E32-xxxT20x User Manual

AT commands, 20dBm LoRa, Wireless Module

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Contents

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1 Introduction

1.1 Product Introduction

E32-xxxT20x series (UART) module is developed based on SEMTECH classic RF chip. It's transmitting power is 20 dBm, with a variety of transmission modes, working frequency band in 400 and 900 band, LoRa spread frequency technology, TTL level output, compatible with 3.3V IO port voltage.

E32-xxxT20x adopts the new generation of LoRa expansion technology, LoRa ™ straight sequence expansion technology has the advantages of farther communication distance, strong anti-interference ability, and strong confidentiality. The default air rate is 2.4 kbps and the transmitting power is 20 dBm, so as to improve the communication stability and extend the communication distance; industrial active temperature filling vibration is adopted to ensure its stability and consistency. At present, it has been stable in mass production, and has been widely used in the three-table industry, Internet of things transformation, smart home and other fields.

The four modules in the figure below have the same power and different frequency bands.

Figure 1: E32-433T20S

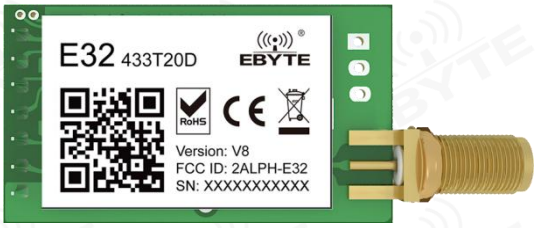


Figure 2: E32-433T20D

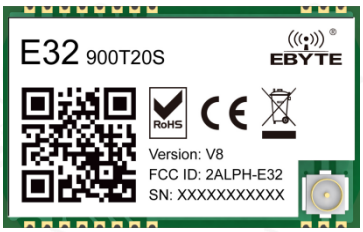


Figure 3:E32-900T20S

Figure 4: E32-900T20D

1.2 Features

- Using the new generation of LoRa spread spectrum modulation technology, bring farther communication distance, anti-interference ability is stronger;
- Support serial port upgrade firmware, update firmware is more convenient;
- Support AT instruction, more convenient to use;
- Support FEC forward error correction to improve communication stability;
- Support for the global license-free ISM 433MHz frequency band;
- Support the 868 / 915 MHz EU universal frequency band;
- Support users to set the communication key, and can not be read, greatly improve the confidentiality of user data;
- Support the LBT function, and monitor the channel environment noise before sending, which can greatly improve the communication success rate of the module in the harsh environment;
- Support RSSI signal strength indication function for assessing signal quality, improving communication network and ranging;
- Support wireless parameter configuration, through wireless sending command packet, remote configuration or reading wireless module parameters;
- Support air wake-up, that is, ultra-low power consumption function, suitable for the application scheme of battery power supply;
- Support fixed-point transmission, broadcast transmission, and channel monitoring;
- Support deep dormancy, the power consumption of the whole machine is about 3 uA;
- Under ideal conditions, the communication distance can reach 5km;
- The parameters are saved, and the module will work according to the set parameters;
- Efficient watchdog design, in case of abnormal, the module will automatically restart, and can continue to work according to the previous parameter Settings;
- Support for 2.4K~19.2K bps of data transmission rate;
- Support 2.7~5.5V power supply, more than 5V power supply can ensure the best performance;
- Industrial grade standard design, support-40~ + 85℃ for a long time to use;
- The maximum module power is 100 mW (20 dBm), and the transmission is farther and more stable.

1.3 Applications

- 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).

2 Specification and parameters

2.1 RF parameters

RF parameter	Unit	Performance			Remarks
		Min	Type	Max	
Max TX Power	dBm	-	20	-	-
RX Sensitivity	dBm	123	124	125	The air rate was 2.4 kbps
Reference Distance	M	-	5K	-	Clear and empty, antenna gain 5 dBi, antenna height 2.5 m, air rate 2.4 kbps.
Work Frequency Band	MHz	410	433	441	Suitable for E32-433T 20S, E32-433T 20D.
	MHz	862	900	930	Suitable for E32-900T 20S, E32-900T 20D.
Air Rate	bps	2.4K	2.4K	19.2K	User programming control
Block Power	dBm	-	-10	-	The probability of burning in close range use is small

2.2 Electrical parameters

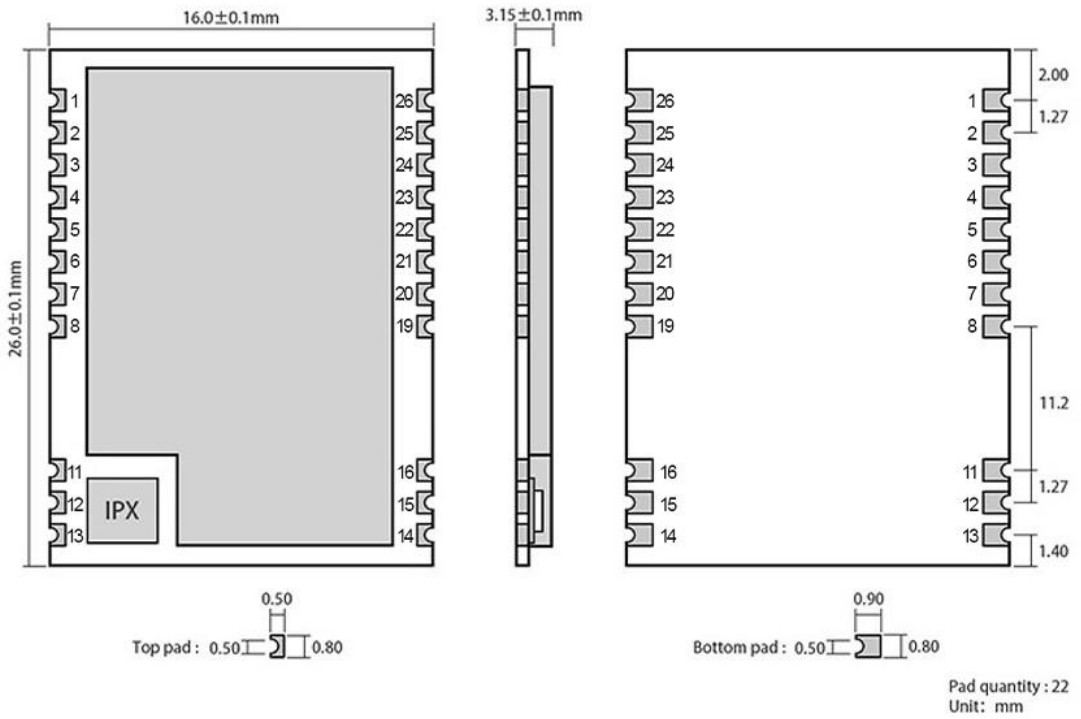
Electrical parameters		Unit	Performance			Remarks
			Min	Type	Max	
Working voltage		V	2.7	5.0	5.5	5V can guarantee the output power, over 5.5V permanently burned module.
Communication level		V	-	3.3V	-	Use 5V TTL
Power Dissipation	emission current	mA	110	110	150	Instantaneous power consumption of @ 20 dBm
	receive current	mA	15	15	17	
	The dormant current	uA	3	3	3	Software off
Temperature	working temperature	℃	-40～+85			Industrial grade design
	storage temperature	℃	-40～+85			Industrial grade design

