Edge I/O System

BL200 Series product

Modbus / MQTT / OPC UA / Profinet / EtherCAT/ BACnet

BL200 User Manual

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Shenzhen BeiLai Technology Co.,Ltd.

Website: www.bliiot.com

Foreword

Thank you for using the Edge I/O system of Shenzhen BeiLai Technology Co., Ltd. Reading this product manual will allow you to quickly understand the function and usage of this product.

Copyright

Disclaimer

This product is mainly used for industrial field automation control, and the operator must be an experienced electrical expert in the field of automation or electrical. Please use it in accordance with the parameters and technical specifications provided in the manual. The company will not be responsible for property or personal injury caused by abnormal use or improper use of this product.

Revision History

Revision Date	Version	Description	Owner
Oct 12, 2021	V1.0	Initial Release	HYQ

Content

1. Product Introduction

1.1 Overview

BL200 series product is **Edge I/O System for data acquisition and industrial control.**
The system consists of two parts : **Edge I/O controller and distributed I/O modules group**. Various types I/O modules are **optional**, for example digital, analog and others particular use. The Edge I/O controller supports **various Fieldbus protocols** such as Modbus, MQTT, OPC UA, Profinet, EtherCAT, BACnet etc.

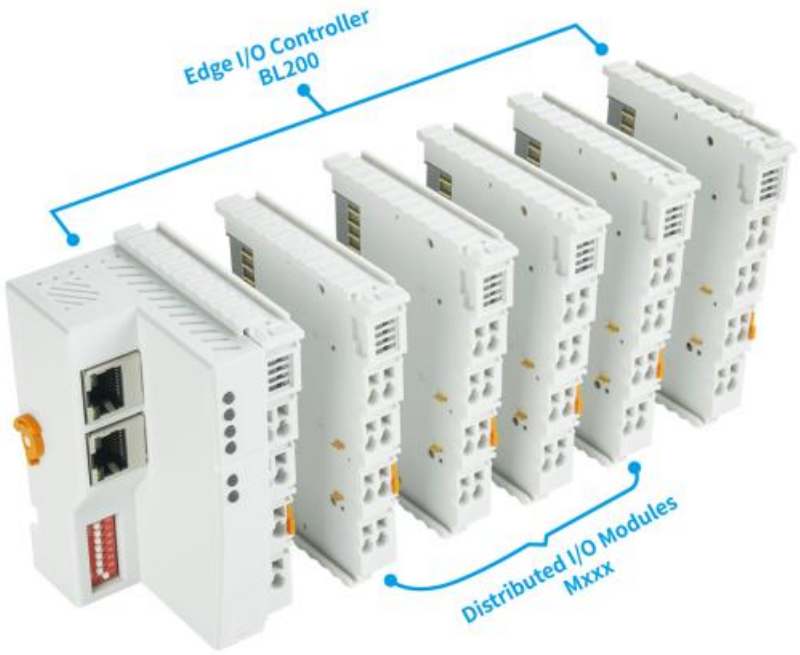


Figure 1：Edge I/O system

The Edge I/O system is design based on powerful microprocessor 32-bit ARM926EJ-S™ and uses Linux operating system. **It can quickly access to industrial field device and software (such as PLC, MES, SCADA and ERP systems), but also able connect to various cloud platforms (AWS IoT Cloud, Thingsboard, Ignition, Huawei Cloud, and Alibaba Cloud).**
It supports programmable logic control, edge computing, customization applications, very suitable for IIoT and industrial automation.
In addition, the device also provides SDK, allowing users to carry out secondary development to meet the needs of the fragmented applications in niche market.

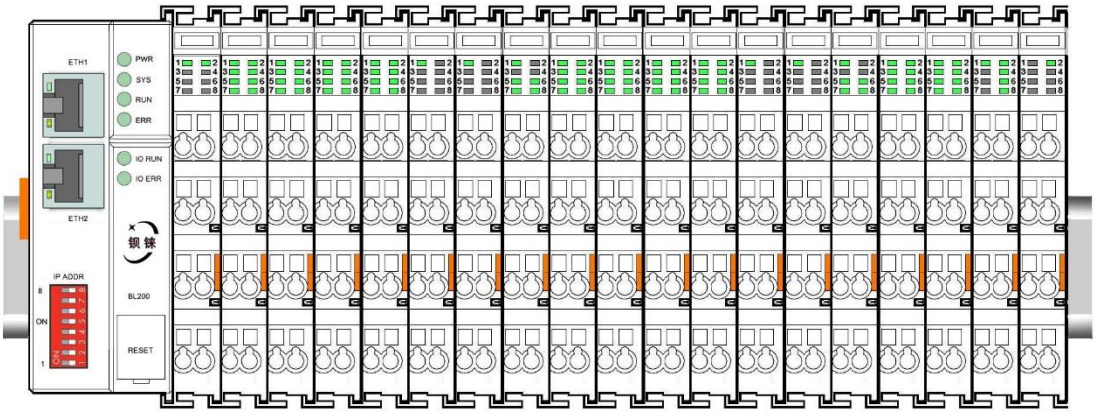


Figure 1：Fieldbus Node --- Edge I/O system

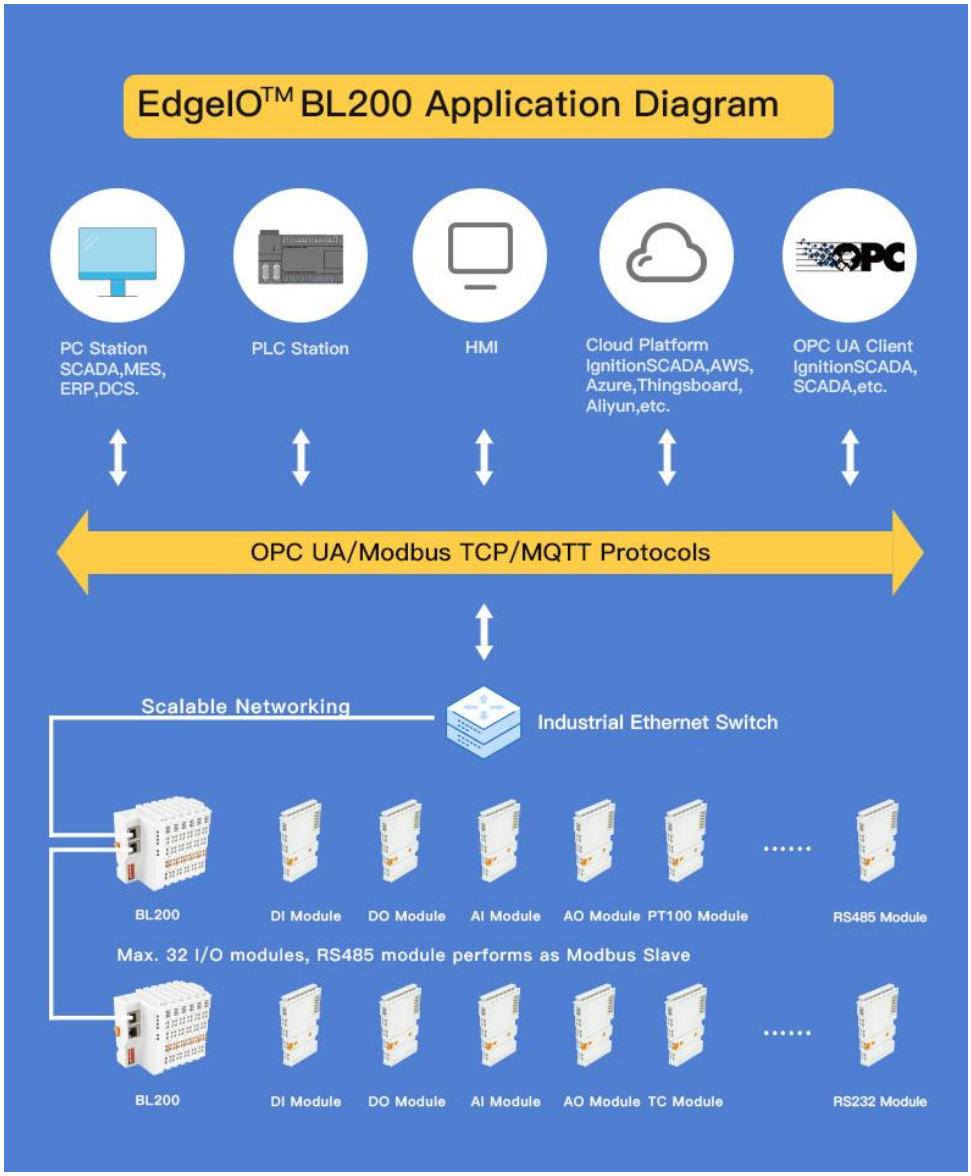
In the industrial field communication, the edge I/O system is considered as a Fieldbus node. The communication between the node and field devices (eg PLC) is through the Ethernet port of Edge I/O controller. The communication between the edge controller and the I/O modules is via the board bus locally insides device.
The two RJ45 Ethernet ports of the BL200 have integrate the switch function inside, which can establish a linear topology without the need for additional switches or hubs.
Two sets of independent power supplies are used to supply 24V DC to the edge controller and I/O modules group respectively, therefore they are electrically isolated from each other.

When people assemble I/O modules, each I/O module can be arranged in any sequence combination. it is not required to be grouped by module type. However, a terminal module (identified as TERM) must be inserted at the end so as to ensure data transfer properly.
People can configure BL200 parameters through web browser for testing the device.

1.2 Typical application

BL200 is **especially suitable for distributed application scenarios,** because BL200 can be cascaded with each other through Ethernet cables. various I/O modules can be distributed on different floors of different buildings in different locations according to user needs.

The whole system has the characteristics of easy expansion, easy configuration, convenient network wiring and high reliability, can be widely used in
industrial automation/industry 4.0/smart factories,
smart building HVAC/smart parking lots/smart communities,
sewage treatment plants,
new energy power generation Factory (solar photovoltaic, wind power generation)



1.3 Features Highlight

- Up to 32pcs I/O modules can be supported, one by one to extend I/O module
- Support various Fieldbus protocols such as Modbus, MQTT, OPC UA, Profinet, EtherCAT, BACnet etc
- Build-in cloud driver, compatible with various cloud platforms (AWS IoT Core, Thingsboard, Ignition, Huawei Cloud, and Alibaba Cloud)
- Programmable logic control, Edge computing, SDK available too
- 2 x RJ45 allows cascading and bypass, save wire cost and wiring cost
- Modular, screw-free installation, easy wiring
- Cyber security + Data encryption protection
- Industrial field side, edge controller side and I/O modules side are electrically isolated from each other.

1.4 Technical parameter

Table 1：technical parameter

name	parameter	describe
Power supply to I/O controller	Input voltage(system):	24 VDC
	Input current(system):	Max. 500 mA@24VDC
	Power Efficiency	84%
	Internal bus voltage	5VDC
	controller consumption current	Max. 300mA@5VDC
	I/O consumption current	Max. 1700mA@5VDC
	Isolation protection	500 V system/supply
Power supply to I/O modules	Input voltage (field)	24 VDC
	Power supply current across 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）
I/O controller System	Operating system	Linux
	Processor	ARM926EJ-S
	CPU	300MHz
	RAM	64MB
	Flash	128MB
	Number of I/O modules	Max. 32
	Process mapping data points serial module(Modbus)	● Bool : 4096 ● 16 Bit : 2048 ● 32 Bit : 1024
	Protocols	Modbus TCP , MQTT , OPC UA , HTTP , BootP , DHCP , DNS , SNTP , SNMP
	Max. number of socket links	15 Modbus TCP
Field Wiring	Connection technology	CAGE CLAMP®
	wire cross-section	0.08 mm² ··· 2.5 mm², AWG 28 ··· 14
	Strip length	8 mm ··· 9 mm / 0.33 in
Working Environment	operation	0 ··· 55 °C
	storage	-40 ··· 70 °C
	Relative humidity	Max. 5%···95% without condensation
	Operating altitude	0 ··· 2000 m
	Protection type	IP20

Product Size	Width	48mm
	Length	100mm
	High	69mm
Material	color	Light grey
	Shell material	Polycarbonate, Nylon 6.6
	Fire load	1.239 MJ
	Weight	180 g
Mechanical	Mounting type	DIN-35 rail
Certification	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

1.5 Product Models Selection Table

Table 2：model selection

No.	Name	Model	Channel	Signal type
1	Digital Input Module	M1082	8	NPN
2	Digital Input Module	M1081	8	PNP
3	Digital Output Module	M2082	8	NPN
4	Digital Output Module	M2081	8	PNP
5	Analog Input Module	M3041	4	Current
6	Analog Output Module	M4043	4	Voltage
7	RTD Input Module	M5041	4	Resistor
8	Serial port Interface Module	M6021	2	RS485
9	24V Power Supply Module	M701	/	/
10	Terminal Module	M801	/	/
11	Modbus-TCP I/O controller	BL200	/	/
12	OPC UA I/O controller	BL200UA	/	/
13	MQTT I/O controller	BL200M	/	/
14	Multiprotocol I/O controller	BL200Pro	/	/
15	Profinet I/O controller	BL200PN	/	/
16	Ethernet/IP I/O controller	BL200EP	/	/
17	EtherCAT I/O controller	BL200EC	/	/
18	BACnet/IP I/O controller	BL200BN	/	/

2. Device description

2.1 View

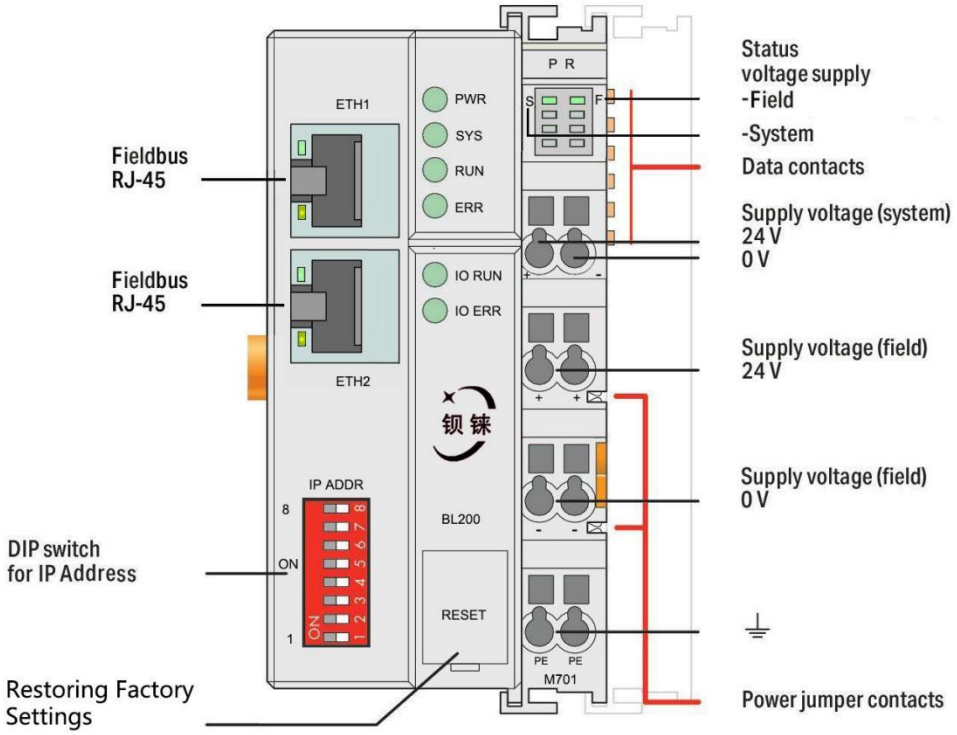


Figure 2：view

2.2 Dimensions

Unit: mm

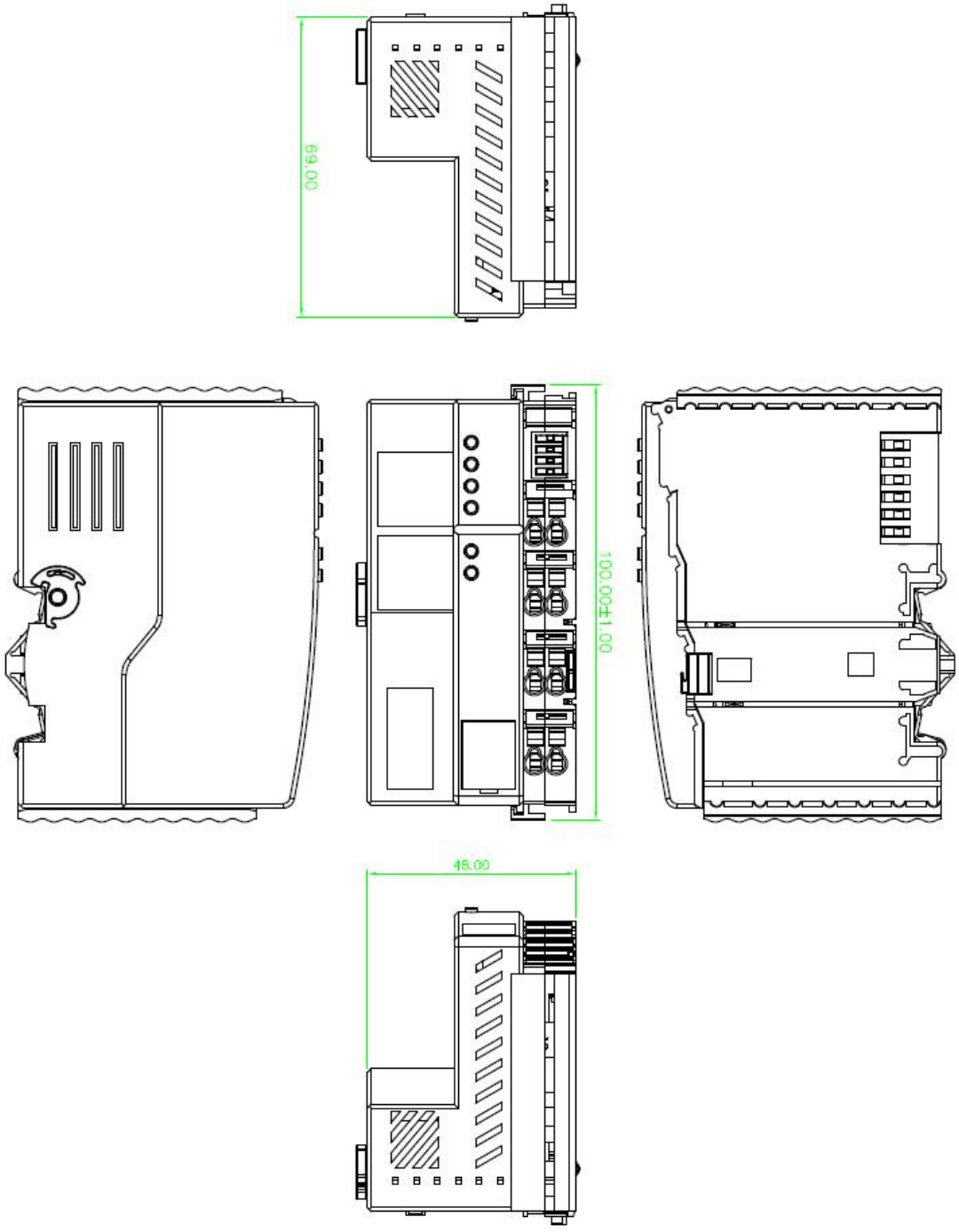


Figure 3: 2D schematic

2.3 Data Contacts/Local Bus

Communication between the fieldbus controller/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the local bus. The contacting for the local bus consists of 6 data contacts, which are available as self-cleaning gold spring contacts.

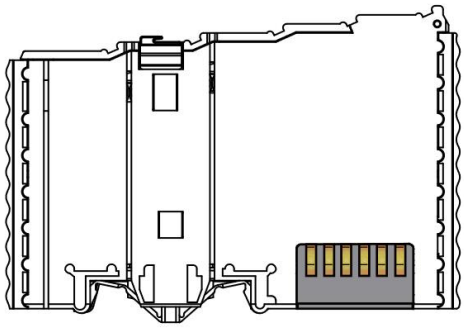


Figure 4：data contacts

2.4 Power Jumper Contacts

The power module that comes with the controller has two self-cleaning power jumper contacts to power the field side. The maximum current of this power supply across the contacts is 10A, exceeding the maximum current will damage the contacts. When configuring the system, make sure that the above current maximum value is not exceeded. If it exceeds, a power supply module must be inserted.

