ESTUN ROBOTICS

Configuration Manual
For
ECAT Slave to ECAT Slave Gateway

GW-ECS256

RCS2 V1.00

ESTUN Automation Co., Ltd.
ESTUN Robotics Engineering Co., Ltd.

- This document is ISO compliant and will be updated in line with changes to the IPD system-

Revision History

S/N	Version	Revision Date	Content	Reviser
1	V1.00	2022.07.05	Create a new document	Liu Chongxiao
2				

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Preface

This Manual is applicable to control system **RCS2 V1.28.00** and provides instructions on the configuration and debugging methods of the EtherCAT Slave to EtherCAT Slave Gateway GW-ECS256 for ESTUN ER Series Robots.

Target Audience

This manual is intended for technical support personnel specifically working with ESTUN Robotics.

Precautions

- During the installation and debugging of these components, operators must strictly follow the instructions and explanations provided in this document.
- Relevant responsible personnel must ensure that the application or use of the products fulfils all safety requirements, including applicable laws, regulations, guidelines, and standards.
- While this document has been carefully prepared, the products described herein are subject to continuous updates and advancements. We may not always verify that the performance data, standards, or other characteristics described herein are consistent with the physical products after each update.
- Technical or editorial errors may occur in this document. We reserve the right to modify the document information without prior notice. If the data, diagrams and text descriptions in this document have not been modified for a product that has been changed, we will not make any specific statement to this effect.
- No modifications to the hardware or software configuration other than those specified in the text file are permitted, and ESTUN shall not be liable for any consequences resulting therefrom.
- The unit of measurement in the illustrations is in millimeters (mm) unless otherwise stated.

Safety Instructions

	Injury Failure to comply with the safety instructions associated with this symbol may jeopardize personal life and health safety.
	Danger to Environment and Equipment Failure to comply with the safety instructions associated with this symbol may pose significant risks to the environment and equipment safety.
	Notes or Tips This symbol indicates that the information is provided to help you better understand the Safety Instructions.

Chapter 1 Overview of Functions

The EtherCAT interface refers to a communication method where an external logic controller communicates with a robot using the standard EtherCAT protocol.

Chapter 2 Protocol Introduction

2.1 Introduction to EtherCAT

EtherCAT (Ethernet for Control Automation Technology) is a real-time industrial fieldbus communication protocol based on Ethernet architecture. It was introduced to the market in 2003, became an international standard in 2007, and became a Chinese national standard in 2014. EtherCAT has set new standards for system real-time performance and flexible topology.

2.2 EtherCAT Features

(1) Full compliance with Ethernet standards. EtherCAT is a modification of the traditional Ethernet protocol, allowing it to coexist with other Ethernet protocols on the same bus. Standard Ethernet devices, such as Ethernet cables, Ethernet cards, switches, routers, and more, can be used in EtherCAT networks. Additionally, any device with a standard Ethernet controller can act as an EtherCAT master, including PC computers and embedded devices with Ethernet controllers.

(2) Excellent performance. EtherCAT is based on Ethernet technology and achieves data transmission speeds of up to 100 Mbit/s, making it the fastest industrial Ethernet technology available. EtherCAT maximizes the utilization of Ethernet bandwidth for data transmission, with an effective data utilization rate of over 90%. Furthermore, EtherCAT exhibits high real-time performance in data frame processing, with data refresh cycles of less than 100 μs, meeting the demands of real-time applications. Additionally, EtherCAT uses high-precision distributed clocks to ensure synchronization accuracy among slave devices with a precision of less than 1 μs.

(3) Simplicity and cost-effectiveness. EtherCAT features a simple architecture without the need for switches or hubs. Both complex devices with advanced functionalities and simple I/O nodes can be used as EtherCAT slaves. Furthermore, EtherCAT has no limitations on network topology and supports various topologies such as line, star, and tree structures, as well as combinations of different topologies, enabling flexible device connections.

(4) Comparison with other real-time Ethernet technologies.

	EtherCAT	SERCOS III	PROFINET-IRT	PowerLink	EPA	Ethernet/IP
Management Organization	ETG	IGS	PNO	EPG	EPA Club	ODVA
Communication Structure	Master/Slave	Master/Slave	Master/Slave	Master/Slave	Client/Server	Client/Server
Transmission Mode	Full duplex	Full duplex	Half-duplex	Half-duplex	Full duplex	Full duplex
Real-Time Characteristics	100 axes, response time 100us	8 axes, response time 32.5us	100 axes, response time 1m	100 axes, response time 1ms		1-5ms
Topology Structure	Star, Line, Ring, Tree, Bus	Line, Ring	Star, Line	Star, Tree, Bus	Line, Star	Star, Tree
Synchronization Method	time slice +IEEE1588	Main node +Cycle time	Time slot scheduling + IEEE1588	time slice + IEEE1588	IEEE1588	IEEE1588
Synchronization Accuracy	100ns	<lus	lus	lus	500ns	lus

According to the comparative analysis, EtherCAT stands out in various aspects of real-time industrial Ethernet: it has extremely low cycle time, high synchronization, ease of use and cost-effectiveness. This makes it highly valuable in applications such as robot control and CNC machines.

2.3 Key indicators

1. The robot supports EtherCAT functionality, with communication data supporting 256 bytes for both input and output.
2. In the Sysmac Studio programming environment, users can configure relevant data to parse EtherCAT data and achieve data interaction.
3. The communication cycle is set by Omron PLC.
4. The device's EDS file is provided by the robot manufacturer.

2.4 Hardware environment

The required hardware modules are:

1. ERC30D Controller
2. Omron NJ101-9000
3. XB6-P2000HE
4. GW-ECS256LE EtherCAT
5. GW-ECS256RE EtherCAT

2.5 Function configuration

When the robot standard product is shipped, by default, only one Ethernet port supports EtherCAT functionality. The following configurations need to be performed:

1. System Configuration:

a) Move the controller's third or fourth network card from the Windows system to the INtime system;(Assuming the third network card is moved to the INtime system)

b) Configure the runtime package file rtk/eclr_config.ini with the relevant settings. Example:

```
[ECAT1]
EtherCATMasterEnable      = 1
LinkLayerType             = 1
MasterInstance            = 3
CycleTime                 = 1000
MasterPrioBase            = 45
DcmMode                   = 2
LicenseKey                =
```

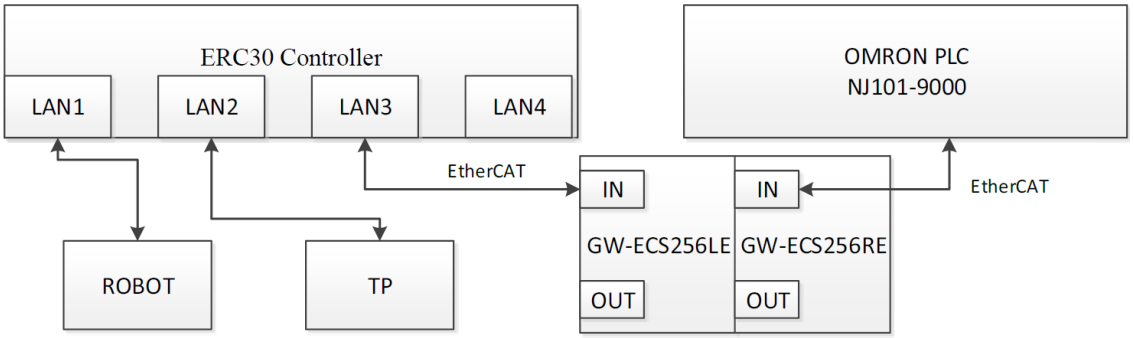
2. PLC Software:

In the Sysmac Studio project, configure the module as an EtherCAT slave. The corresponding PDO data will be used for EtherCAT communication. Parse this data to control the robot accordingly.

