FP30-EC-8A-M12-S0 Master

User Manual

SHENZHEN INVT ELECTRIC CO., LTD.

Contents

1 Product overview

1.1 Product introduction

The FP30-EC-8A-M12-S0 is an IO-Link master IP67 module, a standard IO-Link master device. The device supports the EtherCAT industrial Ethernet bus interface on the bus side and the IO-Link protocol on the user side. It acts as an EtherCAT slave on the bus side and an IO-Link master on the IO-Link side. Both the bus and IO-Link interfaces are compatible with devices from multiple manufacturers, offering high compatibility and providing various options for user data acquisition, system configuration optimization, simplified field wiring, and improved system reliability.

1.2 Product features

- Up to IP67 protection rating

Suitable for harsh industrial environments.

- Standardization

Based on the IO-Link standard V1.1.3, it can remotely control IO-Link slave devices and is easy to operate.

- High compatibility

Support for slave devices with special process data lengths.

- Small size

Suitable for applications with limited space.

- Easy diagnostics

The innovative channel indicator design is placed close to the channel, making the channel status clear at a glance and facilitating inspection and maintenance.

- Easy configuration

Easy to configure and compatible with major PLCs.

- Simple and quick wiring

Using standard cables simplifies wiring.

2 Module model

2.1 Model list

Model	Product description
FP30-EC-8A-M12-S0	IO-Link master with EtherCAT bus protocol and 8 × Class A ports

3 Product parameters

3.1 General parameters

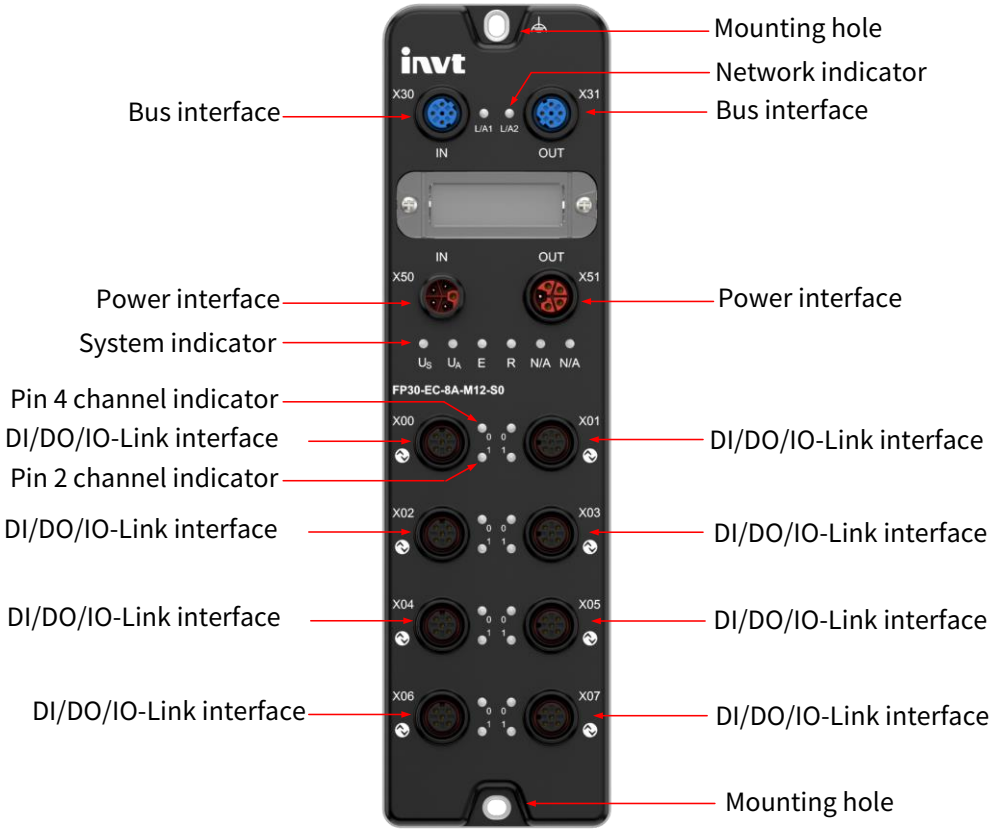
Interface parameters	
Bus protocol	EtherCAT
Bus interface	2×M12-D, 4-pin, female socket
Electrical isolation	500 VAC
Number of I/O stations	According to the master station
Data transmission medium	UTP or STP of category 5 or higher (STP recommended)
Transmission distance	⩽100 m (Station-to-station distance)
Transmission rate	100 Mbps
Technical parameters	
Configuration method	Via the master station
Power interface	2×M12-L, 5-pin, male and female connectors
Power supply	24 VDC (18V–30V)
U_S total current	Max: 9A
U_S current consumption	⩽100 mA
U_A total current	Max: 9A
U_A current consumption	0 mA
Power supply reverse polarity protection	Supported
Weight	665g
Size	225.5×62.5×32.6mm
Operating temperature	-25°C to +70°C
Storage temperature	-40°C–+85°C
Relative humidity	95%, No condensation
Protection level	IP67

3.2 Digital parameters

Product model	FP30-EC-8A-M12-S0
Bus protocol	EtherCAT
Rated voltage	24 VDC (18V–30V)
DI/DO/IO-Link interface	8×M12-A, 5-pin, female socket
Number of IO-Link channels	8
IO-Link version	V1.1.3
IO-Link transmission rate	COM1 (4.8kbps), COM2 (38.4kbps), COM3 (230.4kbps)
Number of input channels	Maximum 16
Input signal type	PNP
Input filter	Supported, fixed at 3ms
Input current	200mA
Maximum number of output channels	Maximum 8
Maximum output current per channel	1.6A
Output signal type	PNP
Load type	Resistive load, inductive load
Total output current	Total output current of U_S and U_A: max. 9 A
Port protection	Overcurrent protection
Isolation method	U_S and U_A are not isolated
Channel indicators	Supported

4 Panel

4.1 Product structure

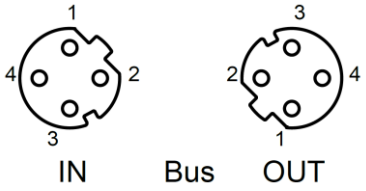


4.2 Indicator light function

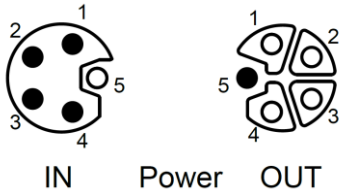
Name	Label	Color	Status	Status description
Network indicator IN	L/A1	Green	ON	Network connection established
			Flashing	Network connected with data exchange
			OFF	No data exchange or communication error
Network indicator OUT	L/A2	Green	ON	Network connection established
			Flashing	Network connected with data exchange
			OFF	No data exchange or communication error
System power indicator	U_S	Green / Red	Green always on	Power supply normal
			Red flashing	System supply voltage: >9V and <18V
			OFF	Power off or abnormal power supply
Auxiliary power indicator	U_A	Green / Red	Green always on	Power supply normal
			Red flashing	Auxiliary voltage: >11V and <18V

Name	Label	Color	Status	Status description
			Red always on	Auxiliary power off or voltage <11V
			OFF	Power off or abnormal power supply
Run status indicator	R	Green	ON	EtherCAT OP state
			Flashing at 2.5Hz	EtherCAT Pre-OP state
			Single flash (on for 200 ms and off for 1s cyclically)	EtherCAT Safe-OP state
			Flashing at 10Hz	Bootstrap state
			OFF	EtherCAT init state
Alarm indicator	E	Red	ON	System error
			OFF	System running normally or power off
Pin4 channel indicator	0	Yellow / Red / Green	Yellow always on	Pin4 input/output = 1
			Red always on	Pin4 overcurrent
			Red flashing	IO-Link error
			Green always on	IO-Link communication established
			Green flashing	IO-Link not connected
			OFF	Pin4 Input/Output = 0
Pin2 channel indicator	1	Yellow / Red	Yellow always on	Pin2 Input/Output = 1
			Red always on	Pin2 overcurrent
			Red flashing	Pin1 overcurrent（LED1 and LED0 flash simultaneously)
			OFF	Pin2 Input/Output = 0

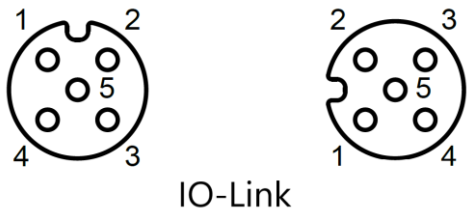
4.3 Bus interface definition

Bus interface connection view (M12-D, Female socket)	Definitions	
	Pin	Function
	1	TX+, Transmit data +
	2	RX+, Receive data +
	3	TX-, Transmit data -
	4	RX-, Receive data -

4.4 Power interface definition

Power interface connection view (M12-L, male and female connectors)	Definitions		
	Pin	Function	Wire color
	1	+24V U_S	Brown
	2	0V GND_A	White
	3	0V GND_S	Blue
	4	+24V U_A	Black
	5	PE	Gray

4.5 I/O interface definition

I/O interface connection view (M12-A, Female socket)	Definitions		
	Pin	Function	Wire color
	1	+24V U_S	Brown
	2	DI/DO/+24V U_A	White
	3	0V GND_S	Blue
	4	DI/DO/IO-Link	Black
	5	PE/0V GND_A	Gray

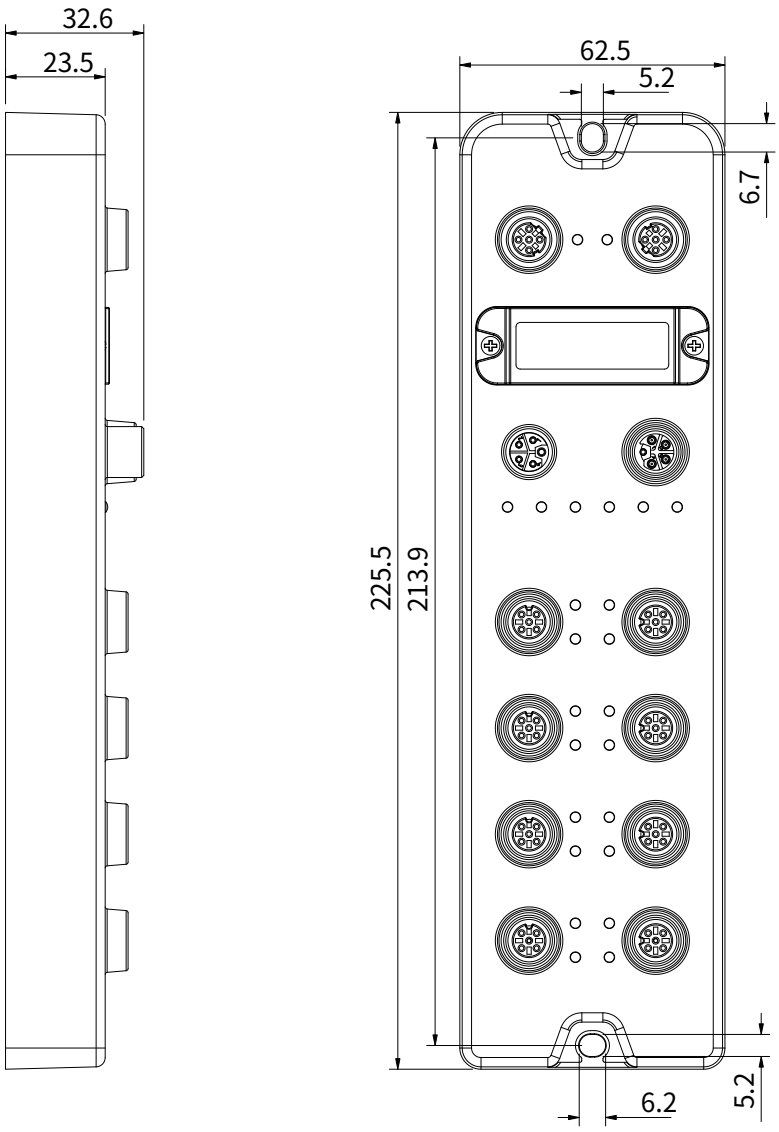
Note:

- Pin 1 and Pin 3 are powered by the system power supply U_S, and Pin4 signal output is also powered by U_S.
- Pin 2 power comes from U_A. If the Pin 2 output function is not used, U_A can be left unconnected.