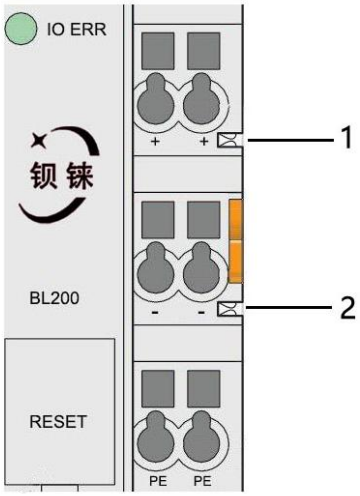


Figure 5： power jumper contacts

Tabel 3： *"power jumper contacts"describe*

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

2.5 Terminal Point

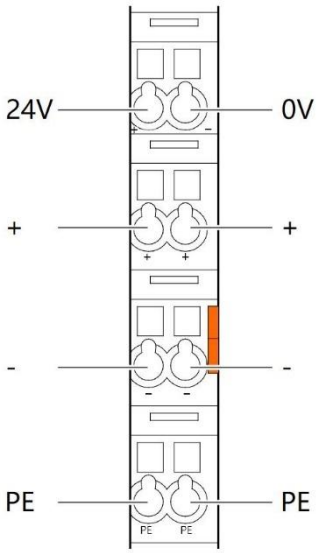


Figure 6：terminal point

Tabel 4： *"terminal point"* *describe*

Name	Describe
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 LED Indicators

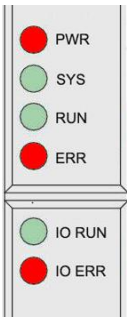


Figure 7：controller LED Indicators

Tabel 5：“controller LED Indicators” describe

LED	Describe	Color	Status	Meaning
PWR	Power indicator	red	Stay on	Normal power supply
			Off	No power
SYS	System indicator	green	Stay 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	Stay on	Northbound protocol connection error
			Off	No errors
I/O RUN	I/O Running indicator	green	Flashing	IO module is operating normally
			Off	No node inserted
I/O ERR	I/O Error indicator	red	Stay on	IO module communication error
			Off	No errors

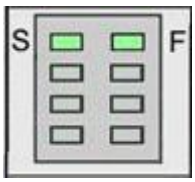


Figure 8：Power Module LED Indicators

Tabel 6：“Power Module LED Indicators” describe

LED	Describe	Color	Status	Meaning
S	System 24V power indicator	green	Stay on	Power is OK
			Off	No power
F	Field 24V power indicator	green	Stay on	Power is OK
			Off	No power

2.7 Ethernet interface

Description: It is connected to the Ethernet-based fieldbus through the ETH2 interface, and the EHT1 is used to connect other nodes that need to be connected to the Ethernet.

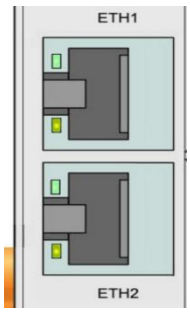


Figure 9：Ethernet interface

2.8 IP address selector switch

The 8-bit DIP switch is used to set the IP address. The encoding of DIP switches is done bit by bit, starting from DIP switch 1 with the least significant bit (2^0) to DIP switch 8 with the most significant bit (2^7), corresponding to decimal values: 0-255.

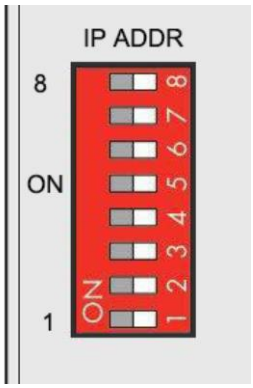


Figure 10：IP address selector switch（eg：set "0"）

When the value of the DIP switch is 1111 1111 (decimal 255), the IP address is set according to the web page. The web page setting can specify the IP or set the automatic acquisition. When the web page is not set, the IP address is: 192.168.1.10.

When the value of the DIP switch is 0000 0000 – 1111 1110 (decimal 0-254), determine the 3rd byte of the IP address, and the 1st, 2nd and 4th bytes are fixed bytes, namely 192.168.xxx.253.

2.9 Factory reset button

This button is used to restore the device configuration parameters to the factory state.

How to operate:

1. When the device is in normal operation, open the flip cover;
2. Press and hold for more than 5 seconds, until all the LED lights go out, indicating that the operation is successful, and then the device will automatically restart.

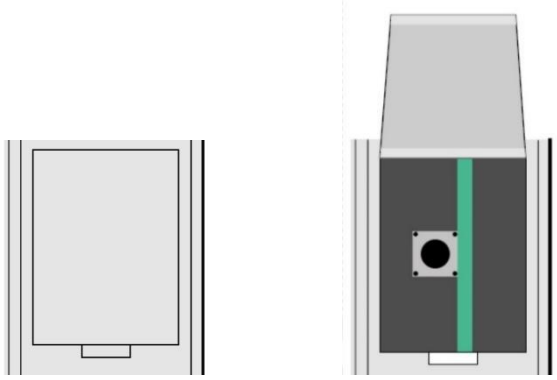


Figure 11：factory reset button

2.10 Electrical schematic

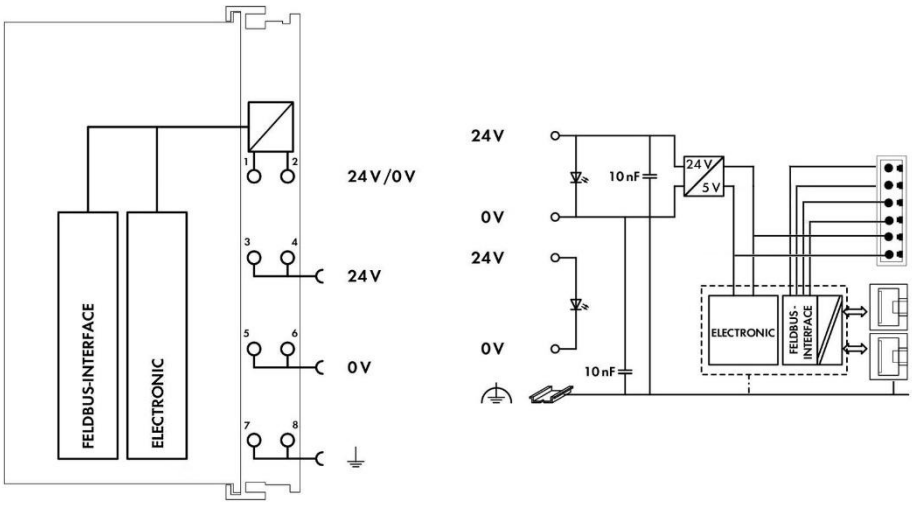


Figure 12：schematic block diagram

3. Product Installation

3.1 Installation sequence

All fieldbus controller and I/O modules must be mounted on standard DIN 35 rails.

Starting with the fieldbus controller, the bus I/O modules are assembled from left to right, with the modules mounted next to each other. All I/O modules have grooves and power jumper contacts on the right side. To avoid assembly errors, the I/O modules must be

inserted from the right side and from the top to avoid damage to the module.

Utilize a reed and groove system for reliable assembly and connection. With the automatic locking function, the individual components are securely fastened to the rail after installation.

Don't forget to install the terminal module! Always insert a terminal module (e.g. TERM) at the end of the fieldbus node to ensure correct data transmission.

3.2 Install the controller

1. Snap the controller onto the DIN rail first
2. Then use a tool such as a screwdriver to turn the locking cam until the locking cam engages the DIN rail.

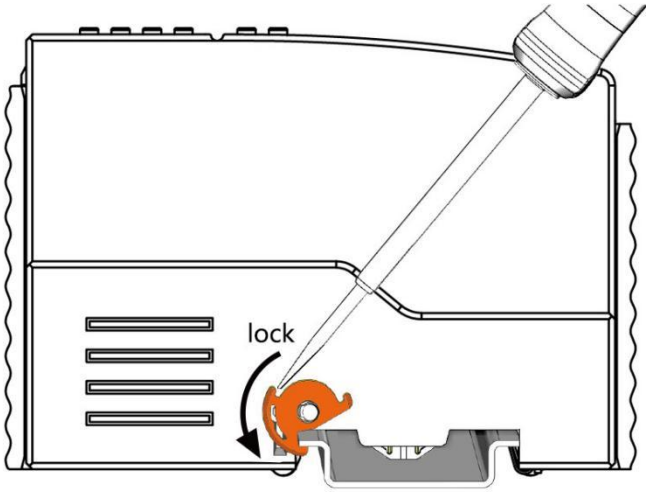


Figure 13：locking controller

3.3 Remove the controller

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

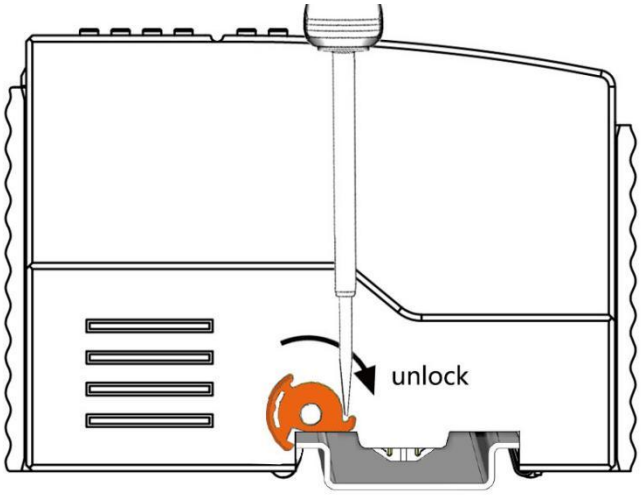


Figure 14：unlock the controller

2. Pull the release tab to remove the fieldbus controller from the assembly.

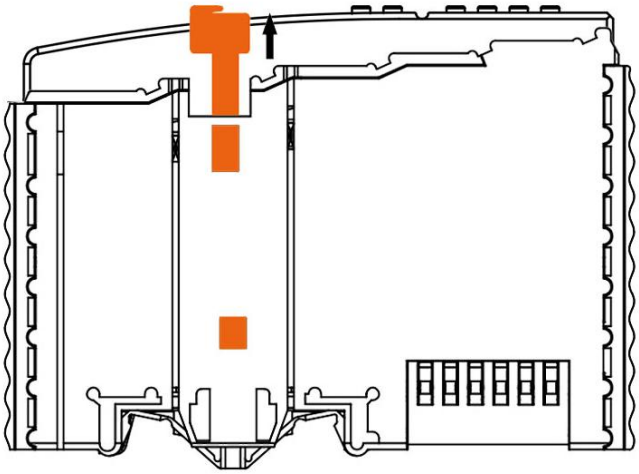


Figure 15：unlock the controller

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

3.4 Insert the I/O module

1 . When inserting the module, make sure the spring on the module aligns with the groove on the attached controller or other I/O module

Figure 16：align the groove (example)

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

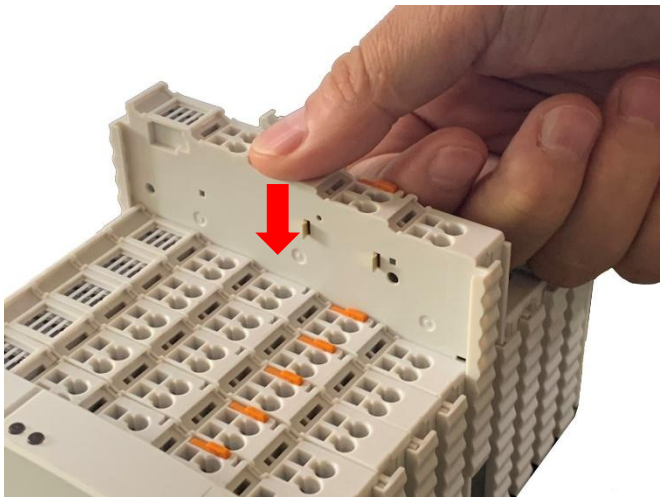


Figure 17：snap the I/O module into place (example)

Once the I/O module is installed, electrical connections to the fieldbus controller (or previous I/O module) and subsequent I/O modules are established through the data contacts and power jumper contacts.

3.5 Remove I/O module

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

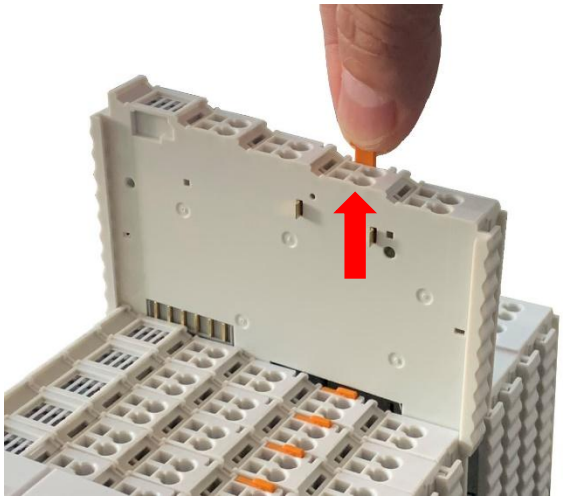


Figure 18：remove I/O module (example)

The electrical connection to the data or power jumper contacts is broken when the I/O module is removed.

4. Device Connection

4.1 Wiring

The CAGE CLAMP® connections are available for solid, stranded, and fine stranded wires. Only one wire can be connected to each CAGE CLAMP®, if there is more than one wire, it must be connected to a point.

- 1. Open the CAGE CLAMP® by first inserting the tool into the opening above the wiring.
- 2.Insert the wire into the corresponding connection opening.
- 3. For closing the CAGE CLAMP® simply remove the tool. The wire is now clamped firmly in place.

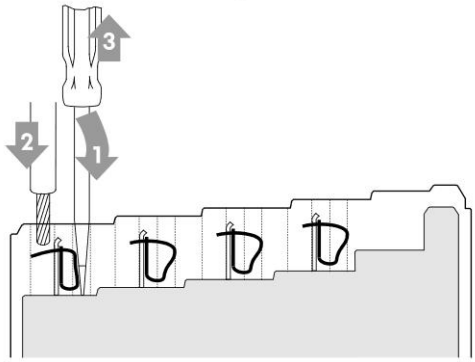


Figure 19：connecting wire

4.2 Supply Power

Both the controller and the I/O modules are powered by the power-supply module. The controller itself is fixed with a power-supply module, which supplies power to the controller and I/O modules. **When there are many I/O modules and the internal current is relatively large, it is necessary to add an independent power-supply module (model M701)**

The field bus side (Ethernet interface), the controller (system side) and the I/O modules (industrial field side) are electrically isolated from each other.

4.2.1 Power supply to Edge controller

The BL200 controller require a 24 V DC system power supply and are connected from the power-supply module's terminal block. The 5V bus voltage required by 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 and load power of the power-supply module to avoid the occurrence of excessive load current.

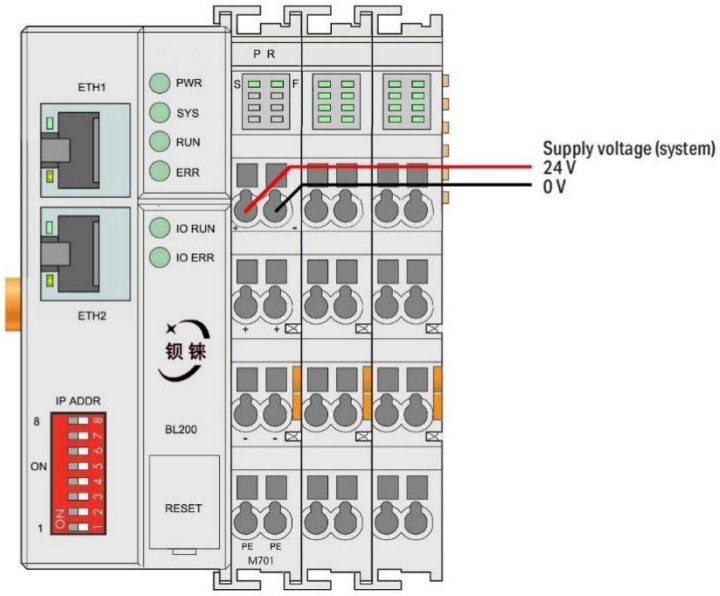


Figure 20：schematic diagram of connecting the system power supply

4.2.2 Power supply to I/O modules

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

Field power only has proper fuse protection. Without over-current protection, electronic

equipment can be damaged.

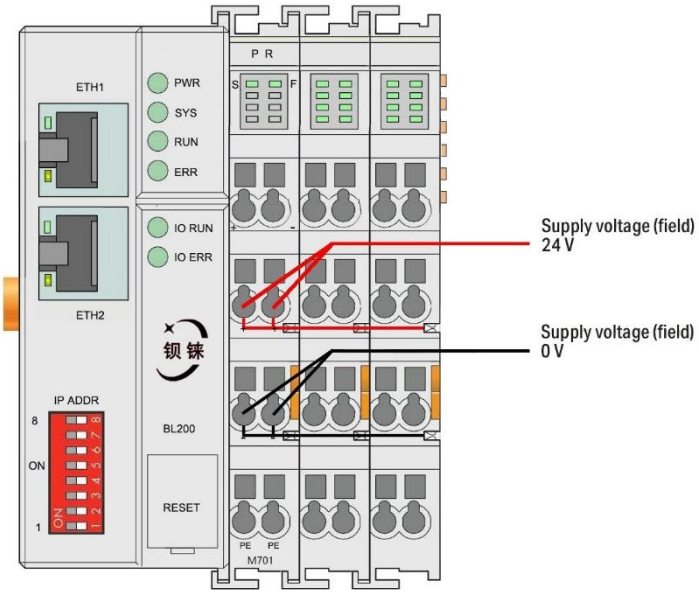


Figure 21：schematic diagram of connecting field power supply

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

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

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

4.2.3 Earthing

When installing a cabinet with an outer shell, the cabinet must be grounded. The rail must be connected to the cabinet using screws to ensure that the rail is properly grounded. Grounding increases resistance to electromagnetic interference. Some components in an I/O system have rail contacts that consume electromagnetic interference onto the rail.

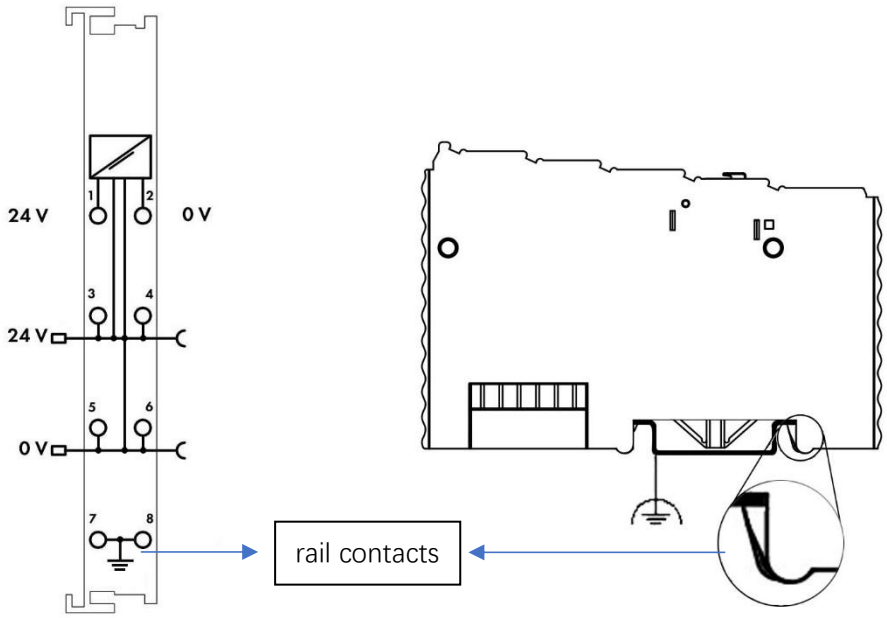


Figure 22：DIN rail contacts

4.3 Connect BL200 devices each other and to network

The BL200 controller have 2 x RJ45 Ethernet interfaces, integrated switch function inside, work in store-and-forward operation mode, each port supports 10/100 Mbit transmission speed and full-duplex and half-duplex transmission mode.

The BL200 controller connect to the router Ethernet network via ETH2 only, while the EHT 1 is for connecting other BL200 field nodes.

The internal integrated switch supports bypass mode, which can automatically start the bypass mode when the controller system fails, and automatically maintain the link between ETH 1 and EHT 2.

The wiring of these Ethernet interfaces conforms to the 100BaseTX specification, which specifies the use of category 5 twisted pair cable as the connecting cable. Cable types S/UTP (Screened unshielded twisted pair) and STP (shielded twisted pair) can be used up to a length of 100 m.

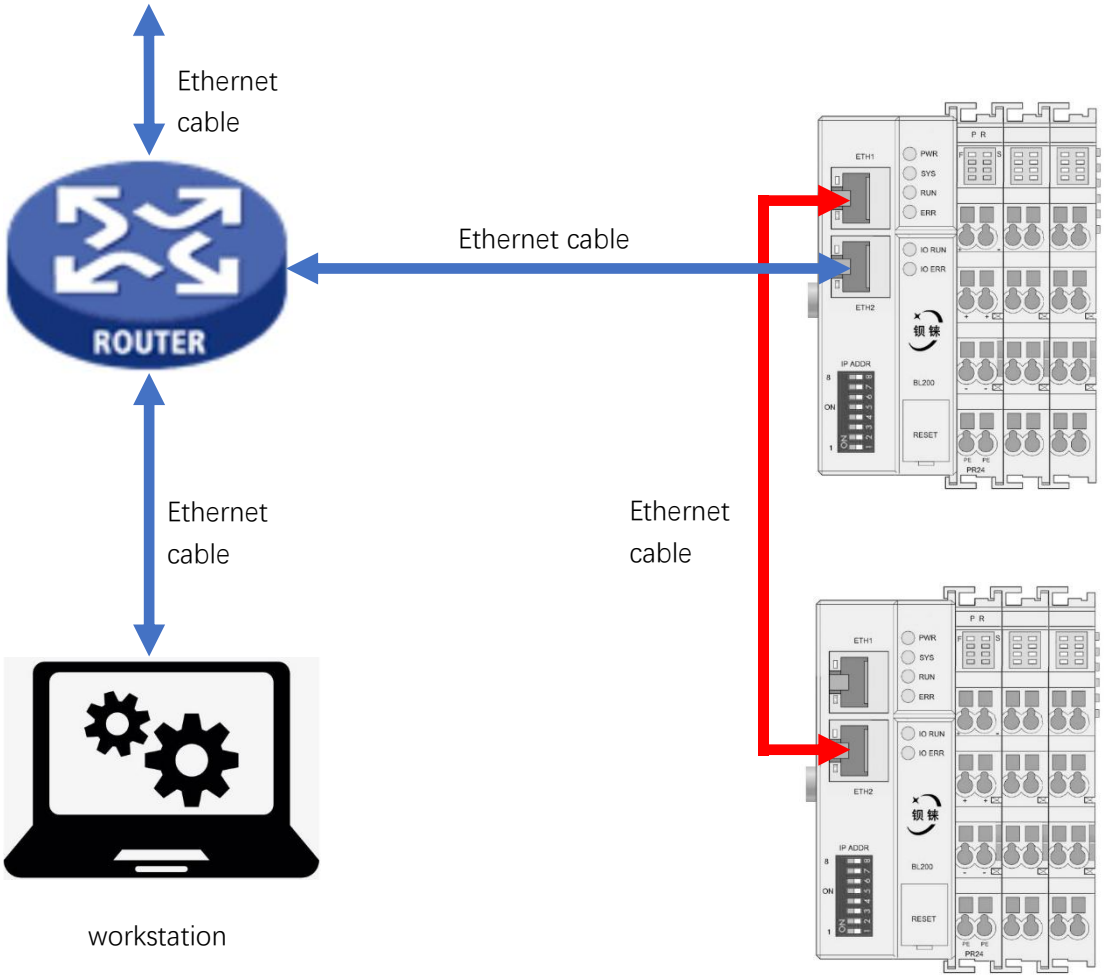


Figure 23：connect the BL200 to the network

It is also possible to connect BL200 directly to a computer via ETH2.

