ODOT

C3351 PLC

User Manual

03/2024

Legal Statement

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As part of a responsible, inclusive business, we will update content that includes non-inclusive terms. However, until we complete the update process, our content may still contain standardized industry terminology that our customers deem inappropriate.

Security Information

Important Information

Before attempting to install, operate, service, or maintain the equipment, please read the following instructions carefully and look to familiarize yourself with the equipment. Specific information described below may appear elsewhere in the text or on the device to alert the user to potential hazards, or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a DANGER or WARNING label indicates the presence of an electric shock hazard which, if instructions are not followed, will result in personal injury.

This is a symbol to remind you to be safe. Remind users of the possible danger of personal injury. Please follow all safety precautions with this symbol to avoid possible personal injury or even death.

⚠ DANGER

DANGER INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN SERIOUS INJURY OR DEATH.

⚠WARNING

WARNING INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN SERIOUS INJURY OR DEATH.

⚠CAUTION

CAUTION INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN MINOR OR MODERATE INJURY OR DEATH.

NOTICE

NOTICE INDICATES A HAZARD NOT RELATED TO PERSONAL INJURY.

Attention

Installation, operation, repair and maintenance of electrical equipment is restricted to qualified personnel only. Sichuan ODOT Automation System Co., Ltd. shall not be responsible for any consequences arising from the use of this user manual.

Qualified personnel are those who have the skills and knowledge related to the manufacturing and operation of electrical equipment and its installation, and who have been trained in safety to be able to detect and avoid related hazards.

Personnel Qualification

Only properly trained personnel who are familiar with and understand the contents of this manual and all other related product documentation are authorized to use this product.

Qualified personnel must be able to detect possible hazards arising from setting parameters and modifying parameter values, usually from mechanical, electrical or electronic equipment. Qualified personnel must be familiar with the various standards, rules and regulations aimed at preventing industrial accidents and must comply with them when designing and building systems.

Expected Usage

The products described or referred to in this document, together with their software, accessories and options, are expansion modules designed for industrial use and should be used in accordance with the relevant instructions, guide, examples and safety instructions in this document and other supporting documents.

This product must be used in compliance with all applicable safety laws and regulations, specified requirements and technical parameters. Due to planned application, you must perform a risk assessment before using this product. Appropriate safety-related measures must be taken based on the results of the evaluation.

Since this product should be used as an integral part of the entire machine or process, the safety of personnel must be ensured through the design of the entire system.

This product must be used with the specified cables and accessories. Please use only original spare parts and original replacement parts.

Any use other than that expressly permitted is prohibited as unintended hazards may result.

Network Safety Tips

A. Use controllers and devices only in protected environments to minimize network exposure and ensure inaccessibility from the outside.

B. Use a firewall to protect the control system network and separate it from other networks.

C. If remote access is required, please use a VPN (Virtual Private Network) tunnel.

D. Restrict access to development and control systems by physical means, operating system capabilities, etc.

E. Protect development and control systems with the latest virus detection solutions.

About this manual

Document Scope

This guide introduces the hardware implementation of C3351 programmable controller and CODESYS programming cases. It provides descriptions, characteristics, wiring diagrams and installation details for Modbus TCP and Modbus COM network adapters and Digital Input, Digital Output, Analog Input, Analog Output, and special modules.

Validity Statement

In accordance with our policy of continuous improvement, we will continue to revise the content of this manual to make it clearer and more accurate.

Sichuan ODOT Automation System Co., Ltd. reserves the right of final interpretation of this manual.

Product Information

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

·Disconnect power from all equipment (including connected equipment) before removing any covers, or installing or removing any accessories, hardware, cables, or wires, unless otherwise specified in the corresponding hardware guide for this equipment.

·As directed, at the appropriate place and time, it is important to always use a properly rated voltage sensing devices to detect if the power is off.

·Replace and secure all covers, accessories, hardware, cables and wires, and verify proper ground connection before powering on the device.

·When operating this equipment and related products, the specified voltage must be used.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

POSSIBLE EXPLOSION HAZARD

·Do not connect or disconnect equipment unless it is unplugged or the location is known to be non-hazardous.

·Use the USB port (if equipped) only if the work area is known to be non-hazardous.

Failure to follow the instructions will result in serious consequences such as personal injury or death.

⚠ WARNING

OUT OF CONTROL

· The designer of any control scheme must account for the possible failure of the control path and provide a means for certain critical control functions could be restored to a safe state during and after path failure. These critical control functions include emergency stop, over-travel stop, power-off restart, and similar safety measures.

·For critical control functions, separate or redundant control paths must be provided.

·System control paths may include communication links. Consideration must be given to the implications of unforeseen transmission delays or link failures.

·Comply with all accident prevention regulations and local safety guidelines.

·To guarantee proper operation, each implementation of the device must be fully tested individually before being placed into service.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Only use software approved by Sichuan ODOT Automation System Co., Ltd. for use with this equipment.

·Please update the application after every change to the physical hardware configuration.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Your risk assessment should include the possibility of a communication failure between the logic controller and any I/O expansion modules.

·If the I/O module output signal "maintain current value" does not meet your application requirements when the I/O expansion Bus error occurs, other solutions should be used to ensure that the application can cope with Bus error events.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

Table of contents

1 Product Overview

1.1 Introduction

The C3351 is the second edition PLC of Sichuan ODOT Automation System Co., Ltd. And the programming environment is CODESYS. It is a programmable system that follows the IEC61131-3 international standard. It supports five programming languages such as ladder diagram (LD), instruction list (IL), structured text (ST), function block diagram (CFC/FBD) and Sequential Function Chart (SFC). The PLC supports to mount 32 modules and user program storage supports 1Mbytes, and data storage supports 1Mbytes. With built-in standard serial communication RS485 interface and RJ45 interfaces, it makes C3351 to be a small PLC with rich functions.

The C3351 is the core component of the entire C series remote I/O system. Its main job is not only to execute the user's logic program, but also to send and receive all I/O data and process communication data. It has rich instructions, reliable functions, good adaptability, compact structure, easy expansion, cost-effective, strong versatility, and is very convenient for programming, monitoring, debugging, and on-site operation. The C3351 could be applied to a variety of automation systems.

The Ethernet interface on the CPU supports the Modbus TCP client function, supports the third-party Modbus TCP servers to access data, supports the Modbus TCP server function, and supports access to the data of the third-party Modbus TCP clients. And the RS485 interface of the CPU supports the Modbus RTU master and Modbus RTU slave function, and it supports third-party equipment to exchange data with PLC through the serial port.

The supported I/O expansion modules include:

A. Digital Input Module
B. Digital Output Module
C. Analog Input Module
D. Analog Output Module
E. Special Function Module

1.2 Version Information

The document has been modified as follows:

Date	Version No.	Modify Content	Author
2023/7/26	V1.00	Initial Version of the Sample PLC Manual	YS
2023/11/17	V2.00	Official User Manual	YS/DFL

1.3 Ownership Information

1.4 Disclaimer

This document is only used to assist readers in using the product, and Sichuan ODOT Automation System Co., Ltd. is not responsible for losses or errors caused by using the information in this document. The products and texts described in this document are under continuous development and improvement. Sichuan ODOT Automation System Co., Ltd. reserves the right to modify this document without notifying users.

1.5 Revision Notes

2023/6/30 Initial version is completed.

2023/11/17 Update the image and modify it to the official version

1.6 Software Download

Please log in to the official website of Sichuan ODOT Automation System Co., Ltd.: https: //www.odotautomation.com, and click to download on the corresponding product page.

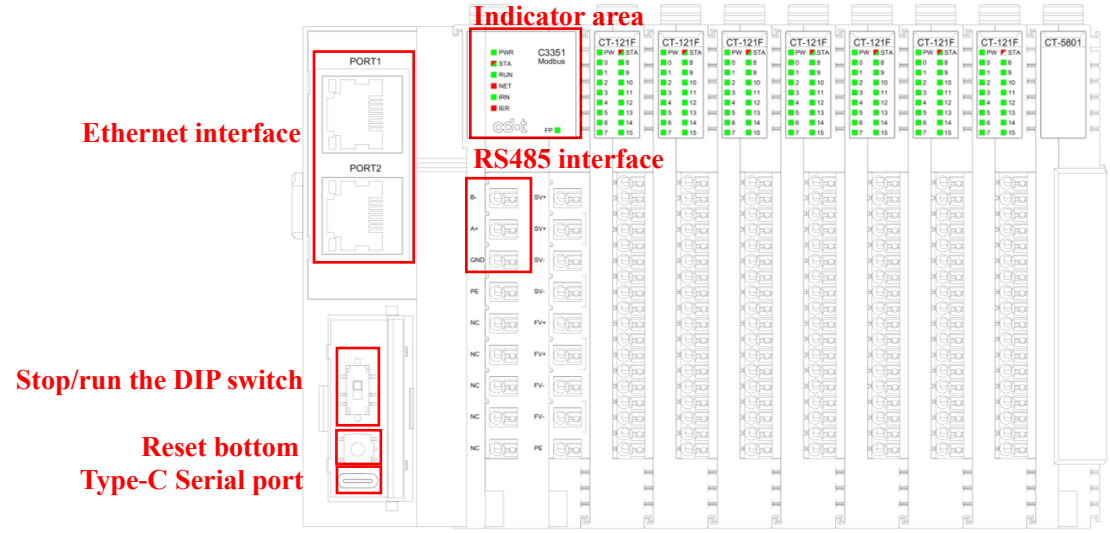
1.7 Selection Table

Serial No.	Model	Functional Description	Status
1	CT-1218	8 channels digital input PNP/24V Valid	Published
2	CT-1228	8 channels digital input / 24VDC/NPN	Published
3	CT-121F	16 channels digital input PNP/24V Valid / Sink	Published
4	CT-122F	16 channels digital input, NPN /0V Valid/ Source	Published
5	CT-124H	32 channels digital input, PNP/24V valid / Sink, NPN/0V valid/ Source	Published
6	CT-124D	32-channel digital input/24VDC/PNP or NPN	Published
7	CT-1314	CT-1314 4 channels digital input/220VAC	Published
8	CT-2218	8 channels digital output/24VDC/NPN	Published
9	CT-221F	16 channels digital output 0.5A/NPN/0V valid/Source	Published
10	CT-222F	16 channels digital output 0.5A/PNP/24V valid/Source	Published
11	CT-221H	32 channels digital output /24VDC/NPN	Published
12	CT-222H	32 channels digital output 0.5A/PNP/24V valid/Source	Published
13	CT-222D	32 channels digital output/24VDC/PNP	Published
14	CT-2224	4 channels digital output 2A/PNP/24V valid/Source	Published
15	CT-2228	8 channels digital output 0.5A/PNP/24V valid/Source	Published
16	CT-2718	8 channels relay output 1A/30VDC/30W	Published
17	CT-2738	8 channels relay output 1A/30VDC/30W	Published
18	CT-2754	4 channels relay output,3A/30VDC/90W	Published
19	CT-2794	4 channel relay output,2A/250VAC/500VA	Published
20	CT-3168	8 channels voltage input 0~5VDC/0~10VDC /±5VDC/±10VDC,15 bits	Published
21	CT-3234	4 channels analog input /0&4~20mA/ 15 bits, single-ended	Published
22	CT-3238	8 channels analog input /0&4~20mA/ 15 bits, single-ended	Published
23	CT-3258	8 channels analog input 0~ 20mA /-20~0mA /±20mA 12 bits, single-ended bipolar	Published
24	CT-3268	8 channels analog input /0 ~ 20mA or -20~0mA or ±20mA / 15 bits, single-ended bipolar	Published
25	CT-3713	3 channels thermal resistance input RTD-PT100	Published
26	CT-3734	4 channels thermal resistance RTD -PT100 temperature acquisition module, with isolation	Published
27	CT-3804	4 channels thermocouple input TC-J/K/ E/T/S/R/B/N type	Published

28	CT-3808	8 channels thermocouple input TC-J/K/ E/T/S/R/B/N type	Published
29	CT-3844	4 channels thermocouple input TC-J/K/ E/T/S/R/B/N type (filter adjustable)	Published
30	CT-3848	8 channels thermocouple input TC-J/K/ E/T/S/R/B/N type (filter adjustable)	Published
31	CT-4154	4 channels voltage output 0~5VDC/0~10VDC /±5VDC/±10VDC, 16 bits	Published
32	CT-4158	8 channels voltage output 0~5VDC/0~10VDC/±5VDC/±10VDC, 16 bits	Published
33	CT-4234	4 channels analog output 0&4~20mA/16 bits, single-ended	Published
34	CT-5102	2 channels encoder input 5VDC	Published
35	CT-5112	2 channels encoder input 24VDC	Published
36	CT-5122	2 channels encoder SSI input	Published
37	CT-5142	2 channels encoder differential input	Published
38	CT-5321	1 channel serial port module Modbus Master/Modbus Slave /Free Protocol	Published
39	CT-5331	CANopen Master module	Published
40	CT-5341	Profibus DP Master module	Published
41	CT-5711	Bus extension master module	Published
42	CT-5721	Bus extension slave module	Published
43	CT-5801	terminal module	Published
44	CT-623F	8 channels digital input PNP/24V valid/Sink, NPN/0V valid/Source 8 channels digital output 0.5A/PNP/24V valid/Source	Published
45	CT-7100	field Power Expansion Module 8A (no configuration required)	Published
46	CT-7220	power expansion module 5V/2A (no configuration required)	Published
47	CT-7221	Power Supply Extension Module 5V/2A	Published
48	CT-730F	18 channels field power distribution module (0Vdc)	Published
49	CT-731F	18 channels field power distribution module (24Vdc)	Published
50	CT-732F	18 channels field power distribution module (PE)	Published
51	CT-7339	18 channels field power distribution module (24Vdc/0Vdc)	Published
52	CT-7346	18 channels field power distribution module （24Vdc/0Vdc/PE）	Published

2 Module description

2.1 Device Preview



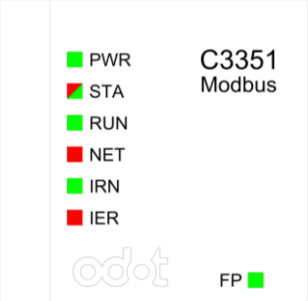
Reset Button: press and hold for 5s so it could to reset the C3351 to its initial state, including device configuration parameters, user program storage area, power-down storage area, etc. will be cleared or reset.

STOP/RUN DIP switch: Dial up and it will turn to RUN mode, then the RUN indicator will be green on, and it means the program is running; Dial down to STOP mode, then the RUN indicator will be off, and it means the program stops running. In addition, the indicator above the dip switch will be green on when it is dialed up, and the indicator below the DIP switch will be red on when it is dialed down.

Type-C serial port: This serial port is a device debugging port for development engineers only.

2.2 LED indicator

The user can easily check the power status, running status, Bus status, and I/O module status of C3351 through the LED status indicators.



PWR —— Power Status Indicator (Green):

On: The system power supply is normal.

Off: The system power supply is abnormal.

FP——**Power Status Indicator (Green):**

On: The field power supply is normal.

Off: The field power supply is abnormal.

STAT—— Module status indicator (Red/Green):

Red flashes twice: The module is abnormal and has been softly restarted.

Green on: Operating mode

Green single flash: Stop mode

Red and Green alternately flashing (slow): The current status is upgrade mode.

Red and Green alternately flashing (fast): Firmware upgrade in progress

RUN —— Device running indicator (Green):

On: The PLC is running.

Off: The PLC is not running.

NET —— Network Status Indicator (Green/Red):

Green on: The current module is consistent with the PLC configuration.

Red flash: The current module and PLC configuration are inconsisten.

Off: No error

IRN ——IO Running indicator (Green):

On: IO initialization is normal.

Off: IO initialization error

IER ——IO Error indicator (Red):

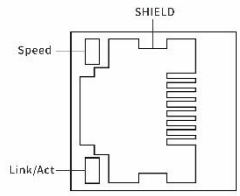
Off: IO communication is normal.

Flash twice: IO communication error

2.3 Interface introduction

2.3.1 Ethernet interface

Port1/Port2 support switch cascading function, 10Mbps/100Mbps adaptive rate.



Speed Network speed indicator (Green)

On: 100Mbps

Off: 10Mbps

Link/Act Link status indicator / Active indicator (orange)

On: Connected

Off: Not connected

Flashing: Active link

SHIELD RJ45 crystal head shield interface

RJ45 interface pin definition

Pin	Definition	Description
1	TD+	Transmitting +
2	TD-	Transmitting -
3	RD+	Receiving +
6	RD-	Receiving -

2.3.2 485 interface

RS485 terminal adopts the top 4 pins of the terminal, which are defined as follows:

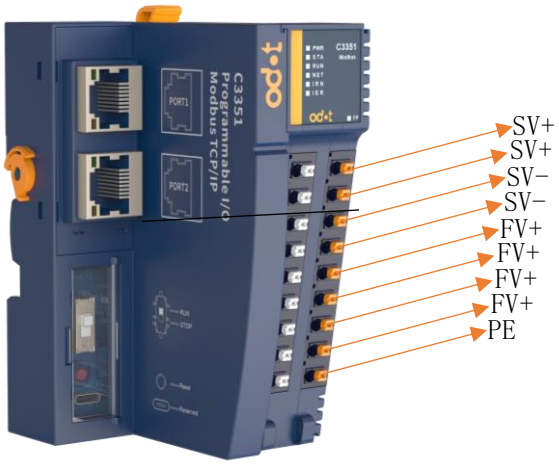
Pin	Definition	Description
1	B-	RS485 B-
2	A+	RS485 A+
3	GND	Signal ground
4	PE	Protective Earth

⚠ WARNING
UNEXPECTED EQUIPMENT OPERATION ·Connecting the RS485 interface to a voltage exceeding the rated voltage will cause permanent damage, and the rated voltage is DC ±5V. **Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.**

2.3.3 Power interface

The CP-PW03 module is used for power supply, and the module pins are defined as follows:

Pin	Definition	Description
1	SV+	System power supply positive
2	SV+	System power supply positive
3	SV-	System power supply negative
4	SV-	System power supply negative
5	FV+	Field power supply positive
6	FV+	Field power supply positive
7	FV-	Field power supply negative
8	FV-	Field power supply negative
9	PE	Protective Earth



2.4 C3351 Installation

2.4.1 Installation and maintenance requirements

The use and application of the information contained in this chapter requires expertise in the design and programming of automatic control systems. Only the user, machine builder or integrator can clearly understand the various situations and factors that may arise during installation and set-up, operation and maintenance, and therefore can determine the effective and correct use of automation and associated equipment, related safety devices and interlocks equipment. When selecting automation and control equipment and any other related equipment or software for a particular application, all applicable local, regional or national standards and/or regulations must also be considered.

In particular, observe any safety information, different electrical requirements and regulatory standards applicable to the machine or the use of the equipment.

2.4.2 Power cut off

Before installing the control system on the DIN Rail, mounting plate or panel, all options and modules should be assembled; when disassembling, first remove the control system from the DIN Rail, mounting plate or panel, and then remove the equipment.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

·Disconnect power from all equipment (including connected equipment) before removing any covers, or installing or removing any accessories, hardware, cables, or wires, unless otherwise specified in the corresponding hardware guide for this equipment.

·As directed, at the appropriate place and time, it is important to always use a properly rated voltage sensing devices to detect if the power is off.

·Replace and secure all covers, accessories, hardware, cables and wires, and verify proper ground connection before powering on the device. When operating this equipment and related products, the specified voltage must be used.

·When operating this equipment and related products, the specified voltage must be used.

Failure to follow the instructions will result in serious consequences such as personal injury or death.

2.4.3 Environmental Specification

All expansion module components must be electrically isolated between the internal circuitry and the input/output channels, and the device is intended for use in a pollution degree 2 industrial environment.

⚠ WARNING

Unexpected equipment operation

·Do not exceed any ratings specified in the Environmental and Electrical Characteristics Table.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.4.4 Programming Notes

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Only use software approved by Sichuan ODOT Automation System Co., Ltd. for use with this equipment.

·Please update the application after every change to the physical hardware configuration.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.4.5 Operating Environment

In addition to the environmental characteristics, please refer to the product-related information at the beginning of this document for important information about installing this specific equipment in hazardous locations.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·The modules are not suitable for use in harsh environments, such as environments with corrosive gases or salt spray.

·Install and operate this equipment in accordance with the conditions described in "Environmental Characteristics".

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.4.6 Installation Precautions

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Use appropriate safety interlocks in situations where there may be a risk of personal injury and/or equipment damage.

·Install and operate the equipment in an enclosure that is locked by a key locking device and complies with the level of the environment in which the equipment operates.

·Use the sensor and actuator power supply only for powering the sensors or actuators connected to the module.

·Wiring and output circuits must be wired and fused in accordance with local and national regulations for specific equipment rated amperage and voltage.

·Do not use this device in a safety-critical machine environment unless it is designated as a functional safety device and complies with applicable regulations and standards.

·Do not disassemble, repair or modify this equipment.

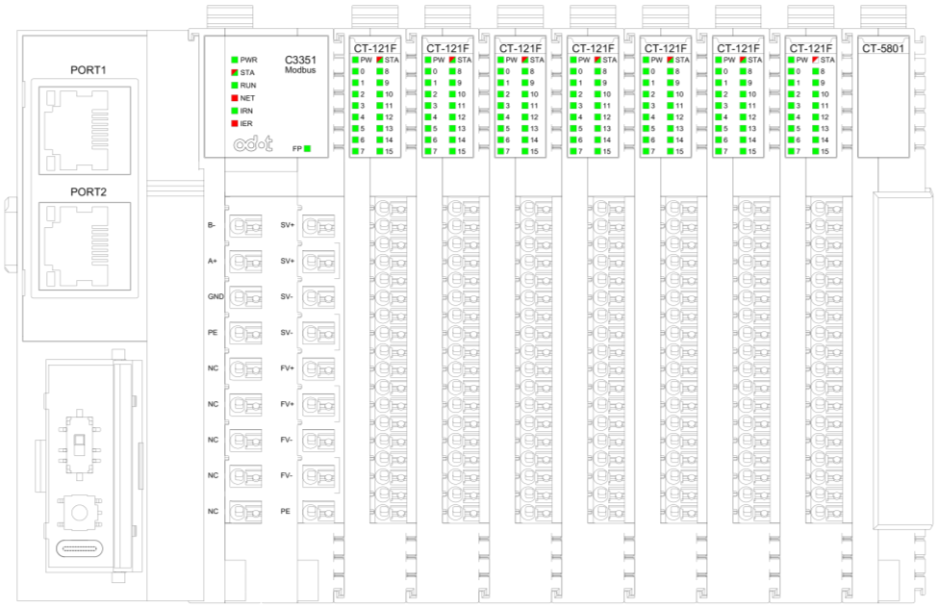
·Do not connect any lines to reserved unused connection points, or connection points indicated as No Connection (NC).

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.4.7 Installation Guide

The remote I/O module can be mounted on a 35mm DIN rail.

The C3351 device is installed on the far left, followed by the other I/O modules (including digital input/output modules, analog input/output modules, and special function modules), and the terminal module is installed on the far right.



NOTICE

DEVICE INOPERABLE

·The installation position of the I/O module in the middle is not fixed. According to the layout position needed by customer, after the actual project confirms the installation position, it is not allowed to move the position of the I/O module.

·Each station needs to add terminal modules.

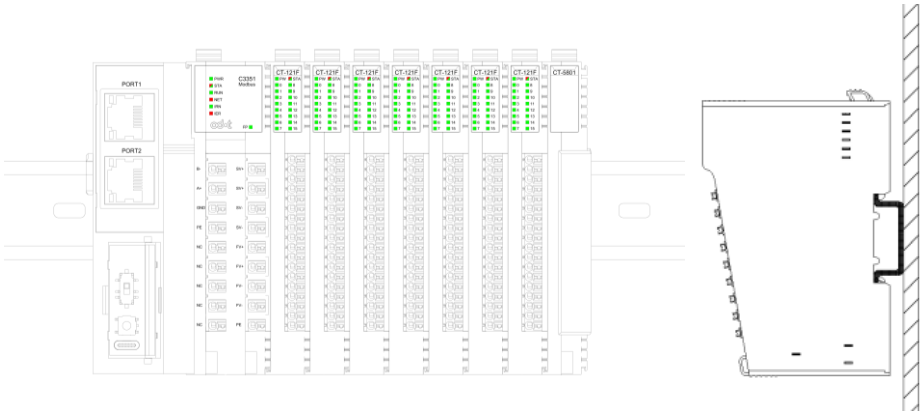
Failure to follow the above instructions could result in damage to the equipment.

Power modules need to be added according to the actual number of I/O modules. The power modules are placed between the I/O modules, and the specific slots are not fixed. The drawing designer needs to consider the installation position of the power modules in advance.

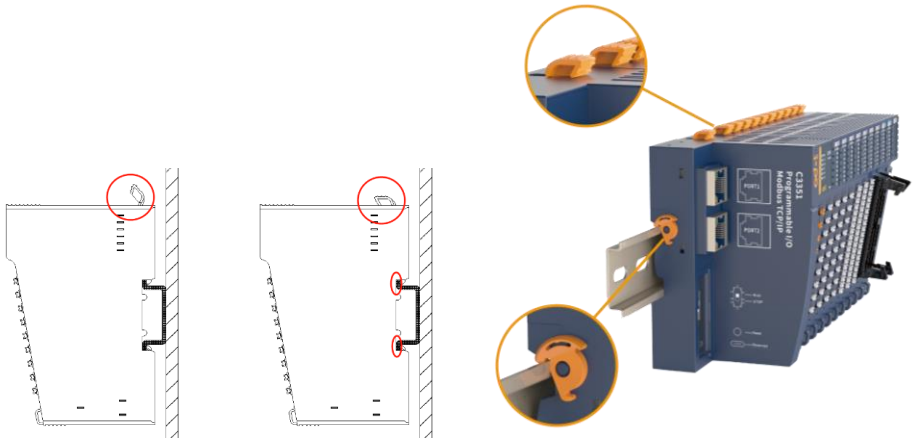
⚠ WARNING
UNINTENDED EQUIPMENT OPERATION ·If the total current of the I/O modules installed at the rear of the C3351 device exceeds the provided current, but no power module is added, the I/O module channels will work abnormally. **Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.**

2.4.8 Correct Installation Position

All modules should be installed horizontally on a vertical surface as much as possible, as shown in the following figure:



After the module is installed vertically, press the lock on the top of the module to ensure that the module is installed in place, and the distance between the module and the upper and lower contact surfaces of the 35mm Din rail is less than 1mm. Press the lock on the left side of the C3351 device counterclockwise to lock the Din rail.



⚠ WARNING

OUT OF CONTROL

·The lock of the I/O module must be pressed firmly; otherwise, the communication of the I/O module may be disconnected.

·The lock of the I/O module must be pressed firmly, otherwise the module may fall off.

·When installing the I/O module, no gap should be left between the modules. Otherwise, the I/O channel may not work properly.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

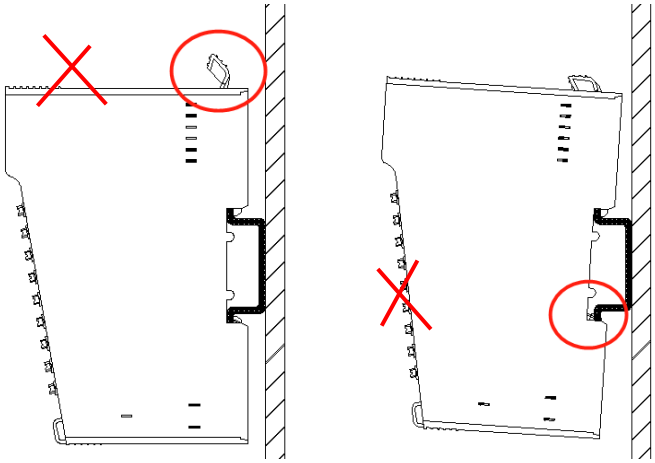
2.4.9 Incorrect Installation Location

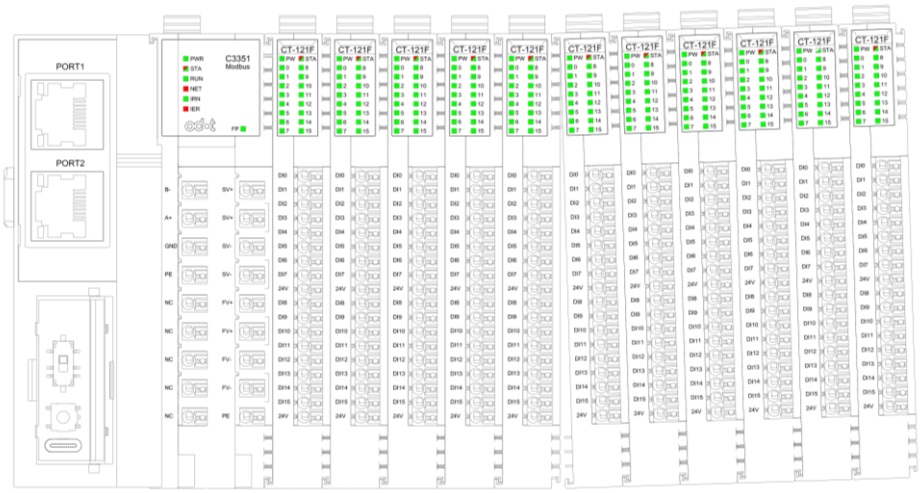
A. The lock on the left side of the C3351 device is not pressed firmly to the Din rail.

B. After the installation is completed, the lock on the upper side of the module is not pressed to lock the Din rail, or the pressed position is not in place.

C. After the installation is completed, the lower part of the side of the module is not installed in place, and the module is not installed vertically, but is inclined to the backplane.

D. There are gaps between modules.





2.4.10 Minimum Clearance

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

·Install the equipment that dissipates the most heat at the top of the cabinet to ensure proper ventilation.

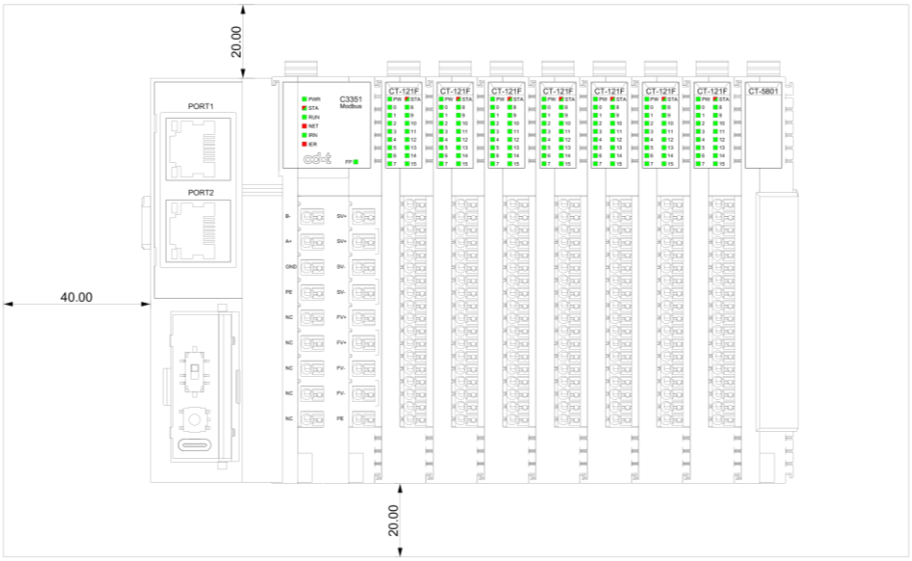
·Please do not place this device near or above equipment that may cause overheating.

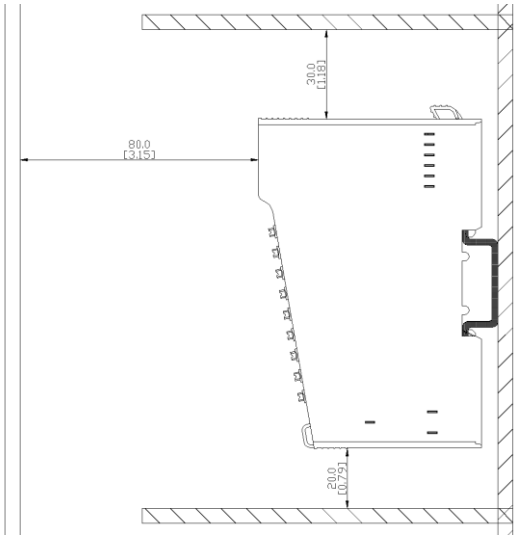
·Install the equipment so that it maintains the minimum clearances stated in this document to all nearby structures and equipment.

·Install all equipment according to the specifications in the relevant documentation.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

The figure below shows the minimum clearances for all C-Series module models（mm）：




30.0
[1.18]
80.0
[3.15]
20.0
[0.79]

2.5 Install I/O modules for C3351

This section describes how to assemble the expansion I/O module to the C3351 programmable controller.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

·Disconnect power from all equipment (including connected equipment) before removing any covers, or installing or removing any accessories, hardware, cables, or wires, unless otherwise specified in the corresponding hardware guide for this equipment.

·As directed, at the appropriate place and time, it is important to always use a properly rated voltage sensing devices to detect if the power is off.

·Replace and secure all covers, accessories, hardware, cables and wires, and verify proper ground connection before powering on the device.

·When operating this equipment and related products, the specified voltage must be used.

Failure to follow the instructions will result in serious consequences such as personal injury or death.

After connecting the new module to the C3351 programmable controller Bus network, it needs to update the application program before putting the system into use. If the application program could not be updated and reflects the new modules, and the I/O on the expansion Bus may not function correctly.

WARNING

UNINTENDED EQUIPMENT OPERATION

·Only use software approved by Sichuan ODOT Automation System Co., Ltd. for use with this equipment.

·Please update the application after every change to the physical hardware configuration.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

Installation Steps

The following describes how to assemble the C3351 device and I/O modules:

Unlock the buckles on the left and upper sides of the C3351 device, and install it vertically on a 35mm Din rail.

Steps	Operations
1	Take all modules out of the box.
2	Open the lock on the left and upper sides of the C3351 device, and install it vertically on a 35mm Din rail.
3	Rotate the lock on the left side of the C3351 device counterclockwise to clamp the Din rail.

4	Press the lock on the upper side of the C3351 device (there will be a 'click' sound to indicate that the lock is in place), so that the C3351 device is firmly fixed on the Din rail.
5	Open the lock on the upper side of the I/O module, move the module from top to bottom along the slot of the C3351 shell, and make the I/O module flush with the C3351 device, then press the lock on the upper side of the module, and it will be clamped with a 'click' sound.
6	Then install the next I/O module until all I/O modules are installed.
7	After the I/O module is installed, please install the terminal module as the last module.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·The module model on the physical slot needs to correspond one-to-one with the module model on the configuration software slot, and please save it after the configuration is completed.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.6 Removing the I/O Module from the C3351

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

·Disconnect power from all equipment (including connected equipment) before removing any covers, or installing or removing any accessories, hardware, cables, or wires, unless otherwise specified in the corresponding hardware guide for this equipment.

·As directed, at the appropriate place and time, it is important to always use a properly rated voltage sensing devices to detect if the power is off.

·Replace and secure all covers, accessories, hardware, cables and wires, and verify proper ground connection before powering on the device.

·When operating this equipment and related products, the specified voltage must be used.

Failure to follow the instructions will result in serious consequences such as personal injury or death.

The following describes how to remove the C3351 programmable controller and I/O modules:

WARNING

UNINTENDED EQUIPMENT OPERATION

·The module does not support the hot swap function. When removing or replacing a module, it is necessary to power off before removing or replacing the module.

·When replacing I/O modules in later maintenance, please note that the model and slot number should be replaced correspondingly. It is not allowed to replace with the wrong module model or move the sequence of I/O modules at will, otherwise there will be a risk of burning out the module or damaging the field equipment.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

Steps	Operations
1	Disconnect all power to the control system.
2	Open the lock of the module to be removed to release it from the Din rail.
3	Remove the wires from the channel of the module that needs to be removed.
4	Pull out the module to be removed in a vertical direction to the Din rail.

2.7 Wiring

2.7.1 Wiring Guidelines

When wiring the system, the following rules must be followed:

·I/O and communication wiring must be done separately from power wiring. These two types of cables cannot be laid in the same cable duct.

·Please check that the operating conditions and environment are within the range allowed by the specification values.

·The specifications of the cables used must meet the voltage and current requirements.

·Please use copper wire.

·Please use shielded twisted pair cables for analog and/or fast I/O.

·Network and fieldbus should use shielded twisted pair cables.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Please use shielded cables for all fast I/O, analog I/O, and communication signals.

