PUSR®
www.pusr.com

USR-LG210-H

LoRa Gateway

User Manual



V2.0

Your Trustworthy Smart Industrial IoT Partner

Table

1. Product Introduction 6
1.1. Product Overview 6
1.2. Product Features 6
1.3. Installation Guide 7
1.4. Standard Accessories 7
1.5. Indicator Lights 7
2. Product Function Overview 8
2.1. Function Framework Diagram 8
2.2. LORA Function Introduction 8
2.2.1. LORA Networking Function 8
2.2.2. LORA Non-Networking Function 8
2.3. LORA Parameter Selection 9
2.4. Network Communication Function Introduction 9
2.4.1. Serial Communication Transmission 9
2.4.2. Network Communication Transmission 9
(1) TCP Connection 9
(2) MQTT Connection 10
(3) PUSR Platform Access 10
(4) Alibaba Cloud Platform Access 10
(5) Relay Transmission 10
(6) IO Control 10
3. Configuration Software Usage Introduction 10
3.1.1. Overview of Configuration Software Functions 10
3.1.2. Login the software 10
3.1.3. Information Overview 11

3.1.4. Basic Settings 12
(6) Networking Mode: Divided into non-networking and networking modes. 12
3.1.5. Interface Settings 13
3.1.6. Network Settings 14
3.1.7. System Settings 17
3.1.8. Local EdgeAcquisitionSettings 17
3.1.9. Auxiliary Tools 19
(1) Input Parameter Description: 19
(2) Output Parameter Description: 19
4. LG210 Gateway User Guide 20
4.1. Preparation 20
4.1.1. Item Preparation 20
4.1.2. Hardware Connection 20
4.2. Networking Function 21
4.2.1. Designated Node Networking Function 21
4.2.2. Networking Broadcast Transparent Transmission Function 24
4.2.3. PUSR Transparent Transmission Function 25
4.2.4. Bidirectional Data Flow Communication Test ..... 错误！未定义书签。
4.2.5. PUSR Edge Collection Function ..... 错误！未定义书签。
4.2.6. Active Reporting Function 25
4.3. Non-networking Function 27
4.3.1. Specified Node Function 27
4.3.2. Broadcast Transparent Transmission Function 29
4.4. Local Edge Collection Function 30

(2) Parameter Settings: 31

(3) Communication Test: Local Edge Computing Reporting to Socket Server 33

4.5. Remote IO Function 33

(1) Parameter Settings: 34

(2) Communication Test: 36

4.6. Relay Function 37

(1) Function Description: 37

(2) Parameter Settings: 37

5. Other Functions: 38

5.1. Node Information Statistics 38

5.2. Protocol Conversion Function 39

5.2.1. ModbusTCP and ModbusRTU Interconversion Function 39

5.3. Firmware Upgrade 40

5.3.1. Setting Software Upgrade 40

5.4. Network Card Function 41

5.5. Network Diagnostics 42

(1) Configuring network diagnostics in the software: 42

5.6. Calibrating Device Time 42

6. AT Command Configuration 43

6.1. Serial Port AT Commands 43

6.1.1. Serial PortAT Command Operations 43

➢ Entering AT Command Mode 43

6.2. Network AT Commands 43

6.2.1. Network AT Command Operations 44

6.3. AT Command Format 46

6.3.1. Format of "Query" in Commands 46

6.3.2. Format of "Response" in Commands 46

6.4. AT Command List 47

7. Typical Application Issues 49

(1) Short Communication Distance 49

(2) Co-frequency Interference 49

(3) High Packet Loss Rate 50

(4) Concentrator Cannot Connect to Server 50

(5) Node Cannot Network with Concentrator 50

(6) Concentrator firmware upgrade failure 50

8. Disclaimer 50

9. Version History 51

1. Product Introduction

1.1. Product Overview

The PUSR LoRa self-organizing network system is a solution designed specifically for wireless ad-hoc network communication, with its core device being the dual-channel gateway USR-LG210. The gateway can connect to private servers, PUSR, or Alibaba Cloud platform via 4G/Ethernet upstream, and communicates downstream with various nodes (such as USR-LG206-H, USR-DR216-H, USR-LG207-H-IO1, and other data transmission terminals) through internal dual-channel LoRa RF. The system supports cloud and edge data collection, low-power transmission, remote control, active device reporting, and status upload. It can be widely used in agriculture, warehousing, building energy consumption, smart meter reading, smart fire protection, and other fields. It features one-time deployment and long-term stable operation, significantly reducing customers' long-term operating costs.

1.2. Product Features

Stable and Reliable

- Full industrial design, metal casing, high protection level;
- Wide voltage DC 9-36V input with reverse power protection;
- Multiple protections against electrostatic discharge, surges, and electrical fast transients;
- High-performance industrial-grade LoRa RF chip;
- High-power LoRa module for longer transmission distance;
- Built-in hardware watchdog to ensure system stability;
- Data encryption and checksum processing to improve data transmission security and reliability;

Intelligent Application

- LoRa intelligent self-organizing network, localized zone management, automatic frequency allocation for connected nodes, reducing on-site construction difficulty;
- Gateway and node data transmission uses networking and broadcasting, with 2-channel mounting for less interference;
- LoRa gateway supports uploading to PUSR, Alibaba Cloud, and private servers, supporting TCP, MQTT, RS232\485 transmission;
- Supports edge collection, active reporting, low power consumption, and other functions;
- Supports relay transmission with nodes to expand wireless transmission distance;
- Supports bidirectional data flow communication; data can be uploaded to both PUSR and private servers.
- LoRa private protocol communication is simple, secure, and reliable. Users do not need to worry about the protocol; simple configuration of the gateway and LORA terminal enables communication.
- Dedicated configuration software allows configuration via serial port and Ethernet port, and supports network commands.
- Supports setting corresponding LoRa node modules to low power mode;
- Supports one-click factory reset and rich status indicator lights;

Powerful Functions

- Various functional modes to meet multi-scenario needs;
- Edge collection, active reporting, low power consumption, networking ID communication, transparent transmission;
- Supports pairing with USR-LG207-L (IO version) for remote IO collection/control;
- Connects to PUSR, Alibaba Cloud, and private servers;
- MQTT/TCP communication, SSL encryption, two-way Socket connection, RS232\485 serial port;
- Supports remote operation and maintenance, convenient and fast;
- Heartbeat packet, registration packet, reconnection without data, restart without data;
- Supports ModbusTCP and ModbusRTU protocol conversion;

1.3. Installation Guide

Antenna Assembly: Please refer to the casing silk screen and antenna label for installation.

Installation Method:DIN rail mount and side ear fixation, as shown in**Figure 1-1 Installation Diagram**.

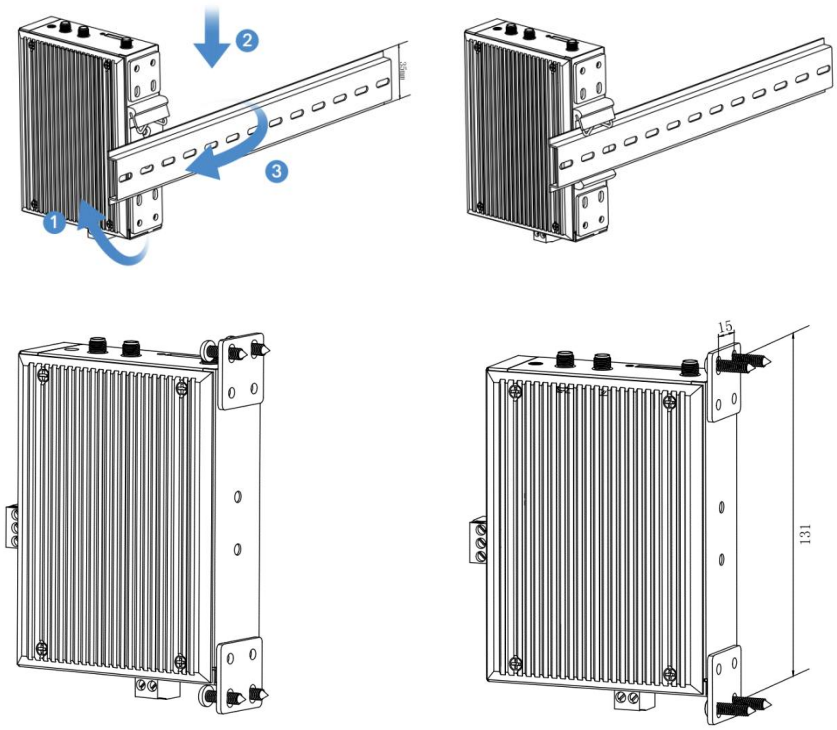


Figure 1-1Installation Diagram

1.4. Standard Accessories



Figure 1-2Standard Accessories

The LoRa frequency supported by the concentrator is 860MHz~930MHz. The standard LoRa antenna supports the frequency band of 860~930MHz. If the LoRa frequency set by the user exceeds the frequency range supported by the antenna, the communication quality will be poor. Users can replace the antenna with one that supports the set frequency band according to their needs.

1.5. Indicator Lights

The USR-LG210 has 1 power PWR light, 1 working status light, 2 LoRa data interaction lights corresponding to the 2 channels. The indicator lights are described as follows:

PWR: Stays on after power is connected.

Work: Flashes with a 1s cycle in working mode; stays on in upgrade mode.

LoRa1, LoRa2: Status flips during LoRa data transmission and reception in working mode; LoRa1 flips status with upgrade data interaction in upgrade mode.

2. Product Function Overview

2.1. Function Framework Diagram

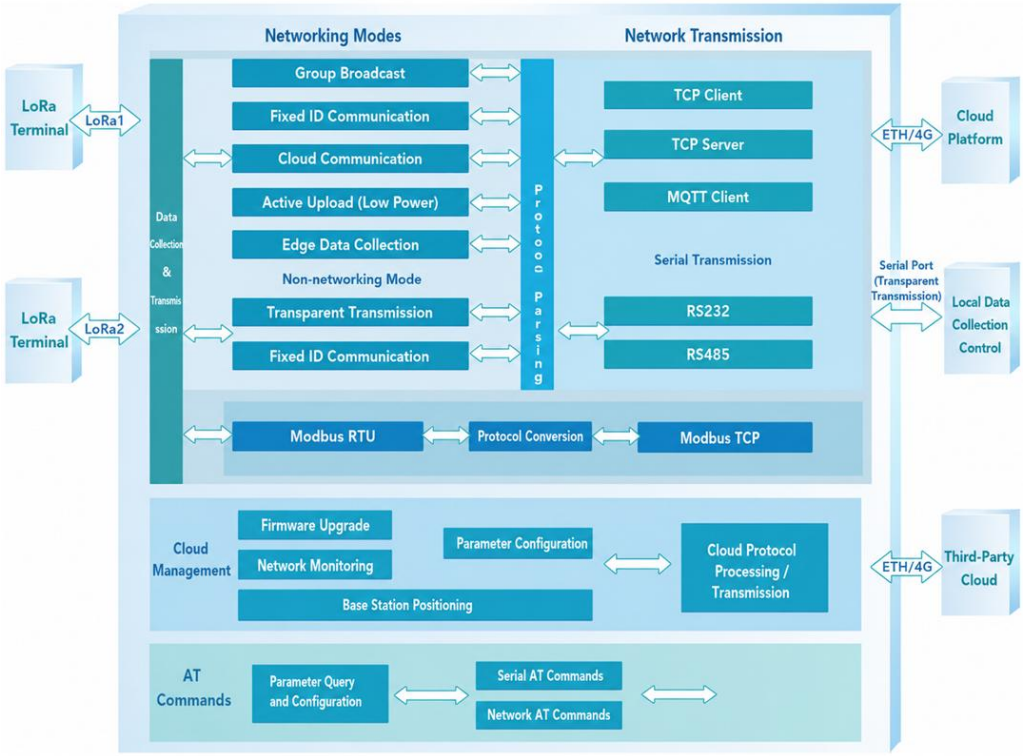


Figure 2-1Function Structure Diagram

2.2. LORA Function Introduction

2.2.1. LORA Networking Function

The LG210 gateway and nodes intelligently self-organize to form a LORA local area network. After the nodes join the network, users can manage the nodes in the LAN centered on the concentrator and selectively transmit data. When node data is uploaded to the concentrator, the concentrator judges whether the node ID is an in-network ID. If so, it reports the received data content to the server; otherwise, it does not report. When the concentrator sends data, only the nodes that have joined the network can receive the downstream data. The networking function currently supports the following modes:

- Designated Node Networking Mode: Supports access to private servers, Alibaba Cloud platform, and serial ports.
- Networking Transparent Transmission Mode: Supports access to private servers, Alibaba Cloud platform, and serial ports.
- Edge Collection Mode: Supports access to PPUSR Platform, private server edge collection, and supports selective bidirectional data flow (reporting to PPUSR Platform and private servers).
- IO Control: Supports use with LG207 (IO) version for remote collection/control.
- Relay Mode: Paired with LORA nodes for relaying to expand wireless communication distance.
- Active Reporting Mode (Low Power): Supports access to private servers, Alibaba Cloud platform, and serial ports.
- PPUSR Mode: Supports access to PPUSR Platform, and supports selective bidirectional data flow (reporting to PPUSR Platform and private servers).

2.2.2. LORA Non-Networking Function

The LG210 gateway and nodes can achieve direct transparent transmission between the server and terminal devices without protocol networking. The non-networking function supports two working modes:

- Designated Node Mode: Supports access to private servers, Alibaba Cloud platform, and serial ports.
- Broadcast Transparent Transmission Mode: Supports access to private servers, Alibaba Cloud platform, and serial ports.

2.3. LORA Parameter Selection

The concentrator adopts a dual LoRa channel working method, where each channel has management and data transmission functions. Wireless communication between the concentrator and nodes is achieved by modifying LoRa parameters.

Table 2-1LoRa Parameter Selection Table

LoRa Parameter Selection			
Item	**Parameter**	**Description**	**Remarks**
Spreading Factor	4 ~ 11	Determines the transmission speed of LoRa data The higher the spreading factor, the faster the transmission speed and the shorter the transmission distance	Spreading factors 1~3 are currently not supported
Frequency	8600 ~ 9300 (*100KHz)	Operating frequency band for LoRa data transmission	
Forward Error Correction	On, Off	Whether to enable forward error correction when sending LoRa data	Enabling it can improve link reliability but will increase transmission time
Transmit Power	12 ~ 30	LoRa signal transmit power; the higher the power, the longer the communication distance	

Note: The rate and frequency settings of the two channels should avoid duplication to prevent interference. It is recommended that the concentrator's two channels operate at different rates and frequencies. If the channels operate at the same rate, it is recommended to set the frequency interval to more than 5000KHZ, and avoid intervals that are integer multiples of 32 between frequencies.

2.4. Network Communication Function Introduction

The LG210 gateway supports serial port and network data transmission pipelines. Network data transmission supports TCP connection, MQTT connection, Alibaba Cloud, and PUSR. This section mainly introduces serial communication and two network communication methods: TCP and MQTT.

2.4.1. Serial Communication Transmission

The LG210 has a serial server function. After enabling the serial server function, the LG210 gateway connects to the local centralized meter reading platform via serial port. You can choose RS232/RS485 interface, and the baud rate can be set in the range of 2400-230400 (default 115200).

2.4.2. Network Communication Transmission

(1) TCP Connection

The LG210 supports two Socket connections (socketA supports TCP client and TCP server functions, socketB supports TCP client function), supports registration packets, heartbeat packets, SSL authentication, keep-alive mechanism, reconnection without data, and restart without data.

(2) MQTT Connection

MQTT function implements MQTT Client functionality on the target device, including complete MQTT Client access, data publishing, and data subscription functions. It can also be paired with SSL to implement MQTTS functionality. Users can easily access their privately built MQTT servers through simple configuration. Both data publishing and subscription support multiple topics.

(3) PUSR Platform Access

Log in to register a PUSR Platform account, configure the product template required for the device, add remote polling and edge collection according to usage requirements, then add gateways and node devices. Once the devices are online, data debugging can be performed. For specific usage methods, please refer to the USR-LG210 Gateway Platform Integration Manual.

(4) Alibaba Cloud Platform Access

The LG210 gateway supports connecting to Alibaba Cloud. After adding devices on the Alibaba Cloud platform and obtaining certificates, use the certificates to generate the necessary parameters for connecting to Alibaba Cloud. The connection is simple and fast, featuring MQTT transparent transmission. When SSL encryption is enabled, it supports mutual certificate verification. It supports various access methods, including triplet information access and SSL access. It supports both Alibaba Enterprise Edition instances and Public instances. For specific usage methods, please refer to the USR-LG210 Gateway Platform Integration Manual.

(5) Relay Transmission

Used with LG207 (IO version). Set the protocol of LG207 (IO version) to "LG210 Protocol (Version 2.0)" and complete parameter configuration in advanced settings to act as a wireless relay, achieving stable bidirectional data forwarding between the gateway and nodes.

(6) IO Control

Used with LG207 (IO version) in LG210 "Non-networking Mode". The IO status of the downstream LG207 (IO version) devices can be collected or controlled via Modbus protocol. This version of LG207-IO1 provides\u00A01 DI signal input (supporting 0-36V voltage detection, compatible with dry and wet contacts) and\u00A01 DO control output (maximum load DC 40V/500mA).

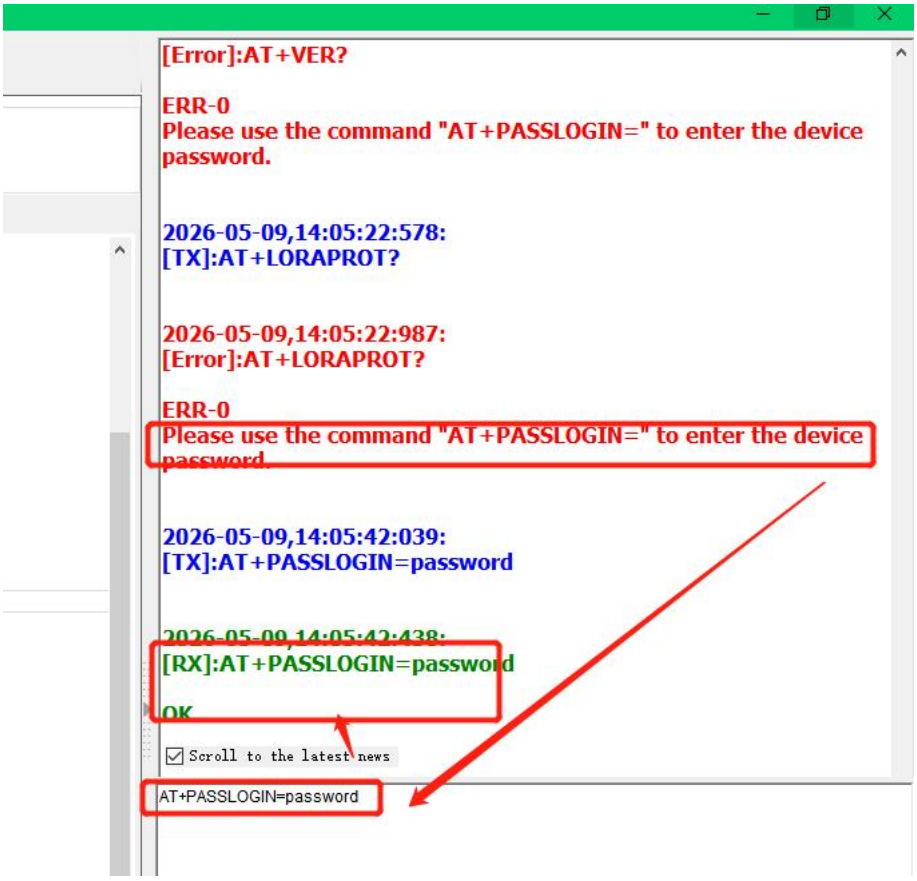
3. Configuration Software Usage Introduction

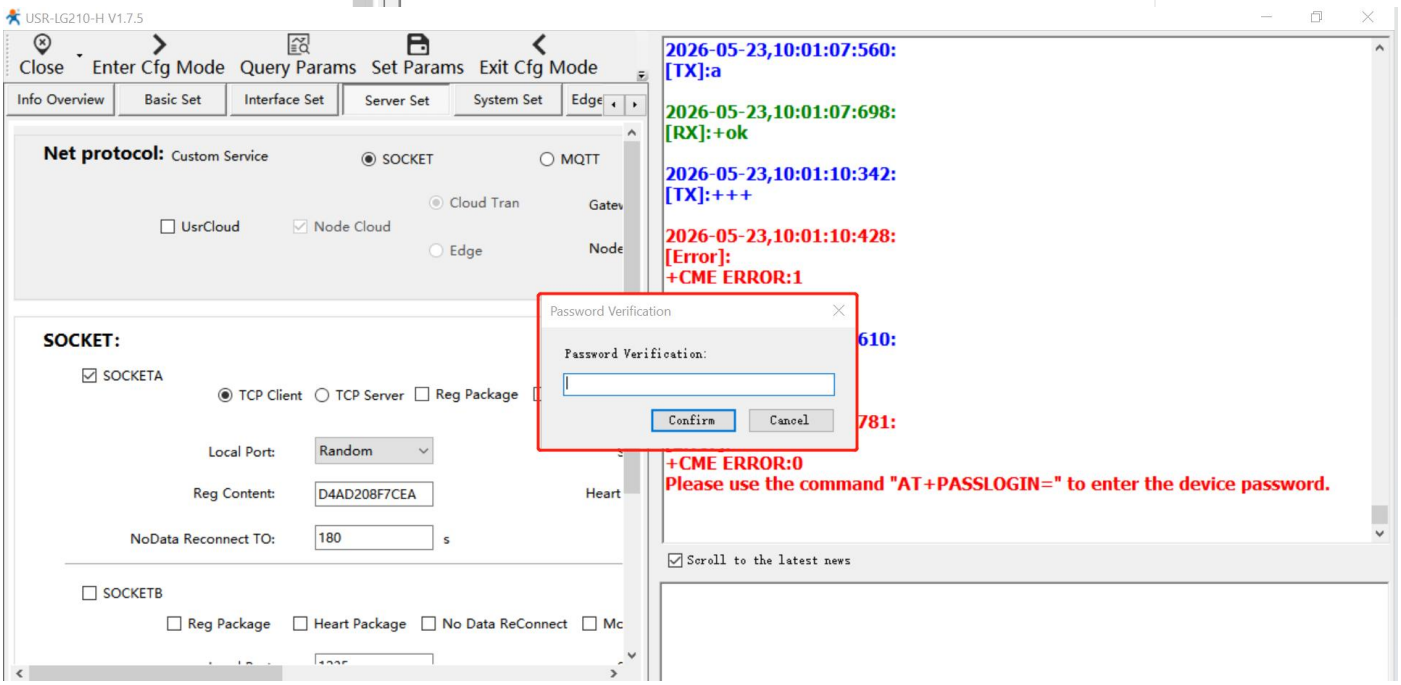
3.1.1. Overview of Configuration Software Functions

USR_LoRa software is the supporting software for the USR-LG210 gateway. It can realize gateway information overview, basic settings, interface settings, system settings, and network settings. It supports configuration via serial port or network connection. The following introduces the functions and setting methods of this configuration software. Software download link:**https://www.pusr.com/wiki/puba/h1XuKTUOJ?lang=en_US#top**

3.1.2. Login the software

If the user is querying/Configuring parameters via the serial port, they must first enter the correct login password. The default is password. After entering the correct password, they can successfully read and set the parameters.





Users can modify the password by using the command "AT+PASSWRD". After the modification, the device needs to be restarted via "AT+Z" to take effect. If the user forgets the password, they need to restore the device to its factory settings to obtain the factory default password. Restoring the factory settings will reset all parameters to their default factory settings, and the user will need to reconfigure them.

3.1.3. Information Overview

In the Information Overview section, you can view two types of information: Gateway Information and Node Information. After reading the parameters, basic gateway information is visible in the Gateway Information section; Node Information requires networking mode, where interaction information between nodes and the gateway is displayed after nodes join the network, as shown in**Figure 3-1 Schematic Diagram of Information Overview**.

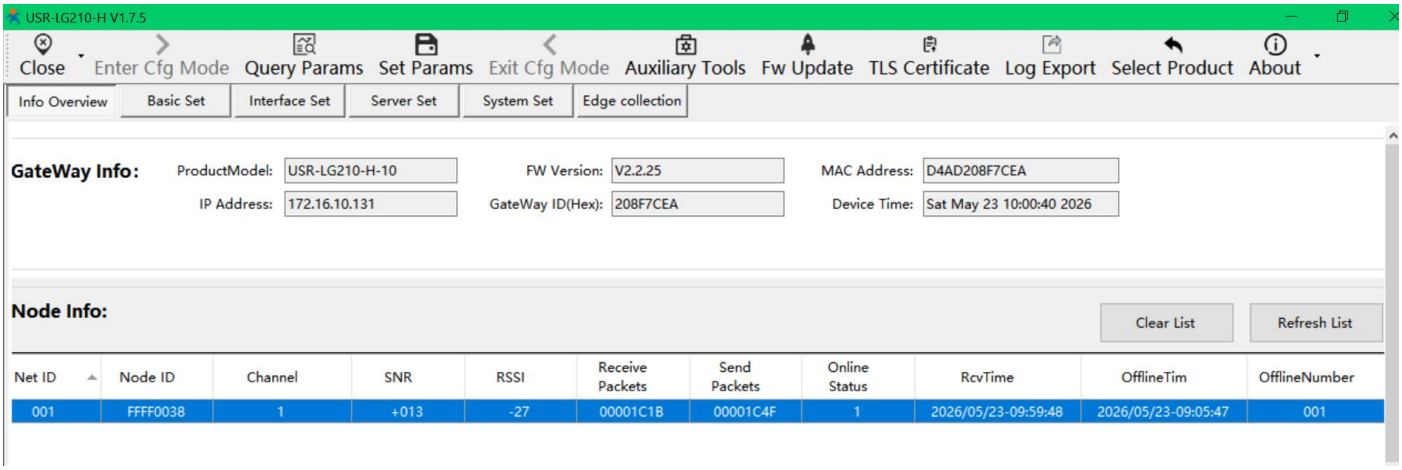


Figure 3-1Schematic Diagram of Information Overview

3.1.4. Basic Settings

In the Basic Settings section, you can select the data communication channel (Network or Serial Port) and choose the gateway's working mode. The settings page is shown in**Figure3-2 Basic Settings Items**:

(1) **Protocol Version**: If you need to use the relay function with nodes, please select Protocol 2.0; if no relay function is required, keep the default protocol.

(2) **Data Channel**: Selecting Network allows using Ethernet or 4G communication; selecting Serial Port requires using a serial server for communication.

(3) **Network Selection: Private Server**: LoRa communication data will be reported to the specified server. Functions such as networking/non-networking, broadcast transparent transmission, specific node targeting, and active reporting are available.

Note: If you need to use cloud transparent transmission or edge collection functions simultaneously, and send LoRa data to your own server, first add the LoRa gateway and nodes to the PUSR platform and configure the corresponding templates or edge rules; then, in the gateway's basic settings, select the data channel as "ALL (PUSR + SOCKET)", enable PUSR service in network settings, select the node cloud function (cloud transparent transmission or edge collection), and fill in the private server SOCKET information; after configuration, LoRa data can be forwarded to your specified server via the PUSR channel.

(4) **Network Selection: PUSR**: LoRa communication data will be reported to the PUSR platform, allowing the use of cloud transparent transmission and edge collection functions.

(5) **Network Selection: ALL**: This means both Private Server and PUSR are selected. LoRa communication data will be reported to both the PUSR platform and the specified server, allowing the use of cloud transparent transmission and edge collection functions. Prerequisite: Users must add the LoRa gateway and node devices to the PUSR platform.

