DX-SMART

DX-LR01

SERIAL APPLICATION GUIDE

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Contact Us

Shenzhen Daxia Longque Technology Co., Ltd.
Email: waimao@szdx-smart.com
TEL: 0755-2997 8125
Website: en.szdx-smart.com
Address: Room 601, Block A1, Huafeng Zhigu, Hangkong Road, Baoan District, Shenzhen

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1. Introduction

DX-LR01 is a low-power LoRa module developed by Shenzhen Daxia Longque Technology Co., Ltd. for intelligent wireless data transmission. It uses the domestic ASR6601 SOC chip, which integrates a Sub 1GHz RF transceiver, Arm China STAR-MC1 microprocessor, built-in Flash storage, and SRAM. This module supports interfaces such as UART, I2C, and I2S, as well as IO port control and ADC collection. It features low power consumption, high performance, long-distance communication, and networking capabilities. It is suitable for various application scenarios in the IoT field, such as smart metering, smart logistics, smart buildings, smart cities, and smart agriculture.

1.1. Serial Port Basic Parameters

- **Module serial port default parameters:** 9600bps/8/n/1（Baud/Data /No Parity/Stop Bits）

1.2. Default RF Basic Parameters of the Module

- **Module Operating Mode:** Transparent transmission
- **Module Power Consumption Mode:** High efficiency mode
- **Module Air Data Rate and Communication Distance Level:** Level 0
- **Module Frequency Band:** 433MHz
- **Module Address:** ffff
- **Module Bandwidth:** 125KHz
- **Module Spreading Factor:** SF12
- **Module RF Coding Rate:** 4/6
- **Module Air Data Rate Configuration:** 244bit/s
- **Module CRC Check:** No check
- **Module Preamble Length:** 8
- **Module IQ Signal:** Not inverted
- **Module Transmit Power:** 22dB

1.3. Transmission And AT Command Mode

- **Transmission Mode:** After powering on, the module enters transmission mode and is ready to start transmitting data.
- **AT Command Mode:** While in transmission mode, switch to AT command mode by sending “+++”. The module will then respond to AT commands. To return to transmission mode, send “+++” to exit AT command mode.

2. PC Test Tools

2.1. PC Test Software

For PC-side testing, please download and install the sscom5.13.1 serial port software from the provided documentation package. The serial port software interface is shown below:

Figure 1 serial port software diagram

3. Serial Port Usage

3.1. Module Test Minimal System

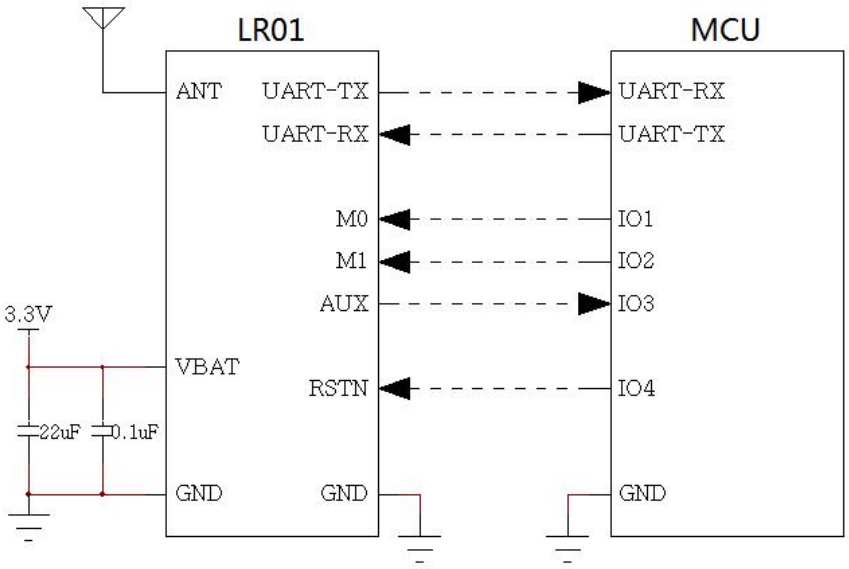
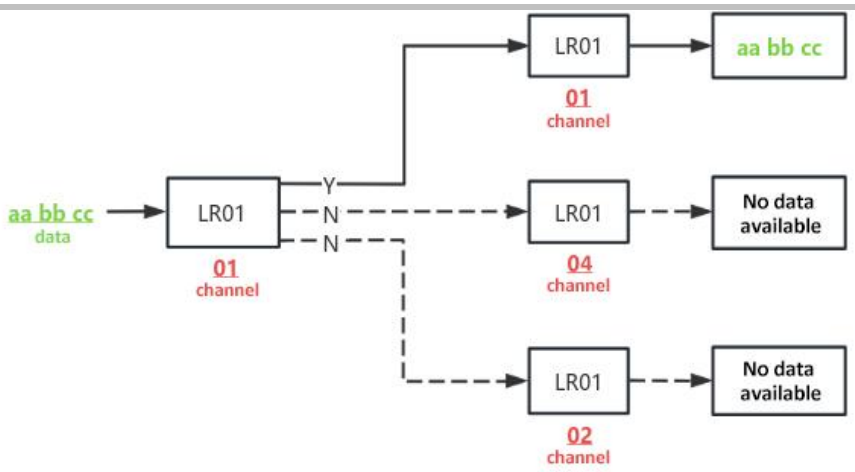


