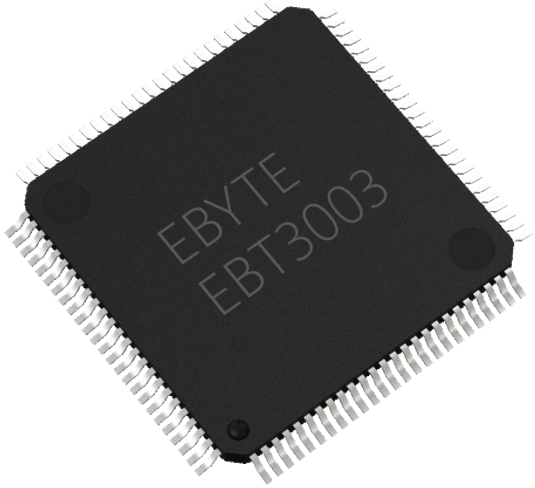


Profinet to Modbus/IO/Pass-through Chips

EBT3003 & EBT3003-TB

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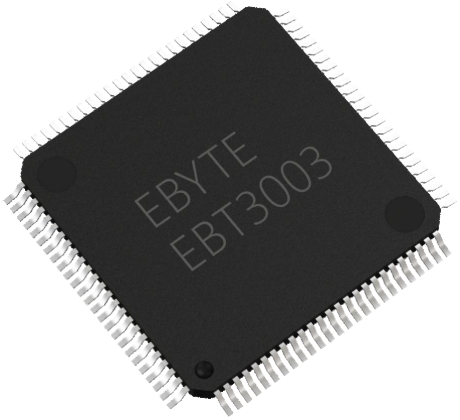
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一 Product Overview

1.1 Product Introduction



The EBT3003 chip is a Profinet chip designed specifically for industrial communication. It supports Profinet-to-Modbus master, Profinet-to- Modbus slave , Profinet -to-serial, and Profinet I/O functions. Integrated using GSD files, it allows for code-free data reading and rapid data configuration and transmission to the PLC. All Modbus commands are loaded as modules, and the memory mapping between Profinet and Modbus is intuitive and can be queried in STEP 7 or TIA Portal software. Status bytes can be loaded to query the connection status of Modbus devices and monitor device status in real time.

The EBT3003-TB test kit comes with a Type-C interface for power supply, and all LEDs, function pins, and reset pins are brought out. The reset pin can be connected to an external button for easy operation, and the operation status indicator pin can also be connected to an external LED for easy observation of the status.

1.2 Features

- Supports Profinet to Modbus conversion , and can be used as a Modbus RTU slave or Modbus RTU master.
- Supports Profinet to serial port pass-through
- Supports 32 Profinet I/O channels (DI/DO/AI)
- Supports 3.3V power supply
- LQFP100 package , small size
- It uses the standard Profinet protocol for communication and can be networked with PLCs, configuration files, and host computers.
- Supports the entire Siemens PLC series 200/300/1200/1500.
- Supports TIA Portal/SETP 7 host computer configuration.
- Supports 10/100M Ethernet interfaces, crossover direct connection auto-sensing.
- It provides GSD files directly, offers simple configuration, and requires no host computer.
- Supports firmware upgrade function
- Widely used for data acquisition and control of Modbus RTU devices in industrial fields

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二、Technical parameters

2.1 Product Model List

Product Model	type
EBT3003	chip
EBT3003-TB	Test kit (with built-in EBT3003)

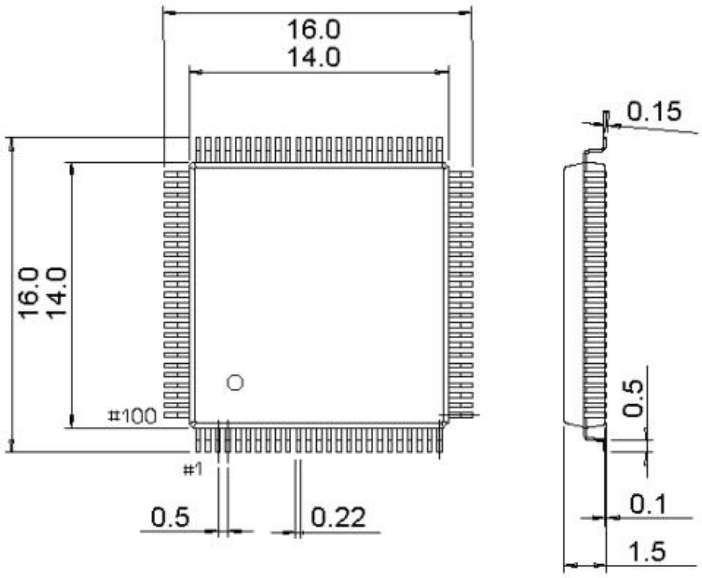
2.2 Specifications

EBT3003		
category	name	parameter
power supply	Operating voltage	3.3V±0.2V
	Operating current	Peak value: 86mA Standby: 83mA
	Communication level	3.3V
Packaging	Packaging	LQFP100
Network parameters	Communication Protocol	Standard Profinet protocol (RT)
	Maximum communication cycle	4ms
	Communication bandwidth	10/100M adaptive
Serial port parameters	Communication Protocol	Standard Modbus RTU Protocol
	baud rate	2400～3.9M bps
	Communication format	Data bits: 8 bits Stop bits: 1/2 Bits (default 1) Validation: None/Odd/Even (default: None)
Work environment	Operating temperature and humidity	-40 to +85℃, 5% to 95%RH (non-condensing)
	Storage temperature and humidity	-40 to +105℃, 5% to 95%RH (non-condensing)
other	Product Dimensions	14.0 mm * 14.0 mm * 1.4 mm (Length * Width * Height)
	Product weight	1 ± 0.1 g

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2.3 Dimensions

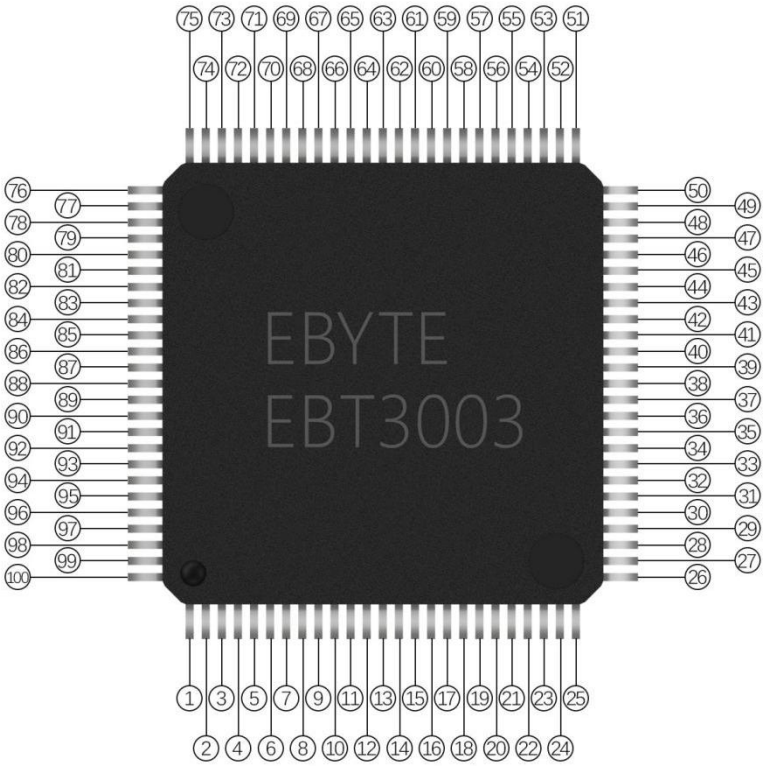


14.0mm * 14.0mm * 1.5mm (Length * Width * Height)

