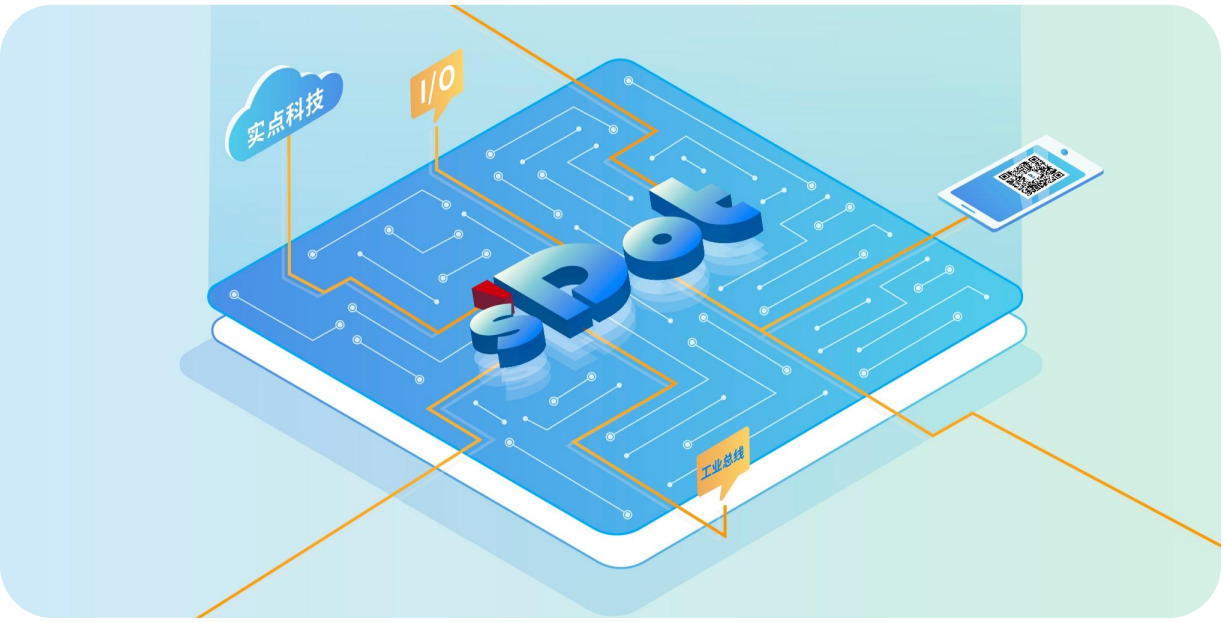

XB6S-PL20

Incremental encoder counting module

User Manual

Nanjing Solidot Electronic Technology Co., Ltd.

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1 Product Overview

1.1 Product Introduction

The XB6S-PL20 is a plug-in incremental encoder counter module that utilizes the X-bus backplane and supports two external 24V single-ended incremental encoders. The module supports functions such as Z-phase zero reset, comparison output, and probe latch. When used with our XB6S series couplers, it can be widely used in various industrial systems and equipment.

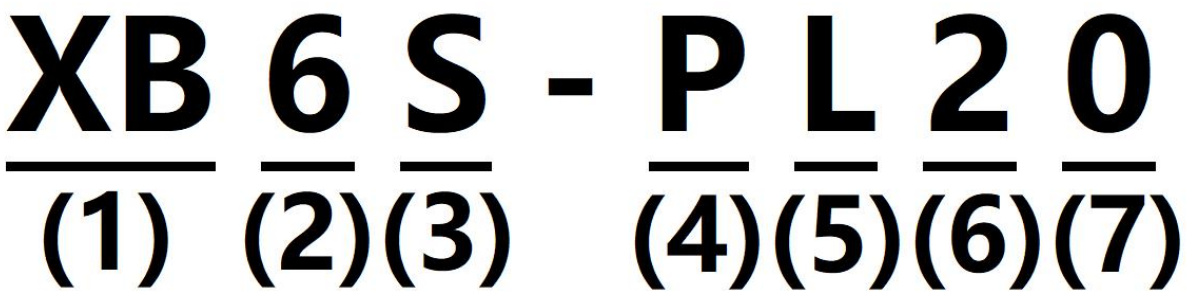
1.2 Product Features

- Three pulse modes
  Supports AB quadrature (ABZ), directional pulse (Pul+Dir), and dual pulse (CW/CCW).
- Two counting ranges for ring counters
  0~2^32-1 or 0~ring counting resolution × counting magnification-1.
- Speed reporting
  Supports reporting the real-time speed of two encoder channels.
- Z phase clear
  Supports Z phase clear function.
- Comparison output
  When the count value reaches the set value, the corresponding output channel outputs a pulse signal with adjustable time.
- Probe latch
  Supports latching the current count value when the voltage of the probe input pin changes.
- Magnification counting
  Supports 4x/2x/1x counting.
- Power-off storage
  Supports power-off storage of count values.
- Small size
  Compact structure and small space occupation.
- Easy configuration
  The configuration is simple and supports mainstream master stations.

- Easy to install
  DIN 35 mm standard rail installation
  It uses spring-type terminal blocks, making wiring quick and easy.

2 Naming conventions

2.1 Naming conventions



Serial Number	Meaning	Description
(1)	Bus type	XB: X-bus
(2)	Product Series	6: Insert type
(3)	Product Version	S: Strengthen, upgraded version
(4)	Module Type	P： Pulse
(5)	Module Function	L： Location S: SSI synchronous serial interface protocol T: Train (PTO: Pulse Train Output) pulse train output C: Count pulse count
(6)	Function input channel number	0, 1, 2, 4, 8
(7)	Function output channel number	0, 1, 2, 4, 8

3 Product Parameters

3.1 General Parameters

Interface parameters	
Product Model	XB6S-PL20
Bus Protocol	X-bus
Process data volume: Downlink	20 Bytes
Process data volume: Uplink	34 Bytes
Channel Type	Encoder input channel: 2 groups of channels (Phase A, Phase B, and Phase Z), PNP/NPN
	Probe input channel: 4 channels (1 encoder with two-probe function), PNP/NPN
	Standard digital input channel: 4 channels （1 encoder with 2 standard digital inputs), PNP/NPN
	Comparison output channel: 4 channels (1 encoder with 2 comparison outputs), NPN
	Ordinary digital output channel: 4 channels (1 encoder with 2 standard digital outputs), NPN
Refresh rate	1ms

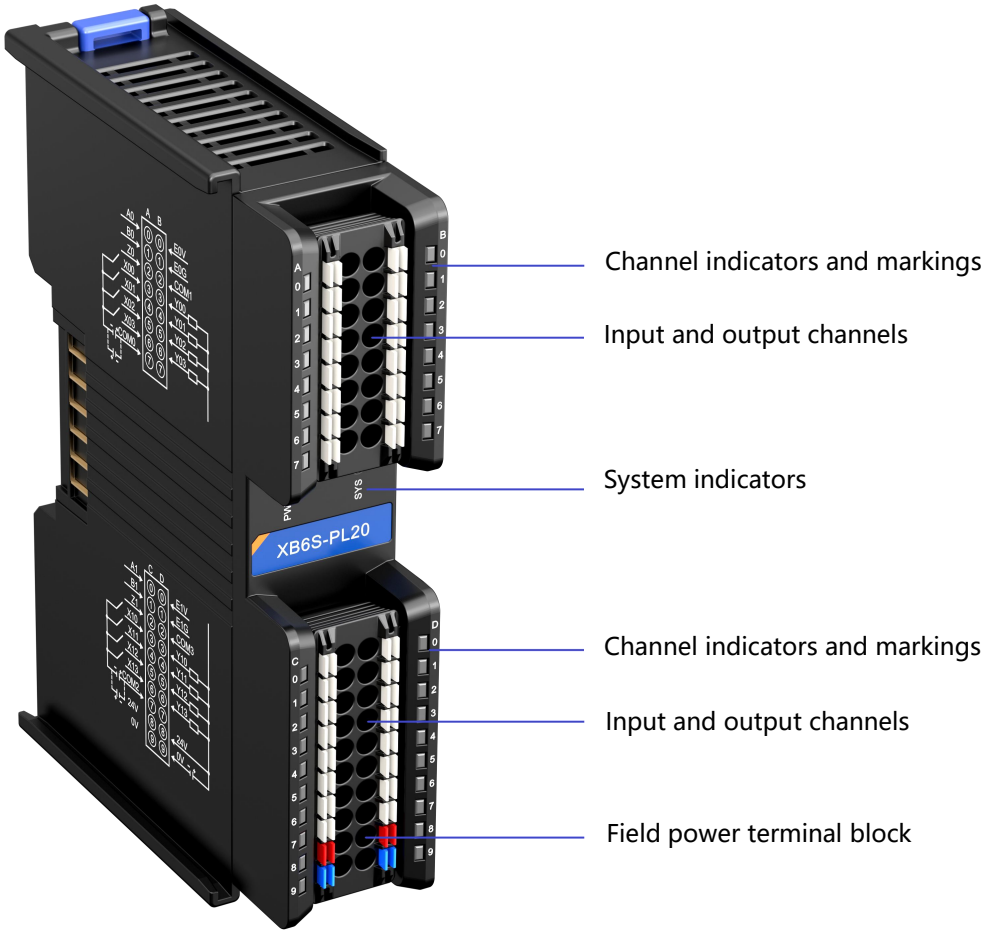
Technical Parameters	
System input power	5VDC (4.5V~5.5V)
Rated current consumption	160mA
Power consumption	0.7W
Field-side power supply rating (range)	24VDC (20.4V~28.8V)
Input channel voltage rating (range)	24VDC (20.4V~28.8V)
Encoder pulse input mode	AB quadrature (ABZ), directional pulse (Pul+Dir), double pulse (CW/CCW)
Encoder pulse input frequency	1MHz
Report channel real-time speed	Support
Z phase clear	Support
Counting rate setting	4x/2x/1x (default 1x)
Ring counting	support
Counting range	0~2^32-1 or0~Ring counting resolution×counting magnification-1
Encoder ring count resolution setting[1]	Support (ring counting resolution setting range is 1~65535)
Count initial value setting	Support (the initial value of the count is set in the range of 0~2^32-1)
Count backward	Support
Encoder input hardware filtering	Support (level 0~15)
Probe function (high-speed hardware latch)	Support
Probe input frequency	1MHz
Comparison output function	support
Comparison of output signal response speed	＜10us
Input and output pin function selection	Support
Power-off storage	Support
Dimensions	106.4×25.7×72.3mm
Weight	110g
Wiring method	Screw-free quick plug
Installation	35mm standard rail installation
Operating temperature	-20℃~+60℃
Storage temperature	-40℃~+80℃
relative humidity	95%, non-condensing
Protection level	IP20

Note [1]: The ring count resolution here is only used to set the ring count range of the encoder and is different from the physical resolution of the encoder itself.

4 Panel

4.1 Panel structure

Name of each part of the product



4.2 Indicator light function

Name	Logo	Color	Status	Status Description
Power indicator	PWR	GREEN	Steady on	Power supply is normal
			OFF	The product is not powered on or the power supply is abnormal
System operation indicator light	SYS	GREEN	Steady on	The system is running normally
			Flashing 1Hz	No business data interaction, waiting for business data interaction to be established
			Flashing 10Hz	Firmware Upgrade
			OFF	System not working
Encoder input AB phase indicator light	0	GREEN	Steady on	Encoder enabled
	1		OFF	Encoder not enabled
Encoder input Z phase indicator	2	GREEN	Steady on	The encoder Z phase clear function has been enabled
			OFF	The encoder Z phase clear function is not enabled
Input channel indicator	3~6 (left side)	GREEN	Steady on	Channel has signal input
			OFF	Channel no signal input
Output channel indicator	3~6 (right side)	GREEN	Steady on	Channel has signal output
			OFF	Channel no signal output

5 Installation and removal

5.1 Installation Guide

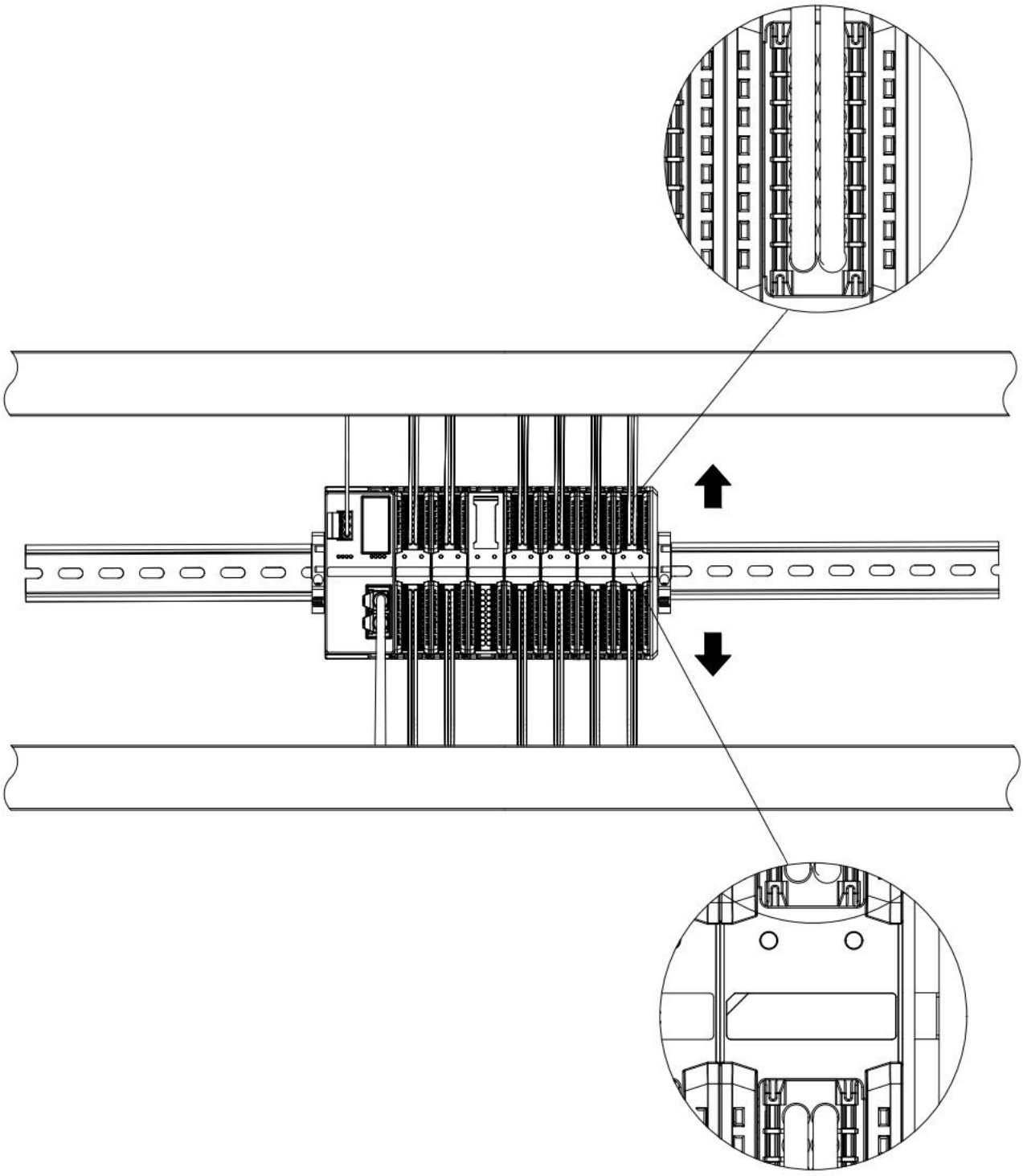
Installation/Removal Precautions

- **The module protection level is IP20. The module needs to be installed in a cabinet and used indoors.**
- **Ensure that the cabinet has good ventilation (such as installing an exhaust fan in the cabinet).**
- **Do not install this device near or over any equipment that may cause overheating.**
- **Be sure to install the module vertically on the fixed rail and ensure that there is sufficient air circulation around it (there should be at least 50 mm of air circulation space above and below the module).**
- **After installing the module, be sure to install the guide rail fixings at both ends to secure the module.**
- **Installation/disassembly must be performed with the power off.**
- **After the module is installed, it is recommended to connect and route the cables in an up-and-down manner.**

