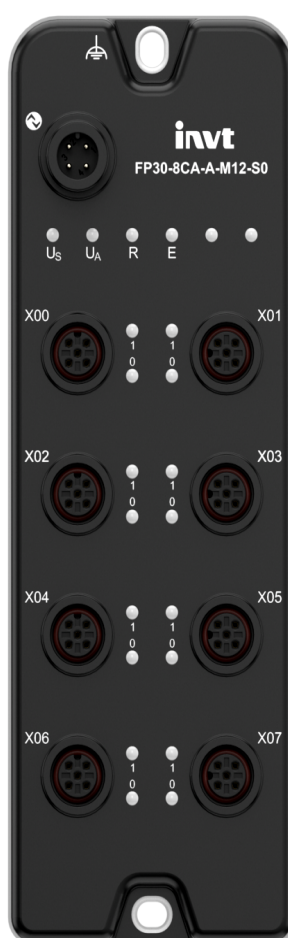


FP30-8CA-A-M12-S0 Analog Voltage and Current Input/Output Compatible Module

User Manual



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1 Product overview

1.1 Product introduction

IO-Link is the world's first standardized cross-vendor I/O technology (IEC 61131-9), an open standard serial communication protocol. The FP30-8CA-A-M12-S0 is an 8-channel IO-Link analog module that supports analog voltage and current input/output compatibility. As an IO-Link slave, it can connect to any brand of IO-Link master, fulfilling users' needs for acquiring process data, diagnostics, and configuration data transmission.

1.2 Product features

- With an IP67 protection rating, it is suitable for harsh industrial environments.
- Analog voltage and current compatible, input and output compatible.
- The wiring is simple and quick, and it can simultaneously provide power and transmit data.
- It is designed using the IO-Link v1.1 specification.
- It can connect to various IO-Link standard devices and standard analog signals.
- LED status display, channel protection, and diagnostics.

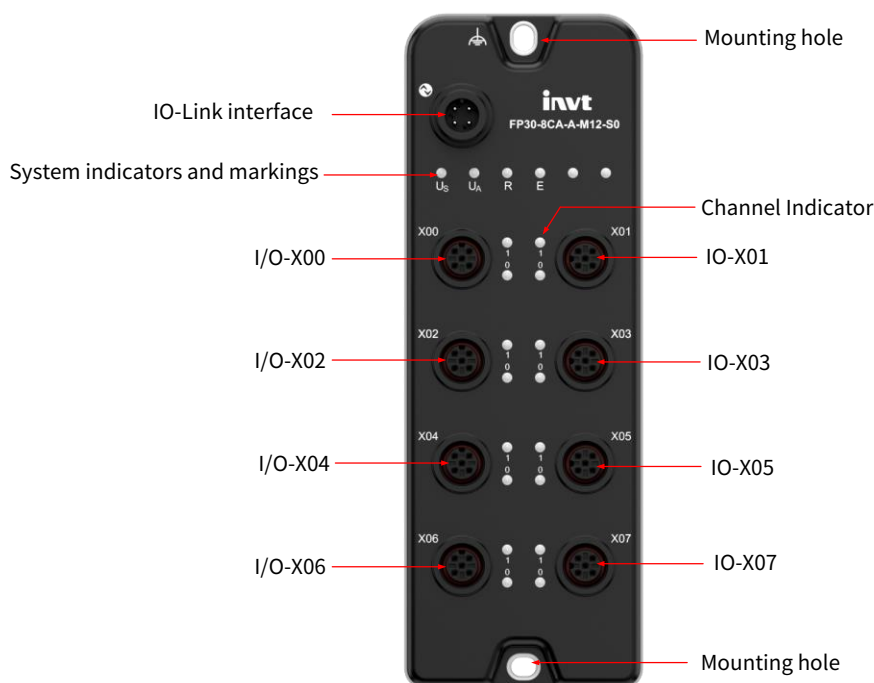
2 Module model

2.1 Model list

Model	Product Description
FP30-8CA-A-M12-S0	8-channel analog voltage and current input/output compatible module, IP67

3 Panel

3.1 Module structure

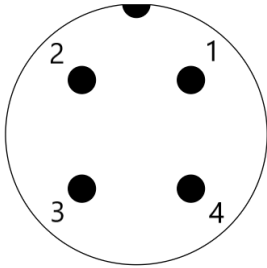


3.2 Indicator light function

Indicator	Color	State	Status description
Power indicator light US	Green	Bright	Power supply is normal
		Extinguish	The product is not powered on or the power supply is abnormal.
Power indicator light UA	Green	Bright	Power supply is normal
		Extinguish	The product is not powered on or the power supply is abnormal.
Communication indicator R	Green	Bright	Communication not connected/Firmware online upgrade
		Flashing	Communication is normal
		Extinguish	Power supply abnormality
Fault indicator light E	Red	Bright	IO-Link communication failure
		Extinguish	No abnormalities
Input channel indicator	Green	Bright	The module channel has a signal input.
		Extinguish	The module channel has no signal input or the signal input is abnormal.
Output channel indicator	Green	Bright	The module channel has signal output.
		Extinguish	The module channel has no signal output or the signal output is abnormal.

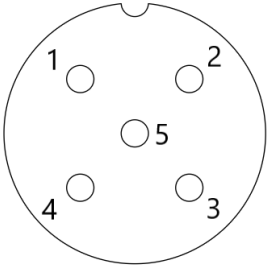
3.3 IO-Link interface definition

IO-Link interface connection view (Class-A port, pin end)	Definitions	
	Pin	Function
	1	Power supply voltage, +24V
	2	NC
	3	0V, Power supply GND
	4	C/Q, IO-Link data transmission channels



3.4 I/O interface definition

I/O interface connection view (M12, female end)	Definition	
	Pin	Function
	1	Power supply voltage, +24V
	2	Signal input/output AI/AO+
	3	Power supply GND, 0V
	4	Signal input/output AI/AO-
	5	Shield ground, PE



4 Product parameters

4.1 General parameters

Communication parameters	
Product Model	FP30-8CA-A-M12-S0
Vendor ID	1044(0×0414)
Vendor Name	INVT
IO-Link version	V1.1
Communication rate	COM3 (230.4kbps)
Minimum cycle time	2000μs
Process data uplink	18 bytes
Downlink process data	16 bytes
Interface type	M12-A, 4-pin, pin tip
Cable length	≤20m (Between HUB and master station)
Electrical parameters	
Operating voltage (V)	24 VDC (18V–30.2V)
Current loss (mA)	No-load: 70mA
Configurable inputs and outputs	Yes
Voltage and current are configurable	Yes
Input/output interfaces	M12-A, 5-pin, hole end
Number of input channels	Maximum 8
Number of output channels	Maximum 8
Over/under voltage monitoring	18V–30.2V
Short circuit and overload protection	Support
Firmware upgrade	Support
Data storage	Support
Power supply output current	100mA
Communication status	LED indicator
General technical parameters	
Specifications and dimensions	165×58×30.5mm
Weight	380g
Operating temperature	-25°C–+70°C
Storage temperature	-40°C–+85°C
Relative humidity	95%, no condensation
Altitude	≤2000m
Protection level	IP67
Overvoltage category	I
Pollution level	Level 2

4.2 Analog parameters

Analog input		
Enter points	Maximum 8	Maximum 8
Input type	Voltage type	Current type
Input signal	Disable, 0V–10V, 0V–5V, 1V–5V, 0mA–20mA, 4mA–20mA (The range is adjustable, with the default value being 0V–10V)	
Input signal type	Single-ended signal	
Channel reaction time	100μs/8ch	
Resolution	16 bits	
Sampling rate (full channel)	≤1ksps	
Accuracy	±0.1% at 25°C, ±0.3% over the entire temperature range.	
Input filtering	Support	
Smooth series	1–200	
Input impedance (voltage type)	≥175kΩ	-
Input impedance (current type)	-	≤200Ω
Maximum allowable voltage for the channel (voltage type)	30V	-
Maximum allowable current for the channel (current type)	-	30mA
Input overload protection	Support clamp protection	Supports current limiting protection
Input protection	±30V	±30mA
Isolation and withstand voltage	500VDC	
Rated current consumption	80mA	80mA
Power consumption	2W	2W

Analog output		
Output points	Maximum 8	Maximum 8
Output type	Voltage type	Current type
Output signal	Disable, 0V–10V, 0V–5V, 1V–5V, 0mA–20mA, 4mA–20mA (Adjustable measurement range)	
Channel reaction time	200us/8ch	
Resolution	13 bits	
Accuracy	±0.1% at 25°C, ±0.3% over the entire temperature range.	
Load impedance (voltage type)	≥2kΩ (1kΩ accuracy: 0.3% at 25°C, ±0.5% at all temperatures)	-
Load impedance (current type)	-	≤500Ω
Output protection	Overload protection, open circuit protection, and short circuit protection (all with automatic recovery mechanisms).	

Analog output		
Isolation and withstand voltage	500VDC	
Rated current consumption	100mA	200mA
Power consumption	2.5W	5W
Clearing and retaining optional functions in non-OP state	Support	

4.2.1 Voltage and current range selection table

Voltage and current range selection and code value range					
Range selection	Measuring range	Code value range	Voltage and current input calculation formulas	Voltage and current output calculation formulas	Code value mapping table
0	Disable indicates that the channel is not enabled.				
1 (default)	0V–10V	0–27648	$D=(27648/10)*U$	$U=(D*10)/27648$	See Code value tables 4.2.2–4.2.5
2	0V–10V	0–32767	$D=(32767/10)*U$	$U=(D*10)/32767$	
3	0V–5V	0–27648	$D=(27648/5)*U$	$U=(D*5)/27648$	
4	0V–5V	0–32767	$D=(32767/5)*U$	$U=(D*5)/32767$	
5	1V–5V	0–27648	$D=(27648/4)*U-6912$	$U=(D+6912)*4/27648$	
6	0mA–20mA	0–27648	$D=(27648/20)*I$	$I=(D*20)/27648$	
7	4mA–20mA	0–27648	$D=(27648/16)*I-6912$	$I=((D+6912)*16)/27648$	

 **Note:** D represents code value, U represents voltage, I represents current, and the default analog range is 1: 0V–10V (0–27648).

