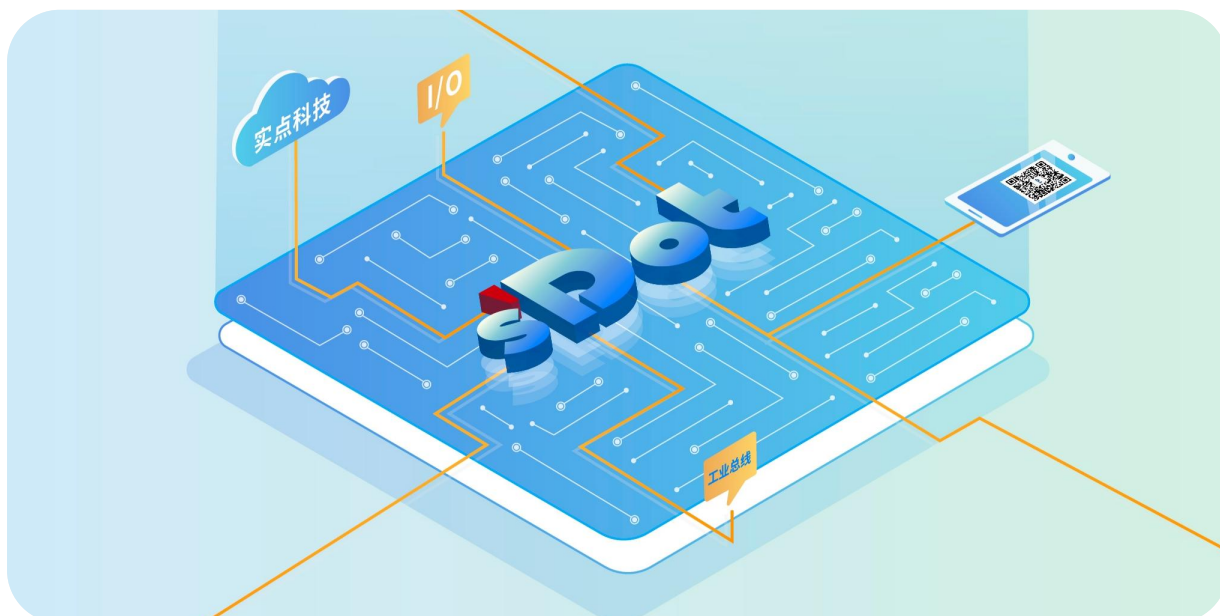




EC4-PX02B

Oversampling High-Speed Output Module

User Manual



Nanjing Solidot Electronic Technology Co., Ltd.

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1 Product Overview

1.1 Product Introduction

The EC4-PX02B is an integrated oversampling high-speed output module that uses the EtherCAT industrial Ethernet bus. The module can be configured with either PWM operating mode or oversampling high-speed output mode. It can be connected to an external laser driver. In PWM output mode, the output frequency and duty cycle can be independently modulated to drive the external laser driver for laser power modulation. Alternatively, the oversampling high-speed output mode can be used for high-speed switching of the laser. The module has two oversampling high-speed output channels, each of which is completely independent and does not affect the others.

1.2 Product Features

- Supports two-channel oversampling high-speed output
The two channels can be adjusted completely independently.
- PWM acceleration/deceleration function
Unique acceleration/deceleration algorithm for smooth transition of frequency and duty cycle.
- Channel-level synchronization function
Both the oversampling high-speed output mode and the PWM output mode support synchronization.
 - PWM output frequency range is wide
Adjustable range 0~20kHz.
 - High duty cycle adjustment accuracy
The adjustment accuracy can reach 0.1%.
 - Small size
It has a compact structure and occupies little space.
 - Easy to diagnose
The innovative channel indicator light design is placed close to the channel, making it easy to see and convenient for inspection and maintenance.
 - Easy configuration

- It is easy to configure and supports mainstream EtherCAT master stations.
- Easy to install
 - DIN 35 mm standard rail mounting
 - It adopts spring-loaded terminal blocks, making wiring convenient and quick.

2 Product Parameters

2.1 General parameters

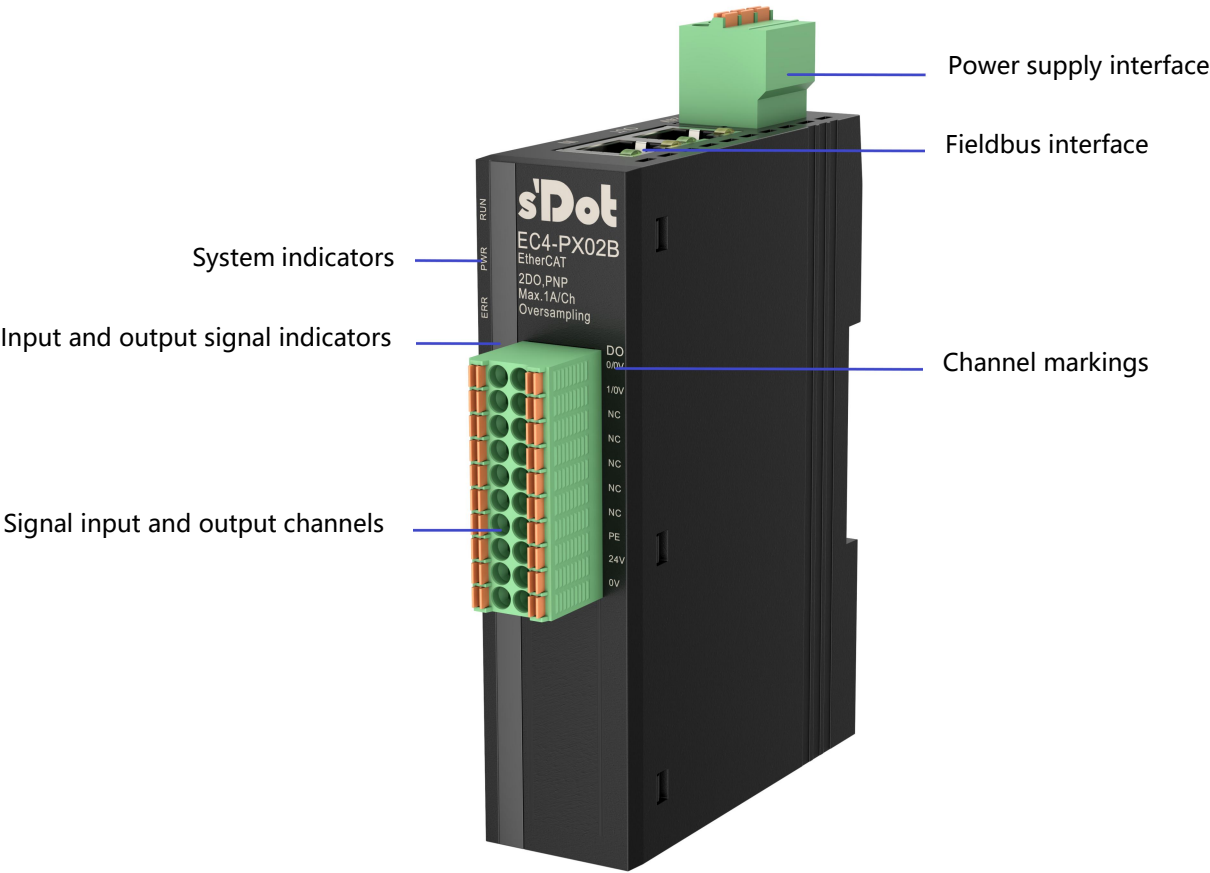
Interface parameters	
Product Model	EC4-PX02B
Bus Protocol	EtherCAT
Process data volume: Upstream	6 Bytes
Process data volume: Downstream	268 Bytes
Channel type	Oversampling high-speed output channel/PWM output channel: 2 channels, PNP
Refresh rate	1 ms

Technical parameters	
System input power	24VDC
Input channel voltage	24VDC
Oversampling high-speed output switching frequency	1MHz
Oversampling high-speed output data length	1000 bits
Maximum output current	1A per channel
PWM output voltage	20.4V~28.8V
PWM output duty cycle	0%~100.0%
PWM output duty cycle adjustment accuracy	0.1%
Maximum error of PWM output duty cycle	±0.1%
PWM output frequency	0~20kHz
PWM output frequency adjustment accuracy	1Hz
PWM output limit parameters	At 20kHz, the duty cycle ranges from 1.0% to 99.0% (all low if below 1%, all high if above 99%).
Channel short circuit protection	support
Channel overload protection	support
Channel overcurrent protection	support
External dimensions	102×72×25mm
Weight	130g
Wiring method	Screwless quick connector
Wire length	<30m (unshielded)
Operating temperature	-10°C~+60°C
Storage temperature	-20°C~+75°C
Relative humidity	95%, no condensation
Protection level	IP20

3 Panel

3.1 Module structure

Product Parts Names



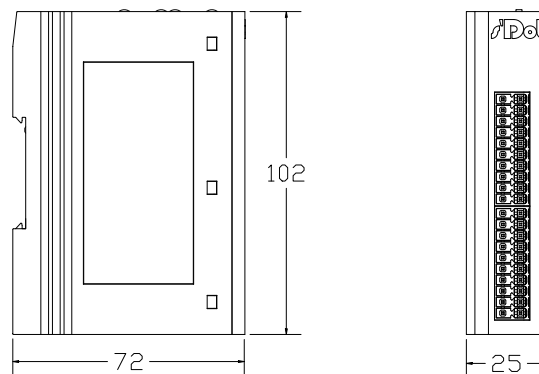
3.2 Indicator light function

Name	Logo	Color	Status	Status Description
Power indicator light	PWR	Green	ON	Power supply is normal
			OFF	The product is not powered on or the power supply is abnormal.
Operating status indicator	RUN	Green	ON	The system is running normally.
			OFF	The device is in an Init or unpowered state.
			Flashing	5Hz: Pre-OP state; 2Hz: Safe-OP state
Alarm indicator	ERR	Red	ON	The system is malfunctioning.
			OFF	The system is running normally or not powered on.
Network port status indicator	IN	Green	ON	Establish network connection
			OFF	No network connection or error
		Yellow	Flashing	Connection established and data exchanged
			OFF	No data interaction or anomaly
	OUT	Green	ON	Establish network connection
			OFF	No network connection or error
		Yellow	Flashing	Connection established and data exchanged
			OFF	No data interaction or anomaly
Output channel status indicator	1 ~ 2	Green	ON	Channel enable
			OFF	Channel disabled

4 Installation and removal

4.1 External dimensions

External dimensions (unit: mm)



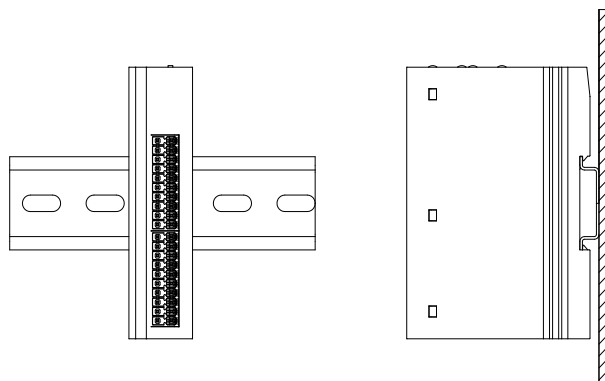
4.2 Installation Guide

Installation/Disassembly Precautions

- Ensure that the server rack has good ventilation (such as installing exhaust fans in the server rack).
- Do not install this device next to or above equipment that may cause overheating.
- Make sure the module is installed vertically and that there is sufficient clearance between the module and surrounding equipment.
- Installation and disassembly must be performed with the power off.

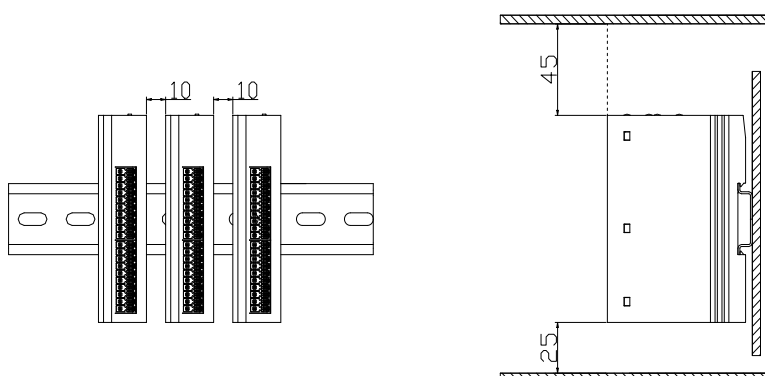
Installation direction

To ensure proper heat dissipation, the module must be installed vertically to ensure unobstructed airflow inside the module.



Minimum spacing

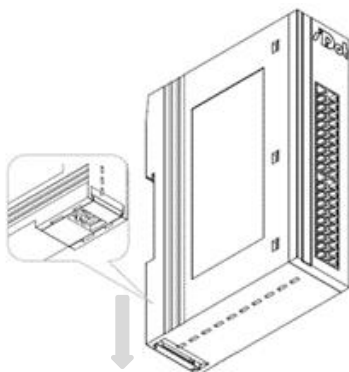
The module has an IP20 protection rating and must be installed inside a box or cabinet. During installation, please maintain the minimum spacing (unit: mm) between the module and other modules or heat-generating devices, or between the module and other devices or wiring channels above and below it, as shown in the diagram below.