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2.4 Pin Definitions



Serial Number	pin silkscreen	describe
1	RESTORE	The software restart pin has an internal weak pull-up. A low level for less than 2 seconds restarts the device. A low level for 5-10 seconds restores the device to factory settings and restarts it. Pulling it low upon power-up enters firmware upgrade mode.
2	NC	Suspended
3	ERR-LED	(Modbus) Communication Error Indicator: Low: Modbus (serial port receive) communication error; High: Modbus communication normal; When the indicator is controlled by software to flash, it flashes simultaneously with SYS.
4	TXD-LED	Serial port 1 flashes rapidly when data is being sent; the default output is high; and a 10Hz square wave is output when data is being sent.
5	SYS-LED	The system (PN connection) indicator light, pulled low: Profinet establishes a connection; pulled high: Profinet does not establish a connection; when the software controls the flashing indicator light, it flashes simultaneously with the ERR indicator.
6	VBAT	Battery powered, no low-power version, directly connected to a power source.
7	RXD-LED	Serial port 1 flashes rapidly when receiving data, outputs a high level by default, and outputs a 10Hz square wave when receiving data.
8	OSC32IN	32.768kHz crystal oscillator input
9	OSC32OUT	32.768kHz crystal oscillator output

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10	VSS_5	Common ground terminal, negative power input terminal
11	VDD_5	Positive power input, supports 3.3V input.
12	OSC-IN	8MHz crystal input
13	OSC-OUT	8MHz crystal oscillator output
14	NRST	Reset output pin, active low
15	TXD	Serial port data transmission, TTL level communication voltage only supports 3.3V
16	RXD	Serial port data reception, TTL level communication voltage supports only 3.3V
17	PC2	In serial port pass-through mode, after the serial port receives erroneous data, PC2 goes high for about 2ms (e.g., abnormal format, CRC check error).
18	PC3	485 enable pin
19	VSSA	Common ground terminal, negative power input terminal
20	VREF-	Reference voltage VREF ground
21	VREF+	Reference voltage. VREF must not exceed VDDA.
22	VDDA	Positive power input, supports 3.3V input.
23	IO1	IO1 pin, sub-slot 1, supports DI, AI, DO
24	IO2	IO2 pin, sub-slot 1, supports DI, AI, DO
25	IO3	IO3 pins, sub-slot 1, supports DI, AI, DO
26	IO4	IO4 pins, sub-slot 1, supports DI, AI, DO
27	VSS_4	Common ground terminal, negative power input terminal
28	VDD_4	Positive power input, supports 3.3V input.
29	IO5	IO5 pins, sub-slot 1, supports DI, AI, DO
30	IO6	IO6 pins, sub-slot 1, supports DI, AI, DO
31	IO7	IO7 pin, sub-slot 1, supports DI, AI, DO
32	IO8	IO has 8 pins, sub-slot 1, and supports DI, AI, and DO.
33	PC4	Hardware watchdog pin
34	NC	Suspended
35	NC	Suspended
36	NC	Suspended
37	NC	Suspended
38	YELLOW-LED	Ethernet port LED, pull-up active
39	GREEN-LED	Ethernet port LED, pull-down enabled
40	VDDK	An external 1uF capacitor to ground is placed close to the chip.
41	VSS_6	Common ground terminal, negative power input terminal
42	TXP	Ethernet transmits TX+ signal
43	TXN	Ethernet transmits TX signal
44	RXP	Ethernet receive RX+ signal
45	RXN	Ethernet receive RX signal
46	VDD-ETH	For powering the 10/100M Ethernet PHY, it is recommended to place a 1uF to 4.7uF capacitor close to the chip. A 10uF capacitor is supported, but a 0.1uF capacitor needs to be connected in parallel.
47	VSS_1	Common ground terminal, negative power input terminal
48	VIO_1	The output voltage of most I/O pins must not exceed VDD.
49	NC	Suspended

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50	NC	Suspended
51	VDD_1	Positive power input, supports 3.3V input.
52	IO9	IO9 pins, sub-slot 2, supports DI and DO.
53	IO10	IO10 pins, sub-slot 2, supports DI and DO.
54	IO11	IO11 pin, sub-slot 2, supports DI and DO.
55	IO12	IO12 pins, sub-slot 2, supports DI and DO.
56	IO13	IO13 pin, sub-slot 2, supports DI and DO.
57	IO14	IO14 pins, sub-slot 2, supports DI and DO.
58	IO15	IO15 pins, sub-slot 2, supports DI and DO.
59	IO16	IO16 pins, sub-slot 2, supports DI and DO
60	NC	Suspended
61	NC	Suspended
62	NC	Suspended
63	NC	Suspended
64	NC	Suspended
65	NC	Suspended
66	IO17	IO17 pin, sub-slot 3, supports DI and DO.
67	IO18	IO18 pins, sub-slot 3, supports DI and DO.
68	NC	Suspended
69	NC	Suspended
70	IO19	IO19 pins, sub-slot 3, supports DI and DO.
71	IO20	IO20 pins, sub-slot 3, supports DI and DO.
72	NC	Suspended
73	NC	Suspended
74	VSS_2	Common ground terminal, negative power input terminal
75	VDD_2	Positive power input, supports 3.3V input.
76	NC	Suspended
77	IO21	IO21 pins, sub-slot 3, supports DI and DO.
78	IO22	IO22 pins, sub-slot 3, supports DI and DO.
79	IO23	IO23 pins, sub-slot 3, supports DI and DO.
80	IO24	IO24 pins, sub-slot 3, supports DI and DO
81	IO25	IO25 pins, 4 sub-slots, supports DI and DO
82	IO26	IO26 pins, 4 sub-slots, supports DI and DO
83	IO27	IO27 pins, 4 sub-slots, supports DI and DO.
84	IO28	IO28 pins, 4 sub-slots, supports DI and DO
85	IO29	IO29 pins, 4 sub-slots, supports DI and DO.
86	IO30	IO30 pins, 4 sub-slots, supports DI and DO.
87	IO31	IO31 pins, 4 sub-slots, supports DI and DO.
88	IO32	IO32 pins, 4 sub-slots, supports DI and DO
89	NC	Suspended
90	NC	Suspended
91	NC	Suspended
92	NC	Suspended

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93	NC	Suspended
94	NC	Suspended
95	NC	Suspended
96	NC	Suspended
97	NC	Suspended
98	NC	Suspended
99	VSS_3	Common ground terminal, negative power input terminal
100	VDD_3	Positive power input, supports 3.3V input.

