# E290-xxxTxxx User Manual

## PAN3060 433/470/868/915 MHz Wireless Module



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Chengdu Ebyte Electronic Technology Co.,Ltd.

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# 1 Product Overview

## 1.1 Product Introduction

E290-xxxTxxx ① series is a new generation of wireless module developed by Chengdu Ebyte Electronic Technology Co., Ltd. It is a wireless serial port module (UART) based on Panqiwei PAN3060 RF chip. It has multiple transmission modes and the working frequency bands are 410.125 ~ 493.125MHz and 850.125 ~ 930.125MHz . The spread spectrum technology adopts ChirpIoT™ and TTL level output.

E290-xxxTxxx 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: E290-400T20S**




**Figure 2: E290-900T20S**




**Figure 3: E290-400T30S**

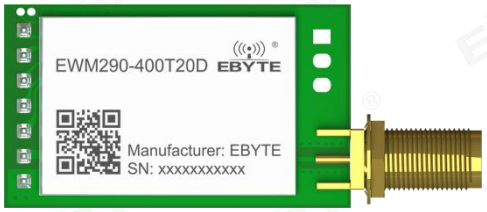



**Figure 5: EWM290-400T20D**




**Figure 6: EWM290-400T30D**

Note ① : E290-xxxTxxx is the abbreviation of multiple models. For detailed models, please see the parameters in Chapter 2.

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## 1.2 Features

- Support AT commands , which makes it more convenient to use;
- 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;
- Support fixed-point transmission, broadcast transmission, and channel monitoring;
- Support deep sleep, in which the power consumption of the whole machine is about 2 u A ;
- E290-400T20S , E290-400T30S , E290-400TxxD support the global license-free ISM 433MHz frequency band and the 470MH z meter reading frequency band ;
- of E290-900T20S is 850.125～930.125MHz, and the factory default is 868.125MHz.
- 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 ;
- Efficient watchdog design, once an abnormality occurs, the module will automatically restart and continue to work according to the previous parameter settings ;
- Support 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 Scenario

- 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 ) .

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# 2 Specifications

## 2.1 RF parameters

| RF parameters | Unit | Model | | | Remark |
|---|---|---|---|---|---|
| | | E290-400T20S EWM290-400T20D | E290-400T30S EWM290-400T30D | E290-900T20S | |
| Maximum transmit power | dBm | 20 | 30 | 20 | - |
| Receiving sensitivity | dBm | -125 | -133～ - 135 | -125 | Air rate is 2.4 kbps |
| Reference distance | m | 5k | 10k | 5k | 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 | 850.125～930.125 | - |
| Air speed | bps | 2.4K～62.5K | 2.4K～62.5K | 2.4K～62.5K | User programmable control |
| Blocking power | dBm | 10 | 10 | 10 | There is a risk of burning when used at close range |
| Launch length | Byte | 240 | 240 | 240 | The command can be set to send packets of 32/64/128/240 bytes |
| Cache capacity | Byte | 500 | 500 | 500 | |

## 2.2 Electrical parameters

| Electrical parameters | | | Unit | Model | | | Remark |
|---|---|---|---|---|---|---|---|
| | | | | E290-400T20S EWM290-400T20D | E290-400T30S EWM290-400T30D | E290-900T20S | |
| Operating voltage | | | V | 2.6～5.5 | 3.3 ～ 5.5 | 2.6～5.5 | ≥ 5 V can guarantee the output power , and exceeding 5.5 V may burn the module . |
| Communication level | | | V | 3.3V | 3.3V | 3.3V | Using 5V TTL may burn out |
| Power consumption | Emission current | | mA | 120 | 610 | 120 | Fixed load instantaneous power consumption , antenna measurement results are different |
| | Receivin | DCDC mode | mA | 6.1 | 13 | 6.1 | - |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | g curr ent | LDO Mode | | 10.2 | 16 | 10.2 | |
| | Sleep current | | uA | 2 | 3 | 2 | Software shutdown |
| Tempe rature | Operating temperature | | ℃ | -40 ～ +85 | | | Industrial-grade design |
| | Storage temperature | | ℃ | -40 ～ +85 | | | Industrial-grade design |

## 2.3 Hardware Parameters

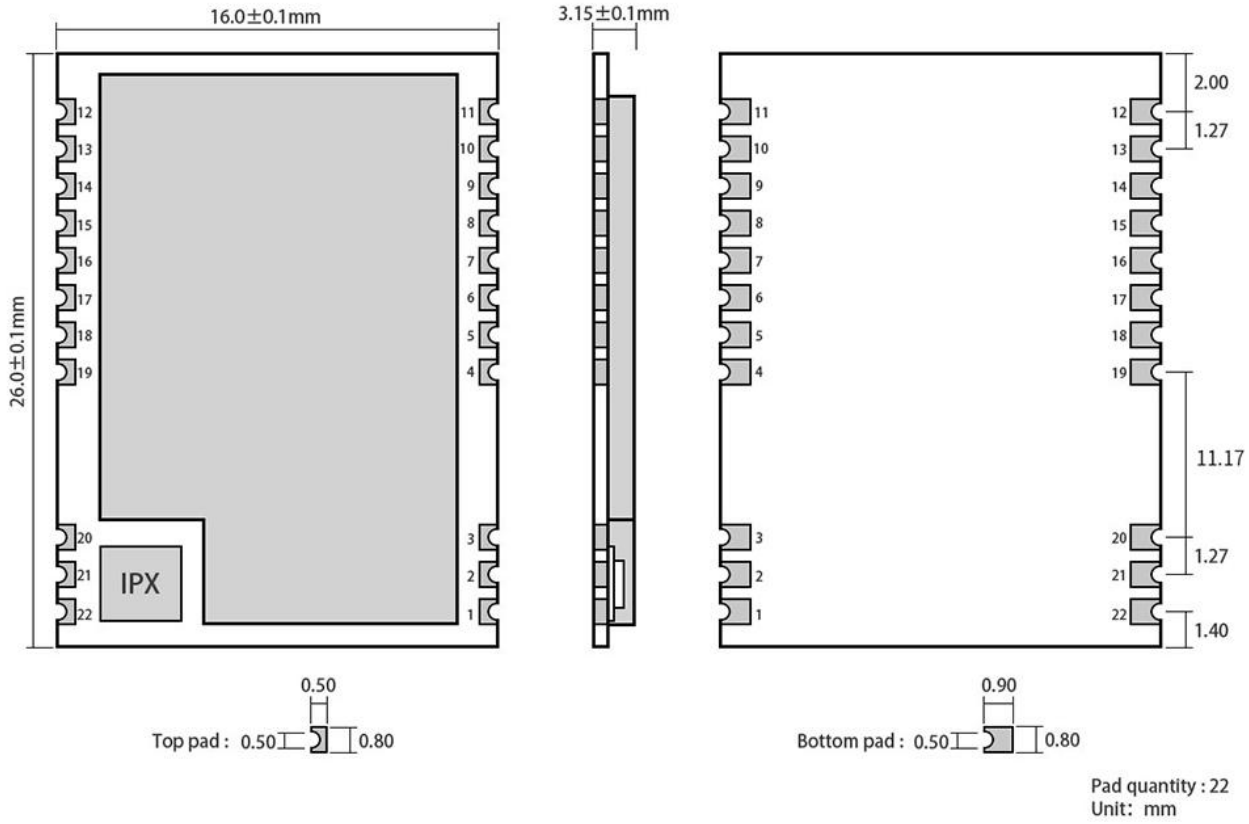
| Hardware Parameters | Model | | | | Remark |
|---|---|---|---|---|---|
| | E290-400T20 S<br>E290-900T20 S | E290-400T30 S | EWM290-400T20D | EWM290-400T30D | |
| Crystal frequency | 32MHz | 32MHz | 32MHz | 32MHz | Industrial grade high precision crystal oscillator |
| Modulation | ChirpIoT™ | ChirpIoT™ | ChirpIoT™ | ChirpIoT™ | Next-generation ChirpIoT™ modulation technology |
| Interface | 1.27mm stamp hole | 1.27mm stamp hole | 2.54mm pin header | 2.54mm pin header | - |
| Communication interface | UART Serial Port | UART Serial Port | UART Serial Port | UART Serial Port | TTL level |
| Packaging | SMD | SMD | Direct plug-in | Direct plug-in | - |
| Antenna interface | IPEX/Stamp Hole | IPEX/Stamp Hole | SMA-K | SMA-K | Equivalent impedance is about 50 Ω |
| Size | 16*26 mm | 40.5 * 25 mm | 21*36 mm | 24*43 mm | ±0.2mm |
| Product Net Weight | 2.37g | 5.8g | 6.5g | 11g | ± 0.05 g |

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# 3 Mechanical dimensions and pin definitions