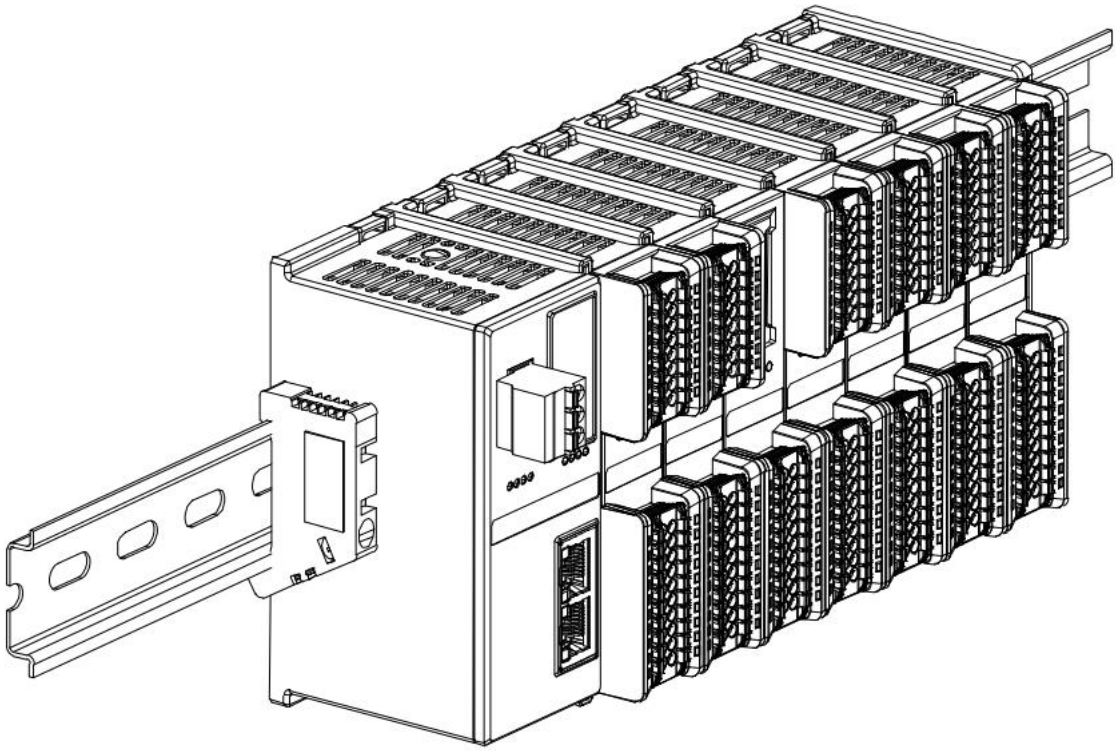
⚠ Warning

- If used in a manner not specified in the product user manual, the protection provided by the equipment may be impaired.

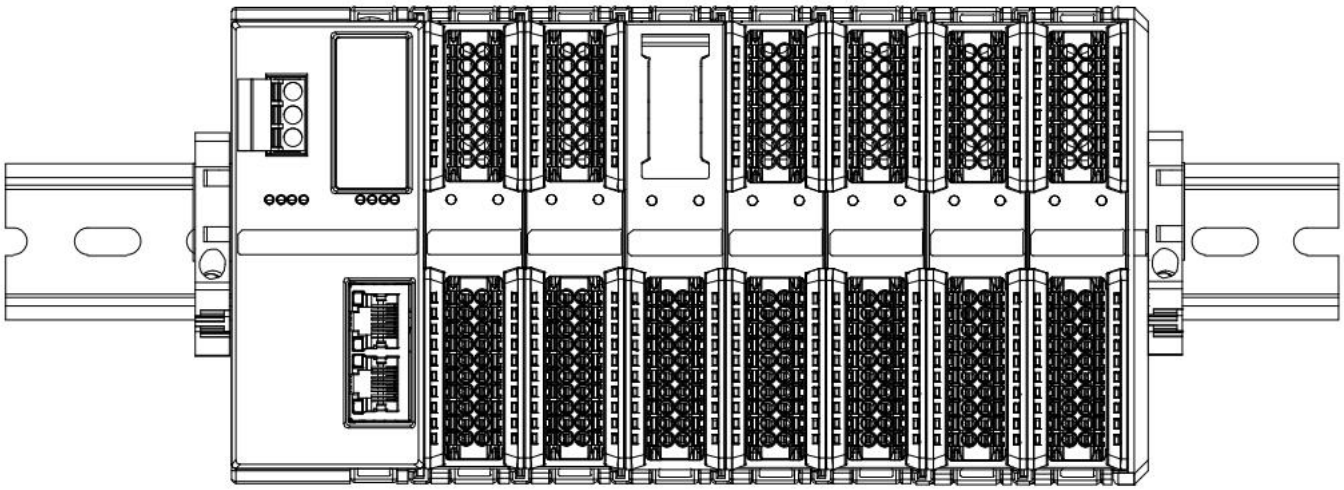
Module installation diagram, minimum clearance between top and bottom (≥ 50mm)



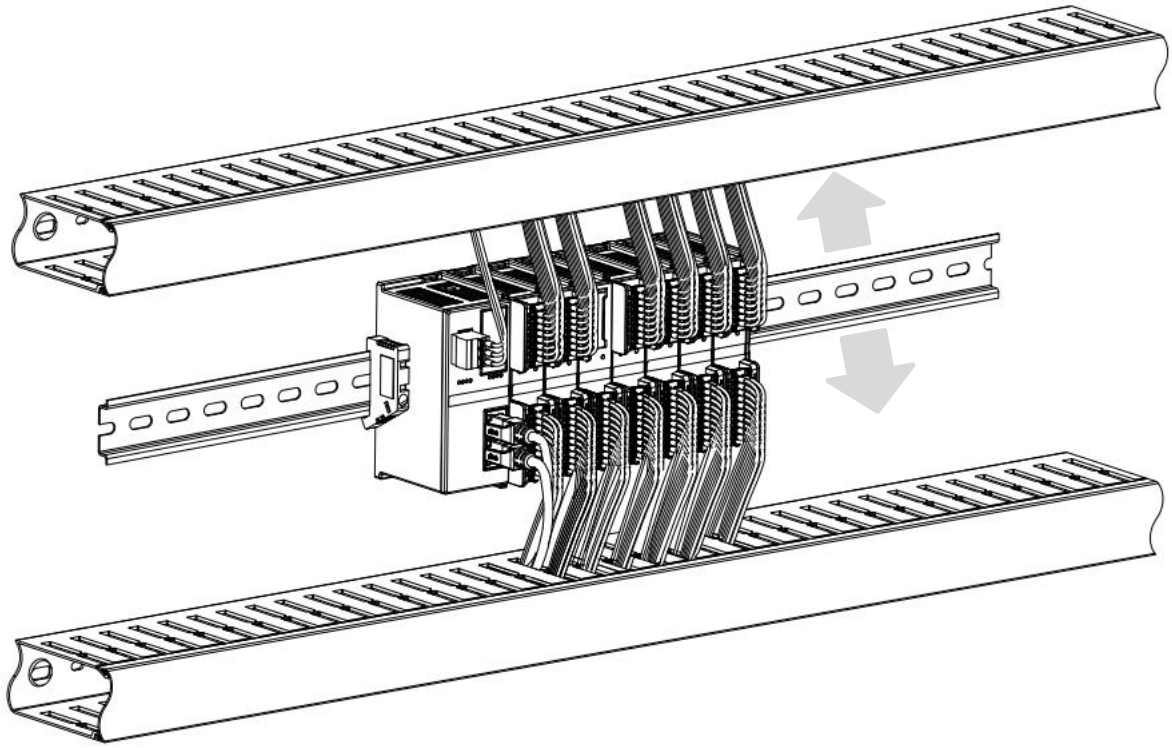
Ensure the module is installed vertically on the fixed rail



Be sure to install the rail fixings



Module upper and lower wiring diagram



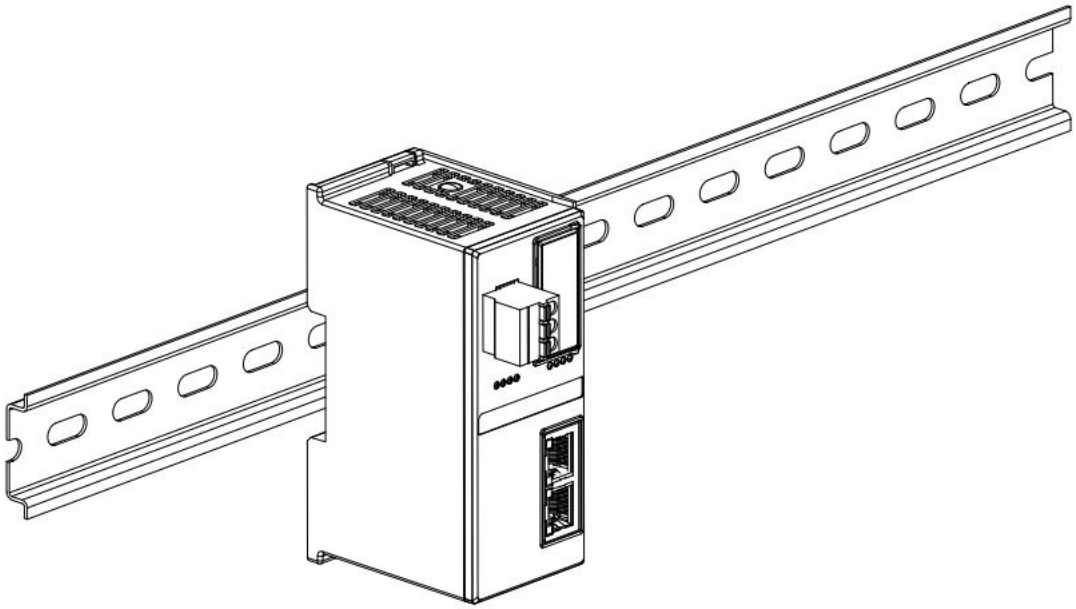
5.2 Installation and removal steps

Module installation and removal	
Module installation steps	1. Install the coupler module on the fixed guide rail first.
	2. Install the required I/O modules or functional modules in sequence on the right side of the coupler module.
	3. After installing all required modules, install the terminal cover to complete the module assembly.
	4. Install the guide rail fixings at both ends of the coupler module and terminal cover to secure the module.
Module disassembly steps	1. Loosen the guide rail fixings at both ends of the module.
	2. Use a flat-blade screwdriver to pry open the module buckle.
	3. Pull out the disassembled module.

5.3 Installation and disassembly diagram

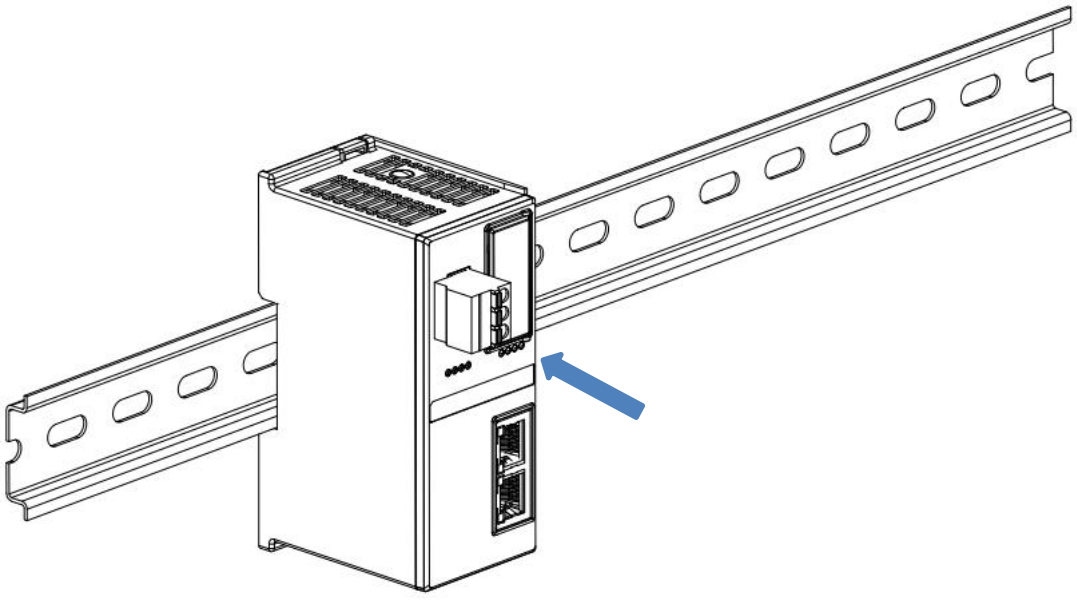
Coupler module installation

- Align the coupler module vertically with the guide rail slot, as shown in Figure ① below.



①

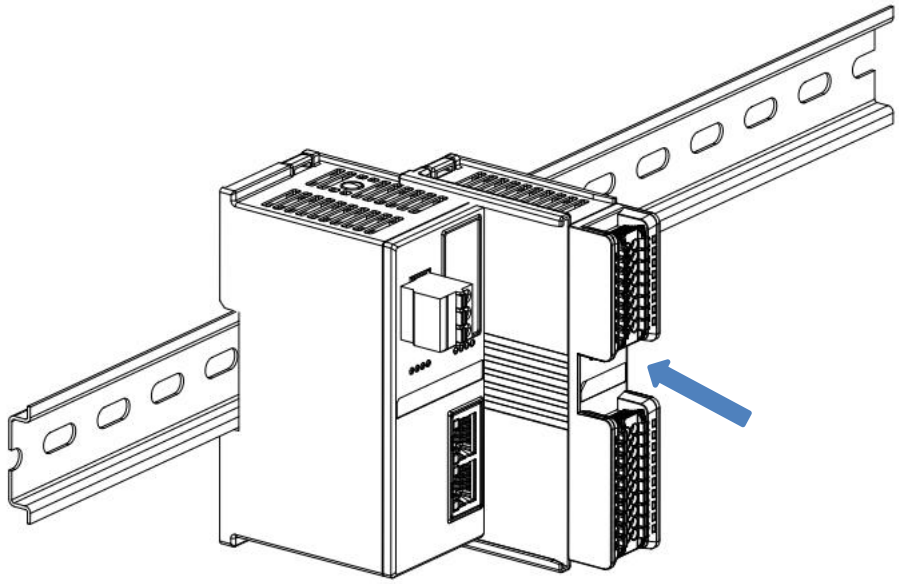
- Press the coupler module toward the guide rail with force until you hear a "click" sound. The module is then installed in place, as shown in Figure ② below.



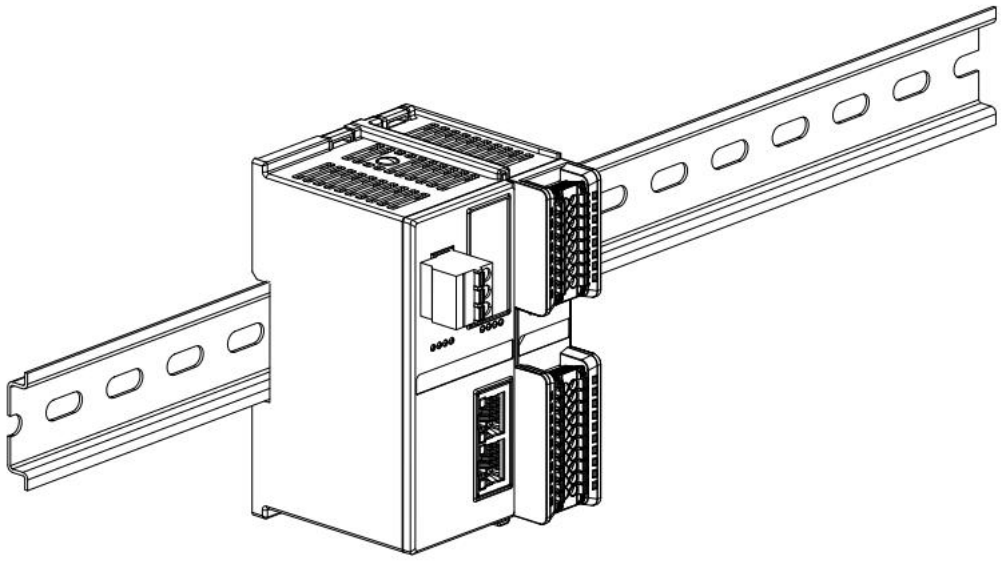
②

I/O module installation

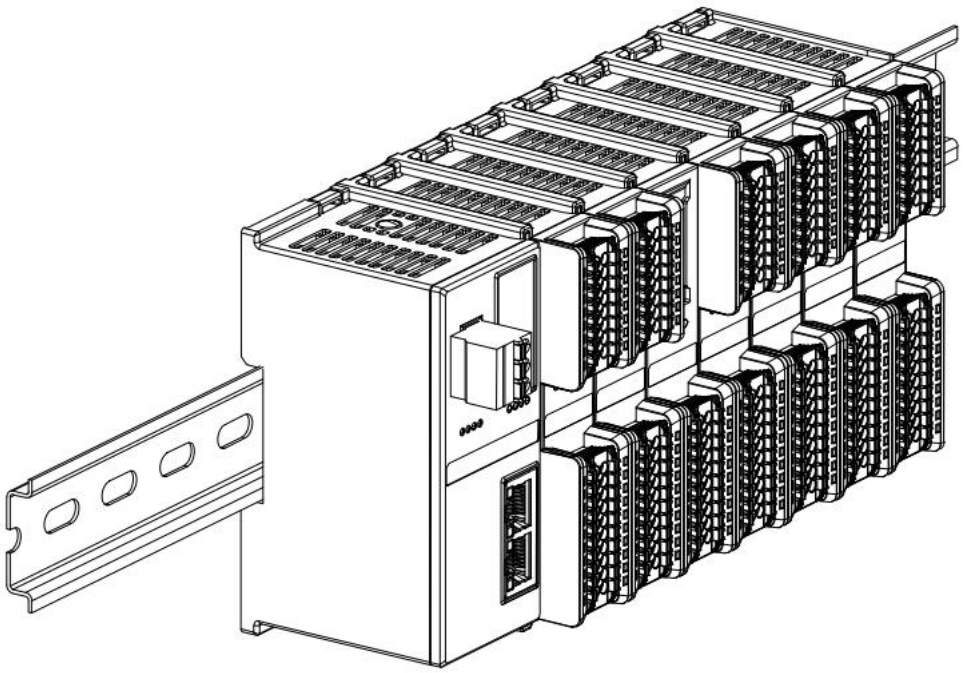
- Follow the steps above to install the coupler module, and install the required I/O modules or functional modules one by one. Push them in as shown in Figures ③, ④, and ⑤ below. When you hear a "click," the module is installed in place.



