INVT Flex Series I/O System

User Manual

SHENZHEN INVT ELECTRIC CO., LTD.

Preface

Overview

Thank you for choosing INVT Flex series I/O system.

INVT Flex series I/O system is a flexible, reliable, and efficient signal transmission system with a more reliable structural design. The system is able to access to multiple standard communication networks, respond in microseconds, and equipped with rich signal modules to meet various industrial automation needs while saving cabinet space, helping you develop more competitive personalized solutions.

Target audience

Personnel with electrical professional knowledge (such as qualified electrical engineers or personnel with equivalent knowledge).

About documentation obtaining

In addition to this user guide, you can also obtain product documentation and technical support from our website:

Visit www.invt.com, choose **Support** > **Download**, enter a keyword, and click **Search**.

Change history

The manual is subject to change irregularly without prior notice due to product version upgrades or other reasons.

No.	Change description	Version	Release date
1	First release.	V1.0	September 2023
2	● Added description information to section 2.1.1.4. ● Added section 2.3 EtherNet/IP communication coupler. ● Added expansion module content to sections 3.1.2, 3.2.2, 3.3.2, and 3.9. ● Added FK1200 related content to section 4.2.1.1. ● Added five 32-point module models to section 4.2.2.1. ● Added PROFINET communication coupler to section 5.4.1. ● Added terminal definition and wiring content to sections 5.4.2.2, 5.4.3.2, 5.4.4.2, and 5.4.10. ● Updated chapter 6 Communication coupler configuration. ● Added chapter 8 EtherCAT functions.	V1.1	August 2024
3	● Added section 2.4 ModbusTCP communication coupler. ● Added section 6.4 ModbusTCP configuration ● Added sections 6.1.1.9 Counting and measurement module (FL6002), 6.1.1.10 Counting and measurement module (FL6112), 6.1.1.11 Counting and measurement module (FL6121)	V1.2	January 2025

No.	Change description	Version	Release date
	● Added sections 6.2.1.12 Analog input module—FL3404(8ADV), 6.2.1.13 Analog input module—FL3504(8ADI), 6.2.1.17 Counting and measurement module—FL6002-2ES, 6.2.1.18 Counting and measurement module—FL6112-2EI, and 6.2.1.19 Counting and measurement module—FL6121-1EI. ● Added chapter 7 Common functions of Ttools-IO software. ● Added appendix A Address mapping table instructions		

Contents

1 Safety precautions

1.1 What this chapter contains

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing the active power filter. Otherwise, equipment damage or physical injury or death may be caused.

We shall not be liable or responsible for any equipment damage or physical injury or death caused due to failure to follow the safety precautions.

1.2 Safety level definition

To ensure personal safety and avoid property damage, you must pay attention to the warning symbols and tips in the manual.

Warning symbols	Name	Description
	Danger	Severe personal injury or even death can result if related requirements are not followed.
	Warning	Personal injury or equipment damage can result if related requirements are not followed.

1.3 Personnel requirements

Trained and qualified professionals: People operating the equipment must have received professional electrical and safety training and obtained the certificates, and must be familiar with all steps and requirements of equipment installing, commissioning, running and maintaining and capable to prevent any emergencies.

1.4 Safety guidelines

General principles	
	● Only trained and qualified professionals are allowed to carry out related operations. ● Do not perform wiring, inspection or component replacement when power supply is applied. Ensure that all the input power supplies are disconnected before wiring and inspection. ● The product design is applied to indoor electrical environments at overvoltage category II. Ensure that the power supply system of the product has lightning protection devices to prevent lightning overvoltage from being applied to the power input or signal I/O terminals of the product so as to avoid equipment damage. ● Do not modify the product unless authorized; otherwise fire, electric shock or other injury may result. ● Prevent cables and other conductive parts from falling into the product. ● Do not contact the product with damp objects or body parts. Otherwise, electric shock may result.

Delivery	
	● Select appropriate tools for product delivery, and take mechanical protective measures like wearing safety shoes and working uniforms to avoid personal injury. ● Protect the product against physical shock or vibration.

Installation	
	● Do not install the product on inflammables. In addition, prevent the product from contacting or adhering to inflammables. ● Do not run a damaged or incomplete product.
	● Install the product in a lockable control cabinet of at least IP20, which prevents the personnel without electrical equipment related knowledge from touching by mistake, since the mistake may result in equipment damage or electric shock. Only personnel who have received related electrical knowledge and equipment operation training can operate the control cabinet. ● During installation, ensure that the modules are tightly connected and fastened. Insecure connection may cause problems such as communication failure and fall-off. ● After installation, ensure that there are no obstructions on the vents of the product; otherwise, the chips of the product may be burned due to overheating and poor heat dissipation, which causes system control failure and misoperation.

Wiring	
	● Before wiring, clearly understand the necessary information including interfaces, power supply types, and specifications, and comply with relevant standards and requirements to ensure that the system wiring is correct. ● To ensure personal safety and equipment use safety, reliably ground the product using cables with proper diameters and specifications. ● Route the control signal and communication signal cables separately from cables with strong interference such as power cables. ● Apply fastening means to long-distance or heavy cables.
	● Cut off all power supplies connected to the product before performing wiring. ● Before power-on for running, ensure that each module terminal cover is properly installed in place after the installation and wiring are completed. This prevents a live terminal from being touched. Otherwise, physical injury, equipment fault or misoperation may result. ● Install proper protection components or devices when using external power supplies for the product. This prevents the product from being damaged due to external power supply faults, overvoltage, overcurrent, or other exceptions.

Commissioning and running	
	● Before power-on for running, ensure that the working environment of the product meets the requirements (See section 4.1.2 Installation environment and site for details), and a protection circuit has been designed to protect the product so that the product can run safely even if an external device fault occurs. ● When the output units such as relays and transistors of the product are damaged, the output cannot be controlled to be On or Off as configured. ● For modules or terminals requiring external power supply, configure external safety devices such as fuses or circuit breakers to prevent damage caused due to external power supply or device faults. ● In the external circuit of the product, configure an emergency braking circuit, a protection circuit, a circuit for interlocking between forward and reverse operations, and an anti-equipment-damage switch for interlocking between the position upper limit and lower limit. ● To ensure the safe running of equipment, design external protection circuits and safety mechanisms for output signals related to major accidents. ● Design proper external control circuits to ensure the proper running of equipment, since outputs may be out of control when the control circuit has an exception.

Maintenance and component replacement	
	● Keep the product and its parts and components away from combustible materials and ensure they have no combustible materials adhered. ● Before carrying out product maintenance or component operations, cut off all power supplies connected to the product. ● Prevent the screws, cables and other conductive parts from falling into the product during maintenance or component replacement. ● During maintenance and component replacement, take proper anti-static measures on the product and its internal parts.
Note	● Use proper torque to tighten screws.

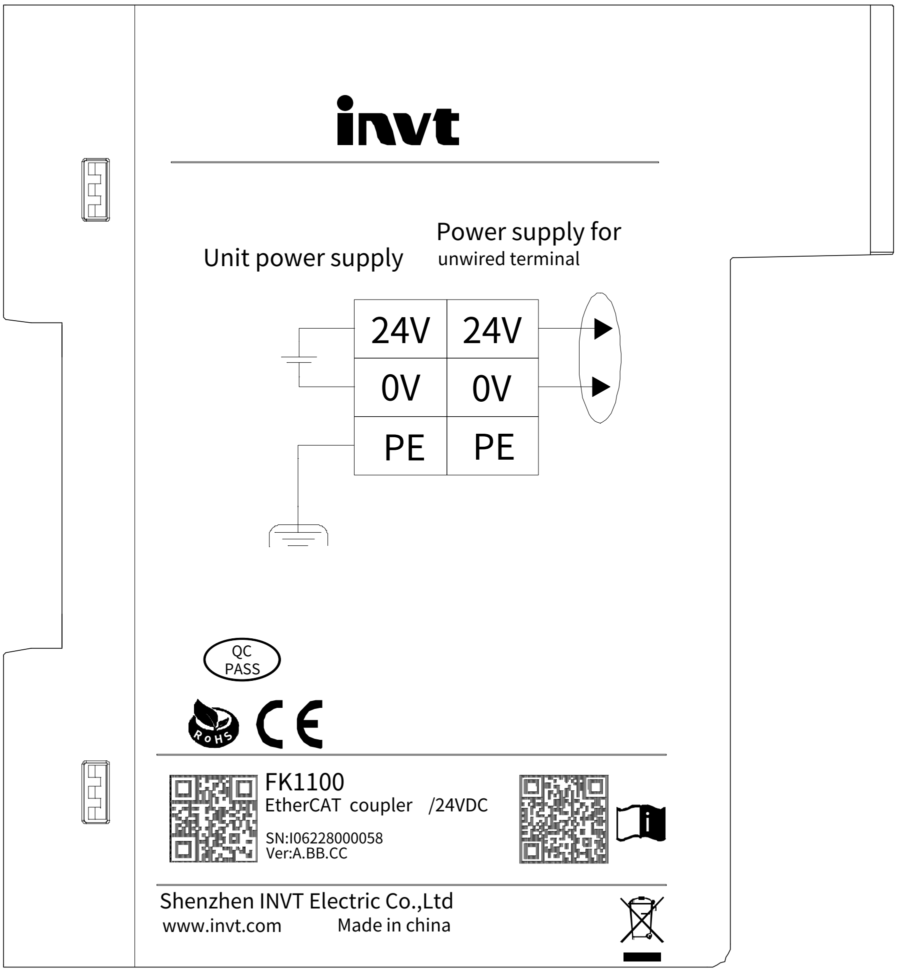
Disposal	
	● The product contains heavy metals. Dispose of a scrap product as industrial waste.
	● Dispose of a scrap product separately at an appropriate collection point but not place it in the normal waste stream.

2 Communication coupler specifications

2.1 EtherCAT communication coupler

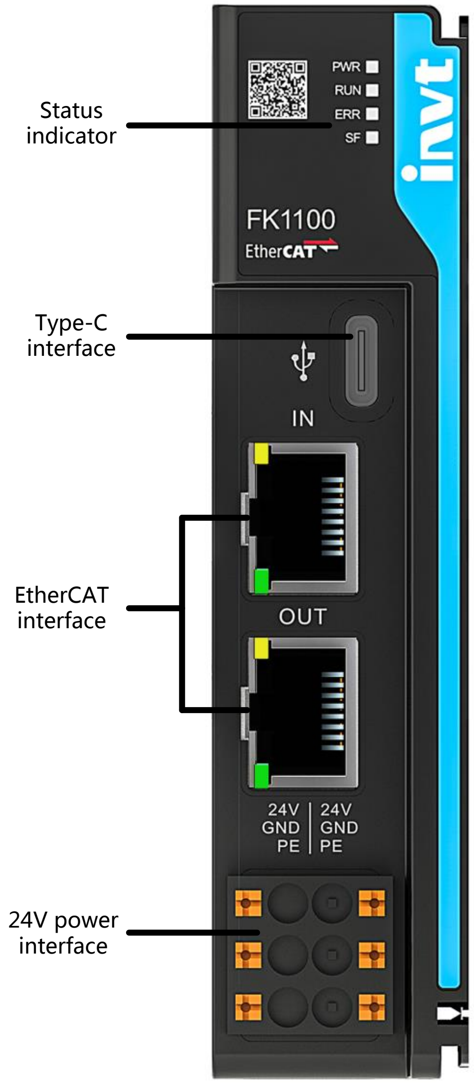
2.1.1 FK1100

2.1.1.1 Basic information



Model	Ordering code	Description	Applicable model
FK1100	11016-00005	Communication coupler, EtherCAT; 4VDC; RoHS	Applicable to INVT and third-party EtherCAT master devices

2.1.1.2 Component description



<table>
<tr><th>Interface</th><th colspan="3">Definition</th></tr>
<tr><td rowspan="10">Status indicator</td><td rowspan="2">PWR: Power indicator (Green)</td><td>Off</td><td>The power connection is abnormal.</td></tr>
<tr><td>On</td><td>The power connection is normal.</td></tr>
<tr><td rowspan="4">RUN: Run indicator (Green)</td><td>Off</td><td>The communication coupler module is in INIT state.</td></tr>
<tr><td>Blinking</td><td>The communication coupler module is Pre-Operational state.</td></tr>
<tr><td>Single flash</td><td>The communication coupler module is in Safe-Operational state.</td></tr>
<tr><td>On</td><td>The communication coupler module is Operational state.</td></tr>
<tr><td rowspan="3">ERR: Fault indicator (Red)</td><td>Off</td><td>The EtherCAT communication is in normal state.</td></tr>
<tr><td>Blinking</td><td>A status conversion command that cannot be executed has been received through the EtherCAT communication.</td></tr>
<tr><td>Single flash</td><td>The network is disconnected, and the communication coupler module</td></tr>
</table>

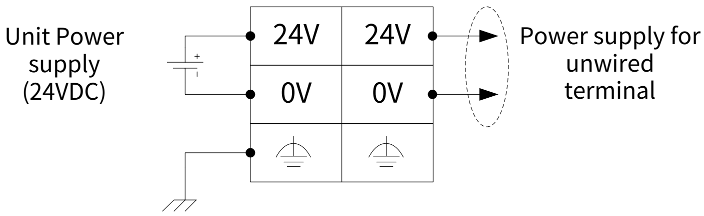
Interface	Definition		
			encounters a synchronization error.
		Double flash	A Watchdog error occurs to the EtherCAT communication.
	SF: Fieldbus fault indicator (Red)	Off	The equipment running is normal.
		Blinking	Configuration error occurs.
		On	A communication coupler FPGA fault occurs.
USB type-C interface	Used for single board software upgrade		
EtherCAT interface	IN: EtherCAT input port		
	OUT: EtherCAT output port		
24V power interface	24VDC power input interface of module		

2.1.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	24V	-	-	24V
	0V	-	-	0V
	⏚	-	-	⏚

- **Terminal wiring**



2.1.1.4 Hardware specifications

Item	Specification
Rated input voltage	24VDC (20.4VDC–28.8VDC)
Rated input current	0.8A (Typical value at 24VDC)
Backplane fieldbus output rated voltage	5VDC (4.75VDC–5.25VDC)
Backplane fieldbus output rated current	2.5A (Typical value at 5VDC)
Isolation	The input power is not isolated.
Power supply protection	Protection against overcurrent, reverse connection, and surges

2.1.1.5 Software specifications

Item	Specification
Alias access	Supporting EtherCAT alias access and site alias setup on backend. Alias range: 1–65535 **Note:** The expansion modules connected behind the EtherCAT communication coupler do not support alias access or setup.
Quantity of input PDO	Up to 768 bytes
Quantity of output PDO	Up to 768 bytes
Input mailbox size	Up to 128 bytes
Output mailbox size	Up to 128 bytes
Max. number of expansion modules	16
Supported min. synchronization period	512μs

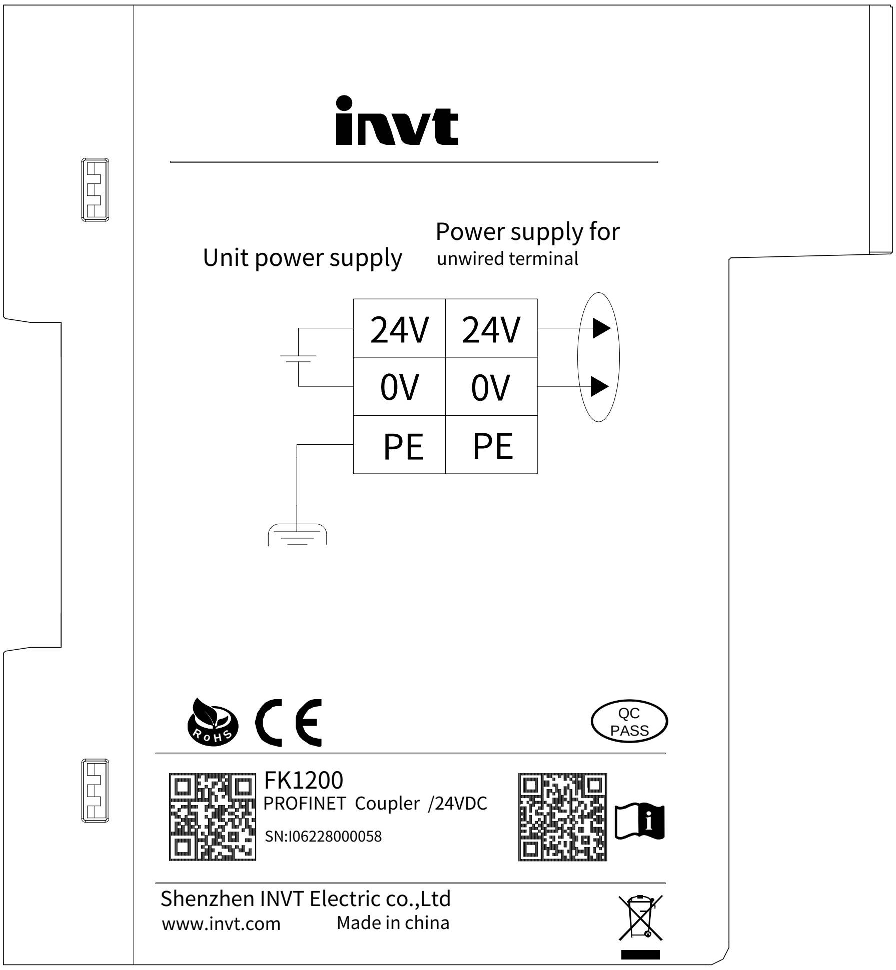
2.1.1.6 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

2.2 PROFINET communication coupler

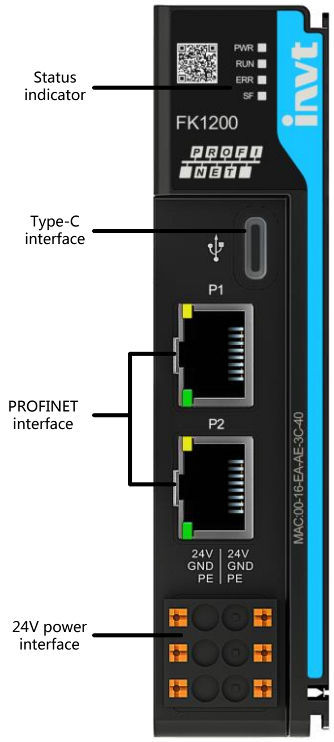
2.2.1 FK1200

2.2.1.1 Basic information



Model	Ordering code	Description	Applicable model
FK1200	11016-00012	Communication coupler, PROFINET, 24VDC; RoHS	Applicable to PROFINET master devices

2.2.1.2 Component description



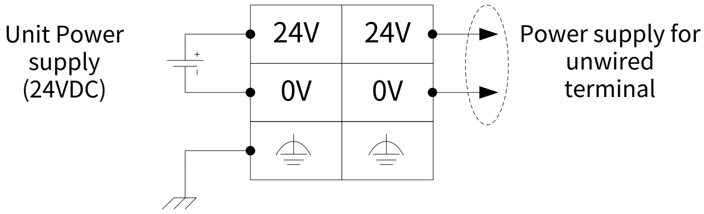
Interface	Definition		
Status indicator	PWR: Power indicator (Green)	Off	The power connection is abnormal.
		On	The power connection is normal.
	RUN: Run indicator (Green)	Off	Initial state
		Fast blinking	Waiting for connection/Connecting.
		Slow blinking	Safe mode
		On	The communication is normal.
	ERR: Fault indicator (Red)	Off	In normal state
		Fast blinking	A communication fault occurred.
		Slow blinking	An expansion module fault occurred.
	SF: Fieldbus fault indicator (Red)	Off	The equipment running is normal.
		Blinking	Configuration inconsistency.
		On	An extended function fault occurred.
USB type-C interface	Used for single board software upgrade		
PROFINET interface	P1: PROFINET interface 1		
	P2: PROFINET interface 2		
24V power interface	24VDC power input interface of module		

2.2.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	24V	-	-	24V
	0V	-	-	0V
	⏚	-	-	⏚

- **Terminal wiring**



2.2.1.4 Hardware specifications

Item	Specification
Rated input voltage	24VDC (20.4VDC–28.8VDC)
Rated input current	0.8A (Typical value at 24VDC)
Backplane fieldbus output rated voltage	5VDC (4.75VDC–5.25VDC)
Backplane fieldbus output rated current	2.5A (Typical value at 5VDC)
Isolation	The input power is not isolated.
Power supply protection	Protection against overcurrent, reverse connection, and surges

2.2.1.5 Software specifications

Item	Specification
Communication mode	RT mode
Min. communication period	1ms
I&M data	From I&M0 to I&M3
PROFINET version	V2.43
Expansion capability	Supporting 16 modules
PROFINET interface quantity	2
PROFINET switch function	Supporting the function of networking
Supported open IE	TCP/IP, SNMP, and LLDP
Alarm/Diagnosis/Status information	Supported. Function codes can be uploaded from the local to the PLC.
Physical layer	100BASE-TX
Communication rate	10Mbit/s (Standard Ethernet); 100Mbit/s (PROFINET)
Communication method	Full duplex

Item	Specification
Topological structure	Linear, star, or tree topology
Transmission medium	Category-5 or higher network cables
Transmission distance	Less than 100m between two nodes
Startup with priority	Reserved
Port disabling	Not supported
Supporting device replacement without configuration	Supported (PN module of the same type)
Restoring factory settings	Supported

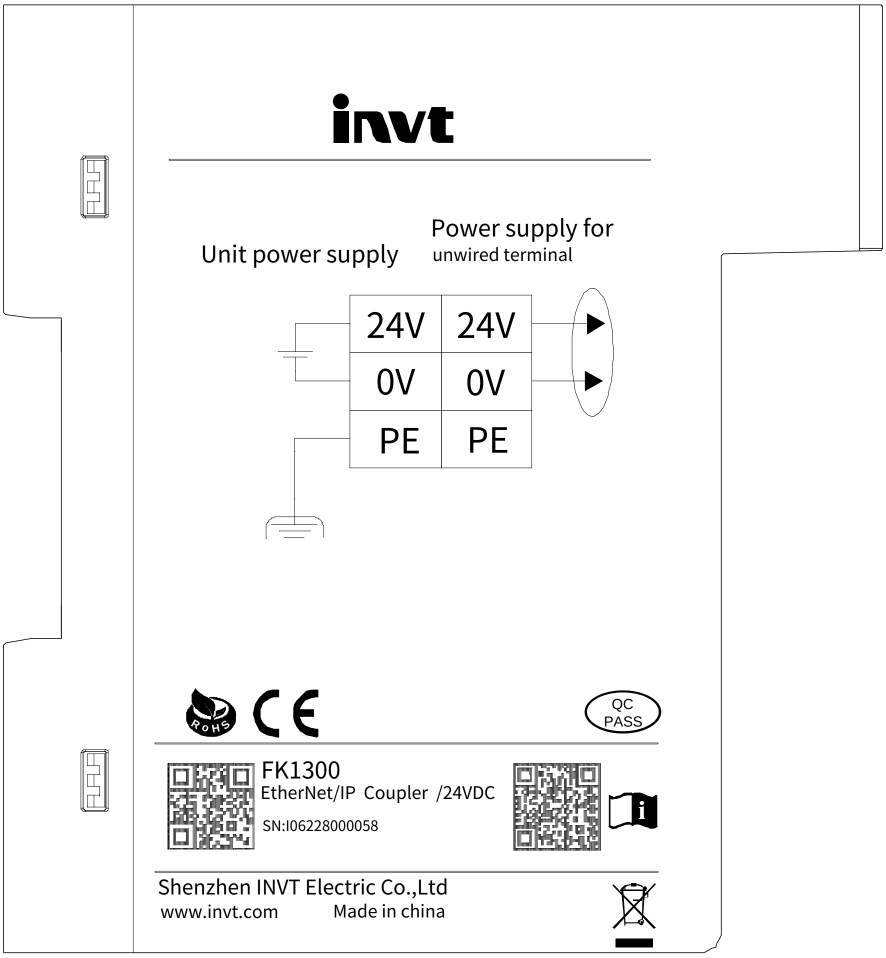
2.2.1.6 Environment specifications

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

2.3 EtherNet/IP communication coupler

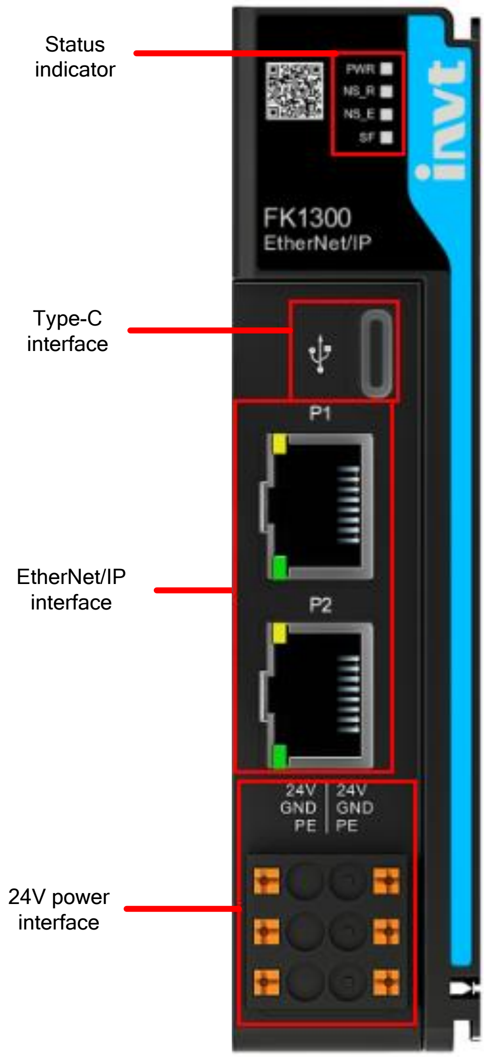
2.3.1 FK1300

2.3.1.1 Basic information



Model	Ordering code	Description	Applicable model
FK1300	11016-00018	Communication coupler; EtherNet/IP; 24VDC; RoHS	Applicable to EtherNet/IP master devices

2.3.1.2 Component description



Interface	Definition		
Status indicator	PWR: Power indicator (Green)	Off	The power connection is abnormal.
		On	The power connection is normal.
	NS_R: Network status indicator (Green)	Off	No IP address configured, no Ethernet connection.
		Blinking at 1Hz	Not connected
		Steady on	Connected
	NS_E: Network status indicator (Red)	Off	The network is working properly.
		Blinking at 1Hz	Connection timed out.
		Steady on	Duplicate IP address
	SF: Fieldbus fault indicator (Red)	Off	The device is normal.
		Blinking at 1Hz	Configuration error occurs.
		Blinking at 0.5Hz	Exception in communication coupler MPU device initialization.
		On	A communication coupler FPGA fault occurs.

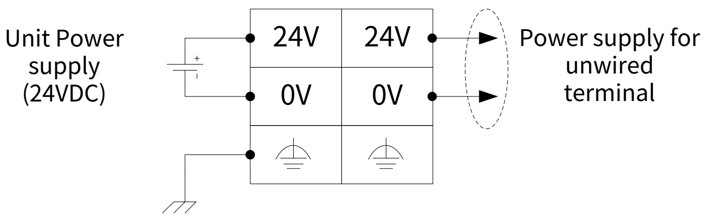
Interface	Definition			
USB type-C interface	For functions such as single-board software upgrades, EDS file export, and IP/MAC address configuration			
EtherNet IP interface	P1 interface	Network port indicator (Green)	Off	Link indicator, indicating Ethernet connection not established.
			On	Link indicator, indicating successful Ethernet connection.
		Network port indicator (Yellow)	Off	ACK indicator, indicating no data interchange.
			On	ACK indicator, indicating data interchange performed.
	P2 interface	Network port indicator (Green)	Off	Link indicator, indicating Ethernet connection not established.
			On	Link indicator, indicating successful Ethernet connection.
		Network port indicator (Yellow)	Off	ACK indicator, indicating no data interchange.
			On	ACK indicator, indicating data interchange performed.
24V power interface	24VDC power input interface of module			

2.3.1.3 Terminal definition and wiring

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	24V	-	-	24V
	0V	-	-	0V
	⏚	-	-	⏚

■ **Terminal wiring**



2.3.1.4 Hardware specifications

Item	Specification
Rated input voltage	24VDC (20.4VDC–28.8VDC)
Rated input current	0.8A (Typical value at 24VDC)
Backplane fieldbus output rated voltage	5VDC (4.75VDC–5.25VDC)
Backplane fieldbus output rated current	2.5A (Typical value at 5VDC)

Item	Specification
Isolation	The input power is not isolated.
Power supply protection	Protection against overcurrent, reverse connection, and surges

2.3.1.5 Software specifications

Item	Specification
Fieldbus protocol	EtherNet/IP
Fieldbus velocity	10/100Mbps, self adaptive, full duplex
Max. number of I/O expansion modules	32
Max. number of output/input bytes	Input: 504 bytes; Output: 504 bytes
Network topology	Linear, star, tree topology, or ring

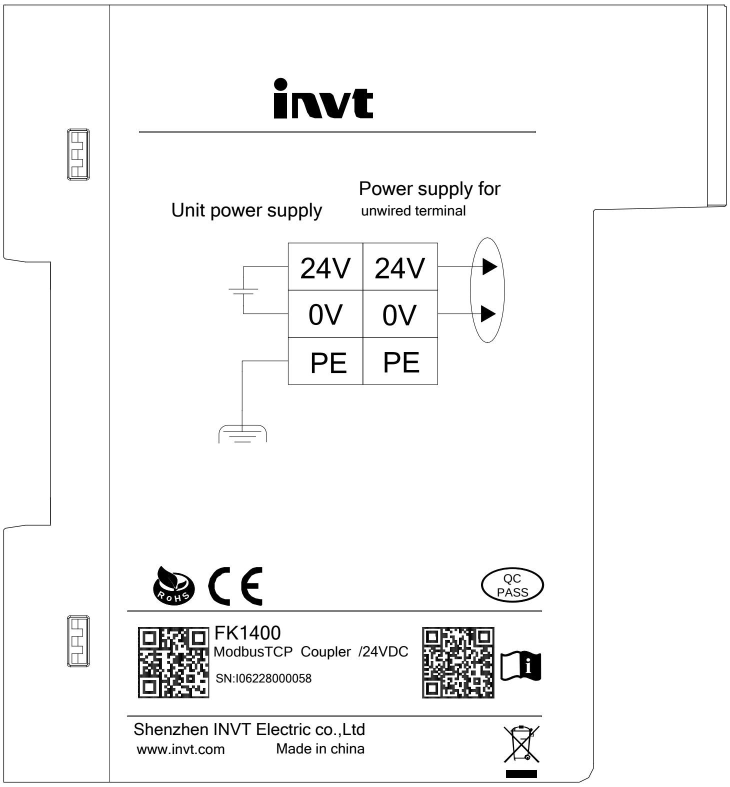
2.3.1.6 Environmental requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

2.4 ModbusTCP communication coupler

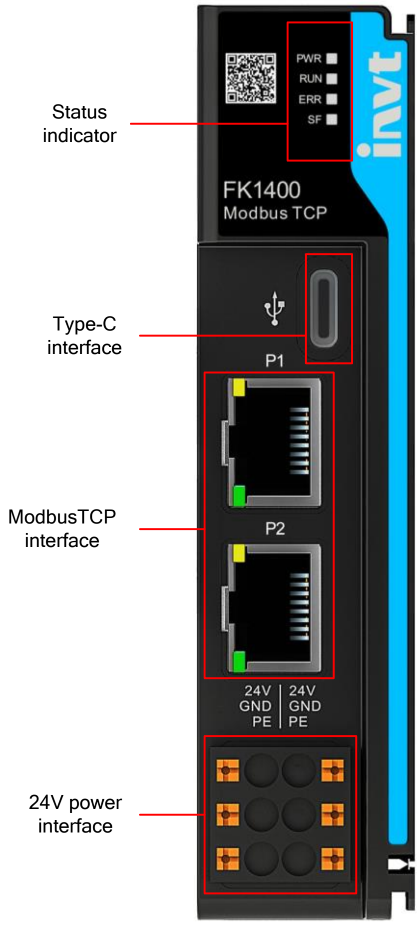
2.4.1 FK1400

2.4.1.1 Basic information



Model	Ordering code	Description	Applicable model
FK1400	11016-00029	Communication coupler;ModbusTCP;24VDC;RoHS	Applicable to ModbusTCP master devices

2.4.1.2 Component description



Interface	Definition		
Status indicator	PWR: Power indicator (Green)	Off	The power connection is abnormal.
		On	The power connection is normal.
	RUN: Network operation status indicator (green)	Off	Not connected to the network.
		Blinking (500ms)	Waiting for connection/Connecting.
		On	The communication is normal.
	ERR: Network error status indicator (red)	Off	The network is working properly.
		Blinking (500ms)	The network is disconnected abnormally after successful connection.
		On	IP conflict.
	SF: System fault indicator (red)	Off	The equipment is normal.
		Blinking (500ms)	Configuration error occurs.
		Blinking (1000ms)	Exception in communication coupler MPU device initialization.
		On	A communication coupler initialization failure occurs.
USB type-C interface	For functions such as single-board software upgrades, EDS file export, and IP/MAC address configuration		

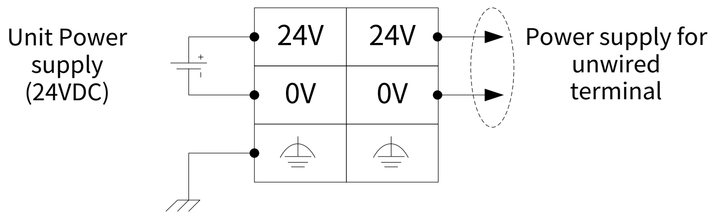
Interface	Definition			
ModbusTCP interface	P1 interface	Network port indicator (Green)	Off	Link indicator, indicating not connected to the network.
			On	Link indicator, indicating connected to the network.
		Network port indicator (Yellow)	Off	ACK indicator, indicating no data interchange.
			On	ACK indicator, indicating data interchange performed.
	P2 interface	Network port indicator (Green)	Off	Link indicator, indicating not connected to the network.
			On	Link indicator, indicating connected to the network.
		Network port indicator (Yellow)	Off	ACK indicator, indicating no data interchange.
			On	ACK indicator, indicating data interchange performed.
24V power interface	24VDC power input interface of module			

2.4.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	24V	-	-	24V
	0V	-	-	0V
	⏚	-	-	⏚

- **Terminal wiring**



Note:

- The terminal PE must be properly grounded through the cable, with a grounding impedance of less than 4Ω.
- Try to configure an independent system power supply for the coupler to avoid mixing with the external field power supply of the expansion module.

2.4.1.4 Hardware specifications

Item	Specification
Rated input voltage	24VDC (-15%–+20%)

Item	Specification
Rated input current	0.8A
Backplane fieldbus output rated voltage	5VDC (4.75VDC–5.25VDC)
Backplane fieldbus output rated current	2.5A (Typical value)
Isolation	No isolation
Power supply protection	Protection against reverse connection and overcurrent

2.4.1.5 Software specifications

Item	Specification
Max. number of client connections	5
TCP Keepalive	Enabled
Supported function codes	01/02/03/04/05/06/15/16/23
IP address settings	Set through the Ttools-IO software
Diagnostic function	Supported
Physical layer	100BASE-TX
Communication rate	10M/100Mbps, self adaptive
Communication method	Full duplex
Topological structure	Linear, star, or tree topology
Transmission medium	Category-5 or higher network cables
Transmission distance	Max. segment length is 100 meters.

2.4.1.6 Environmental requirements

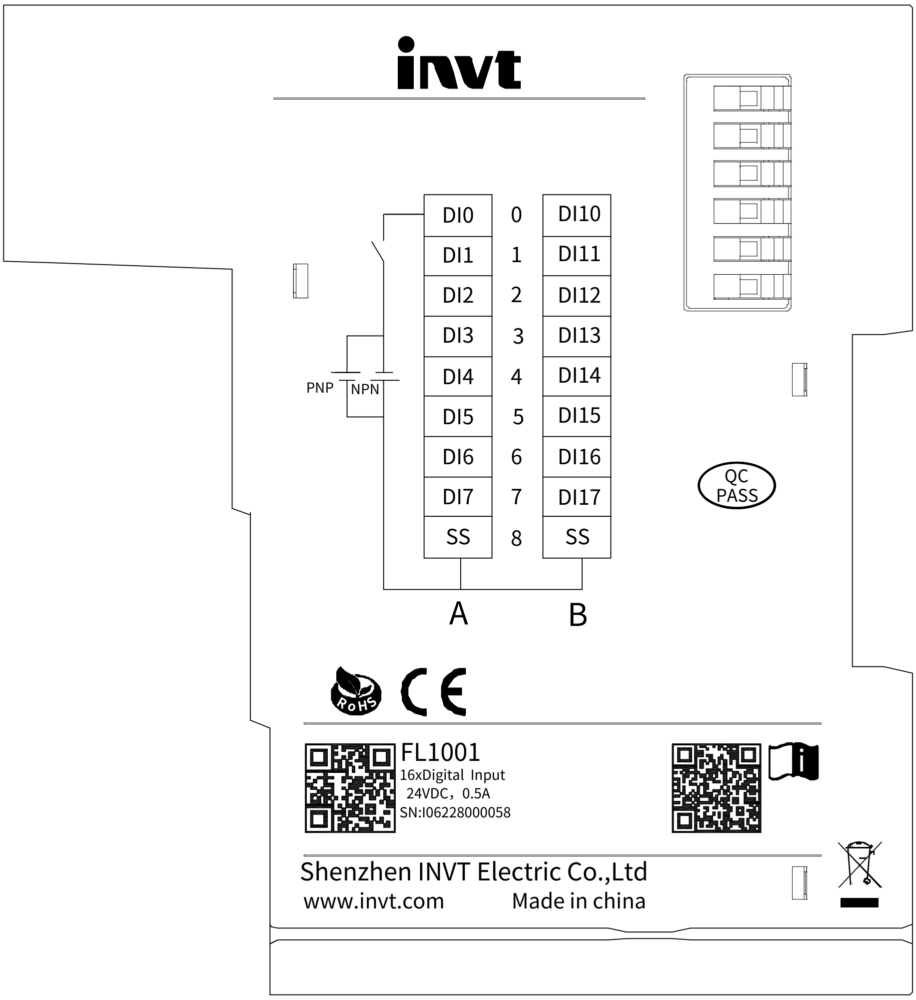
Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 2000m (80kPa)
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3 I/O module specifications

3.1 Digital input module (FL100x)

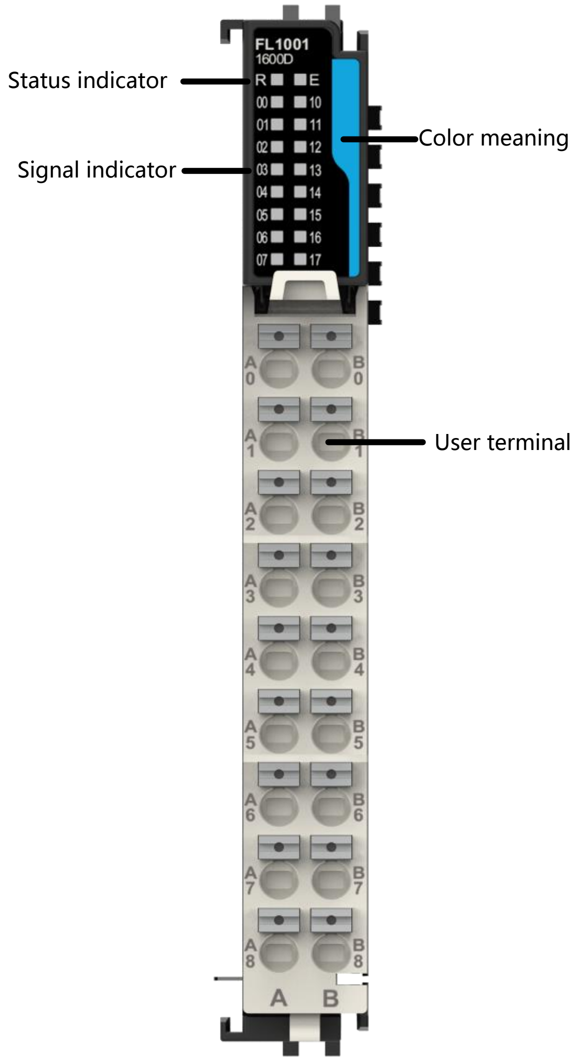
3.1.1 FL1001 (1600D)

3.1.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL1001	11016-00004	Digital input module, 16 channels, supporting the source and sink types, 500mA@ 24 VDC inputs; RoHS	Applicable to INVT Flex/TS/TM series

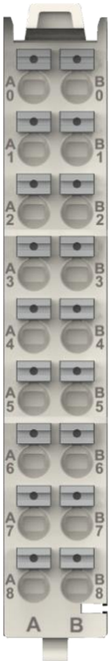
3.1.1.2 Component description



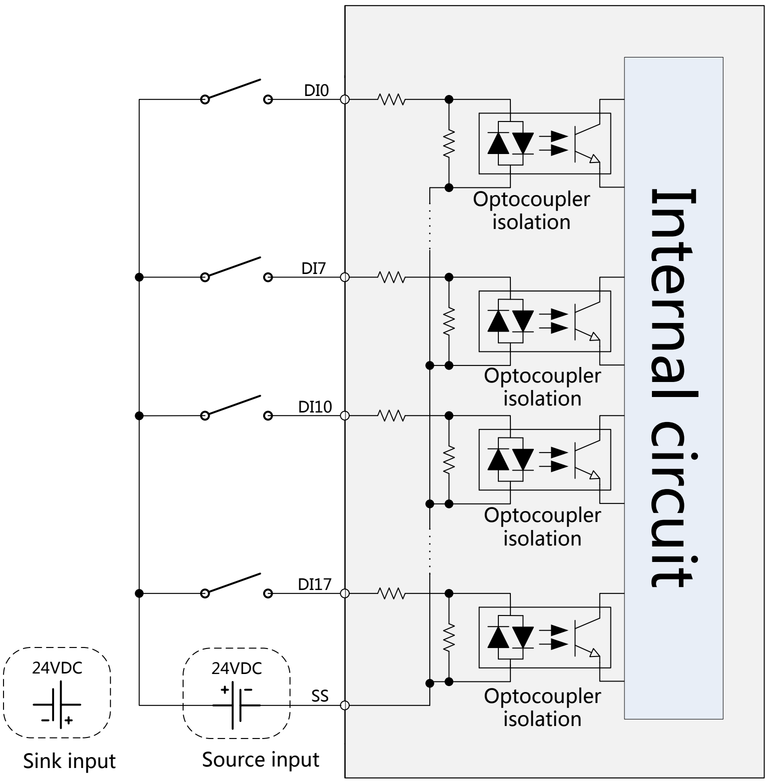
<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td colspan="2">On: The module is running.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td colspan="2">Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td colspan="2">Fast blinking (100ms): The module is offline.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): Incorrect parameter settings.</td></tr>
<tr><td colspan="2">Off: The module works normally.</td></tr>
<tr><td rowspan="2">Signal indicator</td><td rowspan="2">00–07: Green
10–17: Green</td><td rowspan="2">Each corresponds to a channel of input signal.</td><td colspan="2">On: The input is valid.</td></tr>
<tr><td colspan="2">Off: The input is invalid.</td></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td>(blue)</td><td>Digital input</td><td>(light cyan)</td><td>Digital output (source, sink, relay)</td></tr>
<tr><td>(magenta)</td><td>Analog input (voltage, current, thermocouple)</td><td>(orange)</td><td>Analog output</td></tr>
</table>

3.1.1.3 Terminal definition and wiring

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	DI0	**A0**	**B0**	DI10
	DI1	**A1**	**B1**	DI11
	DI2	**A2**	**B2**	DI12
	DI3	**A3**	**B3**	DI13
	DI4	**A4**	**B4**	DI14
	DI5	**A5**	**B5**	DI15
	DI6	**A6**	**B6**	DI16
	DI7	**A7**	**B7**	DI17
	SS	**A8**	**B8**	SS

■ **Terminal wiring**



3.1.1.4 Power supply specifications

Item	Specification
Fieldbus input power	5VDC (4.75VDC–5.25VDC)

Item	Specification
rated voltage	
Fieldbus input power rated current	150mA (Typical value at 5VDC)
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.1.1.5 Input specifications

Item	Specification
Input type	Digital input
Input mode	Source type/Sink type
Input channels	16
Input voltage class	24VDC±10% (21.6VDC–26.4VDC)
Input current (Typical)	7mA (Typical value at 24VDC)
ON voltage	>15V
OFF voltage	<5V
Hardware response time ON/OFF	100μs/100μs
Software filter time	Supported
Input resistance	Reference value is about 3.4kΩ.
Isolation	Optocoupler
Input action display	When the input is in driving state, the input indicator is on.
Input derating	When each terminal is operating at 55°C, it is derated to 75% (with no more than 12 input points of ON at the same time), or the temperature drops by 10°C when all input points are ON.

3.1.1.6 Software specifications

Item	Specification
Software input filter time	Setting range: 1–65535 (default: 1000); unit: 10μs; 1000 indicates 10ms. Able to set two groups of filter parameter. Every eight channels use a group of filter parameter.
Input port exception detection and indication	None
Input channel logic level configuration	Not supported
Configuration of independent channel enabling	Not supported
Configuration of	Diagnosis information will be uploaded by default.

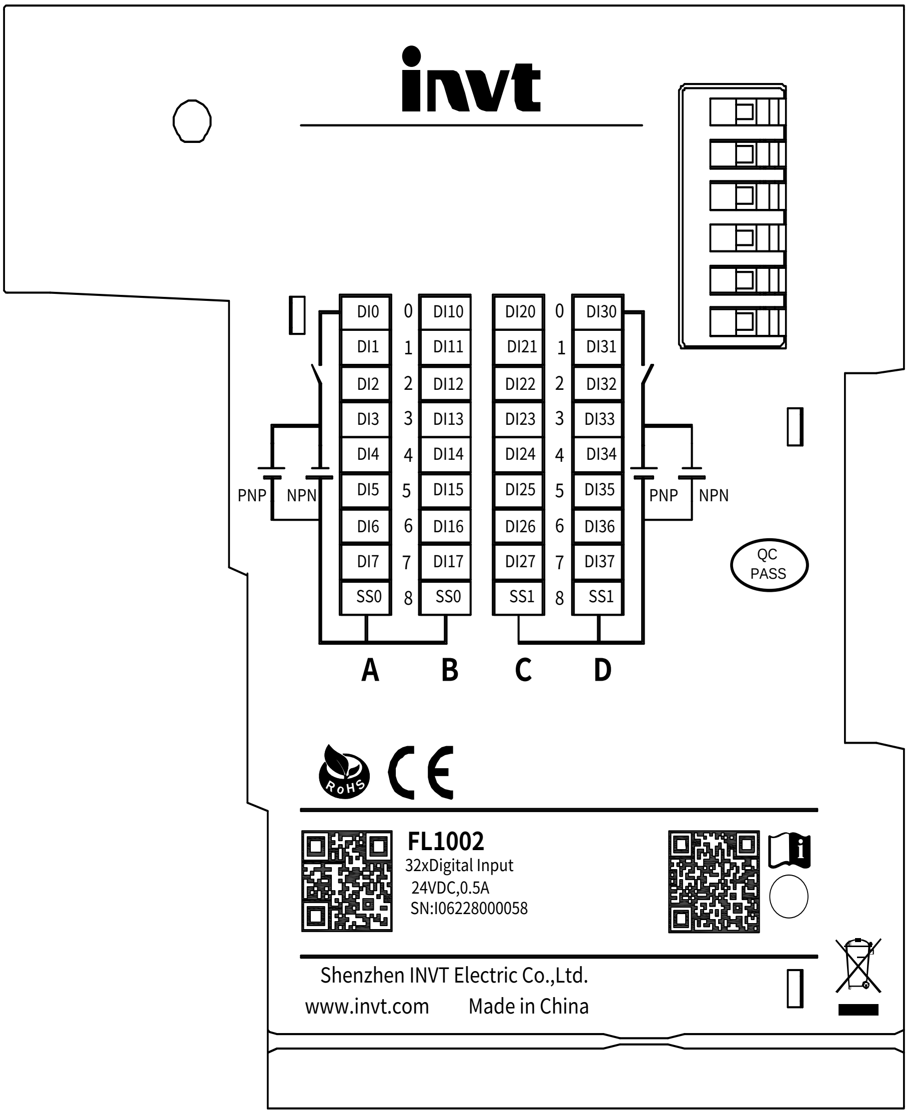
Item	Specification
diagnosis reporting	
In stop mode	Output will not be refreshed, while input supports refreshing in Safe-operational state.
I/O mapping	Supporting the mapping method of bitwise access

3.1.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

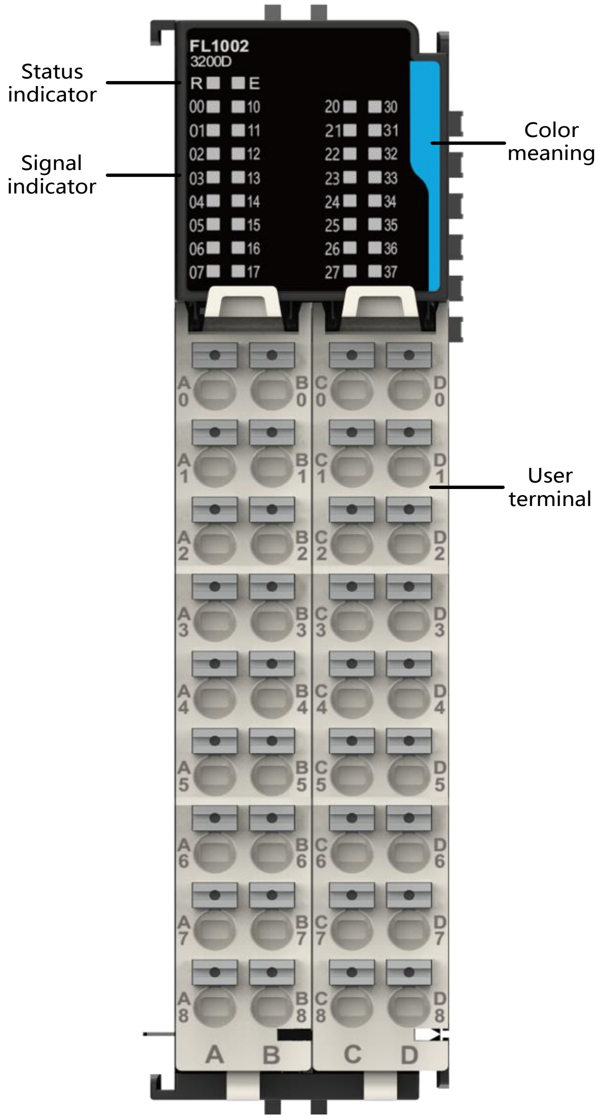
3.1.2 FL1002 (3200D)

3.1.2.1 Basic information



Model	Ordering code	Description	Applicable model
FL1002	11016-00016	Digital input module, 32 channels, supporting the source and sink types, 500mA@ 24 VDC inputs; RoHS	Applicable to INVT Flex/TS/TM series

3.1.2.2 Component description

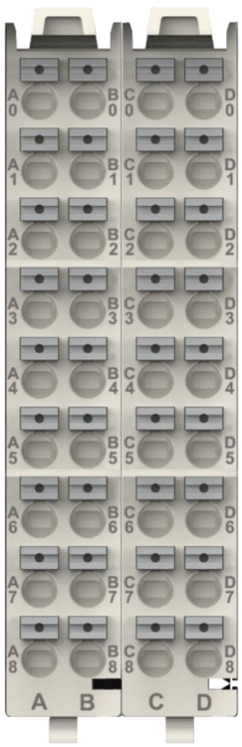


<table>
<tr><th>Name</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td>On: The module is running.</td></tr>
<tr><td>Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td>Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td>Fast blinking (100ms): The module is offline.</td></tr>
<tr><td>Slow blinking (500ms): Incorrect parameter settings.</td></tr>
<tr><td>Off: The module works normally.</td></tr>
<tr><td rowspan="2">Signal indicator</td><td rowspan="2">00–07: Green
10–17: Green
20–27: Green
30–37: Green</td><td rowspan="2">Each corresponds to a channel of input signal.</td><td>On: The input is valid.</td></tr>
<tr><td>Off: The input is invalid.</td></tr>
</table>

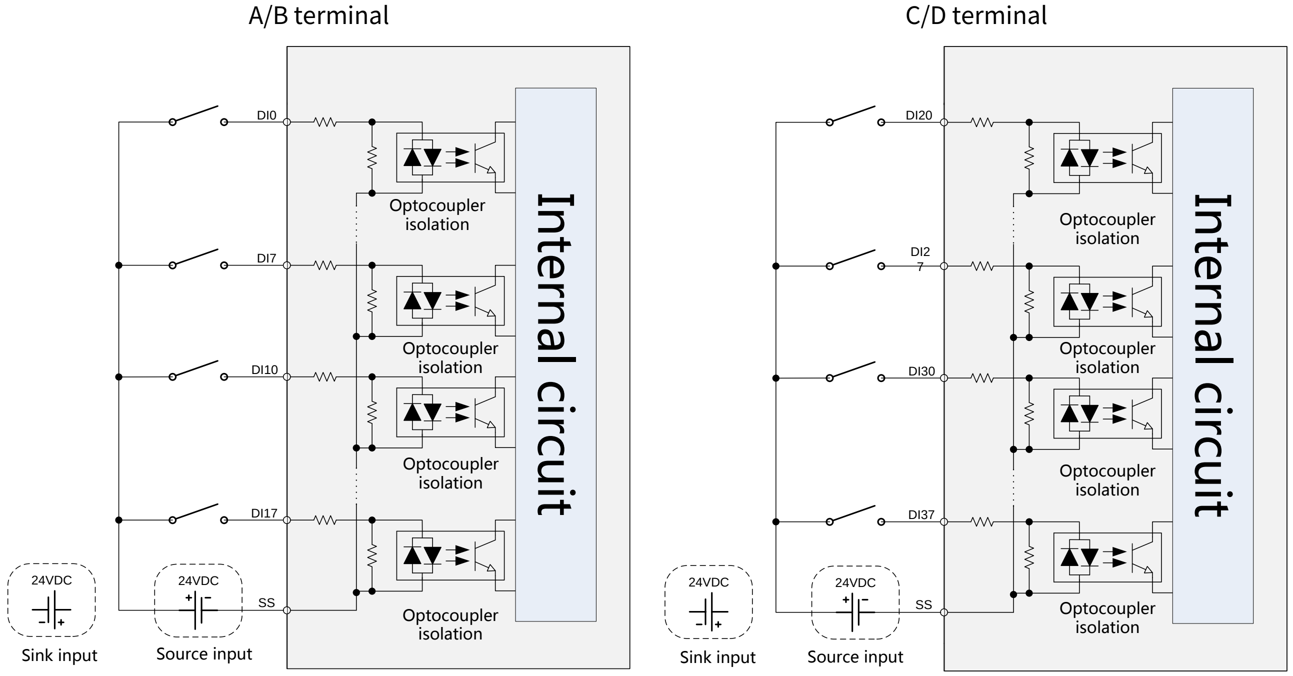
<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td></td><td>Digital input</td><td></td><td>Digital output (source, sink, relay)</td></tr>
<tr><td></td><td>Analog input (voltage, current, thermocouple)</td><td></td><td>Analog output</td></tr>
</table>

3.1.2.3 Terminal definition and wiring

- **Terminal definition**

<table>
<tr><th>Schematic diagram</th><th>Left signal</th><th>Left terminal</th><th>Right terminal</th><th>Right signal</th></tr>
<tr><td rowspan="18">
</td><td>DI0</td><td>A0</td><td>B0</td><td>DI10</td></tr>
<tr><td>DI1</td><td>A1</td><td>B1</td><td>DI11</td></tr>
<tr><td>DI2</td><td>A2</td><td>B2</td><td>DI12</td></tr>
<tr><td>DI3</td><td>A3</td><td>B3</td><td>DI13</td></tr>
<tr><td>DI4</td><td>A4</td><td>B4</td><td>DI14</td></tr>
<tr><td>DI5</td><td>A5</td><td>B5</td><td>DI15</td></tr>
<tr><td>DI6</td><td>A6</td><td>B6</td><td>DI16</td></tr>
<tr><td>DI7</td><td>A7</td><td>B7</td><td>DI17</td></tr>
<tr><td>SS</td><td>A8</td><td>B8</td><td>SS</td></tr>
<tr><td>DI20</td><td>C0</td><td>D0</td><td>DI30</td></tr>
<tr><td>DI21</td><td>C1</td><td>D1</td><td>DI31</td></tr>
<tr><td>DI22</td><td>C2</td><td>D2</td><td>DI32</td></tr>
<tr><td>DI23</td><td>C3</td><td>D3</td><td>DI33</td></tr>
<tr><td>DI24</td><td>C4</td><td>D4</td><td>DI34</td></tr>
<tr><td>DI25</td><td>C5</td><td>D5</td><td>DI35</td></tr>
<tr><td>DI26</td><td>C6</td><td>D6</td><td>DI36</td></tr>
<tr><td>DI27</td><td>C7</td><td>D7</td><td>DI37</td></tr>
<tr><td>SS</td><td>C8</td><td>D8</td><td>SS</td></tr>
</table>

■ **Terminal wiring**



3.1.2.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	150mA (Typical value at 5VDC)
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.1.2.5 Input specifications

Item	Specification
Input type	Digital input
Input mode	Source/Sink
Input channels	16
Input voltage class	24VDC±10% (21.6VDC–26.4VDC)
Input current (Typical)	7mA (Typical value at 24VDC)
ON voltage	>15V
OFF voltage	<5V

Item	Specification
Hardware response time ON/OFF	100μs/100μs
Software filter time	Supported
Input resistance	Reference value is about 3.4kΩ.
Isolation	Optocoupler
Input action display	When the input is in driving state, the input indicator is on.
Input derating	When each terminal is operating at 55℃, it is derated to 75% (with no more than 12 input points of ON at the same time), or the temperature drops by 10℃ when all input points are ON.

3.1.2.6 Software specifications

Item	Specification
Software input filter time	Setting range: 1–65535 (default: 1000); unit: 10μs; 1000 indicates 10ms. Able to set two groups of filter parameter. Every eight channels use a group of filter parameter.
Input port exception detection and indication	None
Input channel logic level configuration	Not supported
Configuration of independent channel enabling	Not supported
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.
In stop mode	Output will not be refreshed, while input supports refreshing in Safe-operational state.
I/O mapping	Supporting the mapping method of bitwise access

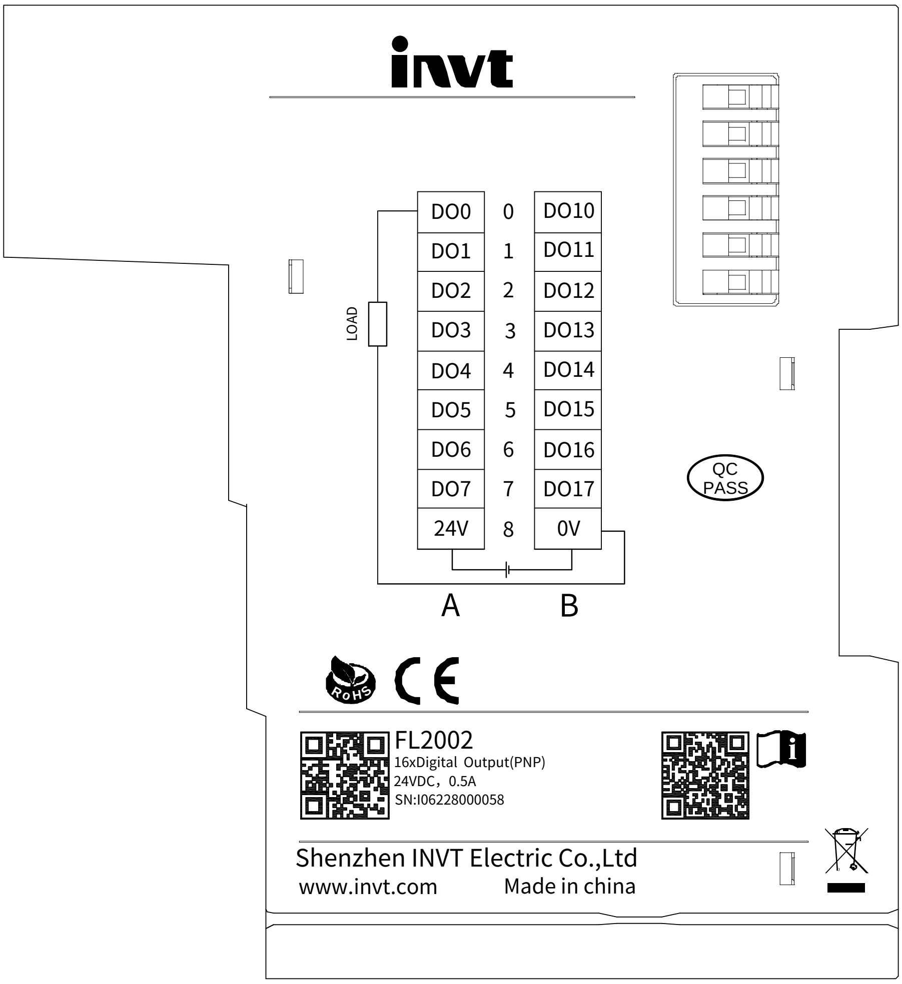
3.1.2.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.2 Digital output module (source type) (FL200x)

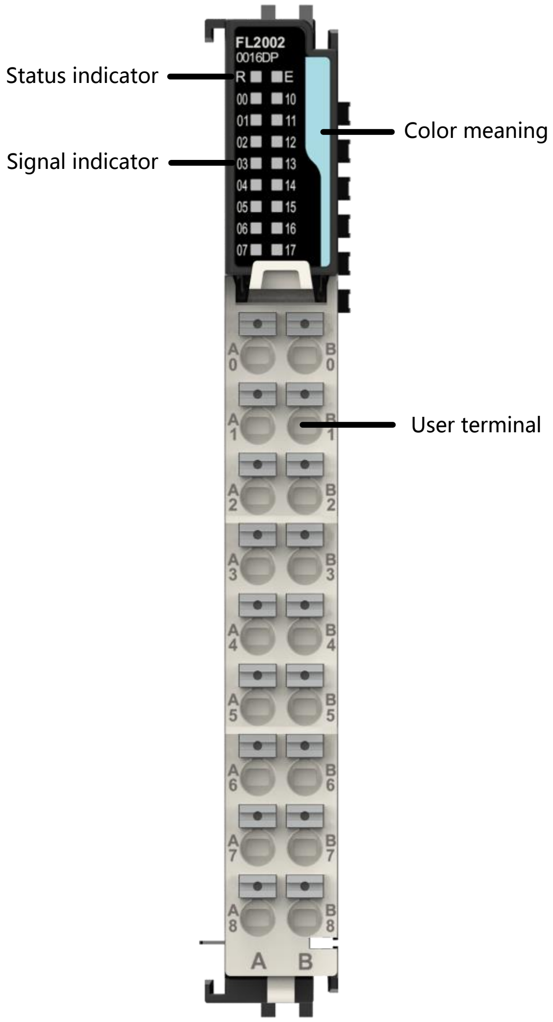
3.2.1 FL2002 (0016DP)

3.2.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL2002	11016-00006	Digital output module, with 16 channels of PNP transistor output, 500mA @ 24 VDC; RoHS	Applicable to INVT Flex/TS/TM series

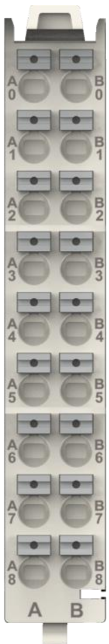
3.2.1.2 Component description



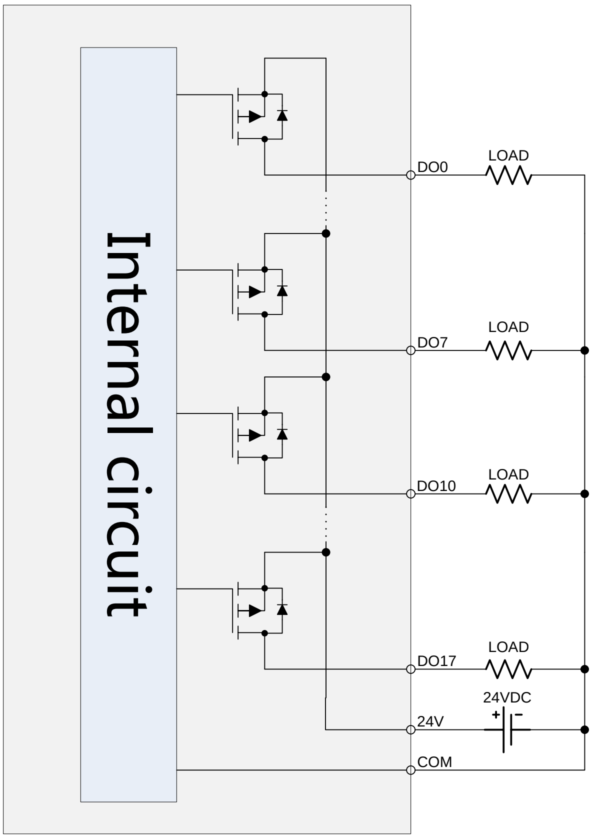
<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td colspan="2">On: The module is running.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td colspan="2">Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td colspan="2">Fast blinking (100ms): The module is offline.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): No power connected externally or incorrect parameter settings.</td></tr>
<tr><td colspan="2">Off: The module works normally.</td></tr>
<tr><td rowspan="2">Signal indicator</td><td rowspan="2">00–07: Green
10–17: Green</td><td rowspan="2">Each corresponds to a channel of output signal.</td><td colspan="2">On: Enable output.</td></tr>
<tr><td colspan="2">Off: Disable output.</td></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td></td><td>Digital input</td><td></td><td>Digital output (source, sink, relay)</td></tr>
<tr><td></td><td>Analog input (voltage, current, thermocouple)</td><td></td><td>Analog output</td></tr>
</table>

3.2.1.3 Terminal definition and wiring

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	DO0	**A0**	**B0**	DO10
	DO1	**A1**	**B1**	DO11
	DO2	**A2**	**B2**	DO12
	DO3	**A3**	**B3**	DO13
	DO4	**A4**	**B4**	DO14
	DO5	**A5**	**B5**	DO15
	DO6	**A6**	**B6**	DO16
	DO7	**A7**	**B7**	DO17
	24VDC	**A8**	**B8**	COM

■ **Terminal wiring**



3.2.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	150mA
Terminal input power rated voltage	24VDC (20.4VDC–28.8VDC)
Terminal input power rated current	2A (Typical value at 24VDC)
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.2.1.5 Output specifications

Item	Specification
Output type	Digital output, high-edge output
Output mode	Source type
Output channel	16
Output voltage class	24VDC±10% (21.6VDC–26.4VDC)
Output load (Resistance load)	0.5A/point, 2A/module
Output load (Inductance load)	7.2W/point, 12W/module
Output load (Light load)	5W/point, 18W/module
Hardware response time ON/OFF	100μs/100μs
Leakage current at OFF	10μA
Switch frequency	100Hz for resistance load, 0.5Hz for resistance load, and 100ms for light load
Isolation	Yes
Output action display	When the output is in driving state, the output indicator is on.
Input derating	None
Protection function	Short-circuit protection and overcurrent protection

3.2.1.6 Software specifications

Item	Specification
Stop/offline output mode	Keeping output, clearing output, or outputting the preset value, which is configured on a point basis
Preset value of stop/offline output	Single-point 0 or 1
Output channel exception detection indication	None
Output channel logic level configuration	Not supported

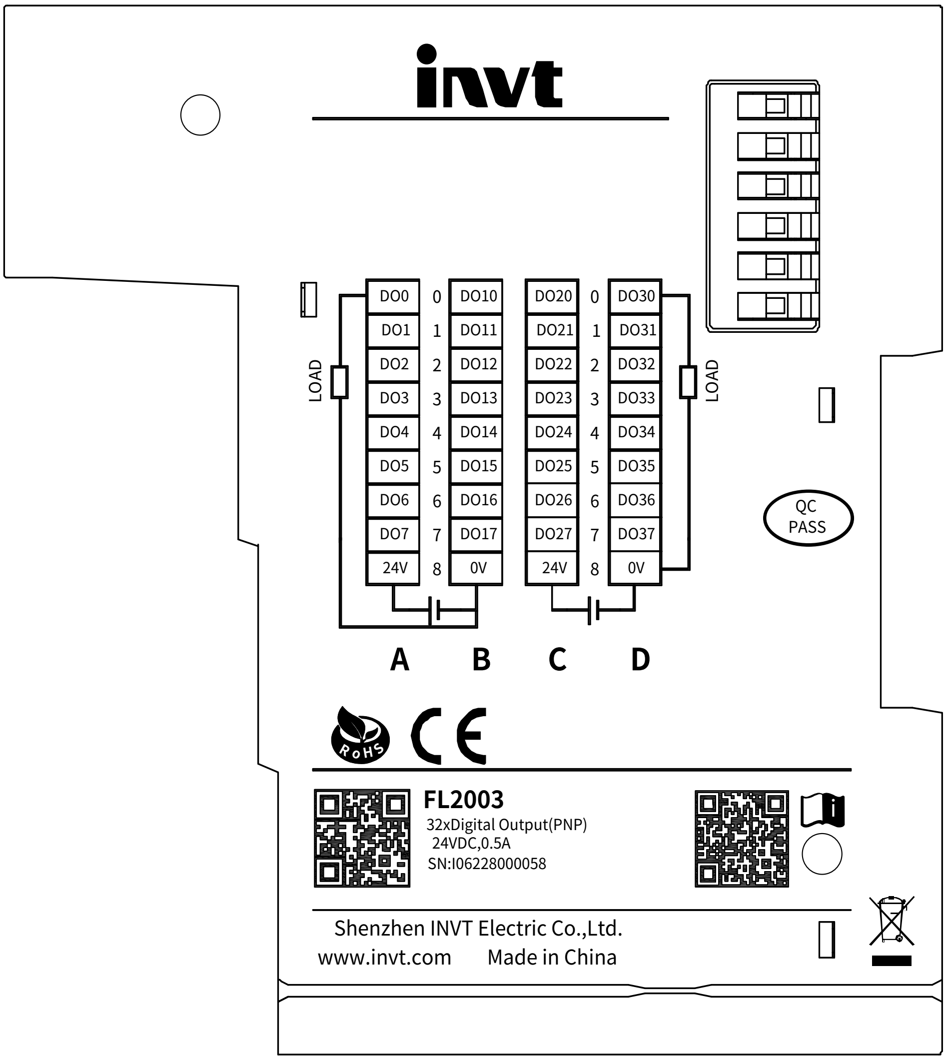
Item	Specification
Configuration of independent channel enabling	Not supported
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.
In stop mode	Output according to the stop/offline output mode and preset value, without refreshing any more
I/O mapping	Supporting the mapping method of bitwise access

3.2.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

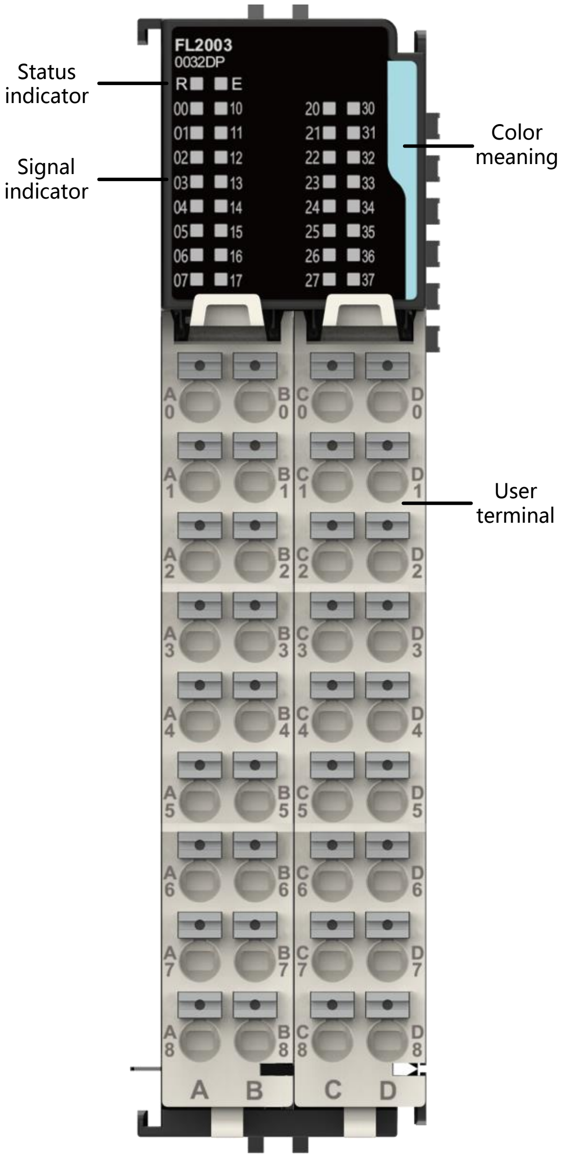
3.2.2 FL2003 (0032DP)

3.2.2.1 Basic information



Model	Ordering code	Description	Applicable model
FL2003	11016-00013	Digital output module, with 32 channels of PNP transistor output, 500mA @ 24 VDC; RoHS	Applicable to INVT Flex/TS/TM series

3.2.2.2 Component description

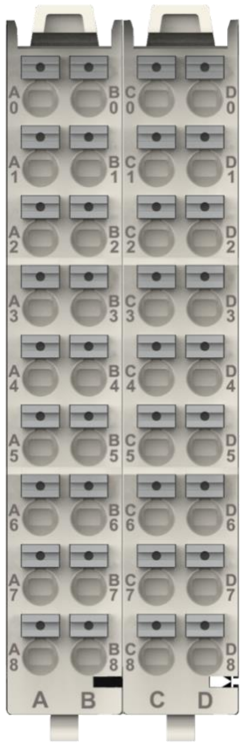


<table>
<tr><th>Name</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td>On: The module is running.</td></tr>
<tr><td>Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td>Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td>Fast blinking (100ms): The module is offline.</td></tr>
<tr><td>Slow blinking (500ms): No power connected externally or incorrect parameter settings.</td></tr>
<tr><td>Off: The module works normally.</td></tr>
<tr><td rowspan="2">Signal indicator</td><td rowspan="2">00–07: Green
10–17: Green
20–27: Green
30–37: Green</td><td rowspan="2">Each corresponds to a channel of output signal.</td><td>On: Enable output.</td></tr>
<tr><td>Off: Disable output.</td></tr>
<tr><td>User terminal</td><td colspan="3">External wiring I/O terminal</td></tr>
</table>

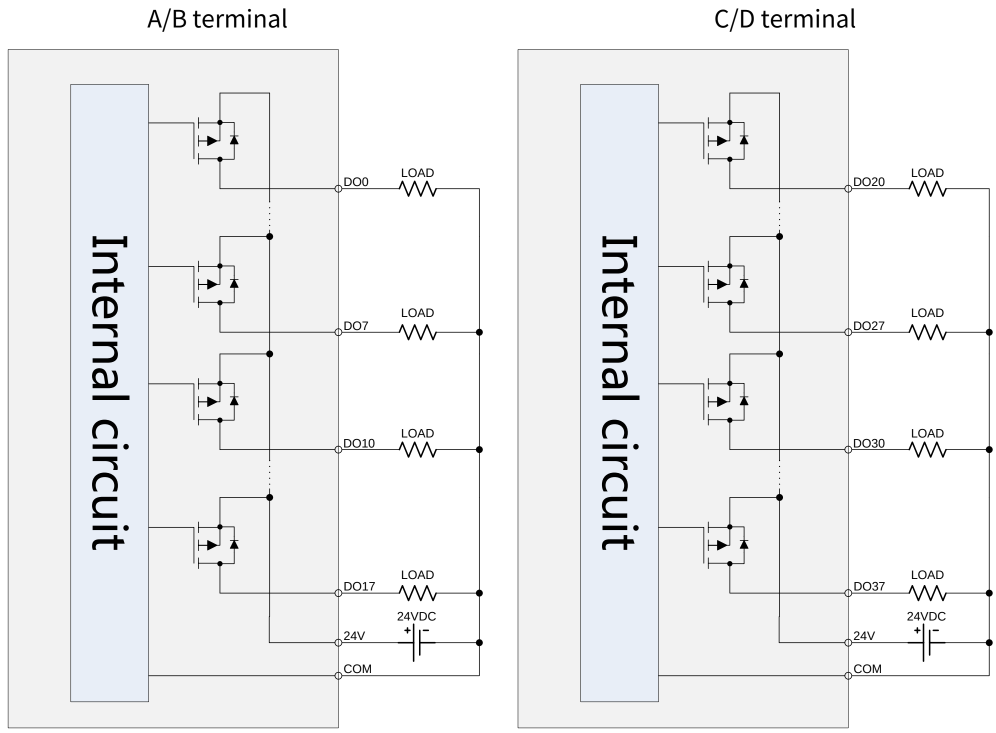
Name	Description			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output

3.2.2.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	DO0	**A0**	**B0**	DO10
	DO1	**A1**	**B1**	DO11
	DO2	**A2**	**B2**	DO12
	DO3	**A3**	**B3**	DO13
	DO4	**A4**	**B4**	DO14
	DO5	**A5**	**B5**	DO15
	DO6	**A6**	**B6**	DO16
	DO7	**A7**	**B7**	DO17
	24VDC	**A8**	**B8**	COM
	DO20	**C0**	**D0**	DO30
	DO21	**C1**	**D1**	DO31
	DOI22	**C2**	**D2**	DO32
	DO23	**C3**	**D3**	DO33
	DO24	**C4**	**D4**	DO34
	DO25	**C5**	**D5**	DO35
	DO26	**C6**	**D6**	DO36
	DO27	**C7**	**D7**	DO37
	24VDC	**C8**	**D8**	COM

- **Terminal wiring**



3.2.2.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	150mA
Terminal input power rated voltage	24VDC (20.4VDC–28.8VDC)
Terminal input power rated current	2A (Typical value at 24VDC)
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.2.2.5 Output specifications

Item	Specification
Output type	Digital output, high-edge output
Output mode	Source type
Output channel	32
Output voltage class	24VDC±10% (21.6VDC–26.4VDC)
Output load (Resistance load)	0.5A/point, 2A/module
Output load (Inductance load)	7.2W/point, 12W/module

Item	Specification
Output load (Light load)	5W/point, 18W/module
Hardware response time ON/OFF	100μs/100μs
Leakage current at OFF	10μA
Switch frequency	100Hz for resistance load, 0.5Hz for resistance load, and 100ms for light load
Isolation	Yes
Output action display	When the output is in driving state, the output indicator is on.
Input derating	None
Protection function	Short-circuit protection and overcurrent protection

3.2.2.6 Software specifications

Item	Specification
Stop/offline output mode	Keeping output, clearing output, or outputting the preset value, which is configured on a point basis
Preset value of stop/offline output	Single-point 0 or 1
Output channel exception detection indication	None
Output channel logic level configuration	Not supported
Configuration of independent channel enabling	Not supported
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.
In stop mode	Output according to the stop/offline output mode and preset value, without refreshing any more
I/O mapping	Supporting the mapping method of bitwise access

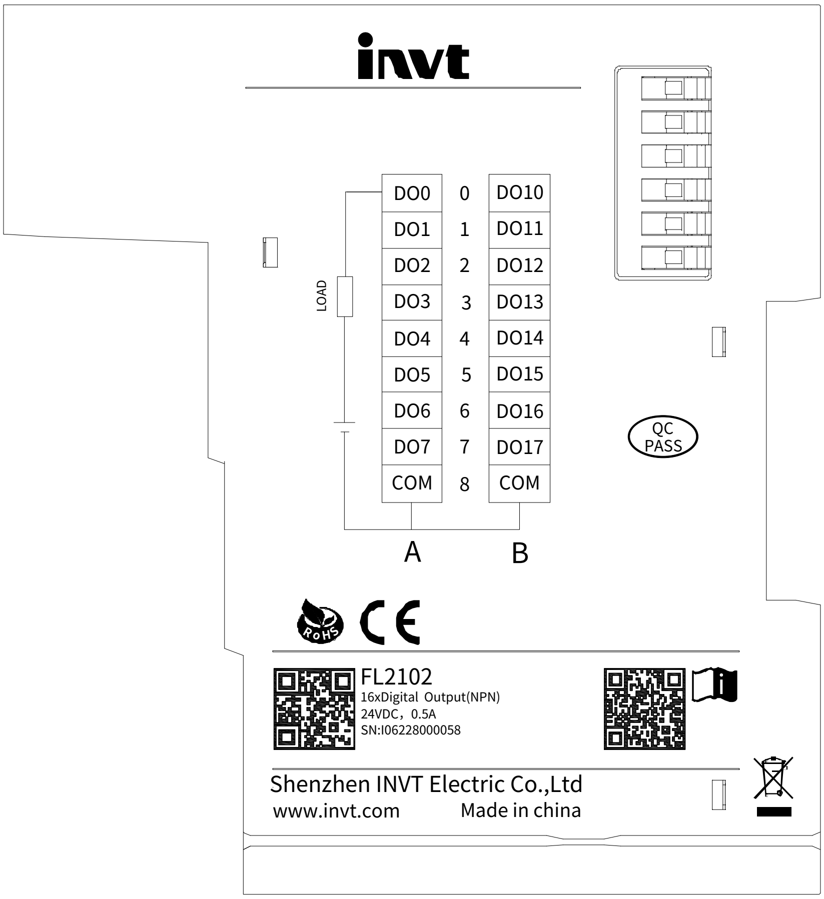
3.2.2.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.3 Digital output module (sink type) (FL210x)

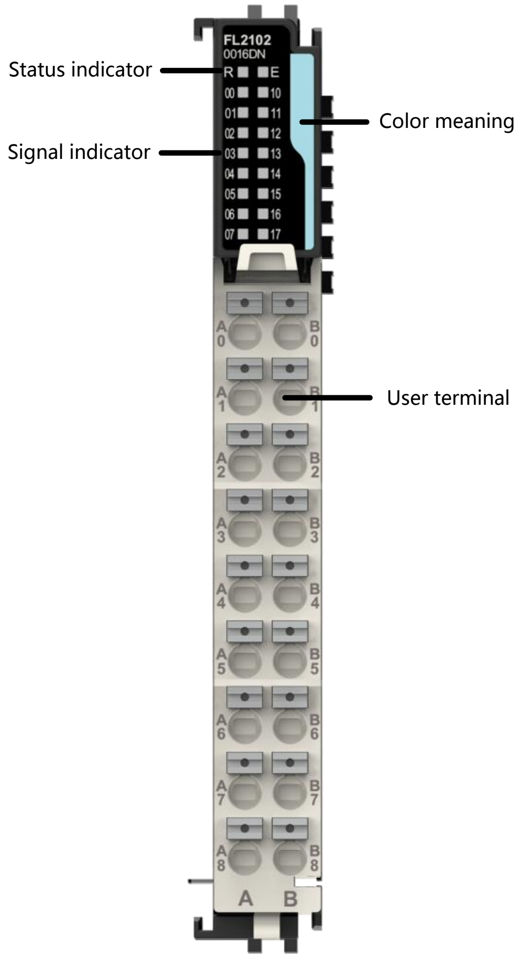
3.3.1 FL2102 (0016DN)

3.3.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL2102	11016-00003	Analog output, 16-channel NPN transistor output, 500mA @ 24VDC; RoHS	Applicable to INVT Flex/TS/TM series

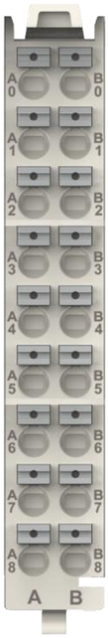
3.3.1.2 Component description



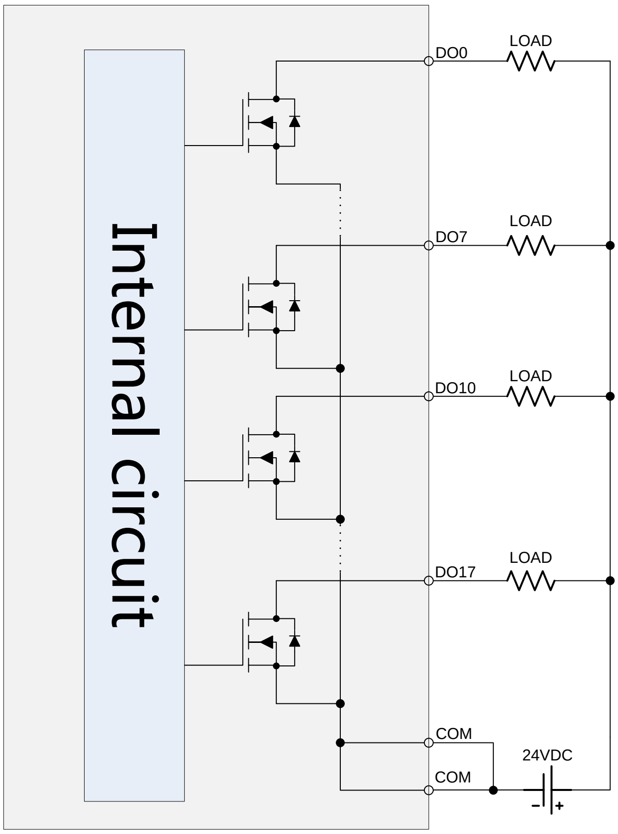
<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="7">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td colspan="2">On: The module is running.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td colspan="2">Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td colspan="2">Fast blinking (100ms): The module is offline.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): Channel overheat/overcurrent alarm or incorrect parameter settings.</td></tr>
<tr><td colspan="2">Off: The module works normally.</td></tr>
<tr></tr>
<tr><td rowspan="2">Signal indicator</td><td rowspan="2">00–07: Green
10–17: Green</td><td rowspan="2">Each corresponds to a channel of output signal.</td><td colspan="2">On: Enable output.</td></tr>
<tr><td colspan="2">Off: Disable output.</td></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td></td><td>Digital input</td><td></td><td>Digital output (source, sink, relay)</td></tr>
<tr><td></td><td>Analog input (voltage, current, thermocouple)</td><td></td><td>Analog output</td></tr>
</table>

3.3.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	DO0	**A0**	**B0**	DO10
	DO1	**A1**	**B1**	DO11
	DO2	**A2**	**B2**	DO12
	DO3	**A3**	**B3**	DO13
	DO4	**A4**	**B4**	DO14
	DO5	**A5**	**B5**	DO15
	DO6	**A6**	**B6**	DO16
	DO7	**A7**	**B7**	DO17
	COM	**A8**	**B8**	COM

- **User terminal wiring**



3.3.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	200mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.3.1.5 Output specifications

Item	Specification
Output type	Digital output, low-edge output
Output mode	Sink
Output channel	16
Output voltage class	24VDC±10% (21.6VDC–26.4VDC)
Output load (Resistance load)	0.5A/point, 4A/module
Output load (Inductance load)	7.2W/point, 24W/module
Output load (Light load)	5W/point, 18W/module
Hardware response time ON/OFF	100μs/100μs
Leakage current at OFF	10μA
Switch frequency	100Hz for resistance load, 0.5Hz for resistance load, and 100ms for light load
Isolation	Yes
Output action display	When the output is in driving state, the output indicator is on.
Input derating	None
Protection function	Short-circuit protection and overcurrent protection

3.3.1.6 Software specifications

Item	Specification
Stop/offline output mode	Keeping output, clearing output, or outputting the preset value, which is configured on a point basis
Preset value of stop/offline output	Single-point 0 or 1
Output channel exception detection indication	Overheat/overcurrent detection and protection on a module basis
Output channel logic level configuration	Not supported

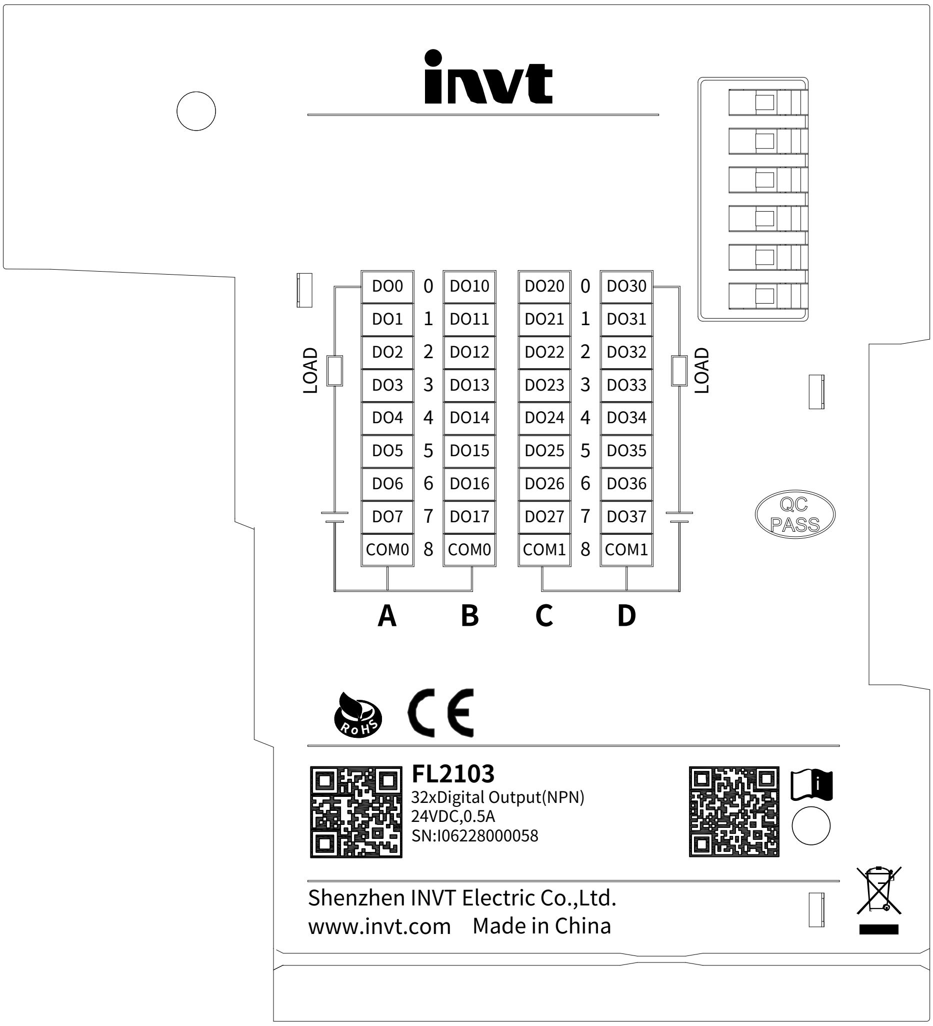
Item	Specification
Configuration of independent channel enabling	Not supported
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.
In stop mode	Output according to the stop/offline output mode and preset value, without refreshing any more
I/O mapping	Supporting the mapping method of bitwise access

3.3.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

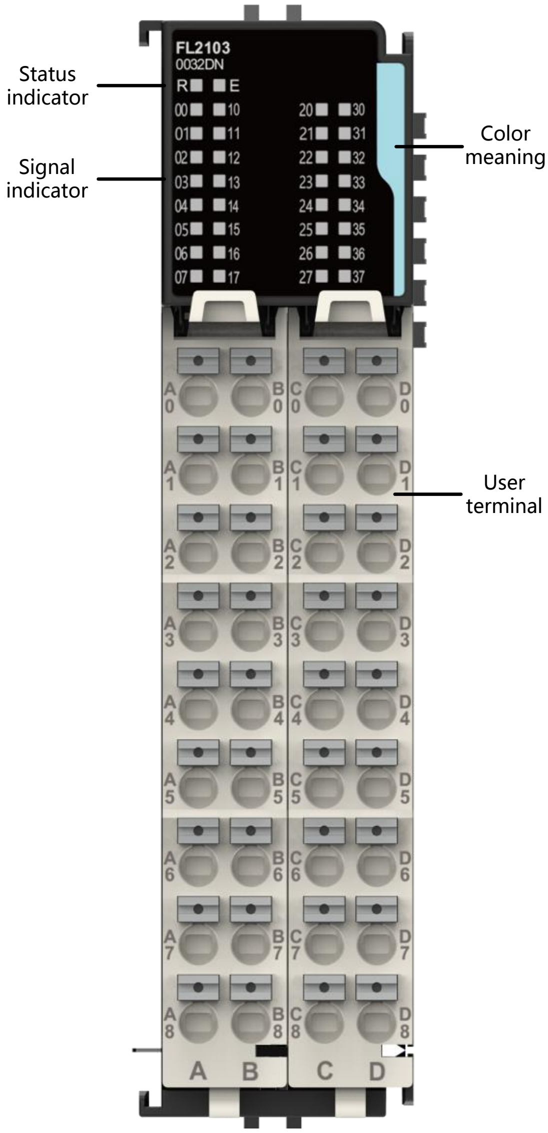
3.3.2 FL2103 (0032DN)

3.3.2.1 Basic information



Model	Ordering code	Description	Applicable model
FL2103	11016-00017	Analog output, 32-channel NPN transistor output, 500mA @ 24VDC; RoHS	Applicable to INVT Flex/TS/TM series

3.3.2.2 Component description

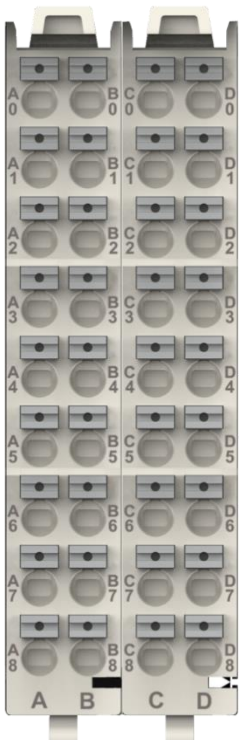


Name	Description		
Status indicator	R: Yellow green	Power-on/Run status indicator	On: The module is running.
			Slow blinking (500ms): The module is establishing communication.
			Off: The module is not powered on or it is abnormal.
	E: Red	Module fault indicator	Fast blinking (100ms): The module is offline.
			Slow blinking (500ms): Channel overheat/overcurrent alarm or incorrect parameter settings.
			Off: The module works normally.
Signal indicator	00–07: Green 10–17: Green 20–27: Green	Each corresponds to a channel of output signal.	On: Enable output.
			Off: Disable output.

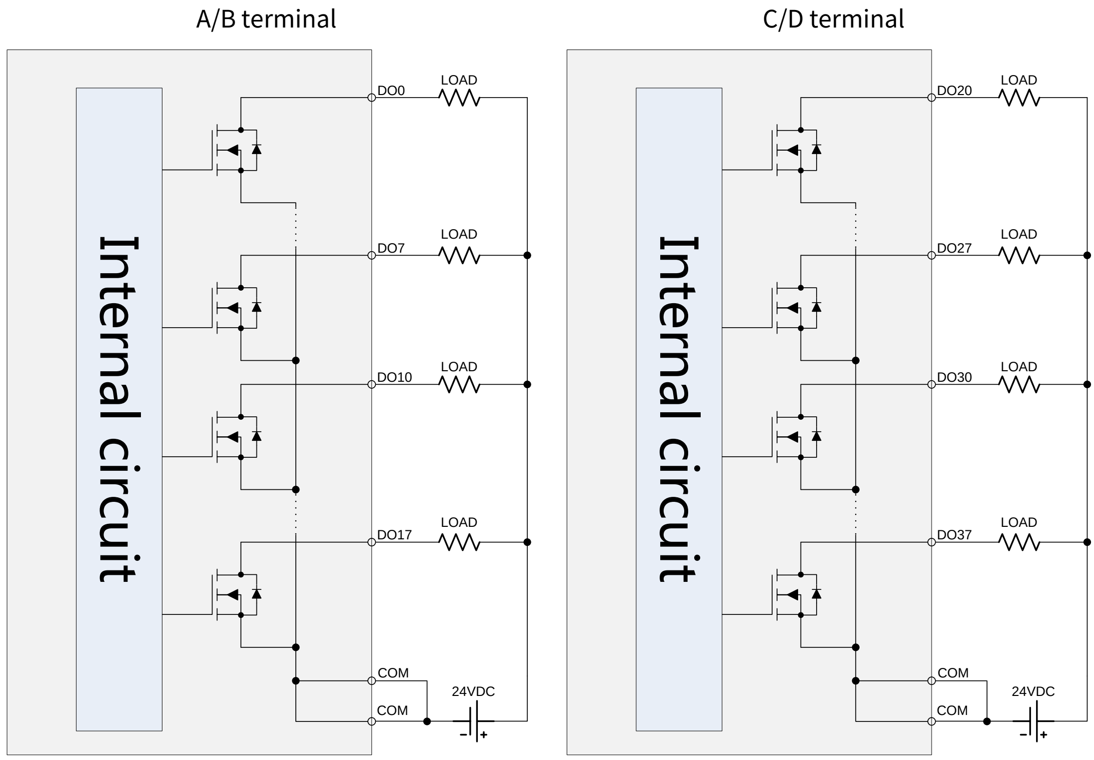
Name	Description			
	30–37: Green			
User terminal	External wiring I/O terminal			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output

3.3.2.3 Terminal definition

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	DO0	**A0**	**B0**	DO10
	DO1	**A1**	**B1**	DO11
	DO2	**A2**	**B2**	DO12
	DO3	**A3**	**B3**	DO13
	DO4	**A4**	**B4**	DO14
	DO5	**A5**	**B5**	DO15
	DO6	**A6**	**B6**	DO16
	DO7	**A7**	**B7**	DO17
	COM	**A8**	**B8**	COM
	DO20	**C0**	**D0**	DO30
	DO21	**C1**	**D1**	DO31
	DOI22	**C2**	**D2**	DO32
	DO23	**C3**	**D3**	DO33
	DO24	**C4**	**D4**	DO34
	DO25	**C5**	**D5**	DO35
	DO26	**C6**	**D6**	DO36
	DO27	**C7**	**D7**	DO37
	COM	**C8**	**D8**	COM

■ **Terminal wiring**



3.3.2.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	300mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.3.2.5 Output specifications

Item	Specification
Output type	Digital output, low-edge output
Output mode	Sink
Output channel	32
Output voltage class	24VDC±10% (21.6VDC–26.4VDC)
Output load (Resistance load)	0.5A/point, 4A/module
Output load (Inductance load)	7.2W/point, 24W/module
Output load (Light load)	5W/point, 18W/module
Hardware response time ON/OFF	100μs/100μs
Leakage current at OFF	10μA
Switch frequency	100Hz for resistance load, 0.5Hz for resistance load, and 100ms for

Item	Specification
	light load
Isolation	Yes
Output action display	When the output is in driving state, the output indicator is on.
Input derating	None
Protection function	Short-circuit protection and overcurrent protection

3.3.2.6 Software specifications

Item	Specification
Stop/offline output mode	Keeping output, clearing output, or outputting the preset value, which is configured on a point basis
Preset value of stop/offline output	Single-point 0 or 1
Output channel exception detection indication	Overheat/overcurrent detection and protection on a module basis
Output channel logic level configuration	Not supported
Configuration of independent channel enabling	Not supported
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.
In stop mode	Output according to the stop/offline output mode and preset value, without refreshing any more
I/O mapping	Supporting the mapping method of bitwise access

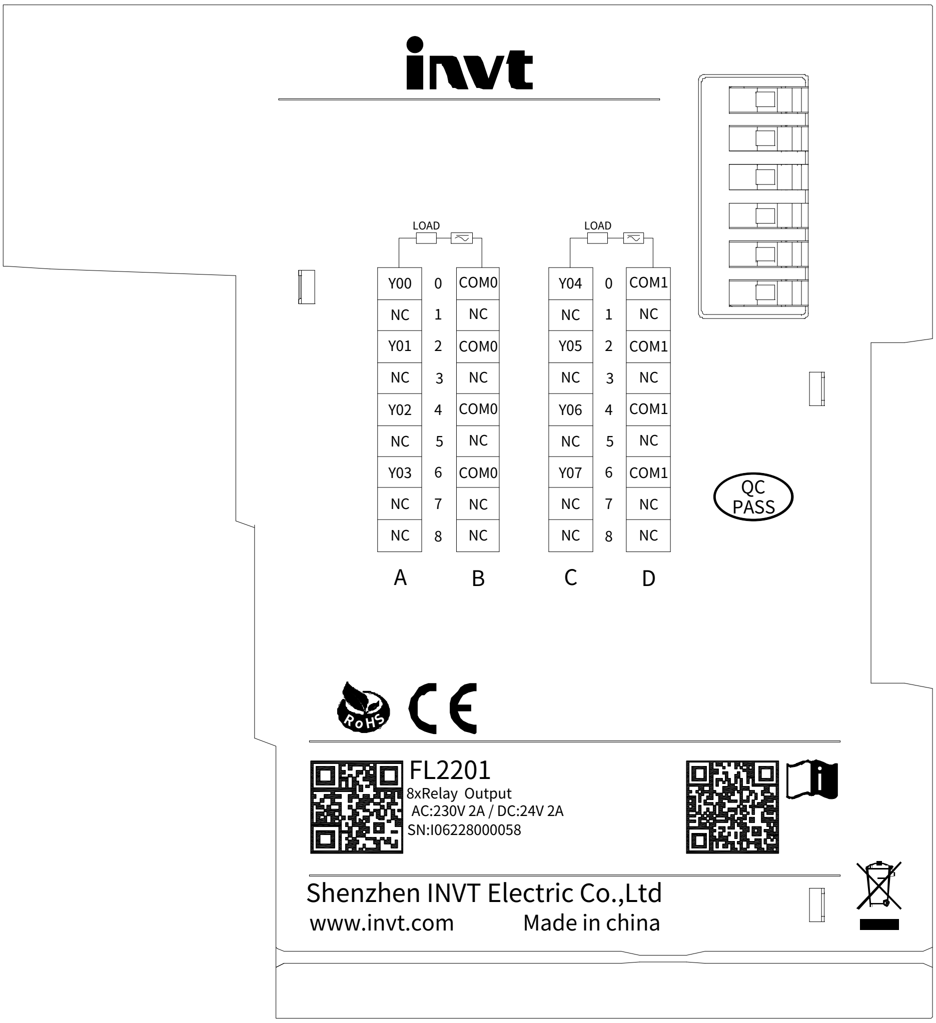
3.3.2.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.4 Digital output module (FL2201)

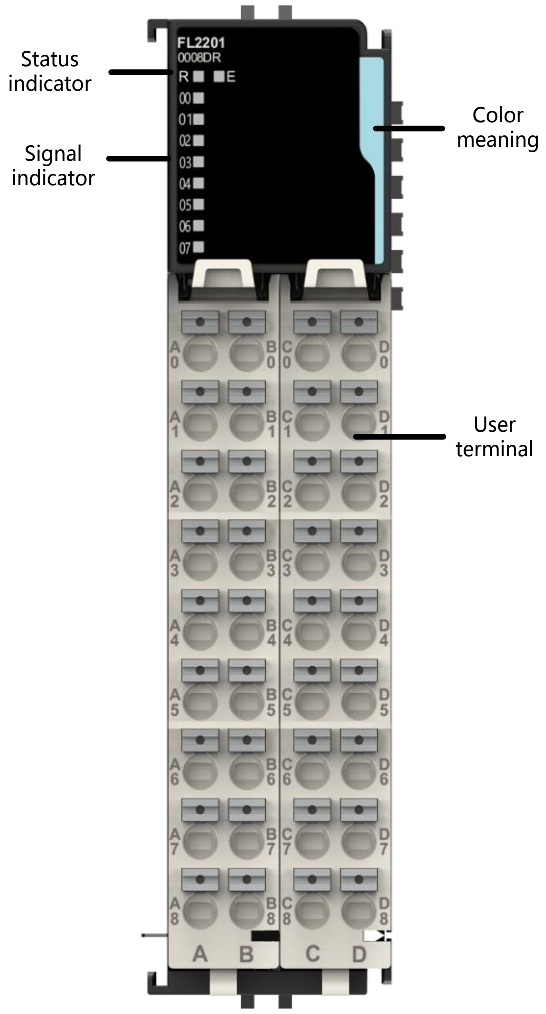
3.4.1 FL2201 (0008DR)

3.4.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL2201	11016-00009	Digital output, 8 relay outputs, dry contacts,3A@30VDC/250VAC;RoHS	Applicable to INVT Flex/TS/TM series

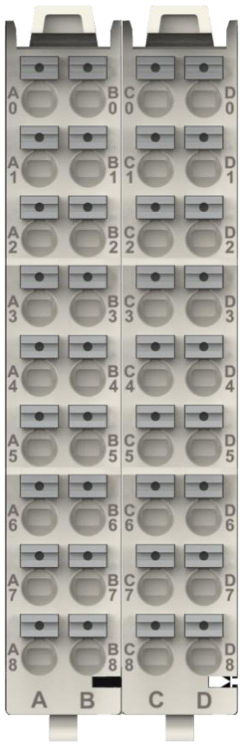
3.4.1.2 Component description



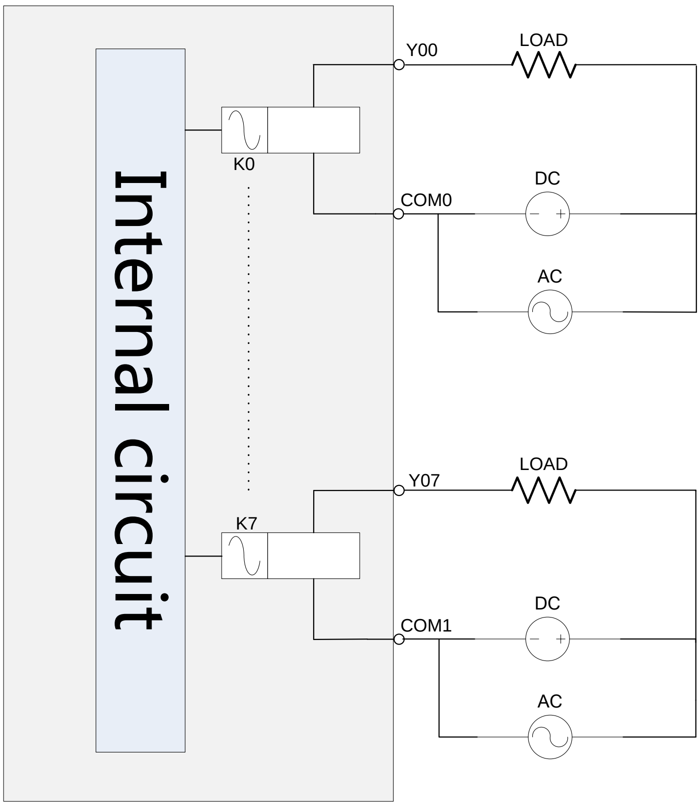
<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td colspan="2">On: The module is running.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td colspan="2">Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td colspan="2">Slow blinking (500ms): Incorrect parameter settings.</td></tr>
<tr><td colspan="2">Fast blinking (100ms): The module is offline.</td></tr>
<tr><td colspan="2">Off: The module works normally.</td></tr>
<tr><td rowspan="2">Signal indicator</td><td rowspan="2">00–07: Green</td><td rowspan="2">Each corresponds to a channel of output signal.</td><td colspan="2">On: Enable output.</td></tr>
<tr><td colspan="2">Off: Disable output.</td></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td>[blue]</td><td>Digital input</td><td>[light blue]</td><td>Digital output (source, sink, relay)</td></tr>
<tr><td>[magenta]</td><td>Analog input (voltage, current, thermocouple)</td><td>[orange]</td><td>Analog output</td></tr>
</table>

3.4.1.3 Terminal definition

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	Y00	**A0**	**B0**	COM0
	-	**A1**	**B1**	-
	Y01	**A2**	**B2**	COM0
	-	**A3**	**B3**	-
	Y02	**A4**	**B4**	COM0
	-	**A5**	**B5**	-
	Y03	**A6**	**B6**	COM0
	-	**A7**	**B7**	-
	-	**A8**	**B8**	-
	Y04	**C0**	**D0**	COM1
	-	**C1**	**D1**	-
	Y05	**C2**	**D2**	COM1
	-	**C3**	**D3**	-
	Y06	**C4**	**D4**	COM1
	-	**C5**	**D5**	-
	Y07	**C6**	**D6**	COM1
	-	**C7**	**D7**	-
	-	**C8**	**D8**	-

■ **Terminal wiring**



3.4.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	300mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.4.1.5 Output specifications

Item	Specification
Output mode	Relay N.O.
Output channel	8
Contact load (Resistance load)	3A 250VAC/30VDC
Max. switching voltage	250VAC/125VDC (@0.3A)
Max. switching current	3A
Contact resistor	<100mΩ (1A 6VDC)
Min. load	5VDC 10mA
Isolation	Strong current isolated from weak current

3.4.1.6 Software specifications

Item	Specification
Stop/offline output mode	Keeping output, clearing output, or outputting the preset value, which is configured on a point basis
Preset value of stop/offline output	Single-point 0 or 1
Output channel exception detection indication	Not supported
Output channel logic level configuration	Not supported
Configuration of independent channel enabling	Not supported
Configuration of diagnosis reporting	Not supported
In stop mode	Output according to the stop/offline output mode and preset value, without refreshing any more
I/O mapping	Supporting the mapping method of bitwise access

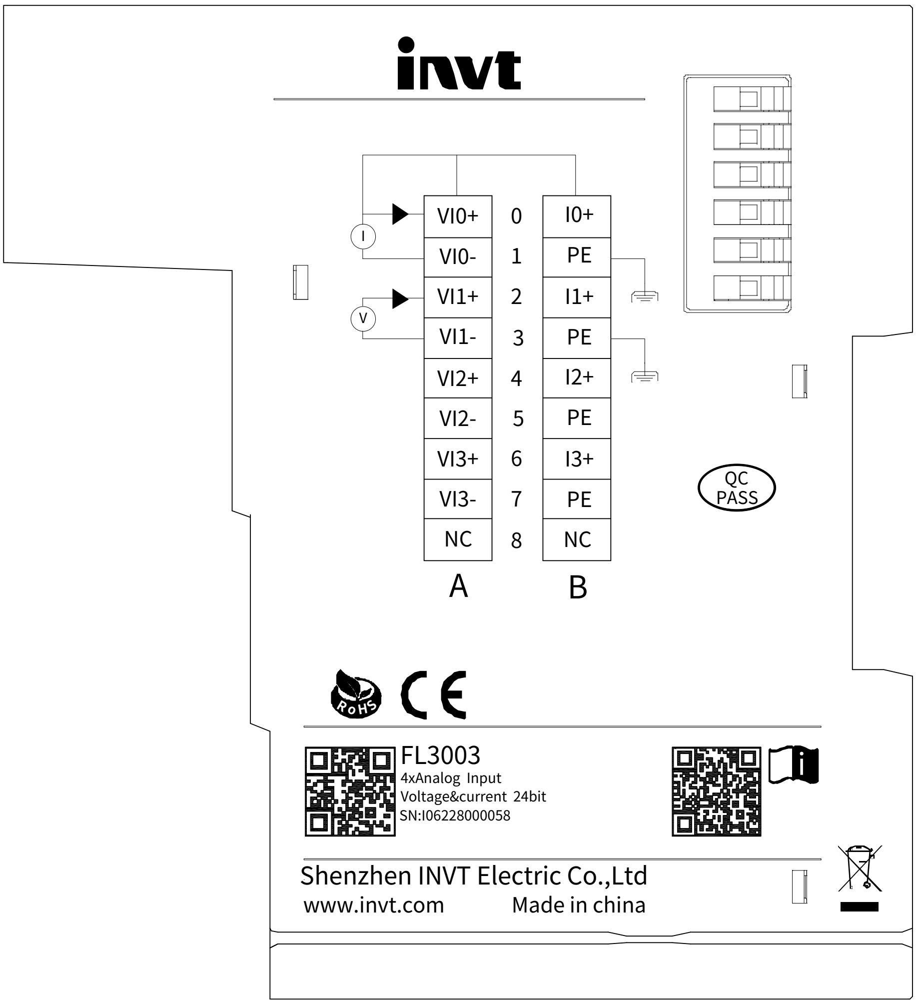
3.4.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.5 Analog input module (FL3xxx)

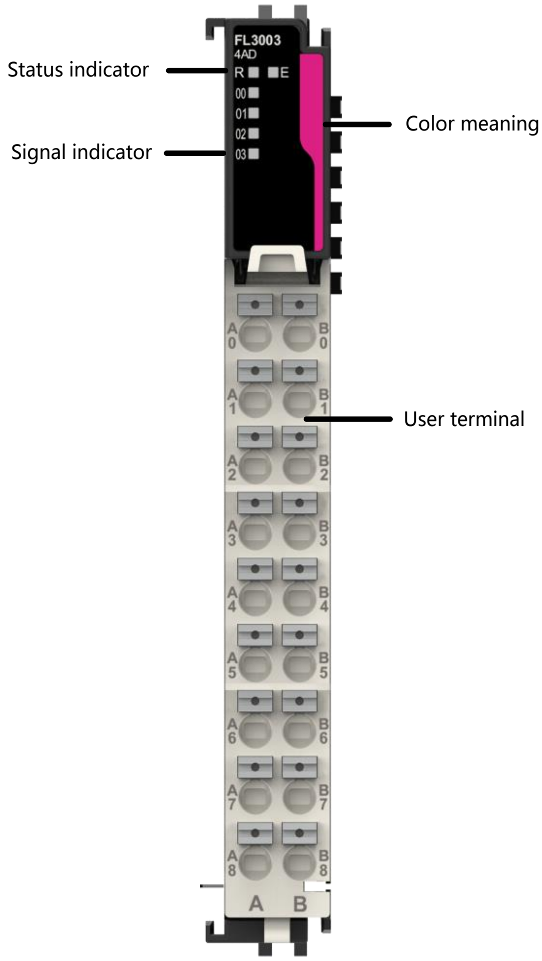
3.5.1 FL3003 (4AD)

3.5.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL3003	11016-00011	Analog input module, 4 channels, 16-bit resolution, room-temperature accuracy of±0.1%FS; RoHS	Applicable to INVT Flex/TS/TM series

3.5.1.2 Component description

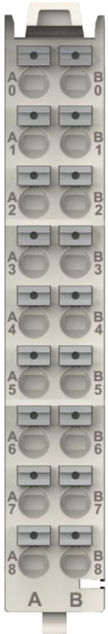


Name	Description			
Status indicator	R: Yellow green	Power-on/Run status indicator	On: The module is running.	
			Slow blinking (500ms): The module is establishing communication.	
			Off: The module is not powered on or it is abnormal.	
	E: Red	Module fault indicator	Fast blinking (100ms): The module is offline.	
			Slow blinking (500ms): ADC chip fault or incorrect parameter settings.	
			Off: The module works normally.	
Signal indicator	00–03: Green	Channel status indicator	On: The channel is enabled.	
			Slow blinking (500ms): Input signal Incorrect parameter settings.	
			Fast blinking (100ms): Offline at the voltage mode.	
			Off: The channel is disabled.	
User terminal	External wiring I/O terminal			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage,		Analog output