2.3 Hardware parameters

Hardware parameters	Model				Remarks
	E32-433T20S	E32-433T20D	E32-900T20S	E32-900T20D	
modulation mode	LoRa				New-generation of LoRa modulation technology
Interface mode	1.27mm stamp hole	Pin plug-in	1.27mm stamp hole	Pin plug-in	
CI	UART gorge line				TTL electrical level
Launch length	58 B tye				Maximum capacity of single package, automatic subcontracting after exceeding
Packaging method	Patch type				-
Cache capacity	512B tye				-
Antenna interface	IPEX / Stamp hole	SMA-K	IPEX / Stamp hole	SMA-K	The equivalent impedance is about 50 Ω
size	16*26mm	21*36 mm	16*26mm	21*36 mm	±0.2mm
Net weight of products	2.3g	7.6	5.8g	2.3g	±0.1g

3 Size and pin definition

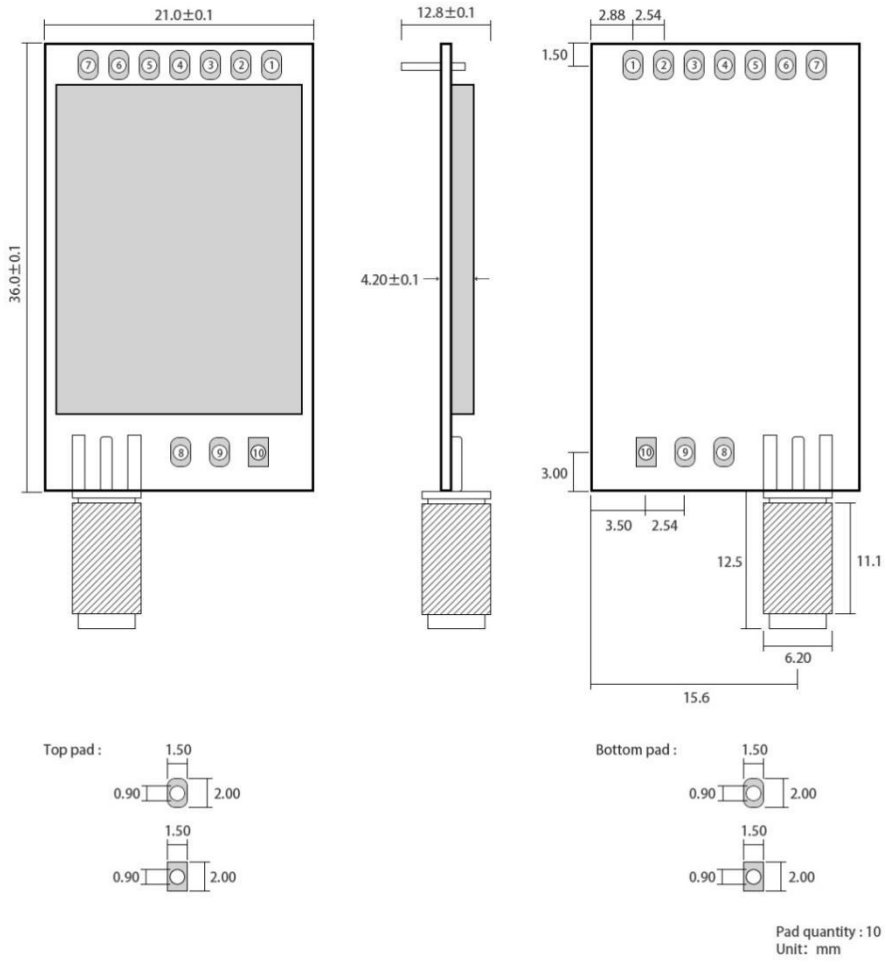
3.1 E32-400 / 900T20S



Pin No.	Item	Direction	Description
1	NRST	import	Module reset pin
2	GND	-	Module ground wire
3	NC	-	Empty feet
4	NC	-	Empty feet
5	NC	-	Empty feet
6	NC	-	Empty feet
7	NC	-	Empty feet
8	GND	-	Module ground wire
11	GND	-	Module ground wire
12	ANT	output	Antenna interface (high-frequency signal output, 50 ohm characteristic impedance)
13	GND	-	Module ground wire
14	GND	-	Module ground wire
15	GND	-	Module ground wire
16	GND	-	Module ground wire

19	GND	-	Module ground wire
20	M0	Input (very weak pull-up)	With M1, determine the four working modes of the module (not suspended, if not grounded)
21	M 1	Input (very weak pull-up)	With M 0, determine the four working modes of the module (not suspended, if not grounded)
22	RXD	import	TTL serial port input, connected to the external TXD output pin;
23	TXD	output	TTL, serial port output, connected to the external RXD output pin;
24	AUX	output	Used to indicate the working state of the module; user awakens external MCU and output low level during self-test initialization (can be suspended)
25	VCC	-	Module power supply is positive reference, voltage range: 2.7~5.5V DC
26	GND	-	Module ground wire

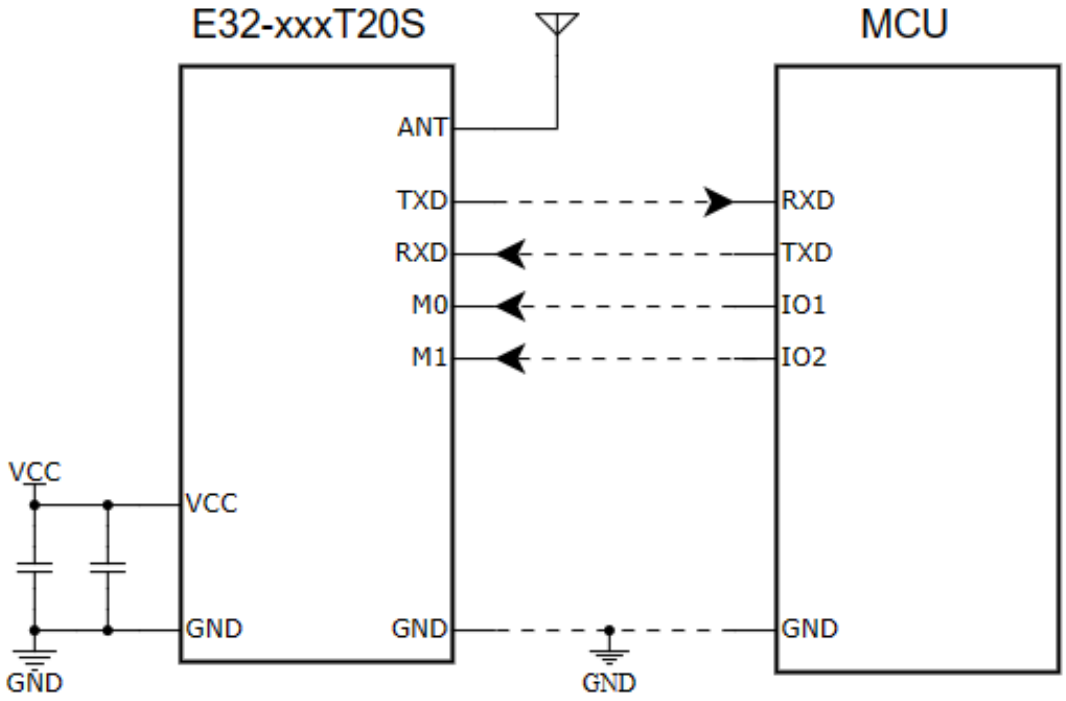
3.2 E32-400 / 900T20D



Pin No.	Item	Direction	Description
1	M0	Input (very weak	And M1, determines the four working modes of the module.