Figure 2 Module minimum system diagram

3.2. Module Usage Examples

1. Module and module transparent transmission

1) Connect the serial port and power supply to both DX-LR01 modules.
2) Send "+++" to enter the AT command mode on the modules
3) Set both modules to transparent transmission mode using the command "AT+MODE0".
4) Configure both LR01 modules to the same rate level using the command "AT+LEVEL". For example, to set the level to 1, send the command "AT+LEVEL1".
5) (Data transmission is possible only when the RF parameters of both modules are the same. If you configured the parameters yourself, you can use the AT+HELP command to compare the basic RF parameters of both modules to ensure they are identical.)
6) Power cycle the modules or use the "AT+RESET" command to restart them. The command will take effect after the restart.
7) One module sends data, and the other module will receive the data.
8) (Note: LoRa is a half-duplex protocol, so only one module can transmit at any given time.)

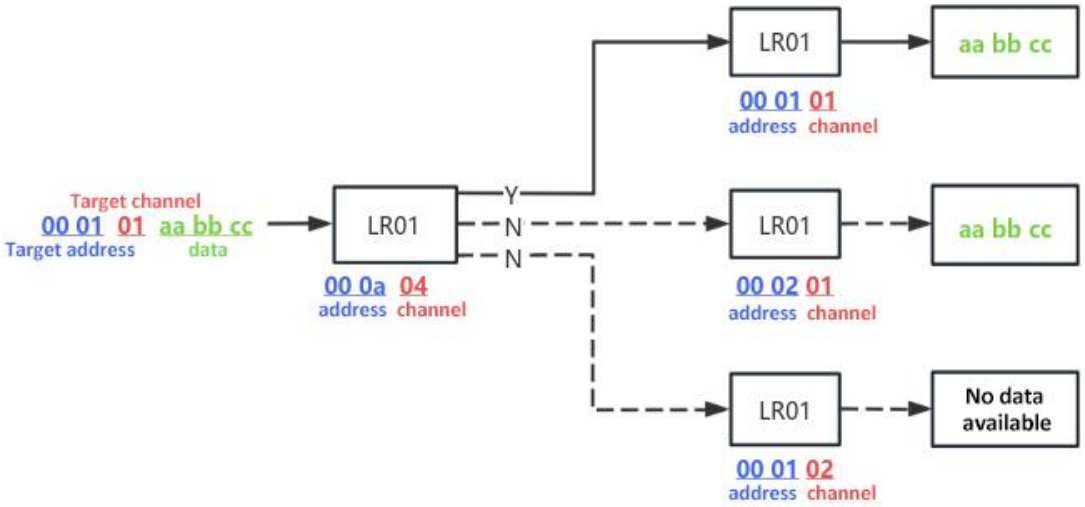


2. Module and module fixed-point transmission

1) Connect the serial port and power supply to both DX-LR01 modules.
2) Send "+++" to enter the AT command mode on the modules.
3) Use the "AT+MODE1" command to set the module working mode to fixed-point transmission mode.
4) Configure both LR01 modules to the same rate level using the command "AT+LEVEL". For example, to set the level to 1, send the command "AT+LEVEL1".
5) (Data transmission is possible only when the RF parameters of both modules are the same. If you configured the parameters yourself, you can use the AT+HELP command to compare the basic RF parameters of both modules to ensure they are identical.)
6) Power cycle the modules or use the AT+RESET command to restart them. The command will take effect after the restart.
7) Select the transmission mode as HEX.
8) Fixed-point transmission uses a proprietary protocol on LoRa, so data must be transmitted in a specific format for proper reception.
9) The transmission format is as follows: device address (2 bytes in hexadecimal) + channel (1 byte in hexadecimal) + data (in hexadecimal).
10) Commands:
    - AT+MAC: This command can be used to query or modify the device address of the current module.
    - AT+CHANNEL: This command can be used to query or modify the operating channel of the current module.