③



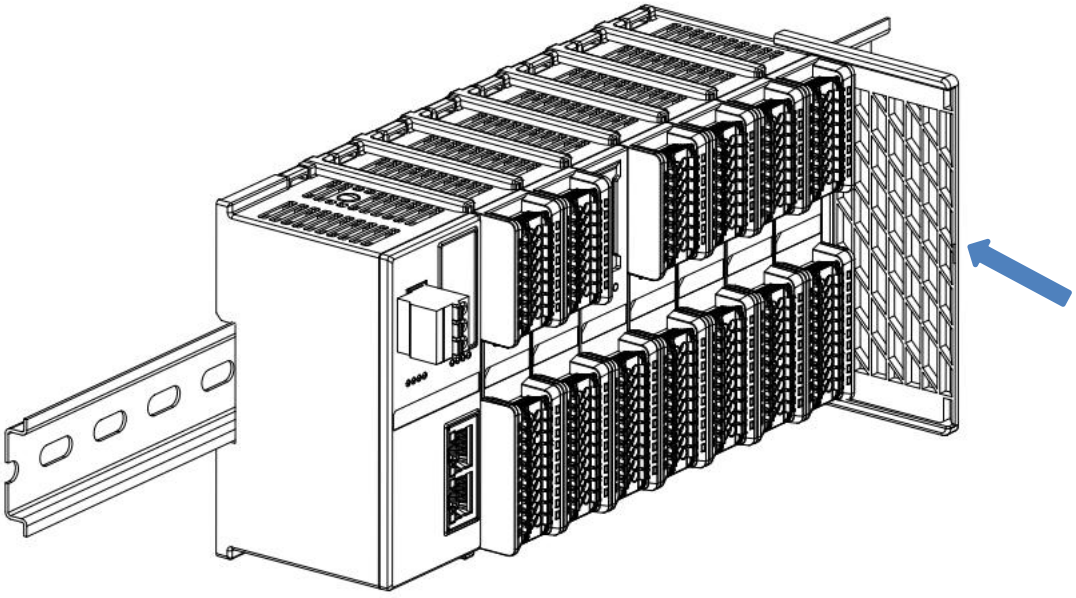
④



⑤

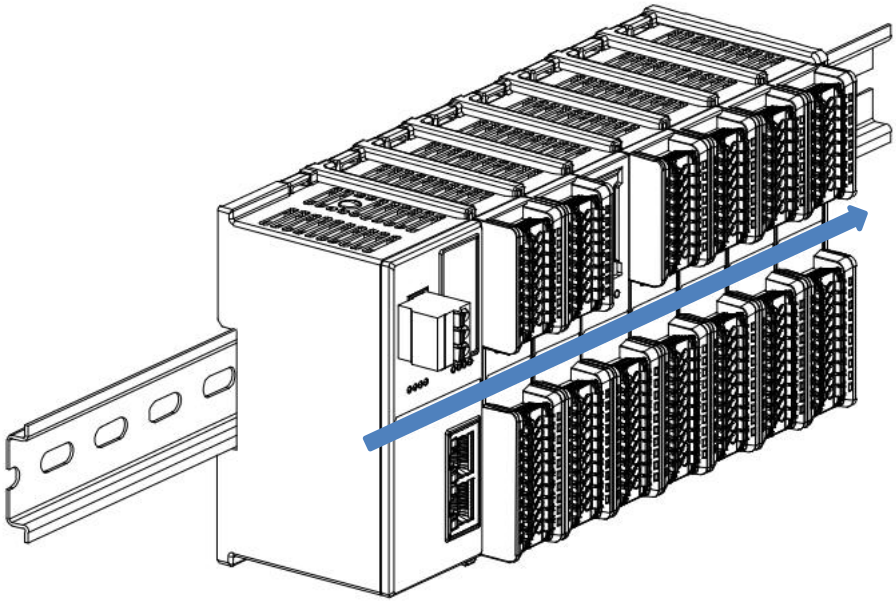
Terminal cover installation

- Install the terminal cover on the right side of the last module, aligning the groove on the terminal cover with the guide rail. Refer to the installation method for the I/O module and push the terminal cover inwards into place, as shown in Figure ⑥ below.



⑥

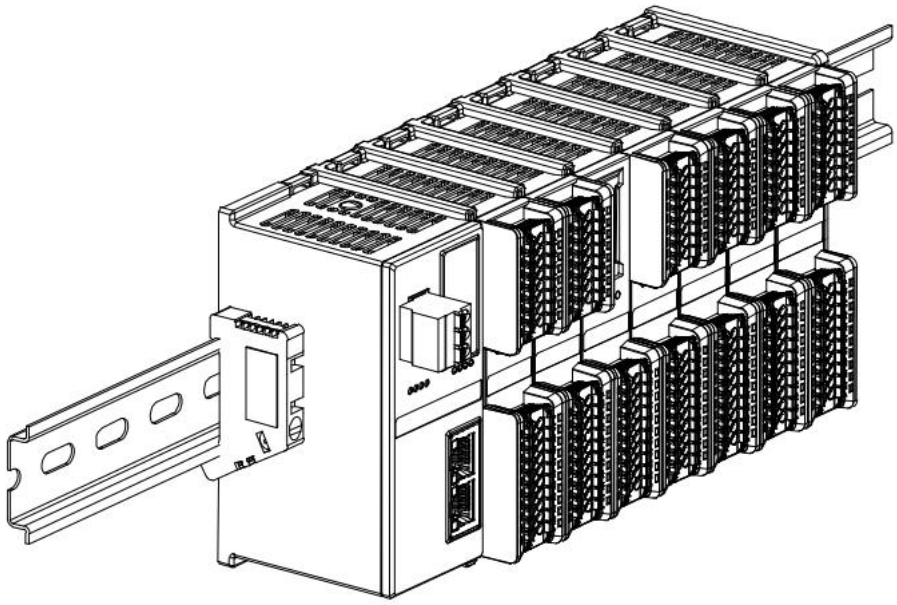
- After the terminal cover is installed, check whether the front of the entire module is flat and ensure that all modules and end covers are installed in place and the front is flush, as shown in Figure 7 below.



⑦

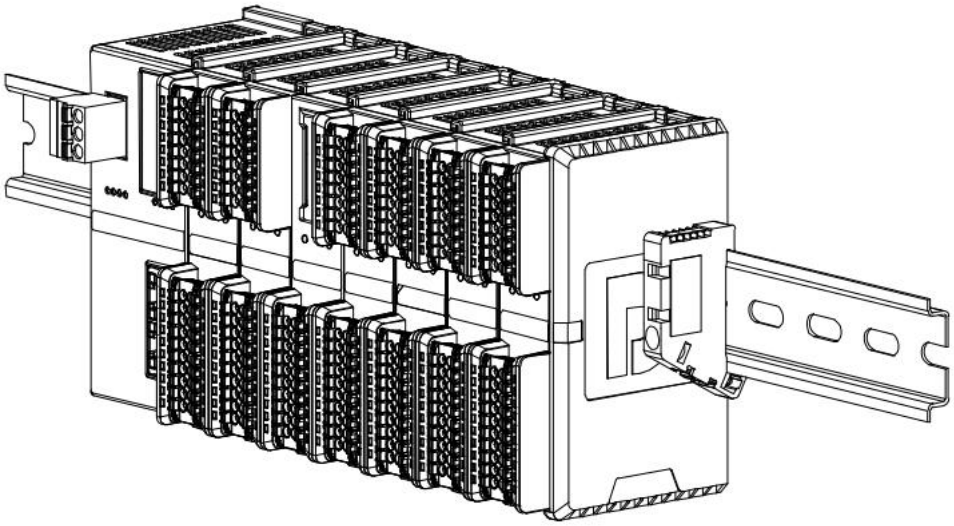
Guide rail fixing installation

- Install and tighten the guide rail fixings close to the left side of the coupler, as shown in Figure ⑧ below.



⑧

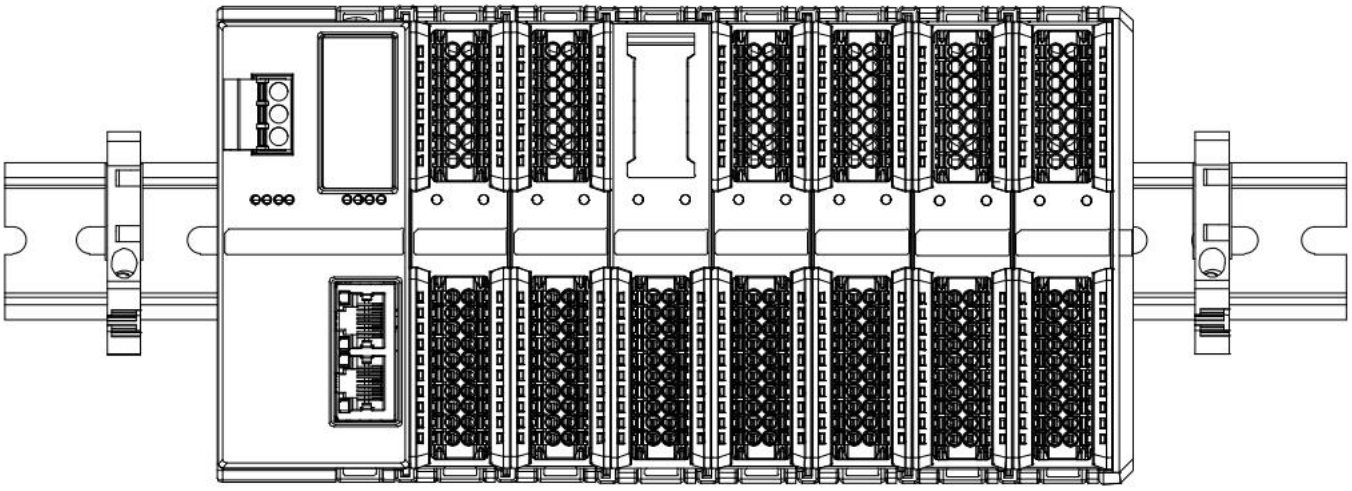
- Install the guide rail fixture on the right side of the terminal cover. First, push the guide rail fixture toward the coupler to ensure that the module is installed firmly, and then tighten the guide rail fixture with a screwdriver, as shown in Figure ⑨ below.



⑨

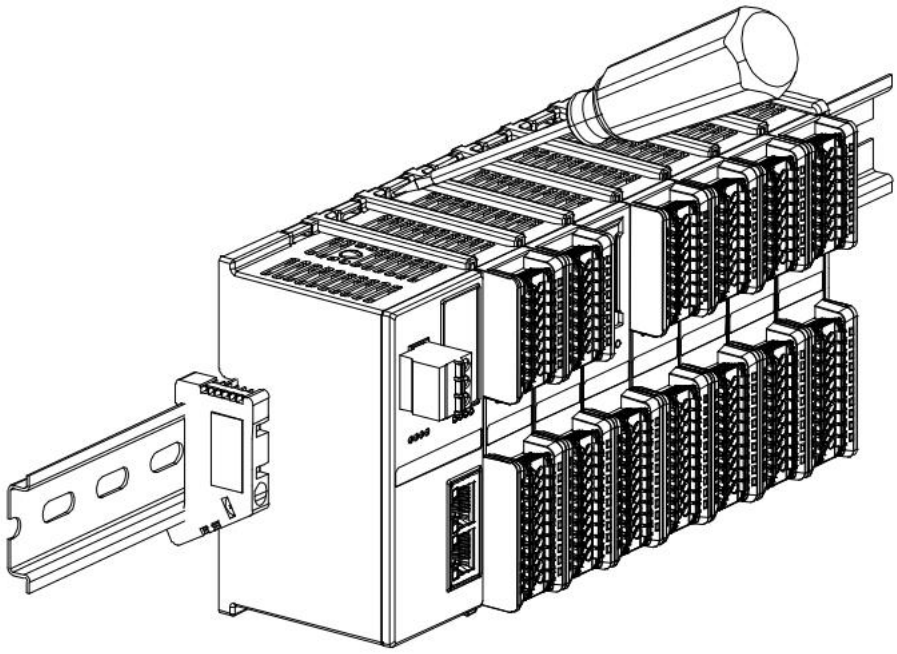
Disassembly

- Use a screwdriver to loosen the guide rail fixture at one end of the module and move it to one side to ensure there is a gap between the module and the guide rail fixture, as shown in Figure ⑩ below.

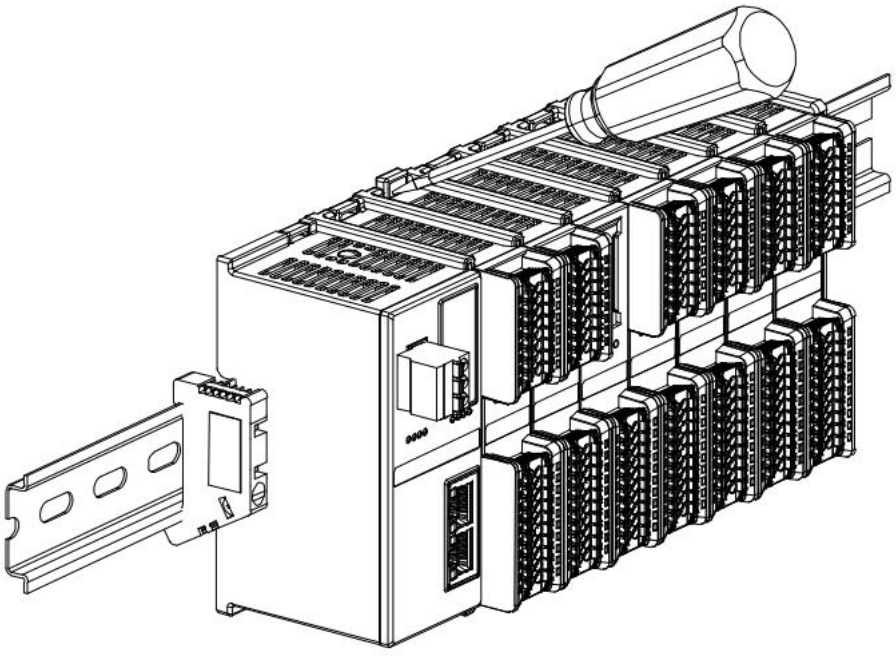


⑩

- Insert a flat-head screwdriver into the buckle of the module to be removed, and apply force sideways toward the module (until you hear a click), as shown in the figure below.⑪and⑫Note: Each module has a buckle on the top and bottom, and both modules are operated in the same way.

