Process data	Maximum 1280 bytes per frame
Compatibility	Support mainstream brand main websites

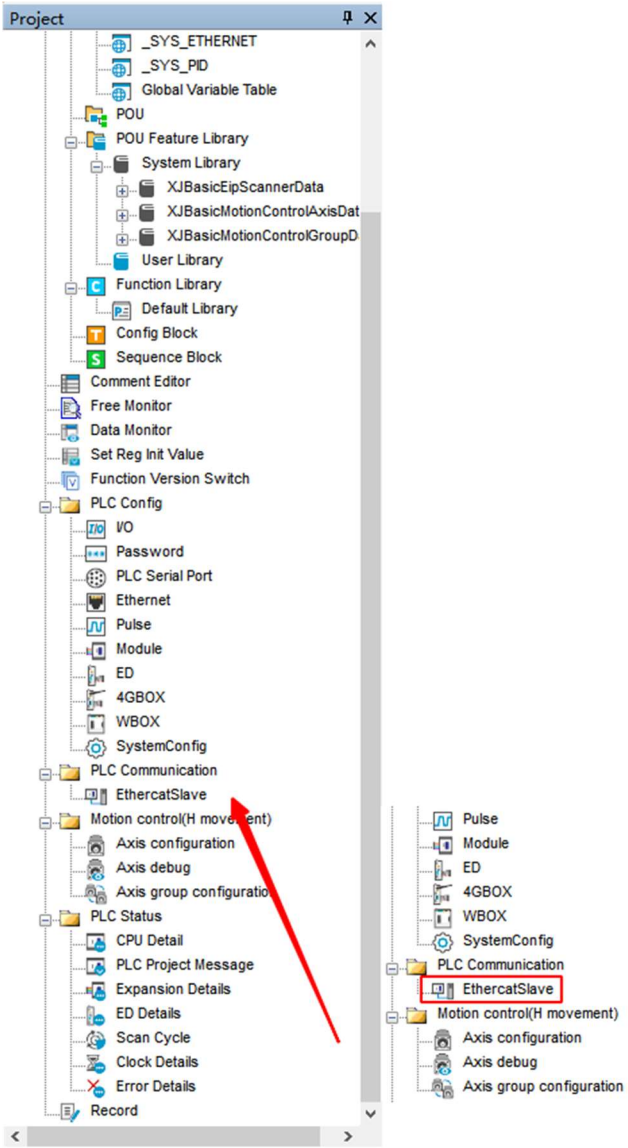
4.1.4 Connection mode

The EtherCAT port of the master station or the ECAT OUT port of the slave station are connected to the ECAT IN port of LC5E, and the ECAT OUT port is connected to the IN port of the subsequent slave station. The

LC5E-32T4 bus wiring follows the principle of "bottom in, top out", taking XDH with two LC5Es as an example, the second network port of the PLC is connected to the first network port of the first LC5E, the second network port of the first LC5E is connected to the first network port of the second LC5E.

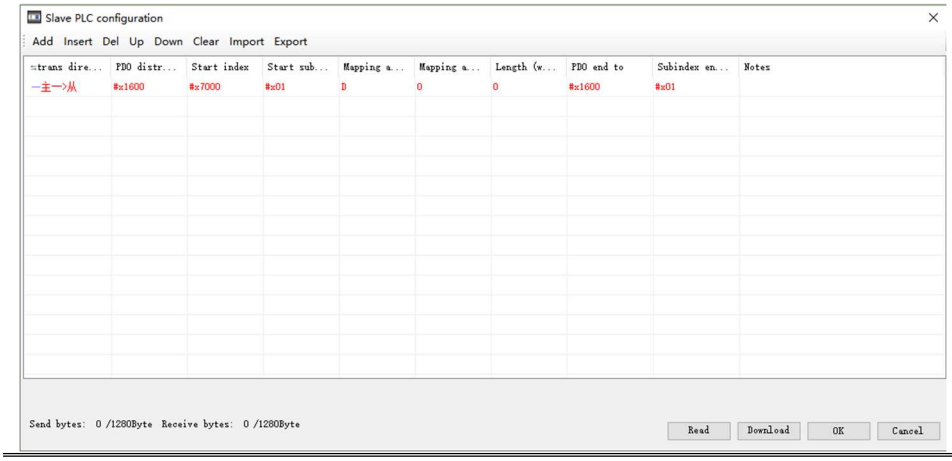
4.2 Configuration description

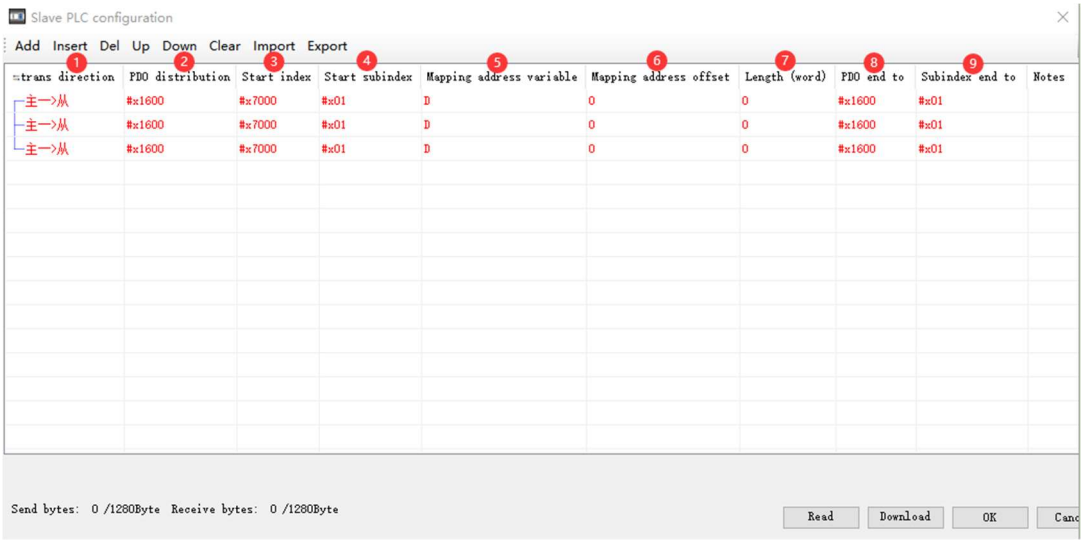
The EtherCAT configuration for LC5E-32T4 requires software of 3.7.17b or higher.
Create a new project, as shown in the figure. In the left engineering bar interface, find Ethercatslave and double-click to open it:

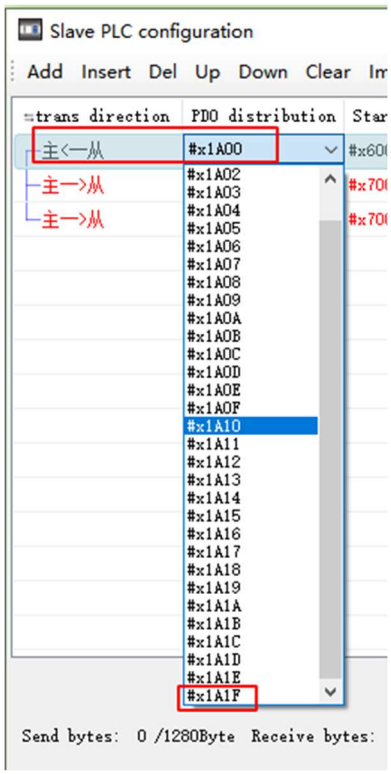


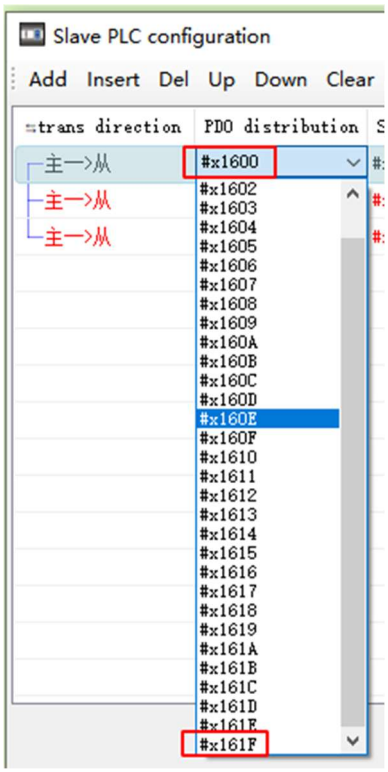
After opening, the following interface will appear, including data transmission direction, PDO parameter selection, index, address configuration, data length, and other parameters.

