E29-T Series User Manual

PAN3031 433/470MHz 160mW Wireless Module



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Chapter 1 Overview

1.1 Introduction

Based on PANCHIP's RF chip PAN3031, the E29-T series products are a new generation of wireless serial port module (UART) independently developed by Chengdu Ebyte Electronics Co., Ltd. It's with a variety of transmission methods, working in the frequency band 410.125～493.125MHz (default 433.125MHz), and using industrial-grade high-precision 32MHz crystal oscillator.

The E29-T series adopts a new generation of ChirpIoT™ spread spectrum technology, supports half-duplex wireless communication, has the characteristics of high anti-interference and high sensitivity; It also has air wake-up, wireless configuration, automatic relay, communication key, AT Command, IAP upgrade and other functions; This series of modules is mainly for application in smart home, industry, scientific research, medical and short-distance wireless communication equipment. It supports packet length setting, and customized development service is also available.

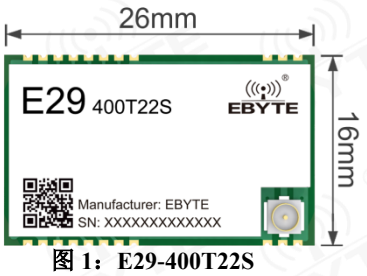


图 1：E29-400T22S

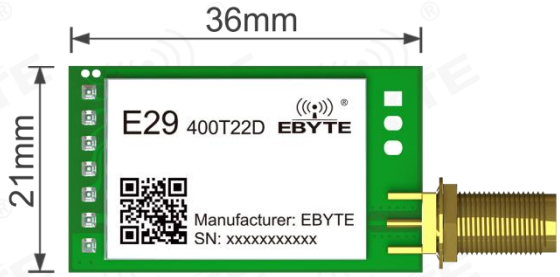


图 2：E29-400T22D

1.2 Features

- Support AT command, more convenient for use.
- Support IAP upgrade, more convenient to update firmware;
- ChirpIoT™-based modulation method brings longer communication distance and stronger anti-interference ability;
- Support automatic relay networking, multi-level relay is suitable for ultra-long-distance communication, and multiple networks run simultaneously in the same area;
- User can set the communication key by himself and the key cannot be read by others. It greatly improving the confidentiality of user data;
- Support RSSI signal strength indicator function for evaluating signal quality, improving communication network, and ranging;
- Support wireless parameter configuration, send command packets wirelessly, remotely configure or read wireless module parameters;
- Support wake-up over the air, that is ultra-low power consumption, suitable for battery-powered applications;
- Support point to point transmission, broadcast transmission, and channel listening;
- Support deep sleep, the power consumption of the whole module is about 2uA in this mode;
- Support global license-free ISM 433MHz frequency band, support 470MHz meter reading frequency band;

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- Under ideal conditions, the communication distance can reach 5km;
- The parameters are saved after power-off, and the module will work according to the set parameters after power-on;
- Efficient watchdog design, once an exception occurs, the module will automatically restart and continue to work according to the previous parameter settings;
- Support 2.4k～16.4kbps air data rate transmission;
- Support 2.6～5.5V power supply, power supply greater than 5V guarantees the best performance;
- Industrial standard design, supporting long-term use at -40～+85℃;

1.3 Application

- Home security alarm and remote keyless entry;
- Smart home and industrial sensors;
- Wireless alarm security system;
- Building automation solutions;
- Wireless industrial-grade remote control;
- Health care products;
- Advanced Meter Reading Architecture (AMI);

Chapter 2 Specification and Parameter

2.1 RF parameters

RF parm	Unit	Model No.		Remark
		E29-400T22S	E29-400T22D	
Max. Tx power	dBm	21.5～22	21.5～22	-
Receiving sensitivity	dBm	-125	-125	Air data rate 2.4kbps
Tested range	M	5Km		Test condition：clear and open area, antenna gain: 5dBi，antenna placement height: 2.5m，air data rate: 2.4kbps
Operating frequency	MHz	410.125～493.125	410.125～493.125	Support ISM frequency band
Air data rate	bps	2.4K～16.4K		To control via user's program
Blocking	dBm	10		Less chance of burning

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Power			when used at close range
TX packet length	Btye	240	Subpackage 32/64/128/240 bytes can be sent by command setting

2.2 Electrical parameters

Electrical parm		Unit	Model No.		Remark
			E29-400T22S	E29-400T22D	
Operating voltage		V	2.6～5.5	2.6～5.5	≥5V ensures output power, and it may be burning down over 5.5V.
Communication level		V	3.3V		For 5V TTL, it may be burning down
Power consumption	TX current	mA	110	110	Instant power consumption
	RX current	mA	15	15	15mA @ DCDC mode，20mA @ LDO mode
	Sleep current	uA	2	2	software shutdown
Temperature	Operating temperature	℃	-40～+85		Industrial grade
	Storage temperature	℃	-40～+85		Industrial grade

2.3 Hardware Parameters

Hardware parm	Model No.		Remark
	E29-400T22S	E29-400T22D	
Chipset	PAN3031		-
Crystal frequency	32MHz		Industrial grade high precision crystal oscillator
Modulation	ChirpIoT™		new-generation ChirpIoT™ modulation technology
Interface	1.27mm Stamp hole	2.54mm header	-
Communication Interface	UART serial port		TTLlevel
TX packet length	240 Btye		Subpackage 32/64/128/240 bytes can be sent by command setting
Encapsulation	SMD	DIP	-

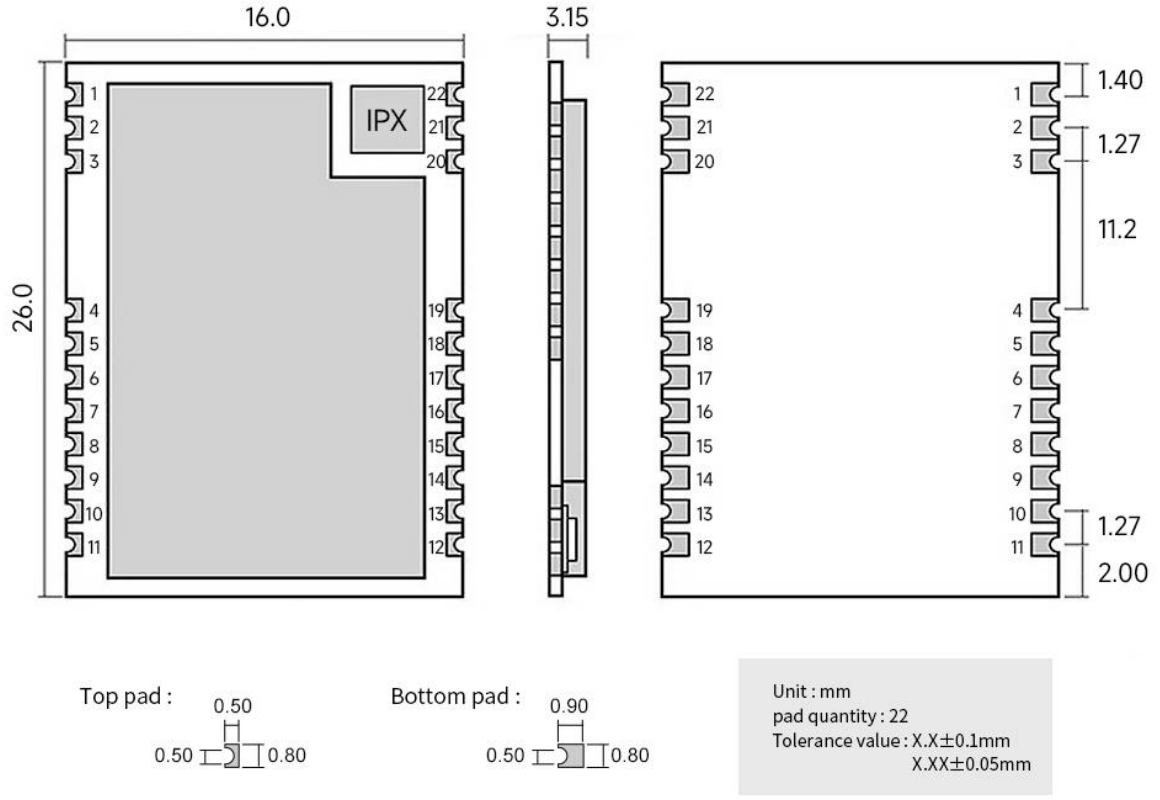
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Cache capacity	700 Btye		-
Antenna interface	IPEX/Stamp hole	SMA-K	Equivalent impedance about 50Ω
Size	26 * 16 mm	36*21mm	±0.1mm
Product Weight	2.37g	6.24g	±0.05g