4.2.2 Voltage input code value table

Range Voltage	0V–10V	0V–10V	0V–5V	0V–5V	1V–5V
	0–27648	0–32767	0–27648	0–32767	0–27648
	Code value	Code value	Code value	Code value	Code value
0	0	0	0	0	-
0.296	818	970	1637	1940	-4866
1	2765	3277	5530	6554	0
2	5530	6554	11060	13107	6912
3	8294	9830	16588	19661	13824
4	11059	13107	22118	26214	20736
5	13824	16384	27648	32767	27648
5.5	15206	18022	30413	-	31104
5.704	15770	18690	-	-	32514
6	16589	19661	-	-	-
7	19354	22937	-	-	-
8	22118	26214	-	-	-
9	24883	29491	-	-	-
10	27648	32767	-	-	-
Code value formula	Code value = $(27648/10)*\text{Voltage}$	Code value = $(32767/10)*\text{Voltage}$	Code value = $(27648/5)*\text{Voltage}$	Code value = $(32767/5)*\text{Voltage}$	Code value = $(27648/4)*\text{Voltage}-6912$

Range Voltage	0V-10V	0V-10V	0V-5V	0V-5V	1V-5V
	0-27648	0-32767	0-27648	0-32767	0-27648
	Code value	Code value	Code value	Code value	Code value
Voltage formula	$\text{Voltage} = (\text{Code value} * 10) / 27648$	$\text{Voltage} = (\text{Code value} * 10) / 32767$	$\text{Voltage} = (\text{code value} * 5) / 27648$	$\text{Voltage} = (\text{code value} * 5) / 32767$	$\text{Voltage} = (\text{code value} + 6912) * 4 / 27648$

Note:

- When the voltage input range is selected as 0V-5V (0-27648), overshoot, overflow, and overflow alarm functions are supported. Overshoot occurs when the channel input range exceeds the range, and the normal calculated code value is displayed within 0V-5.5V. Overflow is displayed as 32767.
- When the voltage input range is selected as 0V-5V (0-32767), overflow and overflow alarm functions are supported. When overflow occurs, the display is 32767.
- Voltage input range selection: 1V - 5V (0-27648) It supports overshoot, underflow or overflow, and underflow or overflow alarm functions. Overshoot occurs when the channel input range exceeds the range, triggering an overshoot alarm. The calculated code value is displayed within 0.296V-5.704V. Underflow or overflow will be displayed as -32768/32767.

4.2.3 Voltage output code value table

Range Voltage	0V-10V	0V-10V	0V-5V	0V-5V	1V-5V
	0-27648	0-32767	0-27648	0-32767	0-27648
	Code value	Code value	Code value	Code value	Code value
0	0	0	0	0	-
1	2765	3277	5530	6554	0
2	5530	6554	11060	13107	6912
3	8294	9830	16588	19661	13824
4	11059	13107	22118	26214	20736
5	13824	16384	27648	32767	27648
6	16589	19661	-	-	-
7	19354	22937	-	-	-
8	22118	26214	-	-	-
9	24883	29491	-	-	-
10	27648	32767	-	-	-
Code value formula	$\text{Code value} = (27648/10) * \text{Voltage}$	$\text{Code value} = (32767/10) * \text{Voltage}$	$\text{code value} = (27648/5) * \text{Voltage}$	$\text{code value} = (32767/5) * \text{Voltage}$	$\text{code value} = (27648/4) * \text{Voltage} - 6912$
Voltage formula	$\text{Voltage} = (\text{Code value} * 10) / 27648$	$\text{Voltage} = (\text{Code value} * 10) / 32767$	$\text{Voltage} = (\text{code value} * 5) / 27648$	$\text{Voltage} = (\text{code value} * 5) / 32767$	$\text{Voltage} = (\text{code value} + 6912) * 4 / 27648$

Note: The voltage output setting code value will not respond if it exceeds the range code value.

4.2.4 Current input code value table

Range Current	4–20mA	0–20mA
	0–27648	0–27648
	Code value	Code value
0	-	0
1	-	1382
1.19	-4856	1645
2	-3456	2765
3	-1728	4147
4	0	5530
5	1728	6912
6	3456	8294
7	5184	9677
8	6912	11059
9	8640	12442
10	10368	13824
11	12096	15206
12	13824	16589
13	15552	17971
14	17280	19354
15	19008	20736
16	20736	22118
17	22464	23501
18	24192	24883
19	25920	26266
20	27648	27648
22.81	32504	31533
23.52	-	32514
Code value formula	Code value = (27648/16) * current - 6912	Code value = (27648/20) * current
Current formula	Current = ((Code value + 6912) * 16) / 27648	Current = ((code value * 20) / 27648

 Note:

- When the current input range is selected as 4mA–20mA (0–27648), overshoot, overflow, and overflow alarm functions are supported. Overshoot occurs when the channel input range exceeds the range, and the normal calculated code value is displayed within the range of 1.19mA–22.81mA. Overflow occurs when the channel input current is greater than 22.81mA, and the maximum overshoot code value of 32767 is displayed, along with an alarm. Underflow occurs when the input current is less than 1.19mA, and the minimum overshoot code value of -32768 is displayed.
- When the current input range is selected from 0mA to 20mA (0–27648), overshoot, overflow, and overflow alarm functions are supported. Overshoot occurs when the channel input range exceeds the range, and the normal calculated code value is displayed within the range of 0mA to 23.52mA. Overflow occurs when the channel input current exceeds 23.52mA, and the maximum overshoot code value of 32767 is displayed, along with an alarm.

4.2.5 Current output code value table

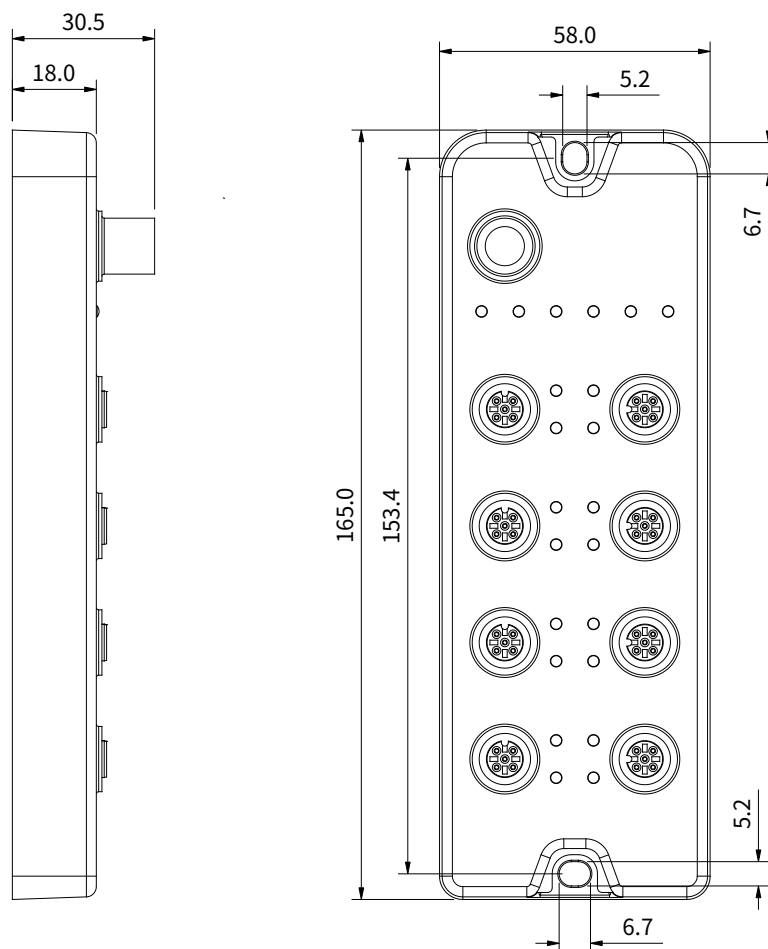
Range Current	4-20mA	0-20mA
	0-27648	0-27648
	Code value	Code value
0	-	0
1	-	1382
2	-	2765
3	-	4147
4	0	5530
5	1728	6912
6	3456	8294
7	5184	9677
8	6912	11059
9	8640	12442
10	10368	13824
11	12096	15206
12	13824	16589
13	15552	17971
14	17280	19354
15	19008	20736
16	20736	22118
17	22464	23501
18	24192	24883
19	25920	26266
20	27648	27648
Code value formula	Code value = (27648/16) * current - 6912	Code value = (27648/20) * current
Current formula	Current = ((Code value + 6912) * 16) / 27648	Current = ((code value * 20) / 27648

 **Note:** The current output setting code value will not respond if it exceeds the range code value.

5 Wiring instructions

5.1 Outline dimensions

Figure 5-1 External dimensions (unit: mm)

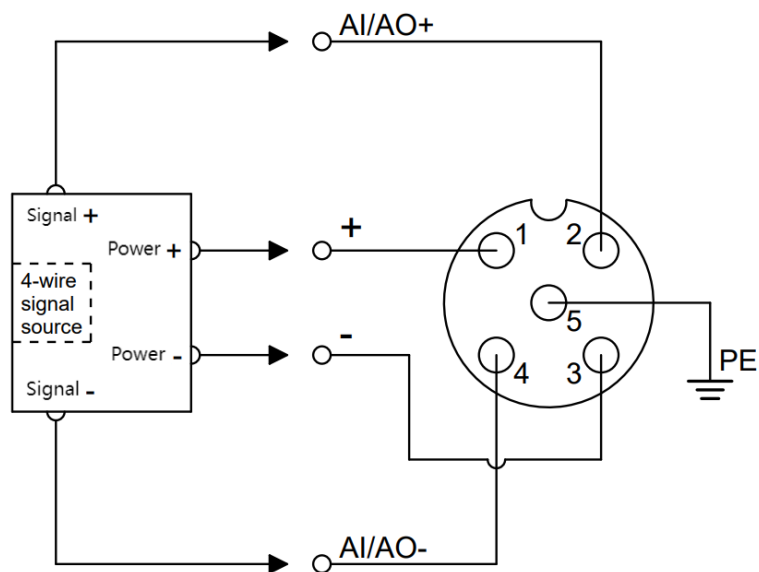


5.2 Wiring instructions

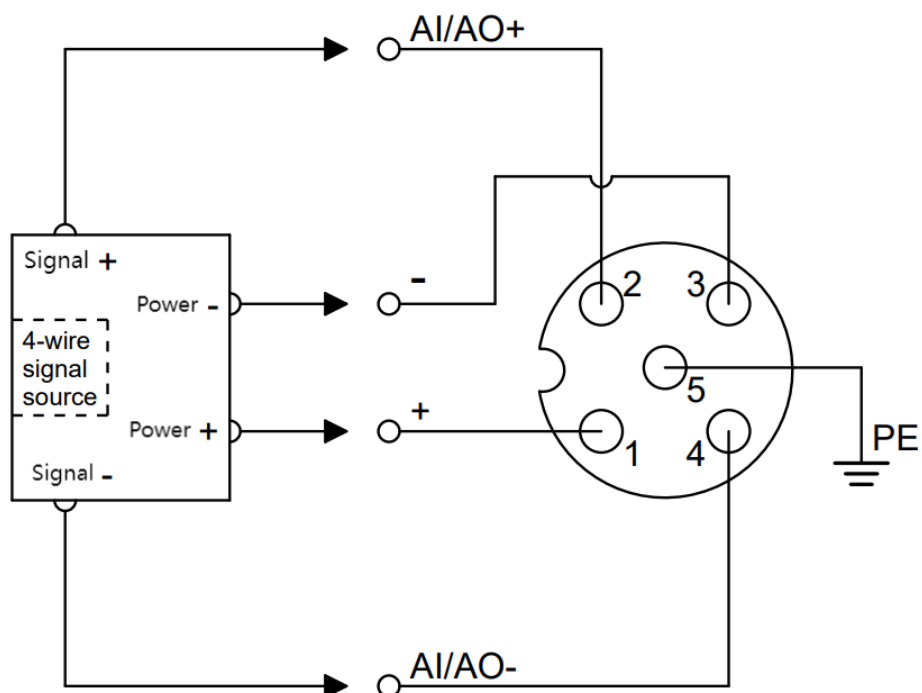
- For personal and equipment safety, it is recommended to disconnect the power supply when performing wiring operations.
- IO-Link Master Interface: Connect the IO-Link analog HUB module to any IO-Link master product using a standardized four-core cable.
- I/O Interface: Connect the IO-Link analog HUB module to sensors or other devices using a standardized five-core cable.