When adding a new address, the default length is 0, and the configuration displays in red.

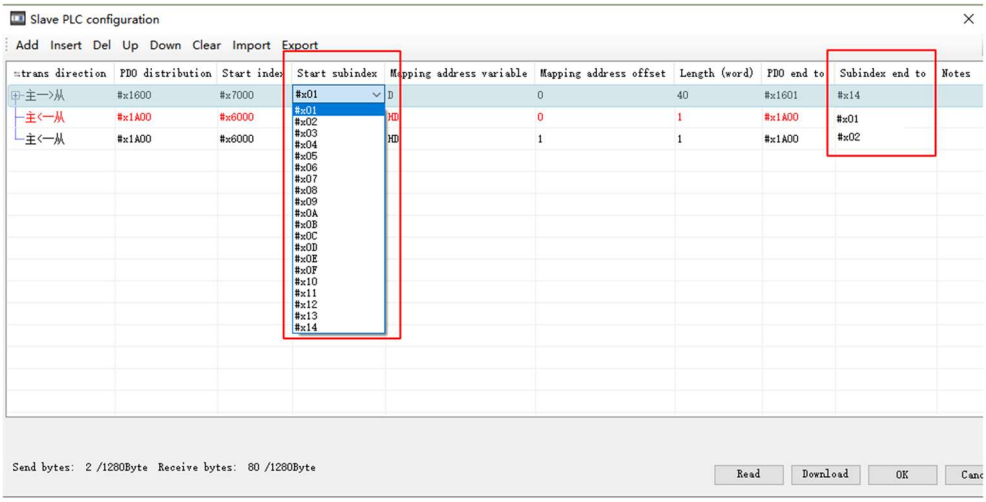


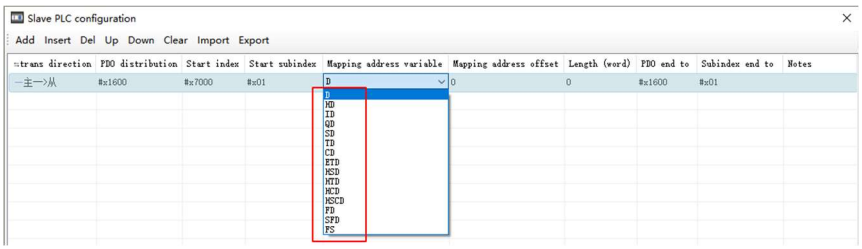






Project	Master ->Slave	Master<- Slave
Transmission direction	The main station writes data to LC5E	Master station reads LC5E data
PDO allocation	PDO parameters can be selected from # x1600~# x161F, with a total of 16 PDO parameters.	PDO parameters can be selected from # x1A00~# x1A1F, with a total of 16 PDO parameters. When allocating PDO parameters, it is not allowed to conflict with other configured PDO parameters, otherwise an error message will appear in the system with an error entry.



Start index	The indexes are # x6000~# x601F or # x700~# x701F, each containing 16 sub indexes.
Starting sub index	An index contains 16 sub indexes, each corresponding to a register. The starting sub index must be greater than the previous ending sub index, otherwise the system will report an error entry.
Mapping address variables	Register addresses that can be communicated, including registers such as D, HD, ID, QD, SD, etc. 
Mapping address offset	The starting address of the corresponding register, for example, if the mapping register D is selected with an address offset of 10, the corresponding starting register address for communication is D10.
Length	Set as many registers as needed.
PDO deadline	According to the set length, occupy the corresponding PDO parameter. If the length exceeds 20, occupy the next PDO parameter.
Sub index until	According to the number (length) of registers, the corresponding index is occupied, and the newly added configuration cannot occupy the same sub index.

- The length (word) setting must be greater than 0.
- PDO allocation and sub indexes must not be within the deadline and cannot conflict. For example, if the previous PDO ended at # x1601, then the subsequent ones must check if there are any unmapped sub indexes in # x1601.

4.3 Case

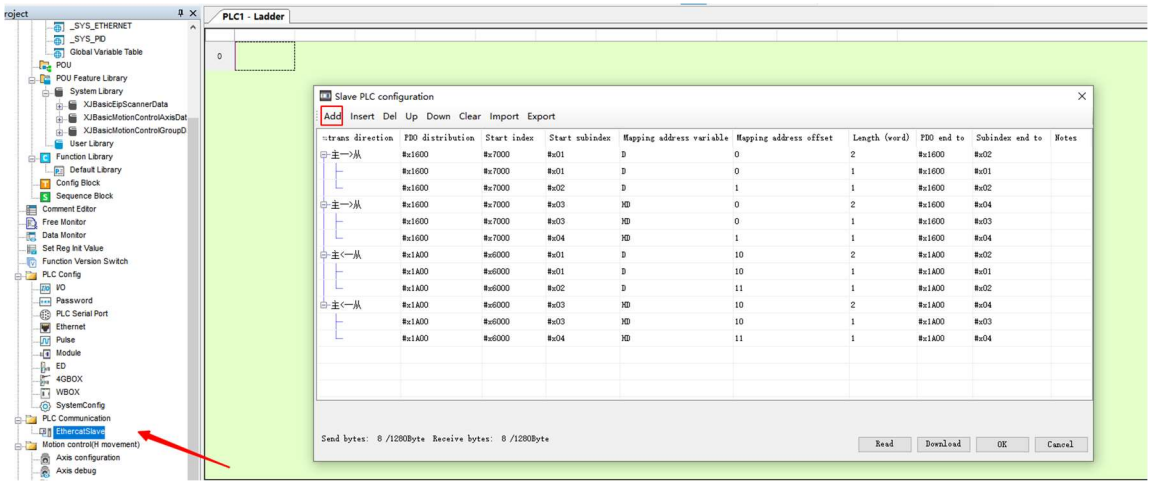
4.3.1 Case 1: XLH and LC5E communication

Using software 3.7.17c, XLH-30A32 and LC5E-30T4 communicate via Ethercat. There are a total of 8 addresses for communication, D and HD.

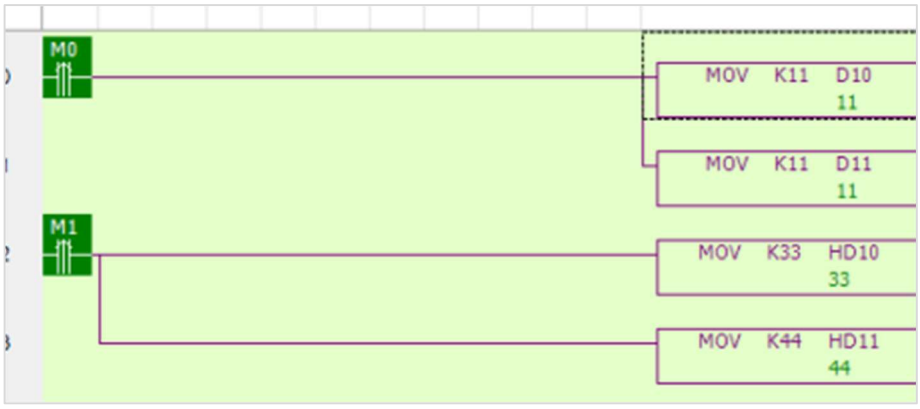
■ Slave station configuration

1. On the left side of the programming software, in the engineering column, PLC communication - EthercatSlave, add the parameters that require communication.
2. Master station writes data to slave stations: Select primary ->secondary communication direction, address selection: D0, D1, HD0, HD1. The first communication PDO ends at # x1600, and the sub index ends at # x02, so the next communication address starts at # x1600, and the sub index configuration starts at # x03 (Greater than the cutoff PDO of the previous cutoff configuration).

Master station reads slave station data: Select communication direction from ->master, address selection: D10, D11, HD10, HD11. The PDO parameters and index cutoff are the same as above.

