E70-433T series User Manual

CC1310 433MHz TTL

high-speed continuous transmission wireless module



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Chapter 1 Product Overview

1.1 Product introduction

E70-433T series is a wireless serial port module (UART) based on TI's CC1310 (built-in dual-core ARM) radio frequency chip, which can work in the 431-446.5 MHz frequency band (default 433MHz), GFSK modulation method, TTL level output, 3.3V IO port voltage; this product adopts 24MHz industrial-grade crystal oscillator to ensure its industriality and stability.

The module has data encryption and compression functions, and the data transmitted by the module in the air is random, and the data interception is meaningless through strict encryption and decryption algorithms. The data compression function has the possibility to reduce the transmission time, reduce the probability of being interfered, and improve reliability and transmission efficiency.

The factory has built-in low-power multi-function wireless serial port program, and users can also carry out secondary development according to their needs.



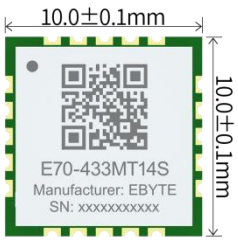
picture 1：E70-433T30S



picture 2：E70-433T14S



picture 3：E70-433T14S2



picture 4：E70-433MT14S

1.2 Features

- Support high-speed continuous transmission, send and receive unlimited data packet length；
- Support continuous data frame without packetization, perfect support for ModBus protocol；
- Support custom subcontracting settings to improve communication efficiency；
- Support fixed-point transmission/broadcast transmission/channel monitoring;

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- Support RSSI signal strength reading;
- Support over-the-air wake-up, i.e. low-power function, suitable for battery-powered solutions;
- Developed based on CC1310 chip, built-in dual-core ARM;
- Ultra-small volume design;
- Ultra-low receiving current, only about 8mA;
- E70-433 T30S maximum transmit power of 30dBm, the other three models are 25mW, softwaremulti-level adjustable;
- Under ideal conditions, the communication distance can reach 1.5km;
- E70-433T30S built-in PA+LNA, transmission power 1W, communication distance up to 6km;
- Supports the global license-free ISM 433MHz band;
- Support 2.5K~168kbps air transmission rate;
- Support 2.2~3.8V power supply, greater than 3.3V power supply can ensure the best performance;
- E70-433T30S supports 2.6~5.5V power supply ,more than 5V power supply can ensure the best performance;
- Dual antenna optional (IPEX/stamp hole) is convenient for users to develop and facilitate integration.

1.3 Application scenarios

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

Chapter 2 Specification Parameters

2.1 RF Parameters

RF parameters	unit	Model				remark
		E70-433T30S	E70-433T14S	E70-433T14S2	E70-433MT14S	
Transmit power	dBm	30	14	14	14	
Receive sensitivity	dBm	-107～-109	-109～-111	-108	-108	The air rate is 2.5kbps
Reference distance	M	6000m	1500m	1500m	1500m	Clear and open, antenna gain 5dBi, antenna height 2.5 meters, air rate 2.5kbps

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Operating frequency band	MHz	425～450.5	The factory default is 433MHz and supports the ISM band
Air velocity	bps	2.5k～168k	User programmatic control
Blocking power	dBm	10	The probability of burning is less when used at close range
Launch length	/	The transmission mode is specified	See Transfer Modes for details

2.2 Electrical parameters

Electrical parameters		unit	Model				remark
			E70-433T30S	E70-433T14S	E70-433T14S2	E70-433MT14S	
Operating voltage		V	2.6～5.5	2.2～3.8	2.2～3.8	2.2～3.8	The E70-433T30S permanently burns modules over 5.5 V, and the other three models permanently burn modules over 3.8 V.
Communication level		V	3.3				Using 5V TTL carries a risk of burnout
power consumption	Emitted current	mA	530	27	36	32	Instantaneous power consumption
	Receive current	mA	14	8	8	9	
	Sleep current	μA	4	1	1.2	1.7	The software shuts down
temperature	Operating temperature	℃	-40～+85				Industrial grade
	Storage temperature		-40～+125				

2.3 Hardware Parameters

Hardware parameters	Model				remark
	E70-433T30S	E70-433T14S	E70-433T14S2	E70-433MT14S	
chip	CC1310				
Cache capacity	2048 Byte				User defined
FLASH	128 KB				
RAM	8 KB				

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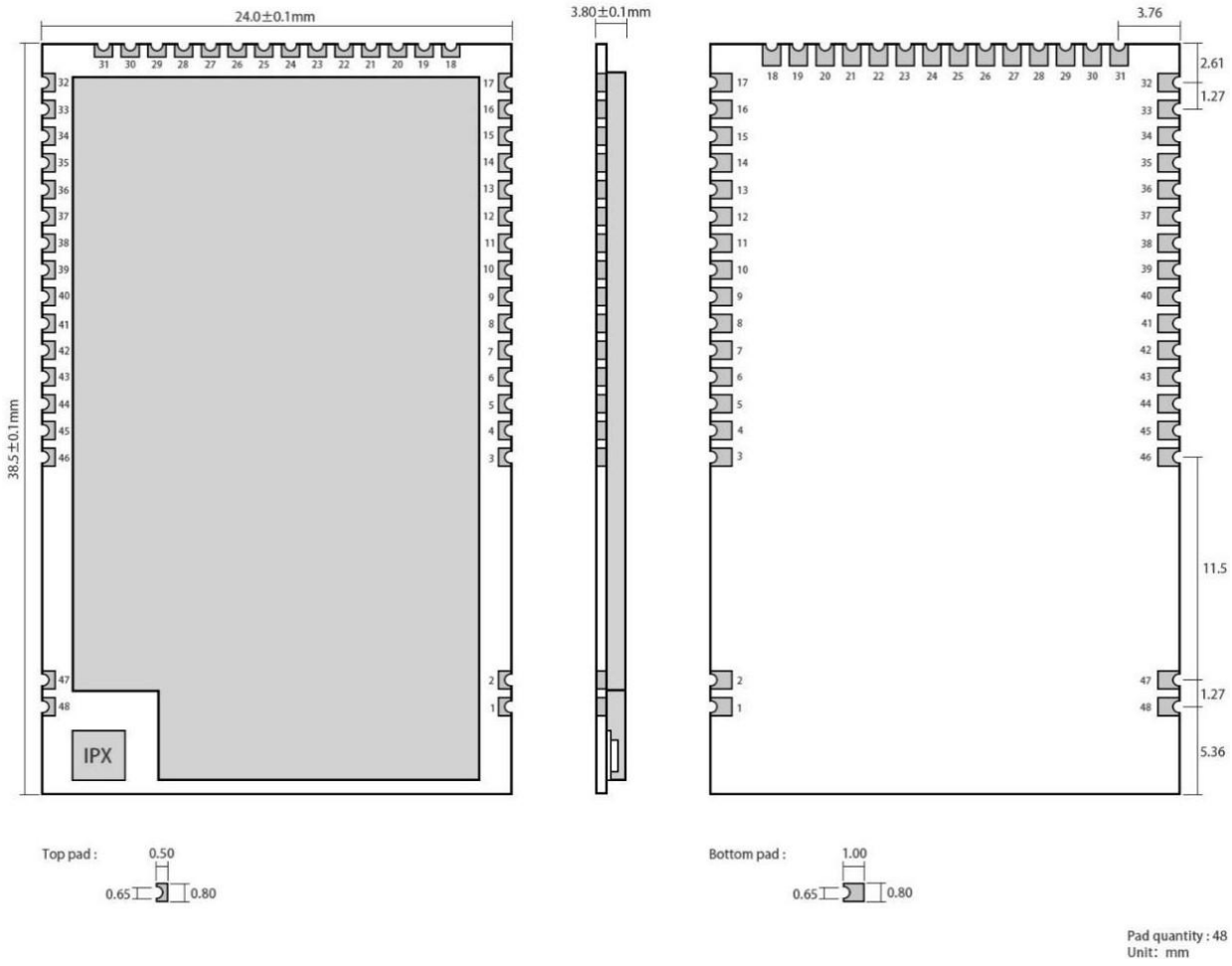
kernel	Cortex-M3（MCU）+Cortex-M0（RF）				
Communication interface	UART serial port				TTL level
Modulation method	GFSK				
Encapsulation method	SMD				
Antenna interface	IPEX/stamp hole	IPEX/stamp hole	IPEX/stamp hole	Stamp holes	The characteristic impedance is about 50 ohms
size	24*38.5mm	16*26 mm	14 * 20 mm	10*10mm	The E70-433T14S2 does not include SMA

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Chapter 3 Mechanical dimensions and pin definitions

3.1 E70-433T30S dimensional drawing and pin definition



Pin Serial Number	Pin Name	Pin Direction	The chip corresponds to the pin	Pin Usage
1	GND	Reference Ground	-	Module Ground Wire
2	GND	Reference Ground	-	Module Ground Wire
3	GND	Reference Ground	-	Module Ground Wire
4	NC	Reserved foot	X32K_Q1	Reserved for unused, need to overhang

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5	NC	Reserved foot	X32K_Q2	Reserved for unused, need to overhang
6	NC	Reserved foot	DIO_1	Reserved for unused, need to overhang
7	NC	Reserved foot	DIO_2	Reserved for unused, need to overhang
8	NC	Reserved foot	DIO_3	Reserved for unused, need to overhang
9	NC	Reserved foot	DIO_4	Reserved for unused, need to overhang
10	NC	Reserved foot	DIO_5	Reserved for unused, need to overhang
11	LNA_EN	Output	DIO_6	Internal microcontroller control LNA pin, active high, connected to pin 44
12	PA_EN	Output	DIO_7	Internal microcontroller control PA pin, active high, connected to pin 45
13	NC	Reserved foot	DIO_8	Reserved for unused, need to overhang
14	NC	Reserved foot	DIO_9	Reserved for unused, need to overhang
15	NC	Reserved foot	DIO_10	Reserved for unused, need to overhang
16	M2	Input	DIO_11	M2M1M0 combined to determine the 8 modes of operation of the module, the use of a series of 1K protection resistor
17	GND	Reference Ground	-	Module Ground Wire
18	M0	Input	DIO_12	The M2M1M0 combination determines the 8 operating modes of the module. When using a series 1K protection resistor, and add a 1M pull-up resistor (not suspended, if not used can be grounded)
19	M1	Input	DIO_13	M2M1M0 Common combination determines the 8 operating modes of the module When using a series 1K protection resistor, and add a 1M pull-up resistor (not suspended, if not used can be grounded)
20	RXD	Input	DIO_14	TTL serial input, connected to external TXD output pins. Configurable as Open drain or pull-up input, See parameter settings for details. A 1K protective resistor in series is required for use.
21	TXD	Output	DIO_15	TTL serial output, connected to the external RXD input pin. Configurable as open-drain or push-pull

