E310-900T23D

AX5045 900MHz 200mW Narrowband Wireless Module

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Contents

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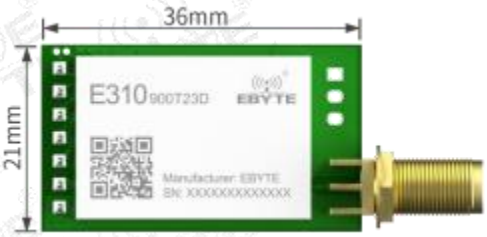
1. Introduction

1. 1 Brief Introduction



E310-900T23D is a wireless serial module based on ON Semiconductor's narrow-band Sub-GHz RF transceiver AX5045 solution. Working in the 900.0MHz to 931.0MHz frequency band (default 915.0MHz), it has functions such as half-duplex transparent transmission, air wake-up (ultra-low power consumption), data relay and forwarding (distance extension).

The module has a data encryption algorithm inside, and adopts a random dynamic password encryption method, which makes data interception meaningless. It has multiple CRC check processes to further ensure the correctness and integrity of user data.

1.2 Features

- Double antennas are optional (IPEX/stamp hole), which is convenient for secondary development and integration.

1.3 Application

- Home security alarm and remote keyless entry;
- Smart 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. Specification and parameter

2. 1 Limit parameter

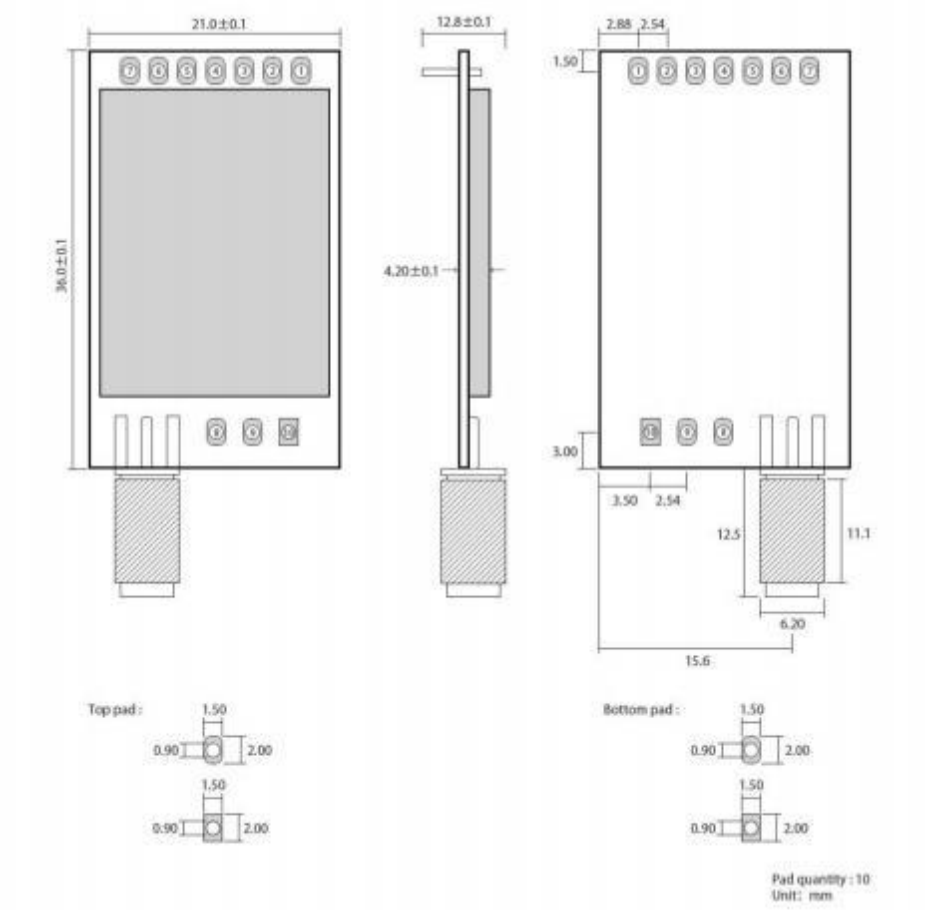
The main parameters	Performance		Remark
	Minimum	Maximum value	
Supply voltage (V)	0	5.5	More than 5.5V will permanently burn the module
Blocking power (dBm)	-	10	The probability of burning at close range is small
Working temperature (℃)	-40	+85	Industrial grade

2.2 Operating parameter

The main parameters		Performance			Remark
		Minimum	Typical value	Maximum value	
Working voltage (V)		2.3	3.3	5.5	≥3.3V can guarantee output power
Communication level (V)		-	3.3	-	Using 5V TTL is recommended to add level shifting
Working temperature (℃)		-40	-	+85	Industrial grade design
Working frequency band (MHz)		900.0	-	931.0	Support ISM band
Power consumption	Emission current (mA)	-	240	-	Instantaneous power consumption
	Receive current (mA)	-	13	-	-
	Sleep current (uA)	-	2	-	software shutdown
Maximum transmit power (dBm)		21.5	23.0	23.5	-
Receive Sensitivity (dBm)		-115	-119	-120	Air rate 1.2Kbps
Air rate (bps)		1.2k	1.2k	125k	User programming control

