

BL201 PROFINET Distributed I/O



BL201 User Manual

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Shenzhen Beilai Technology Co.,Ltd

Website: <https://www.bliiot.com>

Preface

Thanks for choosing BLIIoT Distributed I/O. These operating instructions contain all the information you need for operation of BL201.

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Disclaimer

This document is designed for assisting user to better understand the device. As the described device is under continuous improvement, this manual may be updated or revised from time to time without prior notice. Please follow the instructions in the manual. Any damages caused by wrong operation will be beyond warranty.

Revision History

Update Date	Version	Description	Owner
2021-10-13	V1.0	First Edition	ZLF
2022-07-01	V1.1	Add Profinet, EtherCAT protocol, add platform, logic control functions	HYQ
2023-07-27	V1.1	Change Model name	HYQ
2023-10-24	V1.2	Add BL203, BL206, BL207 description	HYQ
2023-10-24	V1.2	User manual split by model	HYQ

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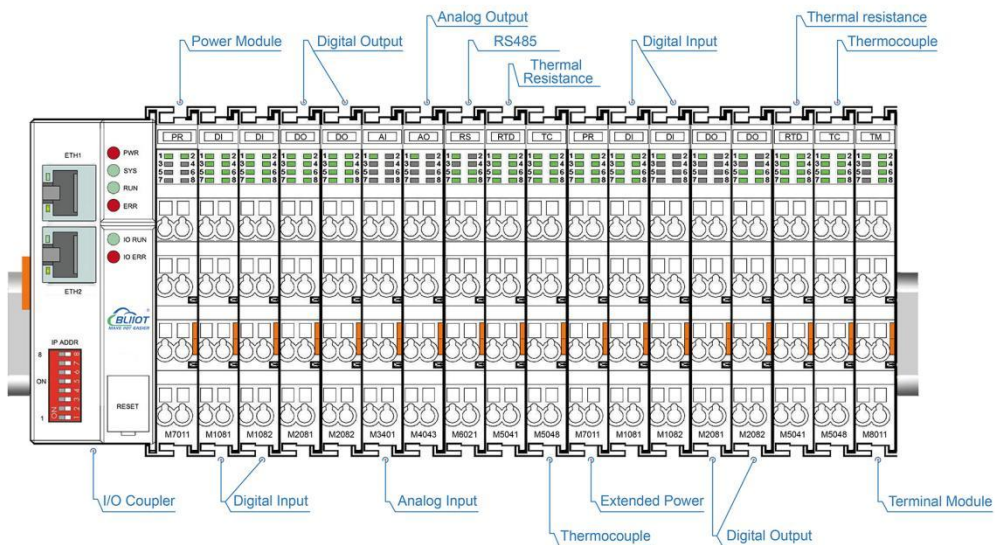
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1 Product Introduction

1.1 Overview

The BL201 coupler is a data acquisition and control system based on a powerful 32-bit microprocessor design with a Linux operating system.

The BL201 distributed I/O system consists of 3 parts: Coupler, I/O modules and terminal modules.



The communication between the node and the field devices (eg PLC) takes place via the Ethernet interface of the fieldbus coupler, and the communication between the fieldbus coupler and the I/O modules takes place via the local bus. The two Ethernet interfaces are internally integrated with a switch function, which can establish a linear topology without the need for additional switches or hubs.

The system needs to use the power module to provide 24VDC system voltage and 24VDC field voltage. Since two independent power supplies are used, the field voltage input interface and system voltage input interface of BL200 series couplers are electrically isolated from each other.

When assembling fieldbus node modules, each I/O module can be arranged in any combination, and it is not required to be grouped by module type.

A terminal module must be plugged into the end of a fieldbus node to ensure correct data transmission.

1.2 Typical Application

High reliability, easy expansion, easy setting, and convenient network wiring, these capabilities let users efficiently adapt the BL201 I/O system to a variety of industrial application.

1.3 Features

- Each I/O system can have a maximum of I/O 32 modules.
- Support Profinet master connection.
- The field side, the system side and the bus side are electrically isolated from each other.
- Support 2 X RJ45 interface, integrated switch function, can establish line topology, without the need for additional switches or hubs.
- Convenient wiring connection technology, screw-free installation.

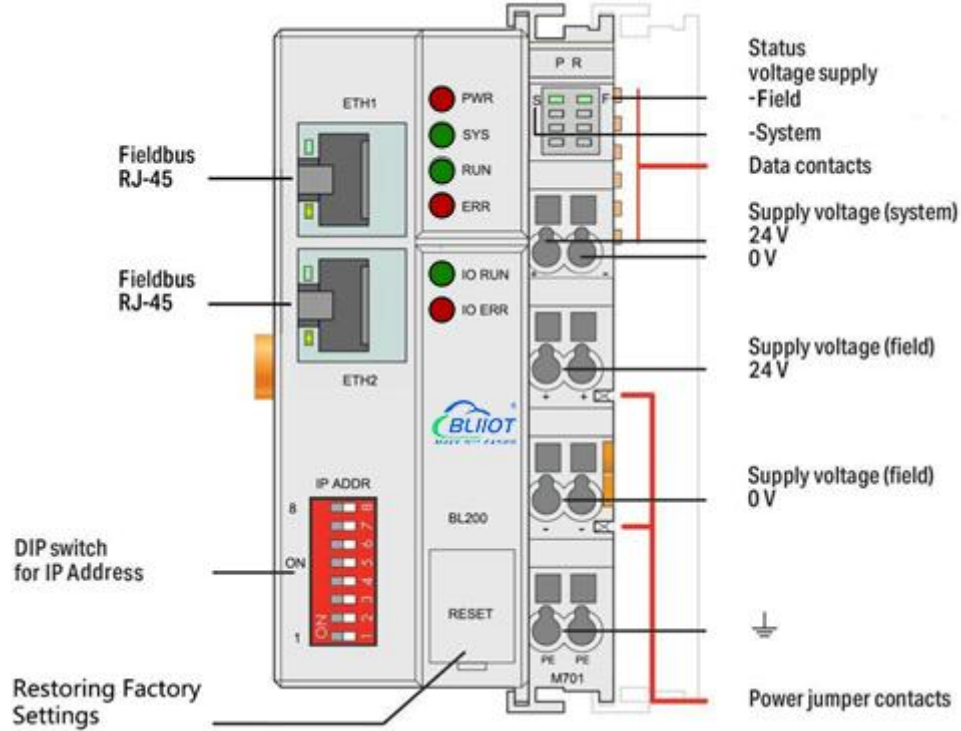
1.4 Model List

Description	Model	Channel	Type
Modbus-TCP I/O Coupler	BL200	/	/
Profinet I/O Coupler	BL201	/	PROFINET
EtherCAT I/O Coupler	BL202	/	/
Ethernet/IP I/O Coupler	BL203	/	/
OPC UA EdgeIO Controller	BL205	/	/
MQTT EdgeIO Controller	BL206	/	/
MQTT+OPC UA+Modbus TCP	BL206Pro	/	/
BACnet/IP I/O Coupler	BL207	/	/
BACnet/IP+MQTT+OPC UA	BL207Pro	/	/
8CH DI	M1081	8	NPN (low level trigger)
8CH DI	M1082	8	PNP (high level trigger)
16CH DI	M1161	16	NPN (low level trigger)
16CH DI	M1162	16	PNP (high level trigger)
4CH DO	M2044	4	Relay
8CH DO	M2081	8	PNP
8CH DO	M2082	8	NPN
16CH DO	M2161	16	PNP
16CH DO	M2162	16	NPN
4CH AI Single-Ended	M3041	4	0-20mA/4-20mA
4CH AI Single-Ended	M3043	4	0-5V/0-10V
4CH AI Differential	M3044	4	0-5V/0-10V
4CH AI Differential	M3046	4	±5V/±10V
4CH AO	M4041	4	0-20mA/4-20mA
4CH AO	M4043	4	0-5V/0-10V
4CH AO	M4046	4	±5V/±10V
2CH RTD	M5021	2	3Wire PT100
2CH RTD	M5022	2	3Wire PT1000
2CH RTD	M5023	2	4Wire PT100
2CH RTD	M5024	2	4Wire PT1000
4CH TC	M5048	4	TC(B/E/J/K/N/R/S/T)
2CH RS485	M6021	2	RS485
2CH RS232	M6022	2	RS232
1CH RS485, 1CH RS232	M6023	2	RS485+RS232

Power module	M7011	/	/	
Terminal module	M8011	/	/	

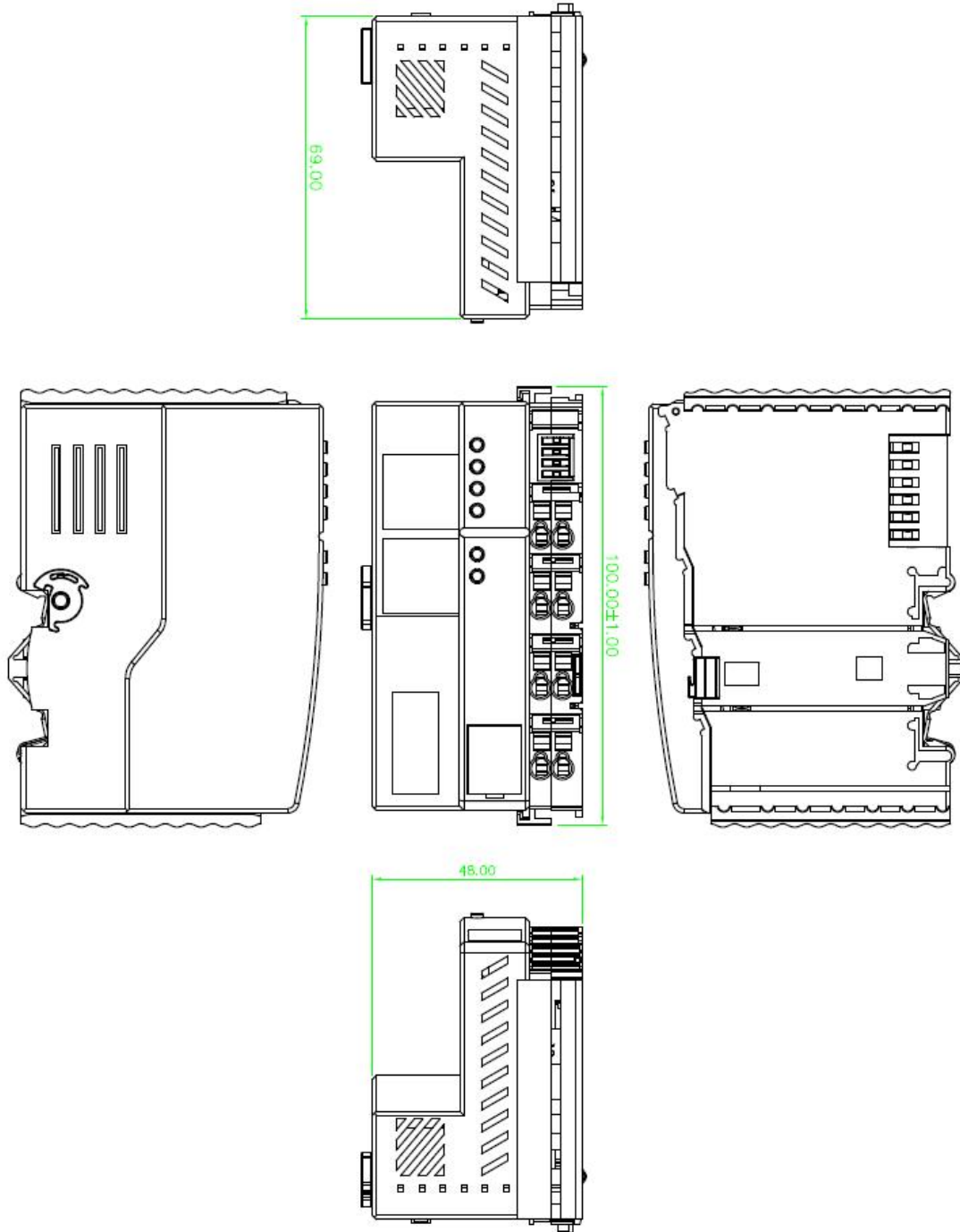
2 Hardware

2.1 I/O Coupler



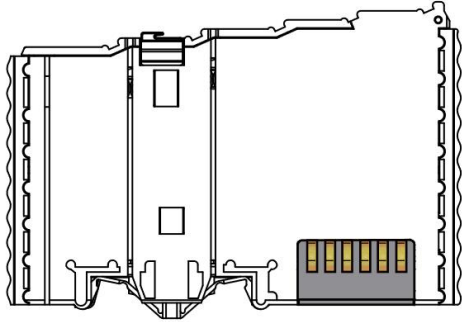
2.2 Dimension

Unit:mm



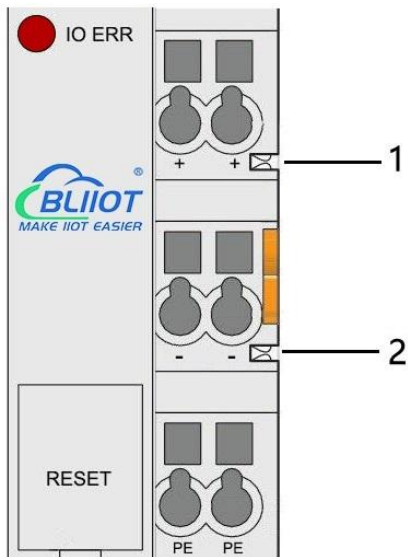
2.3 Data Contacts/Internal Bus

The communication between the fieldbus coupler/controller and the I/O modules, as well as the system power supply of the I/O modules are realized via the internal bus. The internal bus is made up of 6 data contacts, these gold-plated contacts are self-cleaning when connected.