Chapter 3 Size and Pin Definition

3.1 E29-400T22S Dimension and Pin definition



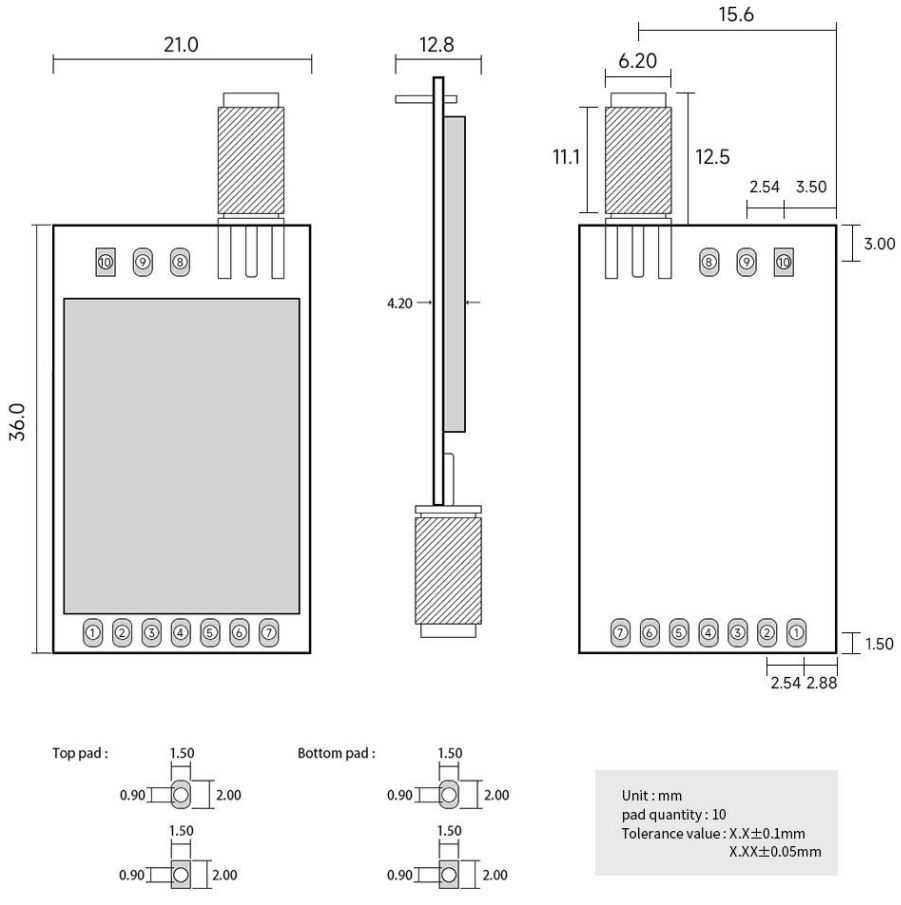
Pin No.	Pin Name	Pin Direction	Pin Function
1	GND	-	Module ground
2	GND	-	Module ground
3	GND	-	Module ground
4	GND	-	Module ground
5	M0	Input (pull-up)	Work with M1 to decide 4 working modes of module (not float, if not used, could be grounded).
6	M1	Input (pull-up)	Work with M0 to decide 4 working modes of module (not float, if not used, could be grounded).

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7	RXD	Input	TTL UART inputs, connects to external TXD output pin.
8	TXD	Output	TTL UART outputs, connects to external RXD input pin.
9	AUX	Output	Used to indicate the working status of the module; For user to wakes up the external MCU and it outputs low level during power-on self-check initialization; (can be left floating)
10	VCC	-	Module power positive reference, voltage range: 2.6～5.5V DC
11	GND	-	Module ground
12	RST	-	Module Reset pin
13	GND	-	Module ground
14	SWDIO	-	-
15	VDD	-	3.3V (The internal power supply is 3.3V, and power supply is prohibited)
16	RS485	-	RS485 enable
17	PA-RXEN	-	NC
18	PA-TXEN	-	NC
19	GND	-	Module ground
20	GND	-	Module ground
21	ANT	-	Antenna
22	GND	-	Module ground

3.2 E29-400T22D Dimension and Pin definition

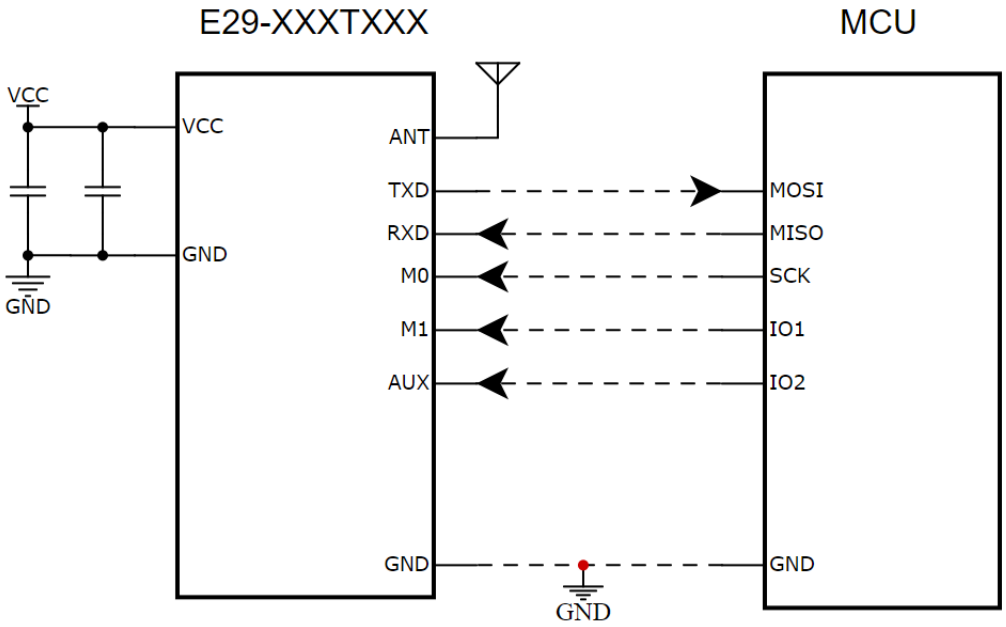


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Pin No.	Pin Name	Pin Direction	Pin Function
1	M0	Input (pull-up)	Work with M1 to decide 4 working modes of module (not float, if not used, could be grounded).
2	M1	Input (pull-up) ）	Work with M0 to decide 4 working modes of module (not float, if not used, could be grounded).
3	RXD	Input	TTL UART inputs, connects to external TXD output pin.
4	TXD	Output	TTL UART outputs, connects to external RXD input pin.
5	AUX	Output	Used to indicate the working status of the module; For user to wakes up the external MCU and it outputs low level during power-on self-check initialization; (can be left floating)）
6	VCC	Power supply	Module power positive reference, voltage range: 2.6～5.5V DC
7	GND	Power supply	Module ground
8	Fixed hole		Fixed hole （connect with module GND）
9	Fixed hole		Fixed hole （connect with module GND）
10	Fixed hole		Fixed hole （connect with module GND）

