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USR-PX520

User Manual

Industrial Protocol Converter



V2.0

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Content

1. Introduction ..... - 3 -
1.1. Features ..... - 3 -
1.2. Parameters table ..... - 3 -
2. Hardware Parameters ..... - 5 -
2.1. Interface description ..... - 5 -
2.2. LED Indicators ..... - 6 -
2.3. Dimension ..... - 7 -
2.4. Termination Resistor ..... - 7 -
3. Get start ..... - 8 -
3.1. PXTool Configuration Software ..... - 8 -
3.1.1. Software Download and Installation ..... - 8 -
3.1.2. Search PX520 device on the PXTool ..... - 9 -
3.1.3. Software interface overview ..... - 10 -
3.2. PLC parameters settings ..... - 12 -
3.2.1. Import ESI File ..... - 12 -
3.2.2. Configuring the PXB Protocol Converter ..... - 12 -
4. Product Functions ..... - 18 -
4.1. Basic Configuration ..... - 18 -
4.2. Interface Configuration ..... - 19 -
4.2.1. Ethernet Configuration ..... - 19 -
4.2.2. Serial Configuration ..... - 20 -
4.3. EtherCAT Parameter Configuration ..... - 21 -
4.3.1. TXPDO ..... - 24 -
4.3.2. RXPDO ..... - 25 -
4.4. Edge computing ..... - 26 -
4.4.1. Slave configuration ..... - 26 -
4.4.2. Data points configuration ..... - 28 -
5. Contact Us ..... - 29 -
6. Disclaimer ..... - 29 -

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1. Introduction

The USR-PX520 is an EtherCAT to Modbus industrial fieldbus protocol converter launched by USR for the industrial sector. This product series features high speed, low latency, stable performance, ease of use, and high cost-effectiveness. On the EtherCAT side, this product operates as an EtherCAT slave, featuring 2 EtherCAT slave ports, 1 RS485 interface, and 1 standard 10/100M Ethernet interface. The USR-PX520 provides PC-based configuration tools for flexible setup, easily enabling the integration of Modbus slave devices with EtherCAT master devices.

This product adopts industrial-grade design standards: wide operating temperature range (-40°C to +85°C), wide-voltage input DC 9-36V, and robust hardware protection. It has undergone multiple rigorous environmental tests, allowing it to adapt to various industry scenarios and operate reliably even in harsh conditions. Parameters can be configured via user-friendly PC software. The product comes with a built-in DIN rail clip for easy and quick installation, suitable for various industrial applications.

1.1. Features

■Aluminum alloy shell, IP40 protection: Reduces the impact of dust.

■Industrial-grade wide temperature design (-40℃ to +85℃), suitable for extreme temperatures.

■Wide voltage input (DC 9-36V) with reverse polarity protection.

■High EMC protection level (Grade 3B), designed for harsh industrial environments.

■Standard 35mm DIN rail mounting.

■2*EtherCAT ports with integrated switch functionality, supporting EtherCAT link redundancy.

■Built-in 120Ω termination resistor, configurable via PC software.

■Supports EtherCAT Slave to ModbusRTU Master and ModbusTCP Master conversion.

■Supports ESI file export.

■Supports up to 128 TXPDO and 128 RXPDO groups for EtherCAT.

■Supports edge data acquisition and computation, up to 2000 data points.

■ModbusRTU supports connection to 32 slaves; ModbusTCP supports up to 8 slave devices.

1.2. Parameters table

Table 1. Specification

Catalog	Parameters	Value

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Power Supply	Power Input	9-36V DC, 12V/1A is recommended
	Working Current	Idle: 158mA/12V (avg), 163mA/12V (max); Full load: 162mA/12V (avg), 165mA/12V (max)
	Connector	5.08×2P pluggable terminal block with anti-reverse and screw lock
RS485 Interface	Connector	3.81×3P pluggable terminal block with screw lock
	Pin	A (RS485 A), B (RS485 B), G (GND)
	Baud Rate	600~230.4K bps
	Data bits	8
	Stop bit	1, 2
	Parity bit	None, Odd, Even
Ethernet Port	EtherCAT	2 × EtherCAT ports (IN/OUT), 10/100Mbps auto-negotiation, integrated switch functoin
	Ethernet	1× RJ45 port (10/100Mbps, auto MDI/MDIX)
	Default IP	192.168.0.7
	Gateway IP	192.168.0.1
Other Interface	Indicators	PWR, WORK, 485, ECAT
	Reload Button	Press for 3-15s to restore factory settings
	Type-C	Debugging interface for troubleshooting
Physical Parameters	EMC Protection	IEC 61000-4-2(ESD): 6kV contact, 8kV air IEC 61000-4-5(Surge): 2kV common mode, 1kV differential mode for power; 2kV for Ethernet/RS485 IEC 61000-4-4(EFT): 2kV for power, 1kV for Ethernet/RS485
	Isolation	Isolation for both serial, Ethernet, CAN, and power
	Dimension	120×85×30mm (without terminals/rail); 137.3×30×109.3mm (with terminals/rail)
	Installation	DIN rail mounting, aluminum housing
	Operating Temperature	-40℃ to +85℃
	Storage Temperature	-40℃ to +105℃ (non-condensing)
	Operating Humidity	5%-95% (non-condensing)
Software	Protocol	EtherCAT slave to Modbus RTU/TCP master

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	EtherCAT protocol	Up to 128 TXPDO and 128 RXPDO groups in EtherCAT, with 128 variables per group
	Modbus protocol	Edge data collection and computation for up to 2,000 data points
	Setup	Setup tool on PC

2. Hardware Parameters

2.1. Interface description

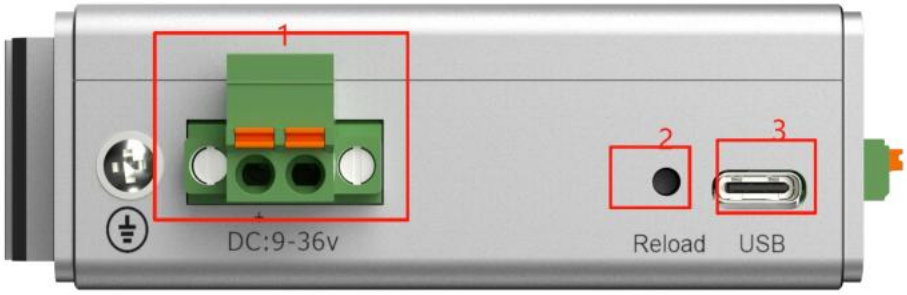


Figure 1. Interface on side



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Figure 2. Interface on front

Table 2. Interface description

No.	Interface	Description
1	DC 9-36V +	Power input, DC 9-36V positive pole
	DC 9-36V -	Power input, DC 9-36V negative pole
2	Reload	Factory reset button
3	Type-C	Debugging interface (for troubleshooting and log capture)
4	IN	EtherCAT interface (IN). Connect directly to an EtherCAT master or cascade from the OUT port of another EtherCAT slave.
	OUT	EtherCAT interface (OUT). Cascade to the IN port of another EtherCAT slave.
5	Ethernet	Standard 10/100M Ethernet communication port (marked 'NET' for configuration)
6	485A	Isolated RS485_A signal line
	485B	Isolated RS485_B signal line
	GND	Isolated RS485 ground

2.2. LED Indicators

LED	Color	Status Description
PWR	Red	Solid On: Powered on Off: Powered off
WORK	Green	Blinking: Device operating normally
485	Green /Red	Green Blinking: Data being received on the serial port Red Blinking: Data being transmitted on the serial port
ECAT	Green / Red	Off: Not connected to master or in INIT state

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LED	Color	Status Description
		Green Blinking: EtherCAT Slave in PRE-OP or SAFE-OP state Green Solid: EtherCAT Slave in OP state Red Blinking: EtherCAT Slave in ERR state (Bootstrap)

2.3. Dimension

➢137.3*30*109.3mm (L*W*H, including terminals and rail clip)

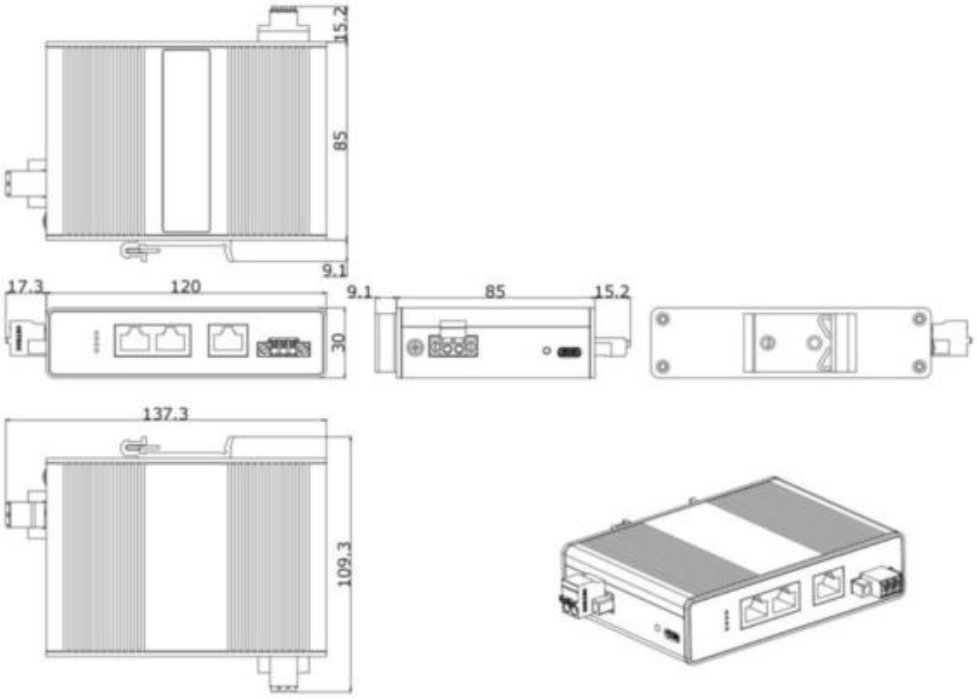


Figure 3. Dimension of USR-PX520

2.4. Termination Resistor

The USR-PX520 comes with a built-in 120Ω termination resistor for the RS485 communication port. It is not connected to the bus by default. Users can configure it via the PC software, as shown in Figure 4. Users can choose to enable or disable the termination resistor, eliminating the need for external wiring or resistor modification.