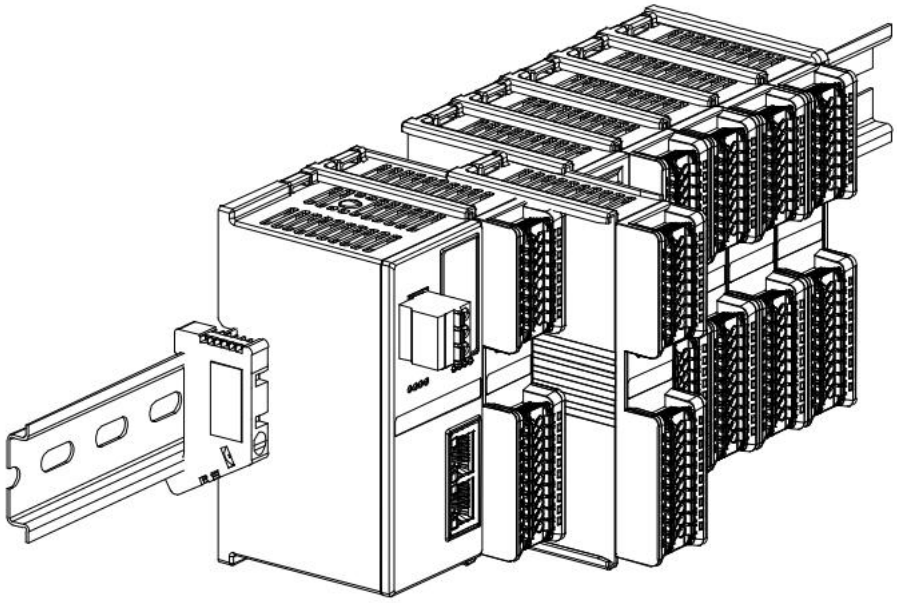


⑪



⑫

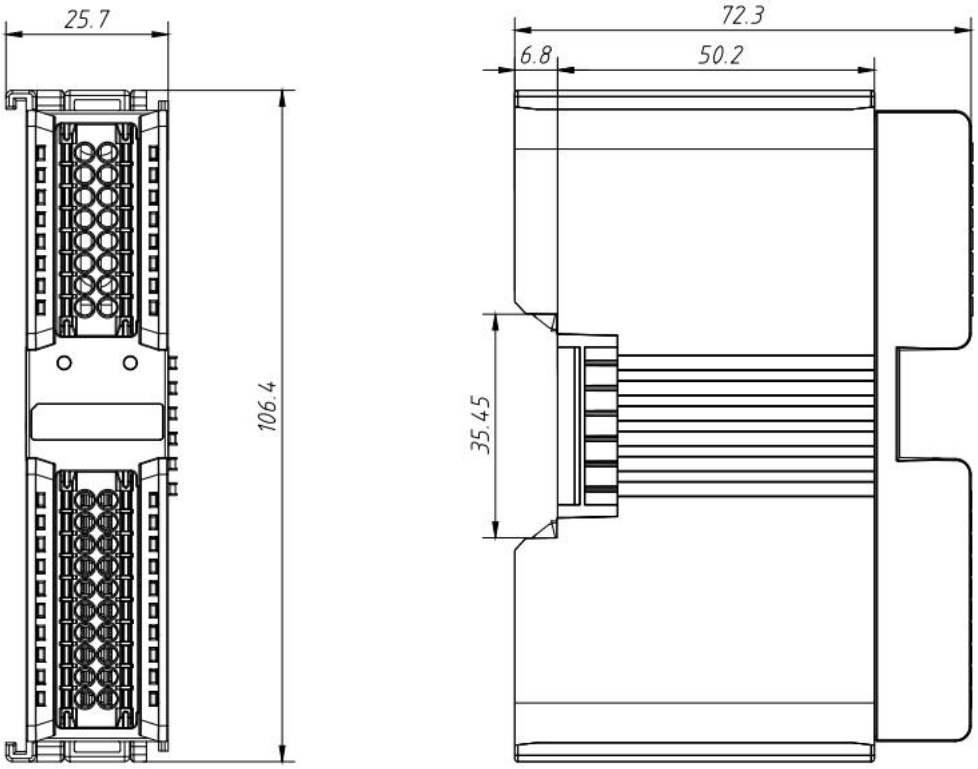
■ Follow the opposite steps of installing the module to disassemble it, as shown below.⑬shown.



⑬

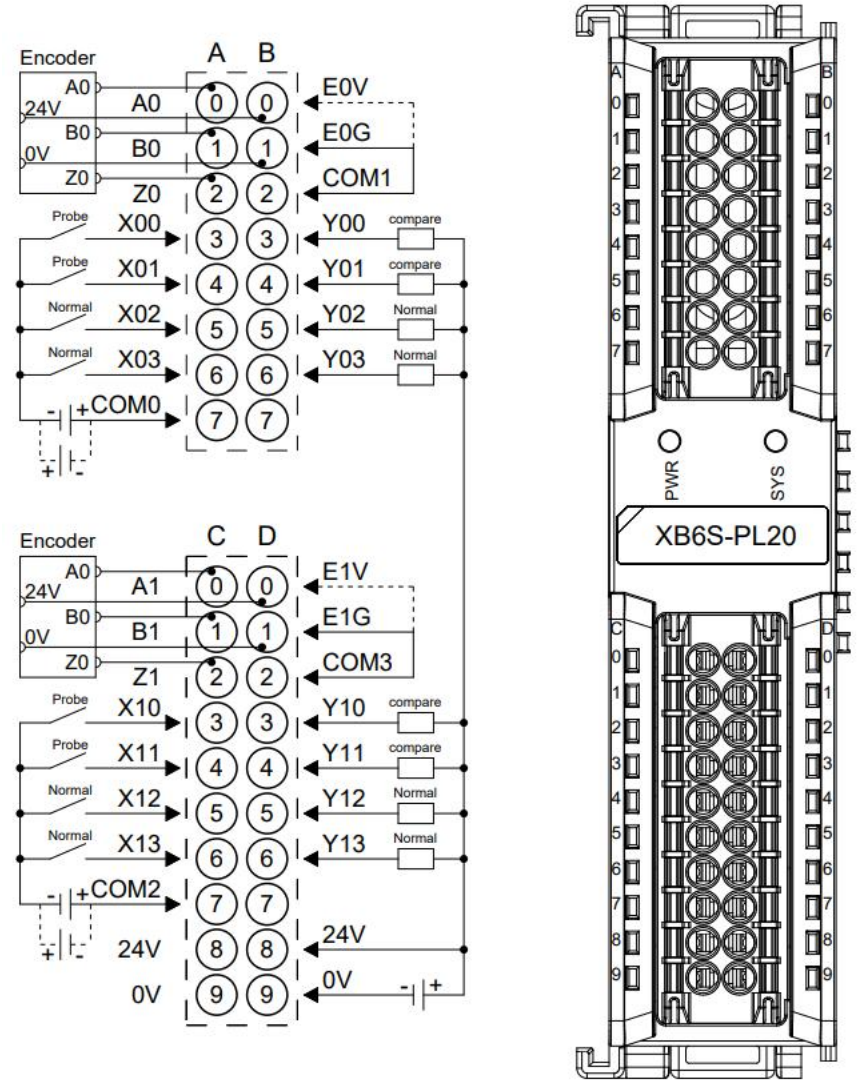
5.4 Dimensions

Overall specifications (unit: mm)



6 Wiring

6.1 Wiring Diagram



- For personal and equipment safety, it is recommended to disconnect the power supply when performing wiring operations.
- COM0 and COM2 are DI common terminals, are not interconnected internally, and are NPN/PNP compatible.
- COM1 and COM3 are common terminals for encoder signals, which are not interconnected internally and are NPN/PNP compatible.
- 24V internal conduction, 0V internal conduction.

6.2 Terminal Block Definition

Encoder0					
A			B		
Terminal marking	Terminal Definition	Description	Terminal marking	Terminal Definition	Description
0	A0	ENC0_A	0	E0V	24V encoder power supply
1	B0	ENC0_B	1	E0G	0V encoder power supply
2	Z0	ENC0_Z	2	COM1	ENC0 encoder common terminal
3	X00	ENC0_Input0 (probe function)	3	Y00	ENC0_Output0 (Comparison Output)
4	X01	ENC0_Input1 (probe function)	4	Y01	ENC0_Output1 (Comparison output)
5	X02	ENC0_Input2 normal DI	5	Y02	ENC0_Output2 standard DO
6	X03	ENC0_Input3 ordinary DI	6	Y03	ENC0_Output3 standard DO
7	COM0	Input common port COM0	7	NC	Empty terminal
Encoder1					
C			D		
Terminal marking	Terminal Definition	Description	Terminal marking	Terminal Definition	Description
0	A1	ENC1_A	0	E1V	24V encoder power supply
1	B1	ENC1_B	1	E1G	0V encoder power supply
2	Z1	ENC1_Z	2	COM3	ENC1 encoder common terminal

3	X10	ENC1_Input0 (probe function)	3	Y10	ENC1_Output0 (Comparison Output)
4	X11	ENC1_Input1 (probe function)	4	Y11	ENC1_Output1 (Comparison Output)
5	X12	ENC1_Input2 normal DI	5	Y12	ENC1_Output2 standard DO
6	X13	ENC1_Input3 ordinary DI	6	Y13	ENC1_Output3 standard DO
7	COM2	Input common port COM2	7	NC	Empty terminal
8	24V	Field side power supply 24V	8	24V	Field side power supply 24V
9	0V	Field side power supply 0V	9	0V	Field side power supply 0V

7 Use

7.1 Process data

7.1.1 Uplink data

Uplink data 34 bytes (17 bytes for each encoder, encoder [n] ranges from 0 to 1)				
name	**meaning**	**Value range**	**Data Type**	**length**
E[n] Input CH0 (Latch)	Encoder probe input signal channel 0	0: No signal input 1: There is signal input	bool	1 bit
E[n] Input CH1 (Latch)	Encoder probe input signal channel 1	0: No signal input 1: There is signal input	bool	1 bit
E[n] Input CH2	Encoder common input signal channel 2	0: No signal input 1: There is signal input	bool	1 bit
E[n] Input CH3	Encoder common input signal channel 3	0: No signal input 1: There is signal input	bool	1 bit
E[n] Latched Flag CH0	Encoder probe input channel 0 latch completion flag	0: 1->0 latch once, toggle once 1: 0->1 latch once, toggle once	bool	1 bit
E[n] Latched Flag CH1	Encoder probe input channel 1 latch completion flag	0: 1->0 latch once, toggle once 1: 0->1 latch once, toggle once	bool	1 bit
E[n] Count Value	Encoder count value	0~2^32-1	unsigned32	4 bytes

E[n] Latch Value CH0	Encoder probe input channel 0 latch value	0~2^32-1	unsigned32	4 bytes
E[n] Latch Value CH1	Encoder probe input channel 1 latch value	0~2^32-1	unsigned32	4 bytes
E[n] Speed	Encoder speed	-2^31~2^31-1	signed32	4 bytes

Uplink data description:

- **Encoder probe input signal channel E[n] Input CH0/CH1 (Latch)**
  Each encoder is equipped with two probe input channels, indicating the presence or absence of input signals from the corresponding probe input channels.
  When the latch function of the probe input channel is not enabled, it can be used as a standard digital input channel.

- **Encoder common input signal channel E[n] Input CH2/CH3**
  Each encoder is equipped with two standard digital input channels, indicating the presence or absence of the corresponding DI channel input signal.

- **Encoder probe input channel latch completion flag E[n] Latched Flag CH0/CH1**
  One encoder is equipped with two probe input channels. After the probe input channel completes a latch, the flag bit will toggle from 0 to 1 or from 1 to 0.
  Example 1: The latch completion flag of encoder 0 probe input channel 1 is 0. After completing one latch, the flag becomes 1. After completing another latch, the flag becomes 0.

- **Encoder count value E[n] Count Value**
  The encoder count value corresponds to the current count value of the encoder, and the value range is 0~2^32-1.

- **Encoder probe input channel latch value E[n] Latch Value CH0/CH1**
  Each encoder is equipped with two probe input channels. By inputting a signal that meets the set conditions into the probe input channel, the current count value of the corresponding encoder can be quickly latched. Therefore, the numerical range of the latched value is the same as the count value, which is 0~2^32-1.

- **Encoder speed E[n] Speed**
  The encoder speed is the pulse speed of the encoder input channel, and its value range is -2^31~2^31-1.

7.1.2 Downlink data

Downlink instruction 20 bytes (10 bytes for each encoder, encoder [n] value 0~1)				
Name	**Meaning**	**Value Range**	**Data Type**	**Length**
E[n] Enable	Encoder counting enable	0: Disability 1: Enable	bool	1 bit bit0
E[n] Z Phase Clear Enable	Encoder Z phase clear enable	0: Disability 1: Enable	bool	1 bit bit1
E[n] Count Clear	Encoder count value cleared	0: Disability 1: Enable	bool	1 bit bit2
E[n] Compare Output CH0 Enable	Encoder comparison output channel 0 enable	0: Disability 1: Enable	bool	1 bit bit3
E[n] Compare Output CH1 Enable	Encoder comparison output channel 1 enable	0: Disability 1: Enable	bool	1 bit bit4
E[n] Compare Output CH0 Direction	Encoder comparison output channel 0 comparison direction	0: Decrement comparison 1: Incremental comparison	bool	1 bit bit5
E[n] Compare Output CH1 Direction	Encoder comparison output channel 1 comparison direction	0: Decrement comparison 1: Incremental comparison	bool	1 bit bit6
E[n] Compare Output CH0 Mode	Encoder comparison output channel 0 trigger mode	0: Single trigger 1: Repeated trigger	bool	1 bit bit7
E[n] Compare Output CH1 Mode	Encoder comparison output channel 1 trigger mode	0: Single trigger 1: Repeated trigger	bool	1 bit bit0
E[n] Output CH0 (Compare)	Encoder output channel 0 (comparison output)	0: Output high level 24V 1: Output low level 0V	bool	1 bit bit1
E[n] Output CH1 (Compare)	Encoder output channel 1 (comparison output)	0: Output high level 24V 1: Output low level 0V	bool	1 bit bit2
E[n] Output CH2	Encoder output channel 2 (standard output)	0: Output high level 24V 1: Output low level 0V	bool	1 bit bit3
E[n] Output CH3	Encoder output channel 3 (standard output)	0: Output high level 24V	bool	1 bit bit4

		1: Output low level 0V		
E[n] Latch CH0 Enable	Encoder probe input channel 0 latch enable	0: Disability 1: Enable	bool	1 bit bit5
E[n] Latch CH1 Enable	Encoder probe input channel 1 latch enable	0: Disability 1: Enable	bool	1 bit bit6
E[n] Compare Value CH0	Encoder comparison output channel 0 setting value	0~2^32-1	unsigned32	4 bytes
E[n] Compare Value CH1	Encoder comparison output channel 1 setting value	0~2^32-1	unsigned32	4 bytes

Downlink data description:

- **Encoder count enable E[n] Enable**
  If the encoder count enable is set to 0, it is disabled; if it is set to 1, it is enabled.

- **Encoder Z phase clear enable E[n] Z Phase Clear Enable**
  If the encoder Z phase clear enable is set to 0, it is disabled, and if it is set to 1, it is enabled.
  After the Z phase clear is enabled, the current count value is cleared by detecting the Z phase signal of the encoder. Each time the encoder rotates one circle, a Z phase pulse is generated and the count value is cleared once.
  The physical resolution of an encoder is the number of pulses it outputs per revolution. The maximum single-turn count is calculated by multiplying the count ratio by the physical resolution. When the Z-phase clear function is enabled and the count value increases or decreases, the count value is cleared once per encoder revolution.

- **Encoder count value cleared E[n] Count Clear**
  Edge control, when it is detected that this bit is set from 0 to 1, the corresponding encoder count value is cleared to 0. If the encoder count initial value is set, the count value is also set to 0.

- **Encoder comparison output--channel enable E[n] Compare Output CH0/CH1 Enable**
  The encoder comparison output enable is set to 0 to disable and to 1 to enable.
  When the comparison output channel function is not enabled, it can be used as a normal digital output channel.
  Note: Before enabling comparison output, you must ensure that the comparison output channel is not outputting. Otherwise, enabling comparison output in the output state will result in constant output.
  See 7.2.3 Comparison output function.

- **Encoder comparison output--channel comparison direction E[n] Compare Output CH0/CH1 Direction**
  When the comparison direction of the encoder comparison output channel is set to 0, it is a decreasing comparison, that is, the count value is from large to small; when it is set to 1, it is an increasing comparison, that is, the count value is from small to large.