Chapter 4 Recommended Connection Diagram



No.	Brief instructions for the connection between module and MCU (Take STM8L as an example)
1	The wireless serial port module is TTL level, please connect with TTL level MCU

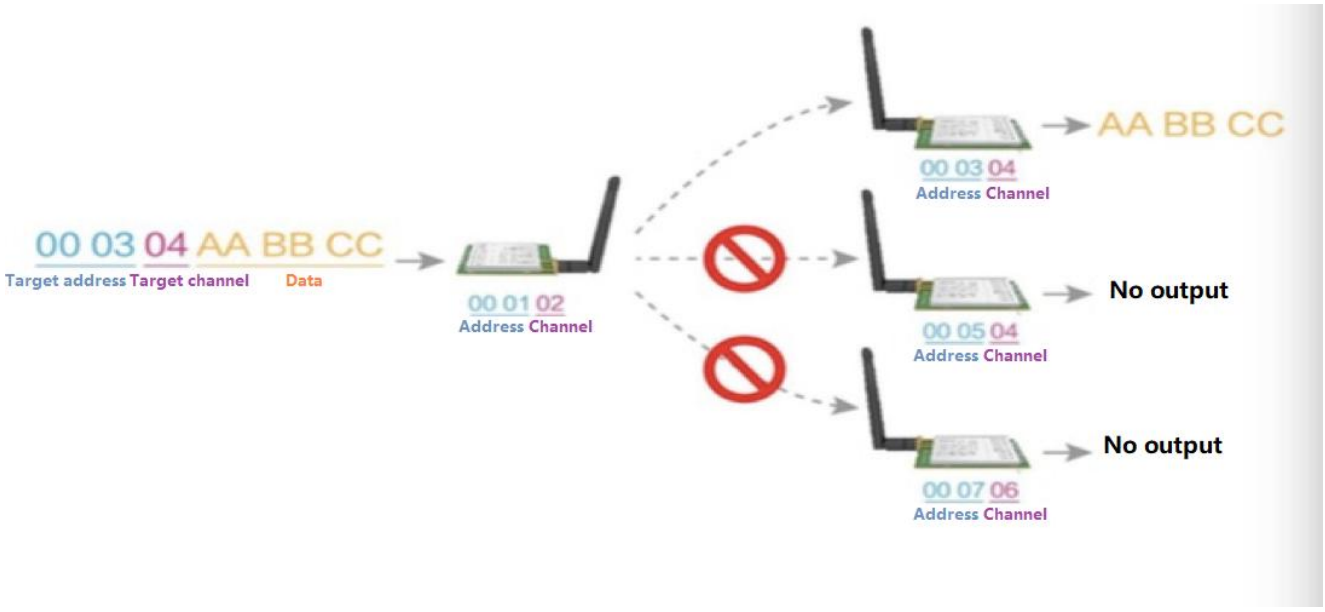
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2	For some 5V microcontrollers, it may be necessary to add 4-10K pull-up resistors to the TXD and AUX pins of the module.

Chapter 5 Function Description

5.1 Fixed Transmission



5.2 Broadcasting Transmission



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5.3 Broadcasting Address

- For 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

- For example: Set the address of module A as 0xFFFF, and the channel as 0x04;
- When module A is the receiver, it can receive the data sent from all modules under channel 0x04, the purpose of listening is realized.

5.5 Module Reset

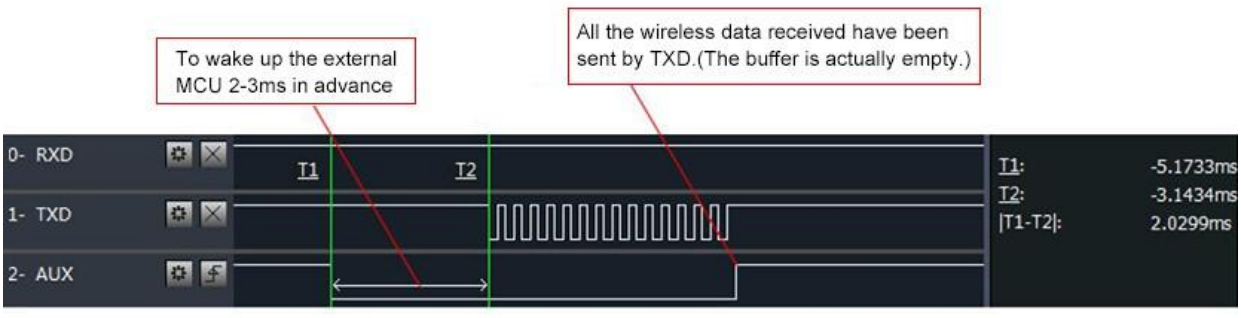
- After the module is powered on, AUX will immediately output low level, perform hardware self-check, and set the working mode according to user parameters;
- During this process, AUX keeps low level, and AUX outputs high level after completion, and starts to work normally according to the working mode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

5.6 AUX Description

- AUX Pin can be used as indication for wireless TX &RX buffer and self-check.
- It can indicate whether there is data not transmitted via wireless way, or whether the received data has not been sent through UART, or whether the module is still in the process of self-check initialization.

5.6.1 Indication of UART Output

- To wake up external MCU;



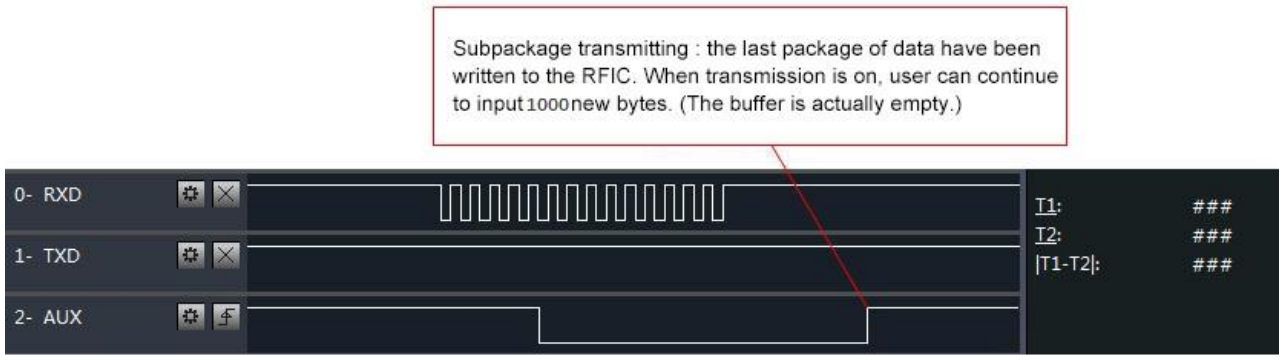
Timing Sequence Diagram of AUX when TXD pin transmits

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5.6.2 Indication of Wireless Transmitting