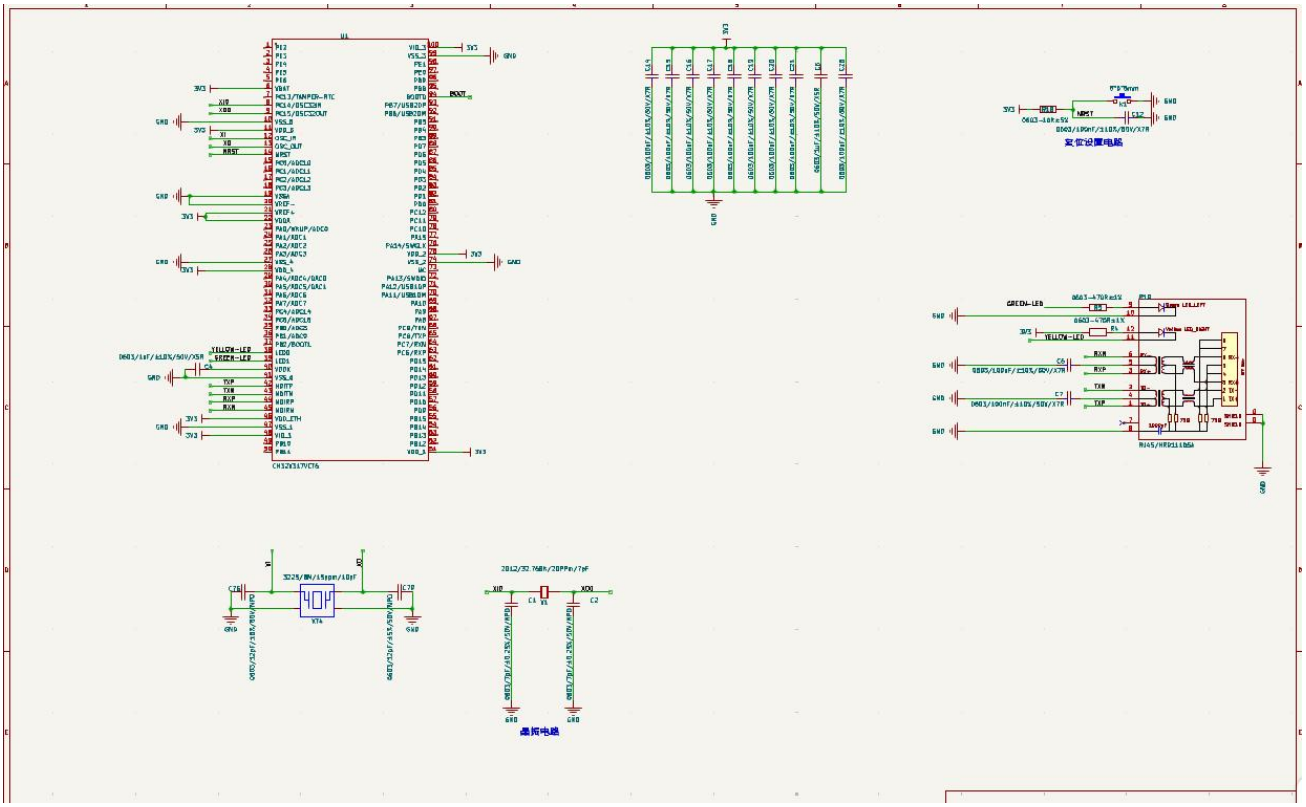
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2.5 Hardware Reference Design

If the image is not clear, please refer to the " Hardware Reference Design.PDF " document .

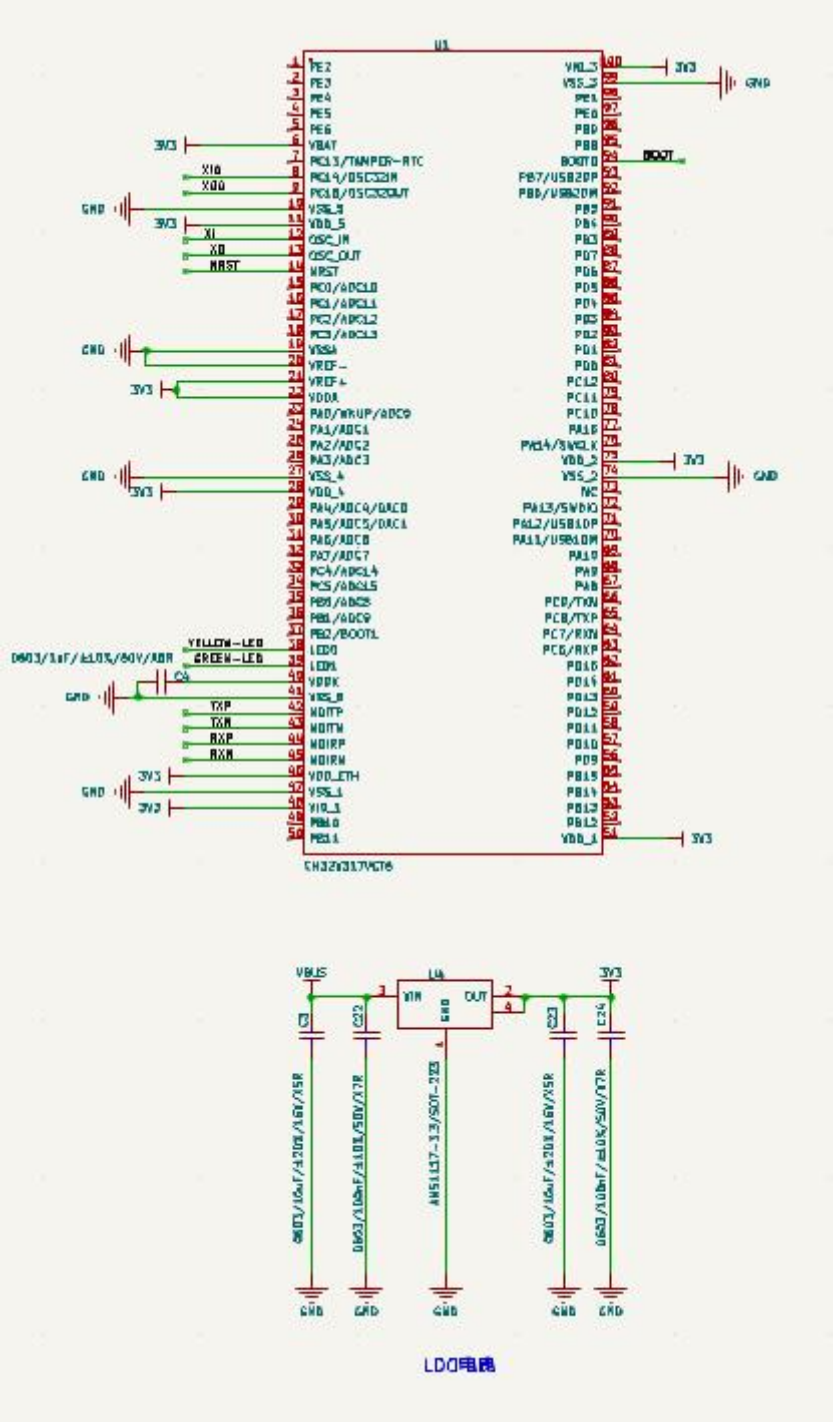
2.5.1. Typical application reference links



