# CC1310 Wireless Module

E70 Series

User Manual

This manual may be modified based on product upgrade, please refer to the latest version.

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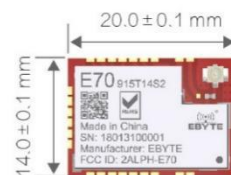| Version	Date	Description	Issued by
1.00	2017/11/06	Initial version	Wu
1.10	2018/02/05	Model merge / rename	huaa

Brief Introduction
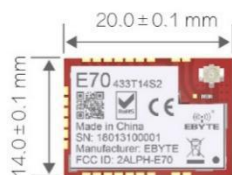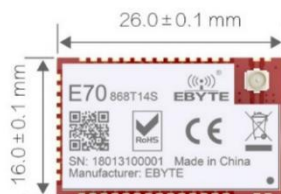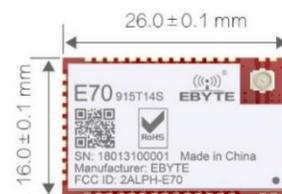

E70 (433T14S2)
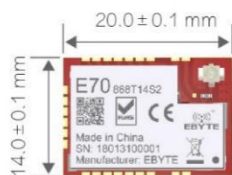
E70 (868T14S2)

E70 (915T14S2)

E70 (433T14S)

E70 (868T14S)

E70 (915T14S)

E70 (433T30S)

E70 (868T30S)

E70 (915T30S)

E70 series wireless transceiver modules, operating at 431~446.5MHz (Default: 433MHz), 861~876.5MHz (Default: 868MHz) and 900~922.5MHz (Default: 915MHz), are based on originally imported CC1310 from TI, with TTL level output, 3.3V IO port voltage.

Forward Error Correction, high coding efficiency & good correction performance. In the case of sudden interference, it can correct the interfered data packets proactively, so that the reliability & transmission range are improved correspondingly. Without FEC, those data packets are easily dropped. The module has the function of data encryption & compression. The data of the module transmitted over the air features randomness. And with the rigorous encryption & decryption, data interception becomes pointless. The function of data compression decreases the transmission time & probability of being interfered, while improving the reliability & transmission efficiency.

Model	Frequency	Transmitting power	Distance(IPX)	Packing	Antenna
E70 (433T14S2)	433M	14dBm	1500m	SMD	IPEX/Stamp
E70 (433T14S)	433M	14dBm	1500m	SMD	IPEX/Stamp
E70 (433T30S)	433M	30dBm	6000m	SMD	IPEX/Stamp
E70 (868T14S2)	868M	14dBm	1500m	SMD	IPEX
E70 (868T14S)	868M	14dBm	1500m	SMD	IPEX/Stamp
E70 (868T30S)	868M	30dBm	6000m	SMD	IPEX/Stamp
E70 (915T14S2)	915M	14dBm	1500m	SMD	IPEX
E70 (915T14S)	915M	14dBm	1500m	SMD	IPEX/Stamp
E70 (915T30S)	915M	30dBm	6000m	SMD	IPEX/Stamp

Contents

1. Features

- **Consumption advantage:** The receiving current is 8mA, and stand by current is 2uA. Battery-powered application is available.

- **Fixed transmission**: Module can communicate with other modules which work in different channels and addresses. It makes networking and repeater easy. For example: module A transmits AA BB CC to module B (address: 0x00 01, channel: 0x80). The HEX format is 00 01 80 AA BB CC (00 01 refers to the address of module B, and 80 refers to the channel of module B). Then module B receives AA BB CC (only module B).

- **Broadcast transmission:** To set the module address as 0xFFFF, then the module can communicate with other modules in the same channel.

- **FEC:** Forward Error Correction has high coding efficiency & good correction performance. In case of sudden interference, it can correct the interfered data packets proactively, so that the reliability & transmission range are improved correspondingly. Without FEC, those data packets can only be dropped.