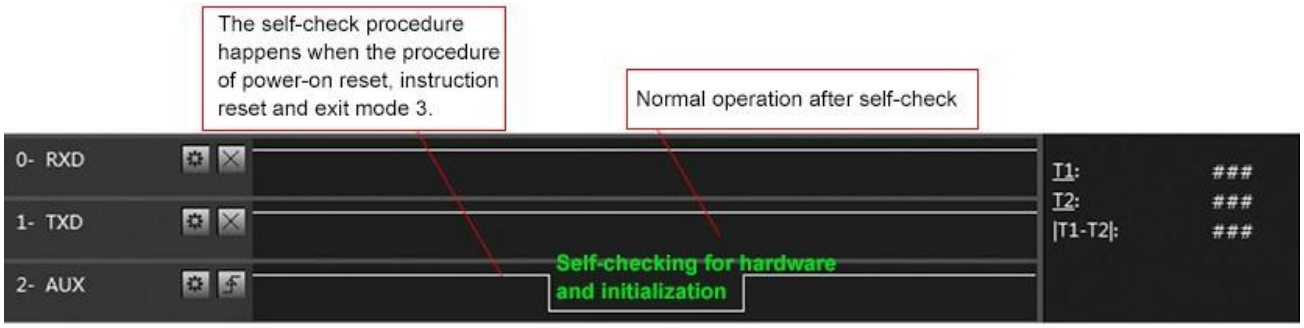
- Buffer empty: the data in the 700byte buffer in the module is written to the wireless chip (automatically sub-packaging);
  When AUX=1, if user continuously sends data less than 700 bytes, it won't overflow;
  When AUX=0, the buffer is not empty: It means data in the module's internal 700byte buffer has not been written to the wireless chip and has not been transmitted. At this time, the module may be waiting for the end of user inputing data (subject to timeout), or the module is going on with wireless sub-packet transmission. (下图中的 1000 需改为 700)



Timing Sequence Diagram of AUX when RXD pin receives

5.6.3 The module is being configured

- Only happened when resetting or exiting sleep mode



Timing Sequence Diagram of AUX when self-check

5.6.4 Notes for AUX

No.	Notes for AUX

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1	For function 1 (5.6.1) & function 2 ((5.6.2) mentioned above, the priority should be given to the one with low level output, which means as long as any output low level condition is met, AUX will output low level; Only when none of the output low level condition is met, AUX will outputs high level.
2	When AUX outputs low level, it means the module is busy & it won't conduct working mode checking. Within 1ms since AUX outputs high level, the module working mode switch will be completed.
3	After switching to new working mode, module will not work in the new mode immediately until AUX rising edge lasts for 2ms. If AUX is always at high level, then the mode switch will take effect immediately;
4	When the user switches to other working modes from mode 3 (sleep mode) or it is still in reset process, the module will reset user parameters, during which AUX outputs low level.
5	Due to the characteristics of the ChirpIoT™ modulation method, the information transmission delay is much longer than FSK. For example, at an air data rate of 1.2kbps, the transmission delay of 100 bytes is about 1.5 seconds. To avoid communication abnormalities caused by data accumulation and data loss, customer is suggested not to transmit large amounts of data at low air data rate.

Chapter 6 Working Mode

There are four working modes, which are set by M1 and M0, the details are as follows:

Mode（0-3）	M1	M0	Description	Remark
0 Transmission Mode	0	0	UART and wireless channel are open, transparent transmission is on	Support over-the-air configuration via special command
1 WOR Mode	0	1	Can be set as WOR Transmitter or WOR Receiver	Support wake up over the air
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 Mode	1	1	Module goes to sleep	

6.1 Notes for Mode Switching

No.	Remark
1	● Users can combine high and low levels with M1 and M0 to determine the module's working mode. Two GPIOs of the MCU can be used to control mode switching; ● After changing M1 and M0: If the module is idle, after 1ms, it can start working according to the new mode; ● If there is serial port data of the module not been transmitted through the wireless, the new working mode can be switched after the transmission is completed; ● If the module receives the wireless data and transmits the data through the serial port, it needs to finish transmission before switching to the new working mode; ● Therefore, mode switching can only be valid when AUX output is 1, otherwise it will delay switching
2	● For example, users 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 the user data before performing the new mode detection; ● Therefore, the general recommendation is to detect the output state of the AUX pin and switch mode after 2ms when AUX outputs high level.

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3	● When the module is switched to sleep mode from other modes, if there is data not been processed yet, the module will process these data (including receiving and sending) before entering sleep mode. This feature can be used for fast sleep to save power; ● For example, the transmitter module works in mode 0, the user transmits the serial port data "12345". At the time, user does need to wait for the AUX pin to be idle (high level), user can directly switch the module to sleep mode and make user's main MCU immediately sleep, then the module will automatically transmit the user data through the wireless, and will enters sleep mode within 1ms automatically; This will saves MCU's working time and reduces its power consumption.
4	● Similarly, any mode switching can use this feature. After the module processes the event in the current mode, it will automatically enter the new mode within 1ms; This saves the user's work of querying AUX and it achieves the purpose of fast switching; ● For example, switching from the transmit mode to the receive mode; the user MCU can also enter sleep before the mode switch, and use the external interrupt function to acquire the AUX change, thereby performing mode switching.
5	● This operation mode is very flexible and efficient. It is designed according to the user's MCU's operation convenience, and it can reduce the workload of the entire system as much as possible, improving system efficiency, and reducing power consumption as well..

6.2 Normal mode（Mode 0）

Type	When M0 = 0，M1 = 0，module works in Mode 0
Transmitting	Users can input data through the serial port and the module will start wireless transmission.
Receiving	The module wireless receiving function is turned on, and after receiving the wireless data, it will be output through the serial port TXD pin.

6.3 WOR mode（Mode 1）

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

6.4 Configuration mode（Mode 2）

Type	When M0 = 0，M1 = 1，module works in Mode 2
Transmitting	Wireless transmitting off, Automatically open during wireless configuration

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Receiving	Wireless receiving off, Automatically open during wireless configuration
Configuration	User can access registers to configure module operating status

6.5 Deep sleep mode（Mode 3）

Type	When M0 = 1，M1 = 1，module works in Mode 3
Transmitting	Unable to transmit wireless data
Receiving	Unable to receive wireless data
Note	When entering other modes from sleep mode, the module will reconfigure parameters. During the configuration process, AUX stays in low level; After completion of comfiguration, AUX will output a high level, so user is recommended to detect the rising edge of AUX.

Chatper 7 Register read and write control

7.1 Command format

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

No.	Command format	Description
1	Set register	Command: C0+starting address+length+parameters Response: C1+starting address+length+parameters E.g 1: Configure Channel to be 0x09 command starting address length parameter Send: C0 05 01 09 Return: C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K). Send: C0 00 04 12 34 00 60 Return: C1 00 04 12 34 00 60
2	Read register	Command: C1+starting address+ length Response: C1+starting address+length+parameters E.g 1：Read channel command starting address length parameter Send: C1 05 01 Returen: C1 05 01 09 E.g 2: Read module address, network address, serial port and air data rate. Send: C1 00 04 Return: C1 00 04 12 34 00 60
3	Set temporary	Command: C2+starting address+length+parameters

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	registers	Response: C1+starting address+length+parameters E.g 1: Configure Channel to be 0x09 command starting address length parameter Send: C2 05 01 09 Return: C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K). Send: C2 00 04 12 34 00 60 Return: C1 00 04 12 34 00 60
4	Wireless configuration	Command: CF CF + normal command Respond: CF CF + normal respond E.g 1: Configure Channel to be 0x09 by wireless configuration Command head command starting address length parameter Send: CF CF C0 05 01 09 Returen: CF CF C1 05 01 09 E.g 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and air data rate (2.4K) by wireless configuration. Send: CF CF C0 00 04 12 34 00 60 Return: CF CF C1 00 04 12 34 00 60
5	Wrong format	Wrong format respond: FF FF FF / “=ERR”

7.2 Register description

<table>
<tr><th>No.</th><th>Read or write</th><th>Name</th><th colspan="5">Description</th><th>Remark</th></tr>
<tr><td>00H</td><td>Read/ Write</td><td>ADDH</td><td colspan="5">ADDH（default 0）</td><td rowspan="2">High byte and low byte in the module address;
Note: When the module address is FFFF, it can be used as the broadcast and listening address, that is: the module will not perform address filtering.</td></tr>
<tr><td>01H</td><td>Read/ Write</td><td>ADDL</td><td colspan="5">ADDL（default 0）</td></tr>
<tr><td>02H</td><td>Read/ Write</td><td>NETID</td><td colspan="5">NETID（default 0）</td><td>Network address, used to distinguish the network. When two or more modules need to communicate with each other, their network address should be the same.</td></tr>
<tr><td rowspan="11">03H</td><td rowspan="11">Read/ Write</td><td rowspan="11">REG0</td><td>7</td><td>6</td><td>5</td><td>UART Serial port rate（bps）</td><td rowspan="10">For the two modules communicating with each other, their serial port baud rate can be different, and their serial parity bit can also be different.