5 Installation and wiring

5.1 Outline dimensions

Figure 5-1 External dimensions (unit: mm)



5.2 Installation environment requirements

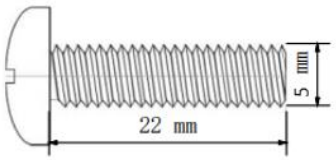
To fully utilize the module's performance and improve its reliability, do not install the module in the following locations:

- Places with direct sunlight
- Locations where ambient temperature or relative humidity exceeds module specifications
- Places containing corrosive or flammable gases
- Places where there are droplets of acid, oil, or chemicals

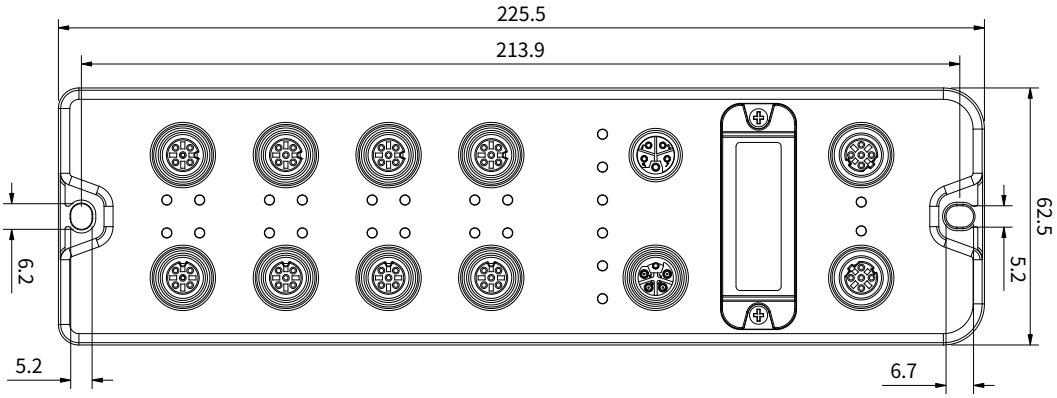
- Places with dust, iron filings, and flying sparks
- Locations where the module body is directly subjected to impact or vibration
- Places with strong electric fields, magnetic fields, radiation, and electrostatic interference
- Locations near power cables or high-voltage AC cables

5.3 Module installation

Please use screws of M5×22mm or larger to secure the module body.



The dimensions of the mounting holes for the module are shown in the figure below (unit: mm).

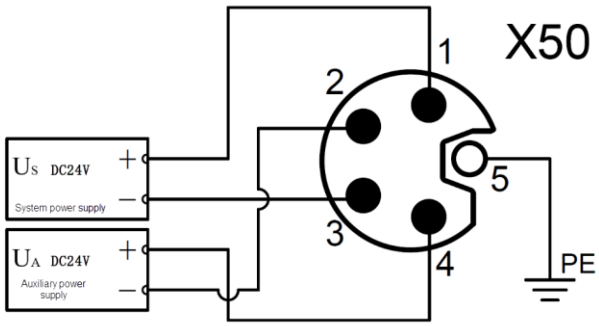


Note:

- The transparent cover on the module is a pre-installed cover for the rotary switch. The cover is already secured at the factory. Please do not disassemble it at will to avoid damaging the IP67 protection rating.
- Please secure the module properly. If it is not securely fixed, vibration may cause a malfunction.

5.4 Wiring instructions

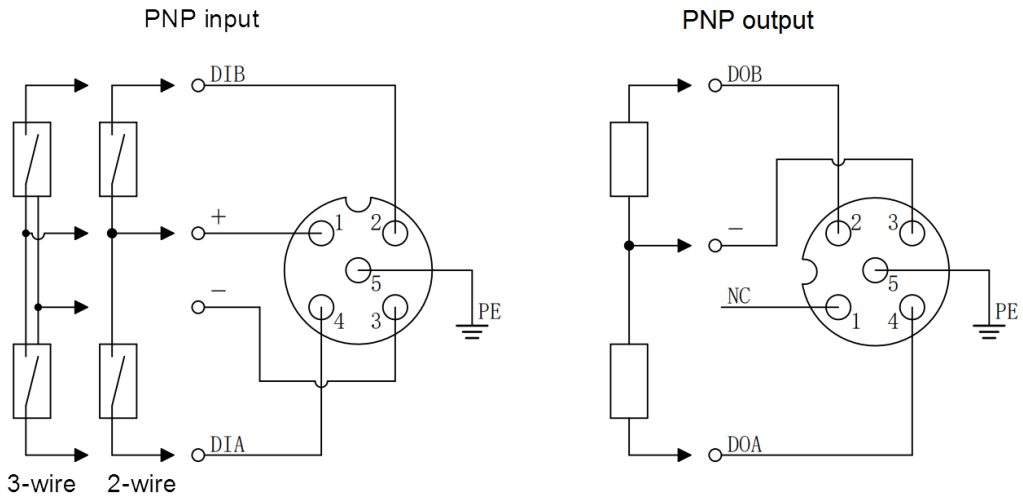
5.4.1 Power interface wiring diagram



Note:

- It is recommended that the system power supply and auxiliary power supply use different switching power supplies to ensure operational stability.
- Please refer to the power supply rules 6 Power supply rules chapter.

5.4.2 I/O interface wiring diagram

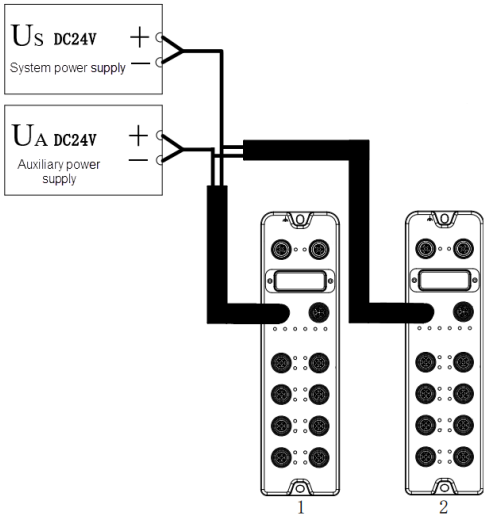


Note: Install the module's waterproof cap on unused connector interfaces and tighten it to avoid compromising the IP67 protection rating.

6 Power supply rules

6.1 Direct power supply rules

Each module is powered directly from the switching power supply, without using an OUT interface. The total current consumption of the auxiliary power supply for each module should be ⩽9A.



The voltage drop in the power cable varies depending on the total current consumption by the module's auxiliary power supply and the cable material. The table below shows the voltage drop when using our standard cable.

Total current consumption (A)	Voltage drop (V) at different cable lengths			
	1m	3m	5m	10m
8	0.64	1.12	1.60	2.72
7	0.56	0.98	1.40	2.38
6	0.48	0.84	1.20	2.04
5	0.40	0.70	1.00	1.70
4	0.32	0.56	0.80	1.36
3	0.24	0.42	0.60	1.02
2	0.16	0.28	0.40	0.68
1	0.08	0.14	0.20	0.34

■ Example of calculating the total current consumption of the module when directly powered

For example, if both modules are FP30-EC-8A-M12-S0, the usage of each module is shown in the table below:

Module name	I/O ports			External connection devices	
	Port name	Pin Name	I/O mode	Product name	Specification
Module 1	Port 1-8	Pin4	DI (Input current 4mA)	3-wire sensor	Current consumption: 30mA
		Pin2	DI (Input current 4mA)		Current consumption: 30mA

Module name	I/O ports			External connection devices	
	Port name	Pin Name	I/O mode	Product name	Specification
Module 2	Port 1-8	Pin4	DO	Solenoid valve	Load current: 500mA
		Pin2	DI	3-wire sensor	Current consumption: 30mA

The total current consumption is calculated, and the current consumption of a single module is calculated as shown in the table below:

Module name	Power type	Total current consumption calculation items	Calculation results
Module 1	System power U_S	System current consumption	Module system-side power consumption 35mA
	System power U_S	Module input current and sensor current consumption	For all ports (Sensor current consumption) + (Channel input current * number of input points) = (30mA * 16) + (4mA * 16) = 544 mA
Module 2	System power U_S	System current consumption	Module system-side power consumption 35mA
	System power U_S	Module input current and sensor current consumption	For port 1–8 Pin2 (Sensor current consumption) + (Channel input current * number of input points) = (30mA * 8) + (4mA * 8) = 272 mA
		Load output current	For port 1–8 Pin4 Channel output current * number of output points = 500mA * 8 = 4A

In summary, the current consumption of each module is as follows:

For the system power supply U_S, each module consumes 35mA of current.

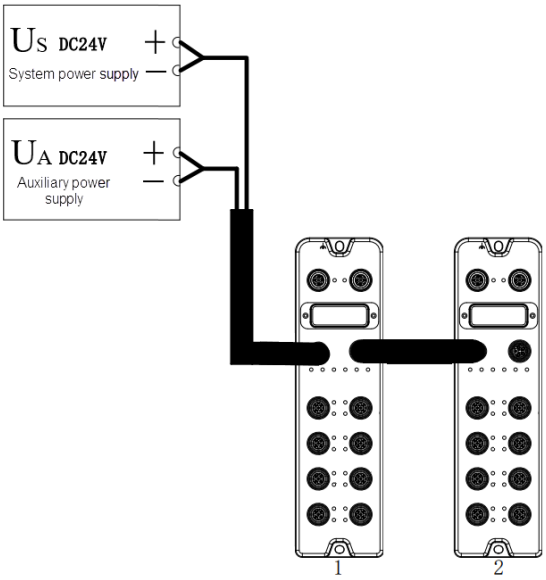
The auxiliary power supply U_A of module 1 (FP30-EC-8A-M12-S0) consumes a current of 35mA + 544mA = 579mA, which is less than the maximum current of the module's auxiliary power supply U_A, which is 9A.

The auxiliary power supply U_A of module 2 (FP30-EC-8A-M12-S0) consumes a current of 35mA + 272mA + 4A = 4.307A, which is less than the maximum current of the module's auxiliary power supply U_A, which is 9A.

In this example, the requirement is met because the total current consumption of each module meets the requirement that the total auxiliary power supply current consumption of the modules is ≤9A.

