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2.4G LoRa DTU

USR-DR124

User Manual

Be Honest & Do Best

Your Trustworthy Smart Industrial IoT Partner

Content

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1. Product Introduction

USR-DR124 is a new generation LoRa wireless data transmission DTU developed based on Sx128x chip. It has high cost performance, high anti-interference and stability. Its working frequency band is 2.4-2.5GHz (default frequency 2.4GHz), operating range 8-24V; it can support point-to-point, point-to-multipoint use, RS485 serial port output.

1.1. Product features

- A new LoRa spread spectrum modulation technology based on Sx128x chip.
- Lipstick size, small size, guide rail installation.
- Pass-through transmission, fixed point, master slave transmission, applicable to a variety of transmission scenarios.
- Supports relay data transfer.
- Supports FLRC/LoRa modulation for high and low speed, medium and long distance transmission.
- High power transmission, 12/27dBm optional, up to 5-8 km.
- 2.4GHz unlicensed frequency band, supporting 2.4GHz-2.5GHz frequency band.
- Modbus is transparent, simple to use.
- Remote configuration parameters, support the application of the upper computer, instructions to wireless configuration of remote devices.
- LORA signal monitoring, indicator light display, can display the signal quality in data transmission and whether there is interference in the use frequency band, to ensure the stability of equipment transmission.
- The LBT function detects the channel environment interference noise before sending data, delays the transmission of noise when detected, prevents channel conflict, and ensures the success rate of equipment data communication.
- Data retransmission, data transmission interaction response mechanism, no response to retransmission, to ensure the reliability of data transmission.
- Data transmission encryption to improve the confidentiality of user data.
- The hardware watchdog function is carefully designed to prevent equipment downtime and abnormal occurrence, and can be quickly restarted and restored.

1.2. Application scenarios

- Wireless smart metering industry
- Wireless control of smart street lights
- Smart agricultural system, intelligent irrigation remote control
- Smart site equipment monitoring, tower crane operation status monitoring
- Smart oil field, oil well condition monitoring
- Smart home and industrial sensors
- Power distribution cabinet power detection, computer room monitoring
- Intelligent building energy monitoring

2. Basic parameters of the equipment

2.1. Specifications and parameters

Category	Specification Parameters	Parameter Range
Wireless Parameters	Wireless Solution	Sx128x
	Modulation Mode	LoRa/FLRC
	Operating Frequency Band	2.4GHz-2.5GHz
	Transmission Power	USR-DR124-27：27±1dBm USR-DR124-12：12±1dBm
	Receiver Sensitivity	-140dBm @0.268Kbps
	Operating Mode	Point-to-point, point-to-multipoint transmission
	Transmission Distance	Sunny, open environment, antenna gain 3dBi, height > 2m 27dBm maximum distance: 8000m @rate 1 12dBm maximum distance: 5000m @rate 1
Hardware Parameters	Serial Port	RS485：1200bps - 921600bps
	Operating Voltage	8V ~ 24V ， 12V recommended
	Operating Current	Transmitting current: 45mA @12V; Receiving current: 11mA @12V
	Weight	34g
	Operating Temperature	-40℃ ~ +85℃
	Operating Humidity	10~90%RH(no condensation)
	Antenna Option	SMA antenna connector (external thread, internal hole) with rod antenna
	Watchdog	Built-in hardware watchdog

2.2. Hardware interface description

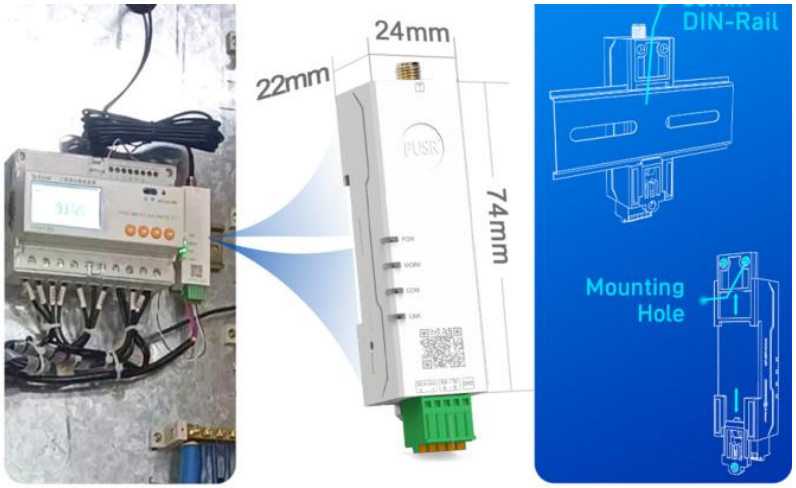
- This is explained as follows:

Name	Function Description	Remarks
Antenna Interface	SMA antenna connector (external thread, internal hole)	
Reload	Factory reset button	When the LoRa data transmission terminal is in normal working state (Work light flashes normally), press and hold for 3-15 seconds or more, then release. You can observe the TXD light flash once, which means the setting parameters of the LoRa data transmission terminal are restored to the factory configuration.
Power Interface	Terminal power supply	
RS485	RS485： A (+) \ B (-) \ G (GND)	Connect to 485 serial port devices, A connects to A, B connects to B

Instructions for indicator lights

Name	Function Description	instruction
POWER	Power indicator	Illuminates steadily when the power input is correct.
WORK	Working indicator	Blinks with a 2-second cycle during normal operation; stays on after network access.
COM	Serial data indicator	Red and green lights blink alternately when there is serial data communication (red for TX, green for RX) during data transmission.
LINK	Signal quality indicator	Indicator for LORA and FLRC signals: Red: For LORA modulation mode, blinks according to signal quality (judged by SNR and RSSI values) in three states: Steady on for excellent signal; blinks every 1 second for good signal; blinks every 3 seconds for poor signal. Green: For FLRC modulation mode, blinks according to signal quality (judged by SNR and RSSI values) in three states: Steady on for excellent signal; blinks every 1 second for good signal; blinks every 3 seconds for poor signal.

- External dimensions



3. Equipment function introduction

3.1. Function overview

functional	Equipment functions	Data transfer format	Function description
Data transfer mode	Transparent transmission	Data	Data
	broadcast transmission	Data	Data (The address of the broadcast equipment is 65535)
	Fixed-point transmission	address + channel+Data	The transmitted data can be flexibly selected for target receiving devices
	Master to slave transmission	address + Data	Master and slave transmission
Intermediate network	relay transmission	Data	Relay network, data transmission, improve the transmission distance
Multi-channel transmission stability mechanism	LBT check	\	Check whether there is interference in the frequency band before sending data
	Data retransmission	\	Start the response mechanism and resend the data after loss
	forward error correction	\	When the signal to noise ratio is low or the bit error rate is high, improve the correctness of data transmission
	Overtime restart without data	\	If the data is not sent and received within the specified time, it will restart
LORA, Signal detection	Channel environment detection	Device serial port output：SNR、RSSI	A single device detects whether there is interference in the current frequency band
	Data transmission signal detection	Output at the receiver：Data+SNR\RSSI	Data is transmitted between devices, and the received data carries signal values for output

	Link Signal indicator	The data transmission indicator shows the RSSI signal quality and intuitively feels the LORA signal situation	Indicator for LORA and FLRC signals: Red: For LORA modulation mode, blinks according to signal quality (judged by SNR and RSSI values) in three states: Steady on for excellent signal; blinks every 1 second for good signal; blinks every 3 seconds for poor signal. Green: For FLRC modulation mode, blinks according to signal quality (judged by SNR and RSSI values) in three states: Steady on for excellent signal; blinks every 1 second for good signal; blinks every 3 seconds for poor signal.
Other features	Remote configuration parameters	Host machine/instruction configuration	Specify node configuration
	Data transmission success sign	SEND OK	The sender sends the data, and the receiver receives the data , SEND OK
	Additional data transfer	Send： Data Receive： Node ID+Data Or Node ID+Data+SNR+RSSI	The receiver selects the additional data type
	LoRa, data packetization	\	Wireless data is output in packets of selected size

3.2. Mode details

3.2.1. Transparent data transfer

❖ function declaration

The transparent transmission protocol means that the transmission process of data does not affect the content of data, and the sent is the same as the received. Under the transparent transmission mode, two or more devices can maintain the same modulation mode, working frequency band, communication rate and communication address to achieve wireless data transmission without other operations.