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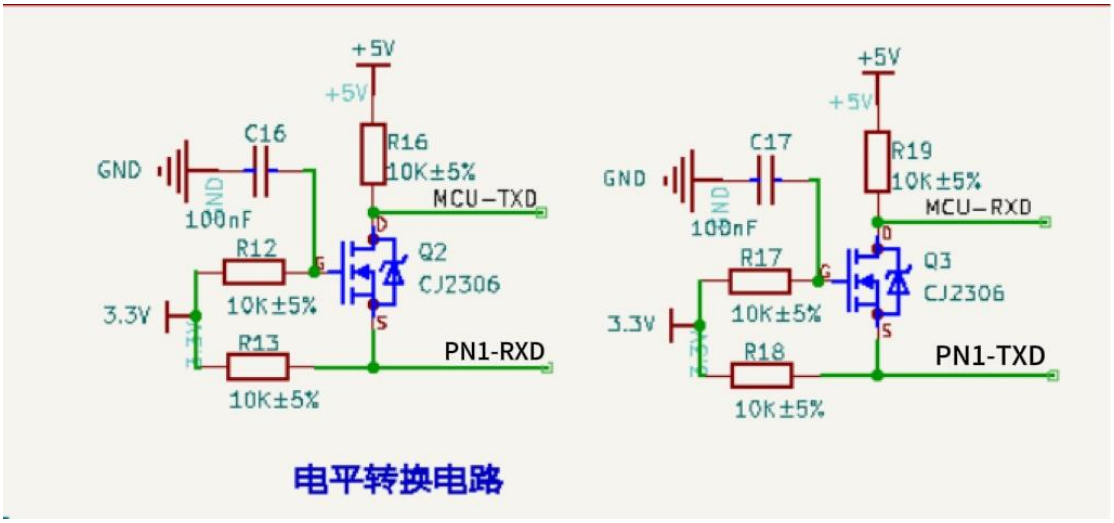
2.5.2. Power circuit reference hardware connection

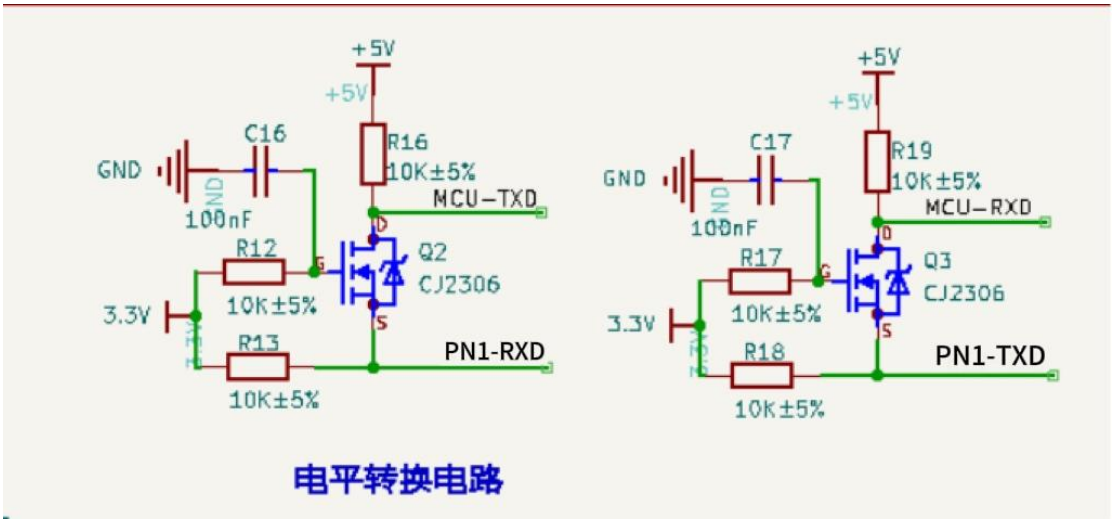


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2.5.3. 1.8V serial port circuit reference connection 3.3V