- **Encoder comparison output--channel trigger mode E[n] Compare Output CH0/CH1 Mode**
  Encoder comparison output channel trigger mode can be set to: 0 (single trigger), 1 (repeated trigger).
  When the single trigger comparison output function is enabled, a pulse output is triggered when the count value meets the conditions, and no comparison is performed thereafter. To trigger the comparison output again, the comparison output function must be enabled again.
  When the repeated triggering comparison output function is enabled, a pulse output is triggered when the count value meets the conditions, and the next comparison will start immediately, but the pulse output will not be restarted for a period of time within the comparison output pulse time. After

the comparison output triggers the pulse for a period of time, the pulse output will be triggered again if the comparison output conditions are met. See 7.2.3 Comparison output function.

- **Encoder output channel (comparison output) E[n] Output CH0/CH1 (Compare)**
  When the comparison output channel function is not enabled, it can be used as a normal digital output channel. Digital channel output (NPN type output): Setting it to "0" outputs a high level of 24V, and setting it to "1" outputs a low level of 0V.
  When the comparison output is established, the level of this pin will be flipped. Therefore, you can set the invalid/valid level corresponding to the comparison output by setting this bit first and then enabling the comparison output.

- **Encoder output channel (standard output) E[n] Output CH2/CH3**
  Digital channel output (NPN type output): Set to "0" to output high level 24V, set to "1" to output low level 0V.

- **Encoder probe input channel latch enable E[n] Latch CH0/CH1 Enable**
  If the encoder input latch channel enable flag is set to 1, the latch function is enabled; if it is set to 0, the latch function is disabled.

- **Encoder comparison output channel set value E[n] Compare Output CH0/CH1 Set Value**
  The encoder comparison output channel setting value is consistent with the encoder counting range, which is 0~2^32-1.
  After the comparison output function is enabled, the module will compare the current count value with the set value to see if they are consistent. When the comparison direction is consistent with the comparison set value, the corresponding comparison output channel will output a pulse with adjustable time.See 7.2.3 Comparison output function.

7.2 Configuration parameter definition

The module configuration has a total of 23 parameters. Eleven of the two encoders' configuration parameters are identical and independently configured, and one parameter is shared by both encoders (the shared parameter is marked green in the table below). The following table describes the configuration parameters for encoder 0 as an example. Note: All configuration parameters take effect the next time the encoder is enabled.

Function	Parameter name	Value range	Default value
Encoder 0 pulse mode	E0 Pulse Mode	0: ABZ (AB orthogonal)	0
		1: Pul+Dir (direction pulse)	
		2: CW/CCW (double pulse)	
Encoder 0 filtering	E0 Filter Level	Level 0-15	7
Encoder 0 count magnification	E0 Count Ratio	MUL_1, 2, 4 (valid only in AB orthogonal mode)	MUL_1
Encoder 0 counting range	E0 Count Range	0: 2^32 (0~2^32-1)	0
		1: Resolution × Multiple (0~ring counting resolution × counting magnification - 1, only valid in AB orthogonal mode)	
Encoder 0 ring count resolution	E0 Count Resolution	1~65535	1
Encoder 0 counting direction	E0 Count Direction	0: Forward	0
		1: Backward	
Encoder 0 count initial value	E0 Initial Value	0~2^32-1	0
Encoder 0 probe mode	E0 Latch Mode	0: CH0 Single, CH1 Single Channel 0 single, channel 1 single	0
		1: CH0 Repeat, CH1 Single Channel 0 repeat, channel 1 single	
		2: CH0 Single, CH1 Repeat Channel 0 single, channel 1 repeated	
		3: CH0 Repeat, CH1 Repeat Channel 0 repeat, channel 1 repeat	
Encoder 0 probe trigger edge	E0 Latch Edge	0: CH0 Raising, CH1 Raising Channel 0 rising edge, channel 1 rising edge	0
		1: CH0 Falling, CH1 Raising Channel 0 falling edge, channel 1 rising edge	
		2: CH0 Raising, CH1 Falling	

		Channel 0 rising edge, channel 1 falling edge	
		3: CH0 Falling, CH1 Falling Channel 0 falling edge, channel 1 falling edge	
Encoder 0 comparison output channel 0 pulse time	E0 Compare Output Time CH0	1~65535 (unit: ms)	10
Encoder 0 comparison output channel 1 pulse time	E0 Compare Output Time CH1	1~65535 (unit: ms)	10
Power-off storage enable	Power Off Storage	0: OFF	1
		1: ON	

7.2.1 Encoder counting function

The encoder counting parameters include 7 parameters: encoder pulse mode, filtering, counting magnification, counting range, ring counting resolution, counting direction and counting initial value.

Encoder pulse mode: The input pulse modes supported by the encoder count include AB quadrature mode, direction pulse mode, and CW/CCW mode.

Encoder filtering: The encoder filter is effective in all three pulse modes and has 16 levels of filtering (0-15), with level 0 indicating no filtering and level 15 indicating maximum filtering. The encoder filter parameter defaults to level 7 and can be configured as needed.

Encoder counting ratio: The encoder count multiplication factor is only effective in AB quadrature pulse mode.

Encoder counting range: The encoder's counting range can be set to 0 to 2^32-1 or 0 to ring counting resolution × counting magnification - 1. The former is suitable for most cases, while the latter is suitable for situations where the encoder has no Z-phase signal but still needs to be used for single-turn counting.

Encoder ring count resolution: The ring counting resolution is used to set the counting range of the encoder, and the setting range is 1~65535.

Note: The ring count resolution here is different from the physical resolution of the encoder itself. When the resolution is set to 0, the counting range is set to 1, that is, 0 to ring count resolution × counting magnification - 1, and the ring count does not take effect.

Encoder counting direction: The encoder counting direction defaults to 0, which is forward counting; when it is set to 1, the encoder will count in the reverse direction after the encoder is re-enabled.

Encoder count initial value: The encoder's initial count value supports configuration and automatically takes effect after the encoder is re-enabled. The setting range of the initial count value is 0 to 2^32-1. Note: When the power-off storage function is enabled, the initial count value is invalid and the encoder's initial count value is 0. If the initial count value is greater than the maximum ring count value, the ring count will not take effect.

Example 1: Set the encoder's pulse mode to AB quadrature mode, the encoder's counting range to 0 to ring count resolution × count magnification - 1, the ring count resolution to 50,000, the count magnification to 4, the counting direction to forward, and the initial count value to 0, so the counting range is 0 to 200,000. Connect an encoder with a physical resolution of 1000 to the module. After counting begins, the count value increases from 0. Each encoder rotation results in a count value of 1000 × 4 = 4000. After reaching 200,000, it returns to 0 and continues counting.

7.2.2 Probe function

The probe function parameters include probe mode and probe trigger edge. Each encoder is equipped with two probe input channels. By inputting the corresponding signal into the probe input channel, the count value of the corresponding encoder can be latched.

Probe Mode: The probe mode parameter can configure each probe function channel of the encoder to single/continuous mode.

If the probe function channel is configured in single mode, after the probe function is enabled, the count value can be latched once when the channel inputs a signal that meets the set conditions; when a signal that meets the set conditions is input again subsequently, the count value will no longer be latched unless the probe function channel is re-enabled.

If the probe function channel is configured in continuous mode, after the probe function is enabled, each time the channel inputs a signal that meets the set conditions, the count value can be latched once, and the count value can be latched multiple times.

Probe trigger edge: The probe trigger edge parameter allows you to configure each encoder probe channel for rising or falling edge triggering. The latch trigger signals for each encoder's two probe function channels can be configured independently, and the latched values can be displayed separately.

The probe input channel is compatible with both PNP and NPN signals through the COM terminal. When the COM terminal is connected to 0V, the input signal is PNP type, and a high-level 24V input signal is valid, while a low-level 0V input signal is invalid. When the COM terminal is connected to 24V, the input signal is NPN type, and a low-level 0V input signal is valid, while a high-level 24V input signal is invalid.

Rising edge triggering means that the probe input channel is triggered from an invalid signal to a valid signal, and falling edge triggering means that the probe input channel is triggered from a valid signal to an invalid signal.

7.2.3 Comparison output function

Comparison output function By configuring the comparison output channel enable, comparison output set value, comparison direction, single/repeated trigger mode, and comparison output channel pulse time, when the encoder count value reaches the set value and satisfies the comparison direction, the corresponding comparison output channel will output a pulse with an adjustable time. The adjustable time is the comparison output pulse time. The comparison output function has a pulse output response speed of up to 10us.

The configuration parameters of the comparison output function include the encoder comparison output channel pulse time, and the configurable time range is 1~65535ms.

Each encoder is equipped with two comparison output channels. The comparison output channel enable, comparison output set value, comparison direction, and single/repeat trigger mode can all be set in the Downlink data. When the comparison output channel function is not enabled, the comparison output channel can be used as a normal digital output.

Example 1: When the comparison output channel 1 of encoder 0 is used as a normal digital output, the output value is set to 0 (NPN type output, the output is 24V), the channel indicator light is off.

Encoder 0 comparison output channel 1 is set to 1000, the comparison direction is set to ascending comparison, the comparison output trigger mode is single trigger, and the comparison output channel 1 pulse duration is configured to 5 seconds. After the comparison output channel 1 function is enabled, when the encoder 0 count value reaches 1000 from small to large (satisfying the comparison direction), comparison output channel 1 will function as the comparison output channel output, and its state will flip from high-level output to low-level output. The pulse output duration is 5 seconds, and the channel indicator will remain on for 5 seconds. After 5 seconds, the high-level output will resume, and the channel indicator will go off. When the count value again meets the comparison output setting value and comparison direction, the comparison output channel will not respond because the comparison output trigger mode is single trigger.

Example 2: When the comparison output channel 1 of encoder 0 is used as a normal digital output, the output value is set to 1 (NPN type output, the output is 0V at this time), the channel indicator light is always on.

The setting value of encoder 0 comparison output channel 1 is set to 1000, the comparison direction is set to decrement comparison, the comparison output trigger mode is repeated trigger, and the comparison output channel 1 pulse time is configured to 5s. After the comparison output channel 1 function is enabled, when the count value of encoder 0 reaches 1000 from small to large (not meeting the comparison direction), comparison output channel 1 does not respond. When the count value of encoder 0 reaches 1000 from large to small (meeting the comparison direction), the comparison output channel will function as the comparison output channel output, and the state will flip from the original low-level output to high-level output. The pulse output time is 5s, and the channel indicator will go out for 5s. After 5s, the low-level output will resume, and the channel indicator will be permanently on.

When the comparison output trigger mode is set to repeat trigger, if the count value again meets the comparison output setting value and comparison direction within the 5-second pulse output time, the comparison output channel will not change the pulse output state and will continue to output pulses for 5 seconds. If the comparison condition is met again after 5 seconds, the state will flip again, from the

original high-level output to low-level output, the pulse output time will be 5 seconds, and the channel indicator will be off for 5 seconds. The same logic applies to repeat triggering of comparison output.

7.2.4 Power-off storage function

When the power-off storage enable parameter is turned on, the encoder count value can be stored when the system is powered off. The default value is 1, which means the power-off storage function is turned on. Set it to 0 to turn off the power-off storage function.

When the power-off storage function is enabled, the encoder count initial value is invalid and the encoder count initial value is 0.

7.3 Use Cases

- **Encoder 0 inputs AB quadrature pulses, the number of pulses is 40,000, and encoder 0 probe input channel 0 is latched**
  a. Configure the configuration parameters;
     a) The encoder 0 pulse mode is set to AB quadrature pulse mode, that is, E0 Pulse Mode is set to 0: ABZ;
     b) The encoder 0 count ratio is set to 4 times, that is, E0 Count Ratio is set to MUL_4;
     c) The encoder 0 count range is set to 0~ring count resolution×count multiplication-1, that is, E0 Count Range is set to 1:Resolution×Multiple;
     d) The encoder 0 ring count resolution is set to 20000, that is, E0 Count Resolution is set to 20000;
     e) The encoder 0 counting direction is set to forward counting, that is, E0 Count Direction is set to 0: Forward;
     f) The initial value of encoder 0 count is set to 0, that is, E0 Initial Value is set to 0;
     g) The encoder 0 probe mode is set to channel 0 single and channel 1 single, that is, E0 Latch Mode is set to 0: CH0 Single, CH1 Single;
     h) The encoder 0 probe trigger edge is set to the rising edge of channel 0 and channel 1, that is, E0 Latch Edge is set to 0: CH0 Raising, CH1 Raising;
  b. Set encoder 0 counting enable and encoder 0 probe input channel 0 latch enable;
     a) Downlink data E0 Enable is set to 1;
     b) Downlink data E0 Latch CH0 Enable is set to 1;
  c. Encoder 0 starts inputting pulses, and encoder 0 probe input channel 0 inputs valid signals.

- **Encoder 0 input direction pulse, pulse quantity 40000, encoder 0 comparison output channel 0 comparison output**
  a. Configure the configuration parameters;
     a) The encoder 0 pulse mode is set to direction pulse mode, that is, E0 Pulse Mode is set to 1: Pul+Dir;
     b) The encoder 0 count range is set to 0~2^32-1, that is, the E0 Count Range is set to 0:2^32;
     c) The encoder 0 counting direction is set to forward counting, that is, E0 Count Direction is set to 0: Forward;
     d) The initial value of encoder 0 count is set to 0, that is, E0 Initial Value is set to 0;
     e) The encoder 0 comparison output channel 0 pulse time is set to 10s, that is, E0 Compare Output Time CH0 is set to 10000;
  b. Set encoder 0 counting enable, encoder 0 comparison output channel 0 set comparison set value, comparison direction and comparison mode and enable;
     a) Downlink data E0 Enable is set to 1;
     b) Downlink data E0 Compare Value CH0 is set to 1000;
     c) Set the Downlink data E0 Compare Output CH0 Direction to 1 for incremental comparison;
     d) Downlink data E0 Compare Output CH0 Mode is set to 1 for repeated triggering;
     e) Set the downlink data E0 Compare Output CH0 Enable to 1 to enable;
  c. Encoder 0 starts inputting pulses.

7.4 Module Configuration Description

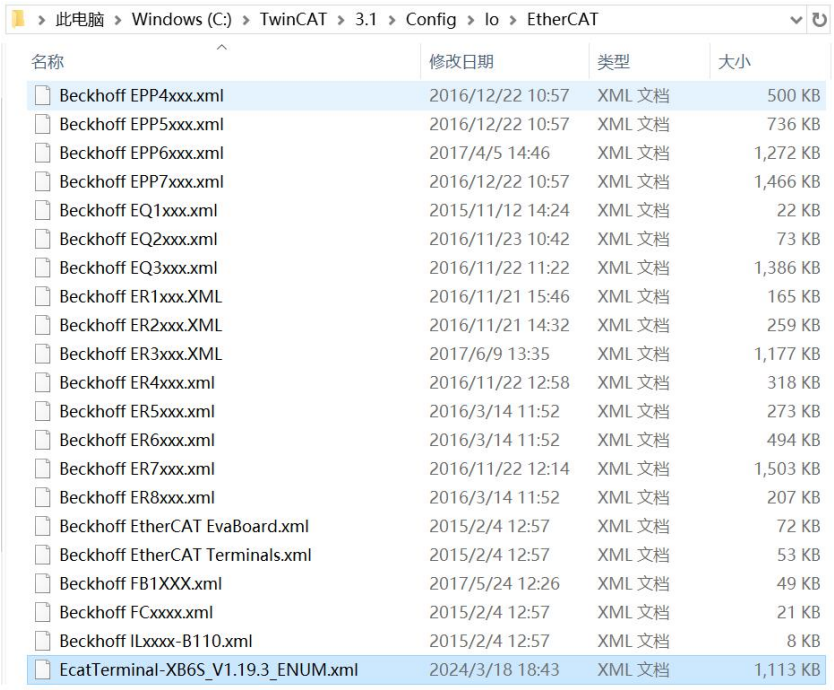
7.4.1 Application in TwinCAT3 software environment

1、Preparation

- **Hardware environment**
  - **Module model XB6S-PL20**
  - **EtherCAT coupler, end cap**
    This description takes the XB6S-EC2002 coupler as an example
  - **A computer with TwinCAT3 software pre-installed**
  - **EtherCAT dedicated shielded cable**
  - **Pulse output type sensors and other equipment, this description takes the connection of XB6S-PT04A module as an example**
  - **Encoders and other equipment**
  - **A switching power supply**
  - **Module mounting rails and rail fixings**
  - **Device Profile**
    Configuration file acquisition address:
    https://www.solidotech.com/cn/resources/configuration-files
- **Hardware configuration and wiring**
  Please follow the "5 Installation and removal""6 Wiring"

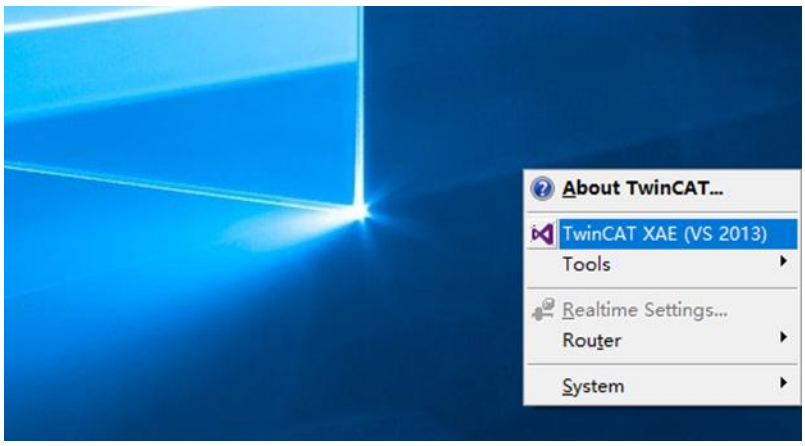
2、Pre-configured profiles

Place the ESI configuration file (EcatTerminal-XB6S_V1.19.3_ENUM.xml) in the TwinCAT installation directory "C:\TwinCAT\3.1\Config\Io\EtherCAT", as shown in the figure below.

