E290-400RxxD User Manual

433 / 470MHz 20/30dBm PAN3060 wireless module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1 Introduction

1.1 Brief Introduction

E290-400RxxD The series is a new generation of wireless modules developed by Chengdu Yibite Electronic Technology Co., Ltd. This series of modules is based on the RS485 interface module developed based on the Panqiwei PAN3060 RF chip . It has multiple transmission modes and works in the (410.125~493.125MHz) frequency band (default 433.125MHz). It supports DC 5V power supply and can be used with the E2 90 -T series of the same frequency band series for low-power applications.

E290-400RxxD adopts the new generation of ChirpIoT™ spread spectrum technology, supports half-duplex wireless communication , and has the characteristics of high anti-interference and high sensitivity ; supports air wake-up, wireless configuration, automatic relay, communication key , AT command, IAP upgrade and other functions, supports sub-packet length setting, and can provide customized development services .

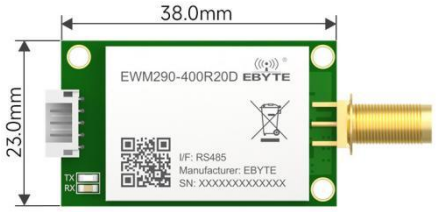


Figure 1 : E290-400R20D



Figure 2 : E290-400R30D

1.2 Features

- Adopting RS485 interface mode, RS485 interface equipment is more convenient for data transmission;
- Support AT commands , which makes it more convenient to use;
- Method based on ChirpIoT™ brings a longer communication distance and stronger anti-interference ability ;
- Supports automatic relay networking, multi-level relay is suitable for ultra-long-distance communication , and multiple networks can run simultaneously in the same area ;
- Supports users to set communication keys by themselves, which cannot be read, greatly improving the confidentiality of user data;
- Support RSSI signal strength indication function , which is used to evaluate signal quality, improve communication network, and measure distance;
- Support wireless parameter configuration, remotely configure or read wireless module parameters by sending command data packets wirelessly ;
- Supports single-point air wake-up, which is an ultra-low power consumption function suitable for battery-powered applications;
- Supports fixed-point transmission, broadcast transmission, and channel monitoring;
- Supports the global license-free ISM 433MHz frequency band and the 470MHz meter reading frequency band;
- Under ideal conditions, the communication distance can reach 10 km;
- The parameters are saved when power is off , and the module will work according to the set parameters after power is turned on again ;

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- Efficient watchdog design, once an abnormality occurs, the module will automatically restart and continue to work according to the previous parameter settings ;
- Supports data transmission rates of 2.4 k to 62.5 k bps;
- Support IAP upgrade, which makes firmware update more convenient;
- Airspeed adaptation, if certain conditions are met, any airspeed gear can be configured and can communicate with each other;
- Industrial standard design, supports long-term use at -40 ~ + 85 ℃ ;

1.3 Application

- Agricultural intelligent irrigation and environmental testing;
- Photovoltaic power station monitoring and distributed photovoltaic system management, etc.;
- Home security alarm and remote keyless entry;
- Smart home and industrial sensors, etc.
- Wireless alarm security system ;
- Building automation solutions;
- Wireless industrial remote control;
- Healthcare products;
- Advanced Metering Infrastructure (AMI).

2 Specification and parameter

2.1 RF parameters

RF parameters	Unit	Model		Remark
		E290-400R20D	E290-400R30D	
Max transmit power	dBm	2 0	30	-
Reference distance	km	5	10	Clear and open air, antenna gain 5dBi, antenna height 2.5 meters, air rate 2.4 kbps .
Working frequency band	MHz	410.125～493.125	410.125～493.125	Support ISM band
Air speed	bps	2.4K～62.5K	2.4K～62.5K	User programmable control

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2.2 Electrical parameters

Electrical parameters		Unit	Model		Remark
			E290-400R20D	E290-400R30D	
Operating voltage		V	4.5～5.5	4.5～5.5	≥ 5 V can guarantee the output power , and exceeding 5.5 V may burn the module.
Power consumption	Emission current	mA	95	61 0	Instantaneous power consumption
	Receiving current	mA	10	30	-
	Sleep current	uA	590	410	-
temperature	Operating temperature	℃	-40 ～ + 85		Industrial-grade design
	Storage temperature	℃	-40 ～ + 85		Industrial-grade design

2.3 Hardware Parameters

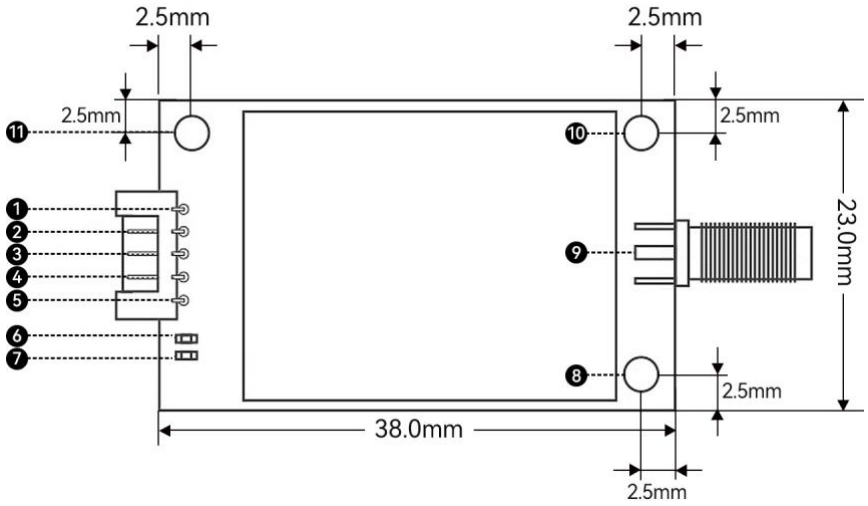
Hardware Parameters	Model		Remark
	E290-400R20D	E290-400R30D	
Crystal frequency	32MHz	32MHz	Industrial grade high precision crystal oscillator
Modulation	ChirpIoT™	ChirpIoT™	New generation ChirpIoT™ modulation technology
Interface	PH2.0	PH2.0	Spacing 2.0mm, with reserved 2.54mm holes
Communication interface	RS 485 interface	RS 485 interface	-
Launch length	240 Bytes	240 Bytes	The command can be set to send packets of 32/64/128/240 bytes
Packaging	Pin type	Pin type	-
Cache capacity	5 00 Bytes	5 00 Bytes	-
Antenna interface	SMA-K	SMA-K	Equivalent impedance is about 50 Ω
size	38*23mm	26*48mm	±0.2mm
Product Net Weight	7.1g	8.9g	±0.2g

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3 Size and pin definition

3.1 E290-400R20D size and pin definition

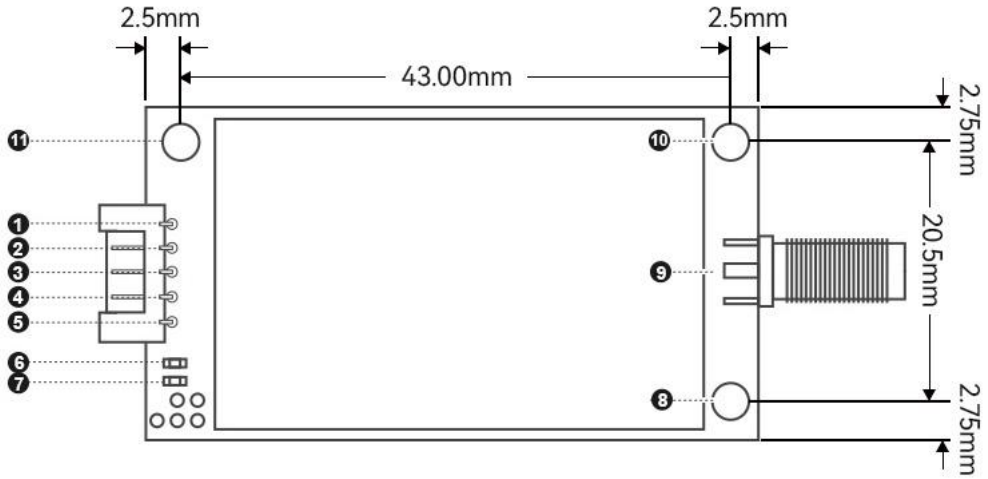


Pin No.	Name	Direction	Description
1	VCC	enter	Module power positive reference, voltage range: 4.5 ~ 5.5V DC
2	GND	-	Module ground wire
3	485A	Input/ Output	A of RS485 interface, A of external RS485 device
4	485B	Input/ Output	B of RS485 interface, B of external RS485 device
5	STB	Output	Essentially AUX, it indicates the module is busy. For details, please refer to Section 5.4 STB Details
6	Send indicator light	-	Green, the indicator light flashes when data is sent
7	Receiving indicator	-	Blue, the indicator light flashes when receiving data
8	Fixing holes	-	Fixing hole (diameter 2.8mm)
9	RF Interface	-	SMA-K, equivalent impedance is about 50 Ω
10	Fixing holes	-	Fixing hole (diameter 2.8mm)
11	Fixing holes	-	Fixing hole (diameter 2.8mm)

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3.2 E290-400R30D size and pin definition