Name	Description			
		current, thermocouple)		

3.5.1.3 Terminal definition

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	VI0+	**A0**	**B0**	I0+
	VI0-	**A1**	**B1**	PE
	VI1+	**A2**	**B2**	I1+
	VI1-	**A3**	**B3**	PE
	VI2+	**A4**	**B4**	I2+
	VI2-	**A5**	**B5**	PE
	VI3+	**A6**	**B6**	I3+
	VI3-	**A7**	**B7**	PE
	-	**A8**	**B8**	-

■ **Terminal wiring**

Figure 3-1 Voltage input wiring

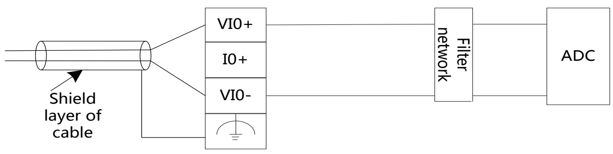
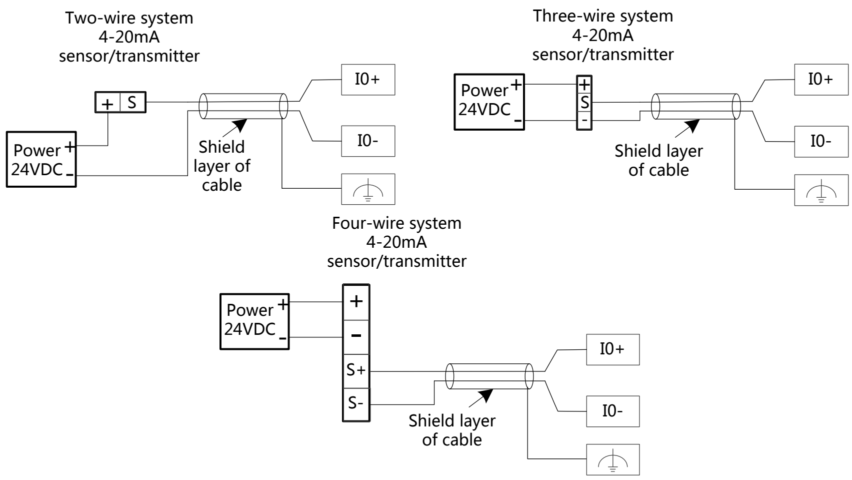


Figure 3-2 Current input wiring



3.5.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	200mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.5.1.5 Input specifications

Item	Specification
Input type	Analog input
Input mode	Voltage/current
Input channels	4
Resolution	16-bit
Conversion time	320μs/channel
Voltage input range	0–5V, 0–10V, -5–+5V, -10–+10V
Voltage input impedance	2.4MΩ
Voltage input accuracy (25°C)	±0.1%
Voltage input accuracy (in full temperature range)	±0.2%
Voltage input limit	±12V
Voltage input diagnosis	Disconnection detection supported
Current input range	±20mA, 0–20mA, 4–20mA
Current input resistance	240Ω
Current input accuracy (at 25°C)	±0.1%
Current input accuracy (in full temperature range)	±0.2%
Current input limit	±24mA
Current input diagnosis	Not supported
Isolation	No isolation between interface channels; voltage isolated from interface; interface isolated from bus
Input action display	None
Input derating	None

3.5.1.6 Software specifications

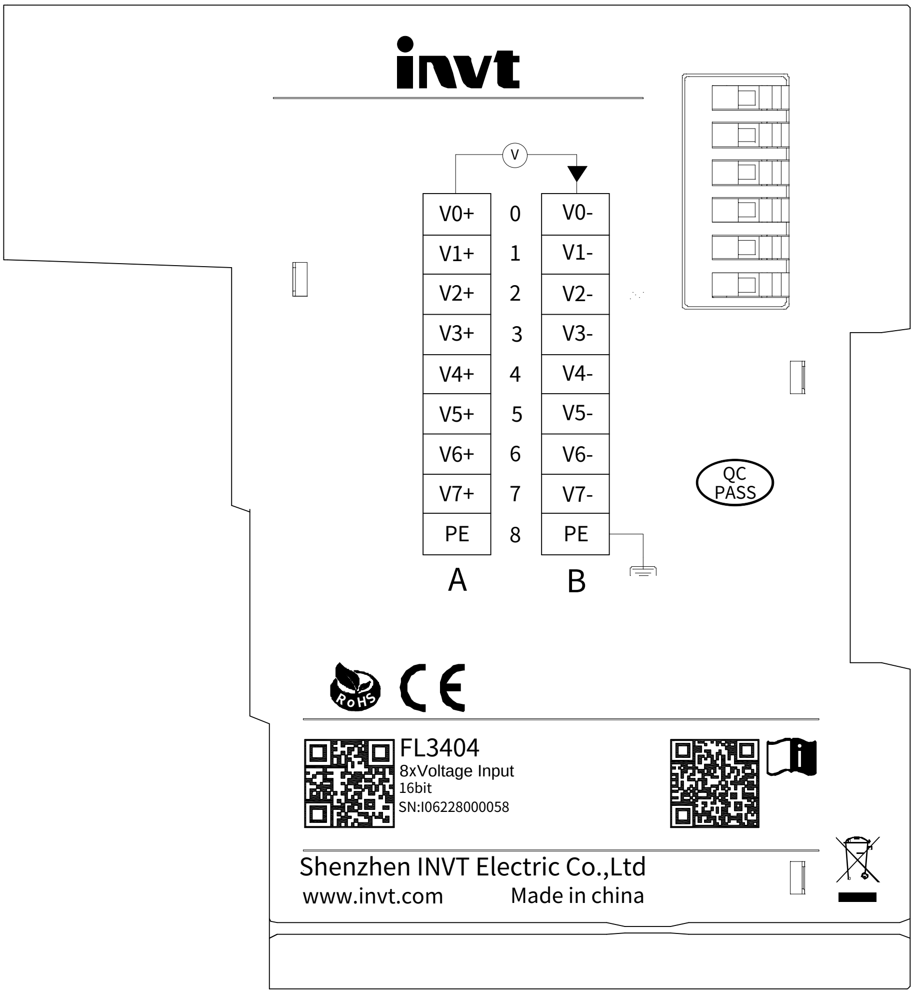
Item	Specification
Configuration of independent channel enabling	Supported
Configuration of diagnosis reporting	Supported
Configuration of enabling diagnosis detection	Voltage-side disconnection, over-range detection, and over-limit detection
Mode switchover configuration	0–5V, 0–10V, ±5V, ±10V, 4–20mA, 0–20mA, ±20mA
Filter parameter configuration	Software filter time can be set through the host controller, which ranges from 1 to 255, with the sampling period as the unit.
Configuration of enabling over-limit detection	Supported
Configuration of enabling peak holding	Not supported
Configuration of conversion digital range	±20000
Sampling time	4 channels at 1.28ms
Sampling refresh	Sampling time based asynchronous refresh, but not bus period based synchronous refresh
Stop mode	Present value kept, without refresh

3.5.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

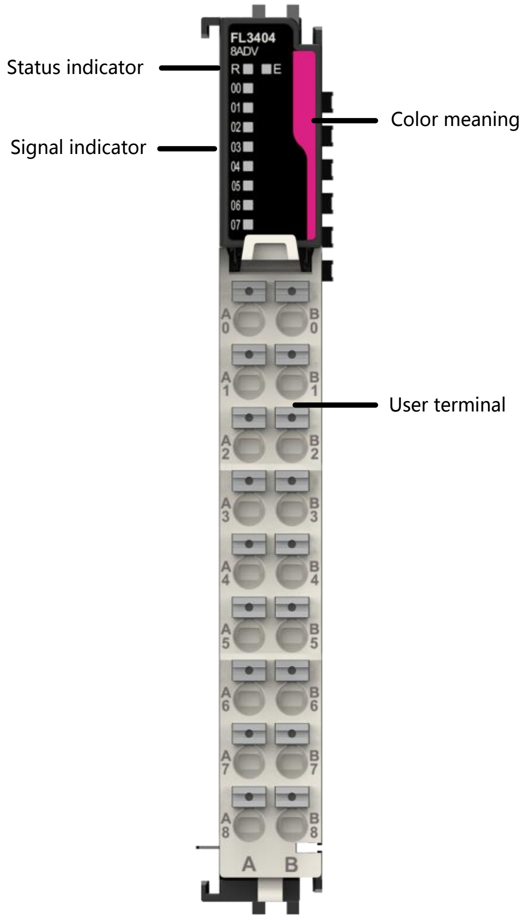
3.5.2 FL3404 (8ADV)

3.5.2.1 Basic information



Model	Ordering code	Description	Applicable model
FL3404	11016-00026	Analog input module, 8 channels, voltage signal, 16-bit resolution, room-temperature accuracy of ±0.15%FS; RoHS	Applicable to INVT Flex/TS/TM series

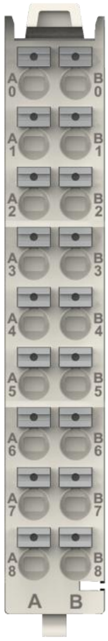
3.5.2.2 Component description



<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td colspan="2">On: The module is running.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td colspan="2">Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td colspan="2">Fast blinking (100ms): The module is offline.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): ADC chip fault or incorrect parameter settings.</td></tr>
<tr><td colspan="2">Off: The module works normally.</td></tr>
<tr><td rowspan="4">Signal indicator</td><td rowspan="4">00–07: Green</td><td rowspan="4">Channel status indicator</td><td colspan="2">On: The channel is enabled.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): Input signal Incorrect parameter settings.</td></tr>
<tr><td colspan="2">Fast blinking (100ms): Offline at the voltage mode.</td></tr>
<tr><td colspan="2">Off: The channel is disabled.</td></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td></td><td>Digital input</td><td></td><td>Digital output (source, sink, relay)</td></tr>
<tr><td></td><td>Analog input (voltage, current, thermocouple)</td><td></td><td>Analog output</td></tr>
</table>

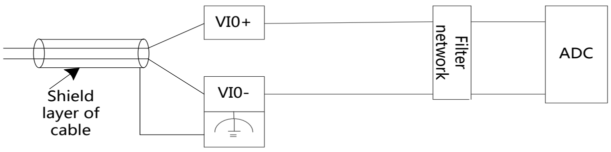
3.5.2.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	V1+	**A0**	**B0**	V1-
	V2+	**A1**	**B1**	V2-
	V3+	**A2**	**B2**	V3-
	V4+	**A3**	**B3**	V4-
	V5+	**A4**	**B4**	V5-
	V6+	**A5**	**B5**	V6-
	V7+	**A6**	**B6**	V7-
	PE	**A7**	**B7**	PE
	V1+	**A8**	**B8**	V1-

- **Terminal wiring**

Figure 3-3 Voltage input wiring



3.5.2.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	200mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.5.2.5 Input specifications

Item	Specification
Input type	Analog input
Input mode	Voltage (differential)
Input channels	8
Resolution	16-bit
Conversion time	<170μs/channel
Voltage input range	0–5V, 0–10V, -5–+5V, -10–+10V
Voltage input impedance	1MΩ
Voltage input accuracy (25°C)	±0.15%
Voltage input accuracy (in full temperature range)	±0.3%
Voltage input limit	±15V
Voltage input diagnosis	Disconnection detection supported
Isolation	No isolation between interface channels; voltage isolated from interface; interface isolated from bus
Input action display	None

3.5.2.6 Software specifications

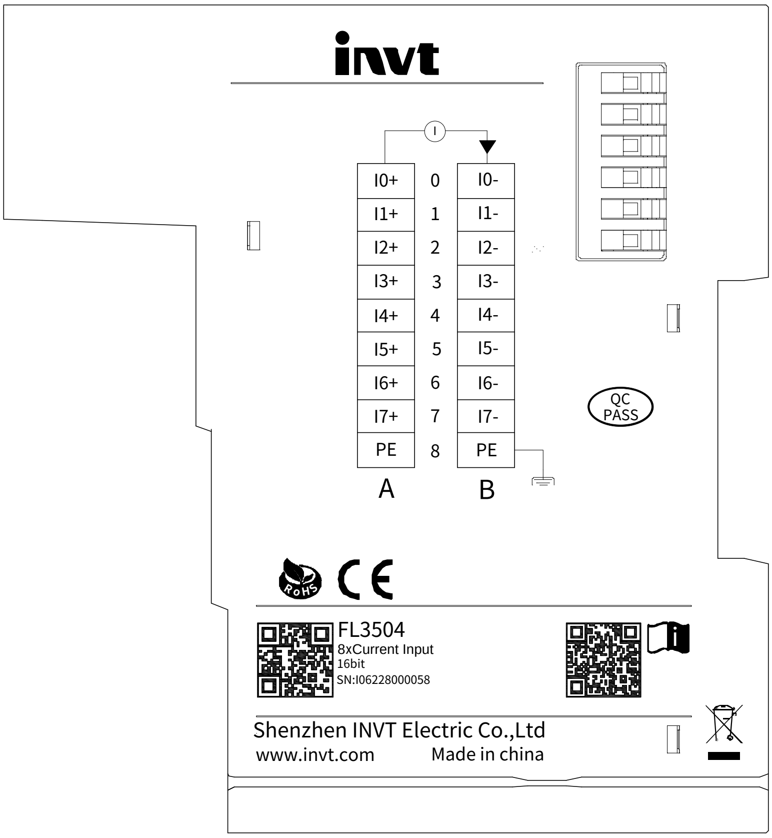
Item		Specification
Configuration of independent channel enabling		Supported
Configuration of diagnosis reporting		Supported
Configuration of enabling diagnosis detection		Over-range detection, and over-limit detection
Mode switchover configuration		0–5V, 0–10V, ±5V, ±10V
Filter parameter configuration		Software filter time can be set through the host controller, which ranges from 1 to 255, with the sampling period as the unit.
Configuration of enabling over-limit detection		Supported
Configuration of enabling peak holding		Not supported
Configuration of conversion digital range	-10–+10VDC	-20000–20000, -32000–32000, -27648–27648
	0–10VDC	0–20000, 0–32000, 0–27648
	-5–+5VDC	-20000–20000, -32000–32000, -27648–27648
	0–5VDC	0–20000, 0–32000, 0–27648
	1–5VDC	0–20000, 0–32000, 0–27648
Sampling time		<170μs/channel
Sampling refresh		Sampling time based asynchronous refresh, but not bus period based synchronous refresh

3.5.2.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

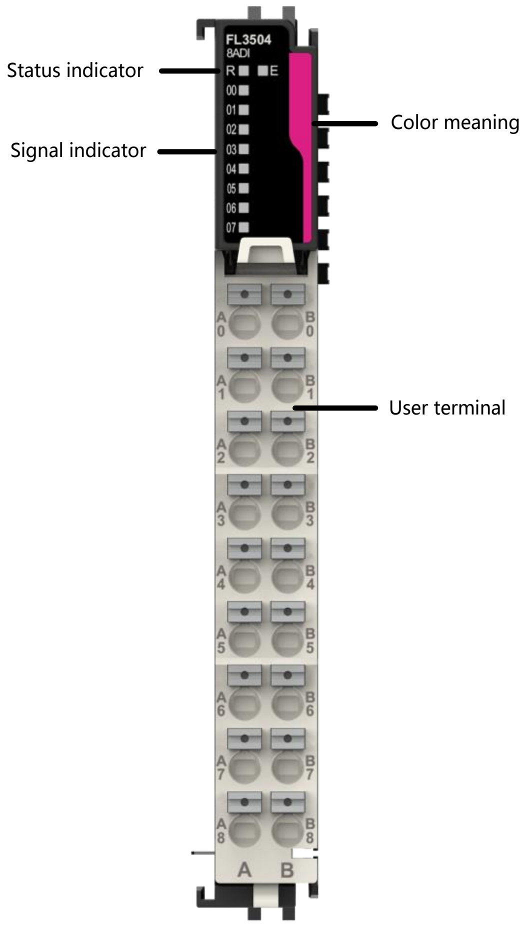
3.5.3 FL3504 (8ADI)

3.5.3.1 Basic information



Model	Ordering code	Description	Applicable model
FL3504	11016-00027	Analog input module, 8 channels, current signal, 16-bit resolution, room-temperature accuracy of ±0.15%FS; RoHS	Applicable to INVT Flex/TS/TM series

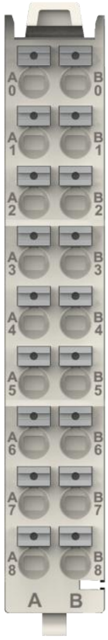
3.5.3.2 Component description



<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td colspan="2">On: The module is running.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td colspan="2">Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td colspan="2">Fast blinking (100ms): The module is offline.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): ADC chip fault or incorrect parameter settings.</td></tr>
<tr><td colspan="2">Off: The module works normally.</td></tr>
<tr><td rowspan="4">Signal indicator</td><td rowspan="4">00–07: Green</td><td rowspan="4">Channel status indicator</td><td colspan="2">On: The channel is enabled.</td></tr>
<tr><td colspan="2">Slow blinking (500ms): Input signal Incorrect parameter settings.</td></tr>
<tr><td colspan="2">Fast blinking (100ms): Offline at the voltage mode.</td></tr>
<tr><td colspan="2">Off: The channel is disabled.</td></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td>(blue)</td><td>Digital input</td><td>(light blue)</td><td>Digital output (source, sink, relay)</td></tr>
<tr><td>(pink)</td><td>Analog input (voltage, current, thermocouple)</td><td>(orange)</td><td>Analog output</td></tr>
</table>

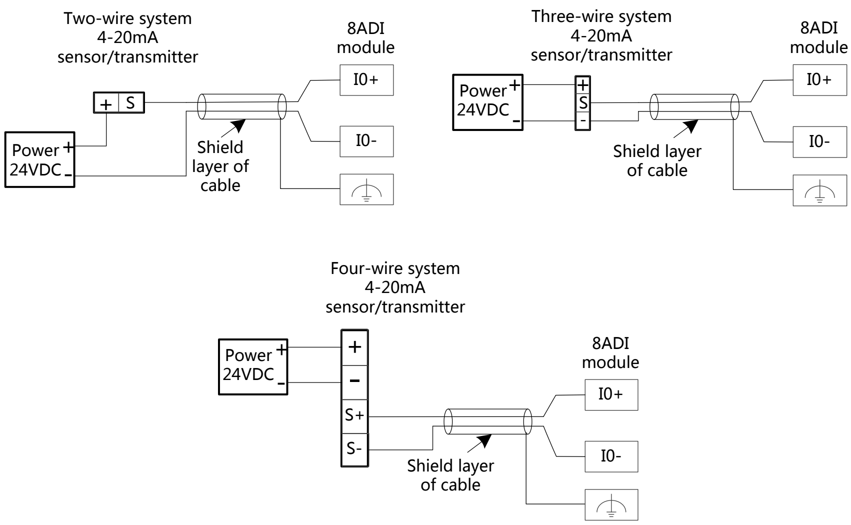
3.5.3.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	I0+	**A0**	**B0**	I0-
	I1+	**A1**	**B1**	I1-
	I2+	**A2**	**B2**	I2-
	I3+	**A3**	**B3**	I3-
	I4+	**A4**	**B4**	I4-
	I5+	**A5**	**B5**	I5-
	I6+	**A6**	**B6**	I6-
	I7+	**A7**	**B7**	I7-
	PE	**A8**	**B8**	PE

- **Terminal wiring**

Figure 3-4 Current input wiring



3.5.3.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	200mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.5.3.5 Input specifications

Item	Specification
Input type	Analog input
Input mode	Voltage
Input channels	8
Resolution	16-bit
Conversion time	<170μs/channel
Current input range	±20mA, 0–20mA, 4–20mA
Current input resistance	240Ω
Current input accuracy (at 25°C)	±0.15%
Current input accuracy (in full temperature range)	±0.3%
Current input limit	±30mA
Current input diagnosis	Not supported
Isolation	No isolation between interface channels; voltage isolated from interface; interface isolated from bus

3.5.3.6 Software specifications

Item	Specification
Configuration of independent channel enabling	Supported
Configuration of diagnosis reporting	Supported
Configuration of enabling diagnosis detection	Over-range detection, and over-limit detection
Mode switchover configuration	4–20mA, 0–20mA, ±20mA
Filter parameter configuration	Software filter time can be set through the host controller, which ranges from 1 to 255, with the sampling period as the unit.

<table>
<tr><th colspan="2">Item</th><th>Specification</th></tr>
<tr><td colspan="2">Configuration of enabling over-limit detection</td><td>Supported</td></tr>
<tr><td colspan="2">Configuration of enabling peak holding</td><td>Not supported</td></tr>
<tr><td rowspan="3">Configuration of conversion digital range</td><td>-20mA–+20mA</td><td>-20000–20000, -32000–32000, -27648–27648</td></tr>
<tr><td>0mA–20mA</td><td>0–20000, 0–32000, 0–27648</td></tr>
<tr><td>4mA–20mA</td><td>0–20000, 0–32000, 0–27648</td></tr>
<tr><td colspan="2">Sampling time</td><td><170μs/channel</td></tr>
<tr><td colspan="2">Sampling refresh</td><td>Sampling time based asynchronous refresh, but not bus period based synchronous refresh</td></tr>
</table>

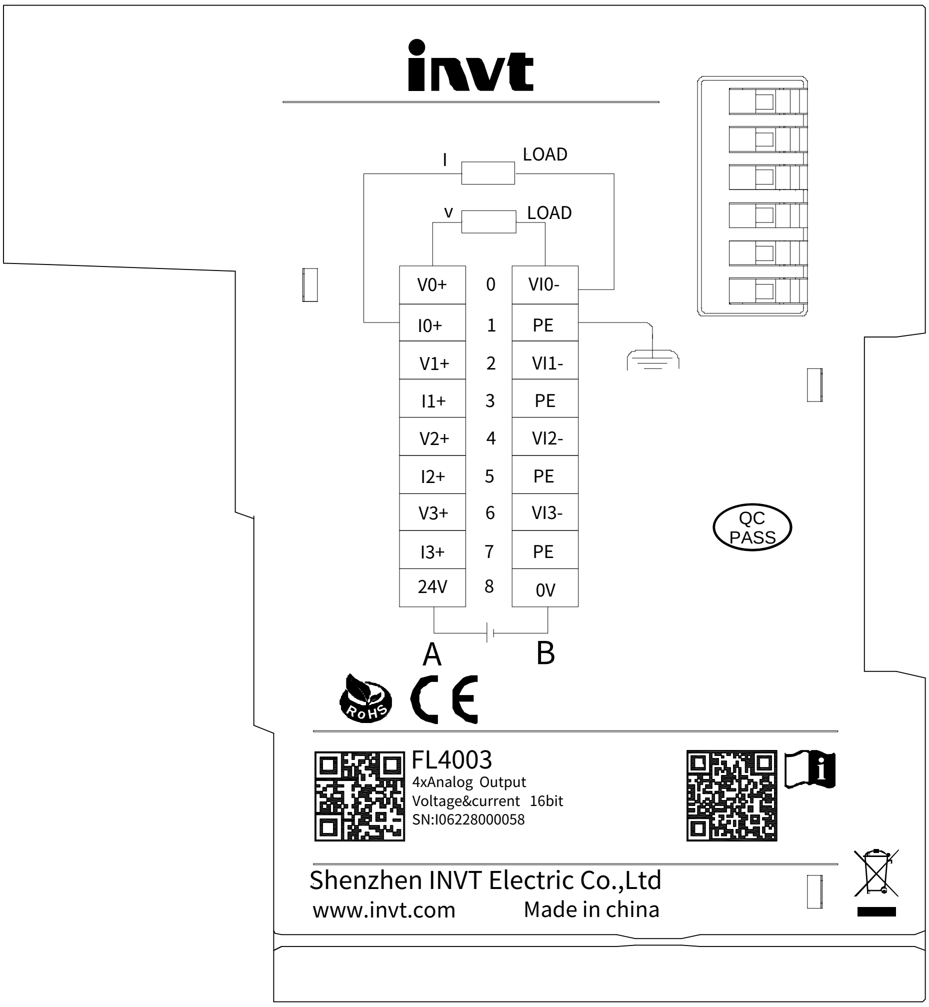
3.5.3.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.6 Analog output module (FL4xxx)

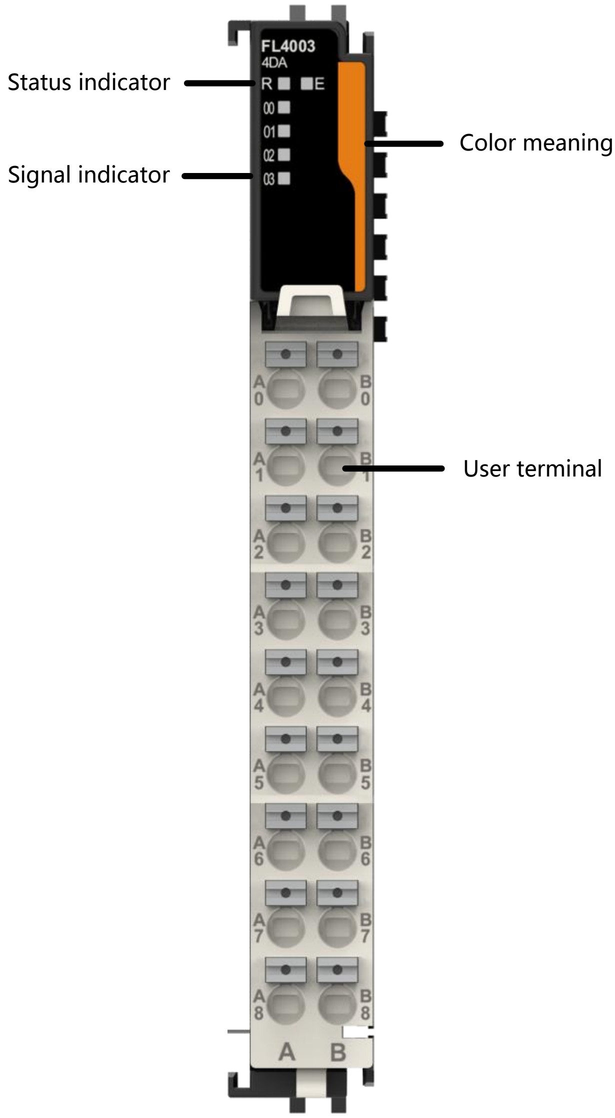
3.6.1 FL4003 (4DA)

3.6.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL4003	11016-00008	Analog output module, 4 channels, 16-bit resolution, room-temperature accuracy of ±0.1% FS; RoHS	Applicable to INVT Flex/TS/TM series

3.6.1.2 Component description

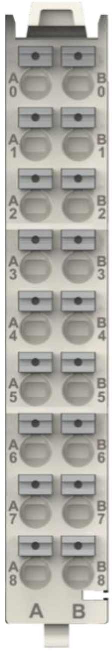


<table>
<tr><th>Name</th><th colspan="3">Description</th></tr>
<tr><td rowspan="11">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td>On: The module is running.</td></tr>
<tr><td>Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td>Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td>Fast blinking (100ms): The module is offline.</td></tr>
<tr><td>Slow blinking (500ms): DAC chip external power exception or parameter setting error.</td></tr>
<tr><td>Off: The module works normally.</td></tr>
<tr><td rowspan="4">00–03: Green</td><td rowspan="4">Channel status indicator</td><td>On: The channel is enabled.</td></tr>
<tr><td>Slow blinking (500ms): Short circuit or incorrect parameter settings.</td></tr>
<tr><td>Fast blinking (100ms): Current disconnection.</td></tr>
<tr><td>Off: The channel is disabled.</td></tr>
<tr><td colspan="3" style="display:none"></td></tr>
<tr><td>User terminal</td><td colspan="3">External wiring I/O terminal</td></tr>
</table>

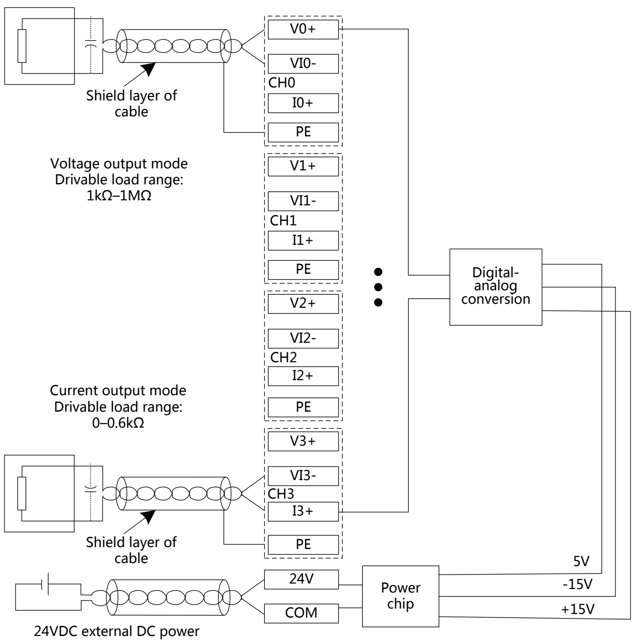
Name	Description			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output

3.6.1.3 Terminal definition and wiring

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	V0+	**A0**	**B0**	VI0-
	I0+	**A1**	**B1**	PE
	V1+	**A2**	**B2**	VI1-
	I1+	**A3**	**B3**	PE
	V2+	**A4**	**B4**	VI2-
	I2+	**A5**	**B5**	PE
	V3+	**A6**	**B6**	VI3-
	I3+	**A7**	**B7**	PE
	24V	**A8**	**B8**	COM

■ **Terminal wiring**



3.6.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	150mA
Terminal input power rated voltage	24VDC (20.4VDC–28.8VDC)
Terminal input power rated current	100mA (Typical value at 24VDC)
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.6.1.5 Output specifications

Item	Specification
Output type	Analog output
Output mode	Voltage/current
Output channel	4
Resolution	16-bit
Conversion time	40μs/channel
Voltage output range	0–5V, 0–10V, -5–+5V, -10–+10V
Voltage output load	1kΩ
Voltage output accuracy (25°C)	±0.1%
Voltage output accuracy (in full temperature range)	±0.5%
Voltage output diagnosis	Short circuit detection and overtemperature protection supported
Current output range	0–20mA, 4–20mA
Current output load	<600Ω
Current output accuracy (25°C)	±0.1%
Current output accuracy (in full temperature range)	±0.5%
Current output diagnosis	Open circuit detection and overtemperature protection supported
Isolation	No isolation between interface channels; voltage isolated from interface; interface isolated from bus
Output action display	None
Output derating	None

3.6.1.6 Software specifications

Item	Specification
Configuration of independent channel enabling	Supported
Configuration of diagnosis reporting	Supported
Configuration of enabling diagnosis detection	Short circuit detection for voltage, and disconnection detection for current
Mode switchover configuration	0–5V, 0–10V, ±5V, ±10V, 4–20mA, 0–20mA
Output status configuration after stop	Clearing, keeping the present output, or outputting the preset value
Preset value output after stop	Supported
Configuration of conversion digital range	±20000
Sampling time	4 channels at 160μs
Sampling refresh	Sampling time based asynchronous refresh, but not bus period based synchronous refresh
Stop mode	Output according to the fault-caused stop mode or the preset value, without refreshing any more

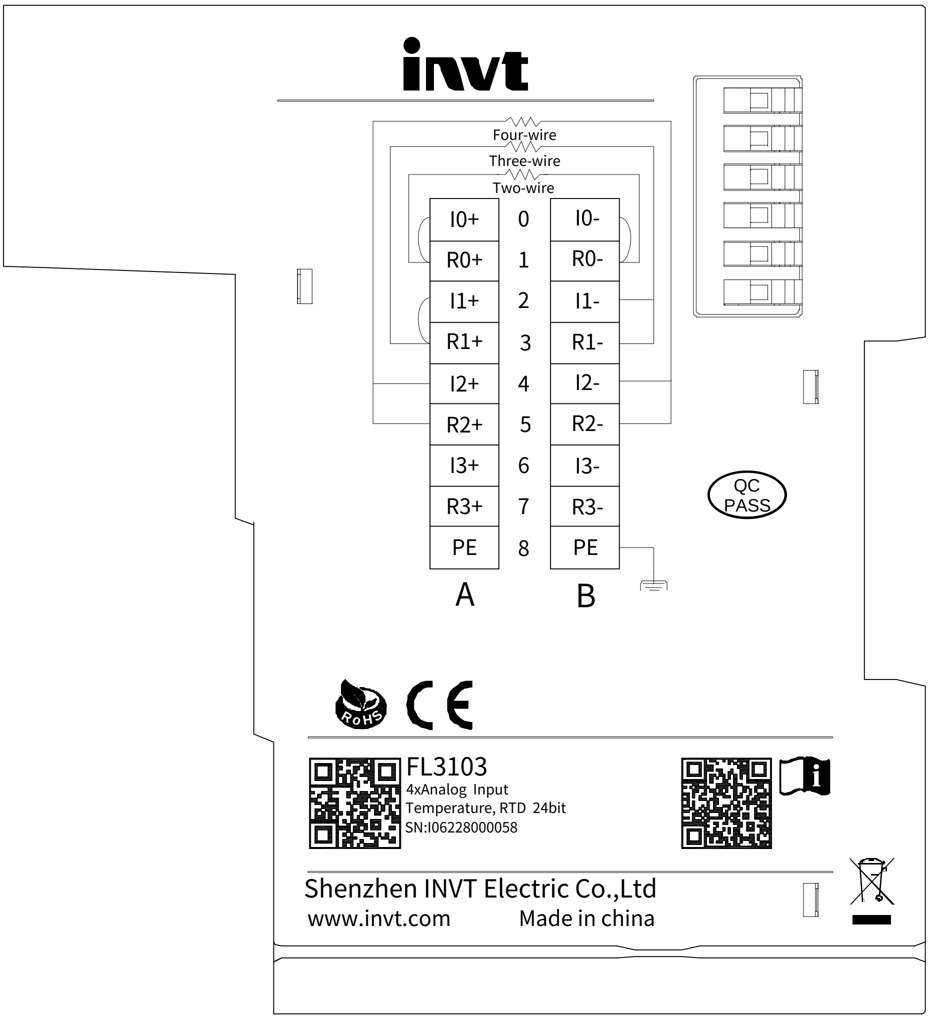
3.6.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.7 Temperature detection module (FL31xx)

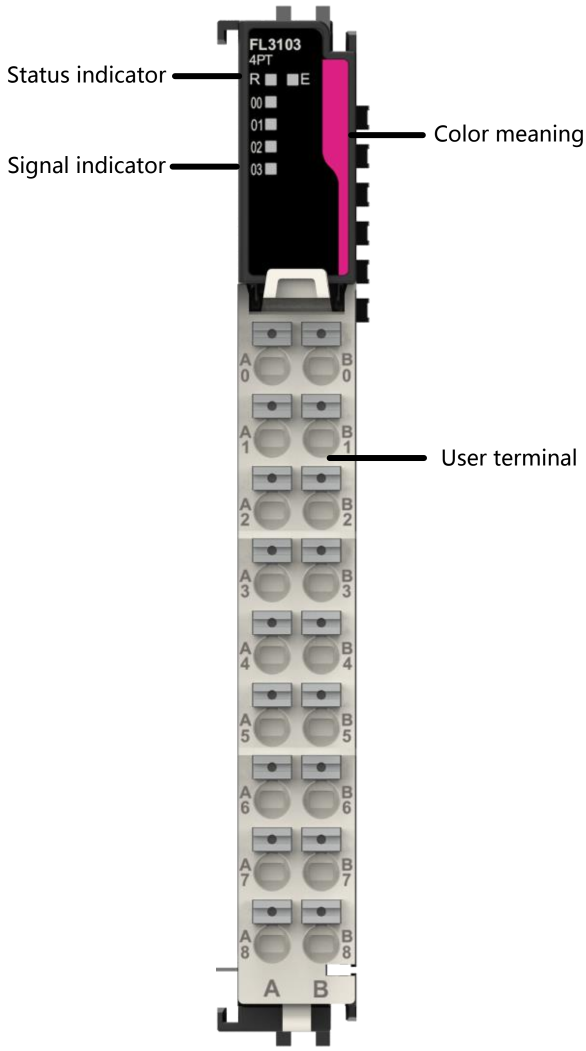
3.7.1 FL3103 (4PT)

3.7.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL3103	11016-00007	Thermal resistor, 4 channels, 24-bit resolution, sensitivity of 0.1°C/°F; RoHS	Applicable to INVT Flex/TS/TM series

3.7.1.2 Component description

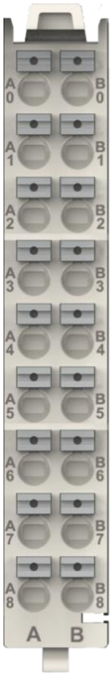


Name	Description		
Status indicator	R: Yellow green	Power-on/Run status indicator	On: The module is running.
			Slow blinking (500ms): The module is establishing communication.
			Off: The module is not powered on or it is abnormal.
	E: Red	Module fault indicator	Fast blinking (100ms): The module is offline.
			Slow blinking (500ms): Error in temperature detection.
			Off: The module works normally.
	00–03: Green	Channel status indicator	On: The channel is enabled.
			Slow blinking (500ms): Input signal out of range or limit.
			Fast blinking (100ms): Disconnection.
			Off: The channel is disabled.
User terminal	External wiring I/O terminal		

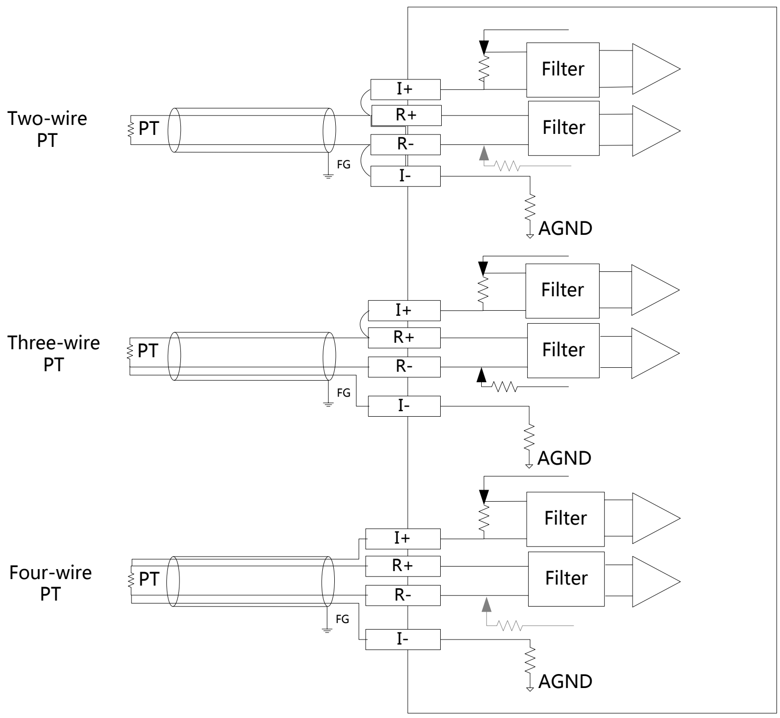
Name	Description			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output

3.7.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	I0+	**A0**	**B0**	I0-
	R0+	**A1**	**B1**	R0-
	I1+	**A2**	**B2**	I1-
	R1+	**A3**	**B3**	R1-
	I2+	**A4**	**B4**	I2-
	R2+	**A5**	**B5**	R2-
	I3+	**A6**	**B6**	I3-
	R3+	**A7**	**B7**	R3-
	PE	**A8**	**B8**	PE

- **Terminal wiring**



3.7.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	250mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.7.1.5 Input specifications

Item	Specification
Input channels	4
Resolution	24-bit
Display sensitivity	0.0625°C, 0.0625°F
Input terminal	Four thermal resistor inputs
Sensor type	PT100, PT500, PT1000, Cu100
Wiring method	Two-wire/Three-wire/Four-wire
Accuracy (at room temperature of 25°C)	Full scale * ± 0.3%
Accuracy (in room temperature -20°C–55°C)	Full scale * ± 1%
Sampling period	Channel 1 and channel 2 form a group, while channel 3 and channel 4 form a group. When both channels within a group are enabled and one channel is configured as a three-wire system, the sampling period is 480ms/channel, and in other cases, the sampling period is 240ms/channel.
Filter parameter	1–255 (Default: 8)
Isolation method	I/O terminals insulated from the power supply; ☒ No insulation between channels

3.7.1.6 Software specifications

Item	Specification
Configuration of diagnosis reporting	Supported
Configuration of enabling diagnosis detection	Over-limit detection and disconnection detection supported

Item	Specification
Configuration of enabling over-limit detection	Supported
Independent channel configuration	Supported
Configuration of enabling temperature offset	Supported
Temperature offset setting range	-204.8–+204.7 temperature unit
Sampling period	Channel 1 and channel 2 form a group, while channel 3 and channel 4 form a group. When both channels within a group are enabled and one channel is configured as a three-wire system, the sampling period is 480ms/channel, and in other cases, the sampling period is 240ms/channel.
Display mode	Celsius degree (°C), Fahrenheit degree (°F)
Sensitivity	0.0625°C, 0.0625°F
Sampling refresh	Sampling time based asynchronous refresh, but not bus period based synchronous refresh
Disconnection or over-limit	Output of max. value plus 10°C. Disconnection detection supported.
System diagnosis	Not supported
Channel diagnosis	Upper limit exceeding alarm and lower limit exceeding alarm.
Software diagnosis	Not supported
Configuration diagnosis	Identifying configuration errors, including channel parameter configuration errors.

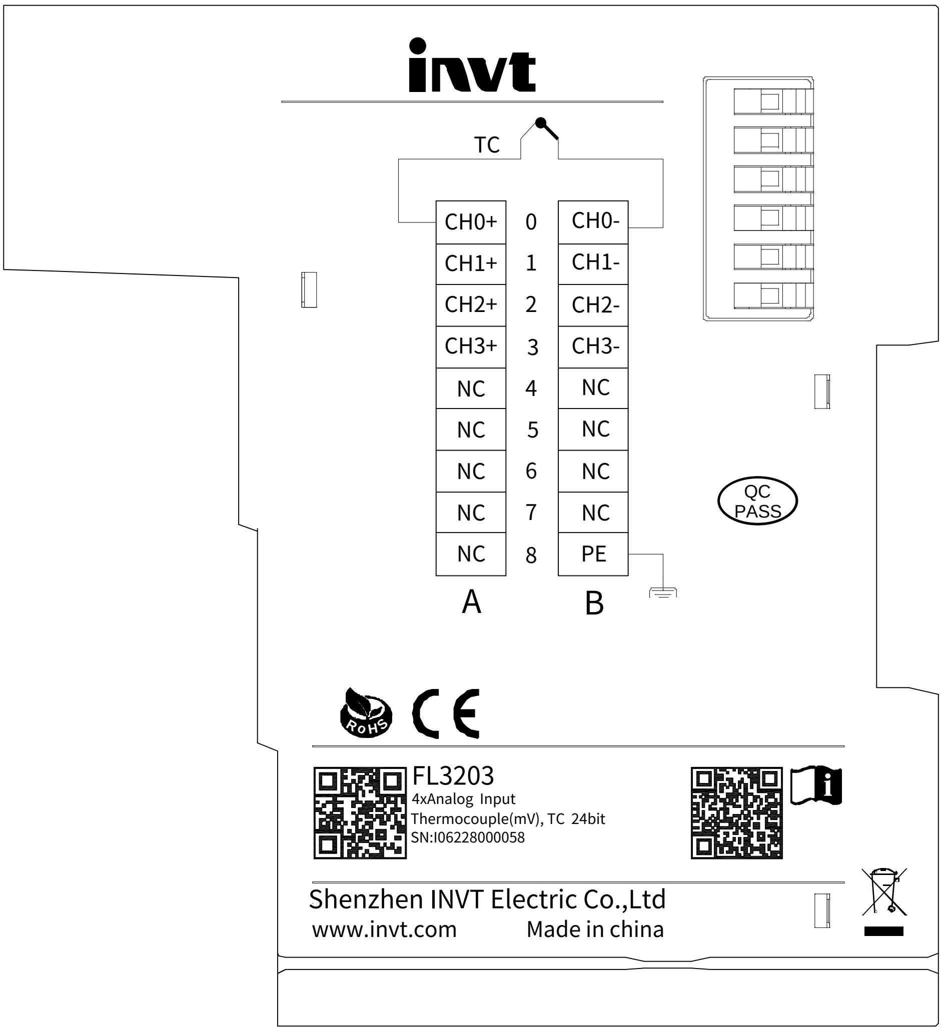
3.7.1.7 Environment requirements

Item	Specification
Working environment temperature	-20℃–+55℃
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40℃–+70℃ (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.8 Temperature detection module (FL32xx)

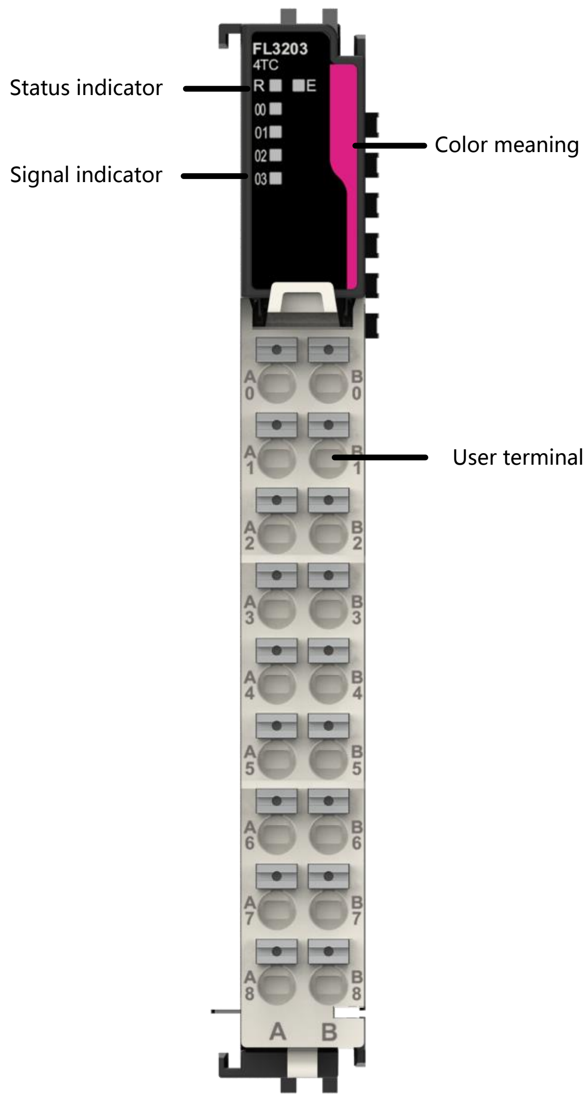
3.8.1 FL3203 (4TC)

3.8.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL3203	11016-00010	Thermocouple, 4 channels, 24-bit resolution, sensitivity of 0.1°C/°F; RoHS	Applicable to INVT Flex/TS/TM series

3.8.1.2 Component description

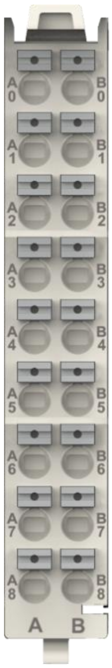


<table>
<tr><th>Name</th><th colspan="3">Description</th></tr>
<tr><td rowspan="10">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td>On: The module is running.</td></tr>
<tr><td>Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td>Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td>Fast blinking (100ms): The module is offline.</td></tr>
<tr><td>Slow blinking (500ms): Error in temperature detection.</td></tr>
<tr><td>Off: The module works normally.</td></tr>
<tr><td rowspan="4">00–03: Green</td><td rowspan="4">Channel status indicator</td><td>On: The channel is enabled.</td></tr>
<tr><td>Slow blinking (500ms): Input signal out of range or limit.</td></tr>
<tr><td>Fast blinking (100ms): Disconnection.</td></tr>
<tr><td>Off: The channel is disabled.</td></tr>
<tr><td>User terminal</td><td colspan="3">External wiring I/O terminal</td></tr>
</table>

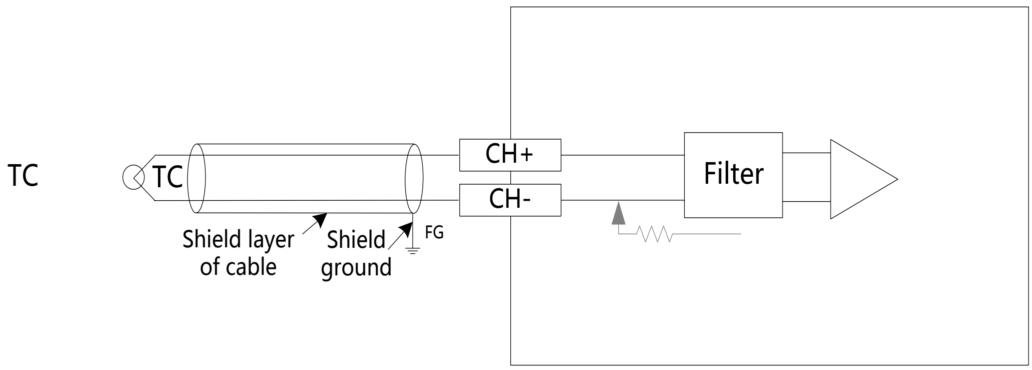
Name	Description			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output

3.8.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	CH0+	**A0**	**B0**	CH0-
	CH1+	**A1**	**B1**	CH1-
	CH2+	**A2**	**B2**	CH2-
	CH3+	**A3**	**B3**	CH3-
	-	**A4**	**B4**	-
	-	**A5**	**B5**	-
	-	**A6**	**B6**	-
	-	**A7**	**B7**	-
	-	**A8**	**B8**	-

- **Terminal wiring**



3.8.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	250mA
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.8.1.5 Input specifications

Item	Specification
Input channels	4
Resolution	24-bit
Display sensitivity	0.0625°C, 0.0625°F
Input terminal	4 thermocouple inputs
Thermocouple type	B, E, N, J, K, R, S, T
Compensation method	Internal cold junction compensation
Accuracy (at room temperature of 25°C)	Full scale * (±0.1%) + Cold junction compensation error
Accuracy (in room temperature -20°C–55°C)	Full scale * (±0.3%) + Cold junction compensation error
Isolation	I/O terminals insulated from the power supply; ☒ No insulation between channels
Input action display	None
Input derating	None
Over-limit and disconnection detection	Supported

3.8.1.6 Cold junction compensation

Installation direction	Cold junction compensation error (-20°C–55°C)
Horizontal and upright installation	±3°C
Non-horizontal but upright installation	±6°C

3.8.1.7 Software specifications

Item	Specification
Configuration of diagnosis reporting	Supported

Item	Specification
Configuration of enabling diagnosis detection	Over-limit detection and disconnection detection supported
Sensor type configuration	Supported thermocouple types: B, E, N, J, K, R, S, T
Filter parameter	1–255 (Default: 8)
Overflow and underflow detection	Not supported
Configuration of enabling over-limit detection	Supported
Independent channel configuration	Supported
Configuration of enabling temperature offset	Supported
Temperature offset setting range	-204.8–+204.7 temperature unit
Sampling period	360ms/channel
Display mode	Celsius degree (°C), Fahrenheit degree (°F)
Sensitivity	0.0625°C, 0.0625°F
Sampling refresh	Sampling time based asynchronous refresh, but not bus period based synchronous refresh
Disconnection or over-limit	Output of max. value plus 10°C.
System diagnosis	Not supported
Channel diagnosis	Upper limit exceeding alarm, lower limit exceeding alarm, and disconnection alarm
Software diagnosis	Not supported
Configuration diagnosis	Identifying configuration errors, including channel parameter configuration errors.

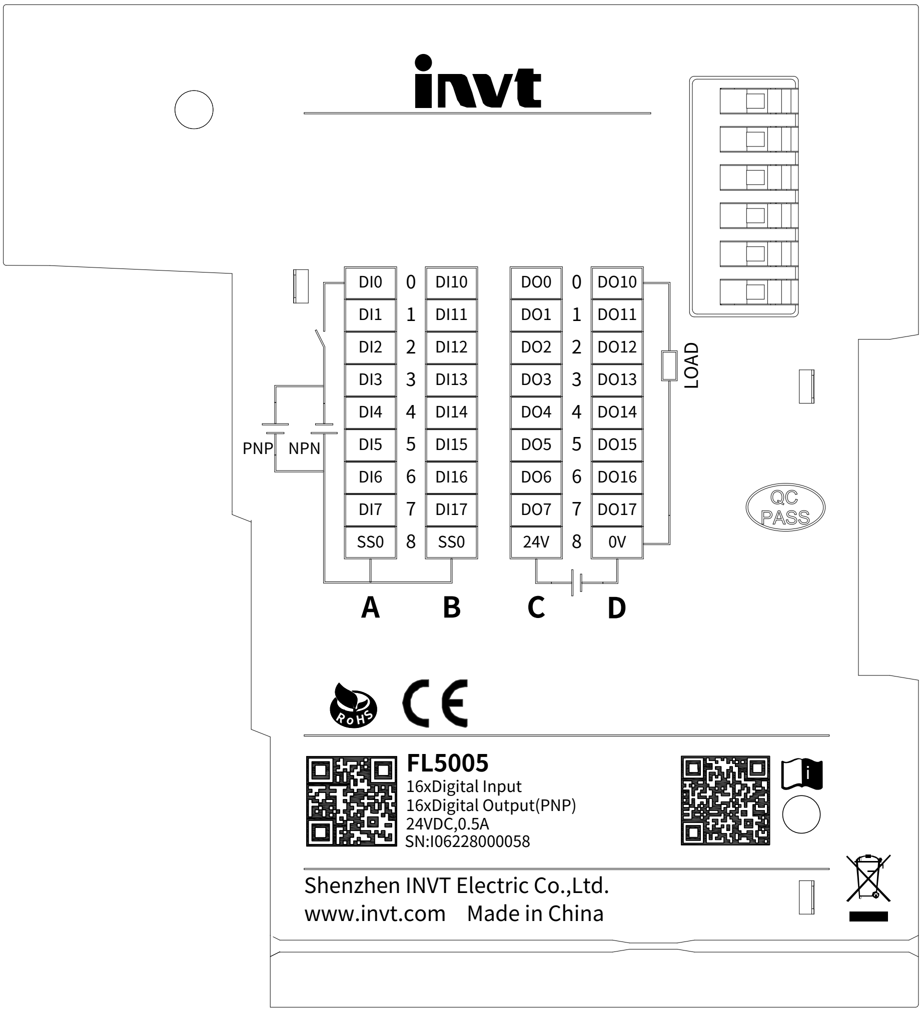
3.8.1.8 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.9 Hybrid module (FL5xxx)

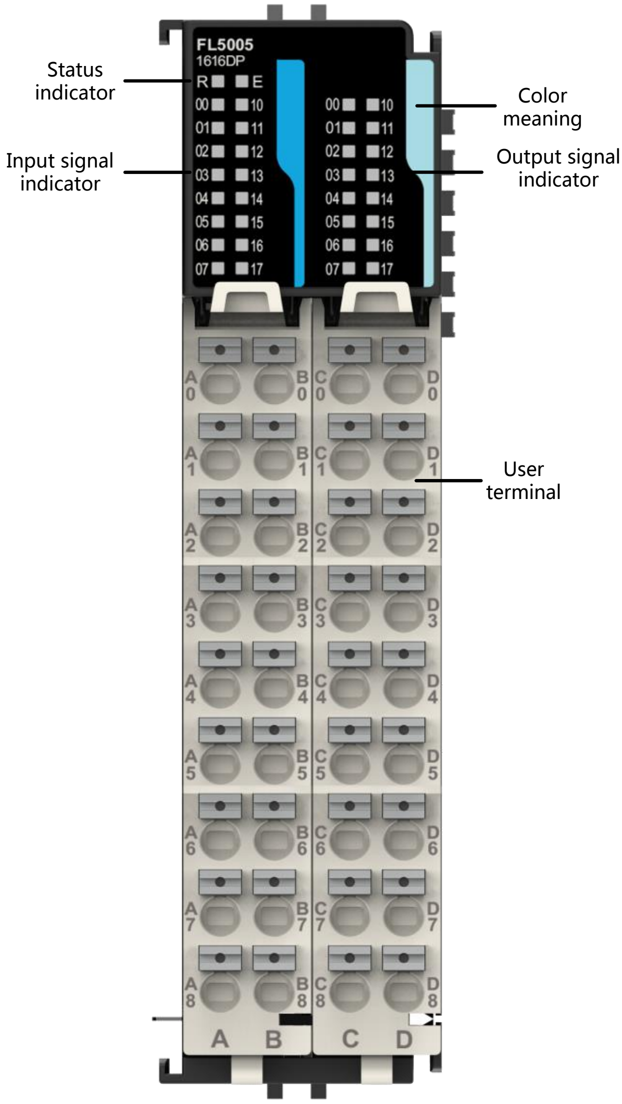
3.9.1 FL5005 (1616DP)

3.9.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL5005	11016-00015	Digital hybrid module, with 16 channels of input + 16 channels of output (PNP), 500mA@24VDC; RoHS	Applicable to INVT Flex/TS/TM series

3.9.1.2 Component description

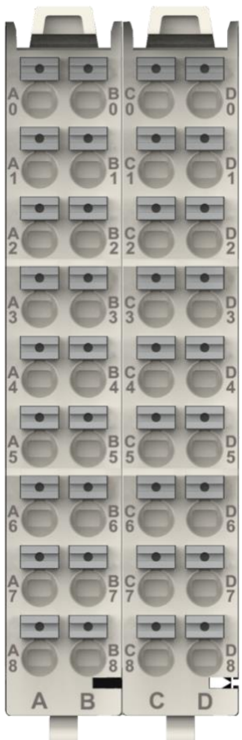


<table>
<tr><th>Name</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">Status indicator</td><td rowspan="3">R: Yellow green</td><td rowspan="3">Power-on/Run status indicator</td><td>On: The module is running.</td></tr>
<tr><td>Slow blinking (500ms): The module is establishing communication.</td></tr>
<tr><td>Off: The module is not powered on or it is abnormal.</td></tr>
<tr><td rowspan="3">E: Red</td><td rowspan="3">Module fault indicator</td><td>Slow blinking (500ms): No power connected externally or incorrect parameter settings.</td></tr>
<tr><td>Fast blinking (100ms): The module is offline.</td></tr>
<tr><td>Off: The module works normally.</td></tr>
<tr><td rowspan="2">Input signal indicator</td><td rowspan="2">00–07: Green
10–17: Green</td><td rowspan="2">Each corresponds to a channel of input signal.</td><td>On: The input is valid.</td></tr>
<tr><td>Off: The input is invalid.</td></tr>
<tr><td rowspan="2">Output signal indicator</td><td rowspan="2">00–07: Green
10–17: Green</td><td rowspan="2">Each corresponds to a channel of output signal.</td><td>On: Enable output.</td></tr>
<tr><td>Off: Disable output.</td></tr>
</table>

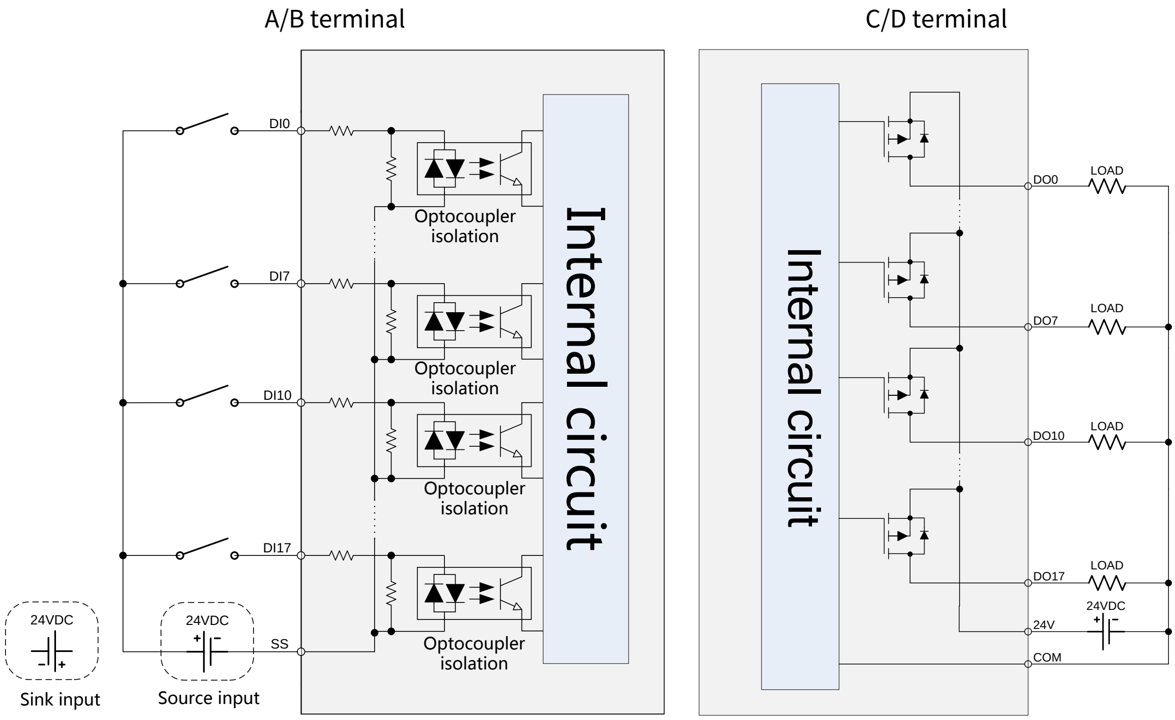
Name	Description			
User terminal	External wiring I/O terminal			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output

3.9.1.3 Terminal definition and wiring

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	DI0	**A0**	**B0**	DI10
	DI1	**A1**	**B1**	DI11
	DI2	**A2**	**B2**	DI12
	DI3	**A3**	**B3**	DI13
	DI4	**A4**	**B4**	DI14
	DI5	**A5**	**B5**	DI15
	DI6	**A6**	**B6**	DI16
	DI7	**A7**	**B7**	DI17
	SS	**A8**	**B8**	SS
	DO0	**C0**	**D0**	DO10
	DO1	**C1**	**D1**	DO11
	DO2	**C2**	**D2**	DO12
	DO3	**C3**	**D3**	DO13
	DO4	**C4**	**D4**	DO14
	DO5	**C5**	**D5**	DO15
	DO6	**C6**	**D6**	DO16
	DO7	**C7**	**D7**	DO17
	24VDC	**C8**	**D8**	COM

■ **Terminal wiring**



3.9.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	150mA (Typical value at 5VDC)
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.9.1.5 Input/output specifications

■ **Input specifications**

Item	Specification
Input type	Digital input
Input mode	Source/Sink
Input channels	16
Input voltage class	24VDC±10% (21.6VDC–26.4VDC)
Input current (Typical)	7mA (Typical value at 24VDC)
ON voltage	>15V

Item	Specification
OFF voltage	<5V
Hardware response time ON/OFF	100μs/100μs
Software filter time	Supported
Input resistance	Reference value is about 3.4kΩ.
Isolation	Optocoupler
Input action display	When the input is in driving state, the input indicator is on.
Input derating	When each terminal is operating at 55°C, it is derated to 75% (with no more than 12 input points of ON at the same time), or the temperature drops by 10°C when all input points are ON.

- **Output specifications**

Item	Specification
Output type	Digital output, high-edge output
Output mode	Source type
Output channel	16
Output voltage class	24VDC±10% (21.6VDC–26.4VDC)
Output load (Resistance load)	0.5A/point, 2A/module
Output load (Inductance load)	7.2W/point, 12W/module
Output load (Light load)	5W/point, 18W/module
Hardware response time ON/OFF	100μs/100μs
Leakage current at OFF	10μA
Switch frequency	100Hz for resistance load, 0.5Hz for resistance load, and 100ms for light load
Isolation	Yes
Output action display	When the output is in driving state, the output indicator is on.
Input derating	None
Protection function	Short-circuit protection and overcurrent protection

3.9.1.6 Software specifications

Item	Specification
Software input filter time	Setting range: 1–65535 (default: 1000); unit: 10μs; 1000 indicates 10ms. Able to set two groups of filter parameter. Every eight channels use a group of filter parameter.
Input port exception detection and indication	None
Input channel logic level configuration	Not supported
Configuration of independent channel enabling	Not supported

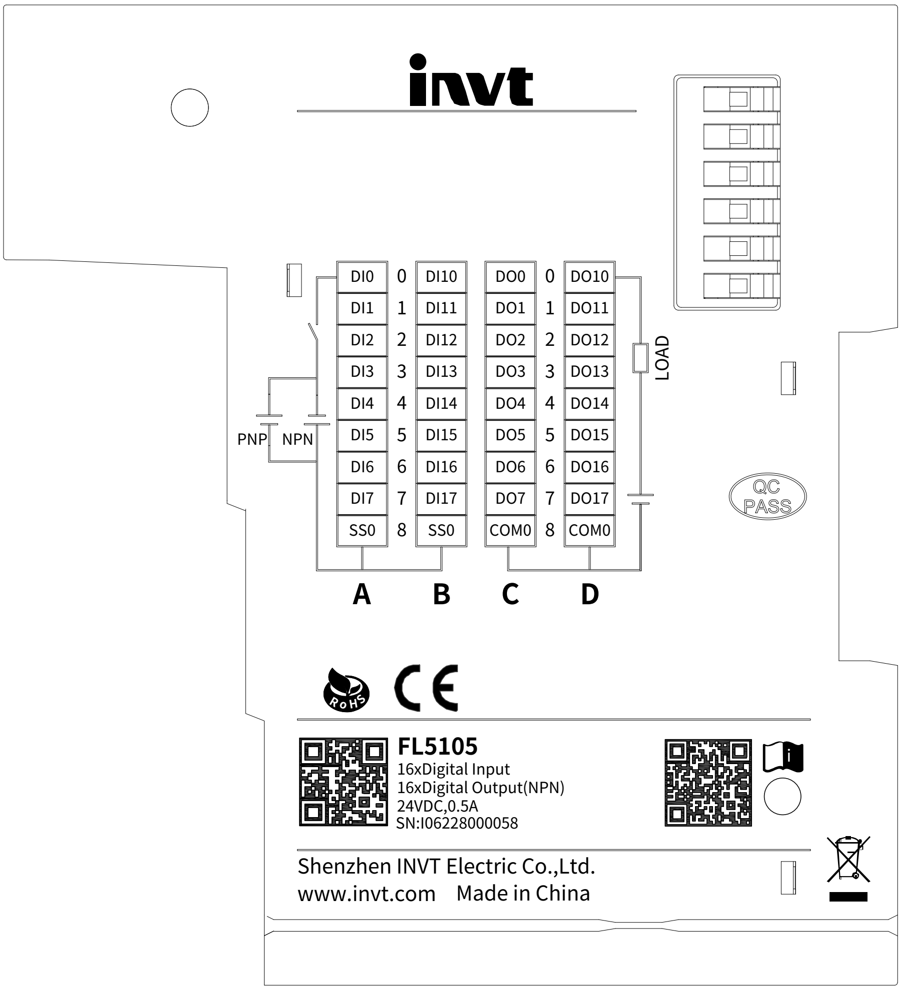
Item	Specification
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.
In stop mode	Output will not be refreshed, while input supports refreshing in Safe-operational state.
I/O mapping	Supporting the mapping method of bitwise access

3.9.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

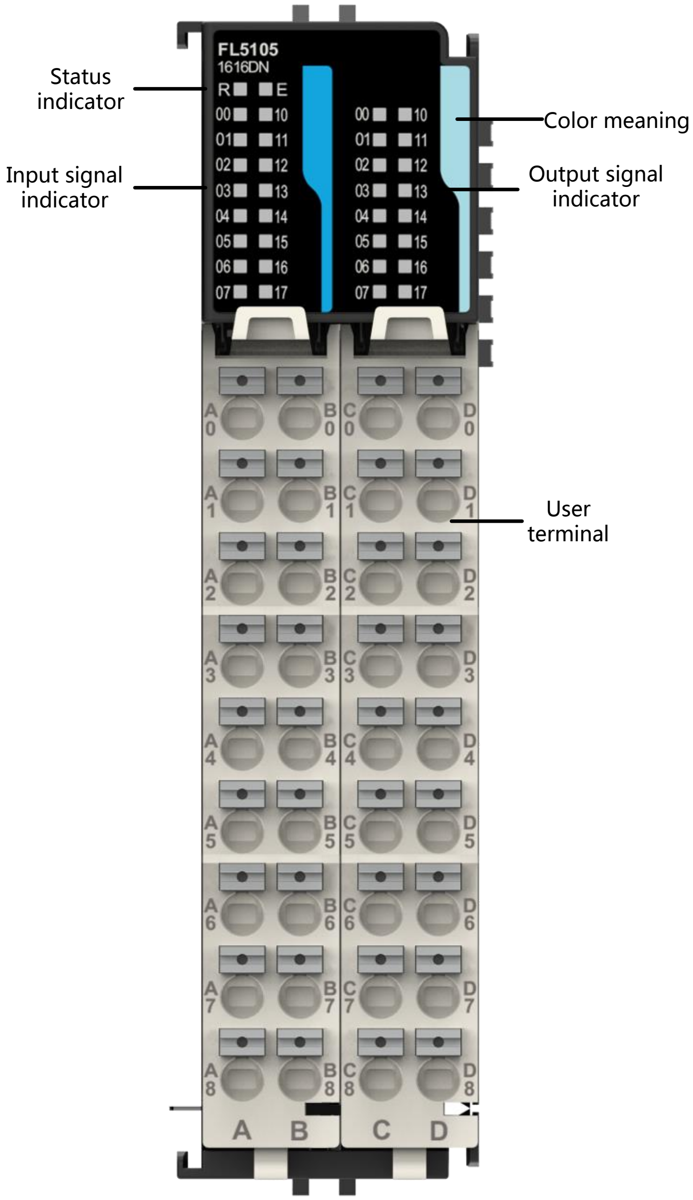
3.9.2 FL5105 (1616DN)

3.9.2.1 Basic information



Model	Ordering code	Description	Applicable model
FL5105	11016-00014	Digital hybrid module, with 16 channels of input + 16 channels of output (NPN), 500mA @ 24VDC; RoHS	Applicable to INVT Flex/TS/TM series

3.9.2.2 Component description

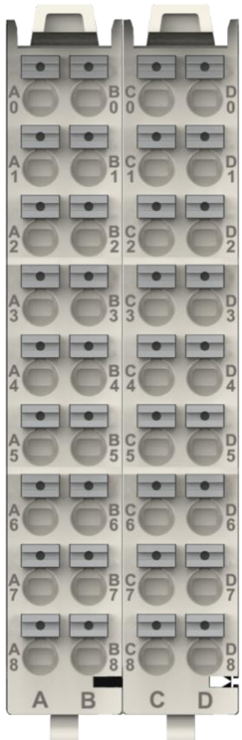


Name	Description		
Status indicator	R: Yellow green	Power-on/Run status indicator	On: The module is running.
			Slow blinking (500ms): The module is establishing communication.
			Off: The module is not powered on or it is abnormal.
	E: Red	Module fault indicator	Slow blinking (500ms): Channel overheat/overcurrent alarm or incorrect parameter settings.
			Fast blinking (100ms): The module is offline.
			Off: The module works normally.
Input signal indicator	00–07: Green 10–17: Green	Each corresponds to a channel of input signal.	On: The input is valid.
			Off: The input is invalid.

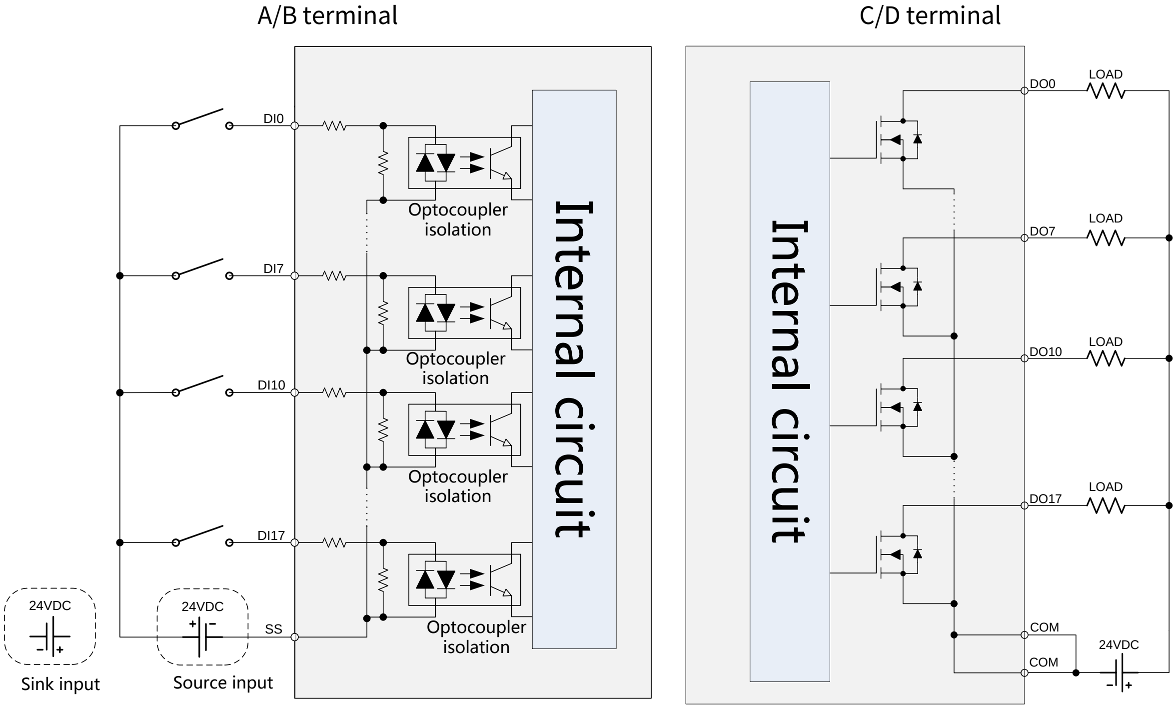
<table>
<tr><th>Name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">Output signal indicator</td><td rowspan="2">00–07: Green
10–17: Green</td><td rowspan="2">Each corresponds to a channel of output signal.</td><td colspan="2">On: Enable output.</td></tr>
<tr><td colspan="2">Off: Disable output.</td></tr>
<tr><td>User terminal</td><td colspan="4">External wiring I/O terminal</td></tr>
<tr><td rowspan="2">Color meaning</td><td></td><td>Digital input</td><td></td><td>Digital output (source, sink, relay)</td></tr>
<tr><td></td><td>Analog input (voltage, current, thermocouple)</td><td></td><td>Analog output</td></tr>
</table>

3.9.2.3 Terminal definition and wiring

■ **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	DI0	**A0**	**B0**	DI10
	DI1	**A1**	**B1**	DI11
	DI2	**A2**	**B2**	DI12
	DI3	**A3**	**B3**	DI13
	DI4	**A4**	**B4**	DI14
	DI5	**A5**	**B5**	DI15
	DI6	**A6**	**B6**	DI16
	DI7	**A7**	**B7**	DI17
	SS	**A8**	**B8**	SS
	DO0	**C0**	**D0**	DO10
	DO1	**C1**	**D1**	DO11
	DO2	**C2**	**D2**	DO12
	DO3	**C3**	**D3**	DO13
	DO4	**C4**	**D4**	DO14
	DO5	**C5**	**D5**	DO15
	DO6	**C6**	**D6**	DO16
	DO7	**C7**	**D7**	DO17
	COM	**C8**	**D8**	COM

■ **Terminal wiring**



3.9.2.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	250mA (Typical value at 5VDC)
Terminal input power rated voltage	None
Terminal input power rated current	None
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.9.2.5 Input/output specifications

■ **Input specifications**

Item	Specification
Input type	Digital input
Input mode	Source/Sink
Input channels	16
Input voltage class	24VDC±10% (21.6VDC–26.4VDC)
Input current (Typical)	7mA (Typical value at 24VDC)
ON voltage	>15V

Item	Specification
OFF voltage	<5V
Hardware response time ON/OFF	100μs/100μs
Software filter time	Supported
Input resistance	Reference value is about 3.4kΩ.
Isolation	Optocoupler
Input action display	When the input is in driving state, the input indicator is on.
Input derating	When each terminal is operating at 55°C, it is derated to 75% (with no more than 12 input points of ON at the same time), or the temperature drops by 10°C when all input points are ON.

■ **Output specifications**

Item	Specification
Output type	Digital output, low-edge output
Output mode	Sink
Output channel	16
Output voltage class	24VDC±10% (21.6VDC–26.4VDC)
Output load (Resistance load)	0.5A/point, 4A/module
Output load (Inductance load)	7.2W/point, 24W/module
Output load (Light load)	5W/point, 18W/module
Hardware response time ON/OFF	100μs/100μs
Leakage current at OFF	10μA
Switch frequency	100Hz for resistance load, 0.5Hz for resistance load, and 100ms for light load
Isolation	Yes
Output action display	When the output is in driving state, the output indicator is on.
Input derating	None

3.9.2.6 Software specifications

Item	Specification
Software input filter time	Setting range: 1–65535 (default: 1000); unit: 10μs; 1000 indicates 10ms. Able to set two groups of filter parameter. Every eight channels use a group of filter parameter.
Input port exception detection and indication	None
Input channel logic level configuration	Not supported
Configuration of independent channel enabling	Not supported
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.

Item	Specification
In stop mode	Output will not be refreshed, while input supports refreshing in Safe-operational state.
I/O mapping	Supporting the mapping method of bitwise access

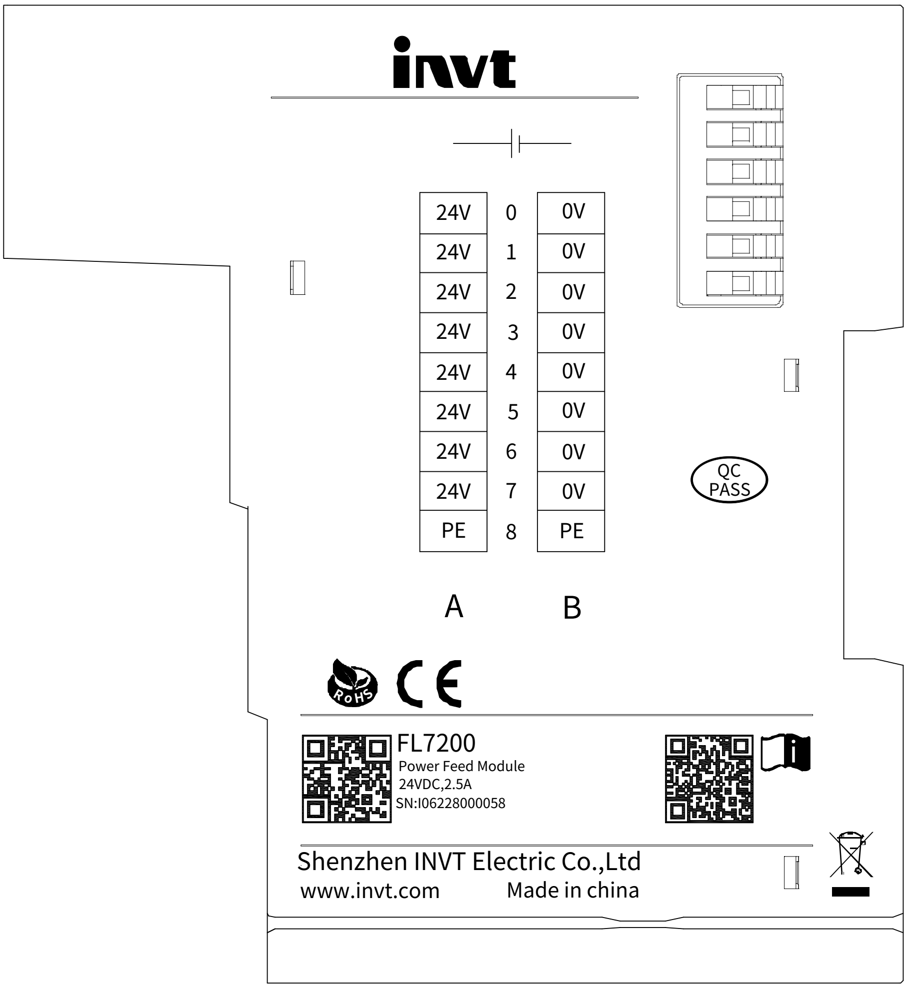
3.9.2.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.10 Power feed module (FL7200)

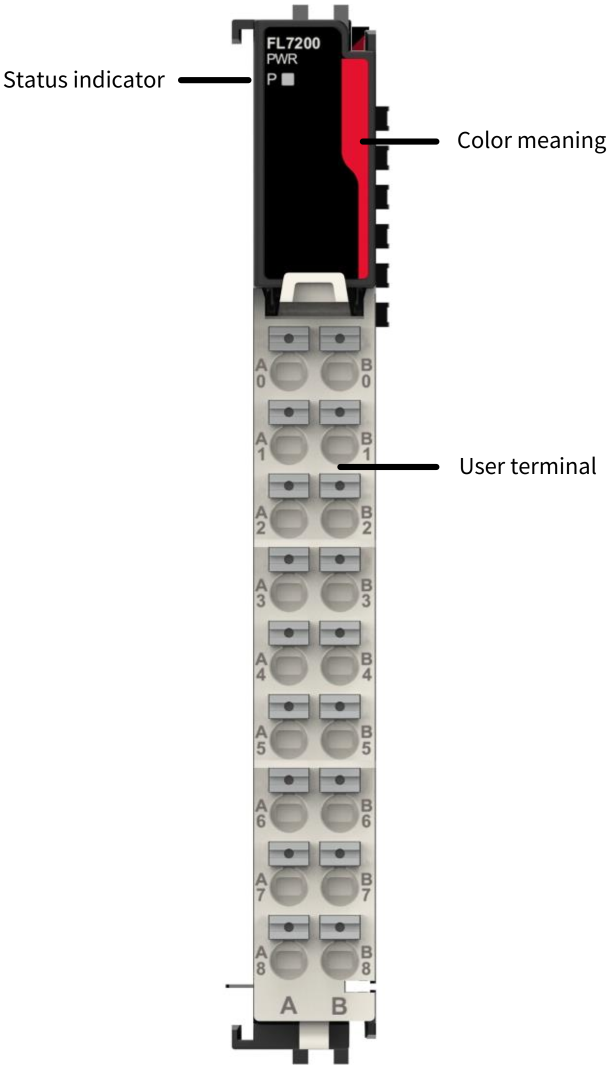
3.10.1 FL7200 (PWR)

3.10.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL7200	11016-00028	Power feed module, input 24VDC, output 5VDC 2.5A; RoHS	Applicable to INVT Flex/TS/TM series

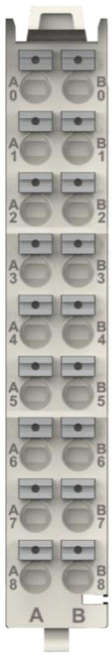
3.10.1.2 Component description



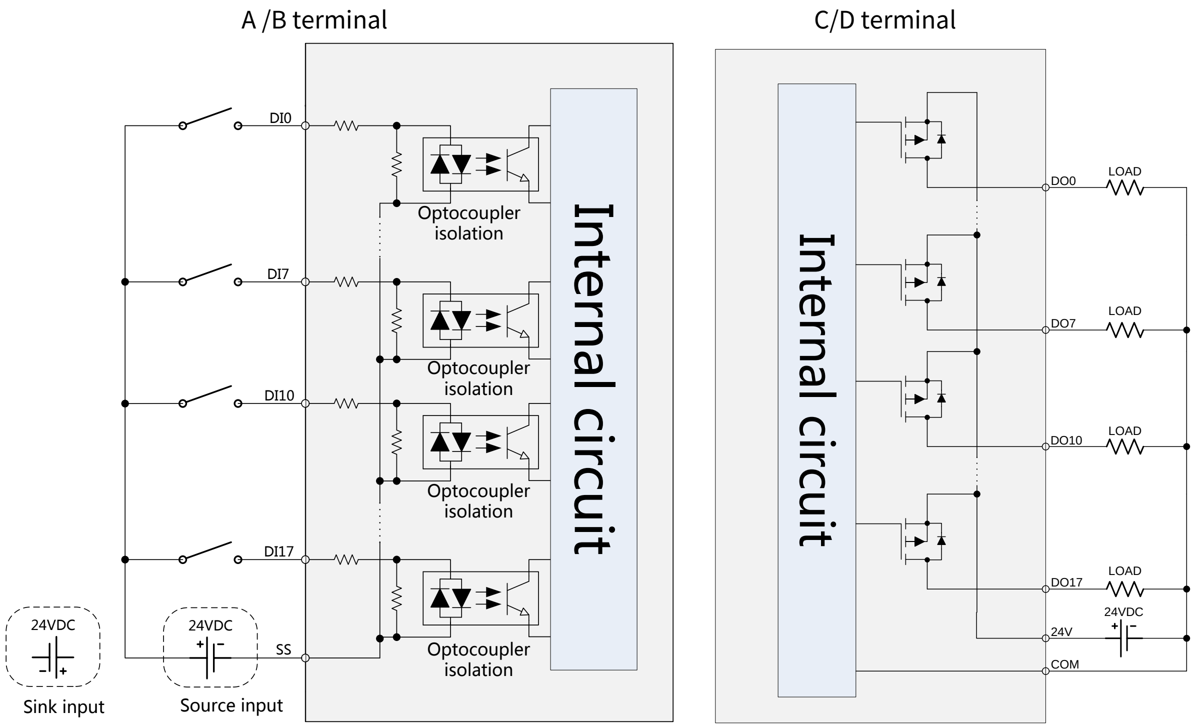
Name	Description			
Status indicator	R: Yellow green			
User terminal	External wiring I/O terminal			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output
		Power feed		Counting and measuring

3.10.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	24V	**A0**	**B0**	0V
	24V	**A1**	**B1**	0V
	24V	**A2**	**B2**	0V
	24V	**A3**	**B3**	0V
	24V	**A4**	**B4**	0V
	24V	**A5**	**B5**	0V
	24V	**A6**	**B6**	0V
	24V	**A7**	**B7**	0V
	PE	**A8**	**B8**	PE

- **Terminal wiring**



3.10.1.4 Power supply specifications

Item	Specification
External input rated voltage	24VDC (-15%–+20%)
External input rated current	0.8A
Output rated voltage	5VDC(4.5–5.5VDC)
Output rated current	2.5A (Typical value at room-temperature 25°C)
Output protection	Short circuit protection, hiccup protection

3.10.1.5 Software specifications

Item	Specification
Module addressing	Not supported
Module status reading	Not supported

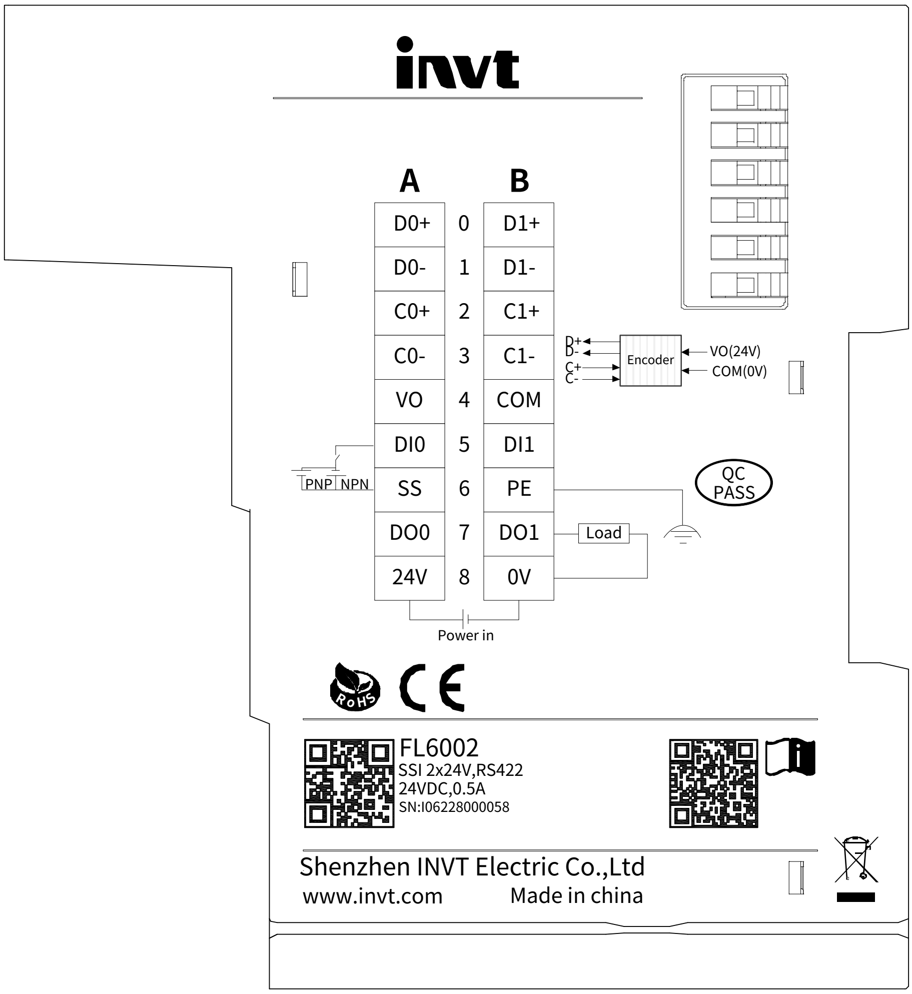
3.10.1.6 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

3.11 Counting and measuring module (FL6xxx)

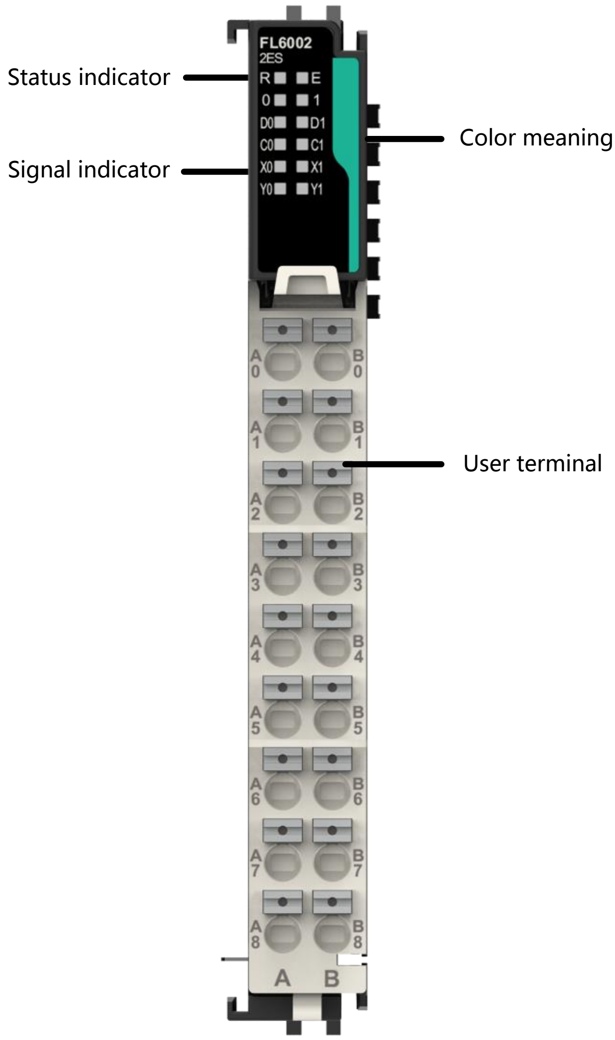
3.11.1 FL6002 (2ES)

3.11.1.1 Basic information



Model	Ordering code	Description	Applicable model
FL6002	11016-00022	SSI absolute encoder input, 2 channels, 24VDC, 2MHz; RoHS	Applicable to INVT Flex/TS/TM series

3.11.1.2 Component description

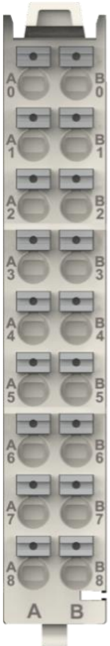


Name	Description		
Status indicator	R: Yellow green	Power-on/Run status indicator	On: The module is running.
			Slow blinking (500ms): The module is establishing communication.
			Off: The module is not powered on or it is abnormal.
	E: Red	Module fault indicator	Fast blinking (100ms): The module is offline.
			Slow blinking (500ms): No power connected externally or incorrect parameter settings.
			Off: The module works normally.
Signal indicator	D0/C0: Green D1/C1: Green	SSI encoder signal detection Indicator.	On: The differential voltage level difference of data/clock remains positive.
			Off: The differential voltage level difference of data/clock remains negative.
	X0/X1: Green	Digital input signal indicator	On: The input signal is valid.
			Off: The input signal is invalid.
	Y0/Y1: Green	Digital output signal indicator	On: Enable output.
			Off: Disable output.

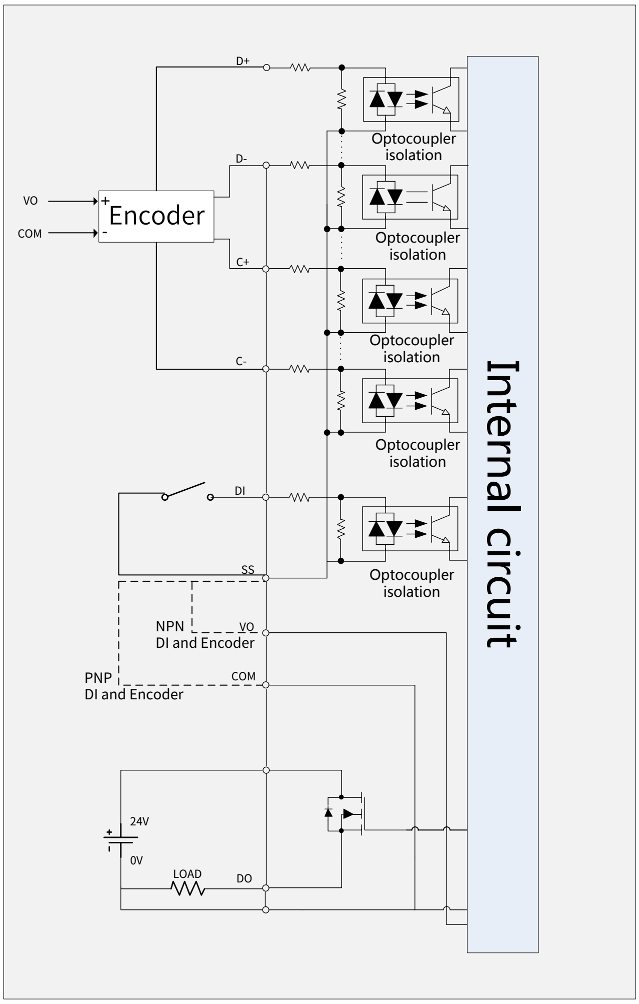
Name	Description			
User terminal	External wiring I/O terminal			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output
		Power feed		Counting and measuring

3.11.1.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	D0+	**A0**	**B0**	D1+
	D0-	**A1**	**B1**	D1-
	C0+	**A2**	**B2**	C1+
	C0-	**A3**	**B3**	C1-
	VO	**A4**	**B4**	COM
	DI0	**A5**	**B5**	DI1
	SS	**A6**	**B6**	PE
	DO0	**A7**	**B7**	DO1
	24V	**A8**	**B8**	0V

■ **Terminal wiring**



3.11.1.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	140mA
Terminal input power rated voltage	24VDC (20.4VDC–28.8VDC)
Terminal input power rated current	2A (Typical value at 24VDC)
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.11.1.5 Input specifications

Item	Specification
Encoder type	SSI absolute encoder
Input mode	RS422 electrical level standards, differential input

Item	Specification
Input channel	2
Encoder voltage	24VDC±15%
SSI frame length	10–40 (Default: 13)
SSI clock frequency (Hz)	125k, 250k, 500k, 1M, 1.5M, 2M
Signal type	Binary/Gray (default)
Number of DI channels	2
DI detection electrical level	24VDC
DI type	PNP (source type)/NPN (sink type)
DI edge selection	Rising edge/Falling edge/Rising or falling edge
DI filter time setting	(0–65535)*0.1μs
DI function	Latch, preset, and clear
Number of DO channels	2
DO level	24VDC
DO type	PNP (source type), rated output current 0.16A
DO function	Comparison output
ON voltage	>15V
OFF voltage	<5V
Hardware response time ON/OFF	100μs/100μs
Input resistance	Reference value about 3.4kΩ
Isolation	Optocoupler
Measurement variable	Frequency/Speed
Update time of the measurement function	20ms/100ms/500ms/1000ms
Gating function	Software gate

3.11.1.6 Software specifications

Item	Specification
Software input filter time	Setting range: 0–65535 (default: 1000); unit: indicates 0.1μs.
Configuration of diagnosis reporting	Diagnosis information will be uploaded by default.
In stop mode	Output will not be refreshed, while input supports refreshing in Safe-operational state.

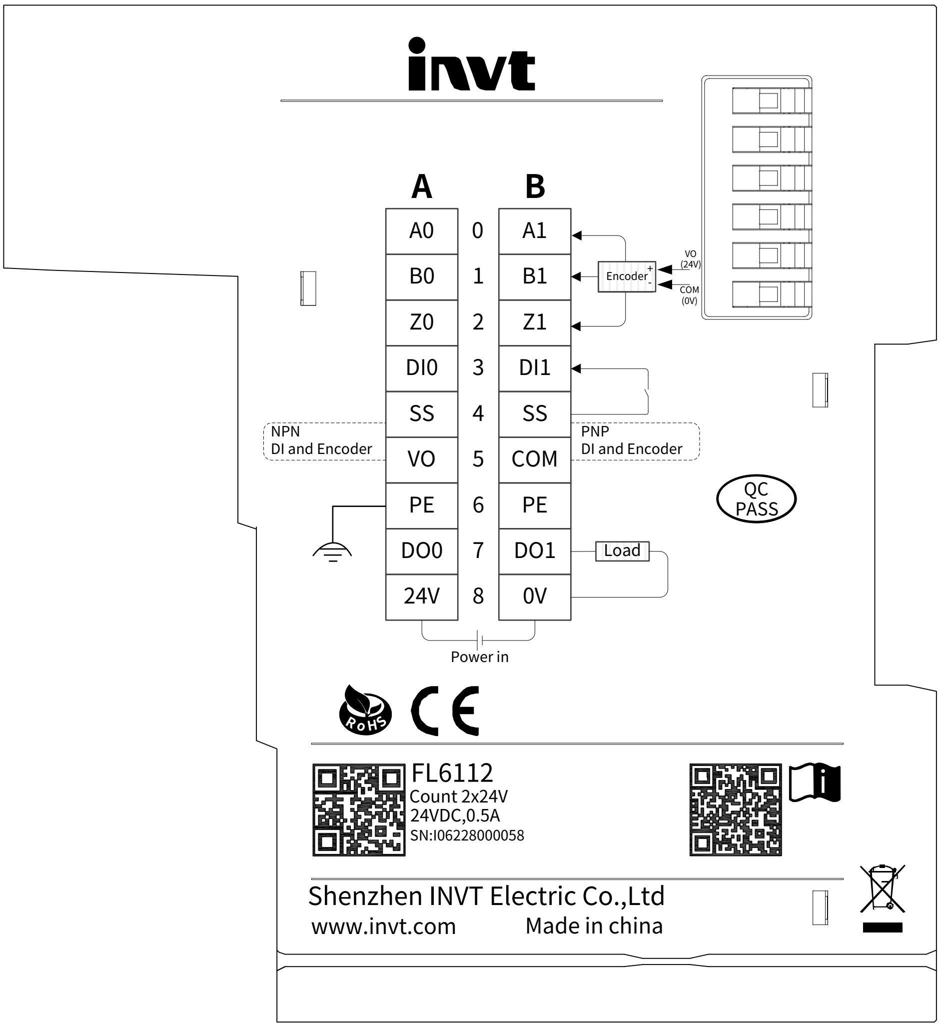
3.11.1.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2

Item	Specification
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

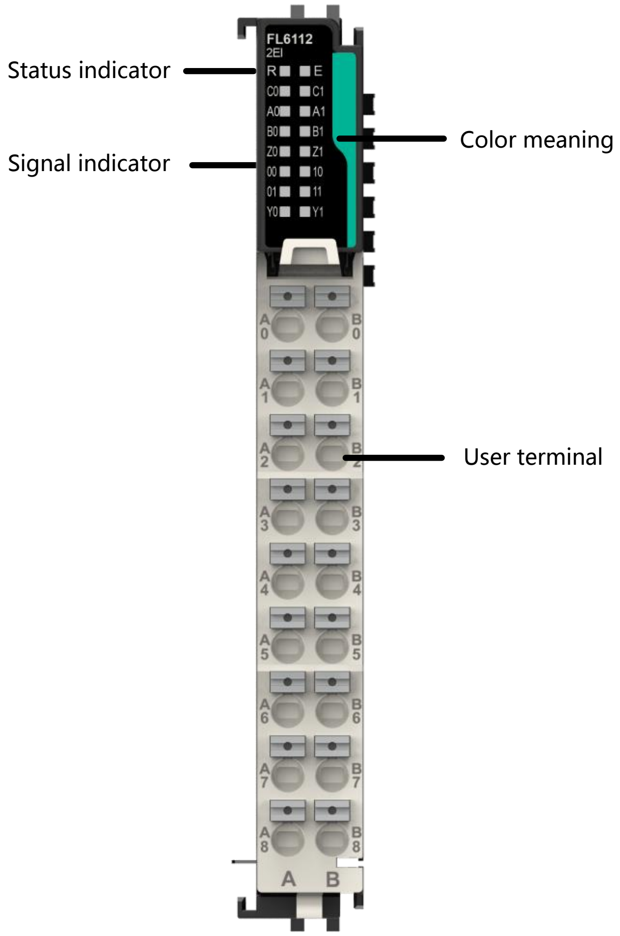
3.11.2 FL6112 (2EI)

3.11.2.1 Basic information



Model	Ordering code	Description	Applicable model
FL6112	11016-00019	incremental encoder input, 2 channels,24VDC,200kHz;RoHS	Applicable to INVT Flex/TS/TM series

3.11.2.2 Component description

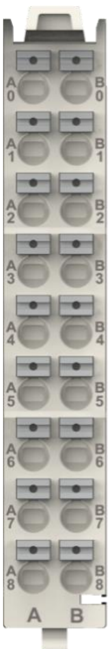


Name	Description		
Status indicator	R: Yellow green	Power-on/Run status indicator	On: The module is running.
			Slow blinking (500ms): The module is establishing communication.
			Off: The module is not powered on or it is abnormal.
	E: Red	Module fault indicator	Fast blinking (100ms): The module is offline.
			Slow blinking (500ms): No power connected externally or incorrect parameter settings.
			Off: The module works normally.
	C0: Green	Channel 0 enabling status indicator	On: Encoder channel enabled.
	C1: Green	Channel 1 enabling status indicator	Off: Encoder channel disabled.
Signal indicator	A0/B0/Z0: Green	Encoder channel 0 input signal indicator	On: The input signal is valid.
			Off: The input signal is invalid.
	A1/B1/Z1: Green	Encoder channel 1 input signal indicator	On: The input signal is valid.
			Off: The input signal is invalid.
	00/01: Green	Channel 0 digital input indicator	On: The input signal is valid. Off: The input signal is invalid.

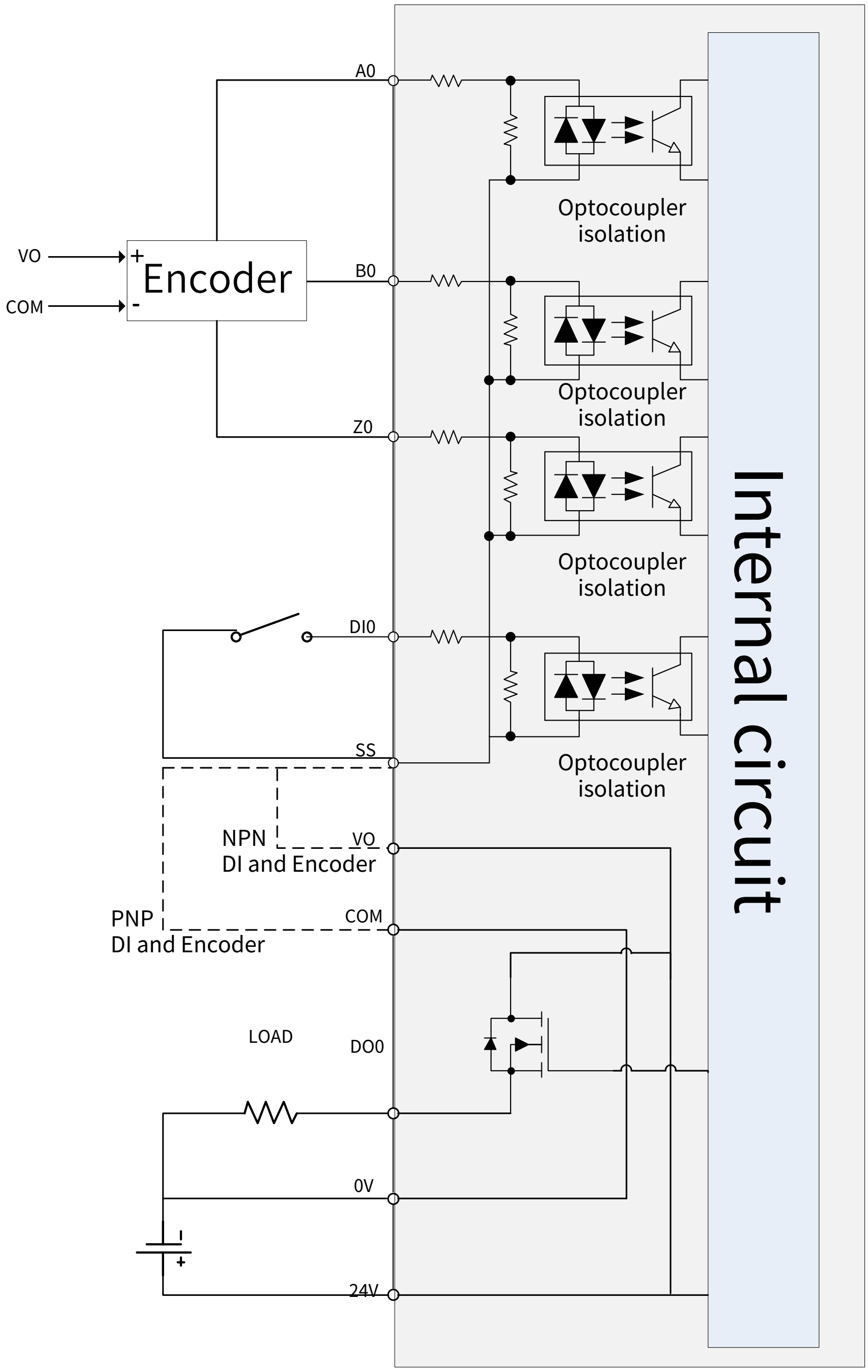
Name	Description			
	10/11: Green	Channel 1 digital input indicator	On: The input signal is valid. Off: The input signal is invalid.	
	Y0: Green	Channel 0 digital output indicator	On: Output enabled. Off: Output disabled.	
	Y1: Green	Channel 1 digital output indicator	On: Output enabled. Off: Output disabled.	
User terminal	External wiring I/O terminal			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output
		Power feed		Counting and measuring

3.11.2.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	A0	**A0**	**B0**	A1
	B0	**A1**	**B1**	B1
	Z0	**A2**	**B2**	Z1
	DI0	**A3**	**B3**	DI1
	SS	**A4**	**B4**	SS
	VO	**A5**	**B5**	COM
	PE	**A6**	**B6**	PE
	DO0	**A7**	**B7**	DO1
	24V	**A8**	**B8**	0V

■ **Terminal wiring**



3.11.2.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	140mA (Typical value at 5VDC)
Terminal input power rated voltage	24VDC (20.4VDC–28.8VDC)
Terminal input power rated current	2A (Typical value at 24VDC)
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.11.2.5 Input specifications

Item	Specification
Encoder type	Incremental encoder
Input channel	2
Encoder voltage	24VDC±15%
Pulse mode	Phase difference pulse/pulse+direction input (supports directionless signals)
Counting range	-2147483648–2147483647
Pulse frequency	200kHz
Frequency multiplication mode	x1/x2/x4
Resolution	1–65535PPR (number of pulses per revolution)
Counter preset	Default is 0, which means the preset is disabled.
Z-pulse calibration	Supported by default when Z signal is connected.
Counter filter	(0–65535)*0.1μs per channel
Number of DI channels	2
DI function	Latch
DI detection electrical level	24VDC
DI type	PNP (source type)/NPN (sink type)
DI edge selection	Rising edge/Falling edge/Rising or falling edge
DI filter time setting	(0–65535)*0.1μs
Number of DO channels	2
DO function	Comparison output
DO level	24VDC
DO type	PNP (source type), rated output current 0.16A
DO function	Comparison output
ON voltage	>15V
OFF voltage	<5V
Hardware response time ON/OFF	100μs/100μs
Input resistance	Reference value about 3.4kΩ
Isolation	Optocoupler

3.11.2.6 Software specifications

Item	Specification
Input filter time	Setting range: 0–65535 (default: 1000); unit: 0.1μs
Measurement variable	Frequency/Speed

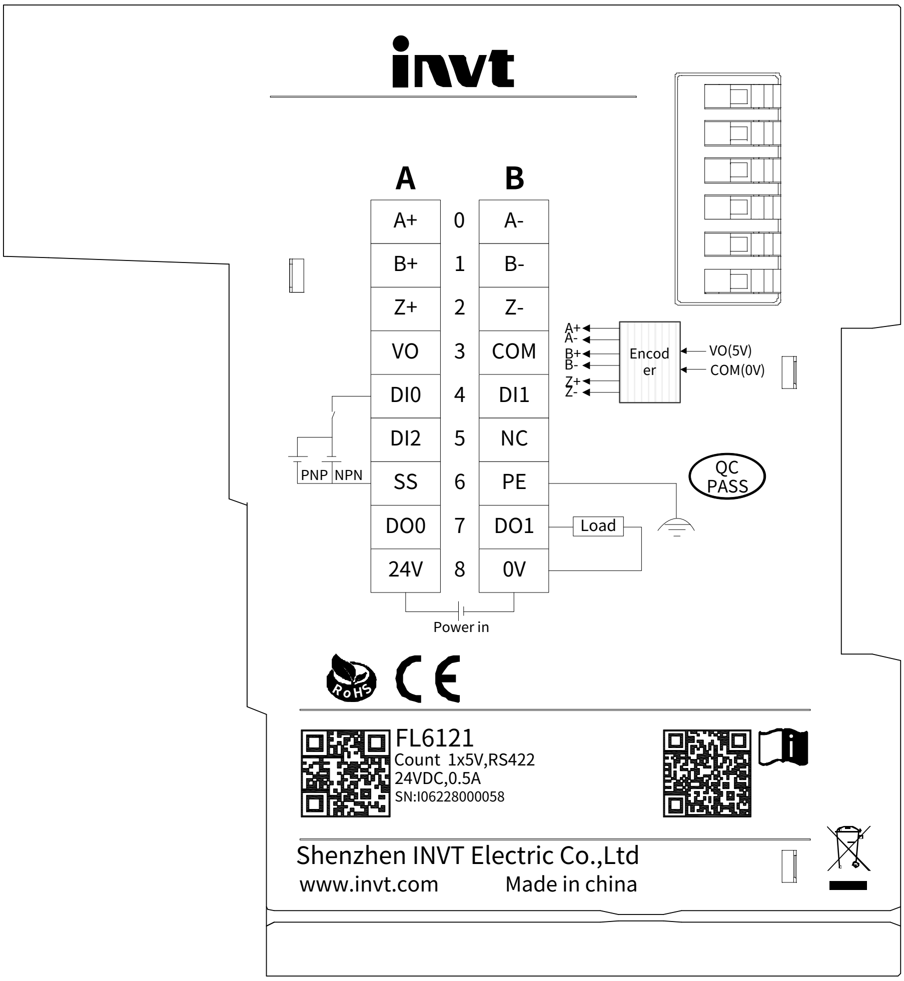
Item	Specification
Update time of the measurement function	20ms/100ms/500ms/1000ms
Gating function	Software gate

3.11.2.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

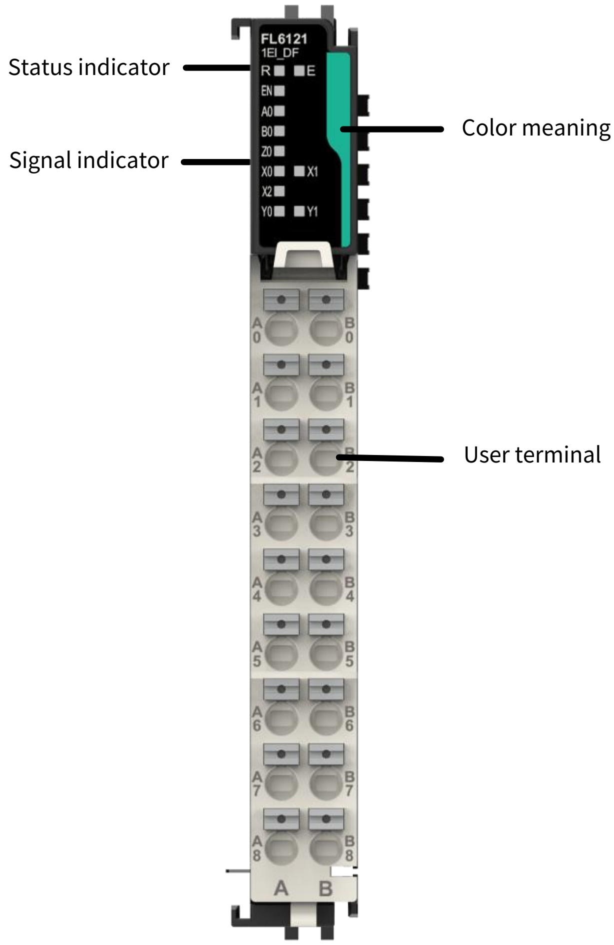
3.11.3 FL6121 (1EI_DF)

3.11.3.1 Basic information



Model	Ordering code	Description	Applicable model
FL6121	11016-00021	Incremental encoder differential input, 1 channels,5VDC,2MHz;RoHS	Applicable to INVT Flex/TS/TM series

3.11.3.2 Component description

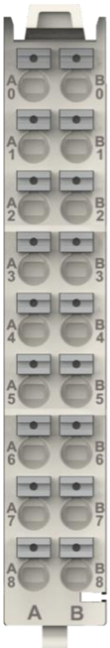


Name	Description		
Status indicator	R: Yellow green	Power-on/Run status indicator	On: The module is running.
			Slow blinking (500ms): The module is establishing communication.
			Off: The module is not powered on or it is abnormal.
	E: Red	Module fault indicator	Fast blinking (100ms): The module is offline.
			Slow blinking (500ms): No power connected externally or incorrect parameter settings.
			Off: The module works normally.
	EN: Green	Enabling status indicator	On: Encoder channel enabled.
Signal indicator	A0/B0/Z0: Green	Encode channel input signal indicator	On: The input signal is valid.
			Off: The input signal is invalid.
	X0/X1/X2: Green	Digital input indicator	On: The input signal is valid. Off: The input signal is invalid.
	Y0/Y1: Green	Digital output indicator	On: Output enabled. Off: Output disabled.
User terminal	External wiring I/O terminal		

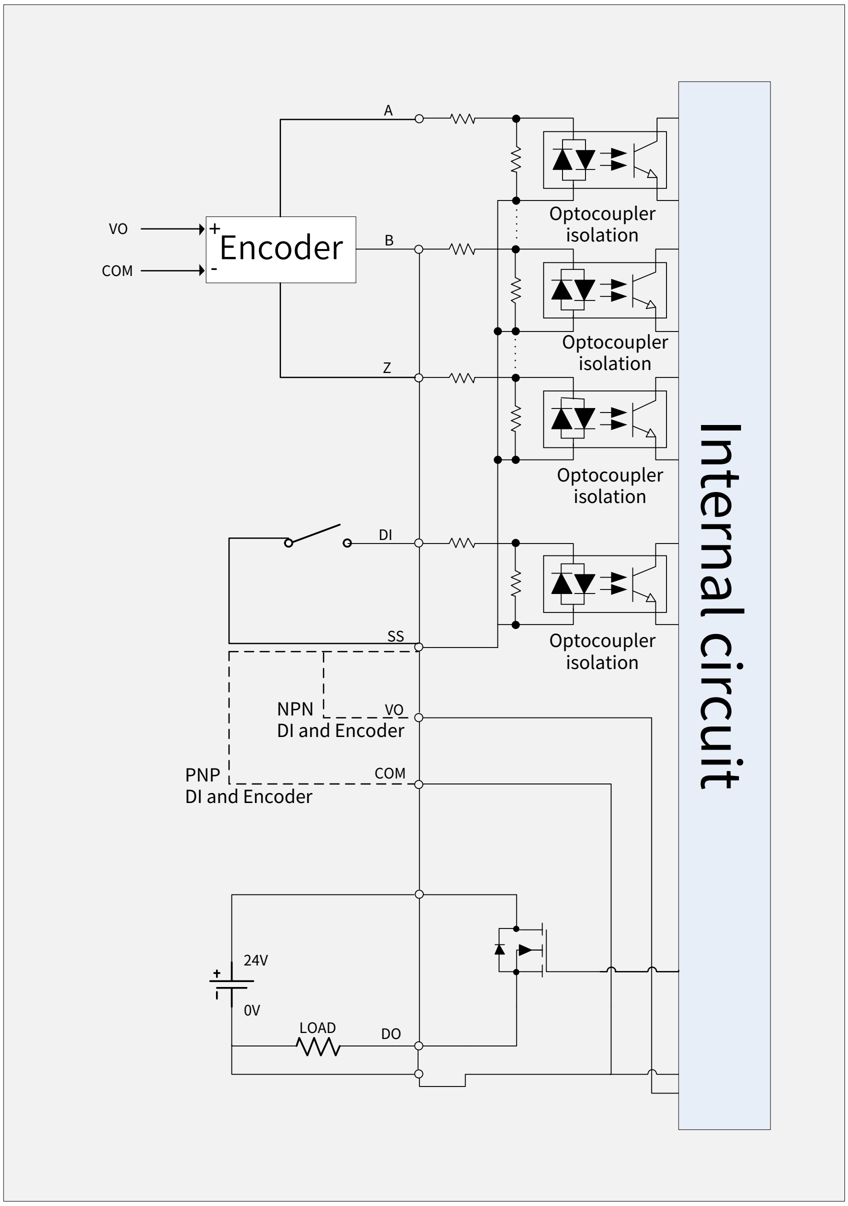
Name	Description			
Color meaning		Digital input		Digital output (source, sink, relay)
		Analog input (voltage, current, thermocouple)		Analog output
		Power feed		Counting and measuring

3.11.3.3 Terminal definition and wiring

- **Terminal definition**

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	A+	**A0**	**B0**	A-
	B+	**A1**	**B1**	B-
	Z+	**A2**	**B2**	Z-
	VO	**A3**	**B3**	COM
	DI0	**A4**	**B4**	DI1
	DI2	**A5**	**B5**	/
	SS	**A6**	**B6**	PE
	DO0	**A7**	**B7**	DO1
	24V	**A8**	**B8**	0V

■ **Terminal wiring**



3.11.3.4 Power supply specifications

Item	Specification
Fieldbus input power rated voltage	5VDC (4.75VDC–5.25VDC)
Fieldbus input power rated current	140mA (Typical value at 5VDC)
Terminal input power rated voltage	24VDC (20.4VDC–28.8VDC)
Terminal input power rated current	2A (Typical value at 24VDC)
Terminal output power rated voltage	None
Terminal output power rated current	None
Hot swapping of module	Not supported

3.11.3.5 Input specifications

Item	Specification
Encoder type	Incremental encoder
Input channel	1
Encoder voltage	5VDC
Input type	RS422 electrical level standards, differential input
Pulse mode	Phase difference pulse/pulse+direction input (supports directionless signals)
Counting range	-2147483648–2147483647
Pulse frequency	100Hz–2MkHz
Frequency multiplication mode	x1/x2/x4
Resolution	1–65535PPR (number of pulses per revolution)
Counter preset	Default is 0, which means the preset is disabled.
Z-pulse calibration	Supported by default when Z signal is connected.
Counter filter	(0–65535)*10ns per channel
Number of DI channels	3
DI function	Latch, preset, and reset
DI detection electrical level	24VDC
DI type	PNP (source type)/NPN (sink type)
DI edge selection	Rising edge/Falling edge/Rising or falling edge
DI filter time setting	(0–65535)*10ns
Hardware reset	Rising edge reset
Number of DO channels	2
DO function	Comparison output
DO level	24VDC
DO type	PNP (source type), rated output current 0.16A
ON voltage	>15V
OFF voltage	<5V
Hardware response	100μs/100μs

Item	Specification
time ON/OFF	
Input resistance	Reference value about 3.4kΩ
Isolation	Optocoupler

3.11.3.6 Software specifications

Item	Specification
Input filter time	Setting range: 0–65535 (default: 1000); unit: indicates 10ns.
Measurement variable	Frequency/Speed
Update time of the measurement function	20ms/100ms/500ms/1000ms
Gating function	Software gate

3.11.3.7 Environment requirements

Item	Specification
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
Vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

4 Installation

4.1 Preparing

4.1.1 Installation precautions

Before installation	
⚠	● Make sure all product modules have been powered off before installation. ● Check the planned overall size and ensure that there is enough space to accommodate the product modules. The module must be installed in a cabinet with each clearance to the surrounding greater than 50mm so that the product hardware has good heat dissipation.

