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# Low-power Edge gateway

User Manual

USR-SC150

## 1. Product

The USR-SC150 is a new low-power scenario-specific DTU (Data Acquisition Terminal) developed by Jinan Youren Internet of Things Technology Co., Ltd. This rail-mounted device combines traditional sensor data acquisition with remote transmission, featuring advanced low-power operation logic for genuine energy efficiency. Capable of integrating with solar photovoltaic power systems, it maintains stable operation even during prolonged rainy weather. Designed to industrial standards, it supports wide-voltage terminal power supply and integrates mainstream communication interfaces including RS485 and AI. Compatible with TCP and MQTT network protocols for standard IoT platform integration, it enables local Modbus RTU autonomous polling and edge computing, with proactive JSON data reporting to facilitate remote field equipment data collection. Widely applicable to low-power scenarios such as urban lifelines, smart farming, intelligent industries, and smart agriculture.

## 2. Product Features

The Cortex-M33 core features a low-power mode, ensuring stable and reliable performance.

Supports sensor power control with smart power-saving features including sleep/wake cycles, significantly reducing energy consumption.

Integrated with RS485, AI, and DI interfaces, it supports data acquisition from multiple sensors.

DIP switch for flexible mode adjustment and quick parameter configuration

Supports edge computing capabilities, enabling edge data collection and JSON reporting via the Modbus protocol.

Supports edge-side change threshold reporting to enable real-time alerts for out-of-bound conditions and enable rapid response.

Supports integration with third-party cloud platforms via TCP and MQTT, enabling seamless device cloud migration.

Supports standard MQTT and SSL/TLS encryption, and can connect to mainstream cloud platforms such as Alibaba Cloud and Huawei Cloud.

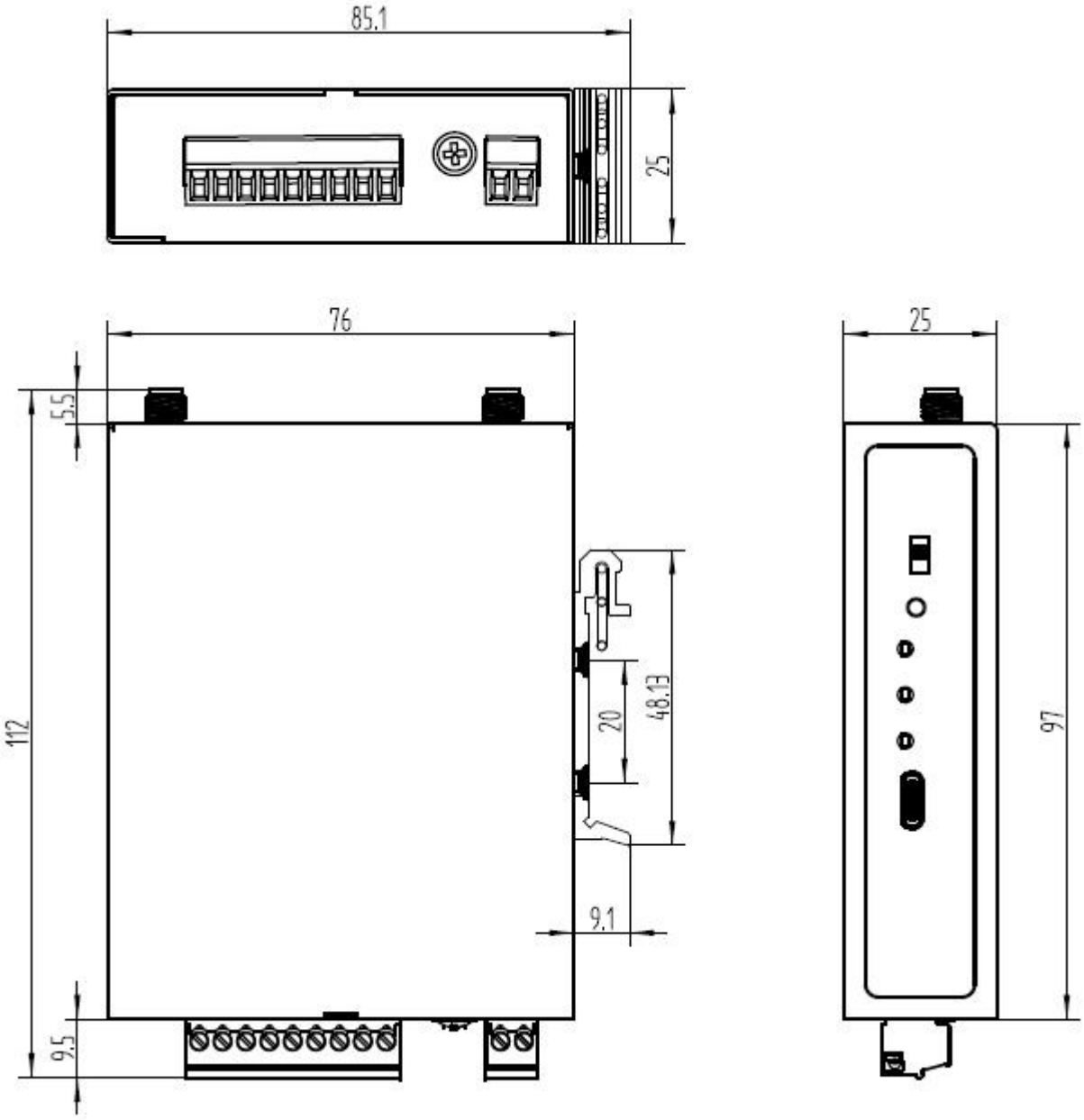
Supports connection to Renyun, enabling configuration and monitoring of Renyun, as well as device status tracking and remote upgrades.

Simple and user-friendly, supports WeChat Mini Programs and DM platform management and configuration.

The serial port supports baud rates from 2400bps to 115200 bps and offers None, Odd, and Even parity modes.

## 3. Product size

Product dimensions: 112*76*25 mm (L*W*H)



## 4. Hardware specifications

| | | |
|---|---|---|
| **physical interface** | Power supply input | DC 9- 36 V |
| | Power supply output | No output (default), 9~36VDC, with an external output power support of up to 10W |
| | analog interface | 2 channels, default 4-20mA, 16-bit resolution |
| | RS485 interface | Protocol 1: Standard Modbus RTU data acquisition<br>Stop bit: 1 (default), 2 Data bit: 8<br>Baud rate: 2400~115200 (default 9600)<br>Check bit: EVEN, ODD, NONE (default) |
| | DI import | Supports DI input acquisition with DI and COM ports |
| | dial switch* | RUN/SLEEP mode adjustment |
| | antenna interface | External antenna, LET Cat1 standard |
| | TF block * | Supports up to 32GB TF card insertion |
| | SIM block | Card 1: Flip-type, standard Nano-SIM card, supports APN (hot-swappable)<br>PAP, CHAP, PAP&CHAP, no authentication (default) |
| | Reload | When the module is running, press the button for 15 seconds. After releasing, the module will reset to factory settings and restart. |
| **low power parameter** | Collection interval | The time interval for external power supply data collection slave devices: 1 to 1440 minutes (default: 15 minutes) |
| | Report interval | Networked data upload time, 1 to 24 times the collection interval (default: 4 times) |
| | sensor power supply time | The data acquisition instrument powers the connected sensor for 3 to 30 seconds (default: 5 seconds). |
| | data cache | Supports off-network and local data caching |
| | power consumption mode | High-power mode: Collection interval ≤5 minutes, the device automatically enters high-power mode. Low-power mode: Collection interval>5 minutes, the device automatically enters low-power mode. |
| **software function** | NTP | NTP is enabled by default, with the default time zone set to Eastern Time (ET). For time zones-12 to 12, you can set the default.<br>12x NTP calibration reporting cycle, configurable from 1x to 24x |
| | communication protocol/platform | TCP, MQTT, and Youren Cloud support domain name resolution |
| | MQTT protocol | 3.1, 3.1.1 (default), supports standard MQTT docking with Huawei Cloud, Alibaba Cloud, etc. |
| | SSL encryption | Supports SSL/TLS encryption and certificate verification |
| | Location reservation* | Keep GPS location |
| **Hardware parameters** | product size | 112* 76* 25 mm |
| | way to install | guide rail installation |
| | work environment | 5%~95% (no condensation), -25~7 5°C |

Note: *Red marked functions are under development

## 5. Wiring Instructions for USR-SC150

### 5.1. USR-SC150 line sequence

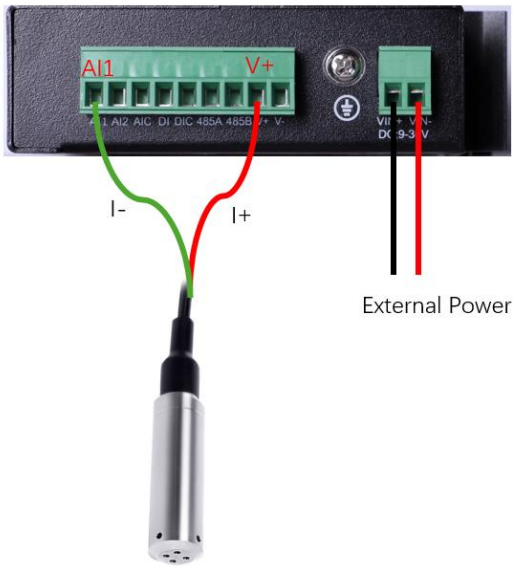
#### 5.1.1. product list

- USR-SC1500 unit
- RS485 Temperature and Humidity Sensor
- 4~20mA level transducer
- DI water immersion sensor