Chapter 3 Instructions for Debugging

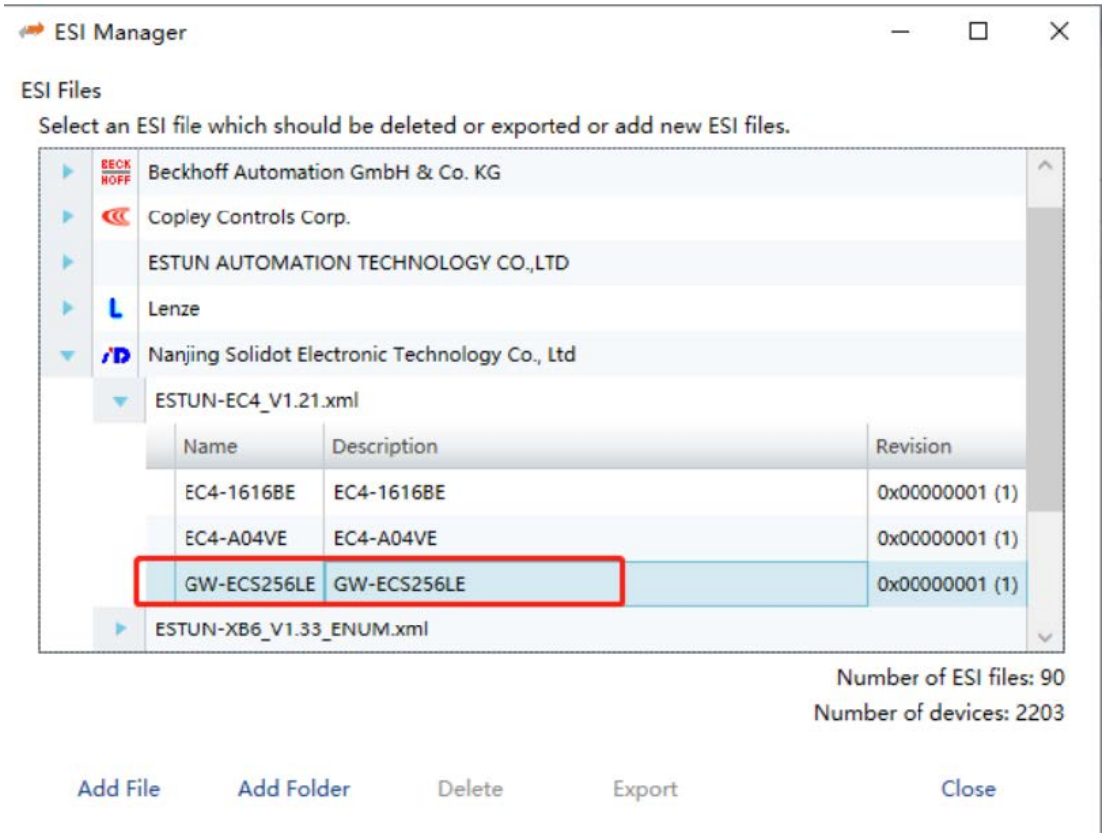
In this section, the hardware OMRON NJ101-9000 is used as an example to illustrate how to use the EtherCAT interface to interact with the robot.