		pull-up)	
2	M1	Input (very weak pull-up)	With M0, we can determine the four working modes of the module.
3	RXD	import	TTL serial port input, connected to the external TXD output pin; Can be configured for drain open or pull-up input, see parameter settings.
4	TXD	output	TTL serial port output, connected to the external RXD input pin; It can be configured as open drain or push output, see parameter settings.
5	AUX	output	To indicate the working status of the module; (it can be suspended) The user wakes up the external MCU and output low level during the self-test; It can be configured as drain open output or push pull output, see parameter settings.
6	VCC	import	Module power supply is positive reference, voltage range: 2.3~5.5V DC
7	GND	import	Module ground wire
8	lashing eye		lashing eye
9	lashing eye		lashing eye
10	lashing eye		lashing eye

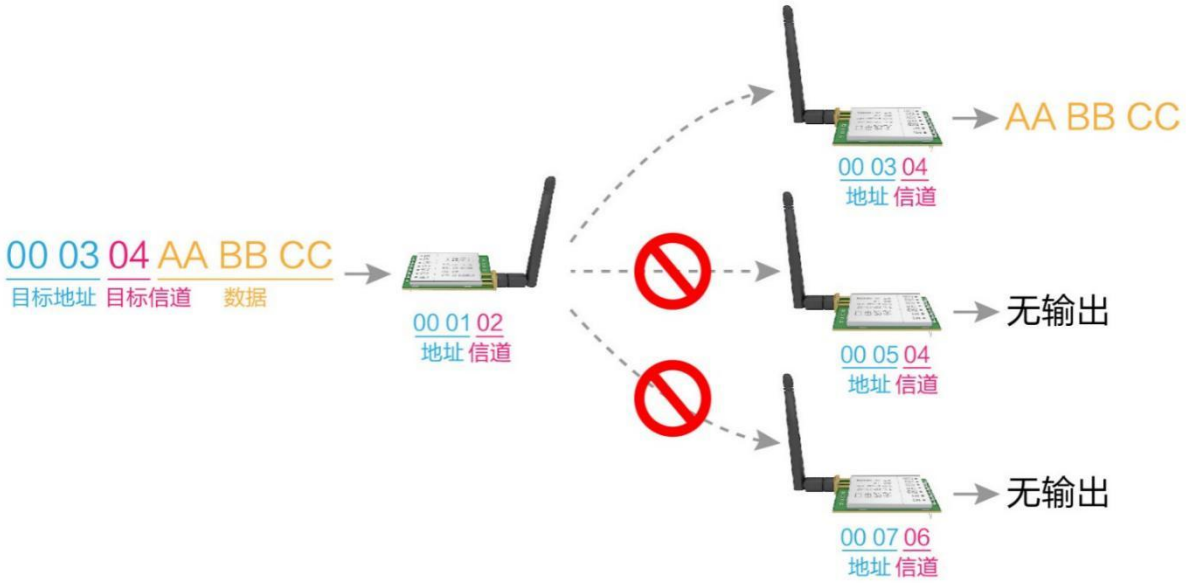
4 Recommended Connections



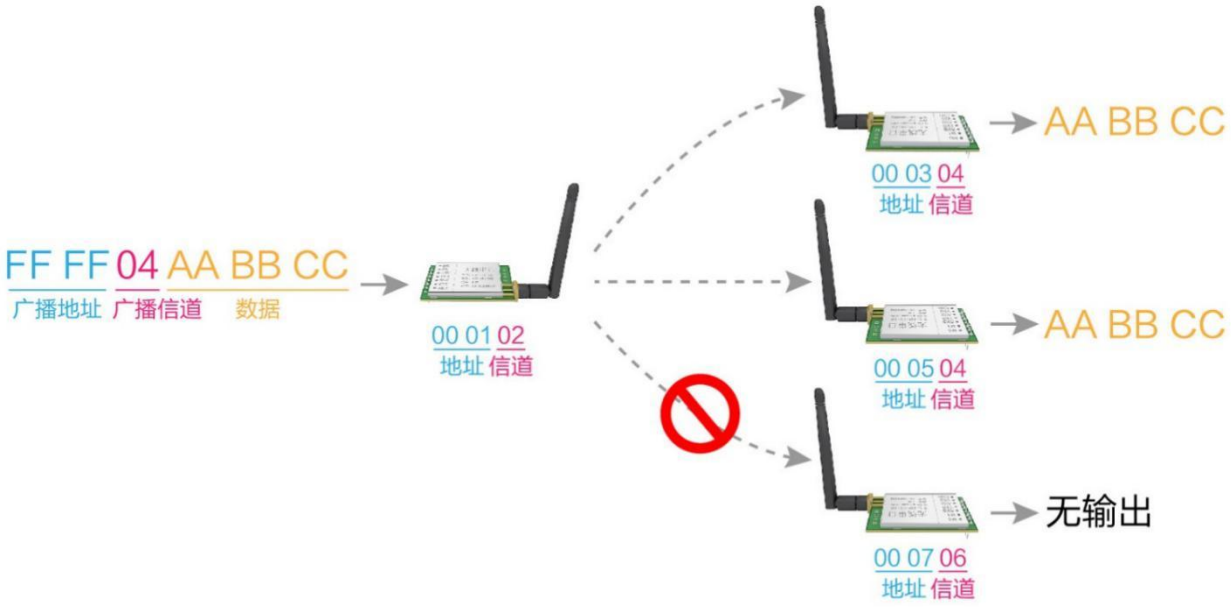
No.	Brief connection between module and MCU (above takes STM 8 L as an example)
1	The wireless serial port module is TTL level, please connect to the MCU of TTL level.
2	Some 5V chips may need to add 4~10K on the TXD and AUX feet of the module.

5 Functional details

5.1 Fixed point sending



5.2 Broadcast



5.3 Broadcast address

- Example: Set module A address to 0xFFFF and channel to 0x04.
- When module A is used as transmission (the same mode, transparent transmission mode), all the receiving modules under the 0x04 channel can receive data to achieve the purpose of broadcasting.

5.4 Listening address

- Example: Set module A address to 0xFFFF and channel to 0x04.
- When module A is received as, all the data under the 0x04 channel to achieve the purpose of monitoring.

5.5 Module reset

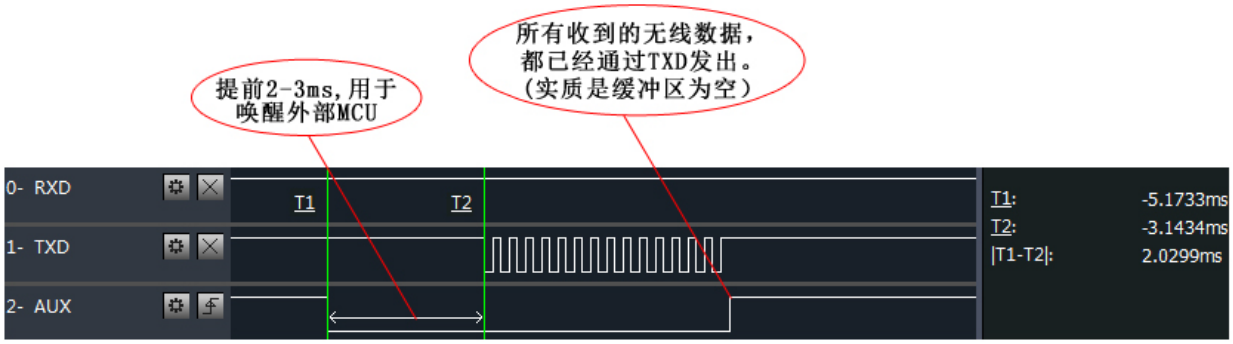
- After the module is powered, AUX will immediately output the low level, conduct hardware self-test, and set the working mode according to user parameters;
- In this process, AUX keeps a low level, after which AUX outputs a high level, and starts to work normally according to the combination of M1 and M0;
- Therefore, the user needs to wait for the AUX to rise along, as the starting point for the normal operation of the module.