When transmitting large packets continuously, users need to consider the data blocking and possible data loss caused by the same baud rate.

It is generally recommended that both communication parties have the same baud rate.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Serial port baud rate 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Serial port baud rate 2400</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Serial port baud rate 4800</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Serial port baud rate 9600（default）</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Serial port baud rate 19200</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Serial port baud rate 38400</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Serial port baud rate 57600</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Serial port baud rate 115200</td></tr>
<tr><td>4</td><td>3</td><td colspan="2">Serial parity bit</td><td>The communication parties can have different</td></tr>
</table>

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			0	0	8N1（default）		serial parity bit.
			0	1	8O1		
			1	0	8E1		
			1	1	8N1（equal to 00）		
			2	1	0	Wireless air data rate（bps）	The communication parties must have the same air data rate. The higher the air data rate is, the smaller the delay in response, and the shorter the transmission distance is. 0~4: BW = 250K 5~7: BW = 500K
			0	0	0	Air data rate 2.4k（default）	
			0	0	1	Air data rate 2.4K	
			0	1	0	Air data rate 2.4K	
			0	1	1	Air data rate 4.6k	
			1	0	0	Air data rate 8.2k	
			1	0	1	Air data rate 4.8k	
			1	1	0	Air data rate 16.4k	
			1	1	1	Air data rate 16.4k	
04H	Read/ Write	REG1	7	6	Sub packet setting		When the data sent is smaller than the sub packet length, the serial output of the receiving end is an uninterrupted continuous output. When the data sent is larger than the sub packet length, the serial port in receiving end will sub packet the data and then output them.
			0	0	240 bytes（default）		
			0	1	128 bytes		
			1	0	64 bytes		
			1	1	32 bytes		
			5	RF Power Mode			Users can change the RF power mode through AT commands: 1. DCDC mode reduces power consumption by sacrificing sensitivity; 2. LDO mode improves sensitivity by sacrificing power consumption; 3. It is recommended to use DCDC mode for battery-powered devices.
			0	DCDC mode（default）			
			1	LDO mode			
			4	3	2	Reserve	
			1	0	Transmitting power		Power and current are nonlinear, and power efficiency is highest at maximum power. The current does not decrease in proportion to the decrease in power.
			0	0	22dBm（default）		
			0	1	20dBm		
			1	0	17dBm		
			1	1	14dBm		
05H	Read/ Write	REG2	Channel control（CH） 0-83 represents a total of 84 channels				Actual Frequency= 410.125 + CH *1M
06H	Read/ Write	REG3	7	Enable RSSI			After enabled, when the module receives the wireless data, it will follow an RSSI strength byte after output via the serial port TXD
			0	Disable（default）			
			1	Enable			
			6	Transmission mode			In Fixed point transmission mode, the module recognizes the first three bytes of the serial data as: address high + address low + channel and takes it as the wireless transmitting target.
			0	Transparent transmission mode（default）			
			1	Fixed point transmission mode			
			5	Repeater function			After the repeater function is enabled, if the target address is not the module itself, the module will forward it once. In order to prevent data return-back, it is
			0	Disable repeater function（default）			
			1	Enable repeater function			

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<table>
<tr><td rowspan="15"></td><td rowspan="15"></td><td rowspan="15"></td><td></td><td colspan="4"></td><td>recommended to use it in conjunction with the fixed-point transmission mode.
That is: the target address is different from the source address.</td></tr>
<tr><td>4</td><td colspan="4">Reserve</td><td rowspan="3">Reserve</td></tr>
<tr><td>0</td><td colspan="4">Reserve</td></tr>
<tr><td>1</td><td colspan="4">Reserve</td></tr>
<tr><td>3</td><td colspan="4">WOR transceiver control</td><td rowspan="3">Below operation is valid for Mode 1 only；

1. In WOR receiving mode (as WOR receiver), the delay time after wake-up can be modified. The default time is 0;

2. To modify the delay time after wake-up, WOR receiver needs to send the command C0 09 02 E8 03 in the configuration mode (C0 is writing command, 09 is the starting address of the register, 02 is the length, 0x03E8 is the set delay, the maximum delay FFFF is 65535ms, if the delay is set to 0, the wake-up delay is turn off.)

3. Data can be sent within the delay.</td></tr>
<tr><td>0</td><td colspan="4">WOR receiver（default）
Working in WOR listening mode, the listening period is shown below (WOR period), which can save a lot of power consumption.</td></tr>
<tr><td>1</td><td colspan="4">WOR transmitter
The module receiving and transmitting functions are turned on, and a wake-up code of a period of time is added when transmitting data.</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>WOR cycle time</td><td rowspan="9">Below description is valid for Mode 1 only；

Cycle time T = (1 + WOR) * 500ms, max.4000ms, min.500ms;

The longer the cycle time T (WOR listening interval period), the lower the average power consumption, but the greater the data delay.

Both the transmitter and the receiver must be set as the same cycle time T (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">High byte of Key（default 0）</td><td rowspan="2">Write only, read returns 0

Used for user encryption to avoid interception of wireless data over the air by similar modules. The module will internally use these two bytes as a calculation factor to do a transform encryption processing for the wireless signal over the air..</td></tr>
<tr><td>08H</td><td>Write</td><td>CRYPT_L</td><td colspan="4">Low byte of Key（default 0）</td></tr>
</table>

7.3 Factory default parameter

Item	Factory default parameter：C0 00 09 00 00 00 60 00 17 03 00 00						
Model No	Frequency	Address	Channel	Air data rate	Baud rate	Parity format	Power
E29-400T22S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	22dbm
E29-400T22D	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	22dbm

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Chatper 8 AT Command

- AT commands are used in configuration mode, there are three kinds of AT commands: command commands, setting commands and query commands;
- The user can query the AT command set supported by the module through "AT+HELP=?", and the baud rate adopted by the AT command is 9600 8N0;
- When the input parameter exceeds the range, it will be restricted. Please do not let the parameter exceed the range, otherwise there will come unknown issues.