6.2 Daisy-chain power supply rules

The modules are connected in daisy-chain via the OUT interface. The total current consumption of the auxiliary power supply of each module should be ⩽9A, and the total current consumption of the system power supply and auxiliary power supply of all modules should be ⩽9A.



When using a daisy-chain power supply, the current consumption of downstream modules flows through the internal circuitry, resulting in a voltage drop within the module. The voltage drop in the power cable varies depending on the total auxiliary current consumption of the modules and the cable material. The table below shows the voltage drop when using our standard cables.

Total current consumption (A)	Voltage drop in internal circuit (V)	Voltage drop (V) at different cable lengths			
		1m	3m	5m	10m
9	0.36	0.72	1.26	1.80	3.06
8	0.32	0.64	1.12	1.60	2.72
7	0.28	0.56	0.98	1.40	2.38
6	0.24	0.48	0.84	1.20	2.04
5	0.20	0.40	0.70	1.00	1.70
4	0.16	0.32	0.56	0.80	1.36
3	0.12	0.24	0.42	0.60	1.02
2	0.08	0.16	0.28	0.40	0.68
1	0.04	0.08	0.14	0.20	0.34

Note:

- The total current consumption of the auxiliary power supply for each module should be ≤9A.
- As shown in the figure above, when power is supplied in series, the total current consumed by the system power supply and auxiliary power supply of all modules should meet the rule of "1 + 2 + 3" ⩽ 9A.

Example of total current consumption calculation in daisy-chain power supply

For example, two modules are both FP30-EC-8A-M12-S0, and their usage conditions are the same as in the *6.1 Direct power supply rules*.

Calculate the total current consumption:

$$U_S = 579mA + 4.307A = 4.886A$$

In this example, the requirement is met because the total current consumed by the system power supply U_S of all modules satisfies the rule "1+2+3"⩽9A.

7 Commissioning

7.1 Parameter description

7.1.1 Output clear and hold function

The Clear/Hold function applies to the output signals of each port and defines the module’ s output behavior in the event of bus communication failure. Three operation modes are supported:

Low-level output (Clear 0): When communication is lost, the module output channels switch to low level.

High-level output (Clear 1): When communication is lost, the module output channels switch to high level.

Hold last value: When communication is lost, the module output channels retain the last output state.

The configuration method for the EtherCAT master station output clear and hold function is introduced using TwinCAT3 software as an example. See details for specific steps in the parameter configuration in section *7.2.1 Application in the TwinCAT3 software environment.*

7.1.2 ISDU remote configuration function

The EtherCAT master station supports ISDU read and write operations. The PROFINET master station only supports ISDU write operations before configuration. Before operation, the slave station ISDU information should be obtained. For details, please refer to Chapter 6 of the *FP30 Series IO-Link Hub User Manual_Vx.xx.pdf*".

The FP30-16CP-A-M12-S0 slave station supports configuration of port direction, input filter, and factory reset functions. The following example demonstrates how to configure these three functions, with port 1 connected to the FP30-16CP-A-M12-S0 and interface 1 displaying status 3 (IO-Link OP status).

EtherCAT master ISDU parameter read/write

Example 1: Configure the FP30-16CP-A-M12-S0 as inputs for the first 8 channels and outputs for the last 8 channels. Refer to *FP30 Series IO-Link Hub User Manual_Vx.xx.pdf section 6.5.2*, set Index to 0x0042, Subindex to 0x00, Length to 2 (0x02), Data to 00FF, and Control to Write.

Example 2: Configure the FP30-16CP-A-M12-S0 to have 2ms input filter on the first 8 channels and input filter disabled on the last 8 channels. Refer to *FP30 Series IO-Link Hub User Manual_Vx.xx.pdf section 6.5.5*, set Index to 0x0049, Subindex to 0x00, Length to 0x10, data to 01010101010101010000000000000000, and Control to Write.

Example 3: Restore FP30-16CP-A-M12-S0 to factory settings. Refer to *FP30 Series IO-Link Hub User Manual_Vx.xx.pdf section 6.3*, set Index to 0x0002, Subindex to 0x00, Length to 0x01, Data to 82, and Control to Write.

Note:

- For ISDU operations, it is best to first set Control to NULL, fill in the Index, Subindex, Length, and Data with data, and then set Control.
- Read operations do not require filling in Length and Data.
- After a write operation, the error code returns 0, indicating that the operation was successful and can be verified through a readback operation.
- If the returned error code is non-zero, it indicates that an error has occurred. The issue can be identified based on the meaning of the error code. For error codes returned by the hub, refer to *Appendix D.*

The configuration method for the EtherCAT master ISDU is introduced using TwinCAT3 software as an example. Refer to parameter configuration in section *7.2.1 Application in the TwinCAT3 software environment* for specific steps.

7.1.3 DI/DO/IO-Link mode functionality

1. **Port DI/DO mode**
   - Pin2 can be configured with DI/DO mode, with the default being standard DI mode.
   - Each port(Pin4) of the EtherCAT master station supports standard DI/DO modes. Simply select the corresponding standard DI or standard DO mode in the module; the default is standard DI mode.
   - Taking the TwinCAT3 environment as an example, the EtherCAT master station uses the standard DI mode, where process data is reflected in digital inputs mapping, and the standard DO mode, where process data is reflected in digital outputs mapping.
2. **Port IO-Link mode**
   - All ports of the EtherCAT master station support IO-Link mode.
   - Taking the TwinCAT3 environment as an example, after configuring the port to IO-Link mode, the port configuration status can be obtained by viewing "TxPDO IO-Link Status". The status definitions are provided in *Appendix B*.
   - Normally, the length of the slave process data should be consistent with the configured module data length, but compatibility is also acceptable. For example, if the slave process data input is 2 bytes, the module can also choose to input more than 2 bytes, such as 4 bytes; however, it cannot choose to input less than 2 bytes, as the device status will indicate an input length mismatch.
   - If the input/output process data length of the slave device is not obtained before configuring IO-Link mode, and it is unclear how to select the corresponding module, the EtherCAT master station, taking the TwinCAT3 environment as an example, can select any module, and the device will re-enter the OP state to view the port information.

     For example, for port 0:

     9000:24 indicates the actual input process data length read by the master from the hub, and 9000:25 indicates the actual output process data length read by the master from the hub. The data length values can be referenced in *Appendix C*. If no corresponding hub data length module is available, a module with a data length greater than that of the hub can be selected; alternatively, select the slave data length module according to *7.3 Custom data length module*.

This article describes the configuration method for EtherCAT master station DI/DO/IO-Link mode using TwinCAT3 software as an example. See details for specific steps in DI/DO/IO-Link settings in section *7.2.1 Application in the TwinCAT3 software environment*.

7.2 EtherCAT master station configuration application

7.2.1 Application in the TwinCAT3 software environment

1. **Preparation**

Hardware environment

- Module model FP30-EC-8A-M12-S0
- X00 port access slave module FP30-16CP-A-M12-S0
- One computer, pre-installed with TwinCAT3 software
- EtherCAT dedicated shielded cable

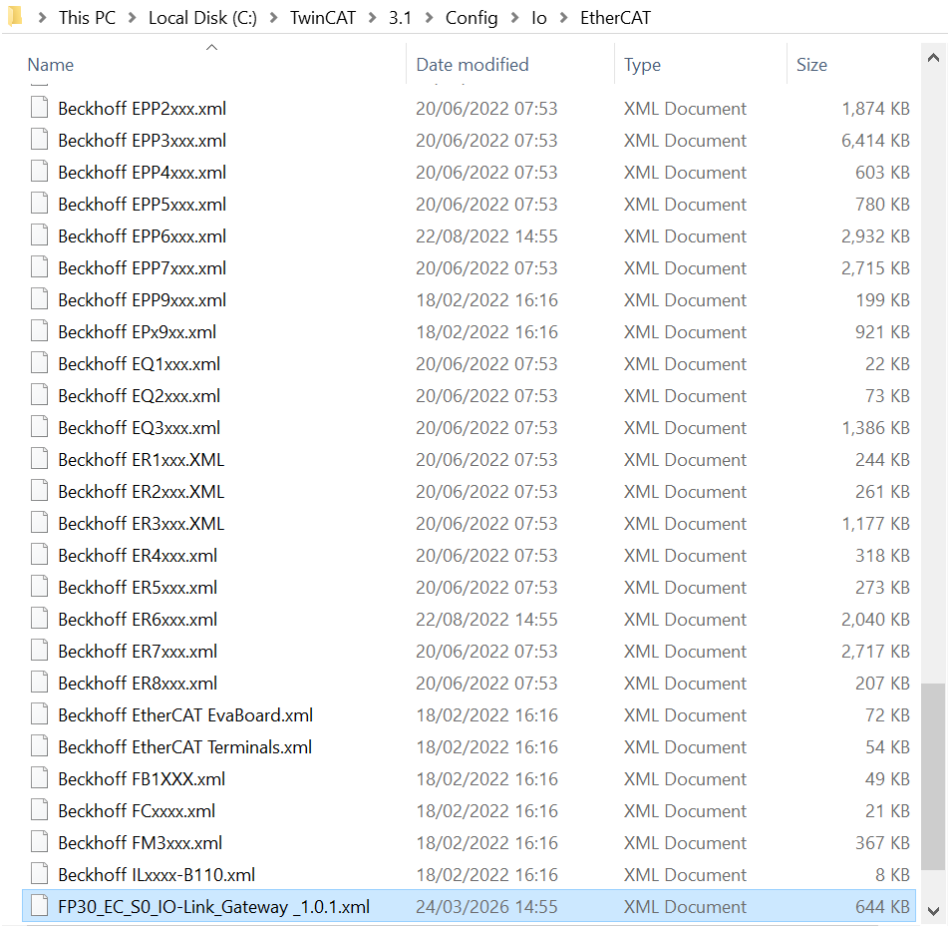
- One switching power supply
- Device configuration file

Hardware configuration and wiring

Please follow the instructions in section *5 Installation and wiring*.

2. Pre-configured configuration files

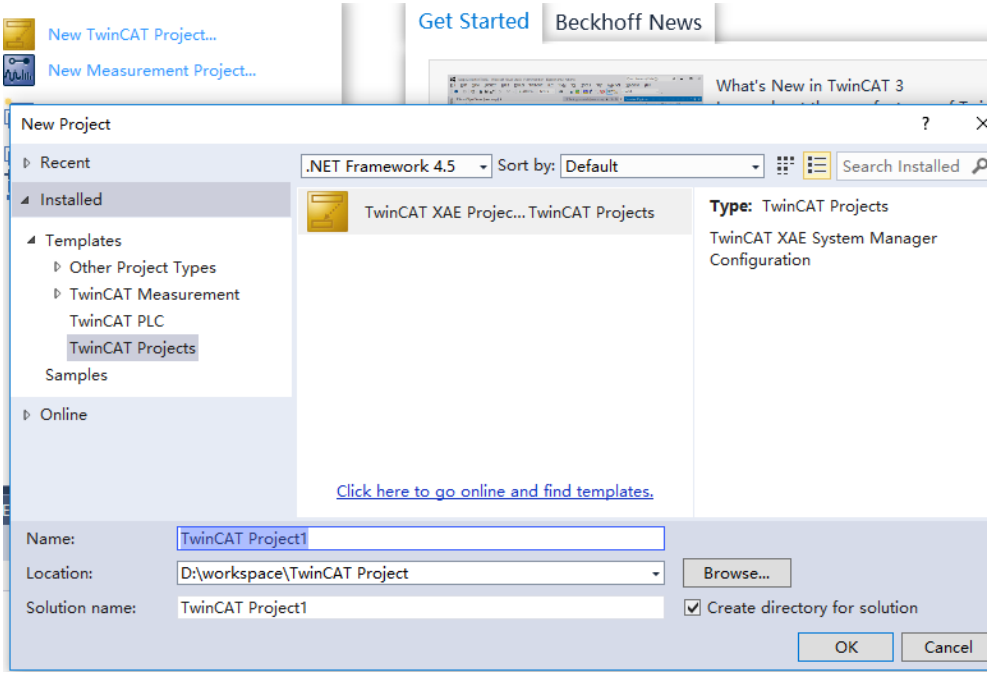
Place the ESI configuration file (FP30_EC_S0_IO-Link_Gateway_1.0.1.xml) in the TwinCAT installation directory "C:\TwinCAT\3.1\Config\Io\EtherCAT", as shown in the figure below.