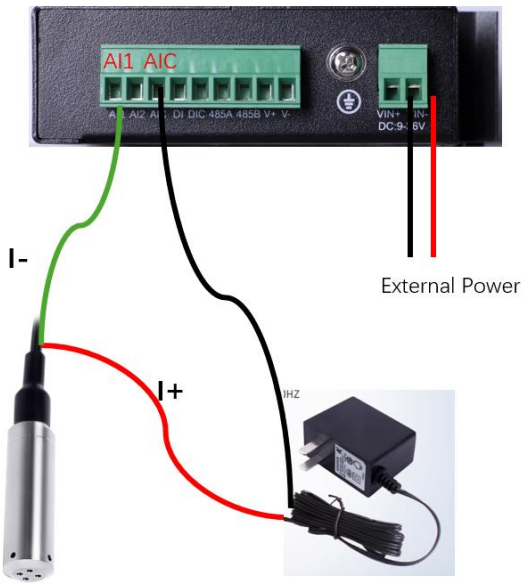
### 5.2. 4~20mA Analog Signal Wiring

#### 5.2.1. Diagram of Analog Quantity Connection for Two-Wire System

SC150 Control Power Supply, 2-Wire Analog Signal Wiring Diagram

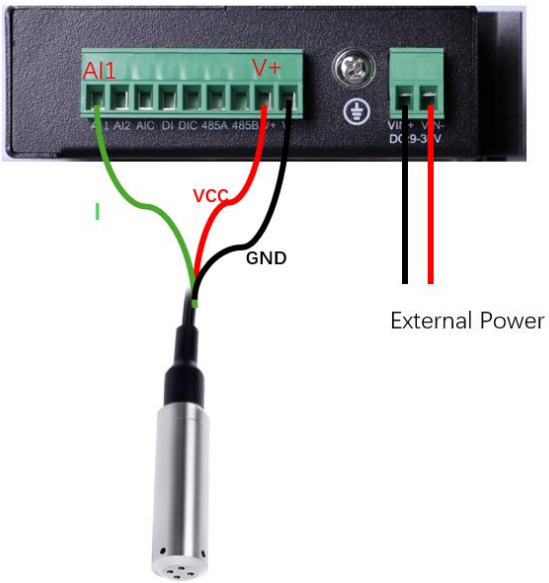



External Power Supply, 2-Wire Analog Signal Wiring Diagram

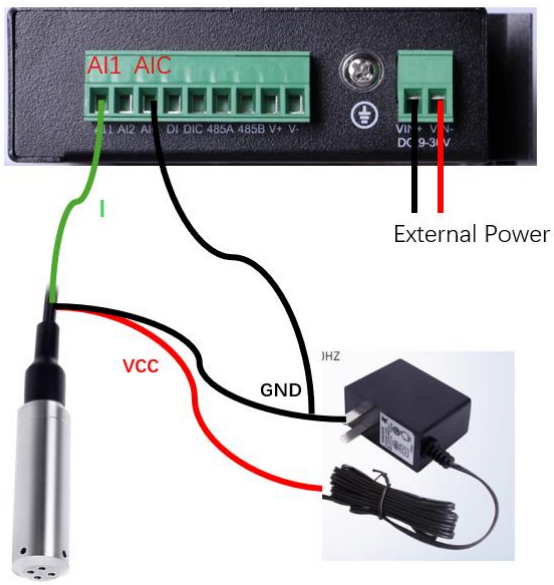



#### 5.2.2. Diagram of three-line analog quantity wiring

SC150 Control Power Supply, 3-Wire Analog Signal Wiring Diagram

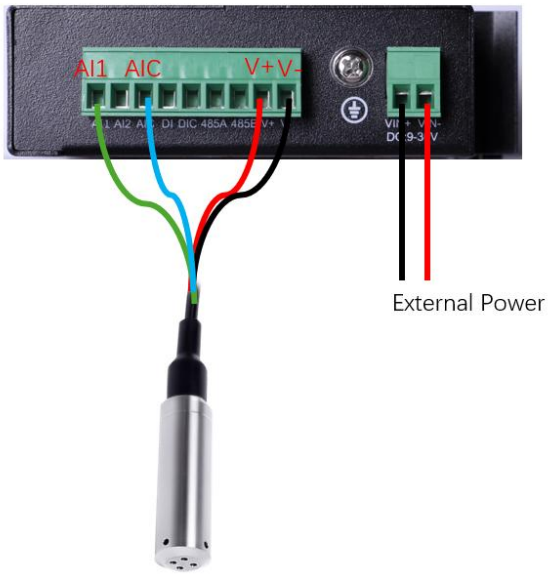



External Power Supply, 3-Wire Analog Signal Wiring Diagram

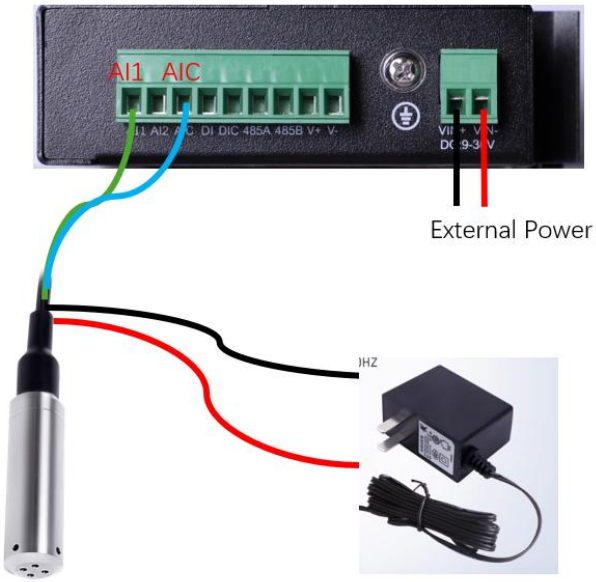


5.2.3. Diagram of four-line analog quantity wiring

SC150 Control Power Supply, 4-Wire Analog Signal Wiring Diagram

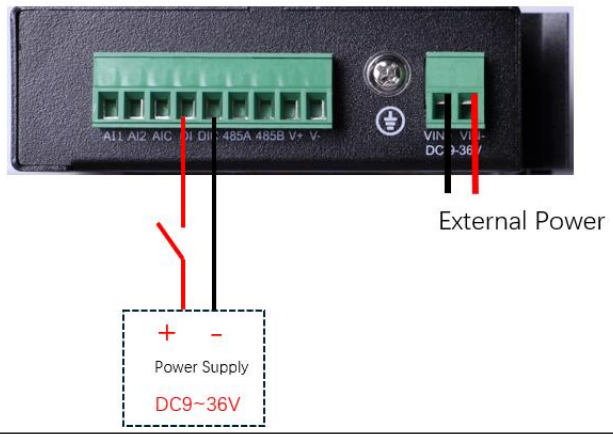
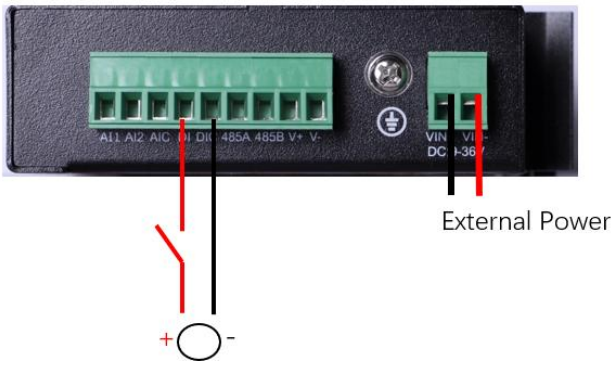



External Power Supply, 4-Wire Analog Signal Wiring Diagram




5.3. switching connection

Connection method: The DI physical interface supports 2-wire access, with each DI corresponding to a DI terminal and a COM terminal, and supports dry/wet node access.

| contact | dry contact | wet contact |
|---|---|---|
| description | Passive switch, with no polarity between the two contacts, interchangeable | An active switch has polarity between its two contacts and cannot be connected in reverse. |
| state | Close, Open | With electricity, without electricity |
| Wiring diagram | DI Connection for Passive Input (Dry Contact)<br>Passive Contact Signal (e.g., Switches, Push-Buttons, etc.)<br>  <br> | DI Connection for Active Input (Wet Contact)<br>Voltage-Level Signal (High/Low Level)<br>(e.g., Infrared Detection, Transistor Output, Level Detection, Smoke Detection, PLC Output, Flow Monitoring)<br>  <br> |

Detection mode: The DI of USR-SC150 can detect switch input, with 9-36V as high (set to 1) and 0-2V as low (set to 0).

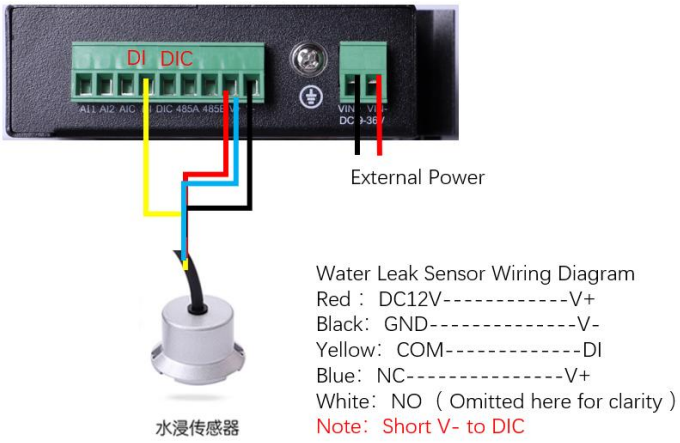
5.3.1. Schematic diagram of passive switch quantity wiring

For passive switch devices, an external voltage must be applied. The USR-SC150s external output port can be used directly

for power supply.

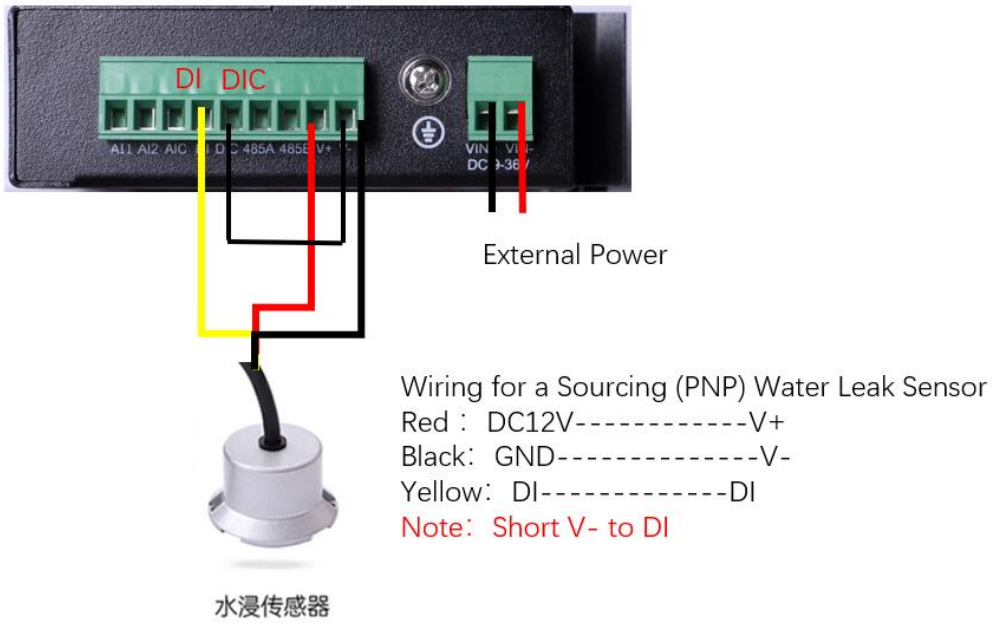
Wiring Diagram Type 1: Passive Dry Contact Digital Input