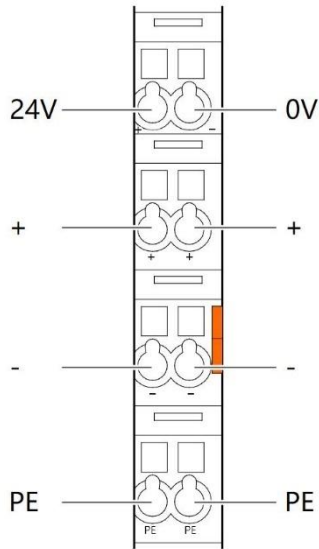
2.4 Power Jumper Contacts

The power module included with the coupler has two self-cleaning power jumper contacts for powering the field side. This power supply has a maximum current of 10A across the contacts, current exceeding the maximum will damage the contacts. When configuring the system, it must be ensured that the above-mentioned maximum current is not exceeded. If it exceeds, a power expansion module needs to be inserted.



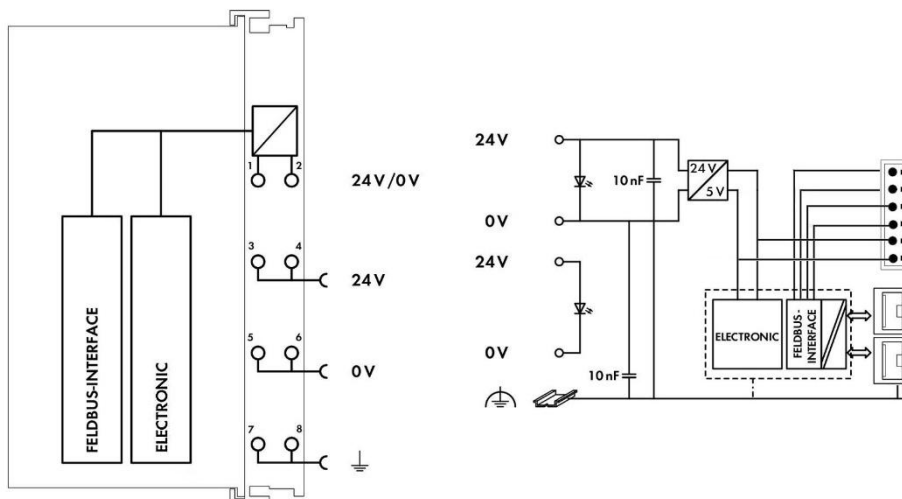
No.	Type	Description
1	Spring contact	Supply 24V to the field side
2	Spring contact	Supply 0V to the field side

2.5 Terminal Point



Name	Description
24V	System Power 24VDC
0V	System Power 0VDC
+	Connections Field Supply 24 VDC
+	Connections Field Supply 24 VDC
-	Connections Field Supply 0 VDC
-	Connections Field Supply 0VDC
PE	Grounding
PE	Grounding

2.6 Electrical Schematic



3 Installation

3.1 Installation Sequence

All distributed couplers/controller and I/O modules from Beilai Technology must be mounted on a standard DIN 35 rail.

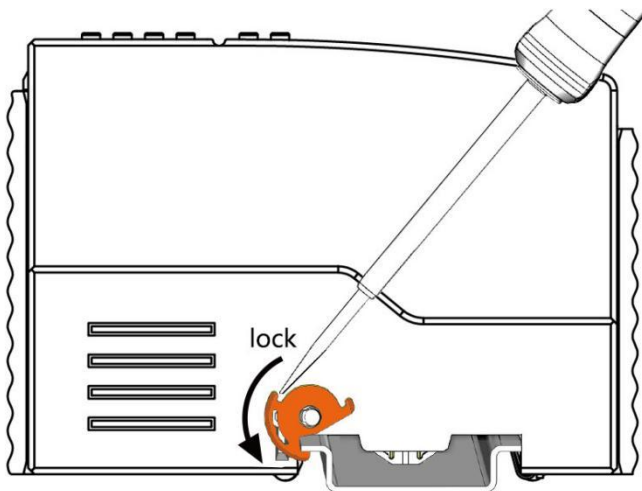
Starting from the coupler, the I/O modules are assembled from left to right, and the modules are installed next to each other. All I/O modules have grooves and power jumper contacts on the right side, to avoid assembly errors, I/O modules must be inserted from the right and top to avoid damage to the modules.

Utilizes a tongue and groove system to form a secure fit and connection. With the automatic locking function, the individual components are securely fixed on the rail after installation.

Don't forget to install the terminal module! Always plug a terminal module (eg TERM) into the end of the I/O module to ensure correct data transmission.

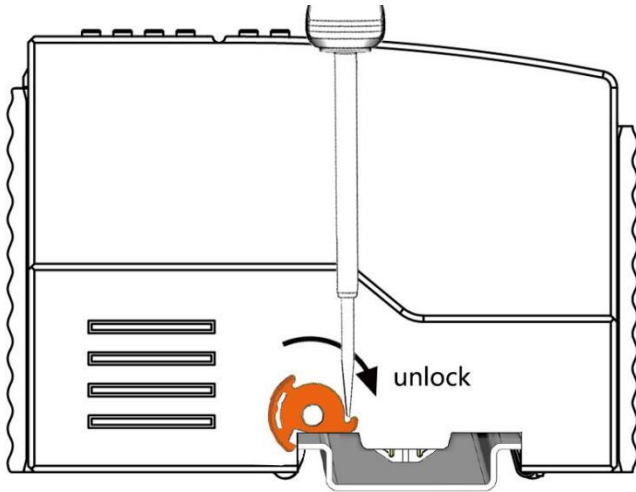
3.2 Install Coupler

- 1.Snap the coupler onto the DIN rail first;
- 2.Use a tool such as a screwdriver to turn the locking cam until the locking cam engages the DIN rail.

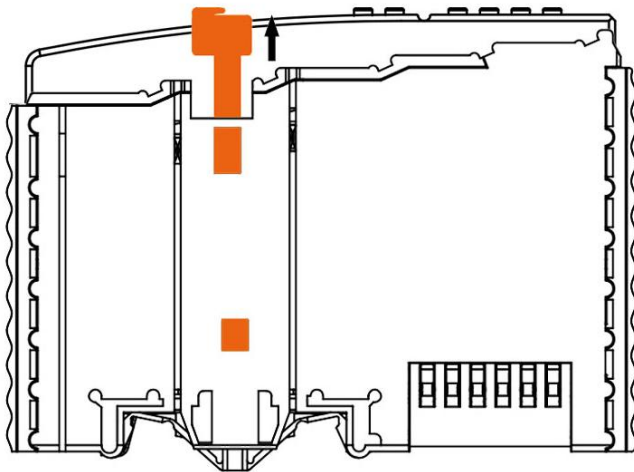


3.3 Remove Coupler

- 1.Use a screwdriver to turn the locking disc cam until the locking cam no longer engages the rail.



2. Pull the release tab to remove the coupler from the assembly



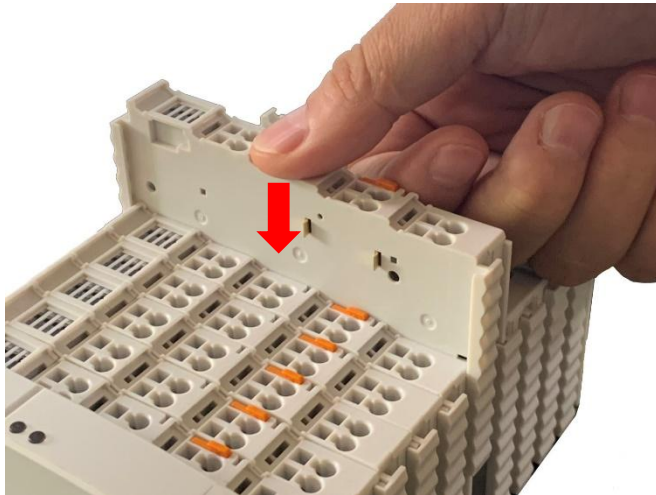
Data or power contacts are electrically disconnected from adjacent I/O modules when the coupler/controller is removed.

3.4 Insert I/O Modules

1. When inserting the module, make sure the tabs on the module line up with the grooves of the coupler or other I/O module to which it is attached.



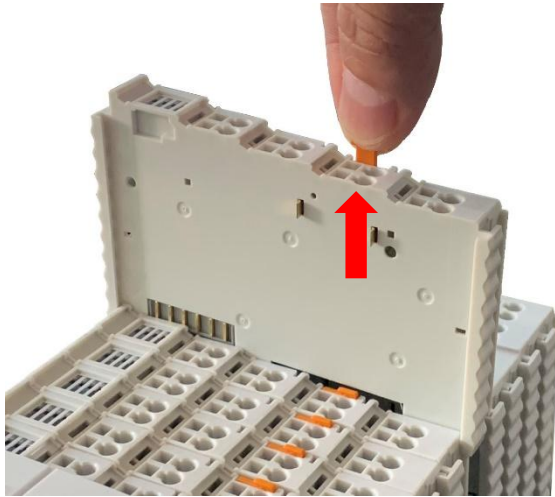
2. Press the I/O module into the assembly position until the I/O module snaps into the rail.



After the I/O module is installed, the electrical connection to the coupler (or the previous I/O module) and the following I/O module is established via the data contacts and the power jumper contacts.

3.5 Remove I/O Modules

Pull up on the latch to remove the I/O module from the assembly.



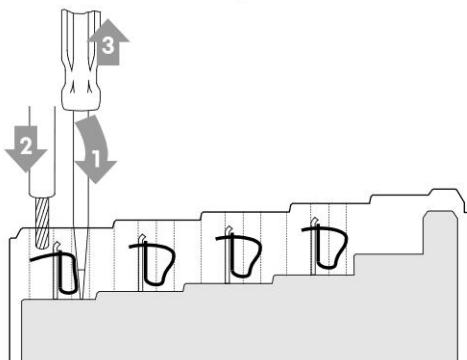
When the I/O module is removed, the electrical connection to the data or power jumper contacts is disconnected.

4 Device Connection

4.1 Wiring

CAGE CLAMP connection is suitable for solid, stranded and fine-stranded conductors. Only one wire can be connected to each CAGE CLAMP. If there is more than one wire, it must be merged into a point before being connected.

1. Open the CAGE CLAMP by inserting the tool into the opening above the junction.
2. Insert the wire into the corresponding open connection terminal.
3. Once the tool is removed, the CAGE CLAMP closes and the wire is clamped firmly by the spring.