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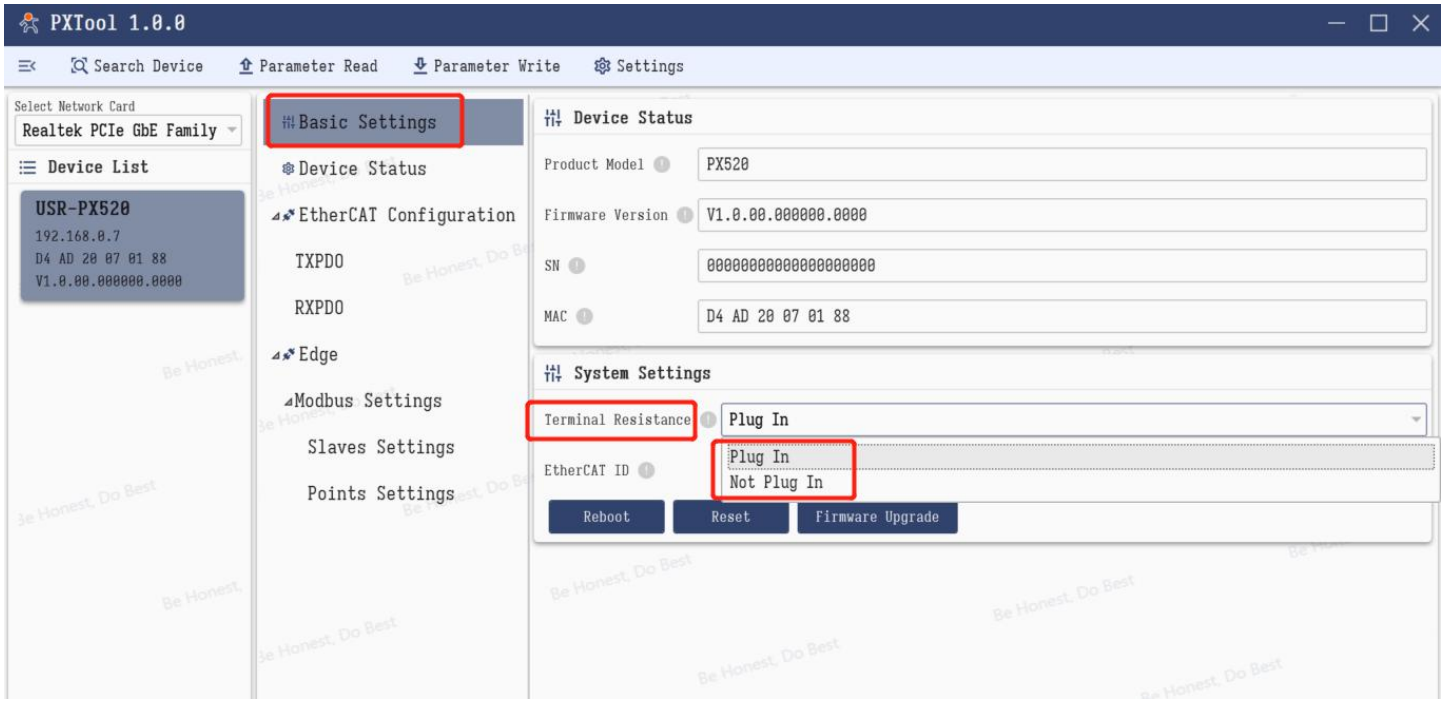


Figure 4. Termination Resistor Configuration Interface

3. Get start

The USR-PX520 can be configured and used by following these steps:

1. Install the PXTool configuration software and TwinCAT3 software on your PC.

2. Connect the appropriate power supply to the DC:9-36V terminals on the side of the device (a 12V/1A adapter is recommended). After powering on the device, connect the USR-PX520 to your PC using an Ethernet cable plugged into the port marked "NET".

3. Open the PXTool configuration software. Configure the device according to your requirements (refer to Section 4) and write the configuration to the USR-PX520 device.

4. Connect the master device to the EtherCAT port marked "IN" on the USR-PX520 using an Ethernet cable.

5. Proceed with data communication and interaction.

Note: If your master device is not TwinCAT3 or an x86 platform, you can import the XML file according to your master device's instructions, connect the USR-PX520, configure it correctly, and use the device accordingly.

3.1. PXTool Configuration Software

3.1.1. Software Download and Installation

The USR-PX520 can be configured using the PXTool software.

Download link: **https://www.pusr.com/support/download/Setup-Software-USR-PX520-PX530-Setup-Software.html**

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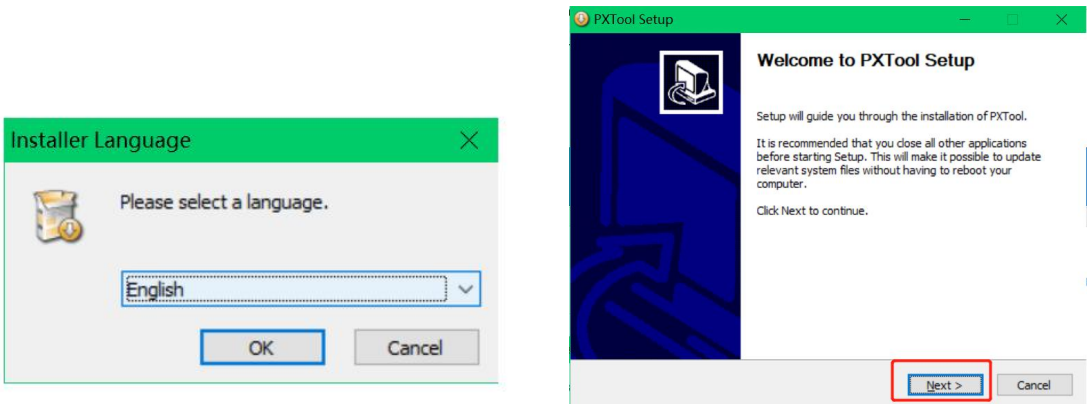


Figure 5. Installation processing

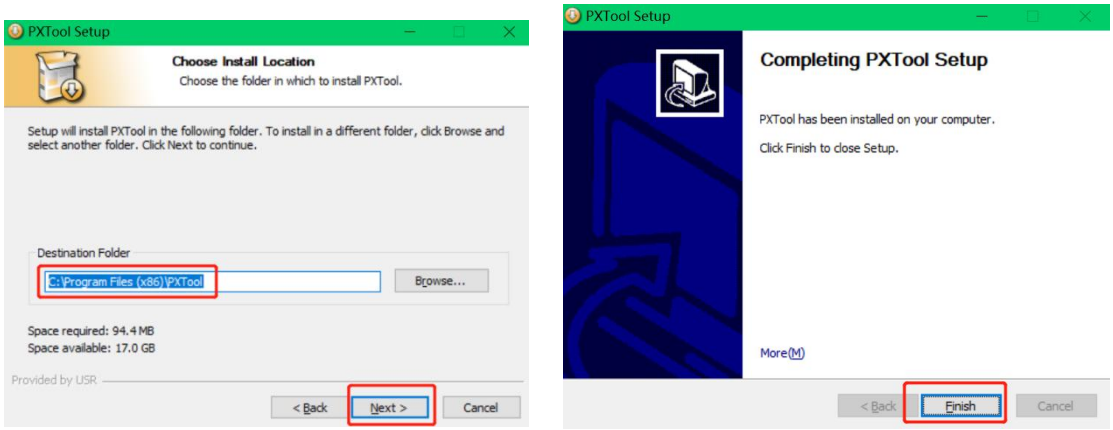


Figure 6. Installation finished

3.1.2. Search PX520 device on the PXTool

1. Connect the port marked "NET" on the USR-PX520 to the PC via Ethernet cable, and power on the PX520. Run the PXTool software and select the appropriate network adapter on your PC.



Figure 7. Select the right network adapter

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2. Search device, the connected device will be displayed in the device list. Click on the scanned device in the list to connect to it.

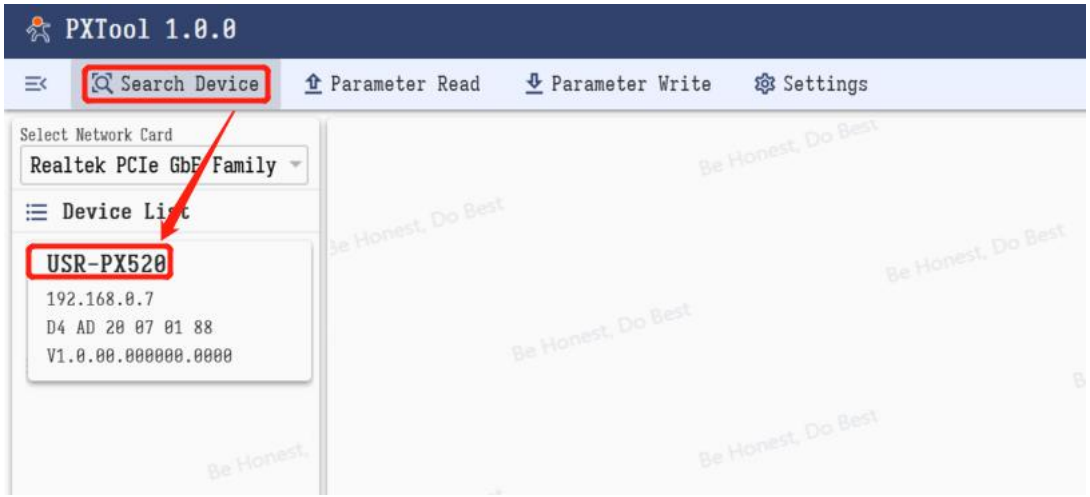


Figure 8. Search device

3. If the local PC's IP address is different from the device's address, a prompt to add a virtual IP will appear. Click "OK".



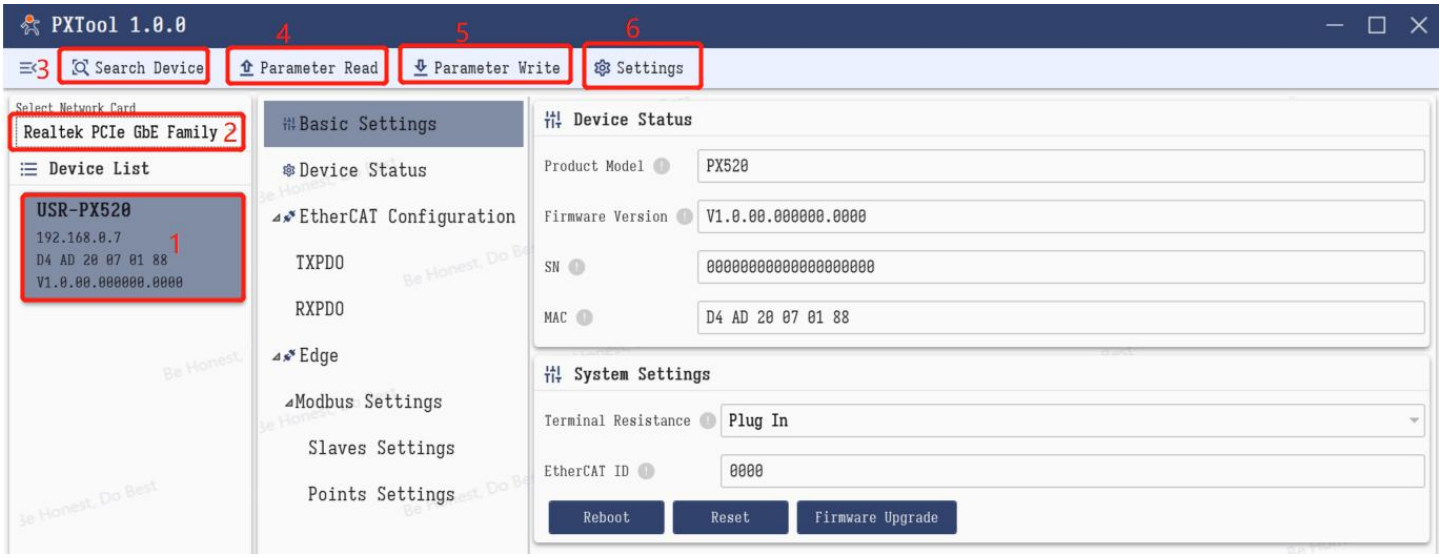
Figure 9. Device Scan Interface

3.1.3. Software interface overview

Run the PXTool software. The interface is shown in the following picture. After powering on the device, connect the port marked "NET" on the USR-PX520 to the PC running PXTool using an Ethernet cable.

The left side of the PXTool interface displays device information for the PX series products, including "Select Network Adapter" and "Device List". The top of the interface is the menu bar, including buttons like [Search Device], [Read Parameters], [Write Parameters], [Settings], etc.

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1. Device list

The device list shows information about searched devices, including default IP, MAC, firmware version, etc.

2. Select Network Card

Click [Select Network Card] to choose the PC's network adapter for device search.

3. Search device

Click the [Search Devices] button. The PXTool software will search for all PX series devices on the current LAN and display the target board's IP address and firmware version in the "Device List" drop-down box. Select the correct device in the "Device List" drop-down box to configure the PX series device.

4. Read parameters

After selecting a device, click the [Read Parameters] button to read the parameters from the PX device into PXTool. The imported configuration can be modified or written directly to another device.