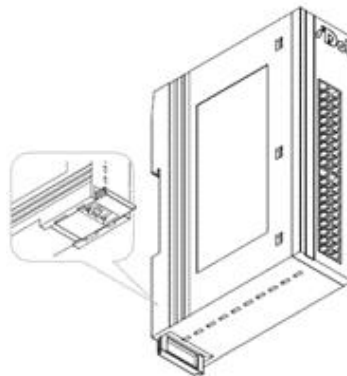
4.3 Installation and removal

Install

Step

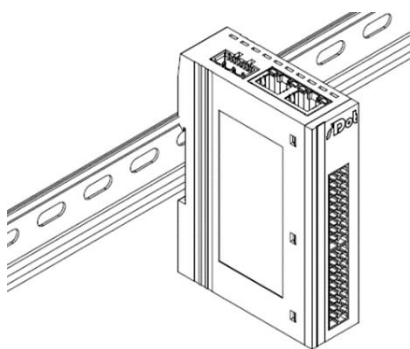


①

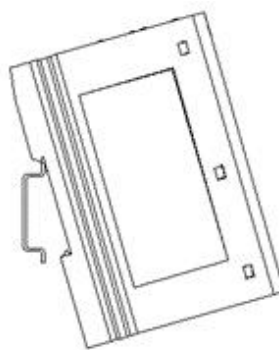


②

Push the latch at the bottom of the module outwards, as shown in Figure ①, until you hear a "click" sound.

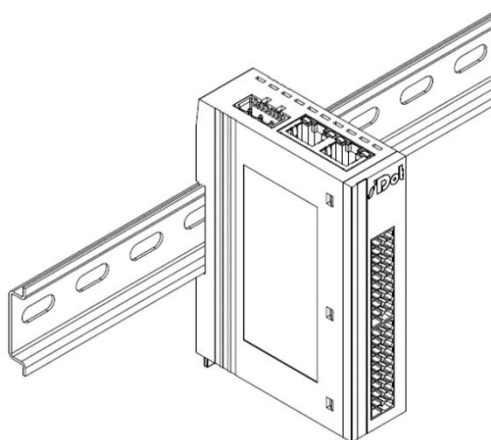


③



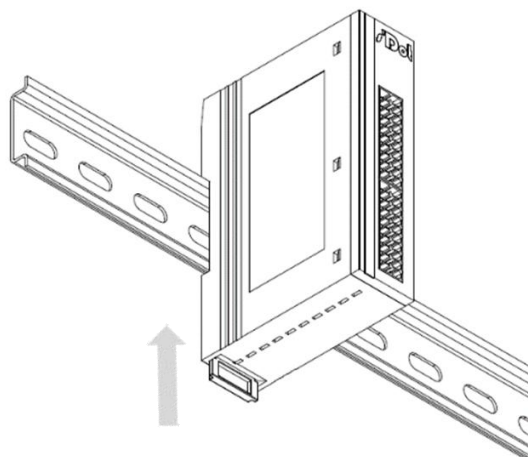
④

Align the upper edge of the module clip with the upper edge of the guide rail, and place the module into the guide rail, as shown in Figures ③ and ④.



⑤

The modules are positioned as shown in Figure ⑤.

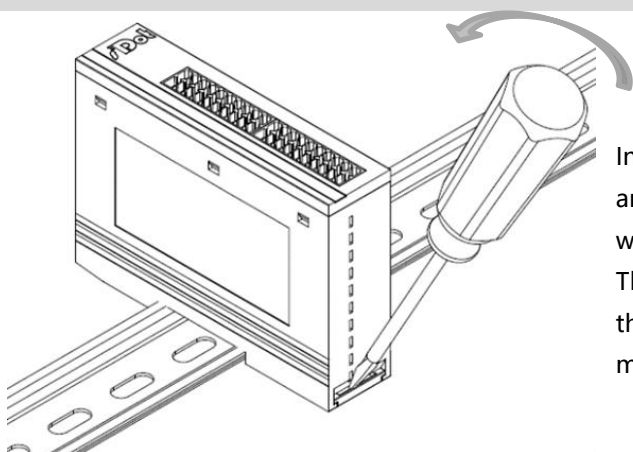


Push the clip along the guide rail until you hear a click, indicating that the module installation is complete, as shown in Figure ⑥.

⑥

Disassembly

Step

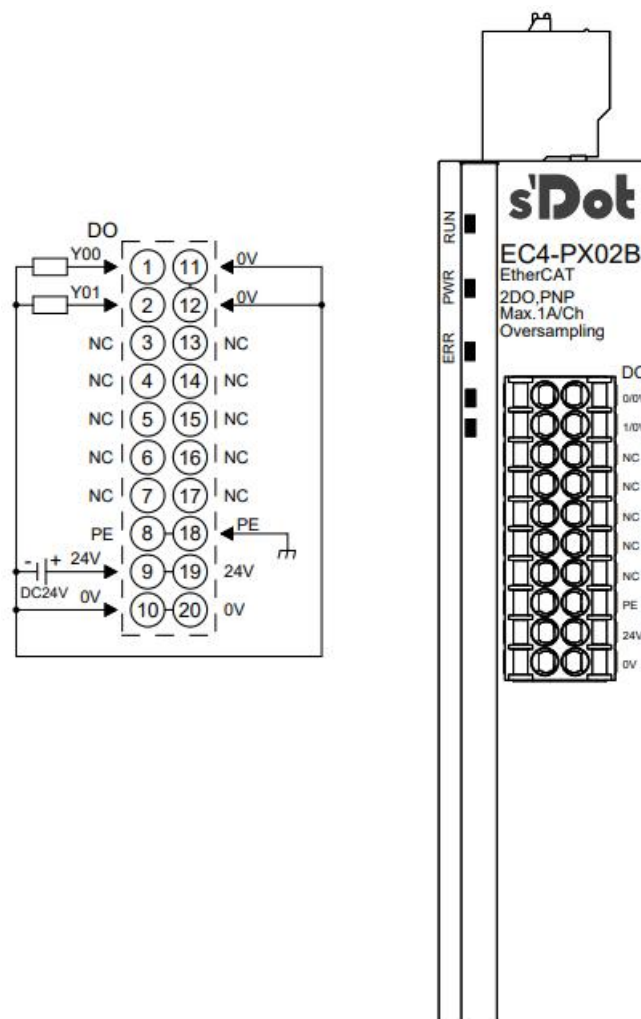


Insert the flathead screwdriver into the clip and apply force towards the module (you will hear a sound), as shown in Figure ⑦. Then, remove the module by performing the reverse operation of installing the module.

⑦

5 Wiring

5.1 Wiring diagram



*24V internal conduction; 0V internal conduction

*PE internal conduction

*For personal and equipment safety, it is recommended to disconnect the power supply when performing wiring operations.

5.2 Terminal block definition

DO					
Terminal serial number	Terminal markings	Description	Terminal serial number	Terminal markings	Description
1	0/0V	PWM/Oversampling Output 0	11	0/0V	Power supply 0V
2	1/0V	PWM/Oversampling Output 1	12	1/0V	Power supply 0V
3	NC	Empty terminal	13	NC	Empty terminal
4	NC	Empty terminal	14	NC	Empty terminal
5	NC	Empty terminal	15	NC	Empty terminal
6	NC	Empty terminal	16	NC	Empty terminal
7	NC	Empty terminal	17	NC	Empty terminal
8	PE	Power supply PE	18	PE	Power supply PE
9	24V	Power supply+	19	24V	Power supply+
10	0V	Power supply-	20	0V	Power supply-

6 Use

6.1 Configuration parameter definition

The module configuration has one parameter, totaling 4 bytes.

Function	Parameter name	Range of values	default value
Output clear/hold function	Clear/Hold	0: Clear	0
		1: Hold	

6.1.1 Output signal clear/hold function

The clear/hold function is for modules with outputs. This function can be configured to handle module output actions in the event of a bus exception.

Clear Output: When communication is lost, the module's output channel automatically clears the output.

Hold output: The module's output channel hold the output even when communication is lost.

In the event of a bus malfunction, the system will temporarily default to a cleared state.

6.2 Process data

6.2.1 Upstream data

Upstream data is 6 bytes (channel[n] takes values 1~2).				
Name	Meaning	Range of Values	Data Types	Length
CH[n] Err Code	Channel n alarm code	0: No alarms	unsigned8	1 bit
		1: Field-side power supply not connected		
		0: No alarms	unsigned8	1 bit
		1: Channel overcurrent		
reserve			unsigned8	6 bit
CH[n] OverSample Valid Bytes	Number of valid bytes of oversample output data for channel n	0~255	unsigned8	1 byte
CH[n] OverSample Valid Bits	Channel n oversample output data less than 1 byte of significant bits	0~255	unsigned8	1 byte

Data Explanation:

◆ Alarm value CH[n] Err Code

The module supports field-side power disconnection alarms and channel-level overcurrent alarms. For example, when the power supply on the channel's field side is not connected, the channel generates a warning message, with the first alarm bit being 1 and the Error Code value being 1; when the channel experiences overcurrent, the channel generates a warning message, with the second alarm bit being 1 and the Error Code value being 2.

◆ The number of valid bytes in the oversample output data of channel n (CH[n])

Channel n oversample output data less than 1 byte valid bits CH[n] OverSample Valid Bits

This function is used in conjunction with the Channel [n] Oversample Valid Bits setting.

For example, when the channel oversample valid bits are set to 16 bits, 16 bits equal 2 bytes. In this case, the number of valid bytes for channel oversample output data is 2, and the number of invalid bits in the last byte is 0.

When the channel oversample valid bits are set to 10 bits, 10 bits equal 1 byte plus 2 bits. Thus, the number of valid bytes for channel oversample output data is 1, and the number of invalid bits in the last byte is 2.

6.2.2 Downstream data

Downstream instruction 268 bytes (channel[n] takes values 1~2, byte[a] takes values 0~124).					
Name		Meaning	Range Of Values	Data Types	Length
Control Word	CH[n] Enable	Channel n output enable	0: Output disabled	bool	1 bit
			1: Output enable		
	CH[n] Mode	Channel n mode selection	0: Oversampling mode	bool	1 bit
			1: PWM mode		
	CH[n] Sync Enable	Channel n synchronization function enabled	0: Synchronous disable	bool	1 bit
			1: Synchronization enable		
	Reserved			bool	2 bit
Sync Source Channel	Synchronization source channel	0~1 (corresponding to output channels 0~1)	unsigned8	1 byte	
OverSample Length	CH[n] OverSample Valid Bits	Channel n oversample data effective bits	0~1000	unsigned16	2 bytes
OverSample Output CH[n]	CH[n] Byte[a]	Channel n oversample output data	0~255	unsigned8	125 bytes
PWM Output	CH[n] PWM Frequency	PWM output channel n frequency	0~20000 (Corresponding to 0~20kHz)	unsigned16	2 bytes
	CH[n] PWM Duty	PWM output channel n duty cycle	0~1000 (Corresponding to 0%~100%)	unsigned16	2 bytes
	CH[n] PWM Accelerate Time	PWM output channel n acceleration/ deceleration time	20~5000ms	unsigned16	2 bytes

Data Explanation:

◆ Channel n output enable CH[n] Enable

Setting the output enable to 1 enables the output of that channel, starting either oversample output or PWM output.

◆ **Channel n mode selection CH[n] Mode**

The module supports two modes: oversampling high-speed output mode and PWM output mode. A setting of 0 enables oversample output, while a setting of 1 enables PWM output.

◆ **Channel n synchronization function enabled CH[n] Sync Enable
Sync Source Channel**

Both the module PWM mode and the oversample output mode support synchronization.

Output synchronization source channel: The valid parameter range (0~1) corresponds to output channel 0~1.

When the output synchronization source channel is set to valid, the output channel synchronization enable is set to 1. In PWM mode, the corresponding channel immediately synchronizes its duty cycle and frequency with the source channel (i.e., it follows the source channel). In oversample output mode, the corresponding channel immediately synchronizes its data with the source channel. When the output channel synchronization enable is set to 0, the original output parameters are restored.

◆ **Channel n Oversample data valid bits CH[n] Valid bits**

The module supports setting the valid bits for oversample data, with a maximum length of 1000 bits.

◆ **Channel n oversample output data CH[n] Byte[a]**

The module supports setting the oversample output data function.

For example, if the effective bit width of the oversample data in a channel is set to 8 bits, then only the first byte of the oversample output data will be valid.

◆ **PWM output channel n frequency CH[n] PWM Frequency**

The valid parameter range (0~20000) corresponds to 0~20kHz. If the parameter exceeds the valid range, the parameter setting will be discarded.

The output frequency parameter can also be dynamically adjusted during PWM output, and will smoothly transition to the new target parameter during acceleration and deceleration. If an invalid parameter is set during the output process, the instruction will be discarded and the original output will continue.

◆ **PWM output channel n duty cycle CH[n] PWM Duty**

The valid range (0~1000) corresponds to a duty cycle of 0%~100%. If the parameter exceeds the valid range, the parameter setting will be discarded.

The output duty cycle parameter can also be dynamically adjusted during PWM output, and will smoothly transition to the new target parameter during acceleration and deceleration. If an invalid parameter is set during the output process, the instruction will be discarded and the original output will continue.

◆ **PWM output channel n acceleration/deceleration time CH[n] PWM Accelerate Time**

Changes in PWM frequency and duty cycle will follow the time set by this parameter. When the frequency or duty cycle changes, the PWM output channel will smoothly transition to the target frequency and duty cycle according to this set time.

The legal range for PWM acceleration/deceleration time is 20~5000ms. When this parameter is set to "0", the acceleration function is turned off.