5.3 Wiring diagram

5.3.1 I/O interfaces - X00/X02/X04/X06



5.3.2 I/O interfaces - X01/X03/X05/X07



6 Commissioning

6.1 Parameter description

6.1.1 Analog input/output selection mode configure

The IO-Link analog voltage and current compatible module can be configured with analog input or output functions, and can be selected as AI or AO according to application needs.

Index	Sub-index	Property	Data length	Data types	Data content	Parameter Options
0x0040	0x01	R/W	8-bit	USINT	Mode Configure Ch00	0: Analog Input 1: Analog Output; Default: 0
	0x02	R/W	8-bit	USINT	Mode Configure Ch01	
	0x03	R/W	8-bit	USINT	Mode Configure Ch02	
	0x04	R/W	8-bit	USINT	Mode Configure Ch03	
	0x05	R/W	8-bit	USINT	Mode Configure Ch04	
	0x06	R/W	8-bit	USINT	Mode Configure Ch05	
	0x07	R/W	8-bit	USINT	Mode Configure Ch06	
	0x08	R/W	8-bit	USINT	Mode Configure Ch07	

6.1.2 Analog range setting range select

The Range Select setting is used to set the range of analog signals. Each channel can be configured individually (see details for range settings 4.2.1 Voltage and current range selection table).

Index	Sub-index	Property	Data length	Data types	Data content	Parameter Options
0x0041	0x01	R/W	8-bit	USINT	Range Select Ch00	0: Disable 1: 0V–10V (0–27648), 2: 0V–10V (0–32767). 3: 0V–5V (0–27648), 4: 0V–5V (0–32767). 5: 1V–5V (0–27648), 6: 0mA–20mA (0–27648), 7: 4mA–20mA (0–27648); Default 1
	0x02	R/W	8-bit	USINT	Range Select Ch01	
	0x03	R/W	8-bit	USINT	Range Select Ch02	
	0x04	R/W	8-bit	USINT	Range Select Ch03	
	0x05	R/W	8-bit	USINT	Range Select Ch04	
	0x06	R/W	8-bit	USINT	Range Select Ch05	
	0x07	R/W	8-bit	USINT	Range Select Ch06	
	0x08	R/W	8-bit	USINT	Range Select Ch07	

6.1.3 Analog output signal clear/hold

The clear/hold function is for modules with output channels. This function configures the output mode of the output channel when the PDO is invalid. This parameter supports the following output states:

Clear output: When communication is disconnected, the module output channel will automatically clear the output.

Maintain output: The module's output channel continues to output even when communication is interrupted.

Output preset value: When communication is disconnected, the module output channel outputs a preset value.

The analog output clear and hold function supports both module-wide settings (template mode) and single-channel settings (single-channel mode). Any channel can be configured using either single-channel mode or template mode, with single-channel mode having higher priority than template mode. Specific configuration methods are shown in the table below; the default is module-wide output clear.

Analog output module clear hold parameters				
Parameter name	Parameter meaning	Parameter values	Parameter value meaning	Default value
TemplateMode	Template mode	1	Clear all channels and output.	1
		2	Hold all channels to maintain output.	
		3	Preset all channel output preset values	
TemplateValue Chx	Single channel clear/keep configuration	0	TemplateValue is the template mode value, meaning single-channel mode is not enabled.	0
		1	Clear single-channel output.	
		2	Hold single channel to maintain output.	
		3	Preset Single Channel Output Preset Value	
Preset Value Chx	Single channel preset value	Code value range	Output code value corresponding to current/voltage value (Corresponding range code value table)	0

Note: When the overall module setting (template mode) is configured to 3, that is, when the full channel output preset value is effective, the preset value is based on the preset code value of channel 0 in the single channel preset value, and the full channel output is performed.

Index	Sub-index	property	Data length	Data types	Data content	Parameter Options
0x0044	0x00	R/W	8-bit	USINT	AO TemplateMode	1: Clear, 2: Hold, 3: Preset; Default: 1
0x0042	0x01	R/W	8-bit	USINT	AO TemplateValue Ch00	0: TemplateValue, 1: Clear, 2: Hold, 3: Preset; Default 0
	0x02	R/W	8-bit	USINT	AO TemplateValue Ch01	
	0x03	R/W	8-bit	USINT	AO TemplateValue Ch02	
	0x04	R/W	8-bit	USINT	AO TemplateValue Ch03	
	0x05	R/W	8-bit	USINT	AO TemplateValue Ch04	
	0x06	R/W	8-bit	USINT	AO TemplateValue Ch05	
	0x07	R/W	8-bit	USINT	AO TemplateValue Ch06	
	0x08	R/W	8-bit	USINT	AO TemplateValue Ch07	
0x0043	0x01	R/W	16-bit	UINT	AO Preset Value Ch00	0-32767; Default 0
	0x02	R/W	16-bit	UINT	AO Preset Value Ch01	
	0x03	R/W	16-bit	UINT	AO Preset Value Ch02	
	0x04	R/W	16-bit	UINT	AO Preset Value Ch03	
	0x05	R/W	16-bit	UINT	AO Preset Value Ch04	
	0x06	R/W	16-bit	UINT	AO Preset Value Ch05	
	0x07	R/W	16-bit	UINT	AO Preset Value Ch06	
	0x08	R/W	16-bit	UINT	AO Preset Value Ch07	

6.1.4 Analog input filtering

■ Analog input filtering function

The analog input filtering function can internally average the data after A/D conversion to reduce the impact of fluctuations in the input signal due to noise and other factors.

The analog input is processed by moving average with a specified number of A/D conversions.

■ Filtering function configuration

All channels share a single configuration item, with a configuration range of 1 to 200 and a default of 10 times.

Index	Sub-index	Property	Data length	Data types	Data content
0x0045	0x00	R/W	8-bit	USINT	Analog Input Average Filter (1–200; default 10)

6.1.5 Analog signal power-off retention

The analog parameters support the function of saving all configuration parameters of the module when communication is interrupted due to abnormal power failure. Analog modules all support power failure saving by default.

6.2 Parameter configuration

EtherCAT masters support ISDU read and write operations, while PROFINET masters only support ISDU write operations before configuration. Before any operation, the slave station's ISDU information should be obtained; details can be found in 6.1 Parameter description.

■ EtherCAT Master ISDU Parameter Read/Write

Example 1: Configure the FP30-8CA-A-M12-S0 so that the first channel is an output (the remaining 7 channels are inputs by default). See reference 6.1.1 Analog input/output selection mode configure. Set Index to 0x0040, Subindex to 0x01, Length to 1 (0x01), Data to 01, 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 operation returns a non-zero error code, it indicates an error. The meaning of the error code can be used to locate the problem. The status definitions are provided in Appendix D.

6.3 Port IO-Link mode

- All ports of the EtherCAT and PROFINET 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 definition is as follows 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 Info information.

For example, in port 0, 9000:24 displays the length of the actual input process data read by the master station from the slave station, and 9000:25 displays the length of the actual output process data read by the master station from the slave station. The length values are referenced. If there is no corresponding slave data length module, you can select a module with a length value greater than the slave data length.

6.4 Uplink and downlink process data

Type	Data length	Data content	Range of values
Input process data (18 bytes)	2 bytes	Channel 0 (Analog input code value)	-32768–32767
	2 bytes	Channel 1 (Analog input code value)	-32768–32767
	2 bytes	Channel 2 (Analog input code value)	-32768–32767
	2 bytes	Channel 3 (Analog input code value)	-32768–32767
	2 bytes	Channel 4 (Analog input code value)	-32768–32767
	2 bytes	Channel 5 (Analog input code value)	-32768–32767
	2 bytes	Channel 6 (Analog input code value)	-32768–32767
	2 bytes	Channel 7 (Analog input code value)	-32768–32767
Output process data (16 bytes)	2 bytes	Error Code (Overflow alarm code value)	See Appendix E
	2 bytes	Channel 0 (Analog output setting code value)	0–32767
	2 bytes	Channel 1 (Analog output setting code value)	0–32767
	2 bytes	Channel 2 (Analog Output Setting Code Value)	0–32767
	2 bytes	Channel 3 (Analog output setting code value)	0–32767
	2 bytes	Channel 4 (Analog output setting code value)	0–32767
	2 bytes	Channel 5 (Analog output setting code value)	0–32767
	2 bytes	Channel 6 (Analog output setting code value)	0–32767
	2 bytes	Channel 7 (Analog output setting code value)	0–32767

6.5 Application in the twinCAT3 software environment

1. Preparation

- **Hardware environment**

- Module model FP30-EC-8A-M12-S0
Connect port X00 to the slave analog module FP30-8CA-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**

Follow the requirements in section 5 Wiring instructions.

