E22-xxxT30x Product Specifications

AT Commands 30dBm LoRa Wireless Module

Chengdu Ebyte Electronic Technology Co.,Ltd.

Contents

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1 Product Overview

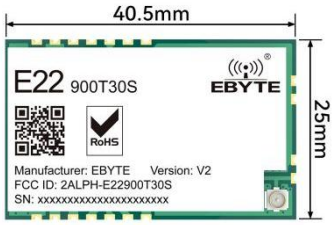
1.1 Product Introduction

E22-xxxT30x is a new generation of LoRa wireless data transmission module. This series (UART) module is developed based on SEMTECH high-performance RF chip. Its maximum transmission power is 30dBm. It has multiple transmission modes. The working frequency bands are 230, 400 and 900. It uses LoRa spread spectrum technology, TTL level output, and is compatible with 3.3V IO port voltage.

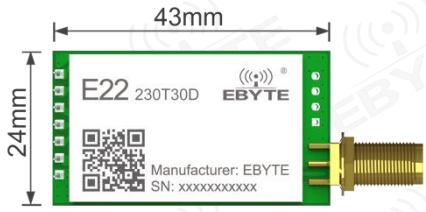
E22-xxxT30x uses a new generation of LoRa spread spectrum technology, which is faster, has lower power consumption, and is smaller in size. It supports air wake-up, wireless configuration, carrier monitoring, automatic relay, communication key and other functions, supports packet length setting, and can provide customized development services. The six modules in the figure below have the same power, different frequency bands, and different packages.

E22-230T30S

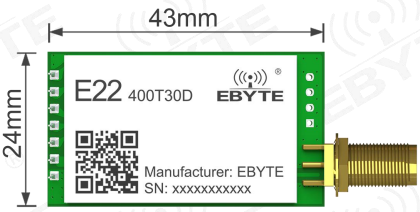
E22-400T30S



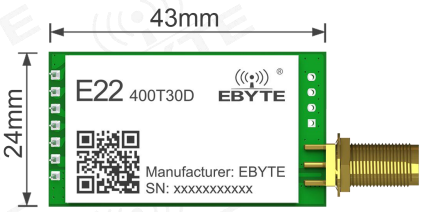
E22-900T30S



E22-230T30D



E22-400T30D



E22-900T30D

1.2 Features

- Adopting the new generation of LoRa spread spectrum modulation technology, it brings a longer communication distance and stronger anti-interference ability;
- Support serial port firmware upgrade , which makes firmware update more convenient;
- Support AT commands, which makes it more convenient to use;
- 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 LBT function, which monitors the channel environment noise before sending, and can greatly improve the communication success rate of the module in harsh environments;

- 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 wake-up on the air, an ultra-low power consumption feature suitable for battery-powered applications;
- Supports fixed-point transmission, broadcast transmission, and channel monitoring;
- Supports deep sleep, in which the power consumption of the whole device is about 2 uA;
- 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;
- Internal watchdog, automatically reset and resume work in unexpected situations;
- E22-400T30D, E22-900T30D, E22-400T30S and E22-900T30S support wireless transmission rates (air rates) of 2.4K to 62.5K bps ;
- E22-230T30D and E22-230T30S support wireless transmission rates (air rates) of 2.4K to 15.6Kbps ;
- Supports 2.7 ~ 5.5V power supply, and the best performance can be guaranteed when the power supply is greater than 5 V;
- Industrial-grade standard design, supports long-term use at -40～+85℃;
- The module's maximum transmission power can reach 1 W (30dBm), allowing for longer and more stable transmission.

1.3 Application Scenario

- 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 Specifications

2.1 RF parameters

RF parameters	Unit	Model			Remark
		E22-230T30D E22-230T30S	E22-400T30D E22-400T30S	E22-900T30D E22-900T30S	
Maximum transmit power	dBm	30.0 ± 1	30.0 ± 1	30.0 ± 1	-
Receiving sensitivity	dBm	-133～- 135			Air rate is 2.4 kbps
Reference distance	m	10k			Clear and open air,

					antenna gain 5dBi, antenna height 2.5 meters, air rate 2.4 kbps .
Working frequency band	MHz	220.125～236.125MHz	410.125～493.125MHz	850.125～930.125MHz	Support ISM band
Air speed	bps	2.4K～15.6K	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	B tye	240	240	240	The command can be set to send packets of 32/64/128/240 bytes

2.2 Electrical parameters

Electrical parameters		Unit	Model			Remark
			E22-230T30D E22-230T30S	E22-400T30D E22-400T30S	E22-900T30D E22-900T30S	
Operating voltage		V	2. 7～5.5			≥ 5 V can guarantee the output power , and exceeding 5.5 V may burn the module .
Communication level		V	3.3V			Using 5V TTL may burn out
Power consumption	Emission current	mA	460～620 (typical value: 510)			Instantaneous power consumption @ 30 dBm
	Receiving current	mA	12～14 (typical value: 13)			
	Sleep current	uA	2			Software shutdown
temperature	Operating temperature	℃	-40 ～ + 85			Industrial-grade design
	Storage temperature	℃	-40 ～ + 85			Industrial-grade design

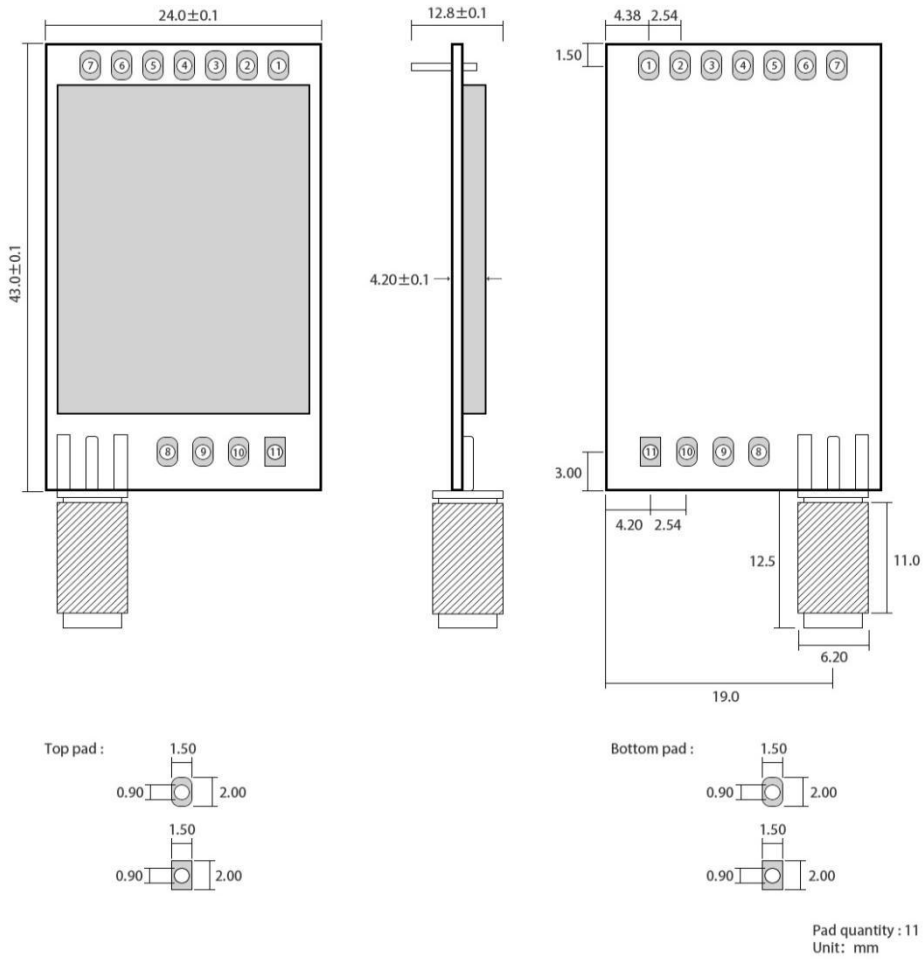
2.3 Hardware Parameters

Hardware Parameters	Model		Remark
	E22-230T30D E22-400T30D E22-900T30D	E22-230T30S E22-400T30S E22-900T30S	
Crystal frequency	32MHz	32MHz	Industrial grade high precision crystal oscillator

Modulation	LoRa	LoRa	New generation LoRa modulation technology
Interface	2.54mm pin header	1.27mm stamp hole	
Communication interface	UART Serial Port	UART Serial Port	TTL level
Launch length	240 Byte	240 Byte	The command can be set to send packets of 32/64/128/240 bytes
Packaging	Direct plug-in	SMD	-
Cache capacity	1000 Bytes	1000 Bytes	-
Antenna interface	SMA-K	IPEX/Stamp Hole	Equivalent impedance is about 50 Ω
size	24*43mm	40.5 * 25 mm	±0.2mm
Product Net Weight	11g	5.8g	±0.2g