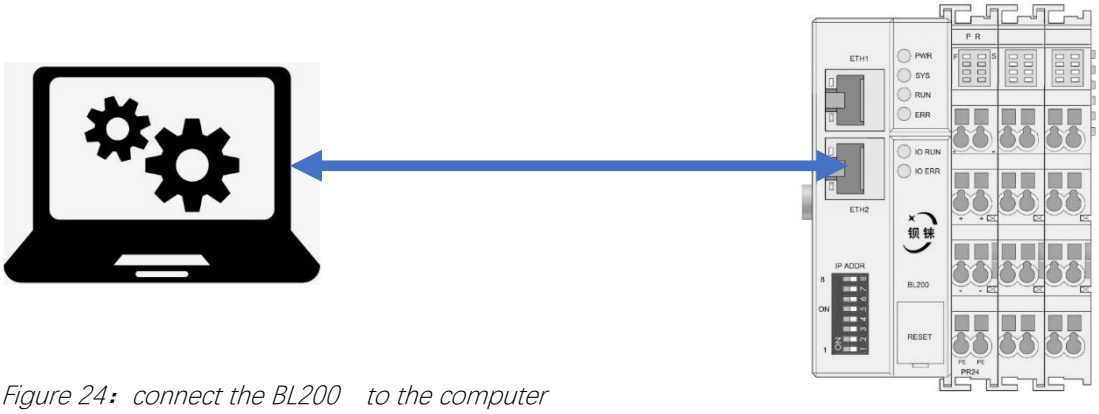


Figure 24：connect the BL200 to the computer

5. Web configuration

The BL200 controller's built-in web server is a browser-based configuration utility. When the node is connected to your network, you can enter the server's IP address in a web browser to access the web console.

5.1 Preparation before configuration

To successfully access the BL200 controller node, it must be properly installed and connected to the computer. In addition, configure them with correct IP addresses to keep them in the same network segment.

5.1.1 Connect computer and controller

1. Mount the fieldbus node on a DIN35 rail. Follow the installation instructions in the “Product Mounting” chapter.
2. Connect the 24 V power supply to the system power terminals.
3. The computer and the bus node can be connected in two ways, one is that the two are connected to the switch device of the local area network through the Ethernet interface; the other is that the two are directly connected point-to-point. For detailed steps, follow the instructions in the "Connection bus" chapter.
4. Turn on the power supply and start supplying power.

The controller is initialized after power-up, creates process image according to the I/O modules configuration of the fieldbus node.

5.1.2 Configure the computer IP address

On the PC, there are two ways to configure its IP address. One is to turn on the automatic IP address option on the PC's local connection to dynamically assign DHCP in the network. The other is to configure a static IP address with the controller node on the same network segment on the local connection of the PC.

The following takes Windows 7 system as an example for configuration. Windows systems are all configured similarly.

1. Click Start > Control Panel > Network and Sharing Center, and click local connection in the window that opens.

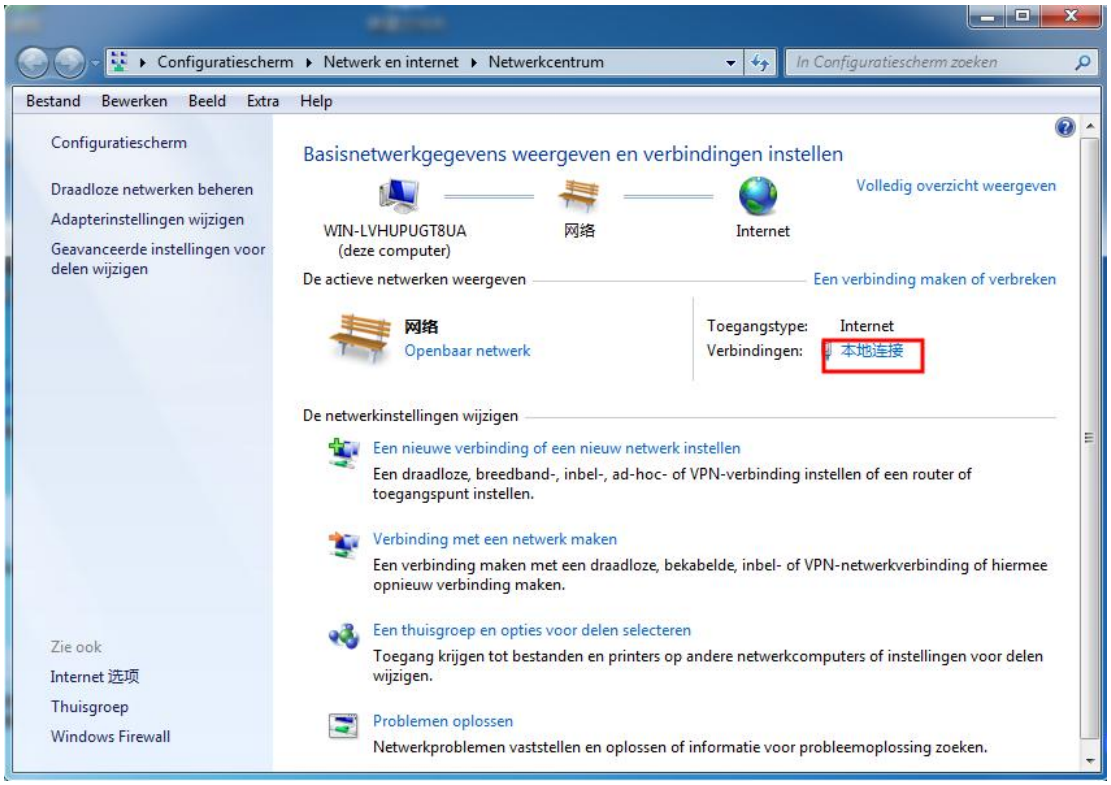


Figure 25：Network and Sharing Center

2. In the local connection status window, click Properties.

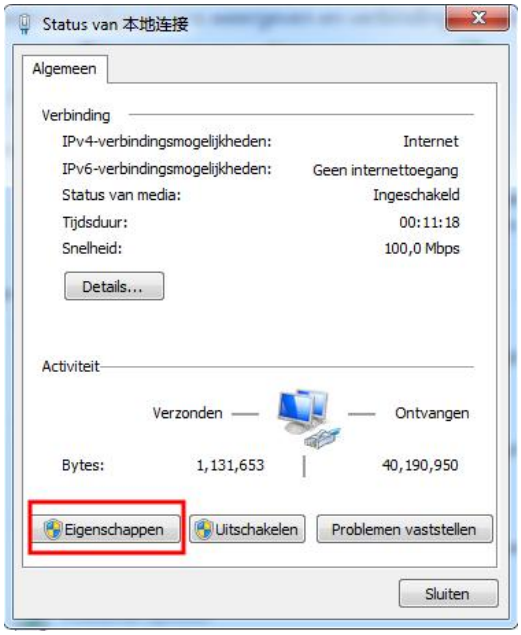


Figure 26：local connection status

3. Double-click "Internet Protocol Version 4 (TCP/IPv4)" on the local connection properties page.

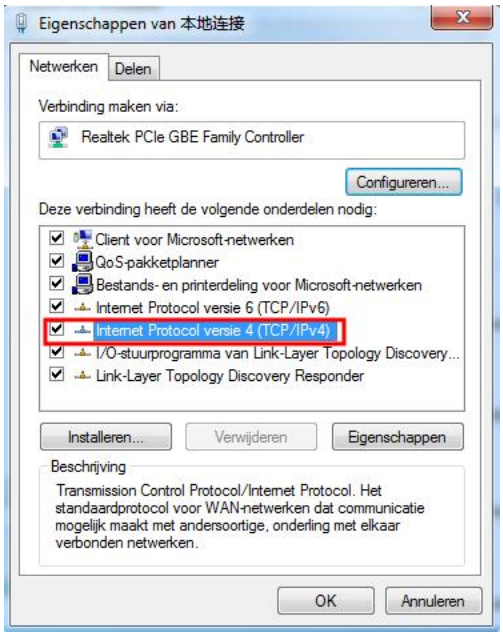


Figure 27：local connection properties

4. There are two ways to configure the IP address of the PC:

■ Obtain IP address automatically (system default mode)

To obtain an IP address automatically from a DHCP server, select "Obtain an IP address automatically";

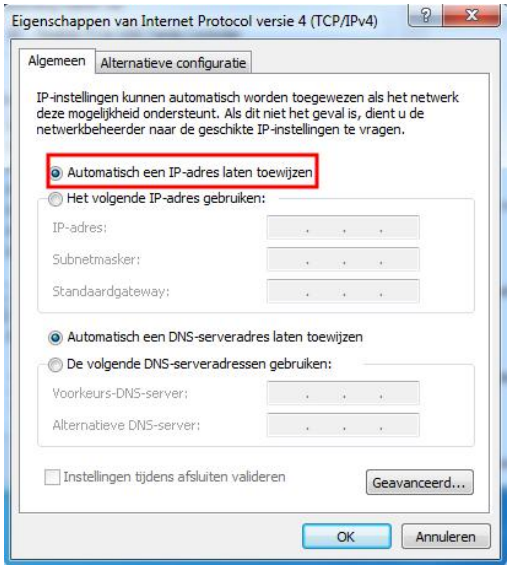


Figure 28：obtain an IP address automatically

- Set a static IP address
  Select "Use the following IP address" and set the correct values for the IP address, subnet mask and default gateway.

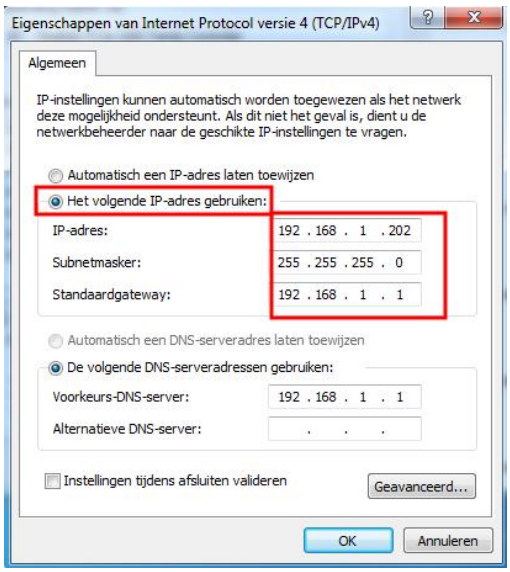


Figure 29：Set static IP

5.1.3 Configure the controller IP address

The controller has 2 ways to assign an IP address

- Assignment via built-in web page (static IP or automatic IP assignment)
- Assign via DIP switch (static IP)

DIP address selector switch definition

Tabel 7：DIP switch position definition

Switch position (ON = 1)	Value	Definition
0000 0000 --- 1111 1110	0-254	Enable the DIP selector switch assignment function and determine the value of the 3rd byte. Example: 0010 0110 (22 decimal), the IP address is "192.168.22.253".
1111 1111	255	Enable the function of specifying IP on the web page, or select the function of DHCP automatic allocation. When the IP is not allocated through the web, the IP is 192.168.1.10.

5.1.3.1 Configuration via web page

The fieldbus controller can be set to an IP address via the "Settings > Local Settings" page after entering the page, or it can be set to be assigned automatically. Select static address, if not set IP address, the IP is 192.168.1.10.

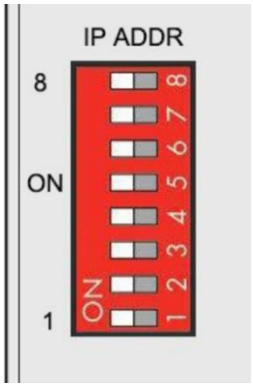


Figure 30：web page settings IP

5.1.3.2 Assign via DIP switch

Set the value of the DIP address selector switch to 0000 0000 - 1111 1110 (decimal 0 - 254), and the IP address will be assigned by the DIP switch.

The IP address consists of fixed bytes and variable bytes. The 1st, 2nd and 4th bytes are fixed bytes, the DIP selector switch determines the 3rd byte, namely: 192.168.xxx.253.

The fieldbus controller assigns an IP address via a DIP switch, and the IP address set in this way is static.

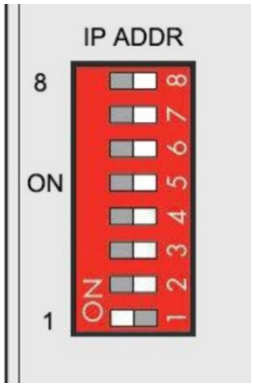


Figure 31：dip switch - assigned via dip selector switch (Example: 192.168.1.253)

5.1.4 Factory default settings

Before logging into the web configuration page, it is necessary for you to understand the following default parameters:
Modbus TCP Server Port: 502, Modbus ID: 1
IP: Determined according to the DIP switch, if the DIP switch is 1111 1111, the default IP is 192.168.1.10.

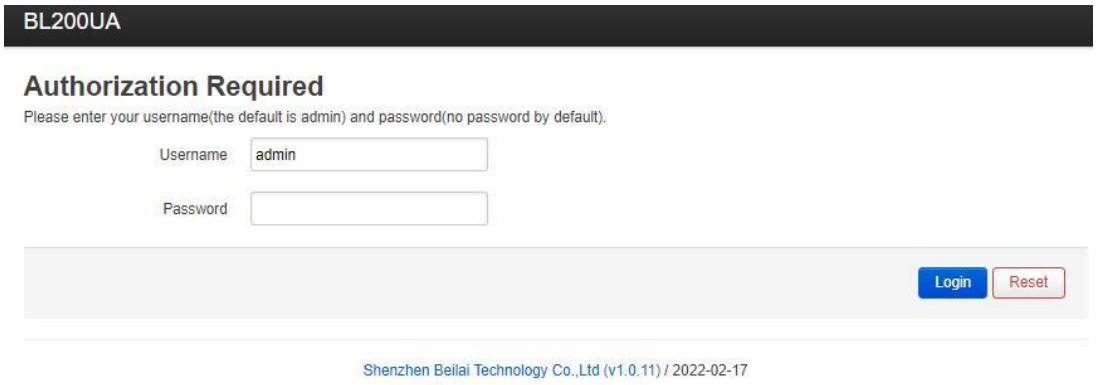
Tabel 8：factory default parameters

Project	Describe
username	admin
password	无

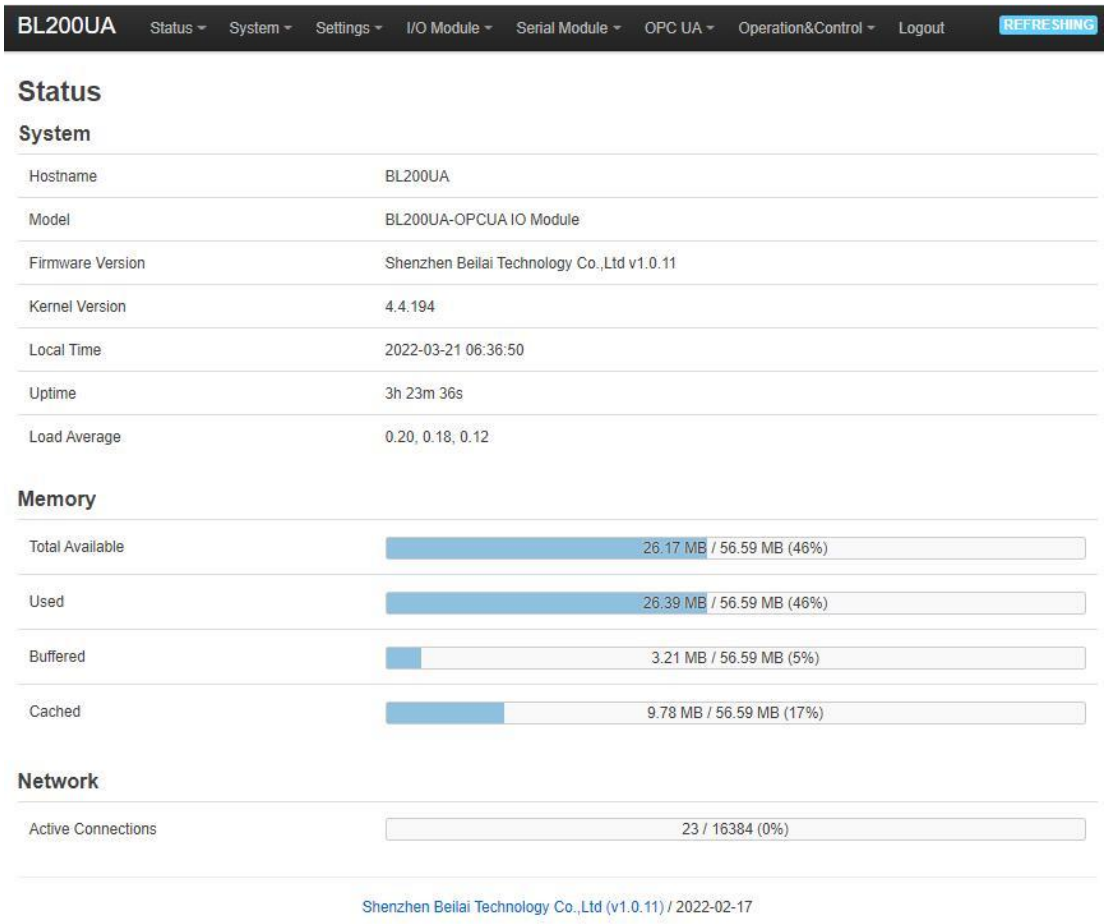
5.1.5 Login configuration page

1. Open a browser on your computer, such as IE, Chrome, Firefox, etc.
2. Enter the IP address of the controller node (192.168.1.10) in the address bar of the browser to enter the user login interface;

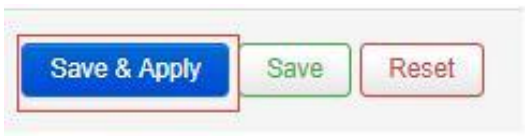
3. Enter "Username" and "Password" in the login interface, and then click Login.



4. After successfully logging in to the web interface, the display is as follows



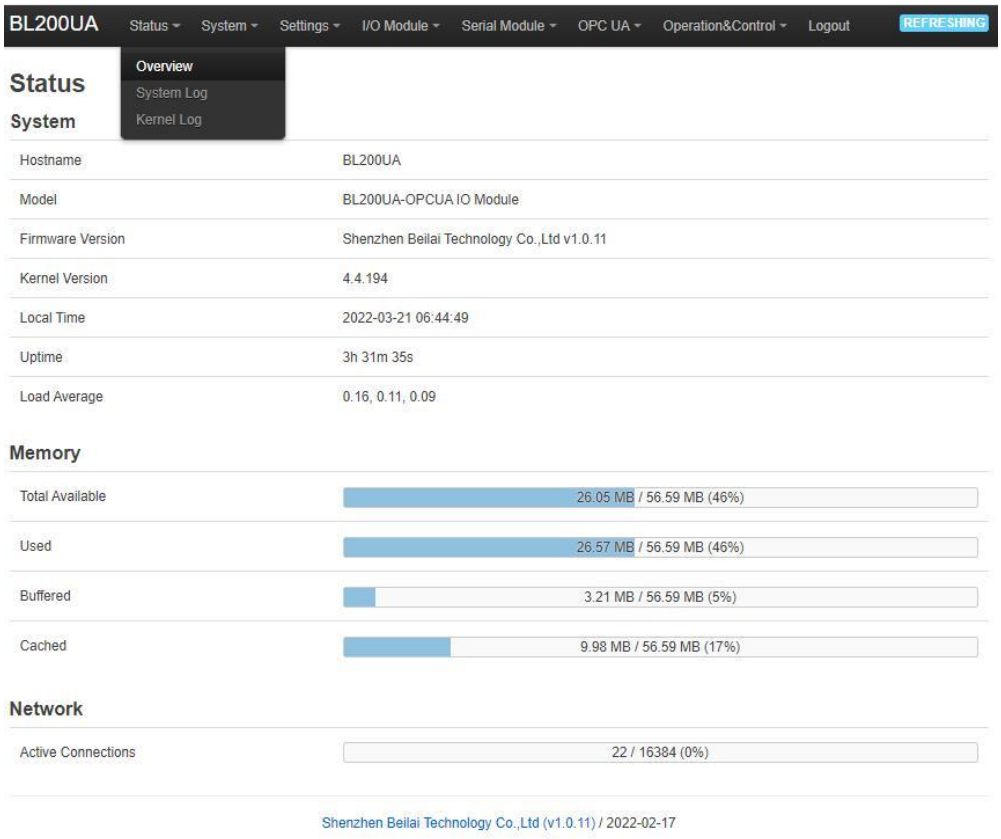
5. After configuring the parameters, you need to click the "Save and Apply" button on the page to take effect.