## 3.1 E290-400T20S & E290-900T20S mechanical dimensions and pin definition



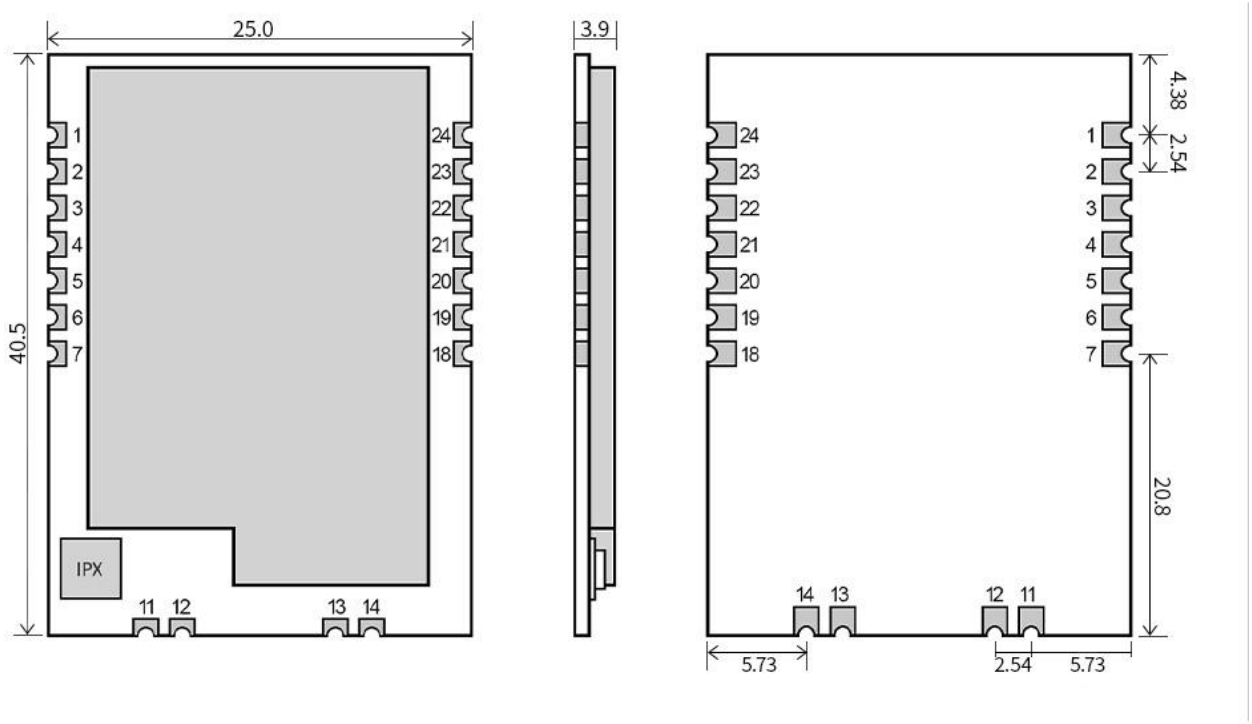

| Pin number | Pin Name | Pin Direction | Pin Purpose |
|---|---|---|---|
| 1 | GND | - | Module ground wire |
| 2 | GND | - | Module ground wire |
| 3 | GND | - | Module ground wire |
| 4 | GND | - | Module ground wire |
| 5 | M0 | Input (pull-up) | Cooperate with M1 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 6 | M1 | Input (pull-up) | Cooperate with M0 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 7 | RxD | Input | TTL serial port input, connected to the external TXD output pin; |
| 8 | TXD | Output | TTL serial port output, connected to the external RXD input pin; |
| 9 | AUX | Input/ Output | Used to indicate the working status of the module ; it is forbidden to be low when powered on, otherwise it will enter the firmware upgrade mode ; The user wakes up the external MCU, and the power-on self-test initialization period outputs a low level; (can be left floating) |

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| | | | |
|---|---|---|---|
| 10 | VCC | - | Module power positive reference, voltage range: 2.6～5.5V DC |
| 11 | GND | - | Module ground wire |
| 12 | RST | - | Module reset pin, pull low for 1ms to reset |
| 13 | GND | - | Module ground wire |
| 14 | NC | - | Floating , not grounded |
| 15 | NC | - | Floating, not grounded |
| 16 | NC | - | Floating, not grounded |
| 17 | NC | - | Floating, not grounded |
| 18 | NC | - | Floating, not grounded |
| 19 | GND | - | Module ground wire |
| 20 | GND | - | Module ground wire |
| 21 | ANT | - | antenna |
| 22 | GND | - | Module ground wire |

## 3.2 E290-400T30S mechanical dimensions and pin definition







Unit : mm
pad quantity : 24
Tolerance value : X.X±0.1mm
X.XX±0.05mm

| Pin number | Pin Name | Pin Direction | Pin Purpose |
|---|---|---|---|
| 1 | GND | Input | Module ground wire |
| 2 | VCC | Input | Module power positive reference, voltage range: 3.3～5.5V DC |

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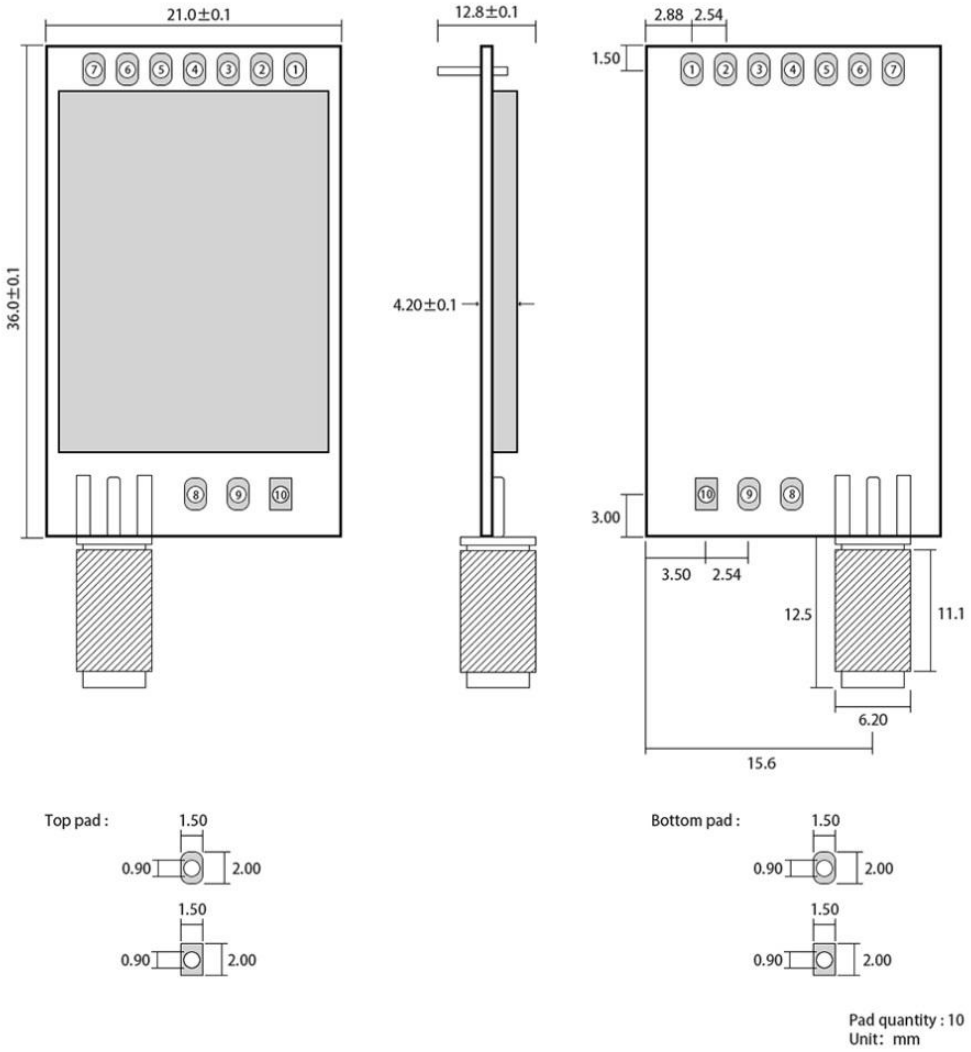

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| | | | |
|---|---|---|---|
| 3 | AUX | Output | Used to indicate the working status of the module; the user wakes up the external MCU, and outputs a low level during the power-on self-test initialization period; (can be left floating) |
| 4 | TXD | Output | TTL serial port output, connected to external RXD input pin; |
| 5 | RxD | Input | TTL serial port input, connected to external TXD output pin; |
| 6 | M1 | Input (very weak pull-up) | Cooperate with M0 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 7 | M0 | Input (very weak pull-up) | Cooperate with M1 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 11 | ANT | Output | Antenna interface (high frequency signal output, 50 ohm characteristic impedance) |
| 12 | GND | - | Fixed |
| 13 | GND | - | Fixed |
| 14 | GND | - | Fixed |
| 15 | NC | - | SWCLK Clock pin when the program is loaded (suspended, user does not need to connect) |
| 16 | NC | - | SWDIO data pin when program is loaded (suspended, user does not need to connect) |
| 17 | NC | - | GPIO/RS485_EN |
| 18 | NC | - | MCU_VDD Power pin for program download (suspended, no need for user to connect) |
| 19 | RESET | Input | Module reset pin |
| 20 | GND | Input | Fixed |
| 21 | NC | - | Empty pin |

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# 3.3 EWM290-400T20D Mechanical Dimensions and Pin Definition



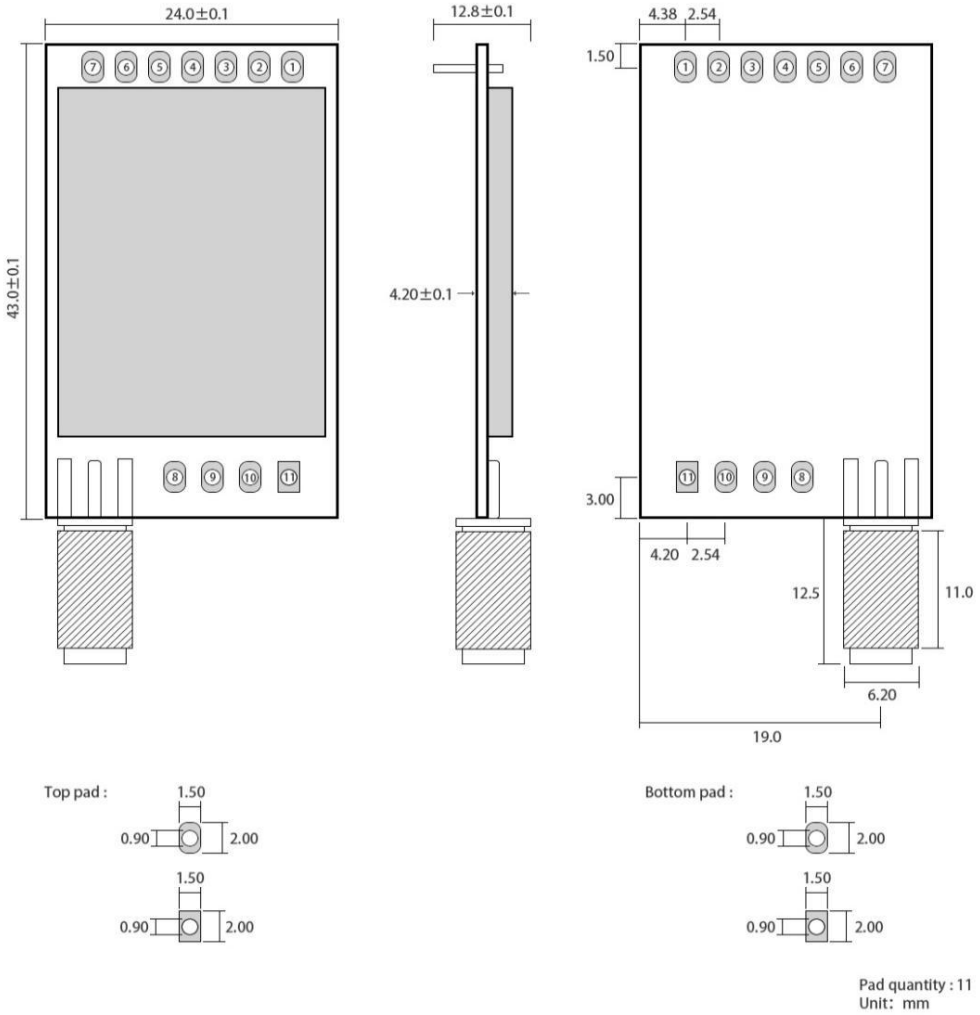

| Serial number | Pin name | Pin Direction | Pin Purpose |
|---|---|---|---|
| 1 | M0 | Input (very weak pull-up) | Cooperate with M1 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 2 | M1 | Input (very weak pull-up) | Cooperate with M0 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 3 | RxD | Input | TTL serial port input, connected to the external TXD output pin; |
| 4 | TXD | Output | TTL serial port output, connected to the external RXD input pin; |
| 5 | AUX | Output | Used to indicate the working status of the module; the user wakes up the external MCU, and outputs a low level during the power-on self-test initialization period; (can be left floating) |
| 6 | VCC | Input | Module power positive reference, voltage range: 3.0 ~ 5.5V (DC) |
| 7 | GND | Input | Module ground wire |
| 8 | Fixing holes | - | Fixing holes |
| 9 | Fixing | - | Fixing holes |