Wiring Diagram Type 2: Passive Dry Contact Digital Input




5.3.2. active switch wiring

Wiring Diagram: Sourcing (PNP) Digital Input



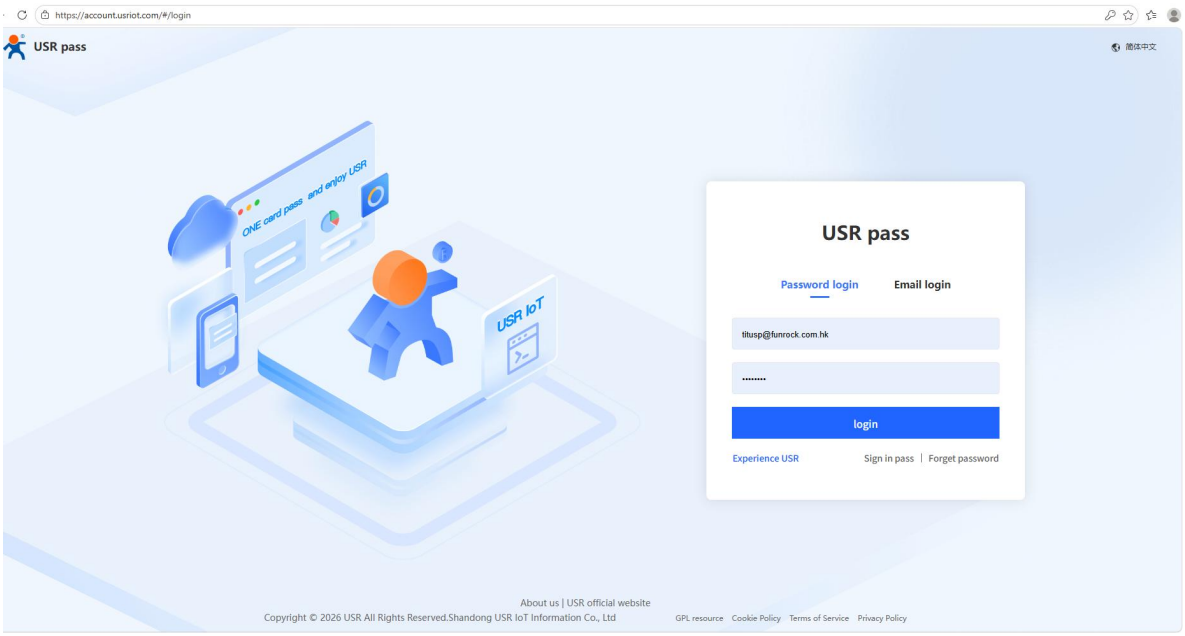

## 6. Some users have shared case studies

### 6.1. link sensor

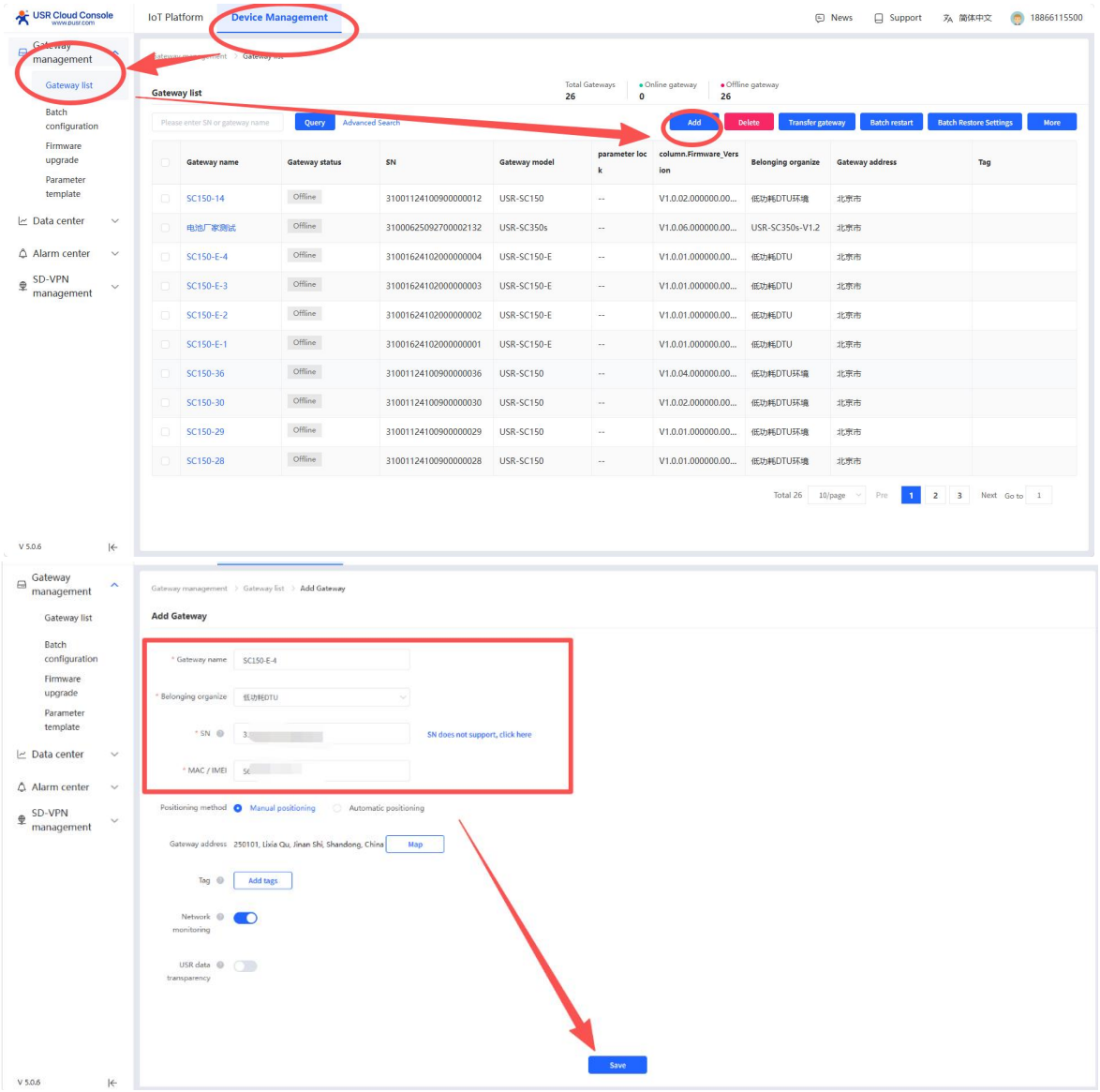
Refer to the wiring method described above to connect RS485, switch signals, and 4-20mA analog signals, and wire the temperature/humidity sensor, water immersion sensor, and liquid level sensor.

### 6.2. Add a data collector to a cloud

Log in to the DM platform: https://dm.usr.cn/. If you dont have an account, register for a pass first.




Add gateway devices to the DM platform. Enter the SN and IMEI on the devices side and click Save. Users can also scan the QR code on the devices front using the WeChat Mini Program to add the device.

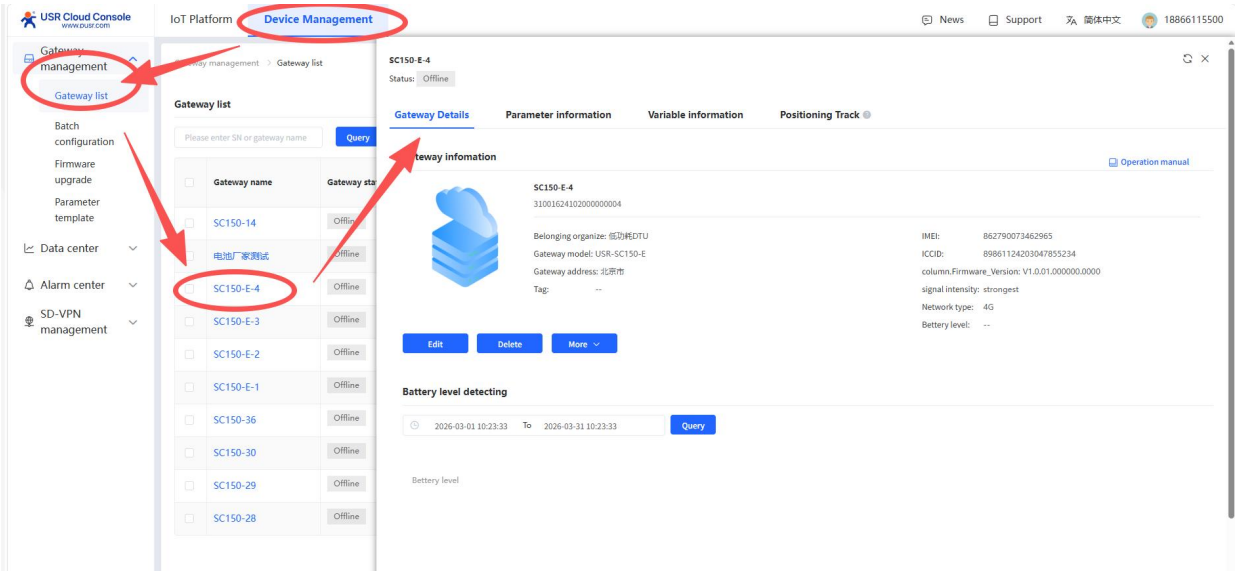



## 6.3. Configure USR-SC150 information

Click the gateway name to view the USR-SC150 configuration parameters

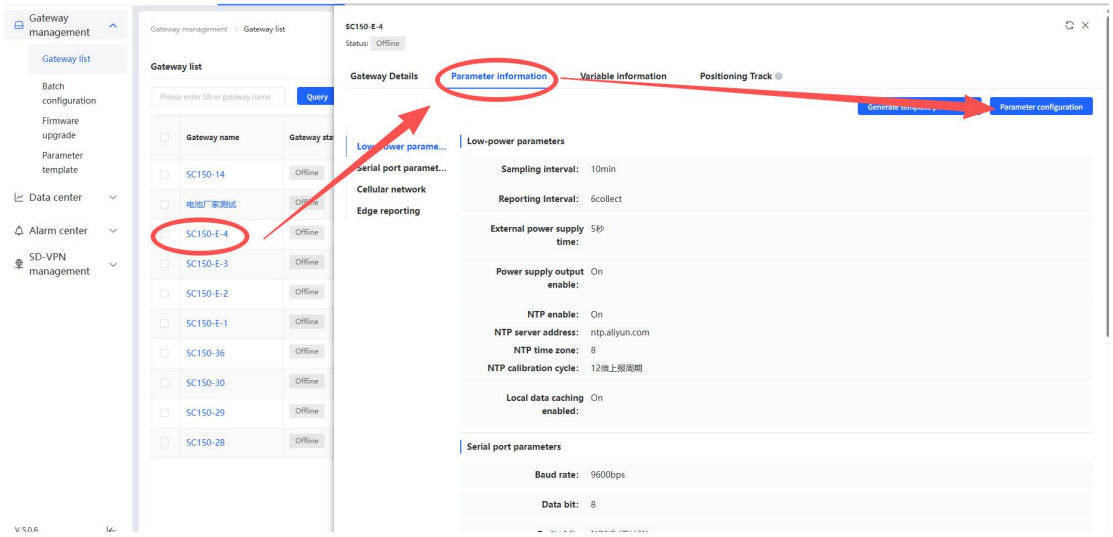
### 6.3.1. Gateway Details

Gateway details: View device specifications and perform firmware upgrades or restart the gateway.




### 6.3.2. Parameter information

Click on parameter information to configure the basic parameters of USR-SC150




The USR-SC series low-power data acquisition instrument features a distinctive low-power operation logic. In this logic, the data collection cycle and reporting cycle serve as critical parameters. Upon startup, the device performs a single round of slave data collection and reports to the server before entering sleep mode. When the data collection cycle arrives, the device awakens from sleep mode, powers up the slave sensors for preheating, and then proceeds with data collection. The collected data is stored within the device before re-entering sleep mode. During the data reporting cycle, the device consolidates multiple collected data points and submits them to the server for centralized storage and display. Consequently, the device exhibits a regular online/offline state pattern on the Yiren Cloud Platform.

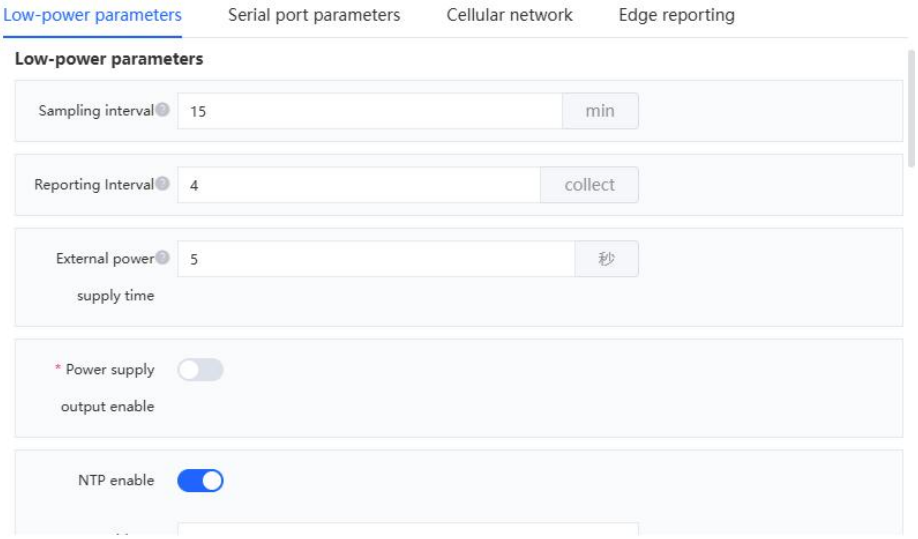
**Collection interval: The time interval between waking up from sleep mode and starting data collection, adjustable from 1 to 1440 minutes with a default of 15 minutes. High-frequency collection: Collection interval ≤5 minutes, keeping the device online continuously and providing uninterrupted power output. Low-frequency collection: Collection interval>5 minutes, keeping the device in a regular offline state and only supplying power during data collection.**

**Reporting interval: The time interval for data batch reporting. You can set it to 1 to 24 times the collection interval, with the default being 4 times.**

**Sensor power supply time: Duration for powering the downstream sensor, adjustable from 3 to 30 seconds, default is 5 seconds**

**Power output: Supplies power to downstream sensors. No output by default.**

**NTP enable: NTP server calibration, enable by default**




In this case, the data collection interval is 5 minutes, the reporting interval is 20 minutes, the sensor power supply duration is 15 seconds, and external power output is enabled. All other parameters remain the factory defaults.