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				output , Details See parameter settings. A 1K protective resistor in series is required for use.
22	TMSC	Input	JTAG_TMSC	JTAG TMSC
23	TCKC	Input	JTAG_TCKC	JTAG TCKC
24	RESET	Input	RESET_N	Module reset pin, active low
25	NC	Reserved foot	DIO_16	Reserved for unused, need to overhang
26	NC	Reserved foot	DIO_17	Reserved for unused, need to overhang
27	AUX	Output	DIO_18	Used to indicate the working status of the module, the user wakes up the external MCU, output low during power-on self-test initialization, can be configured as open-drain output, or push-pull output, see parameter settings for details. A 1K protective resistor needs to be connected in series when using (can be suspended)
28	VCC	-	-	Module power supply positive reference, voltage range: 2.6 to 5.5V DC
29	VCC	-	-	Module power supply positive reference, voltage range: 2.6 to 5.5V DC
30	GND	Reference Ground	-	Module Ground Wire
31	GND	Reference Ground	-	Module Ground Wire
32	NC	Reserved foot	DIO_19	Reserved for unused, need to overhang
33	NC	Reserved foot	DIO_20	Reserved for unused, need to overhang
34	NC	Reserved foot	DIO_21	Reserved for unused, need to overhang
35	NC	Reserved foot	DIO_22	Reserved for unused, need to overhang
36	NC	Reserved foot	DIO_23	Reserved for unused, need to overhang
37	NC	Reserved foot	DIO_24	Reserved for unused, need to overhang
38	NC	Reserved foot	DIO_25	Reserved for unused, need to overhang
39	NC	Reserved foot	DIO_26	Reserved for unused, need to overhang
40	NC	Reserved foot	DIO_27	Reserved for unused, need to overhang

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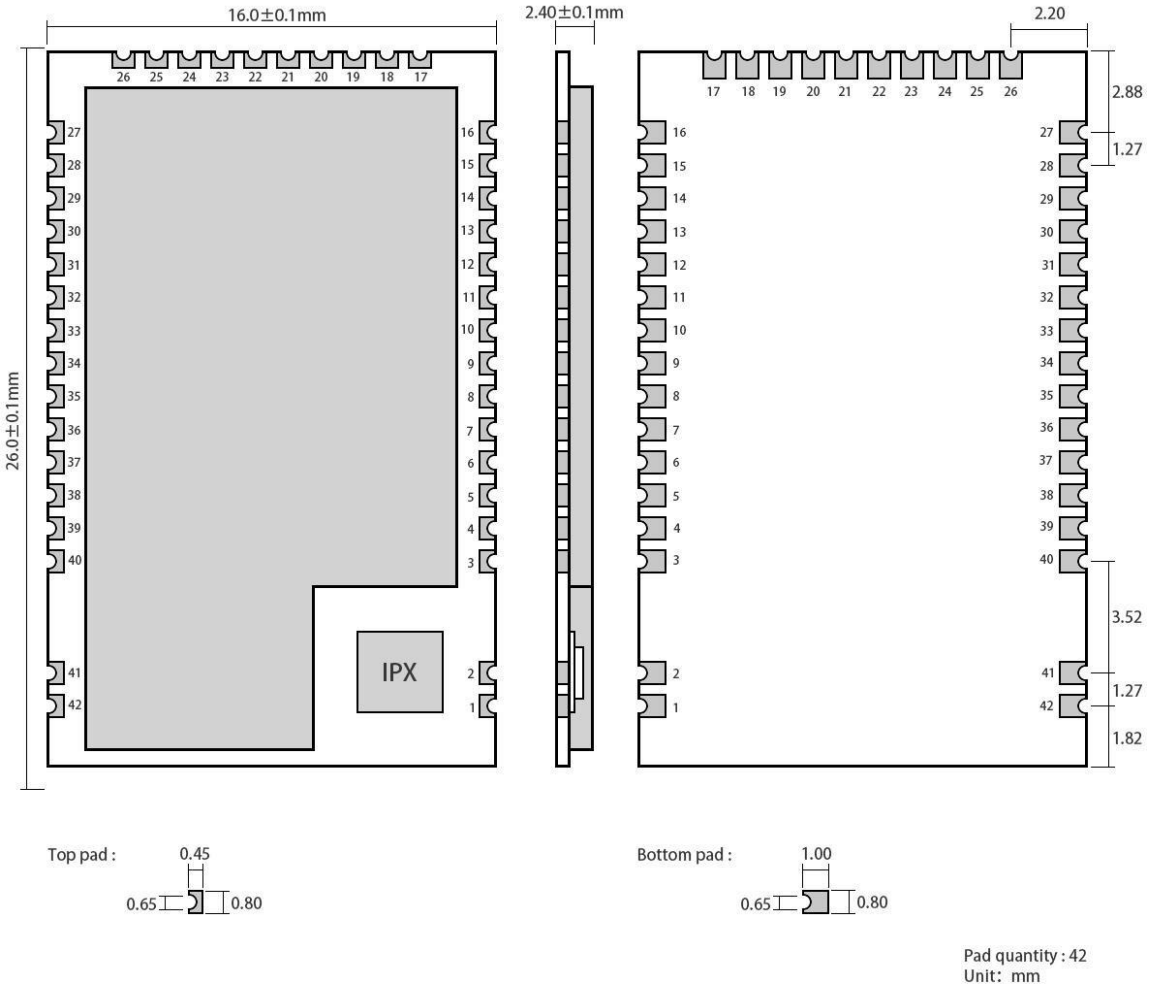
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41	NC	Reserved foot	DIO_28	Reserved for unused, need to overhang
42	NC	Reserved foot	DIO_29	Reserved for unused, need to overhang
43	NC	Reserved foot	DIO_30	Reserved for unused, need to overhang
44	LNA_EN	Input	RX_EN	Internal LNA enable pin, active high, connected to pin 11
45	PA_EN	Input	TX_EN	Internal PA enable pin, active high, connects to 12 pins
46	GND	Reference Ground	-	Module Ground Wire
47	GND	Reference Ground	-	Module Ground Wire
48	ANT	-	-	Antenna (50 Ohm characteristic impedance)

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3. 2 E70-433T14S dimensional drawing and pin definition



Pin Serial Number	Pin Name	Pin Direction	The chip corresponds to the pin	Pin Usage
1	GND	Reference Ground	-	Module Ground Wire
2	ANT	-	-	Antenna (50Ω characteristic impedance)
3	NC	Reserved Foot	X32K_Q1	Reserved for unused, need to overhang
4	NC	Reserved Foot	X32K_Q2	Reserved for unused, need to overhang
5	NC	Reserved Foot	DIO_1	Reserved for unused, need to overhang
6	LNA_EN	Output	DIO_2	External LNA control output, active high (can be dangled)
7	PA_EN	Output	DIO_3	External PA control output, active high (can be

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				dangled)
8	NC	Reserved Foot	DIO_4	Reserved for unused, need to overhang
9	NC	Reserved Foot	DIO_5	Reserved for unused, need to overhang
10	NC	Reserved Foot	DIO_6	Reserved for unused, need to overhang
11	NC	Reserved Foot	DIO_7	Reserved for unused, need to overhang
12	NC	Reserved Foot	DIO_8	Reserved for unused, need to overhang
13	NC	Reserved Foot	DIO_9	Reserved for unused, need to overhang
14	NC	Reserved Foot	DIO_10	Reserved for unused, need to overhang
15	M2	Input	DIO_11	The combination of M2, M1 and M0 determines the 8 modes of operation of the module. A 1K external series protection resistor is required for use
16	GND	Reference Ground	-	Module Ground Wire
17	M0	Input	DIO_12	The combination of M2, M1 and M0 determines the 8 modes of operation of the module. A 1K external series protection resistor is required for use, and a 1M pull-up resistor is added (not suspended, grounded if not in use)
18	M1	Input	DIO_13	The combination of M2, M1 and M0 determines the 8 modes of operation of the module. A 1K external series protection resistor is required for use, and a 1M pull-up resistor is added (not suspended, grounded if not in use)
19	RXD	Input	DIO_14	TTL serial input, connected to the external TXD output pin. Can be configured as an open drain or pull-up input, see parameter settings for details
20	TXD	Output	DIO_15	TTL serial output, connected to the external RXD input pin. Can be configured as open-drain or push-pull output, see parameter settings for details
21	TMSC	Input	JTAG_TMSC	JTAG TMSC
22	TCKC	Input	JTAG_TCKC	JTAG TCKC
23	NC	Reserved Foot	DIO_16	Reserved for unused, need to overhang