5. Write parameters

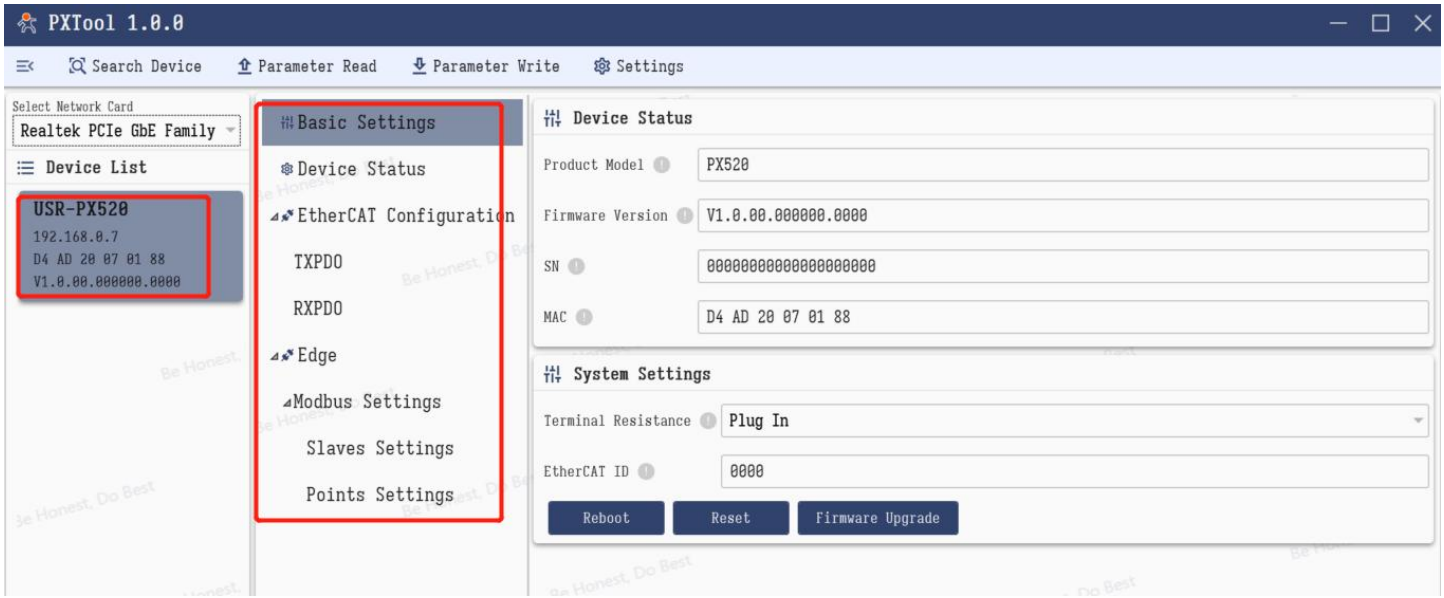
After selecting a device, click the [Write Parameters] button to write the currently configured parameters to the PX device.

6. Settings

This option is currently mainly for setting English/Chinese language.

Select a device searched and listed below the device list to enter the device parameter configuration interface, as shown the following picture.

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3.2. PLC parameters settings

The following will use TwinCAT3 as an example to demonstrate how to add the USR-PX520 protocol converter; if your master is not TwinCAT3, you can import the XML file to add the USR-PX520 EtherCAT slave station according to your master device's manual.

3.2.1. Import ESI File

Copy and paste the ESI file exported from the PXTool configuration software into the TwinCAT3 installation directory, for example:

C:\TwinCAT\3.1\Config\Io\EtherCAT

3.2.2. Configuring the PXB Protocol Converter

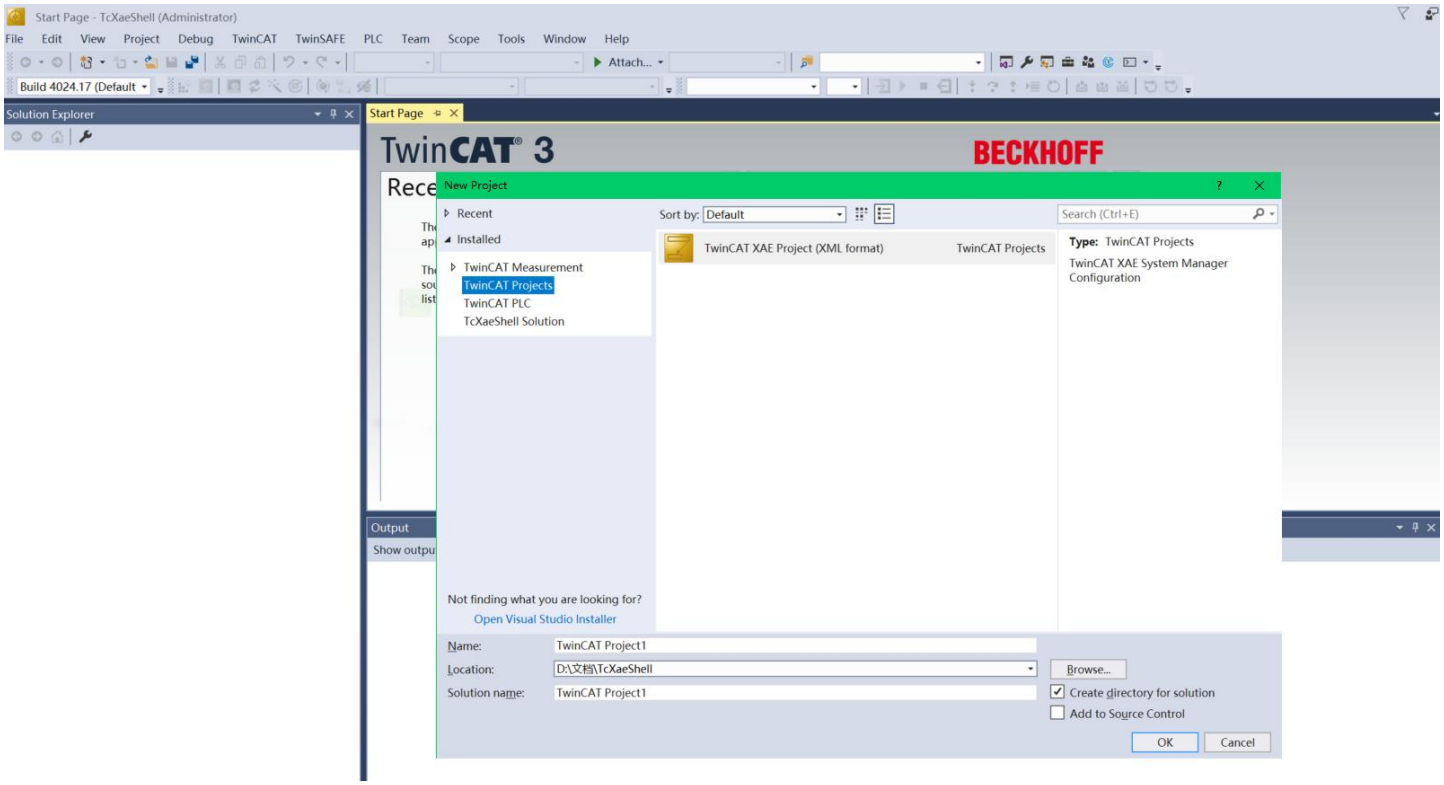
3.2.2.1. Create a New Project

Open the installed TwinCAT3 software and enter the development environment:

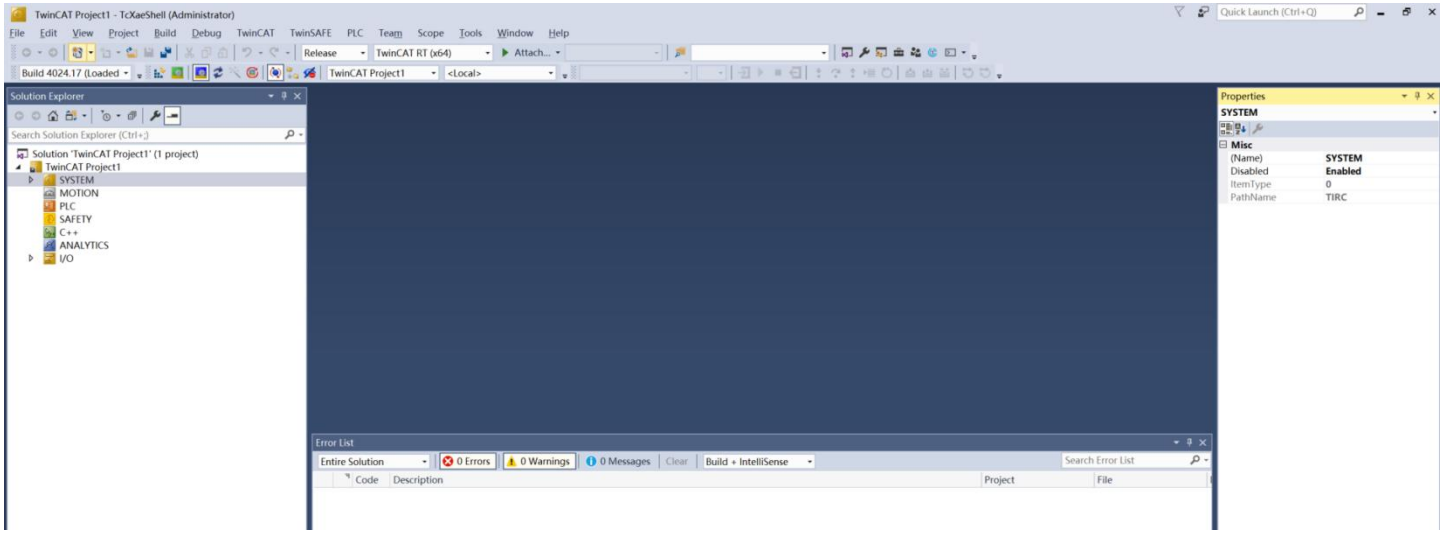
In the top left menu bar, select: "File" -> "New (N)" -> "Project (P)...";

Select TwinCAT Projects, modify the project name, choose a suitable location to save the project, and click "OK":

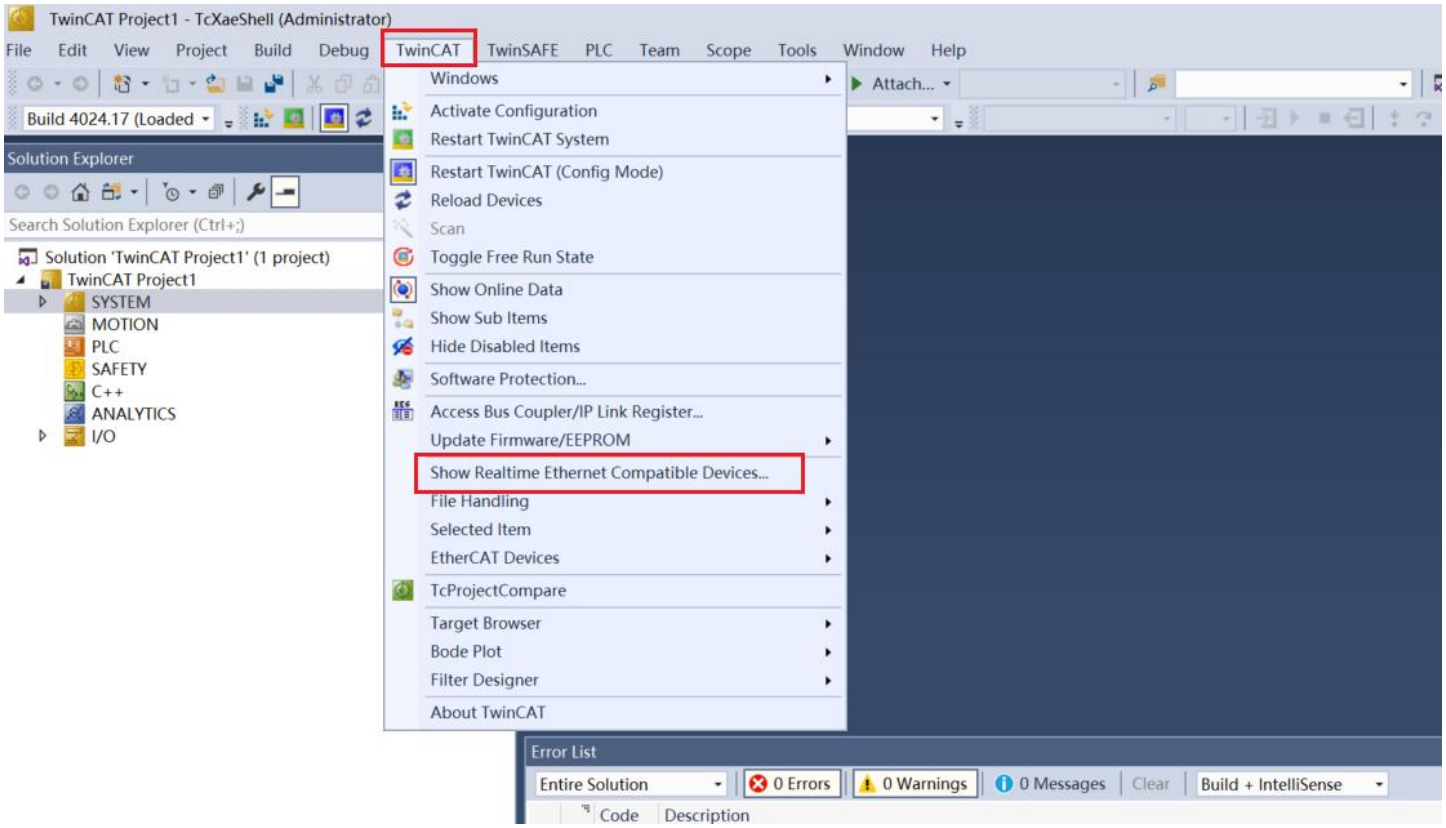
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After the project is created normally, the interface is shown in the following figure