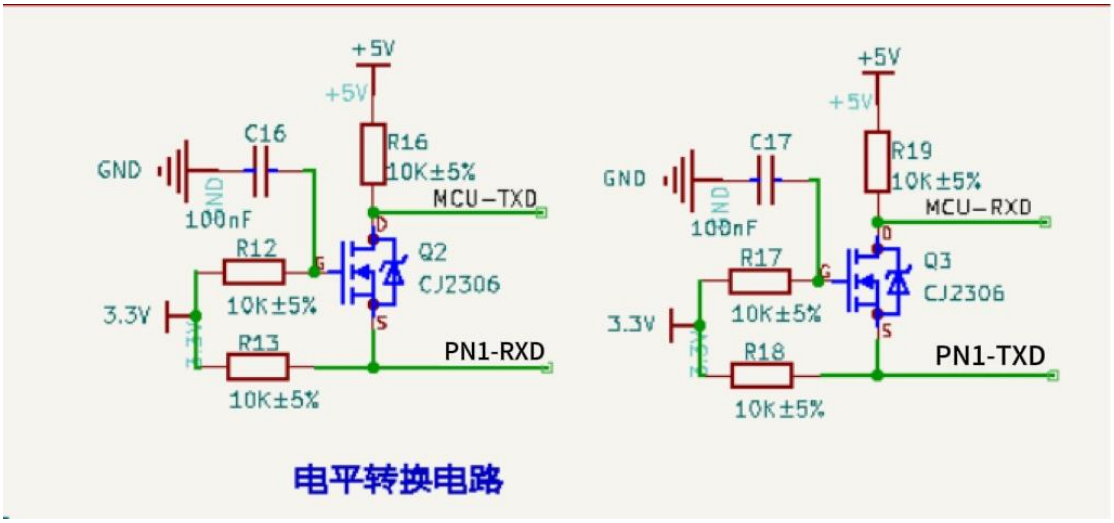




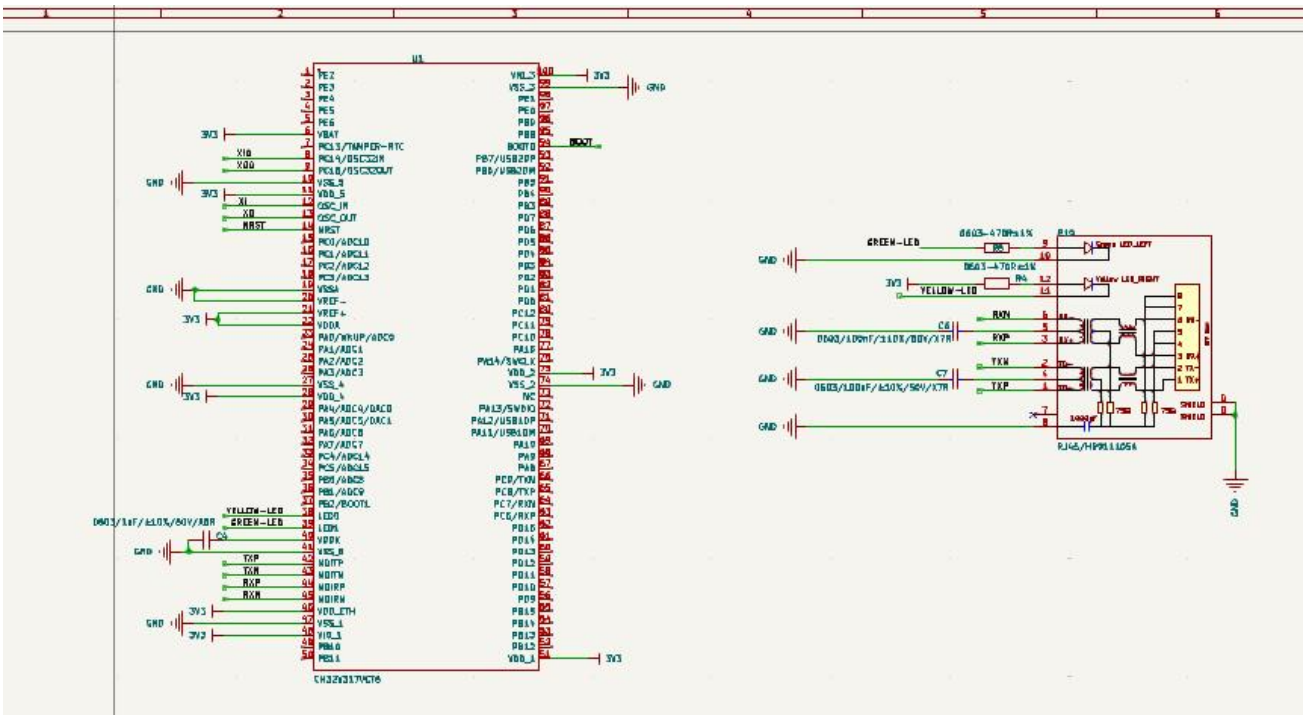
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2.5.4. 5V serial port circuit reference connection



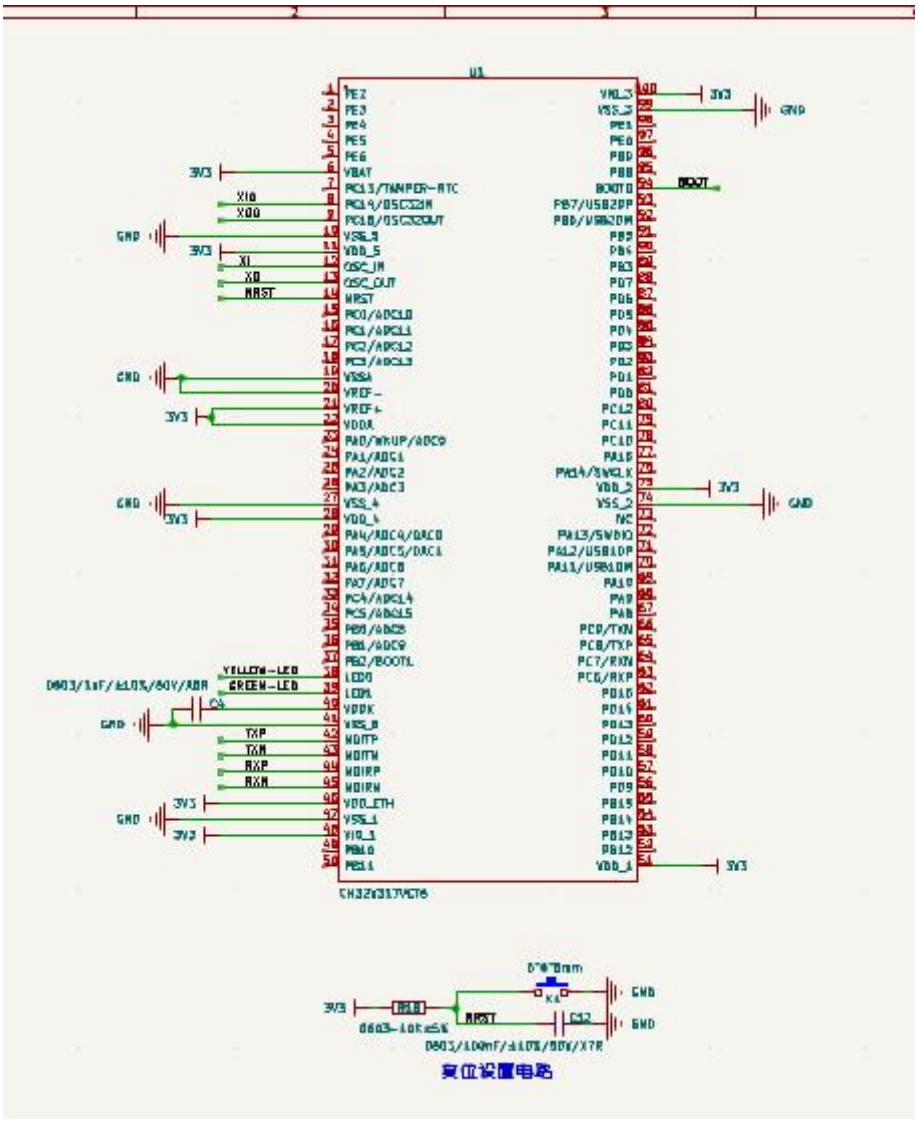
2.5.5. Network port built-in transformer reference connection



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2.5.6. Reset circuit reference connection



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三 Product Function Introduction

EBT3003 Series Function Overview

The EBT3003 chip supports Profinet to Modbus master, Profinet to Modbus slave , Profinet to serial port, and Profinet IO functions.

Among them, Profinet to Modbus master, Profinet to Modbus slave , and Profinet to serial port can only be selected for slot 1 and can be configured with a maximum of 32 instructions. The total number of Profinet to serial port input and output instructions is a maximum of 32.