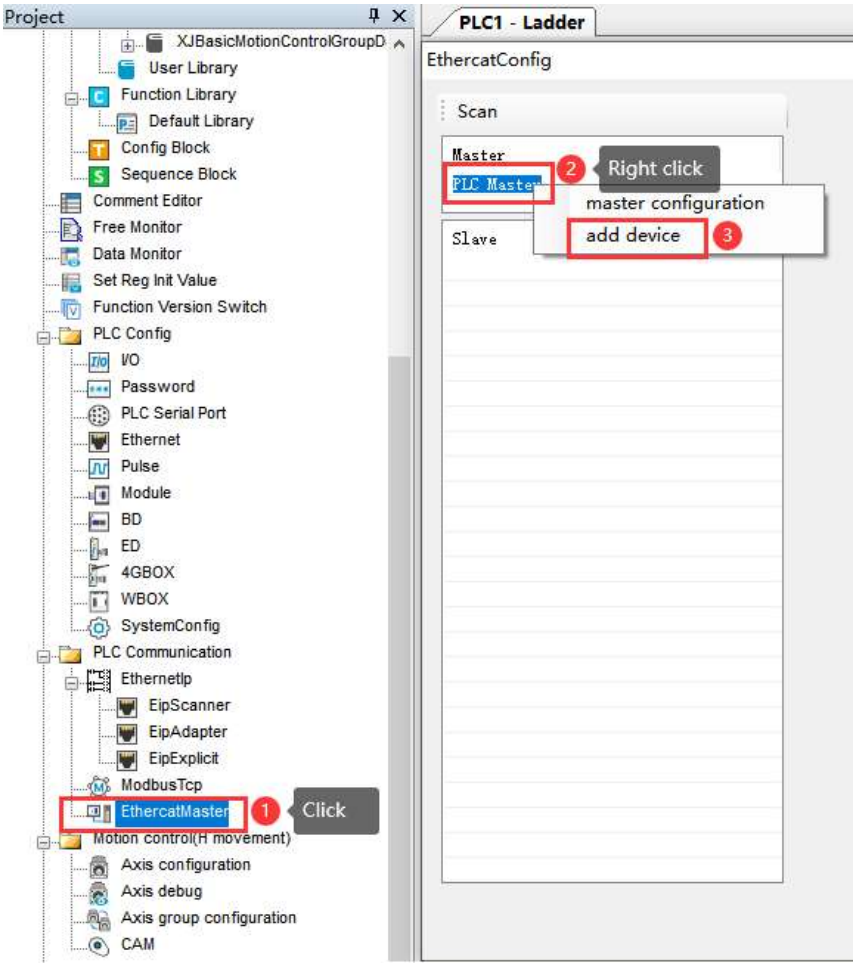


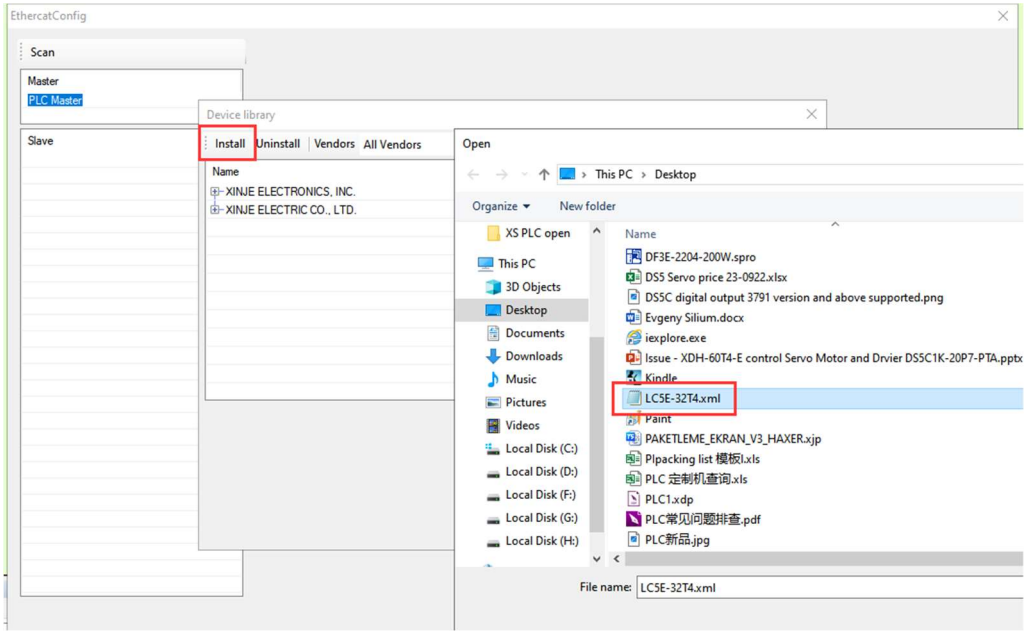
3. Download configuration and write program MOV data from the site to D10, D11, HD10, HD11. The master station writes data to the slave station corresponding to PDO: #x1600, starting index # x7000, sub indexes # x01- # x04. The master station reads the corresponding PDO from the slave station data: #x1A 00, starting index # x6000, sub indexes # x01~# x04.



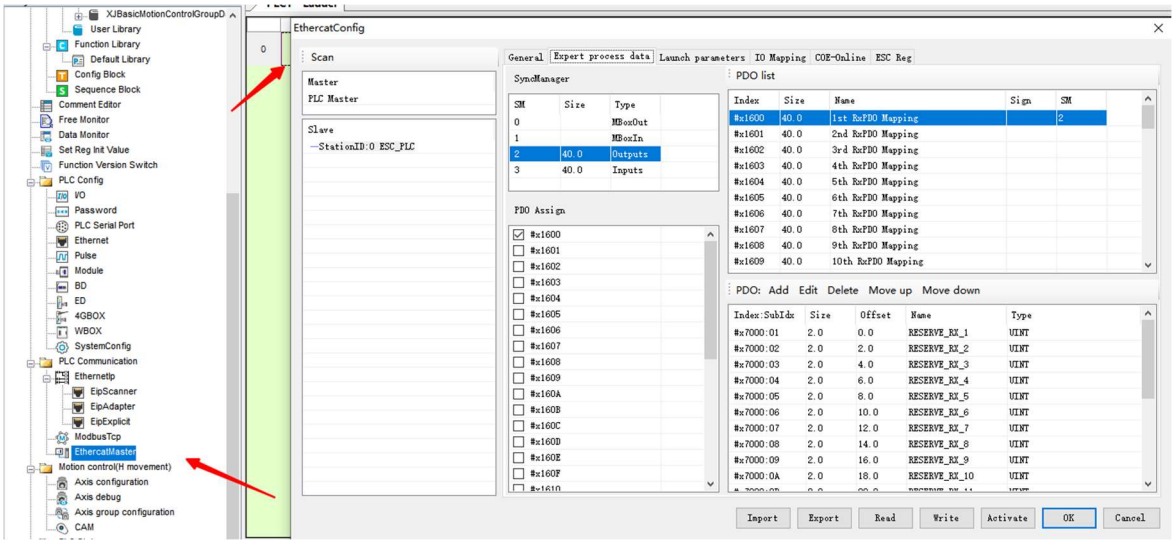
■ Main station configuration

1. Import XML file: In the left engineering column ->PLC communication ->Ethercatmaster ->PLC master, right-click to add a device, select Import Device, and select the XML file for LC5E in the corresponding path.