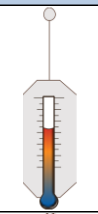
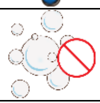
During installation	
⚠	● During installing, use the installation tools that meet the requirements, such as screws and gaskets. ● Prevent metal wire heads, debris, screws, and other objects from falling into the internal of the product. Otherwise, short circuit may occur, or heat dissipation may be degraded.

After installation	
⚠	● Ensure that the terminal of the connected communication cable is firmly fastened. ● Ensure that the rail that hosts the module is reliably fixed. ● Ensure that the strong-electricity cables are separately routed from the weak-electricity cables, and the cables are routed neatly in the cabinet. ● After installation, please remove the sticker attached to the module's ventilation holes to ensure smooth heat dissipation. ● After installation, check the air circulation around the module.

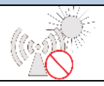
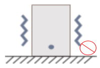
4.1.2 Installation environment and site

Check the installation environment and ensure that the environment meets the working conditions of all the components of the product, which include temperature, humidity, dust and corrosion protection requirements.

■ **Environment requirements**

Environment	Requirement	
Temperature		● -20°C–55°C ● There is no sudden temperature change. ● When the product is installed in a closed space, such as control cabinet, use a cooling fan or air conditioner for temperature adjustment if necessary.
Humidity		● RH: 5%–95%, no condensation

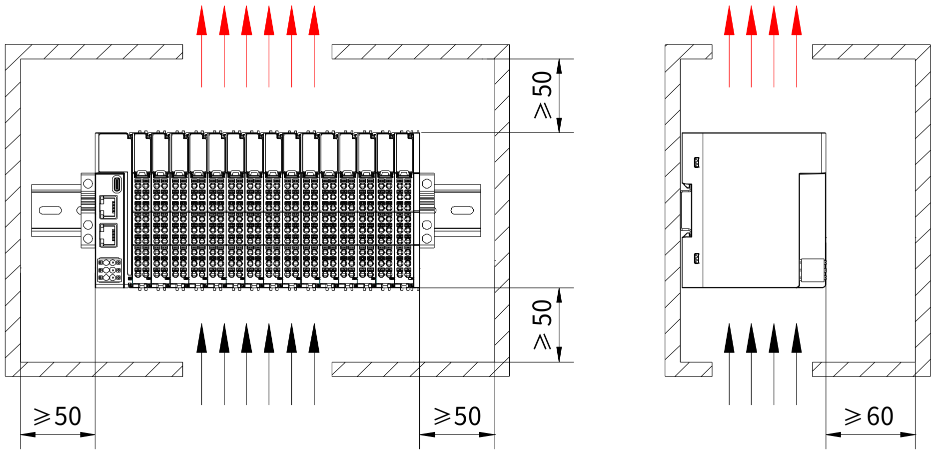
■ **Site requirement**

Site		Requirement
Indoor, overvoltage class II		● No strong electric field, strong magnetic field, or direct sunlight
		● No dust, conductive powder such as iron powder, oil mist, salt, or organic solvent
		● No corrosive gas or flammable gas
		● No factors that will cause the machine to directly vibrate or suffer conductive shocks

4.1.3 Installation space

Sufficient space should be reserved between the top and bottom of the module and the housing and other components to facilitate product replacement, ventilation, and heat dissipation.

Figure 4-1 Installation space (unit: mm)



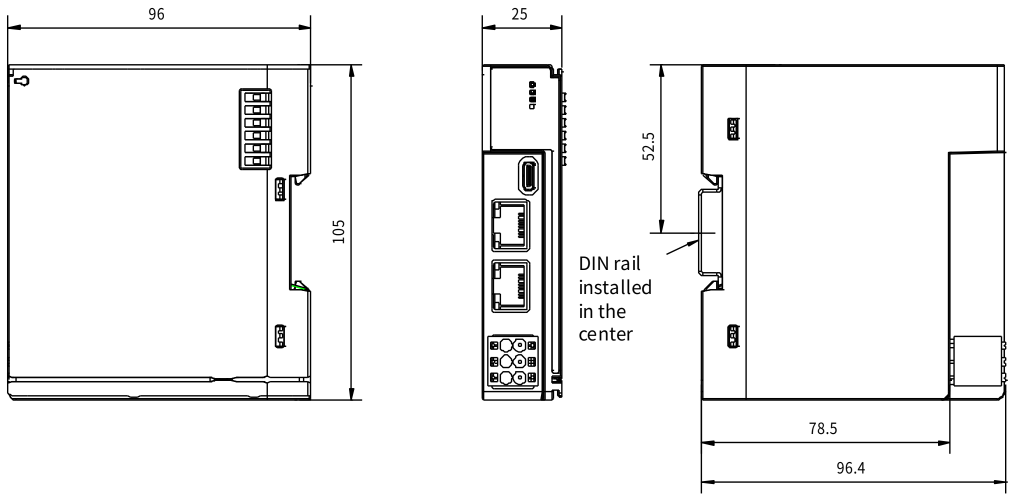
4.2 Installation dimensions

4.2.1 Communication coupler

4.2.1.1 Module installation dimensions

The dimensions are applicable to FK1100, FK1200, and FK1400.

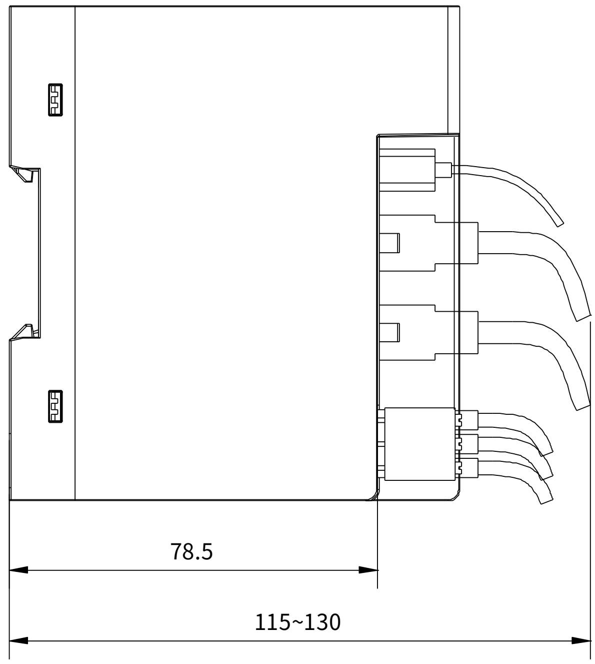
Figure 4-2 Module installation dimensions (unit: mm)



4.2.1.2 Connection cable dimensions

The dimensions are applicable to FK1100, FK1200, and FK1400.

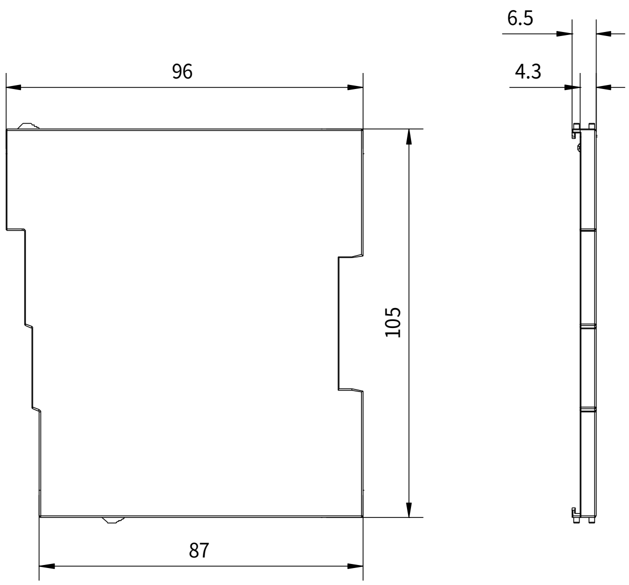
Figure 4-3 Connection cable dimensions (unit: mm)



4.2.1.3 End cover dimensions

The dimensions are applicable to FK1100, FK1200, and FK1400.

Figure 4-4 End cover dimensions (unit: mm)

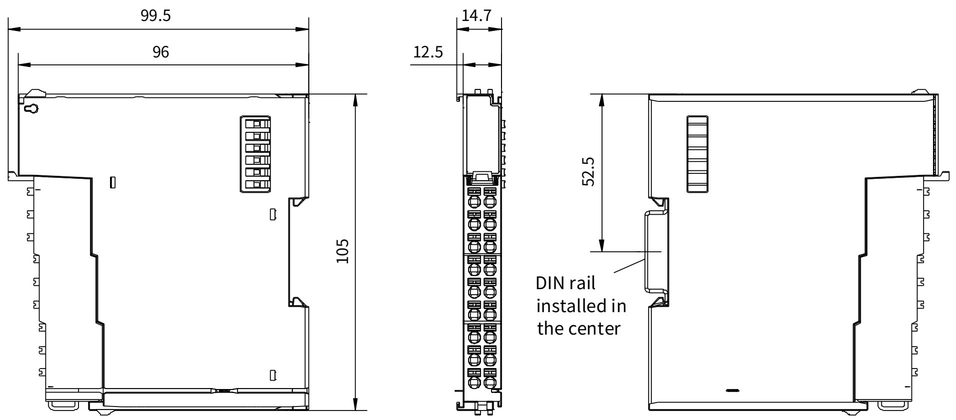


4.2.2 I/O module

4.2.2.1 Module installation dimensions

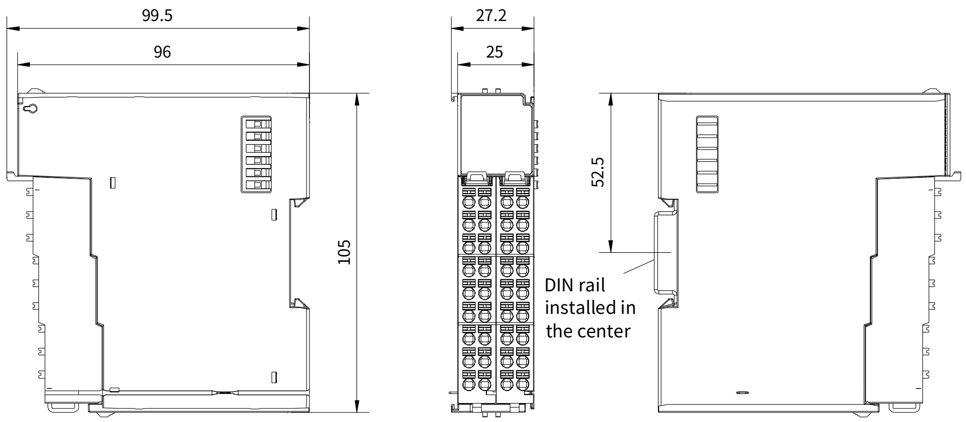
The dimensions are applicable to FL1001, FL2002, FL2102, FL3003, FL3103, FL3203, and FL4003.

Figure 4-5Module installation dimensions set 1 (unit: mm)



The dimensions are applicable to FL1002, FL2003, FL2103, FL2201, FL5005, and FL5105.

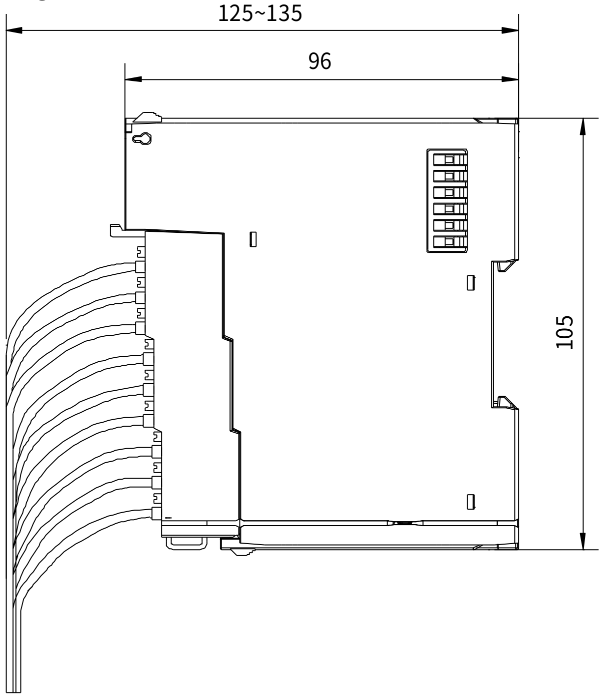
Figure 4-6 Module installation dimensions set 2 (unit: mm)



4.2.2.2 Connection cable dimensions

The dimensions are applicable to all I/O module models.

Figure 4-7Connection cable dimensions (unit: mm)

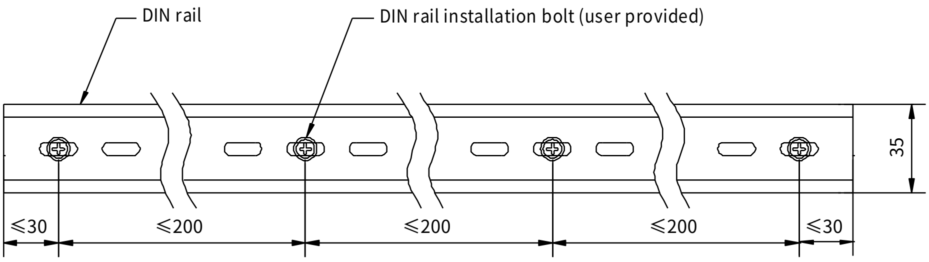


4.3 DIN rail model selection

You can refer to the following table to select the applicable DIN rail model.

Model	Length x Depth (unit: mm)	Fixing screw
TH35-7.5Fe	35×7.5	M4
TH35-7.5A1	35×7.5	M4
TH35-15Fe	35×15	M4

Figure 4-8 DIN rail installation dimensions (unit: mm)

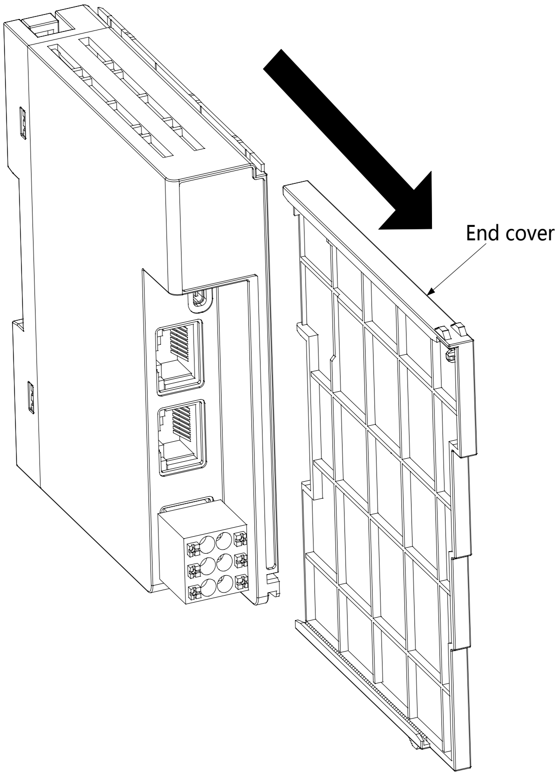


Note: To ensure the strength of the DIN rail, install the DIN rail installation bolts (provided by yourself) at the places within 30mm from both ends of the DIN rail, (for details, see Figure 4-8), and ensure that the interval between two adjacent bolts must be within 200mm.

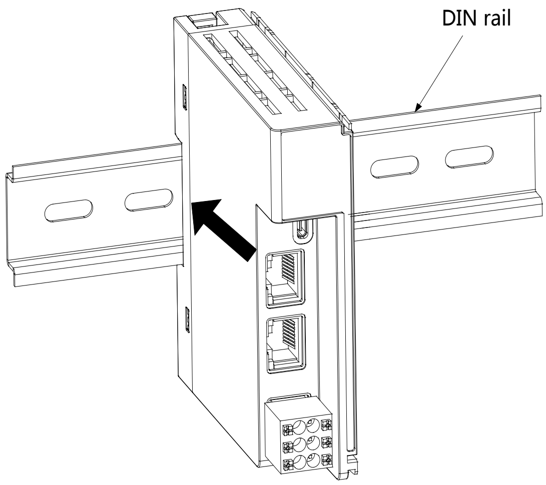
4.4 Installation

The installation procedure is as follows:

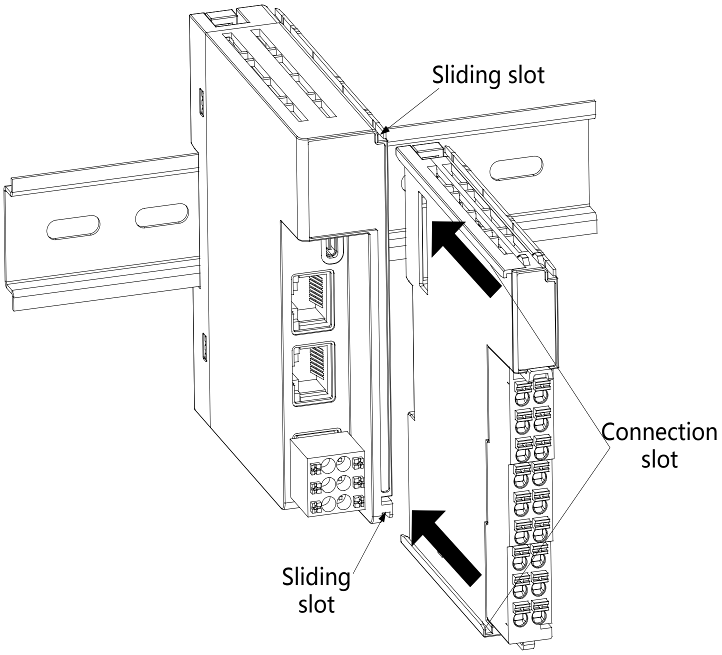
Step 1 Slide the right end cover of the communication coupler forward and remove it.



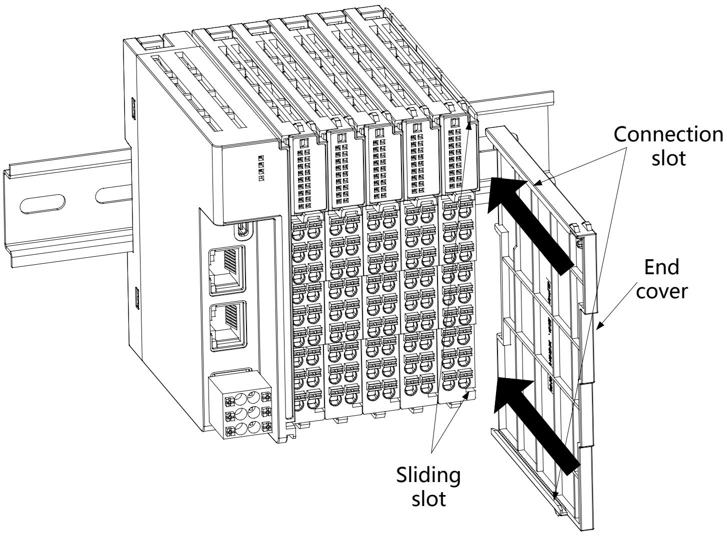
Step 2 Align the communication coupler module with the DIN rail and press inward until the module engages with the DIN rail (there is a noticeable sound of engagement when installed in place).



Step 3 Align the module with the connection rail with the sliding rail of the module fixed on the DIN rail, and push it inward until the module with the connection rail engages with the DIN rail (there is a noticeable sound of engagement when installed in place).

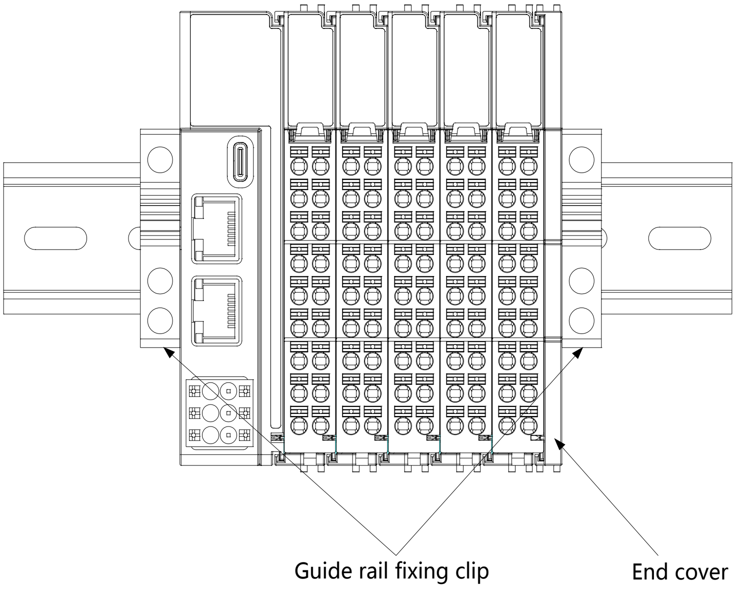


Step 4 Slide the end cover with the connection rail onto the last I/O module.



Note: The metal pins on the last I/O module must not be exposed outside.

Step 5 Install a guide rail fixing clip at the head and tail of the module assembly to prevent it from sliding leftward or rightward.



Note:

- Before installing the module, remove the end cover before proceeding with the next step. Install the end cover on the rightmost module.
- After the module installation is completed, the rail latch will automatically lock. If the rail latch is not locked with the DIN rail, press the top of the latch towards the rail to ensure proper installation.
- The rail fixing clip is user purchased.

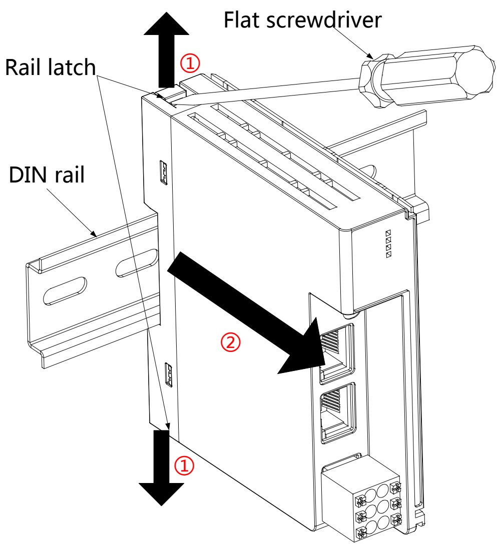
4.5 Disassembly

The disassembly procedure is as follows:

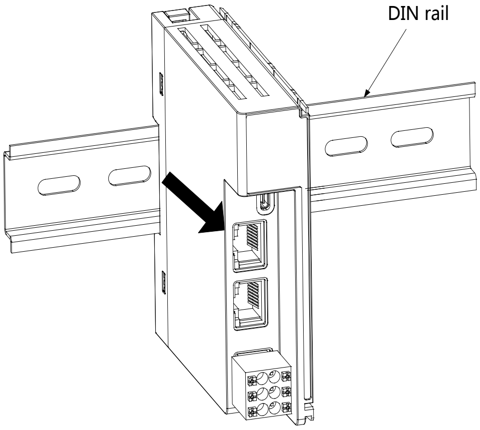
Step 1 Loosen the rail fixing clip to ensure that there is sufficient clearance to pull away the module from the DIN rail.

Note: The rail fixing clip is user purchased.

Step 2 Use a flat screwdriver or other similar tool to pry up the upper and lower rail latches separately.



Step 3 Pull the module out in the direction perpendicular to the DIN rail.



Note: Refer to step 1 in section 4.4 Installation.

5 Wiring

5.1 Wiring requirements

- Before wiring, ensure that all external power supplies have been cut off.
- After completing the wiring, ensure the module top end cover has been installed properly before powering on or operating the module. Otherwise, electric shock or maloperation can result.
- Before wiring, check the rated voltage and terminal configuration according to product specifications to ensure safe wiring. The connection to a power supply that does not match the ratings or incorrect product wiring may cause serious accidents such as fire and product damage.
- Tighten up screws according to specified torque. If screws are loose, short circuit, fire, or maloperation may result.

Note: If terminal screws are too tightened, screw or module damage, falling, short circuit, or faults may result.

- Ensure that there are no metal chips or leftover wires or other foreign objects in each module. The foreign objects may cause short circuit, fire, or maloperation.

5.2 Grounding requirements

- **Power cable grounding**
  - ✧ Use correct, independent wiring methods.
  - ✧ Connect a cable with the cross-sectional area ≥2mm^2 and length ≤30cm for grounding, and ground the power supply module terminal ⏚.
  - ✧ If the grounding point is close to the product, ensure that the grounding cable is secure.
- **Shielded cable grounding**
  - ✧ Use shielded cables for analog I/O, RS485, and EtherCAT cables and other cables that transmit sensitive signals.
  - ✧ The grounding point should be as close as possible to the module.
  - ✧ For the shield part exposed after some of the shield cable is stripped, ground the part and the conductive backplane with an area as large as possible to ensure good contact.

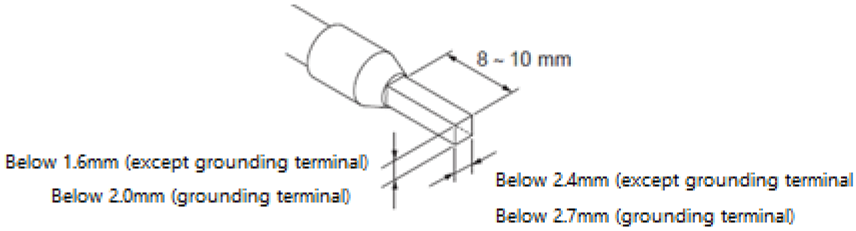
5.3 Cable specifications

Cable material	Cable diameter		Crimping tool
	mm^2	AWG	
Tubular cable lug	0.3	22	Use a proper crimping plier.
	0.5	20	
	0.75	18	
	1.0	18	
	1.5	16	

Note:

- The cable diameters of the tubular cable lugs in the preceding table is only for reference, which can be adjusted based on actual situations.

- When using other tubular cable lugs, crimp multiple strands of cable, and the processing size requirements are as follows:



5.3.1 Digital output module (Source type)

5.3.2 Digital output module (Sink type)

5.3.3 Digital output module (Relay)

5.3.4 Analog input module

5.3.5 Analog output module

5.3.6 Temperature detection module (Thermal resistor)

5.3.7 Temperature detection module (Thermocouple)

5.3.8 Hybrid module

6 Communication coupler configuration

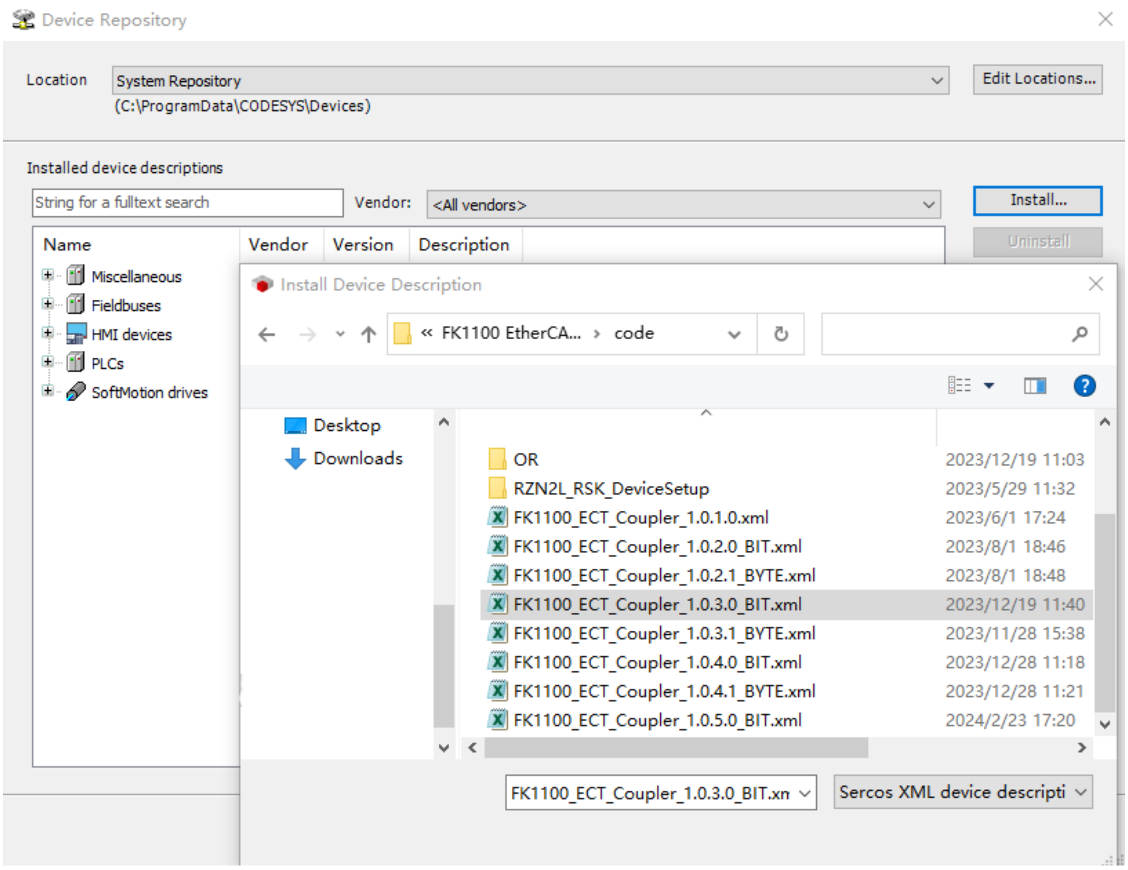
6.1 EtherCAT configuration

6.1.1 CODESYS configuration

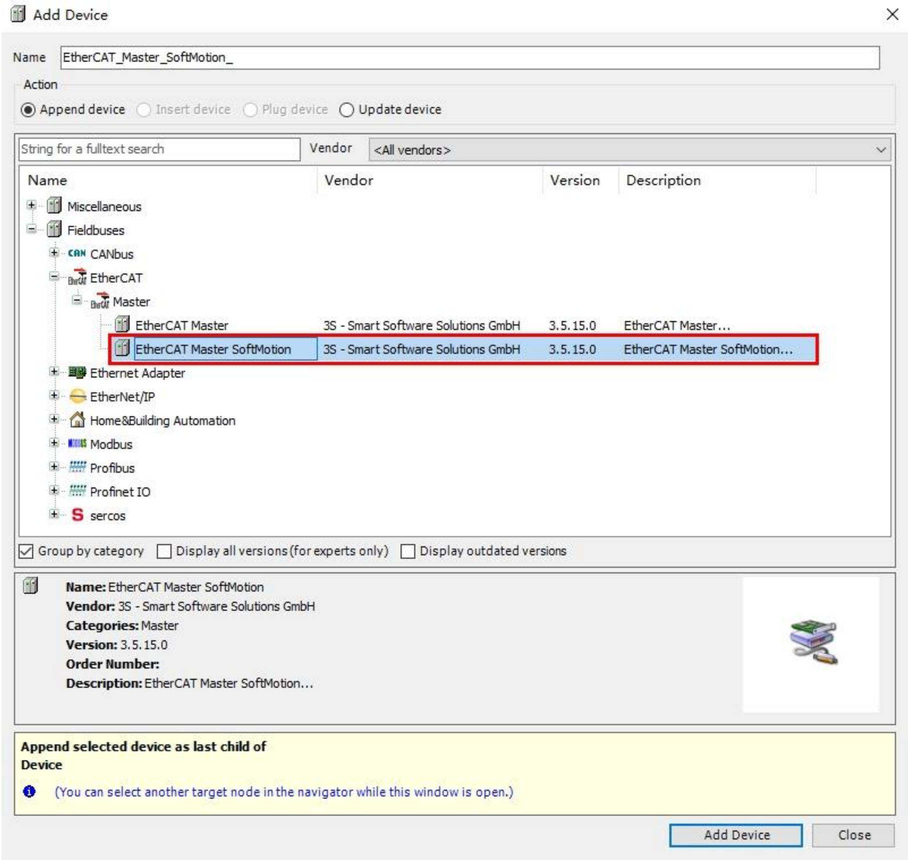
6.1.1.1 EtherCAT communication coupler

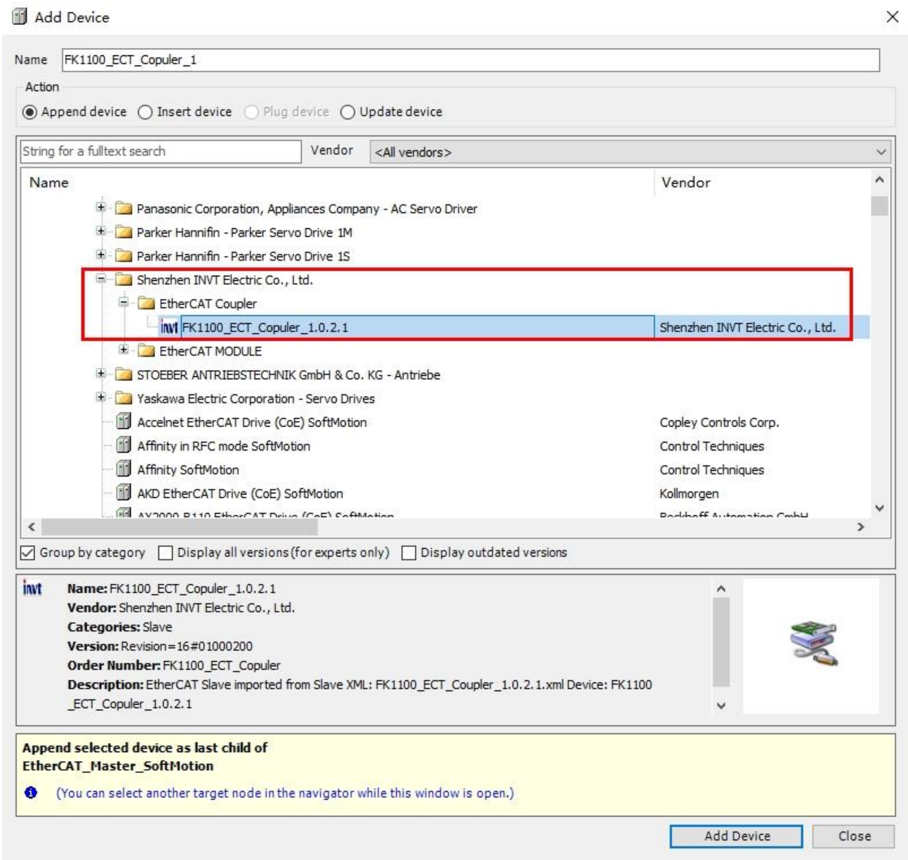
1. Device import

Step 1 Install the device description file named in the format of "FK1100_ECT_Coupler_x.x.x.x.xml".

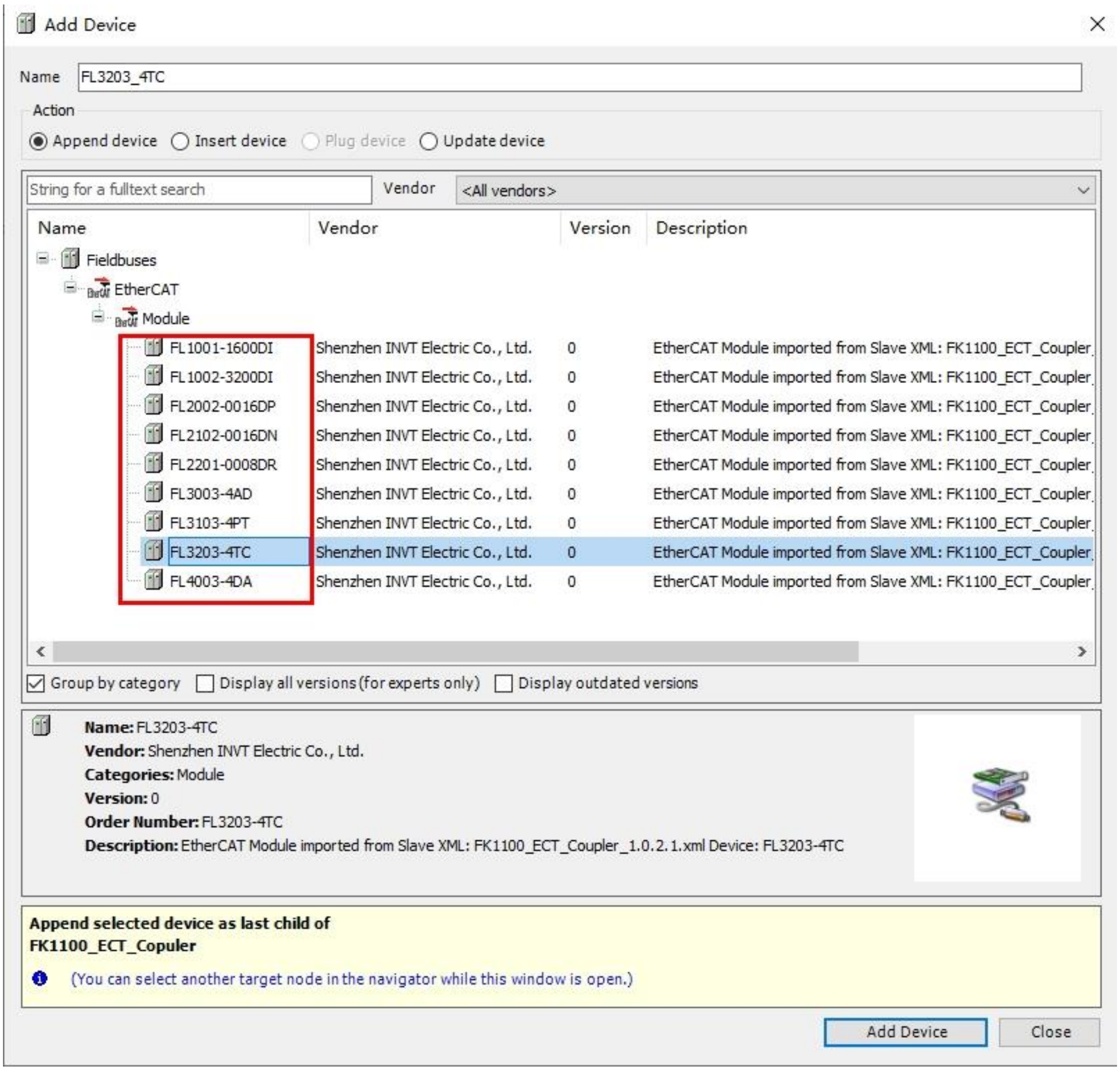


Step 2 Create a project, add the master and slave devices.





Step 3 Add module network configuration based on actual physical configuration (module connection).



Step 4 After completing the module network configuration, set all configuration module parameters. Once compiled, the program can be downloaded and run.

Step 5 (Optional) Enable or disable the module based on actual needs.

2. Parameter description

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>Module Enable</td><td>UDINT</td><td>Control bit of expansion module enabling/disabling.
Bit that controlling the enabling/disabling of the expansion module behind the coupler. Each bit controls the enabling/disabling of a module.<table><tr><th>Bit31</th><th>…</th><th>Bit0</th></tr><tr><td>Controls module 32.</td><td>…</td><td>Controls module 1.</td></tr></table>TRUE: Enable. FALSE: Disable.</td></tr>
<tr><td>Coupler Info.ActNum</td><td>UINT</td><td>Number of connected expansion modules.</td></tr>
<tr><td>Coupler Info.HW Version</td><td>UINT</td><td>Coupler hardware version number.</td></tr>
<tr><td>Coupler Info.SW Version</td><td>USINT</td><td>Coupler software version number.</td></tr>
<tr><td>Coupler Info.FPGA Version</td><td>USINT</td><td>Coupler FPGA software version number.</td></tr>
</table>

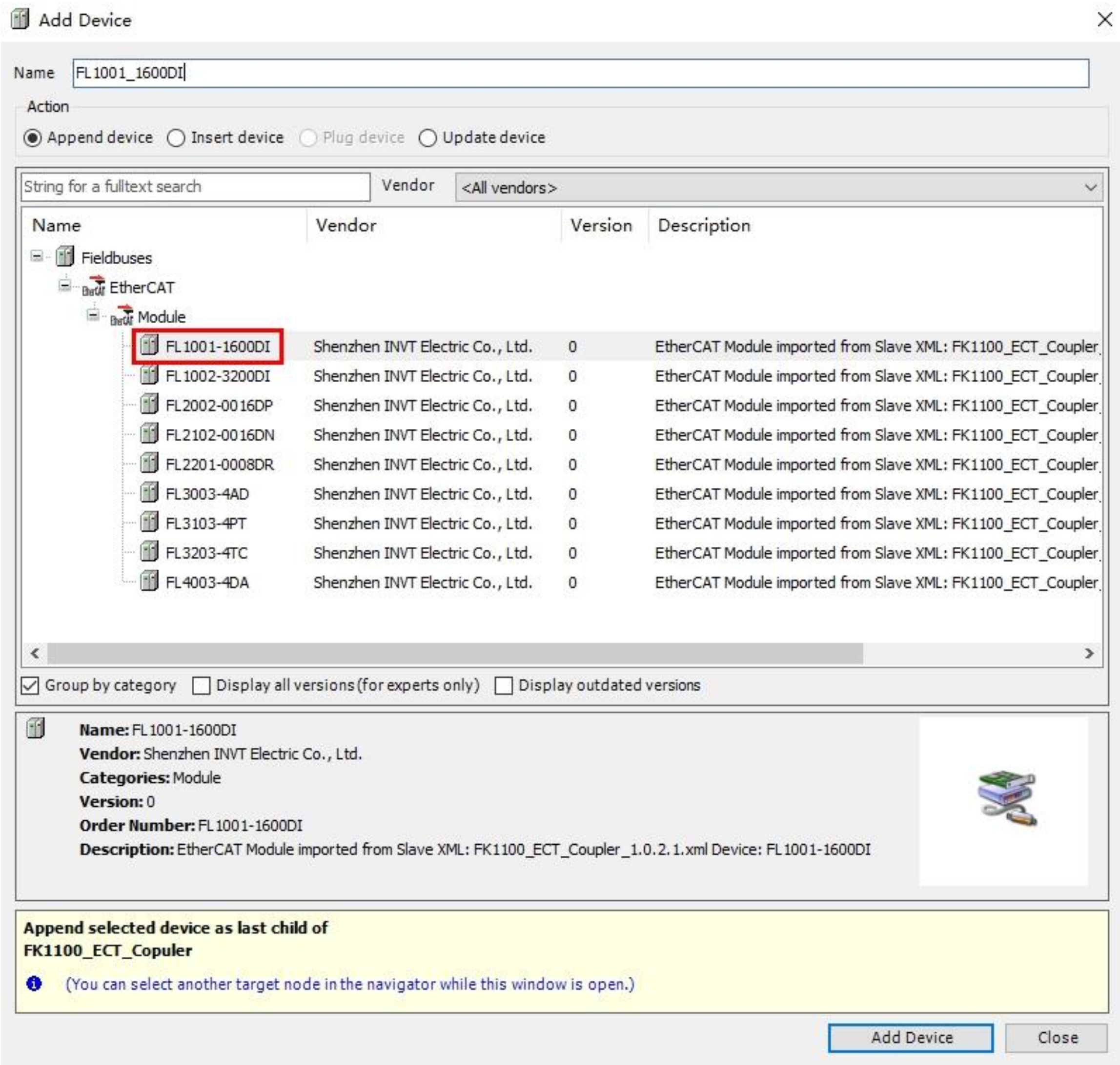
Parameter	Type	Description
Detected Module Ident List	-	Detection module ID list.
Detected Module Ident List .SubIndex 001	UDINT	ID of 1st module detected
Detected Module Ident List .SubIndex 002	UDINT	ID of 2nd module detected
…	…	…
Detected Module Ident List .SubIndex 032	UDINT	ID of 32nd module detected

6.1.1.2 Digital input module

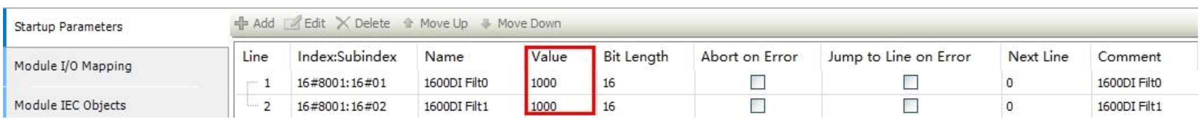
The following takes FL1001 as an example, while FL1002 is set up in a similar way and will not be described in detail here.

1. Device import

Step 1 Add the FL1001-1600DI device.



Step 2 Set the filtering parameters. The digital input module divides every 8 points into a group, and different filtering parameters can be set for each group. Adjust the port filtering mode in the startup parameters according to actual needs, with a unit of 10μs and a default value of 10ms.

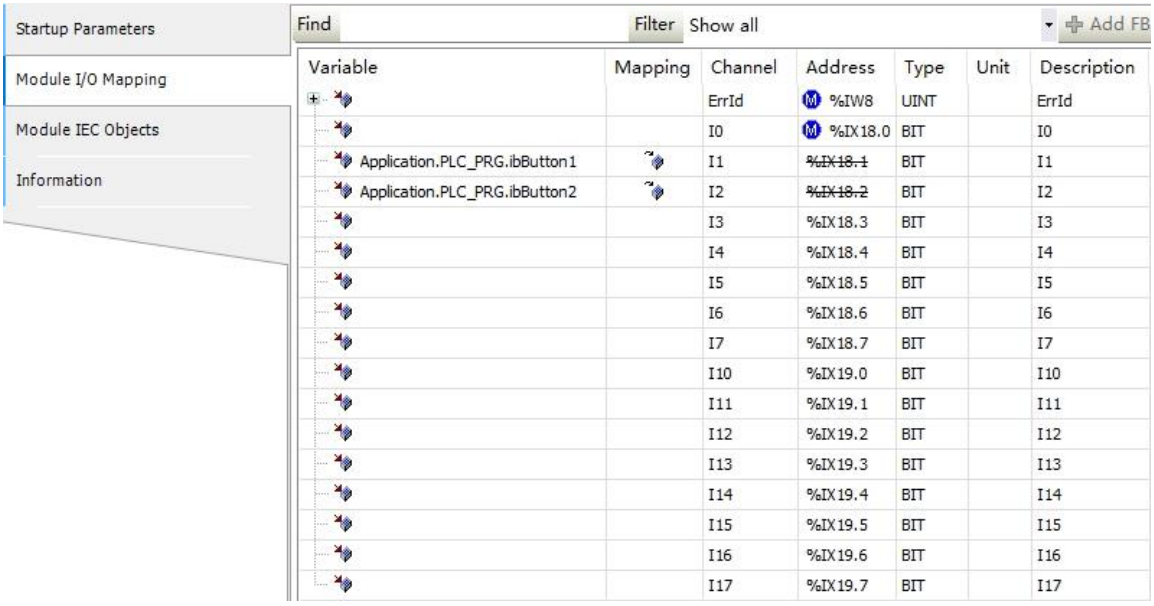


Step 3 Define *ibButton1* and *ibButton2* of the BOOL type in the program.

```
VAR
ibButton1      : BOOL;
ibButton2      : BOOL;

END_VAR
```

Step 4 Choose **Module I/O Mapping**, map *ibButton1* and *ibButton2* to the corresponding input points. You just need to use mapped variables in the program.



Variable	Mapping	Channel	Address	Type	Unit	Description
		ErrId	%IW8	UINT		ErrId
		I0	%IX18.0	BIT		I0
Application.PLC_PRG.ibButton1		I1	~~%IX18.1~~	BIT		I1
Application.PLC_PRG.ibButton2		I2	~~%IX18.2~~	BIT		I2
		I3	%IX18.3	BIT		I3
		I4	%IX18.4	BIT		I4
		I5	%IX18.5	BIT		I5
		I6	%IX18.6	BIT		I6
		I7	%IX18.7	BIT		I7
		I10	%IX19.0	BIT		I10
		I11	%IX19.1	BIT		I11
		I12	%IX19.2	BIT		I12
		I13	%IX19.3	BIT		I13
		I14	%IX19.4	BIT		I14
		I15	%IX19.5	BIT		I15
		I16	%IX19.6	BIT		I16
		I17	%IX19.7	BIT		I17

2. Parameter description

- FL1001

Parameter	Type	Description
Filt0	UINT	Filter parameters I0–I7. Unit: 10μs
Filt1	UINT	Filter parameters I10–I17. Unit: 10μs
ErrId	UINT	Fault code
I0	BIT	I0 status feedback
I1	BIT	I1 status feedback
…	…	…
I17	BIT	I17 status feedback
Module Info. HW Version	UINT	Module hardware version number
Module Info. FPGA Version	UINT	Module FPGA software version number

- FL1002

Parameter	Type	Description
Filt0	UINT	Filter parameters I0–I7. Unit: 10μs
Filt1	UINT	Filter parameters I10–I17. Unit: 10μs
Filt2	UINT	Filter parameters I20–I27. Unit: 10μs
Filt3	UINT	Filter parameters I30–I37. Unit: 10μs
ErrId	UINT	Fault code
I0	BIT	I0 status feedback
I1	BIT	I1 status feedback
…	…	…

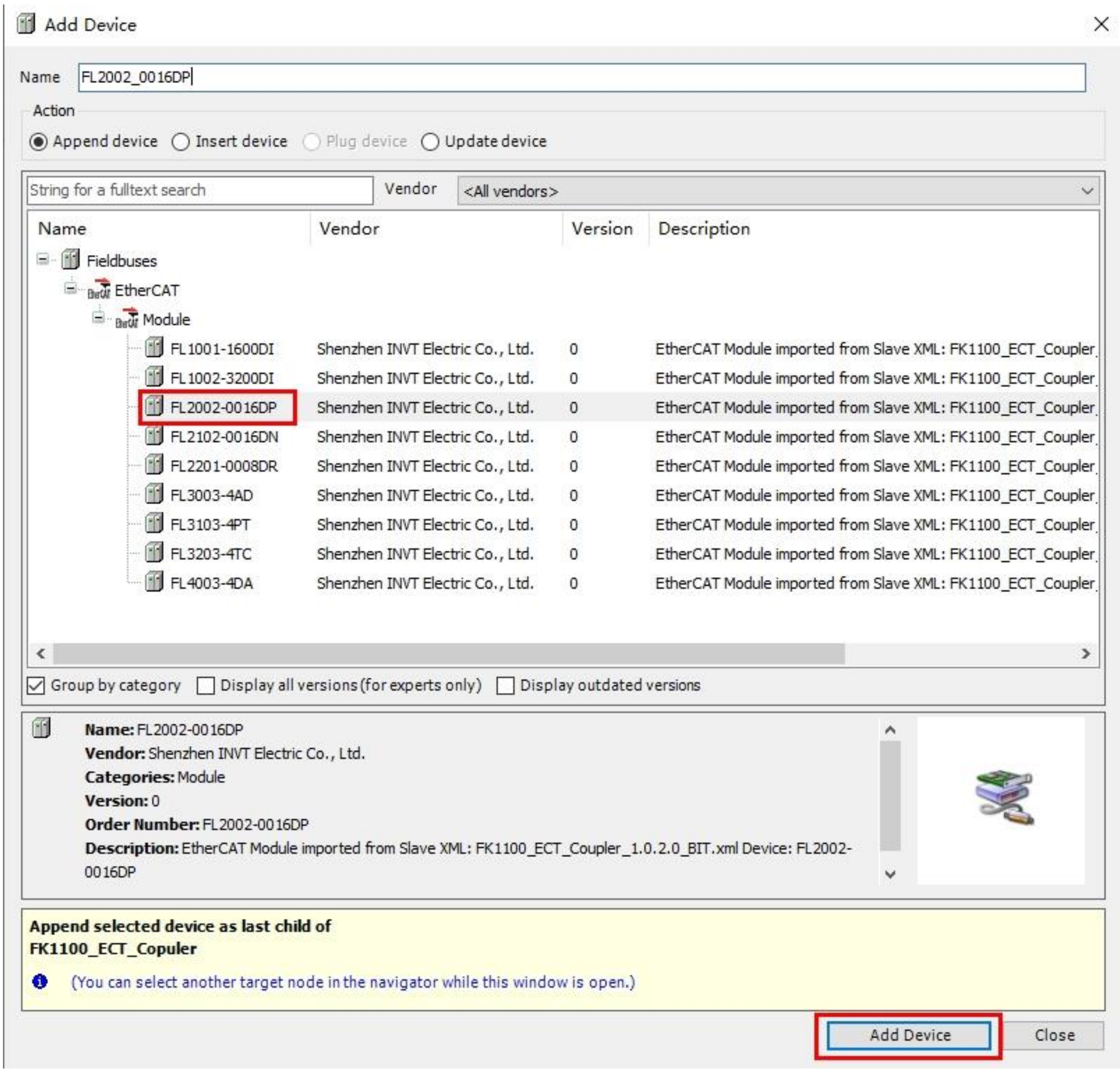
Parameter	Type	Description
I37	BIT	I37 status feedback
Module Info. HW Version	UINT	Module hardware version number
Module Info. FPGA Version	UINT	Module FPGA software version number

6.1.1.3 Digital output module

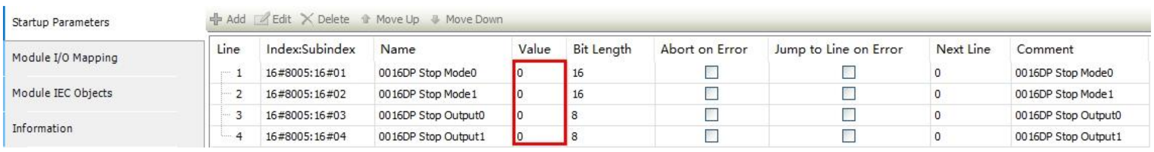
The following takes FL2002 as an example, while the setting of the rest of the digital output modules is similar and will not be described.

1. Device import

Step 1 Add the FL2002-0016DP device.



Step 2 Set the stop/offline output mode and preset value based on actual needs in the startup parameters.



The digital output module divides every eight channels into a group. The following takes Stop Mode0 configuration as an example. The corresponding output channels are Q0–Q7. The data type of Stop Mode0 is UINT, with every two bits defining an output stop mode. Please refer to the following table for detailed data description.

Q7		Q6		Q5		Q4		Q3		Q2		Q1		Q0	
bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0

The two-digit value of the corresponding output channel represents the output mode as follows:

Value	Mode
0b00	Stop/offline output retained
0b01	Stop/offline output cleared
0b10	Stop/offline output preset

For example: Q0 is set to stop/offline output retention; Q1 is set to stop/offline output clearing; Q2–Q7 are all set to stop/offline output preset, then the value of Stop Mode0 is 43684, that is, 2#1010101010100100.

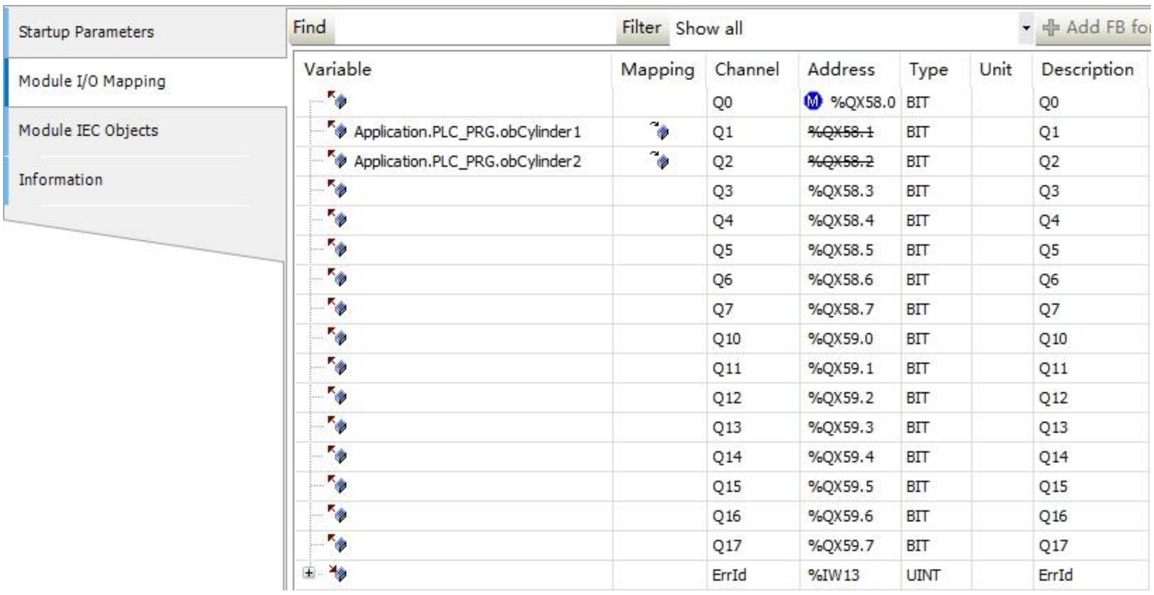
Q7		Q6		Q5		Q4		Q3		Q2		Q1		Q0	
1	0	1	0	1	0	1	0	1	0	1	0	0	1	0	0

Step 3 Define BOOL type variables obCylinder1 and obCylinder2 in the program.

```
VAR
obCylinder1    : BOOL;
obCylinder2    : BOOL;

END_VAR
```

Step 4 Choose **Module I/O Mapping**, map *obCylinder1* and *obCylinder2* to the corresponding output points. You just need to use mapped variables in the program.



2. Parameter description

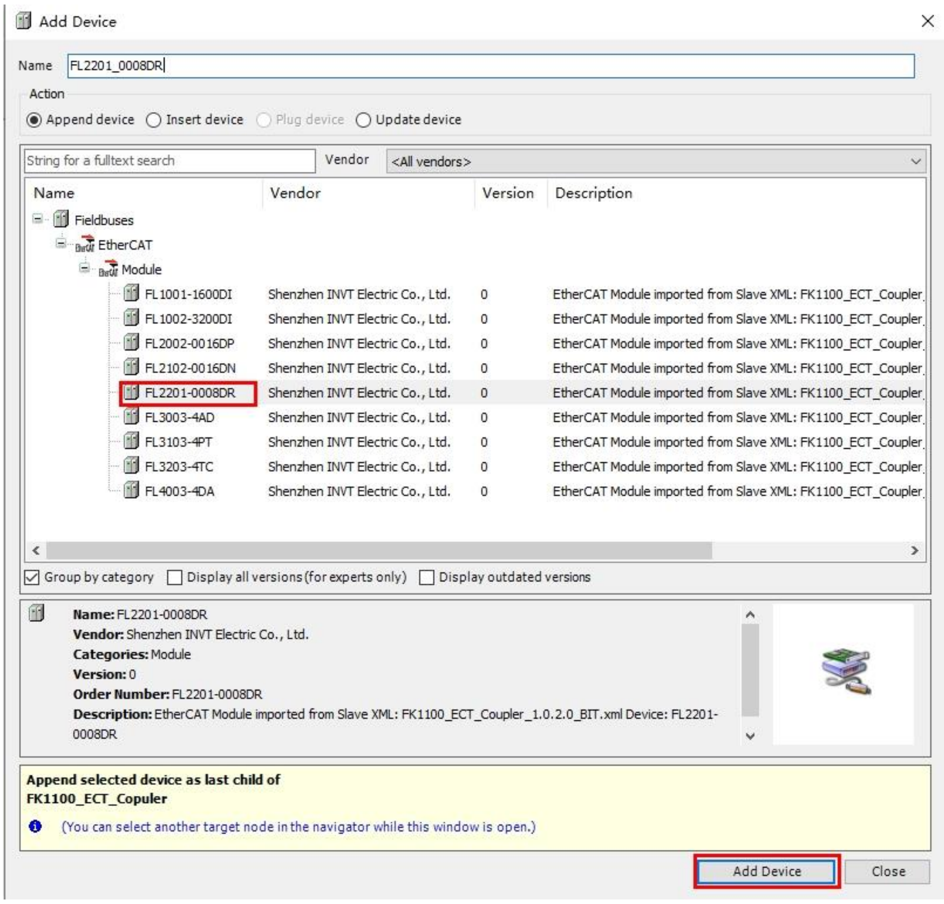
<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>Stop Mode0</td><td>UINT</td><td>Stop/offline output mode:
<table>
<tr><th colspan="2">Q7</th><th colspan="2">…</th><th colspan="2">Q1</th><th colspan="2">Q0</th></tr>
<tr><td>Bit15</td><td>Bit14</td><td>…</td><td>…</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr>
</table>
0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output according to the preset</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>Stop Mode1</td><td>UINT</td><td>Stop/offline output mode
<table>
<tr><th colspan="2">Q17</th><th colspan="2">…</th><th colspan="2">Q11</th><th colspan="2">Q10</th></tr>
<tr><td>Bit15</td><td>Bit14</td><td>…</td><td>…</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr>
</table>
0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output according to the preset</td></tr>
<tr><td>Stop Output0</td><td>USINT</td><td>Preset value of stop/offline output:
<table>
<tr><th>Q7</th><th>…</th><th>Q1</th><th>Q0</th></tr>
<tr><td>Bit7</td><td>…</td><td>Bit1</td><td>Bit0</td></tr>
</table></td></tr>
<tr><td>Stop Output1</td><td>USINT</td><td>Preset value of stop/offline output:
<table>
<tr><th>Q17</th><th>…</th><th>Q11</th><th>Q10</th></tr>
<tr><td>Bit7</td><td>…</td><td>Bit1</td><td>Bit0</td></tr>
</table></td></tr>
<tr><td>Q0</td><td>BIT</td><td>Q0 output control</td></tr>
<tr><td>Q1</td><td>BIT</td><td>Q1 output control</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>Q17</td><td>BIT</td><td>Q17 Output control</td></tr>
<tr><td>ErrId</td><td>UINT</td><td>Fault ID</td></tr>
<tr><td>Module Info. HW Version</td><td>UINT</td><td>Module hardware version number</td></tr>
<tr><td>Module Info. FPGA Version</td><td>UINT</td><td>Module FPGA software version number</td></tr>
</table>

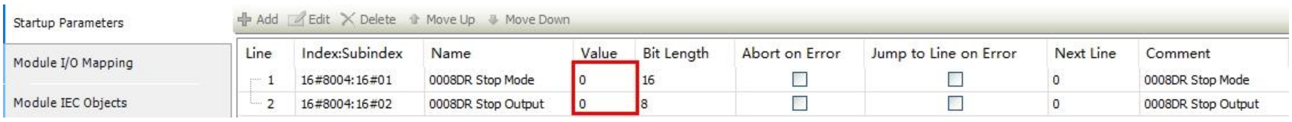
6.1.1.4 Digital output module (Relay)

1. Device import

Step 1 Add the FL2201-0008DR device.



Step 2 Set the stop/offline output mode and preset value based on actual needs in the startup parameters.



Startup Parameters | Module I/O Mapping | Module IEC Objects

Add | Edit | Delete | Move Up | Move Down

Line	Index:Subindex	Name	Value	Bit Length	Abort on Error	Jump to Line on Error	Next Line	Comment
1	16#8004:16#01	0008DR Stop Mode	0	16	☐	☐	0	0008DR Stop Mode
2	16#8004:16#02	0008DR Stop Output	0	8	☐	☐	0	0008DR Stop Output

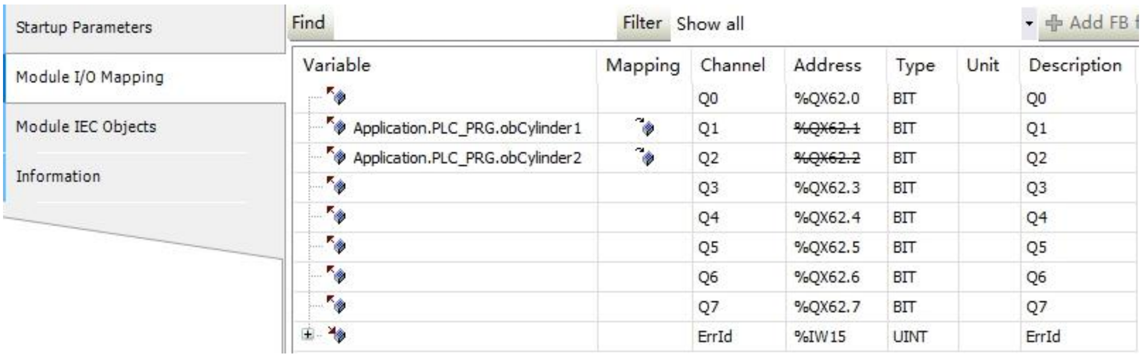
Note: The setting method in this part is similar to the setting in step 2 in 6.1.1.3 Digital output module, and will not be described.

Step 3 Define BOOL type variables obCylinder1 and obCylinder2 in the program.

```
VAR
obCylinder1   : BOOL;
obCylinder2   : BOOL;

END_VAR
```

Step 4 Choose **Module I/O Mapping**, map *obCylinder1* and *obCylinder2* to the corresponding output points. You just need to use mapped variables in the program.



Startup Parameters | Module I/O Mapping | Module IEC Objects | Information

Find | Filter Show all | Add FB

Variable	Mapping	Channel	Address	Type	Unit	Description
		Q0	%QX62.0	BIT		Q0
Application.PLC_PRG.obCylinder1		Q1	~~%QX62.1~~	BIT		Q1
Application.PLC_PRG.obCylinder2		Q2	~~%QX62.2~~	BIT		Q2
		Q3	%QX62.3	BIT		Q3
		Q4	%QX62.4	BIT		Q4
		Q5	%QX62.5	BIT		Q5
		Q6	%QX62.6	BIT		Q6
		Q7	%QX62.7	BIT		Q7
		ErrId	%IW15	UINT		ErrId

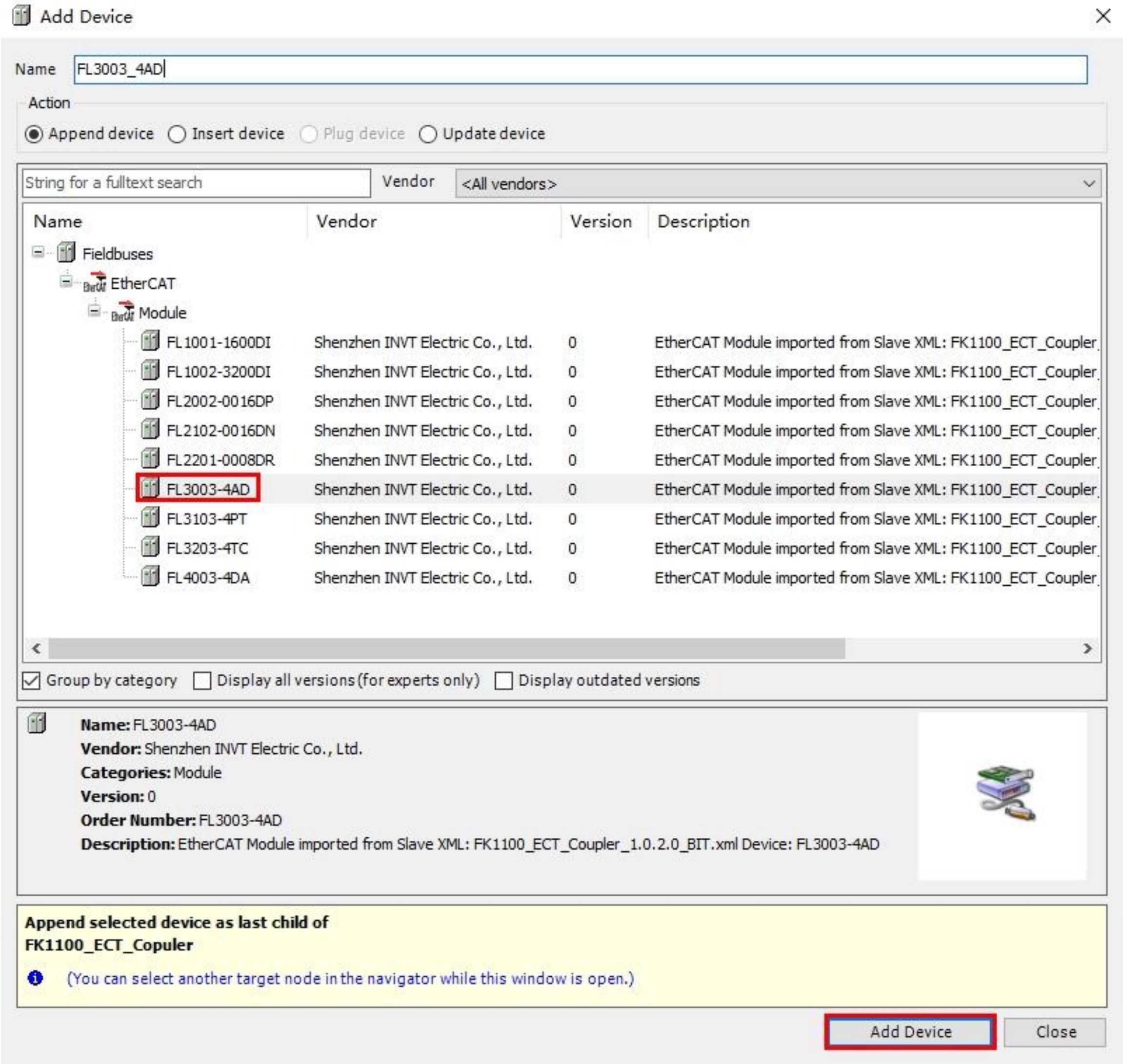
2. Parameter description

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>Stop Mode</td><td>UINT</td><td>Stop/offline output mode:
<table>
<tr><th colspan="2">Q7</th><th colspan="2">…</th><th colspan="2">Q1</th><th colspan="2">Q0</th></tr>
<tr><td>Bit15</td><td>Bit14</td><td>…</td><td>…</td><td>Bit3</td><td>Bit2</td><td>Bit1</td><td>Bit0</td></tr>
</table>
0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b01: Stop/offline output according to the preset</td></tr>
<tr><td>Stop Output</td><td>USINT</td><td>Preset value of stop/offline output:
<table>
<tr><th>Q7</th><th>…</th><th>Q1</th><th>Q0</th></tr>
<tr><td>Bit7</td><td>…</td><td>Bit1</td><td>Bit0</td></tr>
</table></td></tr>
<tr><td>Q0</td><td>BIT</td><td>Q0 output control</td></tr>
<tr><td>Q1–</td><td>BIT</td><td>Q1 output control</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>Q7</td><td>BIT</td><td>Q7 output control</td></tr>
<tr><td>ErrId</td><td>UINT</td><td>Fault code</td></tr>
<tr><td>HW Version</td><td>UINT</td><td>Module hardware version number</td></tr>
<tr><td>FPGA Version</td><td>UINT</td><td>Module FPGA software version number</td></tr>
</table>

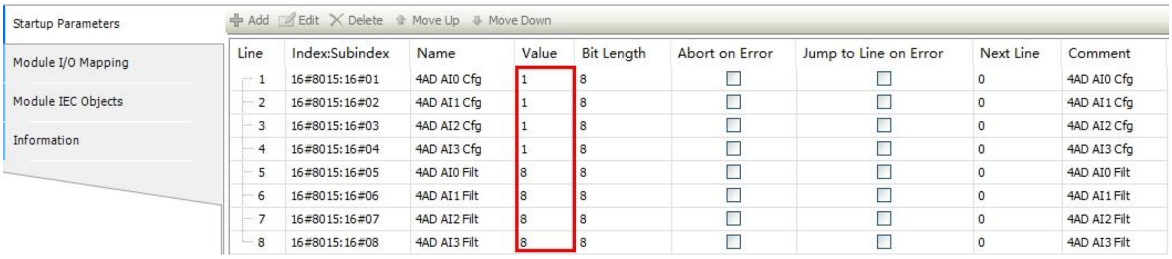
6.1.1.5 Analog input module

1. Device import

Step 1 Add the FL3003-4AD device.



Step 2 Set the channel configuration and channel filter parameters based on actual needs in the startup parameters.



- AIx Cfg(x=0,1,2,3) is a channel configuration parameter of type USINT. Taking the configuration of channel 0 as an example, the data definitions are detailed in the following table of parameters.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Channel conversion mode (range configuration)			Enhanced filter enabling control	Over-range enabling control	Over-range detection enabling control	Open-loop detection enabling control	Channel enabling control
0b000: 0–5V 0b001: 0–10V 0b010: -5V–5V 0b011: -10V–+10V	0b100: 4–20mA 0b101: 0–20mA 0b110: Reserved 0b111: -20–+20mA		0: Disable 1: Enable	0: Disable 1: Enable	0: Disable 1: Enable	0: Disable 1: Enable	0: Disable 1: Enable

For example: Channel 0 is set to channel enabled, open-circuit detection disabled, over-range detection enabled, over-range enabled, enhanced filtering disabled, and the range is set to 4-20mA. The value should be 141, that is, 2#10001101. Details are as follows:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0b100			0	1	1	0	1
0b100:4–20mA			0: Disable	1: Enable	1: Enable	0: Disable	1: Enable

Range conversion:

Measurement range	Current (I)/ Voltage (U)	Decimal (D)	Hexadecimal	Range	Conversion formula
0–5V	8.19175V	32767	0x7FFF	Beyond upper limit	D = 20000×U/5 U = D×5/20000
	5V	20000	0x4E20	Rated range	
	2.5V	10000	0x2710		
	0V	0	0x0000		
	-2.5V	-10000	0xD8F0	Beyond lower limit	
	-5V	-20000	0xB1E0		
	-8.19175V	-32768	0x8000		
0–10V	16.3835V	32767	0x7FFF	Beyond upper limit	D = 20000×U/10 U = D×10/20000
	10V	20000	0x4E20	Rated range	
	5V	10000	0x2710		
	0V	0	0x0000		
	-5V	-10000	0xD8F0	Beyond lower limit	
	-10V	-20000	0xB1E0		
	-16.3835V	-32768	0x8000		
±5V	8.19175V	32767	0x7FFF	Beyond upper limit	D = 20000×U/5 U = D×5/20000
	5V	20000	0x4E20	Rated range	
	2.5V	10000	0x2710		
	0V	0	0x0000		
	-2.5V	-10000	0xD8F0		
	-5V	-20000	0xB1E0		
	-8.19175V	-32768	0x8000	Beyond lower limit	
±10V	16.3835V	32767	0x7FFF	Beyond upper limit	D = 20000×U/10 U = D×10/20000
	10V	20000	0x4E20	Rated range	
	5V	10000	0x2710		

Measurement range	Current (I)/ Voltage (U)	Decimal (D)	Hexadecimal	Range	Conversion formula
	0V	0	0x0000		
	-5V	-10000	0xD8F0		
	-10V	-20000	0xB1E0		
	-16.3835V	-32768	0x8000	Beyond lower limit	
4–20mA	30.2136mA	32767	0x7FFF	Beyond upper limit	D = 20000×(I-4)/16 I = D×16/20000+4
	20mA	20000	0x4E20	Rated range	
	12mA	10000	0x2710		
	4mA	0	0x0000		
	0mA	-5000	0xEC78	Beyond lower limit	
	-22.2136mA	-32768	0x8000		
0–20mA	32.767mA	32767	0x7FFF	Beyond upper limit	D = 20000×I/20 I = D×20/20000
	20mA	20000	0x4E20	Rated range	
	10mA	10000	0x2710		
	0mA	0	0x0000		
	-10mA	-10000	0xD8F0	Beyond lower limit	
	-20mA	-20000	0xB1E0		
	-32.767mA	-32768	0x8000		
±20mA	32.767mA	32767	0x7FFF	Beyond upper limit	D = 20000×I/20 I = D×20/20000
	20mA	20000	0x4E20	Rated range	
	10mA	10000	0x2710		
	0mA	0	0x0000		
	– 10mA	-10000	0xD8F0		
	– 20mA	-20000	0xB1E0		
	– 32.767mA	-32768	0x8000	Beyond lower limit	

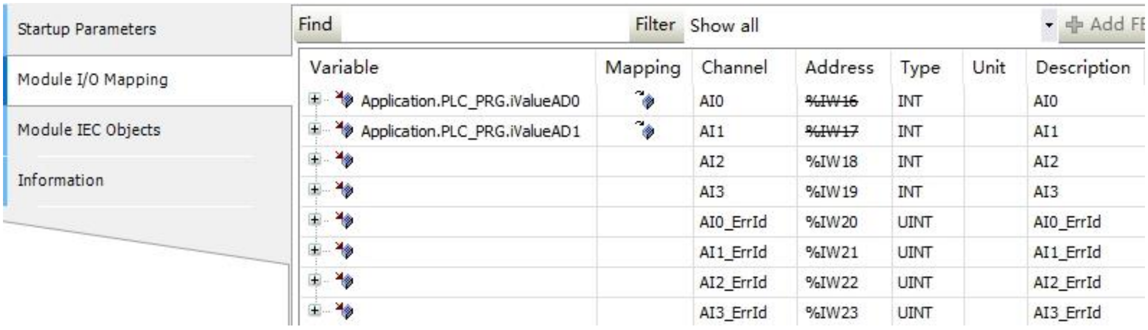
- AIx_Filt(x=0,1,2,3) is a channel filter parameter of type USINT. The parameter setting range is 1 to 255. Generally, a higher value indicates better suppression of high-frequency interference, but it also leads to greater delay. It should be adjusted according to the actual situation.

Step 3 Define INT type variables iValueAD0 and iValueAD1 in the program.

```
VAR
iValueAD0      : INT;
iValueAD1      : INT;

END_VAR
```

Step 4 Choose **Module I/O Mapping**, map *iValueAD0* and *iValueAD1* to the corresponding input channels. You just need to use mapped variables in the program.



2. Parameter description

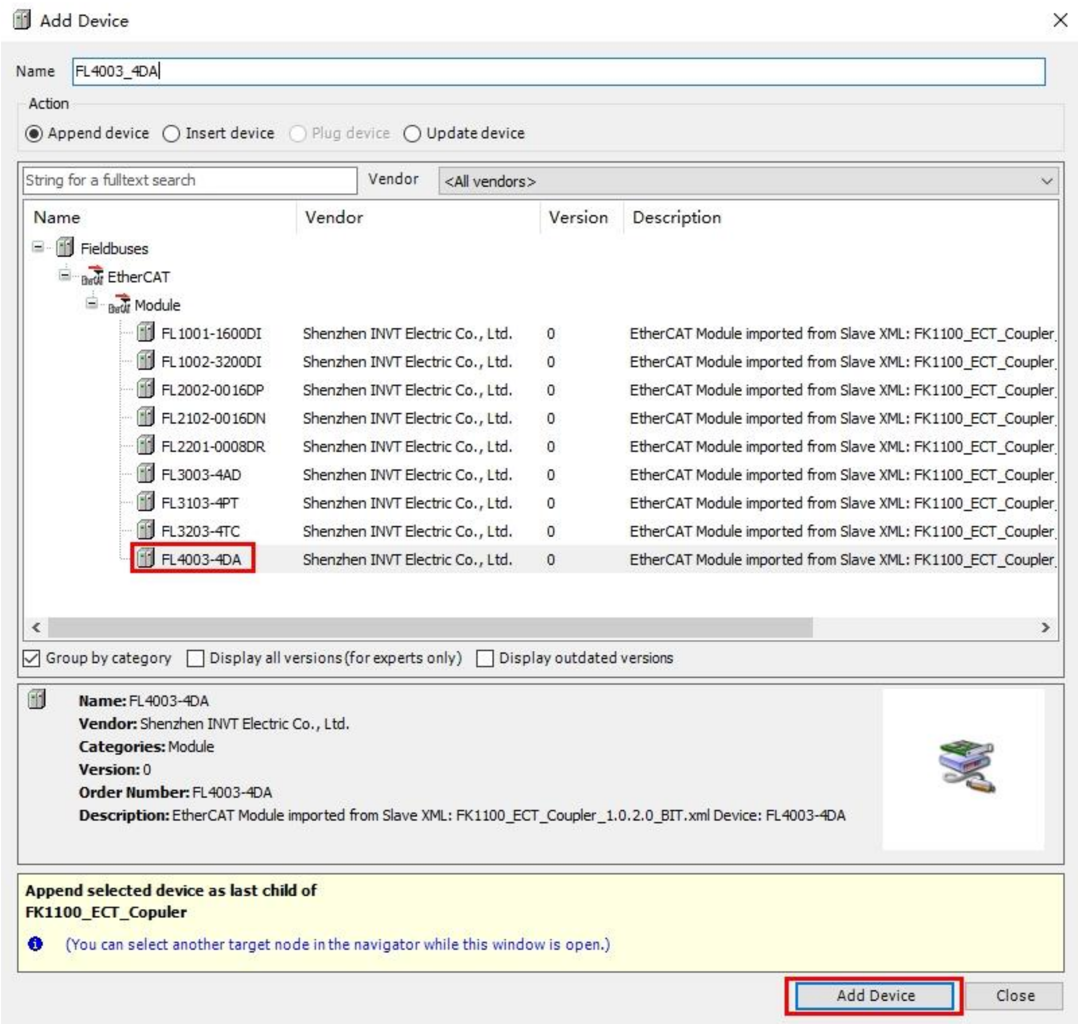
Parameter name	Type	Description
AI0 Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Open-loop detection enabling control. (0: Disable. 1: Enable.) Bit2: Over-range detection enabling control. (0: Disable. 1: Enable.) Bit3: Over-range enabling control. (0: Disable. 1: Enable.) Bit4: Enhanced filter enabling control. (0: Disable. 1: Enable.) Bit7–Bit5: Channel conversion mode. 0b000: Voltage range 0–5V, corresponding to detection value range 0–20000 0b001: Voltage range 0–10V, corresponding to detection value range 0–20000 0b010: Voltage range -5–5V, corresponding to detection value range -20000–20000 0b011: Voltage range -10–10V, corresponding to detection value range -20000–20000 0b100: Current range 4–20mA, corresponding to detection value range 0–20000 0b101: Current range 0–20mA, corresponding to detection value range 0–20000 0b110: Reserved 0b111: Current range -20–20mA, corresponding to detection value range -20000–20000
AI1 Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.
AI2 Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for channel 0.
AI3 Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.
AI0 Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.
AI1 Filt	USINT	Filter parameter for channel 1. The filter parameter setting is consistent with that for channel 0.

Parameter name	Type	Description
AI2 Filt	USINT	Filter parameter for channel 2. The filter parameter setting is consistent with that for channel 0.
AI3 Filt	USINT	Filter parameter for channel 3. The filter parameter setting is consistent with that for channel 0.
AI0	INT	Conversion value for channel 0.
AI1	INT	Conversion value for channel 1.
AI2	INT	Conversion value for channel 2.
AI3	INT	Conversion value for channel 3.
AI0_ErrId	UINT	Fault code for channel 0.
AI1_ErrId	UINT	Fault code for channel 1.
AI2_ErrId	UINT	Fault code for channel 2.
AI3_ErrId	UINT	Fault code for channel 3.
HW Version	UINT	Module hardware version number.
FPGA Version	UINT	Module FPGA software version number.

6.1.1.6 Analog output module

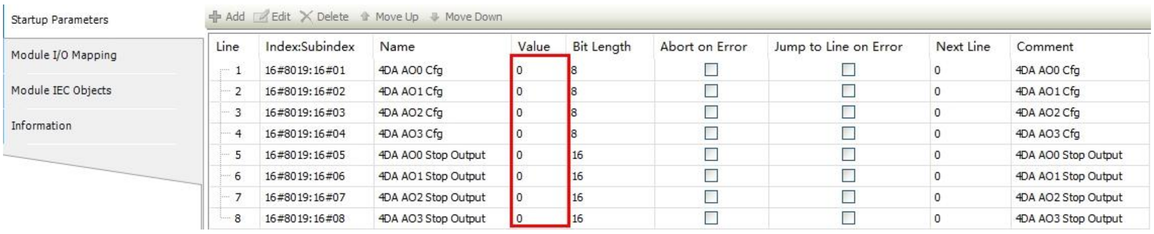
1. Device import

Step 1 Add the FL4003-4DA device.



Step 2 Set the channel configuration and stop/offline output mode preset value parameters based on

actual needs in the startup parameters.



Line	Index:Subindex	Name	Value	Bit Length	Abort on Error	Jump to Line on Error	Next Line	Comment
1	16#8019:16#01	4DA AO0 Cfg	0	8	☐	☐	0	4DA AO0 Cfg
2	16#8019:16#02	4DA AO1 Cfg	0	8	☐	☐	0	4DA AO1 Cfg
3	16#8019:16#03	4DA AO2 Cfg	0	8	☐	☐	0	4DA AO2 Cfg
4	16#8019:16#04	4DA AO3 Cfg	0	8	☐	☐	0	4DA AO3 Cfg
5	16#8019:16#05	4DA AO0 Stop Output	0	16	☐	☐	0	4DA AO0 Stop Output
6	16#8019:16#06	4DA AO1 Stop Output	0	16	☐	☐	0	4DA AO1 Stop Output
7	16#8019:16#07	4DA AO2 Stop Output	0	16	☐	☐	0	4DA AO2 Stop Output
8	16#8019:16#08	4DA AO3 Stop Output	0	16	☐	☐	0	4DA AO3 Stop Output

- AOx Cfg(x=0,1,2,3) is a channel configuration parameter of type USINT. Taking the configuration of channel 0 as an example, the data definitions are detailed in the following table of parameters.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Channel conversion mode			**Reserved**	**Output fault detection enabling control**		**Output fault detection enabling control**	**Channel enabling control**
0b000: 0–5V 0b001: 0–10V 0b010: -5–5V 0b011: -10–+10V		0b100: 4–20mA 0b101: 0–20mA 0b110: Reserved 0b111: Reserved	-	0b00: Offline output retained 0b01: Offline output cleared 0b10: Offline output preset		0: Disable 1: Enable	0: Disable 1: Enable

For example: Channel 0 is configured as channel enabled, output fault detection enabled, offline output cleared, and channel conversion mode is set to 4–20mA. The value should be 135, that is, 2#10000111. Details are as follows:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0b100			0	0b01		1	1
0b100:4–20mA			-	0b01: Offline output cleared		1: Enable	1: Enable

Range conversion:

Output range	Current (I)/ Voltage (U)	Decimal (D)	Hexadecimal	Range	Conversion formula
0-5V	5V	20000	0x4E20	Rated range	D = 20000×U/5 U = D×5/20000
	2.5V	10000	0x2710		
	0V	0	0x0000		
0-10V	10V	20000	0x4E20	Rated range	D = 20000×U/10 U = D×10/20000
	5V	10000	0x2710		
	0V	0	0x0000		
±5V	5V	20000	0x4E20	Rated range	D = 20000×U/5 U = D×5/20000
	2.5V	10000	0x2710		
	0V	0	0x0000		
	– 2.5V	-10000	0xD8F0		
	– 5V	-20000	0xB1E0		
±10V	10V	20000	0x4E20	Rated range	D = 20000×U/10 U = D×10/20000
	5V	10000	0x2710		
	0V	0	0x0000		
	– 5V	-10000	0xD8F0		
	– 10V	-20000	0xB1E0		
4-20mA	20mA	20000	0x4E20	Rated range	D = 20000×(I-4)/16

Output range	Current (I)/ Voltage (U)	Decimal (D)	Hexadecimal	Range	Conversion formula
	12mA	10000	0x2710		I = D×16/20000+4
	4mA	0	0x0000		
0-20mA	20mA	20000	0x4E20	Rated range	D = 20000×I/20 I = D×20/20000
	10mA	10000	0x2710		
	0mA	0	0x0000		

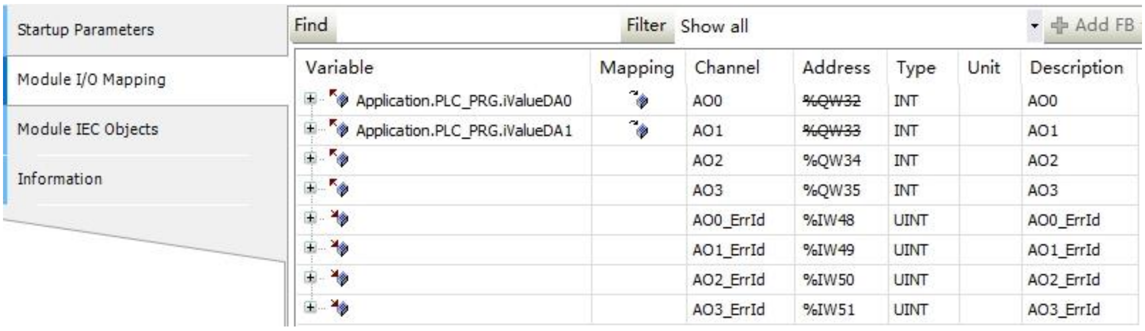
- AIx_Stop Output (x=0,1,2,3) is used for stop/offline output mode control, which can be set as described in 6.1.1.3 Digital output module.

Step 3 Define INT type variables iValueDA0 and iValueDA1 in the program.

```
VAR
iValueDA0    : INT;
iValueDA1    : INT;

END_VAR
```

Step 4 Choose **Module I/O Mapping**, map *iValueDA0* and *iValueDA1* to the corresponding output channels. You just need to use mapped variables in the program.



2. Parameter description

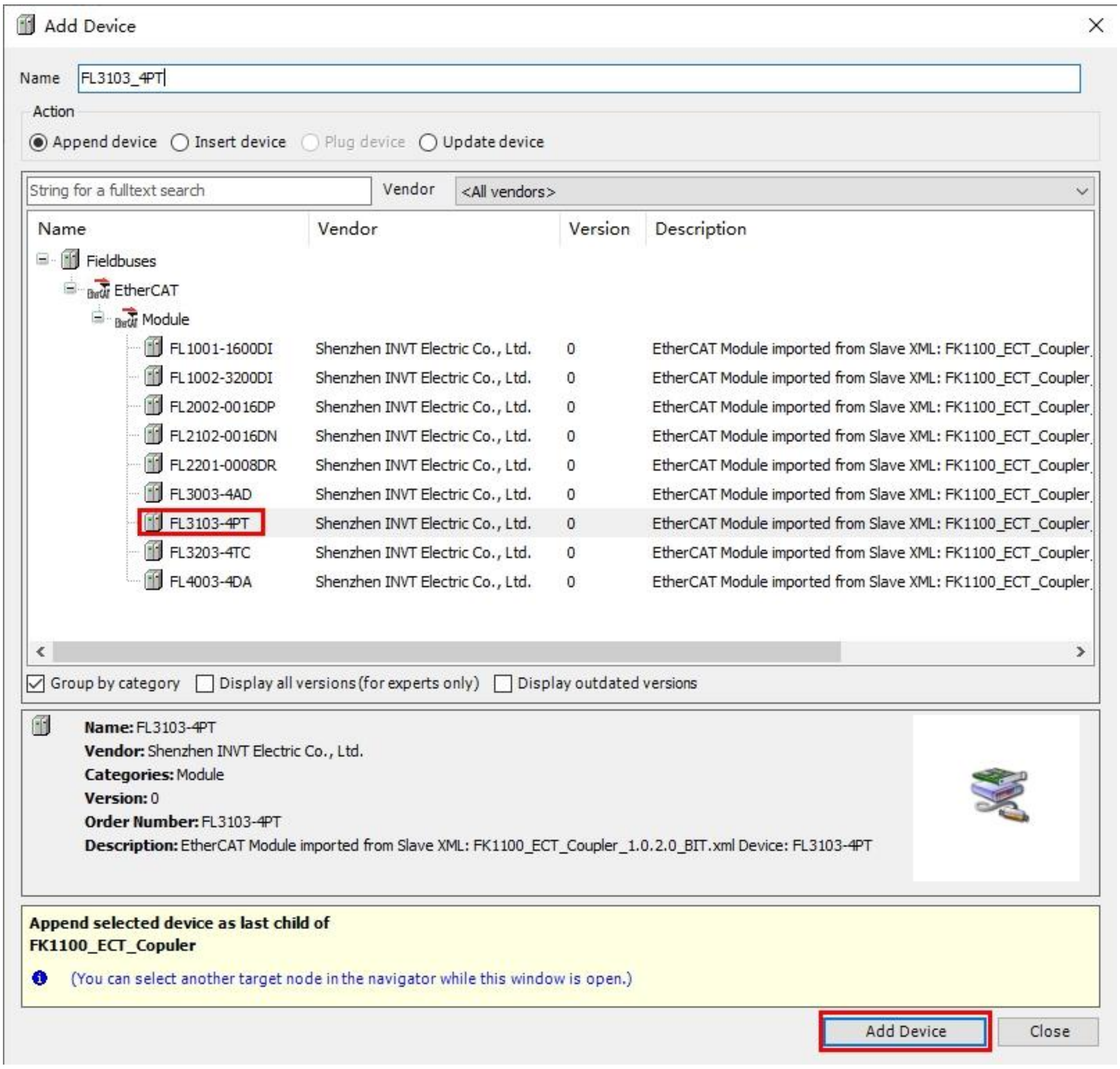
Parameter name	Type	Description
AO0 Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Output fault detection enabling control. (0: Disable. 1: Enable.) Bit3–Bit2: Offline output mode. 0b00: Offline output retained 0b01: Offline output cleared 0b10: Offline output preset Bit4: Reserved Bit7–Bit5: Channel conversion mode. 0b000: Voltage range 0–5V, corresponding to detection value range 0–20000 0b001: Voltage range 0–10V, corresponding to detection value range 0–20000 0b010: Voltage range -5–5V, corresponding to detection value range -20000–20000 0b011: Voltage range -10–10V, corresponding to detection value

Parameter name	Type	Description
		range -20000–20000 0b100: Current range 4–20mA, corresponding to detection value range 0–20000 0b101: Current range 0–20mA, corresponding to detection value range 0–20000 0b110: Reserved 0b111: Reserved
AO1 Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.
AO2 Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for channel 0.
AO3 Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.
AO0 Stop Output	INT	Preset value of stop/offline output for channel 0.
AO1 Stop Output	INT	Preset value of stop/offline output for channel 1.
AO2 Stop Output	INT	Preset value of stop/offline output for channel 2.
AO3 Stop Output	INT	Preset value of stop/offline output for channel 3.
AO0	INT	Output control value for channel 0.
AO1	INT	Output control value for channel 1.
AO2	INT	Output control value for channel 2.
AO3	INT	Output control value for channel 3.
AO0_ErrId	UINT	Fault code for channel 0.
AO1_ErrId	UINT	Fault code for channel 1.
AO2_ErrId	UINT	Fault code for channel 2.
AO3_ErrId	UINT	Fault code for channel 3.
HW Version	UINT	Module hardware version number.
FPGA Version	UINT	Module FPGA software version number.

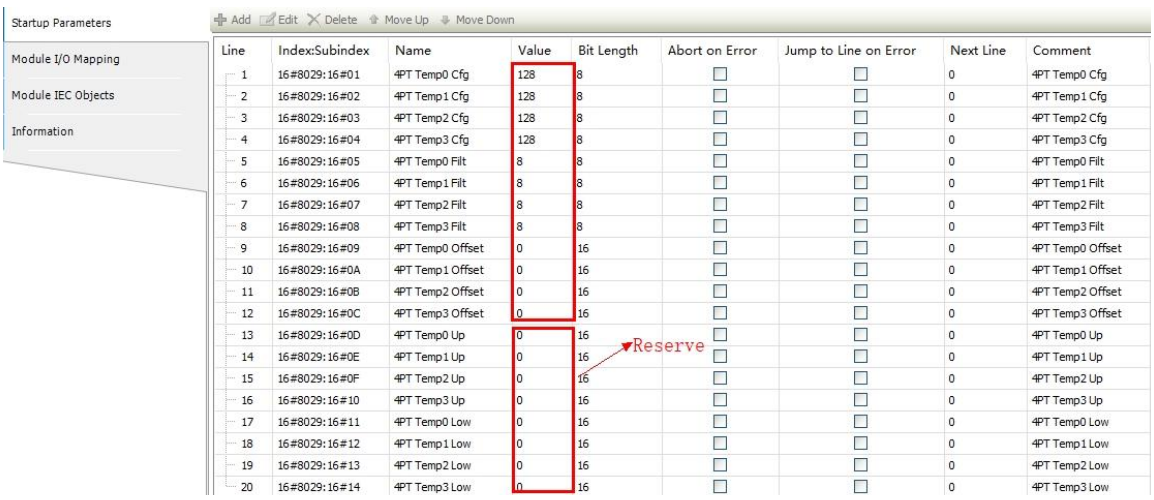
6.1.1.7 Temperature detection module (Thermal resistor)

1. Device import

Step 1 Add the FL3103-4PT device.



Step 2 Set the channel configuration, channel filter parameters, and temperature offset values based on actual needs in the startup parameters.



Line	Index:Subindex	Name	Value	Bit Length	Abort on Error	Jump to Line on Error	Next Line	Comment
1	16#8029:16#01	4PT Temp0 Cfg	128	8	☐	☐	0	4PT Temp0 Cfg
2	16#8029:16#02	4PT Temp1 Cfg	128	8	☐	☐	0	4PT Temp1 Cfg
3	16#8029:16#03	4PT Temp2 Cfg	128	8	☐	☐	0	4PT Temp2 Cfg
4	16#8029:16#04	4PT Temp3 Cfg	128	8	☐	☐	0	4PT Temp3 Cfg
5	16#8029:16#05	4PT Temp0 Filt	8	8	☐	☐	0	4PT Temp0 Filt
6	16#8029:16#06	4PT Temp1 Filt	8	8	☐	☐	0	4PT Temp1 Filt
7	16#8029:16#07	4PT Temp2 Filt	8	8	☐	☐	0	4PT Temp2 Filt
8	16#8029:16#08	4PT Temp3 Filt	8	8	☐	☐	0	4PT Temp3 Filt
9	16#8029:16#09	4PT Temp0 Offset	0	16	☐	☐	0	4PT Temp0 Offset
10	16#8029:16#0A	4PT Temp1 Offset	0	16	☐	☐	0	4PT Temp1 Offset
11	16#8029:16#0B	4PT Temp2 Offset	0	16	☐	☐	0	4PT Temp2 Offset
12	16#8029:16#0C	4PT Temp3 Offset	0	16	☐	☐	0	4PT Temp3 Offset
13	16#8029:16#0D	4PT Temp0 Up	0	16	☐	☐	0	4PT Temp0 Up
14	16#8029:16#0E	4PT Temp1 Up	0	16	☐	☐	0	4PT Temp1 Up
15	16#8029:16#0F	4PT Temp2 Up	0	16	☐	☐	0	4PT Temp2 Up
16	16#8029:16#10	4PT Temp3 Up	0	16	☐	☐	0	4PT Temp3 Up
17	16#8029:16#11	4PT Temp0 Low	0	16	☐	☐	0	4PT Temp0 Low
18	16#8029:16#12	4PT Temp1 Low	0	16	☐	☐	0	4PT Temp1 Low
19	16#8029:16#13	4PT Temp2 Low	0	16	☐	☐	0	4PT Temp2 Low
20	16#8029:16#14	4PT Temp3 Low	0	16	☐	☐	0	4PT Temp3 Low

Note: The temperature upper limit and lower limit are reserved parameters, and therefore they do not need to be set.

- Tempx Cfg(x=0,1,2,3) is a channel configuration parameter of type USINT. Taking the configuration of channel 0 as an example, the data definitions are detailed in the following table of parameters.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Channel conversion mode (sensor type)			**Temperature unit**	**Thermistor wire system**		**Over-range detection enabling control**	**Channel enabling control**
000: Reserved 001: PT100 010: PT500 011: Reserved	100: PT1000 101: Reserved 110: Reserved 111: CU100		0: °C 1: °F	00: Two-wire system 01: Three-wire system 10: Four-wire system 11: Reserved		0: Disable 1: Enable	0: Disable 1: Enable

For example: Channel 0 is configured as channel enabled, over-range detection enabled, using 3-wire system, temperature unit selected as Celsius (℃), sensor selected as PT1000. Temp0 Cfg should be 135, that is, 2#10000111. Details are as follows:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
100			0	01		1	1
	100 : PT1000		0 : °C	01: Three-wire system		1: Enable	1: Enable

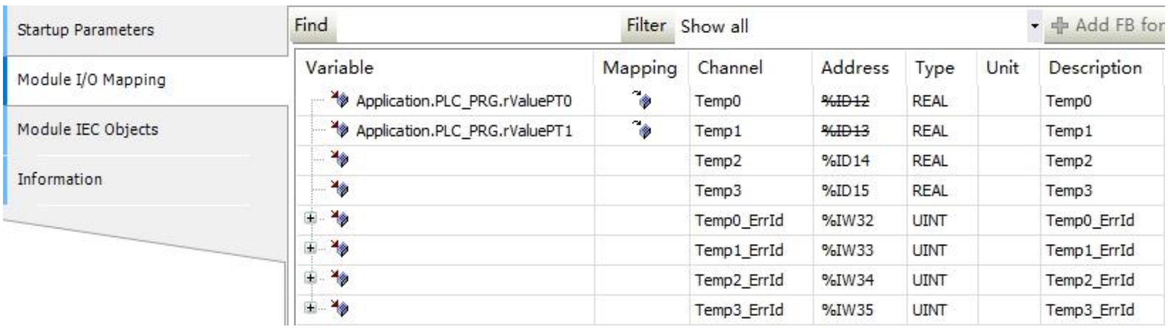
- Tempx Filt(x=0,1,2,3) is the channel filter parameter of type USINT, with the setting range of 1–255. Generally, a higher value indicates better suppression of high-frequency interference, but it also leads to greater delay. It should be adjusted according to the actual situation.
- Tempx Offset(x=0,1,2,3) is a temperature offset parameter of type USINT. The value is magnified by 10 times (for example, the setting 999 represents 99.9), measured value = actual value + offset value.

Step 3 Define REAL type variables rValuePT0 and rValuePT1 in the program.

```
VAR
rValuePT0     : REAL;
rValuePT1     : REAL;

END_VAR
```

Step 4 Choose **Module I/O Mapping**, map the variables rValuePT0 and rValuePT1 to the corresponding input channels in the Module I/O mapping, and use the mapped variables in the program.



2. Parameter description

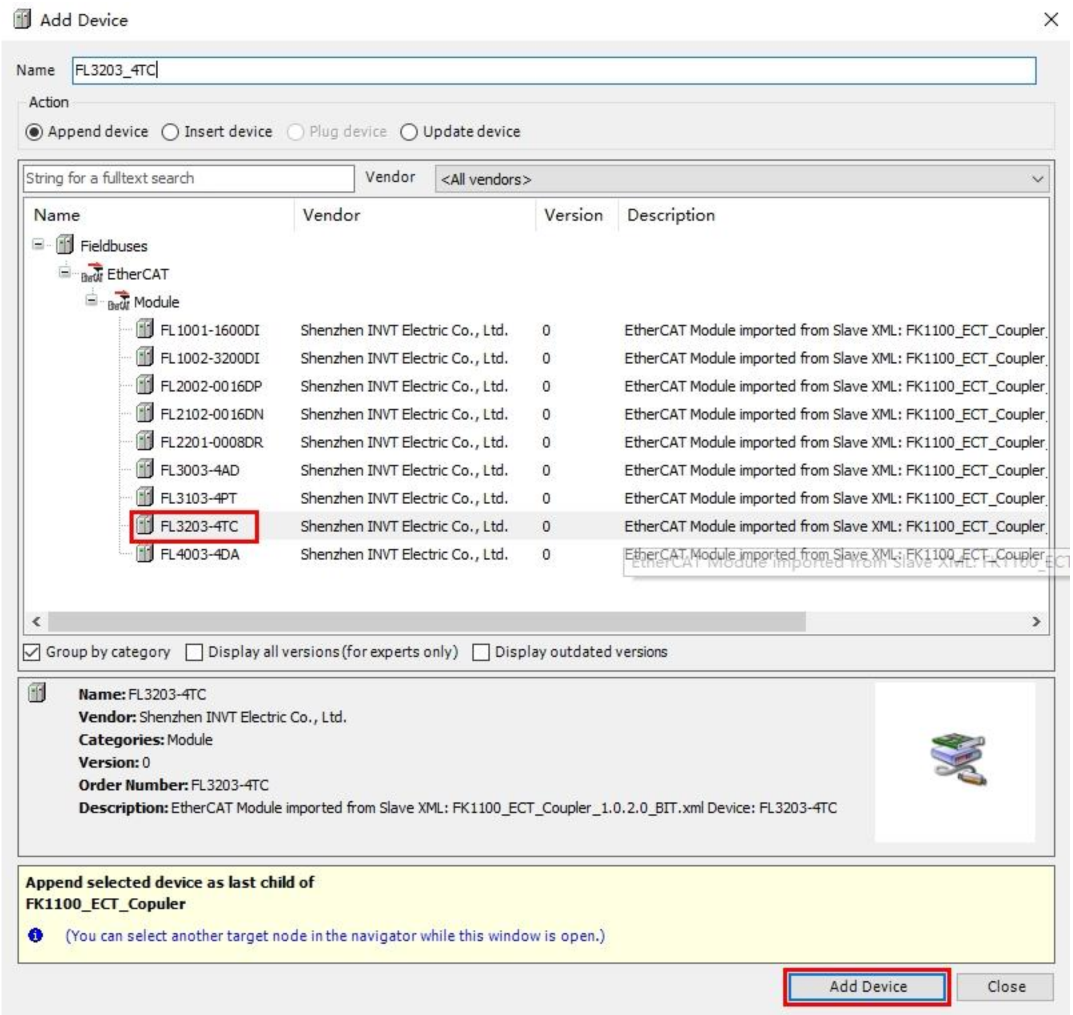
Parameter name	Type	Description
Temp0 Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Over-range detection enabling control. (0: Disable. 1: Enable.) Bit3–bit2: Thermal resistor wire system. (0b00: Two-wire system. 0b01: Three-wire system. 0b10: Four-wire) Bit4: Temperature unit. (0: °C. 1: °F.) Bit7–Bit5: Channel conversion mode. 0b000: Reserved 0b001: PT100 0b010: PT500 0b011: Reserved 0b100: PT1000 0b101: Reserved 0b110: Reserved 0b111: CU100
Temp1 Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.
Temp2 Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for channel 0.
Temp3 Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.
Temp0 Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.
Temp1 Filt	USINT	Filter parameter for channel 1. The filter parameter setting is consistent with that for channel 0.
Temp2 Filt	USINT	Filter parameter for channel 2. The filter parameter setting is consistent with that for channel 0.
Temp3 Filt	USINT	Filter parameter for channel 3. The filter parameter setting is consistent with that for channel 0.
Temp0 Offset	INT	Temperature offset value for channel 0. The value has been amplified by 10 times, with 999 representing 99.9. Detection value = Actually measured value + Offset value
Temp1 Offset	INT	Temperature offset value for channel 1. The temperature offset value is consistent with that for channel 0.
Temp2 Offset	INT	Temperature offset value for channel 2. The temperature offset value is consistent with that for channel 0.
Temp3 Offset	INT	Temperature offset value for channel 3. The temperature offset value is consistent with that for channel 0.
Temp0 Up	INT	Temperature upper limit for channel 0. Reserved. The sensor provided limit value is used.
Temp1 Up	INT	Temperature upper limit for channel 1. Reserved. The sensor provided limit value is used.
Temp2 Up	INT	Temperature upper limit for channel 2. Reserved. The sensor provided limit value is used.
Temp3 Up	INT	Temperature upper limit for channel 3. Reserved. The sensor provided limit value is used.
Temp0 Low	INT	Temperature lower limit for channel 0. Reserved. The sensor provided limit value is used.

Parameter name	Type	Description
Temp1 Low	INT	Temperature lower limit for channel 1. Reserved. The sensor provided limit value is used.
Temp2 Low	INT	Temperature lower limit for channel 2. Reserved. The sensor provided limit value is used.
Temp3 Low	INT	Temperature lower limit for channel 3. Reserved. The sensor provided limit value is used.
Temp0	REAL	Conversion value for channel 0.
Temp1	REAL	Conversion value for channel 1.
Temp2	REAL	Conversion value for channel 2.
Temp3	REAL	Conversion value for channel 3.
Temp0_ErrId	UINT	Fault code for channel 0.
Temp1_ErrId	UINT	Fault code for channel 1.
Temp2_ErrId	UINT	Fault code for channel 2.
Temp3_ErrId	UINT	Fault code for channel 3.
HW Version	UINT	Module hardware version number.
FPGA Version	UINT	Module FPGA software version number.