Profinet IO is used for slot 2, which supports 4 sub-slots. Each sub-slot manages 8 IO ports, for a total of 32 IO ports. Sub-slot 1 manages IO1-IO8, sub-slot 2 manages IO9-IO16, sub-slot 3 manages IO17-IO24, and sub-slot 4 manages IO25-IO32. Sub-slot 1 supports DI, AI, and DO, while the other sub-slots only support DI or DO.

3.1 Configure status words and control words

The device overview configuration shows that slot 1 can only be used to select PNMB Master/ PNMB Slave. In the I address field, the corresponding Profinet input address IB2-6 is the communication status monitoring bit. In the Q address field, the corresponding Profinet output address QB2-6, where QB2 is the communication control word for this bus conversion module, and QB3-6 are the control bits for sending each message.

Communication status monitoring:

Byte 1: Slot number of serial port 1 in case of error

Byte 2: Serial Port 1 Error Code

Other bytes are reserved.

Error code	describe
1	The slave station responded with a Modbus standard error: ILLEGAL FUNCTION
2	The slave station responded with a Modbus standard error: ILLEGAL DATA ADDRESS
3	The slave station responded with a Modbus standard error: ILLEGAL DATA VALUE
4	Slave device responds to Modbus standard error: SLAVE DEVICE FAILURE
10	The message received by the master station is of incorrect length , too long, too short, or does not match the correct length of the slave station's reply data.
11	The CRC checksum of the message received by the master station is incorrect.
12	The number of message registers received by the master station is incorrect.
13	The master station received a message with an incorrect slave address.
14	Main station received timeout
15	The function code in the message received by the master station is inconsistent with the request.
16	The master station received a message register address that is incorrect.
17	Unknown error

Communication control bits:

Bit 0: Whether the Modbus serial port interface is enabled, 1 = enabled, 0 = disabled;

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Bit 1: Clear fault codes. When a rising edge (0→1) is detected, the communication status monitoring is reset to zero. Other bits are reserved.

Bytes 2 to 5:

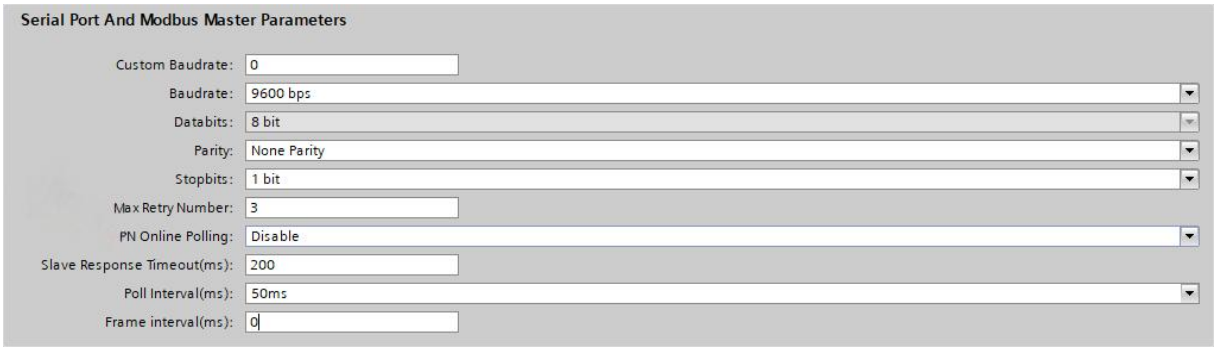
Each slot corresponds to one bit of message. The correspondence is shown in the table below.

When the message is configured to be triggered on the rising edge, changing this bit from 0 to 1 enables the message to be sent once.

When the message is configured to be level-triggered, setting this bit to 1 enables the message to be sent in a loop, while setting it to 0 stops the message from being sent in a loop.

2nd byte							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Sub-slot 9	Sub-slot 8	Sub-slot 7	Sub-slot 6	Sub-slot 5	Sub-slot 4	Sub-slot 3	Sub-slot 2
3rd byte							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Sub-slot 17	Sub-slot 16	Sub-slot 15	Sub-slot 14	Sub-slot 13	Sub-slot 12	Sub-slot 11	Sub-slot 10
4th byte							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Sub-slot 25	Sub-slot 24	Sub-slot 23	Sub-slot 22	Sub-slot 21	Sub-slot 20	Sub-slot 19	Sub-slot 18
5th byte							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Sub-slot 33	Sub-slot 32	Sub-slot 31	Sub-slot 30	Sub-slot 29	Sub-slot 28	Sub-slot 27	Sub-slot 26

3.2 Profinet to Modbus RTU main unit function



Custom Baudrate:

When the serial port is configured as a slave and a custom baud rate is required, the default value is 0. This indicates that the custom baud rate is not enabled. To enable a custom baud rate, set a value between 1200 and 3900000. In this case, the "Baudrate" option will not take effect.

Baudrate:

Standard baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800bps, default: 9600.

Databits:

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Data bits: 8 bits, default: 8.

Parity:
Data validation: None Parity, Odd Parity, Even Parity, Default: None Parity.

Stopbit:
Data stop bits: 1 or 2 bits, default: 1.

Max Retry Number:
The number of error retries when the serial port is used as the master station, 0-255, where 0 means no retransmission, 255 means unlimited retransmission, and 1-254 means retransmission according to the number of attempts. Default: 3.

PN Online Polling:
In Disabled mode, serial port polling continues even if the PN connection is lost. In Enabled mode, serial port polling stops even if the PN connection is lost. Default: Disabled.

Slave Response Timeout (ms):
When the serial port is used as the master station, the module waits for a Modbus device response after sending a Modbus message. If the Modbus device does not respond within the set waiting time, the module stops waiting and continues to send the next Modbus message or resends it. The selection range is 0-65535ms, with a default of 100ms.

Poll Interval(ms):
When the serial port acts as the master station, the bus conversion module delays sending its own Modbus master message after receiving a correct response from the Modbus slave. If the Modbus slave device responds slowly to the master message, and the bus conversion module sends the Modbus message too quickly, a communication failure will occur. The message interval can be appropriately increased. The selection range is 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 500, 1000ms or no delay. The default value is 50ms.

Frame interval (ms):
Data frame break time: 0-65535ms, 0 indicates automatic frame break, default: 0.

Modbus RTU Master Commands
Each Modbus RTU master command has five attributes:
Slave Address (1~247): Represents the address of the Modbus RTU slave device, with a selectable range of 1-247.
Function Code: The function code of the Modbus RTU master station. It is automatically generated based on the Modbus command inserted into the slot and cannot be changed.
Start Address: The starting address for Modbus RTU slave data operations. A non-register PLC address with no prefix. Range: 0-65535.
XX Quantity: Indicates the number of coils or registers to be read or written. It is automatically generated based on the Modbus command inserted into the slot and the quantity can be changed within a range.

Transmission Type: The following four transmission types are available.
Disable: indicates that the command will not be executed.
Poll trigger: After the master station corresponding to the Modbus RTU is enabled, this message will be sent in ascending

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order of slot number.