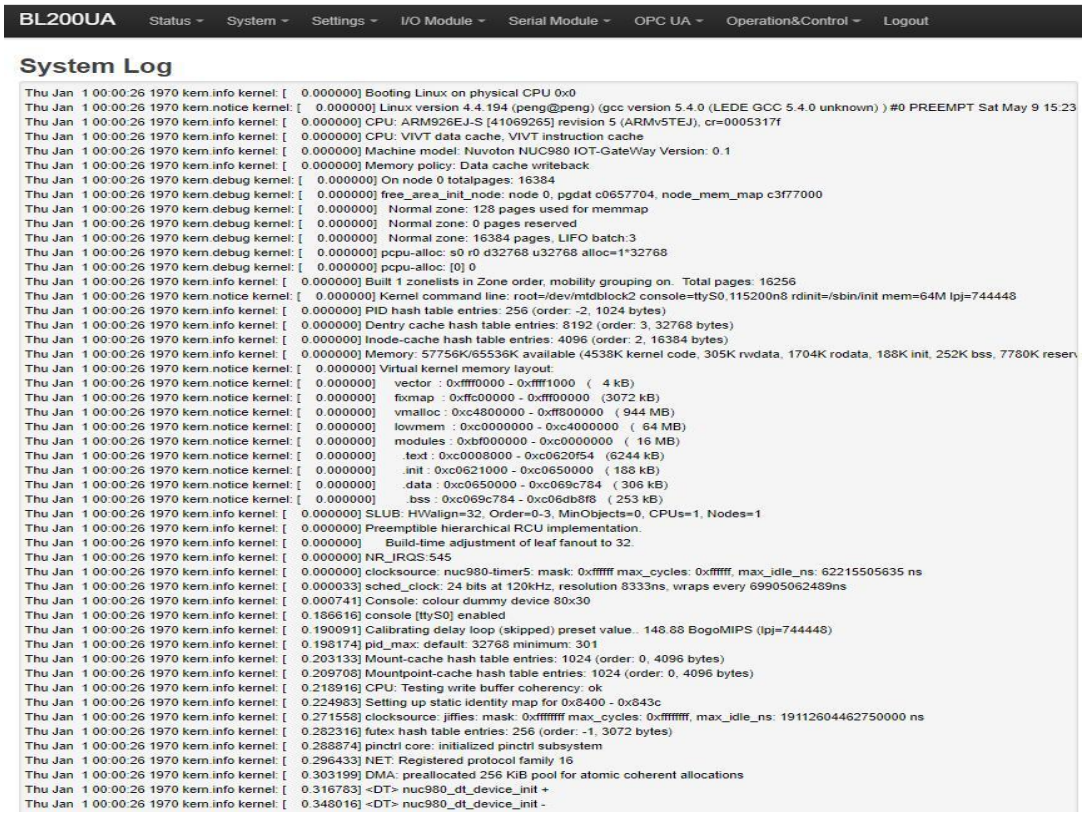
5.2Status

In the status menu, overview, system log and kernel log are provided, and you can view device parameters and device operating status.

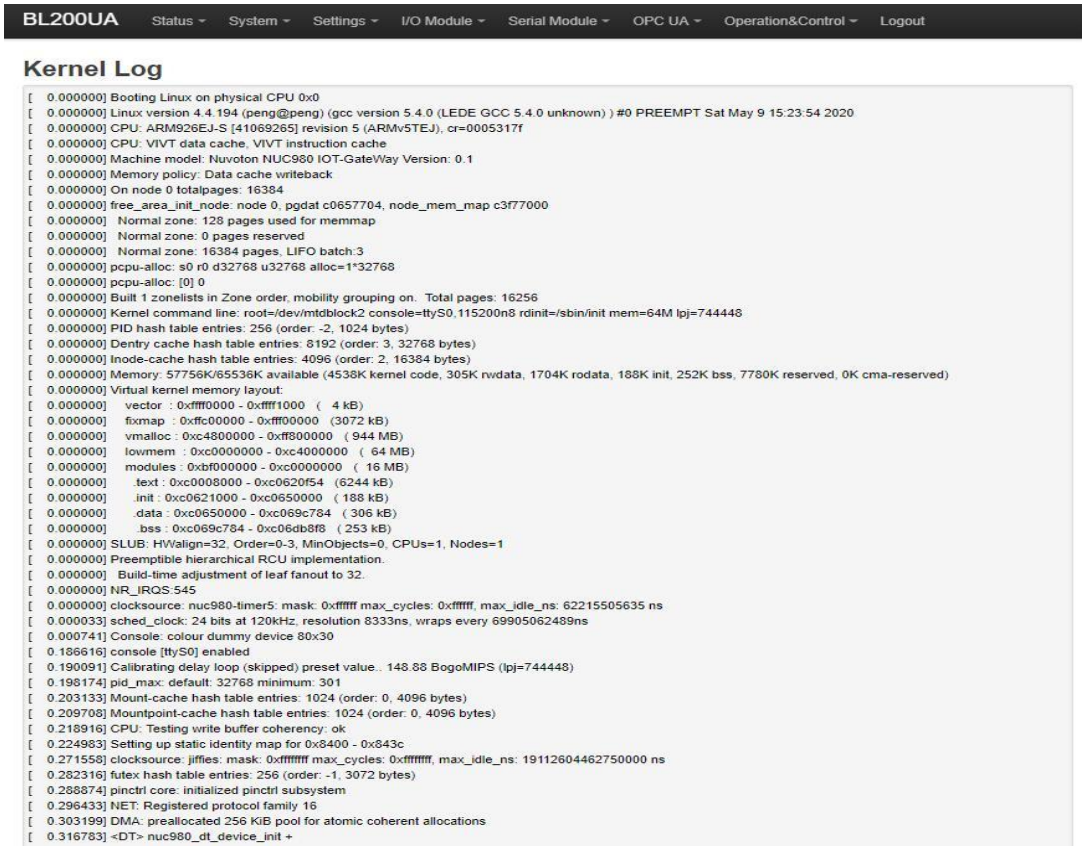
Status > Overview



Status > System Log



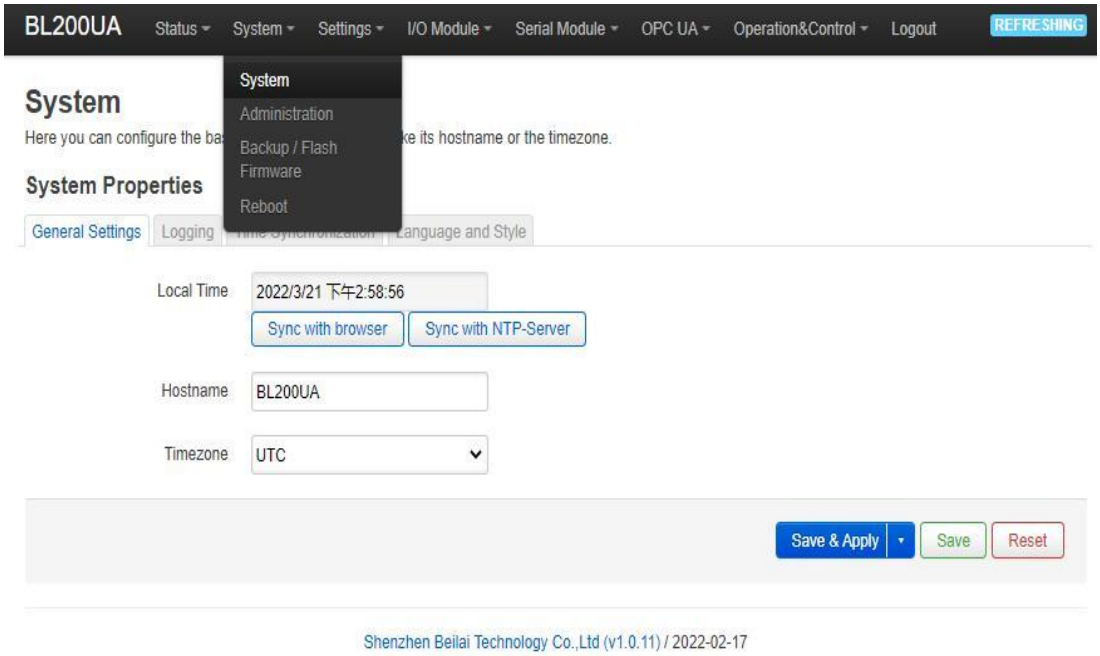
Status > Kernel Log



5.3 System

5.3.1 System

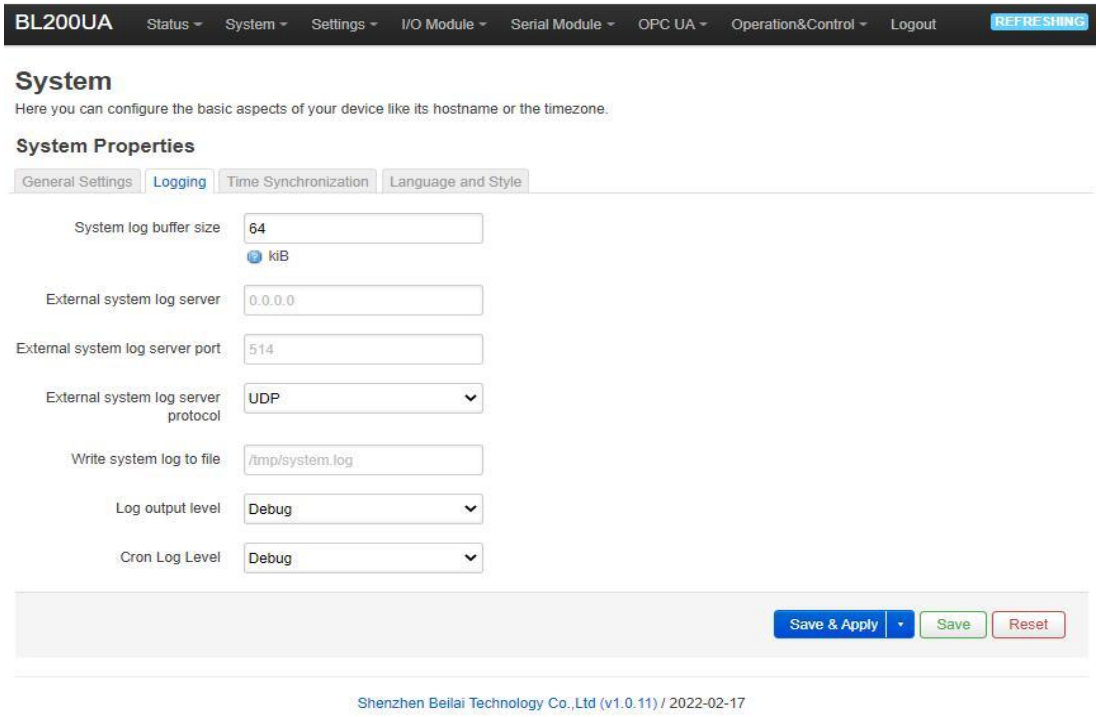
System Properties > General Settings



Tabel 9：System > System Properties > General Settings

Project	Describe	Default
Local time	Displays the current time of the device. You can click the "Sync browser time" or "Sync with NTP server" button to update the device time.	--
Hostname	The device name can be customized to easily distinguish between multiple devices.	BL200
Timezone	The time zone can be selected via the drop down menu	UTC

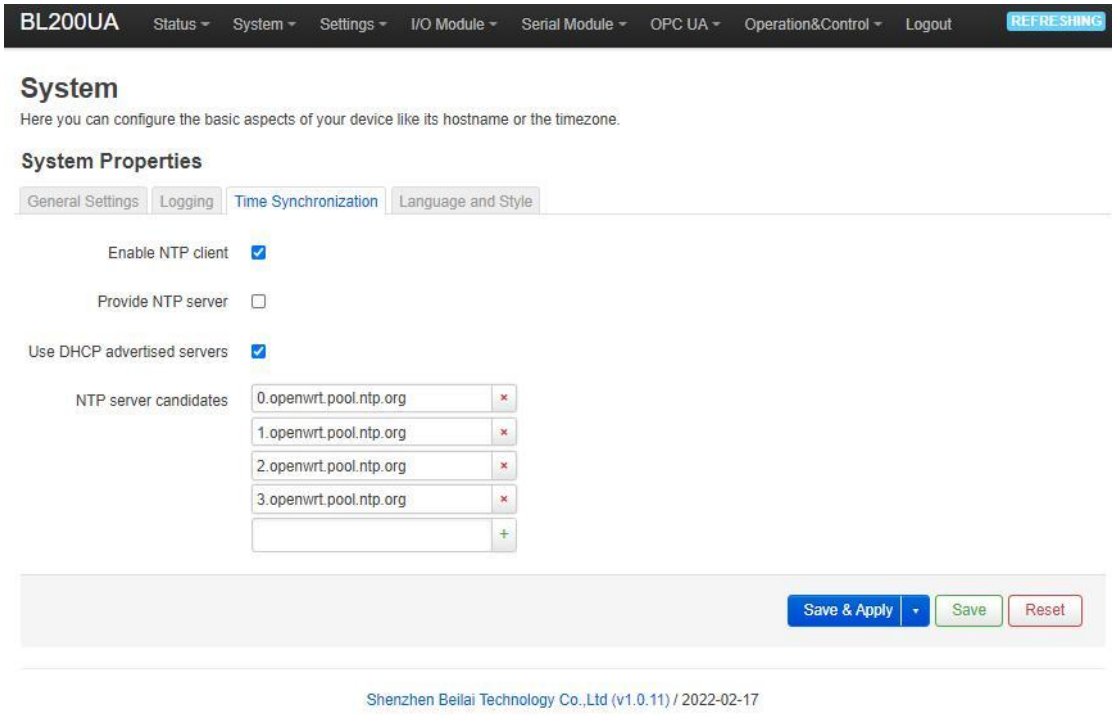
System Properties > Logging



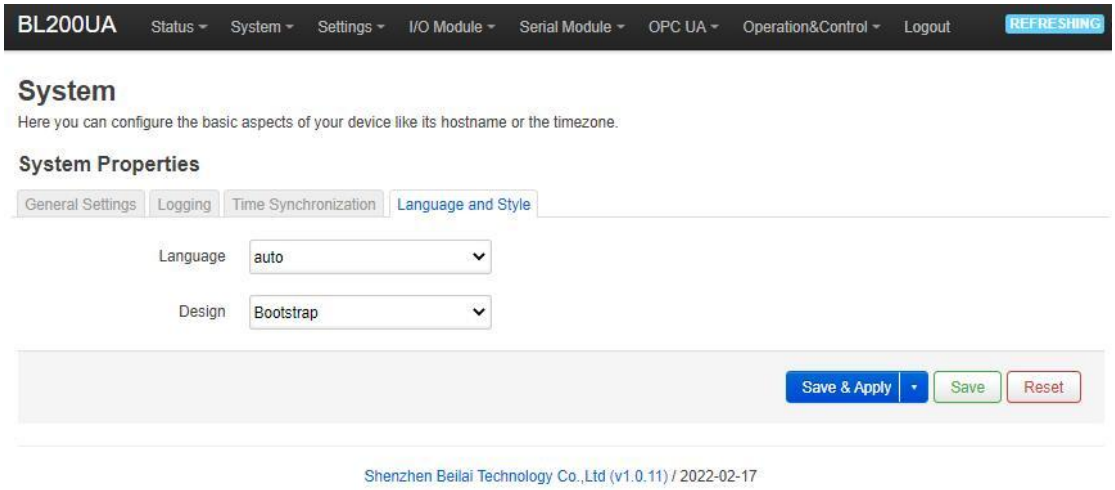
Tabel 10：System > System Properties > Logging

Project	Describe	Default
System log buffer size		64
External system log server		
External system log server port		
External system log server protocol		
Write system log to file		
Log output level		
Cron log level		

System Properties > Time Synchronization
An NTP server can be set to synchronize time.



System Properties > Language and Style



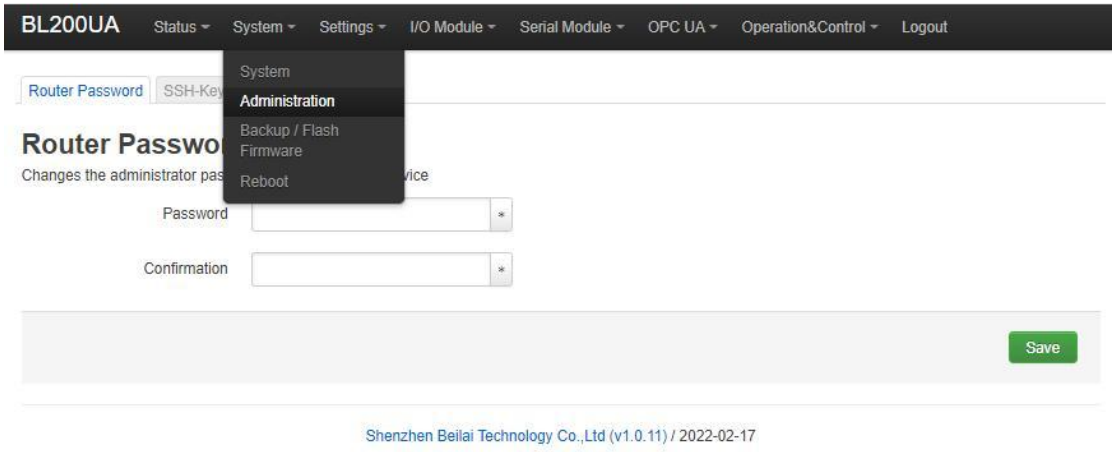
Tabel 11：System > System Properties > Language and Style

Project	Describe	Default
Language	Available in auto, English, Chinese (Chinese)	auto
Design	Currently only Bootstrap is supported.	Bootstrap

5.3.2 Administration

Administration > Router Password

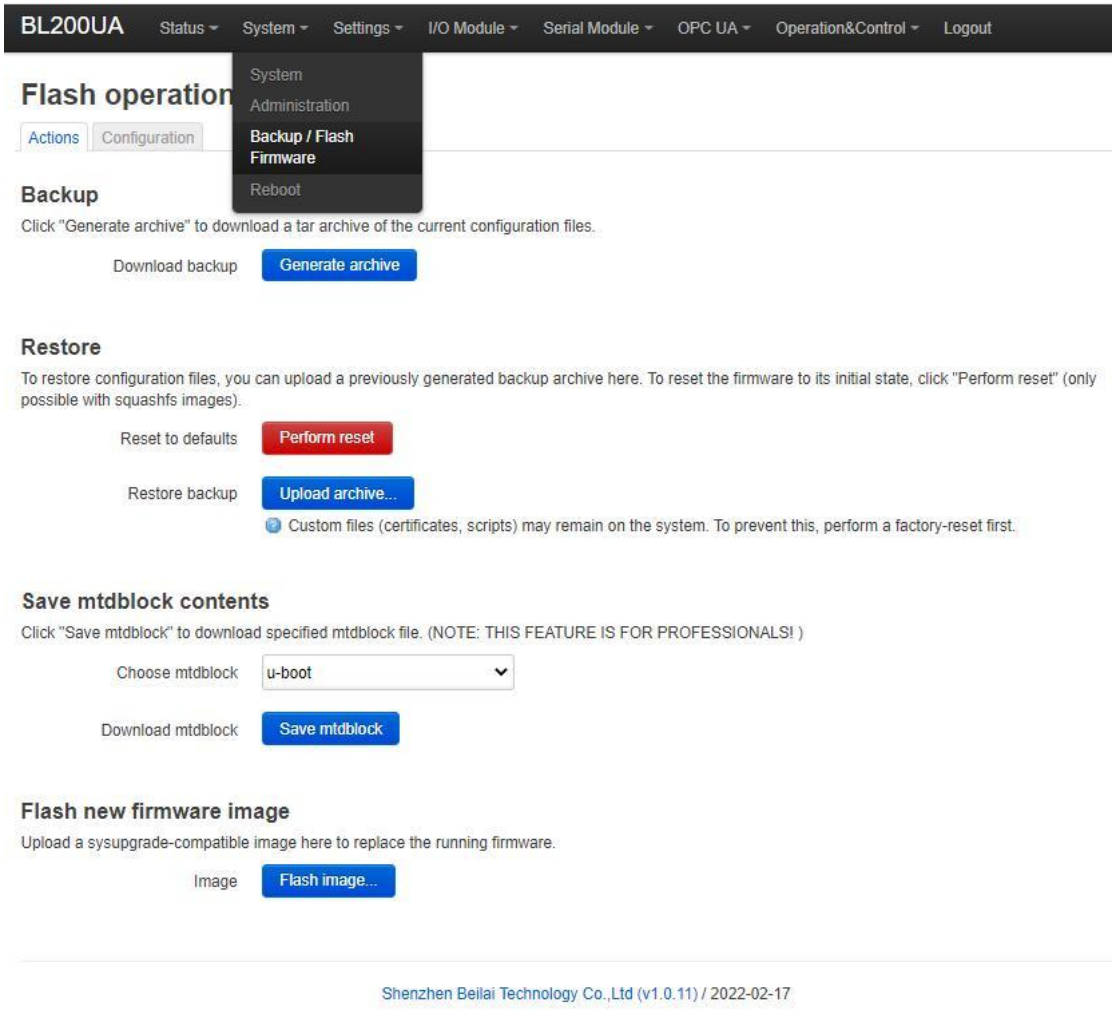
Change the administrator password for accessing the device.



