E22-230T30/33E、E22-400T30/33E

230/400Mhz

Mini PCIE interface 1W/2W LoRa wireless module

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Contents

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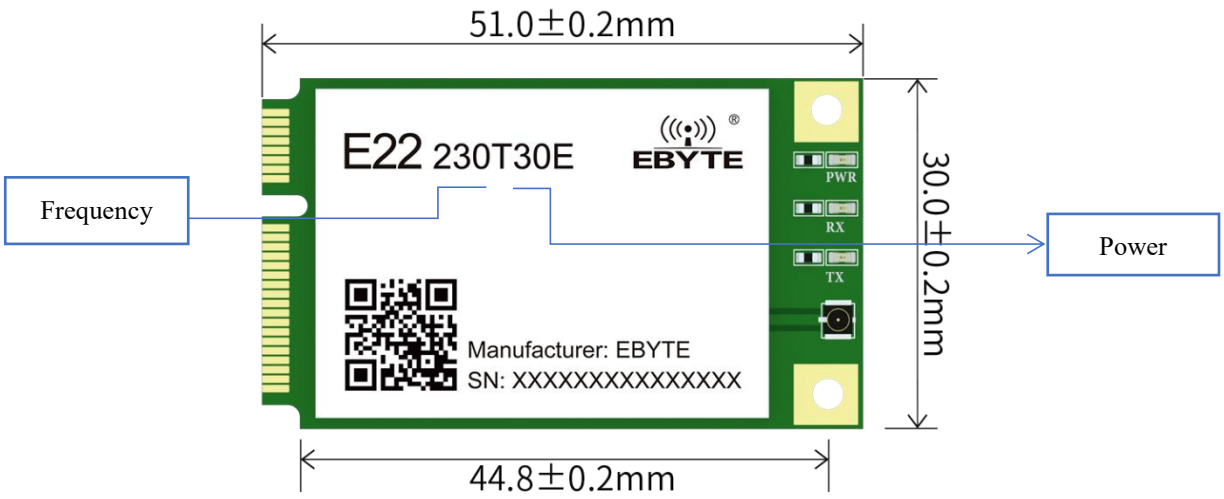
1 Product Overview

1.1 Product Introduction

E22-230T30E, E22-230T33E, E22-400T30E, E22-400T33E is a new generation of LoRa wireless spread spectrum module, based on SEMTECH's new generation of LoRa spread spectrum chip design of wireless serial port module. With a variety of transmission modes, E22-230T30E, E22-230T33E work in the 220.125 ~ 236.125MHz band (default 230.125MHz), E22-400T30E, E22-400T33E work in 410.125 ~ 493.125MHz frequency band (default 433.125MHz), LoRa spread spectrum technology, compatible with 3.3V and 5V IO port voltage, using MINI PCI-e standard package, With UART/RS485/RS232/USB communication interface selection, and communication compatible with E22-T series products, easy to develop and use.

E22-230T30E, E22-230T33E, E22-400T30E, E22-400T33E adopt a new generation of LoRa spread spectrum technology, the program transmission distance is longer, faster; Support air wake up, wireless configuration, carrier monitoring, automatic relay, communication key and other functions, support subcontracting length setting, can provide customized development services.



Note: The above picture is the 3D size drawing of the E22-230T30E module , and the other modules are the same size, pin compatible, and different in frequency band and power.

1.2 Features

- The new LoRa spread spectrum modulation technology based on the new generation of LoRa RF chip developed by SEMTECH company brings longer communication distance and stronger anti-interference ability;
- Automatic relay networking, multi-level relay is suitable for ultra-long-distance communication, and multiple networks run simultaneously in the same area;
- Support users to set the communication key by themselves, and it cannot be read, which greatly improves the confidentiality of user data;

- Support LBT function, monitor the channel environment noise before sending, which can greatly improve the communication success rate of the module in harsh environments;
- Support RSSI signal strength indication function , used to evaluate signal quality, improve communication network, distance measurement;
- Wireless parameter configuration, send command packets wirelessly, remotely configure or read wireless module parameters;
- Support air wake-up, that is, ultra-low power consumption function, suitable for battery-powered applications;
- Fixed-point transmission, broadcast transmission, channel monitoring;
- Support deep sleep, the power consumption of the whole machine is about 2mA in this mode ;
- Support UART /RS485/RS232/USB communication interface selection, single output;
- E22-400T30E and E22-400T33E support global license-free ISM 433MHz frequency band , and support 470MHz meter reading frequency band;
- E22-230T30E and E22-230T33E support 230MHz power frequency band;
- The module has built-in PA+LNA , and the communication distance can reach 8km~12km under ideal conditions ;
- The parameters are saved after power-off, and the module will work according to the set parameters after power-on;
- High-efficiency watchdog design, once an exception occurs, the module will automatically restart and continue to work according to the previous parameter settings;
- E22-400T30E and E22-400T33E support the data transmission rate of 2.4k ~ 62.5kbps ;
- E22-230T30E and E22-230T33E support the data transmission rate of 2.4k ~ 15.6kbps ;
- 3.3 ~ 5.5V power supply, power supply greater than 5V can guarantee the best performance;
- Industrial-grade standard design, supporting long-term use at -40～+85 ℃;
- The first -generation IPEX interface can be easily connected to an external antenna.
- The baud rate supports 1200 , 2400 , 4800 , 9600 (default), 19200 , 38400 , 57600 , 115200 bps .
- Communication is compatible with E22-T series products.

1.3 Applications

- Home security alarm and remote keyless entry;
- Home and industrial sensors, etc.;
- Wireless alarm security system;
- Building automation solutions;
- Wireless industrial grade remote control;
- Healthcare products;
- Advanced Meter Reading Architecture (AMI) ;
- Automotive industry applications.

2 Specifications

2.1 RF parameters

RF parameters	Value		Remark
	E22-230T30E	E22-230T33E	
Working frequency	220.125～236.125 MHz		-
Transmit power	30dBm	33dBm	The software is adjustable and needs to be developed and set by the user
Acceptance sensitivity	-124 dBm		Air rate 2.4 kbps
FIFO	240 Byte		Subpackage 32/64/128/240 bytes can be sent by command setting
Modulation	LoRa		A new generation of LoRa modulation technology
Air speed	2.4k~15.6kbps		User Programmable Control
Measured distance	10km	16km	In a clear and open environment, the antenna gain is 5dBi , the antenna height is 2.5 meters, and the air rate is 2.4kbps

RF parameters	Value		Remark
	E22-400T30E	E22-400T33E	
Working frequency	410.125～493.125 MHz		Support ISM frequency band
Transmit power	30dBm	33dBm	The software is adjustable and needs to be developed and set by the user
Acceptance sensitivity	-124 dBm		Air rate 2.4 kbps
FIFO	240 Byte		Subpackage 32/64/128/240 bytes can be sent by command setting
Modulation	LoRa		A new generation of LoRa modulation technology
Air speed	2.4k～62.5kbps		User Programmable Control
Measured distance	10km	16km	In a clear and open environment, the antenna gain is 5dBi , the antenna height is 2.5 meters, and the air rate is 2.4kbps

2.2 Hardware parameters

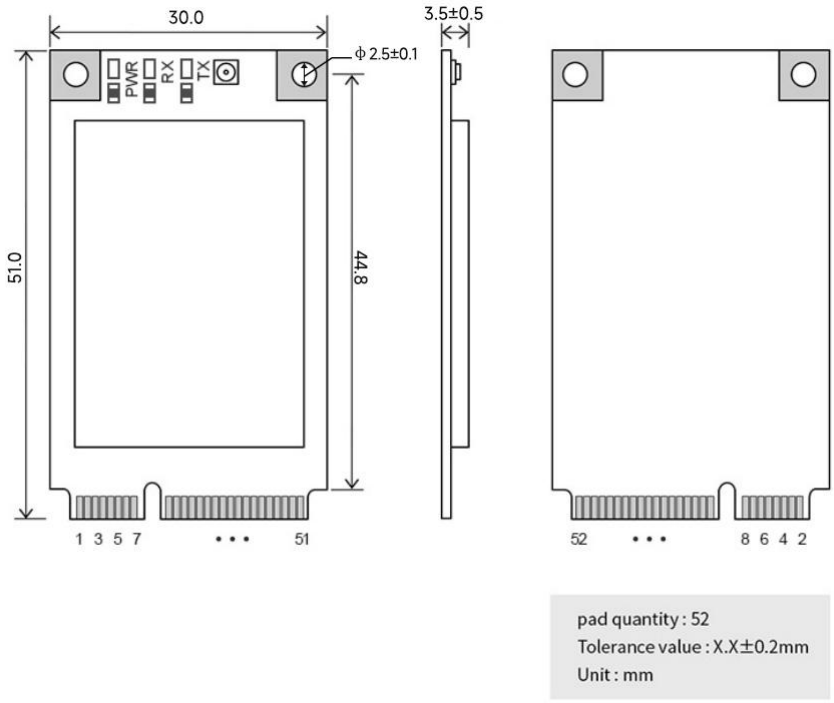
Hardware parameters	Parameter value				Remark
	E22-230T30E	E22-230T33E	E22-400T30E	E22-400T33E	
Communication Interface	UART/RS485/RS232/USB				single output
Crystal frequency	32MHz				-
Encapsulation	In-line				-
Interface	Mini-PCIE				-
Dimensions	30 * 51 mm				±0.2mm
Antenna form	1st generation IPEX				Equivalent impedance about 50 Ω
Product Weight	7.2g	7.2g	7.2g	7.2g	±0.2g