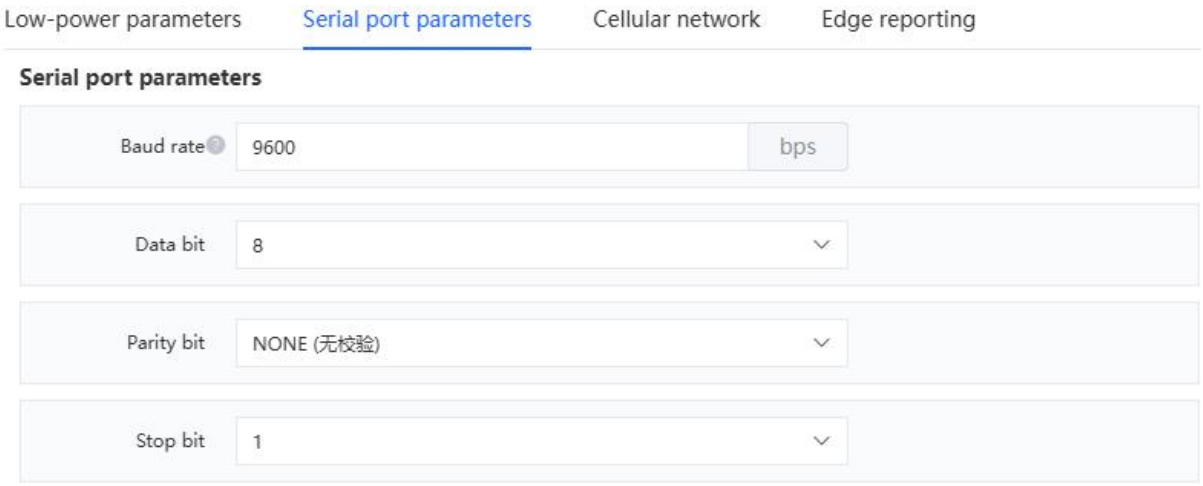
**Serial port parameters:**

Serial port baud rate: 2400~115200 bps, default 9600

Serial port data bits: 8

Serial port parity: odd, even, or no parity. No parity is the default.

Serial port stop bit: 1 or 2, default is 1 bit




In this case, the serial port parameters remain factory default.

**cellular network :**

**SIM Card Mode: The network SIM card selected when the device connects to the internet. The device has a built-in eSIM and comes with 5 years of data. Users can also insert an external card from the top of the device. The SIM card mode options are: External Card First, Internal Card Only, External Card Only, Dual Backup, and External Card First by default.**

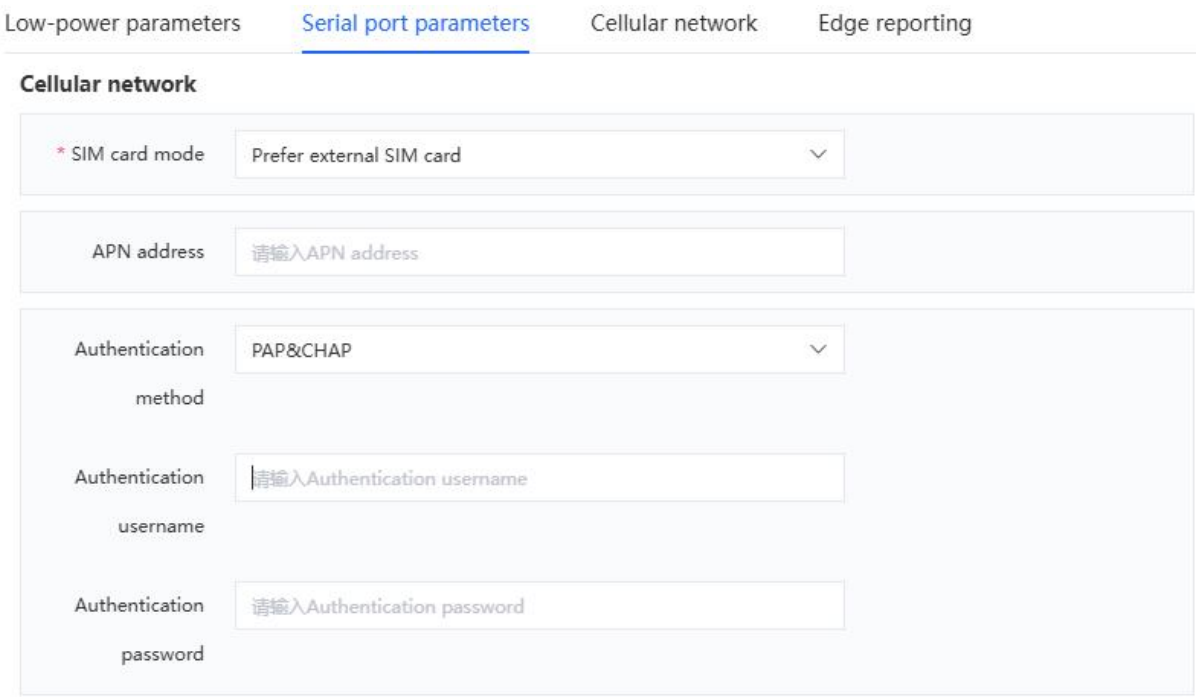
External card priority: Use the external card when inserted, and the internal card when not inserted.

Built-in card only: The device connects to the internet using only the built-in card. Even if the built-in card has no data, inserting an external card will not allow internet access.

External card only: The network is connected only with the external card. Even if the external card is damaged or has no data, the internal card cannot be used.

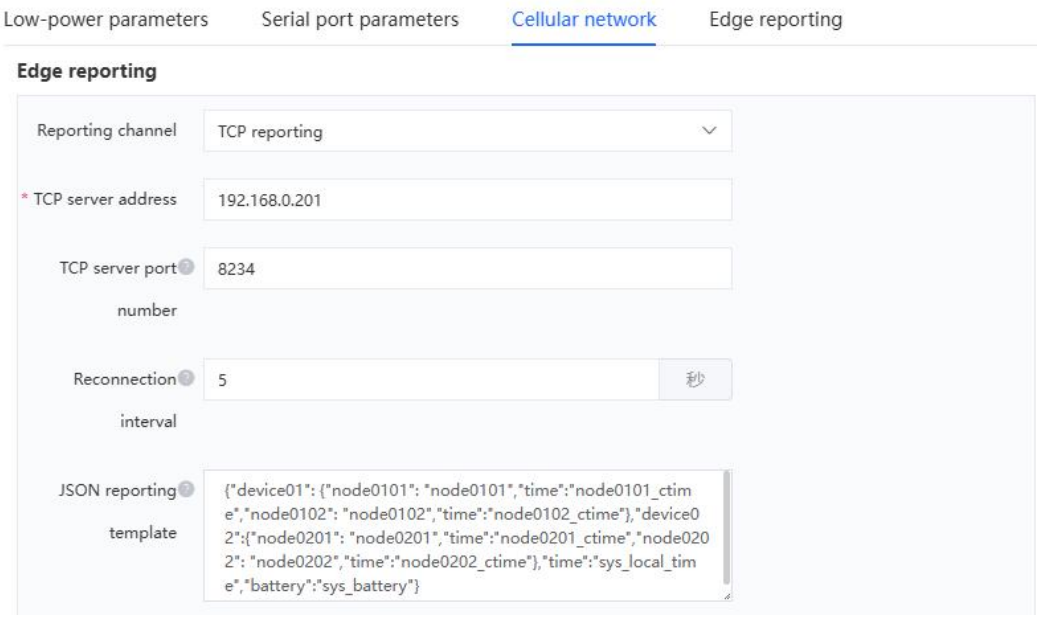
Dual SIM backup: When you need both external and internal SIM data plans, you can seamlessly switch between them during poor network conditions or when one SIM is overdue, ensuring your device stays connected to the server.

**APN address: When using a private network card, insert the external card and enter the APN information. Also, enter the authentication information.**

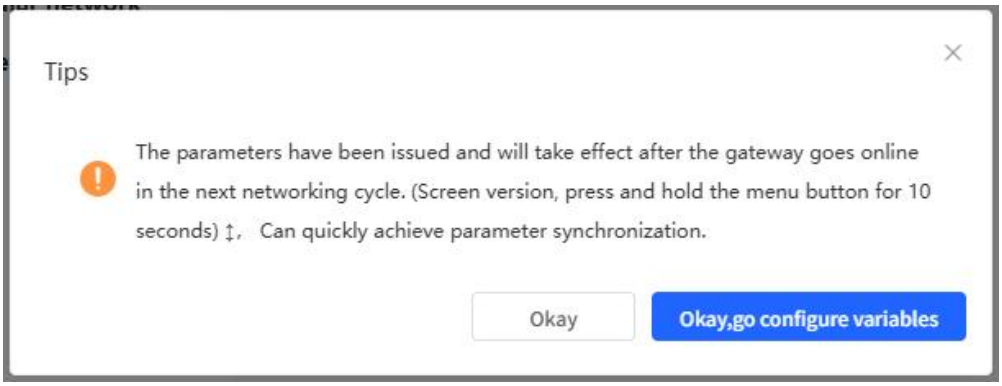



In this case, the cellular network uses the factory default parameters and connects to the internet using the devices built-in SIM card.

Edge Reporting: The data reporting channel for edge collection supports multiple protocols including Renren Cloud, MQTT, and TCP. By default, data is reported to Renren Cloud. For TCP server integration, configure the TCP reporting channel and create a JSON reporting template. For MQTT server integration, configure the MQTT reporting channel and create a JSON reporting template.

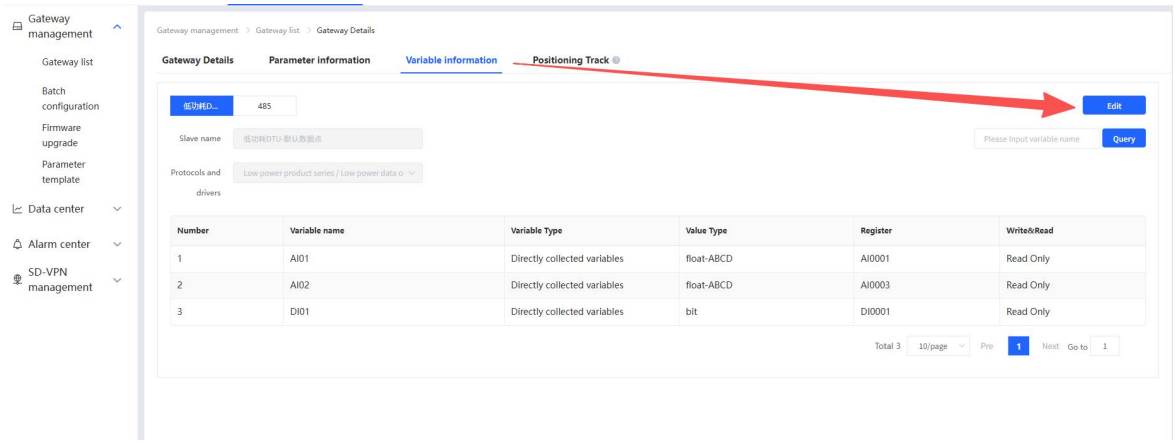


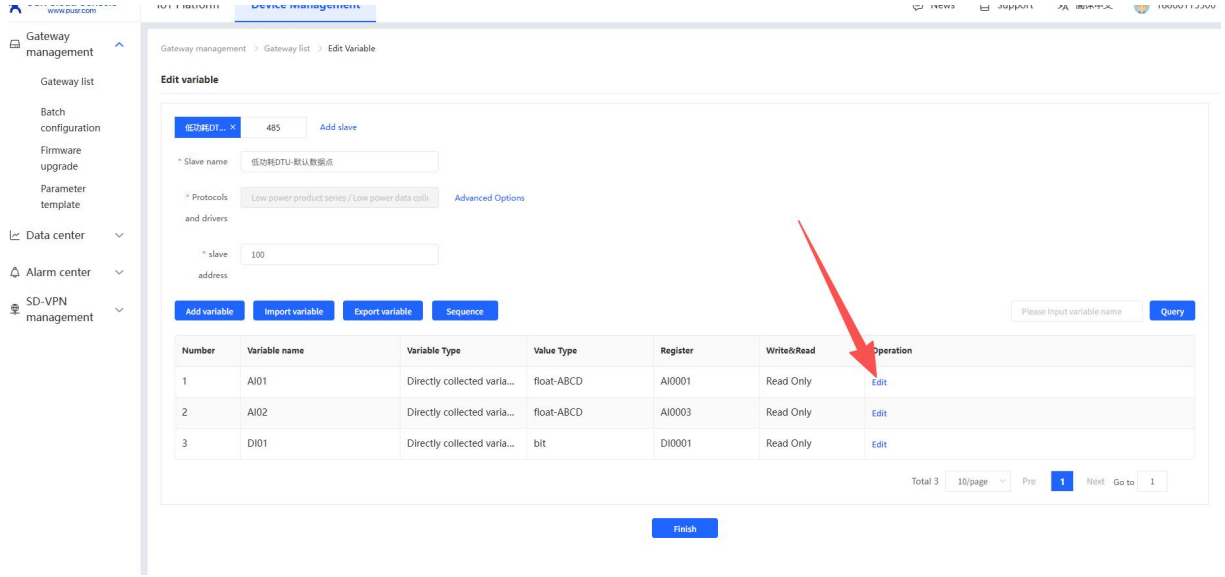

Click Configuration to switch to configuration variables



### 6.3.3. Variable information configuration

Edit analog data for liquid level sensor configuration




The 4~20mA level sensor used in this example has a range of 0~5 meters. To convert the current value into an engineering quantity, refer to the following conversion formula for operation.