6.3 Use Cases

◆ **Oversampling Output Basic Functions ---- Oversampling Output Channel 0 Basic Output Functions**

1. Configure parameters as needed;
2. Output channel 0 is set to oversample output mode;
 - a) Set Control Word -> CH0 Mode to 0;
3. The effective number of bits for the oversample data in channel 0 is set to 16 bits, and the first byte of the oversample output data is set to 170, and the second byte of the output data is set to 254.
 - a) OverSample Length -> CH0; OverSample Valid Bits is set to 16.
 - b) OverSample Output CH0 -> CH0 Byte0 is set to 170;
 - c) OverSample Output CH0 -> CH0 Byte1 is set to 254;
4. Enable output for channel 0;
 - a) Set Control Word -> CH0 Enable to 1.
5. Dynamically adjust the output data of the second byte of output channel 0 to 170;
 - a) OverSample Output CH0 -> CH0 Byte1 is set to 170;
6. Disable the output of channel 0;
 - a) Set Control Word -> CH0 Enable to 0.

◆ **PWM Output Basic Functions ---- PWM Output Channel 0 Basic Output Functions**

1. Configure parameters as needed;
2. Set output channel 0 to PWM output mode;
 - a) Set Control Word -> CH0 Mode to 1;
3. The PWM output channel 0 frequency is set to 5kHz, the duty cycle is set to 40%, and the acceleration/deceleration time is set to 1000ms;
 - a) PWM Output -> CH0 PWM Frequency set to 5000;
 - b) PWM Output -> CH0 PWM Duty set to 400;
 - c) PWM Output -> CH0 PWM Accelerate Time is set to 1000;
4. Enable PWM channel 0 output;
 - a) Set Control Word -> CH0 Enable to 1;
5. Dynamically adjust the PWM output channel 0 frequency to 10kHz and the duty cycle to 60%;
 - a) PWM Output -> CH0 PWM Frequency set to 10000;
 - b) PWM Output -> CH0 PWM Duty set to 600;
6. Disable PWM channel 0 output;
 - a) Set Control Word -> CH0 Enable to 0.

◆ **PWM output synchronization function ---- Synchronize PWM output channel 1 with channel 0**

1. Configure parameters as needed;
2. Set output channel 0~1 to PWM output mode;
 - a) Set Control Word -> CH0~CH1 Mode to 1;
3. The frequency of PWM output channel 1 is set to 5kHz, the duty cycle is set to 40%, and the acceleration/deceleration time is set to 1000ms;
 - a) PWM Output -> CH1 PWM Frequency set to 5000;

- b) PWM Output -> CH1 PWM Duty set to 400;
- c) PWM Output -> CH1 PWM Accelerate Time is set to 1000;
- 4. The PWM output channel 0 frequency is set to 10kHz, the duty cycle is set to 60%, and the acceleration/deceleration time is set to 1000ms;
 - a) PWM Output -> CH0 PWM Frequency set to 10000;
 - b) PWM Output -> CH0 PWM Duty set to 600;
 - c) PWM Output -> CH1 PWM Accelerate Time is set to 1000;
- 5. Enable PWM channel 0~1 output;
 - a) Set Control Word -> CH0~CH1 Enable to 1;
- 6. PWM output synchronization source channel settings;
 - a) Set Control Word -> Sync Source Channel to 0;
- 7. Enable synchronization for PWM output channel 1.
 - a) Set Control Word -> CH1 Sync Enable to 1.

◆ **Oversample output synchronization function ---- Oversample output channel 1 is synchronized with channel 0**

- 1. Configure parameters as needed;
- 2. Output channel 0~1 mode is set to oversample output mode;
 - a) Set Control Word -> CH0~CH1 Mode to 0;
- 3. The effective bit length of the oversample data in channel 0 is set to 16 bits, and the first byte of the oversample output data is set to 168, and the second byte of the output data is set to 45.
 - a) OverSample Length -> CH0; OverSample Valid Bits is set to 16.
 - b) OverSample Output CH0 -> CH0 Byte0 is set to 168;
 - c) OverSample Output CH0 -> CH0 Byte1 is set to 45;
- 4. Enable output for channel 0;
 - a) Set Control Word -> CH0~CH1 Enable to 1;
- 5. Output synchronization source channel settings;
 - a) Set Control Word -> Sync Source Channel to 0;
- 6. Enable synchronization for output channel 1.
 - a) Set Control Word -> CH1 Sync Enable to 1.

6.4 Module configuration instructions

6.4.1 Application in the TwinCAT3 software environment

1、Preparation

- **Hardware environment**

- **Module model EC4-PX02B**
- **One computer, pre-installed with TwinCAT3 software**
- **EtherCAT dedicated shielded cable**
- **Laser drivers and other devices**
- **This instruction manual uses one Beckhoff PLC, specifically the Beckhoff CX5130-0115, as an example**
- **One switching power supply**
- **Module mounting rails and rail fasteners**
- **Device configuration file**

Configuration file retrieval address: <https://www.solidotech.com/documents/configfile>

- **Hardware configuration and wiring**

Please follow the instructions "[4 Installation and Removal](#)" "[5. Wiring](#)"

2、Pre-configured configuration files

Place the ESI configuration file (EcatTerminal-EC4_V4.01_BOOL.xml) in the TwinCAT installation directory "C:\TwinCAT\3.1\Config\Io\EtherCAT", as shown in the image below.

此电脑 > 本地磁盘 (C:) > TwinCAT > 3.1 > Config > Io > EtherCAT >

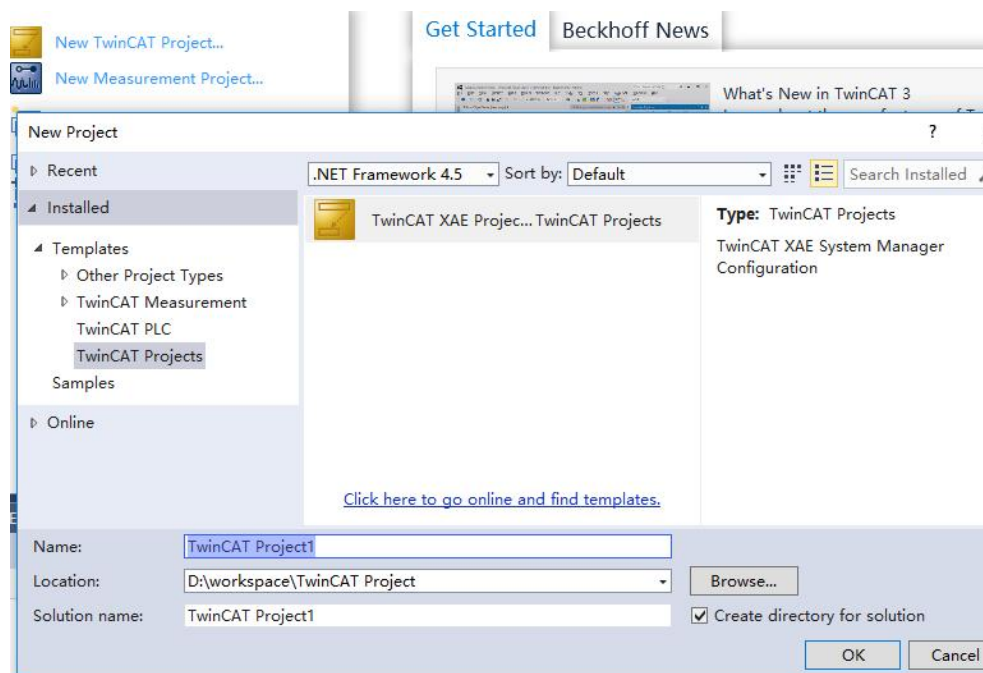
名称	修改日期	类型	大小
Beckhoff EKx9xx.xml	2017/11/3 9:53	XML 文档	1,223 KB
Beckhoff EP7xxx.xml	2017/11/8 9:46	XML 文档	9,290 KB
Beckhoff ATH2xxx.xml	2017/11/23 13:22	XML 文档	439 KB
Beckhoff EPP3xxx.xml	2017/12/8 8:48	XML 文档	2,099 KB
Beckhoff EPP1xxx.xml	2017/12/14 11:34	XML 文档	480 KB
Beckhoff EL34xx.xml	2017/12/15 15:35	XML 文档	5,634 KB
Beckhoff EK13xx.xml	2017/12/19 14:30	XML 文档	16 KB
Beckhoff EPP2xxx.xml	2017/12/28 12:22	XML 文档	1,811 KB
Beckhoff EJ1xxx.xml	2018/1/4 10:00	XML 文档	67 KB
Beckhoff EJ3xxx.xml	2018/1/4 10:07	XML 文档	1,169 KB
Beckhoff EJ7xxx.xml	2018/1/4 10:11	XML 文档	2,339 KB
Beckhoff EJ9xxx.xml	2018/1/4 10:23	XML 文档	160 KB
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Beckhoff EL37xx.xml	2018/1/23 13:59	XML 文档	11,837 KB
Beckhoff EJ2xxx.xml	2018/1/23 14:21	XML 文档	239 KB
Beckhoff EL5xxx.xml	2018/1/23 15:11	XML 文档	6,307 KB
Beckhoff EJ5xxx.xml	2018/1/23 15:12	XML 文档	218 KB
Beckhoff EL2xxx.xml	2018/1/24 9:40	XML 文档	2,868 KB
Beckhoff EL33xx.xml	2018/1/26 9:34	XML 文档	6,727 KB
Beckhoff ELM3xxx.xml	2018/2/1 10:19	XML 文档	14,238 KB
Beckhoff AX5xxx.xml	2018/2/8 16:15	XML 文档	930 KB
Beckhoff EL1xxx.xml	2018/2/19 17:15	XML 文档	3,387 KB
Beckhoff EL25xx.xml	2018/2/21 10:23	XML 文档	6,543 KB
EcatTerminal-EC4_V4.01_BOOL.xml	2023/10/19 13:45	XML 文档	878 KB

3. Create a project

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

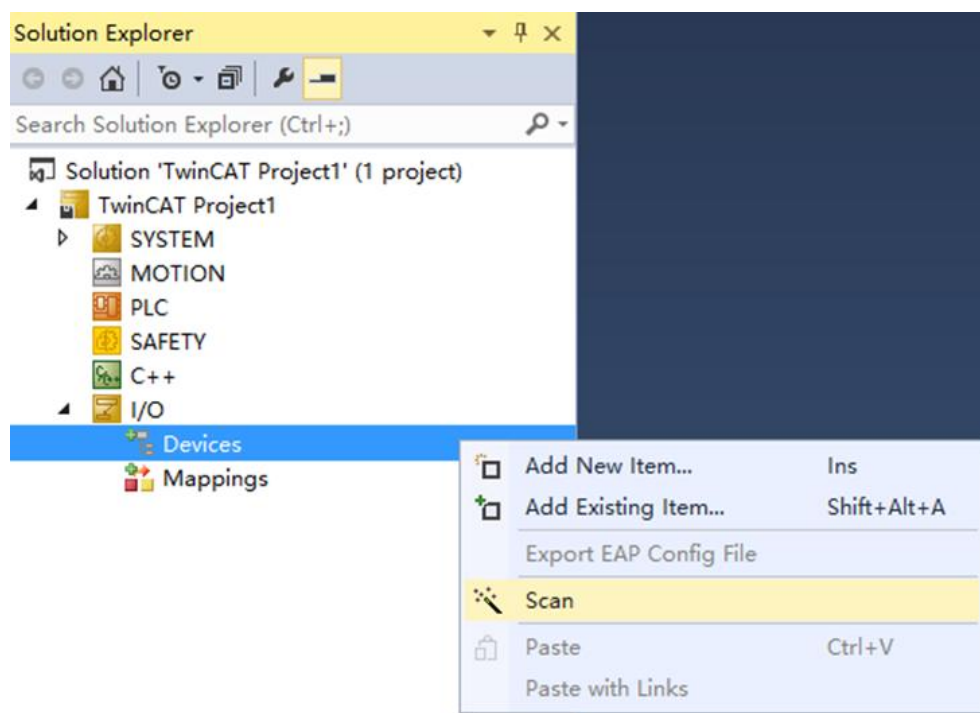


- b. Click "New TwinCAT Project". In the pop-up window, "Name" and "Solution name" correspond to the project name and solution name, respectively, and "Location" corresponds to the project path. These three items can be left as default. Then click "OK". The project will be created successfully, as shown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

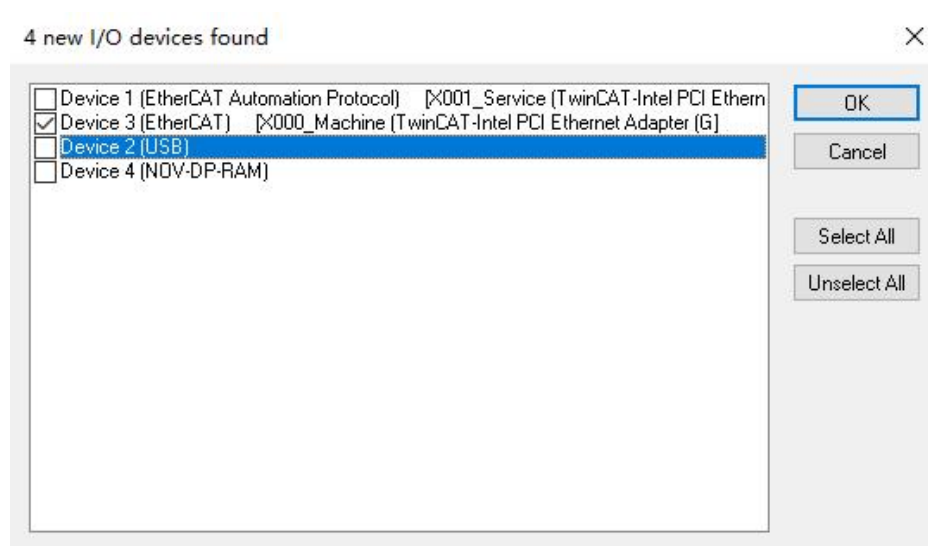


4. Scanning equipment

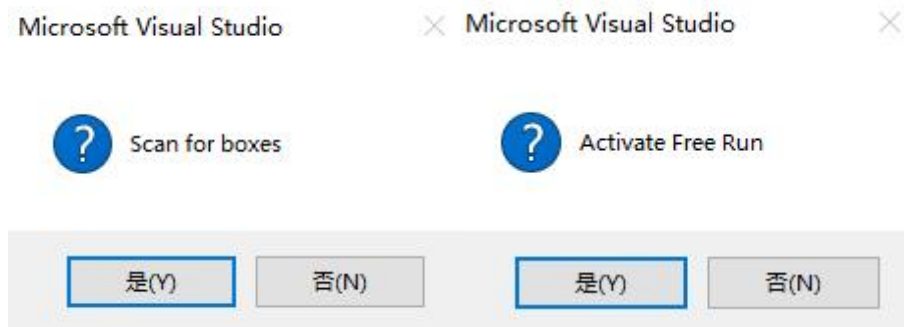
- a. After creating the project, right-click the "Scan" option under "I/O -> Devices" to scan for slave devices, as shown in the figure below.