·Please use shielded cables for single point grounding for all fast I/O, analog I/O, and communication signals. [1]

·Please wire power cables separately from communication cables and I/O cables.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

[1] Multi-point grounding is permitted (and in some cases unavoidable) if connected to the equipotential grounding plane to avoid damage to the cable shield in the event of a power system short-circuit current. **NOTE:** Surface temperatures may exceed 60°C (140°F).

To comply with IEC-61010, the primary wiring (wires connected to the main power supply) should be arranged separately and separated from the secondary wiring (extra low voltage wiring from the intermediate power supply). If separate wiring is not possible, double insulation must be provided, such as conduit or cable gain.

Copper interconnects are required.

⚠DANGER

FIRE HAZARD

·Only use the correct wire rules for the maximum current capacity of the I/O channels and power supplies.

·For relay output (2A) wiring, please use conductors with a cross-sectional area of at least 0.5 mm^2 (AWG20) and a temperature rating of at least 80°C (176°F).

Failure to follow the instructions will result in serious consequences such as personal injury or death.

2.7.2 Push-in Terminal

All module terminals adopt push-in terminals. Use the push-in connection method to connect single wires or crimp terminal (ferrule) wires without any additional tools to ensure fast wiring. Users can save wiring and disconnection time.

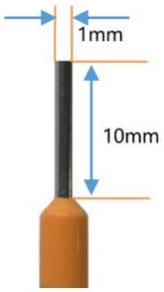
When the push-in terminals are disconnected, the pressing force should be 15 Newtons, and the maximum mechanical bearing pressure of the push-in terminals is 20 Newtons. Using a larger pressing force will affect the spring back of the terminal, and if the tool used for pressing is too sharp and it will damage the push-in terminals.

The module has a cable harness fixing end, which is used to fix the cable when the I/O module is connected to multiple cables.

NOTICE
DEVICE INOPERABLE ·When removing wires from the channel, please do not press the push-in terminals with more than the maximum pressing force specified for this terminal, otherwise it may damage the push-in terminals spring back force and affect the terminal spring back. ·When removing wires from the channel, please do not use sharp tools to press the push-in terminals, otherwise the push-in terminals will be damaged. **Failure to follow the above instructions could result in damage to the equipment.**

2.7.3 Cold-pressed Terminal

It is recommended to use a cable with a core less than 1mm², and the parameters of the cold-pressed terminal are as follows:



⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·The length of stripping off the insulation layer of the wire should be greater than 10mm to ensure the reliable connection of the signal.

·It is recommended to use a wire with a wire core greater than or equal to 0.2mm² and less than or equal to 1mm² to ensure reliable signal connection.

·When the cold-press terminal is terminated, it should be terminated and inspected in strict accordance with the corresponding termination specifications or requirements, and terminated according to the corresponding node number.

·It is forbidden to power on the cold-press terminal before it is correctly connected or completely locked.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

·Disconnect power from all equipment (including connected equipment) before removing any covers, or installing or removing any accessories, hardware, cables, or wires, unless otherwise specified in the corresponding hardware guide for this equipment.

·As directed, at the appropriate place and time, it is important to always use a properly rated voltage sensing devices to detect if the power is off.

·Replace and secure all covers, accessories, hardware, cables and wires, and verify proper ground connection before powering on the device.

·When operating this equipment and related products, the specified voltage must be used.

Failure to follow the instructions will result in serious consequences such as personal injury or death.

⚠ WARNING

OUT OF CONTROL

·The designer of any control scheme must account for the possible failure of the control path and provide a means for certain critical control functions could be restored to a safe state during and after path failure. These critical control functions include emergency stop, over-travel stop, power-off restart, and similar safety measures.

·For critical control functions, separate or redundant control paths must be provided.

·System control paths may include communication links. Consideration must be given to the implications of unforeseen transmission delays or link failures.

·Comply with all accident prevention regulations and local safety guidelines.

·To guarantee proper operation, each implementation of the device must be fully tested individually before being placed into service.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.8 Protects Outputs from Inductive Load Damage

Depending on the load, the outputs of the controller and specific modules may require protection circuits. Inductive loads using DC voltages can create voltage reflections that cause overshoots that can damage or shorten the life of the output device.

⚠ CAUTIOUS

DAMAGE TO OUTPUT CIRCUITS DUE TO INDUCTIVE LOADS

·Use appropriate external protective circuits or devices to reduce the risk of damage to inductive loads.

Failure to follow the instructions may result in personal injury or equipment damage.

If the controller or module contains relay outputs, and these types of outputs can support up to 30 Vdc. Inductive damage to these types of outputs can result in fused contacts and loss of control. Every inductive load must be equipped with protective devices, such as RC circuits or freewheeling diodes. These relays do not support capacitive loads.

⚠ WARNING

RELAY OUTPUT FUSION CLOSURE

·Always use appropriate external protective circuits or devices to protect relay outputs from inductive load damage.

·Please do not connect relay outputs to capacitive loads.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

⚠ WARNING

THERE ARE CONSQUENCES OUT OF CONTROL

·Please install an RC surge suppressor or freewheeling diode on each relay output when connecting to a contactor or other form of inductive load.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.9 Power Supply

2.9.1 Features and Wiring

⚠ DANGER

FIRE HAZARD

·Use only the correct wire specifications for the maximum current capacity of the power supply.

Failure to follow the instructions may result in serious consequences such as personal injury or death.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Please do not exceed any ratings specified in the Environmental and Electrical Characteristics table.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

2.9.2 DC Power Requirements

The C3351 device and associated expansion modules require a power supply rated at 24 Vdc. According to IEC 61140, the 24 Vdc power supply must be rated safety extra-low voltage (SELV) or protective extra-low voltage (PELV). These power supplies are isolated between its electrical input and output circuit.

⚠ WARNING

OVERHEATING AND FIRE HAZARD

·Never connect the device directly to the line voltage.

·Please use only insulated SELV or PELV power supply to power the device. [1]

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

[1] To comply with UL (Underwriters Laboratories) requirements, the power supply must meet the various standards of NEC Class 2 and inherently limit the current to less than the maximum usable power output of 100 VA (approximately 4 A at nominal voltage), or not be affected by intrinsic limits, but limited by additional protective devices (such as circuit breakers or fuses meeting the requirements of UL 61010-1 Clause 9.4, "Energy-Limited Circuits"). In no case shall the current limit exceed that of the electrical characteristics and wiring diagrams of the equipment described in this document. In all cases, the power supply must be grounded, and the user must isolate Class 2 circuits from other circuits. Multiple Class 2 power supplies could be used if the ratings indicated in the electrical characteristics or wiring diagrams are greater than the specified current limit.

2.10 Grounding

2.10.1 Functional grounding on the DIN rail

The system DIN rail is the common functional grounding plane and must always be mounted on a conductive backplane.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION ·Connect the DIN rail to the functional grounding of the installed equipment. **Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.**

2.10.2 System Grounding

Due to the influence of electromagnetic interference, cables carrying fast I/O, analog I/O and fieldbus communication signals must be shielded cables.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION ·Please use shielded cables for all fast I/O, analog I/O, and communication signals. ·Please use shielded cables for single point connection for all fast I/O, analog I/O and communication signals. [1] ·Arrange power cables separately from communication and I/O cables. **Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.**

[1] Multi-point grounding is permitted (and in some cases unavoidable) if it is connected to the equipotential grounding plane to avoid damage to the cable shield in the event of a power system short-circuit current. When using shielded cables, the following wiring rules need to be followed:

·For the protective earthing (PE), metal pipes or wires can be used as part of the shield length, the premise is it should provide the entire earthing connection continuously without interruption. For functional grounding, shielding is used to reduce electromagnetic interference and the shielding must be continuous throughout the cable without interruption. If for both functional and protective purposes (This is usually the case for communication cables), the shielding of the cable must be continuous without interruption.

·Cables carrying different types of signals or power should be separated whenever possible

2.10.3 Protective Earthing on the backplane (PE)

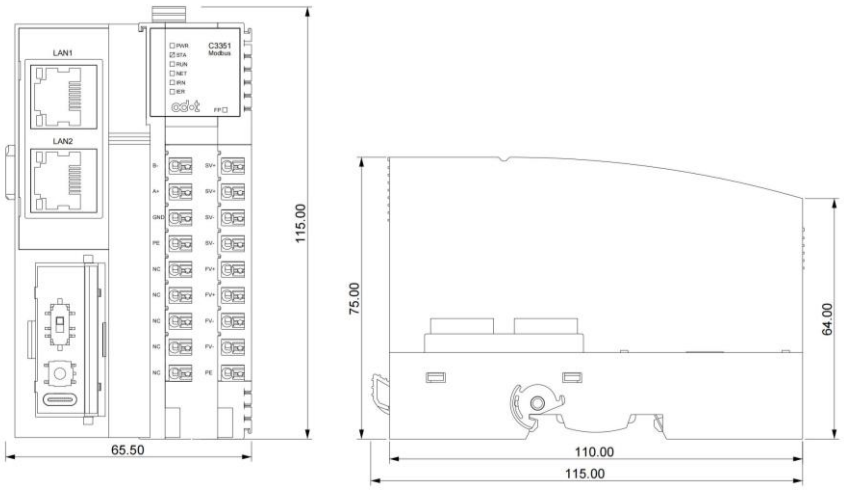
The protective earthing (PE) is connected to the conductive backplane by a heavy-duty conductor (usually a braided copper cable with the largest allowable cable cross-section). There is a metal spring plate on the back of the module, which is used for effective grounding with the Din rail, and the metal spring plate is connected to the inside of the terminal PE of the adapter module.

2.10.4 Shielded Cable Connection

Cables carrying fast I/O, analog I/O and fieldbus communication signals must be shielded. The shielded cable must be firmly grounded. The fast I/O and analog I/O shields can be connected to the functional grounding or protective earthing (PE) of the C3351 expansion module. The fieldbus communication cable shields must be connected to protective earthing (PE) via using connection clamps fastened to the conductive backplane installed.

2.11 Dimensions

C3351 Installation dimensions of the device： 115 * 65.5 * 75 mm



3 Module Parameters

3.1 General Parameters

System power supply: 22-28VDC（Nominal 24VDC）
Protection: Anti-reverse connection protection
Module consumption: 110mA@24Vdc
Internal Bus supply current: Max：2.0A@5VDC
Isolation: system to site power isolation
Field power supply: 22-28V（Nominal 24V）
Field supply current: Max. DC 8A
Number of supported I/O modules: 32 pcs
Wiring diameter: Max.1.5mm² (AWG 16)
Way to install: 35mm DIN rail
Dimension: 115 * 65.5 * 75mm
Weight: 170g

Unexpected equipment operation

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Devices exceeding the above requirements may be damaged or malfunction.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

3.2 Environmental Parameter

Operating Temperature of Horizontal Installation -35℃~70℃
Operating Temperature of Vertical Installation -35℃~60℃
Relative Humidity < 95%RH (No Condensation)
Storage Temperature -40℃~85℃
Storage Humidity < 95%RH (No Condensation)
Manufacturing Test Temperature -40℃~75℃
Ingress Protection Rating IP20

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

·Devices exceeding the above requirements may be damaged or malfunction.

Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

3.3 Programming Specification

Programming Software:	CODESYS SP17
Programming language:	IEC 61131-3 (LD, IL, ST, CFC/FBD, SFC)
Maximum State Task:	5
Bit Instruction Cycle:	0.0738us
Word Transfer Cycle:	0.33us
Floating Point Operation Cycle:	0.38us
Program Memory:	1MBytes
Data Storage:	1MBytes
Power-down Protection Area:	3KBytes
RTC:	Not Supported
Maximum Expansion Module:	32
Modbus Master Max Channel Numbers:	10
Modbus Master Command Max Length:	
Function Code 1(Read Coils):	2000/1 channel
Function Code 2(Read Discrete Inputs):	2000/1 channel
Function Code 3(Read Holding Registers):	125/1 channel
Function Code 4(Read Input Registers):	125/1 channel
Function Code 15(Write Multiple Coils):	440/1 channel
Function Code 16(Write Multiple Registers):	27/1 channel
Function Code 23(Read/Write Multiple Registers):	25+25/1 channel

3.4 Interface Parameters

Interface:	2 * RJ45,1 * RS485
Network Port Baud Rate:	10/100Mbps, Adaptive and full duplex
Network Protocol:	Modbus TCP，the default IP of the device is 192.168.0.15

Serial Port Configuration（RS485）：Supports Modbus RTU/ASCII, the baud rate is 2400~115200bps, and supports the parameter configuration of parity code and stop bit

LED indicator: 6 LEDs PWR STAT RUN NET IRN IER

3.5 Link Parameter

Modbus TCP Client:	Max supports for connecting 6 Modbus TCP servers
Modbus TCP Server:	Max supports for 6 Modbus TCP clients connected
Modbus RTU Master:	Max supports for connecting 5 slave devices
Modbus RTU Slave:	Max supports for connecting 1 master device

NOTICE

DEVICE INOPERABLE

·The maximum number of TCP connections is 6

Failure to follow the above instructions may result in abnormal device communication.

3.6 Electromagnetic Compatibility

Electrostatic Discharge Immunity：

Air discharge ±8kV; contact discharge ±6kV (network port and power supply)

Electrical fast transient group pulse immunity:

±2kV, 5KHz/100KHz (system power port and network cable)

Surge immunity:

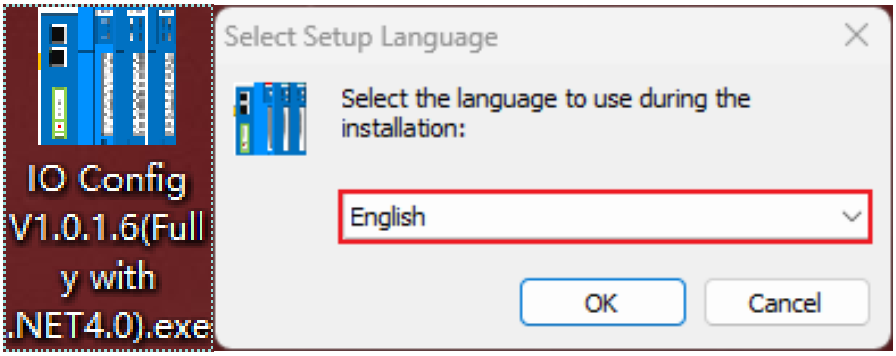
±2kV common mode/differential mode (system power port and network cable)

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION ·Devices exceeding the above requirements may be damaged or malfunction. **Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.**

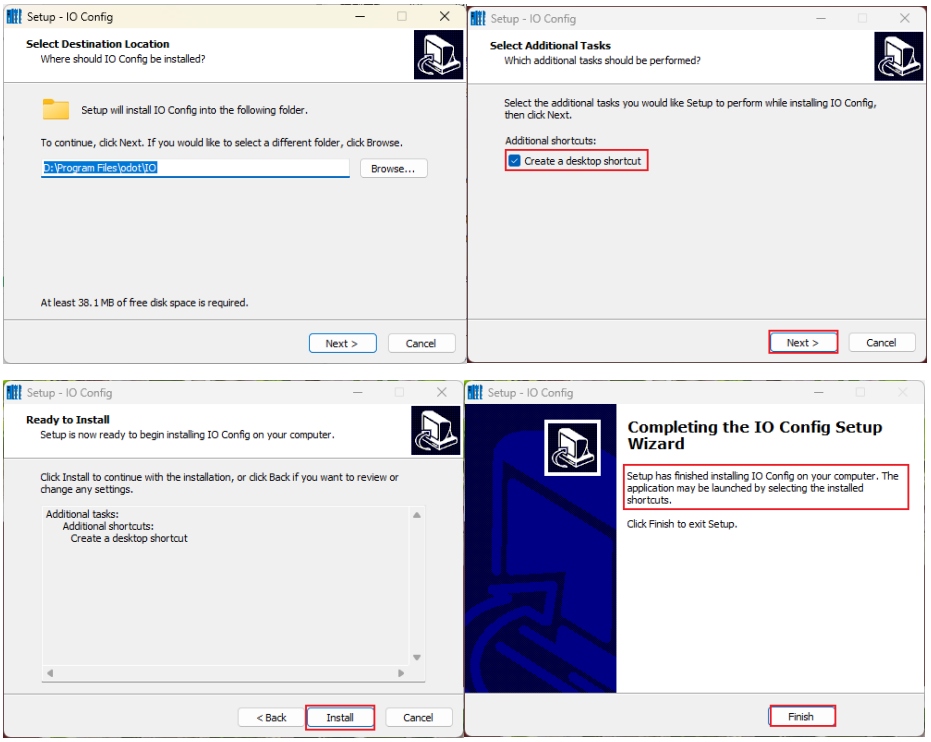
4 IO-Config Software

4.1 IO-Config Configure software installation

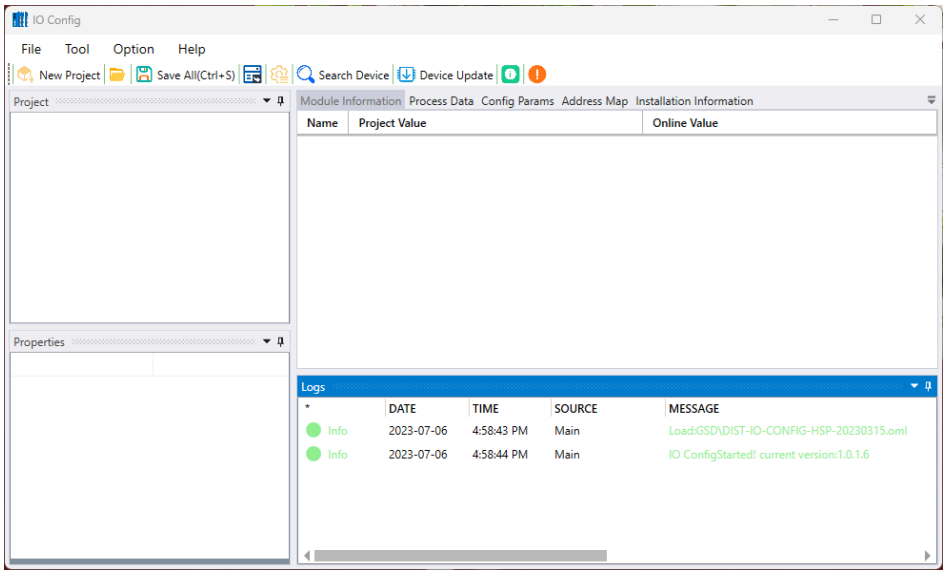
ODOT Automation provides IO Config software for customers. Once receiving the software, customers just double click the software and select language English and click to confirm it, the default language is Chinese.



Confirm the installation directory and click “Next” when the window pops out, select and create “Desktop logo”, then click “next”, click “install”. Once installation is finished, then IO Config logo will be created on the desktop.



4.2 Software Interface



Menu： IO-Config software

Tool： Common user menu

Project Window： projects set down are showed.

Property Window： Current projects' main specific parameters are showed.

Major Window:

Basic Information: it could view module name, module number, hardware version, software version, module description, electrical current consumption and manufacturer name.

Process Data: it could be used for online monitoring of channel data.

Configured parameters: modifiable module parameters.

Address Table: the address area occupied by the I/O module.

Installation Information: it could view module description, current consumption, module size, residual current, and product images.

Message Window：It could output the operation log of the current operation.

4.2.1 Menu

File

Menu	Sub-Menu	Description
Project	New project	Create new project
	Open project	Open saved project
	Save all	Save current project
	Save as	Save current project as new project
Exit		Exit Software

Tool

Menu	Description
Search devices	Pop up a new window to search devices through network or serial communication
Upgrade hardware	Pop up a new window to upgrade hardware for C3351and IO Module

Options

Menu	Description
Configuration	The displayed language and color and device described file path can be modified

Help

Menu	Description
About	Company information and software version information can be checked.
Help for abnormal issue	A new window pops up with an abnormal exit reminder. For Windows 7 Sp1/XP systems below, please install Microsoft patches.

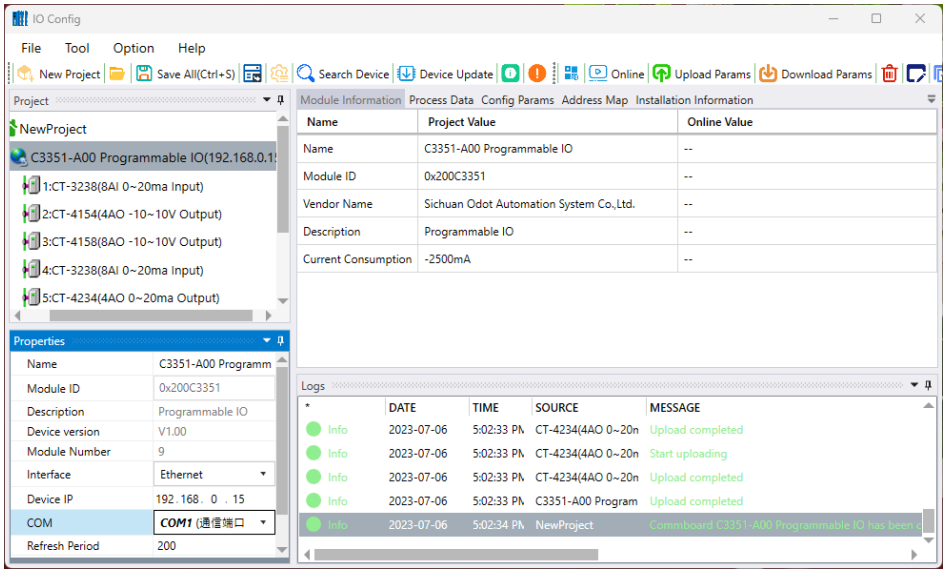
4.2.2 Tool

Menu general shortcut logo.

Logo	Name	Menu	Description
	New project	File-Project-New project	Create New project
	Open project	File-Project-Open project	Open saved project
	Save all	File-Project-Save all	Save current project
	Save as	File-Project-Save as	Save current project as new project
	Config	Options - Configuration	Modify language, color, device described file.
	Search Device	Tool-search device	Pop-up new window and search device
	Upgrade hardware	Tool-hardware upgrade	Pop-up new window for module hardware upgrade
	About	Help-about	Configuration software version can be checked.
	Help for abnormal issue	Help for abnormal issue	A new window pops up with an abnormal exit reminder. For Windows 7 Sp1/XP systems below, please install Microsoft patches.

4.2.3 Project Window

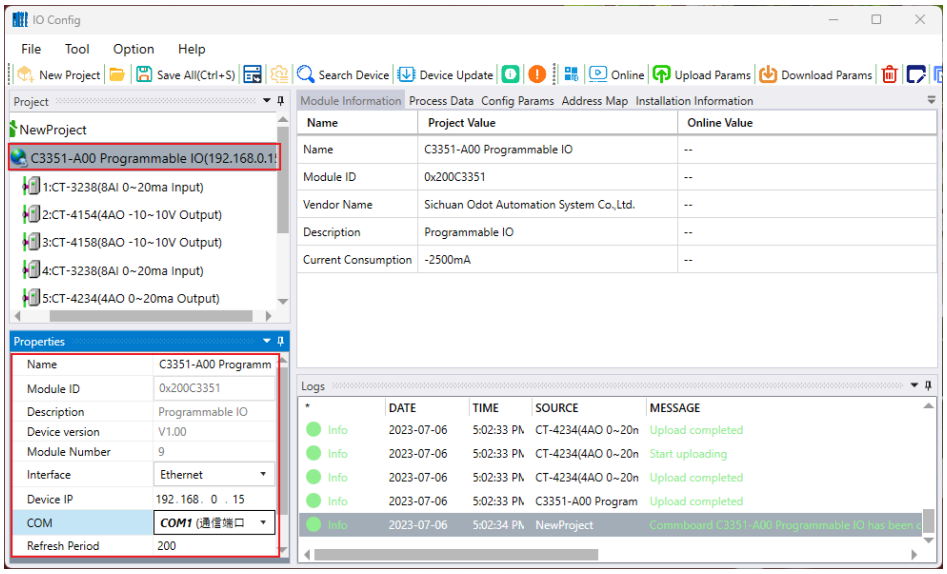
Display the currently created projects.



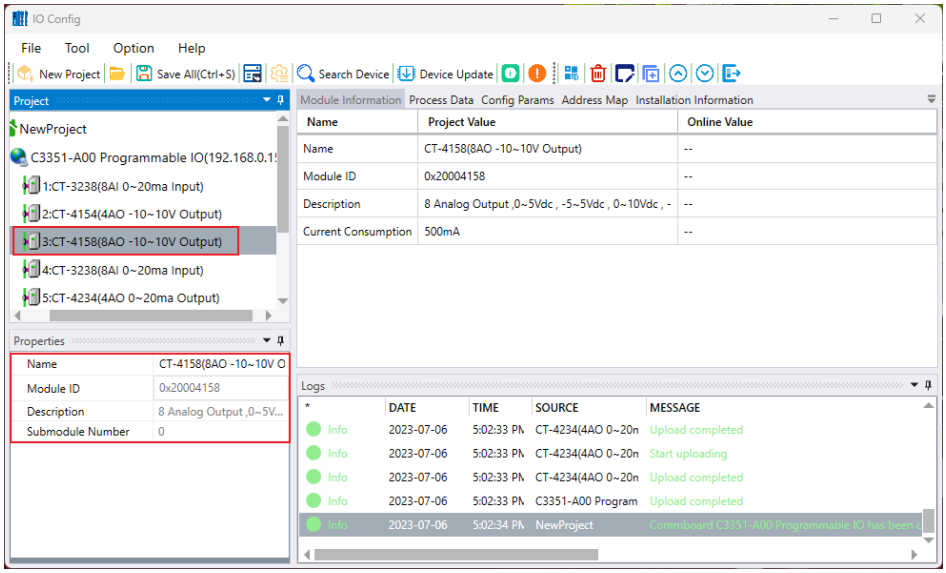
4.2.4 Property Window

Property window shows current specific parameter.

IO Adapters, PLC (Module name, module number, module description, device version, modules quantity, interface option, device IP address, serial port number, online refreshing period)

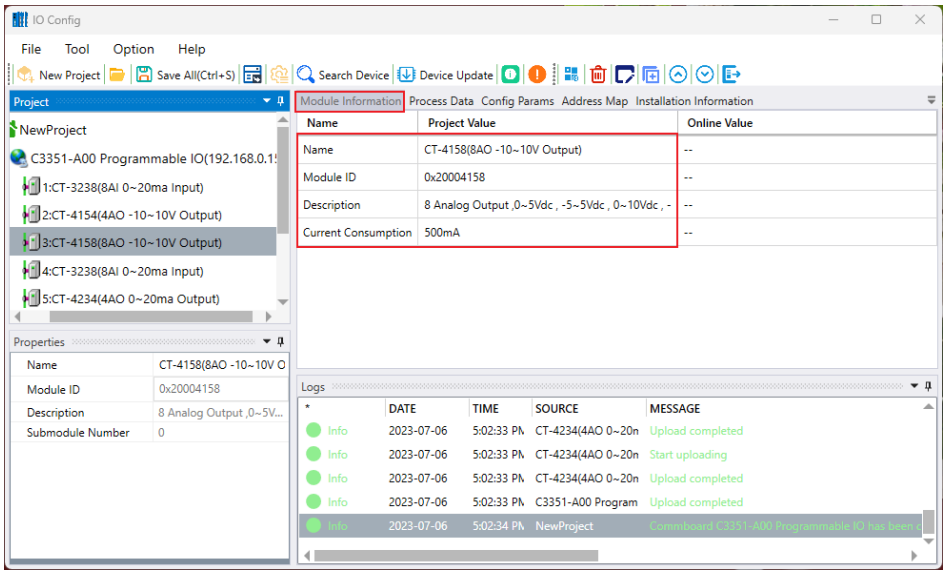


IO Module（module name, module number, module description, extended module numbers)

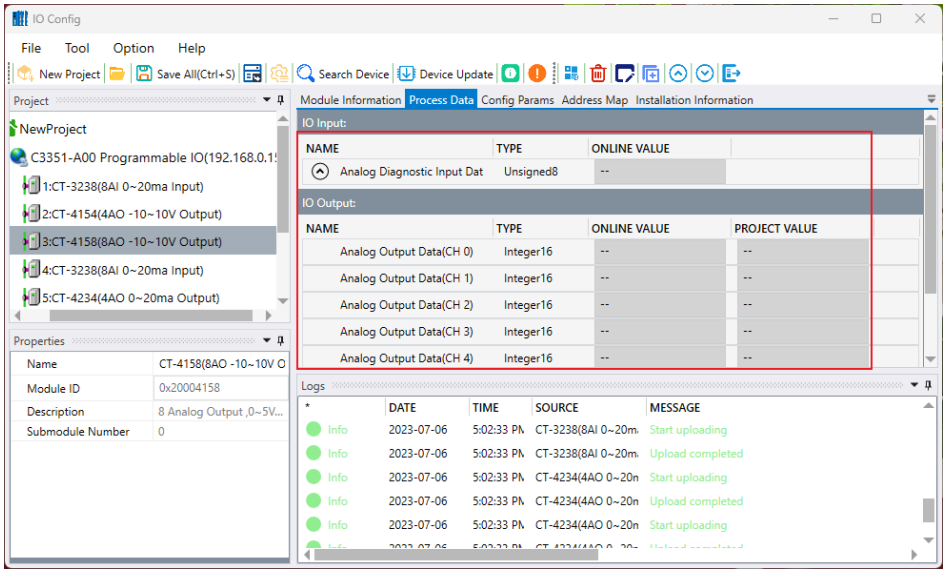


4.2.5 Major Window

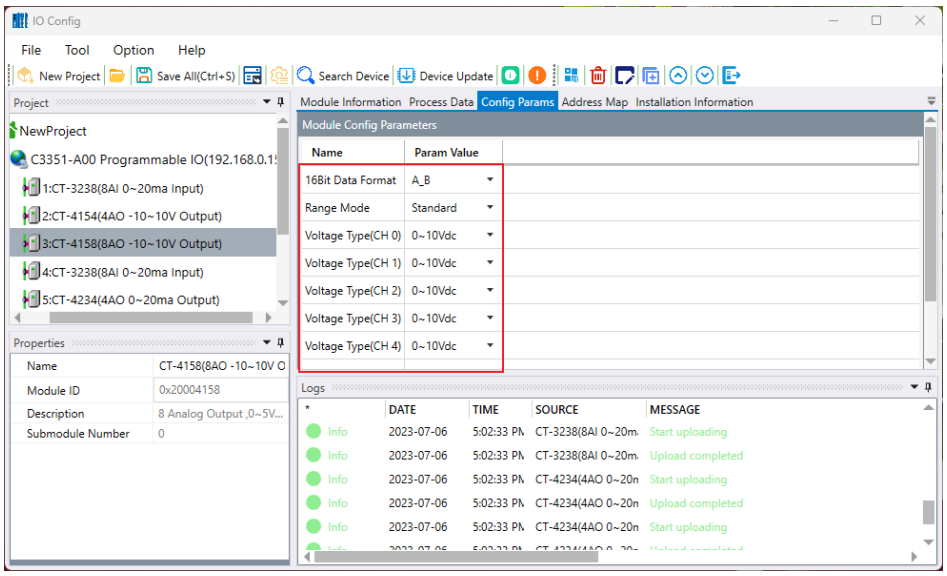
Basic information: IO Adapter module, PLC and IO Module name, module number, hardware version, software version, module description, electrical consumption and manufacturer can be showed.



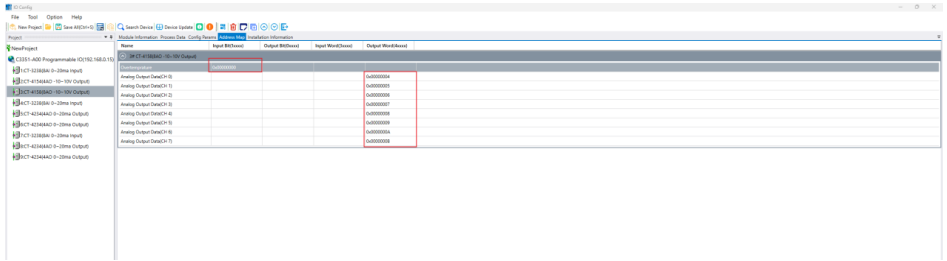
Process data: The channel information of IO Modules can be showed, which is used for online monitoring the channel data.



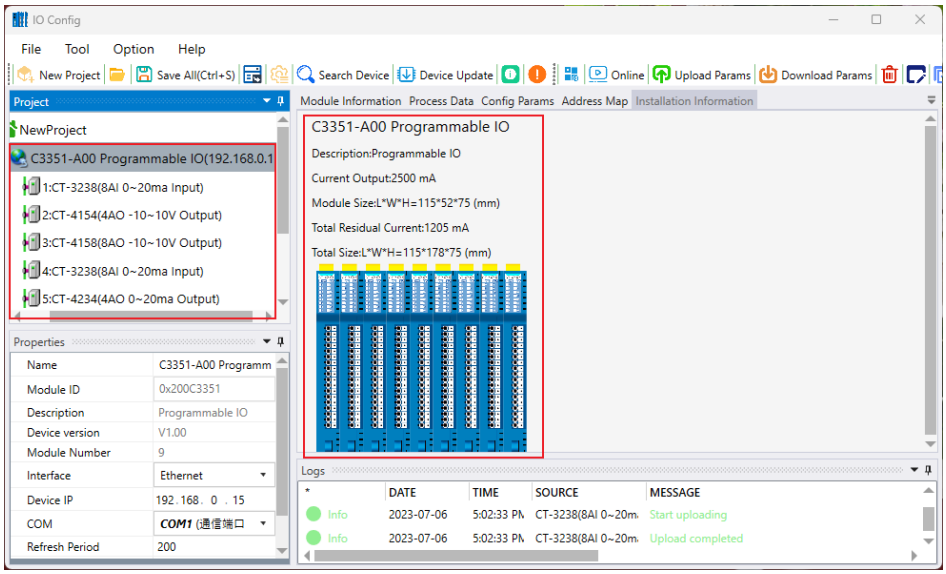
Configured parameter: The module parameter information can be showed and modified, such as IO adapter module, PLC and I/O modules



Address sheet: The storage area of I/O Module input and output channel can be displayed.

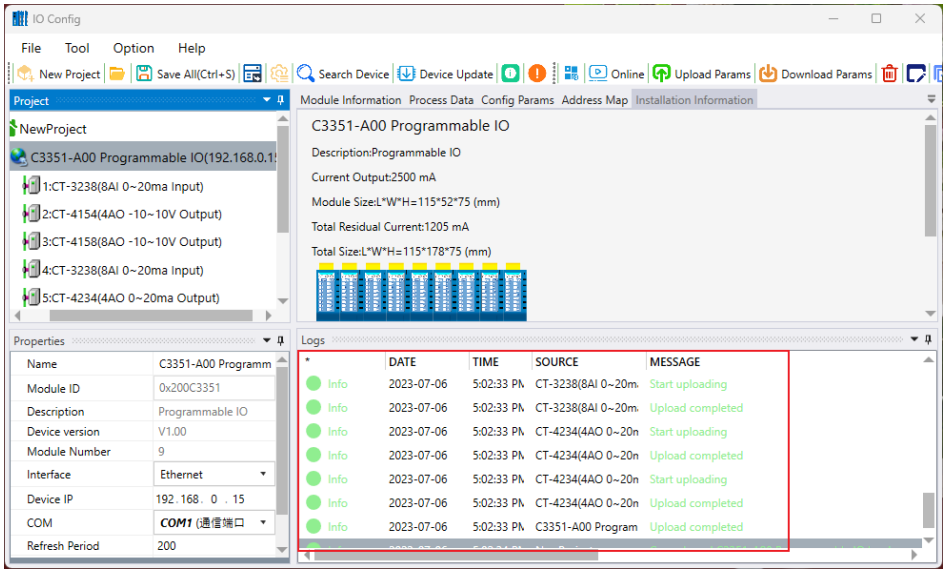


Installation information: The below information can be showed, such as IO Adapter modules, PLC, IO module including module description, current consumption, modules dimension, residual current and product picture.



4.2.6 Message Window

The timely operation information can be showed, such as new project, uploading, downloading, configured parameter modification, copy, paste and etc. all operation details.