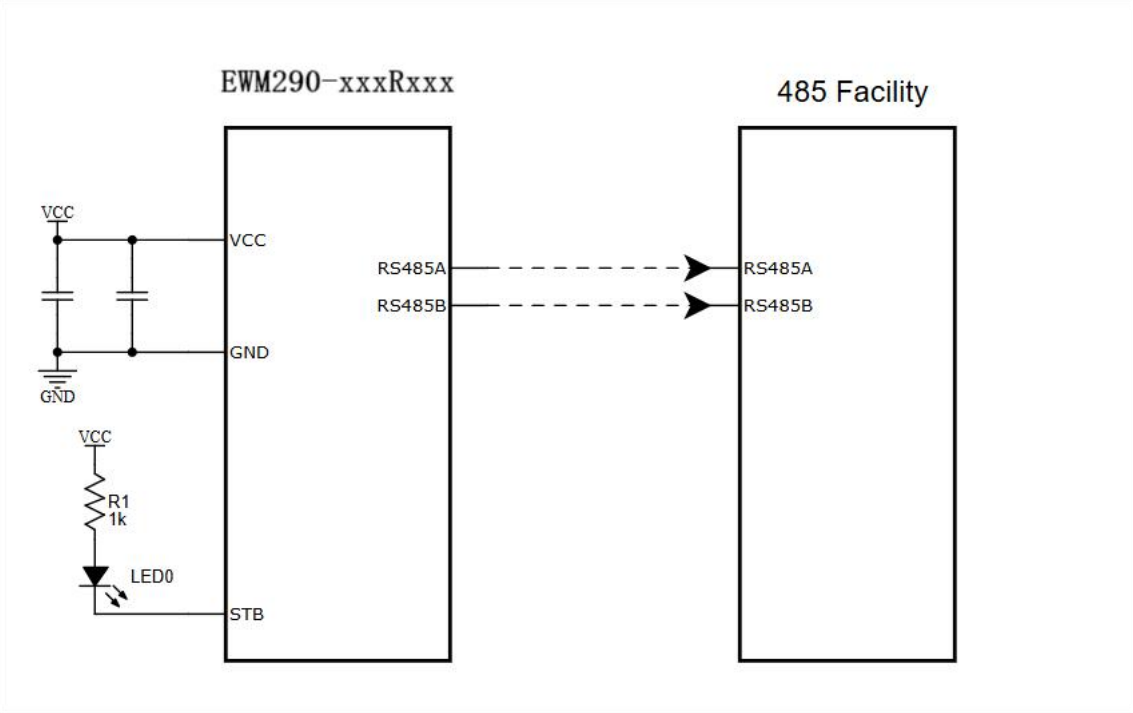


Pin No.	Name	Direction	Description
1	VCC	enter	Module power positive reference, voltage range: 4.5 ~ 5.5V DC
2	GND	-	Module ground wire
3	485A	Input/ Output	A of RS485 interface, A of external RS485 device
4	485B	Input/ Output	B of RS485 interface, B of external RS485 device
5	STB	Output	Essentially AUX, it indicates the module is busy. For details, please refer to Section 5.4 STB Details
6	Send indicator light	-	Green, the indicator light flashes when data is sent
7	Receiving indicator	-	Blue, the indicator light flashes when receiving data
8	Fixing holes	-	Fixing hole (diameter 2.75mm)
9	RF Interface	-	SMA-K, equivalent impedance is about 50 Ω
10	Fixing holes	-	Fixing hole (diameter 2.75mm)
11	Fixing holes	-	Fixing hole (diameter 2.75mm)

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4 Recommended Connection Diagram



No.	Brief connection instructions between module and 485 device
1	RS485 interface A, external RS485 device A; RS485 interface B, external RS485 device B
2	The STB pin can be connected in series with an indicator light (note the series current limiting resistor) to indicate that the module is working properly; it can also be left unconnected.
3	Simply connect a 433MHz/470MHz antenna to the RF interface.

5 Functional Details

5.1 Working mode

The module has four working modes. In the configuration mode, the mode can be changed according to the AT command or by using the host computer . The details are shown in the following table:

Mode (0-3)	Instruction	Mode Introduction	Remark
0 Transfer Mode	AT+MODE=0	Serial port open, wireless open, transparent transmission	Support special command air configuration
1 WOR mode	AT+MODE=1	Can be defined as WOR sender and WOR receiver	Support air wake-up
2 Configuratio	AT+MODE=2	Users can access the registers through the serial port to control the working status of the module	

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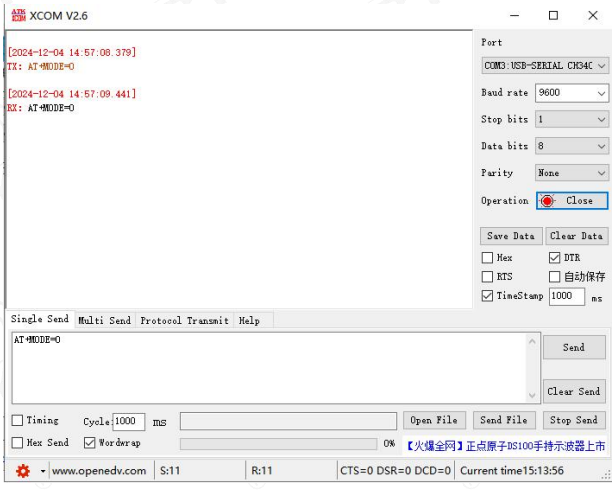
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n Mode			
3 Deep Sleep	AT+MODE=3	The module enters sleep mode	

Note: However, 62.5Kbps and 38.4Kbps are not recommended in WOR mode.

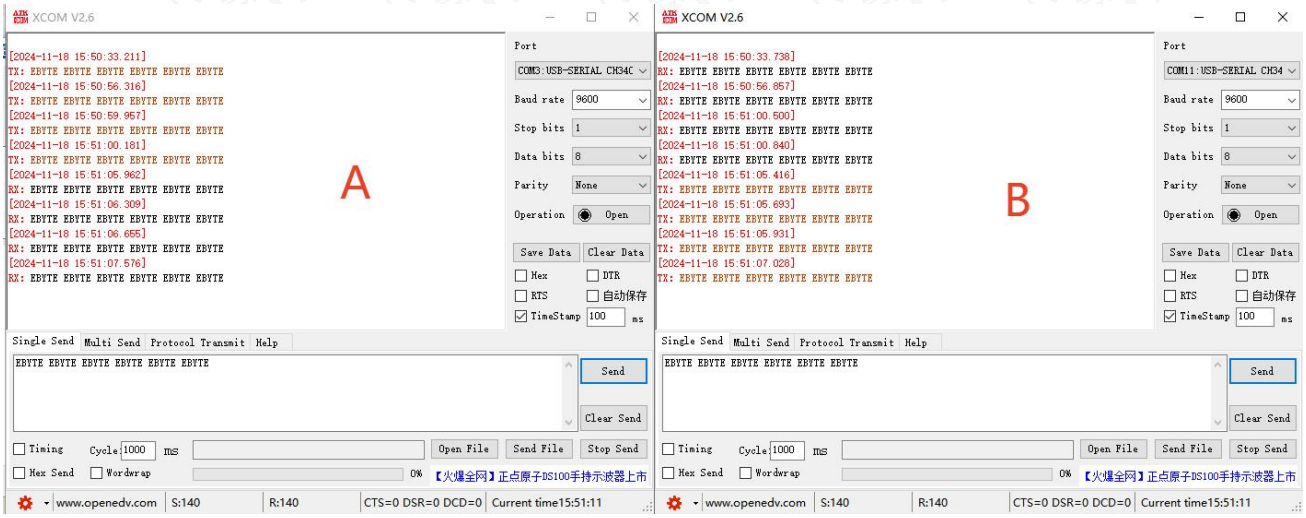
5.1.1 Transmission mode use (working mode is 0, AT+MODE=0)

- Users can use the host computer software developed by Ebyte to change the mode, or use the serial port assistant XCOM to send the mode modification command AT+MODE=0 to change it;

Host computer	XCOM
	

Note: The steps for changing the mode using the host computer are as shown in the figure on the left: Select the corresponding serial port → Open the serial port → Read parameters (the prerequisite is that the configuration mode can be read) → Click the transparent transmission mode → The print information that the mode has been changed appears.

- **Transparent transmission function** : What you send is what you get. Use the serial port assistant to communicate with each other (the factory default parameters are consistent, and the transmission method is transparent transmission). The example is as follows:

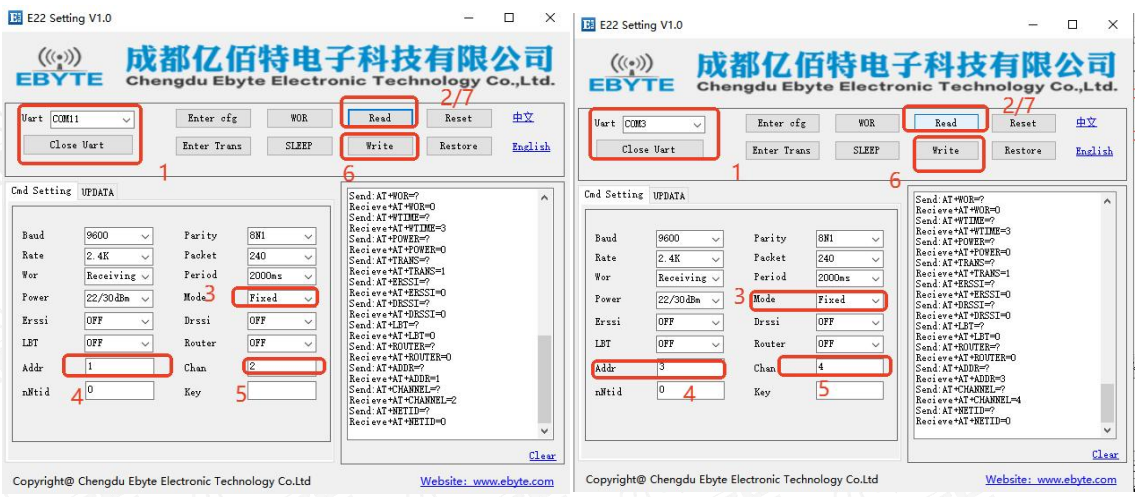
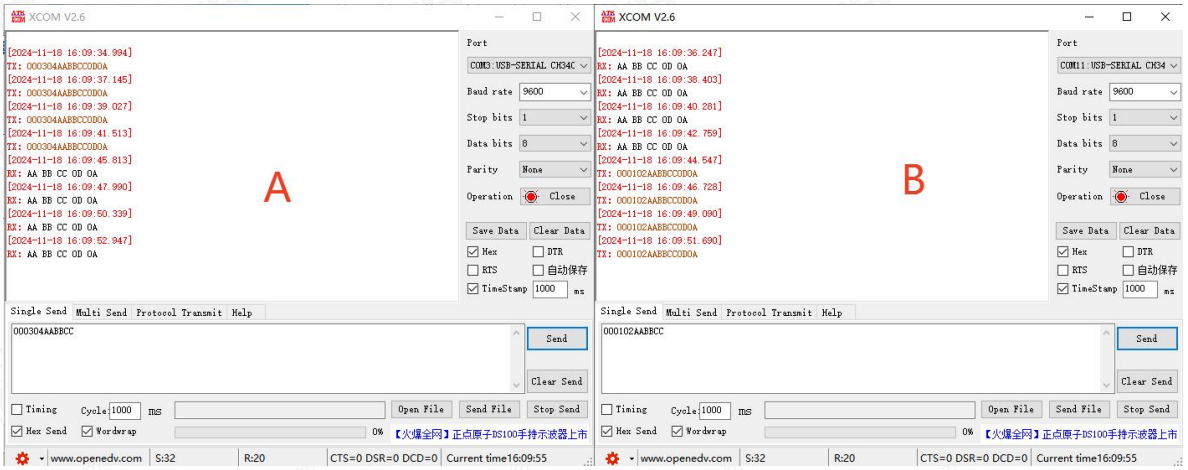


Schematic diagram

- **Fixed-point transmission function:** Send and receive data in a fixed data format, the format is: target address +

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target channel + data, effectively avoiding partial interference.

Serial number	Steps for using fixed-point launch
1. Modify the module parameters through the host computer or serial port assistant: modify the module address and channel in the configuration mode, change the transparent transmission mode to fixed-point transmission, and finally write the parameters to complete the modification .	
2. Change the module working mode to the general mode: edit the parameters of module A to 000304AABBCC and send it to module B. Similarly, the data sent by module B is 000102AABBCC. (The transmission data format in fixed-point mode is: target address + target channel + data)	

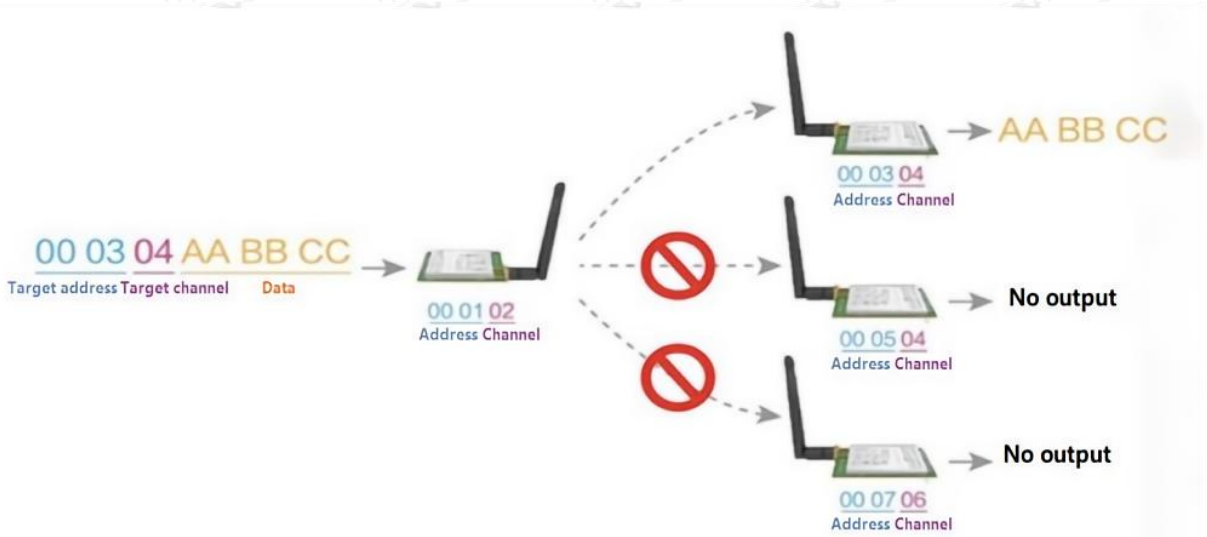


Figure 1 Schematic diagram of fixed-point transmission

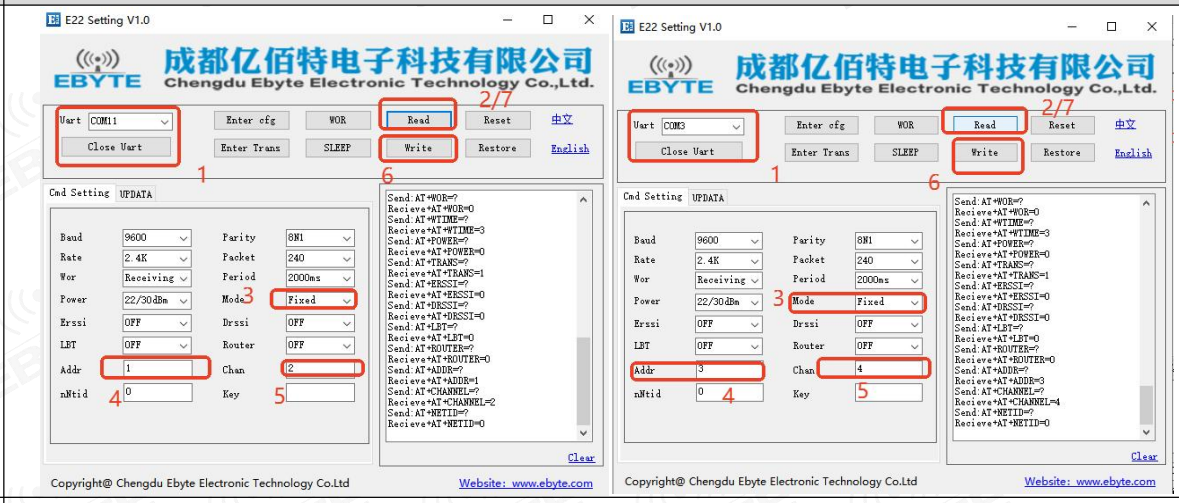
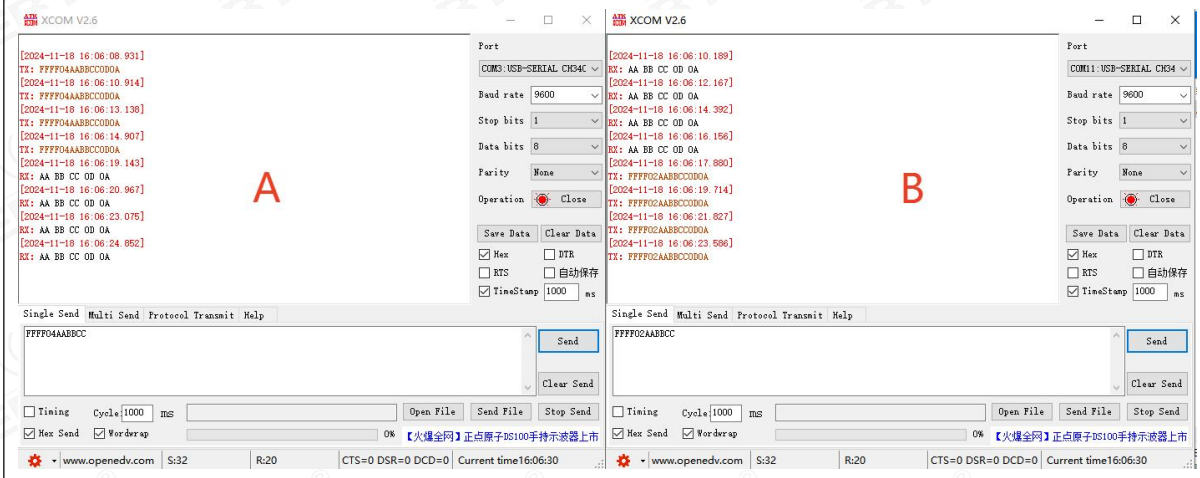
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- **Broadcasting function:**

1) Set the address of module A to 0xFFFF and the channel to 0x04 . When module A is used as a transmitter (same mode, transparent transmission or fixed-point transmission), all receiving modules under the 0x04 channel can receive data, achieving the purpose of broadcasting.

2) Set the address of module A to 0xFFFF and the channel to 0x04. When module A is used as a receiver, it can receive all the data under the 0x04 channel to achieve the purpose of monitoring.