5.6 AUX explanation

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

5.6.1 Serial port data output indication

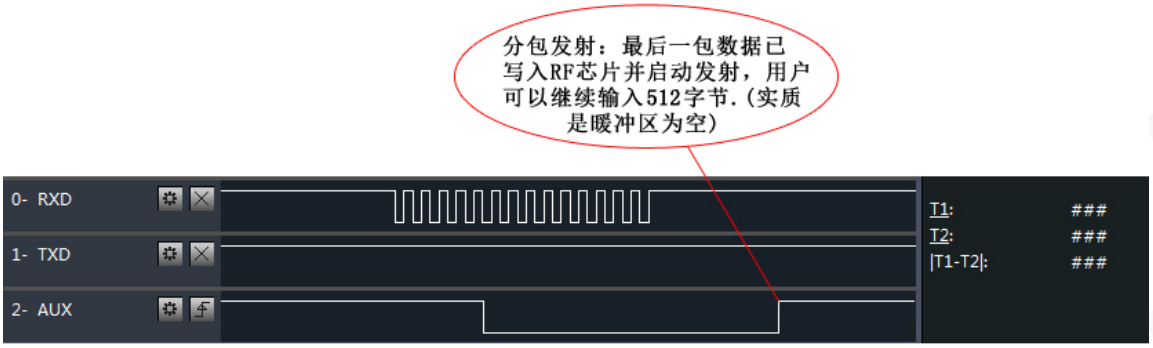
- For awakening the external MCU in dormancy;



模块串口外发数据时，AUX引脚时序图

5.6.2 Wireless transmission indication

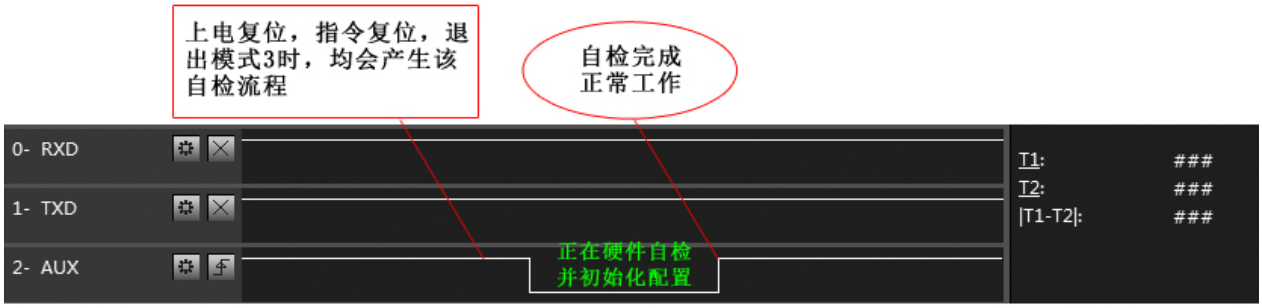
- Buffer blank: data from the internal 512 bytes buffer is written to the wireless chip (automatic subcontracting).
- When AUX = 1, the user initiates less than 512 bytes of data and does not overflow. When AUX = 0, the buffer is not empty: the data of the internal 512-byte buffer has not been fully written to the wireless chip and started transmission. At this time, the module may wait for the user data to end the timeout, or is undergoing wireless subcontract transmission.
- [Note]: AUX = 1 does not mean that all the serial port data of the module is 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 in the configuration process

- Only when reset and exit dormancy mode;



自检期间，AUX引脚时序图

5.6.4 Precautions

No.	AUX matters need attention
1	The above function 1 and function 2, the output low level priority, that is, meet any one of the output low level conditions, AUX output low level; When all low level conditions are not satisfied, AUX outputs a high level.
2	When AUX output is low level, the module is busy and no working mode detection will be conducted at this time; When the module AUX is output within 1ms after the high level, the mode switching work will be completed.
3	After the user switches to the new working mode, he needs to rise the AUX for at least 2ms before the module will really enter this mode; If the AUX is always at a high level, then the mode switch takes effect immediately.
4	The user enters another mode from mode 3 (sleep mode), or during the reset process, the module resets the user parameters, during which the AUX outputs a low level.
5	Due to the characteristics of LoRa modulation mode, the information transmission delay is much longer than that of FSK. For example, at the empty speed of 2.4 kbps, the 100-byte transmission delay is about 1.5 seconds. It is suggested that customers do not carry out large data transmission at low altitude speed, so as to avoid abnormal communication caused by data loss caused by data accumulation.

6 Working mode

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

Pattern (0-3)	M1	M0	Model introduction	Remarks
0 General mode	0	0	Serial port open, wireless open, transparent transmission	The receiver must be mode 0,1
1 Wake up mode	0	1	Serial port open, wireless open; The only difference from mode 0: Before the packet launches, automatically add the wake up code to wake up the receiver working in mode 2	The receiver can be a mode 0 The receiver can be mode 1 The receiver can be

				mode 2
2. Power saving mode	1	0	The serial port is off, and the wireless is in air wake up mode. After receiving the wireless data, open the serial port to send the data.	The itter must mode 1 Cannot launch in this mode
3 Sleep mode	1	1	The module enters hibernation and can receive parameter setting commands	See the working parameters for details

6.1 Notes for mode switching

No.	Remarks
1	Users can combine M1 and M0 at high and low levels to determine the module working mode. Two GPIO of the MCU can be used to control the mode switching; When M1 and M0 are changed: if the module is idle, after 1ms, it can start working according to the new mode; If the module has serial data that has not been transmitted wirelessly, the new working mode can be entered after the transmission mode is completed; If the module receives the wireless data and sends the data through the serial port, it needs to send the data before entering the new working mode; So the mode switching can only be effective when the AUX outputs 1, otherwise the switching will be delayed.
2	For example, if the user continuously inputs a large amount of data and switches the mode, the switching mode operation is invalid; the module will process all the user data before conducting new mode detection; Therefore, it is generally recommended to detect the output state of the AUX pin, and wait for the output high level for 2ms before switching.
3	When the module is switched from other mode to dormant mode, if there is data not processed; The module will process the data (including receiving and sending) before entering the hibernation mode. This feature can be used for fast sleep, thus saving power consumption; for example, the transmission module works in mode 0, the user initiates the serial data "12345", and then do not have to wait for the AUX pin idle (high level), can directly switch to the sleep mode, and the user main MCU immediately sleep, the module will automatically send all the user data through wireless, automatically enter the hibernation within 1ms; This saves the working time of MCU and reduces the power consumption.
4	Similarly, any mode switching, can use this feature, the module handles the current mode event, within 1ms, will automatically enter the new mode; thus eliminating the user query AUX work, and can achieve the purpose of rapid switching; For example, switching from transmitting mode to receiving mode; the user MCU can also enter hibernation before the mode switching premise, and use the external interrupt function to obtain AUX changes, thus performing mode switching.
5	This operation mode is very flexible and efficient, which is designed in accordance with the convenience of operation of the user MCU, and can reduce the workload of the whole system as much as possible, improve the system efficiency and reduce the power consumption.

