E70-900T Series Product Specification

CC1310 900MHz TTL High-speed Connectivity Wireless Modules



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Ⅰ Product Overview

1.1 Product Description

E70-900T30S is a wireless serial module (UART) based on TI's CC1310 (built-in dual-core ARM) RF chip, which can work in the 861-876.5, 907-922.5MHz band (default 868MHz), GFSK modulation, TTL level output, 3.3V IO port voltage; the product uses a high-precision wide temperature The product adopts a high-precision wide temperature crystal, 24MHz industrial-grade high-precision low temperature drift crystal, to ensure its industrial nature and stability.

The module has data encryption and compression functions. The data transmitted by the module in the air has randomness, and the data interception loses its meaning through the strict encryption and decryption algorithm. The data compression function has the probability to reduce the transmission time, reduce the probability of interference, improve reliability and transmission efficiency.

The factory has built-in low-power multi-functional wireless serial program, users can also be secondary development according to needs.

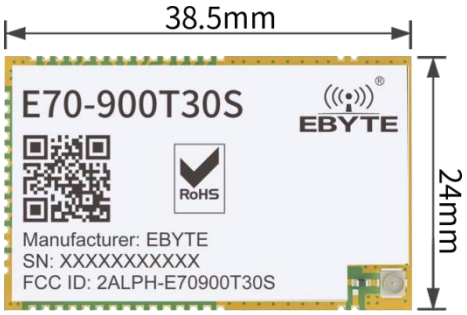


Figure 1：E70-900T30S

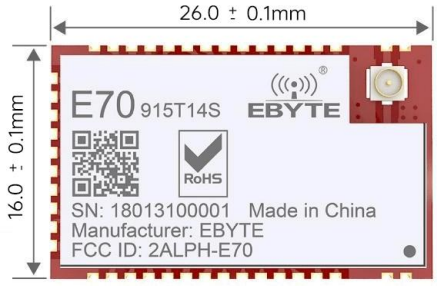


Figure 2：E70-900T14S

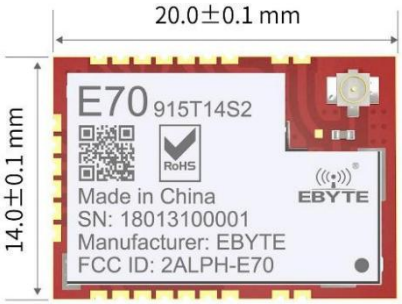


Figure 3：E70-900T14S2

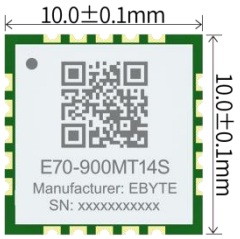


Figure 4：E70-900MT14S

1.2 Features

- Support for high-speed continuous transmission, sending and receiving unlimited packet lengths.
- Support for data unframing without packet splitting, perfect support for ModBus protocol.
- support custom packet splitting settings to improve communication efficiency.

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- Support fixed-point transmission/broadcast transmission/channel monitoring.
- Support RSSI signal strength reading.
- support over-the-air wake-up, i.e. low power consumption function, suitable for battery-powered solutions.
- Development based on CC1310 chip with built-in dual-core ARM.
- Ultra-small size design.
- Using 24MHz temperature complementary crystal, industrial standard design.
- ultra-low receive current, only about 8mA.
- E70-900T30S maximum transmit power of 30dBm, the other three models for 25mW, software multi-level adjustable.
- communication distance of up to 1.5km under ideal conditions.
- E70-900T30S built-in PA+LNA, transmitting power 1W, communication distance up to 6km.
- Support 868, 915MHz North American common frequency band.
- Support 2.5k～168kbps over-the-air transmission rate.
- Supports 2.2 to 3.8V power supply, and any power supply greater than 3.3V can ensure the best performance.
- E70-900T30S supports 2.6~5.5V power supply, more than 5V power supply can guarantee the best performance.
- Dual antennas are optional (IPEX/stamp hole) for user-friendly secondary development and easy integration.

1.3 Application Scenarios

- Home security alarms and remote keyless entry.
- Smart home as well as industrial sensors, etc..
- Wireless alarm security systems.
- Building automation solutions.
- Wireless industrial grade remote controls.
- Healthcare products.
- Advanced meter reading architectures (AMI).
- Automotive industry applications.

Ⅱ Specification parameters

2.1 RF parameters

RF parameters	Unit	Model				备注 Remark
		E70-900T30S	E70-900T14S	E70-900T14S2	E70-900MT14S	
Transmitting power	dBm	30	14	14	14	
Reception sensitivity	dBm	-109～-111	-109～-111	-107～-109	-109～-110	Air speed of 2.5kbps

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Reference Distance	M	6000m	1500m	1500m	1500m	Clear and open, antenna gain 5dBi, antenna height 2.5m, air rate 2.5kbps
Operating Frequency Band	MHz	861～922.5				Factory default 868MHz ,,861～876.5, 907～922.5MHz
Air rate	bps	2.5k～168k				User-programmed control
Blocking power	dBm	30	14	10	10	The probability of burning is small when used in close proximity
Launch length	/	Transmission mode regulations				See Transfer Mode for details

2.2 Electrical parameters

Electrical parameters		Unit	Model				Remark
			E70-900T30S	E70-900T14S	E70-900T14S2	E70-900MT14S	
工作电压 Operating Voltage		V	2.6～5.5	2.2～3.8	2.2～3.8	2.2～3.8	E70-900T30S over 5.5V permanently burned module, the other three models over 3.8V permanently burned module.
通信电平 Communication level		V	3.3				Risk of burnout with 5V TTL
Power consumption	Emission current	mA	610	27	36	31	Instantaneous power consumption
	Receiving current	mA	14	8	8	9	
	Sleeping current	μA	4	1	1.2	1.7	Software shutdown
Temperature	Operating temperature	℃	-40～+85				Industrial Grade
	Storage temperature		-40～+125				

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2.3 Hardware Parameters

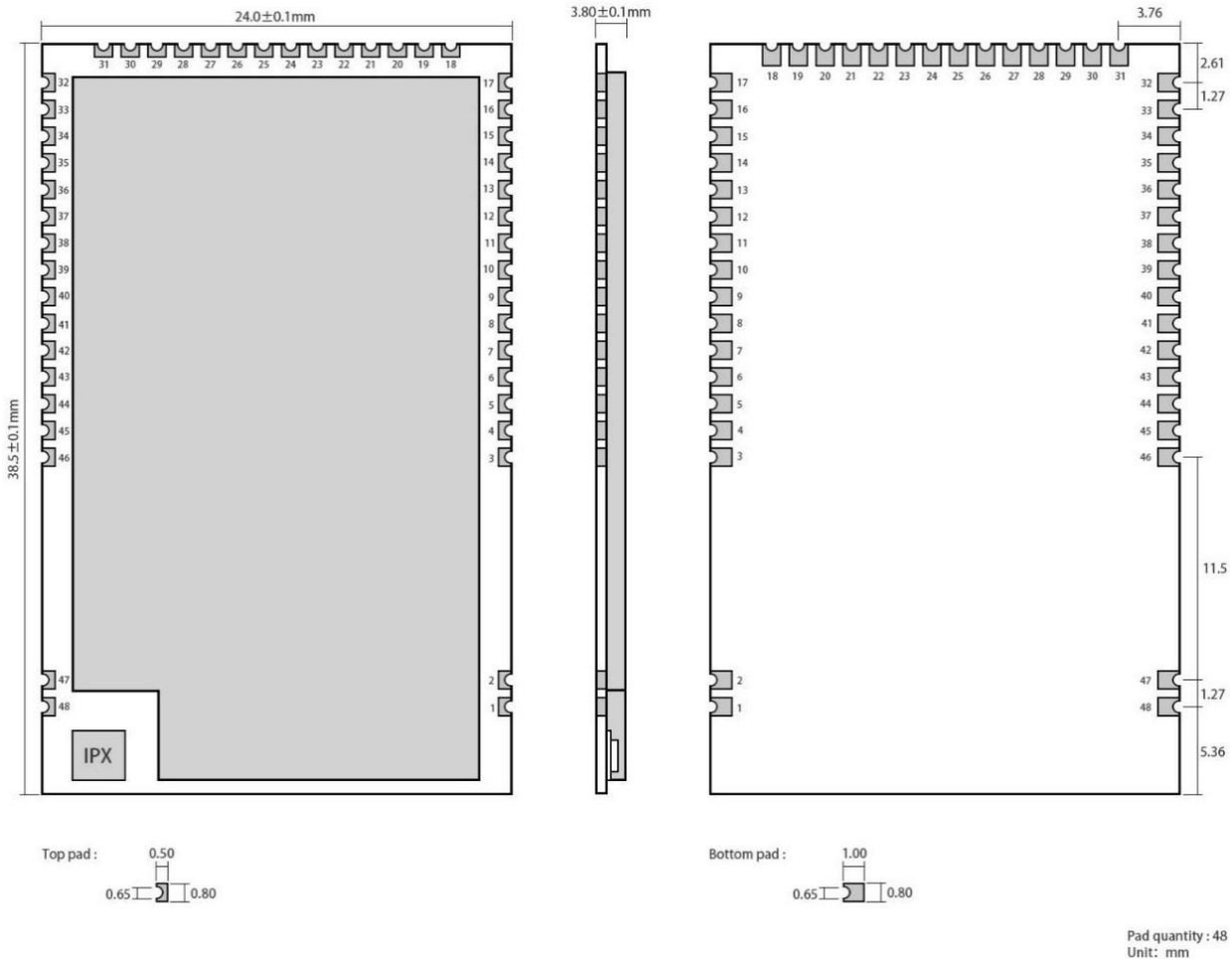
Hardware Parameters	Model				Remark
	E70-900T30S	E70-900T14S	E70-900T14S2	E70-900MT14S	
Chip	CC1310				
Cache capacity	2048 Byte				User-defined
FLASH	128 KB				
RAM	8 KB				
Cores	Cortex-M3（MCU）+Cortex-M0（RF）				
Communication Interface	UART serial port				TTL Level
Modulation method	GFSK				
Packaging method	SMD				
Antenna Interface	IPEX/ Stamp Holes	IPEX/ Stamp Holes	IPEX/ Stamp Holes	Stamp Holes	Characteristic impedance approx. 50 ohms
Size	24*38.5mm	16*26 mm	14 * 20 mm	10*10mm	E70-900T14S2 without SMA