Serial number	Steps for using fixed-point broadcast transmission
1. Modify the parameters of the module through the host computer: modify the module address and channel in the configuration mode , change the transparent transmission mode to fixed - point transmission, and finally write the parameters to complete the modification .	
2. Change the module working mode to the general mode: edit the parameters of module A to FFFF04AABBCC and send it to module B. Similarly, the data sent by module B is FFFF02AABBCC. (The data transmission format in fixed-point broadcast mode is: broadcast address + target channel + data)	

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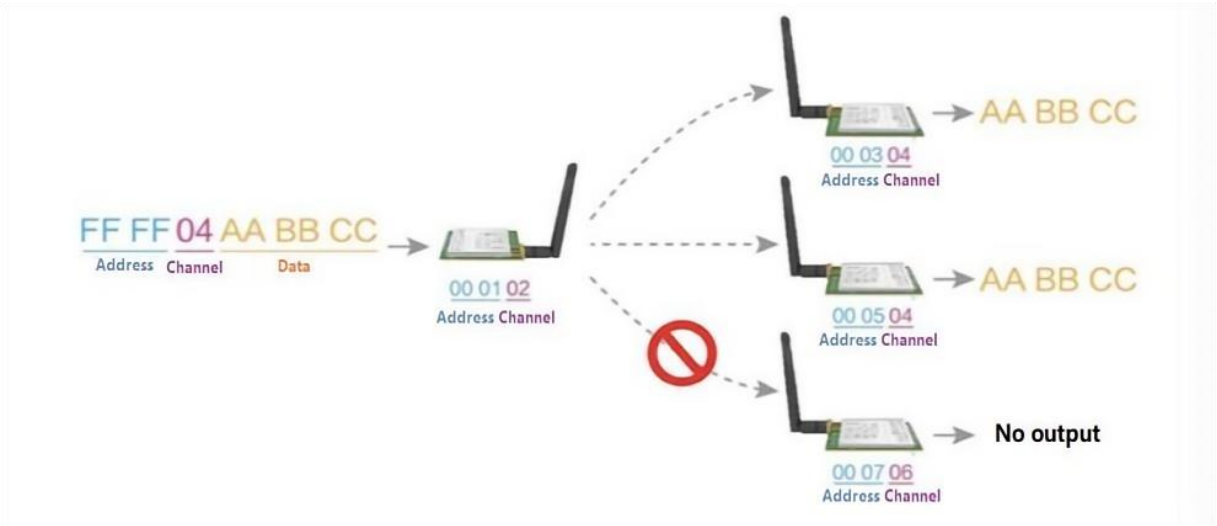


Figure 2 Schematic diagram of fixed-point broadcast transmission

- **Relay networking mode:** Relay networking forwards data between source nodes and target nodes through relay nodes, thereby expanding network coverage and improving communication reliability.

Serial number	Relay Mode Description
1	After setting the relay mode through the configuration mode, switch to the general mode and the relay starts working.
2	In relay mode, ADDH and ADDL are no longer used as module addresses, but are forwarded and paired with NETID respectively. If a signal is received from one network, it will be forwarded to the other network . The repeater's own network ID is invalid.
3	In the relay mode, the relay module cannot send and receive data and cannot perform low-power operation.
4	When the user enters other modes from mode 3 (sleep mode) or during the reset process, the module will reset the user parameters, during which AUX outputs a low level.

Relay networking rules:

1、Forwarding rules, the relay can forward data bidirectionally between two NETIDs.

2、In relay mode, ADDH\ADDL is no longer used as the module address, but as NETID for forwarding pairing.

As shown in the figure:

①First -level relay

"Node 1" NETID is 08.

"Node 2" NETID is 33.

The ADDH\ADDL of relay 1 are 08 and 33 respectively.

So the signal sent by node 1 (08) can be forwarded to node 2 (33)

At the same time, the addresses of node 1 and node 2 are the same, so the data sent by node 1 can be received by node 2.

② Secondary relay

The ADDH\ADDL of relay 2 are 33, 05 respectively.

So relay 2 can forward the data of relay 1 to network NETID:05.

Therefore, nodes 3 and 4 can receive data from node 1. Node 4 outputs data normally, but node 3 does not output data

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because its address is different from that of node 1.

③Two -way relay

As shown in the configuration figure: the data sent by node 1 can be received by nodes 2 and 4, and the data sent by nodes 2 and 4 can also be received by node 1.

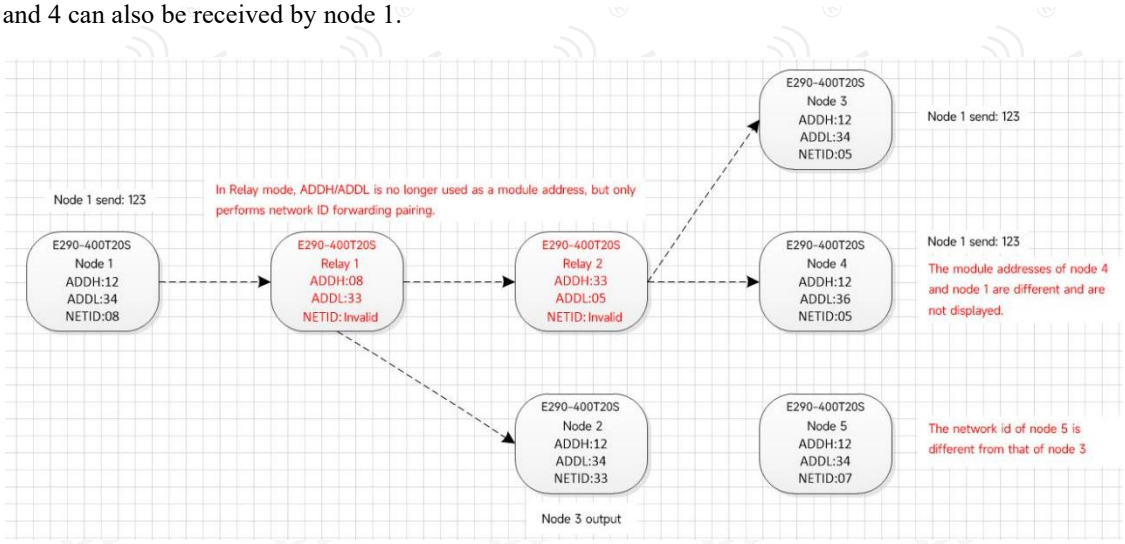
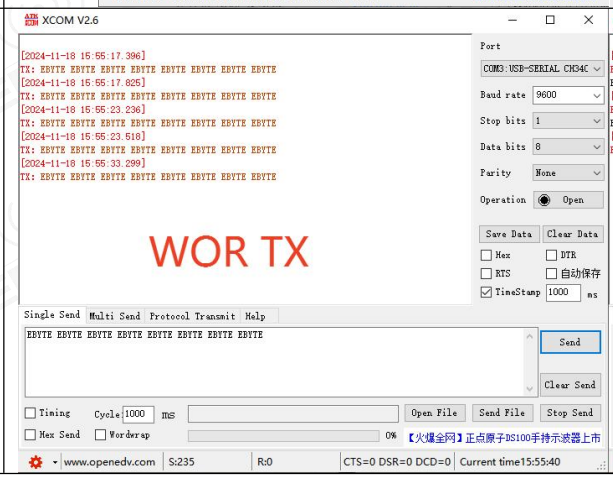
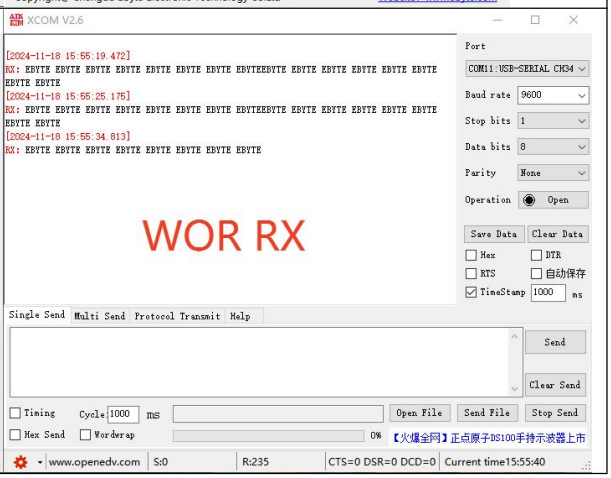


Figure 3 Example of relay mode

5.1.2 Use in WOR mode (working mode is 1, AT+MODE=1)

Serial number	Steps to use WOR mode
1. Users can use the host computer software developed by Ebyte to change the mode, or use the serial port assistant XCOM to send the mode modification command AT+MODE=1 to change it. For detailed command modification, please see Chapter 7 of this article .	 
2. The module working mode is changed to WOR mode: the WOR receiver module sends data to the WOR receiver module, but the WOR receiver module cannot send data to the sender.	 

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Note: In WOR mode, the single-point wake-up function supports only addresses 0-900 at airspeeds of 38.4K and below, and the use of 38.4K and 62.5K airspeeds is not recommended.

5.1.3 Configuration mode use (working mode is 2, AT+MODE=2)

1) The following figure shows the upper computer display interface for module configuration. Users can select the configuration mode on the upper computer to quickly configure and read parameters.



2) In the configuration host computer, the module address, frequency channel, network ID, and key are all displayed in decimal mode; the value range of each parameter is:

Network address: 0-65535 (Note: In WOR mode, the single point wake function only supports 0-900 addresses at 38.4K airspeed and below.)

Frequency channel: 0～83(Note: the 900 MHz band channel range is from 0 to 80)

Network ID: 0-255

Key: 0-65535

3) When users use the host computer to configure the relay mode, they need to pay special attention to the fact that since the parameters in the host computer are displayed in decimal mode, the module address and network ID need to be converted when filling in the decimal system.

If the network ID input by the transmitter A is 02 and the network ID input by the receiver B is 10, when the relay R sets the module address, the hexadecimal value 0X020A is converted to the decimal value 522 as the module address filled in by the relay R;

That is, the module address value that needs to be filled in at the relay end R is 522.

5.1.3 Sleep mode (working mode is 3, AT+MODE=3)

Host computer	XCOM

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Note: The steps for changing the mode using the host computer are as shown in the figure on the left: Select the corresponding serial port → Open the serial port → Read parameters (the prerequisite is that the configuration mode can be read) → Click the transparent transmission mode → The print information that the mode has been changed appears.