- **Parameter saving:** The parameters will be saved after setting and will not be reset when powered off. Once powered on, it will work according to the previous parameters.

- **Ultra-small size:** With half the size of similar modules, E70 series are suitable for applications which have strict requirement on the size.

- **Secondary development:** All IO ports are led out for secondary development.

- **Customized Service:** If the existing UART modules cannot meet customers' requirements, Ebyte can provide customized firmware. Ebyte has provided customized solutions for many well-known enterprises.

- **Complete series:** Ebyte has developed complete series of CC1310 modules with different size, frequency, power and packing. CC1310 owns different packing and the main difference is the amount of GPIO.

2. Technical Parameters

2.1 General Parameters

Model	Core IC	Size	Net weight	Operating temperature	Operating humidity	Storage temperature
E70 (433T14S2)	CC1310	14 * 20 mm	2.0±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (433T14S)	CC1310	16 * 26 mm	1.65±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (433T30S)	CC1310	24 * 38.5 mm	4.9±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (868T14S2)	CC1310	14 * 20 mm	2.0±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (868T14S)	CC1310	16 * 26 mm	1.65±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (868T30S)	CC1310	24 * 38.5 mm	4.9±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (915T14S2)	CC1310	14 * 20 mm	2.0±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (915T14S)	CC1310	16 * 26 mm	1.65±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C
E70 (915T30S)	CC1310	24 * 38.5 mm	4.9±0.1g	-40 ~ 85℃	10% ~ 90%	-40 ~ 125°C

2.2 Electrical Parameters

2.2.1 Transmitting Current

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	33	36	40	mA	
E70 (433T14S)	25	27	30	mA	
E70 (433T30S)	500	530	580	mA	● When designing current supply circuit, 30% margin is recommended to be remained so as to ensure long-term stable operation of the whole module;
E70 (868T14S2)	33	36	40	mA	
E70 (868T14S)	25	27	30	mA	● The current at the instant of transmitting may be high, but the total energy consumed may be lower due to very short transmitting time;
E70 (868T30S)	570	610	670	mA	● When using external antenna, the impedance matching degree at different frequency points between antenna and module may affect the transmitting current value at different levels.
E70 (915T14S2)	33	36	40	mA	
E70 (915T14S)	25	27	30	mA	
E70 (915T30S)	570	600	660	mA	

2.2.2 Receiving Current

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	6	8	9	mA	
E70 (433T14S)	7	8	9	mA	
E70 (433T30S)	13	14	15	mA	• The current consumed when the RF chip is only working at receiving mode is called as receiving current, the tested receiving current may be higher for some RF chips with communication protocol or the developers have loaded their own protocol to the whole module.
E70 (868T14S2)	6	8	9	mA	
E70 (868T14S)	7	8	9	mA	
E70 (868T30S)	13	14	15	mA	• The current at pure receiving mode will be mA level, the users have to realize µA level receiving current through firmware development.
E70 (915T14S2)	6	8	9	mA	
E70 (915T14S)	7	8	9	mA	
E70 (915T30S)	13	14	15	mA	

2.2.3 Turn-off Current

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	1.0	1.2	2.7	µA	
E70 (433T14S)	0.5	1.0	2.5	µA	
E70 (433T30S)	2.0	4.0	5.5	µA	• The turn-off current means the current consumed by CPU, RAM, Clock and some registers which remain operating. SoC is at very low power consumption status.
E70 (868T14S2)	1.0	1.2	2.7	µA	
E70 (868T14S)	0.5	1.0	2.5	µA	
E70 (868T30S)	2.0	4.0	5.5	µA	• The turn-off current is always lower than the current consumed when the power supply source of the whole module is at no-load status.
E70 (915T14S2)	1.0	1.2	2.7	µA	
E70 (915T14S)	0.5	1.0	2.5	µA	
E70 (915T30S)	2.0	4.0	5.5	µA	