2.3 Electrical parameters

Electrical parameters	E22-230T30E			E22-230T33E			unit	Remark
	Mini value	Typical value	Max value	Mini value	Typical value	Max value		
Voltage	3.3	5.0	5.5	3.3	5.0	5.5	V	⩾5.0V can guarantee the output power More than 5.5V burns the module permanently Note: When the communication interface is USB , the working voltage is 3.7 ~ 5.5.
communication level	-	3.3	-	-	3.3	-	V	Use of 5V TTL is recommended plus level shifting
emission current	-	650	-	-	1000	-	mA	Instantaneous power consumption
receive current	-	17	-	-	17	-	mA	-
Sleep current	-	2	-	-	2	-	mA	software shutdown
Operating temperature	-40	20	85	-40	20	85	℃	industrial design
Working humidity	10	60	90	10	60	90	%	-
Storage temperature	-40	20	125	-40	20	125	℃	-

Electrical parameters	E22-400T30E			E22-400T33E			unit	Remark
	Mini value	Typical value	Max value	Min value	Typical value	Max value		
Voltage	3.3	5.0	5.5	3.3	5.0	5.5	IN	⩾5.0V can guarantee the output power More than 5.5V burns the module permanently Note: When the communication mode is USB , the working voltage is 3.7 ~ 5.5.
Communication level	-	3.3	-	-	3.3	-	IN	Use of 5V TTL is recommended plus level shifting
Emission current	-	650	-	-	1000	-	mA	Instantaneous power consumption
Receive current	-	17	-	-	17	-	mA	-
Sleep current	-	2	-	-	2	-	mA	software shutdown
Operating temperature	-40	20	85	-40	20	85	℃	industrial design
Working humidity	10	60	90	10	60	90	%	-
Storage temperature	-40	20	125	-40	20	125	℃	-

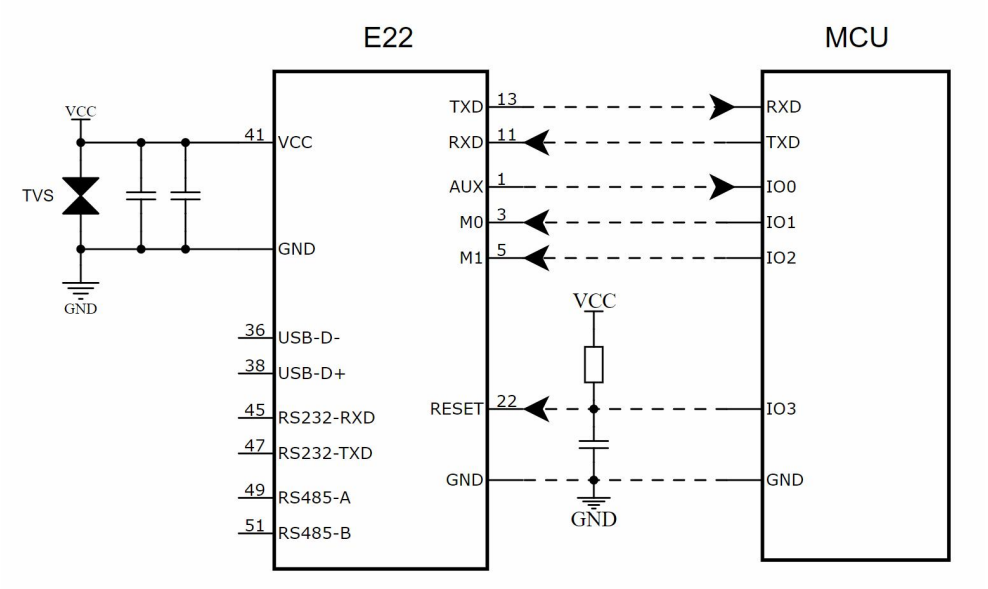
3 Size and pin definition



Pin No.	Item	Direction	Description
1	TO	output	Used to indicate the working status of the module; the user wakes up the external MCU , and outputs a low level during the initialization of the power-on self-test; (can be suspended)
2	VCC	input	Power input 5.0V
3	M0	Input (very weak pull-up)	Cooperate with M1 to determine the 4 working modes of the module (not floating, if not used, it can be grounded)
4	GND	-	power reference ground
5	M1	Input (very weak pull-up)	Cooperate with M0 to determine the 4 working modes of the module (not floating, if not used, it can be grounded)
6	NC	-	-
7	NC	-	-
8	NC	-	-
9	GND	-	power reference ground
10	SWD_DIO	input \ output	Program download data interface (the module needs to be reset or erased before SWD programming)
11	RXD	input	TTL serial port input, connect external TXD output pin
12	SWD_CLK	input \ output	Program download clock interface (the module needs to be reset or erased before SWD programming)
13	TXD	output	TTL serial port output, connect external RXD input pin

14	NC	-	-
15	GND	-	power reference ground
16	NC	-	-
17	NC	-	-
18	GND	-	power reference ground
19	NC	-	-
20	NC	-	power reference ground
21	GND	-	power reference ground
22	RESET	input	The input low level module enters the hardware reset state, and the input high level module recovers the normal working state. This function is used for the reset operation in emergency
23	NC	-	-
24	VCC	input	Power input 5.0V
25	NC	-	-
26	GND	-	power reference ground
27	GND	-	power reference ground
28	NC	-	-
29	GND	-	power reference ground
30	NC	-	-
31	NC	-	-
32	NC	-	-
33	NC	-	-
34	GND	-	power reference ground
35	GND	-	power reference ground
36	USB_D-	input \ output	D- of other external USB devices
37	GND	-	power reference ground
38	USB_D+	input \ output	D+ connected to other USB devices
39	VCC	input	Power input 5.0V
40	GND	-	power reference ground
41	VCC	input	Power input 5.0V
42	NC	-	-
43	GND	-	power reference ground
44	NC	-	-
45	RS232_RXD	input	External TXD of other RS232 devices
46	NC	-	-
47	RS232_TXD	output	RXD connected to other RS232 devices
48	NC	-	-
49	RS485_A	input \ output	A terminal connected to other RS485 devices
50	GND	-	power reference ground
51	RS485_B	input \ output	Connect to the B terminal of other RS485 devices
52	VCC	input	Power input 5.0V