4.2.7 Shortcut keys

Shortcut keys	Menu	Description
Ctrl + C	Project/PLC, IO Adapter -Copy	Copy project, PLC, IO Adapter and IO Module
Ctrl + V	Project/PLC, IO Adapter -Paste	Paste project, PLC, IO Adapter and IO Module
Delete	Project/PLC, IO Adapter -Delete	Delete project, PLC, IO Adapter and IO Module
Ctrl + S	File-Project-Save all	Save configured project
Ctrl + M	PLC, IO Adapter-Output address sheet	Output project, PLC, IO Adapter and the address of IO Module

4.3 Software Function

4.3.1 Function

A. Module selection.

B. Check the module configuration parameters and the data address of the module.

C. Modify module configuration parameters.

D. Online debugging module.

E. Search for devices.

F. Firmware upgrade

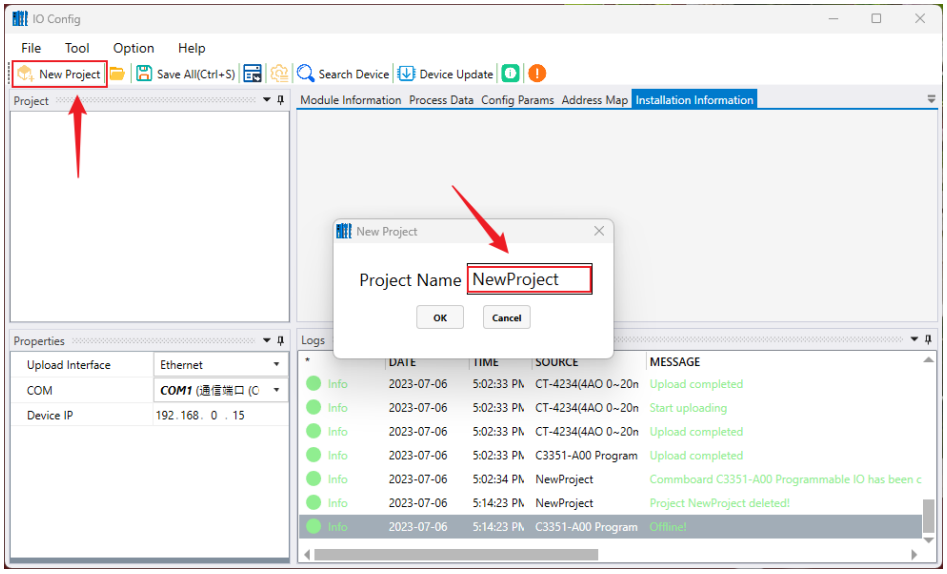
4.3.2 Communication Interface

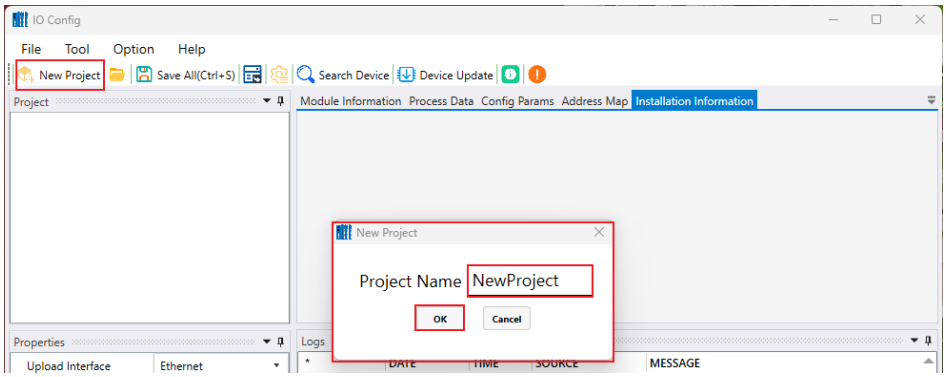
The PLC program upload and download of the C3351 device, the upload and download of the I/O module, the modification of the mounted I/O module parameters, the online test, and the firmware upgrade all use the Ethernet interface as the communication interface.

4.3.3 Module Selection

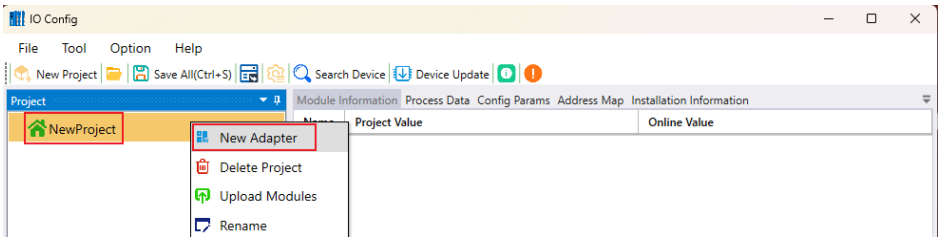
The customer could use the IO-Config software to select the I/O module offline, **the main purpose is to determine whether the selected I/O module needs to add an additional power module**. Of course, the user can also calculate whether to add a power module according to the internal bus power supply current of the adapter module and the power consumption of the I/O module itself. Export the corresponding files of adapter modules, PLC and I/O modules could be convenient for purchasing, drawing, etc.

Double-click the IO-Config shortcut icon to pop up the initial interface of the configuration software, and click the right button in the project directory bar →'Project' → 'New Project' or click the shortcut key of 'New Project' or the menu bar 'File' → 'Project' → 'New Project', then enter the project name manually, and create a new project.

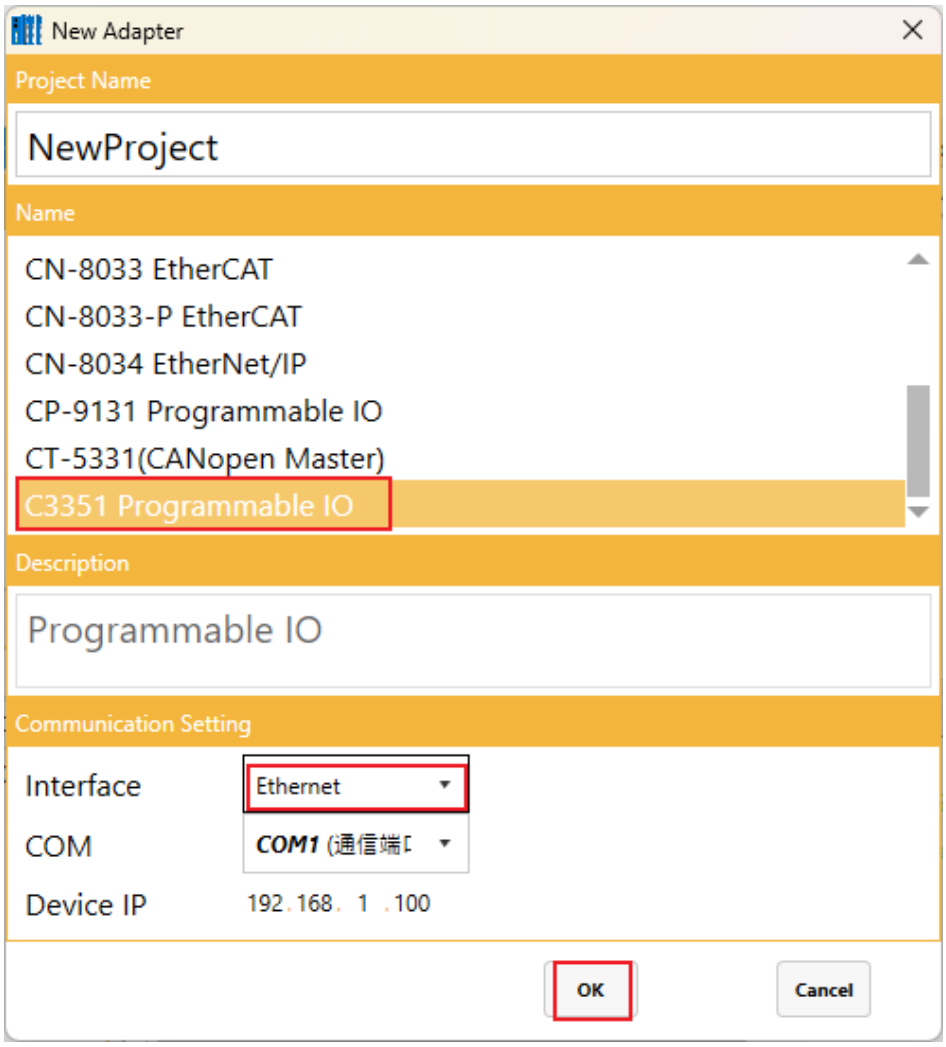




Right-click the newly created project in the project directory bar → 'New Adapter'.

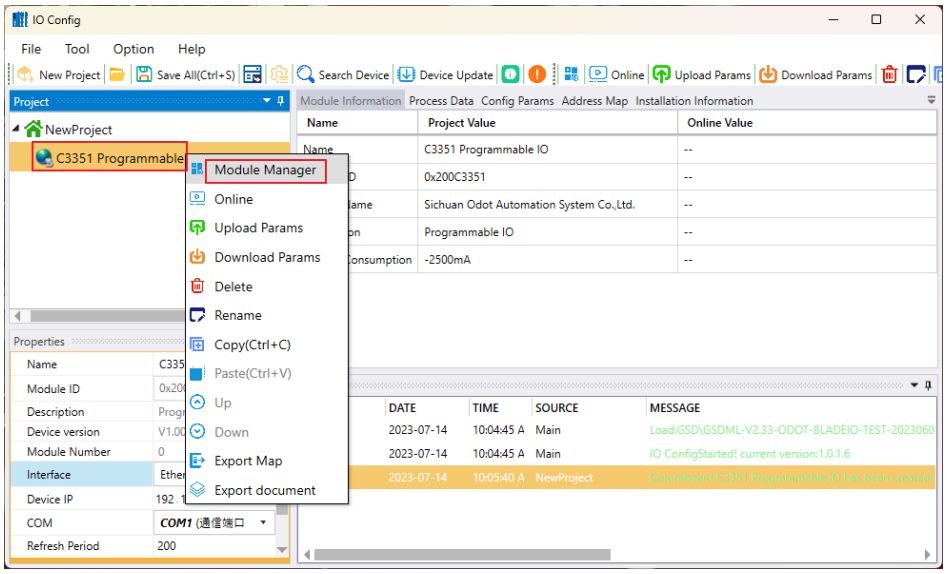


Select 'C3351 Programmable I/O' in the pop-up interface, select 'Ethernet' for the interface, and click 'OK'.

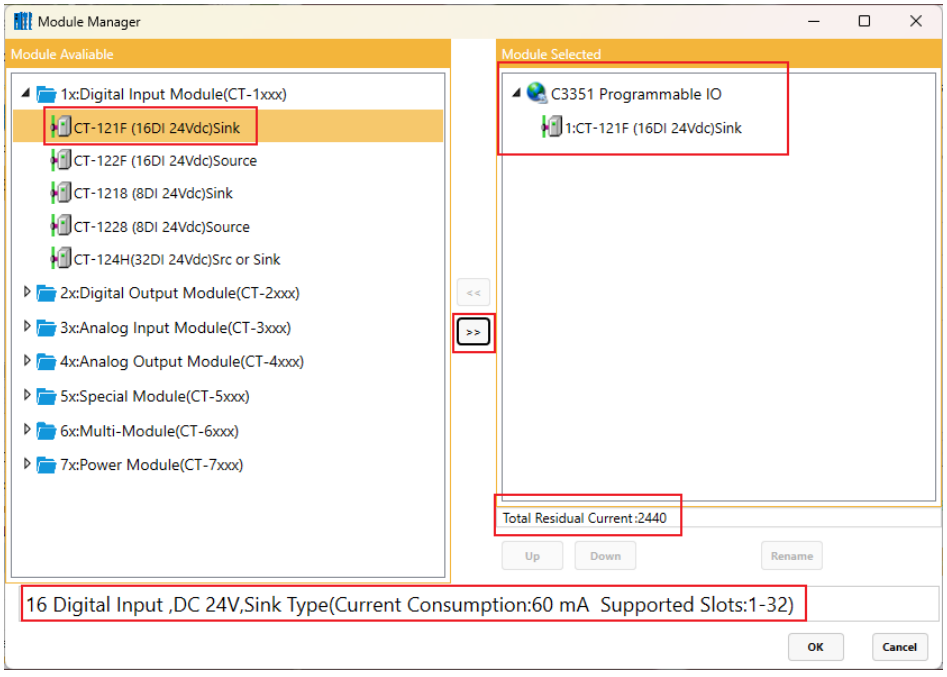


Right-click the 'C3351 Programmable I/O' device generated in the project bar, and

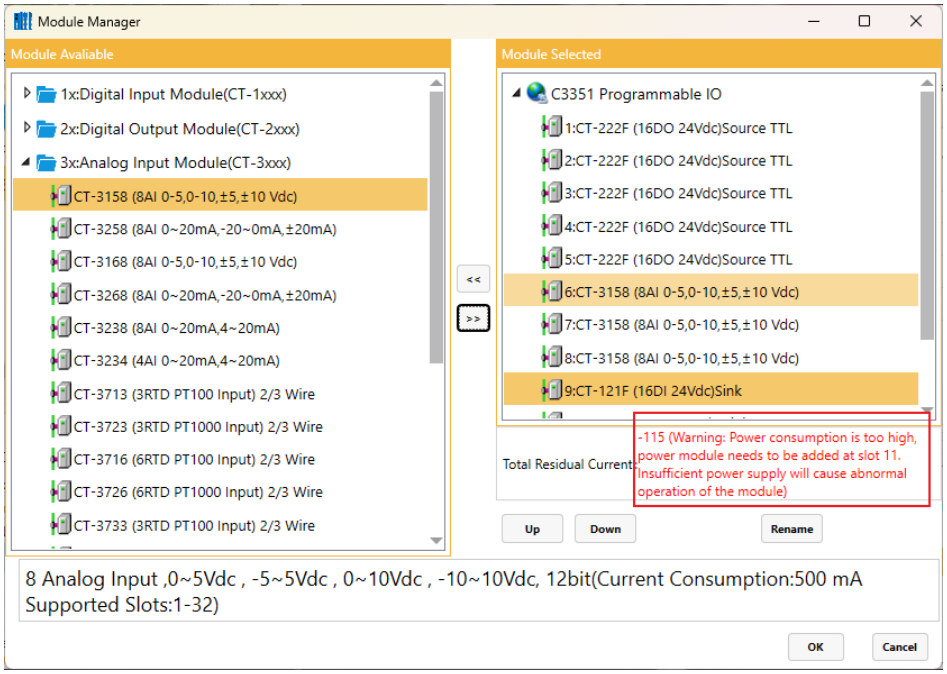
click 'Module Manager'.



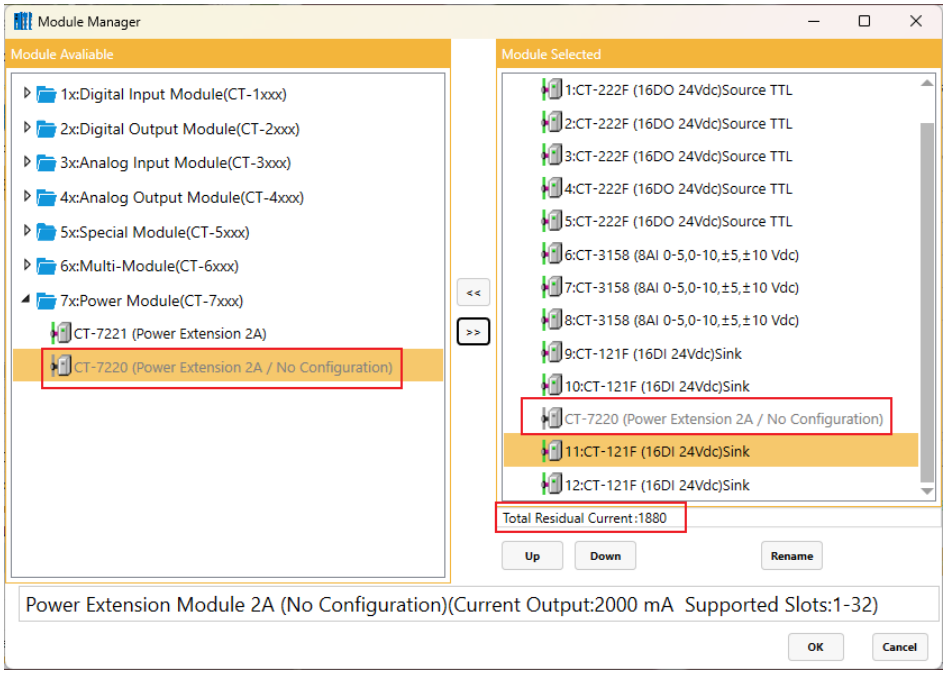
In the pop-up dialog box, please select the I/O module required by the user, and double-click the I/O module or select the module and click the two-way right arrow " >> ".



The power consumption of the selected I/O module will be displayed in the lower left corner. After configuration to the rear side, the total remaining current will be displayed on the lower right side. When the current is exhausted, the font will be displayed in red. At this time, a power module needs to be added.



In this example, it is indicated that the power module should be inserted into slot 11. After the power module is added, the total remaining current displayed on the lower side of the selected module will change to a black font, and other I/O modules can be added behind it.



When actually installing the module, it needs to add a power module (CT-7220) to slot 11. The CT-7220 power module does not require configuration and does not occupy any slot. So, it is grayed out in the screenshot.

⚠ WARNING

ABNORMAL WORKING STATUS OF THE MODULE

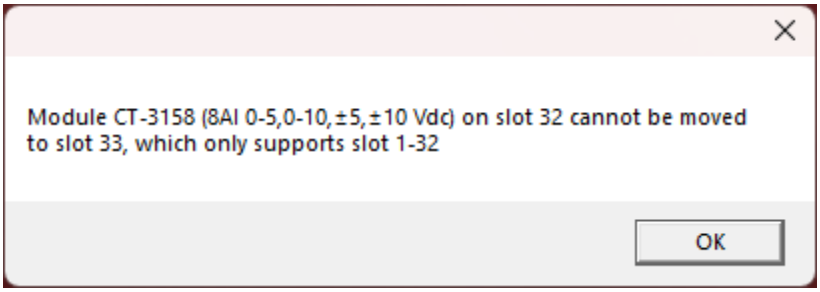
·In the configuration software, there is a configuration function to calculate the power consumption value and prompt the customer whether to add a power module.

·Insufficient current will cause the module channel to operate abnormally.

·The power module does not require configuration and does not occupy a slot. Just add it to the corresponding slot as needed.

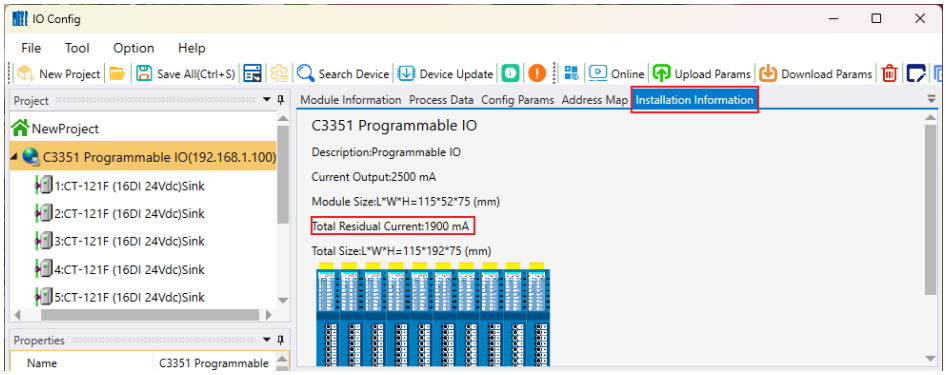
Failure to follow the instructions may result in serious consequences such as personal injury or death or equipment damage.

Continue to configure I/O modules for the C3351 device. When the number of modules exceeds 32, and the following window will pop up. It prompts that the C3351 device only supports slots 1-32. If the customer needs to use more I/O modules, and the customer can add another C3351 device or Modbus adapter to add a new station.

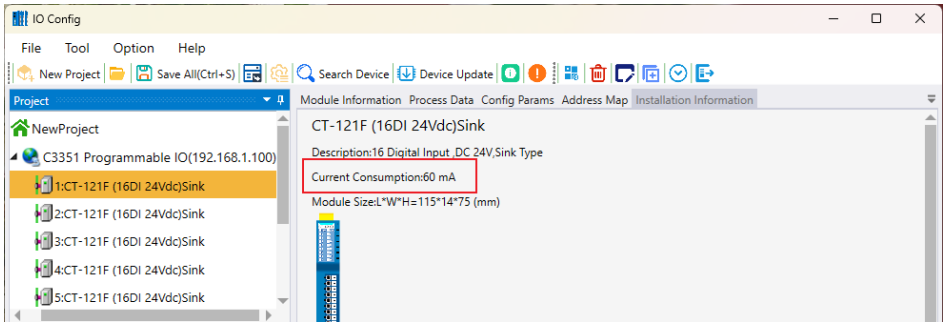


After the I/O module is added, it could click the OK button to automatically generate the I/O module in the project bar.

On the installation information interface on the right, it can see that the 'output current' of the C3351 device is 2500mA, and the current 'remaining total current' is 1900mA after adding the module.



It could click a single I/O module icon to pop up the hardware information of the corresponding module.



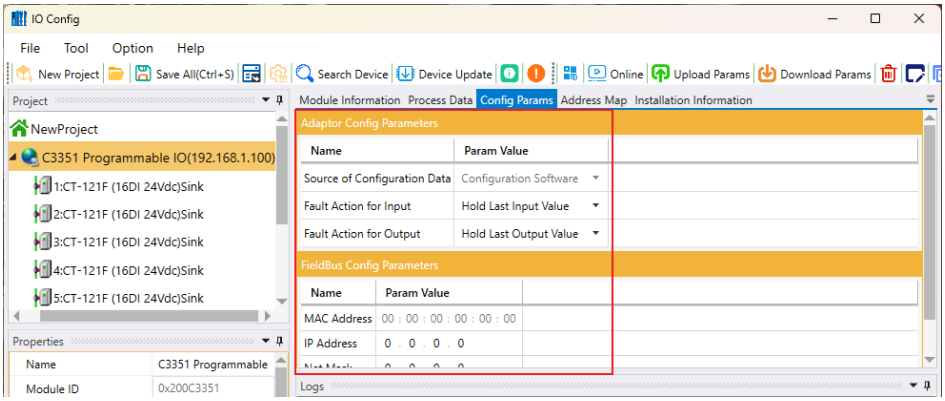
4.3.4 View Configuration Parameters

For C3351 devices and different I/O modules, it could click Configuration Parameters to view the default configuration parameters of the modules.

NOTICE
DEVICE INOPERABLE ·It can only communicate with the IO-Config software in the PC through the Ethernet interface and view the parameters. **Failure to follow the above instructions could result in damage to the equipment.**

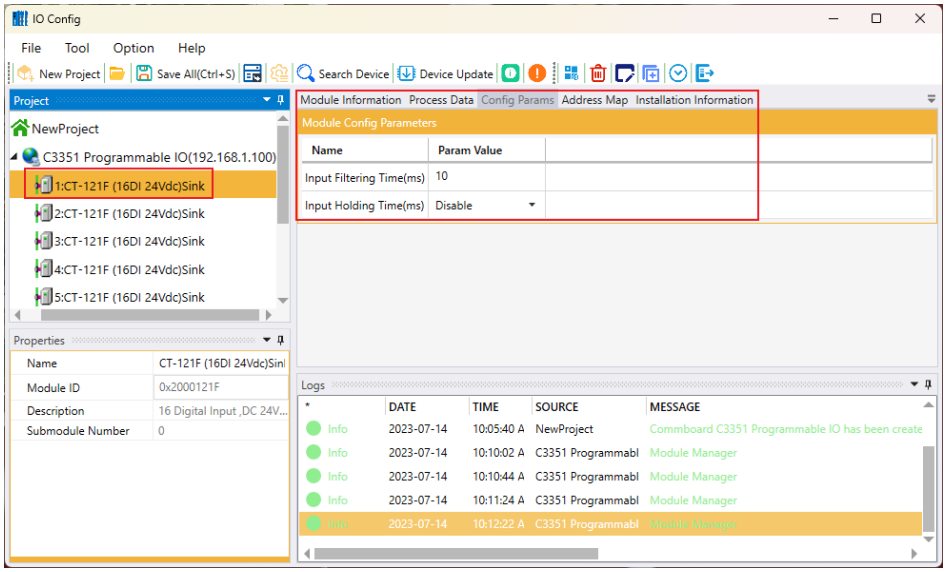
C3351

Default parameter interface.



I/O Module

Taking the 16DI module (CT-121F) as an example, the default parameter interface is as follows, and the configuration parameters of other I/O modules are checked in the same way. And the module default parameter will not be explained one by one.



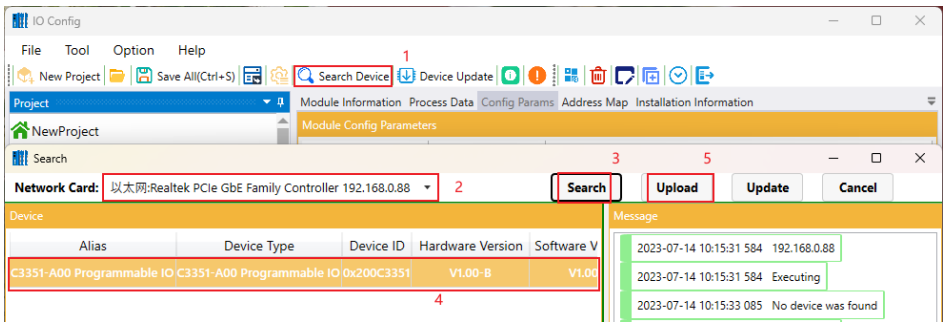
4.3.5 Modify Configuration Parameters

The configuration parameters of C3351 and I/O module can be modified in the IO-Config software. After the modification of the I/O module parameters is completed, it needs to right-click the adapter module → download configuration. C3351 must use IO-Config software to modify parameters.

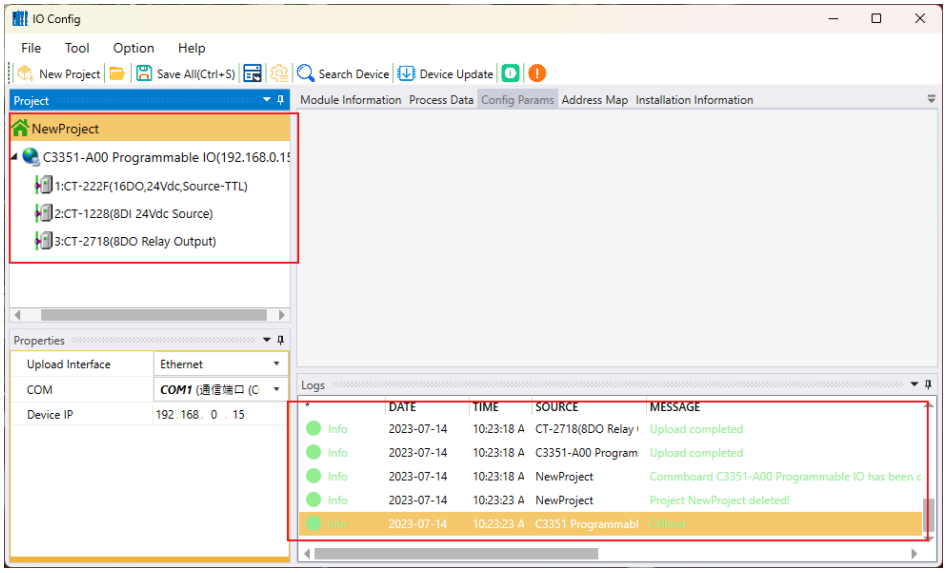
NOTICE
DEVICE INOPERABLE ·For the time being, C3351 can only modify parameters through the Ethernet interface. **Failure to follow the above instructions could result in damage to the equipment.**

Take C3351 PLC and CT-222F, CT-1228, CT-2718 and other modules as examples to demonstrate module parameter configuration.

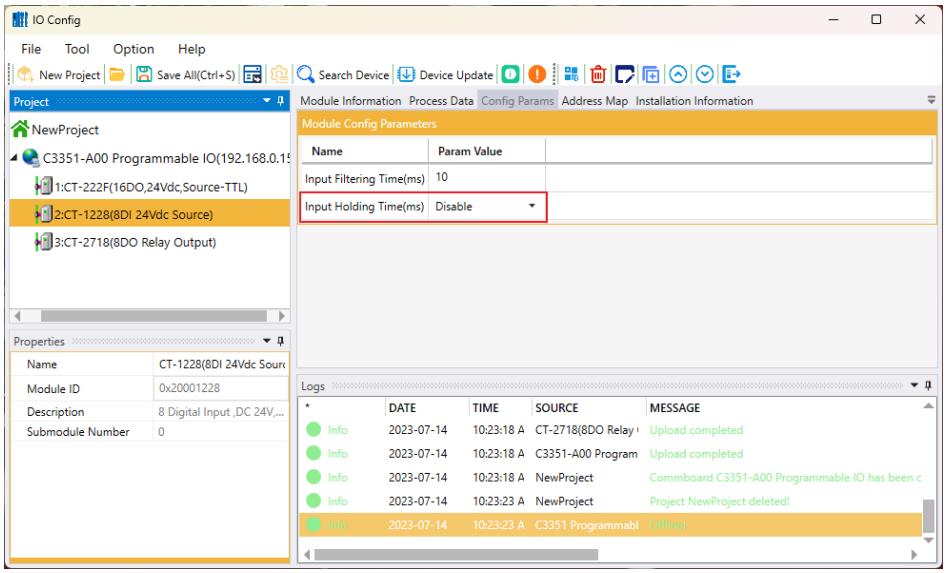
C3351 uses the Ethernet configuration interface, and uploads the device according to the steps in the figure below.

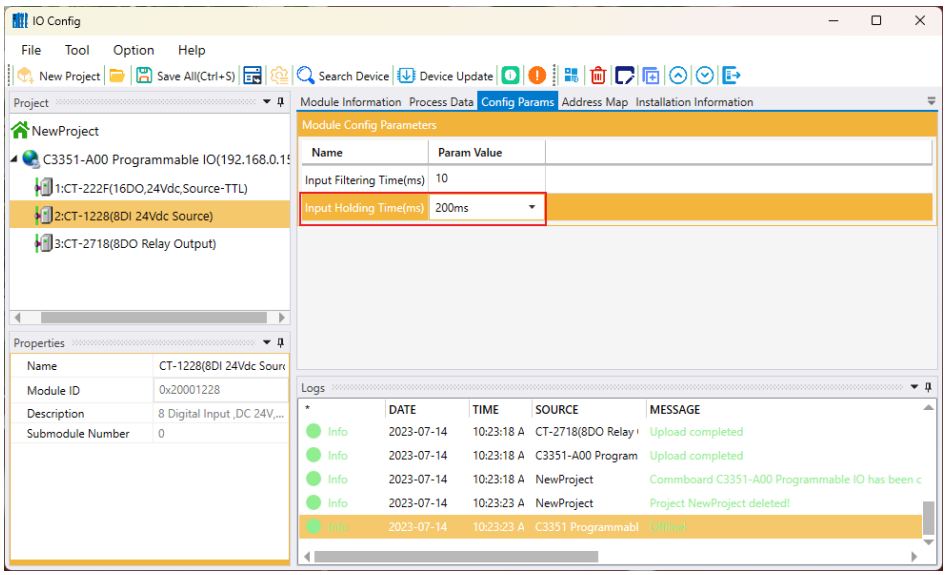


The software will automatically create the project, as shown in the figure below.

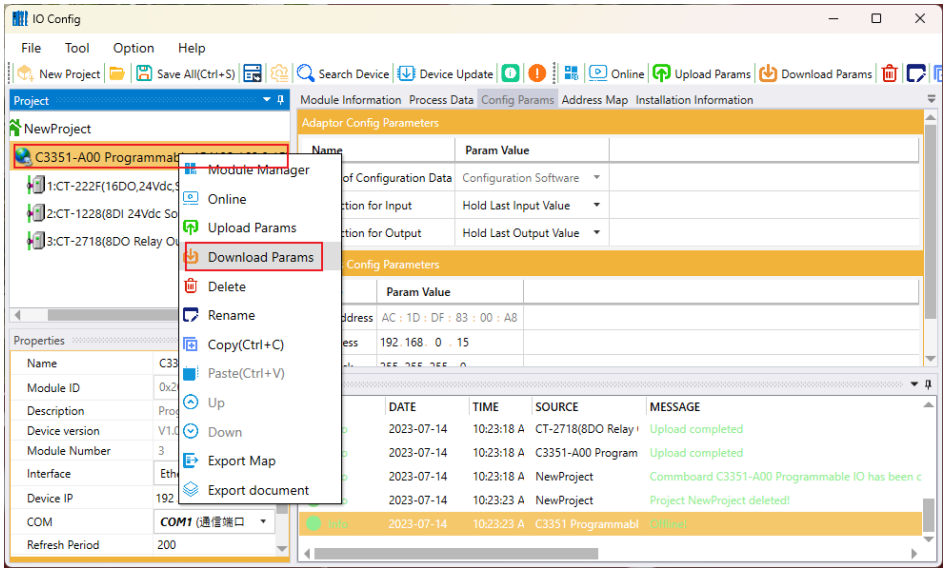


Then modify the parameters of the module.

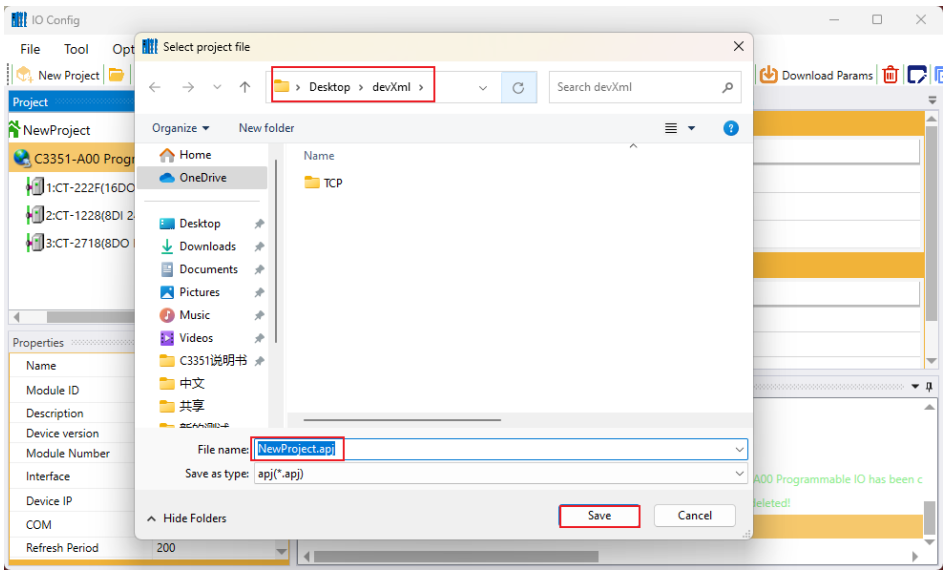




After the setting is complete, right click on the C3351 device in the project directory bar → 'Download Params'. It can realize the modification of configuration parameters of C3351 equipment and I/O modules.



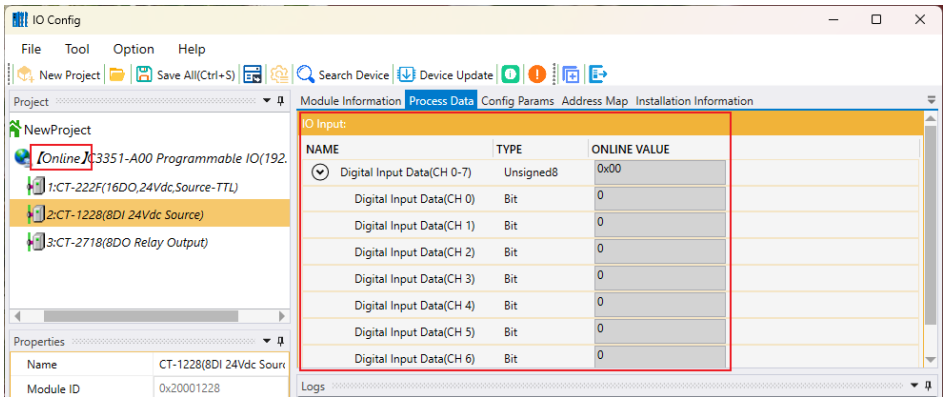
After modifying all module parameters, click the shortcut key 'Save All' or press the keyboard shortcut key 'Ctrl + S' to save the entire configuration project file.



4.3.6 Online Debugging

Refer to chapter 4.3.5 Modify Configuration Parameters , please search device and upload the project, then right click C3351 device and select Online. The real-time data of I/O modules can be monitored on the "Process Data" interface of the main window.