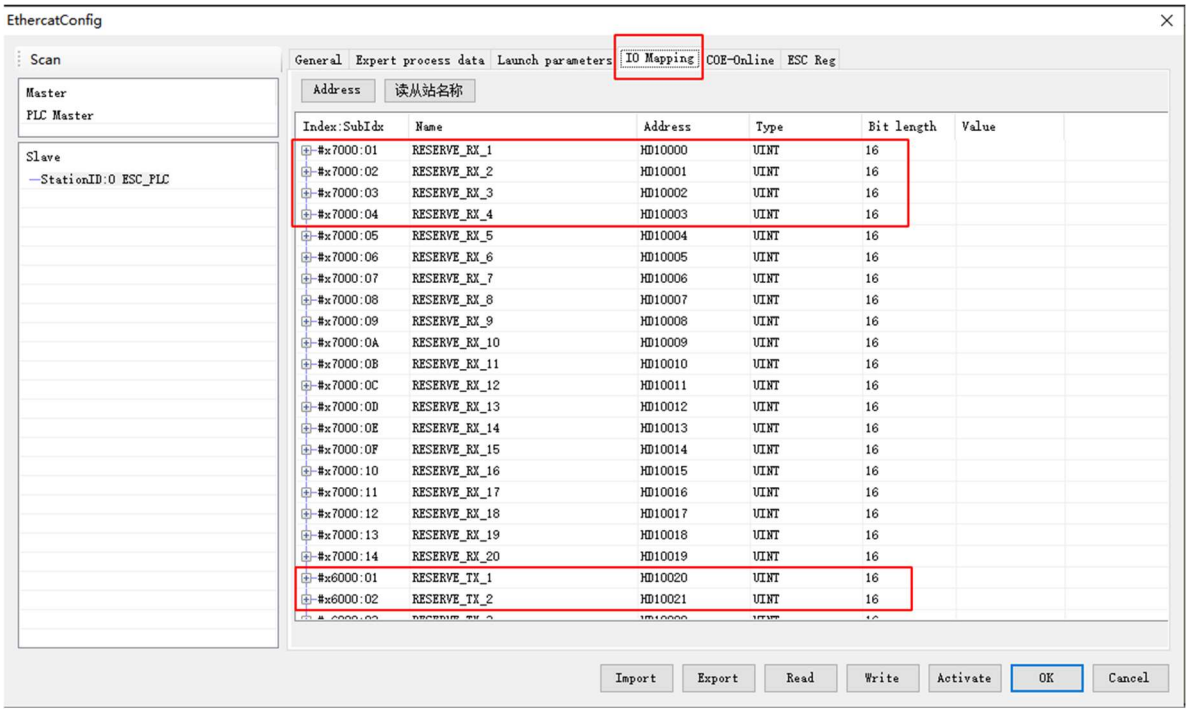




2. Scan the slave station and confirm the PDO parameter configuration on the expert process data interface, since the slave station is configured with # x1600 and # x1A00, selecting these two parameters in the master station configuration will suffice (If adding other PDO parameters from the station, you can check the other PDO parameters). Configure write activation.



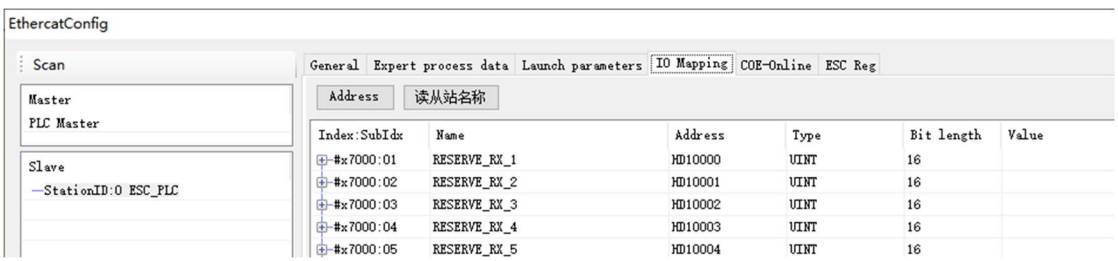
3. Master Station Address: In the IO mapping interface, the master station address corresponding to the PDO parameters of the slave station can be monitored. At the corresponding address, data can be written or read from the slave station to that address.



■ Communication results

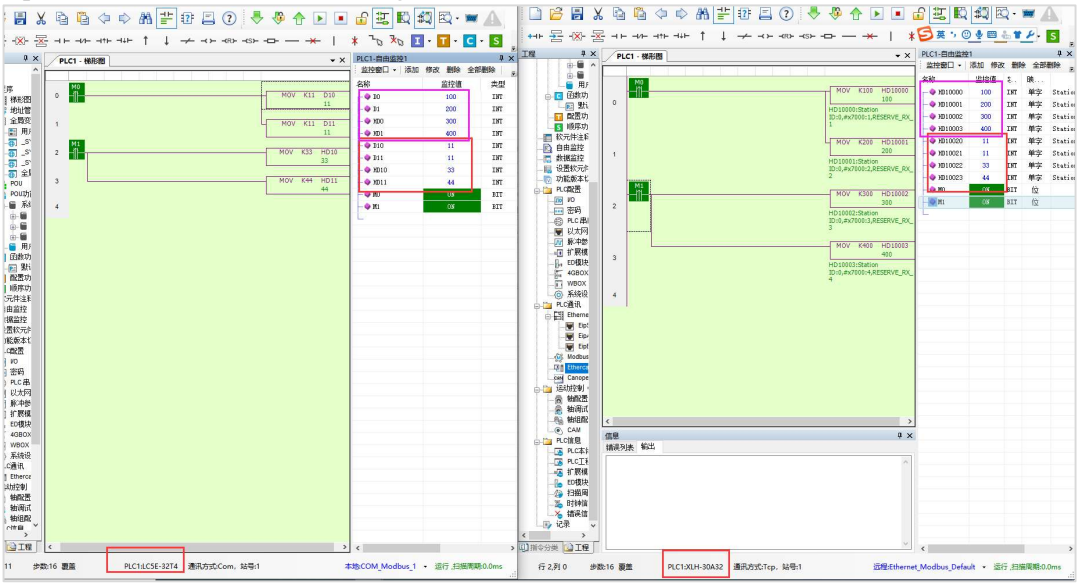
Slave address: D0, D1, HD0, HD1. D10, D11, HD10, HD11.

Main station IO mapping confirmation monitoring address: HD10000~HD10004. HD10020~HD10023.



#x6000:01	RESERVE_TX_1	HD10020	UINT	16	0
#x6000:02	RESERVE_TX_2	HD10021	UINT	16	0
#x6000:03	RESERVE_TX_3	HD10022	UINT	16	0
#x6000:04	RESERVE_TX_4	HD10023	UINT	16	0

In free monitoring, the red box represents the master station reading data from the slave station, and the purple red box represents the master station writing data to the slave station.

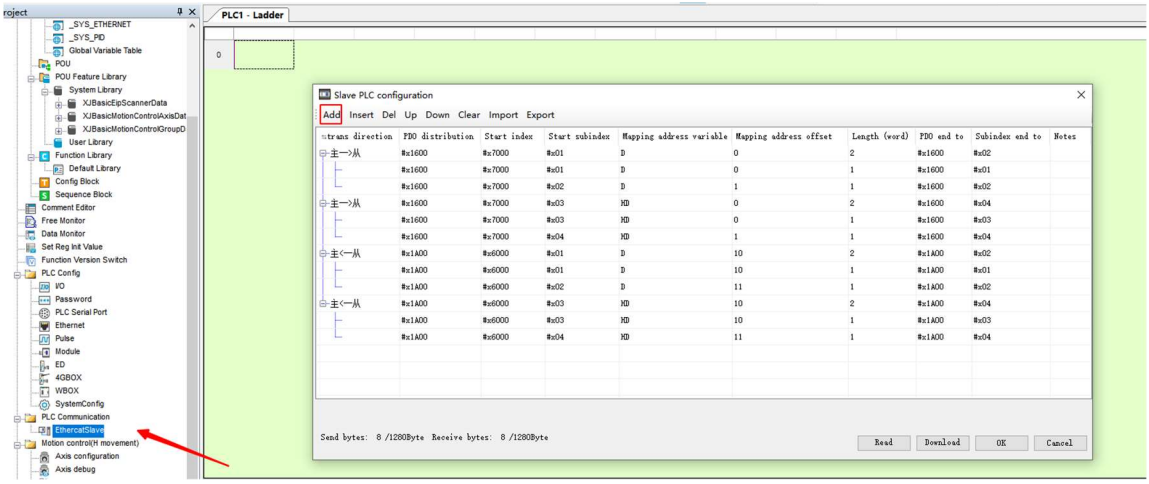


4.3.2 Case 2: Codesys platform and LC5E communication

Use Xinje XSDH-60A32 and LC5E-32T4 for communication, XSDH software uses XS2.2.0, LC5E software uses 3.7.17c, write to LC5E registers D0~D3 and read data from HD0~HD3.