Level trigger: After the control send flag corresponding to the slot number changes from 0 to 1: For read commands, this message will be sent. For write commands, it will only be sent if the data has changed; after the control send flag corresponding to the slot number changes from 1 to 0, both read and write messages will stop being sent. (In the previous section, PLC addresses QB2-QB5 are the send trigger control bits.)

Rising trigger: This message is sent once the trigger control bit corresponding to the slot number changes from 0 to 1. (In the previous section, PLC addresses QB2-QB5 were the sending trigger control bits.)

3.3 Profinet to Modbus RTU Slave Function

PNMB Slave

Custom Baudrate:

When the serial port is configured as a slave and a custom baud rate is required, the default value is 0. This indicates that the custom baud rate is not enabled. To enable a custom baud rate, set a value between 1200 and 3900000. In this case, the "Baudrate" option will not take effect.

Baudrate:

Standard baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800bps, default: 9600.

Databits:

Data bits: 8 bits, default: 8.

Parity:

Data validation: None Parity, Odd Parity, Even Parity, Default: None Parity.

Stopbit:

Data stop bits: 1 or 2 bits, default: 1.

Delay Response Time.

When the serial port is acting as a slave station, how long should it delay before responding to a polling command received from the master station? Range: 0~65535, where 0 indicates an immediate response, in milliseconds. Default: 0.

Slave Address:

The station address when the serial port is used as a slave. Range: 1~247, default: 1.

Modbus RTU slave commands

Each Modbus RTU slave command is prefixed with either Input or Output. Input indicates data input to the PLC, meaning the master station writes data to the slave station, and the slave station then returns the data to the PLC; this corresponds to a write command. Output indicates data output from the PLC, meaning the PLC sends data to the slave station, and the master station then reads the data from the slave station; this corresponds to a read command. More specifically, each slave command ends with a list of supported function codes.

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function code	Function	Operating address area (non-register PLC address)	Operation type
01H	Read the output status of multiple coils	0XXXX	read
02H	Read the status of multiple input coils	1xxXX	read
03H	Reading multiple saved registers	4xxXX	read
04H	Read input register	3XXXX	read
05H	Force a single coil	0XXXX	Write
06H	Preset a single holding register	4XXXX	Write
OFH	Forced multi-coil	0xXXX	Write
10H	Multiple pre-set holding registers	4XXXX	Write

3.4 Profinet to serial port function

The PN to serial port function supports both protocol pass-through and data pass-through modes.
Agreement Transmitted:
Send message: 0xc1 + sub_slot_nbr (sub-slot number, 1 byte) + datalength (data length, big-endian, 2 bytes) + data (data portion, length equal to datalength) + mb_CRC_16 (2 bytes, optional)
Received message: 0xd2 + sub_slot_nbr (sub-slot number, 1 byte) + datalength (data length, big-endian, 2 bytes) + data (data portion, length equal to datalength) + mb_CRC_16 (2 bytes, optional)

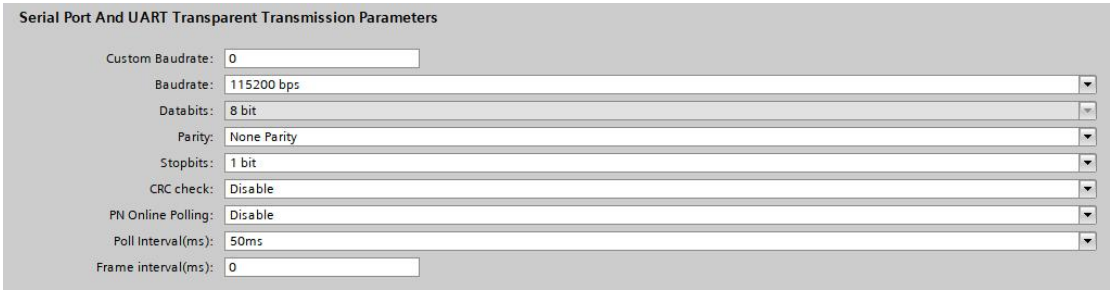
Data pass-through: Only one can be configured, which includes both sending and receiving data.
Send message: data (n bytes) + mb_CRC_16 (two bytes, optional)
Received message: data (n bytes) + mb_CRC_16 (two bytes, optional)

The serial communication status is 8 bytes. The first 4 bytes are used to count the total number of packets received by the serial port. The last 4 bytes, 32 bits, each represent the reception status of a certain sub-slot. A change in bit status (0→1 or 1→0) indicates that data has been received in that sub-slot. Setting the second bit (bit1) of the first byte of the control bit to 1 clears the reception count.

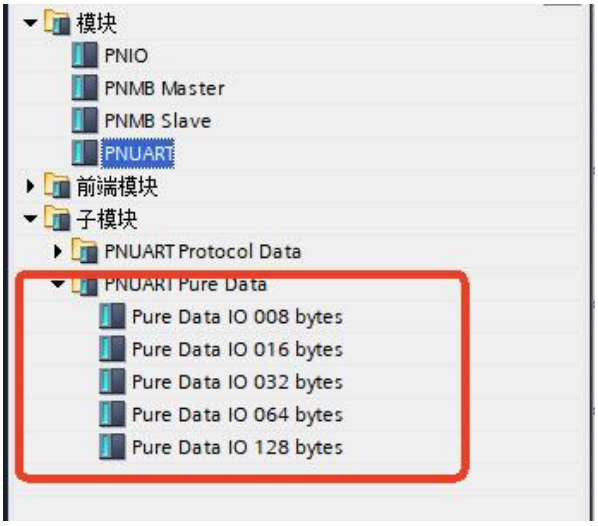
1、The serial port and polling parameters are mostly referenced from the Modbus host parameters. It's worth noting that when CRC check is enabled, a 2-byte Modbus CRC16 checksum will be appended to the end of the transmitted message. For received messages, the last two bytes will be checked for compliance. Only if the check is successful will the PLC data be updated; otherwise, the data will be discarded. PC2 (pin 17 VCT6) will be pulled high approximately 2ms after receiving data until a correct message is received (if necessary, it is recommended that users check this pin 3ms after transmission). The EER LED will remain lit for 3 seconds. This is disabled by default.

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2. Data pass-through module: Each module supports sending and receiving messages. "Actual send" can be configured to send the actual data length. Only one data pass-through module can be configured in sub-slot 2.



