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USR-M100s Industrial Edge I/O Modular Remote Terminal Unit(RTU)

User Manual V1.0.0

Build a Smarter IoT world, Your Trustworthy Partner

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1. Introduction

1.1. Overview

The USR-M100s is an intelligent IoT I/O gateway with comprehensive functions like on-board I/O support and RS-485/232/Ethernet/4G interface, is an advanced modular RTU product with a unique hardware and software design, making it an ideal solution for a variety of industrial data acquisition applications.

The USR-M100s has a unique mechanical design that reduces the amount of time required for installation and removal, simplifying deployment and maintenance. In addition, the USR-M100s supports Modbus RTU Master protocol for retrieving field site serial data from serial meters and also supports OT/IT protocol conversion.

With the ability to convert between multiple protocols, USR-M100s can convert the collected I/O and serial data to protocols suitable for different upper-level software. For example, cloud service via MQTT, SCADA via Modbus TCP, web server via HTTP, and more. This two-in-one design reduces system complexity, the amount of space required in the network topology, and overall installation time. You can also connect your legacy devices to Ethernet, thereby increasing the lifetime of the devices since you can continue using the devices' original protocols.

1.2. Specification

USR-M100s Parameters		
Power	Input Voltage	DC:9~36V
	Power Consumption	Idle：200mA/12V，Max：400mA/12V
Hardware Interface	Serial Port	1 * RS485 / RS232 1 * RS485
	DI	2 * Digital opto-isolated input High level: 9-36V, Low level: 0-2V.
	DO	2 * DO DC contacts rating @R(at resistive load)10A / 28V DC AC contacts rating @R(at resistive load)10A / 277V AC,NO AC contacts rating @R(at resistive load)5A / 250V AC, NC
	AI	2 * Analog input 4-20mA
Physical Spec	Dimensions (W x H x D)	79.6 x 58 x 110 (mm)
	Weight	<300g
	Interface Standard	Terminal, aperture 1.5mm (diameter)
	Mounting options	DIN rail, Wall mounting
	Expansion Method	Slide Rail, Built-in Connector
Hardware Protection	ESD	IEC61000-4-2,Level 3,class B , Contact 6KV , AIR 8KV
	Surge	IEC61000-4-5，Level 3，class B
	EFT	IEC61000-4-4，Level 3，class B
Indicator	POW	ON: Gateway is powered up OFF: Gateway is not power up
	WORK	When the device is working properly, it blinks for 1s frequency
	NET	Blinking when the wan connects to internet

		OFF when there is no network
	DO Status	Light on, the channel output is activated
	DI Status	Light on, the channel is activated by input signal
EtherNET Port	Standard	1 x WAN port 10/100 Mbps, compliance IEEE 802.3, IEEE 802.3u standards, supports auto MDI/MDIX
	Default	Static IP:192.168.0.7
	DNS	Primary DNS server default: 119.29.29.29 Secondary DNS server default: 8.8.8.8
Cellular	Frequency	LTE-FDD:B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28/B66 LTE-TDD: B34/B38/B39/B40/B41 WCDMA: B1/B2/B4/B5/B6/B8/B19 GSM/GPRS/EDGE: 850/900/1800
	Rate	LTE FDD: 150(DL)/ 50(UL) Mbps LTE FDD: 130(DL)/ 30.5(UL) Mbps WCDMA: 384(DL)/ 384(UL) Kbps
	SIM Slot	1 x (3 V/1.8 V) Micro-SIM(3FF)
	Antennas	1 × SMA-K Connectors
Operating Environment	Operating temperature	-25°C ~ 75°C
	Storage Temperature	-40°C ~ 85°C
	Operating humidity	5% ~ 95% non-condensing
Other	Network protocols	ICMP,IPv4,IP,ARP,TCP,DHCP,DNS,HTTP, MQTT
	WebSocket	Supported
	Configuring	Windows Utility, web console (HTTP)
	MQTT	standard MQTT protocol,16 subscription topics and 16 publish topics
	data points	300 - 1000
	Linkage control	Supported. Data collection points, DI, and AI can be used as trigger and executed by DO
	IOT PLATFORMS	Alibaba cloud, AWS IOT, PUSR cloud, Thingsboard
	Offline Cache	Support for SD Card Storage
	Collection Protocol	Modbus RTU/TCP，DL/T645
	Protocol Conversion	Modbus RTU/TCP，Json
	Linked Control	Point Linkage, SMS Alarm
	GPS	GPS/GLONASS/BDS/Galileo/QZSS
Approvals	Regulatory	CE/RED, RoHS

1.3. Ordering Guide

Model	OS	Point	Network	Region	Frequency Band

USR-M100s-C1	RT-Thread	300	LTE Cat1 +Ethernet	China, India	LTE TDD：Band 34/38/39/40/41 LTE FDD：Band 1/3/5/8 GSM：900/1800MHz
USR-M100s-EAU	RT-Thread	300	LTE Cat4 +Ethernet	Europe, Middle East, Africa, Southeast Asia	LTE FDD：B1/3/5/7/8/20/28 LTE TDD：B38/40/41 WCDMA：B1/5/8 GSM/GPRS/EDGE：850/900/1800MHz
USR-M100s-ETH	RT-Thread	300	Ethernet	Global	/
USR-M100s-C1	RTOS	1000	LTE Cat1 +Ethernet	China, India	LTE TDD：Band 34/38/39/40/41 LTE FDD：Band 1/3/5/8 GSM：900/1800MHz
USR-M100s-ETH	RTOS	1000	Ethernet	Global	/
USR-M100s-GL	RTOS	1000	LTE Cat4 +Ethernet	Global	LTE-FDD:B1/B2/B3/B4/B5/B7/B8/B12/ B13/B18/B19/B20/B25/B26/B28/B66 LTE-TDD: B34/B38/B39/B40/B41 WCDMA: B1/B2/B4/B5/B6/B8/B19 GSM: B2/B3/B5/B8 GPS：GPS/GLONASS/BDS/Galileo/QZSS

1.4. Features

- High-performance CPU processing ability, up to 600MHz frequency
- Provides remote serial access over the Internet for industrial serial devices
- 10/100Mbps Ethernet port and support Auto MDI/MDIX
- Built-in 15KV ESD serial port protection
- Supports a wide industrial operating temperature,-40℃~85℃
- Baud rate: 0.6~230.4 Kbps, and any baud rate setting, support None, Odd, Even, Mark, Space Parity bit
- Flexible serial port data framing packing, which can satisfy user’ s various demands for data packets segmentation
- Versatile operation modes: TCP Server, TCP Client
- Provides rich configuration access, including: Windows configuration tool, and Web Browser
- Firmware upgrading via Web Browser and Windows configuration tool
- High security via certificate verification SSL/TLS encryption for serial data transmission,TCPS,MQTTS
- Support modbus RTU master,edge computing, modbus gateway,MQTT gateway
- Support on board I/O for analog input(2 AI), digital input(2 DI), digital output(SSR relay,2 DO), expandable with I/O modules
- Support 2 RS485 serial port, the first one can also be RS232
- Cloud support: MQTT via AWS IOT, Microsoft Azure, Thingsboard, Alibaba Cloud, EMQX, Tuya,Cumulocity IoT and so on

2. Get started

Since the USR-M100s is connected through a TCP/IP network, you may need to know some basic facts about networking in

order to connect the server correctly.

2.1. Installation

You can choose whether to plug in the other peripheral ports at this point or do it later depending on the actual location of the device or level of comfort for performing such operation.

2.1.1. DIN-Rail mounting

The USR-M100s has a unique mechanical design that reduces the amount of time required for installation and removal. In fact, screwdrivers and other tools are not required for any part of the hardware installation, including mounting the device on a DIN-rail, as well as connecting the wiring for both communication and I/O signal acquisition. Furthermore, no tools are required to remove the USR-M100s from a DIN-rail. Removing all of the modules from a DIN-rail is also easy using the latch and release tab.

- ✧ Position the rear panel of the device directly in front of the DIN-Rail, making sure that the top of the clip hooks over the top of the DIN-Rail , as shown in Fig.1. Push up the the release tab towards the bottom of the DIN-Rail until the the mounting clip snaps into place.

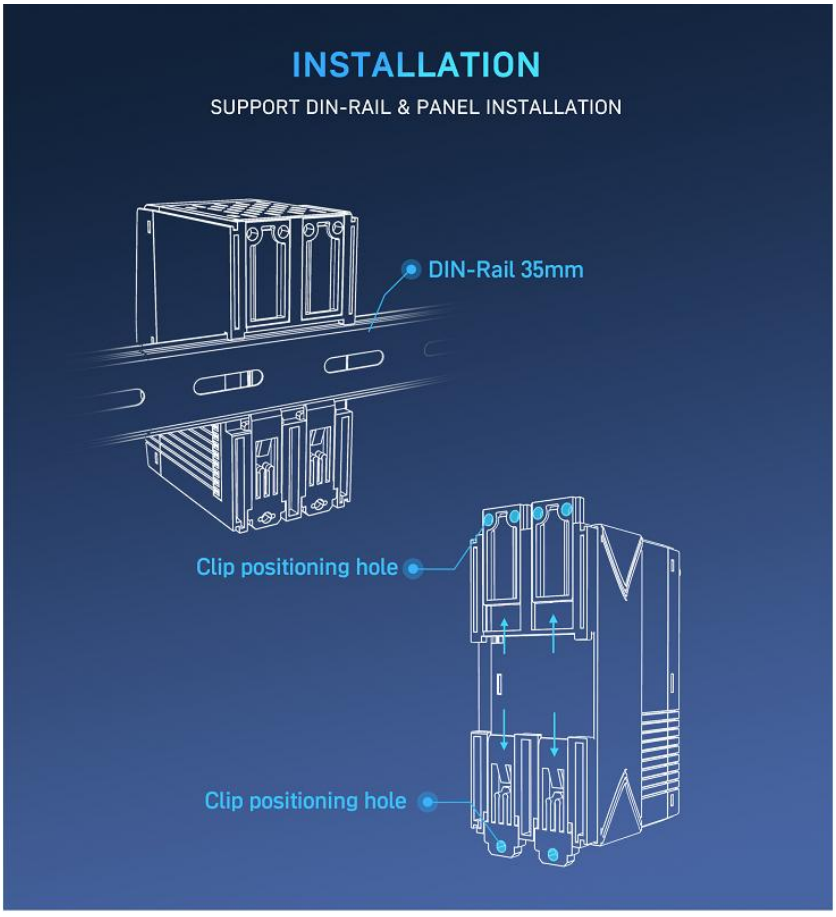


Fig. 1 DIN-Rail mounting and wall mounting

- ✧ If you want to remove the device from DIN-Rail. Pull down the release tab with your finger and then remove the module from the DIN-Rail.
- ✧ NOTE: Disconnect all connections, including Ethernet, serial, and power cables, from the device before removing the device from the DIN rail.

2.1.2. Wall mounting

The wall mounting option provides better shock and vibration resistance than the DIN-Rail vertical mount.

- ✧ Locate the installation site and place the device against the wall. Use the wall mount plates as a guide to mark the locations of the screw holes.

✧ Drill two holes over the 4 marked locations on the wall. Insert the wall sinks into the walls.

✧ Insert the screws(M3 size) into the wall sinks then tighten the screw to enhance stability, see the following Fig.1.

2.2. Serial port

The USR-M100s supports 2 serial ports, 1 RS232/485 and 1 RS485, and adopts Spring-type terminal. The serial port pin assignments are shown in Fig.2. When connecting up Modbus devices via an RS485 network they should be daisy chained together, and a dual twisted pair cable are recommended. The connections should be kept the same throughout the network: positive to positive, and negative to negative. These may sometimes be labeled up as A and B. The maximum length of the serial network cannot exceed 1200m regardless of boosters and repeaters.

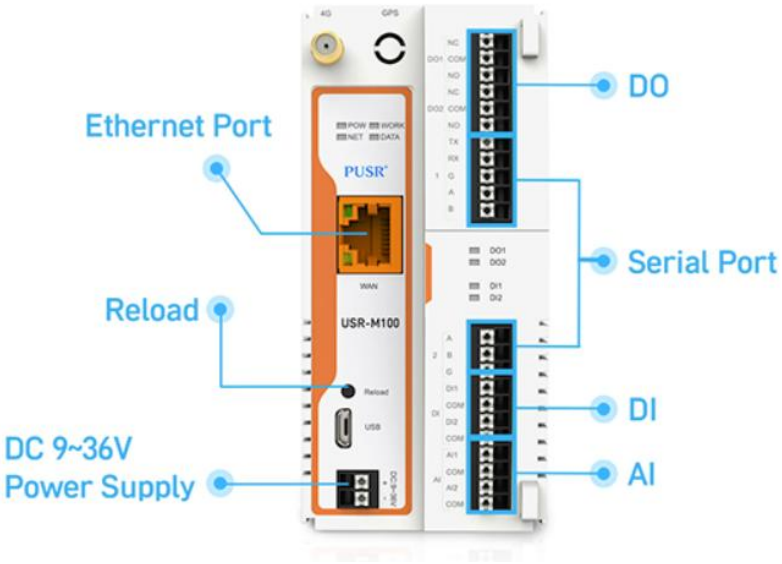


Fig. 2 USR-M100s interfaces

2.3. I/O interfaces

USR-M100s is equipped with two 11-pin Terminal blocks that are used for I/O interfaces. The pin assignments of terminal block are shown in table 1. The PIN assignments are also marked on the device’ s nameplate, in order to avoid confusion.

Table 1 Terminal pin assignments

Terminal block1	Definition
DO1 NC	Relay Output 1 normal close
DO1 COM	Relay Output 1 Common
DO1 NO	Relay Output 1 Normal open
DO2 NC	Relay Output 2 normal close
DO2 COM	Relay Output 2 Common
DO2 NO	Relay Output 2 normal open
TX	COM 1 RS232 TX
RX	COM 1 RS232 RX
G	COM 1 Ground

Terminal block2	Definition
A	COM 2 RS485 A
B	COM 2 RS485 B
G	COM 2 Ground
DI1	DC Digital Input 1
COM	Digital Input 1 Common
DI2	DC Digital Input 2
COM	Digital Input 2 Common
AI1	Analog Input 1
COM	Analog Input 1 Common
AI2	Analog Input 2
COM	Analog Input 2 Common

2.3.1. I/O specifications

Table 2 I/O specification

Inputs		
Digital inputs	DI channels	2
	Input Type	Dry/Wet contact
	Wet contact	On: 9 to 36 VDC Off: 0 to 2 VDC
	Dry contact	On: close Off: open
	Range	9-36V DC
	Input filter time	Software configurable,10~65535ms
Analog inputs	Quantity	2
	Type	Differential input
	Resolution	16 bit
	Range	4~20mA current
	Accuracy	1% FSR
Outputs		
Digital outputs	Quantity	2
	Type	Form C SSR Relay
	AC Contact Current Rating	10A / 277V AC at resistive load, NO 5A / 250V AC at resistive load, NC
	DC Contact Current Rating	10A / 28V DC at resistive load
	Operating time	10 ms max.
	Release time	5ms max.
	Mechanical Endurance	10000000 operations

2.3.2. I/O wiring

The left picture in Fig.3 shows an example of digital input (DI) dry contact in which the digital input channel is controlled by a switch that is wired to the COM pin of the DI port. An external DC power(9~36V) is supplied this external circuit via the wiring of DI pin and the switch. The position of switch and power supply can be interchanged.

The right picture in Fig.3 shows an example of digital input (DI) wet contact in which the digital input channel.

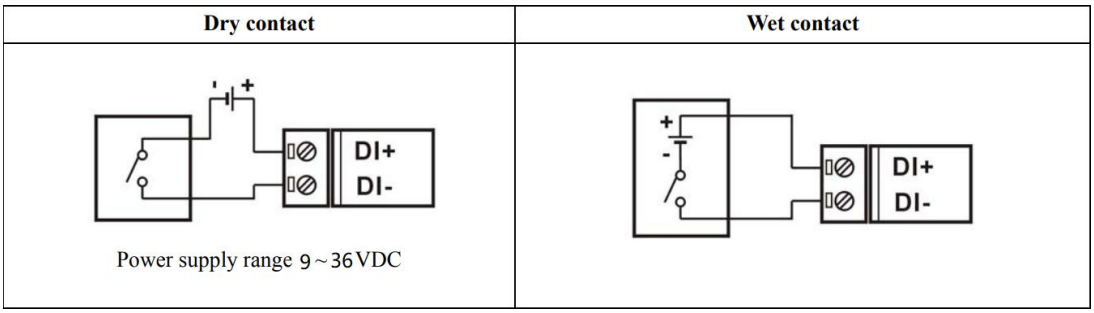


Fig. 3 Dry/Wet contact wiring

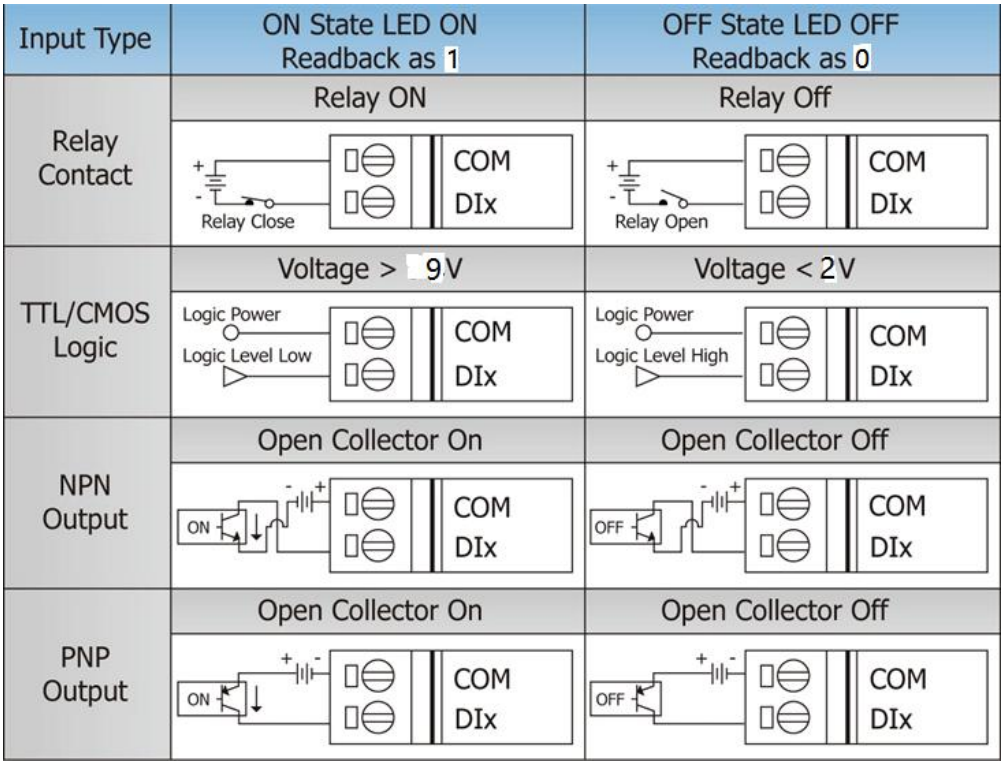


Fig. 4 DI wire connection

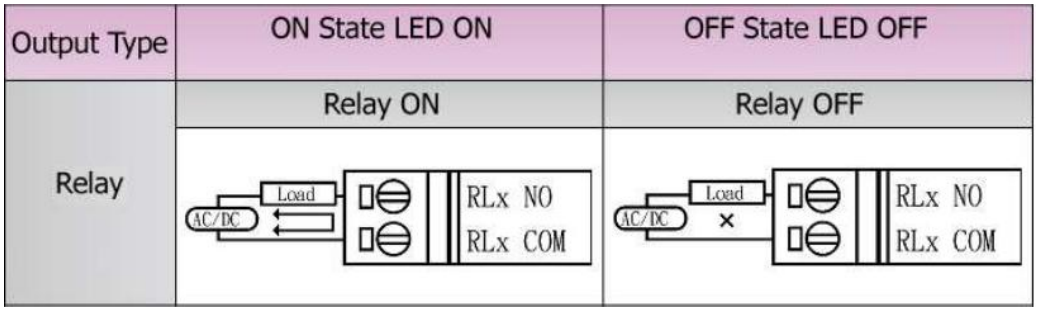


Fig. 5 DO wire connection

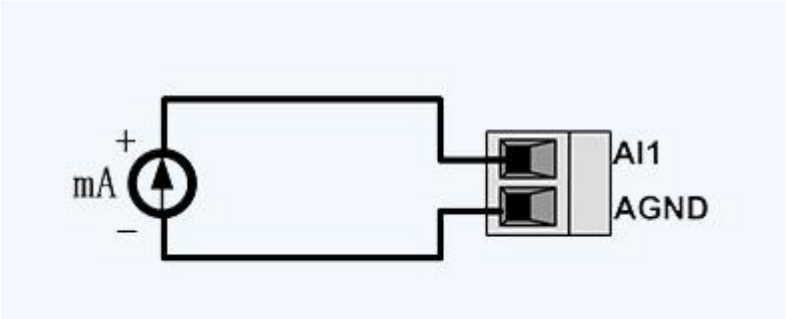


Fig. 6 AI wire connection

NOTE:

–All DI channels should be configured to dry contact or wet contact in the same time

–wire range:28~16 AWG(0.2~0.1 mm^2), strip length 10mm

2.3.3. Modbus address mapping table

The internal register map of USR-M100s field controller node is the data map of digital input and output and analog input module.

