DX-SMART

DX-LR02-900T22D

Serial port application guide

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1. Introduction

DX-LR02-900T22D is a low-power LoRa module, which is built by SHEN ZHEN DX-SMART TECHNOLOGY CO.,LTD,. for intelligent wireless data transmission. It uses domestic ASR6601 SOC chip. The chip integrates SUb 1GHz RF transceiver, Arm China STAR-MC1 microprocessor, built-in Flash storage, SRAM. The module supports UART, I2C, I2S and other interfaces, supports IO port control, ADC acquisition, and has the advantages of low power consumption, high performance, long distance, networking and so on. It is suitable for a variety of application scenarios in the field of IoT, such as smart meters, intelligent logistics, intelligent buildings, smart cities, smart agriculture and many other application scenarios.

1.1. Basic parameters of serial port

- Default parameter of module serial port: 9600bps/8/n/1 (baud rate/data bit/no check/stop bit)

1.2. Module default RF basic parameters

- Module working mode: transparent transmission
- Module power consumption mode: high aging mode
- Module air speed and communication distance LEVEL gear: 0 gear
- Module frequency band: 850MHz
- Module address: ffff
- Module bandwidth: 125KHz
- Module spreading factor: SF12
- Module RF coding rate: 4/6
- Module air rate configuration: 244bit/s
- Module CRC check: No check
- Module preamble length: 8
- Module IQ signal: do not flip
- Module transmit power: 22dB

1.3. Transmission mode and AT command mode

- Transmission mode: After the module is powered on, it is in transmission mode, at this time, it can start to transmit data.
- AT command mode: In transmission mode, use "+++" to switch to AT command mode, which can respond to AT commands. To enter the transmission mode, you need to send "+++" to exit the AT command mode.

2. PC side test tool

2.1. Pc-side testing software

Please download and install the Uart Assistant computer serial port software in the data package for testing. The serial port software interface is as follows:

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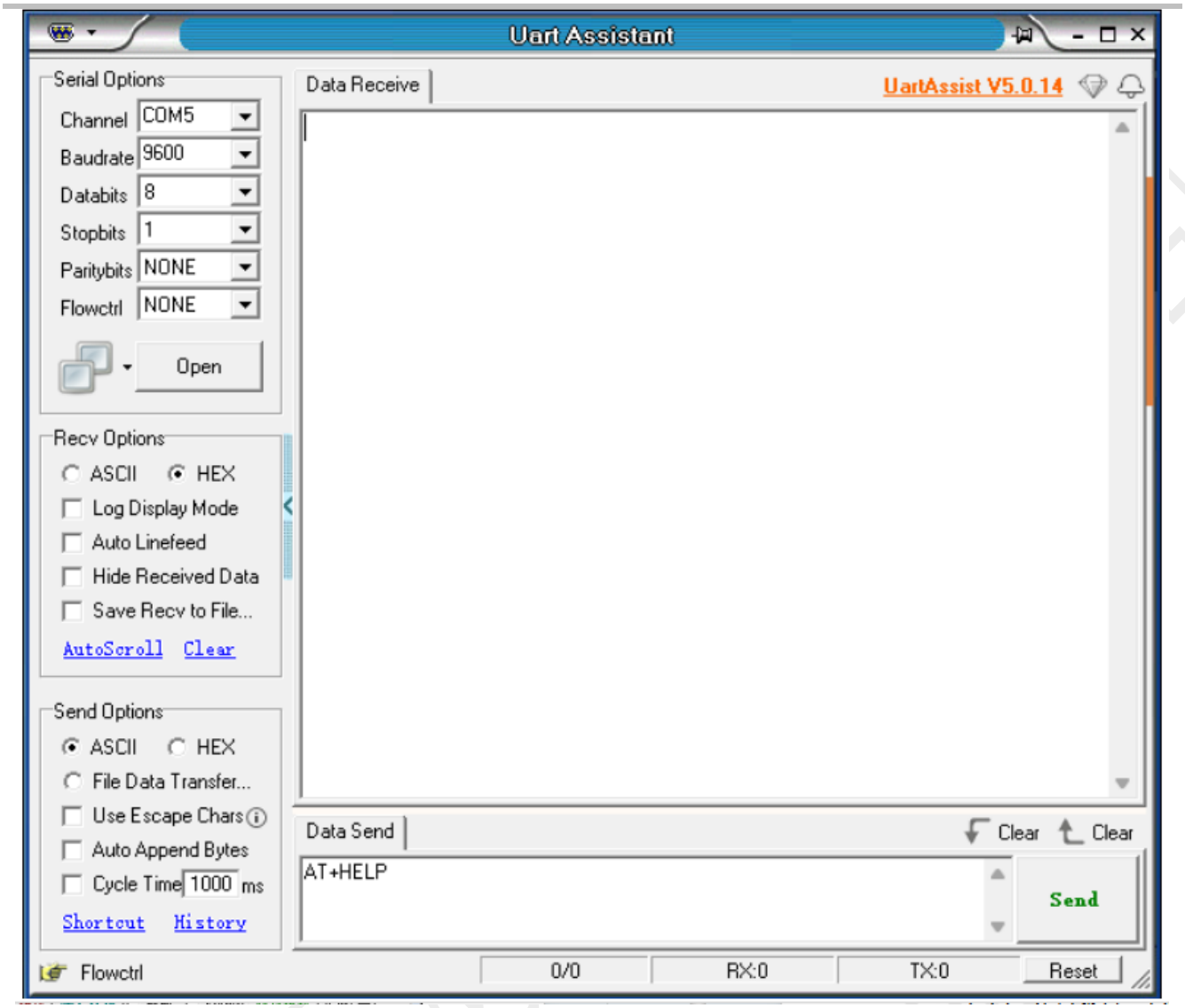