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| | | | |
|---|---|---|---|
| | holes | | |
| 10 | Fixing holes | - | Fixing holes |

## 3.3 EWM290-400T30D Mechanical Dimensions and Pin Definition



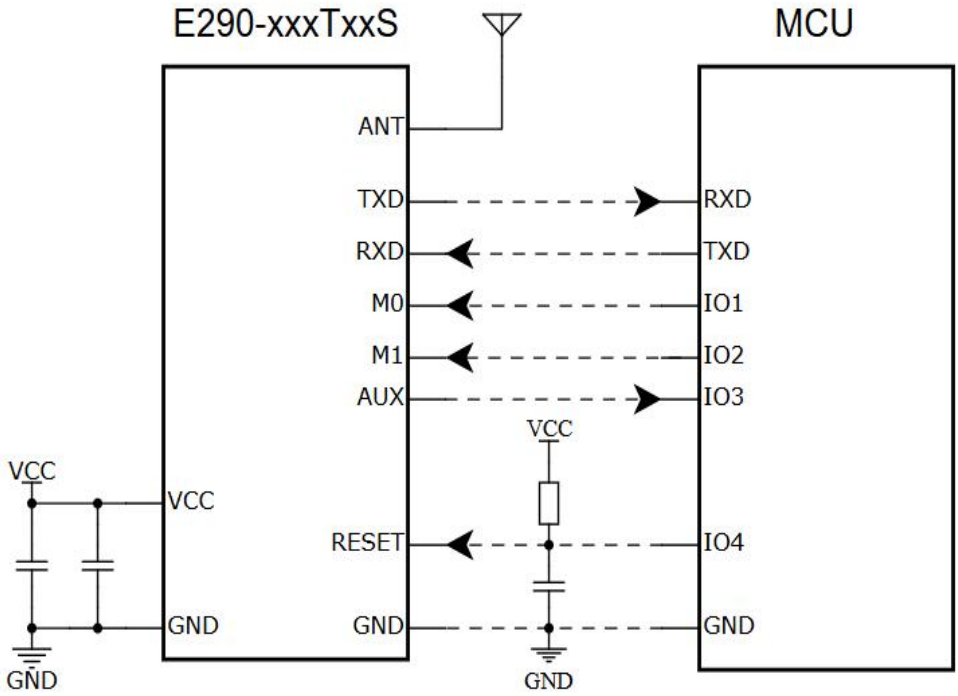

| Pin number | Pin Name | Pin Direction | Pin Purpose |
|---|---|---|---|
| 1 | M0 | Input (very weak pull-up) | Cooperate with M1 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 2 | M1 | Input (very weak pull-up) | Cooperate with M0 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used) |
| 3 | RxD | Input | TTL serial port input, connected to the external TXD output pin;<br>Can be configured as open drain or pull-up input, see parameter settings for details. |
| 4 | TXD | Output | TTL serial port output, connected to the external RXD input pin;<br>Can be configured as open-drain or push-pull output, see parameter settings for details. |
| 5 | AUX | Output | Used to indicate the working status of the module; the user wakes up the external MCU, and outputs a low level during the power-on self-test initialization period; can |

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| | | | |
|---|---|---|---|
| | | | be configured as an open-drain output or a push-pull output, see parameter settings for details. (Can be left floating) |
| 6 | VCC | Input | Module power positive reference, voltage range: 3.3 ~ 5.5V DC |
| 7 | GND | Input | Module ground wire |
| 8 | Fixing holes | - | Fixing holes |
| 9 | Fixing holes | - | Fixing holes |
| 10 | Fixing holes | - | Fixing holes |
| 11 | Fixing holes | - | Fixing holes |

# 4 Recommended connection diagram




| Serial number | Brief connection instructions between the module and the MCU (the above figure takes the STM8L MCU as an example) |
|---|---|
| 1 | The wireless serial port module is TTL level, please connect it to the TTL level MCU. |
| 2 | ~ 10K pull-up resistors to the TXD and AUX pins of the module . |
| 3 | The AUX pin cannot be low when powered on, otherwise it will enter firmware upgrade mode. |

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# 5. Functional Details

## 5.1 Working mode

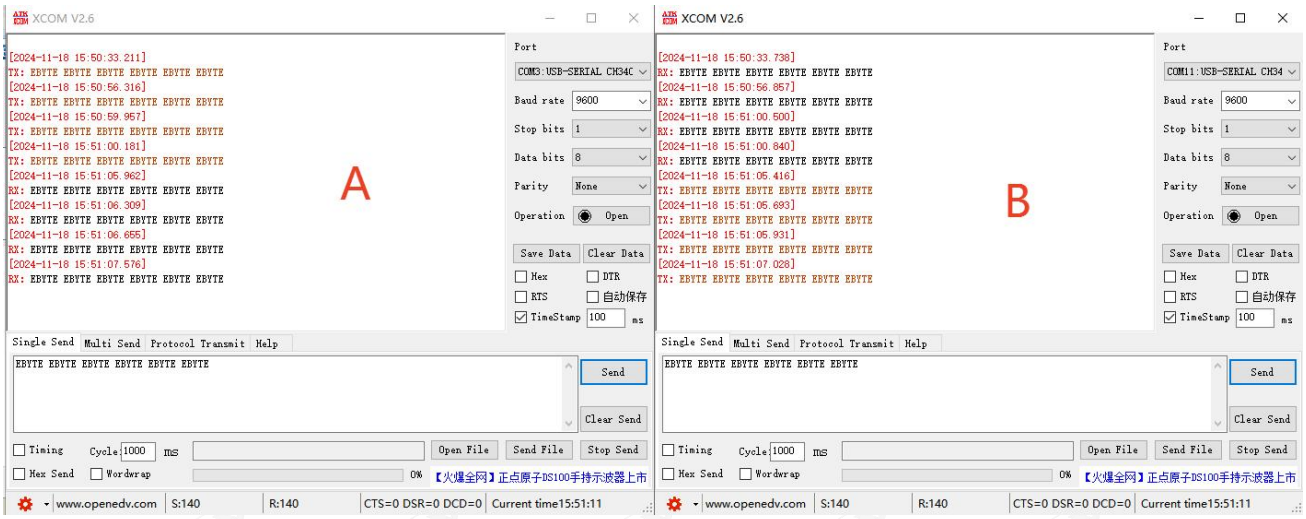
The module has four working modes, which are set by pins M1 and M0 . The details are shown in the following table:

| Mode (0-3) | M1 | M0 | Mode Introduction | Remark |
|---|---|---|---|---|
| 0 Transmission Mode | 0 | 0 | Serial port open, wireless open, transparent transmission | Support special command air configuration |
| 1 WOR mode | 0 | 1 | Can be defined as WOR sender and WOR receiver | Support air wake-up |
| 2 Configuration Mode | 1 | 0 | Users can access the registers through the serial port to control the working status of the module | |
| 3 Deep Sleep | 1 | 1 | The module enters sleep mode | |

Note: In WOR mode, it is not recommended to use the airspeed of 62.5Kbps and 38.4Kbps.

### 5.1.1 Transmission mode is used (M1, M0 pins are set to 0,0)

- **Transparent transmission function** : What you send is what you get. You can 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:

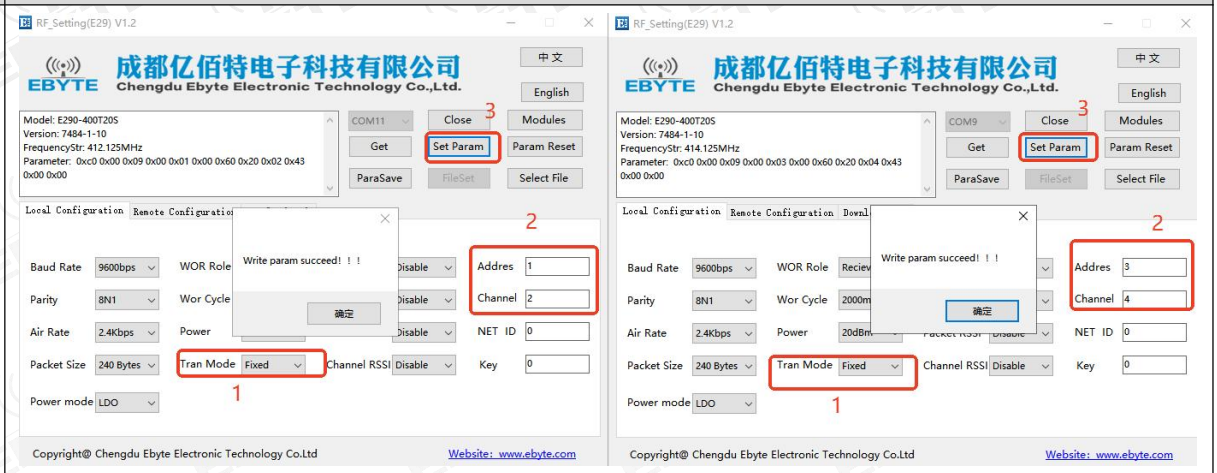
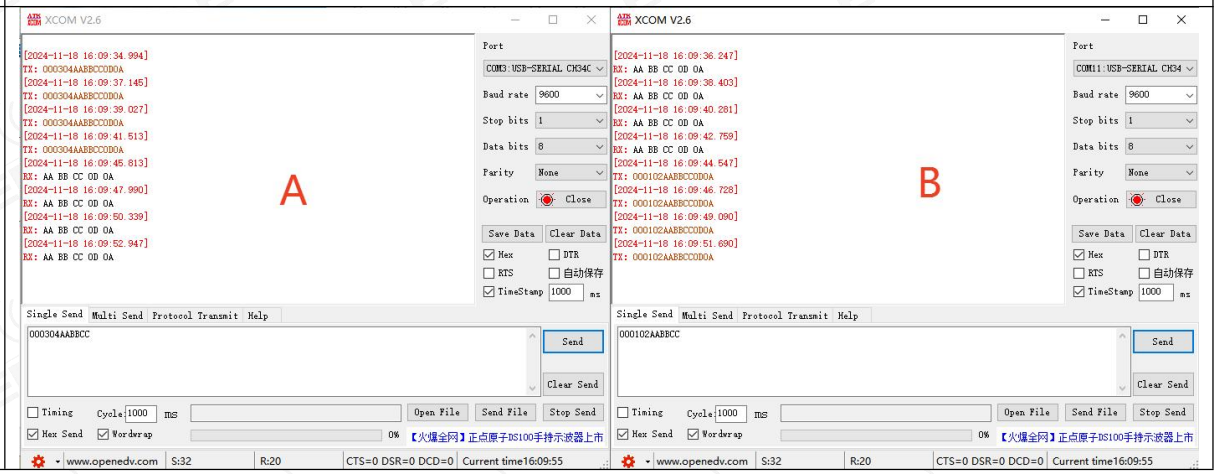