Table 3 IO modbus address

Data points	M100s / IO module	Start address	Register address	Function code	Attribute	Data type	Default status
DO 1	USR-M100s	0000	00001	0x1,0x5,0xF	Write/read	Uint8	NC
DO 2	USR-M100s	0001	00002	0x1,0x5,0xF	Write/read	Uint8	NC
DO 3	IO Module	0002	0003	0x1,0x5,0xF	Write/read	Uint8	NC
…	IO Module	…	…	0x1,0x5,0xF	Write/read	Uint8	NC
DI 1	USR-M100s	0000	10001	0x2	read	Uint8	0
DI 2	USR-M100s	0001	10002	0x2	read	Uint8	0
DI 3	IO Module						
AI 1	100	0000	30001	0x4	read	float32(ABCD)	0
AI 2	100	0001	30003	0x4	read	float32(ABCD)	0

2.4. Power supply

The USR-M100s I/O gateway provides 2-pin power supply input terminal. The power supply support anti-reverse protection. Power supply range: 9～36VDC.

2.5. Ethernet RJ45 interface

The 10Base-T/100Base-TX adaptive Ethernet RJ45 interface supports automatic MDI/MDIX connection, refer to Fig.7 below for the pin distribution of the RJ45 interface.

Link LED: green color. Lights(steady on) when the module is connected to a network.

Activity LED: orange color. Blinks when network data is transmitted through the port.

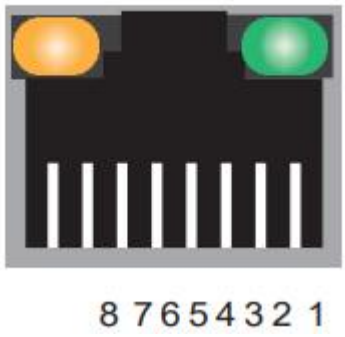


Fig. 7 RJ45 with light

Table 4 Ethernet pin assignments

Pin number	Signal name
1	Send data+(TD+)
2	Send data-(TD-)
3	Receive data+(RD+)
6	Receive data-(RD-)
4,5,7,8	Unused

2.6. Cellular Network

The USR-M100s can also connect to the Internet via 4G/3G/2G cellular network. It’ s very convenient for users to run the projects that there are not Ethernet networks. Using cellular network, the 4G antenna is needed and a sim card should be installed in the slot. Push the side panel to the other side and you will see the SIM card slot. Open the slot, install the sim card

and lock the slot.

Note: SIM card installation requires the USR-M100s to be powered off.

2.7. Extended modules

The USR-M100s supports to extend the I/O ports using extension I/O modules. The USR-M100s supports up to 6 extension I/O modules and can be expanded to a maximum of 50 I/O ports. There are 5 different types of extension modules available for selection: 4DO+4DI, 4AI +4DO, 8DO, 8DI, 4AI+4AO.

M100s has a self-identification mechanism for the expansion module, which can quickly and automatically identify the expansion module model that is accessed, and compare it with the pre-configured sequence of the expansion module by the customer. If the sequence is wrong, the alarm can be given by the indicator light to prevent the application from being caused by the wrong location in the field installation process.

Note: After the expansion machine is connected to the M100 host, the RS485 port of the expansion machine cannot be used. Users can only collect and control the IO status of the expansion machine from M100 host.

The specific steps is as the follows:

1> Connect extended modules to M100 host

2> Power on USR-M100s, and configure the parameters on preconfigured page, and then save settings and restart the M100.

3> Users can check if the sequence is right on preconfigured page.

Model	USR-IO4040	USR-IO0440	USR-IO0080	USR-IO8000	USR-IO0404
Power Input Range	DC12~24V	DC12~24V	DC12~24V	DC12~24V	DC12~24V
Number of DI	4	0	0	8	0
Number of AI	0	4	0	0	4
Number of DO	4	4	8	0	0
Number of AO	0	0	0	0	4
Type of AI	/	Current	/	/	Current
Signal range of AI	/	4~20mA	/	/	4~20mA
Voltage range of DI	9~36V	/	/	9~36V	/
Type of DO	Relay	Relay	Relay	/	/
Capability of DO	3A	3A	3A	/	/
Type of AO	/	/	/	/	Current / Voltage
Signal range of AO	/	/	/	/	4~20mA 0~10V
Communication port	RS485	RS485	RS485	RS485	RS485
Support extendable	√	√	√	√	√

2.8. LED indicators

The USR-M100s smart RTU provides LED indicators to monitor the device working status with a comprehensive simplified troubleshooting, the LED indicator behaviors are defined below.

Table 5 LED indicators

LED name	status	description
POW	Steady on	Power supply is normal
	Off	No power supply or abnormal power supply
WORK	Blinking	Power is on and the device is ready. System is booted up and running
NET	Blinking	Ethernet WAN connection
	Steady on	4G LTE network connection
	off	No network
DATA	Blinking	Serial port is transmitting data
DO1	Steady on	Light on, the channel output is activated
DO2	Steady on	Light on, the channel output is activated
DI1	Steady on	Light on, the channel is activated by input signal
DI2	Steady on	Light on, the channel is activated by input signal

2.9. Factory default settings

The USR-M100s remote IO module comes with the following default settings.

Table 6 Default parameters

Parameter	Default Values
User Name	admin
Password	admin
Device IP address	192.168.0.7
Subnet Mask	255.255.255.0
Gateway IP	192.168.0.1
COM port	9600,None,8,1
Socket function	Disable
MQTT	Disable
Edge computing	Disable

2.10. Quick test

USR-M100s has a built-in Web server, which provides a convenient way to access and configure the remote IO module. Users can use Edge , Firefox or Google browser to access it. This chapter is a quick introduction to the USR-M100s smart IO gateway. It is recommended that users read this chapter and follow the instructions once for the system, and you will have a basic understanding of the product. For specific function details and instructions, please refer to the subsequent chapters.

2.10.1.Download the software

Download the setting software from PUSR’ s website:

https://www.pusr.com/support/downloads/H7-version-set-up-software.html

https://www.pusr.com/support/downloads/usr-tcp232-test-V13.html

You may find it in the download section under your product page. Run the software when the installation has been completed as shown in Fig.8 and Fig.9.

It is strongly recommended for the users to set the Network Parameters through configuration tool first. Other device-specific configurations can later be carried out via user-friendly Web-Interface.

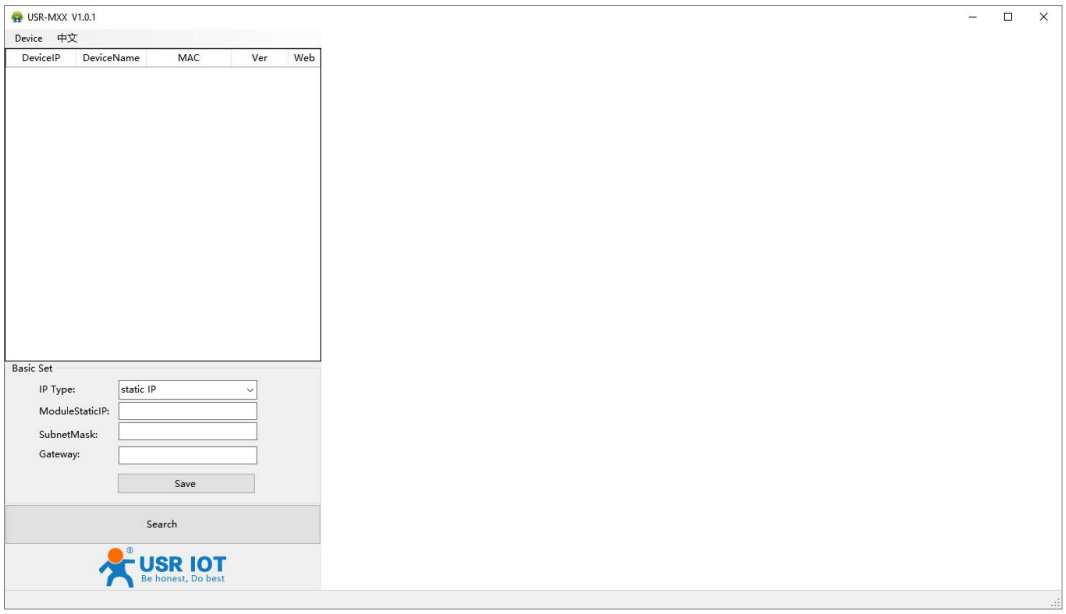


Fig. 8 Windows configuration tool

2.10.2.Hardware connection

For fast networking of USR-M100s smart RTU, you need to prepare a PC, a router, a network cable, a serial cable, and a

DC12V/1A power supply. The hardware connection is shown in Fig.10. To establish a TCP / IP network all devices must be connected to the same network either locally or via gateway connections.

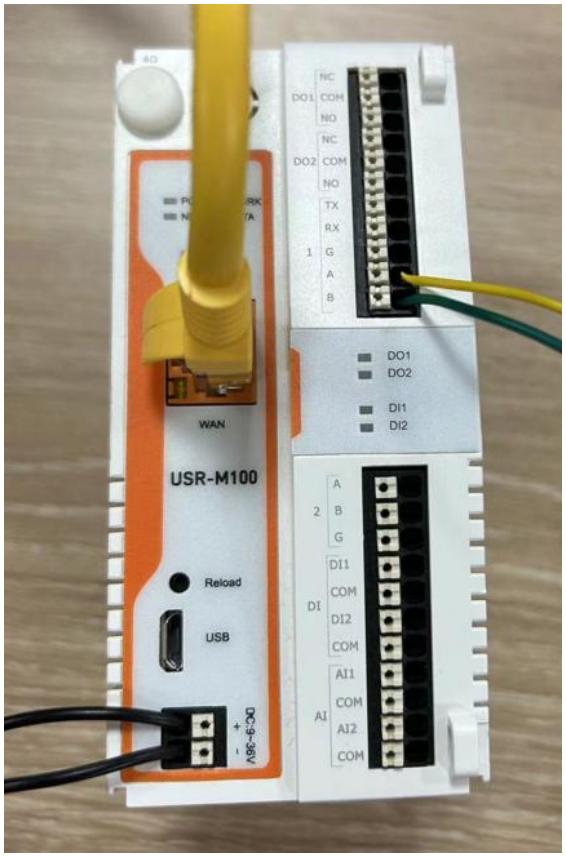


Fig. 9 Hardware connection

- ✧ Connect the power line with the USR-M100s power input. If the power is properly supplied, the "PWR" LED will show a solid red color. After the system is ready, the "WORK" LED will blink.
- ✧ Connect one end of the Ethernet cable to the M100s' s 10/100M Ethernet port and the other end of the cable to the same Ethernet network(same router or switch).
- ✧ Connect a serial data cable(USB to RS232 or RS485) between the USR-M100s and PC. Screwless push-in type connection for simple and easy connection.

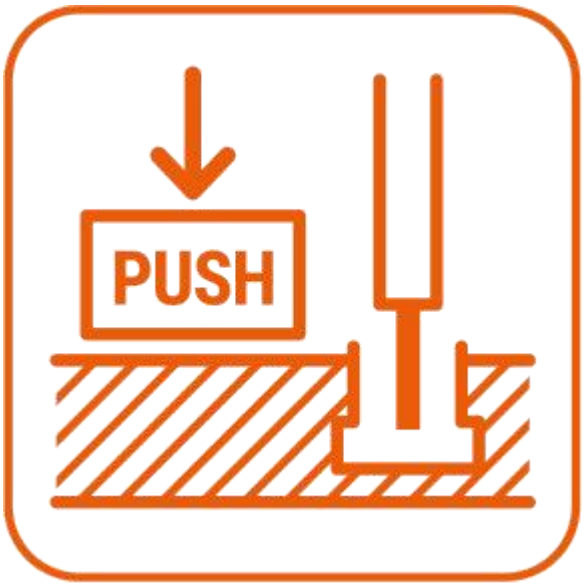


Fig. 10 Push in type connector

2.10.3.Network configuration (Step1)

The Broadcast Search function is used to locate all USR-M100s gateways that are connected to the same LAN as your

computer. Since the Broadcast Search function searches by MAC address and not IP address, all M100s connected to the LAN will be located, regardless of whether or not they are part of the same subnet as the host.

Click Search to search for USR-M100s gateways. When your unit appears in the search results, you can click device to select it and change the IP type to DHCH, save your change. Wait for 5s and search it again.

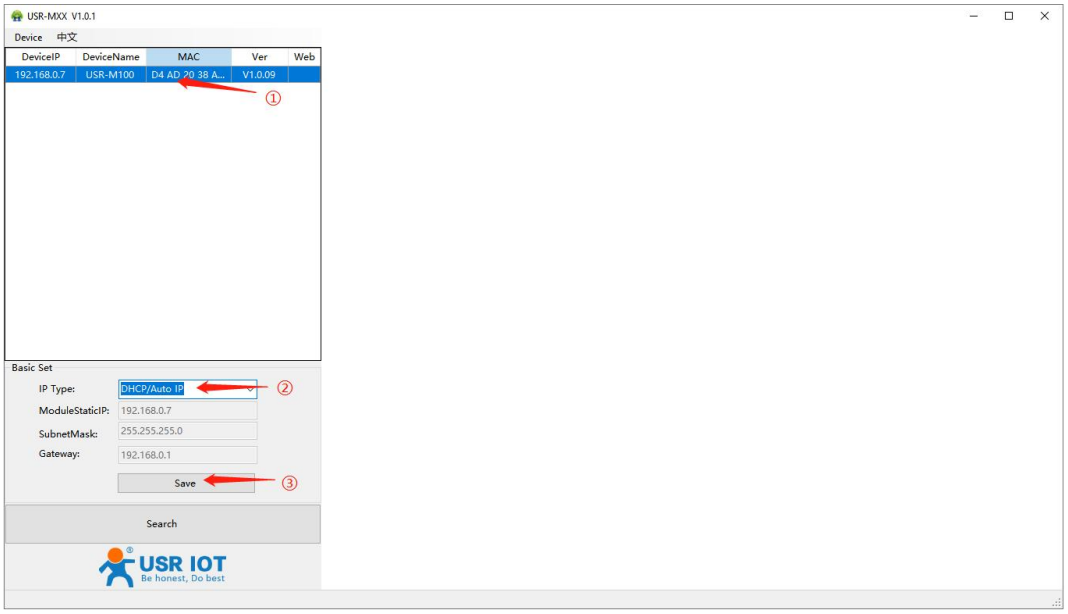


Fig. 11 IP network setting

When accessing the M100s gateway through the Web, the IP address of the M100s gateway and the PC must be in the same network segment. After changing the IP address of the M100s gateway, you can access the Web page of the M100s gateway through browser and perform related configuration operations on it. The user name and initial password are both "admin".After entering the user name and password, click "OK" and the server will authenticate. After success, you will enter the main page of the Web server, as shown in Fig.12.

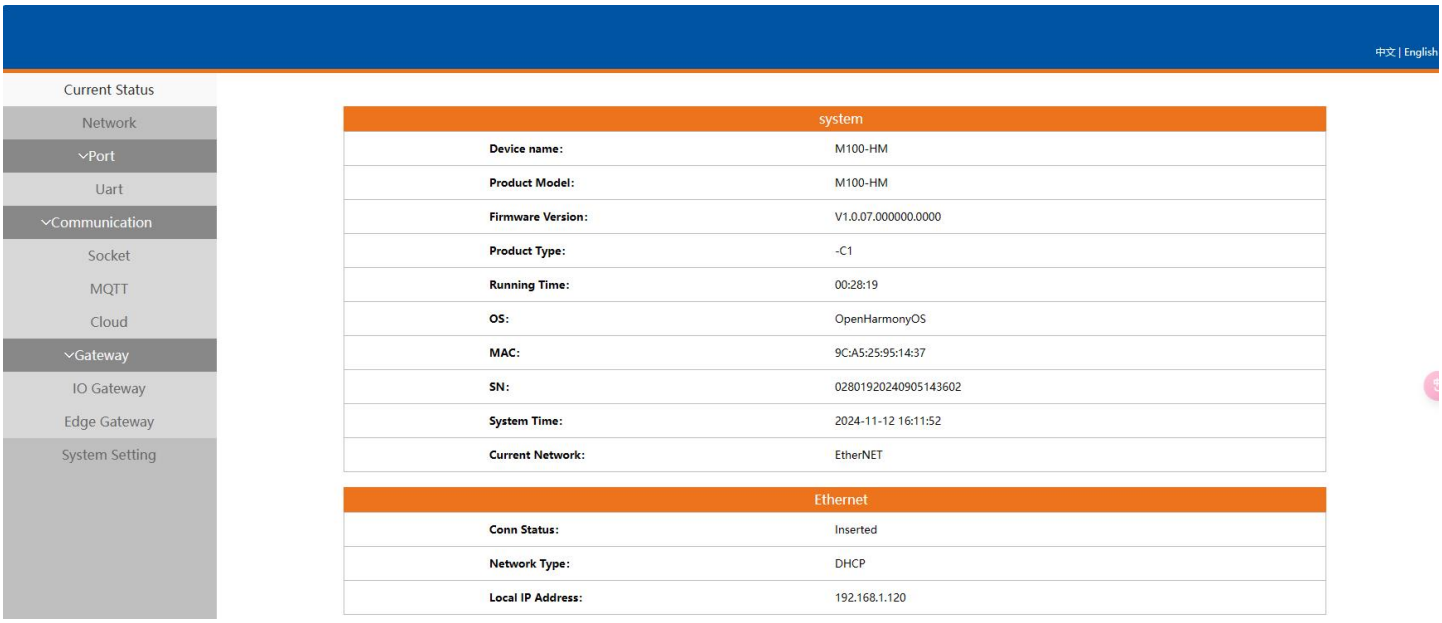


Fig. 12 The main interface of the Web server

The IP address of the PC must be modified to ensure that it is in the same local area network as the IP of the M100s gateway if you want to connect M100s to PC directly via a net cable. The default IP address of M100s IO gateway is: 192.168.0.7. Set the PC's IP address as: 192.168.0.X (X is any valid value from 2 to 253 except 7). The specific Windows system operation page is shown in Fig.14. you can access the Web page of the USR-M100s gateway through browser as mentioned above.