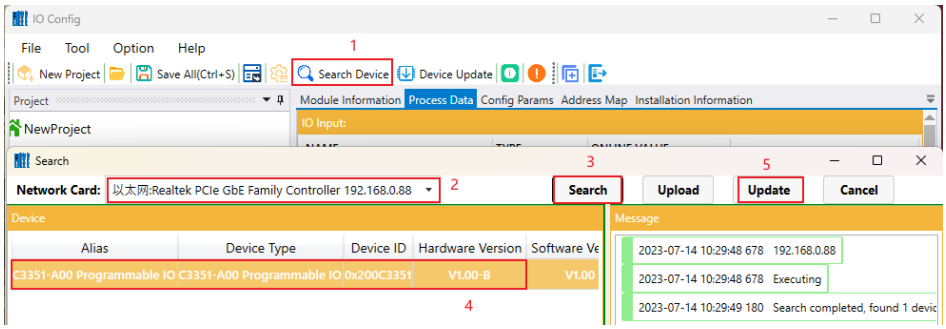
Example: The CT-1228 module in slot 2, as shown in the figure below, it can view the real-time changes of IO points.



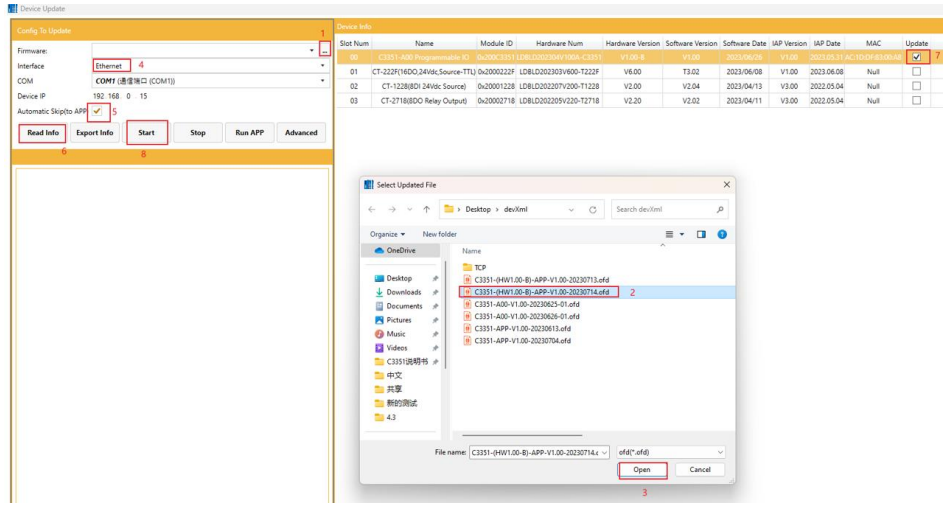
Note: For digital input modules, it could right-click the module and manually add a 'counting sub-module'. After the addition is complete, the configuration must be downloaded again.

4.3.7 Device Firmware Upgrade

Open the IO-Config configuration software and follow the steps in the figure below.



In the pop-up interface, it needs to set the upgrade file, and select the interface to set 'Ethernet', then 'Read Info', and selects the device to be upgraded, and sets 'Automatic Skip (to APP) ', then click 'Start ' and wait for the upgrade to complete.

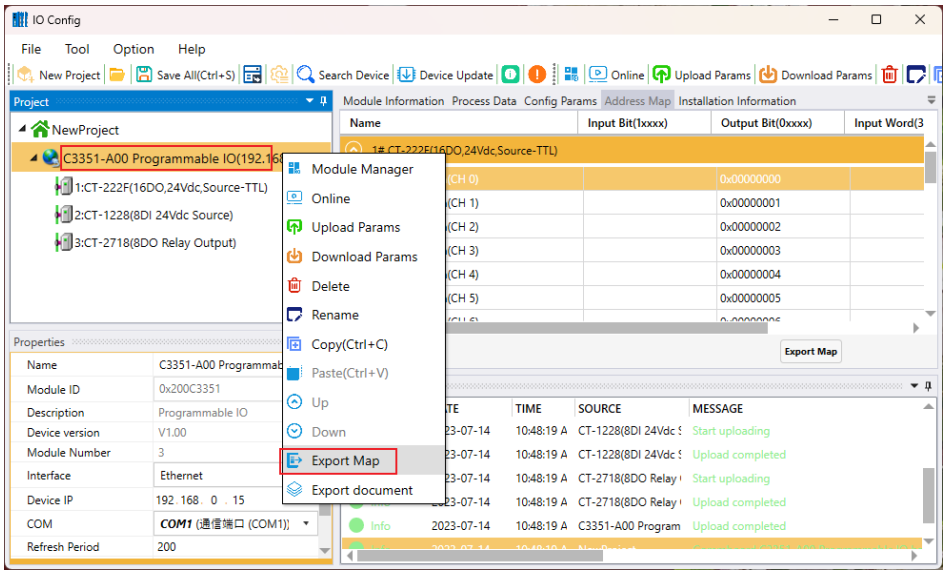


The above is the firmware upgrade process. Similarly, it can use this method to upgrade the equipped I/O module.

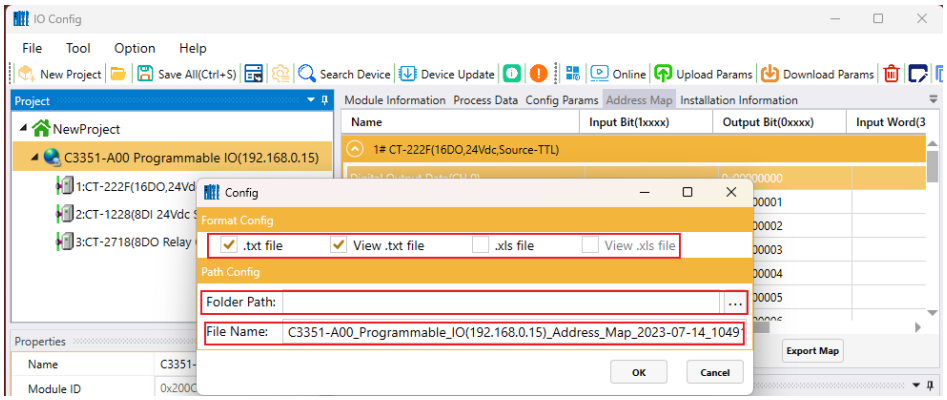
4.3.8 Data Export

Export Address Table

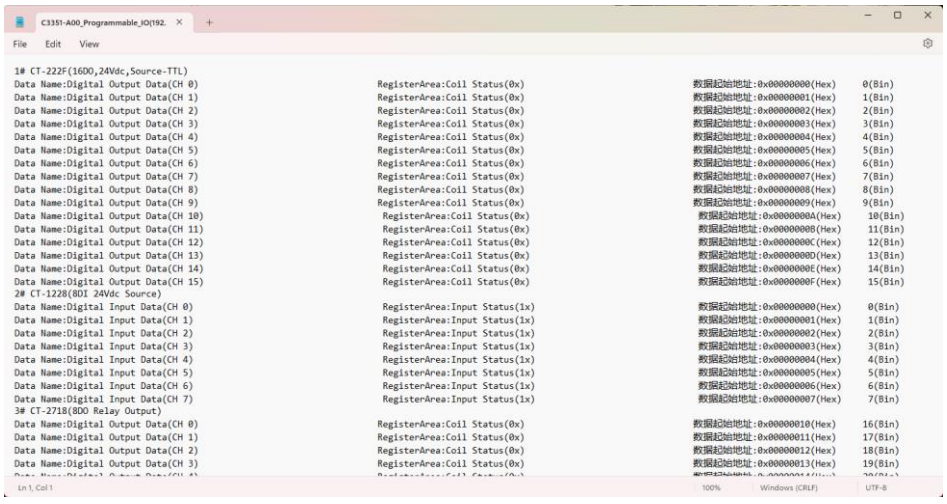
After the project is established, pls right-click on 'C3351 Device' and select 'Export Map'.



In the pop-up window, it could select the file format, output Folder Path, and File Name, and then click OK.

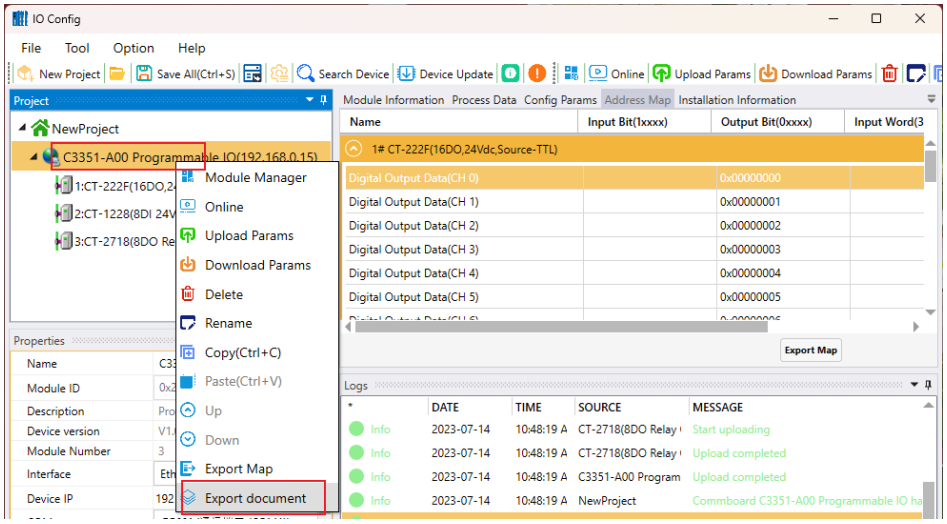


An example of the generated file is as follows:

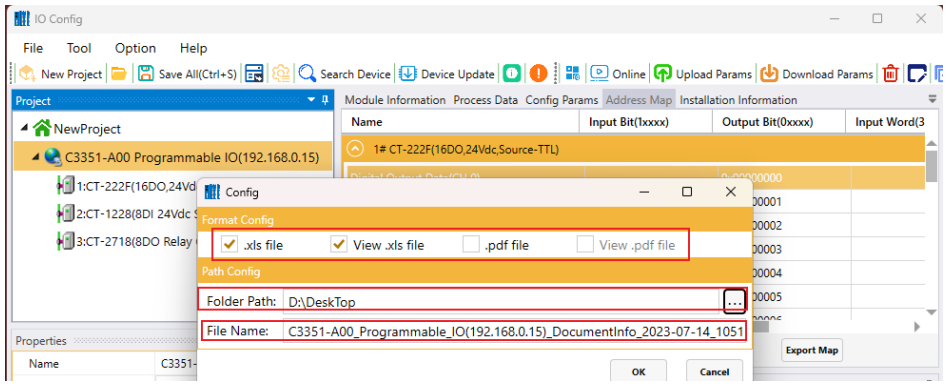


Export Document

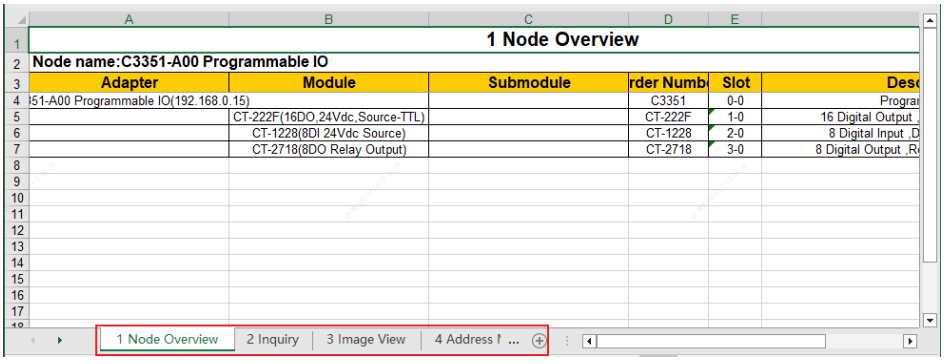
After the project is established, please right click on the C3351 device and select Export Document.



In the pop-up window, please select the file format, output Folder Path, and File Name, and then click OK.



The example of the generated file is as follows, and a total of 5 aspects of information are generated, including the overview of the submodules, the statistics of the number of submodules, the schematic diagram of the submodules, the address table, and the parameter settings of the submodules:



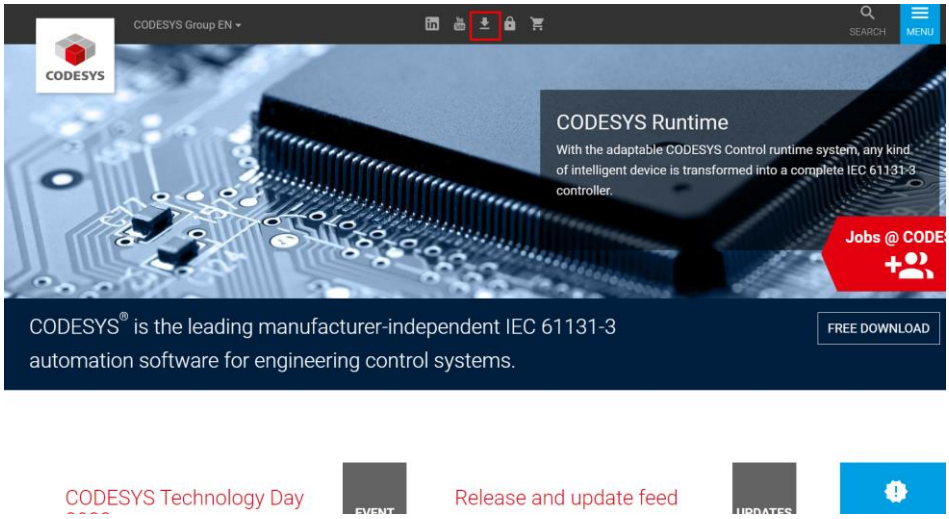
5 Programming Software（CODESYS）

5.1 Programming software installation

Please go to CODESYS official website to download the latest version or install it according to the software installation package provided by our company. Here, the SP19 version is used as an example to install and demonstrate.

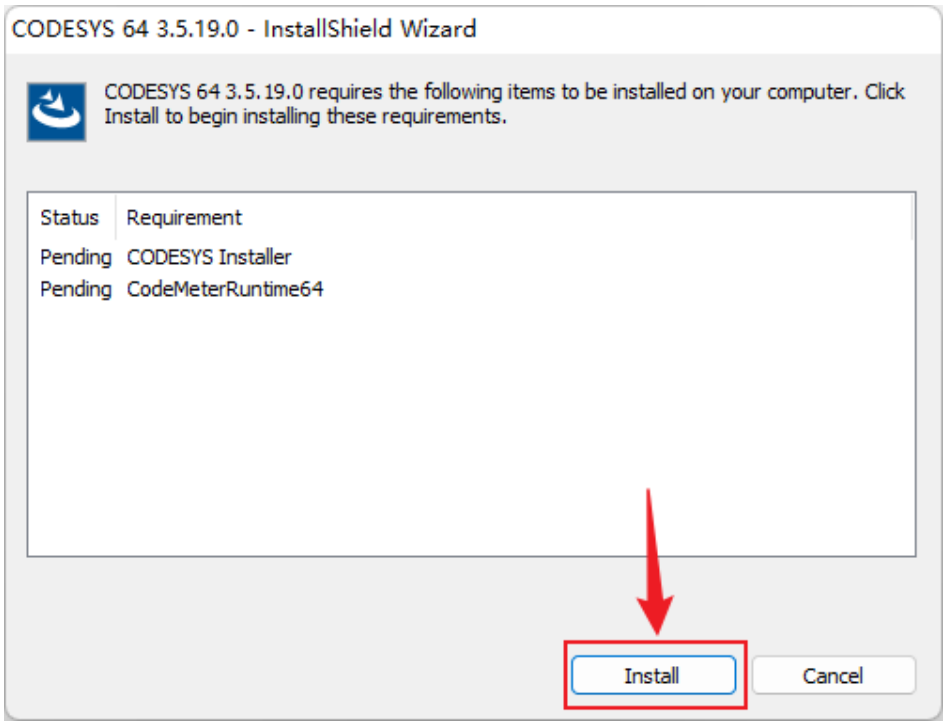
Please log in https: //www.codesys.com/， then find the download area and click：

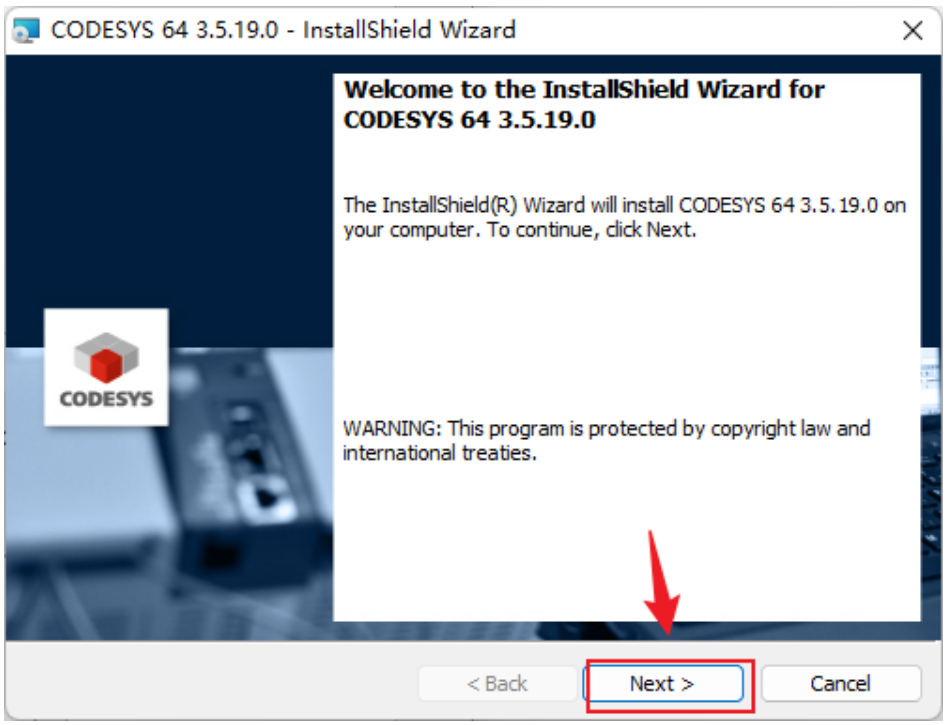
Attention
Device inoperable This website is not the website of our company, and our company has nothing to do with the loss caused by visiting this website. **Failure to follow the above instructions could result in damage to the equipment.**

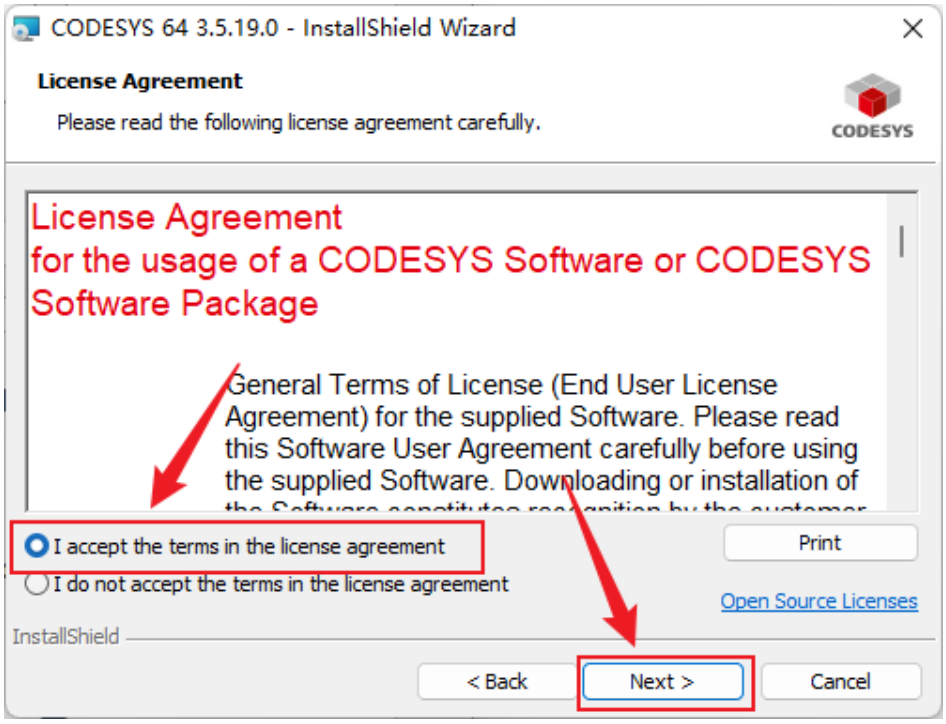


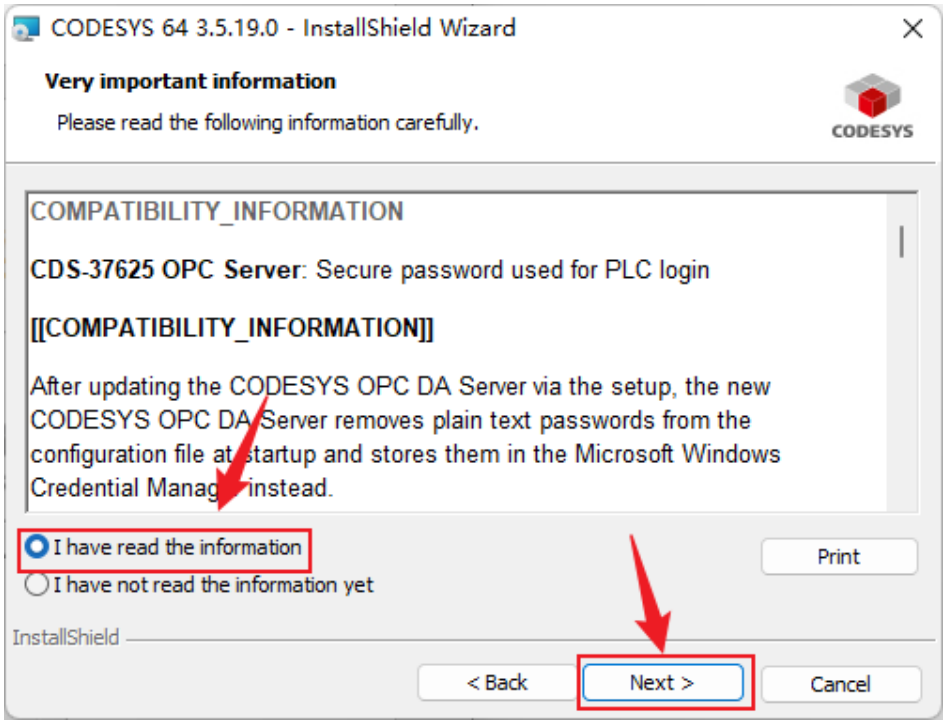
Then enter the download page, https: //store.codesys.com/de/， then select the appropriate installation package to download according to the configuration of the computer:

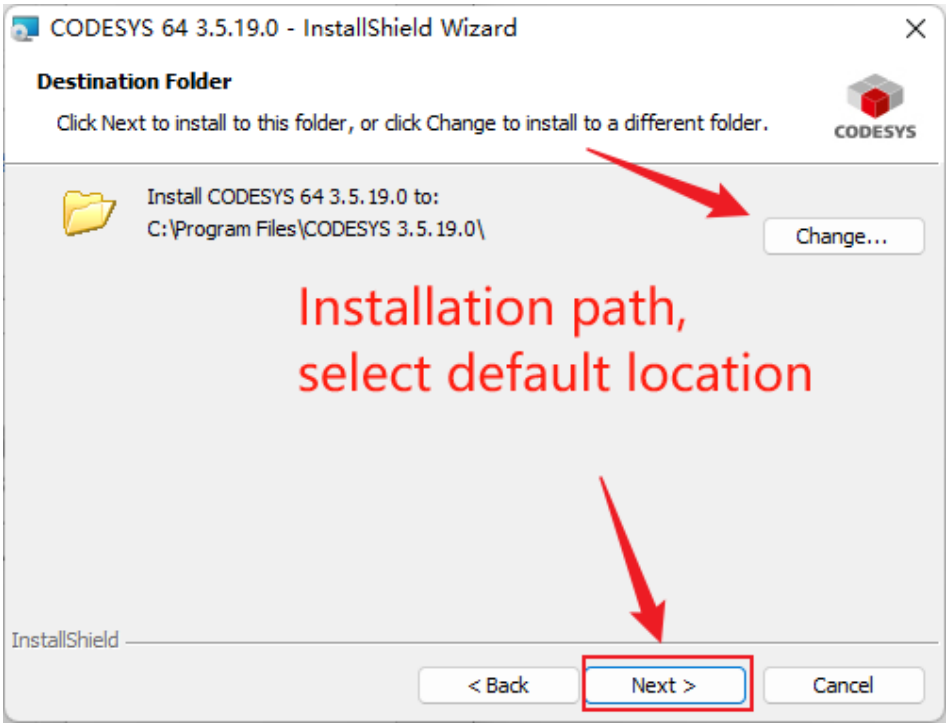
Double-click after getting the installation package, and follow the steps in the pop-up window:

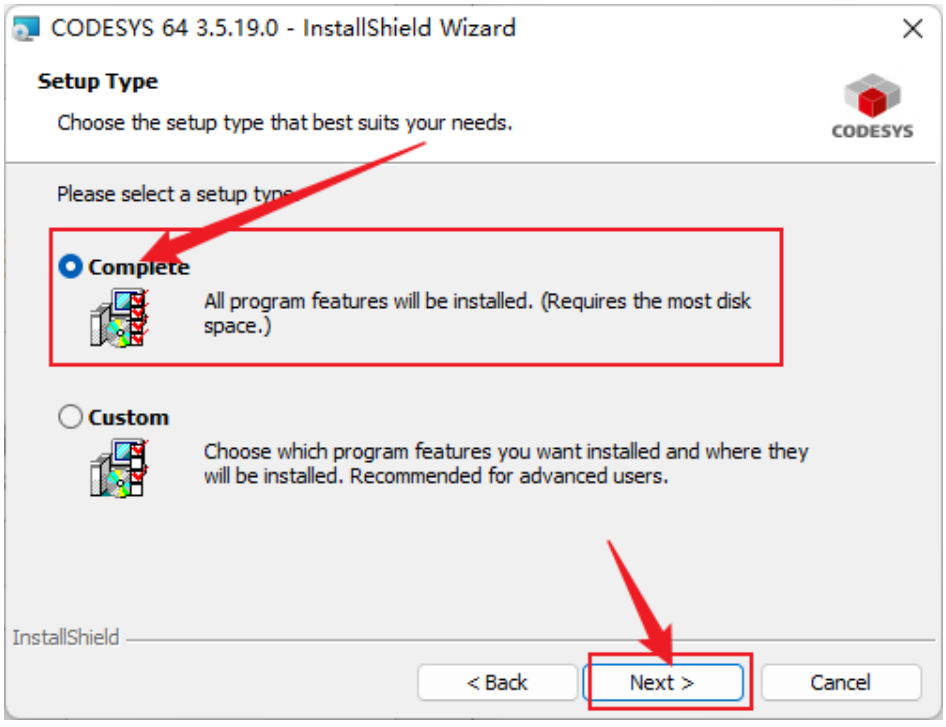


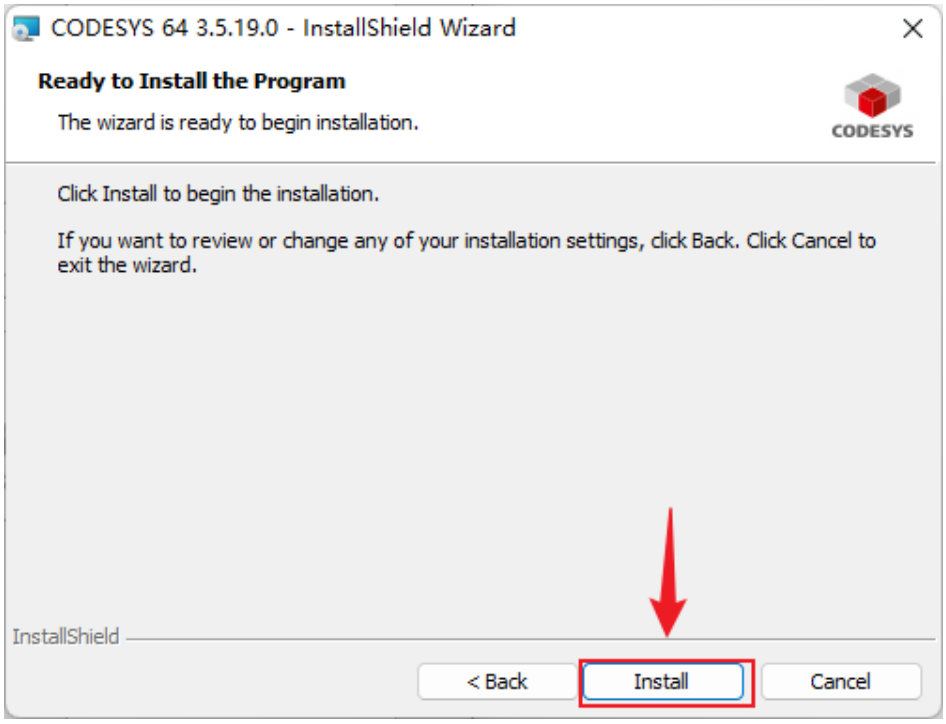



CODESYS 64 3.5.19.0 - InstallShield Wizard
License Agreement
Please read the following license agreement carefully.
CODESYS
License Agreement
for the usage of a CODESYS Software or CODESYS Software Package
General Terms of License (End User License Agreement) for the supplied Software. Please read this Software User Agreement carefully before using the supplied Software. Downloading or installation of
I accept the terms in the license agreement
I do not accept the terms in the license agreement
Print
Open Source Licenses
InstallShield
< Back
Next >
Cancel


CODESYS 64 3.5.19.0 - InstallShield Wizard
Very important information
Please read the following information carefully.
CODESYS
COMPATIBILITY_INFORMATION
CDS-37625 OPC Server: Secure password used for PLC login
[[COMPATIBILITY_INFORMATION]]
After updating the CODESYS OPC DA Server via the setup, the new CODESYS OPC DA Server removes plain text passwords from the configuration file at startup and stores them in the Microsoft Windows Credential Manag instead.
I have read the information
I have not read the information yet
Print
InstallShield
< Back
Next >
Cancel


CODESYS 64 3.5.19.0 - InstallShield Wizard
Destination Folder
Click Next to install to this folder, or click Change to install to a different folder.
CODESYS
Install CODESYS 64 3.5.19.0 to:
C:\Program Files\CODESYS 3.5.19.0\
Change...
Installation path,
select default location
InstallShield
< Back
Next >
Cancel

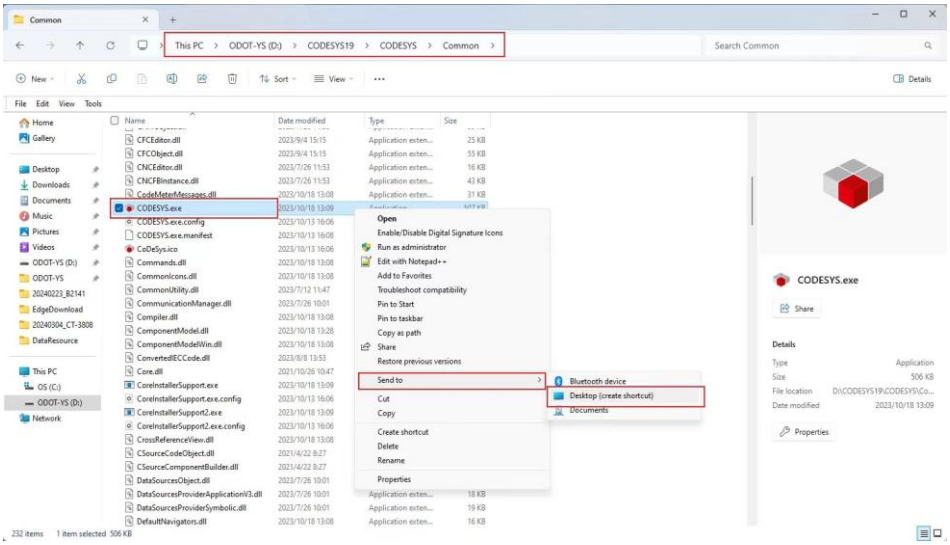

CODESYS 64 3.5.19.0 - InstallShield Wizard
Setup Type
Choose the setup type that best suits your needs.
CODESYS
Please select a setup type.
Complete
All program features will be installed. (Requires the most disk space.)
Custom
Choose which program features you want installed and where they will be installed. Recommended for advanced users.
InstallShield
< Back
Next >
Cancel



Just wait for the installation to be completed.

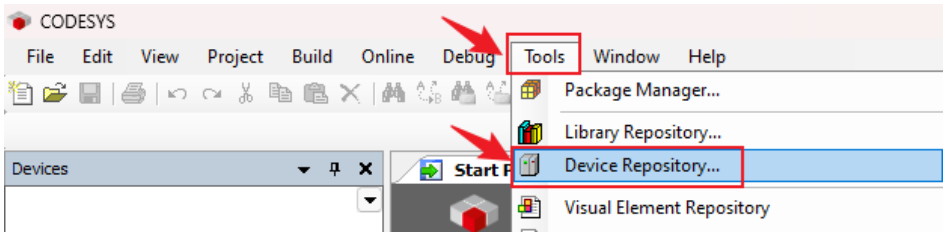
5.2 CODESYS Software Using

Find CODESYS.exe in the installation location, right-click to create a new desktop shortcut, and double-click on the desktop to run the CODESYS programming software.

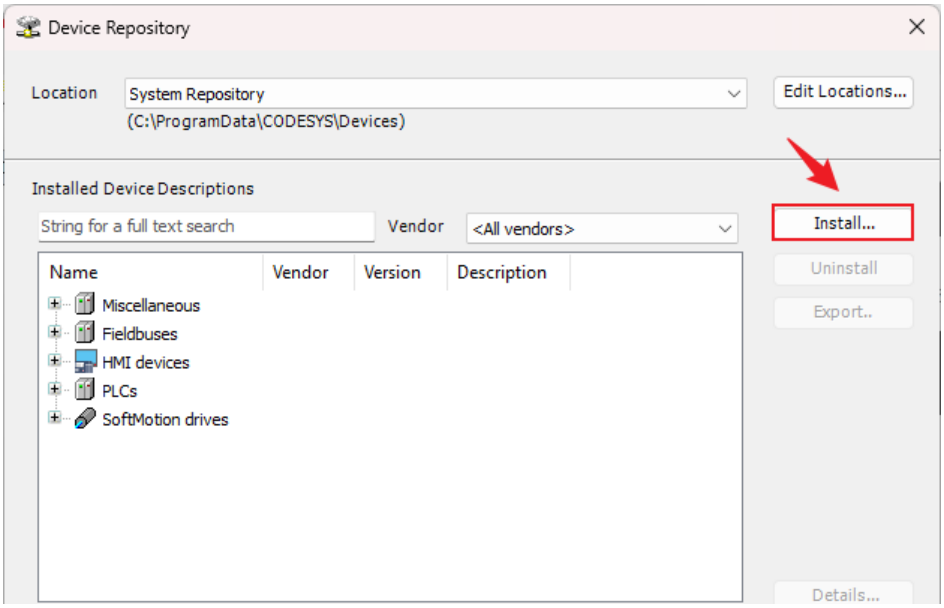


5.2.1 Create a project

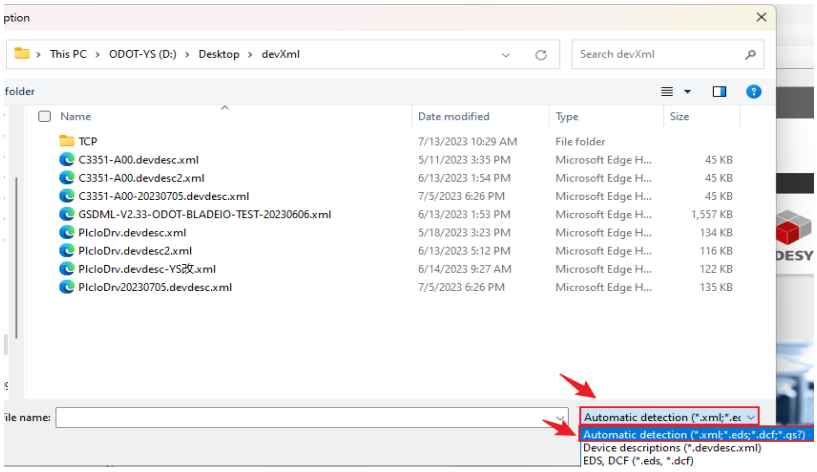
Firstly, open the CODESYS software and select 'Tools' - 'Device Storage Library' in the menu bar.