5.2 Module reset

- After the module is reset, AUX will output a low level, perform hardware self-test, and set the working mode according to user parameters;
  During this process, AUX maintains a low level. After completion, AUX outputs a high level and starts normal operation according to the instructions issued, such as sending the command AT+MODE=0/1/2/3 to determine the working mode;
  Therefore, the user needs to wait for the AUX rising edge as the starting point for the module to work normally.

5. 3 Single point wake-up

- The following measurement parameters are all default parameters, only the address and WOR role are changed
- EWM290-xxxRxxx supports single-point wake-up function, which can wake up a module alone without waking up all modules. The current consumption diagram of the receiving device when it is the target device is shown in Figure 1 below , and the other non-target devices will re-enter the sleep state as shown in Figure 2.
- The EWM290-xxxRxxx can also partially sleep while receiving a wake-up code, further reducing power consumption.
- **Note: When the airspeed is 38.4K or 62.5K, this single-point wake-up function is temporarily unavailable and only the traditional WOR mode can be used.**

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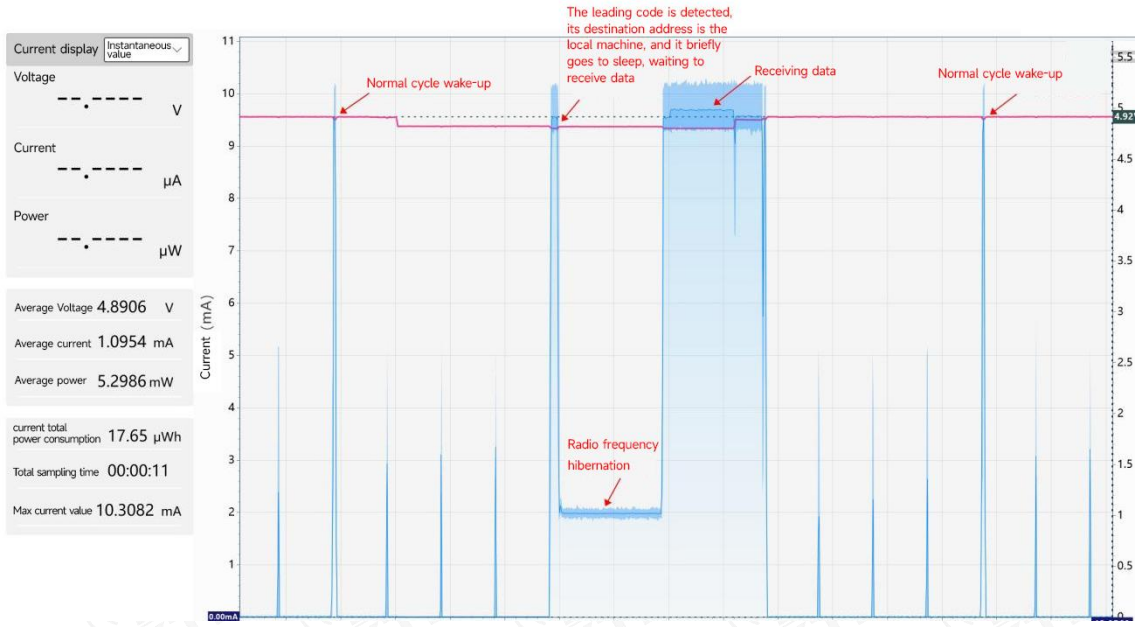


Figure 1 Target device current consumption diagram

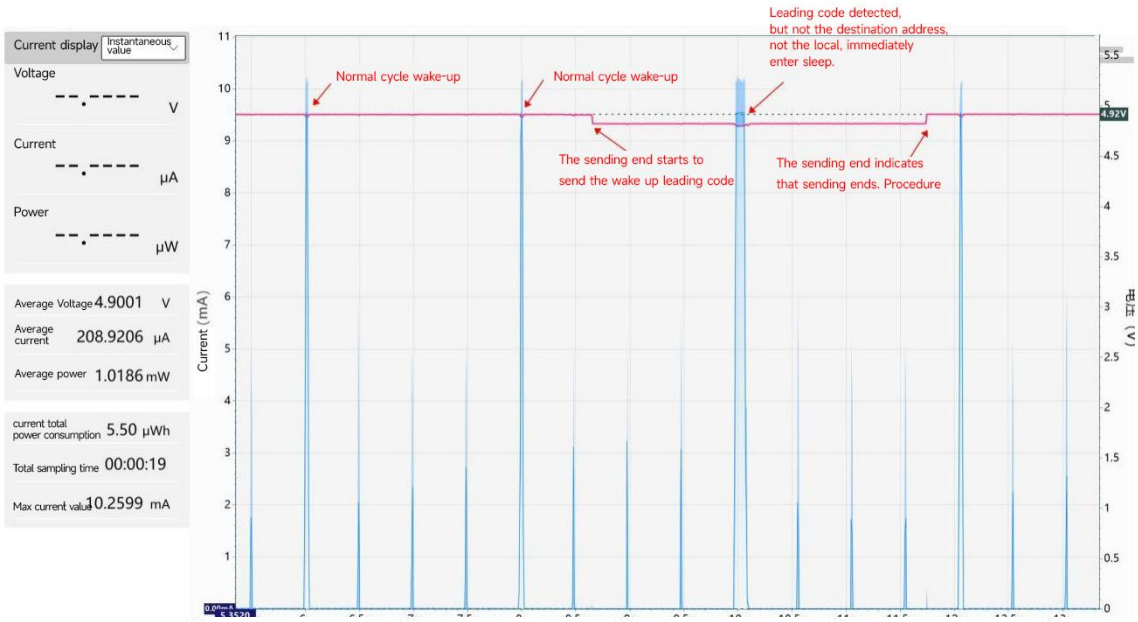


Figure 2 Current consumption of non-target devices

- In addition, EWM290-xxxRxxx cannot actively send data through RF by default in WOR receiving mode. In order to solve the problem that users repeatedly switch between WOR receiving mode and transparent transmission mode in the polling structure to achieve response , EWM290-xxxRxxx can enable this function by setting C0 09 02 E8 03 or AT+DELAY=1000. After enabling this function, users can send wireless data through UART within 1000 ms after receiving data in WOR receiving mode.
- HEX instruction (C0 09 02 E8 03): C0 is the write command, 09 is the register start address, 02 is the length, 0x03E8 is the set delay, the maximum value 0xFFFF is 65535ms, and setting it to 0 will turn off the wake-up delay.

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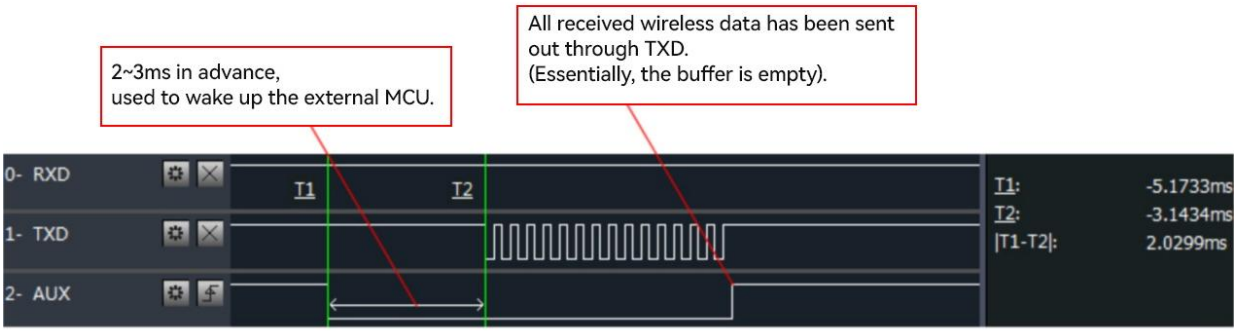
5. 4 STB Detailed Explanation

Note: STB is essentially AUX, which is the busy status indicator of the module. The following AUX are all STB!

- AUX is used for wireless transceiver buffer indication and self-test indication.
- It indicates whether the module has data that has not been transmitted wirelessly, or whether the received wireless data has not been sent out through the serial port, or the module is in the process of initializing self-test.
- AUX cannot be low at the moment of power-on, otherwise it will be forced into firmware upgrade mode.

5.4.1 Serial port data output indication

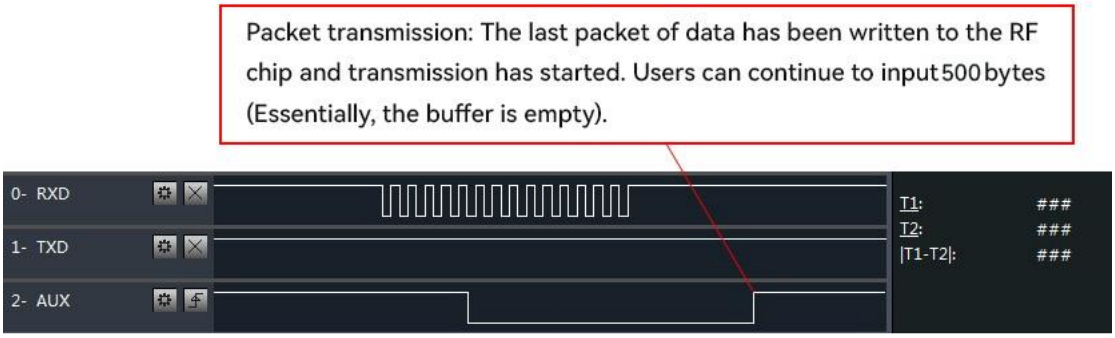
- Used to wake up the external MCU in sleep mode;



AUX pin timing diagram when module serial port sends out data.

