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USR-LG207

Data Radio Station

User Manual

V2.0

Your Trustworthy Smart Industrial IoT Partner

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1. Product Overview

The USR-LG207-L-IO1 is a cost-effective LoRa wireless data transmission DTU developed by USR-IOT based on the SX1262 solution. It supports the 860M-930MHz frequency band (default 868MHz), operates at DC 9-36V, and features 1 DI input and 1 DO output, making it flexible for industrial control scenarios. The device supports point-to-point communication or networking with a LoRa gateway, provides RS485/RS232 serial output, and includes functions such as relay networking and signal detection. It is characterized by strong anti-interference capability and high stability, suitable for long-distance, high-reliability wireless data transmission needs.

1.1. Product Features

- Based on the Sx1262 chip, the new LoRa spread spectrum modulation technology offers higher anti-interference, stability, and longer transmission distance.
- Supports DI acquisition, DO control, and remote wireless linkage.
- Integrates three communication protocols, supporting point-to-point communication and communication with the USR-LG210-H gateway, making one device suitable for multiple scenarios.
- Supports relay data transmission, enabling ultra-long-distance wireless data transmission through multi-device relaying.
- Operating frequency band 860M-930MHz, long-distance transmission up to 8000 meters, receiving sensitivity up to -148dBm@0.268Kbps.
- LoRa signal monitoring with indicator lights displays signal quality during data transmission and whether there is interference in the used frequency band, ensuring transmission stability.
- LBT (Listen Before Talk) function detects channel environment interference and noise before sending data. If noise is detected, transmission is delayed to prevent channel conflicts and ensure data communication success rate.
- Data re-transmission mechanism with interactive acknowledgment; if no acknowledgment is received, data is resent to ensure transmission reliability.
- Data transmission encryption enhances user data confidentiality.
- Supports transparent transmission, broadcast transmission, master-slave transmission, and fixed-point transmission functions.
- Carefully designed hardware watchdog function prevents device crashes and allows quick restart and recovery in case of anomalies.

1.2. Application Scenarios

- Wireless transmission for Smart Factory PIC/HMI
- Smart agriculture and livestock, IO control
- Wireless smart meter reading industry
- Wireless control for smart street lights
- Smart agriculture systems, remote control for intelligent irrigation
- Smart construction site equipment monitoring, tower crane operation status monitoring
- Smart oil fields, oil pump status monitoring
- Smart home and industrial sensors
- Power distribution cabinet power detection, server room monitoring

◆ Smart building energy monitoring

2. Basic Device Parameters

2.1. Specifications

Items	Description
Power Supply	DC: 9-36V, reverse polarity protection, surge protection
Working Current	Working mode: 125.6mA@12V, Idle mode: 45.3mA @12V
Serial port	
No.	1 x RS485/RS232
Connector	RS485: 2-PIN 5.08 terminal blocks, A/B signal RS232: DB9 male connector
Baud rates	1200 ~ 230400bps(Default 115200bps)
Data bits	7, 8
Stop bits	1, 2
Parity	NONE, ODD, EVEN
IO Interface	
DI	1 x Digital Input, dry & wet, range: 0-36V
DO	1 x Digital output, DC40V/500mA
LoRa	
Radio Chip	SX1262+PA
Frequency	860-930MHz
Tx Power	17-30dBm, default value: 30dBm
Rx Sensitivity	-148dBm @0.268Kbps
Coverage distance	Max 8KM Test conditions: clear weather, open field of view, maximum power 30 ±0.5dBm, antenna gain 3dBi, height greater than 2m.
Antenna Connector	Female SMA Connector
Physical Property	
Casing material	Metal, IP30 protection
Dimensions	102.2 x 85 x 22mm(L x W x H, terminal blocks are not included)
Installation	Wall mounting
EMC	Surge protection: level 3, IEC61000 ESD protection: level 3, IEC61000 EFT protection: level 3, IEC61000
Operating temperature	-40℃ ~ +85℃
Storage temperature	-40℃ ~ +125℃

Operating humidity	10% ~ 90% RH, non-condensing
Storage humidity	5% ~ 90% RH, non-condensing
Software Function	
Communication	Point-to-point, point-to-multipoint, point to gateway
Linkage control	Remote linkage control, local linkage control
User Configuring	Config utility, AT command
Others	
Reload	Pinhole reset button
Indicator	PWR, WORK, COM, LINK, DI, DO
APPROVALS	
Regulatory	CE/RED*, RoHS*, WEEE*, FCC*

2.2. Hardware Interface Description

- The hardware interfaces and indicator lights of USR-LG207-L-IO1 are described as follows:

Table 1 Hardware Interface Description

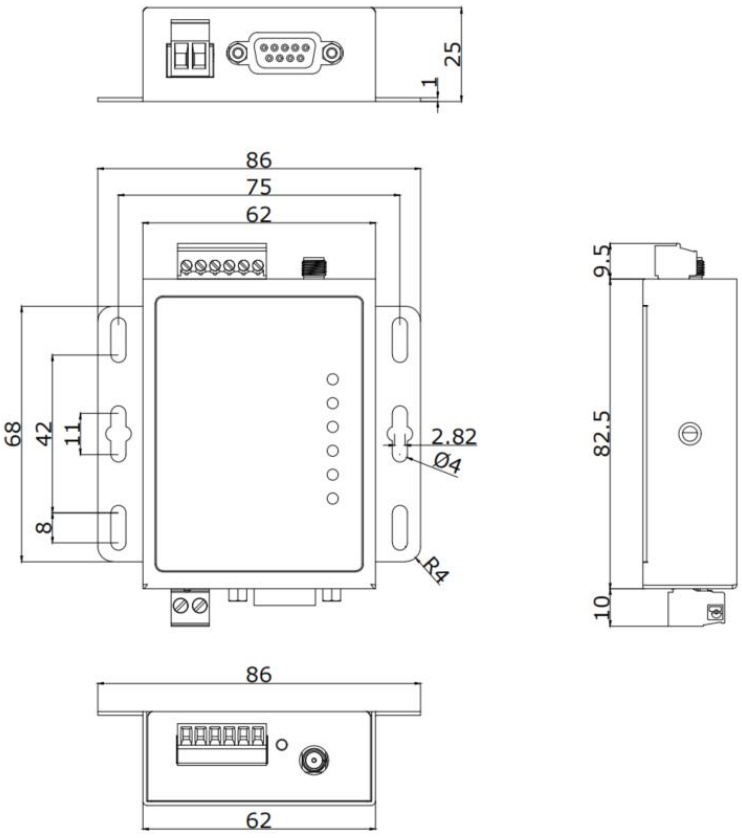
No.	Interface Name	Function Description	Remarks
1	Antenna Interface	SMA antenna connector (external thread, internal hole)	
2	Reload Button	Factory Reset Button	When the LoRa data transmission terminal is working normally (Work light flashing normally), press and hold for more than 3 seconds and then release. You can observe the TXD light flashing once, which means the settings of the LoRa data transmission terminal have been restored to the factory configuration.
3	Power Interface	Power Supply Port	
4	RS485Interface	RS485 : A(data+),B(data-)and GND. When connecting to thenodeRS485, connect A(+) to A(+), B(-) to B(-), and G to GND.	
5	RS232	DB9 male connector, RS232 communication	
6	DI/DO	DI, com: Supports1* digital input, supports dry and wet contacts, range 0-36V	

		DO, com: Supports1* digital output, maximum voltage DC40V\500MA	

Table 2 Indicator Light Description

Indicator Light	Function	Description
Power	Power Indicator	Stays on when power input is correct
Work	Working Indicator	Flashes once every 1 second during normal operation; flashes once every 500ms during upgrade process.
COM	Serial Port Indicator	Flashes once every 500ms when there is serial data communication
Link	Signal Indicator	Blinks according to signal quality, judged by SNR and RSSI values, with three display states: Good signal, LORA indicator stayson; Fair signal, LORA indicator blinks once every 1 second; Poor signal, LORA indicator blinks once every 3 seconds.
DI	DI Acquisition Indicator	Lights on for valid input, off for wireless input, flashes once during detection process
DO	DO Control Indicator	Lights on when closed, off when open; indicator flashes once during DO control process

❖ ProductDimensions

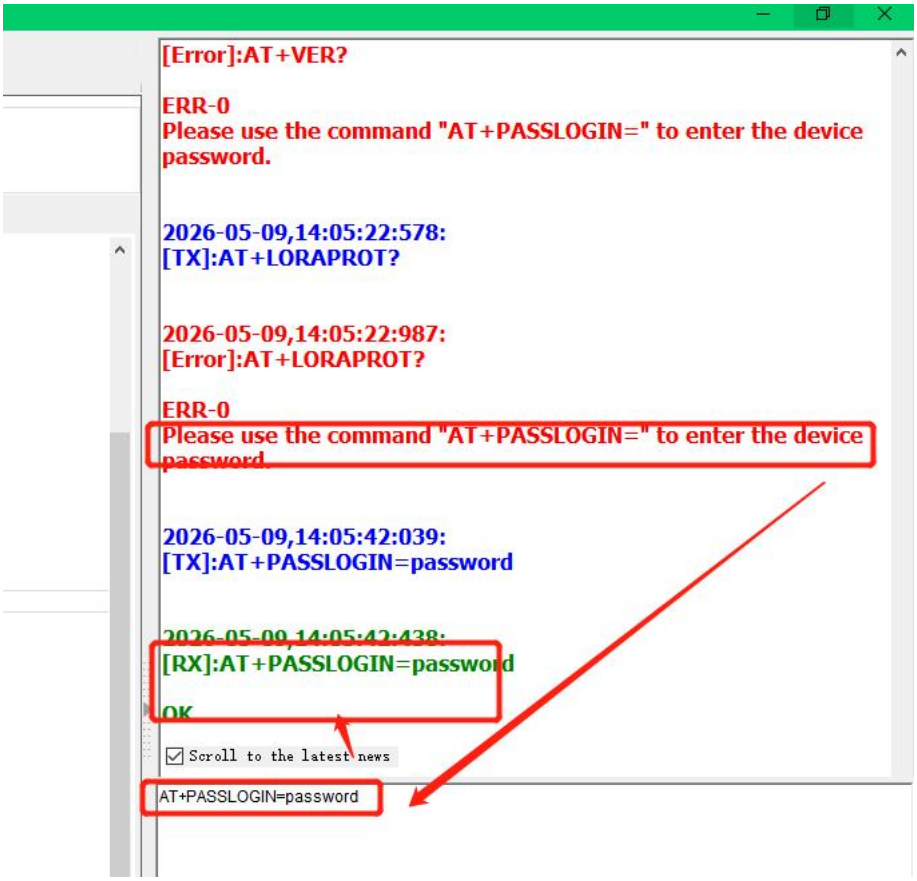


Sheet metal casing, fixing holes on both sides;
Length, width, and height are 102*86*25mm respectively.

2.3. Login setup software

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

To ensure the security of parameter settings, when users use the setting software to read and set parameters, they need to first send a command with the password. The default password 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. Device Function Introduction

3.1. Function Overview

Function Category	Device Function	Data Transmission Format	Function Description
Data Transmission	Transparent Transmission	Data	Source data transmission, no format restrictions
	Broadcast Transmission	Data	Source data broadcast, no format restrictions, broad cast device address set to 65535

Mode	Point-to-Point Transmission	Target Address + Channel + Data	Flexible selection of target receiving device for data transmission
	Master-Slave Transmission	Target Address + Data	Master-slave transmission, one master multiple slaves
DIDO Function	Acquisition, Control, Linkage	Modbus Protocol	Select the corresponding Modbus protocol based on usage
Relay Networking	Relay Transmission	Data	Relay network, data forwarding,extending transmission distance
Power Consumption Mode	RUN Power Mode	According to each data transmission mode	Standby operation, can send and receive data at any time
	WU Power Mode	According to each data transmission mode	Air wake-up for LR modedevices, periodically sends wake-up codes, used with LR mode
Data Transmission Stability Mechanism	LBT Detection	\	Detects interference in the used frequency band before data transmission; if interference is detected, transmission is delayed to avoid data packet loss
	Data Re-transmission	\	Activates acknowledgment mechanism; retransmits lost data to ensure data integrity
	Forward Error Correction	\	When SNR is low or BER is high,improves data transmission accuracy
	Timeout Restart	\	Restarts if no data is sent or received within a specified time
LoRa Signal Detection	Channel Environment Detection	Device serial output: SNR, RSSI	Single device detects interference in the current frequency band and prompts whether channel parameter configuration is reasonable
	Data Transmission Signal Detection	Receiver output: Data+SNR\RSSI	Data transmission between devices; received data carries signal values for output, allowing judgment of whether device placement distance and parameter settings are reasonable
	LoRa Signal Indicator (DTU devices only)	Data transmission indicator displays RSSI signal quality, providing an intuitive sense of LoRa signal status	Three display states: Good signal, LoRa indicator is solidlylit; Fair signal, LoRa indicator flashes every 1s; Poor signal, LoRa indicator flashes once every 3s.
Other Functions	Data Transmission Success Indicator	Returns SEND OK after successful data transmission	Sender transmits data;upon successful reception, the receiver replies with confirmation, at which point the sender outputs SEND OK to the serial port
	Additional Data	Send: Data	

	Transmission	Receive: Node ID+Data or Node ID+Data+SNR+RSSI	Receiver selects additional data type
	LoRa Data Packetization	\	Wireless data is packetized and out put according to the selected packet size

3.2. Detailed Explanation of Data Transmission Modes

3.2.1. Transparent Data Transmission

❖ Function Description

The transparent transmission protocol means thatthe data transmission process does not affect the content of the data; what is sent is what is received,in transparent modetwoor moremoduleskeep the same protocol selection, operating frequency band, communication rate, and communication address to enable wireless data transmission, withoutother operations.