(6) **Networking Mode**: Divided into non-networking and networking modes.

(7) **Working Mode**: In non-networking mode, you can choose between broadcast transparent transmission and specific node modes; in networking mode, you can choose from broadcast transparent transmission, specific node, and active reporting modes.

(8) **Communication Parameters**: You can select four functions for nodes: Low Power, Retransmission, ID Carrier, Heartbeat, and LBT. Set the corresponding reporting cycle, number of nodes, offline detection time, and retransmission time according to usage requirements. For setting methods and timing, please refer to the introduction of3.1.7 Auxiliary Toolsbelow.

Precautions: Communication parameter settings can be filled in using reference values calculated by the auxiliary tool. The reference value is only the minimum calculated time. Users can set values greater than the reference value based on actual conditions, but must not set values less than the reference value, otherwise, it may cause LoRa data packet collisions.

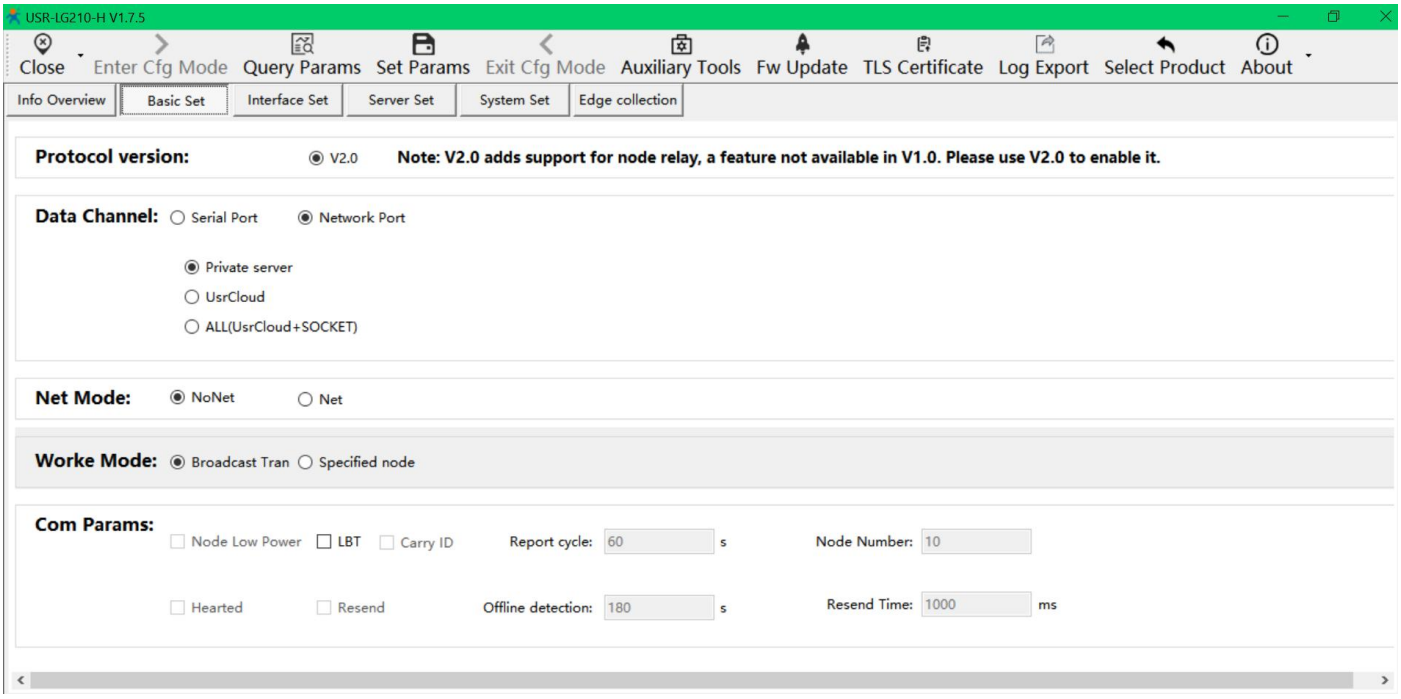


Figure3-2Basic Settings Items

3.1.5. Interface Settings

Interface Settings mainly involve configuring LoRa parameters, serial port parameters, network parameters, and NIC priority. The interface settings page is shown in the example diagram of**Figure3-3 Interface Settings Items.**

① **LoRa Parameters:**You can set the frequency, rate, transmit power, and whether to enable forward error correction for the two LoRa channels. Frequency setting range: 8600-9300 (x100KHz), Rate setting range: 4-11, Forward Error Correction: NO or OFF

② **Serial Port Parameters:**Baud rate range: 2400-230400, Data bits: 7, 8, Parity: NONE, ODD, EVEN, Stop bits: 1, 2.

③ **Ethernet Port Parameters:**IP address acquisition can be set to Dynamic IP or Static IP.

④ **NIC Priority:**You can choose Ethernet priority or 4G priority.

Precautions: The rate andfrequencysettings for the two channels should avoid duplication to prevent interference. It is recommended that the concentrator's two channels operate at different rates andfrequencies. If channels operate at the same rate, it is recommended to set thefrequencyinterval to more than 5000KHZ,and the frequency interval value should not be a multiple of 4; Forward error correction can effectively improve link reliability but will reduce data transmission speed.

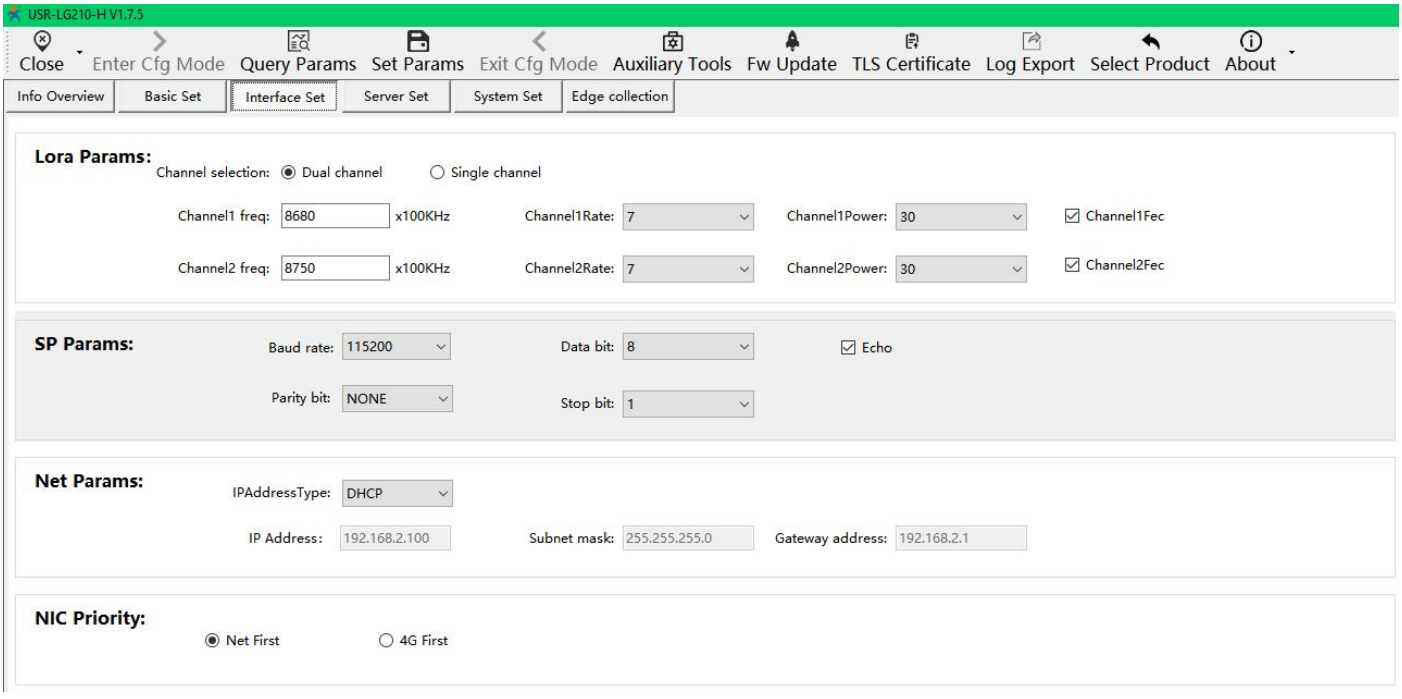


Figure3-3Interface Settings

3.1.6. Network Settings

In network settings, the network protocol can be selected as SOCKET, MQTT, Aliyun, PUSR, or Node Cloud.

➢ For network settings, see**Figure 3-4 Network Settings Parameters**:

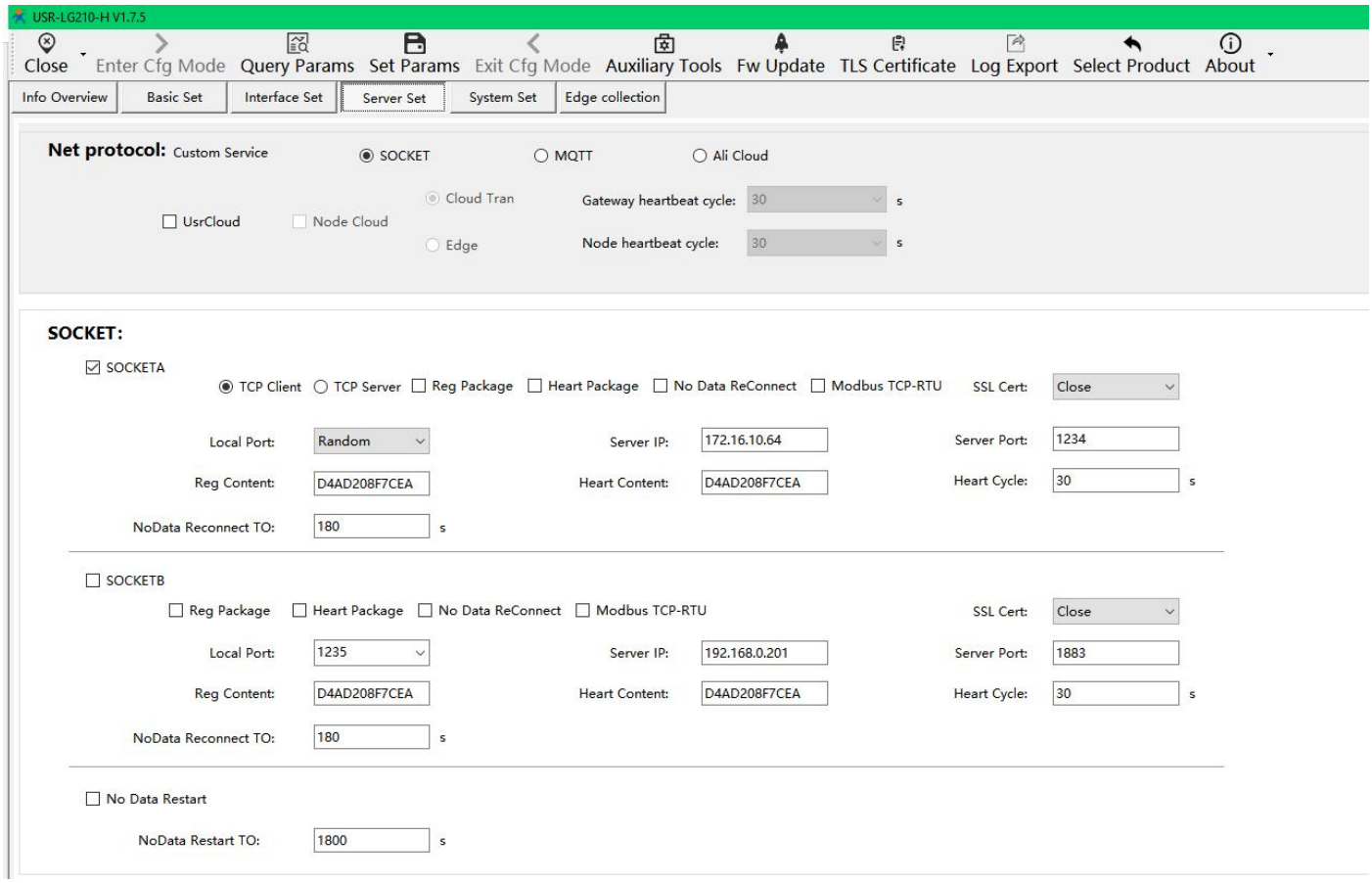


Figure 3-4 Network Settings Parameters

(1) **PUSR Function**: You need to select the Node Cloud function, with two PUSR collection modes: Cloud Transparent Transmission and Edge Computing. The heartbeat period between the gateway and the cloud, and between the node and the cloud, can be set to different times. Specific setting requirements are as follows:

Cloud Transparent Transmission: The LG210 gateway connects to the PUSR platform's cloud polling function. The PUSR platform polls and collects data according to the cloud polling template added for the node device. The node replies with corresponding data upon receiving collection instructions, which is then reported to the PUSR platform.

Edge Collection: The LG210 gateway connects to the PUSR platform's edge collection function. The PUSR platform sends edge collection template rules to the LG210 gateway according to the node device configuration. The LG210 gateway collects data from the node end and reports it according to the rules.

Gateway-Cloud Heartbeat Period: The heartbeat period for interaction between the LG210 gateway and the PUSR platform, used to determine the online status of the gateway. It is recommended to use the default setting.

Node-Cloud Heartbeat Period: The heartbeat period for interaction between the LORA node and the PUSR platform, used to determine the online status of the node. It is recommended to use the default setting.

(2) **Socket Function:**The LG210 gateway TCP connection can choose to connect to socketA and socketB. SocketA supports both TCP client and TCP server functions, while socketB only supports TCP client function. Both sockets can be enabled simultaneously.

(3) **Registration Packet Function:**This function allows the server to know that a device has connected online, or to identify which device has come online. After successfully connecting to the server, the configured registration packet content is sent to the server once upon connection success. (Registration packet function is disabled by default; registration packet content defaults to MAC address, custom content in Hex format <=64Byte)

(4) **Heartbeat Packet Function:**After successful Socket connection, the device reports heartbeat packet content

periodically according to the set heartbeat interval. No reply from the server is required. The content of the heartbeat packet can be configured. (Heartbeat packet function is disabled by default; heartbeat interval can be set from 1-6000S; heartbeat packet content defaults to MAC address, custom content in Hex format <=64Byte)

(5) **No Data Reconnection Function:**In normal socket connection state, if there is no data interaction with the server within the set timeout period, the socket connection will be disconnected, and the device will re-initiate the connection request. (No data reconnection function is disabled by default; reconnection time can be set from 60-6000S)

(6) **No Data Restart Function:**When the no data restart function is enabled, if there is no data interaction with the server within the set timeout period, the device will restart. (No data restart function is disabled by default; no data restart time can be set from 60-60000S)

① If both SocketA and SocketB have the no data restart function enabled, the restart will only be executed if conditions are met for both.

② If SocketA has the no data restart function enabled and SocketB is not enabled at all, the device will restart based on SocketA meeting the conditions; vice versa.

(7) **SSL Authentication Function (disabled by default):**SSL (Secure Sockets LayerSecure Socket Protocol), and its successorTransport Layer Security(TLS), is a security protocol that provides security anddata integrityfornetwork communication. TLS and SSL encrypt network connections between thetransport layerand theapplication layer. The device supports SSL data encryption. If the SSL authentication certificate function is enabled, the certificate needs to be uploaded to the device via the configuration software.

(8) **Modbus TCP-RTU:**Conversion between Modbus TCP format and Modbus RTU format data (function disabled by default). For specific operation examples, refer to**5.2.**Protocol Conversion Function.

➢ MQTT connection, see**Figure 3-5 MQTT Settings Parameters**:

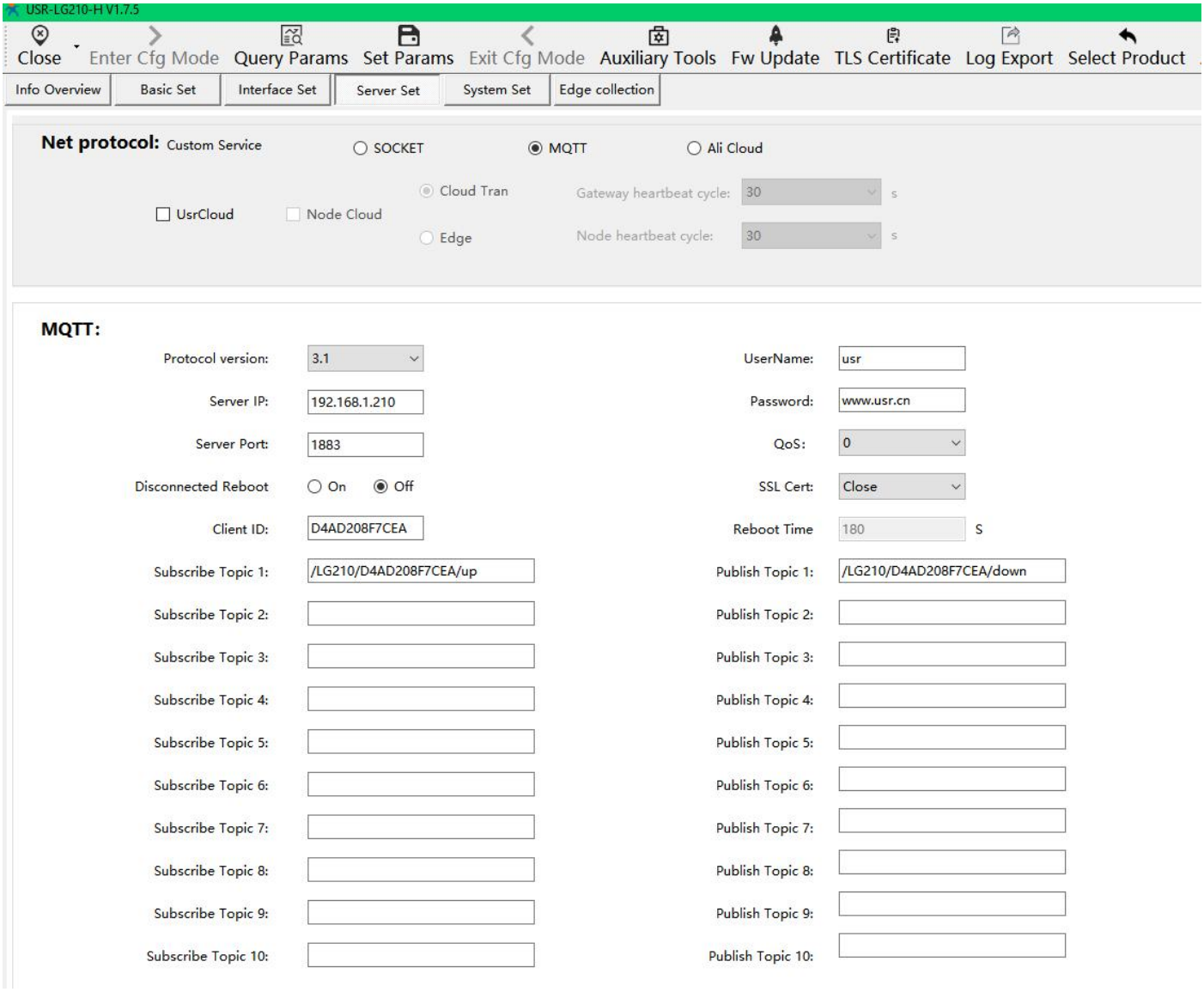


Figure 3-5 MQTT Settings Parameters

(1) **Protocol Version:**Default is protocol version 3.1, supporting versions 3.1 and 3.1.1.

(2) **Server IP/Domain:**The IP address or domain name of the MQTT server to connect to.

(3) **Server Port:**The port of the MQTT server to connect to.

(4) **Client ID:**User device ID, data length <= 32 Bytes.

(5) **Username:**If the MQTT server has username verification enabled, the correct username must be entered. Data length <= 32 Bytes.

(6) **Password:**If the MQTT server has password verification enabled, the correct password must be entered. Data length <= 32 Bytes.

(7) **QoS:**Device Quality of Service level, default is level 0, supporting levels 0, 1, and 2.

(8) **SSL Authentication:**Disabled by default. Supports enabling without certificate authentication, or enabling with certificate authentication.

(9) **Subscribed Topics:**MQTT topics subscribed by the device. Supports 1-10 topics. Data length <= 32 Bytes.

(10) **Published Topics:**MQTT topics published by the device. Supports 1-10 topics. Data length <= 32 Bytes.

Communication Example:

① Before proceeding, ensure that the LG210 gateway can communicate normally with the nodes. First, configure the device network to select MQTT communication, and configure the MQTT server information to be connected into the device. After successful configuration, the device needs to be restarted for the changes to take effect.

② Use an MQTT network assistant to connect to the MQTT server used by the device, subscribe to the topic (the topic published by the device), and publish to the topic (the topic subscribed by the device). Use a serial debugging assistant to connect to the node's serial port; data sent by the node is transmitted wirelessly via LoRa to the LG210 gateway, and the

LG210 gateway pushes data to the MQTT server via 4G or Ethernet. The MQTT network assistant will then receive the data pushed from the LG210 gateway. Conversely, when the MQTT network assistant publishes a message, the LG210 receives the data and forwards it downstream, and the LoRa node receives the data, as shown in**Figure 3-6 MQTT Communication Example**.

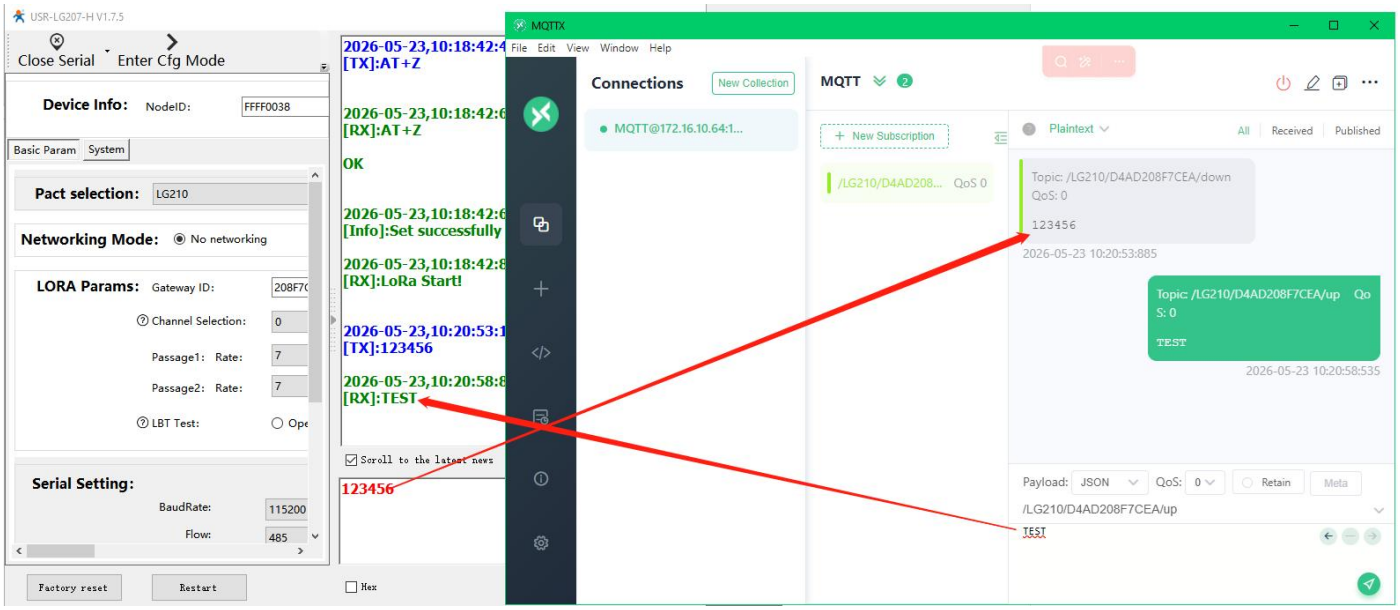


Figure 3-6 MQTT Communication Example

3.1.7. System Settings

Mainly for network diagnostics and local time settings, as shown in**Figure 3-7 System Settings Items**.

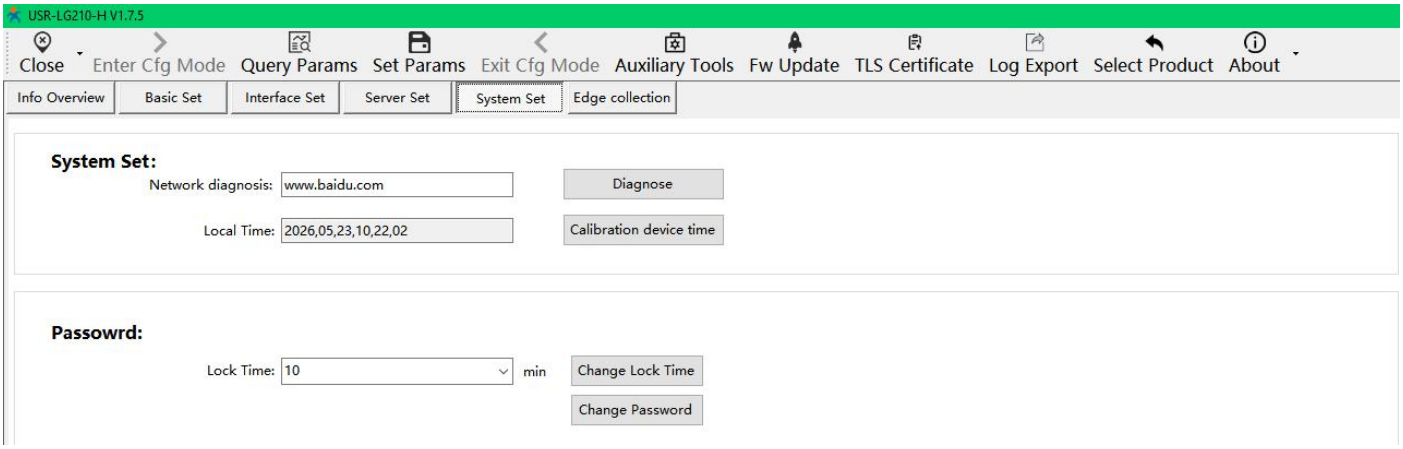


Figure 3-7System Settings Items

3.1.8. Local EdgeAcquisitionSettings

This page is used to configure thelocal edge acquisition function. This function is mutually exclusive with the PUSR service. Please ensure that cloud-related configurations are disabled before enabling this feature. The page supports operations such as JSON data packaging, adding LoRa nodes, and configuring terminal slave device points. These settings must be performed while thehost computer and thedeviceare connected via Ethernet. During configuration, please click the "Point Settings" button at the top of the page to save the parameters to the gateway.

(1) **JSON Packaging Content**: The gateway reports data in JSON format. You can choose to include protocol version, report identifier, slave device name, LoRa node signal value, timestamp, and other data in the report.