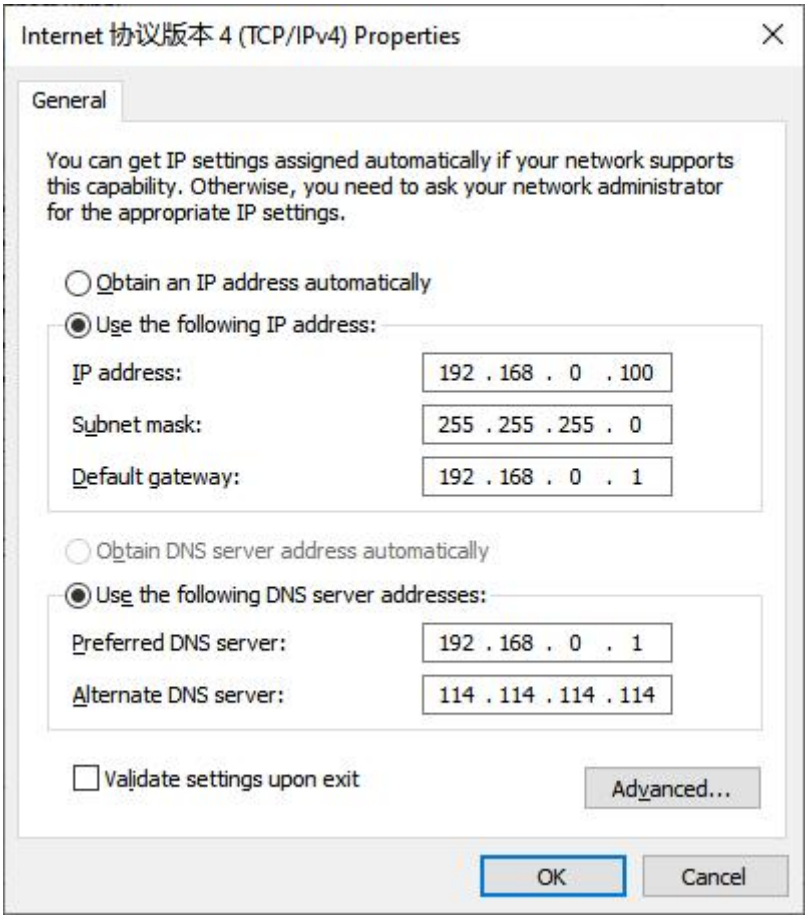


Fig. 13 IP setting of PC

2.11. Reload factory settings button

Press the "Reload" button (inside a small hole) on the back panel for 3-15 seconds and then release or follow the procedure in Section 3.1.9, to restore the USR-M100s gateway to the factory default settings.

2.12. Technical support and assistance

Please visit the USR IoT website: https://www.pusr.com where you can find the latest information about the product.

Contact your distributor, sales representative, or PUSR's support center:

http://h.usriot.com/index.php?c=frontTicket&m=sign for technical support if you need additional assistance. Please have the following information ready before you submit a ticket:

- Product model
- Description of your peripheral attachments
- Description of your software (firmware version, application,function description,etc.)
- A complete description of the issue and steps to reproduce

3. Configuration and parameter details

3.1. Web interface

The USR-M100s' s user-friendly web configuration tool was designed specifically to make configuration and reconfiguration easy; no reconfiguration effort is required for the unchanged modules.

Every USR-M100s Industrial IO gateway is equipped with a built-in web server in the firmware. Therefore, the device can be accessed by using a web browser for configuring by entering the device' s IP address in the URL field of your web browser. An authentication will be required and you will have to enter the username (Default value is "admin") and password (Default value is "admin") for accessing the web interface as shown in Fig. 16. This approach (web interface) for configuring your device is the most user-friendly. Please go to its corresponding section for a detailed explanation.

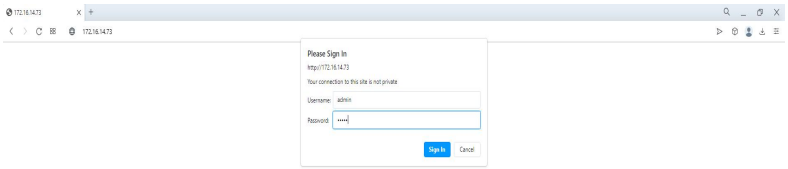


Fig. 14 Authentication Required for Accessing Web Interface

3.1.1. Status

After entering the correct user name and password and the authentication is successful, you will enter the main page of the Web, as shown in Fig.15

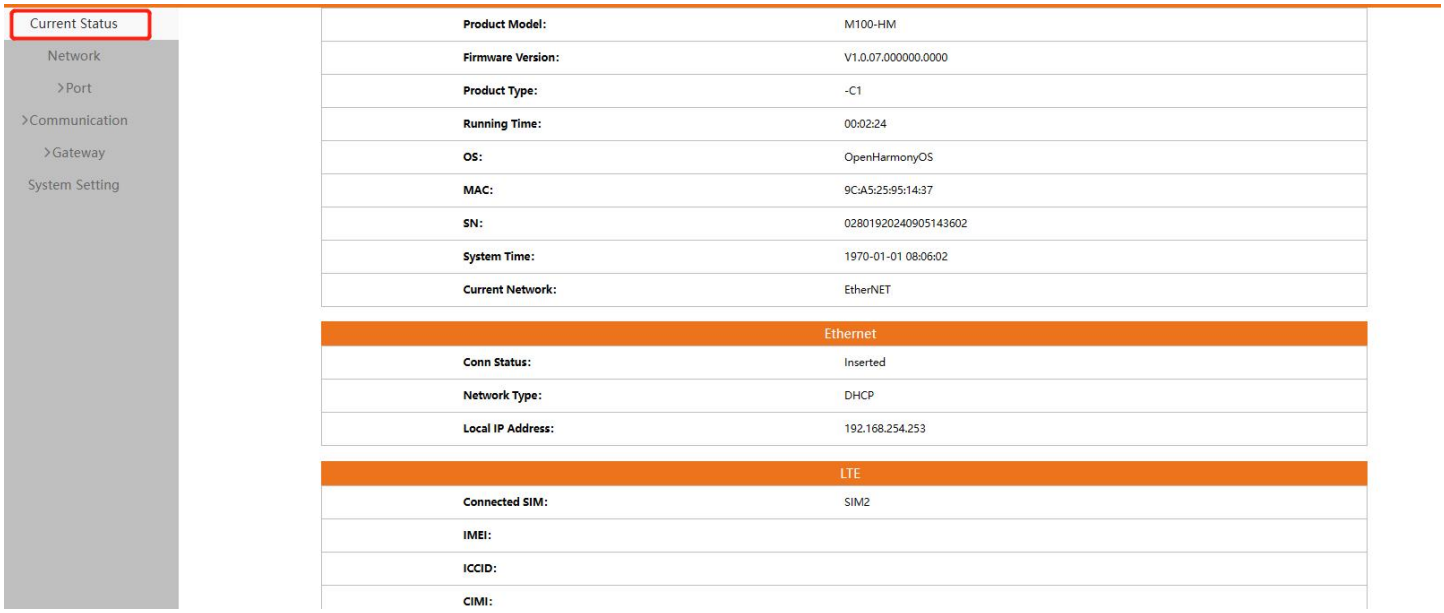


Fig. 15 Status

The function of the device status part is to display some specific information of the current device, including system, network, serial port, mqtt gateway and Edge computing status.

Table 7 Overview status list

Parameter Item	Description
System	
Model name	The name of the gateway, which can be customized by the user on the "Miscellaneous settings" page.
Firmware version	The current software version of the gateway.
Type	The current hardware version of the gateway.
Running time	Total time after the device start work. It will starts from 0 after reboot.
OS	Operating system.
MAC address	The MAC address of the gateway.
Current network type	Which interface to access the internet, default WAN interface, that is ethernet port.
Ethernet	
Conn Status	If the Network cable is connected
Network Type	DHCP or static
Local IP address	The IP address of the gateway.
LTE	
ICCID	If it’s blank, indicating that the USR-M100s can’t check the sim card or there’s not installation of the sim card.
CIMI	International Mobile Subscriber Identity
Signal Value	The larger the value, the better the signal.
Signal Strength	Another expression of signal value.
Local IP Address	The IP address of the gateway based on cellular network.
Network Type	Being used network standard.
Connection Status	Whether connect to the cellular network
TCP connection status	
Socket1	Whether socket1 is enable
Socket2	Whether socket2 is enable
MQTT connection status	
MQTT1	Whether MQTT1 is enable
MQTT2	Whether MQTT2 is enable
Cloud connection status	
Enable status	Whether PUSR cloud is enable
Connection status	Connection status of Edge computing. CONNECTING:M100s is connecting to PUSR cloud CONNECTED: M100s has connected to PUSR cloud

3.1.2. Network configuration

If using Ethernet port to connect to the Internet, you must assign a valid IP address to the USR-M100s before it will work in your network environment. The IP address must be unique within the network. If the device is connected to the Internet and should connect to other servers over the Internet to get some services such as Network Time Protocol (NTP) server, you will

need to configure the DNS server in order to be able to resolve the host name of the NTP server. The detailed description of the configuration parameters on this interface is shown in table 8.

Users can choose the network method according to their needs in network priority webpage. The settings of cellular network is in LTE Cat1 webpage.

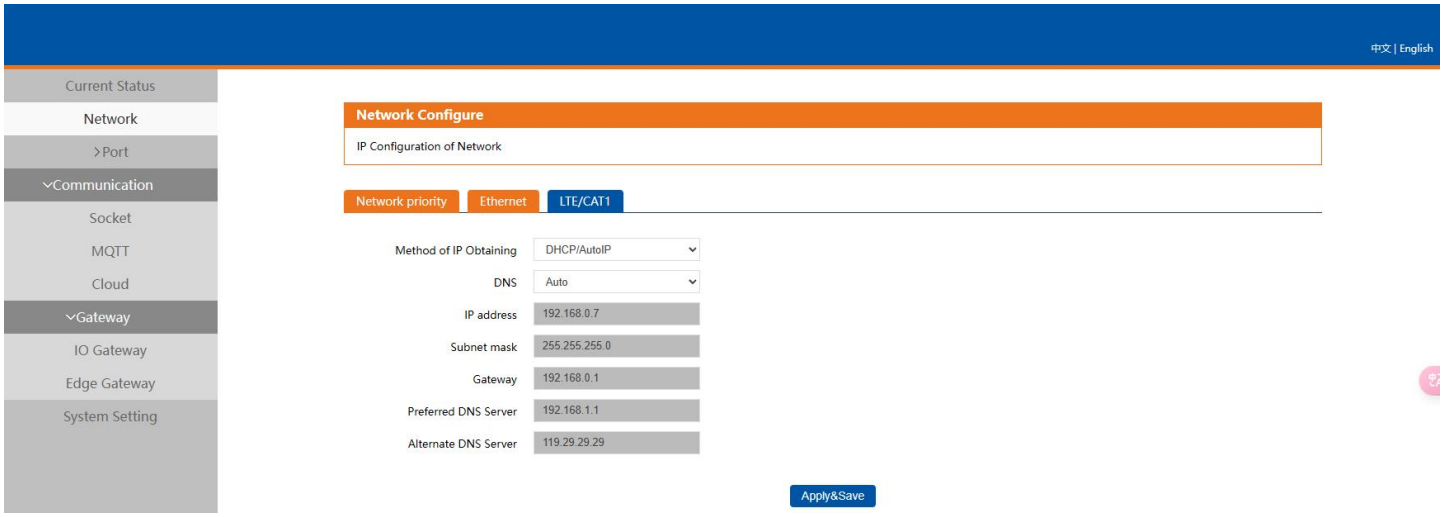


Fig. 16 Network web page

Table 8 Network configuration list

Parameter Item	Description
Network priority	EtherNET Only: Connect to the Internet via ethernet port(WAN). default setting. EtherNET: Prefer to use Ethernet port for networking. If Ethernet port is not available, switch to cellular network. LTE Cat1: Prefer to use cellular network for networking. If cellular network is not available, switch to Ethernet port.
IP obtaining type	Click the drop-down menu to select the IP Address Setting mode: Static or DHCP. If you choose DHCP, the rest of the options will be greyed out or disabled.
DNS type	Click the drop-down menu to select the DNS mode: auto or manual. If you choose auto, the DNS options will be greyed out or disabled.
IP address	IP address is a 32-bit address assigned to devices connected to the Internet. The IP address consists of two fields: the network number field (Net-id) and host number field (host-id). In order to facilitate the management of IP addresses,IP addresses are divided into five categories: Class A, B, and C addresses are unicast addresses, Class D addresses are multicast addresses, Class E addresses are reserved addresses for future special purposes. The IP addresses currently in large numbers belong to three types of addresses: A, B, and C.
Subnet mask	The mask is a 32-bit number corresponding to an IP address. Some of these numbers are 1, and the others are 0. The mask can divide the IP address into two parts: the subnet address and the host address. The part of the IP address corresponding to the 1 bit in the mask is the subnet address, and the other bits are the host address. The mask for class A addresses is 255.0.0.0, the mask for class B addresses is 255.255.0.0, the mask for class C addresses is 255.255.255.0.
Gateway	The default gateway in the host is usually called the default route. The default route (Default route) is the route chosen by the router when no other route exists for the destination address in the IP packet. All

	packets whose destination is not in the router's routing table will use the default route.
DNS	The IP address of the DNS server. DNS Server part is where you can specify the IP Address of your Preferred DNS (Domain Name Server) and Alternate DNS. When the device uses a static IP address, the user is required to fill in this item, 8.8.8.8(Google) will be a good choice. If a specific DNS server is not used, the default gateway IP address is generally sufficient.
LTE Cat1	APN Name: A string that identifies a particular service in the cellular network usually provided by operator. Username: Usually provided by operator. Password: Usually provided by operator. DNS: "Auto" means obtaining the DNS server from operator's base station. "Manual" means the DNS server is user-defined.

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

3.1.3. Serial port settings

The serial port module includes: serial port parameter configuration, network parameter configuration. The main function of the gateway is to carry out two-way transparent transmission of standard serial bus data (RS-232, RS-485) and standard Ethernet data supporting TCP/IP protocol to solve common serial equipment Networking problems on the Internet. The Port configuration page can configure the parameters of the serial port and socket, as shown in Fig.19. Details on work mode connectivity protocols and its settings of USR-M100s gateway are given in Chapter 4 Operation modes, this section will only focus on the part of parameter description. The description of the configuration parameters on this interface is shown in table 9 and table 10.

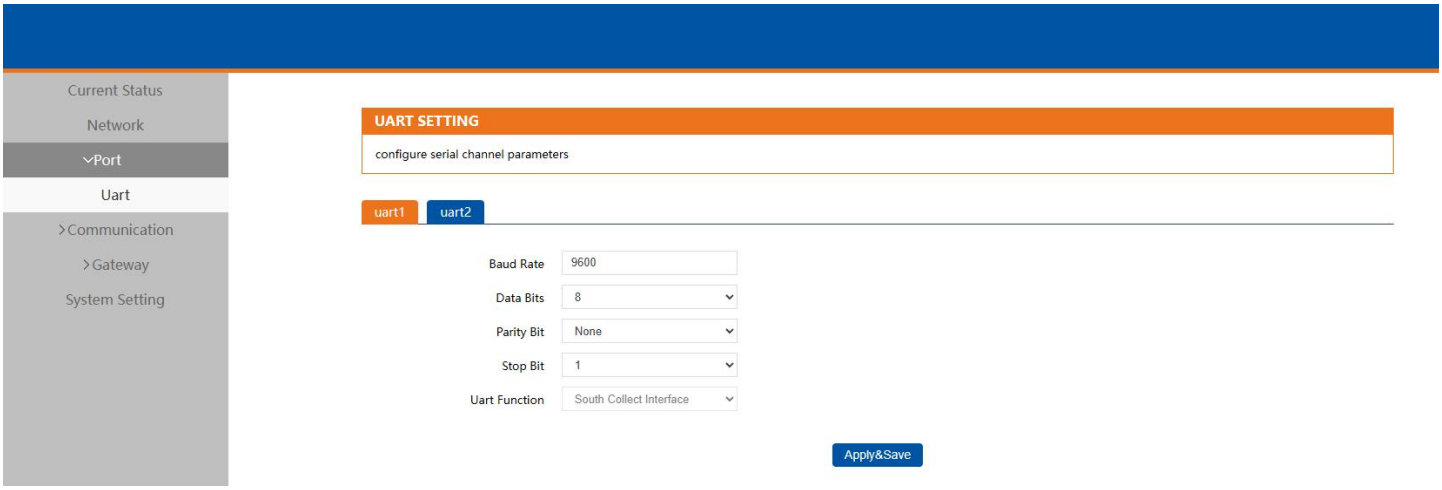


Fig. 17 Serial port configuration web page

Table 9 Serial settings list

Parameter Item	Description
Baud rate	This sets the port's data transfer speed. Choices are from 600—230400. Set this to match the baud rate setting of the connected device. Default is 9600.
Data bits	This sets the number of bits used to transmit one character of data. Choices are: 7 and 8. Set this to match the data bit setting of the connected device. Default is 8 (which is the default for the majority of serial devices).
Parity bits	This bit checks the integrity of the transmitted data. Choices are: None, Odd, Even, Space, Mark. Set this to match the parity setting of the connected device. Default is None (which is the default for the majority of serial devices).

Stop bits	This indicates that a character has been transmitted. Set this to match the stop bit setting of the connected device. Choices are: 1 and 2. Default is 1 (which is the default for the majority of serial devices).
Uart Function	For now, it only support South Collect Interface

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

3.1.4. Socket function

For socket function, the device supports two working modes: TCP Client and TCP Server. And the device support two socket connections, each of which is configured and communicated independently. At the same time, each channel supports the independent network cache function. SSL encryption is valid for TCP client mode.

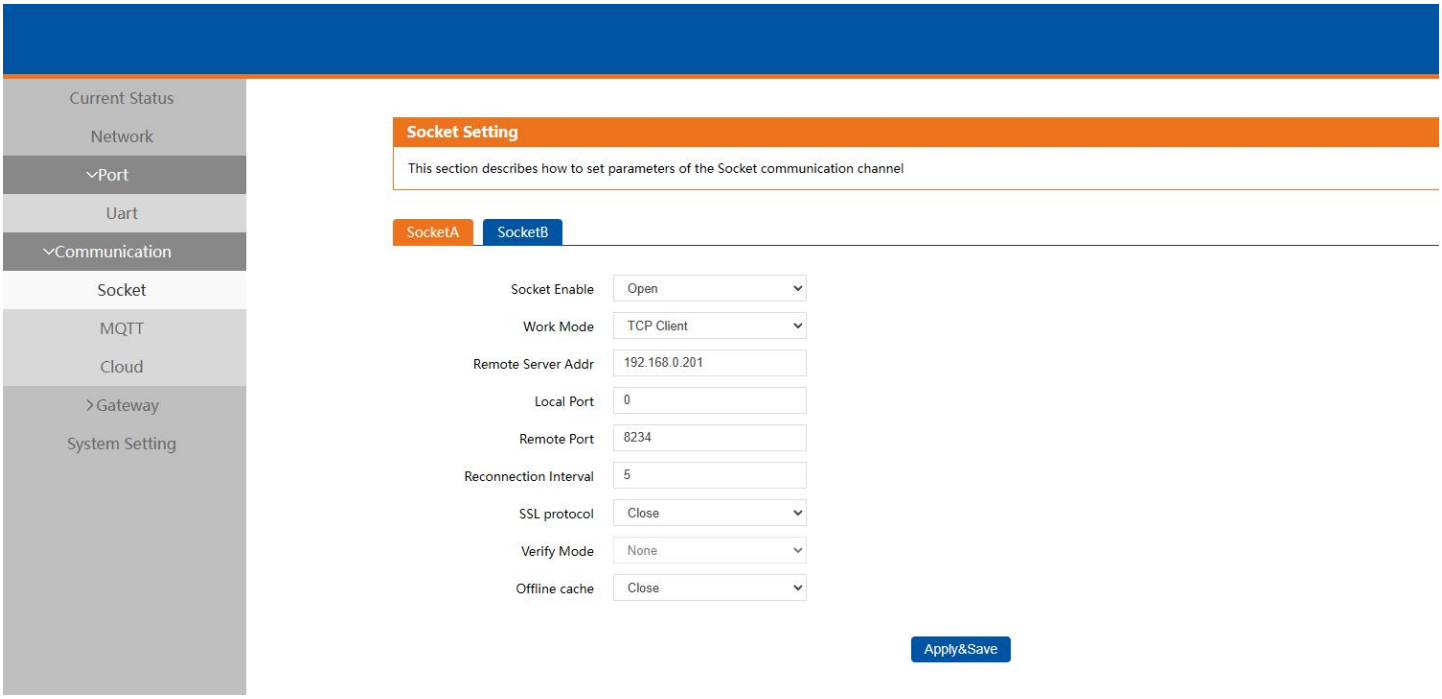


Fig. 18 Socket configuration web page

Table 10 Operation modes settings list

Parameter Item	Description
Socket enable	Whether the socket function is enabled
Working mode	USR-M100s gateway supports 2 different operation Modes which are TCP Server, TCP Client. The operation Mode describes the role of the device and the connection between the device and other remote devices in the network which would like to communicate with serial device on M100s' s COM port.
Maximum socket no.(TCP server only)	This option specifies the maximum number of remote devices/clients (with maximum of 16 clients)
Local port	This option specifies the port number that the TCP server should listen to. It is also used by the remote TCP client to connect to the TCP server. The default local port is 20108. You can enter different port numbers in this option.
Remoter server addr.	Please specify the IP address of the TCP server program on the remote host in this field. This should match the IP settings of the TCP server program.
Remote port	Please specify the port number of the TCP server program on the remote host in this field. Once again, this should match the IP setting of the TCP server program.