2.2.4 Voltage Supply

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	2.1	3.3	3.8	V DC	
E70 (433T14S)	2.1	3.3	3.8	V DC	
E70 (433T30S)	2.6	5.0	5.5	V DC	• If the module stays at maximum voltage for a long time, it may be damaged.
E70 (868T14S2)	2.1	3.3	3.8	V DC	
E70 (868T14S)	2.1	3.3	3.8	V DC	• The power supply pin has certain anti-surge ability, but users must note the potential pulse higher than the maximum power supply voltage.
E70 (868T30S)	2.6	5.0	5.5	V DC	
E70 (915T14S2)	2.1	3.3	3.8	V DC	• The power supply is not advisable to be below 3.0V, or the RF parameters will be influenced at different degree.
E70 (915T14S)	2.1	3.3	3.8	V DC	
E70 (915T30S)	2.6	5.0	5.5	V DC	

2.2.5 Communication Level

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	2.1	3.3	3.8	V DC	
E70 (433T14S)	2.1	3.3	3.8	V DC	
E70 (433T30S)	2.1	3.3	3.8	V DC	● If the module stays at maximum communication level for a long time, it may be damaged.
E70 (868T14S2)	2.1	3.3	3.8	V DC	
E70 (868T14S)	2.1	3.3	3.8	V DC	
E70 (868T30S)	2.1	3.3	3.8	V DC	● Though there are may ways to switch communication level, but the whole power consumption will be affected to a large extent.
E70 (915T14S2)	2.1	3.3	3.8	V DC	
E70 (915T14S)	2.1	3.3	3.8	V DC	
E70 (915T30S)	2.1	3.3	3.8	V DC	

2.3 RF Parameters

2.3.1 Transmitting Power

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	13.7	14.0	14.6	dBm	● Due to the error of the materials, each LRC component has ±0.1% error, so error accumulation will occur since multiple LRC components are used in the whole RF circuit, and the transmitting currents will be different at different modules;
E70 (433T14S)	13	14	15	dBm	
E70 (433T30S)	29	30	31	dBm	
E70 (868T14S2)	13.7	14.0	14.6	dBm	
E70 (868T14S)	13	14	15	dBm	● The power consumption can be lowered by lowering the transmitting power, but the efficiency of the internal PA will be decreased by lowering transmitting power due to various reasons;
E70 (868T30S)	29	30	31	dBm	
E70 (915T14S2)	13.7	14.0	14.6	dBm	● The transmitting power will be lowered by lowering the power supply voltage.
E70 (915T14S)	13	14	15	dBm	
E70 (915T30S)	29	30	31	dBm	

2.3.2 Receiving Sensitivity

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	-106.0	-108.0	-110.0	dBm	
E70 (433T14S)	-109	-110	-110	dBm	
E70 (433T30S)	-109	-110	-110	dBm	● The sensitivity is tested at the air data rate of 2.5kbps.
E70 (868T14S2)	-106.0	-108.0	-110.0	dBm	● Due to the error of the materials, each LRC component has ±0.1% error, so error accumulation will occur since multiple LRC components are used in the whole RF circuit, and the transmitting currents will be different at different modules;
E70 (868T14S)	-109	-110	-110	dBm	
E70 (868T30S)	-109	-110	-110	dBm	
E70 (915T14S2)	-106.0	-108.0	-110.0	dBm	● The receiving sensitivity will be reduced and communication range will be shortened while increasing the air data rate.
E70 (915T14S)	-109	-110	-110	dBm	
E70 (915T30S)	-109	-110	-110	dBm	

2.3.3 Recommended Working Frequency

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	431.0	433.0	446.5	MHz	
E70 (433T14S)	425.0	433.0	450.5	MHz	
E70 (433T30S)	425.0	433.0	450.5	MHz	
E70 (868T14S2)	861.0	868.0	876.5	MHz	●To work within the recommended frequency, the RF performance of all the parameters of module can be assured.
E70 (868T14S)	861.0	868.0	876.5	MHz	● It is recommended to avoid the crowded integer frequency such as 433.0MHz、868.0MHz, 915MHz etc.
E70 (868T30S)	861.0	868.0	876.5	MHz	
E70 (915T14S2)	907.0	915.0	922.5	MHz	
E70 (915T14S)	907.0	915.0	922.5	MHz	
E70 (915T30S)	907.0	915.0	922.5	MHz	