(2) **Import Data/Export Data**: You can import or export LoRa node and slave device point configurations via CSV files. To ensure file format compatibility and avoid content errors,it is recommended to use professional CSV editing tools for operation (refer to the attached templateand tool)

Template:

	A	B	C	D	E	F	G	H	I	J	K	L
1	Node Id	Slave name	Slave addr	Point name	Function c	Register a	Data type	Formula	Report ty	Change ra	Cycle time	
2	FFFF0038	TEST	1	TEMP	03	1	0		2		15	
3	FFFF0038	TEST	1	HUM	03	2	0		2		15	
4												
5												
6												
7												
8												
9												

The exported file

Node ID: LoRa Node ID connected under the gateway,
Slave name: Remarks for Collection Terminal: Max. 6 Chinese characters / 12 characters,
Slave Address: Slave Address of Collection Terminal Device,
Point name: Variable Name of Collection Command: Max. 6 Chinese characters / 12 characters,
Function Code: Optional — 01, 02, 03, 04,
Register Address:
Data Type (select by serial number):

- 0 — 16-bit Unsigned Integer
- 1 — 16-bit Signed Integer
- 2 — 32-bit Signed Integer (ABCD Byte Order)
- 3 — 32-bit Signed Integer (CDAB Byte Order)
- 4 — 32-bit Unsigned Integer (ABCD Byte Order)
- 5 — 32-bit Unsigned Integer (CDAB Byte Order)
- 6 — 32-bit Float (ABCD Byte Order)
- 7 — 32-bit Float (CDAB Byte Order)
- 8 — Bit (only applicable for Function Code 01 & 02)

Calculation Formula Remarks: Device uplink data is displayed after calculation via the formula. %s in the formula is a fixed placeholder. Leave blank if no calculation is required.

Examples:Addition: %s+10

Subtraction: %s-10

Multiplication: %s*10

Division: %s/10

Modulo: %s%10

Reporting Mode:

0: Change-triggered Reporting

1: Change-range Triggered Reporting

2: Periodic Reporting

3: Change-range Triggered + Periodic Reporting

4: Change-triggered + Periodic Reporting

Change Range Value: Absolute value (not percentage). Accepts non-negative integers/decimals, range: 0-4294967295. Set to 0 for reporting on every data change.

Reporting Interval: 15-86400 seconds, default 60 seconds



RonsCSVEditor_V2020.11.16_XiT

Tool:

(3) **Read Points/Set Points**: Read and set local edge parameters. This button can only read point parameters.

(4) **Add LoRa Node**: Enter the IDs of the LoRa nodes connected to the gateway. Supports adding up to 30 nodes.

(5) **Add Terminal Slave Device**: Enter the acquisition point parameters. Supports up to 10 acquisition points.

(6) **Delete All**: Delete all written node and point parameters.

Note: This function is mutually exclusive with the PUSR service. If you cannot configure settings on this page, please check if the "PUSR" function was previously enabled. If it is enabled, please disable it first to proceed with the configuration on

this page.

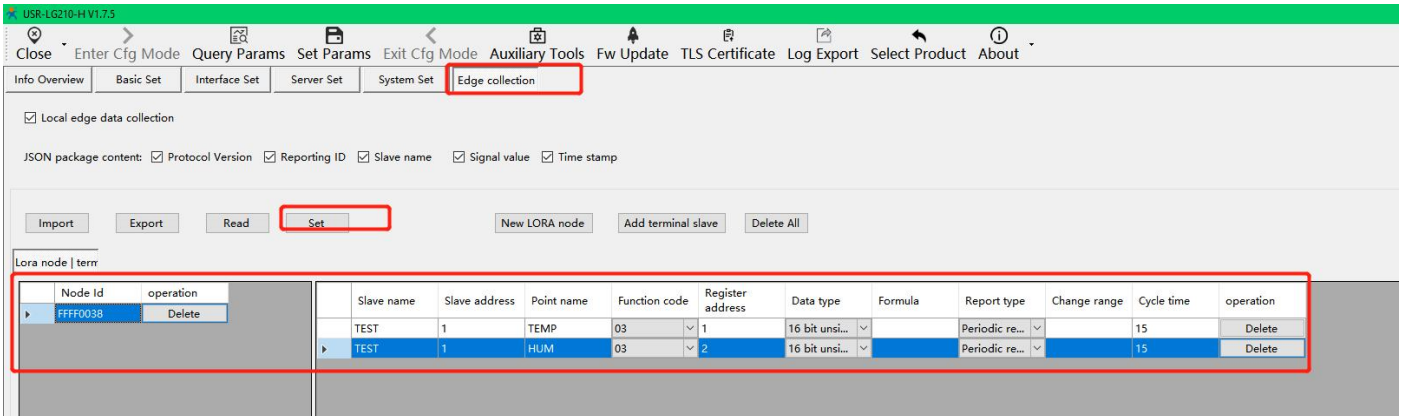


Figure 3-8Local Edge Acquisition Settings

3.1.9. Auxiliary Tools

To facilitate users in reasonably setting the communication parameters between the gateway and nodes, we have specially added an auxiliary calculation tool in the configuration software. It calculates a reasonable acquisition cycle, offline detection time, and reporting cycle based on actual application scenarios. After calculating the values, you can choose one-click fill to complete the settings, as shown in**Figure 3-9 Auxiliary Tool Example**.

(1) Input Parameter Description:

① **Number of Nodes:**The number of nodes the user wants to connect to the network. The value entered here can be larger than the actual number of nodes to be connected, but cannot be smaller than the actual number.

② **Data Length:**The length of the actual valid data the user needs to transmit. The value entered here can be larger than the actual length of valid data to be transmitted, but cannot be smaller than the actual length.

③ **Rate:**The actual selected channel rate. If two channels are used for data transmission and their rates are inconsistent, enter the lower rate value, i.e., the slower one.

④ **Wake-up Cycle:**If the low-power function of the node is enabled in non-"Active Reporting" mode, this parameter indicates the time cycle from when the node enters sleep to when it wakes up next.**It is recommended**that customers do not change this setting arbitrarily; using the default 2000ms is sufficient.

⑤ **Reporting Slot:**In "Active Reporting" mode, the time between one node finishing its report and the next node starting its report.**It is recommended**that customers do not change this setting arbitrarily; using the default 1s is sufficient.

(2) Output Parameter Description:

① **Acquisition Cycle:**In "Broadcast Transparent Transmission" or "Specified Node" mode, when the user sends data through the server, data is collected by polling each node sequentially. This is the minimum cycle reference value for completing polling of all nodes, helping users reasonably allocate acquisition time for nodes.

② **Offline Detection:**The configuration reference value for the minimum offline detection time for each node in non-"Active Reporting" mode. A node is considered offline if there is no data interaction within this time.

③ **Reporting Cycle:**The minimum reporting cycle reference value for all nodes to complete one round of reporting in "Active Reporting" mode.

Precautions: Please fill in the corresponding parameters strictly according to the actual situation, as the calculation results differ for each mode and depending on whether heartbeat and retransmission switches are enabled. Currently, nodes only support low power consumption in "Active Reporting" mode, so the wake-up cycle does not need to be filled in temporarily.

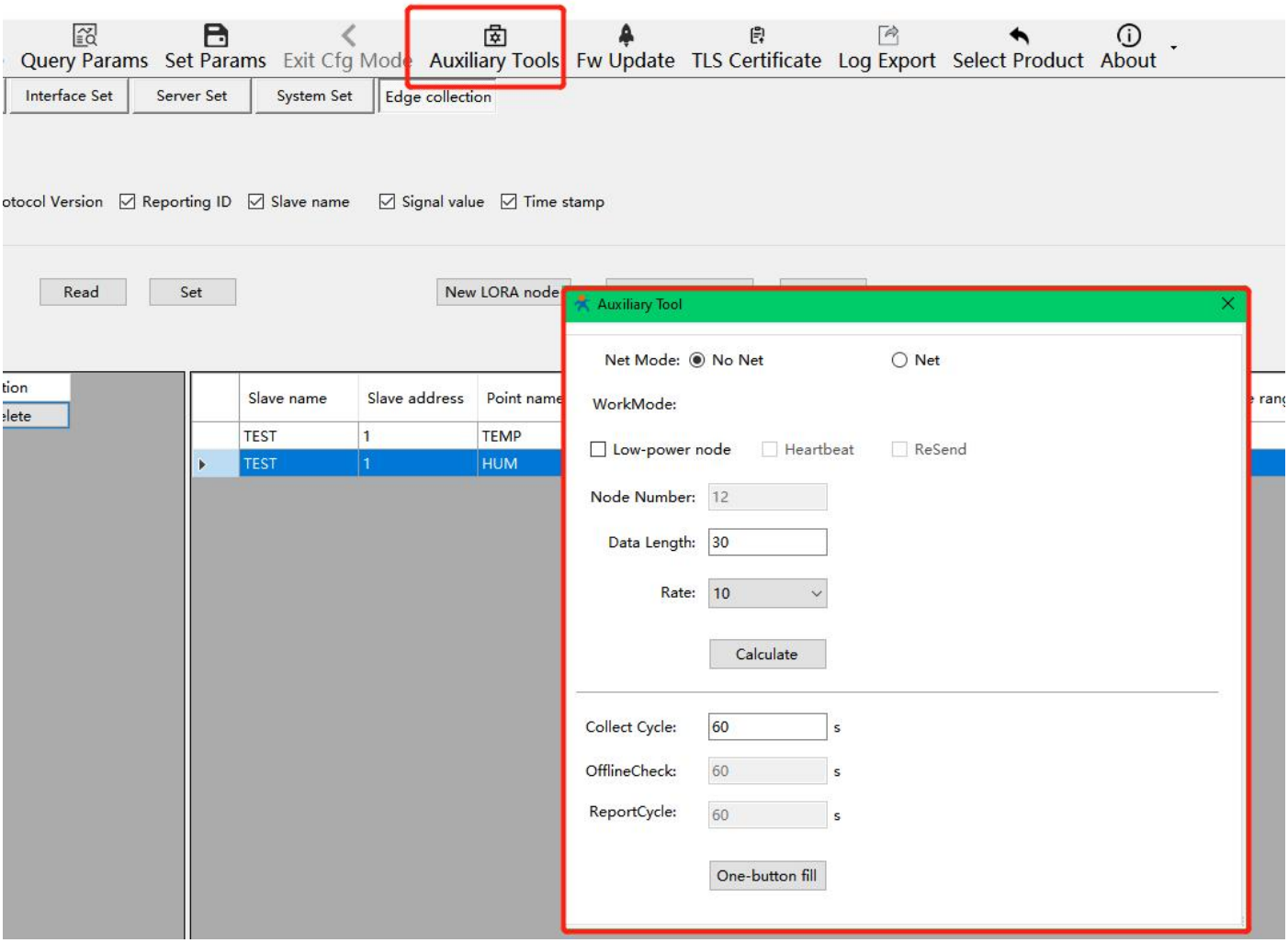


Figure 3-9 Auxiliary Tool Example

4. LG210 Gateway User Guide

4.1. Preparation

Function Usage IntroductionThis section will use theUSR-LG210gatewayandUSR-LG207-Hnode as examples to introduce the configuration process for thegatewayand nodes, as well as establishing communication, helping users quickly build their own LoRa application platform.

The relevant software involved is as follows:

Gatewayand node configuration software and instructions download address:

https://www.pusr.com/support/download/Setup-Software-USR-LG207.html

4.1.1. Item Preparation

(1) Prepare USR-LG210 and its accessories. For accessories, please refer to section1.4. Standard Accessories.

(2) Prepare USR-LG207-H and its accessories.

(3) Prepare USR_LoRa configuration softwareto configure the gateway and nodes; additionally, the gateway also supports AT command configuration, and nodes support both configuration software and AT command settings.

4.1.2. Hardware Connection

Before testing, please make hardware connections according to the diagram below,as shown in**Figure 4-1 Hardware Connection Diagram**.



Figure 4-1Hardware Connection Diagram

4.2. Networking Function

4.2.1. Designated Node Networking Function

Communication Process:

The cloud platform/control center sends data frames in the format of "Target Node ID + User Data". The concentrator receives and parses whether the target node ID is an internal network ID. If it is an internal network ID, it sends the "User Data" part to the corresponding node in a point-to-point manner. After the node verifies that the ID is correct, it transmits the "User Data" part to the terminal device. The data replied by the device after recognizing the data command is uploaded to the cloud platform/control center through the node and concentrator,as shown in **Figure 4-2 Communication Process**.



Figure 4-2 Communication Process

Instructions for Use:

① For free networking between the concentrator and nodes, ensure that thefrequencyand rate are consistent. If onlyone channel'sparameters of the node match those of a certain channel of the concentrator, you need to select the channel same as the gateway and node in the node'sLORA parameter channel selection. If the parameters set for both channels of the node are the same as those of the gateway, the user can select channel 0. After successful networking, the gateway will automatically assign LORA parameters.

② The node completes the network access interaction using the gateway ID, so it is essential to ensure that theconcentrator gateway ID set in the nodeis correct.

③ Select the network protocol to connect to the private server.

④ The settings page is the same as the settings software parameters.

⑤ It is recommended to read the parameters before setting them. Read first, then set.

⑥ After all LG210 parameter settings are completed, you need to click restart to take effect.

4.2.1.1. Private Server Designated Node Communication

Private server designated node communication allows flexible changing of the target address when sending data, achieving one-to-one LORA communication function in the format of"Target Node ID + User Data". The gateway connecting to the private server can choose TCP, MQTT, or serial port methods.

（1）Parameter Settings:

① Basic LG210 Gateway Settings: Open Gateway Configuration -> Enter Configuration State -> Read Parameters -> Select Network/Private Server for Data Channel -> Select Networking for Networking Mode -> Select Designated Node for Work Mode. Refer to **Figure 4-3 Setting Example**.

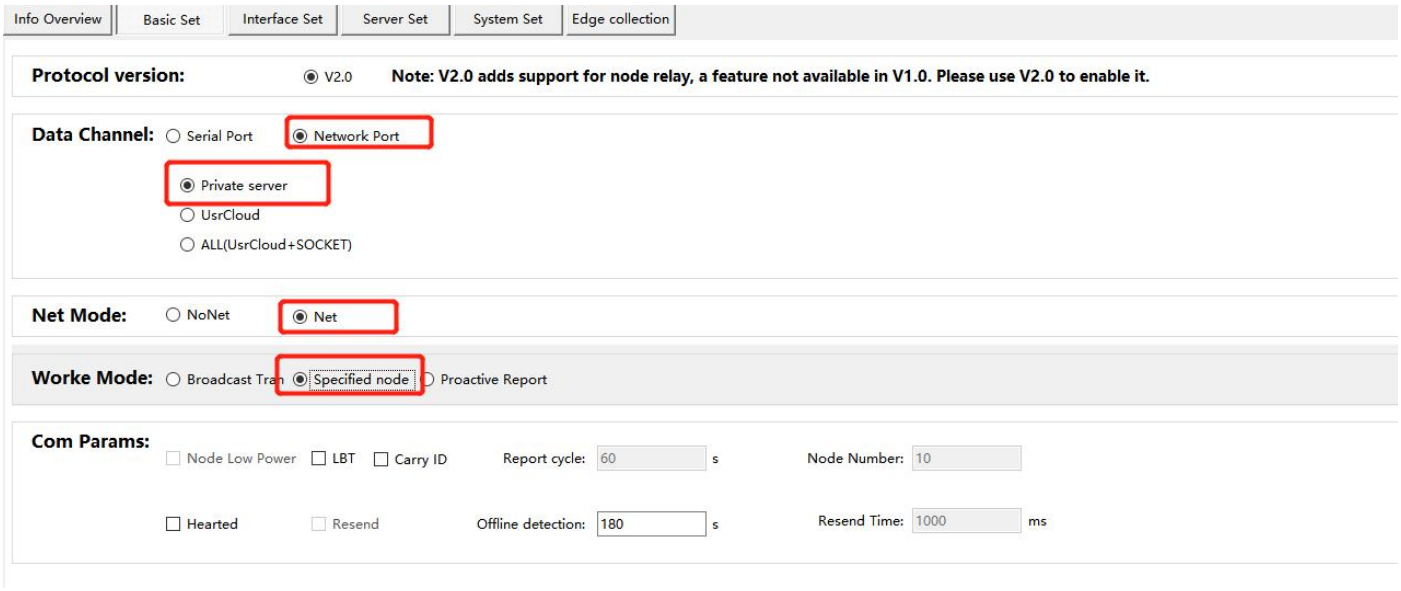


Figure 4-3 Setting Example

② LG210 Gateway LoRa Parameter Settings: Set LORA parameters [Channel 1 and 2 frequency, rate, transmit power, and whether to enable forward error correction based on actual usage requirements (Default: Channel 1 frequency 8680x100KHz, rate 7, transmit power 25, forward error correction enabled; Channel 2 frequency 4800x100KHz, rate 7, transmit power 26, forward error correction enabled)] -> Network Port Parameter Settings [Select DHCP/Dynamic IP (default), select Network Port Priority for NIC priority (default)]. Refer to **Figure 4-4 Setting Example**.

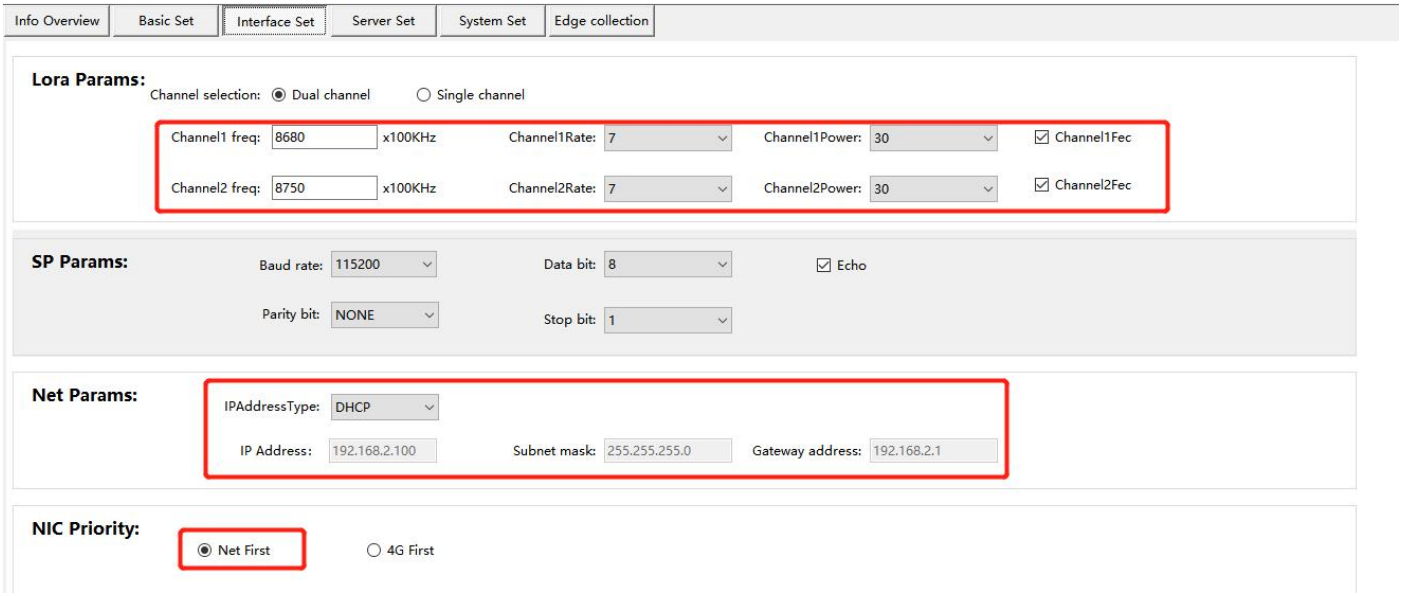


Figure 4-4 Setting Example

③ Network Settings: Configure LG210 gateway to connect to TCP private server. Set network protocol to SOCKET -> Select Enable Socket or MQTT, SOCKETA (default) -> Click Set -> Click Restart to take effect. Refer to **Figure 4-5 Setting Example** .

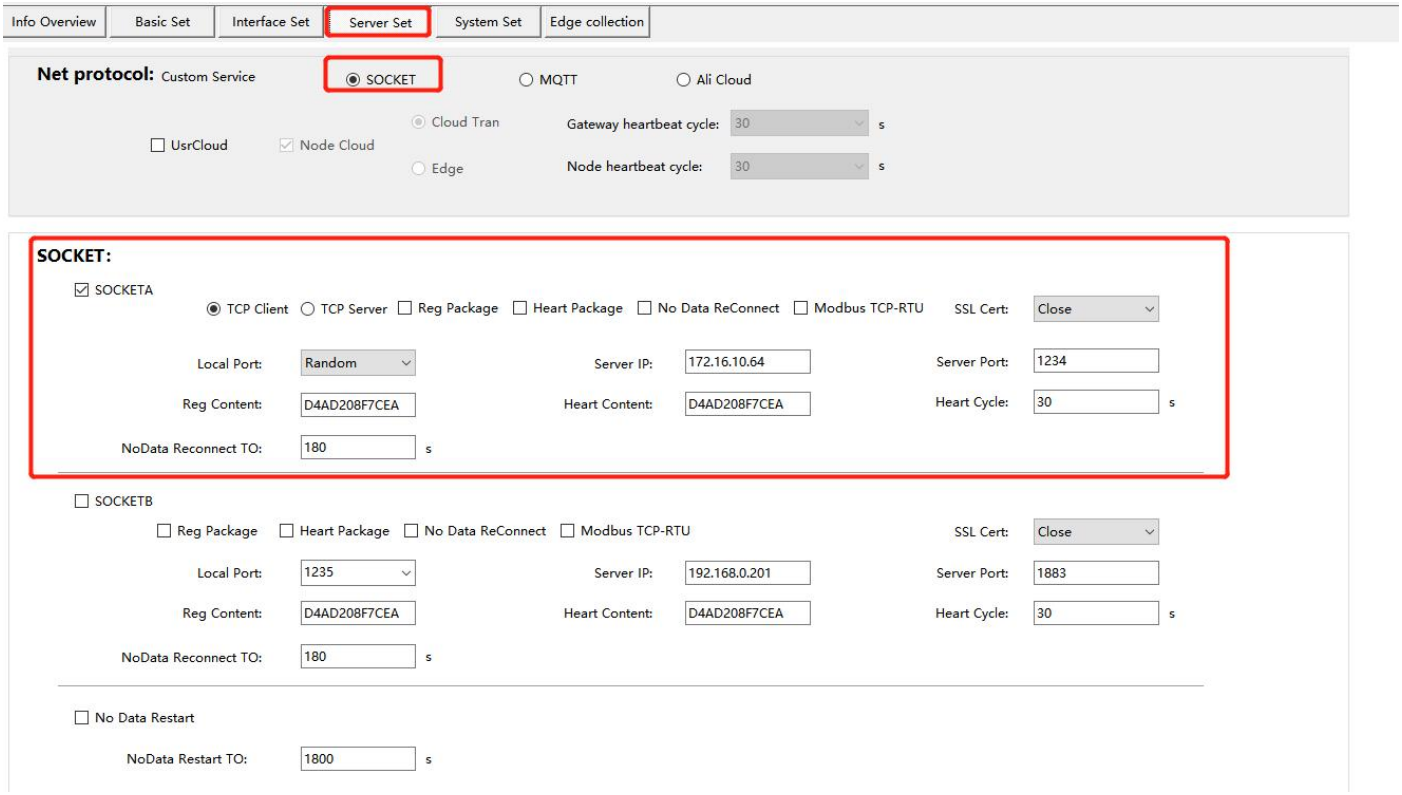


Figure 4-5 Configuration Example

④ Node Configuration: Open the serial port — Enter configuration mode — Read parameters — Select protocol LG210 — Ensure work mode, LoRa parameters, and LG210 gateway settings are consistent — Configure serial port settings as needed — Click 'Set Parameters' to complete. Refer to**Figure 4-6 Configuration Example.**

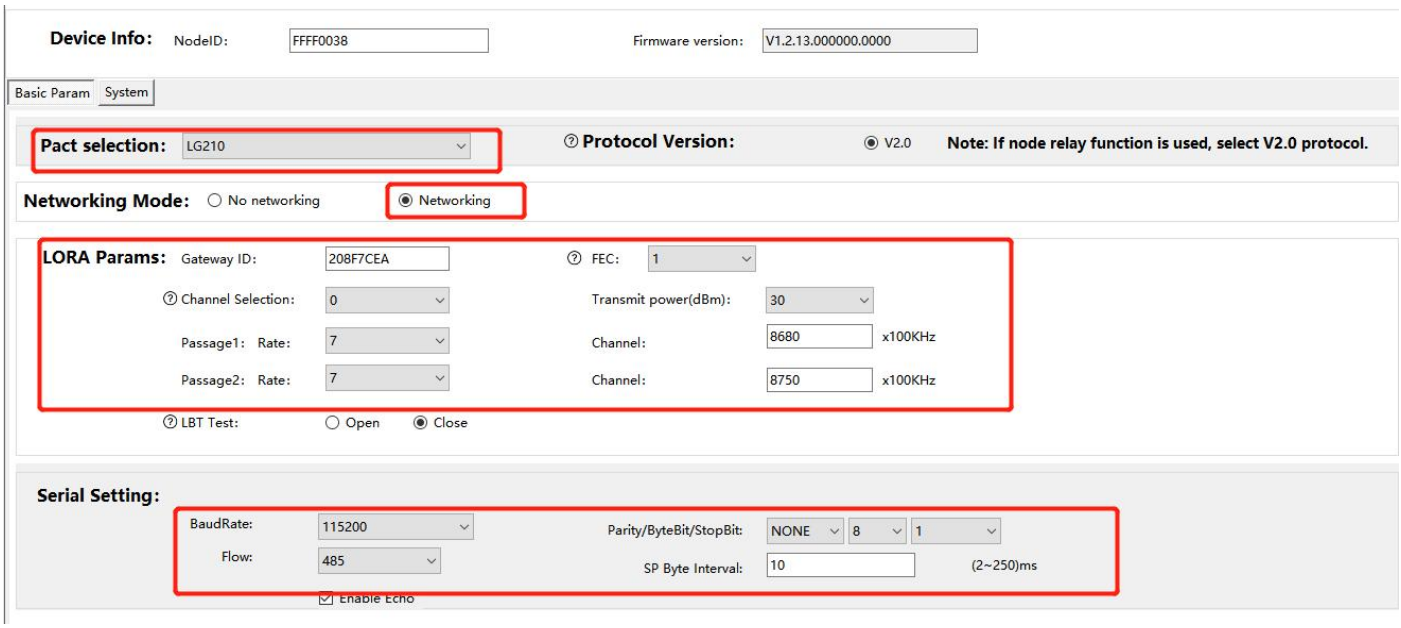


Figure 4-6 Configuration Example

（2）Communication Test:

Through the above steps, networking and communication with specified nodes between the terminal device and the private server can be achieved. The communication effect is shown in**Figure 4-7 Data Communication Example**:

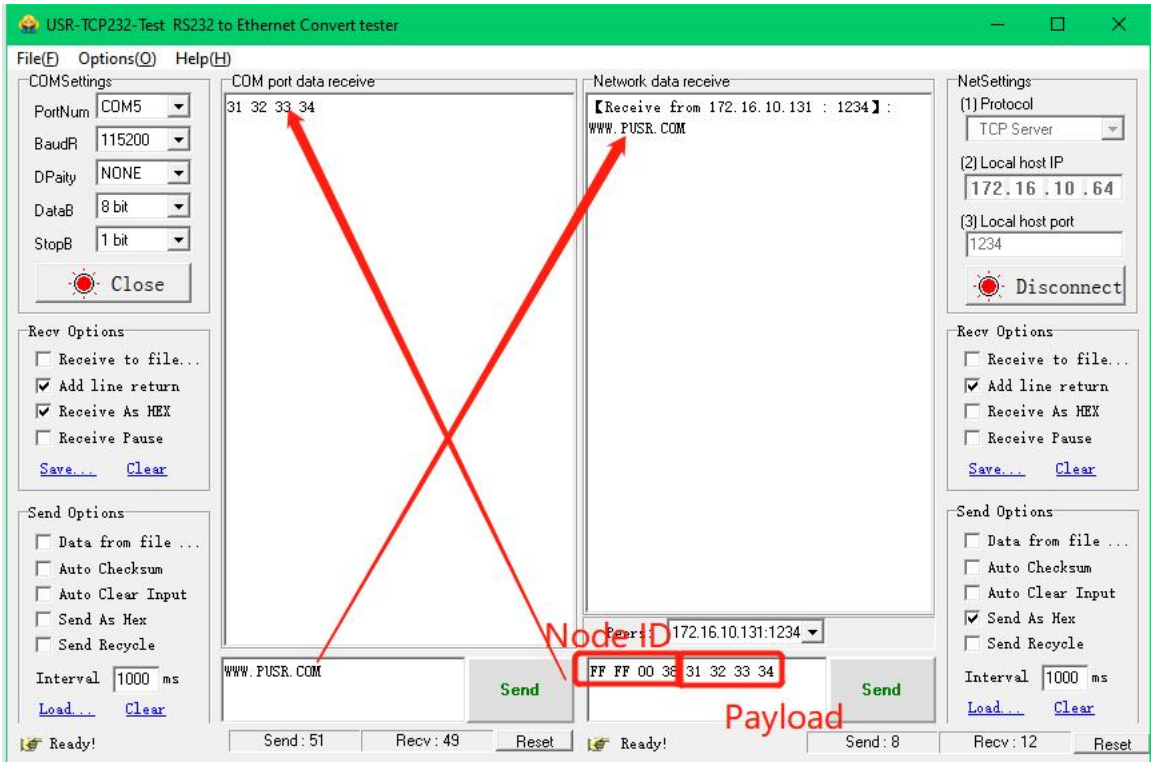


Figure 4-7 Data Communication Example

Note: Data sent from the network side must use the hexadecimal format "Node ID + Data". Data reported by the node side can use either hexadecimal or ASCII format.