Re-connection Interval (TCP client)	If TCP client doesn’ t connect to TCP server, the device will connect in reconnection interval. The default is 5 seconds.
SSL protocol(TCP client)	Choose TLS/SSL data encryption protocol version
Offline cache	Whether to enable the offline cache function

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

3.1.5. MQTT connection

If you enable MQTT Broker as your northbound connection, the M100s gateway will be configured as MQTT Client. In Client mode, you can setup MQTT broker basic settings, TLS secure transmission, last will message.

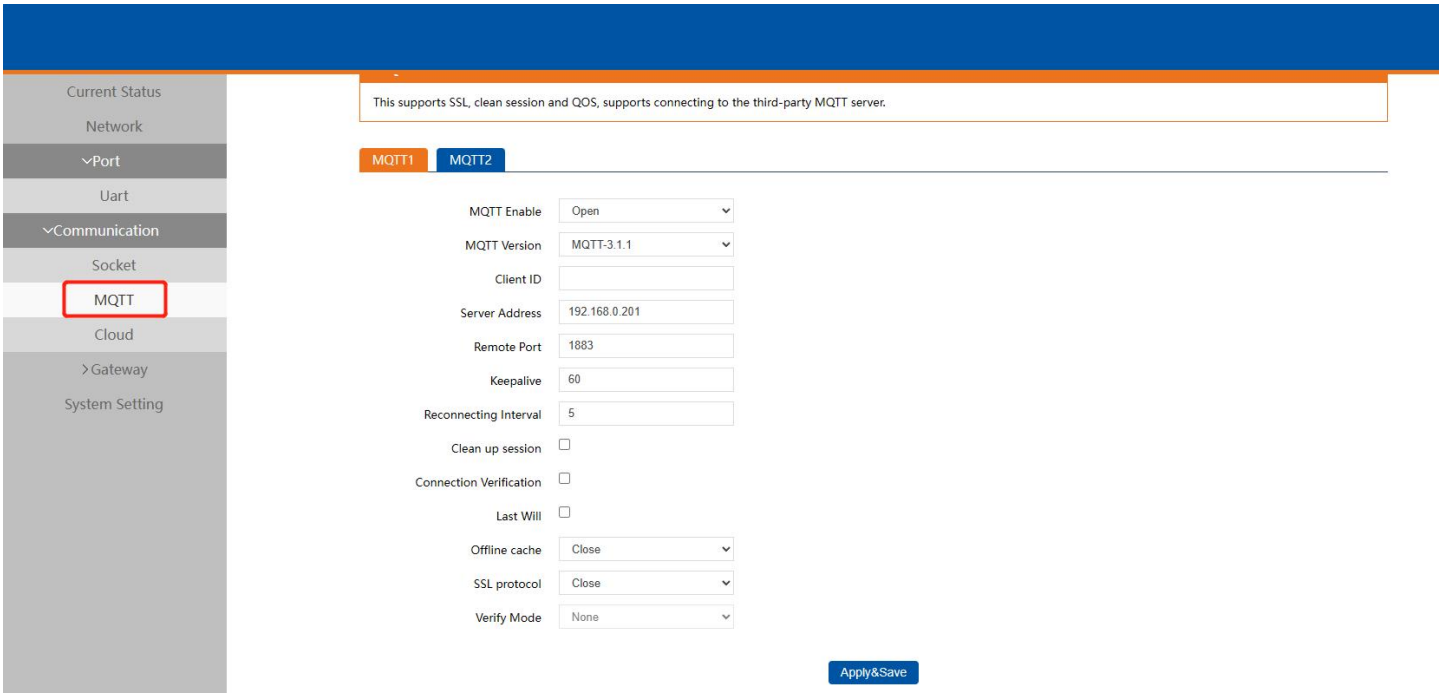


Fig. 19 MQTT connection profiles

Table 11 MQTT basic setting

Parameter Item	Description
Enable MQTT	Turns MQTT gateway on or off.
MQTT Version	Select the mqtt protocol version. V3.1 and V3.1.1 are supported.
Client ID	The client ID defined the identifier of the USR-M100s Gateway. The IDs of the various MQTT clients have to be unique for the respective MQTT Broker. If two MQTT clients are using an identical ID, the connections of theses clients to the MQTT Broker are disconnected. For an individual client, there is no way to find out whether a specific client ID is already used by another client or not.
Server address	IP address or hostname of an MQTT broker.
Remote Port	Port number of the MQTT broker.
Keep alive	The Keep Alive is a time interval measured in seconds. It is the maximum time interval that the broker permits between when a client finishes sending one MQTT packet and starts to send the next.
Re-connection interval	Automatic reconnection interval after a fail network connection.
Clean session	Valid only for Qos1 and Qos2. When the clean session is checked, the client does not want a persistent session. If the client disconnects for any reason, all information and messages that are

	queued from a previous persistent session are lost. When the clean session is unchecked, the broker creates a persistent session for the client. All information and messages are preserved until the next time that the client requests a clean session.
Connection Verification	If enabled, it needs user name and password.
User name	Username for authentication to the MQTT broker.
Password	Password for authentication to the MQTT broker.
Last will	The last will message is part of the Last Will and Testament (LWT) feature of MQTT. The will message notifies other clients when a client disconnects ungracefully.
Offline cache	Whether to enable the offline cache function, the default is off.
SSL/TLS	If you use a TLS connection, click the SSL/TLS tab, select Enable SSL/TLS, and then set the Protocol parameter to TLSv1.2

Table 12 Publish message setting

Parameter Item	Description
Transmission mode	Transparent transmission, just as its name implies,the gateway does not process any data, forward the data directly. Topic distribution,in this mode users should define a topic name when configuring the topic. After receiving serial port data, the device pushes it to the associated topics based on the topic name. Topic name and payload are separated by comma. For example, topic name, {"message": "Hello from USR-M100s gateway"} as serial data. Different topics are allowed to have the same topic name. In this way, data is pushed to all topics with the same topic name. Custom mode, add topic, Qos(0,1,2), retain(ON,OFF) message before payload. After receiving the serial data, USR-M100s publishes the payload of the corresponding topic to cloud according to rules. This method can be used to publish any topic at any time. For example, awsiot/test,0,ON,{"message": "Hello from USR-M100s gateway"} as serial data.
TOPIC string	An MQTT topic is a UTF-8 string that the broker uses to filter messages for each connected client. To receive messages, the client must subscribe to the topic. A topic can have one or more topic levels. Each topic level is separated by a slash (Topic Level Separator).
Binding Port	The MQTT topic is bound to the serial port number of the device. Any data from the COM Port1 of the gateway will send to all the TOPIC it bindings to.
Qos	QoS 0: at most once. In this case, the client publishes a message to the broker only once. QoS 1: at least once. In this case, when a client publishes a message to the broker, the client expects the broker to acknowledge whether or not a client has received the message. If the publisher does not receive acknowledgement from the broker within a preset time interval, it will republish the message again and again until acknowledgment is received. QoS 2: exactly once. The MQTT protocol uses the confirmation of confirmations to ensure that a message is delivered exactly once.
Retained message	By setting the Retain flag the MQTT Broker is instructed to save the most recent data value for the topic. Data values without Retain flag are only transferred from the MQTT Broker to those MQTT

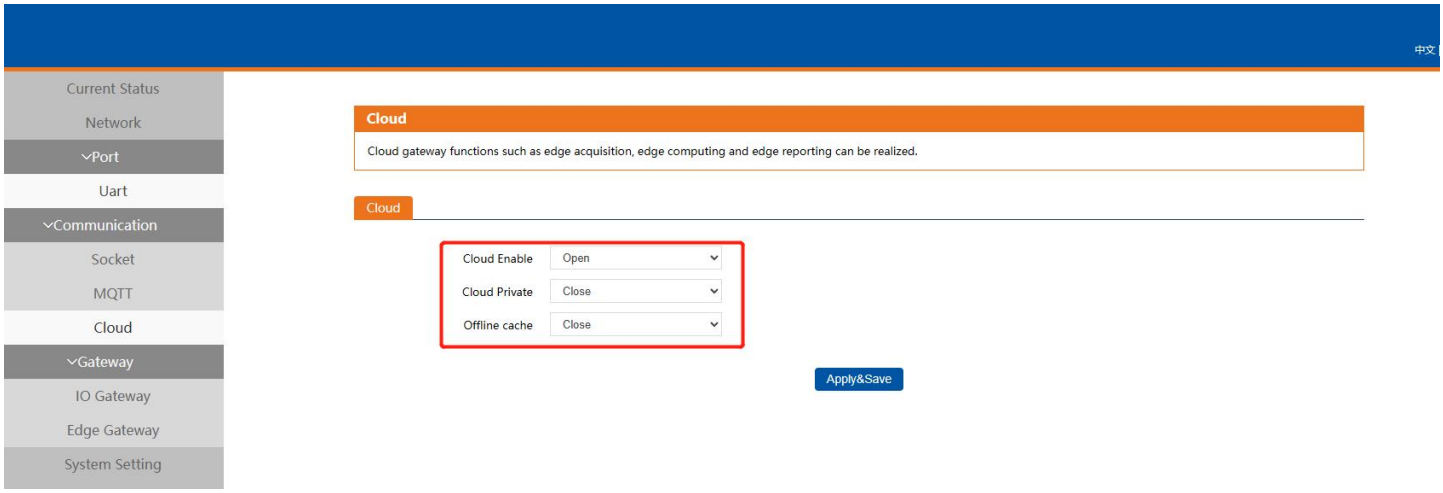
	Subscribers that are registered at the broker and have subscribed to the appropriate topic in the moment when sending the data to the broker.
IO control/Query	Used to reply for IO status to server

Table 13 Subscribe message setting

Parameter Item	Description
Transmission mode	The data printed to the serial port can be set whether to carry the Topic
Topic string	Same to Table 12
Binding port	Same to Table 12
QoS	Same to Table 12
IO control/Query	Used to Query IO status from server

3.1.6. PUSR cloud

Users can achieve remote management of the USR-M100s through PUSR cloud. And for PUSR cloud, users can deploy the full platform on local server(the private cloud platform).



3.1.7. IO gateway

USR-M100s gateway can support a number of Digital Input (DI), Digital Output (DO-Relays), Analog Input (AI) ports. There are a few combinations of I/O extension board. Because the I/O status of M100s is mainly displayed via Modbus protocol, the user has to configure the Modbus settings if the user wants to use the Modbus protocol. Fig.29 shows the parameter that must be set for the Modbus protocol that is the Modbus Slave ID.

On pre-configured page, user can select the extend module model based on the installation sequence.

On IO control page, users can check the I/O status and can control the ON/OFF status of DO interface.

On IO function page, users can set the filter time of DI interface and set the soft restart hold function of DO interface.

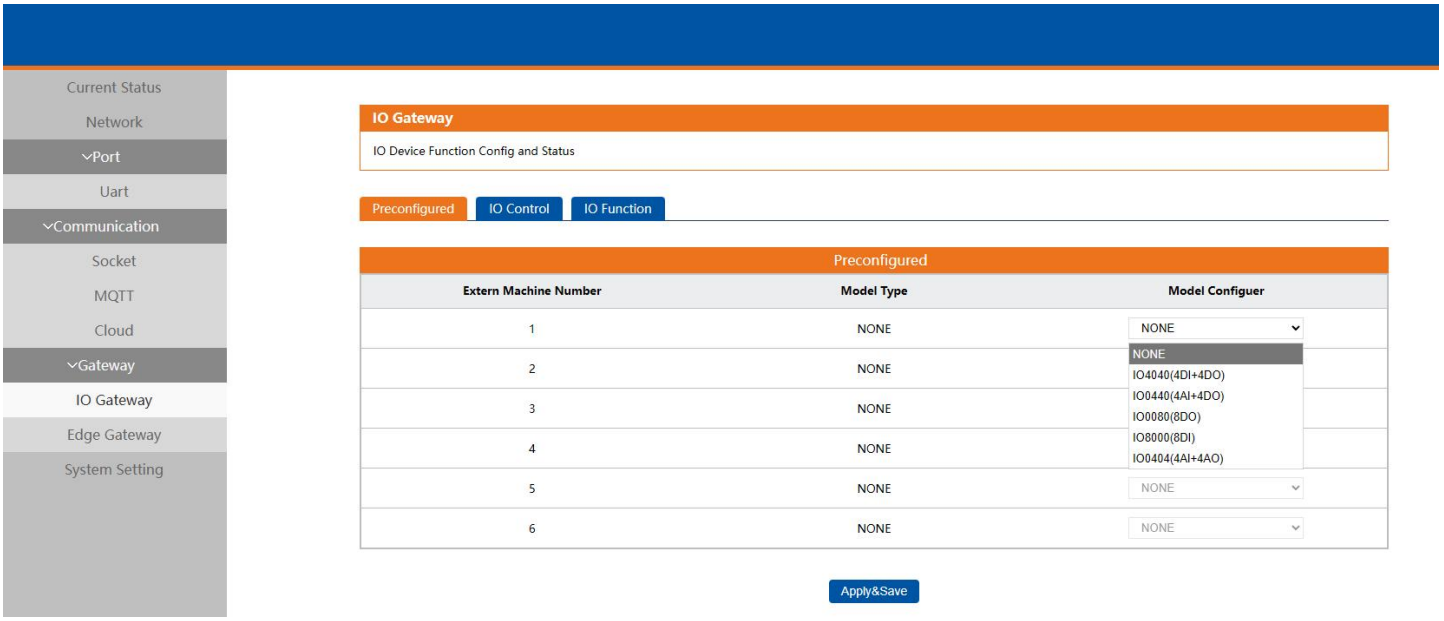


Fig. 20 Preconfigured Page

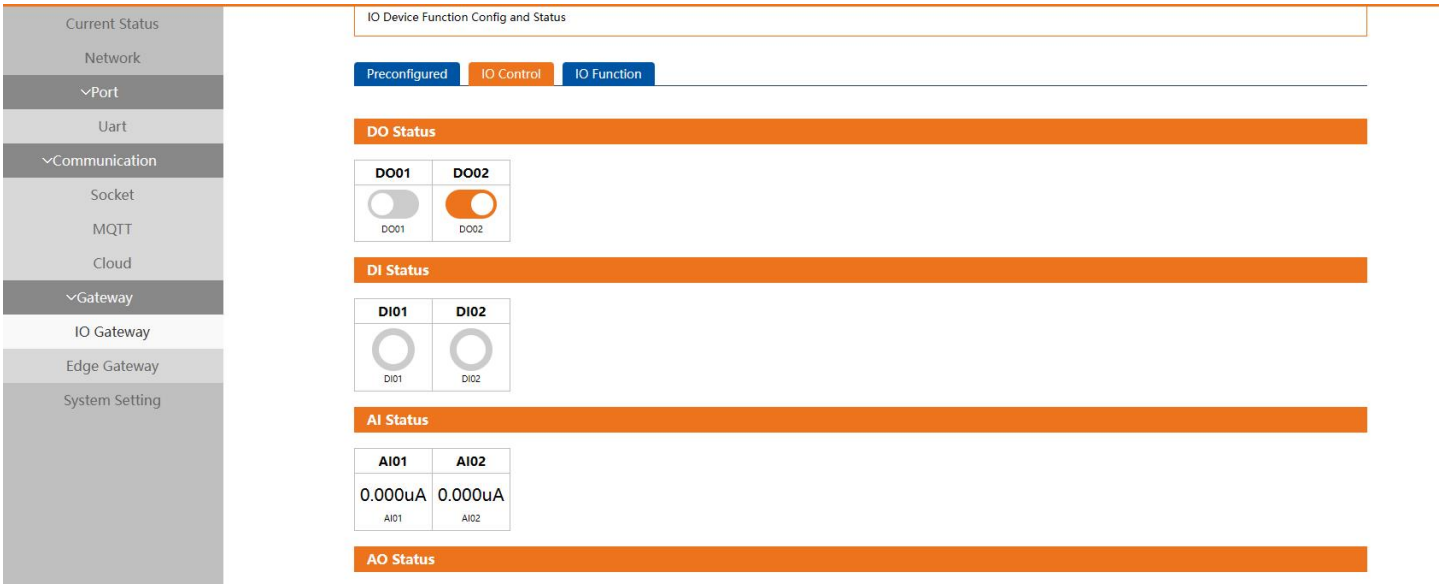


Fig. 21 IO control

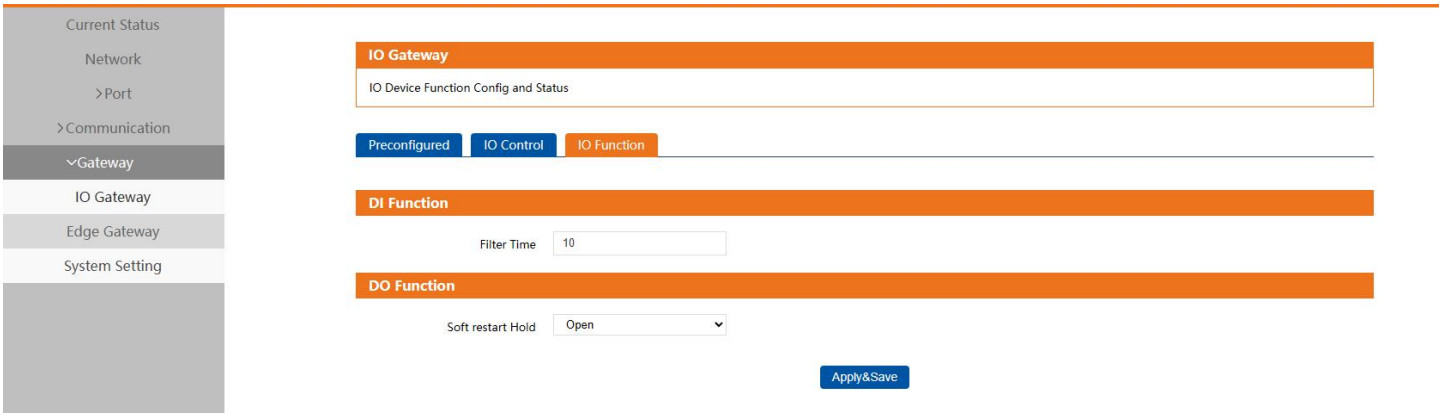


Fig. 22 IO function

Table 14 IO function

Parameter Item	Description
Restart Hold	Whether the DO output status remains after the restart
DI filter time	By setting the filtering time, the device will automatically filter the waveform jitter of the DI interface, thereby eliminating the detection error caused by clutter.

	The filter time defaults to 10ms, and the setting range supports 10~65535ms.

3.1.8. Edge gateway

The M100s gateway supports southbound fieldbus protocols of Modbus RTU protocols. It also supports northbound MQTT/TCP in socket, AWS IOT, and Alibaba Cloud IoT Platform. The M100s gateway fulfills a different role on each of its sides. Each role is determined by your devices' settings. Therefore, set the role of each of your devices correctly.