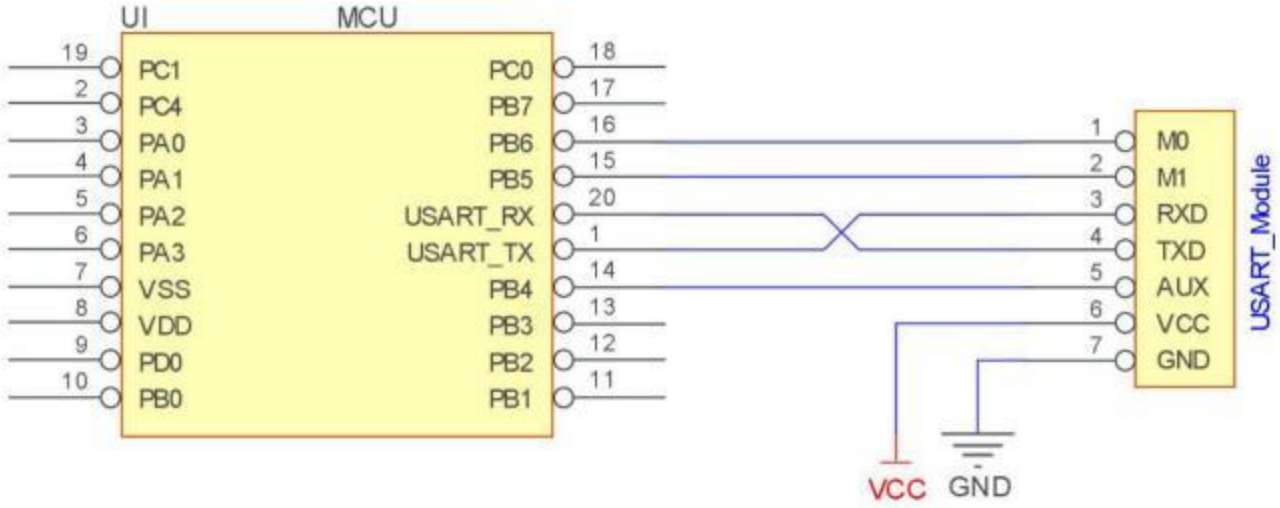
The main parameters	Description	Remark
Reference distance	5.6km	Clear and open, antenna gain 5dBi, antenna height 2.5m, air rate 1.2kbps
Launch length	190 Btye	It can be sent in packets of 32/64/ 128/ 190 bytes by setting the instruction
Cache capacity	240 Btye	-
Modulation	GFSK	
Communication Interface	UART serial port	TTL level
Packaging method	DIP	-
Interface	1.27mm	-
Dimensions	21*36 mm	-
Antenna interface	SMA-K	Equivalent impedance is about 50Ω

3. Size and pin definition



Pin number	Pin name	Pin Orientation	Pin usage
1	M0	Input (very weak pull-up)	Cooperate with M1 to determine the 4 working modes of the module (can not be suspended, if not used, it can be grounded)
2	M1	Input (very weak pull-up)	Cooperate with M0 to determine the 4 working modes of the module (can not be suspended, if not used, it can be grounded)
3	RXD	Input	TTL serial port input, connected to the external TXD output pin;
4	TXD	output	TTL serial output, connected to external RXD input pin;
5	AUX	output	Used to indicate the working status of the module; The user wakes up the external MCU, and outputs a low level during the power-on self-test initialization; (can be left floating)
6	VCC	Power supply	Module power positive reference, voltage range: 2.3 ~ 5.5V DC
7	GND	Power supply	Module ground
8	Fixing hole		Fixing hole (connect to GND on the module)
9	Fixing hole		Fixing hole (connect to GND on the module)
10	Fixing hole		Fixing hole (connect to GND on the module)