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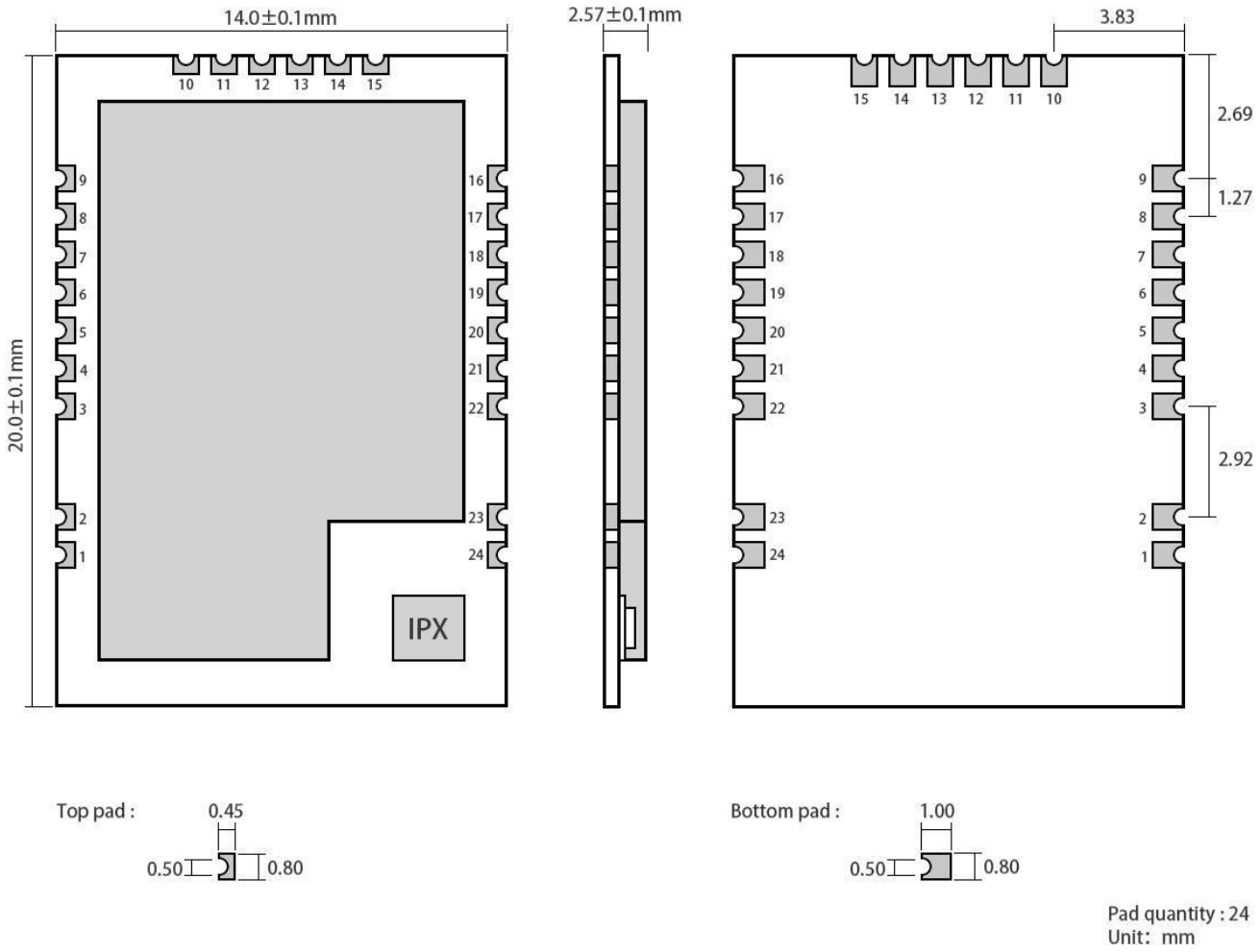
24	NC	Reserved Foot	DIO_17	Reserved for unused, need to overhang
25	AUX	Output	DIO_18	Indicates the working status of the module, the user wakes up the external MCU, outputs low during power-on self-test initialization, can be configured as open-drain output, or push-pull output, see parameter settings for details. A 1K external series protection resistor is required for use (can be suspended)
26	VCC	-	-	Module power supply positive reference, voltage range: 2.2 to 3.8V DC
27	GND	Reference Ground	-	Module Ground Wire
28	NC	Reserved Foot	DIO_19	Reserved for unused, need to overhang
29	NC	Reserved Foot	DIO_20	Reserved for unused, need to overhang
30	NC	Reserved Foot	DIO_21	Reserved for unused, need to overhang
31	NC	Reserved Foot	DIO_22	Reserved for unused, need to overhang
32	RESET	Input	RESET_N	Module reset pin
33	NC	Reserved Foot	DIO_23	Reserved for unused, need to overhang
34	NC	Reserved Foot	DIO_24	Reserved for unused, need to overhang
35	NC	Reserved Foot	DIO_25	Reserved for unused, need to overhang
36	NC	Reserved Foot	DIO_26	Reserved for unused, need to overhang
37	NC	Reserved Foot	DIO_27	Reserved for unused, need to overhang
38	NC	Reserved Foot	DIO_28	Reserved for unused, need to overhang
39	NC	Reserved Foot	DIO_29	Reserved for unused, need to overhang
40	NC	Reserved Foot	DIO_30	Reserved for unused, need to overhang
41	GND	Reference Ground	-	Module Ground Wire
42	GND	Reference	-	Module Ground Wire

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		Ground		

3. 3 E70-433T14S2 dimensional drawing and pin definition



Pin Serial Number	Pin Name	Pin Direction	The chip corresponds to the pin	Pin Usage
1	GND	Reference Ground	-	Module Ground Wire
2	GND	Reference Ground	-	Module Ground Wire
3	GND	Reference Ground	-	Module Ground Wire
4	NC	Reserved Foot	X32K_Q2	Reserved for unused, need to overhang
5	NC	Reserved Foot	X32K_Q1	Reserved for unused, need to overhang

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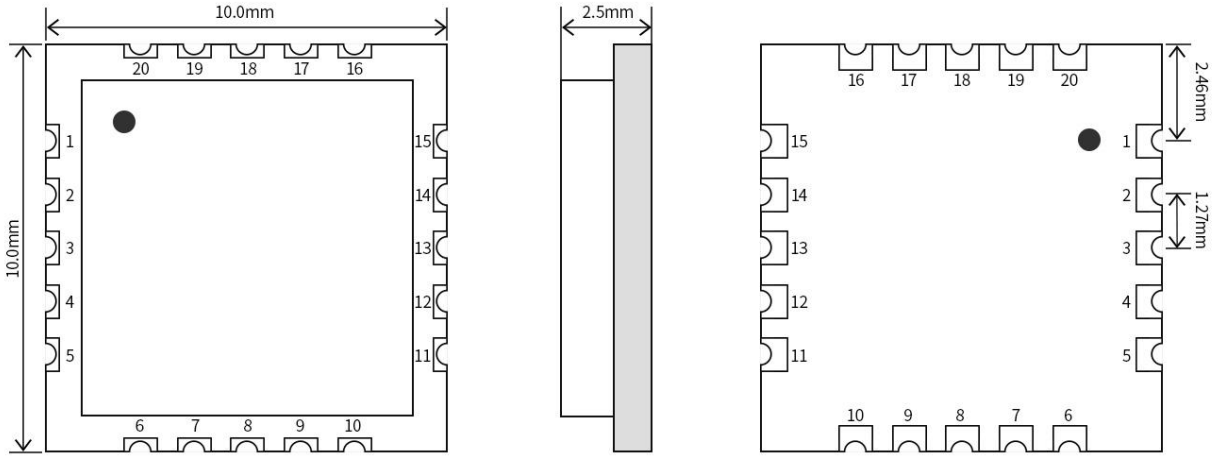
6	NC	Reserved Foot	DIO_9	Reserved for unused, need to overhang
7	NC	Reserved Foot	DIO_8	Reserved for unused, need to overhang
8	VCC	-	-	Module power supply positive reference, voltage range: 2.2 to 3.8V DC
9	GND	Reference Ground	-	Module Ground Wire
10	GND	Reference Ground	-	Module Ground Wire
11	PA_EN	Output	DIO_7	External PA control output, active high (can be dangled)
12	LNA_EN	Output	DIO_6	External LNA control output, active high (can be dangled)
13	M2	Input	DIO_5	The M2M1M0 combination determines the 8 operating modes of the module and requires a 1K external series protection resistor for use
14	RESET	Input	RESET_N	Module reset pin, active low
15	GND	Reference Ground	-	Module Ground Wire
16	AUX	Output	DIO_4	Used to indicate the working status of the module, the user wakes up the external MCU, output low during power-on self-test initialization, can be configured as can be configured as open drain output or push-pull output, see parameter setting (can be suspended)
17	TXD	Output	DIO_3	Can also be used as a TTL serial output, connected to an external RXD input pin. Can be configured as an open-drain or push-pull output, see parameter settings for details
18	TCKC	Input	JTAG_TCKC	JTAG TCKC
19	TMSC	Input	JTAG_TMSC	JTAG TMSC
20	RXD	Input	DIO_2	TTL serial input, connected to the external TXD output pin. Can be configured as an open drain or pull-up input, see parameter settings for details
21	M1	Input	DIO_1	M2M1M0 Common combination determines the 8 operating modes of the module (not suspended, can be grounded if not in use)

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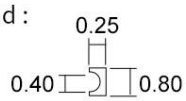
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22	M0	Input	DIO_0	M2M1M0 Common combination determines the 8 operating modes of the module (not suspended, can be grounded if not in use)
23	GND	Reference Ground	-	Module Ground Wire
24	ANT	-	-	Antenna (50Ω characteristic impedance)

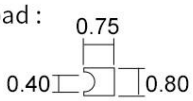
3.4 E70-433MT14S dimensional drawing and pin definition



Top pad :



Bottom pad :



Unit : mm
pad quantity : 20
Tolerance value : X.X±0.1mm
X.XX±0.05mm

Pin Serial Number	Pin Name	Pin Direction	Corresponds to the chip pin	Pin Usage
1	VCC	Power supply	-	Module power supply positive reference, voltage range: 2.2 to 3.8V DC
2	GND	Reference Ground	-	Ground wire, connected to power reference ground
3	RESET	Input	RESET_N	Module reset pin, active low
4	TCK	Input/output	JTAG_TCKC	Program download port, JTAG TCKC
5	TMS	Input/output	JTAG_TMSC	Program download port, JTAG TMSC
6	ANT	Input/output	-	Antenna connector, stamp hole (50Ω characteristic impedance)
7	GND	Reference	-	Ground wire, connected to power reference ground

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		Ground		
8	NC	Reserved Foot	-	Reserved for unused, need to overhang
9	NC	Reserved Foot	X32K_Q2	Reserved for unused, need to overhang
10	NC	Reserved Foot	X32K_Q1	Reserved for unused, need to overhang
11	AUX	Output	DIO_4	Used to indicate the working status of the module, the user wakes up the external MCU, output low during power-on self-test initialization, can be configured as open-drain output, or push-pull output, see parameter settings for details (can be overhung)
12	TXD	Output	DIO_3	Can also be used as a TTL serial output, connected to an external RXD input pin. Can be configured as an open-drain or push-pull output, see parameter settings for details
13	RXD	Input	DIO_2	TTL serial input, connected to the external TXD output pin. Can be configured as an open drain or pull-up input, see parameter settings for details
14	LNA_EN	Output	DIO_6	External LNA control output, active high (can be overhung)
15	PA_EN	Output	DIO_7	External PA control output, active high (can be overhung)
16	GND	Reference Ground	-	Ground wire, connected to power reference ground
17	NC	Reserved Foot	DIO_9	Reserved for unused, need to overhang
18	M2	Input	DIO_5	M2M1M0 combined to determine the module's eight operating modes, the use of an external series of 1K protection resistor
19	M1	Input	DIO_1	M2M1M0 combined to determine the module's eight operating modes, the use of an external series of 1K protection resistor
20	M0	Input	DIO_0	M2M1M0 combined to determine the module's eight operating modes, the use of an external series of 1K protection resistor