8.1 AT command table

Command commands	Description	Example	Example description
AT+IAP (Use with caution, please refer to 8.3 IAP Upgrade Notes for details)	Enter IAP upgrade mode	AT+IAP	Enter IAP upgrade mode
AT+RESET	Device restart	AT+RESET	Device restart
AT+DEFAULT	restore default settings	AT+DEFAULT	restore default settings

Setting commands	Description	Example	Example description
AT+UART=baud,parity	Set baud rate and parity	AT+UART=3,0	Set baud rate 9600，8N0
AT+RATE=rate	Set air data rate	AT+RATE=7	Set air data rate 16.4K
AT+PACKET=packet	Set packet length	AT+PACKET=0	Set packet length 240bytes
AT+WOR=role,period	Set WOR role and cycle	AT+WOR=0,3	Set as WOR receiver，cycle 2000ms
AT+POWER=power	Set TX power	AT+POWER=0	Set TX power: 22dBm
AT+TRANS=mode	Set transmission mode	AT+TRANS=1	Set as fixed transmission mode
AT+ROUTER=router	Set repeater mode	AT+ROUTER=1	Set as repeater mode
AT+DRSSI=data_rssi	Turn on the RSSI output	AT+DRSSI=1	Receive data RSSI function open
AT+LDO=ldo	RF LDO Power Mode Switch	AT+LDO=1	Set RF LDO mode
AT+ADDR=addr	Set module address	AT+ADDR=1234	Set module address: 1234
AT+CHANNEL=channel	Set module working channel	AT+CHANNEL=23	Set working frequency: 433.125M
AT+NETID=netid	Set network ID	AT+NETID=2	Set network ID: 2
AT+KEY=key	Set module key	AT+KEY=1234	Set module key: 1234
AT+DELAY=delay	Set WOR delay sleep time	AT+DELAY=1000	Set WOR delay sleep time: 1000ms

Query commands	Description	Example	Example description
AT+HELP=?	Query the AT command		Return the AT command

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	table		table
AT+DEVTYPE=?	Query module model	DEVTYPE=E29-400T22S/D	Return module model
AT+FWCODE=?	Query firmware code	FWCODE=7432-0-10	Return firmware code
AT+UART=?	Query baud rate and parity	AT+UART=3,0	Return baud rate and parity: 9600，8N0
AT+RATE=?	Query air data rate	AT+RATE=7	Return air data rate 16.4K
AT+PACKET=?	Query packet length	AT+PACKET=0	Return packet length 240bytes
AT+WOR=?	Query WOR roles and cycle	AT+WOR=0,3	Return WOR receiver，cycle 2000ms
AT+POWER=?	Query TX power	AT+POWER=0	Return TX power 22dBm
AT+TRANS=?	Query transmission mode	AT+TRANS=1	Return fixed transmission mode
AT+ROUTER=?	Query repeater mode	AT+ROUTER=1	Return repeater mode
AT+DRSSI=?	Query RSSI output	AT+DRSSI=1	Return channel RSSI function is turned on
AT+LDO=?	Query RF Power Mode	AT+LDO=0	Return DCDC RF Power Mode
AT+ADDR=?	Query module address	AT+ADDR=1234	Return module address 1234
AT+CHANNEL=?	Query module working channel	AT+CHANNEL=23	Return working frequency 433.125M
AT+NETID=?	Query network ID	AT+NETID=2	Return network ID 2
AT+KEY=?	Query module key	AT+KEY=0（unreadable）	Return module key 0
AT+DELAY=?	Query WOR delay sleep time	AT+DELAY=1000	Return WOR delay sleep time 1000ms

8.2 AT parameter analysis

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

Command parameter	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 parity）	0:8N1 1:8O1 2:8E1 3:8N1
Rate（air data rate）	0:2.4K 1:2.4K 2:2.4K 3:4.6K 4:8.2K 5:4.8K 6:16.4K 7:16.4K
Packet（packet length）	0:240 1:128 2:64 3:32
Role（WOR role）	0: receiver 1: transmitter
Period（WOR cycle）	0:500ms 1:1000ms 2:1500ms 3:2000ms 4:2500ms 5:3000ms 6:3500ms 7:4000ms
Power（TX power）	0:22dBm 1:20dBm 2:17dBm 3:14dBm
Mode（transmission mode）	0: transparent 1: fixed

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Router（repeater mode）	0: close 1: open
Data_rssi（data RSSI）	0: close 1: open
Ldo（LDO mode switch）	0:DCDC 1:LDO
Addr（module address）	Module address 0~65535（Decimal）
Channel（module channel）	Module channel 0~83（Decimal）
Netid（network ID）	Module network 0~255（Decimal）
Key（key）	Module key 0~65535（Decimal）
Delay（WOR delay sleep time）	delay sleep time 0~65535（Decimal）

8.3 IAP upgrade Notes

If the customer needs to upgrade the firmware, please find the corresponding BIN file provided by the official, and then use the official host control software to upgrade the firmware. Generally, the user does not need to upgrade the firmware. Please do not use the "AT+IAP" command .

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

After entering the upgrade mode, the baud rate will automatically switch to 115200 until it exits automatically, during which there will be log output.

Chatper 9 Repeater networking mode

No.	Repeater mode description
1	User need to set the repeater function in configuration mode. After setting, switch module to the normal mode. Then the repeater starts working.
2	In the repeater mode, ADDH/ADDL is no longer used as the module address, it is used as a NETID to pair and forwarding. If the reperater receive the data from a network, then it will forward the data to the other network. The network ID of the repeater itself is invalid in this case. (See below examples)
3	The repeater module cannot transmit and receive data, and cannot perform low-power operation.
4	When module enters the other modes from mode 3 (sleep mode) or during the reset process, it will reset the user parameters. During this period, AUX outputs low level.

Repeater networking rules:

1. Forwarding rules: the repeater can forward data in both directions between two NETIDs.

2. In repeater mode, ADDH\ADDL is no longer used as the module address. It is used as a NETID to pair and forwarding.

As shown in the figure：

① Primary repeater

“Node 1” NETID is 08.

“Node 2” NETID is 33.

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ADDH\ADDL of Repeater 1 are 08，33 respectively.

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

Meanwhile,node 1 and node 2 have the same address, so the data transmitted by node 1 can be received by node 2.

② Secondary repeater

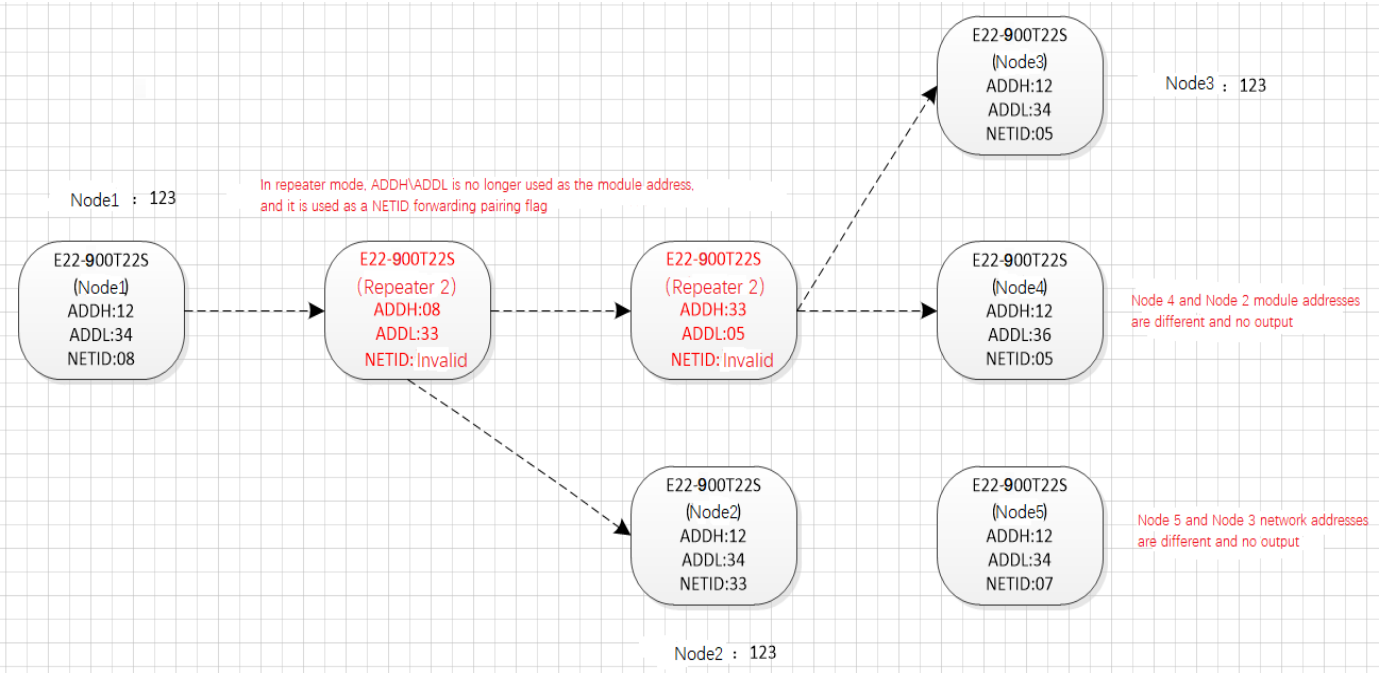
ADDH\ADDL of Repeater 2 are 33，05 respectively.