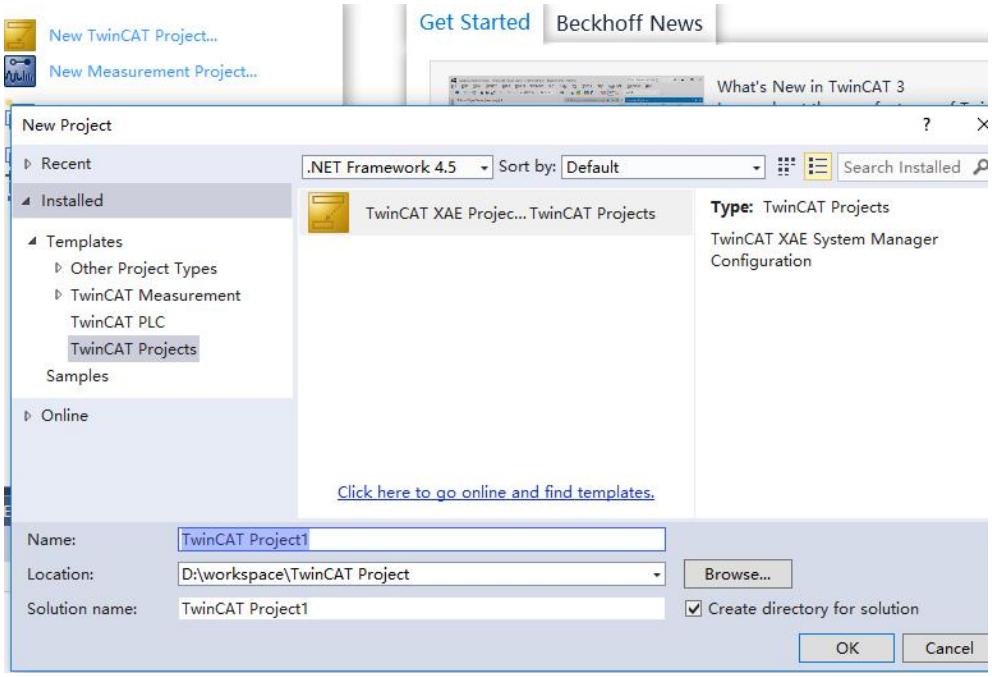


3、Create a project

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

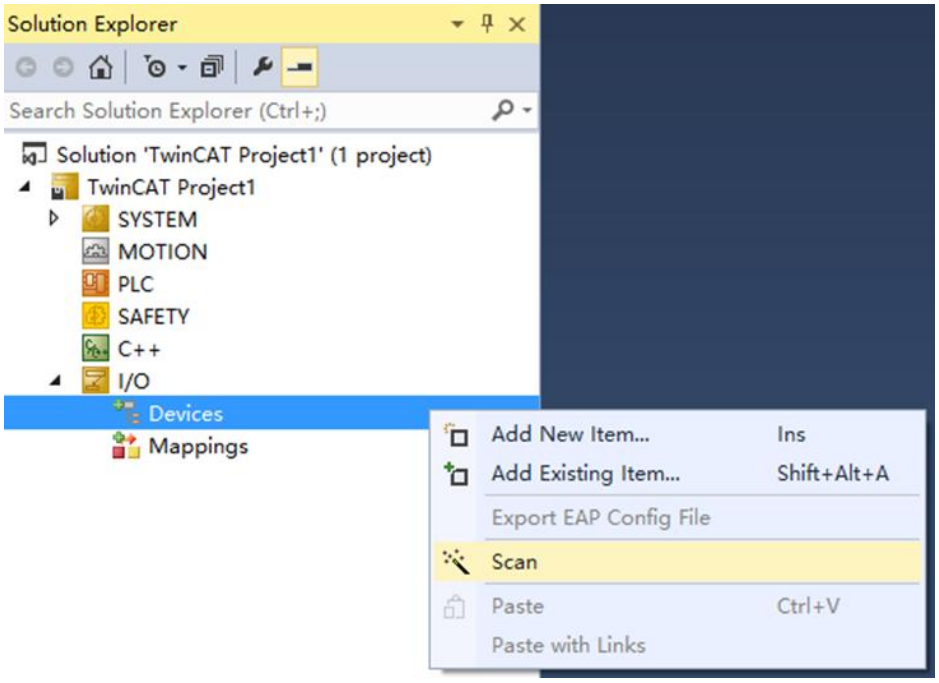


b. Click "New TwinCAT Project". In the pop-up window, enter the project name and solution name in "Name" and "Solution name" respectively, and the project path in "Location". You can select the default values for these three items. Then click "OK". The project is created successfully, as shown in the figure below.

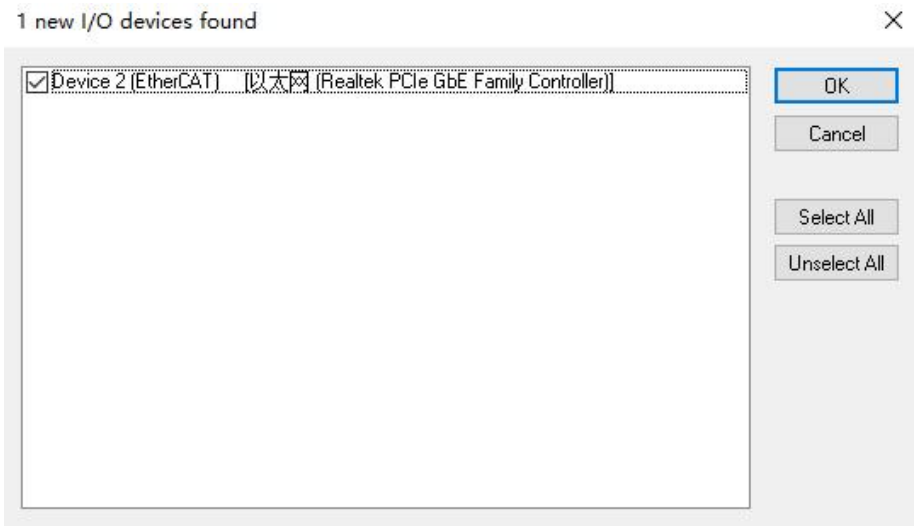


4、Scanning Devices

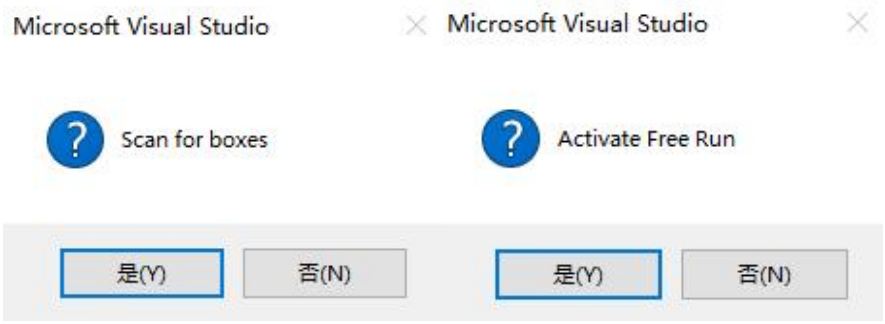
a. After creating the project, right-click the "Scan" option under "I/O -> Devices" to scan the slave devices, as shown in the figure below.



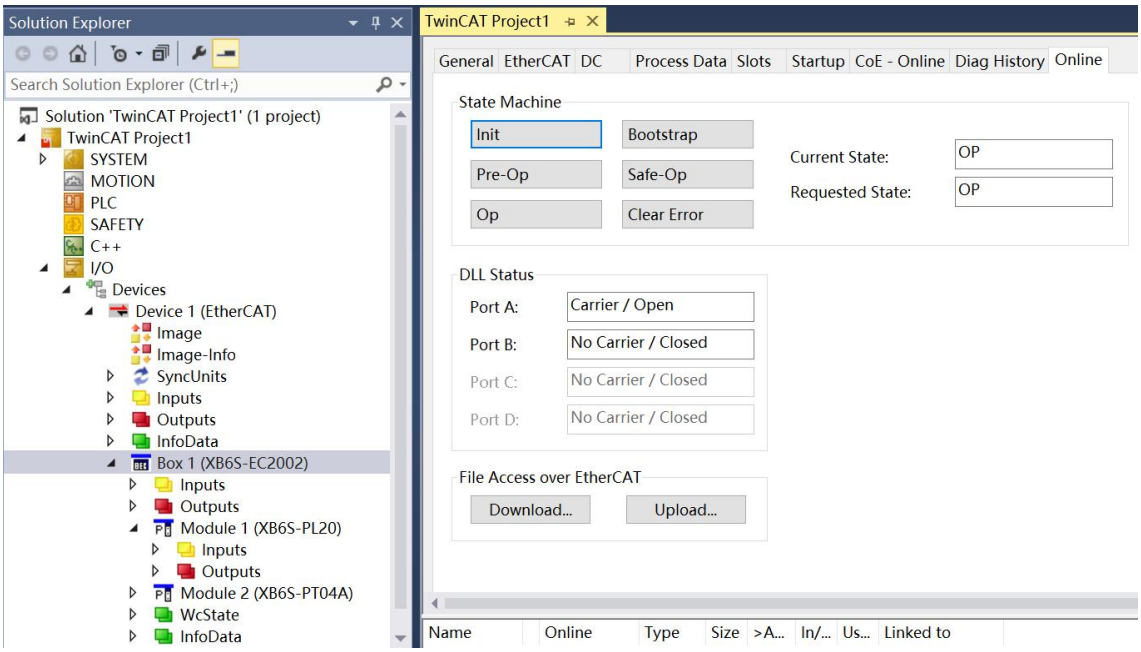
b. Check the "Local Area Connection" network card, as shown below.



c. In the pop-up window "Scan for boxes", click and select "Yes"; in the pop-up window "Activate Free Run", click and select "Yes", as shown in the following figure.

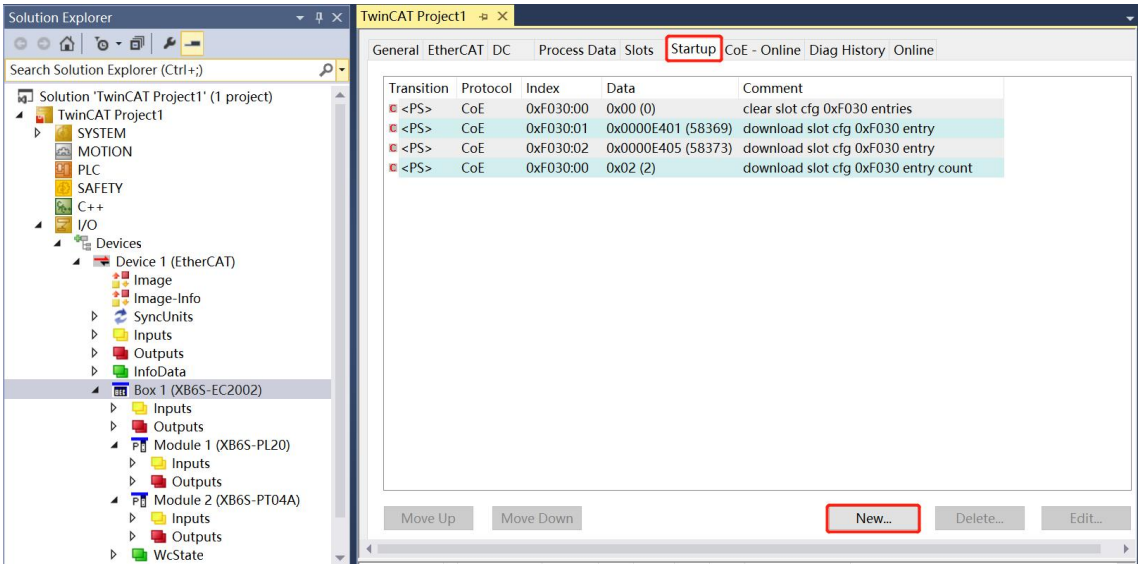


d. After scanning the devices, you can see Box 1 (XB6S-EC2002) and Module 1 (XB6S-PL20) in the left navigation tree. Under "Online", you can see that TwinCAT is in "OP" status, and the RUN indicator of the slave device is always on, as shown in the figure below.

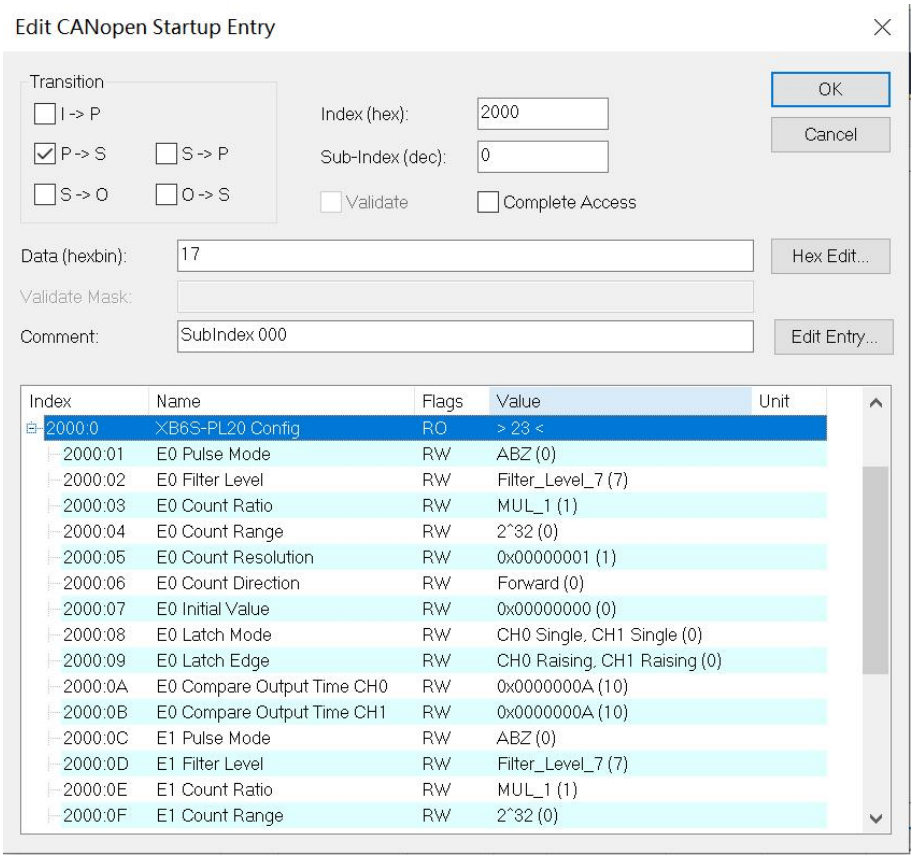


5、Verify basic functionality

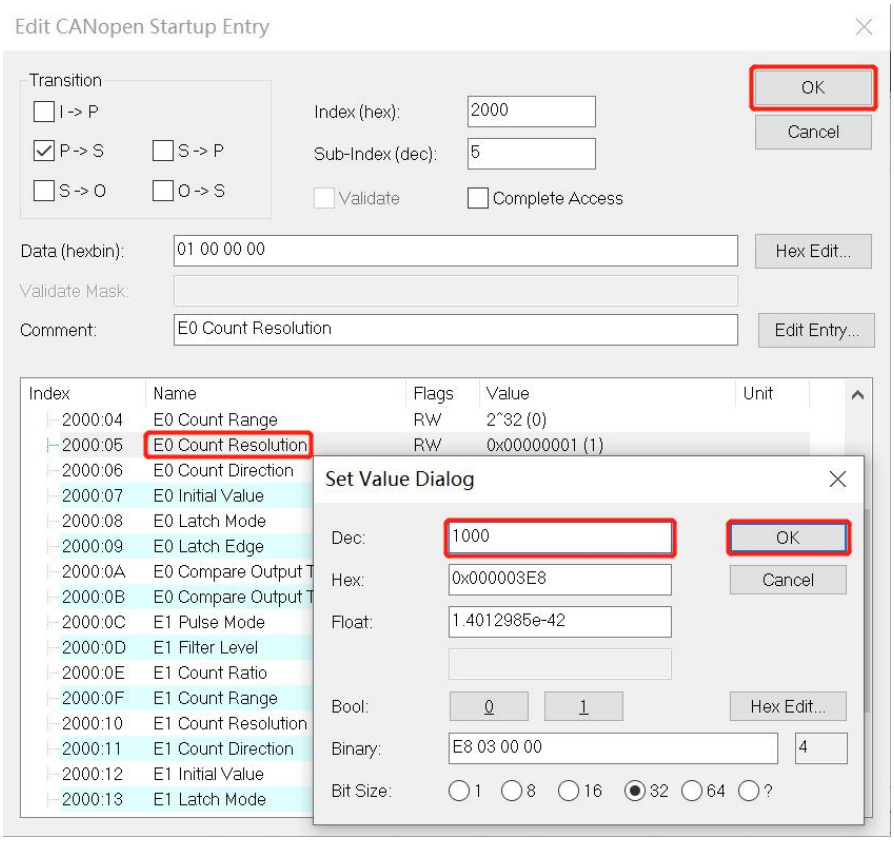
a. Click "Box1 -> Startup -> New" in the left navigation tree to enter the configuration parameter editing page, as shown in the figure below.