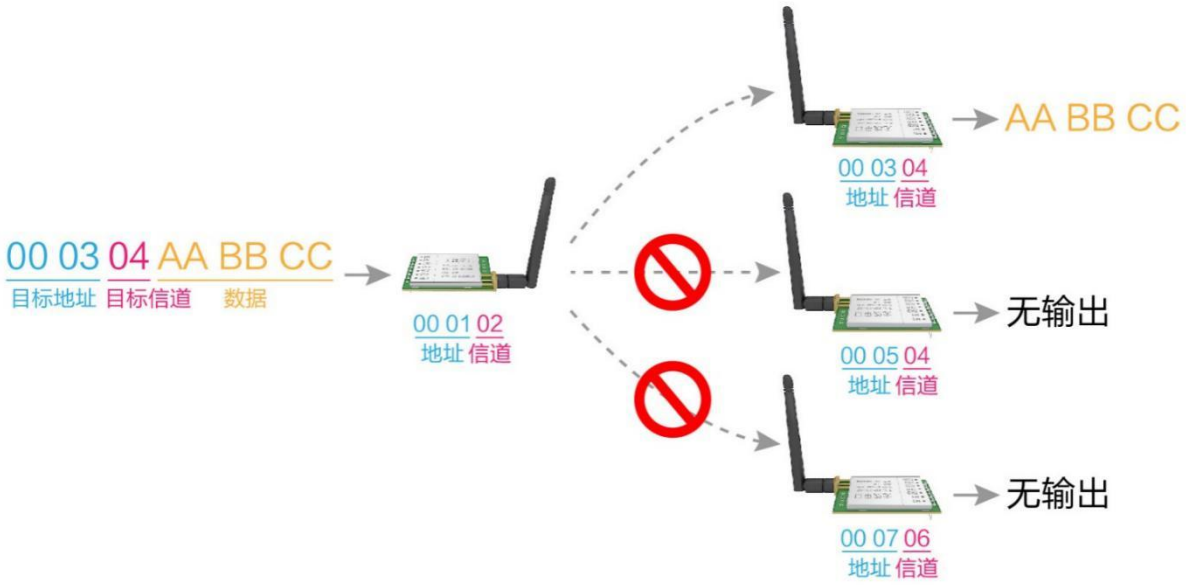
4 Recommended Connection Diagram



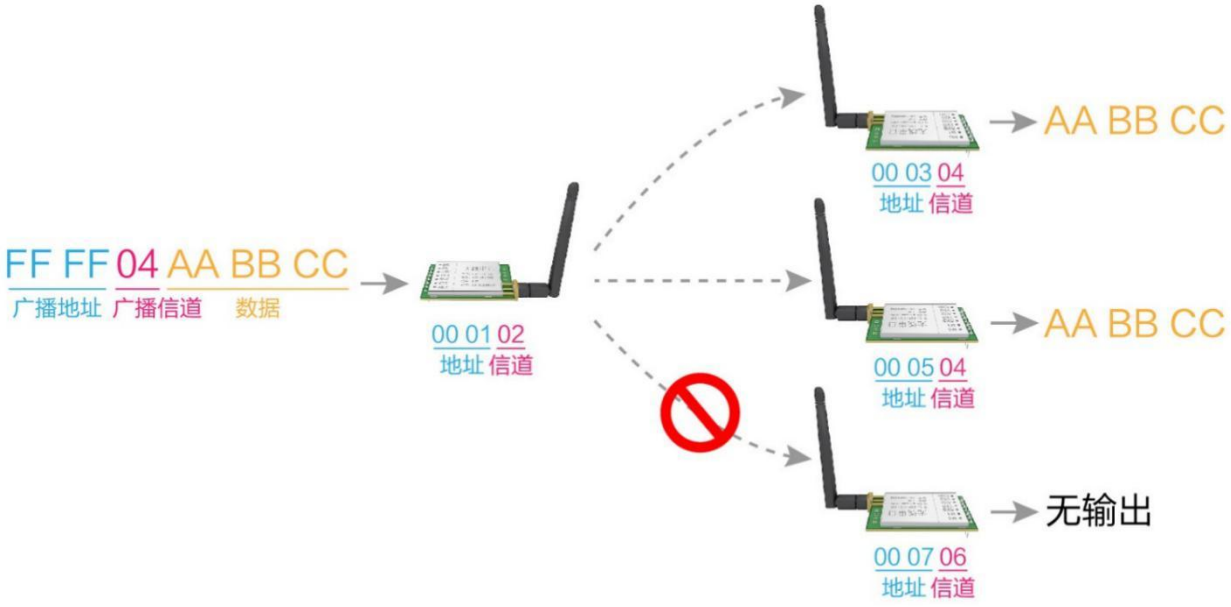
No	A brief description of the connection between the module and the microcontroller (the above figure takes the STM8L microcontroller as an example)
1	The wireless serial port module is TTL level, please connect it with TTL level MCU .
2	For some 5V microcontrollers, it may be necessary to add 4 ~ 10K pull-up resistors to the TXD and AUX pins of the module.
3	It is recommended to add a TVS diode before the power supply of the E22-230/400T33E module to prevent the instantaneous voltage from being too high, thus burning the chip.

5 Models

5.1 Fixed model



5.2 Broadcast model



5.3 Broadcast address

- Example: 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 mode), all receiving modules under the 0x04 channel can receive data to achieve the purpose of broadcasting.

5.4 Listening address

- Example: 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.

5.5 Module reset

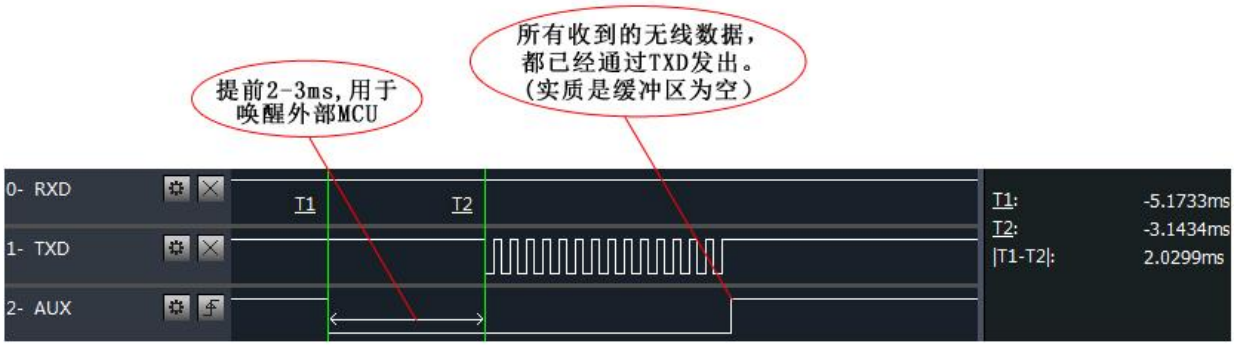
- After the module is powered on, AUX will immediately output low level, and perform hardware self-test, and set the working mode according to user parameters; During this process, AUX keeps low level, and after the completion, AUX outputs high level, and starts to work normally according to the working mode composed of M1 and M0 ; Therefore, the user needs to wait for the rising edge of AUX as the starting point for the normal operation of the module.

5.6 Detailed explanation of AUX

- AUX is used for wireless transceiver buffer indication and self-inspection indication.
- It indicates whether the module has data that has not been transmitted through the wireless, or whether the received wireless data has not been sent through the serial port, or the module is in the process of initializing self-test.

5.6.1 Serial port data output indication

- Used to wake up the external MCU in sleep ;



模块串口外发数据时，AUX引脚时序图

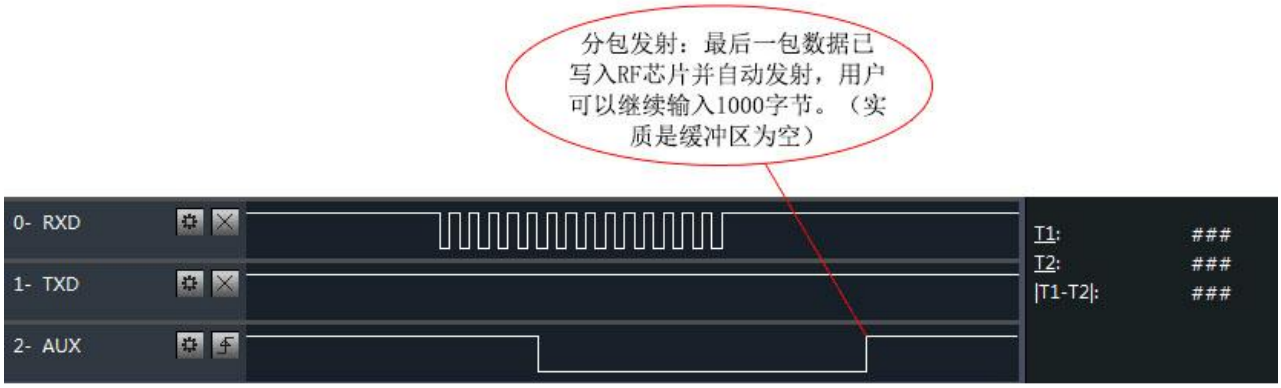
5.6.2 Wireless transmission indication

- The buffer is empty: the data in the internal 1000 -byte buffer is written to the wireless chip (automatic packetization);

  When AUX=1 , the user continuously initiates data less than 1000 bytes, which will not overflow;

  When AUX=0 , the buffer is not empty: the data in the internal 1000 -byte buffer has not been written into the wireless chip and the transmission is started. At this time, the module may be waiting for the end of user data to time out, or it is transmitting wireless packets. .