2. Pre-configured configuration files

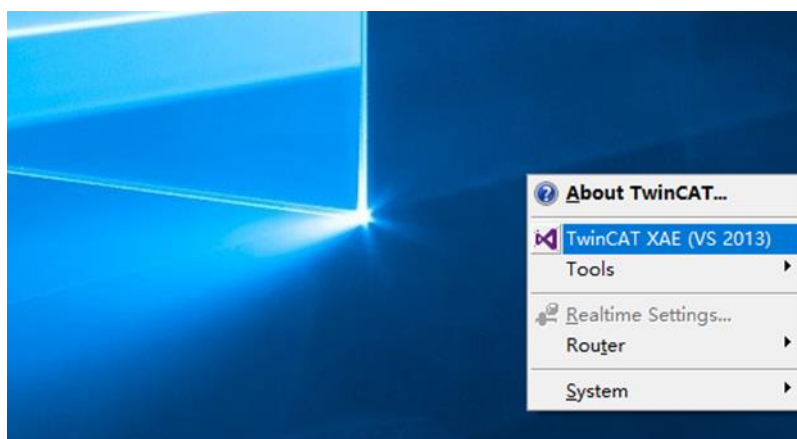
Place the ESI configuration file (FP30_EC_S0_IO-Link_Gateway_1.0.1.xml) in the TwinCAT installation directory "C:\TwinCAT\3.1\Config\Io\EtherCAT", as shown in the figure below.

📁 > This PC > Local Disk (C:) > TwinCAT > 3.1 > Config > Io > EtherCAT

Name	Date modified	Type	Size
Beckhoff EPP2xxx.xml	20/06/2022 07:53	XML Document	1,874 KB
Beckhoff EPP3xxx.xml	20/06/2022 07:53	XML Document	6,414 KB
Beckhoff EPP4xxx.xml	20/06/2022 07:53	XML Document	603 KB
Beckhoff EPP5xxx.xml	20/06/2022 07:53	XML Document	780 KB
Beckhoff EPP6xxx.xml	22/08/2022 14:55	XML Document	2,932 KB
Beckhoff EPP7xxx.xml	20/06/2022 07:53	XML Document	2,715 KB
Beckhoff EPP9xxx.xml	18/02/2022 16:16	XML Document	199 KB
Beckhoff EPx9xx.xml	18/02/2022 16:16	XML Document	921 KB
Beckhoff EQ1xxx.xml	20/06/2022 07:53	XML Document	22 KB
Beckhoff EQ2xxx.xml	20/06/2022 07:53	XML Document	73 KB
Beckhoff EQ3xxx.xml	20/06/2022 07:53	XML Document	1,386 KB
Beckhoff ER1xxx.XML	20/06/2022 07:53	XML Document	244 KB
Beckhoff ER2xxx.XML	20/06/2022 07:53	XML Document	261 KB
Beckhoff ER3xxx.XML	20/06/2022 07:53	XML Document	1,177 KB
Beckhoff ER4xxx.xml	20/06/2022 07:53	XML Document	318 KB
Beckhoff ER5xxx.xml	20/06/2022 07:53	XML Document	273 KB
Beckhoff ER6xxx.xml	22/08/2022 14:55	XML Document	2,040 KB
Beckhoff ER7xxx.xml	20/06/2022 07:53	XML Document	2,717 KB
Beckhoff ER8xxx.xml	20/06/2022 07:53	XML Document	207 KB
Beckhoff EtherCAT EvaBoard.xml	18/02/2022 16:16	XML Document	72 KB
Beckhoff EtherCAT Terminals.xml	18/02/2022 16:16	XML Document	54 KB
Beckhoff FB1XXX.xml	18/02/2022 16:16	XML Document	49 KB
Beckhoff FCxxx.xml	18/02/2022 16:16	XML Document	21 KB
Beckhoff FM3xxx.xml	18/02/2022 16:16	XML Document	367 KB
Beckhoff ILxxx-B110.xml	18/02/2022 16:16	XML Document	8 KB
FP30_EC_S0_IO-Link_Gateway_1.0.1.xml	24/03/2026 14:55	XML Document	644 KB

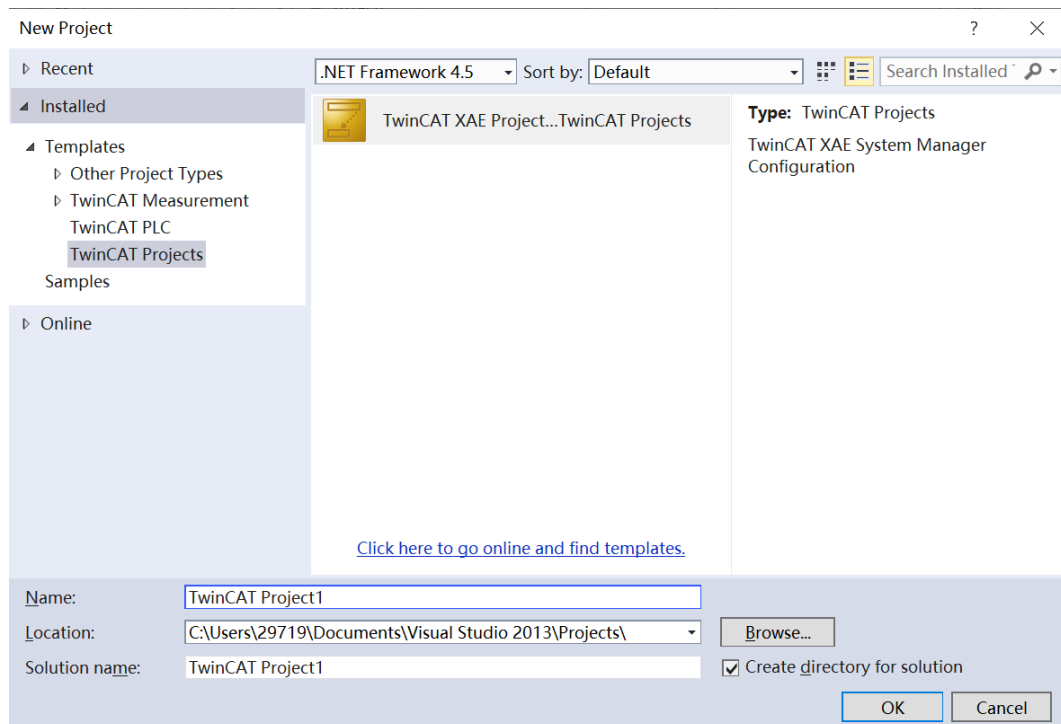
3. Create a project

- a) Click the TwinCAT icon in the lower right corner of the desktop, select "TwinCAT XAE (VS 2013)" to open the TwinCAT software, as shown in the image below.



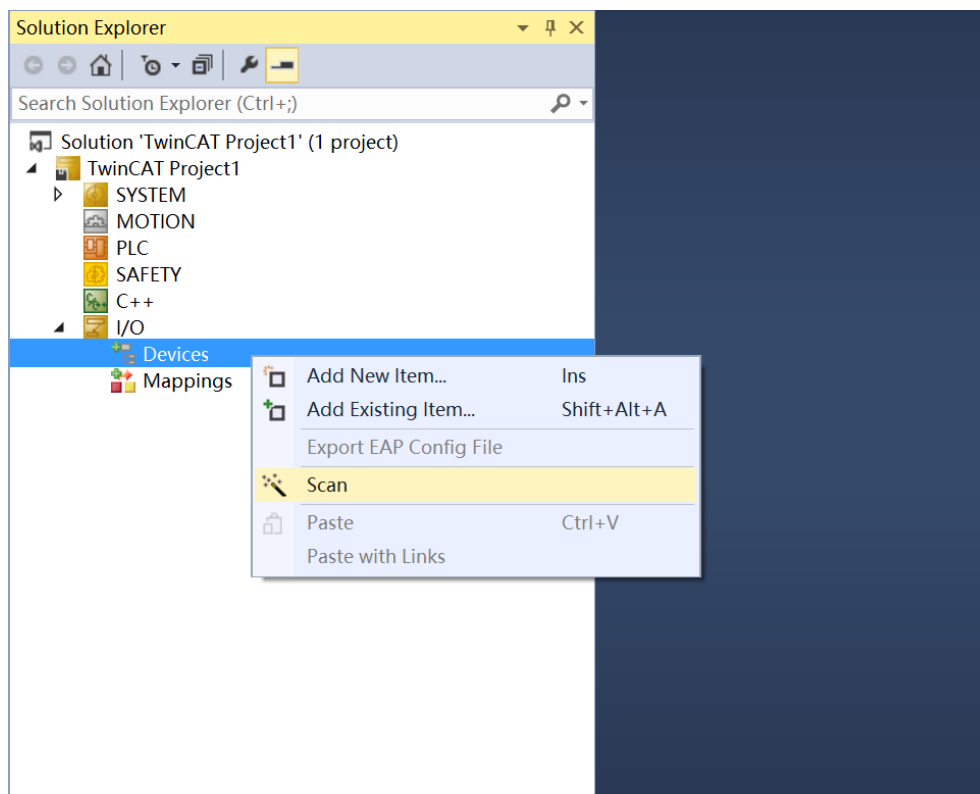
- b) Click "New TwinCAT Project". In the pop-up window, "Name" and "Solution name" correspond to the project name and solution name, respectively, and "Location" corresponds to the project path. These

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

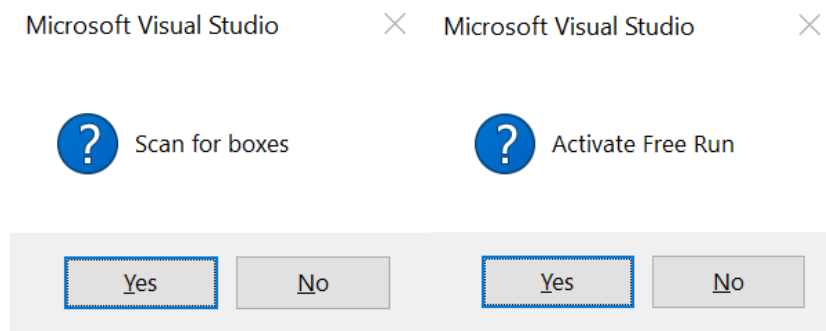
- a) After creating the project, right-click the "Scan" option under "I/O -> Devices" to scan for slave devices, as shown in the figure below.