3 Mechanical dimensions and Pin definition

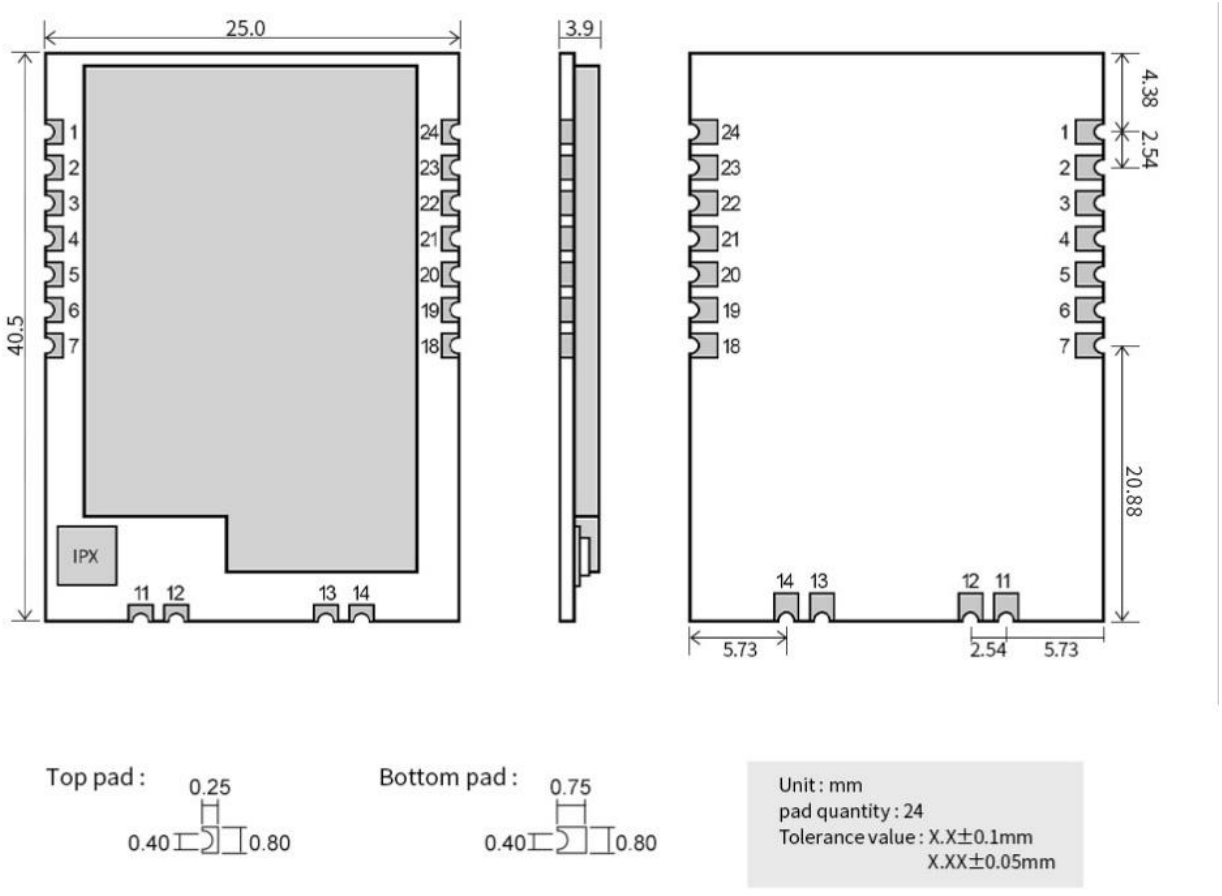
3.1 E22-230/400/900T30D Mechanical Dimensions and Pin Definition



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	enter	TTL serial port input, connected to external TXD output pin; 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; 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; when the user wakes up the external MCU, the pin outputs a low level during the power-on self-test initialization; when the module is just powered on to execute the boot

			program, the pin is in the pull-up input state. If it is not detected to be pulled down externally, it will immediately switch to output, normally indicating the working status of the module, and output a low level during the self-test initialization (high level: module idle, low level: module busy).
6	VCC	enter	power positive reference, voltage range: 2.7 ~ 5.5V DC
7	GND	enter	Module ground wire
8	Fixing holes	-	Fixing holes
9	Fixing holes	-	Fixing holes
10	Fixing holes	-	Fixing holes
11	Fixing holes	-	Fixing holes

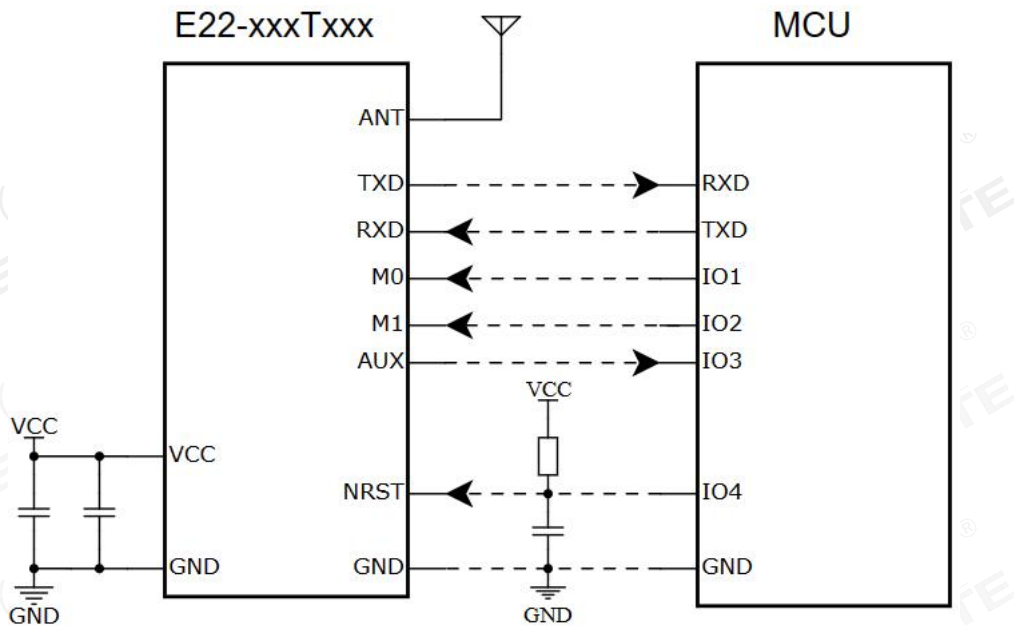
3.2 E22-230/400/900T30S Mechanical Dimensions and Pin Definition



Pin number	Pin Name	Pin Direction	Pin Purpose

1	GND	enter	Module ground wire
2	VCC	enter	power positive reference, voltage range: 2.7 ~ 5.5V DC
3	AUX	Output	Used to indicate the working status of the module; when the user wakes up the external MCU and the module is just powered on to execute the boot program, the pin is in the pull-up input state. If it is not detected to be pulled down externally, it will immediately switch to output and normally indicate the working status of the module. During the self-test initialization, it outputs a low level (high level: module idle, low level: module busy).
4	TXD	Output	TTL Serial port output, connected to external RXD input pin;
5	RxD	enter	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
18	NC		SWCLK
19	NC		SWDIO
20	NC		-
21	NC		-
22	RESET	enter	Module reset pin, low level trigger. It is recommended that customers use a microcontroller to connect to the module to reset and resume operation in unexpected situations.
23	GND	-	Fixed
24	NC		-

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 .

5 Functional Details

5.1 Working mode

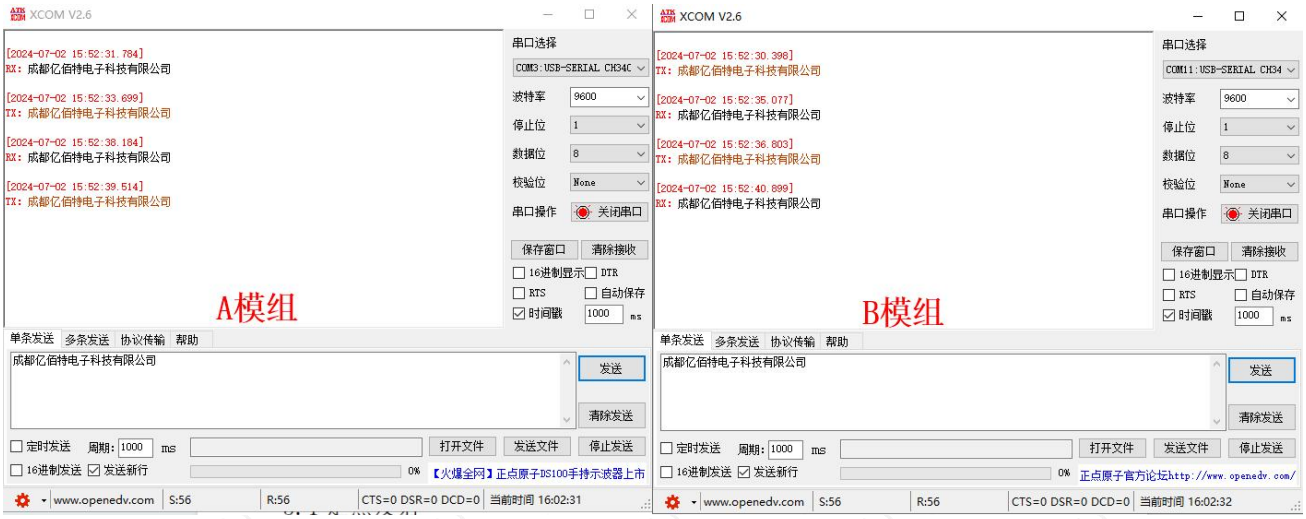
The module has four working modes, which are set by pins M1 and M0 . The details are shown in the following table:

Mode (0-3)	M1	M0	Mode Introduction	Remark
0 Transfer 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	

5.1.1 Transfer mode use (M1, M0 pins set to 0,0)

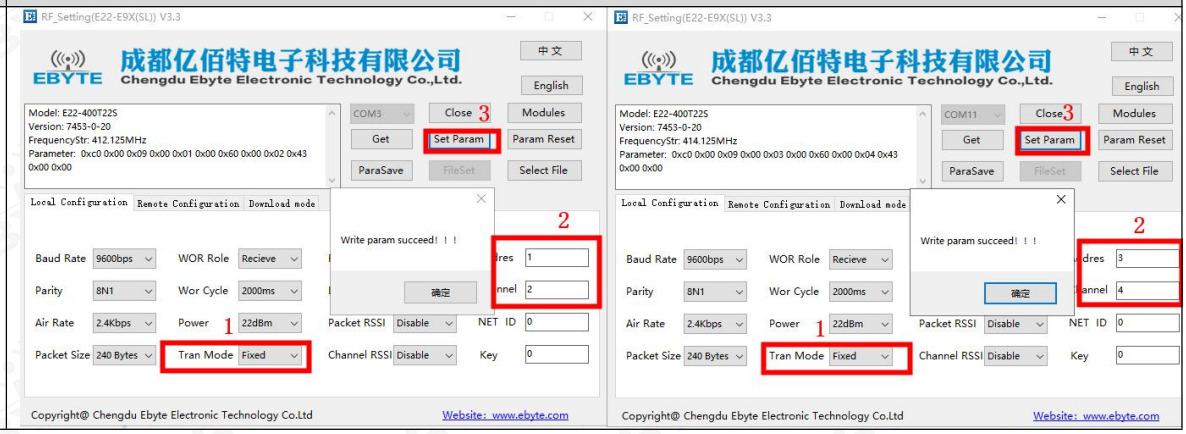
- **Transparent transmission function** : What you send is what you get. You can use the serial port assistant to communicate with each other (the factory default parameters are consistent, and the transmission method is transparent transmission). The

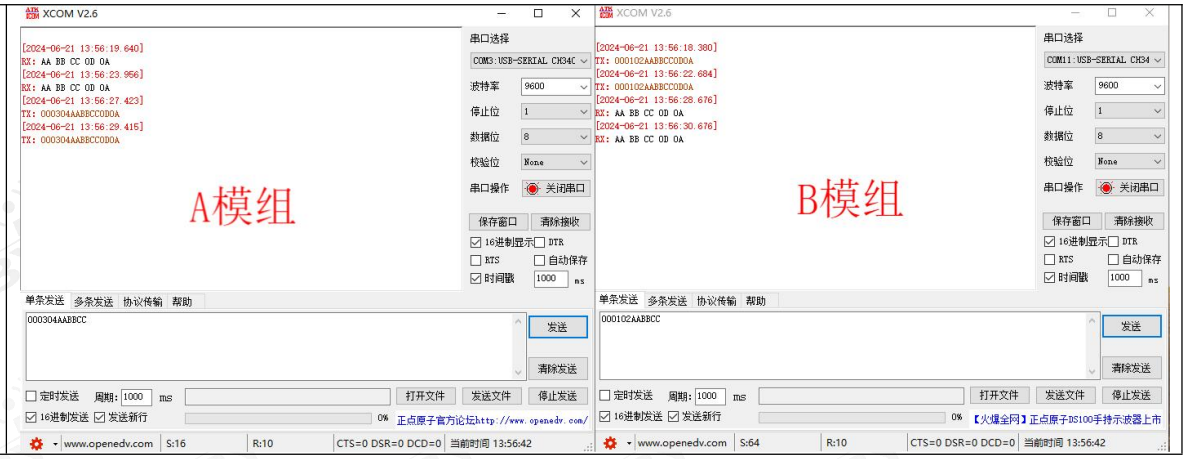
example is as follows:



Schematic diagram

- **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 data transmission format in fixed-point mode is: target address + target channel + data)	

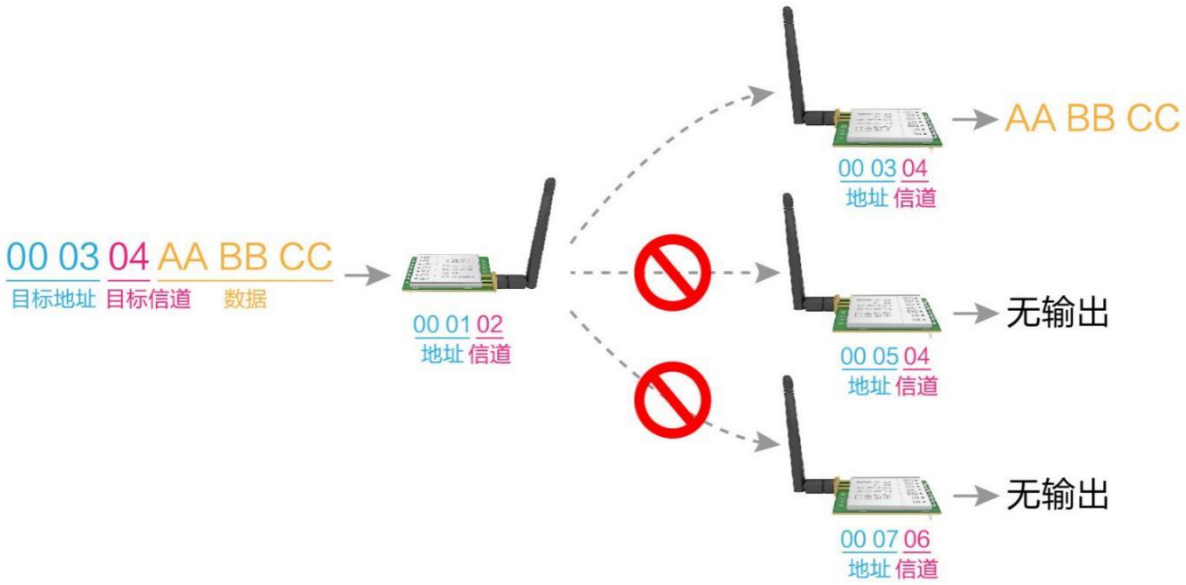


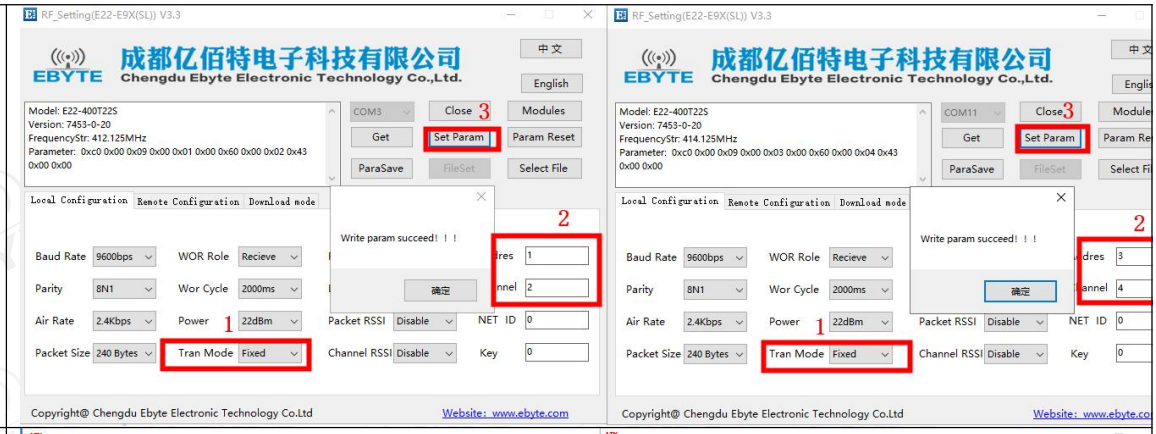
Figure 1 Schematic diagram of fixed-point transmission

- **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)	

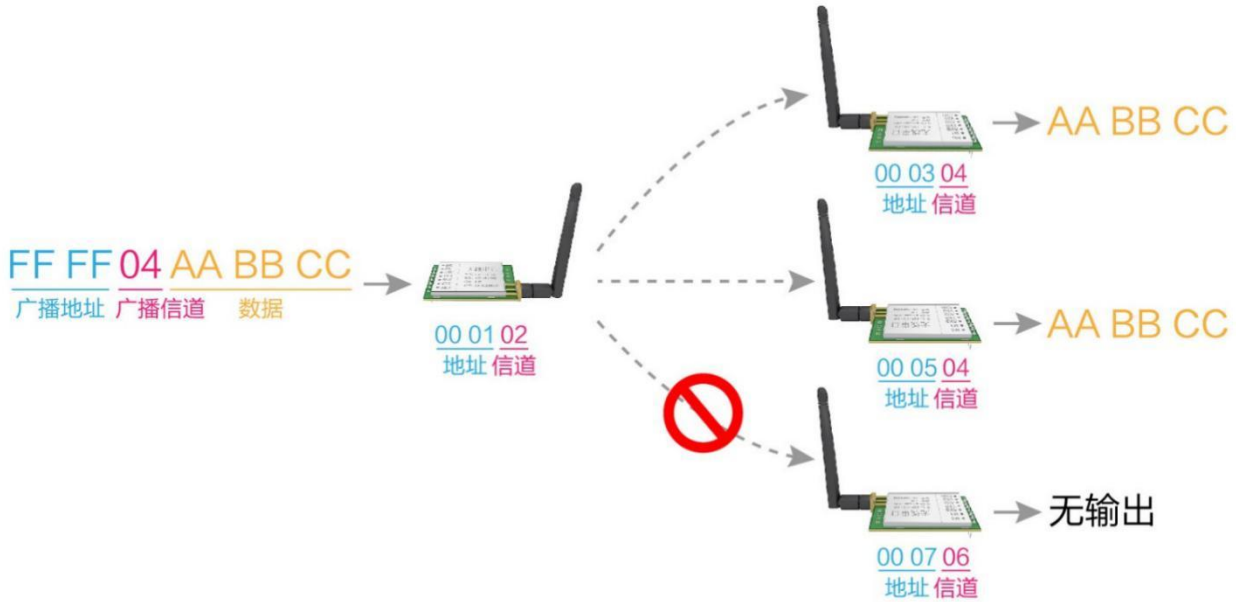


Figure 2 Schematic diagram of fixed-point broadcast transmission

- **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 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.