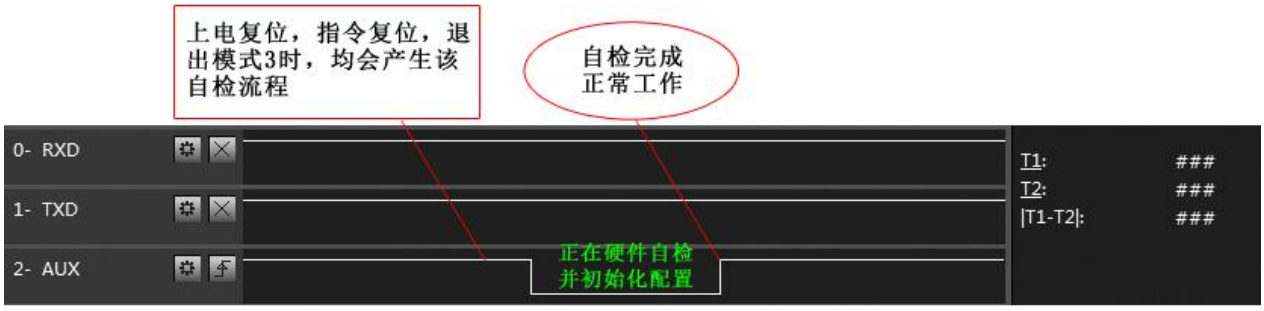
【Note】: When AUX=1 , it does not mean that all the serial port data of the module have been transmitted wirelessly, or the last packet of data may be being transmitted.



模块接收串口数据时，AUX引脚时序图

5.6.3 The module is being configured

- Only when reset and exiting sleep mode.

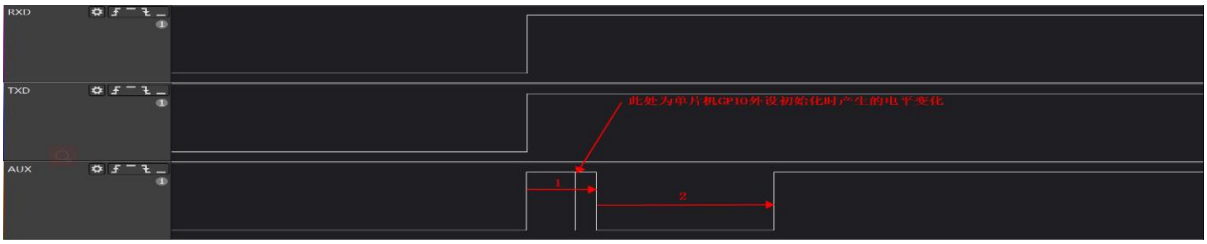


自检期间，AUX引脚时序图

5.6.4 Module power-on initialization process

- ' 1 ' in the figure: represents the initialization of the microcontroller peripherals (initialization time is 4-5ms);
- In the figure, ' 2 ': represents the initialization of RF chip configuration parameters (initialization time is about 12ms);

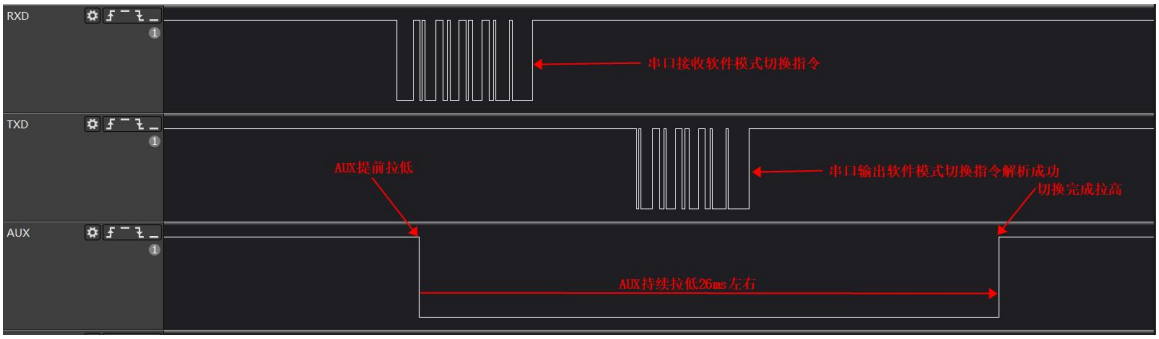
- When the AUX pin is initialized, the pin will be pulled low for a short time due to the configuration of GPIO peripherals, as shown in the figure below.



5.6.5 Module Mode Switching Process

- The process of switching modes through M0 and M1 hardware:
- M0 , M1 pin external interrupt trigger;
- AUX pulls down the pin;
- Exit the current task mode, and then read the M0 and M1 pin levels to judge the new mode;
- Enter a new mode task, pull AUX high, and complete the mode switch (the maximum hardware mode switch time is about 35ms), note that the mode switch time will vary between different modes, for example, the time to switch from sleep mode to other modes is relatively long, yes Because the MCU and RF chip are in a deep sleep state in sleep mode, it is necessary to re-initialize the RF and MCU parameter configurations when entering other modes from sleep.

Hardware mode switching AUX timin



Software mode switching AUX timing

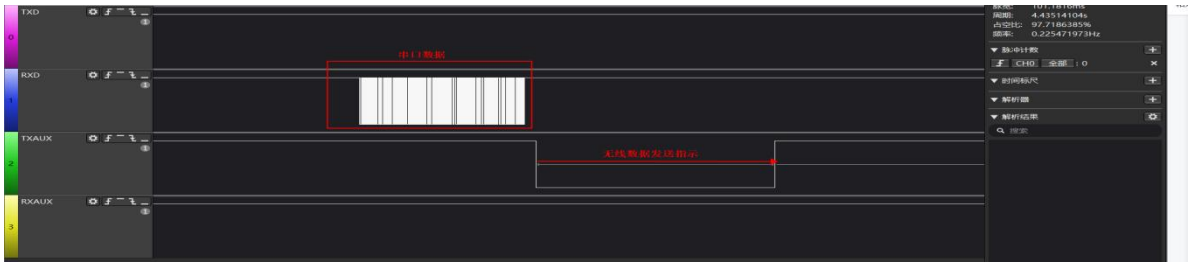
Note: The software mode switching time will increase relative to the mode switching time due to the time required for serial port data processing (switching time is about 45ms).

5.6.6 Precautions

No.	Notes on AUX
1	The above function 1 and function 2 , output low level priority, that is: meet any output low level condition, AUX will output low level; When all low-level conditions are not met, AUX outputs a high level.
2	When the AUX outputs a low level, it means the module is busy, and the working mode detection will not 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, at least 2ms after the rising edge of AUX , the module will actually enter this mode; If AUX is always at high level, then 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 low level.

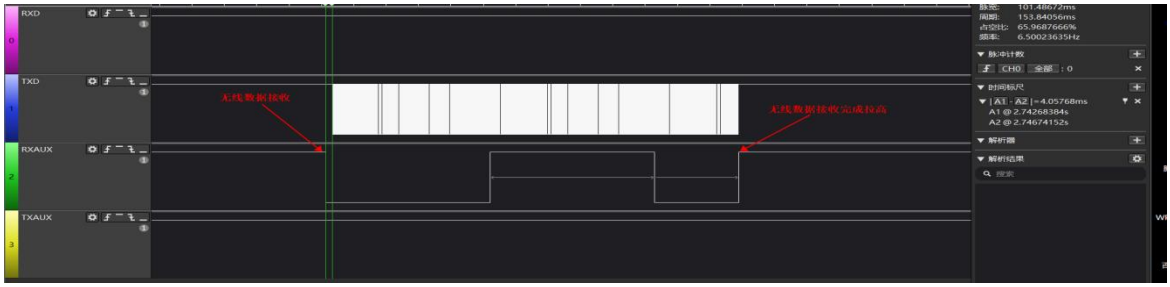
5.7 Detailed Explanation of Wireless Sending and Receiving Instructions

- It is used for wireless data sending and receiving processing instructions, and the flip frequency is 100ms (according to the actual data size, airspeed, and baud rate, it may be pulled up or pulled down in advance if it is less than 100ms);
- It indicates whether the module has data that has not been transmitted through the wireless, or whether the wireless data that has been received has not been sent out through the serial port.



Wireless data transmission TX_AUX timing

Note: The wireless data transmission TX_AUX starts to pull down after the serial port receives the data and the wireless data packet is established (the flip frequency is 100ms), and it does not flip until the RF data is sent, and keeps high.