6.2 General Mode (Mode 0)

Type	When M0 = 0 and M1 = 0, the module works in mode 0
TX	The module receives the user data from the serial port, The module transmitting wireless packet length of 58 bytes, When the amount of user input data reaches 58 bytes, The module will initiate the wireless transmission, At this point, the user can continue to input the data needed to be launched; When the user needs to transmit less than 58 bytes, Module waiting for a 3-byte time, If no user data is further entered, The data is considered terminated, At this time, the module sends out all the data packets wirelessly; When the module receives the first user data, The AUX output low level, After the module puts all the data into the RF chip and starts the launch, AUX output high level; this moment, Indicates that the last package of wireless data has initiated launched, Users can continue to enter up to 512 bytes of data; Pages issued by mode 0, Can only be received by receiving modules in mode 0 and 1.
RX	The module always turns on the wireless receiving function, which can receive the data packets sent from mode 0 and mode 1; After receiving the packet, the module AUX outputs the low level and delays for 5ms, and starts to send the wireless data through the serial port TXD pin. After all the wireless data is output through the serial port, the module outputs the AUX at the high level.

6.3 WOR Mode (Mode 1)

Type	When M0 = 1 and M1 = 0, the module works in mode 1
TX	The condition of the module startup packet launch is equivalent to the AUX function; the only difference is that the module automatically adds the wake code before each packet, the length of the wake up code depends on the wake time set in the user parameters; the wake code is used to awaken the receiving module working in mode 2; so the data transmitted by mode 1 can be received by mode 0,1 and 2.
RX	Equivalent to mode 0.

6.4 Power-saving mode (mode 2)

Type	When M0 = 0 and M1 = 1, the module works in mode 2
TX	The module is dormant, and the serial port is closed, unable to receive the serial port data from the external MCU, so this mode does not have the wireless transmission function.
RX	In mode 2, Ask the transmitter to work in mode 1; Timed listening for the wake-up code, Once a valid wake code, The module will remain in the receiving state, And wait for the entire valid data packet to be received; The AUX will then output a low-level, After a 5-ms delay, Opening the serial port will send out the received wireless data through the TXD, After finishing the AUX output high level; The wireless module continues to enter the working state of "sleep-listening" (polling); By setting the different wake-up times, The module has

	different receiving response delay (maximum 2s) and average power consumption (minimum 30 uA); Users need to strike a balance between the communication delay time and the average power consumption.

6.5 Deep dormancy mode (mode 3)

Type	When M0 = 1 and M1 = 1, the module works in mode 3
TX	Unable to transmit the wireless data.
RX	Unable to receive the wireless data.
Configure	The hibernation mode can be used for the module parameter setting, using the serial port 9600,8N1, to set the module working parameters by a specific instruction format.
Note	When entering from the hibernation mode to the other mode, the module will reconfigure the parameters. During the configuration process, the AUX remains low; after the output is high, so the user should detect the AUX rising edge.

7 Register read and write control

7.1 Directive introduction

In hibernation mode (mode 3: M0=1, M1=1), the supported instruction list is as follows (when setting, only 9600,8N1 format is supported):

NO.	Format	Define
1	And C0 + operating parameters	16 C0 + 5 bytes working parameters, 6 bytes, must be sent continuously (power out)
2	C1+C1+C1	16 The binary format sends three C1s, and the module returns the saved parameters, which must be sent continuously.
3	And C2 + operating parameters	16 binary format to send C2 + 5 bytes working parameters, a total of 6 bytes, must be sent continuously (power loss is not saved)
4	C3+C3+C3	16 In ary format sends three C3, module returns version information, must be sent continuously.
5	C4+C4+C4	16 The decimal format sends three C4, the module will produce a reset, must be sent continuously.

7.2 Read working parameter

Format	Define
C1+C1+C1	In dormant mode (M0=1, M1=1), issue a command to the module serial port (HEX format): C1 C1 C1, The module returns the current configuration parameters, such as: C0 00 00 1A 06 44.

7.3 Read firmware

Format	Define
C3+C3+C3	In dormant mode (M0=1, M1=1), issue a command to the module serial port (HEX format): C3 C3 C3, The module returns the current configuration parameters, such as: C3 32 XX YY; C3 is the command prefix, 32 represents the product model, XX represents the version number, and YY represents the interface format + module maximum power value (16 decimal point). The TTL interface is 0x10, RS232 is 0x40, and 0x80 for RS485

7.4 Resignation command

Format	Define
C4+C4+C4	In dormant mode (M0=1, M1=1), issue a command to the module serial port (HEX format): C4 C4 C4, The module will produce a single reset; During the reset process, the module conducts self-test and AUX outputs low level. After the reset, AUX outputs high level and the module starts to work normally; At this point, you can mode switch or initiate the next command.

7.5 E32-xxxT20x register description

	Name	Descriptions			Note
0	HEAD	Fixed 0xC0 or 0xC2, indicating that this frame data is a control command			Must be 0xC0 or C2 C0: The set parameters are saved by power-down. C2: The set parameters will not be saved by power-down.
1	ADDH	High byte of module address (default 00H)			00H-FFH
2	ADDL	Module address low byte (default 00H)			00H-FFH
3	SPED	7	6	serial port parity bit	Serial port modes can be different on both sides of the communication
		0	0	8N1（default）	

		0	1	8O1		
		1	0	8E1		
		1	1	8N1（Equivalent to 00）		
		5	4	3	TTL serial port rate (bps)	The baud rate can be different between the two sides of the communication The serial port baud rate has nothing to do with the wireless transmission parameters and does not affect the wireless transceiver characteristics.
		0	0	0	Serial port baud rate of 1200	
		0	0	1	Serial port baud rate of 2400	
		0	1	0	Serial port baud rate of 4800	
		0	1	1	Serial port baud rate of 9600（default）	
		1	0	0	Serial port baud rate of 19200	
		1	0	1	Serial port baud rate of 38400	
		1	1	0	Serial port baud rate of 57600	
		1	1	1	Serial port baud rate of 115200	
		2	1	0	Universal Radio Air Rate（bps）	The lower the air rate, the longer the distance, the stronger the anti-interference performance, and the longer the sending time. The airborne wireless transmission rate must be the same for both sides of the communication.
		0	0	0	Air rate 2.4k	
		0	0	1	Air rate 2.4k	
		0	1	0	Air rate 2.4k（default）	
		0	1	1	Air rate 4.8k	
		1	0	0	Air rate 9.6k	
		1	0	1	Air rate 19.2k	
		1	1	0	Air rate 19.2k	
		1	1	1	Air rate 19.2k	
4	CHAN	General Model				
		7	6	5	Retain unused	Write 0
		communication channel				00H-1FH, corresponding to 410～441MHz 00H-45H, corresponding to 862-930MHz
		4 to 0, corresponding to (410MHz + CHAN * 1MHz), default 17H (433MHz) (for 400 band) 4 to 0, corresponds to (862MHz + CHAN * 1MHz), default 06H (868MHz) (applicable to 900 band)				
5	OPTION	7	Fixed-point transmit enable bit (MODBUS-like)			When it is 1, the first 3 bytes of each user data frame are used as high and low address and channel. When transmitting, the module changes its own address and channel, and when finished, restores the original settings.
		0	transparent transfer mode			
		1	fixed-point transmission mode			
		6	IO drive mode (default 1)			This bit is used to enable the module's internal pull-up resistor. The open drain method level adaptation is more robust and may require an external pull-up resistor in some cases.
		1	TXD, AUX push-pull outputs, RXD pull-up inputs			
		0	TXD, AUX open output, RXD open input			
		5	4	3	Wireless Wake-Up Time	Both transceiver modules work in mode 0. This delay time is invalid and can be any value; The transmitter works in mode 1 and will continuously transmit the wake-up code for the corresponding time; The receiver works in mode 2, this time is the listening interval time (wireless wake-up) of the receiver, and can only receive data from the transmitter working in mode 1.
		0	0	0	250ms（default）	
		0	0	1	500ms	
		0	1	0	750ms	
		0	1	1	1000ms	
		1	0	0	1250ms	
		1	0	1	1500ms	
		1	1	0	1750ms	
		1	1	1	2000ms	
		2	FEC switches			When FEC is turned off, the actual data transmission rate is increased, but the anti-interference ability is weakened, and the distance is slightly closer, so please choose according to the actual application; Both sides of communication must be on or off.
		0	Close FEC error correction			
		1	Turn on FEC error correction (default)			
		1	0	Transmit power (approximate)		The external power supply must provide more