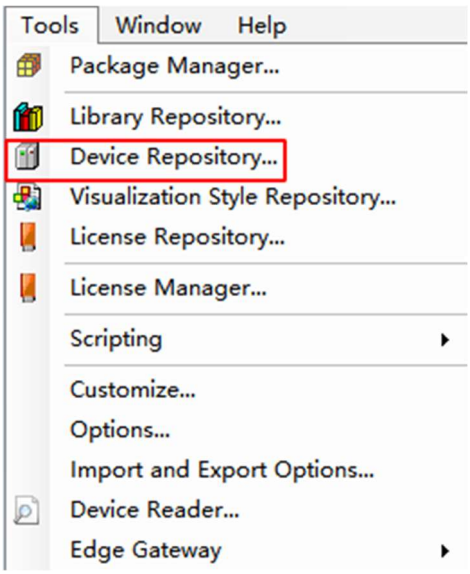
■ Slave station configuration

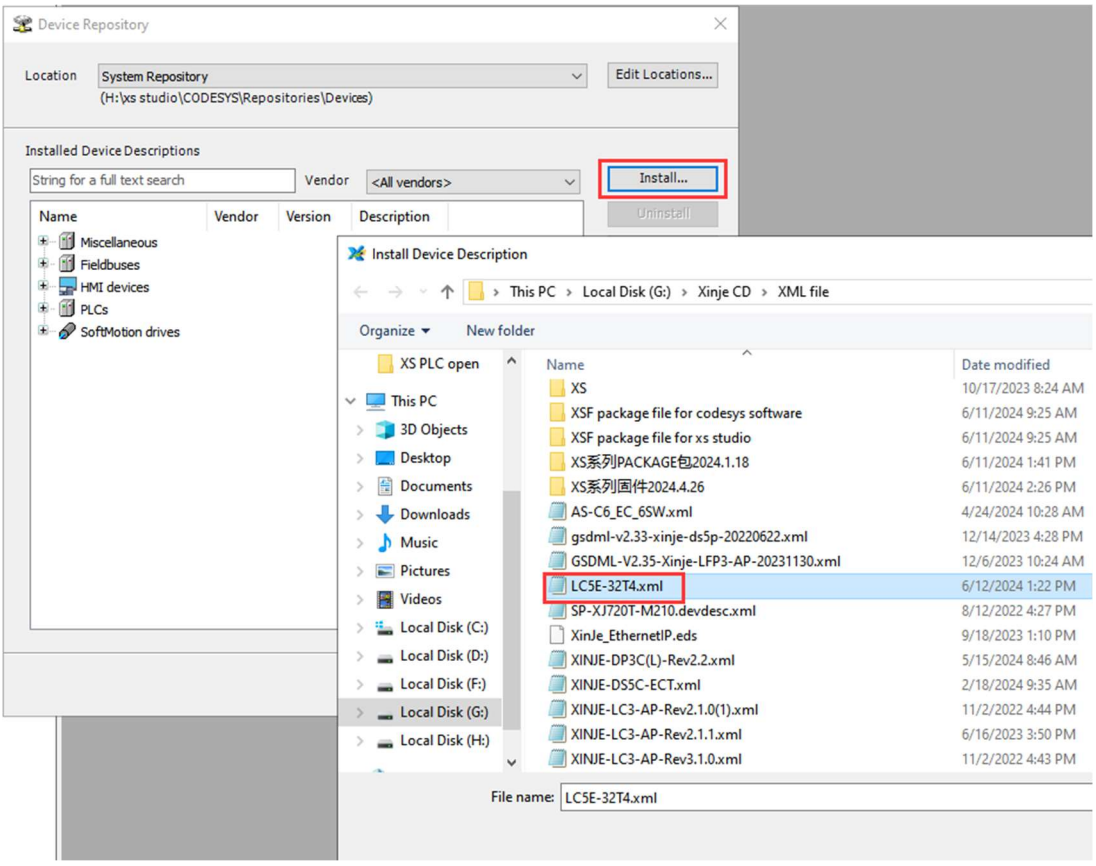
Configuration can refer to Case 1, in the left engineering column, PLC communication, select EthercatSlave, and the master station writes data to the slave station, D0, D1, HD0, HD1. The first communication PDO ends at # x1600 and the sub index ends at # x02, so the next communication address starts at # x1600 and the sub index configuration starts at # x03 (PDO cutoff greater than the previous cutoff configuration). The master station reads data from the slave station, D10, D11; HD10, HD11. Then download the configuration.



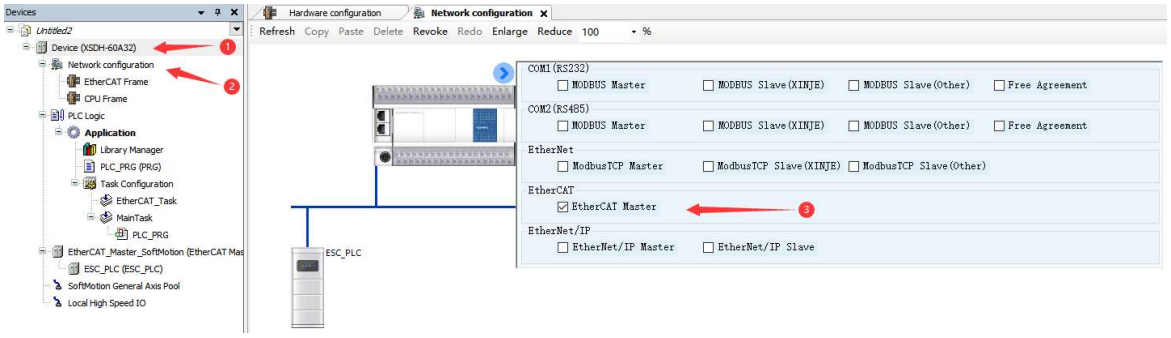
■ Main station configuration

1. Import XML file: Above the programming software, go to Tools ->Device repository, click Install, select the corresponding LC5E XML file in the path, open it, and import it.