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Ⅲ Mechanical dimensions and pin definition

3.1 E70-900T30S Dimensional drawings and pin definitions



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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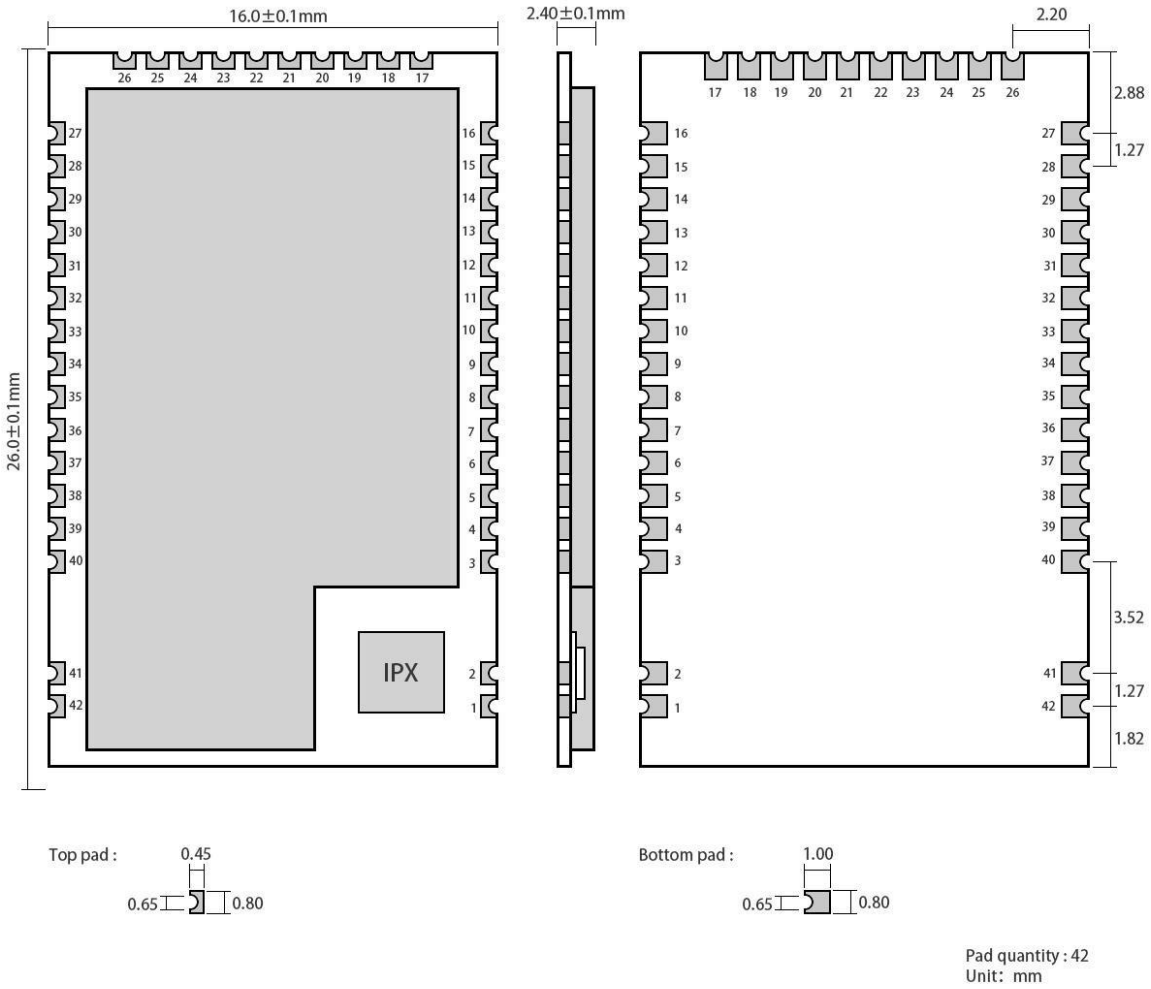
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41	NC	Reserved foot	DIO_28	Reserved for unused, need to overhang
42	NC	Reserved foot	DIO_29	Reserved for unused, need to overhang
43	NC	Reserved foot	DIO_30	Reserved for unused, need to overhang
44	LNA_EN	Input	RX_EN	Internal LNA enable pin, active 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 E70-900T14S Dimensional drawings and pin definitions



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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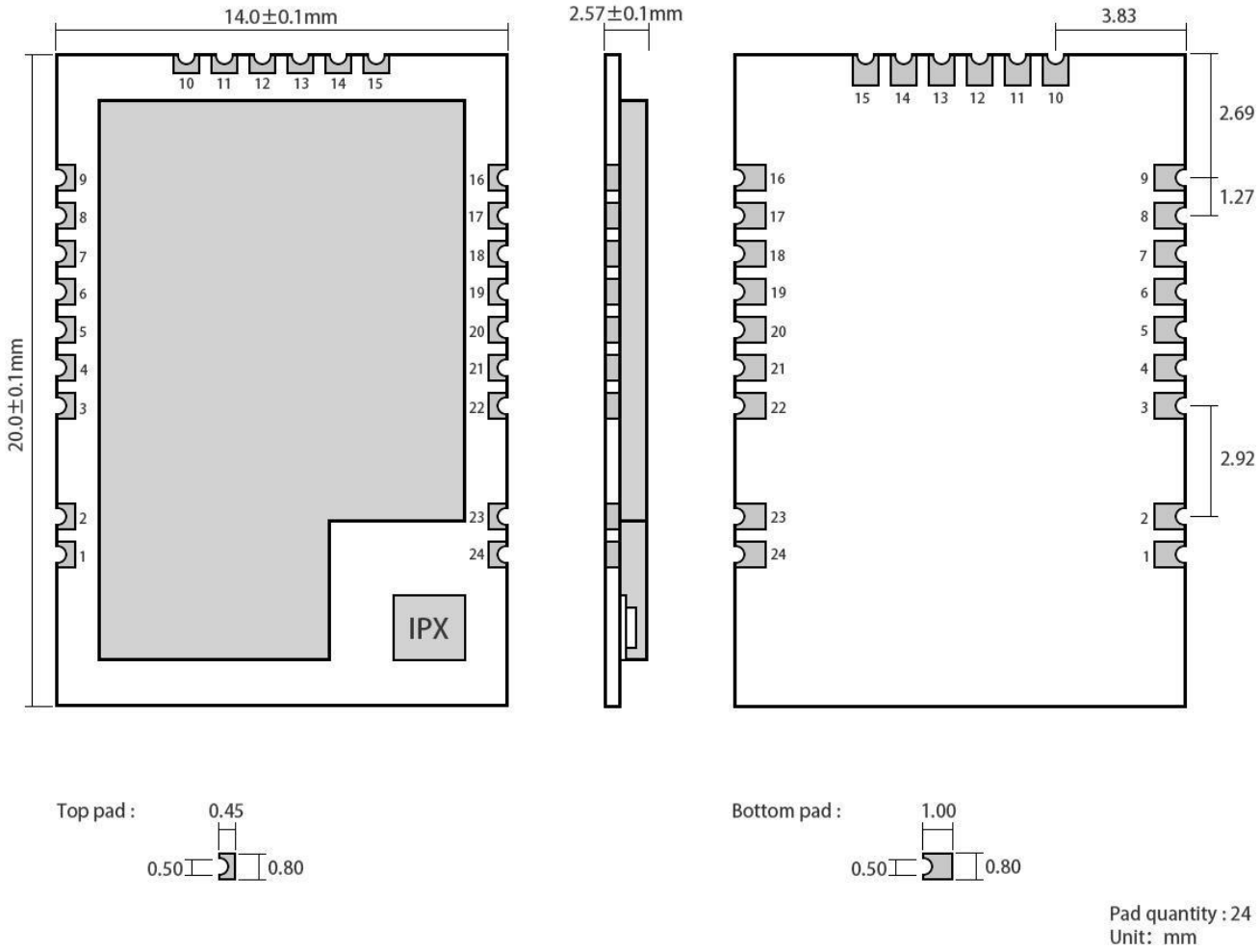
24	NC	Reserved Foot	DIO_17	Reserved for unused, need to overhang
25	AUX	Output	DIO_18	Indicates the working status of the module, the user wakes up the external MCU, outputs low during power-on self-test initialization, can be configured as open-drain output, or push-pull output, see parameter settings 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 E70-900T14S2 Dimensional drawings and pin definitions