❖ Device Settings

(1) Parameter Settings:

a. Protocol Selection: Select point-to-point protocol, keep the protocol version consistent

b. Data Transmission Function: Select transparent transmission for communication devices

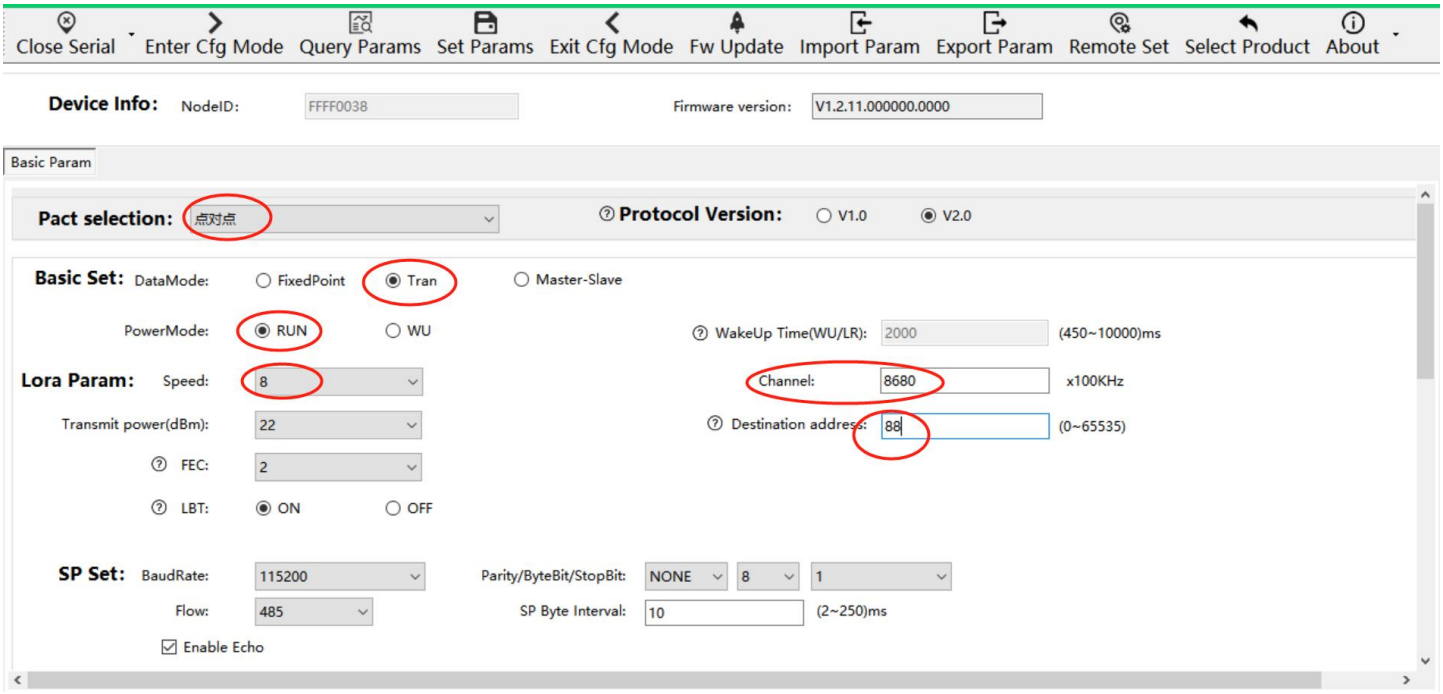
c. Working Mode: Select RUN for communication devices

d. Communication Frequency Band: Set the same frequency band for communication devices

e. Communication Rate: Set the same rate for communication devices

f. Target Address: Set the same target address for communication devices

(2) Host Computer Software Usage Settings:



❖ Communication Example

Setting Item	Transmitter	Receiver
Protocol Selection	Point-to-Point	Point-to-Point
Function	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)
Communication Frequency Band	8680	8680
Communication Rate	8	8
Target Address	88	88
Data Transmission	123456	123456

3.2.2. Broadcast Data Transmission

❖ Function Description

In the device transparent transmission function, if the transmitting device sets the target address to 65535, it is in broadcast mode. Other devices with the same rate and channel can receive the data sent by this device.

❖ Device Settings

(1) Parameter Settings:

a. Protocol Selection: Select point-to-point protocol, keep the protocol version consistent

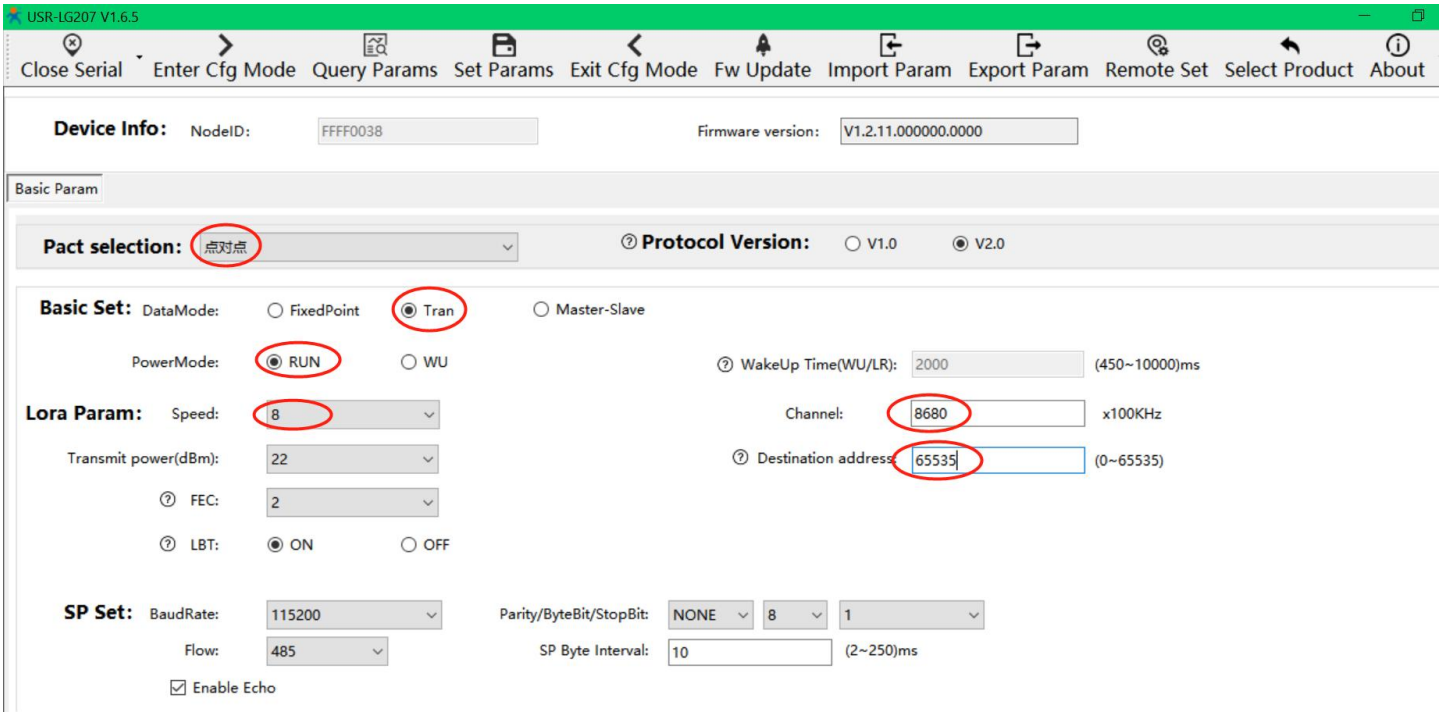
b. Data Transmission Mode: Select transparent transmission for communication devices

c. Communication Frequency Band: Set the same frequency band for communication devices

d. Communication Rate: Set the same rate for communication devices

e. Target Address:The transmitting device sets 65535, and other receiving devices can set 0-65534

(2) Host Computer Software Usage Settings:



❖ Communication Example

Setting Item	Transmitter	Receiver
Protocol Selection	Point-to-Point	Point-to-Point
Function	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)
Communication Frequency Band	8680	8680
Communication Rate	8	8
Target Address	65535	66
Data Transmission	123456	123456

3.2.3. Fixed-point Data Transmission

❖ Function Description

Fixed-point Transmission Protocol builds upon transparent transmission by using the first 2 bytes of the sent data as the receiver device target address (high byte first). The 3rdand4th bytes serve as the receiver device channel.The data format is: Receiver Target Address (hex) + Receiver Channel (hex) + Data; when sending, the module changes the target address and channel, and restores the original settings after completion. The advantage of the fixed-point transmission protocol is that during data transmission, it can flexibly change the target address and channel, thereby achieving flexible targeting of different modules.

❖ Device Settings

(1) Parameter Settings:

a. Protocol Selection: Select point-to-point protocol, ensure protocol versions are the same.

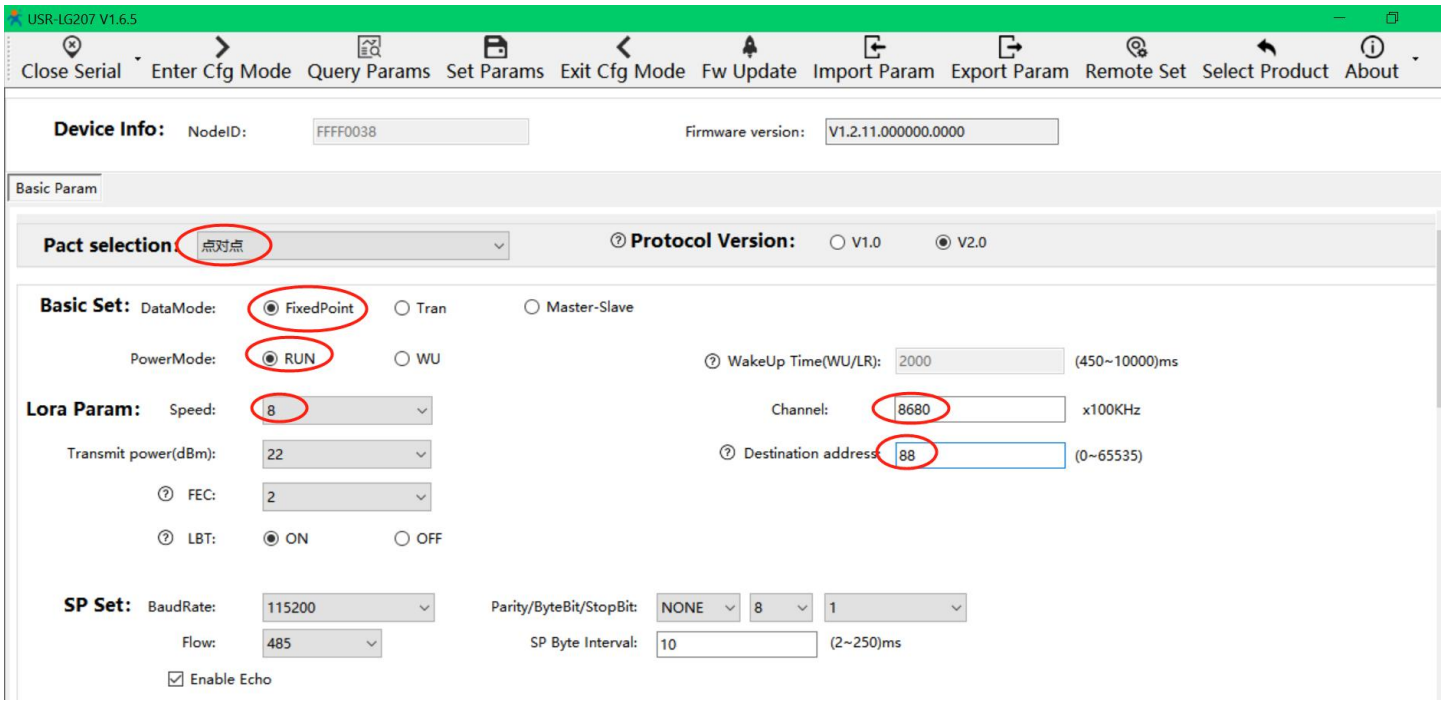
b. Data Transmission Mode: Set the transmitter's data transmission mode to fixed-point mode; the receiver's transmission mode can be the same or different.

c. Communication Frequency Band: No restrictions on frequency band settings for communication devices.

d. Communication Rate: Communication devices must have the same rate setting.

e. Target Address: No restrictions on communication devices; when the transmitter is set to 65535, all devices with the same frequency band and rate can receive the data.

(2) Host Computer Software Usage Settings:



❖ Communication Example

Settings	Transmitter	Receiver
Protocol Selection	Point-to-Point	Point-to-Point
Function	Fixed Point (FP)	Transparent Transmission (TRANS)
Communication Frequency Band	8680	4800
Communication Rate	8	88
Target Address	88	66
Data Transmission	004212C0123456	123456

3.2.4. Master-Slave Data Transmission

❖ Function Description

One master with multiple slaves, the host distributes data to each slave device. The host must send data to the LoRa slave devices in the group according to the protocol format.Format: Slave target address (hexadecimal) + Data. Slaves send data to the host (no need to follow the data transmission protocol, just send directly).

❖ Device Settings

(1) Parameter Settings:

a. Protocol Selection: Select point-to-point protocol, keep the protocol version consistent.

b. Data Transmission Mode: Both transmitter and receiver are set to master-slave mode.

c. Master/Slave Setting: Set the transmitter as master and the receiver as slave.

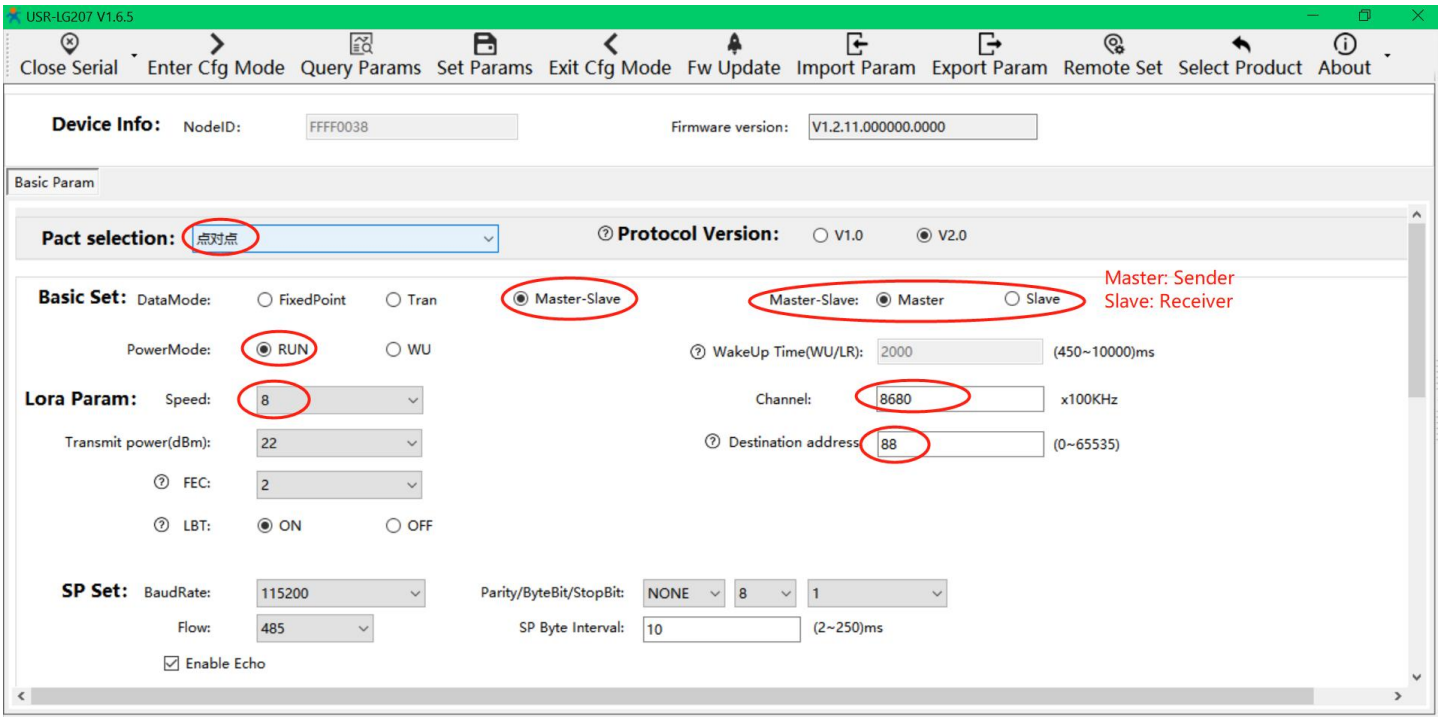
d. Communication Frequency Band: Set the same frequency band for communication devices.

e. Communication Rate: Set the same rate for communication devices.

f. Target Address: No restrictions on communication devices; when the host is set to 65535, all other devices with the

same frequency band and rate can receive data.