5.4.2 Wireless transmission indicator

- Buffer empty: data in the internal 500- byte buffer are all written to the wireless chip (automatically divided into packets) ;
  When AUX=1, the user can continuously send data less than 500 bytes without overflow ;
  When AUX=0, the buffer is not empty: the data in the internal 500 -byte buffer has not been fully written to the wireless chip and the transmission has not yet started. At this time, the module may have timed out waiting for the end of user data, or is transmitting wireless packets .



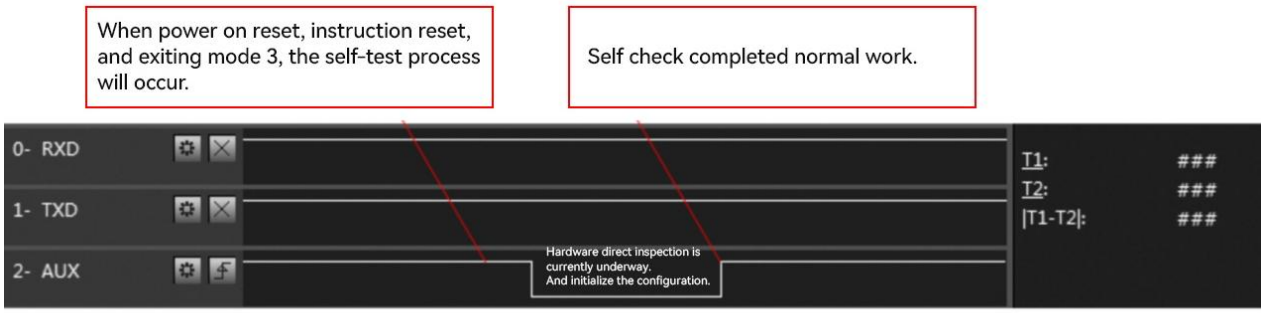
AUX pin timing diagram when the module receives serial port data.

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5.4.3 The module is being configured.

- Only when resetting and exiting sleep mode;



During self check, AUX pin timing diagram.

5.4.4 Precautions

When the module switches between all modes, AUX will indicate busy status. The specific time is as follows:

No.	AUX Notes
1	For the above functions 1 and 2, the output low level is given priority, that is, if any output low level condition is met, AUX will output low level; When all low-level conditions are not met, AUX outputs a high level.
2	When AUX outputs a low level, it means the module is busy and no working mode detection will be performed at this time; When the module AUX outputs a high level within 1ms, the mode switching will be completed.
3	After the user switches to a new working mode, the module will not actually enter this mode until at least 2ms after the AUX rising edge. If AUX is always at a high level, the mode switch will take effect immediately.
4	When the user enters other modes from mode 3 (sleep mode) or during the reset process, the module will reset the user parameters, during which AUX outputs a low level.
5	Due to the characteristics of ChirpIoT™ modulation, the information transmission delay is much longer than FSK. For example , at an airspeed of 2.4 kbps, the transmission delay of 100 bytes is about 1 second . Customers are advised not to transmit large amounts of data at low airspeeds to avoid data loss due to data accumulation and cause communication abnormalities.

5. 5 Wireless transceiver indicator

- The wireless is in sending state and the sending indicator light will be on.
- The wireless is in receiving state and the receiving indicator light will be on.

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6 Register Read and Write Control

6.1 Instruction format

Configuration mode (mode 2: AT+MODE=2), the supported commands are listed as follows (**when setting, only 9600 and 8N1 formats are supported**):

Serial number	Instruction Format	Detailed description
1	Setting Registers	Instruction: C0+starting address+length+parameter Response: C1+starting address+length+parameters Example 1: Restore factory default parameters Instruction start address length parameter Send: C0 0 0 0 9 00 00 00 60 20 17 03 00 00 Returns: C1 0 0 0 9 00 00 00 60 20 17 03 00 00 Example 2: Configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4 K) at the same time Send: C0 00 04 12 34 00 6 0 Return: C1 00 04 12 34 00 6 0
2	Read Register	Instruction: C1+starting address+length Response: C1+starting address+length+parameters Example 1: Read all setting parameters Instruction start address length parameter Send: C1 0 0 0 9 Returns: C1 0 0 0 9 00 00 00 60 20 17 03 00 00 Example 2: Read module address, network address, serial port, and airspeed simultaneously Send: C1 00 04 Return: C1 00 04 12 34 00 6 0
3	Setting up temporary registers	Instruction: C2 + starting address + length + parameter Response: C1 + start address + length + parameter Example 1: Configure the channel to 0x09 Instruction start address length parameter Send: C2 05 01 09 Return: C1 05 01 09 Example 2: Configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4 K) at the same time Send: C2 00 04 12 34 00 6 0 Return: C1 00 04 12 34 00 6 0
4	Wireless Configuration	Instruction: CF CF + regular instruction Response: CF CF + normal response Example 1: The wireless configuration channel is 0x09 Wireless command header command start address length parameter Send: CF CF C0 05 01 09 Return: CF CF C1 05 01 09 Example 2: Wirelessly configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4 K) at the same time Send: CF CF C0 00 04 12 34 00 6 0 Return: CF CF C1 00 04 12 34 00 6 0
5	Format Error	Format Error Response FF FF FF / " =ERR "

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6.2 Register Description

<table>
<tr><th>Serial number</th><th>Read and Write</th><th>Name</th><th colspan="5">describe</th><th>Remark</th></tr>
<tr><td>00H</td><td>Read/Write</td><td>ADDH</td><td colspan="5">ADDH (default 0)</td><td rowspan="2">The high byte and low byte of the module address . When the module address is equal to FFFF, it can be used as a broadcast and monitoring address.</td></tr>
<tr><td>01H</td><td>Read/Write</td><td>ADDL</td><td colspan="5">ADDL (default 0)</td></tr>
<tr><td>02H</td><td>Read/Write</td><td>NETID</td><td colspan="5">NETID (default 0)</td><td>Network address, used to distinguish networks ;
When communicating with each other, they should be set to the same.</td></tr>
<tr><td rowspan="19">0 3H</td><td rowspan="19">Read/Write</td><td rowspan="19">REG0</td><td>7</td><td>6</td><td>5</td><td colspan="2">UART serial port rate (bps)</td><td rowspan="10">The two modules that communicate with each other can have different serial port baud rates and verification methods ;
When transmitting large data packets continuously, users need to consider data blocking or even data loss caused by the same baud rate ;
It is generally recommended that both parties in communication have the same baud rate.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td colspan="2">The serial port baud rate is 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td colspan="2">The serial port baud rate is 2400</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td colspan="2">The serial port baud rate is 4800</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td colspan="2">The serial port baud rate is 9600 (default)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td colspan="2">The serial port baud rate is 19200</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td colspan="2">The serial port baud rate is 38400</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td colspan="2">The serial port baud rate is 57600</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td colspan="2">The serial port baud rate is 115200</td></tr>
<tr><td>4</td><td>3</td><td colspan="3">Serial port check digit</td><td rowspan="5">The serial port modes of the two communicating parties can be different ;</td></tr>
<tr><td>0</td><td>0</td><td colspan="3">8 N1 (default)</td></tr>
<tr><td>0</td><td>1</td><td colspan="3">8 O1</td></tr>
<tr><td>1</td><td>0</td><td colspan="3">8 E1</td></tr>
<tr><td>1</td><td>1</td><td colspan="3">8 N1 (equivalent to 0 0)</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td colspan="2">Wireless air rate (bps)</td><td rowspan="8">The air rate of both communicating parties must be the same ;
air rate, the smaller the delay and the shorter the transmission distance.
0~2: BW = 250K
3~7: BW = 500K</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td colspan="2">Air rate 2.4k (default)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td colspan="2">Air speed 2.4k</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td colspan="2">Air speed 2.4k</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td colspan="2">Air speed 4.8 k</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td colspan="2">Air speed 9.6 k</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td colspan="2">Air speed 19.2 k</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td colspan="2">Air speed 38.4 k</td></tr>
</table>

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			1	1	1	Air speed 62.5 k	
0 4H	Read/Write	REG1	7	6	Subcontracting settings		The data sent by the user is smaller than the packet length, and the serial port output at the receiving end appears as uninterrupted continuous output ; If the data sent by the user is larger than the packet length, the receiving serial port will output it in packets.
			0	0	2 40 bytes (default)		
			0	1	1 28 bytes		
			1	0	6 4 bytes		
			1	1	3 2 bytes		
			5	RF Power Mode			Users can change the RF power mode according to their needs: 1、DCDC mode reduces power consumption by sacrificing sensitivity 2、LDO mode improves sensitivity at the expense of power consumption 3. DCDC mode can be used for battery-powered devices
			0	DCDC mode			
			1	LDO mode (default)			
			4	RSSI environment noise enable			When enabled, you can send commands in transfer mode or WOR send mode. Let C0 C1 C2 C3 instruction read register; Register 0x00: Current ambient noise RSSI; Register 0X01: RSSI when receiving data last time (The current channel noise is: dBm = -(256 - RSSI)); Instruction format: C0 C1 C2 C3 + starting address + read length; Return: C1 + address + read length + read valid value; such as: Send C0 C1 C2 C3 00 01 Return C1 00 01 RSSI (address can only start from 00
			0	Disabled (default)			
			1	Enable			
			3	2	reserve		The relationship between power and current is nonlinear. When the power is at maximum, the power efficiency is the highest . The current does not decrease in the same proportion as the power decreases.
			1	0	Transmit power		
			0	0	20dBm / 30dBm (default)		
			0	1	18dBm / 28dBm		
			1	0	14dBm / 24dBm		
			1	1	10dBm / 20dBm		
0 5H	Read/Write	REG2	Channel control (CH) 0-83 represent a total of 8 4 channels				Actual frequency = 410.125 + CH * 1M
0 6H	Read/Write	REG3	7	Enable RSSI Byte			After enabling, the module receives wireless data and outputs it through the serial port TXD, followed by an RSSI strength byte.
			0	Disabled (default)			
			1	Enable			
			6	Transmission method			During fixed-point transmission, the module will recognize the first three bytes of the serial port data as: address high + address low + channel, and use it as the wireless transmission target.
			0	Transparent transmission (default)			
			1	Fixed-point transmission			
			5	Relay function			After the relay function is enabled, if the destination address is not the module itself,
			0	Disable relay functionality (default)			