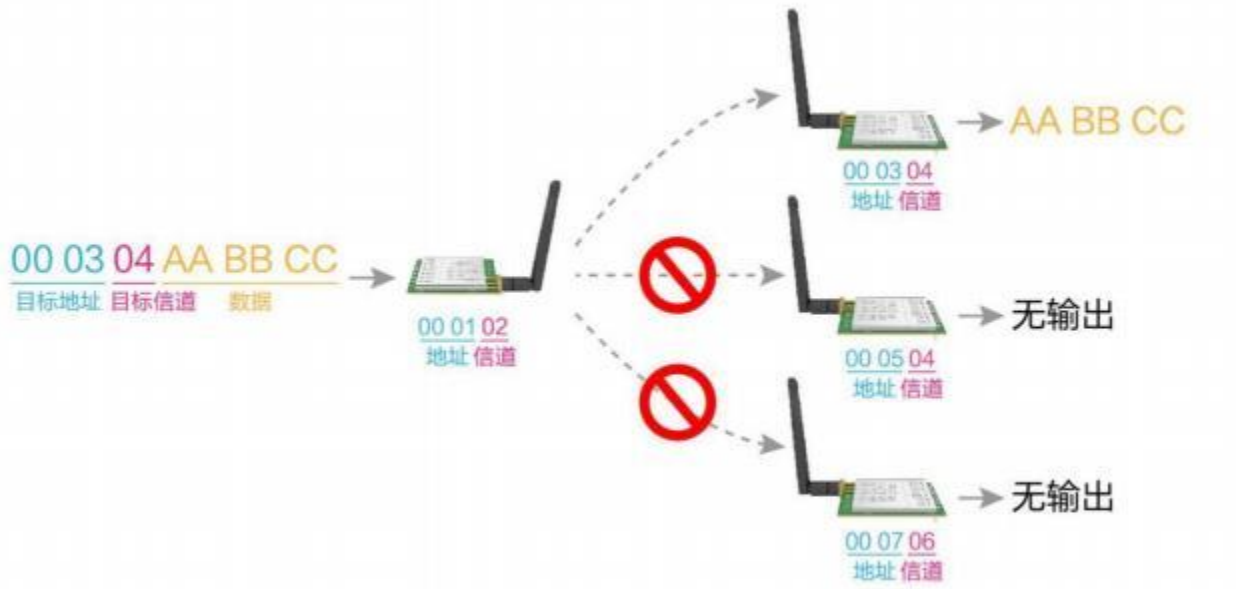
4. Recommended Wiring Diagram



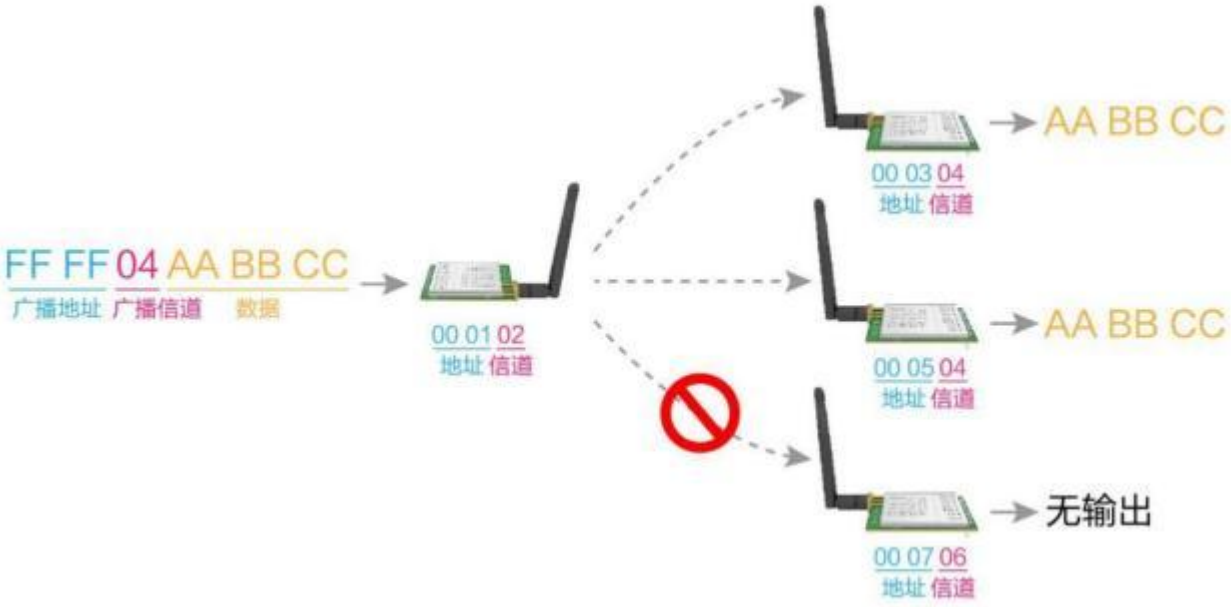
No.	Brief description of the connection between the module and the microcontroller (the above picture takes the STM8 L microcontroller as an example)
1	The wireless serial port module is TTL level, please connect with TTL level MCU.
2	5V serial level communication needs to add a level conversion circuit.
3	A standard 50 ohm impedance antenna is required, and an unmatched antenna may cause a short communication distance.
3	If necessary, TVS can be added to the power supply or capacitors can be added to the power supply to suppress surge capability

5. Detailed Function

5. 1 Fixed point transmission



5.2 Broadcast transmission



5.3 Broadcast address

- Example: Set the module A address 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 Listen address

- Example: Set the module A address 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

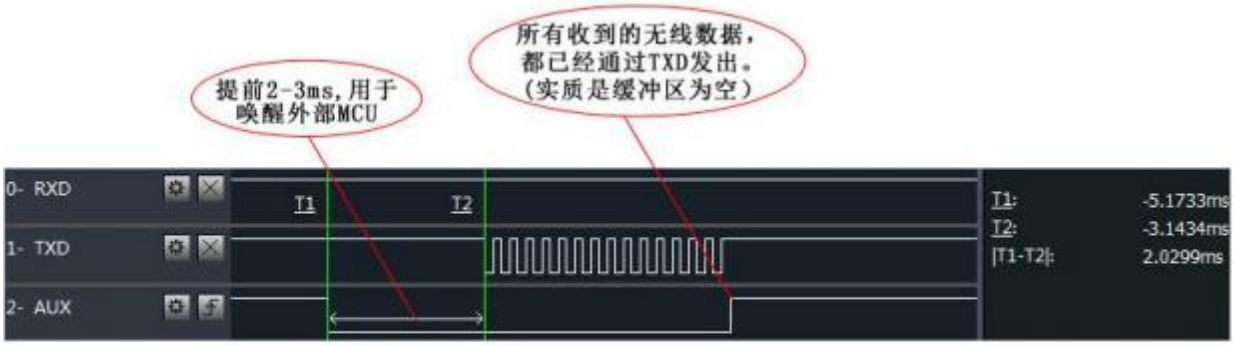
- After the module is powered on, AUX will output low level immediately, perform hardware self-check, and set the working mode according to user parameters;
- During this process, the AUX keeps the low level, and after the completion, the AUX outputs the high level, and starts to work normally according 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 AUX Detailed Description