Schematic diagram

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- **Fixed-point transmission function:** Send and receive data in a fixed data format, the format is: target address + target channel + data, effectively avoiding partial interference.

| Serial number | Steps for using fixed-point launch |
|---|---|
| 1. Modify the parameters of the module through the host computer: modify the module address and channel under the configuration mode ( M1, M0 pins are set to 1, 0 ) , 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) |  |

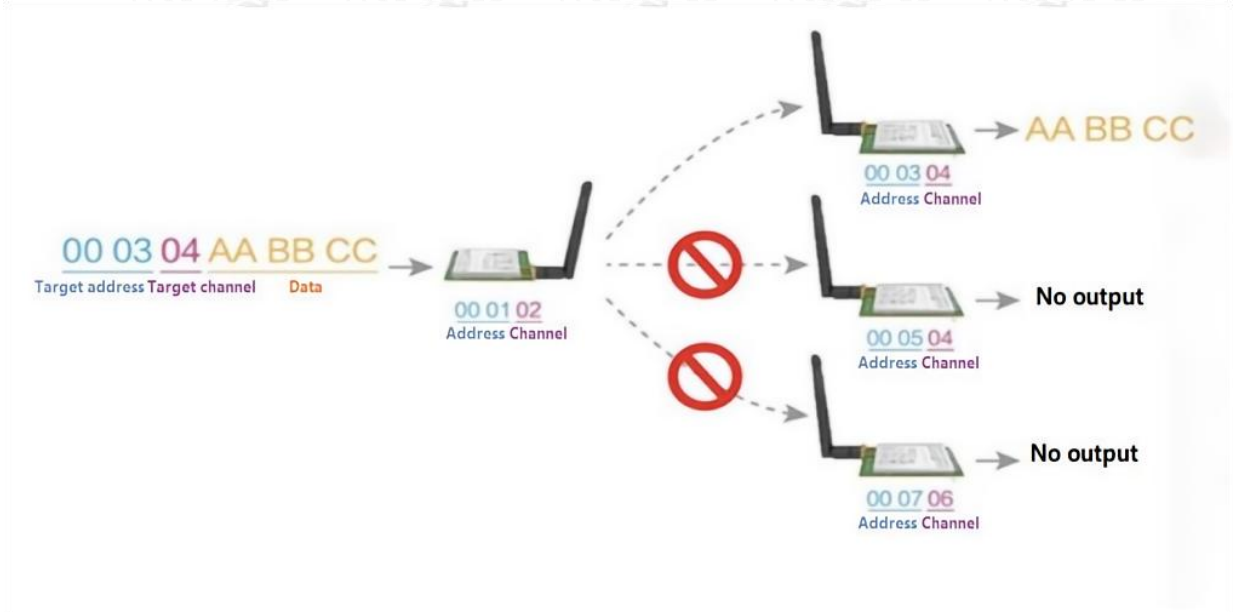



Figure 1 Schematic diagram of fixed-point transmission

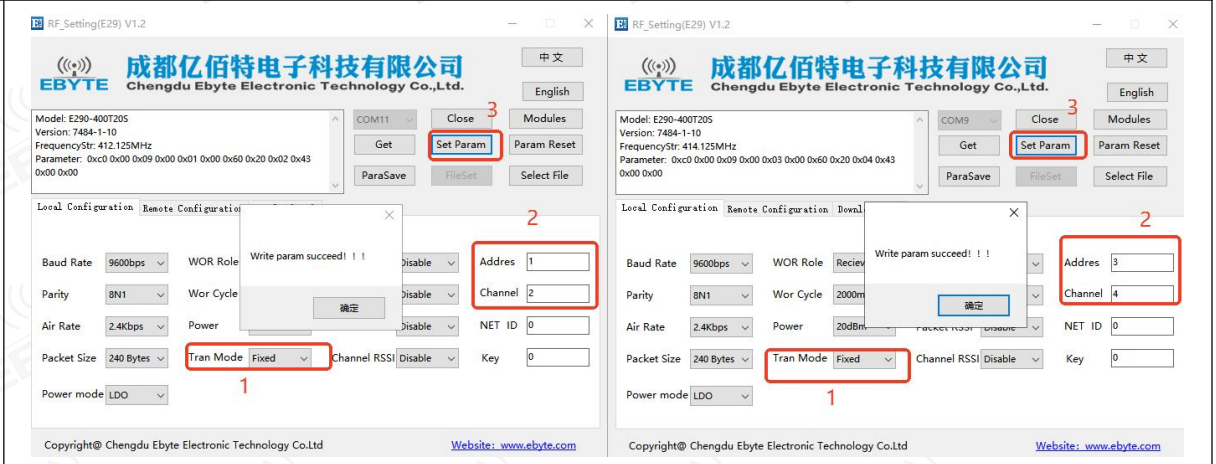
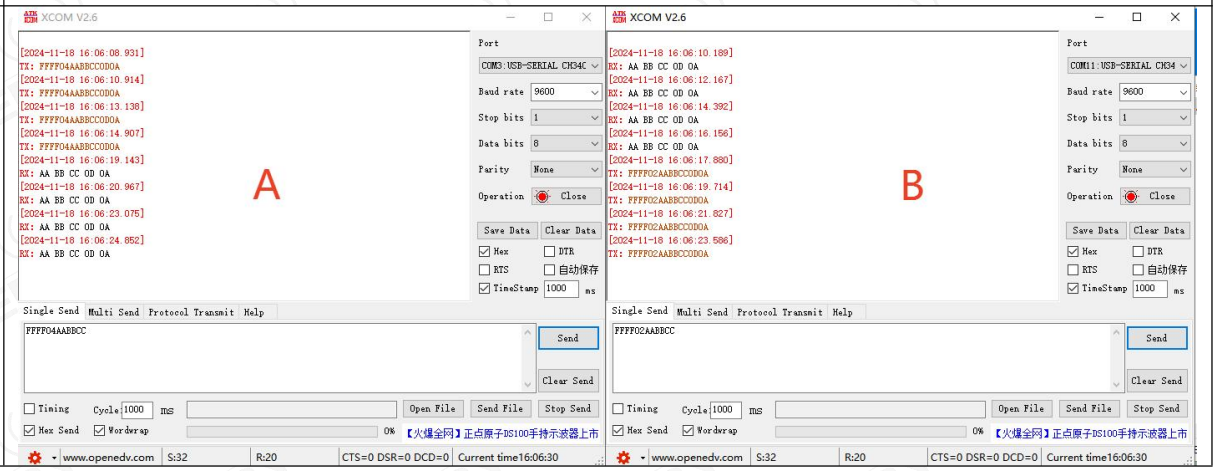
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- **Broadcasting function:**

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 ( M1, M0 pins are set to 1, 0 ) , 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) |  |

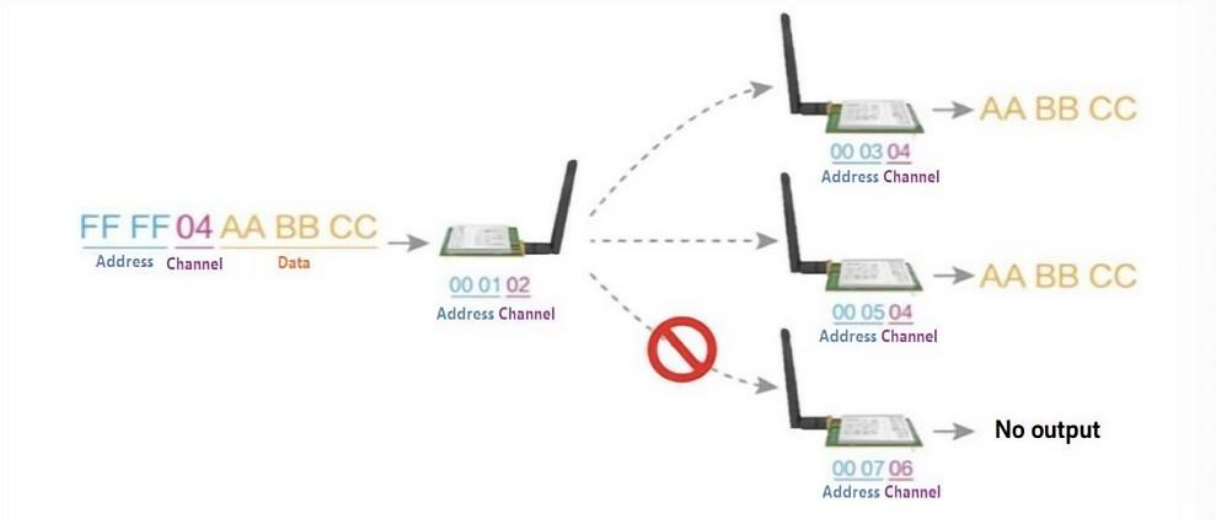



Figure 2 Schematic diagram of fixed-point broadcast transmission

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- **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 .<br>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 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.