Example:

If the receiving module's address is 0001 and the channel is 01, and the transmitting module sends the data aabbcc, the transmitted data content would be: 000101aabbcc (hexadecimal: 00 01 01 61 61 62 62 63 63).



3. Modules and module broadcast transmission

1) Connect the serial port and power supply to both DX-LR01 modules.

2) Send "+++" to enter the AT command mode on the modules.

3) Use the "AT+MODE2" command to set the module's operating mode to broadcast transmission mode.

4) Configure the rate level of both LR01 modules to be the same using the "AT+LEVEL" command. For example, to set the level to 1, send the command "AT+LEVEL1".

5) (Data transmission is only possible when the RF parameters of both modules are the same. If you configured the parameters yourself, you can use the "AT+HELP" command to compare the basic RF parameters of both modules to ensure they are identical.)

6) Power cycle the modules or use the AT+RESET command to restart them. The command will take effect after the restart.

7) Send "+++" to exit AT command mode and enter transmission mode.

8) Select HEX as the transmission mode.

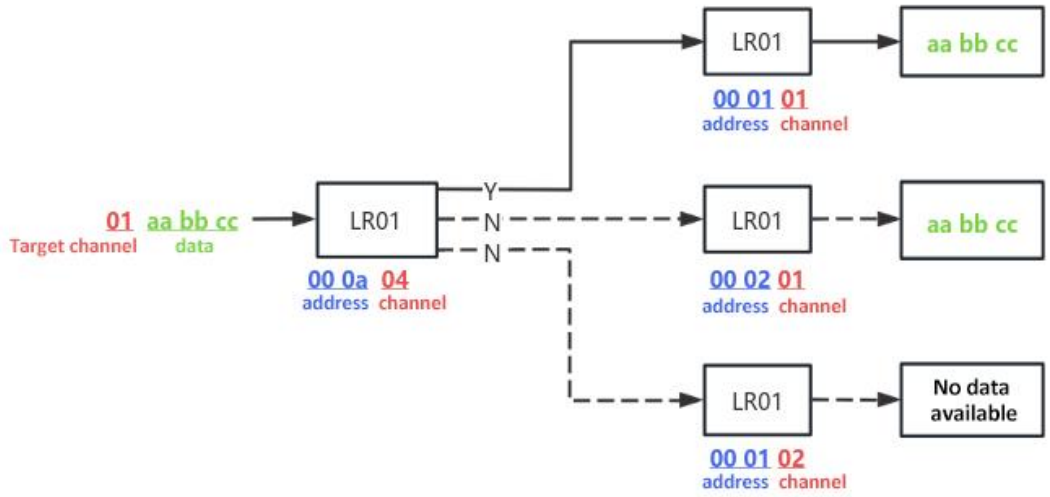
9) Broadcast transmission uses a proprietary protocol on LoRa, so data must be transmitted in a specific format for proper reception.

10) The transmission format is as follows: channel (1 byte in hexadecimal) + data (in hexadecimal).

- Command: AT+CHANNEL can be used to query or modify the operating frequency of the current module.

Example:

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



4. Detailed Explanation Of Related AT Commands

4.1. Command Format Description

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

- All commands start with AT , end with <CR><LF>， In the table showing commands and responses in this document, <CR><LF> is omitted, and only commands and responses are displayed.
- All AT command characters are uppercase.
- <>The content inside is optional， If there are multiple parameters in the command， Separate by comma ","，The angle brackets are not included in the actual command.
- <CR>stands for "carriage return" \r，corresponding hex is 0X0D.
- <LF>stands for "line feed" \n，corresponding hex is 0X0A.
- The command is executed successfully, the corresponding command is returned and ends with OK, and EEROR=<> if it fails，The content of "<>" is the corresponding error code（Please refer to 5.5.)

4.2. Response Format Instructions

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

- Response commands start with a plus sign “+” and end with.
- The response parameter follows the equals sign “=”.