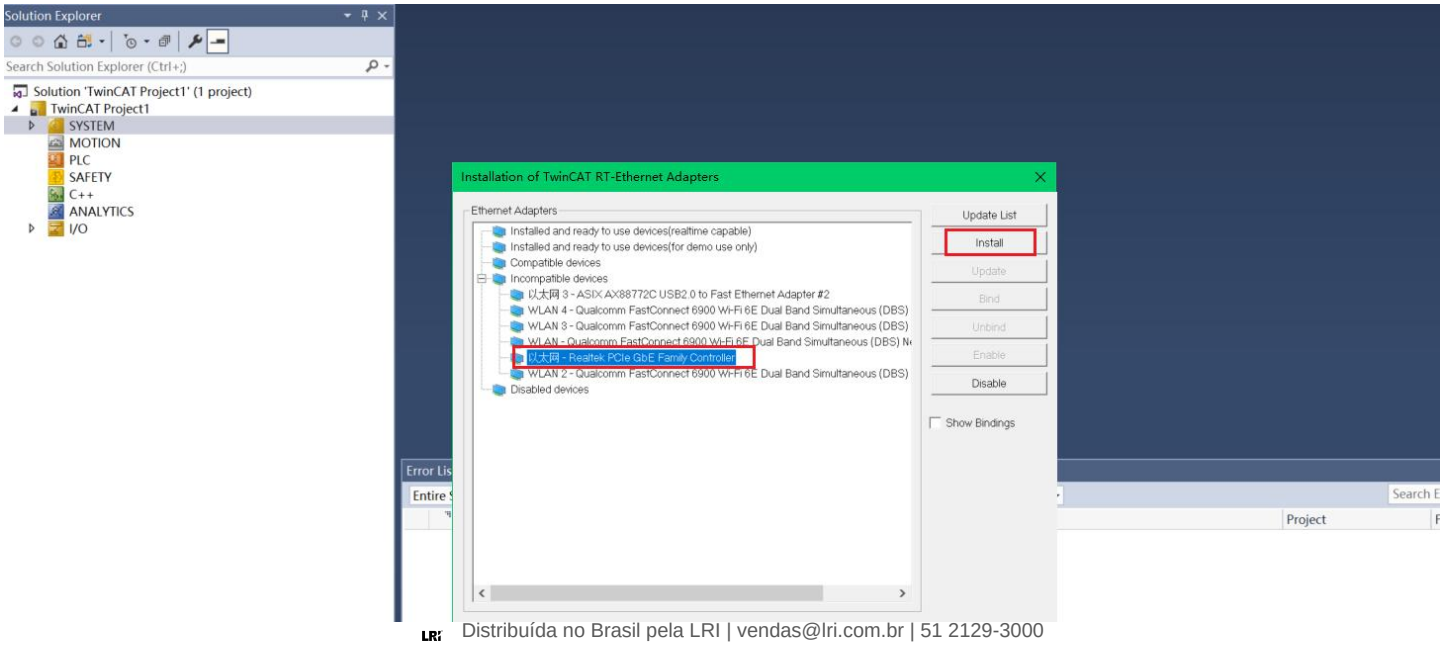


Install the EtherCAT master network card driver within TwinCAT3. Click "Show Realtime Ethernet Compatible Devices..." under the main menu bar "TwinCAT", select the local network card, and click "Install";



The normal network card installation interface is shown in the following figure:

Note: Using real-time protocols like EtherCAT requires the TwinCAT RT driver for the network port. Therefore, the EtherCAT master has requirements for network card compatibility. Please refer to the relevant chapter on "Supported Network Controllers" in the TwinCAT3 overview on the Beckhoff website. For computers with non-Intel network cards, the network card driver installation may fail.



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3.2.2.2. Scan for Devices

Under the project directory, select "I/O" to expand, select "Device", right-click the mouse and select "Scan" to

search for connected slave devices. Before this operation, ensure that the USR-PX520 protocol converter is powered on normally and connected to the EtherCAT master device using an Ethernet cable.

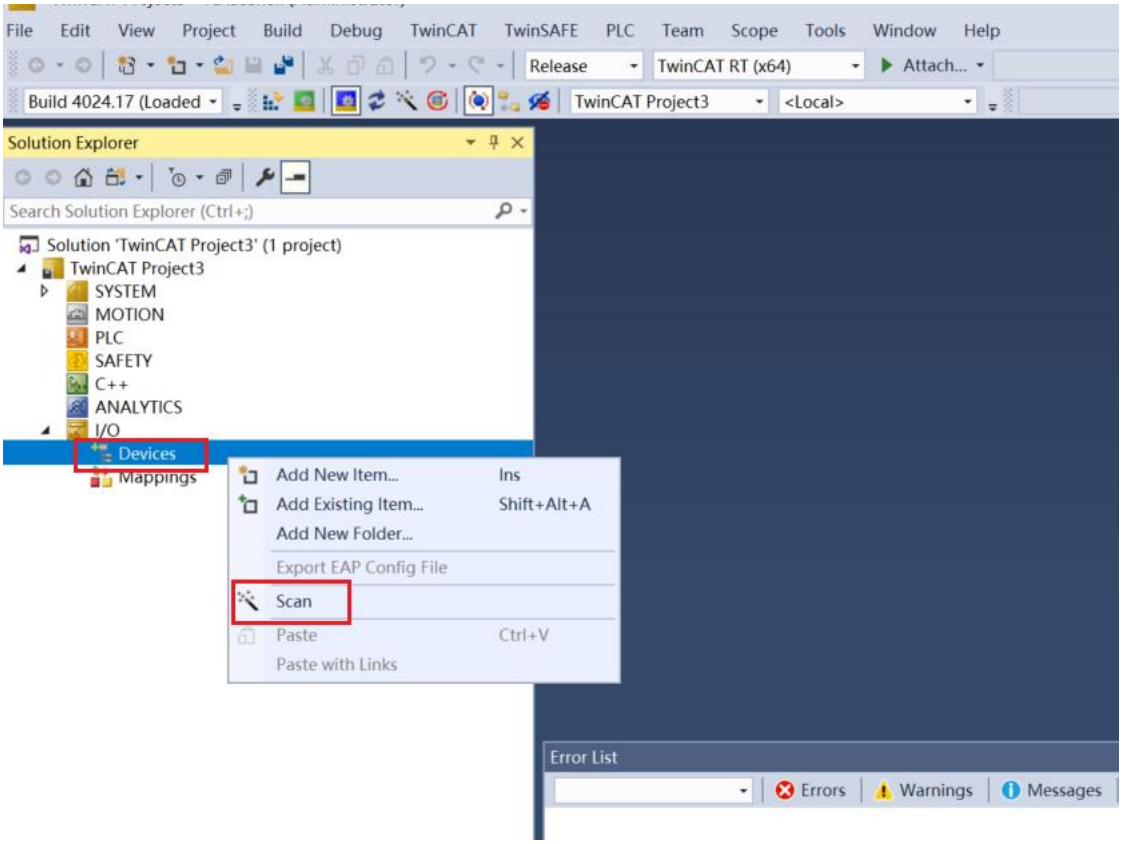
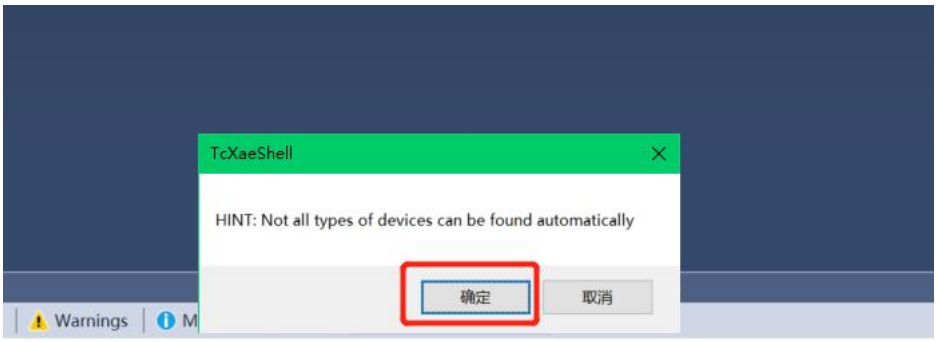
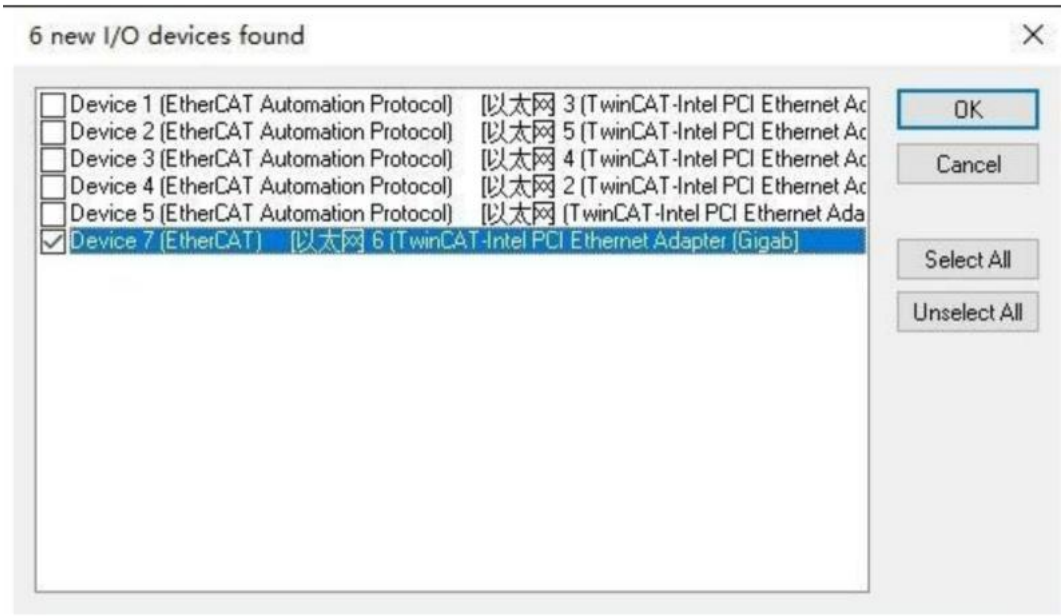


Figure 10. Scan Devices Interface

A pop-up dialog appears, click the "OK" button;



A "6 new I/O devices found" dialog appears, select the required Ethernet interface, click "OK"; as shown below:



6 new I/O devices found

Click "Yes (Y)" to scan for slave devices;

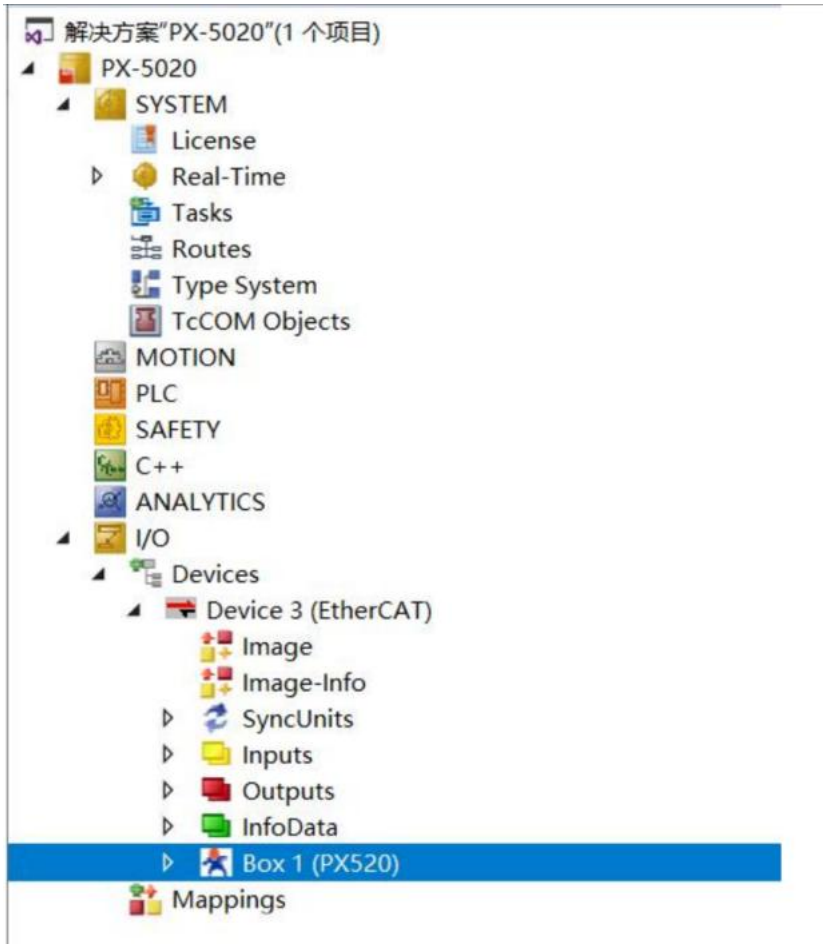


Choose whether to enter "Activate Free Run", click "No";



The following device is scanned normally:

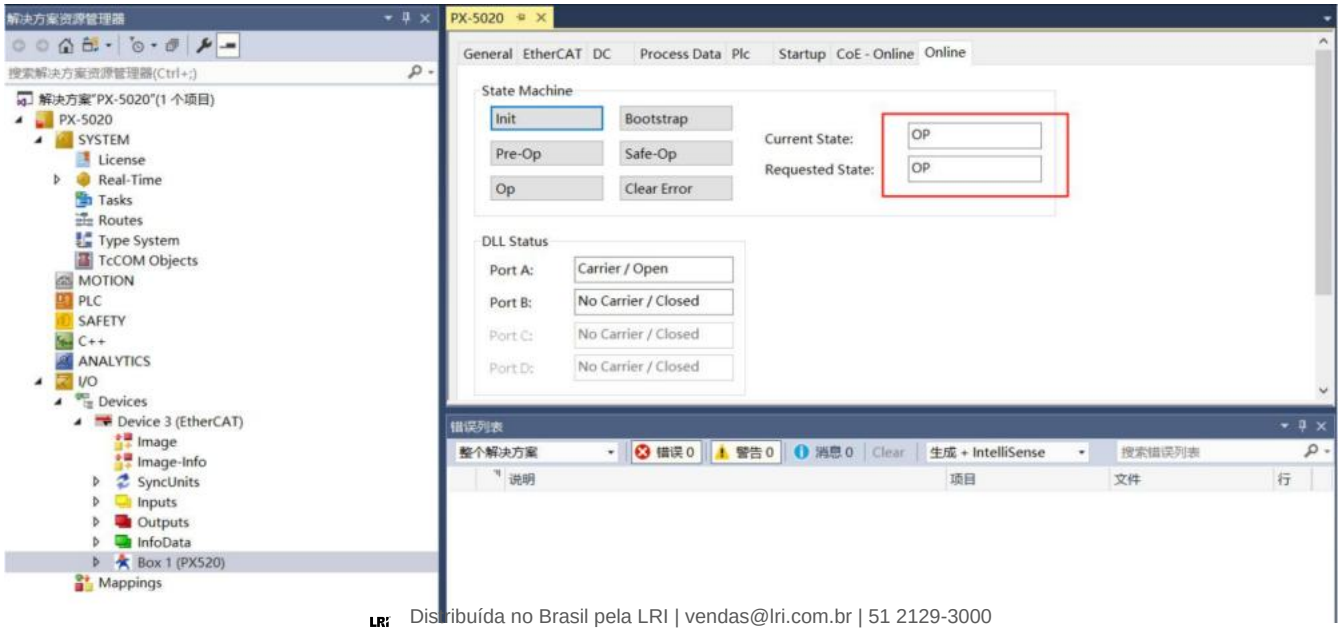
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You can see that "PX520" has been scanned, which indicates that the USR-PX520 protocol converter has been successfully recognized by the master station.

3.2.2.3. Check Connection

After the master controller establishes communication with the USR-PX520 protocol converter, you can see that the slave device has entered the "OP" state; indicating that the EtherCAT communication link has been successfully established;



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In the "Process Data" tab, you can clearly see that TwinCAT3 has allocated I/O data to the PX520 protocol converter; the sizes of MbxOut and MbxIn do not need to be modified. "Size" indicates the number of command bytes used to access the data.

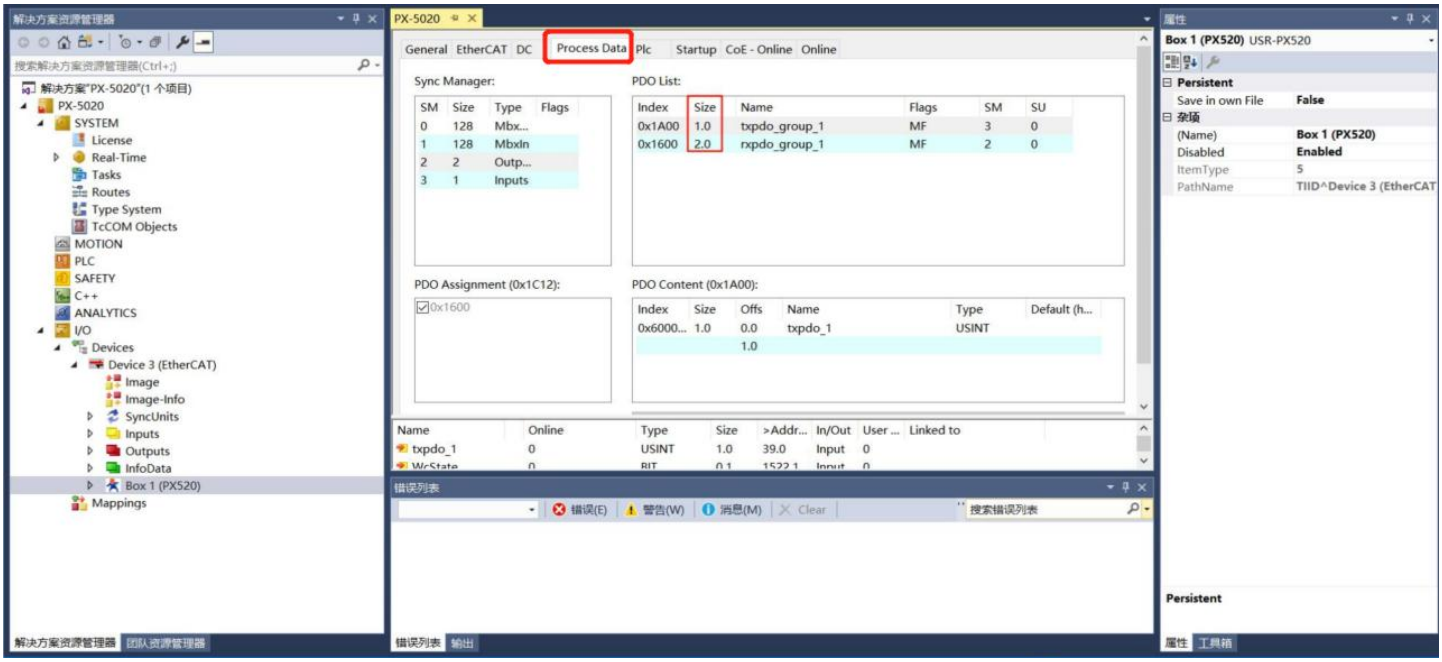


Figure 11. Process Data Interface

4. Product Functions

4.1. Basic Configuration

After scanning and connecting to the device, the configuration software interface will display the Basic Configuration interface, including [Device Status] and [System Settings], as shown in the following figure.

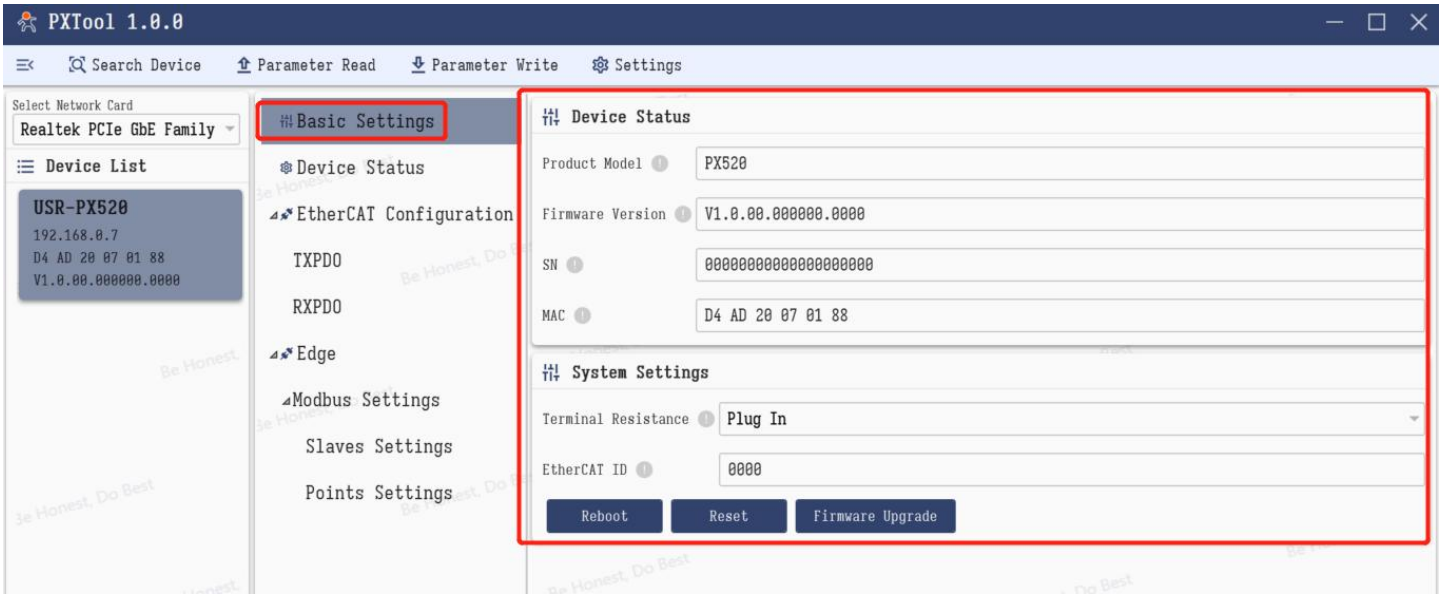


Figure 12. Basic settings

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Device Status: Displays the main information of the currently connected device, including product model, firmware version, SN, and MAC.