3. Create a project

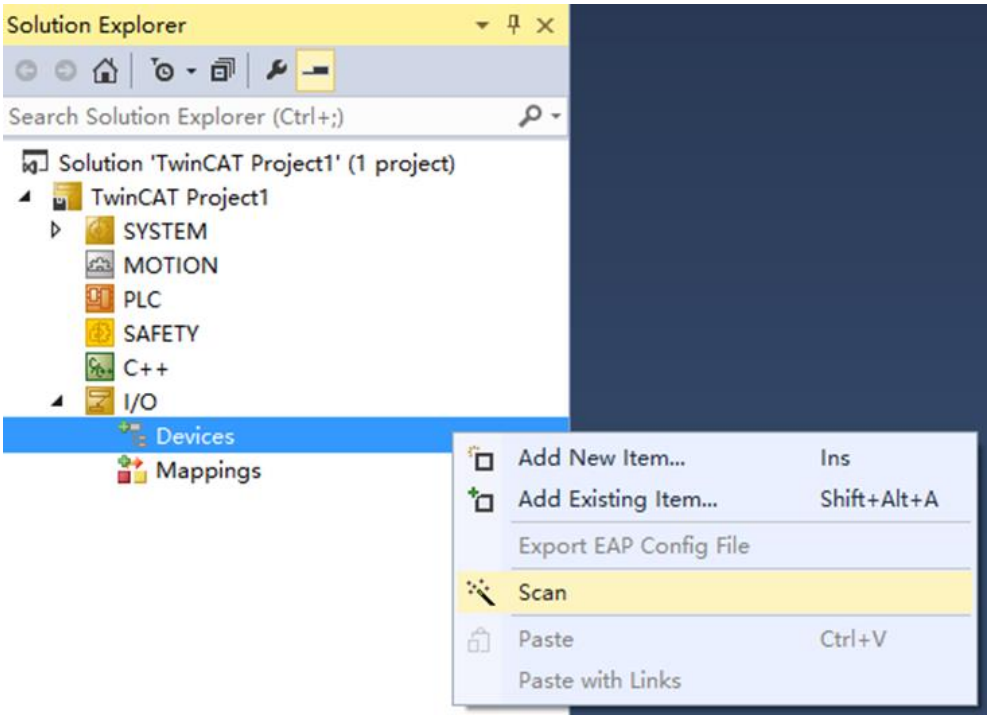
a) Click the TwinCAT icon in the lower right corner of the desktop, select "TwinCAT XAE (VS xxxx)" to open the TwinCAT software, as shown in the image below.

b) Click "New TwinCAT Project". In the pop-up window, "Name" and "Solution name" correspond to the project name and solution name, respectively, and "Location" corresponds to the project path. These three items can be left as default. Then click "OK". The project will be created successfully, as shown in the figure below.



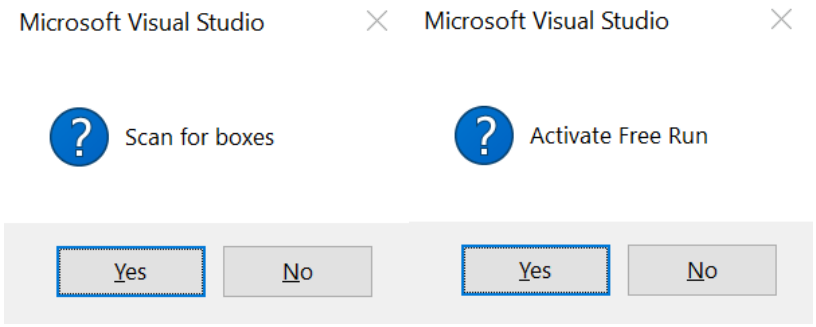
4. Scanning equipment

a) After creating the project, right-click the "Scan" option under "I/O -> Devices" to scan for slave devices, as shown in the figure below.

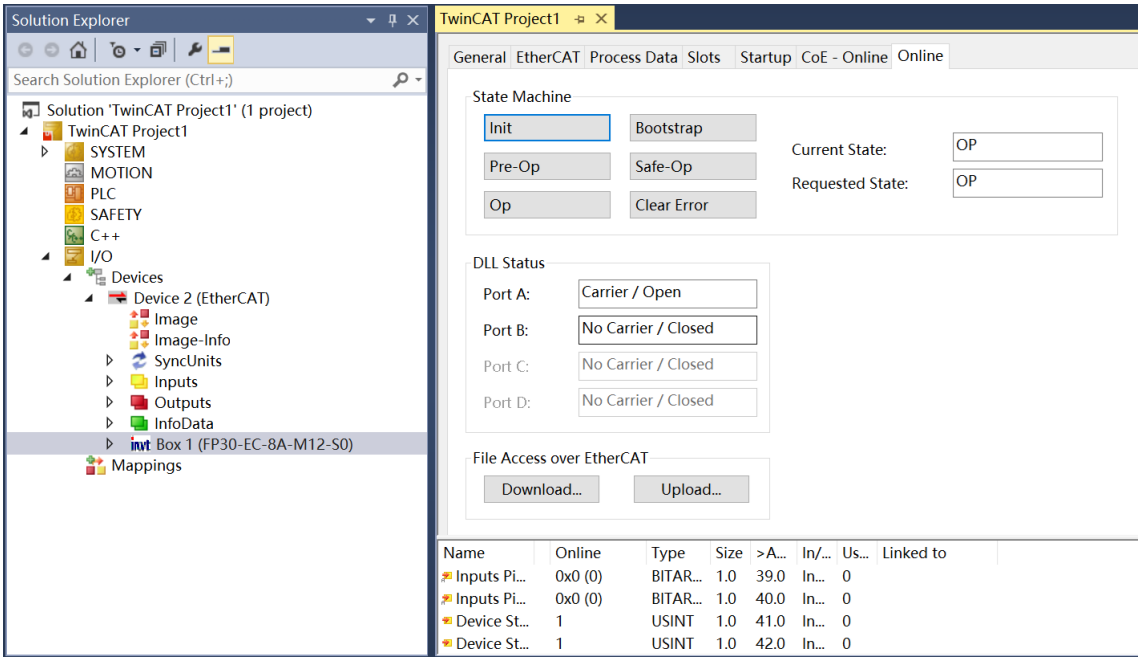


b) Select the "Local Area Connection" network adapter, as shown in the image below.

c) In the pop-up window "Scan for boxes", click "Yes"; in the pop-up window "Activate Free Run", click "Yes", as shown in the image below.



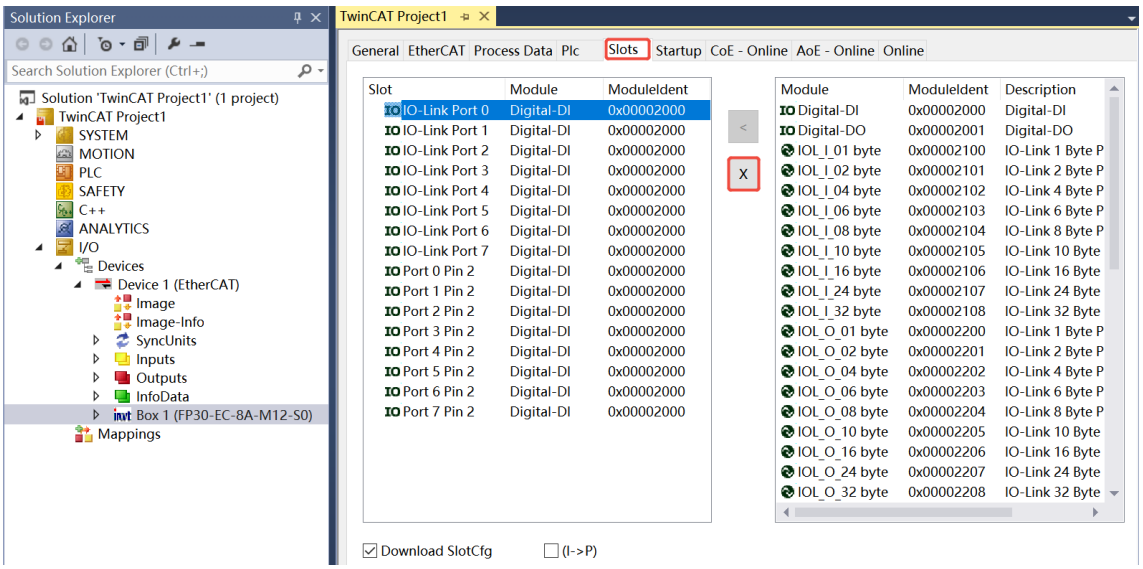
d) After the device is scanned, you can see Box1 in the left navigation tree. Under "Online", you can see that TwinCAT is in "OP" state. You can also observe that the RUN light of the slave device is always on, as shown in the figure below.