4.2 Power Supply

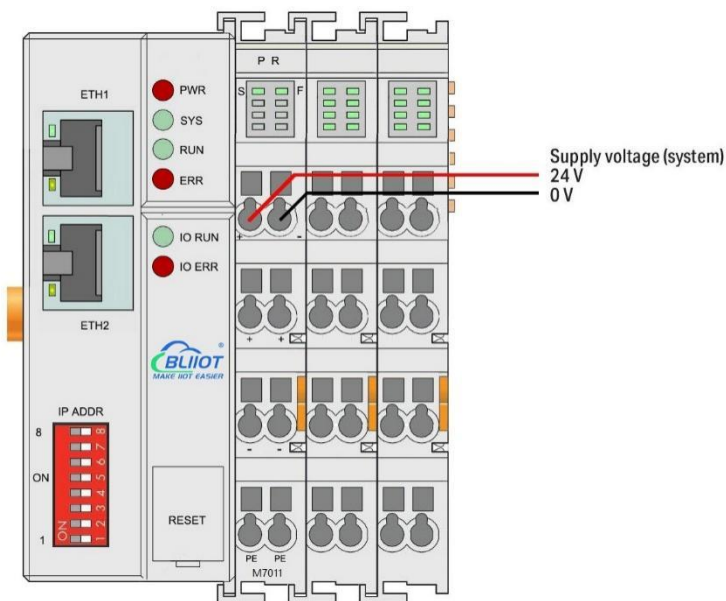
System and field voltages are supplied by power supply modules. The power supply module of the BL201 coupler supplies power for the internal electronics of the coupler and the I/O modules. If necessary (there are many I/O modules and the current is relatively high), it can also be provided through an independent power supply module. The fieldbus interface (Ethernet interface), system and field are galvanically isolated from each other.

4.2.1 System Power

BL201 coupler require 24V DC system power, which is connected from the terminal of the power supply module. The 5V bus voltage required inside the system is converted from the 24V system voltage.

The power supply module only has proper fuse protection, please provide proper overcurrent protection externally.

Please pay attention to matching the output power of the power supply module and the load power to avoid excessive load current.

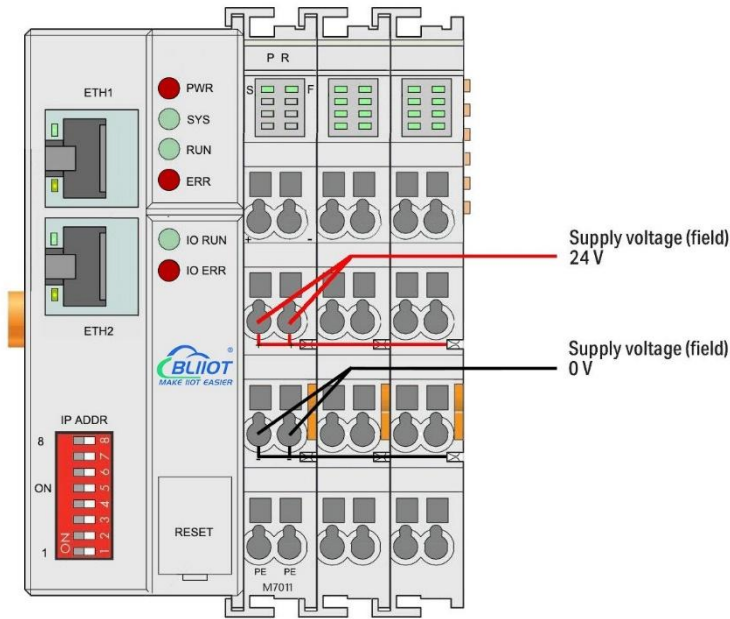


4.2.2 On-site Power Supply

The power supply module supplies 24 VDC on the field side to power the sensors and actuators.

Field power supply only has proper fuse protection. Without overcurrent protection,

electronic equipment can be damaged.



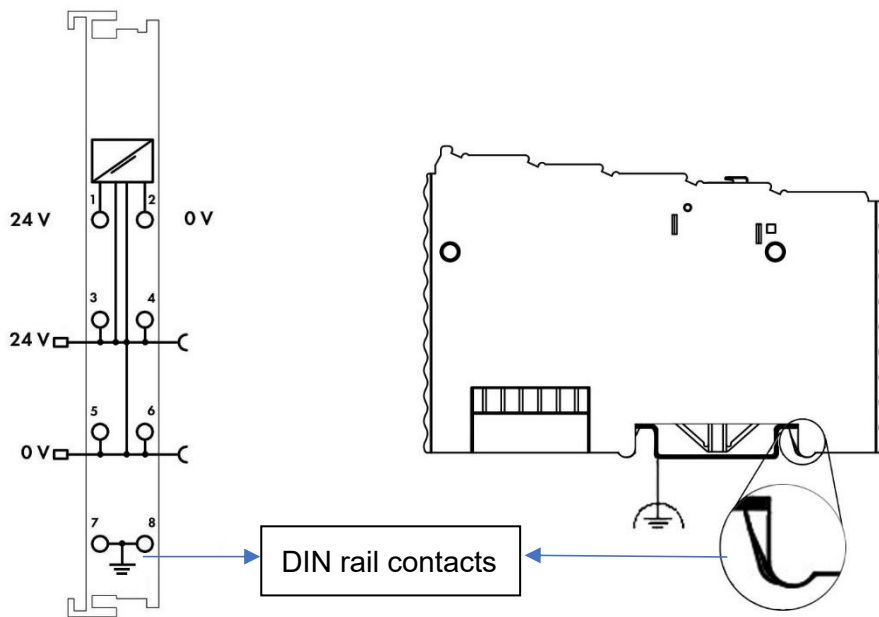
Field-side power is automatically output from the power jumper contact when the I/O module is connected. The continuous load current across the contacts of the power supply must not exceed 10 A.

The problem of excessive load power on the system side or on the field side can be solved by plugging in additional power supply modules. After plugging in an additional power supply module, a new voltage potential may appear on the field side.

In the case where electrical isolation is not required, the field power supply and the system power supply can use the same power supply.

4.2.3 Grounding

When installing the enclosure cabinet, the cabinet must be grounded, and the rail is electrically connected to the cabinet through screws to ensure that the rail is properly grounded. Grounding can increase resistance to electromagnetic interference. Some components in the I/O system have rail contacts that dissipate EMI onto the rail.



5 BL201 Profinet Coupler

5.1 BL201 Coupler Overview

BL201 coupler supports standard Profinet I/O Device communication. Support RT real-time communication, the minimum period of RT real-time communication is 1ms. The coupler supports a maximum input of 1440 bytes, a maximum output of 1440 bytes, and supports 32 extended I/O modules.

5.2 Technical Parameters

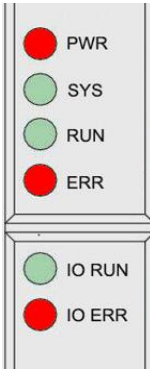
Name	Parameter	Description
System power	Input voltage(system)	24 VDC
	Input current(system)	MAX 500 mA@24VDC
	Power Efficiency	84%
	Internal bus voltage	5VDC
	Coupler current consumption	MAX 300mA@5VDC
	I/O current consumption	MAX 1700mA@5VDC
	Isolation protection	500 V system/supply

Field power	Input voltage (field)	24 VDC
	Current carrying capacity (power jumper contacts)	MAX 10 ADC
Ethernet	Number	2 X RJ45
	Transmission medium	Twisted Pair STP 100 Ω Cat 5
	MAX cable length	100m
	Baud rate	10/100 Mbit/s
	Isolation protection	ESD contact: 8KV, Surge: 4KV(10/1000us)
System	Operating system	Linux
	CPU	300MHz
	RAM	64MB
	Flash	128MB
	I/O Modules	MAX 32
	Protocol	Profinet
	Process data area	Input up to 1440 bytes, output up to 1440 bytes
	RT	Support, minimum cycle 1ms
Connection	Method	CAGE CLAMP
	Wire diameter	0.08 mm ² ... 2.5 mm ² , AWG 28 ... 14
	Strip length	8 mm ... 9 mm / 0.33 in
Environment	Working temperature	0 ... 55 ° C
	Storage temperature	-40 ... 70 ° C
	Relative humidity	5 ... 95% no condensation
	Working altitude	0 ... 2000 m
	Protection type	IP20
Dimension	Width	48mm
	Length	100mm
	Height	69mm
Material	Color	Light gray
	Housing material	Polycarbonate, Nylon 6.6
	Fire load	1.239 MJ
	Weight	180g
Installation	Method	DIN-35 rail
Certificates	EMC	EN 55022: 2006/A1: 2007 (CE &RE) Class B

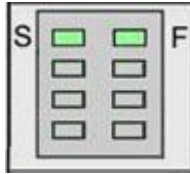
		IEC 61000-4-2 (ESD) Level 4
		IEC 61000-4-3 (RS) Level 4
		IEC 61000-4-4 (EFT) Level 4
		IEC 61000-4-5 (Surge)Level 3
		IEC 61000-4-6 (CS)Level 4
		IEC 61000-4-8 (M/S) Level 4

5.3 Hardware Interface

5.3.1 LED Indicators



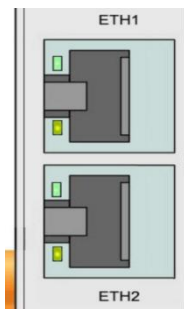
LED	Description	Color	Status	Meaning
PWR	Power indicator	Red	ON	Power connection successful
			OFF	No power
SYS	System indicator	Green	ON	System is abnormal
			OFF	System is running normally
RUN	Running indicator	Green	Flashing	System is running normally
			OFF	System is abnormal
ERR	Error indicator	Red	ON	Profinet protocol connection error
			OFF	No errors
I/O RUN	I/O Running indicator	Green	Flashing	I/O module is working normally
			OFF	Module not inserted
I/O ERR	I/O Error indicator	Red	ON	I/O module communication error
			OFF	No errors



LED	Description	Color	Status	Meaning
S	System 24V power indicator	Green	ON	Power is OK
			OFF	No power
F	Field 24V power indicator	Green	ON	Power is OK
			OFF	No power

5.3.2 Ethernet Port

ETH1 and ETH2 are Profinet communication ports, support switch function, 10M/100M self-adaptive.



5.3.3 IP Address Selection Switch

It's not working on BL201 couplers.

5.4 Process Data Definition

BL201 does not support the data collected by the serial port module temporarily, the data point address of the I/O module is determined by the Profinet master, and the data of AI and AO are mapped to 0-65535.

AO 0-5V/0-10V output value

Voltage(0-5V)	Voltage(0-10V)	Decimal	Hexadecimal
5	10	65535	0xFFFF
.	.	.	.

.	.	.	.
2.5	5	32767	0x7FFF
.	.	.	.
.	.	.	.
0	0	0	0x0000

If analog output 3V is required

When the range is 0-5V, send value $3*65535/5=39321$

When the range is 0-10V, send value $3*65535/10=19660.5$, because AO is an integer, then send down 19660

AO -5-5V/-10-10V output value

Voltage(-5-5V)	Voltage(-10-10V)	Decimal	Hexadecimal
5	10	32767	0x7FFF
.	.	.	.
2.5	5	16383	0x3FFF
.	.	.	.
-2.5	-5	-16383	0xC001
.	.	.	.
-5	-5	-32767	0x8001

If analog output 3V is required

When the range is -5-5V, send value $3*65534/10=19660.2$, because AO is integer, then send down 19660

When the range is -10-10V, send value $3*65534/20=9830.1$, because AO is integer, then send down 9830.

AO 0-20mA/4-20mA output value

Current(0-20mA)	Current(4-20mA)	Decimal	Hexadecimal
20	20	65535	0xFFFF
.	.	.	.
.	.	.	.
10	12	32767	0x7FFF
.	.	.	.
.	.	.	.
0	4	0	0x0000

If AO output 17mA is required

When the range is 0-20mA, send value $17*65535/20=55704.75$, because AO is

integer, then send down 55705.

When the range is 4-20mA, send value $(17-4)*65535/16=53247.19$, because AO is integer, then send down 53247.