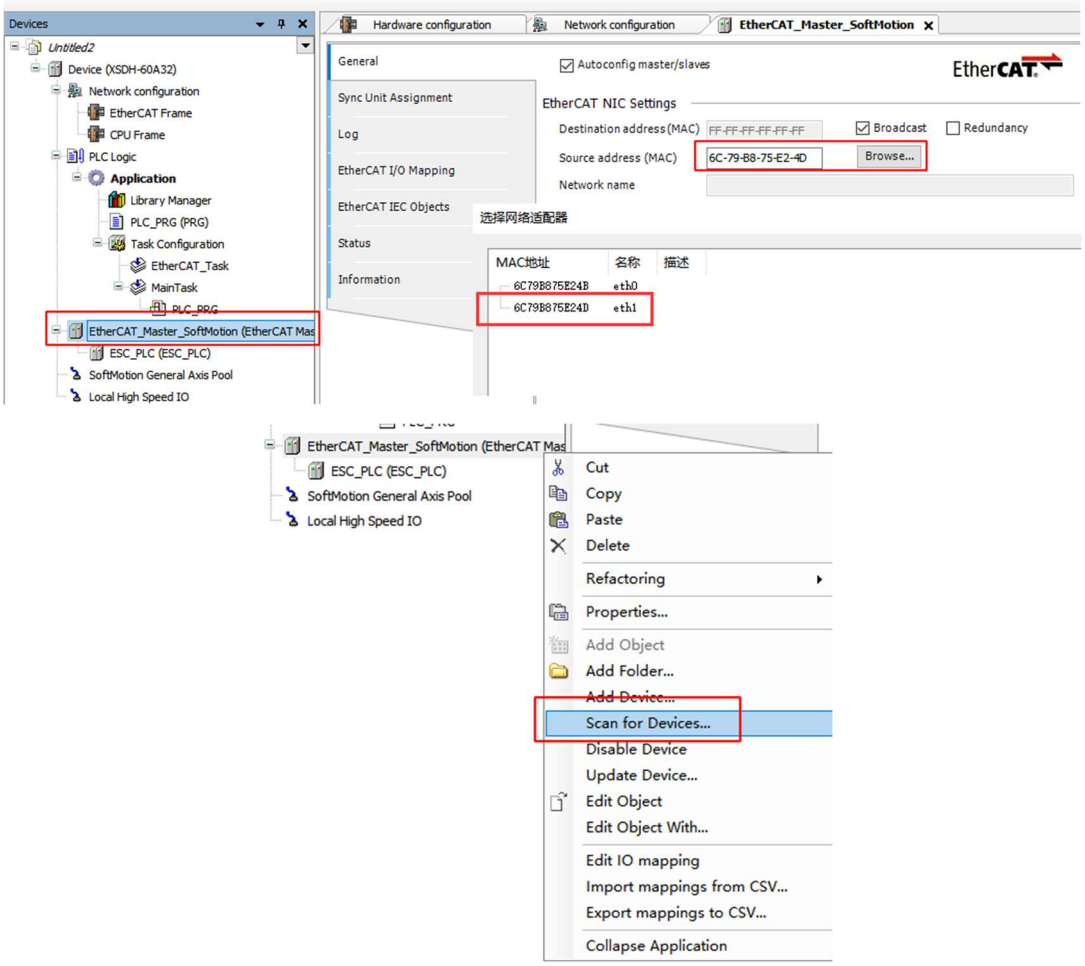




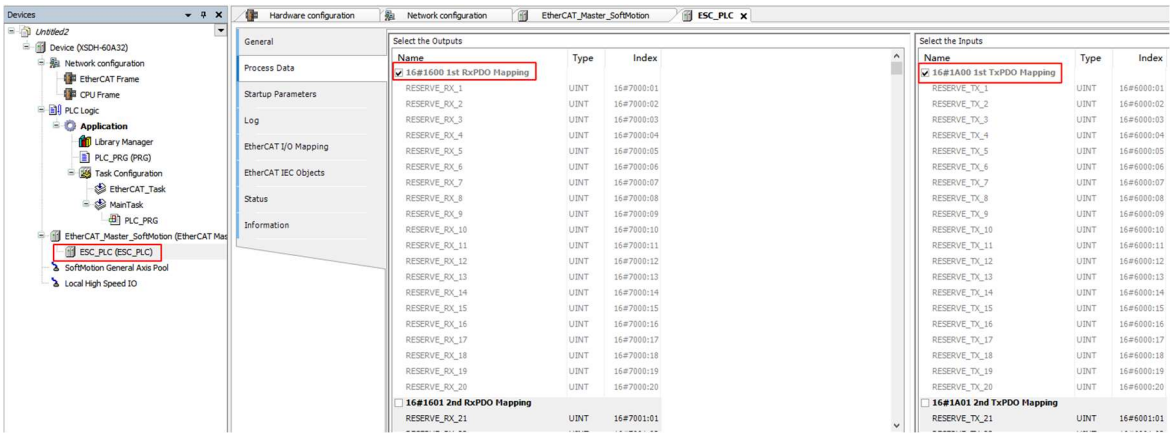
2. Right click on Device, update the device, and select the corresponding model. Select EtherCAT master station for network configuration.



3. Click on Ethercat_master, select the second Ethernet port (EtherCAT port), right-click on Ethercat_master and select the scanning device.



4. Click ESC-PLC, select the PDO parameters that require communication for expert process data, and default to # x1600 and # x1A00(If other PDO parameter communication is required, please check the box).

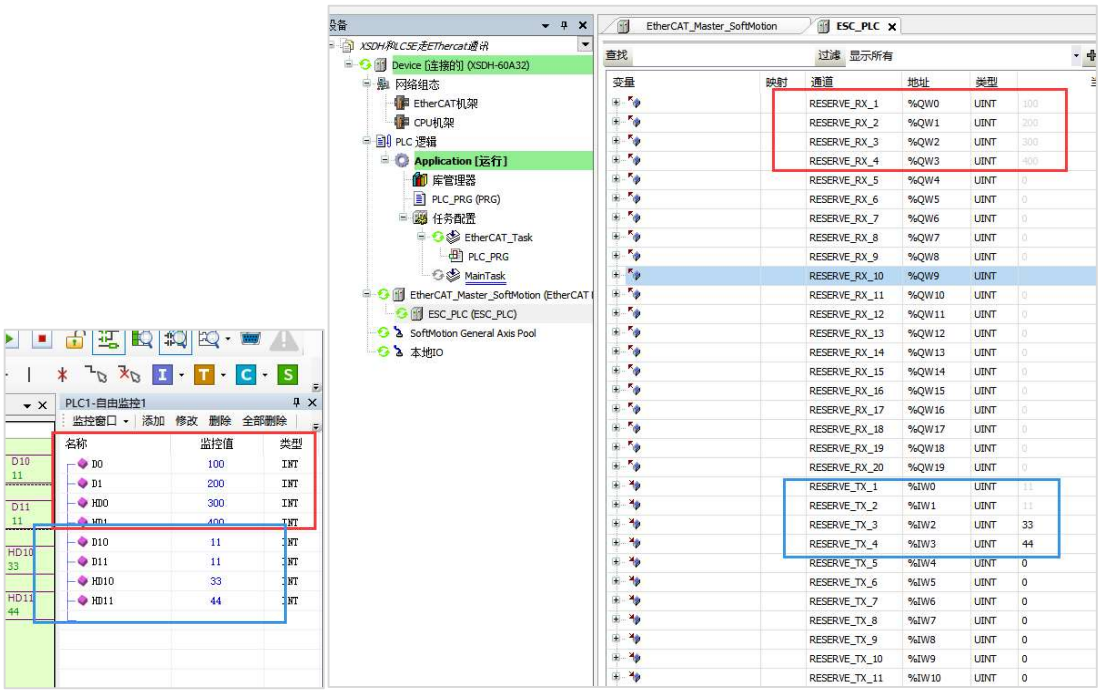


■ Communication results

Add D0 for free monitoring from the station D1, HD0, HD1. D10, D11, HD10, HD11.

The main station monitors the PDO parameters corresponding to # x1600 and # x1A00.

Write values 11, 11, 33, and 44 for the slave address, read by the master station (blue box), and write data 100, 200, 300, and 400 (red box) to the slave station.

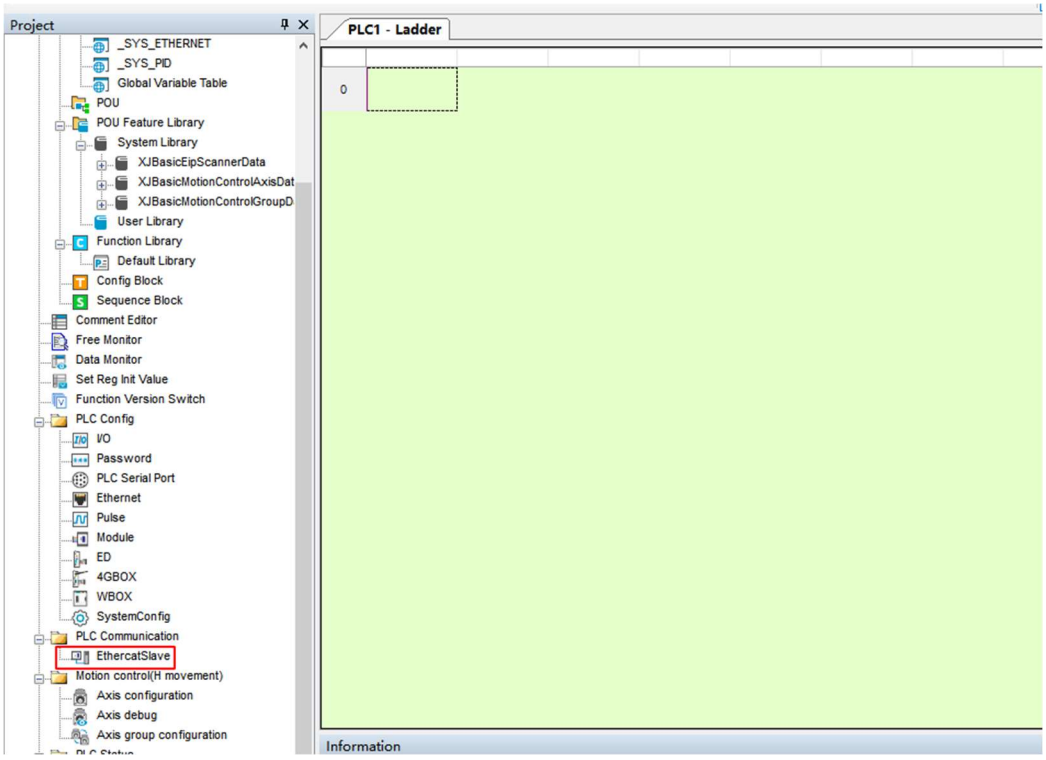


4.3.3 Case 3: Omron and LC5E Communication

Using Omron NX1P2 and LC5E-32T4 communication, transfer the data from LC5E-32T4 registers D0~D9 to NX1P2, and transfer the data from NX1P2 to LC5E-32T4 registers D100~D109.