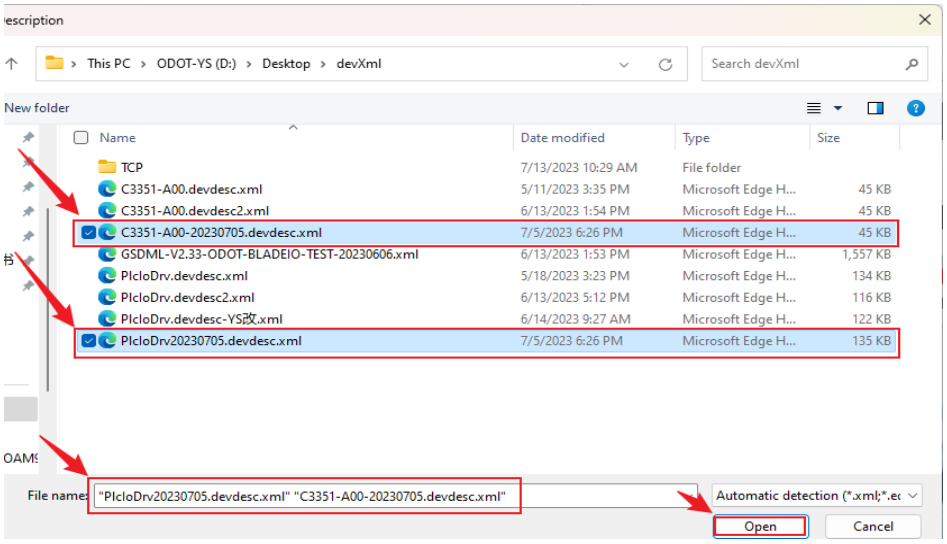
Select Install on the pop-up page.



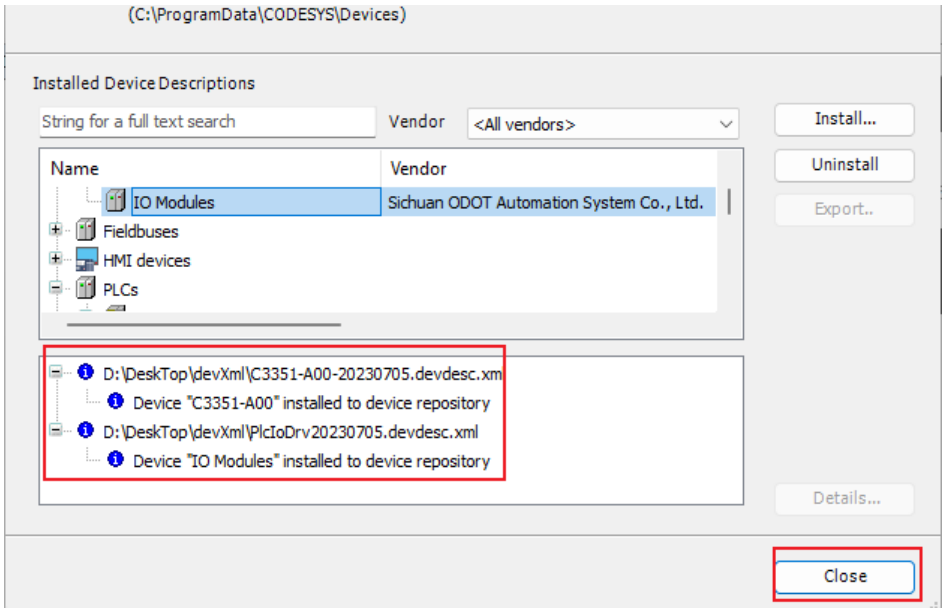
Select Automatically detect file types in the pop-up page.



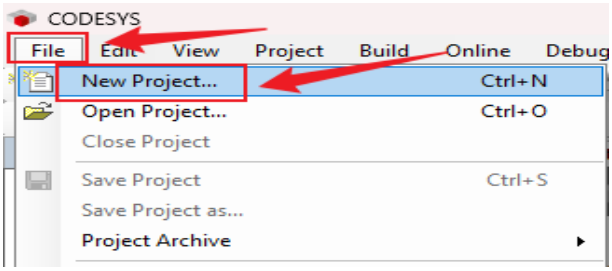
Select (multiple choice) the xml file provided by our company (including C3351 device and IO module) and open it



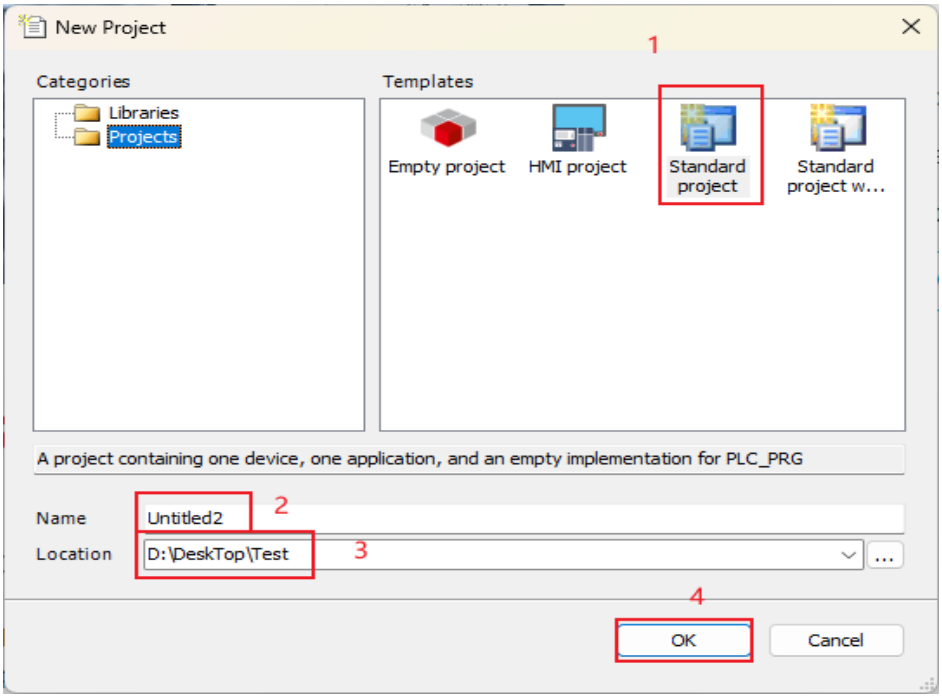
Close the device repository interface when done.



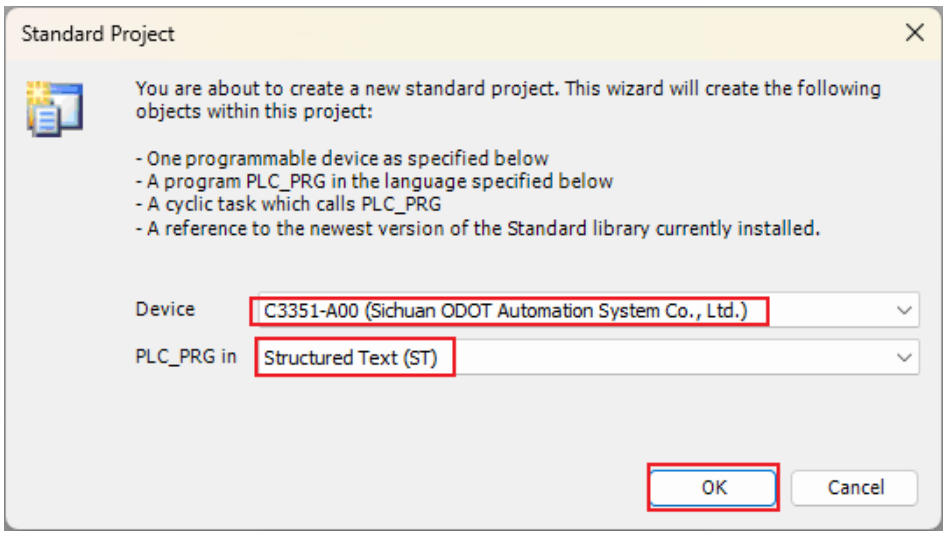
Select 'File' → 'New Project' from the menu bar.



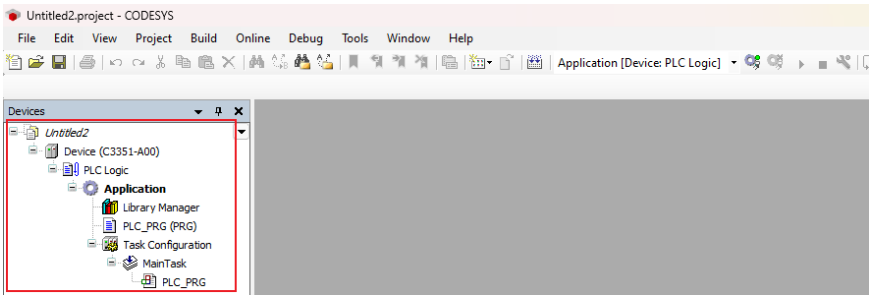
Select Standard Project in the pop-up menu, name it and select a storage location, and then click OK.



Then the device creation page will pop up automatically, select the C3351 device and confirm.



Wait for a while, and the software will automatically create a standard project file tree for the user.



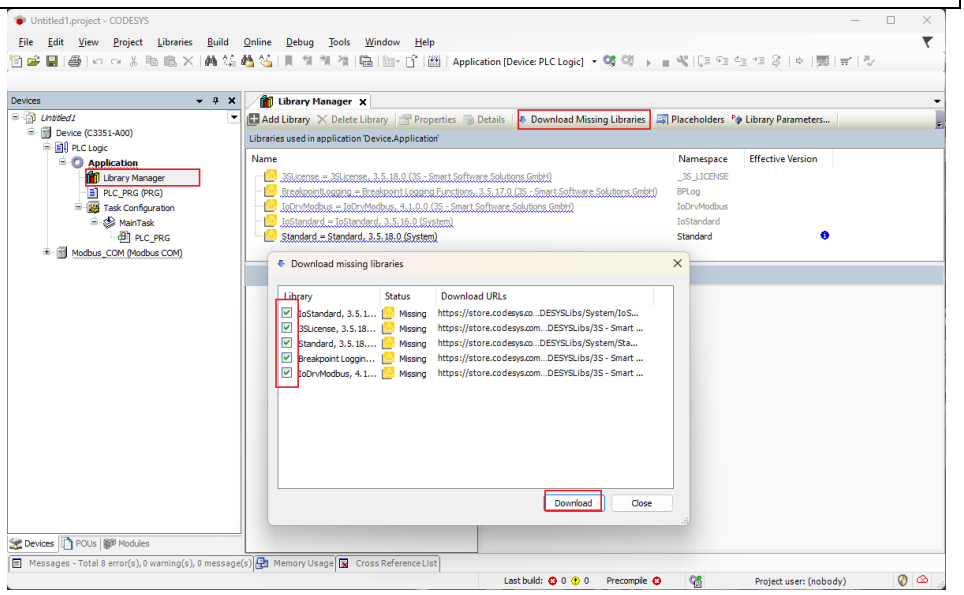
So far, the project has been established.

Attention

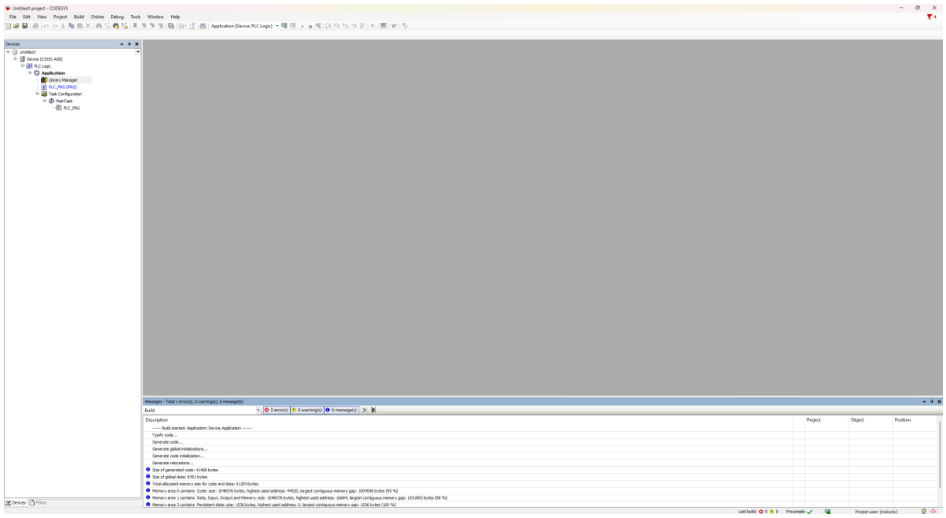
DEVICE INOPERABLE

The first time when install CODESYS and build a project to compile, it will find many missing items. The solution is to open the library manager, then click Download the missing library-select all-start download, wait for the download to complete, and compile again.

Failure to follow the above instructions could result in damage to the equipment.



5.2.2 CODESYS Software Interface

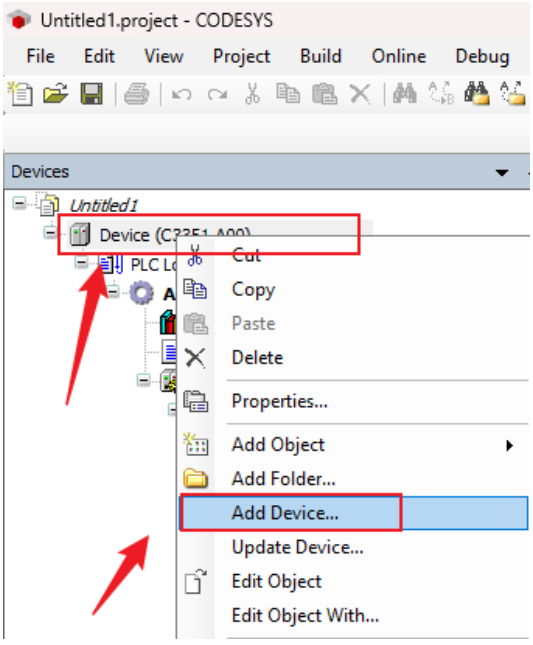


For detailed function introduction, please refer to "The BOOK of CODESYS"., https: //us.store.codesys.com/the-book-of-codesys.html.

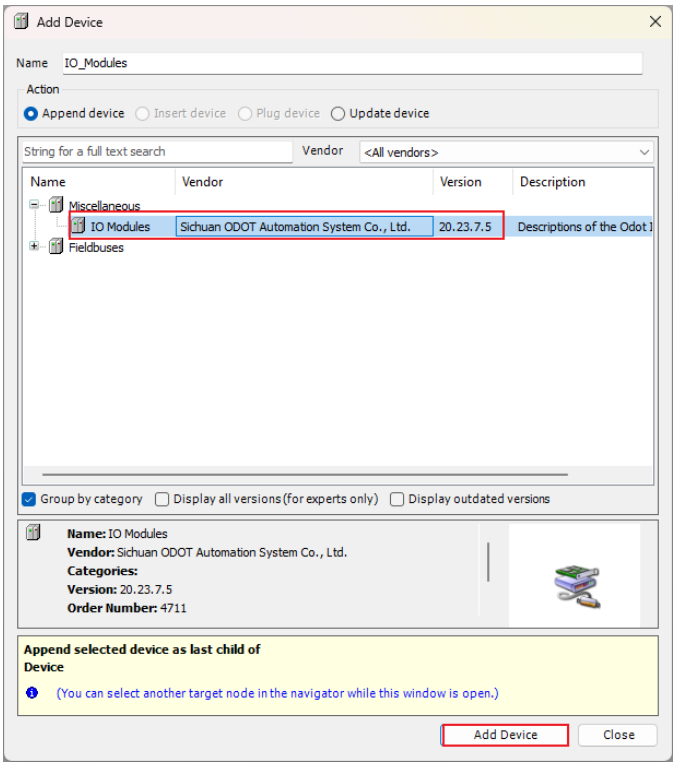
NOTICE
DEVICE INOPERABLE This basic programming and application guide are not written by our company. **Failure to follow the above instructions could result in damage to the equipment.**

5.2.3 Configure the IO module

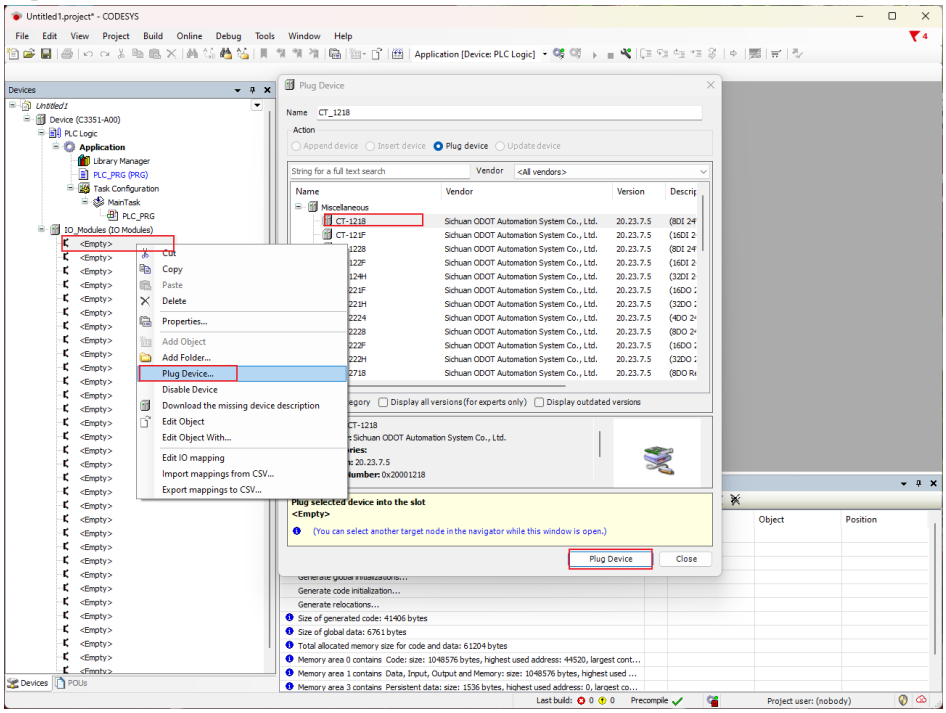
Firstly, after the project is established, right-click the C3351 device icon → 'Add Device'.



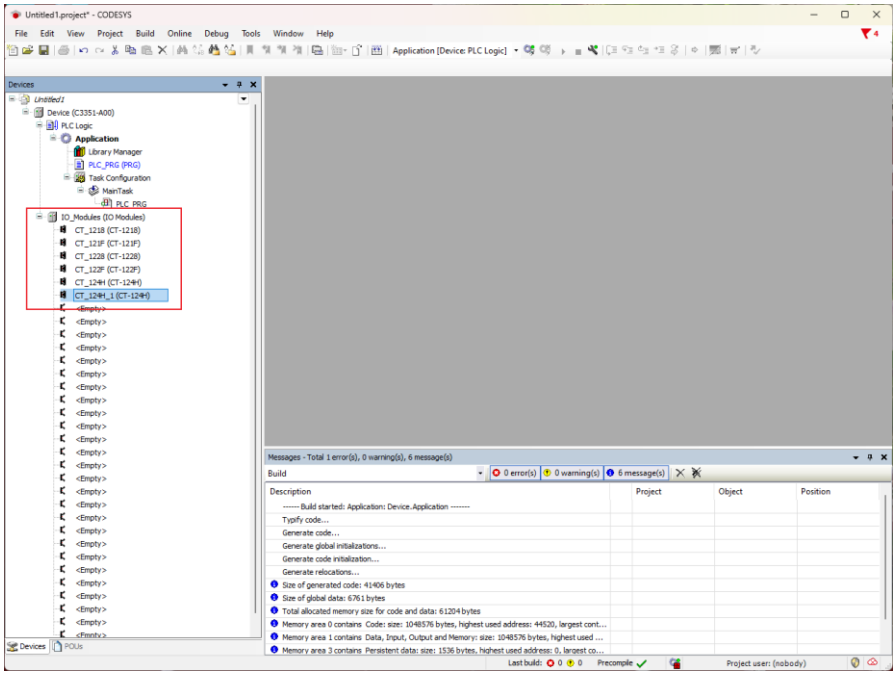
Find the IO-Modules device provided by our company in the pop-up window, select it and click 'Add Device', you don't need to close this page after adding.



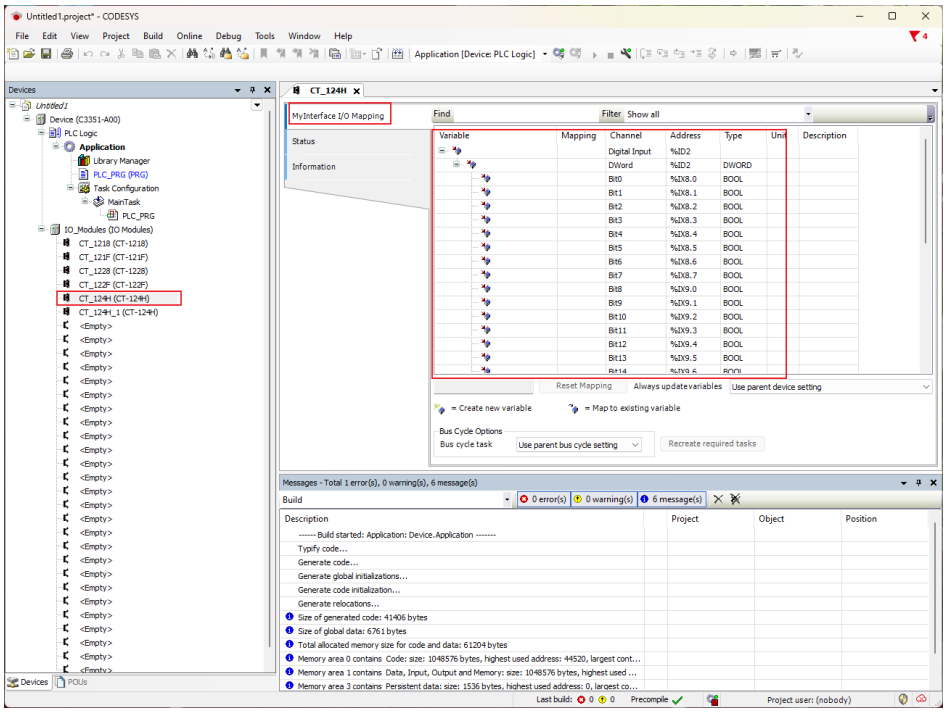
Then select the 'empty' slot, right-click and select 'Insert Device', and insert the required module. For the function of the module, refer to the 1.7Selection Table .



The figure below is the view after inserting the module：



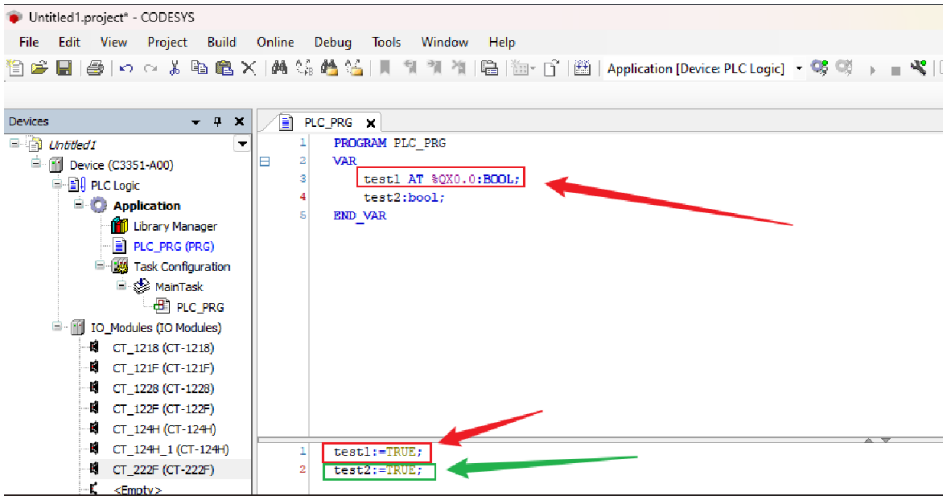
Double-click the corresponding module to view the corresponding I/O address and set the corresponding mapping relation.

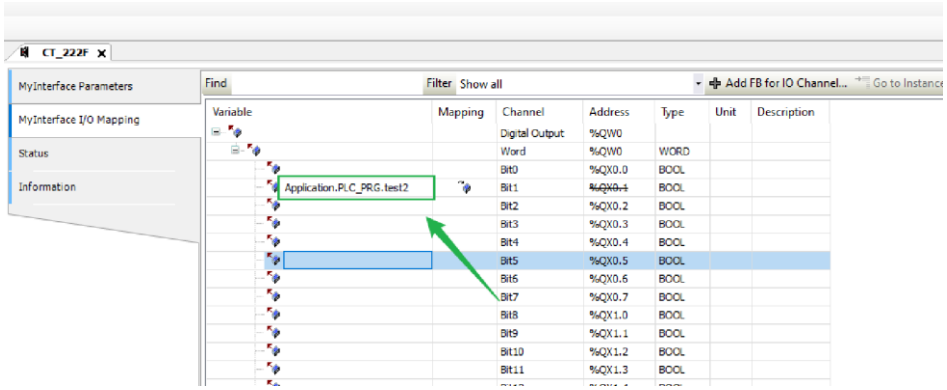


5.3 Programming

This chapter is recommended to try after referring to "The BOOK of CODESYS"., https: //us.store.codesys.com/the-book-of-codesys.html. ODOT-C3351 supports five programming languages including Instruction List (IL), Ladder Diagram (LD), Structured Text (ST), Function Block Diagram (CFC/FBD), and Sequential Function Chart (SFC).

In the project management tree, double-click the PLC_PRG (PRG) program under the program organization unit.

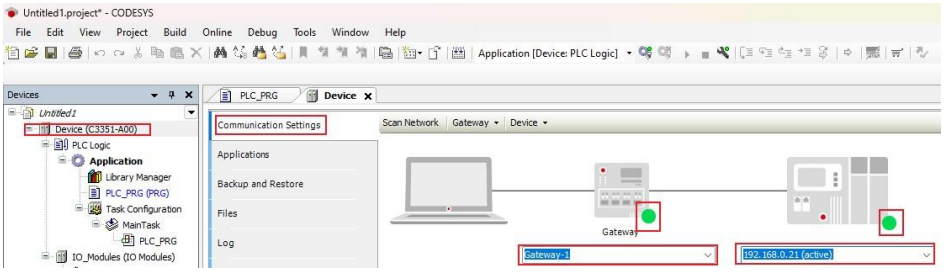




It could make a simple output variable assignment program, and observe the changes of the indicator lights of the C3351 physical equipment. Connect QX0.0 and QX0.1 of BT-221F to the variables test1 and test2 in two ways. The first way is the way marked in green in the above picture, and the second way is the way marked in red in the picture above. Two ways can associate channels with variables.

5.4 Download, Monitor

Double-click the device icon, enter the IP address of the C3351 device in the "Communication Settings" and press Enter, wait for the device to be activated successfully. For the IP address, refer to 4.3.4 view the configuration parameters the IP address of the C3351 device obtained from.



After activation, log in to the device and run the program. At this point, you can observe the change of the indicator light of the IO device. You can see that the indicator light of the first and second channels of BT-221F is lit, indicating that the program is successfully written.

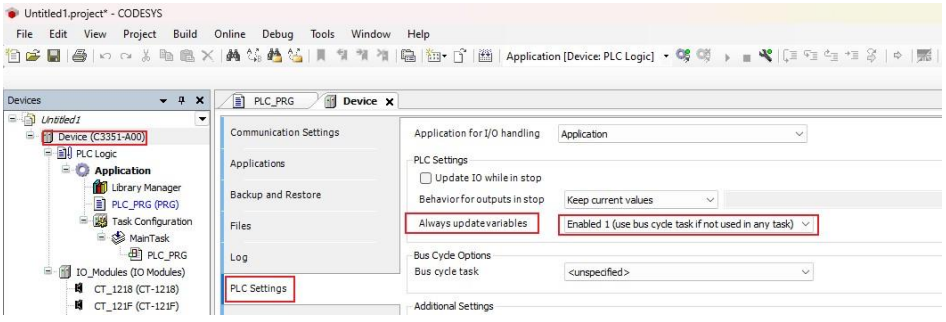
NOTICE

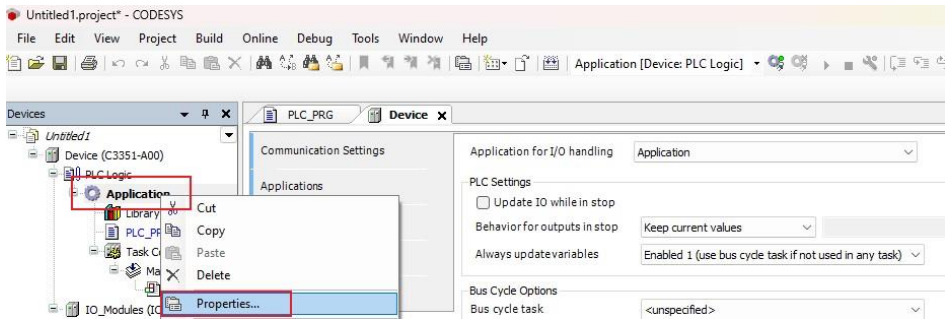
DEVICE INOPERABLE

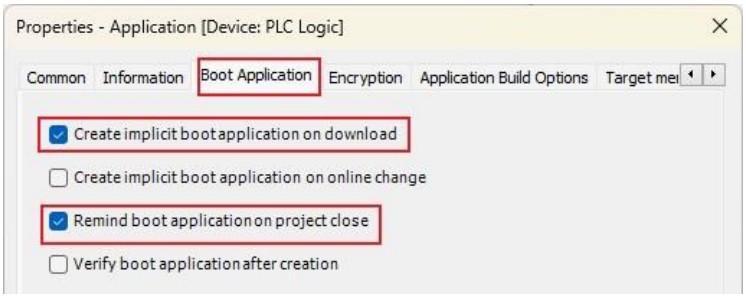
·To observe the current value of the I/O map in real time, it must set 'always update variables' to enable 1 in the PLC settings of the C3351 device.

·To run the PLC program as soon as the power is turned on, create an implicit start application in the Application-properties.

Failure to follow the above instructions could result in damage to the equipment.



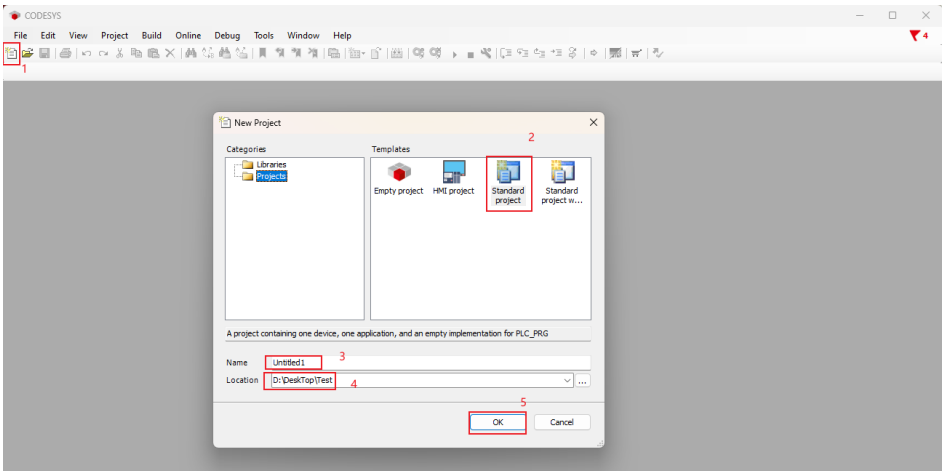




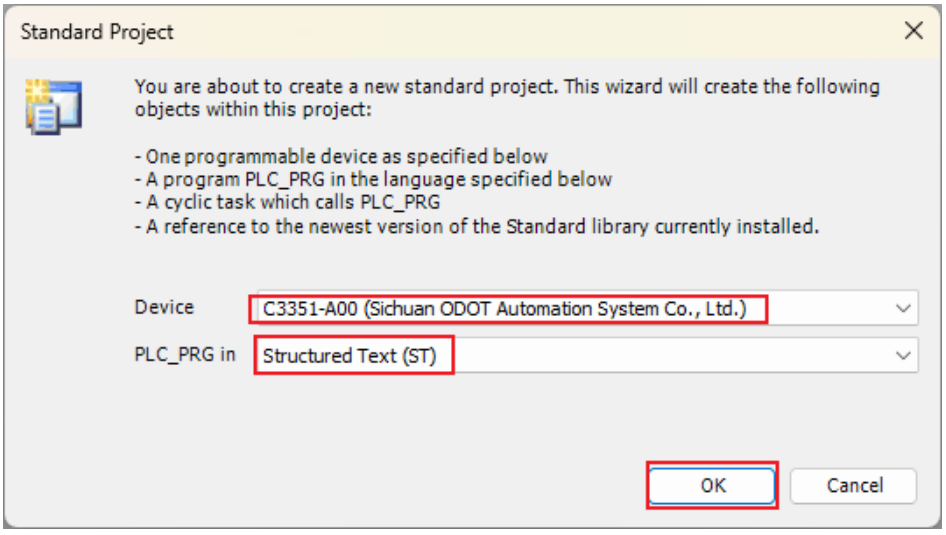
5.5 Modbus TCP client/server functionality

It is recommended to read Annex 7 before performing operations in this section.

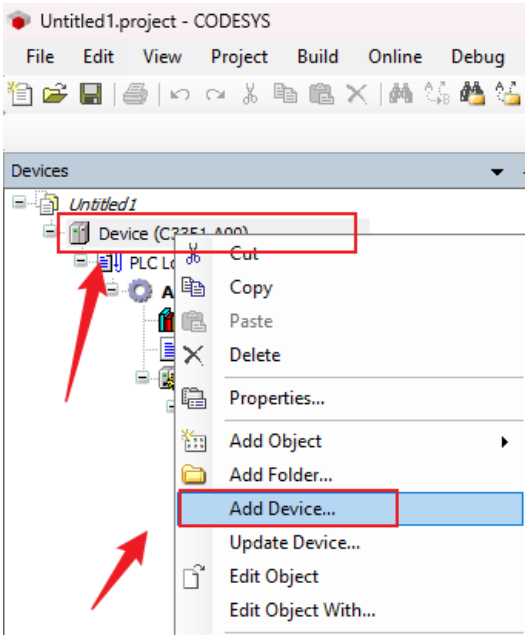
The first step is to establish the project, as follows:



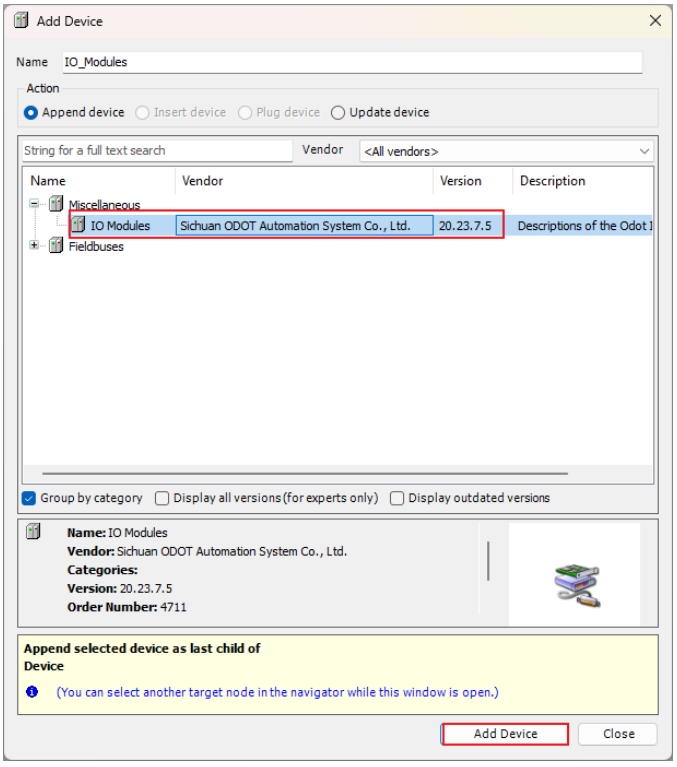
Then select the C3351 device. If the device cannot be found, please refer to 5.2.1 Create a project installation device description file.