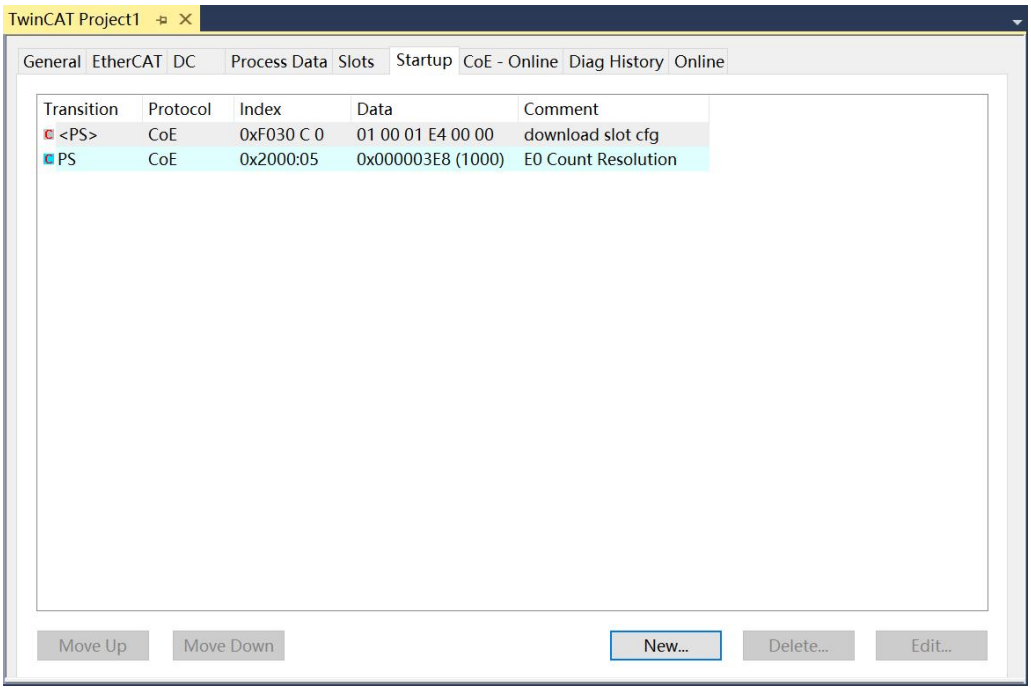
b. In the Edit CANopen Startup Entry pop-up window, click the "+" in front of Index 2000:0 to expand the configuration parameter menu. You can see 23 configuration parameters. Click any parameter to set the related configuration, as shown in the figure below.



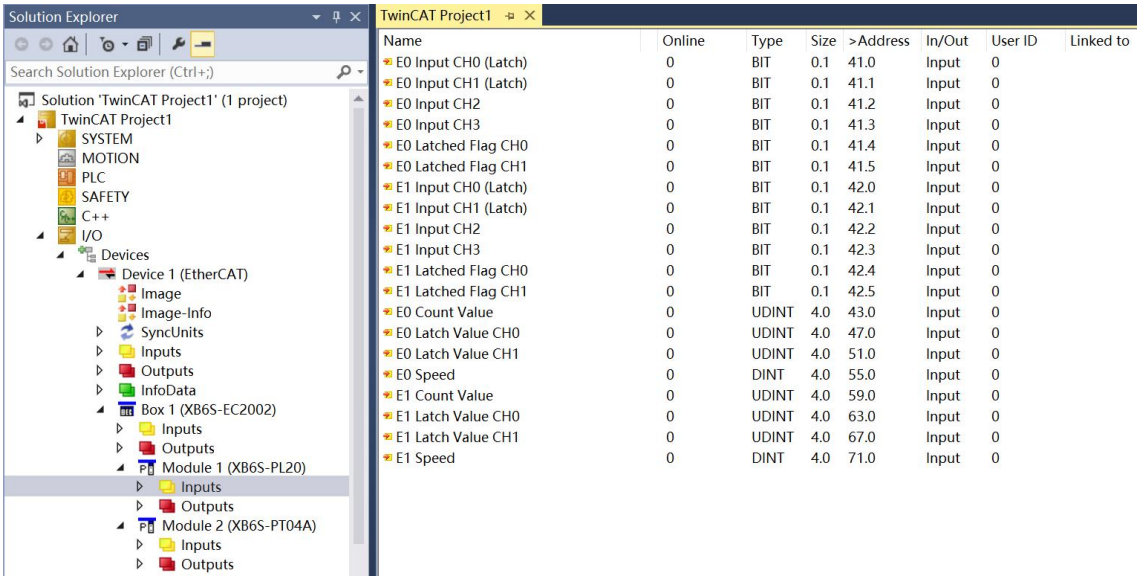
c. For example, to modify the encoder 0 ring count resolution parameter, double-click "E0 Count Resolution" and modify the parameter value, as shown in the figure below.



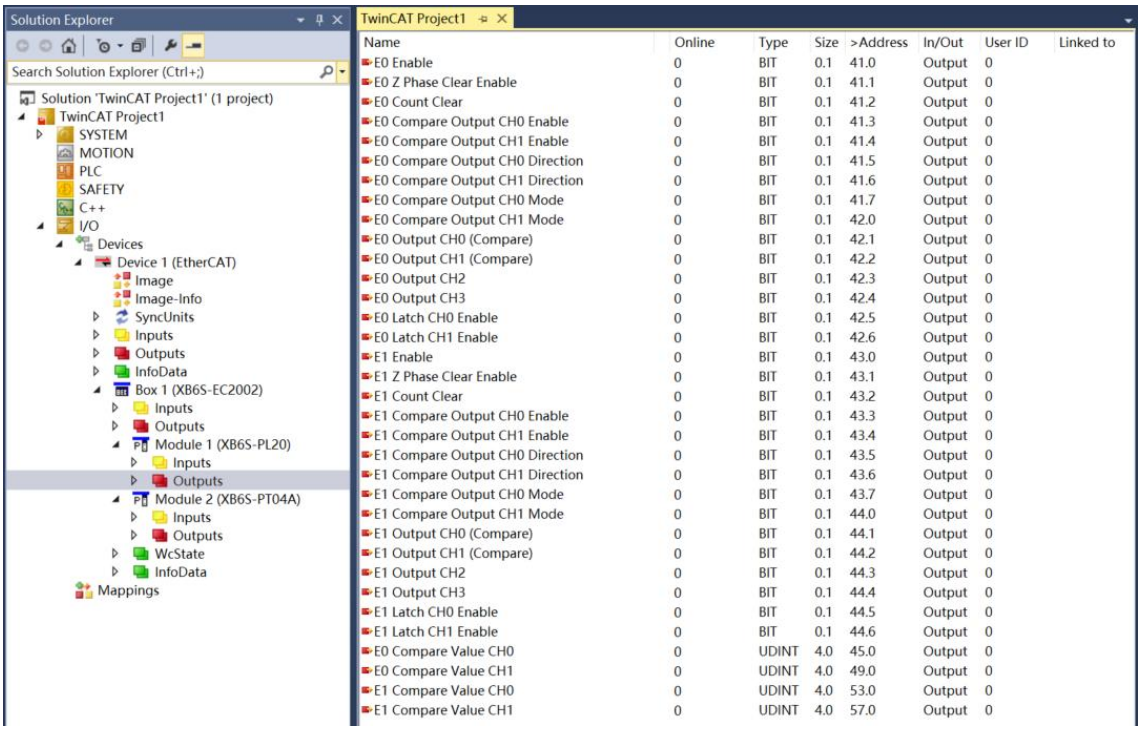
d. After the parameter modification is completed, the modified parameter items and parameter values can be seen under Startup, as shown in the figure below. After the parameter setting is completed, the Reload operation and the module power-on are required to realize the automatic transmission of parameter settings by the master station.



e. The left navigation tree "Module 1 -> Inputs" displays the module's uplink data and is used to monitor the module's input, as shown in the following figure.



f. The left navigation tree "Module 1 -> Outputs" displays the module's Downlink data, which is used to control the module's output, as shown in the following figure.



Module function examples

- **Encoder 0 inputs AB quadrature pulses, the number of pulses is 40,000, and encoder 0 probe input channel 0 is latched**

a. Configure the configuration parameters as shown in the figure below.

a) The encoder 0 pulse mode is set to AB quadrature pulse mode, that is, E0 Pulse Mode is set to 0: ABZ;

b) The encoder 0 count ratio is set to 4 times, that is, E0 Count Ratio is set to MUL_4;

c) The encoder 0 count range is set to 0~ring count resolution×count multiplication-1, that is, E0 Count Range is set to 1:Resolution×Multiple;

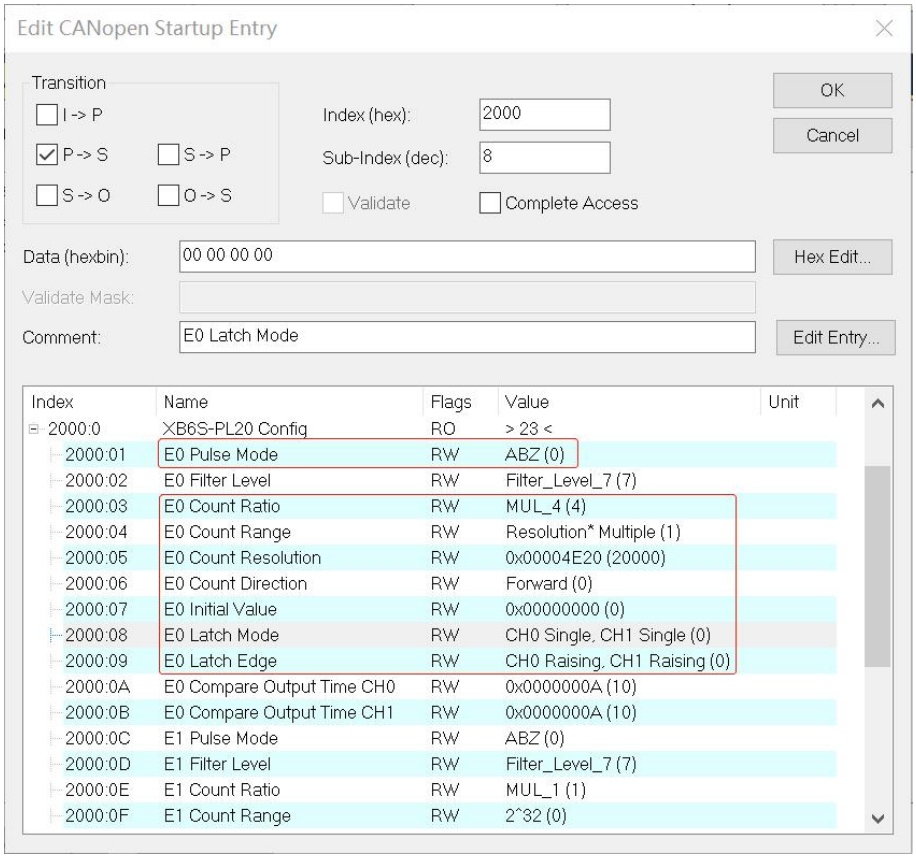
d) The encoder 0 ring count resolution is set to 20000, that is, E0 Count Resolution is set to 20000;

e) The encoder 0 counting direction is set to forward counting, that is, E0 Count Direction is set to 0: Forward;

f) The initial value of encoder 0 count is set to 0, that is, E0 Initial Value is set to 0;

g) The encoder 0 probe mode is set to channel 0 single and channel 1 single, that is, E0 Latch Mode is set to 0: CH0 Single, CH1 Single;

h) The encoder 0 probe trigger edge is set to the rising edge of channel 0 and the rising edge of channel 1, that is, E0 Latch Edge is set to 0: CH0 Raising, CH1 Raising.

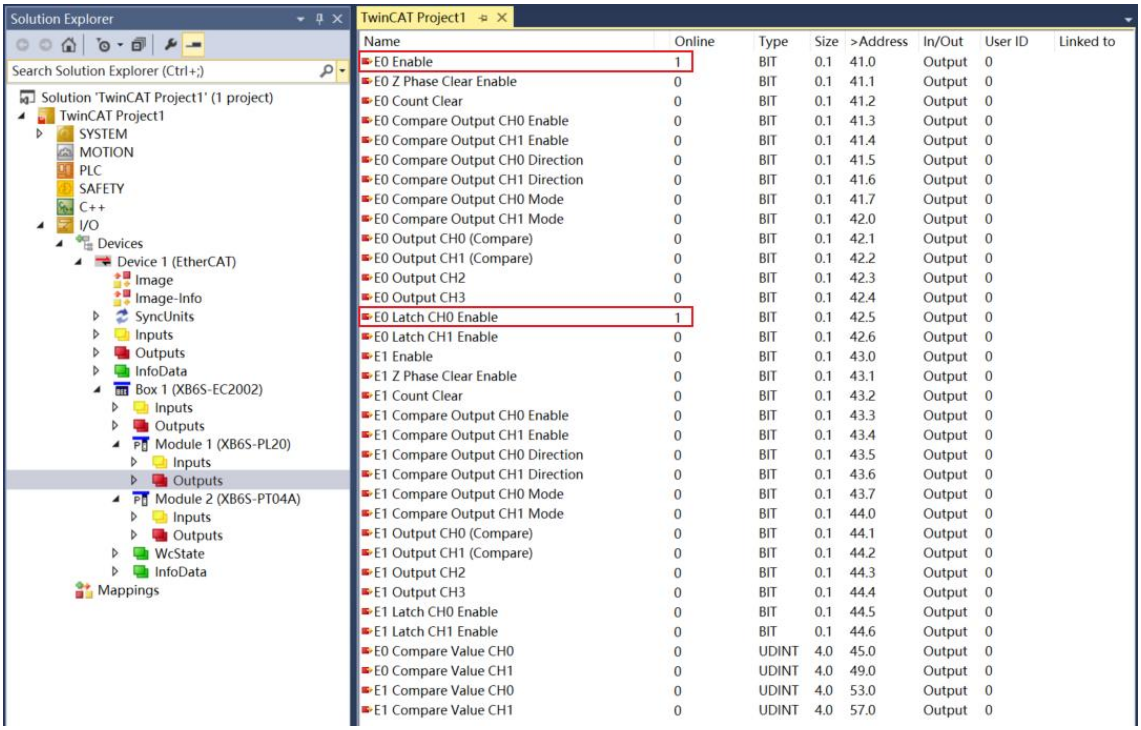


After the parameter settings are completed, you need to perform the Reload operation and re-power the module to enable the master station to automatically send the parameter settings.