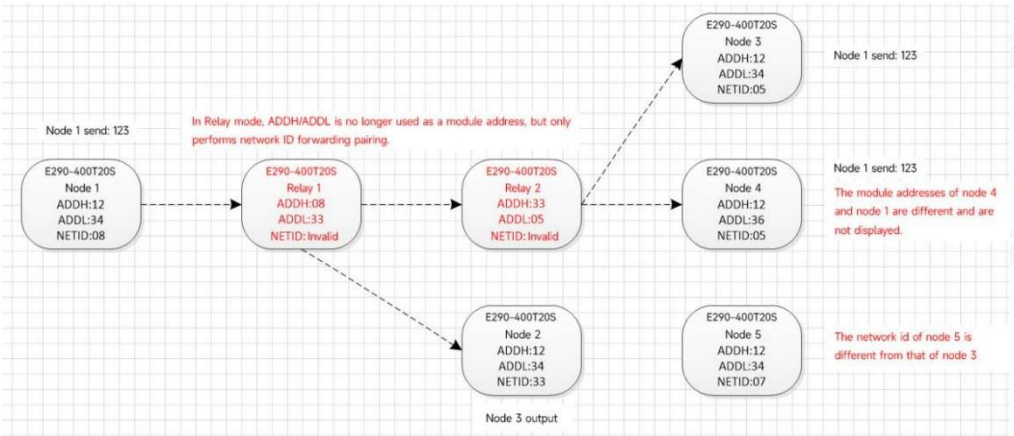
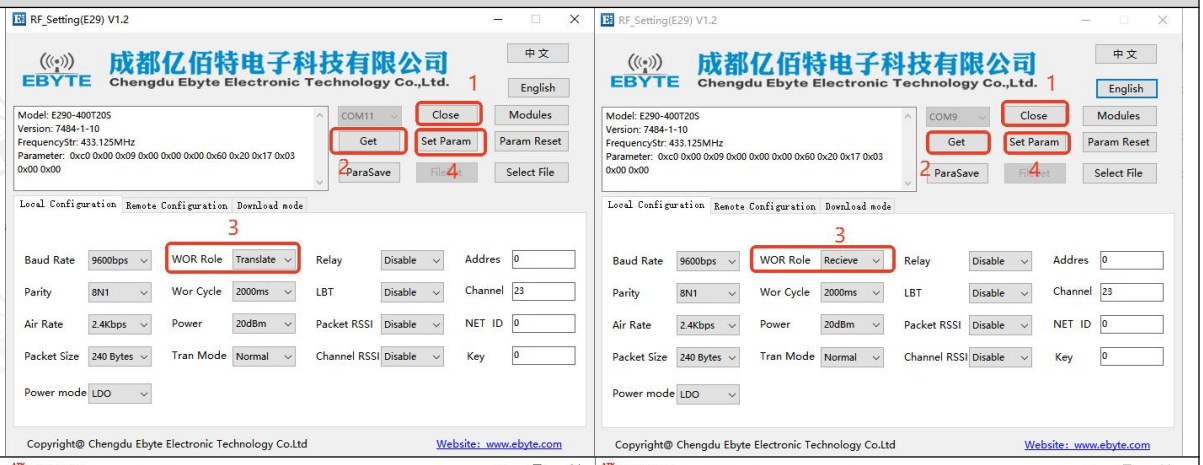
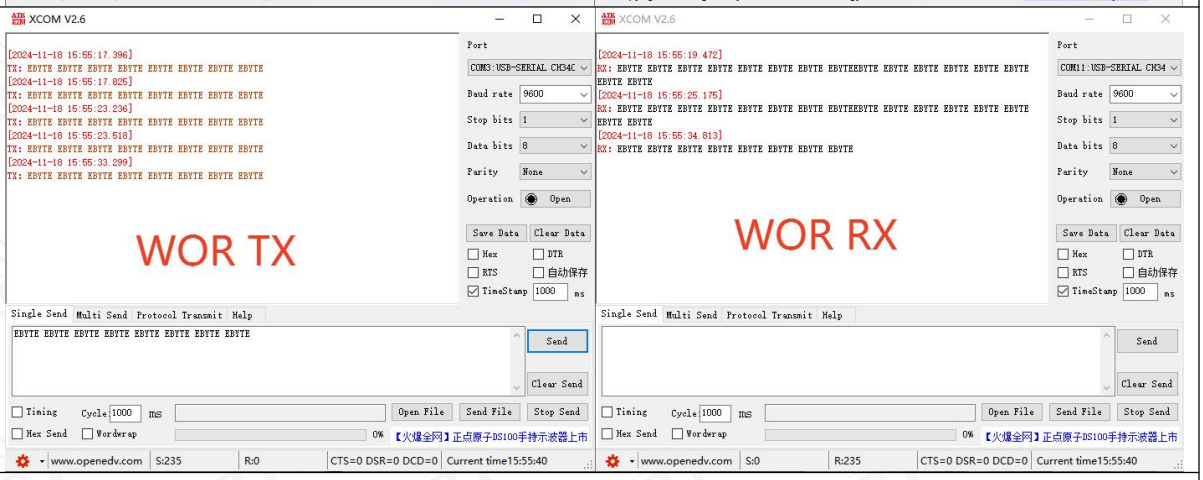



Figure 3 Example of relay mode

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### 5.1.2 WOR mode use (M1, M0 pins set to 0,1)

| Serial number | Steps to use WOR mode |
|---|---|
| 1. Modify the parameters of the module through the host computer: modify the module WOR role in the configuration mode (M1, M0 pins are set to 1, 0), and write the parameters to complete the modification . |  |
| 2. The module working mode is changed to WOR mode (M1, M0 pins are set to 0, 1): The WOR receiver module sends data to the WOR receiver module, but the WOR receiver module cannot send data to the sender. |  |

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

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### 5.1.3 Configuration mode use (M1, M0 pins set to 1, 0)

1) The following figure shows the upper computer display interface of the module configuration. Users can switch to command mode through M0 and M1 to quickly configure and read parameters on the upper computer.




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-up function only supports 0-900 addresses at 38.4K airspeed and below. )

Frequency channel: 0~8 3 (Note: the channel range of 900MHz frequency band is 0~80)

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.

4) Remote configuration : Remotely read and modify module parameters through the host computer: Module A and module B must have the same parameters to perform remote configuration . For example: Module A is in configuration mode, and module B is in general mode. Module A can use the host computer to open remote configuration and read parameters.

### 5.1.4 Sleep mode use (M1, M0 pins set to 1,1)

- **To enter sleep mode, just set the M1 and M0 pins to 1, 1.**

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## 5.2 Module reset

- 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 working normally according to the working mode composed of M1 and M0.

  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
- E290-xxxTxxx 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 E290-xxxTxxx can also partially sleep while receiving a wake-up code, further reducing power consumption.
- Note: When the airspeed is 62.5K and 38.4K, this single-point wake-up function is temporarily unavailable and only the traditional WOR mode can be used.

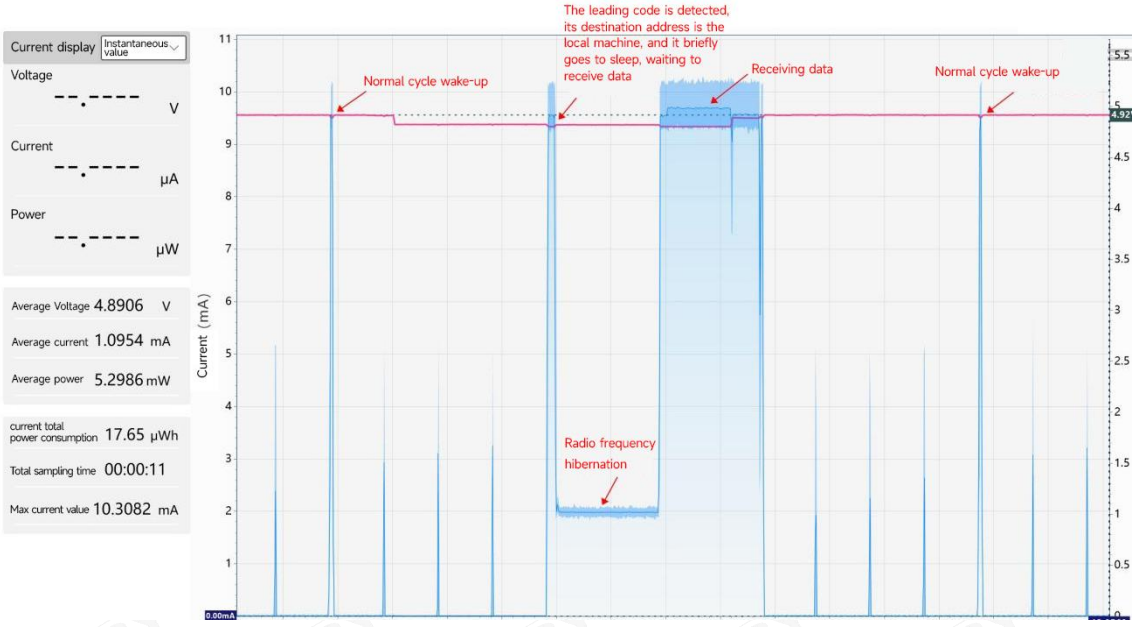



Figure 1 Target device current consumption diagram

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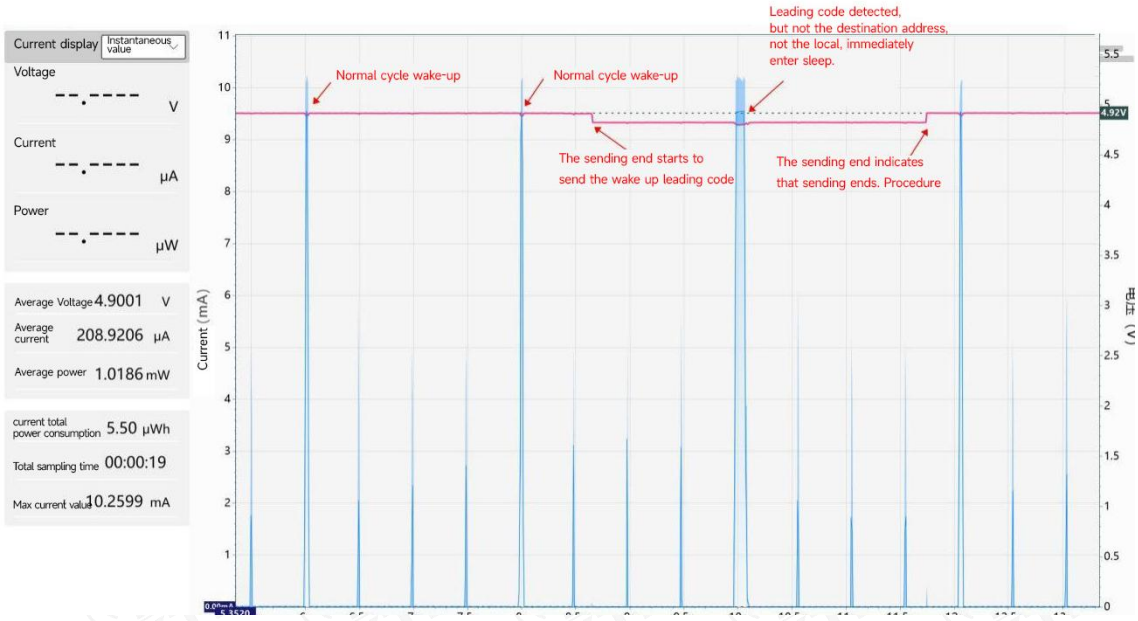