3. 5 Precautions

- This series of products can achieve pin compatibility, Pin to Pin replacement.
- The single-chip microcomputer control PA and LNA truth table is as follows:

state	PA_EN	LNA_EN

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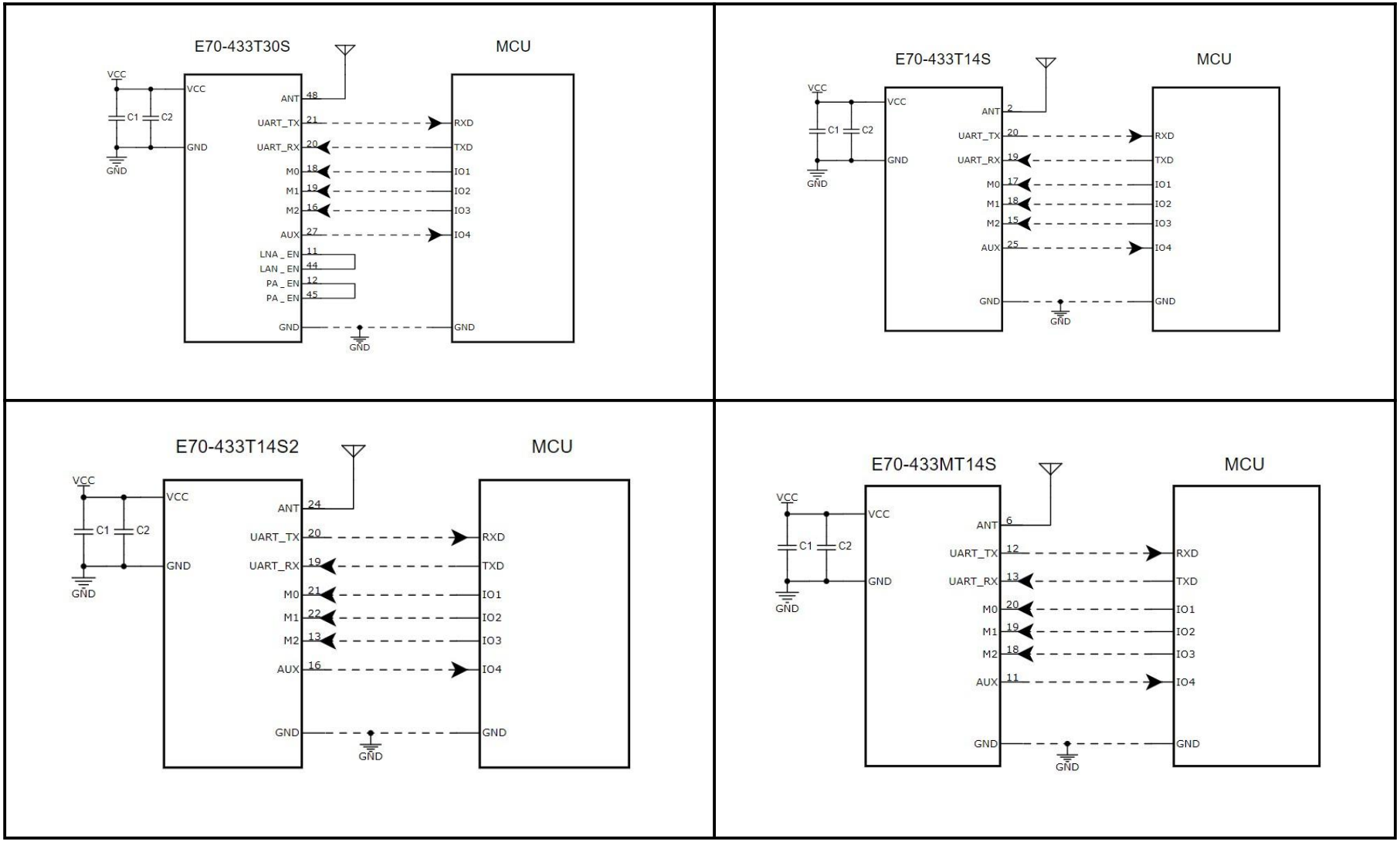
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When launched	1	0
When receiving	0	1
When sleeping	0	0

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Chapter 4 Recommended Wiring Diagrams



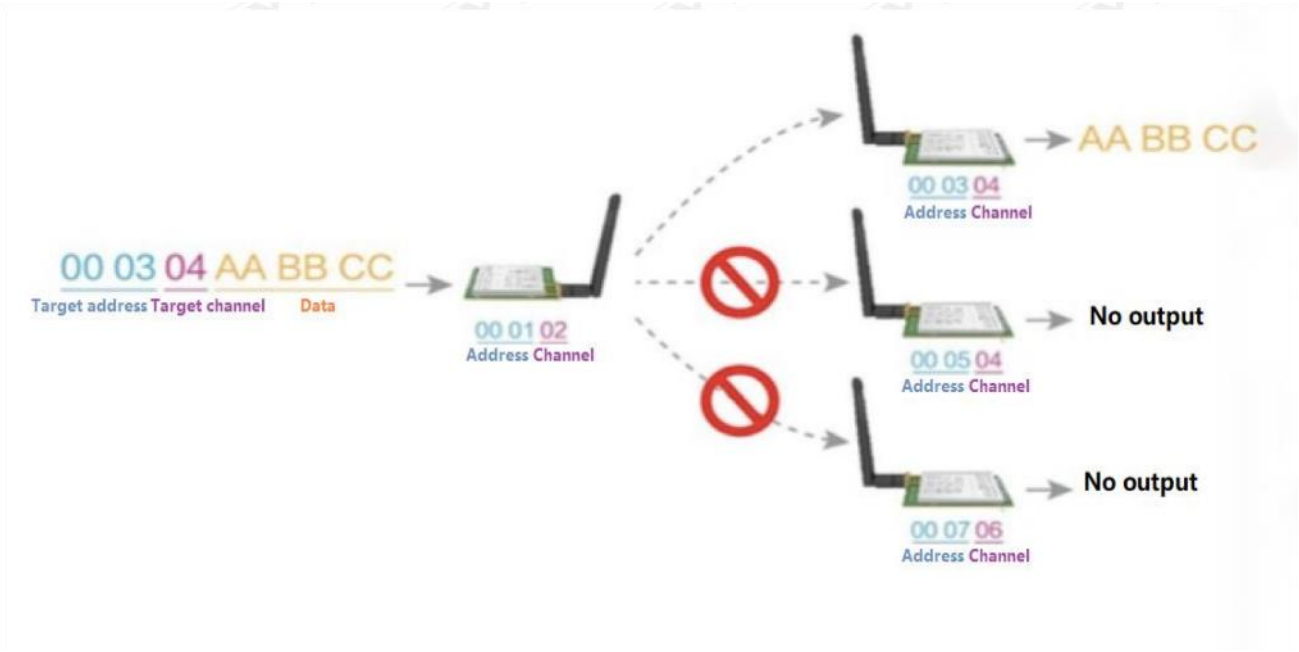
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serial number	Brief connection description of the module and the MCU (the above figure takes the STM8L MCU as an example).
1	The wireless serial port module is TTL level, please connect with the TTL level MCU.
2	Some 5V MCUs may need to add 4~10K pull-up resistors to the TXD and AUX pins of the module.

Chapter 5 Detailed Explanation of Functions

5.1 Fixed-point launch (1in base 6).



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5.2 Broadcast transmission (16 base).



5.3 Broadcast Address

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

5.4 Listening address

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

5.5 Module reset

- After the module is powered on, AUX will immediately output a low level, perform hardware self-test, and set the working mode according to user parameters;
  During this process, AUX remains low, and after completion, AUX outputs a high level, and starts to work normally according to the working mode formed by the combination of M2, M1 and M0;
  Therefore, the user needs to wait for the AUX rising edge as a starting point for the module to work normally.

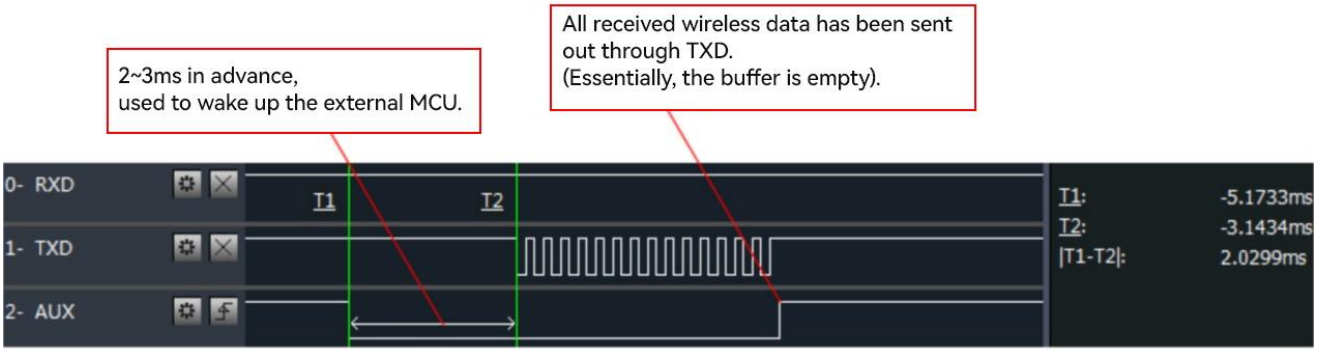
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5.6 AUX in detail

5.6.1 Serial port data output indication

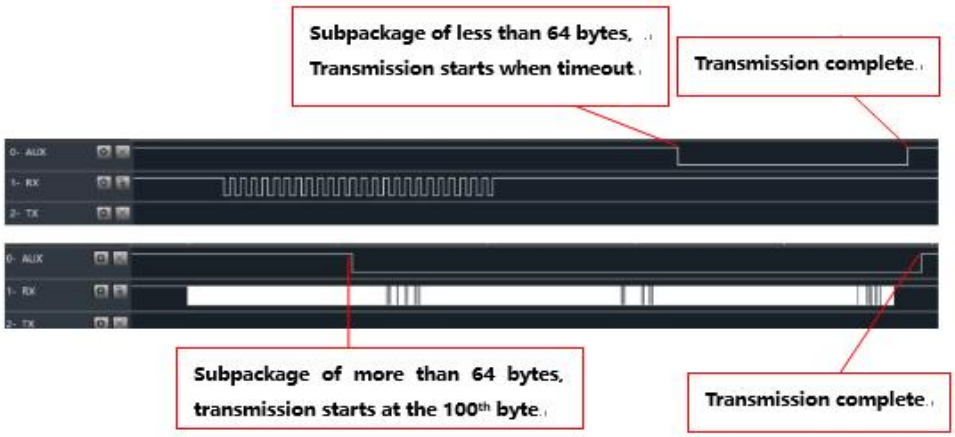
- Used to wake up the external MCU in sleep (note that AUX indicates no delay in continuous transmission mode);



AUX pin timing diagram when module serial port sends out data.