2.4 Tested Parameters

Model	Min	Typ	Max	Unit	Remarks
E70 (433T14S2)	1350	1500	1600	m	
E70 (433T14S)	1350	1500	1650	m	
E70 (433T30S)	5400	6000	6600	m	● The external antenna used is of 2.5dBi gain and vertical polarization. The height is 2.5 meters;
E70 (868T14S2)	1400	1500	1750	m	● The interval between each data packet is 2s, sending 100 packets with 30 bytes in each packet, the range at data lose rate of lower than 5% is valid range;
E70 (868T14S)	1350	1500	1650	m	● In order to obtain meaningful and reproducible results, we conducted the tests under in clear weather with little electromagnetic interference at suburb areas;
E70 (868T30S)	5400	6000	6600	m	● Distance may be shorter with interference or obstacles.
E70 (915T14S2)	1400	1500	1750	m	
E70 (915T14S)	1350	1500	1650	m	
E70 (915T30S)	5400	6000	6600	m	

3.Mechanical Characteristics

3.1 E70 (433T14S2)/ E70 (868T14S2)/ E70 (915T14S2)

3.1.1 Dimension

3.1.2 Pin Definition

No.	Pin item	Pin direction	Application
1、2、3	GND	Ground	Ground electrode
4、5、6、7	NC	Reserved pin	Reserved, to be floated
8	GND		Power positive reference, Power supply 2.2V ~ 3.8V DC
9、10	GND	Ground	Ground electrode
11	PA_EN	Output	Internal MCU controlled PA pin, valid in high level, （to be floated）
12	LNA_EN	Output	Internal MCU controlled LNA pin, valid in high level, （to be floated）
13	M2	Input	M2, M1, M0 together decide the 8 kinds of working modes; An external 1k protective resistor shall be connected in series when in use.
14	RESET	Input	Reset pin, valid in low level
15	GND	Ground	Ground electrode
16	AUX	Output	It is used to indicate the operation status of module, for user to wake up the external MCU, the module outputs low level during self-checking and initialization at power on, it can be configured as open-drain output or pull-up output, please refer to parameter setting part. An external 1k protective resistor shall be connected in series when in use. (can be floated)

17	TXD	Output	TTL serial port output connecting to external RXD input pin. It can be configured as open-drain or push-pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use.
18	TCKC	Input	JTAG TCKC
19	TMSC	Input	JTAG TMSC
20	RXD	Input	TTL serial port input connecting to external TXD pin. It can be configured as open-drain or high pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use.
21	M1	Input	M2, M1, M0 together decide the 8 kinds of working modes; An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, but it can be grounded when not used)
22	M0	Input	M2, M1, M0 together decide the 8 kinds of working modes; An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, it can be grounded when not used)
23	GND	Ground	Ground electrode
24	ANT		Antenna (50Ω characteristic impedance)