❖ Equipment setup

(1) parameter setting：

a. Multi-transport mode: the sender and receiver select transparent transport

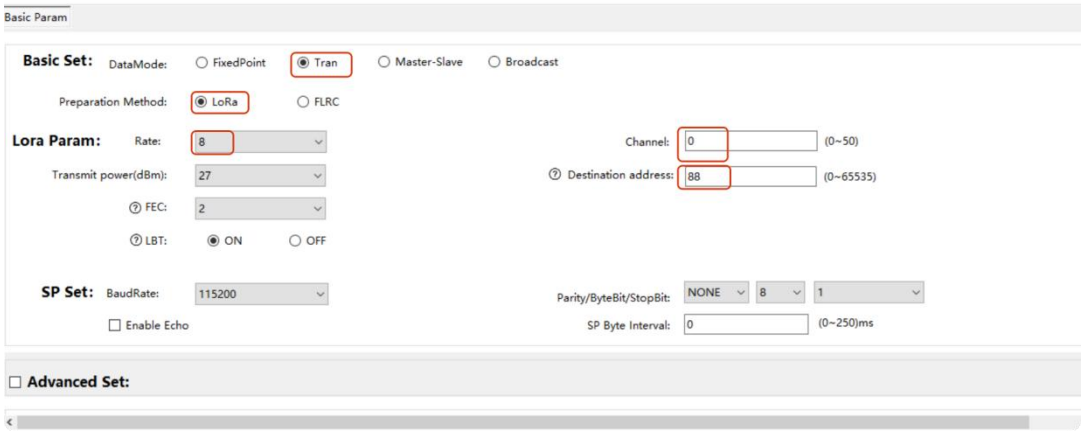
b. Modulation mode: The transmitter and receiver select the same modulation mode

c. Communication frequency band: Set the same frequency band

d. Communication rate: Set the same rate

e. Target address: Set the same target address

(2) Host computer software usage and Settings:



❖ Communication example

Setup items	Send	receive
function	transmission（TRANS）	transmission（TRANS）
modulation mode	LoRa	LoRa
frequency	0（2.4GHz）	0（2.4GHz）
Rate	8	8
destination address	88	88
data transmission	123456	123456

3.2.2. Broadcast data transmission

❖ Function declaration

In the device broadcast function, both the transmitting and receiving modes of the wireless LAN should be selected as broadcast. Any data sent by one party can be received by other devices.

❖ Equipment setup

(1) parameter setting：

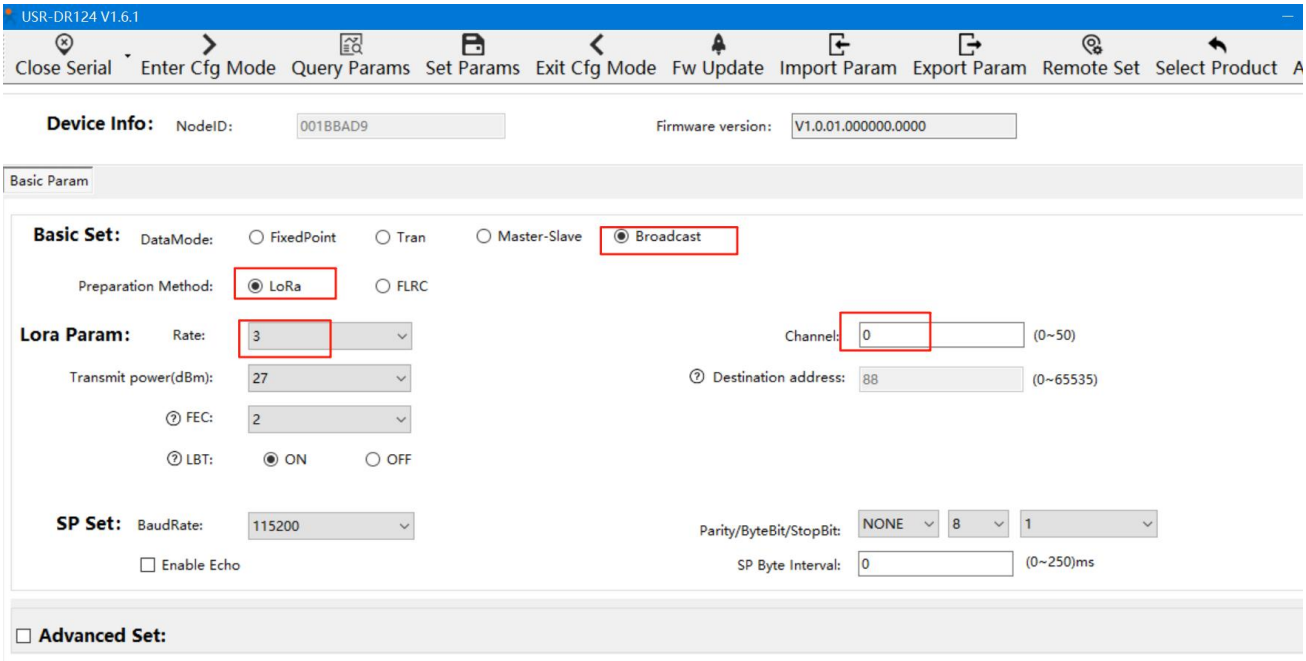
a. Multi-transmission mode: The sender and receiver select broadcast

b. Modulation mode: The transmitter and receiver select the same modulation mode

c. Communication frequency band: The communication equipment is set in the same frequency band

d. Communication rate: The communication equipment is set at the same rate

(2) Host computer software usage and Settings:



❖ Communication example

Setup items	Send	receive
Data transmission mode	broadcast	broadcast
Modulation mode	FLRC	FLRC
Frequency band	0（2.4GHz）	0（2.4GHz）
Rate	3	3
Data transmission	123456	123456

3.2.3. Fixed-point data transmission

❖ Function declaration

The fixed-point transmission protocol enhances transparent transmission by using the first two bytes of transmitted data as the destination address (high byte first) and the third byte as the channel identifier. The data format follows this pattern: Destination Address (16-bit) + Channel Identifier (16-bit) + Data. During transmission, the device dynamically modifies these parameters and reverts them after completion. This protocol's key advantage lies in its ability to flexibly adjust destination addresses and channels during data transmission, enabling seamless configuration changes for target modules.