Wireless data receiving RX_AUX timing

Note: The wireless data receiving RX_AUX starts to pull down 3-4ms before the serial port output data (the flipping

frequency is 100ms), and does not flip until the serial port outputs the wireless receiving data and keeps high level.

6 Working Mode

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

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
2 Configuration mode	1	0	Users can access the registers through the serial port to control the working status of the module	It needs to be configured at a baud rate of 9600
3 Deep sleep	1	1	Module goes to sleep	Support software mode switching function

6.1 Mode switching

Serial No.	Remark
1	The user can combine the high and low levels of M1 and M0 to determine the working mode of the module. 2 GPIOs of MCU can be used to control mode switching; After changing M1 and M0 : if the module is idle, it can start working in the new mode after 1ms ; If the module has serial port data that has not been transmitted wirelessly, it can enter a new working mode only after the transmission is completed; If the module receives the wireless data and sends out the data through the serial port, it needs to send the data before entering the new working mode; So the mode switch can only be valid when the AUX output is 1 , otherwise the switch will be delayed.
2	For example: the user continuously inputs a large amount of data and simultaneously performs mode switching. At this time, the switching mode operation is invalid; the module will process all user data before performing new mode detection; Therefore, the general suggestion is: detect the output state of the AUX pin, wait for 2ms after outputting a high level, and then switch.
3	When the module is switched from other modes to sleep mode, if there is data that has not been processed; The module will enter the sleep mode after processing the data (including receiving and sending). This feature can be used for fast sleep to save power consumption; for example: the transmitter module works in mode 0 , the user initiates the serial port data "12345" , and then does not have to wait for the AUX pin to be idle (high level), it can directly switch to sleep mode, And the main MCU of the user will sleep immediately, and the module will automatically enter the sleep within 1ms after sending all the user data through wireless ; thereby saving the working time of the MCU and reducing power consumption.

4	Similarly, any mode switching can take advantage of this feature. After the module processes the current mode event, it will automatically enter the new mode within 1ms ; thus saving the user from the work of querying AUX and achieving the purpose of fast switching ; For example, switch from transmitting mode to receiving mode; the user MCU can also go to sleep before the mode switching, and use the external interrupt function to obtain AUX changes, so as to perform mode switching.
5	This mode of operation is very flexible and efficient, designed completely according to the user 's MCU operation convenience, and can reduce the workload of the entire system as much as possible, improve system efficiency, and reduce power consumption.

6.2 General Mode (Mode 0)

Type	When M0 = 0 , M1 = 0 , the module works in mode 0
Emission	Users can input data through the serial port, and the module will start wireless transmission.
Take over	The wireless receiving function of the module is turned on, and the wireless data will be output through the TXD pin of the serial port after receiving the wireless data.

6.3 WOR mode (Mode 1)

Type	When M0 = 1 , M1 = 0 , the module works in mode 1
Emission	When defined as the transmitter, the wake-up code for a certain period of time will be automatically added before the launch
Take over	Data can be received normally, and the receiving function is equivalent to mode 0

6.4 Configuration Mode (Mode 2)

Type	When M0 = 0 , M1 = 1 , the module works in mode 2
Emission	radio off
Take over	wireless reception off
Configuration	User can access registers to configure module operating status

6.5 Deep Sleep Mode (Mode 3)

Type	When M0 = 1 , M1 = 1 , the module works in mode 3
Emission	Unable to transmit wireless data.
Take over	Unable to receive wireless data.
Notice	When entering other modes from sleep mode, the module will reconfigure the parameters. During the configuration process, AUX remains low; the mode can be switched by software; Output high level after completion, so it is recommended that users detect the rising edge of T_BUSY .

7 Register read and write control

7.1 Instruction format

In configuration mode (mode 2 : M1=1 , M0=0), the list of supported commands is as follows (when setting, only 9600 and 8N1 formats are supported):

No.	command format	Detailed description
1	set register	Command: C0+ start address + length + parameter Response: C1+ start address + length + parameter Example 1 : Configure the channel as 0x09 Instruction start address length parameter Send: C0 05 01 09 Returns: C1 05 01 09 Example 2 : Simultaneously configure module address (0x1234), network address (0x00) , serial port (9600 8N1) , airspeed (2.4K) Send: C0 00 04 12 34 00 62 Returns: C1 00 04 12 34 00 62
2	read register	Command: C1+ start address + length Response: C1+ start address + length + parameter Example 1 : Reading a channel Instruction start address length parameter Send: C1 05 01 Returns: C1 05 01 09 Example 2 : Simultaneously read module address, network address, serial port, and

		airspeed (2.4K) Send: C1 00 04 Returns: C1 00 04 12 34 00 62
3	set temporary register	Command: C2 + start address + length + parameters Response: C1 + start address + length + parameters Example 1 : Configure the channel as 0x09 Instruction start address length parameter Send: C2 05 01 09 Returns: C1 05 01 09 Example 2 : Simultaneously configure module address (0x1234), network address (0x00) , serial port (9600 8N1) , airspeed (2.4K) Send: C2 00 04 12 34 00 62 Returns: C1 00 04 12 34 00 62
5	wireless configuration	Instructions: CF CF + regular instructions Response: CF CF + Regular Response Example 1 : The wireless configuration channel is 0x09 Wireless instruction header instruction start address length parameter Send: CF CF C0 05 01 09 Returns: CF CF C1 05 01 09 Example 2 : Simultaneous wireless configuration module address (0x1234), network address (0x00) , serial port (9600 8N1) , airspeed (2.4K) Send: CF CF C0 00 04 12 34 00 62 Returns: CF CF C1 00 04 12 34 00 62
6	wrong format	format error response FF FF FF

No.	read and write	name	describe	Remark
00H	read / write	ADHD	ADDH (default 0)	Module address high byte and low byte; Note: When the module address is equal to FFFF , it can be used as the broadcast and listening address, that is, the module will
01H	read / write	ADDL	ADDL (default 0)	

<table>
<tr><td></td><td></td><td></td><td colspan="6"></td><td>not perform address filtering at this time</td></tr>
<tr><td>02 H</td><td>read / write</td><td>NETWORKS</td><td colspan="6">NETID (default 0)</td><td>Network address, used to distinguish the network;
When communicating with each other, they should be set to be the same.</td></tr>
<tr><td rowspan="20">03 H</td><td rowspan="20">read / write</td><td rowspan="20">REG0</td><td>7</td><td>6</td><td>5</td><td colspan="3">UART serial port speed (bps)</td><td rowspan="10">For the two modules communicating with each other, the serial port baud rate can be different, and the verification method can also be different;

When continuously transmitting large data packets, users need to consider the data blocking caused by the same baud rate, and may even be lost;

It is generally recommended that the baud rate of both communication parties be the same.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td colspan="3">The serial port baud rate is 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td colspan="3">The serial port baud rate is 2400</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td colspan="3">The serial port baud rate is 4800</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td colspan="3">The serial port baud rate is 9600 (default)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td colspan="3">The serial port baud rate is 19200</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td colspan="3">The serial port baud rate is 38400</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td colspan="3">The serial port baud rate is 57600</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td colspan="3">The serial port baud rate is 115200</td></tr>
<tr><td>4</td><td>3</td><td colspan="4">serial check digit</td><td rowspan="5">The serial port modes of the communication parties can be different;</td></tr>
<tr><td>0</td><td>0</td><td colspan="4">8N1 (default)</td></tr>
<tr><td>0</td><td>1</td><td colspan="4">8O1</td></tr>
<tr><td>1</td><td>0</td><td colspan="4">8E1</td></tr>
<tr><td>1</td><td>1</td><td colspan="4">8N1 (equivalent to 00)</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">1</td><td rowspan="2">0</td><td colspan="3">Wireless air rate (bps)</td><td rowspan="8">The air speed of both communication parties must be the same;

The higher the air rate, the smaller the delay and the shorter the transmission distance.</td></tr>
<tr><td>E22-230T30/33E</td><td>E22-400T30/33E</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Air rate 2.4k</td><td>Air rate 2.4k</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Air rate 2.4k</td><td>Air rate 2.4k</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Air rate 2.4k (default)</td><td>Air rate 2.4k (default)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Air rate 2.4k</td><td>Air rate 4.8k</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Air rate 4.8k</td><td>Air rate 9.6k</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Air rate</td><td>Air rate 19.2k</td></tr>
</table>