Figure 2 Current consumption of non-target devices

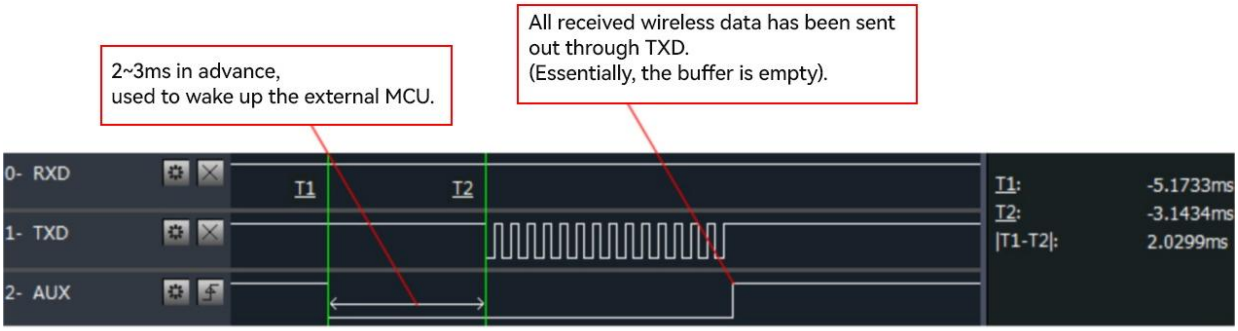
- In addition, E290-xxxTxxx cannot actively send data via RF by default in WOR receiving mode. In order to solve the problem that users repeatedly switch between WOR receiving mode and transparent transmission mode in the polling structure to achieve response , E290-xxxTxxx can enable this function by setting C0 09 02 E8 03 or AT+DELAY=1000. After enabling this function, users can send wireless data via 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.

## 5.4 AUX Detailed Explanation

- 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;



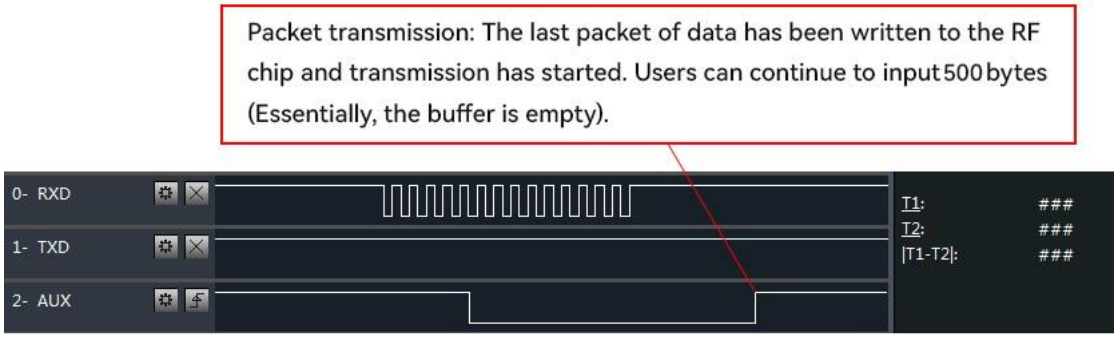

AUX pin timing diagram when module serial port sends out data.

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### 5.4.2 Wireless transmission indication

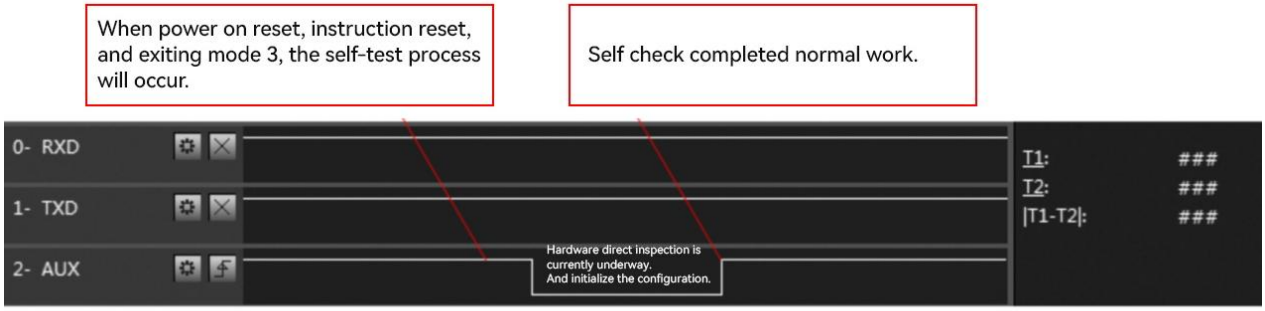
- Buffer empty: data in the internal 500- byte buffer are all written to the wireless chip (automatically divided into packets) ;
  When AUX=1, the user can continuously send data less than 500 bytes without overflow ;
  When AUX=0, the buffer is not empty: the data in the internal 500 -byte buffer has 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.

### 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

| Serial number | 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;<br>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;<br>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.<br>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. |

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| | |
|---|---|
| 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. |

# 6 Register read and write control

## 6.1 Instruction format

Configuration mode (mode 2: M1=1, M0=0 ), the supported command list is as follows ( **when setting, only 9600, 8N1 format is supported** ):

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

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| | | |
|---|---|---|
| | | Example 2: Wirelessly configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed ( 2.4 K) at the same time<br>Send: CF CF C0 00 04 12 34 00 6 0<br>Return: CF CF C1 00 04 12 34 00 6 0 |
| 5 | Format Error | Format Error Response<br>FF FF FF / " =ERR " |

## 6.2 Register Description

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

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 0 | 0 | Air speed 9.6 k | |
| | | | 1 | 0 | 1 | Air speed 19.2 k | |
| | | | 1 | 1 | 0 | Air speed 38.4 k | |
| | | | 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 ;<br>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:<br>1、DCDC mode reduces power consumption by sacrificing sensitivity<br>2、LDO mode improves sensitivity at the expense of power consumption<br>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.<br>Let C0 C1 C2 C3 instruction read register;<br>Register 0x00: Current ambient noise RSSI;<br>Register 0X01: RSSI when receiving data last time<br>(The current channel noise is: dBm = -(256 - RSSI));<br>Instruction format: C0 C1 C2 C3 + starting address + read length;<br>Return: C1 + address + read length + read valid value; such as:<br>Send C0 C1 C2 C3 00 01<br>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 .<br>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)<br>0-83 represent a total of 8 4 channels (corresponding to the 410.125 ~ 493.125MHz frequency band )<br>0-8 0 represents a total of 8 1 channels (corresponding to the 850.125 ~ 930.125MHz frequency band ) | | | | Actual frequency = 410.125 + CH * 1M<br>Actual frequency = 850.125 + 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) | | | |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | 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, the module will initiate a forwarding ;<br>To prevent data from being transmitted back, it is recommended to use it in conjunction with fixed-point mode ; that is, the target address and source address are different. |
| | | | 0 | Disable relay functionality (default) | | | |
| | | | 1 | Enable relay function | | | |
| | | | 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;<br>1. In the WOR receiving mode, the module can modify the delay time after wake-up, the default time is 0;<br>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.)<br>3. Data can be sent within the delay |
| | | | 0 | W OR Receiver (Default)<br>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<br>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;<br>Period T = ( 1+WOR ) *500ms , maximum 4000ms , minimum 500ms ;<br>The longer the WOR monitoring interval is, the lower the average power consumption is, but the greater the data delay is;<br>The sender and receiver must be consistent (very important) |
| | | | 0 | 0 | 0 | 500 ms | |
| | | | 0 | 0 | 1 | 1000 ms | |
| | | | 0 | 1 | 0 | 1500 ms | |
| | | | 0 | 1 | 1 | 2000 ms | |
| | | | 1 | 0 | 0 | 2500 ms | |
| | | | 1 | 0 | 1 | 3000 ms | |
| | | | 1 | 1 | 0 | 3500 ms | |
| | | | 1 | 1 | 1 | 4000 ms | |
| 0 7H | Write | CRYPT_H | Key high byte (default 0) | | | | Write only, read returns 0 ;<br>Used for encryption to prevent wireless data from being intercepted by similar modules ;<br>The module will use these two bytes as calculation factors to transform and encrypt the wireless signal in the air. |
| 0 8H | Write | CRYPT_L | Key low byte (default 0) | | | | |

## 6.3 Heartbeat packet function configuration

Configuration mode (mode 2: M1=1, M0=0 ), the supported command list is as follows ( **when setting, only 9600, 8N1 format is supported** ):

| Serial number | Instruction Format | Detailed description |
|---|---|---|

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| | | |
|---|---|---|
| 1 | Configuration directives | Instruction: C 5 + starting address + length + parameter<br>Configuration command: C5 + 00 + 01 + 00<br><br>**Instruction structure meaning:**<br>● **C5** : Command header<br>● **00** : Register address (00: Heartbeat packet function selection register ; 01: Heartbeat packet custom cycle time configuration register ; 02: Heartbeat packet custom data configuration .<br>● **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 . )<br>● **00** : Register data |
| 2 | Register Function Description | **00 register data meaning :**<br>● The configuration parameter is 00: turn off the heartbeat packet function .<br>● The configuration parameter is 01: output the heartbeat packet data with custom timing through the serial port .<br>● The configuration parameters are 02: Send heartbeat packet data via wireless (sending address, channel, network ID) .<br>● 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:**<br>The register configuration parameter is two bytes, which configures the cycle time of the heartbeat packet.<br>For example: C5 01 02 00 05 configures the time to 5s<br><br>**02 Register:**<br>Customize heartbeat packet parameter configuration<br>For example: C5 02 05 11 22 33 44 55<br>Configure the heartbeat packet return data to be : 11 22 33 44 55<br><br>**Read instruction:**<br>C6 00 01<br>C6: Command Header<br>00: Register address<br>01: Length of the register data read |
| 4 | Format Error | Format Error Response<br>FF FF FF / " =ERR " |

## 6.4 Factory default parameters

| **Model** | **Factory default parameter values** | | | | | | |
|---|---|---|---|---|---|---|---|
| Module Model | Frequency | Address | Channel | Air speed | Baud rate | Serial port format | Transmit power |
| E290-400T20S | 433.125MHz | 0x0000 | 0x17 | 2.4kbps | 9600 | 8N1 | 20 dbm |
| E290-400T30S | 433.125MHz | 0x0000 | 0x17 | 2.4kbps | 9600 | 8N1 | 30dbm |
| E290-900T20S | 868.125MHz | 0x0000 | 0x12 | 2.4kbps | 9600 | 8N1 | 20dbm |
| EWM290-400T20D | 433.125MHz | 0x0000 | 0x17 | 2.4kbps | 9600 | 8N1 | 20dbm |
| EWM290-400T30D | 433.125MHz | 0x0000 | 0x17 | 2.4kbps | 9600 | 8N1 | 30dBm |

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# 7 AT commands

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 commands is 9600 8N1.