❖ Equipment setup

(1) parameter setting：

a. Data transmission mode: The sending and receiving ends set the data transmission mode to fixed-point mode；

b. Modulation mode: The transmitter and receiver select the same modulation mode；

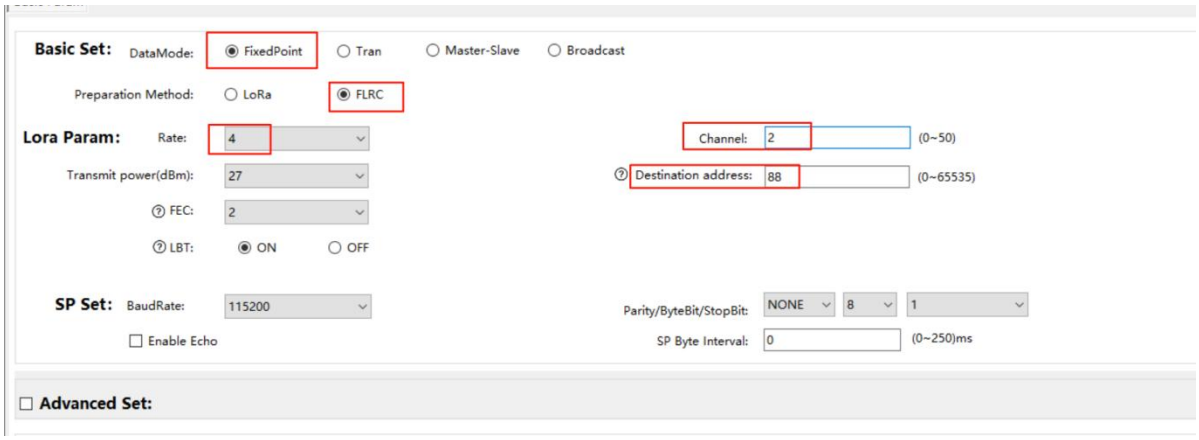
c. Communication frequency band: There is no limit to the frequency band set by the communication mode equipment；

d. Communication rate: The communication equipment is set at the same rate；

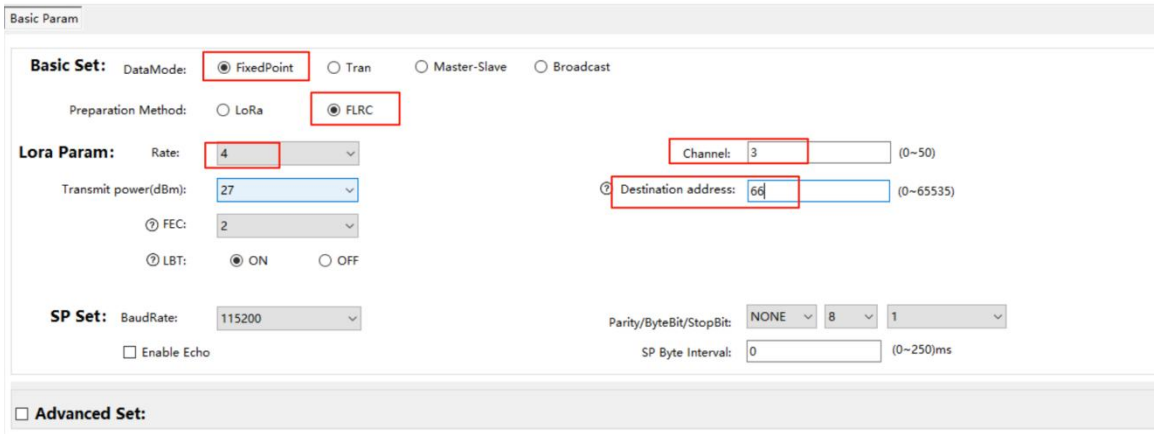
e. Target address: unlimited communication equipment, according to the target address of the receiving end (16 hexadecimal) + the channel of the receiving end (16 hexadecimal) + Data to send data.；

(2) Host computer software usage and Settings:

transmitting terminal：



Receiving terminal：



❖ Communication example

Setup items	sending	receiving
Data transmission mode	fixed point （FP）	fixed point （FP）
Modulation mode	FLRC	FLRC
Frequency band	2（2.404GHz）	3（2.406GHz）
Rate	4	4
Address	88	66
Data transmission	004203123456	123456

3.2.4. Master slave data transfer

❖ Function declaration

One master and multiple slaves. The master distributes data to the slave devices. The master needs to send data to the slave devices in the group according to the protocol format. The format is: Slave target address (16-bit, 1 byte) +Data. The slave sends data to the master (without following the data transmission protocol, directly sending).

❖ Equipment setup

（1）**parameter setting：**

a. Data transmission mode: Set the master-slave mode for the master and slave machines.

b. Master-slave machine setup: Select "master" at the master machine end and "slave" at the slave machine end.

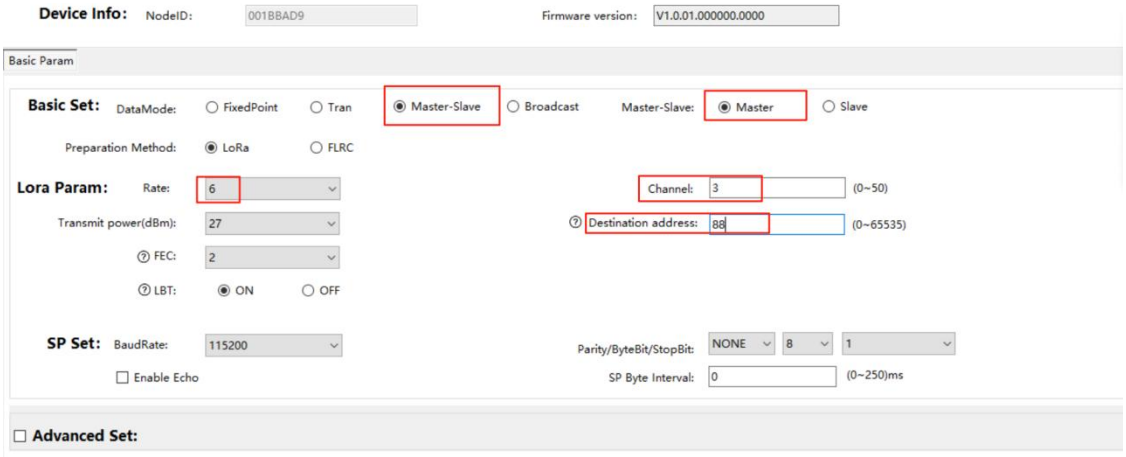
c. Modulation mode: The transmitting and receiving ends should choose the same modulation mode.

d. Communication frequency band: The communication module devices should be set to the same frequency band.

e. Communication rate: The communication devices should be set to the same rate.

f. Target address: No restrictions on the communication devices.

（2）**Host computer software usage and Settings:**



❖ Communication example

Setting Item	Transmitting End	Receiving End
Data Transmission Mode	Master - Slave (MS)	Master - Slave (MS)
Master - Slave Setting	Master (1)	Slave (0)
Modulation Mode	LoRa	LoRa
Communication Frequency Band	3 (2.406GHz)	3 (2.406GHz)
Communication Rate	6	6
Target Address	88	66
Data Transmission	0042123456	123456

3.2.5. Relay network transmission

❖ Function declaration

The relay networking function is mainly used to increase the transmission distance and data penetration performance. After the equipment used in the relay networking is set to relay mode, the relay starts to work.

(1) Basic logic of relay networking

Network terminal: In the relay network, the device with this mode is set to receive the relay data (same group number and the same target address), and then it will not forward it directly to the serial port. It can be used in the receiving terminal.