AI 0-20mA/4-20mA input value

Current(0-20mA)	Current(4-20mA)	Decimal	Hexadecimal
20	20	65535	0xFFFF
.	.	.	.
.	.	.	.
10	12	32767	0x7FFF
.	.	.	.
.	.	.	.
0	4	0	0x0000

For example: The AI value in the master station is 56789, then when the range is 0-20mA, the theoretical value of AI is: $56789/65535*20=17.33089\text{mA}$. When the range is 4-20mA, the theoretical value of AI is: $56789/65535*16+4=17.86471\text{mA}$.

AI 0-5V/0-10V input value

Voltage(0-5V)	Voltage(0-10V)	Decimal	Hexadecimal
5	10	65535	0xFFFF
.	.	.	.
.	.	.	.
2.5	5	32767	0x7FFF
.	.	.	.
.	.	.	.
0	0	0	0x0000

Example: In the master station, the AI display value is 56789, then when the range is 0-5V, the AI theoretical value is $56789/65535*5=4.33\text{V}$. When the range is 0-10V, the AI theoretical value is: $56789/65535*10=8.67\text{V}$.

AI -5-5V/-10-10V input value

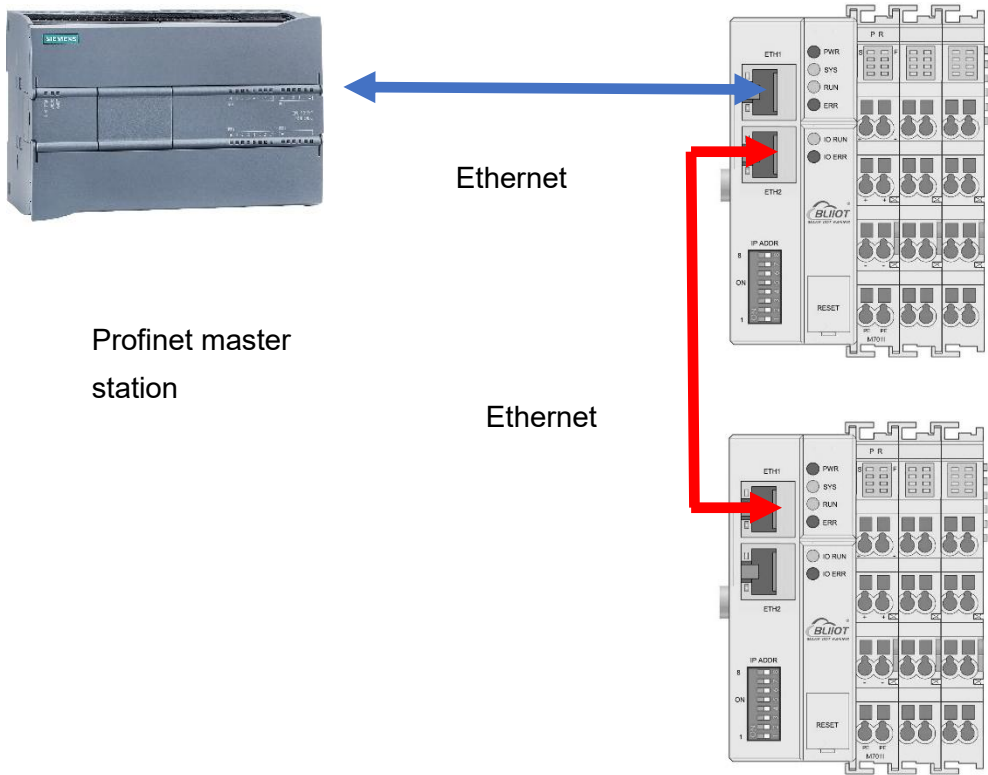
Voltage(-5-5V)	Voltage(-10-10V)	Decimal	Hexadecimal
5	10	32767	0x7FFF
.	.	.	.
2.5	5	16383	0x3FFF
.	.	.	.
-2.5	-5	-16383	0xC001
.	.	.	.

-5	-10	-32767	0x8001
----	-----	--------	--------

Example: The value of AI displayed in the master station is 23456, then the theoretical value of AI for range -5-5V is $23456/65534*10=3.579V$. For range -10-10V, the theoretical value of AI is $23456/65534*20=7.158V$.

5.5 Coupler Connection

The BL201 coupler is used as a Profinet slave, and both ETH1 and ETH2 network ports can be directly connected to the Profinet master station, or connected to the Profinet master through a switch. BL201 coupler does not have a separate web configuration interface.

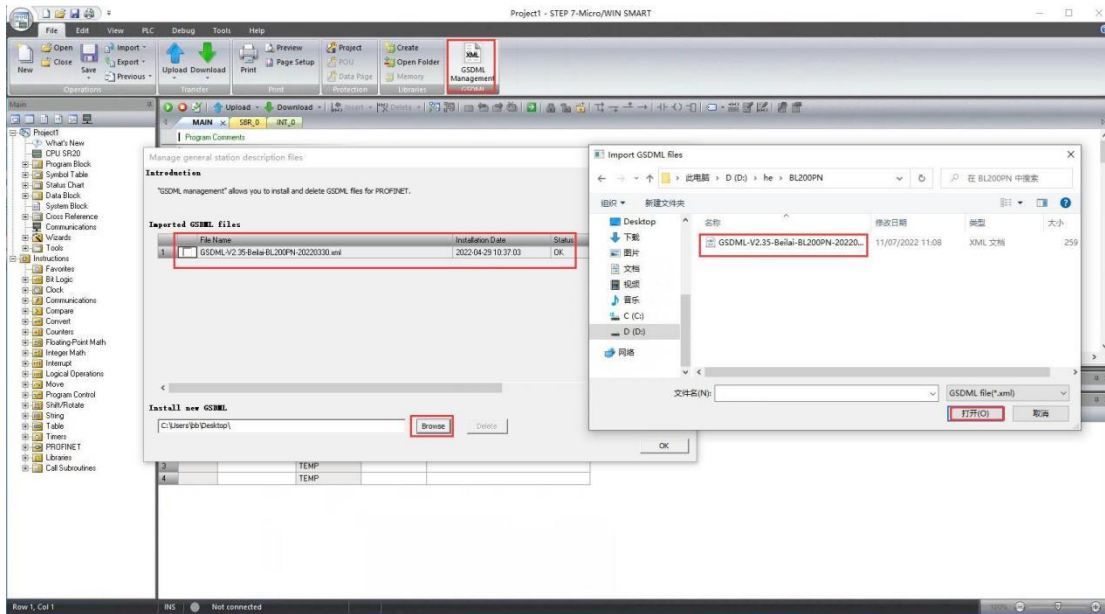


6 BL201 Communication Example

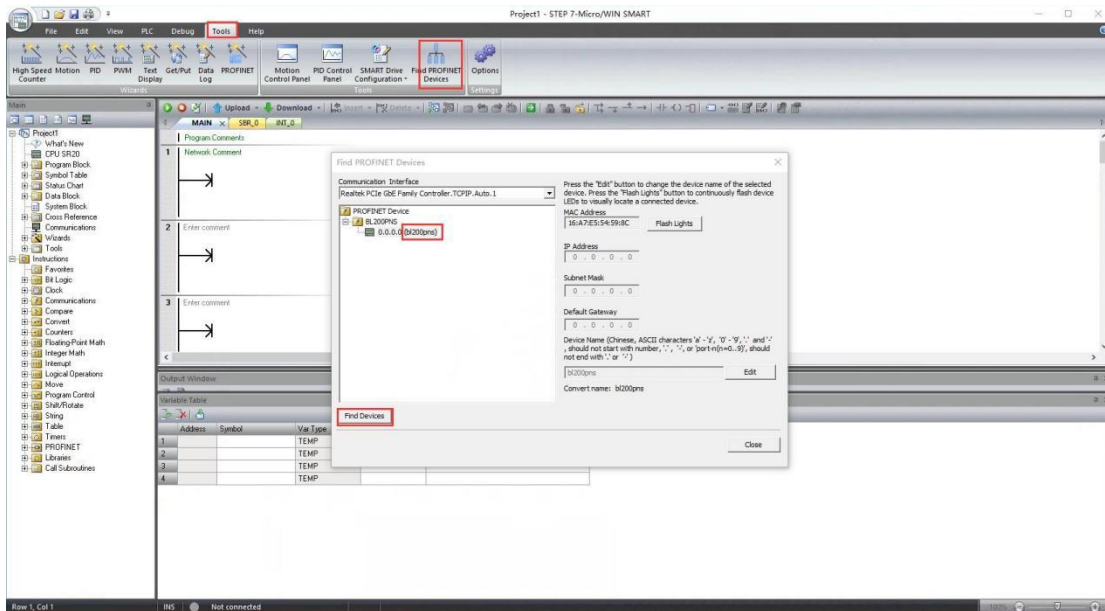
6.1 Siemens S7-200SMART and BL201

1. Prepare I/O modules: Coupler BL201, digital output module M2082, digital input module M1081, analog input module M3401, analog output M4043. Module assembly and wiring refer to chapter3 Installation, chapter4 Device connection.
2. BL201, S7-200SMART, and PC need to be in the same LAN. Power on BL201 and

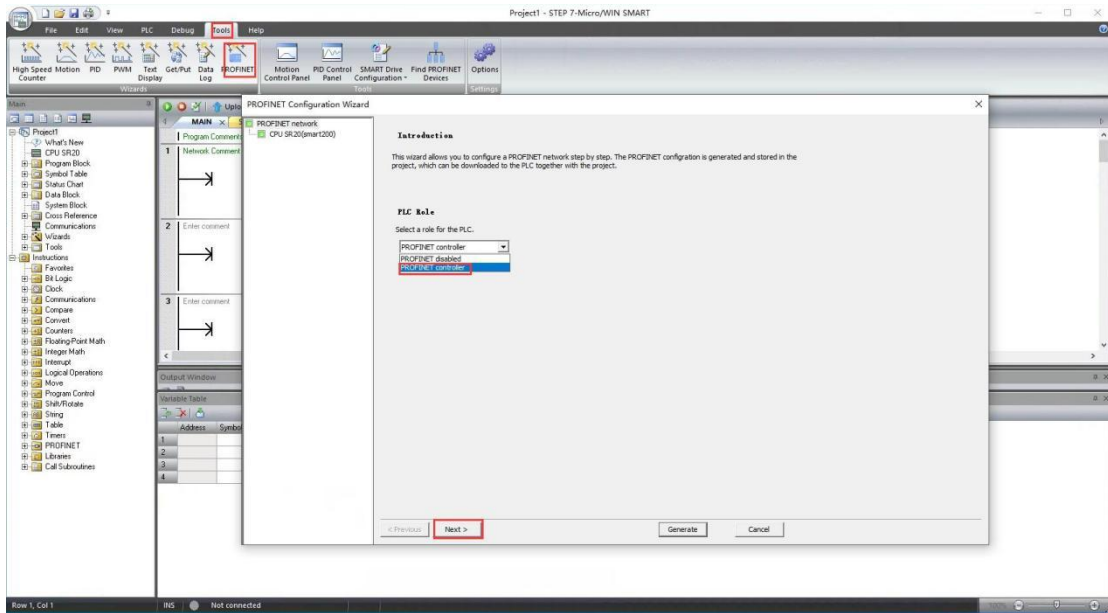
S7-200SMART, and open Siemens STEP 7-MicroWIN SMART software. Click GSDML management, in the pop-up window, click Browse to find the GSD file of BL201 and click Open, click Open to complete the installation of the GSD file.