4.2.2. Networking Broadcast Transparent Transmission Function

Communication Process:

After the cloud platform/control center sends a data frame to the concentrator, the concentrator broadcasts the data frame within the network. All nodes that have successfully joined the network can receive the data frame and forward it to terminal devices. Devices that recognize the data command reply with data, which is uploaded to the cloud platform/control center via nodes and the concentrator. Data actively reported by terminal devices can also be sent to the concentrator through nodes that have joined the network, and the concentrator uploads it to the cloud platform/control center after confirming its ID is correct,as shown in**Figure 4-10 Schematic Diagram of Communication Process**.

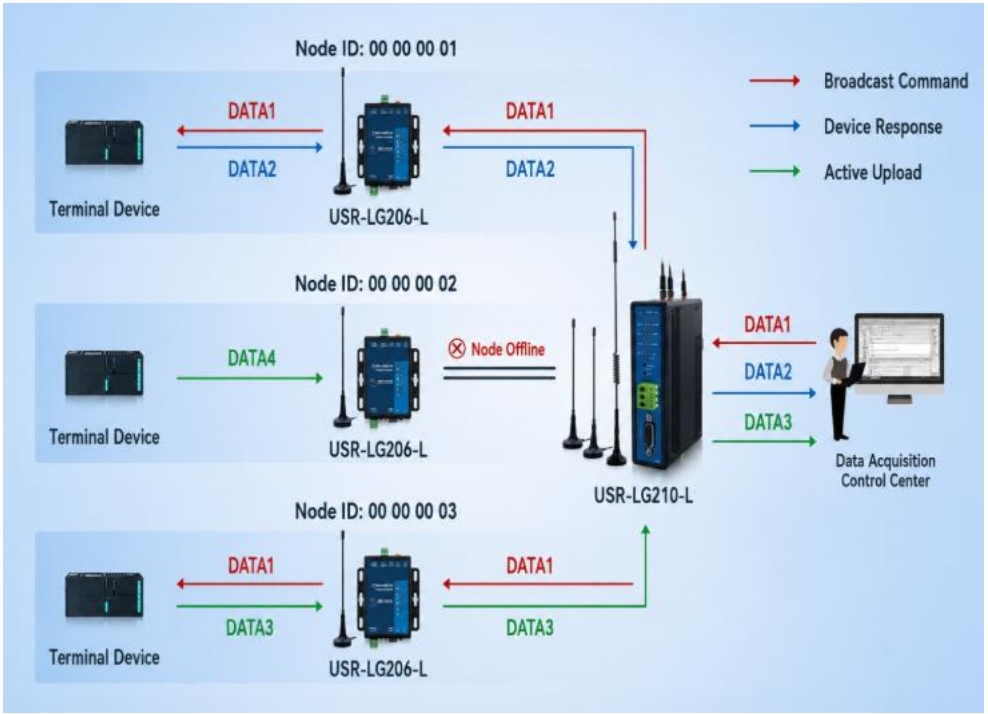


Figure 4- Schematic Diagram of Communication Process

4.2.2.1. Private Server Broadcast Transparent Transmission Communication

In private server broadcast transparent transmission communication,allnodes that have successfully joined the

network can receive the data frame and forward it to terminal devices. Devices that recognize the data command reply with data, which is uploaded to the cloud platform/control center via nodes and the concentrator. The gateway connection to the private server can choose from three methods: TCP, MQTT, or serial port.

（1）Parameter Settings:

① In Basic Settings, set the LG210 gateway data channel to select Network and Private Server; select Networking for Networking Mode, and Select Node for Working Mode. For details, please refer to section4.2.1.1Private Server Specified Node Communication.

② LORA parameters are set to General Settings.For details, please refer to section4.2.1.1Private Server Specified Node Communication.

③ Configure the LG210 gateway to connect to the TCP private server, set the network protocol to SOCKET, select Enable Socket or MQTT, SOCKETA (default), and click Set.For details, please refer to section4.2.1.1Private Server Specified Node Communication.

（2）Communication Test: Through the above steps, networking broadcast transparent transmission communication between terminal devices and the private server can be achieved. The communication effect is shown in**Figure 4-11 Data Communication Example**:

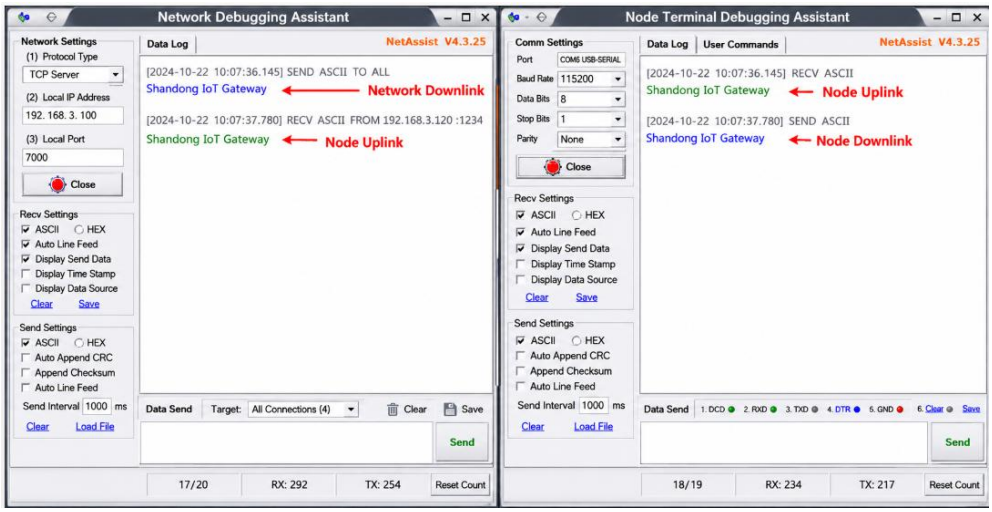


Figure 4-Data Communication Example

Note: Both network-side downlink and node-side uplink can use hexadecimal or ASCII format.

4.2.3. PUSR Cloud Communication

For PUSR cloud application, users can refer to this user guide:

https://www.pusr.com/wiki/puba/5oSSNvCZ3?lang=en_US

4.2.4. Active Reporting Function

Communication Process:

When the gateway is in active reporting mode, it calculates the reporting time for each node based on user-set parameters (reporting period / total number of nodes = reporting interval). When a node joins the network, the gateway informs the node of its first reporting time in the ACK response message during networking. After that, the node starts data reporting operations based on its own timing (when the timer expires, it sends wake-up data to the serial port; after receiving the wake-up data, the user device can immediately report the collected data. If the node device receives data, it sends it directly to the gateway via LoRa; otherwise, if there is no data on the serial port for 2 seconds, the module times out and starts timing again, waiting for the next reporting cycle).

Each time the gateway receives data reported by a node, it recalculates the next reporting time for that node and replies to the node via ACK. If the gateway has data to send to the node, it must wait for the node to report data, and then send it to the node in the ACK response packet (sending data to the node in reporting mode must follow the format: Node ID + Data).

(1) Retransmission Function:

① When the retransmission function is enabled, within one reporting cycle,the node starts timing after sending data.

If the gateway does not reply with data when the retransmission time is reached,the data will be retransmitted when the next retransmission time arrives, performing data retransmission up to 3 times in sequence.

② Note: 1. Retransmission time x 3 must be less than the reporting period time / number of nodes; 2. If a private server needs to reply with data, it must follow the "Node ID + Data" format. 3. The default serial port waiting time is 2 seconds.

4.2.4.1. Private Server Active Reporting Communication

The gateway device selects the networking active reporting function, and the node-side devices send data according to the active reporting communication process. The gateway connection to the private server can choose from three methods: TCP, MQTT, or serial port.

For private server active reporting, taking low power mode as an example:

(1) Parameter Settings:

① Set the LG210 gateway data channel to select Network and Private Server, select Networking for networking mode, select Active Reporting for working mode, and select Node Low Power for communication parameters. Fill in reasonable communication parameters to make the settings effective (you can use the auxiliary tools in the setting software to complete parameter calculations), as shown in**Figure 4-29 Setting Example**.

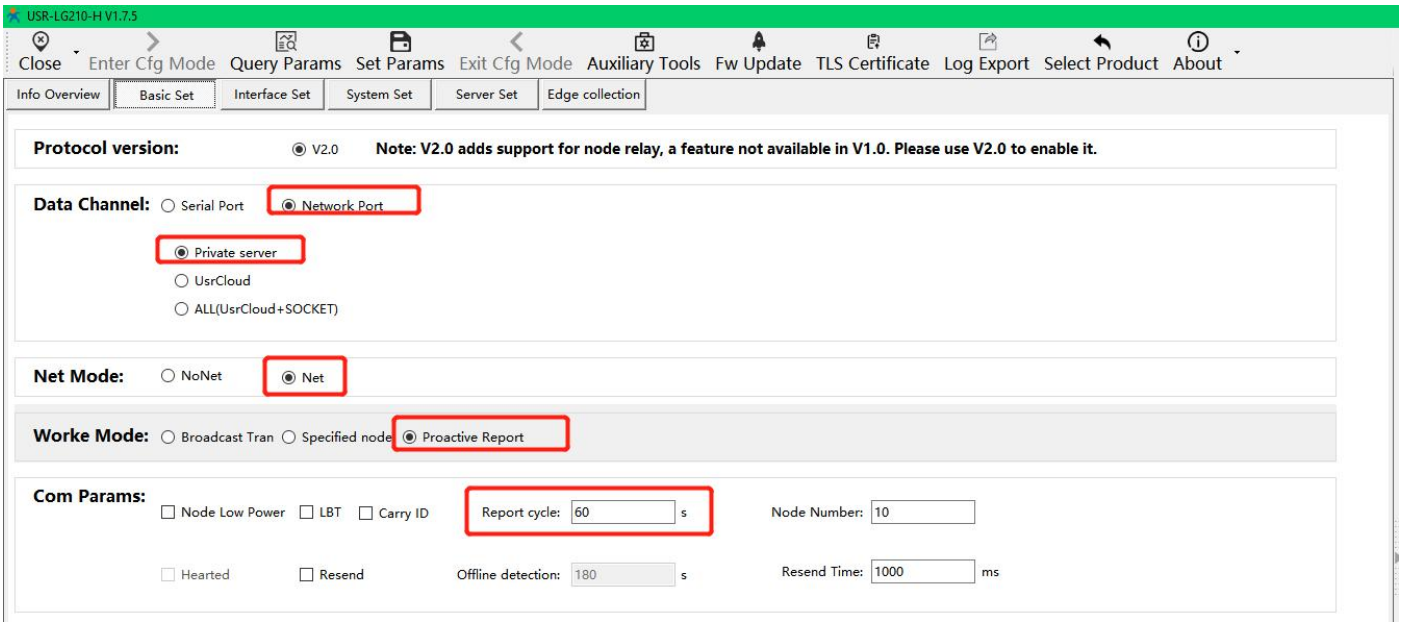


Figure 4-8Setting Example

② LORA parameters are set to general settings,please refer to4.2.1.1Private Server Specified Node Communication section.

③ Configure the LG210 gateway to connect to the TCP private server, set the network protocol to SOCKET, select Enable Socket or MQTT, SOCKETA (default), and click Settings.Please refer to4.2.1.1Private Server Specified Node Communication section.

(2) Communication Test:

After the node receives the wake-up data, it reports the data. After the gateway receives the data, it will reply with an ACK internally. If the private server needs to manually reply to the data, the replied data will be printed to the node serial port after the next report, as shown in**Figure 4-30 Communication Example**.

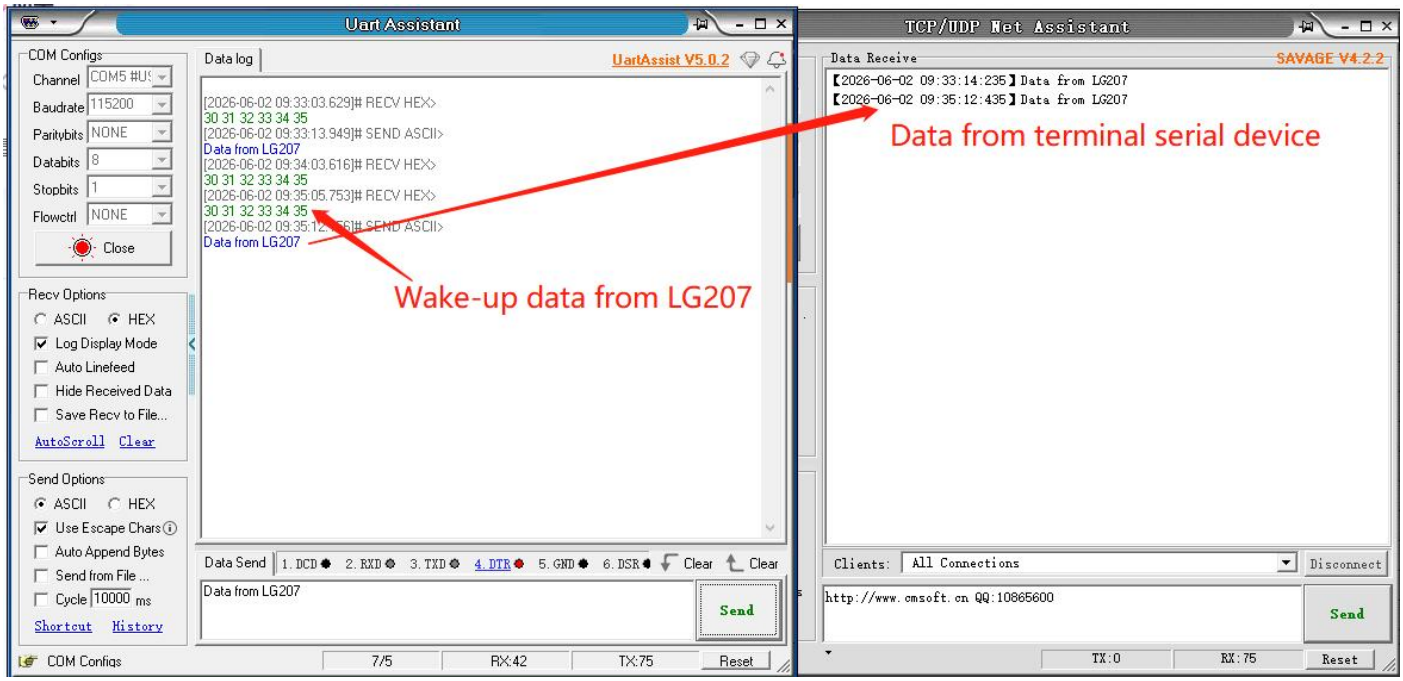


Figure 4-9Communication Example

Note: Node reported data can use hexadecimal or ASCII code format. LG210 gateway manual reply data needs to follow the "Node ID + Data" format.

4.3. Non-networking Function

In this mode, the concentrator and nodes can achieve direct transparent transmission between the server and terminal devices without protocol networking. There are the followingtwoworking modes for transparent transmission:Specified NodeandBroadcast Transparent Transmissionmode. We will introduce thesetwoworking modes in detail below.

Note: If the LG210 gateway selects the non-networking mode, it can only select the private server or serial port as the network data channel.

4.3.1. Specified Node Function

Communication Process:

Designated Node mode allows flexible changes to the target address when sending data, achieving one-to-one communication functionality on the basis of transparent transmission; the cloud platform/control center issues data frames in the format of "Target Node ID + User Data". After the concentrator receives and parses the frame, it transparently transmits the data frame in a point-to-point manner. The node whose ID matches the target ID will transmit the "User Data" part to the terminal device upon receiving the data. After the device identifies the data command, it replies with data that is uploaded to the cloud platform/control center via the node and concentrator. Meanwhile, data transmitted from the terminal device to the node can also be uploaded to the collection control center via the concentrator, as shown in **Figure 4-32 Communication Process Schematic**.

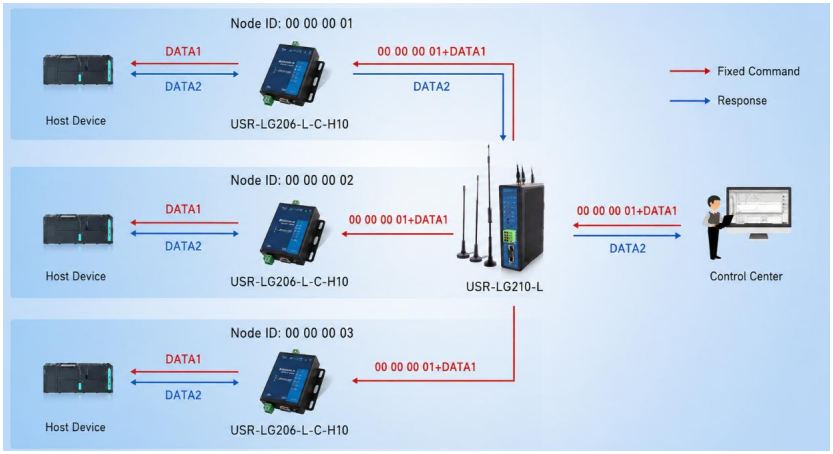


Figure 4-10 Communication Process Schematic

(1) Mode Description:

① The prerequisite for successful communication between the concentrator and the node in this mode is to ensure that the LoRa channel frequency and rate are consistent.

② The node has two sets of communication parameters corresponding to the two-channel parameters of the concentrator. When setting parameters, if only one set of node parameters matches one channel parameter of the concentrator, you need to select that set of parameters in the node's parameter selection option; if both sets of parameters match the two channel parameters of the concentrator, either random parameters or specifying a certain set of parameters is acceptable.

③ The LG210 gateway supports selecting Serial Port, TCP, MQTT, and Alibaba Cloud. The following will demonstrate the communication process using the designated node serial port connection as an example.

(2) Parameter Settings:

① Set the LG210 gateway data channel to select Serial Port, networking mode to No Networking, and working mode to Designated Node, as shown in **Figure 4-33 Parameter Settings**.

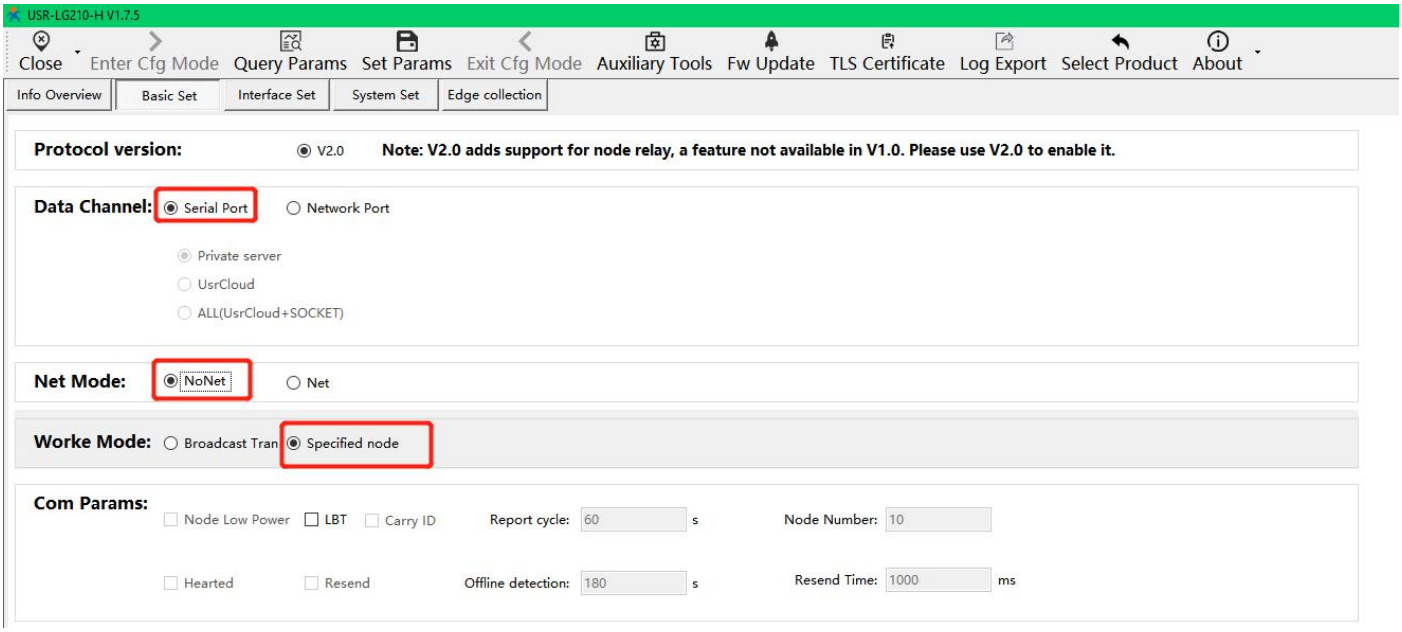


Figure 4-11 Parameter Settings

② LORA parameters are set to general settings, for details please refer to 4.2.1.1 Private Server Designated Node Communication section.

③ Configure the LG210 gateway serial port parameters according to actual needs, as shown in **Figure 4-34 Parameter Settings**.

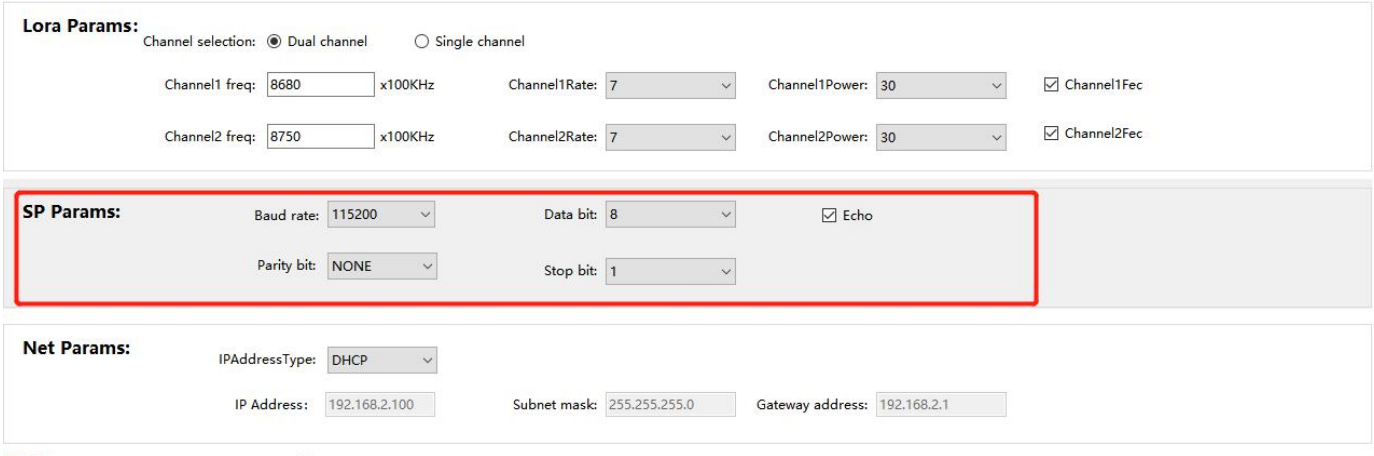


Figure 4-12 Parameter Settings

(3) Communication Test: Through the above steps, non-networking designated node communication between the terminal device and the private server can be achieved. The communication effect is shown in **Figure 4-35 Communication Example**:

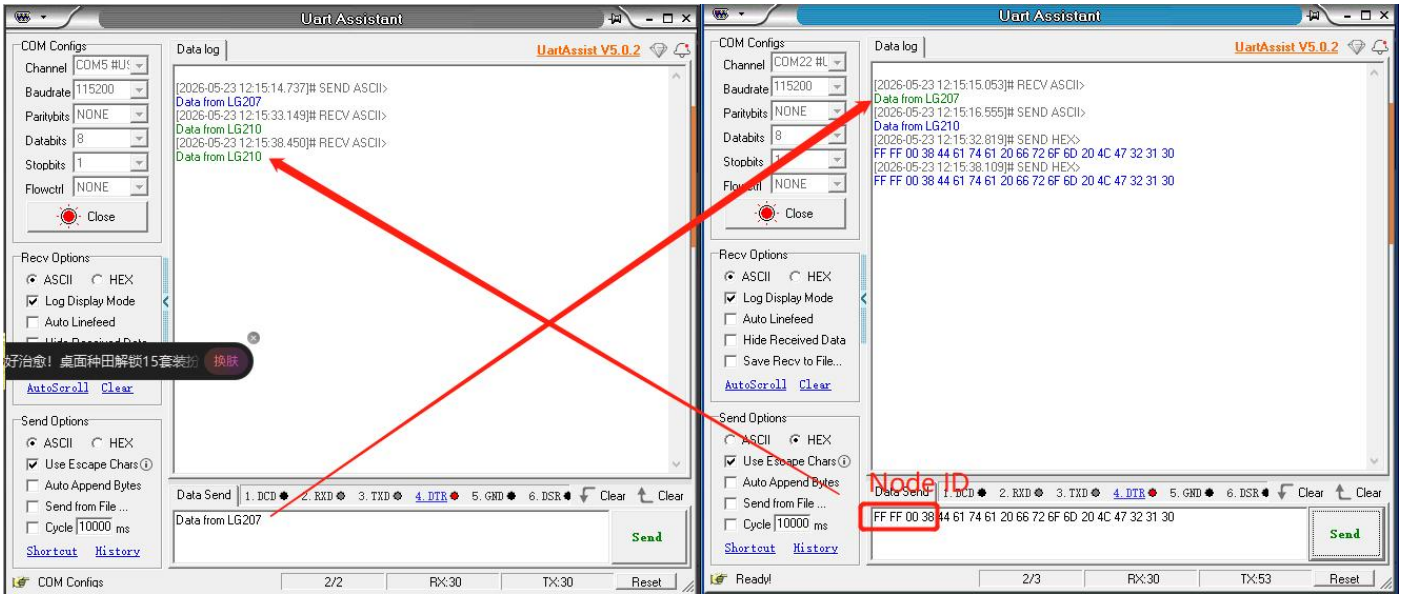


Figure 4-13 Communication Example

Note: Data sent from the network side must use the hexadecimal "Node ID + Data" format, while data reported by the node side can use either hexadecimal or ASCII format.