Therefore, Repeater 2 can forward the data of Repeater 1 to the network NETID: 05.

Thus node 3 and node 4 can receive the data from node . Node 4 outputs data normally, but no ourput from Node3 because Node 3 has a different address from Node 1.

③ Two-way repeater

As shown in below： The data sent by Node 1 can be received by Node 2 and Node 4; The data sent by by Node 2 and Node 4 can also be received by Node 1.



Chapter 10 Configuration instructions on computer

- The following figure is the display interface of E29-400T22S configuration on computer. User can switch to the command mode through M0, M1, and quickly configure and read the parameters on computer. (配置软件要英文界面)

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- In the configuration on computer, the module address, Channel, network ID, and key are all in decimal. The range of values of each parameter is:

  Network address: 0～65535

  Channel：0～83

  Network ID：0～255

  Key：0～65535

- When user configures the repeater mode using the host computer, one point much be paid attention to: In the configuration software, each parameter is in decimal, so the module address and network ID need to be converted when set it.
- For example, in the configure software, if the network ID of Transmitter A is input 02, and the network ID of Receiver B is input 10, then the module address of Repeater R should be set as 522. (The address of Repeater R is 0X020A in hex, and it need to be converted to decimal.)

Chapter 11 Hardware design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible, and the module needs to 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 it is within the recommended voltage, otherwise, the module will be permanently damaged when it exceeds the maximum voltage;
- Please check the stability of the power supply, the voltage can not be fluctuated frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, which is beneficial for long-term stable operation of the whole machine ;
- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and

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other parts with large electromagnetic interference.;

- High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;
- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees;
- It is assumed that there are devices with large electromagnetic interference around the module that will greatly affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;
- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference.If necessary, appropriate isolation and shielding can be done.
- If the communication line uses a 5V level, a 1k-5.1k resistor must be connected in series (5V communication level is not recommended, there is still a risk of damage);
- The mounting structure of antenna has a great influence on the performance of the module. It is necessary to ensure that the antenna is exposed, preferably vertically upward.
- When the module is mounted inside the case, user could use a good antenna extension cable to extend the antenna to the outside;
- The antenna must not be installed inside the metal case, which will decrease the transmission distance greatly.

Chapter 12 FAQ

12.1 Communication range is too short

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly;
- Temperature, humidity, and co-channel interference will increase the communication packet loss rate;
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing module near ground.
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea.
- The signal will be attenuated seriously when there is metal objects near the antenna or module is put in a metal case.
- Power register was set incorrectly, air data rate is set too high (the higher the air data rate, the shorter the transmission distance).
- The power supply voltage is lower than the recommended value under room temperature. (the lower the voltage, the lower the transmitting power.)
- Due to antenna quality or poor matching between antenna and module.

12.2 Module is easy to be damaged

- Please check the power supply, ensure it is in right range, voltage higher than max value will damage the module.

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- Please check the stability of power supply, the voltage cannot fluctuate too much.
- Please ensure anti-static operation during installation and in use, high-frequency devices are sensitive to static electricity
- Please ensure that the humidity during installation and in use should not be too high, some components are sensitive to humidity.
- Please avoid using modules at too high or too low temperature if there is no special requirement.

12.3 BER(Bit Error Rate) is high

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

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Chapter 13 Welding Work Instructions

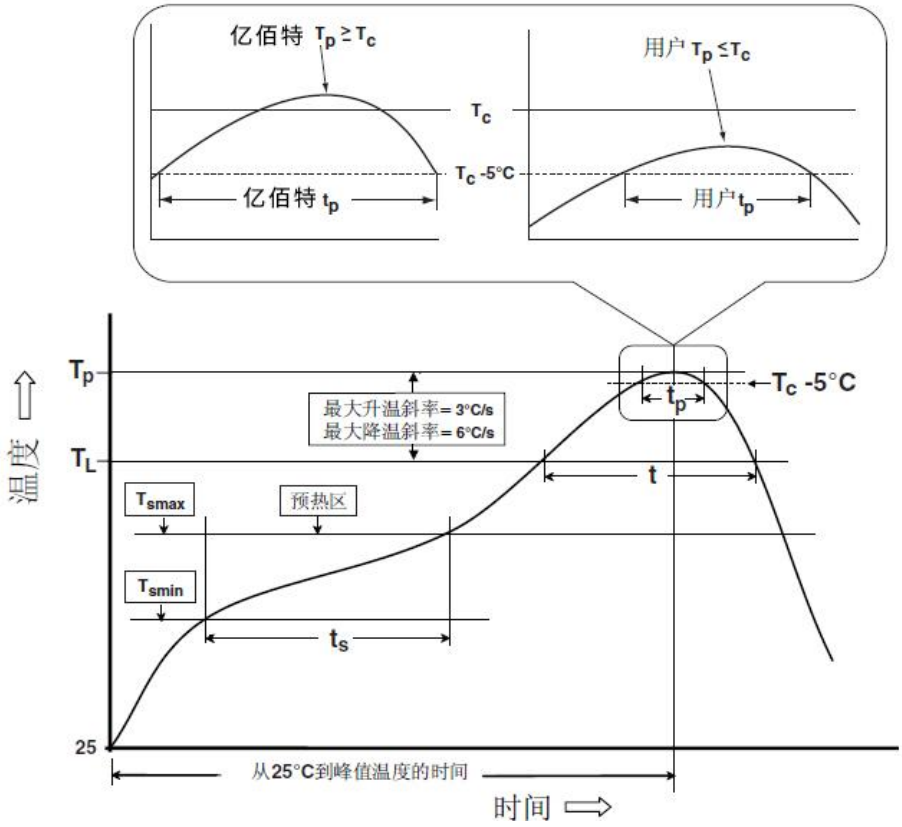
13.1 Reflow soldering temperature

Reflow Soldering Profile Characteristics		**Sn-Pb Assembly**	**Pb-Free Assembly**
Preheat/keep warm	Min. Temperature（Tsmin）	100℃	150℃
	Max. Temperature（Tsmax）	150℃	200℃
	Time（Tsmin~Tsmin）	60-120s	60-120s
Average ramp-up rate（T_L~T_P）		3℃/s, Maximum	3℃/s, Maximum
Liquidous Temperature（T_L）		183℃	217℃
Time（tL）Maintained Above		60~90s	60~90s
Package peak temperature T_P		Should not exceed the temperature indicated on the product's label of "Moisture Sensitivity".	Should not exceed the temperature indicated on the product's label of "Moisture Sensitivity".
The time (Tp) within 5°C of the specified classification temperature (Tc), see the figure below		20s	30s
Aveage ramp-down rate（Tp~T_L）		6℃/s, Maximum	6℃/s, Maximum
Time from 25℃ to peak temperature		6min，Maximum	8min，Maximum
※The peak temperature (Tp) tolerance definition of the temperature profile is an upper limit for the user			