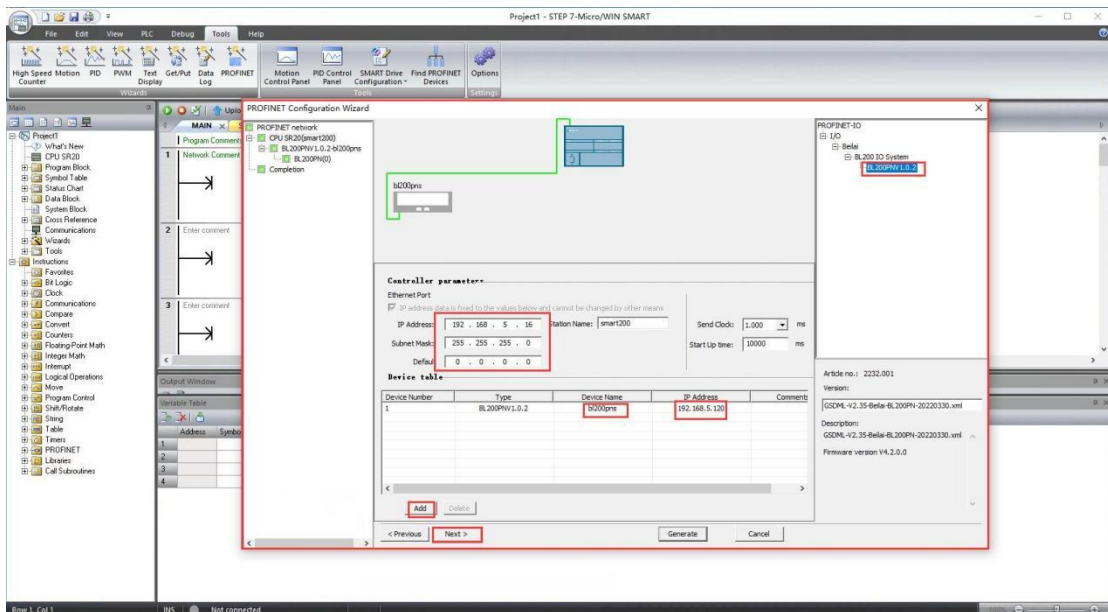
3. Click Tools, click Find PROFINET Devices, click Find Devices, find BL201, and the name of the BL201 coupler is bl201s. (The found coupler name must be consistent with this name during configuration.)



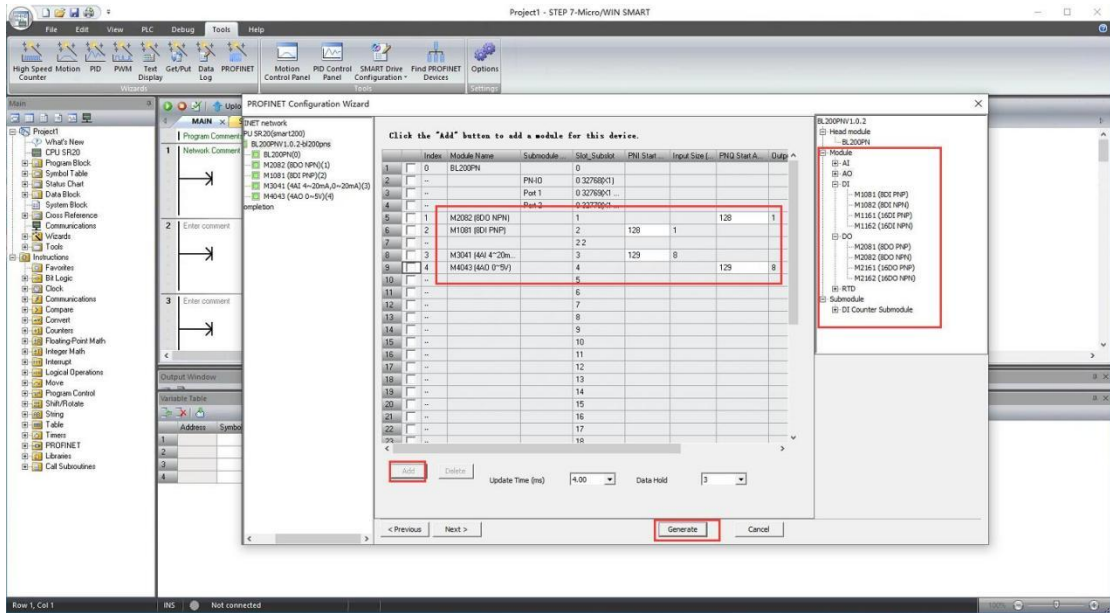
4. Click Tools, click PROFINET. Select the controller and click Next.



5. Find BL201 in the hardware catalog, click Add, add it to the device list, modify the name of the coupler to bl201s (communication key parameters), and assign the IP address of 192.168.5.10 to the coupler. The IP address assigned to the coupler must be in the same LAN as the IP address of the PLC. You can also modify the IP address of the PLC on this interface. After the modification is complete, click Next.

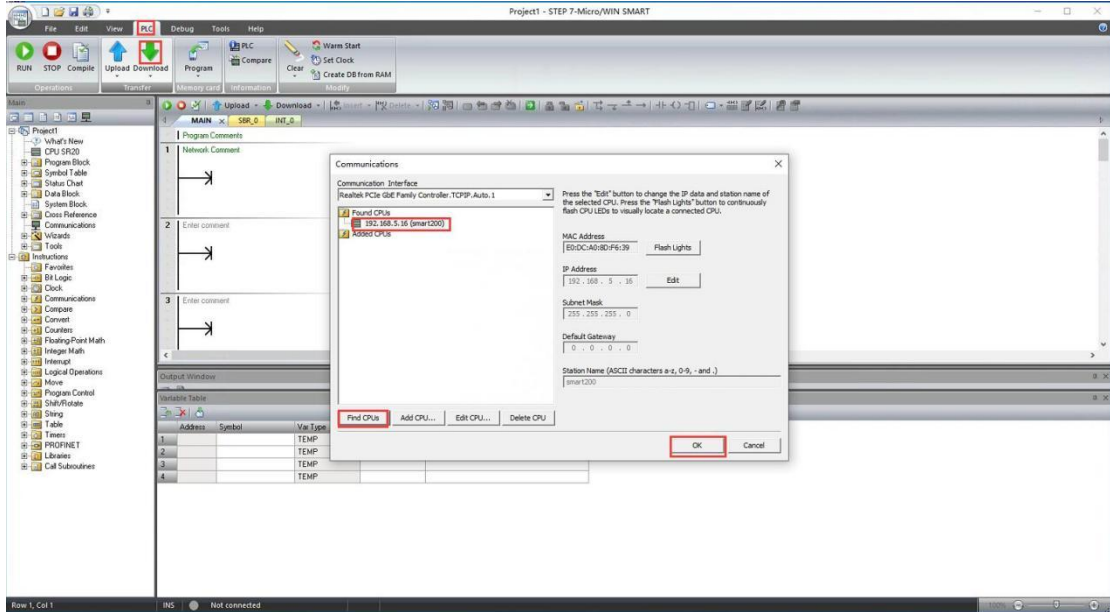


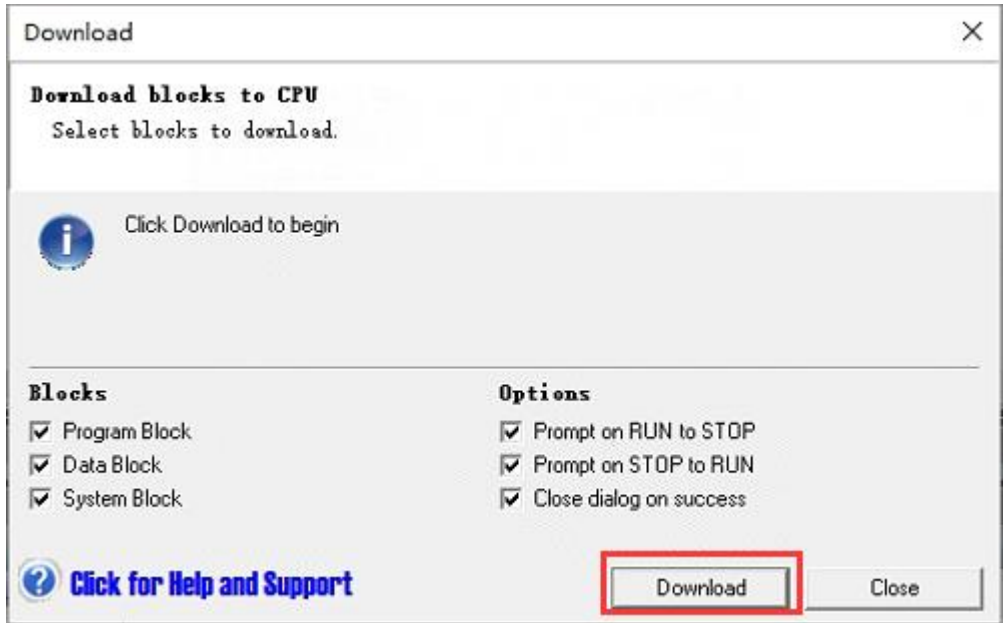
6. Configure the I/O module connected with the BL201. Click Generate. Add modules in the order of the I/O modules connect with the BL201. Power supply modules, extended power supply modules, and terminal modules do not need to be configured and do not participate in the sorting.



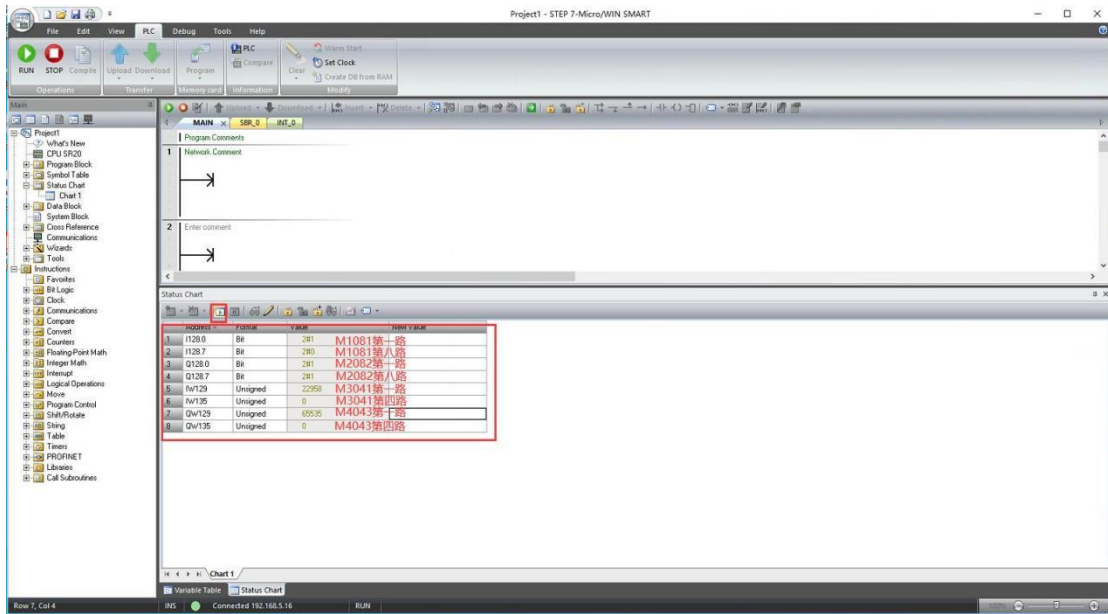
M2082 corresponds to address QW128, M1081 corresponds to address IW128, M3401 corresponds to address IW129-IW136, and M4043 corresponds to address QW129-QW136.