3.2 E70 (433T14S)/ E70 (868T14S)/ E70 (915T14S)

3.2.1 Dimension

3.2.2 Pin Definition

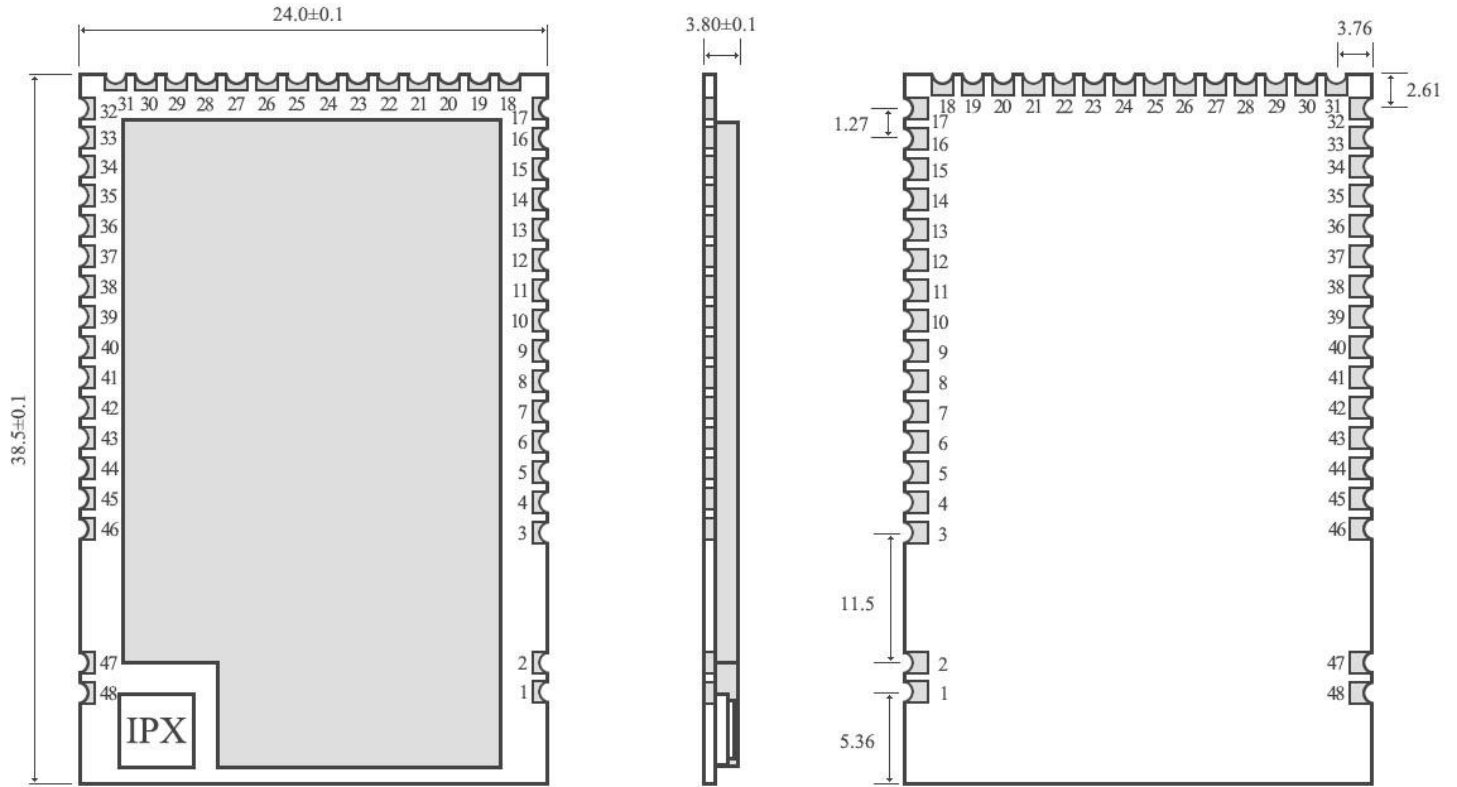| No.	Pin item	Pin direction	Application
1	GND	Ground	Ground electrode
2	ANT	Ground	Antenna (50Ω characteristic impedance)
4	NC	Reserved pin	Reserved, to be floated
5	NC	Reserved pin	Reserved, to be floated
6	LNA_EN	Output	Internal MCU controlled LNA pin, valid in high level, connect to pin 44
7	PA_EN	Output	Internal MCU controlled PA pin, valid in high level, connect to pin 45
8	NC	Reserved pin	Reserved, to be floated
9	NC	Reserved pin	Reserved, to be floated
10	NC	Reserved pin	Reserved, to be floated
11	NC	Reserved pin	Reserved, to be floated
12	NC	Reserved pin	Reserved, to be floated
13	NC	Reserved pin	Reserved, to be floated
14	NC	Reserved pin	Reserved, to be floated
15	M2	Input	M2, M1, M0 jointly decide the 8 working modes; An external 1k protective resistor shall be connected in series when in use.
16	GND	Ground	Ground electrode
17	M1	Input	M2, M1, M0 jointly decide the 8 working modes; An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, it can be grounded when not used)
18	M0	Input	M2, M1, M0 jointly decide the 8 working modes; An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, it can be grounded when not used)
19	RXD	Input	TTL serial port input connecting to external TXD pin. It can be configured as open-drain or high pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use.
20	TXD	Output	TTL serial port output connecting to external RXD input pin. It can be configured as open-drain or push-pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use.
21	TMSC	Input	JTAG TMSC
22	TCKC	Input	JTAG TCKC
23	NC	Reserved pin	Reserved, to be floated
24	NC	Reserved pin	Reserved, to be floated
25	AUX	Output	It is used to indicate the operation status of module, for user to wake up the external MCU, the module outputs low level during self-checking and initialization at power on, it can be configured as open-drain output or pull-up output, please refer to parameter setting par. An external 1k protective resistor shall be connected in series while using (can be floated)
26	VCC	-	Power positive reference, Power supply 2.1V ~ 3.8V DC