- If there are multiple response parameters, they will be separated by commas ",".

4.3. Examples Of AT Commands

Example: Modify the baud rate of the LoRa device to 128000

Send: AT+BAUD9

Return: OK

5. AT Command

5.1. Basic Commands

5.2. Test Command

Function	Command	Response	Description
Test	AT	OK	

5.2.1. Enter Or Exit AT Command Mode

Function	Command	Response	Description
Enter Or Exit AT Command Mode	+++	Exit AT or Entry AT	Exit AT: Exit AT Command Mode Entry AT: Entry AT Command Mode The power-on default is transmission mode

Remark:

1、It will automatically reset when exiting AT command mode.
2、This command will not be saved when power is off.

5.2.2. Query configuration information

Function	Command	Response	Description
Query module basic configuration information	AT+HELP	========== LoRa Parameter: +VERSION=<version> MODE:<mode> LEVEL:<level> SLEEP:<sleep> Frequency:<frequency> MAC:<mac>	LoRa Parameter: LoRa Parameter <version>: version <mode>: data transmission mode <level>: air rate configuration <sleep>: power consumption mode <frequency>: operating frequency <mac>: device address <bandwidth>: RF bandwidth

	Bandwidth:<bandwidth> Spreading Factor:<spreading factor> Coding rate:<coding rate> CRC:<crc> Preamble:<preamble> IQ:<iq> Power:<power> ==========	<spreading factor>: spreading factor <coding rate>: RF coding rate <crc>: CRC check <preamble>: preamble length <iq>: whether the IQ signal is flipped <power>: transmission power

Example:

Query module basic information

Send: AT+HELP

Return: ==========

LoRa Parameter:

+VERSION=V1.0.0

MODE:0

LEVEL:0 >> 244.140625bps

SLEEP:2

Frequency:433000000hz >> 0

MAC:ffff

Bandwidth:0

Spreading Factor:12

Coding rate:2

CRC:0(false)

Preamble:8

IQ:0(false)

Power:22dBm

==========

5.2.3. Set/Query—Serial Port Baud Rate

Function	Command	Response	Description
Query Baud Rate	AT+BAUD	+BAUD=<baud>	<baud>Baud rate corresponding serial number 1: 1200 6: 38400 2: 2400 7: 57600 3: 4800 8: 115200 4: 9600 9: 128000 5: 19200 default value: 4(9600)
Set Baud rate	AT+BAUD<baud>	OK	

Remark:

After setting this command, you need to restart it to take effect.

5.2.4. Set/Query—Serial-port Stop Bit

Function	Command	Response	Description
Query Serial-port Stop Bit	AT+STOP	+STOP=<param>	< param>Serial number 0: 1 Stop Bit 1: 2 Stop Bit Default value: 0
Set Serial-port Stop Bit	AT+STOP<param>	OK	

Remark:

After setting this command, you need to restart it to take effect.

5.2.5. Set/Query—Serial-port Parity Bit

Function	Command	Response	Description
Query parity bit	AT+PARI	+PARI=<param>	< param>Serial number 0: No Parity 1: Odd parity 2: Even parity Default value: 0
Set parity bit	AT+PARI<param>	OK	

Remark:

After setting this command, you need to restart it to take effect.

5.2.6. Set/Query—Working Mode

Function	Command	Response	Description
Query Working Mode	AT+MODE	+MODE=<param>	param: 0，1，2 0: Transparent transmission 1: Fixed-point transmission 2: Broadcast transmission Default: 0
Set Working Mode	AT+MODE<param>	+MODE=<param> OK	