Figure 1: Computer side serial port software diagram1

3. Serial port usage

3.1. Module test minimum system

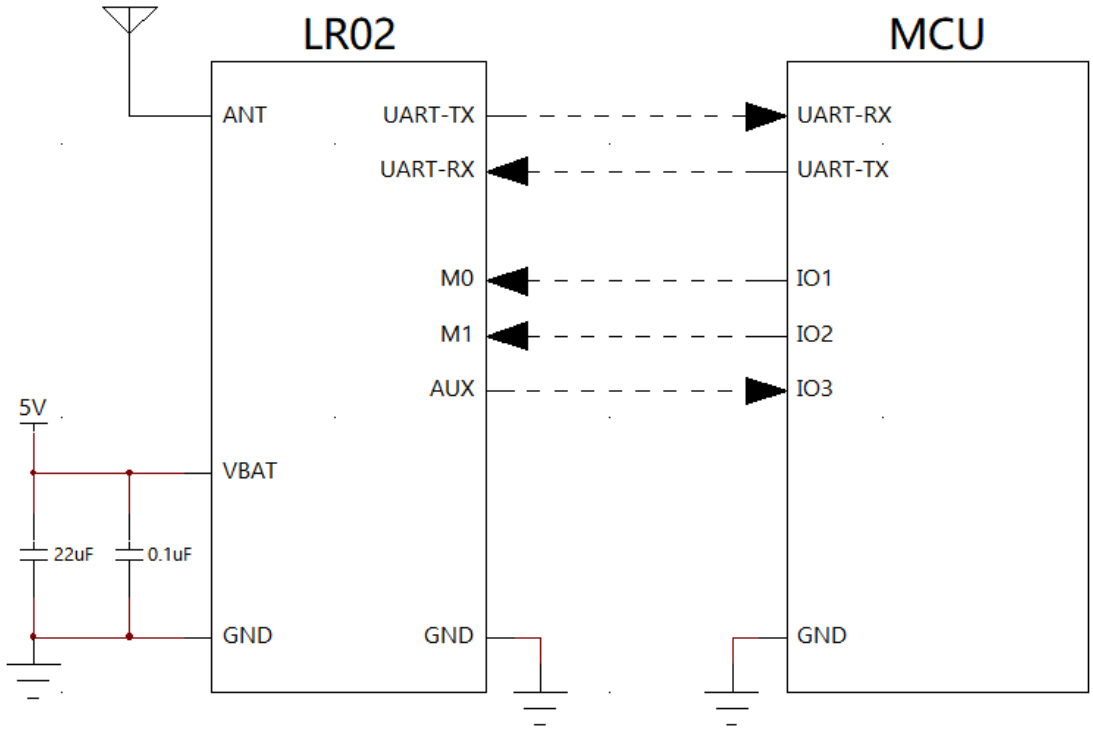


Figure 2: Module minimum system diagram2

3.2. Example of module usage operation

3.2.1. Module to module transparent transfer

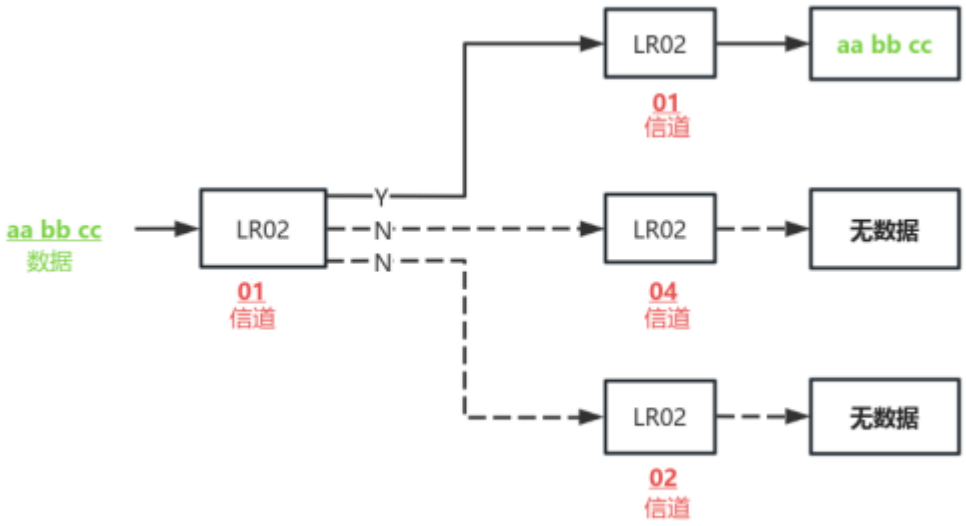
1. Connect the two DX-LR02-900T22D modules to the serial port and power supply.
2, send +++, let the module into the AT command mode.
3, use AT+MODE0 to set both modules in transparent transmission mode.
4, use AT+LEVEL to configure two LR02-900T22D modules for the same rate level, for example: set the level to 1, send instructions