7. Click PLC, click Download, search for PLC in the pop-up window, and click OK. click to download.





8. After the download is successful, open the status chart and monitor the channel value of the I/O module.

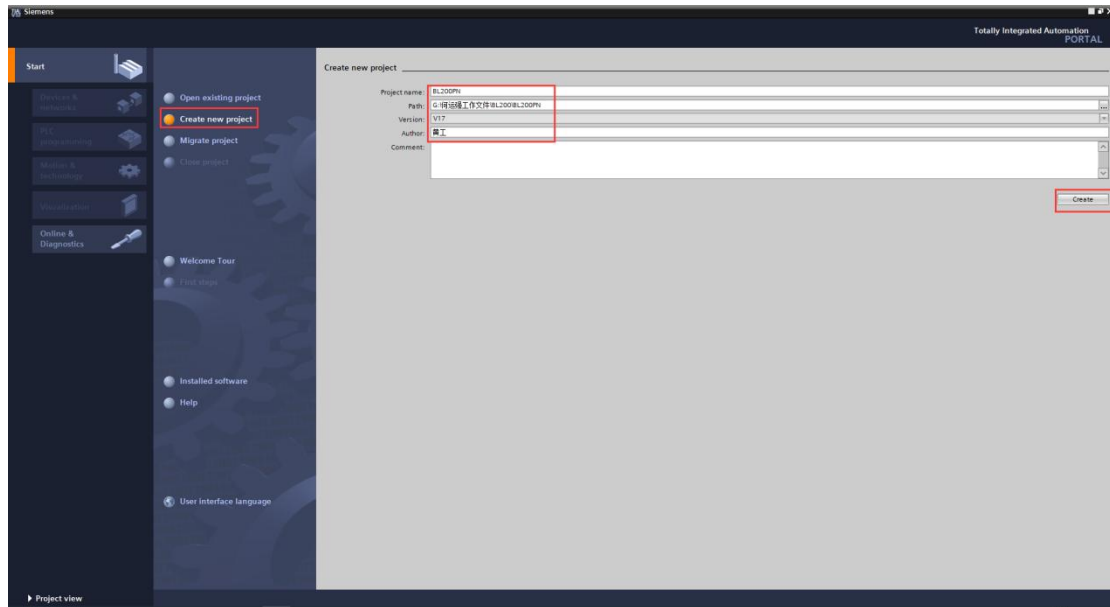


Refer to 5.4 Process Data Definition. When the range is 4-20mA, the theoretical value input of AI first channel IW129 is: $22958/65535 * 16 + 4 = 9.60507\text{mA}$. When the range is 0-5V, the output of the first AO QW129 is: $65535/65535 * 5 = 5\text{V}$.

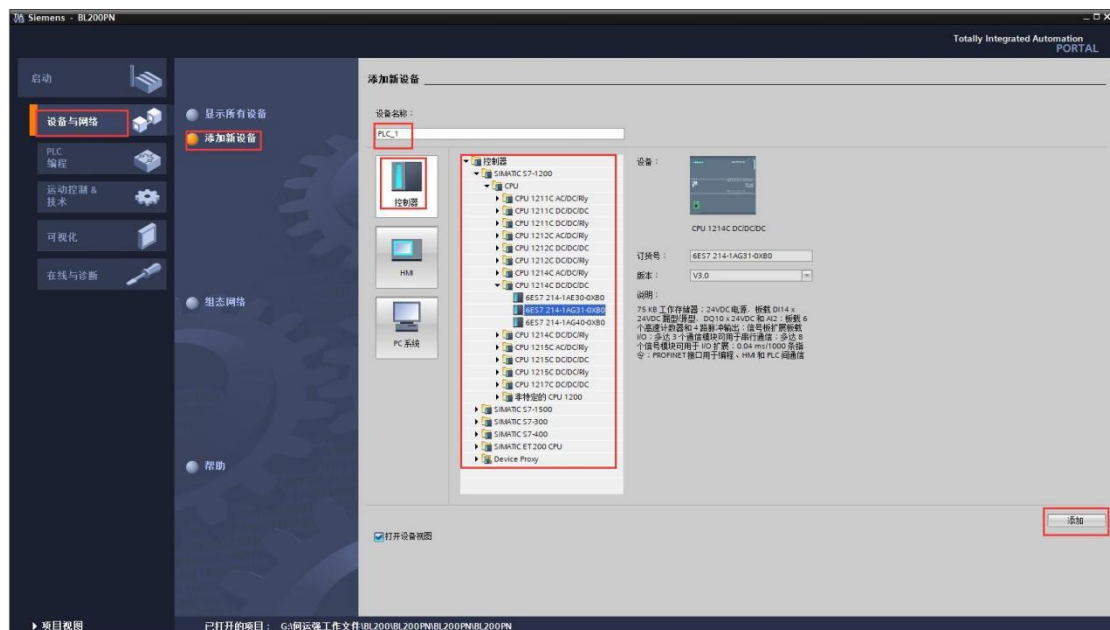
6.2 Siemens S7-1200 and BL201

1. Prepare I/O modules: Coupler BL201, digital output module M2082, digital input module M1081, analog input module M3401, analog output M4043. Module assembly and wiring refer to chapter3 Installation, chapter4 Device connection.

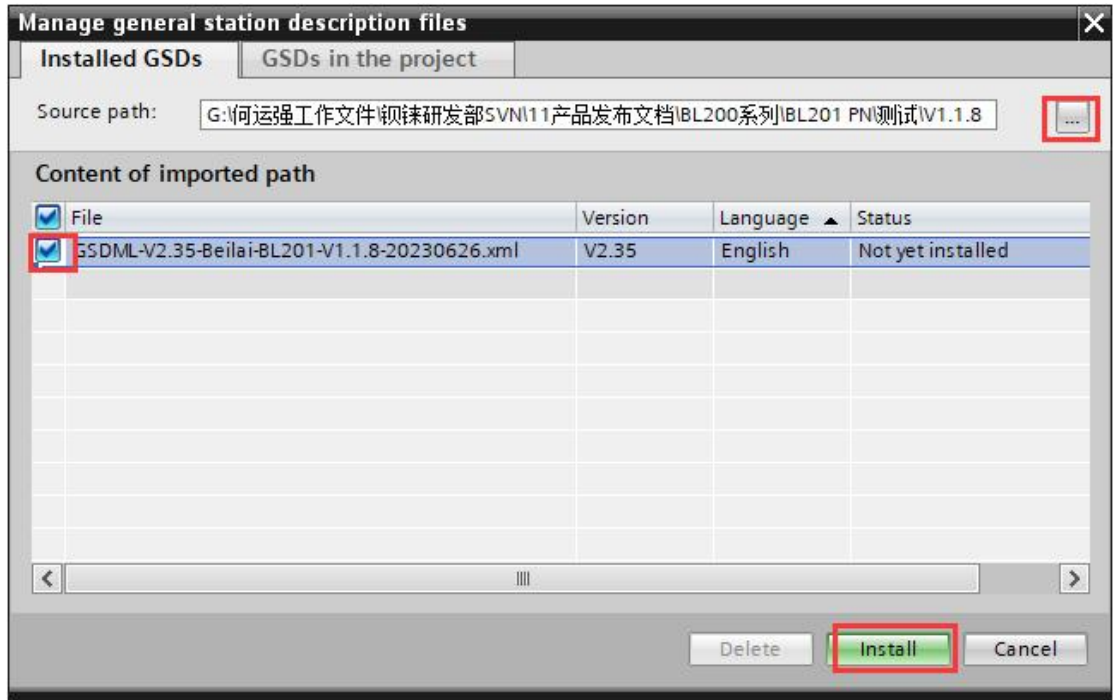
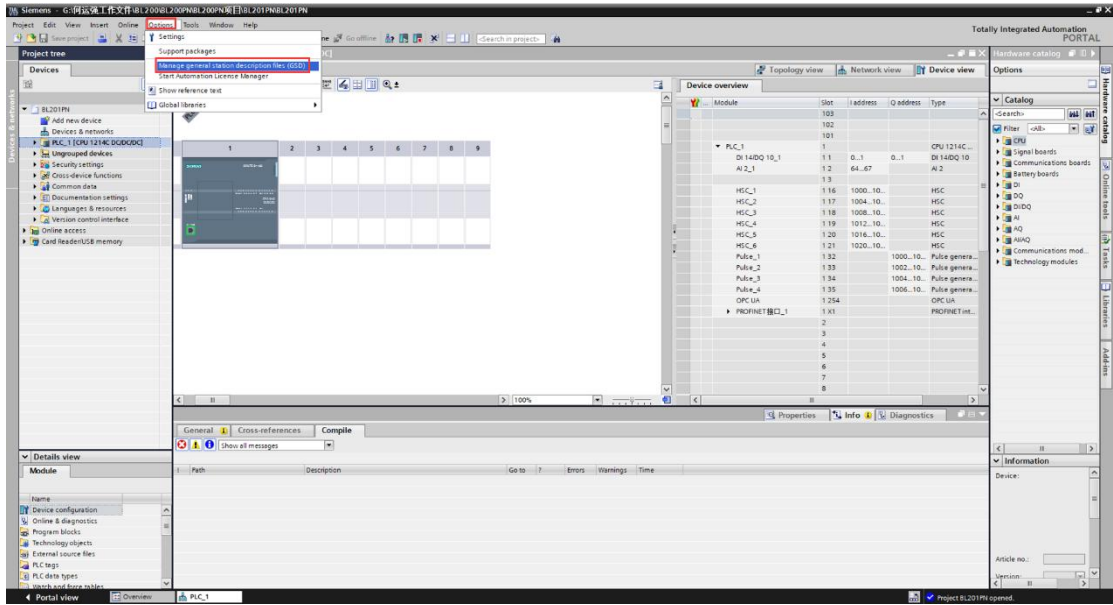
2. BL201, S7-1200, and PC need to be in the same LAN. Power on BL201 and S7-1200, open Siemens TIA V13 software, and create a new project "BL201".

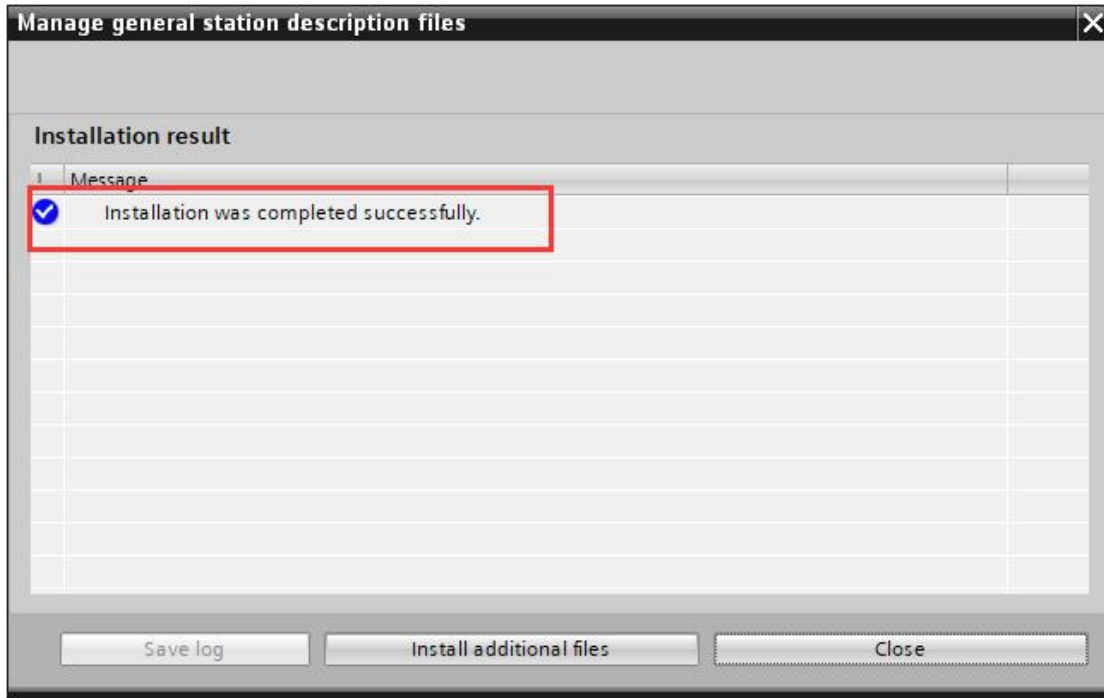


3. Click Devices and Network, click Add New Device, select the controller, select the corresponding CPU of S7-1200, and click Add.