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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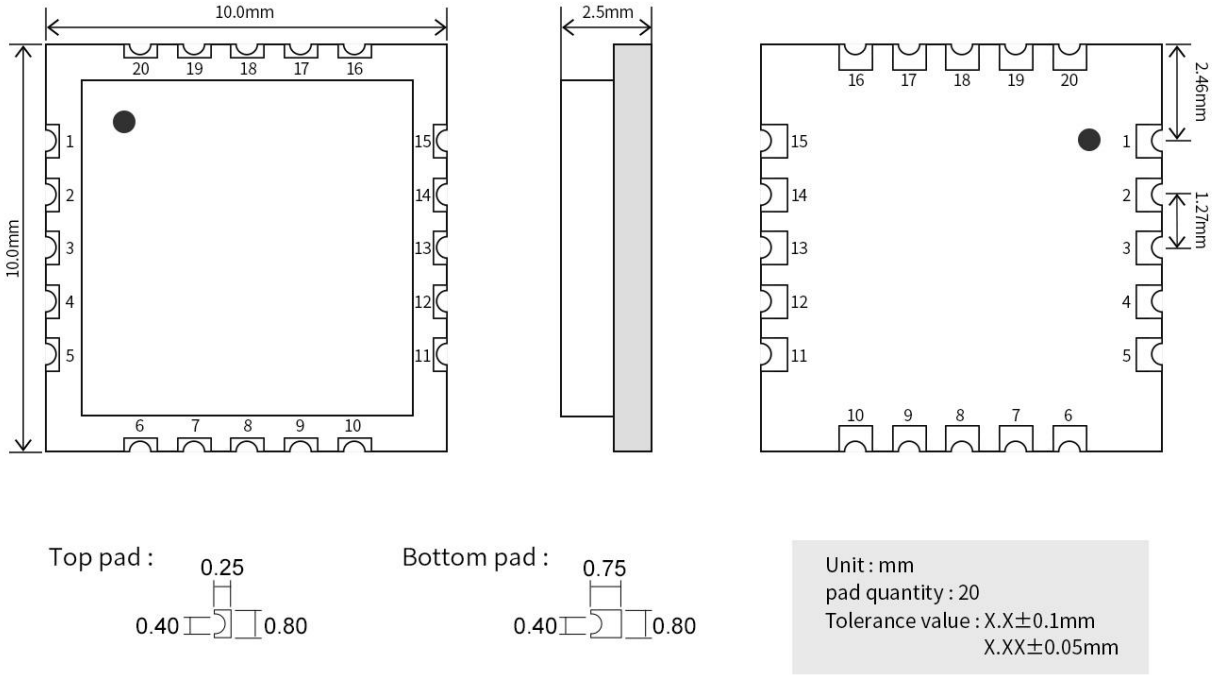
6	NC	Reserved Foot	DIO_9	Reserved for unused, need to overhang
7	NC	Reserved Foot	DIO_8	Reserved for unused, need to overhang
8	VCC	-	-	Module power supply positive reference, voltage range: 2.2 to 3.8V DC
9	GND	Reference Ground	-	Module Ground Wire
10	GND	Reference Ground	-	Module Ground Wire
11	PA_EN	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)
22	M0	Input	DIO_0	M2M1M0 Common combination determines the 8

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				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 E70-900MT14S Dimensional drawings and pin definitions



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 Cautions

- The series can achieve pin-to-pin compatibility and Pin to Pin replacement.
- Microcontroller control PA, LNA truth table as follows.

Status	PA_EN	LNA_EN
At Transmit	1	0

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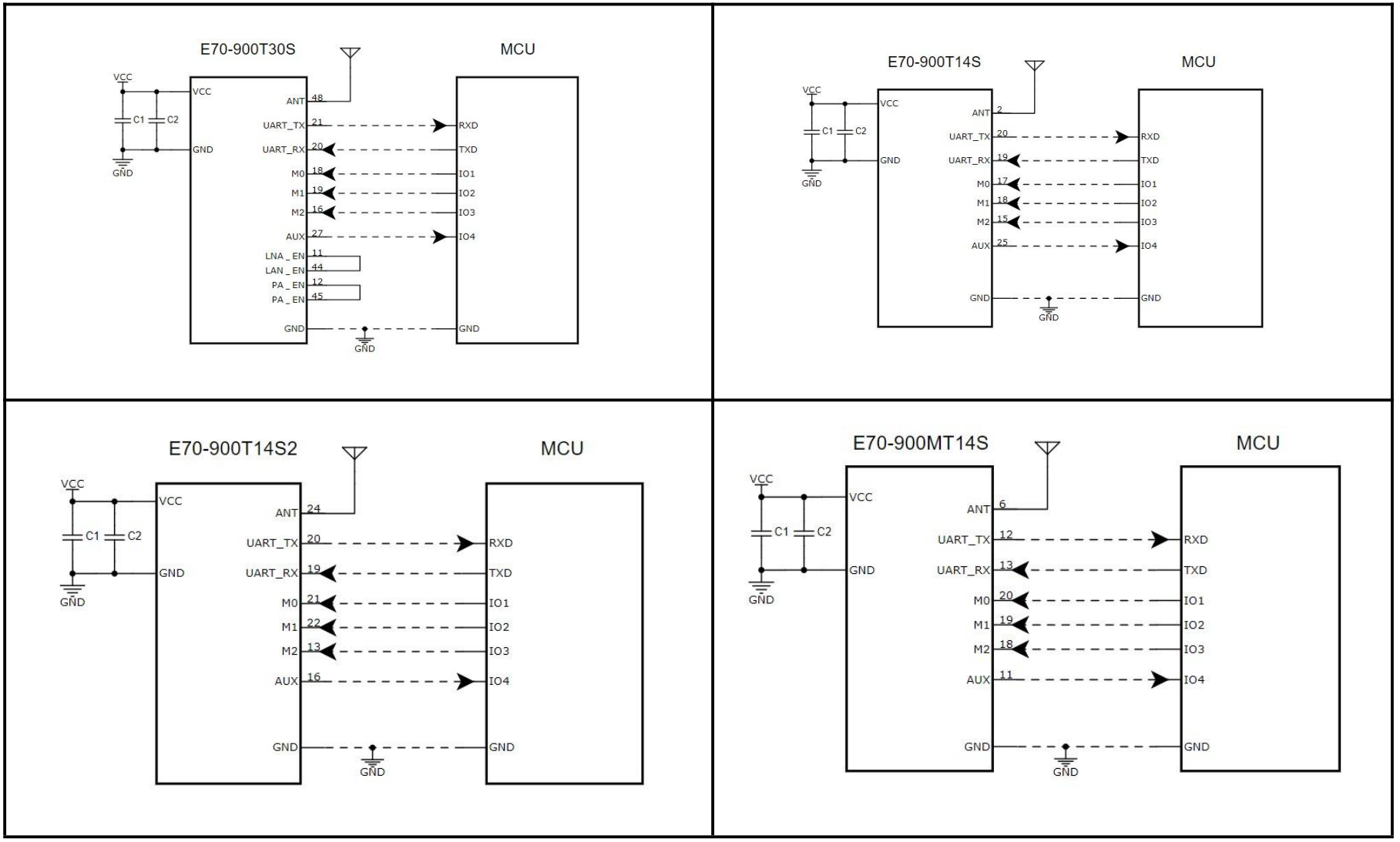
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When receiving	0	1
When sleeping	0	0

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Ⅳ Recommended Connecting Diagram



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Serial number	Module and microcontroller brief connection instructions (above diagram with STM8L microcontroller as an example)
1	The wireless serial module is TTL level, please connect with MCU of TTL level.
2	For some 5V microcontrollers, it may be necessary to add 4 to 10K pull-up resistors to the TXD and AUX pins of the module.

V Detailed explanation of functions

5.1 Fixed-point Transmit (hexadecimal)



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5.2 Broadcast transmission (hexadecimal)



5.3 Broadcast Address

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

5.4 Listening Address

- Example: Set the address of module A to 0xFFFF and the channel to 0x04.
- When module A acts as a receiver, it can receive all the data under 0x04 channel to achieve the purpose of listening.

5.5 Module Reset

- When the module is powered on, AUX will output low level immediately and perform hardware self-test as well as work mode setting according to user parameters.
  During this process, AUX stays low, and when it is finished, AUX outputs high and starts to work normally according to the working mode made by the combination of M2, M1 and M0;. Therefore, the user needs to wait for the rising edge of AUX as the starting point of the normal operation of the module.