Terminal Resistor: The PX series device has a built-in terminal resistor. The configuration software can be used to choose whether to connect the terminal resistor or not. The default is not connected.

EtherCAT Serial Number: Mainly used to differentiate ESI files between devices. In the case of EtherCAT devices from the same vendor, if the cascaded devices have the same ESI configuration file, this serial number does not need to be set. If the ESI files are different, each device needs to be configured with a serial number to identify its own ESI file. The serial number can be auto-incremented.

Restart: Allows the device to power cycle and restart.

Restore Factory Defaults: Restores the device's default factory parameters, including the default IP address, ports, etc. It can also be restored to factory settings via hardware: after powering on, press and hold the Reload button, keep it pressed for 3-15 seconds, then release to perform a hardware factory reset.

Firmware Upgrade: The device firmware can be upgraded directly through the host computer software.

4.2. Interface Configuration

The Interface Configuration interface includes [Ethernet Configuration] and [Serial Configuration], as shown in the following figure:

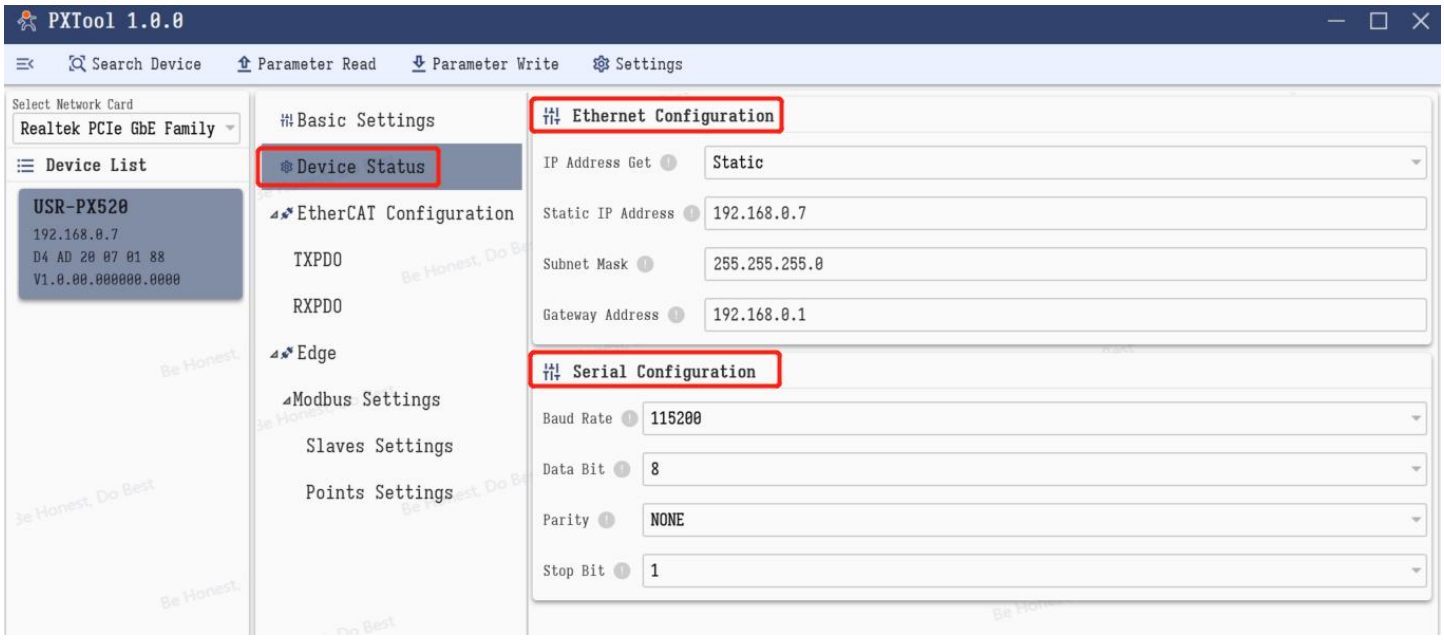


Figure 13. Device status

4.2.1. Ethernet Configuration

1. IP Address Get:

The IP address is the identity of the module in the local area network (LAN) and must be unique within the

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LAN, so it cannot be duplicated with other devices in the same LAN. The PX520's IP address can be obtained via Static IP or DHCP.

●Static IP

A static IP needs to be set manually by the user. During setup, pay attention to setting the IP, Subnet Mask, and Gateway simultaneously. Static IP is suitable for scenarios where IP addresses and devices need to be tracked and correspond one-to-one.

Advantages: Devices that cannot assign IP addresses can be discovered via full network segment broadcast mode.

Disadvantages: Different network segments in different LANs may prevent normal TCP/UDP communication.

●DHCP

DHCP's main function is to dynamically obtain the IP address, Gateway address, DNS server address, and other information from the gateway host, thus eliminating the tedious steps of setting the IP address. It is suitable for scenarios where there are no specific requirements for the IP address and a strict one-to-one correspondence between the IP and the module is not necessary.

Advantages: Reduces the hassle of setting IP addresses, gateway addresses, and subnet masks when connecting to devices with a DHCP Server, like routers.

Disadvantages: If connected to a network without a DHCP Server, such as a direct connection to a computer, the PX520 will not function properly.

2. Subnet Mask

The subnet mask is a 32-bit address used to mask part of the IP address to distinguish the network identifier from the host identifier, and to indicate whether the IP address is on the local area network or a remote network. The subnet mask cannot exist alone; it must be used together with the IP address. The commonly used Class C subnet mask is 255.255.255.0, which allows for 2 to the power of 8 minus 2 IP addresses within the subnet, i.e., 256-2=254 addresses. Generally, host addresses with all 0s or all 1s (in binary) have special purposes.

3. Gateway Address

The gateway address refers to the network number of the network where the module's current IP address resides. If connecting to the external network through a device like a router, the gateway is the router's IP address. If set incorrectly, it cannot correctly access the external network. If such devices are not connected, it does not need to be set; the default is sufficient.

4.2.2. Serial Configuration

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Baud Rate: Supports multiple baud rates from 600 to 230400. The slave's baud rate must match after

configuration.

Data Bits: Default is 8.

Parity Bit: none, even, or odd can be configured. The slave's data bits must match after configuration.

Stop Bits: 1 or 2 can be configured. The slave's stop bits must match after configuration.

4.3. EtherCAT Parameter Configuration

As shown in the following Figure, the EtherCAT Parameter Configuration interface includes TXPDO parameter configuration and RXPDO parameter configuration. PDO groups can be added to associate with the Modbus point table configuration on the edge computing side. CSV files can also be imported or exported for rapid configuration.

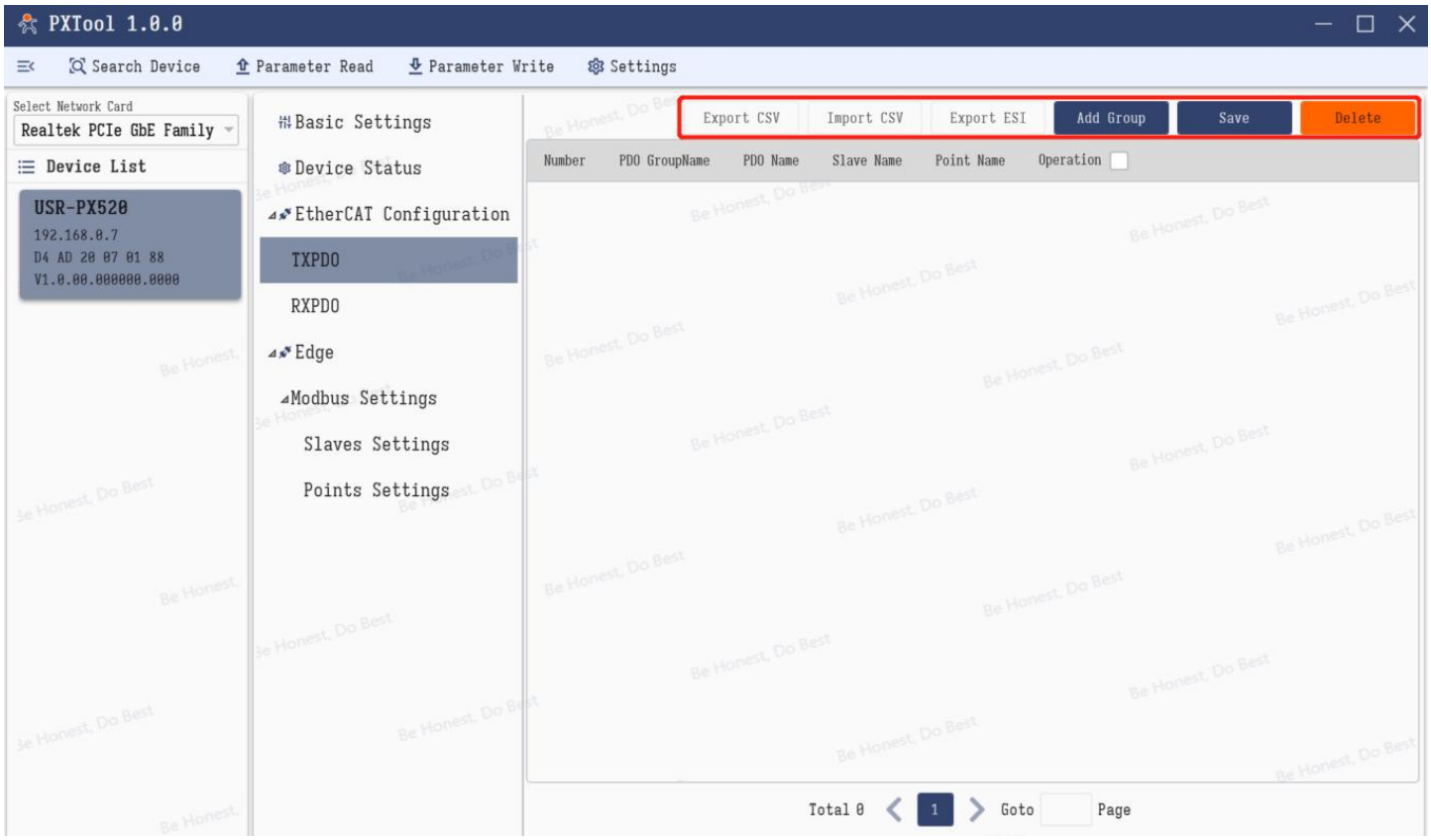


Figure 14. Relevant operation of the PDO

PDO (Process Data Object): It is used for real-time data transmission and represents the data objects that need to be transferred between the master and slave stations during the periodic control process. The definitions of these data objects are described in the object dictionary of CoE.

In the cia402 protocol, 0x6040 (Control word) and 0x6041 (Status word) belong to the PDO and are transmitted periodically.

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Import/Export CSV: When a large number of data points need to be configured, the default data acquisition configuration can be exported in the format of .csv file, edited in batches using software such as WPS, Office, and

then imported into the device to achieve rapid configuration.

Export: Click the [Export CSV] button to export the current EtherCAT configuration of TXPDO and RXPDO in the format of a .csv file.