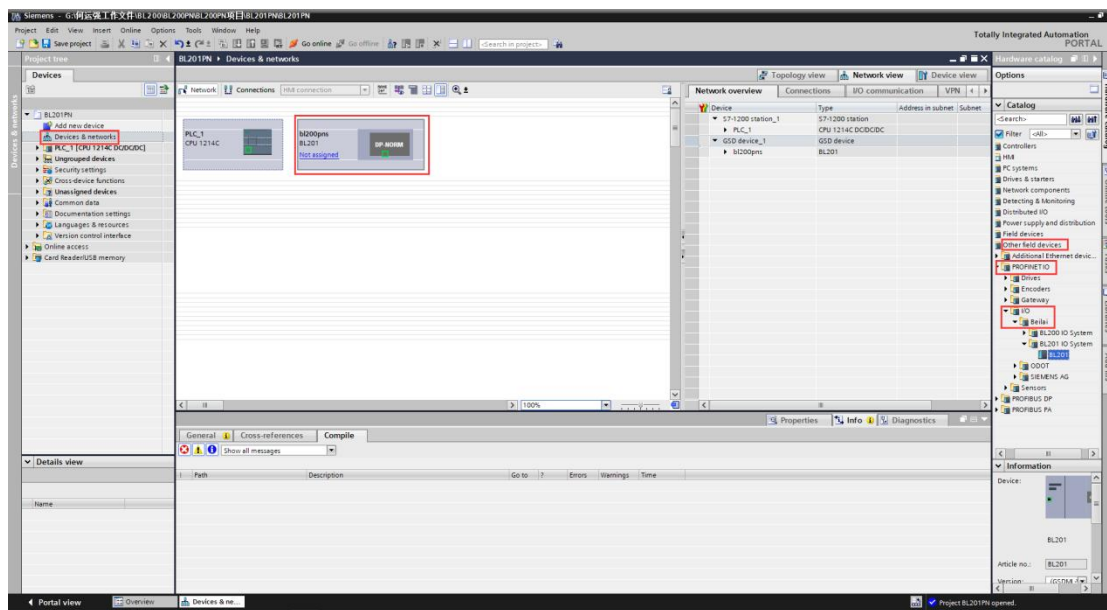


4. Click "Options" - "Manage General Station Description File GSD", in the pop-up interface, click "Source Path", search for the target folder where the GSD file is stored in the source path, select the file, click "OK", and select the GSD file, click Install, after the installation is complete, the hardware catalog will be updated automatically.

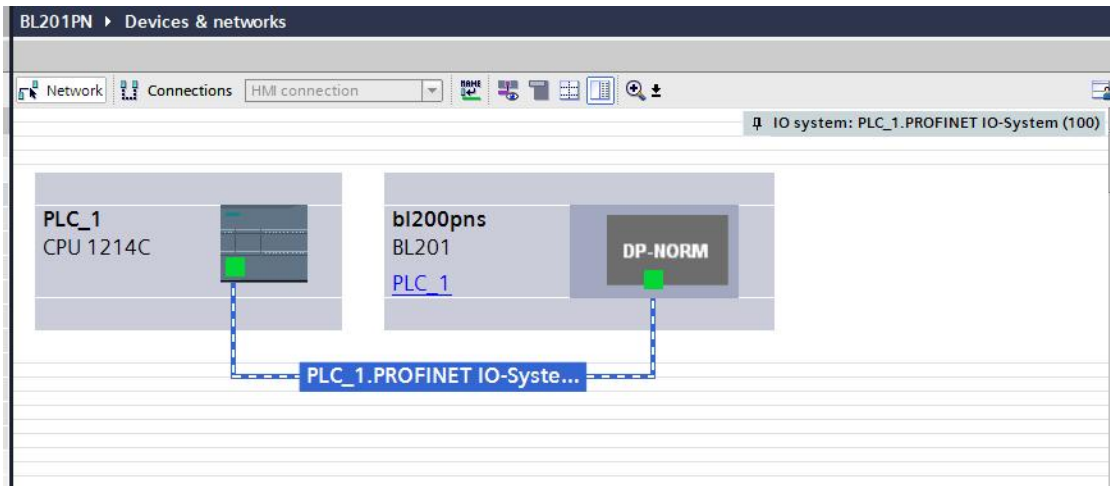
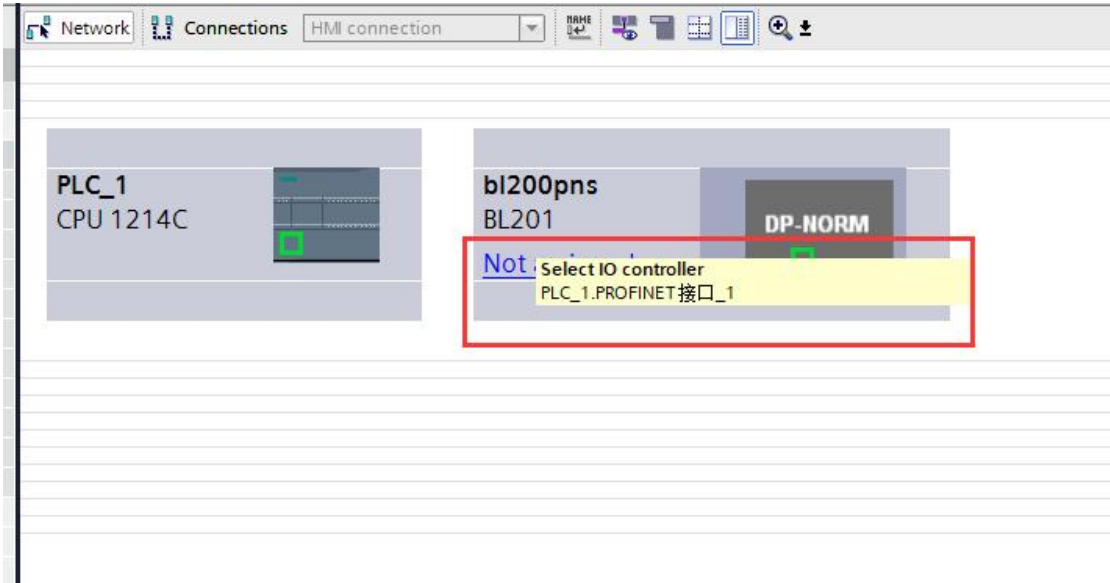




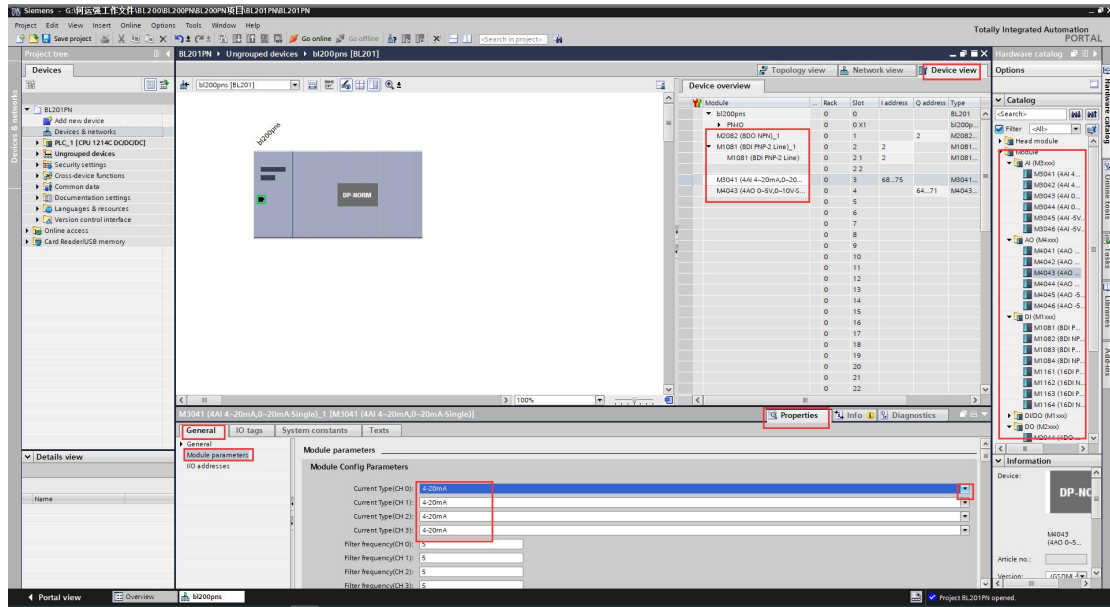
5. Double-click "Device and Network", in the right directory of the network view, find the product model of the GSD file installed above, the path is as shown in the figure (Other field devices->PROFINETIO->I/O->Beilai->BL200 IO System->BL201), drag or double-click BL201 to "Network View".



6. In "Network View", click "Unassigned (blue font)" on the BL201 coupler and select "PLC_1.PROFINET interface_1".

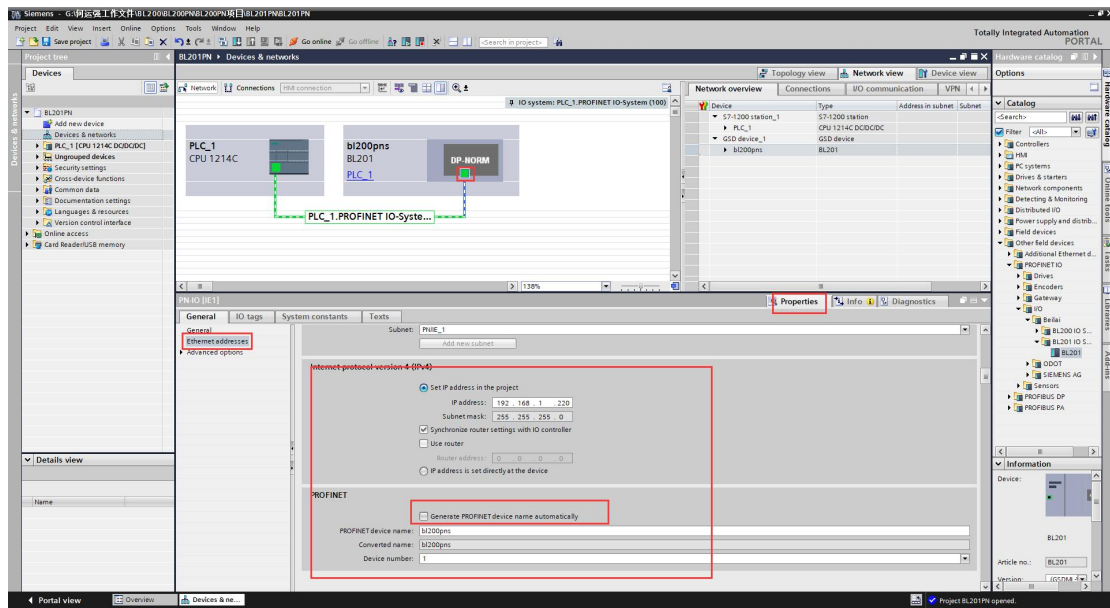


7. Double-click the coupler icon to enter the "Device View", add an extended I/O module in the "Device Overview", find the corresponding I/O module under the right directory - module, double-click the icon, the order of the modules should be in accordance with the order of the I/O modules connect with the BL201, the power module , extended power supply module, and terminal module do not need to be configured, and do not participate in the sorting.

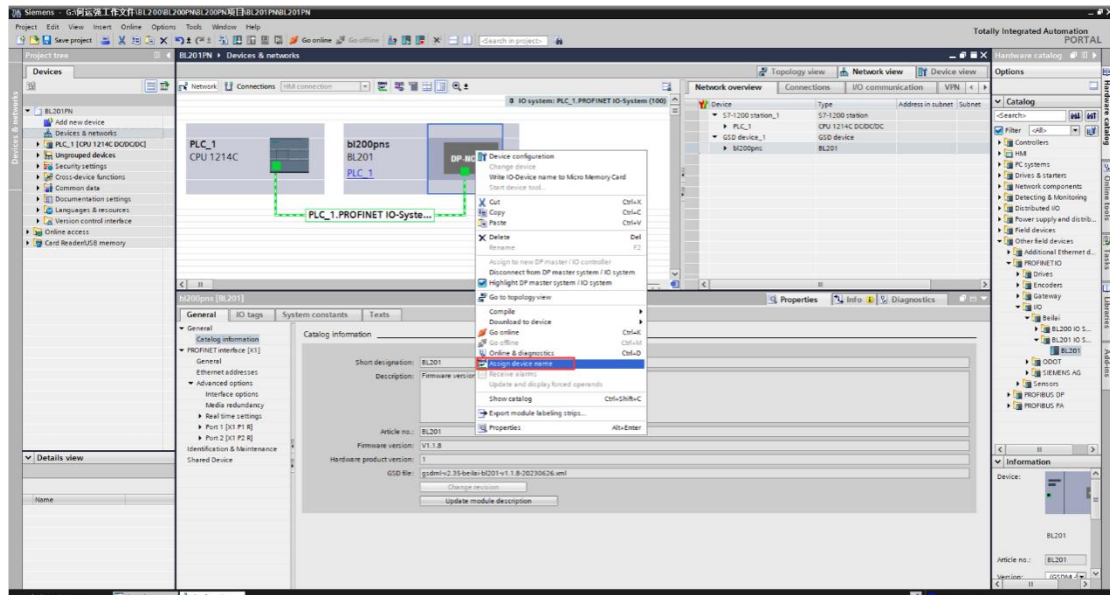


8. Click the network port of the coupler, click Properties, select the Ethernet address, and modify the Ethernet parameters of the coupler. The IP address must be in the same network segment as the S7-1200, and the PROFINET device name of the coupler is "bl201s".