						9.6k		
			1	1	0	Air rate 15.6k	Air rate 38.4k	
			1	1	1	Air rate 15.6k	Air rate 62.5k	
04 H	read / write	REG1	7	6	subcontract settings			The data sent by the user is less than the sub-packet length, and the serial port output of the receiving end presents an uninterrupted continuous output; If the data sent by the user is larger than the length of the packet, the serial port at the receiving end will output the packet.
			0	0	240 bytes (default)			
			0	1	128 bytes			
			1	0	64 bytes			
			1	1	32 bytes			
			5	RSSI ambient noise enable				After enabling, the command C0 C1 C2 C3 can be sent in the transmission mode or WOR transmission mode to read the register; Register 0x00 : current ambient noise RSSI ; Register 0X01 : RSSI at Last Data Received (Current channel noise is: dBm =-RSSI/2); Instruction format: C0 C1 C2 C3+ start address + read length; Return: C1 + address + read length + read effective value; such as: send C0 C1 C2 C3 00 01 Return C1 00 01 RSSI (the address can only start from 00)
			0	disabled (default)				
			1	enable				
			4	3	reserve			
			2	software mode switching				If you don't want to use the M0 and M1 pins to switch the working mode, you can enable this function and use specific serial port commands to switch modes. Format: C0 C1 C2 C3 02 +
			0	disabled (default)				
			1	enable				

<table>
<tr><td rowspan="8"></td><td rowspan="8"></td><td rowspan="8"></td><td></td><td colspan="3"></td><td>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 + work mode
Note: After enabling this function, WOR mode and sleep mode only support 9600 baud rate.</td></tr>
<tr><td rowspan="6">1</td><td rowspan="6">0</td><td colspan="2">transmit power</td><td rowspan="6">The relationship between power and current is non-linear, and the power supply efficiency is the highest at maximum power;

Current does not decrease proportionally with power reduction.</td></tr>
<tr><td>E22-230/400T30E</td><td>E22-230/400T33E</td></tr>
<tr><td>0</td><td>0</td><td>30dBm (default)</td><td>33dBm (default)</td></tr>
<tr><td>0</td><td>1</td><td>27dBm</td><td>30dBm</td></tr>
<tr><td>1</td><td>0</td><td>24dBm</td><td>27dBm</td></tr>
<tr><td>1</td><td>1</td><td>21dBm</td><td>24dBm</td></tr>
<tr><td rowspan="2">05 H</td><td rowspan="2">read / write</td><td rowspan="2">REG2</td><td>E22-230T30/33E</td><td colspan="3">Channel Control (CH)
0-64 represent a total of 65 channels</td><td>Actual frequency = 220.125 + CH *0.25M</td></tr>
<tr><td>E22-</td><td colspan="3">Channel Control (CH)
0-83 represent a total of 84 channels</td><td>Actual frequency = 410.125 + CH *1M</td></tr>
</table>

			400T30/33E		
06H	read / write	REG3	7	enable rssi byte	When enabled, the module receives wireless data and outputs it through the serial port TXD , followed by an RSSI strength byte.
			0	disabled (default)	
			1	enable	
			6	transfer method	During fixed-point transmission, the module will recognize the first three bytes of 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 target address is not the module itself, the module will start a forwarding; In order to prevent data return, it is recommended to use it in conjunction with the fixed-point mode; that is, the destination address is different from the source address.
			0	Disable relay function (default)	
			1	Enable relay function	
			4	LBT enable	After enabled, wireless data will be monitored before transmission, which can avoid interference to a certain extent, but may cause data delay; The maximum stay time of LBT is 2 seconds, and it will be issued forcibly when it reaches 2 seconds.
			0	disabled (default)	
			1	enable	
			3	WOR mode transceiver control	Only valid for mode 1 ;
			0	WOR receiver (default) Working in WOR monitoring mode, see below for the monitoring cycle (WOR cycle), which can save a lot of	1. In WOR receiving mode, the module can modify the delay time after wake-up, and the

<table>
<tr><td></td><td></td><td></td><td></td><td colspan="4">power consumption.</td><td>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 address of the register initiator, 02 is the length, 03 E8 is the set delay, the maximum FFFF is 65535ms , set to 0 turns off the wake-up delay.)
3. Data can be sent within the delay</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td colspan="4">WOR transmitter
The transceiver of the module is turned on, and when transmitting data, a wake-up code for a certain period of time is added.</td><td></td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>1</td><td>0</td><td>WOR cycle</td><td rowspan="9">Only valid for mode 1 ;

Period T= (1+WOR) *500ms , the maximum is 4000ms , and the minimum is 500ms ;

The longer the WOR monitoring interval period, the lower the average power consumption, but the greater the data delay;

The sending and receiving parties must be consistent (very important)</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>0</td><td>0</td><td>500ms</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>0</td><td>1</td><td>1000ms</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>1</td><td>0</td><td>1500ms</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>1</td><td>1</td><td>2000ms</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>0</td><td>0</td><td>2500ms</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>0</td><td>1</td><td>3000ms</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>1</td><td>0</td><td>3500ms</td></tr>
<tr><td></td><td></td><td></td><td>1</td><td>1</td><td>1</td><td>4000ms</td></tr>
<tr><td>07 h</td><td>Write</td><td>CRYPT_H</td><td colspan="5">key high byte (default 0)</td><td rowspan="2">Write only, read returns 0 ;
Used for encryption to avoid interception of air wireless data by similar modules;
Inside the module, these two bytes will be used as calculation factors to transform and encrypt the wireless signal in the air.</td></tr>
<tr><td>08 H</td><td>Write</td><td>CRYPT_L</td><td colspan="5">key low byte (default 0)</td></tr>
<tr><td>80 H ～ 86 H</td><td>read</td><td>PID</td><td colspan="5">Product information 7 bytes</td><td>Product information 7 bytes</td></tr>
</table>

7.2 Register description

7.3 Factory Default Parameters

Model	Factory default parameter value: C0 00 00 62 00 00						
Module model	frequency	address	channel	air speed	baud rate	Serial format	transmit power
E22-230T30E	230.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30dbm
E22-230T33E	230.125MHz	0x0000	0x17	2.4kbps	9600	8N1	33dbm
E22-400T30E	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30dbm
E22-400T33E	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	33dbm

8 Relay Networking Mode

No.	Description of relay mode
1	After setting the relay mode through the configuration mode, switch to the general mode and the relay starts to work.
2	In relay mode, ADDH and ADDL are no longer used as module addresses, but are forwarded and paired corresponding to NETID respectively . If one of the networks is received, it will be forwarded to another network; The repeater's own network ID is invalid.
3	In relay mode, the relay module cannot send and receive data, and cannot operate with low power consumption.
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 low level.

Relay networking rules description:

Forwarding rules, the relay can forward data in both directions between two NETIDs .

repeater mode, ADDH\ADDL is no longer used as the module address, but as the NETID forwarding pair.

As shown in the picture:

①Level 1 relay

" Node 1" has a NETID of 08 .

" Node 2" has a NETID of 33 .

The ADDH\ADDL of trunk 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, node 1 and node 2 have the same address, so the data sent by node 1 can be received by node 2 .

② Secondary relay

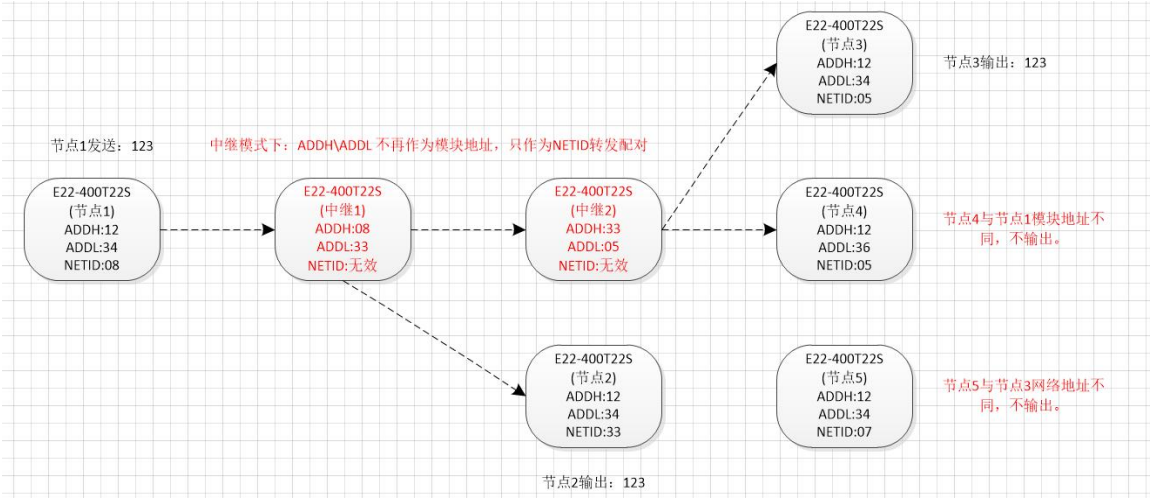
The ADDH\ADDL of relay 2 are 33 and 05 respectively .