5.6.2 Wireless Transmission Indication

- In packet transmission mode, the internal buffer size is specified by the packet size, such as the packet length is set to 1024 bytes, the corresponding buffer size is 1024 bytes, and the user can continuously initiate no more than 1024 bytes of data when AUX=1;
- In continuous transmission mode, AUX=1 remains unchanged, and the length of user data input data is not limited;
- In WOR send mode, AUX=1 users can continuously initiate data less than 84 bytes;
- When AUX=1, it means that all serial port data of the module is transmitted wirelessly.



Time sequence diagram of AUX pin when module receiving serial port data (subpackage mode)



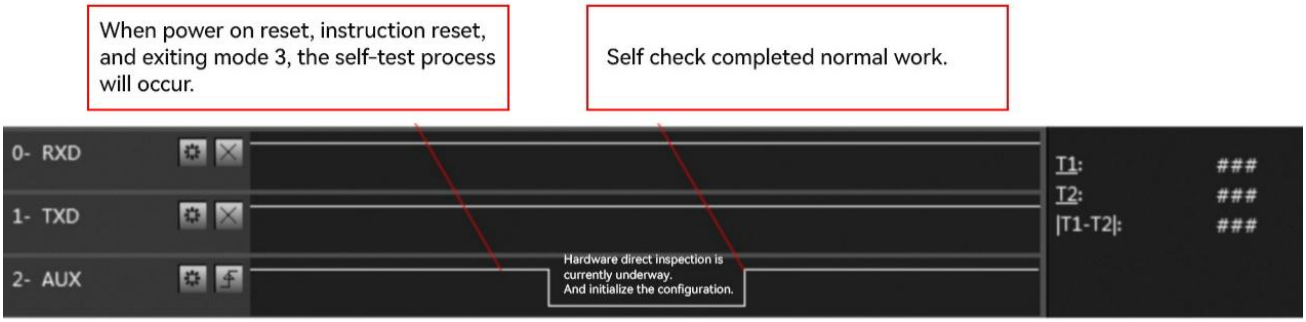
Time sequence diagram of AUX pin when module receiving serial port data (continuous mode)

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5.6.3 Module is in the process of being configured

- only when resetting and exiting sleep mode;



During self check, AUX pin timing diagram.

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Chapter 6 Work Modes

6.1 Mode switching

Mode (0-7).	M2	M1	M0	Schema introduction	remark
0 RSSI mode	0	0	0	The serial port is open, closed wirelessly, and cannot be transmitted	The module outputs RSSI intensity values every 100ms serial port
1 Continuous transmission mode	0	0	1	The serial port is opened, the wireless is opened, and the transmission is continuous and transparent	The airspeed is automatically adjusted with the baud rate, and the baud rate of both sides must be consistent. Suitable for high-speed continuous data
2 Subcontracting mode	0	1	0	The serial port is opened, the wireless is opened, and the subpacket is transmitted transparently	Airspeed and baud rate and independent configuration for packet communication.
3 Configuration mode	0	1	1	The serial port is open and closed wirelessly for parameter configuration	The baud rate is fixed at 9600 8N1
4 Wake mode	1	0	0	The serial port is opened, the wireless is opened, and the subpacket is transmitted transparently	This mode can not receive, automatically increase the wake code before transmission, Receiver in wake-up mode 6.
5 Same mode 3 (configuration mode).	1	0	1	The serial port is open and closed wirelessly for parameter configuration	The baud rate is fixed at 9600 8N1
6 Power saving mode	1	1	0	The serial port is closed, and it works wirelessly in WOR power-saving mode, and multiple time levels can be configured	This mode cannot transmit and can be woken up by the transmitter operating in mode 4 for low-power wireless reception
7 Sleep mode	1	1	1	The serial port is closed, wireless propagation, and sleep	Can be awakened by any falling edge of M2M1M0

- The user can combine the high and low levels of M2M1M0 to determine the module operating mode. The MCU's GPIO can be used to control mode switching; When changing M2M1M0: if the module is idle (AUX high), it can start working according to the new mode; If the module has serial port data that has not been transmitted wirelessly, it can enter the new working mode only after the transmission is completed; If the module receives wireless data and sends out data through the serial port, it needs to be sent before it can enter the new working mode; So the mode switch can only be used when AUX outputs 1, otherwise the switching will be delayed.

- For example, in mode 2 or mode 4, the user continuously enters a large amount of data and switches the mode at the same time, and the switching mode operation is invalid; The module will process all user data before performing new pattern detection; Therefore, the general recommendation is: detect the AUX pin output status, wait for the AUX output high level and then switch for 2ms.

- When the module is switched from other modes to configuration mode, if there is data that has not been processed; The

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module will process this data, including sending and receiving, before entering sleep mode. This feature can be used for fast sleep, thus saving power consumption; For example: the transmitter module works in mode 0, the user initiates the serial port data "12345", and then does not have to wait for the AUX pin to be idle (high level), you can directly switch to sleep mode, and the user's main MCU immediately sleeps, the module will automatically send all the user data through the wireless Automatically enter sleep within 1ms; This saves the working time of the MCU and reduces power consumption.

- Similarly, any mode switch can take advantage of this feature, after the module processes the current mode event, within 1ms, it will automatically enter the new mode; Thus, the user's work of querying AUX is omitted, and the purpose of fast switching can be achieved; For example, switching from transmit mode to receive mode; The user MCU can also go to sleep early before the mode switch and use the external interrupt function to capture the AUX change for mode switching.
- This operation is very flexible and efficient, designed exactly for the user's MCU to operate, and can minimize the workload of the entire system, improve system efficiency, and reduce power consumption.

6.2 RSSI mode (mode 0).

state	M2、M1、M0 = 000
launch	Wireless data transmission is not possible.
reception	Wireless data reception is not possible.
Baud rate and airspeed	The current baud rate
merit	The module outputs a byte RSSI signal strength value at a timed 100ms for determining the noise value of the current environment.
shortcoming	Data sending and receiving is not possible
Applicable scenarios	Used to listen to ambient noise
note	not

6.3 Continuous transmission mode (mode 1).

state	M2、M1、M0 = 001
launch	Wireless data transmission is possible.
reception	Wireless data reception is possible.
Baud rate and airspeed	Based on the user's baud rate setting, the module automatically calculates the minimum airspeed required to meet continuous output requirements. Since modules with different airspeeds cannot communicate, the serial port parameter settings of both sides of the sending and receiving must be consistent.
merit	The serial data output of the wireless receiver is continuous, which meets the continuous transmission requirements of MODBUS and also meets the requirements of low time delay.
shortcoming	The baud rate of the serial port of both the sending and receiving parties must be consistent; After the serial baud rate

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	is increased, the module will be adjusted to a higher airspeed, resulting in a decrease in reception sensitivity and a decrease in transmission distance.
Applicable scenarios	It is suitable for occasions where the distance requirements are not high, but the data continuity and response time are very high.
note	1. The "wireless air rate" in the configuration instruction is invalid (SPED.210 bits), the software automatically calculates; 2. 0000 and FFFF are broadcast addresses that can be used for monitoring and broadcasting; 3. The addresses and baud rates of both communicating parties must be consistent; 4. Both transceiver modules must use the same model, such as E70 (868T14S) and E70 (868T30S) cannot communicate continuously.

6.4 Subcontracting mode (mode 2).

state	M2、M1、M0 = 010
launch	Wireless data transmission is possible.
reception	Wireless data reception is possible.
Baud rate and airspeed	In this mode, the serial port baud rate and airspeed are independent, and the sending and receiving parties can have different serial port baud rates, but must have the same airspeed setting.
merit	A very low airspeed can be set to achieve long-distance transmission, and the continuity between output data bytes depends on the module package length.
shortcoming	Depending on the setting, the airspeed can be set very low and the transmitter needs to wait for the number of packet length bytes or timeout bytes.
Applicable scenarios	Occasions where the distance requirements are high, and a certain output continuity is required, but the transmission rate is required to be low.
note	1、Airspeed and baud rate are independent and their settings are in effect. 2、0000 and FFFF are broadcast addresses that can be used for monitoring and broadcasting. 3、The airspeed and address of both sides of the communication must be consistent, and the baud rate can be inconsistent. 4、The maximum packet data per packet is defined by the packet size [7:5] (excluding addresses and channels for directed sends).

6.5 Configuration Mode (Mode 3).

state	M2、M1、M0 = 011
launch	Wireless transmission is not possible, and the received serial port data will be discarded.
reception	Wireless reception is not possible.
disposition	It can be used for module parameter setting, using serial ports 9600, 8N1, to set module working parameters through a specific instruction format
note	When entering other modes from the setup mode, the module will reconfigure the parameters, and AUX will remain low during the configuration process;

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	The output level is high after completion, so it is recommended that the user detect the rising edge of the AUX.

6.6 Wake mode (mode 4).

state	M2、M1、M0 = 100
launch	Wireless data transmission is possible.
reception	Wireless data reception is not possible.
Baud rate and airspeed	In this mode, the serial port baud rate and airspeed are independent, and the sending and receiving parties can have different serial port baud rates, but must have the same airspeed setting.
merit	Can wake up receivers operating in mode 6; The wake code is automatically increased before launch, and the number of increases depends on the wake-up time setting.
shortcoming	The transmission time is long, and it is only suitable for waking the receiver, not for conventional transmission data.
Applicable scenarios	Used to wake up receivers in WOR state.
note	In wake-up mode, the maximum transmit length of a single packet is 84 bytes (excluding directed addresses and channels).