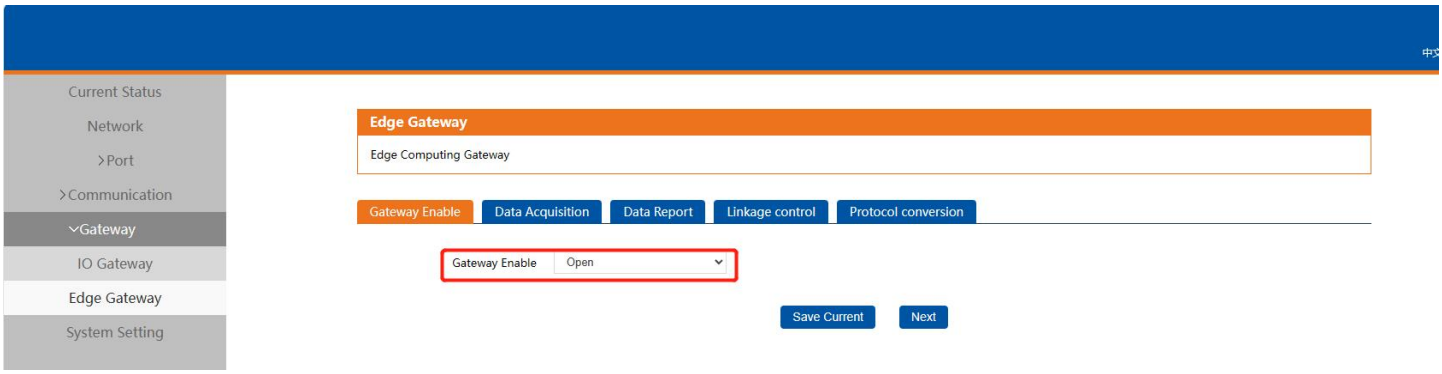


Fig. 23 Edge computing enabled

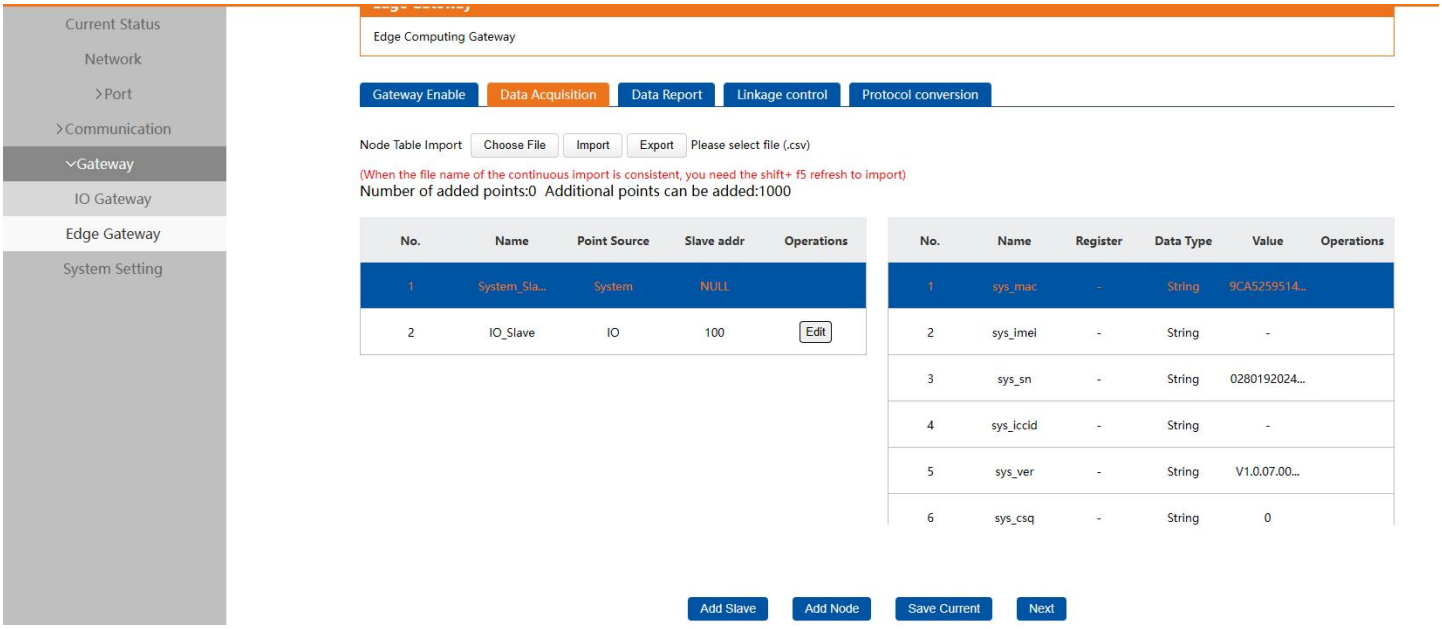


Fig. 24 Data acquisition settings

Table 15 Slave device parameters

Parameter Item	Description
Device name	Name of slave device, which is unique for the current gateway.
Detail	Detail information of the slave device.
Protocol	The are 4 options for users: Modbus RTU: the slave device supports Modbus RTU, and send query command in Modbus RTU. Modubs TCP:the slave device supports Modbus TCP, and send query command in Modbus TCP. DLT645/2007:the slave device supports DLT645/2007, and send query command in DLT645/2007. Virtual: The data point is from the virtual register.

Modbus RTU protocol	Uart: Select the serial port to which the Modbus slave device is connected. Slave address: the ID of slave device. Polling interval: the time interval between 2 consecutive query command. Merge acquisition: This function is used when the register address of many data points are sequential.
Modbus TCP protocol	Remote Server Addr: the IP address of the Modbus slave device Remote Port: the listening port of the modbus slave device Polling interval: the time interval between 2 consecutive query command. Merge acquisition: This function is used when the register address of many data points are sequential.
DLT645/2007 protocol	Uart: Select the serial port to which the DLT645/2007 slave device is connected. Electricity meter number: the ID of the electrical meter.

Table 16 Data point(node) configuration

Parameter Item	Description
Data point name	Identifier of the data point, which must be unique for the gateway.
Modbus function code	The Modbus RTU master supports the following Modbus functions: 1 Read Coils, 2 Read Discrete Inputs,3 Read Multiple Holding Registers, 4 Read Input Registers.
Register address	The first blank is for function code, and the second blank is the address of the register from which data will be read.
Data type	Defines how read data will be stored.
Decimal places	How many places do we keep after the decimal point
Timeout	If the Modbus device does not receive a response within the time specified here, the communication times out.
Collect formula	Modbus register store only whole numbers. For this reason a scale factor often needs to be applied. For example a modbus register with a temperature value may read as 723 and a multiplier of 0.1 need to be applied to get the correct value of 72.3 in the SCADA system,the formula is %s*0.1. If the data type is a Float then the multiplier is not needed. This computation supports +, -, * and / operators. This formula is for data collecting.
Formula of control	This formula is for data writing.
Change reporting	Enable change reporting function. The report is triggered if the collected data changes. You can use a tolerance to only log the data point if the value changes more than X amount.
Range	The report is triggered if the collected data changes. You can use a tolerance to only log the data point if the value changes more than preset range.

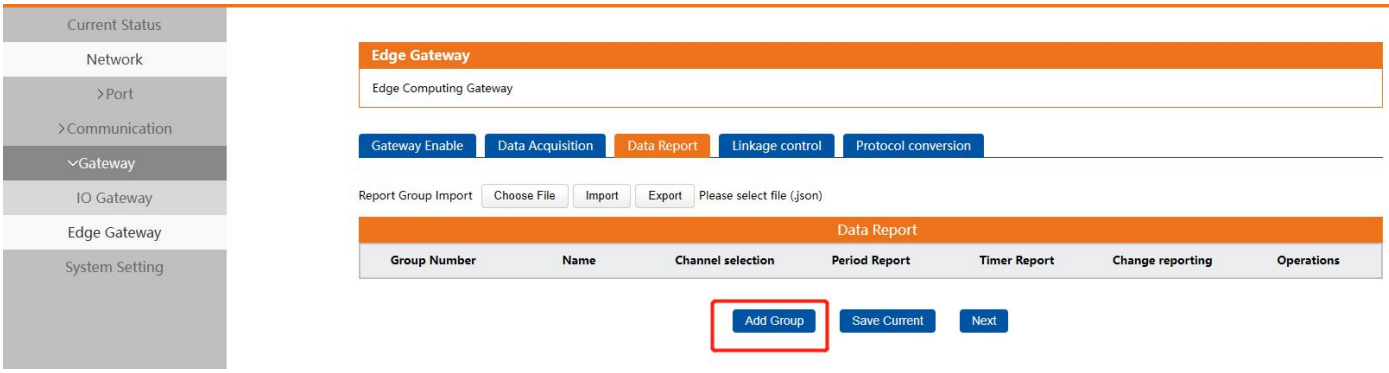


Fig. 25 Data report

Table 17 Data report

Parameter Item	Description
Channel Selection	Select the channel in the socket type.
Report Topic	Whether data query from remote server or cloud is enable.
QOS	Whether data setting command from remote server or cloud is enable.
Retain Message	You can choose Modbus RTU, Modbus TCP or JSON. Users can send the right format query command from remote modbus master or MQTT publisher to the M100s gateway. The data is retrieved from the device's cache of corresponding modbus instructions.
Period Report	Data is automatically reported at a certain interval. The reporting interval can be configured.
Report Period	The data reporting interval.
Timer Report	In the 24-hour system, the NTP function need be enabled first to correct the device clock. Four types of timing logic are supported: Report at the exact hour: Reporting every hour from 0′ clock. Report at the exact quarter:Reporting every 15 minutes from 0′ clock. Report at the exact minute: Reporting every 1 minute from 0′ clock. Report at the fixed time: Reporting data at a fixed time every day, For example, if you select 12:05, data is reported at 12:05 every day.
Report Data Format	Primate type: Reporting data to server by the original format. To string: Convert the collected data to string format to reporting to the server.
Error Fill	After data points fail to be collected, the value in the data template is replaced with the filling content, for example, {"temperature":"error"}.
Error Message	The payload format. Users can custom which data points should report to the server.

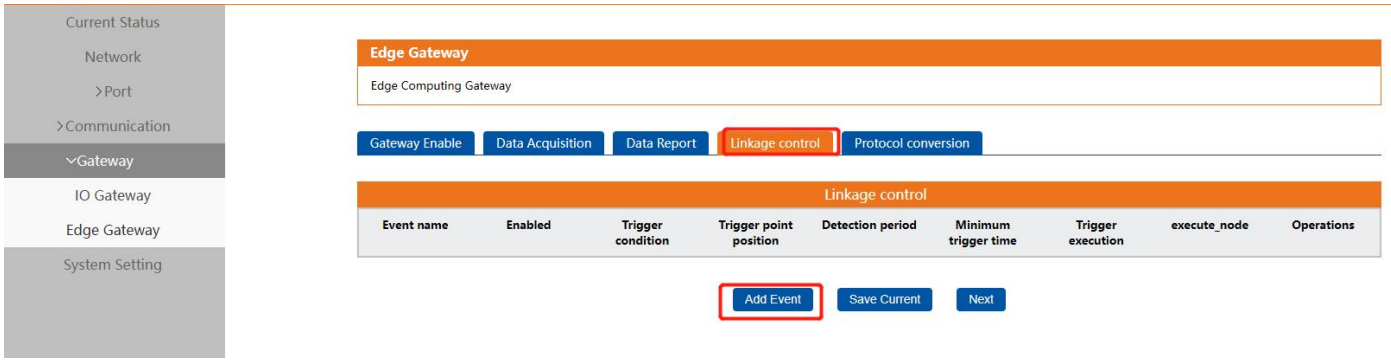


Fig. 26 Linkage Control

3.1.9. System setup

➢ Parameter setting

This setting tab includes several system level settings, such as host name, user name, password, web port, parameter export and parameter import. Most of these settings are optional.

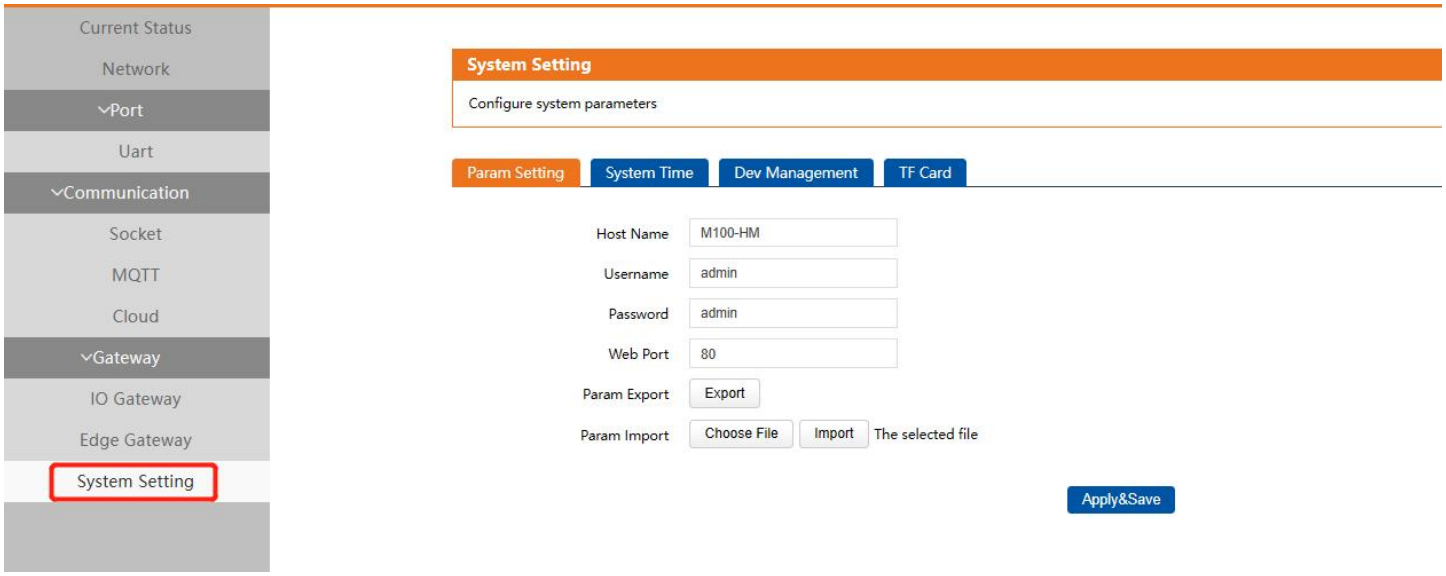


Fig. 27 System settings

Table 18 System settings list

Parameter Item	Description
Host name	The name of the device, up to 32 characters,can’ t be null
User name	The user name of web console and can be modified. up to 16 characters,can’ t be NULL
Password	The password of web console and can be modified. up to 16 characters,can’ t be NULL
Web port	The port of login page
Param Export	Export the configured parameters and users can import the file to the other device directly.
Param Import	Import the parameters to simple the configuration steps

The configuration will save to flash memory after clicking Save button. All configurations take effect after a system reboot.

➢ System time

Users can configure time relevant parameters on this page.

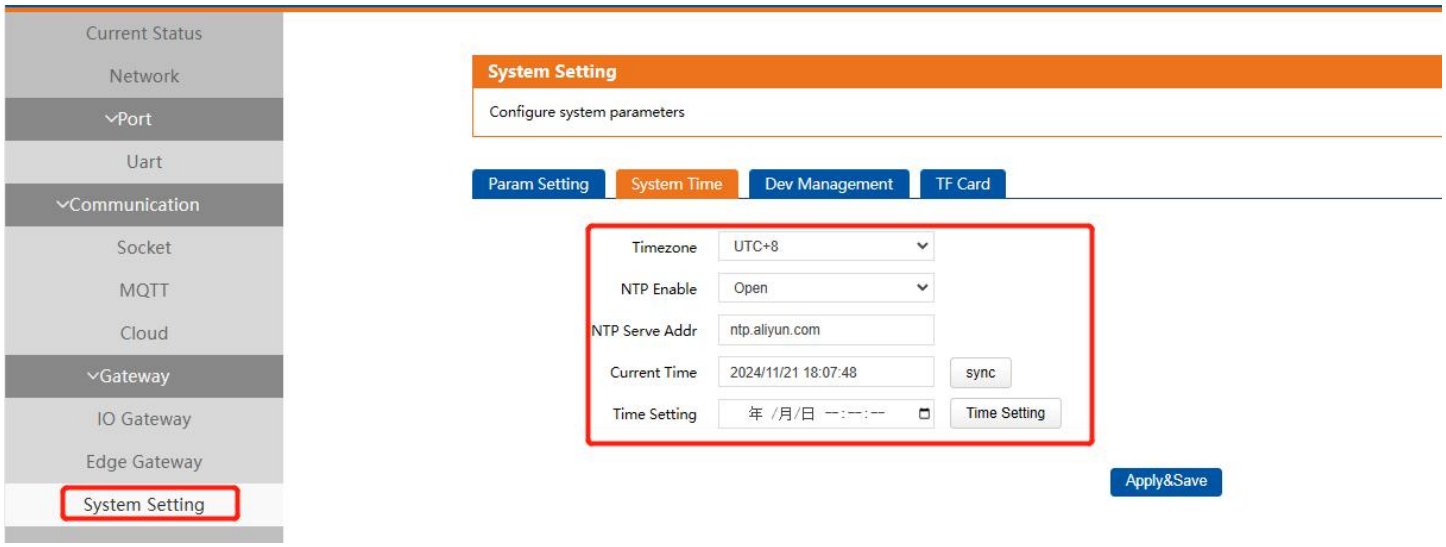
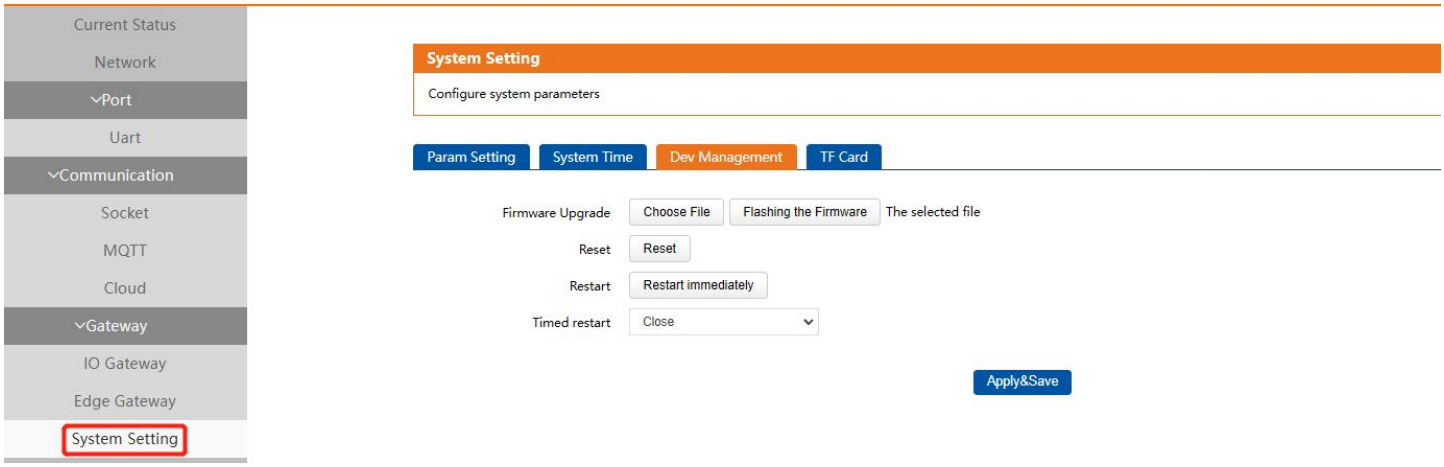


Fig. 28 System time

➢ Device management



A. Firmware upgrade

USR IoT continually upgrades its firmware to add new features and optimize performance. Please contact the sales to obtain the latest version of the firmware. Before upgrading the firmware, please make sure that the device has a reliable power source that will not be powered off or restarted during the firmware upgrading process(please be patient as this whole process might take up to 1 -2 minutes). Choose file to upload and flashing the firmware.

B. Reset(Restore factory defaults)

This function is used to restore the gateway to the factory settings and automatically restart the gateway at the same time. Before the gateway restarts successfully, the device does not work and cannot forward any data packets. This function is to restore the factory default configuration value once the user sets the wrong parameter and causes the gateway to work abnormally. Click the "Restore factory defaults" button, and a prompt box will pop up on the page. Click "OK".