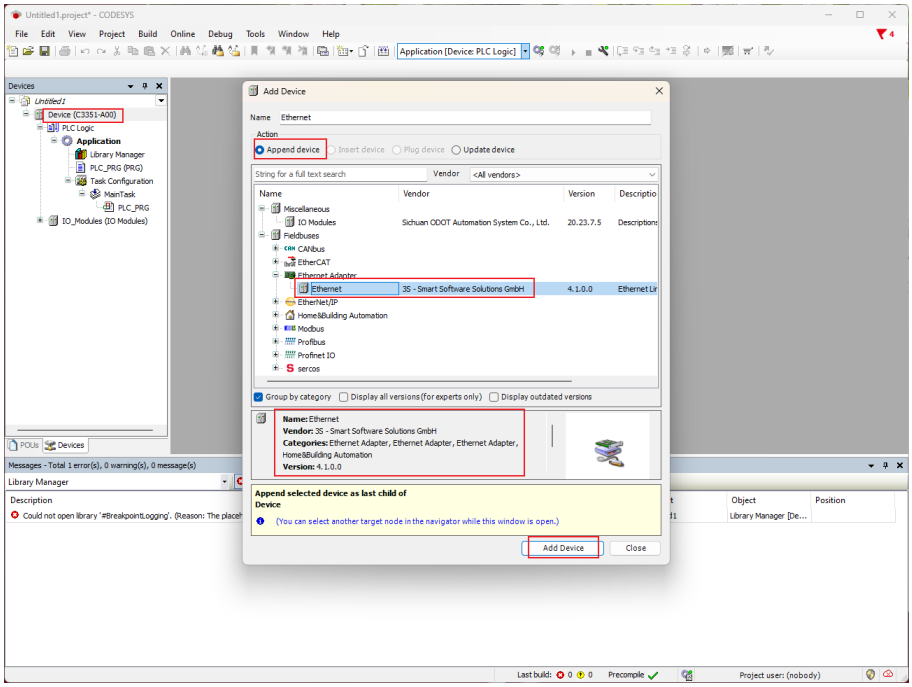
The project file tree will be created automatically, right click on the C3351 device → 'Add Device':



Add an 'IO Modules device' to the project in the pop-up interface. If this device is not found, refer to 5.2.1 to create a project and install device description file。

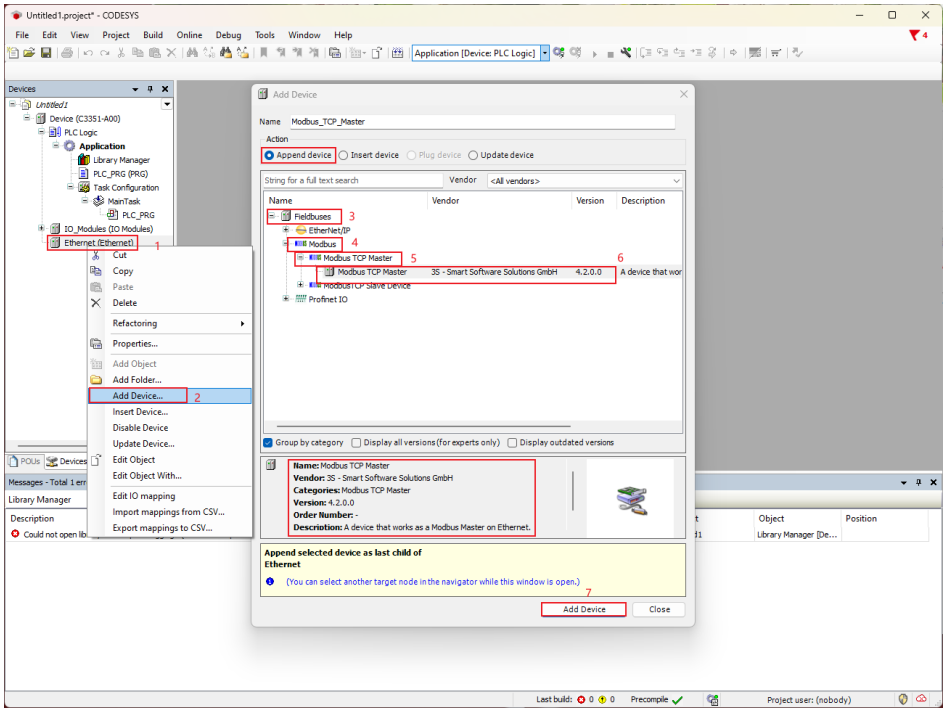


Similarly, find 'Ethernet Device' and add it to the project:

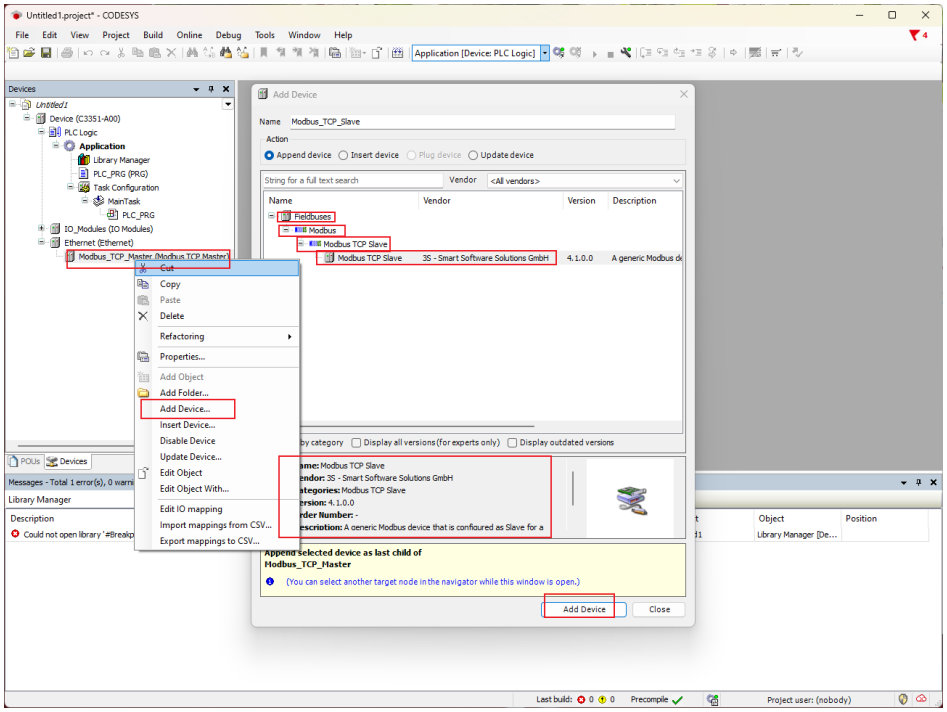


The next step is to create a TCP client and server:

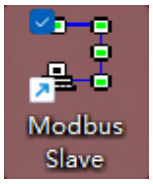
When treating C3351 as a client, right click on the Ethernet device in the project - 'Add Device' - add a device named 'Modbus TCP Master', the supplier is 3S – Smart Software Solutions GmbH.



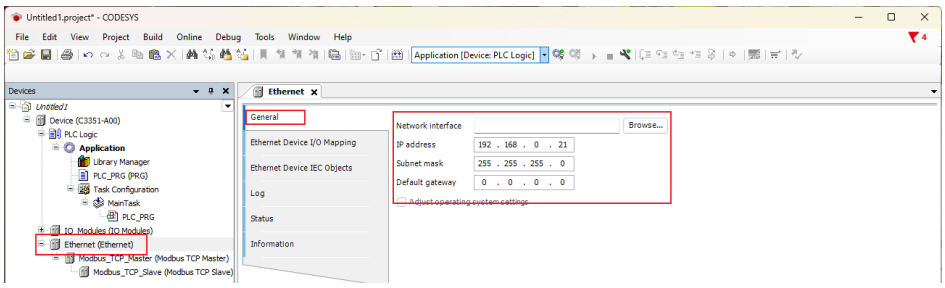
Similarly, right-click the 'Modbus TCP Master Device' just added to the project → 'Add Device' → add a device named 'Modbus TCP Slave', the supplier is 3S – Smart Software Solutions GmbH.



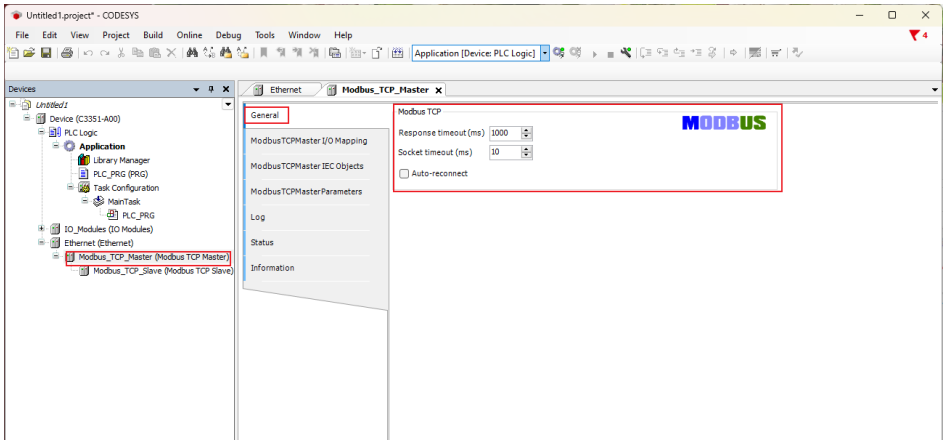
Next, let's set the parameters of the master station and the third-party slave station. Here, the third-party simulation software Modbus Slave is used to simulate the connection of the slave station device:



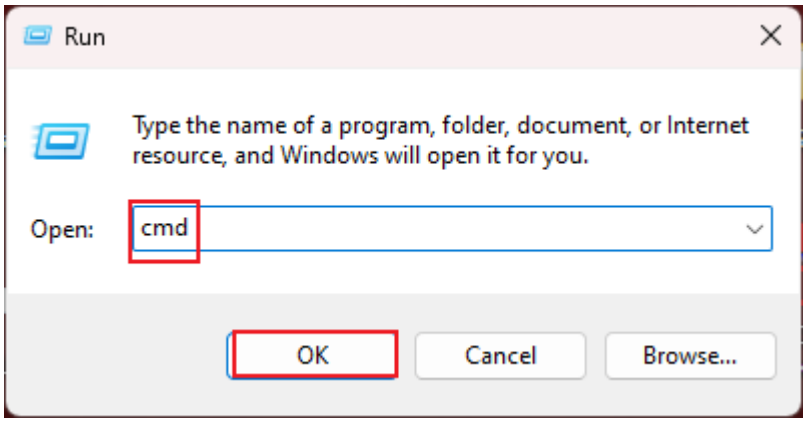
Double-click 'Ethernet Device' in the CODESYS interface - select 'General' in the main interface on the right, and we will see the settings of the network interface. For the IP address here, refer to 4.3.4 to view the configuration parameters the IP address of the C3351 device scanned by IO-Config, and fill it in:



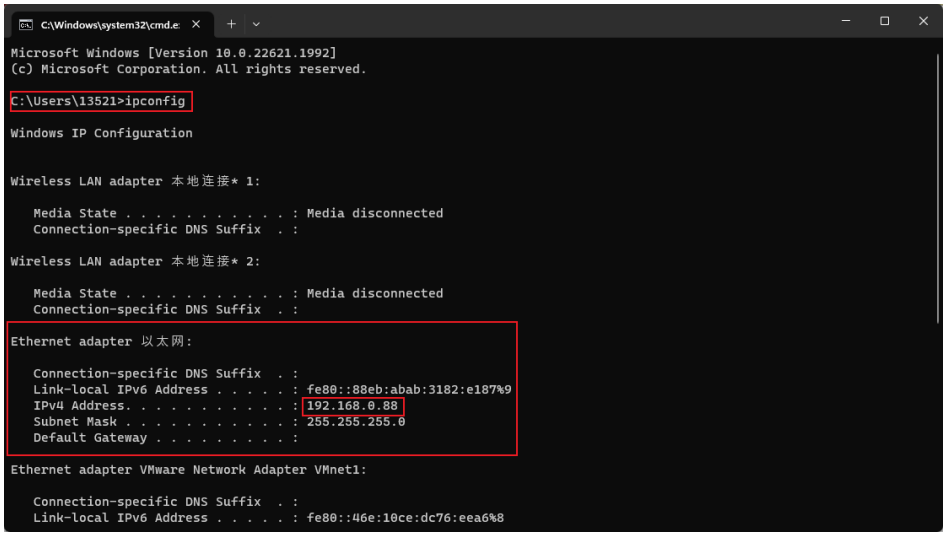
Similarly, double-click 'Modbus TCP Master Device' in the CODESYS interface → select the general setting of Modbus TCP's 'Response Timeout' time and 'Socket Timeout' time in the main interface on the right, and it is recommended to click the Auto-reconnect function:



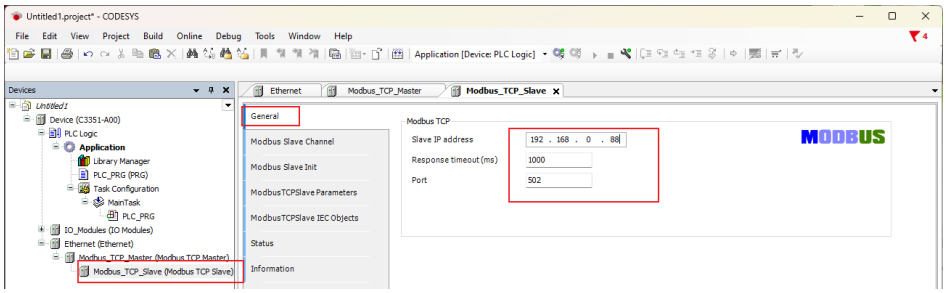
Similarly, double-click the 'Modbus TCP Slave device' in the CODESYS interface - select the general settings of Modbus TCP's 'slave station IP address', 'response timeout' time and 'port number' in the main interface on the right. This IP address is the IP address of the third-party slave station simulation software, that is, the IP address set by the local PC, press the Win+R key, enter CMD and press Enter:



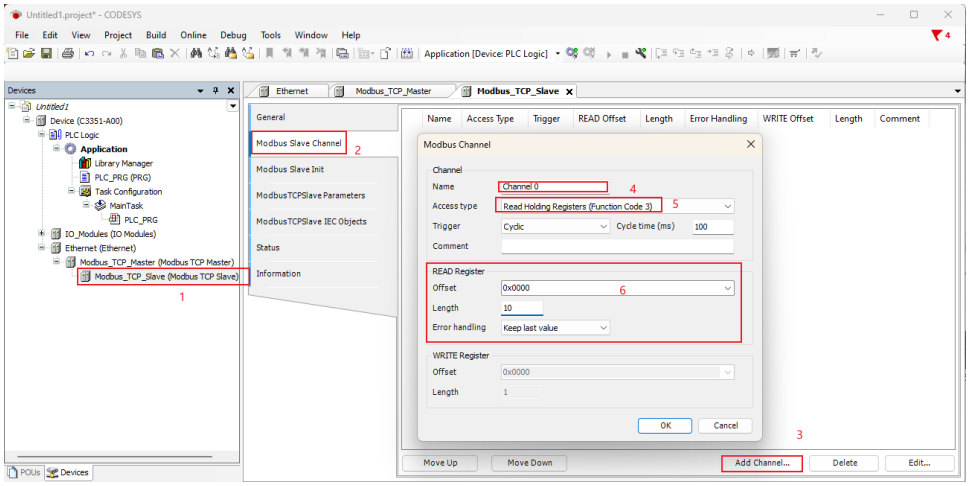
Enter ipconfig in the pop-up window and press Enter



It can be seen that the IPv4 address used here is 192.168.0.88, so the IP address of the slave station it should enter in the CODESYS interface is 192.168.0.88, and the port can be consistent with the port set by the third-party slave station. The setting here is 502.



Next, continue to set the Modbus slave station channel of the "Modbus TCP Slave device" →the step "Add Channel" as shown in the figure below, here a channel type of "Read Holding Registers" is added, and its length is 10 WORD:



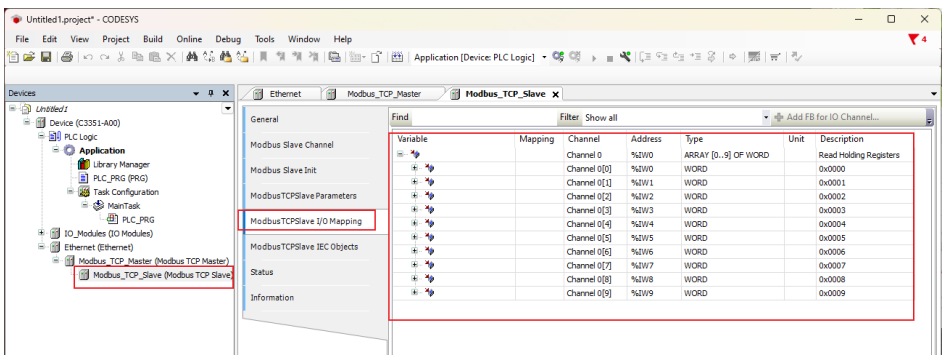
After the addition is complete, we can find that there is an option of 'Modbus TCP Slave I/O Mapping' in the menu on the right. Click this option to view the address mapped in the C3351 device by the channel just established.

NOTICE

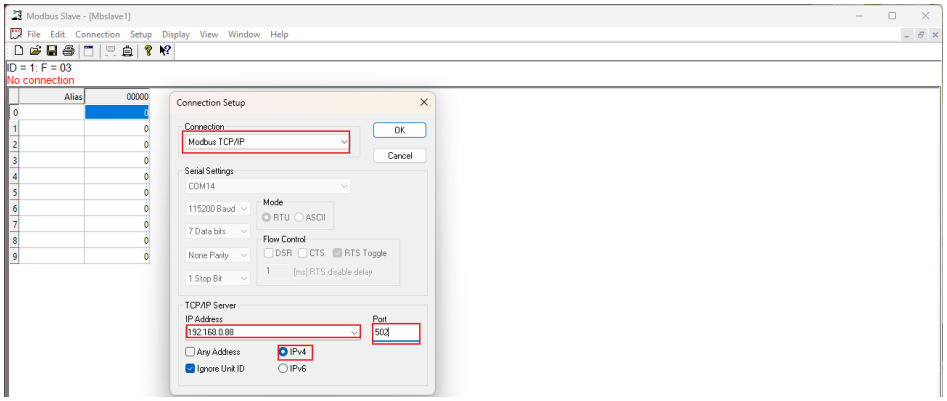
DEVICE INOPERABLE

·The channel length is limited, please refer to 3.3 Programming Specifications.

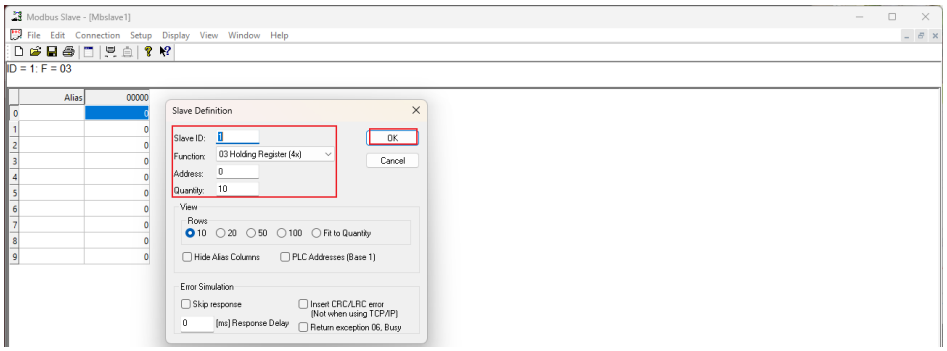
Failure to follow the above instructions could result in damage to the equipment.



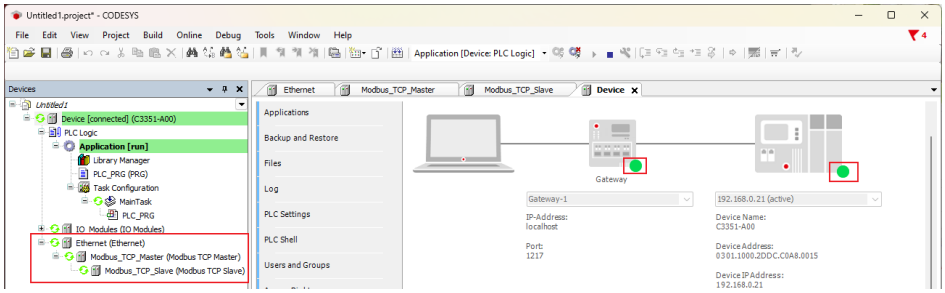
Next, we open the third-party slave station simulation software 'Modbus Slave', and press 'Ctrl+N' to create a new Mbslave1 window, and press 'F3' to connect, and then set the following settings on the pop-up page. The 'IP Address' should be filled in the 192.168.0.88 just checked through CMD:



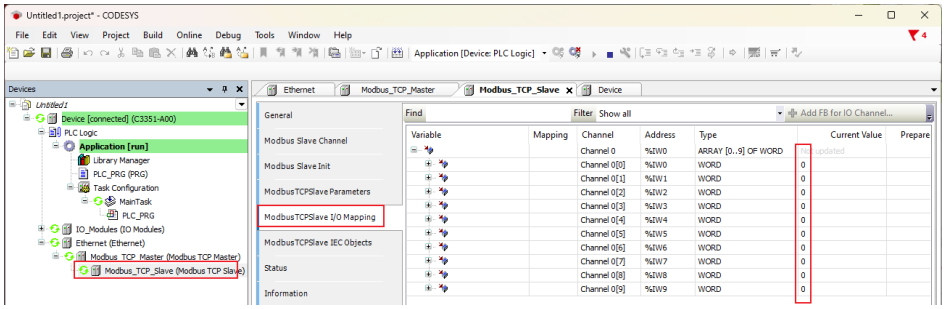
Right-click on the blank space of the Mbslave1 window - select 'Slave Definition', and set as follows in the pop-up window. The specific parameters should correspond to the channel parameters set by the 'Modbus TCP Slave device' in CODESYS. If the parameters do not correspond, it may cause errors and Communication exception:



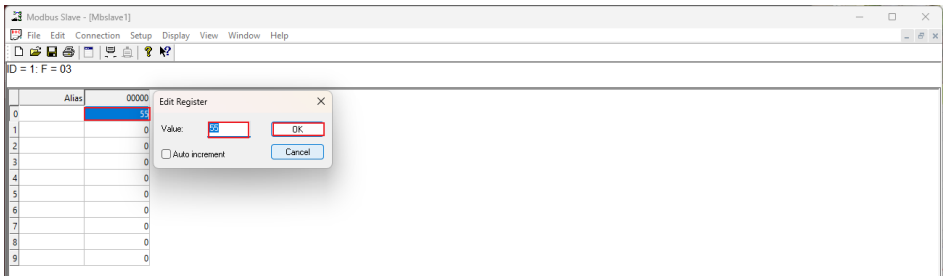
After completion, return to the CODESYS interface, download and log in to the C3351 device. For the method, refer to 5.4 download, monitor:



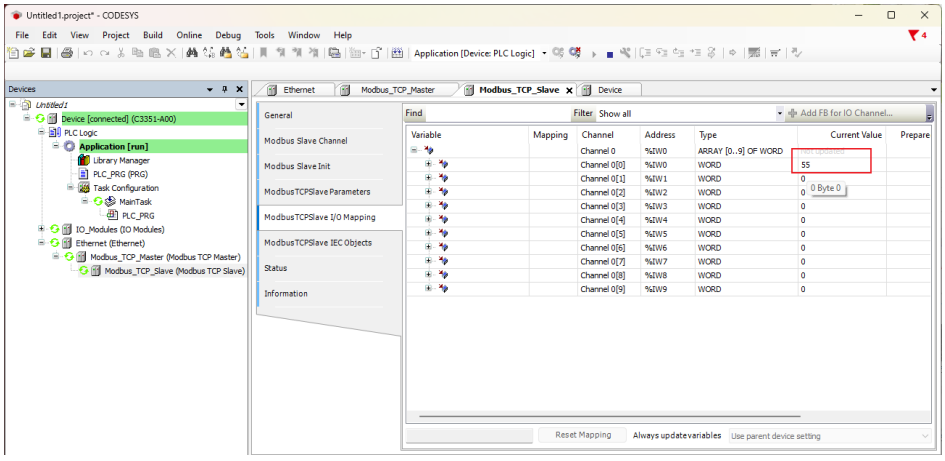
All devices are in the running state, indicating that the connection is successful. Now click on the 'ModbusTCPSlaveI/O Mapping' menu of the 'Modbus TCP Slave Device' to monitor the current value of the channel mapping:



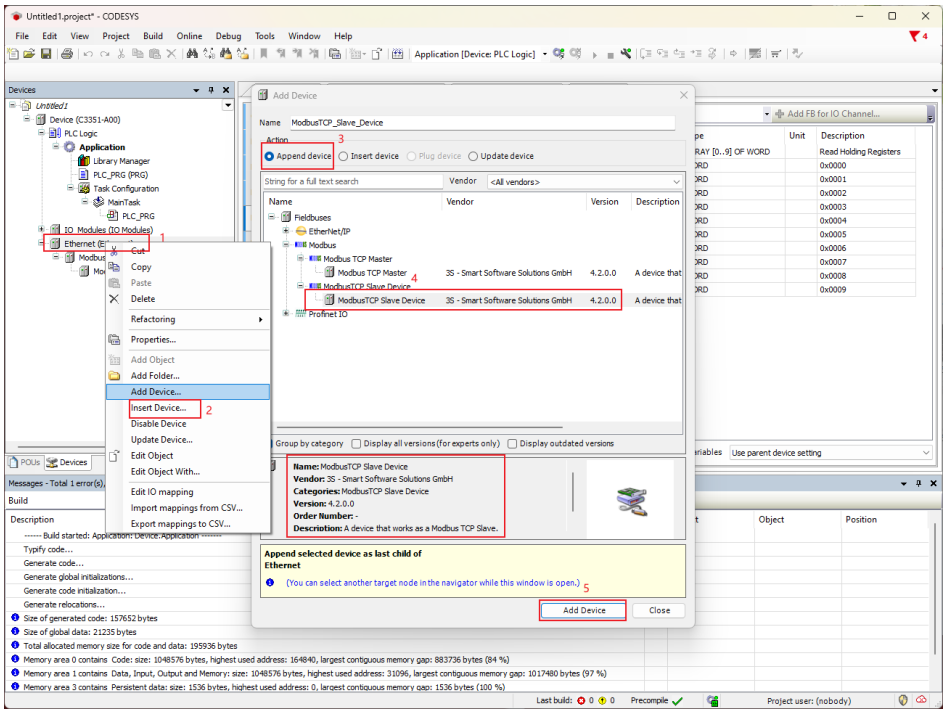
Go back to the third-party slave station simulation software Modbus Slave, double-click the first data, a modification window will pop up, modify the value of 'Value' to 55 and click 'OK':



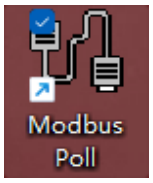
Back to the CODESYS page, we can find that the current value of the WORD type data with the address %IW0 has been changed to 55, indicating that the communication is normal and the master station function is successfully implemented:



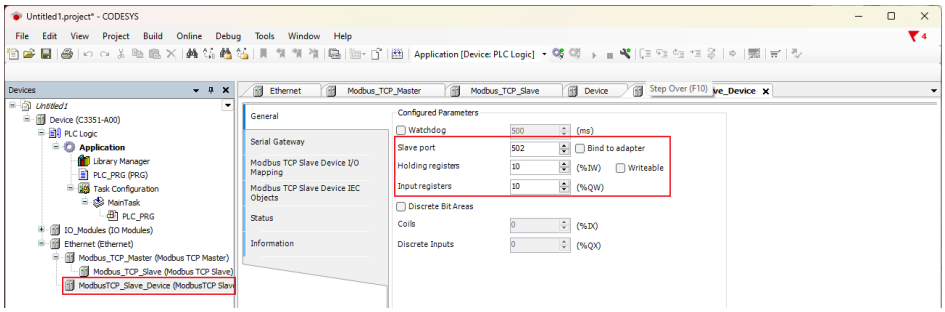
When C3351 is regarded as a server, on the previous basis, right-click 'Ethernet Device' in the project → 'Add Device' → add a device named 'Modbus TCP Slave Device', the supplier is 3S – Smart Software Solutions GmbH.



Next, let's set the parameters of the server and the third-party client. Here, the third-party client simulation software 'Modbus Poll' is used to simulate the connection of the server device:



Double-click 'Modbus TCP Slave Device', select 'General' in the main interface on the right, and set the length of 'Slave port', 'Holding registers', 'Input registers', 'Coils', 'Discrete inputs' in the configuration parameters:



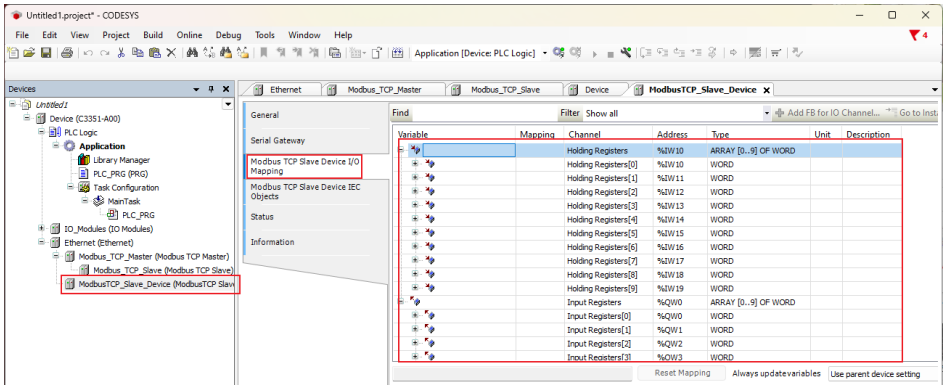
After the setting is complete, we click the option of 'ModbusTCPSlaveDeviceI/O Mapping' to view the address mapped in the C3351 device by the newly established slave device.

Notice

DEVICE INOPERABLE

·The channel length is limited, please refer to 3.3 Programming Specifications.

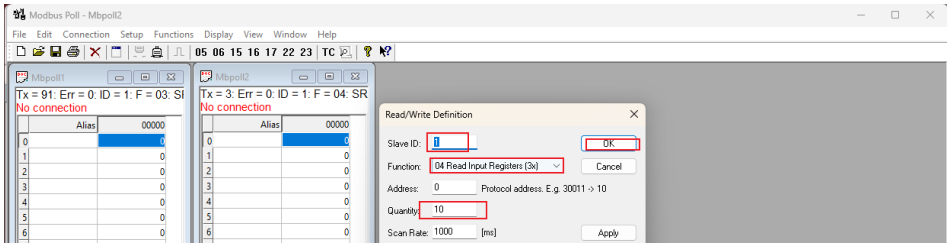
Failure to follow the above instructions could result in damage to the equipment



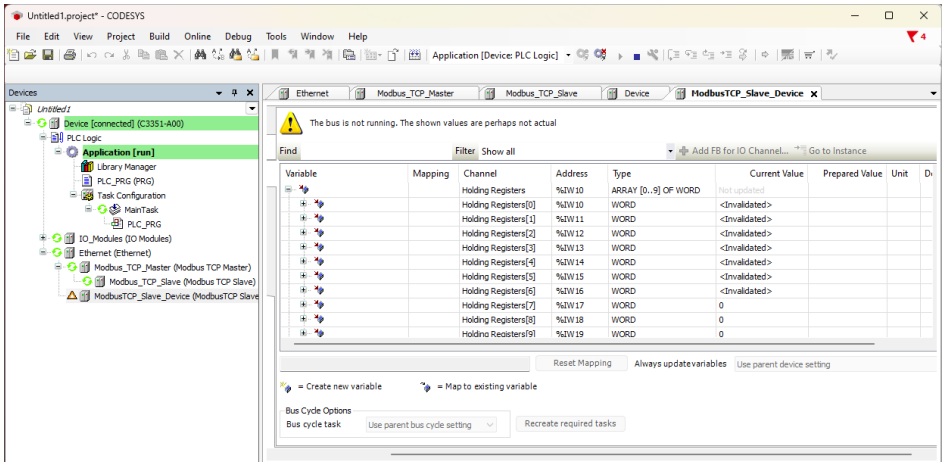
Next, open the third-party master station simulation software 'Modbus Poll', and press 'Ctrl+N' to create two Modbus Poll windows, right-click on the blank space of the two windows respectively - select the 'Read/Write Definition' setting.

Click the 'Function' of the 1st window and select '03 Read Holding Registers (4x)', and 'Quantity' could be set to the holding register length configured in CODESYS.

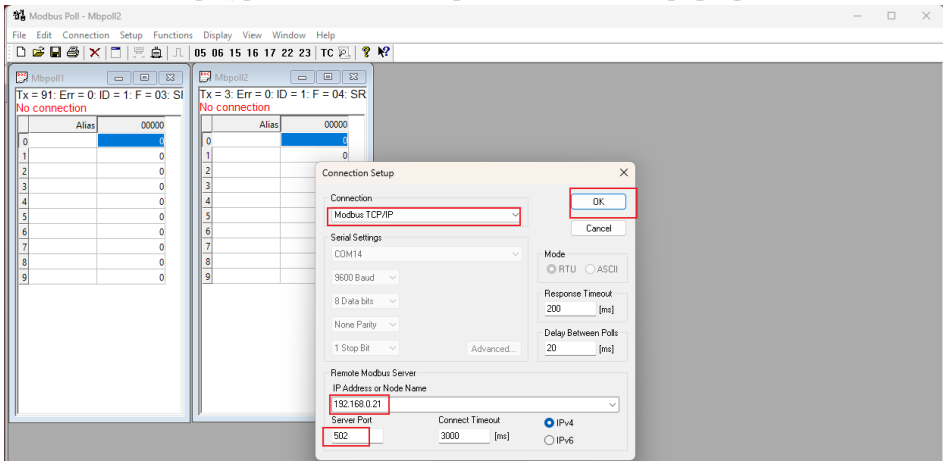
Click the 'Function' of the 2nd window and select '04 Read Input Registers (3x)', and 'Quantity' could be set to the input register length configured in CODESYS:



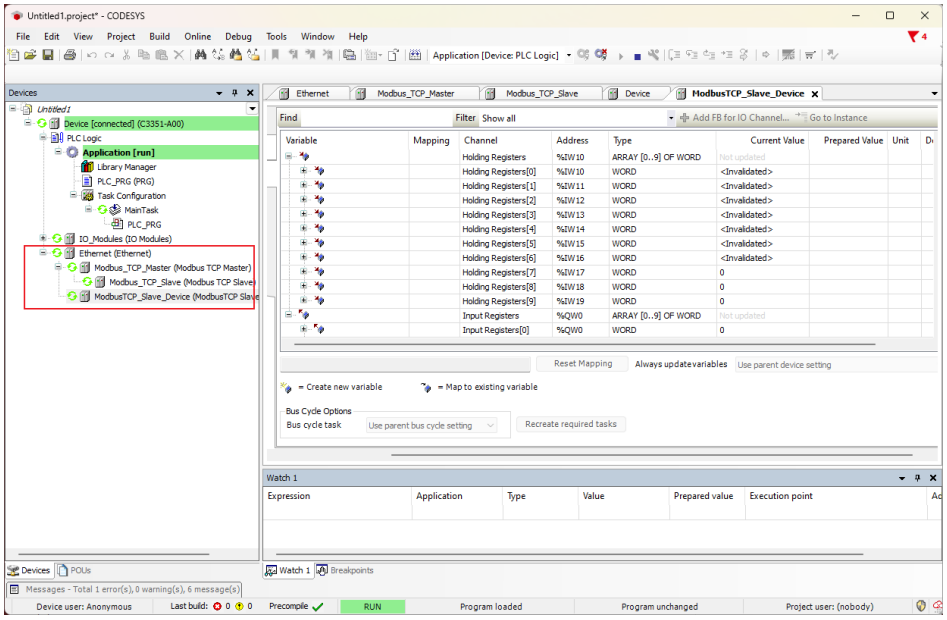
After the completion, return to the CODESYS interface, re-download and log in to the C3351 device. For the method, refer to 5.4 download, Monitor. At this time, it will prompt that the Bus is not running. This is a normal situation:



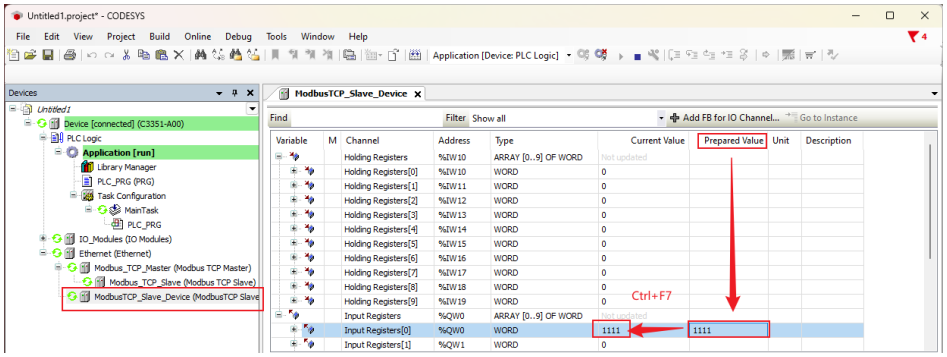
Go back to the 'Modbus Poll' software, and press 'F3' to connect, and set the 'Connection Setup' type, IP address and port number in the pop-up interface:



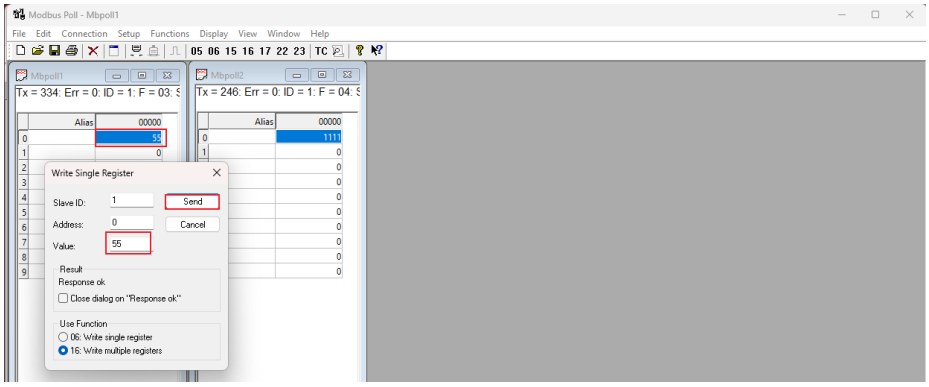
Back to CODESYS, it could find that all devices are running normally:



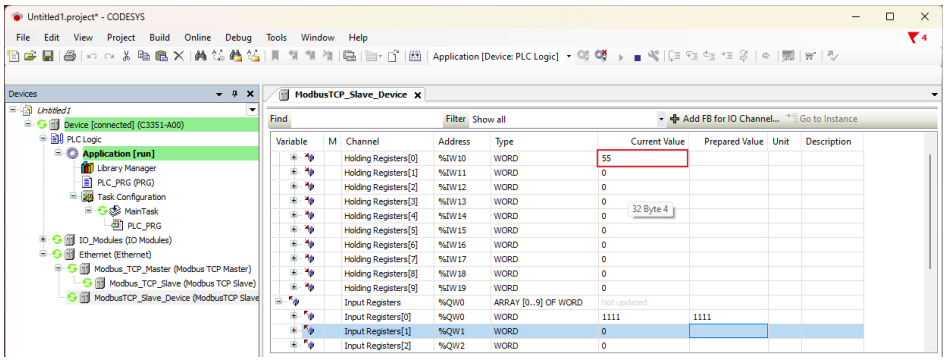
The following is the verification of the communication. The first step is to double-click to modify the input register Prepared Value to 1111 in the 'ModbusTCPSlaveDeviceI/O Mapping' of the 'Modbus TCP Slave Device', and press 'Ctrl+F7' to write:



Back to the 'Modbus Poll' software, you will find that the value of Mbpoll2 has been modified successfully, now double-click the first data of Mbpoll1, and modify the 'Value' to 55:



Back to the CODESYS software, we will find that the first data value of the holding register has been modified to 55, this indicating that the communication function is normal:

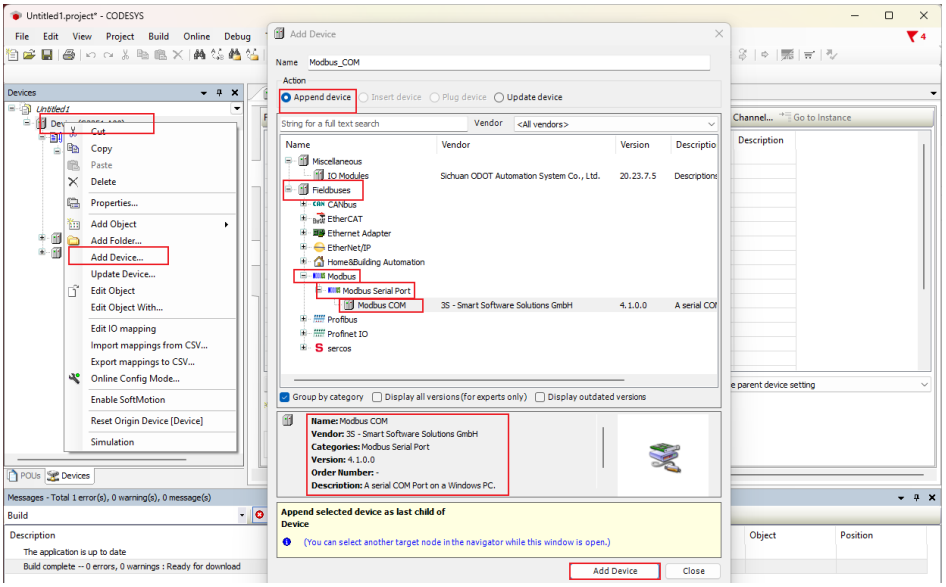


So far, the Modbus TCP client/server function test of the C3351 device is completed.