6.7 Configuration Mode (Mode 5).

state	M2、M1、M0=101
launch	Wireless transmission is not possible, and the data of the serial port is regarded as a configuration instruction.
reception	Wireless reception is not possible.
disposition	It can be used for module parameter setting, using serial ports 9600, 8N1, to set module working parameters through a specific instruction format
note	When entering other modes from the setup mode, the module will reconfigure the parameters, and AUX will remain low during the configuration process; The output level is high after completion, so it is recommended that the user detect the rising edge of the AUX.

6.8 Power saving mode (mode 6).

state	M2、M1、M0 = 110
launch	No wireless data transmission.
reception	Wireless data reception is possible.
Baud rate and airspeed	In this mode, the serial port baud rate and airspeed are independent, and the sending and receiving parties can have different serial port baud rates, but must have the same airspeed setting.
merit	The module works in the WOR state, periodically automatically wakes up and listens to the air wireless packets, when the packet is heard, the module enters the receive mode and receives the whole packet, serial port output, and then enters the WOR state again. Power consumption can be greatly saved.

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shortcoming	This mode cannot emit data, and when you need to emit data, you need to switch to another working mode.
Applicable scenarios	Devices that require high power consumption and need to receive data.
note	Only data from the transmitter of mode 4 can be received.

6.9 Sleep mode (mode 7).

state	M2、M1、M0 = 111
launch	Wireless data cannot be transmitted.
reception	Unable to receive wireless data.
other	All other functions of the module are turned off and can only exit sleep mode by state switching of M2M1M0.

Chapter 7 Instruction Format

- In the configuration mode (mode 3: M0=1, M1=1, M2=0), the list of supported instructions is as follows (when setting, only 9600, 8N1 format is supported):

serial number	Instruction format	Detailed description
1	C0+ operating parameters	The base 16 format sends C0+5 bytes of working parameters, a total of 6 bytes, which must be sent continuously (saved by power loss).
2	C1+C1+C1	Three C1s are sent in base 16 format, and the module returns saved parameters that must be sent consecutively.
3	C2+ operating parameters	The base 16 format sends C2+5 bytes of working parameters, a total of 6 bytes, which must be sent continuously (power down is not saved).
4	C3+C3+C3	The decimal format sends three C3s, and the module returns version information, which must be sent continuously.
5	C4+C4+C4	The decimal format sends three C4s, and the module will produce a reset that must be sent continuously.

7.1 Factory default parameters

Model	Factory default parameter value: C0 00 00 18 04 1C						
Module model	frequency	address	channel	Air velocity	baud rate	Serial port format	Transmit power
E70-433MT14S	433MHz	0x0000	0x04	2.5kbps	9600	8N1	25mW

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7.2 Working parameter reading

Instruction format	Detailed description
C1+C1+C1	Under configuration (M0=1, M1=1, M2 =0), issue commands (HEX format) to the module serial port: C1 C1 C1, The module returns the current configuration parameters, such as: C0 00 00 18 4E 1C.

7.3 Version number read

Instruction format	Detailed description
C3+C3+C3	Under Configuration (M0=1, M1=1, M2 =0), issue the command (HEX format) to the module serial port: C3 C3 C3, and the module will return the current configuration parameters For example: C3 0070 XX1 XX2 XX3 XX4 XX5; The 70 here represents the module model E70 series, if it is 71, then the E71 series; XX1 is the version number, and XX2 XX3 XX4 XX5 refers to other features of the module.

7.4 Reset Command

Instruction format	Detailed description
C4+C4+C4	Under the configuration (M0=1, M1=1, M2 =0), issue a command (HEX format) to the module serial port: C4 C4 C4, and the module will generate a reset; During the reset process, the module performs a self-test, the AUX output is low, and after the reset is completed, the AUX output is high, and the module starts to work normally. At this point, you can switch modes or initiate the next instruction.

7.5 Parameter Setting Instructions

serial number	name	description	remark
0	HEAD	Fixed 0xC0 or 0xC2, indicating that this frame data is a control command	C0: The set parameters will be saved in power failure; C2: The set parameters will not be saved without power loss.
1	ADDH	Module address high byte (default 00H).	00H-FFH
2	ADDL	Module address low byte (default 00H).	00H-FFH

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<table>
<tr><td rowspan="20">3</td><td rowspan="20">SPED</td><td>7</td><td>6</td><td colspan="2">Serial port check digit</td><td rowspan="5">The serial port mode of the communication side can be different.</td></tr>
<tr><td>0</td><td>0</td><td colspan="2">8N1 (default).</td></tr>
<tr><td>0</td><td>1</td><td colspan="2">8O1</td></tr>
<tr><td>1</td><td>0</td><td colspan="2">8E1</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">8N1 (equivalent 00).</td></tr>
<tr><td>5</td><td>4</td><td>3</td><td>TTL serial port baud rate (bps).</td><td rowspan="10">The baud rate of the two sides of the communication can be different;

The serial port baud rate has nothing to do with wireless parameters and does not affect the wireless transceiver characteristics.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>The serial port baud rate is 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>The serial port baud rate is 2400</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>The serial port baud rate is 4800</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>The serial port baud rate is 9600 (default).</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>The serial port baud rate is 19200</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>The serial port baud rate is 38400</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>The serial port baud rate is 57600</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>The serial port baud rate is 115200</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>Wireless air rate (bps).</td><td rowspan="10">The lower the air speed, the farther the distance, the stronger the anti-interference performance, and the longer the transmission time;

Both communicating parties must have the same over-the-air wireless transmission rate.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>The air speed is 2.5k (default).</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>The air rate is 5k</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>The air rate is 12k</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>The air rate is 28k</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>The air rate is 64k</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>The air speed is 168k</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>The air speed is 168k</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>The air speed is 168k</td></tr>
<tr><td rowspan="12">4</td><td rowspan="12">CHAN</td><td>7</td><td>6</td><td>5</td><td>Package length setting (subcontracting mode only)</td><td rowspan="10">In continuous transmission mode (M2, M1, M0 = 001), this parameter is invalid.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>16 bytes</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>32 bytes</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>64 bytes (default).</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>128 bytes</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>256 bytes</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>512 bytes</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1024 bytes</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>2048 bytes</td></tr>
<tr><td colspan="4">Communication channel</td><td rowspan="2">DEFAULT 04H (433MHZ).</td></tr>
<tr><td colspan="4">00H~1FH, corresponding to 431~446.5MHz</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">OPTION</td><td>7</td><td colspan="3">FIXED-POINT TRANSMIT ENABLE BIT (MODBUS-LIKE).</td><td rowspan="3">is 1, the first 3 bytes of each user data frame serve as high, low, channel; When transmitting, the module changes its own address and channel, and after completion, it restores the original settings; The continuous transmission mode is transparent transmission.</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>
</table>

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		6	5	4	Wake-up time	This parameter is only valid for modes 4 and 6; For mode 6, the wake-up time affects the WOR period of the module and has a large impact on power consumption. For mode 4, the wake-up time determines the number of wake-up codes that the module increases before launching, so as to ensure that the module in mode 6 is effectively awakened; Generally speaking, modes 4 and 6 need to be used together, and the wake-up time set by both parties must be consistent.
		0	0	0	500ms	
		0	0	1	1000ms (default).	
		0	1	0	1500ms	
		0	1	1	2000ms	
		1	0	0	2500ms	
		1	0	1	3000ms	
		1	1	0	3500ms	
		1	1	1	4000ms	
		3	FEC switch (forward error correction).			After the FEC is turned off, the actual data transmission rate is increased, but the anti-interference ability is weakened, and the distance is slightly closer, which is selected according to the actual application; Both parties to the communication must be on or off.
		0	Turn off the FEC			
		1	Open FEC (default).			
		2	IO drive mode			This bit is used to enable the internal pull-up resistor of the module; Open-drain mode is more level adaptable, and external pull-up resistors may be required in some cases.
		0	TXD, AUX open output, RXD open input			
		1	TXD, AUX push-pull output, RXD pull-up input (default).			
		1	0	Transmit power		The external power supply must provide a current output capability of more than 80mA and ensure that the power supply ripple is less than 100mV; It is not recommended to use smaller power transmission, and its power utilization efficiency is not high.
		0	0	14dBm (default).	30dBm (default).	
		0	1	10dBm	27dBm	
		1	0	7dBm	24dBm	
		1	1	4dBm	21dBm	

Give an example (the meaning of the ordinal number 3 "SPED" byte).

The binary bit of the byte	7	6	5	4	3	2	1	0
Specific value (user configuration)	0	0	0	1	1	0	0	0
Representative meaning	Serial port check digit 8N1		The serial port baud rate is 9600			The air rate is 2.5k		
Corresponds to hexadecimal	0		18					

Chapter 8 Parameter Configuration

- When the module is in mode 3 (M2, M1, M0 = 011) or mode 5 (M2, M1, M0 = 101), you can configure the module parameters through instructions or host computer software, and please visit www.ebyte.com download for supporting

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host computer software.



Chapter 9 Secondary Development

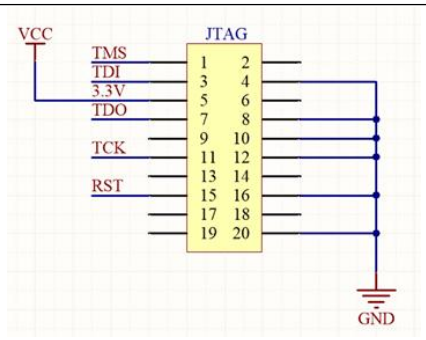
- The module supports secondary development, CC1310 RF chip, users can carry out secondary development according to the product pin description required in **Chapter 3** of this article;
- Ebaite can customize function development for customers, please contact the sales hotline 4000-330-990 .