Set: The current measurement is X, and the actual temperature data is Y, where Y = kX + b

This is because: 0 m corresponds to 4mA, 5m corresponds to 20mA, and the unit of current values collected by the data acquisition instrument is microampere (UA).

Thus, we obtain two sets of X-Y relationships: (X, Y)---(4000UA, 0 m) and (20000UA, 5 m).

Therefore: 0=4000k+b---------Formula 1

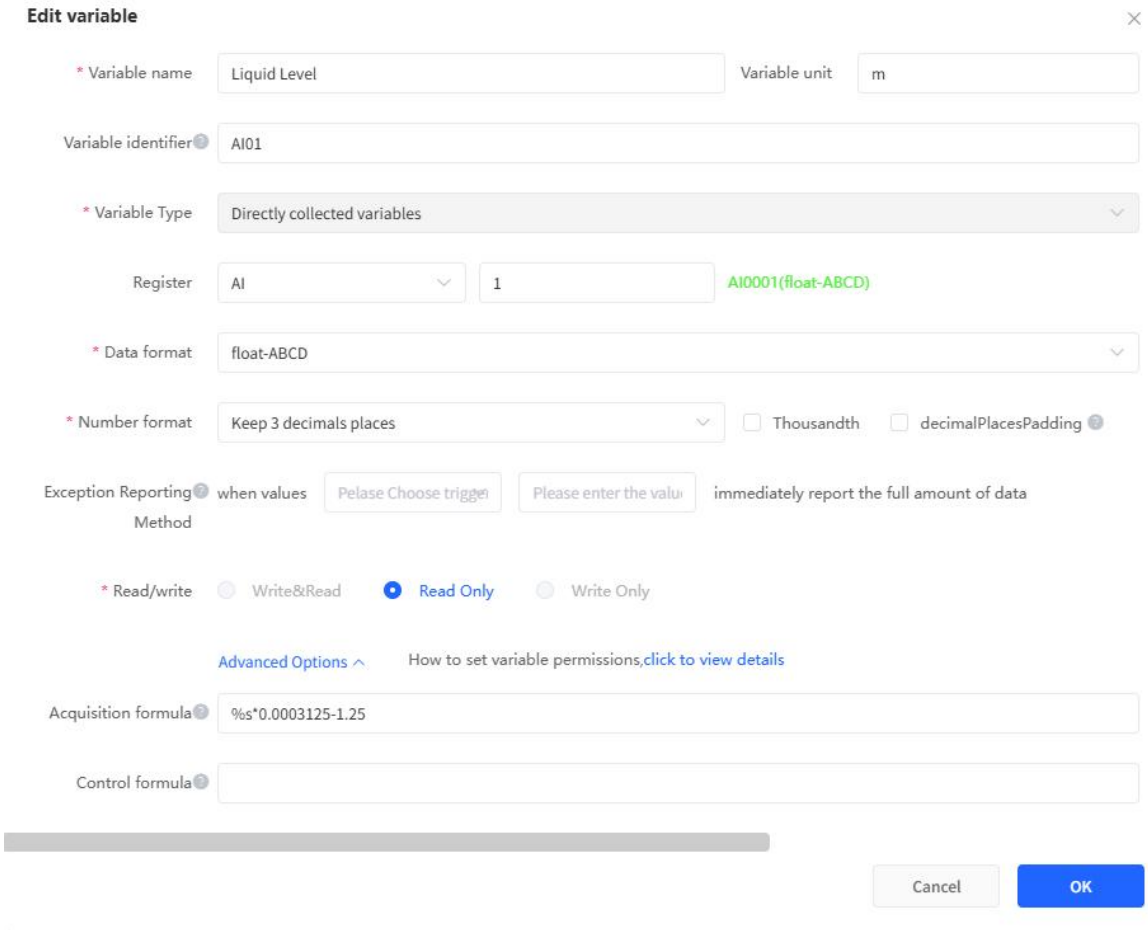
5=20000k+b------Formula 2

From formula 2 and formula 1, we derive: 5 = 16000k, yielding k = 0.

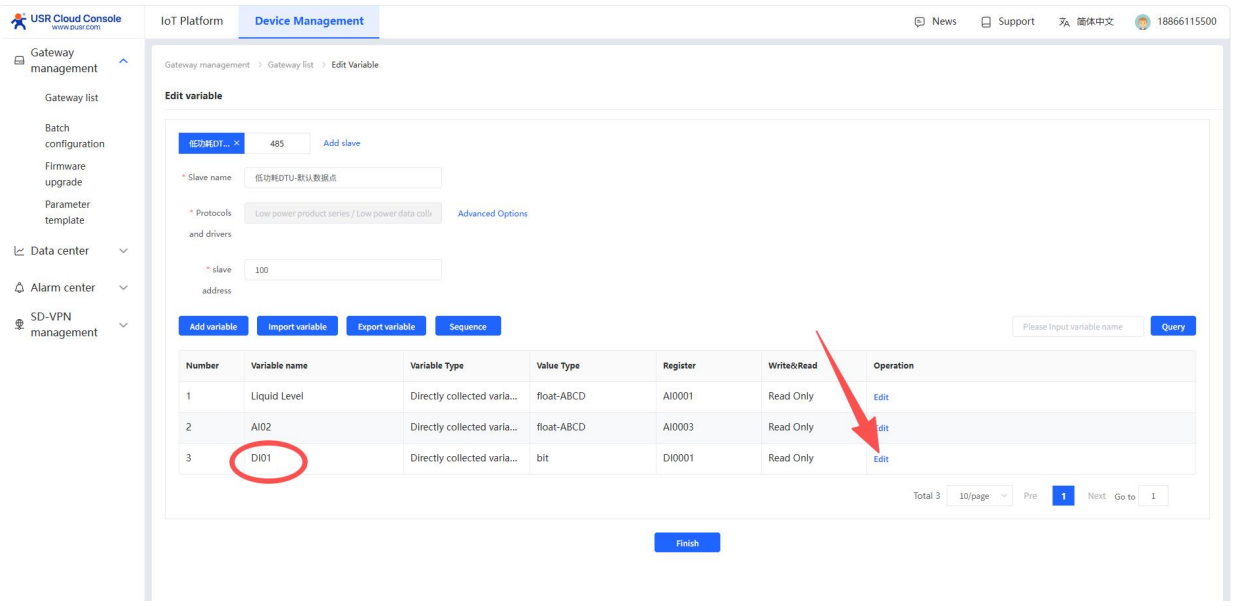
0003125

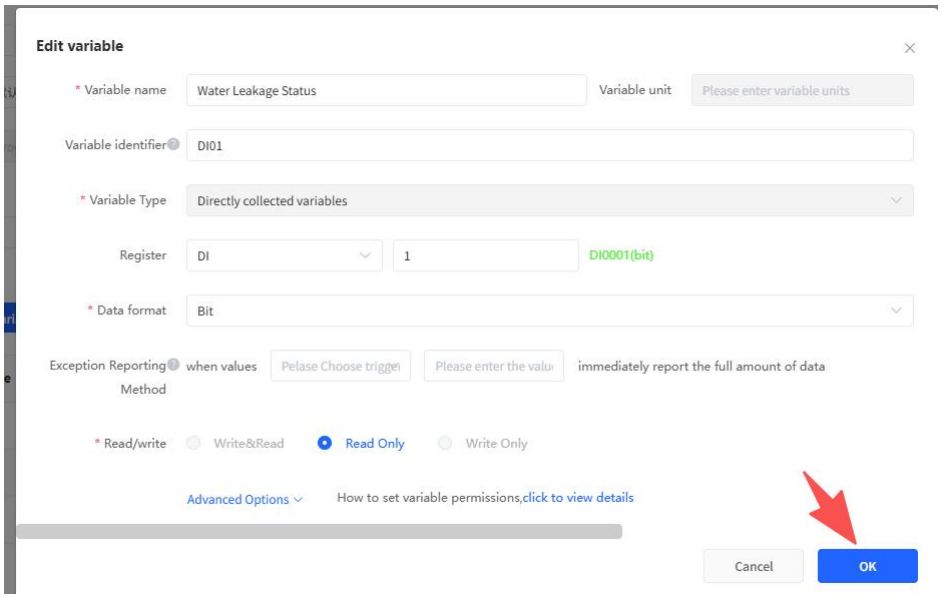
Substituting k=0.003125 into Equation 1 yields: 0=4000×0.0003125+b calculates: b = -1.25

The relationship between the variable value temperature and the measured value current is given by: Y=0.0003125X-1.25. Therefore, the formula for collecting data in the cloud template should be:%S*0.0003125-1.25 (where%S represents the measured value in the cloud platform).




Click Edit DI01 to rename the variable to leakage status and test the switch-type water immersion sensor data.






Add a new temperature and humidity sensor slave

**Slave name: Temperature and humidity sensor, customizable by users**

**Protocol and product: Universal Modbus/PLC/DL/Modbus/Modbus RTU (with optional human body temperature/humidity sensors: sensor/temperature/humidity sensor. In this case, the universal Modbus RTU variable is explicitly specified, so the option is not selected).**

**Slave address: sensor device address**

Variable name: Custom

Variable unit: Humidity%RH, Temperature ℃. The temperature and humidity units can be displayed on the screen. For more units, see the specification document at XXXXX link.

Variable identifier: When the data acquisition instrument reports data to MQTT or TCP servers, the JSON template must establish a one-to-one correspondence.

Register: PLC address. For detailed rules, see http://cloud.usr.cn/document/892.html

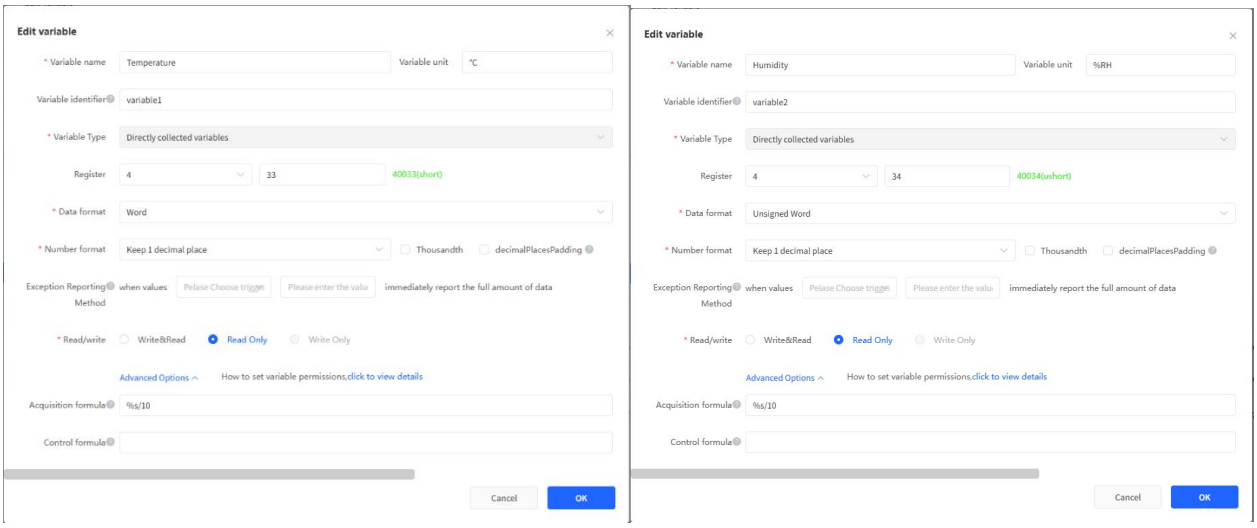
Data format: humidity is 16-bit unsigned, temperature is 16-bit signed

Number format: one decimal place

Exception reporting: When the collected parameter value reaches the trigger threshold, it will be reported immediately without waiting for the reporting interval.