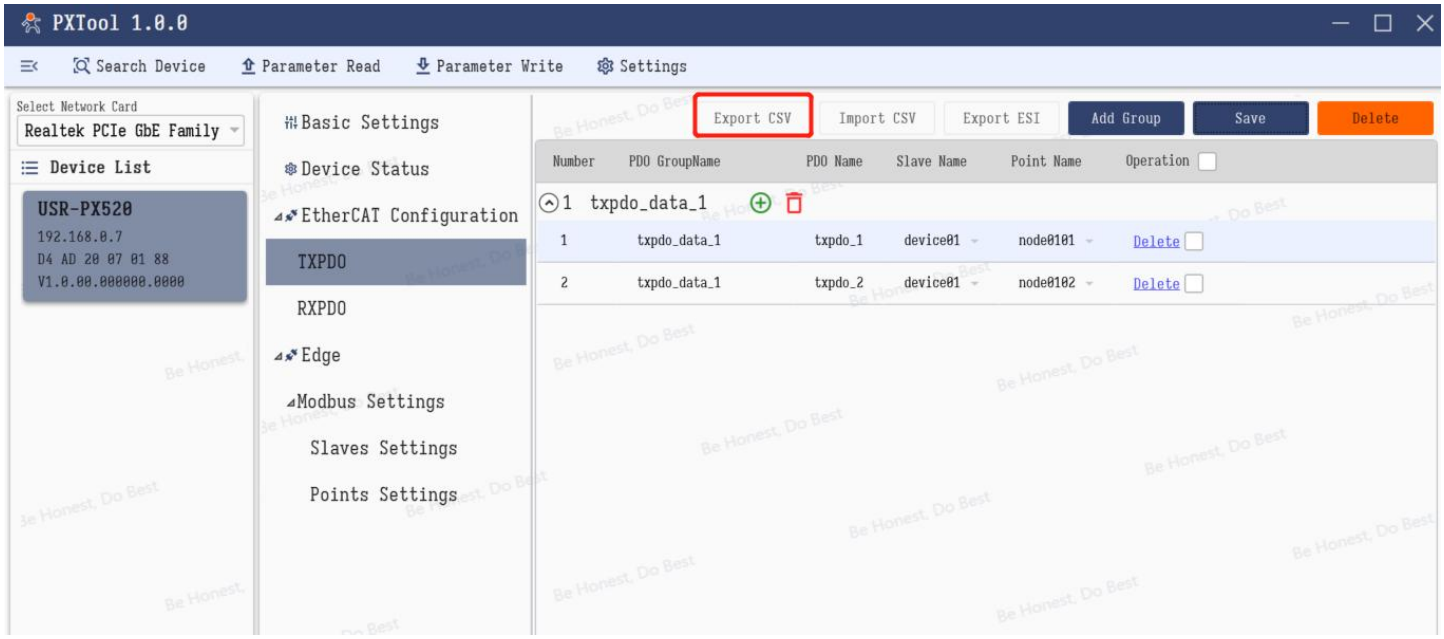
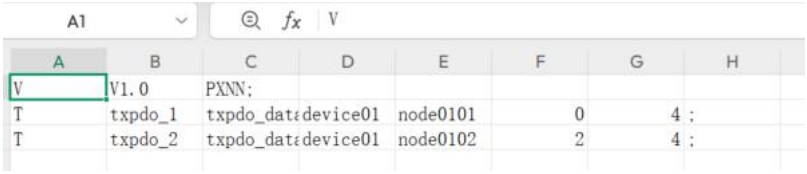


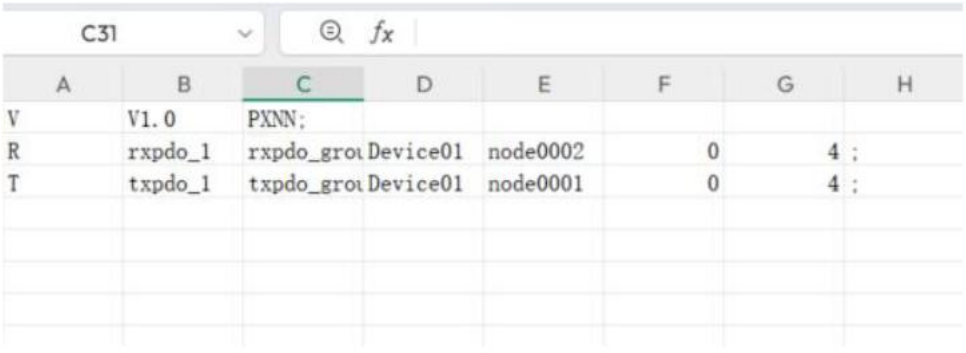
Figure 15. Export CSV file



	A	B	C	D	E	F	G	H
1	V	V1.0	PXNN;					
2	T	txpdo_1	txpdo_data	device01	node0101	0	4 ;	
3	T	txpdo_2	txpdo_data	device01	node0102	2	4 ;	

Figure 16. Exported .csv file

Edit: The opened .csv file is shown in the above figure. According to actual needs, add the following data points in the original format and save the file as shown in the following picture.



	A	B	C	D	E	F	G	H
1	V	V1.0	PXNN;					
2	R	rxpdo_1	rxpdo_gro	Device01	node0002	0	4 ;	
3	T	txpdo_1	txpdo_gro	Device01	node0001	0	4 ;	

Figure 17. Edit the .csv file

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A	B	C	D	E	F	G
V	V1.0	PXNN;				
T	txpdo_1	txpdo_data_1	device01	node0101	0	4 ;
T	txpdo_2	txpdo_data_1	device01	node0102	2	4 ;
T	txpdo_2	txpdo_data_1	device01	node0103	0	4 ;

Figure 18. Add data points

Import: Click the "Import CSV" button, select the modified CSV file, and after successful import, the interface will directly display the configuration of the slave devices and data points that were added, deleted, or modified in the configuration file.

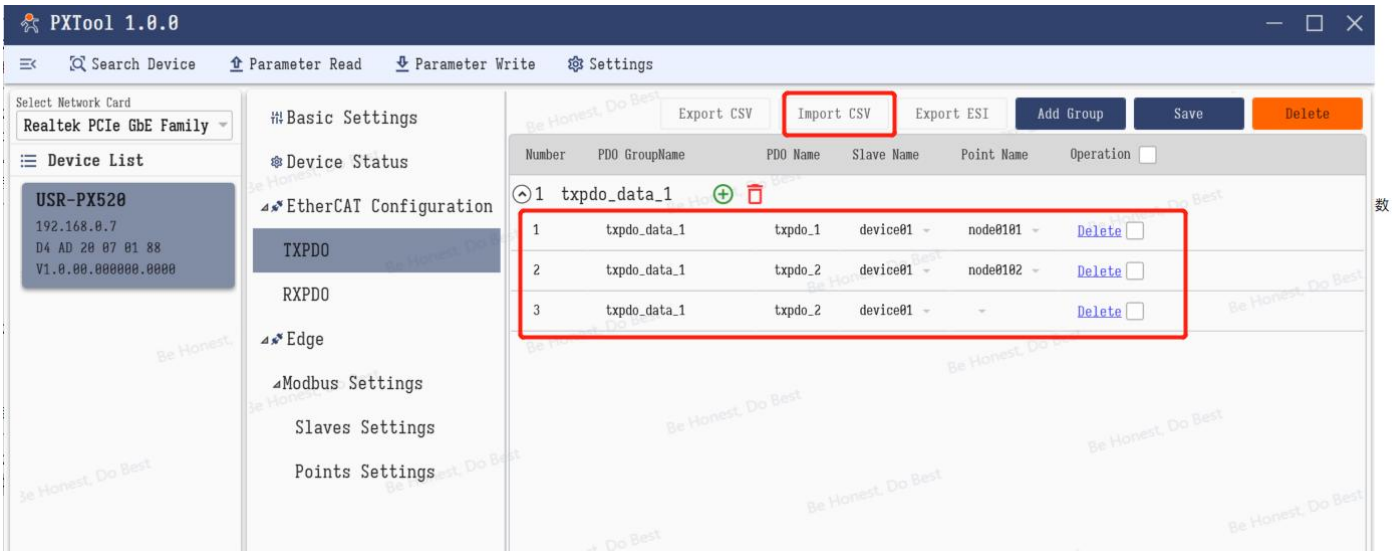


Figure 19.

Note:

1. The point table file exported from the English page can only be imported in the English interface.

2. The name of the data point must be unique throughout the table.

3. If the import fails, please check whether the parameter types, values, etc. modified in the configuration file are beyond the normal range.

Export ESI: After completing the editing configuration of the TXPDO list and RXPDO list, by exporting ESI, an ESI file corresponding to the current configuration can be generated. Subsequent operations require importing this ESI file into the main station to complete the update of device parameters.

Add Group: Click to add PDO group

Save: Save the current modified data. The modified parameter data will be saved in the configuration software when the configuration software is opened next time.

Delete: You can select multiple PDO data entries and delete them all at once.

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Parameters introduction:

Name	Description	Range
PDO GroupName	Name of added PDO group	Combination of [a-z], [A-Z], [0-9], it supports up to 128 groups
PDO Name	Name of PDO in every different group	Combination of [a-z], [A-Z], [0-9], it supports up to 128 PDO in every PDO groups
Slave Name	Name of slave device	Need be added in advance
Point Name	Name of data points	Need be configure in advance

4.3.1. TXPDO

From slave station, what the slave station sends to the master station is called TxPDO.

TXPDO Configuration:

(1) Click on 【TXPDO】 and use the 【Add Group】 button at the top right corner of the interface to add a PDO group.

(2) Click on the 【+】 button add data columns.

(3) Users can double-click the PDO name and edit it.

(4) The slave name is selected from the slave station configuration under the slave station configuration. It needs to be configured in advance under Edge → Modbus Settings → Slave Settings. For details, see the Edge Computing Modbus Configuration section.

(5) The name of the data point is selected from the point table configuration under the point table configuration. It needs to be configured in advance under Edge Computing → Modbus Configuration → Point Table Configuration. For details, see the Edge Computing Modbus Configuration section. The interface is shown in the following figure.

Note: The maximum number of PDO groups that can be added is 128, and the total number of data points can be up to 1000.

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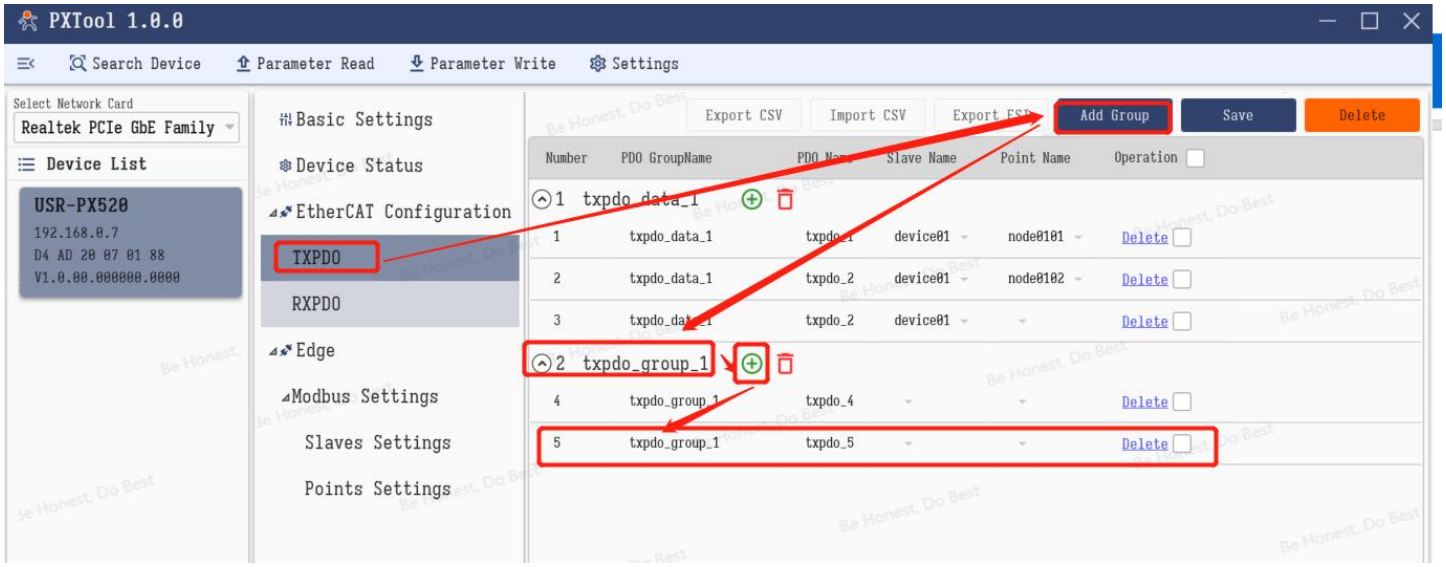


Figure 20. Add new PDO group and new PDO data



Figure 21. Edit the PDO name

4.3.2. RXPDO

From slave station, what the master station sends to the slave station is called RXPDO.