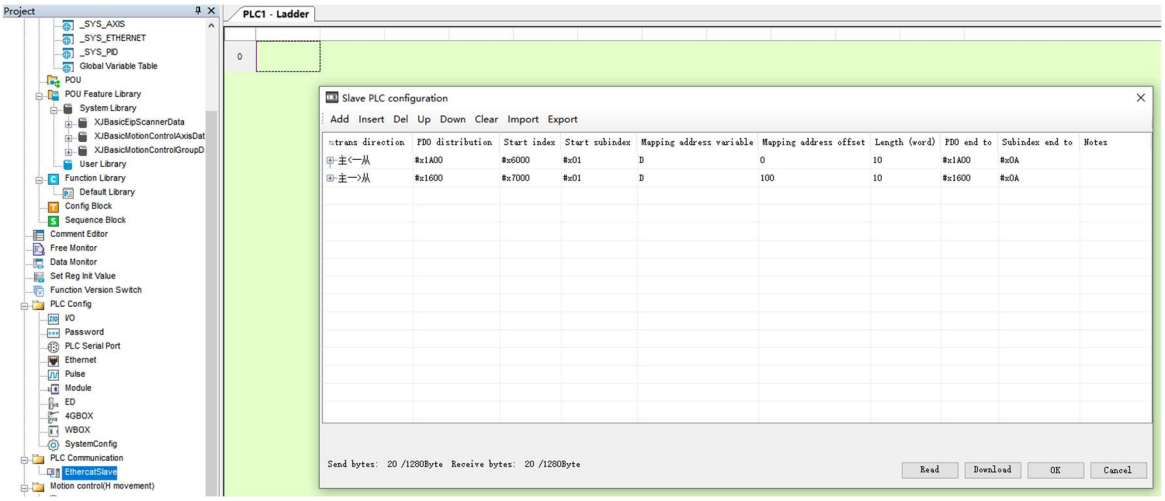
■ Slave station configuration

1. Open the upper computer software to connect LC5E-32T4. After successful connection, double-click "EtheccatSlave" in the PLC communication folder under the "Engineering" tree on the left to configure communication.



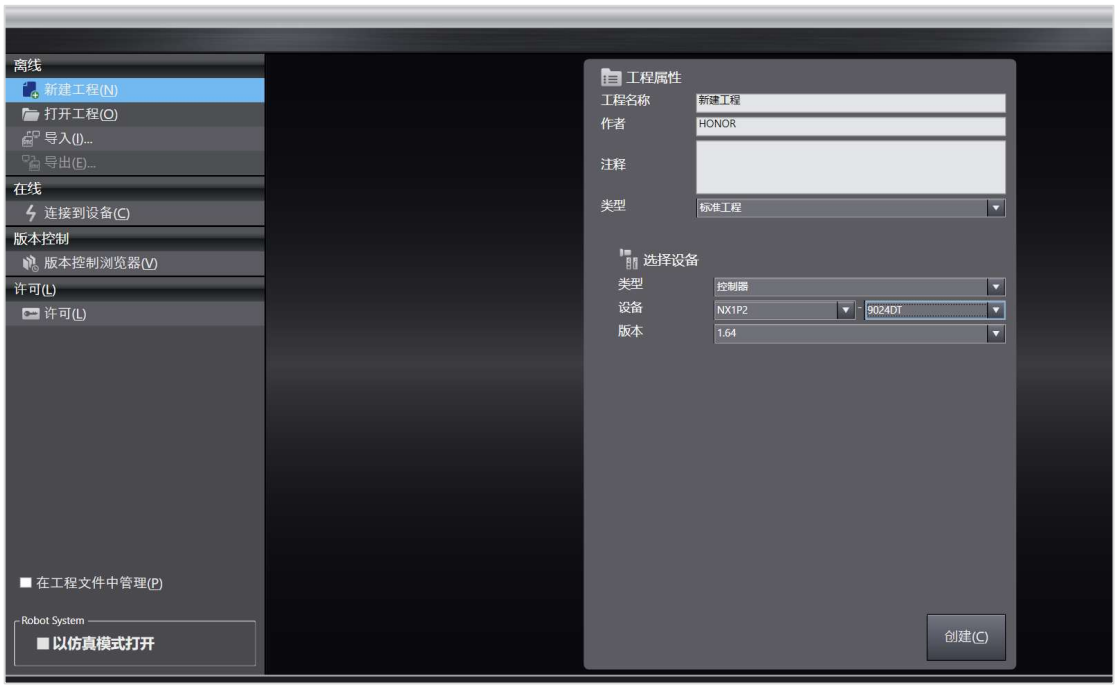
2. Configure data transmission in the slave PLC configuration interface, add the first data connection, select the "master<-- slave" direction for transmission, assign PDO to # x1A00, select sub index # x01, select D0 as the starting address, and have a length of 10. Add the second connection, select the "master -->slave"

direction for transmission, assign PDO to # x1600, select sub index # x01, select D100 as the starting address, with a length of 10, and click "configure download" after configuration is completed.