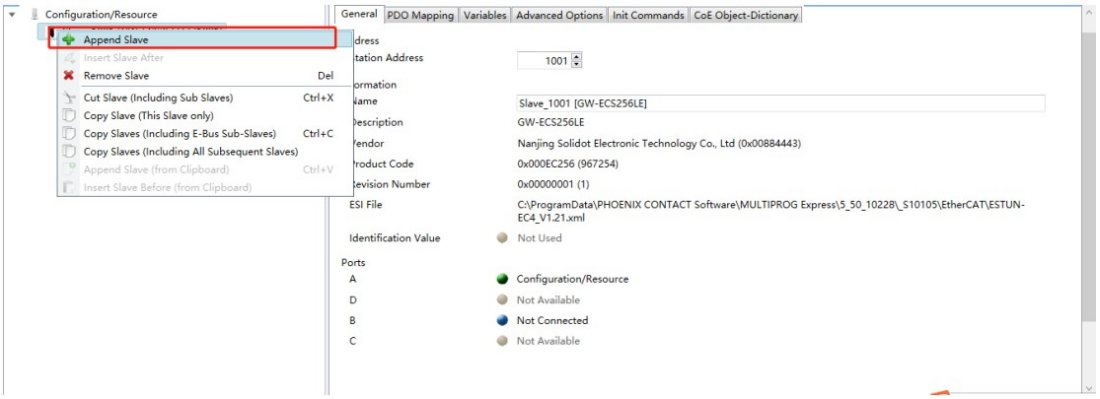
3.1 Hardware wiring diagram

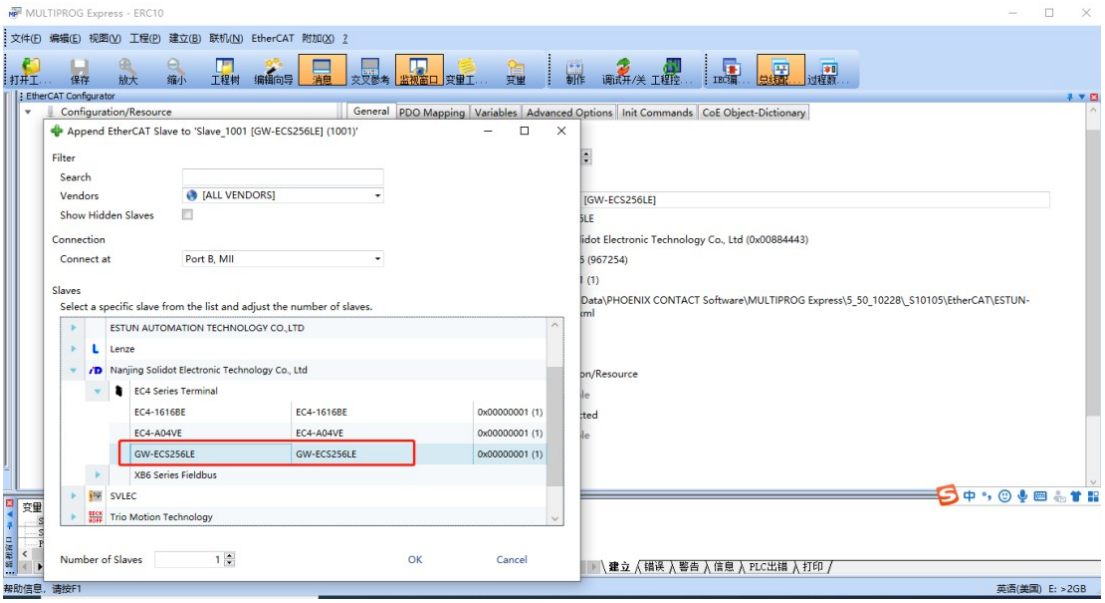


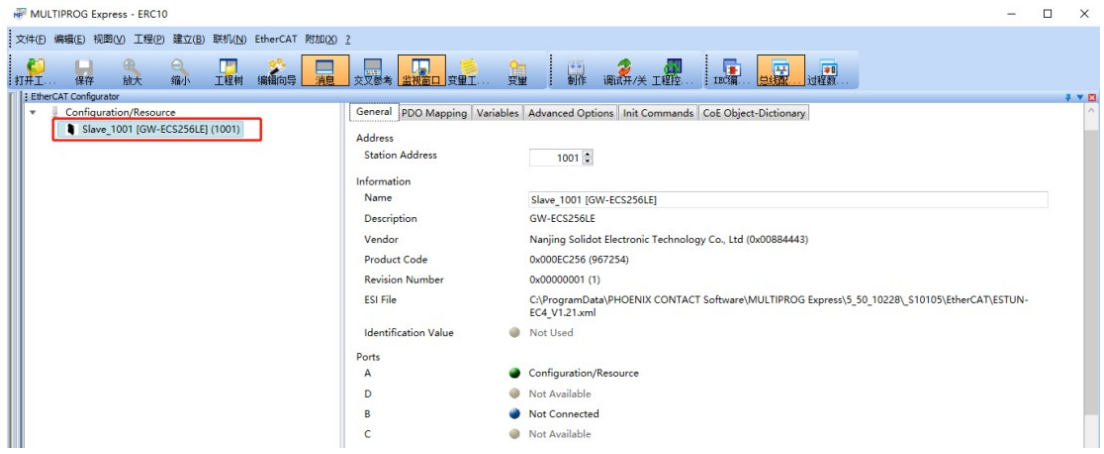
3.2 Multiprog configuration

1. Open the Multiprog project and perform the relevant configuration using the device description file.

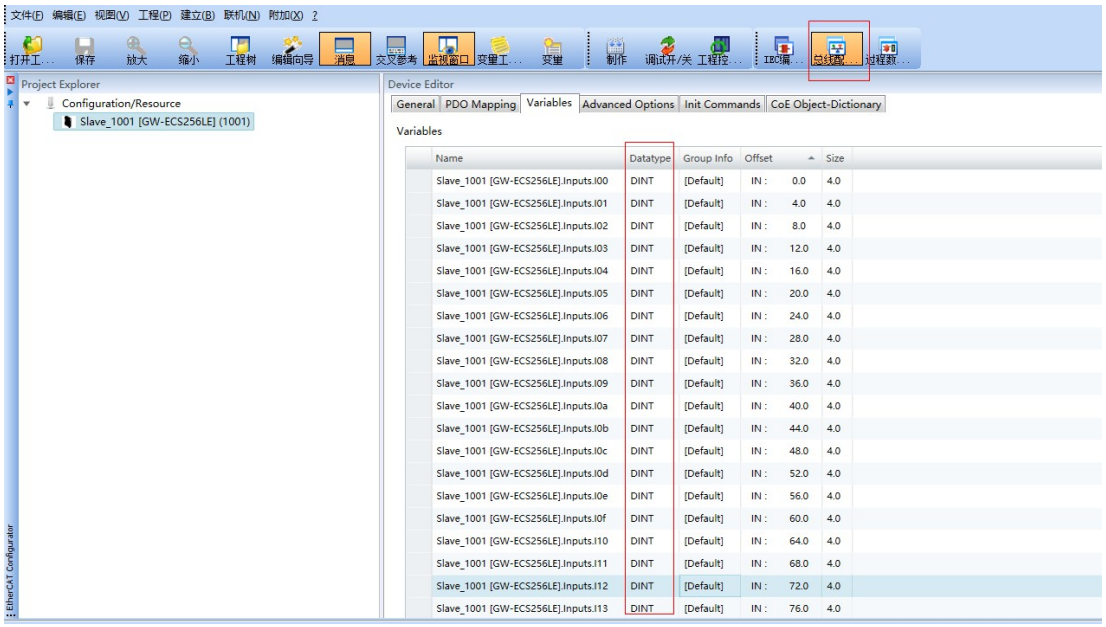




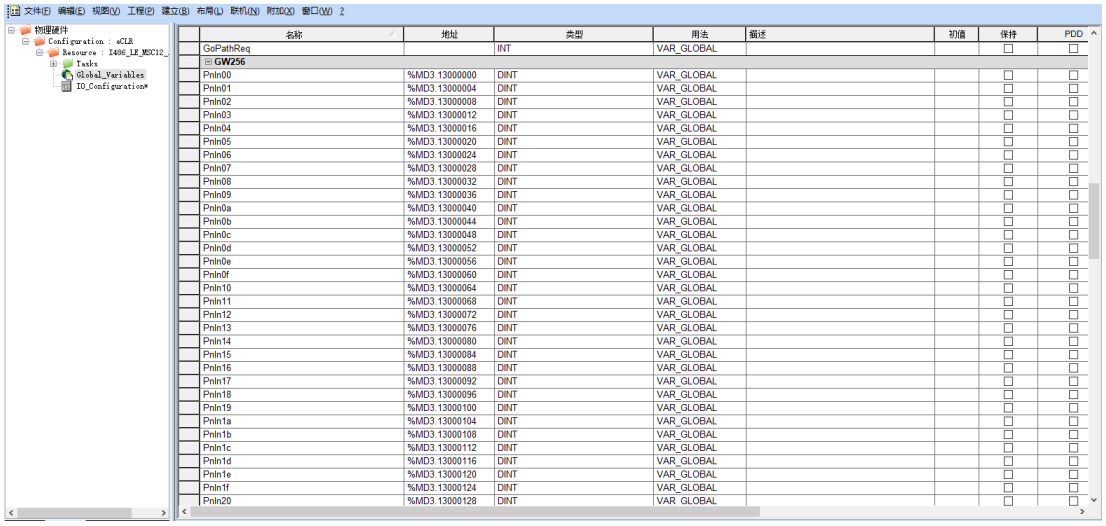




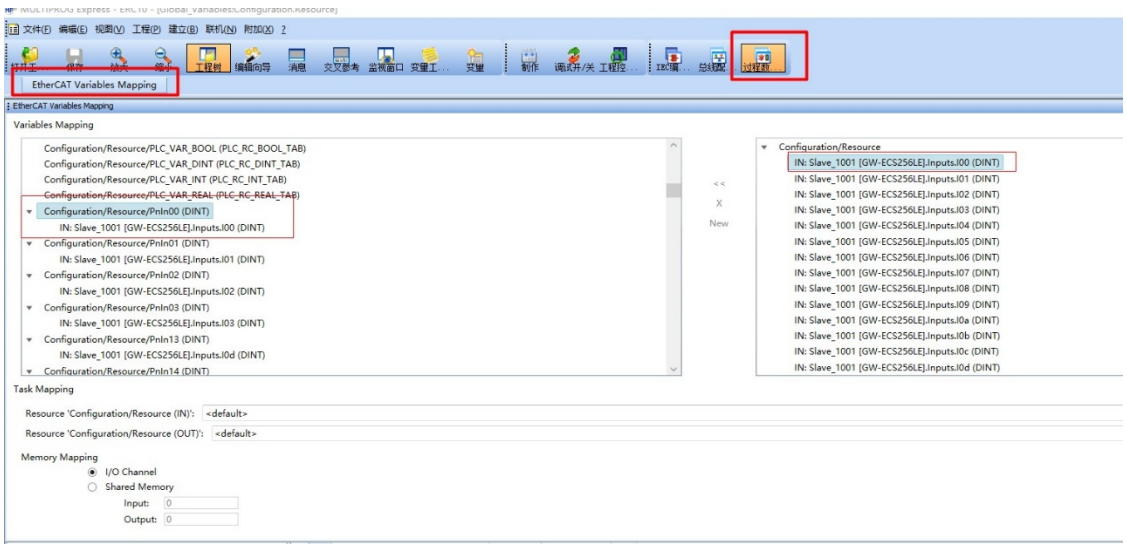
2. The GW-PNS256RE module's slave PDO data corresponds to a type length of 64 DINT.