Read/Write mode: Read-only. The data acquisition instrument only supports reading and does not support data writing.

Collection formula: Add based on actual parameters




Click Complete to configure the variable.

The USR-SC150 supports 9 slave devices and 32 variable points.

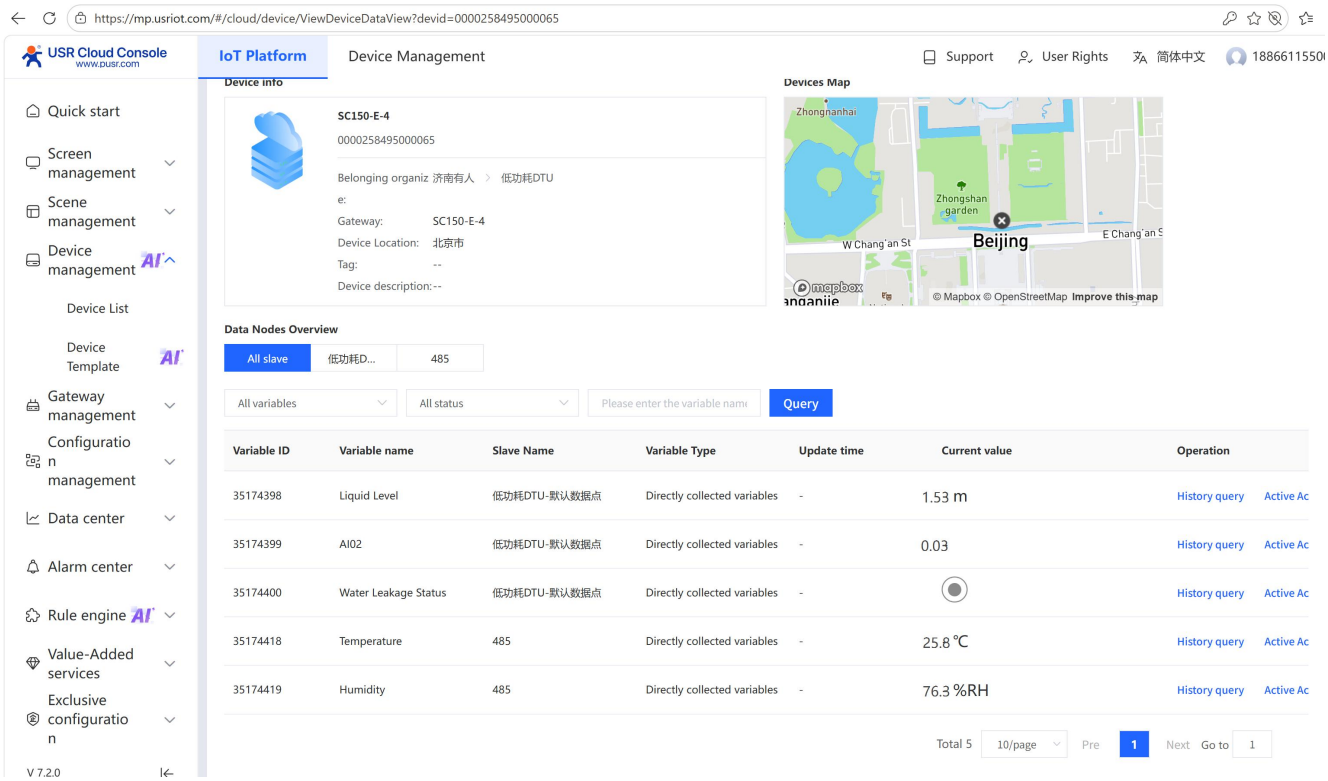
## 6.4. Device startup

After completing the parameter and variable configuration, power on the device. The red WORK indicator light on the top front of the device will flash, indicating successful power-up.

The device is launched on the platform and its status changes to "Configuring". After parameter configuration is completed, collect slave data once.

### 6.5. Confirm reported data

On the IoT platform, go to Device Management> Device List to view collected slave data.



# 7. MQTT application case

## 7.1. MQTT Application Case

Given users existing data platforms, for data security considerations, the data is directly connected to their own MQTT platform without secondary forwarding through Renren Cloud. The MQTT+ edge reporting mechanism enables direct data transmission to user platforms, while data collector device management remains on the Renren Cloud DM platform. Device management and data reporting operate as two independent channels with no interference. In this example, MQTT.X will be used to simulate receiving data reported by data collectors.

## 7.2. MQTT configuration procedure

### 7.2.1. MQTT configuration for data acquisition instrument

In the aforementioned case, we successfully received data from sensor slaves on the Youren Cloud IoT platform. By configuring MQTT in Section 3.2.2 parameter settings and enabling the edge reporting channel, the data was uploaded to the MQTT platform.

Reporting channel: MQTT

MQTT protocol: optional 3.1, 3.1.1

Client ID: Device SN information for identification of data acquisition instrument

Server address: MQTT server

Server port: The port number for the MQTT server (1~65535), with 1883 as the default

MQTT heartbeat keep-alive period: 0~65535 (default: 60 seconds)

Reconnect interval: 1 to 10 seconds (default: 5 seconds)

Clear conversation: Disabled by default, enable

SSL mode: Supports unencrypted, TLS 1.1, and TLS 1.2 encryption modes

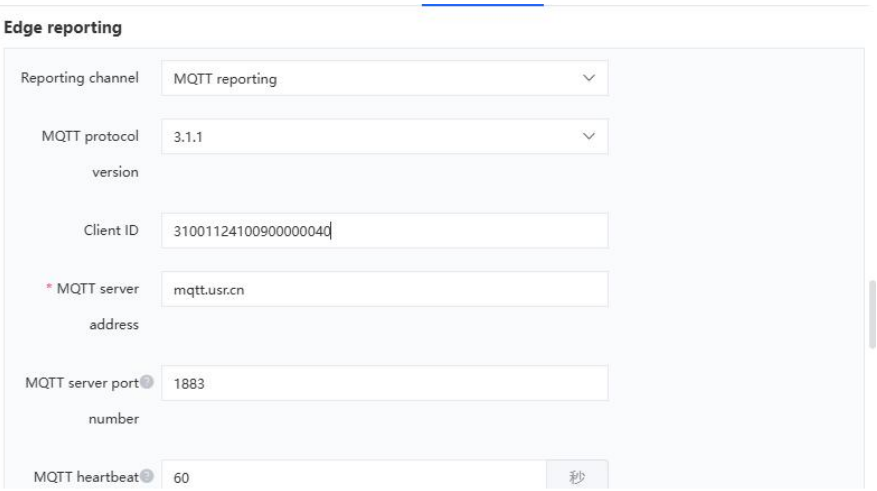
Authentication method: supports no authentication, server certificate verification, and two-way authentication

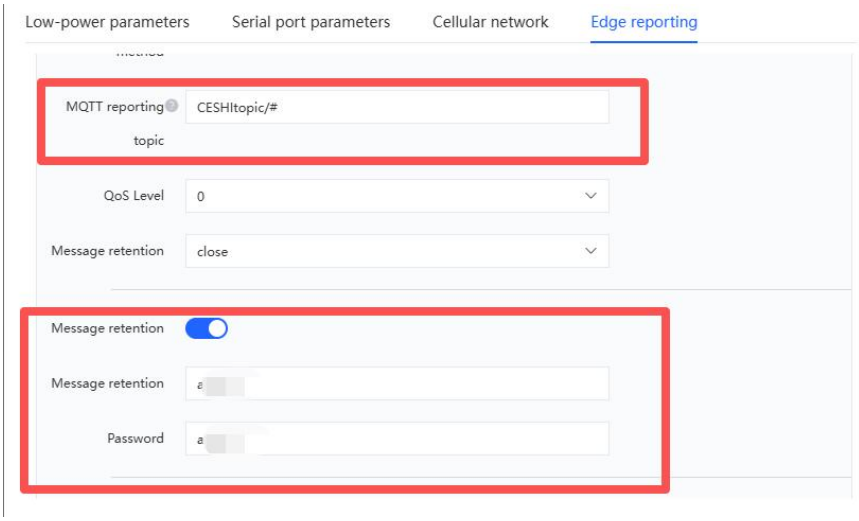
MQTT 上报主题: When MQTT is enabled, the MQTT 上报主题 cannot be set to empty, otherwise the device will not enter low-power mode.

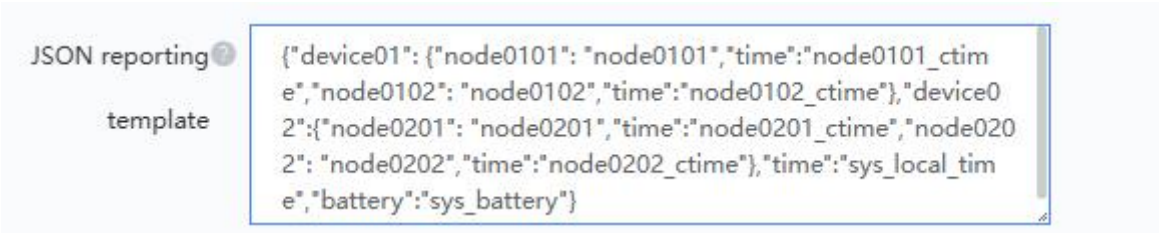
QOS level: Message quality level, options: 0, 1, 2

Link verification: Supports link verification

MQTT legacy enablement: When MQTT legacy is enabled, legacy topics and content cannot be set to null, otherwise the device will not enter low-power mode.






Select the MQTT protocol version based on the server. The client ID defaults to the device serial number (SN), and the reporting topic is set to CESHItopic/#. Connection verification is enabled. (Parameters such as encryption authentication and willful message can be added based on actual needs, but are omitted in this example.)