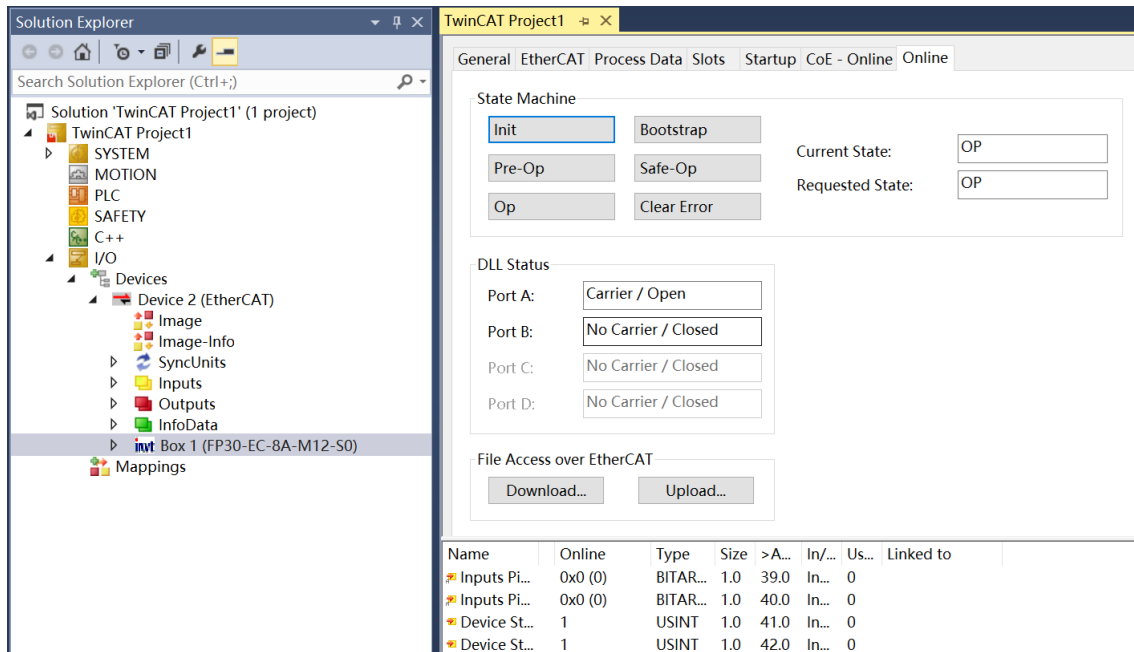
b) Select the "Local Area Connection" network adapter, as shown in the image below.



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.

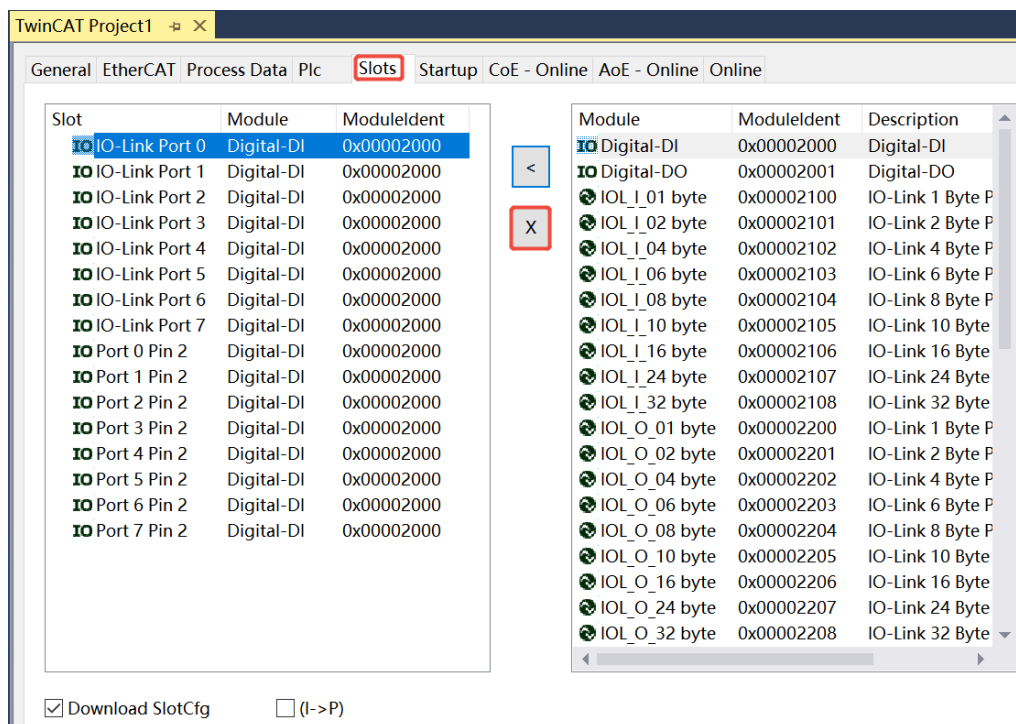


- d) After the device is scanned, you can see Box1 in the left navigation tree. Under "Online", you can see that TwinCAT is in "OP" state. You can also observe that the RUN light of the slave device is always on, as shown in the figure below.

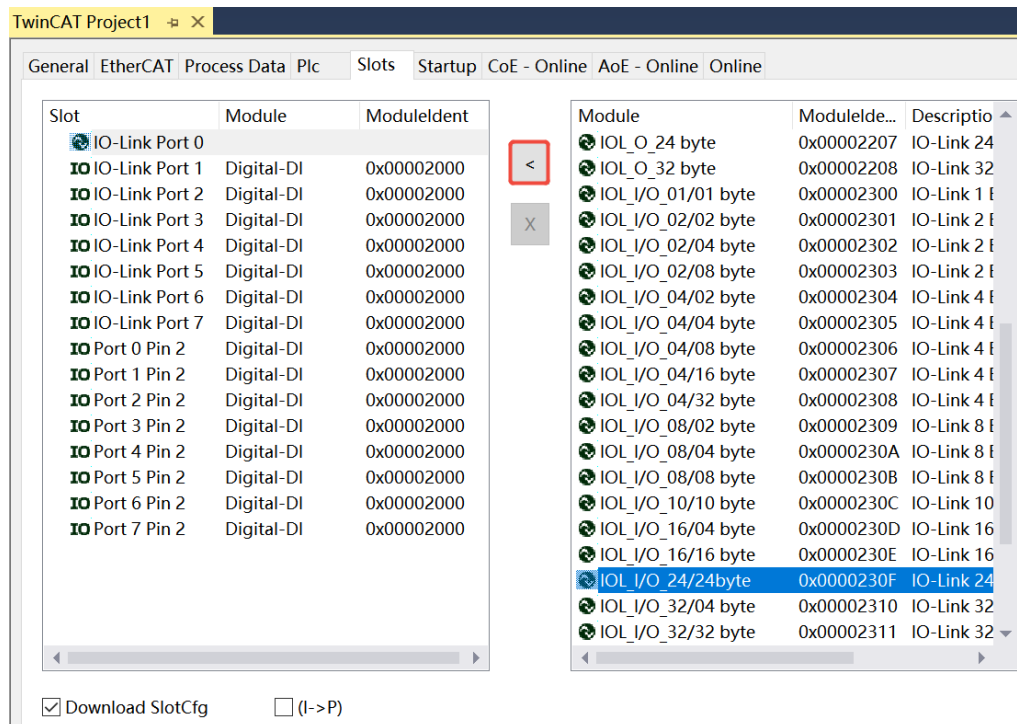


5. IO-Link mode settings

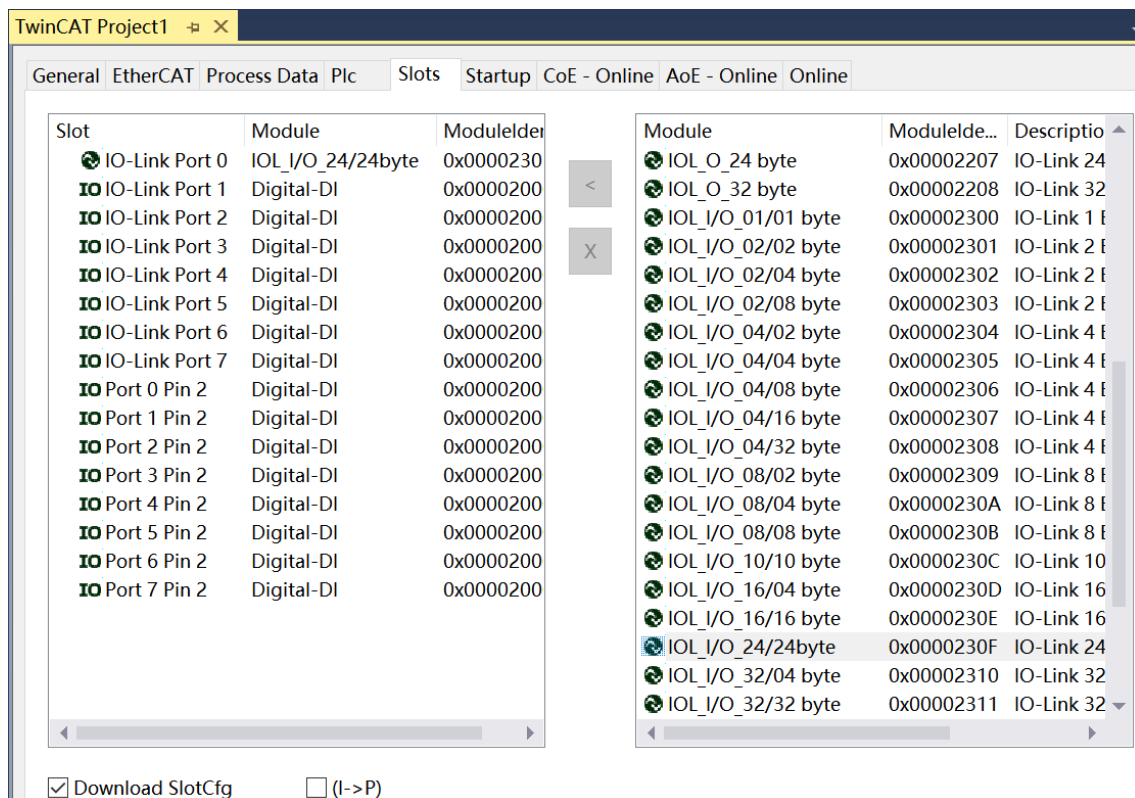
- a) The master station port 0 has been connected to the slave station module FP30-8CA-A-M12-S0. Check the power indicator of FP30-8CA-A-M12-S0; the power indicator is constantly on.
- b) On the right side of the master configuration interface, click "Slots", select IO-Link Port 0, and click "Delete", as shown in the figure below.