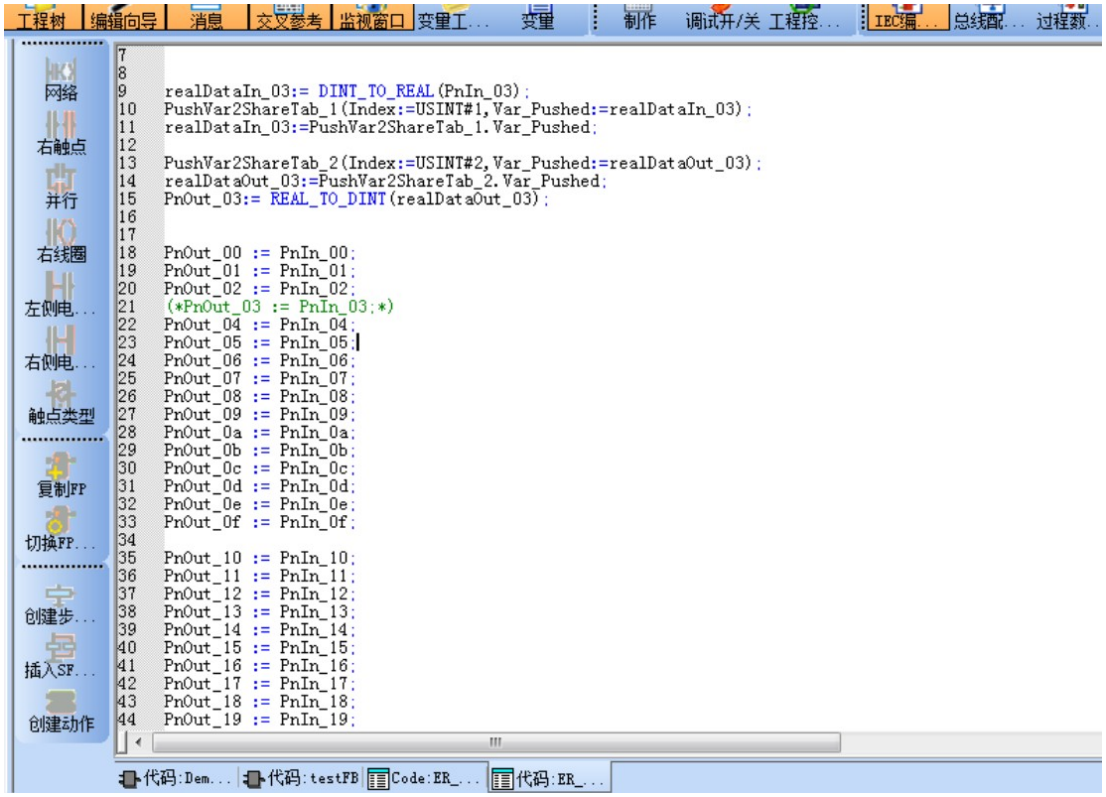
3. Create global variables and map them to the PDO data.



Click on the newly created global variable in "Variables Mapping" and double-click on the corresponding module variable in the right Configuration/Resource section. Repeat this process for all newly created global variables to complete the mapping.



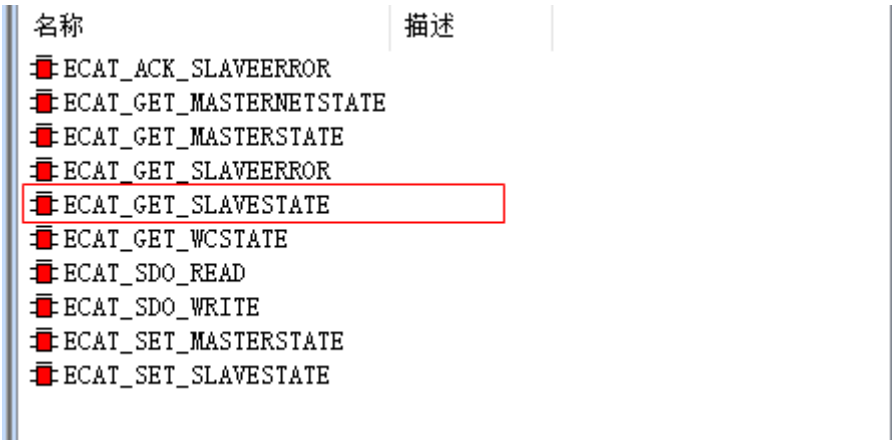
4. The PDO data of the module slave is the data transmitted via PROFINET. Users can write their own code to implement the required functionality (User Control Task or create a new Task). For example, assign the received data to the transmitted data and send a response. The process is shown in the following diagram.



5. Download the debugged project to the controller and monitor the data to observe if the communication is functioning correctly.

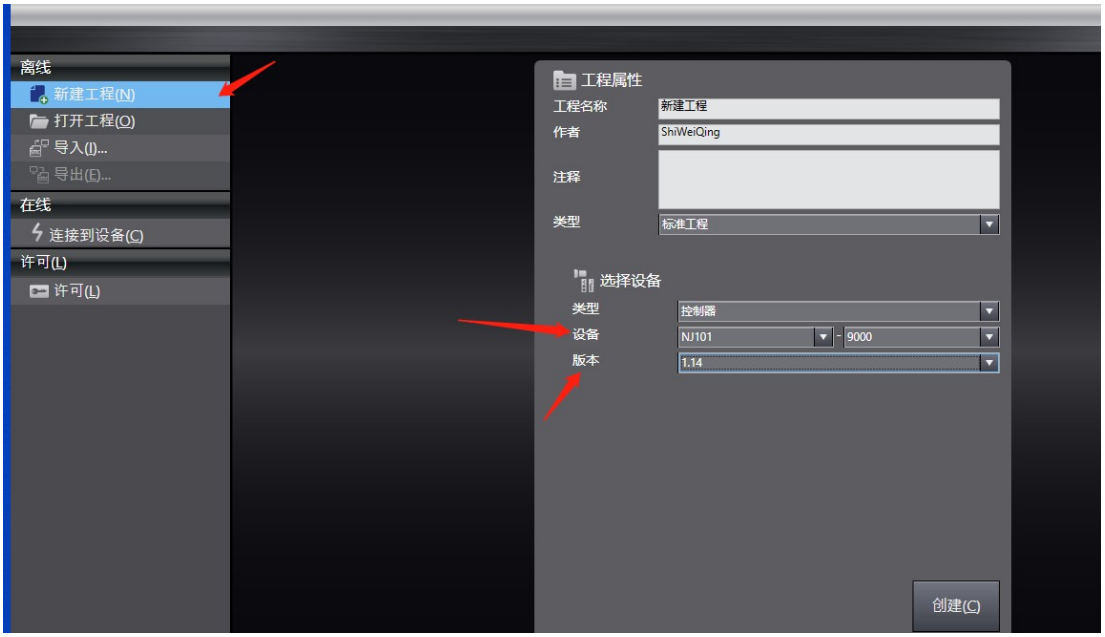
Note:

When LAN3 is used for ECAT communication, the system does not detect disconnection states. When writing programs, you can use the ECAT_GET_SLAVESTATE function block to check the connection status. If the return value is 8 during operation, it indicates an abnormality. You can define error handling in the PLC.