AT+LEVEL1.

(Only when the RF parameters of the two modules are the same can the data be transmitted. If the parameters are configured by yourself, you can use AT+HELP to compare whether the basic RF parameters of the two modules are the same.)

5. Power off and restart the module or use AT+RESET to restart, and the instructions will take effect after restarting.
6, a module to send data, another module can receive data.

(Note: lora is a half-duplex protocol, so only one module can be sent at a time)



信道 channel

数据 date

无数据 no date

Figure 3: Transparent transmission diagram3

3.2.2. Module-to-module fixed-point transmission

1. Connect the two DX-LR02-900T22D modules to the serial port and power supply.
2, send +++, let the module into the AT command mode.
3, use AT+MODE1 command, set the module working mode to fixed-point transmission mode.
4, use the AT+LEVEL instruction to configure the rate level of the LR02-900T22D module and make it the same, for example: set the level to 1, send the instruction AT+LEVEL1.
(Data can only be transmitted when the RF parameters of the two modules are the same. If it is the parameter configured by yourself, you can use AT+HELP to compare whether the basic RF parameters of the two modules are the same)
5. Power off and restart the module or use AT+RESET to restart, and the instructions will take effect after restarting.
6, choose the send method to HEX send.
7. Fixed-point transmission is a private protocol done on lora, so it needs to be received in accordance with a certain data transmission format.

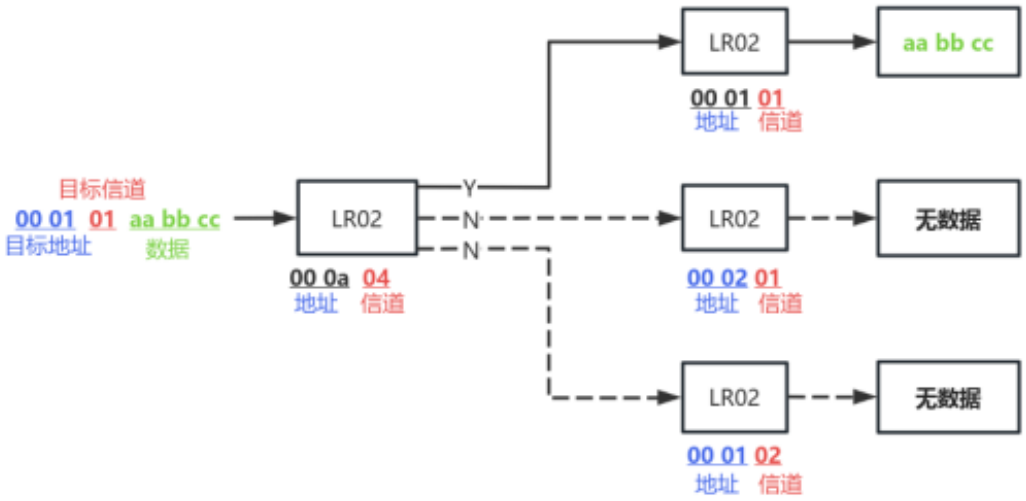
The transmission format is described as follows: device address (hexadecimal, two bytes) + channel (hexadecimal, 1 byte) + data (hexadecimal)

Instructions use: AT+MAC instruction, you can query or modify the device address of the current module

The AT+CHANNEL command allows you to query or modify the current module's working channel

For example:

The address of the receiver module is 0001, and the channel is 01; The data sent by the transmitting module is aabbcc, so the data content sent is: 000101aabbcc (hexadecimal: 000101 61 61 62 62 63 63)



目标信道 Target channel

地址 address

数据 date

无数据 no date

Figure 4: Fixed-point transmission diagram4

3.2.3. Module-to-module broadcast transmission

1. Connect the two DX-LR02-900T22D modules to the serial port and power supply.
2, send +++, let the module into the AT command mode.
3, use AT+MODE2, set the module working mode to broadcast transmission mode.
4. Use the AT+LEVEL command to configure the rate level of the two LR02-900T22D modules and make them the same, for example: set the level to 1,

Send instruction AT+LEVEL1.