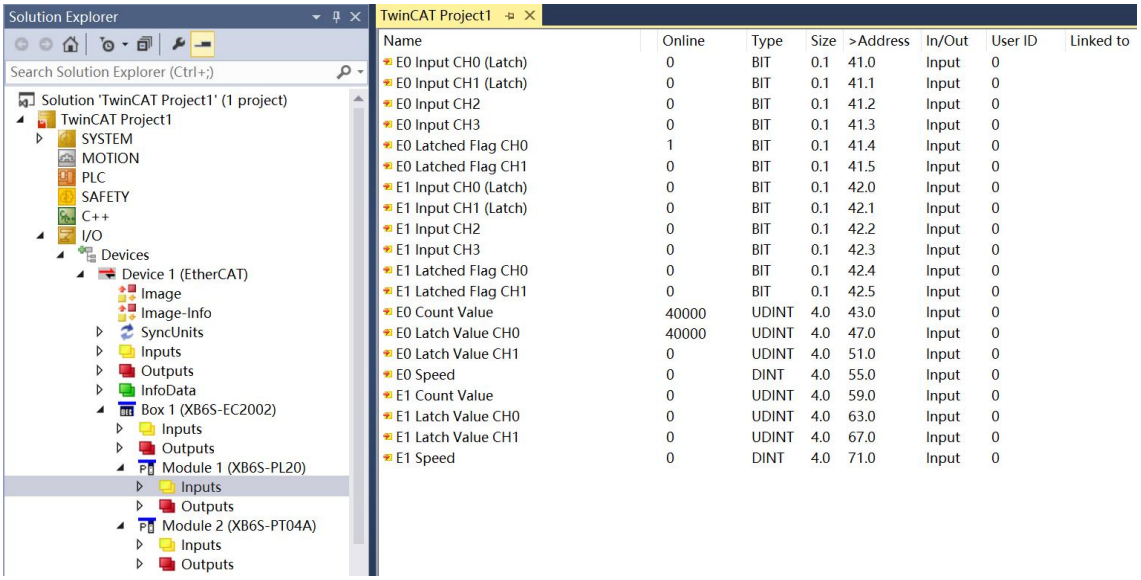
b. Set encoder 0 count enable and encoder 0 probe input channel 0 latch enable, as shown in the figure below.

a) Downlink data E0 Enable is set to 1;

b) Set the Downlink data E0 Latch CH0 Enable to 1.



c. Encoder 0 starts to input 40,000 pulses. After the pulse counting is completed, encoder 0 probe input channel 0 inputs a valid signal, the encoder 0 count value is 40,000, the probe input channel 0 latch value is 40,000, and the encoder probe input channel 0 latch completion flag value toggles once to 1, as shown in the figure below.



- **Encoder 0 input direction pulse, pulse quantity 40000, encoder 0 comparison output channel 0 comparison output**

a. Configure the configuration parameters as shown in the figure below.

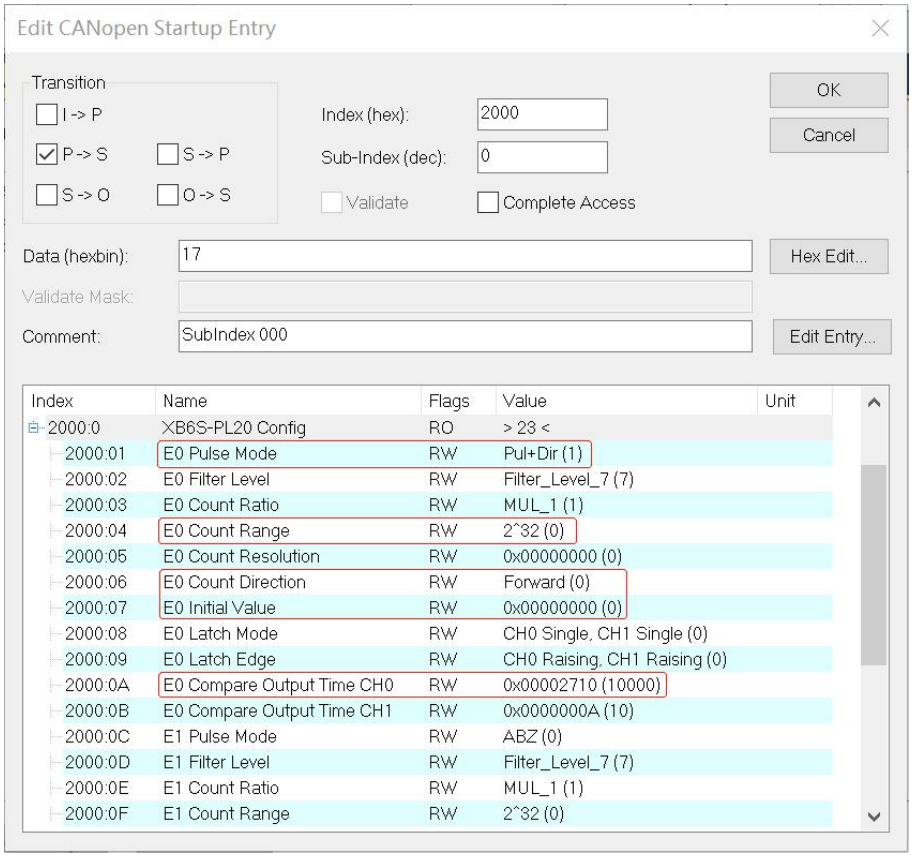
a) The encoder 0 pulse mode is set to direction pulse mode, that is, E0 Pulse Mode is set to 1: Pul+Dir;

b) The encoder 0 count range is set to 0~2^32-1, that is, the E0 Count Range is set to 0:2^32;

c) The encoder 0 counting direction is set to forward counting, that is, E0 Count Direction is set to 0: Forward;

d) The initial value of encoder 0 count is set to 0, that is, E0 Initial Value is set to 0;

e) The encoder 0 compare output channel 0 pulse time is set to 10s, that is, E0 Compare Output Time CH0 is set to 10000.



After the parameter settings are completed, you need to perform the Reload operation and re-power the module to enable the master station to automatically send the parameter settings.

b. Set encoder 0 counting enable, encoder 0 comparison output channel 0 set comparison set value, comparison direction and comparison mode and enable, as shown in the following figure.

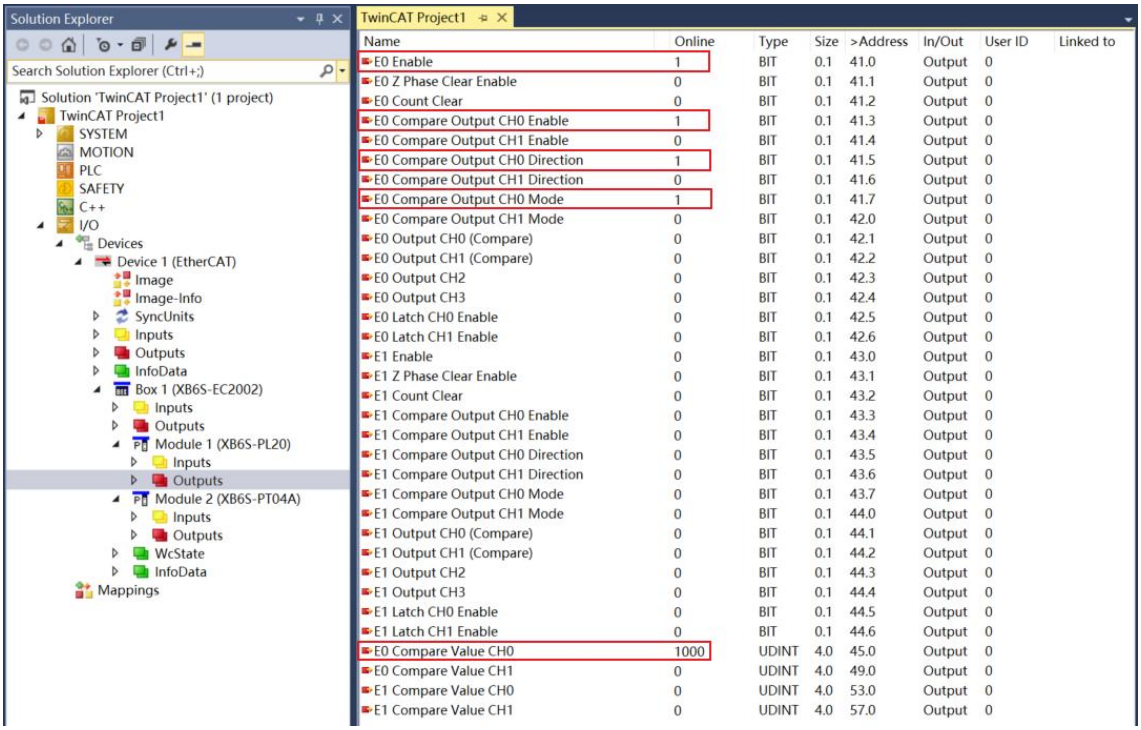
a) Downlink data E0 Enable is set to 1;

b) Downlink data E0 Compare Value CH0 is set to 1000;

c) Set the Downlink data E0 Compare Output CH0 Direction to 1 for incremental comparison;

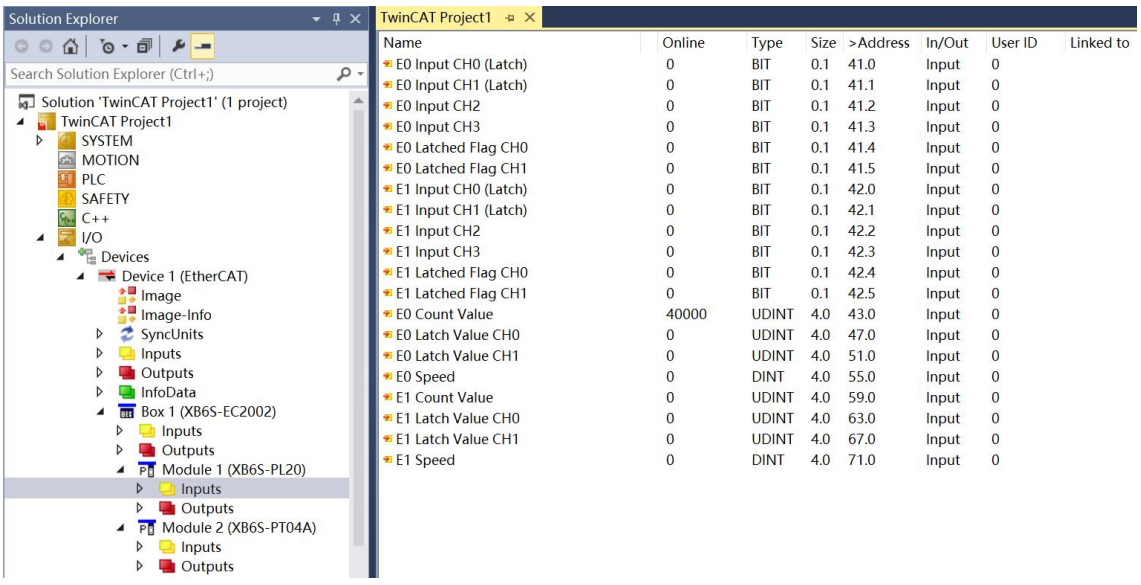
d) Downlink data E0 Compare Output CH0 Mode is set to 1 for repeated triggering;

e) Set the Downlink data E0 Compare Output CH0 Enable to 1 to enable.



Name	Online	Type	Size	>Address	In/Out	User ID	Linked to
E0 Enable	1	BIT	0.1	41.0	Output	0	
E0 Z Phase Clear Enable	0	BIT	0.1	41.1	Output	0	
E0 Count Clear	0	BIT	0.1	41.2	Output	0	
E0 Compare Output CH0 Enable	1	BIT	0.1	41.3	Output	0	
E0 Compare Output CH1 Enable	0	BIT	0.1	41.4	Output	0	
E0 Compare Output CH0 Direction	1	BIT	0.1	41.5	Output	0	
E0 Compare Output CH1 Direction	0	BIT	0.1	41.6	Output	0	
E0 Compare Output CH0 Mode	1	BIT	0.1	41.7	Output	0	
E0 Compare Output CH1 Mode	0	BIT	0.1	42.0	Output	0	
E0 Output CH0 (Compare)	0	BIT	0.1	42.1	Output	0	
E0 Output CH1 (Compare)	0	BIT	0.1	42.2	Output	0	
E0 Output CH2	0	BIT	0.1	42.3	Output	0	
E0 Output CH3	0	BIT	0.1	42.4	Output	0	
E0 Latch CH0 Enable	0	BIT	0.1	42.5	Output	0	
E0 Latch CH1 Enable	0	BIT	0.1	42.6	Output	0	
E1 Enable	0	BIT	0.1	43.0	Output	0	
E1 Z Phase Clear Enable	0	BIT	0.1	43.1	Output	0	
E1 Count Clear	0	BIT	0.1	43.2	Output	0	
E1 Compare Output CH0 Enable	0	BIT	0.1	43.3	Output	0	
E1 Compare Output CH1 Enable	0	BIT	0.1	43.4	Output	0	
E1 Compare Output CH0 Direction	0	BIT	0.1	43.5	Output	0	
E1 Compare Output CH1 Direction	0	BIT	0.1	43.6	Output	0	
E1 Compare Output CH0 Mode	0	BIT	0.1	43.7	Output	0	
E1 Compare Output CH1 Mode	0	BIT	0.1	44.0	Output	0	
E1 Output CH0 (Compare)	0	BIT	0.1	44.1	Output	0	
E1 Output CH1 (Compare)	0	BIT	0.1	44.2	Output	0	
E1 Output CH2	0	BIT	0.1	44.3	Output	0	
E1 Output CH3	0	BIT	0.1	44.4	Output	0	
E1 Latch CH0 Enable	0	BIT	0.1	44.5	Output	0	
E1 Latch CH1 Enable	0	BIT	0.1	44.6	Output	0	
E0 Compare Value CH0	1000	UDINT	4.0	45.0	Output	0	
E0 Compare Value CH1	0	UDINT	4.0	49.0	Output	0	
E1 Compare Value CH0	0	UDINT	4.0	53.0	Output	0	
E1 Compare Value CH1	0	UDINT	4.0	57.0	Output	0	

c. Encoder 0 starts with 40,000 pulses. When the count reaches 1,000 (satisfying the comparison setting and direction), the comparison output channel 0 toggles from a low-level output to a high-level output. The pulse output lasts for 10 seconds, and the channel indicator stays on for 10 seconds. After the count is complete, the encoder 0 count is 40,000, as shown in the figure below.



Name	Online	Type	Size	>Address	In/Out	User ID	Linked to
E0 Input CH0 (Latch)	0	BIT	0.1	41.0	Input	0	
E0 Input CH1 (Latch)	0	BIT	0.1	41.1	Input	0	
E0 Input CH2	0	BIT	0.1	41.2	Input	0	
E0 Input CH3	0	BIT	0.1	41.3	Input	0	
E0 Latched Flag CH0	0	BIT	0.1	41.4	Input	0	
E0 Latched Flag CH1	0	BIT	0.1	41.5	Input	0	
E1 Input CH0 (Latch)	0	BIT	0.1	42.0	Input	0	
E1 Input CH1 (Latch)	0	BIT	0.1	42.1	Input	0	
E1 Input CH2	0	BIT	0.1	42.2	Input	0	
E1 Input CH3	0	BIT	0.1	42.3	Input	0	
E1 Latched Flag CH0	0	BIT	0.1	42.4	Input	0	
E1 Latched Flag CH1	0	BIT	0.1	42.5	Input	0	
E0 Count Value	40000	UDINT	4.0	43.0	Input	0	
E0 Latch Value CH0	0	UDINT	4.0	47.0	Input	0	
E0 Latch Value CH1	0	UDINT	4.0	51.0	Input	0	
E0 Speed	0	DINT	4.0	55.0	Input	0	
E1 Count Value	0	UDINT	4.0	59.0	Input	0	
E1 Latch Value CH0	0	UDINT	4.0	63.0	Input	0	
E1 Latch Value CH1	0	UDINT	4.0	67.0	Input	0	
E1 Speed	0	DINT	4.0	71.0	Input	0	