C. Restart

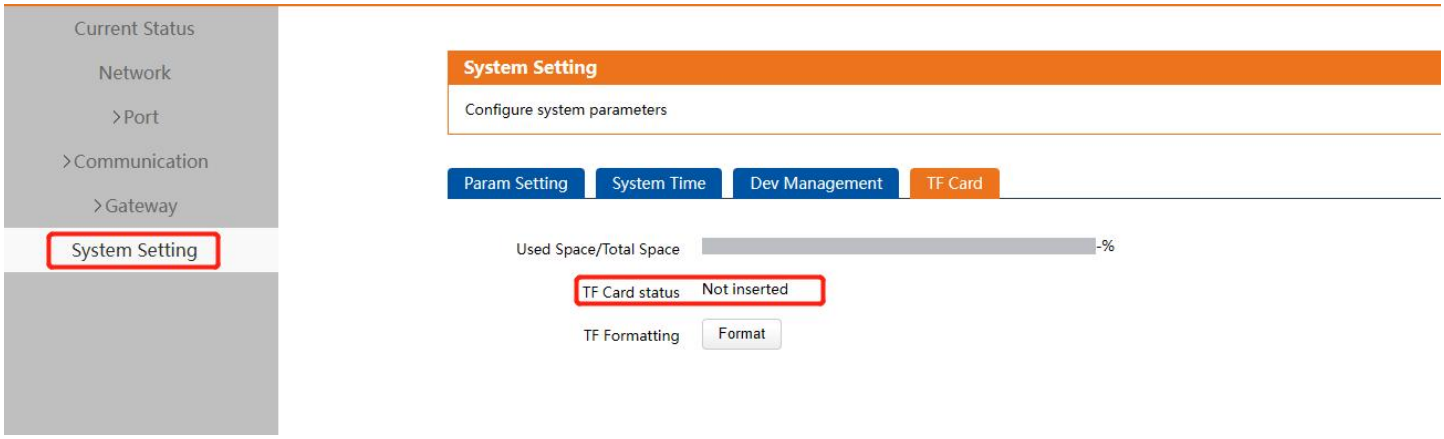
This function is used to restart the gateway by software. Before the gateway is completely restarted, the device does not work and cannot forward any data packets. This restart is different from the hardware reset of power-on restart, but the gateway system software is reset, just like the "warm restart" of the windows operating system. Once a new setting is changed, you can use the Save function to accept the changes. You will need to reset the device to save the settings to flash memory. Click on "restart" Button, the page pops up a prompt box, click "OK".

D. Time restart

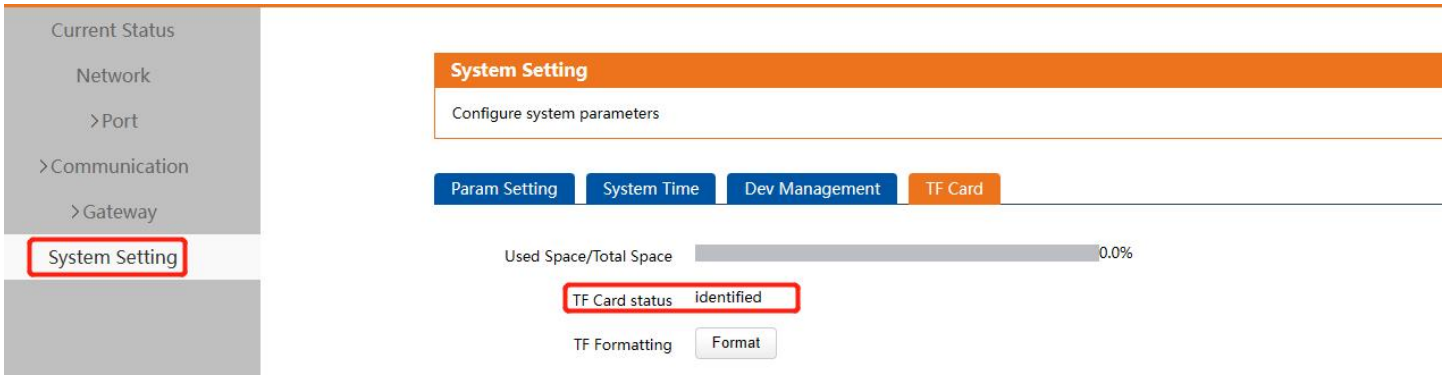
After opening this function, the device will restart at the preset time.

3.1.10.SD card function

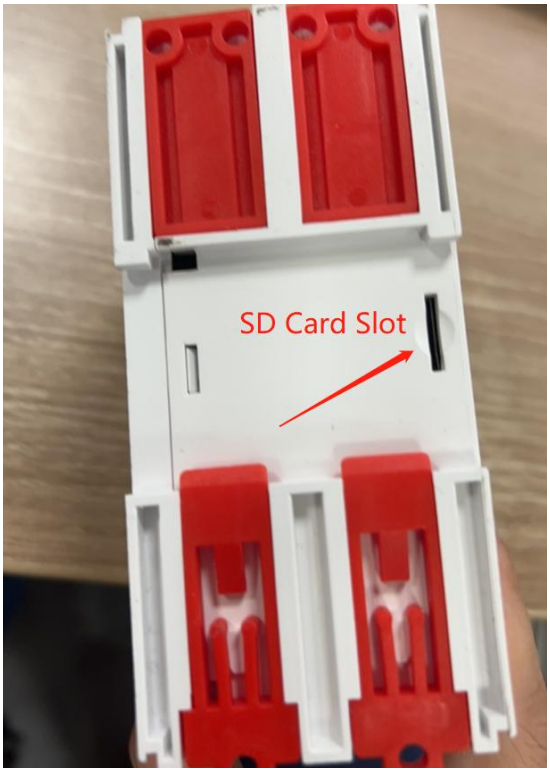
The USR-M100s supports external SD card to restore the collected data when the Internet connection is disconnected. When the SD card is not inserted, the webpage will give the status.



When inserting the SD card, the web page will identify and display.



Insert the SD card like the following picture



3.2. Configuration software

3.2.1. Discovering your gateway

After you start configuration software, if the USR-M100s gateway is already connected to the same gateway as your PC, the device can be accessed via broadcast packets. Users can search all the USR-M100s gateways on the network and show them on the Deivce List Area of the utility. Please select the right Ethernet adapter(Device menu) if you did not see any gateway.

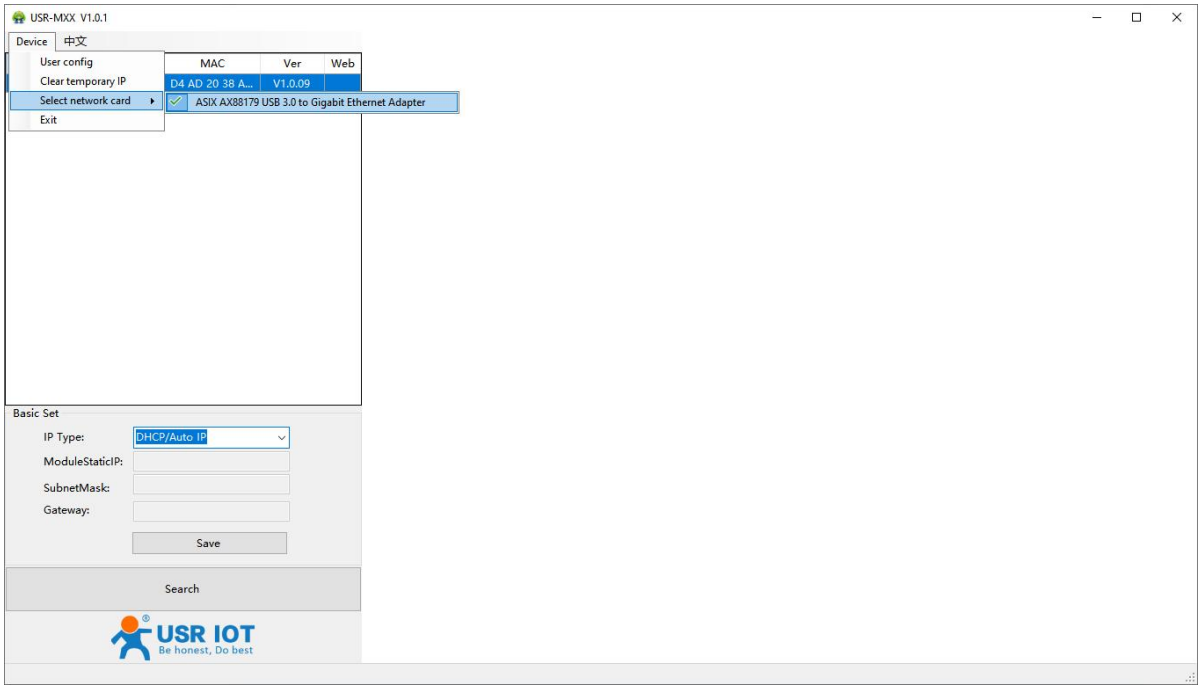


Fig. 29 Searching

3.2.2. Network setting

Sometime the USR-M100s gateway might not be in the same subnet as your PC, therefore, you will have to use this utility to locate it in your environment. To configure each device, first click to select the desired device (default IP:192.168.0.7) in the list of configuration utility, and then change the IP address to avoid any IP address conflict with other hosts on your LAN, save your change.

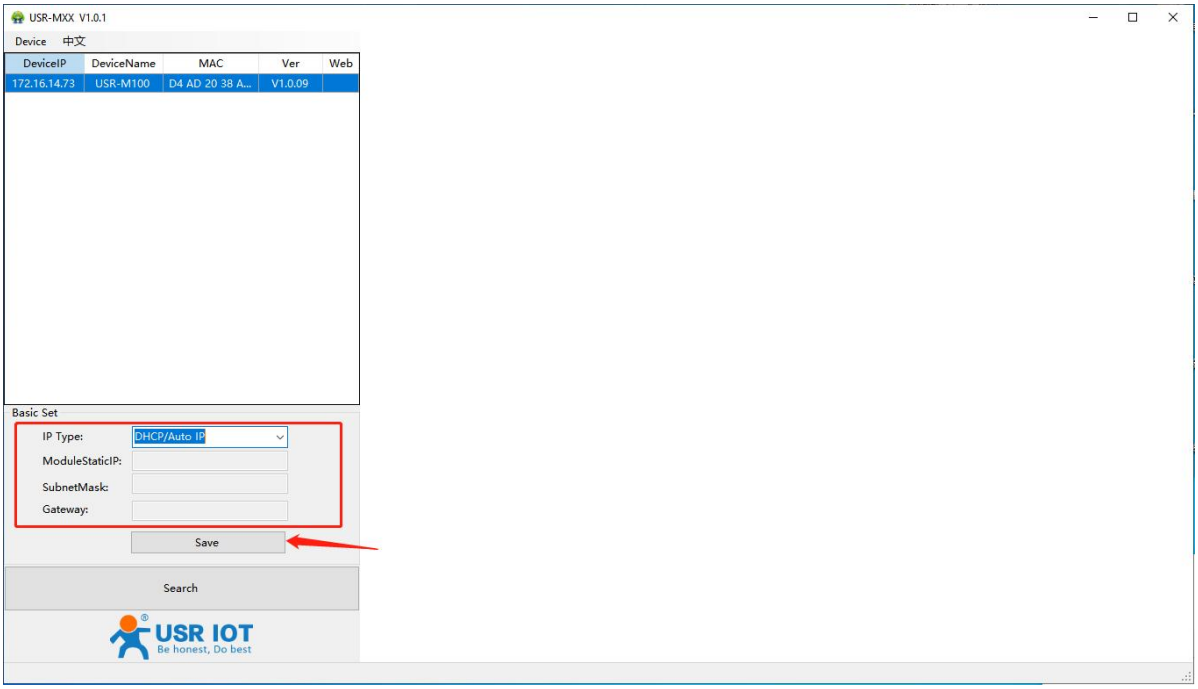


Fig. 30 Changing network settings

3.2.3. Reboot the device

This function is available to allow you to reset the gateway. The function disconnects both the ethernet and serial connections. The function also allows the gateway to save new configuration settings to flash memory. To reset the device:

1. Right-click a desired device to display the settings menu.

2. Select Reboot.

Press the Reboot button and the system will give a reset response.

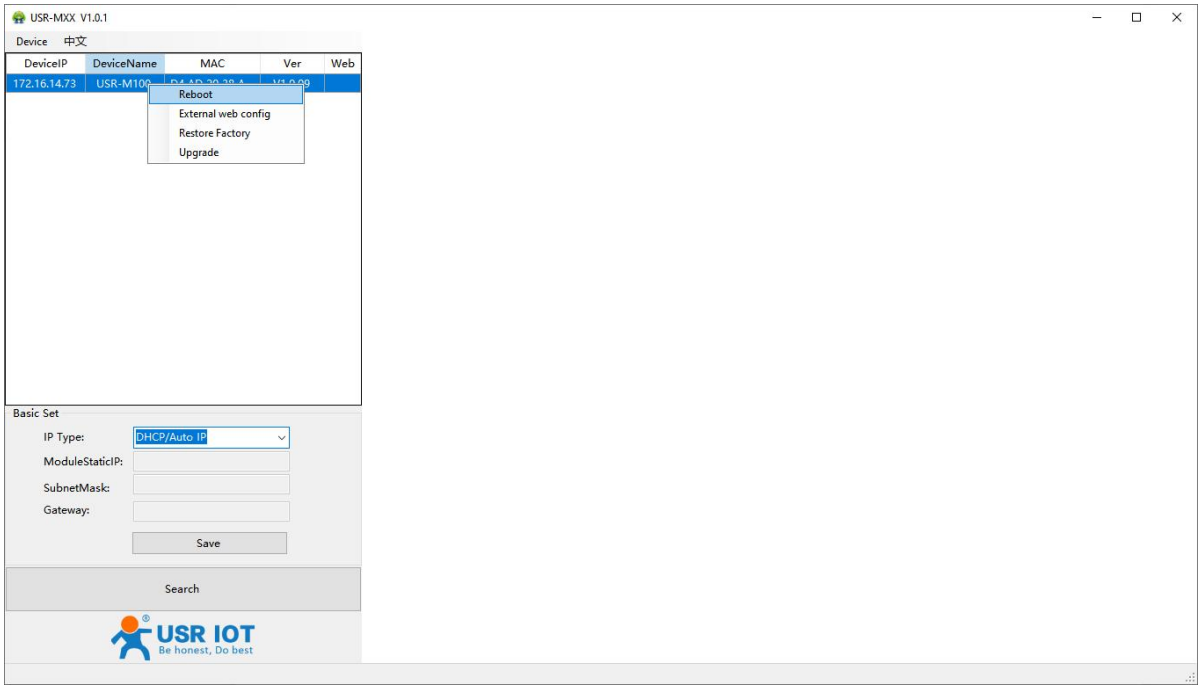


Fig. 31 Reboot the device

3.2.4. Restore to factory default settings

The configuration utility provides the function to restore the gateway to factory default settings. If you really want to restore the gateway to factory default settings, please click restore factory button to continue. As shown in Fig.34.

3.2.5. Open web server

Users can visit the web server of the gateway conveniently with configuration tool. Select the device you want to visit and right click,then click External web config ,you will open the web server with default browser such as Google Chrome. As shown in Fig.34.

4. Edge Gateway

The USR-M100s supports Modbus RTU Master for retrieving field site data from serial meters. After collecting data, users can convert serial data to MQTT json format data, allowing users to get field site data. This two-in-one design reduces system complexity and the amount of space required in the network topology, as well as overall installation time. In addition, you can extend the useful life of legacy devices by connecting them to Ethernet and accessing the devices using a preferred protocol,TCP/UDP , HTTP , MQTT.

First,users need to enable edge computing function.

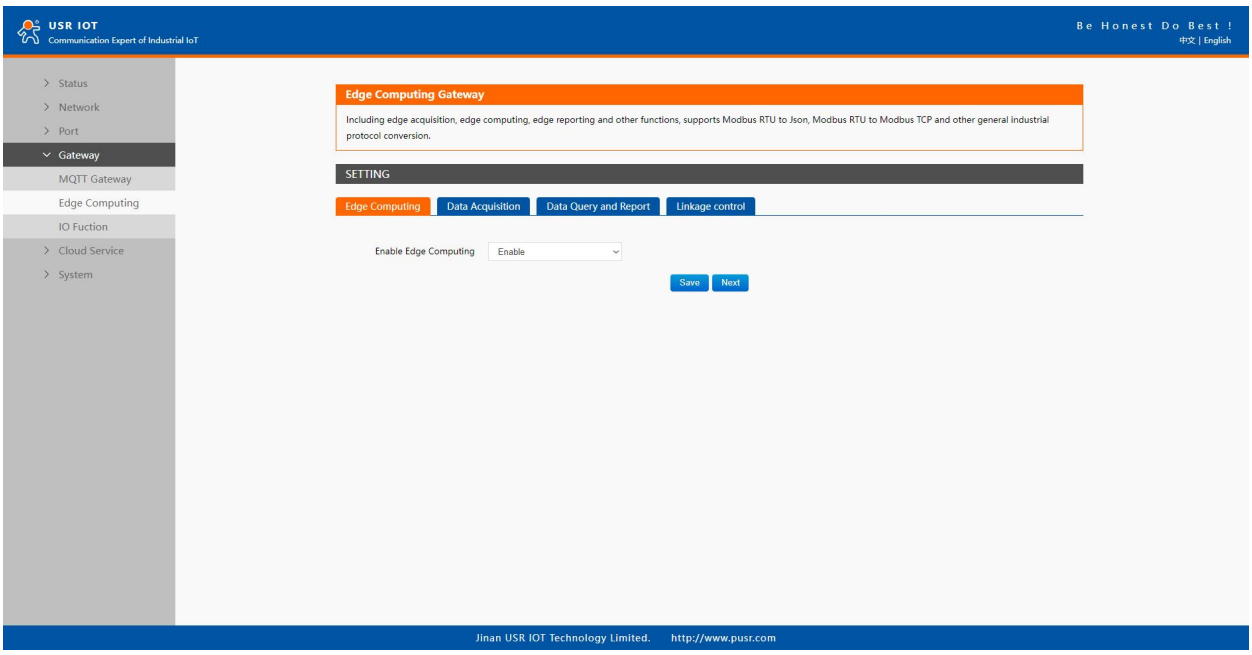


Fig. 32 Enable edge computing

4.1. Add modbus slave device

Connect serial device to the serial port of USR-M100s gateway, and then configure the slave parameter on the data acquisition tab.

Click add slave to add a device, click edit to configure the device.