(2) PC Software Usage Settings:



❖ Communication Example

Setting Item	Transmitter	Receiver
Protocol Selection	Point-to-Point	Point-to-Point
Function	Master-Slave (MS)	Master-Slave (MS)
Master-Slave Setting	Master (1)	Slave (0)
Communication Band	8680	8680
Communication Rate	8	8
Target Address	88	66
Data Transmission	0042123456	123456

3.2.5. Relay Networking Transmission

❖ Function Description

The relay networking function is mainly used to increase transmission distance and data penetration performance. After all devices used in the relay network are set to relay mode, the relay starts working.

Basic Logic of Relay Networking:

After enabling the relay function for the mode requiring relay networking, when the receiving device receives LORA data, it judges the data protocol bytes. If the group number and address carried in the received data are consistent with its own, the receiving device will output directly to the serial port without forwarding; if inconsistent, the receiving device will compare the relay group number in the data with the relay rule value to see if it conforms to the relay forwarding rules. If it conforms, the data will be relayed and forwarded; if not, the data will be discarded.

The relay function supports point-to-point transmission, master-slave transmission, and broadcast transparent

transmission. Data is sent according to the protocol format of different transmission modes. For example, in master-slave mode, the sender is set to master mode, and the final receiver is set to slave mode. The sending data follows the protocol format: Slave Target Address (Hex) + Datafor data transmission.The slave sends data to the master (no need to follow the data transmission protocol, send directly), and the relay module forwards the data according to the relay networking transmission logic..

Group Number Carried in Data: If the relay rule is set, the group number carried in the data received by the receiver will be converted according to the relay rule.

Relay Rule: If the group number carried in the data received by the receiver is consistent with the input value set in the relay rule, the group number carried in the data will be converted to the output value of the relay rule as the current group number for output.

Note:1. In the relay network, all devices must be set to use the same frequency band and rate.

2. Only devices with the relay function enabled can communicate with each other. They can send and receive relay data packets but do not have the relay function themselves. Only when the**relay rule**is set (non-0-0), do they possess the relay function.

(1) Example of Relationship between Group Number, Relay Rule, and Target Address:

Setting Item	Sender	Relay 1	Relay 2	Receiver
Group Number	1	Default	Default	3
Relay Rule	**0-0**	**1-2**	**2-3**	**0-0**
Target Address	66	77	88	66
Description	**RelayDevice1**: Set**Relay Rule 1-2**, meaning: Upon receiving data with group number 1 from theSender, the group number changes to 2, allowing the received data from the sender to be passed to Relay 2**(the relay rule containsgroup number 2)**'sdevice; **RelayDevice2**: Set**Relay Rule 2-3**, meaning: Upon receiving data with group number 2 fromRelay 1, the group number changes to3, allowing the data received from Relay 1 to be passed to the next**group number3**'sdevice; **Receiver:**The group numbermatches the group number contained in Relay 2's relay rule, and the target address is consistent with the sender. With the relay rule disabled, data can be transmitted transparently.			

❖ Device Settings

(1) Parameter Settings:

a. Protocol Selection: Select point-to-point protocol, keep the protocol version consistent

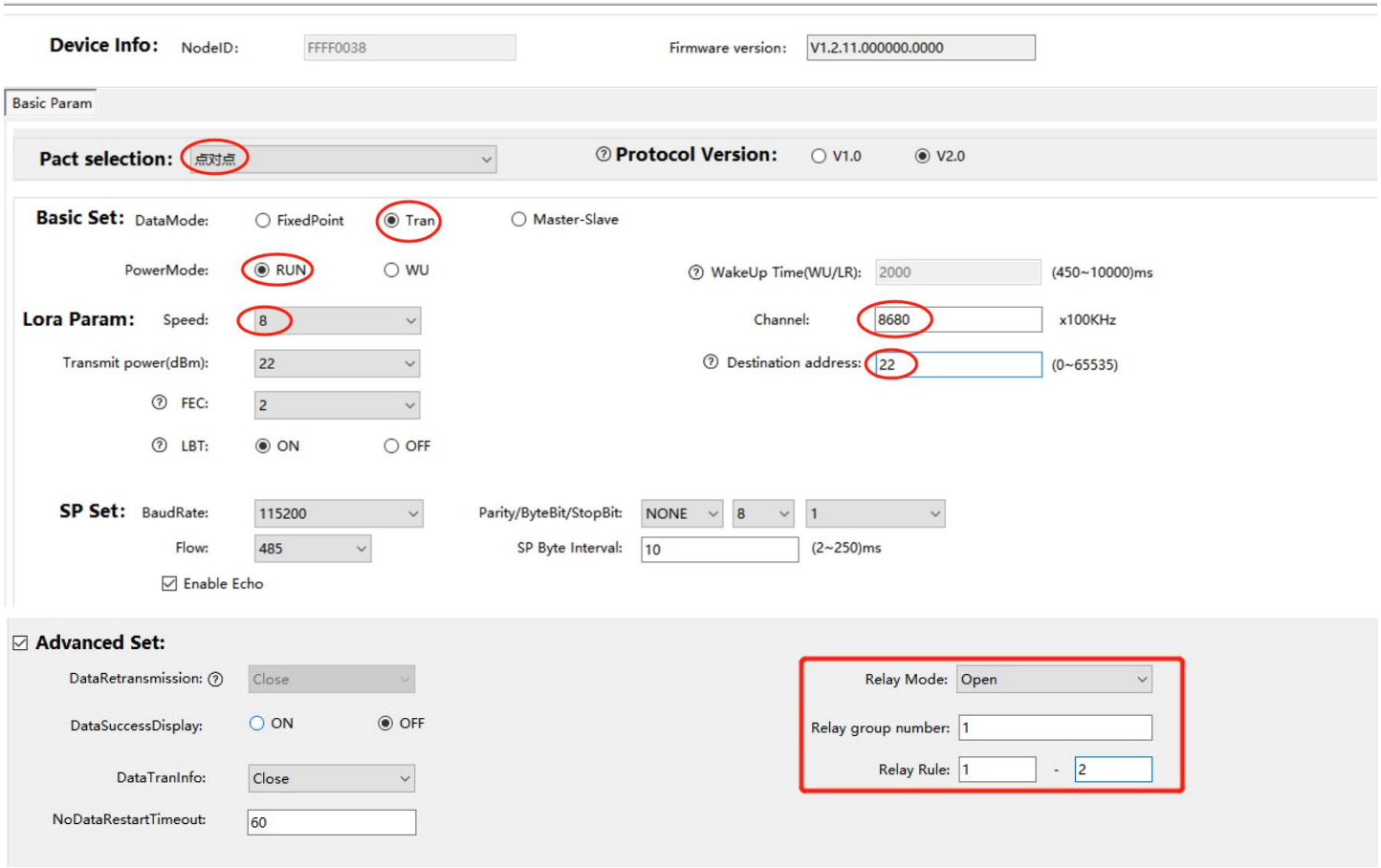
b. Relay Mode: Enable relay switch, refer to a. Example of Group Number, Relay Rule, and Target Address Relationship for settings

c. Communication Band: Set communicating devices to the same band

d. Communication Rate: Set communicating devices to the same rate

e. Target Address: The sender device and relay devices must set different target addresses or refer to Relay Networking Basic Logic . Example of Group Number, Relay Rule, and Target Address Relationshipfor settings. The receiver device must have the same target address as the preceding relay device.

(2) Host Computer Software Usage Settings:



❖ Communication Example

Settings	Transmitter	Relay 1	Relay 2	Receiver
Protocol Selection	Point-to-Point	Point-to-Point	Point-to-Point	Point-to-Point
Communication Frequency	8680	8680	8680	8680
Communication Rate	8	8	8	8
Relay Switch	On	On	On	On
Relay Group Number	1	Default	Default	3
Relay Rule	0-0	1-2	2-3	0-0
Target Address	11	22	33	11
Data	Send 123456	Receive 123456 and	Receive 123456 and	Group numbermatches

Transmission		forward to Relay 2	forward to the next leveldevice	the group number included in the relay rule of the upper-level relay,target address is the same as the transmitter, receive 123456 without further forwarding, data printed to serial port

3.3. Detailed Explanation of Power Consumption Modes

3.3.1. RUN Mode

❖ Function Description

RUN mode is the operating mode. After power-on, the device enters a continuous receiving state. When data is transmitted, it switches to the transmitting state, and after sending, it returns to the receiving state. It can receive data sent by devices operating in any function mode.

3.3.2. WU Mode

❖ WU Function Description

WU mode is the Air Wake-up mode. In this mode, it can wake up L101devicesin low-power mode.Before the LG207-L-IO1devicein WU mode sends data, it automatically adds a wake-up code of specified duration before the data internally. Users only need to care about sending the data; the wake-up code is formed internally by the device based on the wake-up time. LR mode devices detect the wake-up code sent by the LG207-L-IO1 device in WU mode, thereby waking up into the running state for data transmission and reception.

3.4. DI/DO Function

USR-LG207-IO1 supports1 channel of DI signal acquisition (0-36V detection) and 1 channel of DO control output (max DC40V/500mA), compatible with dry and wet node inputs. The device features local DI/DO linkage and remote wireless linkage functions, enabling flexible digital monitoring and control to meet the high reliability requirements of industrial automation and intelligent control scenarios.

3.4.1. DI Detection Function

Supports switch detection, DI counting, and key detection. By default, the signal rising edge is used as the valid trigger. Before use, it must be set to communication state (refer to the communication function section for specific settings). In data transmission, DI acquisition data is transmitted via Modbus protocol: in master-slave mode, input must follow the "Target Address + Modbus Acquisition Protocol" format, while in transparent transmission mode, the Modbus acquisition protocol can be used directly.

Note that only IO devices in the same group number can perform remote detection. When the slave address in the

acquisition protocol is set to the device's own address, the local DI status can be acquired.

- DI Acquisition Protocol:

DI Acquisition Mode	Function Code	Register Address	Result Range
Switch Mode	02	0x0021	Trigger: 01, No Trigger: 00
Count 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

- Command Settings:

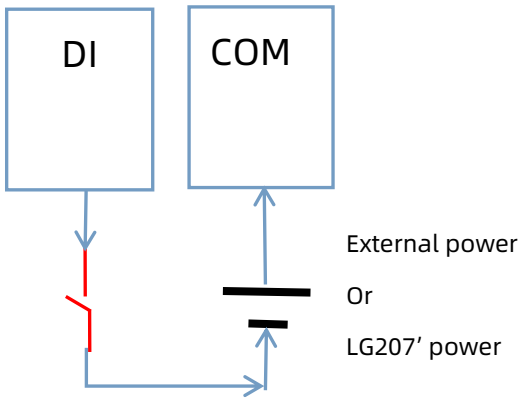
Name	Command	Parameter	Default Value	Description
IO Function Switch	AT+DIO	OFF, FOLLOW, NOFOLLOW	OFF	OFF: Disabled FOLLOW: Linked NOFOLLOW: Not Linked For first-time use, it is recommended to use the parameter NOFOLLOW
IO Device Group Number	AT+DIOGROUP	0-255	0	Communication is possible under the same group number
Slave Address	AT+DIOADDR	1-255	1	It is recommended to set different slave addresses for LG207 devices. If multiple devices use the same slave address, sending MODBUS acquisition commands will only collect data from the local device, and remote data interaction between devices cannot be achieved.
DI Debounce Time	AT+DITIME	20-1000ms	20	Maintain state stability
IO Auxiliary Function	AT+DIOUART	OFF, ON	OFF	When the linkage function is not enabled, users can enable the data serial port output function. They can use the IO function of

				LG207, or perform independent data acquisition and control operations on user terminal equipment.
DI Status Inversion	AT+DIINVERT	OFF, ON	OFF	After enabling this function, DI detection will take the falling edge as the valid signal.

- DI Detection Wiring Method:

Power can be supplied from the power port on the device, or voltage can be obtained from an external power source. The voltage range is 9~32V. A switch can be inserted in series between the COM and DI-X interfaces to control the on/off status of the power circuit. Supports 1* digital input, supports dry and wet contacts, range 0-36V.

If detecting passive switches, power can be taken from the LG207 power terminals. Refer to the wiring diagram below.



- DI Acquisition Test:

Set two LG207 devices to transparent transmission mode with consistent channel and target address settings. Enable the DI function via command settings, set different slave addresses for the devices, and send commands to acquire the DI switch status:

02 02 01 00 A1 CC
>[Tx ->][15:39:18:483][Hex]
02 02 00 21 00 01 E9 F3 Slave ID: 02, DI register address:
>[Rx <-][15:39:18:692][Hex]
02 02 01 01 60 0C Response from slave device: High level in DI
>[Tx ->][15:39:19:323][Hex]
02 02 00 21 00 01 E9 F3
>[Rx <-][15:39:19:532][Hex]
02 02 01 01 60 0C
>[Tx ->][15:39:19:968][Hex]
02 02 00 21 00 01 E9 F3
>[Rx <-][15:39:20:175][Hex]
02 02 01 01 60 0C
>[Tx ->][15:39:20:507][Hex]
02 02 00 21 00 01 E9 F3
>[Rx <-][15:39:20:720][Hex]
02 02 01 01 60 0C
>[Tx ->][15:42:56:077][Hex]
02 02 00 21 00 01 E9 F3
>[Rx <-][15:42:56:277][Hex]
02 02 01 00 A1 CC Response from slave device: Low level in DI

3.4.2. DO Control Function

Supports digital output, capable of driving external relays with a maximum drive voltage/current of 40V/500mA. It allows for DO output status detection, output status control, and DO hold. Before use, it must be set to communication state (refer to the communication function section for specific settings). During data transmission, DO data is transmitted via the Modbus protocol: in master-slave mode, input in the format "Target Address + Modbus Acquisition/Control Protocol"; in transparent transmission mode, the Modbus Acquisition/Control Protocol can be used directly.