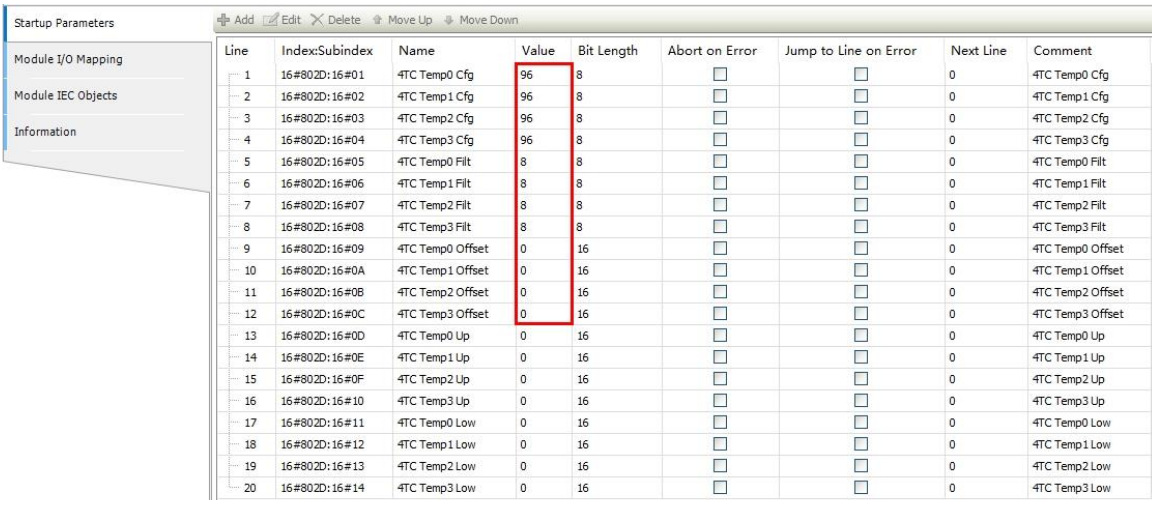
6.1.1.8 Temperature detection module (Thermocouple)

1. Programming instance

Step 1 Add the FL3203-4TC device.



Step 2 Set the channel configuration, channel filter parameters, and temperature offset values based on actual needs in the startup parameters.



Line	Index:Subindex	Name	Value	Bit Length	Abort on Error	Jump to Line on Error	Next Line	Comment
1	16#802D:16#01	4TC Temp0 Cfg	96	8			0	4TC Temp0 Cfg
2	16#802D:16#02	4TC Temp1 Cfg	96	8			0	4TC Temp1 Cfg
3	16#802D:16#03	4TC Temp2 Cfg	96	8			0	4TC Temp2 Cfg
4	16#802D:16#04	4TC Temp3 Cfg	96	8			0	4TC Temp3 Cfg
5	16#802D:16#05	4TC Temp0 Filt	8	8			0	4TC Temp0 Filt
6	16#802D:16#06	4TC Temp1 Filt	8	8			0	4TC Temp1 Filt
7	16#802D:16#07	4TC Temp2 Filt	8	8			0	4TC Temp2 Filt
8	16#802D:16#08	4TC Temp3 Filt	8	8			0	4TC Temp3 Filt
9	16#802D:16#09	4TC Temp0 Offset	0	16			0	4TC Temp0 Offset
10	16#802D:16#0A	4TC Temp1 Offset	0	16			0	4TC Temp1 Offset
11	16#802D:16#0B	4TC Temp2 Offset	0	16			0	4TC Temp2 Offset
12	16#802D:16#0C	4TC Temp3 Offset	0	16			0	4TC Temp3 Offset
13	16#802D:16#0D	4TC Temp0 Up	0	16			0	4TC Temp0 Up
14	16#802D:16#0E	4TC Temp1 Up	0	16			0	4TC Temp1 Up
15	16#802D:16#0F	4TC Temp2 Up	0	16			0	4TC Temp2 Up
16	16#802D:16#10	4TC Temp3 Up	0	16			0	4TC Temp3 Up
17	16#802D:16#11	4TC Temp0 Low	0	16			0	4TC Temp0 Low
18	16#802D:16#12	4TC Temp1 Low	0	16			0	4TC Temp1 Low
19	16#802D:16#13	4TC Temp2 Low	0	16			0	4TC Temp2 Low
20	16#802D:16#14	4TC Temp3 Low	0	16			0	4TC Temp3 Low

Note: The temperature upper limit and lower limit are reserved parameters, and therefore they do not need to be set.

- Tempx Cfg(x=0,1,2,3) is a channel configuration parameter of type USINT. Taking the configuration of channel 0 as an example, the data definitions are detailed in the following table of parameters.

<table>
<tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr>
<tr><th colspan="3">Channel conversion mode (sensor type)</th><th>Temperature unit</th><th colspan="2">Reserved</th><th>Over-range detection enabling control</th><th>Channel enabling control</th></tr>
<tr><td>0b00:
Thermocouple of type B.
0b001:
Thermocouple of type E.
0b010:
Thermocouple of type J.
0b011:
Thermocouple of type K.</td><td colspan="2">0b100:
Thermocouple of type N.
0b101:
Thermocouple of type R.
0b110:
Thermocouple of type S.
0b111:
Thermocouple of type T.</td><td>0: °C
1: °F</td><td colspan="2">-</td><td>0: Disable
1: Enable</td><td>0: Disable
1: Enable</td></tr>
</table>

For example: Channel 0 is configured as channel enabled, over-range detection enabled, temperature unit selected as Celsius (°C), sensor selected as J-type thermocouple. Temp0 Cfg should be 67, that is, 2#01000011. Details are as follows:

<table>
<tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr>
<tr><td colspan="3">0b010</td><td>0</td><td colspan="2">0b00</td><td>1</td><td>1</td></tr>
<tr><td colspan="3">0b010: Thermocouple of type J.</td><td>0: °C</td><td colspan="2">Reserved</td><td>1: Enable</td><td>1: Enable</td></tr>
</table>

- Tempx Filt(x=0,1,2,3) is a channel filter parameter of type USINT, with the setting range of 1–255. Generally, a higher value indicates better suppression of high-frequency interference, but it also leads to greater delay. It should be adjusted according to the actual situation.
- Tempx Offset(x=0,1,2,3) is a temperature offset parameter of type USINT. The value is magnified by 10

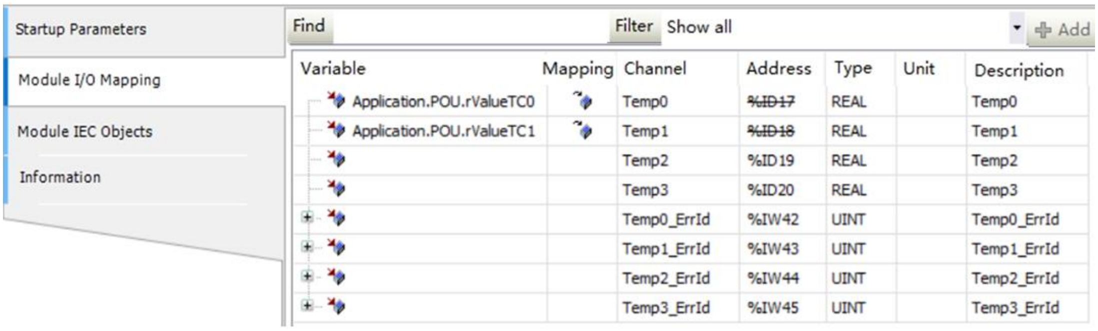
times (for example, the setting 999 represents 99.9), measured value = actual value + offset value.

Step 3 Define REAL type variables rValueTC0 and rValueTC1 in the program.

```
VAR
rValueTC0      : REAL;
rValueTC1      : REAL;

END_VAR
```

Step 4 Map the variables rValueTC0 and rValueTC1 to the corresponding input channels in the Module I/O mapping, and use the mapped variables in the program.



2. Parameter description

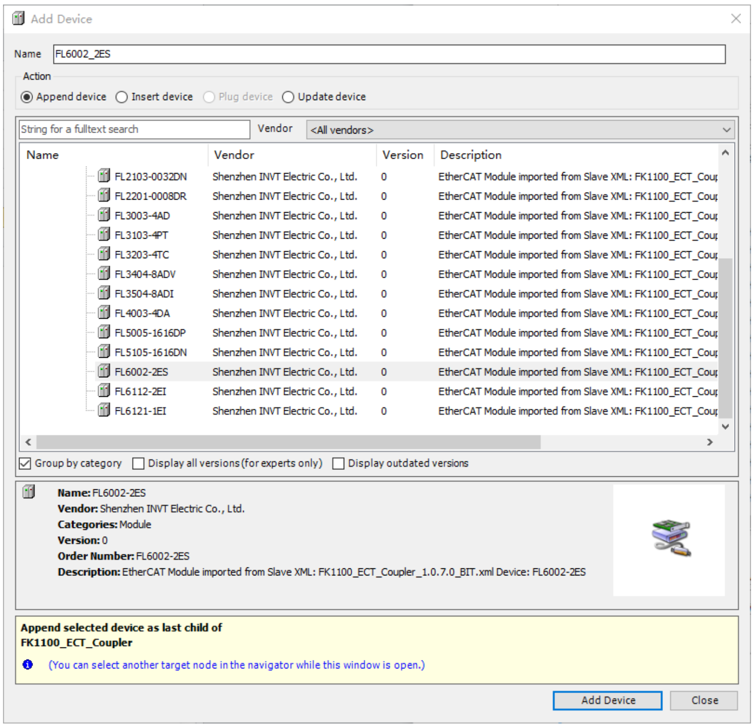
Parameter name	Type	Description
Temp0 Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Over-range detection enabling control. (0: Disable. 1: Enable.) Bit3–Bit2: Reserved Bit4: Temperature unit. (0: °C. 1: °F.) Bit7–Bit5: Channel conversion mode. 0b000: Thermocouple of type B. 0b001: Thermocouple of type E. 0b010: Thermocouple of type J. 0b011: Thermocouple of type K. 0b100: Thermocouple of type N. 0b101: Thermocouple of type R. 0b110: Thermocouple of type S. 0b111: Thermocouple of type T.
Temp1 Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.
Temp2 Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for channel 0.
Temp3 Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.
Temp0 Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.
Temp1 Filt	USINT	Filter parameter for channel 1. The filter parameter setting is consistent with that for channel 0.
Temp2 Filt	USINT	Filter parameter for channel 2. The filter parameter setting is consistent with that for channel 0.

Parameter name	Type	Description
Temp3 Filt	USINT	Filter parameter for channel 3. The filter parameter setting is consistent with that for channel 0.
Temp0 Offset	INT	Temperature offset value for channel 0. (The value has been amplified by 10 times, with 999 representing 99.9.) Detection value = Actually measured value + Offset value
Temp1 Offset	INT	Same as the temperature offset value for channel 0.
Temp2 Offset	INT	Same as the temperature offset value for channel 1.
Temp3 Offset	INT	Same as the temperature offset value for channel 2.
Temp0 Up	INT	Temperature upper limit for channel 0. Reserved. The sensor provided limit value is used.
Temp1 Up	INT	Temperature upper limit for channel 1. Reserved. The sensor provided limit value is used.
Temp2 Up	INT	Temperature upper limit for channel 2. Reserved. The sensor provided limit value is used.
Temp3 Up	INT	Temperature upper limit for channel 3. Reserved. The sensor provided limit value is used.
Temp0 Low	INT	Temperature lower limit for channel 0. Reserved. The sensor provided limit value is used.
Temp1 Low	INT	Temperature lower limit for channel 1. Reserved. The sensor provided limit value is used.
Temp2 Low	INT	Temperature lower limit for channel 2. Reserved. The sensor provided limit value is used.
Temp3 Low	INT	Temperature lower limit for channel 3. Reserved. The sensor provided limit value is used.
Temp0	REAL	Conversion value for channel 0.
Temp1	REAL	Conversion value for channel 1.
Temp2	REAL	Conversion value for channel 2.
Temp3	REAL	Conversion value for channel 3.
Temp0_ErrId	UINT	Fault code for channel 0.
Temp1_ErrId	UINT	Fault code for channel 1.
Temp2_ErrId	UINT	Fault code for channel 2.
Temp3_ErrId	UINT	Fault code for channel 3.
HW Version	UINT	Module hardware version number
FPGA Version	UINT	Module FPGA software version number

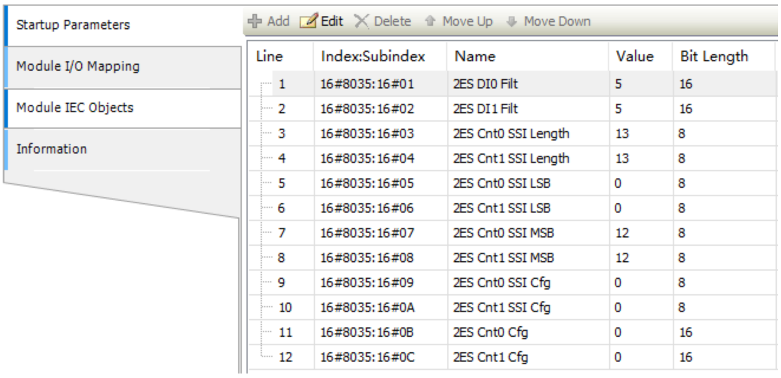
6.1.1.9 Counting and measurement module (FL6002)

1. Programming instance

Step 1 Add the FL6002-2ES device.



Step 2 In the startup parameters, set the counter DI filter time (unit: 0.1μs), SSI communication frame length, the number of least significant bits and number of most significant bits in the SSI communication position value, SSI communication configuration, and counter configuration according to actual needs.


Startup Parameters | Module I/O Mapping | Module IEC Objects | Information

Add | Edit | Delete | Move Up | Move Down

Line	Index:Subindex	Name	Value	Bit Length
1	16#8035:16#01	2ES DI0 Filt	5	16
2	16#8035:16#02	2ES DI1 Filt	5	16
3	16#8035:16#03	2ES Cnt0 SSI Length	13	8
4	16#8035:16#04	2ES Cnt1 SSI Length	13	8
5	16#8035:16#05	2ES Cnt0 SSI LSB	0	8
6	16#8035:16#06	2ES Cnt1 SSI LSB	0	8
7	16#8035:16#07	2ES Cnt0 SSI MSB	12	8
8	16#8035:16#08	2ES Cnt1 SSI MSB	12	8
9	16#8035:16#09	2ES Cnt0 SSI Cfg	0	8
10	16#8035:16#0A	2ES Cnt1 SSI Cfg	0	8
11	16#8035:16#0B	2ES Cnt0 Cfg	0	16
12	16#8035:16#0C	2ES Cnt1 Cfg	0	16

- DIx Filt (x=0,1) is the filter parameter for the external DI channel, with a unit of 0.1μs and a default value of 5. If it is set to 10, it means that only signals that remain stable and do not jump within 1μs are sampled.
- Cntx SSI Length (x=0,1) is the encoder SSI communication frame length, with a setting range of 10–40 and a default value of 13. If a 23-bit multi-turn encoder is used, indicating that the position value has 23 bits, this parameter should be set to 23.
- Cntx SSI LSB (x=0,1) is the number of least significant bits in the SSI communication frame position value, with a default value of 0. If a 23-bit multi-turn encoder is used, indicating that the position value has 23 bits, this parameter should be set to 0.

- Cntx SSI MSB (x=0,1) is the number of most significant bits in the SSI communication frame position value, with a default value of 12. If a 23-bit multi-turn encoder is used, indicating that the position value has 23 bits, this parameter should be set to 22.

Note: See the corresponding encoder's manual to set the SSI Length/SSI LSB/SSI MSB parameters based on the actual situation.

- Cntx SSI Cfg (x=0,1) is a counter SSI communication configuration parameter of type USINT. The data definitions are detailed in the following parameter description table.

Bit	Name	Parameter description
Bit2–Bit0	SSI clock frequency	2#000: 125kHz (Default) 2#001: 250kHz 2#010: 500kHz 2#011: 1MHz 2#100: 1.5MHz 2#101: 2MHz 2#110: Reserved 2#111: Reserved
Bit3	SSI data format	2#0: Binary (Default) 2#1: Gray code
Bit7–bit4	Position reading interval time in SSI communication	Unit: 100μs. Default: 0 For example, 2#0001 (decimal 1) indicates 100μs; 2#1001 (decimal 9) indicates 900μs.

- If the counter SSI clock frequency is set to 500kHz, SSI data format is Gray code, and the position reading interval time is 500μs, Cntx SSI Cfg(x=0,1) should be set to 90, that is, 2#01011010. For details, see the following table.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
2#0101				2#1	2#010		
Unit: 100μs				Gray code	500kHz		

- Cntx Cfg (x=0,1) is a counter configuration parameter of type USINT. The data definitions are detailed in the following parameter description table.

Bit	Name	Parameter description
Bit1–bit0	Frequency measurement period	2#00:20ms (Default) 2#01:100ms 2#10:500ms 2#11:1000ms
Bit3–bit2	DI edge latch enabling	2#00: Disable (Default) 2#01: Rising edge 2#10: Falling edge 2#11: Dual edges
Bit5–bit4	Comparison consistent pulse output width	2#00:1ms (Default) 2#01:2ms 2#10:4ms 2#11:8ms
Bit7–bit6	Output mode for comparison	2#00: Consistent output for comparison (Default) 2#01: Output between [Count lower limit, Comparison value] 2#10: Output between [Comparison value, Count upper limit] 2#11: Reserved
Bit15–bit8	Reserved	-

If the counter is configured with a frequency measurement period of 100 ms, with DI rising edge latch enabled, a period of 8ms for consistent output for comparison, and DO output mode for comparison set to generate consistent output within the range [Comparison value, Counter upper limit], then Cntx Cfg (x=0,1) should be set to 53, that is, 2#0000000000110101. See the following table for details.

Bit15–Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
2#00000000	2#00		2#11		2#01		2#01	
Reserved	Comparison consistent output		8ms		Rising edge		100ms	

Step 3 After configuring the preceding startup parameters and downloading the program, control the counter on the Module I/O mapping interface.

Variable	Mapping	Channel	Address	Type	Unit	Description
		Cnt0_Ctrl	%QB68	USINT		Cnt0_Ctrl
		Cnt1_Ctrl	%QB69	USINT		Cnt1_Ctrl
		Cnt0_CmpVal	%QD18	DINT		Cnt0_CmpVal
		Cnt1_CmpVal	%QD19	DINT		Cnt1_CmpVal
		Cnt0_Status	%IB120	USINT		Cnt0_Status
		Cnt1_Status	%IB121	USINT		Cnt1_Status
		Cnt0_Val	%ID31	DINT		Cnt0_Val
		Cnt1_Val	%ID32	DINT		Cnt1_Val
		Cnt0_LatchVal	%ID33	DINT		Cnt0_LatchVal
		Cnt1_LatchVal	%ID34	DINT		Cnt1_LatchVal
		Cnt0_Freq	%ID35	UDINT		Cnt0_Freq
		Cnt1_Freq	%ID36	UDINT		Cnt1_Freq
		Cnt0_Velocity	%ID37	REAL		Cnt0_Velocity
		Cnt1_Velocity	%ID38	REAL		Cnt1_Velocity
		Cnt0_ErrId	%IW78	UINT		Cnt0_ErrId
		Cnt1_ErrId	%IW79	UINT		Cnt1_ErrId

- Cntx_Ctrl(x=0,1) is a counter control parameter. See the following table for detailed parameter description.

Bit	Name	Parameter description
Bit0	Enable counting	2#0: Disable 2#1: Enable
Bit1	Reserved	-
Bit2	Reserved	-
Bit3	Reserved	-
Bit4	Counter comparison	2#0: Disable 2#1: Enable
Bit7–bit5	Reserved	-

- Cntx_CmpVal(x=0,1) is a counter comparison value of type DINT.

If Cnt0_CmpVal is set to 1000000 and you want to enable the counter for comparison, set Cnt0_Ctrl to 17, that is, 2#00010001. The details are as follows.

Bit7–Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
2#000	2#1	2#0	2#0	2#0	2#1
Reserved	Power on	Effective at the rising edge	Reserved	Reserved	Power on

- Cntx_Val (x=0,1) is a counter comparison value of type DINT.

According to the previously mentioned Cntx Cfg (x=0,1) configuration value of 53 (enabling DO consistent output for comparison, with the pulse output of 8ms), when the count value Cntx_Val (x=0,1) is 1,000,000, the DO will output pulse lasting 8ms.

Note: DI0/DI1 are the counter latch inputs, and the corresponding latch values are Cntx_LatchVal (x=0,1).

2. Parameter description

Parameter name	Type	Description
2ES DI0 Filt	UINT	DI0 filter time. Unit: 0.1μs.
2ES DI1 Filt	UINT	DI1 filter time. Unit: 0.1μs.
2ES Cnt0 SSI Length	USINT	Cnt0 SSI communication frame length.
2ES Cnt1 SSI Length	USINT	Cnt1 SSI communication frame length.
2ES Cnt0 SSI LSB	USINT	Cnt0 SSI position value least significant bit count.
2ES Cnt1 SSI LSB	USINT	Cnt1 SSI position value least significant bit count.
2ES Cnt0 SSI MSB	USINT	Cnt0 SSI position value most significant bit count.
2ES Cnt1 SSI MSB	USINT	Cnt1 SSI position value most significant bit count.
2ES Cnt0 SSI Cfg	USINT	Cnt0 SSI configuration parameter. [2:0] SSI clock frequency 2#000: 125kHz; 2#001: 250kHz; 2#010: 500kHz; 2#011: 1MHz; 2#100: 1.5MHz; 2#101: 2MHz; 2#110: Reserved; 2#111: Reserved; [3] Data format. 0: Binary 1: Gray code [7:4] Position reading interval time (Unit: 100μs)
2ES Cnt1 SSI Cfg	USINT	Cnt1 SSI configuration parameter. [2:0] SSI clock frequency 2#000: 125kHz; 2#001: 250kHz; 2#010: 500kHz; 2#011: 1MHz; 2#100: 1.5MHz; 2#101: 2MHz; 2#110: Reserved; 2#111: Reserved; [3] Data format. 0: Binary 1: Gray code [7:4] Position reading interval time (Unit: 100μs)
2ES Cnt0 Cfg	UINT	Cnt0 count configuration parameter. [1:0] Frequency measurement period 2#00:20ms; 2#01:100ms; 2#10:500ms; 2#11:1000ms; [3:2] L0 edge latch count value enabling 2#00: Disable; 2#01: Rising edge; 2#10: Falling edge; 2#11: Dual edges; [5:4] Comparison consistent output pulse width 2#00:1ms; 2#01:2ms;

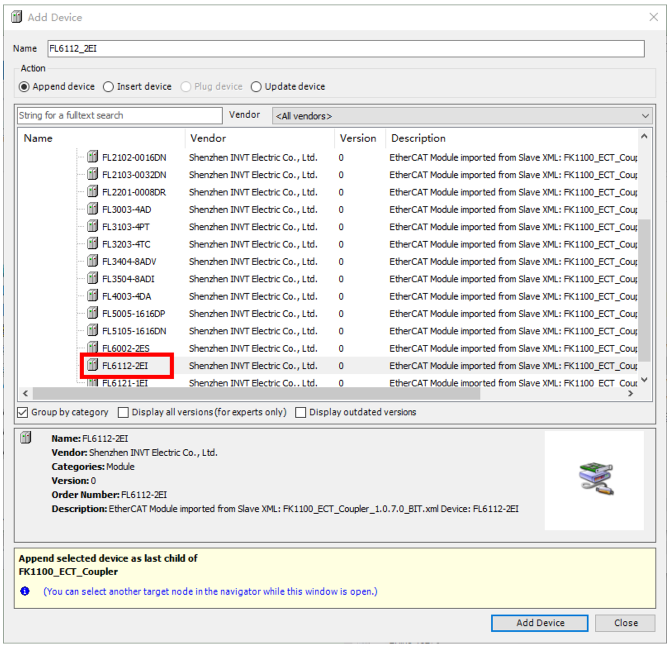
Parameter name	Type	Description
		2#10:4ms; 2#11:8ms; [7:6] Output mode for comparison 2#00: Comparison consistent output; 2#01: Output between [Count lower limit, Comparison value); 2#10: Output between (Comparison value, Count upper limit]; 2#11: Reserved (Comparison consistent output); [15:8] Reserved
2ES Cnt1 Cfg	UINT	Cnt1 count configuration parameter. [1:0] Frequency measurement period 2#00:20ms; 2#01:100ms; 2#10:500ms; 2#11:1000ms; [3:2] L0 edge latch count value enabling 2#00: Disable; 2#01: Rising edge; 2#10: Falling edge; 2#11: Dual edges; [5:4] Comparison consistent output pulse width 2#00:1ms; 2#01:2ms; 2#10:4ms; 2#11:8ms; [7:6] Output mode for comparison 2#00: Comparison consistent output; 2#01: Output between [Count lower limit, Comparison value); 2#10: Output between (Comparison value, Count upper limit]; 2#11: Reserved (Comparison consistent output); [15:8] Reserved
Cnt0_Ctrl	USNT	Control parameter for counter 0. Bit0: Enable counting, valid at high levels; Bit1: Reserved; Bit2: Reserved; Bit3: Reserved; Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit7–Bit5: Reserved.
Cnt1_Ctrl	USNT	Control parameter for counter 1. Bit0: Enable counting, valid at high levels; Bit1: Reserved; Bit2: Reserved; Bit3: Reserved; Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.)

Parameter name	Type	Description
		Bit7–Bit5: Reserved.
Cnt0_CmpVal	DINT	Counter 0 comparison value
Cnt1_CmpVal	DINT	Counter 1 comparison value
Cnt0_Status	USINT	Counter 0 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Reserved Bit3: Reserved Bit4: DI latch completion flag Bit5: Reserved Bit6: Status when the data line is idle Bit7: Reserved
Cnt0_Status	USINT	Counter 1 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Reserved Bit3: Reserved Bit4: DI latch completion flag Bit5: Reserved Bit6: Status when the data line is idle Bit7: Reserved
Cnt0_Val	DINT	Count value of counter 0
Cnt1_Val	DINT	Count value of counter 1
Cnt0_LatchVal	DINT	Latched value of counter 0
Cnt1_LatchVal	DINT	Latched value of counter 1
Cnt0_Freq	UDINT	Counter 0 frequency
Cnt1_Freq	UDINT	Counter 1 frequency
Cnt0_Velocity	REAL	Counter 0 speed (Valid for single-turn encoder)
Cnt1_Velocity	REAL	Counter 1 speed (Valid for single-turn encoder)
Cnt0_ErrId	UINT	Counter 0 error code
Cnt1_ErrId	UINT	Counter 1 error code

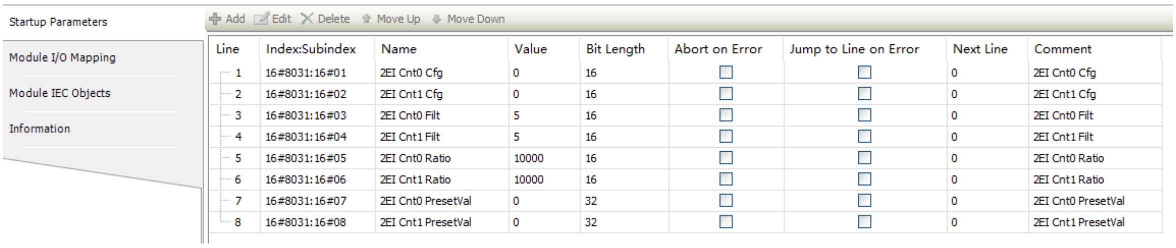
6.1.1.10 Counting and measurement module (FL6112)

1. Programming instance

Step 1 Add the FL6112_2EI device.



Step 2 Choose **Startup Parameters**, set the counter, filtering mode, encoder resolution, and counter preset values based on the actual needs, with a filter unit of 0.1μs.



Line	Index:Subindex	Name	Value	Bit Length	Abort on Error	Jump to Line on Error	Next Line	Comment
1	16#8031:16#01	2EI Cnt0 Cfg	0	16	☐	☐	0	2EI Cnt0 Cfg
2	16#8031:16#02	2EI Cnt1 Cfg	0	16	☐	☐	0	2EI Cnt1 Cfg
3	16#8031:16#03	2EI Cnt0 Filt	5	16	☐	☐	0	2EI Cnt0 Filt
4	16#8031:16#04	2EI Cnt1 Filt	5	16	☐	☐	0	2EI Cnt1 Filt
5	16#8031:16#05	2EI Cnt0 Ratio	10000	16	☐	☐	0	2EI Cnt0 Ratio
6	16#8031:16#06	2EI Cnt1 Ratio	10000	16	☐	☐	0	2EI Cnt1 Ratio
7	16#8031:16#07	2EI Cnt0 PresetVal	0	32	☐	☐	0	2EI Cnt0 PresetVal
8	16#8031:16#08	2EI Cnt1 PresetVal	0	32	☐	☐	0	2EI Cnt1 PresetVal

Cntx Cfg(x=0,1) is the counter configuration parameter of type UINT. Taking the counter 0 configuration as an example, the data definition can be found in the parameter description.

Bit	Name	Description
Bit1–bit0	Channel mode	00: A/B phase quadruple frequency; 01: A/B phase double frequency 10: A/B phase rated frequency; 11: Pulse+direction
Bit3–bit2	Frequency measurement period	00: 20ms; 01: 100ms; 10: 500ms; 11: 1000ms
Bit5–bit4	Edge latch enabling	00: Disabled; 01: Rise edge; 10: Fall edge; 11: Two edges
Bit7–bit6	Reserved	Reserved
Bit9–bit8	Comparison consistent pulse output width	00: 1ms; 01: 2ms; 10: 4ms; 11: 8ms
Bit11–bit10	DO comparison output mode	00: Comparison consistent output 01: Output between [lower limit of count, comparison value] 10: Output between [comparison value, upper limit of count] 11: Reserved
Bit15–bit12	Reserved	Reserved

Assuming that counter 0 is configured as A/B phase quadruple frequency, the frequency measurement period is 100ms, DI0 rising edge latch is enabled, and comparison mode is comparison consistent output 8ms, Cnt0 Cfg should be configured as 788, i.e. 2#0000001100010100, as detailed below.

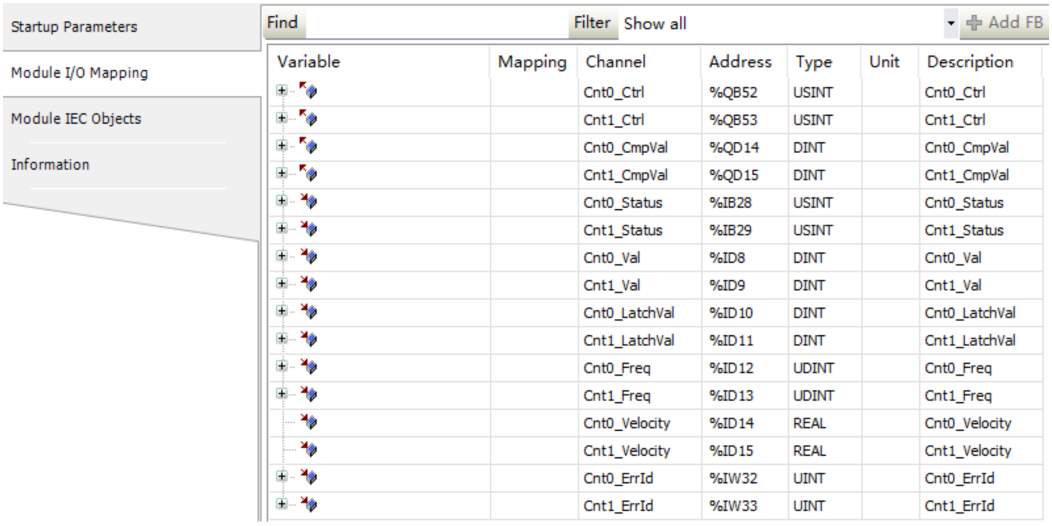
<table>
<tr><th>Bit15–bit12</th><th>Bit11</th><th>Bit10</th><th>Bit9</th><th>Bit8</th><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr>
<tr><td>0000</td><td colspan="2">00</td><td colspan="2">11</td><td colspan="2">00</td><td colspan="2">01</td><td colspan="2">01</td><td colspan="2">00</td></tr>
<tr><td>Reserved</td><td colspan="2">Comparison consistent output</td><td colspan="2">8ms</td><td colspan="2">Reserved</td><td colspan="2">Rising edge</td><td colspan="2">100ms</td><td colspan="2">A/B phase quadruple frequency</td></tr>
</table>

Cntx Filt(x=0,1) is the filter parameter of A/B/Z/DI port with a unit of 0.1μs。 If it is set to 10, it means that only signals that remain stable and do not jump within 1μs are sampled.

Cntx Ratio(x=0,1) is the encoder resolution (number of pulses fed back from one revolution, i.e. the pulse increment between two Z pulses). Assuming the resolution labeled on the encoder is 2500P/R, the Cnt0 Ratio should be set to 10000 since the Cnt0 Cfg is configured as A/B phase quadruple.

Cntx PresetVal(x=0,1) is the counter preset value of type DINT.

Step 3 After configuring the above startup parameters and downloading the program, control the counter on the Module I/O mapping interface.



Variable	Mapping	Channel	Address	Type	Unit	Description
		Cnt0_Ctrl	%QB52	USINT		Cnt0_Ctrl
		Cnt1_Ctrl	%QB53	USINT		Cnt1_Ctrl
		Cnt0_CmpVal	%QD14	DINT		Cnt0_CmpVal
		Cnt1_CmpVal	%QD15	DINT		Cnt1_CmpVal
		Cnt0_Status	%IB28	USINT		Cnt0_Status
		Cnt1_Status	%IB29	USINT		Cnt1_Status
		Cnt0_Val	%ID8	DINT		Cnt0_Val
		Cnt1_Val	%ID9	DINT		Cnt1_Val
		Cnt0_LatchVal	%ID10	DINT		Cnt0_LatchVal
		Cnt1_LatchVal	%ID11	DINT		Cnt1_LatchVal
		Cnt0_Freq	%ID12	UDINT		Cnt0_Freq
		Cnt1_Freq	%ID13	UDINT		Cnt1_Freq
		Cnt0_Velocity	%ID14	REAL		Cnt0_Velocity
		Cnt1_Velocity	%ID15	REAL		Cnt1_Velocity
		Cnt0_ErrId	%IW32	UINT		Cnt0_ErrId
		Cnt1_ErrId	%IW33	UINT		Cnt1_ErrId

Cntx_Ctrl(x=0,1) is the counter control parameter. Taking the counter 0 as an example, the data definition can be found in the parameter description.

Bit	Name	Description
Bit0	Enable counting	0: Disable 1: Enable
Bit1	Clear count value	Effective at the rising edge
Bit2	Write counter preset value	Effective at the rising edge
Bit3	Clear count overflow flag	Effective at the rising edge
Bit4	Counter comparison	0: Disable 1: Enable
Bit7–bit5	Reserved	Reserved

Cntx_CmpVal(x=0,1) is the counter comparison value of type DINT.

Assuming that Cnt0_CmpVal is set to 1000000 and you want to enable the counter for comparison, set Cnt0_Ctrl to 17, which is 2#00010001. The details are as follows.

Bit7–bit5	Bit4	Bit3	Bit2	Bit1	Bit0
000	1	0	0	0	1
Reserved	1: Enable	Effective at the rising edge	Effective at the rising edge	Effective at the rising edge	1: Enable

According to the configuration value 788 of Cnt0 Cfg mentioned above (enabling DO comparison consistent output and output pulse 8ms), when the count value Cnt0_Val is equal to 1000000, DO0 will output 8ms.

To clear the current count value of counter 0, set Cnt0_Ctrl to 2, which is 2#00000010. The details are as follows.

Bit7–bit5	Bit4	Bit3	Bit2	Bit1	Bit0
000	0	0	0	1	0
Reserved	0: Disable	Effective at the rising edge	Effective at the rising edge	Effective at the rising edge	0: Disable

At this point, the bit1 of Cnt0_Ctrl changes from 0 to 1. The FL6112_2EI module monitors the rising edge of this bit and clears the count value of counter 0, which means Cnt0_Val is cleared.

2. Parameter description

Parameter name	Type	Description
2EI Cnt0 Cfg	UINT	Configuration parameter for counter 0: Bit1–Bit0: Channel mode configuration 0b00: A/B phase quadruple frequency; 0b01: A/B phase double frequency; 0b10: A/B phase rated frequency; 0b11: Pulse+direction (high level, positive); Bit3–Bit2: Frequency measurement period 0b00: 20ms; 0b01: 100ms; 0b10: 500ms; 0b11: 1000ms; Bit5–Bit4: Edge latch count value enabling 0b00: Disable; 0b01: Rising edge; 0b10: Falling edge; 0B11: Dual edges; Bit7–Bit6: Reserved Bit9–Bit8: Comparison consistent output pulse width 0b00: 1ms; 0b01: 2ms; 0b10: 4ms; 0b11: 8ms; Bit11–Bit10: DO comparison output mode 0b00: Comparison consistent output; 0b01: Output between [lower limit of count, comparison value]; 0b10: Output between [comparison value, upper limit of count];

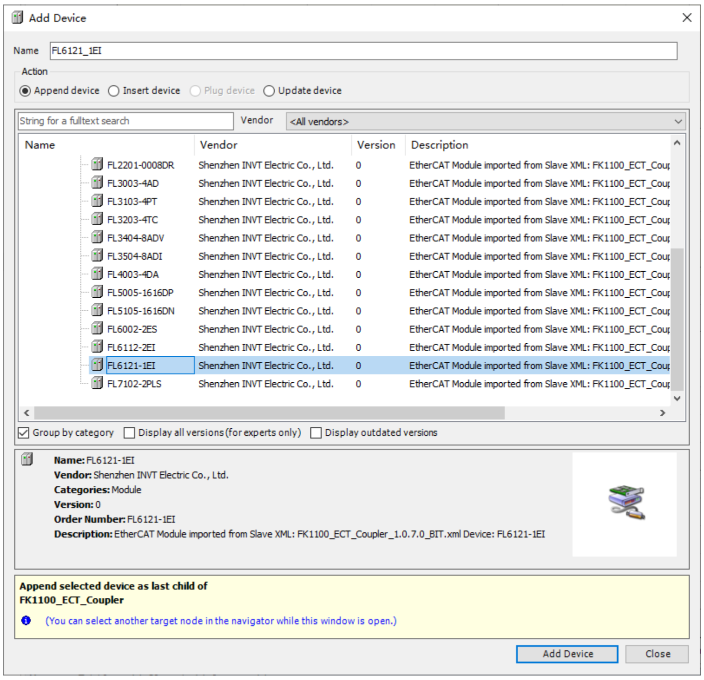
Parameter name	Type	Description
		0b11: Reserved (Comparison consistent output) Bit15–Bit12: Reserved
2EI Cnt0 Cfg	UINT	Configuration parameter for counter 1. The parameter configuration is consistent with counter 0.
2EI Cnt0 Filt	UINT	Filtering parameter for counter 0 A/B/Z/DI port. Application scope 1–65535 (Unit: 0.1μs)
2EI Cnt1 Filt	UINT	Filtering parameter for counter 1 A/B/Z/DI port. Application scope 1–65535 (Unit: 0.1μs)
2EI Cnt0 Ratio	UINT	Encoder resolution for counter 0 (number of pulses fed back from one revolution, the pulse increment between two Z pulses).
2EI Cnt1 Ratio	UINT	Encoder resolution for counter 1 (number of pulses fed back from one revolution, the pulse increment between two Z pulses).
2EI Cnt0 PresetVal	DINT	Counter 0 preset value.
2EI Cnt1 PresetVal	DINT	Counter 1 preset value.
Cnt0_Ctrl	USINT	Control parameter for counter 0. Bit0: Enable counting, valid at high levels; Bit1: Clear counting, valid at the rising edge; Bit2: Write counter preset value, valid at the rising edge; Bit3: Clear count overflow flag, valid at the rising edge; Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit7–Bit5: Reserved.
Cnt1_Ctrl	USINT	Control parameter for counter 1. The parameter configuration is consistent with counter 0.
Cnt0_CmpVal	DINT	Counter 0 comparison value.
Cnt1_CmpVal	DINT	Counter 1 comparison value.
Cnt0_Status	USINT	Counter 0 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI0 latch completion flag Bit7–Bit5: Reserved
Cnt1_Status	USINT	Counter 1 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI1 latch completion flag Bit7–Bit5: Reserved
Cnt0_Val	DINT	Count value of counter 0
Cnt1_Val	DINT	Count value of counter 1
Cnt0_LatchVal	DINT	Latched value of counter 0
Cnt1_LatchVal	DINT	Latched value of counter 1
Cnt0_Freq	UDINT	Counter 0 frequency
Cnt1_Freq	UDINT	Counter 1 frequency

Parameter name	Type	Description
Cnt0_Velocity	REAL	Counter 0 speed
Cnt1_Velocity	REAL	Counter 1 speed
Cnt0_ErrId	UINT	Counter 0 error code
Cnt1_ErrId	UINT	Counter 1 error code

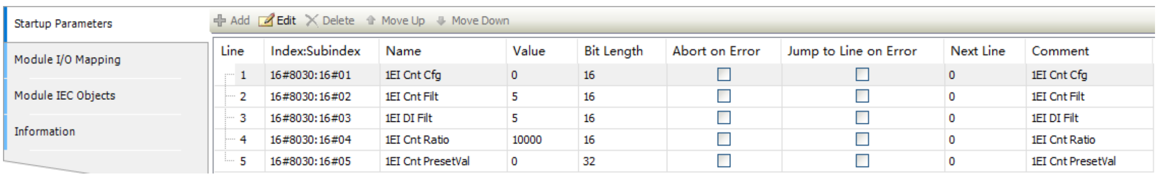
6.1.1.11 Counting and measurement module (FL6121)

1. Programming instance

Step 1 Add the FL6121-1EI device.



Step 2 Choose **Startup Parameters**, set the counter, filtering mode, encoder resolution, and counter preset values based on the actual needs, with a filter unit of 10ns.



Line	Index:Subindex	Name	Value	Bit Length	Abort on Error	Jump to Line on Error	Next Line	Comment
1	16#8030:16#01	1EI Cnt Cfg	0	16	☐	☐	0	1EI Cnt Cfg
2	16#8030:16#02	1EI Cnt Filt	5	16	☐	☐	0	1EI Cnt Filt
3	16#8030:16#03	1EI DI Filt	5	16	☐	☐	0	1EI DI Filt
4	16#8030:16#04	1EI Cnt Ratio	10000	16	☐	☐	0	1EI Cnt Ratio
5	16#8030:16#05	1EI Cnt PresetVal	0	32	☐	☐	0	1EI Cnt PresetVal

- Cnt Cfg is a counter configuration parameter, with data type of UINT. Refer to the parameter description table for data definition.

Bit	Name	Parameter description
Bit1–bit0	Channel mode configuration	2#00: A/B phase quadruple frequency (Default) 2#01: A/B phase double frequency 2#10: A/B phase rated frequency 2#11: Pulse + direction
Bit3–bit2	Frequency measurement period	2#00:20ms (Default) 2#01:100ms 2#10:500ms 2#11:1000ms

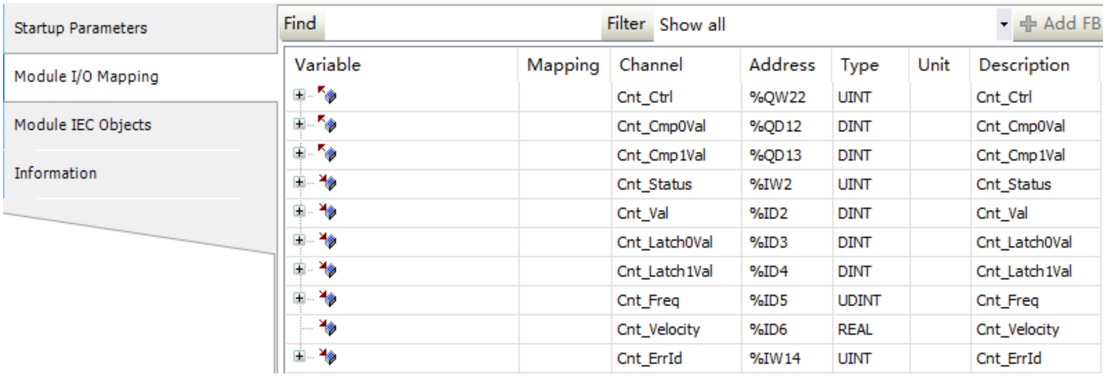
Bit	Name	Parameter description
Bit5–bit4	DI0 edge latch enabling	2#00: Disable (Default) 2#01: Rising edge 2#10: Falling edge 2#11: Dual edges
Bit7–bit6	DI1 edge latch enabling	2#00: Disable (Default) 2#01: Rising edge 2#10: Falling edge 2#11: Dual edges
Bit9–bit8	Comparison consistent pulse output width	2#00:1ms (Default) 2#01:2ms 2#10:4ms 2#11:8ms
Bit11–bit10	DO0 comparison output mode	2#00: Consistent output for comparison (Default) 2#01: Output between [Count lower limit, Comparison value] 2#10: Output between [Comparison value, Count upper limit] 2#11: Reserved
Bit13–bit12	DO1 comparison output mode	2#00: Consistent output for comparison (Default) 2#01: Output between [Count lower limit, Comparison value] 2#10: Output between [Comparison value, Count upper limit] 2#11: Reserved
Bit15–bit14	Reserved	-

Assuming that counter is configured as A/B phase quadruple frequency, the frequency measurement period is 100ms, DI0 rising edge latch and DI1 falling edge latch are enabled, comparison consistent output of 8ms, DO0 comparison output mode is comparison consistent output , DO1 comparison output mode is output between [comparison value, upper limit of count], then Cnt Cfg should be configured as 9108, i.e. 2#0010001110010100, as detailed below.

Bit15–Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
2#00	2#10		2#00		2#11		2#10		2#01		2#01		2#00	
Reserved	Output between [comparison value, upper limit of count]		Comparison consistent output		8ms		fall edge		Rising edge		100ms		A/B phase quadruple frequency	

- Cnt Filt is the filtering parameter for A/B/Z ports, in units of 10ns, with a default value of 5. If it is set to 100, it means that only signals that remain stable and do not jump within 1μs are sampled.
- DI Filt is the filtering parameter for DI0/ DI1/ DI2 ports, in units of 10ns, with a default value of 5. If it is set to 100, it means that only signals that remain stable and do not jump within 1μs are sampled.
- Cnt Ratio is the encoder resolution (number of pulses fed back from one turn, namely the pulse increment between two Z pulses), with a default value of 10000. Assuming the resolution labeled on the encoder is 2500P/R, the Cnt Ratio should be set to 10000 since the Cnt Cfg is configured as A/B phase quadruple.
- Cnt PresetVal is the counter preset value, with a default value of 0 and a parameter type of DINT.

Step 3 After configuring the above startup parameters and downloading the program, control the counter on the Module I/O mapping interface.



Variable	Mapping	Channel	Address	Type	Unit	Description
		Cnt_Ctrl	%QW22	UINT		Cnt_Ctrl
		Cnt_Cmp0Val	%QD12	DINT		Cnt_Cmp0Val
		Cnt_Cmp1Val	%QD13	DINT		Cnt_Cmp1Val
		Cnt_Status	%IW2	UINT		Cnt_Status
		Cnt_Val	%ID2	DINT		Cnt_Val
		Cnt_Latch0Val	%ID3	DINT		Cnt_Latch0Val
		Cnt_Latch1Val	%ID4	DINT		Cnt_Latch1Val
		Cnt_Freq	%ID5	UDINT		Cnt_Freq
		Cnt_Velocity	%ID6	REAL		Cnt_Velocity
		Cnt_ErrId	%IW14	UINT		Cnt_ErrId

- Cnt_Ctrl is the counter control parameter. Refer to the parameter description table for data definition.

Bit	Name	Parameter description
Bit0	Enable counting	2#0: Disable 2#1: Enable
Bit1	Clear counting	Effective at the rising edge
Bit2	Write counter preset value	Effective at the rising edge
Bit3	Clear counter overflow flag	Effective at the rising edge
Bit4	Counter comparison	2#0: Disable 2#1: Enable
Bit7–bit5	Reserved	-

- Cnt_CmpxVal (x=0,1) is the counter comparison value of type DINT.

Assuming that Cnt_Cmp0Val is set to 1000000, if you need to enable the counter for comparison, set Cnt_Ctrl to 17, which is 2#00010001. The details are as follows.

Bit7–Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
2#000	2#1	2#0	2#0	2#0	2#1
Reserved	Power on	Effective at the rising edge	Effective at the rising edge	Effective at the rising edge	Power on

- Cnt_Val is the counter counting value of type DINT.

According to the configuration value 9108 of Cnt Cfg mentioned above (enabling DO0 comparison consistent output and output pulse 8ms), when the count value Cnt_Val is equal to 1000000, DO0 will output 8ms.

If you want to clear the current count value of the counter, you need to set Cnt_Ctrl to 2, i.e. 2#00000010, as detailed below.

Bit7–Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
2#000	2#0	2#0	2#0	2#1	2#0
Reserved	Disable	Effective at the rising edge	Effective at the rising edge	Effective at the rising edge	Disable

At this point, bit1 of Cnt_Ctrl changes from 0 to 1. The FL6121_1EI module detects the rising edge of this bit, and the counter value is cleared to zero, that is, Cnt_Val is cleared to zero.

Note:

- DI0/DI1 serves as the counter latch input, with corresponding latch values of Cnt_Latch0Val/Cnt_Latch1Val.

- In Cnt_Ctrl, the function of bit1 is to clear the count value. When clearing the count value, the overflow flag of the counter will also be cleared. The function of bit3 in Cnt_Ctrl is to clear the overflow flag, and at the same time as clearing the overflow flag, the count value will not be cleared.
- DI2 is the counter reset input and it is valid at the rising edge. After the FL6121_1EI module detects a rising edge on DI2, it will reset the count value Cnt_Val to the preset value Cnt PresetVal, clear the overflow flag of the counter, and reset the latch values Cnt_Latch0Val/Cnt_Latch1Val to 0.

2. Parameter description

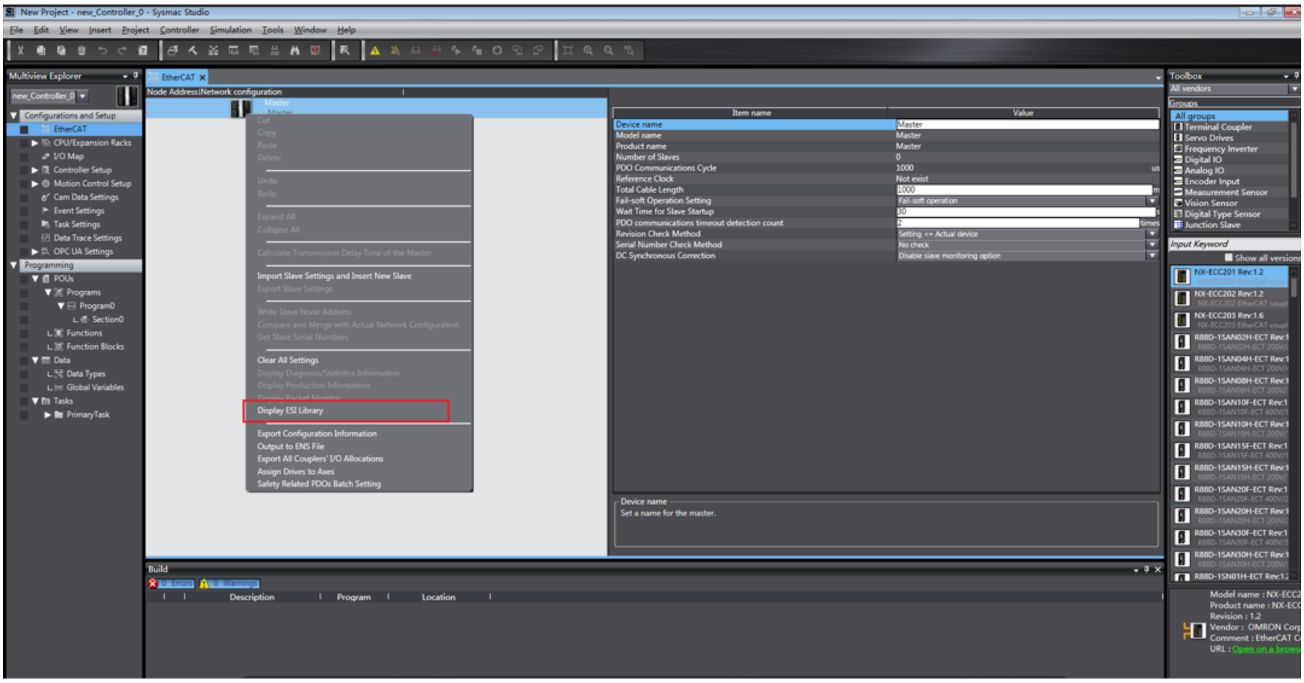
Parameter name	Type	Description
1EI Cnt Cfg	UINT	Configuration parameter for counter 0: Bit1–Bit0: Channel mode configuration 0b00: A/B phase quadruple frequency; 0b01: A/B phase double frequency; 0b10: A/B phase rated frequency; 0b11: Pulse+direction (high level, positive); Bit3–Bit2: Frequency measurement period 0b00: 20ms; 0b01: 100ms; 0b10: 500ms; 0b11: 1000ms; Bit5–Bit4: DI0 edge latch count value enabling 0b00: Disable; 0b01: Rising edge; 0b10: Falling edge; 0B11: Dual edges; Bit7–Bit6: DI1 edge latch count value enabling 0b00: Disable; 0b01: Rising edge; 0b10: Falling edge; 0B11: Dual edges; Bit9–Bit8: Comparison consistent output pulse width 0b00: 1ms; 0b01: 2ms; 0b10: 4ms; 0b11: 8ms; Bit11–Bit10: DO0 comparison output mode 0b00: Comparison consistent output; 0b01: Output between [lower limit of count, comparison value]; 0b10: Output between [comparison value, upper limit of count]; 0b11: Reserved (Comparison consistent output) Bit13–Bit12: DO1 comparison output mode 0b00: Comparison consistent output; 0b01: Output between [lower limit of count, comparison value]; 0b10: Output between [comparison value, upper limit of count]; 0b11: Reserved (Comparison consistent output) Bit15–Bit14: Reserved

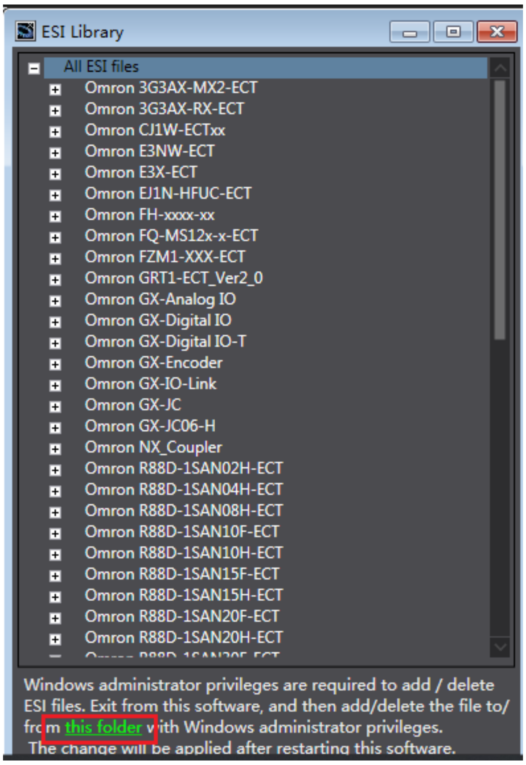
Parameter name	Type	Description
1EI Cnt Filt	UINT	Filtering parameter for counter A/B/Z port. Application scope 1–65535 (Unit: 10ns)
1EI DI Filt	UINT	Filtering parameter for counter DI port. Application scope 1–65535 (Unit: 10ns)
1EI Cnt Ratio	UINT	Encoder resolution (number of pulses fed back from one revolution, the pulse increment between two Z pulses).
1EI Cnt PresetVal	DINT	Counter preset value
Cnt_Ctrl	UINT	Control parameter for counter 0. Bit0: Enable counting, valid at high levels; Bit1: Clear counting, valid at the rising edge; Bit2: Write counter preset value, valid at the rising edge; Bit3: Clear count overflow flag, valid at the rising edge; Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit7–Bit5: Reserved.
Cnt_Cmp0Val	DINT	Counter comparison value 0
Cnt_Cmp1Val	DINT	Counter comparison value 1
Cnt_Status	UINT	Counter 0 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI0 latch completion flag Bit5: DI1 latch completion flag Bit7–Bit6: Reserved
Cnt_Val	DINT	Count value of counter
Cnt_Latch0Val	DINT	Latched value 0 of counter
Cnt_Latch1Val	DINT	Latched value 1 of counter
Cnt_Freq	UDINT	Counter frequency
Cnt_Velocity	REAL	Counter speed
Cnt_ErrId	UINT	Counter error code

6.1.2 Sysmac Studio configuration description

6.1.2.1 Installing the device descriptor file

Double-click **EtherCAT**, right-click **Master device** on the pop-up interface, choose **Display ESI library**, click **this folder** on the pop-up ESI library interface to open the ESI library folder, put the device description file **FK1100_ECT_Coupler_x.x.x.x.xml** into the folder, and restart the Sysmac Studio software.

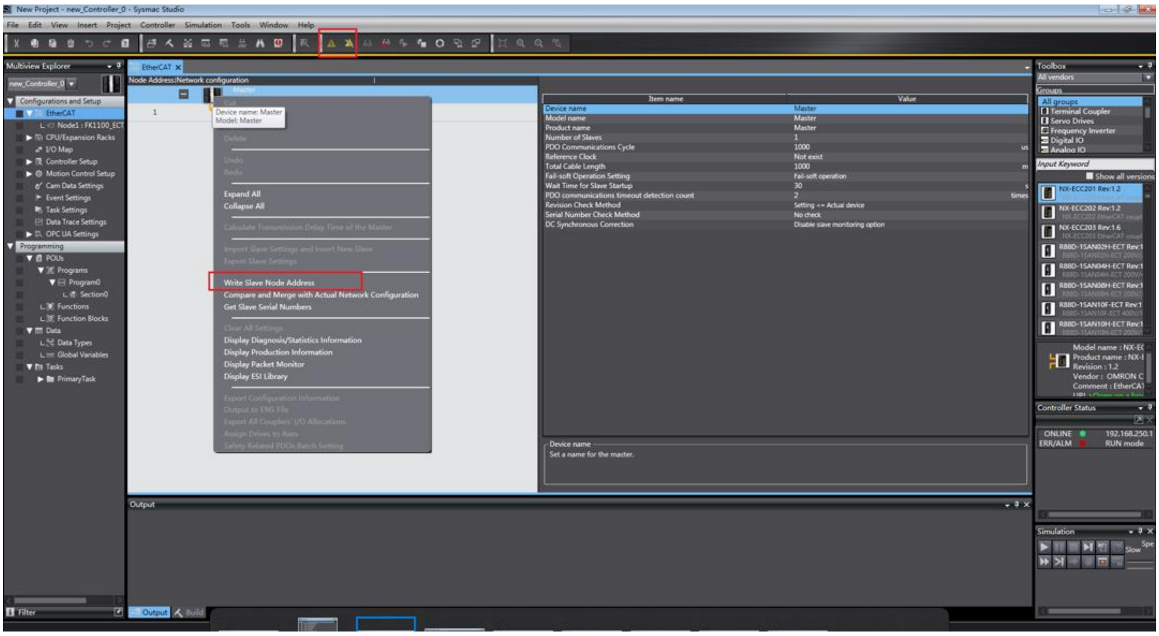


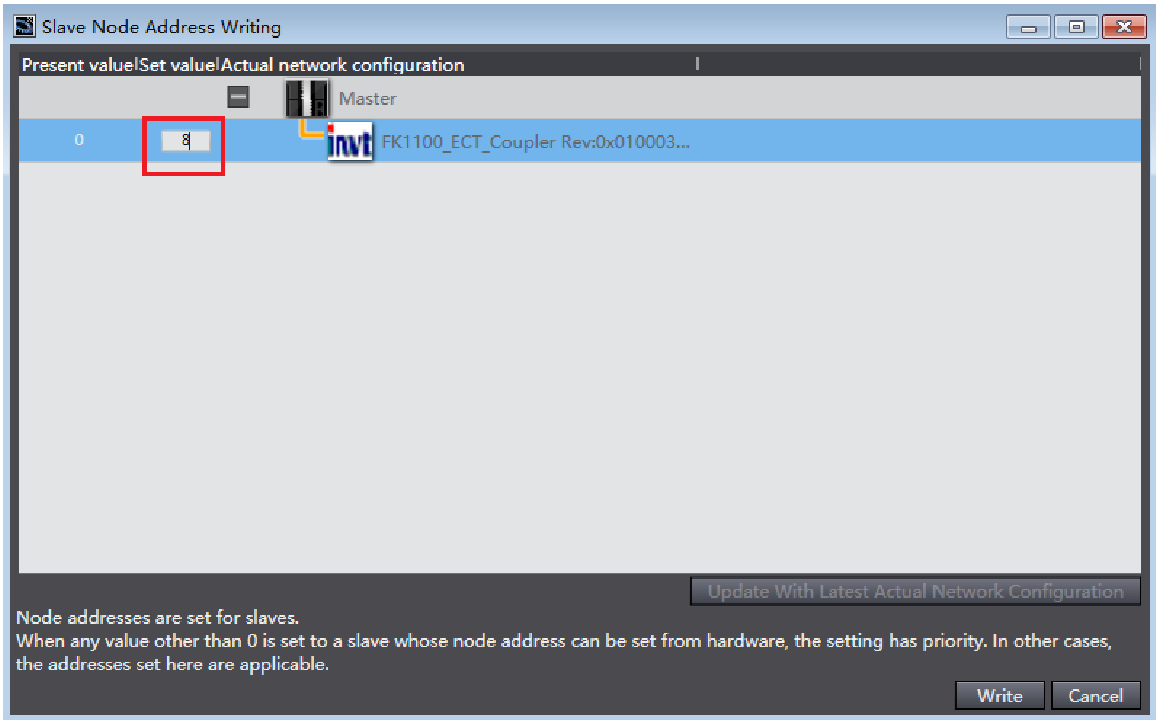


6.1.2.2 Setting the slave node address

When the coupler module is used for the first time, you need to configure the slave node address.

After the device is connected, click the online button, right-click the main device, choose **Write to Slave Node Address**, modify the setting on the pop-up **Sub-device node address writing in progress** interface (the setting ranges from 1 to 192 and cannot be repeated), and click **Write**. After successful writing, the FK1100_ECT_Coupler coupler module will take effect after power off and restart.



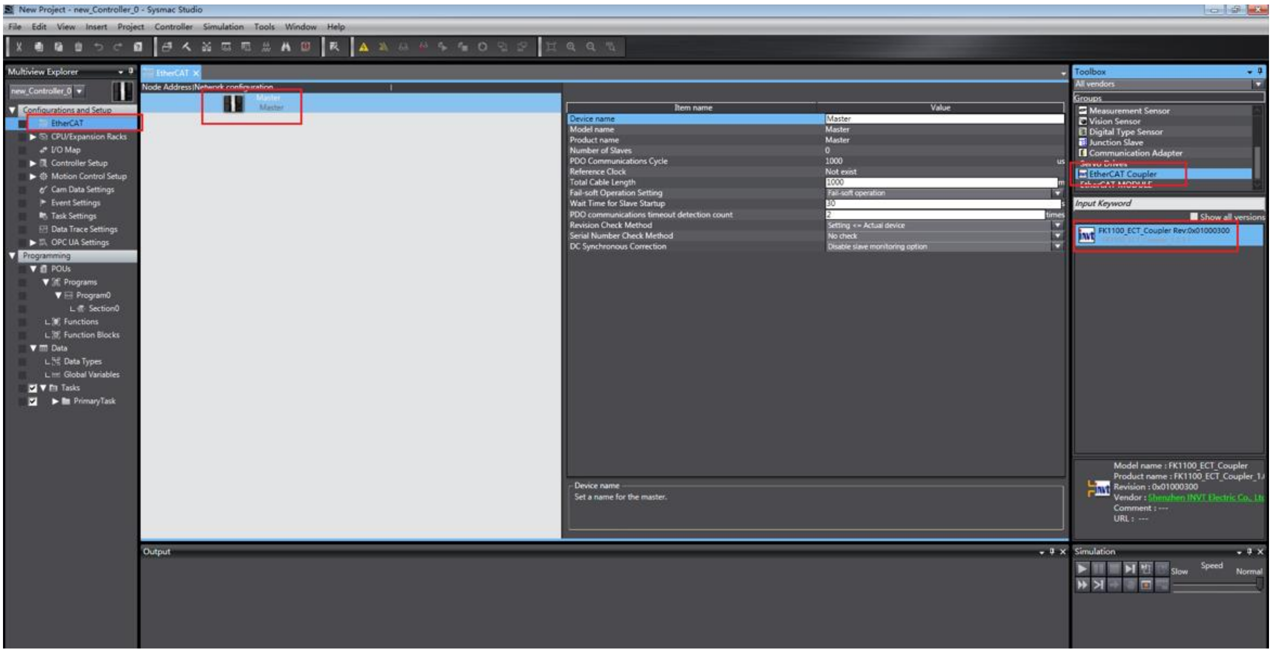


6.1.2.3 Performing network configuration

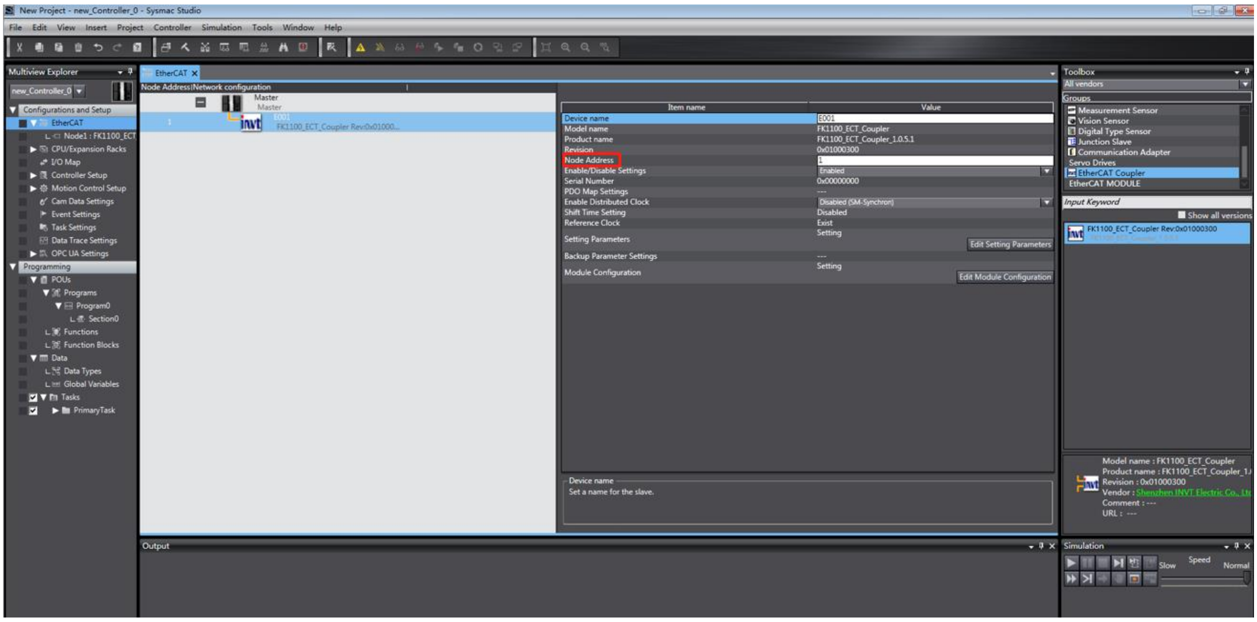
■ **Manual configuration**

1. Add FK1100 ECT Couper Slave.

In offline state, double-click **EtherCAT** > **Master**, find the EtherCAT coupler with the INVT label in the toolbar on the right, double-click **FK1100_ECT_Coupler** to add the coupler slave.

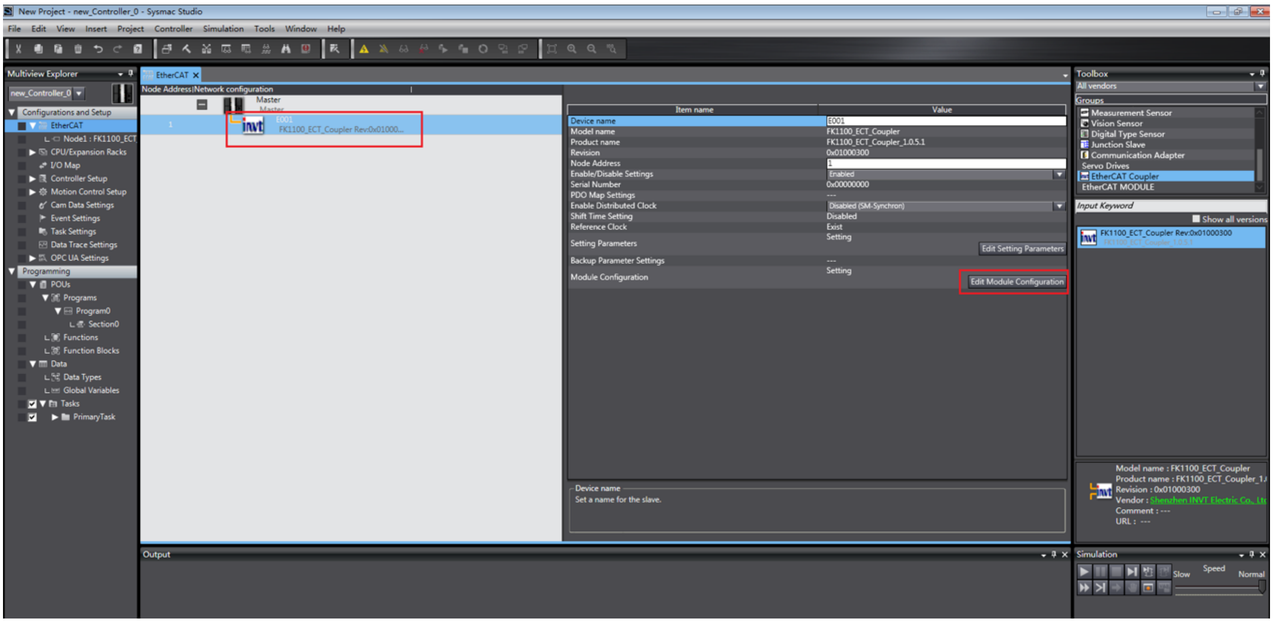


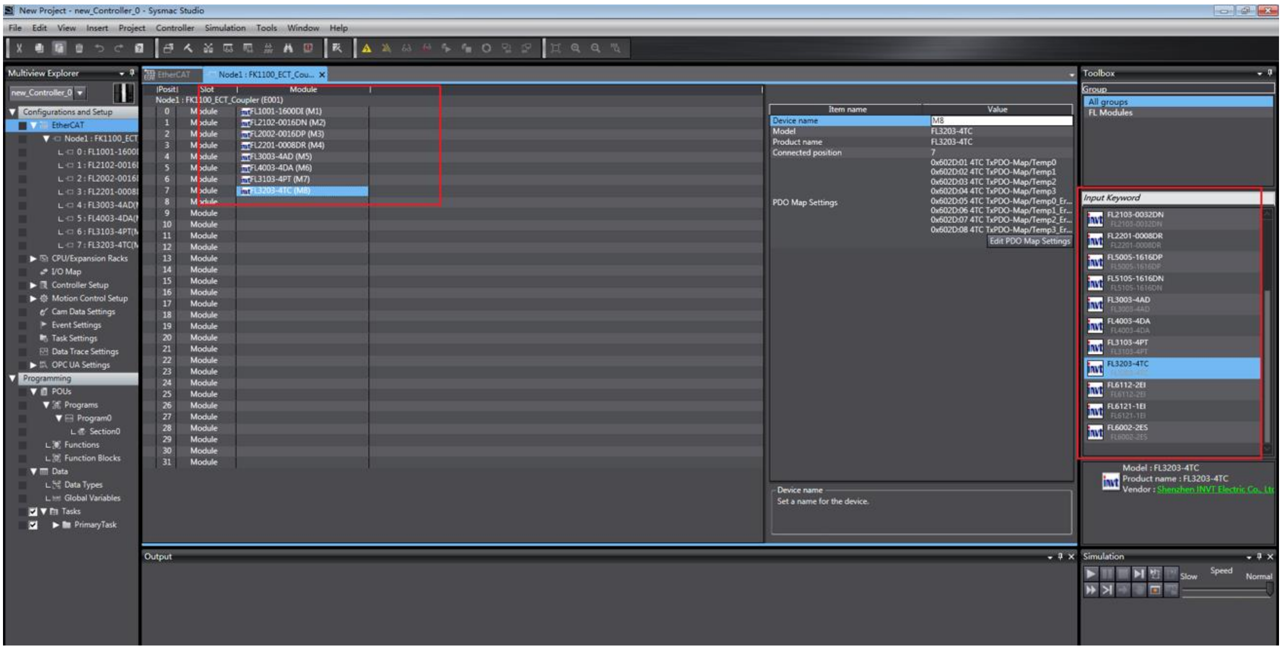
Note: The address of the sub-node here needs to be consistent with the one configured in 6.1.2.2 Setting the slave node address.



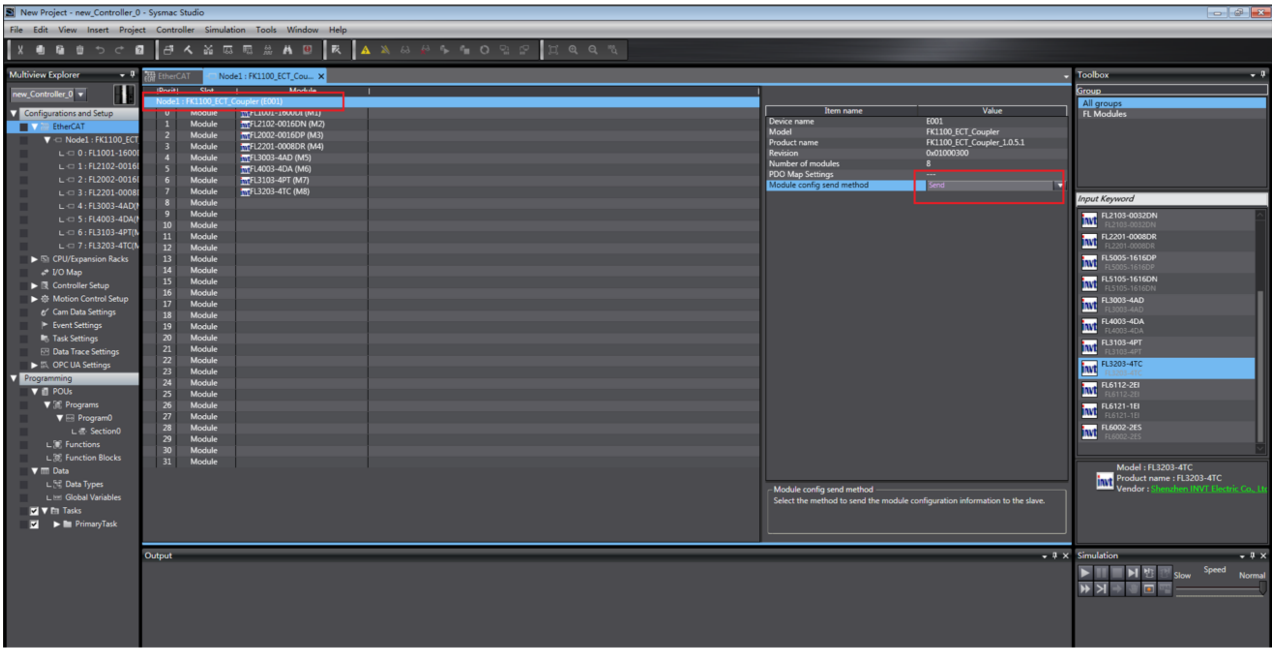
2. Add the expansion module.

Click **FK1100_ECT_Coupler** that has been added, then click **Edit Module Configuration** in the configuration box on the right. Based on the actual physical connection of the modules, add the modules from the toolbar to the slots.





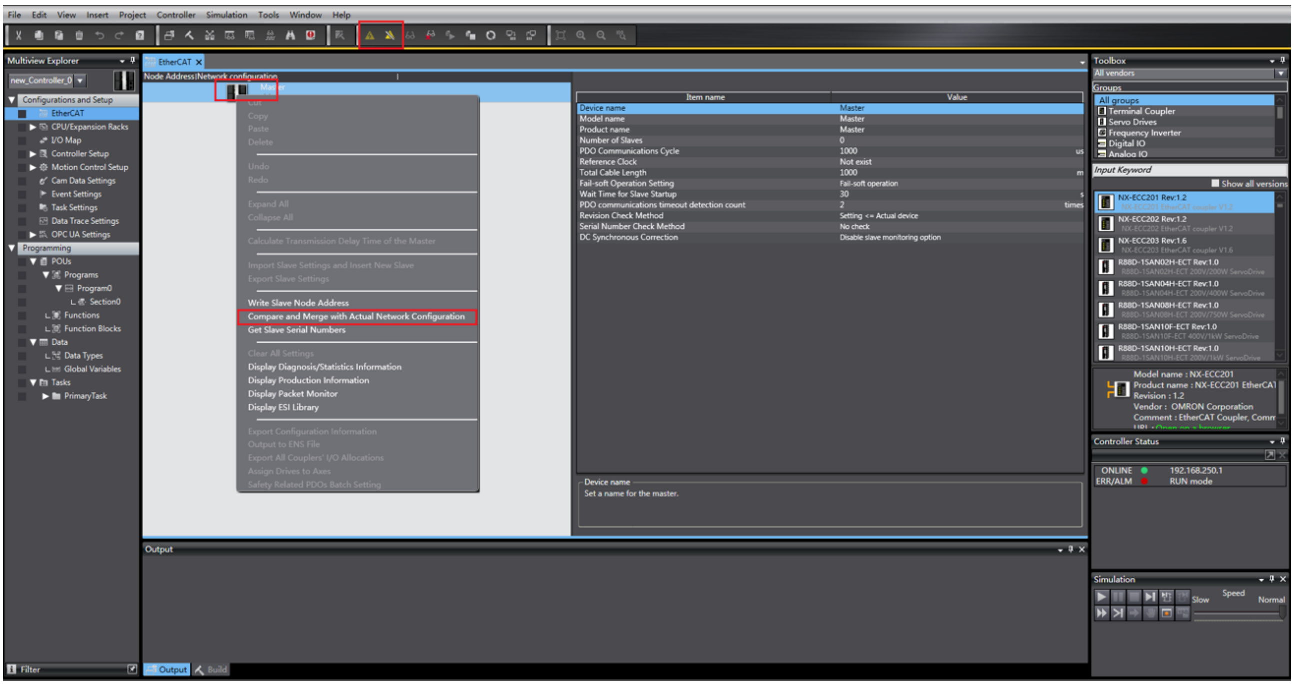
✎**Note**: On this interface (node configuration interface), click **Node: FK1100_ECT_Coupler**, and change **Module config send method** to **Send** on the right configuration interface. If the network configuration is not modified, it will not be sent to the slave node, and thus the slave node cannot receive the network configuration, resulting in a configuration mismatch error. In addition, EtherCAT communication will also fail to enter the OP state.

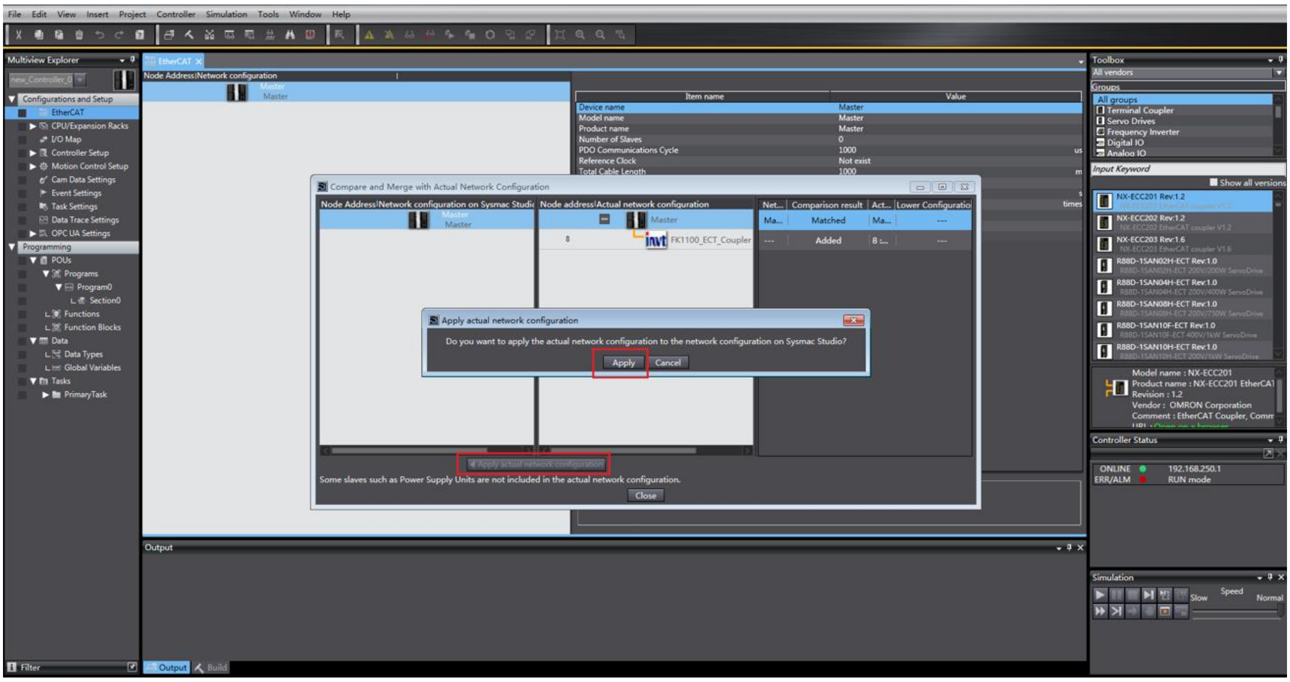


Note: The physical configuration must be consistent with the network configuration. If the configuration is inconsistent, EtherCAT communication cannot enter the OP state.

- **Automatic scanning**

Click the online button, right-click **Master**, choose **Compare and Merge with Actual Network Configuration**, and click **Apply actual network configuration** on the pop-up **Compare and Merge with Actual Network Configuration** interface.



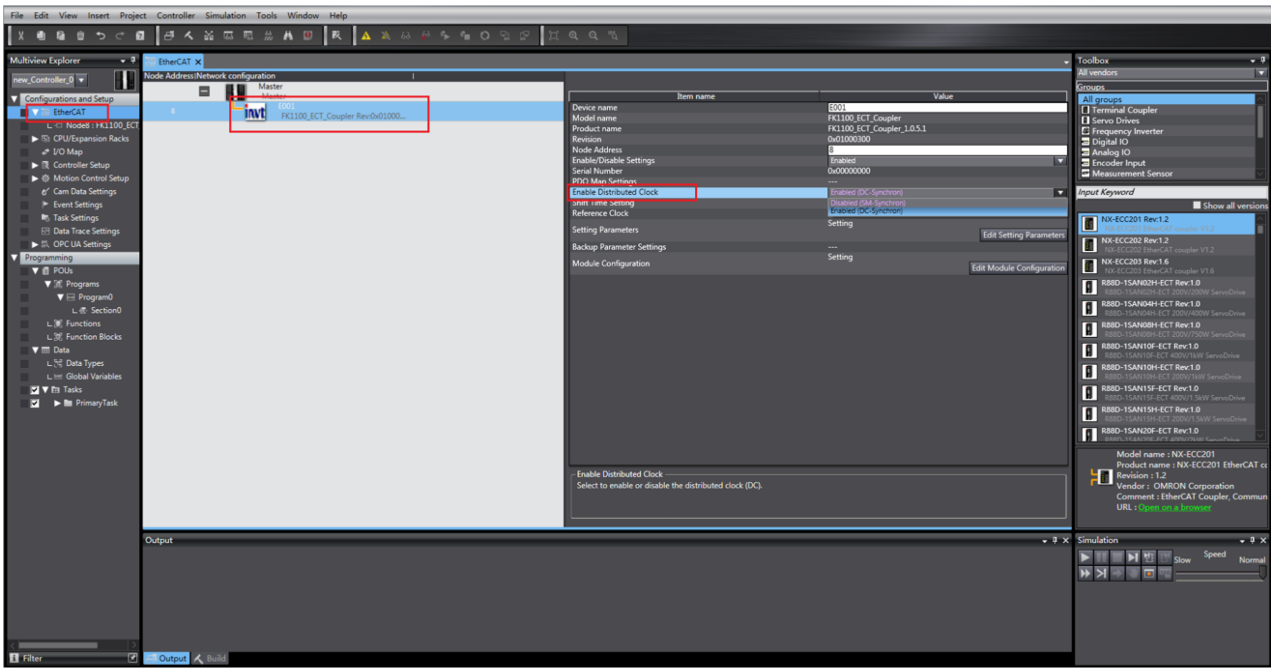


Note:

- For offline state, on the node configuration interface, click **Node: FK1100_ECT_Coupler**, and change **Module config send method** to **Send** on the right configuration interface. If the network configuration is not modified, it will not be sent to the slave node, and thus the slave node cannot receive the network configuration, resulting in a configuration mismatch error. In addition, EtherCAT communication will also fail to enter the OP state.
- After the automatic scanning, it is recommended to check whether the network configuration and physical configuration added by the scan match, and adjustments can be made manually.

6.1.2.4 EtherCAT communication parameter configuration

1. Synchronous mode: Double-click **EtherCAT**, click **FK1100_ECT_Coupler** on the pop-up interface, and set **Enable Distributed Clock** on the right side.



2. Synchronization period: /

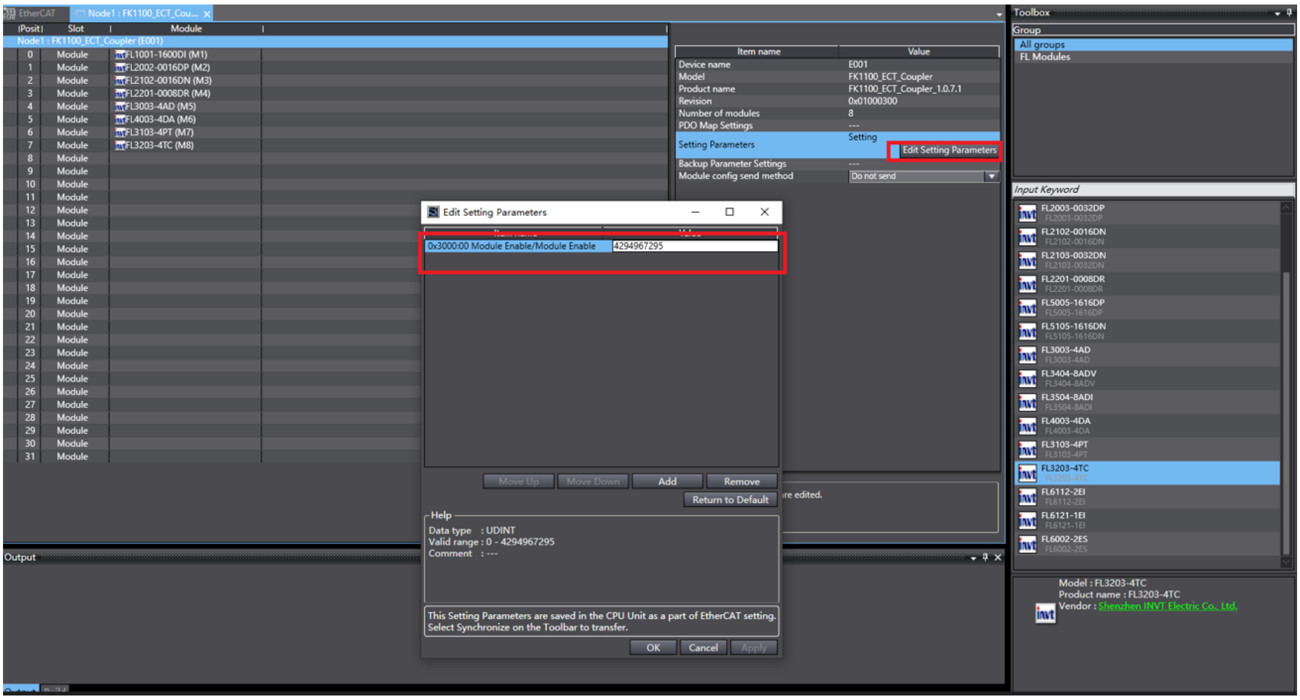
6.1.2.5 Module configuration parameter

Testing revealed that some versions of Omron support visual configuration of initialization parameters, while others do not. The testing results on Omron's Sysmac Studio V1.52 are as follows; other versions may vary depending on specific conditions.

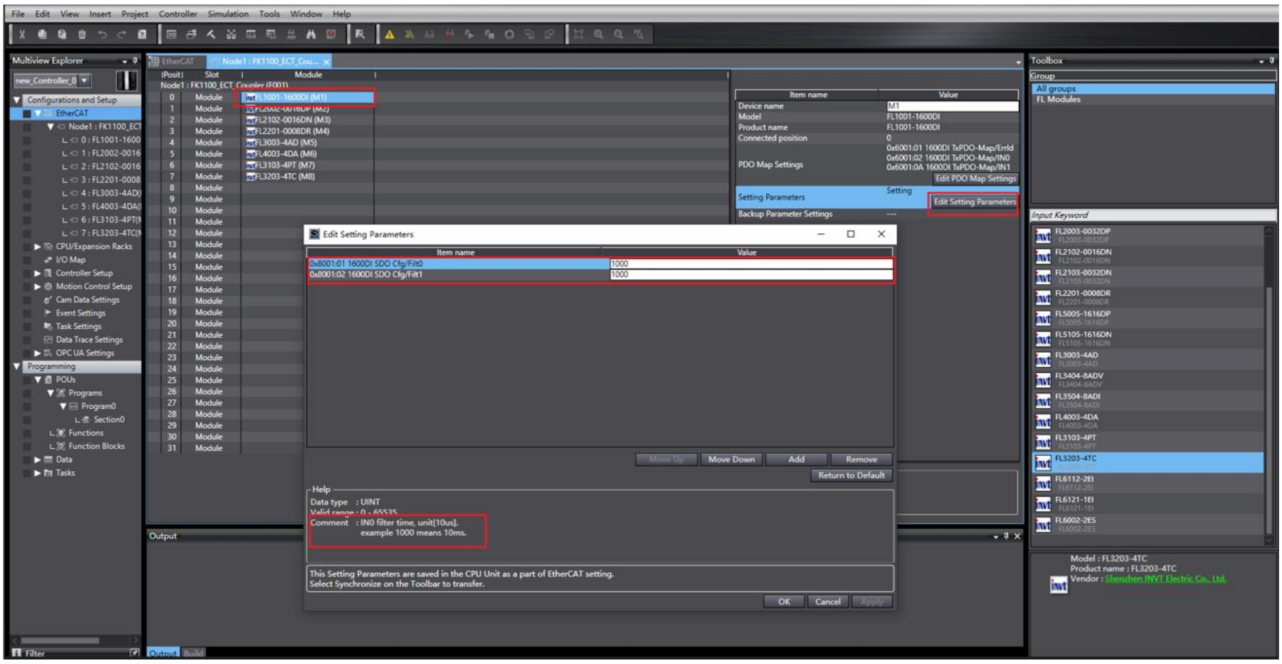
Omron host controller	Model	PLC version	Support visual configuration
NJ501	1300 1400 1500	V1.40 and later	Supported
		V1.21	Not supported
		V1.20 and earlier	Not supported
NX701	1600 1700	V1.21 and earlier	Not supported
NX1P2	9024DT 1040DT 1140DT	V1.40 and later	Supported
		V1.21	Not supported
		V1.20 and earlier	Not supported

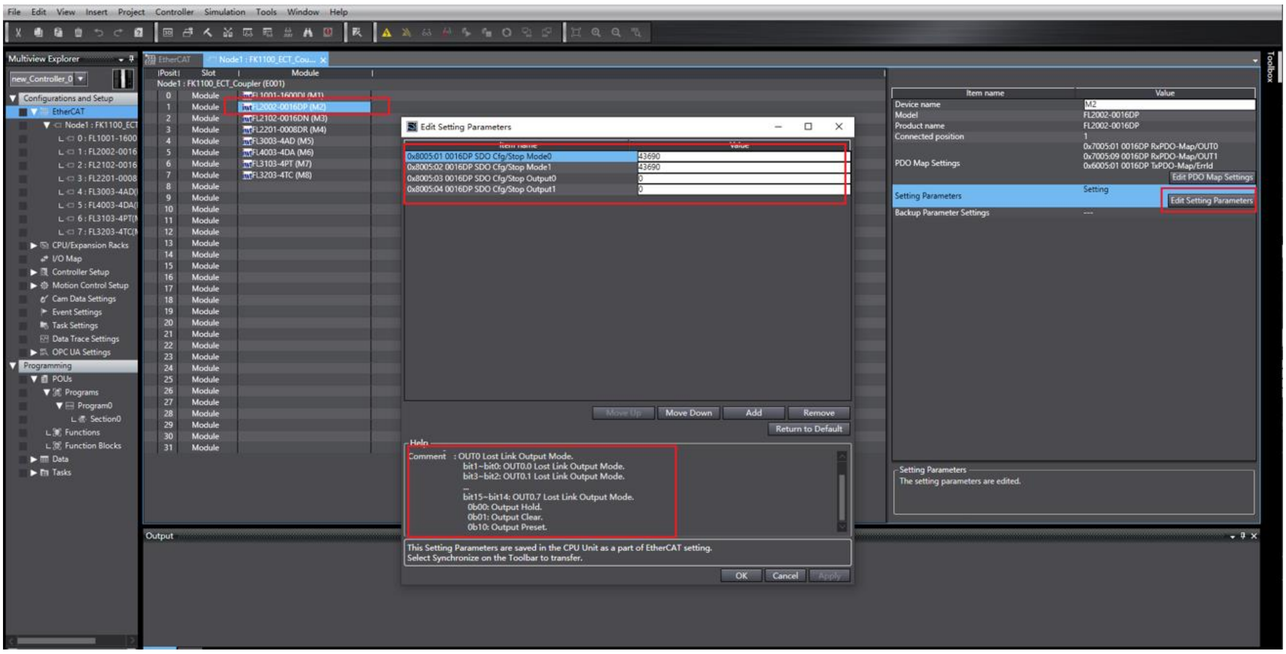
■ **Visual modification of initialization parameters**

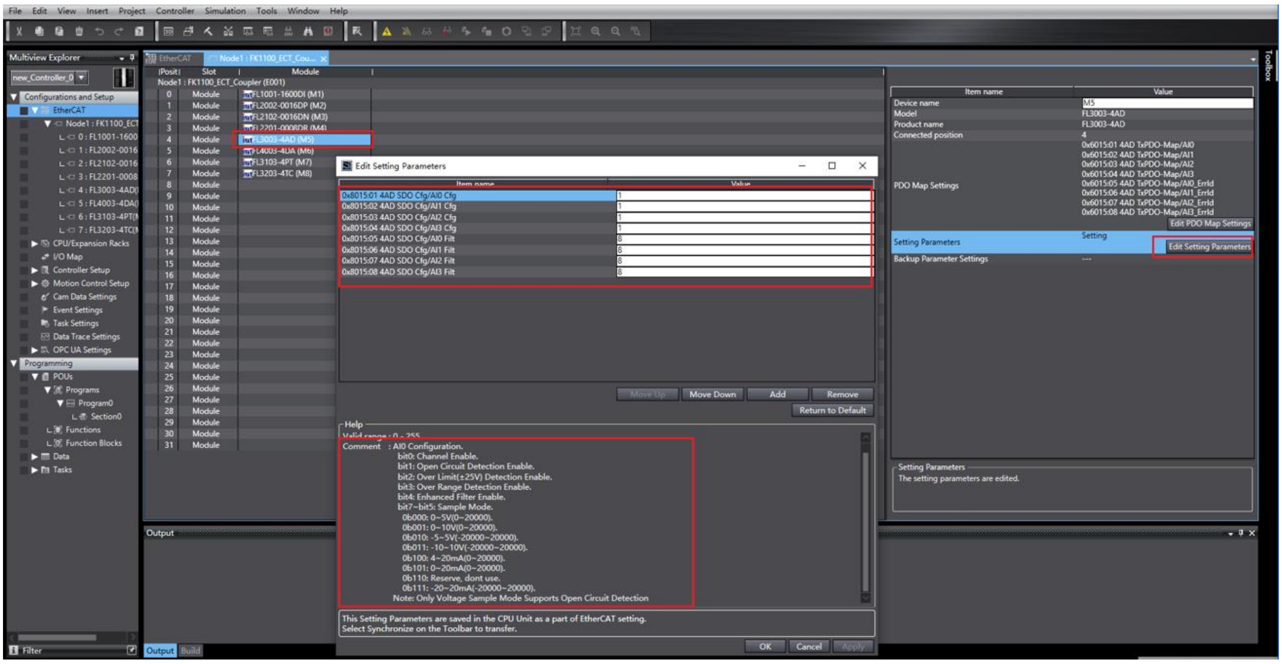
Double-click **Node 1: FK1100_ECT_Coupler**, click **Edit Setting Parameters** on the right side, and modify the coupler configuration parameter **Module Enable** on the pop-up **Edit Setting Parameters** interface. For the specific meanings of the parameters, refer to 6.1.2.7 Object dictionary description.

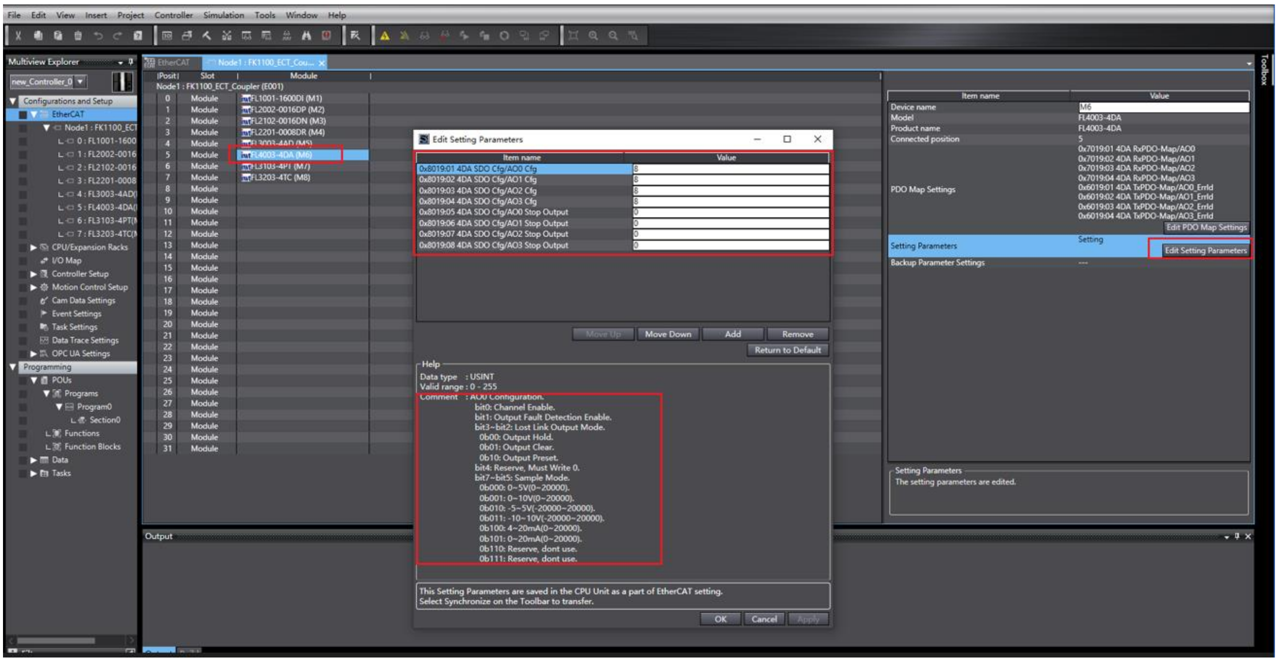


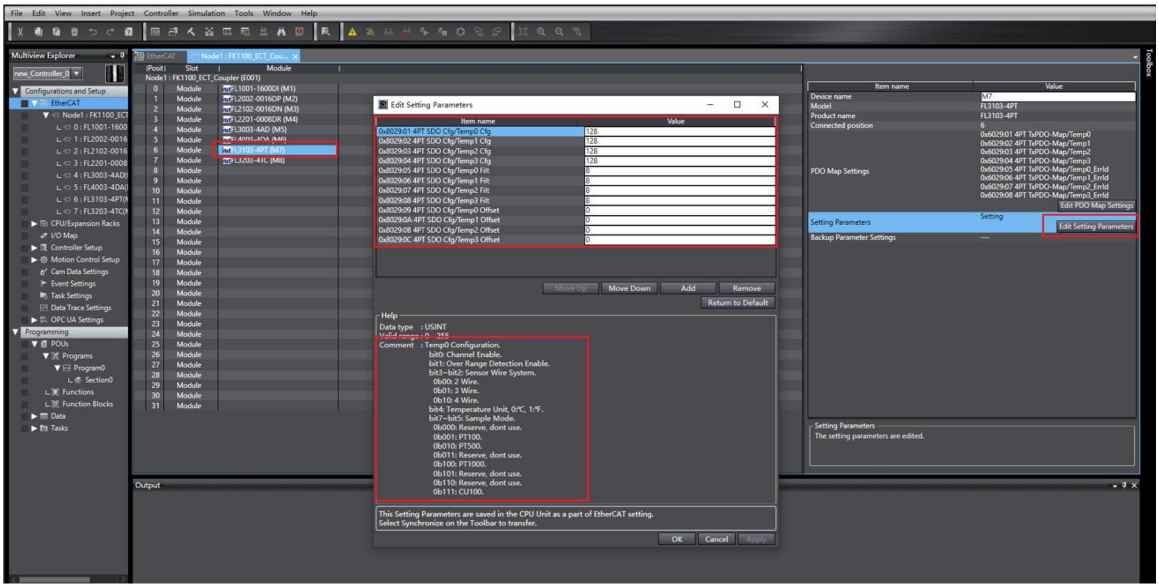
The visual configuration of other digital, analog, and temperature sampling modules can be seen in the following figures. For details of the parameters, refer to the parameter remarks in the figures and 6.1.2.7 Object dictionary description.

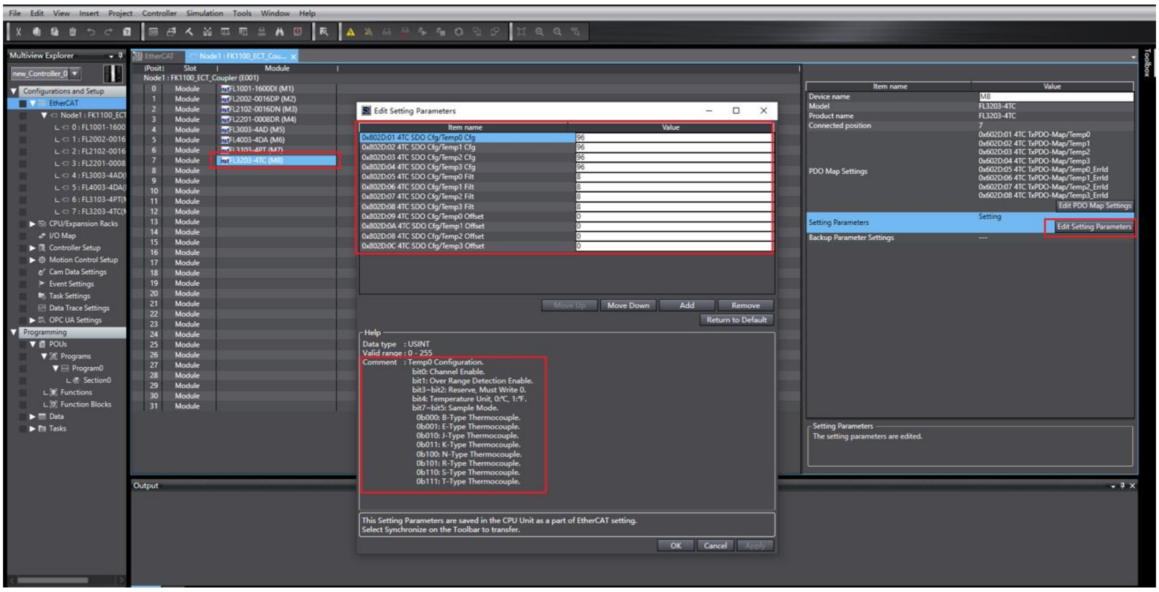






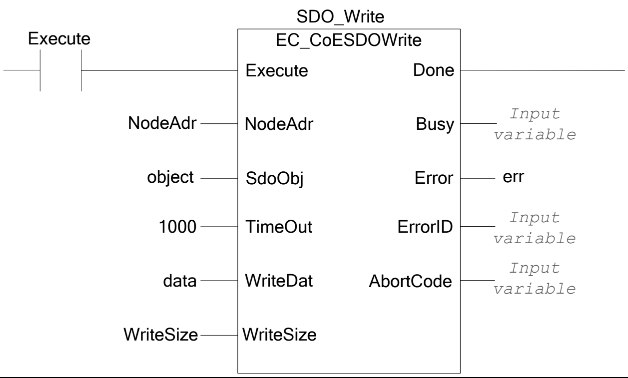






■ **Modify initialization parameters of the SDO function block**

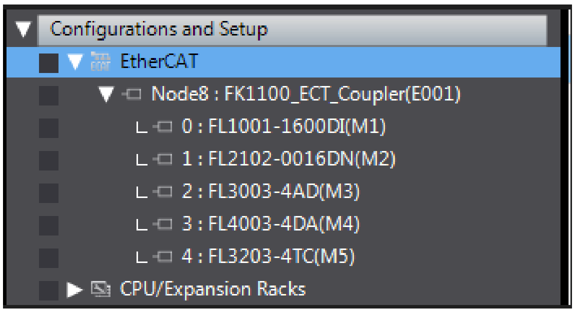
Configuration parameters are all SDO parameters. Omron does not support a PLC version that visually configures initialization parameters. Configuring SDO parameters requires the use of the EC_CoESDOWrite function block.



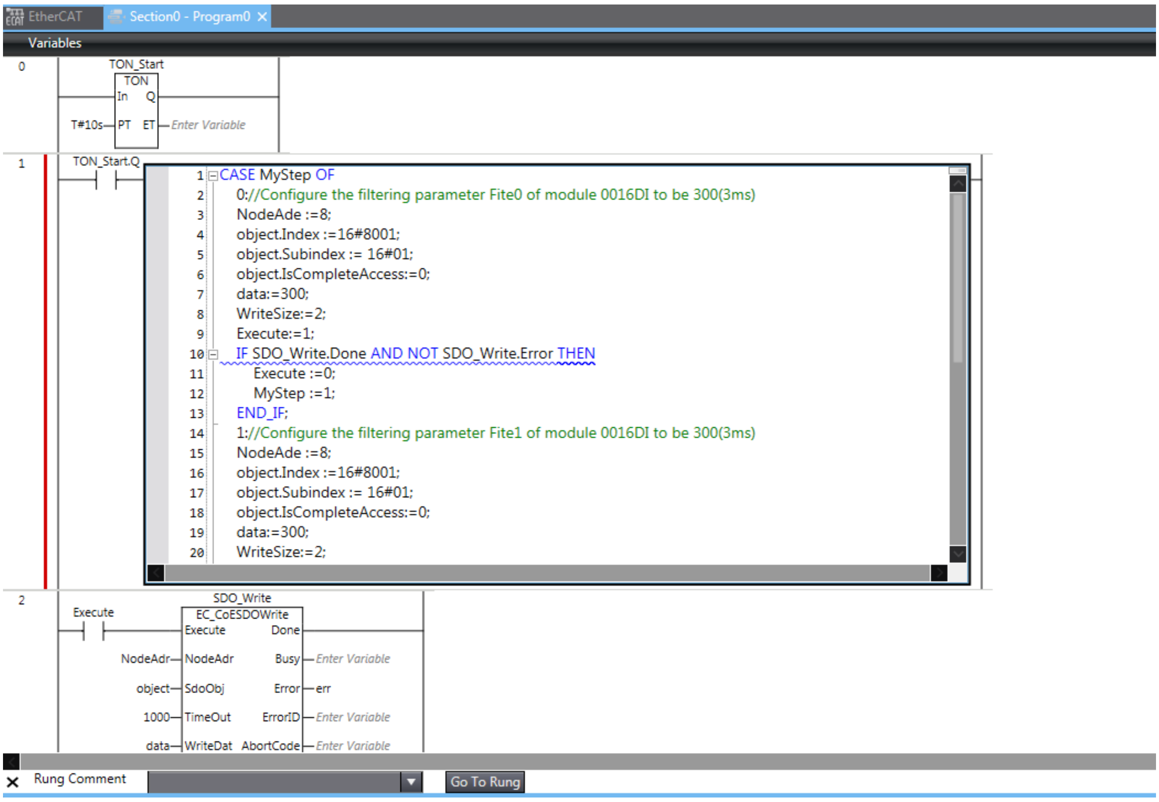
Name	Description
Execute	Rising edge active, and the rising edge enables the SDO Write function block.
NodeAdr	Node address

Name	Description
SdoObj	Object dictionary SDO parameter SdoObj.Index: Index SdoObj.Subindex: Subindex SdoObj.IsCompleteAccess: Indicates whether to access all indexes
TimeOut	Timeout time
WriteDat	Data written
WriteSize	Written data size, unit: byte

Each module configuration parameter index can be calculated by referring to 9.3 Expansion module object dictionary allocation and 6.1.2.7 Object dictionary description, each subindex can also be calculated by referring to 6.1.2.7 Object dictionary description, and the same configuration can be set up in the Invtmatic Studio to view the index and subindex of each configuration parameter in the software.



Configuration example for FK1100_ECT_Coupler + FL1001-1600DI + FL2102-0016DN + FL3003-4AD + FL4003-4DA + FL3201-4TC is as follows:



The delay before starting to write the SDO should be adjusted according to the actual situation; here, only a simple example is provided.