		0	0	20 dBm (by default)	than 250mA of current output capability and ensure that the power supply ripple is less than 100mV; It is not recommended to use lower power transmission, its power utilization efficiency is not high.
		0	1	17dBm	
		1	0	14dBm	
		1	1	10dBm	

Example (Meaning of the byte "SPED" in serial number 3):								
Binary bits of this byte	7	6	5	4	3	2	1	0
Specific values (user-configurable)	0	0	0	1	1	0	1	0
representativeness	Serial port parity bit 8N1		Serial port baud rate of 9600			Air rate of 2.4k		
Corresponding hexadecimal	1					A		

7.6 Default parameters

Model	433MHz Factory default parameter value: C0 00 00 1A 17 03 868MHz Factory default parameter value: C0 00 00 1A 06 03						
PN	Frequency	Address	Channel	Air rate	Baud rate	Serial port format	Transmitting power
E32-433T20S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	20dbm
E32-900T20S	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	20dbm
E32-433T20D	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	20dbm
E32-900T20D	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	20dbm

8 AT command

- Using AT instructions for parameter configuration or query should be performed in configuration mode;
- AT instructions are used in configuration mode, AT instructions are divided into three categories: command instruction, setting instruction and query instruction;
- Users can go through the words " AT + HELP =?"Query to the AT instruction set supported by the module, the AT instruction adopts the port rate of 9600 8N1;
- When the input parameter exceeds the range, it will be limited. Please do not let the parameter exceed the range to avoid the unknown situation.

8.1 AT Command Table

Command instruction	Descriptions	Example	Example Description
AT+IAP(Use caution, see this article 8.3 Notes on Upgrading Firmware on Serial Ports for more information)	Entering IAP upgrade mode	AT+IAP	Entering IAP upgrade mode
AT+RESET	Device Restart	AT+RESET	Device Restart
AT+DEFAULT	Configuration parameters are restored to default and the device restarts	AT+DEFAULT	Configuration parameters are restored to default and the device restarts

Setup instruction	Description	Example	Example Description
AT+UART=baud,parity	Set baud rate and parity	AT+UART=3,0	Set the baud rate to 9600, 8N1
AT+RATE=rate	Setting the air rate	AT+RATE=7	Set the air rate to 19.2K
AT+WOR=role	Setting WOR roles and cycles	AT+WOR=0	Set to receive WOR
AT+POWER=power	Setting the transmission power	AT+POWER=0	Set the transmit power to 20dBm
AT+TRANS=mode	Setting the sending mode	AT+TRANS=1	Set to fixed point mode
AT+ADDR=addr	Setting the module address	AT+ADDR=1234	Set the module address to 1234
AT+CHANNEL=channel	Setting the module operating channel	AT+CHANNEL=23	Set frequency to 433.125M
AT+DELAY=delay	Setting the WOR delayed hibernation time	AT+DELAY=1000	Set WOR delayed sleep time to 1000ms
AT+SWITCH=switch	Setting the software toggle mode switch	AT+SWITCH=1	Setting on in configuration mode allows software switching.
AT+MODE=mode	Switching operating modes	AT+MODE=0	Switch to pass-through mode

Query Instructions	Descriptions	Return to Example	Example Description
AT+HELP=?	Query AT command table		Return to the AT command table
AT+DEVTYPE=?	Query Module Model	DEVTYPE=E32-400T20S/D	Return to Module Models
AT+FWCODE=?	Query Firmware Code	FWCODE=7432-0-10	Return to Firmware Version
AT+UART=?	Query baud rate and calibration	AT+UART=3,0	Returns baud rate of 9600, 8N1

AT+RATE=?	Query Air Rate	AT+RATE=7	Return air rate of 19.2K
AT+WOR=?	Query WOR Role	AT+WOR=0	Returns as WOR receive
AT+POWER=?	Query Transmit Power	AT+POWER=0	Return to transmit power of 20dBm
AT+TRANS=?	Query Send Mode	AT+TRANS=1	Return to fixed-point mode
AT+ADDR=?	Query Module Address	AT+ADDR=1234	Returns the module address to 1234
AT+CHANNEL=?	Query module operating channel	AT+CHANNEL=23	Return frequency is 433.125M
AT+DELAY=?	Query WOR delayed hibernation time	AT+DELAY=1000	Returns WOR delayed sleep time of 1000ms
AT+SWITCH=?	Query software switching mode switch	AT+SWITCH=0	Software switching mode off
AT+MODE=?	Query the current working mode (all modes can be queried)	AT+MODE=0	Returns the current transmission mode

8.2 AT Parameter Analysis

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

command parameter	meaning of a parameter
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 bits)	0:8N1 1:8O1 2:8E1 3:8N1
Rate（airspeed）	0:2.4K 1:2.4K 2:2.4K 3:4.8K 4:9.6K 5:19.2K 6:19.2K 7:19.2K
Packet（Packet length）	0:240 1:128 2:64 3:32
Role（WOR Role）	0:receive 1:send
Period（WOR cycle）	0:500ms 1:1000ms 2:1500ms 3:2000ms 4:2500ms 5:3000ms 6:3500ms 7:4000ms
Power（transmission power）	0:20dBm 1:17dBm 2:14dBm 3:10dBm
Mode（transfer mode）	0: transparency 1: fixed point
LBT(listen before talk)	0:close 1:open
Addr（module address）	Module address 0 to 65535 (decimal)
Channel（module channel）	Module channel 0 to 45 (decimal)
Netid（Network ID）	Module network 0~255 (decimal)
Key（keys）	Module key 0~65535 (decimal)
Delay（WOR time-delayed hibernation）	Delayed hibernation 0~65535 (decimal)
Mode(operating mode)	0: Transmission mode 1: Wake-up mode 2: Power saving mode 3: Sleep mode

8.3 Upgrade firmware via serial port

If the customer needs to upgrade the firmware, it needs to find the corresponding BIN file provided by the official, and then use the official provided upper machine to upgrade the firmware. Generally, the user does not need to upgrade the firmware, so do not use the "AT + IAP" command.

The first necessary pins for the upgrade must be introduced (M1, M0, AUX, TXD, RXD, VCC, GND), and then send "AT + IAP" command into the upgrade mode. If you need to exit the IAP upgrade mode, you need to stay on and wait for 60 seconds, the program will automatically exit, otherwise even if the restart, it will enter the upgrade mode indefinitely.

After entering the upgrade mode, the port rate will automatically switch to 115200 until you automatically exit, with a log output.

9 Software configuration description

- The following figure shows the example of the upper computer display interface of E 32-900T 30S. Users can switch to command mode through M0 and M1, and quickly configure and read parameters in the upper computer.