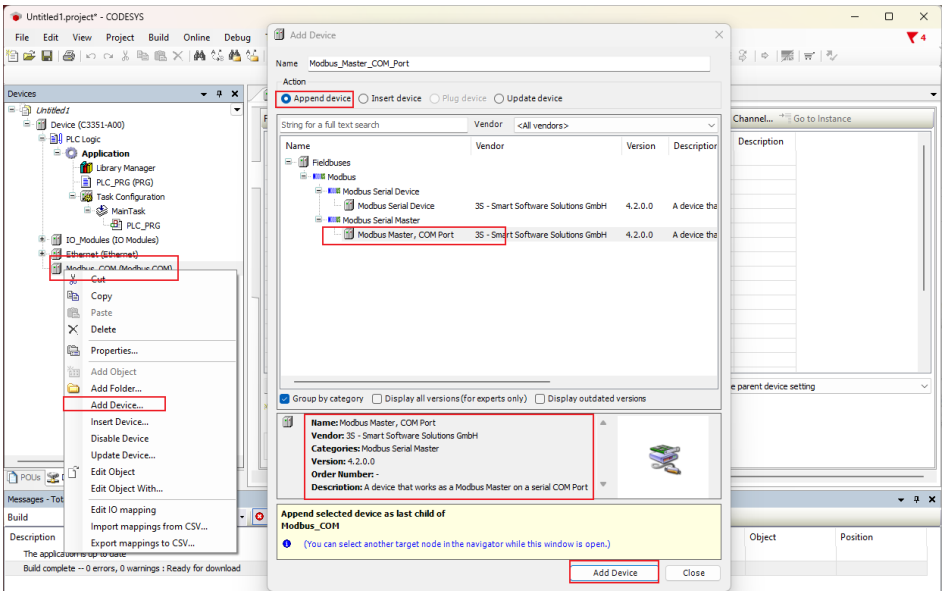
5.6 Modbus RTU Master function

NOTICE
DEVICE INOPERABLE ·This section involves the use of USB to 485 converter equipment. It is recommended to read Annex 7.2.3 in advance and purchase relevant equipment to connect to the 485 interface of the C3351 device before performing operations in this section. Refer to 2.3.2 485 interface. **Failure to follow the above instructions could result in damage to the equipment.**

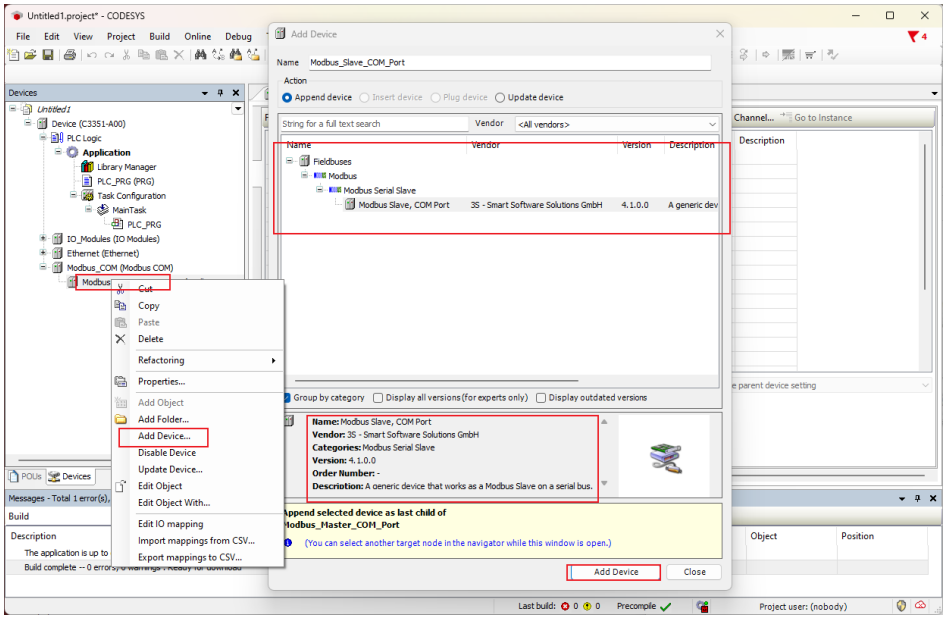
Next, we continue to demonstrate the Modbus RTU master function. Continue to use the project in the previous section, right-click the C3351 device → 'Add Device', and select Modbus-Modbus serial port 'Modbus COM' in the pop-up page, the supplier is 3S – Smart Software Solutions GmbH.



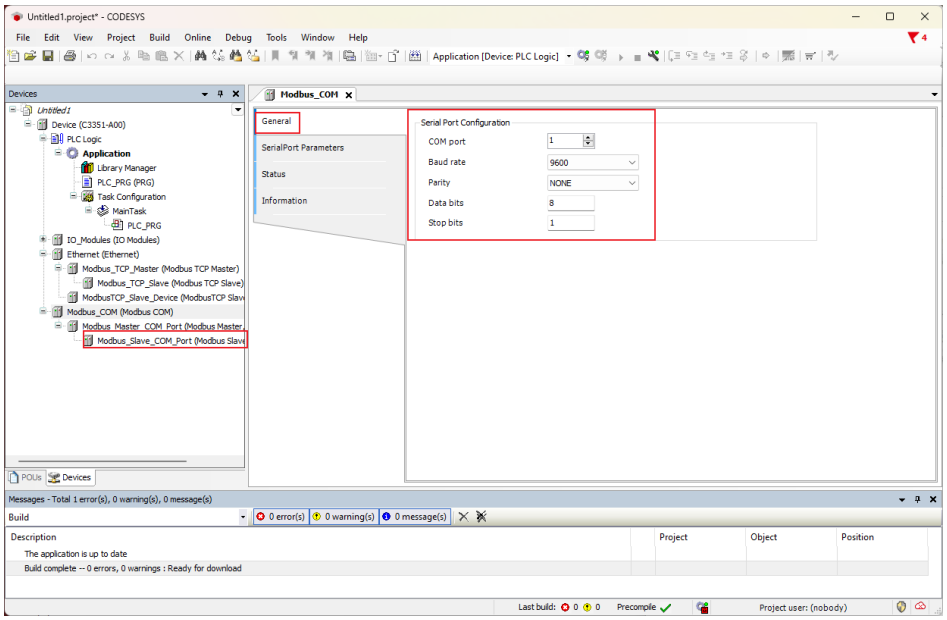
Right-click the 'Modbus_COM' just created in the project tree, select 'Add Device' → add a device named 'Modbus Master, COM Port'.



Right-click the 'Modbus Master, COM Port device' just created in the project tree, select 'Add Device' → add a device named 'Modbus Slave, COM Port'.



The required equipment has been created. Next, we configure the parameters of the master station and the third-party slave station simulation software Modbus Slave. Double-click the 'Modbus COM device' in the project tree-select 'General' in the main interface on the right, and then configure the serial port according to the actual situation:



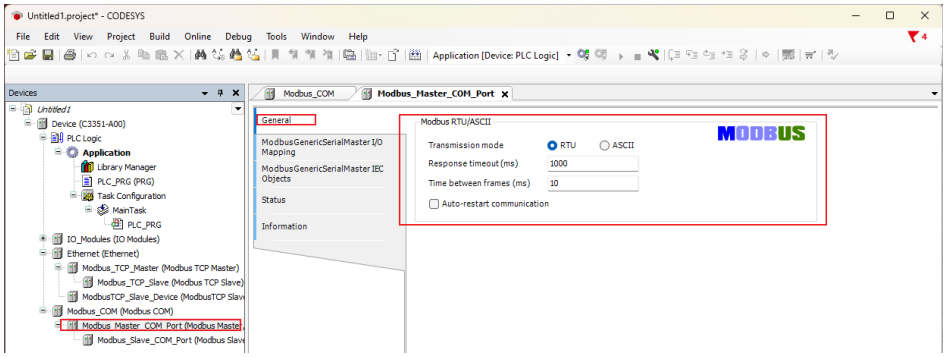
NOTICE

DEVICE INOPERABLE

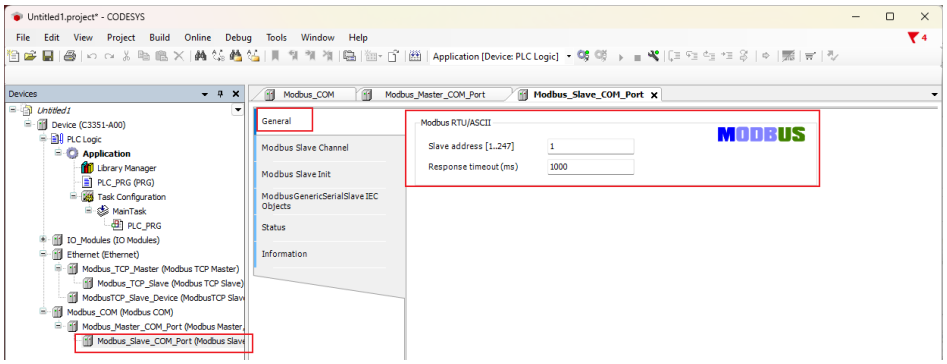
·The COM port here must be set to 2.

Failure to follow the above instructions could result in damage to the equipment.

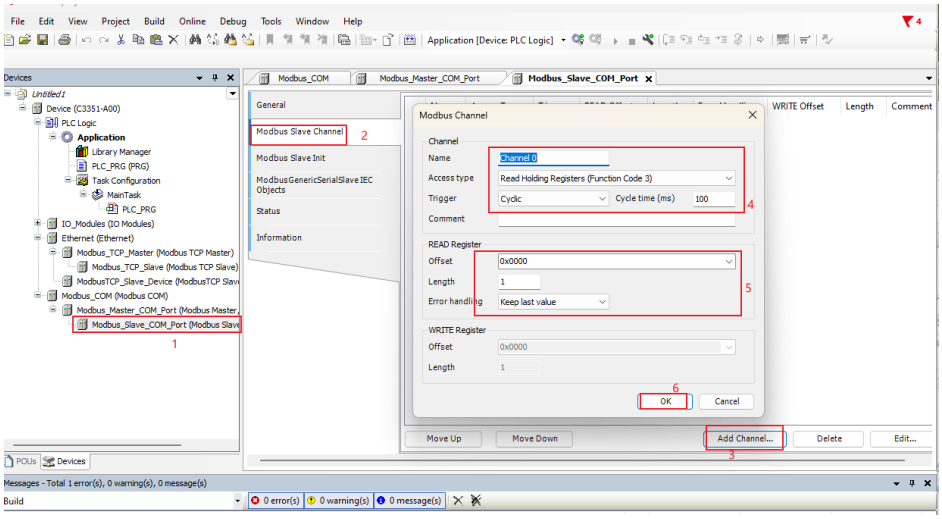
Next, double-click 'Modbus Master COM Port Device' → select 'General' on the main interface on the right, and set the transmission mode to RTU, and set the response timeout time, frame interval time. It is recommended to click 'Auto-restart communication':



Next, double-click 'Modbus Slave COM Port Device' → select 'General' on the main interface on the right, and set the slave station address and response timeout time:



Then select 'Modbus Slave Channel' - 'New Channel', and set various parameters in the pop-up window:



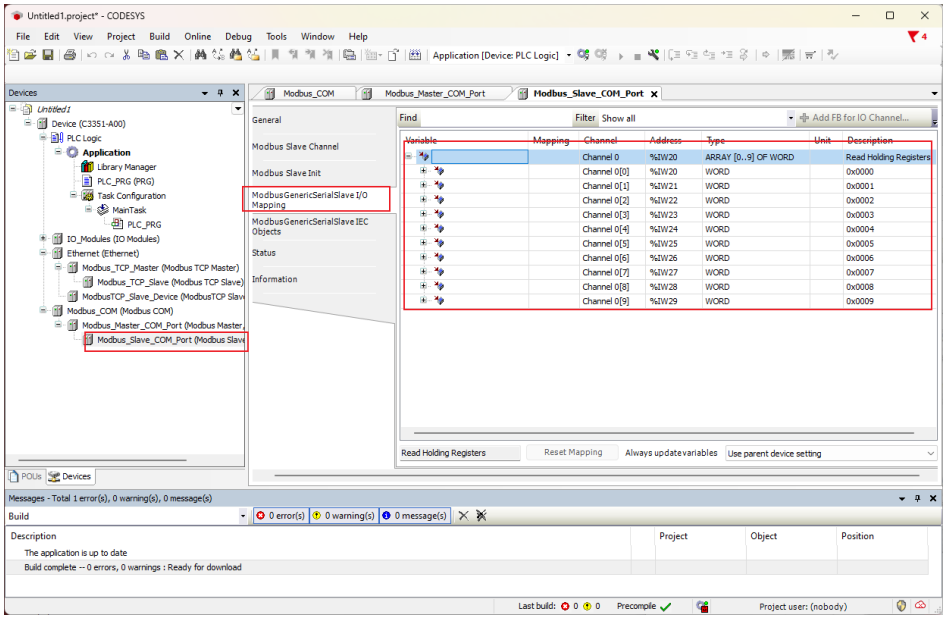
After the addition is complete, we can find that there is an option of 'ModbusGenericSerialSlaveI/O Mapping' in the menu. Click this option to view the address mapped in the C3351 device by the channel just established.

NOTICE

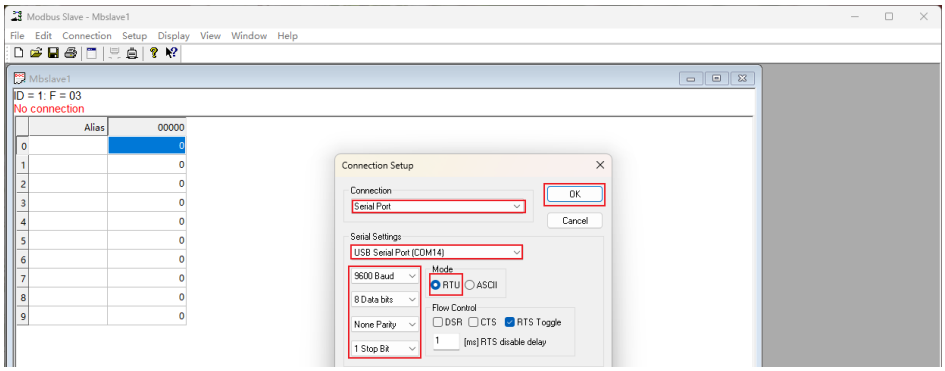
DEVICE INOPERABLE

·The channel length is limited, please refer to 3.3 Programming Specification

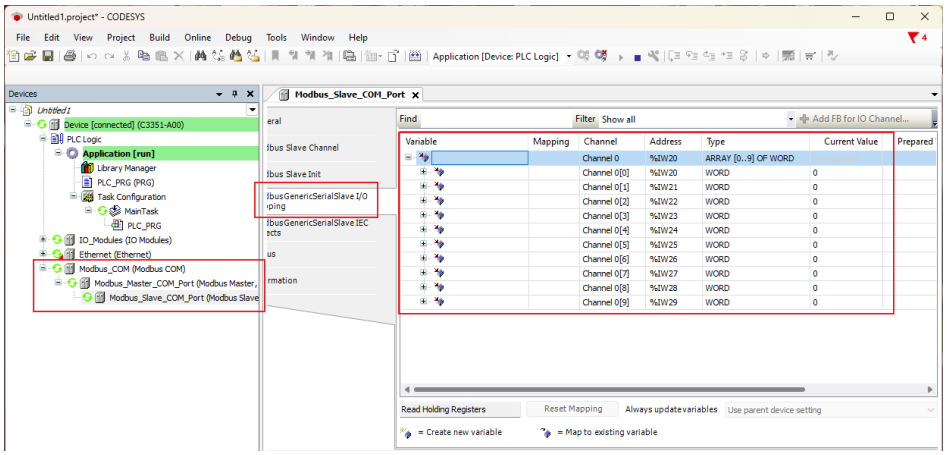
Failure to follow the above instructions could result in damage to the equipment.



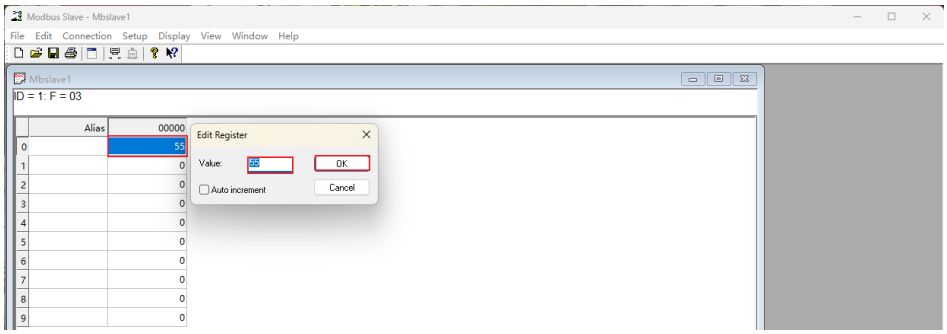
Now it needs to open the 'Modbus Slave' third-party slave station simulation software. And press 'F3' to open the connection setting page, then set 'Connection' to 'Serial Port'. The Serial Settings include COM port selection, baud rate selection, data bit selection, parity check, stop bit selection and mode selection, which should match the parameters of the Modbus COM device in CODESYS:



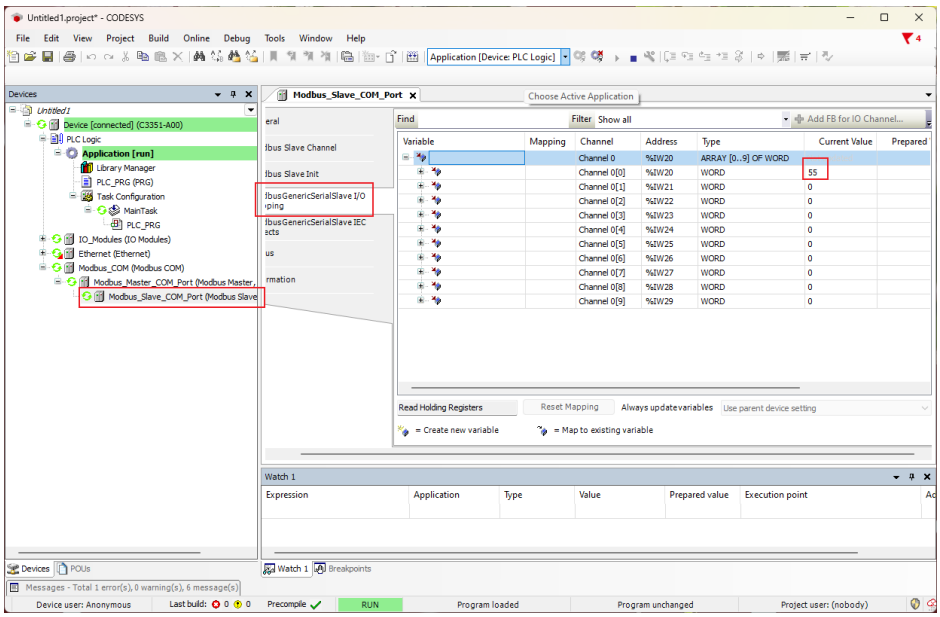
After completion, return to the CODESYS interface, it could download and log in to the C3351 device. For the method, please refer to 5.4 download, Monitor. Then it could find all devices are in the running status, which indicates that the connection is successful. Now click on the 'ModbusGenericSerialSlaveI/O Mapping' option of the 'Modbus Slave COM Port Device', it can monitor the current value of the channel map:



Go back to the third-party slave station simulation software 'Modbus Slave', double-click the first data, and a modification window will pop up, then modify the value of the first data to 55:



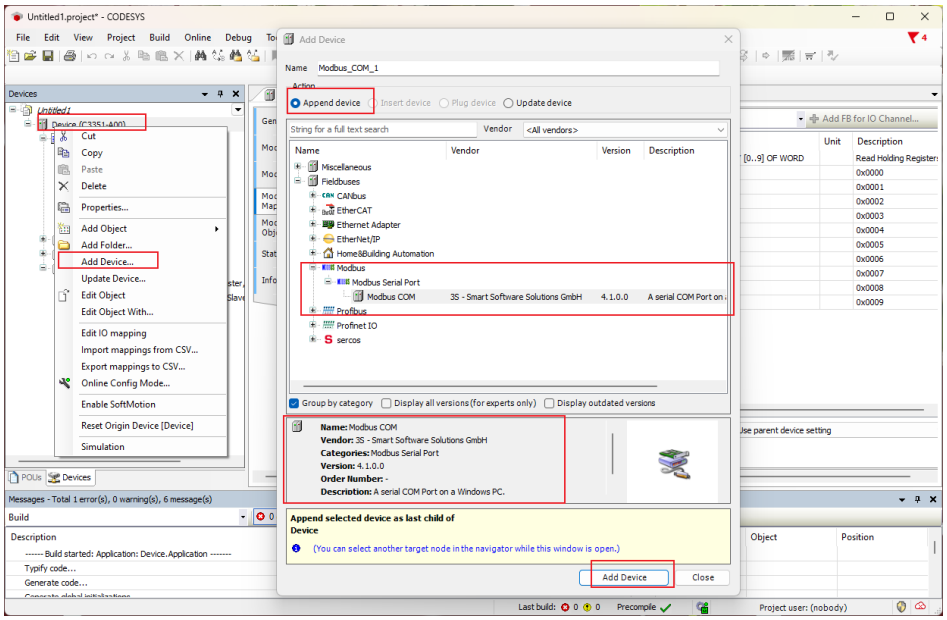
Going back to the CODESYS page, we can find that the current value of the WORD type data with the address %IW20 has been changed to 55, indicating that the communication is normal and the master station function is successfully implemented:



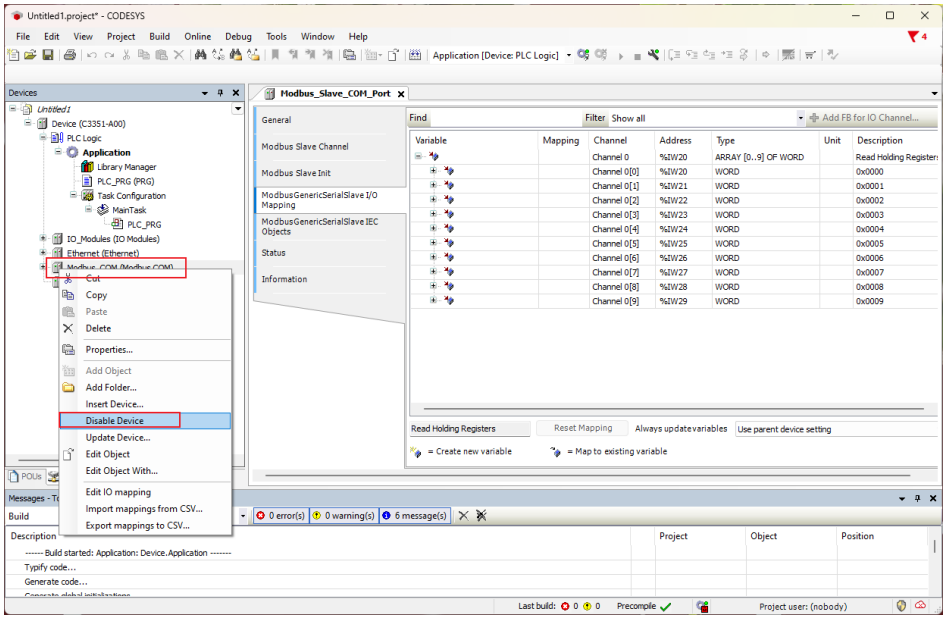
So far, the Modbus RTU master function test of the C3351 device is completed.

5.7 Modbus RTU Slave Station Function

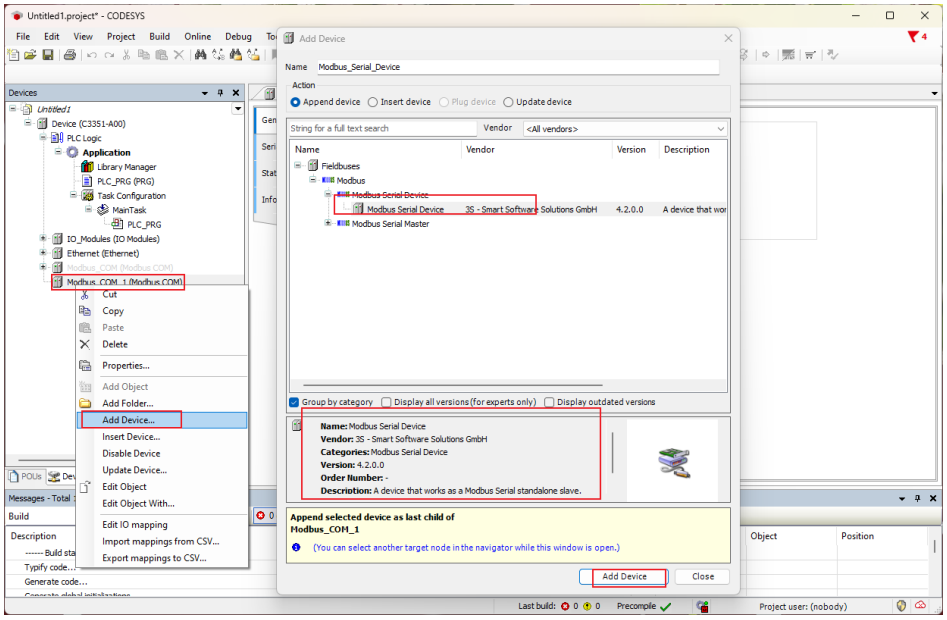
We continue to demonstrate the Modbus RTU master functionality. Continue to use the project in the previous section, right-click on the C3351 device → 'Add Device', and select Modbus-Modbus Serial Port→'Modbus COM' in the pop-up page. The supplier is 3S – Smart Software Solutions GmbH.



The difference is that we need to disable the Modbus COM device added in the previous section, and it needs to right click on the device and select Disable Device.



Right-click the newly created Modbus COM 1 in the project tree, select Add Device → add a device named 'Modbus Serial Device'.



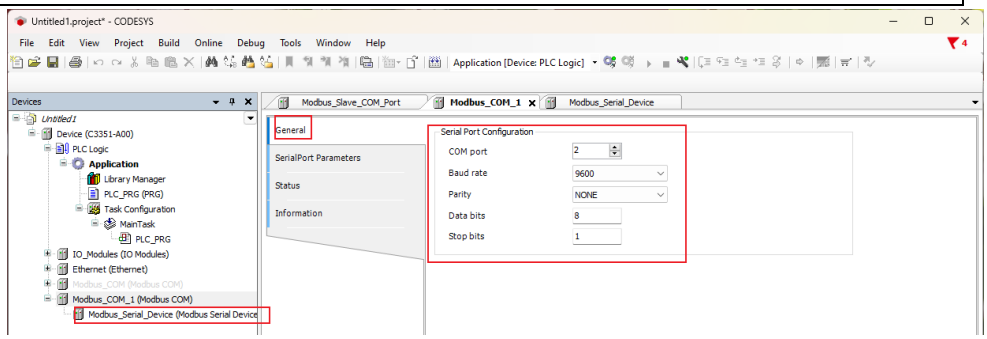
Next, it could set the parameters of the slave station and the third-party master station. Here, the third-party master station simulation software Modbus Poll is used to simulate the connection of the slave station device. Similarly, double-click the Modbus COM 1 device just added to the project → select 'General' option and configure the serial port.

NOTICE

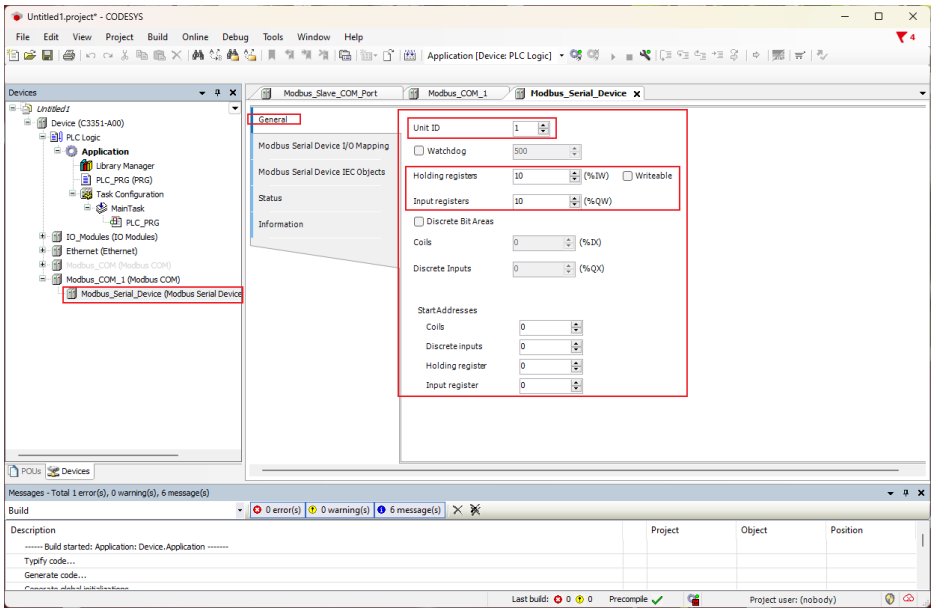
DEVICE INOPERABLE

·Here the COM port must be set to 2.

Failure to follow the above instructions could result in damage to the equipment.



Double-click 'Modbus Serial Device', and select 'General' in the main interface on the right, and set the unit ID, holding register length, and input register length in the configuration parameters:



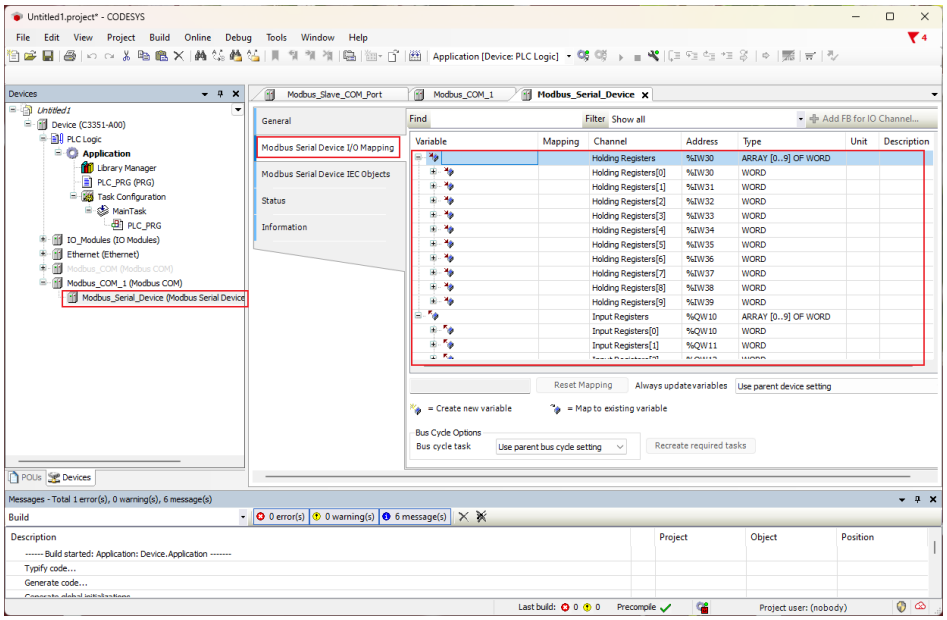
After the setting is complete, we click the option of 'Modbus Serial Device I/O Mapping' to view the address mapped in the C3351 device by the newly established slave device.