When the input parameter exceeds the range, an error message will be returned.

Note: AT commands do not require carriage return and line feed (\r\n).

## 7.1 AT command table

| Command Instructions | describe | Example | Example Description |
|---|---|---|---|
| AT+IAP (Use with caution) | Enter IAP upgrade mode | AT+IAP | Enter IAP upgrade mode |
| AT+RESET | Device restart | AT+RESET | Device restart |
| AT+DEFAULT | Restore Default Settings | AT+DEFAULT | Restore Default Settings |

| 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, cycle 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 1234 |
| AT+CHANNEL=channel | Set the module working channel | AT+CHANNEL=23 | Set the frequency to 433.125M /868.125MHz |
| 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. |

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| | | | |
|---|---|---|---|
| AT+SEARCH=search | Setting the airspeed adaptation function<br>(The airspeed of both parties cannot be 2.4K) | AT+SEARCH=search | Turn on the airspeed adaptive function.<br>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=E290-xxxTxxx/D | 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 |
| AT+CHANNEL=? | Query module working channel | AT+CHANNEL=23 | return frequency is 433.125M /868.125MHz |
| 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 |

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| | |
|---|---|
| | 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<br>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<br>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 |
| 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 |

## 7.3 IAP Upgrade

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 .

The pins necessary for upgrading must be brought out (M1, M0, AUX, TXD, RXD, VCC, GND), and then send the "AT+IAP" command in the configuration mode to enter the upgrade mode. If you need to exit the IAP upgrade mode, you need to keep the power on and wait for 60 seconds, the program will automatically exit, otherwise it will enter the firmware upgrade mode indefinitely even if you restart.

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.

If AUX is pulled low before power-on, it will also force the software to enter the firmware upgrade mode to avoid failure in the upgrade mode.

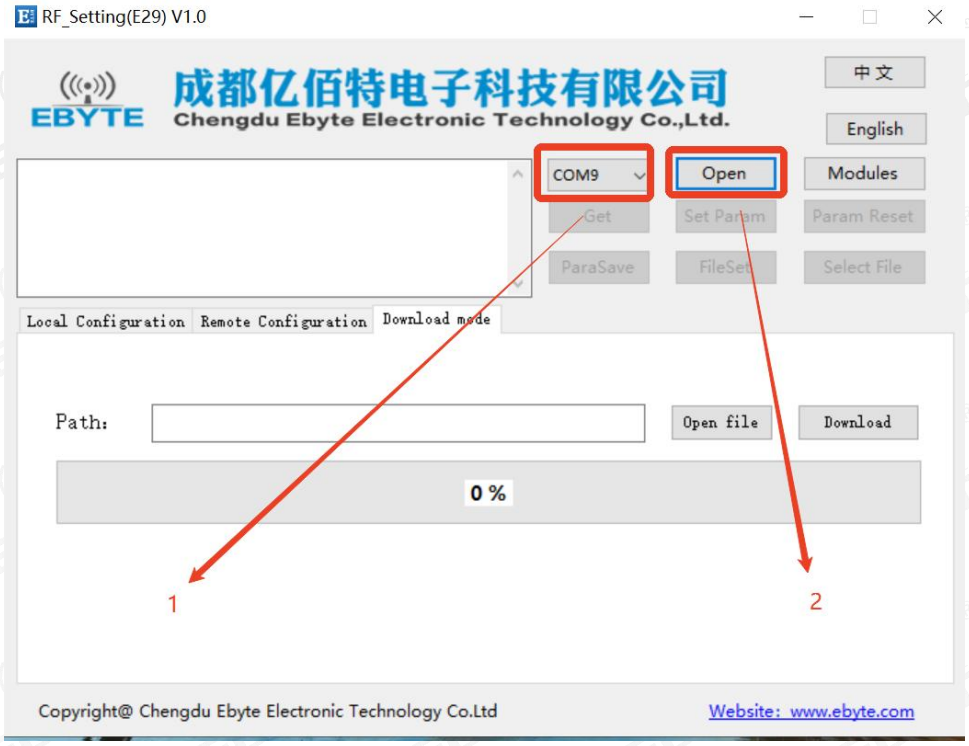
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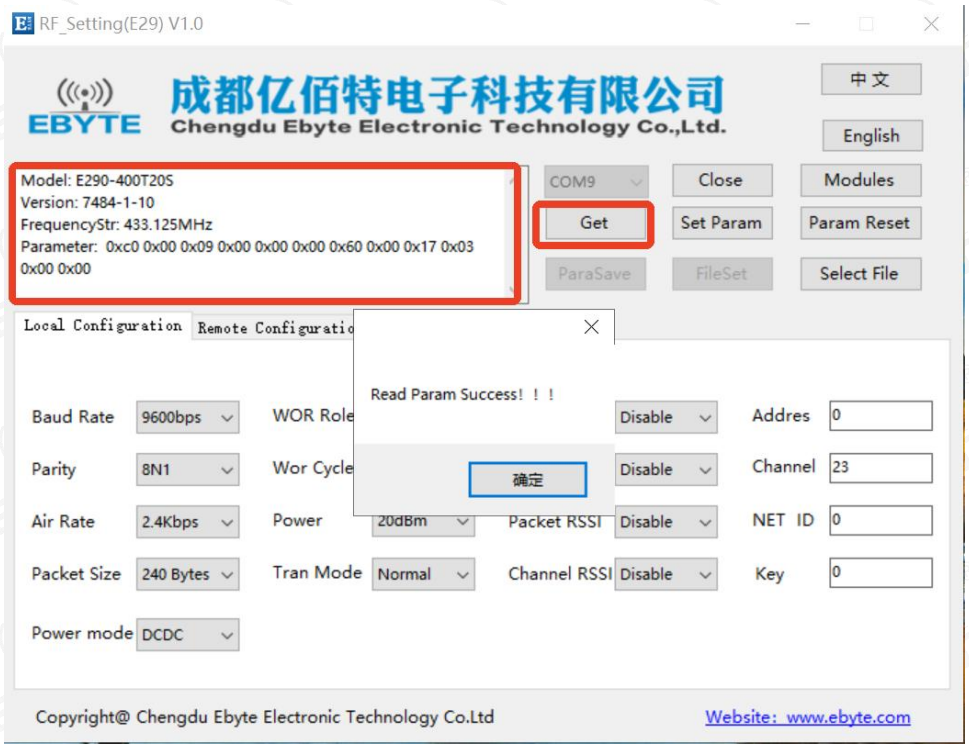
- **Host computer command upgrade guide**

1. Make the module enter configuration mode by changing M0 and M1 (note: the baud rate in configuration mode is 9600);

2. Open the official website to configure the host computer "RF_Setting(E29) V1.0.exe", select Serial Port > Open Serial Port;




3、Click Read Parameters to view the module information in the left window of the host computer;




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4. Click Firmware Upgrade > Click Open File (select the firmware .bin file) > Click Start Downloading;




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# 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.
- 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.

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# 9 FAQ

## 9.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly ;
- Temperature, humidity, and co-channel interference can increase the communication packet loss rate ;
- The ground absorbs and reflects radio waves, so the test results are poor when close to the ground ;
- Seawater has a strong ability to absorb radio waves, so the test effect at the seaside is poor ;
- If there are metal objects near the antenna, or the antenna is placed in a metal shell, the signal attenuation will be very serious ;
- The power register is set incorrectly, or the air rate is set too high (the higher the air rate, the closer the distance) ;
- The power supply voltage at room temperature is lower than the recommended value. The lower the voltage, the lower the power output .
- The antenna used does not match the module well or the antenna itself has quality issues.

## 9.2 Module is easily damaged

- 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 .
- Please ensure anti-static operation during installation and use, as high-frequency components are sensitive to static electricity ;
- Please ensure that the humidity is not too high during installation and use, as some components are humidity sensitive devices ;
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

## 9.3 Bit error rate is too high

- There is interference from the same frequency signal nearby. Stay away from the interference source or change the frequency or channel to avoid interference.
- An unsatisfactory power supply may also cause garbled characters, so the reliability of the power supply must be ensured;
- Extension cables or feeder cables that are of poor quality or are too long can also cause a high bit error rate.