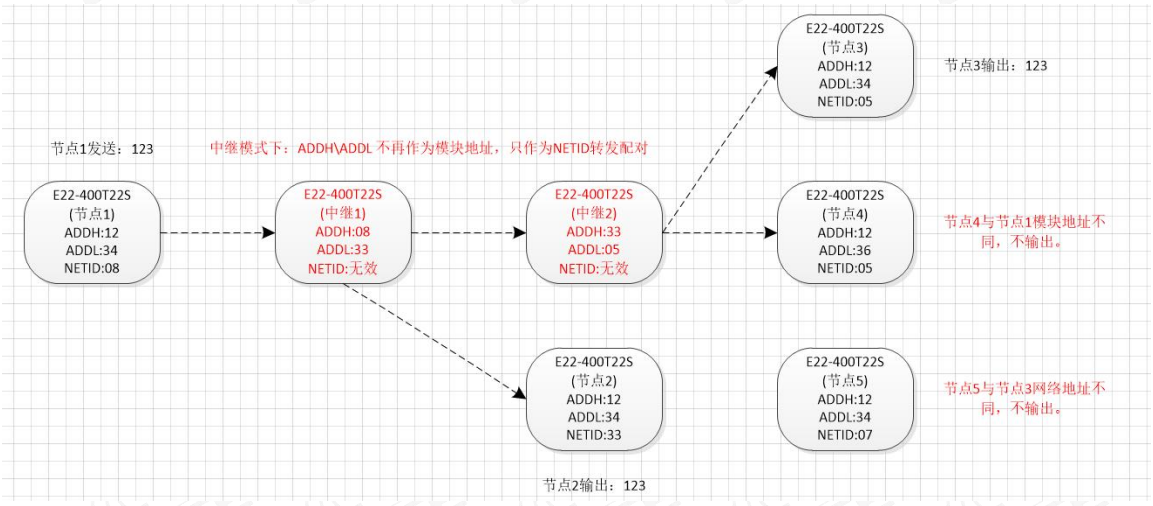
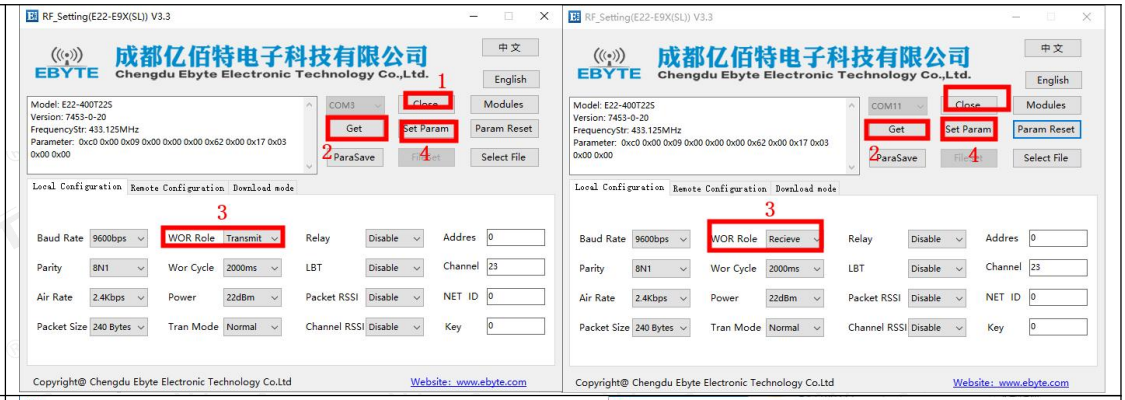
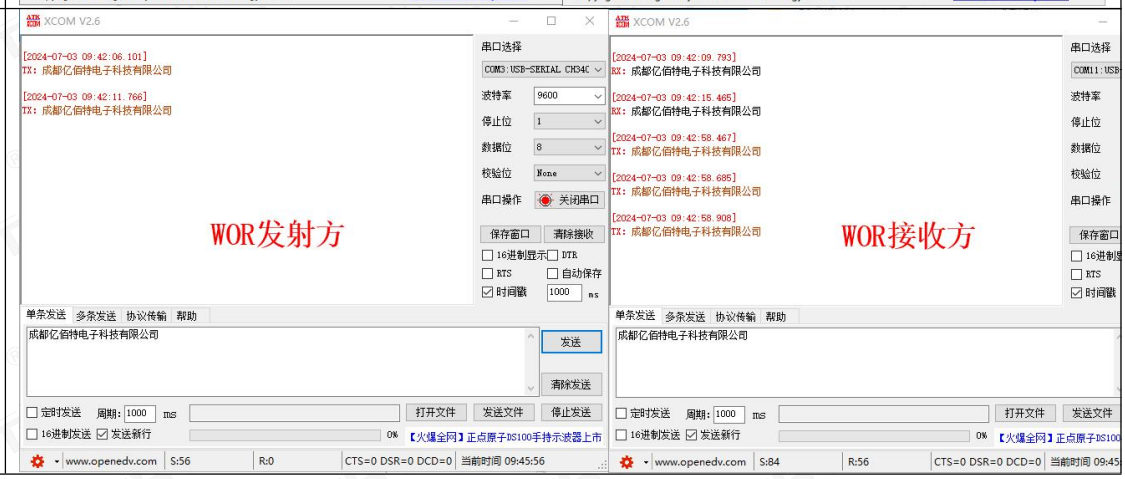


Figure 3 Example of relay mode

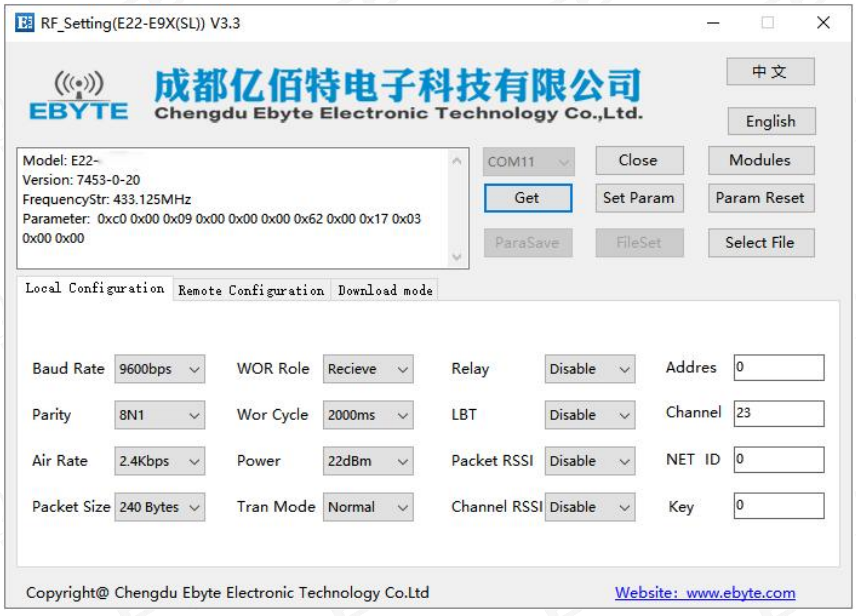
5.1.2 WOR mode use (M1, M0 pins set to 0,1)

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.	