(Only if the RF parameters of the two modules are the same can you transmit data, if it is your own configured parameters, you can use AT+HELP to compare whether the basic RF parameters of the two modules are the same)

5. Power off and restart the module or use AT+RESET to restart, and the instructions will take effect after restarting.

6, send +++, exit the AT command mode, enter the transmission mode.

7, select the send method to HEX send.

8. Broadcast transmission is a private protocol done on lora, so it needs to be received in accordance with a certain data transmission format.

The transmission format is explained as follows: channel (1 byte, hexadecimal) + data (hexadecimal)

The command uses the: AT+CHANNEL command to query or change the frequency of the current module

For example:

The channel of the receiving module is 01, and the data sent by the transmitting module is aabbcc, so the data content sent is: 01aabbcc (hexadecimal: 01 61 61 62 62 63 63)

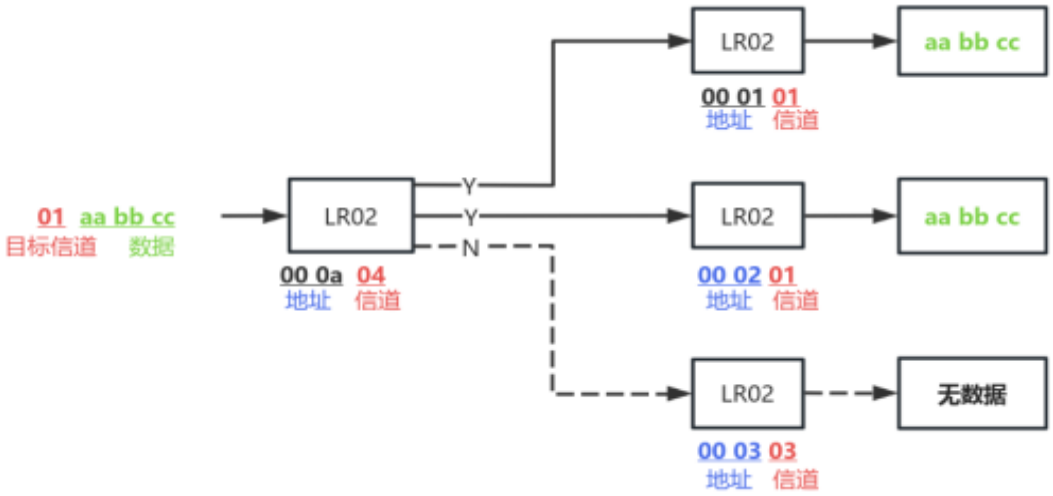


Figure 5: Broadcast transmission diagram5

4. Related AT commands explained in detail

4.1. Command Format Description

AT+Command<param1, param2, param3> <CR><LF>

- All commands begin with AT and end with <CR><LF>. In the table that shows commands and responses in this document, <CR><LF> is omitted and only commands and responses are displayed.
- All AT command characters are capitalized in English.
- <> is optional content, if there are multiple arguments in the command, separated by a comma ", ", the actual command does not contain Angle brackets.
- <CR> is the carriage return character \r, which is 0X0D in hexadecimal.
- <LF> is the newline character \n, which is 0X0A in hexadecimal.
- If the instruction is executed successfully, the corresponding command is returned with the end of OK, and if it fails, EERROR=<> is returned, and the "<>" content is the corresponding error code (refer to 5.5).

4.2. Response Format Description

+Indication<=param1, param2, param3><CR><LF>

- The response instruction begins with the plus sign "+" and ends with <CR><LF>
- Equals "=" followed by the response parameter
- If there are multiple arguments in the response argument, they are separated by a comma ","

4.3. An example of the AT command

Example: Modify the LoRa device baud rate to 128000

Send: AT+BAUD9

Return: OK

4.4. List of AT commands

Instructions	Functions	Instructions
AT	Test instructions	Used to test the serial port
+++	Enter or exit the AT command mode	Power on defaults to transmission mode
AT+HELP	Query basic module configuration information	-
AT+BAUD	Set \ Query baud rate	Default: 4 (9600)
AT+STOP	Set \ Query serial port stop bit	Default: 0 (0 stop bit)
AT+PARI	Set \ Query serial port check bits	Default: 0 (no parity)
AT+MODE	Set \ Query working mode	Default: 0 (transparent transfer)
AT+SLEEP	Set \ Query Power mode	Default: 2 (high aging mode)
AT+RESET	Software restart	-
AT+DEFAULT	factory data reset	-
AT+LEVEL	Set \ Query module air rate and communication distance	Default: 0
AT+CHANNEL	Set \ Query working channel	Default: 00
AT+MAC	Set \ Query device address	Default: ff,ff
AT+POWE	Set \ Query transmit power	Default: 22dB
AT+BW	Query RF bandwidth	Default: 0
AT+CR	Set \ Query RF coding rate	Default: 2
AT+SF	Set \ Query spread spectrum factor	Default: 12
AT+CRC	Set \ Query CRC check	Default: 0
AT+IQ	Set \ Query whether the Iq signal is flipped	Default: 0