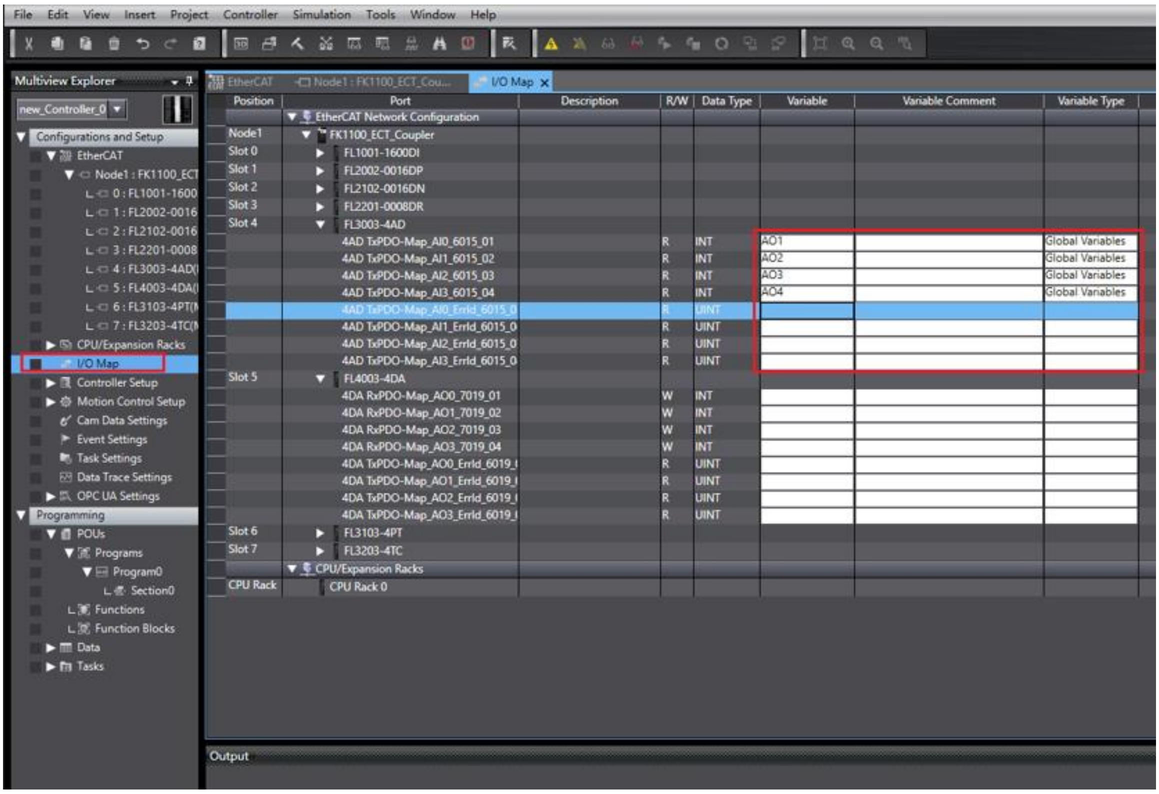
```
CASE myStep OF
```

```
0://Set the 1600DI module filter parameter Filt0 to 300 (3ms).
    NodeAdr := 8;
    object.Index := 16#8001;
    object.Subindex := 16#01;
    object.IsCompleteAccess := 0;
    data := 300;
    WriteSize  := 2;
    Execute := 1;
    IF SDO_Write.Done AND NOT SDO_Write.Error THEN
        Execute := 0;
        myStep := 1;
    END_IF;
1://Set the 1600DI module filter parameter Filt1 to 300 (3ms).
    NodeAdr := 8;
    object.Index := 16#8001;
    object.Subindex := 16#02;
    object.IsCompleteAccess := 0;
    data := 300;
    WriteSize  := 2;
    Execute := 1;
    IF SDO_Write.Done AND NOT SDO_Write.Error THEN
        Execute := 0;
        myStep := 2;
    END_IF;
2://Set the 4AD module channel 0 configuration parameter AI0 Cfg.
    NodeAdr := 8;
    object.Index := 16#8115;
    object.Subindex := 16#01;
    object.IsCompleteAccess := 0;
    data := 16#01; //0-5V channel enable
    WriteSize  := 1;
    Execute := 1;
    IF SDO_Write.Done AND NOT SDO_Write.Error THEN
        Execute := 0;
        myStep := 3;
    END_IF;
3://Set the 4AD module channel 1 configuration parameter AI1 Cfg.
    NodeAdr := 8;
    object.Index := 16#8115;
    object.Subindex := 16#02;
    object.IsCompleteAccess := 0;
    data := 16#21; //0-10V channel enable
    WriteSize  := 1;
    Execute := 1;
    IF SDO_Write.Done AND NOT SDO_Write.Error THEN
        Execute := 0;
        myStep := 4;
    END_IF;
4://Set the 4AD module channel 2 configuration parameter AI2 Cfg.
    NodeAdr := 8;
    object.Index := 16#8115;
```

```
        object.Subindex := 16#03;
        object.IsCompleteAccess := 0;
        data := 16#81; //4-20mA channel enable
        WriteSize  := 1;
        Execute := 1;
        IF SDO_Write.Done AND NOT SDO_Write.Error THEN
            Execute := 0;
            myStep := 5;
        END_IF;
    5://Set 4DA module channel 0 configuration parameter AO0 Cfg.
        NodeAdr := 8;
        object.Index := 16#8199;
        object.Subindex := 16#01;
        object.IsCompleteAccess := 0;
        data := 16#1; //0-5 channel enable
        WriteSize  := 1;
        Execute := 1;
        IF SDO_Write.Done AND NOT SDO_Write.Error THEN
            Execute := 0;
            myStep := 6;
        END_IF;
    6://Set 4DA module channel 1 configuration parameters AO1 Cfg.
        NodeAdr := 8;
        object.Index := 16#8199;
        object.Subindex := 16#02;
        object.IsCompleteAccess := 0;
        data := 16#21; //0-10 channel enable
        WriteSize  := 1;
        Execute := 1;
        IF SDO_Write.Done AND NOT SDO_Write.Error THEN
            Execute := 0;
            myStep := 7;
        END_IF;
    7://Set 4DA module channel 2 configuration parameter AO2 Cfg.
        NodeAdr := 8;
        object.Index := 16#8199;
        object.Subindex := 16#03;
        object.IsCompleteAccess := 0;
        data := 16#81; //4-20mA channel enable
        WriteSize  := 1;
        Execute := 1;
        IF SDO_Write.Done AND NOT SDO_Write.Error THEN
            Execute := 0;
            myStep := 8;
        END_IF;
    8://Set 4TC module channel 0 configuration parameter Temp0 Cfg.
        NodeAdr := 8;
        object.Index := 16#822D;
        object.Subindex := 16#01;
        object.IsCompleteAccess := 0;
        data := 16#61; // K-type thermocouple channel enable
```

```
            WriteSize  := 1;
            Execute := 1;
            IF SDO_Write.Done AND NOT SDO_Write.Error THEN
                Execute := 0;
                myStep := 9;
            END_IF;
        9:
            //do something
            ;
    END_CASE;
```

6.1.2.6 Module process data



6.1.2.7 Object dictionary description

■ **FK1100_ECT_Coupler**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x3000:00	Module Enable	UDINT	Enabling/disabling control bits for the expansion modules behind the coupler, with each bit controlling the enabling/disabling of a module. ● bit0 controls the 1st module. ● bit1 controls the 2nd module. ● … ● bit31 controls the 32nd module. TRUE: Enable FALSE: Disable
Control parameter	-	-	-	-

Name	Index--Subindex	Parameter	Type	Description
RxPDO				
Feedback parameter TxPDO	-	-	-	-
Status parameter SDO	0x3080	Coupler Info	-	Coupler information.
	Subindex 0x01	ActNum	UINT	Number of connected expansion modules.
	Subindex 0x02	HW Version	UINT	Coupler hardware version number.
	Subindex 0x03	SW Version	USINT	Coupler software version number.
	Subindex 0x04	FPGA Version	USINT	Coupler FPGA software version number.
	0xF050	Detected Module Ident List	-	Detection module ID list.
	Subindex 0x01	SubIndex 001	UDINT	ID of 1st module detected.
	Subindex 0x02	SubIndex 002	UDINT	ID of 2nd module detected.
	…	…	…	…
	Subindex 0x20	SubIndex 032	UDINT	ID of 32nd module detected.

■ **FL1001-1600DI**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x8001+0x80*n	1600DI SDO Cfg	-	1600DI module filter configuration parameter.
	Subindex 0x01	Filt0	UINT	I0–I7 filter parameter. Unit: 10μs
	Subindex 0x02	Filt1	UINT	I10–I17 filter parameter. Unit: 10μs
Control parameter RxPDO	-	-	-	-
Feedback parameter TxPDO	0x6001+0x80*n	1600DI TxPDO	-	1600DI module status feedback parameter.
	Subindex 0x01	ErrId	UINT	Fault code.
	Subindex 0x02	I0	BIT	I0 status feedback.
	Subindex 0x03	I1	BIT	I1 status feedback.
	…	…	…	…
	Subindex 0x11	I17	BIT	I17 status feedback.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

■ **FL1002-3200DI**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x8002+0x80*n	3200DI SDO Cfg	-	3200DI module filter configuration parameter.
	Subindex 0x01	Filt0	UINT	I0–I7 filter parameter. Unit: 10μs
	Subindex 0x02	Filt1	UINT	I10–I17 filter parameter. Unit: 10μs

Name	Index--Subindex	Parameter	Type	Description
	Subindex 0x03	Filt2	UINT	I20–I27 filter parameter. Unit: 10μs
	Subindex 0x04	Filt3	UINT	I30–I37 filter parameter. Unit: 10μs
Control parameter RxPDO	-	-	-	-
Feedback parameter TxPDO	0x6002+0x80*n	3200DI TxPDO	-	3200DI module status feedback parameter.
	Subindex 0x01	ErrId	UINT	Fault code.
	Subindex 0x02	I0	BIT	I0 status feedback.
	Subindex 0x03	I1	BIT	I1 status feedback.
	…	…	…	…
	Subindex 0x21	I37	BIT	I37 status feedback.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

■ **FL2002(0016DP) & FL2102(0016DN)**

<table>
<tr><th>Name</th><th>Index--Subindex</th><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td rowspan="4">Configuration parameter SDO</td><td>0x8005+ 0x80*n</td><td>0016D* SDO Cfg</td><td>-</td><td>0016DP/DN module stop/offline configuration parameter.</td></tr>
<tr><td>Subindex 0x01</td><td>Stop Mode0</td><td>UINT</td><td>Stop/offline output mode<table><tr><td>Q0</td><td>bit1: bit0</td></tr><tr><td>Q1</td><td>bit3: bit2</td></tr><tr><td>…</td><td>…</td></tr><tr><td>Q7</td><td>bit15: bit14</td></tr></table>● 0b00: Stop/offline output retained
● 0b01: Stop/offline output cleared
● 0b10: Stop/offline output preset</td></tr>
<tr><td>Subindex 0x02</td><td>Stop Mode1</td><td>UINT</td><td>Stop/offline output mode.<table><tr><td>Q10</td><td>bit1: bit0</td></tr><tr><td>Q11</td><td>bit3: bit2</td></tr><tr><td>…</td><td>…</td></tr><tr><td>Q17</td><td>bit15: bit14</td></tr></table>● 0b00: Stop/offline output retained
● 0b01: Stop/offline output cleared
● 0b10: Stop/offline output preset</td></tr>
<tr><td>Subindex 0x03</td><td>Stop Output0</td><td>USINT</td><td>Preset value of stop/offline output.
● Bit0: Q0 stop/offline output preset
● Bit1: Q1 stop/offline output preset</td></tr>
</table>

Name	Index--Subindex	Parameter	Type	Description
				● … ● Bit7: Q7 stop/offline output preset
	Subindex 0x04	Stop Output1	USINT	Preset value of stop/offline output. ● Bit0: Q10 stop/offline output preset ● Bit1: Q11 stop/offline output preset ● … ● Bit7: Q17 stop/offline output preset
Control parameter RxPDO	0x7005+0x80*n	0016D* RxPDO	-	0016DP/DN module output control value.
	Subindex 0x01	Q0	BIT	Q0 output control.
	Subindex 0x02	Q1	BIT	Q1 output control.
	…	…	…	…
	Subindex 0x10	Q17	BIT	Q17 Output control.
Feedback parameter TxPDO	0x6005+0x80*n	0016D* TxPDO	-	0016 DP/DN module status feedback parameter.
	Subindex 0x01	ErrId	UINT	Fault code.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

■ **FL2003(0032DP) & FL2103(0032DN)**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x8006+ 0x80*n	0032D* SDO Cfg	-	0032DP/DN module stop/offline configuration parameter.
	Subindex 0x01	Stop Mode0	UINT	Stop/offline output mode. Q0: bit1: bit0 Q1: bit3: bit2 …: … Q7: bit15: bit14 ● 0b00: Stop/offline output retained ● 0b01: Stop/offline output cleared ● 0b10: Stop/offline output preset
	Subindex 0x02	Stop Mode1	UINT	Stop/offline output mode. Q10: bit1: bit0 Q11: bit3: bit2 …: … Q17: bit15: bit14 ● 0b00: Stop/offline output retained

<table>
<tr><th>Name</th><th>Index--Subindex</th><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>0b01: Stop/offline output cleared
0b10: Stop/offline output preset</td></tr>
<tr><td></td><td>Subindex 0x03</td><td>Stop Mode2</td><td>UINT</td><td>Stop/offline output mode.<table><tr><td>Q20</td><td>bit1: bit0</td></tr><tr><td>Q21</td><td>bit3: bit2</td></tr><tr><td>…</td><td>…</td></tr><tr><td>Q27</td><td>bit15: bit14</td></tr></table>
0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output preset</td></tr>
<tr><td></td><td>Subindex 0x04</td><td>Stop Mode3</td><td>UINT</td><td>Stop/offline output mode.<table><tr><td>Q30</td><td>bit1: bit0</td></tr><tr><td>Q31</td><td>bit3: bit2</td></tr><tr><td>…</td><td>…</td></tr><tr><td>Q37</td><td>bit15: bit14</td></tr></table>
0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output preset</td></tr>
<tr><td></td><td>Subindex 0x05</td><td>Stop Output0</td><td>USINT</td><td>Stop/offline output preset.
Bit0: Q0 stop/offline output preset
Bit1: Q1 stop/offline output preset
…
Bit7: Q7 stop/offline output preset</td></tr>
<tr><td></td><td>Subindex 0x06</td><td>Stop Output1</td><td>USINT</td><td>Preset value of stop/offline output.
Bit0: Q10 stop/offline output preset
Bit1: Q11 stop/offline output preset
…
Bit7: Q17 stop/offline output preset</td></tr>
<tr><td></td><td>Subindex 0x07</td><td>Stop Output2</td><td>USINT</td><td>Stop/offline output preset.
Bit0: Q20 stop/offline output preset
Bit1: Q21 stop/offline output preset
…
Bit7: Q27 stop/offline output preset</td></tr>
<tr><td></td><td>Subindex 0x08</td><td>Stop Output3</td><td>USINT</td><td>Stop/offline output preset.</td></tr>
</table>

<table>
<tr><th>Name</th><th>Index--Subindex</th><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>● Bit0: Q30 stop/offline output preset
● Bit1: Q31 stop/offline output preset
● …
● Bit7: Q37 stop/offline output preset</td></tr>
<tr><td rowspan="5">Control parameter RxPDO</td><td>0x7006+0x80*n</td><td>0032D* RxPDO</td><td>-</td><td>0032DP/DN module output control value.</td></tr>
<tr><td>Subindex 0x01</td><td>Q0</td><td>BIT</td><td>Q0 output control.</td></tr>
<tr><td>Subindex 0x02</td><td>Q1</td><td>BIT</td><td>Q1 output control.</td></tr>
<tr><td>…</td><td>…</td><td>…</td><td>…</td></tr>
<tr><td>Subindex 0x20</td><td>Q17</td><td>BIT</td><td>Q37 output control.</td></tr>
<tr><td rowspan="2">Feedback parameter TxPDO</td><td>0x6006+0x80*n</td><td>0032D* TxPDO</td><td>-</td><td>0032DP/DN module status feedback parameter.</td></tr>
<tr><td>Subindex 0x01</td><td>ErrId</td><td>UINT</td><td>Fault code.</td></tr>
<tr><td rowspan="3">Status parameter SDO</td><td>0x8078+0x80*n</td><td>Module Info</td><td>-</td><td>Module information.</td></tr>
<tr><td>Subindex 0x01</td><td>HW Version</td><td>UINT</td><td>Module hardware version number.</td></tr>
<tr><td>Subindex 0x02</td><td>FPGA Version</td><td>UINT</td><td>Module FPGA software version number.</td></tr>
<tr><td colspan="5">Note: n represents the slot where the expansion module is located, n∈[0,31]</td></tr>
</table>

■ **FL2201-0008DR**

<table>
<tr><th>Name</th><th>Index--Subindex</th><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td rowspan="3">Configuration parameter SDO</td><td>0x8004+0x80*n</td><td>0008DR SDO Cfg</td><td>-</td><td>0008DR module stop/offline configuration parameter.</td></tr>
<tr><td>Subindex 0x01</td><td>Stop Mode</td><td>UINT</td><td>Stop/offline output mode.<table><tr><td>Q0</td><td>bit1: bit0</td></tr><tr><td>Q1</td><td>bit3: bit2</td></tr><tr><td>…</td><td>…</td></tr><tr><td>Q7</td><td>bit15: bit14</td></tr></table>● 0b00: Stop/offline output retained
● 0b01: Stop/offline output cleared
● 0b10: Stop/offline output preset</td></tr>
<tr><td>Subindex 0x02</td><td>Stop Output</td><td>USINT</td><td>Preset value of stop/offline output.
● Bit0: Q0 stop/offline output preset
● Bit1: Q1 stop/offline output preset
● …
● Bit7: Q7 stop/offline output preset</td></tr>
<tr><td rowspan="3">Control parameter RxPDO</td><td>0x7004+0x80*n</td><td>0008DR RxPDO</td><td>-</td><td>0008DR module output control value.</td></tr>
<tr><td>Subindex 0x01</td><td>Q0</td><td>BIT</td><td>Q0 output control.</td></tr>
<tr><td>Subindex 0x02</td><td>Q1</td><td>BIT</td><td>Q1 output control.</td></tr>
</table>

Name	Index--Subindex	Parameter	Type	Description
	...	...	...	...
	Subindex 0x08	Q7	BIT	Q7 output control.
Feedback parameter TxPDO	0x6004+0x80*n	0008DR TxPDO	-	0008DR module status feedback parameter.
	Subindex 0x01	ErrId	UINT	Fault code.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

■ **FL3003-4AD**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x8015+0x80*n	4AD SDO Cfg	-	4AD module configuration parameter.
	Subindex 0x01	AI0 Cfg	USINT	Configuration parameter for channel 0. ● bit0: Channel enabling control. (0: Disable. 1: Enable.) ● bit1: Open-loop detection enabling control. (0: Disable. 1: Enable.) ● bit2: Over-limit detection enabling control. (0: Disable. 1: Enable.) ● bit3: Over-range enabling control. (0: Disable. 1: Enable.) ● bit4: Enhanced filter enabling control. (0: Disable. 1: Enable.) ● bit7–bit5: Channel conversion mode. ✧ 0b000: voltage 0–5V Corresponding code value: 0–20000 ✧ 0b001: voltage 0–10V Corresponding code value: 0–20000 ✧ 0b010: voltage -5–5V Corresponding code value: 20000–20000 ✧ 0b011: voltage -10–10V Corresponding code value: 20000–20000 ✧ 0b100: current 4–20mA Corresponding code value: 0–20000 ✧ 0b101: current 0–20mA Corresponding code value: 0–20000

Name	Index--Subindex	Parameter	Type	Description
				✧ 0b110: reserved ✧ 0b111: current -20–20mA Corresponding code value: 20000–20000
	Subindex 0x02	AI1 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x03	AI2 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x04	AI3 Cfg	USINT	Same as the configuration parameters for channel 0.
	Subindex 0x05	AI0 Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.
	Subindex 0x06	AI1 Filt	USINT	Same as the filter parameter for channel 0.
	Subindex 0x07	AI2 Filt	USINT	Same as the filter parameter for channel 0.
	Subindex 0x08	AI3 Filt	USINT	Same as the filter parameter for channel 0.
Control parameter RxPDO	-	-	-	-
Feedback parameter TxPDO	0x6015+0x80*n	4AD TxPDO	-	4AD module status feedback parameter.
	Subindex 0x01	AI0	INT	Conversion value for channel 0.
	Subindex 0x02	AI1	INT	Conversion value for channel 1.
	Subindex 0x03	AI2	INT	Conversion value for channel 2.
	Subindex 0x04	AI3	INT	Conversion value for channel 3.
	Subindex 0x05	AI0_ErrId	UINT	Fault code for channel 0.
	Subindex 0x06	AI1_ErrId	UINT	Fault code for channel 1.
	Subindex 0x07	AI2_ErrId	UINT	Fault code for channel 2.
	Subindex 0x08	AI3_ErrId	UINT	Fault code for channel 3.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

■ **FL4003-4DA**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x8019+0x80*n	4DA SDO Cfg	-	4DA module configuration parameter.
	Subindex 0x01	AO0 Cfg	USINT	Configuration parameter for channel 0. ● bit0: Channel enabling control. (0: Disable. 1: Enable.) ● bit1: Output fault detection

Name	Index--Subindex	Parameter	Type	Description
				enabling control. (0: Disable. 1: Enable.) ● bit3–bit2: Offline output mode ✧ 0b00: Offline output retained ✧ 0b01: Offline output cleared ✧ 0b10: Offline output preset ● bit4: Reserved ● bit7–bit5: Channel conversion mode. ✧ 0b000: voltage 0–5V Corresponding code value: 0–20000 ✧ 0b001: voltage 0–10V Corresponding code value: 0–20000 ✧ 0b010: voltage -5–+5V Corresponding code value: 20000–20000 ✧ 0b011: voltage -10–+10V Corresponding code value: 20000–20000 ✧ 0b100: current 4–20mA Corresponding code value: 0–20000 ✧ 0b101: current 0–20mA Corresponding code value: 0–20000 ✧ 0b110: Reserved ✧ 0b111: Reserved
	Subindex 0x02	AO1 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x03	AO2 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x04	AO3 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x05	AO0 Stop Output	INT	Preset value of stop/offline output for channel 0.
	Subindex 0x06	AO1 Stop Output	INT	Preset value of stop/offline output for channel 1.
	Subindex 0x07	AO2 Stop Output	INT	Preset value of stop/offline output for channel 2.
	Subindex 0x08	AO3 Stop Output	INT	Preset value of stop/offline output for channel 3.
Control parameter RxPDO	0x7019+0x80*n	4DA RxPDO	-	4DA module output control value.
	Subindex 0x01	AO0	INT	Output control value for channel 0.
	Subindex 0x02	AO1	INT	Output control value for channel 1.
	Subindex 0x03	AO2	INT	Output control value for channel 2.
	Subindex 0x04	AO3	INT	Output control value for channel 3.
Feedback	0x6019+0x80*n	4DA TxPDO	-	4DA module status feedback

Name	Index--Subindex	Parameter	Type	Description
parameter TxPDO				parameter.
	Subindex 0x01	AO0_ErrId	UINT	Fault code for channel 0.
	Subindex 0x02	AO1_ErrId	UINT	Fault code for channel 1.
	Subindex 0x03	AO2_ErrId	UINT	Fault code for channel 2.
	Subindex 0x04	AO3_ErrId	UINT	Fault code for channel 3.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

■ **FL3101-4PT**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x8029+0x80*n	4PT SDO Cfg	-	4PT module configuration parameter.
	Subindex 0x01	Temp0 Cfg	USINT	Configuration parameter for channel 0. ● bit0: Channel enabling control. (0: Disable. 1: Enable.) ● bit1: Over-range detection enabling control. (0: Disable. 1: Enable.) ● bit3–bit2: Thermistor wire system ✧ 0b00: Two-wire system ✧ 0b01: Three-wire system ✧ 0b10: Four-wire system ● bit4: Temperature unit ✧ 0: °C ✧ 1: °F ● bit7–bit5: Channel conversion mode. ✧ 0b000: Reserved ✧ 0b001: PT100 ✧ 0b010: PT500 ✧ 0b011: Reserved ✧ 0b100: PT1000 ✧ 0b101: Reserved ✧ 0b110: Reserved ✧ 0b111: CU100
	Subindex 0x02	Temp1 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x03	Temp2 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x04	Temp3 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x05	Temp0 Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value

Name	Index--Subindex	Parameter	Type	Description
				indicates a more effective filtering effect, though this consequently leads to an increased delay.
	Subindex 0x06	Temp1 Filt	USINT	Same as the filter parameter for channel 0.
	Subindex 0x07	Temp2 Filt	USINT	Same as the filter parameter for channel 0.
	Subindex 0x08	Temp3 Filt	USINT	Same as the filter parameter for channel 0.
	Subindex 0x09	Temp0 Offset	INT	Temperature offset value for channel 0. Amplified by a factor of ten, 999 represents 99.9. Detected value = Actually measured value + Offset value
	Subindex 0xA	Temp1 Offset	INT	Same as the temperature offset value for channel 0.
	Subindex 0xB	Temp2 Offset	INT	Same as the temperature offset value for channel 1.
	Subindex 0xC	Temp3 Offset	INT	Same as the temperature offset value for channel 2.
	Subindex 0xD	Temp0 Up	INT	Channel 0 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0xE	Temp1 Up	INT	Channel 1 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0xF	Temp2 Up	INT	Channel 2 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0x10	Temp3 Up	INT	Channel 3 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0x11	Temp0 Low	INT	Channel 0 temperature lower limit, reserved. Use sensor inherent limitations.
	Subindex 0x12	Temp1 Low	INT	Channel 1 temperature lower limit, reserved. Use sensor inherent limitations.
	Subindex 0x13	Temp2 Low	INT	Channel 2 temperature lower limit, reserved. Use sensor inherent limitations.
	Subindex 0x14	Temp3 Low	INT	Channel 3 temperature lower limit, reserved. Use sensor inherent limitations.
Control parameter RxPDO	-	-	-	-
Feedback	0x6029+0x80*n	4PT TxPDO	-	4PT module status feedback

Name	Index--Subindex	Parameter	Type	Description
parameter TxPDO				parameter.
	Subindex 0x01	Temp0	REAL32	Conversion value for channel 0.
	Subindex 0x02	Temp1	REAL32	Conversion value for channel 1.
	Subindex 0x03	Temp2	REAL32	Conversion value for channel 2.
	Subindex 0x04	Temp3	REAL32	Conversion value for channel 3.
	Subindex 0x05	Temp0_ErrId	UINT	Fault code for channel 0.
	Subindex 0x06	Temp1_ErrId	UINT	Fault code for channel 1.
	Subindex 0x07	Temp2_ErrId	UINT	Fault code for channel 2.
	Subindex 0x08	Temp3_ErrId	UINT	Fault code for channel 3.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

■ **FL3203-4TC**

Name	Index--Subindex	Parameter	Type	Description
Configuration parameter SDO	0x802D+0x80*n	4TC SDO Cfg	-	4TC module configuration parameter.
	Subindex 0x01	Temp0 Cfg	USINT	Configuration parameter for channel 0. ● bit0: Channel enabling control. (0: Disable. 1: Enable.) ● bit1: Over-range detection enabling control. (0: Disable. 1: Enable.) ● bit3–bit2: Reserved ● bit4: Temperature unit ✧ 0: °C ✧ 1: °F ● bit7–bit5: Channel conversion mode. ✧ 0b000: Thermocouple of type B. ✧ 0b001: Thermocouple of type E. ✧ 0b010: Thermocouple of type J. ✧ 0b011: Thermocouple of type K. ✧ 0b100: Thermocouple of type N. ✧ 0b101: Thermocouple of type R. ✧ 0b110: Thermocouple of type S. ✧ 0b111: Thermocouple of type T.

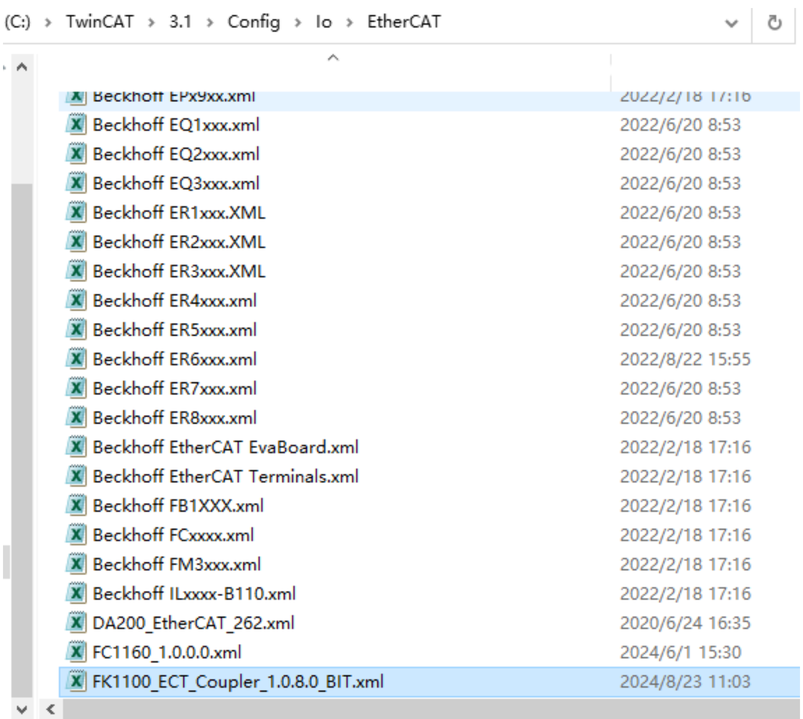
Name	Index--Subindex	Parameter	Type	Description
	Subindex 0x02	Temp1 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x03	Temp2 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x04	Temp3 Cfg	USINT	Same as the configuration parameter for channel 0.
	Subindex 0x05	Temp0 Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.
	Subindex 0x06	Temp1 Filt	USINT	Same as the filter parameter for channel 0.
	Subindex 0x07	Temp2 Filt	USINT	Same as the filter parameter for channel 0.
	Subindex 0x08	Temp3 Filt	USINT	Same as the filter parameter for channel 0
	Subindex 0x09	Temp0 Offset	INT	Temperature offset value for channel 0. Amplified by a factor of ten, 999 represents 99.9. Detected value = Actually measured value + Offset value
	Subindex 0xA	Temp1 Offset	INT	Same as the temperature offset value for channel 0.
	Subindex 0xB	Temp2 Offset	INT	Same as the temperature offset value for channel 1.
	Subindex 0xC	Temp3 Offset	INT	Same as the temperature offset value for channel 2.
	Subindex 0xD	Temp0 Up	INT	Channel 0 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0xE	Temp1 Up	INT	Channel 1 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0xF	Temp2 Up	INT	Channel 2 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0x10	Temp3 Up	INT	Channel 3 temperature upper limit, reserved. Use sensor inherent limitations.
	Subindex 0x11	Temp0 Low	INT	Channel 0 temperature lower limit, reserved. Use sensor inherent limitations.
	Subindex 0x12	Temp1 Low	INT	Channel 1 temperature lower limit, reserved. Use sensor inherent limitations.
	Subindex 0x13	Temp2 Low	INT	Channel 2 temperature lower limit, reserved. Use sensor inherent limitations.

Name	Index--Subindex	Parameter	Type	Description
	Subindex 0x14	Temp3 Low	INT	Channel 3 temperature lower limit, reserved. Use sensor inherent limitations.
Control parameter RxPDO	-	-	-	-
Feedback parameter TxPDO	0x602D+0x80*n	4TC TxPDO	-	4TC module status feedback parameter.
	Subindex 0x01	Temp0	REAL32	Conversion value for channel 0.
	Subindex 0x02	Temp1	REAL32	Conversion value for channel 1.
	Subindex 0x03	Temp2	REAL32	Conversion value for channel 2.
	Subindex 0x04	Temp3	REAL32	Conversion value for channel 3.
	Subindex 0x05	Temp0_ErrId	UINT	Fault code for channel 0.
	Subindex 0x06	Temp1_ErrId	UINT	Fault code for channel 1.
	Subindex 0x07	Temp2_ErrId	UINT	Fault code for channel 2.
	Subindex 0x08	Temp3_ErrId	UINT	Fault code for channel 3.
Status parameter SDO	0x8078+0x80*n	Module Info	-	Module information.
	Subindex 0x01	HW Version	UINT	Module hardware version number.
	Subindex 0x02	FPGA Version	UINT	Module FPGA software version number.
Note: n represents the slot where the expansion module is located, n∈[0,31]				

6.1.3 TwinCAT3 configuration description

6.1.3.1 Installing the device description file

Copy the device description file named like FK1100_ECT_Coupler_x.x.x.x.xml to the directory **C:\TwinCAT\3.1\Config\Io\EtherCAT**, and restart the TwinCAT software.

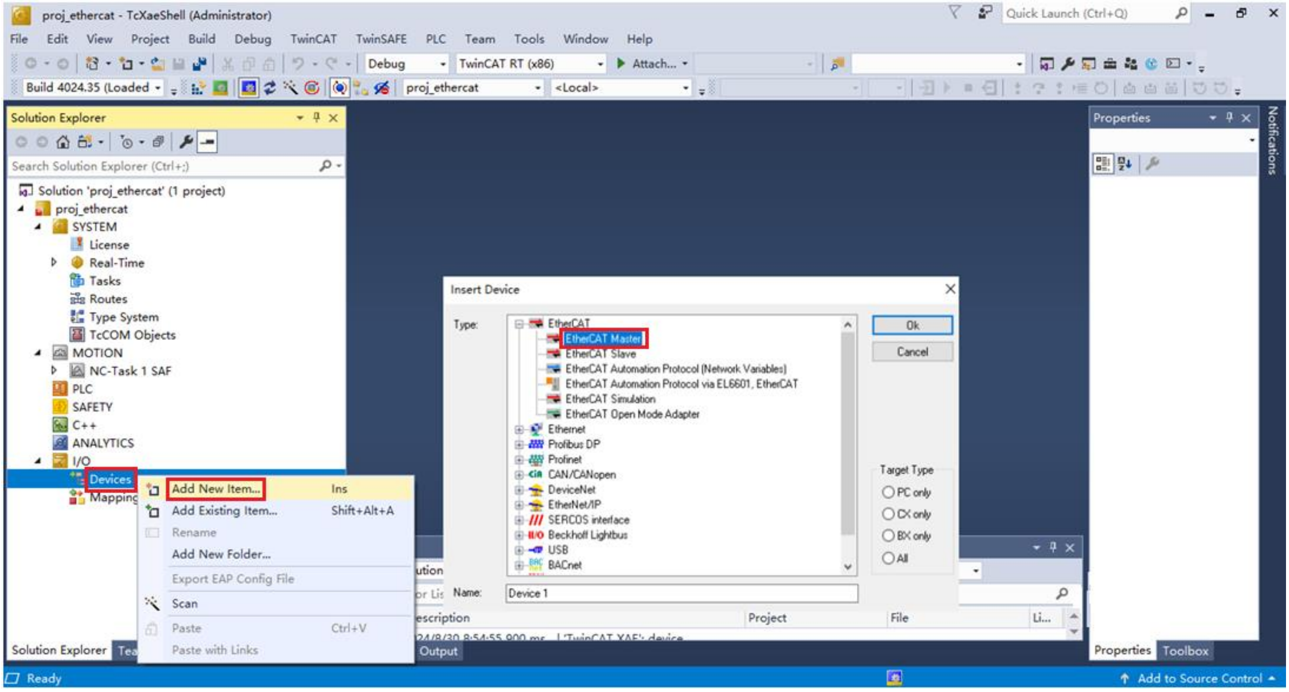


6.1.3.2 Performing network configuration

■ **Manual configuration**

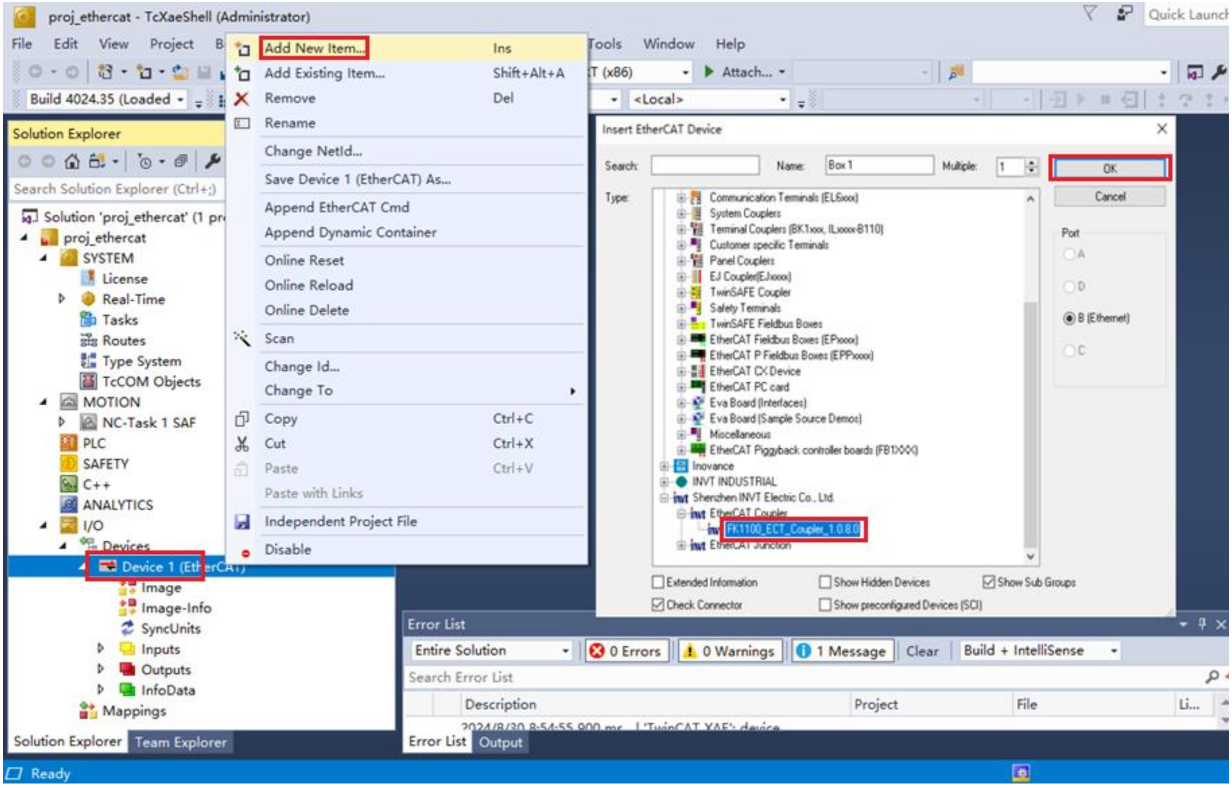
Step 1 Add EtherCAT Master.

Right-click **Devices** under **I/O**, choose **Add New Item**, choose **EtherCAT Master** on the pop-up **Insert Device** interface, and select the correct network port on the pop-up **Device Found At** interface.



Step 2 Add FK1100_ECT_Coupler Slave.

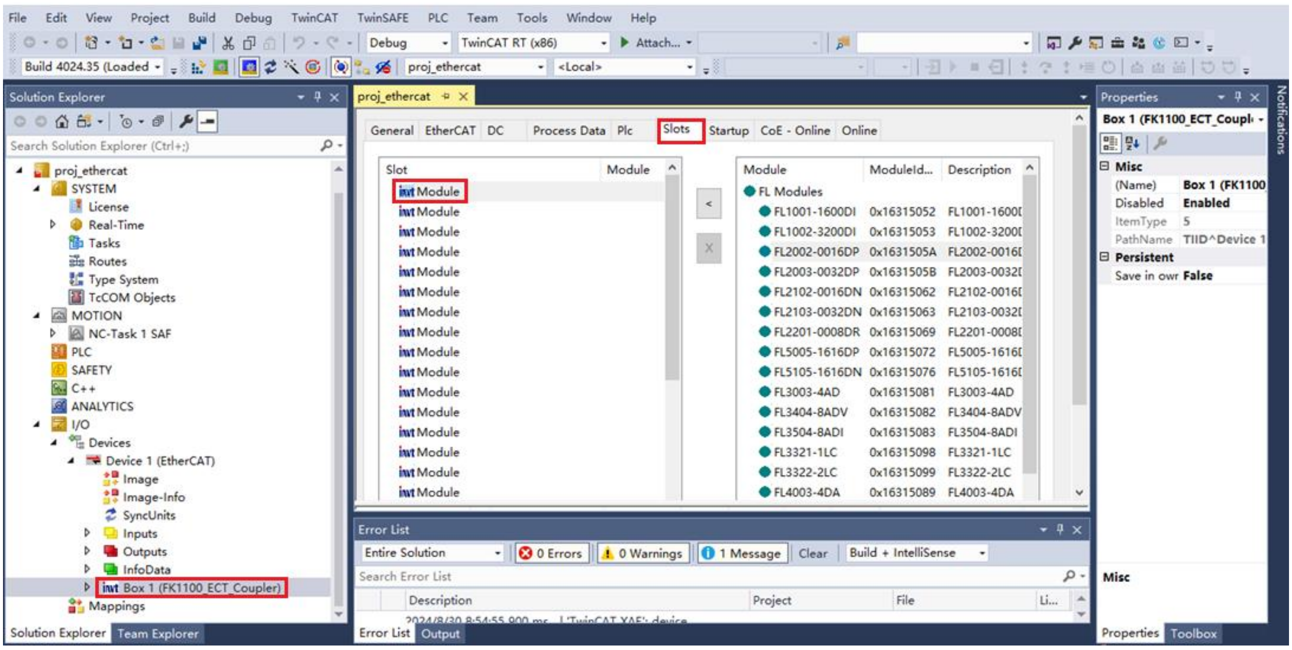
Right click **Device 1**(**EtherCAT)** under **Devices**, choose **Add New Item**, find FK1100_ECT_Coupler on the pop-up **Insert EtherCAT Device** interface, and click **OK** to add an EtherCAT slave.

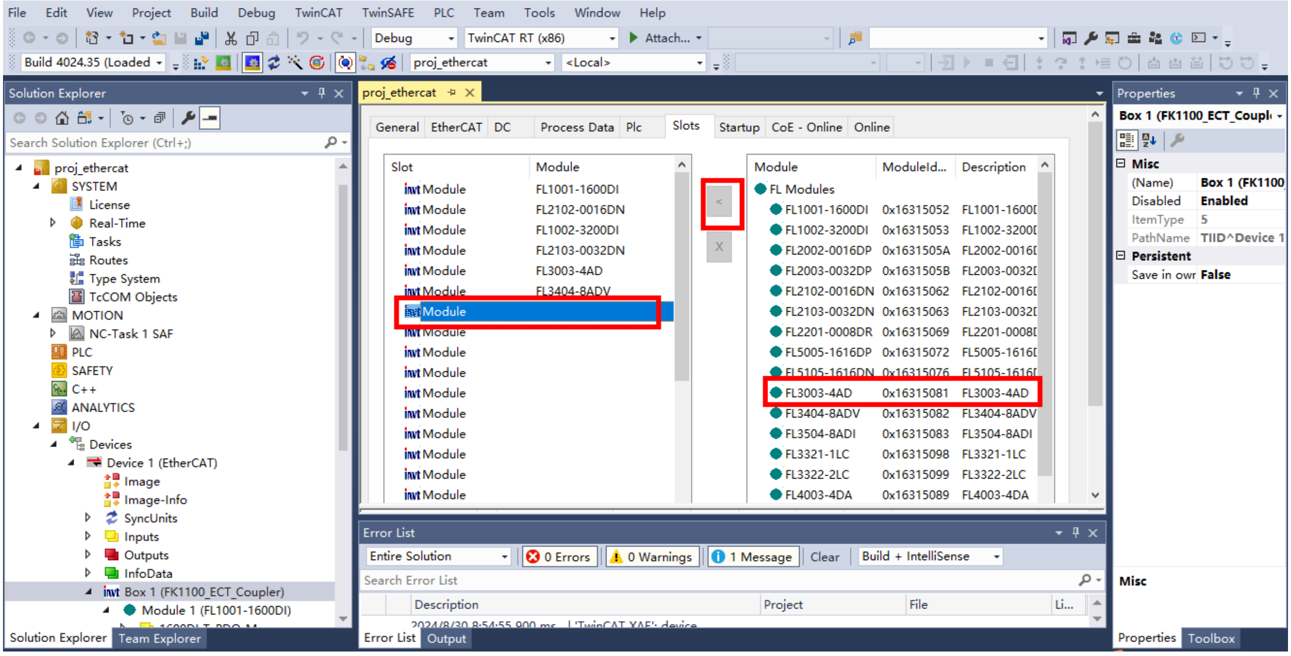


Step 3 Add the expansion module.

Double click **FK1100_ECT_Coupler** and click the **Slots** tab. Based on the physical configuration (actual physical connection sequence), correctly add the modules on the right to the slots on the left.

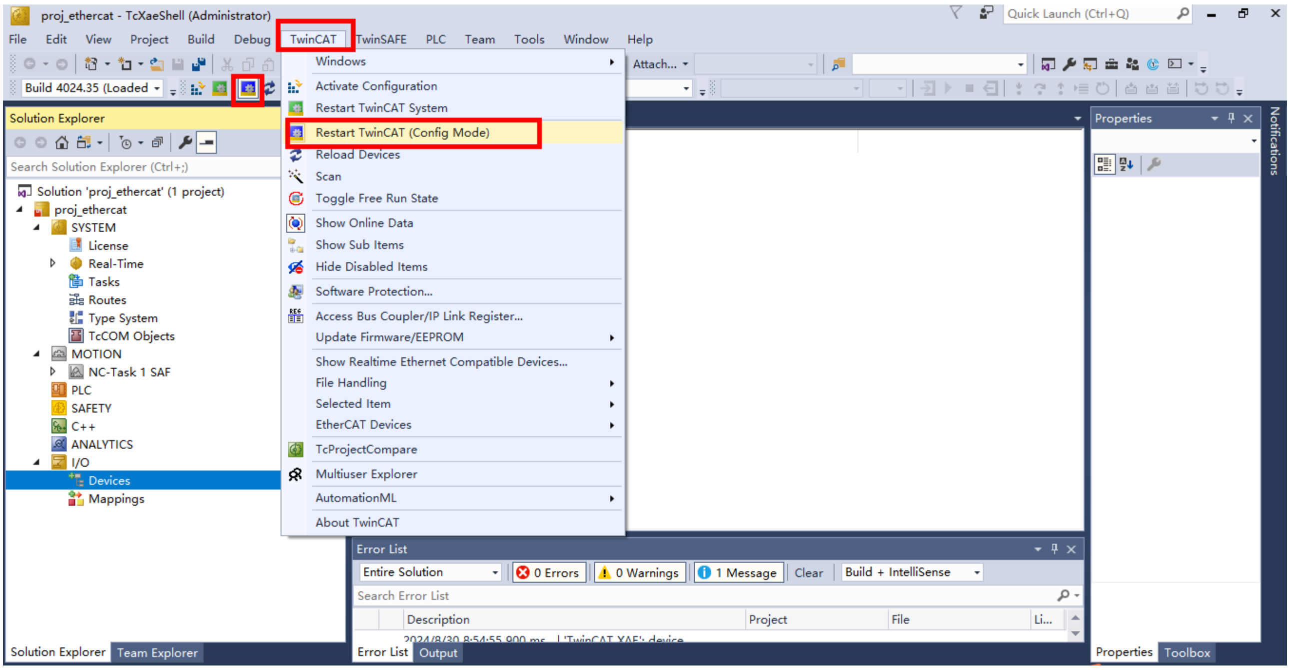
Note: The physical configuration must be consistent with the network configuration. If the configuration is inconsistent, EtherCAT communication cannot enter the OP state.





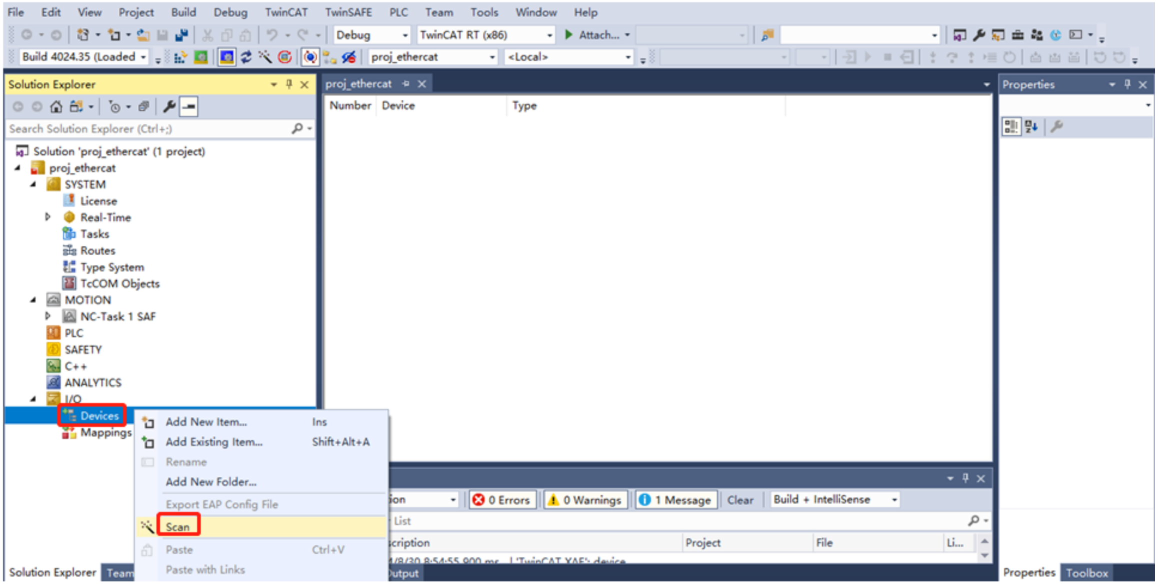
■ **Automatic scanning**

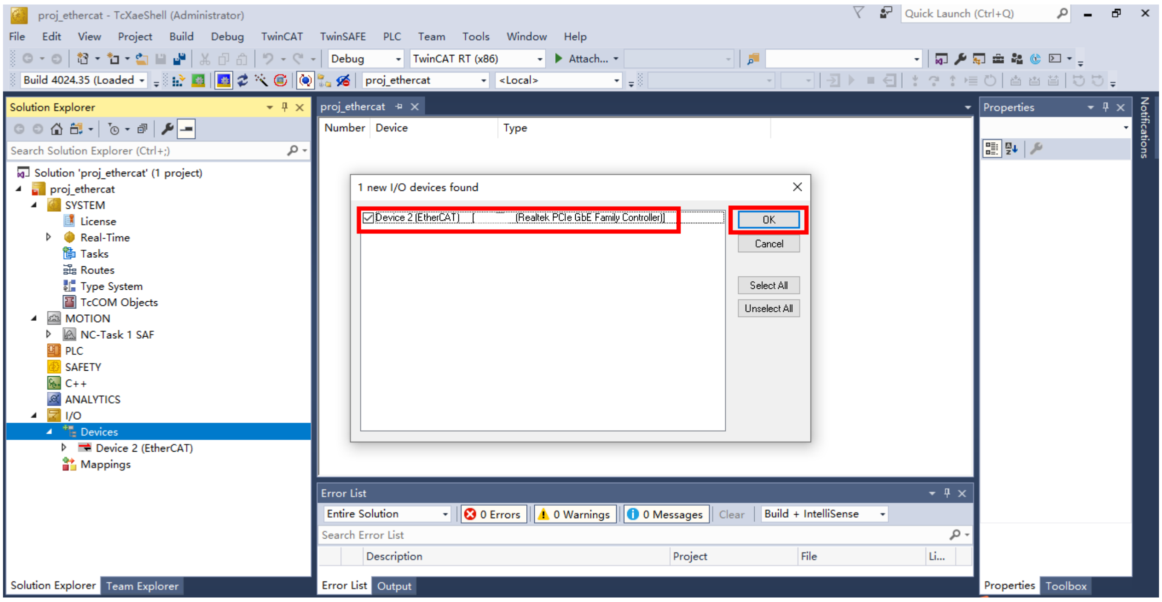
Step 1 Establish a reliable physical connection for Computer > PLC > FK1100_ECT_Coupler, and switch the PLC to configuration mode.



Step 2 Right-click **Devices** under **I/O**, choose **Scan**, and click **OK** in the pop-up dialog box to wait for the scan results. Select the devices scanned as needed, click **OK**, and click **Yes** in the pop-up **Scan for boxes** dialog box to wait for the scan results.

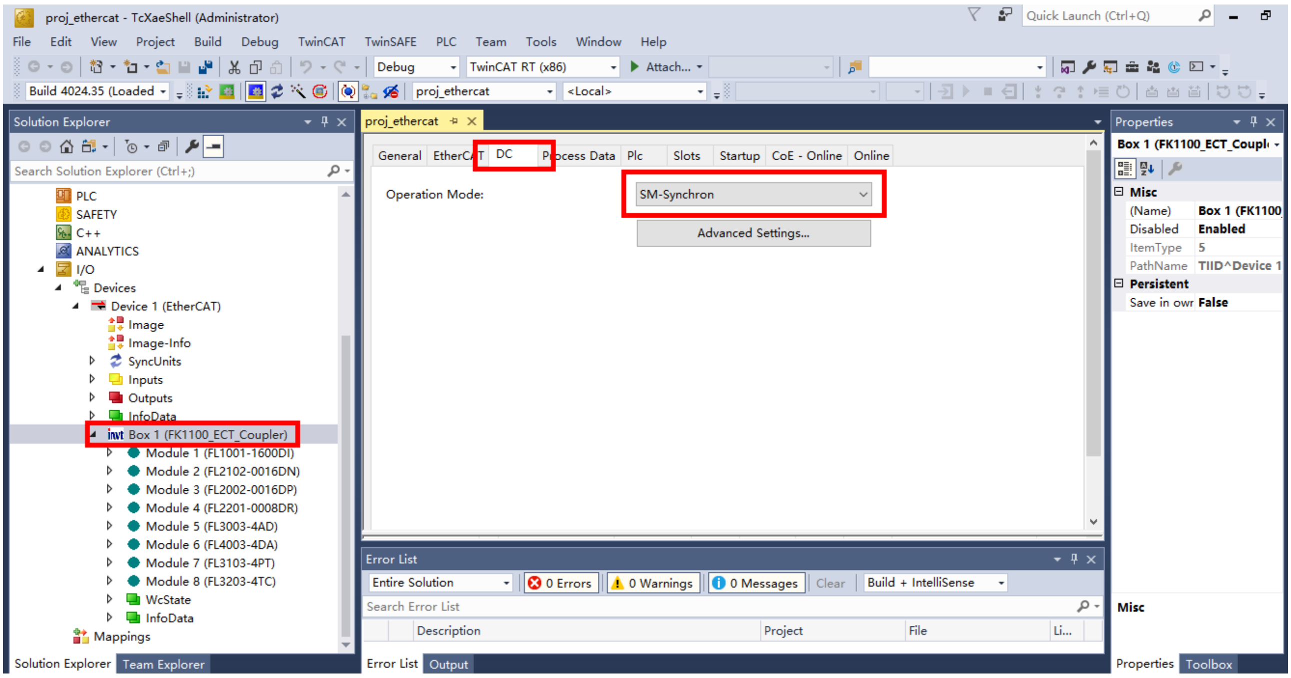
Note: It is recommended to check whether the network configuration and physical configuration added in automatic scan match, and adjustments can be made manually.





6.1.3.3 EtherCAT communication parameter configuration

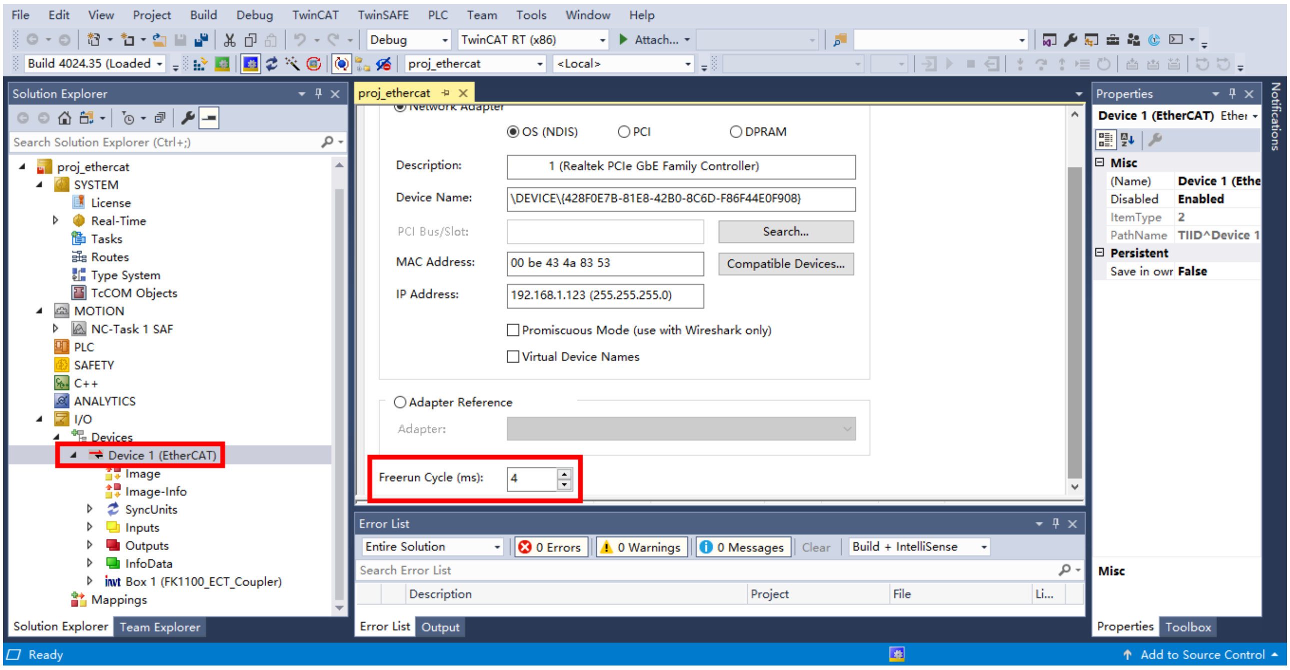
1. Synchronous mode: Double click **FK1100_ECT_Coupler** and click the **DC** tab, and set **Operation Mode**.

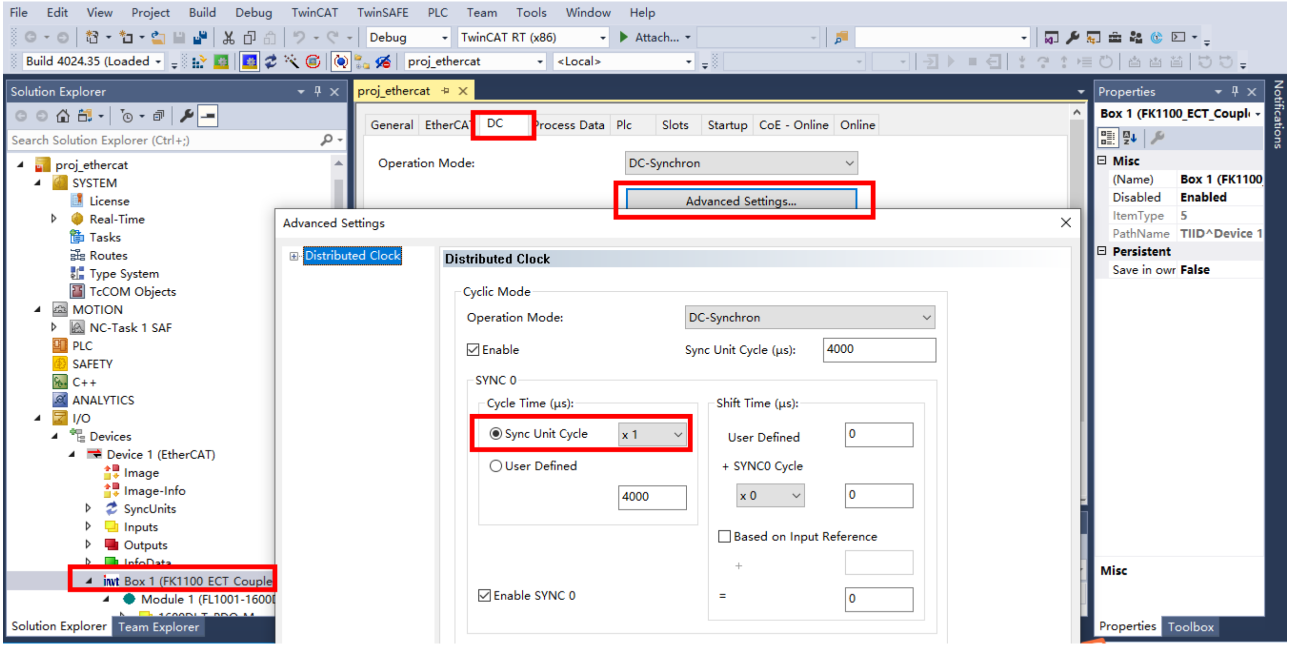


2. Synchronization period:

A. Double-click **I/O** > **Devices** > **EtherCAT**, click the **Adapter** tab, and set **Freerun Cycle(ms)** (recommended to adjust).

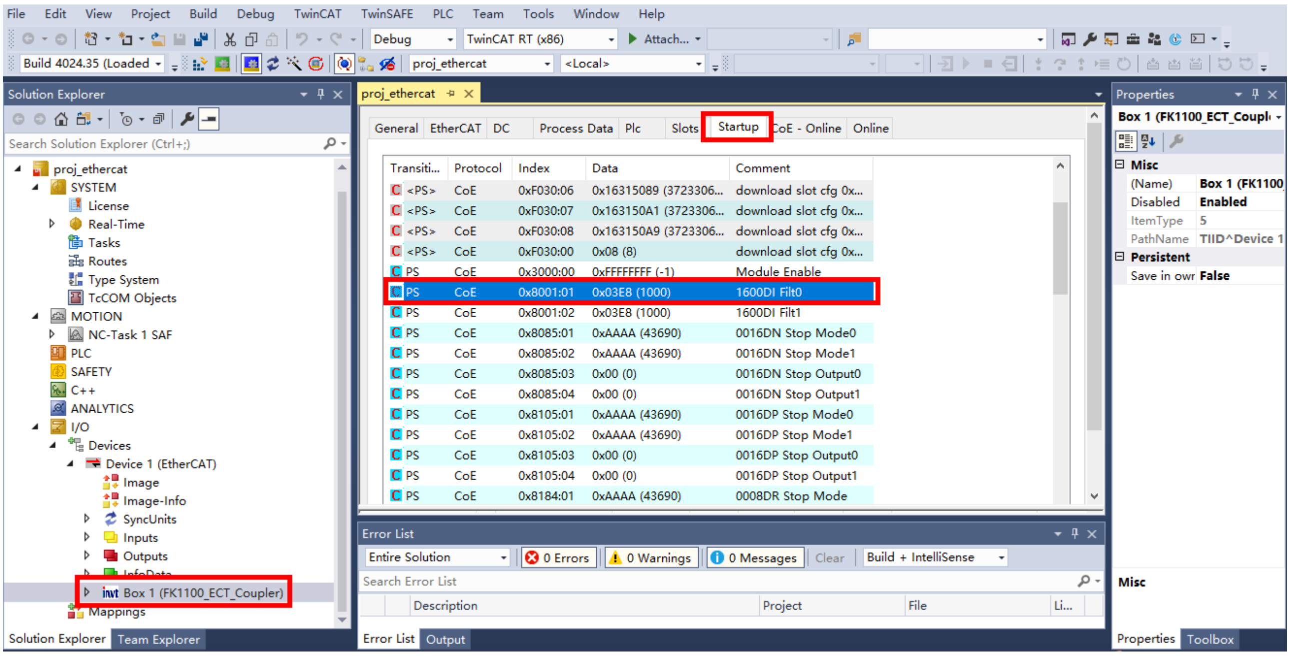
B. Double-click **FK1100_ECT_Coupler**, click the **DC** tab, click **Advanced Settings**, in the **SYNC 0** area, set **Sync Unit Cycle** (not recommended to adjust).



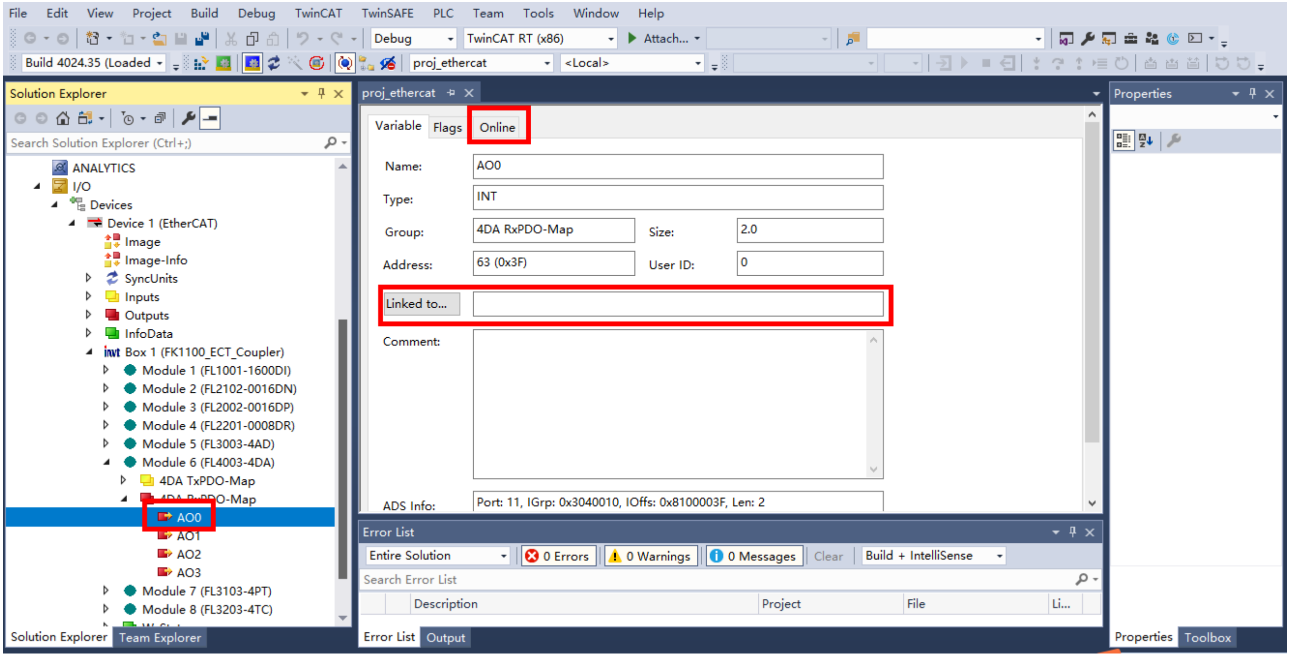


6.1.3.4 Module configuration parameter

On the **FK1100_ECT_Coupler** > **Startup** interface, the **Startup** parameters are all SDO data, which are the initialization configuration parameters of each module. They are sent to the slave node during the transition from Pre-OP to Safe-OP in EtherCAT communication. Refer to 6.1.2.7 Object dictionary description for parameter details.



6.1.3.5 Module process data



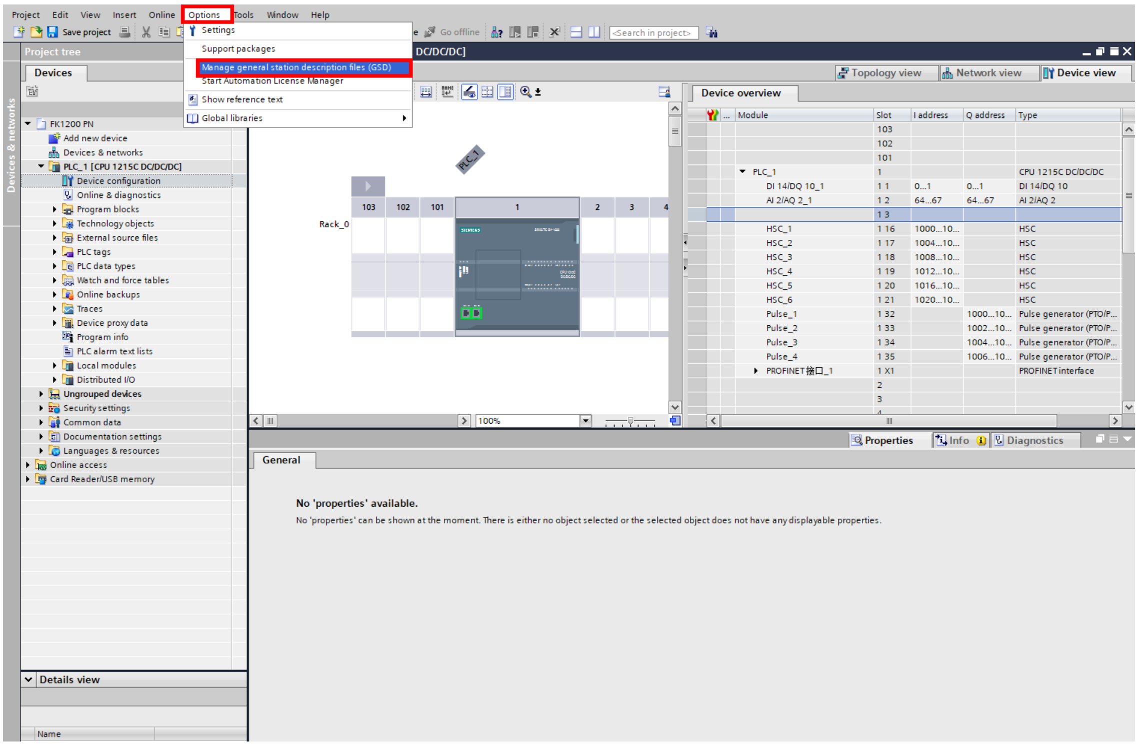
6.2 PROFINET configuration description

6.2.1 TIA Portal configuration description

6.2.1.1 PROFINET communication coupler—FK1200

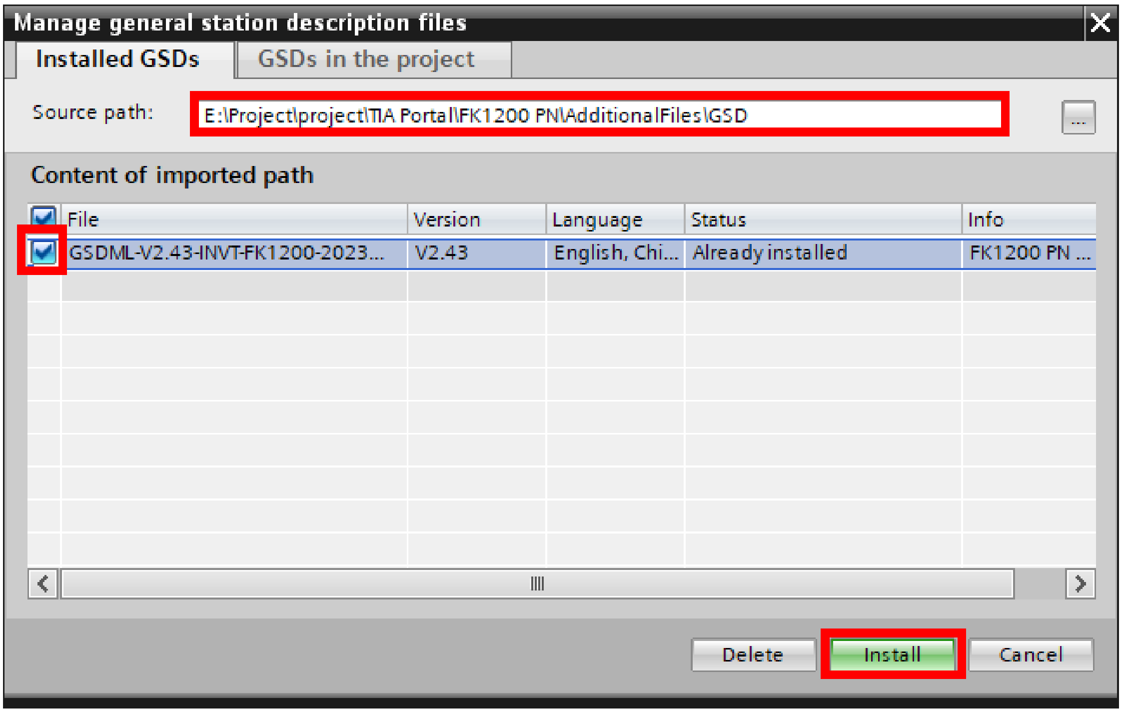
1. Install the device description file named in the format of GSDML-V2.43-INVT-FK1200-xxxxxxxx.xml.

Step 1 Choose **Options** > **Manage general station description files (GSD)** from the menu bar.



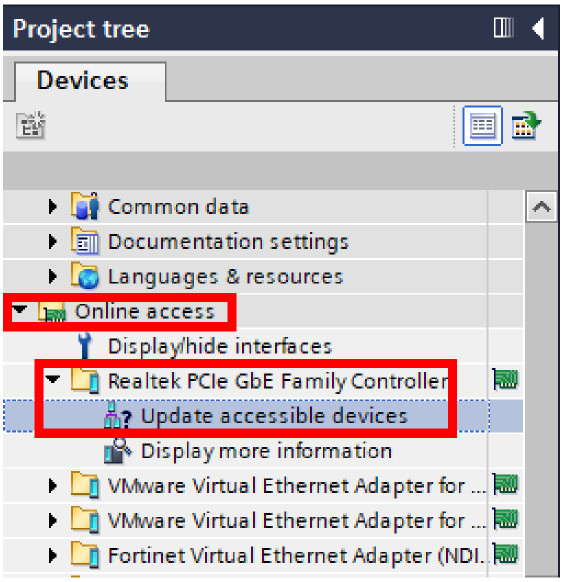
Step 2 In the **Manage general station description files** window that appears, set **Source path** to the GSD

file saving path, select the GSD file to be installed, and then click **Install**.

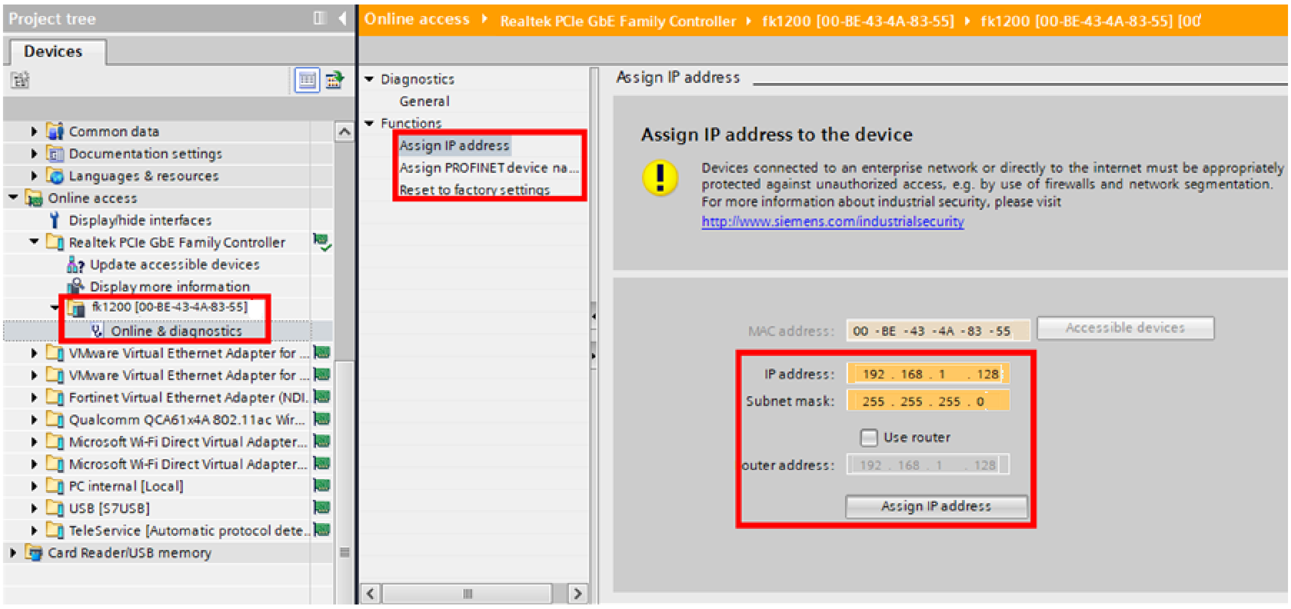


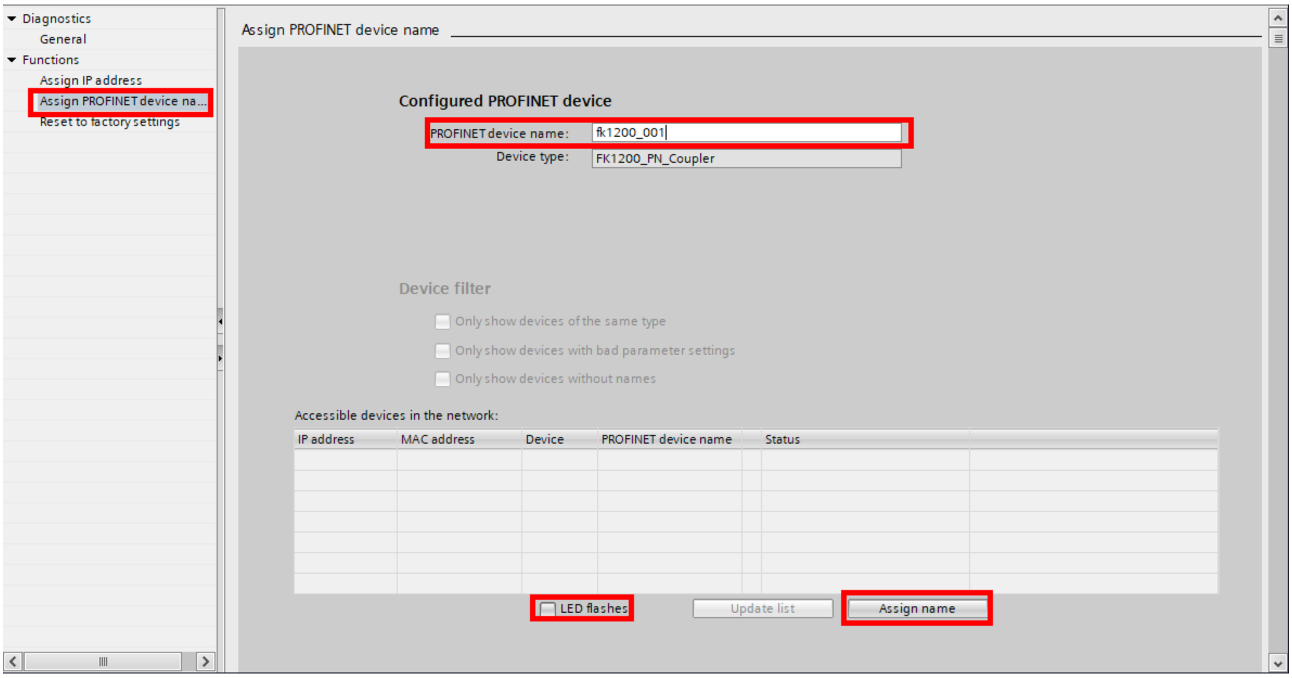
2. Set the PN device name and IP address.

Step 1 Complete the actual physical connection. Under **Project tree**, choose **Devices** > **Online access** > **Realtek PCIe GbE Family Controller** > **Update accessible devices**.



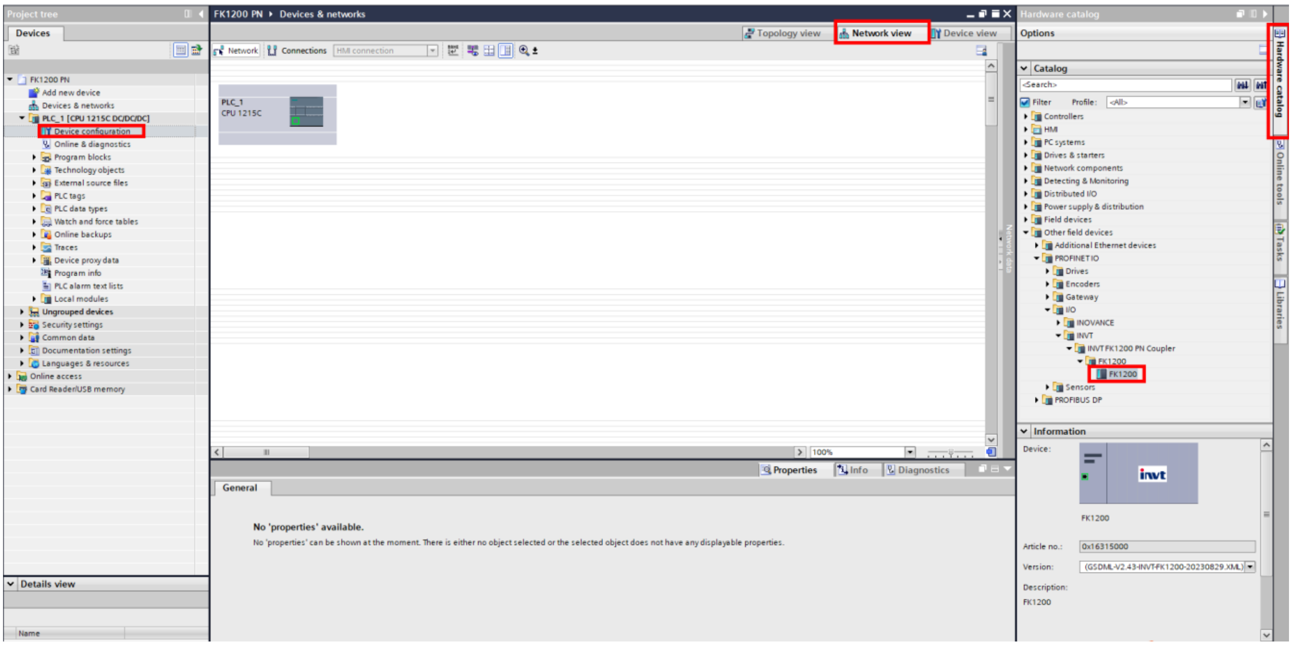
Step 2 Choose the refreshed PN coupler device (you can confirm the device according to the MAC address). Choose **Online & diagnostics** under **fk1200**, choose **Functions** > **Assign IP address**, set **IP address** and **Subnet mask**, and click **Assign IP address**. After the IP address assignment, choose **Assign PROFINET device name**, set **PROFINET device name**, and click **Assign name**.



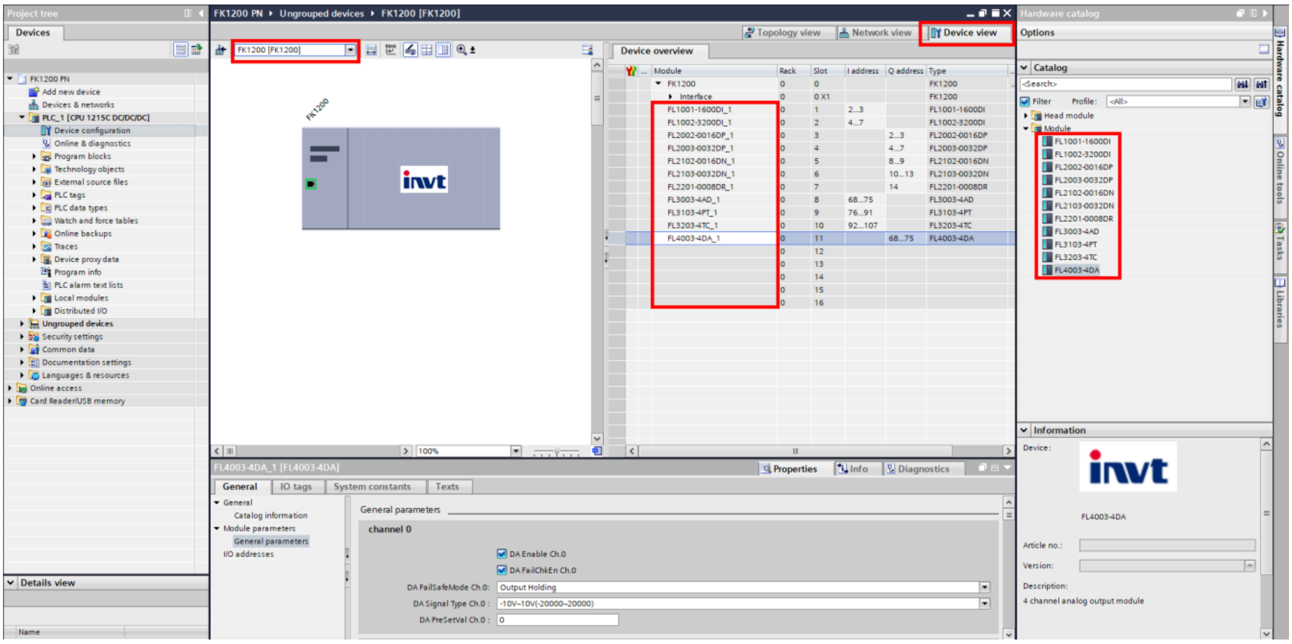


3. Network configuration

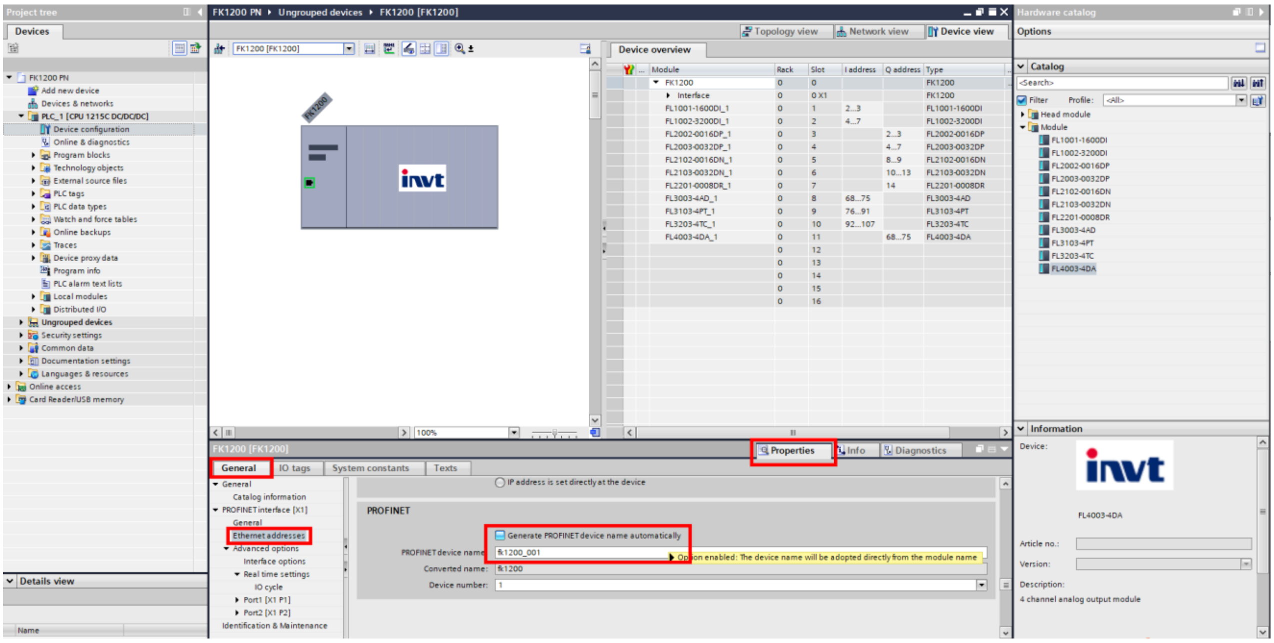
Step 1 Choose **PLC_1** > **Device configuration** on the left, click **Network view** on the main interface, click **Hardware catalog** on the right, choose **Other field devices** > **PROFINET IO** > **I/O** > **INVT** > **FK1200** > **FK1200**.



Step 2 Choose **PLC_1** > **Device configuration** on the left, click **Device view** on the main interface, choose the FK1200 devices, and add modules to the slots according to actual physical configuration on the right.



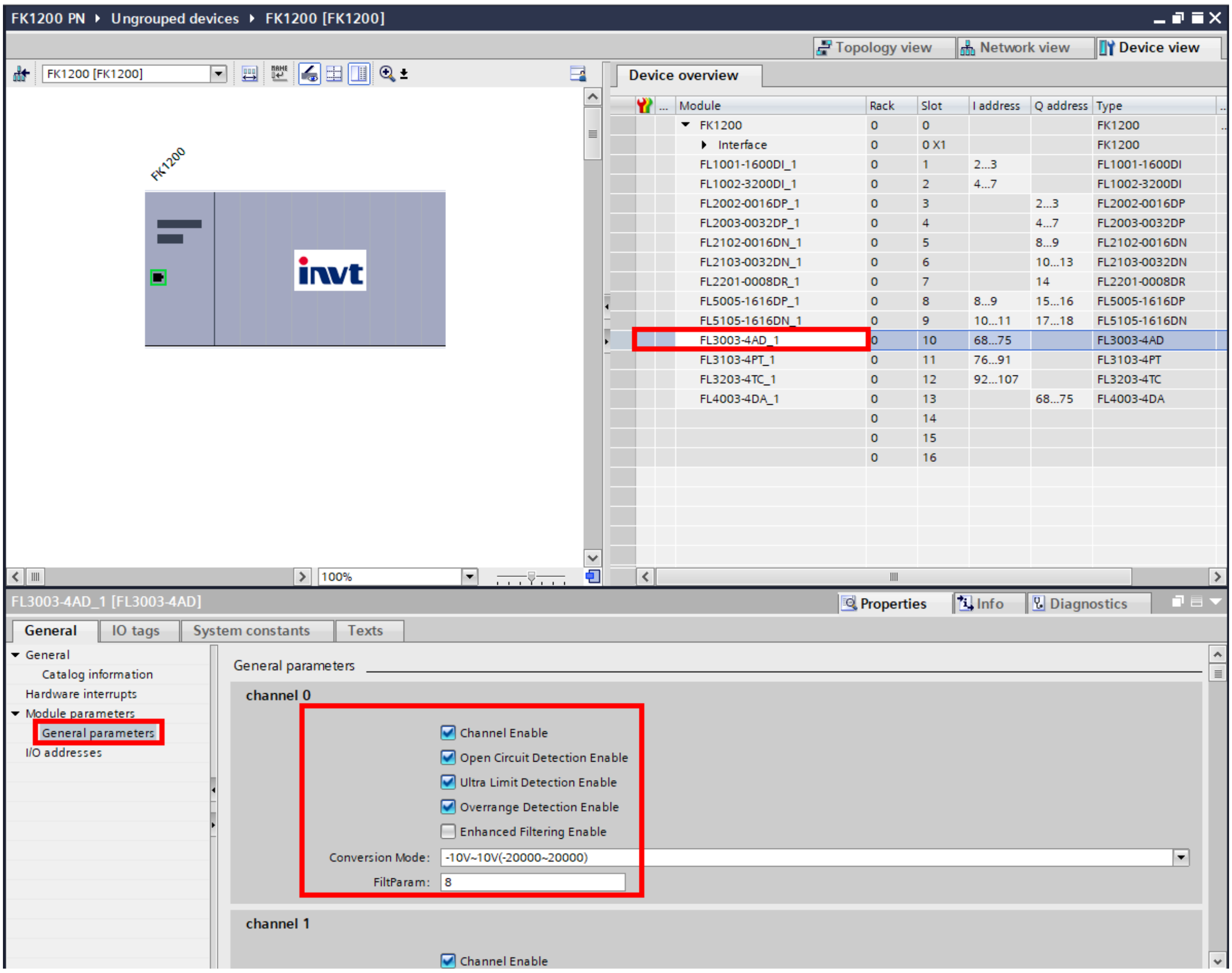
Step 3 On the **Device view** interface, double click **FK1200**. Under the lower part of interface, choose **Properties** > **General** > **PROFINET interface [X1]** > **Ethernet addresses**, deselect **Generate PROFINET device automatically**, and set **PROFINET device name** to the current device name.



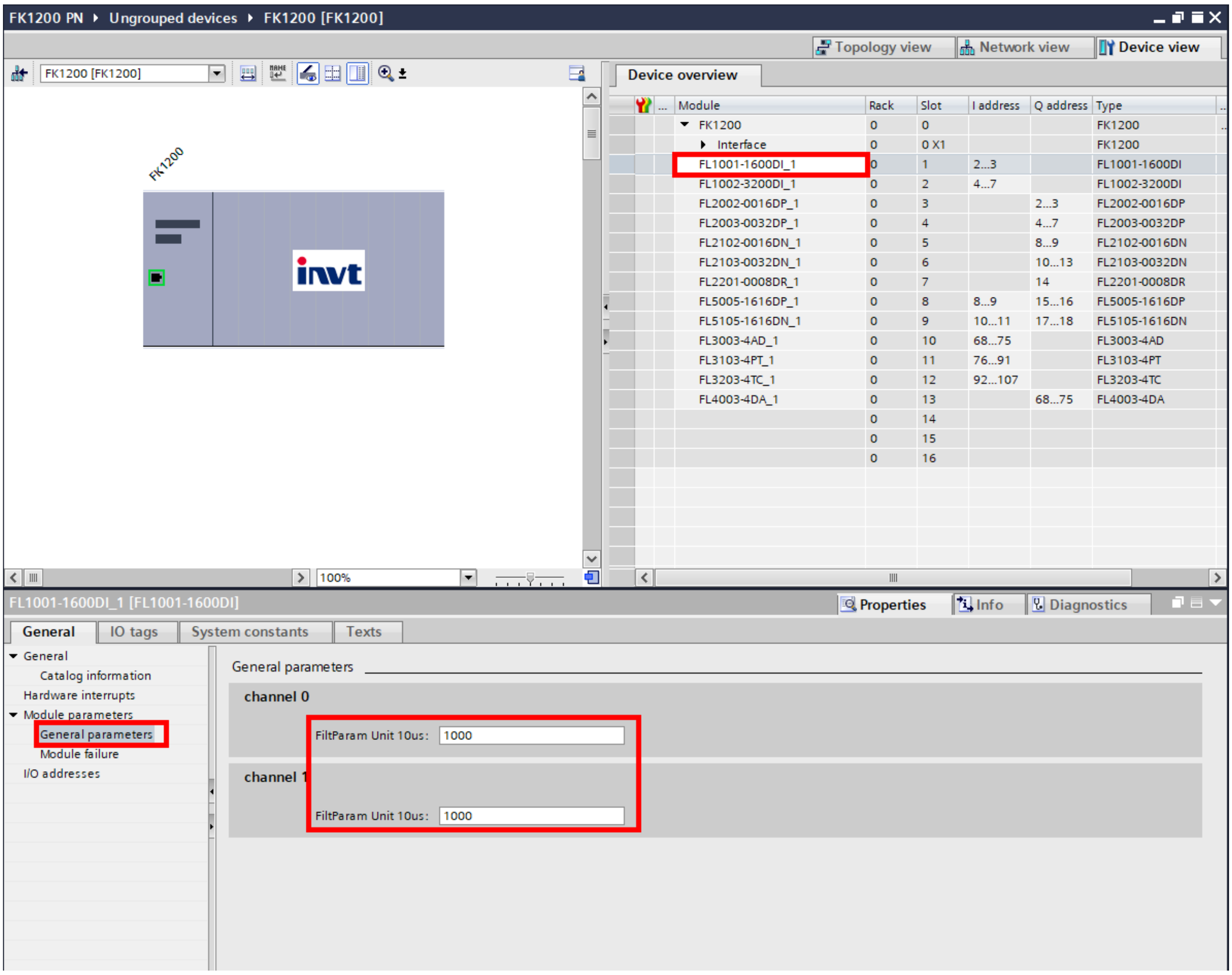
Note: In PROFINET communication, devices are identified through device names. Therefore, the set device names must match the actual device names of modules, and each device name must be unique.

Step 4 Set module parameters.

Example 1: On the **Device view** interface, double click **FL3003-4AD** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



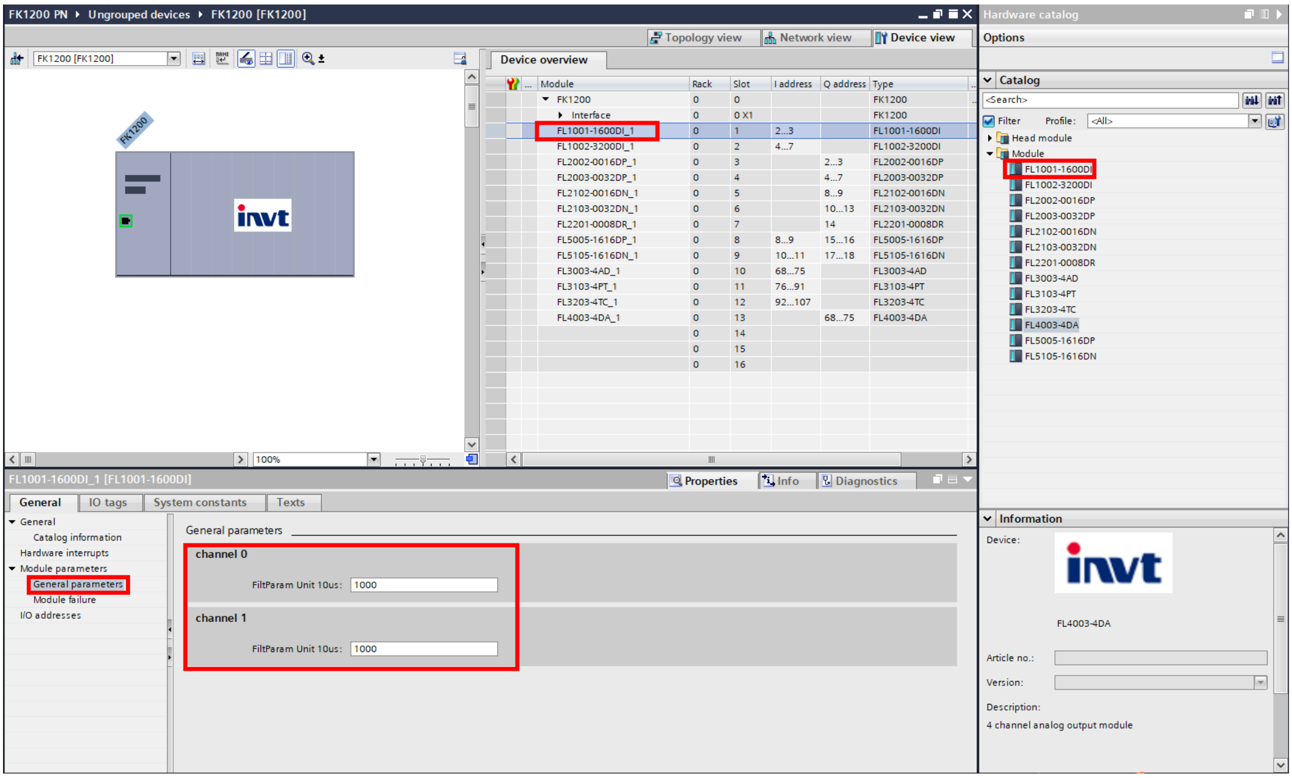
Example 2: On the **Device view** interface, double click **FL1001-1600DI** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



Step 5 After completing the network configuration, set all configuration module parameters. Once compiled, the program can be downloaded and run.

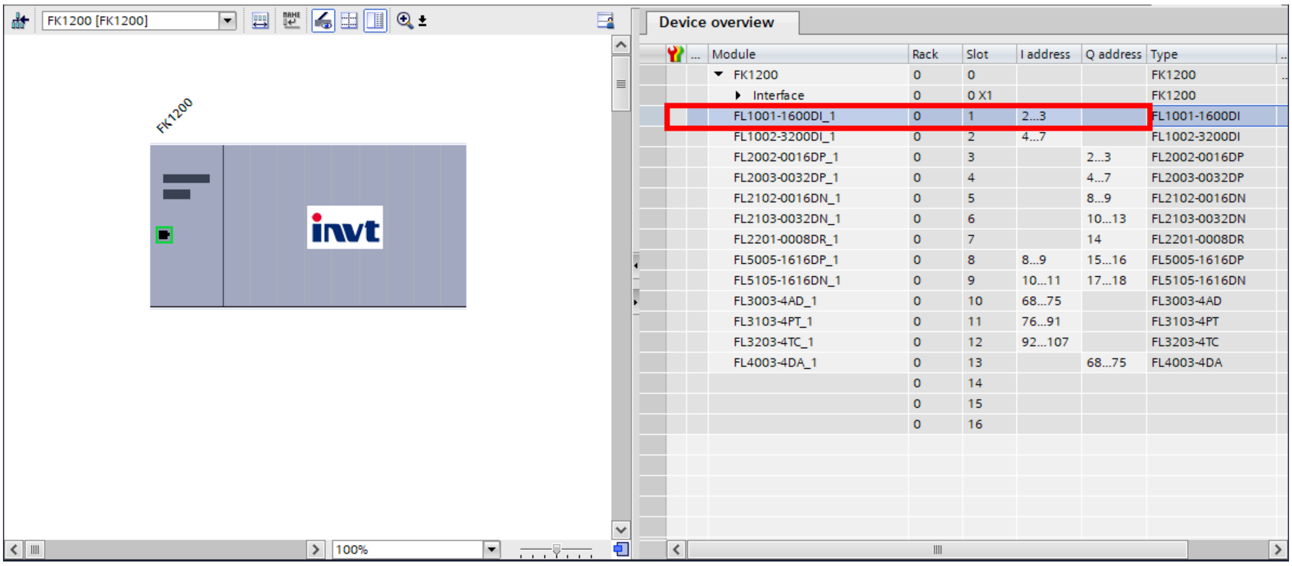
6.2.1.2 Digital input module—FL1001 (1600D)

Step 1 On the **Device view** interface, add **FL1001-1600DI**, double click **FL1001-1600DI** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



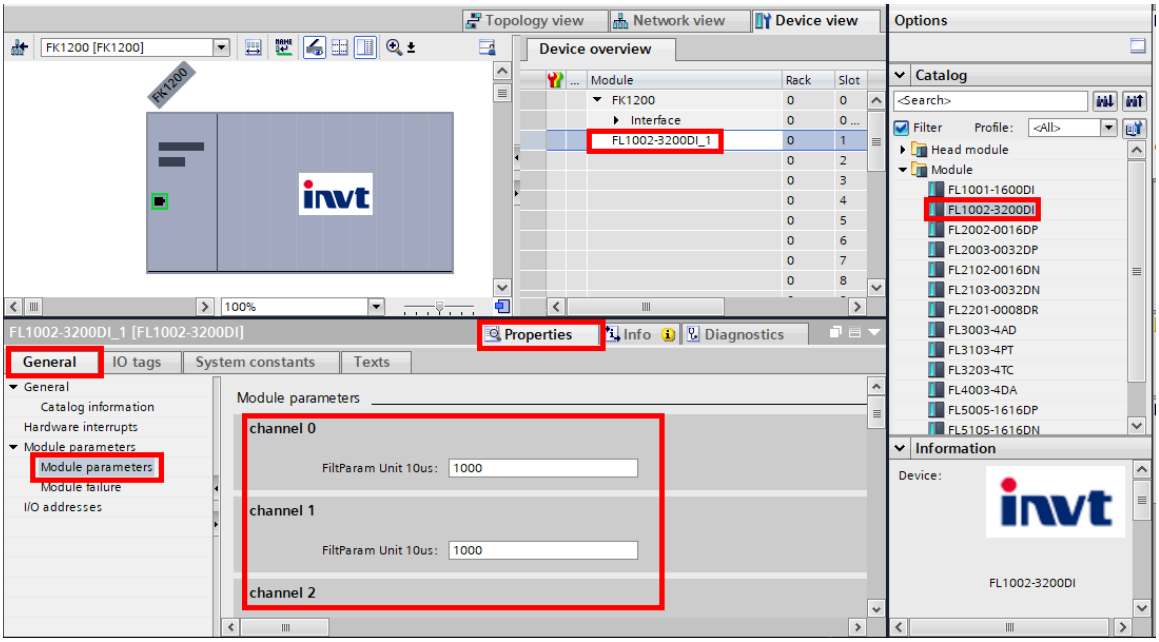
Note: For filtering parameter setting, the digital input module divides every 8 points into a group, and different filtering parameters can be set for each group. Adjust the port filtering mode in the startup parameters according to actual needs, with a unit of 10μs and a default value of 10ms.

Step 2 Obtain sampling values through I addresses.



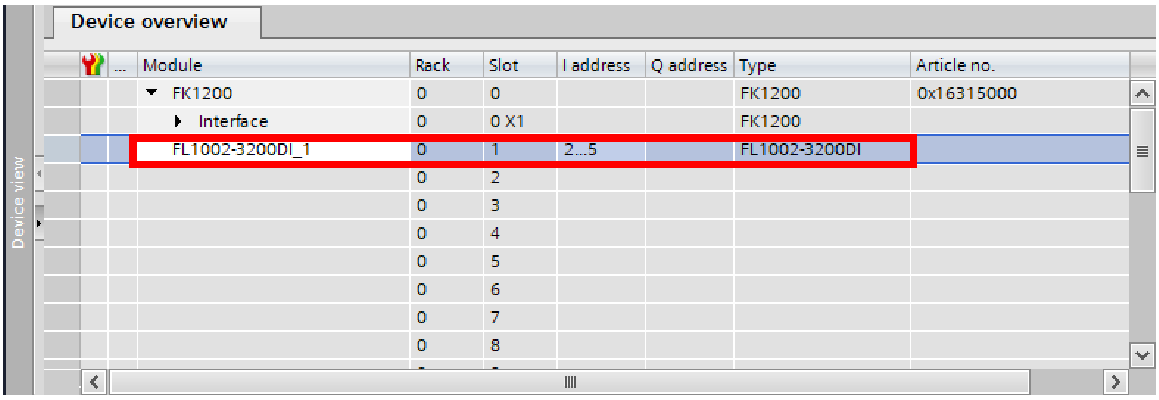
6.2.1.3 Digital input module—FL1002 (3200D)

Step 1 On the **Device view** interface, add **FL1002-3200DI**, double click **FL1002-3200DI** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



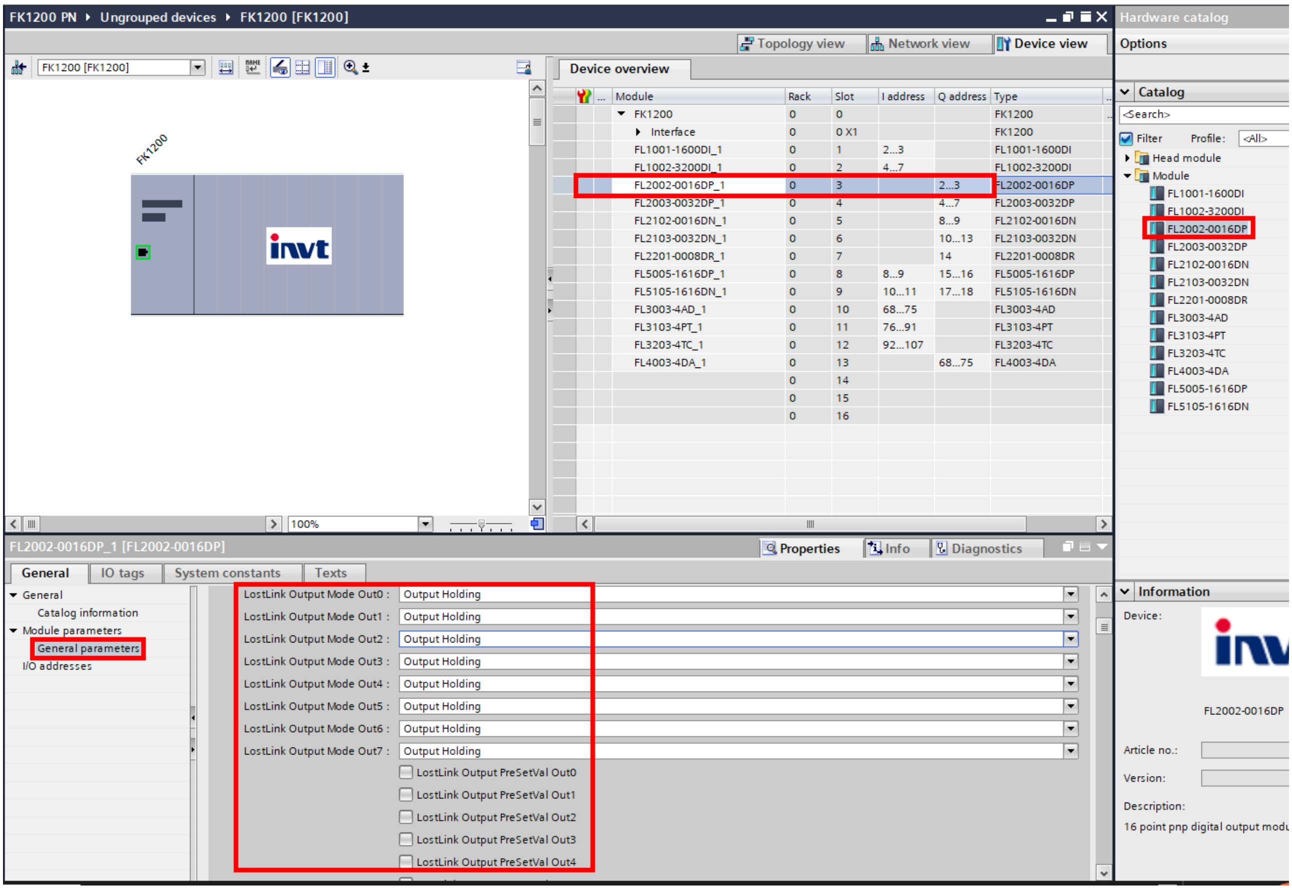
Note: For filtering parameter setting, the digital input module divides every 8 points into a group, and different filtering parameters can be set for each group. Adjust the port filtering mode in the startup parameters according to actual needs, with a unit of 10μs and a default value of 10ms.

Step 2 Obtain sampling values through I addresses.

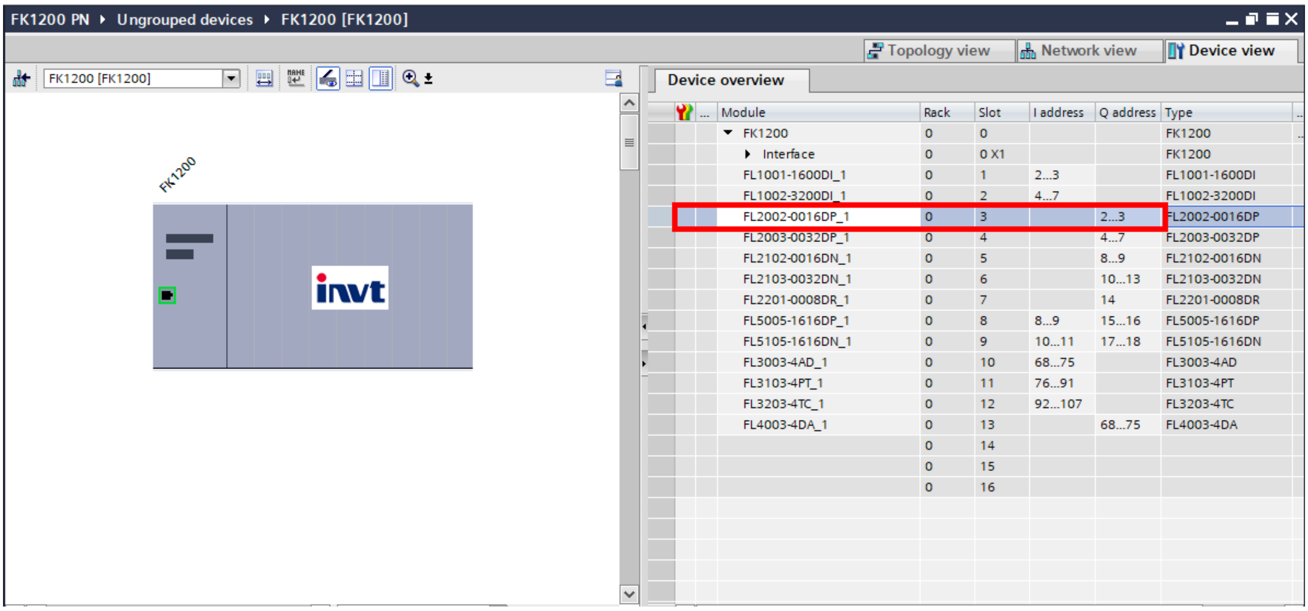


6.2.1.4 Digital output module (source type)—FL2002 (0016DP)

Step 1 On the **Device view** interface, add **FL2002-0016DP**, double click **FL2002-0016DP** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

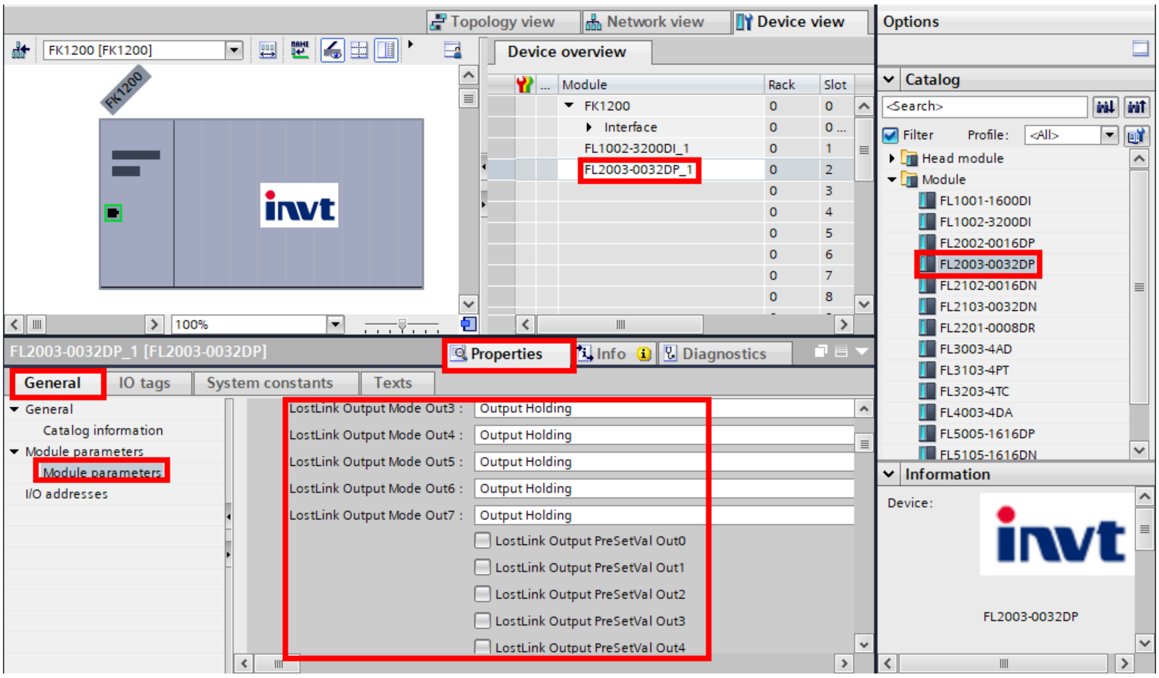


Step 2 Control output through Q addresses.

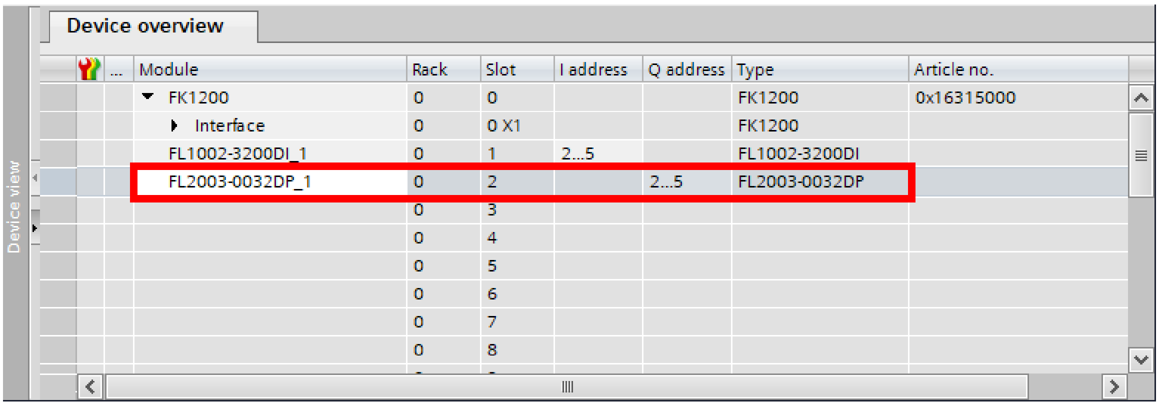


6.2.1.5 Digital output module (source type)—FL2003 (0032DP)

Step 1 On the **Device view** interface, add **FL2003-0032DP**, double click **FL2003-0032DP** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



Step 2 Control output through Q addresses.