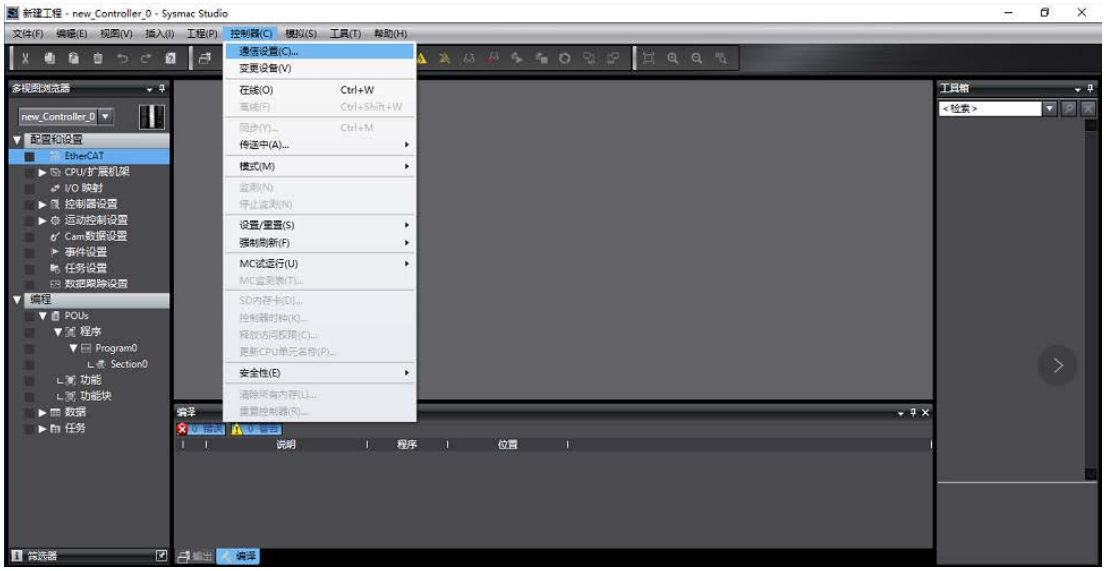
3.3 OMRON PLC configuration

1. Open OMRON's SysmacStudio software, create a new project, and add a device by selecting the corresponding PLC model and version.

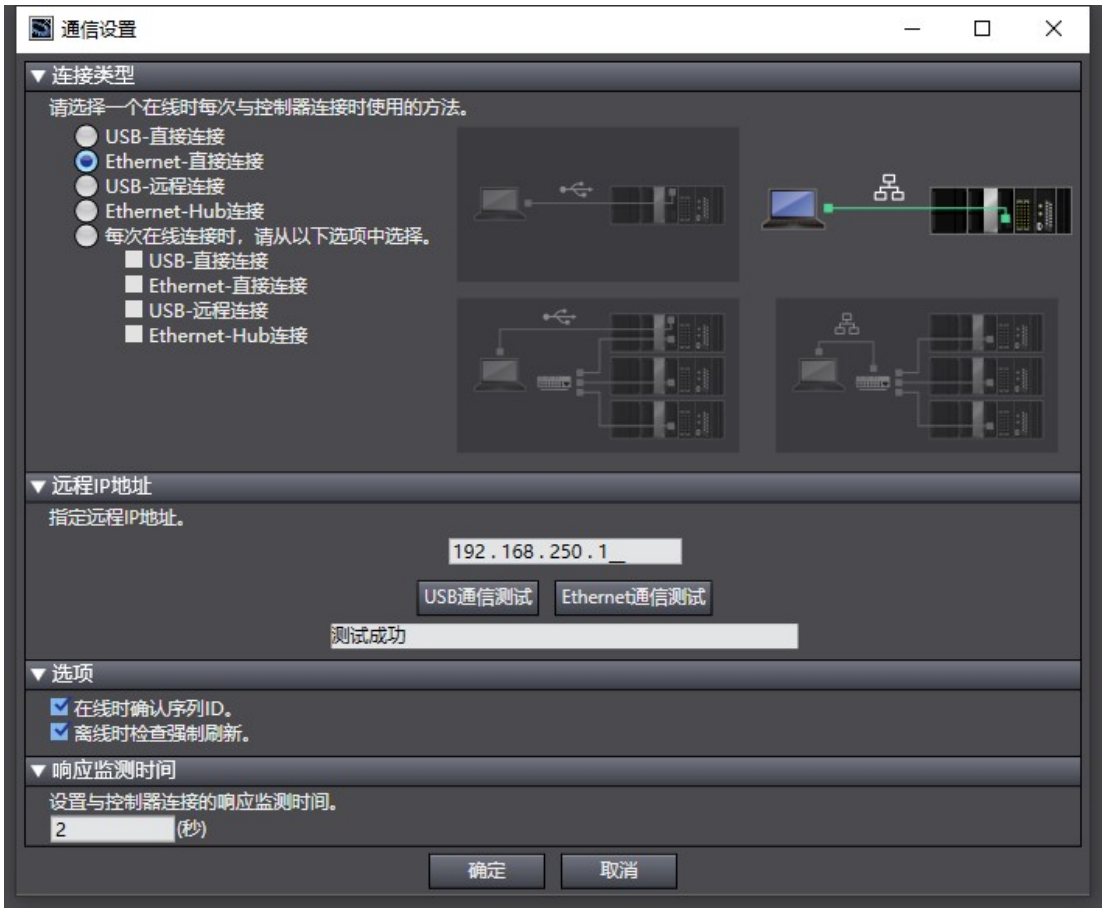


2. Connect to the PLC.

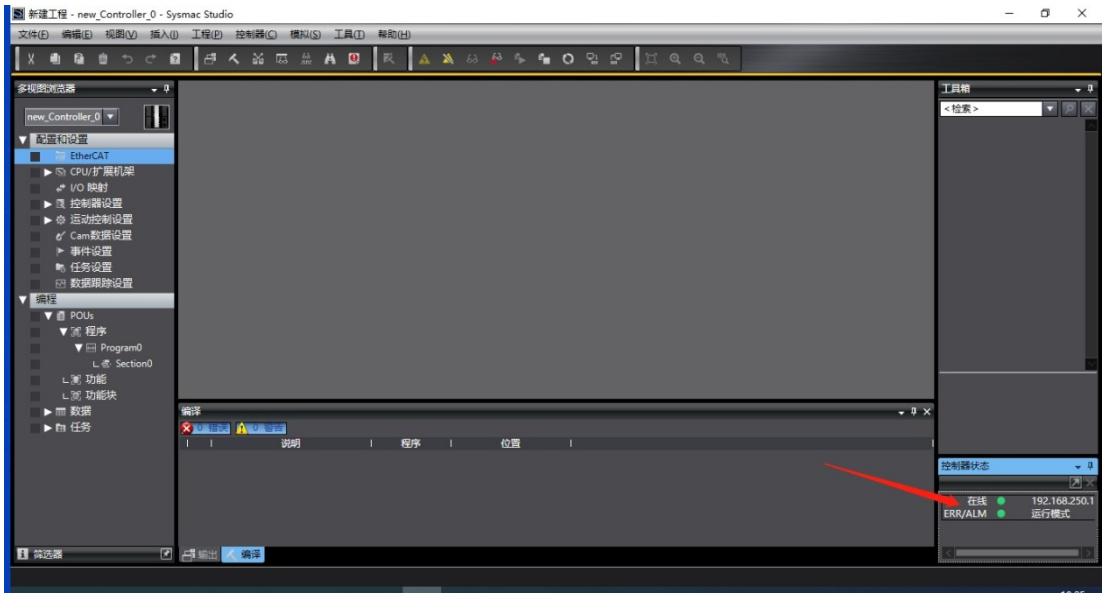
For this project, connect the laptop directly to the controller using an Ethernet connection. Follow these steps: Controller -> Communication Setup



Select Ethernet - Direct Connection. Use the default PLC IP address: 192.168.250.1. Click "Ethernet Communication Test" and confirm a successful test.