Note that only IO devices within the same group number can perform remote acquisition/control of DO. When the slave address in the Modbus protocol matches the device's own address, it can acquire/control its own DO.

- DO Query/Control Protocol:

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

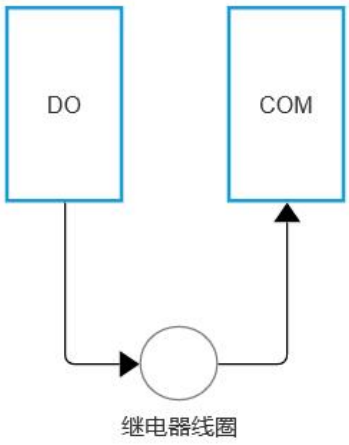
- Command Settings:

Name	Command	Parameter	Default Value	Description

IO Function Switch	AT+DIO	OFF, FOLLOW, NOFOLLOW	OFF	OFF: Disable FOLLOW: Linkage NOFOLLOW: No Linkage For first-time use, it is recommended to use the parameter NOFOLLOW
IO Device Group Number	AT+DIOGROUP	0-255	0	Communication is possible under the same group number
Slave Address	AT+DIOADDR	1-255	1	It is recommended to set different slave addresses for LG207 devices. If multiple devices use the same slave address, sending MODBUS acquisition commands will only collect data from the local device, and remote data interaction between devices cannot be achieved.
DO State Retention	AT+DOSAVE	KEEP: Retain CLOSE: Closed OPEN: Open	KEEP	DO state after device soft reset
IO Auxiliary Function	AT+DIOUART	OFF, ON	OFF	When linkage function is not enabled, users can enable the data serial port output function, use the IO function of LG207, and perform independent data acquisition and control operations on user terminal devices.

- DO Control Wiring Method:

Power can be supplied from the device's power port or from an external power source, with a voltage range of 9~32V. The power circuit can be controlled by inserting a switch between the COM and DI-X interfaces. 1* Digital Output, maximum withstand voltage DC40V\500MA



- DO Acquisition Test:

Set two LG207 devices to transparent transmission mode with consistent channel and target address settings. Enable the DO function using command settings, set different slave addresses for the devices, and send commands to control the DO switch:

```
[2025-09-01 18:15:18.625]# SEND HEX>
02 05 00 01 00 00 9C 39
```
Function code: 05 data: 0000, disconnect DO

```
[2025-09-01 18:15:18.943]# RECV HEX>
02 05 00 01 00 00 9C 39

[2025-09-01 18:15:19.907]# SEND HEX>
02 05 00 01 00 00 9C 39

[2025-09-01 18:15:20.230]# RECV HEX>
02 05 00 01 00 00 9C 39

[2025-09-01 18:15:57.391]# SEND HEX>
02 05 00 01 FF 00 DD C9
```
Function code: 05, data: FF00, connect DO

```
[2025-09-01 18:15:57.718]# RECV HEX>
02 05 00 01 FF 00 DD C9

[2025-09-01 18:16:23.665]# SEND HEX>
02 01 00 01 00 01 AC 39
```
Function code: 01, collect the DO status

```
[2025-09-01 18:16:23.982]# RECV HEX>
02 01 01 01 90 0C
```

3.4.3. DI/DO Linkage Function

Supports linkage between local DI and DO, as well as remote wireless linkage of DO control based on DI status. During linkage operation, the device must work in master-slave data transmission mode. The IO function group numbers must be consistent, and the slave device addresses within the group must be unique for normal linkage operation. It supports switch detection control, counting detection control, and button detection control. The three synchronous control methods are as follows:

(1) Switch Control:

(2) Positive Follow: The DO output status is positively correlated with the DI input status; if DI has valid input, DO

closes; if DI has no valid input, DO opens.

(3) Negative Follow: The DO output status is negatively correlated with the DI input status; if DI has valid input, DO opens; if DI has no valid input, DO closes.

(4) Counting Control:

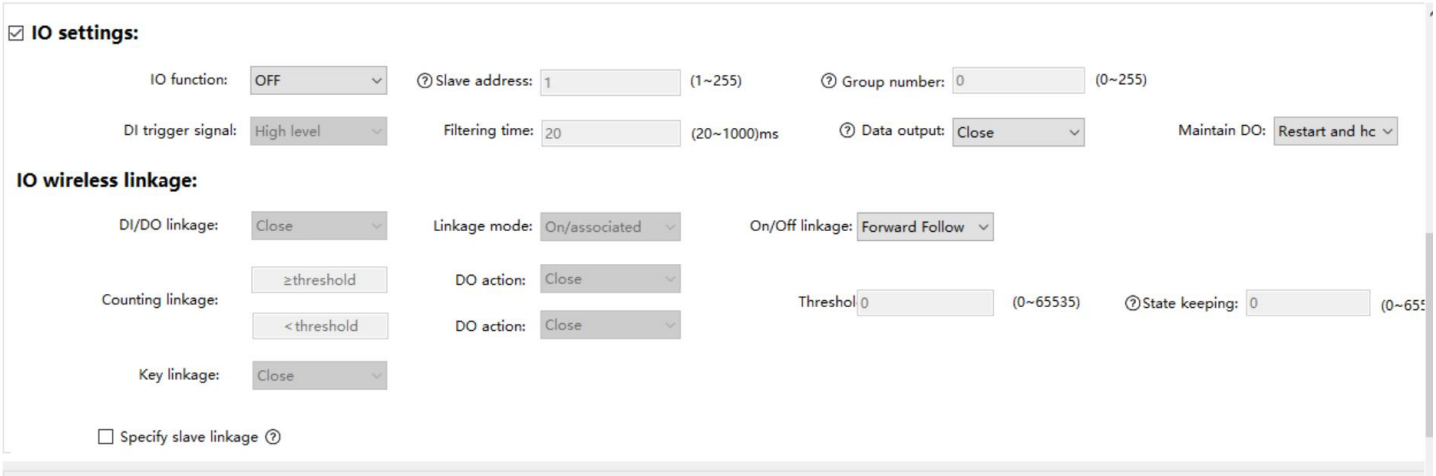
(5) Detection Count ≥ Threshold: Controls DO based on the counting threshold. The DO status can be selected as open or closed. When the count value is ≥ the threshold, DO acts.

(6) Detection Count < Threshold: Controls DO based on the counting threshold. The DO status can be selected as open or closed. When the count value is < the threshold, DO acts.

(7) DO Status Lock: The duration for which the DO status is maintained after reaching the threshold in counting control, selectable from 0-65535s. When set to 0, it acts immediately based on the count and threshold conditions. When set to 1-65535s, the DO action is maintained for the set time after reaching the threshold condition, and then acts again based on the threshold conditions.

(8) Button Control:

(9) When DI detects a button action, DO outputs (open, close, or toggle options). Toggle: If DI has button input, the DO output status is opposite to the current status (e.g.,if currently closed, DI button input changes it to open; another DI button input changes it back to closed); if DI has no valid input, the DO output status remains unchanged.



3.4.3.1. Local Linkage

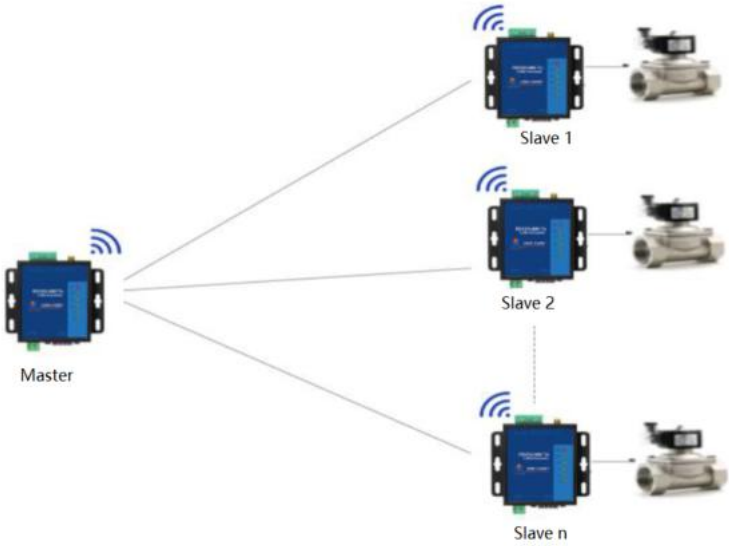
Set the device to work in master-slave mode, enable the IO function, select the linkage method as "Local + Wireless Linkage", and set the corresponding control method to perform local DI control of DO. For DI/DO wiring methods, refer toDI Detection FunctionandDOControlFunction.

3.4.3.2. Wireless Linkage

Wireless Linkage: LG207 local DI detection links the DO status of remote LG207 devices via LORA wireless transmission. It supports two linkage methods: broadcast and polling.

Wireless Linkage Diagram:

(1) Broadcast Linkage: Factory default state. To use IO broadcast linkage, set all group numbers under the specified slave linkage to 0. The host DI status can control the DO status of all slaves within the same group.

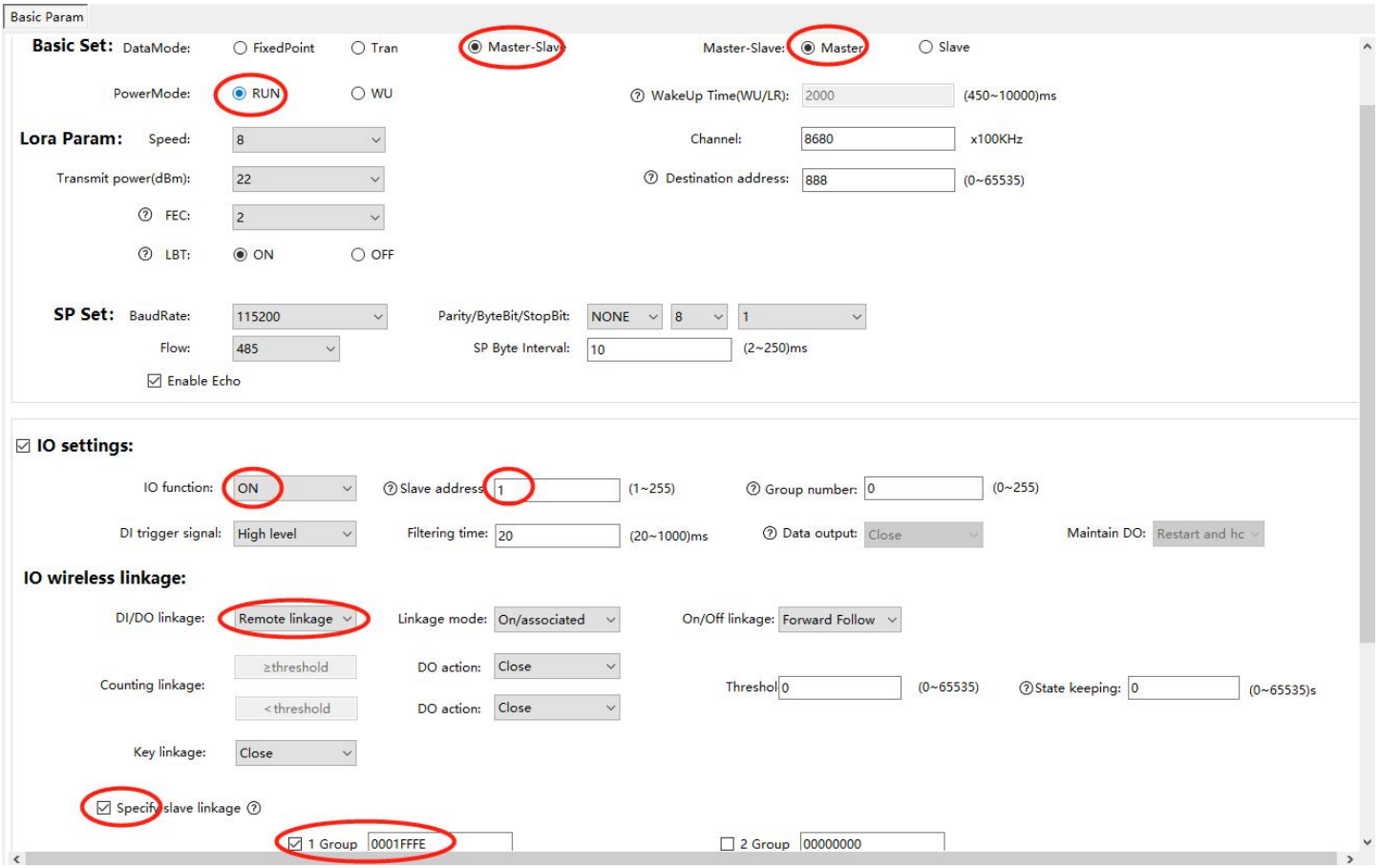


(2) Host Polling Linkage: Control according to the protocol. Configure on the host to divide slave addresses 1-255 into 8 groups, with each group representing 32 slaves.**Use 32-bit binary to indicate whether linkage is required (1 for linkage, 0 for no linkage; high bit first, low bit last)**. Users need to convert each group of binary into an 8-digit hexadecimal number to fill in the parameters. Fill in according to actual needs.