Network relay: Relay networking equipment needs to be enabled. After network relay, when the receiving device receives LORA and data, it will judge the data protocol byte. If the data is received

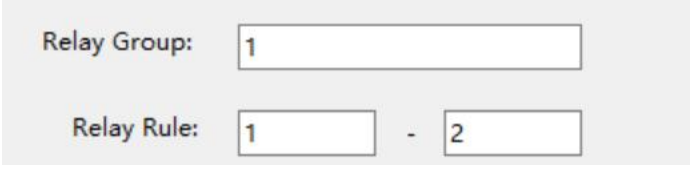
If the group number and address in the message match the receiver's own, the device will directly output to the serial port without forwarding. If they don't match, the receiver will check whether the relay group number in the data aligns with the relay forwarding rules. If it does, the data will be forwarded; otherwise, it will be discarded.

The relay function supports three transmission modes: fixed-point transmission, master-slave transmission, and broadcast-through. It transmits data according to the protocol format of each mode. For example, in master-slave mode: the transmitting end is configured as the host mode, while the final receiving end is set as the slave mode.

Data transmission follows the format: Slave Target Address (16-bit) + Data. The slave directly sends data to the host without following the data transmission protocol. The relay module then forwards the data according to the relay network transmission logic.

Group number carried in the data: After the relay rule is set, the group number is converted according to the relay rule when the receiver receives the data.

Relay Rule: When the group number carried in the data received by the receiving end is consistent with the input value in the relay rule, the group number carried in the data will be converted to the output value specified in the relay rule and output as the current group number.



Attention:

（1）All devices in the relay network must be set to use the same frequency band and data rate.

（2）Only devices with the relay function enabled can communicate with each other. Devices that can send/receive relay data packets but do not have the relay function themselves can only operate in the network relay mode to acquire relay capabilities.

（3） Group number, relay rules, and example of target address relationship

Setup items	sending end	Relay 1	Relay 2	receiving end
Relay Mode	network terminal	Network relay	Network relay	network terminal
group number	1	default	default	3
Relay Rules	**/**	**1-2**	**2-3**	**/**
Target Address	66	77	88	66
Description	**Relay 1 Device**: Set relay rule 1 - 2. It means: Receive the data sent to group number 1, change the group number to 2, and can transmit the received data from the sending end to the device of Relay 2 (where group number 2 is included in the relay rule). **Relay 2 Device**: Set relay rule 2 - 3. It means: Receive the data of group number 2 from Relay 1, change the group number to 3, and can transmit the received data from Relay 1 to the next device with group number 3. **Receiving End**: Set to network terminal mode. When receiving wireless data with the same target address and the same group number, it will no longer forward, but directly output to the serial port.			

❖ Equipment setup

(1) parameter setting：

a. **Data transmission mode:** Both the transmitting and receiving ends select transparent transmission.

b. **Modulation mode:** The transmitting and receiving ends select the same modulation mode.

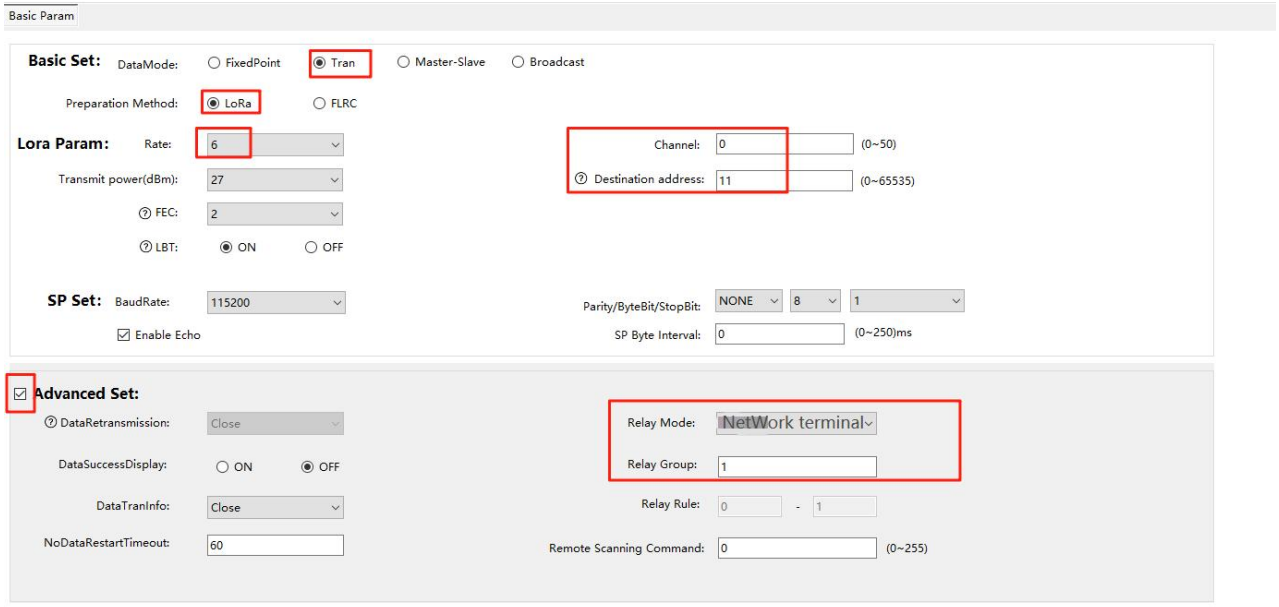
c. **Relay mode:** Turn on the relay switch, and set the relay group number and relay rules with reference to the example of (2) group number, relay rules, and target address relationship.

d. **Communication frequency band:** The communication modules/devices shall be set to the same frequency band.

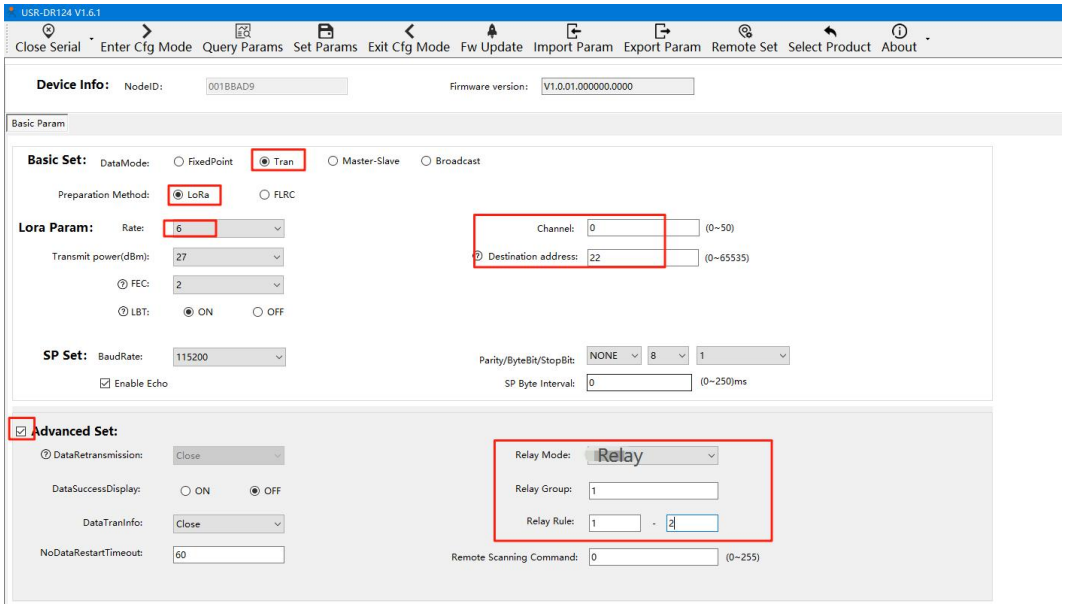
e. **Communication rate:** The communication devices shall be set to the same rate.

f. **Target address:** The transmitting end device and the relay device shall be set with different target addresses, or set with reference to (1) the basic logic of relay networking and (2) the example of group number, relay rules, and target address relationship; the target address of the receiving end device shall be consistent with that of the previous relay device.