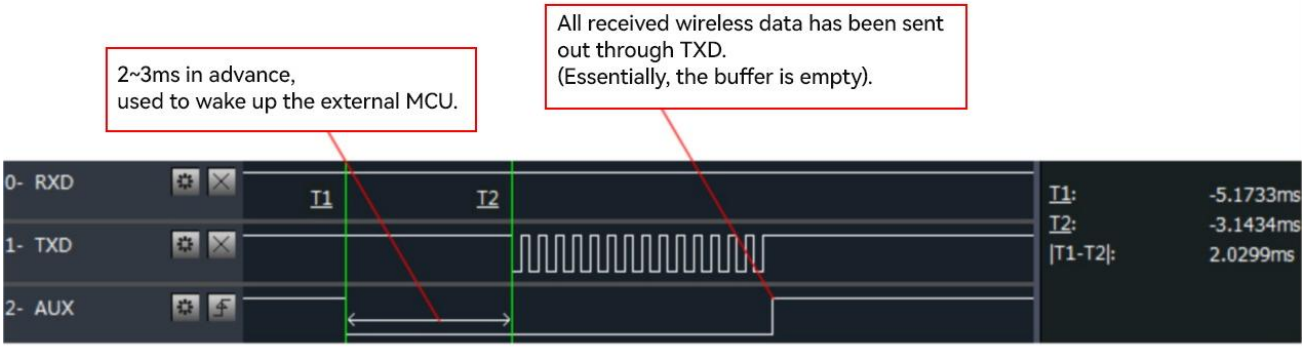
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5.6 AUX Explained

5.6.1 Serial data output indication

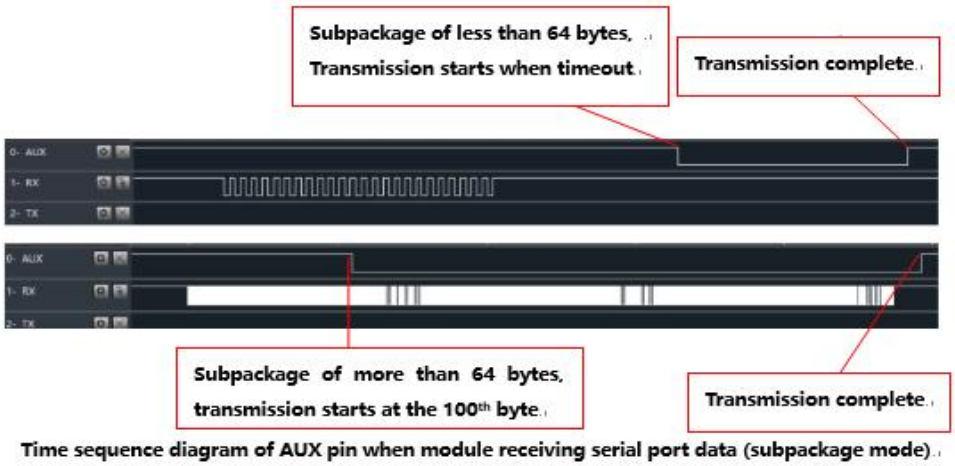
- Used to wake up a dormant external MCU (note that there is no delay in the AUX indication in continuous mode).



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

5.6.2 Wireless transmit indication

- In packet transmission mode, the internal buffer size is specified by the sub-packet size, e.g., if 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.
- continuous transmission mode, AUX=1 remains unchanged and the user data input data length is not limited.
- WOR transmit mode, AUX=1 user can continuously initiate less than 84 bytes of data.
- AUX=1 means all serial data of the module are transmitted through wireless.



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



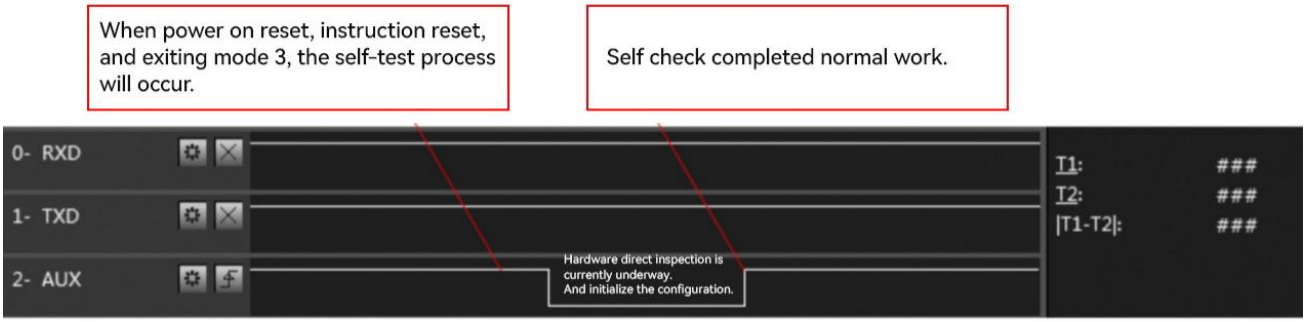
Time sequence diagram of AUX pin when module receiving serial port data (continuous mode)

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5.6.3 Modules are in the process of being configured

- Only when resetting and exiting hibernation mode.



During self check, AUX pin timing diagram.

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VI Working mode

6.1 Mode Switching

Mode (0-7)	M2	M1	M0	Model Introduction	Remark
0 RSSI Mode	0	0	0	Serial port open, wireless off, no transmission	The module outputs RSSI intensity values every 100ms on the serial port
1 Continuous transmission mode	0	0	1	Serial port open, wireless open, continuous transparent transmission	The air speed is automatically adjusted with the baud rate, and the baud rate of both sides must be the same. Suitable for high-speed continuous data
2 Subcontracting Model	0	1	0	Serial port open, wireless open, sub-packet transparent transmission	Airspeed and baud rate and independent configuration for packet communication
3 Configuration Mode	0	1	1	Serial port on, wireless off, for parameter configuration	Baud rate fixed 9600 8N1
4 Wake-up mode	1	0	0	Serial port open, wireless open, sub-packet transparent transmission	This mode cannot receive, and the wake-up code is automatically added before transmitting the wakes up the receiver in mode 6.
5 Same as mode 3 (configuration mode)	1	0	1	Serial port on, wireless off, for parameter configuration	Baud rate fixed 9600 8N1
6 Power saving mode	1	1	0	Serial port off, wireless works in WOR power saving mode, multiple time levels can be configured	This mode cannot transmit and can be woken up by the transmitter working in mode 4 for low-power wireless reception
7 Sleeping mode	1	1	1	Serial port off, wireless propagation, go to sleep	Can be woken up by any falling edge of M2M1M0

- Users can combine M2M1M0 high and low levels to determine the module working mode. The GPIO of MCU can be used to control the 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 data not yet finished transmitting through wireless, it can enter the new working mode only after the transmitting is finished; if the module receives wireless data and sends data out through serial, it needs to finish sending before it can enter the new working mode; so the mode switching can only be effective when AUX output 1, otherwise the switching will be delayed.

- For example, in mode 2 or mode 4, the user continuously inputs a large amount of data and switches modes at the same time, the switching mode operation at this time is invalid; the module will process all the user data before the new mode detection; so the general recommendation is: detect the AUX pin output

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state and wait for 2ms after the AUX output goes high before switching.

- When the module is switched from other modes to configuration mode, if there is data that has not yet been processed; the module will process this data (both incoming and outgoing) before entering sleep mode. This feature can be used for fast hibernation to save power; for example, if the transmitter module works in mode 0, the user initiates the serial data "12345", then without waiting for the AUX pin to be idle (high level), it can directly switch to hibernation mode and hibernate the user's main MCU immediately, and the module will automatically put all the user data into hibernation mode. The module will automatically send out all the user data through wireless and then automatically go into hibernation within 1ms; thus saving the MCU's working time and reducing power consumption.
- Similarly, any mode switching can take advantage of this feature. The module will automatically enter the new mode within 1ms after processing the current mode event; thus saving the user the work of querying AUX and achieving the purpose of fast switching; for example, switching from transmitting mode to receiving mode; the user MCU can also go into hibernation before the mode switching and use the external interrupt function to get the AUX change so as to perform the mode switching.
- This operation method is very flexible and efficient, designed exactly according to the user's MCU operation convenience, and can reduce the overall system workload as much as possible, improve system efficiency and reduce power consumption.

6.2 RSSI mode (mode 0)

Status	M2、M1、M0 = 000
Transmit	Wireless data transmission is not available.
Receiving	Wireless data reception is not available.
Baud rate and airspeed	Current baud rate
Advantages	The module outputs a byte of RSSI signal strength value at 100ms timings for use in determining the current noise level of the environment.
Disadvantages	Unable to send and receive data
Applicable scenarios	For listening to ambient noise
Attention	None

6.3 Continuous pass mode (mode 1)

Status	M2、M1、M0 = 001
Transmit	Wireless data transmission is possible.