5. AT command details

5.1. Basic instructions

5.1.1. Test instructions

Function	Instructions	Response	Instructions
Testing	AT	OK	

5.1.2. Enter or exit the AT command mode

Features	Instructions	Response	Instructions
Enter or exit the AT command mode	+++	Exit AT or Entry AT	Exit AT: Exit AT command mode Entry AT: Enter the AT command mode Power on defaults to transmission mode

Notes:

1、It will be reset automatically when you exit the AT command mode.
2、The command will not be saved when the power is off.

5.1.3. Querying configuration information

Features	Instructions	Response	Instructions
Query basic module configuration	AT+HELP	========== LoRa Parameter: +VERSION=<version> MODE:<mode> LEVEL:<level>	LoRa Parameter: LoRa parameter <version> : Version <mode> : Data sending mode <level> : Air rate configuration

informati on	SLEEP:<sleep> Frequency:<frequency> MAC:<mac> Bandwidth:<bandwidth> Spreading Factor:<spreading factor> Coding rate:<coding rate> CRC:<crc> Preamble:<preamble> IQ:<iq> Power:<power> ======================	<sleep> : Power mode <frequency> : Operating frequency <mac> : device address <bandwidth> : RF bandwidth <spreading factor> : Spreading factor <coding rate> : radio frequency coding rate <crc> : CRC check <preamble> : length of the preamble <iq> : Whether the IQ signal is flipped or not <power> : Transmit power

Examples:

Query module basic information

Send: AT+HELP

Return to: ====================================

LoRa Parameter:
+ VERSION = V1.0.0
MODE:0
LEVEL:0 >> 244.140625bps
SLEEP:2
Frequency:850000000hz >> 0
MAC:ffff
Bandwidth:0
Spreading Factor:12
Coding rate:2
CRC:0(false)
Preamble:8
IQ:0(false)
Power:22dBm
==================================

5.1.4. Set \ Query - Serial baud rate

Features	Instructions	Response	Instructions
Query baud rate	AT+BAUD	+BAUD=<baud>	<baud> The baud rate corresponds to the serial number 1: 1200 6: 38400 2: 2400 7: 57600 3: 4800 8: 115200 4: 9600 9: 128000 5: 19200 Default: 4(9600)
Set baud rate	AT+BAUD<baud>	OK	

Notes:

After setting this instruction, it should be restarted to take effect.

5.1.5. Set \ Query - serial port stop bit

Features	Instructions	Response	Instructions
Query the serial port stop bit	AT+STOP	+STOP=<param>	< param> sequence number 0:1 stop bit 1:2 stop bits Default: 0
Set the serial port stop bit	AT+STOP<param>	OK	

Notes:

After setting this instruction, it should be restarted to take effect.

5.1.6. Set \ query - serial port parity bit

Features	Instructions	Response	Instructions
Query the serial port check bit	AT+PARI	+PARI=<param>	< param> sequence number 0: No validation 1: odd check 2: Even check Default: 0
Set the serial port check bit	AT+PARI<param>	OK	

Remarks:

After setting this instruction, it should be restarted to take effect.

5.1.7. Set \ Query - Work mode

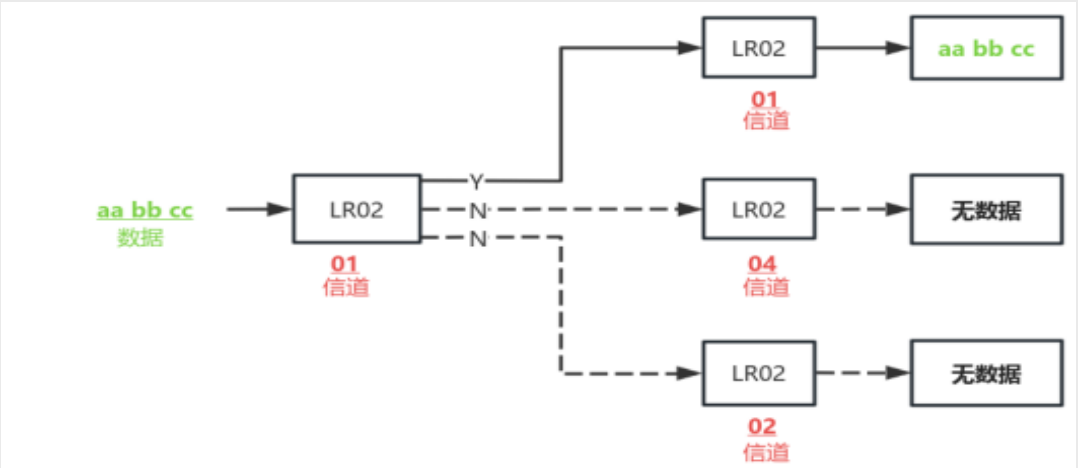
Features	Instructions	Response	Instructions
Query working mode	AT+MODE	+MODE=<param>	param: 0,1,2 0: Transparent transmission 1: Fixed-point transmission 2: Broadcast transmission Default setting: 0
Set working mode	AT+MODE<param>	+MODE=<param> OK	