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

5.6. 1 Serial 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

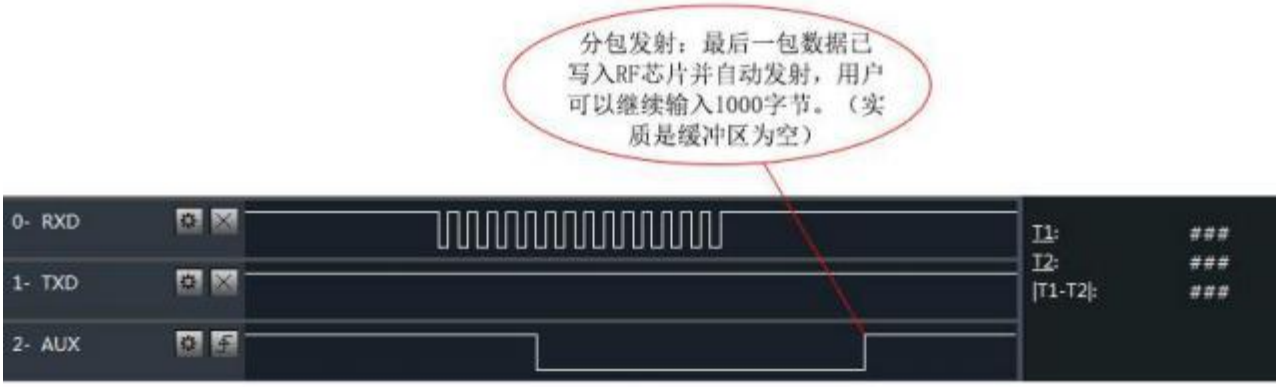
5.6.2 Wireless transmission indication

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

  When AUX= 1, the user continuously initiates 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 completely written to the wireless chip and the started the transmission. At this time, the module may be waiting for the end of the user data to time out, or the wireless packet transmission is in progress.

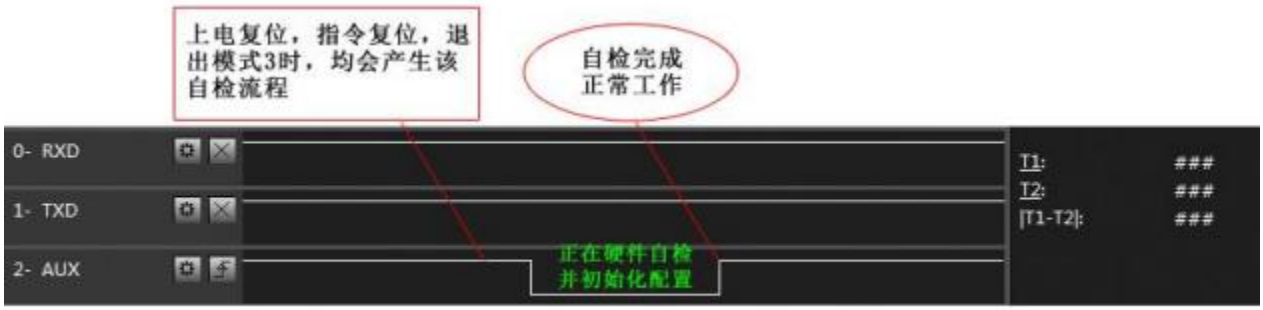
  [Note]: When AUX= 1, it does not mean that all serial port data of the module has been transmitted wirelessly, the last packet of data may be being transmitted.



模块接收串口数据时，AUX引脚时序图

5.6.3 Module is being configured

- Only when resetting and exiting sleep mode;



自检期间，AUX引脚时序图

5.6.4 Precautions

No.	AUX Precautions
1	For the above functions 1 and 2, the output low level has priority, that is, if any one of the output low level conditions is satisfied, the AUX outputs the low level; when all the low level conditions are not satisfied, the AUX outputs the high level.
2	When AUX outputs a low level, it means that 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 1 ms, the mode switching work will be completed.
3	After the user switches to the new working mode, the module will enter this mode at least 2ms after the rising edge ofAUX; ifAUX is always at a high level, the mode switching 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	It is recommended that customers do not transmit large amounts of data at low airspeeds, so as to avoid data loss caused by data accumulation and cause communication anomalies.

6. Operating 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	Remarks
0 transmission mode	0	0	Serial port open, wireless open, transparent transmission	
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	Module goes to sleep	

6. 1 Mode switch

No.	Remarks
1	● Users can combine M1 and M0 with high and low levels to determine the working mode of the module. The 2 GPIOs of the MCU can be used to control the mode switching; ● After changing M1 and M0: if the module is idle, after 1ms, it can start to work according to the new mode; ● If the module has serial port data that has not been transmitted wirelessly, the new working mode can only be entered after the transmission is completed; ● If the module receives the wireless data and sends out the data through the serial port, it needs to be sent out before it can enter the new working mode; ● Therefore, the mode switching can only be effective when the AUX output is 1, otherwise the switching will be delayed.
2	● For example: if the user continuously inputs a large amount of data and switches the mode at the same time, the mode switching operation is invalid at this time; the module will process all the user data before performing the new mode detection; ● So the suggestion is: Detect the output state of the AUX pin, wait for 2ms, after output the high level, and then switch mode.
3	● When the module is switched from other modes to sleep mode, if there is data that has not been processed yet; the module can only enter sleep mode after processing these 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 serial port data "12345", and then does not need to wait for the AUX pin to be idle (high level), and can directly switch to sleep mode, The main MCU of the user is put to sleep immediately, and the module will automatically go to sleep within 1ms after sending all the user data wirelessly, thereby saving the working time of the MCU and reducing power consumption.
4	● Similarly, this feature can be used for any mode switching. After the module processes the current mode event, it will automatically enter the new mode within 1ms; thus saving the user's work of querying AUX, and achieving the purpose of fast switching ; For example, switching from transmit mode to receive mode; the user MCU can also go to sleep in advance before the mode switch, and use the external interrupt function to obtain the AUX change, so as to switch the mode.