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

Thus node 3 and node 4 can receive node 1 data. Node 4 outputs data normally, and node 3 has a different address from node 1 , so no data is output.

③Two -way relay

Configure as shown in the 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 .



9 PC Configuration Instructions

- The figure below shows the display interface of the host computer for E22 series products. Users can switch to the command mode through M0 and M1 , and quickly configure and read parameters on the host computer.

- the configuration of the host computer, the module address, frequency channel, network ID , and key are all in decimal display mode; the value range of each parameter:
- Network address: 0 ~ 65535

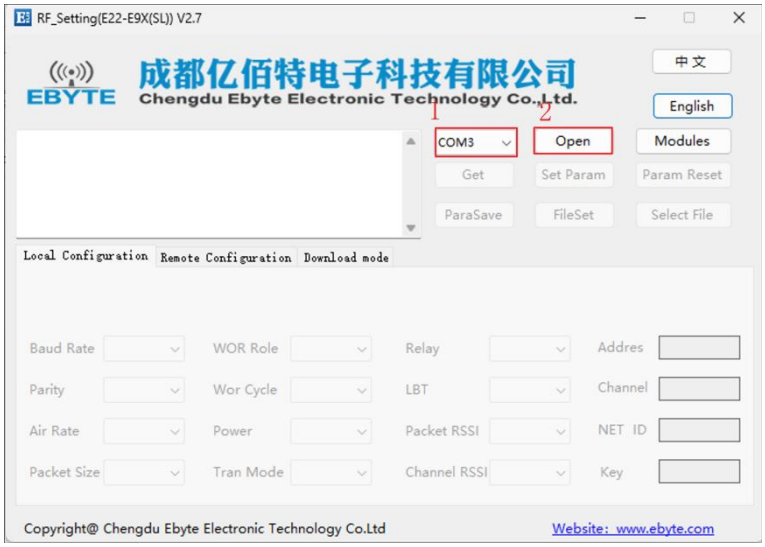
- Frequency channel: 0 ~ 83
- Network ID : 0 ~ 255
- Key: 0 ~ 65535
- When using the host computer to configure the relay mode, the user needs to pay special attention. Since the parameters in the host computer are in decimal display mode, the module address and network ID need to be converted to decimal when filling in;
- For example, the network ID input by the transmitter A is 02 , and the network ID input by the receiver B is 10 , then when the relay terminal R sets the module address, convert the hexadecimal value 0X020A to the decimal value 522 and fill it in as the relay terminal R module address;
- That is , the module address value that needs to be filled in at the relay end R is 522 at this time .

10 IAP online firmware upgrade

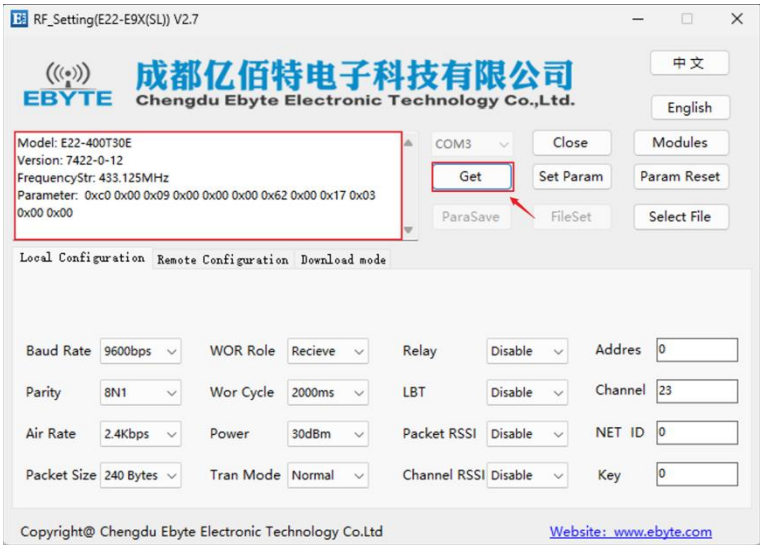
IAP (In Application Programming) refers to online application programming. This module adopts this method to upgrade the firmware online through serial ports. At the same time, this series of modules support two ways to enter the online upgrade mode: upper computer command and AUX level input.

- Upper computer instruction upgrade

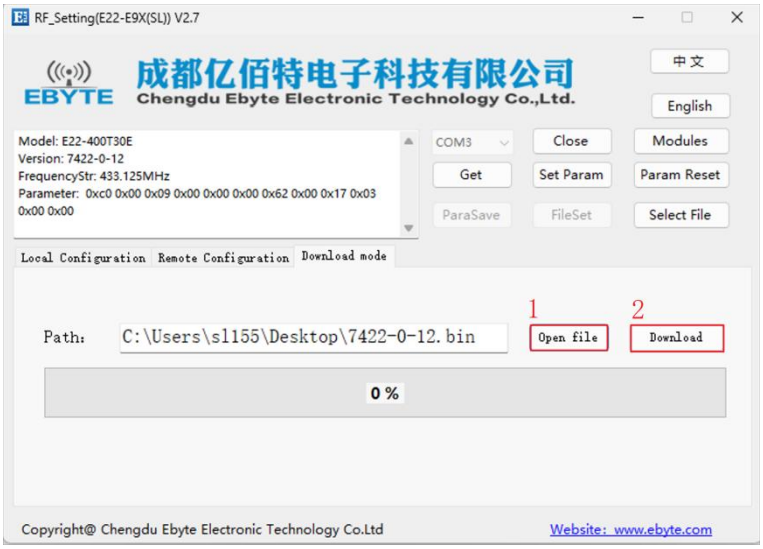
1. Make the module enter the configuration mode by changing M0 and M1 (note: the baud rate is 9600 in the configuration mode);
2. Open the official website to configure the upper computer "RF_Setting (E22-E9X (SL)) V2.7. exe", and select Serial Port > Open;



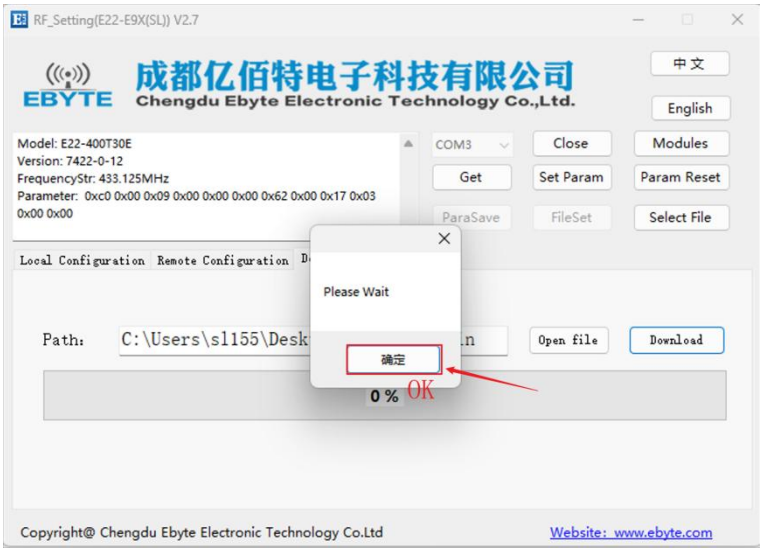
3. Click Get to view the module information in the left window of the upper computer;



4. Click Download mode > Click Open File (select Firmware. bin file)> Click Download;



5. Click 确定（OK），Firmware upgrade starts；



6. Click 确定（OK），Firmware upgrade completed；

- AUX pull down to enter upgrade mode

1. Ensure that AUX is in the lower state before powering on the module, and ensure that AUX stays in the lower state for at least 1s after powering on the module.
2. After the serial port continues to output "C" character (baud rate 115200), AUX can be pulled up and operated according to the above mode of "Upper computer instruction upgrade";
3. Wait until the module automatically resets and the upgrade succeeds.