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			1	Enable relay function			the module will initiate a forwarding ; In order to prevent data from being transmitted back, it is recommended to use it in conjunction with the fixed-point mode ; that is, the target address and source address are different.
			4	LBT (Listen Before Send)			After enabling, the wireless data will be intercepted before transmitting, which can avoid interference to a certain extent, but may cause data delay; the maximum dwell time of LBT is 2 seconds, and it will be forced to send after reaching the time limit.
			0	Disable LBT (default)			
			1	Enable LBT			
			3	WOR mode transceiver control			Only valid for mode 1; 1. In the WOR receiving mode, the module can modify the delay time after wake-up, the default time is 0; 2. The receiving end needs to send the command C0 09 02 E8 in configuration mode 03 (C0 is the write command, 09 is the register start address, 02 is the length, 0x 03E8 is the set delay, the maximum FFFF is 65535ms, and setting it to 0 turns off the wake-up delay.) 3. Data can be sent within the delay
			0	W OR Receiver (Default) Working in WOR monitoring mode, the monitoring cycle is shown below (WOR cycle), which can save a lot of power consumption.			
			1	W OR transmitter The module is turned on for transmission and reception, and a wake-up code is added for a certain period of time when transmitting data.			
			2	1	0	W OR Cycle	Only valid for mode 1; Period T = (1+WOR) *500ms , maximum 4000ms , minimum 500ms ; The longer the WOR monitoring interval is, the lower the average power consumption is, but the greater the data delay is; The sender and receiver must be consistent (very important)
			0	0	0	500 ms	
			0	0	1	1000ms	
			0	1	0	1500ms	
			0	1	1	2000ms	
			1	0	0	2500ms	
			1	0	1	3000ms	
			1	1	0	3500ms	
			1	1	1	4000ms	
07H	Write	CRYPT_H	Key high byte (default 0)				Write only, read returns 0 ; Used for encryption to prevent wireless data from being intercepted by similar modules ; The module will use these two bytes as calculation factors to transform and encrypt the wireless signal in the air.
08H	Write	CRYPT_L	Key low byte (default 0)				

6.3 Heartbeat packet function configuration

Configuration mode (mode 2: AT+MODE=2), the supported commands are listed as follows (**when setting, only 9600 and 8N1 formats are supported**):

Serial number	Instruction Format	Detailed description
1	Configuration directives	Instruction: C 5 + starting address + length + parameter Configuration command: C5 + 00 + 01 + 00 **Instruction structure meaning:**

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		● **C5** : Command header ● **00** : Register address (00: Heartbeat packet function selection register ; 01: Heartbeat packet custom cycle time configuration register ; 02: Heartbeat packet custom data configuration . ● **01** : Register data length (the heartbeat packet function selection register data length is 1 byte, the heartbeat packet custom cycle time configuration register data length is 2 bytes, and the heartbeat packet custom data configuration length is up to 128 bytes .) ● **00** : Register data
2	Register Function Description	**00 register data meaning :** ● The configuration parameter is 00: turn off the heartbeat packet function . ● the heartbeat packet data with custom timing through the serial port . ● The configuration parameters are 02: Send heartbeat packet data via wireless (sending address, channel, network ID) . ● The configuration parameter is 03: Send heartbeat packet data via wireless fixed point (the parameters of the network ID module itself , the sending address and channel depend on the first three bytes of the custom heartbeat packet data: 2 bytes address + 1 byte channel, followed by the heartbeat wireless sending data) .
3	Example	**01 Register:** The register configuration parameter is two bytes, which configures the cycle time of the heartbeat packet. For example: C5 01 02 00 05 configures the time to 5s **02 Register:** Customize heartbeat packet parameter configuration For example: C5 02 05 11 22 33 44 55 Configure the heartbeat packet return data to be : 11 22 33 44 55 **Read instruction:** C6 00 01 C6: Command Header 00: Register address 01: Length of the register data read
4	Format Error	Format Error Response FF FF FF / " =ERR "

6.3 Factory default parameters

Model	**Factory default parameter value: C0 00 09 00 00 00 6 0 2 0 17 03 00 00**						
	Frequency	Address	Channel	Air speed	Baud rate	Serial port format	Transmit power
E290-400R20D	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	2 0 dbm
E290-400R30D	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30 dBm

7 AT Commands

- Parameter configuration or query using AT commands must be performed in configuration mode;
- AT commands are used in configuration mode. AT commands are divided into three categories: command commands, setting commands and query commands;
- Users can query the AT command set supported by the module through "AT+HELP=?". The baud rate used by AT

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commands is 9600 8N1.

- When the input parameters exceed the range, they will be restricted. Please do not let the parameters exceed the range to avoid unknown situations.

7.1 AT command table

7.1.1 Command Instructions

Command Instructions	Describe	Example	Example Description
AT+IAP (Use with caution, see 7.3 Notes on Serial Port Firmware Upgrade for details)	Enter IAP upgrade mode	AT+IAP	Enter IAP upgrade mode
AT+RESET	Device restart	AT+RESET	Device restart
AT+DEFAULT	Configuration parameters restored to default And the device restarts	AT+DEFAULT	Configuration parameters restored to default And the device restarts

7.1.2 Setting Instructions

Setting Instructions	Describe	Example	Example Description
AT+UART=baud,parity	Set baud rate and parity	AT+UART=3,0	Set the baud rate to 9600, 8N 1
AT+RATE=rate	Set air speed	AT+RATE=7	Set the air speed to 62.5 K
AT+PACKET=packet	Set packet length	AT+PACKET=0	Set the packet size to 240 bytes
AT+WOR=role,period	Set WOR roles and cycles	AT+WOR=0,3	Set to WOR reception, period is 2000ms
AT+POWER=power	Set the transmit power	AT+POWER=0	Set the transmit power to 20 dBm / 30 dBm
AT+TRANS=mode	Set the sending mode	AT+TRANS=1	Set to fixed point mode
AT+ROUTER=router	Set Repeater Mode	AT+ROUTER=1	Set to Repeater Mode
AT+DRSSI=data_rssi	Setting data RSSI output function	AT+DRSSI=1	Receive data RSSI function is enabled
AT+ERSSI =env_rssi	Setting the environment RSSI reading function	AT+ERSSI=1	The ambient RSSI reading function is enabled
AT+LBT=lbt	Setting the channel monitoring function	AT+LBT=1	Channel monitoring function is enabled
AT+LDO=ldo	Set LDO power mode switch	AT+LDO=1	Set the RF to LDO mode
AT+ADDR=addr	Set module address	AT+ADDR=1234	Set the module address to

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			1234
AT+CHANNEL=channel	Set the module working channel	AT+CHANNEL=23	Set the frequency to 433.125M
AT+NETID=netid	Set Network ID	AT+NETID=2	Set the network ID to 2
AT+KEY=key	Set module key	AT+KEY=1234	Set the module key to 1234
AT+DELAY=delay	Set the wake-up delay sleep time , and the single-point wake-up mode can restore data within the time.	AT+DELAY=1000	Set the wake-up delay sleep time to 1000ms , and the single-point wake-up mode can restore data within the time.
AT+SEARCH=search	Setting the airspeed adaptation function (The airspeed of both parties cannot be 2.4K)	AT+SEARCH=search	Turn on the airspeed adaptive function. Communication is possible even if the airspeed is not 2.4K
Query command	describe	Return to example	Example Description
AT+HELP=?	Query AT command table		Return to AT command table
AT+DEVTYPE=?	Query module model	DEVTYPE=E WM 290-xxx R xxD	Return module model
AT+FWCODE=?	Query firmware code	FWCODE=74 84 -0-10	Returns the firmware version
AT+UART=?	Query baud rate and checksum	AT+UART=3,0	return baud rate is 9600, 8N 1
AT+RATE=?	Query air speed	AT+RATE= 0	return air speed is 2.4 K
AT+PACKET=?	Query packet length	AT+PACKET=0	return packet is 240 bytes
AT+WOR=?	Query WOR roles and cycles	AT+WOR=0, 1	The return is WOR reception, the cycle is 1 000ms
AT+POWER=?	Query the transmit power	AT+POWER=0	Return transmit power is 20 dBm / 30 dBm
AT+TRANS=?	Query sending mode	AT+TRANS=1	Return to fixed-point mode
AT+ROUTER=?	Query relay mode	AT+ROUTER=1	Return to relay mode
AT+DRSSI=?	Query RSSI data output enable	AT+DRSSI=1	Data RSSI function enable
AT+ERSSI =?	Query and read RSSI function enable	AT+ERSSI=1	RSSI reading function enabled
AT+LBT=?	Query whether the channel monitoring function is enabled	AT+LBT=1	Channel monitoring function enabled
AT+LDO=?	Query the RF power mode status	AT+LDO=0	RF works in DCDC mode
AT+ADDR=?	Query module address	AT+ADDR=1234	returned module address is 1234