Administration > SSH Keys

Public keys allow for the passwordless SSH logins with a higher security compared to the use of plain passwords. In order to upload a new key to the device, paste an OpenSSH compatible public key line or drag a `.pub` file into the input field.

5.3.3 Backup/Flash Firmware

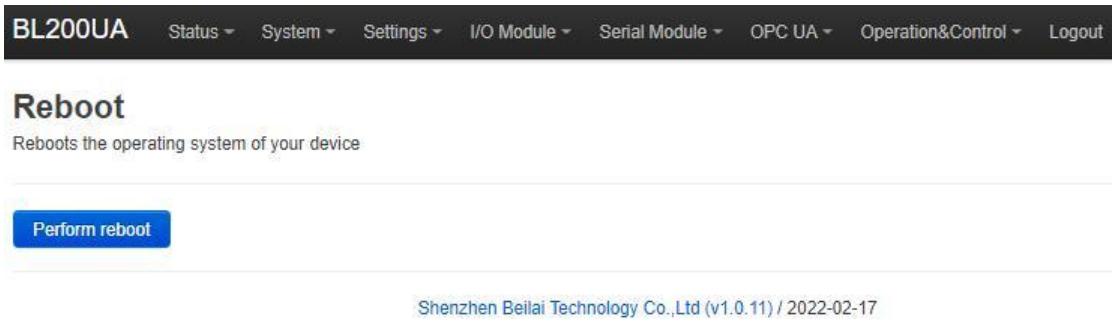


Tabel 12：System > Backup/ Flash Firmware > Actions

Project	Describe	Default
Backup	Click "Generate archive" to download a tar archive of the current configuration files.	--
Restore	To restore configuration files, you can upload a previously generated backup archive here. To reset the firmware to its initial state, click "Perform reset" (only possible with squashfs images).	--
Save mtdblcok contents	Click "Save mtdblock" to download specified mtdblock file. (NOTE: THIS FEATURE IS FOR PROFESSIONALS!)	--
Flash new firmware image	Upload a sysupgrade-compatible image here to replace the running firmware.	--

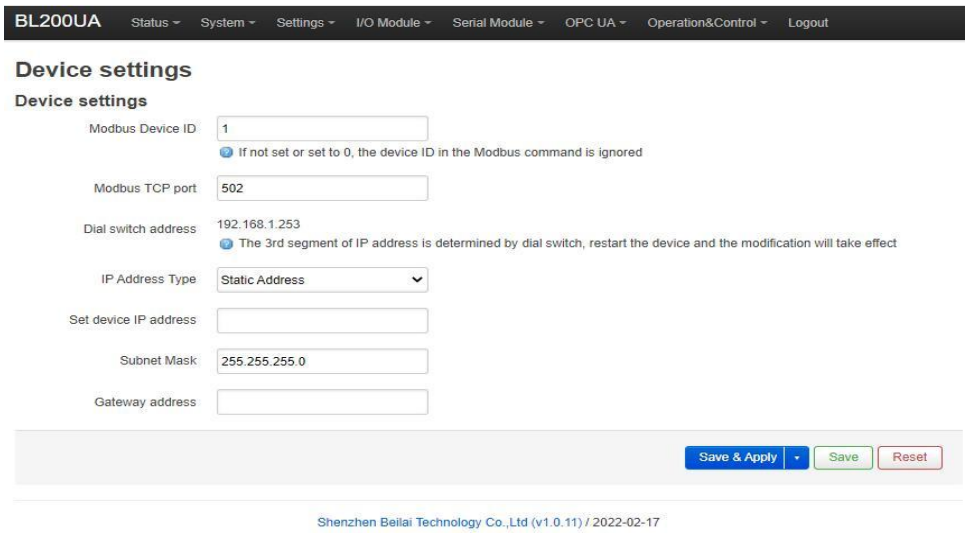
5.3.4 Reboot

Clicking on "Perform reboot" will reboot your device.



5.4Settings

Device settings



Tabel 13：Settings > Device settings

Project	Describe	Default
Modbus Device ID	Modbus device ID range is 1~247.	1
Modbus TCP port	Modbus TCP protocol port number, which can be customized.	502
Dial switch address	Displays the IP address set by the Dial switch.	
IP address type	Select from "Static Address", "Dynamic Address(DHCP)".	
Set device IP address	The IP address of the device can be set by yourself, and it needs to be restarted to take effect after setting.	--
Subnet mask	Set IP subnet mask	

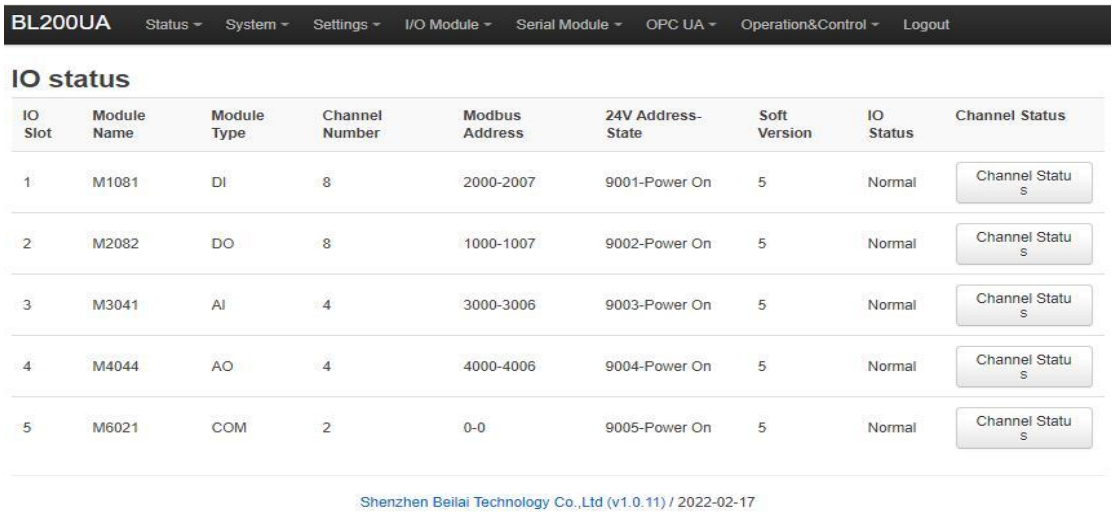
Gateway address	Set IP gateway address	

5.5 I/O modules

After power-up, the controller automatically recognizes all I/O modules connected to it and creates an internal local process image based on the module type, data width and the module's position in the node.

If I/O modules are added, changed or removed, a new process image is created and the process data addresses change. When adding an I/O module, the process data of all previous I/O modules must be considered.

The controller can connect up to 32 I/O modules, including digital input and output, analog input and output and special function modules.

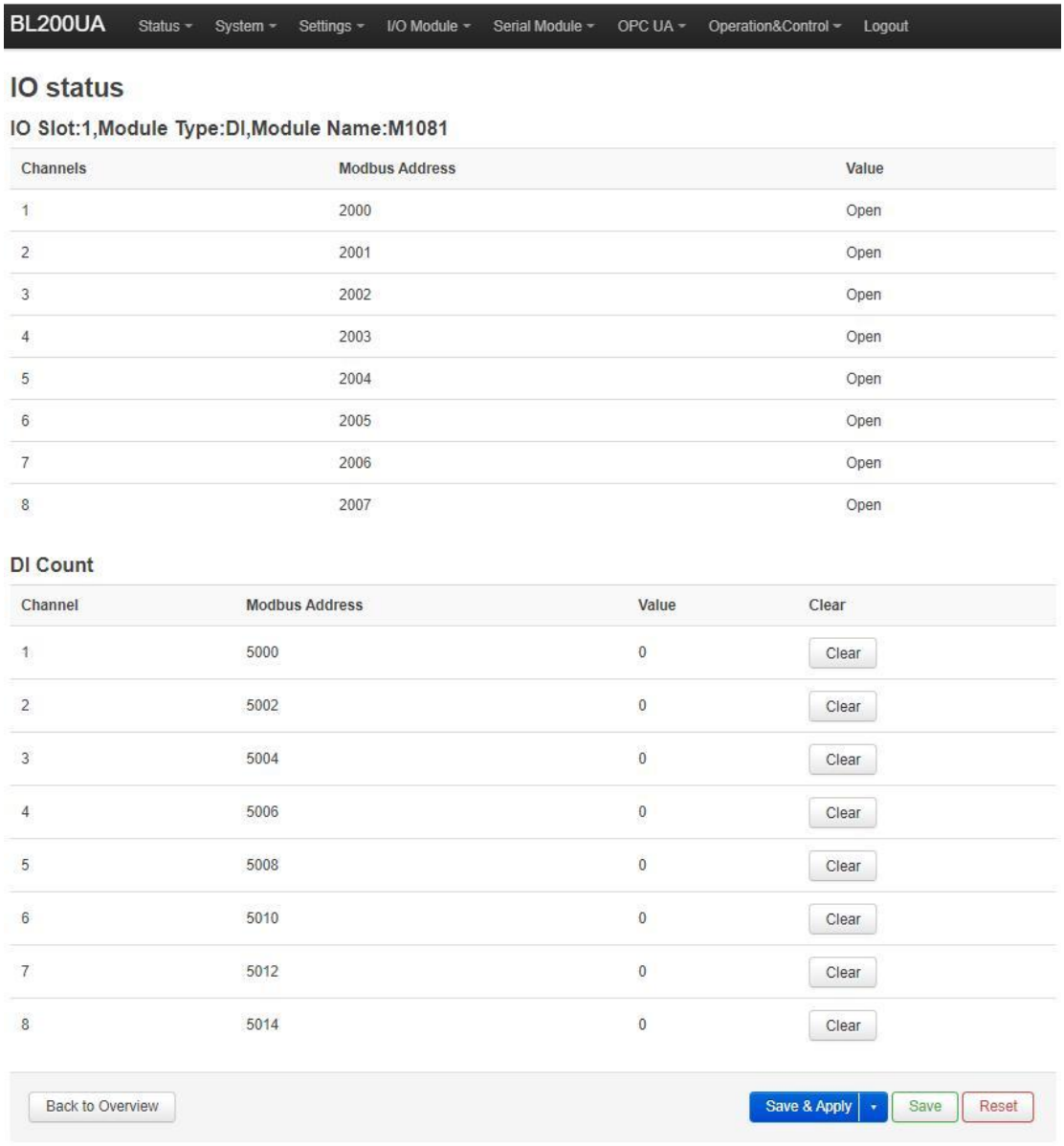


Tabel 14：I/O Module > I/O Status

Project	Describe
IO slot	The order of IO modules in the card slot, the first module card position close to the controller is 1, and the following ones are 2 3 4...
Module name	Detailed model of IO module
Module type	IO module function type
Channel Number	Data width of IO module
Modbus Address	Process map address of the IO module inside the controller
24V Address State	Power supply status on the field side of the IO module, digital, 1 bit
Software version	IO module internal firmware version
IO status	IO module and controller communication status
Channel status	Click to view and set the parameters of different types of IO modules

5.5.1 Digital input module

The digital input module can provide two types of data, one is the current input state value, Boolean type; the other is the counter value, 32-bit numerical type, which supports the clear function.



Tabel 15：Digital Input Modules > IO Status

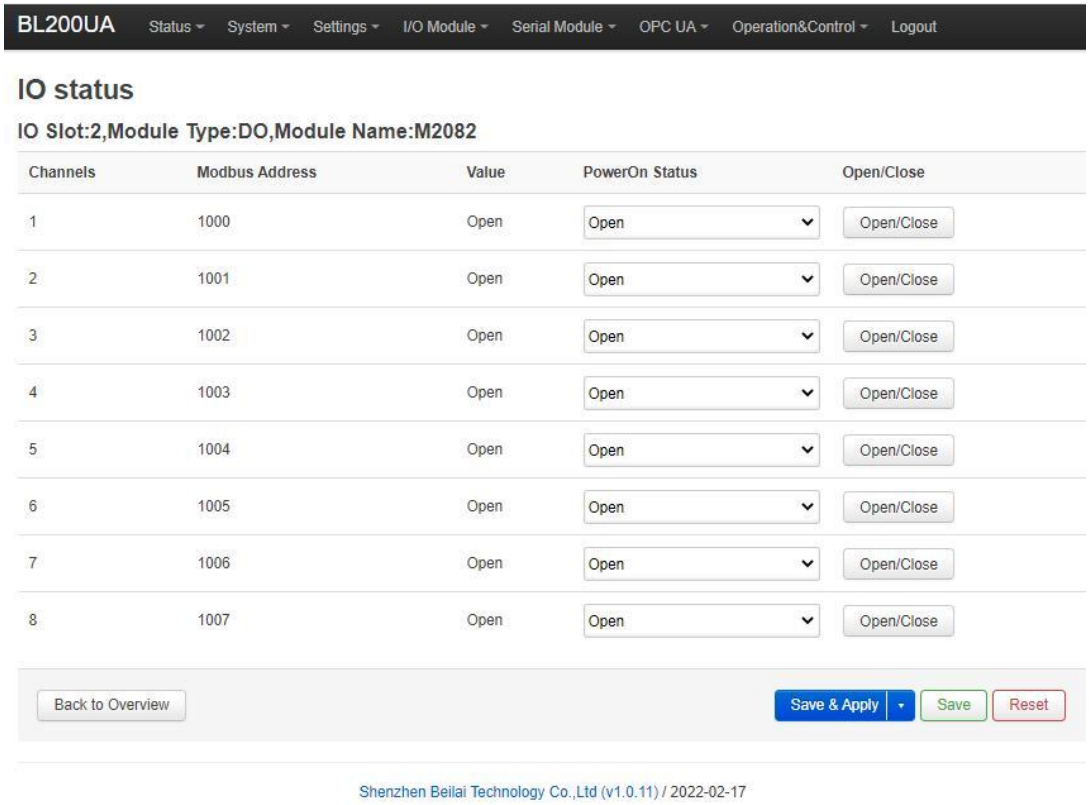
Project	Describe
Channels	Channel number of the digital input module
Modbus Address	Process map address of Boolean status data inside the

	controller
Value	Display the current input state, open: logic 0, close: logic 1

Tabel 16：Digital Input Modules > DI Count

Project	Describe
Channels	Channel number of the digital input module
Modbus Address	Process map address of the count value inside the controller
Value	Display the current input count value, 32-bit unsigned integer
Clear	Can clear the current channel counter value

5.5.2 Digital output module



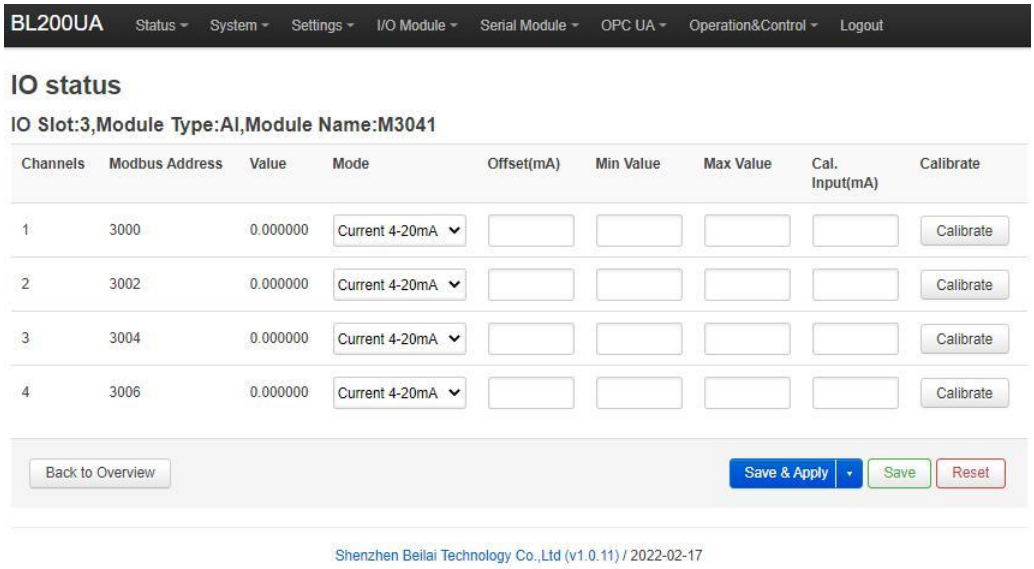
Tabel 17：Digital output module

Project	Describe
Channels	Channel number of the digital output module
Modbus address	Process map address of the digital output boolean data inside the controller
Value	Display the current output state, open: 0, close: 1
power-on status	Set the state of DO after power-on, select from "open", "close", "last"

open/close	Can control the current channel output state

5.5.3 Analog input module

The analog input (AI) type module supports setting parameters through the controller web page, so that the data conversion is automatically realized inside the module, and the actual engineering value corresponding to the sensor can be directly output.



Tabel 18：Analog input module

Project	Describe
Channels	Channel number of the analog input module
Modbus Address	Process map address of the analog input module inside the controller
Value	Display the actual project value input by the current channel, 32-bit single-precision floating-point type
Mode	Different models of analog input modules have different options, please refer to the specific analog input I/O module manual for details.
Offset(mA)	The offset can be used to adjust the acquisition and actual error.
Min Value	Sensor range minimum
Max Value	sensor range maximum
Calibrate Input(mA)	To calibrate the AI, enter the actual current of the AI.
Calibrate	Click "Calibrate" to confirm the calibration AI.

There is a linear relationship between the electrical signal value of the analog input module (usually a sensor) and the actual engineering value. Their formulas are as follows (take 4-20mA as an example):

Actual engineering value = (current value - 4) * ((maximum - minimum) / (20 - 4)) + minimum

Take the 4-20mA type water level sensor to measure the depth of the water tower as an example:

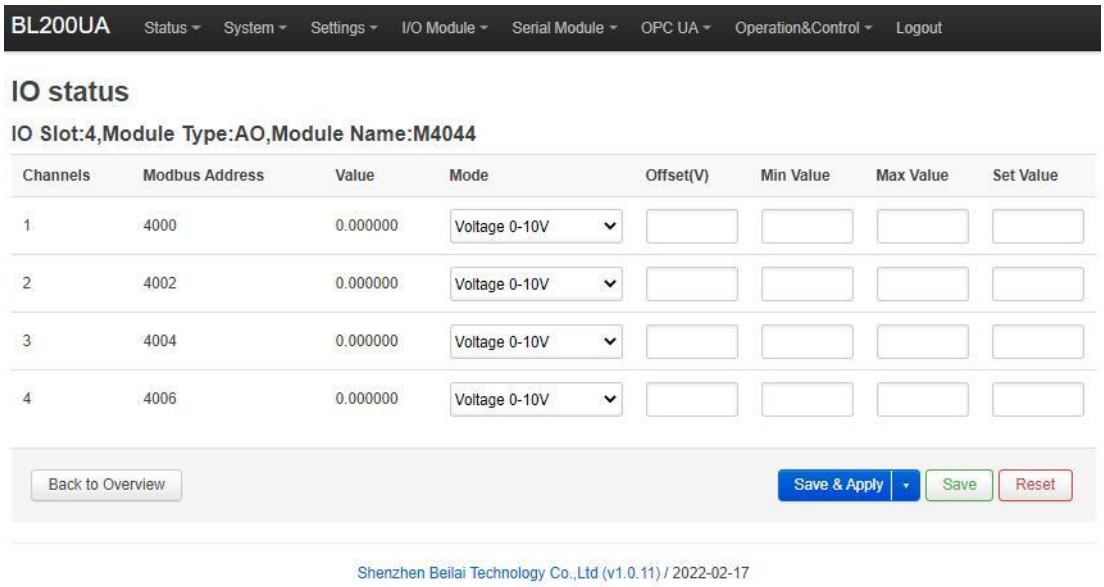
The known water level sensor range is 0-100m, the current data is 5.6mA, and the depth of the water tower is calculated:

Into the formula:

(5.6 - 4) * ((100 - 0) / (20 - 4)) + 0 = 10

the depth of the water tower is 10m

5.5.4 Analog output module



Tabel 19：*Analog output module*

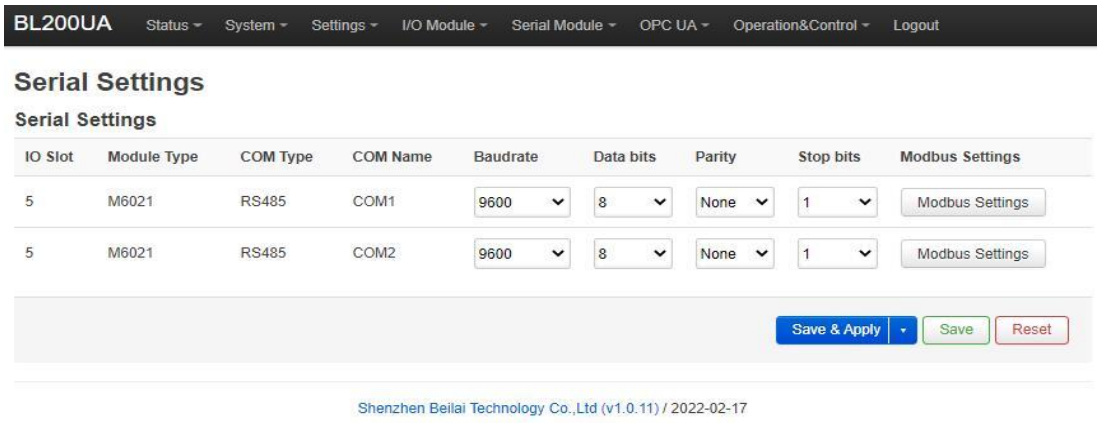
Project	Describe
Channels	Channel number of the analog output module
Modbus Address	Process map address of the analog output module inside the controller
Value	Display the actual project value output by the current channel, 32-bit single-precision floating-point type
Mode	Different models of analog output modules have different options, please refer to the specific analog output I/O module manual for details.