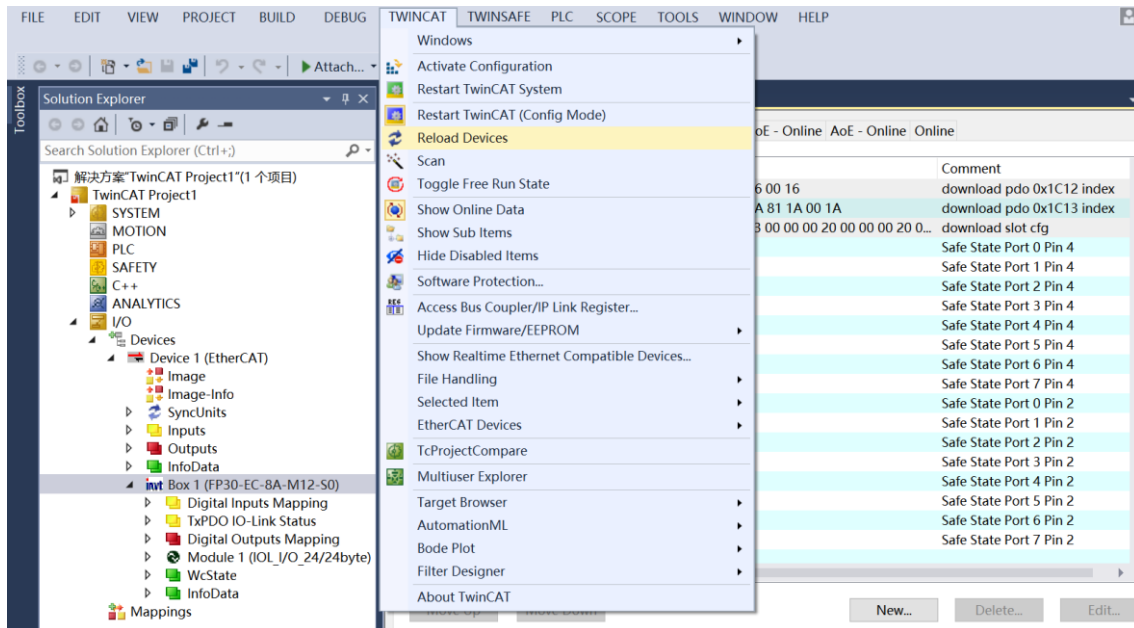
- c) After deletion, select "IOL_I/O_24/24 byte" on the right, and click the "<" button to move it to the left, as shown in the figure below. (Note: The FP30-8CA-A-M12-S0 can be configured with a maximum of 8 channels of analog input or 8 channels of analog output, so select IOL_I/O_24/24 byte.)



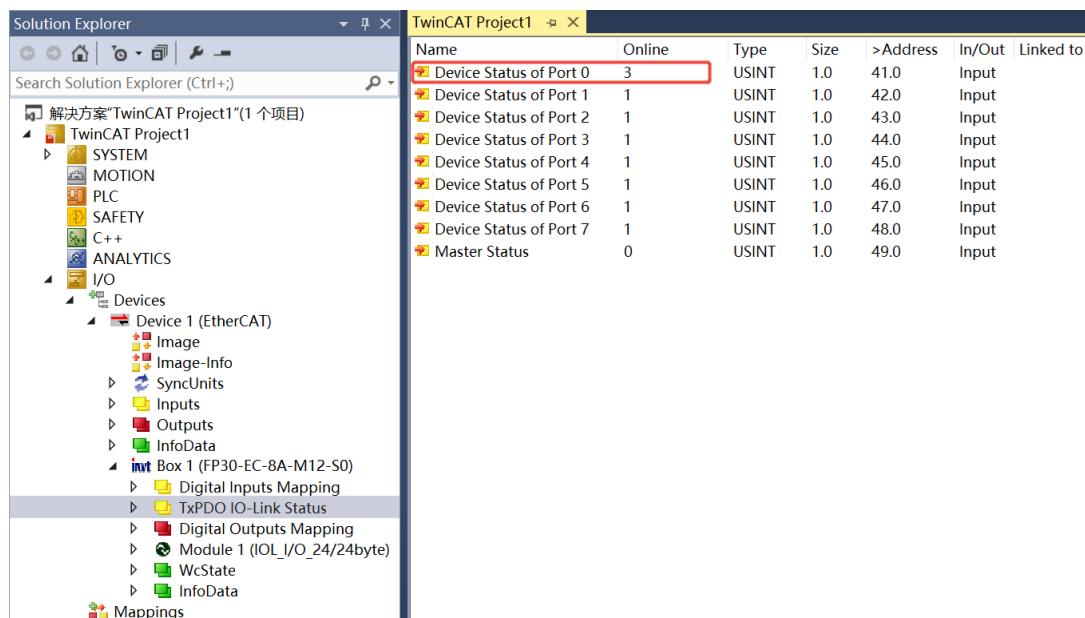
- d) After adding, Ports 0-7 on the left will appear as shown in the image below. The method for configuring DI/DO/IO-Link on other ports is the same as described here.



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



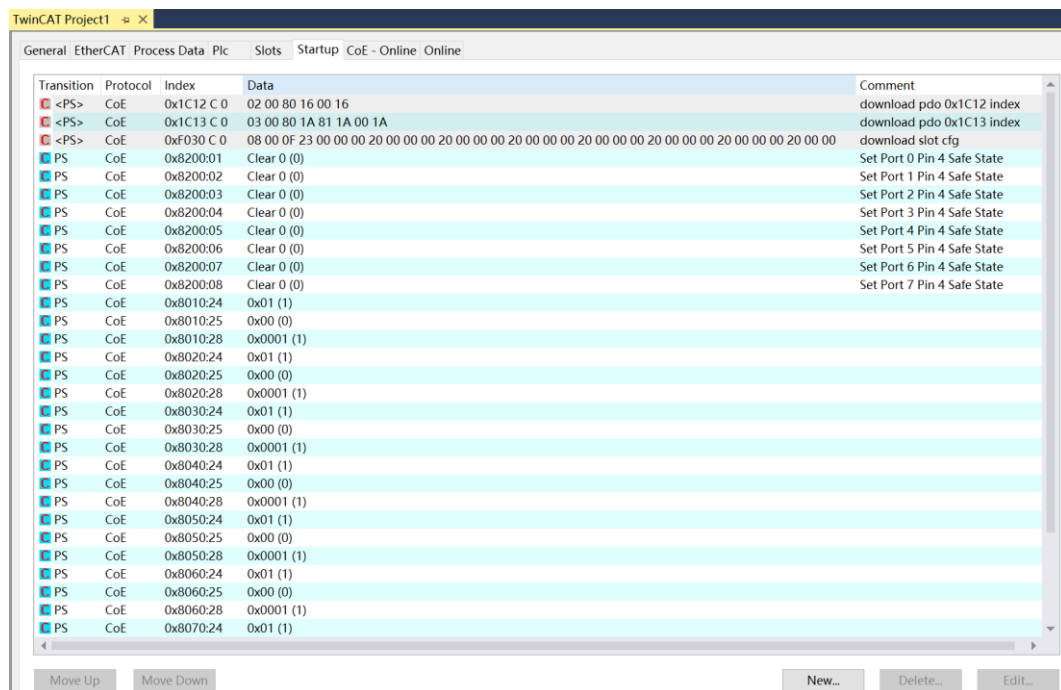
- f) After the reload operation is complete, the device re-enters the OP state. Click "TxPDO IO-Link Status" in the left navigation tree to view it. A value of 3 for "Device Status of Port 0" indicates normal IO-Link communication, as shown in the image below. See [link to port status definition] for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



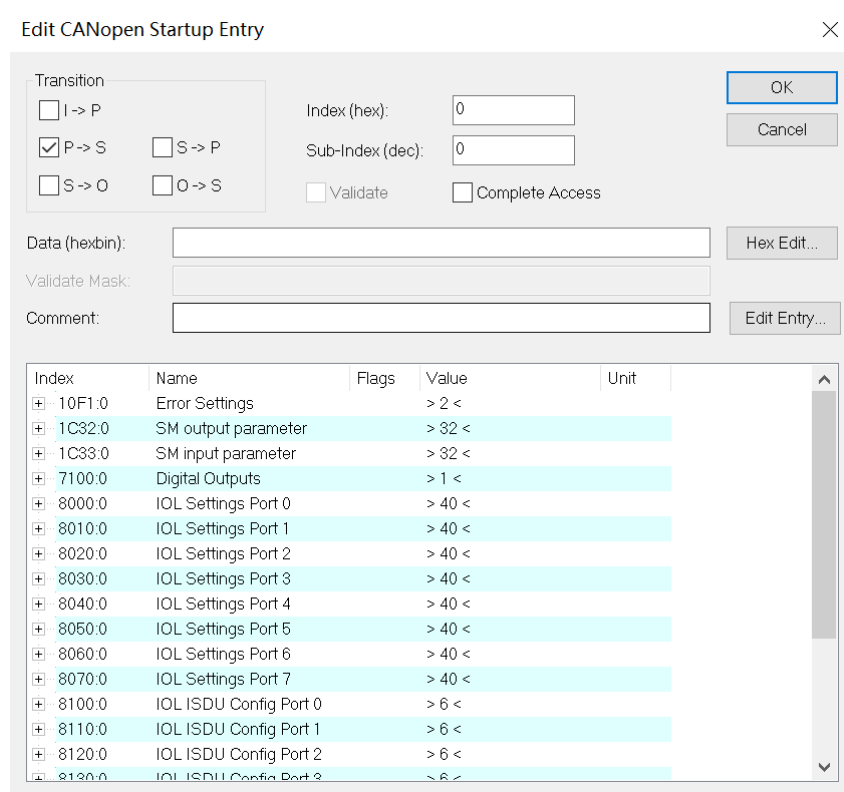
6. Parameter settings

- a) Click "Startup" on the configuration interface on the right side of the main station to see the parameters and parameter values of the main station module FP30-8CA-A-M12-S0, including the

output clear and hold function of the 7 ports Pin4 and the IOL related settings information 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.



Edit CANopen Startup Entry

Transition:
☐ I → P
☒ P → S
☐ S → P
☐ S → O
☐ O → S

Index (hex):
 Sub-Index (dec):
☐ Validate ☐ Complete Access

Data (hexbin):
 Validate Mask:
 Comment:

OK Cancel Hex Edit... Edit Entry...

Index	Name	Flags	Value	Unit
+ 8030:0	IOL Settings Port 3		> 40 <	
+ 8040:0	IOL Settings Port 4		> 40 <	
+ 8050:0	IOL Settings Port 5		> 40 <	
+ 8060:0	IOL Settings Port 6		> 40 <	
+ 8070:0	IOL Settings Port 7		> 40 <	
+ 8100:0	IOL ISDU Config Port 0		> 6 <	
+ 8110:0	IOL ISDU Config Port 1		> 6 <	
+ 8120:0	IOL ISDU Config Port 2		> 6 <	
+ 8130:0	IOL ISDU Config Port 3		> 6 <	
+ 8140:0	IOL ISDU Config Port 4		> 6 <	
+ 8150:0	IOL ISDU Config Port 5		> 6 <	
+ 8160:0	IOL ISDU Config Port 6		> 6 <	
+ 8170:0	IOL ISDU Config Port 7		> 6 <	
+ 8200:0	Safe State Configuration		> 16 <	
+ F030:0	Configured Module Ident...		> 8 <	

- 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".