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AT+CHANNEL=?	Query module working channel	AT+CHANNEL=23	returned frequency is 433.125M
AT+NETID=?	Query Network ID	AT+NETID=2	returned network ID is 2
AT+KEY=?	Query module key	AT+KEY= 0 (cannot read)	Returns the module key as 0
AT+DELAY=?	Query WOR delayed sleep time	AT+DELAY=1000	Return WOR delay sleep time is 1000ms
AT+SEARCH= ?	Query airspeed adaptation	AT+SEARCH=1	Return airspeed adaptation is on
AT+UID=?	Query unique serial number	AT+UID=xx	Returns the unique serial number xx

7.2 AT parameter analysis

When the serial port receives the correct command, the serial port will return "Command = OK", otherwise it will return "=ERR"

Command parameters	Parameter meaning
Baud (serial port baud rate)	0:1200 1:2400 2:4800 3:9600 4:19200 5:38400 6 : 57600 7:115200
Parity (serial port check bit)	0:8N1 1:8O1 2:8E1 3:8N1
Rate	0:2.4K 1:2.4K 2:2.4K 3 : 4.8K 4 : 9.8K 5: 19.2 K 6 :38 .4K 7: 62.5 K
Packet (packet length)	0: 240 1: 128 2: 64 3: 32
Role	0: Receive 1: Send
Period	0: 500 ms 1: 10 00 ms 2: 1 500 ms 3: 20 00 ms 4: 2 500 ms 5: 30 00 ms 6 :3 500 ms 7: 4000 ms
Power (transmit power)	0: 20dBm 1: 18dBm 2: 14dBm 3: 10dBm 0: 30dBm 1: 27dBm 2: 24dBm 3: 21dBm
Mode (Transmission Mode)	0: Transparent 1: Fixed point
Router (Relay Mode)	0: Off 1: Enable
Data_rssi (Data RSSI)	0: Off 1: Enable
Env_rssi (Environmental RSSI)	0: Off 1: Enable
Lbt (channel listening)	0: Off 1: Enable
Ldo (LDO mode switch)	0: DCDC 1: LDO
Addr (module address)	Module address 0~65535 (decimal)
Channel (module channel)	Module channel 0~83 (decimal)
Netid (Network ID)	Module network 0~255 (decimal)
Key	Module key 0~65535 (decimal)
Delay (WOR delay sleep)	Delay sleep 0~65535 (decimal)
Search (airspeed adaptation)	0: Disable 1: Enable

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7.3 Notes on upgrading firmware via serial port

- If the customer needs to upgrade the firmware, he needs to find the corresponding BIN file provided by the official, and then use the official host computer to upgrade the firmware. Under normal circumstances, users do not need to upgrade the firmware, and please do not use the "AT+IAP" command .
- In configuration mode, send the “AT+IAP” command to enter upgrade mode .
- After entering the upgrade mode, the baud rate will automatically switch to 115200 until it automatically exits, during which time there will be log output.
- **Host computer upgrade guide**

1、Make the module enter configuration mode by changing the host computer or serial port assistant XCOM (note: the baud rate in configuration mode is 9600);

2、Open the official website to configure the host computer, select Select Serial Port → Open Serial Port → Read Parameters → Select Firmware Upgrade → Click to Open File, and select the firmware to be upgraded → Click to Download ;



8 Hardware Design

- It is recommended to use a DC regulated power supply to power the module. The power supply ripple coefficient should be as small as possible and the module should be reliably grounded.
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module.
- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, the module will be permanently damaged.
- Please check the stability of the power supply. The voltage should not fluctuate greatly or frequently.

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- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, which is conducive to long-term stable operation of the whole machine;
- The module should be kept as far away as possible from power supplies, transformers, high-frequency wiring and other parts with large electromagnetic interference;
- High-frequency digital routing, high-frequency analog routing, and power routing must avoid the bottom of the module. If it is necessary to pass under the module, assuming that the module is soldered on the Top Layer, ground copper should be laid on the Top Layer of the module contact part (all copper should be laid and well grounded), and it must be close to the digital part of the module and routed on the Bottom Layer ;
- Assuming the module is soldered or placed on the Top Layer, it is also wrong to randomly route the wires on the Bottom Layer or other layers, which will affect the module's spurious signal and receiving sensitivity to varying degrees ;
- If there are devices with large electromagnetic interference around the module, it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power traces), it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If the communication line uses 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage) ;
- Try to stay away from some TTL protocols whose physical layer is also 2.4GHz, such as USB3.0;
- The antenna installation structure has a great impact on the module performance. Make sure the antenna is exposed and preferably vertically upward;
- When the module is installed inside the case, you can use a high-quality antenna extension cable to extend the antenna to the outside of the case;
- The antenna must not be installed inside a metal shell, as this will greatly reduce the transmission distance.

9 FAQ

9.1 Communication range is too short

- The communication distance will be affected when obstacle exists;
- Data lose rate will be affected by temperature, humidity and co-channel interference;
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground;
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea;
- The signal will be affected when the antenna is near metal object or put in a metal case;
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance);
- The power supply low voltage under room temperature is lower than 2.5V, the lower the voltage, the lower the transmitting power;

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- Due to antenna quality or poor matching between antenna and module.

9.2 Module is easy to damage

- Please check the power supply source, ensure it is 2.0V~3.6V, voltage higher than 3.6V will damage the module;
- Please check the stability of power source, the voltage cannot fluctuate too much;
- Please make sure antistatic measure are taken when installing and using, high frequency devices have electrostatic susceptibility;
- Please ensure the humidity is within limited range, some parts are sensitive to humidity;
- Please avoid using modules under too high or too low temperature.

9.3 BER(Bit Error Rate) is high

- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- Poor power supply may cause messy code. Make sure that the power supply is reliable;
- The extension line and feeder quality are poor or too long, so the bit error rate is high.

10 Production guidance

10.1 Reflow Temperature

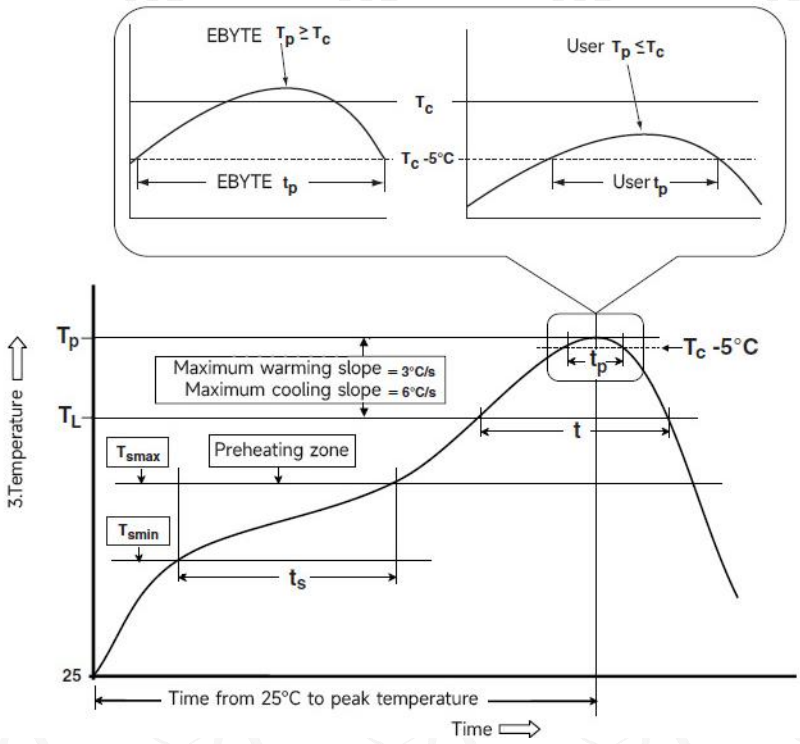
Reflow profile characteristics		Leaded process assembly	Lead-free assembly
Preheating /keeping	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (T smax)	150℃	200℃
	Time (T smin ~T smin)	60-120 seconds	60-120 seconds
Heating slope (T L ~T p)		3℃/sec, max.	3℃/sec, max.
Liquidus temperature (TL)		183℃	217℃
T L above the holding time		60~90 seconds	60~90 seconds
Package peak temperature Tp		Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.	Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.
p) within 5°C of the specified classification temperature (Tc) is shown in the figure below.		20 seconds	30 seconds
Cooling slope (T p ~T L)		6℃/sec, max.	6℃/sec, max.

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Time from room temperature to peak temperature	6 minutes, longest	8 minutes, longest
※The peak temperature (Tp) tolerance of the temperature curve is defined as the upper limit of the user		

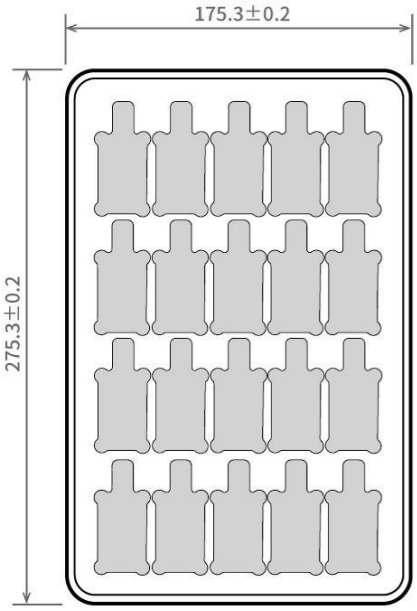
10.2 Reflow Oven Curve



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13 Bulk Packaging Methods

13.1 Bulk Packaging Method





Unit: mm
Each Layer: 20 pcs
Each Package: 5 layers

Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2024-11-25	Initial release	Hao
1.1	2025-1-17	WOR added description	Hao
1.2	2026-4-2	Correct partial description	Hao
1.3	2026-5-13	Correct partial description	Hao

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