- In the configuration computer, the module address, frequency channel and key are all decimal display mode; taking the values of each parameter:
- Network address: 0~65535
- Frequency channel: 0~45
- Key: 0~65535

10 Hardware Design

- It is recommended to use DC voltage regulator power to supply the module, the power ripple coefficient is as small as possible, and the module should be reliably grounded;
- Please note the correct connection of the positive and negative poles of the power supply, if the reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that between the recommended supply voltage, exceeding the maximum value will cause permanent damage to the module;
- Please check the stability of the power supply, and the voltage cannot fluctuate substantially and frequently;
- When designing power supply circuit for modules, it is often recommended to retain more than 30% allowance, and the whole machine is conducive to long-term stable work;
- Modules should be as far as possible away from the power supply, transformer, high frequency wiring and other electromagnetic interference parts;
- High frequency digital routing, high frequency analog wiring, power wiring must avoid below the module, if really need to pass below the module, assuming that the module is welded in Top Layer, Top Layer in the contact part of the module paving copper (all paved copper and good grounding), must be close to the digital part of the module and line in Bottom Layer;
- Assuming that the module is welded or placed in Top Layer, it is also wrong to walk randomly in Bottom Layer or other layers, which will affect the stray dispersion and receiving sensitivity of the module to different degrees;
- Assuming that there are devices with large electromagnetic interference around the module will also greatly affect the performance of the module, according to the strength of the interference according to the module, if the situation allows to do appropriate isolation and shielding;
- Assuming that there is a wiring around the module with large electromagnetic interference (high frequency digital, high frequency simulation, power wiring) will also greatly affect the performance of the module, according to the strength of the interference is recommended to be appropriate away from the module, if the situation allows to do appropriate isolation and shielding;
- If the communication line uses a 5V level, the 1k-5.1k resistance must be connected in series (not recommended, there is still a risk of damage);
- Keep away from the 2.4GHz TTL protocol, such as USB3.0;
- The antenna installation structure has a great impact on the performance of the module, so make sure that the antenna is exposed and the best vertical upward;
- When the module is installed inside the casing, a high-quality antenna extension line 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 FAQ

11.1 Communication range is too short

- When there is a linear communication obstacle, the communication distance will decay accordingly;

- Temperature, humidity, the same frequency interference, will lead to the communication packet loss rate increased;
- Ground absorption, reflection of radio waves, close to the ground test effect 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 the metal shell, the signal attenuation will be very serious;
- Power register setting is wrong, the air rate setting is too high (the higher the air rate, the closer the distance);
- At room temperature, the low voltage of the power supply is lower than the recommended value, and the lower the voltage, the lower the power generation;
- The antenna is poor to match the module or the quality of the antenna itself.

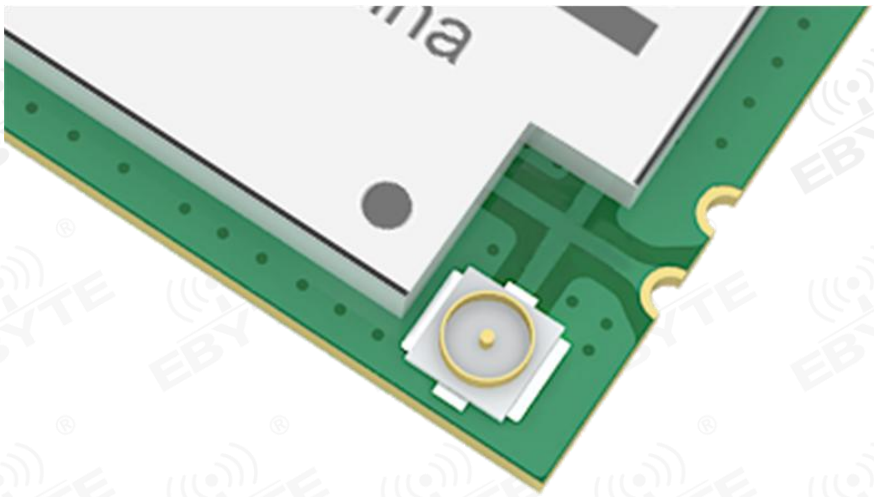
11.2 Module is easy to damage

- Please check the power supply to ensure that between the recommended supply voltage, exceeding the maximum value will cause permanent damage to the module;
- Please check the stability of the power supply, and the voltage cannot fluctuate;
- Please ensure anti-static operation during installation and use process and static sensitivity of high frequency devices;
- Please ensure that the humidity should not be too high, and some components are humidity-sensitive devices;
- If there is no special demand, it is not recommended to use it at too high or too low temperature.

11.3 BER(Bit Error Rate) is high

- There is the same frequency signal interference nearby, stay away from the interference source or modify the frequency, channel to avoid interference;
- The lock waveform on SPI is not standard, check whether there is interference on SPI line, SPI bus line should not be too long;
- The power supply is not ideal may also cause disorderly code, be sure to ensure the reliability of the power supply;
- Extension line, feeder quality is poor or too long, will also cause high bit error rate.

11.4 Antenna selection



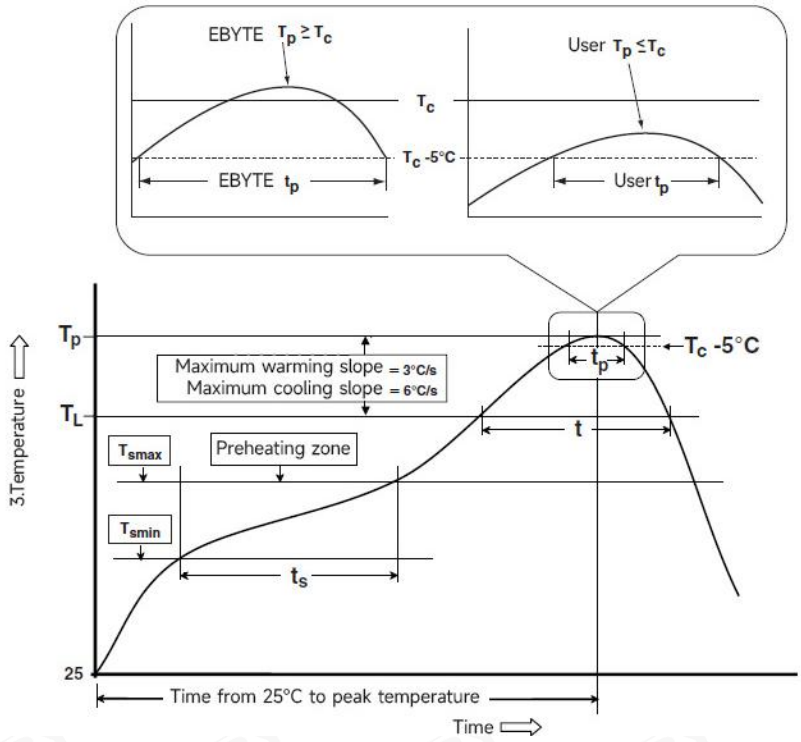
At the same time, IPEX interface and stamp hole interface, IPEX interface and stamp hole interface can be selected

12 Production guidance

12.1 Reflow weld temperature

Reflow weld curve characteristics		Lead process assembly	Lead-free process assembly
Preheat / heat preservation	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (T smax)	150℃	200℃
	Time (T smin ~T smin)	For the next time, 60-120 seconds	For the next time, 60-120 seconds
Temperature rise slope (TL ~ Tp)		At 3℃ / s, with the maximum value	At 3℃ / s, with the maximum value
Liquid-phase temperature (TL)		183℃	217℃
Hold time above the TL		60~90 Seconds	60~90 Seconds
Package bulk peak temperature Tp		Users must not exceed the temperature specified on the "Humidity sensitivity" label of the product.	Users must not exceed the temperature specified on the "Humidity sensitivity" label of the product.
Time (Tp) within 5℃ of the specified grade temperature (Tc), shown in the figure below		20 Seconds	30 Seconds
Cooling slope (Tp ~ TL)		6℃ / s, max	6℃ / s, max
Time from the room temperature to the peak temperature		Six minutes, the longest	8 Minutes, longest
The peak temperature (Tp) tolerance of the temperature curve is defined as the upper limit of the user			