**Report template: JSON data template**

{

device0 1": //Slave 1 name, customizable. device0 1 refers to USR-SC150 local machine

{

"YW": "AI01" // YW: Data point name and level value, customizable; AI01: Data point, corresponding to the variable identifier in the template

"time": "AI01_ctime", // Collection time of data point AI01 (Unix timestamp + 3-digit millisecond value)

"LS": "DI01", // LS: Switching data point name for leakage detection, DI01 data point, corresponding to variable identifier in the template

"time": "DI01_ctime" // Collection time of data point DI01 (Unix timestamp + 3-digit millisecond value)

},

"TH": //Slave 2 name (customizable), where TH stands for temperature and humidity sensor

{

"H": "HUM", // H: Data point name humidity, customizable; HUM: Data point, corresponding to the variable identifier in the template

"time": "HUM_ctime", // Collection time of data point node01 (Unix timestamp + 3-digit millisecond value)

T ":" TEM", // T: Data point name (temperature), customizable; TEM: Data point, corresponding to the variable identifier in the template

"time": "TEM_ctime" // The collection time of data point node02 (Unix timestamp with 3-digit millisecond value)

},

"time": "sys_local_time" //Report the frame time of the data frame group (format: plaintext string, optional)

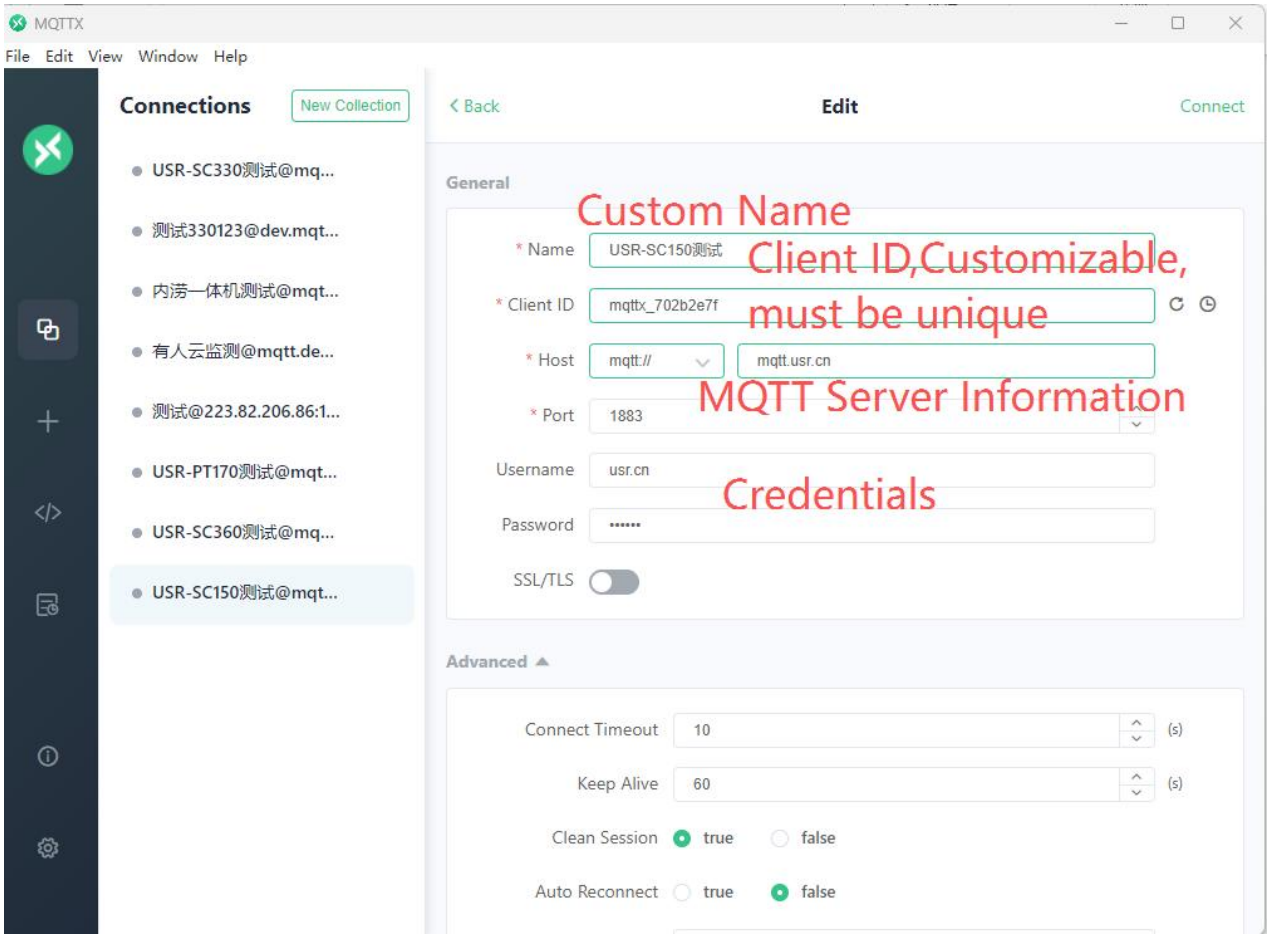
}

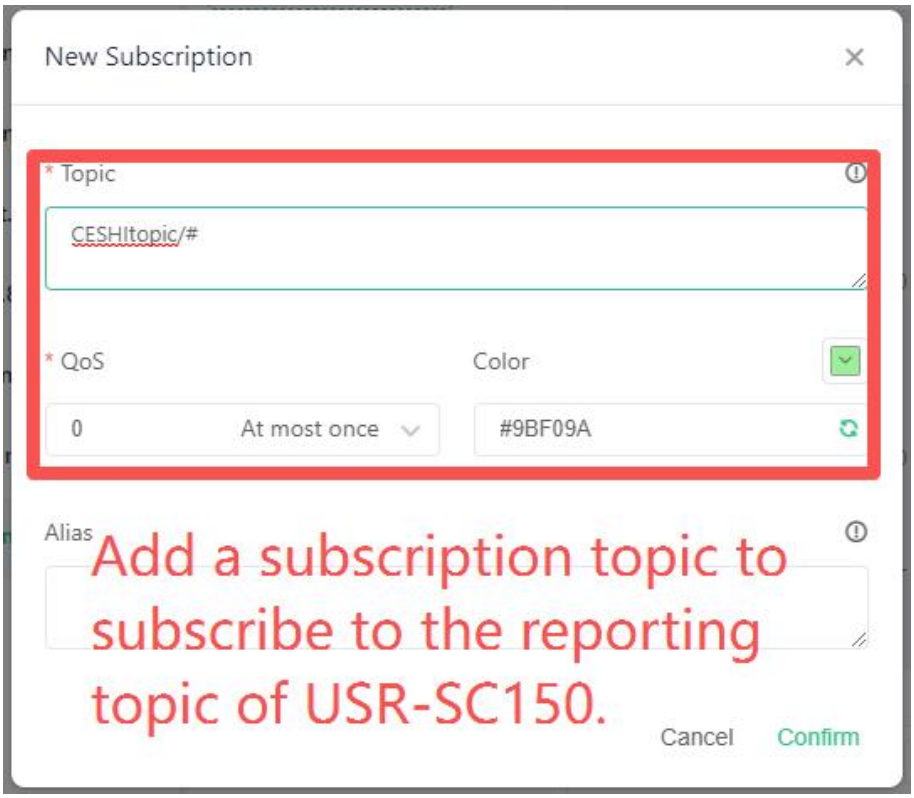
The low-power DTU supports both data variables and device system points, with specific parameters listed in the table below.

| Monitoring Points of the Low-power Data Logger System | | | |
|---|---|---|---|
| System Point | Explanation | Examples of Writing Format | Reported Value Examples |
| sys_mac | mac | "mac":"sys_mac" | D4AD20B80881 |
| sys_imei | imei | "time" :"sys_time" | 866858074512819 |
| sys_iccid | ICCID | "iccid":"sys_iccid" | 89861234567891245268 |
| sys_ver | Firmware Version | "ver":"sys_ver" | V1.0.01.000000.0000 |
| sys_sn | SN | "sn":"sys_sn" | 31000124010800000823 |
| sys_utc_time | UTC Time | "time":"sys_utc_time" | 2025-03-20T01:03:05Z |
| sys_local_time | System Time | "time":"sys_local_time" | 2025-03-20, 09:03:05 |
| sys_timestamp | Timestamp (S) | "time":"sys_timestamp" | 1742432585 |
| sys_time | Timestamp (ms) | "time":"sys_time" | 1742432585002 |
| sys_model | Device Name | "model":"sys_model" | SC360 |
| sys_battery | Battery Level | "battery":"sys_battery" | 100 |
| Point ID_ctime | Sample Timestamp (MS) | "varltime":"variable_ctime" | 1742434911425 |

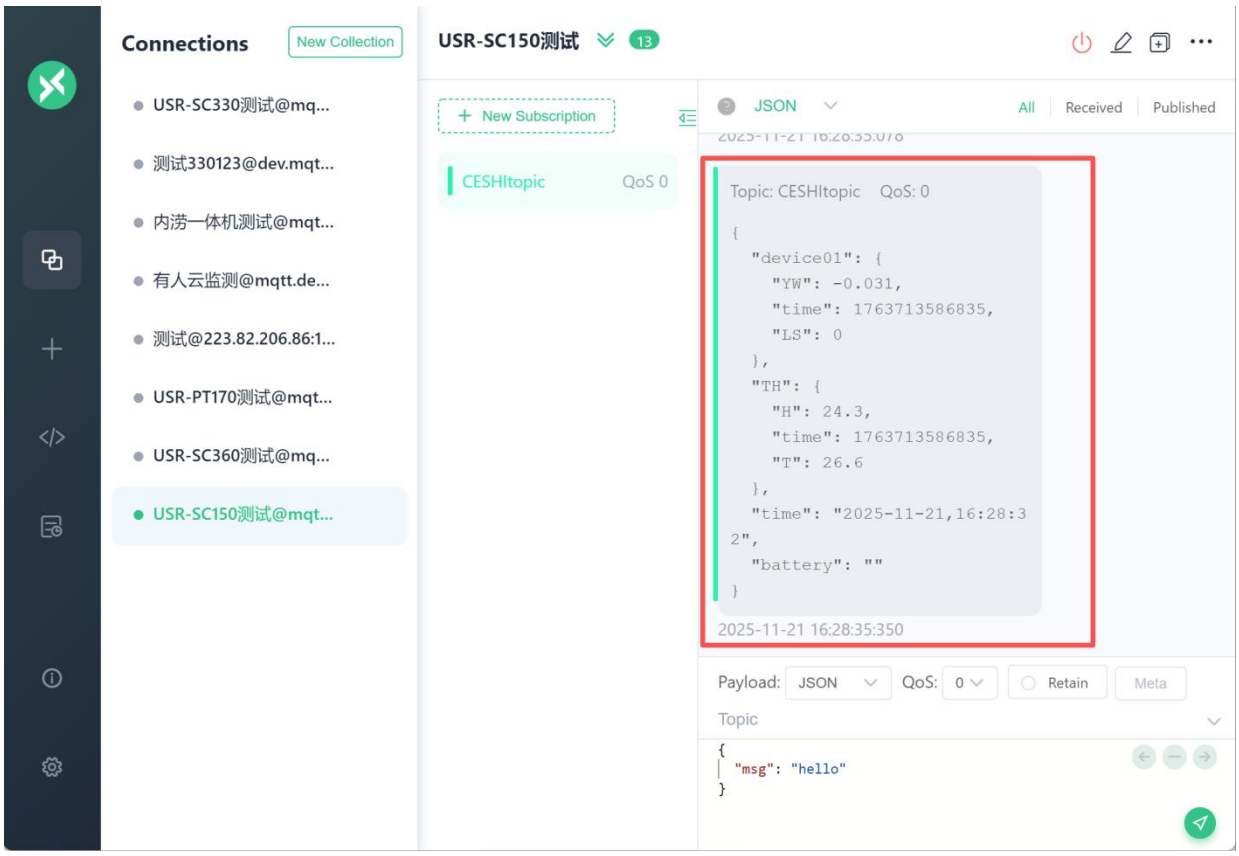
### 7.2.2. MQTT.X software configuration

Open the MQTTX software and create a new connection






MQTTX receives the reported data.



# 8. TCP application case

## 8.1. Application Case of TCP

Given that users operate their own data platforms, for data security considerations, the data is directly connected to their own TCP platform without secondary forwarding through the Human Cloud. The TCP+Edge Reporting mechanism enables direct data transmission to user platforms, while the device management of data acquisition instruments remains on the Human Cloud DM platform. Device management and data reporting operate as two independent channels with no interference. In this example, the Remote Desktop Network Debugging Assistant will simulate a TCP server to receive data.