Offset	Adjust the setting and the actual error
Min value	Actual engineering value minimum value
Max value	Actual engineering value maximum value
Set value	You can set the actual project value required for the output

5.6 Serial port RS485 module

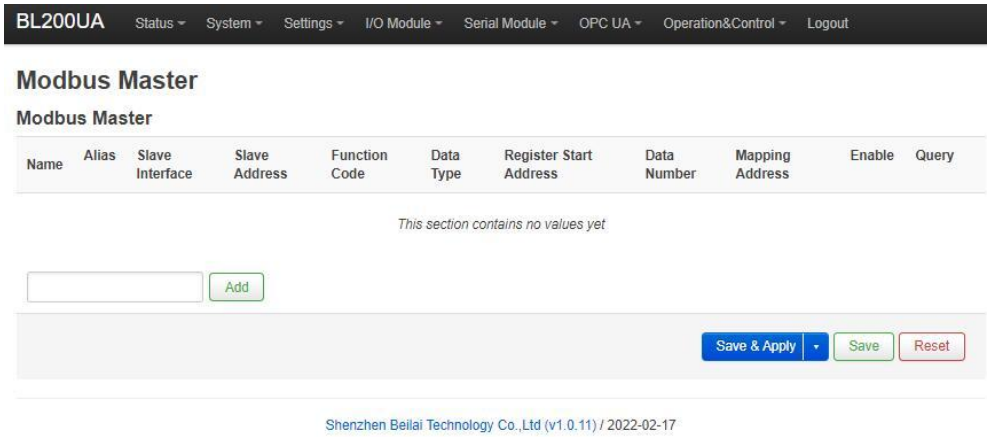
Various sensors, meters and other devices that support Modbus RTU protocol can be connected to the edge controller through the serial port module. It allows process mapping between external sensor data and the controller via the local bus.

5.6.1 Serial port settings

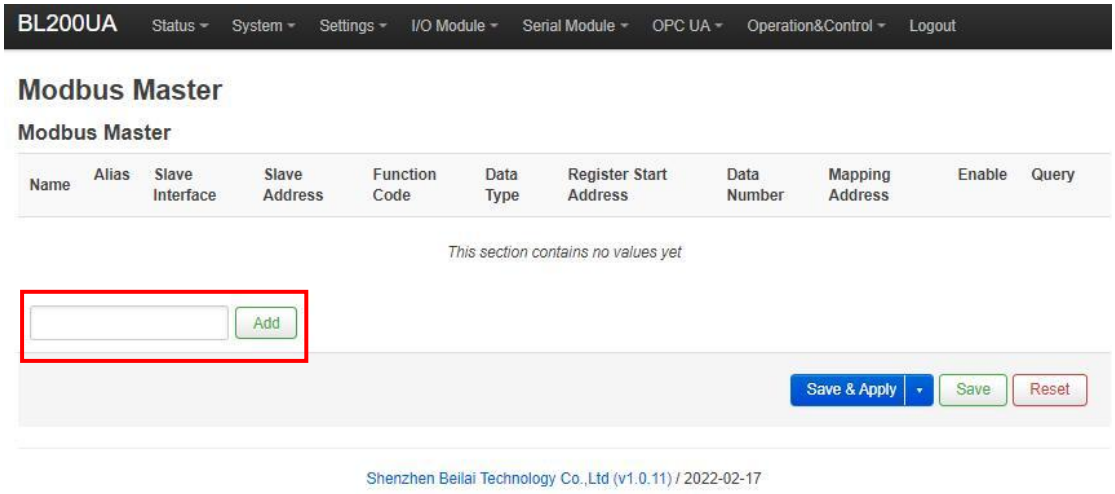


5.6.2 Modbus settings

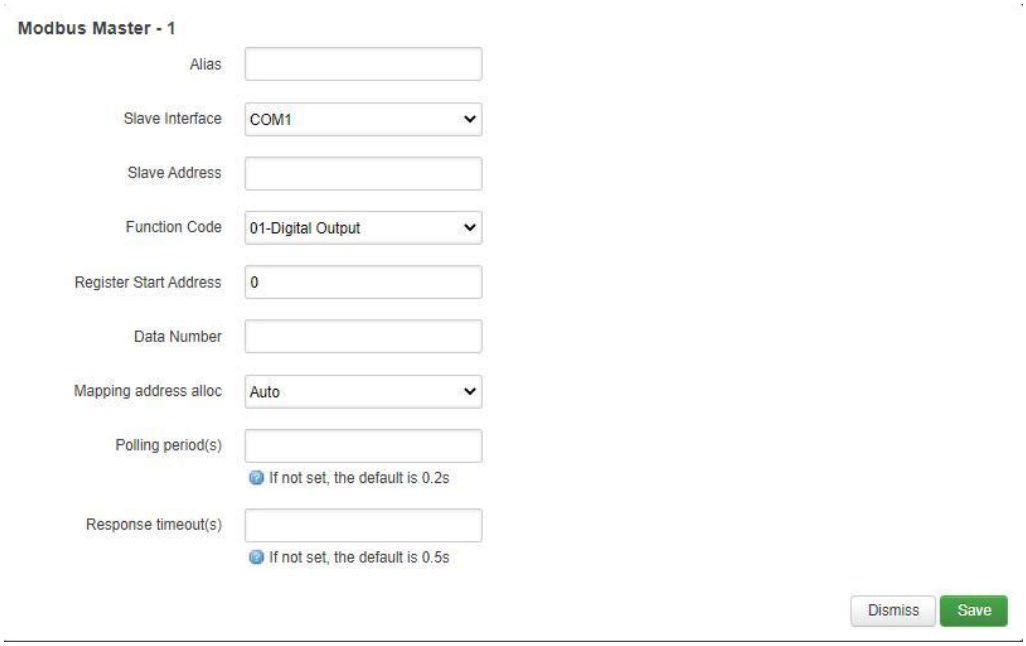
Modbus settings are used to add Modbus RTU devices to the serial communication I/O module.



Enter the custom data name in the input box and click Add



The configuration box pops up to configure

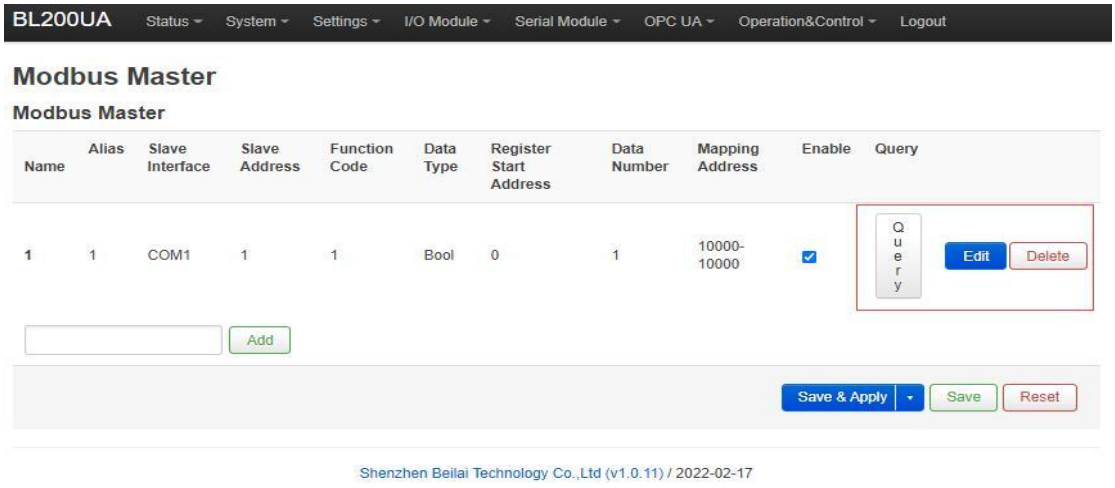


Tabel 20：Modbus master

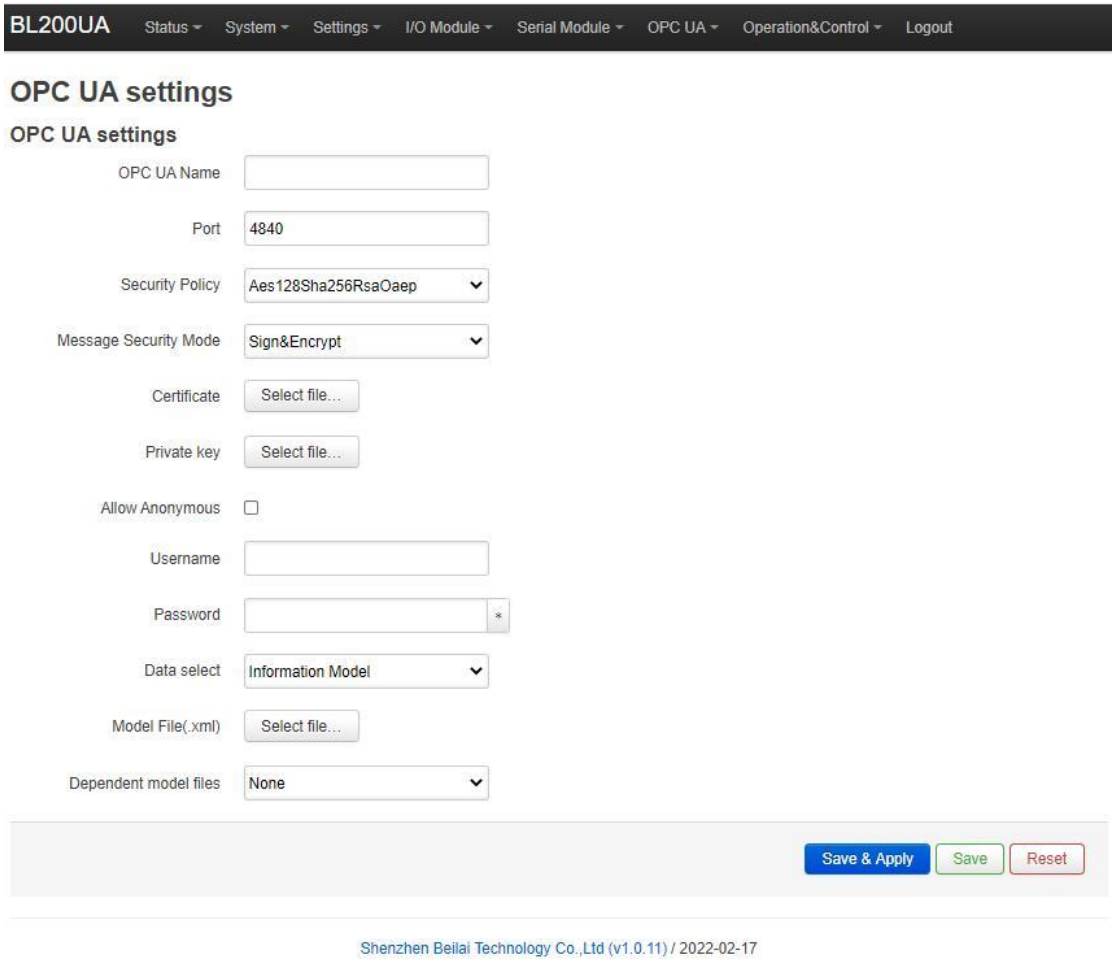
Project	Describe
Alias	Device nickname can be used to distinguish data
Slave Interface	Select serial channel
Slave address	Slave device address, range 1-247
Function code	Select according to the slave data type, including: "01", "02", "03", "04"
Register start address	Register start address of slave data
Data number	Number of slave data
Mapping address	Support distribution method:

alloc	auto According to different data types, the system automatically allocates down the starting address of the mapping, and the addresses are continuous. manual Manual allocation allows mapping addresses to be allocated across segments
Polling period (s)	The interval between two adjacent polling commands
Response timeout (s)	After sending the command to the slave station, wait for the maximum time for the slave station to return data. If the time exceeds this time, the slave station will be considered to have no response.

For the built slave, you can modify, delete, and view data, or you can disable collection.



5.7OPC UA settings



Tabel 21： *OPC UA settings*

Project	Describe	Default
OPC UA name	OPC UA server name	
Port	OPC UA service port number	4840
Security policy	None、 basic128rsa15 basic256 basic256sha256 aes128sha256rsaoaep All security policies	None
Message security mode	sign Sign and encrypt	
Certificate	OPC UA certificate, click the uploaded certificate to load the configuration page.	
Private key	OPC UA private key, click on the uploaded	

	certificate to load it into the configuration page.	
Allow anonymous	Whether to enable user name and password login	
Username	Fill in the username	
Password	Fill in password	
Data select	all data Select data point information model	all data
Select data point	You can select the data points you want to read. "Data selection" option to select "select data point" to have this option	
Model file (.xml)	Upload the information model (.xml) file, select "Information Model" in the "Data Selection" item to have this option	
Dependent model files	Select the number of information models to reference, up to 5 can be selected.	
Dependent Models 1-5	Upload the information model (.xml) file to be referenced	

Note: For a customized information model, the data point description item must be in the format of REG + Modbus address during modeling. For example, DO1 point description item fills in REG1000, and other items are customized.

5.8Other functions

1、Logic operation and control function
2、OpenVPN function
3、Uplink protocols: Huawei Cloud IoT, Ali Cloud IoT, AWS IoT, MQTT, thingsboard, sparkplugB, Kingpigeon Cloud and other protocols.
These functions are introduced in the subsequent manual.

6. Fieldbus Communication

6.1Modbus

6.1.1 Overview

Modbus is an open, manufacturer-independent fieldbus standard protocol for a variety of applications in manufacturing and process automation.

MODBUS is an application layer messaging protocol at layer 7 of the OSI model that

enables client/server communication between devices connected on different types of buses or networks.

Several commonly used networks are as follows:

- TCP/IP over Ethernet。
- Asynchronous serial transmission of multiple media (wired: EIA/TIA-232-E, EIA-422, EIA/TIA-485-A; optical fiber, radio, etc.).
- MODBUS PLUS, high-speed token.

MODBUS is a request/response protocol that provides services specified by function codes.

The MODBUS protocol allows easy communication within all types of network architectures.

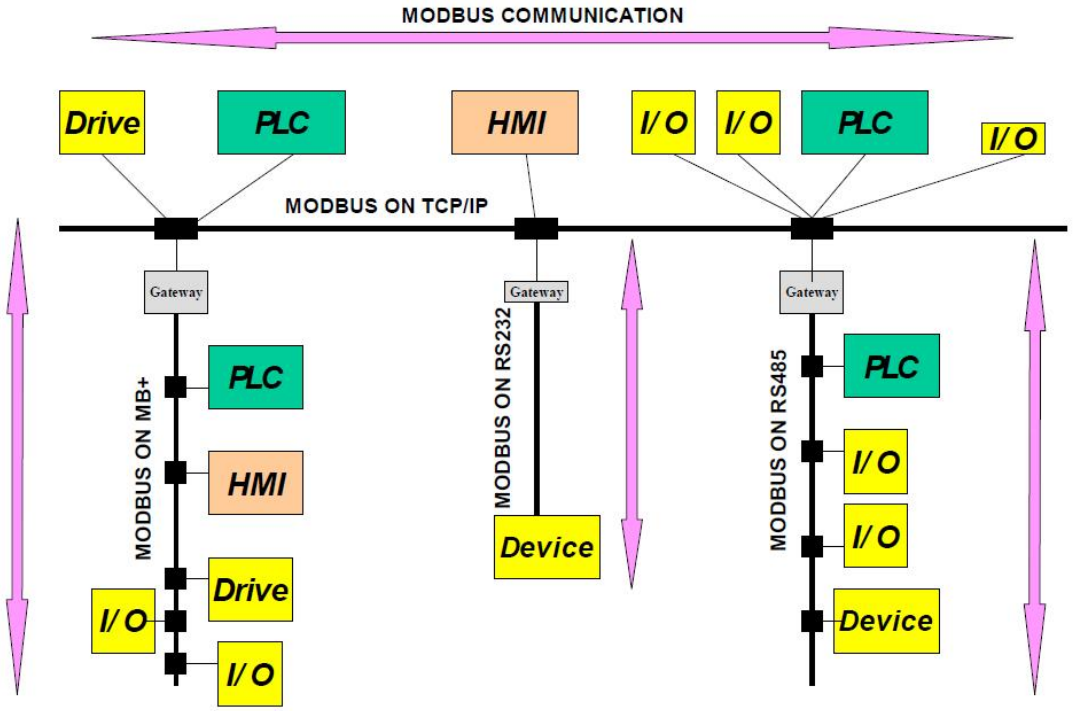


Figure 32：Modbus Network Architecture

The MODBUS protocol defines a simple protocol data unit (PDU) independent of the underlying communication layer. The mapping of the MODBUS protocol on a specific bus or network can introduce some additional fields on the Application Data Unit (ADU).

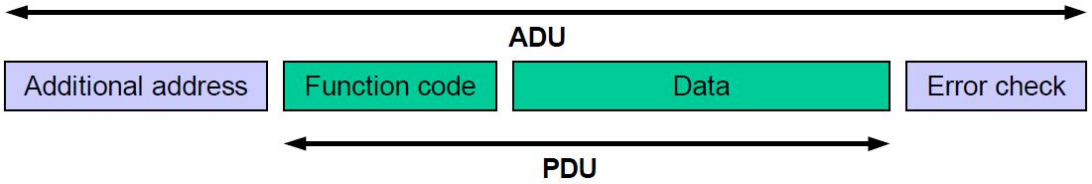


Figure 33：Modbus data frame

More details on the Modbus open protocol specification can be found on the website www.modbus.org.

6.1.1 Modbus TCP

The Modbus TCP protocol is a variant of the Modbus protocol that is optimized for communication over a TCP/IP connection. The protocol is designed for data exchange at the field level (ie for I/O data exchange in the process image). On the server side, all packets are sent over a TCP connection with port number 502.
The general Modbus TCP message is as follows:

byte	0	1	2	3	4	5	6	7	8 - n
definition	transaction identifier		protocol identifier		field length		slave address	Modbus function code	data

6.1.2 Modbus data encoding

Modbus uses "big endian" representation for addresses and data items. This means that when transferring numbers larger than a single byte, the most significant byte is sent first.

6.1.3 Modbus data type

The modbus protocol is based on the following basic data types:

Tabel 22：Modbus basic data type

type of data	object type	access type	describe
digital input	1 bit	read	digital input
coil	1 bit	read/write	digital output
input register	16 bit (word)	read	analog input
holding register	16 bit (word)	read/write	analog output

For each basic data type, one or more function codes are defined. These function codes allow digital or analog input and output data, as well as internal variables to be set or read directly from the fieldbus node.

6.1.2 Modbus function code description

The function codes supported by the BL200 fieldbus node are shown in the table below. To perform the required functions, please specify the respective function codes and the

address of the selected input or output channel or register.

Tabel 23：Modbus function code list

Modbus function code	function	access type	describe
0x02	read digital input	read	Access by 1 bit
0x01	read coil	read/write	
0x05	write a single coil	read/write	
0x0F	write multiple coils	read/write	
0x04	read input register	read	Access by 16 Bit
0x03	read multiple registers	read/write	
0x06	write a single register	read/write	
0x10	write multiple registers	read/write	

The MODBUS function is performed as follows:

1. The MODBUS TCP master station (such as PC) sends a request to the BL200 fieldbus node using a specific function code;

2. The BL200 fieldbus node receives the data message, and then responds to the master with correct data according to the master's request.

If a fieldbus node receives an incorrect request, it sends an error data telegram (exception) to the master.

The meaning of the exception code contained in the exception is as follows:

Tabel 24：Modbus exception code

Exception code	Describe
0x01	illegal function
0x02	illegal data address
0x03	illegal data value
0x04	slave device failure

6.1.2.1 Function code 0x02 (read digital input)

This function code is used to read the continuous state of single or multiple digital inputs.

1. request

The request specifies the starting address and the quantity to be read.

Tabel 25：Function code 0x02 - request message

Field Name	Number of bytes	Example	Describe
Transaction	2 Byte	0x00 01	Identification of Modbus

identifier			request/response transactions
Protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
Message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
Function code	1 Byte	0x02	Read digital input, use function code 0x02
Start address	2 Byte	0x07 D0	The address is detailed in the "Modbus Register Mapping" chapter
Enter quantity	2 Byte	0x08	Read 8 digital inputs

2. response

The data field indicates the value of the input state. A binary 1 corresponds to the on state and a 0 corresponds to the off state. The least significant bit (LSB) of the first data byte contains the first bit of the request, the others are in ascending order. If the response data is not a multiple of 8, the remaining bits of the last data byte will be padded with zeros (towards the upper bits of the byte).

Tabel 26：Function code 0x02-response message

Field Name	Number of bytes	Example	Describe
Transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
Protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
Message length	2 Byte	0x00 04	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
Function code	1 Byte	0x02	Read digital input, use function code 0x02
Data bytes	1 Byte	0x01	number of bytes of data
Data	1 Byte	0x89	response data

3. abnormal

Tabel 27：Function code 0x02 - abnormal response

Field Name	Number of bytes	Example	Describe
…			
Function code	1 Byte	0x82	Modbus function code + 0x80

abnormal code	1 Byte	0x01	0x01 or 0x02

4. Example

Read the value of 8 digital inputs from address 2000 to 2007.

request

0x00 01 00 00 00 06 01 02 07 D0 00 08

Tabel 28: Function Code 0x02-Request Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	01	07 D0		00 08	
illustrate	transaction identifier		protocol identifier		message length		device address	function code	stat address		number of coils	

response

0x00 01 00 00 00 04 01 02 01 89

Tabel 29: Function Code 0x02-Response Message-Example

Byte	1	2	3	4	5	6	7	8	9	10
Data	00 01		00 00		00 04		01	01	01	89
illustrate	transaction identifier		protocol identifier		message length		device address	function code	data bytes	data

Status from 2007 to 2000 is displayed as byte value 0x89 or binary 1000 1001. Address 2007 is the most significant bit MSB of the byte, 2000 is the least significant bit LSB, the distribution from high to low is as follows:

Tabel 30: digital input data

Bit	7	6	5	4	3	2	1	0
address	2007	2006	2005	2004	2003	2002	2001	2000
status	1	0	0	0	1	0	0	1
illustrate	close	open	open	open	close	open	open	close

6.1.2.2 Function code 0x01 (read coil)

This function code is used to read the continuous status of single or multiple coils in the remote device.