5	● This operation mode is very flexible and efficient, and is completely designed 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 Normal 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.
Receive	The wireless receiving function of the module is turned on, and after receiving wireless data, it will be output through the serial port TXD pin.

6.3 WOR Mode (Mode 1)

Type	When M0 = 1, M1 = 0, the module works in mode 1
Emission	When defined as a transmitter, a wake-up code for a certain period of time will be automatically added before transmission.
Receive	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	Wireless transmission off
Receive	Wireless reception is 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.

Receive	Unable to receive wireless data.
Note	When entering other modes from sleep mode, the module will reconfigure parameters. During the configuration process, AUX remains low;

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.	Instruction format	Detailed Description
1	Register Setting	Command: C0+start address+length+parameter Response: C1+start address+length+parameter Example 1 : Configure the channel as 0x09 Command 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 airspeed (1.2K) at the same time Send: C0 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61
2	Register Reading	Instruction: C1+start address+length Response: C1+start address+length+parameter Example 1: Reading a channel Command Start Address Length Parameter Send : C1 05 01 Return: C1 05 01 09 Example 2: Read module address, network address, serial port, airspeed at the same time Send: C1 00 04 Return: C1 00 04 12 34 00 61
3	Set temporary register	Command: C2 + start address + length + parameter Response: C1 + start address + length + parameter Example 1 : Configure the channel as 0x09 Command Start Address Length Parameter Send : C2 05 01 09 Return: C1 05 01 09 Example 2: Configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (1.2K) at the same time Send: C2 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61

4	Wrong format	Malformed response FF FF FF

7.2 Register Description

No.	Read and Write	Name	Description	Remark
00H	Read/ Write	ADDH	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 not perform address filtering at this time.
01H	Read/ Write	ADDL	ADDL （Default 0）	
02H	Read/ Write	NETID	NETID （Default 0）	Network address, used to distinguish the network; When communicating with each other, they should be set to the same.
03H	Read/ Write	REG0	7 6 5 UART serial rate (bps) 0 0 0 Serial port baud rate is 1200 0 0 1 Serial port baud rate is 2400 0 1 0 Serial port baud rate is 4800 0 1 1 Serial port baud rate is 9600 (default) 1 0 0 Serial port baud rate is 19200 1 0 1 Serial port baud rate is 38400 1 1 0 Serial port baud rate is 57600 1 1 1 Serial port baud rate is 115200	For the two modules that communicate 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 both sides of the communication have the same baud rate.
			4 3 Serial check digit 0 0 8N1 (default) 0 1 8O1 1 0 8E1 1 1 8N1 (equivalent to 00)	The serial port modes of both sides of the communication can be different;
			2 1 0 Wireless air rate (bps) 0 0 0 Air rate 1.2k (default) 0 0 1 Air rate 2.4k 0 1 0 Air rate 4.8k 0 1 1 Air rate 9.6k 1 0 0 Air rate 19.2k	The air speed of both parties must be the same; The higher the air rate, the lower the delay and the shorter the transmission distance.

			1	0	1	Air rate 38.4k	
			1	1	0	Air rate 70k	
			1	1	1	Air rate 125k	
04H	Read/ Write	REG1	7	6	Subcontracting settings		When the data sent by the user is less than the packet length, the serial output of the receiving end is presented as uninterrupted continuous output; If the data sent by the user is larger than the packet length, the serial port of the receiving end will be output in packets.
			0	0	190 bytes (default)		
			0	1	128 bytes		
			1	0	64 bytes		
			1	1	32 bytes		
			5	RSSI Ambient Noise Enable			After it is enabled, the C0 C1 C2 C3 instruction can be sent in the transmission mode or the WOR transmission mode to read the register; Register 0x00: current channel AGC coefficient (can be used as LBT); Register 0X01: RSSI when data was last received (Data RSSI calculation: dBm = -(256 - RSSI)); Instruction format: C0 C1 C2 C3+start address+ read length; Return: C1 + address + read length + read valid value; such as: send C0 C1 C2 C3 00 01 Return C1 00 01 RSSI (address can only start from 00)
			0	Disabled (default)			
			1	Enable			
			4	3	Retain		
			2	Enable command to switch working mode			If you do not want to use the MO M1 pin to switch the working mode, you can enable this function and use a specific serial port command to switch. After enabling, use the command C0 C1 C2 C3 02 + mode. Such as: Send C0 C1 C2 C3 02 00 to switch to transparent transmission mode Send C0 C1 C2 C3 02 01 switch to WOR mode Send C0 C1 C2 C3 02 02 to switch to configuration mode Send C0 C1 C2 C3 02 03 switch to sleep mode Returns: C1 C2 C3 02 + Mode
			0	disabled (default)			
			1	enable			
			1	0	Transmit power		Power and current have a non-linear relationship, and the power supply efficiency is the highest at the maximum power; The current does not decrease proportionally as the power decreases.
			0	0	23dBm (default)		
			0	1	18dBm		
			1	0	13dBm		
			1	1	8dBm		
05H	Read/	REG2	Channel Control (CH)				Actual frequency= 425.0MHz + CH *0.2M