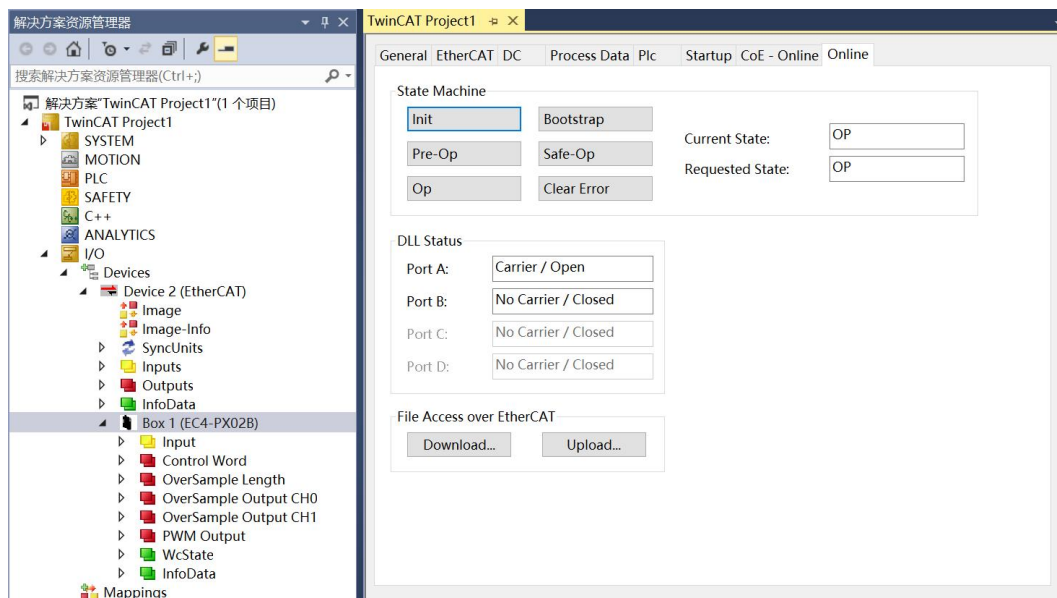
- b. Select the "Local Area Connection" network adapter, as shown in the image below.



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

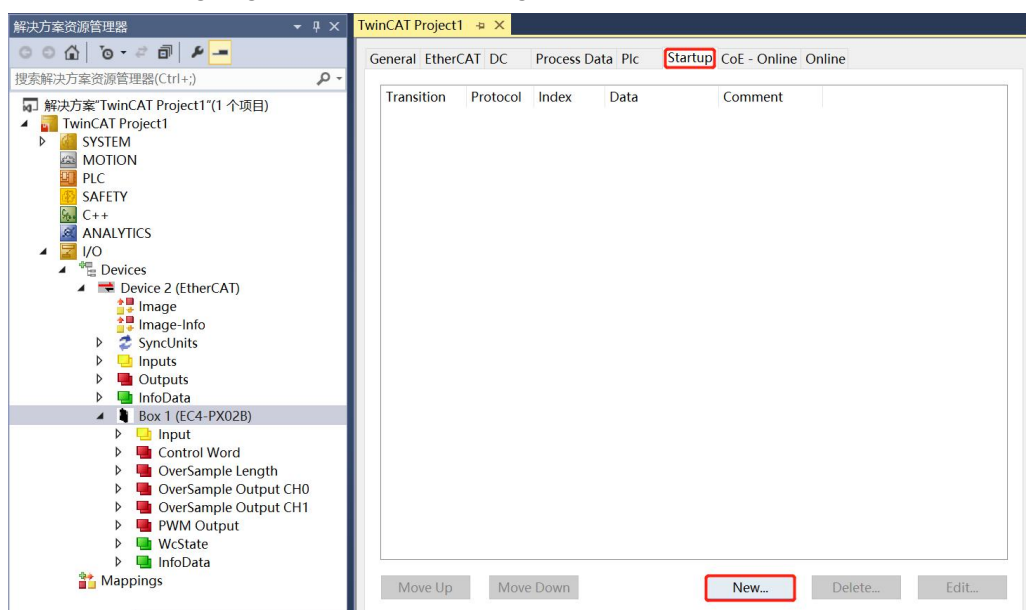


- d. After the device is scanned, you can see Box1 (EC4-PX02B) in the left navigation tree. Under "Online", you can see that TwinCAT is in "OP" state. You can also observe that the RUN light of the slave device is always on, as shown in the figure below.

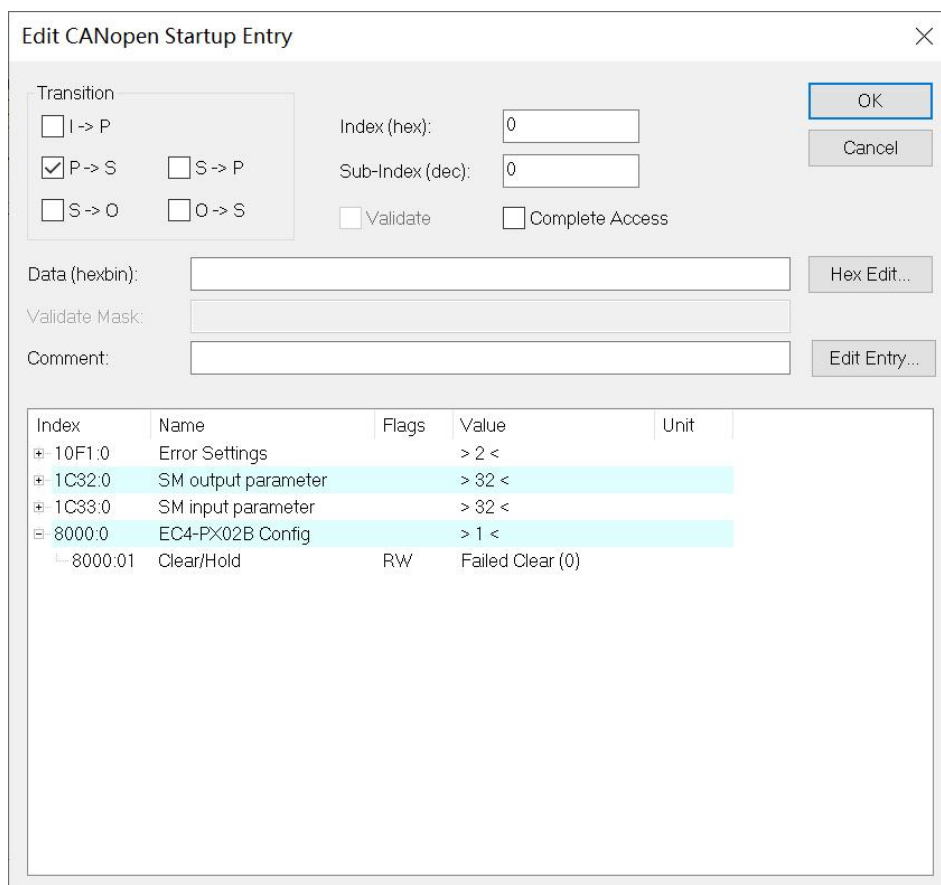


5. Verify basic functions

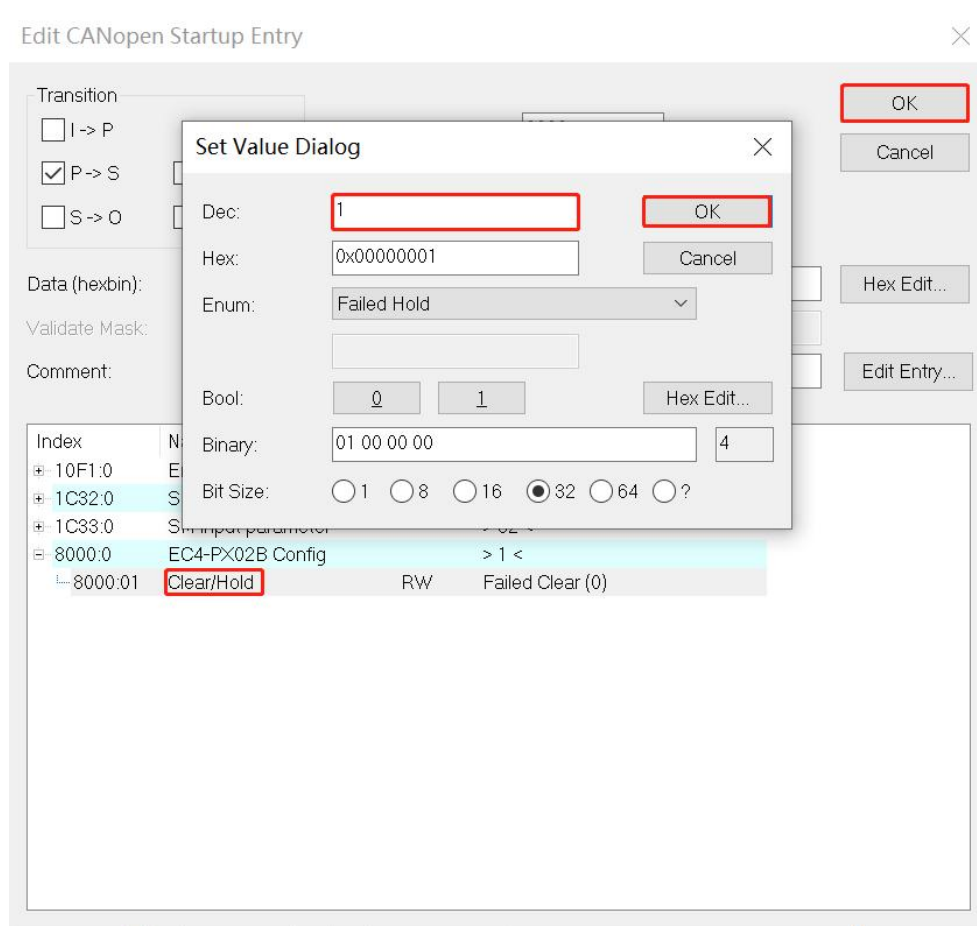
- a. Clicking "Box1 -> Startup -> New" in the left navigation tree will take you to the configuration parameter editing page, as shown in the image below.



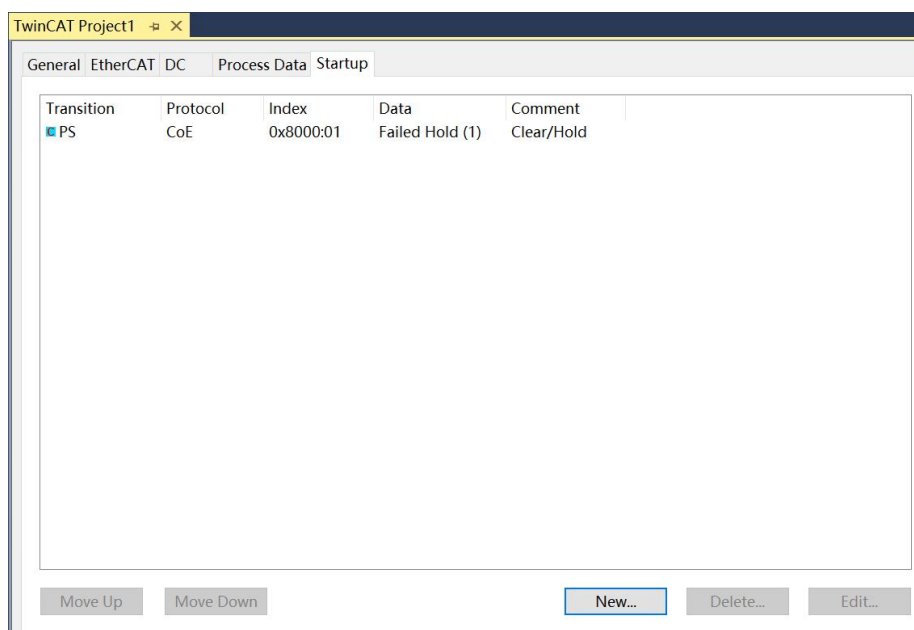
- b. In the Edit CANopen Startup Entry pop-up window, click the "+" in front of Index 8000:0 to expand the configuration parameter menu. You will see one configuration parameter. Click on any parameter to set the relevant configuration, as shown in the figure below.