9.1 Program Burning

keywords	Precautions
Programming procedures	The module is an SoC module, with its own GPIO port, and the program downloads using a CC series dedicated downloader : JTAG downloader (or TI official CC1310 supporting development board), can not use serial port or any other ISP, ICP tools. The figure below shows a JTAG connection diagram (XDS100), and the specific development method is detailed in the relevant documents of Ti (where the TDI and TDO pins can not be connected). 。

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Chapter 10 Hardware Design

- It is recommended to use a DC regulated power supply to supply the module, the power supply ripple coefficient 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, such as reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that between the recommended supply voltages, if the maximum value is exceeded, the module will be permanently damaged;
- Please check the stability of the power supply, the voltage can not fluctuate sharply and frequently;
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% of the margin, which is conducive to long-term stable work;
- The module should be as far away as possible from the power supply, transformer, high-frequency wiring and other parts with large electromagnetic interference;
- High-frequency digital traces, high-frequency analog wiring, power traces must avoid the bottom of the module, if it is really necessary to pass under the module, assuming that the module is welded in the Top Layer, the Top Layer of the module contact part is covered with copper (all copper is laid and well grounded), must be close to the digital part of the module and routed in Bottom Layer;
- Assuming that the module is soldered or placed in the Top Layer, it is also wrong to route the wire at will in the Bottom Layer or other layers, which will affect the spurious and receiving sensitivity of the module to varying degrees;
- Assuming that there are devices with large electromagnetic interference around the module will also greatly affect the performance of the module, it is recommended to stay away from the module appropriately according to the intensity of interference, and if the situation permits, 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 wiring) will also greatly affect the performance of the module, it is recommended to stay away from the module appropriately according to the intensity of interference, and if the situation permits, appropriate isolation and shielding can be done;
- If the communication line uses 5V level, 1k-5.1k resistors must be connected in series (not recommended, there is still a risk of damage);
- Try to stay away from some TTL protocols that are also 2.4GHz at the physical layer, such as USB3.0;
- The antenna installation structure has a great impact on the performance of the module, so it is necessary to ensure that the antenna is exposed and preferably vertically upward;
- When the module is installed inside the case, a high-quality antenna extension cable can be used to extend the antenna

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to the outside of the case;

- The antenna must not be installed inside the metal case, which will greatly weaken the transmission distance.

Chapter 11 Frequently Asked Questions

11.1 The transmission distance is not ideal

- When there is a straight-line communication barrier, the communication distance will be attenuated accordingly;
- Temperature, humidity, and co-frequency interference will lead to an increase in 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;
- If there is a metal object near the antenna, or placed in a metal case, the signal attenuation will be very serious;
- power register setting error, air rate setting too high (the higher the air speed, 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 smaller the power;
- The use of antennas is poorly matched with the module or the quality of the antenna itself is a problem.

11.2 Modules are prone to breakage

- Please check the power supply to ensure that between the recommended supply voltages, if the maximum value is exceeded, the module will be permanently damaged;
- Please check the stability of the power supply, the voltage can not fluctuate sharply and frequently;
- Please ensure that the installation and use process anti-static operation, high-frequency device 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 need, it is not recommended to use it at too high or too low temperature.

11.3 The bit error rate is too high

- There is co-frequency signal interference nearby, stay away from the source of interference or modify the frequency and channel to avoid interference;
- The power supply is not ideal, it may also cause garbled codes, and the reliability of the power supply must be guaranteed;
- Poor quality or long extension cables and feeders will also cause high bit error rates.

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Chapter 12 Welding Operation Instructions

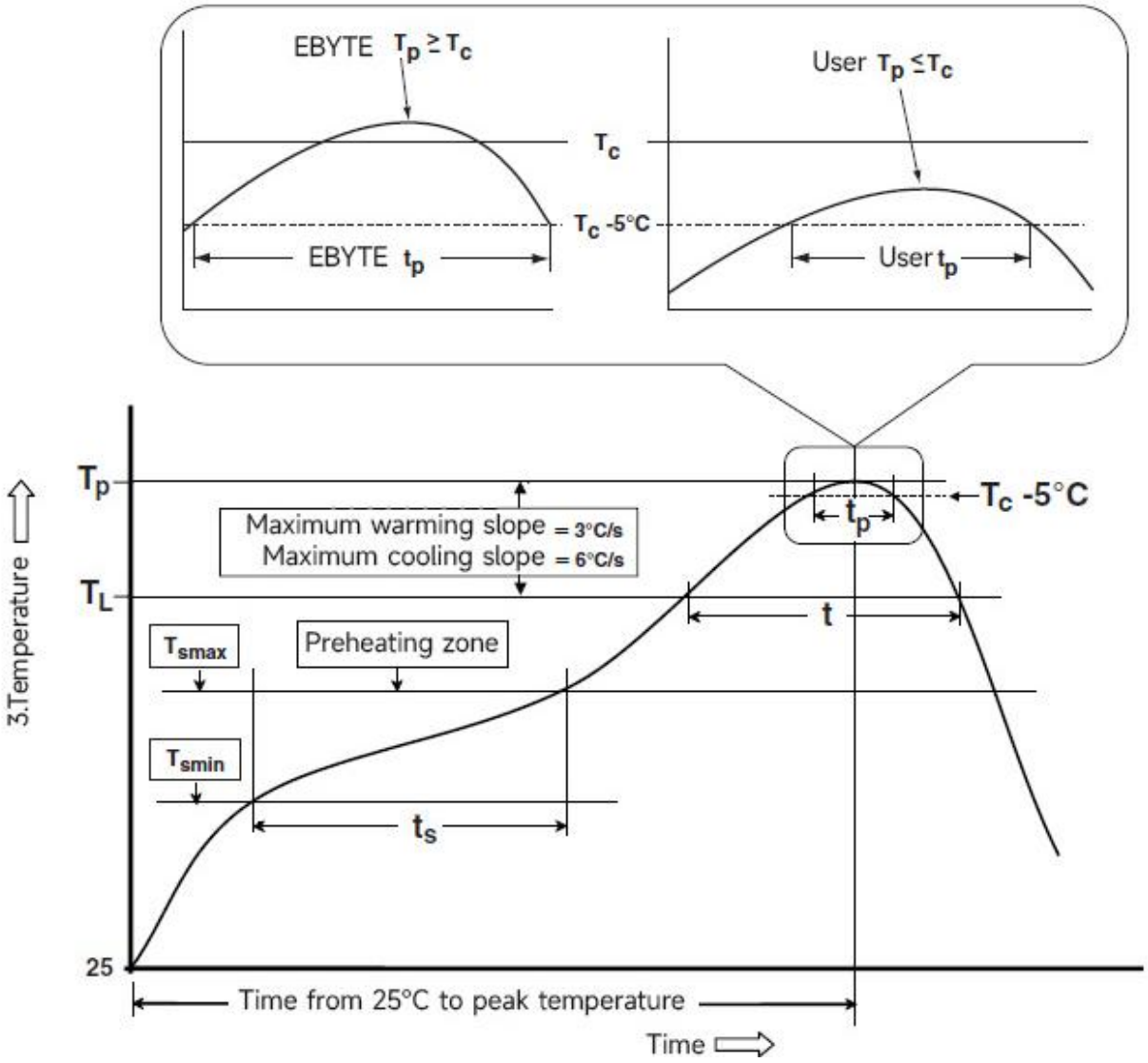
12.1 Reflow soldering temperature

Reflow curve features		There is lead process assembly	Lead-free process assembly
Preheating/insulation	Minimum temperature (Tsmin).	100℃	150℃
	Maximum temperature (Tsmax).	150℃	200℃
	Time (T smin~Tsmin).	60-120 seconds	60-120 seconds
Heating slope (T L~Tp).		3°C/sec, maximum	3°C/sec, maximum
Liquid phase temperature (TL).		183℃	217℃
Hold time above TL		60~90 seconds	60~90 seconds
The peak temperature of the package body is Tp		The user must not exceed the temperature indicated on the product's "Moisture Sensitivity" label.	The user must not exceed the temperature indicated on the product's "Moisture Sensitivity" label.
The time (Tp) within 5°C of the specified grading temperature (Tc) is shown in the figure below		20 seconds	30 seconds
Cooling slope (T p~TL).		6 °C/sec, max	6 °C/sec, max
Time from room temperature to peak temperature		6 minutes, the longest	8 minutes, the longest
※The peak temperature (Tp) tolerance definition of the temperature curve is the upper limit for the user			

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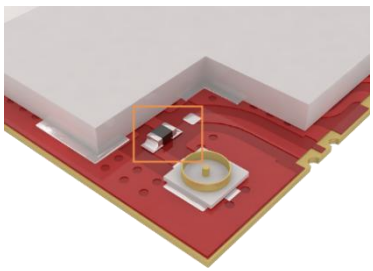
12.2 Reflow soldering curve