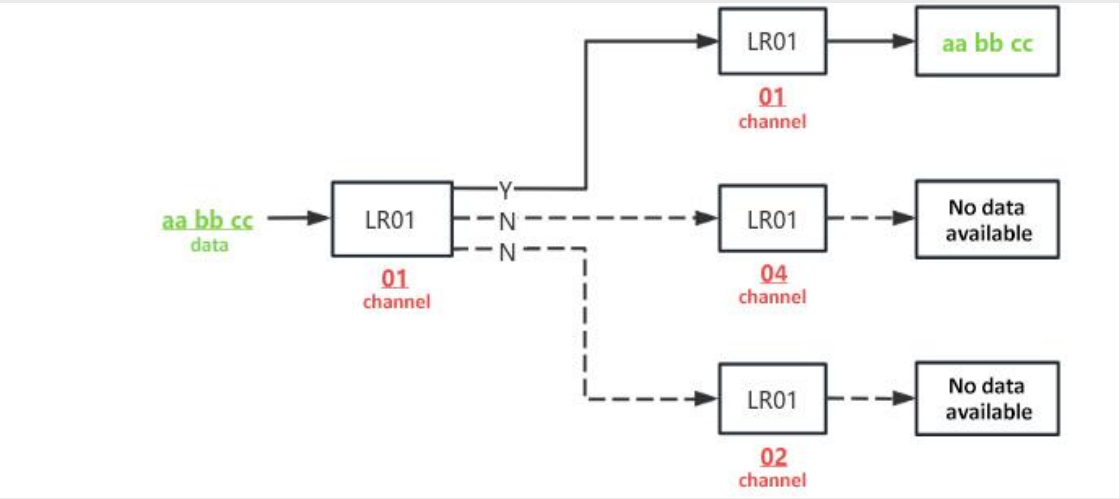
Remark:

After setting this command, a restart is required for it to take effect.

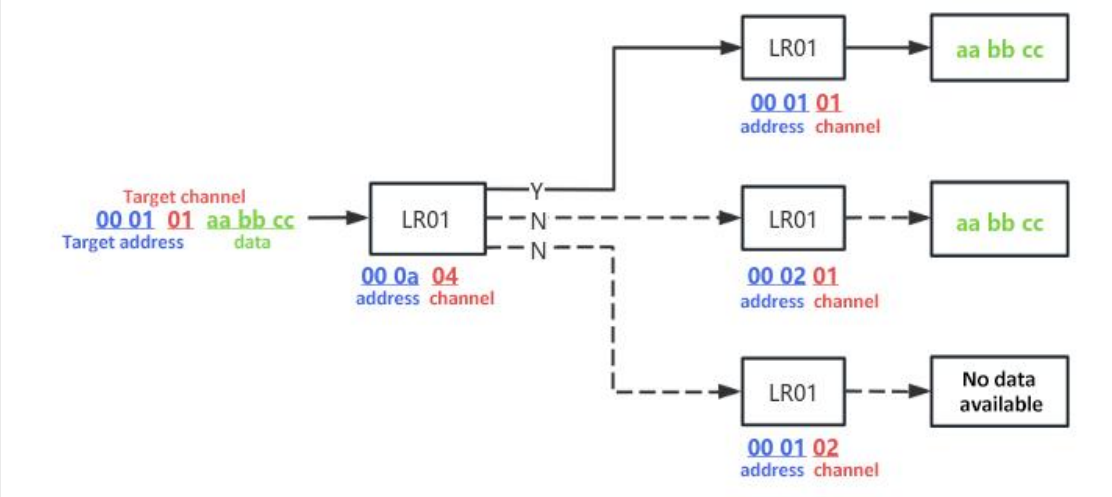
- **Transparent transmission data format:** Directly send data
- **Fixed-point transmission data format:** Device address (2 bytes in hexadecimal) + Channel number (1 byte in hexadecimal) + Data (in hexadecimal)
- **Broadcast transmission data format:** Channel number (1 byte in hexadecimal) + Data (in hexadecimal)

Example:

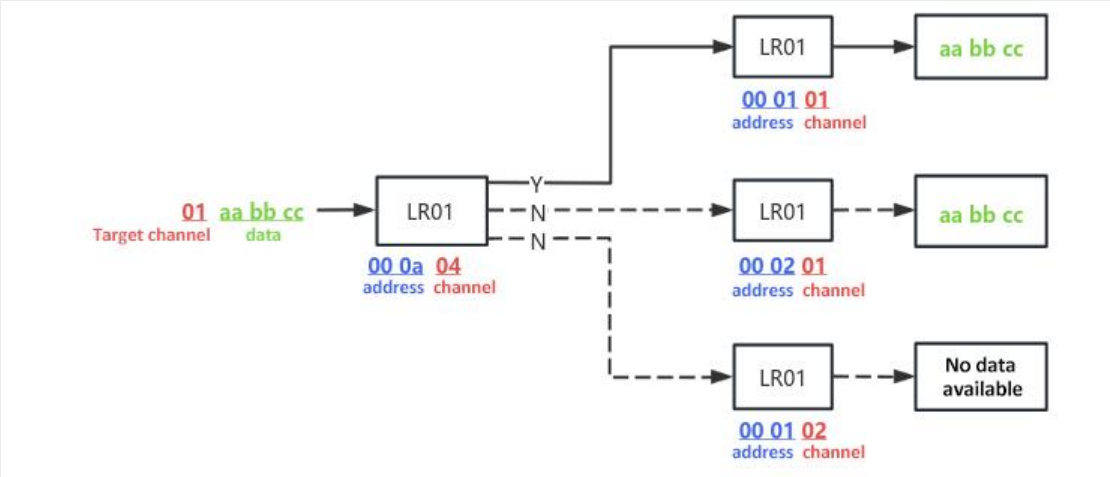
1、 Transparent Transmission:



2、Fixed-Point Transmission:



3、 Broadcast Transmission:



5.2.7. Set/Query—Power Consumption Mode

Function	Command	Response	Description
Query Power Consumption Mode	AT+SLEEP	+SLEEP=<param>	< param>Serial number 0: Sleep mode 1: Air wake-up mode 2: High time efficiency mode Default value: 2
Set Power Consumption Mode	AT+SLEEP<param>	OK	

Remark:

1. **Sleep Mode:** In this mode, both the MCU and RF enter a sleep state. The module is woken up by the UART when data is received. This mode does not save settings; every time the module enters sleep mode, it needs to be activated by a command.
2. **Over-the-Air Wake-Up Mode:**

A. In this mode, the module performs CAD detection every four seconds (the total sleep time is 4 seconds minus the CAD detection time). If the module detects data, it will switch to receive mode. After receiving the data, it automatically returns to sleep mode. During sleep, the RF is asleep, but the MCU is not.

B. When using over-the-air wake-up mode, both the receiver and the transmitter should be in over-the-air wake-up mode to send and receive data.

C、This mode allows for settings to be saved.

3. **High-Efficiency Mode:** In this mode, the module is always in receive mode and can receive data from other devices at any time. When the module's UART receives data from the main control unit, it switches to transmit mode to send the data out. After transmission is complete, it switches back to receive mode.

Note: **CAD Explanation:** LoRa CAD (Channel Activity Detection) is a technology used in LoRa networks to detect channel activity. It helps determine if there is activity (such as transmissions from other devices) on a specified physical channel to aid devices in selecting appropriate transmission times and avoiding collisions.

5.2.8. Software Reset

Function	Command	Response	Description
Software Reset	AT+RESET	OK Power On	

5.2.9. Factory Reset

Function	Command	Response	Description
Factory Reset	AT+DEFAULT	OK Power On	

5.3. Module RF Parameters (One-Click Configuration of Module Air Rate and Communication Distance)

5.3.1. Set/Query-One-Click Configuration of Module Air Rate and Communication Distance

Function	Command	Response	Description
Query module parameters	AT+LEVEL	+LEVEL =<param>	<param>: 0-7, Air speed and communication distance configuration, with eight gears Default value: 0
Set module parameters	AT+LEVEL<param>	OK	

Remark:

1、You can select different levels based on your data volume and communication distance (refer to the table below for data volume and distance). The larger the air rate, the faster the data can be sent.

2、This command sets the RF bandwidth, RF coding rate, and spreading factor, making it ready for direct use.

3、The transmission and reception devices must have the same LEVEL setting to send and receive data.

4、After setting this command, a restart is required for it to take effect.

Note: The table below shows the configuration parameters for different levels under the premise of a coding rate of CR=4/6. The outdoor distance (clear line-of-sight) and urban distance listed are for reference only; the actual distance should be based on empirical measurements.

LEVEL (gear)	SF (spreading factor)	BW (bandwidth KHz)	Air Character Rate(bit/s)	Outdoor Distance(Km)	Urban Distance(Km)
0	12	125	244	8.0	3.8
1	11	125	447	7.5	2.8
2	10	125	813	5.7	2.8
3	9	125	1464	5.3	2.7
4	8	125	2604	5.2	2.7
5	7	125	4557	5.0	2.7
6	6	125	7812	4.5	2.7
7	5	125	13020	4.1	2.5

5.4. Module RF Parameter Configuration (General Configuration)

5.4.1. Set/Query - Working Channel

Function	Command	Response	Description
Query Working Channel	AT+CHANNEL	+ CHANNEL=<param>	param: 00-1E（hexadecimal） Starts at 433Mhz, Increases to 1400Khz Defaults: 00
Set Working Channel	AT+CHANNEL <param>	+CHANNEL=<param> OK	

Remark:

1、This module has 31 general channels configured. For more channels, please contact our staffs.