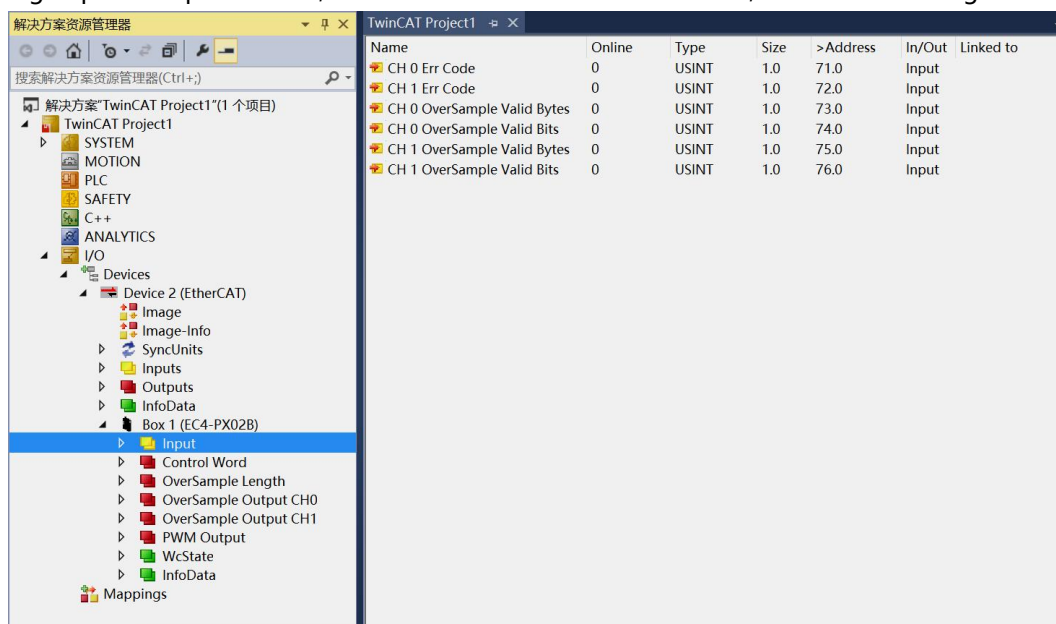
- c. For example, to modify the encoder's output signal clear/hold function, you can double-click "Clear/Hold" and modify the parameter value, as shown in the figure below.



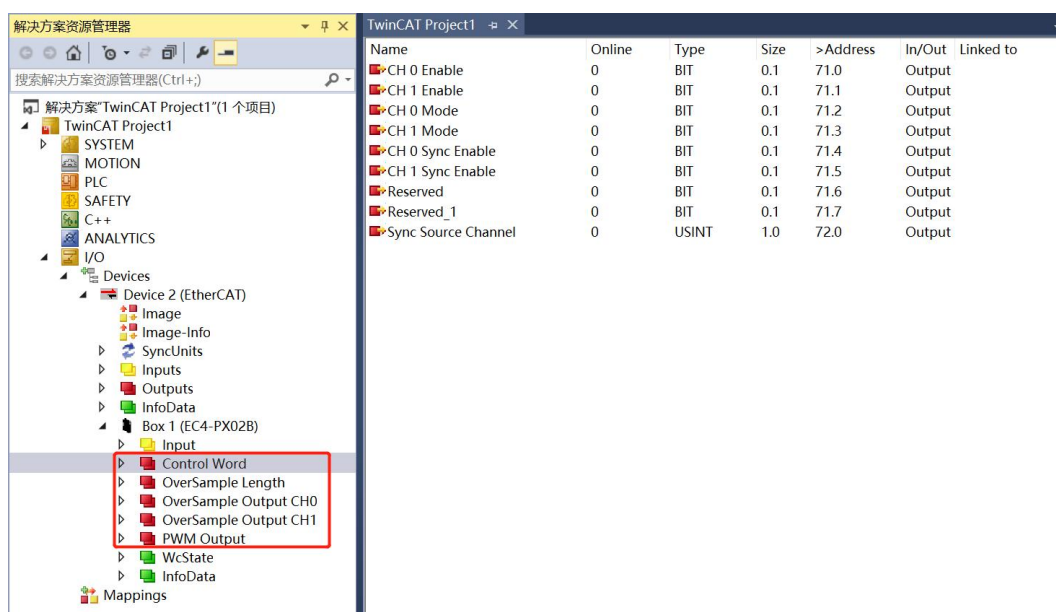
- d. After modifying the parameters, you can see the modified parameter items and values below Startup. After setting the parameters, you need to perform a Reload operation to enable the main site to automatically distribute the parameter settings, as shown in the figure below.



- e. The left-hand navigation tree "Box 1 -> Inputs" displays the Upstream data of the oversample high-speed output module, used to monitor the module's status, as shown in the figure below.



- f. The left navigation tree "Box 1 -> Control Word/OverSample Length/OverSample Output CH0/OverSample Output CH1/PWM Output" displays the Downstream data of the oversample high-speed output module, used to monitor the output status of the module, as shown in the figure below.



Module Function Examples

◆ Oversample output channel 0 basic output function

- a. Configure the configuration parameters as shown in the following figure.

Transition

☐ I -> P ☒ P -> S ☐ S -> P ☐ S -> O ☐ O -> S

Index (hex): 8000 Sub-Index (dec): 1

☐ Validate ☐ Complete Access

Data (hexbin): 00 00 00 00

Validate Mask:

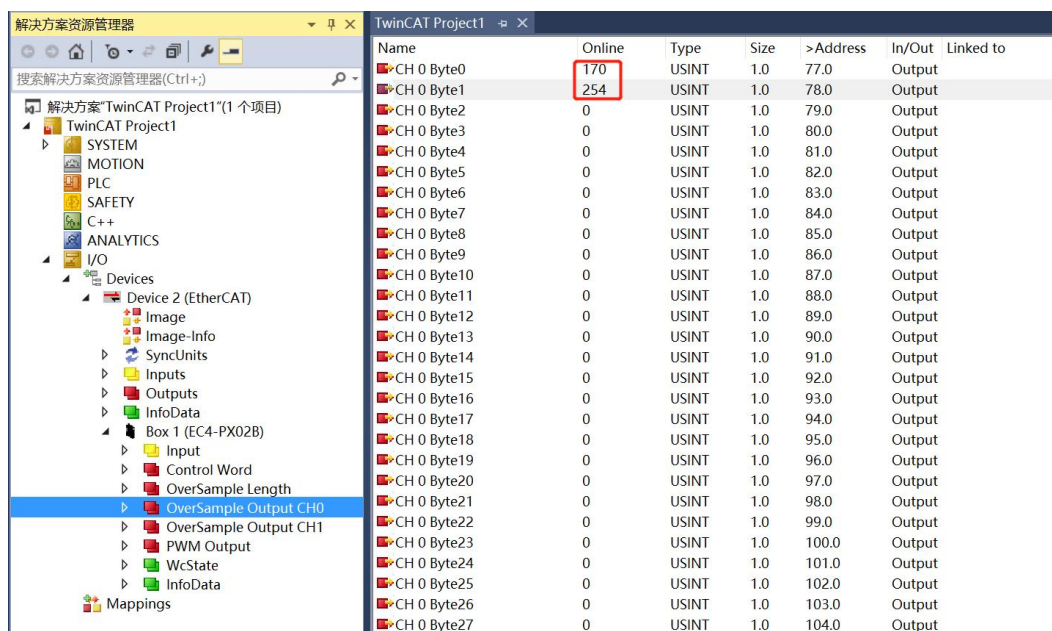
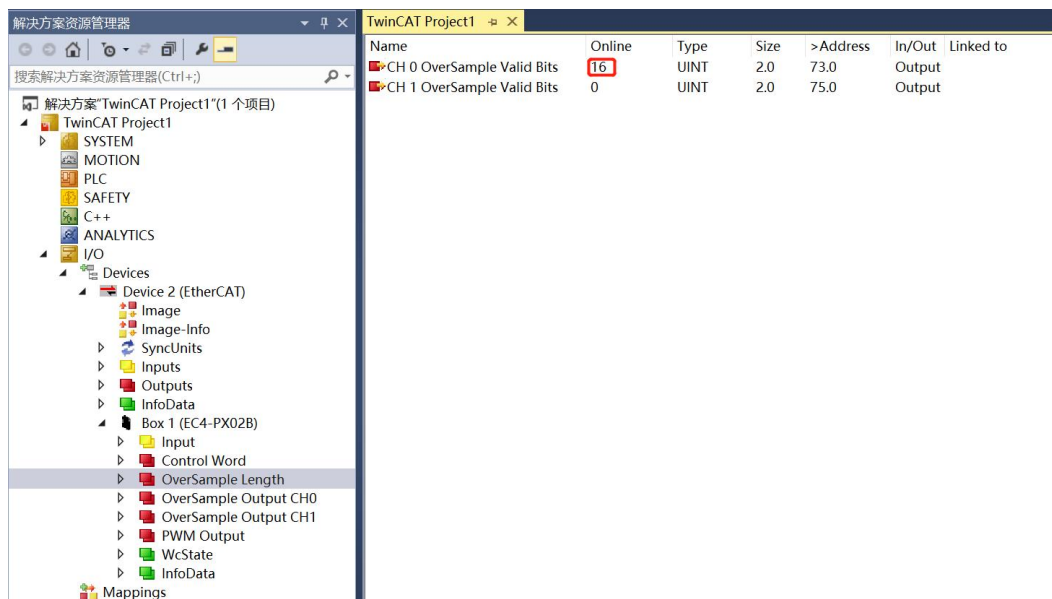
Comment: Clear/Hold

Index	Name	Flags	Value	Unit
10F1:0	Error Settings		> 2 <	
1C32:0	SM output parameter		> 32 <	
1C33:0	SM input parameter		> 32 <	
8000:0	EC4-PX02B Config		> 1 <	
8000:01	Clear/Hold	RW	Failed Clear (0)	

- b. Output channel 0 is set to oversample output mode, as shown in the figure below.

Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	0	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	0	BIT	0.1	71.2	Output	
CH 1 Mode	0	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

- c. The effective number of bits for oversample data is set to 16 bits. The first byte of oversample output data is set to 170, and the second byte of oversample output data is set to 254, as shown in the figure below.



d. Enable the output of channel 0 as shown in the figure below.

The screenshot shows the TwinCAT Project1 interface. On the left, the 'I/O' tree is expanded, showing 'Device 2 (EtherCAT)' and 'Box 1 (EC4-PX02B)'. The 'Control Word' is selected. On the right, the 'I/O' table is displayed, showing the configuration for the 'Control Word'.

Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	1	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	0	BIT	0.1	71.2	Output	
CH 1 Mode	0	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

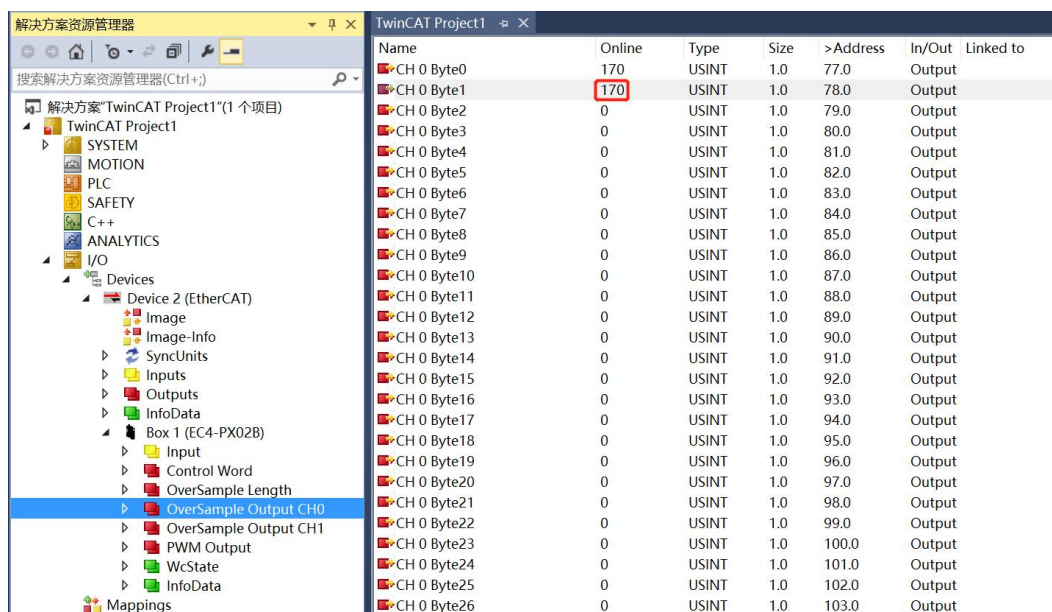
e. As you can see, the number of valid bytes in the oversample output data is 2 bytes, as shown in the figure below.

The screenshot shows the TwinCAT Project1 interface. On the left, the 'I/O' tree is expanded, showing 'Device 2 (EtherCAT)' and 'Box 1 (EC4-PX02B)'. The 'Input' is selected. On the right, the 'I/O' table is displayed, showing the configuration for the 'Input'.

Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Err Code	0	USINT	1.0	71.0	Input	
CH 1 Err Code	0	USINT	1.0	72.0	Input	
CH 0 OverSample Valid Bytes	2	USINT	1.0	73.0	Input	
CH 0 OverSample Valid Bits	0	USINT	1.0	74.0	Input	
CH 1 OverSample Valid Bytes	0	USINT	1.0	75.0	Input	
CH 1 OverSample Valid Bits	0	USINT	1.0	76.0	Input	



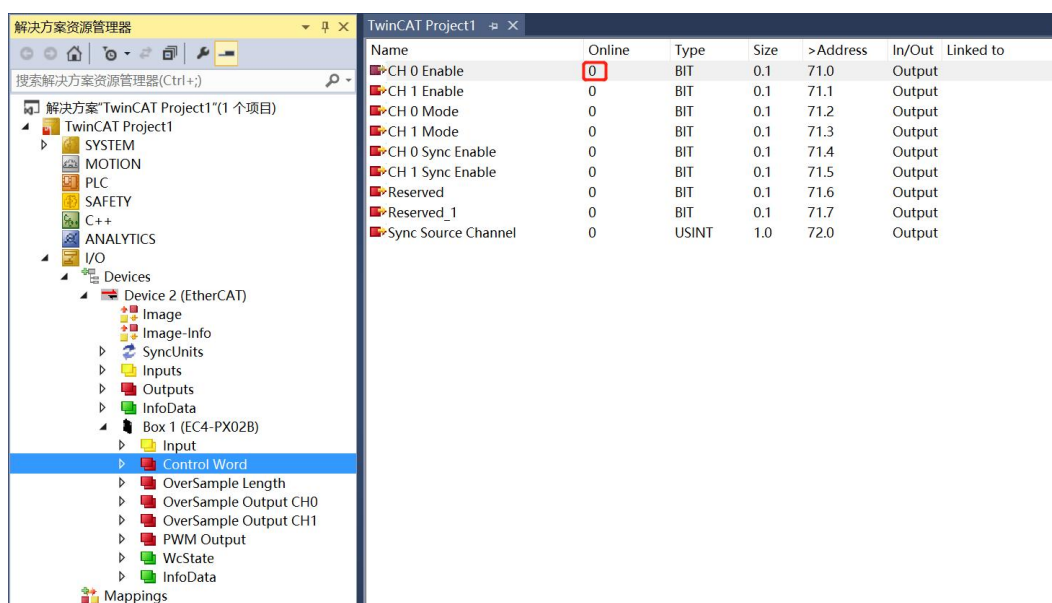
- f. The output data of the second byte of output channel 0 is dynamically adjusted to 170, as shown in the figure below.



Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Byte0	170	USINT	1.0	77.0	Output	
CH 0 Byte1	170	USINT	1.0	78.0	Output	
CH 0 Byte2	0	USINT	1.0	79.0	Output	
CH 0 Byte3	0	USINT	1.0	80.0	Output	
CH 0 Byte4	0	USINT	1.0	81.0	Output	
CH 0 Byte5	0	USINT	1.0	82.0	Output	
CH 0 Byte6	0	USINT	1.0	83.0	Output	
CH 0 Byte7	0	USINT	1.0	84.0	Output	
CH 0 Byte8	0	USINT	1.0	85.0	Output	
CH 0 Byte9	0	USINT	1.0	86.0	Output	
CH 0 Byte10	0	USINT	1.0	87.0	Output	
CH 0 Byte11	0	USINT	1.0	88.0	Output	
CH 0 Byte12	0	USINT	1.0	89.0	Output	
CH 0 Byte13	0	USINT	1.0	90.0	Output	
CH 0 Byte14	0	USINT	1.0	91.0	Output	
CH 0 Byte15	0	USINT	1.0	92.0	Output	
CH 0 Byte16	0	USINT	1.0	93.0	Output	
CH 0 Byte17	0	USINT	1.0	94.0	Output	
CH 0 Byte18	0	USINT	1.0	95.0	Output	
CH 0 Byte19	0	USINT	1.0	96.0	Output	
CH 0 Byte20	0	USINT	1.0	97.0	Output	
CH 0 Byte21	0	USINT	1.0	98.0	Output	
CH 0 Byte22	0	USINT	1.0	99.0	Output	
CH 0 Byte23	0	USINT	1.0	100.0	Output	
CH 0 Byte24	0	USINT	1.0	101.0	Output	
CH 0 Byte25	0	USINT	1.0	102.0	Output	
CH 0 Byte26	0	USINT	1.0	103.0	Output	



- g. Disable the output of channel 0 as shown in the figure below.



Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	0	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	0	BIT	0.1	71.2	Output	
CH 1 Mode	0	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

◆ PWM output channel 0 basic output function

- a. Configure the configuration parameters as shown in the following figure.

Transition

☐ I->P

☒ P->S ☐ S->P

☐ S->O ☐ O->S

Index (hex): 8000

Sub-Index (dec): 1

☐ Validate ☐ Complete Access

Data (hexbin): 00 00 00 00

Validate Mask:

Comment: Clear/Hold

Index	Name	Flags	Value	Unit
10F1:0	Error Settings		> 2 <	
1C32:0	SM output parameter		> 32 <	
1C33:0	SM input parameter		> 32 <	
8000:0	EC4-PX02B Config		> 1 <	
8000.01	Clear/Hold	RW	Failed Clear (0)	

- b. Output channel 0 is set to PWM output mode, as shown in the figure below.

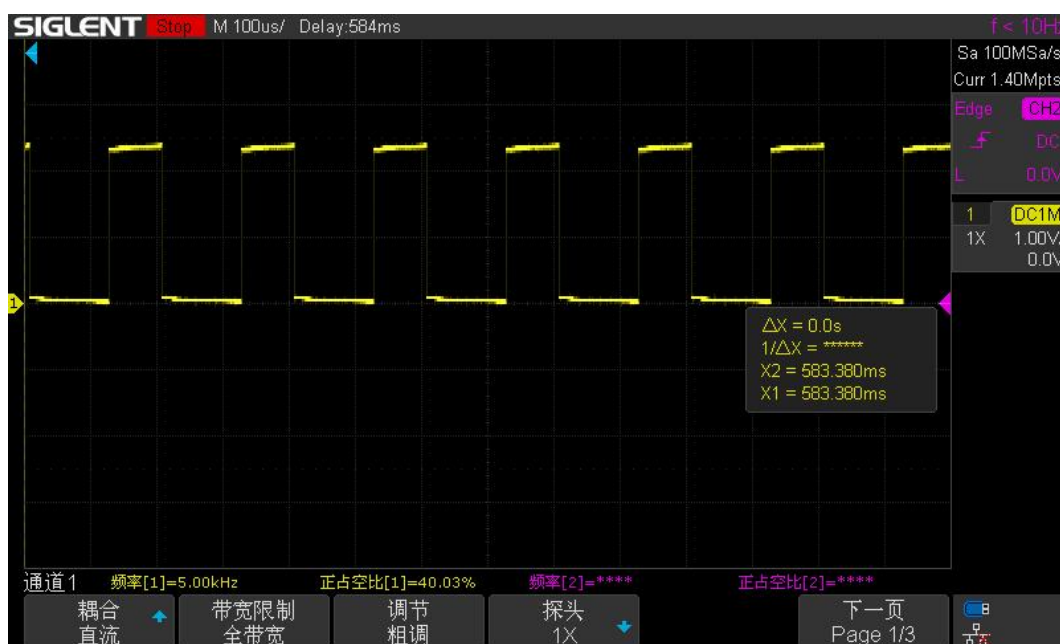
Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	0	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	1	BIT	0.1	71.2	Output	
CH 1 Mode	0	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

- c. The PWM output channel 0 frequency is set to 5kHz, the duty cycle is set to 40%, and the acceleration/deceleration time is set to 1000ms, as shown in the figure below.

Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 PWM Frequency	5000	UINT	2.0	327.0	Output	
CH 1 PWM Frequency	0	UINT	2.0	329.0	Output	
CH 0 PWM Duty	400	UINT	2.0	331.0	Output	
CH 1 PWM Duty	0	UINT	2.0	333.0	Output	
CH 0 PWM Accelerate Time	1000	UINT	2.0	335.0	Output	
CH 1 PWM Accelerate Time	0	UINT	2.0	337.0	Output	

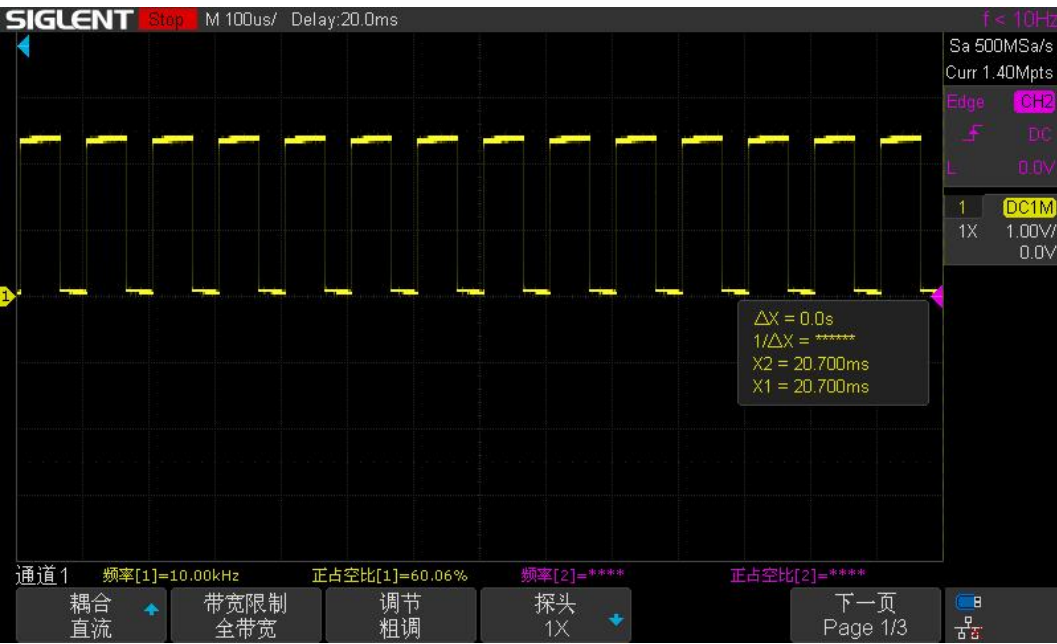
- d. Enable PWM channel 0 output as shown in the figure below.

Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	1	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	1	BIT	0.1	71.2	Output	
CH 1 Mode	0	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

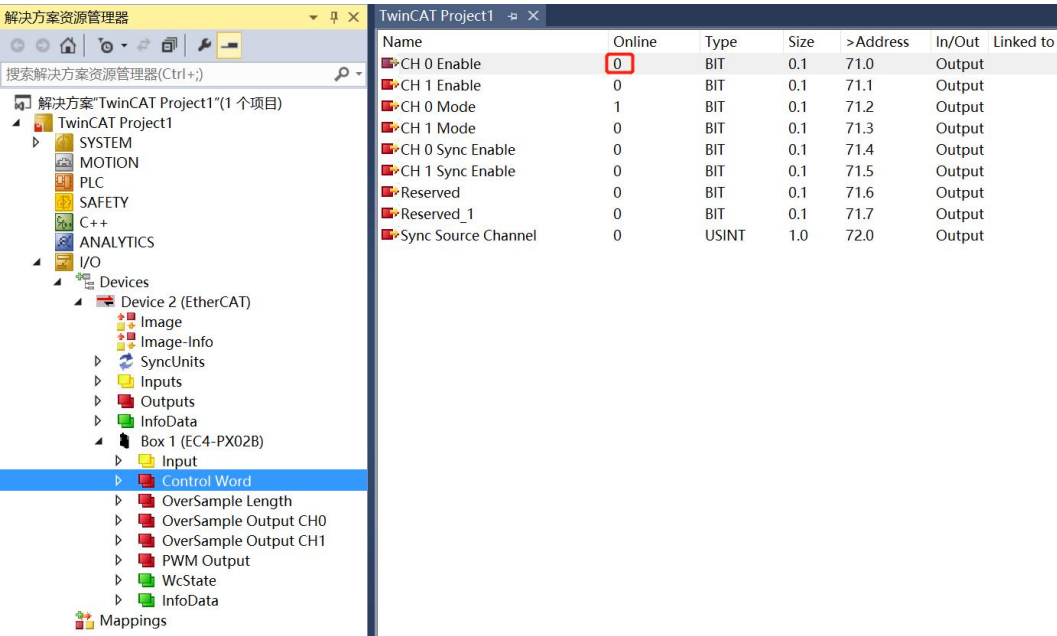


- e. The frequency of the PWM output channel 0 is dynamically adjusted to 10kHz, and the duty cycle is set to 60%, as shown in the figure below.

TwinCAT Project1						
Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 PWM Frequency	10000	UINT	2.0	327.0	Output	
CH 1 PWM Frequency	0	UINT	2.0	329.0	Output	
CH 0 PWM Duty	600	UINT	2.0	331.0	Output	
CH 1 PWM Duty	0	UINT	2.0	333.0	Output	
CH 0 PWM Accelerate Time	1000	UINT	2.0	335.0	Output	
CH 1 PWM Accelerate Time	0	UINT	2.0	337.0	Output	



f. Disable the output of PWM channel 0, as shown in the figure below.



◆ **PWM output channel 1 is synchronized with channel 0**

- a. Configure the configuration parameters as shown in the following figure.

Edit CANopen Startup Entry

Transition:
☐ I->P
☒ P->S ☐ S->P
☐ S->O ☐ O->S

Index (hex): 8000
 Sub-Index (dec): 1
☐ Validate ☐ Complete Access

Data (hexbin): 00 00 00 00
 Validate Mask:
 Comment: Clear/Hold

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

Index	Name	Flags	Value	Unit
10F1:0	Error Settings		> 2 <	
1C32:0	SM output parameter		> 32 <	
1C33:0	SM input parameter		> 32 <	
8000:0	EC4-PX02B Config		> 1 <	
8000.01	Clear/Hold	RW	Failed Clear (0)	

- b. The output channel 0~1 is set to PWM output mode, as shown in the figure below.