4.3.2. Broadcast Transparent Transmission Function

Communication Process:

The cloud platform/control center sends a data frame to the concentrator, which then broadcasts this data frame. All nodes operating on the samefrequencyand rate as the concentrator can receive this data frame and forward it to terminal devices. Terminal devices that recognize the data frame will send back reply data, which is transmitted through the nodes and concentrator, and finally uploaded to the cloud platform/control center. Meanwhile, data actively reported by terminal devices to the nodes can also be uploaded to the cloud platform/control center via the concentrator,as shown in**Figure 4-36Schematic Diagram of Communication Process**.

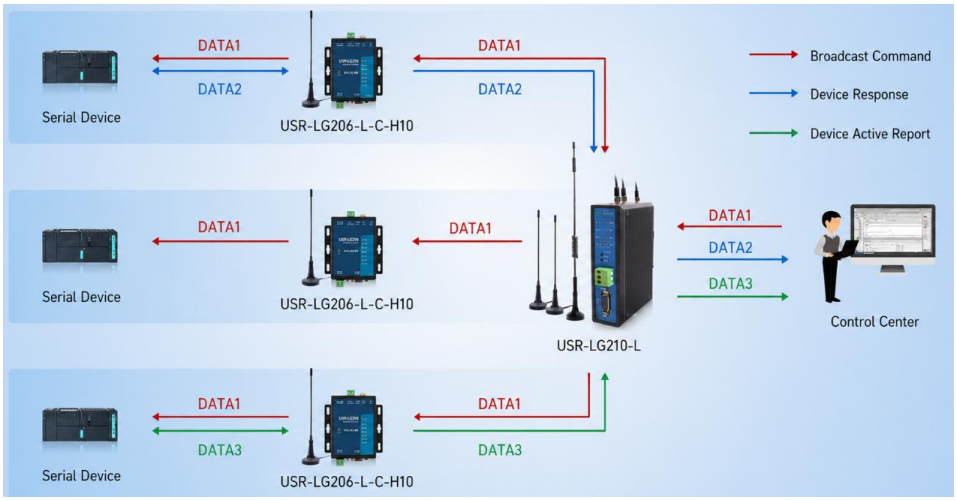


Figure 4-14Schematic Diagram of Communication Process

(1) Mode Description:

① The prerequisite for successful communication between the concentrator and nodes in this mode is to ensure that the LoRa channelfrequency andrate are consistent.

② Nodes have two sets of communication parameters corresponding to the two channels of the concentrator. When setting parameters, if only one set of node parameters matches one channel of the concentrator, you need to select that set of parameters in the node's parameter selection option; if both sets of parameters match the twofrequencyparameters of the concentrator, you can either choose randomly or specify a particular set.

③ The LG210 gateway supports selecting Serial Port, TCP, MQTT, and Alibaba Cloud. The following will demonstrate the communication process using broadcast transparent transmission with a private server as an example.

(2) Parameter Settings:

① Set the LG210 gateway data channel to select Network and Private Server, set Networking Mode to No Networking, and set Working Mode to Broadcast Transparent Transmission, as shown in**Figure 4-37 Parameter Settings**.

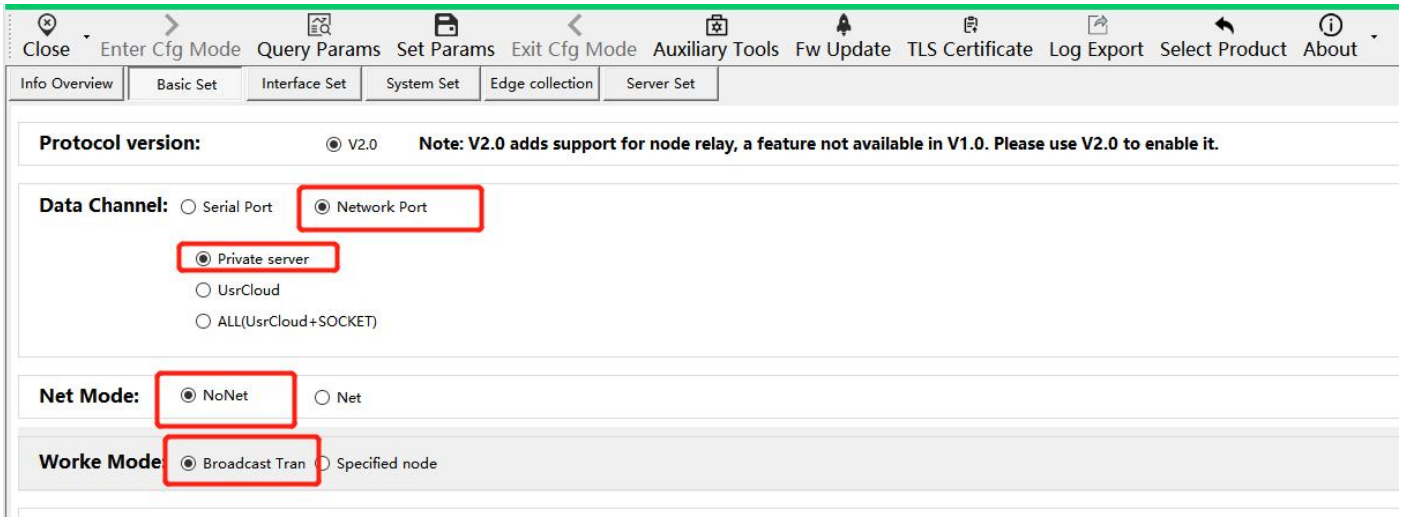


Figure 4-15Parameter Settings

② LORA parameters are set to general settings.For details, please refer to section4.2.1.1Private Server Specified Node Communication.

③ Configure the LG210 gateway to connect to the TCP private server, set the network protocol to SOCKET, select Enable Socket or MQTT, SOCKETA (default), and click Set.For details, please refer to section4.2.1.1Private Server Specified Node Communication.

(3) Communication Test: Through the above steps, non-networking broadcast transparent transmission communication between terminal devices and the private server can be achieved. The communication effect is**as shown inFigure 4-38 Communication Process**:

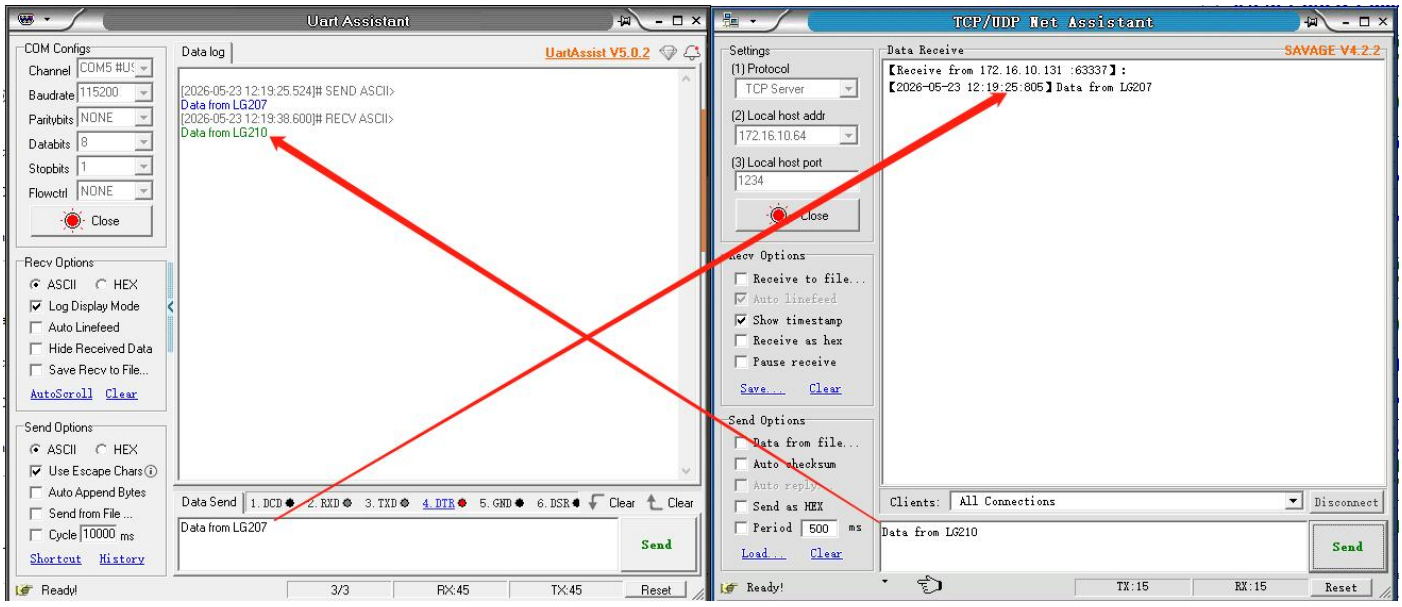


Figure 4-16Communication Process

Note: Both data sent from the network side and data reported by the node side can use either hexadecimal or ASCII format.

4.4. Local Edge Collection Function

This system supports local edge computing for gateways and nodes. Users can set up data collection points via the host computer, and the gateway assigns corresponding collection rules to each LoRa node. After collecting data, the node

performs local judgments based on the rules and reports to the gateway if conditions are met. Upon receiving the data, the gateway encapsulates it into a JSON packet according to the specified format and uploads it to the user's private server (supporting serial port, Socket, MQTT, Alibaba Cloud, etc.). A single gateway supports up to 30 LoRa nodes, with each node configurable for 10 collection points.

Note: The local edge computing function can only be used normally in the networking mode.

For configuration methods, please refer to section3.1.7.

(1) **Function Description:**In LG210 local edge mode, the main parameter settings for collection point nodes and collection points are as follows:

① Supports setting slave name and point name with up to 6 Chinese characters or 12 characters.

② Function codes support optional values: 01, 02, 03, 04.

③ Data types support: 16-bit unsigned, 16-bit signed, 32-bit signed (ABCD), 32-bit signed (CDAB), 32-bit unsigned (ABCD), 32-bit unsigned (CDAB), 32-bit float (ABCD), 32-bit float (CDAB), Bit (limited to function codes 01 and 02).

④ The calculation formula applies only to function codes 3 and 4. "%s" is a placeholder and a fixed field. For example: if the upstream data needs to be multiplied by 10 before reporting, the calculation formula can be set as: %s*10

⑤ Report types support: 0: Change report; 1: Change magnitude report; 2: Periodic report; 3: Change magnitude report + Periodic report; 4: Change report + Periodic report.

⑥ Change Magnitude: Effective only when the report type includes "Change magnitude report"; not required for other modes. Allows input of integers or decimals between 0 and 4294967295. Setting it to 0 means the node reports immediately upon collecting data; unless necessary, it is recommended to avoid using 0 to reduce unnecessary network data load.

⑦ Period Time: Effective only when the report type includes "Periodic report"; not required for other modes. Allows input of 15-86400s, default is 60s.

(2) Parameter Settings:

① Please ensure that theLoRa basic parameters (such asrate, channel, etc.) of the LG210 gateway and LoRa nodes are configured identically, and select "LG210 Protocol" and "Networking Mode" on theLORAnode side to establish a stable LoRa communication connection.

② In the basic settings of the LG210 host computer, the data channel can be selected asSerial Port or Private Server. If Private Server is selected, further specify the access method inNetwork Settingsaccording to project requirements, supporting Socket, MQTT, or Alibaba Cloud protocols.

③ In the LG210 host computer, configure nodes and points under Edge Collection. For configuration methods, please refer to section3.1.7.

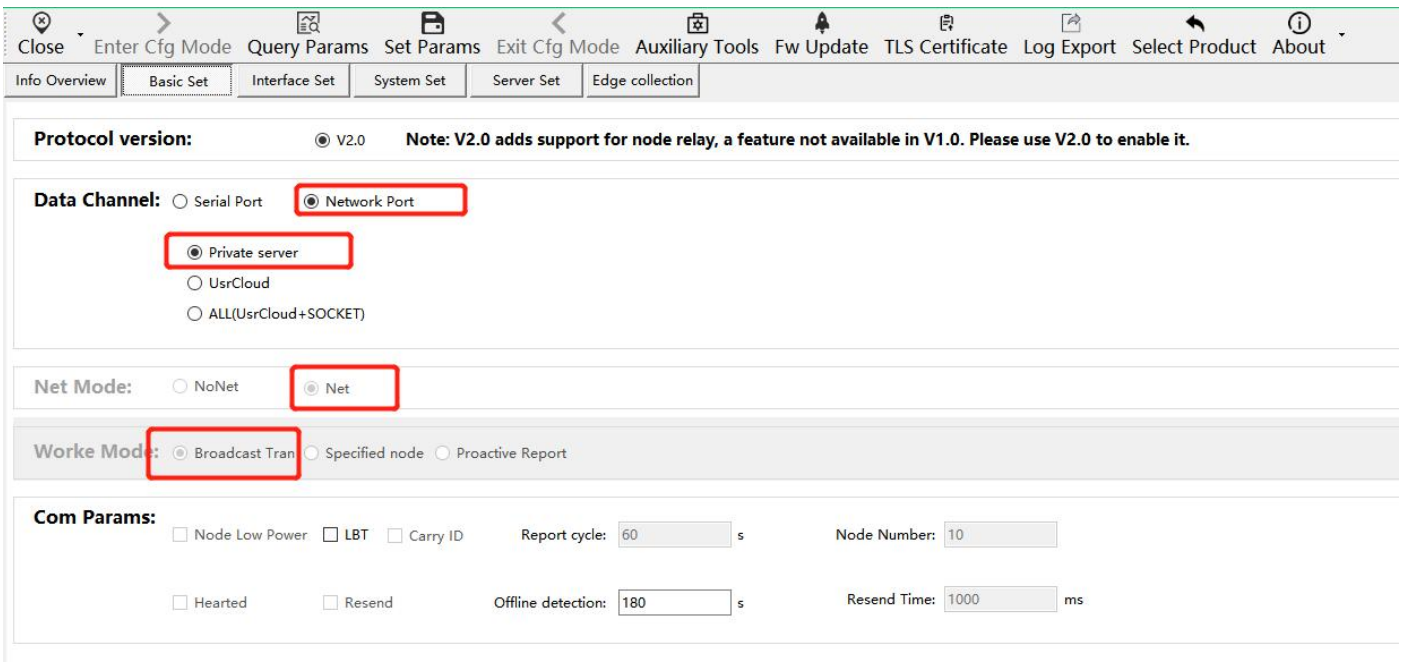


Figure 4-17LG210 Basic Data Channel Settings

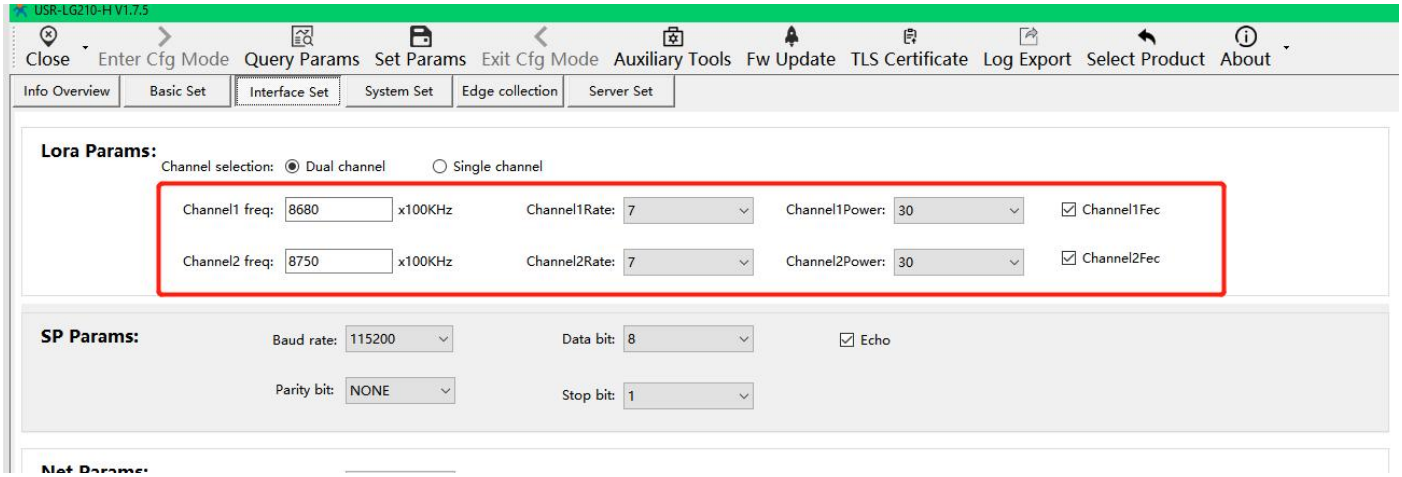


Figure 4-18 LG210 Interface Settings

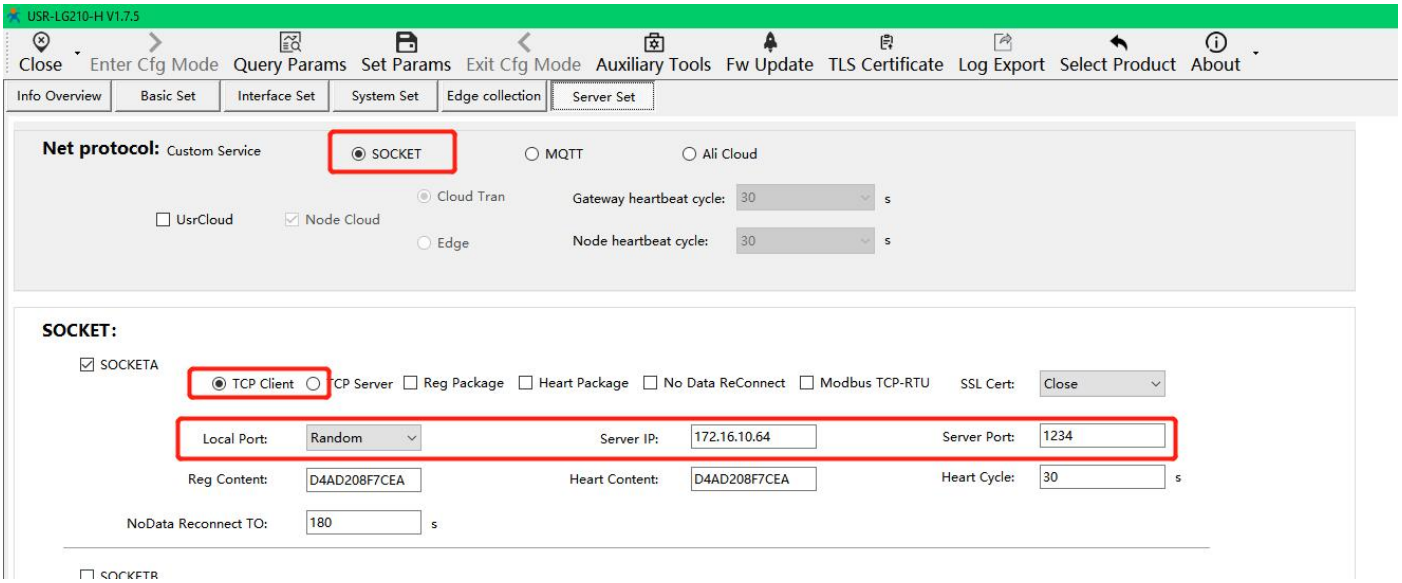


Figure 4-19LG210 Network Protocol Settings

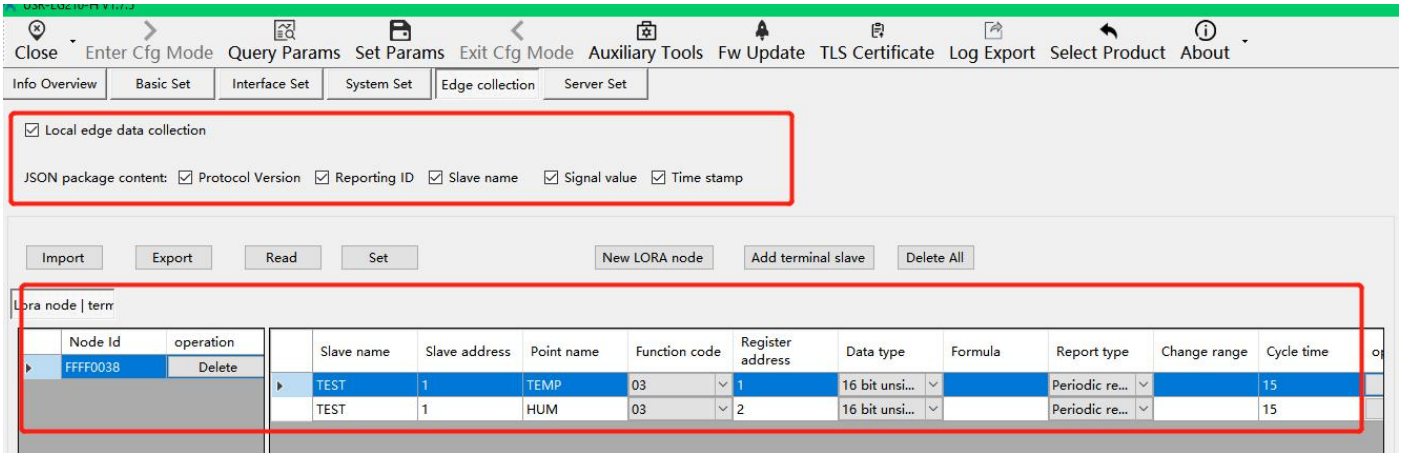


Figure 4-20LG210 Edge Collection Settings

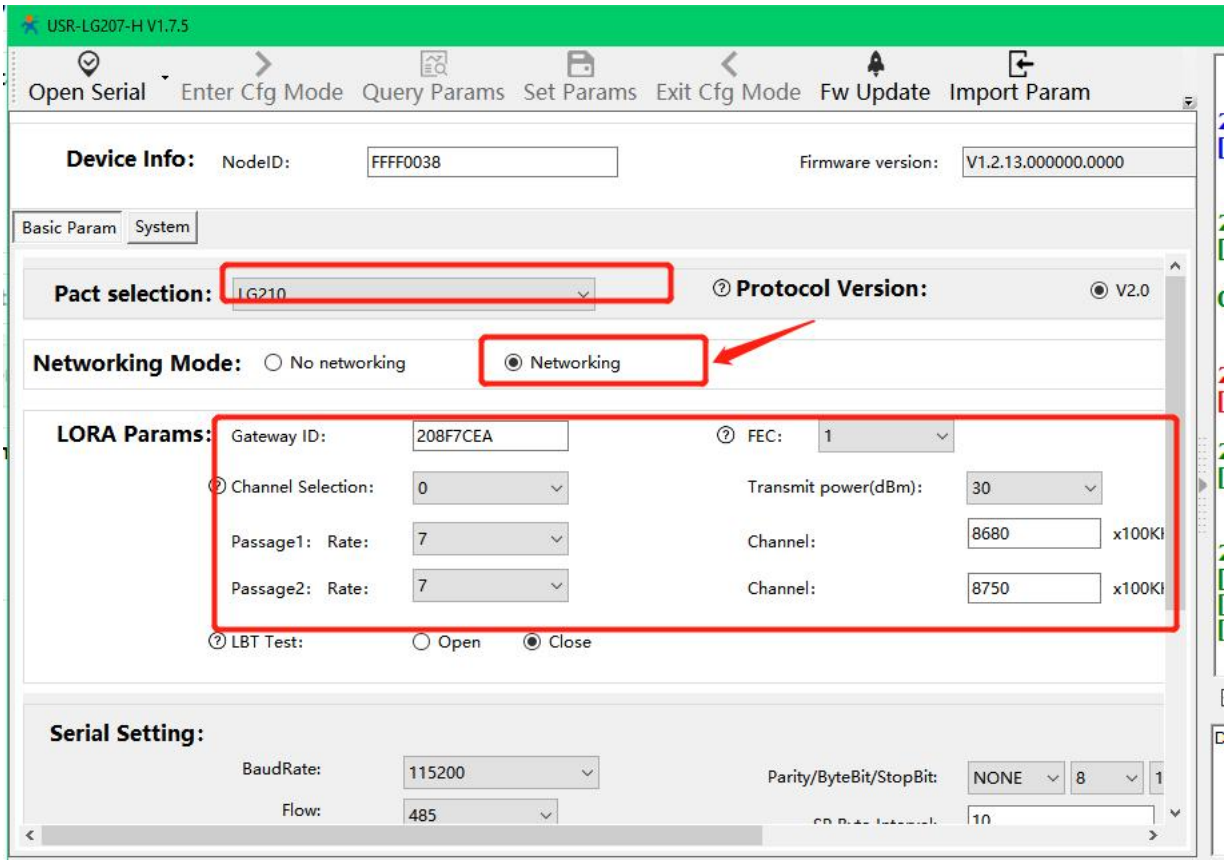


Figure 4-21LORA Node Parameter Settings

(3) Communication Test: Local Edge Computing Reporting to Socket Server

USR-LG207 acts as a LORA node, using Modbus Slave as a simulated terminal sensor. The LG210 gateway reports the collected data to a TCP server.

Figure 4-22 Modbus Slave Simulation

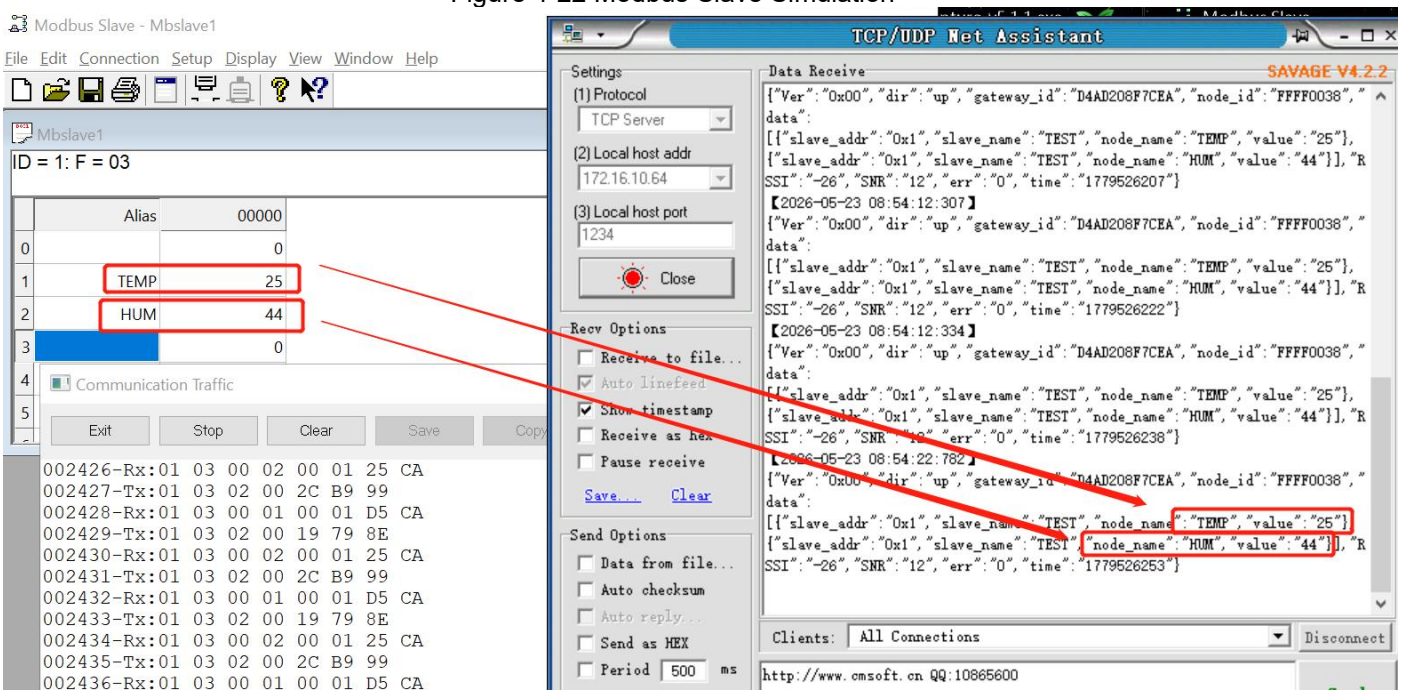


Figure 4-23 TCP Server Receiving Data

4.5. Remote IO Function

Function Description: The LG210 gateway can be used with USR-LG207 (IO version) to remotely collect or control its IO status via LoRa wireless transmission and Modbus protocol in non-networking mode. During operation, simply enter the corresponding commands on the gateway side to achieve remote operation of the LG207 (IO version).This version

(LG207-IO1) provides 1 DI input (supports 0-36V voltage detection, compatible with dry and wet contacts) and 1 DO output (max load DC 40V/500mA). For specific operationsand wiring methods, please refer to the relevant chapters in the "LG207 (IO Version) User Manual":
https://www.pusr.com/support/download/User-Manual-USR-LG207-User-Manual-point-to-point.html.