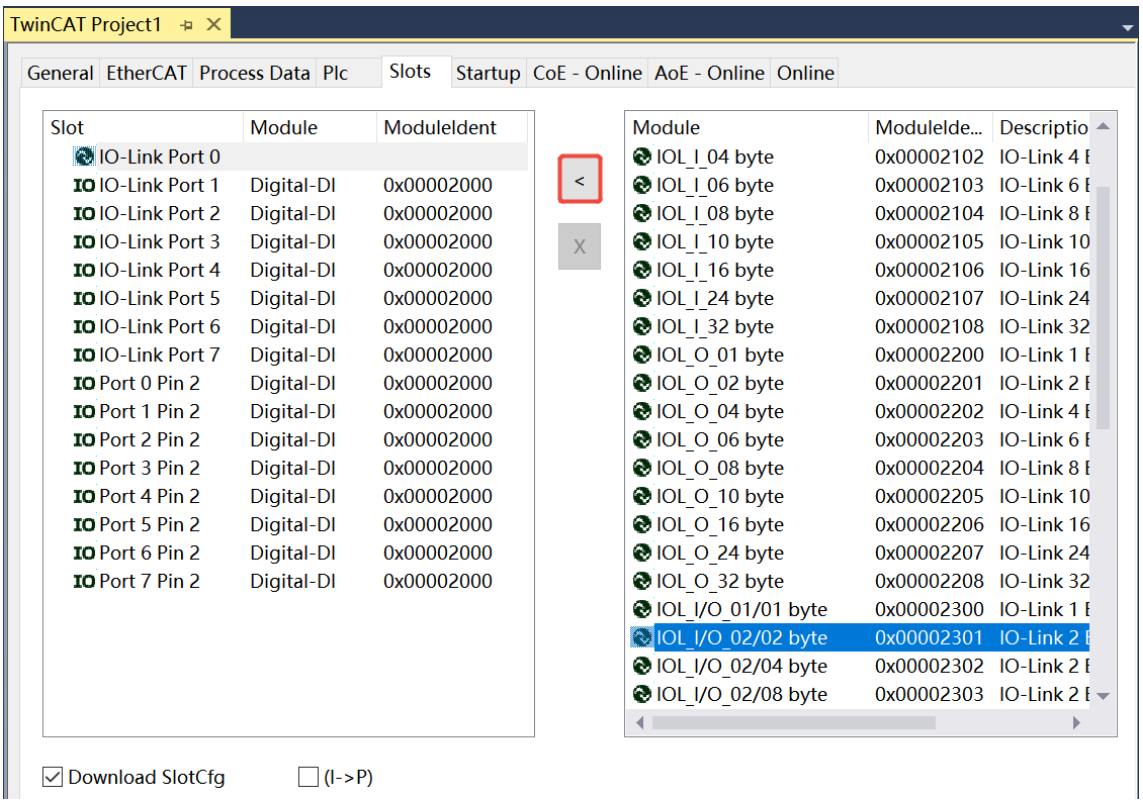
5. DI/DO/IO-Link settings

a) The master station port 0 has been connected to the slave station module FP30-16CP-A-M12-S0. Check the power indicator of FP30-16CP-A-M12-S0; the power indicator is constantly on.

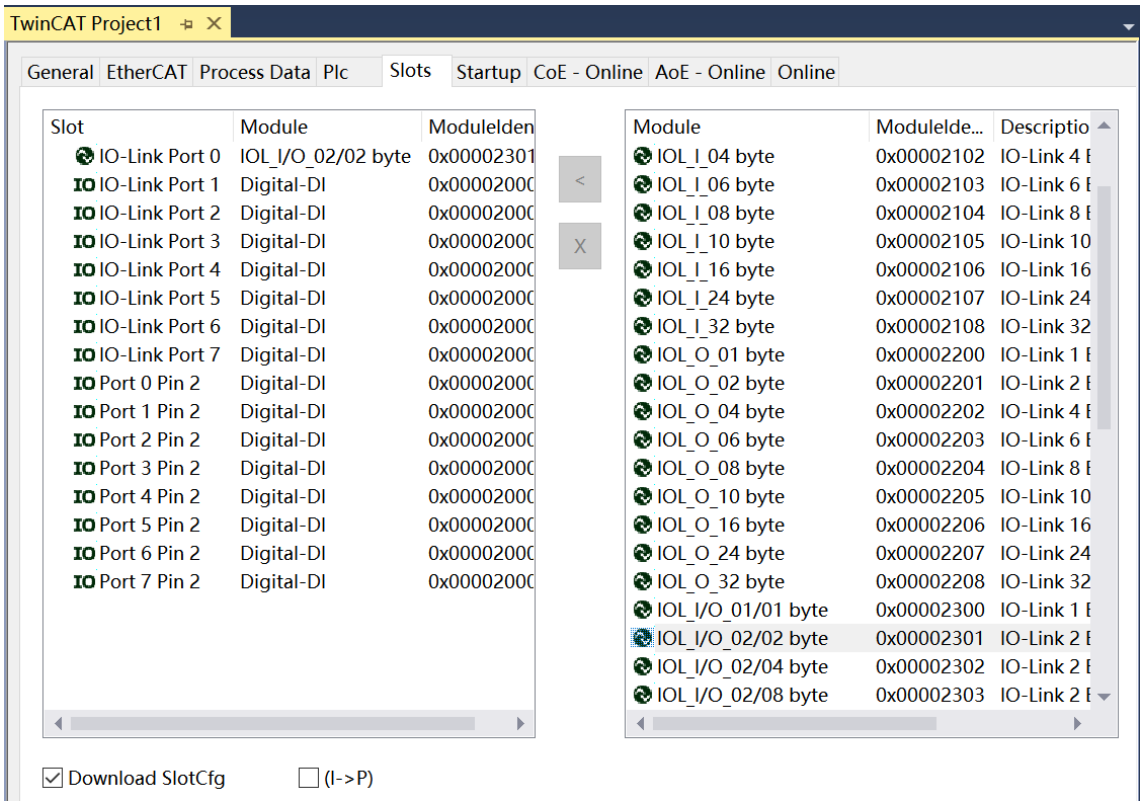
b) On the right side of the master station configuration interface, click "Slots", select IO-Link Port 0, and click "Delete", as shown in the figure below.



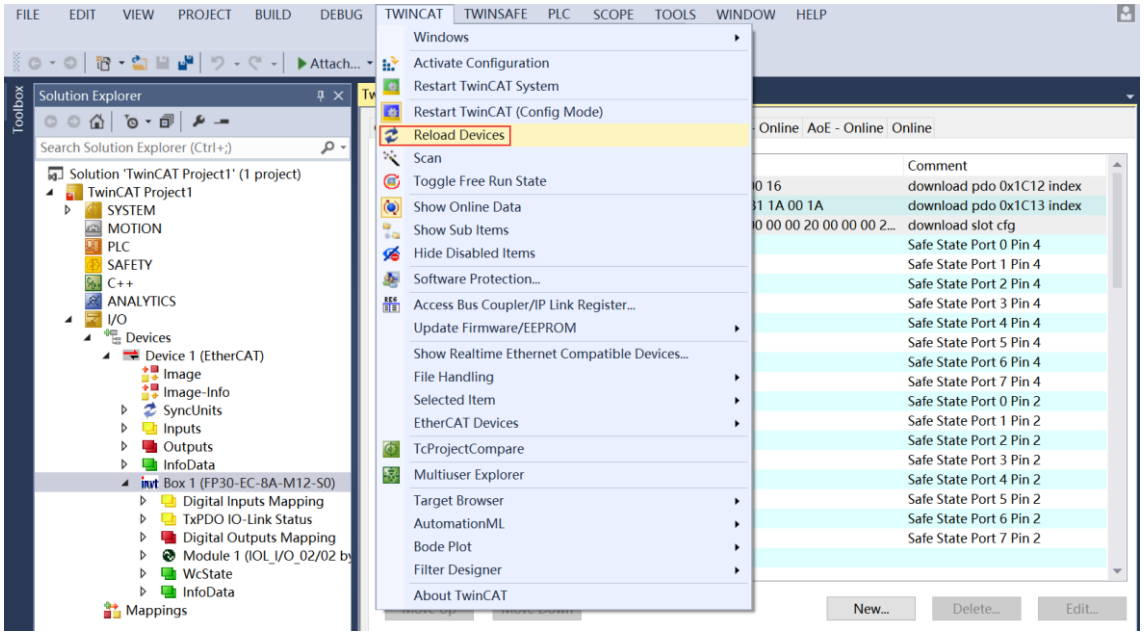
c) After deletion, select "IOL_I/O_02/02 byte" on the right, and click the "<" button to move it to the left, as shown in the figure below. (Note: The FP30-16CP-A-M12-S0 can be configured with a maximum of 16 input channels or 16 output channels, so select IOL_I/O_02/02 byte.)



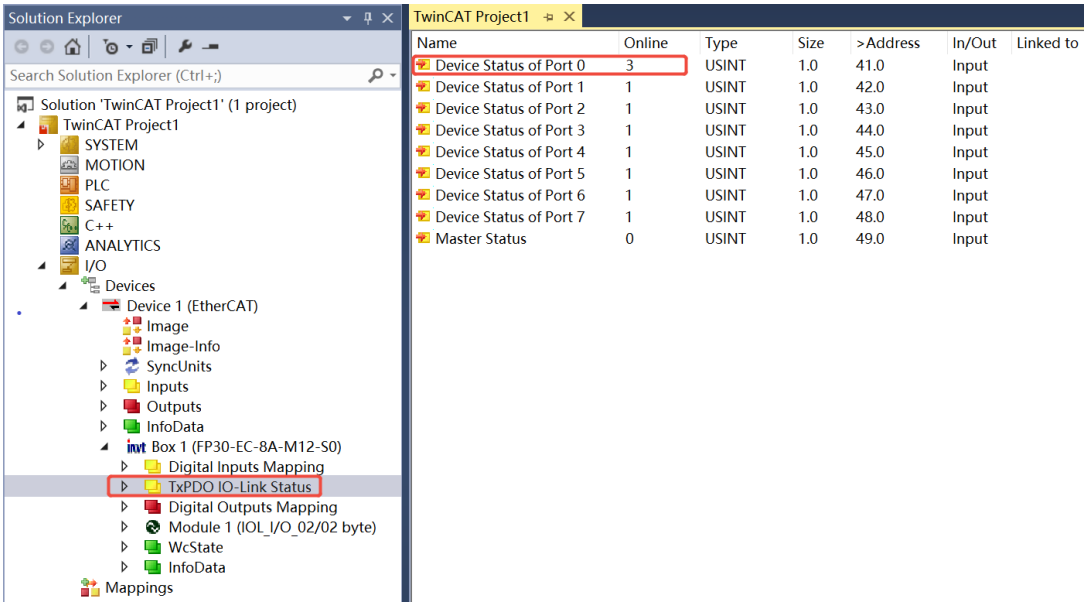
d) After adding, port 0-7 on the left will appear as shown in the image below. The method for configuring DI/DO/IO-Link on other interfaces is the same as described here.



e) After configuration, a reload operation is required. Click the "TWINCAT -> Reload Devices" option in the menu bar, as shown in the figure below.

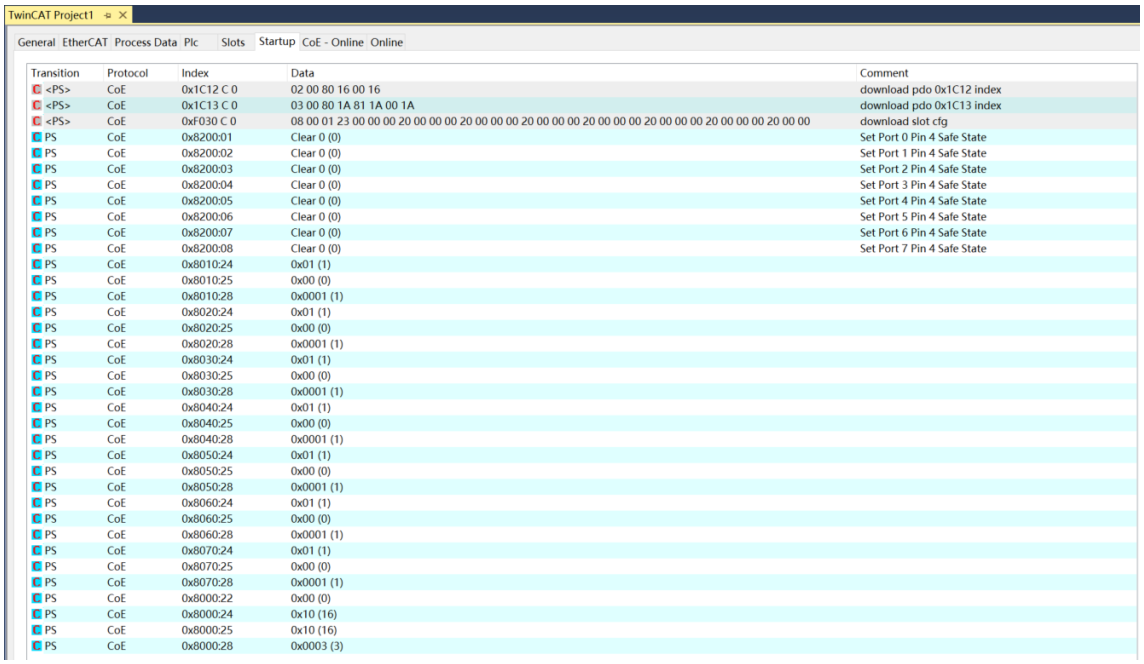


f) After the reload operation is complete, the device re-enters the OP state. Click "TxPDO IO-Link Status" in the left navigation tree to view it. A value of 3 for "Device Status of Port 0" indicates normal IO-Link communication, as shown in the image below. Refer to Appendix B for more information. Check that the channel indicator on the master station port 0 is constantly on, and the slave station operation indicator flashes periodically.