12.2 Reflow welding curve diagram



13 Related models

PN	Carrier frequency Hz	TX power dBm	Distance km	Air rate bps	Packaging form	Size mm	Antenna
E32-170T30D	170M	30	8	0.3k ～9.6k	straight pin	24*43	SMA-K
E32-433T20DC	433M	20	3	0.3k ～19.2k	straight pin	21*36	SMA-K
E32-433T20S1	433M	20	3	0.3k ～19.2k	paster	17*25.5	Stamp hole
E32-433T20S2T	433M	20	3	0.3k ～19.2k	paster	17*30	IPEX / Stamp hole
E32-400T20S	433/470M	20	3	0.3k ～19.2k	paster	16*26	IPEX / Stamp hole
E32-433T30D	433M	30	8	0.3k ～19.2k	straight pin	24*43	SMA-K
E32-433T30S	433M	30	8	0.3k ～19.2k	paster	25*40.3	IPEX / Stamp hole
E32-868T20D	868M	20	3	0.3k ～19.2k	straight pin	21*36	SMA-K
E32-868T20S	868M	20	3	0.3k ～19.2k	paster	16*26	IPEX / Stamp hole
E32-868T30D	868M	30	8	0.3k ～19.2k	straight pin	24*43	SMA-K
E32-868T30S	868M	30	8	0.3k ～19.2k	paster	25*40.3	IPEX / Stamp hole

E32-915T20D	915M	20	3	0.3k ～19.2k	straight pin	21*36	SMA-K
E32-915T20S	915M	20	3	0.3k ～19.2k	paster	16*26	IPEX / Stamp hole
E32-915T30D	915M	30	8	0.3k ～19.2k	straight pin	24*43	SMA-K
E32-915T30S	915M	30	8	0.3k ～19.2k	paster	25*40.3	IPEX / Stamp hole

14: Antenna recommendation

14.1 Recommendation

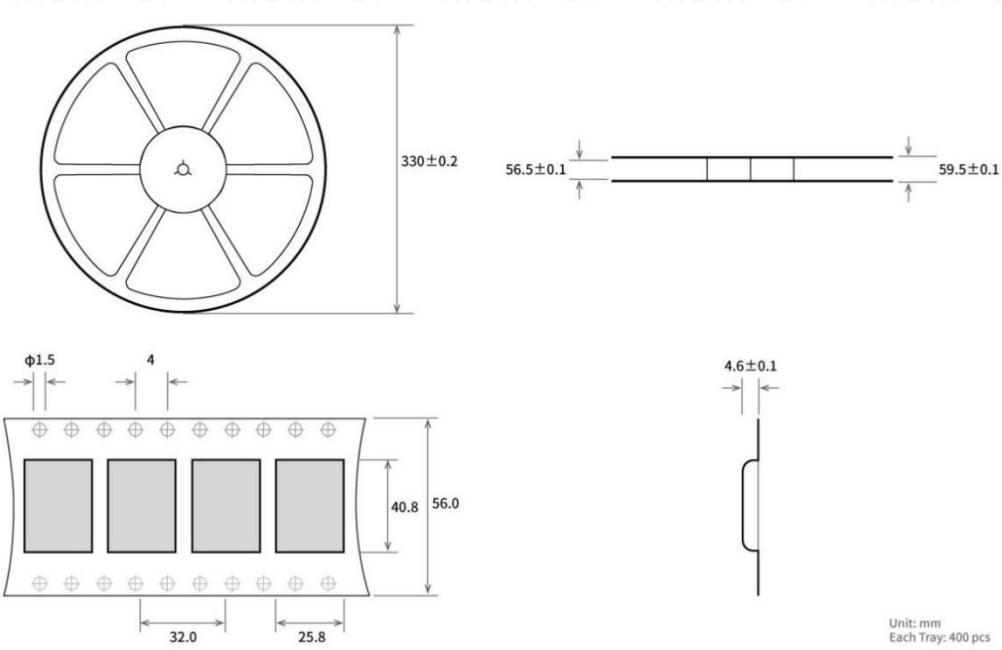
Antenna is an important role in the communication process, and often inferior antenna will have a great impact on the communication system, so our company recommends some antennas as antennas supporting our wireless modules with excellent performance and reasonable price.

PN	Type	Frequency Hz	Interface	Gain dBi	Size mm	feeder cm	Features
TX433-NP-4310	Flexible antenna	433M	weld	2.0	43.8*9.5	-	Built-in flexible, FPC soft antenna
TX433-JZ-5	Rubber rod antenna	433M	SMA-J	2.0	52	-	Ultra-short straight, omnidirectional antenna
TX433-JZG-6	Rubber rod antenna	433M	SMA-J	2.5	62	-	Ultra-short straight, omnidirectional antenna
TX433-JW-5	Rubber rod antenna	433M	SMA-J	2.0	50	-	Bend the adhesive rod, and use the omnidirectional antenna
TX433-JWG-7	Rubber rod antenna	433M	SMA-J	2.5	75	-	Bend the adhesive rod, and use the omnidirectional antenna
TX433-JK-11	Rubber rod antenna	433M	SMA-J	2.5	110	-	Bendable adhesive rod, omnidirectional antenna
TX433-JK-20	Rubber rod antenna	433M	SMA-J	3.0	210	-	Bendable adhesive rod, omnidirectional antenna
TX433-XPL-100	The suction dish antenna	433M	SMA-J	3.5	185	100	Small suction cup antenna, cost-effective
TX433-XP-200	The suction dish antenna	433M	SMA-J	4.0	190	200	Neutral suction cup antenna, low loss
TX433-XPH-300	The suction dish antenna	433M	SMA-J	6.0	965	300	Large sucker antenna, with high gain
TX490-JZ-5	Rubber rod antenna	470/490M	SMA-J	2.0	50	-	Ultra-short straight, omnidirectional antenna

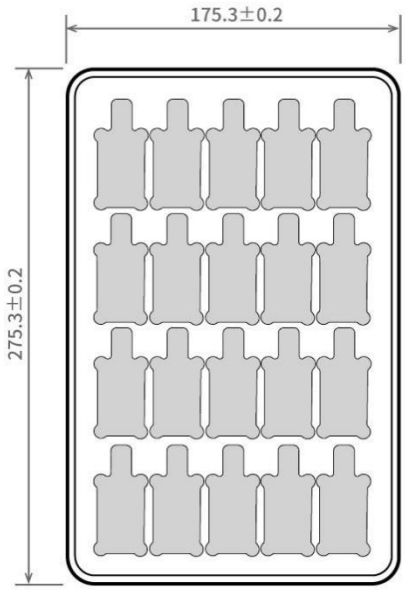
TX490-XPL -100	The suction dish antenna	470/490M	SMA-J	3.5	120	100	Small suction cup antenna, cost-effective

15. Packing methods

15.1 E32-433 / 900T20S bulk packaging method



15.2 E32-433 / 900T20D bulk packaging method



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

Revise the history

Version	Date	Description	Issued by
1.0	2023-10-25	The initial version	LIU
1.1	2024-12-26	Delete the authentication description	Lei
1.2	2025-7-24	Content revision	Hao

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