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Receiving	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 the continuous output requirements. Since modules with different airspeeds are not communicable, it is required that the serial port parameters of both the transmitter and receiver must be set the same.
Advantages	The serial data output from the wireless receiver is continuous, satisfying the continuous transmission requirements of MODBUS and the low time delay requirements.
Disadvantages	The baud rate of the serial port on both sides of the receiver and transmitter must be the same; when the serial baud rate is increased, the module will adjust to a higher airspeed, which leads to a decrease in reception sensitivity and a decrease in transmission distance.
Applicable scenarios	Suitable for applications with low distance requirements and high requirements for data continuity and response time.
Attention	1. the "wireless air rate" in the configuration command is invalid (SPED.210 bits) and is calculated automatically by the software. 2. 0000 and FFFF are broadcast addresses, which can be used for listening and broadcasting. 3. the address and baud rate of both sides of the communication must be the same. 4. Both the transmitter and receiver modules must be of the same model, such as E70 (868T14S) and E70 (868T30S) cannot communicate with each other.

6.4 Subcontracting mode (Mode 2)

Status	M2、M1、M0 = 010
Transmit	Wireless data transmission is possible.
Receiving	Wireless data reception is possible.
Baud rate and airspeed	In this method, the serial port baud rate and airspeed are independent, and both senders and receivers can have different serial port baud rates, but must have the same airspeed setting.
Advantages	Very low airspeeds can be set for long distance transmission purposes, and the continuity between output data bytes depends on the module packet length.
Disadvantages	Since the airspeed can be set very low and the transmitter has to wait for the number of packet length bytes or the number of timeout bytes, it may cause some delay time depending on the specific setting.
Applicable scenarios	For high distance requirements, and requires a certain output continuity, but the transmission rate requirements are low.
Attention	1、Air speed and baud rate are irrelevant, and their setting values are in effect. 2、0000 and FFFF are broadcast addresses, which can be used for listening and broadcasting. 3、The airspeed and address must be the same for both sides of communication, and the baud rate can be inconsistent. 4、The maximum single packet data is limited by the sub-packet size CHAN[7:5] (excluding the address and channel sent in the direction).

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6.5 Configuration mode (mode 3)

Status	M2、M1、M0 = 011
Transmit	Wireless transmitting is not allowed, and the received serial data will be discarded.
Receiving	Wireless reception is not available.
Configuration	Can be used for module parameter setting, using serial port 9600, 8N1, set the module operating parameters through a specific command format
Attention	When entering from setting mode to other modes, the module will reconfigure the parameters and AUX is kept low during the configuration. When finished, it outputs high level, so users are recommended to detect the rising edge of AUX.

6.6 Wake-up mode (mode 4)

Status	M2、M1、M0 = 100
Transmit	Wireless data transmission is possible.
Receiving	Wireless data reception is not available.
Baud rate and airspeed	In this method, the serial port baud rate and airspeed are independent, and both senders and receivers can have different serial port baud rates, but must have the same airspeed setting.
Advantages	It can wake up the receiver working in mode 6; the wake-up code will be increased automatically before transmitting, and the number of increase depends on the wake-up time setting.
Disadvantages	Longer transmitting time, only suitable for waking up the receiver, not for regular transmitting data.
Applicable scenarios	Used to wake up a receiver in the WOR state.
Attention	The maximum length of a single packet sent in wake-up mode is 84 bytes (excluding the address and channel of the directed transmission).

6.7 Configuration mode (mode 5)

Status	M2、M1、M0=101
Transmit	No wireless transmitting is allowed, and all data from the serial port are considered as configuration commands.
Receiving	Wireless reception is not available.
Configuration	Can be used for module parameter setting, using serial port 9600, 8N1, set the module operating parameters through a specific command format
Attention	When entering from setting mode to other modes, the module will reconfigure the parameters and AUX is kept low during the configuration. When finished, it outputs high level, so users are recommended to detect the rising edge of AUX.

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6.8 Power saving mode (mode 6)

Status	M2、M1、M0 = 110
Transmit	No wireless data transmission.
Receiving	Wireless data reception is possible.
Baud rate and airspeed	In this method, the serial port baud rate and airspeed are independent, and both senders and receivers can have different serial port baud rates, but must have the same airspeed setting.
Advantages	The module works in the WOR state, automatically wakes up periodically and listens for over-the-air wireless packets. When listening to the packets, the module enters the receive mode and receives the whole packet, serial port output, and then enters the WOR state again. It can greatly save power consumption.
Disadvantages	This mode can not transmit data, when you need to transmit data, you need to switch to other operating modes.
Applicable scenarios	Devices that have high power requirements and need to receive data.
Attention	Only data from the transmitter of mode 4 can be received.

6.9 Sleeping mode (mode 7)

Status	M2、M1、M0 = 111
Transmit	Unable to transmit wireless data.
Receiving	Unable to receive wireless data.
Others	All other functions of the module are disabled and only the state switching of M2M1M0 can be used to exit the hibernation mode.

Ⅶ Command Format

- The list of supported commands in configuration mode (mode 3: M0=1, M1=1, M2=0) is as follows (when set, only 9600, 8N1 format is supported):

Serial number	Command Format	Detailed description
1	C0+ working parameters	Send C0 + 5 bytes of working parameters in hexadecimal format, 6 bytes in total, must be sent continuously (power down save)
2	C1+C1+C1	Three C1s are sent in hexadecimal format and the module returns the saved parameters, which must be sent consecutively.
3	C2+ working parameters	Send C2 + 5 bytes of working parameters in hexadecimal format, total 6 bytes, must be sent continuously (power down is not saved)

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4	C3+C3+C3	Three C3s are sent in hexadecimal format and the module returns version information, which must be sent consecutively.
5	C4+C4+C4	Three C4s sent in hexadecimal format will generate one reset by the module and must be sent continuously.

7.1 Factory default parameters

Model	Factory default parameter values:C0 00 00 18 04 1C						
Module Model	Frequency	Address	Signal Channel	airspeed	Baud rate	Serial port format	Transmitting power
E70-900MT14S	868MHz	0x0000	0x04	2.5kbps	9600	8N1	25mW

7.2 Working parameter reading

Command Format	Detailed description
C1+C1+C1	Under configuration (M0=1,M1=1,M2 =0), issue the command (HEX format): C1 C1 C1 to the module serial port. The module will return the current configuration parameters, for example: C0 00 00 18 4E 1C.

7.3 Version number reading

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

7.4 Reset command

Command Format	Detailed description

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C4+C4+C4	Under configuration (M0=1,M1=1,M2 =0), a command (HEX format) is issued to the module serial port: C4 C4 C4 and the module will generate a reset. During the reset process, the module performs self-test, AUX outputs low level, after the reset is completed, AUX outputs high level and the module starts to work normally. At this time, mode switching or initiating the next command can be performed.

7.5 Parameter setting commands

Serial number	Name	Description				Remarks
0	HEAD	Fixed 0xC0 or 0xC2, indicating that this frame data is a control command				C0: the set parameters will be saved with power down. C2: the set parameters will not be saved by power-down.
1	ADDH	Module address high byte (default 00H)				00H-FFH
2	ADDL	Module address low byte (default 00H)				00H-FFH
3	SPED	7	6	Serial port parity bits		The serial port mode can be different for 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 baud rate (bps)	The baud rate can be different for both sides of the communication. The serial port baud rate is independent of the wireless 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	Wireless Air Speed (bps)	The lower the air rate, the greater the distance, the greater the immunity to interference and the longer the
		0	0	0	Air rate of 2.5k (default)	
		0	0	1	Air rate of 5k	
		0	1	0	Air rate of 12k	
		0	1	1	Air rate of 28k	

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		1	0	0	Air rate of 64k	transmission time. The airborne radio transmission rate must be the same for both sides of the communication.
		1	0	1	Air rate of 168k	
		1	1	0	Air rate of 168k	
		1	1	1	Air speed of 168k	
4	CHAN	7	6	5	Package length setting (subcontracting mode only)	In continuous transmission mode (M2, M1, M0 = 001), this parameter is invalid.
		0	0	0	16 bytes	
		0	0	1	32 bytes	
		0	1	0	64 bytes(default)	
		0	1	1	128 bytes	
		1	0	0	256bytes	
		1	0	1	512bytes	
		1	1	0	1024bytes	
		1	1	1	2048 bytes	
		Communication channel				
		00H～1FH, Corresponding to 861～922.5MHz				Default 04H (868MHz)
5	OPTION	7	Fixed-point transmit enable bit (MODBUS-like)			When 1 is set, the first 3 bytes of each user data frame are used as high and low addresses and channels; when transmitting, the module changes its own address and channel and restores the original settings when finished; the continuous transmission mode is all transparent.
		0	Transparent transmission (default)			
		1	Fixed-point transmission			
		6	5	4	Wake-up time	This parameter is valid only for modes 4 and 6. For mode 6, the wake-up time affects the module WOR cycle and has a greater impact on power consumption. For mode 4, the wake-up time determines the number of wake-up codes that the module adds before transmitting, thus ensuring effective wake-up of the module for mode 6. Generally speaking, modes 4 and 6 need to be used together, and the wake-up time set by both sides must be the same.
		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)			With FEC turned off, the actual data transmission rate is increased but the interference immunity is reduced and the distance is slightly closer, chosen according to the actual application. Both sides of the communication must be turned
		0	Close FEC			
		1	Open FEC (default)			