Remarks:

1. After the upgrade is complete, ensure that AUX does not keep pulling down.
2. Upper computer instruction upgrade logic: Upper computer sends: "AT+IAP", the module replies: "AT+IAP=OK", and waits for the module to reset automatically and enter the IAP upgrade mode. The serial port output "C" character indicates that the module is waiting to receive the firmware bin file. When the upper computer detects the character "C", it starts to send the bin file automatically. After receiving the module, it automatically resets and enters the application program, and the upgrade is complete.

11 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 must be reliably grounded;
- Please pay attention to the correct connection of the positive and negative poles of the power supply, such as reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that it is between the recommended power supply voltage, if it exceeds the maximum value, it will cause permanent damage to the module;
- Please check the stability of the power supply, the voltage cannot fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, and the whole machine is conducive to long-term stable work;
- The module should be kept as far away as possible from parts with large electromagnetic interference such as power supply, transformer, and high-frequency wiring;
- High-frequency digital traces, high-frequency analog traces, and power traces must avoid the bottom of the module.

If it is really necessary to pass through the bottom of the module, assuming that the module is soldered to the Top Layer , lay copper on the top layer of the module contact part (all copper) And good grounding), must be close to the digital part of the module and routed in the Bottom Layer ;

- Assuming that 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 stray and receiving sensitivity of the module to varying degrees;
- Assuming that there are devices with large electromagnetic interference around the module, which will greatly affect the performance of the module, it is recommended to keep away from the module according to the intensity of the interference. If the situation permits, proper isolation and shielding can be done;
- Assuming that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power supply traces) will also greatly affect the performance of the module. According to the intensity of the interference, it is recommended to keep away from the module. If the situation permits, it can be done Appropriate isolation and shielding;
- If the communication line uses a 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);
- TTL protocols whose physical layer is also 2.4GHz , for example: USB3.0 ;
- The antenna installation structure has a great influence on the performance of the module. Make sure that the antenna is exposed and preferably vertically upward;
- When the module is installed inside the case, a high-quality antenna extension cable can be used to extend the antenna to the outside of the case;
- The antenna must not be installed inside the metal shell, which will greatly weaken the transmission distance.

12 FAQ

12.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly;
- Humidity, and co-frequency interference will lead to an increase in communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect is poor when it is close to the ground;
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
- If there is a metal object near the antenna, or it is placed in a metal case, the signal attenuation will be very serious;
- The power register is set incorrectly, and the air speed is set too high (the higher the air speed, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value, the lower the voltage, the lower the power output;
- The matching degree between the antenna and the module is poor or the quality of the antenna itself is problematic.

12.2 The module is easily damaged

- Please check the power supply to ensure that it is between the recommended power supply voltage, if it exceeds the

maximum value, it will cause permanent damage to the module;

- Please check the stability of the power supply, the voltage cannot fluctuate greatly and frequently;
- Please ensure anti-static operation during installation and use, and high-frequency devices are electrostatically sensitive;
- Please ensure that the humidity during installation and use should not be too high, 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.

12.3 The bit error rate is too high

- There is co-channel signal interference nearby, stay away from the source of interference or modify the frequency and channel to avoid interference;
- power supply may also cause garbled characters, so ensure the reliability of the power supply;
- cables and feeders are of poor quality or are too long, which will also cause a high bit error rate.

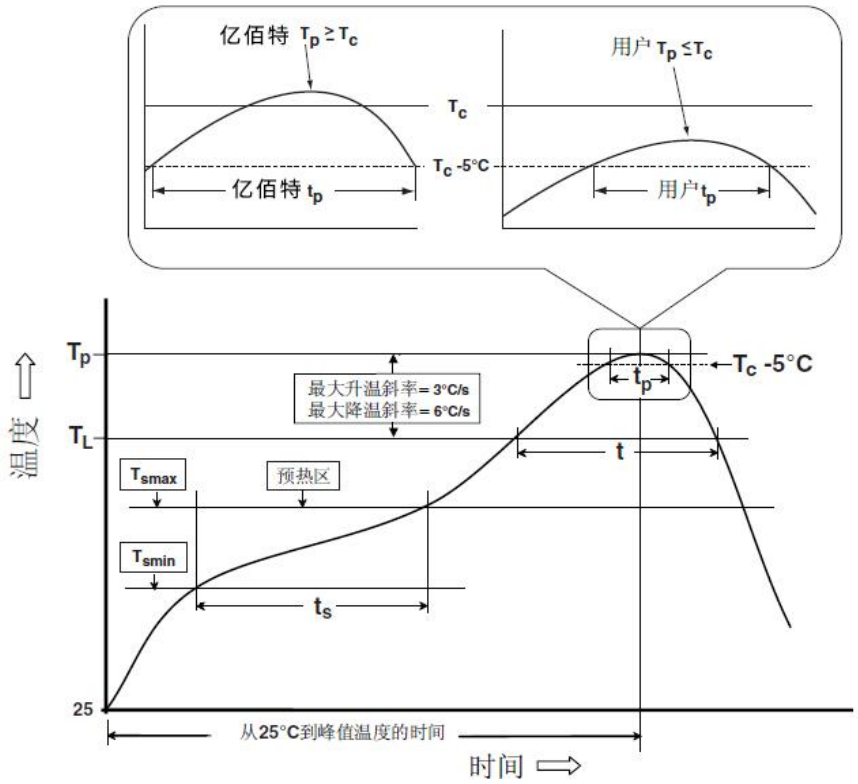
13 Welding Operation Instructions

13.1 Reflow soldering temperature

Reflow Soldering Profile Characteristics		leaded process assembly	Lead-free process assembly
Preheat / keep warm	Minimum temperature (Tsmin)	100 ° C	150 ° C
	Maximum temperature (Tsmax)	150 ° C	200 ° C
	Time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Heating slope (TL~Tp)		3 ° C / sec, max	3 ° C / sec, max
Liquidus temperature (TL)		183 ° C	217 ° C
Hold time above TL		60~90 seconds	60~90 seconds
Package peak temperature Tp		Users should not exceed the temperature indicated on the product's "Moisture Sensitivity" label.	Users should not exceed the temperature indicated on the product's "Moisture Sensitivity" label.
The time (Tp) within 5 ° C of the specified classification temperature (Tc) , see the figure below		20 seconds	30 seconds
Cooling slope (Tp~TL)		6 ° C / sec, max	6 ° C / sec, max

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

13.2 Reflow Soldering Curve



14 Related Models

Product number	Carrier frequency Hz	Transmit power dBm	Test distance km	Package form	Product Size mm	Communication Interface
E22-230T22S	230m	twenty two	5	patch	16*26	TTL
E22-230T30S	230m	30	10	patch	20*40.5	TTL
E22-400T22S	433/470M	twenty two	5	patch	16*26	TTL
E22-400T30S	433/470M	30	10	patch	20*40.5	TTL
E22-900T22S	868/915M	twenty two	5	patch	16*26	TTL
E22-900T30S	868/915M	30	10	patch	20*40.5	TTL
E22-400M22S	433/470M	twenty two	7	patch	14*20	SPI
E22-400M30S	433/470M	30	12	patch	24*38.5	SPI
E22-900M22S	868/915M	twenty two	7	patch	14*20	SPI
E22-900M30S	868/915M	30	12	patch	24*38.5	SPI

15 Antenna Guide

15.1 Antenna Recommendation

Antennas play an important role in the communication process, and often inferior antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as antennas with excellent performance and reasonable price to match our wireless modules.

Product number	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	62	-	Ultra-short straight, omnidirectional antenna
TX433-JW-5	Glue Stick Antenna	433M	SMA-J	2.0	50	-	Bending glue stick, omnidirectional antenna
TX433-JWG-7	Glue Stick Antenna	433M	SMA-J	2.5	75	-	Bending 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-XPL-100	Suction cup antenna	433M	SMA-J	3.5	185	100	Small suction cup antenna, cost-effective
TX433-XP-200	Suction cup antenna	433M	SMA-J	4.0	190	200	Neutral suction cup antenna, low loss
TX433-XPH-300	Suction cup antenna	433M	SMA-J	6.0	965	300	Large suction cup antenna, high gain
TX490-JZ-5	Glue Stick Antenna	470/490M	SMA-J	2.0	50	-	Ultra-short straight, omnidirectional antenna
TX490-XPL-100	Suction cup antenna	470/490M	SMA-J	3.5	120	100	Small suction cup antenna, cost-effective

Revise history

Version	revision date	Revision Notes	Maintenance man
1.0	2022.11.18	Merger Manual	Hao
1.1	2023.03.02	error correct	Bin
1.2	2024.04.12	error correct	Bin

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