<table>
<tr><td></td><td>Write</td><td></td><td colspan="4">0- 155 respectively represent a total of 156 channels</td><td></td></tr>
<tr><td rowspan="20">06H</td><td rowspan="20">Read/ Write</td><td rowspan="20">REG3</td><td>7</td><td colspan="3">Enable RSSI bytes</td><td rowspan="3">When enabled, the module receives wireless data and outputs it through the serial port TXD, followed by an RSSI strength byte.</td></tr>
<tr><td>0</td><td colspan="3">disabled (default)</td></tr>
<tr><td>1</td><td colspan="3">enable</td></tr>
<tr><td>6</td><td colspan="3">transfer method</td><td rowspan="3">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.</td></tr>
<tr><td>0</td><td colspan="3">transparent transmission (default)</td></tr>
<tr><td>1</td><td colspan="3">fixed point transmission</td></tr>
<tr><td>5</td><td colspan="3">Relay function</td><td rowspan="3">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 in conjunction with fixed-point mode; that is, the destination address and the source address are different.</td></tr>
<tr><td>0</td><td colspan="3">Disable relay function (default)</td></tr>
<tr><td>1</td><td colspan="3">Enable relay function</td></tr>
<tr><td>4</td><td colspan="3">LBT enable</td><td rowspan="3">After enabling, the 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 two seconds.</td></tr>
<tr><td>0</td><td colspan="3">Disabled (default)</td></tr>
<tr><td>1</td><td colspan="3">Enable</td></tr>
<tr><td>3</td><td colspan="3">WOR Mode Transceiver Control</td><td rowspan="3"></td></tr>
<tr><td>0</td><td colspan="3">WOR receiver (default), Working in WOR monitor mode, the monitor cycle is shown below (WOR cycle), which can save a lot of power consumption.</td></tr>
<tr><td>1</td><td colspan="3">WOR transmitter
The transceiver is turned on, and a wake-up code for a certain period of time is added when transmitting data.</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>WOR cycle</td><td rowspan="10">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 sender and receiver must be the same (very important)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>500ms</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1000ms</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1500ms</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>2000ms</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>2500ms</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>3000ms</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>3500ms</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>4000ms</td></tr>
<tr><td>07H</td><td>Write</td><td>CRYPT_H</td><td colspan="4">Key high byte (default 0)</td><td rowspan="2">Write only, read returns 0;
It is used for encryption to avoid the interception of wireless data in the air by similar modules;
The module will use these two bytes as a calculation factor to transform and encrypt the air wireless signal.</td></tr>
<tr><td>08H</td><td>Write</td><td>CRYPT_L</td><td colspan="4">key low byte (default 0)</td></tr>
</table>

7.3 Factory Default Parameters

Model	Factory default parameter value：C0 00 09 00 00 00 60 00 28 03 00 00						
Module model	Frequency	Address	Channel	Air Rate	Baud Rate	Serial Format	Transmit Power
E310-900T23D	915.0MHz	0x0000	0x28	1.2kbps	9600	8N1	23dbm

8. Use of relay networking mode

No	Relay Mode Description
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 network is received, it will be forwarded to the other network; The network ID of the repeater itself is invalid
3	In 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 description:

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

2. In relay mode, ADDH\ADDL is no longer used as module address, but as NETID 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.

②Secondary relay

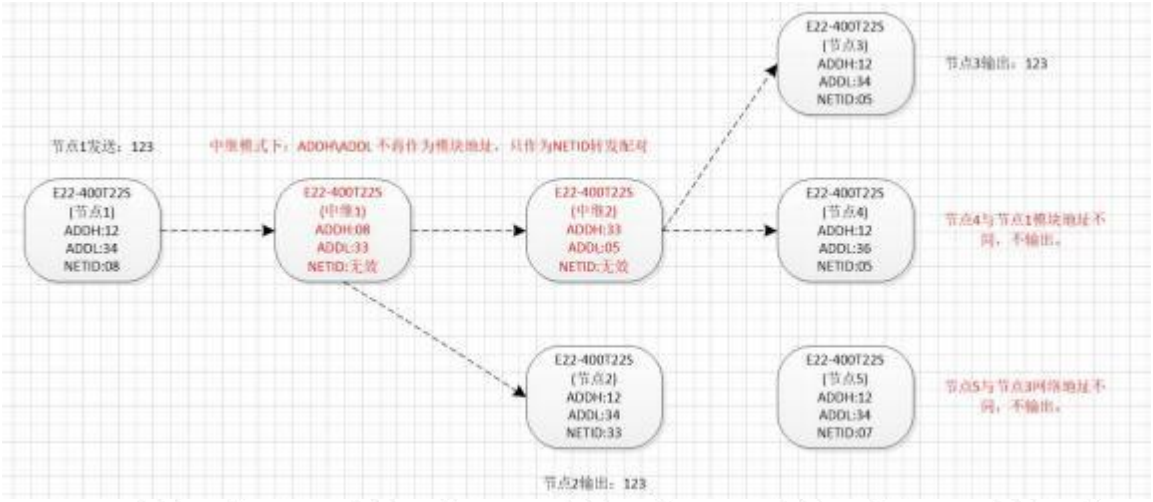
The ADDH\ADDL of relay 2 are 33 and 05 respectively.

So relay 2 can forward relay 1's data to network NETID: 05.

Therefore, node 3 and node 4 can receive the data of node 1. Node 4 outputs data normally, and node 3 and node 1 have different addresses, so no data is output.

③Two-way relay

As shown in the configuration: 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. Host computer configuration instructions

- The following figure shows the display interface of the E310-900T23D configuration host computer. Users can switch to the command mode through M0 and M1, and quickly configure and read parameters on the host computer.