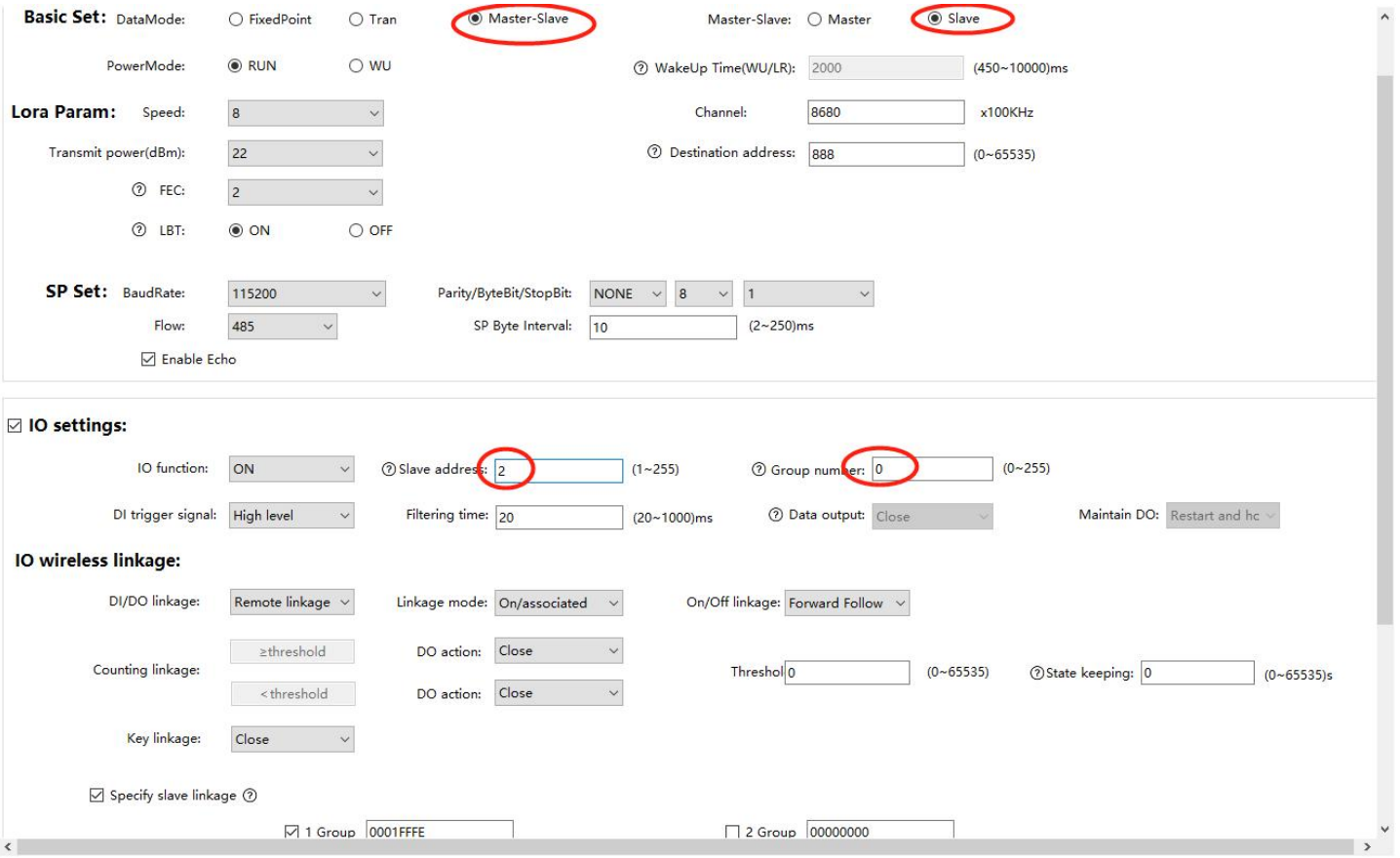
Note: Within the same IO group, avoid setting the IO slave address of the LG207 host device to be the same as that of the LG207 slave device.

- Example 1: Host DI switch detection controls 16 slave DOs for switch linkage, positive follow. The IO slave address of the LG207 host device is 1, so the IO slave addresses of the 1-16 LG207 slave devices should be set to 2-17. The corresponding polling binary data is "00000000000000001111111111111110", which converts to hexadecimal

"0001FFFE",we can set it by checking group number 1 and filling in "0001FFFE", without checking other group numbers. Host settings are as follows:

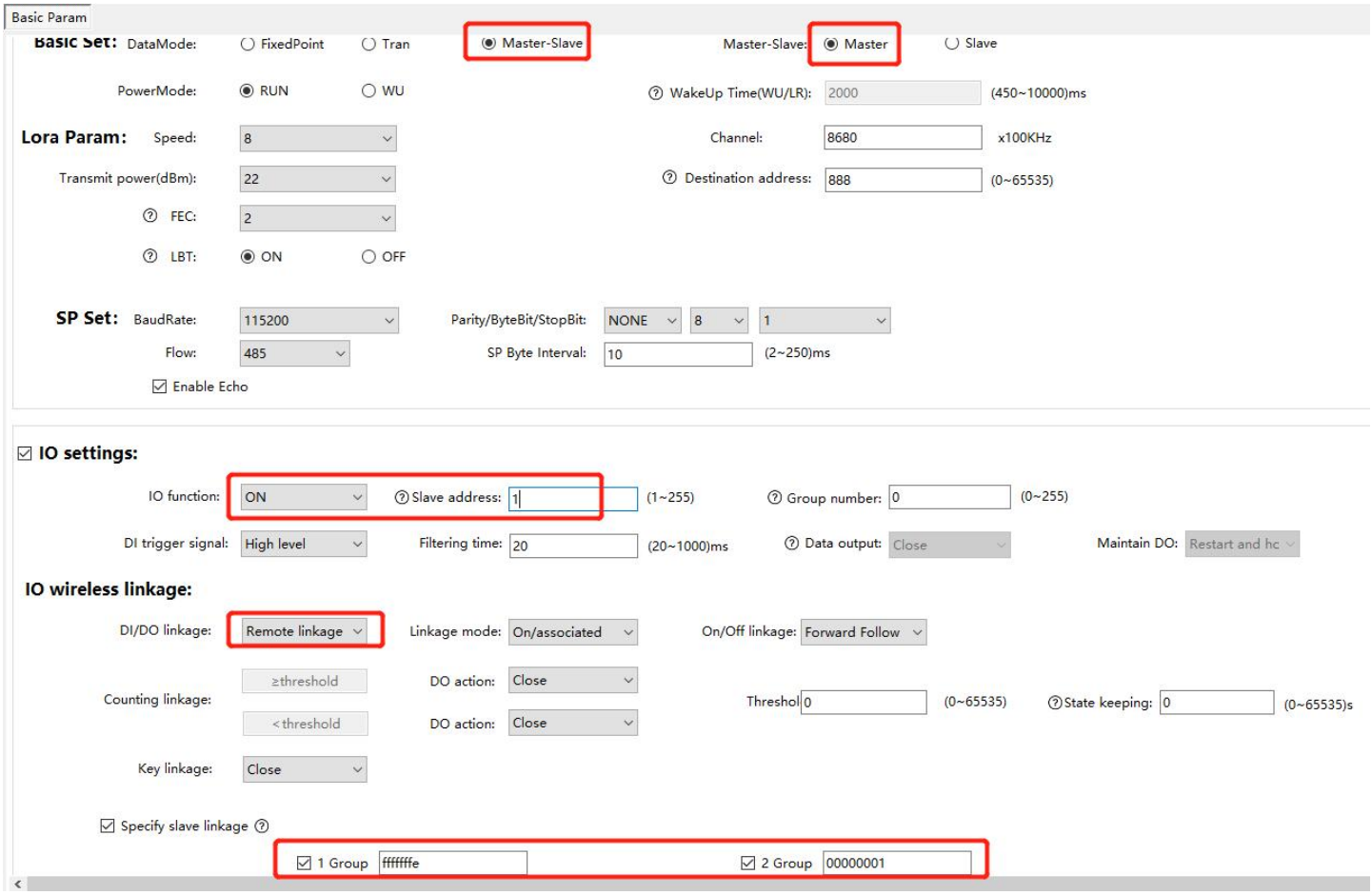


Slave settings only require setting the data transmission mode to slave, enabling IO function, enabling linkage function, and setting the IO slave address (distinct from the host settings), as shown below:

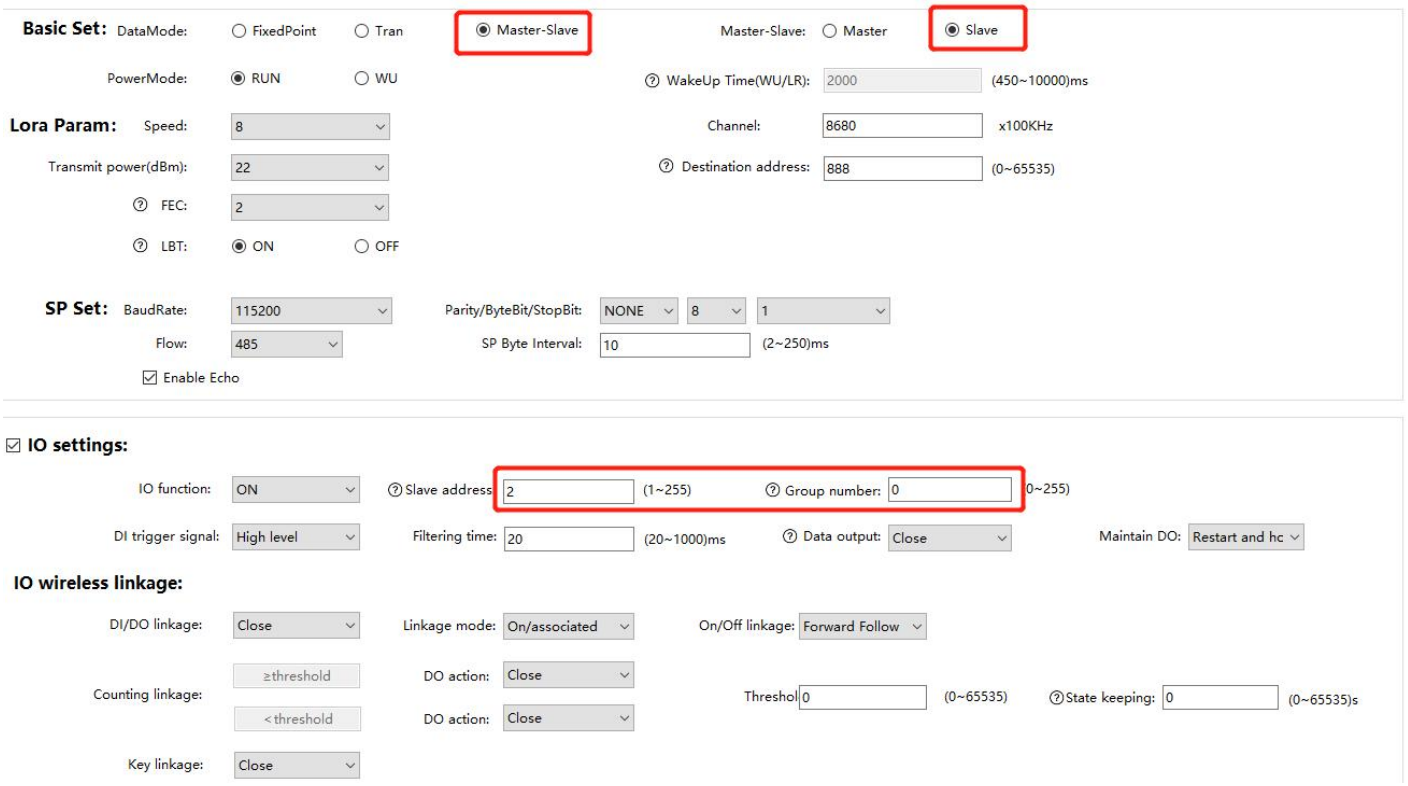


- Example 2: Host DI switch detection controls 32 slave DOs for switch linkage, positive follow. The IO slave address of the LG207 host device is 1, so the IO slave addresses of the 1-32 LG207 slave devices should be set to 2-33. The corresponding binary needs to be divided into two groups. Group 1 is "11111111111111111111111111111110" which converts to hexadecimal "fffffffe", and Group 2 is "00000000000000000000000000000001" which converts to hexadecimal "00000001". We can set it by checking group number 1 and filling in "fffffffe", checking group number 2 and filling in "00000001", without checking other group numbers.

Host settings are shown in the figure:



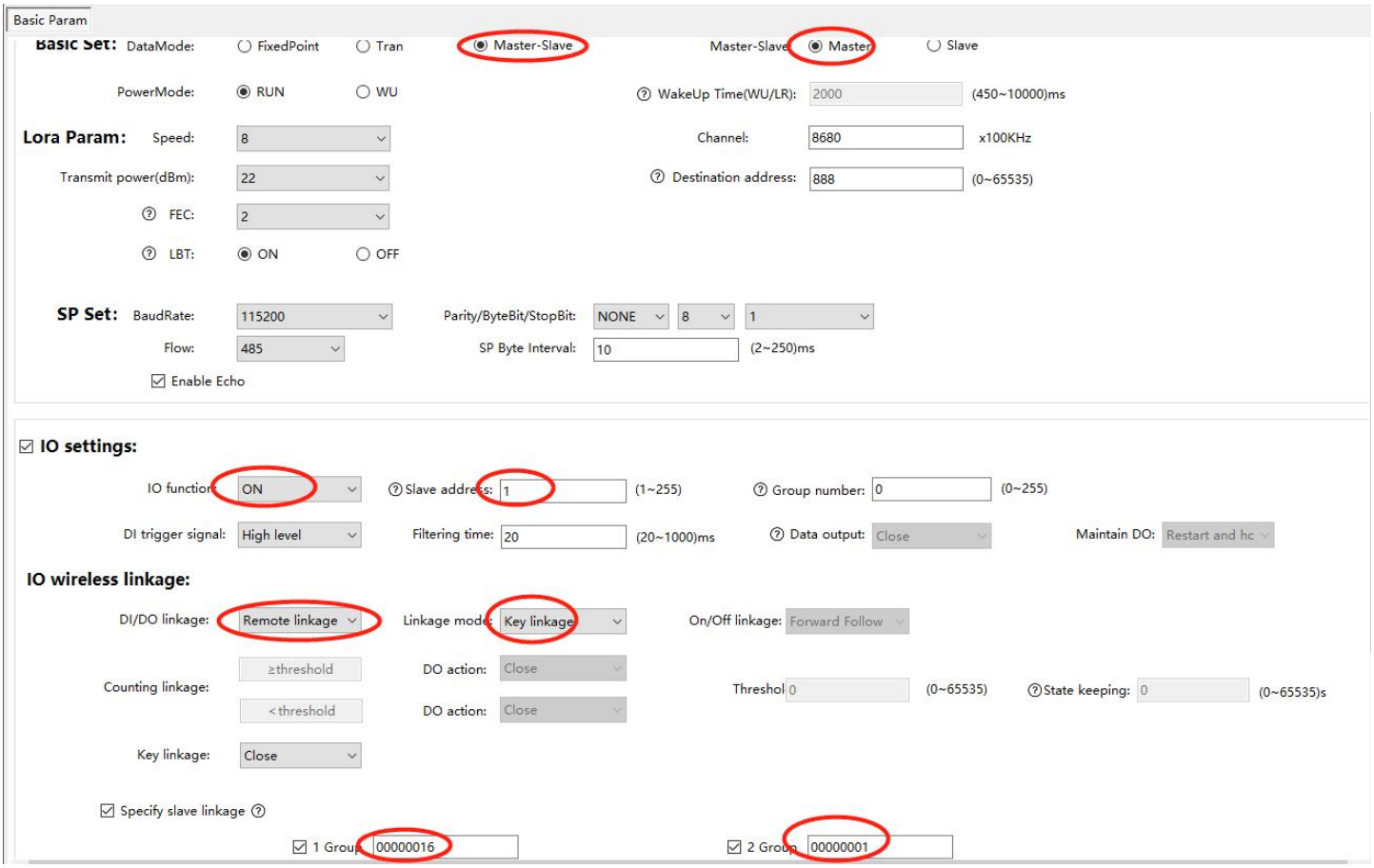
Slave settings only require setting the data transmission mode to slave, enabling IO function, enabling linkage function, and setting the IO slave address (distinct from the host settings), as shown below:



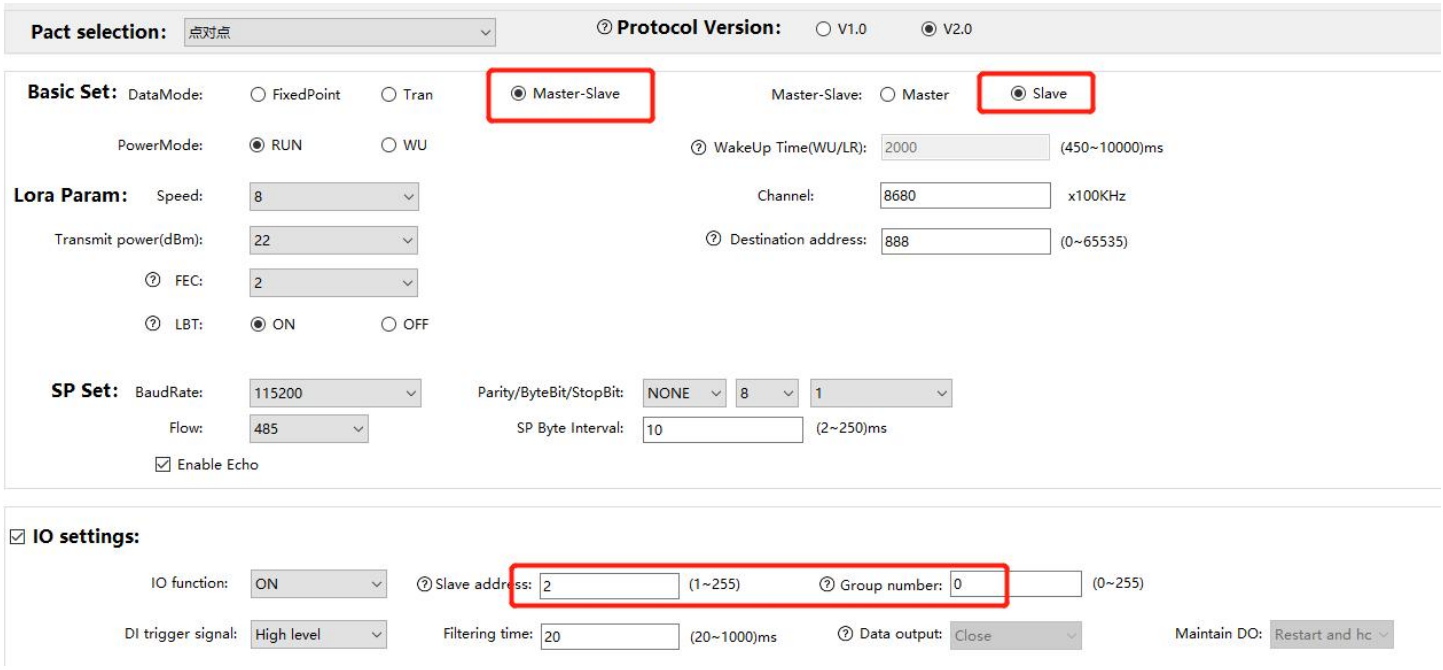
- Example 3: There is 1 LG207 host and 32 LG207 slaves in the same IO group number. The IO slave address of the

LG207 host device is 1, so the IO slave addresses of the 1-32 LG207 slave devices can be set to 2-33. DI button detection controls the DO output of four LG207 slave IOs: 2, 3, 5, and 33. Similarly, the corresponding binary needs to be divided into two groups. Group 1 is "00000000000000000000000000010110" which converts to hexadecimal "00000016", and Group 2 is "00000000000000000000000000000001" which converts to hexadecimal "00000001". We can set it by checking group number 1 and filling in "00000016", checking group number 2 and filling in "00000001", without checking other group numbers.

Host settings are as follows:



Slave settings only require setting the data transmission mode to slave, enabling IO function, enabling linkage function, and setting the IO slave address (distinct from the host settings), as shown below:

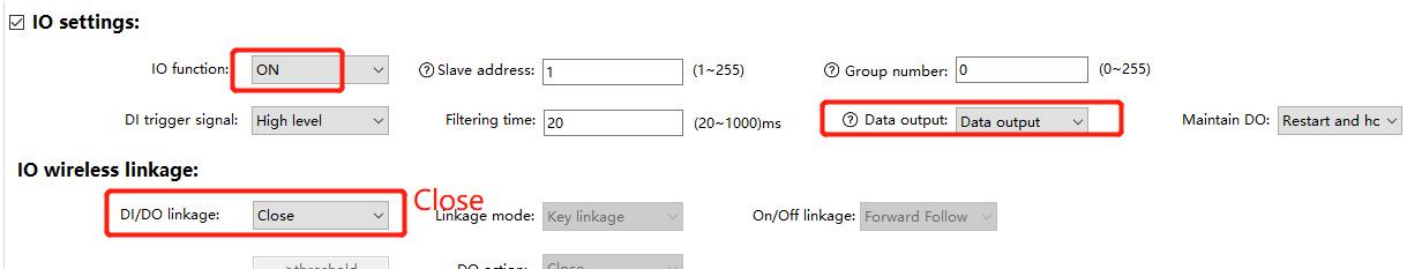


3.4.4. LG207 IO Acquisition and Control of Lower-end Devices

In this function, the device distinguishes whether the received Modbus data slave address is the LG207 local IO slave address or the slave address of the LG207 lower-end device. By enabling this function, users can transmit data to the LG207 serial port lower-end device for acquisition and control. By default, if the LG207 identifies that the received data slave address does not match the local address, the data is output to the serial port device. This function also supports selecting to discard data if the received data slave address does not match the local address.

Note: This function needs to be used when IO wireless linkage is disabled.

Configuration Example:



3.5. Detailed Explanation of Other Functions

3.5.1. LoRa Signal Detection

❖ Function Description

The signal detection function can determine whether there is interference in the working frequency band of the LORA devices deployed on-site during use, and output the signal quality during LORA wireless data transmission. It helps judge whether the distance arrangement between wireless devices is reasonable based on signal instructions. The LoRa signal detection function greatly helps users reasonably select LORA parameters suitable for on-site applications, ensuring the stability of data transmission and saving debugging time.

(1) Environmental Detection: Single device detection;After enabling this function,the device will read the signal quality of the current environment every 1s, and output via serial port every 3s(SNR\RSSI)values. Generally, if RSSIis lower than-110dBm and SNR is lower than 0dB, it means there is interference from other objects in this working frequency

band, and the frequency band needs to be changed.

(2) Wireless Data Transmission Signal Detection: Requires 2 or more devices capable of data transmission;After enabling the function,the devicewill carry the instantaneous (SNR\RSSI) at the time of receiving data from the sender in the data and output it via serial port,Generally, if the RSSI value is lower than -110dBm and SNR is lower than -5dB, it means the deployment distance between LORA devices is too far or there are too many obstacles in between. In this case, you can lower the working rate or reduce the distance between devices.

Indicator Light Display: Good signal, LORA indicator light is always on; Fair signal, LORA indicator light flashes every 1s; Poor signal, LORA indicator light flashes once every 3s(It can still be used in the current situation, but observe carefully. If the packet loss rate requirement is high, adjust the rate or channel).

❖ Device Settings

(1) Parameter Settings:

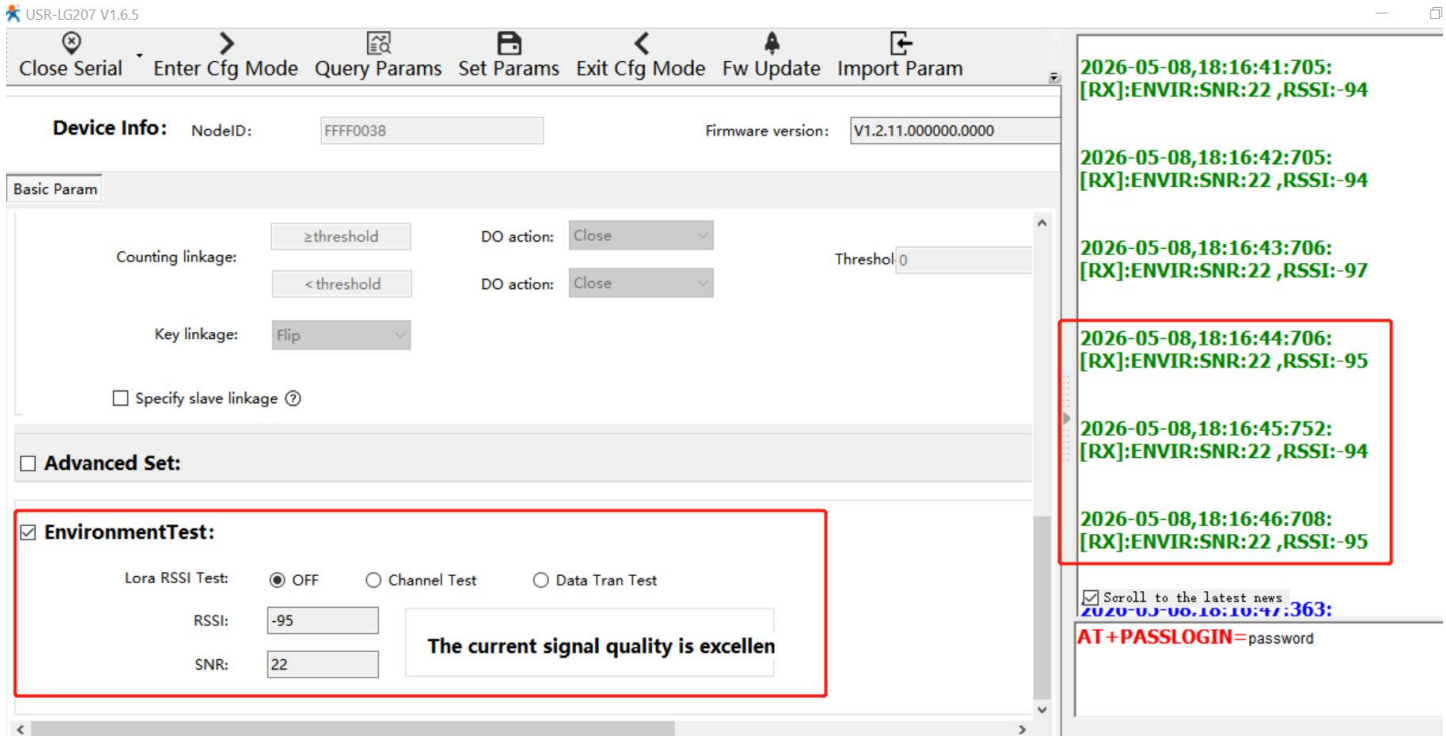
a. Protocol Selection: Select point-to-point protocol, keep the protocol version the same

b. Communication Frequency Band: Select the required working frequency band for the detection device

c. Communication Rate: Select the required working frequency band for the detection device

d. Target Address: Set according to the regulations of the selected function mode

(2) Upper Computer Software Usage Settings:



❖ Communication Example

Settings	**Channel Environment Detection**(Single Device Detection)	**Data Transmission Signal Detection**(2 or more devices, data transmission detection)	
Protocol Selection	Point-to-Point	Point-to-Point	Point-to-Point
Function	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)

Power Mode	RUN	RUN	RUN
Communication Frequency Band	8680	4800	4800
Communication Rate	10	10	10
Target Address	66	88	88
Environment Detection Selection	Channel Environment Detection	\ (Normal LORA device sends data)	Data Transmission Signal Detection
Data Transmission	Output via serial port every 3s(SNR\RSSI)value	Send: 123456	Received data printed via serial port: 123456+SNR+RSSI

3.5.2. Additional Data Transmission

❖ Function Description

Additional Data Transmission FunctionWhen enabled, the LoRa receiver can add the sender's node ID or node ID, SNR, and RSSI before and after the received data, effectively marking the data.

❖ Device Settings

(1) Parameter Settings:

a. Protocol Selection: Select point-to-point protocol, keep the protocol version consistent

b. Function Mode: Can select Transparent Transmission, Fixed Point, Master-Slave

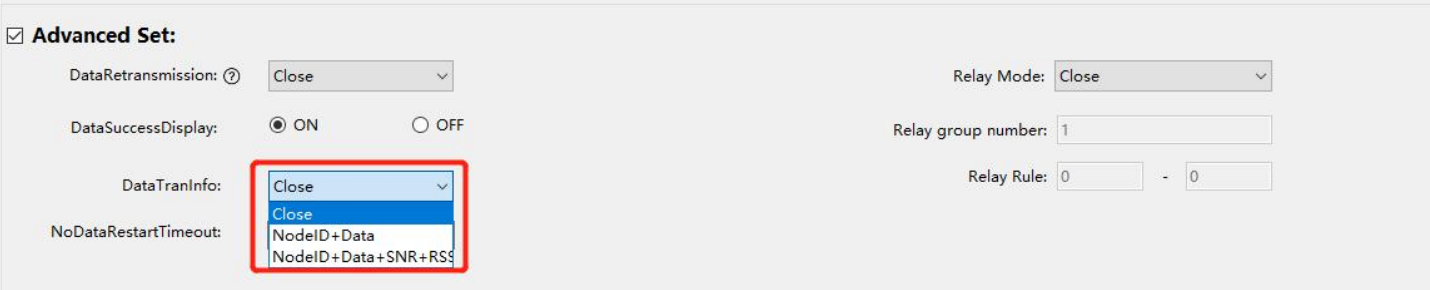
c. Power Mode: Sender selects WU, receiver selects LR

d. Communication Frequency Band: Set according to usage requirements for communication module devices

e. Communication Rate: Communication devices must have the same rate setting

f. Target Address: Communication devices 0-65535; when the sender sets 65535, other devices with the same frequency band and rate can receive the data

(2) Host Computer Software Usage Settings:



❖ Communication Example

Setting Item	Transmitter	Receiver	
Protocol Selection	Point-to-Point	Point-to-Point	Point-to-Point
Function	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)

Power Mode	RUN	RUN	RUN
Communication Band	8680	8680	8680
Communication Rate	10	10	10
Target Address	88	88	88
Additional Data Transmission	\	1 (Node ID + Data)	2 (Node ID + Data + SNR + RSSI)
Data Transmission	123456	Node ID + Data	Node ID + Data + SNR + RSSI

3.5.3. LBT Detection

❖ Function Description

When using LoRa data transmission, enabling the LBT function will perform environmental noise listening on the current frequency band before sending data. If the noise exceeds a certain threshold, data transmission will be delayed, which can greatly reduce data packet loss and errors, improving the success rate of data transmission in harsh environments.