1. request

The request specifies the starting address, which specifies the address of the first coil, and the number of coils.

Tabel 31: Function code 0x01 - request message

Field Name	Number of bytes	Example	illustrate
Transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
Protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
Message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
Function code	1 Byte	0x01	Read coil, use function code 0x01
Start address	2 Byte	0x03 E8	The address is detailed in the "Modbus Register Mapping" chapter
Number of coils	2 Byte	0x00 08	Read 8 coil states

2. response

The data field indicates the value of the input state. A binary 1 corresponds to the on state and a 0 corresponds to the off state. The least significant bit (LSB) of the first data byte contains the first bit of the request, the others are in ascending order. If the response data is not a multiple of 8, the remaining bits of the last data byte will be padded with zeros (towards the upper bits of the byte).

Tabel 32：Function code 0x01-response message

Field Name	Number of bytes	Example	illustrate
Transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
Protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
Message length	2 Byte	0x00 04	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
Function code	1 Byte	0x01	Read coil, use function code 0x01
Data bytes	1 Byte	0x01	number of bytes of data
Data	1 Byte	0x89	response data

3. abnormal

Tabel 33：Function code 0x01-abnormal

Field Name	Number of bytes	Example	illustrate
…			

function code	1 Byte	0x81	Modbus function code + 0x80
abnormal code	1 Byte	0x01	0x01 or 0x02

4. example

Read the status values of 8 coils from addresses 1000 to 1007.
request
0x00 01 00 00 00 06 01 01 03 E8 00 08

Tabel 34: Function Code 0x01-Request Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	01	03 E8		00 08	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	initial address		Number of coils	

response
0x00 01 00 00 00 04 01 01 01 89

Tabel 35: Function code 0x01-response message

Byte	1	2	3	4	5	6	7	8	9	10
Data	00 01		00 00		00 04		01	01	01	89
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	data bytes	data

Status from 1007 to 1000 is displayed as byte value 0x89 or binary 1000 1001. Address 1007 is the most significant bit MSB of the byte, 1000 is the least significant bit LSB, the distribution from high to low is as follows:

Tabel 36: Coil data

Bit	7	6	5	4	3	2	1	0
address	1007	1006	1005	1004	1003	1002	1001	1000
status	1	0	0	0	1	0	0	1
illustrate	close	open	open	open	close	open	open	close

6.1.2.3 Function code 0x05 (write a single coil)

This function will write a single coil status to the slave device.

1. request

Tabel 37：Function code 0x05 - request message

Field Name	Number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x05	To write a single coil, use function code 0x05
register address	2 Byte	0x03 E8	The address is detailed in the "Modbus Register Mapping" chapter
data input	2 Byte	0xFF 00	This value is: 0xFF 00 or 0x00 00. 0xFF 00 means write 1, 0x00 00 means write 0.

2. response

Tabel 38：Function code 0x05-response message

Field Name	Number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x05	To write a single coil, use function code 0x05
data bytes	2 Byte	0x03 E8	Write the register address of the coil
data input	2 Byte	0xFF 00	This value is: 0xFF 00 or 0x00 00. 0xFF 00 means write 1, 0x00 00 means write 0.

3. abnormal

Tabel 39：Function code 0x05-abnormal

Field Name	Number of bytes	Example	illustrate
…			

function code	1 Byte	0x85	Modbus function code + 0x80
abnormal code	1 Byte	0x81	0x01 or 0x02

4. example

Write the state value of the coil at address 1000 as 1, that is, the closed state.

request

0x00 01 00 00 00 06 01 05 03 E8 FF 00

Tabel 40：Function Code 0x05-Request Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	05	03 E8		FF 00	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	Coil address		write "1"	

response

0x00 01 00 00 00 06 01 05 03 E8 FF 00

Tabel 41：Function Code 0x05-Response Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	05	03 E8		FF 00	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	Coil address		write "1"	

6.1.2.4 Function code 0x0F (write multiple coils)

This function code is used to set multiple consecutive coils to open or close. The on/off state of the request is specified by the content of the request data field. A logical "1" requests the corresponding output to close, and a logical "0" requests it to open. The normal response returns the function code, the starting address and the number of coils executed.

1. request

Tabel 42：Function code 0x0f - request message

Field Name	**number of bytes**	**Example**	**illustrate**
transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 08	The number of bytes of the following data

Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x0F	Write multiple coils, use function code 0x0F
start address	2 Byte	0x03 E8	The address is detailed in the "Modbus Register Mapping" chapter
Number of coils	2 Byte	0x00 08	
data bytes	1 Byte	0x01	
data	1 Byte	0xFF	

2. response

Tabel 43：Function code 0x0f - response message

Field Name	number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 00	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x0F	Write multiple coils, use function code 0x0F
start address	2 Byte	0x03 E8	
Number of coils	2 Byte	0x00 08	

3. abnormal

Tabel 44：Function code 0x0f-abnormal

Field Name	number of bytes	Example	illustrate
…			
function code	1 Byte	0x8F	Modbus function code + 0x80
abnormal code	1 Byte		0x01 or 0x02

4. example

Starting from address 1000, close all 8 coils, that is, write the value of 8 coils as 0xFF.

request

0x00 01 00 00 00 08 01 0F 03 E8 00 08 01 FF

Tabel 45：Function code 0x0f-request message-example

Byte	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Data	00 01		00 00		00 08		01	0F	03 E8		00 08		01	FF

illustrate	transaction identifier	protocol identifier	message length	Device address	function code	start address	Number of coils	data bytes	data

response

0x00 01 00 00 00 06 01 0F 03 E8 00 08

Tabel 46: Function code 0x0f-response message-example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	0F	03 E8		00 08	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	start address		Number of coils	

6.1.2.5 Function code 0x04 (read input register)

This function code is used to read consecutive input registers in multiple remote devices. The request PDU specifies the address of the starting register and the number of registers. The register data in the response message is packed into two bytes per register, and the binary content within each byte is right-aligned.

1. request

Tabel 47: Function code 0x04 - request message

Field Name	number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x04	Read input register, use function code 0x04
start address	2 Byte	0x0B B8	The address is detailed in the "Modbus Register Mapping" chapter
Number of registers	2 Byte	0x00 08	

2. response

Tabel 48：Function code 0x04-response message

Field Name	number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 00	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 13	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x04	Read input register, use function code 0x04
data bytes	1 Byte	0x10	
data	16 Byte	0x 3F 8E 38 86 40 0E 38 86 40 55 54 CA 40 8E 35 3F	

5. abnormal

Tabel 49：Function code 0x04-abnormal

Field Name	number of bytes	Example	illustrate
…			
function code	1 Byte	0x84	Modbus function code + 0x80
abnormal code	1 Byte	0x01	0x01 or 0x02

6. example

Starting at address 3000, read the values of the 4 analog inputs. Since the BL200 controller node register map data type is 32Bit Float, that is, 1 analog input data = 2 registers = 4 bytes, 8 input registers need to be read.

request

0x00 01 00 00 00 06 01 04 0B B8 00 08

Tabel 50：Function Code 0x04-Request Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	04	0B B8		00 08	
illu	transaction		protocol		message		Device	function	start		Number of	

stra te	identifier	identifier	length	address	code	address	registers

response

0x00 01 00 00 00 13 01 04 10 3F 9D 70 A4 40 15 C2 8F 40 5C CC CD 40 91 EB 85

Tabel 51：Function Code 0x04-Response Message-Example

Byte	1	2	3	4	5	6	7	8	9	10…25
Data	00 01		00 00		00 13		01	04	10	xxx
illu stra te	transaction identifier		protocol identifier		message length		Device address	function code	data bytes	data

The data part has a total of 16 bytes, which are converted into decimal as follows

Tabel 52：read input register - convert data to decimal

Byte	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Data	3F 9D 70 A4				40 15 C2 8F				40 5C CC CD				40 91 EB 85			
decimal	1.23				2.34				3.45				4.56			
illustrate	first data				second data				third data				fourth data			

6.1.2.6 Function code 0x03 (read holding register)

This function code is used to read continuous holding registers in multiple remote devices. The request PDU specifies the address of the starting register and the number of registers. The register data in the response message is packed into two bytes per register, and the binary content within each byte is right-aligned.

1. request

Tabel 53：Function code 0x03 - request message

Field Name	number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x03	Read holding register, use function

			code 0x03
start address	2 Byte	0x0F A0	The address is detailed in the "Modbus Register Mapping" chapter
Number of registers	2 Byte	0x00 08	Number of holding registers to read

2. response

Tabel 54：Function code 0x03-response message

Field Name	number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 00	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 13	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x03	Read holding register, use function code 0x03
data bytes	1 Byte	0x10	data bytes
data	16 Byte	0x 3F 9D 70 A4 40 15 C2 8F 40 5C CC CD 40 91 EB 85	response data

3. abnormal

Tabel 55：Function code 0x03-abnormal

Field Name	number of bytes	Example	illustrate
…			
function code	1 Byte	0x83	Modbus function code + 0x80
abnormal code	1 Byte	0x01	0x01 or 0x02

4. example

Starting at address 4000, read the values of the 4 analog outputs (belonging to the holding registers). Since the analog output I/O module register map data type is 32Bit Float, that is, 1 analog output data = 2 registers = 4 bytes, it is necessary to read 8 holding registers.

request
0x00 01 00 00 00 06 01 03 0F A0 00 08

Tabel 56: Function Code 0x03-Request Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	03	0F A0		00 08	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	start address		Number of registers	

response
0x00 01 00 00 00 13 01 03 10 3F 9D 70 A4 40 15 C2 8F 40 5C CC CD 40 91 EB 85

Tabel 57: Function Code 0x03-Response Message-Example

Byte	1	2	3	4	5	6	7	8	9	10…25
Data	00 01		00 00		00 13		01	03	10	xxx
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	data bytes	data

The data part has a total of 16 bytes, and the conversion to decimal is as follows:

Tabel 58: Read Holding Registers - Convert Data Decimal

Byte	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Data	3F 9D 70 A4				40 15 C2 8F				40 5C CC CD				40 91 EB 85			
decimal	1.23				2.34				3.45				4.56			
illustrate	first data				second data				third data				fourth data			

6.1.2.7 Function code 0x06 (write a single register)

This function code is used to write to holding registers in a single remote device. The request PDU specifies the address of the starting register and the number of registers. The register data in the response message is packed into two bytes per register, and the binary content within each byte is right-aligned.

This function code is only suitable for reading the serial port I/O module register mapping data, the address range: 40000 ... 49999. The data type of the analog input/output I/O module is 32Bit Float format, the complete data cannot be read, and this function cannot be used.

1. request

Tabel 59: Function code 0x06 - request message

Field Name	number of	Example	illustrate

	bytes		
transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x06	Write a single holding register, use function code 0x06
register address	2 Byte	0x9C 40	The address is detailed in the "Modbus Register Mapping" chapter
data	2 Byte	0x04 D2	

2. response

Tabel 60：Function code 0x06-response message

Field Name	number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 00	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 06	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x06	Write a single holding register, use function code 0x06
Register address	2 Byte	0x75 30	
data	2 Byte	0x04 D2	

3. abnormal

Tabel 61：Function code 0x06-abnormal

Field Name	number of bytes	Example	illustrate
…			
function code	1 Byte	0x86	Modbus function code + 0x80
abnormal code	1 Byte	0x01	0x01 or 0x02

4. example

Write the value of register address 40000 to 1234 (0x04 D2).

request

0x00 01 00 00 00 06 01 06 9C 40 04 D2

Tabel 62：Function Code 0x06-Request Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	06	9C 40		04 D2	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	register address		Data	

response

0x00 01 00 00 00 06 01 06 9C 40 04 D2

Tabel 63：Function Code 0x06-Response Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	0F	9C 40		04 D2	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	register address		Data	

6.1.2.8 Function code 0x10 (write multiple registers)

This function code is used to write to consecutive holding registers in multiple remote devices. The request PDU specifies the address of the starting register and the number of registers. The register data in the response message is packed into two bytes per register, and the binary content within each byte is right-aligned.

1. request

Tabel 64：Function code 0x10 - request message

Field Name	**number of bytes**	**Example**	**illustrate**
transaction identifier	2 Byte	0x00 01	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 17	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x10	Write multiple holding registers, use function code 0x10
start address	2 Byte	0x0F A0	The address is detailed in the "Modbus Register Mapping" chapter

Number of registers	2 Byte	0x00 08	
data bytes	1 Byte	0x10	
data	16 Byte	0x 3F 9D 70 A4 40 15 C2 8F 40 5C CC CD 40 91 EB 85	

2. response

Tabel 65： Function code 0x10-response message

Field Name	number of bytes	Example	illustrate
transaction identifier	2 Byte	0x00 00	Identification of Modbus request/response transactions
protocol identifier	2 Byte	0x00 00	0x00 00: Modbus protocol
message length	2 Byte	0x00 13	The number of bytes of the following data
Device address	1 Byte	0x01	Slave address identification
function code	1 Byte	0x10	Write multiple holding registers, use function code 0x10
start address	2 Byte	0x0F A0	
Number of registers	2 Byte	0x00 08	

3. abnormal

Tabel 66：Function code 0x10-abnormal

Field Name	number of bytes	Example	illustrate
…			
function code	1 Byte	0x90	Modbus function code + 0x80
abnormal code	1 Byte	0x01	0x01 or 0x02

4. example

Starting at address 4000, write the values of the 4 analog outputs. Since the BL200 controller node register map data type is 32Bit Float, that is, 1 analog output data = 2 holding registers = 4 bytes, 8 holding registers need to be written.

request

0x00 01 00 00 00 17 01 10 0F A0 00 08 10 3F 9D 70 A4 40 15 C2 8F 40 5C CC CD 40 91 EB 85

Tabel 67: Function code 0x10-request message-example

Byte	1	2	3	4	5	6	7	8	9	10	11	12	13	14…23
Data	00 01		00 00		00 17	01		10	0F A0		00 08		10	xxx
illustrate	transaction identifier		protocol identifier		message length	Device address		function code	start address		Number of registers		data bytes	Data

The data part has a total of 16 bytes, and the conversion to decimal is as follows:

Tabel 68: Write Holding Registers - Convert Data Decimal

Byte	14															
Data	3F 9D 70 A4				40 15 C2 8F				40 5C CC CD				40 91 EB 85			
decimal	1.23				2.34				3.45				4.56			
illustrate	first data				second data				third data				fourth data			

response

0x00 01 00 00 00 06 01 10 0F A0 00 08

Tabel 69: Function Code 0x10-Response Message-Example

Byte	1	2	3	4	5	6	7	8	9	10	11	12
Data	00 01		00 00		00 06		01	10	0F A0		00 08	
illustrate	transaction identifier		protocol identifier		message length		Device address	function code	start address		Number of registers	

6.1.3 Modbus register mapping address

The internal register map of BL200 field controller node consists of 2 parts, one part is the data map of digital input and output and analog input and output module, the address range is 1000...9999; the other part is the serial port module, the address range is 10000... 49999

The state of digital and analog I/O modules can be determined or changed through the register map (addresses 1000 ... 9999).

Tabel 70: Modbus Register Mapping address - I/O Modules

Modbus address		type of data	access type	function code	describe
decimal	hex				
1000…1999	0x03 E8…0x07 CF	1 Bit	read/write	0x01/05/0F	Digital output DO

2000…2999	0x07 D0…0x0B B7	1 Bit	read	0x02	Digital input DI
3000…3999	0x0B B8…0x0F 9F	32 Bit Float	read	0x04	Analog input AI
4000…4999	0x0F A0…0X13 87	32 Bit Float	read/write	0x03/06/10	Analog output AO
5000…8999	0x13 88…0x23 27	32 Bit Unint	read/write	0x03/04/10	DI count value
9000…9999	0x23 28…0x27 0F	1 Bit	read	0x02	Module power-on status

And through addresses 10000 ... 49999 it is possible to determine or change the state of the data mapped from the serial I/O module.

Tabel 71： Modbus Register Mapping address - Serial Port Module

Modbus address		type of data	access type	function code	describe
decimal	hex				
10000…19999	0x27 10…0x4E 1F	1 Bit	read/write	0x01/05/0F	Digital output DO
20000…29999	0x4E 20…0x75 2F	1 Bit	read	0x02	Digital input DI
30000…39999	0x75 30…0x9C 3F	16 Bit	read	0x04	Analog input AI
40000…49999	0x9C 40…0XC3 4F	16 Bit	read/write	0x03/06/10	Analog output AO

6.2OPC UA

6.2.1 Overview

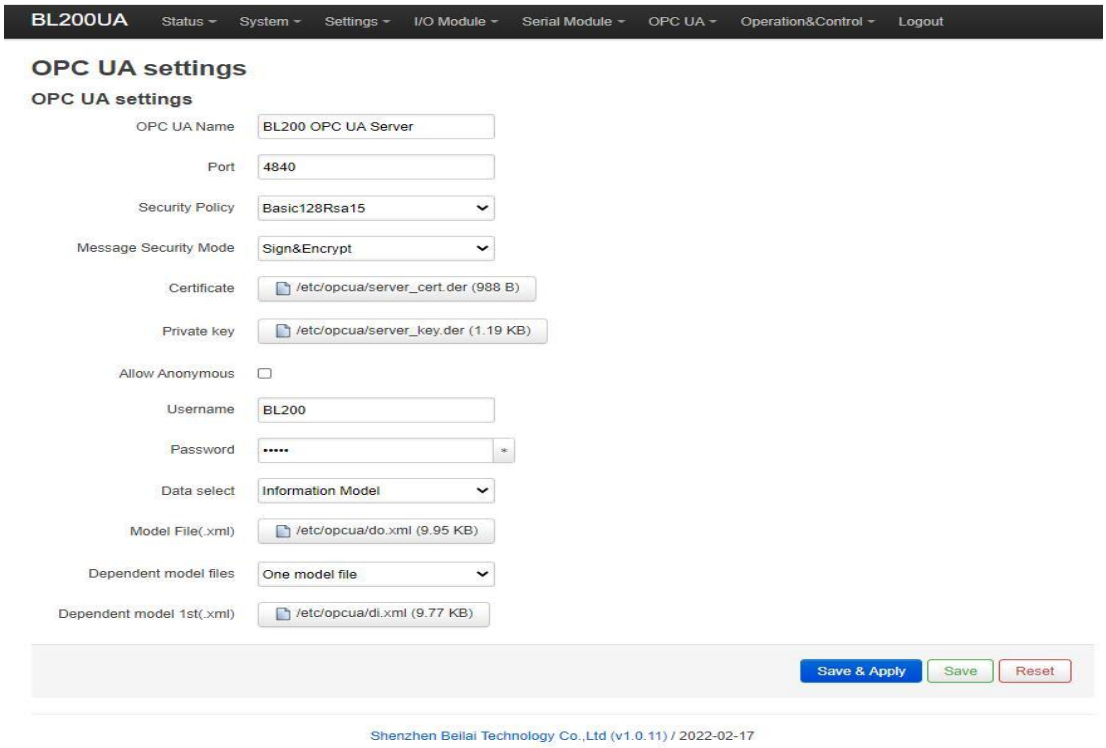
BL200 series distributed I/O system supports OPC UA Server function and provides external data in the form of server. Compliant with IEC 62541 industrial automation unified architecture communication standard, data can be transmitted by encryption (X.509 certificate) and authentication. The security policy supports basic128rsa15, basic256, basic256sha256, aes128sha256rsaoaep, optional signature or signature and encryption. Support custom information model function, you can fill in up to 5 reference models.

6.2.2 Application example

Take the collection of DI, DO, and AI modules, select basic128rsa15 for the security policy, select the signature and encryption method, and use the custom information model for the data format. Refer to an information model as an example. Data can also be

uploaded directly in the company's format. For the definition of each configuration, please refer to the introduction in chapter 5.7 OPC UA.