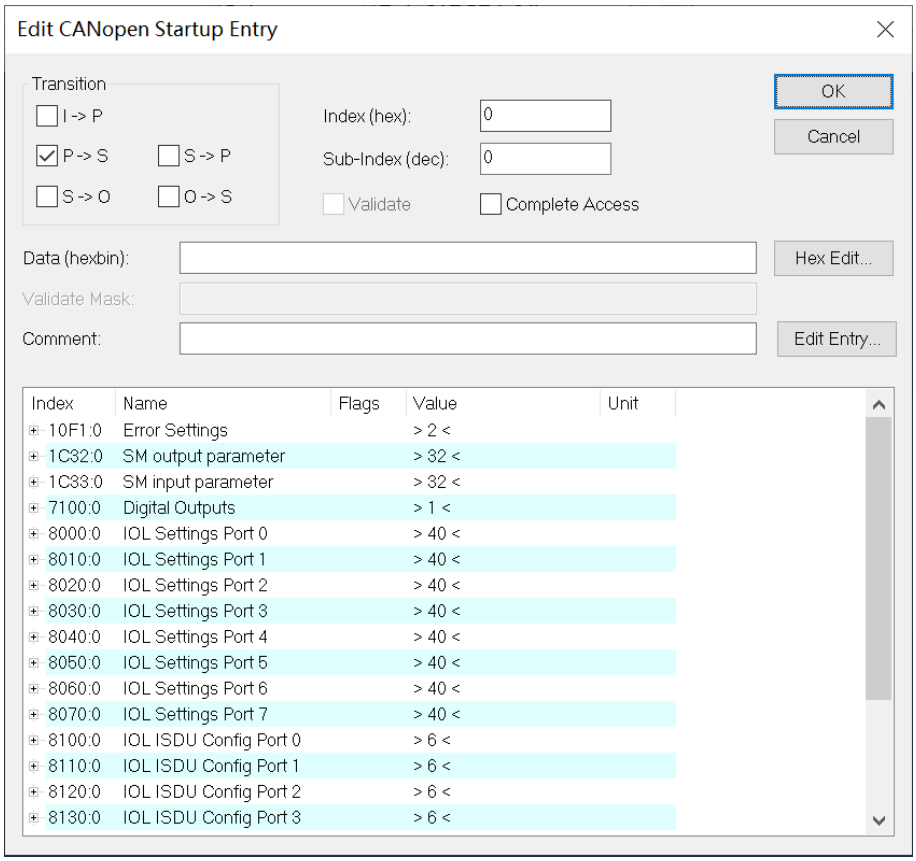


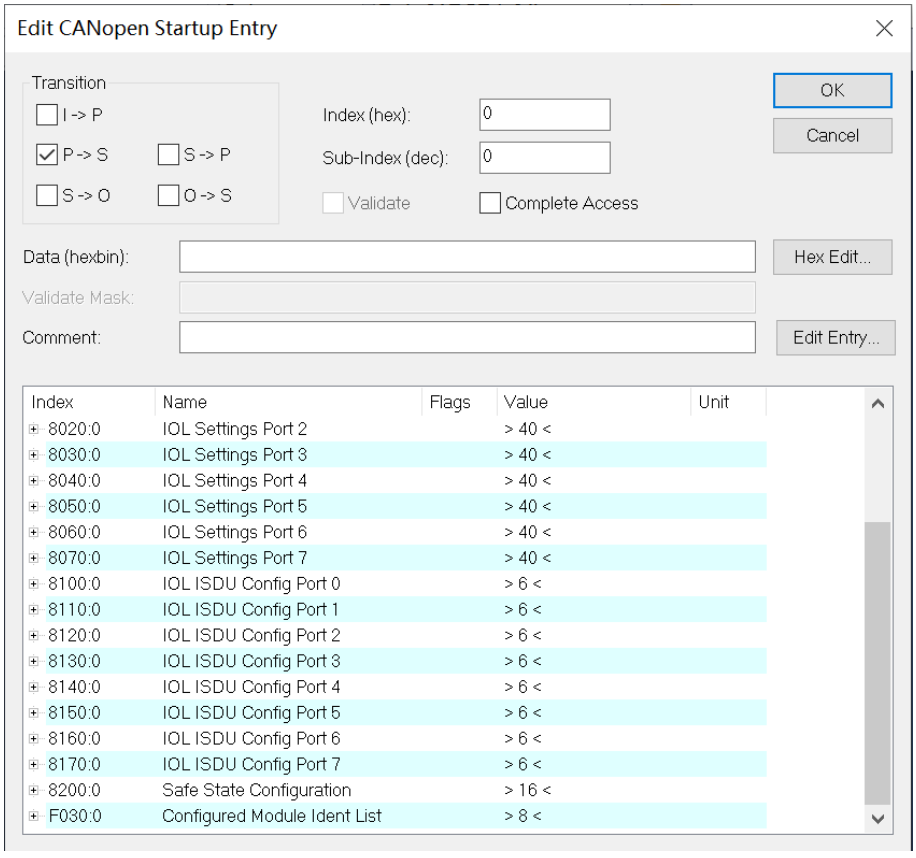
6. Parameter settings

a) Click "Startup" on the configuration interface on the right side of the master station to see the parameters and parameter values of the master station module FP30-EC-8A-M12-S0, including the output clear and hold function of the 7 ports Pin4 and the IOL related settings of the 7 interfaces, as shown in the figure below.

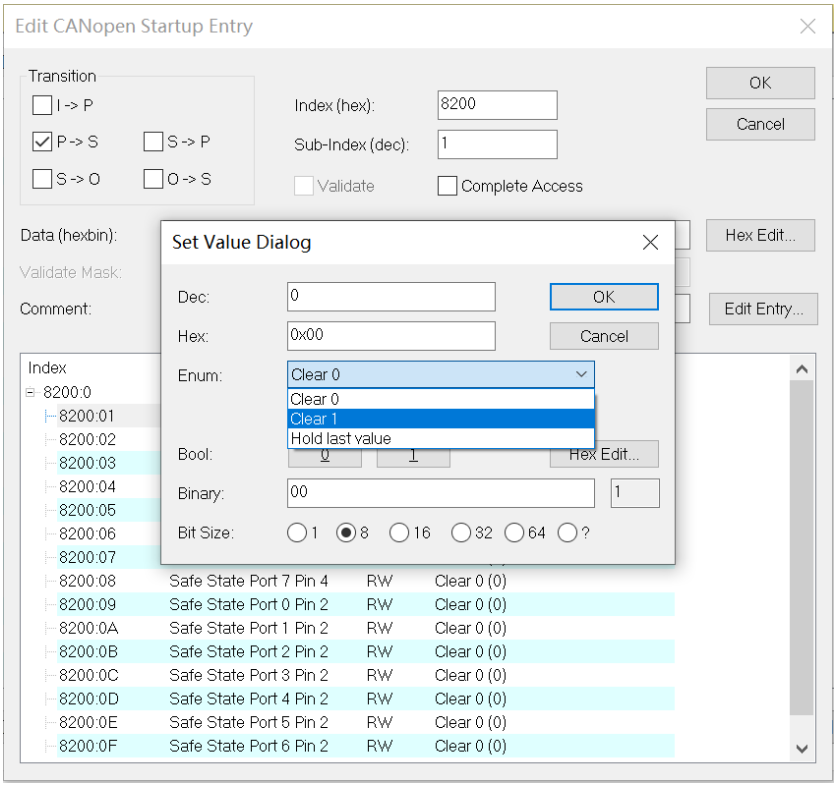


b) Click "New" at the bottom of the "Startup" interface to enter the "Edit CANopen Startup Entry" interface, as shown in the figure below.