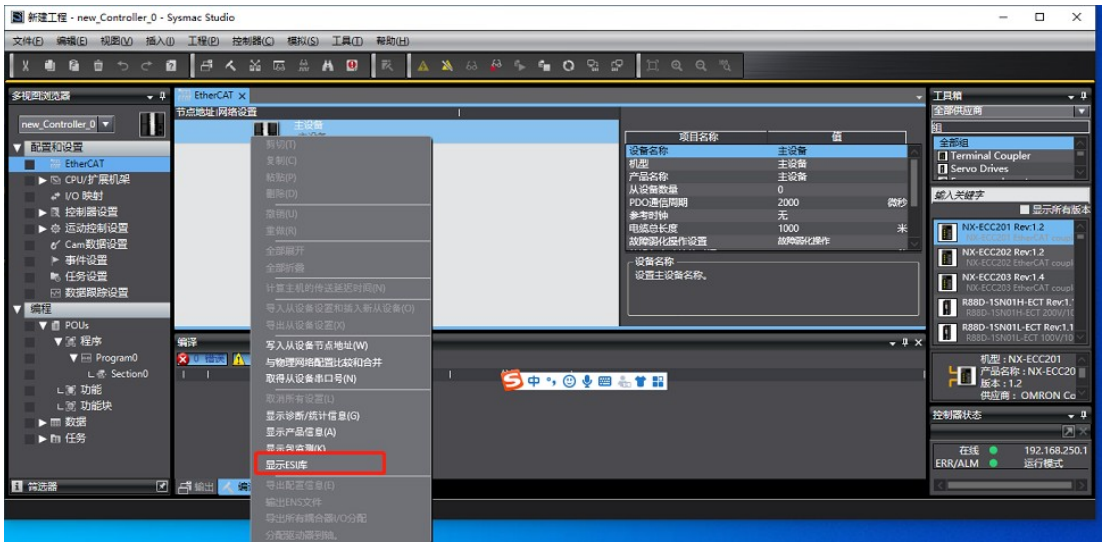


Click on the controller and select "Online." If both the "Online" and "ERR/ALM" indicators in the lower-right corner of the software are green, it means the connection is successful.

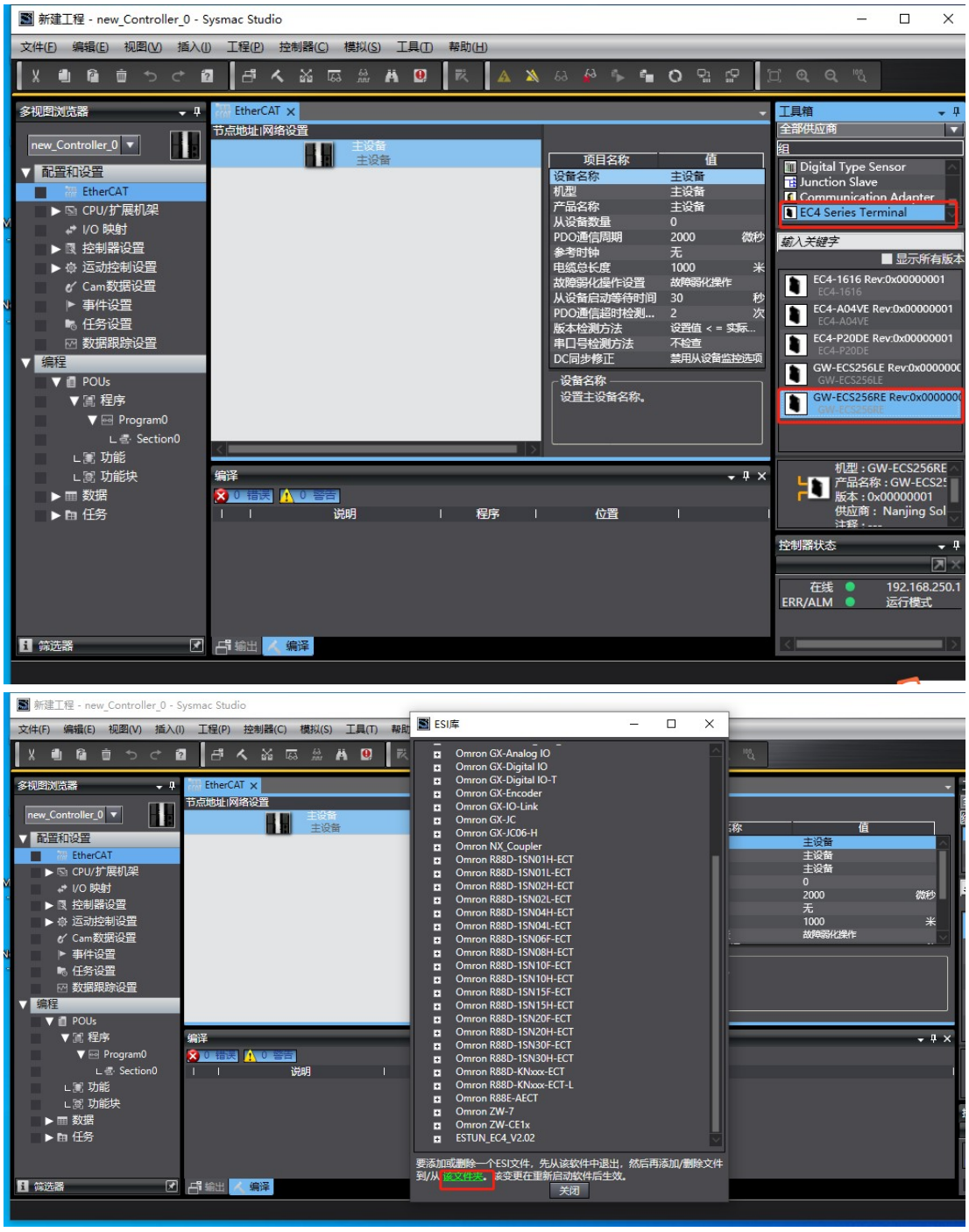


3. Add the device.

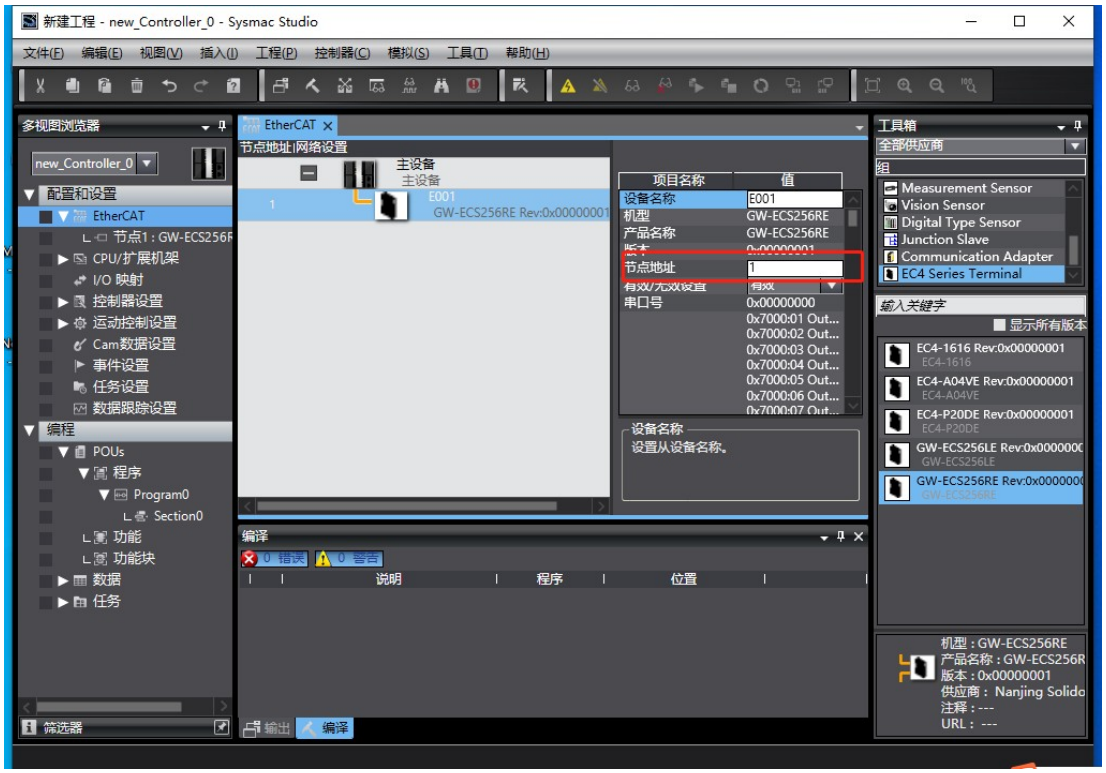
In the multi-view browser on the left side, find "Configuration and Settings" and double-click on "EtherCAT." Right-click on the master device and select "Show ESI Library."