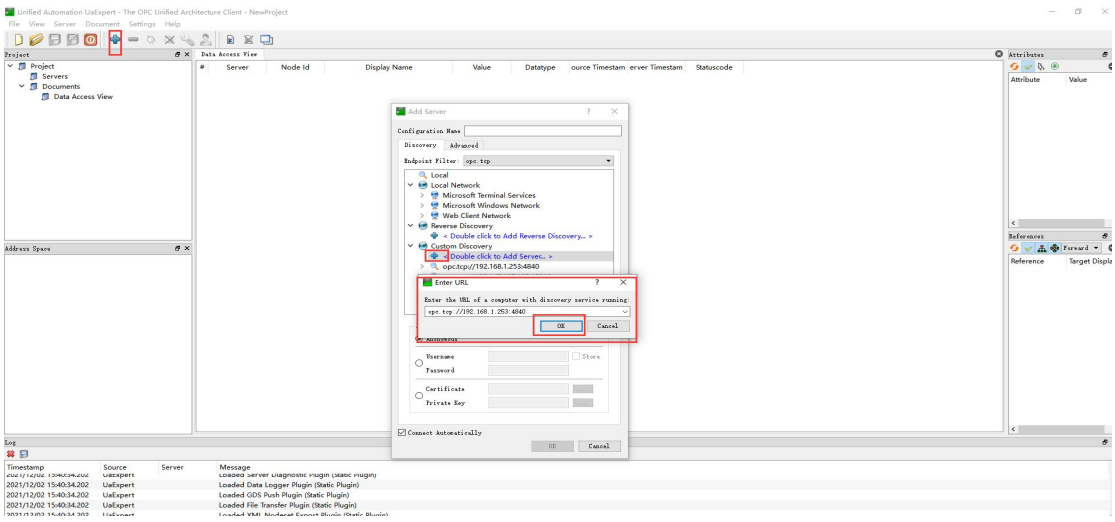
6.2.2.1 OPC UA web configuration



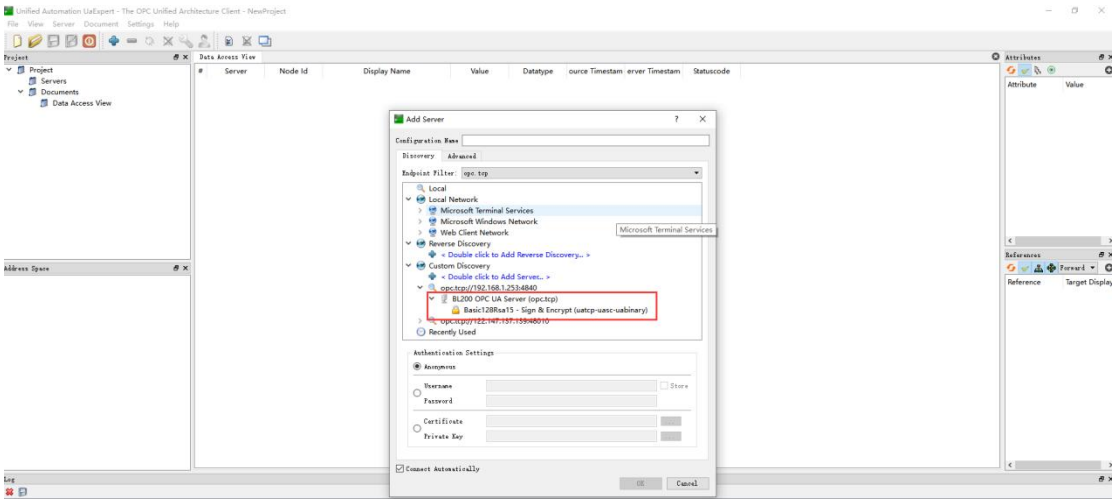
Steps: (1) Fill in the OPC UA name, which can be customized to facilitate the OPC UA client to search and distinguish different OPC UA servers. For example: fill in "BL200 OPC UA Server". (2) The port number of the OPC UA server, default: 4840. (3) Security policy selection. For example, choose basic128rsa15. (4) Message security mode selection. For example, choose Signing and Encryption. (5) Upload the certificate and key, click "Select File" > click "Upload File" > select your certificate or key file, click Open > After it is displayed in the file name box, click Upload file > After uploading the file successfully The file you uploaded will be displayed in the box, click the certificate or key file you uploaded > then your certificate or key file will be displayed in the certificate or key item. (6) Whether to allow anonymity, because of the use of signature and encryption methods, allow anonymity is not checked. (7) Fill in the username and password. The client needs to fill in the username and password when connecting. (8) Select the data, because the user-defined information model is used, so choose the "information model". (9) Upload the information model file. The upload method is the same as uploading the certificate or key file. The uploaded file is an xml file. (10) Depends on the model file, whether there is a reference model, and how many references are there. (11) Dependent model: Upload the model you refer to. The upload method is the same as uploading the certificate or key file. The upload is an xml file. (12) Click "Save and Apply".

6.2.2.2 Send and receive data using UaExpert client connection

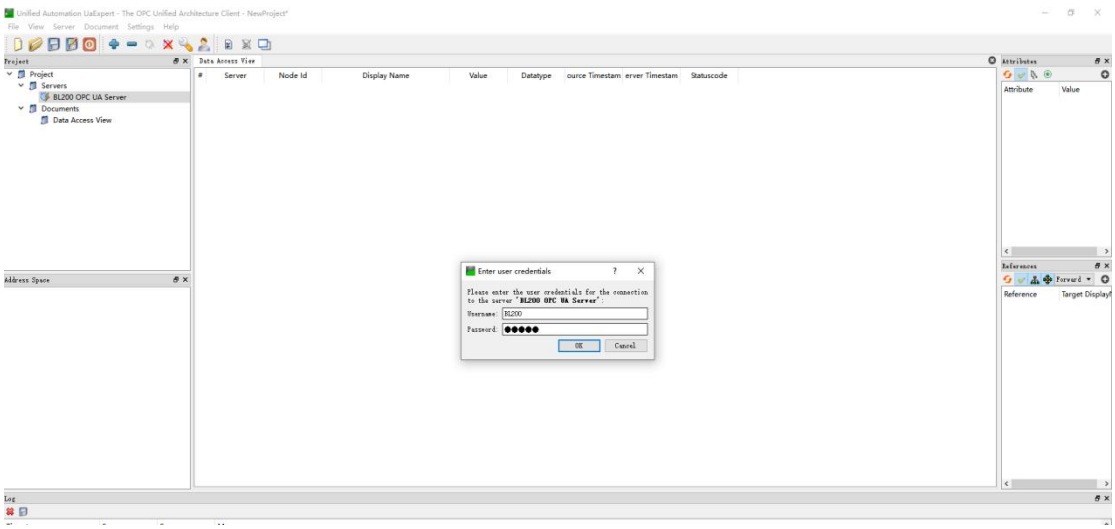
Open UaExpert (OPC UA client) and enter the OPC UA server IP and port.



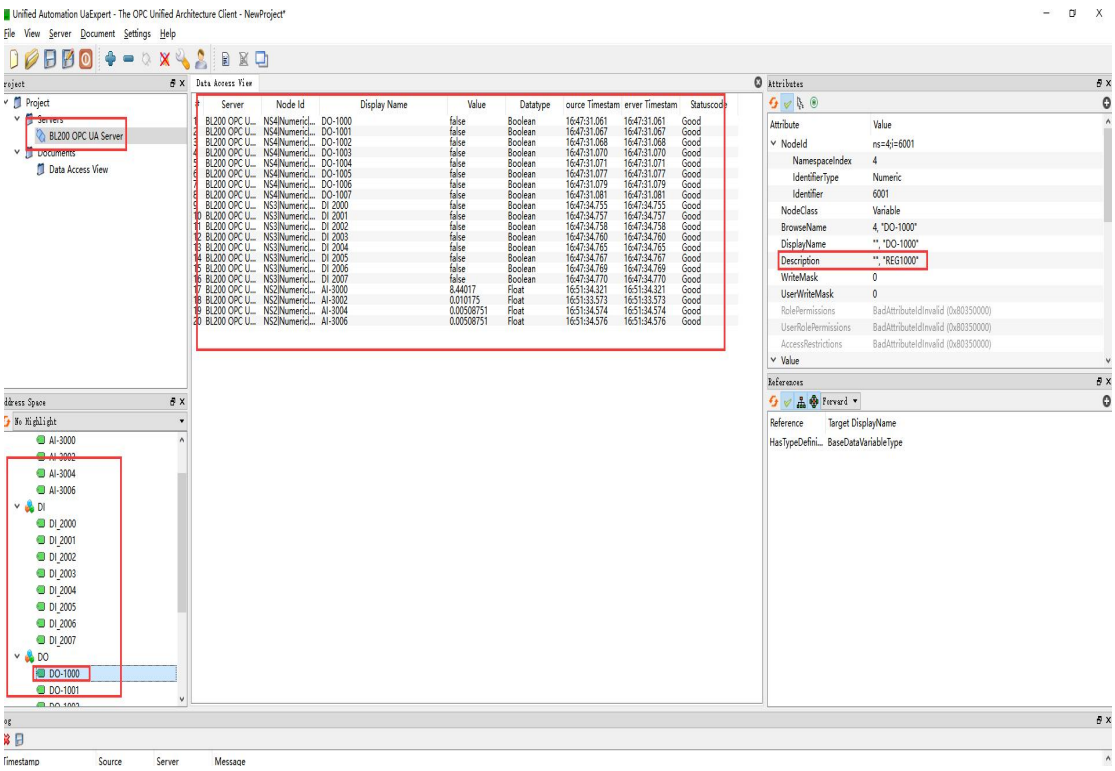
Click Search, click the searched OPC UA server, and click basic128rsa15 for Signature and Encryption.



Enter the set username and password



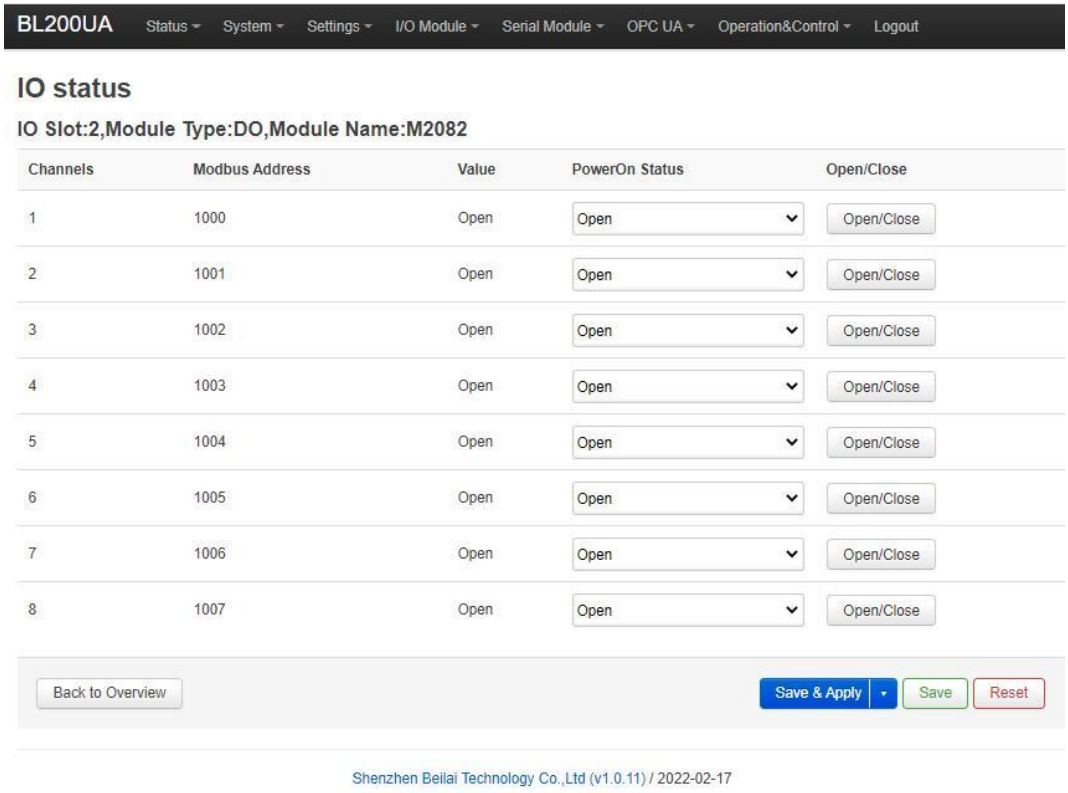
The collected data is as follows:



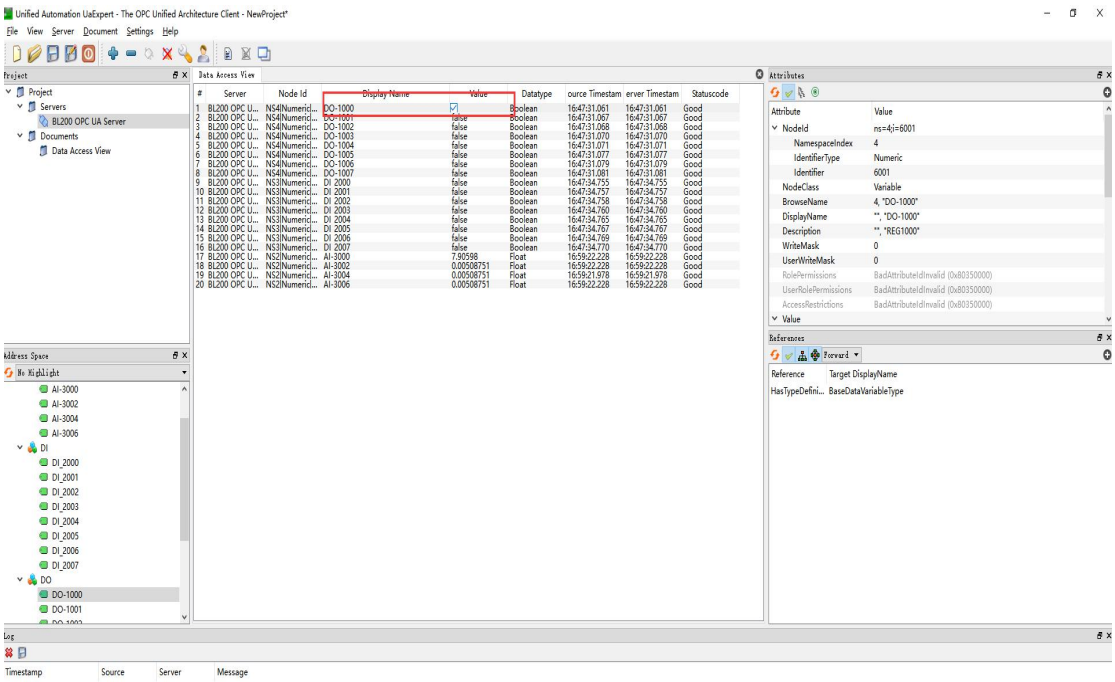
The description item of the custom information model data point must be REG+Modbus address, as shown in the description of the DO-1000 point in the figure above.

OPC UA client data delivery

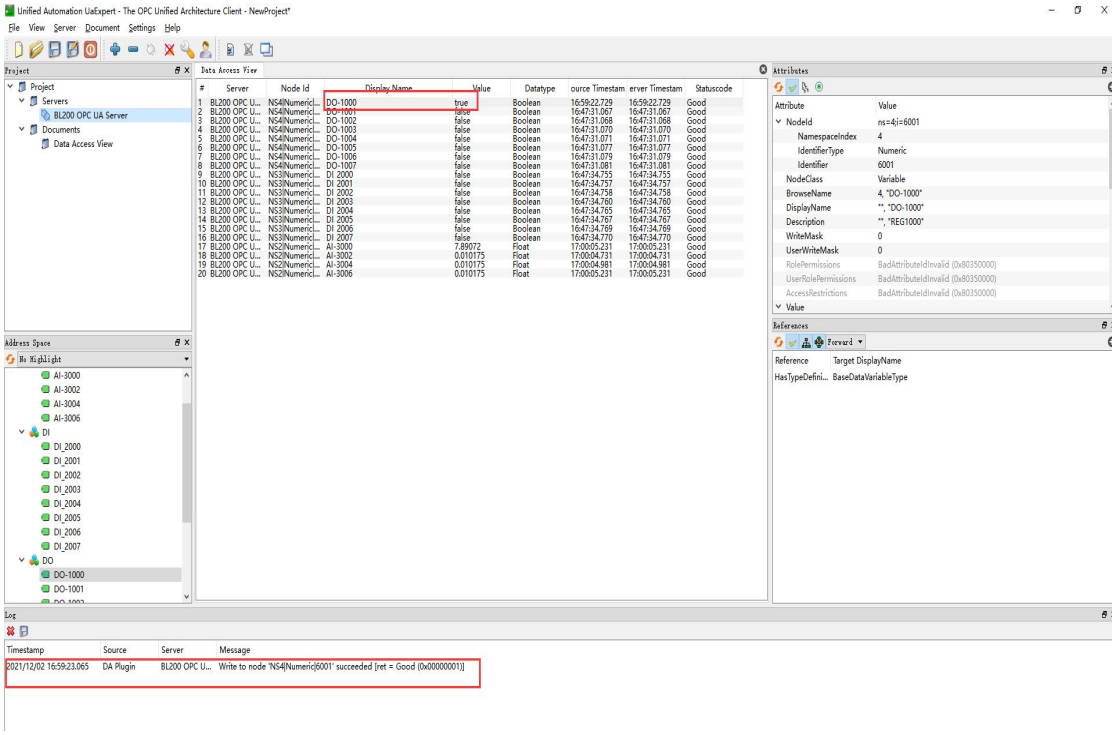
Take the following data point DO-1000 as an example



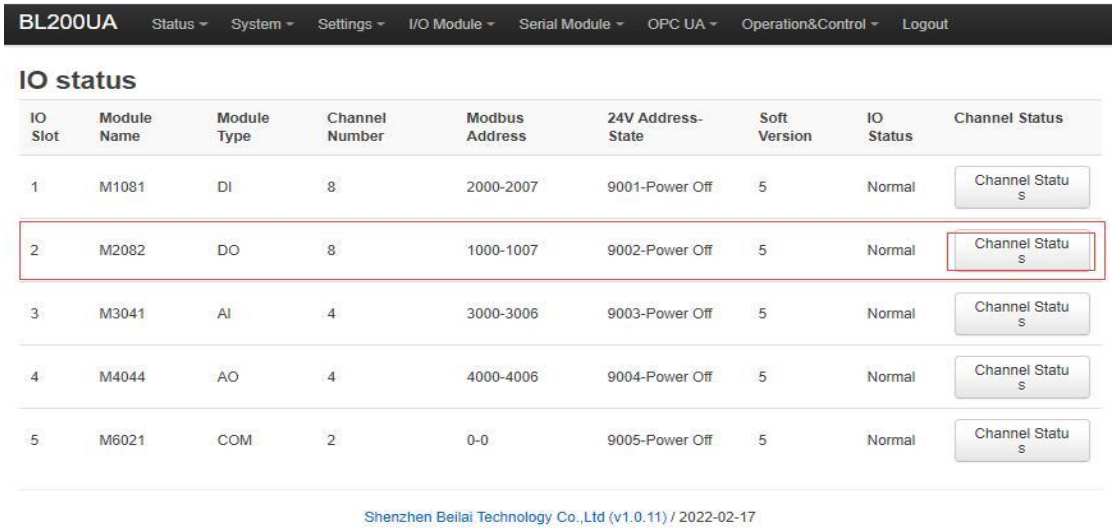
Click the value of the DO-1000 data point, it turned out to be false, there is no √ in the square, click once to put √, click the left mouse button in the blank space or press the [Enter] key on the keyboard

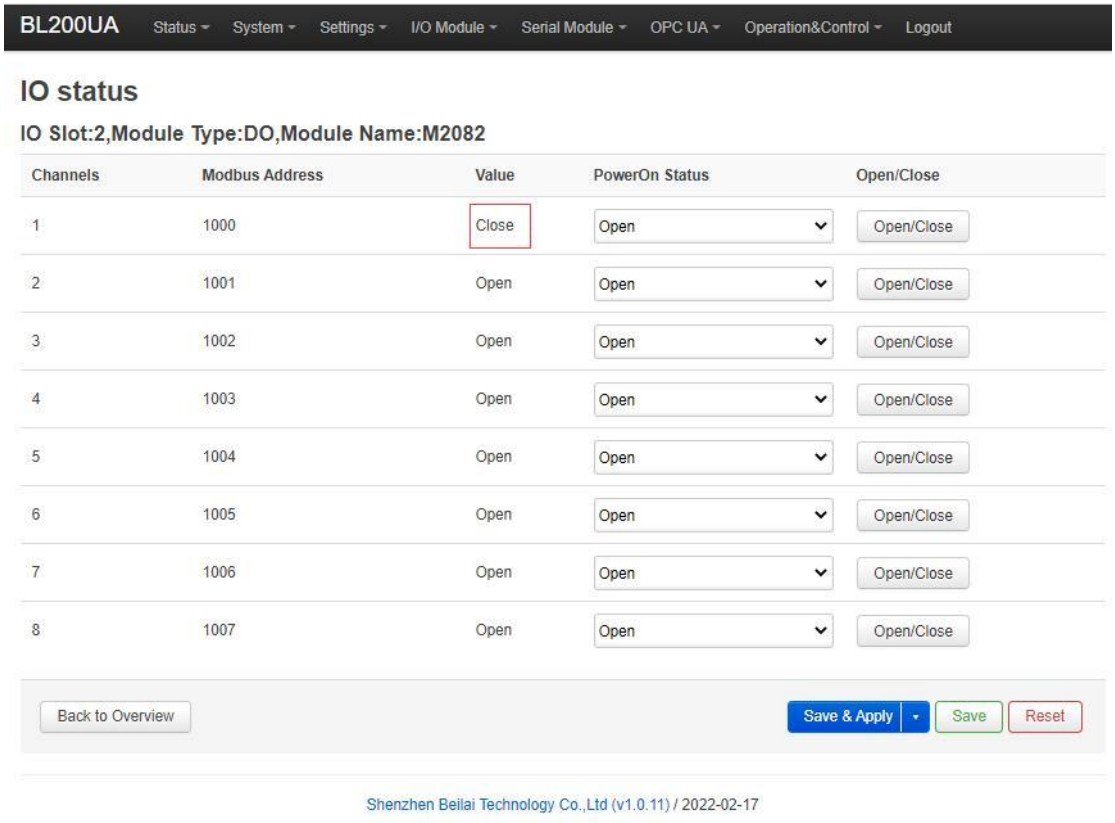


The OPC UA client will send a message successfully. Because the server responds quickly, you can see that the value has changed to "true".



Check the DO status in the web configuration of BL200. DO1 is also changed from the original open to close.





7. Appendix

7.1 List of Figures

7.2 List of Tables