Edit CANopen Startup Entry

Transition:
☐ I → P
☒ P → S
☐ S → P
☐ S → O
☐ O → S

Index (hex):
 Sub-Index (dec):
☐ Validate ☐ Complete Access

Data (hexbin):
 Validate Mask:
 Comment:

OK Cancel Hex Edit... Edit Entry...

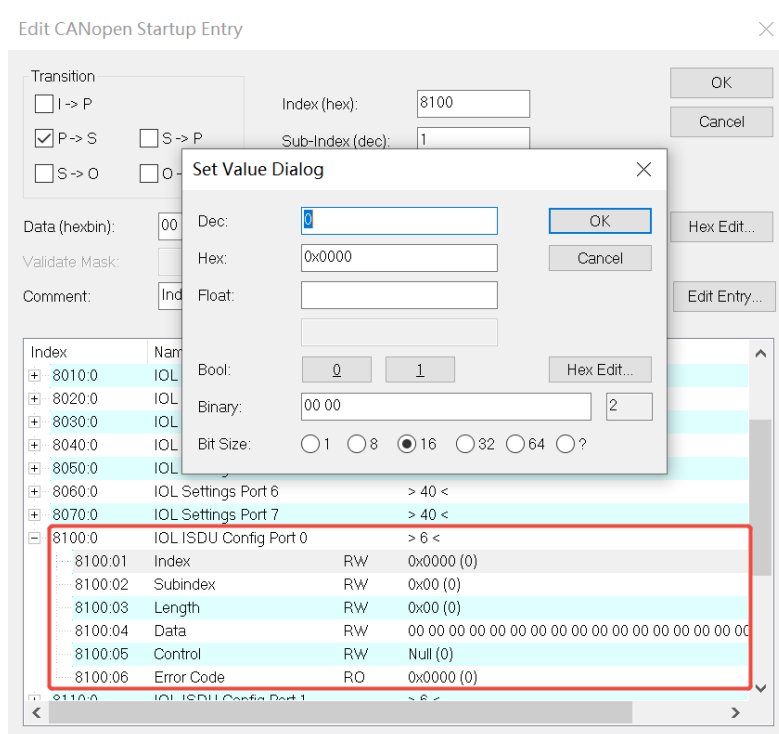
Set Value Dialog

Dec:
 Hex:
 Enum:
 Bool:
 Binary:
 Bit Size: ☐ 1 ☒ 8 ☐ 16 ☐ 32 ☐ 64 ☐ ?

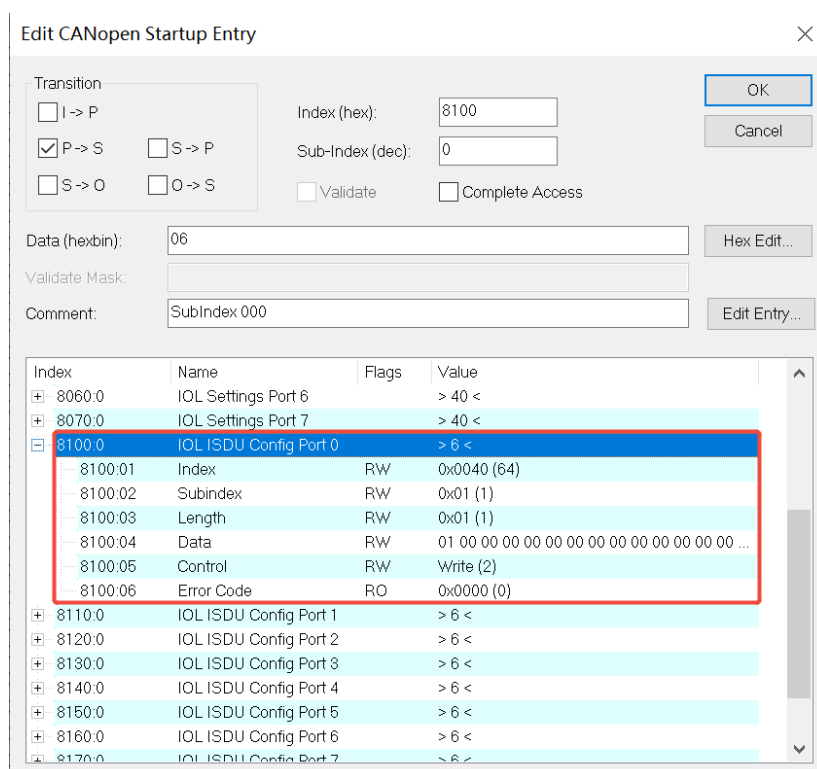
OK Cancel Hex Edit... Edit Entry...

Index	Name	Flags	Value	Unit
+ 8200:0	Safe State Configuration		> 16 <	
+ 8200:01	Safe State Port 0 Pin 4	RW	Clear 0 (0)	
+ 8200:02	Safe State Port 1 Pin 4	RW	Clear 0 (0)	
+ 8200:03	Safe State Port 2 Pin 4	RW	Clear 0 (0)	
+ 8200:04	Safe State Port 3 Pin 4	RW	Clear 0 (0)	
+ 8200:05	Safe State Port 4 Pin 4	RW	Clear 0 (0)	
+ 8200:06	Safe State Port 5 Pin 4	RW	Clear 0 (0)	
+ 8200:07	Safe State Port 6 Pin 4	RW	Clear 0 (0)	
+ 8200:08	Safe State Port 7 Pin 4	RW	Clear 0 (0)	
+ 8200:09	Safe State Port 0 Pin 2	RW	Clear 0 (0)	
+ 8200:0A	Safe State Port 1 Pin 2	RW	Clear 0 (0)	
+ 8200:0B	Safe State Port 2 Pin 2	RW	Clear 0 (0)	
+ 8200:0C	Safe State Port 3 Pin 2	RW	Clear 0 (0)	
+ 8200:0D	Safe State Port 4 Pin 2	RW	Clear 0 (0)	
+ 8200:0E	Safe State Port 5 Pin 2	RW	Clear 0 (0)	
+ 8200:0F	Safe State Port 6 Pin 2	RW	Clear 0 (0)	

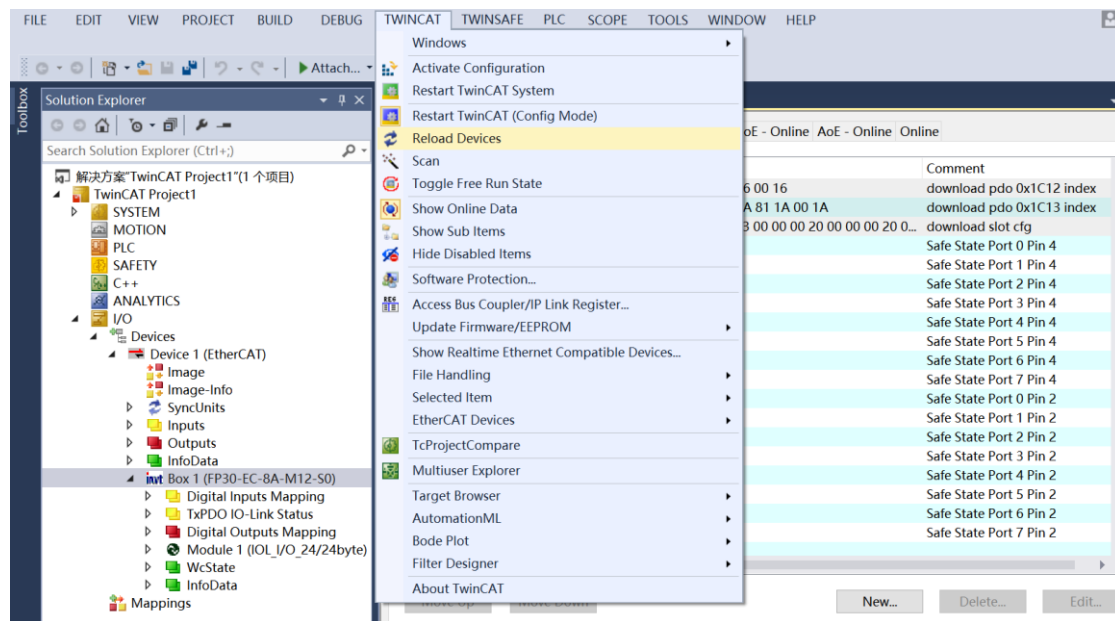
- d) ISDU function configuration method: Taking Port 0 as an example, click "New" to enter the "Edit CANopen Startup Entry" interface, double-click the parameter items such as "8100:01" to configure, as shown in the figure below.



- e) Taking port direction configuration as an example, the ISDU function on the FP30-8CA-A-M12-S0 has 8 channels that are analog inputs by default. Configure the first channel as an output and the remaining channels as inputs. (Reference) Set Index to 0x0040, Subindex to 0x01, Length to 1 (0x01), Data to 01, 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

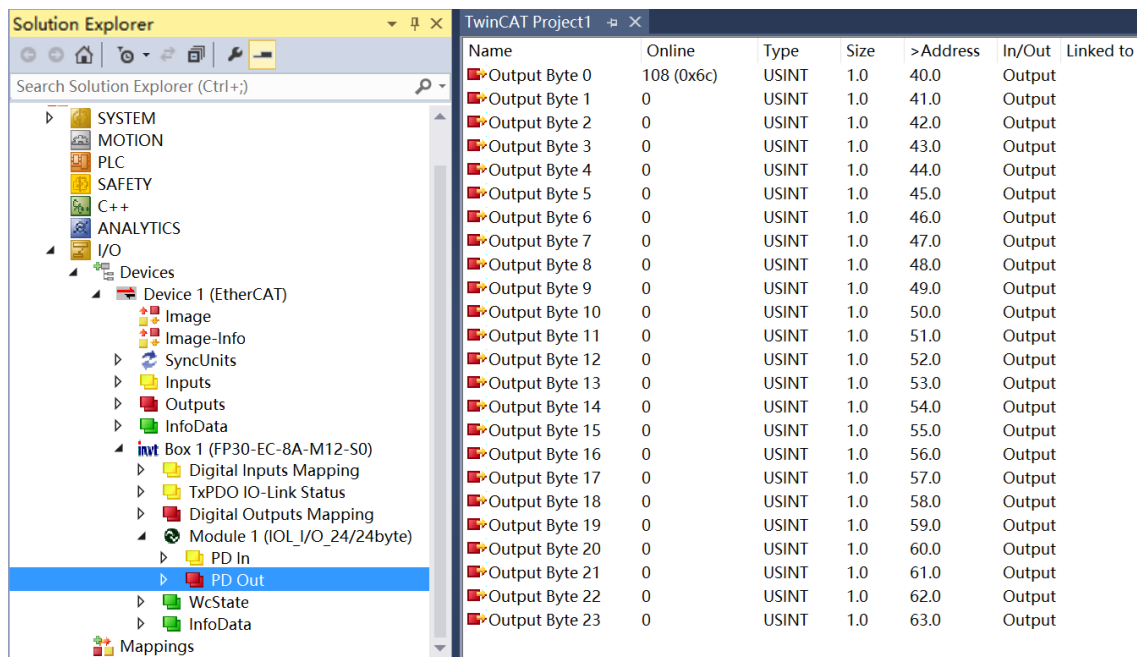
- a) In the left navigation tree, the process data for the standard DI mode port is shown in Digital Inputs Mapping; the process data for the standard DO mode port is shown in Digital Outputs Mapping; and the process data for the IO-Link mode port is shown in Module 1->PD In/Out, as shown in the figure below.