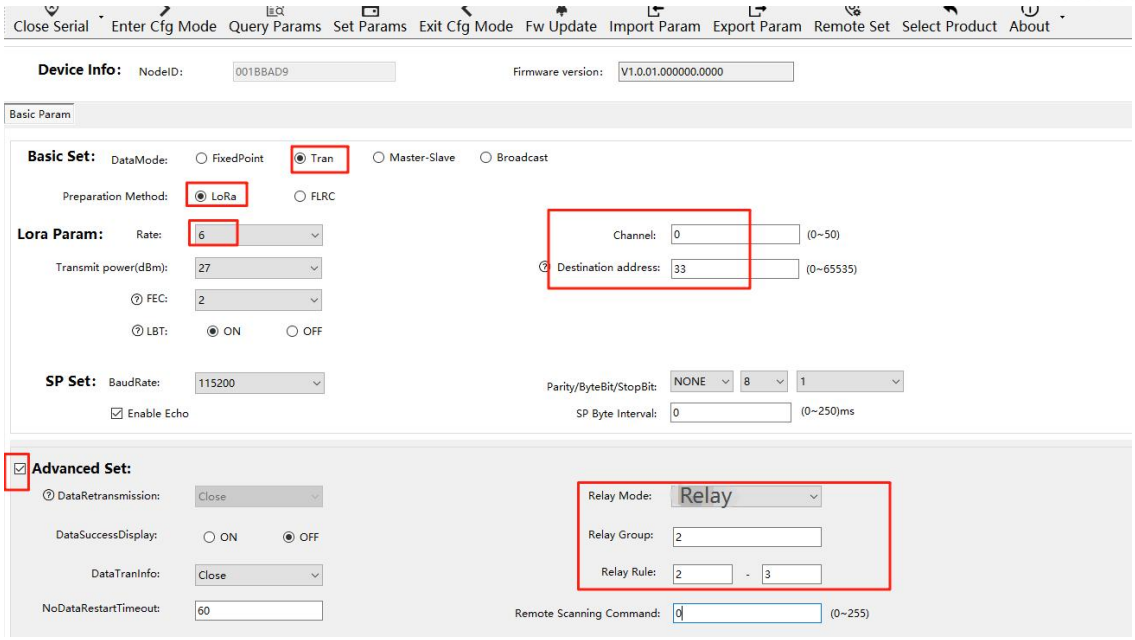
(2) Software Settings transmitting terminal：



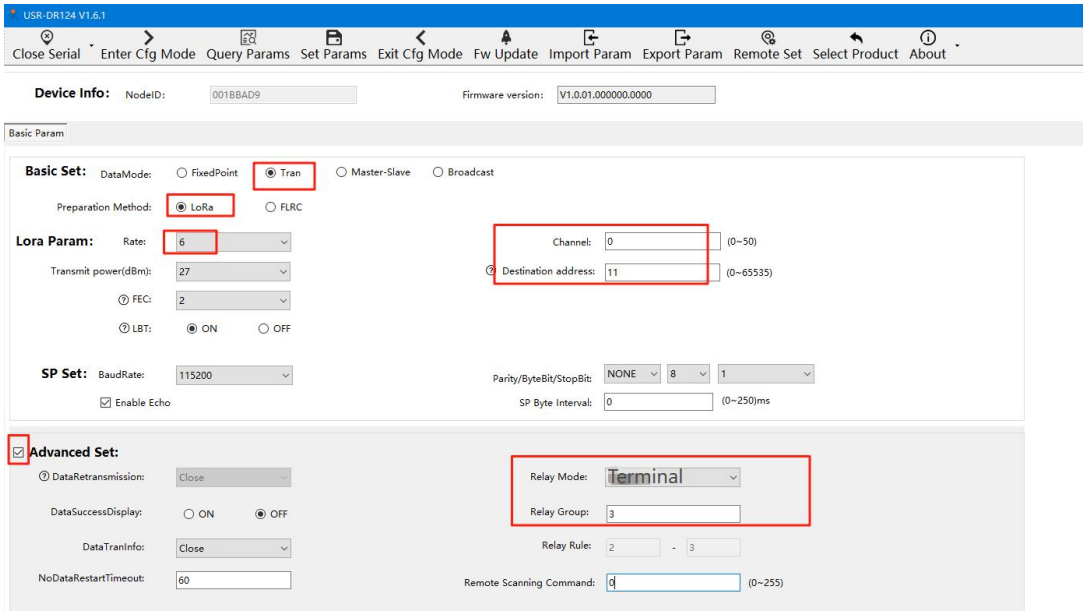
Relay 1:



Relay 2:



Receiving terminal :



- Communication example

Setting Item	Transmitting End	Relay 1	Relay 2	Receiving End
Data Transmission Mode	Transparent Transmission	Transparent Transmission	Transparent Transmission	Transparent Transmission
Modulation Mode	LoRa	LoRa	LoRa	LoRa
Communication Frequency Band	0	0	0	0
Communication Rate	6	6	6	6
Relay Mode	Network Terminal	Network Relay	Network Relay	Network Terminal
Relay Group Number	1	1	2	3
Relay Rule	/	1 - 2	2 - 3	/
Target Address	11	22	33	11
Data Transmission	Send 123456	Receive 123456 and transmit to Relay 2	Receive 123456 and transmit to the next - level device	Receive 123456 and no longer transmit; print data to serial port

3.3. Other functions are detailed

3.3.1. LoRa signal detection

❖ function declaration

The signal detection function can, during use, determine whether there is interference in the operating frequency band of the LORA devices deployed on - site and the quality of the output signal during the LORA wireless data transmission process. Based on the signal instructions, it can judge whether the distance arrangement between wireless devices is reasonable; the LoRa signal detection function helps users to a large extent to reasonably select LORA parameters suitable for on - site applications, ensure the stability of data transmission, and save debugging time.

（1）Channel environment detection: Detection for a single device. After enabling this function, the device will read the signal quality in the current environment at 1 - second intervals and output (SNR\RSSI) values through the serial port at 3 - second intervals. Generally, if the RSSI value is lower than - 100dBm and the SNR is lower than 0dB, it means there is interference from other objects in this operating frequency band, and the frequency band needs to be changed for use.

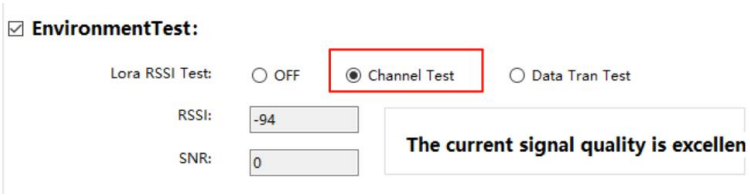
（2）Wireless data transmission signal detection: Requires 2 or more devices to be able to transmit data; after enabling the function, when the device receives data from the transmitting end each time, it will carry the instantaneous (SNR\RSSI) when receiving the data and output it through the serial port after the data. Generally, if the RSSI value is lower than - 110dBm and the SNR is lower than - 5dB, it means that the distance between LORA devices is too far or there are too many obstacles in between. Then, the working rate can be reduced and the distance between devices can be decreased. Note: The FLRC modulation method only supports detecting the RSSI value.