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# 10 Welding Operation Instructions

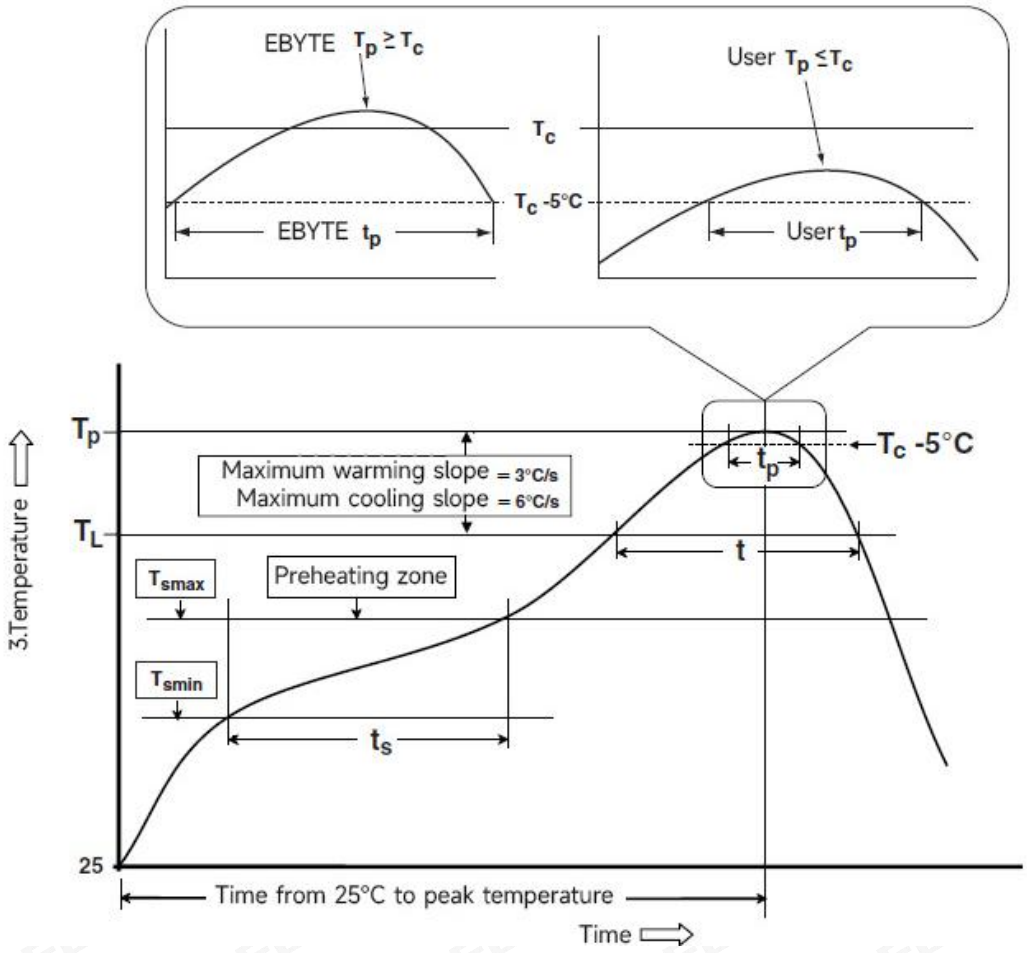
## 10.1 Reflow temperature

| 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. |
| The time (T p ) within 5℃ 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. |
| 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 | | | |

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# 10.2 Reflow Oven Profile

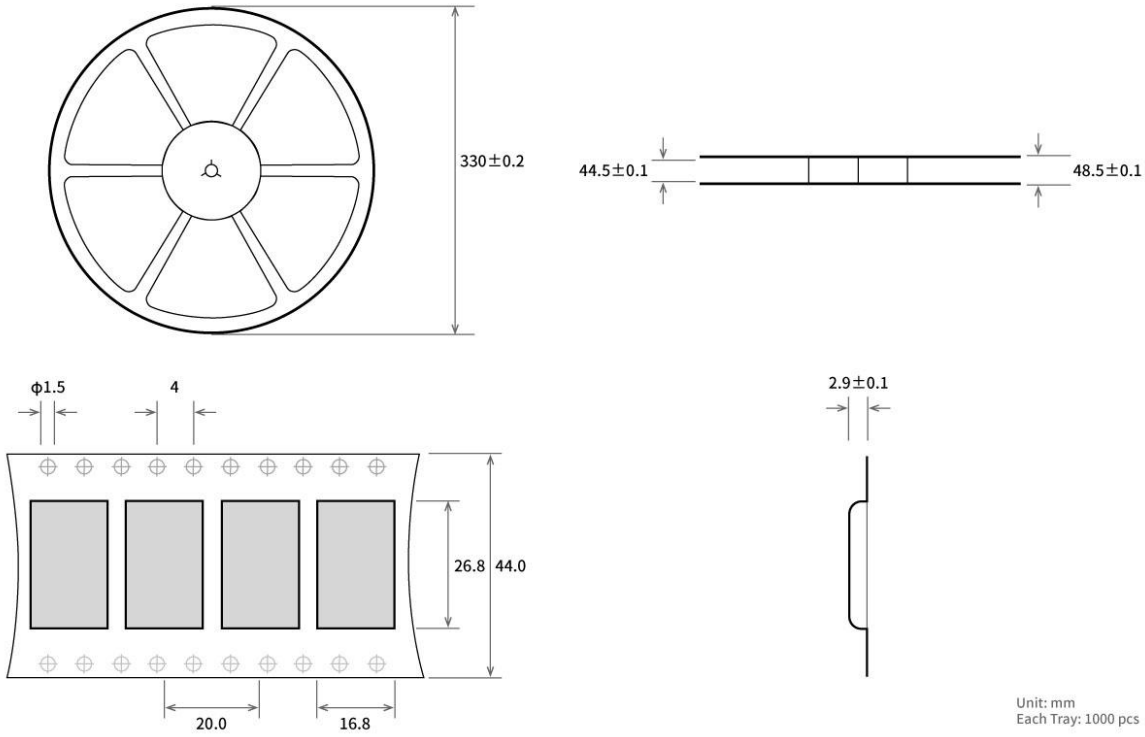



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# 11 Bulk Packaging Methods

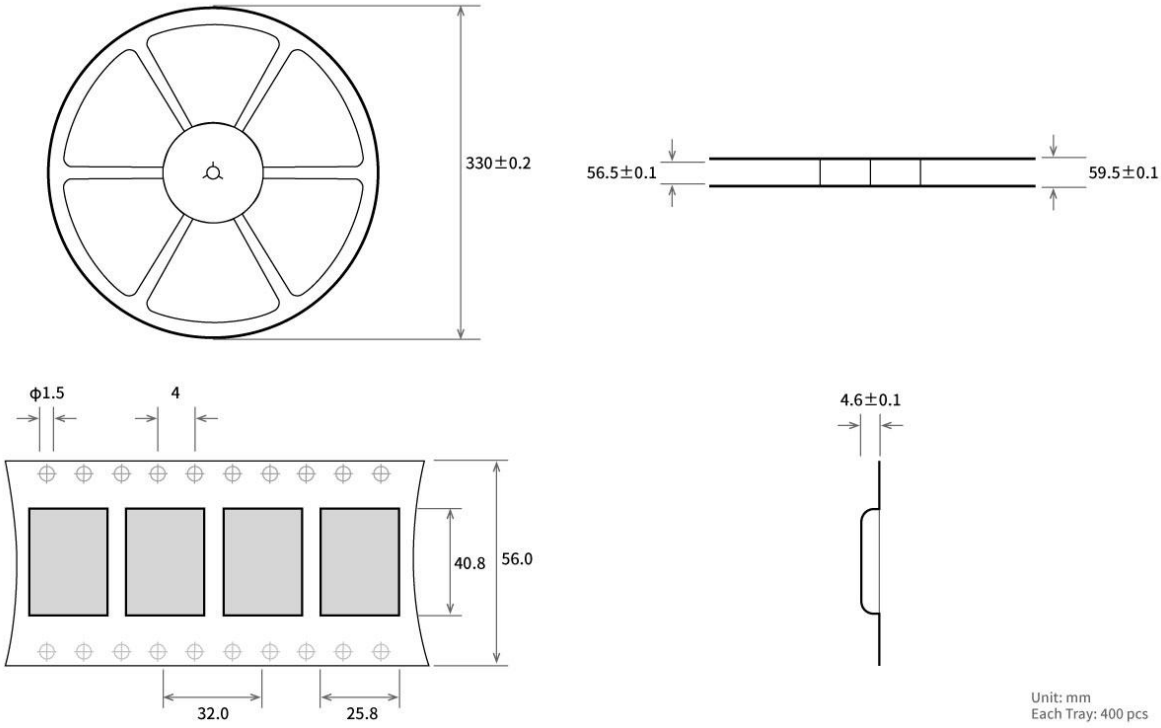
## 11.1 E290-400/900T20S Batch Packaging



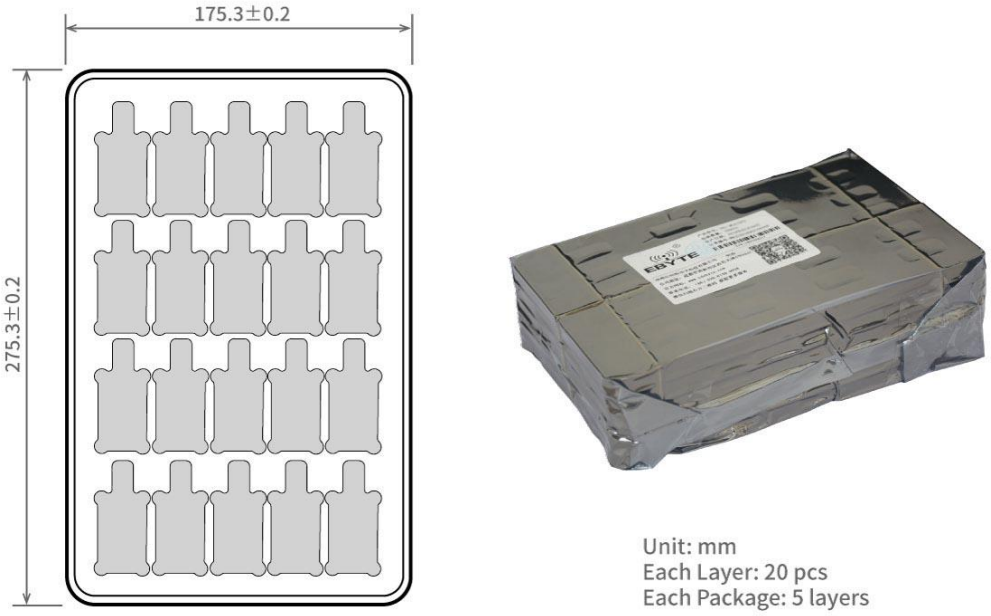

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## 11.2 E290-400T30S Batch Packaging Method




## 11.3 EWM290-xxxTxxD Batch Packaging Method




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# Revision History

| Version | Revision Date | Revision Notes | Maintainer |
|---|---|---|---|
| 1.0 | 2024-3-29 | Initial release | Weng |
| 1.1 | 2024-11-5 | Text and image modification | Hao |
| 1.2 | 2024-11-7 | Model Merge | Hao |
| 1.3 | 2024-11-21 | Modify the heartbeat packet function description | Hao |
| 1.4 | 2025-1-17 | WOR added description | Hao |
| 1.5 | 2025-3-6 | New direct plug-in model | Hao |

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