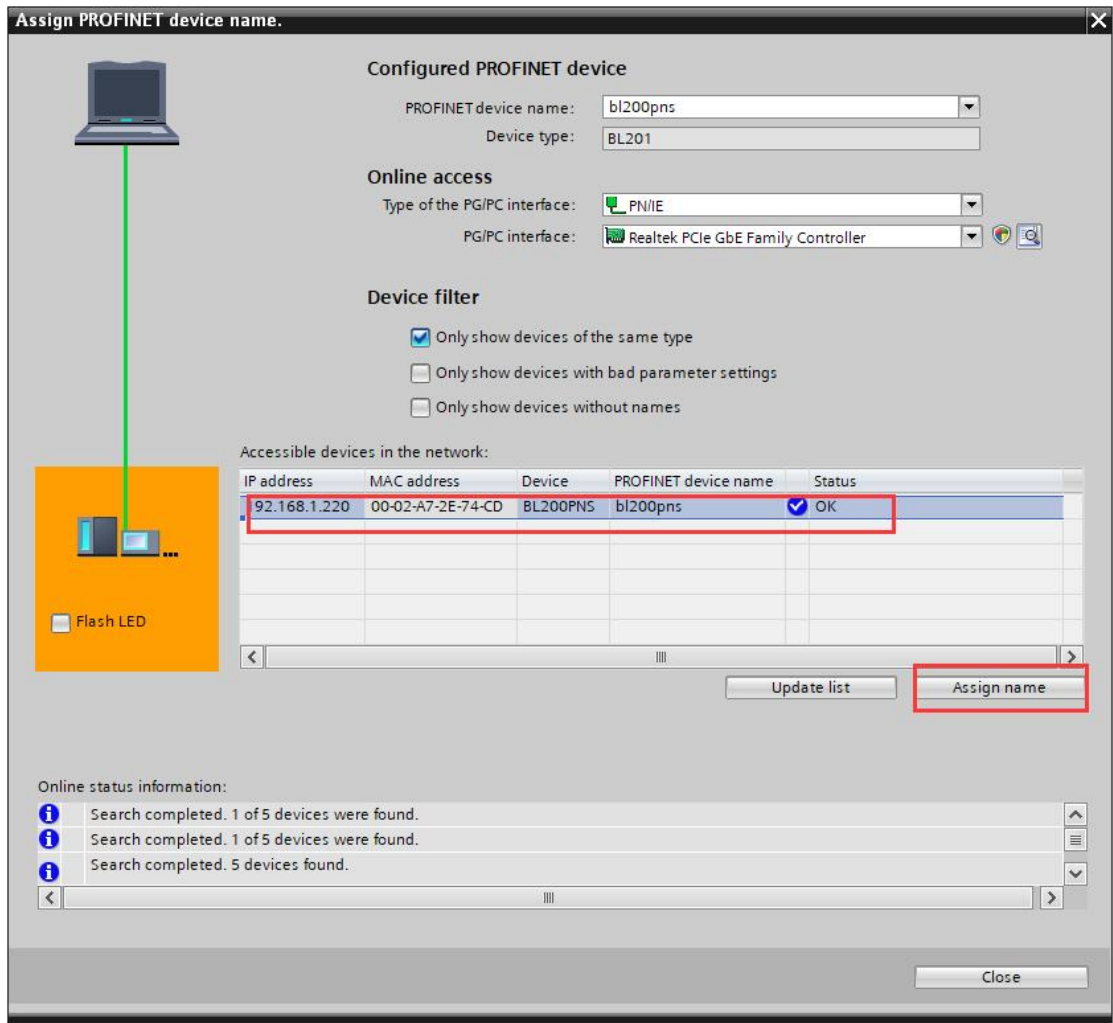
Note: Remove the "√" in front of "Generate PROFINET device name automatically".



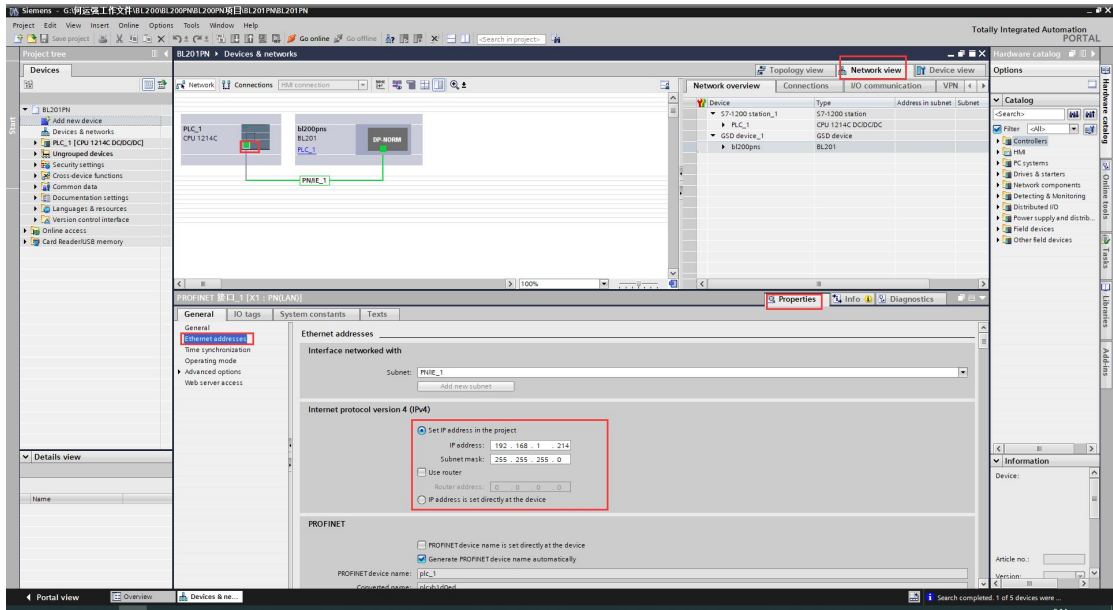
The default name of the BL201 coupler is "bl201s". If it is not filled with this name, click on the coupler and right-click to select the assigned name.



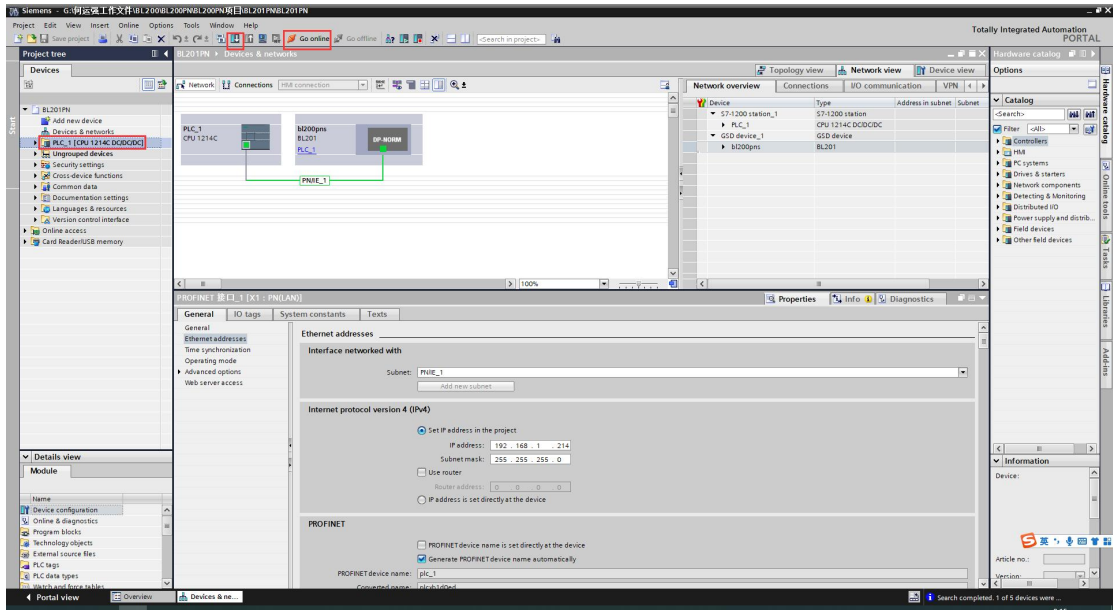
Click the drop-down menu behind "PROFINET device name", select the name of the device that has been allocated before, select "PN/IE" for "PG/PC interface type"; select your own network device for "PG/PC interface"; click " Update the list" and wait for the prompt "Search is complete. Select BL201 coupler, click "Assign Device Name" below to complete the assignment of the coupler name, and click "Close" to close the page.

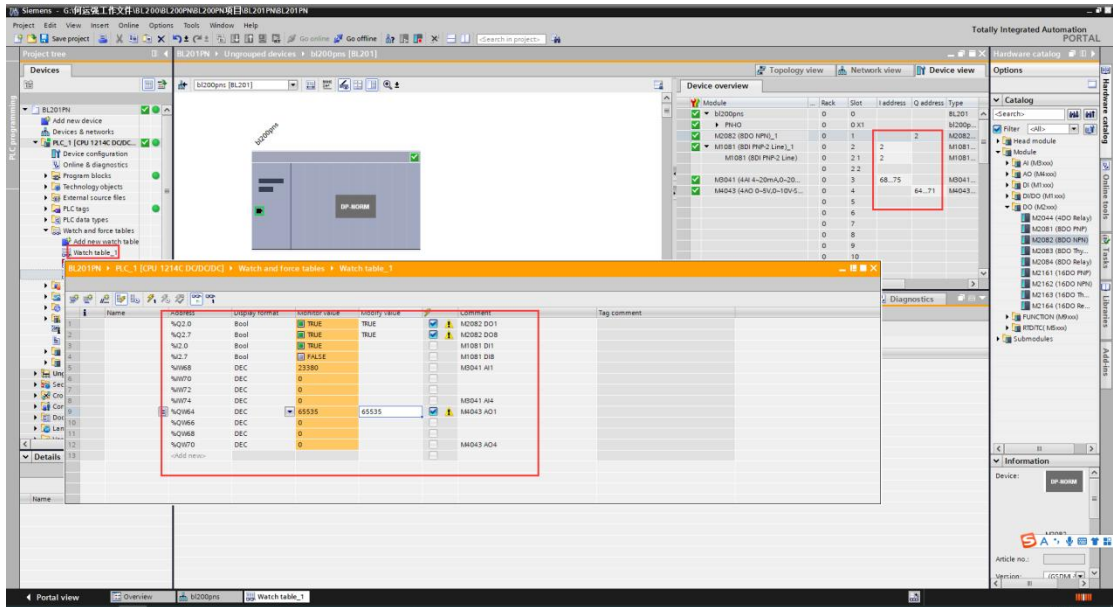


9. In the network view, select the S7-1200 PLC network port, click Properties, select the Ethernet address, and set the network port parameters.



10. The hardware configuration is completed, save, compile, and download. Click "Go Online". At the same time, a new monitoring table can be added, and the on-site I/O value can be monitored online on the monitoring table.





Refer to 5.4 Process Data Definition. When the range is 4-20mA, the theoretical value input of AI fourth channel IW74 is: $23333/65535*16+4=9.69662\text{mA}$. When the range is 0-5V, the first QW64 output of AO is: $65535/65535*5=5\text{V}$.

7 Warranty

- 1) This equipment will be repaired free of charge for any material or quality problems within one year from the date of purchase.
- 2) This one-year warranty does not cover any product failure caused by man-made damage, improper operation, etc.

8 Technical Support

Shenzhen Beilai Technology Co., Ltd
 Website: <https://www.bliiot.com>