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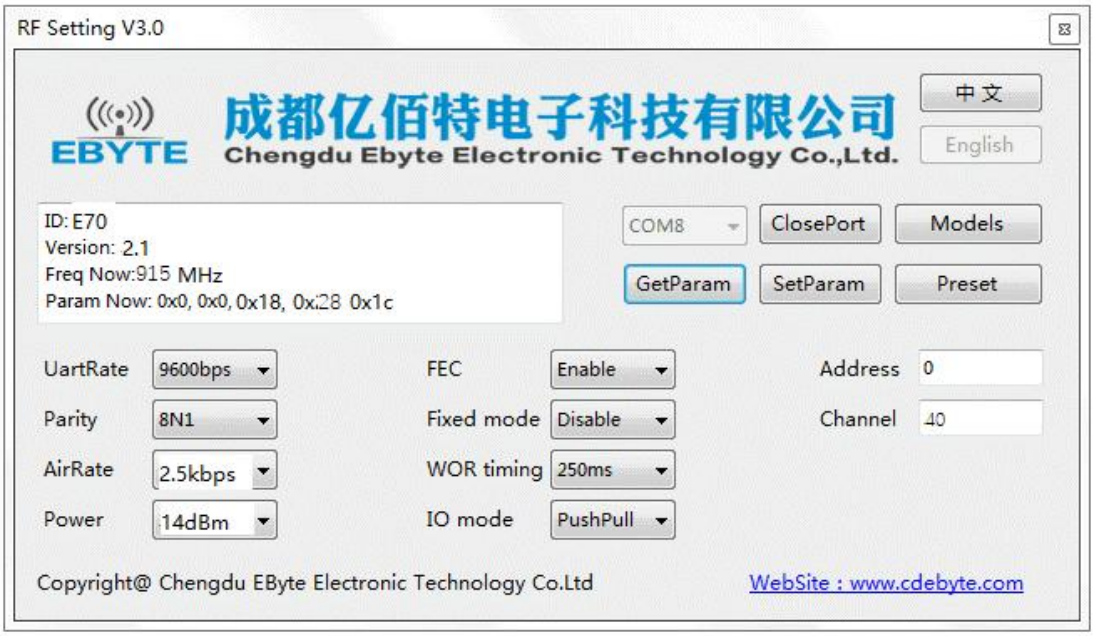
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<table>
<tr><td colspan="2"></td><td colspan="4"></td><td>on or both turned off.</td></tr>
<tr><td colspan="2" rowspan="11"></td><td colspan="4">2 IO drive method</td><td rowspan="3">This bit is used to enable the module's internal pull-up resistor.
The open drain method is more level adaptive and some cases may require external pull-up resistors.</td></tr>
<tr><td colspan="4">0 TXD, AUX open output, RXD open input</td></tr>
<tr><td colspan="4">1 TXD, AUX push-pull output, RXD pull-up input (default)</td></tr>
<tr><td>1</td><td>0</td><td colspan="2">Transmitting power</td><td rowspan="6">External power supply must provide more than 80mA current output capability and ensure that the power supply ripple is less than 100mV.

It is not recommended to use smaller power sends, whose power utilization efficiency is not high.</td></tr>
<tr><td>0</td><td>0</td><td>14dBm (default)</td><td>30dBm (default)</td></tr>
<tr><td>0</td><td>1</td><td>10dBm</td><td>27dBm</td></tr>
<tr><td>1</td><td>0</td><td>7dBm</td><td>24dBm</td></tr>
<tr><td>1</td><td>1</td><td>4dBm</td><td>21dBm</td></tr>
<tr><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td colspan="2"></td><td colspan="4"></td></tr>
<tr><td colspan="7">Example (meaning of the "SPED" byte in serial number 3)</td></tr>
<tr><td>Binary bits of this byte</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Specific values (user configurable)</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Representation</td><td colspan="2">Serial port parity bit 8N1</td><td colspan="2">Serial port baud rate of 9600</td><td colspan="3">Air rate of 2.5k</td></tr>
<tr><td>Corresponding hexadecimal</td><td colspan="3">0</td><td colspan="5">18</td></tr>
</table>

Ⅷ Parameter Configuration

When the module is in mode 3 (M2, M1, M0 = 011) or mode 5 (M2, M1, M0 = 101), the module parameters can be configured by command or by the host software, the supporting host software can be found at www.ebyte.com

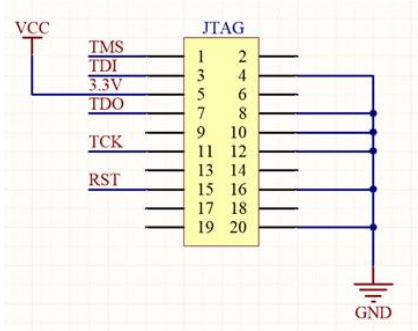


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Ⅸ Secondary Development

- Module support for secondary development, CC1310 RF chip, the user can be based on the product pin description required in Chapter 3 of this paper for secondary development.
- EBYTE can develop custom features for customers, please contact our sales hotline 4000-330-990 for more details.

9.1 Program Burning

Keyword	Cautions
Burning programs	The module is a SoC module with its own GPIO port, and the program is downloaded using a special downloader for CC series: JTAG downloader (or TI's official CC1310 development board), not using serial port or any other ISP or ICP tools. The following diagram shows the JTAG connection diagram (XDS100), please refer to the official Ti documentation for details of the development method (the TDI and TDO pins can not be connected). 

Ⅹ Hardware Design

- Recommend using a DC regulated power supply to power the module with as small a ripple coefficient as possible, and the module needs to be reliably grounded.
- Please pay attention to the correct connection of the positive and negative terminals of the power supply, as a reversed connection may cause permanent damage to the module.
- Please check the power supply to ensure that it is between the recommended supply voltage, if it exceeds the maximum value it may cause permanent damage to the module.
- Please check the stability of the power supply, the voltage should not fluctuate significantly and frequently.
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin to have the whole machine conducive to long-term stable operation.
- modules should be as far as possible from the power supply, transformers, high-frequency alignments and other parts of the electromagnetic interference.
- High-frequency digital alignment, high-frequency analog alignment, power supply alignment must be

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avoided below the module, if it is necessary to pass below the module, assuming that the module is soldered in the Top Layer, in the module contact part of the Top Layer pavement copper (all pavement copper and good grounding), must be close to the digital part of the module and alignment in the Bottom Layer.

- Assuming that the module is soldered or placed in the Top Layer, it is also wrong to run wires randomly in the Bottom Layer or other layers, which will affect the spurious and reception sensitivity of the module to varying degrees.
- Assuming that there are large electromagnetic interference devices around the module will also greatly affect the performance of the module, according to the strength of the interference is recommended to be properly away from the module, if the situation allows the appropriate isolation and shielding.
- Assuming that there are large electromagnetic interference alignments around the module (high-frequency digital, high-frequency analog, power supply alignments) will also greatly affect the performance of the module, according to the intensity of the interference, it is recommended to keep away from the module, and if the situation permits, appropriate isolation and shielding can be done.
- communication line if the use of 5V level, must be connected in series with 1k-5.1k resistors (not recommended, there is still a risk of damage).
- try to stay away from some of the physical layer is also 2.4GHz TTL protocol, for example: USB3.0.
- the antenna mounting structure has a big impact on the module performance, make sure the antenna is exposed and preferably vertically upwards.
- When the module is installed inside the case, you can use high quality antenna extension cable to extend the antenna to the outside of the case.
- The antenna must not be installed inside the metal case, it will cause the transmission distance to be greatly weakened.

XI Frequently Asked Questions

11.1 Unsatisfactory transmission distance

- A corresponding attenuation of communication distance when linear communication barriers exist.
- Temperature, humidity, and co-channel interference, which can lead to higher communication packet loss rates.
- The ground absorbs and reflects radio waves, and the test effect is poor near the ground.
- seawater has a very strong ability to absorb radio waves, so the seaside test effect is poor.
- metal objects near the antenna, or placed in a metal shell, signal attenuation will be very serious.
- Wrong setting of power register, too high setting of air rate (the higher the air rate, the closer the distance).
- the low voltage of the power supply at room temperature is lower than the recommended value, the lower the voltage the less power is generated
- The use of antenna and module match the degree of poor or antenna itself quality problems.

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11.2 Module is easy to break

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

11.3 BER is too high

- Nearby interference with the same frequency signal, away from the source of interference or modify the frequency, channel to avoid interference.
- unsatisfactory power supply may also cause garbled codes, be sure to ensure the reliability of the power supply.
- Poor quality or too long extension cable or feeder line may also cause high BER.