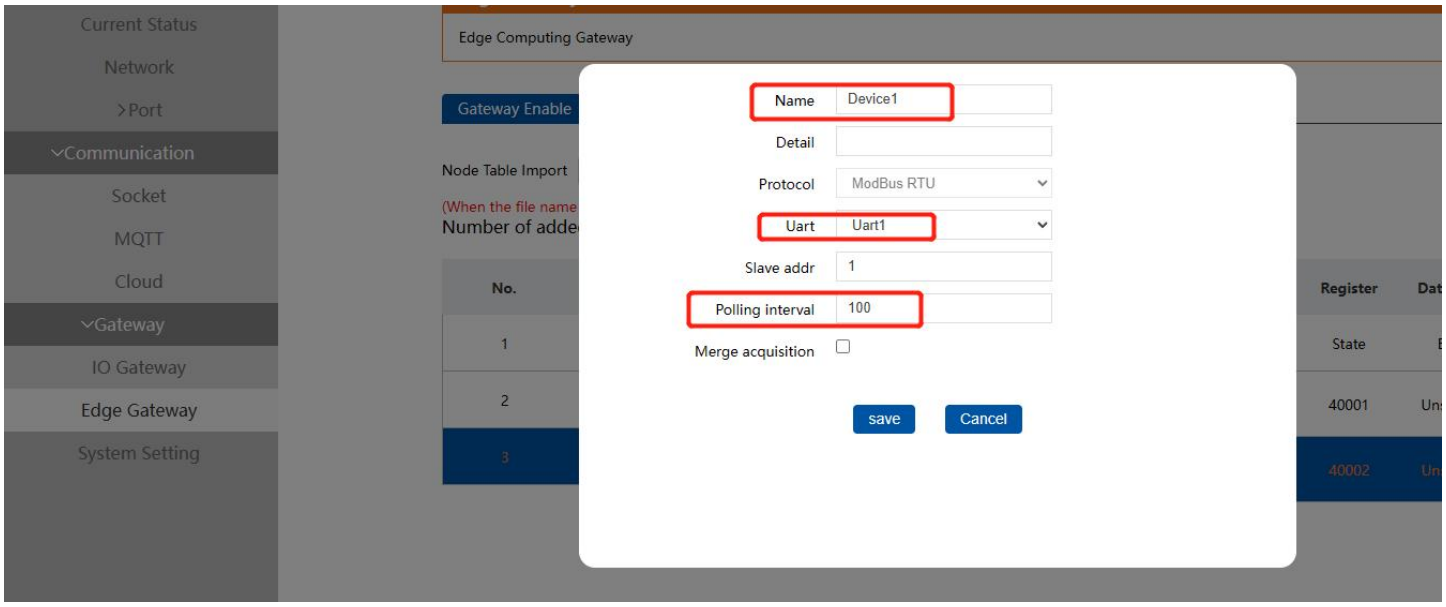


Fig. 33 Add a slave device

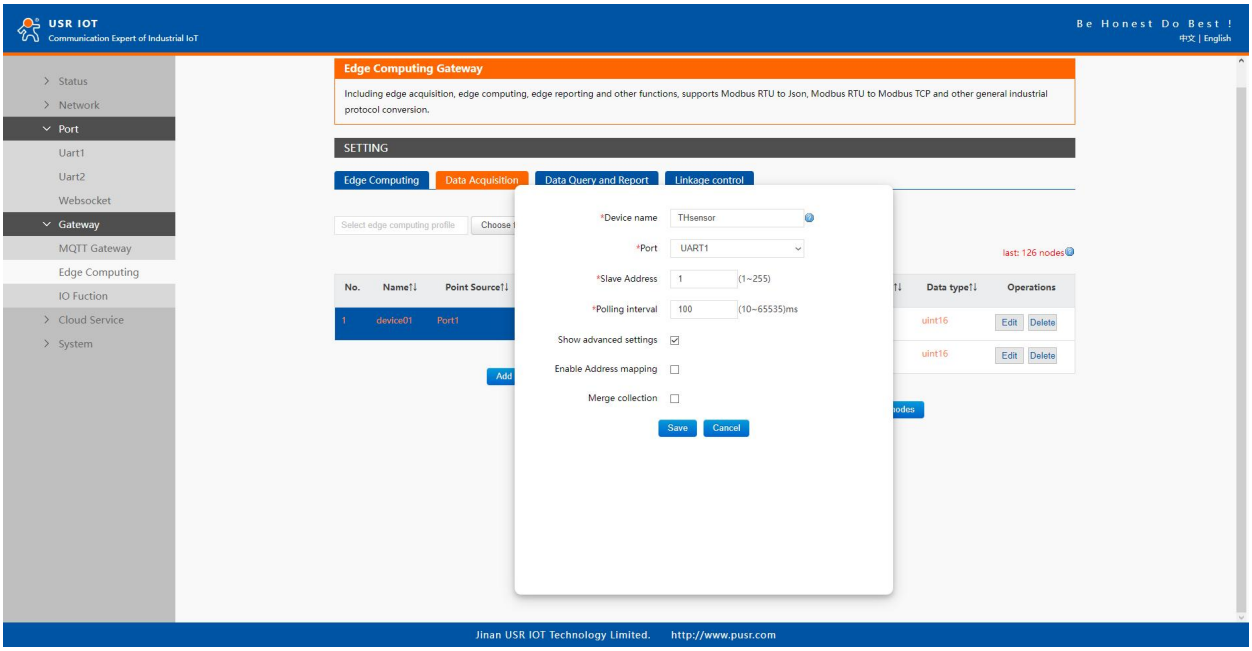
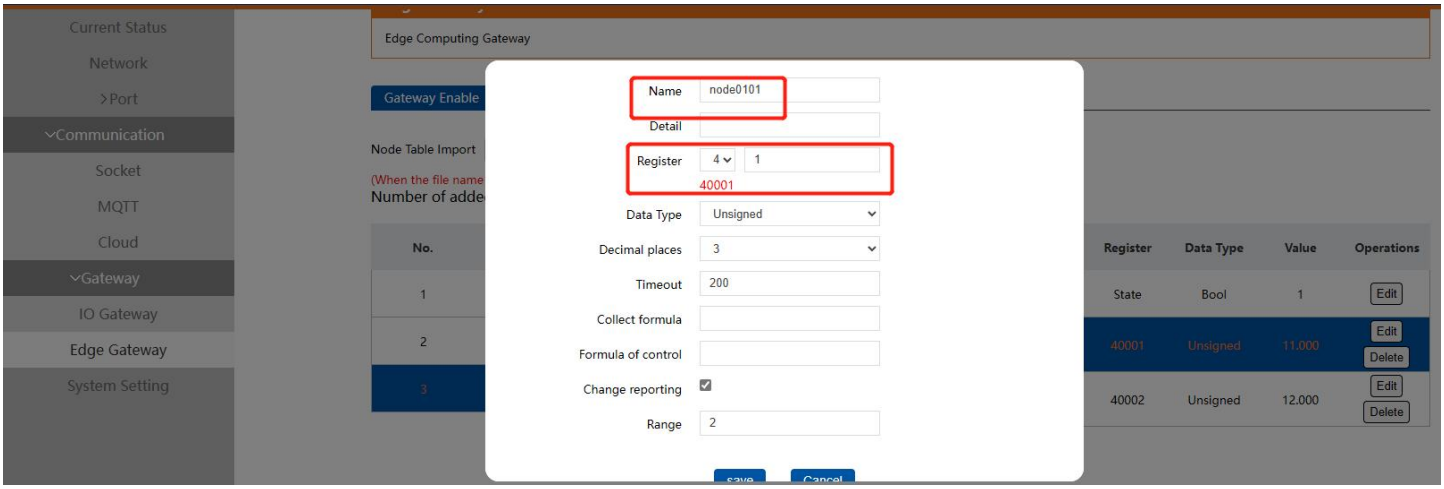
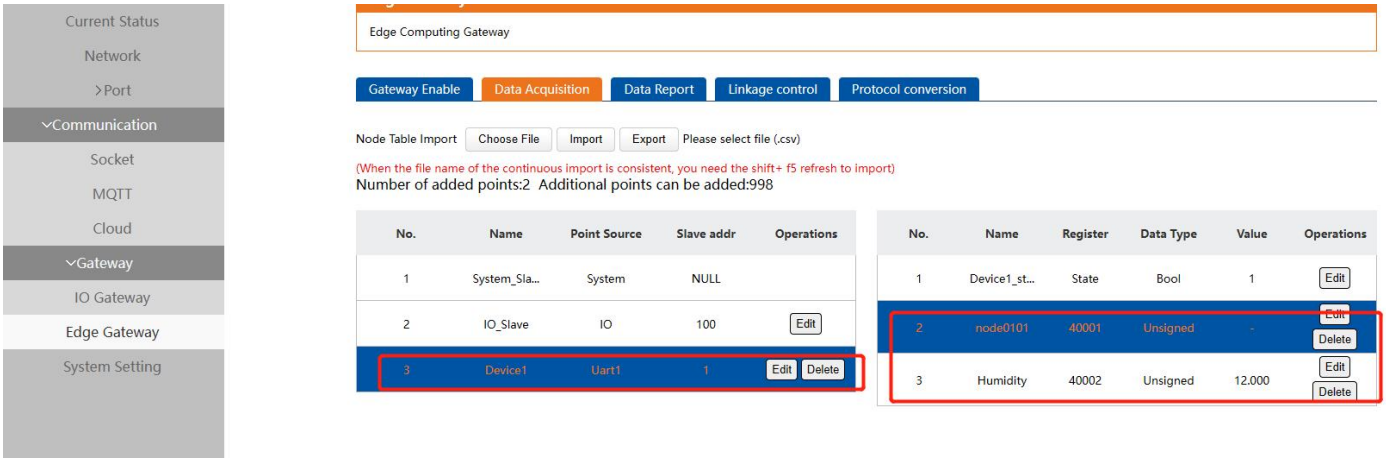


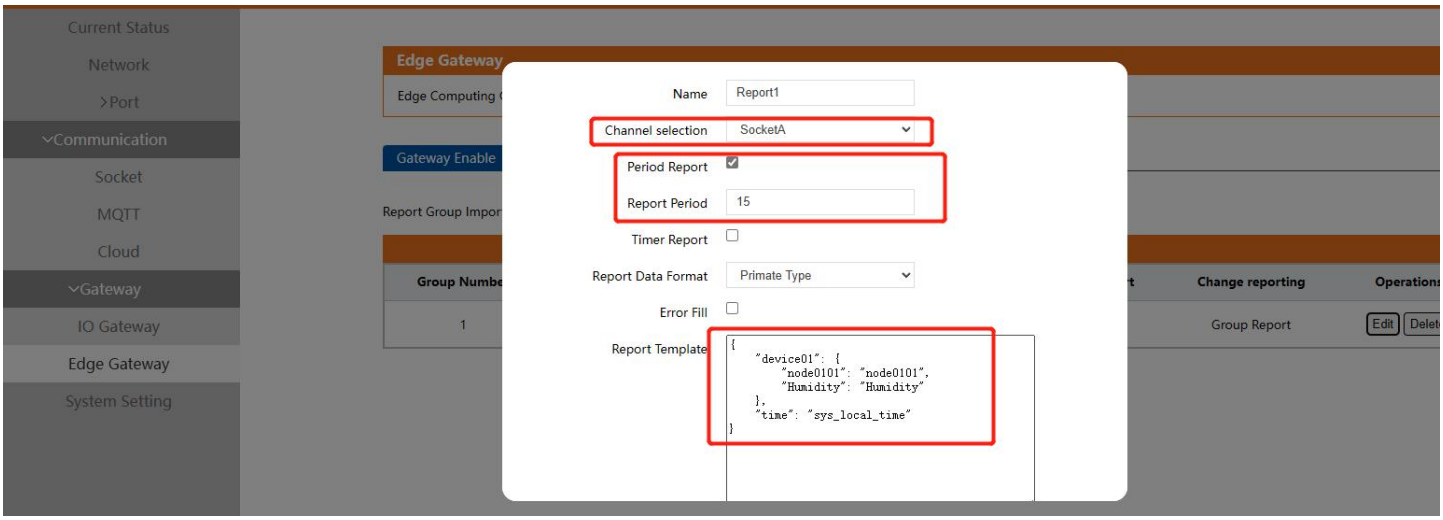
Fig. 34 Polling slave device configuration

4.2. Add modbus data points

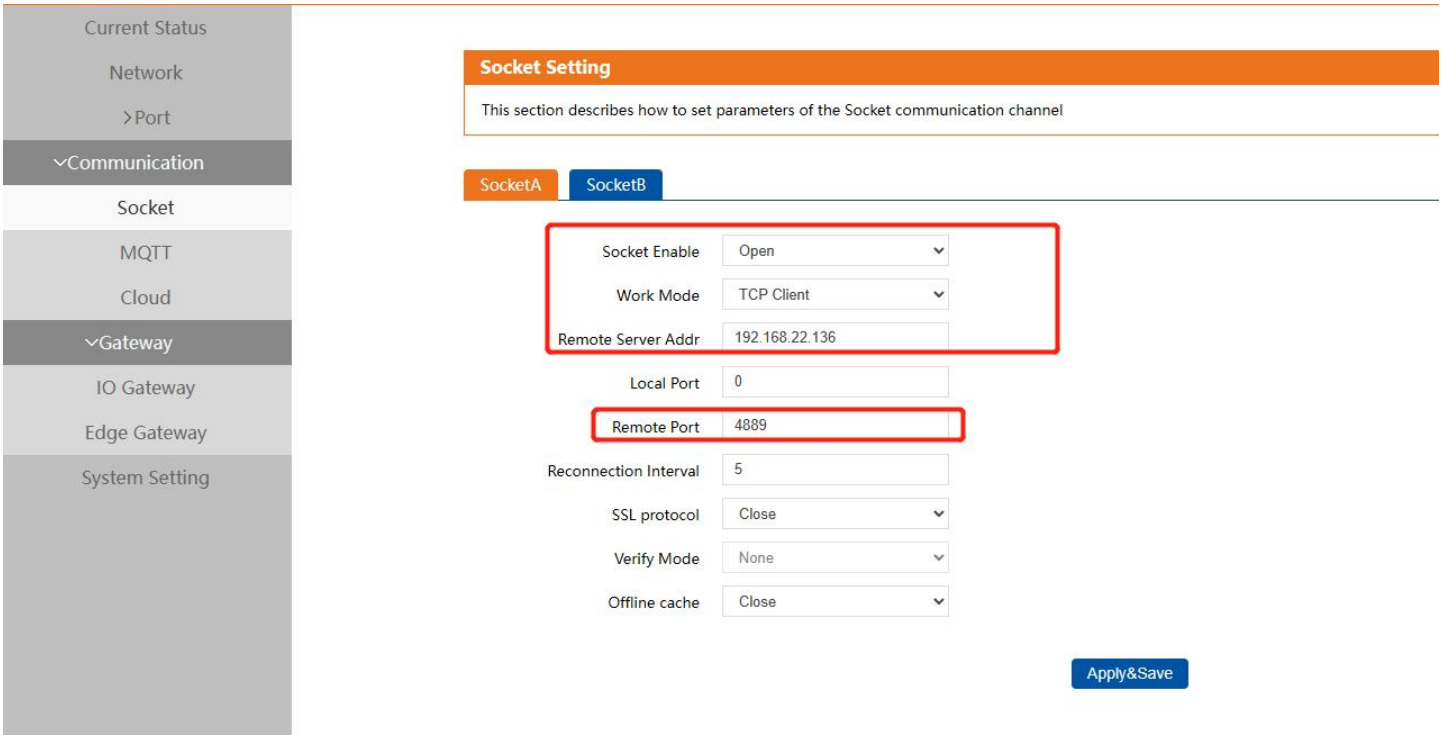




4.3. Add group

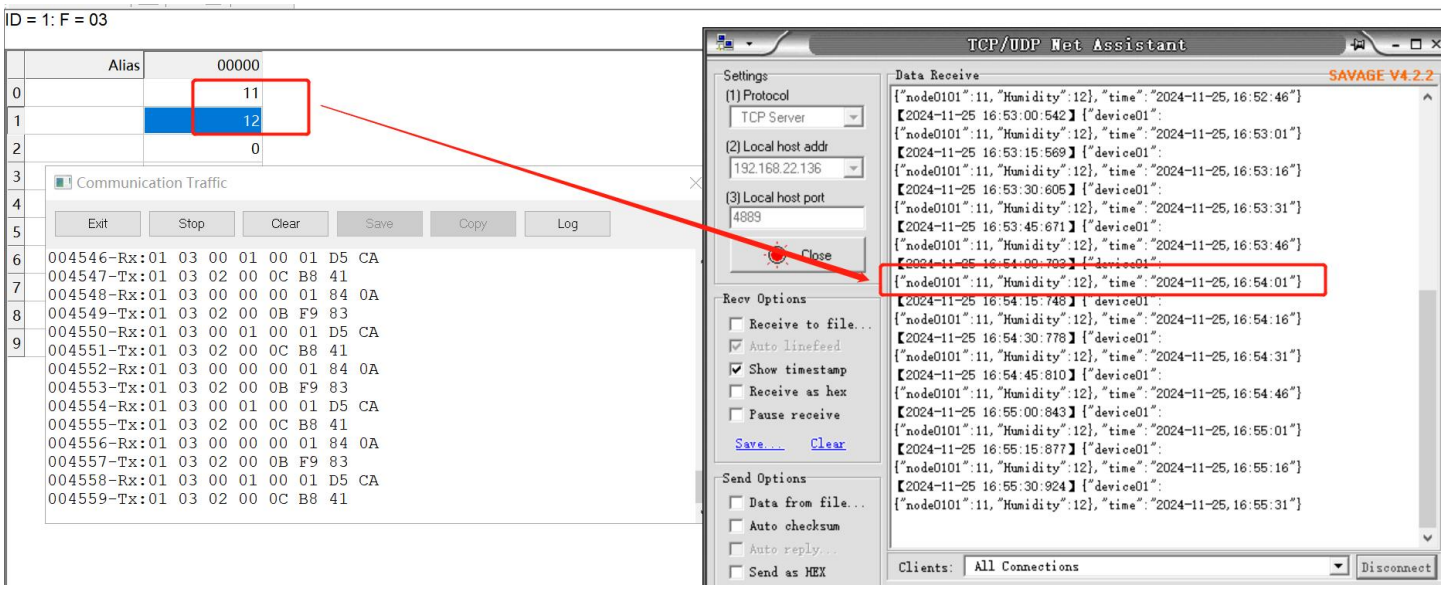


If reporting the data via socket A, users need to configure the socket A parameters first.



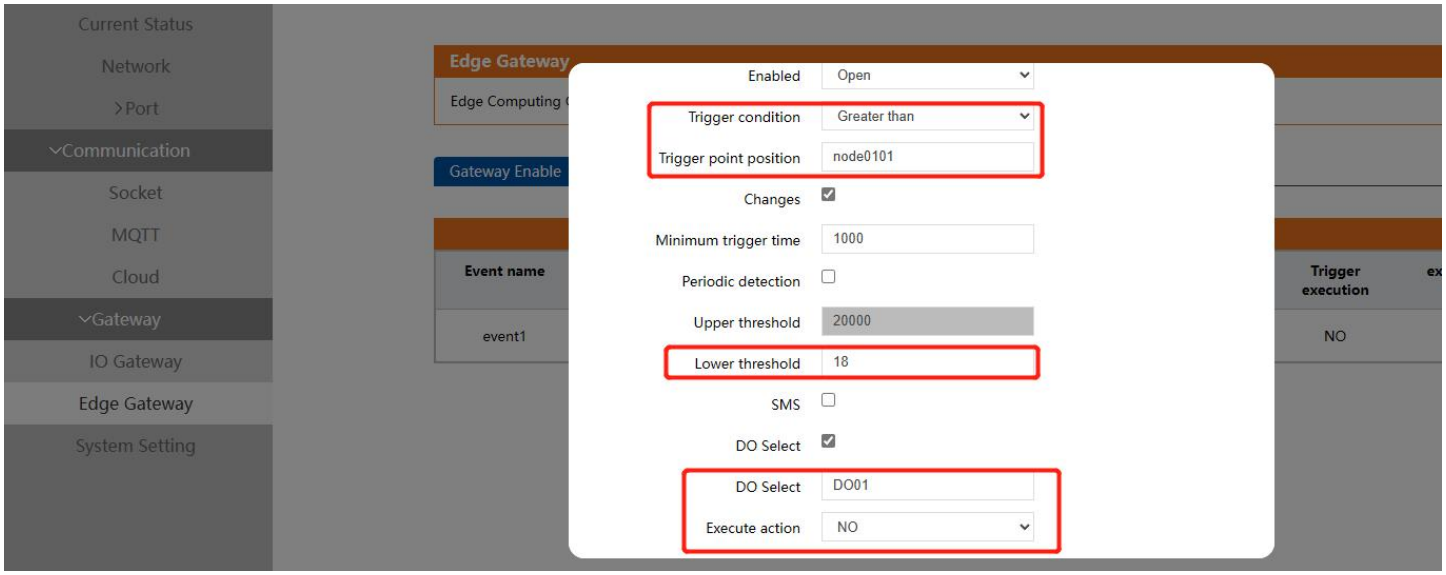
4.4. Test result of data report

In this document, we use Modbus Slave software to replacement the real Modbus Slave device to do the test. From the TCP server side, we can notice that the data interval is 15s, it's keep the same that we set in the adding group page.

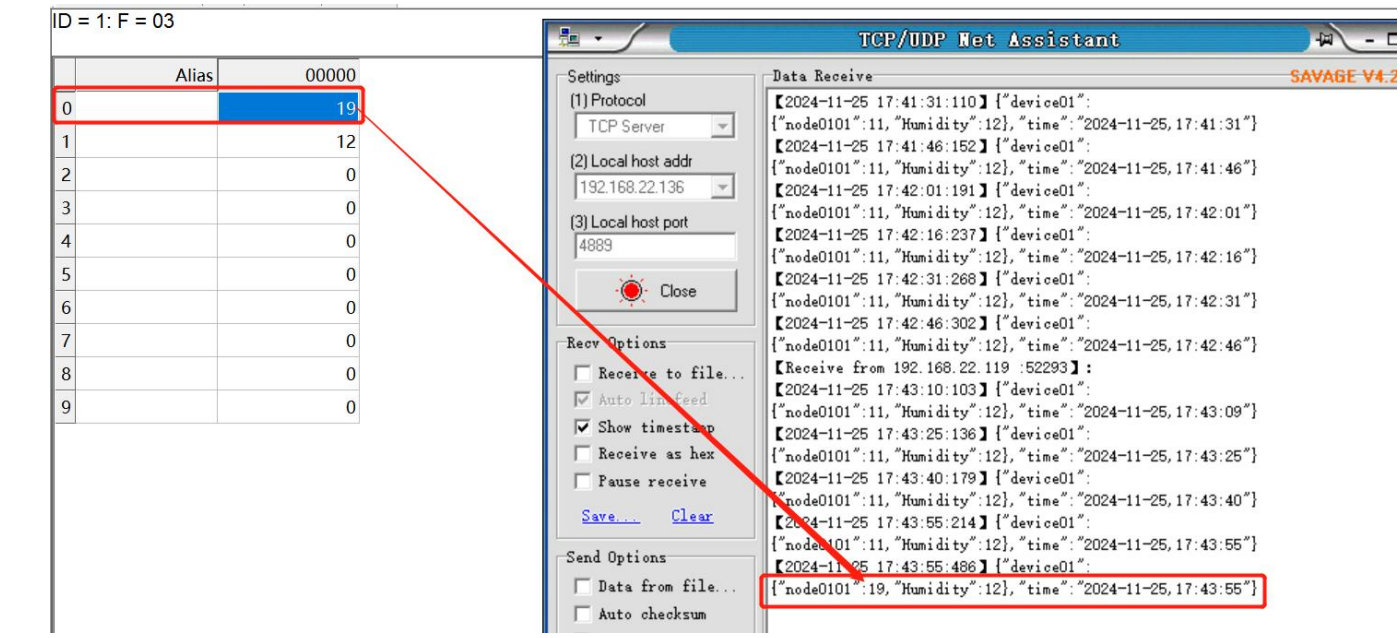


4.5. Linkage control

Now let's add event to check how the linkage control working. Add the event first, in this doc, the configuration is like the following.