Notes:

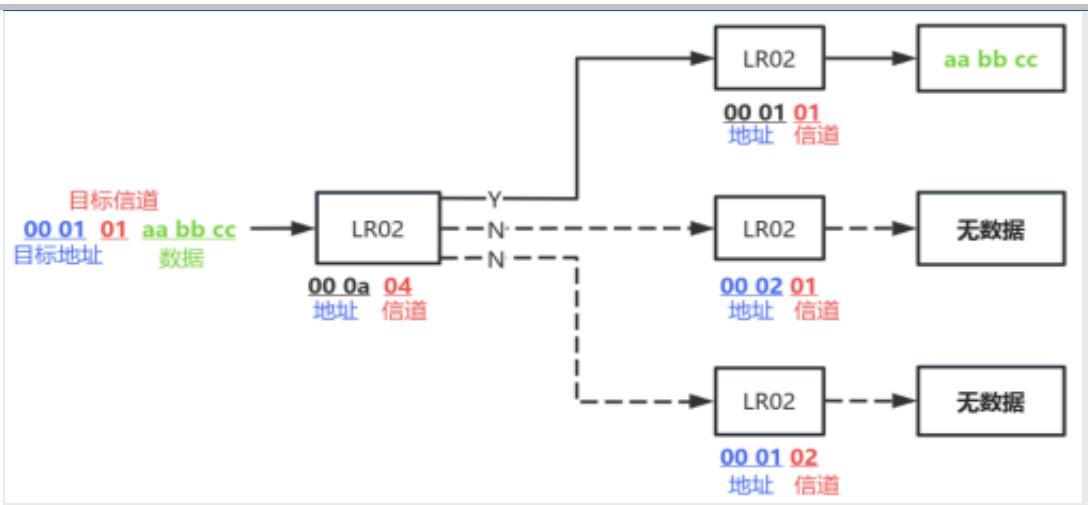
1、After setting this instruction, it should be restarted to take effect.
2、Transparent transmission data format: Send data directly
3、Fixed-point transmission data format: device address (hexadecimal, two bytes) + channel number (hexadecimal, one byte) + data (hexadecimal)
4、Broadcast transmission data format: channel number (hexadecimal, one byte) + data (hexadecimal)

Examples:

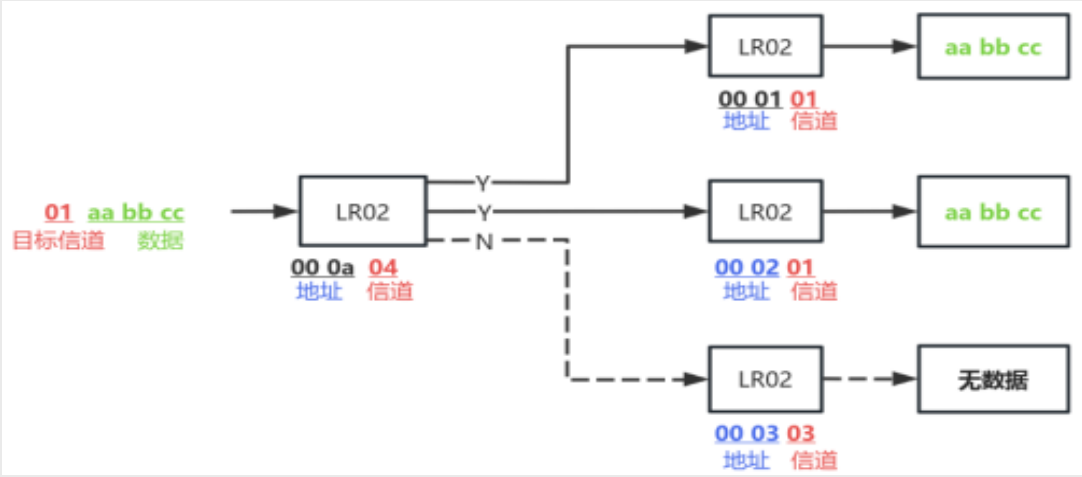
1、Transparent transmission:



2、Fixed-point transfer:



3、Broadcast transmission:



5.1.8. Set \ Query - Power Consumption mode

Functions	Instructions	Response	Notes
Querying power consumption mode	AT+SLEEP	+SLEEP=<param>	< param> serial number 0: Sleep mode 1: Air wake-up mode 2: High Time mode Default value: 2
Set Power mode	AT+SLEEP<param>	OK	

Notes:

1. Sleep mode: In this mode, both MCU and RF enter the sleep state. Use the serial port to wake up, that is, when the serial port receives data, the module wakes up automatically. This mode does not write to save, every time you enter the sleep mode, you need to use the command to enter.
2. Air wake-up mode:

A. In this mode, the module performs CAD detection in a cycle of four seconds (the overall sleep time is: 4s minus CAD detection time). If the module detects data, it will enter the receiving mode, and automatically enter the sleep after receiving data. During the sleep period, the RF will sleep, and the MCU will not sleep.