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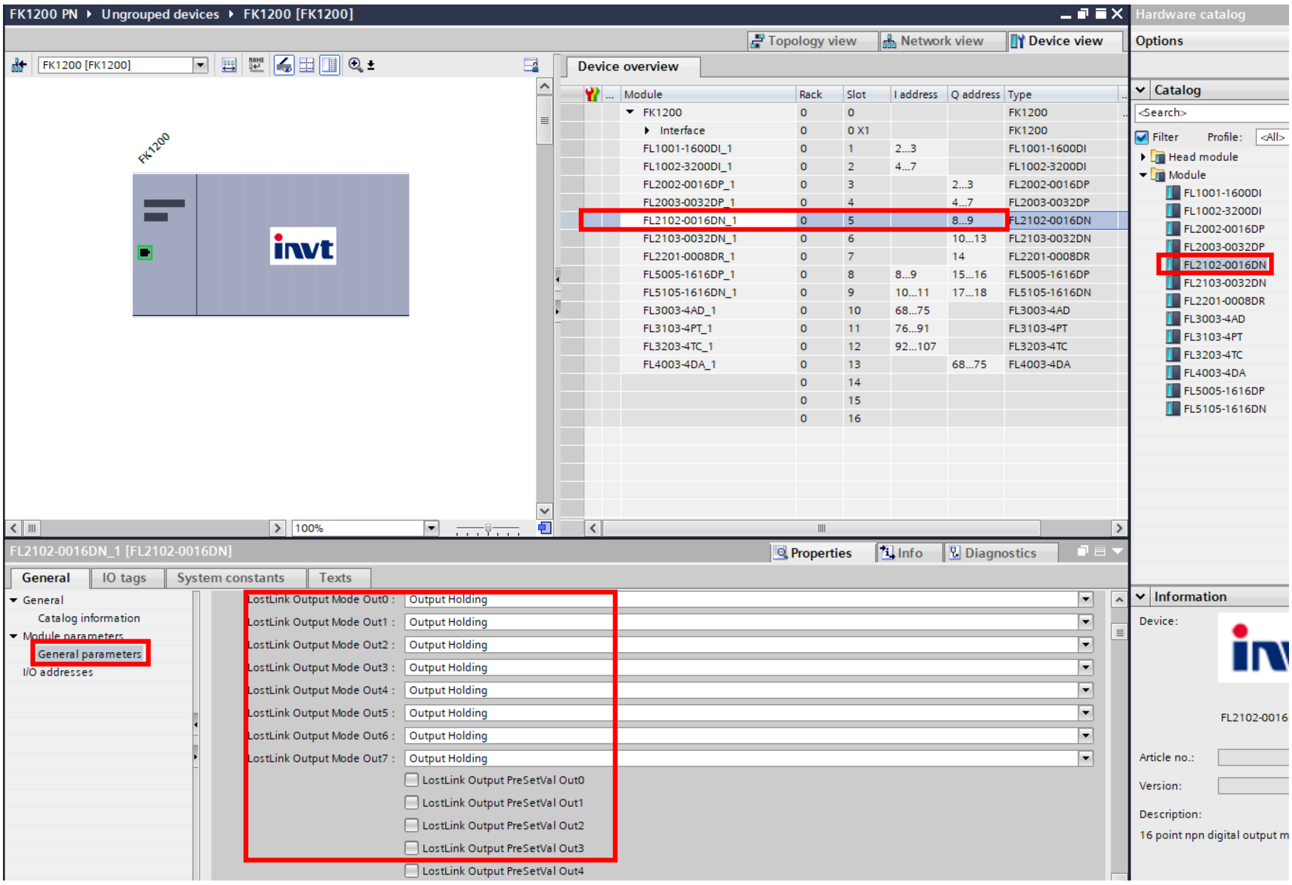
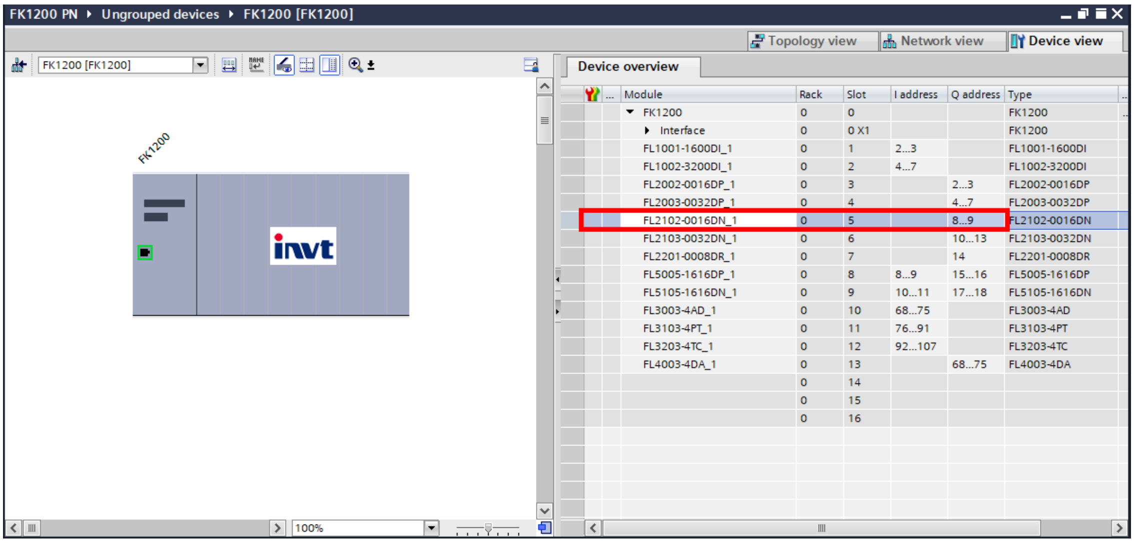
6.2.1.6 Digital output module (sink type)—FL2102 (0016DN)

Step 1 On the **Device view** interface, add **FL2102-0016DN**, double click **FL2102-0016DN** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

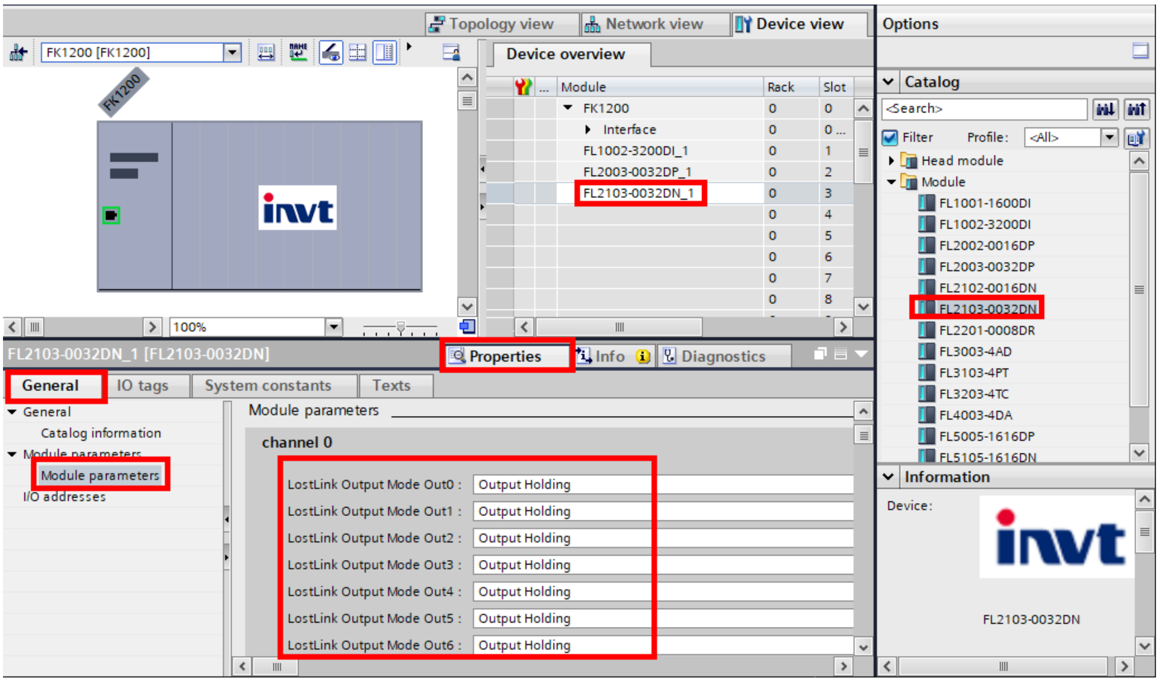


Step 2 Control output through Q addresses.

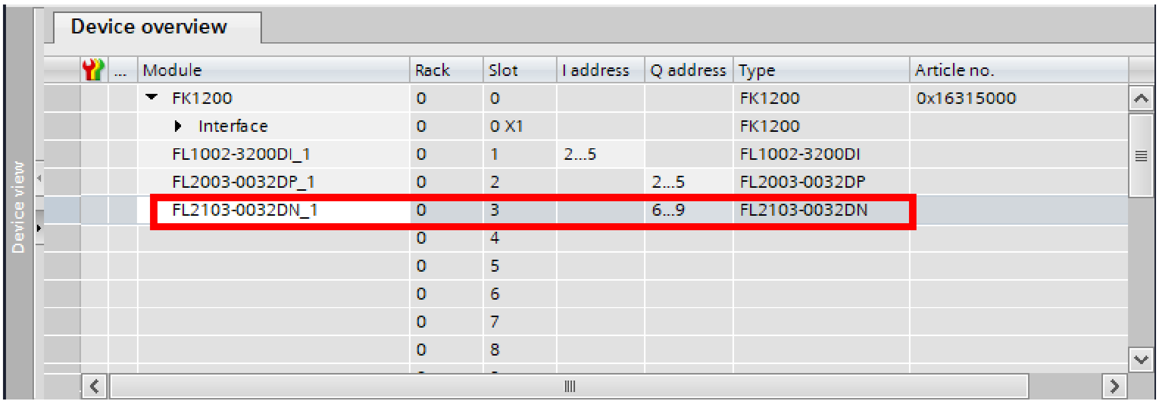


6.2.1.7 Digital output module (sink type)—FL2103 (0032DN)

Step 1 On the **Device view** interface, add **FL2103-0032DN**, double click **FL2103-0032DN** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

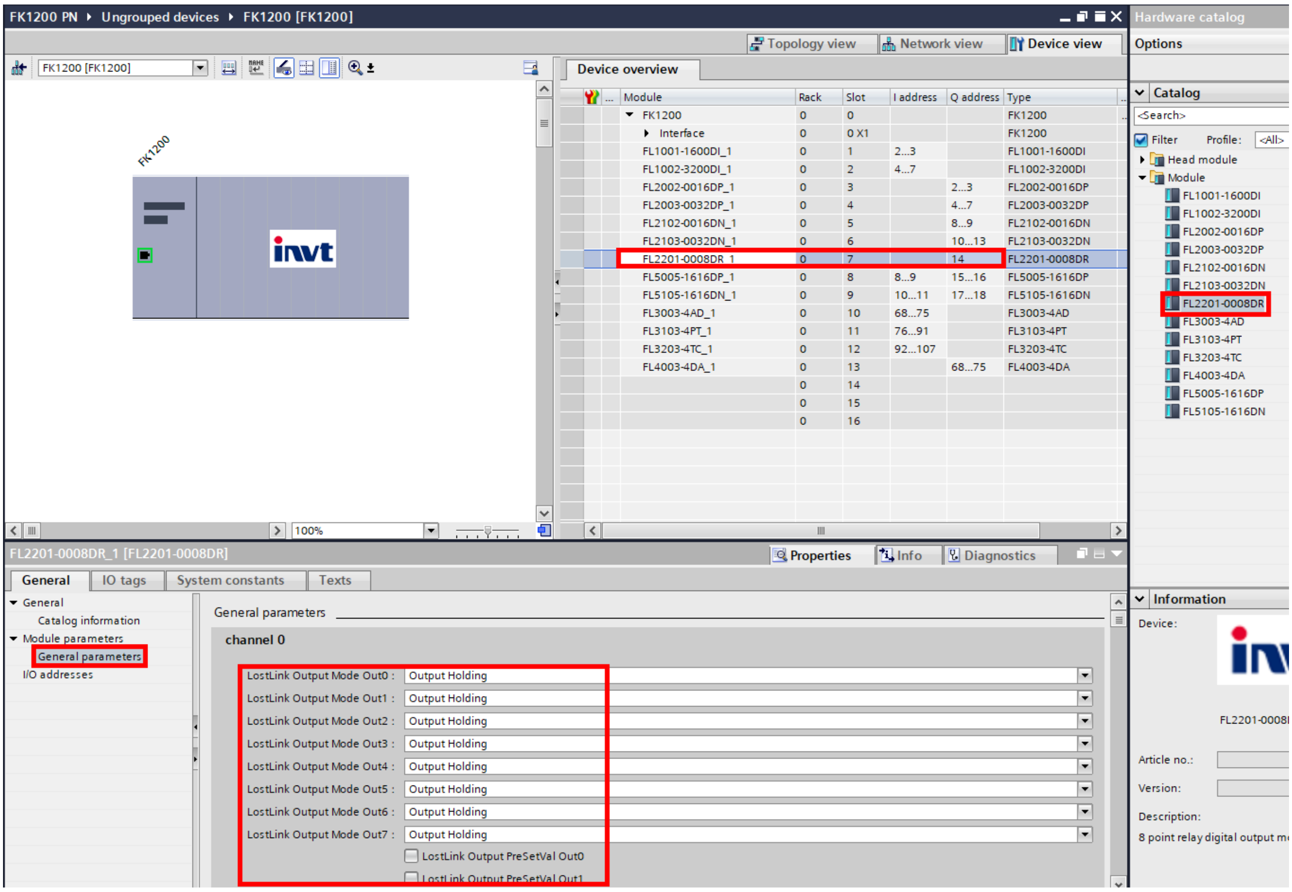


Step 2 Control output through Q addresses.

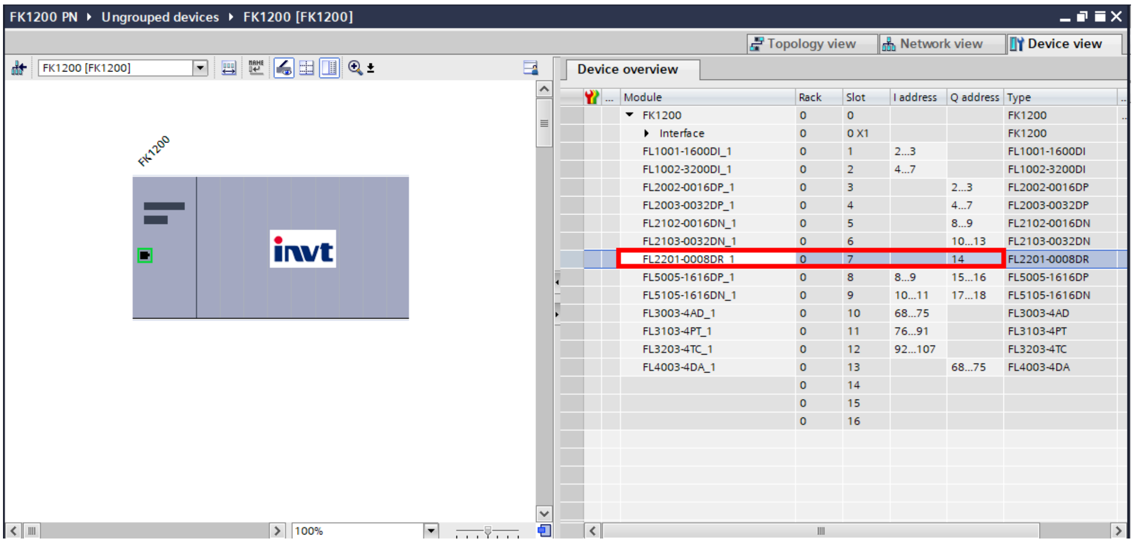


6.2.1.8 Digital output module (relay)—FL2201 (0008DR)

Step 1 On the **Device view** interface, add **FL2201-0008DR**, double click **FL2201-0008DR** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

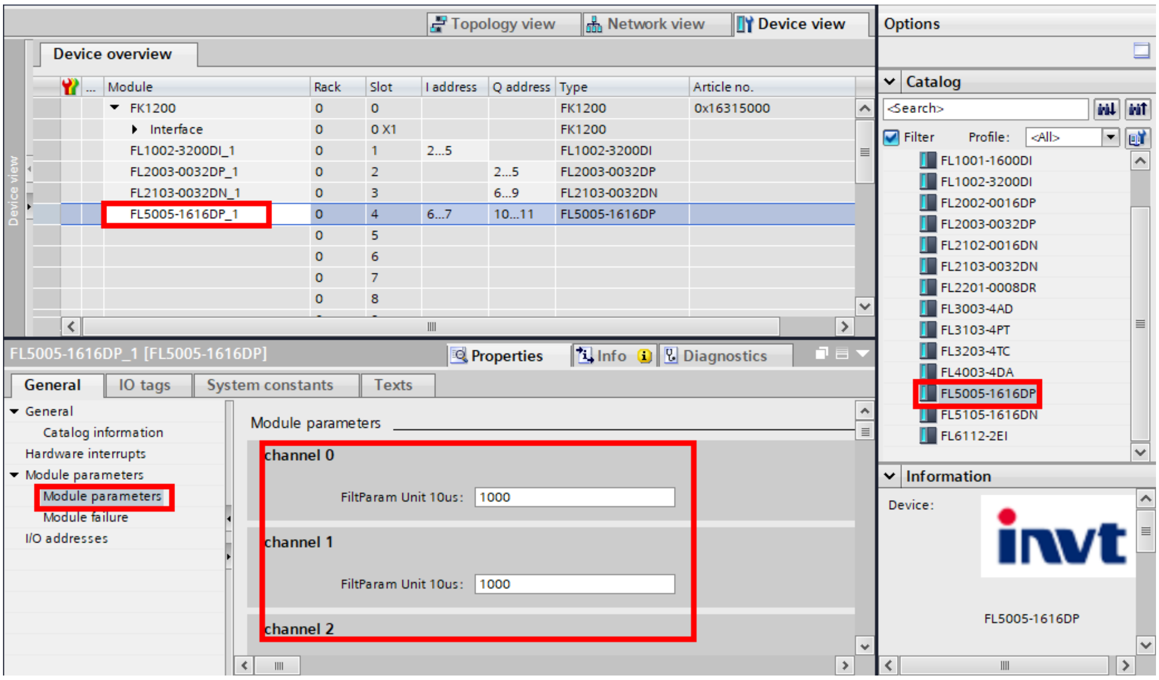


Step 2 Control output through Q addresses.

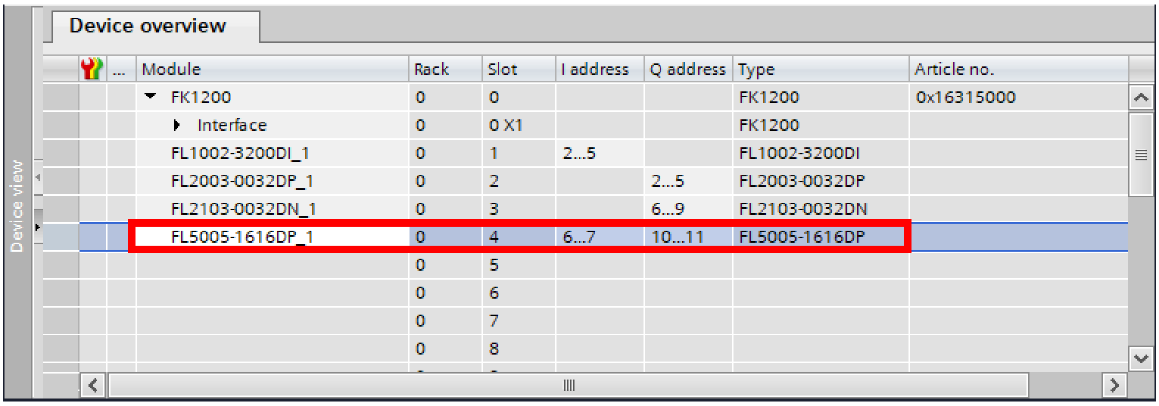


6.2.1.9 Digital hybrid module—FL5005 (1616DP)

Step 1 On the **Device view** interface, add **FL5005-1616DP**, double click **FL5005-1616DP** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

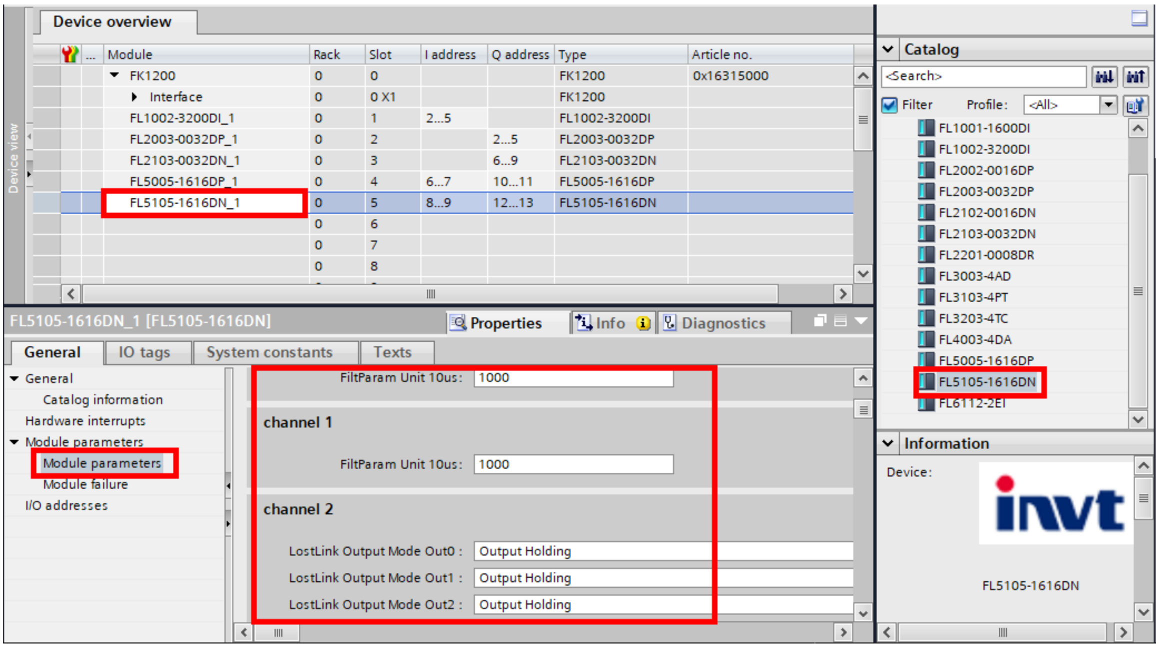


Step 2 Obtain sampling values through I addresses and control output through Q addresses.

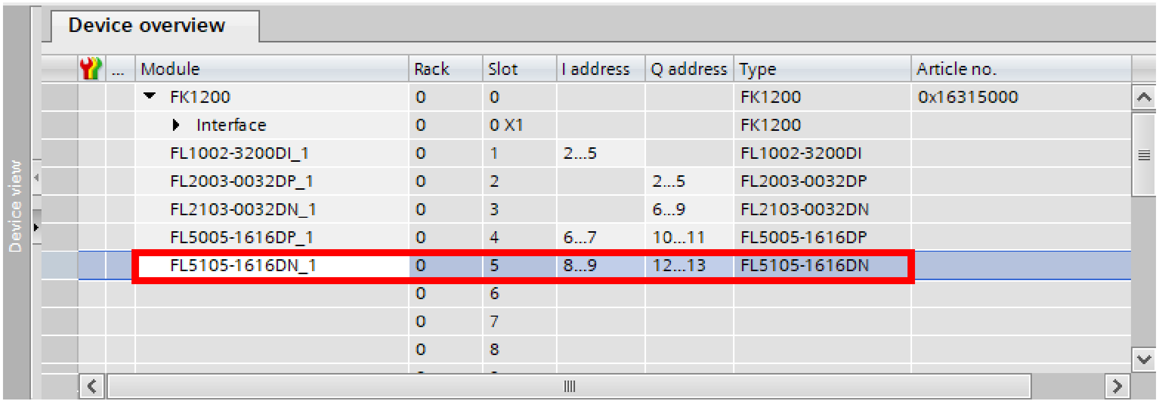


6.2.1.10 Digital hybrid module—FL5105 (1616DN)

Step 1 On the **Device view** interface, add **FL5105-1616DN**, double click **FL5105-1616DN** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

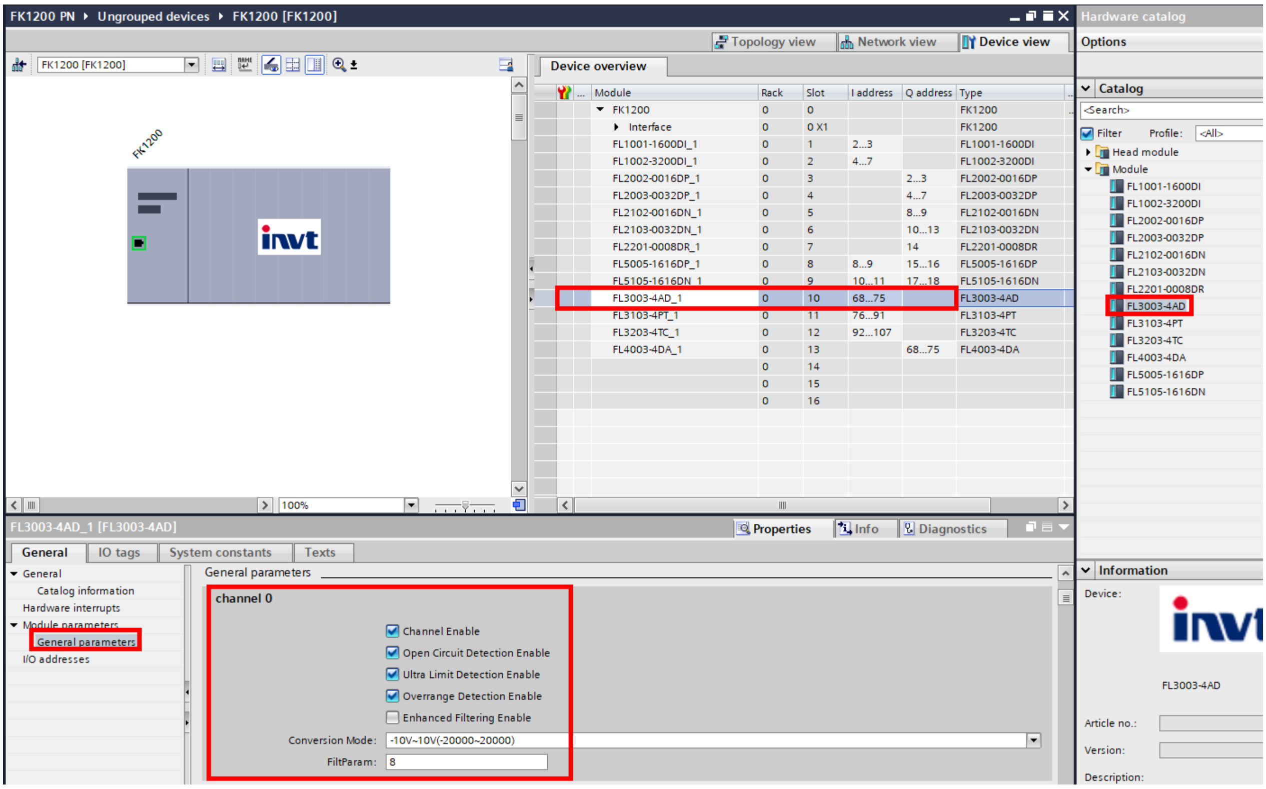


Step 2 Obtain sampling values through I addresses and control output through Q addresses.

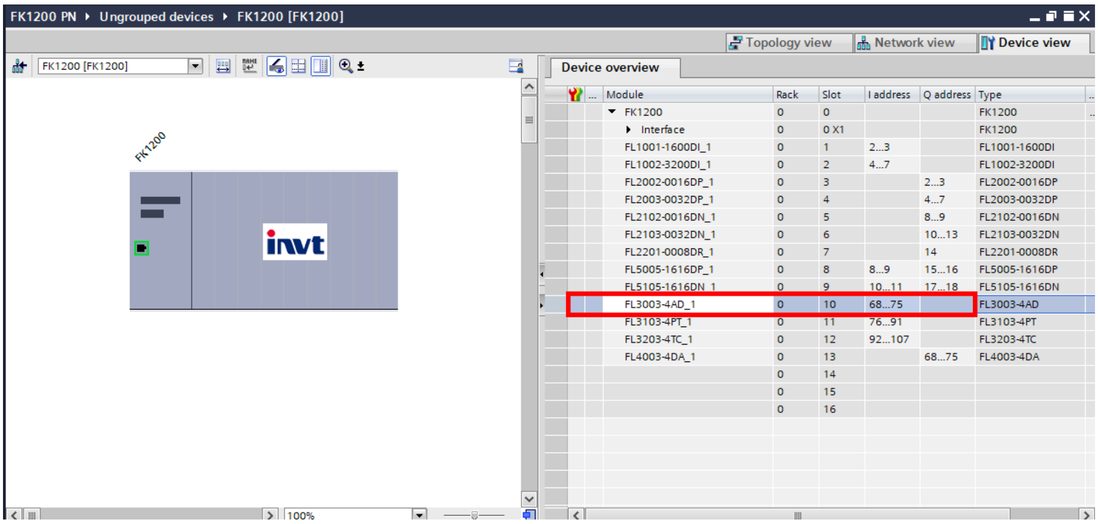


6.2.1.11 Analog input module—FL3003 (4AD)

Step 1 On the **Device view** interface, add **FL3003-4AD**, double click **FL3003-4AD** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

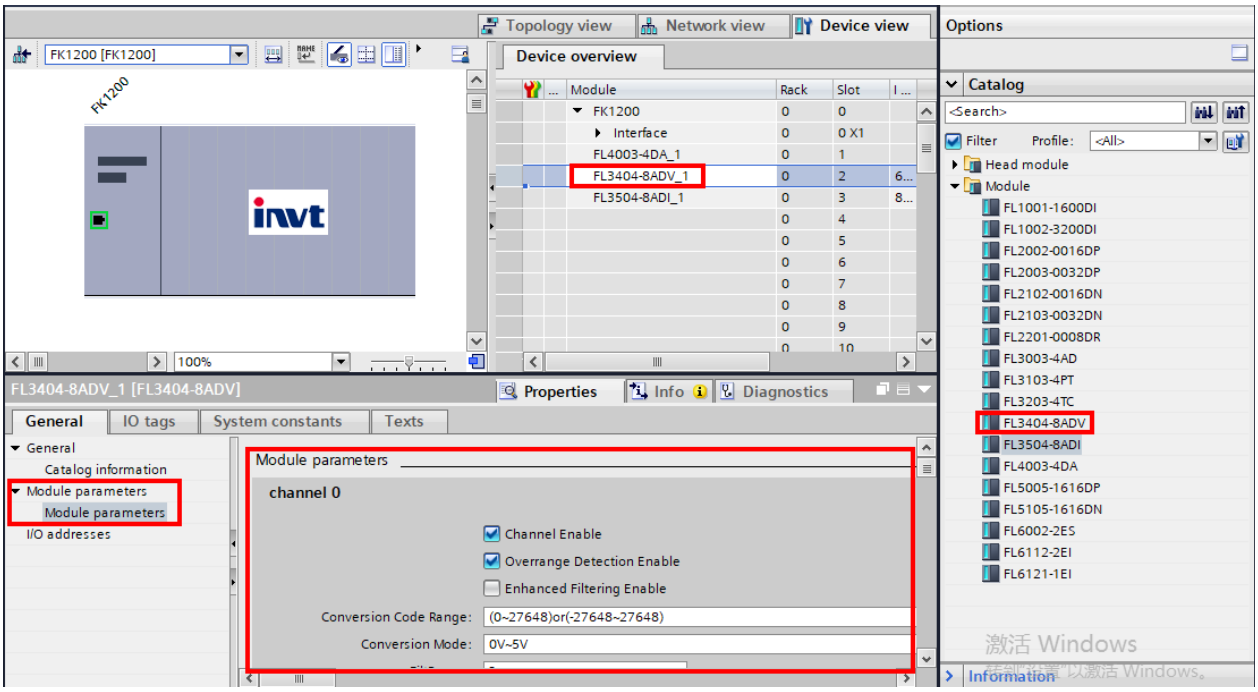


Step 2 Obtain sampling values through I addresses.

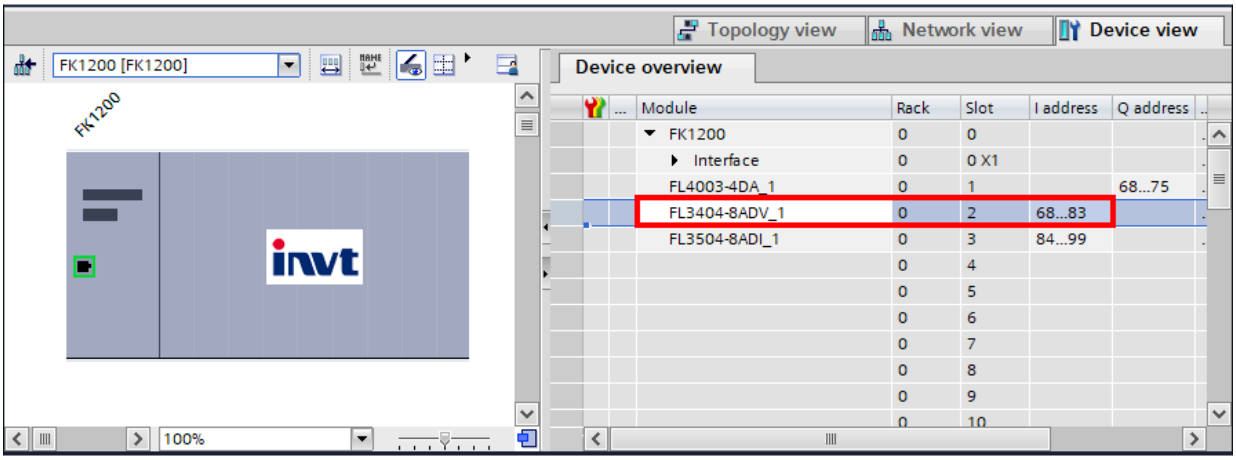


6.2.1.12 Analog input module—FL3404(8ADV)

Step 1 In the **Device view** interface, add **FL3404-8ADV**, double click **FL3404-8ADV** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

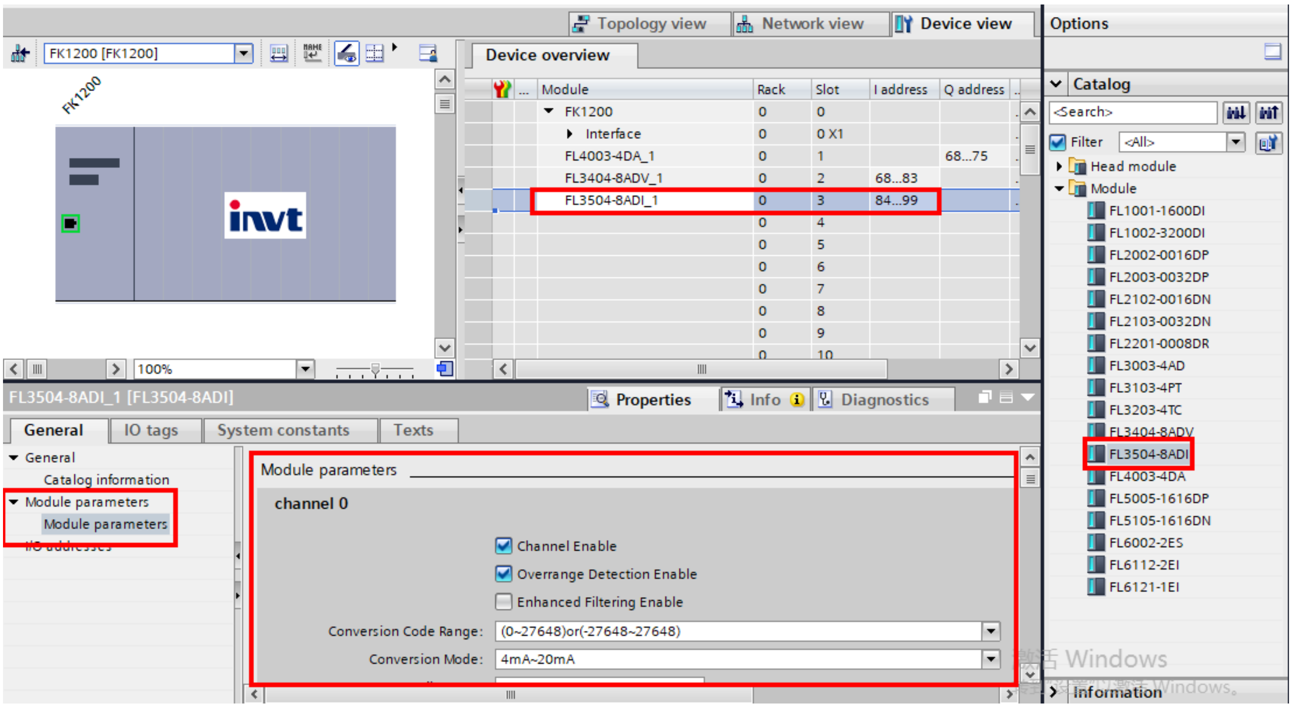


Step 2 Obtain sampling values through I addresses.

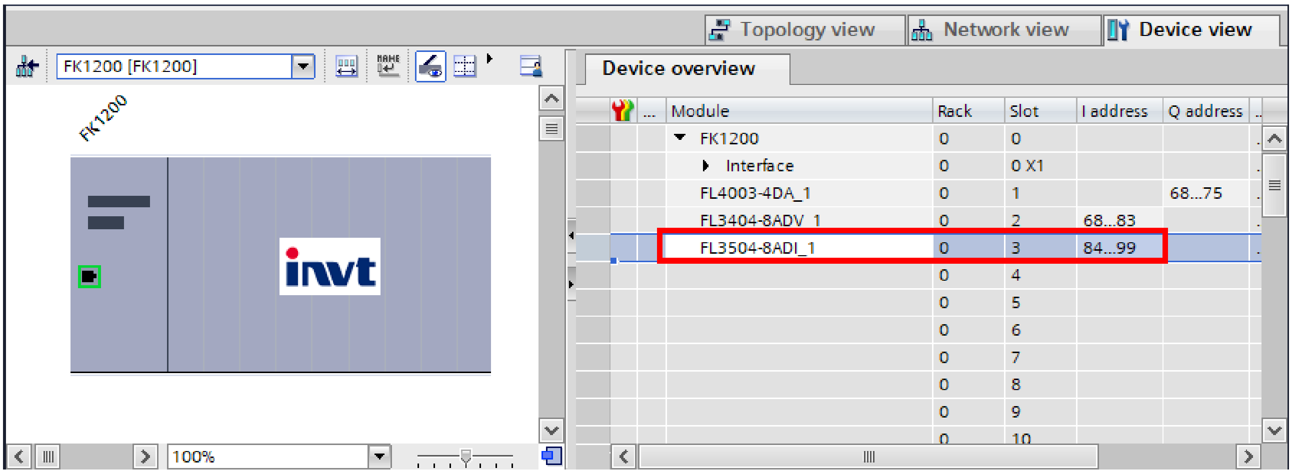


6.2.1.13 Analog input module—FL3504(8ADI)

Step 1 In the **Device view** interface, add **FL3504-8ADI**, double click **FL3504-8ADI** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

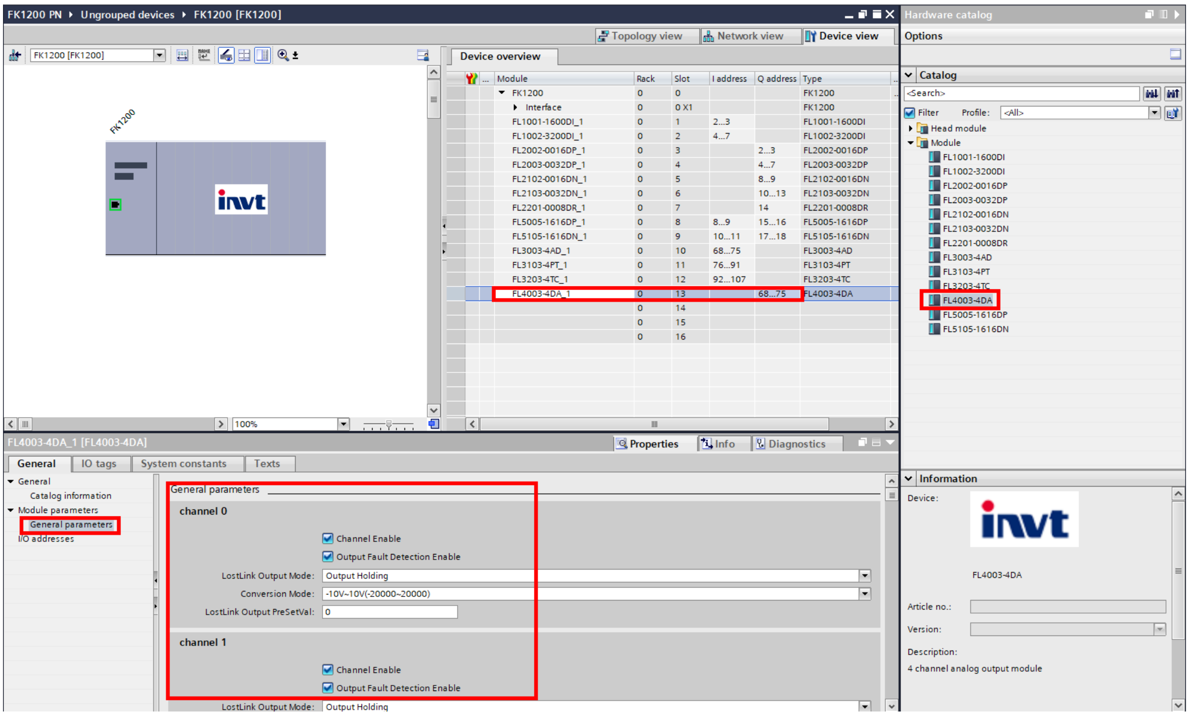


Step 2 Obtain sampling values through I addresses.

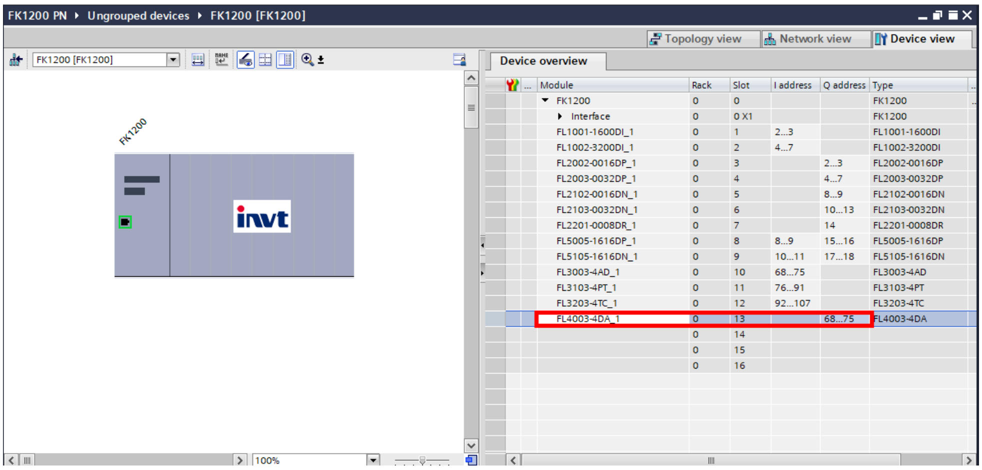


6.2.1.14 Analog output module—FL4003 (4DA)

Step 1 On the **Device view** interface, add **FL4003-4DA**, double click **FL4003-4DA** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

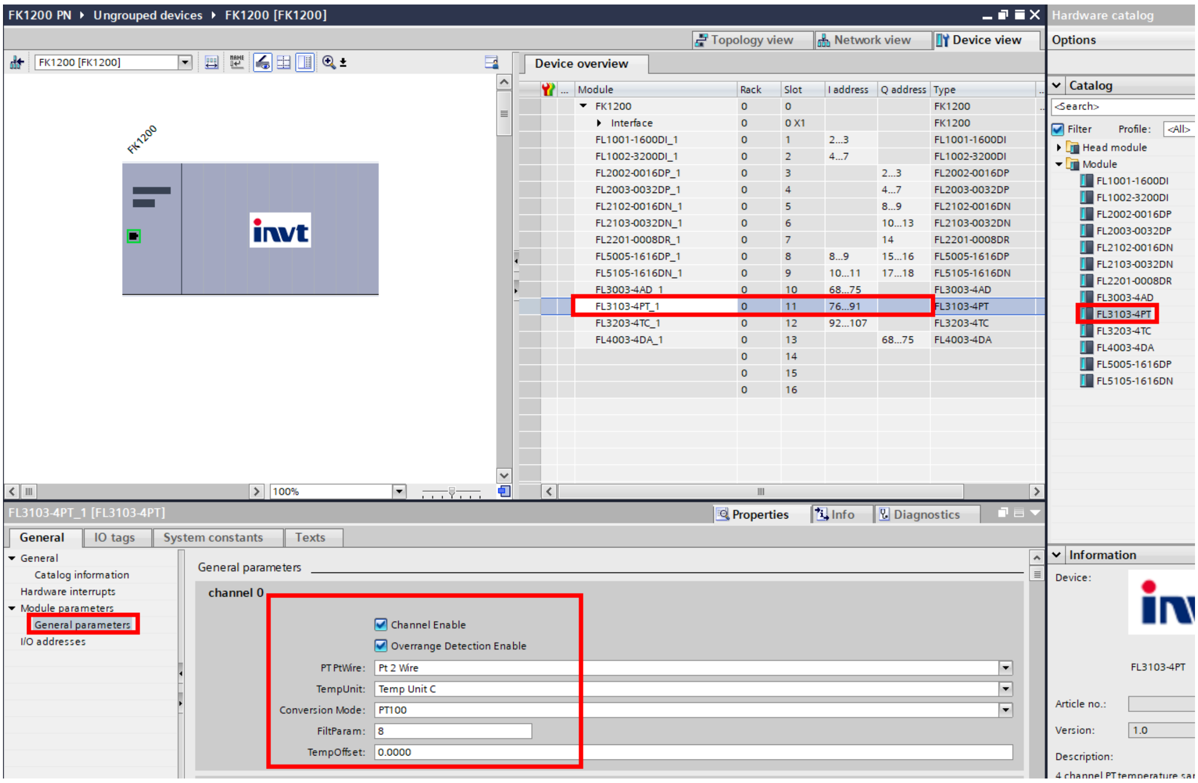


Step 2 Control output through Q addresses.

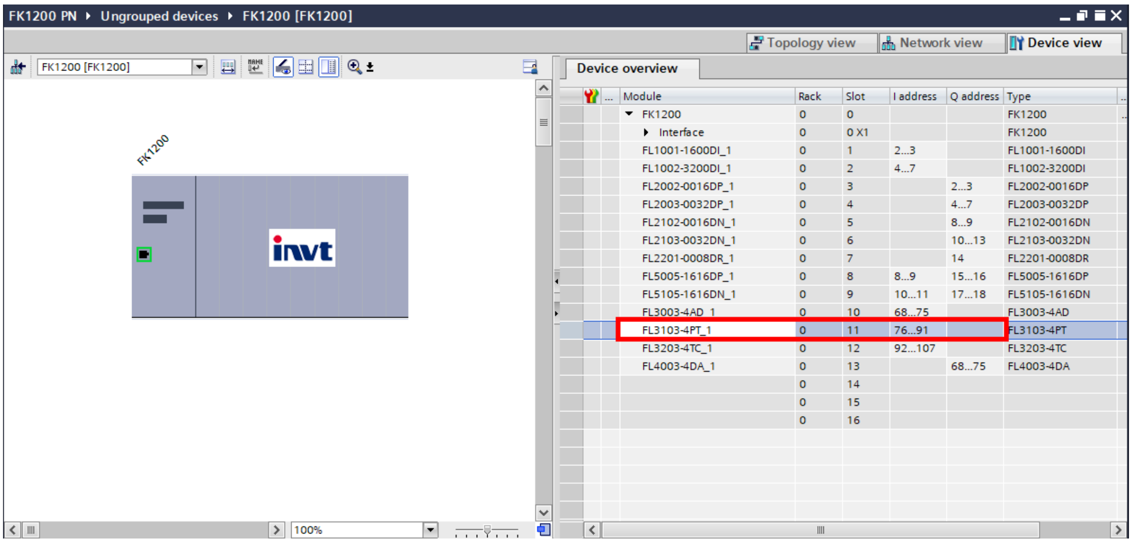


6.2.1.15 Temperature detection module (thermistor)—FL3103 (4PT)

Step 1 On the **Device view** interface, add **FL3103-4PT**, double click **FL3103-4PT** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

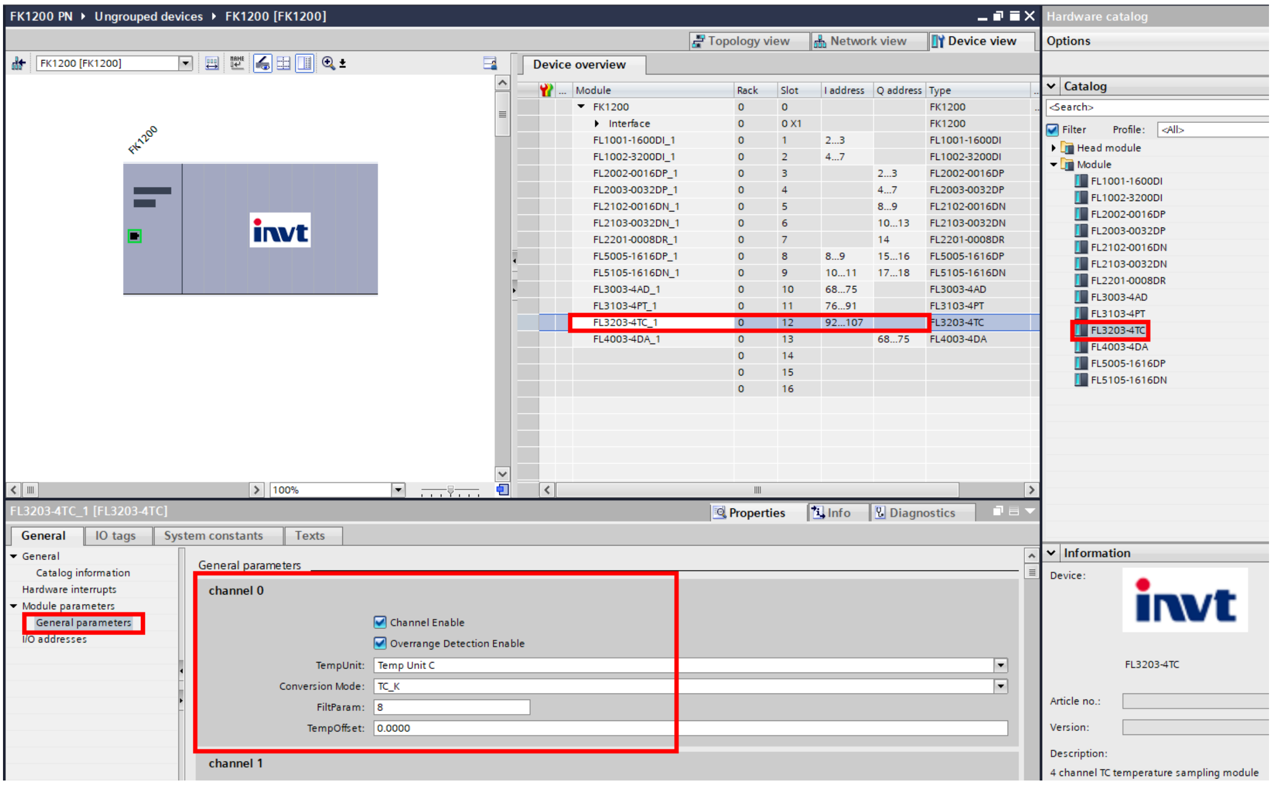


Step 2 Obtain sampling values through I addresses.

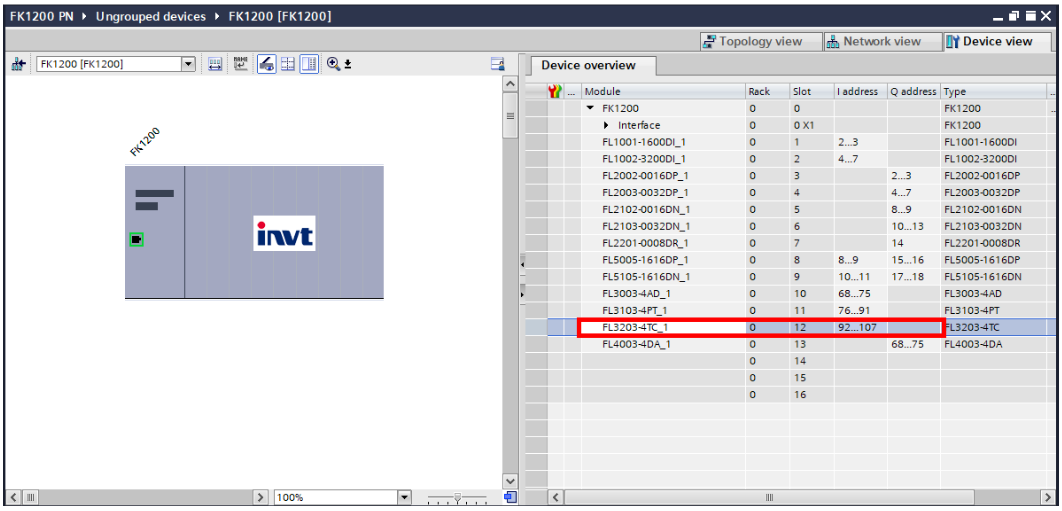


6.2.1.16 Temperature detection module (thermistor)—FL3203 (4TC)

Step 1 On the **Device view** interface, add **FL3203-4TC**, double click **FL3203-4TC** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.

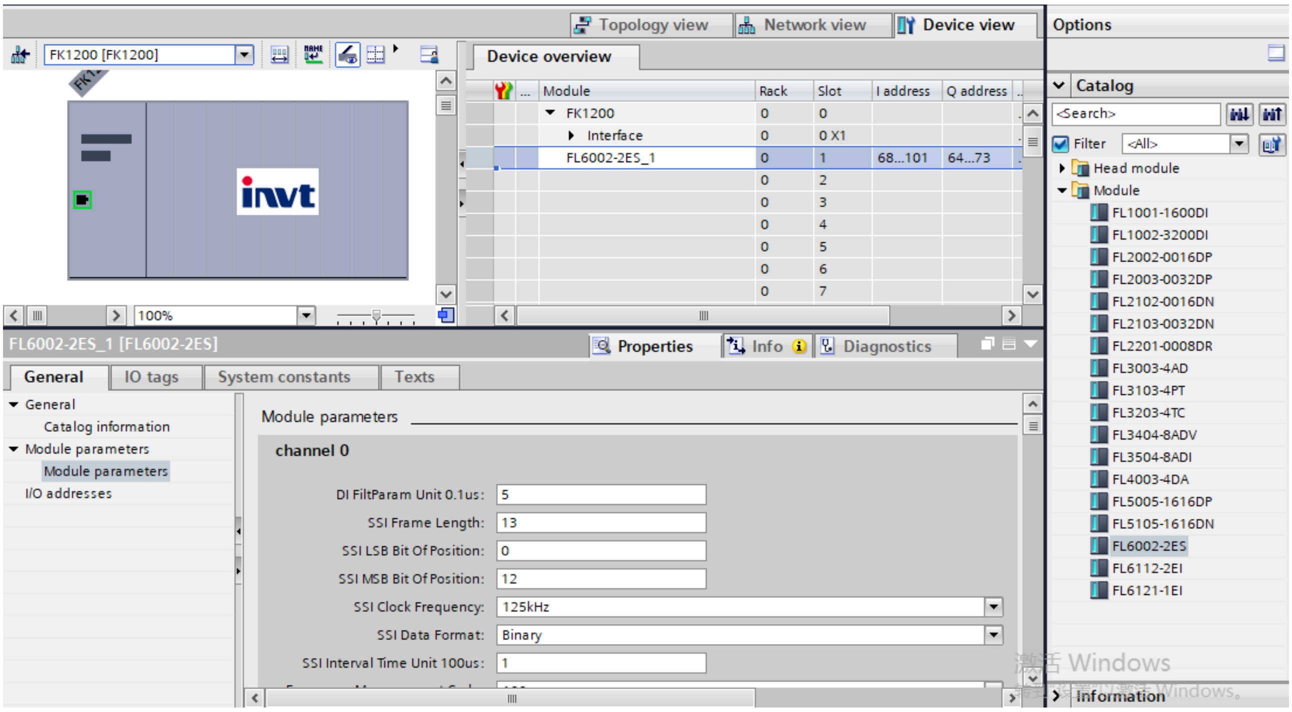


Step 2 Obtain sampling values through I addresses.

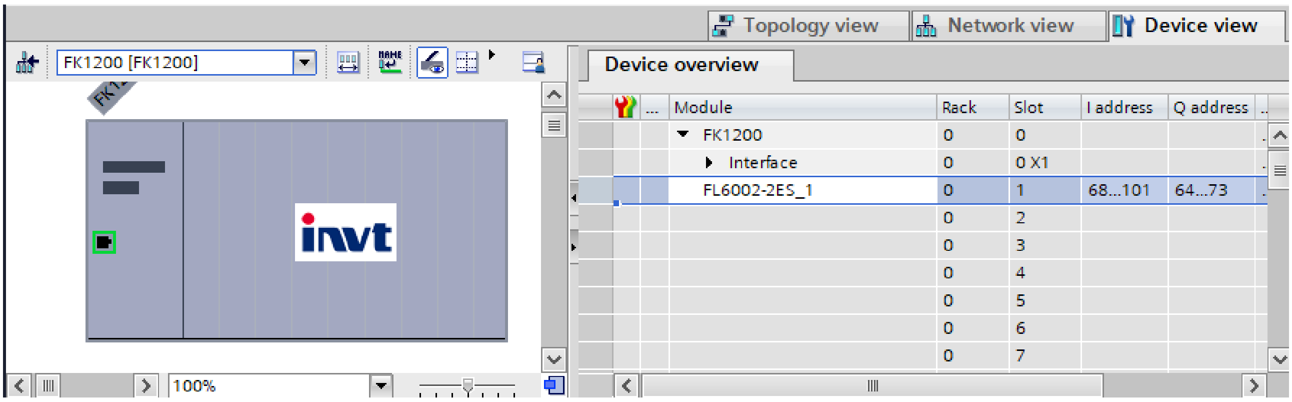


6.2.1.17 Counting and measurement module—FL6002-2ES

Step 1 In the **Device view** interface, add **FL6002-2ES**, double click **FL6002-2ES** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



Step 2 Obtain sampling values through I addresses and control the module through Q addresses.



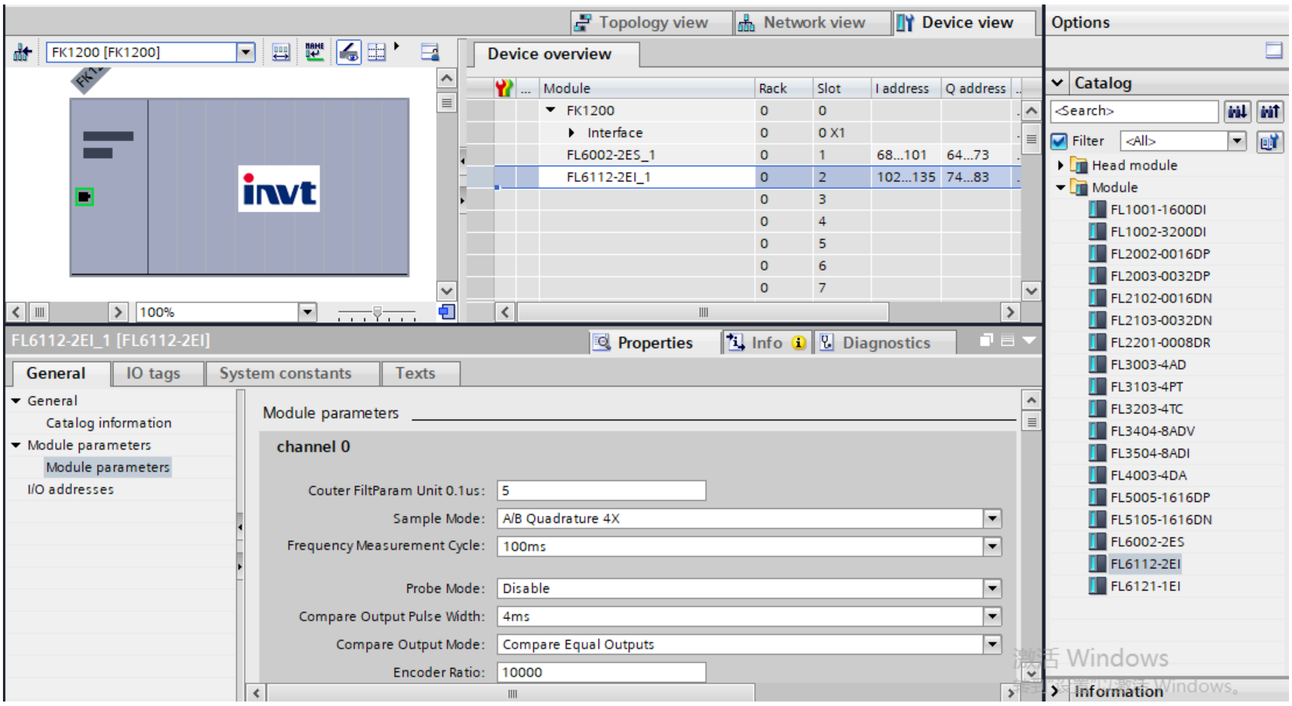
The meaning of I and Q addresses is as follows:

Address	Parameter name	Type	Description
%QB64	Cnt0_Ctrl	USNT	Control parameter for counter 0. Bit0: Enable counting, valid at high levels; Bit1: Reserved; Bit2: Reserved; Bit3: Reserved; Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit7–Bit5: Reserved.
%QB65	Cnt1_Ctrl	USNT	Control parameter for counter 1. Bit0: Enable counting, valid at high levels; Bit1: Reserved;

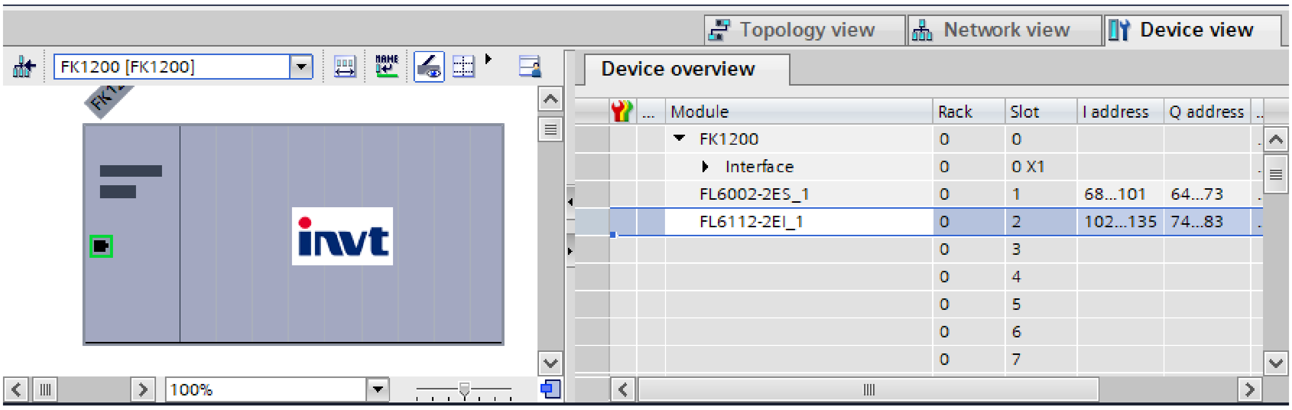
Address	Parameter name	Type	Description
			Bit2: Reserved; Bit3: Reserved; Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit7–Bit5: Reserved.
%QD66	Cnt0_CmpVal	DINT	Counter 0 comparison value
%QD70	Cnt1_CmpVal	DINT	Counter 1 comparison value
%IB68	Cnt0_Status	USINT	Counter 0 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Reserved Bit3: Reserved Bit4: DI latch completion flag Bit5: Reserved Bit6: Status when the data line is idle Bit7: Reserved
%IB69	Cnt0_Status	USINT	Counter 1 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Reserved Bit3: Reserved Bit4: DI latch completion flag Bit5: Reserved Bit6: Status when the data line is idle Bit7: Reserved
%ID70	Cnt0_Val	DINT	Count value of counter 0
%ID74	Cnt1_Val	DINT	Count value of counter 1
%ID78	Cnt0_LatchVal	DINT	Latched value of counter 0
%ID82	Cnt1_LatchVal	DINT	Latched value of counter 1
%ID86	Cnt0_Freq	UDINT	Counter 0 frequency
%ID90	Cnt1_Freq	UDINT	Counter 1 frequency
%ID94	Cnt0_Velocity	REAL	Counter 0 speed (Valid for single-turn encoder)
%ID98	Cnt1_Velocity	REAL	Counter 1 speed (Valid for single-turn encoder)

6.2.1.18 Counting and measurement module—FL6112-2EI

Step 1 In the **Device view** interface, add **FL6112-2EI**, double click **FL6112-2EI** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



Step 2 Obtain sampling values through I addresses and control the module through Q addresses.



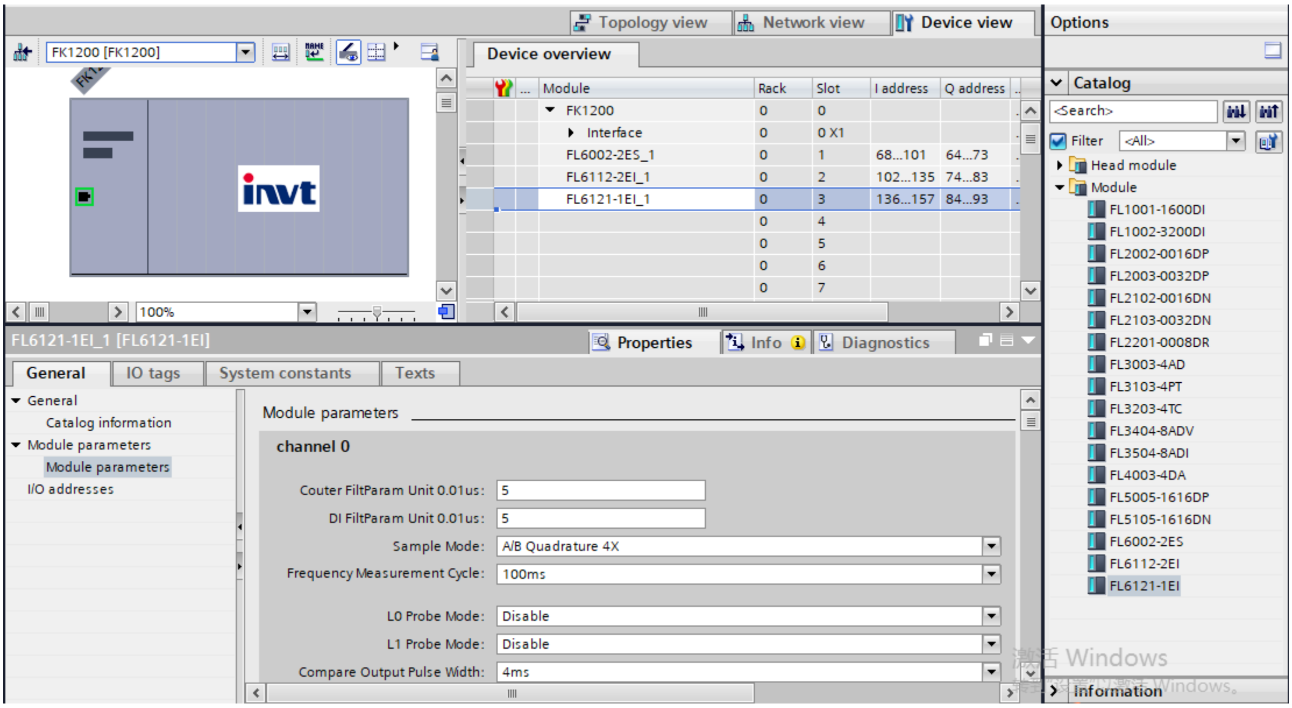
The meaning of I and Q addresses is as follows:

Address	Parameter name	Type	Description
%QB74	Cnt0_Ctrl	USINT	Control parameter for counter 0. Bit0: Enable counting, valid at high levels; Bit1: Clear counting, valid at the rising edge; Bit2: Write counter preset value, valid at the rising edge; Bit3: Clear count overflow flag, valid at the rising edge; Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit7–Bit5: Reserved.
%QB75	Cnt1_Ctrl	USINT	Control parameter for counter 1. The

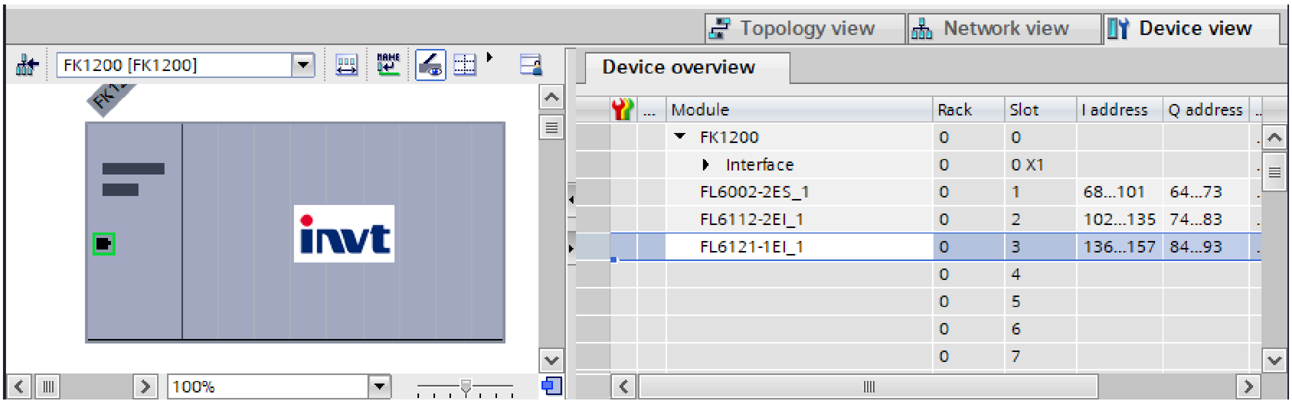
Address	Parameter name	Type	Description
			parameter configuration is consistent with counter 0.
%QD76	Cnt0_CmpVal	DINT	Counter 0 comparison value.
%QD80	Cnt1_CmpVal	DINT	Counter 1 comparison value.
%IB102	Cnt0_Status	USINT	Counter 0 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI0 latch completion flag Bit7–Bit5: Reserved
%IB103	Cnt1_Status	USINT	Counter 1 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI1 latch completion flag Bit7–Bit5: Reserved
%ID104	Cnt0_Val	DINT	Count value of counter 0
%ID108	Cnt1_Val	DINT	Count value of counter 1
%ID112	Cnt0_LatchVal	DINT	Latched value of counter 0
%ID116	Cnt1_LatchVal	DINT	Latched value of counter 1
%ID120	Cnt0_Freq	UDINT	Counter 0 frequency
%ID124	Cnt1_Freq	UDINT	Counter 1 frequency
%ID128	Cnt0_Velocity	REAL	Counter 0 speed
%ID132	Cnt1_Velocity	REAL	Counter 1 speed

6.2.1.19 Counting and measurement module—FL6121-1EI

Step 1 In the **Device view** interface, add **FL6121-1EI**, double click **FL6121-1EI** under **Module**, choose **Properties** > **General** > **Module parameters**, and then set module initialization parameters.



Step 2 Obtain sampling values through I addresses and control the module through Q addresses.



The meaning of I and Q addresses is as follows:

Address	Parameter name	Type	Description
%QW84	Cnt_Ctrl	UINT	Counter control parameter. Bit0: Enable counting, valid at high levels Bit1: Clear counting, valid at the rising edge Bit2: Write counter preset value, valid at the rising edge Bit3: Clear count overflow flag, valid at the rising edge Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit15–Bit5: Reserved
%QD86	Cnt_Cmp0Val	DINT	Counter comparison value 0.

Address	Parameter name	Type	Description
%QD90	Cnt_Cmp1Val	DINT	Counter comparison value 1.
%IW136	Cnt_Status	UINT	Counter count state feedback. Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI0 latch completion flag Bit5: DI1 latch completion flag Bit15–Bit6: Reserved
%ID138	Cnt_Val	DINT	Count value of counter
%ID142	Cnt_Latch0Val	DINT	Latched value 0 of counter
%ID146	Cnt_Latch1Val	DINT	Latched value 1 of counter
%ID150	Cnt_Freq	UDINT	Counter frequency
%ID154	Cnt_Velocity	REAL	Counter speed

6.3 EtherNet/IP configuration description

6.3.1 EDS use description

The FK1300 EIP coupler EDS files come in two forms: one is a generic EDS file, and the other is a specialized EDS file generated by the Ttools-IO host controller software based on the configuration.

6.3.1.1 Module parameter

- FK1300 coupling

Parameter	Type	Description	Data type
hwVersion	UINT	Coupler hardware version	Input Data(T→O)
swVersion	UINT	Coupler software version	

- Digital input module

Parameter	Type	Description	Data type
1600DI-Filt0/3200DI-Filt0	UINT	I0–I7 filter parameter. Unit: 10μs	Config Param
1600DI-Filt0/3200DI-Filt1	UINT	I10–I17 filter parameter. Unit: 10μs	
3200DI-Filt2	UINT	I20–I27 filter parameter. Unit: 10μs	
3200DI-Filt3	UINT	I30–I37 filter parameter. Unit: 10μs	
1600DI-ErrId/3200DI-ErrId	UINT	Fault code	Diagnosis Data
1600DI-IN0/3200DI-IN0	USINT	I0–I7 status feedback	Input (T→O)
1600DI-IN0/3200DI-IN1	USINT	I10–I17 status feedback	
3200DI-IN2	USINT	I20–I27 status feedback	
3200DI-IN3	USINT	I30–I37 status feedback	

- Digital output module

<table>
<tr><th>Parameter</th><th>Type</th><th colspan="4">Description</th><th>Data type</th></tr>
<tr><td rowspan="2">(0016DP/N)-Stop_Mode0
(0032DP/N)-Stop_Mode0</td><td rowspan="2">UINT</td><td colspan="4">Stop/offline output mode:</td><td rowspan="2">Config Param</td></tr>
<tr><td>Q7</td><td>…</td><td>Q1</td><td>Q0</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th><th>Data type</th></tr>
<tr><td></td><td></td><td><table><tr><td>bit15</td><td>bit14</td><td>…</td><td>…</td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr></table>0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output preset</td><td rowspan="8"></td></tr>
<tr><td>(0016DP/N)-Stop_Mode1
(0032DP/N)-Stop_Mode1</td><td>UINT</td><td>Stop/offline output mode<table><tr><th colspan="2">Q17</th><th colspan="2">…</th><th colspan="2">Q11</th><th colspan="2">Q10</th></tr><tr><td>bit15</td><td>bit14</td><td>…</td><td>…</td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr></table>0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output according to the preset</td></tr>
<tr><td>(0032DP/N)-Stop_Mode2</td><td>UINT</td><td>Stop/offline output mode<table><tr><th colspan="2">Q27</th><th colspan="2">…</th><th colspan="2">Q21</th><th colspan="2">Q20</th></tr><tr><td>bit15</td><td>bit14</td><td>…</td><td>…</td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr></table>0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output according to the preset</td></tr>
<tr><td>(0032DP/N)-Stop_Mode3</td><td>UINT</td><td>Stop/offline output mode<table><tr><th colspan="2">Q37</th><th colspan="2">…</th><th colspan="2">Q31</th><th colspan="2">Q30</th></tr><tr><td>bit15</td><td>bit14</td><td>…</td><td>…</td><td>bit3</td><td>bit2</td><td>bit1</td><td>bit0</td></tr></table>0b00: Stop/offline output retained
0b01: Stop/offline output cleared
0b10: Stop/offline output preset</td></tr>
<tr><td>(0016DP/N)-Stop Output0
(0032DP/N)-Stop Output0</td><td>USINT</td><td>Stop/offline output preset<table><tr><th>Q7</th><th>…</th><th>Q1</th><th>Q0</th></tr><tr><td>bit7</td><td>…</td><td>bit1</td><td>bit0</td></tr></table></td></tr>
<tr><td>(0016DP/N)-Stop Output1
(0032DP/N)-Stop Output1</td><td>USINT</td><td>Stop/offline output preset<table><tr><th>Q17</th><th>…</th><th>Q11</th><th>Q10</th></tr><tr><td>bit7</td><td>…</td><td>bit1</td><td>bit0</td></tr></table></td></tr>
<tr><td>(0032DP/N)-Stop Output2</td><td>USINT</td><td>Stop/offline output preset<table><tr><th>Q27</th><th>…</th><th>Q21</th><th>Q20</th></tr><tr><td>bit7</td><td>…</td><td>bit1</td><td>bit0</td></tr></table></td></tr>
<tr><td>(0032DP/N)-Stop Output3</td><td>USINT</td><td>Stop/offline output preset<table><tr><th>Q37</th><th>…</th><th>Q31</th><th>Q30</th></tr><tr><td>bit7</td><td>…</td><td>bit1</td><td>bit0</td></tr></table></td></tr>
<tr><td>(0016DP/N)-OUT0
(0032DP/N)-OUT0</td><td>USINT</td><td>Q0–Q7 output control</td><td rowspan="5">Output (O →T)</td></tr>
<tr><td>(0016DP/N)-OUT1
(0032DP/N)-OUT1</td><td>USINT</td><td>Q10–Q17 output control</td></tr>
<tr><td>(0032DP/N)-OUT2</td><td>USINT</td><td>Q20–Q27 output control</td></tr>
<tr><td>(0032DP/N)-OUT3</td><td>USINT</td><td>Q30–Q37 output control</td></tr>
<tr><td>Satisfy Parameter</td><td>USINT</td><td>Empty parameter, used for alignment and padding for modules with fewer than 16 points</td></tr>
<tr><td>(0016DP/N)-ErrID/
(0032DP/N)-ErrID</td><td>UINT</td><td>Fault code</td><td>Diagnosis Data (Input(T → O))</td></tr>
</table>

The digital output module divides every eight channels into a group. Taking configuration

0016DP-Stop_Mode0 as an example, the corresponding output channels are Q0–Q7. The data type of 0016DP-Stop_Mode0 is UINT. The data definition is detailed in the following parameter description table.

Q7		Q6		Q5		Q4		Q3		Q2		Q1		Q0	
bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0

The output modes represented by bit1 and bit0 values are as follows:

Value	Mode
0b00	Stop/offline output retained
0b01	Stop/offline output cleared
0b10	Stop/offline output preset

If Q0–Q7 are all configured as output retained, then the value of 0016DP-Stop_Mode0 is 0, that is, 2#0000000000000000.

Q7		Q6		Q5		Q4		Q3		Q2		Q1		Q0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

- Analog input module-FL3003 (4AD)

Parameter name	Type	Description	Data type
4AD-AI0_Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Open-loop detection enabling control. (0: Disable. 1: Enable.) Bit2: Over-range detection enabling control. (0: Disable. 1: Enable.) Bit3: Over-range enabling control. (0: Disable. 1: Enable.) Bit4: Enhanced filter enabling control. (0: Disable. 1: Enable.) Bit7–bit5: Channel conversion mode. 0b000: Voltage range 0–5V, corresponding to detection value range 0–20000 0b001: Voltage range 0–10V, corresponding to detection value range 0–20000 0b010: Voltage range -5–5V, corresponding to detection value range -20000–20000 0b011: Voltage range -10–10V, corresponding to detection value range -20000–20000 0b100: Current range 4–20mA, corresponding to detection value range 0–20000 0b101: Current range 0–20mA, corresponding to detection value range 0–20000 0b110: Reserved 0b111: Current range -20–20mA, corresponding to detection value range -20000–20000	Config Param
4AD-AI1_Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.	
4AD-AI2_Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for channel 0.	

Parameter name	Type	Description	Data type
4AD-AI3_Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.	
4AD-AI0_Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.	
4AD-AI1_Filt	USINT	Filter parameter for channel 1. The filter parameter setting is consistent with that for channel 0.	
4AD-AI2_Filt	USINT	Filter parameter for channel 2. The filter parameter setting is consistent with that for channel 0.	
4AD-AI3_Filt	USINT	Filter parameter for channel 3. The filter parameter setting is consistent with that for channel 0.	
4AD-AI0	DINT	Conversion value for channel 0.	Input(T→O)
4AD-AI1	DINT	Conversion value for channel 1.	
4AD-AI2	DINT	Conversion value for channel 2.	
4AD-AI3	DINT	Conversion value for channel 3.	
4AD-AI0_ErrId	UINT	Fault code for channel 0.	Diagnosis Data (Input(T → O))
4AD-AI1_ErrId	UINT	Fault code for channel 1.	
4AD-AI2_ErrId	UINT	Fault code for channel 2.	
4AD-AI3_ErrId	UINT	Fault code for channel 3.	

Taking channel 0 as an example, the parameter type is USINT. See the following table for detailed definition of 4AD-AI0_Cfg.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Channel conversion mode (range configuration)			**Enhanced filter enabling control**	**Over-range enabling control**	**Over-range detection enabling control**	**Open-loop detection enabling control**	**Channel enabling control**
0b000: 0–5V 0b001: 0–10V 0b010: -5V–+5V 0b011: -10V–+10V	0b100: 4–20mA 0b101: 0–20mA 0b110: Reserved 0b111: -20–+20mA		0: Disable 1: Enable	0: Disable 1: Enable	0: Disable 1: Enable	0: Disable 1: Enable	0: Disable 1: Enable

Channel 0 is set to channel enabled, open-circuit detection disabled, over-range detection enabled, over-range enabled, enhanced filtering disabled, and the range is set to 4-20mA. The value should be 141, that is, 2#10001101. Details are as follows:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0b100			0	1	1	0	1
0b100:4–20mA			0: Disable	1: Enable	1: Enable	0: Disable	1: Enable

Range conversion:

Measurement range	Current (I)/ Voltage (U)	Decimal (D)	Hexadecimal	Range	Conversion formula
0–5V	8.19175V	32767	0x7FFF	Beyond upper limit	D = 20000×U/5 U = D×5/20000
	5V	20000	0x4E20	Rated range	

Measurement range	Current (I)/ Voltage (U)	Decimal (D)	Hexadecimal	Range	Conversion formula
	2.5V	10000	0x2710		
	0V	0	0x0000		
	-2.5V	-10000	0xD8F0	Beyond lower limit	
	-5V	-20000	0xB1E0		
	-8.19175V	-32768	0x8000		
0–10V	16.3835V	32767	0x7FFF	Beyond upper limit	D = 20000×U/10 U = D×10/20000
	10V	20000	0x4E20	Rated range	
	5V	10000	0x2710		
	0V	0	0x0000		
	-5V	-10000	0xD8F0	Beyond lower limit	
	-10V	-20000	0xB1E0		
	-16.3835V	-32768	0x8000		
±5V	8.19175V	32767	0x7FFF	Beyond upper limit	D = 20000×U/5 U = D×5/20000
	5V	20000	0x4E20	Rated range	
	2.5V	10000	0x2710		
	0V	0	0x0000		
	-2.5V	-10000	0xD8F0		
	-5V	-20000	0xB1E0		
	-8.19175V	-32768	0x8000	Beyond lower limit	
±10V	16.3835V	32767	0x7FFF	Beyond upper limit	D = 20000×U/10 U = D×10/20000
	10V	20000	0x4E20	Rated range	
	5V	10000	0x2710		
	0V	0	0x0000		
	-5V	-10000	0xD8F0		
	-10V	-20000	0xB1E0		
	-16.3835V	-32768	0x8000	Beyond lower limit	
4–20mA	30.2136mA	32767	0x7FFF	Beyond upper limit	D = 20000×(I-4)/16 I = D×16/20000+4
	20mA	20000	0x4E20	Rated range	
	12mA	10000	0x2710		
	4mA	0	0x0000		
	0mA	-5000	0xEC78	Beyond lower limit	
	-22.2136mA	-32768	0x8000		
0–20mA	32.767mA	32767	0x7FFF	Beyond upper limit	D = 20000×I/20 I = D×20/20000
	20mA	20000	0x4E20	Rated range	
	10mA	10000	0x2710		
	0mA	0	0x0000		
	-10mA	-10000	0xD8F0	Beyond lower limit	
	-20mA	-20000	0xB1E0		
	-32.767mA	-32768	0x8000		
±20mA	32.767mA	32767	0x7FFF	Beyond upper	D = 20000×I/20

Measurement range	Current (I)/ Voltage (U)	Decimal (D)	Hexadecimal	Range	Conversion formula
				limit	I = D×20/20000
	20mA	20000	0x4E20	Rated range	
	10mA	10000	0x2710		
	0mA	0	0x0000		
	– 10mA	-10000	0xD8F0		
	– 20mA	-20000	0xB1E0		
	– 32.767mA	-32768	0x8000	Beyond lower limit	

- Analog output module-FL4003 (4DA)

Parameter name	Type	Description	Data type
4DA-AO0_Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Output fault detection enabling control. (0: Disable. 1: Enable.) Bit3–bit2: Offline output mode. 0b00: Offline output retained 0b01: Offline output cleared 0b10: Offline output preset Bit4: Reserved Bit7–bit5: Channel conversion mode. 0b000: Voltage range 0–5V, corresponding to detection value range 0–20000 0b001: Voltage range 0–10V, corresponding to detection value range 0–20000 0b010: Voltage range -5–+5V, corresponding to detection value range -20000–20000 0b011: Voltage range -10–+10V, corresponding to detection value range -20000–20000 0b100: Current range 4–20mA, corresponding to detection value range 0–20000 0b101: Current range 0–20mA, corresponding to detection value range 0–20000 0b110: Reserved 0b111: Reserved	Config Param
4DA-AO1_Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.	
4DA-AO2_Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for channel 0.	
4DA-AO3_Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.	
4DA-AO0_Stop_Output	INT	Preset value of stop/offline output for channel 0.	
4DA-AO1_Stop_Output	INT	Preset value of stop/offline output for channel 1.	
4DA-AO2_Stop_Output	INT	Preset value of stop/offline output for channel 2.	

Parameter name	Type	Description	Data type
4DA-AO3_Stop_Output	INT	Preset value of stop/offline output for channel 3.	
4DA-AO0	DINT	Output control value for channel 0.	Output(O →T)
4DA-AO1	DINT	Output control value for channel 1.	
4DA-AO2	DINT	Output control value for channel 2.	
4DA-AO3	DINT	Output control value for channel 3.	
4DA-AO0_ErrId	UINT	Fault code for channel 0.	Diagnosis Data (Input(T → O))
4DA-AO1_ErrId	UINT	Fault code for channel 1.	
4DA-AO2_ErrId	UINT	Fault code for channel 2.	
4DA-AO3_ErrId	UINT	Fault code for channel 3.	

- Temperature detection module-FL3103 (4PT)

Parameter name	Type	Description	Data type
4PT-Temp0_Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Over-range detection enabling control. (0: Disable. 1: Enable.) Bit3–bit2 Thermistor wire system configuration (0b00: Two-wire system; 0b01: Three-wire system; 0b10: Four-wire system) Bit4: Temperature unit. (0: °C. 1: °F.) Bit7–bit5: Channel conversion mode. 0b000: Reserved 0b001: PT100 0b010: PT500 0b011: Reserved 0b100: PT1000 0b101: Reserved 0b110: Reserved 0b111: CU100	Config Param
4PT-Temp1_Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.	
4PT-Temp2_Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for channel 0.	
4PT-Temp3_Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.	
4PT-Temp0_Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.	
4PT-Temp1_Filt	USINT	Filter parameter for channel 1. The filter parameter setting is consistent with that for channel 0.	
4PT-Temp2_Filt	USINT	Filter parameter for channel 2. The filter parameter setting is consistent with that for channel 0.	

Parameter name	Type	Description	Data type
4PT-Temp3_Filt	USINT	Filter parameter for channel 3. The filter parameter setting is consistent with that for channel 0.	
4PT-Temp0_Offset	DINT	Temperature offset value for channel 0. The value has been amplified by 10 times, with 999 representing 99.9. Detection value = Actually measured value + Offset value	
4PT-Temp1_Offset	DINT	Temperature offset value for channel 1. The temperature offset value is consistent with that for channel 0.	
4PT-Temp2_Offset	DINT	Temperature offset value for channel 2. The temperature offset value is consistent with that for channel 0.	
4PT-Temp3_Offset	DINT	Temperature offset value for channel 3. The temperature offset value is consistent with that for channel 0.	
4PT-Temp0	REAL	Conversion value for channel 0.	Input(T→O)
4PT-Temp1	REAL	Conversion value for channel 1.	
4PT-Temp2	REAL	Conversion value for channel 2.	
4PT-Temp3	REAL	Conversion value for channel 3.	
4PT-Temp0_ErrId	UINT	Fault code for channel 0.	Diagnosis Data (Input(T → O))
4PT-Temp1_ErrId	UINT	Fault code for channel 1.	
4PT-Temp2_ErrId	UINT	Fault code for channel 2.	
4PT-Temp3_ErrId	UINT	Fault code for channel 3.	

- Temperature detection module-FL3203 (4TC)

Parameter name	Type	Description	Data type
4TC-Temp0_Cfg	USINT	Configuration parameter for channel 0. Bit0: Channel enabling control. (0: Disable. 1: Enable.) Bit1: Over-range detection enabling control. (0: Disable. 1: Enable.) Bit3–bit2: Reserved Bit4: Temperature unit. (0: °C. 1: °F.) Bit7–bit5: Channel conversion mode. 0b000: Thermocouple of type B. 0b001: Thermocouple of type E. 0b010: Thermocouple of type J. 0b011: Thermocouple of type K. 0b100: Thermocouple of type N. 0b101: Thermocouple of type R. 0b110: Thermocouple of type S. 0b111: Thermocouple of type T.	Config Param
4TC-Temp1_Cfg	USINT	Configuration parameter for channel 1. The parameter setting is consistent with that for channel 0.	
4TC-Temp2_Cfg	USINT	Configuration parameter for channel 2. The parameter setting is consistent with that for	

Parameter name	Type	Description	Data type
		channel 0.	
4TC-Temp3_Cfg	USINT	Configuration parameter for channel 3. The parameter setting is consistent with that for channel 0.	
4TC-Temp0_Filt	USINT	Filter parameter for channel 0. Range: 1–255. A greater value indicates better filter effect but greater lagging.	
4TC-Temp1_Filt	USINT	Filter parameter for channel 1. The filter parameter setting is consistent with that for channel 0.	
4TC-Temp2_Filt	USINT	Filter parameter for channel 2. The filter parameter setting is consistent with that for channel 0.	
4TC-Temp3_Filt	USINT	Filter parameter for channel 3. The filter parameter setting is consistent with that for channel 0.	
4TC-Temp0_Offset	DINT	Temperature offset value for channel 0. (The value has been amplified by 10 times, with 999 representing 99.9.) Detection value = Actually measured value + Offset value	
4TC-Temp1_Offset	DINT	Same as the temperature offset value for channel 0.	
4TC-Temp2_Offset	DINT	Same as the temperature offset value for channel 1.	
4TC-Temp3_Offset	DINT	Same as the temperature offset value for channel 2.	
4TC-Temp0	REAL	Conversion value for channel 0.	Input (T→O)
4TC-Temp1	REAL	Conversion value for channel 1.	
4TC-Temp2	REAL	Conversion value for channel 2.	
4TC-Temp3	REAL	Conversion value for channel 3.	
4TC-Temp0_ErrId	UINT	Fault code for channel 0.	Diagnosis Data (Input(T → O))
4TC-Temp1_ErrId	UINT	Fault code for channel 1.	
4TC-Temp2_ErrId	UINT	Fault code for channel 2.	
4TC-Temp3_ErrId	UINT	Fault code for channel 3.	

- Incremental encoder input detection module-FL6112(2EI)

Parameter	Type	Description	Data type
2EI_Cnt0_Cfg	UINT	Bit[1:0] Channel mode configuration ● 0b00: A/B phase quadrature mode x4 ● 0b01: A/B phase quadrature mode x2 ● 0b10: A/B phase quadrature mode x1 ● 0b11: Pulse + Direction (high level forward) Bit[3:2] Frequency measurement period ● 0b00: 20ms ● 0b01: 100ms ● 0b10: 500ms ● 0b11: 1000ms	Config Param

Parameter	Type	Description	Data type
		Bit[5:4] Edge latch count value enabling ● 0b00: Disable ● 0b01: Rising edge ● 0b10: Falling edge ● 0b11: Dual edge Bit[7:6] Reserved Bit[9:8] Consistent output pulse width for comparison ● 0b00: 1ms ● 0b01: 2ms ● 0b10: 4ms ● 0b11: 8ms Bit [11:10] DO comparison output mode ● 0b00: Consistent output for comparison ● 0b01: Output between [Lower count limit, Comparison value) ● 0b10: Output between [Comparison value, Upper count limit] ● 0b11: Reserved (Consistent output for comparison) Bit[15:12] Reserved	
2EI_Cnt1_Cfg	UINT	Bit[1:0] Channel mode configuration ● 0b00: A/B phase quadrature mode x4 ● 0b01: A/B phase quadrature mode x2 ● 0b10: A/B phase quadrature mode x1 ● 0b11: Pulse + Direction (high level forward) Bit[3:2] Frequency measurement period ● 0b00: 20ms ● 0b01: 100ms ● 0b10: 500ms ● 0b11: 1000ms Bit[5:4] Edge latch count value enabling ● 0b00: Disable ● 0b01: Rising edge ● 0b10: Falling edge ● 0b11: Dual edge Bit[7:6] Reserved Bit[9:8] Consistent output pulse width for comparison ● 0b00: 1ms ● 0b01: 2ms ● 0b10: 4ms ● 0b11: 8ms Bit [11:10] DO comparison output mode ● 0b00: Consistent output for comparison ● 0b01: Output between [Lower count limit, Comparison value) ● 0b10: Output between [Comparison value, Upper count limit]	

Parameter	Type	Description	Data type
		● 0b11: Reserved (Consistent output for comparison) Bit[15:12] Reserved	
2EI_Cnt0_Filt	UINT	Cnt A/B/Z/L/R Port filter parameter. Unit: 0.1μs	
2EI_Cnt1_Filt	UINT	Cnt A/B/Z/L/R Port filter parameter. Unit: 0.1μs	
2EI_Cnt0_Ratio	UINT	Encoder resolution, number of pulses per revolution, pulse increment between two Z pulses	
2EI_Cnt1_Ratio	UINT	Encoder resolution, number of pulses per revolution, pulse increment between two Z pulses	
2EI_Cnt0_PresetVal	DINT	Counter preset value	
2EI_Cnt1_PresetVal	DINT	Counter preset value	
2EI_Cnt0_Status	USINT	Counter status feedback Bit[0] Forward rotation flag Bit[1] Reverse rotation flag Bit[2] Overflow flag Bit[3] Underflow flag Bit[4] L0 latch completion flag Bit[7:5] Reserved	Input (T→O)
2EI_Cnt1_Status	USINT	Counter status feedback Bit[0] Forward rotation flag Bit[1] Reverse rotation flag Bit[2] Overflow flag Bit[3] Underflow flag Bit[4] L0 latch completion flag Bit[7:5] Reserved	
2EI_Cnt0_Val	DINT	Count value feedback	
2EI_Cnt1_Val	DINT	Count value feedback	
2EI_Cnt0_Freq	DINT	Count frequency feedback Hz	
2EI_Cnt1_Freq	DINT	Count frequency feedback Hz	
2EI_Cnt0_LatchVal	DINT	Count latch value feedback	
2EI_Cnt1_LatchVal	DINT	Count latch value feedback	
2EI_Cnt0_Velocity	DINT	Running speed feedback r/min	
2EI_Cnt1_Velocity	DINT	Running speed feedback r/min	
2EI_Cnt0_ErrId	UINT	Fault code	Diagnosis Data (Input(T → O))
2EI_Cnt1_ErrId	UINT	Fault code	
2EI_Cnt0_Ctrl	USINT	Bit[0] Counter enabling, high active Bit[1] Counter reset, rising edge active Bit[2] Counter preset value writing, rising edge active Bit[3] Counter overflow flag clear, rising edge active Bit[4] Counter compare function enabling, high active (Counter enabling required) bit[7:5] Reserved	Output (O →T)
2EI_Cnt1_Ctrl	USINT	Bit[0] Counter enabling, high active Bit[1] Counter clearing, rising edge active Bit[2] Counter preset value writing, rising edge active	

Parameter	Type	Description	Data type
		Bit[3] Counter overflow flag clearing, rising edge active Bit[4] Counter compare function enabling, high active (Counter enabling required) Bit [7:5] Reserved	
2EI_Cnt0_CmpVal	DINT	Counter comparison value	
2EI_Cnt1_CmpVal	DINT	Counter comparison value	

6.3.1.2 Universal EDS file

FK1300_universal_V1.0.eds: This is a universal EDS file that is used regardless of how the module configuration changes or which master node it is compatible with. The current version in use is V1.0.

EDS has declared 6 connections:

1. Exdusive Owner
2. Input Only
3. Listen Only
4. Exdusive Owner Diagnosis Interface
5. Input Only Diagnosis Interface
6. Listen Only Diagnosis Interface

Note: Generally, connections 1, 2, and 3 are used based on the situation; connections 4, 5, and 6 are for diagnostics (not recommended for use).

- **Input(T→O) size and output(O→T) size settings**

When configuring, it is necessary to set the sizes of the connected input (T→O) and output (O→T). The bytes occupied by each I/O module are listed as follows.

Table 6-1 Number of bytes occupied I/O modules

No.	Module	Input(T→O): bytes	Output(O→T): bytes
0	FK1300	4	0
1	FL1001_1600DI	2	0
2	FL1002_3200DI	4	0
3	FL2002_0016DP	0	2
4	FL2003_0032DP	0	4
5	FL2102_0016DN	0	2
6	FL2103_0032DN	0	4
7	FL2201_0008DR	0	2
8	FL3003_4AD	8	0
9	FL3103_4PT	16	0
10	FL3203_4TC	16	0
11	FL4003_4DA	0	8
12	FL5005_1616DP	2	2
13	FL5105_1616DN	2	2
14	FL6112_2EI	34	10

For example, combination of FK1300 + FL1001_1600DI + FL3103_4PT + FL2201_0008DR

After checking the table:

FK1300: 4 bytes Input(T→O), Parameter name: hwVersion, swVersion

FL1001_1600DI: 2bytes Input(T→O), Parameter name: 1600DI -IN0, 1600DI –IN1

FL3103_4PT: 16bytes Input(T→O), Parameter name: 4PT-Temp0 – 4PT-Temp4

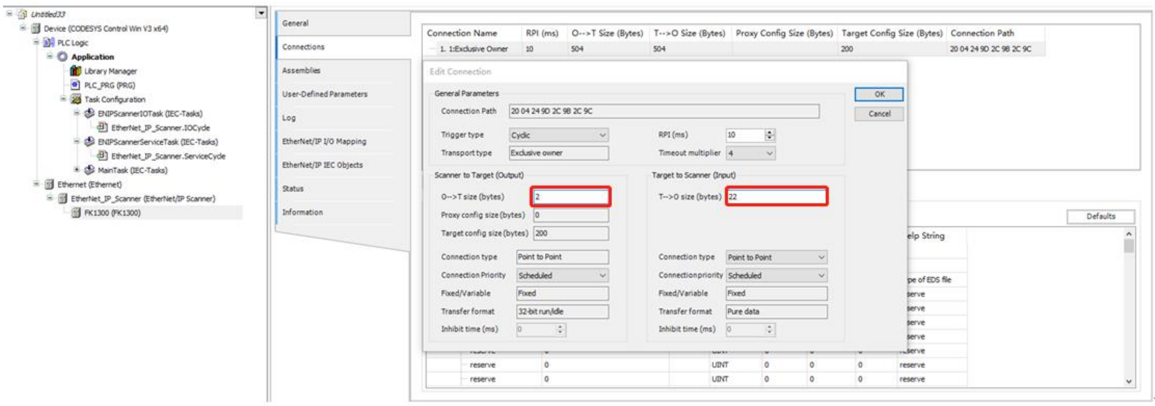
FL2201_0008DR: 2bytes Output(O→T), Parameter name: 0008DR-OUT0, Satisfy Parameter (empty parameter)

T→O byte	T→O parameter name
0	hwVersion
1	
2	swVersion
3	
4	1600DI_IN0
5	1600DI_IN1
6	4PT-Temp0
7	
8	
9	
10	4PT-Temp1
11	
12	
13	
14	4PT-Temp2
15	
16	
17	
18	4PT-Temp3
19	
20	
21	
O→T byte	**O→T parameter name**
0	0008DR-OUT0
1	Satisfy Parameter (Empty parameter)

Input(T→O) length: 4+2+16+0=22

Output(O→T) length: 0+0+2=2

The configuration is as follows if in Codesys:



Note:

- The length of the data in the input and output process must be set correctly; otherwise a connection cannot be established.

- When calculating the length of input data, please note that the FK1300 coupler occupies 4 bytes of data.

■ **Config Param configuration parameter description**

The current ConfigParam field includes the configuration for 14 supported I/O modules, with uniform settings for the same modules within the configuration, with a total length of 206 bytes. The specific offsets are as follows:

Module	Configuration parameter name	Offset	Default value	Configurable
FK1300	EDS type	0	1	No
		1		
	SLOT 1–8 Module Enable Bit	2	255	Yes
	SLOT 9–16 Module Enable Bit	3	255	Yes
	SLOT 17–24 Module Enable Bit	4	255	Yes
	SLOT 25–32 Module Enable Bit	5	255	Yes
FL1001-1600DI	slot1_FlexIO(FL1001)	6	372330578	No
		7		
		8		
		9		
	slot1_1600DI_Filt0	10	1000	Yes
		11		
	slot1_1600DI_Filt1	12	1000	Yes
		13		
FL1002-3200DI	slot2_FlexIO(FL1002)	14	372330579	No
		15		
		16		
		17		
	slot2_3200DI_Filt0	18	1000	Yes
		19		
	slot2_3200DI_Filt1	20	1000	Yes
		21		
	slot2_3200DI_Filt2	22	1000	Yes
		23		
	slot2_3200DI_Filt3	24	1000	Yes
		25		
FL2002-0016DP	slot3_FlexIO(FL2002)	26	372330586	No
		27		
		28		
		29		
	slot3_0016DP_Stop_Mode0	30	0	Yes
		31		
	slot3_0016DP_Stop_Mode1	32	0	Yes
		33		
	slot3_0016DP_Stop_Output0	34	0	Yes
	slot3_0016DP_Stop_Output1	35	0	Yes
FL2003-0032DP	slot4_FlexIO(FL2003)	36	372330587	No
		37		
		38		

Module	Configuration parameter name	Offset	Default value	Configurable
		39		
	slot4_0032DP_Stop_Mode0	40	0	Yes
		41		
	slot4_0032DP_Stop_Mode1	42	0	Yes
		43		
	slot4_0032DP_Stop_Mode2	44	0	Yes
		45		
	slot4_0032DP_Stop_Mode3	46	0	Yes
		47		
	slot4_0032DP_Stop_Output0	48	0	Yes
	slot4_0032DP_Stop_Output1	49	0	Yes
	slot4_0032DP_Stop_Output2	50	0	Yes
	slot4_0032DP_Stop_Output3	51	0	Yes
FL2102-0016DN	slot5_FlexIO(FL2102)	52	372330594	No
		53		
		54		
		55		
	slot5_0016DN_Stop_Mode0	56	0	Yes
		57		
	slot5_0016DN_Stop_Mode1	58	0	Yes
		59		
	slot5_0016DN_Stop_Output0	60	0	Yes
	slot5_0016DN_Stop_Output1	61	0	Yes
FL2103-0032DN	slot6_FlexIO(FL2103)	62	372330595	No
		63		
		64		
		65		
	slot6_0032DN_Stop_Mode0	66	0	Yes
		67		
	slot6_0032DN_Stop_Mode1	68	0	Yes
		69		
	slot6_0032DN_Stop_Mode2	70	0	Yes
		71		
	slot6_0032DN_Stop_Mode3	72	0	Yes
		73		
	slot6_0032DN_Stop_Output0	74	0	Yes
	slot6_0032DN_Stop_Output1	75	0	Yes
	slot6_0032DN_Stop_Output2	76	0	Yes
	slot6_0032DN_Stop_Output3	77	0	Yes
FL2201-0008DR	slot7_FlexIO(FL2201)	78	372330601	No
		79		
		80		
		81		
	slot7_0008DR_Stop_Mode	82	0	Yes
		83		
	slot7_0008DR_Stop_Output	84	0	Yes
FL3003-4AD	slot8_FlexIO(FL3003)	85	372330625	No
		86		

Module	Configuration parameter name	Offset	Default value	Configurable
		87		
		88		
	slot8_4AD_AI0_Cfg	89	97	Yes
	slot8_4AD_AI1_Cfg	90	97	Yes
	slot8_4AD_AI2_Cfg	91	97	Yes
	slot8_4AD_AI3_Cfg	92	97	Yes
	slot8_4AD_AI0_Filt	93	8	Yes
	slot8_4AD_AI1_Filt	94	8	Yes
	slot8_4AD_AI2_Filt	95	8	Yes
	slot8_4AD_AI3_Filt	96	8	Yes
FL3103-4PT	slot9_FlexIO(FL3103)	97	372330657	No
		98		
		99		
		100		
	slot9_4PT_Temp0_Cfg	101	129	Yes
	slot9_4PT_Temp1_Cfg	102	129	Yes
	slot9_4PT_Temp2_Cfg	103	129	Yes
	slot9_4PT_Temp3_Cfg	104	129	Yes
	slot9_4PT_Temp0_Filt	105	8	Yes
	slot9_4PT_Temp1_Filt	106	8	Yes
	slot9_4PT_Temp2_Filt	107	8	Yes
	slot9_4PT_Temp3_Filt	108	8	Yes
	slot9_4PT_Temp0_Offset	109	0	Yes
		110		
	slot9_4PT_Temp1_Offset	111	0	Yes
		112		
	slot9_4PT_Temp2_Offset	113	0	Yes
		114		
	slot9_4PT_Temp3_Offset	115	0	Yes
		116		
FL3203-4TC	slot10_FlexIO(FL3203)	117	372330665	No
		118		
		119		
		120		
	slot10_4TC_Temp0_Cfg	121	129	Yes
	slot10_4TC_Temp1_Cfg	122	129	Yes
	slot10_4TC_Temp2_Cfg	123	129	Yes
	slot10_4TC_Temp3_Cfg	124	129	Yes
	slot10_4TC_Temp0_Filt	125	8	Yes
	slot10_4TC_Temp1_Filt	126	8	Yes
	slot10_4TC_Temp2_Filt	127	8	Yes
	slot10_4TC_Temp3_Filt	128	8	Yes
	slot10_4TC_Temp0_Offset	129	0	Yes
		130		
	slot10_4TC_Temp1_Offset	131	0	Yes
		132		
	slot10_4TC_Temp2_Offset	133	0	Yes
		134		

Module	Configuration parameter name	Offset	Default value	Configurable
	slot10_4TC_Temp3_Offset	135	0	Yes
		136		
FL4003-4DA	slot11_FlexIO(FL4003)	137	372330633	No
		138		
		139		
		140		
	slot11_4DA_AO0_Cfg	141	97	Yes
	slot11_4DA_AO1_Cfg	142	97	Yes
	slot11_4DA_AO2_Cfg	143	97	Yes
	slot11_4DA_AO3_Cfg	144	97	Yes
	slot11_4DA_AO0_Stop_Output	145	0	Yes
		146		
	slot11_4DA_AO1_Stop_Output	147	0	Yes
		148		
	slot11_4DA_AO2_Stop_Output	149	0	Yes
		150		
	slot11_4DA_AO3_Stop_Output	151	0	Yes
		152		
FL5005-1616DP	slot12_FlexIO(FL5005)	153	372330610	No
		154		
		155		
		156		
	slot12_1616DP_Filt0	157	1000	Yes
		158		
	slot12_1616DP_Filt1	159	1000	Yes
		160		
	slot12_1616DP_Stop_Mode0	161	0	Yes
		162		
	slot12_1616DP_Stop_Mode1	163	0	Yes
		164		
	slot12_1616DP_Stop_Output0	165	0	Yes
	slot12_1616DP_Stop_Output1	166	0	Yes
FL5105-1616DN	slot13_FlexIO(FL5105)	167	372330614	No
		168		
		169		
		170		
	slot13_1616DN_Filt0	171	1000	Yes
		172		
	slot13_1616DN_Filt1	173	1000	Yes
		174		
	slot13_1616DN_Stop_Mode0	175	0	Yes
		176		
	slot13_1616DN_Stop_Mode1	177	0	Yes
		178		
	slot13_1616DN_Stop_Output0	179	0	Yes
	slot13_1616DN_Stop_Output1	180	0	Yes
FL6112_2EI	slot14_FlexIO(FL6112)	181	372330673	No
		182		

Module	Configuration parameter name	Offset	Default value	Configurable
		183		
		184		
	slot14_2EI_Cnt0_Cfg	185	772	Yes
		186		
	slot14_2EI_Cnt1_Cfg	187	772	Yes
		188		
	slot14_2EI_Cnt0_Filt	189	5	Yes
		190		
	slot14_2EI_Cnt1_Filt	191	5	Yes
		192		
	slot14_2EI_Cnt0_Ratio	193	10000	Yes
		194		
	slot14_2EI_Cnt1_Ratio	195	10000	Yes
		196		
	slot14_2EI_Cnt0_PresetVal	197	0	Yes
		198		
		199		
		200		
	slot14_2EI_Cnt1_PresetVal	201	0	Yes
		202		
		203		
		204		
FK1300	Satisfy Parameter	205	0	No

For specific module configuration instructions, see 6.3.1.1 Module parameter.

FK1300 configurable parameter descriptions are listed in the following table.

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>SLOT 1-8 Module Enable</td><td>USINT</td><td>Control bit of expansion module enabling/disabling.
Bit that controlling the enabling/disabling of the expansion module behind the coupler. Each bit controls the enabling/disabling of a module.<table><tr><th>Bit7</th><th>…</th><th>Bit0</th></tr><tr><td>Controls module 8.</td><td>…</td><td>Controls module 1.</td></tr></table>TRUE: Enable. FALSE: Disable.</td></tr>
<tr><td>SLOT 9-16 Module Enable</td><td>USINT</td><td>Control bit of expansion module enabling/disabling.
Bit that controlling the enabling/disabling of the expansion module behind the coupler. Each bit controls the enabling/disabling of a module.<table><tr><th>Bit7</th><th>…</th><th>Bit0</th></tr><tr><td>Controls module 16.</td><td>…</td><td>Controls module 9.</td></tr></table>TRUE: Enable. FALSE: Disable.</td></tr>
<tr><td>SLOT 17-24 Module Enable</td><td>USINT</td><td>Control bit of expansion module enabling/disabling.
Bit that controlling the enabling/disabling of the expansion module behind the coupler. Each bit controls the enabling/disabling of a module.</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td><table><tr><th>Bit7</th><th>…</th><th>Bit0</th></tr><tr><td>Controls module 24.</td><td>…</td><td>Controls module 17.</td></tr></table>TRUE: Enable. FALSE: Disable.</td></tr>
<tr><td>SLOT 25-32 Module Enable</td><td>USINT</td><td>Control bit of expansion module enabling/disabling.
Bit that controlling the enabling/disabling of the expansion module behind the coupler. Each bit controls the enabling/disabling of a module.<table><tr><th>Bit7</th><th>…</th><th>Bit0</th></tr><tr><td>Controls module 32.</td><td>…</td><td>Controls module 25.</td></tr></table>TRUE: Enable. FALSE: Disable.</td></tr>
</table>

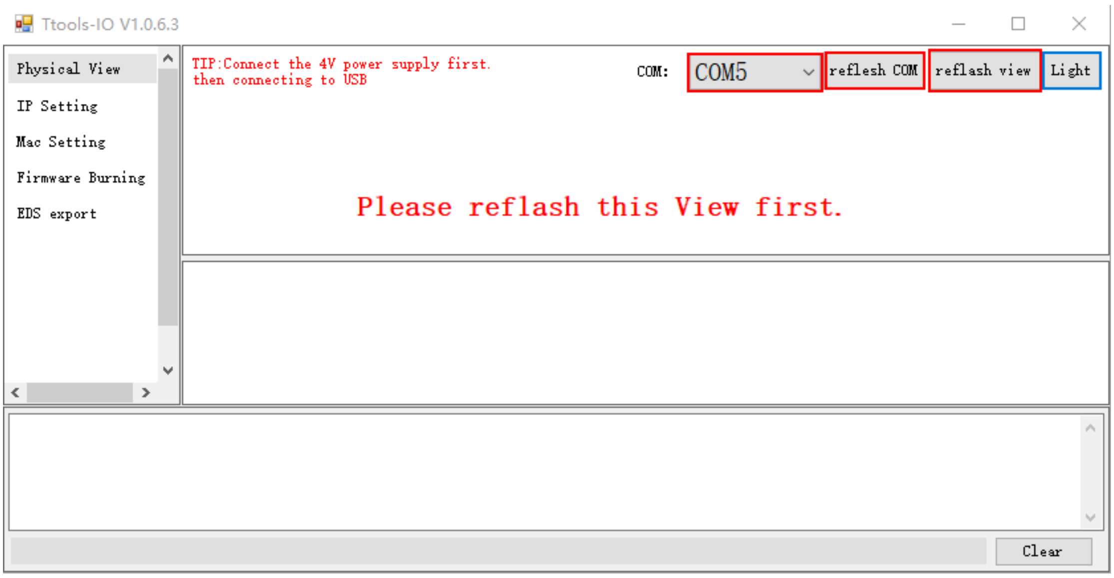
6.3.1.3 Specialized EDS file

Based on the actual configuration, the corresponding EDS file is generated using a tool, and there is no need to set input(T→O) size/output(O → T) size again during master node configuration.