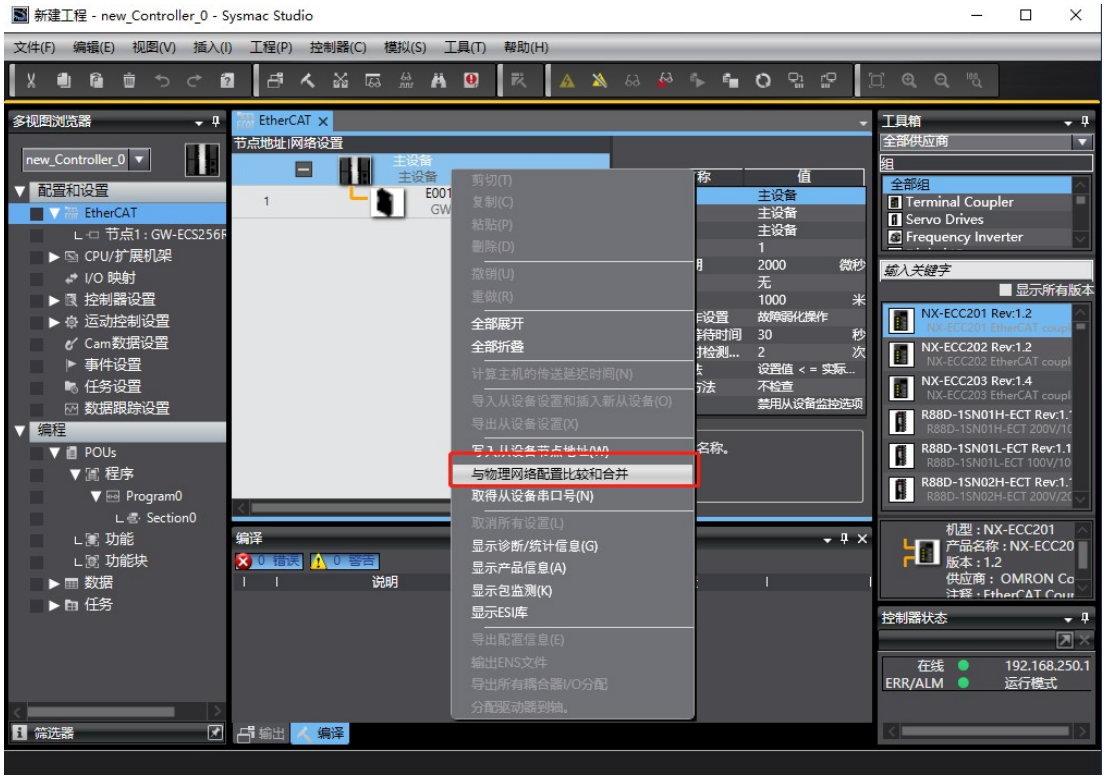
Select "This File" and place the device's XML file in the popped-up file path. After restarting the software, you will see the device ESTUN_EC4_V2.02.



In the vendor group, select "EC4 Series Terminal" and choose GW-ECS256RE. Drag this device under the master device. If you encounter issues while dragging, change the device status to offline mode before proceeding. Don't forget to add the node address. Once added, change the device status to online.

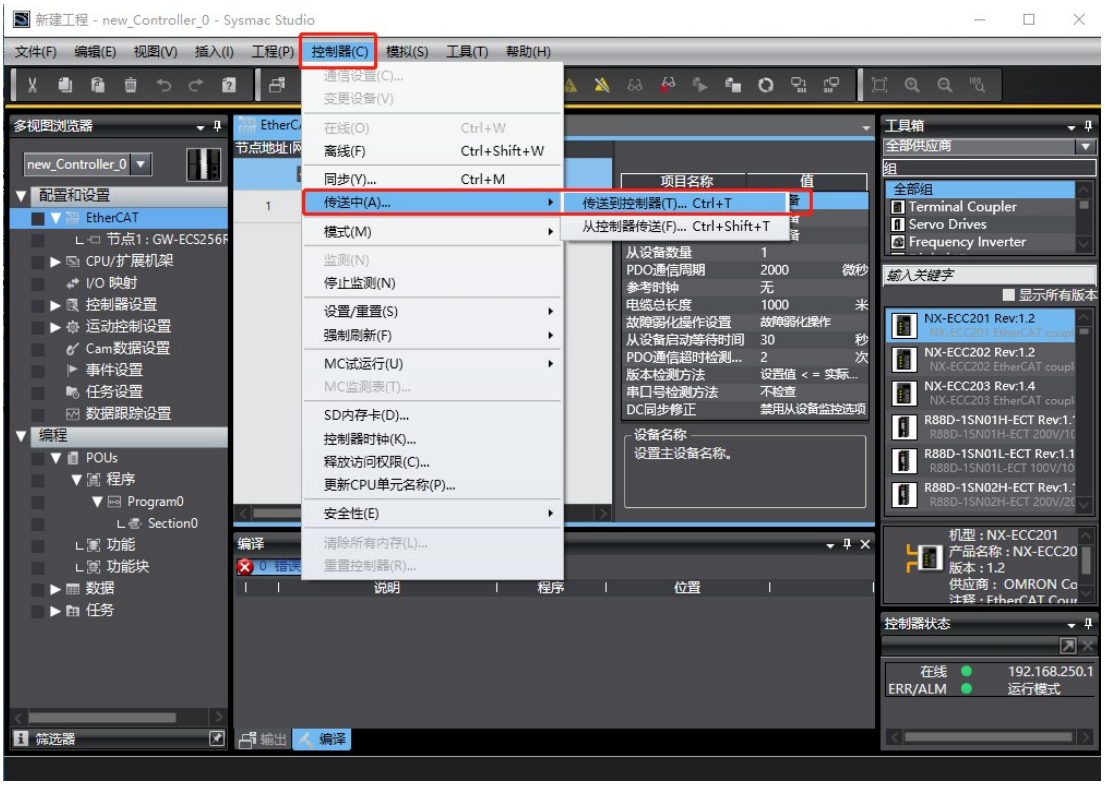


If an error occurs in the lower-right corner after changing to the online state, right-click on the master device, select "Compare and Merge with Physical Network Configuration", and click "Apply Physical Network Configuration.