DI Collection Modbus Protocol:

DI Acquisition Mode	Function Code	Register Address	Result Range
Switch Quantity Mode	02	0x0021	Trigger: 01, No Trigger: 00
Counting Mode	03, 04, 06, 10	0x0026	0-65525, Clear on Overflow
Key Detection Mode	03, 04, 06, 10	0x002b	Key Press: 01, No Key Press: 00

DO Query/Control Modbus Protocol:

DO Mode	Function Code	Register Address	Result Range
DO Query	01	0x0001	Closed: 01, Open: 00
DO Control	05, 0F	0x0001	Closed: Function Code 05: FF00, Function Code 0F: 0001, Open: 00

(1) Parameter Settings:

① To ensure stable communication between the LG210 gateway and LoRa nodes, please configure as follows: First, set the LG210 gateway to "Non-networking Mode"; then, on the LoRa node side, select "LG210 Protocol" and "Transparent Transmission Mode", enable "IO Settings", and set the LoRa node slave address; finally, confirm that basic parameters such as LoRa rate and channel are identical on both sides.

② In the basic settings of the LG210 host computer, the data channel can be selected asSerial Port or Private Server.If a private server is selected, further specify the access method inNetwork Settingsaccording to project requirements, supporting Socket, MQTT, or Alibaba Cloud protocols.

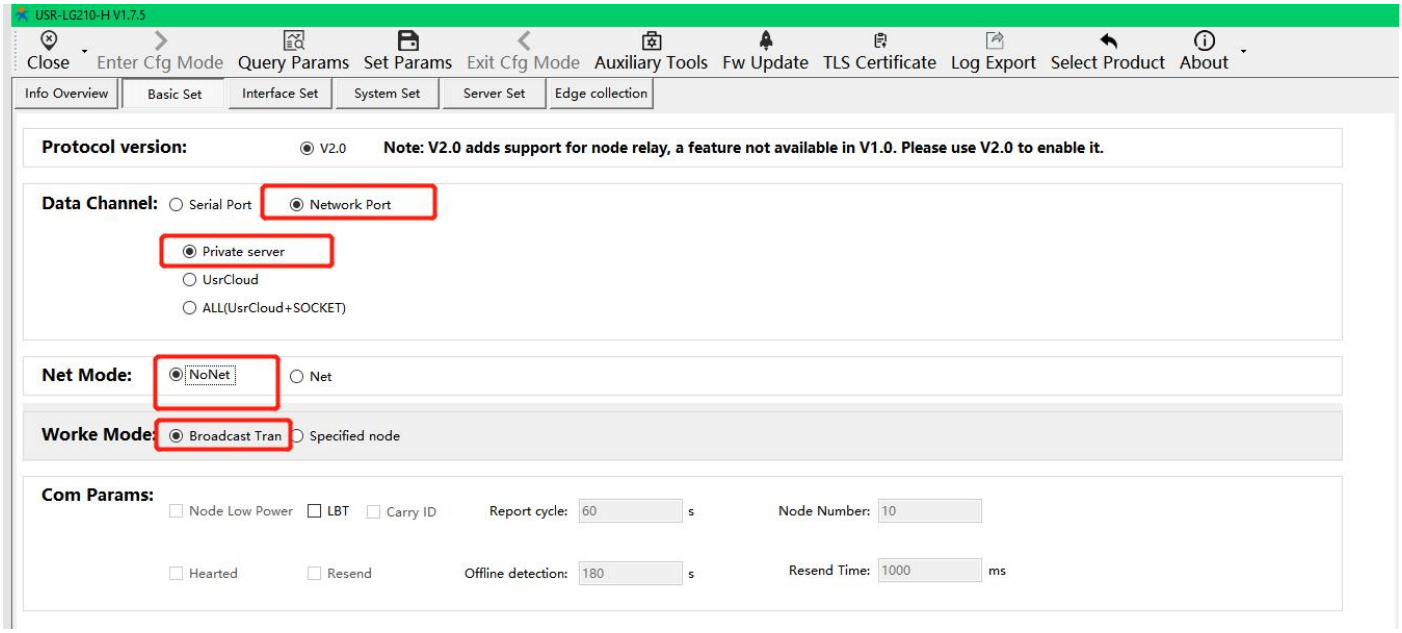


Figure 4-24 LG210 Basic Settings

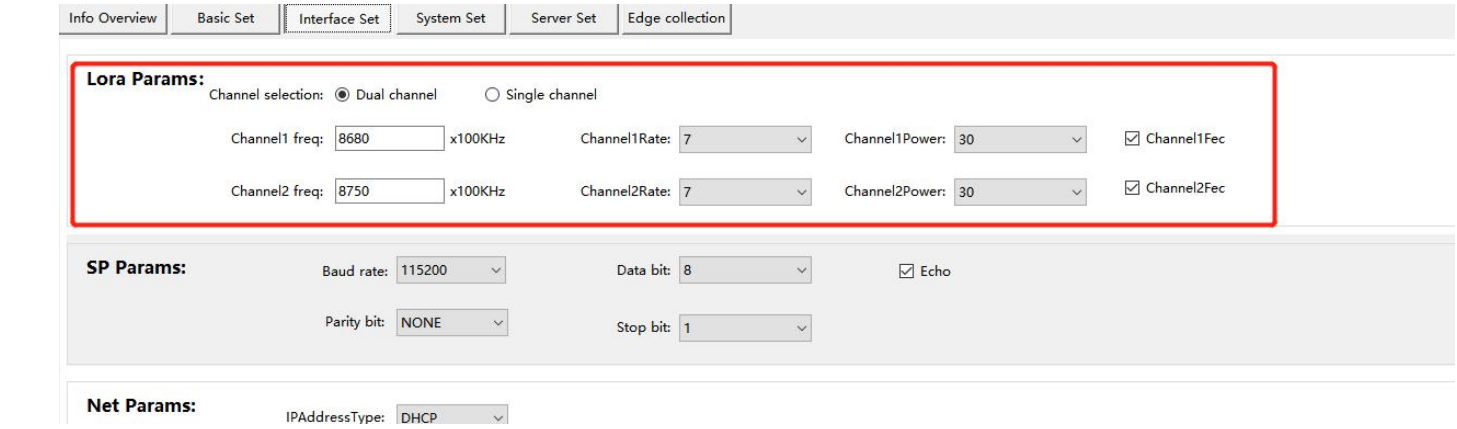


Figure 4-25 LG210 Interface Settings

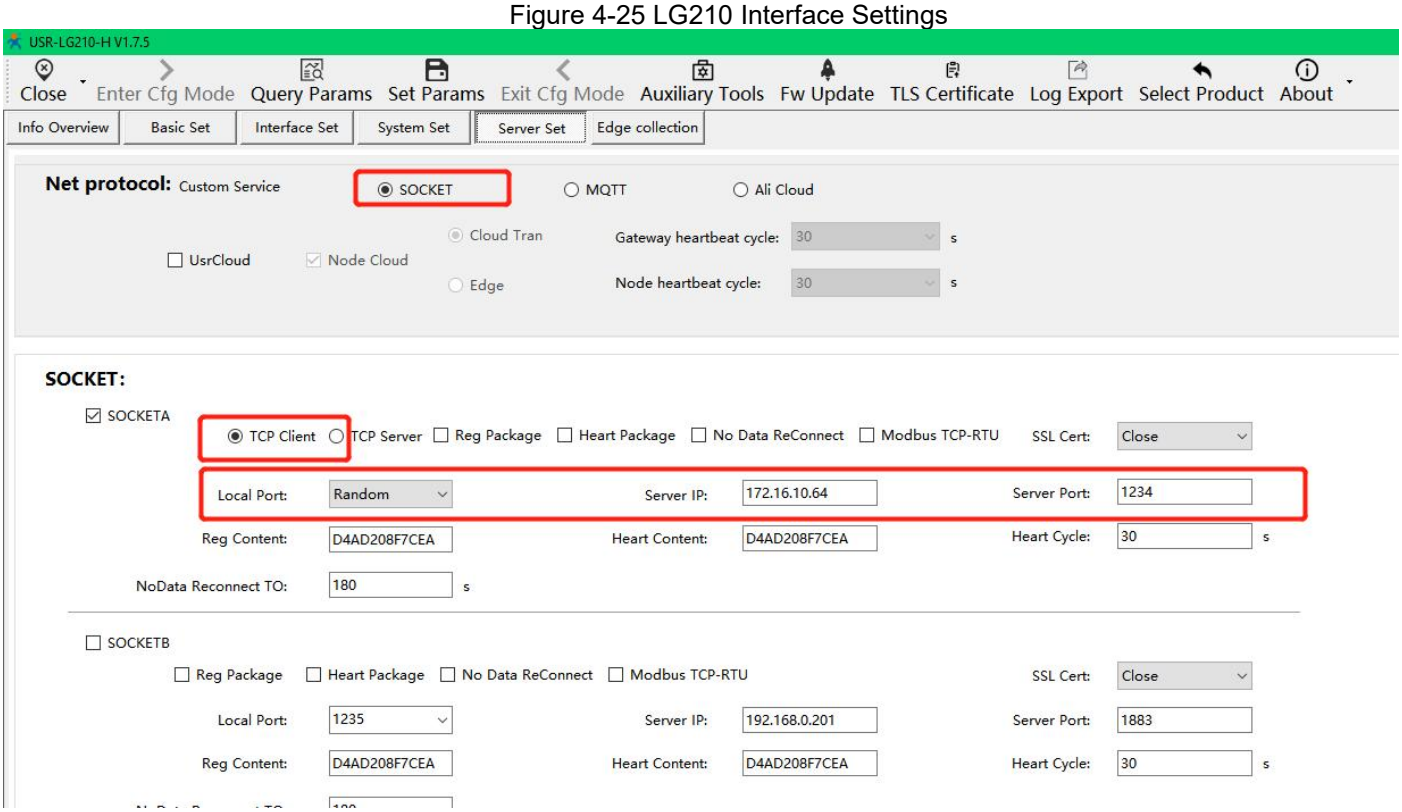


Figure 4-26 LG210 Network Protocol Settings

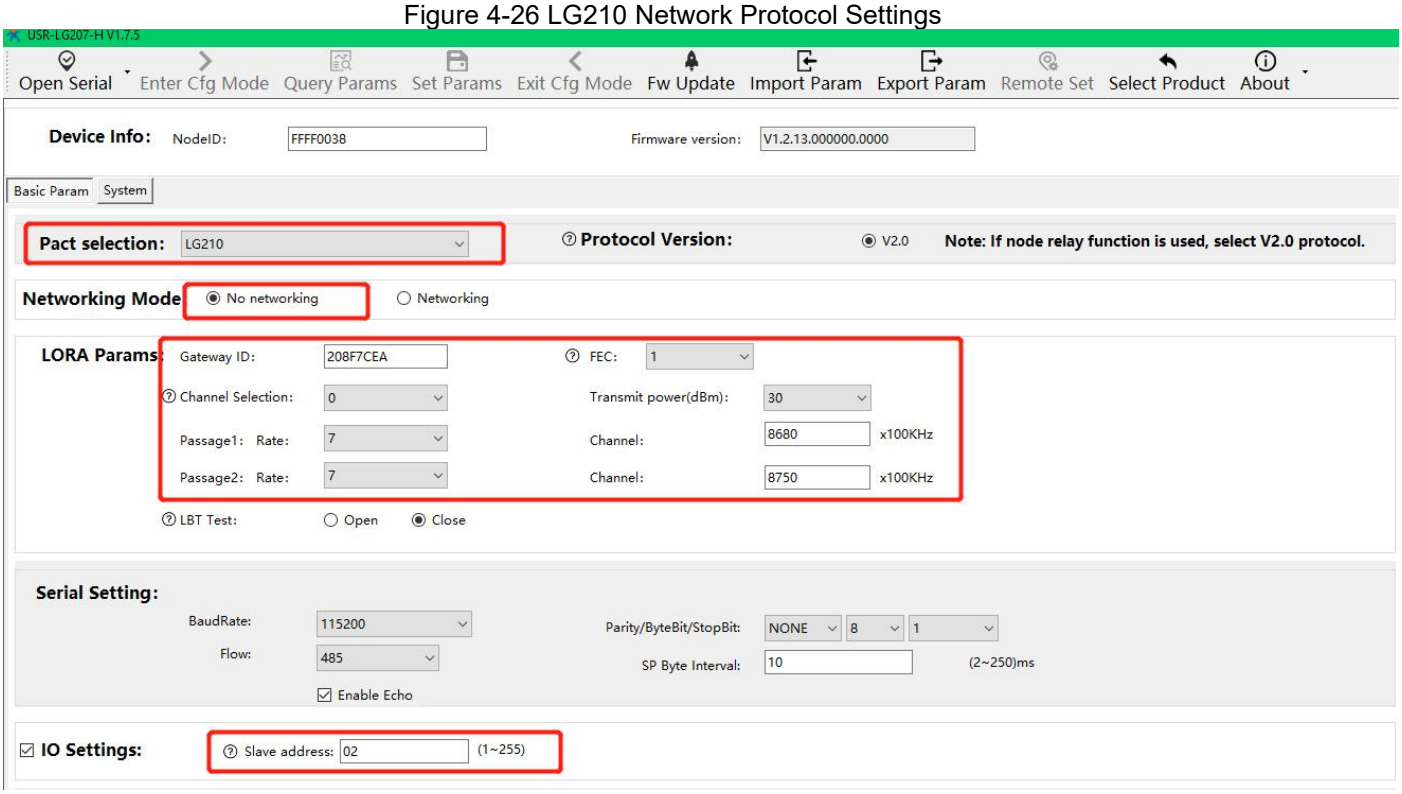


Figure 4-27 LG207-L IO Settings

(2) Communication Test:

① DI Acquisition

The server sends Modbus commands to the gateway to wirelessly collect the DI switch status of USR-LG207 (IO version) via LORA:

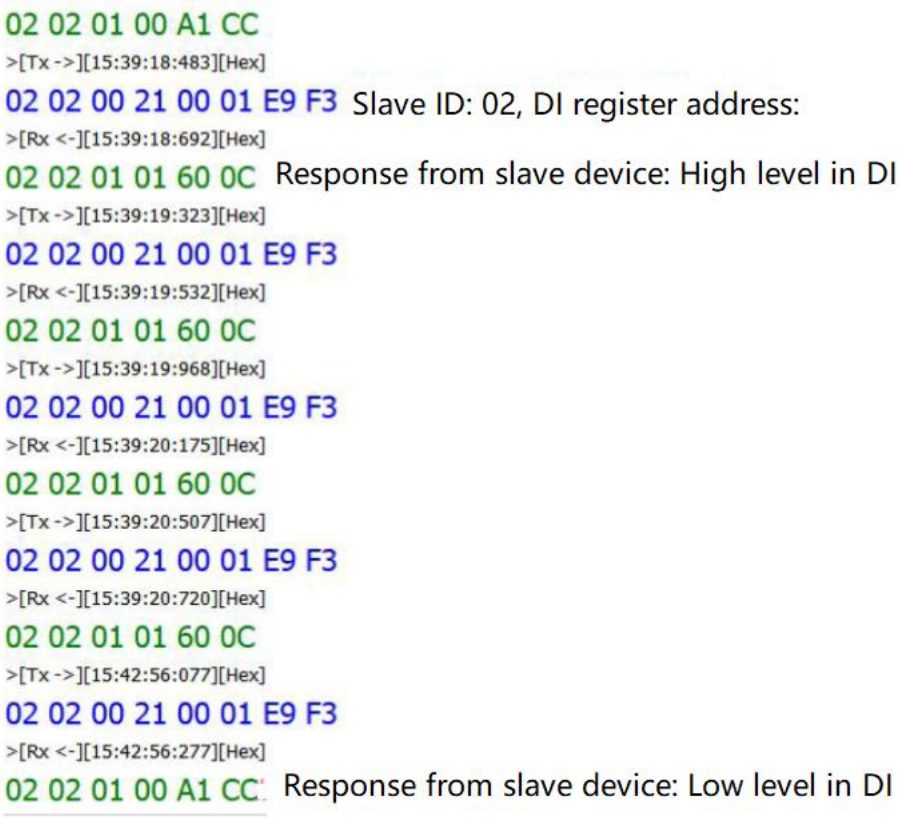


Figure 4-28 DI Acquisition Communication Diagram

② DO Control

The server sends Modbus commands to the gateway to wirelessly control the DO switch status of USR-LG207 (IO version) via LORA

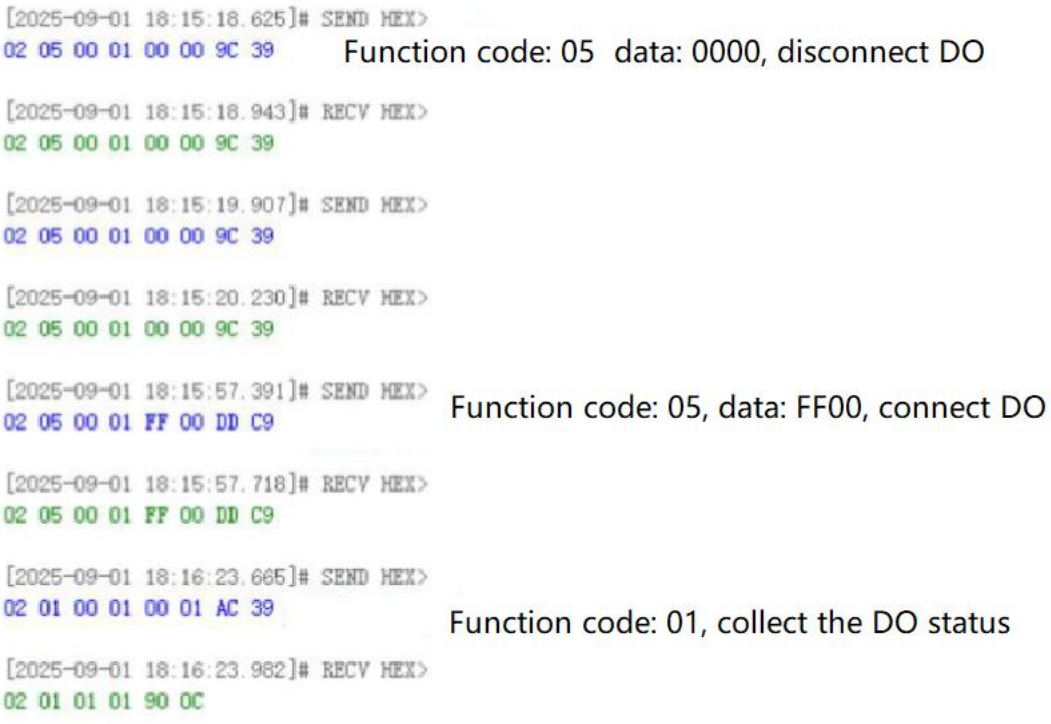


Figure 4-29 DO Control Communication Diagram

4.6. Relay Function

(1) Function Description:

The relay networking function aims to extend the transmission distance between the LG210 gateway and LoRa nodes and enhance data penetration capabilities. By configuring LoRa node devices as relay nodes, data forwarding can be achieved between the gateway and terminal nodes. To enable this function, all devices participating in the relay must be set to relay mode. After setting, data transmission will proceed according to the relay link.

Note:

① This function needs to be used in "Specified Node" and "Active Reporting" data transmission modes, transmitting data according to the data format.

② Specified Node Data Format: Downlink data frames in the format of "Target Node ID + User Data".

③ When a LoRa node acts as a relay device, a relay device number must be set for it, and data will be transmitted in sequence based on the device number. Meanwhile, communication between the LG210 gateway and each relay node can only occur under the same relay group number.

(2) Parameter Settings:

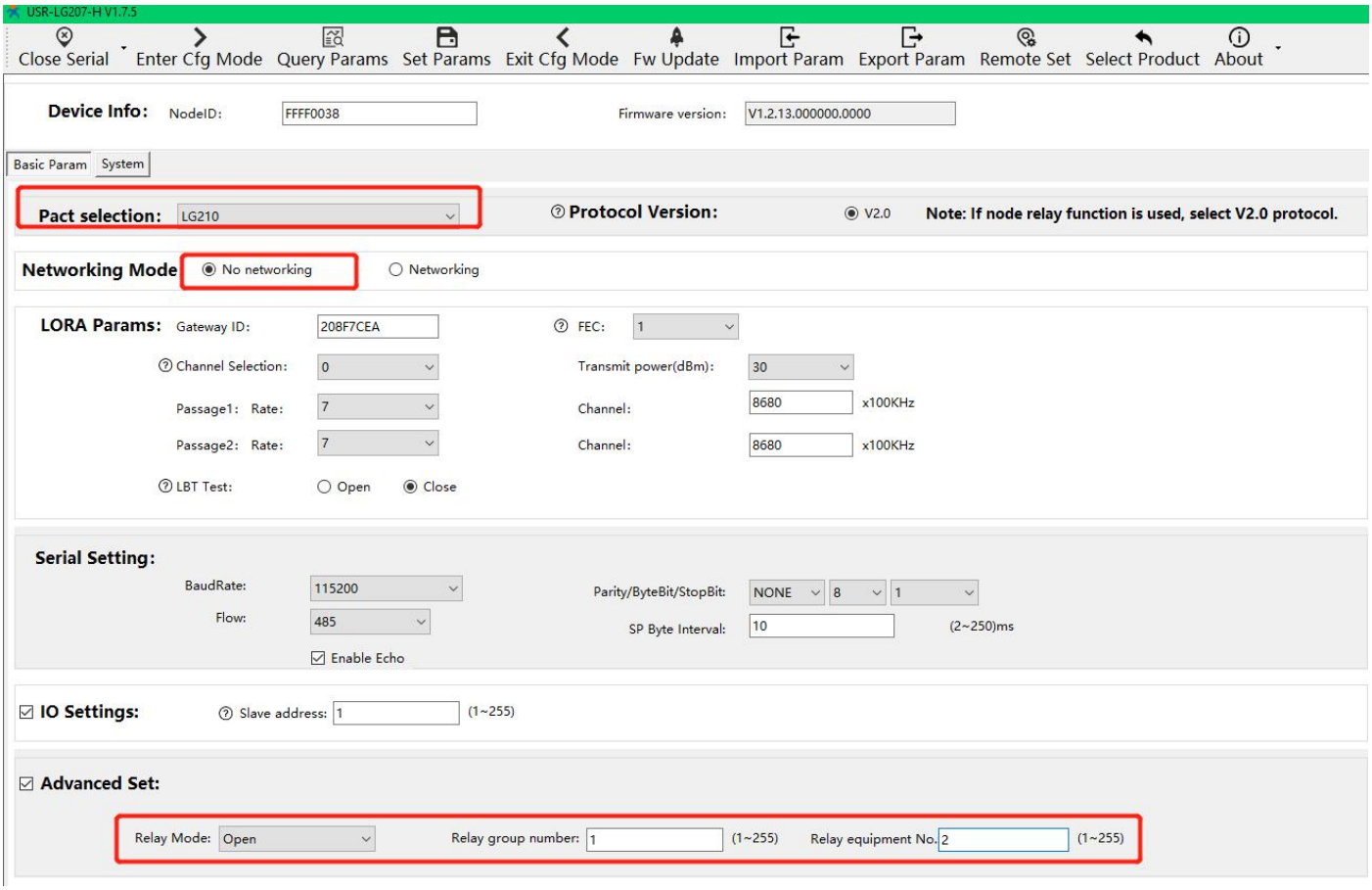


Figure 4-30 LG207 Node Settings

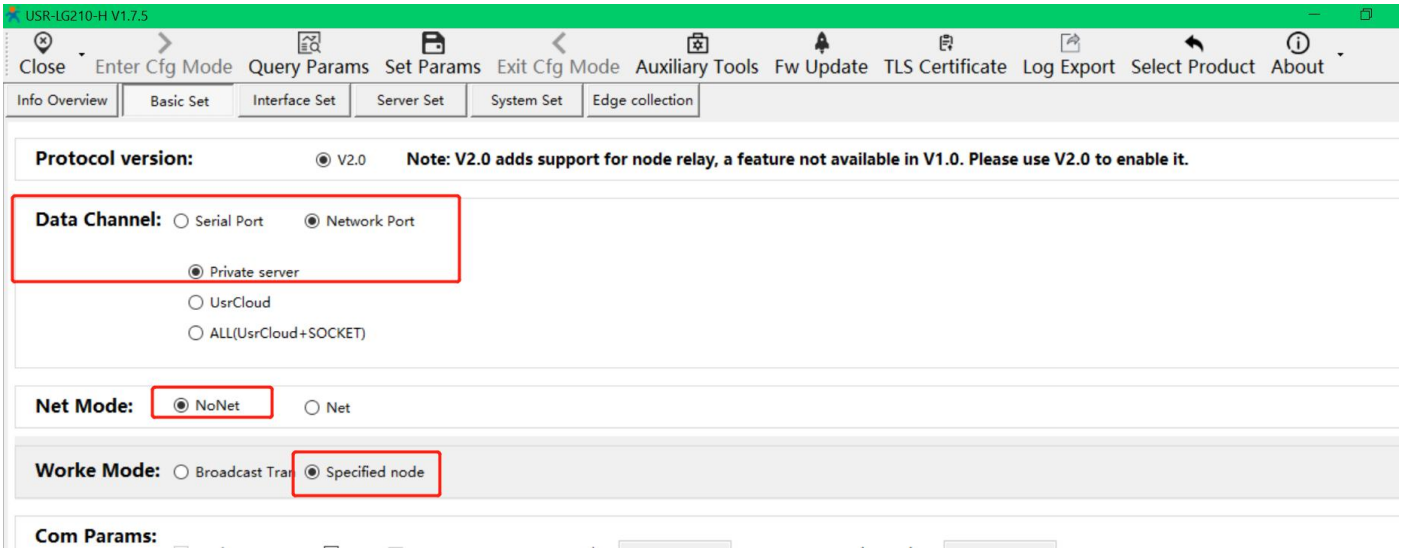


Figure 4-31 LG210 Basic Settings

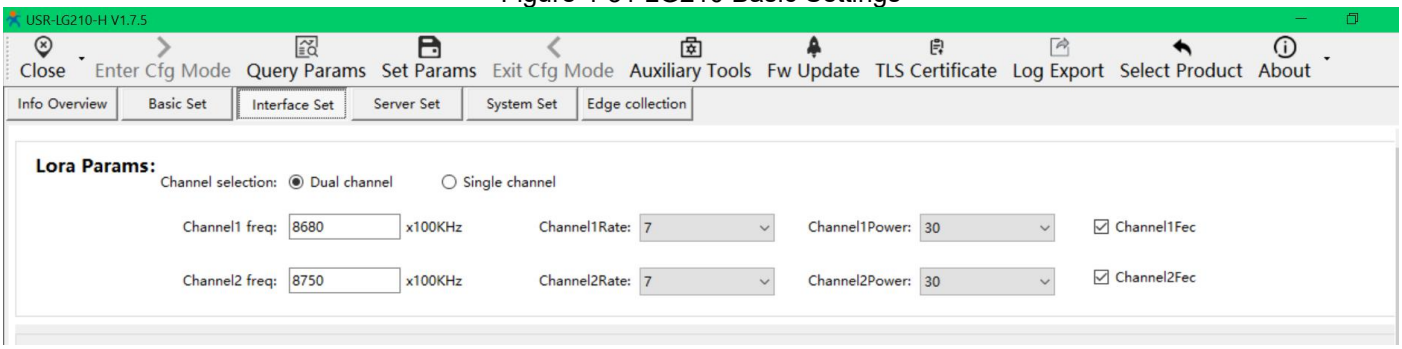


Figure 4-32 LG210 Interface Settings

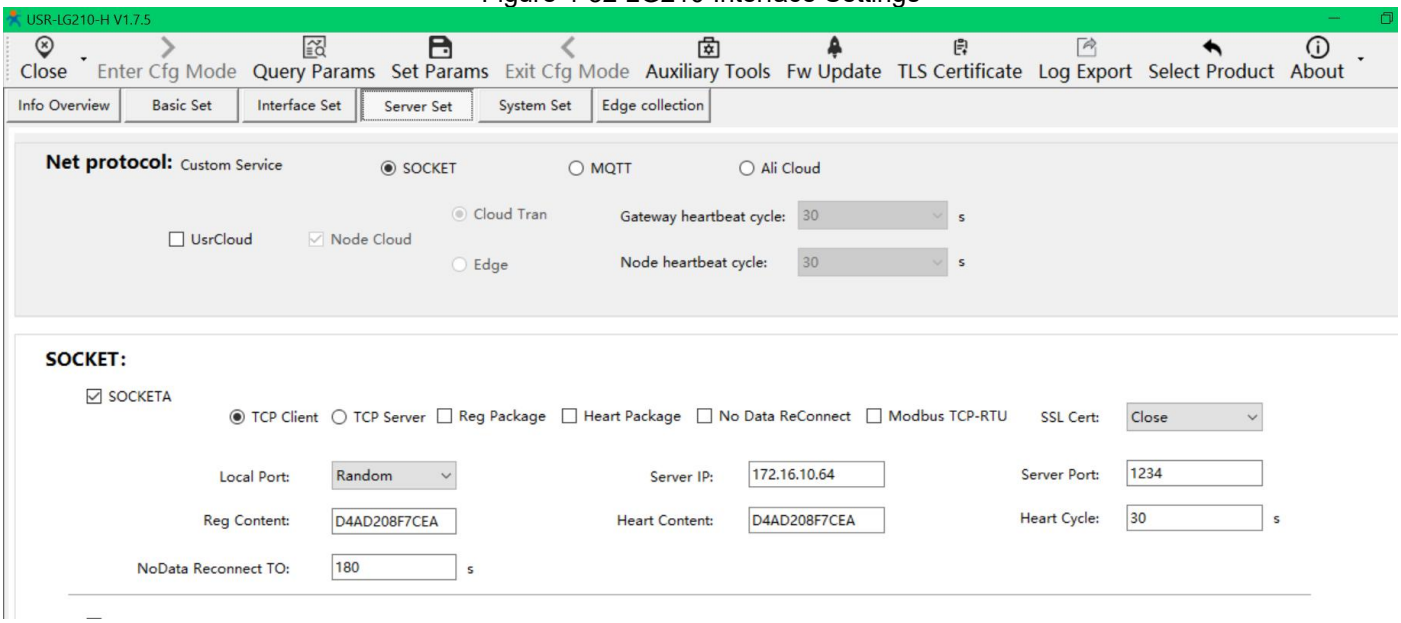


Figure 4-33 LG210 Network Settings

5. Other Functions:

5.1. Node Information Statistics

(1) **Function Description:**In networking mode, the gateway manages connected nodes, primarily reflected in the storage and updating of node information. The node information statistics content can refresh the statistics list in real-time (requires entering configuration state, then clicking refresh list), as shown in**Figure 5-1 Node Information Statistics Diagram**.

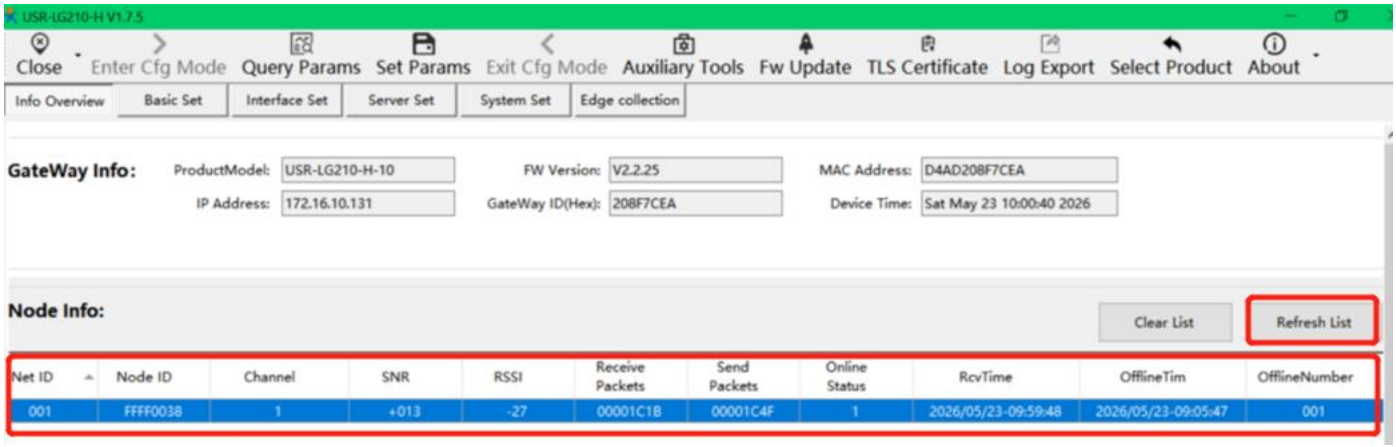


Figure 5-1 Node Information Statistics Diagram

5.2. Protocol Conversion Function

5.2.1. ModbusTCP and ModbusRTU Interconversion Function

(1) **Function Description:**

Converts ModbusTCP format data received from the network side to ModbusRTU format data and forwards it to LoRa nodes, or converts ModbusRTU format data received from the LoRa side to ModbusTCP format data and then forwards it to the network side. The gateway operating mode can be selected as Networking Broadcast Transparent Transmission, Networking Specified Node, Networking Active Reporting, Non-Networking Broadcast Transparent Transmission, or Non-Networking Specified Node, with TCP selected for network communication. (The following examples use Networking Specified Node and Networking Broadcast Transparent Transmission)

Note: In Specified Node and Active Reporting modes,server downlink datamust follow the "Node ID + Modbus TCP" format. In Broadcast Transparent Transmission mode, server downlink data only needs to follow the "Modbus TCP" format, and node uplink data follows the "Modbus RTU" format.

(2) Parameter Settings:

① Ensure normal communication between the gateway and nodes.

② Select SOCKET for the network protocol, check Modbus TCP-RTU, as shown in**Figure 5-2 Setting Reference Diagram**.

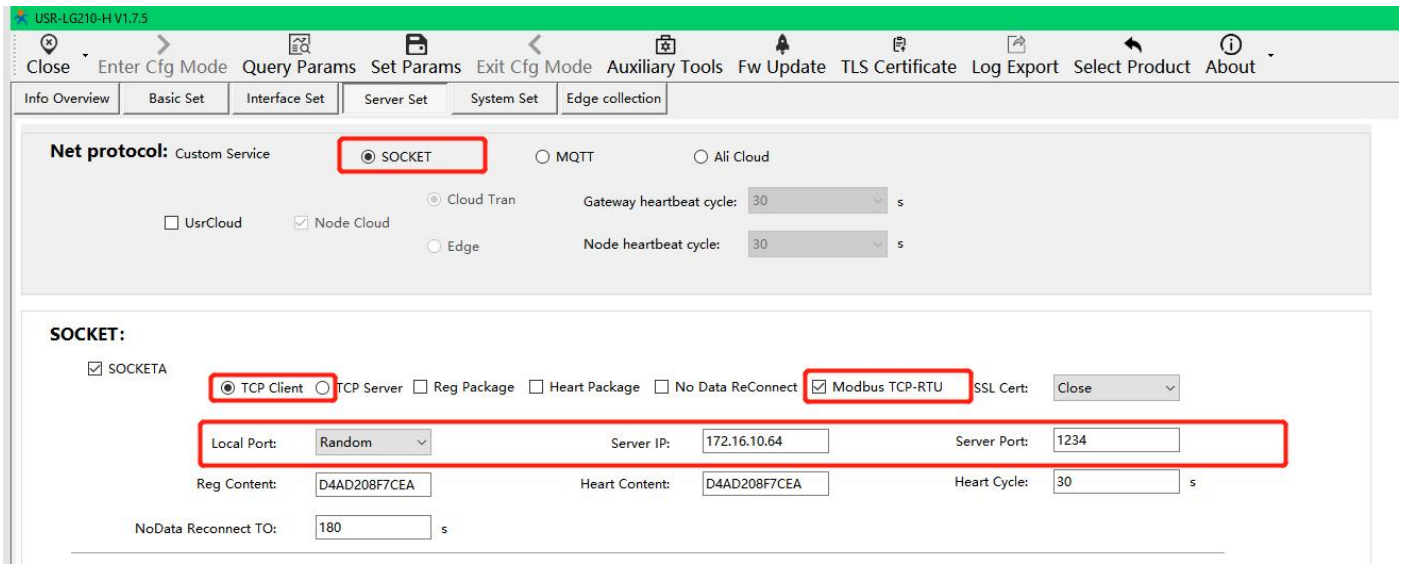


Figure 5-2 Set Reference Figure

(3) Communication Test:

① Networking broadcast transparent transmission mode, as shown in**Figure 5-3 Communication Example**:

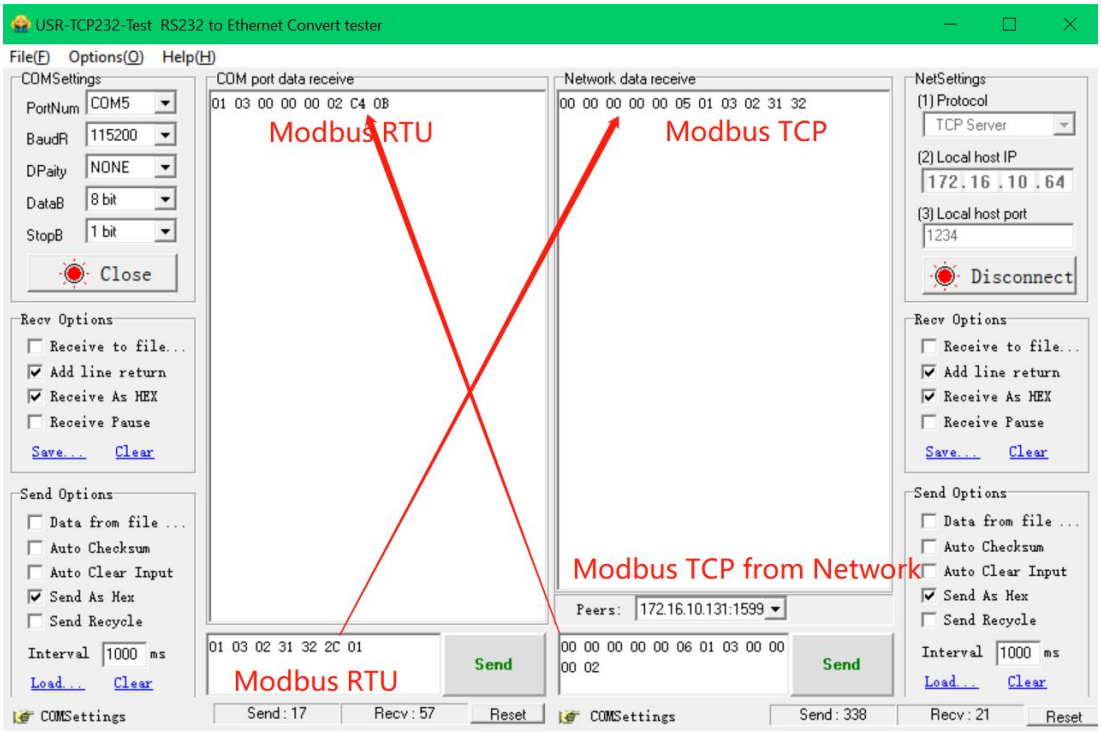


Figure 5-3 Communication Example

② Networking designated node mode, as shown in**Figure 5-4 Communication Example**:

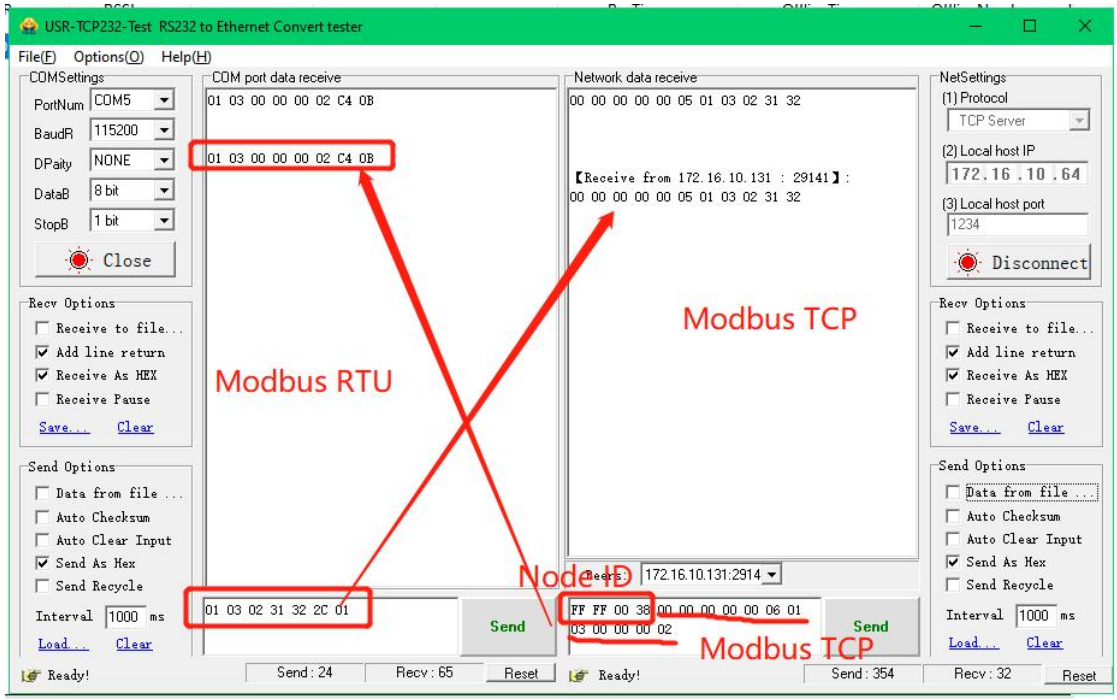


Figure 5-4 Communication Example

The network side sends Modbus TCP format data, and the node side receives the converted Modbus RTU format data; the node side reports Modbus RTU format data, and the network side receives the converted Modbus TCP format data.

5.3. Firmware Upgrade

The concentrator supports localnetwork connectionfirmware upgradeand built-in page firmware upgrade. The firmware upgrade steps are briefly introduced below.

5.3.1. Setting Software Upgrade

(1) Connect the gateway device to the same network as the computer using an Ethernet cable. Open the setting software, select Network Connection — Enter Search Device — Click Search Device — Click the searched device — Click Select Device. The LOG interface on the right will show that the network is connected, as shown in**Figure 5-5 Setting Schematic Diagram**.

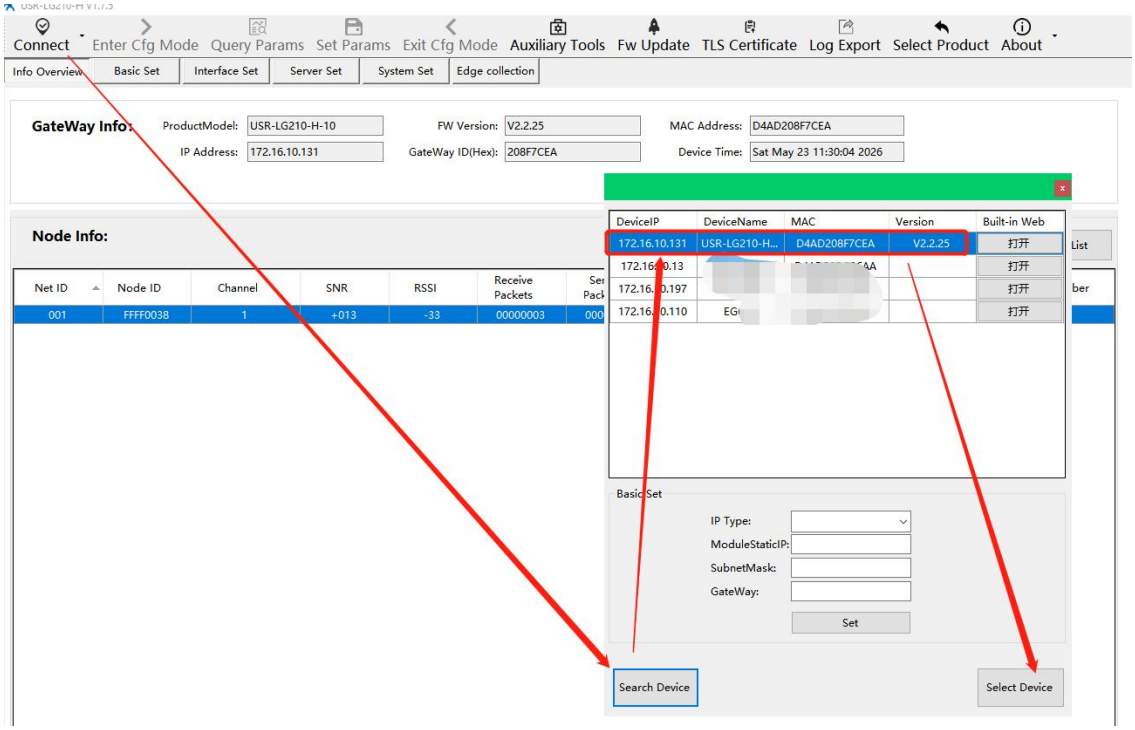


Figure 5-5 Setting Schematic Diagram

(2) Click Firmware Upgrade in the settings interface — You will see that the target selection is automatically filled — Select firmware — Click Upgrade — Wait for the upgrade progress bar to complete, and exit when prompted that the firmware upgrade is successful (the upgrade firmware automatically saves previous configurations), as shown in**Figure 5-6 Firmware Upgrade Schematic Diagram**.

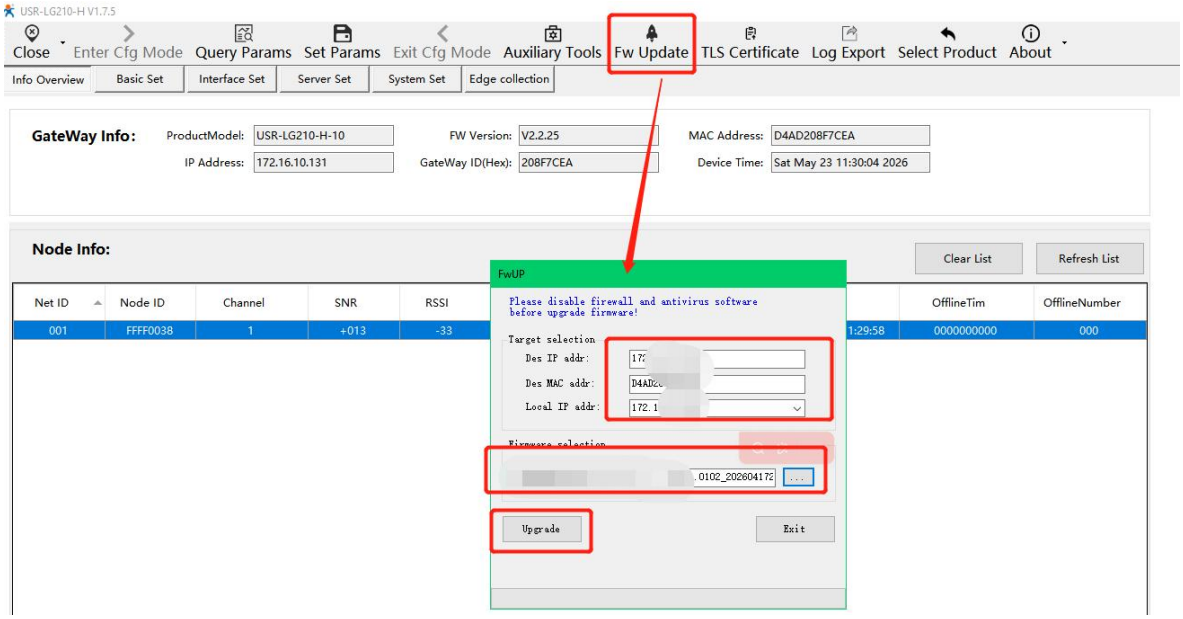


Figure 5-6 Firmware Upgrade Schematic Diagram

5.4. Network Card Function

The USR-LG210 currently only supports connecting via the Ethernet port and does not support connecting via 4G at present.

For Ethernet port parameter configuration, DHCP/dynamic IP automatic acquisition is the default. Users can choose to use STATIC/static IP. Static IP address: the static IP address used by the gateway, Subnet mask: network address mask, Gateway IP address: the IP address of the gateway's upstream router, as shown in**Figure 5-7 Schematic diagram of Ethernet port parameter configuration**.

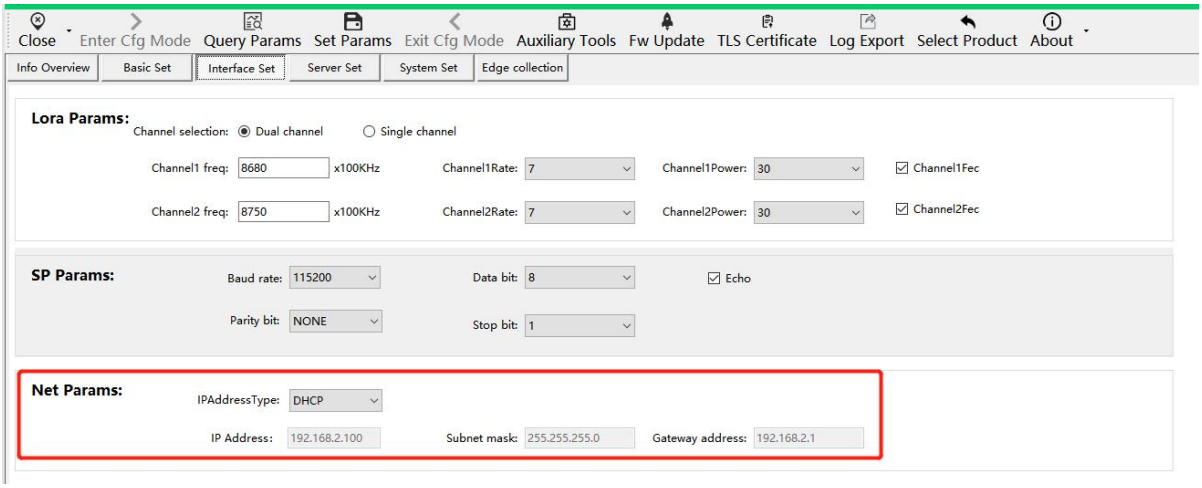


Figure 5-7 Schematic diagram of Ethernet port parameter configuration

5.5. Network Diagnostics

The LG210 gateway supports network diagnostics. Enter the IP address or domain name to be diagnosed. A successful diagnosis displays "success," while an error displays "failed." The network diagnostic process is shown in**Figure 5-9 Schematic diagram of network diagnostics**:

(1) Configuring network diagnostics in the software:

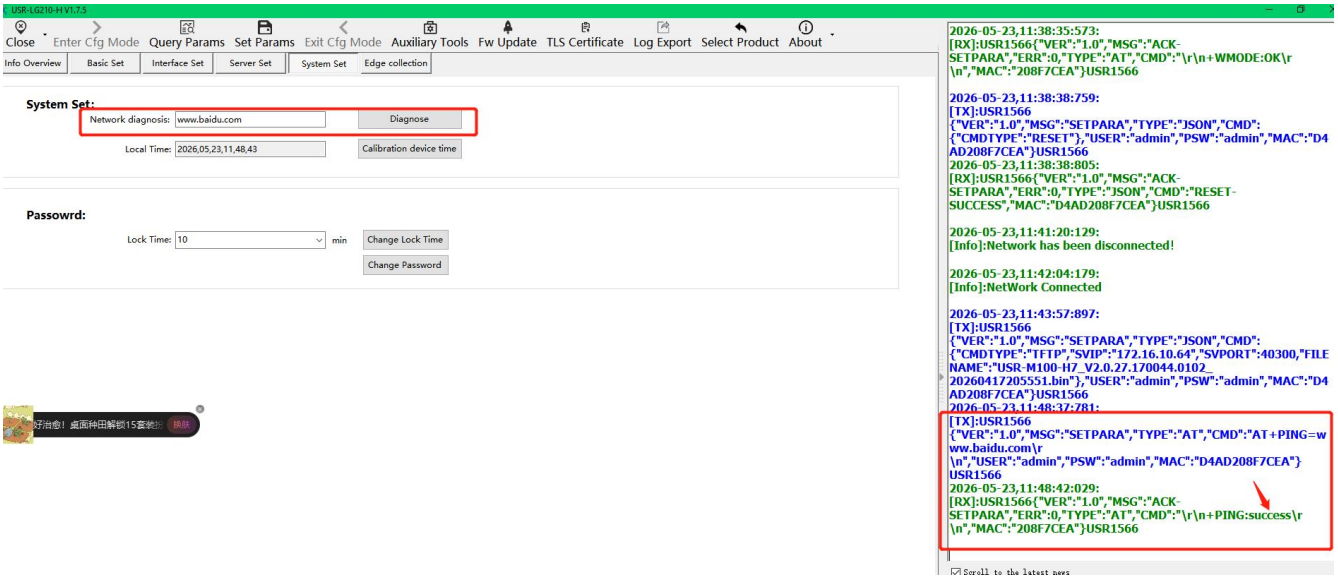


Figure 5-8 Schematic diagram of network diagnostics

5.6. Calibrating Device Time

The LG210 gatewayhas an internal real-time clock. The concentrator time can be queried and calibrated via commands. Below, we describe calibrating the concentrator to match the local PC time using theconfiguration softwareand thebuilt-in web page. The calibration process is shown in**Figure 5-10 Schematic diagram of device time calibration settings**:

(1) Enter the configuration state, calibrate the device time using the configuration software, and click restart to apply the changes after setting:

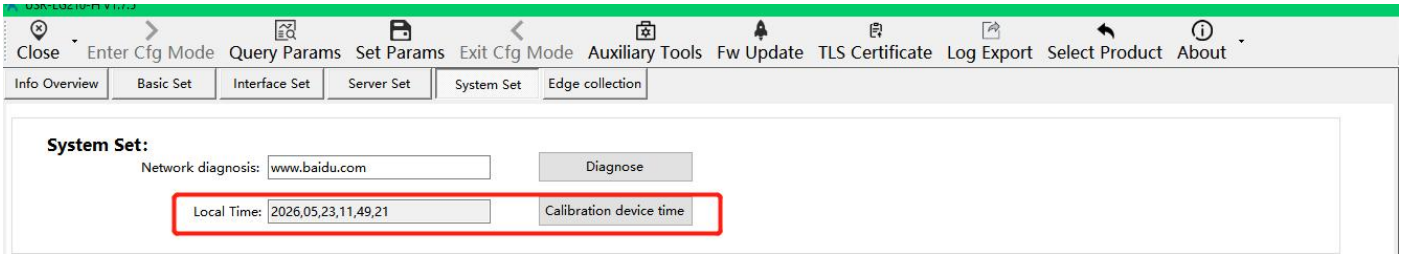


Figure 5-9 Schematic diagram of device time calibration settings

6. AT Command Configuration

The LG210 gateway supports both serial port AT commands and network AT commands. The following sections describe how to use each command mode.