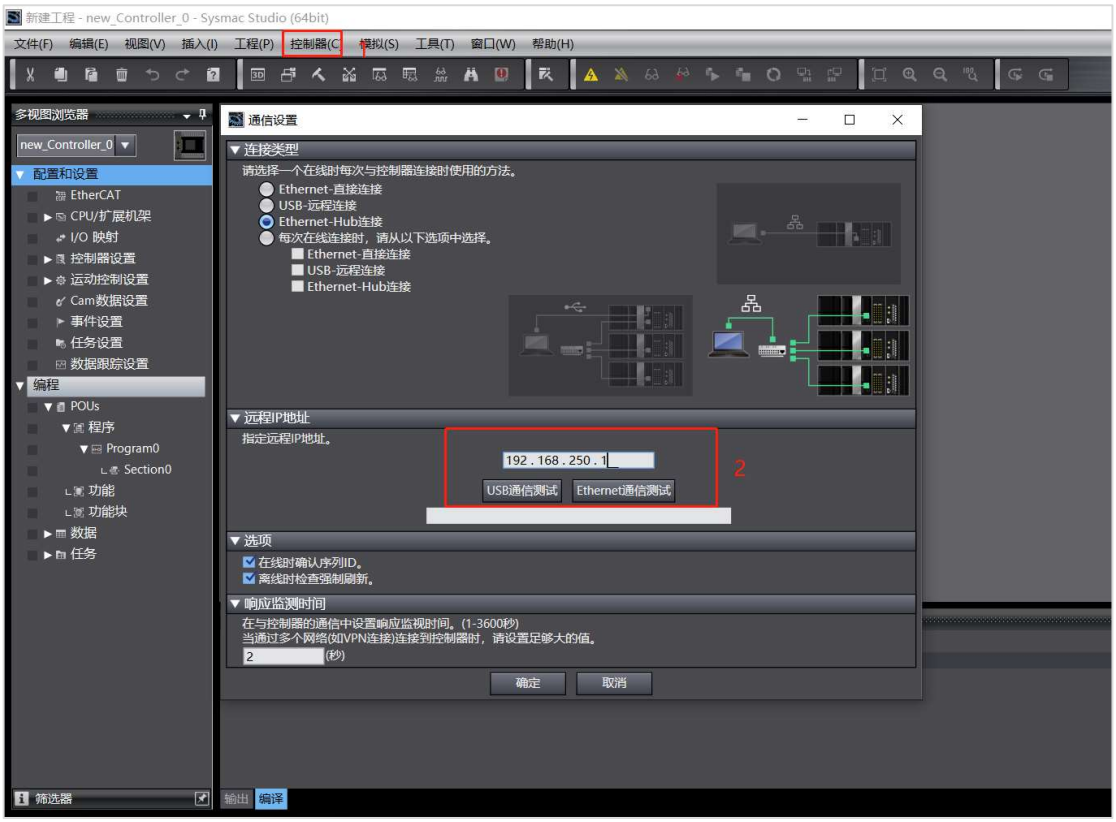


■ Main station configuration

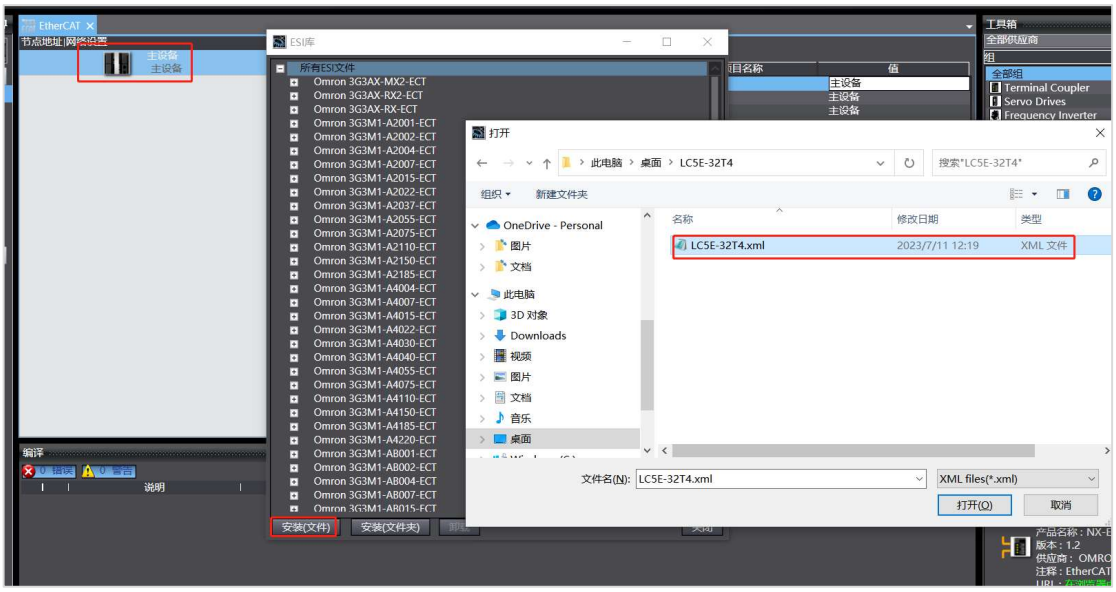
1. Open the Omron upper computer software, select the corresponding PLC model and version of Omron, and create the corresponding project.



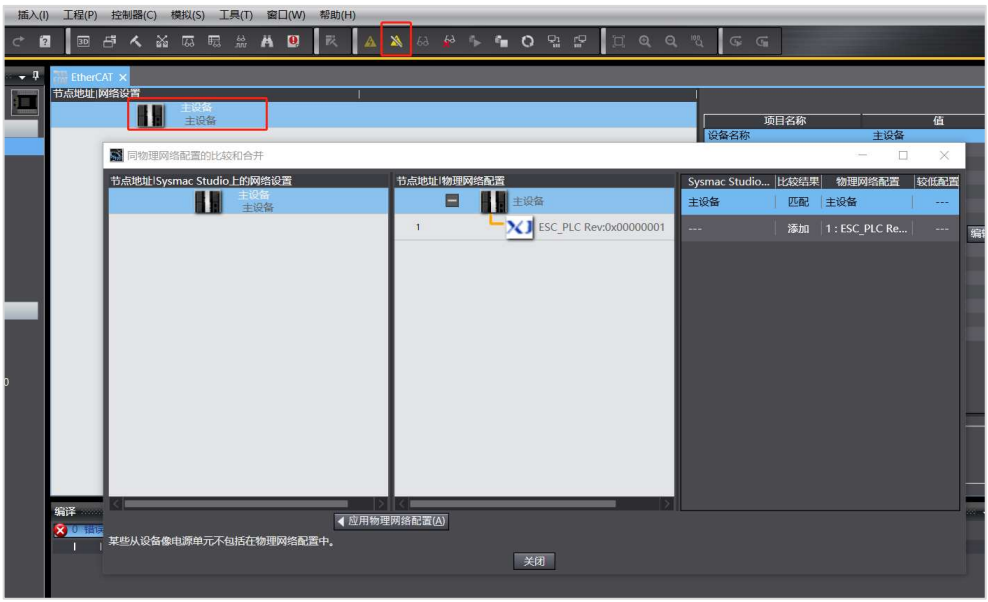
2. Click on "Communication Settings" under the "Controller (C)" tab, configure the PLC address, and establish a communication connection with the PLC.



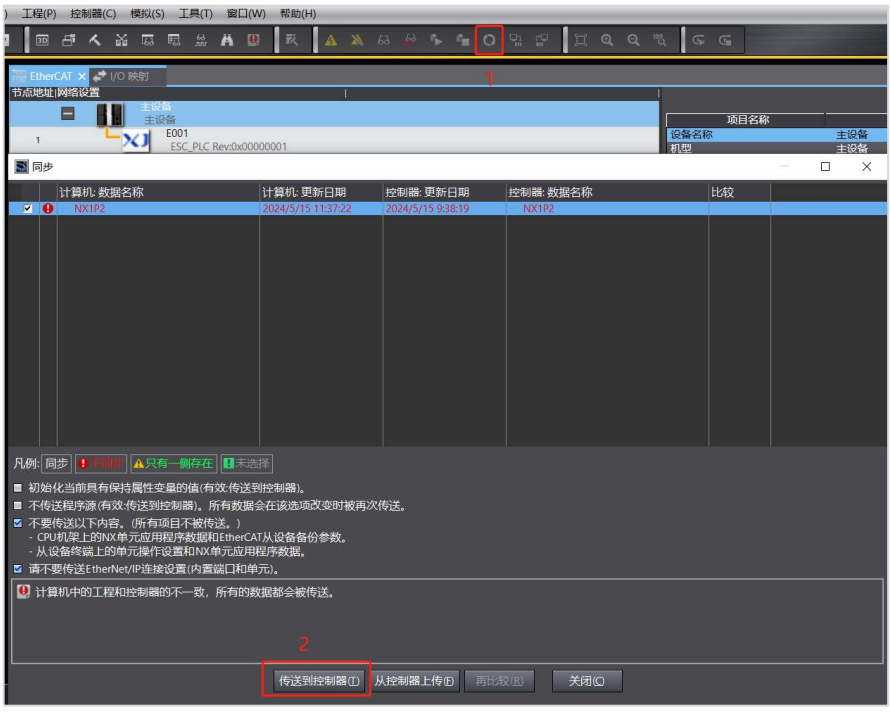
3. Click on Ethercat under "Configuration and Settings", right-click on the main device, select "Display ESI Library", click "Add" Install (File) ", and install the corresponding file for LC5E-32T4 Add an XML file.



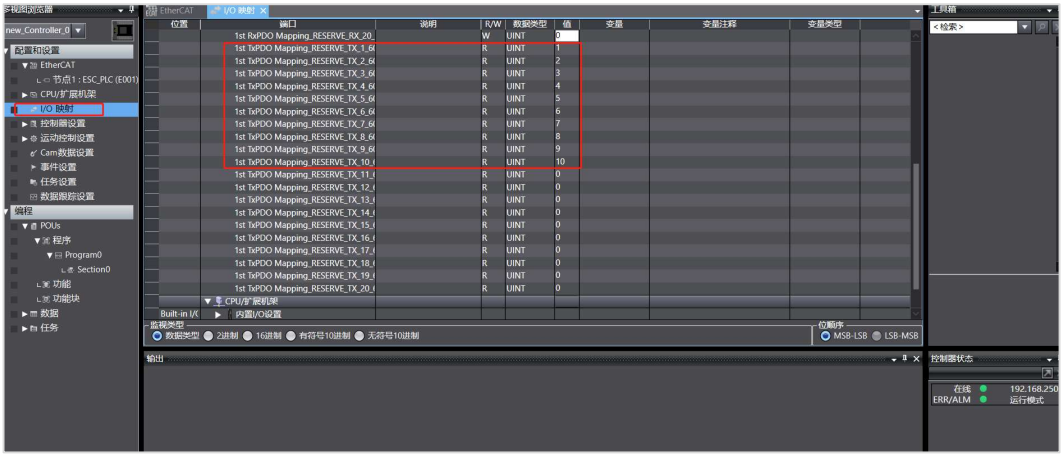
4. Place the PLC in the login state, right-click on the main device and select "Compare and Merge with Physical Network Configuration" to scan LC5E-32T4. Click "Apply Physical Network Configuration" to configure and apply the scanned devices.



5. After scanning the configuration, click "Sync" to download the configuration information or program to the PLC.



6. After downloading, click on I/O mapping to view and verify the transmitted data.



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