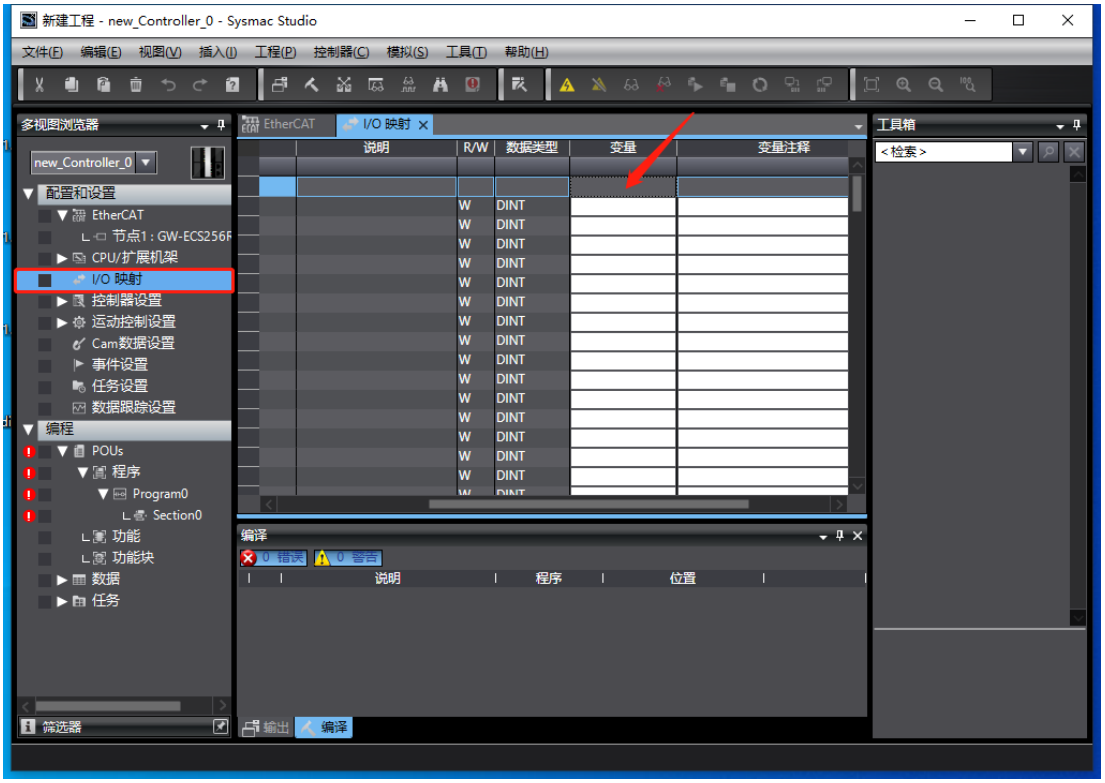
After powering off and restarting the slave station, download the program to the PLC by following these steps:

Click on the controller -> Transfer -> Transfer to Controller.

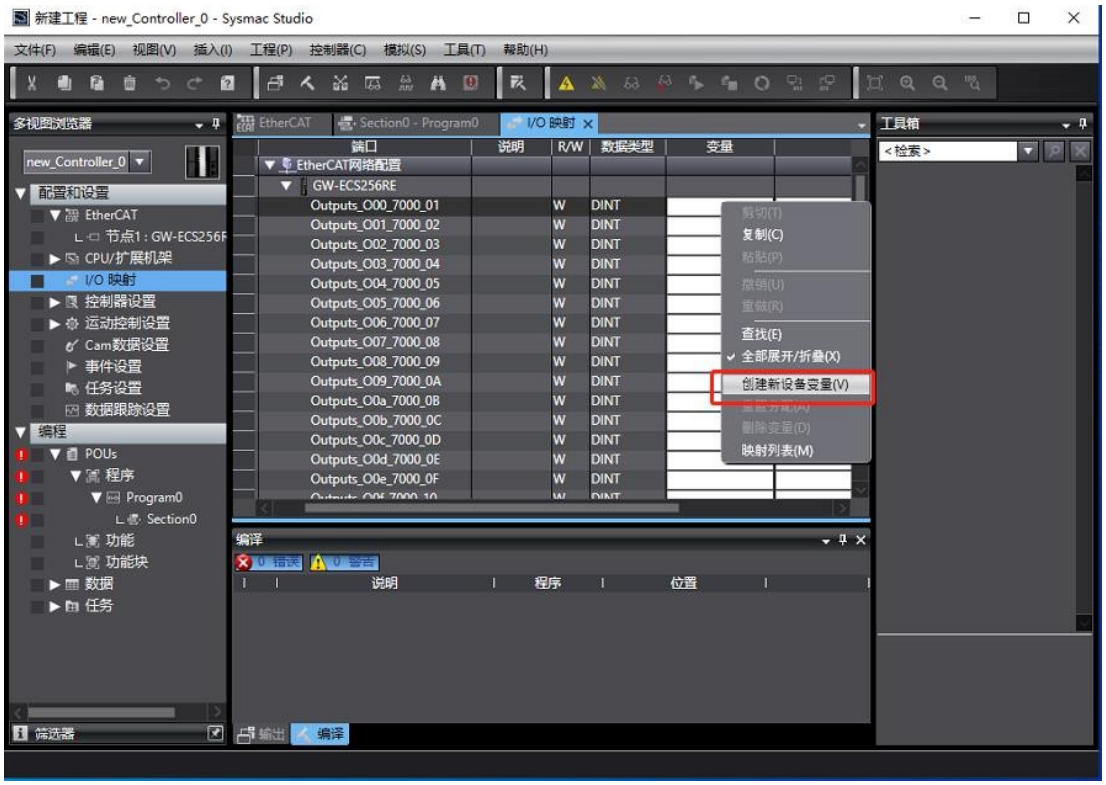


4. PDO I/O Mapping

Locate the "I/O Mapping" under the Configuration and Settings.



Right-click at the arrow and create a new device variable to complete the mapping for all variables.


新建工程 - new_Controller_0 - Sysmac Studio
文件(F) 编辑(E) 视图(V) 插入(I) 工程(P) 控制器(C) 模拟(S) 工具(T) 帮助(H)
多视图浏览器
new_Controller_0
配置和设置
EtherCAT
节点1 : GW-ECS256F
CPU/扩展机架
I/O 映射
控制器设置
运动控制设置
Cam数据设置
事件设置
任务设置
数据跟踪设置
编程
POUs
程序
Program0
Section0
功能
功能块
数据
任务
筛选器
EtherCAT
Section0 - Program0
I/O 映射
端口
说明
R/W
数据类型
变量
EtherCAT网络配置
GW-ECS256RE
Outputs_O00_7000_01 W DINT
Outputs_O01_7000_02 W DINT
Outputs_O02_7000_03 W DINT
Outputs_O03_7000_04 W DINT
Outputs_O04_7000_05 W DINT
Outputs_O05_7000_06 W DINT
Outputs_O06_7000_07 W DINT
Outputs_O07_7000_08 W DINT
Outputs_O08_7000_09 W DINT
Outputs_O09_7000_0A W DINT
Outputs_O0a_7000_0B W DINT
Outputs_O0b_7000_0C W DINT
Outputs_O0c_7000_0D W DINT
Outputs_O0d_7000_0E W DINT
Outputs_O0e_7000_0F W DINT
剪切(T)
复制(C)
粘贴(P)
撤销(U)
重做(R)
查找(E)
全部展开/折叠(X)
创建新设备变量(V)
删除变量(D)
映射列表(M)
编译
0 错误
0 警告
说明
程序
位置
输出
编译
工具箱
<检索>