XII Welding work instruction

12.1 Reflow Temperature

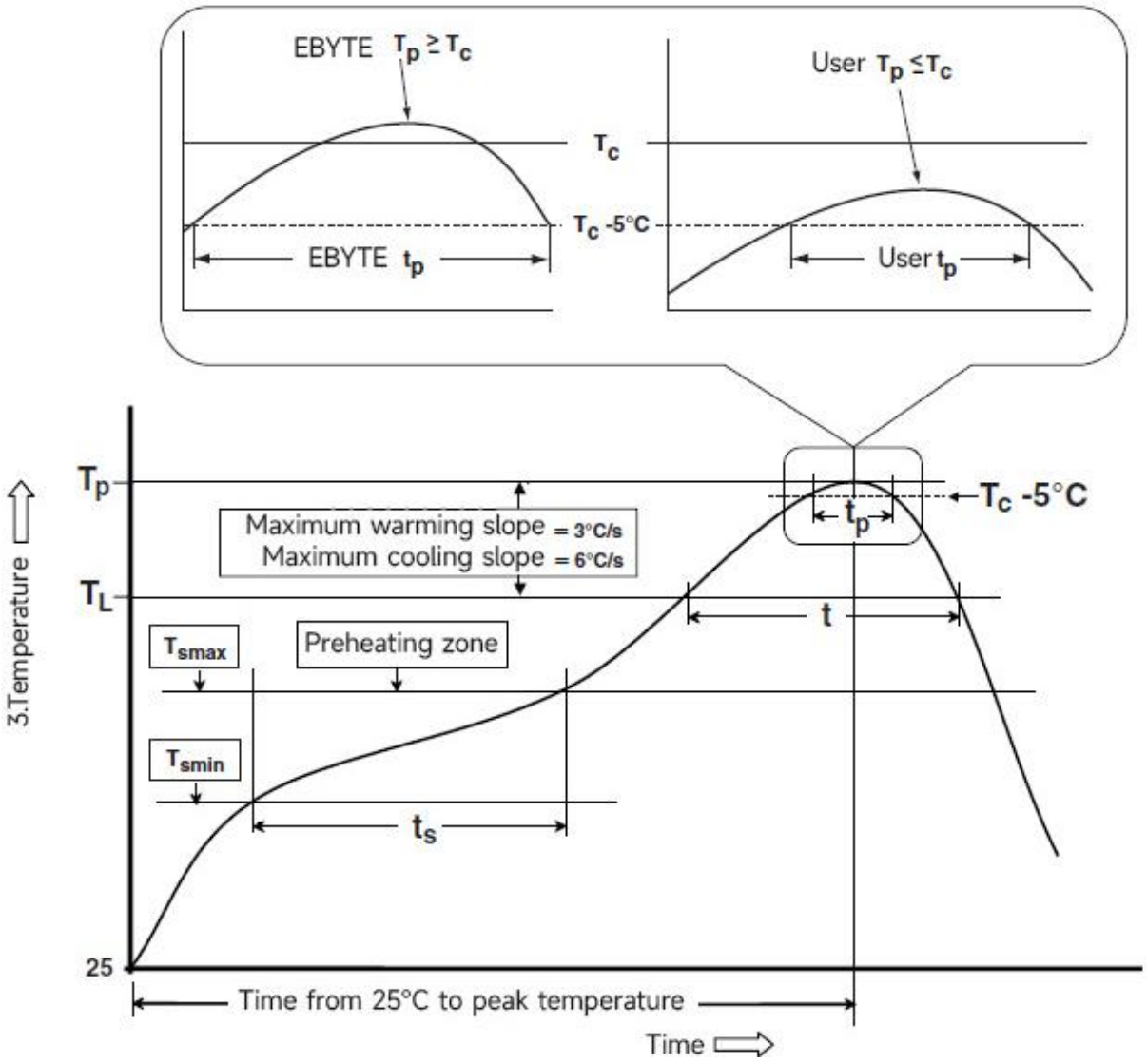
Reflow profile characteristics		Leaded process assembly	Lead-free process assembly
Preheat/warming	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Temperature rise slope (TL~Tp)		3℃/sec, max.	3℃/sec, max.
Liquid phase temperature (TL)		183℃	217℃
Hold time above TL		60~90 秒	60~90 秒
Peak temperature of the package Tp		The user must not exceed the temperature indicated on the "Moisture Sensitivity" label of the product.	The user must not exceed the temperature indicated on the "Moisture Sensitivity" label of the product.

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The time (Tp) within 5°C of the specified grading temperature (Tc), see the figure below	20 seconds	30 seconds
Cooling slope (Tp~TL)	6℃/sec, max.	6℃/sec, max.
Room temperature to peak temperature time	6 minutes, maximum	8 minutes, maximum
※The peak temperature (Tp) tolerance of the temperature profile is defined as the upper limit of the user		

12.2 Reflow Profile



XIII Related Model

Product Model	Chip	frequency Hz	Transmitting power dBm	Test Distance km	Airspeed bps	Package form	Size mm	Antenna Form

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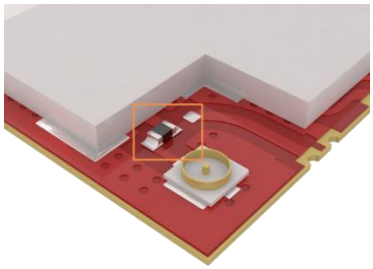
E70-433T14S	CC1310	433M	14	1.5	2.5k～168k	SMD	16 * 26	IPEX/ Stamp Hole
E70-433T30S	CC1310	433M	30	6.0	2.5k～168k	SMD	24 * 38.5	IPEX/ Stamp Hole
E70-433T14S2	CC1310	433M	14	1.5	2.5k～168k	SMD	14 * 20	IPEX/ Stamp Hole
E70-900T30S	CC1310	868M	30	6.0	2.5k～168k	SMD	24 * 38.5	IPEX/ Stamp Hole
E70-900T14S	CC1310	868M	14	1.5	2.5k～168k	SMD	16 * 26	IPEX/ Stamp Hole
E70-900T14S2	CC1310	868M	14	1.5	2.5k～168k	SMD	14 * 20	IPEX/ Stamp Hole

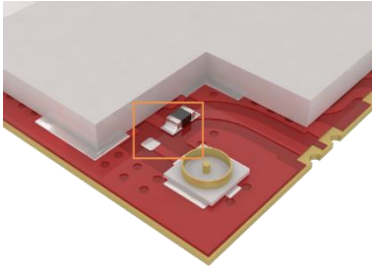
XIII Antenna Guide

13.1 Antenna Recommendations

Model No.	Type	Frequency Hz	Interface	Gain dBi	Height mm	Feeder cm	Features
TX868-JZ-5	Rubber Antenna	868M	SMA-J	2.0	52	-	Ultra-short straight, omnidirectional antenna
TX868-JK-20	Rubber Antenna	868M	SMA-J	3.0	210	-	Bendable rubber, omnidirectional antenna
TX868-XPL-100	Suction Antenna	868M	SMA-J	3.5	290	100	Small suction antenna, cost-effective
TX915-JZ-5	Rubber Antenna	915M	SMA-J	2.0	52	-	Ultra-short straight, omnidirectional antenna
TX915-JK-11	Rubber Antenna	915M	SMA-J	2.5	110	-	Bendable rubber, omnidirectional antenna
TX915-JK-20	Rubber Antenna	915M	SMA-J	3.0	210	-	Bendable rubber, omnidirectional antenna
TX915-XPL-100	Suction Antenna	915M	SMA-J	3.5	290	100	Small suction antenna, cost-effective

13.2 Antenna Selection





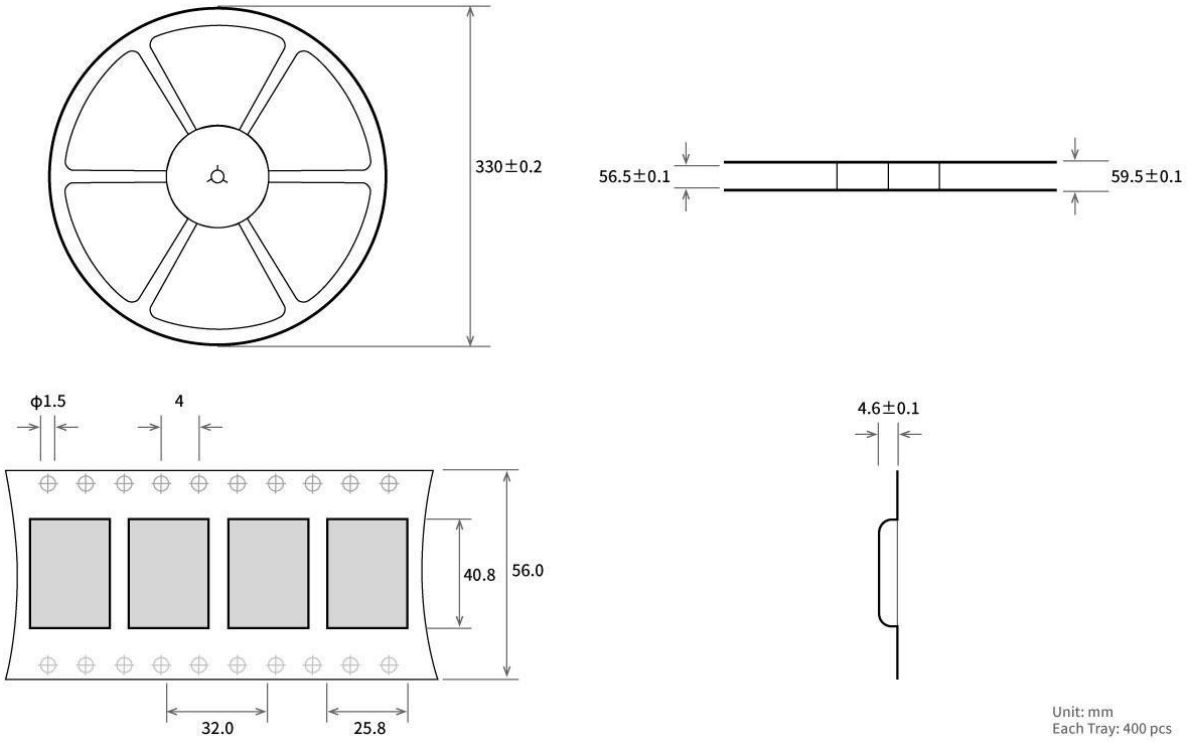
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Enable IPEX interface (default) Enabling Stamp Hole