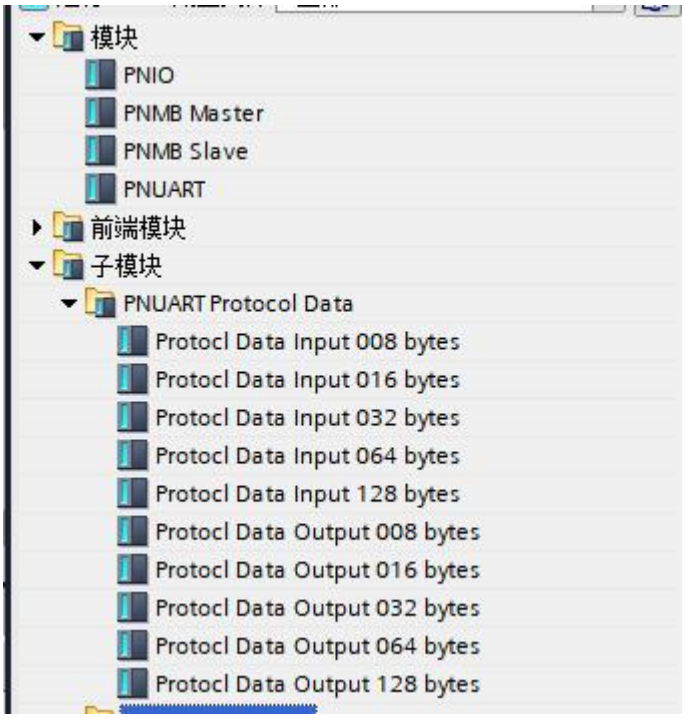


The "Trigger type" trigger mode can be configured to send messages using the trigger mode. Refer to PN to Modbus conversion. The default is polling trigger "pool trigger". Under "Level trigger", output data will only be sent when the control position is 1 and the output data changes.

2、The protocol pass-through module can be configured as either an input or output mode. The parameter configuration for sending messages is the same as that of the data pass-through module, and up to 32 messages can be configured in sub-slots 2-33.

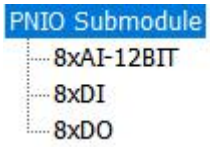
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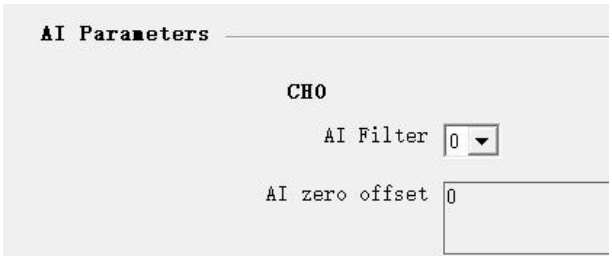


3.5 Profinet IO Functionality



Profinet IO is used in slot 2 and supports three IO types: AI, DI, and DO. It supports four sub-slots, each managing eight IO ports, for a total of 32 IO ports. Sub-slot 1 manages IO1-IO8, sub-slot 2 manages IO9-IO16, sub-slot 3 manages IO17-IO24, and sub-slot 4 manages IO25-IO32. Sub-slot 1 supports DI, AI, and DO, while the other sub-slots only support DI or DO.

AI Parameters:

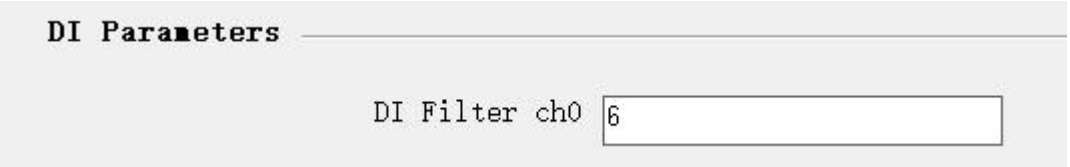


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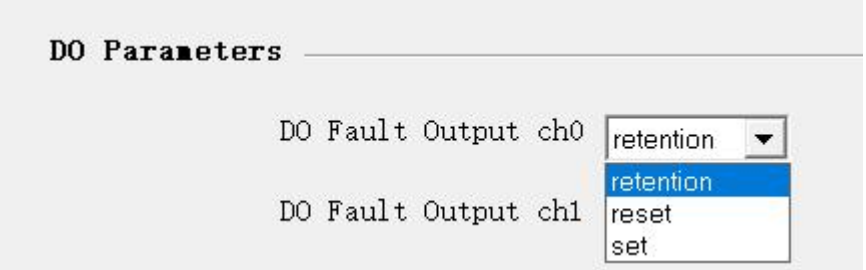
AI Filter: The AI filtering level for each channel can be set individually. The higher the level, the longer the filtering time.
AI zero offset (AI zero-point multi-offset): (cannot be set).
Note: AI is a 12-bit ADC that converts the AI pin voltage value (0-4095) based on the reference voltage (VREF+). It supports only one sub-slot and a maximum of 8 AIs. The AI filter parameters are configurable from 0 to 4. Higher levels result in more stable sampling values but also data lag.

DI Parameters:



DI Filter: The DI filtering time for each channel can be set individually. The input filtering time range is configurable, from 1 to 65535 ms.
Note: DI detects a high level; a low level corresponds to a data bit of 0, and a high level corresponds to a data bit of 1. It supports sub-slots 1-4, with a maximum of 32 DIs.

DO Parameters:



DO Fault Output: When the bus malfunctions, the output status of the DO for each channel can be set individually.
Retention: In the event of a fault, retain the current state of the DO output.
Reset: In case of a fault, resets the DO output to its previous state.
Set (Set bit): In case of a fault, set the DO output state before the fault occurs.
Note: When the DO data bit is 1, the output is high; when it is 0, the output is low. It is in a high-impedance state upon power-on until the PN connection configuration is sent to configure it into output mode. It supports sub-slots 1-4, with a maximum of 32 DOs.

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四 Equipment alarm information description

When an error occurs in the EBT3003 module , Profinet's alarm mechanism will send specific error information to the PLC. The specific error information can be viewed through the corresponding host computer on the PLC.
The specific error message is explained below:

error message	Description
Illegal Fun Code	The slave device responded with a Modbus standard error: The requested function is not recognized or supported by the slave device.
Illegal Data Address	The slave station responded with a Modbus standard error: the data address is not within the device's accessible range.
Illegal Data Value	The slave responded with a Modbus standard error: The requested operation attempted to set an invalid or illegal value.
Slave Device Failure	The slave station responded with a Modbus standard error: Slave device failure, unknown device failure.
Frame Length Error	The message length received by the master station is incorrect ; it is too long, too short, or does not match the correct length of the slave station's reply data.
CRC Check Error	The CRC checksum of the message received by the master station is incorrect.
Register Number Error	The number of message registers received by the master station is incorrect.
SLave Address Error	The master station received a message with an incorrect slave address.
Master Wating RSP Timeout	Main station received timeout
Function Code Different	The function code in the message received by the master station is inconsistent with the request.
Register Address Error	The master station received a message register address that is incorrect.
Unknown Error	Unknown error

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Revision History

Version	Revision Date	Revision Notes	maintainer
1.0	2026-05-20	Initial version	LT
1.1	2026-7-15	Correction pin	LT

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Phone: +86 028-61399028
Web: www.ebyte.com
Address: B5 Mould Park, 199# Xiqu Ave, High-tech District, Sichuan, China

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