NOTICE

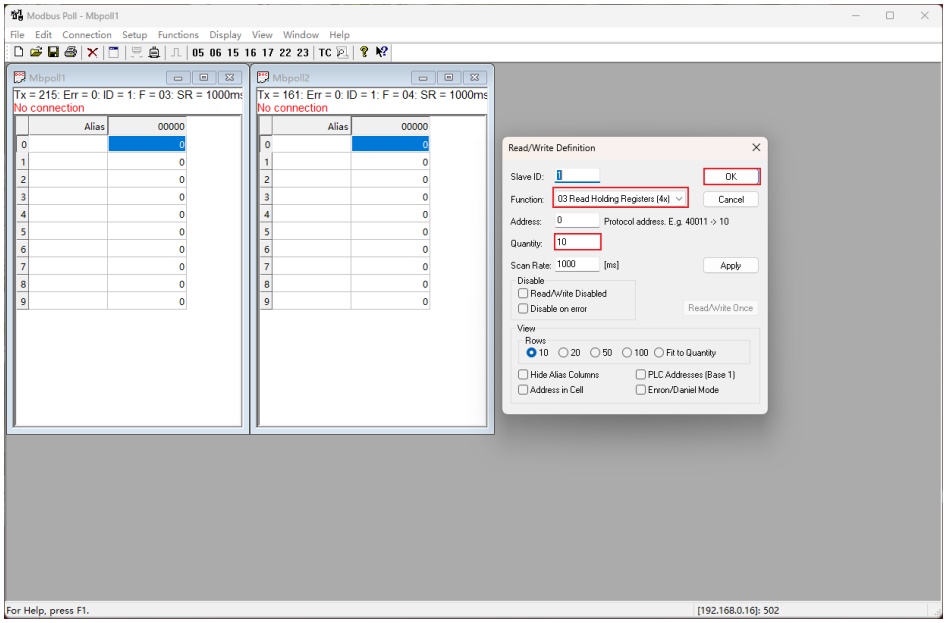
DEVICE INOPERABLE

·The channel length is limited, please refer to 3.3 Programming Specification.

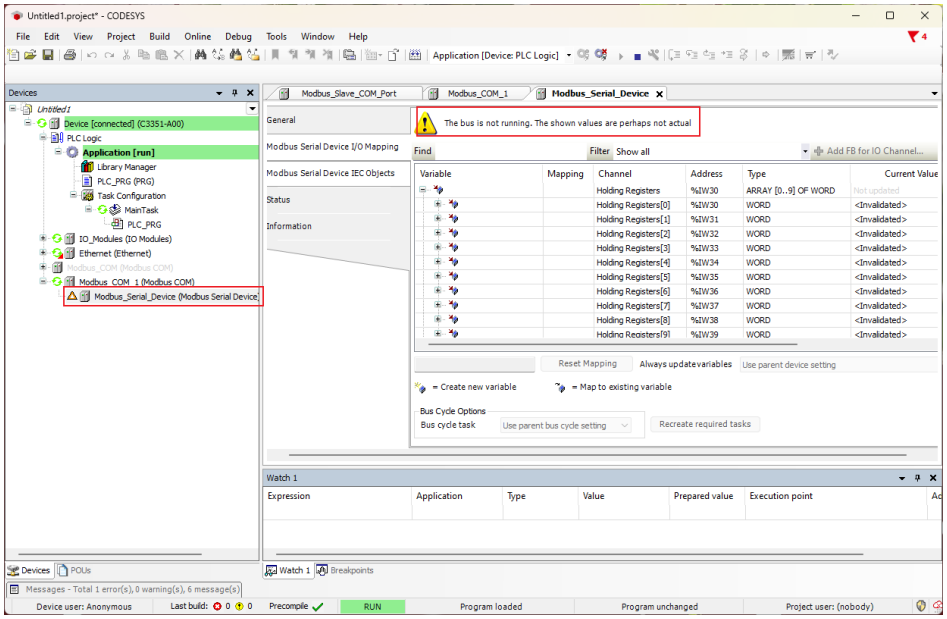
Failure to follow the above instructions could result in damage to the equipment.



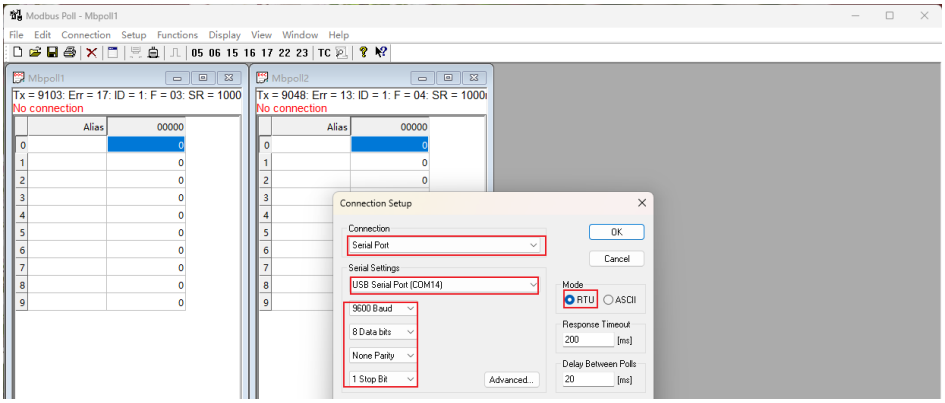
Next, please open the third-party master station simulation software 'Modbus Poll', and press 'Ctrl+N' to create two Mbpoll windows, and right-click on the blank space of the two windows respectively - select the 'Read/Write Definition' setting. Click the 'Function' of the 1st window and select '03 Read Holding Registers (4x)' and 'Quantity' could be set to the holding register length configured in CODESYS. Click the 'Function' of the 2nd window and select '04 Read Input Registers (3x)', and 'Quantity' could be set to the input register length configured in CODESYS:



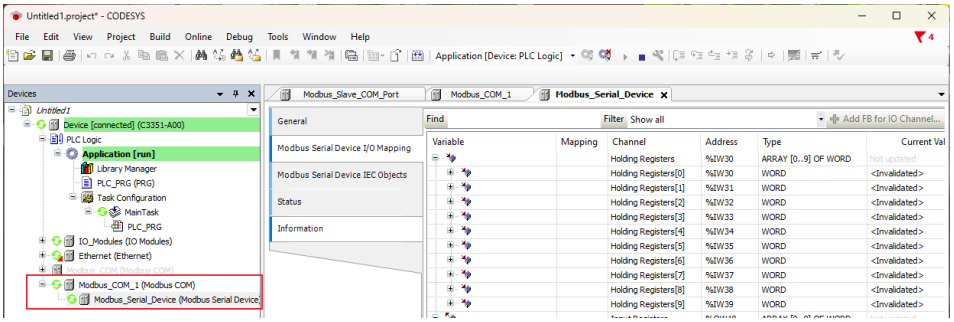
After the completion, please return to the CODESYS interface, re-download and log in to the C3351 device. For the method, pls refer to 5.4 Download, monitor. At this time, it will prompt that the Bus is not running. This is a normal situation:



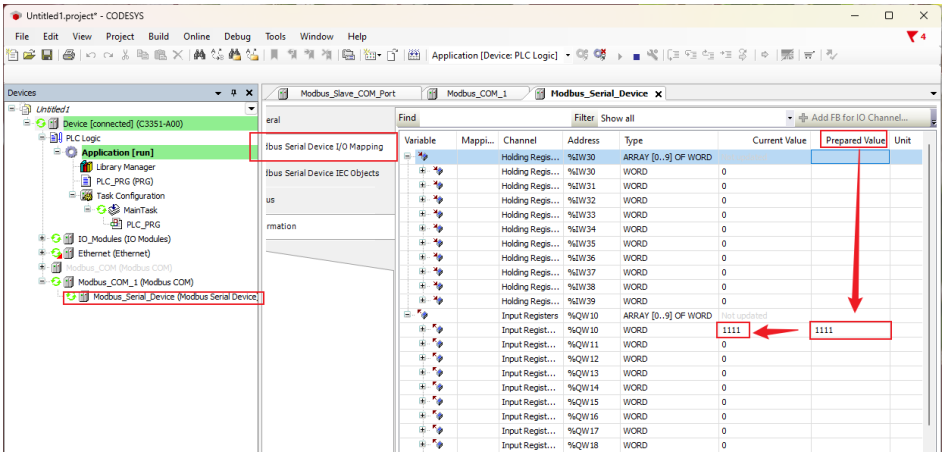
Go back to the Modbus Poll software, press 'F3' to connect. And it could set the type of 'Connection Setup' to Serial Port in the pop-up interface, and select the correct COM port, baud rate and other parameters are consistent with the parameters configured in the CODESYS software:



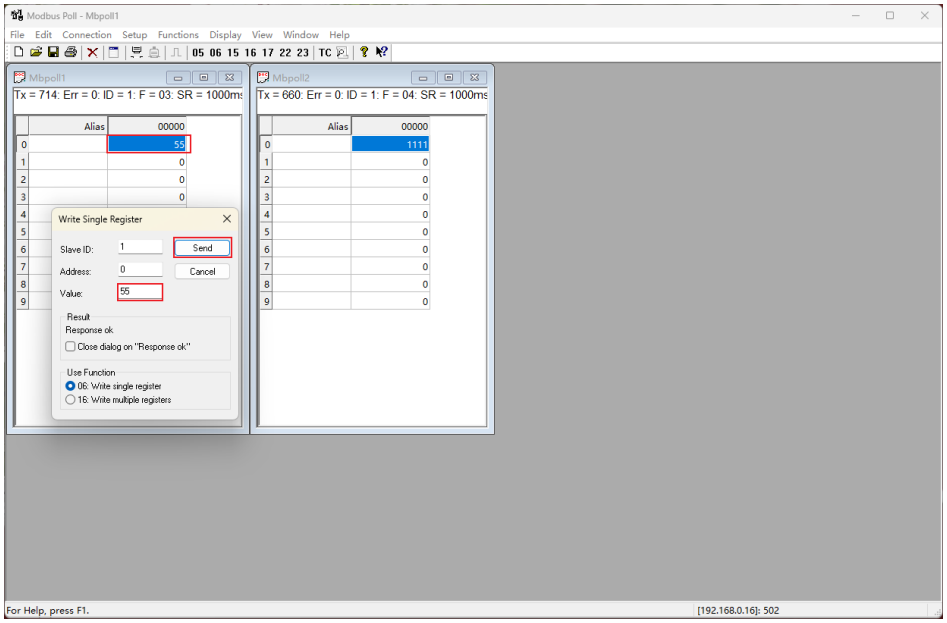
Back to CODESYS, it could find that all devices are running normally:



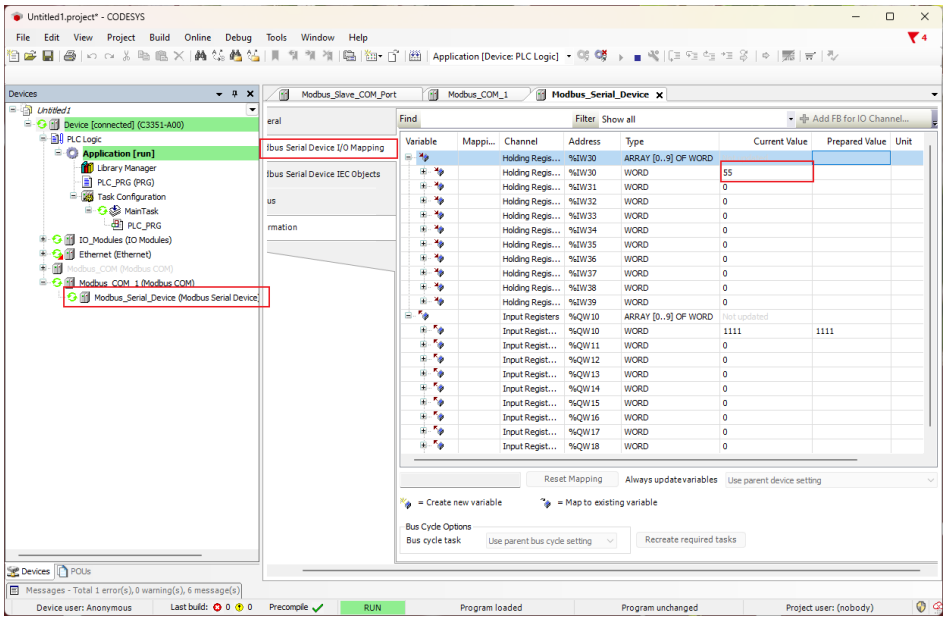
The following is the verification of the communication. The first step is to double-click to modify the input register preparation value to 1111 in the 'ModbusSerialDeviceI/O Mapping' of the 'Modbus Serial Device device', and press 'Ctrl+F7' to write:



Back to the 'Modbus Poll' software, it could find that the value of Mbpoll2 has been modified successfully. Now we double-click the first line of Mbpoll1 to modify the value to 55:



Back to the CODESYS software, it could find that the first WORD value of the holding register has been changed to 55, indicating that the communication function is normal:



So far, the Modbus RTU slave function test of the C3351 device is completed.

6 Demo

6.1 Control requirement

Project name: Water conservancy valve control system

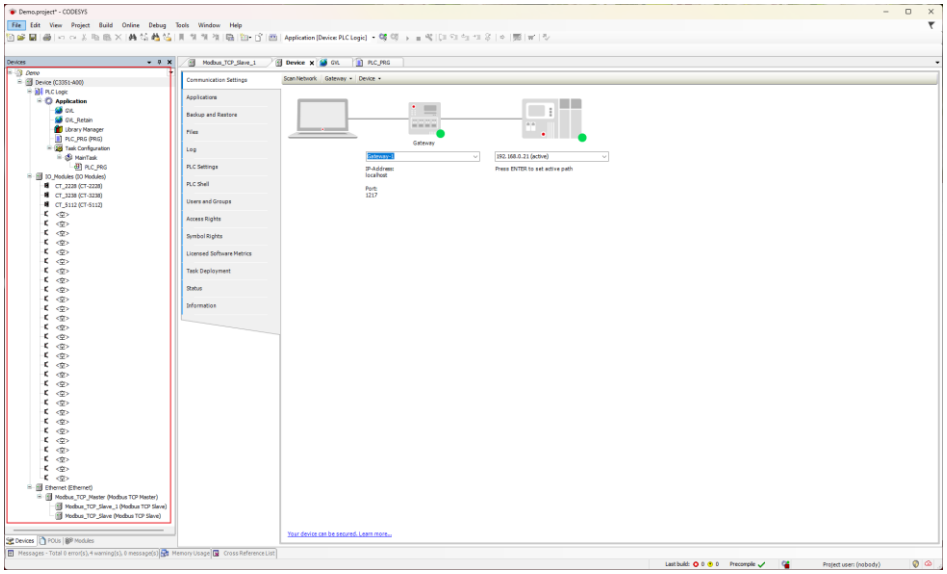
Project function: Controlling the opening of the drain valve according to the water level of the reservoir and water level growth rate.

6.2 Preparation

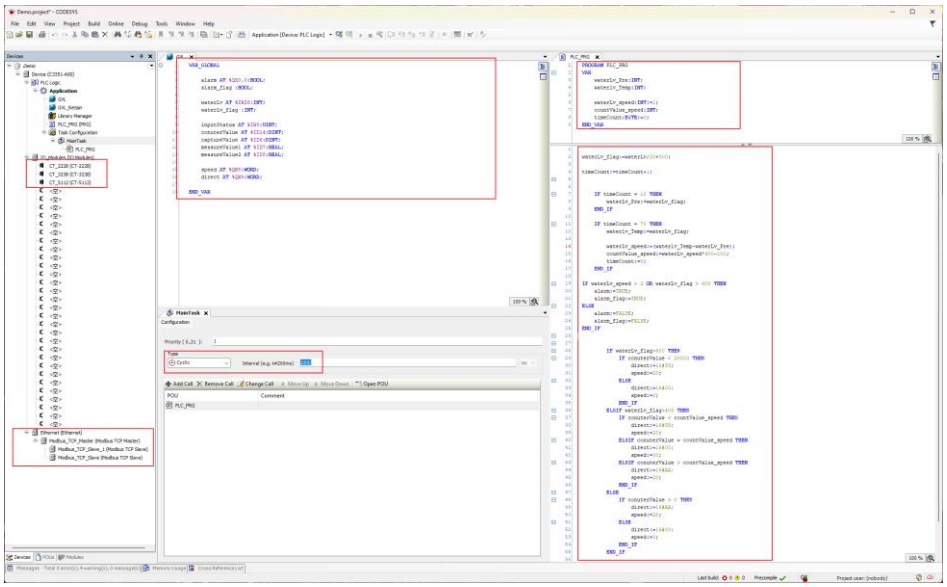
Project Analysis: According to the actual situation of C3351 and the module selection table: selecting module CT-2228 to be used as alarm controller, the alarm accepts 24V high level alarm; selecting module CT-3238 to be as water level sensor signal input; selecting module CT-5112 as valve opening value reading, and get data from encoder; using Modbus TCP master function to control the steering and speed of the valve motor. It is assumed that the motor controller D CAC only needs these two parameters to control the motor.

6.3 Project creation

Create the project as shown below



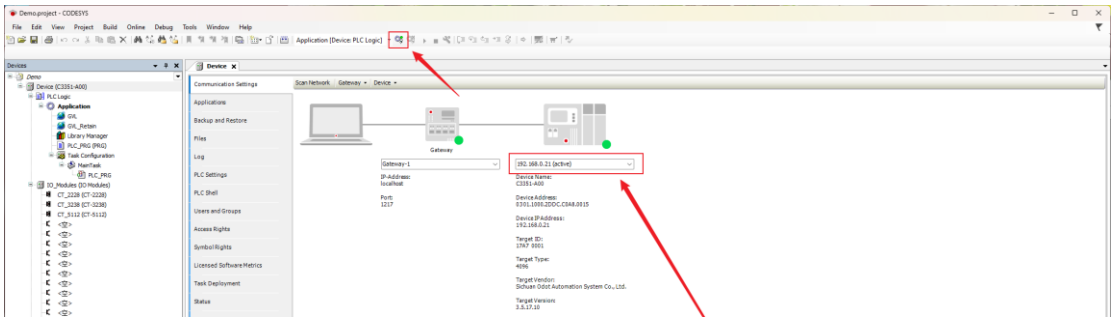
Programming and Setting parameters



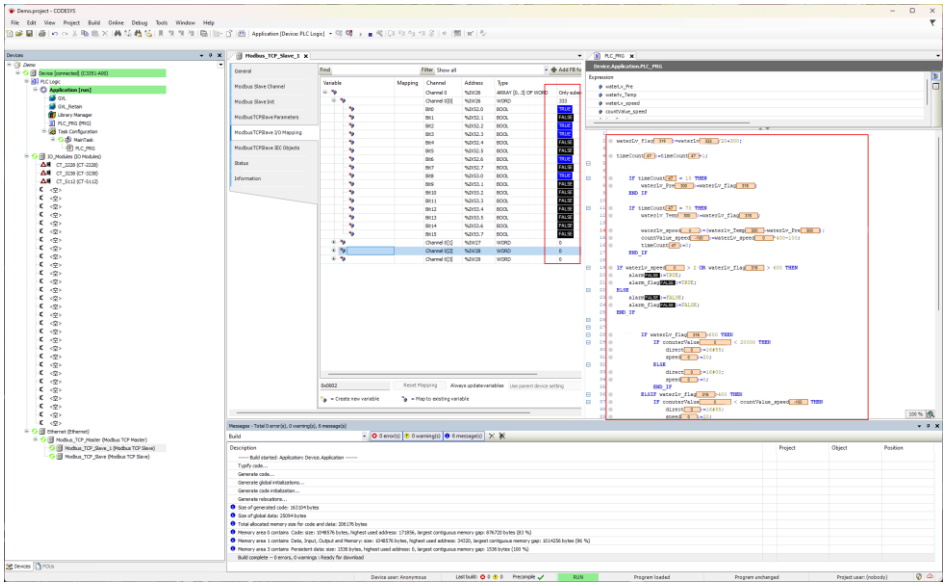
The above program can realize simple water conservancy valve control, but the results are not 100% accurate.

6.4 Program download and monitoring

Activate the device, then log in to the device.



It can monitor changes in variables in real time.



Above are all the demo, the relevant file can be found in the attached Demo.

7 Annex

7.1 Modbus-RTU Protocol Introduction

For user, it is important to understand that Modbus has 8 important function codes corresponding to 4 areas: 4 read, 2 write a single bit or register, and 2 write multiple bits or multiple registers (Address description adopts PLC address).

7.1.1 Modbus Storage Area

The storage area of the controller (or Modbus device) involved in Modbus is identified by 0XXXX, 1XXXX, 3XXXX and 4XXXX.

Storage ID	Name	Data Type	Read/Write	Storage Unit Address
0XXXX	Output Coil	Bit	Read/Write	00001~0XXXX, XXXX：related to the device
1XXXX	Discrete Input	Bit	Read Only	10001~1XXXX, XXXX：related to the device
3XXXX	Input Register	Word	Read Only	30001~3XXXX, XXXX：related to the device
4XXXX	Output/Holding Registers	Word	Read/Write	40001~4XXXX, XXXX：related to the device

7.1.2 Modbus Function Code

Modbus messages are relatively fixed, so it could know the structure after reading a few messages, and users can inquire about it when necessary.

(1) Read output coil status

Function Code：01H

Master station inquiry message format:

Address	Function Code	Start Address High Byte	Start Address Low Byte	Number of coils High Byte	Number of coils Low Byte	CRC
0x11	0x01	0x00	0x13	0x00	0x25	xxxx

Function: Read slave station output coil 0XXXX status.

Note: Some device coil start address is 00000, which corresponds to address 00001 in the device, and the sequence is postponed.

In this example: read the output coil of the slave station No. 0x11, the register start address is 0x13=19, and the number of coils is 0x0025H=37.

Therefore, the function of this query message is: read the output coil 00019-00055 of the slave

station No. 0x11 (17), A total of 37 coil status.

Slave station response format:

Address	Function Code	Byte Count	Coil Status 19-26	Coil Status 27-34	Coil Status 35-42	Coil Status 43-50	Coil Status 51-55	CRC
0x11	0x01	0x05	0xCD	0x6B	0xB2	0x0E	0x1B	xxxx

Function: Slave returns to output coil 0XXXX status.

(2) Read discrete input status

Function Code: 02H

Master station query message format：

Address	Function Code	Start Address High Byte	Start Address Low Byte	Number of coils High Byte	Number of coils Low Byte	CRC
0x11	0x02	0x00	0xC4	0x00	0x16	xxxx

Function: Read the status of slave station input coil 1XXXX.

Note: Some equipment coil start address is 10000, which corresponds to the address of 10001 in the device, and the sequence is postponed.

In this example: read the input coil of the slave station No. 0x11, the starting address is 0x00C4=196, and the number of coils is 0x0016=22.

Therefore, the function of this query message is: read the input coil 10196-10217 of the slave station No. 0x11 (17), a total of 22 discrete input status.

Slave station response format:

Address	Function Code	Byte Count	DI 10196-10203	DI 10204-10211	DI 10212-10217	CRC
0x11	0x02	0x03	0xAC	0xDB	0x35	xxxx

Function: Slave returns to input coil 1 XXXX status.

(3) Read output/holding register

Function Code: 03H

Master station query message format:

Address	Function Code	Register Start Address High Byte	Register Start Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	CRC
0x11	0x03	0x00	0x6B	0x00	0x03	xxxx

Function: Read slave station holding register 4XXXX value.

Note: The starting address of some device registers is 40000, which corresponds to the address

40001 in the device, and the sequence is postponed.
In this example: read the holding register value of the slave station No. 0x11, the starting address is 0x006BH=107, and the number of registers is 0x0003.
Therefore, the function of this query message is: read the value of 3 holding registers 40107-40109 of the slave station No. 0x11 (17H).

Address	Function Code	Byte Count	Register 40107 High Byte	Register 40107 Low Byte	Register 40108 High Byte	Register 40108 Low Byte	Register 40109 High Byte	Register 40109 Low Byte	CRC
0x11	0x03	0x06	0x02	0x2B	0x01	0x06	0x2A	0x64	xxxx

Function: The slave returns to the value of the holding register: (40107)=0x022B，(40108)=0x0106，(40109)=0x2A64

(4) Read the input register
Function code: 04H
Master station query message format:

Address	Function Code	Register Start Address High Byte	Register Start Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	CRC
0x11	0x04	0x00	0x08	0x00	0x01	xxxx

Function: Read slave station input register 3XXXX value.
Note: In some devices, the register start address is 30000, which corresponds to the address 30001 in the device, and the sequence is postponed.

In this example: read the input register value of the slave station No. 0x11, the start address is 0x0008H, and the register number is 0x0001.
Therefore, the function of this query message: read the value of 1 input register 30008 of slave station No. 0x11 (17).
Slave station response format:

Address	Function Code	Byte Count	Input Register 30008 High Byte	Input Register 30008 Low Byte	CRC
0x11	0x04	0x02	0x01	0x01	xxxx

Function: The slave station returns to the value of the input register 30008;（30008）=0x0101

(5) Force a single coil
Function code: 05H
Master station query message format:

Address	Function Code	Coil Address High Byte	Coil Address Low Byte	Break Flag	Break Flag	CRC

0x11	0x05	0x00	0xAC	0xFF	0x00	xxxx

Function: Force the 0XXXX value of slave station coil 0x01 (17). In some devices, the coil start address is 00000, which corresponds to the address 00001 in the device, and the sequence is postponed.

Break Flag = FF00, force the coil ON.
Break Flag = 0000, force the coil OFF.

Example: The starting address is 0x00AC=172. Force No. 17 slave station coil 0172 to ON status.
Response format: return to the original text
Function: Force No. 17 slave device coil 0172 ON and return to the original text

Address	Function Code	Coil Address High Byte	Coil Address Low Byte	Break Flag	Break Flag	CRC
0x11	0x05	0x00	0xAC	0xFF	0x00	xxxx

(6) Preset single holding register
Function Code: 06H
Master station query message format:

Address	Function Code	Register Start Address High Byte	Register Start Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	CRC
0x11	0x06	0x00	0x87	0x03	0x9E	xxxx

Function: Preset single holding register 4XXXX value. In some devices, the coil start address is 40000, which corresponds to the address 40001 in the device, and the sequence is postponed.

Example: Preset the value of the single holding register 40135 of No. 17 slave device to 0x039E;
Response format: return to the original text

Address	Function Code	Register Start Address High Byte	Register Start Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	CRC
0x11	0x06	0x00	0x87	0x03	0x9E	xxxx

Function: Preset the No. 17 slave device single holding register 40135 value to 0x039E and return to the original text.

(7) Force Multi-coil
Function Code: 0FH
Master station query message format:

Address	Function Code	Coil Start Address High Byte	Coil Start Address Low Byte	Number of coils High Byte	Number of coils Low Byte	Byte Count	Coil Status 20-27	Coil Status 28-29	CRC
0x11	0x0F	0x00	0x13	0x00	0x0A	0x02	0xCD	0x00	xxxx

Function: Force multiple continuous coils 0XXXX to ON/OFF status.
Note: In some devices, the coil start address is 00000, which corresponds to the address 00001 in the device, and the sequence is postponed.

In this example: Force multiple continuous coils in slave station 0x11, the start address of the coil is 0x0013=19, and the number of coils is 0x000A=10.
Therefore, the function of this query message is: to force the value of 00019-00028 of the 10 coils of slave station No. 0x11 (17); CDH→00019-00026; 00H→00027-00028.

Slave station response format:

Address	Function Code	Coil Start Address High Byte	Coil Start Address Low Byte	Number of coils High Byte	Number of coils Low Byte	CRC
0x11	0x0F	0x00	0x13	0x00	0x0A	xxxx

(8) Preset multiple registers
Function Code: 10H
Master station query message format:

Address	Function Code	Start Register Address High Byte	Start Register Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	Byte Count	Data High Byte	Data Low Byte	Data High Byte	Data Low Byte	CRC
0x11	0x10	0x00	0x87	0x00	0x02	0x04	0x01	0x05	0x0A	0x10	xxxx

Function: Preset multiple holding register values 4XXXX of the slave station.
Note: In some devices, the holding register start address is 40000, which corresponds to the address 40001 in the device, and the sequence is postponed.

In this example: Preset multiple holding register values of slave station 0x11, the register start address is 0x0087=135, and the number of coils is 0x0002=2.
Therefore, the function of this query message is: preset the value of 2 holding registers of slave station No. 0x11 (17);
0105H→40135; 0A10H→40136.

Response Format:

Address	Function Code	Start Register Address High Byte	Start Register Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	CRC
0x11	0x10	0x00	0x87	0x00	0x02	xxxx

7.2 Brief introduction of serial port network topology

7.2.1 RS232

RS232 is one of serial communication interfaces controlled by industry. It is widely used to connect computer serial interface with peripherals. RS232 using a signal and a signal transmission form, return lines were in the land of the three wire connection mode, can realize full-duplex communications, the transmission signals for single ended, the total transmission of easy to generate common-mode interference, so the noise resistance is weak, the transmission distance is limited, RS232 interface standards stipulated in the code element distortion maximum transmission distance is less than 4% under the condition of standard values of 50 feet (15 meters) (more than 15 m long distance communication, need to adopt modem), the maximum transmission distance is also associated with communication baud rate, in the process of practical application, if the transmission distance is far, Please reduce the baud rate. In order to reduce the electromagnetic interference from the outside during the signal transmission, please use the shielded cable as the communication cable.

RS232 interface standard specifies that TXD and RXD:

RS232 USES negative logic to transmit signals and takes the signal of -(3~15) V as logic "1". Take the signal of +(3~15) V as logical "0"; Voltages between -3 and +3V are meaningless, as are voltages lower than -15V or higher than +15V.

RS232 Interface Classification:

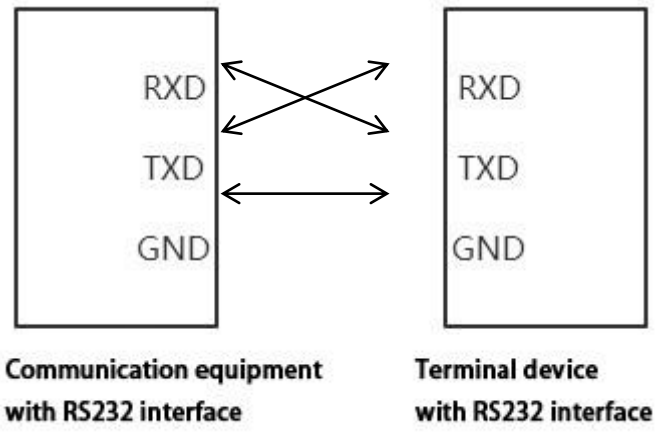
DB9 header interface

The top left corner is 1, the bottom right corner is 9

9-pin RS232 serial port（DB9）		
Pin	Name	Function
1	CD	Carrier detect
2	RXD	Receive data
3	TXD	Send data
4	DTR	Data terminal ready
5	GND	Signal ground
6	DSR	Data ready
7	RTS	Request to send
8	CTS	Clear to send
9	RI	Ring alert

As the RS232 interface has the above electrical characteristics, it can only realize point-to-point communication.

RS232 communication wiring diagram is shown in the figure below:



7.2.2 RS422

The full name of RS422 interface standard is "Electrical Characteristics of Balanced Voltage Digital Interface Circuit", which defines the characteristics of the interface circuit. RS422 adopts four-wire plus ground wire (T+, T-, R+, R-, GND), full-duplex, differential transmission,

multi-point communication data transmission protocol. It USES a balanced transmission line that is unidirectional/non-reversible, with or without an enabling end. Because the receiver USES a high input impedance and the sending driver is stronger than RS232, it is allowed to connect multiple receiving nodes on the same transmission line, up to 10 nodes. That is, one Master device (Master), the rest are slave devices (Salve), and the slave devices cannot communicate with each other, so RS-422 supports point-to-many two-way communications.

The RS-422 has a maximum transmission range of 4,000 feet and a maximum transmission rate of 10Mb/s. The length of the balanced twisted pair is inversely proportional to the transmission rate, and the maximum transmission distance can be reached only if the rate is below 100KB /s. The highest rate of transmission can be obtained only over very short distances. Generally, the maximum transmission rate obtained on 100 meters long twisted pair is only 1Mb/s.

The RS-422 requires a terminal resistance that is approximately equal to the characteristic impedance of the transmission cable. In short distance transmission, no final resistance is required, that is, no final resistance is generally required below 300 meters. The final resistance is connected to the farthest end of the transmission cable.

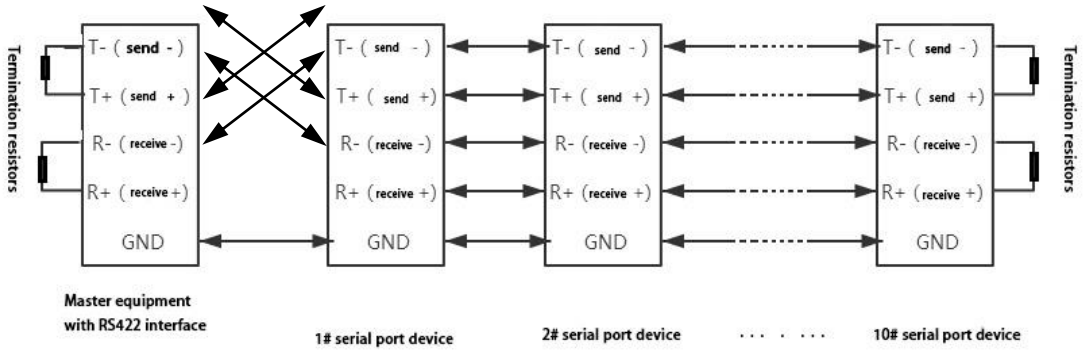
In a master multi-slave network connection, all the sending terminals of the slave connect to the receiving terminals of the master station by daisy-chain. All the receiving ends of the slave stations are connected by daisy-chain to the sending end which is finally connected to the master station.

The RS422 pin definition:

RS422（9 Pin）		Function	Remark
3	R-	Receive negative	Must connect
2	T-	Send negative	Must connect
7	R+	Receiving positive	Must connect
8	T+	Send positive	Must connect

The upper left corner is 1, the lower right corner is 9.

The RS422 communication wiring diagram is shown in the figure:



7.2.3 RS485

Since the RS-485 is developed from the RS-422, many electrical provisions of the RS-485 are similar to those of the RS-422.If they all adopt the balanced transmission mode, they all need to connect the final resistance on the transmission line, etc. The RS-485 can adopt two - wire and four - wire mode, and the two - wire system can realize real multi - point two - way communication.

RS485 is a standard for defining the electrical characteristics of drivers and receivers in a balanced digital multipoint system, using a combination of balanced drivers and differential receivers for enhanced common-mode dry resistance, i.e., good noise interference resistance. Because the semi-duplex network composed of RS485 interface generally adopts the wiring mode of two-wire system and adopts differential signal to transmit data, the voltage difference between the two lines is -(2-6)V to represent logic "0 ", and the voltage difference between the two lines is +(2-6)V to represent logic "1".

RS485 signal transmission distance is related to communication baud rate, the higher the baud rate, the shorter the transmission distance, under the condition of the baud rate is not higher than 100 KBPS, theory of the maximum communication distance is about 1200 meters, in the process of practical application, Due to electromagnetic interference and other factors, often cannot meet the maximum communication distance, if in a long-distance communication, please reduce the baud rate, to reduce the signal during transmission by external electromagnetic interference, please use twisted-pair shielded cable as a communication cable.

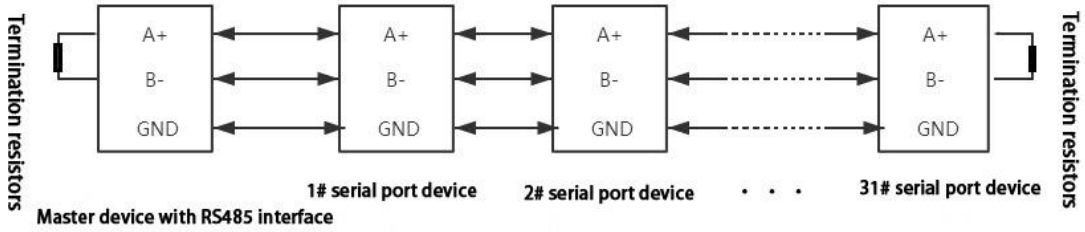
RS485 bus in the case of no trunk to support a maximum of 32 nodes, node and node between the "Daisy chain" connection mode, in the communication cable at both ends need to add terminal

resistance, the resistance value is required to be approximately equal to the transmission cable characteristic impedance. In short distance transmission, no final resistance is required, that is, no final resistance is generally required below 300 meters. The final resistance is connected at the ends of the transmission cable.

RS485 9 pin definition:

Pin	Name	Function	Remark
1	Data-/B-/485-	Send positive	Must connect
2	Data+/A+/485+	Receiving positive	Must connect
5	GND	Ground wire	

The RS485 communication wiring diagram is shown in the figure:



Odot Automation System Co., Ltd.

Add: Plant No. 204 MianYang Comprehensive Bonded Zone, Eastern section of FeiYun Avenue, MianYang,Sichuan Province,China.621000

Tel: +86-0816-2538289

Zip Code: 621000

Email: sales@odotautomation.com

Web: www.odotautomation.com