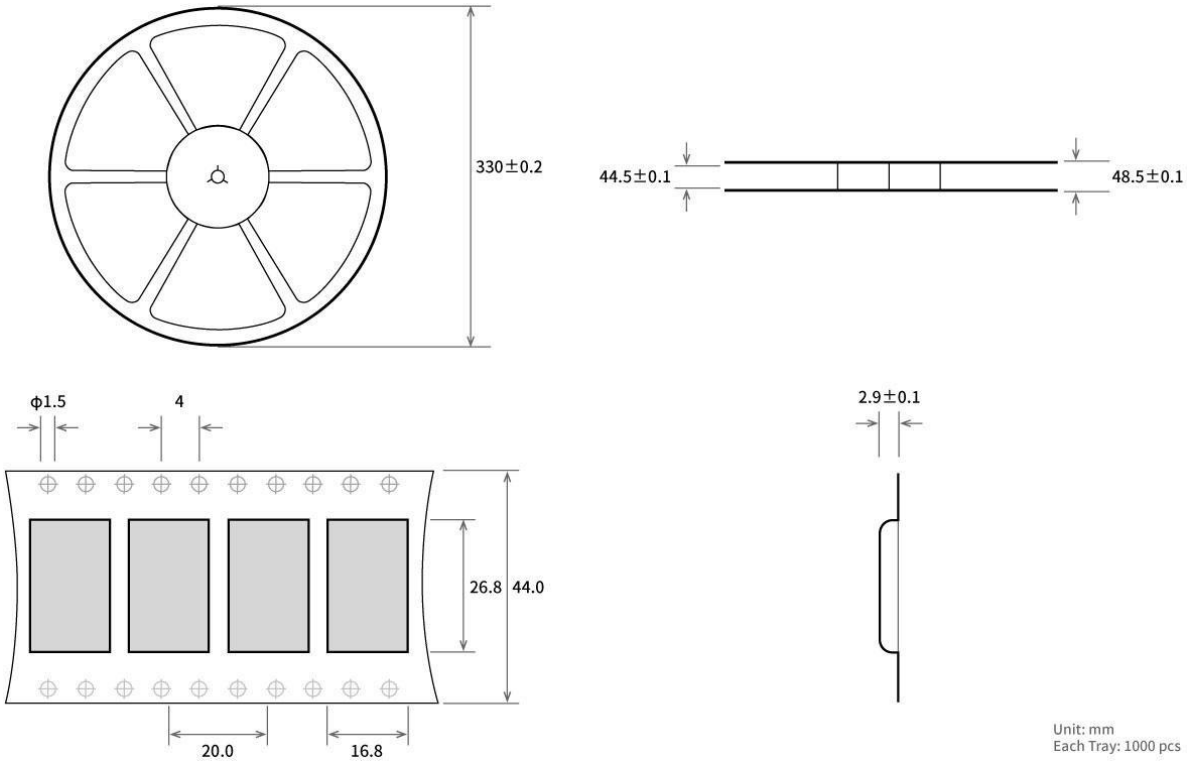
XIV Batch packing method

14.1 E70-900T30S Batch packing

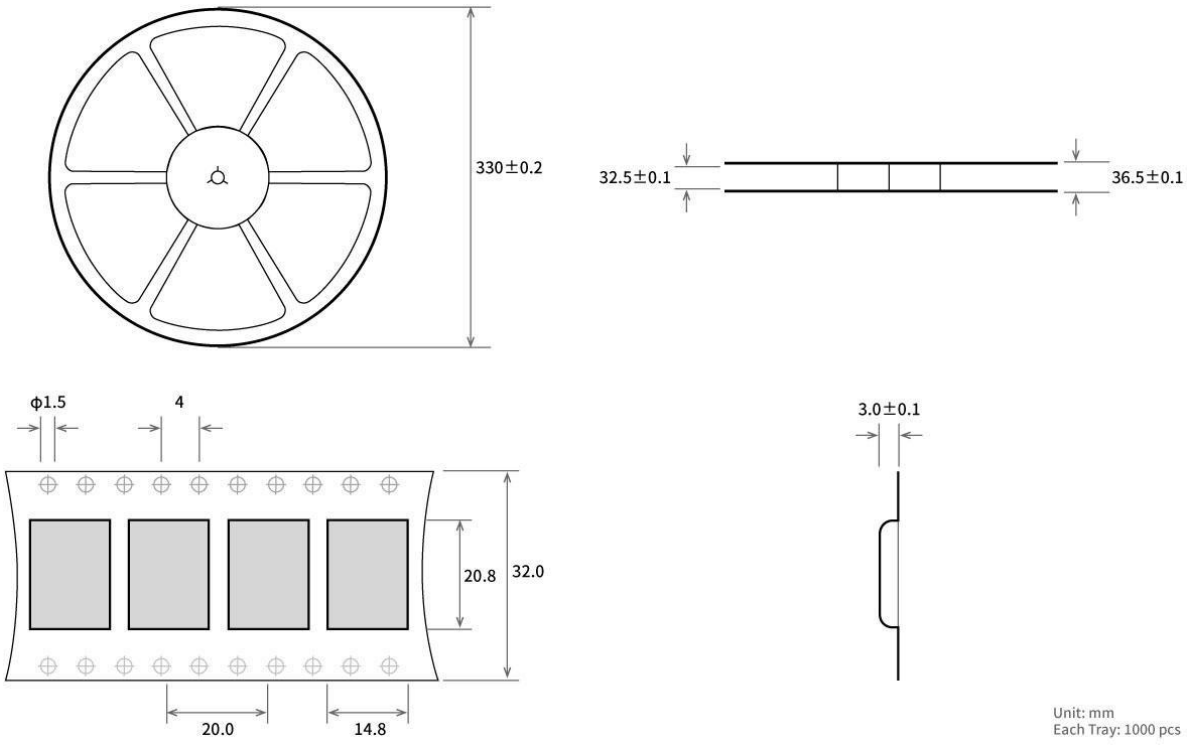


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14.2 E70-900T14S Batch packing



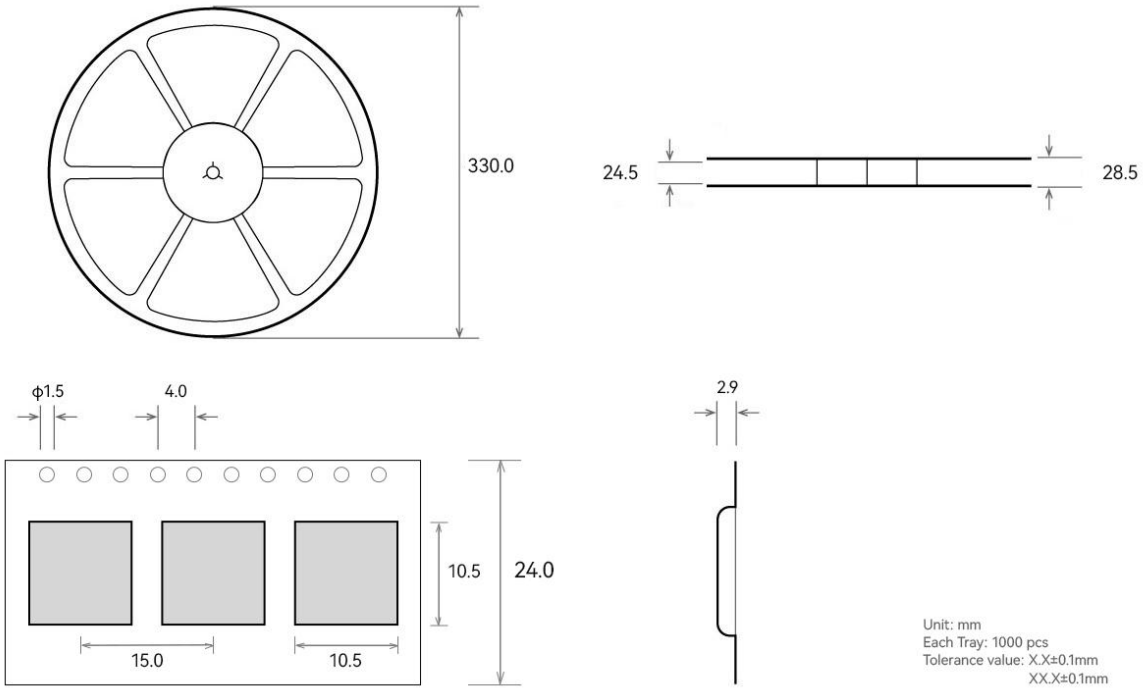
14.3 E70-900T14S2 Batch packing



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14.4 E70-900MT14S Batch packing



Revision History

Versions	Revision Date	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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