When the data of node0101 changed, and the data is greater than 18(the lower threshold), the DO1 status changed, users can check the DO1 indicator is on.

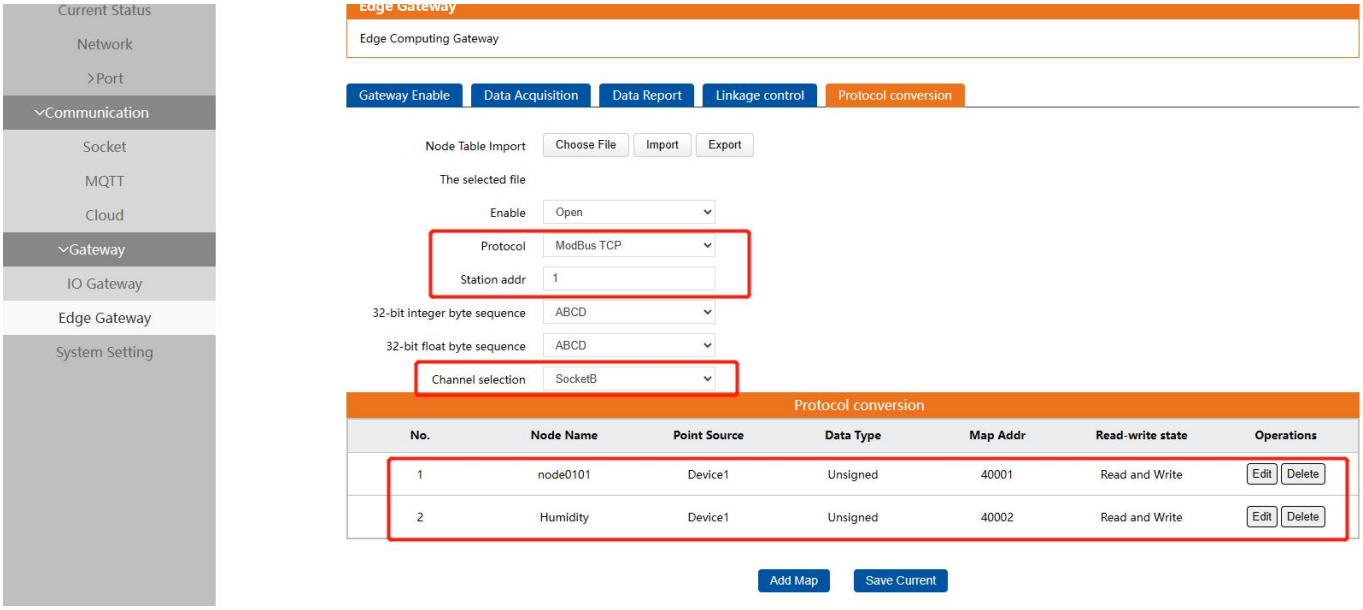


4.6. Protocol conversion

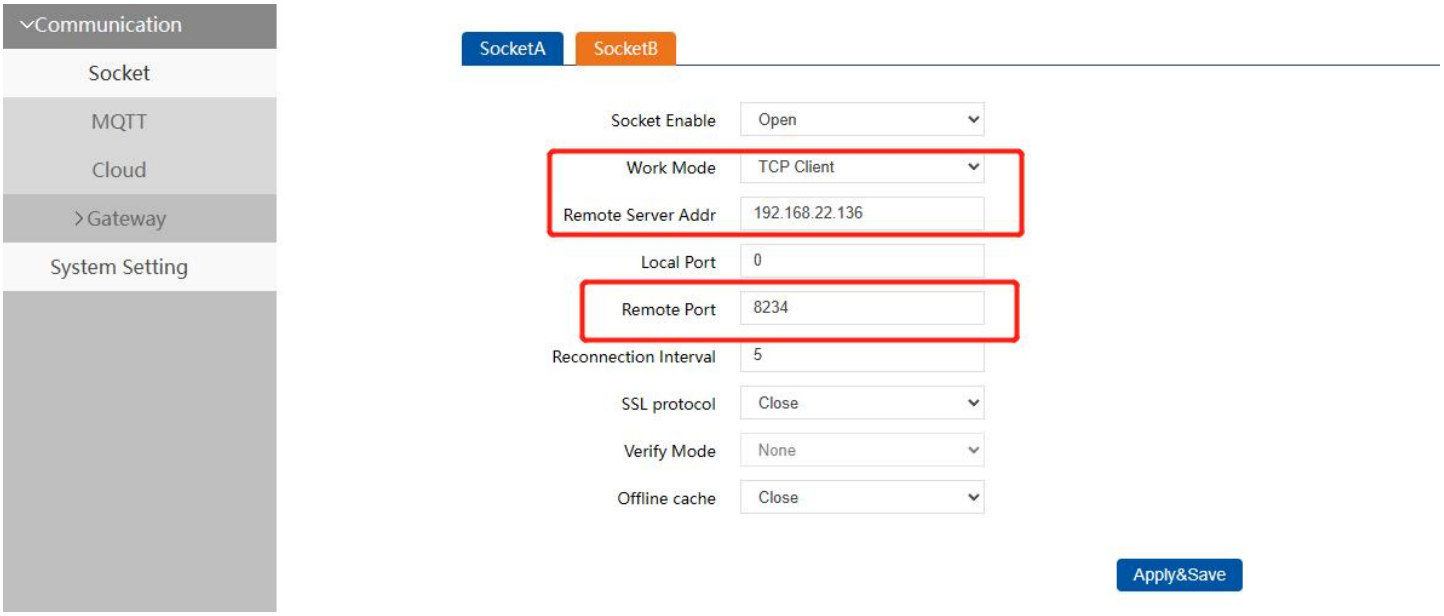
The protocol conversion function is mainly applied in the scenario where the server actively sends protocol commands to obtain data or control points from the M100.

After the M100 is connected to the server through the link of protocol conversion, the server issues standard protocol commands to realize the collection and control of all point data of the M100. Current protocol conversion including 2 protocol standards: Modbus TCP and Json.

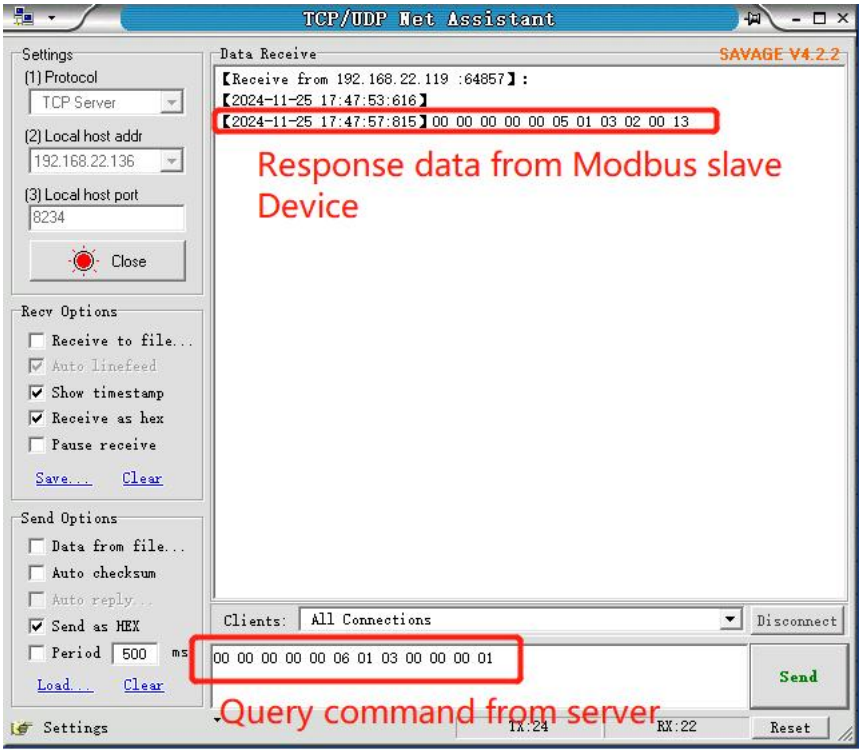
Query data using Modbus TCP:



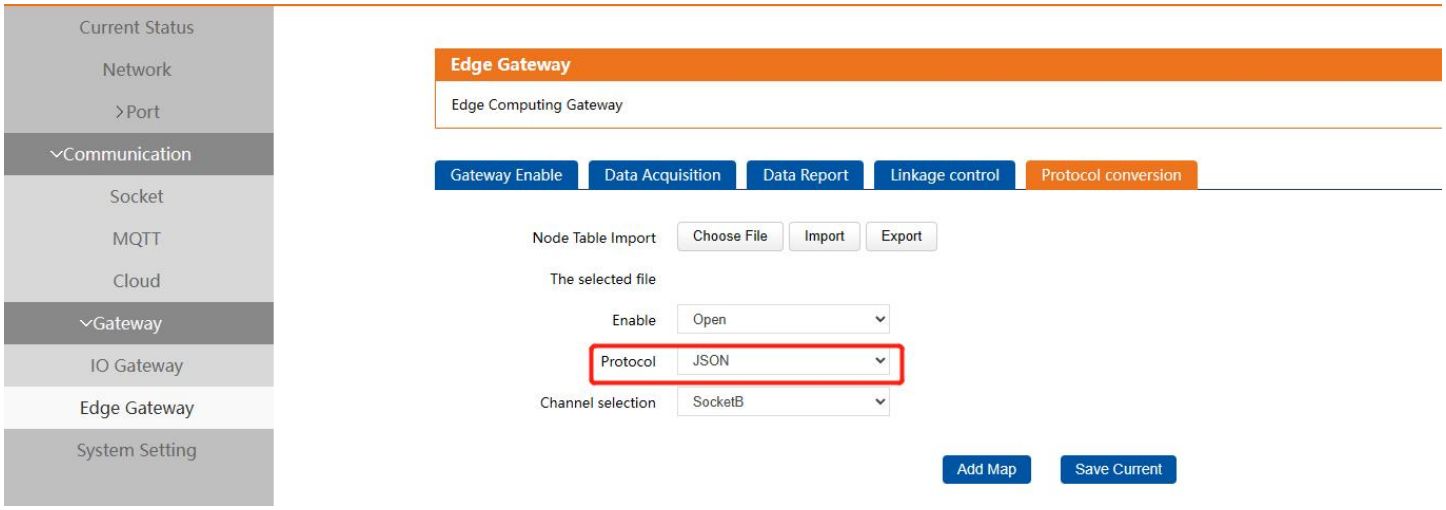
Parameters of socket B:



Query command from TCP server:



Query data using JSON:



When sending query command from the server should in specific format. The query/control

Json contents are the following format:

{"rw_prot": {"Ver": "protocol version","dir": "transmission direction","id": "id","r_data": [{"name": "name of data points"],"w_data": [{"name": "name of data points","value": "data"}]}

Key-value	Description
rw_prot	Protocol header
ver	Protocol version, fixed value: 1.0.1
dir	Data transmission direction In query/control command, the option should be down. Means transmit data from network to serial device, “down” must be lowercase.
id	User defined parameter. The id is same in query/control and response data. Sometimes, the query/control data is high frequency, the response data may be disordered. The program in network can confirm the relevant response data by the id.
r_data	The data load for querying data
w_data	The data load for controlling data
name	The name of data points
value	Means the data need to be sent to the data points. In query data, this key-value can be ignored.

The response data contents are the following format:

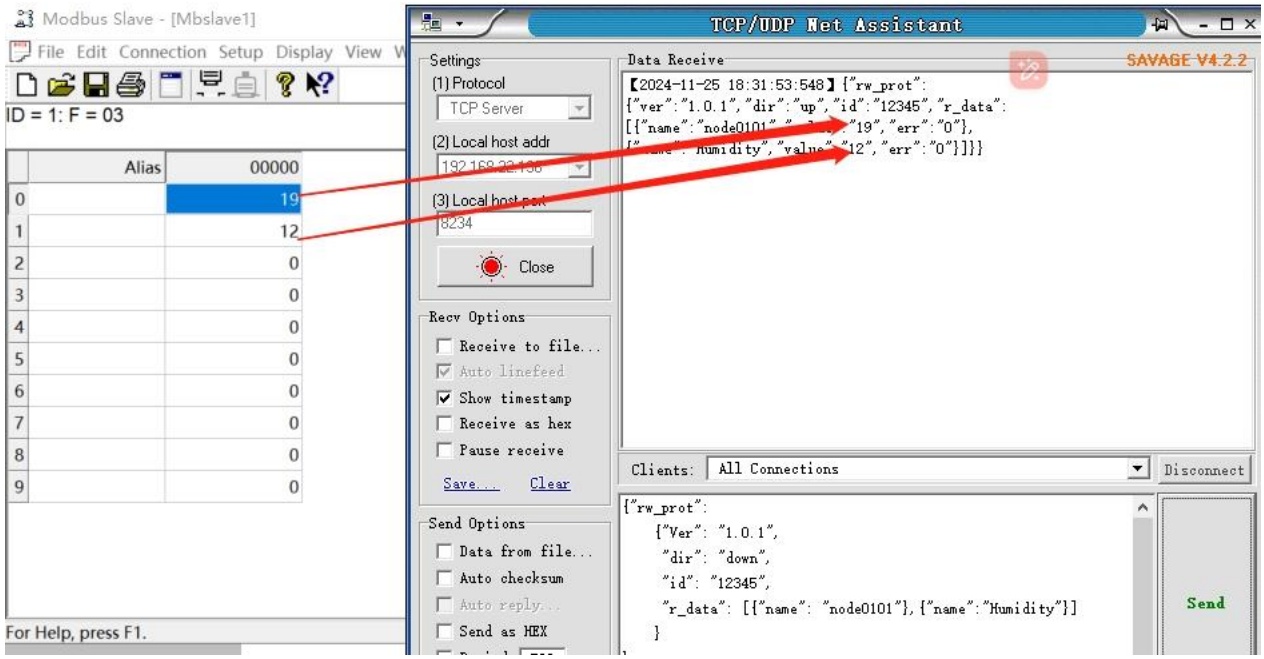
{"rw_prot": {"Ver": "protocol version","dir": "transmission direction","id": "id","r_data": [{"name": "name of data points","value": "data","err": "error code"}],"w_data": [{"name": "name of data points","value": "data","err": "error code"}]}

Key-value	Description
rw_prot	Protocol header
ver	Protocol version,fixed value: 1.0.1
dir	Data transmission direction In response data, the option should be up. Means transmit data from serial device to network, “up” must be lowercase.
id	User defined parameter. The id is same in query/control and response data. Sometimes, the query/control data is high frequency, the response data may be disordered. The program in network can confirm the relevant response data by the id.
r_data	The data load for querying data
w_data	The data load for controlling data
name	The name of data points.
value	The valid data of the data points
err	Error code, 0: The command can be operated by the USR-M100, 1: The command can’ t be operated by the USR-M100.

To read the value of node0101 and the Humidity, we can send data like the following:

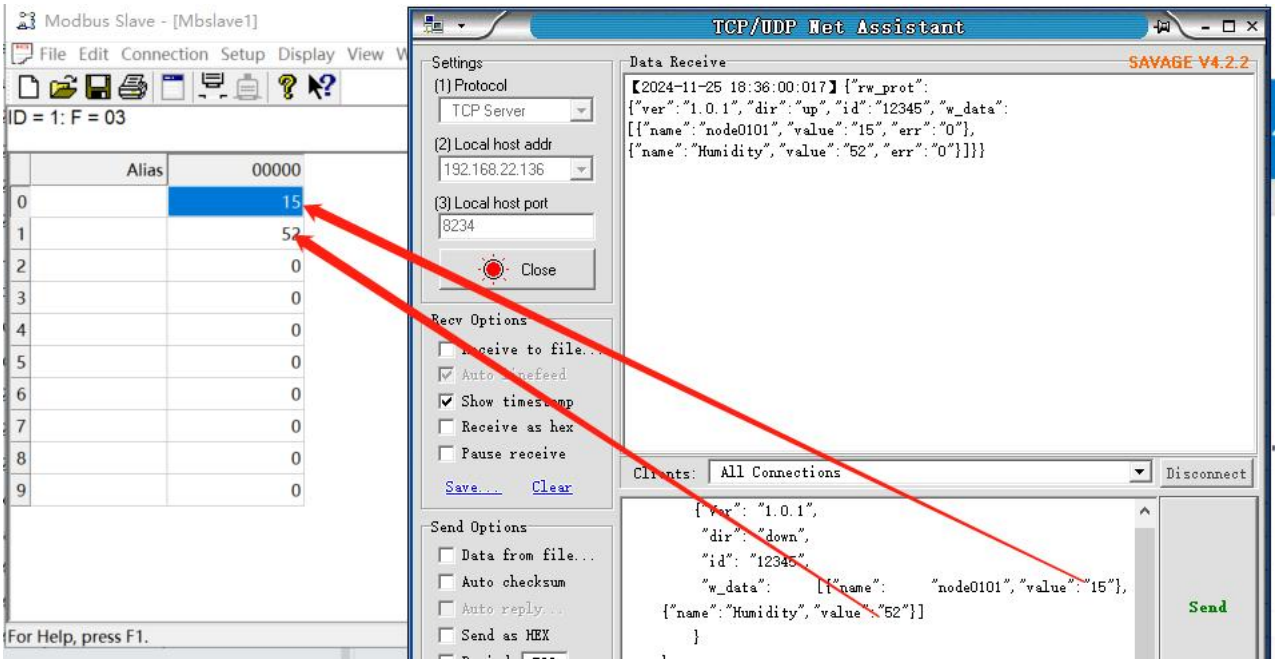
{"rw_prot":
{"Ver": "1.0.1",
"dir": "down",
"id": "12345",

```
    "r_data": [{"name": "temperature"},{"name":"Humidity"}]
  }
}
```



To write the value of node0101 and the Humidity, we can send data like the following:

```
{"rw_prot":
    {"Ver": "1.0.1",
     "dir": "down",
     "id": "12345",
     "w_data": [{"name": "node0101","value":"15"},{"name":"Humidity","value":"52"}]
    }
}
```



There are 3 response data for the unoperated command:

- The USR-M100 responses no data to the command,
- The USR-M100 will response data conforming to the error protocol if the ver/dir/id is not right,

- The USR-M100 will response data conforming to the error protocol if the contents of r_data and w_data are both wrong,

  the USR-M100 will response data of the right one if only one of the r_data and w_data is wrong.

The error protocol format is the following:

{"rw_prot": {"Ver": "1.0.1","dir": "up","err":"1"}

Tips:

1. If the query command is incorrect, the value of the read command reply is empty, and the value of the write command reply is the historical data value.

2. The maximum read and write operation is 127 data points at the same time.

5. PUSR cloud service

In order to reduce the length of this document, we have organized this section into a special document. Please refer to "USR-M100s Quick Start Guide with PUSR cloud" for detail.

6. Warranty

7. Contact Us

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9. Revision History

Version	Date	Author	Description
1.0.0	2023.01.30	Dean,Gao	Initial
1.0.1	24.03.06	May	Add expansion machine selection table