解决方案资源管理器

搜索解决方案资源管理器(Ctrl+):

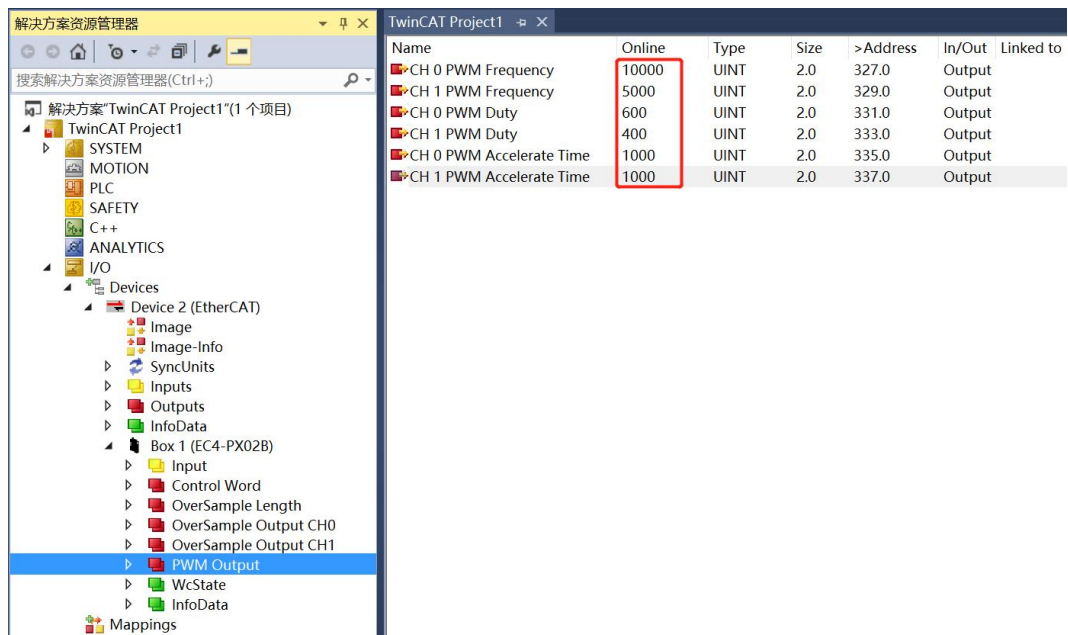
解决方案 TwinCAT Project1 (1 个项目)

- TwinCAT Project1
 - SYSTEM
 - MOTION
 - PLC
 - SAFETY
 - C++
 - ANALYTICS
 - I/O
 - Devices
 - Device 2 (EtherCAT)
 - Image
 - Image-Info
 - SyncUnits
 - Inputs
 - Outputs
 - InfoData
 - Box 1 (EC4-PX02B)
 - Input
 - Control Word
 - OverSample Length
 - OverSample Output CH0
 - OverSample Output CH1
 - PWM Output
 - WcState
 - InfoData

Mappings

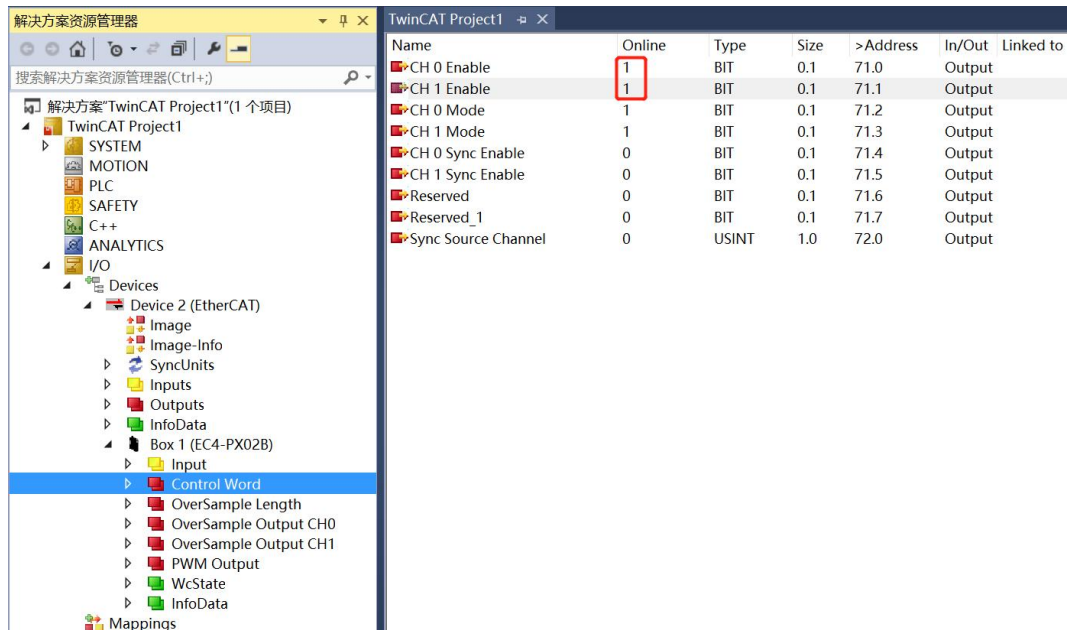
Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	0	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	1	BIT	0.1	71.2	Output	
CH 1 Mode	1	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

- c. The frequency of PWM output channel 1 is set to 5kHz, the duty cycle to 40%, and the acceleration/deceleration time to 1000ms; the frequency of PWM output channel 0 is set to 10kHz, the duty cycle to 60%, and the acceleration/deceleration time to 1000ms, as shown in the figure below.



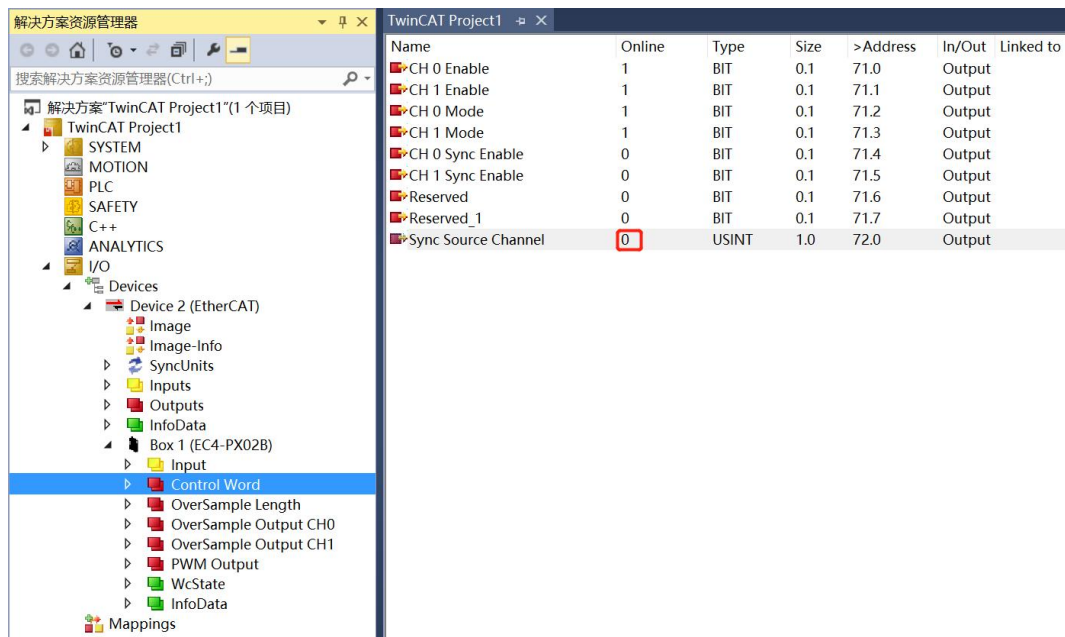
Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 PWM Frequency	10000	UINT	2.0	327.0	Output	
CH 1 PWM Frequency	5000	UINT	2.0	329.0	Output	
CH 0 PWM Duty	600	UINT	2.0	331.0	Output	
CH 1 PWM Duty	400	UINT	2.0	333.0	Output	
CH 0 PWM Accelerate Time	1000	UINT	2.0	335.0	Output	
CH 1 PWM Accelerate Time	1000	UINT	2.0	337.0	Output	

- d. Enable PWM channel 0~1 output as shown in the figure below.

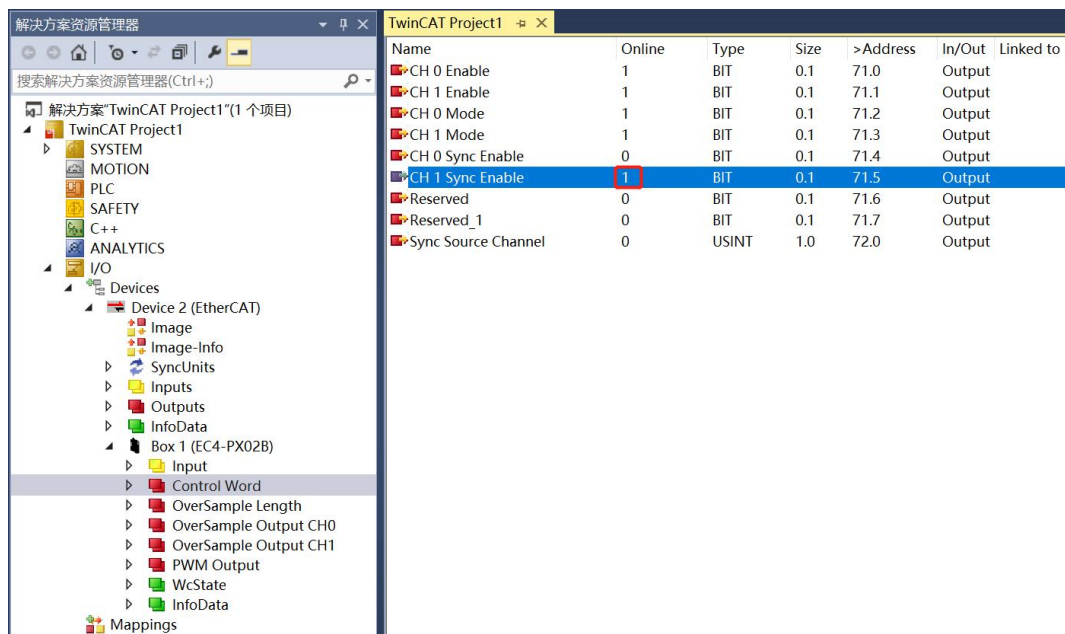


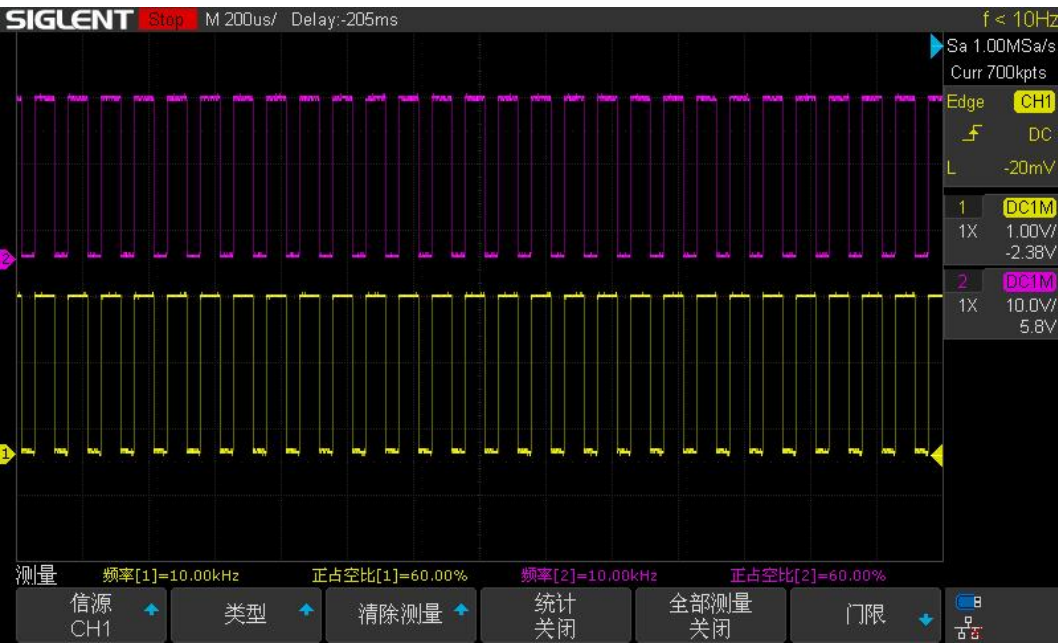
Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	1	BIT	0.1	71.0	Output	
CH 1 Enable	1	BIT	0.1	71.1	Output	
CH 0 Mode	1	BIT	0.1	71.2	Output	
CH 1 Mode	1	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

- e. The PWM output synchronization source channel is set to 0, as shown in the figure below.



- f. Configure PWM output channel 1 to enable synchronization, as shown in the figure below.





- ◆ **Oversample output channel 1 is synchronized with channel 0**
 - Configure the configuration parameters as shown in the following figure.

Edit CANopen Startup Entry

Transition

☐ I -> P
☒ P -> S
☐ S -> P
☐ S -> O
☐ O -> S

Index (hex): 8000
Sub-Index (dec): 1
☐ Validate
☐ Complete Access

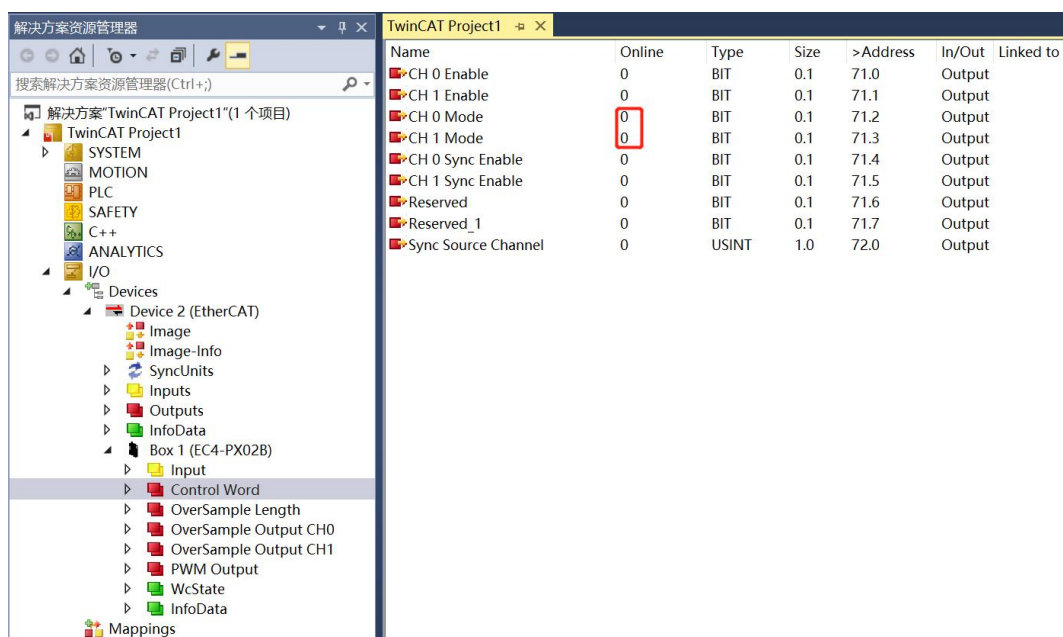
Data (hexbin): 00 00 00 00
Hex Edit...