❖ Equipment setup

(1) Parameter Settings:

a. **Data Transmission Mode**: Select transparent transmission for both the transmitting and receiving ends.
b. **Modulation Mode**: Select the same modulation mode for both the transmitting and receiving ends.
c. **Communication Frequency Band**: Set the same frequency band.
d. **Communication Rate**: Set the same rate.
e. **Target Address**: Set according to the specified rules of the selected function mode.
f. **Environment Detection**: Turn on the LoRa signal detection switch and select.

(2) Software Settings:



❖ Communication example

Setting Item	Channel Environment Detection (Single-device Detection)	Data Transmission Signal Detection (Detection for 2 or More Devices, Data Transmission Detection)	
Data Transmission Mode	Transparent Transmission	Transparent Transmission	Transparent Transmission
Modulation Mode	LoRa	LoRa	LoRa
Channel	0	0	0
Rate	8	8	8
Target Address	66	88	88
Environment Detection Selection	Channel Environment Detection	Data Transmission Signal Detection	Data Transmission Signal Detection
Data Transmission	Output (SNR\RSSI) values via serial port at 3-second intervals	Send: 123456	Receive data and print via serial port: 123456+SNR+RSSI

3.3.2. Additional data transfer

❖ Function declaration

After the additional data transmission function is enabled, when the device receives wireless data, it can add the node ID of the sending device before and after the data frame, or add the node ID, SNR (signal to noise ratio) and RSSI (received signal strength indicator) at the same time, so as to effectively mark the data.

❖ Equipment setup

(1) parameter setting：

a. Data transmission mode: the sender and receiver select transparent transmission

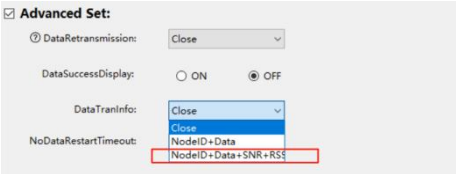
b. Modulation mode: The transmitter and receiver select the same modulation mode

c. Communication frequency band: the same frequency band is set

d. Communication rate: Set the same rate

e. Target address: Set the same target address

(2) Host computer software Settings:



❖ Communication example

Setting Item	Transmitting End	Receiving End	
Data Transmission Mode	Point-to-Point	Point-to-Point	Point-to-Point
Modulation Mode	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)	Transparent Transmission (TRANS)
Channel	0	0	0
Rate	10	8	8
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

3.3.3. LBT check

❖ function declaration

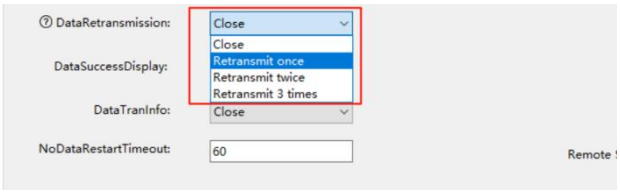
When using LoRa data transmission, the LBT function is enabled. Before sending data, the ambient noise of the current frequency band is listened to. If the noise exceeds a certain threshold, the data will be sent with delay, which can greatly reduce packet loss and packet error and improve the success rate of data transmission in harsh environment.

3.3.4. Data retransmission

❖ function declaration

This critical feature ensures data transmission success in challenging environments by enabling data retransmission. During data transfer, it activates a response mechanism where the sender waits for feedback after transmitting data. Upon receiving confirmation, the transmission is deemed successful. If no response is received within the timeout period, the transmission is considered failed and will be attempted again, with a maximum of three retransmissions allowed.

Note: Retransmission is not supported in relay mode



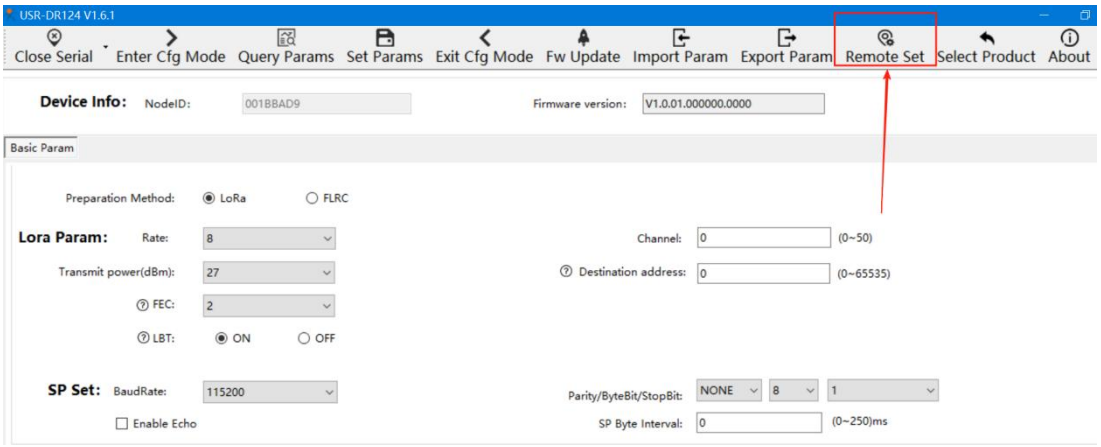
3.4. Remote configuration

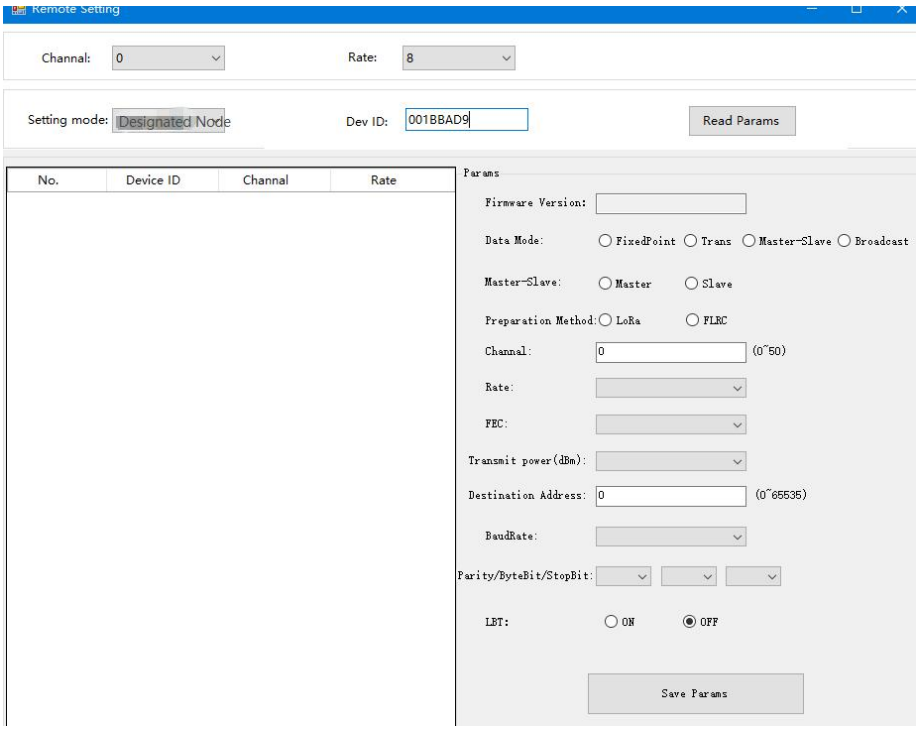
The wireless remote reading configuration parameter function provides a way to remotely configure and read device parameters through node devices using upper-level computer software and AT instructions. It supports remote search of node configuration and specified node ID configuration, which greatly facilitates the debugging and operation and maintenance of our products.