The screenshot shows the TwinCAT software interface with the 'Digital Inputs Mapping' and 'Digital Outputs Mapping' sections. The 'Module 1 (IOL I/O 24/24byte)' is selected, and the 'PD In' and 'PD Out' options are highlighted. The right pane shows a table of input and output bytes.

Name	Online	Type	Size	>Address	In/Out	Linked to
Input Byte 0	0	USINT	1.0	50.0	Input	
Input Byte 1	0	USINT	1.0	51.0	Input	
Input Byte 2	0	USINT	1.0	52.0	Input	
Input Byte 3	0	USINT	1.0	53.0	Input	
Input Byte 4	0	USINT	1.0	54.0	Input	
Input Byte 5	0	USINT	1.0	55.0	Input	
Input Byte 6	0	USINT	1.0	56.0	Input	
Input Byte 7	0	USINT	1.0	57.0	Input	
Input Byte 8	0	USINT	1.0	58.0	Input	
Input Byte 9	0	USINT	1.0	59.0	Input	
Input Byte 10	0	USINT	1.0	60.0	Input	
Input Byte 11	0	USINT	1.0	61.0	Input	
Input Byte 12	0	USINT	1.0	62.0	Input	
Input Byte 13	0	USINT	1.0	63.0	Input	
Input Byte 14	0	USINT	1.0	64.0	Input	
Input Byte 15	0	USINT	1.0	65.0	Input	
Input Byte 16	0	USINT	1.0	66.0	Input	
Input Byte 17	0	USINT	1.0	67.0	Input	
Input Byte 18	0	USINT	1.0	68.0	Input	
Input Byte 19	0	USINT	1.0	69.0	Input	
Input Byte 20	0	USINT	1.0	70.0	Input	
Input Byte 21	0	USINT	1.0	71.0	Input	
Input Byte 22	0	USINT	1.0	72.0	Input	
Input Byte 23	0	USINT	1.0	73.0	Input	

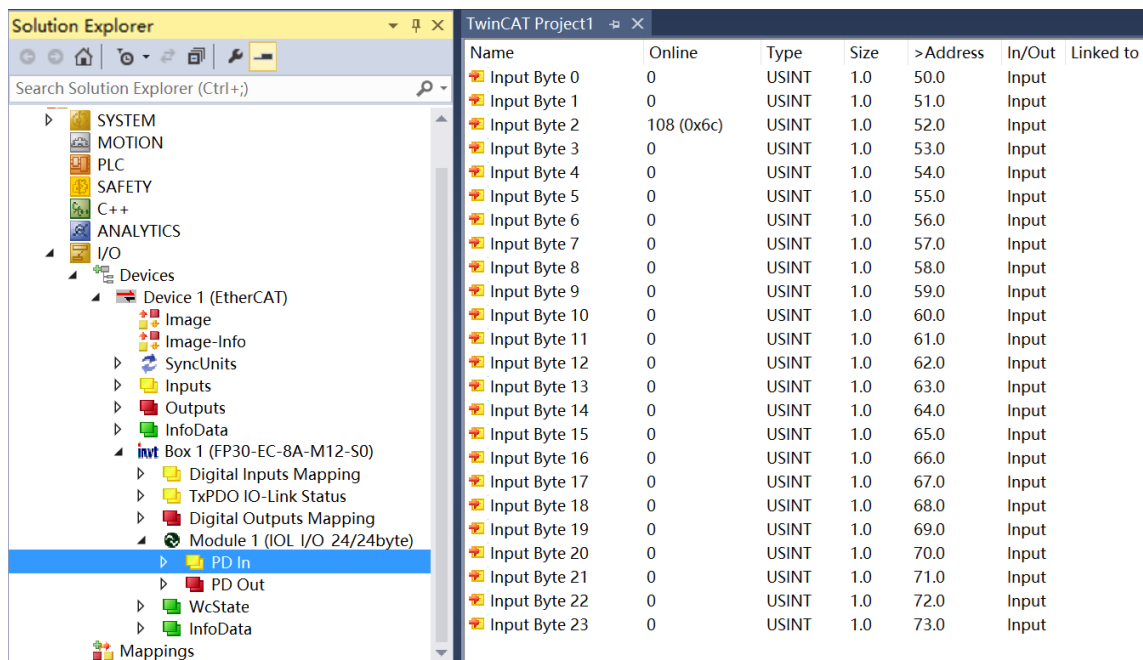
- b) Connect the slave station via the master station's X00 port. Taking the FP30-8CA-A-M12-S0 as an example, with the first channel as an output and the remaining channels as inputs, Output Bytes 0-1 represent the output signal values of slave module X00, and Input Bytes 2-15 represent the input signal

values of slave modules X01-X07. Writing "0x(6C00)" to Output Bytes 0-1 will illuminate the channel indicator lights of slave module X00, as shown in the following figure.



Name	Online	Type	Size	>Address	In/Out	Linked to
Output Byte 0	108 (0x6c)	USINT	1.0	40.0	Output	
Output Byte 1	0	USINT	1.0	41.0	Output	
Output Byte 2	0	USINT	1.0	42.0	Output	
Output Byte 3	0	USINT	1.0	43.0	Output	
Output Byte 4	0	USINT	1.0	44.0	Output	
Output Byte 5	0	USINT	1.0	45.0	Output	
Output Byte 6	0	USINT	1.0	46.0	Output	
Output Byte 7	0	USINT	1.0	47.0	Output	
Output Byte 8	0	USINT	1.0	48.0	Output	
Output Byte 9	0	USINT	1.0	49.0	Output	
Output Byte 10	0	USINT	1.0	50.0	Output	
Output Byte 11	0	USINT	1.0	51.0	Output	
Output Byte 12	0	USINT	1.0	52.0	Output	
Output Byte 13	0	USINT	1.0	53.0	Output	
Output Byte 14	0	USINT	1.0	54.0	Output	
Output Byte 15	0	USINT	1.0	55.0	Output	
Output Byte 16	0	USINT	1.0	56.0	Output	
Output Byte 17	0	USINT	1.0	57.0	Output	
Output Byte 18	0	USINT	1.0	58.0	Output	
Output Byte 19	0	USINT	1.0	59.0	Output	
Output Byte 20	0	USINT	1.0	60.0	Output	
Output Byte 21	0	USINT	1.0	61.0	Output	
Output Byte 22	0	USINT	1.0	62.0	Output	
Output Byte 23	0	USINT	1.0	63.0	Output	

c) When the slave module X01 receives an effective voltage, the input value “27648”, which is “16#6c00”, can be monitored in Input Bytes 2-3, as shown in the figure below.



Name	Online	Type	Size	>Address	In/Out	Linked to
Input Byte 0	0	USINT	1.0	50.0	Input	
Input Byte 1	0	USINT	1.0	51.0	Input	
Input Byte 2	108 (0x6c)	USINT	1.0	52.0	Input	
Input Byte 3	0	USINT	1.0	53.0	Input	
Input Byte 4	0	USINT	1.0	54.0	Input	
Input Byte 5	0	USINT	1.0	55.0	Input	
Input Byte 6	0	USINT	1.0	56.0	Input	
Input Byte 7	0	USINT	1.0	57.0	Input	
Input Byte 8	0	USINT	1.0	58.0	Input	
Input Byte 9	0	USINT	1.0	59.0	Input	
Input Byte 10	0	USINT	1.0	60.0	Input	
Input Byte 11	0	USINT	1.0	61.0	Input	
Input Byte 12	0	USINT	1.0	62.0	Input	
Input Byte 13	0	USINT	1.0	63.0	Input	
Input Byte 14	0	USINT	1.0	64.0	Input	
Input Byte 15	0	USINT	1.0	65.0	Input	
Input Byte 16	0	USINT	1.0	66.0	Input	
Input Byte 17	0	USINT	1.0	67.0	Input	
Input Byte 18	0	USINT	1.0	68.0	Input	
Input Byte 19	0	USINT	1.0	69.0	Input	
Input Byte 20	0	USINT	1.0	70.0	Input	
Input Byte 21	0	USINT	1.0	71.0	Input	
Input Byte 22	0	USINT	1.0	72.0	Input	
Input Byte 23	0	USINT	1.0	73.0	Input	

Appendix

Appendix A

The configuration files for the FP30 series EtherCAT and PROFINET master stations define modules for different byte lengths of input process data, output process data, and combined input/output process data, as 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 is 4 bytes, and the output process data length is 16 bytes.
IOL_I/O_04/32 Byte	Input process data length is 4 bytes, and the output process data length is 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 is 16 bytes, and the output process data length is 4 bytes.

Name	Description
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 is 32 bytes, and the output process data length is 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 port status is represented by 1 byte, where Bit 0–3 indicates the IO-Link port status and Bit 4–7 indicates the IO-Link port error message. See Chapter 7 of "ETG.5001.6220 S (D) V1.0.5.pdf".

Bit0–3 is defined as follows:

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

Bit4–7 is defined as follows:

Value (DEC)	Description
0	No errors
1	Watchdog fault
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 a port is configured in IO-Link mode but no slave device is actually connected, the status will be 0xA4. If a port 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 ErrorTypes 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

Appendix E

Error code		
Classification	Error code	Description
Analog input underflow alarm	0x0001	Channel 0 underflow alarm
	0x0002	Channel 1 underflow alarm
	0x0004	Channel 2 underflow alarm
	0x0008	Channel 3 underflow alarm
	0x0010	Channel 4 underflow alarm
	0x0020	Channel 5 underflow alarm
	0x0040	Channel 6 underflow alarm
	0x0080	Channel 7 underflow alarm
Analog input overflow alarm	0x0100	Channel 0 overflow alarm
	0x0200	Channel 1 overflow alarm
	0x0400	Channel 2 overflow alarm
	0x0800	Channel 3 overflow alarm
	0x1000	Channel 4 overflow alarm
	0x2000	Channel 5 overflow alarm
	0x4000	Channel 6 overflow alarm
	0x8000	Channel 7 overflow alarm

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