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

Frequency channel: 0～8 0

Network ID: 0-255

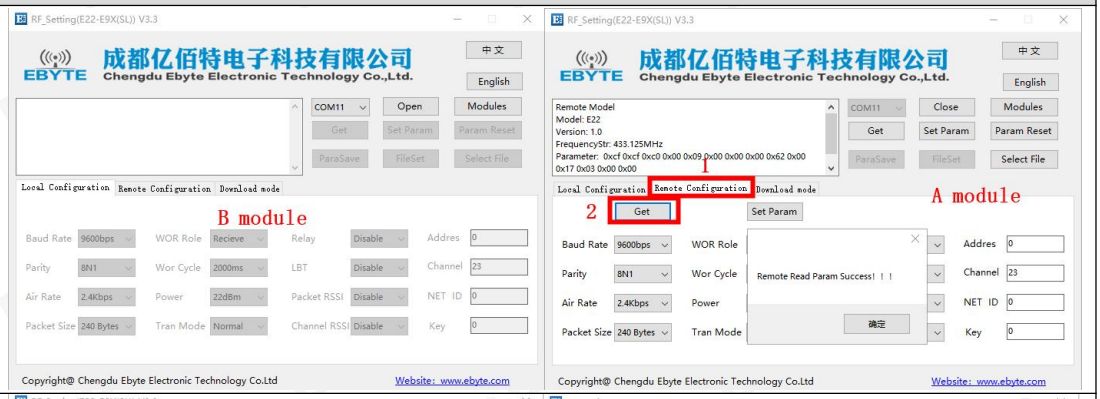
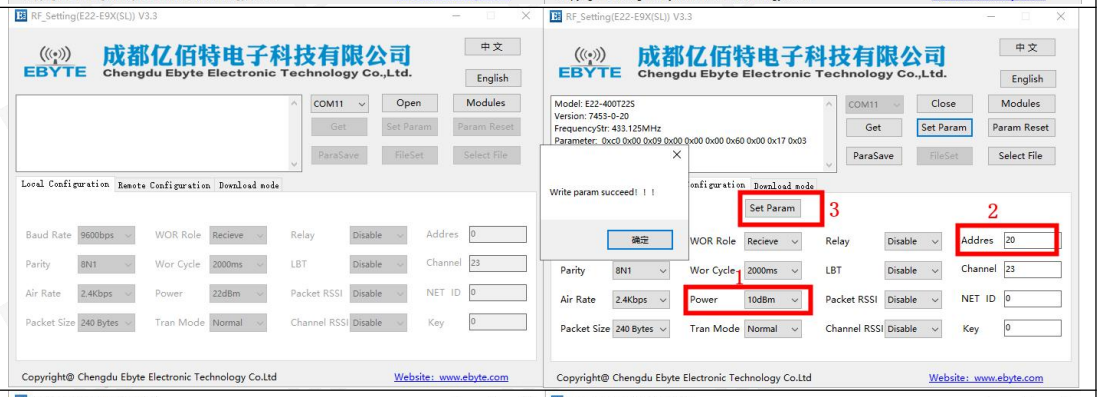
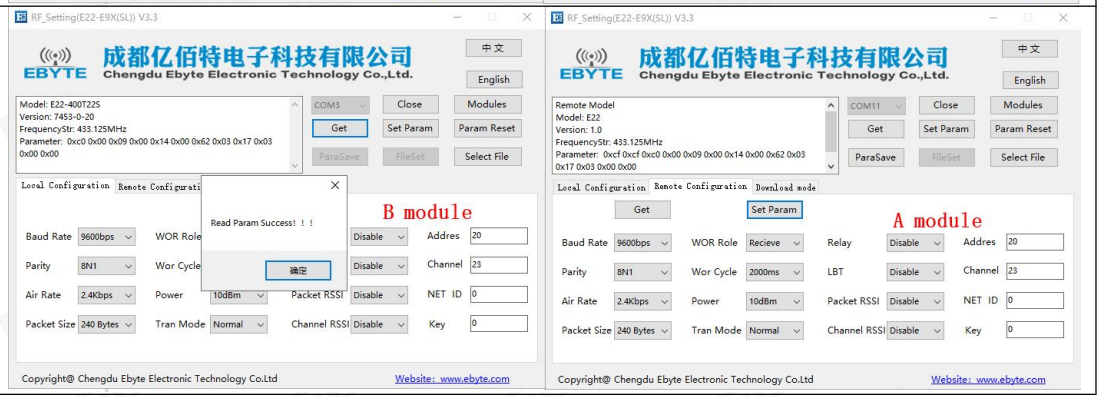
Key: 0-65535

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.

- **Use of the Over-the-Air Configuration Function**

Serial number	Over-the-air configuration steps
1. Remotely read and modify the module parameters through the host computer: Module A and module B must have the same parameters to perform remote configuration . The example is shown in the right figure: 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.	
2. Remote parameter modification and parameter writing .	
3. Switch module B to configuration mode to view the modified 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.**

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 AUX Detailed Explanation

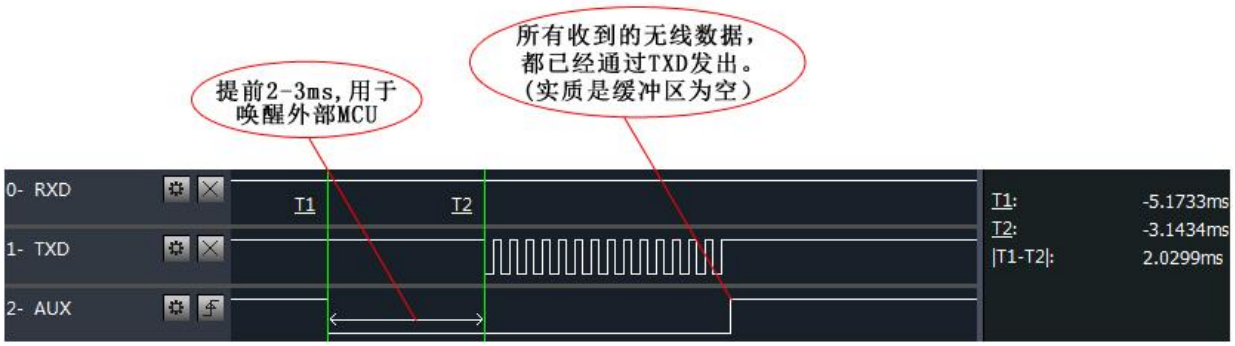
5.3.1 Power-on start indication

1) After power-on, the entire startup process (entering the mode working state) takes about 16ms
2) power-on and VCC is established, AUX does not immediately indicate a busy state (low level) because the internal microcontroller also requires a certain amount of startup time.

Figure 4 Power-on startup timing diagram

5.3.2 Serial port data output indication

1) When the receiving module receives a wireless data packet, it will indicate a busy state (low level) through the AUX pin before giving data on the wired serial port;
2) Used to wake up the external MCU in sleep mode;

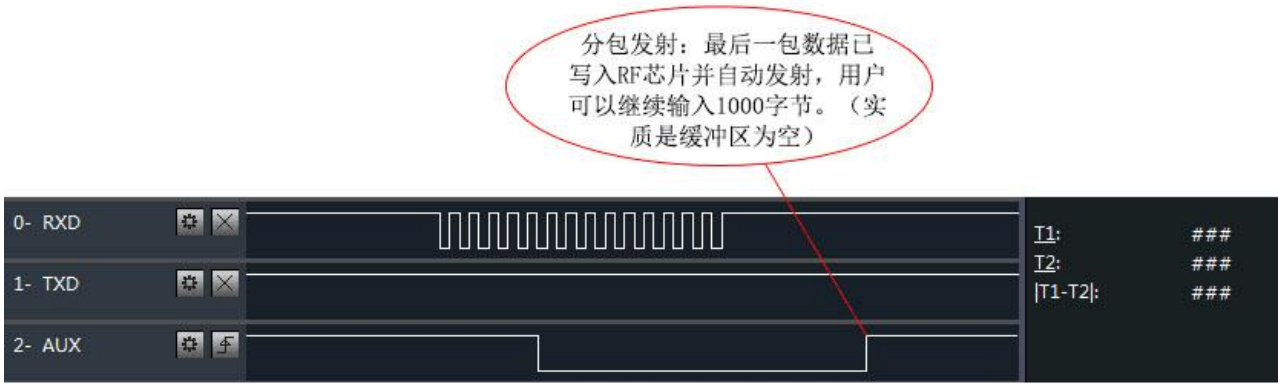


模块串口外发数据时，AUX引脚时序图

5.3.3 Wireless transmission indicator

1) When the module is in idle state (not in sleep mode), if the user inputs data to the module, the module will start to indicate busy state (low level) only after the first byte of the serial data packet is recognized and received by the module. There is a one-byte delay difference depending on the serial port baud rate, and the user program needs to pay attention to the AUX detection logic.

2) Buffer empty: data in the internal 1000-byte buffer are all written to the wireless chip (automatically divided into packets) ;
When AUX=1, the user can continuously send data less than 1000 bytes without overflow ;
When AUX=0, the buffer is not empty: the data in the internal 1000-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 .