Note: Configuration end node devices need to operate in instruction mode.

3.4.1. Specify node configuration

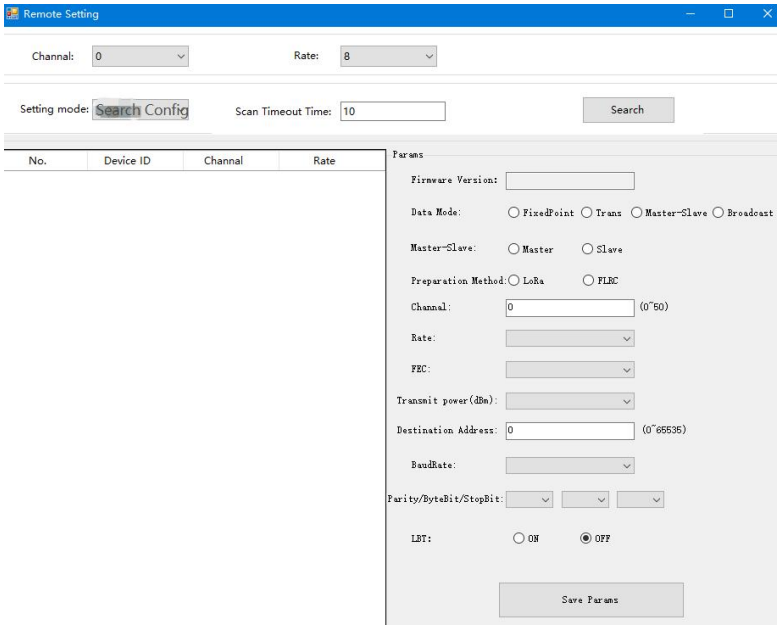
To configure a remote specified node through the node ID, you need to configure the parameters of channel and rate.





3.4.2. Search configuration

When configuring by searching nearby nodes, the configuration terminal searches for discoverable nodes on the same channel and displays these nodes in a list format on the host computer. Users only need to select the target node and configure it through the parameter bar on the right side of the list.



3.4.3. Use of remote AT commands

The remote use of AT command setting needs to follow a certain protocol for setting:

- Scan search devices:

AT+SCANCMD=<CH>,<SPD>{{,<timeout>}} Search returns

+SCANCMD:

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

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

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

OK

Parameter definition: <CH> Channel number 0-50; <SPD> Rate level LoRa: 1-8 FLRC: 1-6; <Timeout> Scan timeout, optional parameter, default is 10s, scan time support 10-255, restart invalid.

Note: The device information is output in sequence, and OK or ERR-5 is returned after the arrival time.

- Read specific device

parameters:AT+READCMD=<NID>,<CH>,<SPD>,<#CH#VER#...#>

Device return:

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

OK

Parameter definition <NID>: node ID; <CH>: channel number 0-50; <SPD>: rate level LoRa: 1-8 FLRC:1-6; <#CH#VER#...#>: read parameter, support multiple instructions at a time, instructions are separated by #,

the maximum length of response content is 110 bytes.

Note: The timeout time is 2S

- Remote configuration parameters: AT+WRITECMD=<NID>,<CH>,<SPD>,<#CH=8#LBT=1#...#>

Equipment returned : OK

Parameter definition: <NID> Node ID; <CH> Channel number 0-50; <SPD> Rate level LoRa: 1-8; Parameter content FLRC:1-6;<#CH=8#LBT=1#...#> Parameter content, support setting multiple parameters at a time, command with # interval, content length up to 110 bytes.

Note: Setting a parameter command requires a restart to take effect. Send the parameter content <#Z#> command and restart the configured device. The timeout time is 2 seconds.

3.4.4. Remote parameter ranges can be set

Supports remote setting of data transmission mode, master and slave machine selection, channel, rate, transmission power, forward error correction, target address, LBT, serial port parameters, etc. The parameter name and setting range can be referenced from the instruction document.

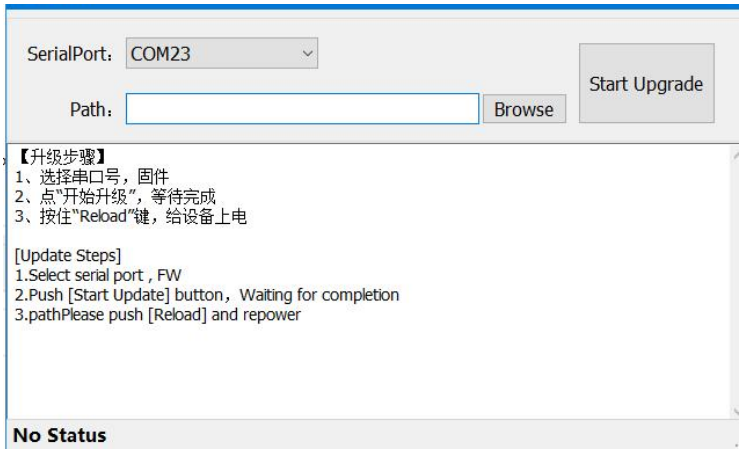
3.5. Factory default parameters

Setting Category	Setting Function	Default Parameter	Remarks
Basic Parameters	Data Transmission Mode	Transparent Transmission	Fixed - point, Master - Slave, Broadcast
	Modulation Mode	LoRa	LoRa, FLRC Optional
	Rate	10	
	Channel	0	2.4GHz
	Transmit Power	27	12, 27; Unit: dBm
	Target Address	0	0 - 65535
	Forward Error Correction	Code Rate 4/5 (1)	4/6 (2), 4/8 (3)
	LBT	On (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	1 Time, 2 Times, 3 Times
Advanced Settings	Data Transmission Carrying Information	Off	Node ID + Data; Node ID + Data + SNR + RSSI
	Restart on Timeout with No Data	60	Unit: Minute
	Relay Function	Off	Network Terminal, Network Relay Optional
	Remote Scan Command Word	0	0 - 255
Environmental Detection	LoRa Signal Detection	Off	

3.6. Firmware upgrade

❖ Solid state upgrade steps

To configure the LoRa device: 1) Open the settings software (select USR-DR206),2) Connect to the serial port, 3) Click to enter configuration mode, 4) Manually enter AT+BOOT=1 to activate serial port upgrade mode. Alternatively, set the device's Reload pin to low and power it on to enable serial port upgrade mode. Then follow the steps illustrated in the diagram below, where numbered steps correspond to the following five procedures:



(1) Click "Firmware Upgrade" via the configuration software.

(2) Serial port upgrade may cause parameters to revert to factory settings. If you select "Confirm", follow the prompts to save. After saving, the "Firmware Upgrade" software will pop up automatically; if you select "Cancel", the "Firmware Upgrade" software will open directly.