## 8.2. TCP configuration procedure

### 8.2.1. MQTT configuration for data acquisition instrument

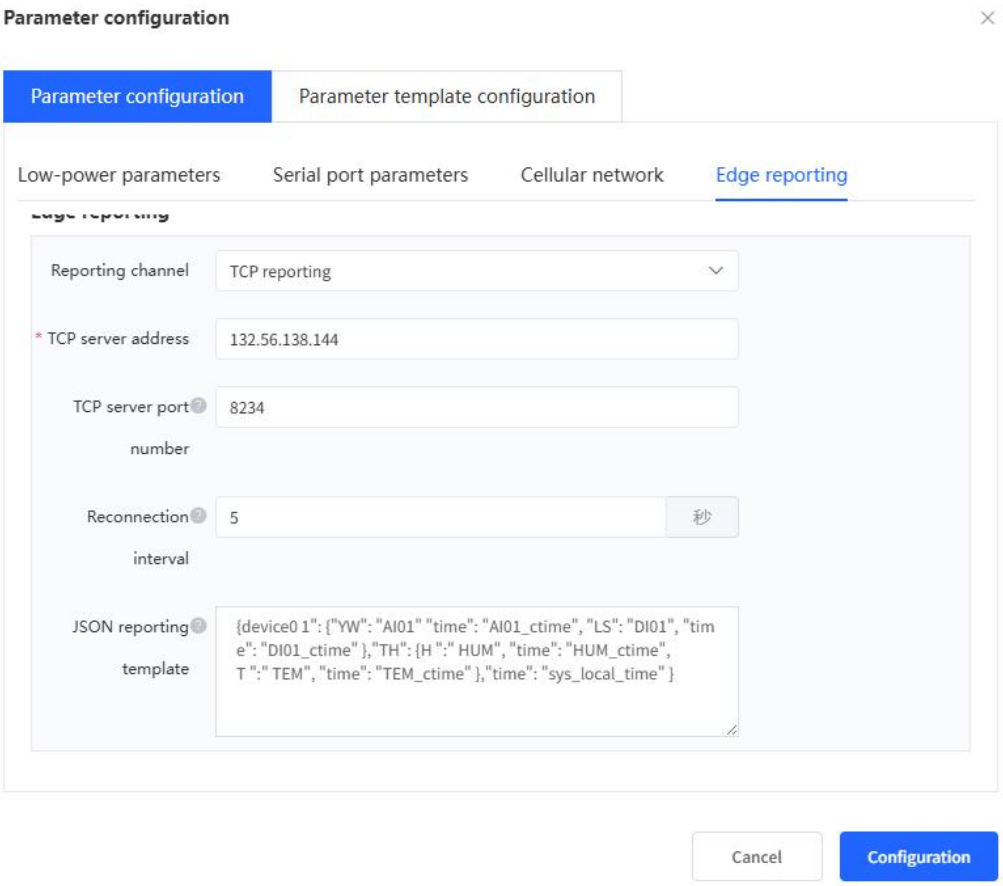
In the aforementioned case, we successfully received data from liquid level sensors and temperature/humidity slave sensors on the Yiren Cloud IoT platform. By configuring TCP enablement and edge reporting channels in Section 3.2.2 parameter information, the data was transmitted to the TCP platform.

**Reporting channel: TCP**

**Server address: TCP server address**

**Remote port: 1~65535. The default is 8234.**

**Reconnect interval: 1 to 10 seconds (default: 5 seconds)**




In this example, a human remote desktop serves as the TCP server. Users can connect to their own TCP server by entering the server address and port information as needed.

**Edge reporting:**

**Reporting channel: TCP**

**Report template: JSON data template**

```
{
device0 1": // Slave 1 name (customizable), device0 1 refers to USR-SC150 local machine
{
"YW": "AI01" // YW: Data point name and level value, customizable; AI01: Data point, corresponding to the variable identifier in the template
"time": "AI01_ctime", // Collection time of data point AI01 (Unix timestamp + 3-digit millisecond value)
"LS": "DI01", // LS: Switching data point name for leakage detection, DI01 data point, corresponding to variable identifier
```

```
in the template
        "time": "DI01_ctime" // Collection time of data point DI01 (Unix timestamp + 3-digit millisecond value)
    },
    "TH": //Slave 2 name (customizable), where TH stands for temperature and humidity sensor
    {
    H ":" HUM", // H: Data point name humidity, customizable; HUM: Data point, corresponding to the variable identifier in
the template
    "time": "HUM_ctime", // Collection time of data point node01 (Unix timestamp + 3-digit millisecond value)
    T ":" TEM", // T: Data point name (temperature), customizable; TEM: Data point, corresponding to the variable identifier
in the template
    "time": "TEM_ctime" // The collection time of data point node02 (Unix timestamp with 3-digit millisecond value)
    },
    "time": "sys_local_time" //Report the frame time of the data frame group (format: plaintext string, optional)
    }
```

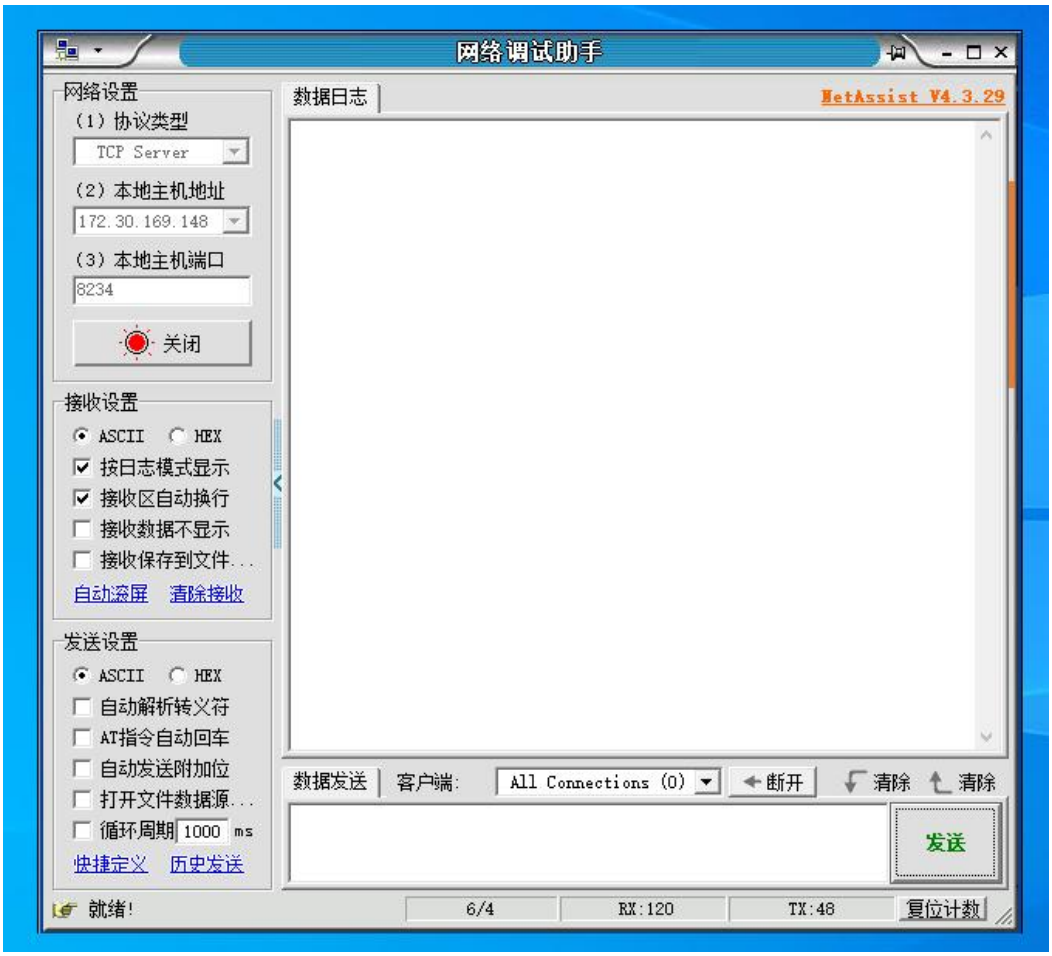
The low-power DTU supports both data variables and device system parameters, with specific values listed in the table below.

Monitoring Points of the Low-power Data Logger System

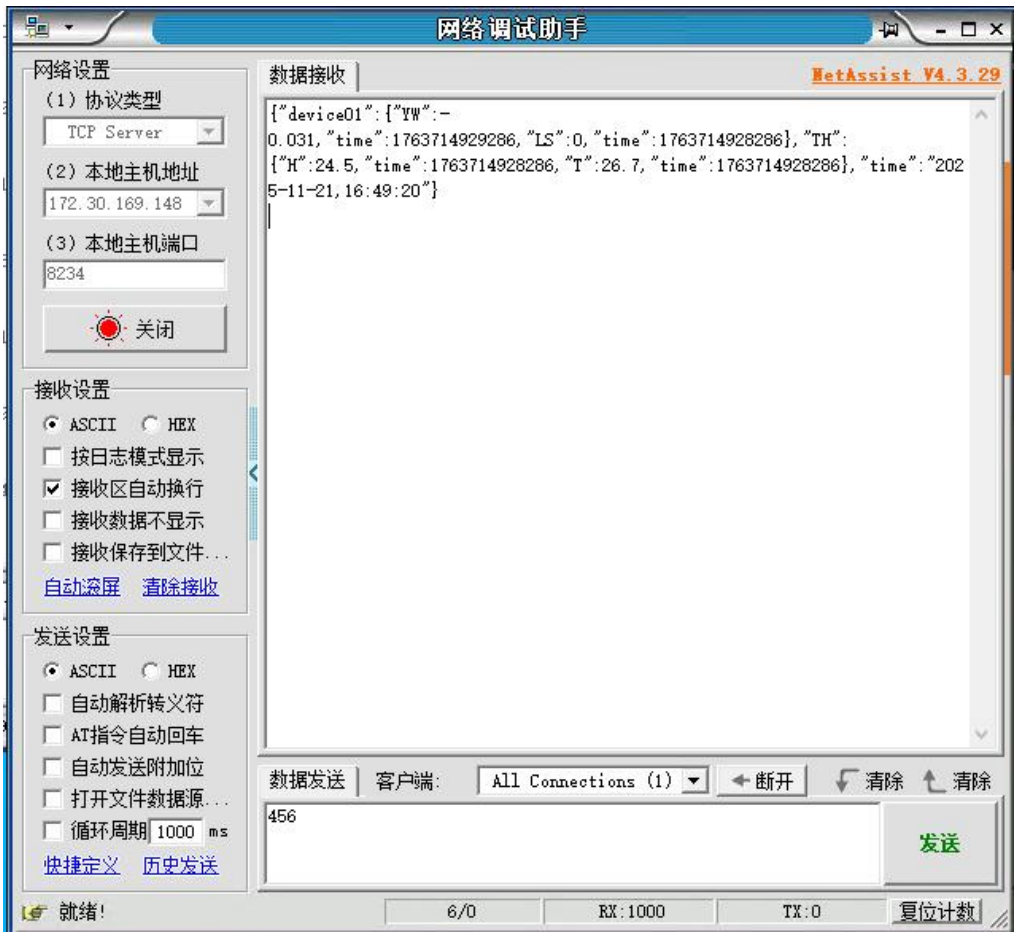
| System Point | Explanation | Examples of Writing Format | Reported Value Examples |
|---|---|---|---|
| sys_mac | mac | "mac":"sys_mac" | D4AD20B80881 |
| sys_imei | imei | "time" :"sys_time" | 866858074512819 |
| sys_iccid | ICCID | "iccid":"sys_iccid" | 89861234567891245268 |
| sys_ver | Firmware Version | "ver":"sys_ver" | V1.0.01.000000.0000 |
| sys_sn | SN | "sn":"sys_sn" | 31000124010800000823 |
| sys_utc_time | UTC Time | "time":"sys_utc_time" | 2025-03-20T01:03:05Z |
| sys_local_time | System Time | "time":"sys_local_time" | 2025-03-20, 09:03:05 |
| sys_timestamp | Timestamp (S) | "time":"sys_timestamp" | 1742432585 |
| sys_time | Timestamp (ms) | "time":"sys_time" | 1742432585002 |
| sys_model | Device Name | "model":"sys_model" | SC360 |
| sys_battery | Battery Level | "battery":"sys_battery" | 100 |
| Point ID_ctime | Sample Timestamp (MS) | "varltime":"variable_ctime" | 1742434911425 |

### 8.2.2. Network Debug Assistant Configuration

In this example, a remote desktop simulates a TCP server. Launch a network debugging assistant to set up the TCP server.




The network debugging assistant receives JSON-formatted data reported by the device.



## 9. contact way

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**Positioning: Trusted Smart Industrial IoT Partner**

**Some people have a vision: to become an ecological enterprise in the field of industrial Internet of Things**

**Some people have a mission: to connect value and value connection**

**Values: Integrity, Diligence, Critical Thinking, Seriousness, Innovation, Trust, Responsibility, Customer Service, Respect for Heaven and Love for People**

**Product Philosophy: Reliable, User-Friendly, and Affordable**

## 10. Update History

| Documentation Edition | Update content | refresh time |
|---|---|---|
| V1.0.0 | editio princeps | 2025-11-21 |
| | | |

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