RXPDO Configuration:

(1) lick on 【RXPDO】 and use the 【Add Group】 button at the top right corner of the interface to add a PDO group.

(2) Click on the 【+】 button add data columns.

(3) Users can double-click the PDO name and edit it.

(4) The slave name is selected from the slave station configuration under the slave station configuration. It needs to be configured in advance under Edge → Modbus Settings → Slave Settings. For details, see the Edge Computing Modbus Configuration section.

(5) The name of the data point is selected from the point table configuration under the point table configuration. It needs to be configured in advance under Edge Computing → Modbus Configuration → Point Table Configuration. For details, see the Edge Computing Modbus Configuration section. The interface is shown in the following figure.

Note: The maximum number of PDO groups that can be added is 128, and the total number of data points can be up to 1000.

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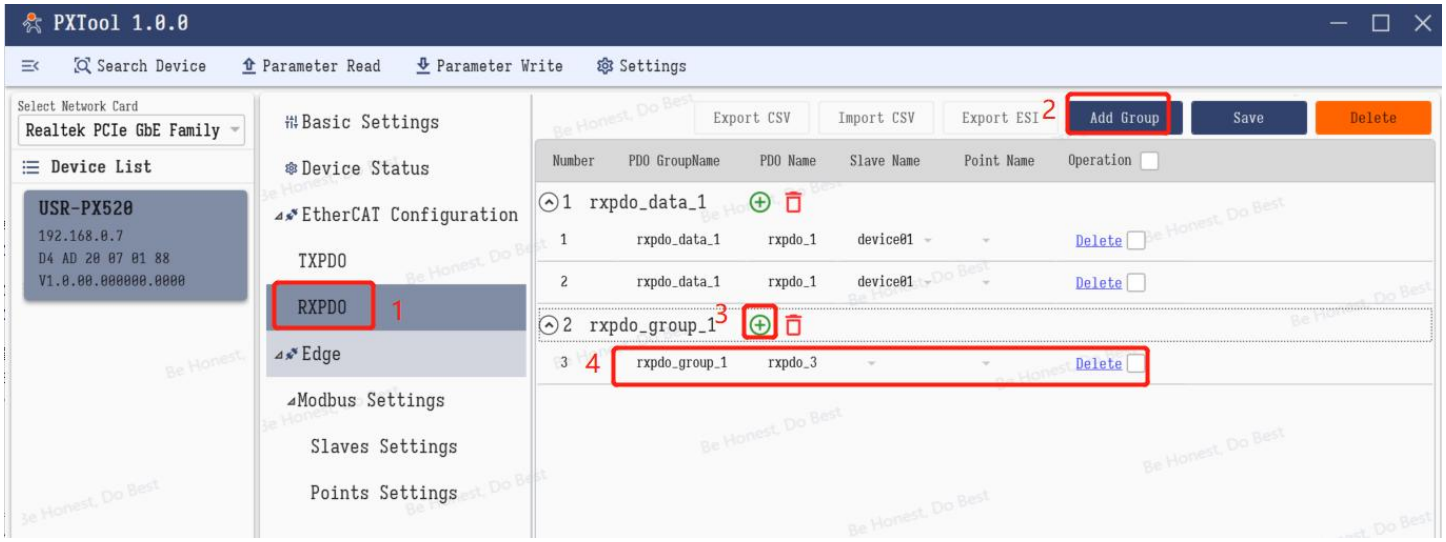


Figure 22. RCPDO configuration

4.4. Edge computing

Edge computing mainly involves edge data acquisition, users configure the specific settings, and the PX520 will send the acquisition command to the slave device auto. it supports Modbus RTU and ModbusTCP industrial bus protocols. For Modbus protocol, users need configure the slave device parameters and the data points parameters. We will introduce it detail.

4.4.1. Slave configuration

In the following figure, Modbus Settings--add slave, users can edit the slave device in the relevant rows.

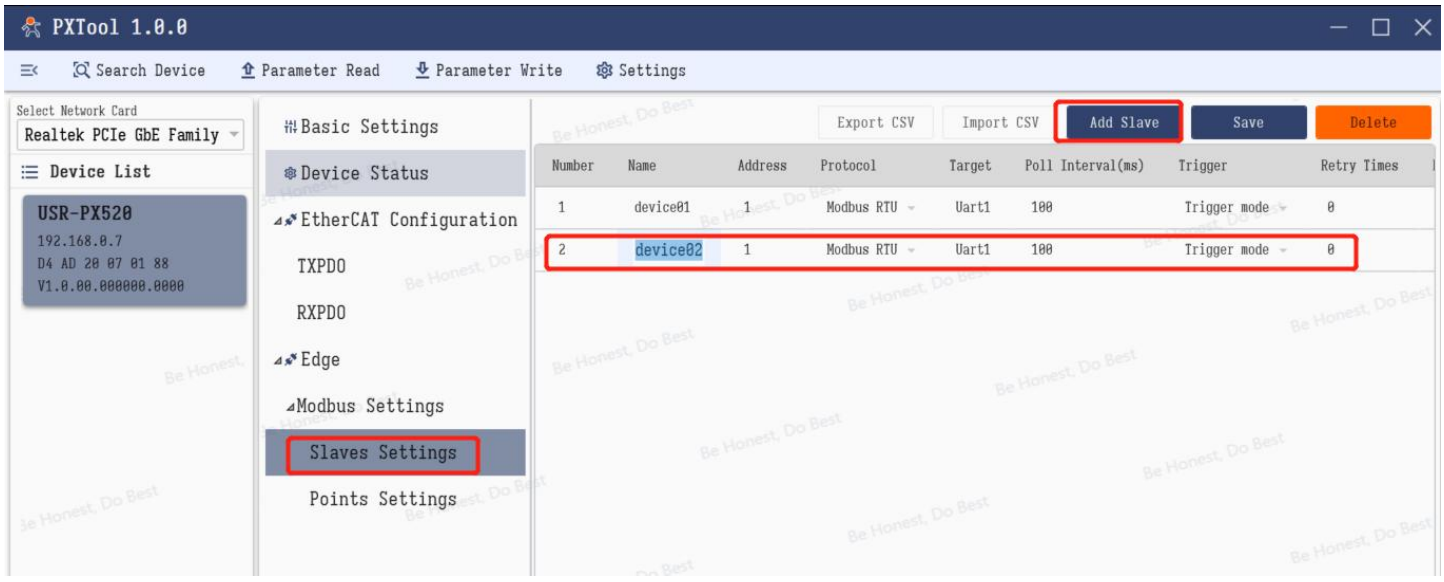


Figure 23. Slave configuration

Export/import CSV: When a large number of data points need to be configured, the default data collection configuration can be exported in the format of a.csv file, edited in software like Office in batches, and then

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imported into the device to achieve rapid configuration.

Add slave: add Modbus slave device.

Save: Save the current modified data.

Delete: delete the slave station in single or in batch.

Parameters detail:

Name	Description	Range	Value in CSV file
Name	Name of slave device	Less than 16 characters	Combination of [0-9], [A-Z], [a-z]
Address	ID/Address of slave device	1-255, Default: 1	1-255
Protocol	Protocol type of Modbus	Modbus RTU/TCP	Modbus RTU: 1 Modbus TCP: 2
Target	Identification of the slave device	For modbus RTU, it is Uart1, and can't be codified. For modbus TCP, it is the IP and port of the slave device.	Modbus RTU: URT1 Modbus TCP: IP:Port
Poll interval	The interval for polling this slave device	100-65536ms, Default: 100ms	100-65536
Trigger	Trigger mode for collecting data from the slave station	Polling mode / trigger mode Default: Trigger mode	Polling mode: 0 Trigger mode: 1
Retry time	Set the number of retry attempts after fail to collect the slave device data	0-5 Default: 0	0-5
Failed data policy	If fail to collect the slave device data this time, how to handle the current data of the relevant function code	Remain / Clear Default: Remain	Remain: 0 Clear: 1
Merge collection	If there are discontinuous register addresses, combine them into a single acquisition instruction.	Close / Open Default: close	Close: 0 Open: 1

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4.4.2. Data points configuration

Configure the data points of the slave station.

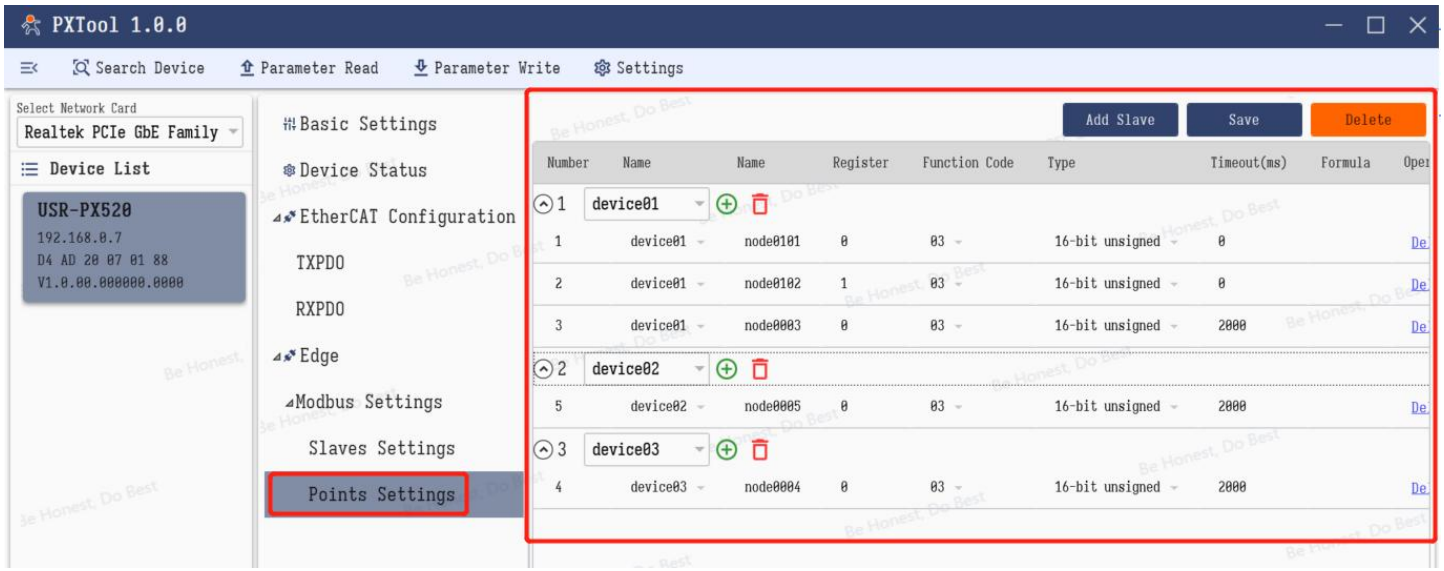


Figure 24. Data point configuration

Add slave: add Modbus slave device.

Save: Save the current modified data.

Delete: delete the slave station in single or in batch.

Parameters detail:

Name	Description	Range
Slave name	Name of slave device, users can select the relevant slave device	Up to 200 modbus slaves
Data name	The only identification of the data point in the data table. Combination of [0-9], [A-Z], [a-z], don't support pure number.	Up to 16 characters
Register	Register address of the Modbus slave	0-65534
Function code	Function code	01, 02, 03, 04, 05, 06, 15, 16
Data type		8-bit unsigned, 8-bit signed, 16-bit unsigned, 16-bit signed, 32-bit unsigned(ABCD), 32-bit unsigned(CDAB), 32-bit signed(ABCD), 32-bit signed(CDAB), 32-bit floating-point number(ABCD),

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		32-bit floating-point number(CDAB), 64-bit floating-point number
Timeout	The maximum waiting response time when polling this data point	100-65535ms
Formula	Perform simple arithmetic operations on the collected data points	+, -, *, /, ()

5. Contact Us

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