模块接收串口数据时，AUX引脚时序图

5.3.4 Switching Mode

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

Original working mode	Switching Mode	E22-XXXTXXX switching time (ms)
Sleep Mode	Transparent mode	9-11
	WOR Mode	9-11
	Configuration Mode	9-11
Transparent mode	Sleep Mode	9-11
	WOR Mode	9-11
	Configuration Mode	9-11
Configuration Mode	Sleep Mode	9-11
	Transparent mode	9-11
	WOR Mode	9-11
WOR Mode	Sleep Mode	9-11
	Transparent mode	9-11
	Configuration Mode	9-11

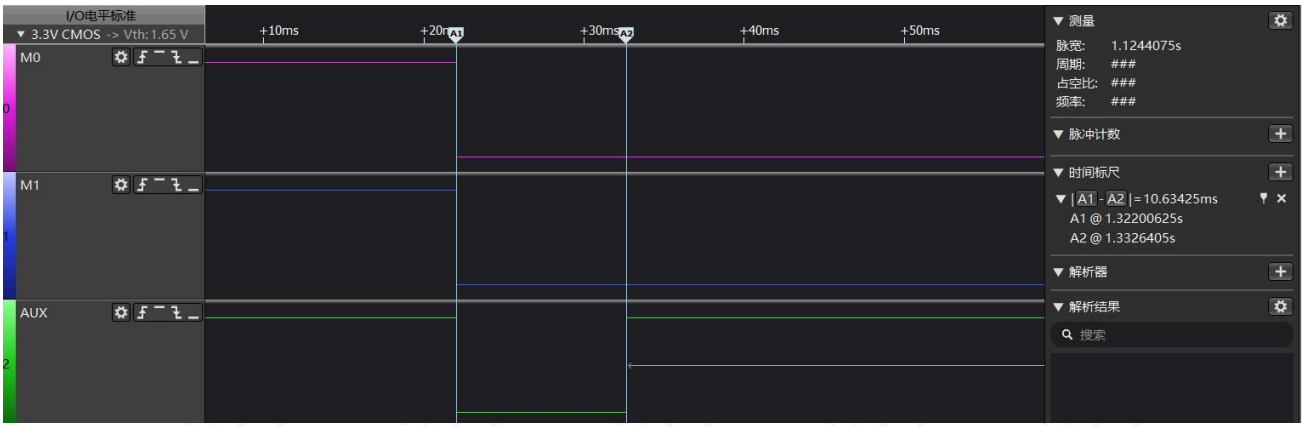


Figure 5 Mode switching timing diagram

5.3.5 Notes

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; 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 LoRa modulation, the information transmission delay is much longer than FSK.

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 Response: C1+starting address+length+parameters Example 1: Configure the channel to 0x09 Instruction start address length parameter Send: C0 05 01 09 Return: C1 05 01 09 Example 2: Configure the module address (0x1234), network address (0x00), serial port (9600

		8N1), and speed (1.2K) at the same time Send: C0 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61
2	Read Register	Instruction: C1+starting address+length Response: C1+starting address+length+parameters Example 1: Reading a channel Instruction start address length parameter Send: C1 05 01 Return: C1 05 01 09 Example 2: Read module address, network address, serial port, and airspeed simultaneously Send: C1 00 04 Return: C1 00 04 12 34 00 61
3	Setting up temporary registers	Instruction: C2 + start 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 speed (1.2K) at the same time Send: C2 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61
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: Wireless simultaneous configuration module address (0x1234), network address (0x00), serial port (9600 8N1), airspeed (1.2K) Send: CF CF C0 00 04 12 34 00 61 Return: CF CF C1 00 04 12 34 00 61
5	Format Error	Format Error Response FF FF FF

6.2 Register Description

<table>
<tr><th>Serial number</th><th>Read and Write</th><th>name</th><th colspan="4">describe</th><th>Remark</th></tr>
<tr><td>00H</td><td>Read/Write</td><td>ADDH</td><td colspan="4">ADDH (default 0)</td><td rowspan="2">Module address high byte and low byte ;
Note: When the module address is equal to FFFF, it can be used as a broadcast and monitoring address, that is, the module will not perform address filtering at this time</td></tr>
<tr><td>01H</td><td>Read/Write</td><td>ADDL</td><td colspan="4">ADDL (default 0)</td></tr>
<tr><td>02H</td><td>Read/Write</td><td>NETID</td><td colspan="4">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="3">0 3H</td><td rowspan="3">Read/Write</td><td rowspan="3">EG0</td><td>7</td><td>6</td><td>5</td><td>UART serial port rate (bps)</td><td rowspan="3">The two modules that communicate with each other can have different serial port baud rates and verification methods ;</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>The serial port baud rate is 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>The serial port baud rate is 2400</td></tr>
</table>

			0	1	0	The serial port baud rate is 4800		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.
			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 ; air rate, the smaller the delay and the shorter the transmission distance.
						E22-400T30D E22-900T30D E22-400T30S E22-900T30S	E22-230T30S E22-230T30D	
			0	0	0	Air speed 2.4k	Air speed 2.4k	
			0	0	1	Air speed 2.4k	Air speed 2.4k	
			0	1	0	Air rate 2.4k (default)	Air speed 2.4k	
			0	1	1	Air speed 4.8k	Air rate 2.4k (default)	
			1	0	0	Air speed 9.6k	Air speed 4.8k	
			1	0	1	Air speed 1 9.2k	Air speed 9.6k	
			1	1	0	Air speed 38.4 k	Air speed 15.6 k	
			1	1	1	Air speed 62.5 k	Air speed 15.6 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	RSSI Ambient Noise Enable				After enabling, you can send instructions C0 C1 C2 C3 in transfer mode or WOR send mode to read registers ;
			0	Disabled (default)				

			1	Enable	Register 0x00: Current ambient noise RSSI ; Register 0X01: RSSI when receiving data last time (The current environmental 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 0 0)**
			4	3 reserve	
			2	Software mode switching	**If you use our host computer to configure the parameters, this bit will be automatically turned off.** If you do not want to use the M0 M1 pins to switch the working mode, you can To enable this function, use specific serial port commands to switch modes. Format: C0 C1 C2 C3 02 + working mode Send C0 C1 C2 C3 02 00 to switch to transparent transmission mode Send C0 C1 C2 C3 02 01 to switch to WOR mode Send C0 C1 C2 C3 02 02 to switch to configuration mode Send C0 C1 C2 C3 02 03 to switch to sleep mode Return: C1 C2 C3 02 + working mode Note: After enabling this function, the configuration mode still supports 9600 baud rate.
			0	Disabled (default)	
			1	Enable	
			1	0 Transmit power	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.
			0	0 30 dB m (default)	
			0	1 2 7 d B m	
			1	0 24dBm	
			1	1 21 d B m	
0 5H	Read/Write	REG2	Channel control (CH) 0-64 represent a total of 65 channels (applicable to 230 frequency band) 0-83 represent a total of 8 4 channels (applicable to 400 frequency band) 0-80 represent a total of 81 channels (applicable to 900 frequency band)		Actual frequency = 220.125 + CH *0.25M Actual frequency = 410.125 + CH * 1M 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 a RSSI strength byte. The current data packet RSSI is: dBm = -(256 - RSSI)
			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, the module will initiate a forwarding ;
			0	Disable relay functionality (default)	

			1	Enable relay function			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	L BT Enable			When enabled, wireless data will be monitored before transmission, which can avoid interference to a certain extent, but may cause data delays ; The maximum stay time of LBT is 2 seconds, and it will be forcibly issued after 2 seconds.
			0	Disabled (default)			
			1	Enable			
			3	WOR mode transceiver control			Only valid for mode 1; 1. In the receiving mode of wor, 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 03 E8 in the configuration mode (C0 is the write command, 09 is the register start address, 02 is the length, 03 E8 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	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 ; 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.
0 8H	Write	CRYPT_L	Key low byte (default 0)				
8 0H ～ 8 6H	read	PID	Product information 7 bytes				Product information 7 bytes Note: Please refer to section 7.1 for more convenient query command AT+DEVTYPE=?

6.3 Factory default parameters

model	**E22-230T30D, E22-230T30S factory default parameter value: C0 00 09 00 00 00 63 00 28 03 00 00 E22-400T30D, E22-400T30S factory default parameter value: C0 00 09 00 00 00 62 00 17 03 00 00 E22-900T30D, E22-900T30S factory default parameter value: C0 00 09 00 00 00 62 00 12 03 00 00**						
Module Model	frequency	address	Channel	Air speed	Baud rate	Serial port format	Transmit power

E22-230T30D	230.125MHz	0x0000	0x28	2.4kbps	9600	8N1	30 dBm
E22-400T30D	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30 dBm
E22-900T30D	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	30 dBm
E22-230T30S	230.125MHz	0x0000	0x28	2.4kbps	9600	8N1	30 dBm
E22 -400T30S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30 dBm
E22-900T30S	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	30 dBm

7 AT Commands

- Parameter configuration or query using AT commands needs to 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 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 8.3 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 rate to 62.5K / 15.6K
AT+PACKET=packet	Set packet length	AT+PACKET=0	Set the packet size to 240 bytes

AT+WOR=role	Setting WOR Roles	AT+WOR=0	Set to WOR reception
AT+ WTIME =wtime	Setting the WOR period	AT+ WTIME = 0	Set the WOR period to 500ms
AT+POWER=power	Set the transmit power	AT+POWER=0	Set the transmit power to 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+LBT=lbt	Set the Listen Before Talk function switch	AT+LBT=1	Set to on, refer to Section 6.2 LBT Enable for details
AT+ERSSI=erssi	Setting the ambient noise RSSI switch	AT+ERSSI=1	Set to on, refer to Section 6.2 RSSI Environment Noise Function for details
AT+DRSSI=data_rssi	Set the RSSI switch for receiving data	AT+DRSSI=1	Receive data RSSI function is enabled
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 channel to 23
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 WOR delay sleep time	AT+DELAY=1000	Set the WOR delay sleep time to 1000ms
AT+SWITCH=switch	Set software switching mode switch	AT+SWITCH=1	Set to on, allowing software switching
AT+SWITCH=switch	Set software switching mode switch	AT+SWITCH=1	Set it up in configuration mode to allow software switching
AT+MODE=mode	Switch working mode	AT+MODE=0	Switch to transparent mode