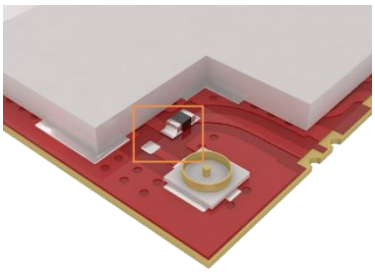


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Chapter 13 Antenna Guide

13. 1 Antenna selection

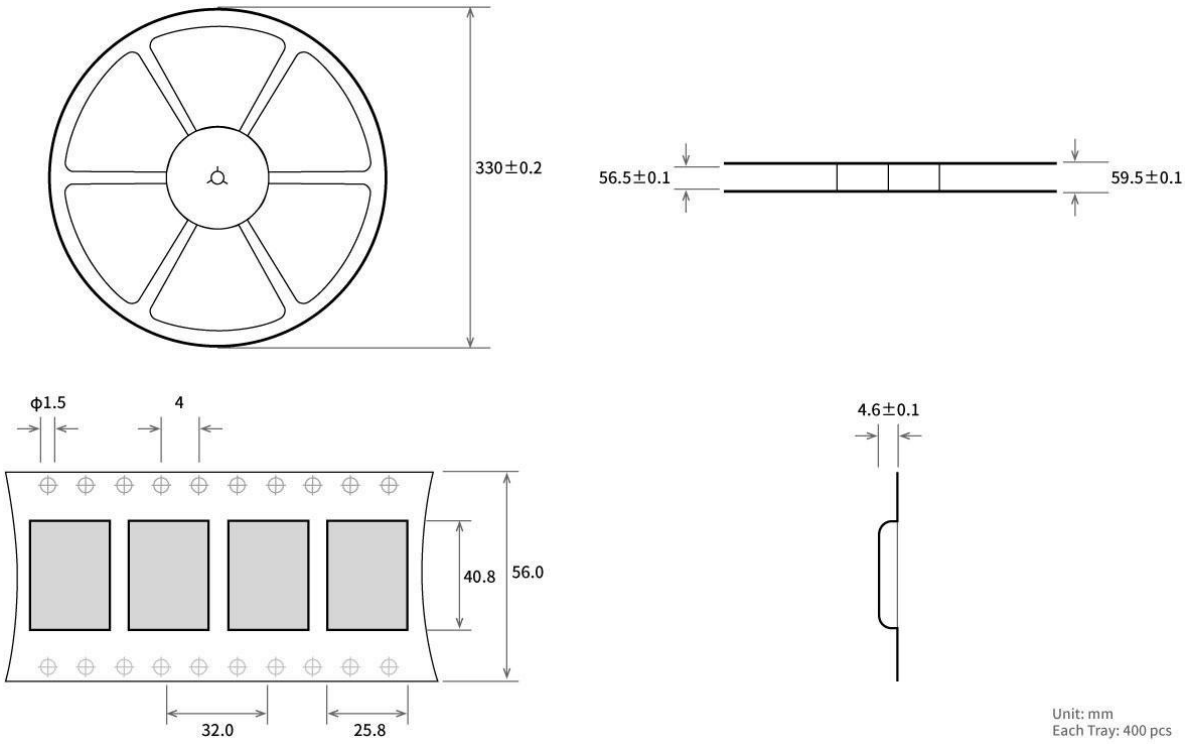




Enable IPEX interface (default) Enable the stamp hole

Chapter 14 Bulk packaging method

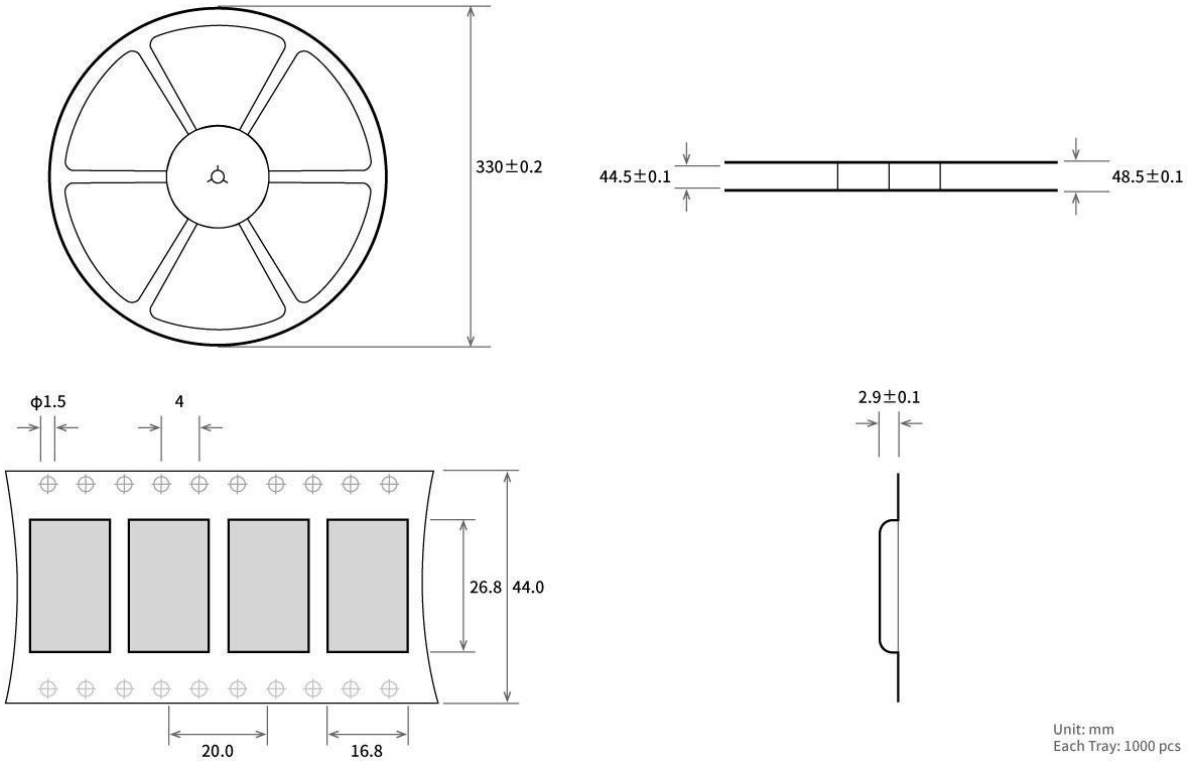
14.1 E70-433T30S bulk packaging



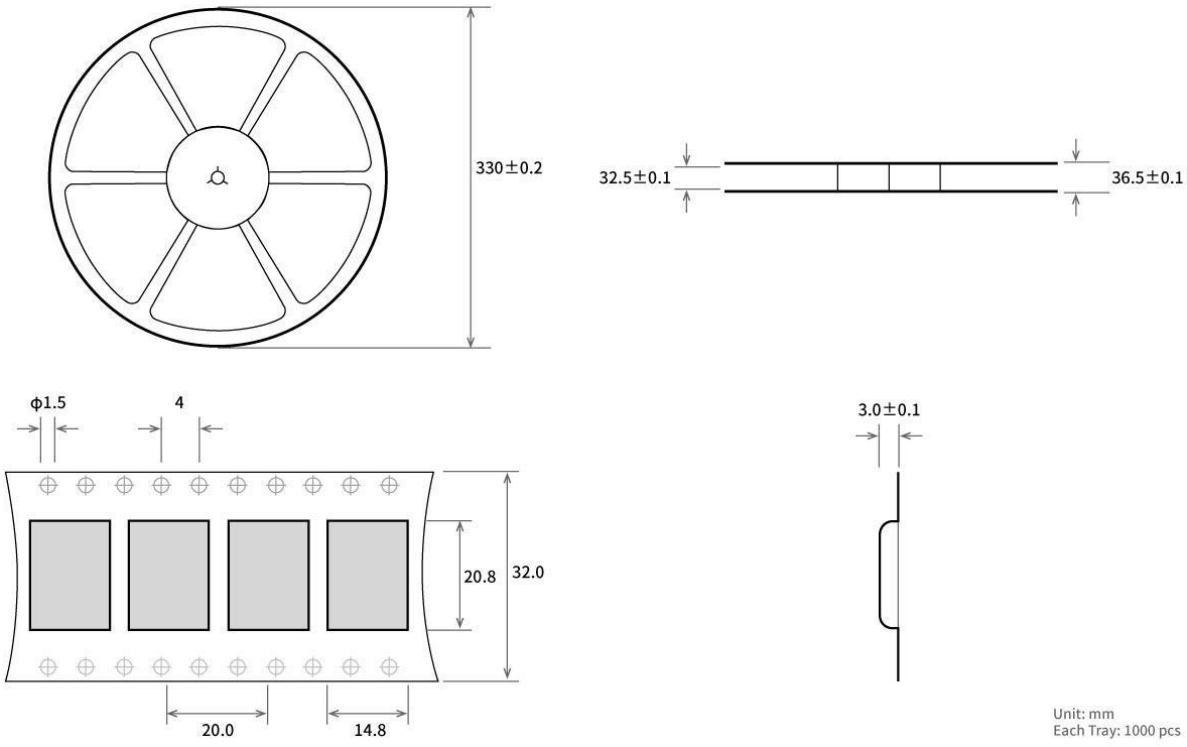
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14. 2 E70-433T14S batch packing



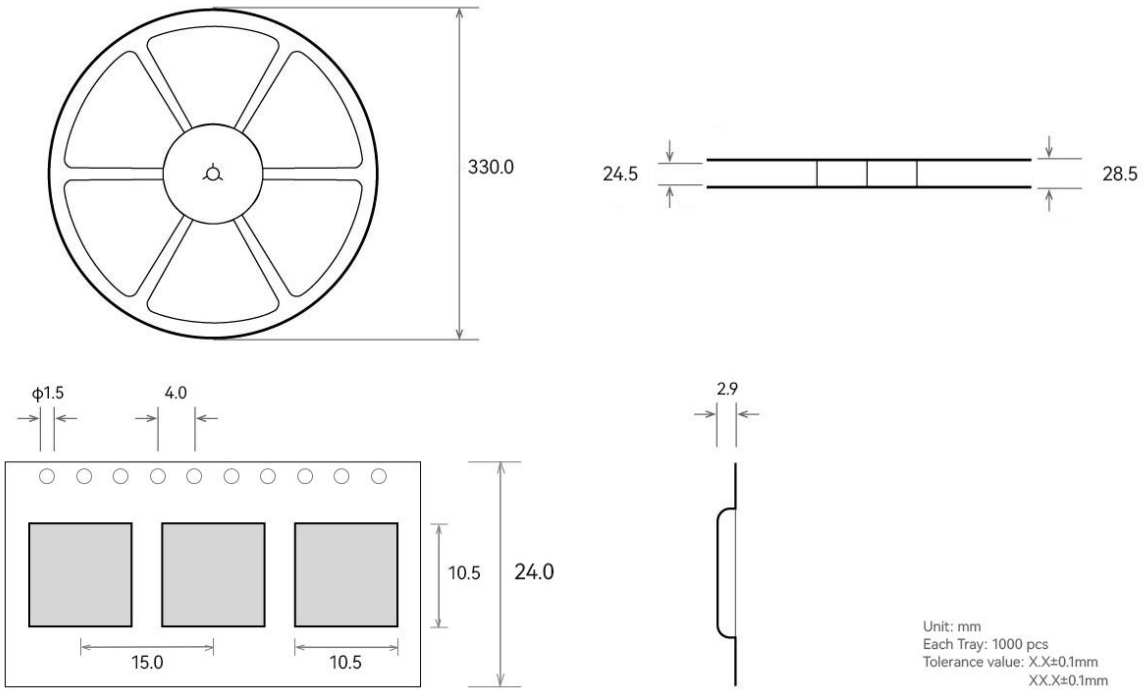
14. 3 E70-433T14S2 bulk packaging



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14. 4 E70-433MT14S bulk packing



Revision history

version	Date of revision	Revision Notes	Maintainers
1.0	2022-10-22	Initial Version	Hao
1.1	2024-6-19	Add the chip corresponding pin description	Hao
1.2	2025-1-16	Content correction	Hao
1.3	2026-7-28	Content correction	Hao

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