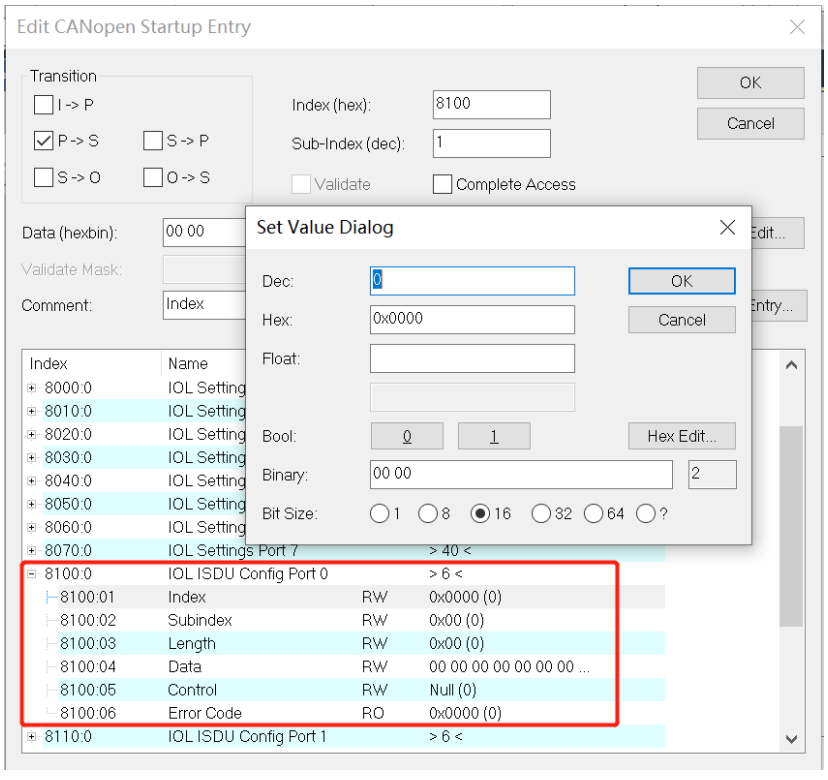




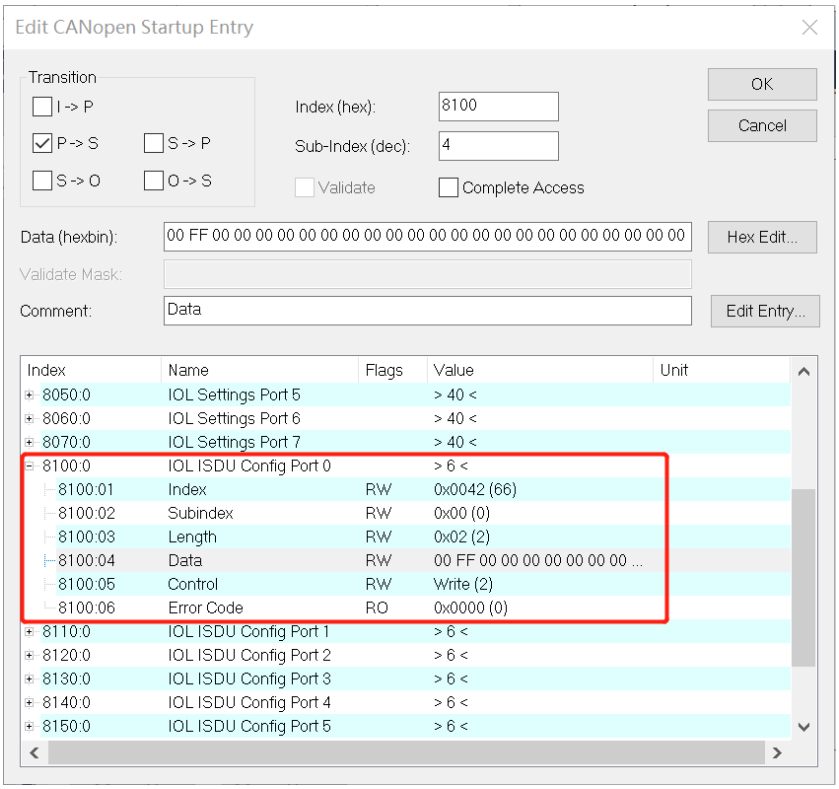
c) Output clear/hold function configuration method: Taking port 0 Pin 4 as an example, click "New" to enter the "Edit CANopen Startup Entry" interface, double-click "8200:01" to configure the clear/hold function, as shown in the figure below. After configuration, click "OK".



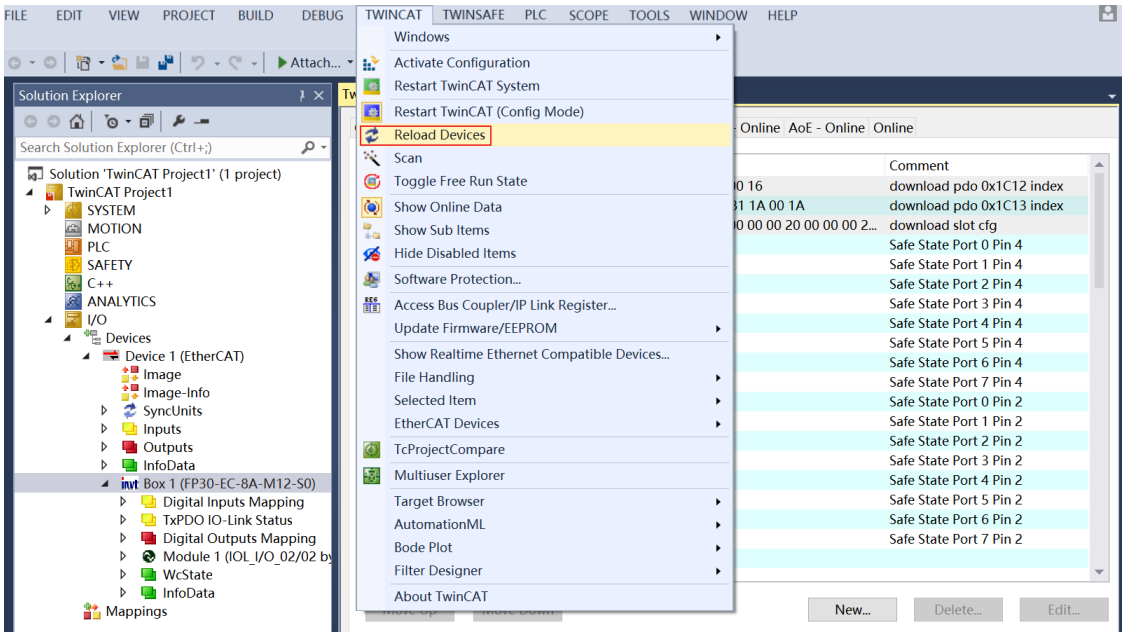
d) ISDU function configuration method: Taking Port 0 as an example, click "New" to enter the "Edit CANopen Startup Entry" interface, double-click the parameter items such as "8100:01" to configure, as shown in the figure below.



e) Taking interface direction configuration as an example, the 16 channels of the FP30-16CP-A-M12-S0 are all in input mode by default. Configure them so that the first 8 channels are inputs and the last 8 channels are outputs. Refer to section 6.5.2 of the "FP30 Series IO-Link Hub User Manual_Vx.xx.pdf". Set Index to 0x0042, Subindex to 0x00, Length to 2 (0x02), Data to 00FF, and Control to Write. Configure each parameter under IOL ISDU Config Port 0 in sequence, as shown in the figure below. After configuration, click "OK".

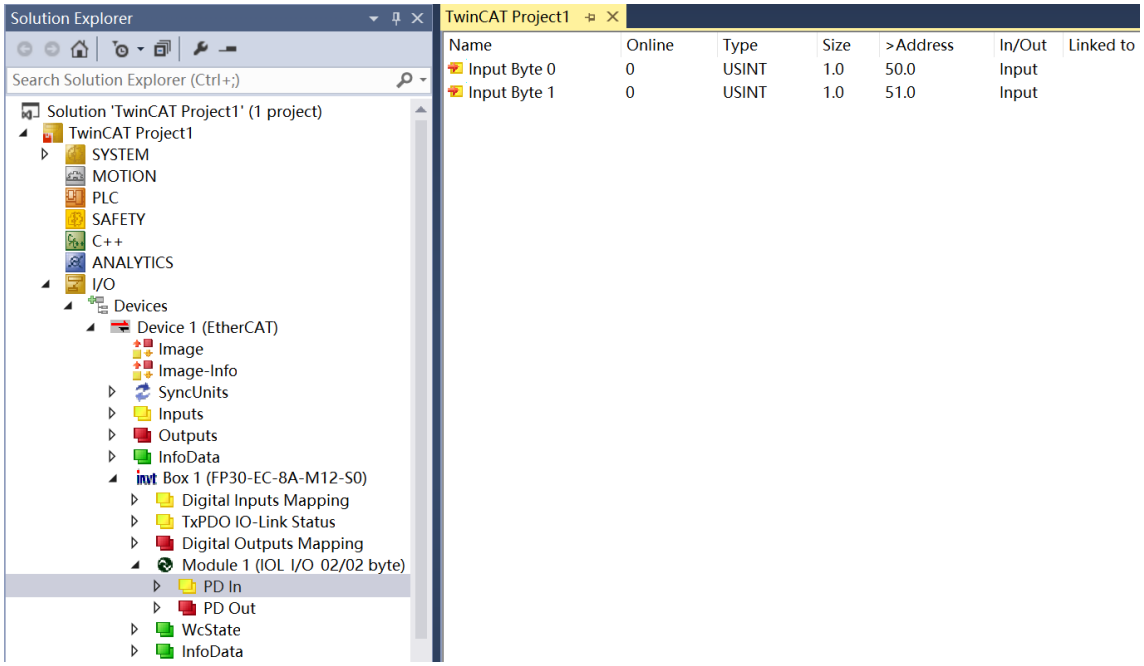


f) After setting parameters such as output clear/hold function and ISDU function, a reload operation is required. Click the "TWINCAT -> Reload Devices" option in the menu bar, as shown in the figure below.