7.1.3 Query command

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=E22-400T30 S /D	Return module model
AT+FWCODE=?	Query firmware code	FWCODE=7432-0-10	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=7	Return air speed is 62.5K / 15.6K
AT+PACKET=?	Query packet length	AT+PACKET=0	return packet is 240 bytes
AT+WOR=?	Query WOR roles	AT+WOR=0	Return to WOR Receive
AT+POWER=?	Query the transmit power	AT+POWER=0	Return transmit power is 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+LBT=?	Query the Listen Before Talk function switch	AT+LBT=1	Returns the LBT switch status
AT+ERSSI=?	Query the ambient noise RSSI	AT+ERSSI=1	Returns the ambient noise

	switch		on/off status
AT+DRSSI=?	Query RSSI output	AT+DRSSI=1	Return channel RSSI function is enabled
AT+ADDR=?	Query module address	AT+ADDR=1234	returned module address is 1234
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	Reading is not supported (for security reasons)	Return ERR
AT+DELAY=?	Query WOR delay sleep time	AT+DELAY=1000	Return WOR delay sleep time is 1000ms
AT+ SWITCH =?	Query software switching mode switch	AT+SWITCH=0	Software switch mode off
AT+MODE=?	Query the current working mode (can be queried in all modes)	AT+MODE=0	Returns the current transparent mode

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 Applicable to 400MHz and 900MHz bands	0:2.4K 1:2.4K 2:2.4K 3:4.8K 4:9.6K 5:19.2K 6 : 38.4K 7:62.5K
Rate Applicable to 230MHz frequency band	0:2.4K 1:2.4K 2:2.4K 3 : 2.4K 4 : 4.8K 5 : 9.6K 6 : 1 5 . 6 K 7:1 5 . 6 K
Packet (packet length)	0: 240 1: 128 2: 64 3: 32
Role	0: Receive 1: Send
Period /WTIME (WOR 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: 30dBm 1: 27dBm 2: 24dBm 3: 21dBm
Mode (Transmission Mode)	0: Transparent 1: Fixed point
Router (Relay Mode)	0: Off 1: Enable
LBT (listen before talk)	0: Off 1: Enable
Erssi (Environmental RSSI)	0: Off 1: Enable
Data_rssi (Data RSSI)	0: Off 1: Enable
Addr (module address)	Module address 0~65535 (decimal)
400MHz Channel (module channel)	Module channel 0~83 (decimal)
900MHz Channel (module channel)	Module channel 0~80 (decimal)
230MHz Channel (module channel)	Module channel 0~64 (decimal)

Netid (Network ID)	Module network 0~255 (decimal)
Key	Module key 0~65535 (decimal)
Delay (WOR delay sleep)	Delay sleep 0~65535 (decimal)
SWITCH (Software mode switch)	0: Off; 1: On
Mode (Working Mode)	0: Transparent mode 1: WOR mode 2: Configuration mode 3: Sleep mode

7.3 Notes on upgrading firmware via serial port

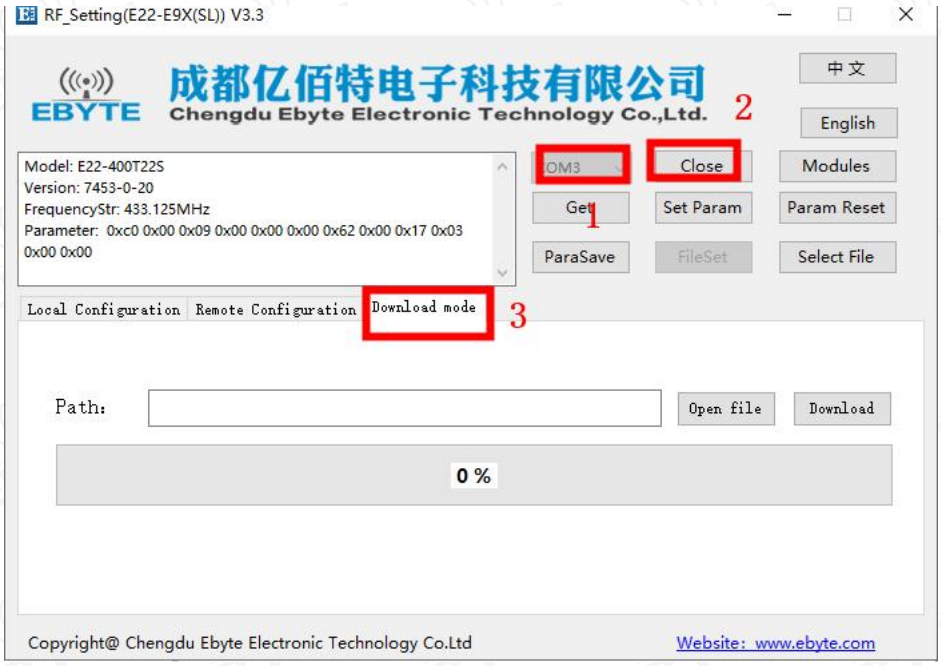
- If the customer needs to upgrade the firmware, he needs to find the corresponding BIN file provided by the official, and then use the official host computer to upgrade the firmware. Under normal circumstances, users do not need to upgrade the firmware, and please do not use the "AT+IAP" command .
- The pins necessary for upgrading must be brought out (M1, M0, AUX, TXD, RXD, VCC, GND), and then send the "AT+IAP" command in configuration mode to enter the 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.

7.3.1 PC upgrade operation steps

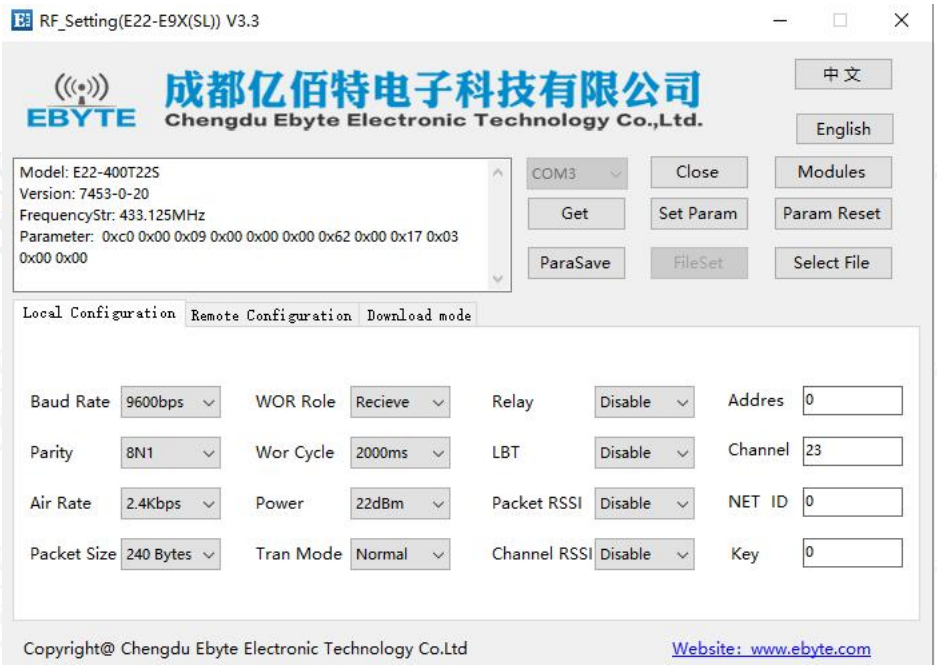
- **Host computer command upgrade**

1、By changing M0 and M1, the module enters the configuration mode (note: the baud rate in the configuration mode is 9600);

2、Open the official website to configure the host computer "RF_Setting(E22-E9X(SL)) V3.2.exe", select firmware upgrade > select serial port > open serial port;

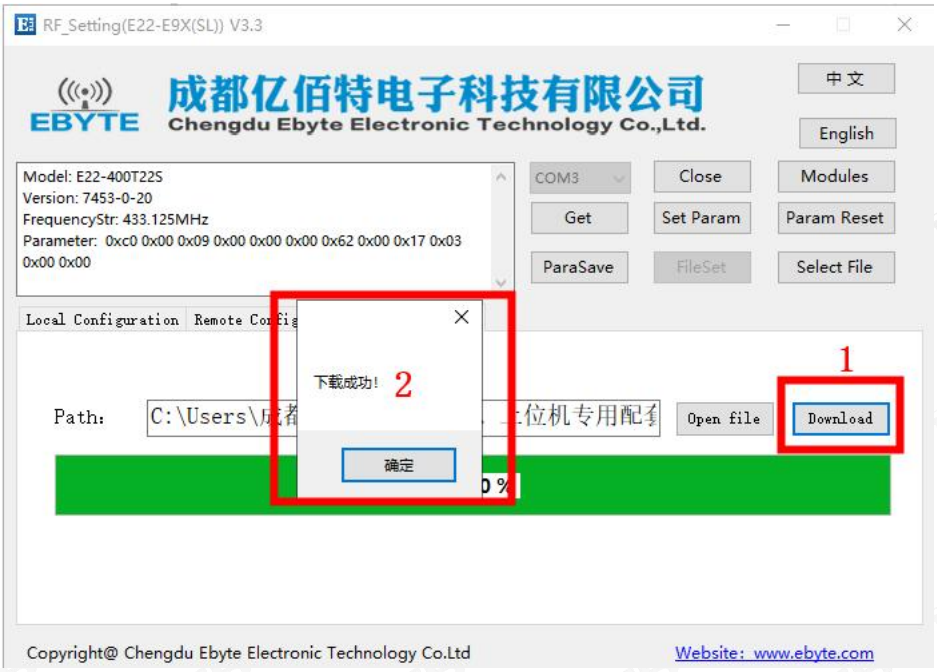


3、Click Read Parameters to view the module information in the left window of the host computer;



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

5、Click Start Downloading, the firmware will start upgrading, and after it is completed, it will prompt that the download is successful;



6、After the firmware upgrade is complete, reopen the serial port to confirm the reading parameters.