B. When the air wake-up mode is used, both the receiver and the sender should be in the air wake-up mode before they can receive and send data.

C. This mode can be written and saved.

3. High aging mode: in this mode, the module is always in the receiving state and can receive data from other devices at any time. When the serial port of the module receives the data from the master control, it switches to the transmitting state, and transmits the data out. After the transmission is completed, it switches back to the receiving state.

Note: CAD explanation: LoRa CAD (Channel Activity Detection) is a technology used to detect channel activity in LoRa network. It is used to determine whether there is activity (such as transmission by other devices) on a specified physical channel to help the device choose the right time to send and avoid collisions.

5.1.9. Software Restarts

Features	Instructions	Response	Instructions
Software restart	AT+RESET	OK Power On	

5.1.10. factory data reset

Features	Instructions	Response	Instructions
factory data reset	AT+DEFAULT	OK Power On	

5.2. Module RF parameters (one-click configuration module air rate and communication distance)

5.2.1. Set/Query - Configure module air rate and communication range with one click

Functions	Instructions	Response	Instructions
Query module parameters	AT+LEVEL	+LEVEL =<param>	<param> : 0-7, Air rate and communication range configuration, there are eight gears Default value: 0
Set module parameters	AT+LEVEL<param>	OK	

Notes:

1. You can choose different gears according to your own data volume and communication distance (data volume and distance can refer to the table below). The larger the air character rate, the faster the amount of data that can be sent.
2, the command will RF bandwidth, RF coding rate, spread spectrum factor has been set, can be used directly.
3. The LEVEL of transmitting equipment and receiving equipment should be consistent to receive and send data.
4. After setting the instruction, it needs to be restarted.

Note: The following table is the configuration parameters under different gear under the premise of coding rate CR=4/6, the following outdoor distance (open visible distance) and urban distance are for reference only, the actual distance is subject to the actual measurement.

LEVEL(gear)	SF(spread spectrum factor)	BW(bandwidth KHz)	Air character rate (bit/s)	Outdoor distance (Km)	Distance within city (Km)
0	12	125	244	8.0	2.9
1	11	125	447	7.5	2.85
2	10	125	813	5.7	2.6
3	9	125	1464	5.3	2.5
4	8	125	2604	5.2	2.5
5	7	125	4557	5.0	1.3
6	6	125	7812	4.1	0.59
7	5	125	13020	3.8	0.33

5.3. Module RF parameter configuration (general configuration)

5.3.1. Setup \ Query - Working Channel

Functions	Instructions	Response	Instructions
Query the working channel	AT+CHANNEL	+ CHANNEL=<param>	param: 00-A2 (hexadecimal) Starting at 850Mhz, And grow at 500Khz Default setting: 00
Set the working channel	AT+CHANNEL <param>	+CHANNEL=<param> OK	

Notes:

1, this module is set with 162 general channels, if you need more, please contact our company.
2. After the instruction is set, it needs to be restarted.
3. When multiple receiving devices are too close to the transmitting device, it may lead to the receiving device of different channels can receive data, so the distance between the transmitting device and the receiving device is required to be as far as possible.

Note: The following table is a comparison of the working frequency bands of different channels,

unit: Mhz.

Channel	Operating frequency band	Channel	Operating frequency band	Channel	Operating frequency band	Channel	Operating frequency band	Channel	Operating frequency band
00	850	21	866.5	42	883	63	899.5	84	916
01	850.5	22	867	43	883.5	64	900	85	916.5
02	851	23	867.5	44	884	65	900.5	86	917
03	851.5	24	868	45	884.5	66	901	87	917.5
04	852	25	868.5	46	885	67	901.5	88	918
05	852.5	26	869	47	885.5	68	902	89	918.5
06	853	27	869.5	48	886	69	902.5	8A	919
07	853.5	28	870	49	886.5	6A	903	8B	919.5
08	854	29	870.5	4A	887	6B	903.5	8C	920