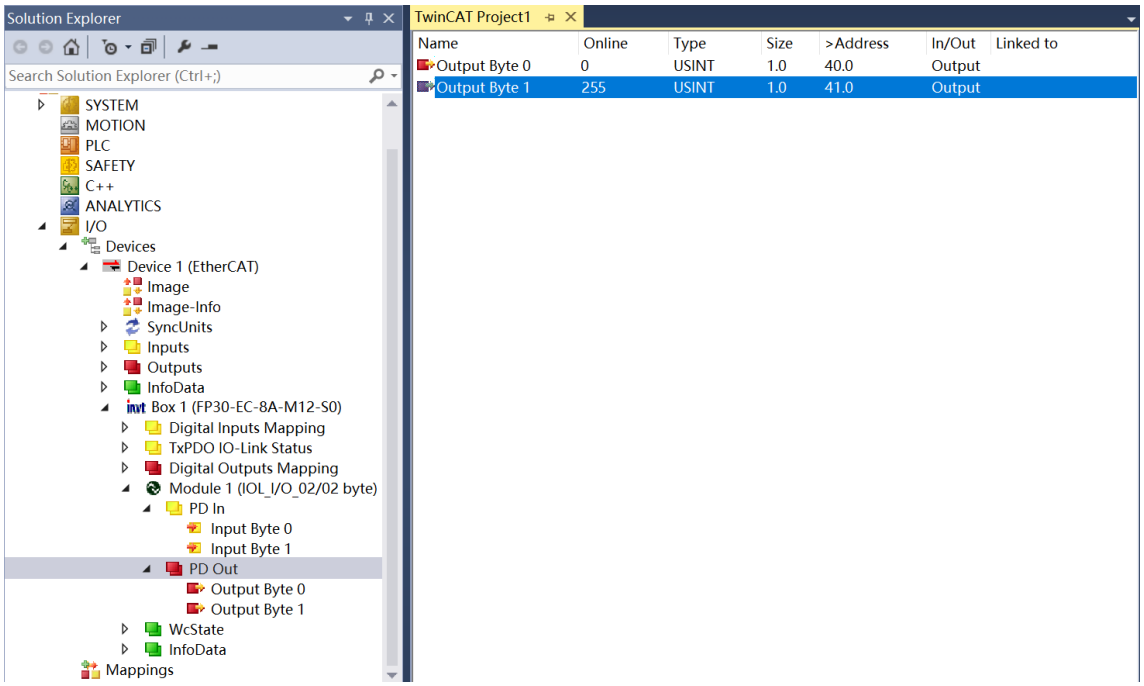


7. Functional verification

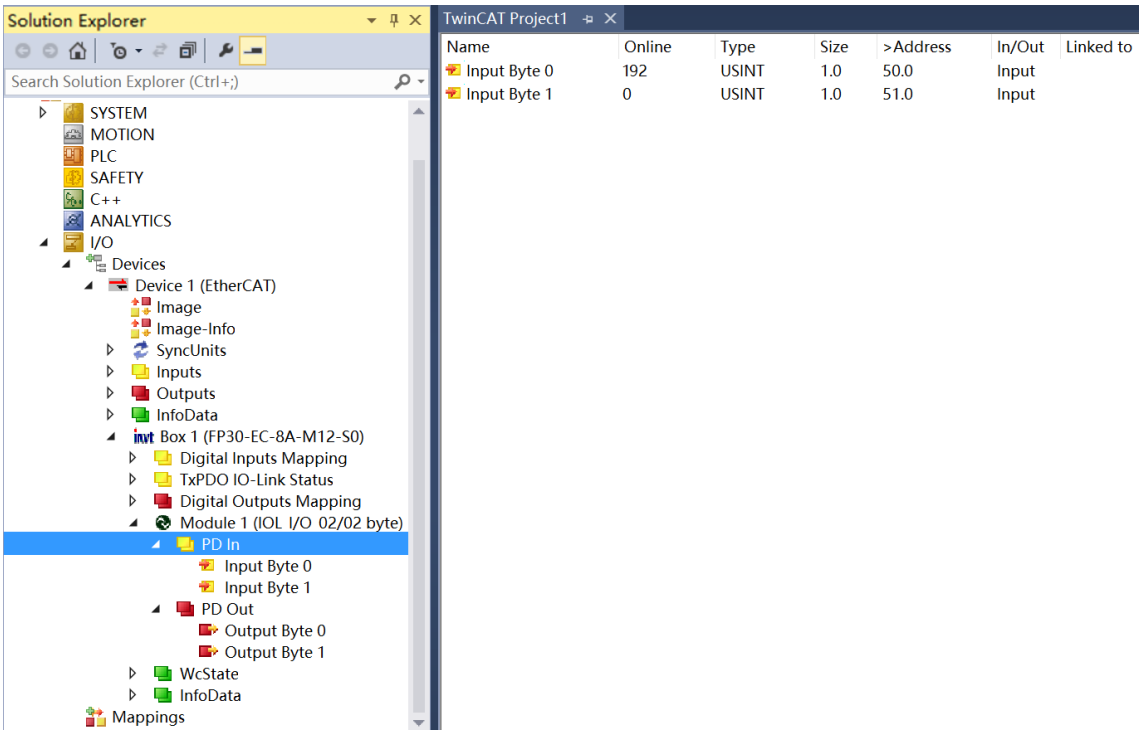
a) In the left navigation tree: in port standard DI mode, the process data is mapped to digital inputs mapping; in port standard DO mode, the process data is mapped to digital outputs mapping; in Port IO-Link mode, the process data is mapped to Module 1 → PD In/Out, as shown in the figure below.



b) Taking the master station's X00 port as an example, connecting the slave station FP30-16CP-A-M12-S0, and configuring the FP30-16CP-A-M12-S0 with the first 8 channels as inputs and the last 8 channels as outputs, input byte 0 represents the input signal value of slave modules X00–X03, and output Byte 1 represents the output signal value of slave modules X04–X07. Writing "255" to output byte 1 will illuminate the 8 channel indicators of slave modules X04–X07, as shown in the figure below.



c) When the slave module X00 receives an effective voltage, the input value "192" can be monitored in input byte 0, which is "2#11000000", as shown in the figure below.



7.3 Custom data length module

In Appendix A, different protocol master stations define process data modules with different byte lengths. These modules generally meet the interfacing needs of mainstream slave devices in the market. However, in actual use, there are still instances where the process data length used by some slave devices cannot match that of the modules. For example, a slave device may have an input process data length of 16 bytes and an output process data length of 32 bytes. Using an input process data length of 32 bytes and an output process data length of 32 bytes is compatible, or the process data length can be customized. This section describes how to customize the process data length.

7.3.1 EtherCAT master custom module

1. The length value of the slave process data can be determined by obtaining it from the port Info as described in section 7.1.3 DI/DO/IO-Link mode functionality, or by obtaining this information from the slave manual;
2. Modify the configuration file, add a module, and define the module ID as 0x0001xxyy, where xx represents the input process data length in bytes (HEX value), and yy represents the output process data length in bytes (HEX value). For example, with an input process data length of 16 bytes and an output process data length of 32 bytes: the module ID is defined as 0x00011020; add supporting module IDs to each slot of the Device;
3. As per section *7.2.1 Application in the TwinCAT3 software environment,* place the configuration file in the TwinCAT installation directory and restart TwinCAT;
4. Scan the device, update the device's EEPROM, and once the update is successful, power off and restart.

8 FAQ

8.1 The device cannot be found in the software.

1. Verify whether the ESI configuration file is correctly installed.
2. Verify whether the ESI configuration file version is correct.
3. After installing the ESI configuration file, verify whether TwinCAT has been restarted or whether “Reload Device Descriptions” has been executed.

8.2 The device cannot enter OP state.

1. Verify whether the project configuration is correct.
2. Verify the node address settings.
3. Verify whether the device power supply is normal.
4. Check whether the EtherCAT communication cable is functioning properly.
5. After changing the slave device node address, verify whether the device has been power-cycled.

Appendix

Appendix A

Different byte inputs have been defined in the EtherCAT master configuration file. The modules for process data length, output process data length, and input/output combined process data length are listed in the table below:

Name	Description
Std input	Standard input
Std output	Standard output
IOL_I_01 Byte	Input process data length 1 byte
IOL_I_02 Byte	Input process data length 2 bytes
IOL_I_04 Byte	Input process data length 4 bytes
IOL_I_06 Byte	Input process data length 6 bytes
IOL_I_08 Byte	Input process data length 8 bytes
IOL_I_10 Byte	Input process data length 10 bytes
IOL_I_16 Byte	Input process data length 16 bytes
IOL_I_24 Byte	Input process data length 24 bytes
IOL_I_32 Byte	Input process data length 32 bytes
IOL_O_01 Byte	Output process data length 1 byte
IOL_O_02 Byte	Output process data length 2 bytes
IOL_O_04 Byte	Output process data length 4 bytes
IOL_O_06 Byte	Output process data length 6 bytes
IOL_O_08 Byte	Output process data length 8 bytes
IOL_O_10 Byte	Output process data length 10 bytes
IOL_O_16 Byte	Output process data length 16 bytes
IOL_O_24 Byte	Output process data length 24 bytes
IOL_O_32 Byte	Output process data length 32 bytes
IOL_I/O_01/01 Byte	Input process data length 1 byte, output process data length 1 byte
IOL_I/O_02/02 Byte	Input process data length 2 bytes, output process data length 2 bytes
IOL_I/O_02/04 Byte	Input process data length 2 bytes, output process data length 4 bytes
IOL_I/O_02/08 Byte	Input process data length 2 bytes, output process data length 8 bytes
IOL_I/O_04/02 Byte	Input process data length 4 bytes, output process data length 2 bytes
IOL_I/O_04/04 Byte	Input process data length 4 bytes, output process data length 4 bytes
IOL_I/O_04/08 Byte	Input process data length 4 bytes, output process data length 8 bytes
IOL_I/O_04/16 Byte	Input process data length 4 bytes, output process data length 16 bytes
IOL_I/O_04/32 Byte	Input process data length 4 bytes, output process data length 32 bytes
IOL_I/O_08/02 Byte	Input process data length 8 bytes, output process data length 2 bytes
IOL_I/O_08/04 Byte	Input process data length 8 bytes, output process data length 4 bytes
IOL_I/O_08/08 Byte	Input process data length 8 bytes, output process data length 8 bytes
IOL_I/O_10/10 Byte	Input process data length 10 bytes, output process data length 10 bytes
IOL_I/O_16/04 Byte	Input process data length 16 bytes, output process data length 4 bytes
IOL_I/O_16/16 Byte	Input process data length 16 bytes, output process data length 16 bytes
IOL_I/O_24/24 Byte	Input process data length 24 bytes, output process data length 24 bytes
IOL_I/O_32/04 Byte	Input process data length 32 bytes, output process data length 4 bytes
IOL_I/O_32/32 Byte	Input process data length 32 bytes, output process data length 32 bytes

Appendix B

The IO-Link interface status is represented by 1 byte, where bits 0–3 indicate the IO-Link interface status and bits 4–7 indicate IO-Link interface error messages.

Bit0–3 is defined as follows:

Value (DEC)	Description
0	Port not activated
1	The interface is in input mode
2	The interface is in output mode
3	The interface is in IO-Link mode and communication is normal
4	The interface is in IO-Link mode, and communication is abnormal

Bit4–7 is defined as follows:

Value (DEC)	Description
0	No errors
1	Watchdog abnormal
2	Cache overflow
3	Invalid device ID
4	Invalid vendor ID
5	Invalid IO-Link version
6	Invalid frame capability
7	Ineffective cycle time
8	Invalid input process data length
9	Invalid output process data length
10	No device detected
11	PreOP status error

For example: If an interface is configured in IO-Link mode but no slave device is actually connected, the status will be 0xA4. If an interface is configured in IO-Link mode but the input data length does not match, the status will be 0x84.

The IO-Link master status is represented by 1 byte, as defined below:

Value (DEC)	Description
0	No errors
1	Undervoltage
2	Overvoltage
3	Overcurrent, overload
4–255	Reserved

Appendix C

The 1-byte process data length defined in the IO-Link standard has different meanings represented by different bits. See Appendix B.1.6 of "IOL-Interface-Spec_10002_V113_Jun19.pdf".

Bit	Description
0–4	Length
5	Reserved
6	Does it support standard input or standard output mode?
7	The byte flag bit, when set, indicates a data length of 0–4 plus 1; when not set, the length value of 0–4 represents the bit length.

Ignoring bit6, the simple correspondence between its value and the length of the process data is as follows:

Byte	Description
0x01	The process data length is 1 bit, typically used for standard input or standard output.
0x08	Process data length 1 byte
0x10	Process data length 2 bytes
0x18	Process data length 3 bytes
0x83	Process data length 4 bytes
0x84	Process data length 5 bytes
0x85	Process data length 6 bytes
0x86	Process data length 7 bytes
0x87	Process data length 8 bytes
0x88	Process data length 9 bytes
0x89	Process data length 10 bytes
0x8A	Process data length 11 bytes
0x8B	Process data length 12 bytes
0x8C	Process data length 13 bytes
0x8D	Process data length 14 bytes
0x8E	Process data length 15 bytes
0x8F	Process data length 16 bytes
0x90	Process data length 17 bytes
0x91	Process data length 18 bytes
0x92	Process data length 19 bytes
0x93	Process data length 20 bytes
0x94	Process data length 21 bytes
0x95	Process data length 22 bytes
0x96	Process data length 23 bytes
0x97	Process data length 24 bytes
0x98	Process data length 25 bytes
0x99	Process data length 26 bytes
0x9A	Process data length 27 bytes
0x9B	Process data length 28 bytes
0x9C	Process data length 29 bytes
0x9D	Process data length 30 bytes
0x9E	Process data length 31 bytes
0x9F	Process data length 32 bytes

Appendix D

The slave ISDU may return an error, and the error codes are defined as follows. Please refer to Appendix C error types of "IOL-Interface-Spec_10002_V113_Jun19.pdf".

Error code	Description
0x8000	Device application layer error
0x8011	Unreachable index
0x8012	Unreachable sub-index
0x8020	Service temporarily unavailable
0x8021	Local control services are temporarily unavailable.
0x8022	Equipment control services are temporarily unavailable.
0x8023	Permission error
0x8030	Parameters out of range
0x8031	Parameter exceeds limit value
0x8032	Parameters below the limit
0x8033	The parameter length is too long
0x8034	Insufficient parameter length
0x8035	Function unavailable
0x8036	Functionality temporarily unavailable
0x8040	Invalid parameter set
0x8041	Inconsistent parameter sets
0x8082	Application not ready
0x81xx	Manufacturer customization

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