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13.2 Reflow soldering curv



Chatper 14 Retaled series

Model No.	**Chip**	Frequency **Hz**	Tx power **dBm**	Tested Distance **km**	Package	**Size mm**	Communication Interface
E22-230T22S	SX1262	230M	22	5	SMD	16*26	TTL
E22-230T30S	SX1262	230M	30	10	SMD	20*40.5	TTL
E22-400T22S	SX1262	433/470M	22	5	SMD	16*26	TTL
E22-400T30S	SX1262	433/470M	30	10	SMD	20*40.5	TTL
E22-900T22S	SX1262	868/915M	22	5	SMD	16*26	TTL
E22-900T30S	SX1262	868/915M	30	10	SMD	20*40.5	TTL
E22-400M22S	SX1262	433/470M	22	7	SMD	14*20	SPI
E22-400M30S	SX1262	433/470M	30	12	SMD	24*38.5	SPI
E22-900M22S	SX1262	868/915M	22	7	SMD	14*20	SPI
E22-900M30S	SX1262	868/915M	30	12	SMD	24*38.5	SPI

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Chapter 15 Antenna recommendation

15.1 Antenna recommendation

The antenna is an important role in the communication process. A good antenna can largely improve the communication system. Therefore, we recommend some antennas for wireless modules with excellent performance and reasonable price.

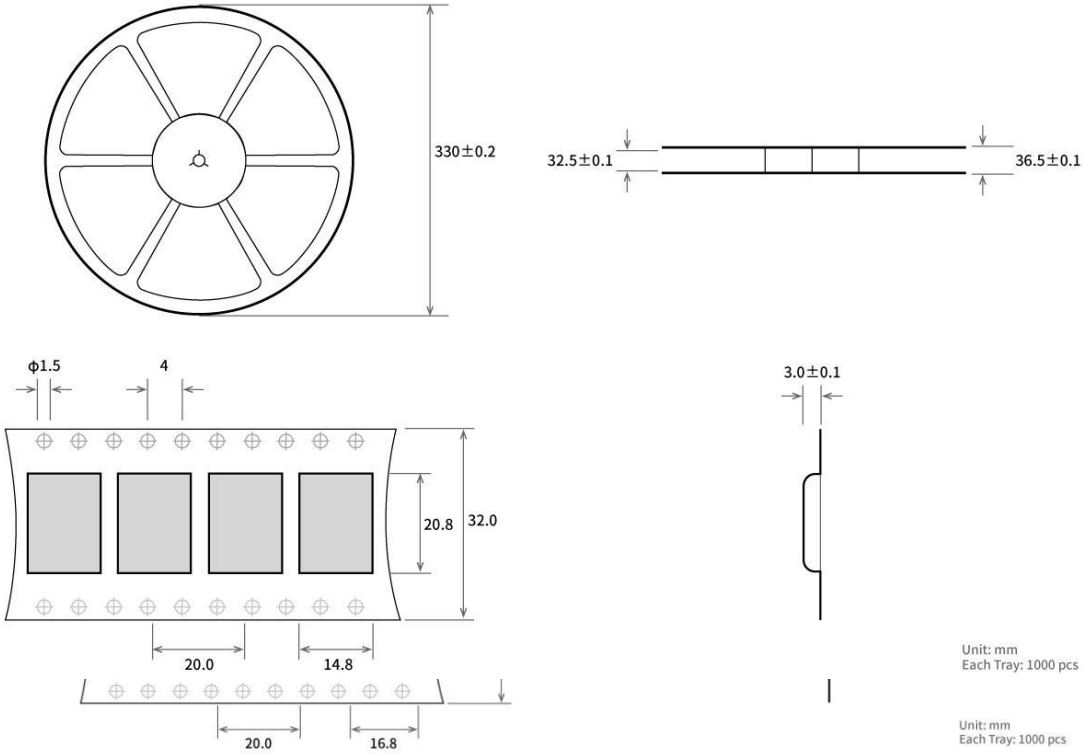
Model No.	Type	Frequency Hz	nterface	Gain dBi	Height	Cable length cm	Function & Feature
TX433-NP-4310	FPC antenna	433M	焊接	2.0	43.8*9.5	-	Embedded FPC antenna
TX433-JZ-5	Rubber antenna	433M	SMA-J	2.0	52	-	Short straight &omnidirectional
TX433-JZG-6	Rubber antenna	433M	SMA-J	2.5	62	-	Short straight &omnidirectional
TX433-JW-5	Rubber antenna	433M	SMA-J	2.0	50	-	Flexible &omnidirectional
TX433-JWG-7	Rubber antenna	433M	SMA-J	2.5	75	-	Flexible &omnidirectional
TX433-JK-11	Rubber antenna	433M	SMA-J	2.5	110	-	Flexible &omnidirectional
TX433-JK-20	Rubber antenna	433M	SMA-J	3.0	210	-	Flexible &omnidirectional
TX433-XPL-100	Sucker antenna	433M	SMA-J	3.5	185	100	Small sucker antenna, cost-effictive
TX433-XP-200	Sucker antenna	433M	SMA-J	4.0	190	200	Medium sucker antenna,low power comsumption
TX433-XPH-300	Sucker antenna	433M	SMA-J	6.0	965	300	Large sucker antenna, high gain
TX490-JZ-5	Sucker antenna	470/490M	SMA-J	2.0	50	-	Short straight &omnidirectional
TX490-XPL-100	Sucker antenna	470/490M	SMA-J	3.5	120	100	Small sucker antenna, cost-effictive

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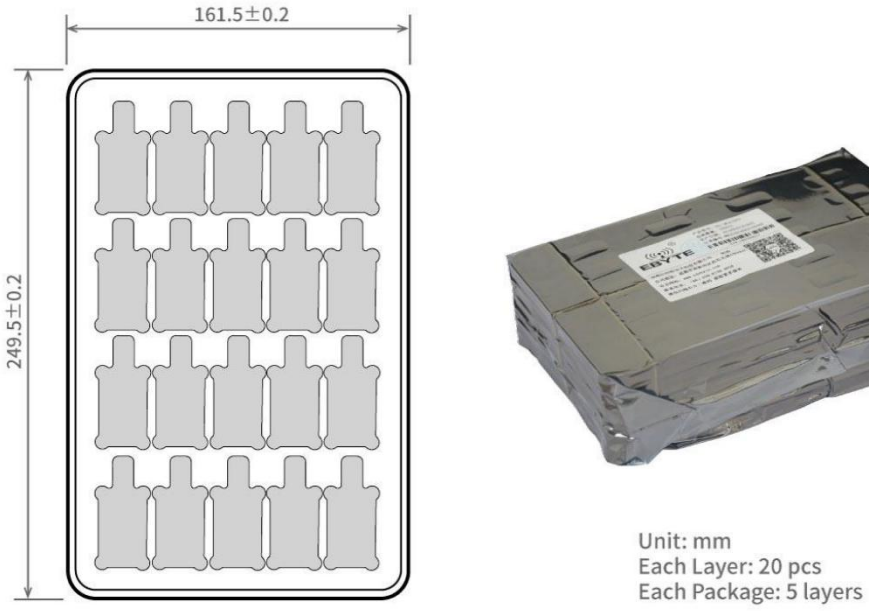
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Chapter 16 Bulk Packing

15.1 E29-400T22S bulk packing



15.1 E29-400T22D bulk packing



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Revision history

Version	Date	Description	Issued by
1.0	2022-12-12	Initial version	Weng
1.1	2024-3-8	Content Modifications	Lau
1.2	2025-5-26	Content Modifications	Lau

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