Validate Mask:

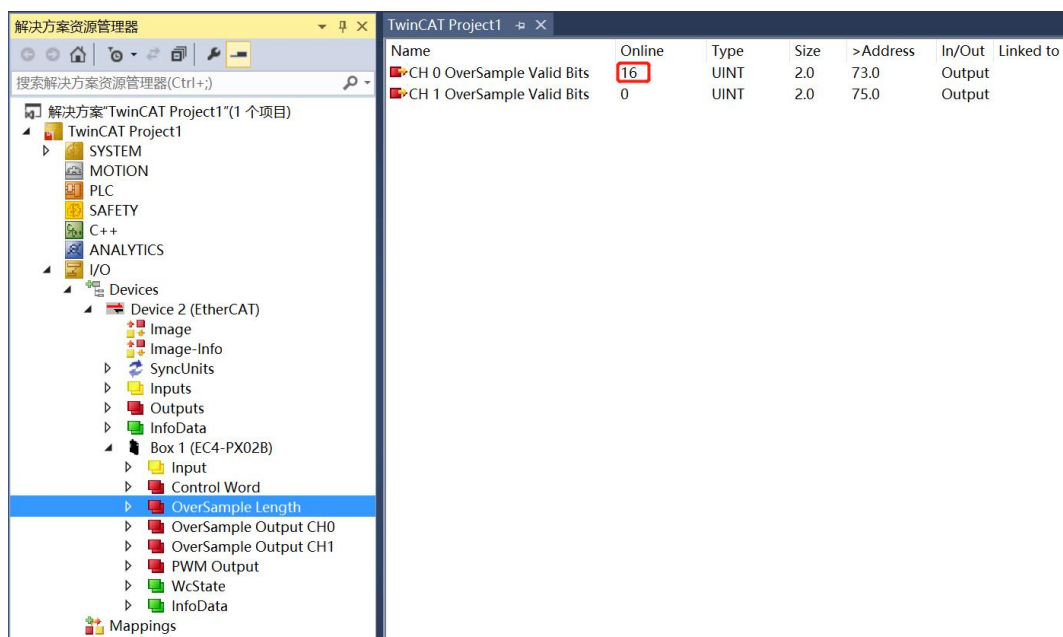
Comment: Clear/Hold
Edit Entry...

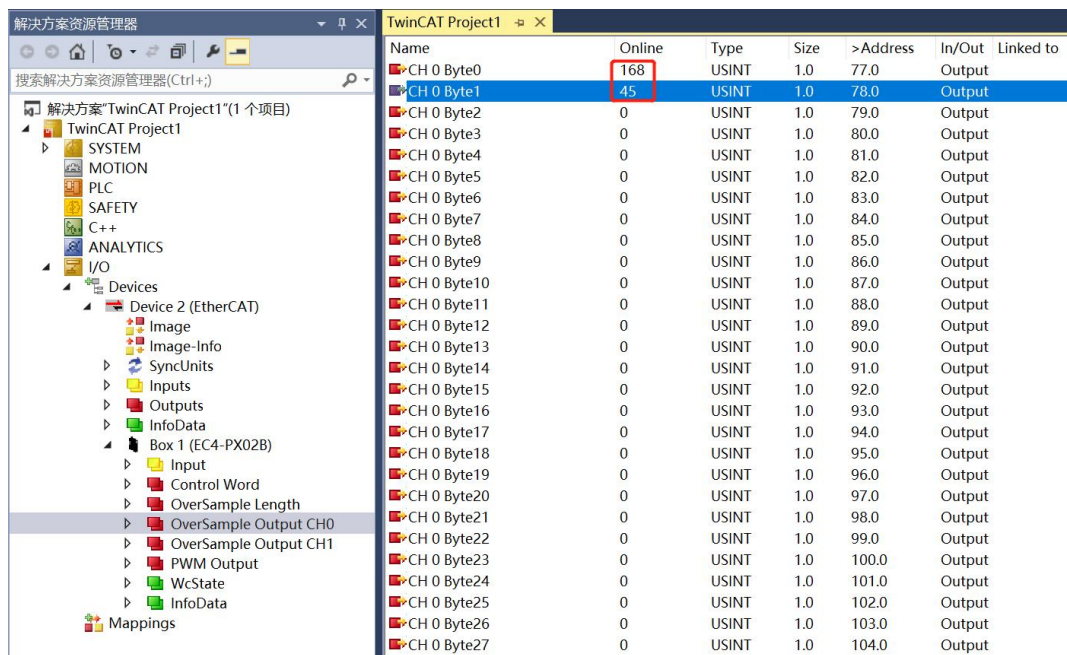
Index	Name	Flags	Value	Unit
10F1:0	Error Settings		> 2 <	
1C32:0	SM output parameter		> 32 <	
1C33:0	SM input parameter		> 32 <	
8000:0	EC4-PX02B Config		> 1 <	
8000:01	Clear/Hold	RW	Failed Clear (0)	

- b. The output channel 0~1 is set to oversample output mode, as shown in the figure below.



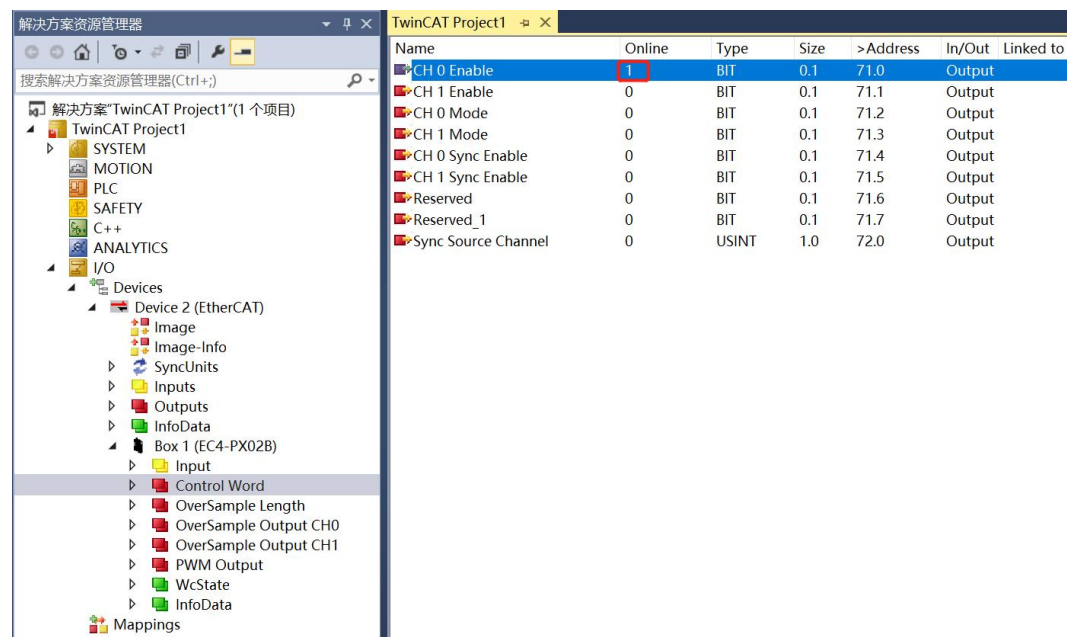
- c. The effective number of bits for the oversample data in channel 0 is set to 16 bits. The first byte of the oversample output is set to 168 bits, and the second byte is set to 45 bits, as shown in the figure below.





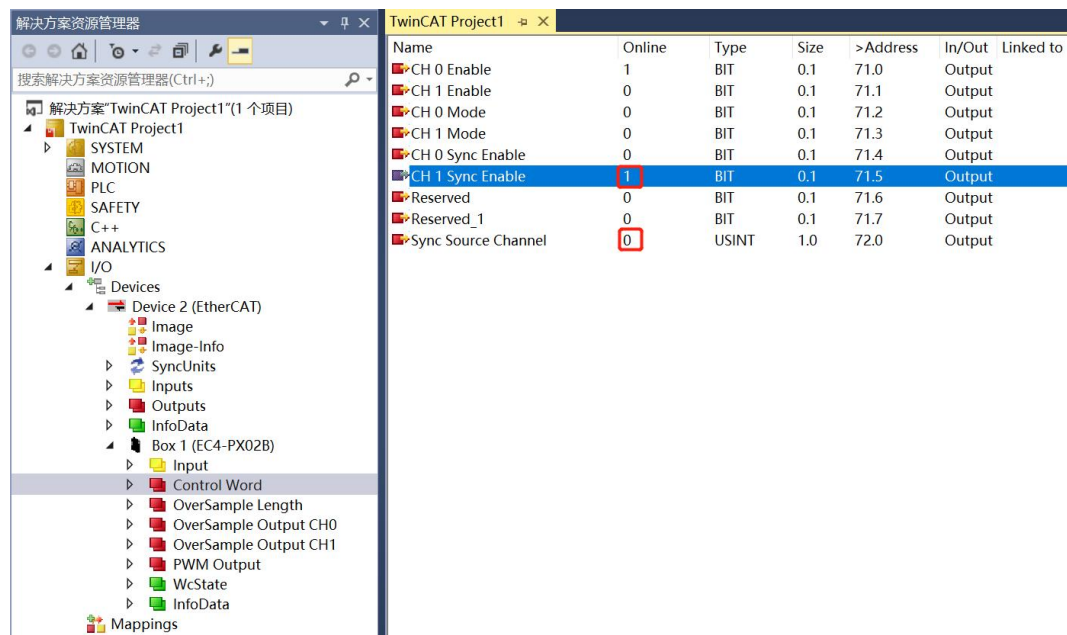
Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Byte0	168	USINT	1.0	77.0	Output	
CH 0 Byte1	45	USINT	1.0	78.0	Output	
CH 0 Byte2	0	USINT	1.0	79.0	Output	
CH 0 Byte3	0	USINT	1.0	80.0	Output	
CH 0 Byte4	0	USINT	1.0	81.0	Output	
CH 0 Byte5	0	USINT	1.0	82.0	Output	
CH 0 Byte6	0	USINT	1.0	83.0	Output	
CH 0 Byte7	0	USINT	1.0	84.0	Output	
CH 0 Byte8	0	USINT	1.0	85.0	Output	
CH 0 Byte9	0	USINT	1.0	86.0	Output	
CH 0 Byte10	0	USINT	1.0	87.0	Output	
CH 0 Byte11	0	USINT	1.0	88.0	Output	
CH 0 Byte12	0	USINT	1.0	89.0	Output	
CH 0 Byte13	0	USINT	1.0	90.0	Output	
CH 0 Byte14	0	USINT	1.0	91.0	Output	
CH 0 Byte15	0	USINT	1.0	92.0	Output	
CH 0 Byte16	0	USINT	1.0	93.0	Output	
CH 0 Byte17	0	USINT	1.0	94.0	Output	
CH 0 Byte18	0	USINT	1.0	95.0	Output	
CH 0 Byte19	0	USINT	1.0	96.0	Output	
CH 0 Byte20	0	USINT	1.0	97.0	Output	
CH 0 Byte21	0	USINT	1.0	98.0	Output	
CH 0 Byte22	0	USINT	1.0	99.0	Output	
CH 0 Byte23	0	USINT	1.0	100.0	Output	
CH 0 Byte24	0	USINT	1.0	101.0	Output	
CH 0 Byte25	0	USINT	1.0	102.0	Output	
CH 0 Byte26	0	USINT	1.0	103.0	Output	
CH 0 Byte27	0	USINT	1.0	104.0	Output	

d. Enable the output of channel 0 as shown in the figure below.



Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	1	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	0	BIT	0.1	71.2	Output	
CH 1 Mode	0	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	0	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

- e. Set the output synchronization source channel to 0 and enable synchronization for output channel 1, as shown in the figure below.



The screenshot shows the TwinCAT Project1 resource manager. The left pane displays the project hierarchy, and the right pane shows the variable declaration table. The 'CH 1 Sync Enable' variable is highlighted in blue, and its value is set to 1. The 'Sync Source Channel' variable is also highlighted, and its value is set to 0.

Name	Online	Type	Size	>Address	In/Out	Linked to
CH 0 Enable	1	BIT	0.1	71.0	Output	
CH 1 Enable	0	BIT	0.1	71.1	Output	
CH 0 Mode	0	BIT	0.1	71.2	Output	
CH 1 Mode	0	BIT	0.1	71.3	Output	
CH 0 Sync Enable	0	BIT	0.1	71.4	Output	
CH 1 Sync Enable	1	BIT	0.1	71.5	Output	
Reserved	0	BIT	0.1	71.6	Output	
Reserved_1	0	BIT	0.1	71.7	Output	
Sync Source Channel	0	USINT	1.0	72.0	Output	