- In the configuration of the 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 : 0~155

  Network ID: 0~255

  Key: 0~65535

- Users need to pay special attention when using the host computer to configure the relay mode, because in the host computer, each parameter is displayed in decimal mode, so the module address and network ID need to be

converted into decimal when filling in;

For example, the network ID input by transmitter A is 02, and the network ID input by receiver B is 10, then when relay terminal R sets the module address, convert the hexadecimal value 0X020A to decimal value 522 and fill in as relay terminal R the module address;

That is, the module address value that needs to be filled in by the relay terminal R at this time is 522.

10. 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 grounded reliably;
- 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 voltages. 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 and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so that the whole machine can work stably for a long time;
- The module should be kept away from the parts with large electromagnetic interference such as power supply, transformer and high-frequency wiring as far as possible;
- High-frequency digital traces, high-frequency analog traces, and power traces must avoid the underside of the module. If it is necessary to pass under the module, assuming that the module is soldered on the Top Layer, lay copper on the Top Layer of the contact part of the module (all copper). And well grounded), it must be close to the digital part of the module and routed on the Bottom Layer;
- Assuming that the module is soldered or placed on the Top Layer, it is also wrong to arbitrarily route 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, it will also greatly affect the performance of the module. It is recommended to stay away from the module according to the intensity of the interference. If the situation allows, appropriate 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 traces), it will also greatly affect the performance of the module. It is recommended to stay away from the module according to the intensity of the interference. Proper isolation and shielding;
- 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, 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 casing, a high-quality antenna extension cable can be used to extend the antenna to the outside of the casing;
- The antenna must not be installed inside the metal shell, which will greatly weaken the transmission distance.

11. Common Issue

11. 1 The transmission distance is not ideal

- When there is a straight line communication obstacle, the communication distance will be correspondingly attenuated;
- Temperature, humidity, and co-channel interference will increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect close to the ground is poor;
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
- There are metal objects near the antenna, or placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly, and the air rate is set too high (the higher the air rate, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value, and the lower the voltage, the lower the output power;
- The antenna and the module are poorly matched or the quality of the antenna itself is a problem.

11.2 Module is easily damaged

- Please check the power supply to ensure that it is between the recommended power supply voltages. 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 and frequently;
- Please ensure that the installation and use of anti-static operation, high-frequency components electrostatic sensitivity;
- Please ensure that the humidity during installation and use should not be too high, and 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.

11.3 Bit error rate too high

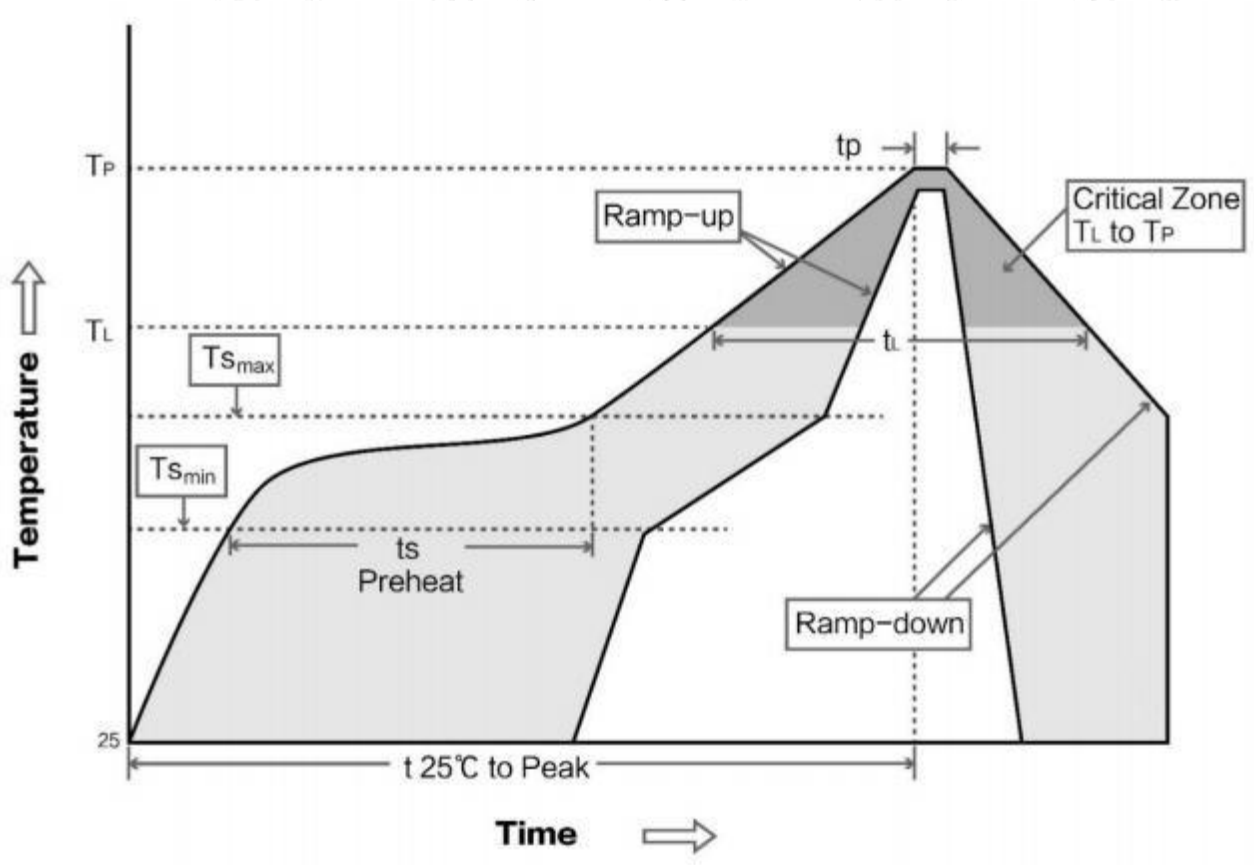
- There is co-frequency signal interference nearby, stay away from the interference source or modify the frequency and channel to avoid interference;
- Unsatisfactory power supply may also cause garbled characters, be sure to ensure the reliability of the power supply;
- The extension line and feeder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