6.1. Serial Port AT Commands

In serial port AT command mode, users can send AT commands to theLG210 gatewayvia serial port software (such as thegateway's accompanyingconfiguration software or other general-purpose serial software) or a serial device to query and setgatewayparameters. The concentrator's accompanying configuration software (USR_LoRa) covers most of the concentrator's function queries and settings. If you use the accompanying configuration software to configure the concentrator parameters, please refer to Section3.2. Configuration Software Usage Introduction

Using other serial software or serial devices to configure the concentrator parameters generally involves the following steps:

(1) Enter AT command mode.

(2) Send AT commands from the command set to configure the concentrator parameters.

(3) If the set parameters require a restart to take effect, send the concentrator restart AT command to reboot the concentrator; if they take effect immediately, simply send the command to exit AT command mode.

Note: AT command set: This is the command set for users to communicate with the concentrator via UART in AT command mode. For detailed instructions and command descriptions, please refer to**USR-LG210 Gateway AT Command Set:**https://www.usr.cn/Download/1174.html

6.1.1. Serial PortAT Command Operations

- **Entering AT Command Mode**

(1) The serial software sends "+++" to the concentrator. Upon receiving "+++", the concentrator returns an acknowledgment code "a".

(2) After receiving "a", the serial software must reply with the acknowledgment code "a" within 3 seconds (i.e., T3 < 3s).

(3) Upon receiving the acknowledgment code, the concentrator returns "+OK" to confirm entry into AT command mode,as shown in**Figure 6-1 Schematic Diagram of Entering AT Command Mode**.

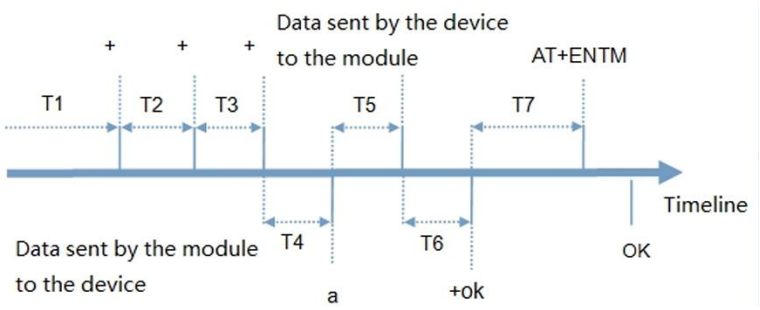


Figure 6-1 Schematic Diagram of Entering AT Command Mode

- **Exiting AT Command Mode**

In AT command mode, send the "AT+ENTM" command to the concentrator via the serial port. The concentrator will then exit AT command mode.

6.2. Network AT Commands

For network AT commands, the gateway device must be connected to the same network as the computer via an Ethernet cable. After successful connection, parameters can be read. You will see that the commands read in the LOG box on the right side of the configuration software include network protocols. Users can query or set parameters using network AT commands via the configuration software or a network assistant.

LG210 Gateway Network Connection: Open the configuration software, select Network Connection, enter the device

search interface, click Search Device, select the found device, and click Select Device. In the LOG interface on the right, you will see that the network is connected. Then, read the parameters, as shown in**Figure 6-2 Schematic Diagram of Network Connection Settings**.

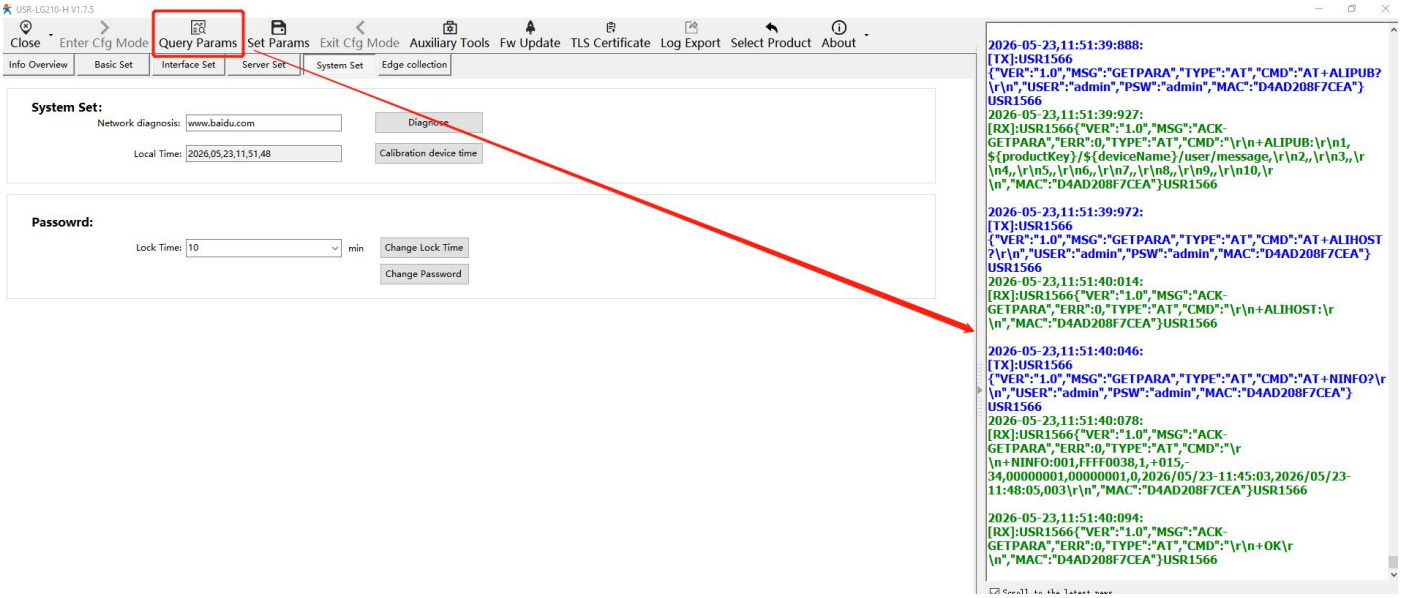


Figure6-2 Schematic Diagram of Network Connection Settings

Note: When using our configuration software to query or set network AT commands, simply send the AT command in the send box; there is no need to use the specific network AT command protocol. If using other network debugging assistants to query or set network AT commands, you must follow the network AT command protocol.

6.2.1. Network AT Command Operations

➢ **Using Network AT Commands via Our Configuration Software:**

① Querying via Configuration Software: After successfully connecting via network, click Read Parameters. See**Figure 6-2 Schematic Diagram of Network Connection Settings**.

② Setting via Configuration Software: After successfully connecting via network, click the relevant setting parameters or enter AT commands in the input box on the right. The configuration software will automatically format the network AT command protocol and send it to the LG210 gateway. After setting, restart the device for changes to take effect. See**Figure 6-3 Setting Network AT Commands Using Configuration Software**.

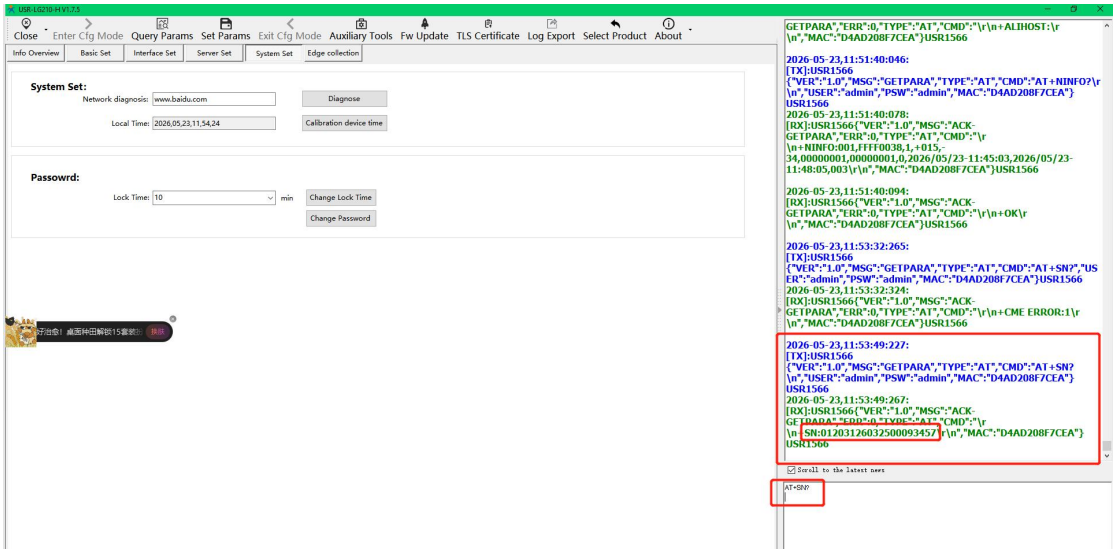


Figure 6-3 Setting Network AT Commands Using Configuration Software

Note: Perform these operations while in the network connected state.

➢ **Using Network AT Commands with Other Network Debugging Assistants:**

Before use, the Network Assistant tool must be used to establish UDP broadcasting. The local IP address and port are random, and the remote host needs to be manually set to (255.255.255.255:1566). Then, send commands according to the network AT command protocol.

Note: Operations must be performed under a network connection. Network AT commands do not require entering/exiting configuration mode; simply send queries or parameter settings according to the protocol format.

① Using Network Debugging Assistant for Query:

The query must follow the format [USR1566{"VER":"1.0","MSG":"GETPARA","TYPE":"AT","CMD":"AT Command\r\n","USER":"Username","PSW":"Password","MAC":"MAC Address" } USR1566]. Fill in the (AT Command, Username (default admin), Password (default admin), MAC Address) according to the actual LG210 gateway in use.

For example, to query the device SN number (AT+SN?), as shown in**Figure 6-4 Using other network assistants for network AT command queries**:

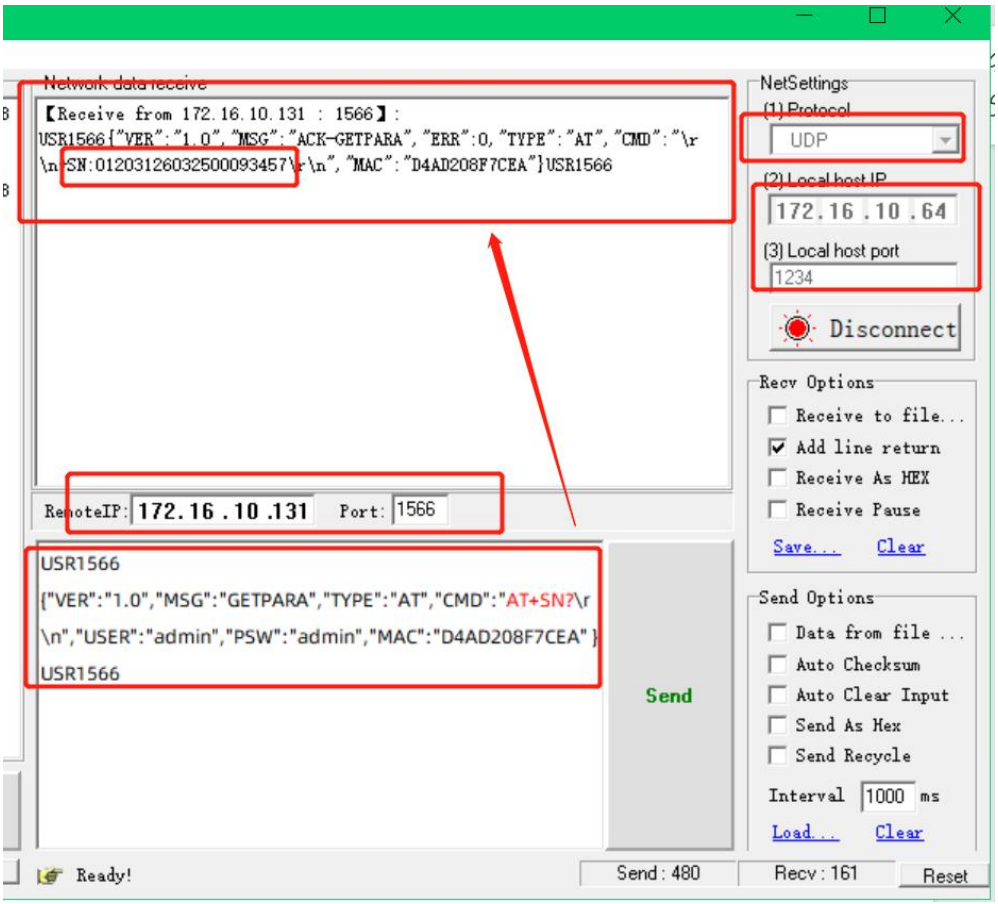


Figure 6-4 Using other network assistants for network AT commandquery

The replied SN number can be queried as: 01203126032500093457

USR1566{"VER":"1.0","MSG":"ACK-GETPARA","ERR":0,"TYPE":"AT","CMD":"\r\n+SN:01203126032500093457\r\n","MAC":"D4AD208F7CEA"}USR1566

② Using Network Debugging Assistant for Settings:

The setting must follow the format

[USR1566{"VER":"1.0","MSG":"SETPARA","TYPE":"AT","CMD":"AT Command\r\n","USER":"Username","PSW":"Password","MAC":"MAC Address" } USR1566].

Fill in the (AT Command, Username (default admin), Password (default admin), MAC Address) according to the actual LG210 gateway in use.

For example, to set the device networking broadcast transparent transmission working mode (AT+WMODE=0), as shown inFigure 6-5 Using other network assistants for network AT command settings:

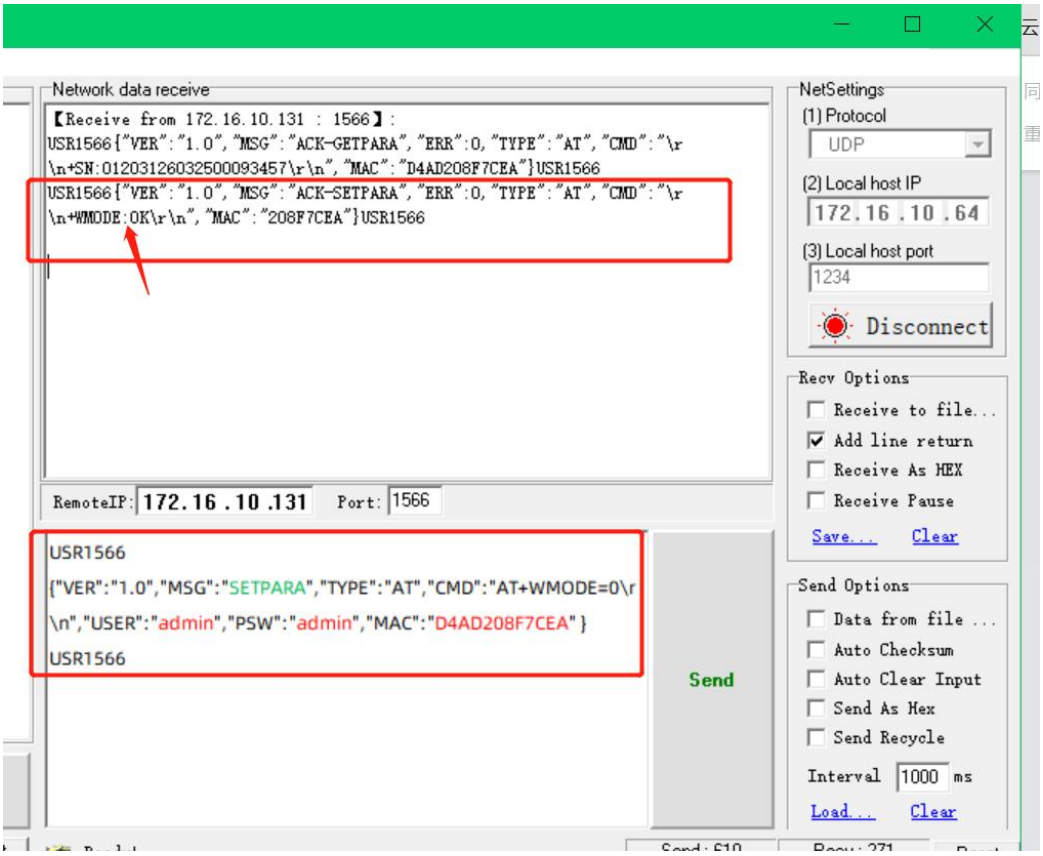


Figure 6-5 Using other network assistants for network AT command settings

An "OK" reply indicates successful setting.

USR1566{"VER":"1.0","MSG":"ACK-SETPARA","ERR":0,"TYPE":"AT","CMD":"\r\n+WMODE:OK\r\n","MAC":"208F7CEA"}USR1566

6.3. AT Command Format

6.3.1. Format of "Query" in Commands

Send commands ending with Carriage Return <CR>, Line Feed <LF>, or Carriage Return + Line Feed <CR><LF>

Table 6-1 AT Command Query Format

Command Format	Description	Example
AT+CMD? <CR><LF>	Query parameters	AT+VER?<CR><LF>
AT+CMD <CR><LF>	Query parameters	AT+VER<CR><LF>
AT+CMD=para <CR><LF>	Set parameters	AT+CH1=66<CR><LF>

6.3.2. Format of "Response" in Commands

Terminal response format (echo off):

Set parameter command response: <CR><LF><CR><LF>OK<CR><LF>

Query parameter command response: <CR><LF> +CMD:PARA<CR><LF><CR><LF>OK<CR><LF>

CMD: Command word

PARA: Parameter

Table 6-2 AT Command Response Format

Return Code	Return Description	Remarks
OK	Response successful	
ERR-1	Invalid command format	
ERR-2	Invalid command	
ERR-3	Invalid operator	

ERR-4	Invalid parameter	
ERR-5	Operation failed	

6.4. AT Command List

No.	Command	Description
1	Z	Restart device
2	VER	Query device firmware version
3	ENTM	Exit AT command mode, switch to working mode
4	RELD	Restore factory settings
5	HWVER	Query hardware version
6	INMDL	Query device model
7	E	Device AT command echo setting
8	SN	Query SN
9	MAC	Query MAC
10	LTIME	Set/Query device time
11	WANN	Set/Query WAN port IP obtained by device
12	NTPEN	Enable/Disable NTP time synchronization
13	UART	Set/Query UART interface parameters
14	GWID	Query gateway ID
15	CH(n)? / AT+CH1/CH2...?	Query LoRa channel (1, 2...) frequency
16	AT+SPD(n)? / AT+SPD1/SPD2...?	Query/Set LoRa channel (1, 2...) data rate
17	AT+PWR(n)? / AT+PWR1/PWR2...?	Query LoRa channel (1, 2...) power
18	AT+FEC(n)?	Query/Set LoRa channel (1, 2...) FEC switch status
19	AT+LBT?	Query/Set signal interference detection function
20	LOWPWR	Query/Set node low power function
21	NWMODE	Query/Set whether device is in networking mode
22	TTMODE	Query/Set working mode under non-networking protocol
23	WMODE	Query/Set working mode under networking protocol
24	UPWID	Query/Set whether upstream data in networking carries node ID
25	RPTNUM	Query/Set maximum number of nodes in networking reporting mode
26	RPTCYCLE	Query/Set cycle in networking reporting mode
27	RPTINTVAL	Query/Set reporting interval in networking reporting mode
28	RPTRET	Query/Set retransmission status in networking reporting mode
29	LRHEART	Query/Set heartbeat status in networking transparent transmission and fixed ID mode
30	LROFFLINE	Query/Set offline time in networking transparent transmission and fixed ID mode
31	AT+SERVERCH	Query/Set node data uplink data stream
32	NNUM(n)? /AT+NNUM1/NNUM2...?	Query number of networked nodes in LoRa channel (1/2...)
33	NINFO	Query stored network node information
34	CLEARNINFO	Clear stored node information

35	NETIFPRI	Query/Set device network interface priority
36	DHCP	Query/Set DHCP status
37	GWIP	Query/Set device IP address
38	GW	Query/Set router gateway IP
39	MASK	Query/Set device subnet mask
40	PING	Detect network connectivity status
41	OPTION	Query/Set current network mode
42	SOCKLINKAC	Query Socket-A connection status
43	SOCKLINKBC	Query Socket-B connection status for port n
44	SOCKEN	Query/Set SOCKET-A and SOCKET-B switch status
45	SOCKA	Query/Set SOCKET-A parameters
46	SOCKB	Query/Set SOCKET-B parameters
47	SOCKSVRA	Query/Set SOCKET-A client server IP address
48	SOCKSVRB	Query/Set SOCKET-B client server IP address
49	SOCKPORTAS	Query/Set SOCKA-server port number
50	SOCKPORTAC	Query/Set SOCKA local port number
51	SOCKPORTBC	Query/Set SOCKB-client server port number
52	MODBUS	Query/Set MODBUS TCP-RTU conversion enable
53	SOCKSSLAS	Query/Set SOCKET-A server SSL encryption status
54	SOCKSSLAC	Query/Set SOCKET-A client SSL encryption status
55	SOCKSSLBC	Query/Set SOCKET-B SSL encryption status
56	SOCKREGAS	Query/Set SOCKET-A server registration packet information
57	SOCKREGAC	Query/Set SOCKET-A client registration packet information
58	SOCKREGBC	Query/Set SOCKET-B client registration packet information
59	SOCKHEARTAS	Query/Set SOCKET-A server heartbeat packet information
60	SOCKHEARTAC	Query/Set SOCKET-A client heartbeat packet information
61	SOCKHEARTBC	Query/Set SOCKET-B client heartbeat packet information
62	SOCKRECONAS	Query/Set SOCKET-A server no-data reconnection
63	SOCKRECONAC	Query/Set SOCKET-A client no-data reconnection
64	SOCKRECONBC	Query/Set SOCKET-B client no-data reconnection
65	SOCKREBOOT	Query/Set SOCKET no-data reboot
66	MQTTSER	Query/Set MQTT client server IP address and port number
67	MQTTCID	Query/Set MQTT client ID
68	MQTTSUB	Query/Set MQTT subscription topic

69	MQTTPUB	Query/Set MQTT publish topic
70	MQTTUSER	Query/Set MQTT username
71	MQTTPSW	Query/Set MQTT password
72	MQTTVER	Query/Set MQTT protocol version
73	MQTTQOS	Query/Set MQTT QoS level
74	MQTTSSL	Query/Set SSL encryption status under MQTT protocol
75	CSQ	Query device signal strength
76	SYSINFO	Query device network information
77	IMEI	Query device IMEI
78	ICCID	Query SIM card ICCID
79	ALIREGION	Query/Set Alibaba Cloud region information
80	ALIPRODKEY	Query/Set Alibaba Cloud product device key
81	ALIDEVNAME	Query/Set Alibaba Cloud device name
82	ALIDEVSCRT	Query/Set Alibaba Cloud device password
83	ALISUB	Query/Set Alibaba Cloud subscription topic
84	ALIPUB	Query/Set Alibaba Cloud publish topic
85	USRCLDEN	Query/Set PUSR function switch
86	CLOUDNODE	Query/Set node PUSR function switch
87	CLOUDGWHEART	Query/Set heartbeat period between PUSR and gateway
88	CLOUDNODEHEART	Query/Set heartbeat period between PUSR and node

7. Typical Application Issues

(1) Short Communication Distance

Possible reasons include:

① The antenna is placed inside a metal casing or in a basement, resulting in higher signal attenuation.

② Heavy fog or rain can reduce the communication success rate between the concentrator and nodes.

③ If the data rate is set too high, the spreading factor and bandwidth will be high, resulting in a shorter transmission distance.

④ Low transmit power.

Solutions:

① Place the antenna at a high location outdoors.

② For long-distance communication, set LoRa to a low data rate and high transmit power.

(2) Co-frequency Interference

During use, USR-LG207-H devices with consistent data rates but differentfrequenciesreceived data sent from the concentrator.

Possible reasons include:

① The operatingfrequenciesof the nodes are relatively close.

② The node antennas are positioned relatively close to each other.

Solutions:

① Increase the spacing between thefrequenciesset for different nodes, by at least 5000KHz.

② It is recommended to keep a distance of more than 2 meters between the suction cup antennas of adjacent nodes.

③ Set different data rates for the nodes.

(3) High Packet Loss Rate

Possible reasons include:

① The transmission distance exceeds the limit.

② Significant environmental interference.

Solutions:

① Reduce the communication distance between the node and the concentrator.

② Check for surrounding interference sources.

(4) Concentrator Cannot Connect to Server

① Possible reasons include:

② Incorrect server address and port number.

③ The concentrator cannot connect to the external network.

Solutions:

① Ensure the server address and port number are accurate and that the server is functioning normally.

② In Ethernet mode, check if the concentrator has obtained an IP address and ensure it can interact with the external network;

In 4G mode, check if the concentrator has read the SIM card information. If no information is found, power off and reinsert the SIM card to ensure proper contact. After restarting, if it still cannot connect to the server, read the concentrator's 4G information to check its network status. If the SIM card fails to register on the network, please check if the SIM card can access the internet.

(5) Node Cannot Network with Concentrator

Possible reasons are as follows:

① The LoRa parameters of the node and the concentrator are different.

② The node network access gateway ID is incorrect.

Solution:

① Ensure that the LoRa parameters set on the node are consistent with those of the concentrator.

② Check whether the node network access gateway ID is the same as the concentrator gateway ID.

(6) Concentrator firmware upgrade failure

Possible reasons are as follows:

① Incorrect firmware file selection.

② Firmware upgrade steps do not comply with specifications.

Solution:

① Ensure that the firmware file selected for upgrade is in ".bin" format.

② Ensure that you release the Reload button promptly after powering on while holding it down. Do not keep pressing the Reload button throughout the entire upgrade process.

8. Disclaimer

This document provides information about the USR-LG210 product. This document does not grant any license to intellectual property rights, either expressly or impliedly, by estoppel or otherwise. Except for the liabilities stated in the

sales terms and conditions of its products, our company shall not bear any other liabilities. Furthermore, our company makes no express or implied warranties regarding the sale and/or use of this product, including but not limited to warranties of fitness for a particular purpose, merchantability, or non-infringement of any patent, copyright, or other intellectual property rights. We reserve the right to modify product specifications and descriptions at any time without prior notice.

9. Version History

Version	Update Content	Update Time
V1.0.0	Initial version	2026-5-23