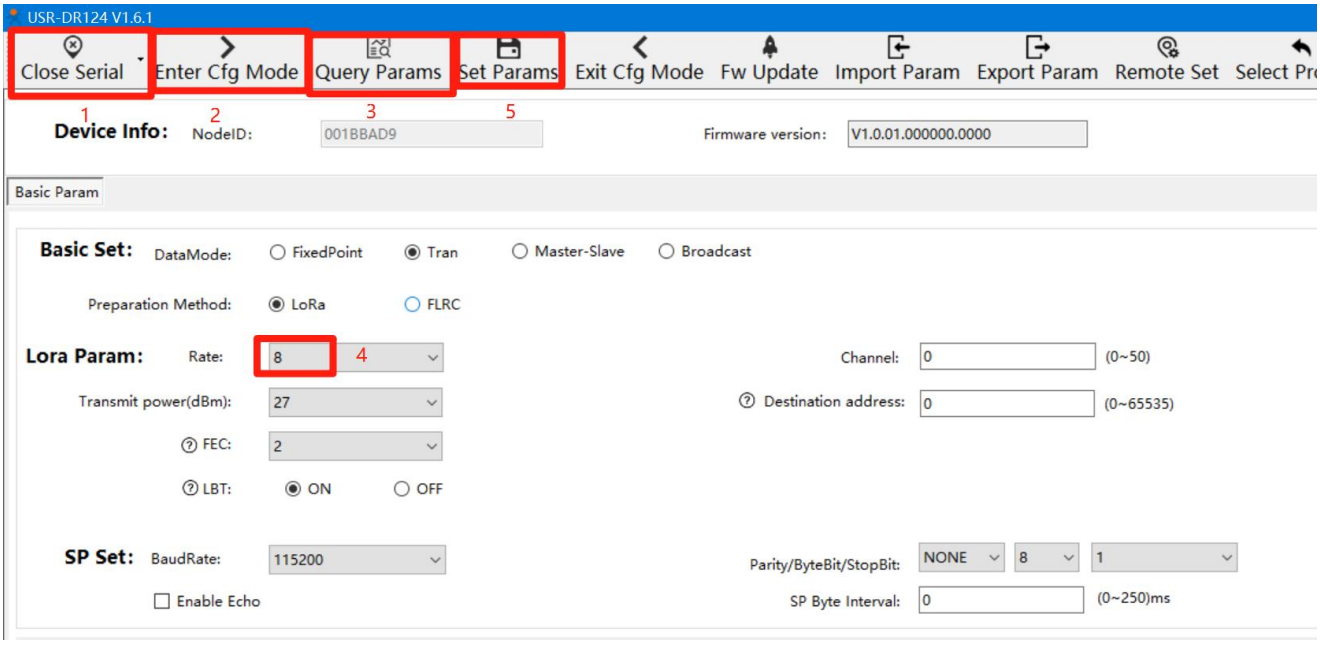
(3) Select the corresponding serial port.

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

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

4. Introduction to Upper Computer Configuration

This supporting configuration software is applicable for parameter reading and configuration of USR - DR124. First, open the configuration software, select USR - DR124 to enter the configuration interface, and then operate according to the following steps (the serial numbers in the figure correspond to the following 5 steps in sequence):



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

(2) Click the “Enter Configuration Status” button, and the node will reply +OK, meaning the node enters the AT command mode.

(3) Select the 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 the node parameters in the basic parameters.

(6) If you are reading parameters, click the “Exit Configuration Status” button to exit the AT command mode; if you are setting parameters, click the “Set Parameters” button, and the software will automatically set the node parameters. After the setting is completed, the node will restart and the parameters will take effect.

Download address of the supporting configuration software: https://www.usr.cn/Download/1294.html

5. AT Command

5.1. AT command order mode

- Enter the configuration command format

After the device is powered on and starts up successfully, if parameter configuration is required, it is necessary to enter the AT command state through UART following a certain procedure. The default UART port parameters of the module are: baud rate 115200, no parity, 8 - bit data bit, 1 - bit stop bit.

The procedure for switching from other modes to the AT command mode is as follows:

(1) Input "+++" on UART. After the module receives "+++", it will return a confirmation code "a".

(2) Input the confirmation code "a" on UART. After the module receives the confirmation code, it returns "+OK" for confirmation, and then successfully enters the AT command mode. Note: The module needs to follow the timing sequence requirements as shown in the following figure to enter the command mode.

5.2. AT Command Error Codes

Return Code	Return Description
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

Sending command format: End with carriage return <CR>, line feed <LF>, or carriage return + line feed <CR><LF>

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

Module Reply Format (Echo Disabled)

Setting Parameters: <CR><LF><CR><LF>OK<CR><LF>

Querying Parameters: <CR><LF> +CMD:PARA<CR><LF><CR><LF>OK<CR><LF>

CMD: Command word

PARA: Parameter

5.4. AT Command Set

Number	Command	Description
1	ENTM	Exit AT command
2	E	Module AT command echo setting
3	Z	Restart module
4	CFGTF	Save current settings as default settings
5	RELD	Restore default settings
6	NID	Query module node ID
7	AT+MODEL	Set/query device model number
8	SN	Query module node SN
9	VER	Module firmware version
10	WMOD	Set/query module working mode
11	UART	Set/query serial port parameters
12	UARTFT	Set/query serial port packet interval time parameter
13	RF	Set/query frequency parameter
14	ADDR	Set/query address
15	FEC	Set/query whether forward error correction is enabled
16	POWER	Set/query transmit power
17	CSQ	Set/query signal detection
18	ENC	Set/query encryption switch
19	AT+ENCKEY	Set data encryption key
20	SENDOK	Set/query transmission completion reply flag
21	RFTM	Set/query timeout for module LoRa data communication to restart frequency hopping
22	AT+LOG	Set/query log switch
23	LBT	Set/query whether to enable channel status function before sending (currently detected by LBT method)
24	SCANCMD	Remote search device command
25	READCMD	Remote parameter reading command
26	WRITECMD	Remote parameter setting command
27	SCANWORD	Set/query data retransmission function
28	RESEND	Set/query data retransmission function
29	DMOD	Set/query additional data transmission function
30	LORACSQ	Query/set environment detection
31	RFTO	Query/set no - data restart function
32	RELAY	Query/set relay function switch
33	RELAYGID	Query/set device group ID for relay function
34	RELAYRULE	Query/set relay function rules

6. Common Problems

6.1. Unideal Transmission Distance

✧ If the antenna is placed inside a metal shell or in a basement, the signal will be attenuated, resulting in a short signal distance.

✧ When there are too many obstacles for straight - line communication, the communication distance will be attenuated.

✧ Heavy fog or rainy days will affect signal transmission, leading to a high communication packet loss rate.

✧ Testing near the ground has poor results. Generally, it needs to be at least 2 meters above the ground.

✧ If the rate is set too high, the spreading factor and bandwidth will be inappropriate, and the distance will be short.

✧ Poor matching between the antenna and the module or poor antenna gain will lead to a short communication distance.

6.2. Equipment Damage

✧ Before use, be sure to check whether the power supply meets the recommended power supply. If it exceeds the maximum value, it may burn out the equipment.

✧ During installation and use, pay attention to the equipment's anti - static protection to prevent damage during some high - frequency periods.

✧ The stability of the power supply. Try to reduce fluctuations. If the fluctuation is large, it may cause damage in the short term.

✧ Unless necessary, do not use it in an environment with extremely low temperature. Also, pay attention to short circuits caused by water accumulation and corrosive gases.

6.3. Slow Data Transmission Speed

✧ If the used rate is too low, the lower the rate, the slower the transmission speed, and the longer the transmission distance; conversely, the higher the rate, the faster the transmission speed, and the relatively shorter the transmission distance.

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

6.4. Interference in Data Transmission

✧ There are other devices with the same frequency band nearby. Change the communication channel or stay away from the interference source.

✧ Poor antenna feeder and extension line quality lead to errors in signal transmission.

✧ Large - scale noise is generated on the bottom board, interfering with data reception.

✧ The power supply setting is unreasonable and does not meet the regulations, resulting in garbled codes.

7. Disclaimer

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8. Update History

Firmware Version	Update Content	Update Time
V1.0.0	Initial Release	2025-08-25

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