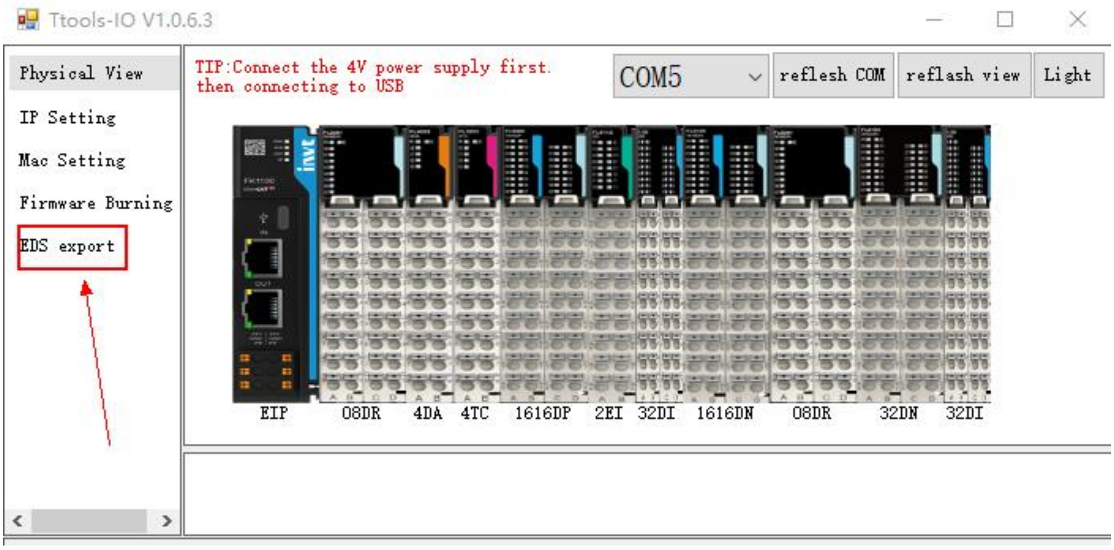
■ **Instructions for generating a specialized EDS file**

- Tool software: **Ttools-IO.exe**, use version V1.0.6.2 or later.
- USB cable: Type-C

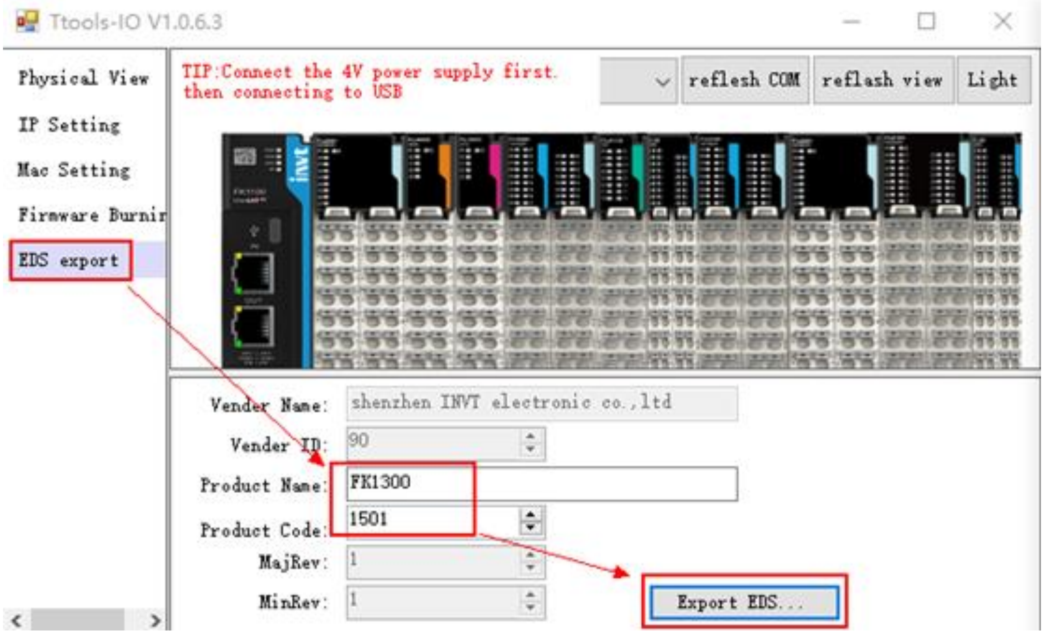
1. After the coupler is powered on, connect the Type-C cable to the computer, and then run the Ttools-IO software. See the following figure.



2. Click **refresh COM** and **refresh view**. See the following figure.



3. Click the buttons shown in the following figure for EDS file generation.



Note: Distinguish non-configured EDS files by modifying the product code.

Two files are generated:

- **FK1300.eds**: Specialized EDS file.
- **FK1300_IO.excel**: IO mapping table for easy querying of parameter offset addresses.

Description of a parameter name in the document: Slot name + Module name + Parameter name; you can know the slot and module type according to the name.

For example:

- **slot1_1600DI_IN0**: slot1 is the first slot counted from the coupler end is , the module is 1600DI, and the parameter is **IN0**.
- **slot10_4TC_Temp0**: slot10 is the tenth slot counted from the coupler end, the module is 4TC, and the parameter is **Temp0**.

IO mapping table description:

	A	B	C	D
1	Module	Param	Byte no.	
2	FL1001-1600DI	slot1_1600DI_IN0	0	
3		slot1_1600DI_IN1	1	
4	FL1002-3200DI	slot2_3200DI_IN0	2	
5		slot2_3200DI_IN1	3	
6		slot2_3200DI_IN2	4	
7		slot2_3200DI_IN3	5	
8	FL5105-1616DN	slot3_1616DN_IN0	6	
9		slot3_1616DN_IN1	7	
10	FL5005-1616DP	slot4_1616DP_IN0	8	
11		slot4_1616DP_IN1	9	
12	FL3203-4TC	slot10_4TC_Temp0	10	
13			11	
14			12	
15			13	
16		slot10_4TC_Temp1	14	
17			15	
18			16	
19			17	
20		slot10_4TC_Temp2	18	
21			19	
22			20	
23			21	
24		slot10_4TC_Temp3	22	
25			23	
26			24	
27			25	
28		slot11_4PT_Temp0	26	
29			27	
30			28	

Input | Config | Output

According to the byte sequence number, you can know the offset address and the number of bytes occupied.

There are a total of three tables as follows:

- Input: Input process data
- Output: Output process data
- Config: Configuration data

■ **Parameter description**

See 6.3.1.1 Module parameter for the specific module configuration description.

6.3.1.4 Object information

The object information can be obtained/configured through UCMM using the Get Attribute Single (0x0E) and Set Attribute Single (0x10) services. Common object information is listed in the following table.

Data object	Class	Instance	Attribute	Service	Remarks
Coupler information	0x04	0x68	0x03	0x0E	Bytes 0–1: Number of Act num modules Bytes 2–3: Hw version Bytes 4–5: Sw version Bytes 6–7: Fpga version

Data object	Class	Instance	Attribute	Service	Remarks
Module configuration	0x04	0x69	0x03	0x0E	Bytes 0–31: Slot 1–32 module type Module does not exist: 0x00 FL1001-1600DI: 0x12 FL2002-0016DP: 0x1A FL2102-0016DN: 0x22 FL2201-0008DR: 0x29 FL3003-4AD: 0x41 FL4003-4DA: 0x49 FL3103-4PT: 0x61 FL3203-4TC: 0x69
Slot 1 module info	0x04	0x70	0x03	0x0E	Bytes 0–1: Hw version Bytes 2–3: FPGA version
…	0x04	…	0x03	0x0E	
Slot 32 module info	0x04	0x8F	0x03	0x0E	
IP configuration method	0xF5	0x01	0x03	0x0E, 0x10	CIP standard object
IP interface configuration	0xF5	0x01	0x05	0x0E, 0x10	CIP standard object
IP address	0x04	0x92	0x03	0x0E, 0x10	-
Subnet mask	0x04	0x93	0x03	0x0E, 0x10	-
Gateway	0x04	0x94	0x03	0x0E, 0x10	-

6.3.2 KV STUDIO configuration description

6.3.2.1 Preparation

- PLC: KV-8000
- Computer: Pre-installed KV STUDIO software
- network cable, power supply, coupler, module

The list is as follows:

Type	Model	Qty	Slot
PLC	KV-8000	1	-
Coupler	FK1300	1	0
IO module	FL1001(1600D)	1	1
	FL2002(0016DP)	1	2
	FL1002(3200D)	1	3
	FL2002(0016DP)	1	4
Bottom cover	Bottom cover	1	5

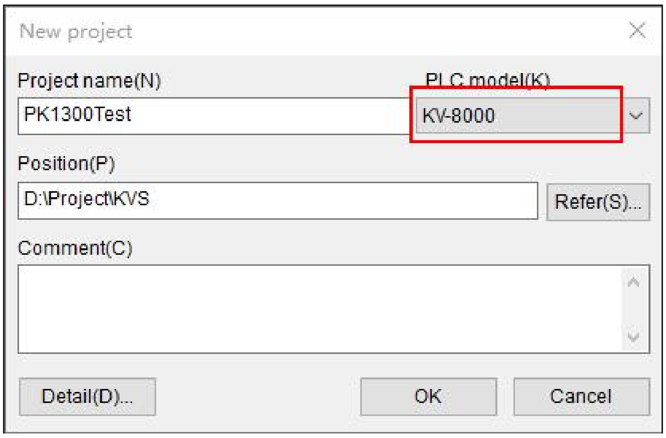
Device configuration file (choose one from two options; this example uses a universal EDS file)

- Universal EDS file: **FK1300_universal_V1.0.eds**
- Specialized EDS file: **FK1300.eds** that is generated using the Ttools-IO software.

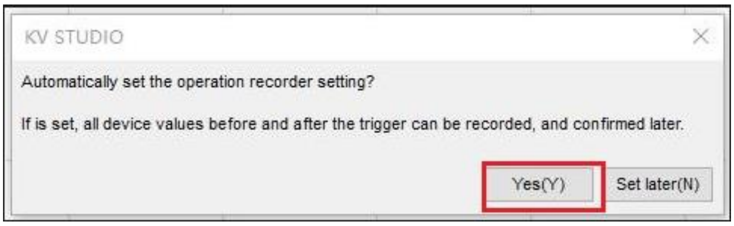
For hardware configuration and connection, see the requirements and operations described in chapters 4 Installation and 5 Wiring.

6.3.2.2 Project establishing

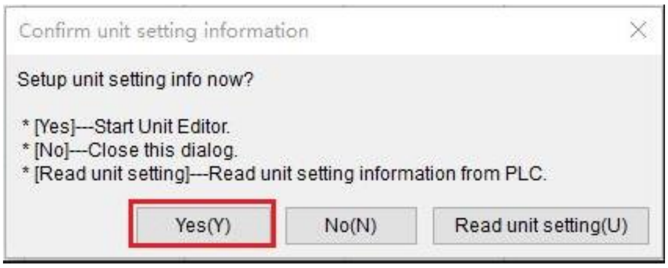
Step 1 Open KV STUDIO software, choose **File** > **New Project**, enter information such as **Project name** and **PLC model**, and click **OK** on the pop-up interface.



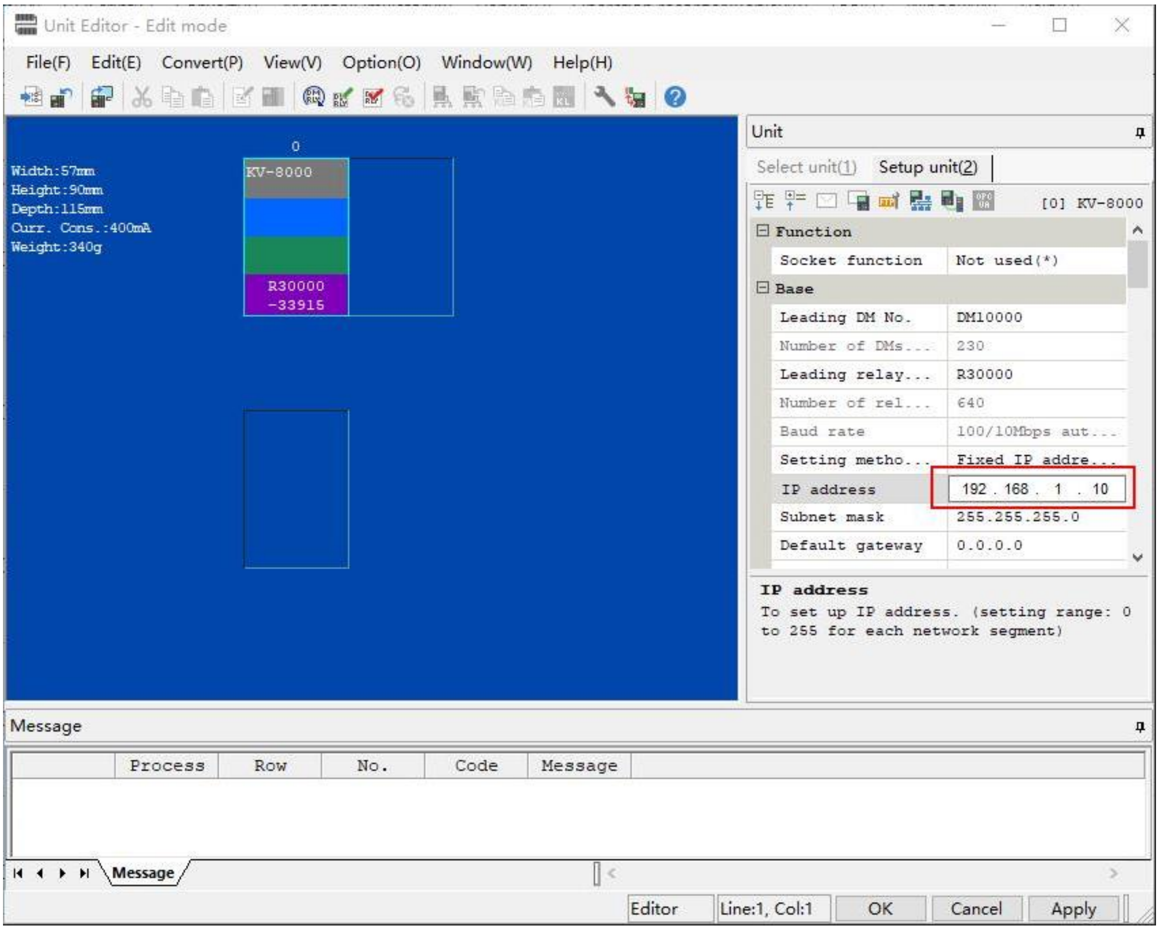
Step 2 Click **Yes**.



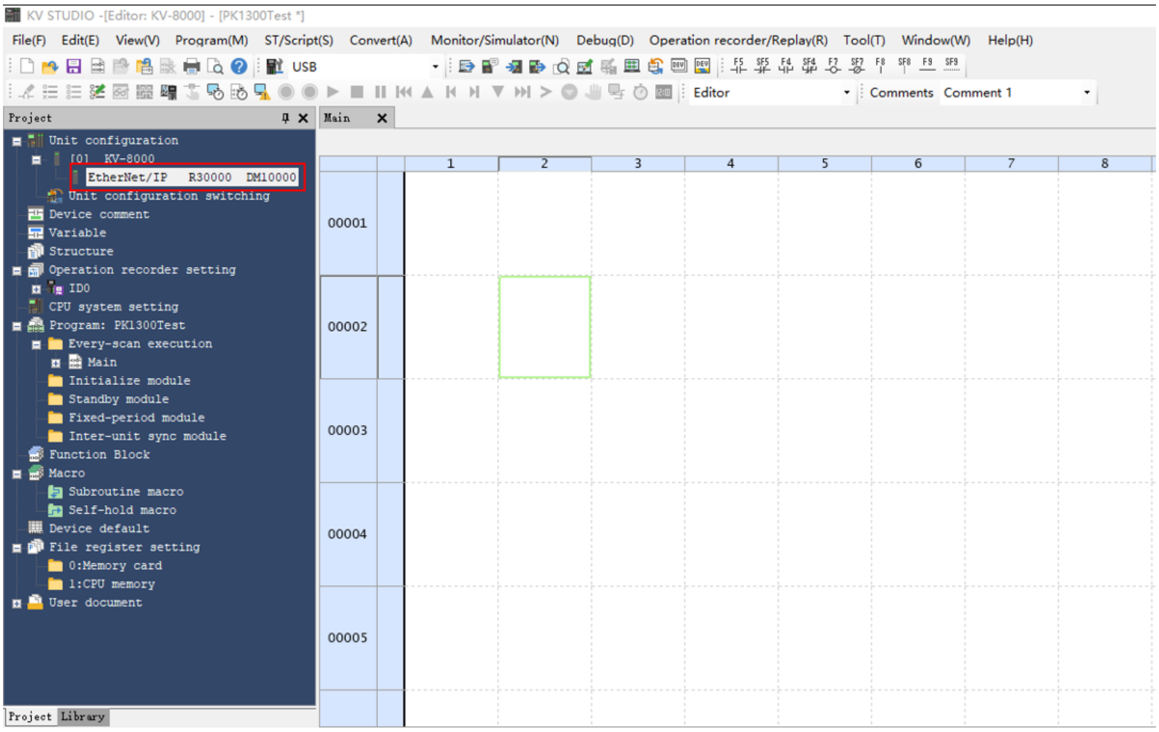
Step 3 Click **Yes**.



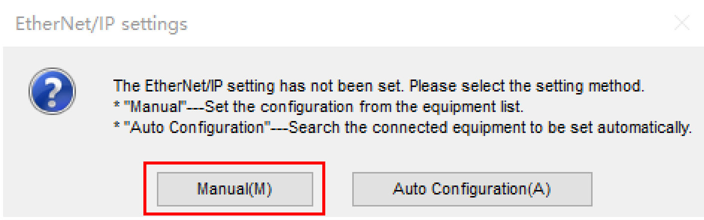
Step 4 Set the IP address of KV-8000. Ensure it is in the same network segment as PK1300.

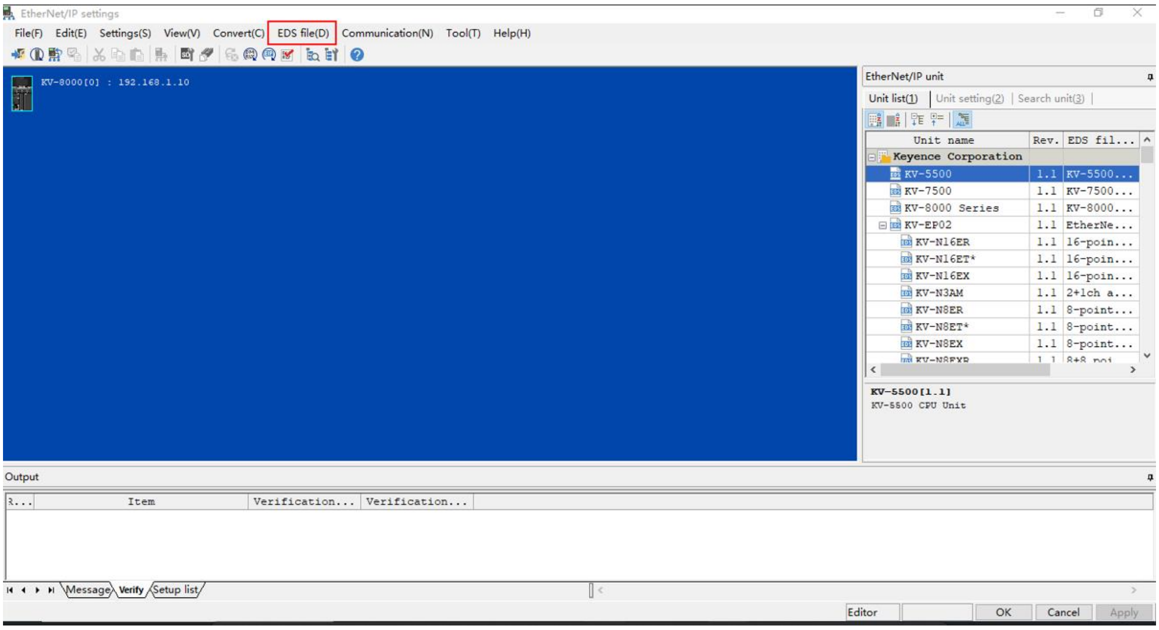


Step 5 Double-click the unit in the red box to configure the network.

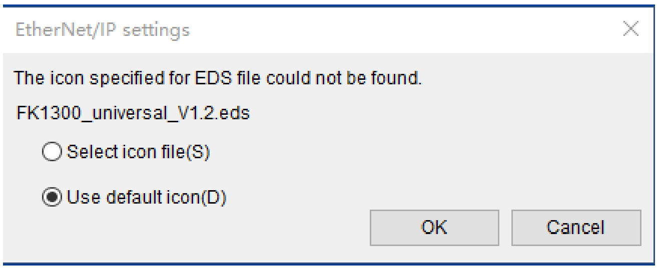


Step 6 Click **Manual**, enter the **EtherNet/IP settings** interface, and click **EDS file** to add an EDS file.



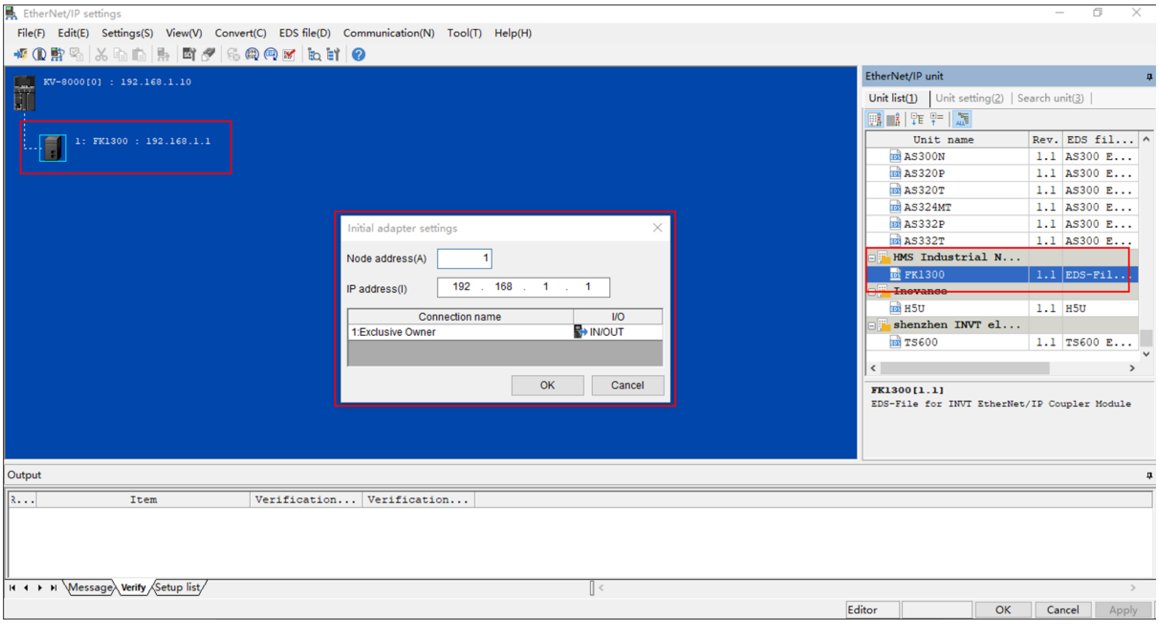


Step 7 Select **FK1300_universal_V1.0.eds** and then click **OK**.

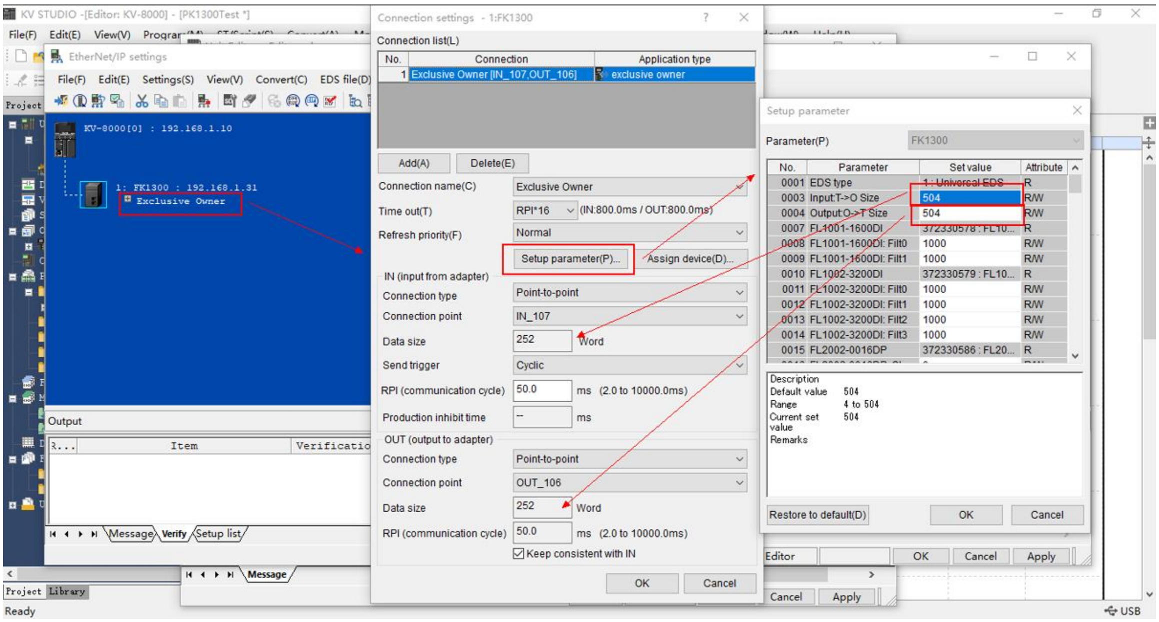


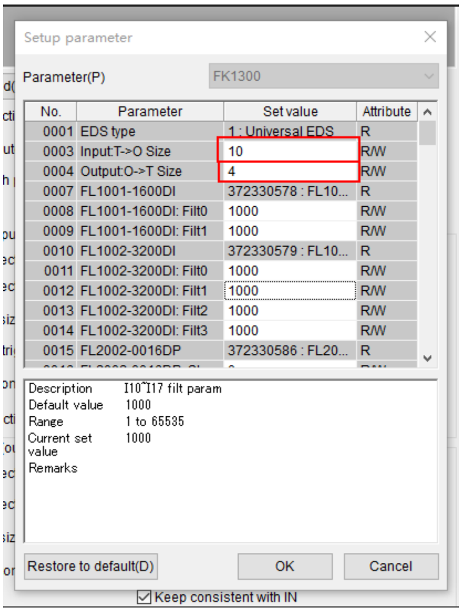
After successful adding, the interface shown in the following figure appears.

Step 8 Double click **FK1300**, change the corresponding IP to the actual IP of the coupler, and add the device to the configuration.



Step 9 After adding the module, click **Exclusive Owner** to enter the module settings window, click **Setup parameter**, and set the correct T→O and O→T sizes.



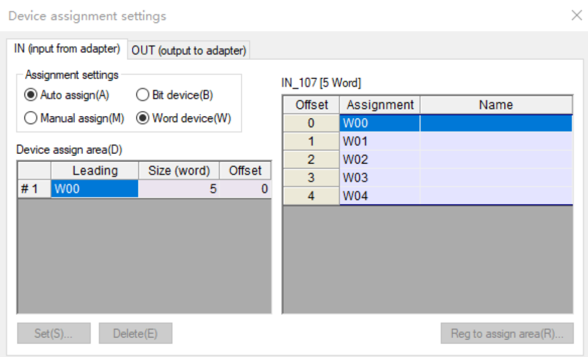


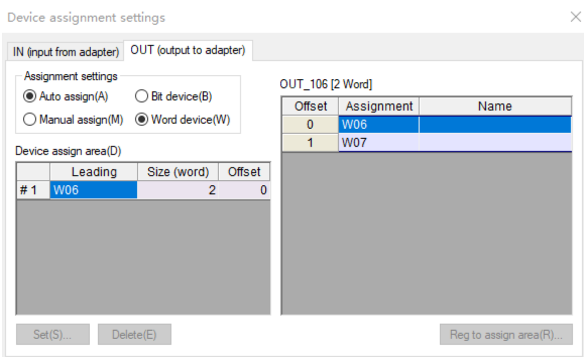
Assign soft elements by referring to Table 6-1 based on the actual IO module configuration.

Type	Model	Slot	T→O size (Bytes)	O→T size (Bytes)	Automatic soft element assignment (word access)	Manual assignment (bit access)
IO module	FK1300	0	4	0	W00, W01	-
	FL1001(1600D)	1	2	0	W02	R78000–R78015
	FL2002(0016DP)	2	0	2	W06	R78400–R78415
	FL1002(3200D)	3	4	0	W03, W04	R78100–R78115, R78200–R78215
	FL2002(0016DP)	4	0	2	W07	R78500–R78515

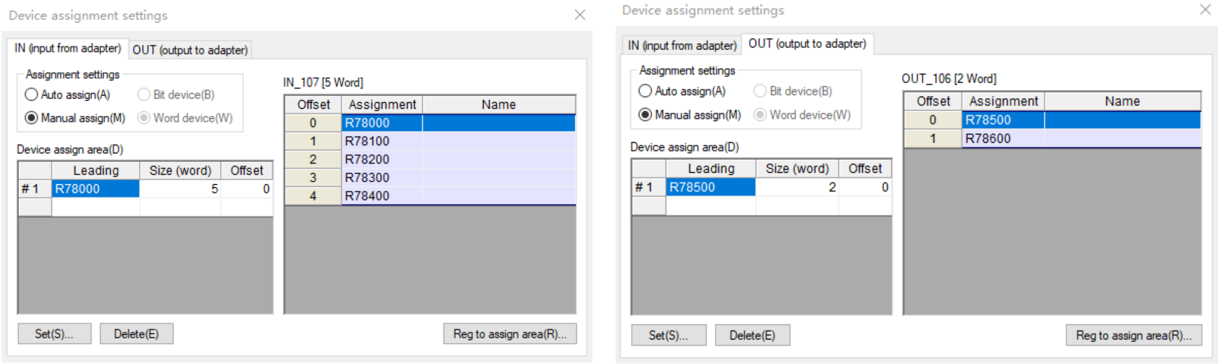
Step 10 Soft element assignment: choose manual or automatic. See the preceding table for corresponding module parameters.

Automatic assignment:





Manual assignment: Use the unit of R.

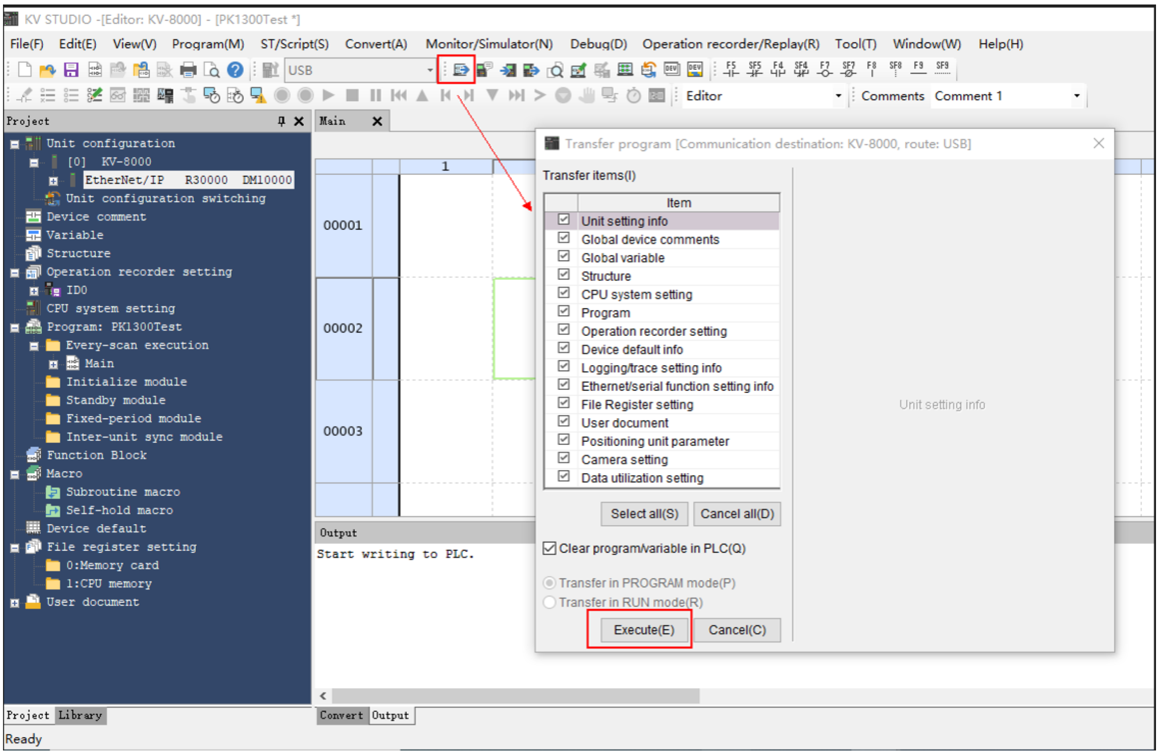


Step 11 Set RPI.

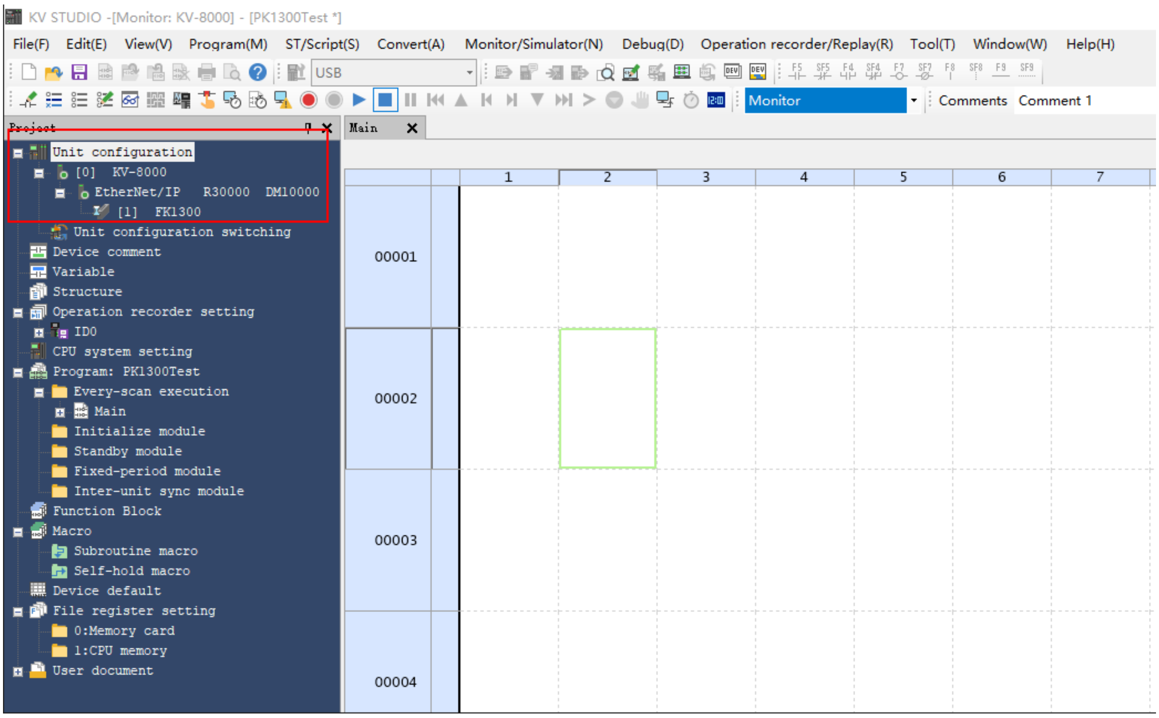
Step 12 After setting is completed, click **OK** to enter the download verification.

6.3.2.3 Configuration download and verification

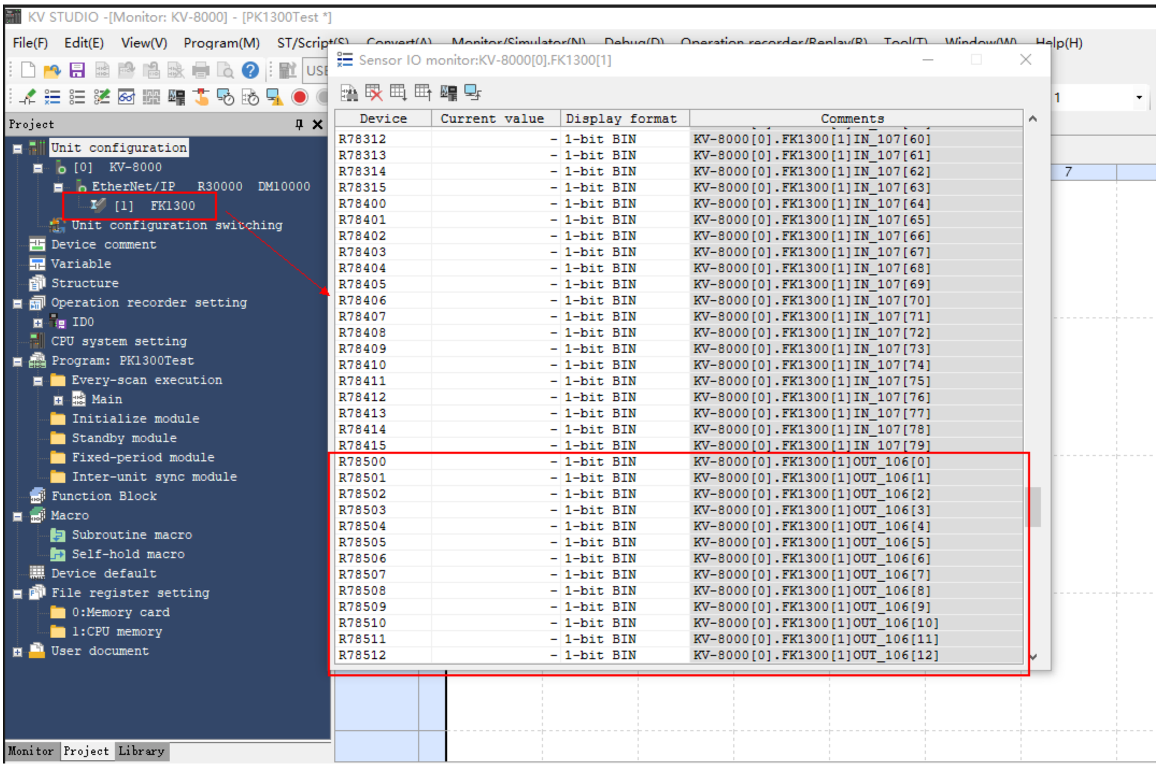
Choose **Monitor/Simulator (N)** > **PLC Transfer** > **Monitor Mode (C)**, and click **Execute** to download to the PLC.



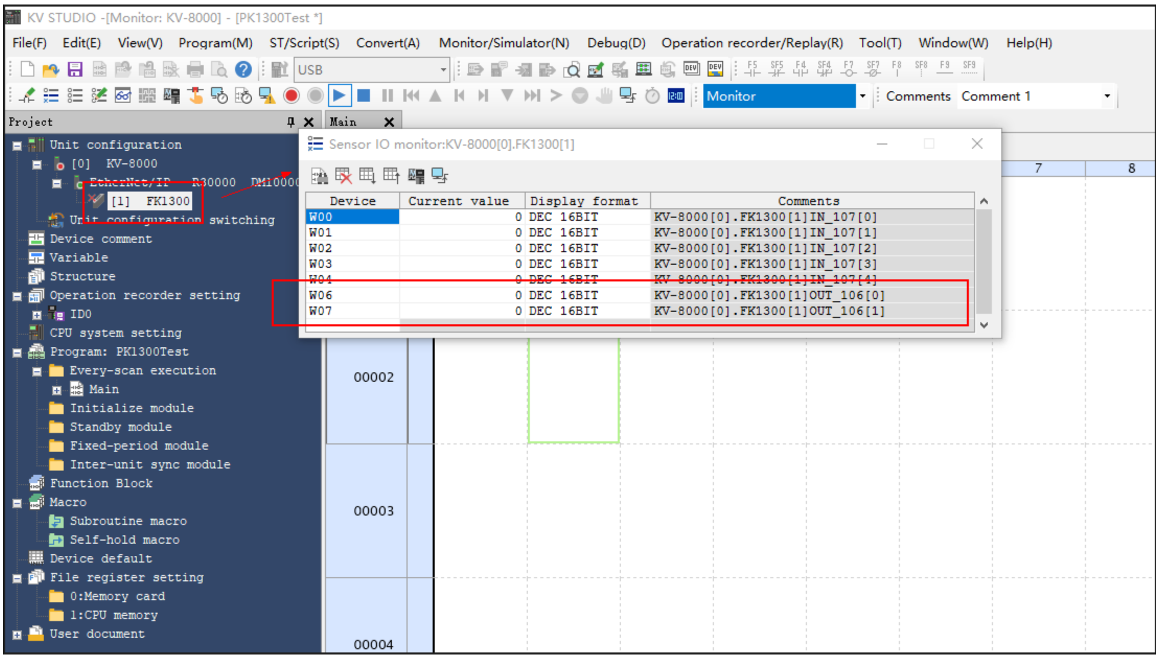
At this time, the PK1300 indicator lights PWR and MS_R are steady on in green.



Manual soft element configuration:



Automatic soft element configuration:



6.3.3 RSLogix5000 configuration description

6.3.3.1 Preparation

- PLC: Rockwell 1769-L36ERMS LOGIX5370 SAFETY
- Computer: Preinstalled with STUDIO 5000 software
- network cable, power supply, coupler, module

The list is as follows:

Type	Model	Qty	Slot
PLC	Rockwell 1769-L36ERMS LOGIX5370 SAFETY	1	-
Coupler	FK1300	1	0
IO module	FL1001(1600D)	1	1
	FL2002(0016DP)	1	2
	FL1002(3200D)	1	3
	FL2002(0016DP)	1	4
Bottom cover	Bottom cover	1	5

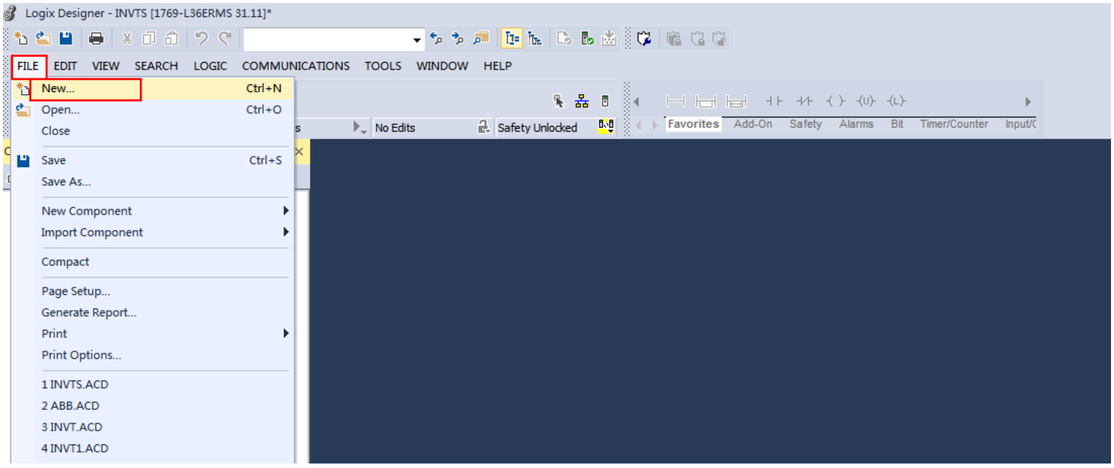
Device configuration file (choose one from two options; this example uses a universal EDS file)

- Universal EDS file: **FK1300_universal_V1.0.eds**
- Specialized EDS file: **FK1300.eds** that is generated using the Ttools-IO software.

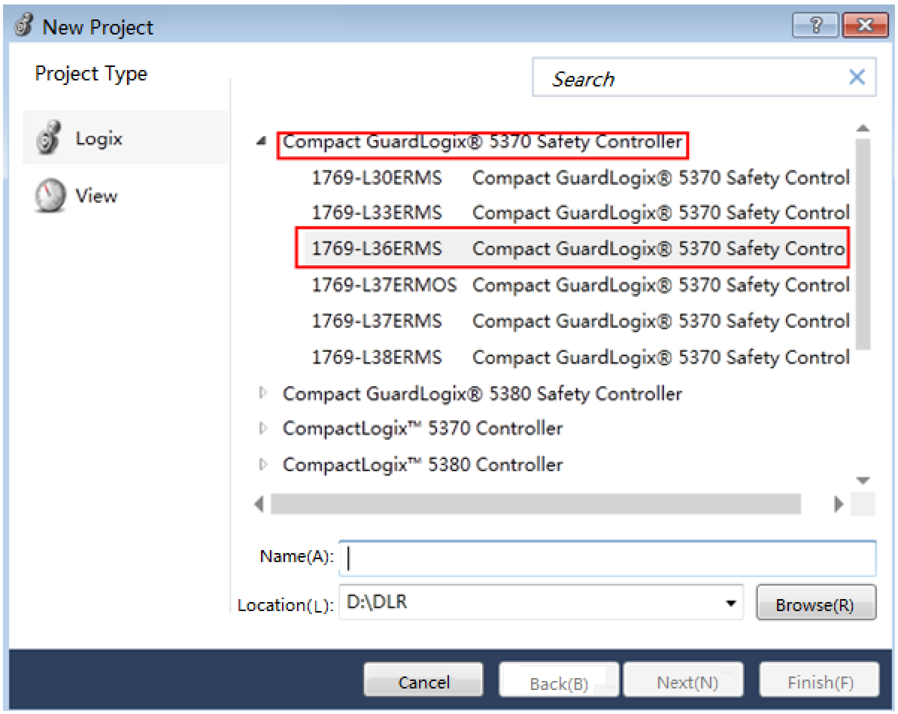
For hardware configuration and connection, see the requirements and operations described in chapters 4 Installation and 5 Wiring.

6.3.3.2 Project establishing

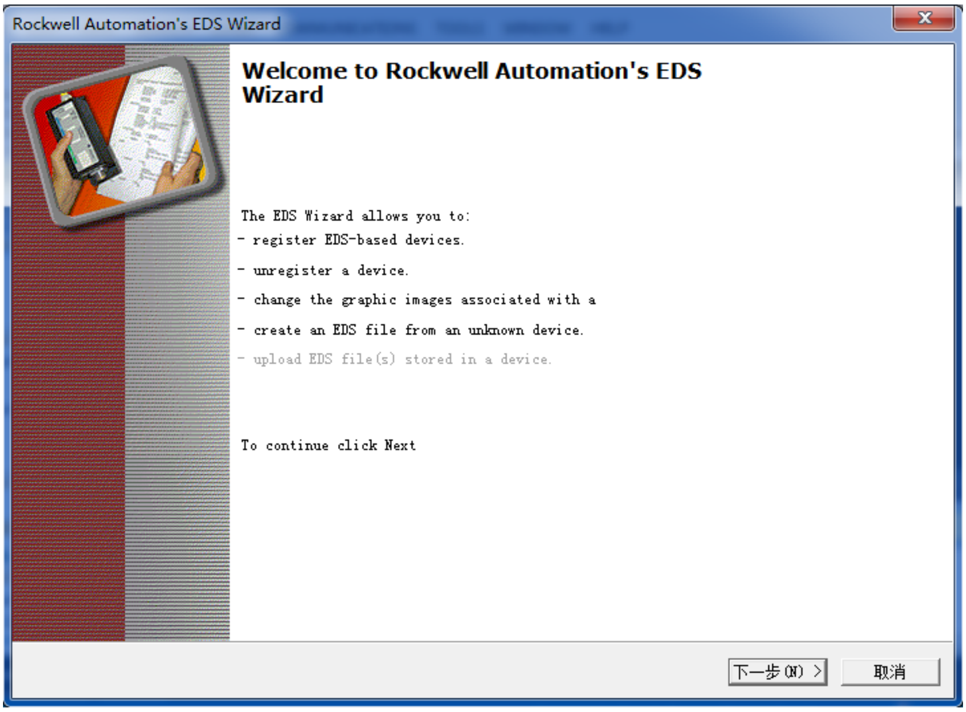
Step 1 Use a printer cable or Ethernet cable to connect the computer and the PLC, open Studio5000 software, right-click the **File** option, and then click **New**.



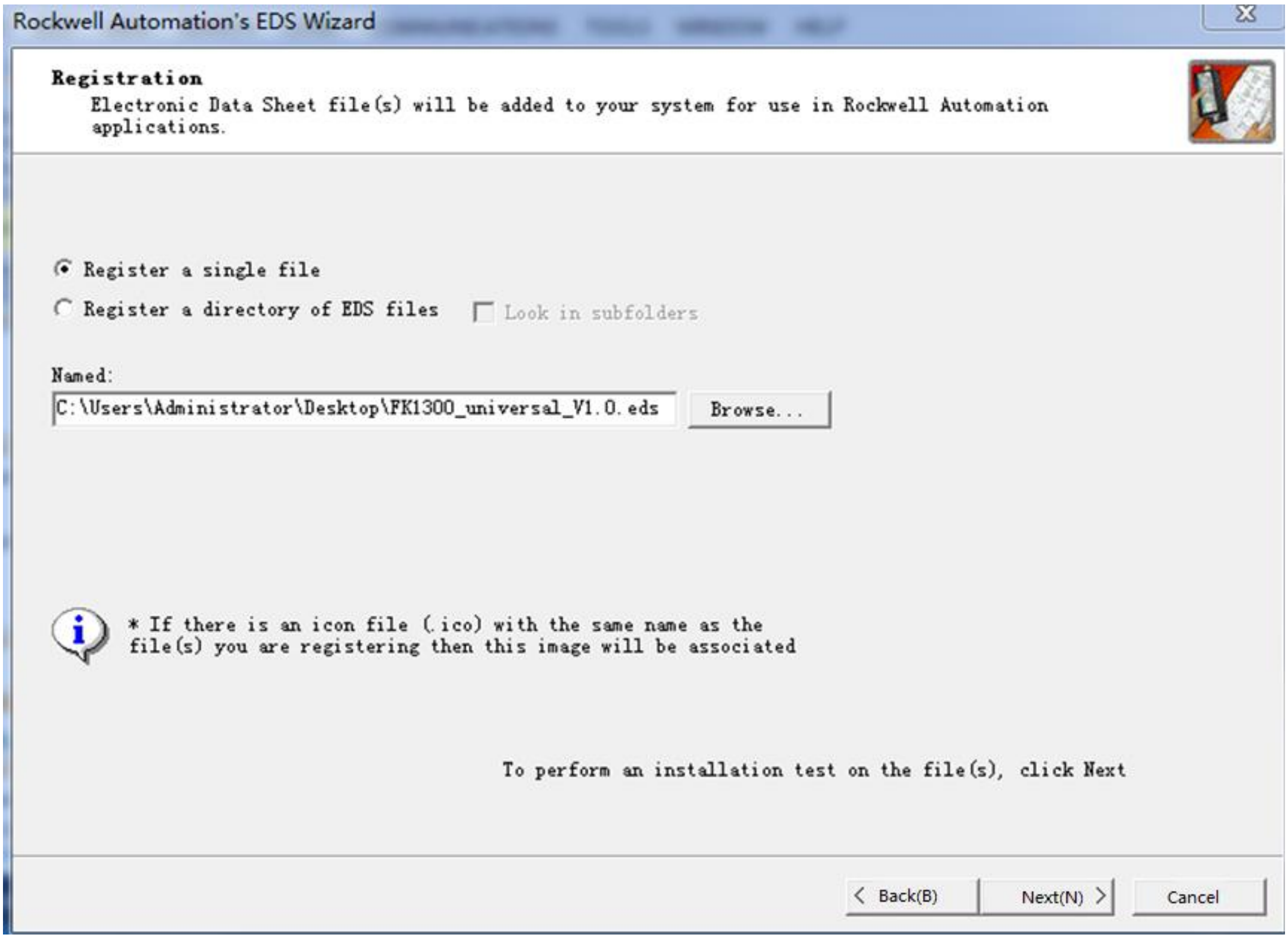
Step 2 Select the correct PLC model, fill in the project name, and click **Next**.



Step 3 Add the EDS file. Click **TOOLS** > **EDS Hardware Installation Tool**. The following interface appears.

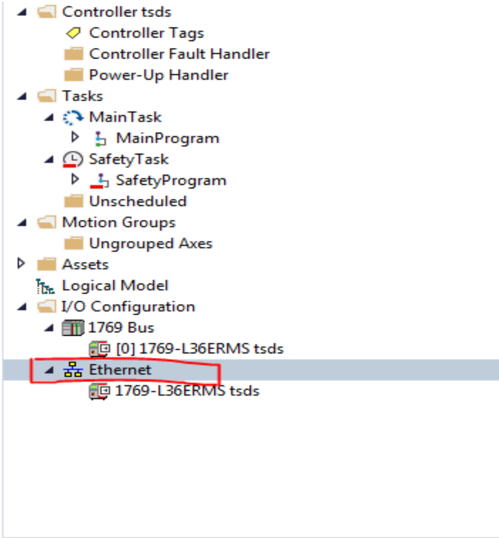


Step 4 Click **Next** to proceed to the next page, choose **Register an EDS file(s)**, then click **Next** again to enter the interface shown below. Choose the path of the EDS file we want to install.

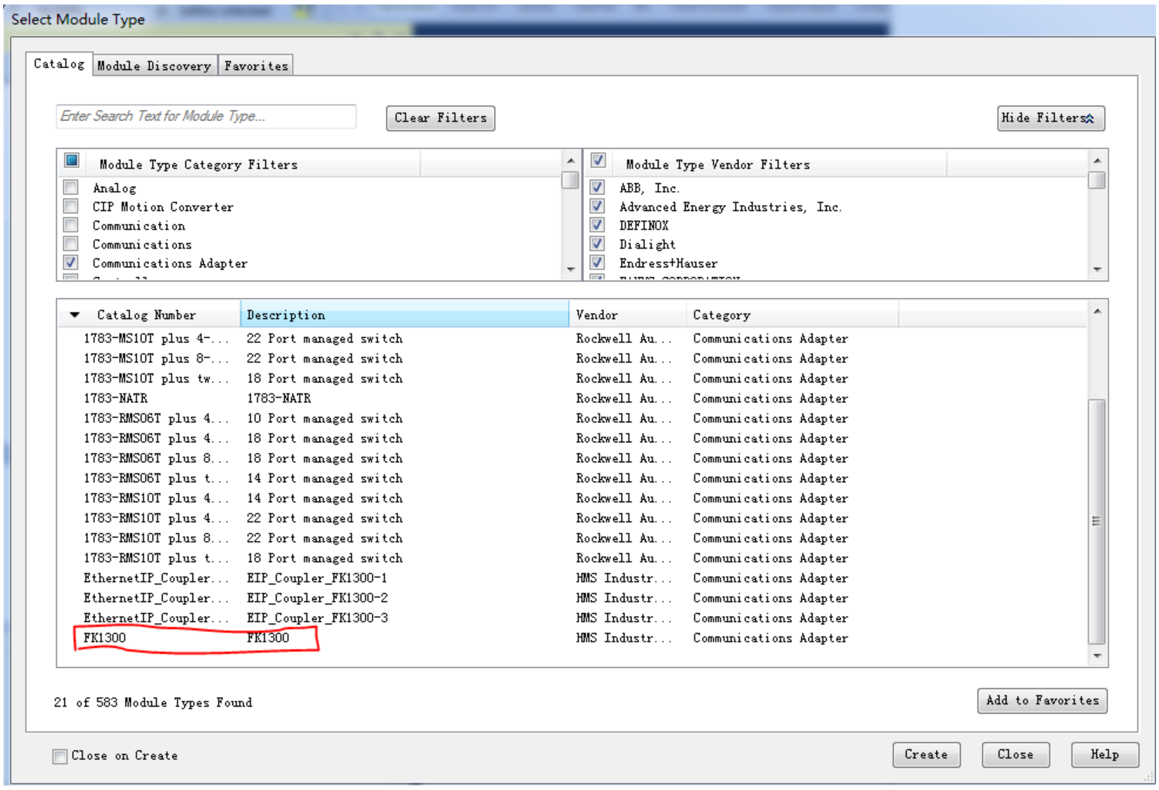


Step 5 Keep clicking **Next** until **OK**.

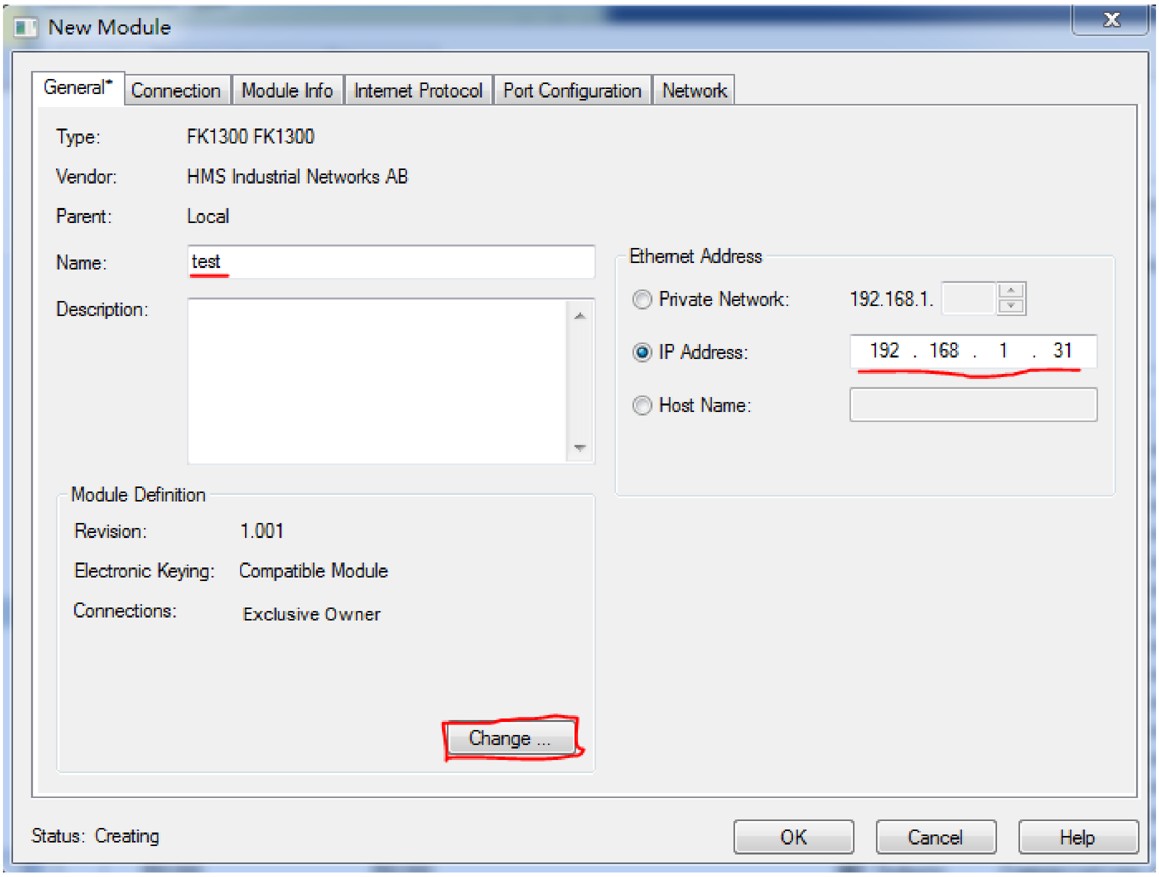
Step 6 Right-click **Ethernet** and choose **New Module**.



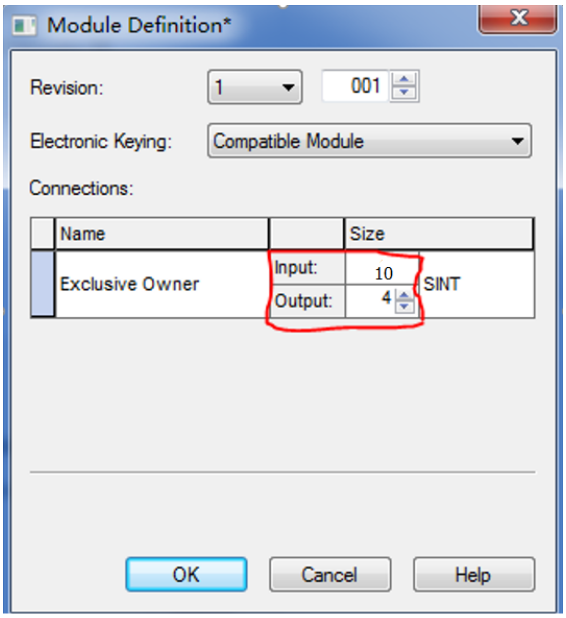
Step 7 Double click **FK1300** to add the device to the configuration.



Step 8 Set FK1300 name and IP address, and then click **Change**.



Step 9 Modify the input(T→O) size and output(O→T) size.



Assign soft elements by referring to Table 6-1 based on the actual IO module configuration.

Type	Model	Slot	T→O size (Bytes)	O→T size (Bytes)
IO module	FK1300	0	4	0
	FL1001(1600D)	1	2	0
	FL2002(0016DP)	2	0	2
	FL1002(3200D)	3	4	0

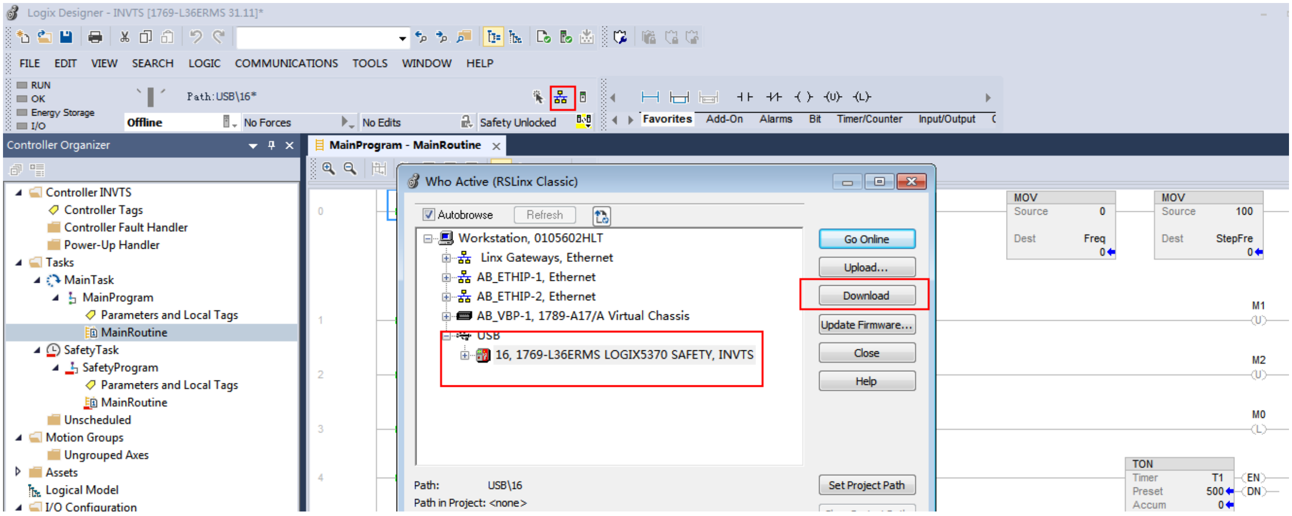
Type	Model	Slot	T→O size (Bytes)	O→T size (Bytes)
	FL2002(0016DP)	4	0	2

- Input(T→O) Size: 10
- Output(O→T) Size: 4

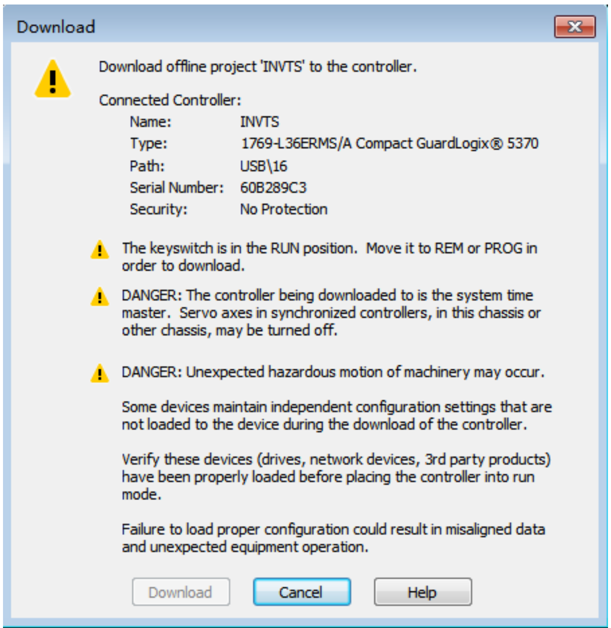
Step 10 Click **OK** > **Yes** > **OK** > **Close**.

6.3.3.3 Download

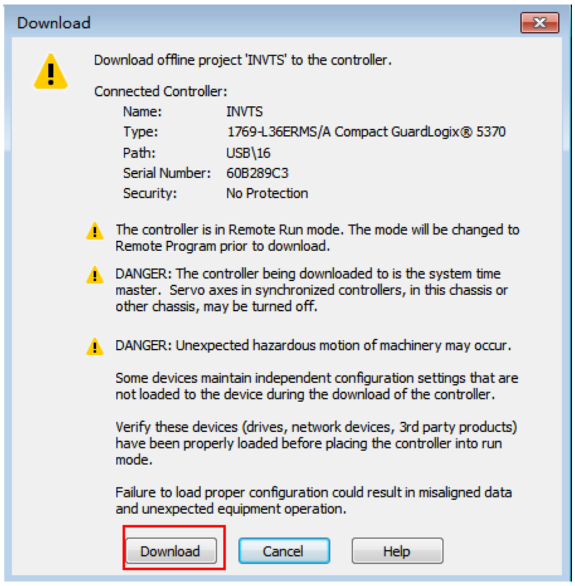
Select the bus symbol (as shown in the red box in the middle of the following figure) to enter the WHO Active interface, select the controller you are using, and click **Download**.



If the following interface appears, set the gear of the PLC controller to REM or PROG mode.

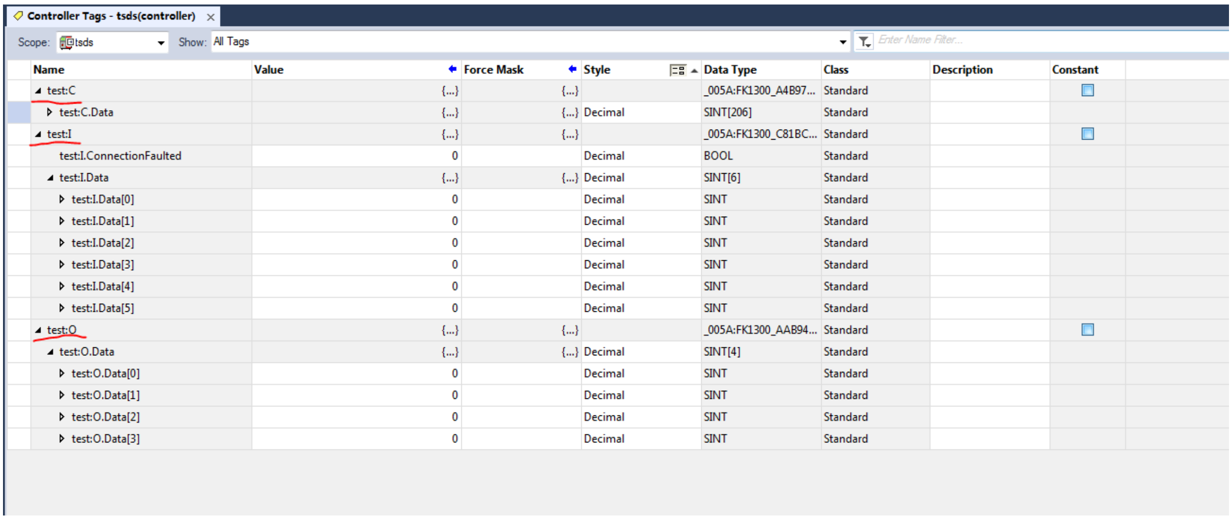


Then click Download again to complete the download successfully.



At this time, the PK1300 indicator lights PWR and MS_R are steady on in green.

To view the data: choose **Menu** > **LOGIC** > **Monitor Tags**.



Name	Value	Force Mask	Style	Data Type	Class	Description	Constant
test:C	{...}	{...}		_005A:FK1300_A4B97...	Standard		☐
test:C.Data	{...}	{...}	Decimal	SINT[206]	Standard		
test:I	{...}	{...}		_005A:FK1300_C81BC...	Standard		☐
test:I.ConnectionFaulted	0		Decimal	BOOL	Standard		
test:I.Data	{...}	{...}	Decimal	SINT[6]	Standard		
test:I.Data[0]	0		Decimal	SINT	Standard		
test:I.Data[1]	0		Decimal	SINT	Standard		
test:I.Data[2]	0		Decimal	SINT	Standard		
test:I.Data[3]	0		Decimal	SINT	Standard		
test:I.Data[4]	0		Decimal	SINT	Standard		
test:I.Data[5]	0		Decimal	SINT	Standard		
test:O	{...}	{...}		_005A:FK1300_AAB94...	Standard		☐
test:O.Data	{...}	{...}	Decimal	SINT[4]	Standard		
test:O.Data[0]	0		Decimal	SINT	Standard		
test:O.Data[1]	0		Decimal	SINT	Standard		
test:O.Data[2]	0		Decimal	SINT	Standard		
test:O.Data[3]	0		Decimal	SINT	Standard		

- Test: When FK1300 is loaded, enter **Name**.
- test:C: Configuration information
- test: I: Input process data
- test:O: Output process data

6.3.4 CODESYS configuration description

6.3.4.1 Preparation

Hardware environment:

- One computer pre-installed with CODESYS V3.5 software
- Network cable and power module model should be configured according to the actual situation.

The list is as follows:

Type	Model	Slot
PLC	CODESYS Control WIN V3 – x64 SysTray software	-

Type	Model	Slot
Coupler	FK1300	0
I/O module	FL1002-3200DI	1
	FL2103-0032DN	2
	FL3203-4TC	3
	FL3003-4AD	4
	FL4003-4DA	5
	FL6112_2EI	6
	FL1001-1600DI	7
	FL5005-1616DP	8
	FL5105-1616DN	9
	FL2201-0008DR	10
	FL3103-4PT	11
	FL2003-0032DP	12
	FL2002-0016DP	13
Bottom cover	Bottom cover	15

Device configuration file (Choose one from the two)

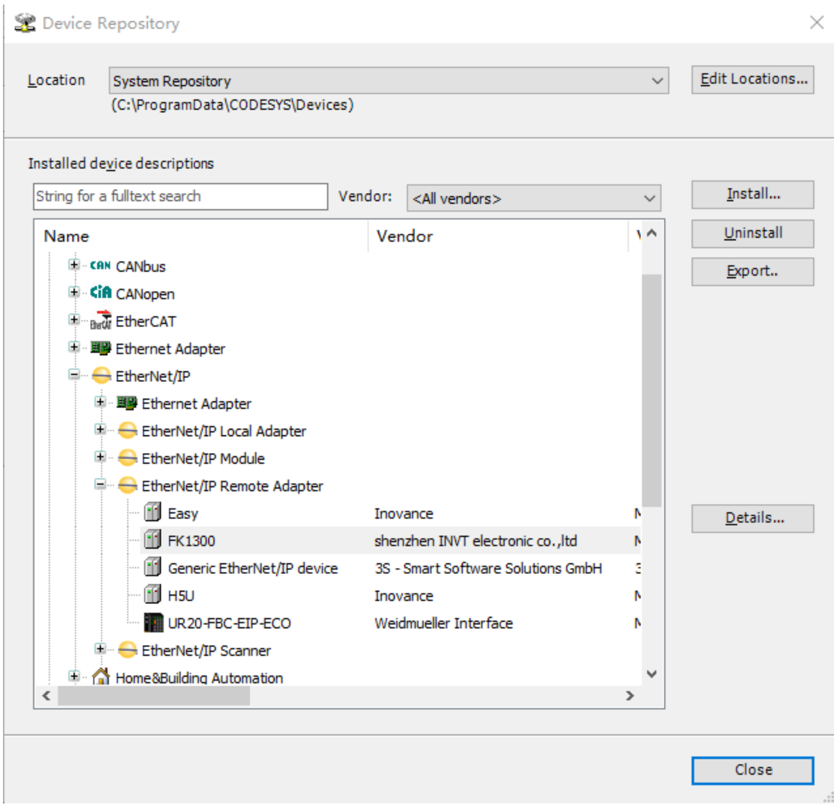
- Universal EDS file: **FK1300_universal_V1.0.eds**
- Specialized EDS file: **FK1300.eds** that is generated using the Ttools-IO software.

For hardware configuration and connection, see the requirements and operations described in chapters 4 Installation and 5 Wiring.

6.3.4.2 EDS file installing

Install the EDS device descriptor file (**FK1300_universal_V1.0.eds**).

Open the CODESYS software, choose **Tools** > **Device Repository**, click **Install**, and select **FK1300_universal_V1.0.eds** to install. See the following figure.



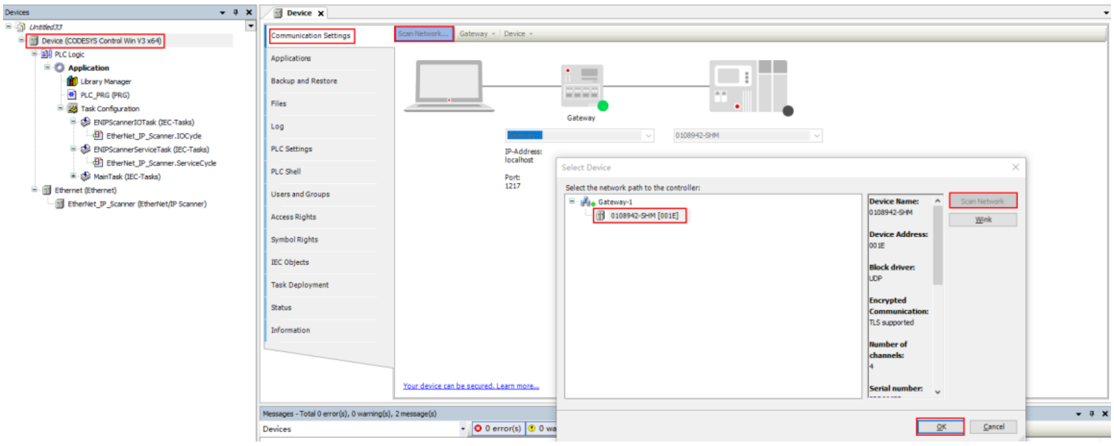
6.3.4.3 Project establishing

1. Click **File** and choose **New Project**.
2. Add **Ethernet**.

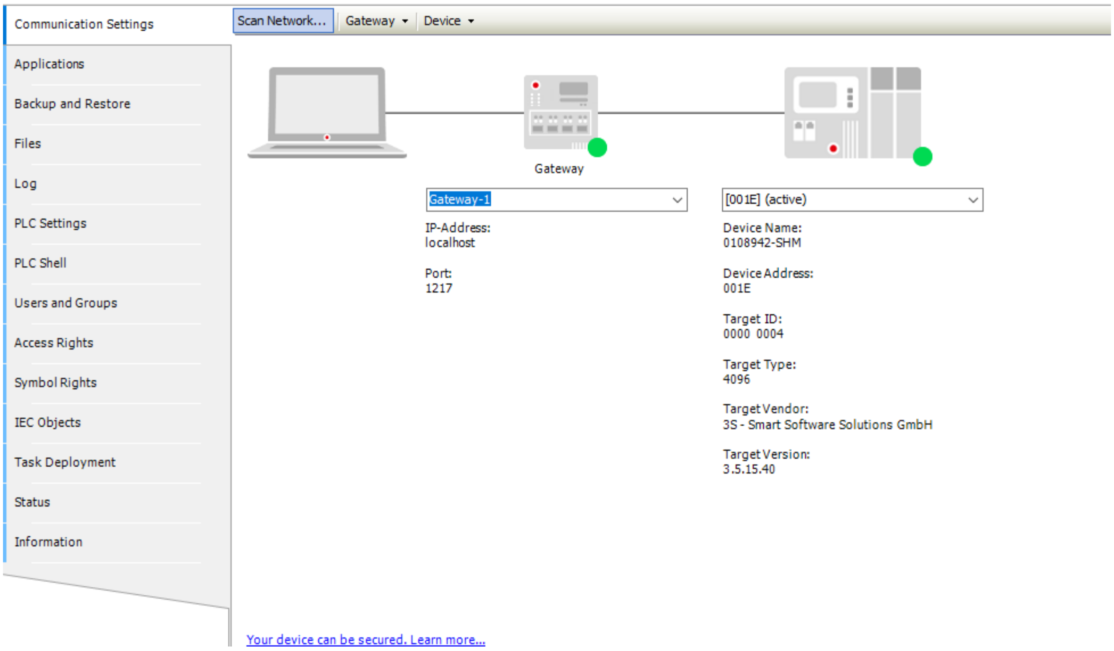
Step 1 Start the PLC: **CODESYS Control Win V3 - x64 SysTray**.

Step 2 Double click **Device (CODESYS Control Win V3 x64)** in the left navigation tree, and then click **Scan Network**.

Step 3 Select the device, click **Scan Network**, and select the network path.

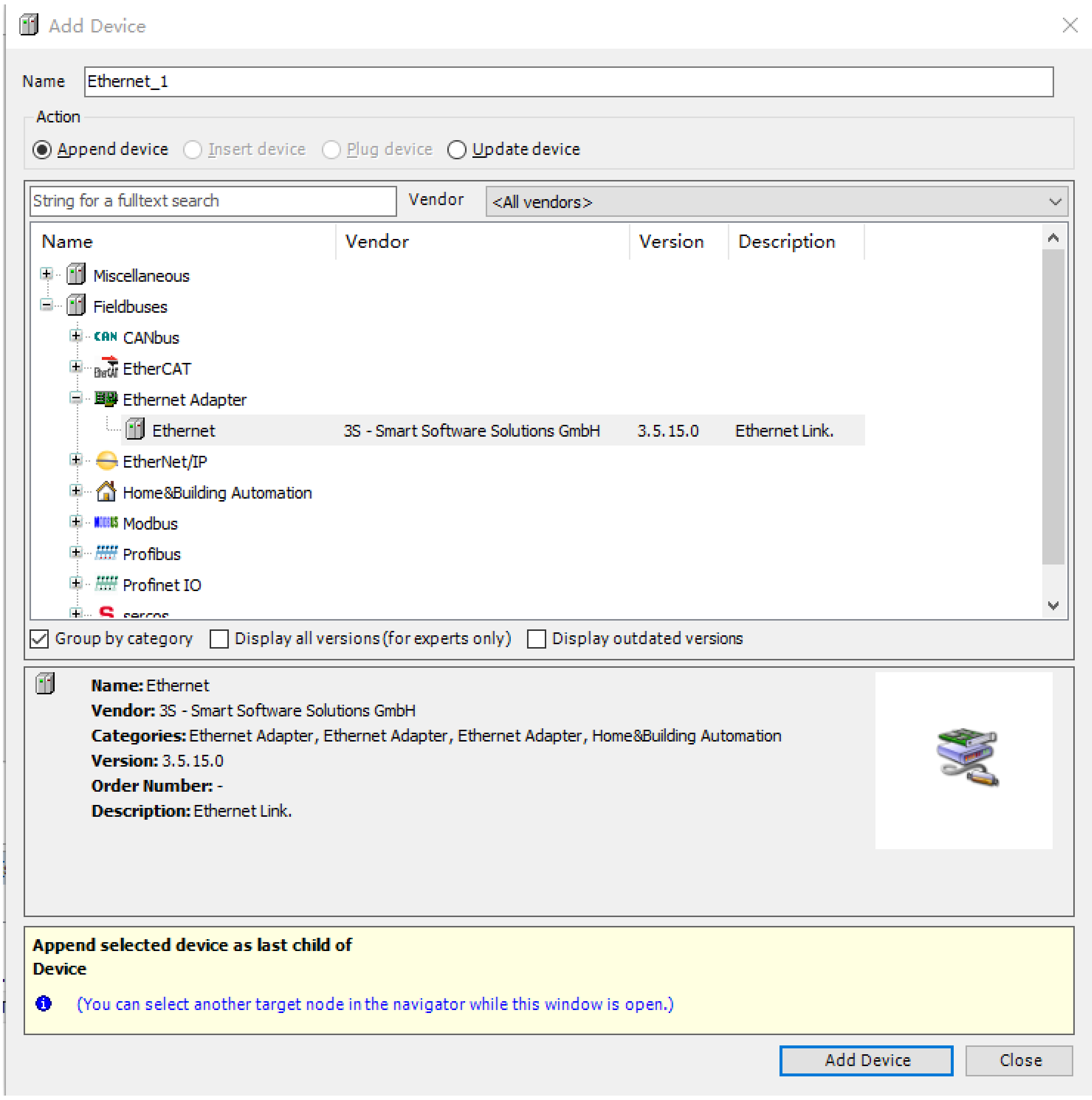


Step 4 Click **OK** to enter the interface as shown in the following figure. The network is in activated state.



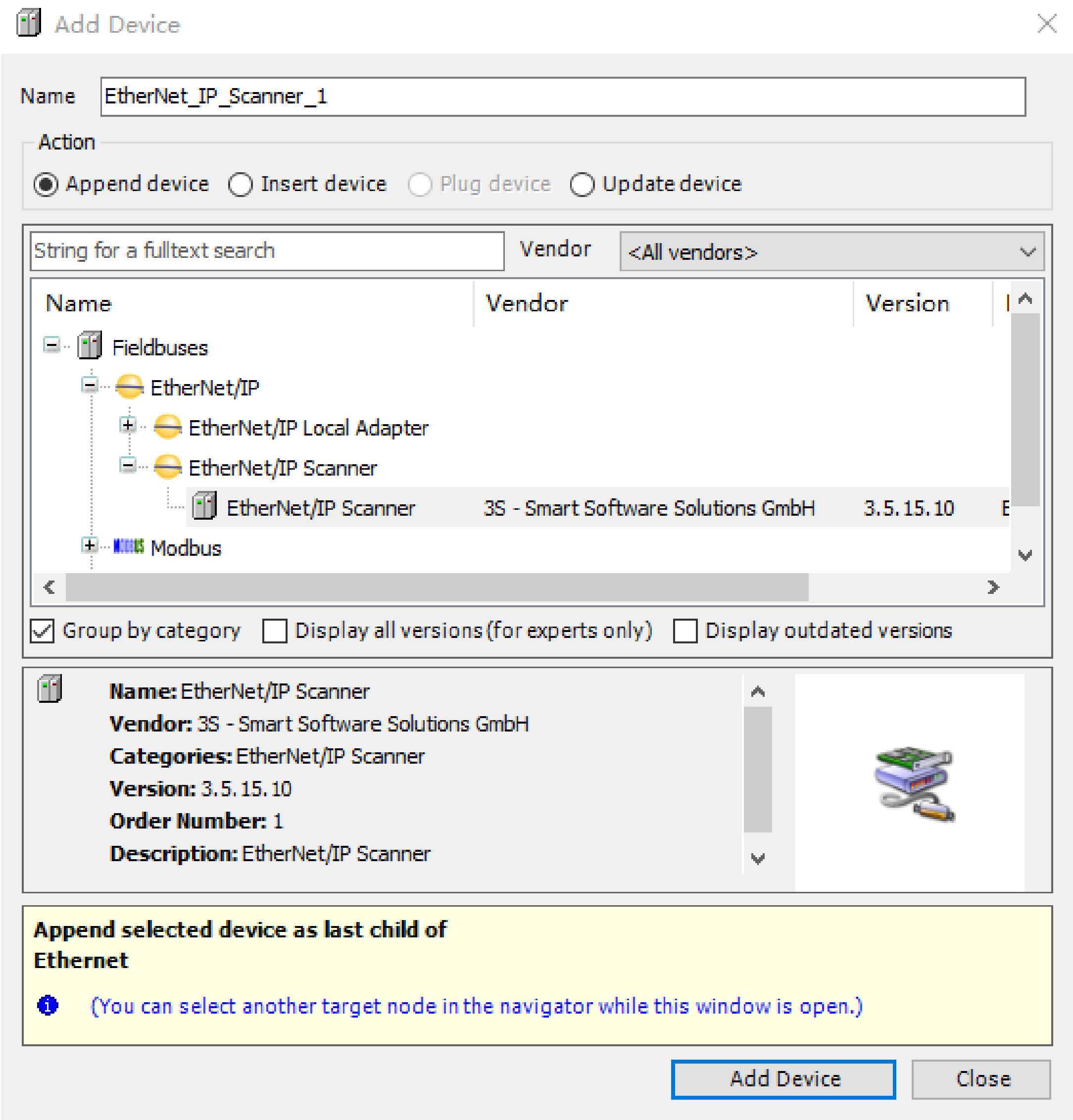
Step 5 Choose **Device (CODESYS Control Win V3 x64)** from the left navigation tree, right-click and choose **Add Device**.

Step 6 Choose **EthernetIP** > **Ethernet Adapter** > **Ethernet**. See the following figure.

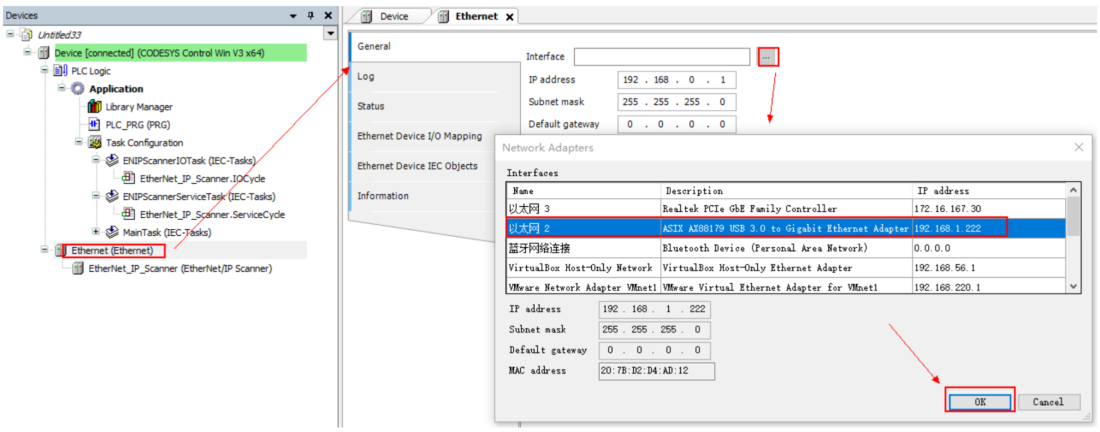


Step 7 Choose **Ethernet (Ethernet)** from the navigation tree on the left, right-click and choose **Add Device**.

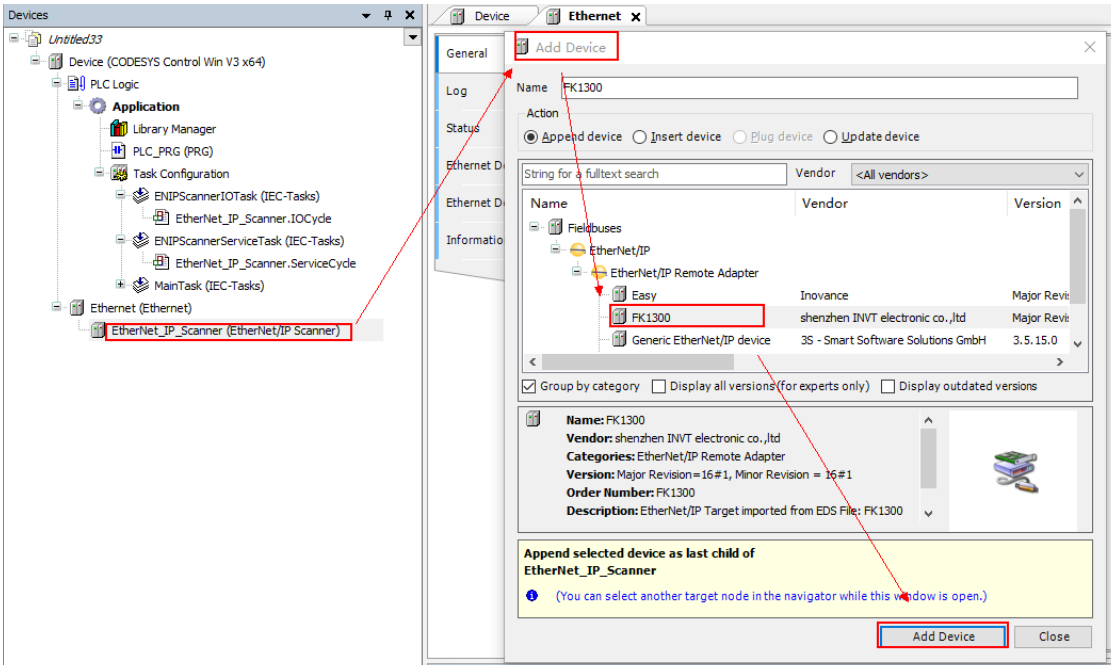
Step 8 Choose **EtherNetIP** > **EtherNet/IP Scanner** > **EtherNet/IP Scanner**. See the following figure.



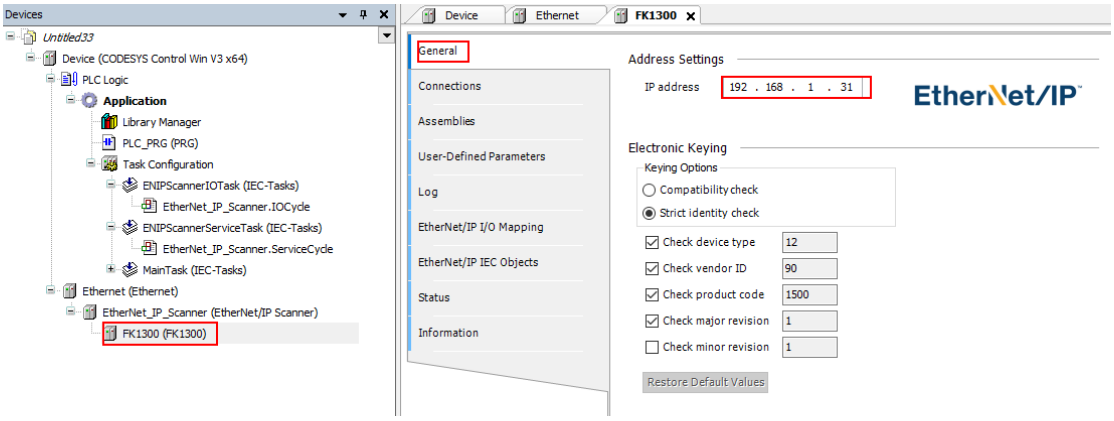
Step 9 Configure **EthernetIP**. Double-click **Ethernet (Ethernet)** in the left navigation tree to open the configuration window. On the **General** tab, click the right side of **Interface** and select the network adapter, as shown in the following figure.



Step 10 Add a device. Right-click **EtherNet_IP_Scanner** and choose **Add Device**. See the following figure.

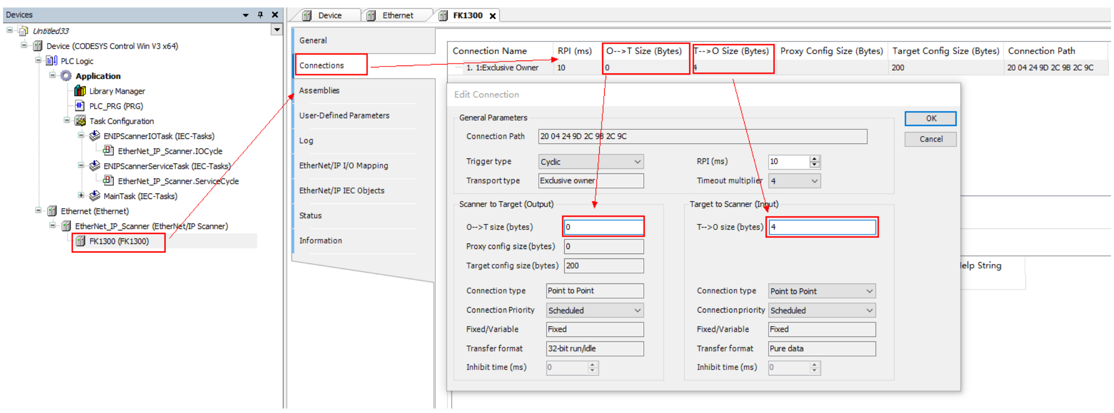


Step 11 After adding the device, configure the device communication parameters, setting the actual IP of the coupler. Ensure that the coupler and the Ethernet IP master are on the same network segment.



Step 12 Set device connection parameters.

Double click the device **FK1300**, open the device configuration window, and switch to the **Connection** page. See the following figure.



See Table 6-1 for the O→T size (bytes) and T→O size (bytes).

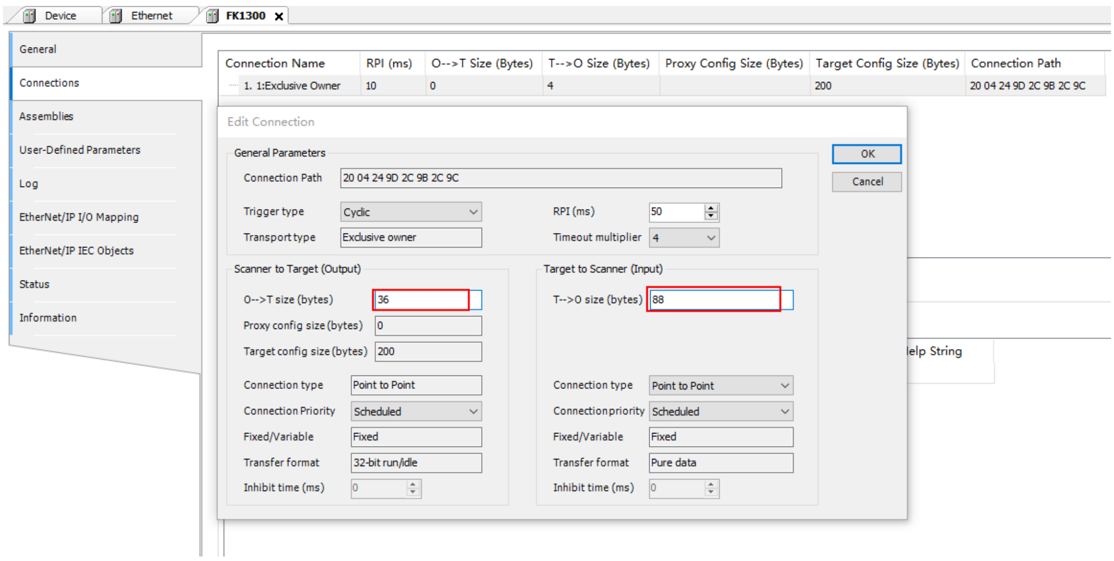
According to the actual IO module configuration, check the table.

Type	Model	Slot	T→O size (Bytes)	O→T size (Bytes)
IO module	FK1300	0	4	0
	FL1002-3200DI	1	4	0
	FL2103-0032DN	2	0	4
	FL3203-4TC	3	16	0
	FL3003-4AD	4	8	0
	FL4003-4DA	5	0	8
	FL6112_2EI	6	34	10
	FL1001-1600DI	7	2	0
	FL5005-1616DP	8	2	2
	FL5105-1616DN	9	2	2
	FL2201-0008DR	10	0	2
	FL3103-4PT	11	16	0
	FL2003-0032DP	12	0	4
	FL2002-0016DP	13	0	2
	FL2102-0016DN	14	0	2
Summary			88	36

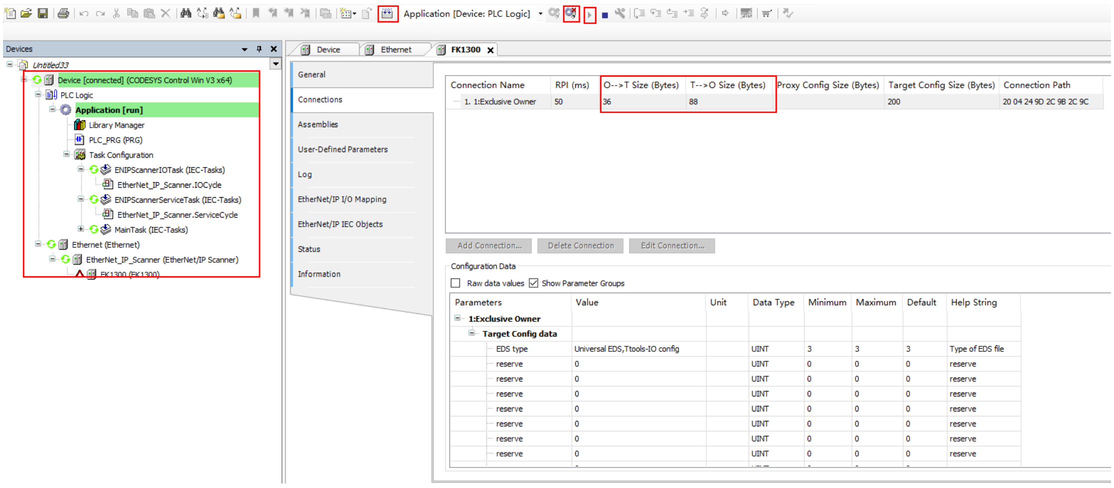
Calculate based on the preceding table: O→T size (bytes): 36

T→O size (Bytes): 88

The following figure shows the corresponding positions.



Step 13 Click **OK**. Then click the compile, and download, and run buttons. See the following figure.



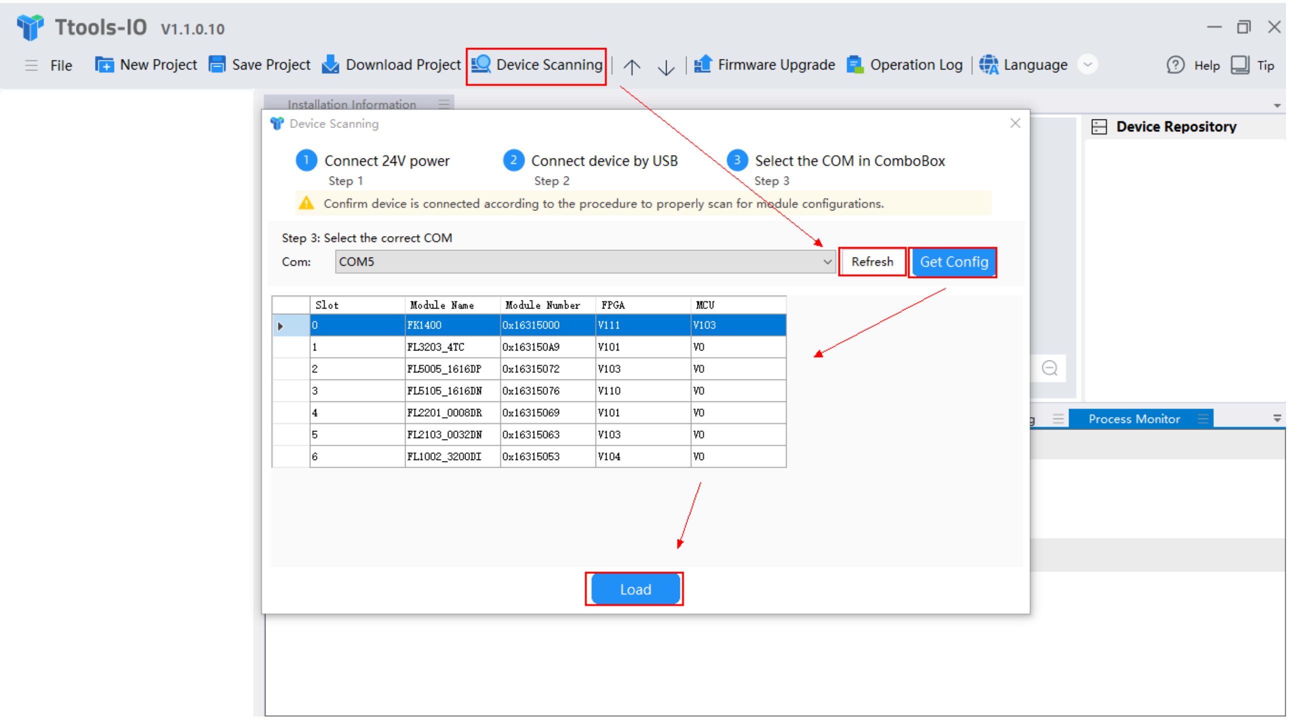
Step 14 Configuration is completed and the PLC program can be written and verified in practice.

6.4 ModbusTCP configuration

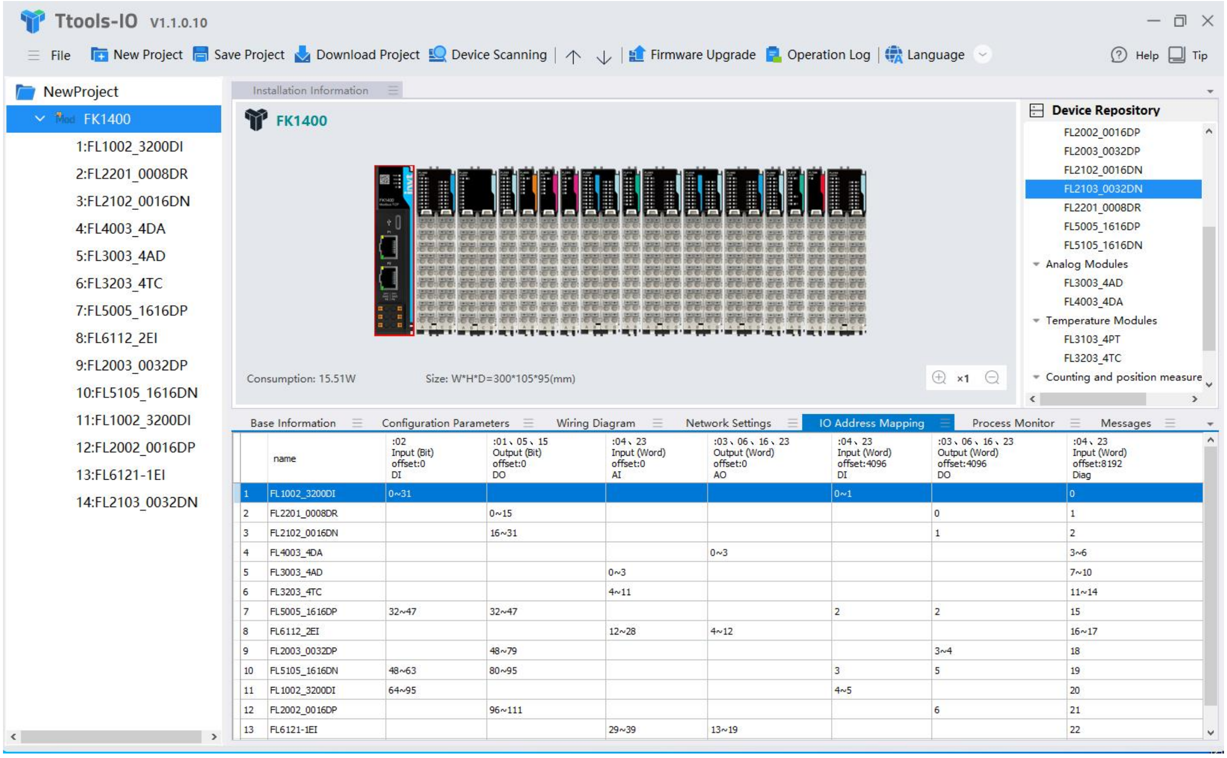
6.4.1 Ttools-IO upper computer configuration example

Use Ttools-IO to configure the FK1400. Note that the power must be turned on before connecting the type-C cable to the computer.

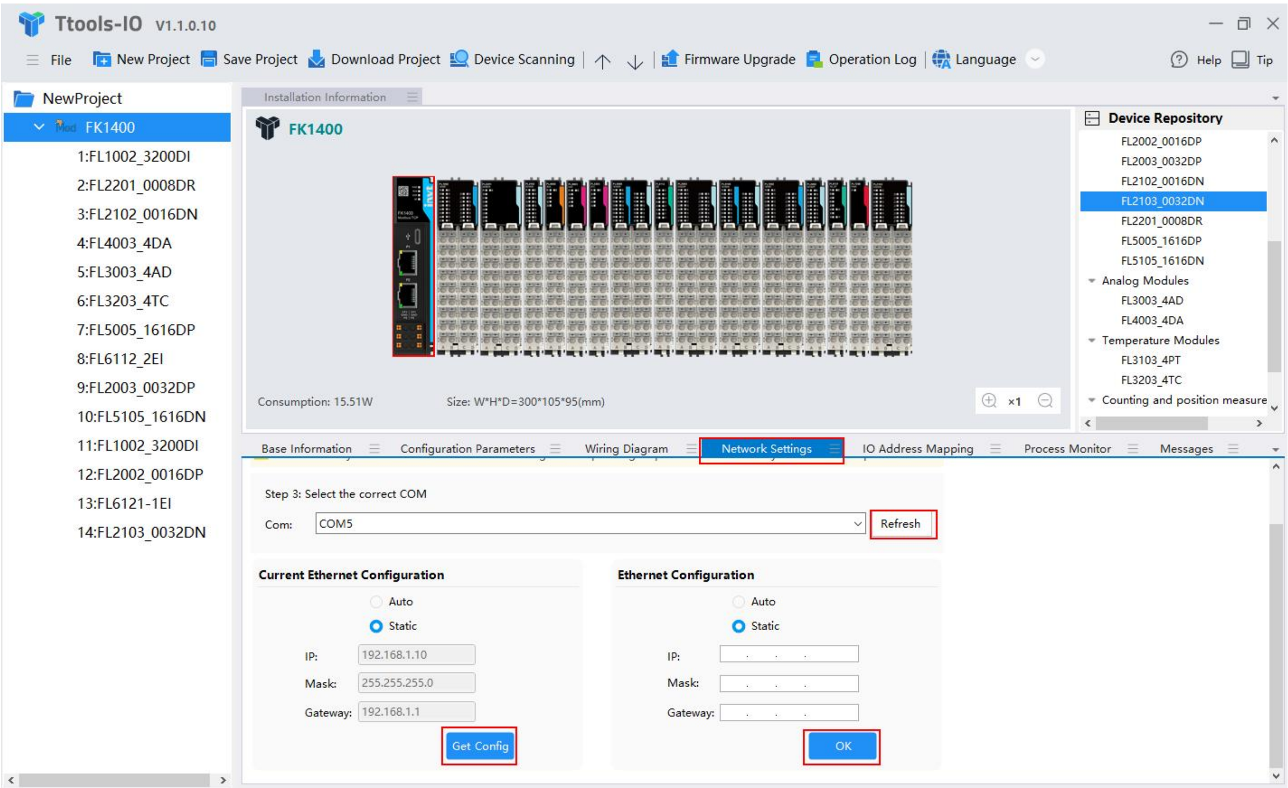
- Configuration reading



Click **Device Scanning** > **Refresh** to select the serial port corresponding to the device. Click **Get Config** to load the version information and slots of each module in the configuration. Then click **Load** to proceed to the next page.



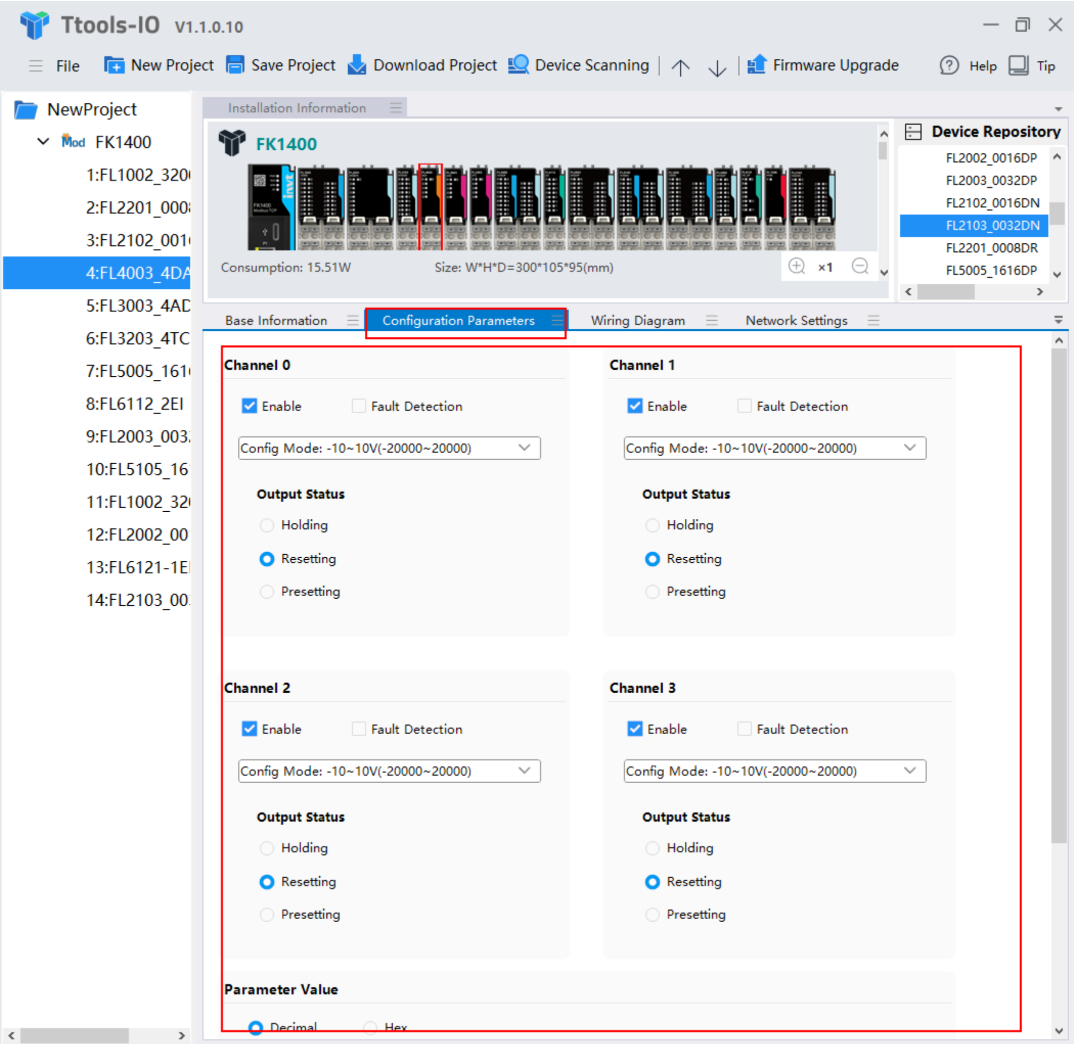
- IP configuration



Read: Click the **Get Config** button to load the device configuration information such as IP address, subnet mask, etc.

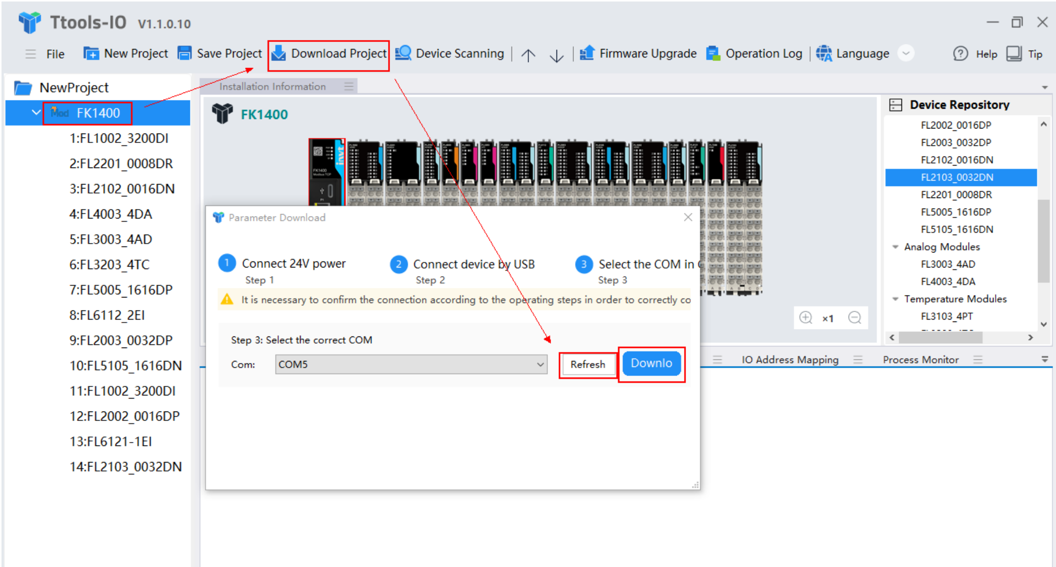
Modify: After entering the IP address, subnet mask, and gateway, click **OK**. The settings will take effect after the device is powered on again.

- Module parameter configuration



By clicking on each slot module in the configuration information column on the left, you can enter the **Configuration Parameters** interface to set parameters for each channel. After making the necessary modifications, use the **Download Project** function to download the settings to the coupler, which will then save the configuration information.

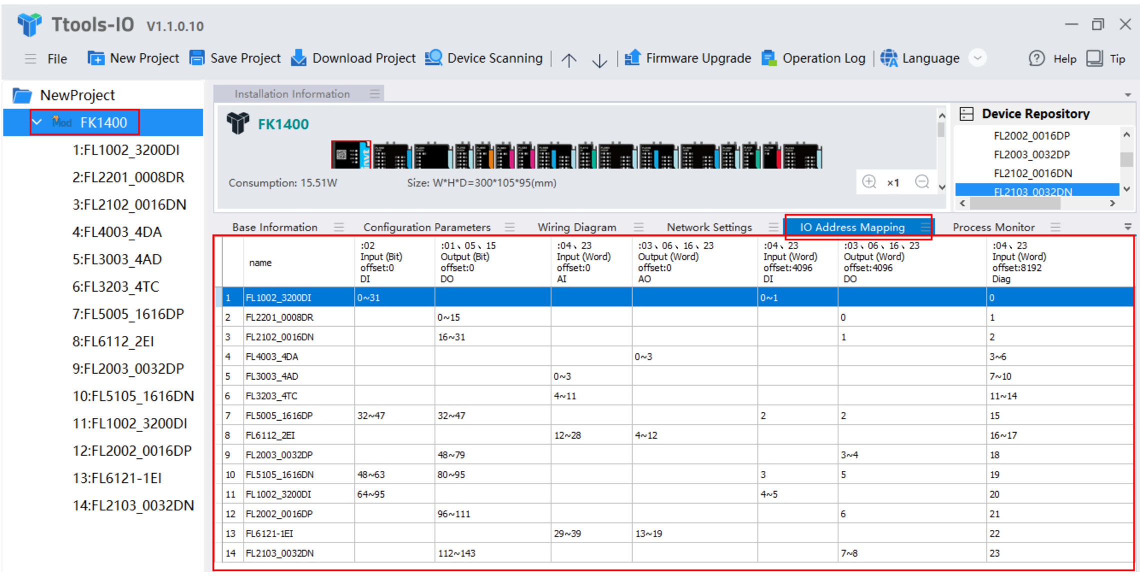
- Configuration writing



When all modules have been configured, click in the order shown in the above diagram to write the configuration settings and module configurations to the coupler.

If the configuration information does not match the actual configuration, the SF indicator on the coupler will illuminate to indicate a configuration mismatch. Please carefully verify that the configuration information on the left side of the diagram above matches the actual configuration.

- Address mapping table



Note: The Address mapping table requires reference to Appendix A for operation.