3.5.4. Data Retransmission

❖ Function Description

This is another important guarantee function to ensure successful data transmission in harsh environments. Using this function allows for retransmission of lost data. During data transmission, an acknowledgment mechanism is enabled. After the transmitter sends data, it waits for a response from the receiver. If a response is received, it proves that the data was sent successfully. If no response is received within the timeout period, it is considered that the data transmission failed, and the data will be sent again. Up to 3 data retransmissions can be enabled.

3.6. Factory Default Parameters

Setting Category	Setting Function	Default Parameters	Remarks
Basic Parameters	Protocol Selection	Point-to-Point (2.0)	
	Data Transmission Function	Transparent Transmission (TRANS)	Fixed Point (FP), Master-Slave (MS)
	Power Consumption Mode	RUN	
	Wake-up Time	2000ms	Unit: milliseconds
	Rate	10	
	Receive Channel	8680	Unit: 100KHz, 4200-5250
	Transmit Power	22	Unit: dBm
	Target Address	0	0-65535
	Forward Error Correction	Coding Rate 4/5 (1)	4/6 (2), 4/8 (3)
	LBT	Enable (ON)	
	Baud Rate	115200	

	Parity\\Data\\Stop	n\\8\\1	
	Flow Control	NFC	
Serial Port Settings	Serial Port Packet Interval	10ms	Unit: ms, 2-250
	Echo	On (ON)	
	Data Retransmission	Off (0)	1 time (1), 2 times (2), 3 times (3)
	Acknowledgement Reply	Off (OFF)	
	LoRa Packet Length	240	Unit: byte, 32B, 64B, 128B, 240B
Advanced Settings	Additional Data Transmission	Disable (0)	
	Timeout No Data Restart	60	Unit: minutes
	Uplink/Downlink Frequency Division	Off (OFF)	
	Relay Function	Off (0)	
Environment Detection	LoRa Signal Detection	Off (0)	

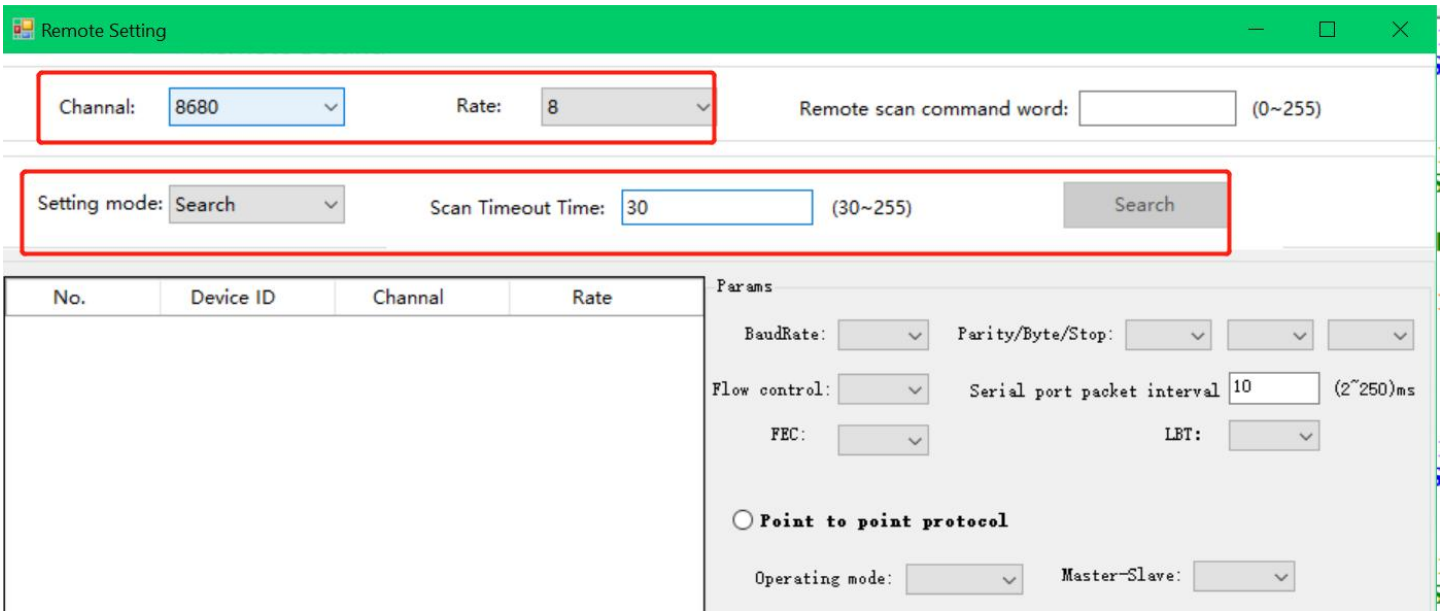
3.7. Remote Configuration

The wireless remote parameter reading function provides a method to remotely configure and read device parameters using host computer software or AT commands via node devices. It supports remote search for node configurations and configuration by specifying node IDs,greatly facilitating the debugging and maintenance of our products.

Note: The configuration terminal node device needs to operate in command mode.

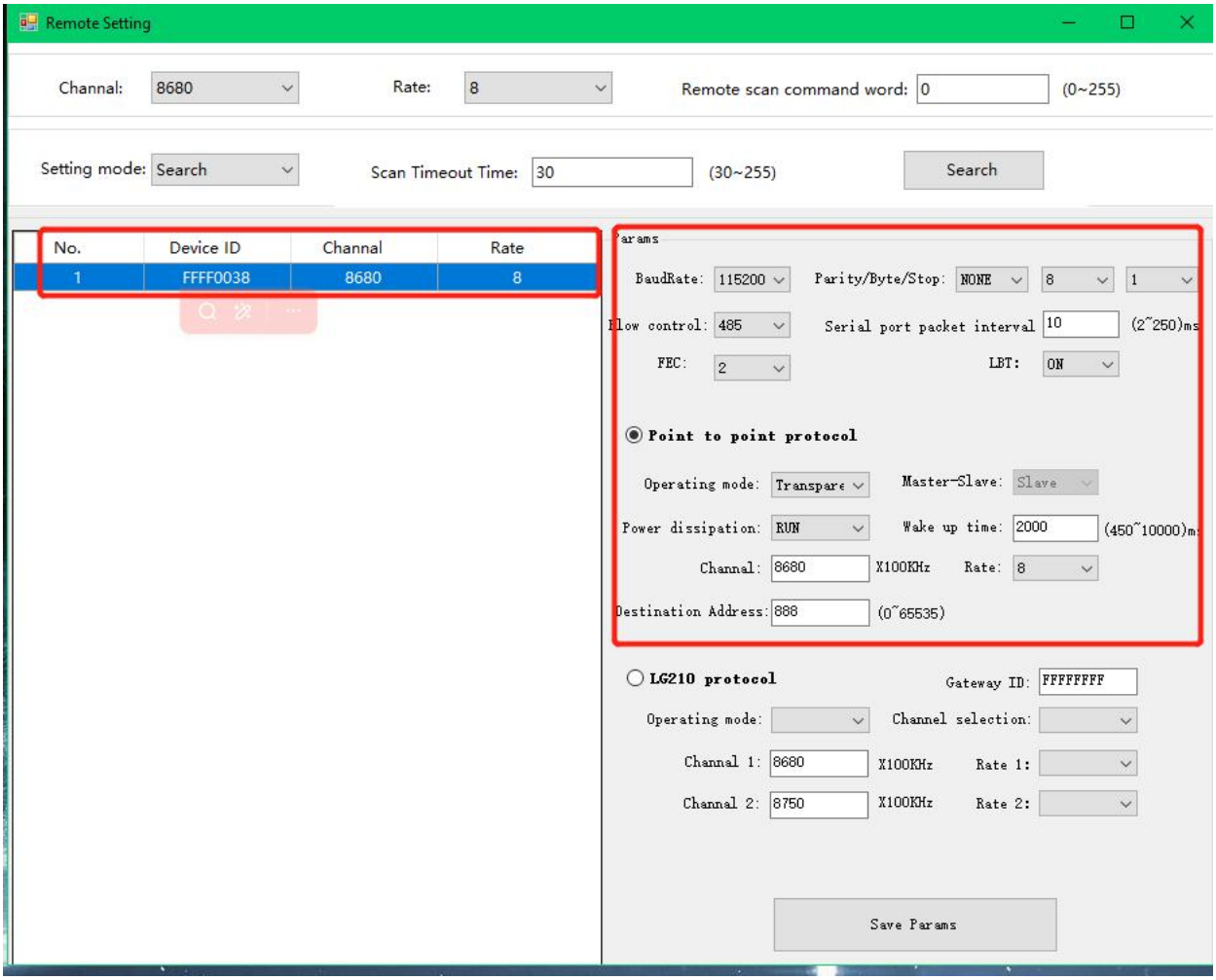
3.7.1. Specify Node Configuration

Remote configuration by specifying node ID requires configuration under the same channel and rate parameters.



3.7.2. Search Configuration

When configuring by searching for nearby nodes, the configuration terminal will search for discoverable nodes on the same channel and display these nodes in a list on the host computer. Users can simply select the target node and configure it via the parameter bar on the right side of the list.



3.7.3. Use of Remote AT Commands

Remote use of AT commands for setting requires following a specific protocol:

❖ Scan and search for devices: AT+SCANCMD=<CH>,<SPD>{{,<timeout>}}

Search return:

+SCANCMD:

1,<NID1>,<CH>,<SPD>

2,<NID2>,<CH>,<SPD>

3,<NID3>,<CH>,<SPD>

OK

Parameter definitions: <CH>: Frequency band; <SPD>: Rate level; <timeout>: Scan timeout, optional parameter, default is 10s, scan time supports 10-255, invalid after restart.

Note: Device information is output sequentially, ending with OK or ERR-5 upon timeout.

❖ Read specific device parameters: AT+READCMD=<NID>,<CH>,<SPD>,<#CH#VER#...#>

Device return:

+READCMD:#CH:8#VER:1.0.0.000000.0000#

OK

Parameter definitions:<NID>: Node ID; <CH>:Frequency band; <SPD>: Rate level ; <#CH#VER#...#>: Read parameters, supports reading multiple commands at once, commands separated by #, maximum response content length is 110 bytes.

Note: Timeout is 2S

❖ Remote parameter setting: AT+WRITECMD=<NID>,<CH>,<SPD>,<#CH=8#LBT=1#...#>

Device return: OK

Parameter definitions:<NID>: Node ID;<CH>: Frequency band; <SPD>: Rate level; <#CH=8#LBT=1#...#>: Parameter content, supports setting multiple parameters at once, commands separated by #, maximum content length is 110 bytes.

Note: Setting parameter commands require a restart to take effect. You need to send the parameter content <#Z#> command to restart the configured device. The timeout is 2 seconds.

3.7.4. Remotely Configurable Parameter Range

Supports remote settings. Point-to-point: Serial port parameters, Forward Error Correction (FEC), LBT, Work Mode, Master/Slave Selection, Power Consumption Mode, Channel, Rate, Transmit Power, Target Address; Point-to-LG210 Protocol: Serial port parameters, Forward Error Correction (FEC), LBT, Gateway ID, Work Mode, Channel Rate, Channel 1, Channel 2, Rate 1, Rate 2. Refer to the command documentation for parameter names and setting ranges.

3.8. Firmware Upgrade

❖ Firmware Upgrade Steps

Open the LoRa configuration software(SelectUSR-LG207-L-IO1)to enter. Open the serial port, click to enter configuration state, manually input AT+BOOT=1 to enter serial upgrade mode; or press the Reload button while powering on to enter serial upgrade mode. The nope rate as shown in the figure below.The numbers in the figure correspond to the following5steps:

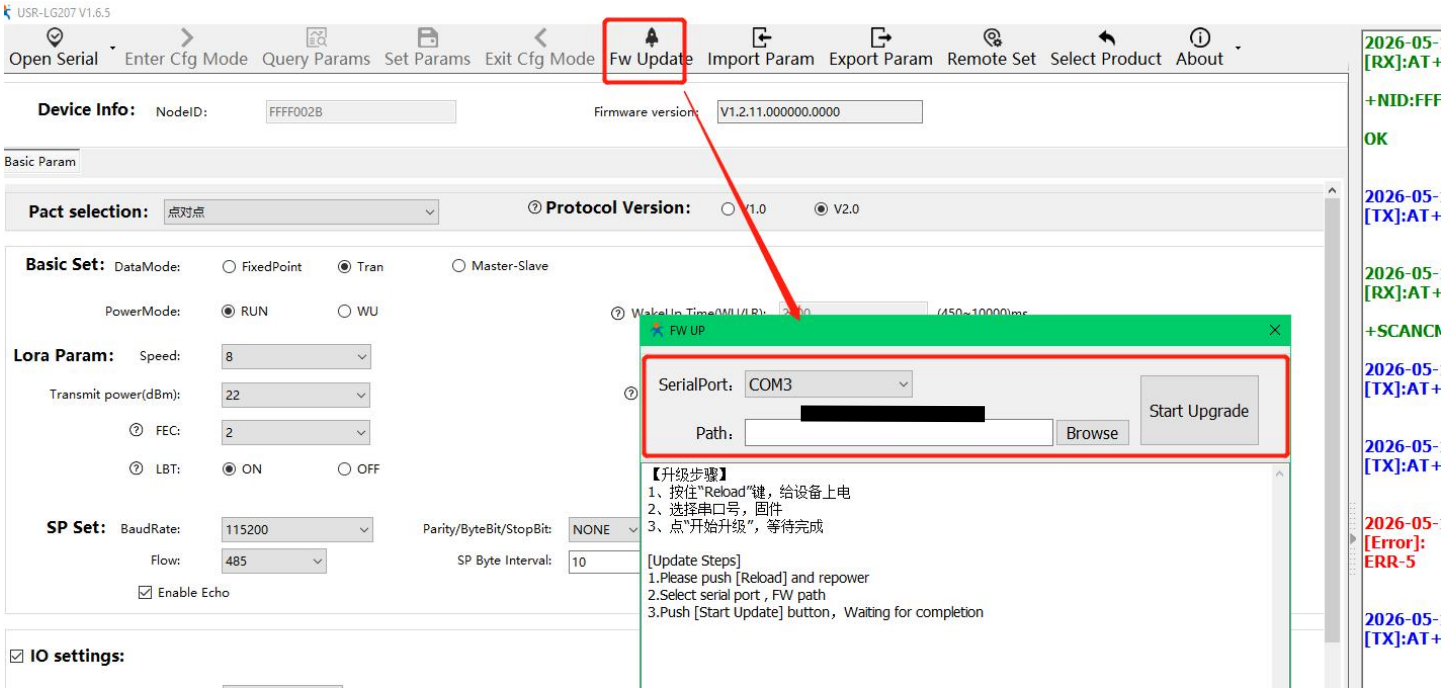


Figure1. Firmware Upgrade

(1) Click Firmware Upgrade via the configuration software;