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, so that the whole machine can work stably for a long time;
- 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 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 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 results at the seaside are 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 is lower than the recommended value at room temperature. 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

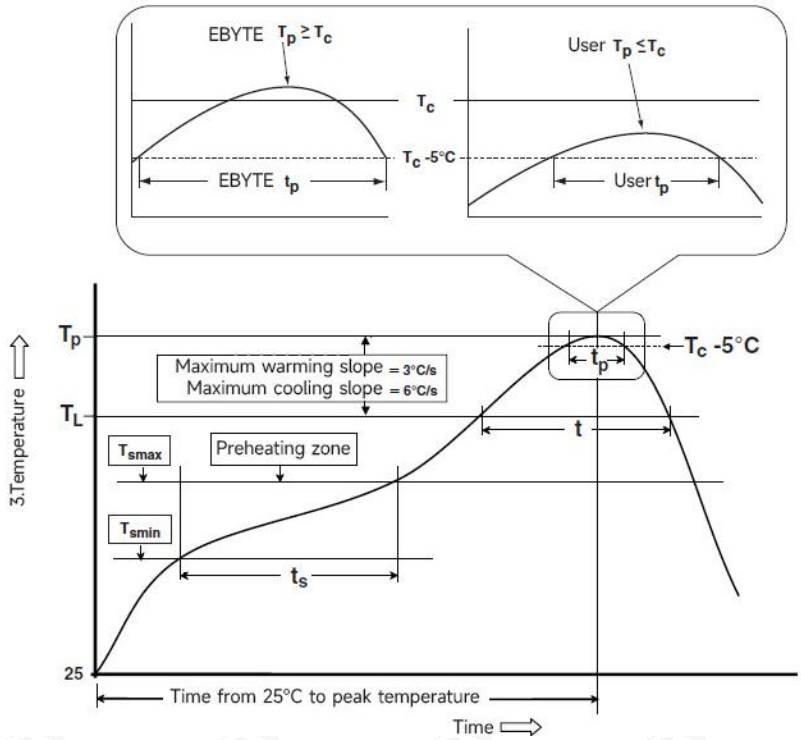
- There is interference from the same frequency signal nearby. Stay away from the interference source or change the frequency or channel to avoid interference.
- Unsatisfactory power supply may also cause garbled characters, so the reliability of the power supply must be ensured;
- Extension cables or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

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 (Tsmax)	150℃	200℃
	Time (Tsmin ~Tsmin)	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.
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



11 Related Models

Product Model	Carrier frequency Hz	Transmit power dBm	Test distance km	Package	Product size mm	Communication interface
E22-230T22S	230M	twenty two	5	Patches	16*26	TTL
E22-230T30D	230M	30	10	Patches	20*40.5	TTL
E22-400T22S	433/470M	twenty two	5	Patches	16*26	TTL
E22-400T30D	433/470M	30	10	Patches	20*40.5	TTL
E22-900T22S	868 / 915M	twenty two	5	Patches	16*26	TTL
E22-900T30D	868 / 915M	30	10	Patches	20*40.5	TTL
E22-400M22S	433/470M	twenty two	7	Patches	14*20	SP
E22-400M30S	433/470M	30	12	Patches	24*38.5	SP
E22-900M22S	868 / 915M	twenty two	7	Patches	14*20	SP

E22-900M30S	868 / 915M	30	12	Patches	24*38.5	SP

12 Antenna Guide

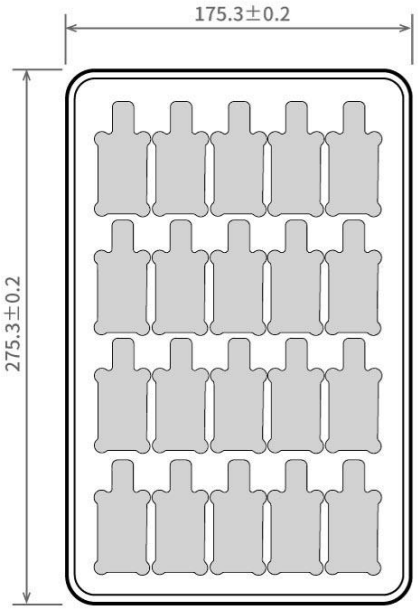
12.1 Antenna Recommendation

Antennas play an important role in the communication process. Often, poor-quality antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as supporting antennas for our wireless modules with excellent performance and reasonable prices.

Product Model	type	Frequency band Hz	interface	Gain dBi	high mm	Feeder cm	Features
TX433-NP-4310	Flexible Antenna	433M	welding	2.0	43.8*9.5	-	Built-in flexible, FPC soft antenna
TX433-JZ-5	Glue stick antenna	433M	SMA-J	2.0	52	-	Ultra-short straight, omnidirectional antenna
TX433-JZG-6	Glue stick antenna	433M	SMA-J	2.5	6 2	-	Ultra-short straight, omnidirectional antenna
TX433-JW-5	Glue stick antenna	433M	SMA-J	2.0	50	-	Bend the glue stick, omnidirectional antenna
TX433-JWG-7	Glue stick antenna	433M	SMA-J	2.5	75	-	Bend the glue stick, omnidirectional antenna
TX433-JK-11	Glue stick antenna	433M	SMA-J	2.5	110	-	Bendable glue stick, omnidirectional antenna
TX433-JK-20	Glue stick antenna	433M	SMA-J	3.0	210	-	Bendable glue stick, omnidirectional antenna
TX433-XP L -100	Suction cup antenna	433M	SMA-J	3.5	18 5	100	Small suction cup antenna, cost-effective
TX433-XP-200	Suction cup antenna	433M	SMA-J	4.0	19 0	200	Neutral suction cup antenna, low loss
TX433-XPH-30 0	Suction cup antenna	433M	SMA-J	6.0	96 5	300	Large suction cup antenna, high gain
TX490-JZ-5	Glue stick antenna	470/490 M	SMA-J	2.0	50	-	Ultra-short straight, omnidirectional antenna
TX490-XP L -100	Suction cup antenna	470/490 M	SMA-J	3.5	12 0	100	Small suction cup antenna, cost-effective

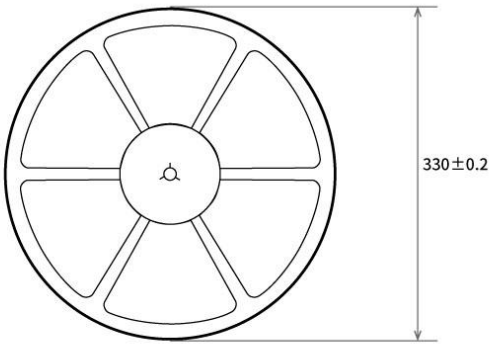
13 Bulk Packaging Methods

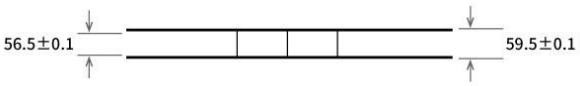
13.1 E22-230/400/900T30D Batch Packaging

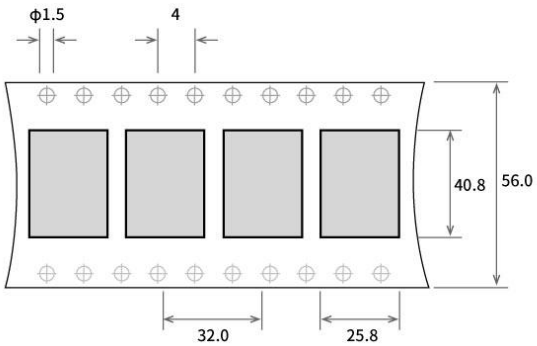


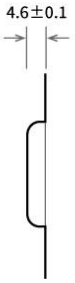
Unit: mm
Each Layer: 20 pcs
Each Package: 5 layers

13.2 E22-230/400/900T30S Batch Packaging









Unit: mm
Each Tray: 400 pcs

Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2023- 10 - 2 5	Initial release	Hao
1.1	2024-3-20	Content Correction	Hao
1.2	2024-3-29	Content Correction	Hao
1.3	2024-6-21	Content format update	Hao
1.4	2025-2-13	Update the size diagram of the patch products	Hao

About us

Technical support: support@cdebyte.com
Documents and RF Setting download link:https://www.ru-ebyte.com
Thank you for using Ebyte products! Please contact us with any questions or suggestions: info@cdebyte.com
Address: B5 Mould Park, 199# Xiqu Ave, High-tech District, Sichuan, China

Chengdu Ebyte Electronic Technology Co.,Ltd.