09	854.5	2A	871	4B	887.5	6C	904	8D	920.5
0A	855	2B	871.5	4C	888	6D	904.5	8E	921
0B	855.5	2C	872	4D	888.5	6E	905	8F	921.5
0C	856	2D	872.5	4E	889	6F	905.5	90	922
0D	856.5	2E	873	4F	889.5	70	906	91	922.5
0E	857	2F	873.5	50	890	71	906.5	92	923
0F	857.5	30	874	51	890.5	72	907	93	923.5
10	858	31	874.5	52	891	73	907.5	94	924
11	858.5	32	875	53	891.5	74	908	95	924.5
12	859	33	875.5	54	892	75	908.5	96	925
13	859.5	34	876	55	892.5	76	909	97	925.5
14	860	35	876.5	56	893	77	909.5	98	926
15	860.5	36	877	57	893.5	78	910	99	926.5
16	861	37	877.5	58	894	79	910.5	9A	927
17	861.5	38	878	59	894.5	7A	911	9B	927.5
18	862	39	878.5	5A	895	7B	911.5	9C	928
19	862.5	3A	879	5B	895.5	7C	912	9D	928.5
1A	863	3B	879.5	5C	896	7D	912.5	9E	929
1B	863.5	3C	880	5D	896.5	7E	913	9F	929.5
1C	864	3D	880.5	5E	897	7F	913.5	A0	930
1D	864.5	3E	881	5F	897.5	80	914	A1	930.5
1E	865	3F	881.5	60	898	81	914.5	A2	931
1F	865.5	40	882	61	898.5	82	915		
20	866	41	882.5	62	899	83	915.5		

5.3.2. Settings \ Query - Device Address

Features	Instructions	Response	Instructions
Looking up device addresses	AT+MAC	+MAC=<param><param>	param: Hexadecimal, one byte Default setting: ffff
Set device address	AT+MAC<param>,<param>	+MAC=<param><param> OK	

Notes:

After setting this instruction, it should be restarted to take effect.

Examples:

Set the module address to 0a01
Send: AT+MAC0a,01
Return: +MAC=0a01
OK

5.3.3. Set \ Query - Transmit power

Features	Instructions	Response	Instructions
Query transmit power	AT+POWE	+POWE=<param>	param: 0-22dB (take integer values) Default setting: 22dB
Set transmit power	AT+POWE<param>	+POWE=<param> OK	

Notes:

After setting this instruction, it should be restarted to take effect.

Examples:

Modify the transmit power to 10dB
Send: AT+POWE10
Return: +POWE=10
OK

5.4. Module RF parameter configuration (differentiated configuration)

5.4.1. Query - RF bandwidth

Features	Instructions	Response	Instructions
Querying RF	AT+BW	+BW=<param>	<param> : 0

bandwidth	0:125K Default: 0

Notes:

For other RF bandwidth, please contact us.

5.4.2. Set \ Query - RF Coding rate

Features	Instructions	Response	Instructions
Query the RF coding rate	AT+CR	+CR=<param>	<param> : 1-4 1:4/5 2:4/6 3:4/7 4:4/8 Default: 2
Set the RF coding rate	AT+CR<param>	+CR=<param> OK	

Notes:

After setting this instruction, it should be restarted to take effect.

5.4.3. Set \ Query - spread factor

Features	Instructions	Response	Instructions
Query the spreading factor	AT+SF	+SF=<param>	<param> : 5-12 5: SF5 6: SF6 7: SF7 8: SF8 9: SF9 10: SF10 11: SF11 12: SF12 Default value: 12
Set the spreading factor	AT+SF<param>	+SF=<param> OK	

Remarks:

After setting this instruction, it should be restarted to take effect.

5.4.4. Set \ query-crc check

Features	Instructions	Response	Instructions
Inquire about CRC validation	AT+CRC	+CRC=<param>	<param> : 0,1 0: Turns off CRC validation 1: Turn CRC check on Default: 0
Set the CRC check	AT+CRC<param>	OK	

Notes:

After setting this instruction, it should be restarted to take effect.

5.4.5. Set \ Query - Iq signal flip

Features	Instructions	Response	Instructions
Inquire if the Iq signal is flipped	AT+IQ	+IQ = <param>	<param> : 0,1 0: The Iq signal does not flip 1: Iq signal flips Default: 0
Set Iq signal flip	AT+IQ<param>	OK	

Notes:

1、After setting this instruction, it should be restarted to take effect.
2、IQ explanation: IQ flip refers to the phase flip operation of the received IQ signal in LoRa communication. This operation can be performed before or after demodulation and is used to change the phase of the signal to achieve different functions or optimize performance.

5.5. List of error codes

The details of the error code in EEROR=<> are as follows:

Return value	Error Message Description
101	Abnormal parameter data
102	Instruction error

6. Value-added services

In order to meet the various functional requirements of customers, our company can provide the following technical value-added services:

- Module program customization, such as: IO function port customization, AT instruction customization, broadcast package customization, etc.
- Module PCB hardware customization, can be customized to the hardware requirements of customer needs.
- A variety of Bluetooth program customization, can be customized according to customer needs, a full set of bluetooth software and hardware solutions.
- A full set of networking solutions customization, can be customized according to customer needs, a full set of networking, gateway solutions.

If you have the above customized requirements, please contact our business personnel directly.

深圳大夏龙雀科技有限公司