2、After setting this command, a restart is required for it to take effect.

3、When multiple receiving devices are too close to the transmitting device, it may cause receiving devices on different channels to receive the data. Therefore, it is recommended to keep a considerable distance between the transmitting device and the receiving devices.

Note: The following table is a comparison of the operating frequency bands of different channels, unit: Mhz.

Channel	Operating Frequency	Channel	Operating Frequency
00	433	10	455.4
01	434.4	11	456.8
02	435.8	12	458.2
03	437.2	13	459.6
04	438.6	14	461
05	440	15	462.4
06	441.4	16	463.8
07	442.8	17	465.2
08	444.2	18	466.6
09	445.6	19	468
0A	447	1A	469.4
0B	448.4	1B	470.8
0C	449.8	1C	472.2
0D	451.2	1D	473.6
0E	452.6	1E	475
0F	454		

5.4.2. Set/Query-Device Address

Function	Command	Response	Description
Query Device Address	AT+MAC	+MAC=<param><param>	param:

Set Device Address	AT+MAC<param>, <param>	+MAC=<param><param> OK	Hexadecimal, one byte Default setting: ffff

Remark:

After setting this command, a restart is required for it to take effect.

Example:

Set the module address to 0a01

Send: AT+MAC0a,01

Return: +MAC=0a01

OK

5.4.3. Set/Query-Transmit Power

Function	Command	Response	Description
Query transmit power	AT+POWE	+POWE=<param>	param: 0-22dB（integer value） Default setting: 22dB
Set transmit power	AT+POWE<param>	+POWE=<param> OK	

Remark:

After setting this command, a restart is required for it to take effect.

Example:

Modify the transmit power to 10dB

Send: AT+POWE10

Return: +POWE=10

OK

5.5. Module RF parameter configuration (differentiated configuration)

5.5.1. Query - RF bandwidth

Function	Command	Response	Description
Query RF bandwidth	AT+BW	+BW=<param>	<param>: 0 0: 125K Default value: 0

Remark:

If you need other RF bandwidth, please contact our staff.

5.5.2. Set/Query—RF Coding Rate

Function	Command	Response	Description
Query RF Coding Rate	AT+CR	+CR=<param>	<param>: 1-4 1: 4/5 2: 4/6 3: 4/7 4: 4/8 Default value: 2
Set RF Coding Rate	AT+CR<param>	+CR=<param> OK	

Remark:

After setting this command, a restart is required for it to take effect.

5.5.3. Set/Query—Spreading Factor

Function	Command	Response	Description
Query 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 Spreading Factor	AT+SF<param>	+SF=<param> OK	

Remark:

After setting this command, a restart is required for it to take effect.

5.5.4. Set/Query - CRC Check

Function	Command	Response	Description
Query CRC Check	AT+CRC	+CRC=<param>	<param>: 0，1 0: Turn off CRC check 1: Turn on CRC check Default value: 0
Set CRC Check	AT+CRC<param>	OK	

Remark:

After setting this command, a restart is required for it to take effect.

5.5.5. Set/Query - I/Q Signal Inversion

Function	Command	Response	Description
Query if I/Q Signal is Inverted	AT+IQ	+IQ = <param>	<param>: 0，1 0: I/Q signal not inverted 1: I/Q signal inverted Default value: 0
Set I/Q Signal Inversion	AT+IQ<param>	OK	

Remark:

1．After setting this command, a restart is required for it to take effect.

2．Explanation of IQ Inversion: IQ inversion refers to the phase inversion of the received IQ signal in LoRa communication. This operation can be performed before or after demodulation to change the phase of the signal, thereby achieving different functionalities or optimizing performance.

5.6. Error Code List

The detailed information of the error code in ERROR=<> is listed as follows:

Return value	Error message description
101	Parameter length error
102	Parameter format error
103	Parameter data error
104	Command error

6. Value-added Services

To meet the various functional requirements of customers, we can provide the following technical value-added services:

- Module program customization, such as: IO function port customization, AT command customization, broadcast package customization, etc.
- Module PCB hardware customization, which can be customized to the hardware requirements required by customers.
- Various Bluetooth solution customization, you can customize a full set of Bluetooth software and hardware solutions according to customer needs.
- Full set of networking solution customization, you can customize a full set of networking and gateway solutions according to customer needs.

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