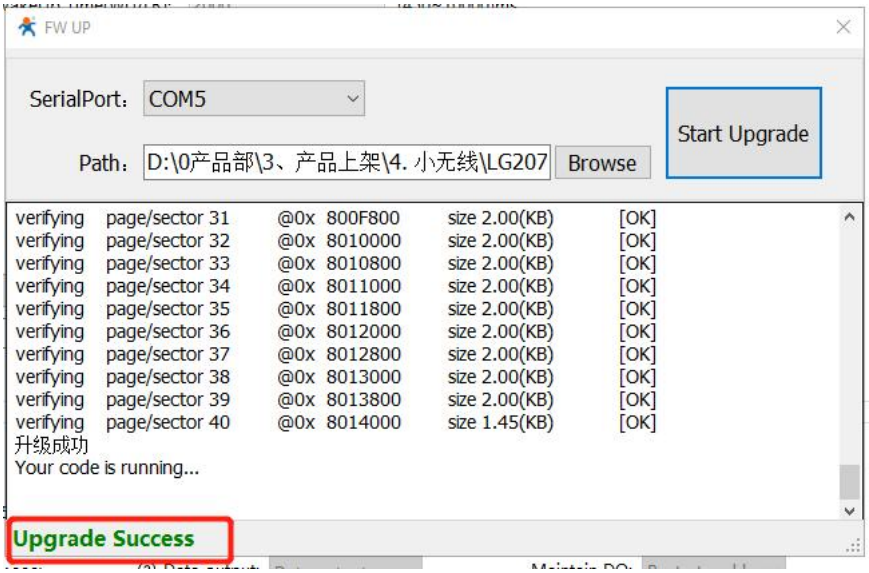
(2) Serial upgrade may restore parameters to factory settings. Select OK and follow the prompts to save. After saving, the "Firmware Upgrade" software will automatically pop up;

Select Cancel to directly open the "Firmware Upgrade" software;

(3) Select the corresponding serial port;

(4) Open the provided upgrade firmware (*.hex);

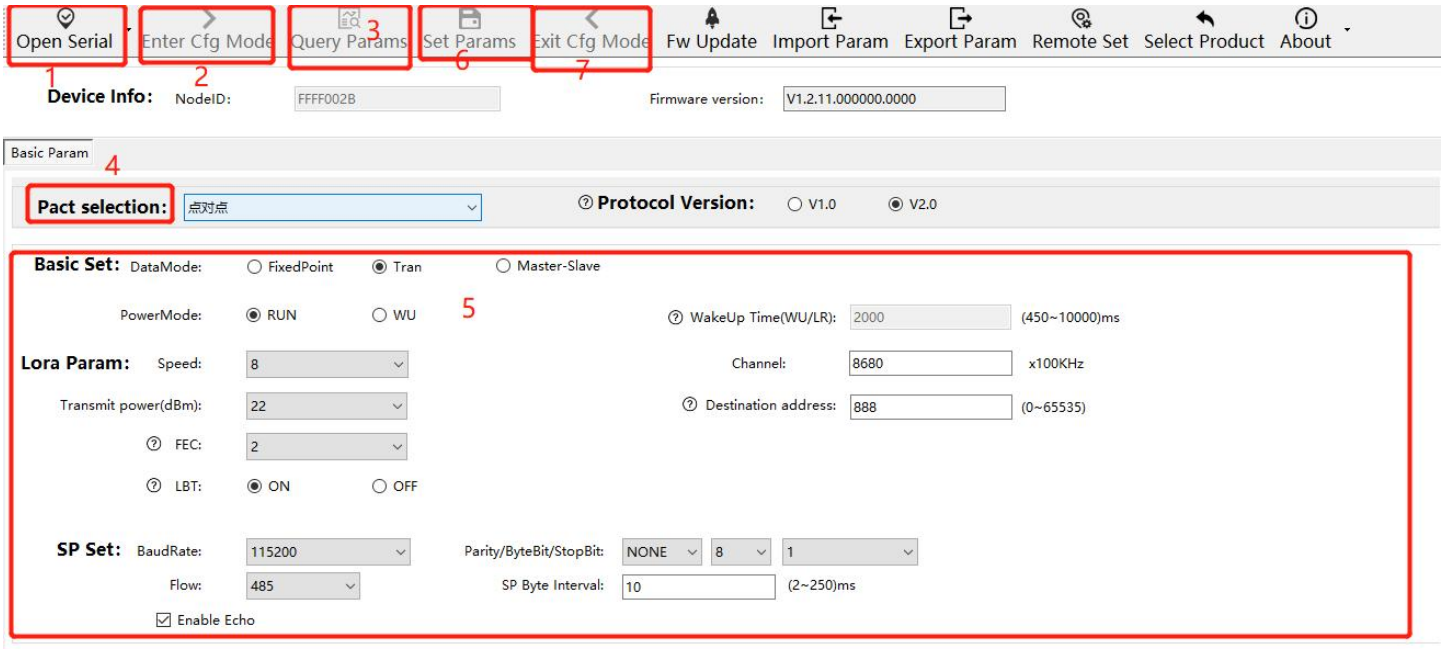
(5) Click Download and wait for the download to complete;



4. Host Computer Configuration Introduction

The product comes with general configuration software(AT Command Configuration Software)and dedicated configuration software, supporting parameter settings, which greatly simplifies user operations. It is recommended to use the dedicated configuation software to configure parameters.

This supporting configuration software is applicable toUSR-LG207-L-IO1for parameter reading and configuration.First, open the configuration software, select USR-LG207-L-IO1 to enter the configuration interface, and then follow the steps below (the numbers in the figure correspond to the following6steps in order):



(1) Click the serial port configuration button in the drop-down menu of the Open Serial Port button, select the serial port of the connection node, set the baud rate, parity bit, data bit, and stop bit to the corresponding parameters of the node. The default serial port parameters of the node are 115200, NONE, 8, 1. Click the Open Serial Port button.

(2) Click the Enter Configuration State button. If the node replies +OK, it means the node has entered AT command mode.

(3) Select Point-to-Point Protocol.

(4) Click the Read Parameters button, and the software will automatically read the node parameter information.

(5) You can view and modify node parameters in Basic Parameters.

(6) If reading parameters, click the Exit Configuration State button to exit AT command mode; if setting parameters, click the Set Parameters button, the software will automatically set the node parameters. After setting, the node restarts and the parameters take effect.

Supporting configuration software download address:

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

5. AT Command Introduction

5.1. AT Command Mode

❖ Command format for entering configuration

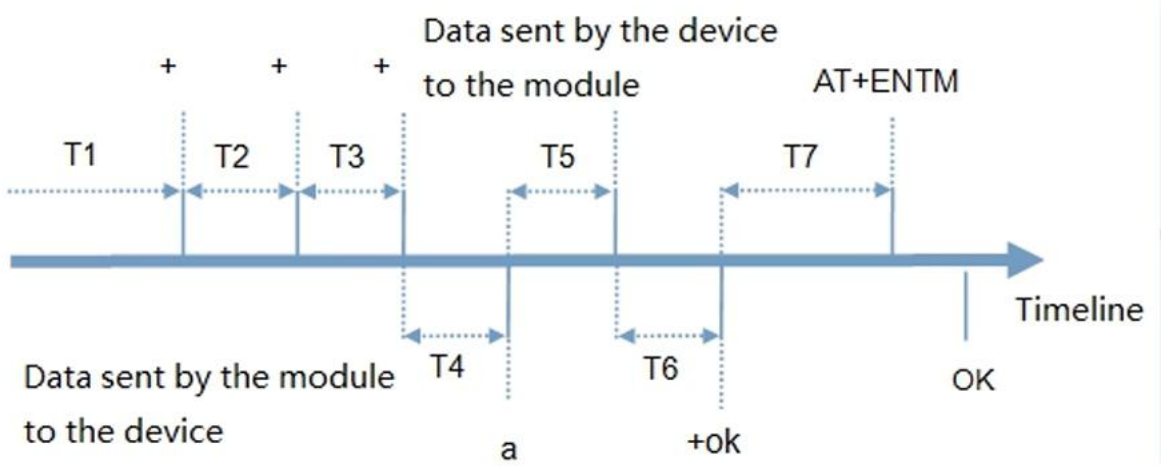
Device after successful power-on startup,if parameters need to be configured, you need to enter the AT command state via UART according to certain steps.

The default UART port parameters of the module are: baud rate 115200, no parity, 8 data bits, 1 stop bit.The steps to switch other modes to AT command mode are:

(1) Input "+++" on UART, the module will return a confirmation code "a" after receiving "+++";

(2) Input the confirmation code "a" on UART, after the module receives the confirmation code, it returns "+OK" confirmation,then successfully enter AT command mode;

Note: The module entering command mode needs to follow the timing requirements shown in the figure below:



Toggles the timing of command mode:

T2<300ms

T3<300ms

T5<3s

5.2. AT Command Error Codes

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 not allowed	

5.3. AT Command Format

Send command format: ends with carriage return<CR>, line feed<LF>or carriage return and line feed<CR><LF>

Type	Command String Format	Description	Example
0	AT+CMD? <CR><LF>	Query parameters	AT+VER? <CR><LF>
1	AT+CMD <CR><LF>	Query parameters	AT+VER<CR><LF>
2	AT+CMD=para <CR><LF>	Set parameters	AT+CH=66<CR><LF>

Module reply format (echo off):

Set parameters:**<CR><LF><CR><LF>OK<CR><LF>**

Query parameters:**<CR><LF> +CMD:PARA<CR><LF><CR><LF>OK<CR><LF>**

CMD: Command word

PARA: Parameter

5.4. AT Command Set

No.	Command	Description
		Basic Commands
1	ENTM	Exit AT command mode
2	E	Module AT command echo setting
3	Z	Restart module
4	CFGTF	Save current settings as default
5	RELD	Restore default settings
6	NID	Query module node ID
7	VER	Module firmware version
8	WMODE	Set/Query module working mode
9	UART	Set/Query serial port parameters
10	PMODE	Set/Query power consumption mode
11	SPD	Set/Query data rate level
12	ADDR	Set/Query address
13	CH	Set/Query channel
14	TXCH	Set/Query uplink/downlink frequency division function status and transmit channel

15	FEC	Set/Query Forward Error Correction (FEC) enable status
16	PWR	Set/Query transmit power
17	SQT	Signal strength display
18	KEY	Set data encryption key
19	SENDOK	Set/Query send completion reply flag
20	RFTM	Set/Query timeout for restarting RF when no LoRa data communication occurs
21	LBT	Set/Query channel state detection before transmission (currently using LBT method)
22	FDMODE	Set/Query uplink/downlink frequency division function
23	LORAPROT	Set/Query communication protocol version
24	PROTSEL	Set/Query Point-to-Point/LG210 protocol
		New Point-to-Point Function Protocol
25	MTU	Set/Query LoRa single packet length limit
26	RESEND	Set/Query data retransmission function
27	DATAMODE	Set/Query additional data transmission function
28	LORACSQ	Query/Set environment detection
29	RFTO	Query/Set no-data restart function
30	RELAY	Query/Set relay function switch
31	RELAYGID	Query/Set device group number under relay function
32	RELAYRULE	Query/Set relay function rules
33	TMODE	Query/Set master/slave mode
34	DIO	IO function switch
35	DIOUART	Modbus serial output without linkage function
36	DIOGROUP	IO group number
37	DIOADDR	IO slave number (Modbus slave address)
38	DIINVERT	DI active state inversion
39	DITIME	DI function debounce time
40	DOSAVE	DO soft reset output state
41	FDIOPEN	Enable local linkage function
42	FDIMODE	Configure IO linkage mode
43	FDIORULE	Configure linkage rules for each mode
44	FDIOSLAVEALL	Slave device table for polling control in linkage mode
45	FDIOSLAVEDEL	Delete polled device in linkage mode
46	FDIOSLAVEADD	Add polled device in linkage mode
		Gateway Protocol
47	NET	Query gateway working mode
48	CAD	Set/Query CAD detection
49	PNUM	Set/Query channel index
50	SPD1	Set/Query Channel 1 LoRa air data rate level
51	SPD2	Set/Query Channel 2 LoRa air data rate level
52	CH1	Set/Query Channel 1 channel
53	CH2	Set/Query Channel 2 channel
54	GWID	Set/Query Gateway ID
55	LBT	Set/Query channel detection function
56	RTO	Set/Query LoRa receive timeout
57	RELAYNET	Relay rule configuration for Point-to-210

		Remote Configuration Parameters
58	SCANCMD	Remote configuration search command
59	READCMD	Remote read parameter command
60	WRITECMD	Remote parameter setting
61	SCANWORD	Remote scan command word

6. Frequently Asked Questions

6.1. Poor Transmission Distance

The antenna is placed inside a metal casing or in a basement,which causes signal attenuation and results in shorter transmission distance.

Excessive line-of-sight obstacles will reduce the communication distance.

Heavy fog or rainy weather canaffect signal transmission, leading to a high packet loss rate.

Testing close to the ground yields poor results; generally, it needs to be more than 2 meters above the ground.

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

6.2. Device Damage Due to Improper Use

Before use, ensure that the power supply meets the recommended specifications. Exceeding the maximum value may damage the device.

During installation and use, pay attention to electrostatic discharge (ESD) protection to prevent damage to high-frequency components.

Ensure power supply stability and minimize fluctuations. Large fluctuations may cause component damage.

Avoid using the device in extremely low-temperature environments unless necessary. Also, beware of short circuits caused by condensation or corrosive gases.

6.3. Slow Data Transmission Speed

Using a low data rate results in slower transmission speed but longer transmission distance. Conversely, a higher data rate leads to faster transmission speed but relatively shorter transmission distance.

Using a low serial port baud rate results in slow data transmission.

6.4. Data Transmission Interference

Other devices operating on the same frequency band nearby. Change the channel or move away from the interference source.

Poor quality of antenna feeders or extension cables causes bit errors in signal transmission.

Significant noise on the baseboard interferes with data reception.

Unreasonable or non-compliant power supply settings cause garbled data.

7. Disclaimer

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8. Update History

Firmware Version	Update Content	Update Time
V1.0.1	Initial Release	2026-5-5