12. Welding Work Guide

12. 1 Reflow Temperature

Profile Feature	Curve feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	Preheat Temperature min （Tsmin）	100℃	150℃
Preheat temperature max (Tsmax)	Preheat temperature max (Tsmax)	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheat Time (Tsmin to Tsmax)(ts)	60- 120 sec	60- 120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate(Tsmax to Tp)	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquidous Temperature (TL)	183℃	217℃
Time （tL） Maintained Above （TL）	Time （tL） Maintained Above （TL）	60-90 sec	30-90 sec
Peak temperature （Tp）	Peak temperature （Tp）	220-235℃	230-250℃
Aveage ramp-down rate （Tp to Tsmax）	Aveage ramp-down rate （Tp to Tsmax）	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time 25℃ to peak temperature	6 minutes max	8 minutes max

12.2 Reflow Soldering Curve



13. Related models

Product Model	Chip Solution	Carrier Frequency Hz	Transmit power dBm	Test distancekm	Package form Product size	Product size mm	communication interface

14. Antenna Guide

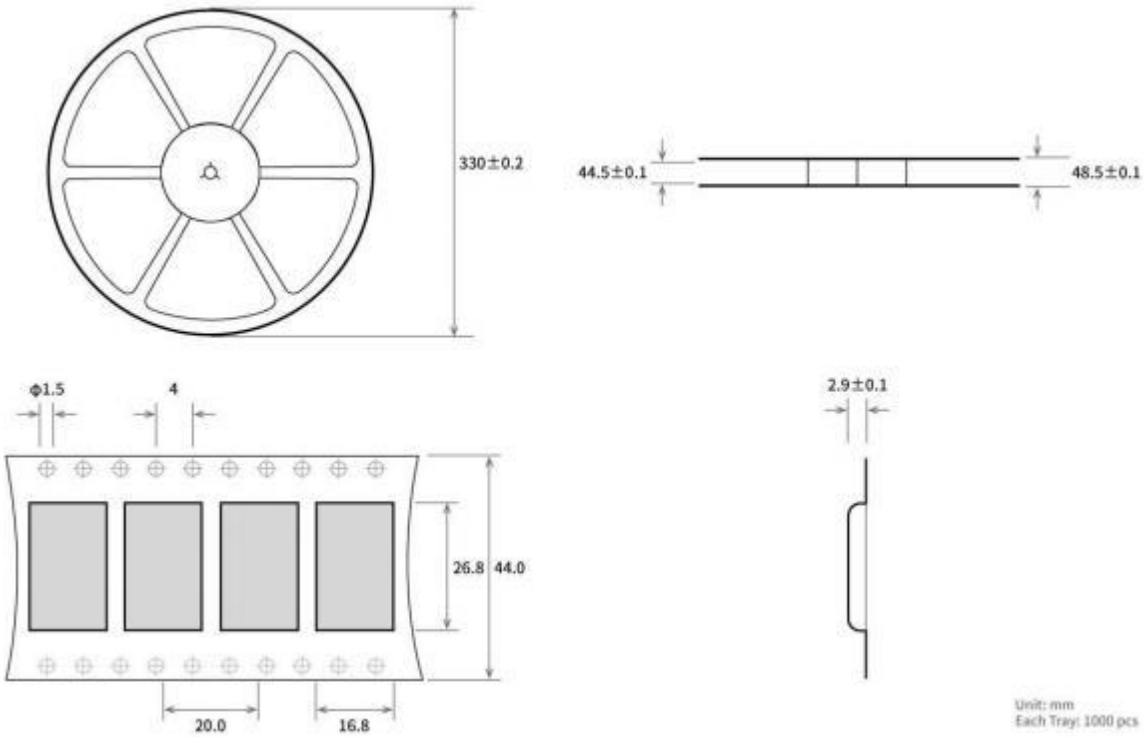
14. 1 Antenna recommendation

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 for our wireless modules.

Product Model	Type	Band Hz	Interface	Gain dBi	Height mm	Feeder cm	Features
TX868-JZ-5	Rubber rod antenna	868M	SMA-J	2.0	52	-	Ultra short straight, omnidirectional antenna
TX868-JK-20	Rubber rod antenna	868M	SMA-J	3.0	210	-	Bending rubber rod, omnidirectional antenna
TX868-XPL-100	Rubber rod antenna	868M	SMA-J	3.5	290	100	Small sucker antenna, cost performance
TX915-JZ-5	Rubber rod antenna	915M	SMA-J	2.0	52	-	Ultra short straight, omnidirectional antenna
TX915-JK-11	Rubber rod antenna	915M	SMA-J	2.5	110	-	Bendable rubber rod, omnidirectional antenna
TX915-JK-20	Rubber rod antenna	915M	SMA-J	3.0	210	-	Bendable rubber rod, omnidirectional antenna

TX915-XPL-100	Sucker antenna	915M	SMA-J	3.5	290	100	Small sucker antenna, cost performance

15. Batch packaging method



Revision history

Version	Revision Date	Revision Description	Maintainer
1.0	2022-03-23	Initial version	Jiang Heng
1.1	2023-06-20	Content correction	Hao

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