6.4.2 Module configuration application example

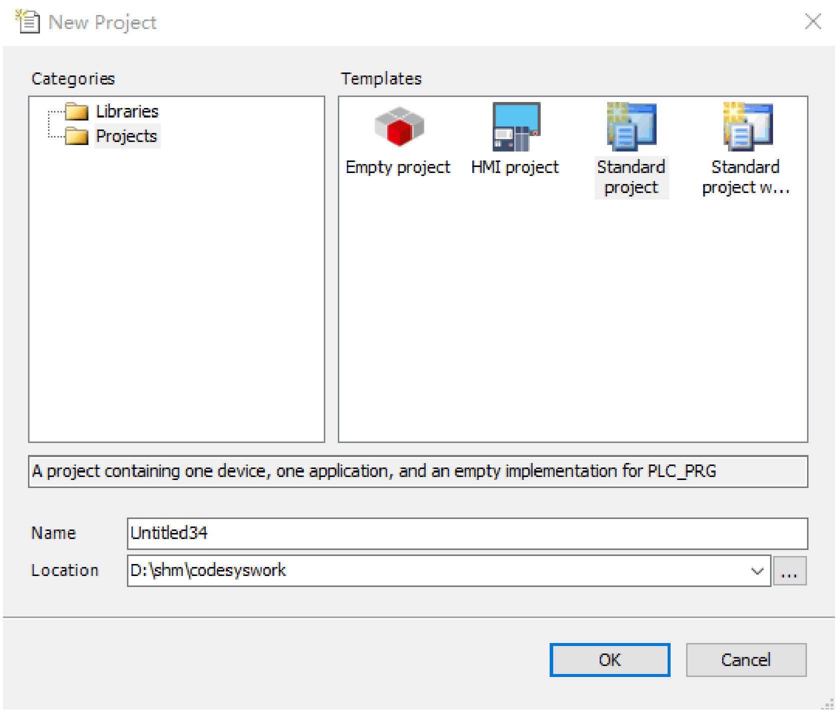
6.4.2.1 Codesys configuration example

- Environment

Perform the configuration operation according to the Ttools-IO setup. Power on the coupler and connect the network cable to the computer. Ensure that the IP address of the coupler and the IP address of the computer are in the same subnet. The computer should be pre-installed with the software "CODESYS V3.5, CODESYS Control Win V3 - x64 SysTray".

- Creating a new project

Log in to CODESYS, click **File** > **New Project**, enter a name, and click **OK**, as shown in the figure below.

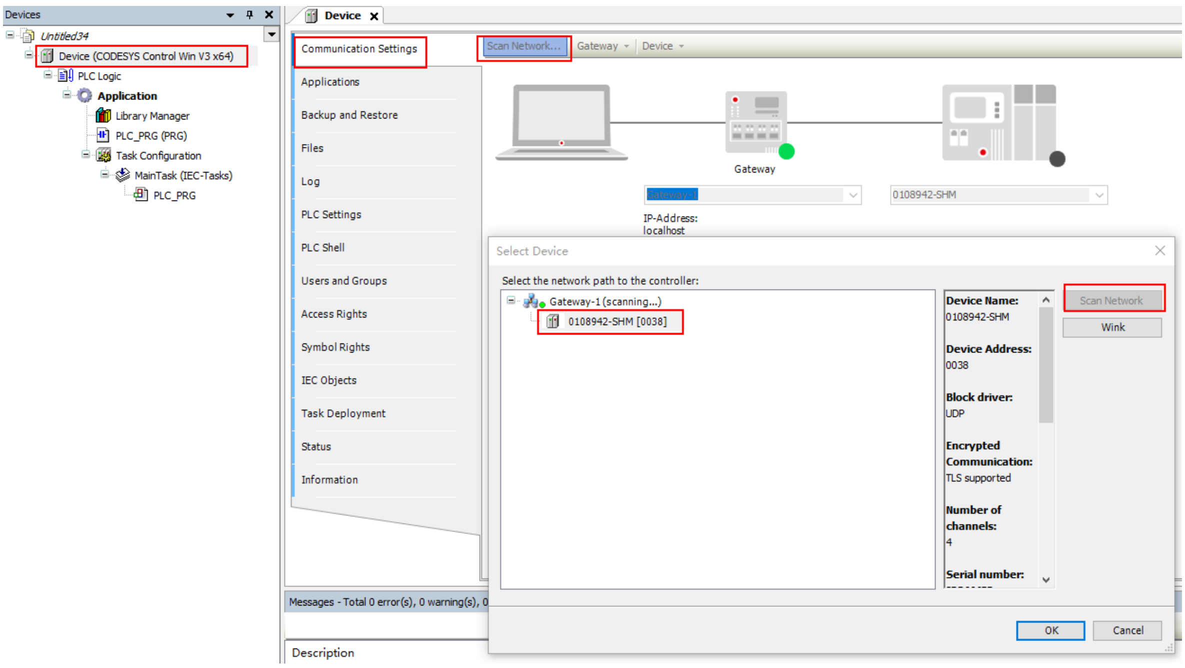


- Scanning network

Step 1 Use "CODESYS Control Win V3 - x64 SysTray" to start the PLC. Locate "CODESYS Control Win V3 - x64 SysTray" in the bottom right corner of the computer, right-click it, and select **Start PLC**.

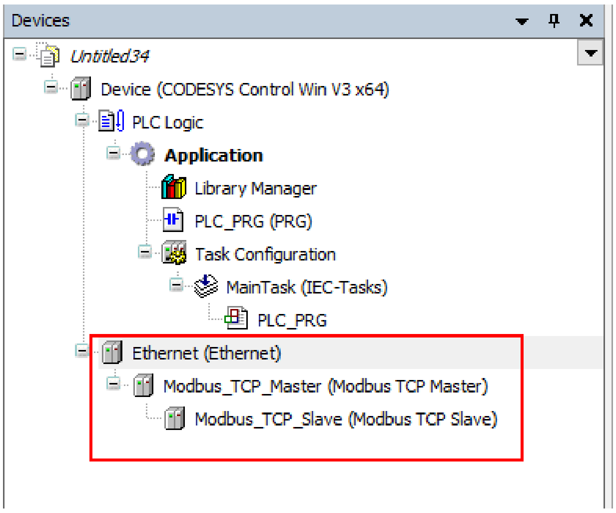
Step 2 Double-click **Device (CODESYS Control Win V3 X64)** in the left navigation tree of CODESYS, and then click on **Scan Network**.

Step 3 Select the device and choose the correct network path to the controller, as shown in the following figure.

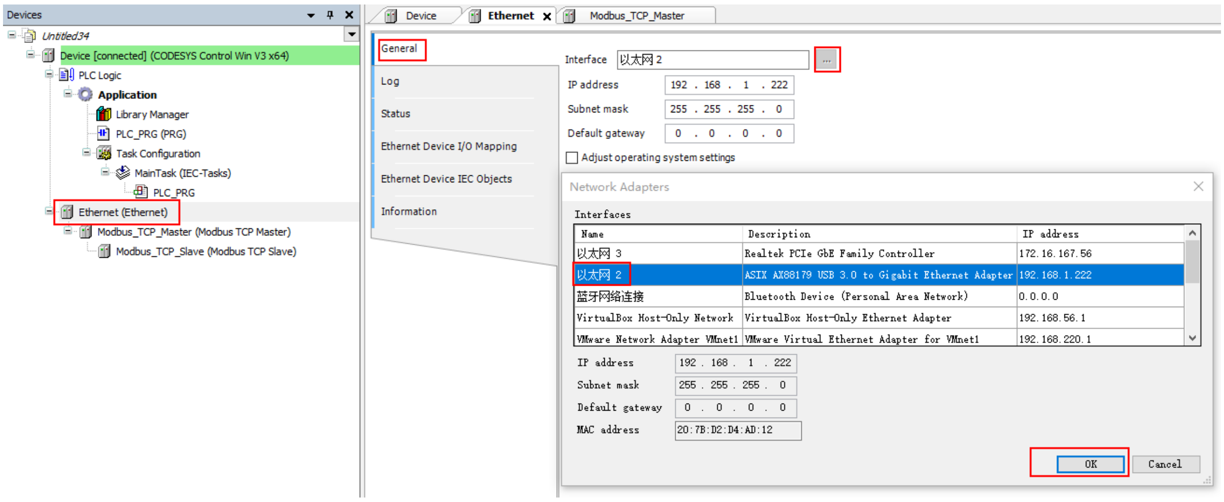


- Adding devices
  - Add Ethernet.
  - Add a ModbusTCP master node.
  - Add a ModbusTCP slave node.

After adding, it appears as shown in the following figure.

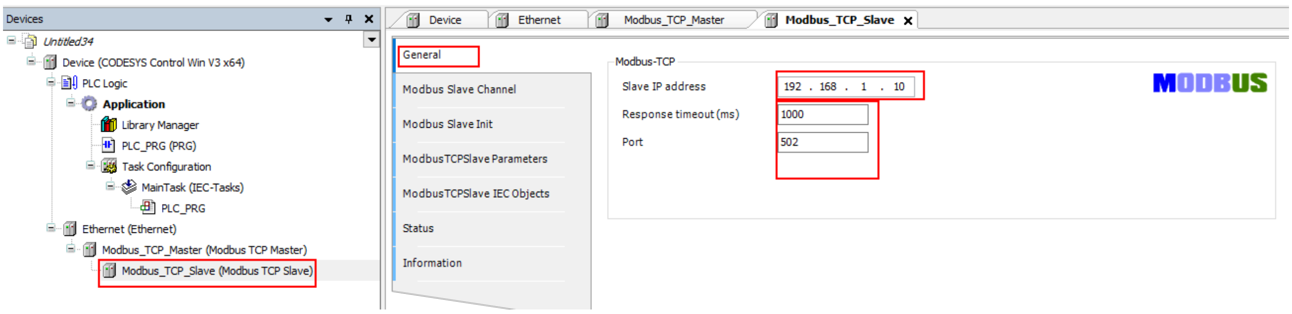


✧ Ethernet configuration



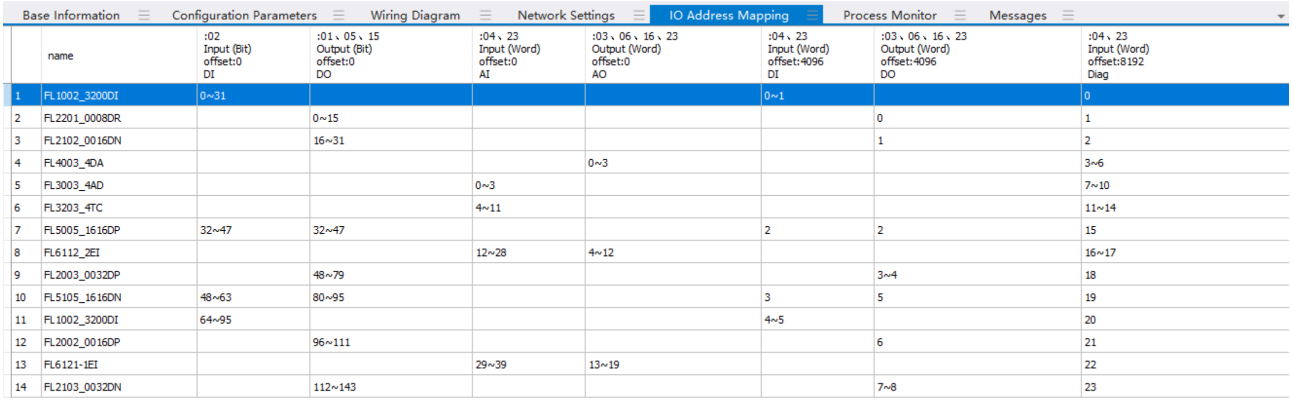
✧ ModbusTCP slave node configuration

1) Configuring the network



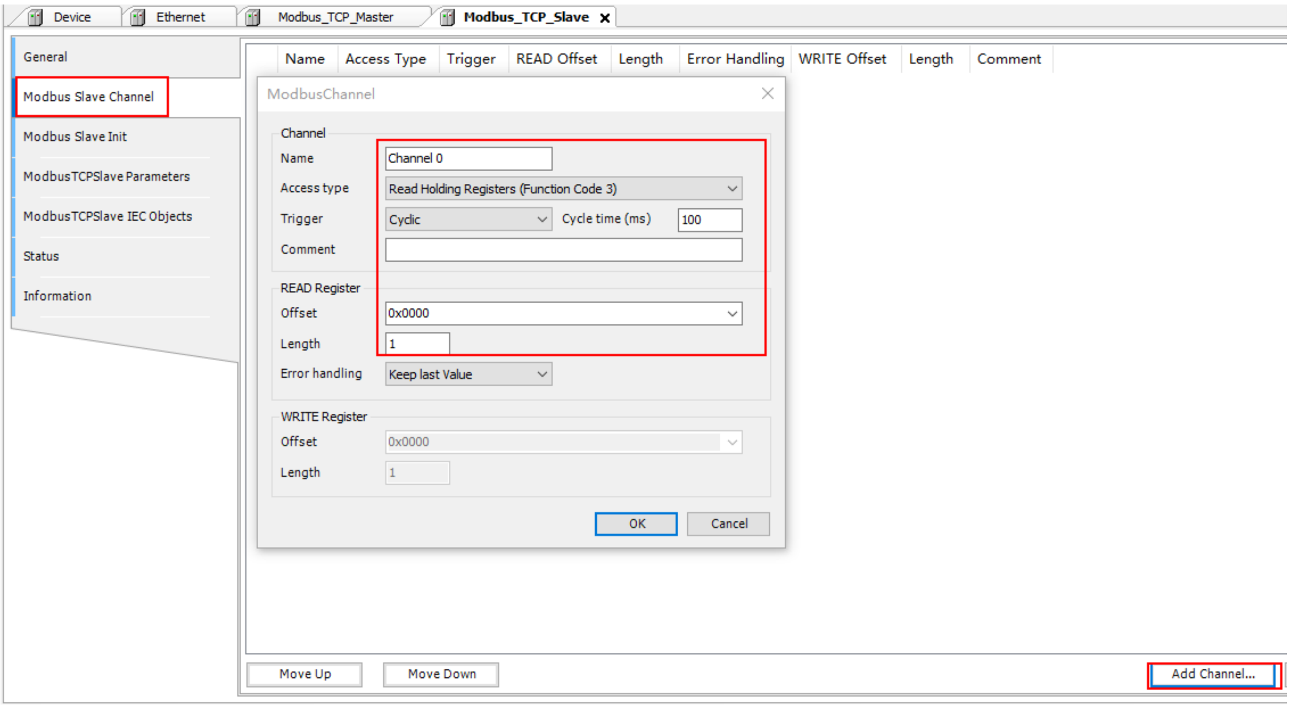
2) Configuring the channel

Step 1 With the Ttools-IO software, you can view the topology structure's IO module address mapping table. This table displays the function code for each module, the starting address offset, and the corresponding monitoring address range for the module, as shown in the following figure.

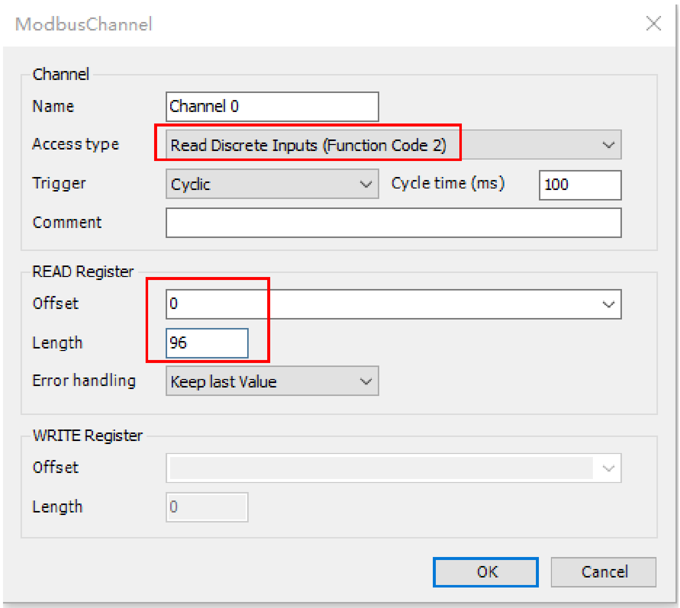


	name	:02 Input (Bit) offset:0 DI	:01、05、15 Output (Bit) offset:0 DO	:04、23 Input (Word) offset:0 AI	:03、06、16、23 Output (Word) offset:0 AO	:04、23 Input (Word) offset:4096 DI	:03、06、16、23 Output (Word) offset:4096 DO	:04、23 Input (Word) offset:8192 Diag
1	FL1002_3200DI	0~31				0~1		0
2	FL2201_0008DR		0~15				0	1
3	FL2102_0016DN		16~31				1	2
4	FL4003_4DA				0~3			3~6
5	FL3003_4AD			0~3				7~10
6	FL3203_4TC			4~11				11~14
7	FL5005_1616DP	32~47	32~47			2	2	15
8	FL6112_2EI			12~28	4~12			16~17
9	FL2003_0032DP		48~79				3~4	18
10	FL5105_1616DN	48~63	80~95			3	5	19
11	FL1002_3200DI	64~95				4~5		20
12	FL2002_0016DP		96~111				6	21
13	FL6121-1EI			29~39	13~19			22
14	FL2103_0032DN		112~143				7~8	23

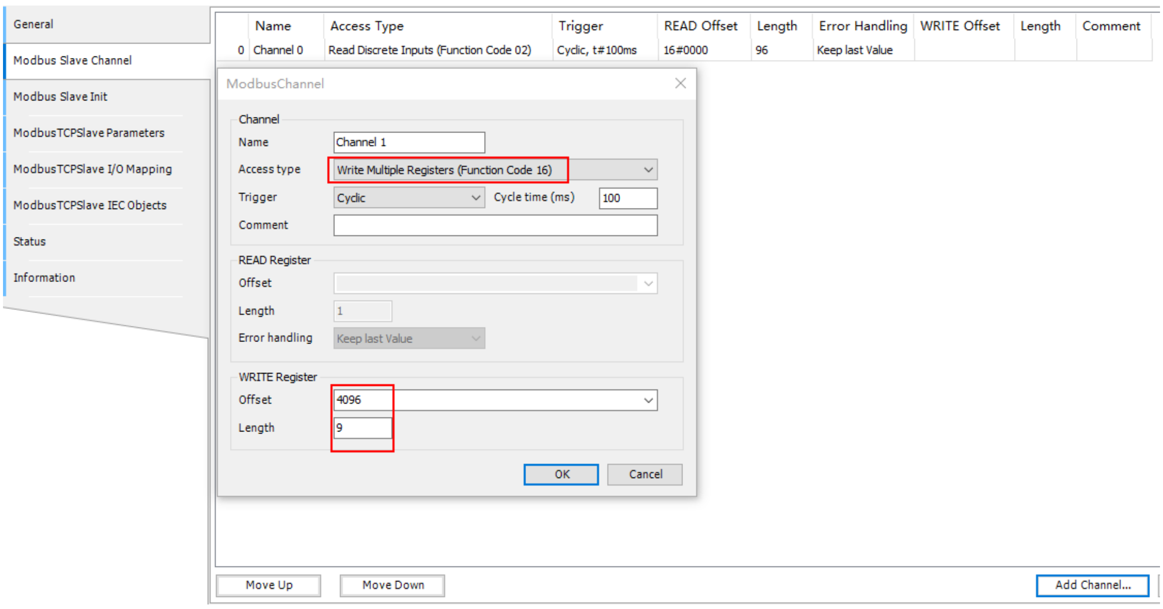
Step 2 On the left side of the Modbus_TCP_Slave page, click **Modbus Slave Channel**, then click **Add Channel** to open the Channel 0 configuration window, as shown in the following figure.



Step 3 The digital input modules FL1002_3200DI, FL5005_1616DP, FL5105_1616DN, and FL1002_3200DI have a function code of 02 corresponding to DI (Input Bit), with an offset address of 0x00 and address ranges of 0–31, 32–47, 48–63, and 64–95, totaling 96 bits. In the Channel 0 configuration window, set the Access type to **Read Discrete Inputs (Function Code 2)**, set the **READ Register Offset** to 0 and **Length** to 96, and click **OK**, as shown in the following figure. (You can also customize the offset address and length based on actual needs by referring to the IO module address mapping table.)

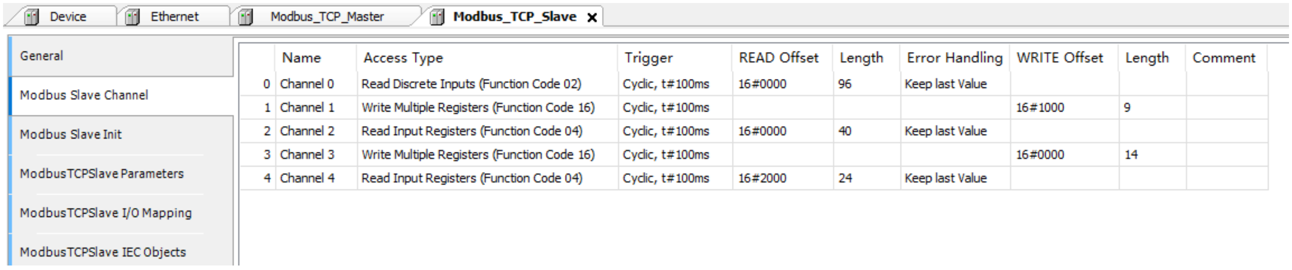


Step 4 The digital output modules FL2201_0008DR, FL2102_0016DN, FL5005_1616DP, FL2003_0032DP, FL5105_1616DN, FL2002_0016DP, and FL2103_0032DN correspond to an address range of 0–8 when using the Output (Word) write function. When configuring Channel 1, set the Access type to **Write Multiple Registers (Function Code 16)** and set the **WRITE Register Offset** to 4096 and **Length** of 9, as shown in the following figure.



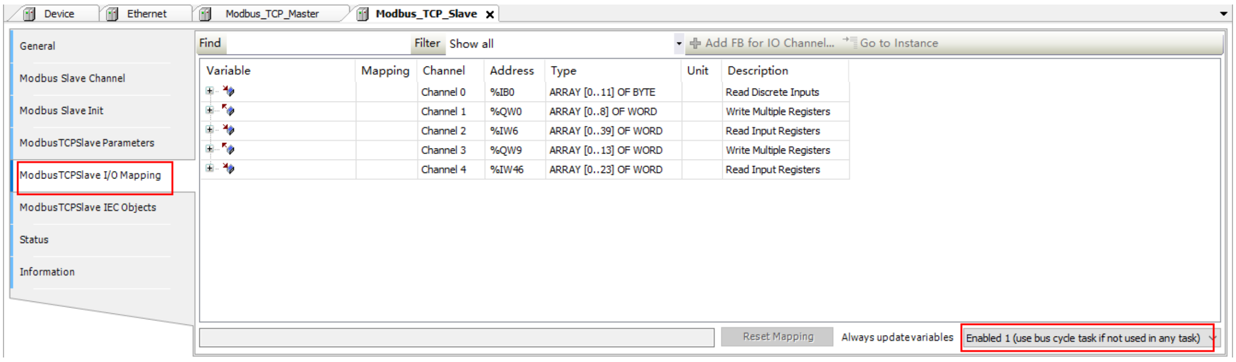
Note: If the Output (Word) write function is used, the Output (Bit) write operation cannot be performed simultaneously. Otherwise, multiple write operations to the same output point may cause conflicts.

Configure the other channels in sequence as follows:



- Verifying

Step 1 On the left side of the Modbus_TCP_Slave page, click **ModbusTCPSlave I/O Mapping** to monitor the IO modules. In the lower right corner, select **Enabled 1** for **Always update variables**, as shown in the following figure.



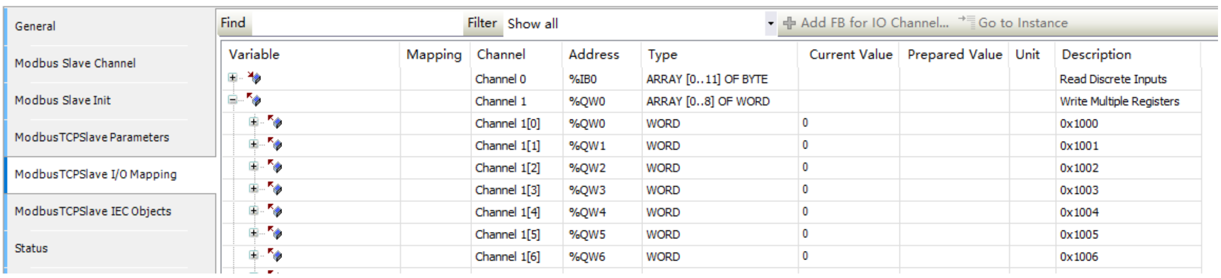
Step 2 On the menu bar, click **Build** > **Build** to start the compilation process.

Step 3 On the menu bar, click **Online** > **Login** or click the login icon to log in.

Step 4 On the menu bar, click **Online** > **Multiple Download**, select **Always perform a full download**, and click **OK**.

Step 5 Click the start icon to perform the verification test.

Modify the output value for a simple verification.



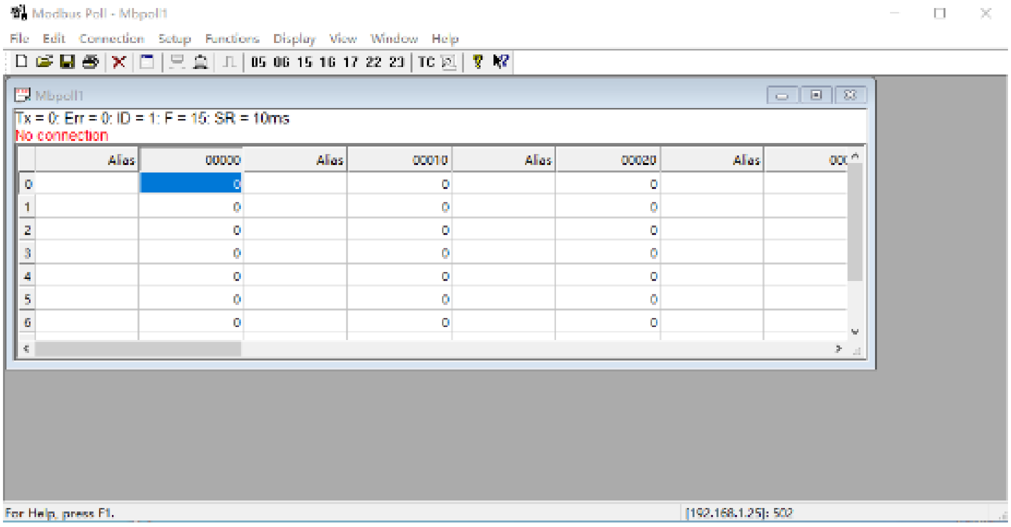
6.4.2.2 Modbus Poll example

- Environment

Perform the configuration operation according to the Ttools-IO setup. Power on the coupler and connect the network cable to the computer. Ensure that the IP address of the coupler and the IP address of the computer are in the same subnet. The computer should be pre-installed with the software "Modbus Poll".

- Module connection

Step 1 Open the Modbus Poll software, and the main window is shown in the following figure.



Tx = 0 indicates the number of data frames sent to the master node, which is 0 in the figure.

Err = 0 indicates the number of communication errors, which is 0 in the figure.

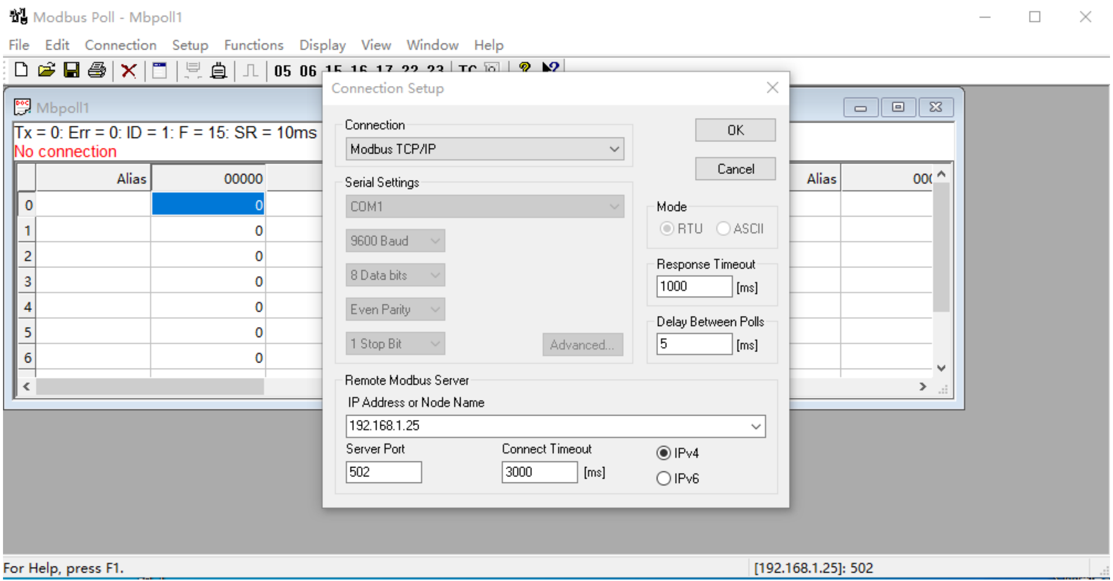
ID = 1 indicates the device address of the simulated Modbus slave device, which is 1 in the figure.

F = 15 indicates the Modbus function code being used, which is function code 15 in the figure.

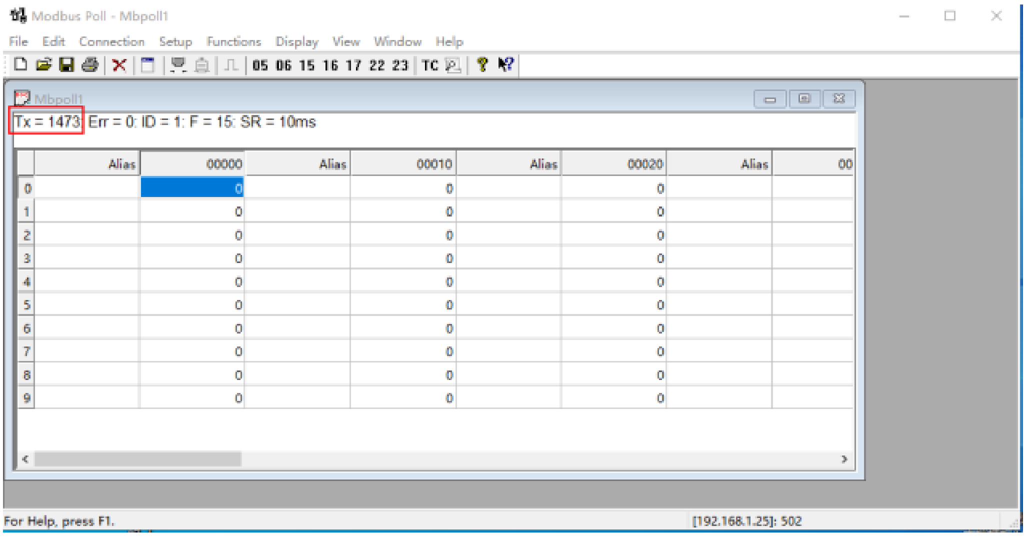
SR = 10ms indicates the scan period, and the red text indicates the current error status.

"No Connection" indicates a disconnected status.

Step 2 On the menu bar, click **Connection** > **Connect** to open the **Connection setup** window. In the **Connection** options, select **Modbus TCP/IP**, which is the communication protocol used by Modbus TCP. Enter the IP address of the coupler in the IP address field, and then click **OK**, as shown in the following figure.



Step 3 After the connection is established, Tx will continue to increase. See the following figure.



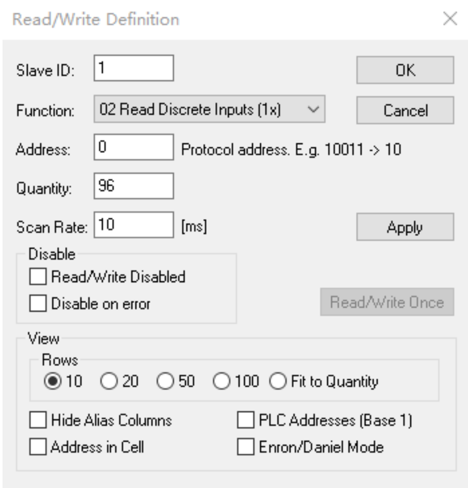
- Channel settings and monitoring

Step 1 With the Ttools-IO software, you can view the topology structure's IO module address mapping table. This table displays the function code for each module, the starting address offset, and the corresponding monitoring address range for the module, as shown in the following figure.

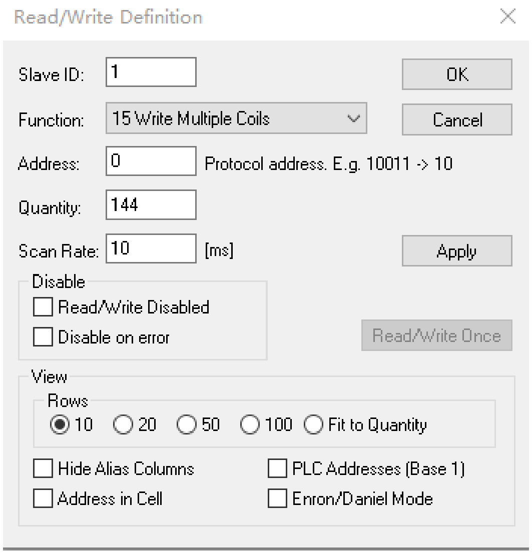
	名称	功能码:02 Input (Bit) offset:0 DI	功能码:01、05、15 Output (Bit) offset:0 DO	功能码:04、23 Input (Word) offset:0 AI	功能码:03、06、16、23 Output (Word) offset:0 AO	功能码:04、23 Input (Word) offset:4096 DI	功能码:03、06、16、23 Output (Word) offset:4096 DO	功能码:04、23 Input (Word) offset:8192 Diag
1	FL1002_3200DI	0~31				0~1		0
2	FL2201_0008DR		0~15				0	1
3	FL2102_0016DN		16~31				1	2
4	FL4003_4DA				0~3			3~6
5	FL3003_4AD			0~3				7~10
6	FL3203_4TC			4~11				11~14
7	FL5005_1616DP	32~47	32~47			2	2	15
8	FL6112_2EI			12~28	4~8			16~17
9	FL2003_0032DP		48~79				3~4	18
10	FL5105_1616DN	48~63	80~95			3	5	19
11	FL1002_3200DI	64~95				4~5		20
12	FL2002_0016DP		96~111				6	21
13	FL6121-1EI			29~39	9~13			22
14	FL2103_0032DN		112~143				7~8	23

Step 2 Configure the channels as follows according to the table above:

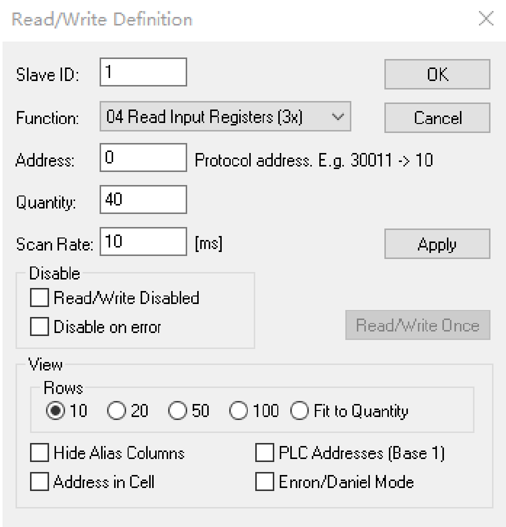
A. Function code 2, Input (bit), offset: 0, length: 96



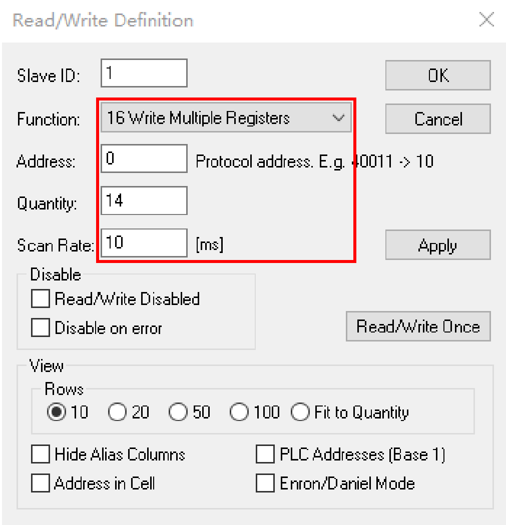
B. Function code 15, Output(bit), offset: 0, length: 144



C. Function code 04, Input(Word), offset: 0, length: 40



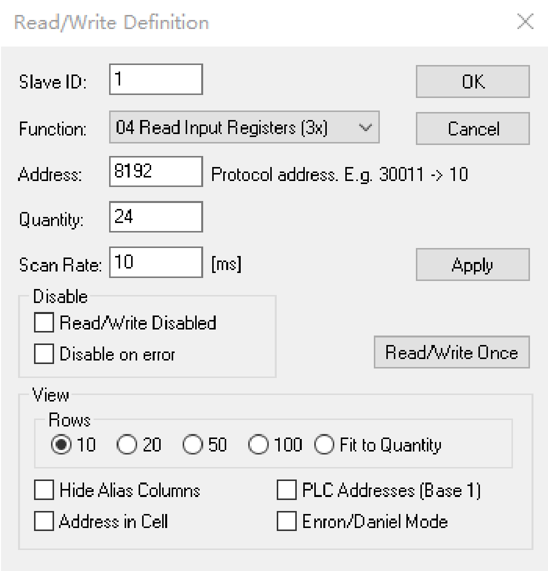
D. Function code 16, Output(Word), offset: 0, length: 14



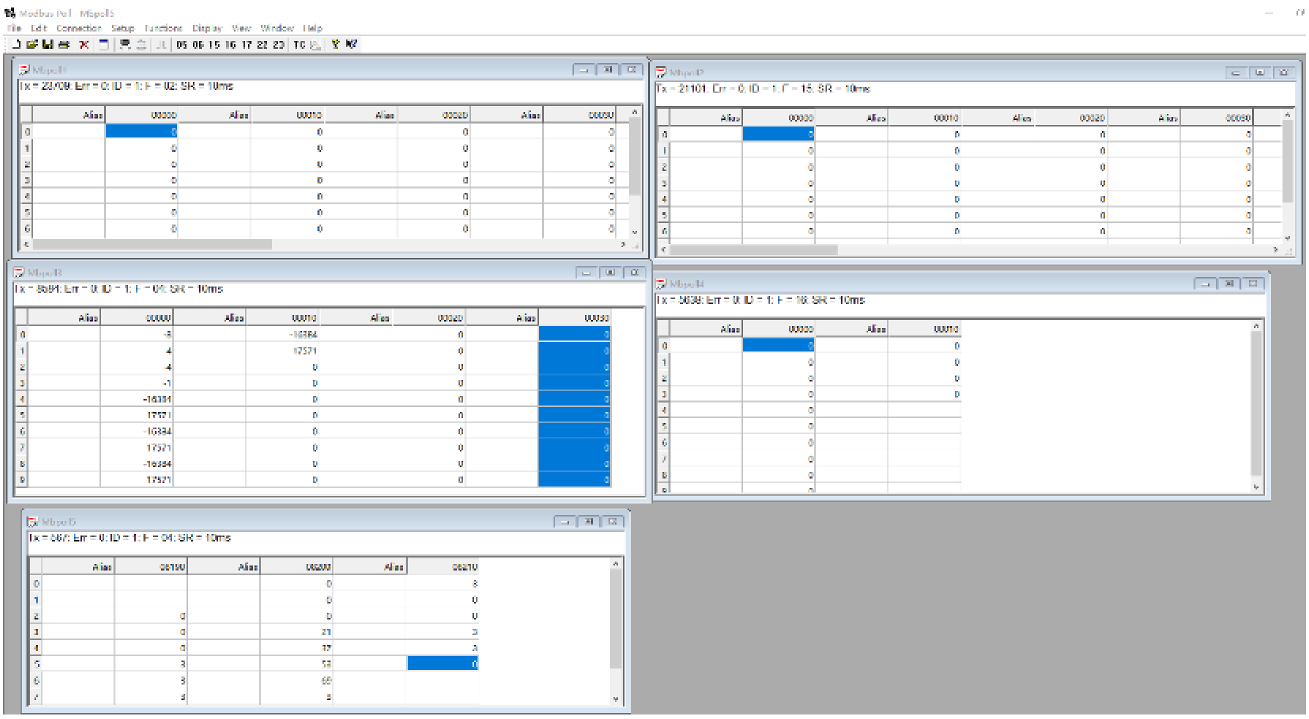
Note: Input (Word), offset: 4096; and Output (Word), offset: 4096 are the digital Word access mappings. They correspond to the same signals as Input (Bit), offset: 0; and Output (Bit), offset: 0. Generally, use them as needed, but do not access both Bit and Word simultaneously. Concurrent write operations on outputs may lead to conflicts.

Step 3 Configure the diagnostic information as follows:

Function code 04, Input(Word), offset: 8192, length: 24



The result is as shown in the following figure:



7 Common functions of Ttools-IO software

The following are the main commonly used functions of Ttools-IO software:

- Coupler firmware upgrade
- Creating a new project
- Opening an existing project
- Scanning a module
- Adding a module
- Adjusting module order
- Deleting a module
- Editing parameters
- Downloading project parameters
- EDS export
- Module firmware upgrade
- Online monitoring
- Viewing logs
- Checking for updates

Note:

- The following common functions of Ttools-IO software are illustrated using the FK1300 module as an example.
- The minimum version of EIP for firmware compatibility is 103. Users need to confirm the firmware version during operation.

■ **Operating environment**

Type	Description
OS	Windows7, Windows10
Communication interface	USB
Power supply	24V
Module	FL1001-1600DI, FL1002-3200DI, FL2002-0016DP, FL2003-0032DP, FL2102-0016DN, FL2103-0032DN, FL2201-0008DR, FL3003-4AD, FL3103-4PT, FL3203-4TC, FL4003-4DA, FL5005-1616DP, FL5105-1616DN, FL6002-2ES, FL6112-2EI, FL6121-1EI

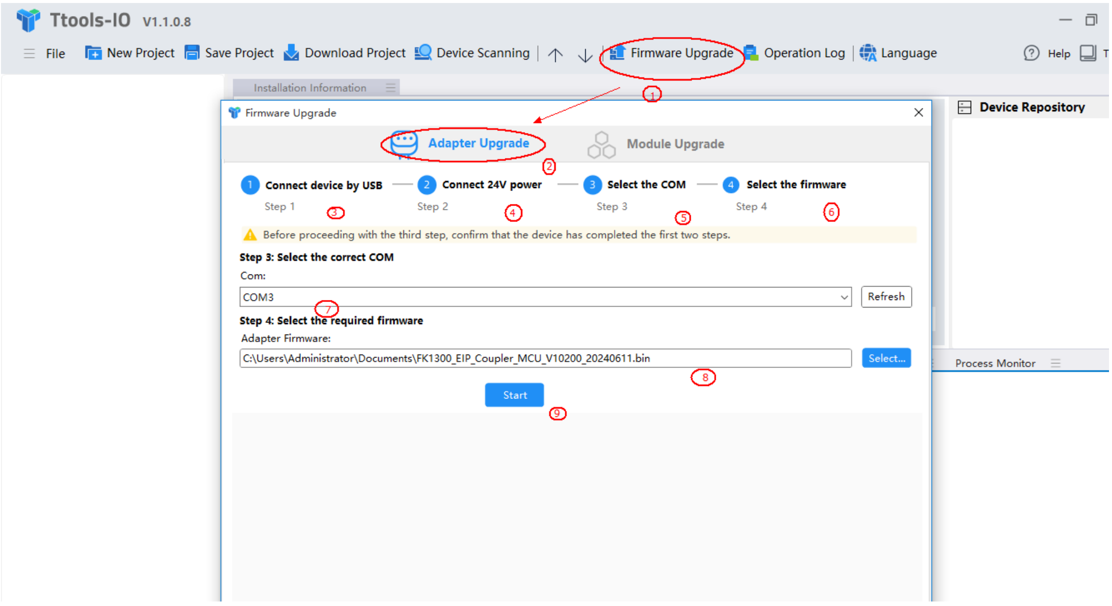
■ **Precautions**

1. When upgrading the coupler firmware, first connect the USB, and then connect the power supply. It is very important to follow the correct sequence for the upgrade to proceed normally.
2. For module scanning, module upgrading, and parameter downloading, the power supply must be connected first, followed by the USB cable. The correct connection order is necessary for normal operation.
3. Some operations require power to be turned off and then back on to take effect, such as firmware upgrades, module upgrades, and IP modifications. Pay attention to the prompt information during

these operations.

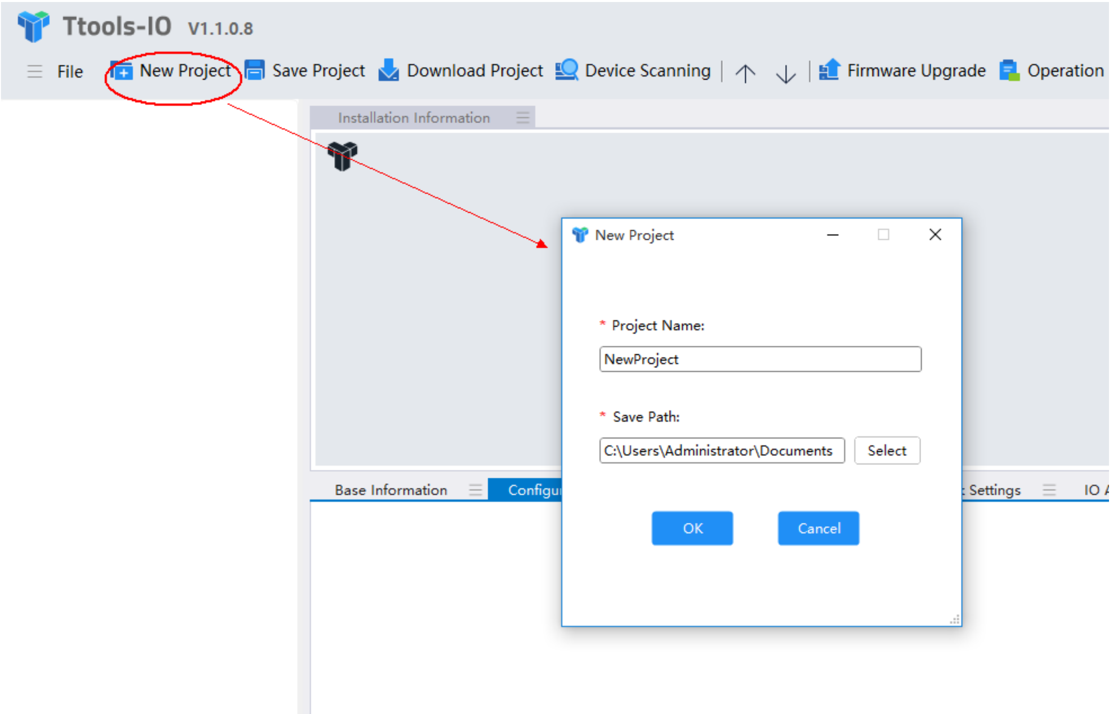
4. The coupler module can connect a maximum of 32 modules. If the total power of the modules exceeds the output power provided by the coupler, a power relay module must be used to ensure stable operation of the entire module configuration.
5. When connecting the USB to the coupler, be sure to select the correct COM port to avoid errors. It is recommended to connect only one set of couplers for operation at a time.

7.1 Coupler firmware upgrade



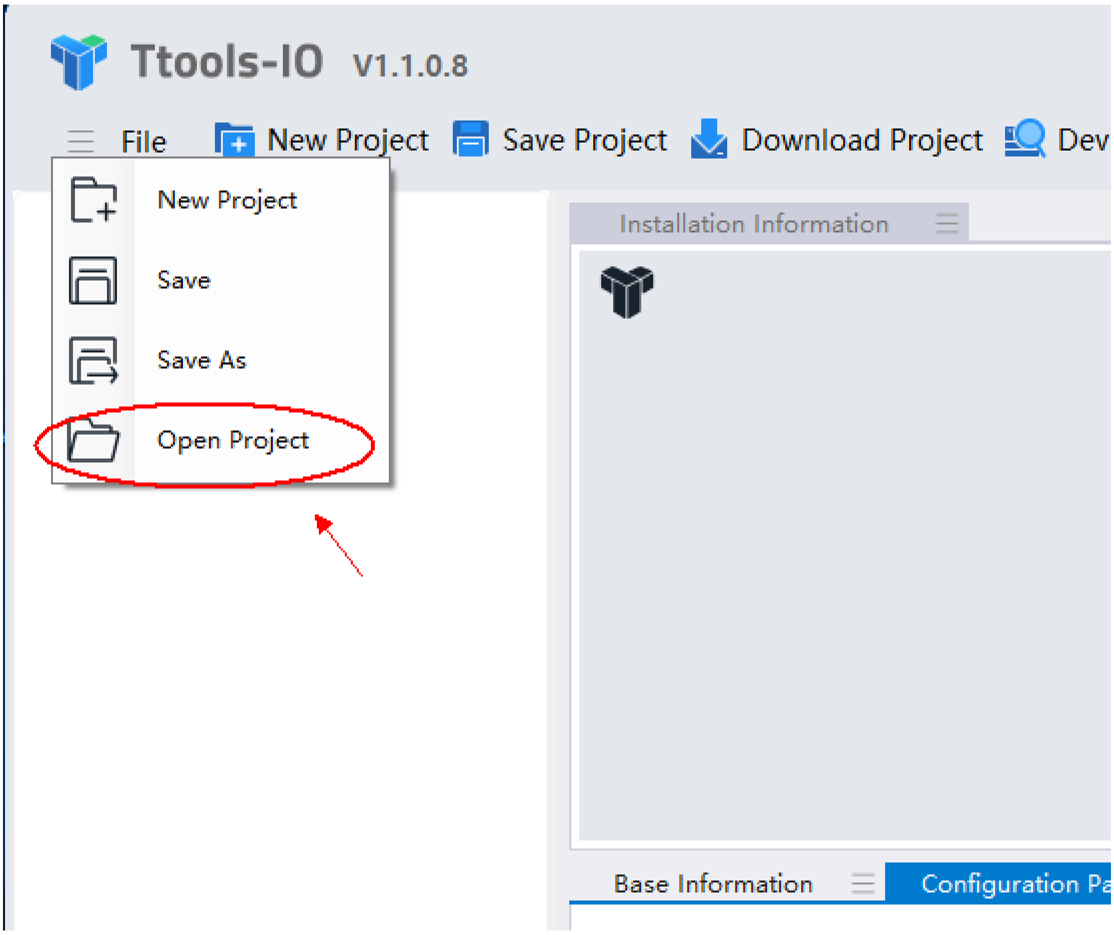
As shown in the above figure, select **Firmware Upgrade**, and then select **Adapter Upgrade** in the pop-up window. Next, select the corresponding COM port and the required firmware, and finally click **Start** to start the upgrade.

7.2 Creating a new project

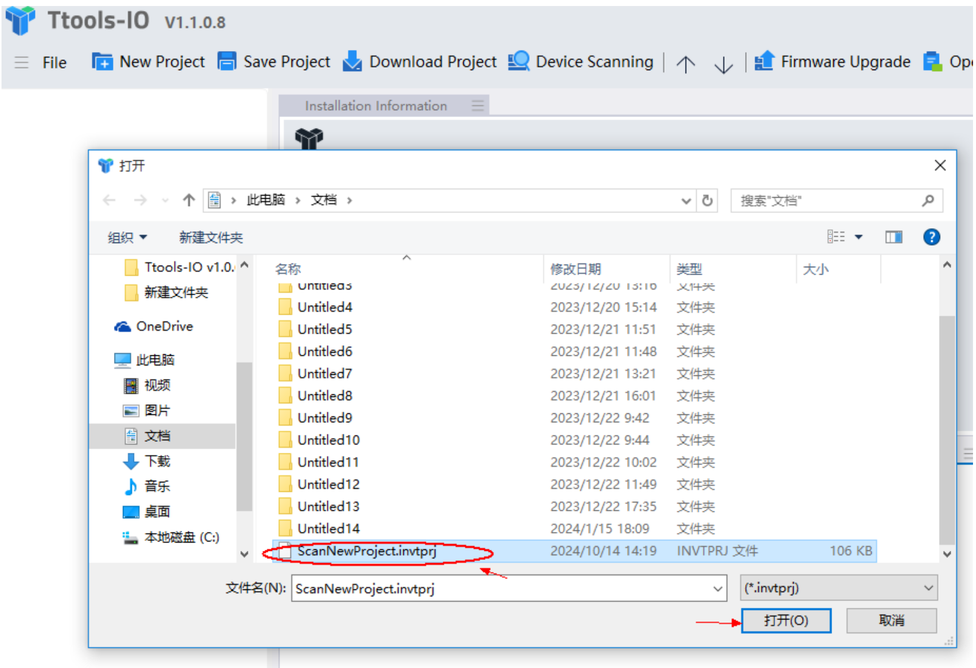


As shown in the above figure, you can manually create a new project by clicking the **New Project** button in the menu bar to open the corresponding window. Enter a project name, select a save path, and click **OK** to create a new project.

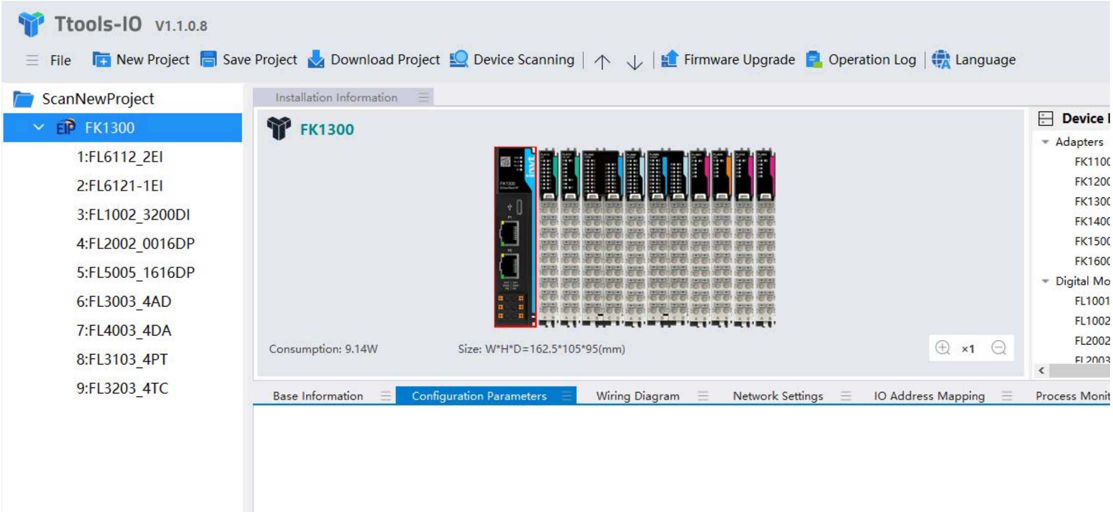
7.3 Opening an existing project



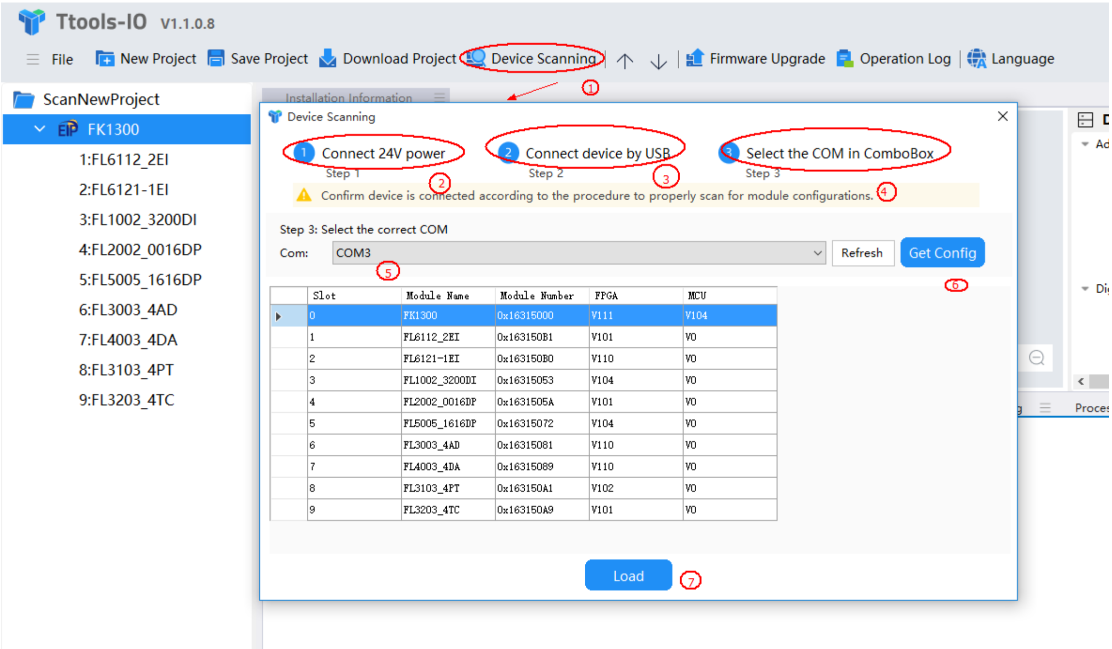
Click **File** > **Open Project** from the menu bar. The following operation interface will be displayed. Select the required project and click **Open** to open the project.



The interface shown in the following figure indicates that the project has been successfully opened.



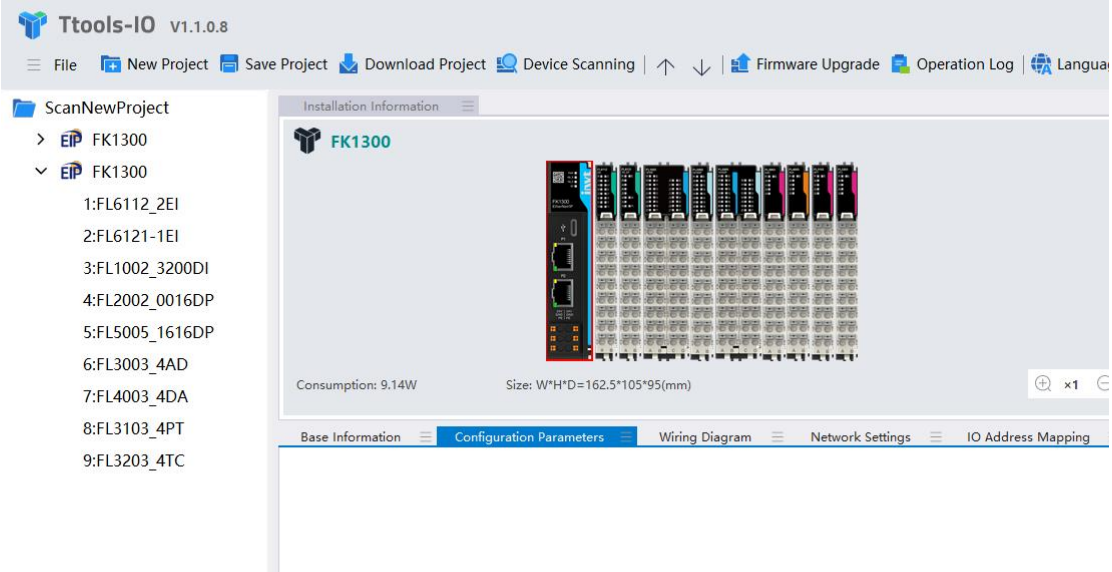
7.4 Scanning a module



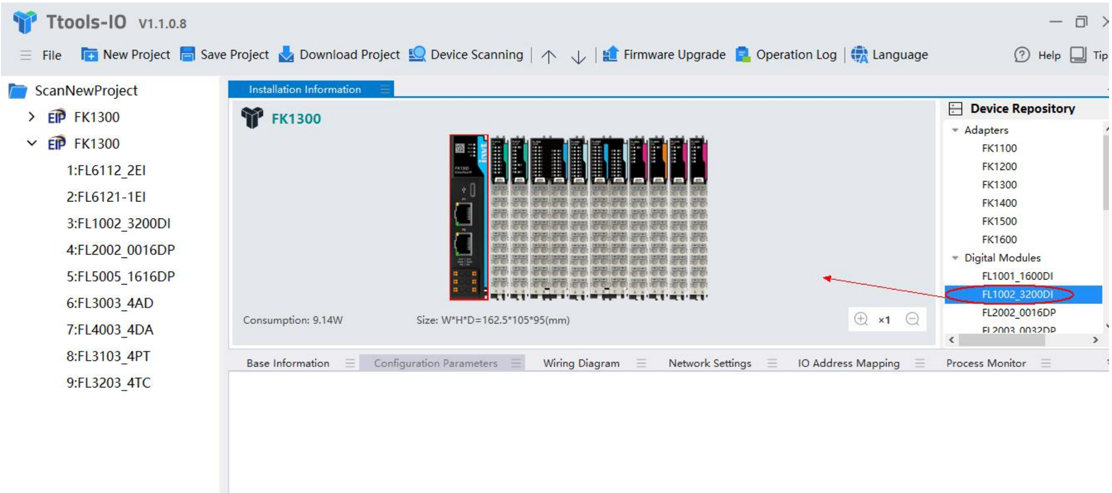
Slot	Module Name	Module Number	FPGA	MCU
0	FK1300	0x16315000	V111	V104
1	FL6112_2EI	0x163150B1	V101	V0
2	FL6121-1EI	0x163150B0	V110	V0
3	FL1002_3200DI	0x16315053	V104	V0
4	FL2002_0016DP	0x1631505A	V101	V0
5	FL5005_1616DP	0x16315072	V104	V0
6	FL3003_4AD	0x16315081	V110	V0
7	FL4003_4DA	0x16315089	V110	V0
8	FL3103_4PT	0x163150A1	V102	V0
9	FL3203_4TC	0x163150A9	V101	V0

Module scanning is used to obtain information about the physical configuration. Once the scanning is complete, you can load it into the project by clicking the **Load** button, creating a saveable software project that facilitates subsequent parameter editing and downloading.

The interface shown in the following figure indicates that the scanned module has been successfully loaded.

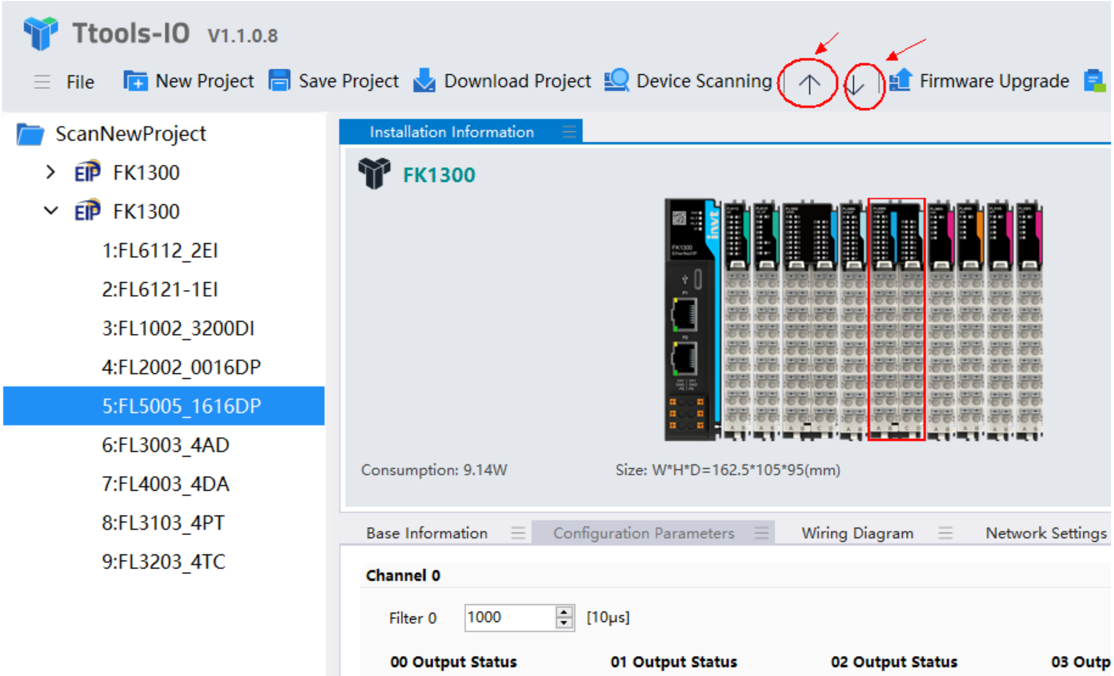


7.5 Adding a module



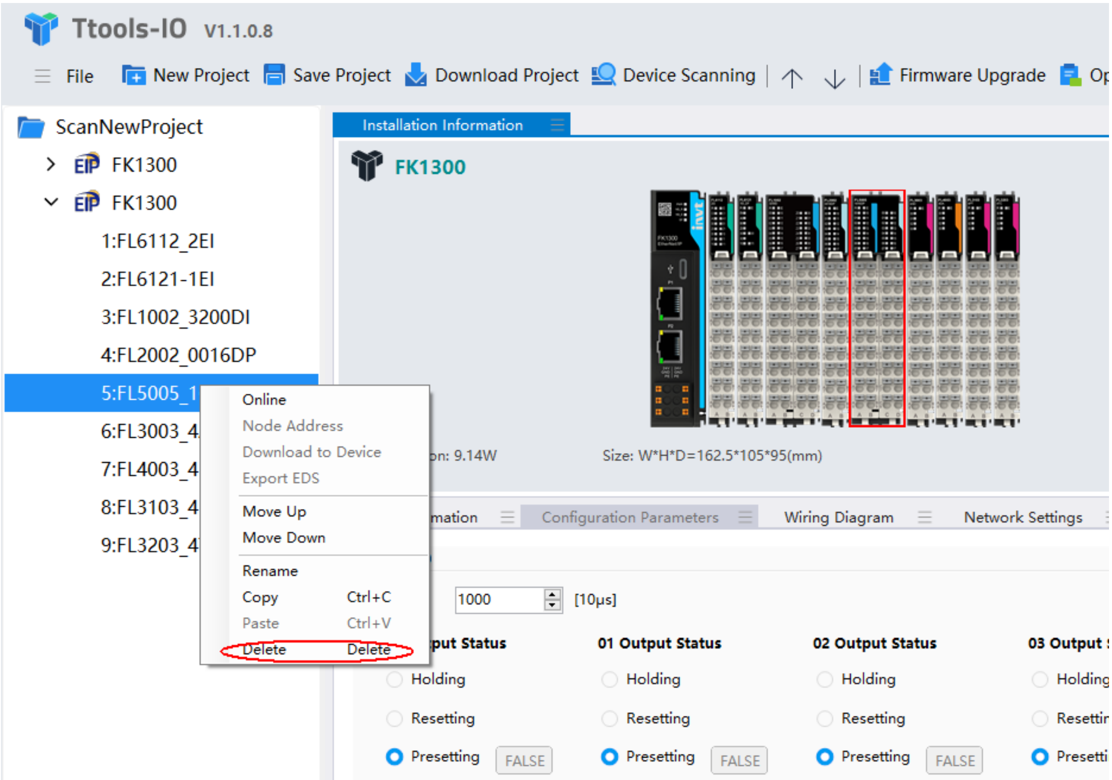
For an opened project, you can add modules by double-clicking the corresponding module in the device tree or by dragging the module into the software view.

7.6 Adjusting module order



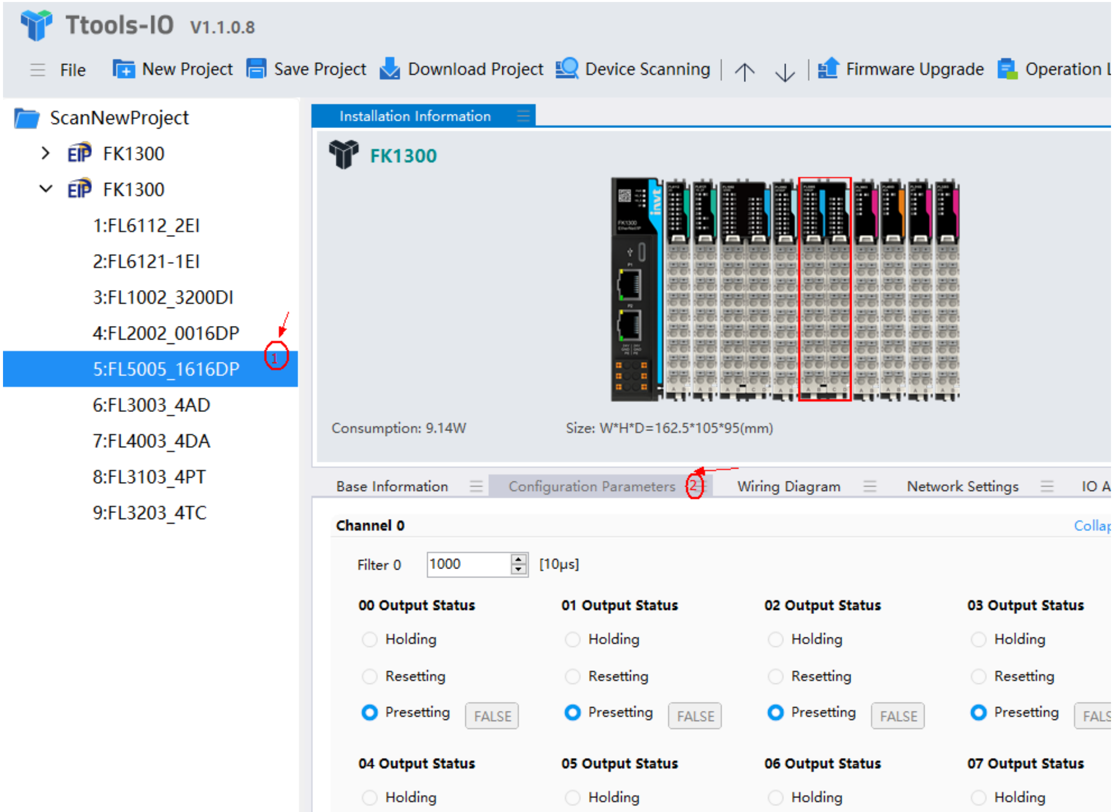
1. When selecting a module in the project tree, you can adjust the module order using the move up and move down buttons.
2. When selecting the **Configuration** window in the **Installation Information** section, you can adjust the window order using the left and right arrow keys or through the right-click menu.

7.7 Deleting a module



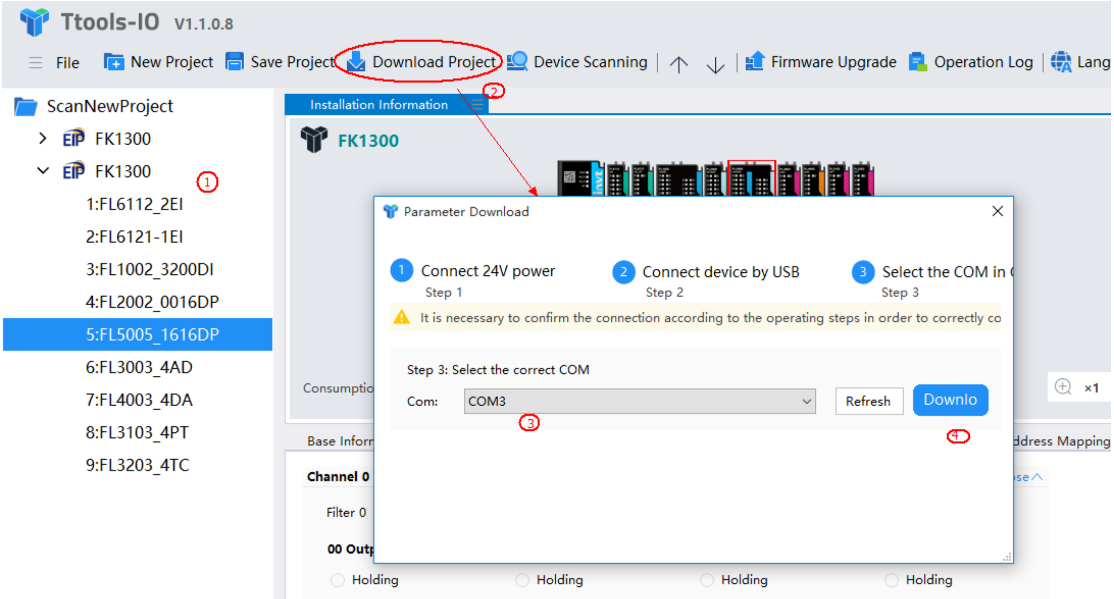
1. When selecting a module in the project tree, you can delete the module using the Delete key on the keyboard or through the right-click menu.
2. When selecting the **Configuration** window in the **Installation Information** section, you can delete the corresponding module using the right-click menu.

7.8 Editing parameters



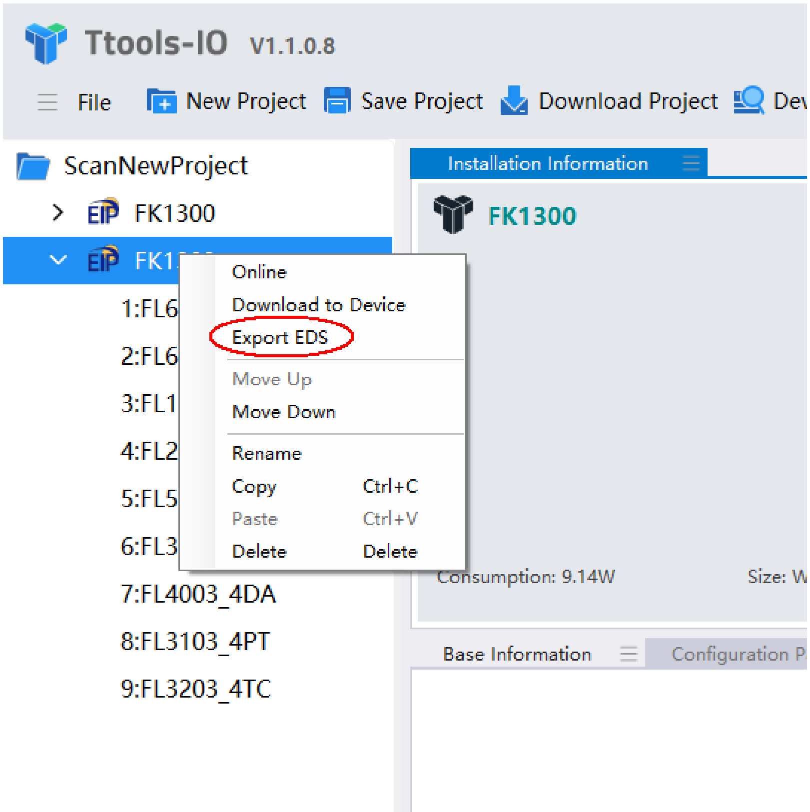
In the project tree interface, after selecting a module or installation information, you can select the **Configuration Parameters** tab to edit the corresponding module's parameters. Once you have finished editing, please remember to save the project.

7.9 Downloading project parameters

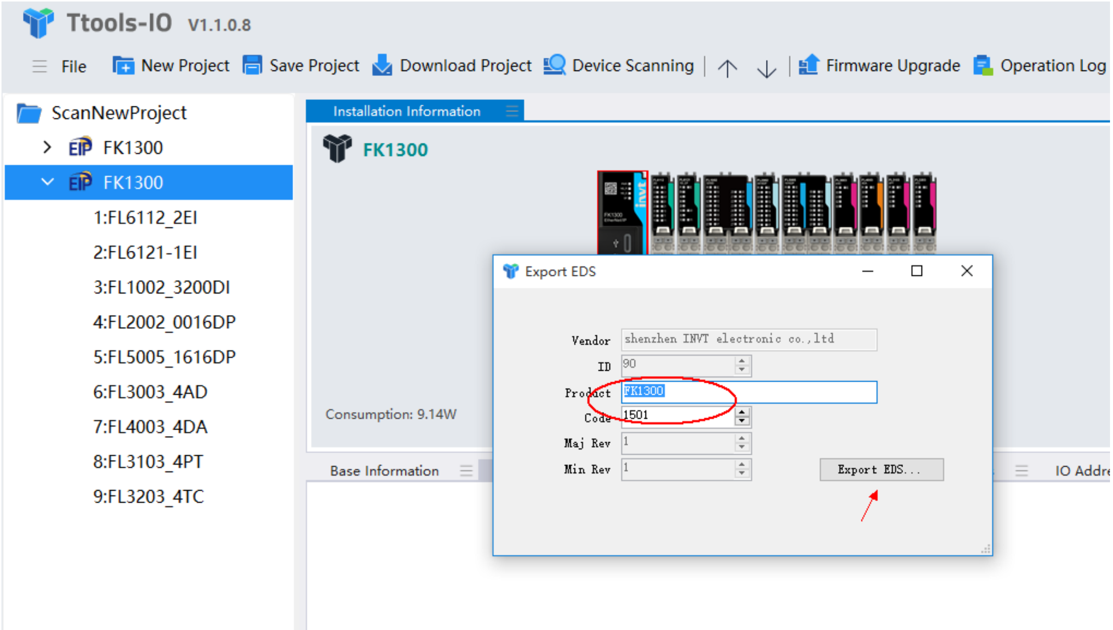


In the project tree interface, select the coupler for which you need to download parameters. Click **Download Project** in the menu bar to open the corresponding operation interface, where you can download parameters for all edited modules to the device.

7.10 EDS export

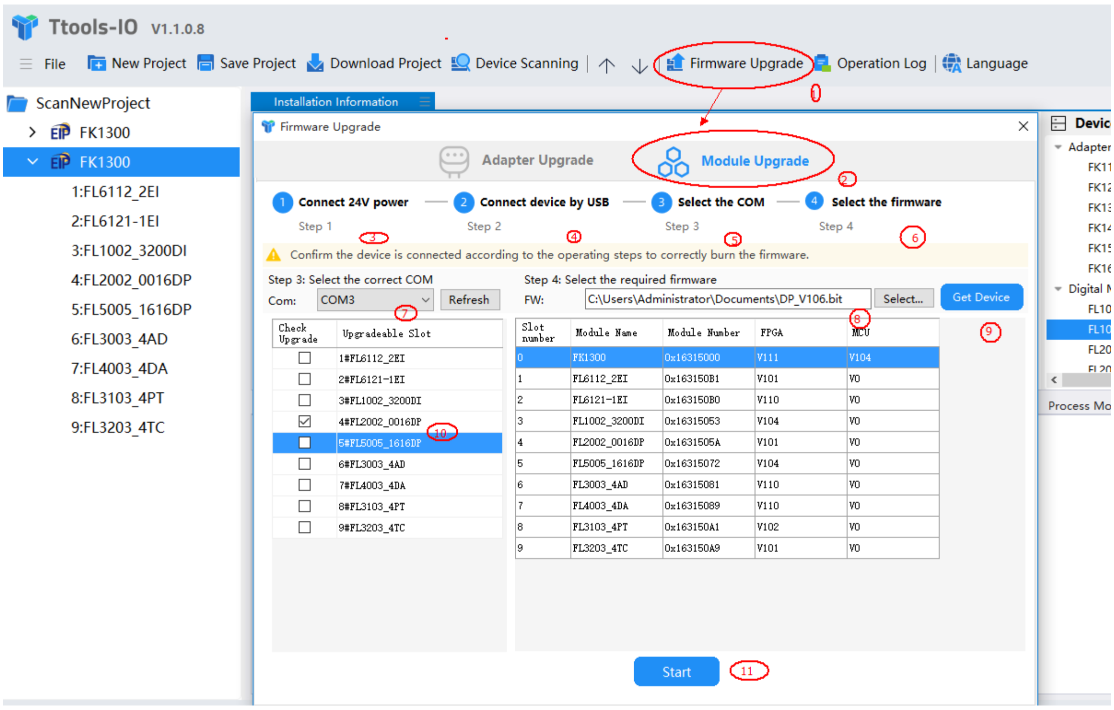


Right-click the coupler that you need to export the EDS file for, and select **Export EDS** from the menu.



On the pop-up windows, enter a product name and product code, click Export EDS to save the exported file in the selected path.

7.11 Module firmware upgrade

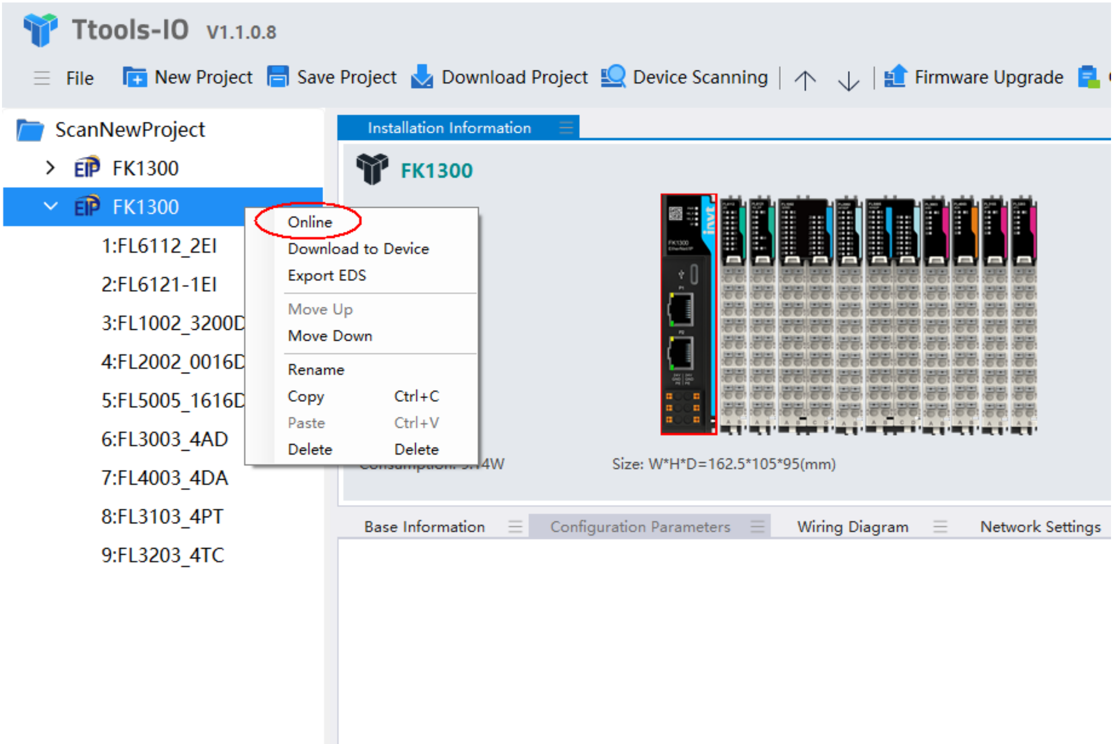


Module upgrades are performed on the modules connected to the coupler. Select **Firmware Upgrade** from the menu bar, then choose **Module Upgrade** in the pop-up interface. Follow the prompts to connect the coupler and select the appropriate serial port to obtain the physical configuration, which will be displayed on the interface.

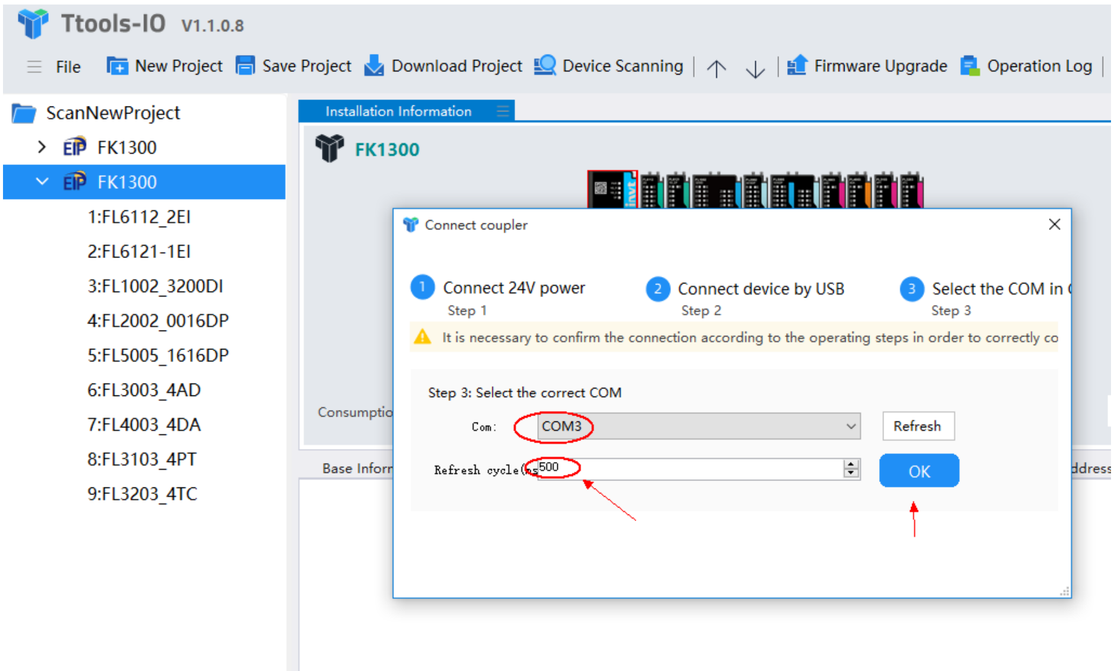
When selecting the firmware to upgrade, please note that only one type of module can be upgraded at a time. You can select modules one by one for upgrading, or you can select multiple modules of the same type at once, but you cannot select different types of modules for upgrading simultaneously. Once the upgrade is complete, be sure to reconnect the power and proceed with subsequent operations via USB.

Note: Currently, only coupler firmware upgrades are supported. Module firmware upgrades are not available at this time.

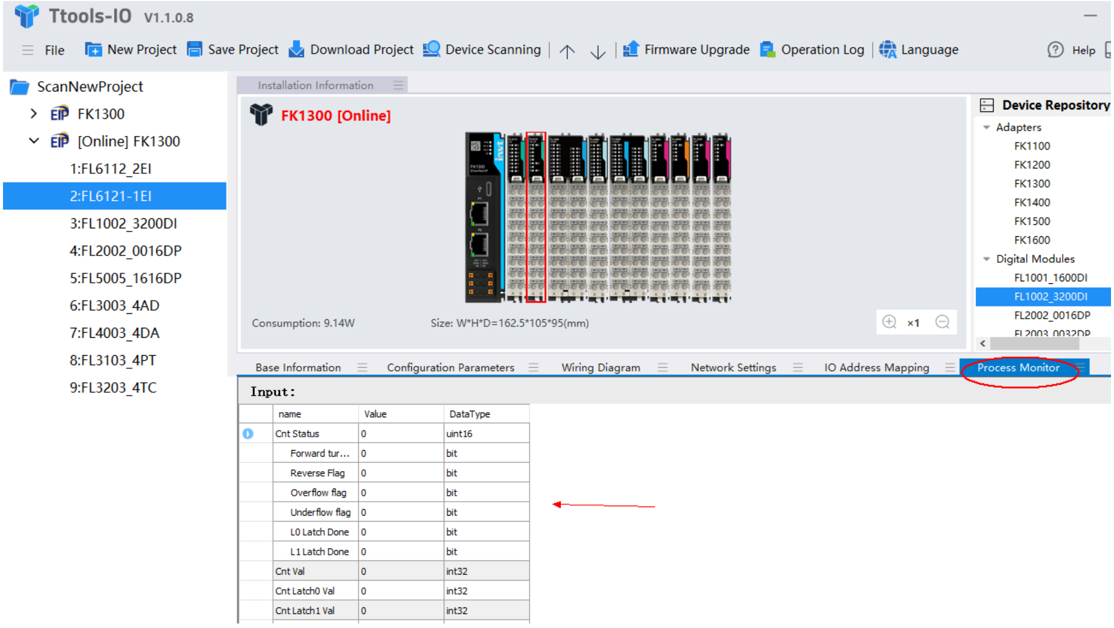
7.12 Online monitoring



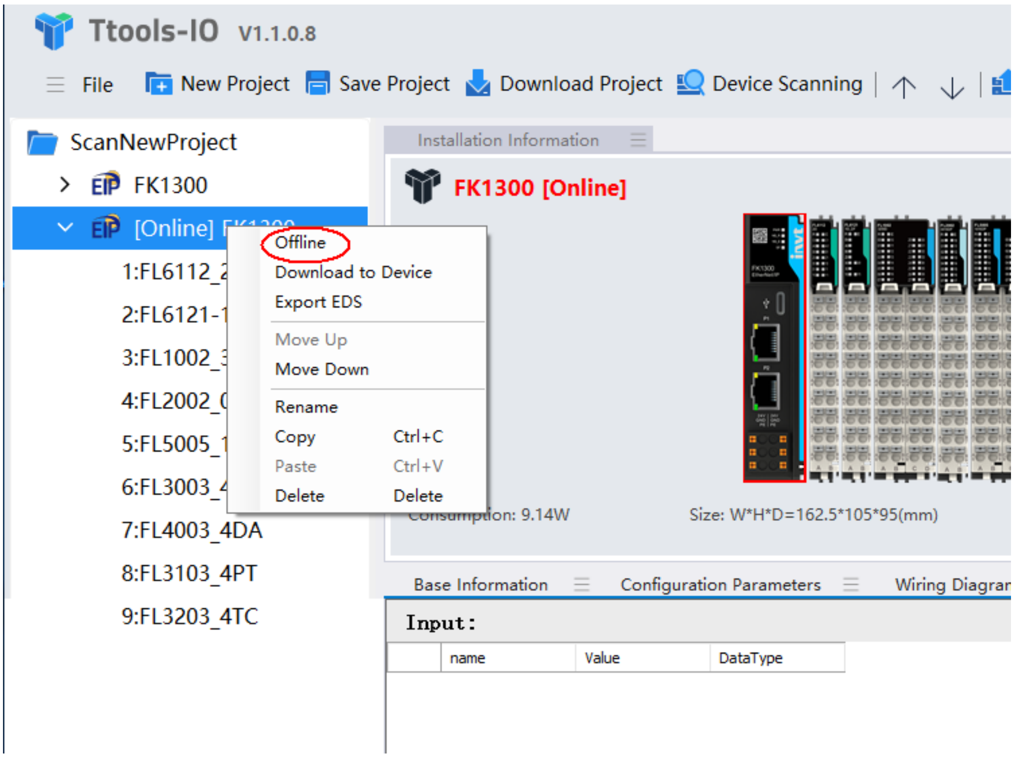
As shown in the above figure, right-click the coupler in the project tree, select **Online** from the menu, and then select the corresponding serial port for the coupler in the pop-up window to start the online monitoring function.



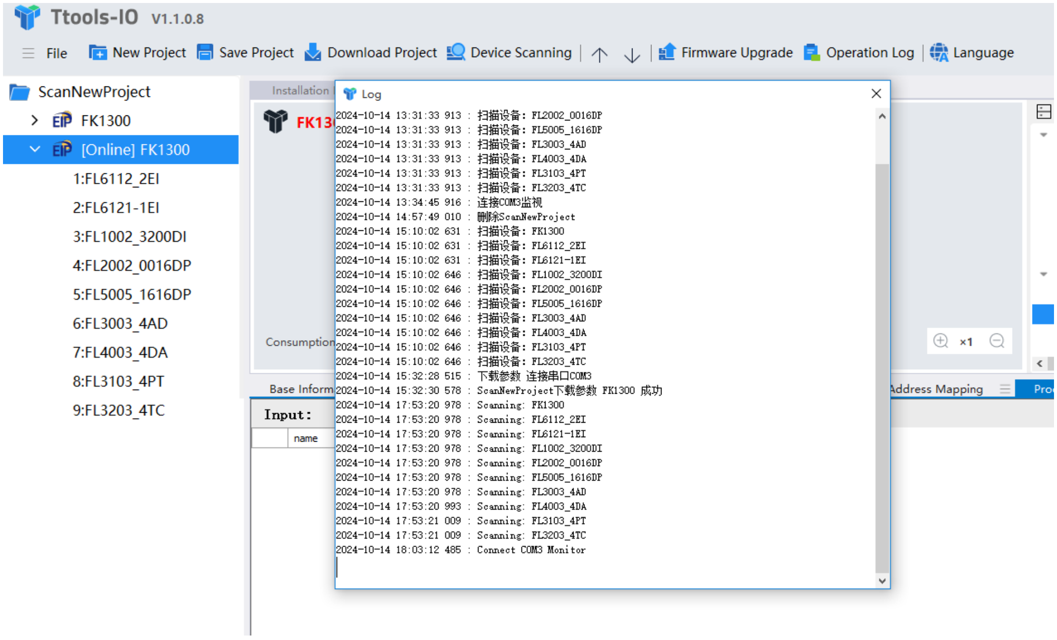
After selecting the module you wish to monitor, you can view the real-time data in the **Value** column.



To stop the online monitoring function, right-click the coupler or module, and select **Offline** in the menu.

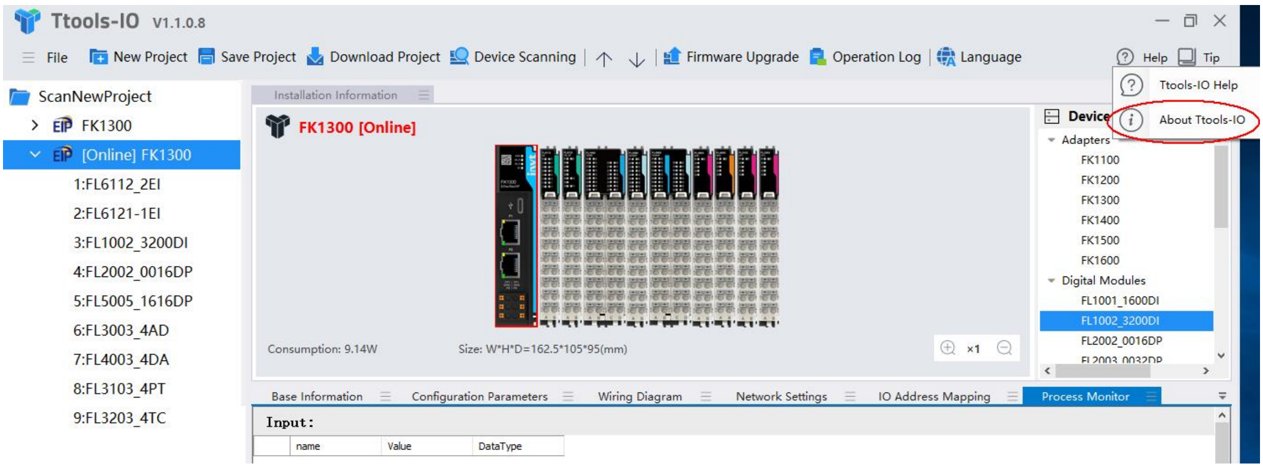


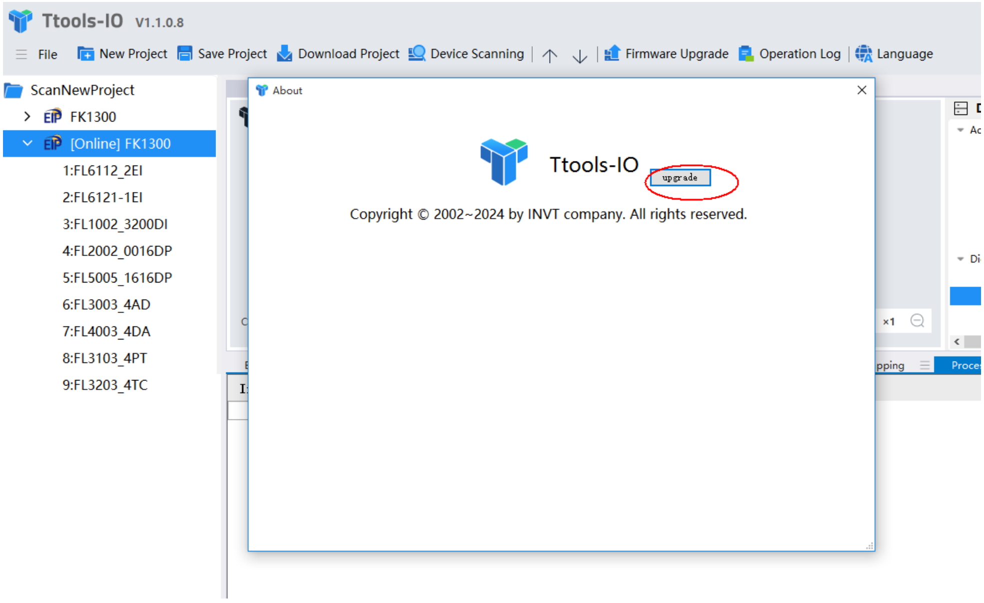
7.13 Viewing logs



The log viewing function is primarily designed to track records of key operations.

7.14 Checking for updates





If there are updates available, a prompt will appear. Follow the instructions to download and then install the updates.

8 Fault code

Fault code	Fault code (in hex.)	Fault Type	Solution
1	0x0001	Module configuration fault	Ensure the correct mapping between module network configuration and physical configuration.
2	0x0002	Incorrect module parameter setting	Ensure that module parameter settings are correct.
3	0x0003	Module output port power supply fault	Ensure that the module output port power supply is normal.
4	0x0004	Module output fault	Ensure that the module output port load is within the specified range.
18	0x0012	Incorrect parameter setting for channel 0	Ensure that the parameter settings for channel 0 are correct.
20	0x0014	Output fault on channel 0	Ensure that the output of channel 0 has no short circuit or open circuit.
21	0x0015	Signal source open circuit fault on channel 0	Ensure that the signal source physical connection of channel 0 is normal.
22	0x0016	Sampling signal limit exceeding fault on channel 0	Ensure that the sampling signal on channel 0 does not exceed the chip limit.
23	0x0017	Sampling signal measurement upper limit exceeding fault on channel 0	Ensure that the sampling signal on channel 0 does not exceed the measurement upper limit.
24	0x0018	Sampling signal measurement lower limit exceeding fault on channel 0	Ensure that the sampling signal on channel 0 does not exceed the measurement lower limit.
34	0x0022	Incorrect parameter setting for channel 1	Ensure that the parameter settings for channel 1 are correct.
36	0x0024	Output fault on channel 1	Ensure that the output of channel 1 has no short circuit or open circuit.
37	0x0025	Signal source open circuit fault on channel 1	Ensure that the signal source physical connection of channel 1 is normal.
38	0x0026	Sampling signal limit exceeding fault on channel 1	Ensure that the sampling signal on channel 1 does not exceed the chip limit.
39	0x0027	Sampling signal measurement upper limit exceeding fault on channel 1	Ensure that the sampling signal on channel 1 does not exceed the measurement upper limit.
40	0x0028	Sampling signal measurement lower limit exceeding fault on channel 1	Ensure that the sampling signal on channel 1 does not exceed the measurement lower limit.
50	0x0032	Incorrect parameter setting for channel 2	Ensure that the parameter settings for channel 2 are correct.
52	0x0034	Output fault on channel 2	Ensure that the output of channel 2 has no short circuit or open circuit.
53	0x0035	Signal source open circuit fault on channel 2	Ensure that the signal source physical connection of channel 2 is normal.

Fault code	Fault code (in hex.)	Fault Type	Solution
54	0x0036	Sampling signal limit exceeding fault on channel 2	Ensure that the sampling signal on channel 2 does not exceed the chip limit.
55	0x0037	Sampling signal measurement upper limit exceeding fault on channel 2	Ensure that the sampling signal on channel 2 does not exceed the measurement upper limit.
56	0x0038	Sampling signal measurement lower limit exceeding fault on channel 2	Ensure that the sampling signal on channel 2 does not exceed the measurement lower limit.
66	0x0042	Incorrect parameter setting for channel 3	Ensure that the parameter settings for channel 3 are correct.
68	0x0044	Output fault on channel 3	Ensure that the output of channel 3 has no short circuit or open circuit.
69	0x0045	Signal source open circuit fault on channel 3	Ensure that the signal source physical connection of channel 3 is normal.
70	0x0046	Sampling signal limit exceeding fault on channel 3	Ensure that the sampling signal on channel 3 does not exceed the chip limit.
71	0x0047	Sampling signal measurement upper limit exceeding fault on channel 3	Ensure that the sampling signal on channel 3 does not exceed the measurement upper limit.
72	0x0048	Sampling signal measurement lower limit exceeding fault on channel 3	Ensure that the sampling signal on channel 3 does not exceed the measurement lower limit.

9 EtherCAT functions

9.1 Basic functions

FK1100 ECT Coupler is an EtherCAT coupler that enables our Flex series expansion modules to connect to a high-speed EtherCAT network. In this way, Flex series expansion modules of different types can be configured an EtherCAT slave node, reducing the number of slave nodes connected.

9.2 Object dictionary overview

According to the definition of the standard protocol, the device object dictionary is uniformly divided, and all devices must be divided according to the rules of the protocol. The general structure allocation of the object dictionary is shown in the following table:

Index	Description
0x0000–0x0FFF	Data type
0x1000–0x1FFF	EtherCAT standard communication object dictionary
0x2000–0x5FFF	Manufacturer defined parameters
0x6000–0x6FFF	TxPDO, used to map the output process data of the expansion module.
0x7000–0x7FFF	RxPDO, used to map the input process data of the expansion module.
0x8000–0x8FFF	SDO, used for parameter configuration and status feedback of the expansion module.
0xF000–0xFFFF	Device description area, coupler configuration object dictionary

9.3 Expansion module object dictionary allocation

Each expansion module connected to the FK1100 ECT Coupler module is standardized as a module type, and the configuration parameters and process data of each module are instantiated as object dictionaries for management. The index of the module object dictionary is dynamically allocated and related to the location of the module. The object dictionary dynamic allocation range is as follows.

Type	Module 0	Module 1	Module n	Module 31
RxPDO mapping	0x1600	0x1601	0x1600+n*0x01	0x161F
TxPDO mapping	0x1A00	0x1A01	0x1A00+n*0x01	0x1A1F
TxPDO parameter	0x6000–0x607F	0x6080–0x60FF	0x6000+n*0x80–0x607F+n*0x80	0x6F80–0x6FFF
RxPDO parameters	0x7000–0x707F	0x7080–0x70FF	0x7000+n*0x80–0x707F+n*0x80	0x7F80–0x7FFF
SDO parameter	0x8000–0x807F	0x8080–0x80FF	0x8000+n*0x80–0x807F+n*0x80	0x8F80–0x8FFF

Each Flex series expansion module connected to the EtherCAT coupler is assigned a unique object dictionary base value. This base object dictionary is used to calculate the dynamic allocation of PDO mappings, PDO data, and SDO parameters based on the slot position of the module.

The calculation methods for the RxPDO and TxPDO mappings of expansion modules are as follows:

Object dictionary index = Object dictionary base value + Module position n * 0x01

The calculation methods for the RxPDO parameters, TxPDO parameters, and SDO parameters of expansion modules are as follows:

Object dictionary index = Object dictionary base value + Module position n * 0x80

Note: Module position n is calculated starting from 0, representing the position number of the slot where the module is located.

The object dictionary basic value distribution of Flex series is as follows.

Module	Object dictionary					
	RxPDO mapping	TxPDO mapping	TxPDO parameter	RxPDO parameter	SDO configuration parameter	SDO status parameter
FL1001-1600DI	-	0x1A00	0x6001	-	0x8001	0x8078
FL1002-3200DI	-	0x1A00	0x6002	-	0x8002	0x8078
FL2201-0008DR	0x1600	0x1A00	0x6004	0x7004	0x8004	0x8078
FL2102-0016DN	0x1600	0x1A00	0x6005	0x7005	0x8005	0x8078
FL2002-0016DP	0x1600	0x1A00	0x6005	0x7005	0x8005	0x8078
FL3003-4AD	-	0x1A00	0x6015	-	0x8015	0x8078
FL4003-4DA	0x1600	0x1A00	0x6019	0x7019	0x8019	0x8078
FL3101-4PT	-	0x1A00	0x6029	-	0x8029	0x8078
FL3201-4TC	-	0x1A00	0x602D	-	0x802D	0x8078

For example, the actual configuration is as follows.

FK1100_ECT_Coupler + FL1001-1600DI + FL2102-0016DN + FL3003-4AD + FL4003-4DA + FL3201-4TC

According to the object dictionary allocation rules, the object dictionary for this configuration is as follows.

Module	Object dictionary					
	RxPDO mapping	TxPDO mapping	TxPDO parameter	RxPDO parameter	SDO configuration parameter	SDO status parameter
FL1001-1600DI slot 0	-	0x1A00	0x6001	-	0x8001	0x8078
FL2102-0016DN slot 1	0x1601	0x1A01	0x6085	0x7085	0x8085	0x80F8
FL3003-4AD slot 2	-	0x1A02	0x6115	-	0x8115	0x8178
FL4003-4DA slot 3	0x1603	0x1A03	0x6199	0x7199	0x8199	0x81F8
FL3201-4TC slot 4	-	0x1A04	0x622D	-	0x822D	0x8278

9.4 Expansion module scanning function

The local bus protocol stack inside the FK1100_ECT Coupler has an automatic scanning function for modules, through this function the master node can directly scan and obtain the types and positions of the Flex series modules connected to the coupler module, and therefore directly determine the actual access module type of each slot, thus determining the configuration relationship of the modules. The configuration settings and scanning of modules are identified through the device identification code of the Flex series modules themselves.

Each Flex series expansion module is assigned a unique device ID, which is a 32-bit long data. During the power-on initialization process, the FK1100_ECT_Coupler module queries the identification code of the expansion module in each slot, and then write them to into subindex 1 to subindex 32 of the 0xF050 object dictionary from slot 0 to slot 31. When the master node starts the scanning function, it reads the 0xF050 object dictionary to obtain the device identification codes of the expansion modules connected to

FK1100_ECT_Coupler. Through these identification codes, the model of each module connected to each slot behind the coupler can be determined, thereby configuring the modules accordingly.

Regardless of whether the master node obtains the module configuration through manual configuration or scanning, it must send the user-configured network configuration information to the coupler while the FK1100_ECT_Coupler module is still in the Pre_Operational state. Specifically, the master node must write the identification codes of the Flex series modules detected in slot 0 to slot 31 into subindex 1 to subindex 32 of the 0xF030 object dictionary in sequence. The FK1100_ECT_Coupler will check whether the device identification codes in index 0xF030 match those in index 0xF050. If they match, the system can start normally; if they do not match, an error will be reported.

The device identification codes for the modules are as follows:

Expansion module	Module ID identification code
FK1100_ECT_Coupler	0x16315000
FL1001-1600DI	0x16315052
FL1002-3200DI	0x16315053
FL2201-0008DR	0x16315069
FL2102-0016DN	0x1631505A
FL2002-0016DP	0x16315062
FL3003-4AD	0x16315081
FL4003-4DA	0x16315089
FL3101-4PT	0x163150A1
FL3201-4TC	0x163150A9

9.5 Fault diagnosis

<table>
<tr><th colspan="2">Indicator</th><th>Description</th><th>Handling method</th></tr>
<tr><td>PWR</td><td>Off</td><td>Coupler 24V power supply exception</td><td>1. Check whether the module power connection is secure.
2. Assess whether the power supply capacity is sufficient.</td></tr>
<tr><td rowspan="2">RUN</td><td>Off</td><td>No data in EtherCAT communication</td><td>1. Check whether the physical connection between the master and slave is secure.
2. Check whether the slave node address matches.</td></tr>
<tr><td>Blinking</td><td>EtherCAT communication not in OP state</td><td>1. The SDO data volume is large, and the master node's performance in sending SDO data is insufficient, causing the slave node to remain in the Pre-Operational state for a long period of time.
2. Check whether the configuration is consistent.</td></tr>
<tr><td>SF</td><td>Blinking</td><td>Configuration mismatch</td><td>1. Check whether the physical configuration and network configuration are consistent.
2. Perform an automatic scan to check whether the scanned physical configuration matches the actual physical configuration and network configuration. This can help determine whether any module is damaged.</td></tr>
</table>

Appendix A Address mapping table descriptions

A.1 Function code planning

Supported function codes: 01, 02, 03, 04, 05, 06, 15, 16, 23

A.1.1 Function codes in Modbus standard

Function code	Name	Definition	Operation type
1	Read Coils	Read coils	Bit operation (multiple)
2	Read Discrete Inputs	Read discrete inputs	Bit operation (multiple)
3	Read Holding Registers	Read holding registers	Word operation (multiple)
4	Read Input Registers	Read input registers	Word operation (multiple)
5	Write Single Coil	Write a single coil	Bit operation (single)
6	Write Single Register	Write a single holding register	Word operation (single)
15	Write Multiple Coils	Write multiple coils	Bit operation (multiple)
16	Write Multiple Registers	Write multiple holding registers	Word operation (multiple)
23	Read/Write Multiple Registers	Read/Write multiple holding registers	Word operation (multiple)

A.1.2 BIT access

A.1.2.1 BIT read

02: Read Discrete Inputs / Read discrete input status/bit operation (multiple)

This function code allows for bitwise read operations on all digital input modules configured, with address offsets starting from 0 and following the configuration order.

A.1.2.2 BIT write

- 01: Read Coils / Read coil status/bit operation (multiple)
- 05: Write Single Coil / Write single coil/bit operation (single)
- 15: Write Multiple Coils / Write multiple coils/bit operation (multiple)

These three function codes allows for bitwise write operations or read back on all digital output modules configured, with address offsets starting from 0 and following the configuration order.

A.1.3 WORD access

A.1.3.1 WORD read

- 04: Read Input Registers / Read input registers/word operation (multiple)
- 23: Read/Write Multiple Registers / Read/Write multiple holding registers/word operation (multiple)

Note: The read and write operations for function 23 do not map to the same address.

These two function codes allows for word-wise read operations on the input data of all configured modules. The digital input module can perform bit operations using function code 02, as well as word operations here (offset address 4096). The error diagnostic information for all modules is also mapped to address 8192.

- ✧ The parameters of the analog modules are offset sequentially from address 0 according to the configuration order.
- ✧ The parameters of the digital modules are offset sequentially from address 4096 according to the configuration order.
- ✧ The error diagnostic information parameters for all modules are offset sequentially from address 8192 according to the configuration order.

A.1.3.2 WORD write

- 03: Read Holding Registers / Read holding registers/word operation (multiple)
- 06: Write Single Register / write single holding register/word operation (single)
- 16: Write Multiple Registers / Write multiple holding registers/word operation (multiple)
- 23: Read/Write Multiple Registers / Read/Write multiple holding registers/word operation (multiple)

Note: The read and write operations for function 23 do not map to the same address.

These four function codes allows for word-wise write operations or read back the output data of all configured modules. The digital input module can perform bit operations using function code 15, as well as word operations here (offset address 4096). The master node should not perform both bit write operations and word write operations on the same digital output simultaneously, as this will cause conflicts.

- ✧ The parameters of the analog output modules are offset sequentially from address 0 according to the configuration order.
- ✧ The parameters of the digital output modules are offset sequentially from address 4096 according to the configuration order.

A.2 Address mapping table

A.2.1 Address allocation

A.2.1.1 Area

The address space is divided into four address regions according to the planned access method.

1. BIT read:

    0–2048; Digital input module

2. BIT write:

0–2048; Digital output module

3. WORD read: 0–12288;

   0–4095: Corresponding to the analog input module

   4096-8191; Corresponding to the digital input module

   8192–12287: Corresponding to diagnostic information, including error codes for the module

4. WORD write: 0–8192;

   0–4095: Corresponding to the analog output module

   4096-8191; Corresponding to the digital output module

A.2.1.2 Module address count table

No.	Function code	02	01, 05, and 15	04, 23	03, 06, 16, 23	04, 23	03, 06, 16, 23	04, 23
	Offset address	0	0	0	0	4096	4096	8192
	Function	Input Bit	Output Bit	Input Word	Output Word	Input Word	Output Word	Input Word
		DI	DO	AI	AO	DI	DO	Diag
0	**FK1400**							
1	FL1001_1600DI	16	-	-	-	1	-	1
2	FL1002_3200DI	32	-	-	-	2	-	1
3	FL2002_0016DP	-	16	-	-	-	1	1
4	FL2003_0032DP	-	32	-	-	-	2	1
5	FL2102_0016DN	-	16	-	-	-	1	1
6	FL2103_0032DN	-	32	-	-	-	2	1
7	FL2201_0008DR	-	16	-	-	-	1	1
8	FL5005_1616DP	16	16	-	-	1	1	1
9	FL5105_1616DN	16	16	-	-	1	1	1
10	FL3003_4AD	-	-	4	-	-	-	4
11	FL3404-8ADV	-	-	8	-	-	-	8
12	FL3504-8ADI	-	-	8	-	-	-	8
13	FL3103_4PT	-	-	8	-	-	-	4
14	FL3203_4TC	-	-	8	-	-	-	4
15	FL4003_4DA	-	-	-	4	-	-	4
16	FL6112_2EI	-	-	17	9	-	-	2
17	FL6121-1EI	-	-	11	7	-	-	1
18	FL6002-2ES	-	-	17	5	-	-	2

A.2.1.3 Example

Configuration: total number of modules: 18								
No.	Function code	02	01, 05, and 15	04, 23	03, 06, 16, 23	04, 23	03, 06, 16, 23	04, 23
	Offset address	0	0	0	0	4096	4096	8192
	Function	Input Bit	Output Bit	Input Word	Output Word	Input Word	Output Word	Input Word
		DI	DO	AI	AO	DI	DO	Diag
0	**FK1400**							
1	FL1001_1600DI	0–15	-	-	-	0	-	0
2	FL1002_3200DI	16–47	-	-	-	1–2	-	1
3	FL2002_0016DP	-	0–15	-	-	-	0	2
4	FL2003_0032DP	-	16–47	-	-	-	1–2	3
5	FL2102_0016DN	-	48–63	-	-	-	3	4
6	FL2103_0032DN	-	64–95	-	-	-	4–5	5
7	FL2201_0008DR	-	96–111	-	-	-	6	6
8	FL5005_1616DP	48–63	112–127	-	-	3	7	7
9	FL5105_1616DN	64–79	128–143	-	-	4	8	8
10	FL3003_4AD	-	-	0–3	-	-	-	9–13
11	FL3404-8ADV	-	-	4–11	-	-	-	14–21
12	FL3504-8ADI	-	-	12–19	-	-	-	22–29
13	FL3103_4PT	-	-	20–27	-	-	-	30–33
14	FL3203_4TC	-	-	28–35	-	-	-	34–37
15	FL4003_4DA	-	-	-	0–3	-	-	38–41
16	FL6112_2EI	-	-	36–52	4–12	-	-	42–43
17	FL6121-1EI	-	-	53–63	13–19	-	-	44
18	FL6002-2ES	-	-	64–80	20–24	-	-	45–46

A.3 Additional notes

The address range for accessing the above function codes is calculated based on the configuration. If it exceeds the actual configured address range, an 'Illegal data address' error will be reported during access.

Function code 23 reads data from the 'WORD read' area, not from the 'WORD write' area. Therefore, if the master node supports function code 23, it can read and write input and output data simultaneously, improving communication efficiency.

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