27	GND	Ground	Ground electrode
28	GND	Ground	Ground electrode
29	NC	Reserved pin	Reserved, to be floated
30	NC	Reserved pin	Reserved, to be floated
31	NC	Reserved pin	Reserved, to be floated
32	RESET	Input	Reset pin
33	NC	Reserved pin	Reserved, to be floated
34	NC	Reserved pin	Reserved, to be floated
35	NC	Reserved pin	Reserved, to be floated
36	NC	Reserved pin	Reserved, to be floated
37	NC	Reserved pin	Reserved, to be floated
38	NC	Reserved pin	Reserved, to be floated
39	NC	Reserved pin	Reserved, to be floated
40	NC	Reserved pin	Reserved, to be floated
41	GND	Ground	Ground electrode
42	GND	Ground	Ground electrode

3.3 E70 (433T30S)/ E70 (868T30S)/ E70 (915T30S)

3.3.1 Dimension

3.3.2 Pin Definition

No.	Pin item	Pin direction	Application
1	GND	Ground	Ground electrode
2	GND	Ground	Ground electrode
3	GND	Ground	Ground electrode
4	NC	Reserved pin	Reserved, to be floated
5	NC	Reserved pin	Reserved, to be floated
6	NC	Reserved pin	Reserved, to be floated
7	NC	Reserved pin	Reserved, to be floated
8	NC	Reserved pin	Reserved, to be floated
9	NC	Reserved pin	Reserved, to be floated
10	NC	Reserved pin	Reserved, to be floated
11	LNA_EN	Output	Internal MCU controlled LNA pin, valid in high level, connect to pin 44
12	PA_EN	Output	Internal MCU controlled PA pin, valid in high level, connect to pin 45
13	NC	Reserved pin	Reserved, to be floated
14	NC	Reserved pin	Reserved, to be floated
15	NC	Reserved pin	Reserved, to be floated
16	M2	Input	M2, M1, M0 jointly decide the 8 working modes; An external 1k protective resistor shall be connected in series when in use.
17	GND	Ground	Ground electrode
18	M0	Input	M2, M1, M0 jointly decide the 8 working modes; An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, it can be grounded when not used)
19	M1	Input	M2, M1, M0 jointly decide the 8 working modes; An external 1k protective resistor shall be connected in series and a 1M pull-up resistor shall be added when in use. (Cannot be floated, it can be grounded when not used)
20	RXD	Input	TTL serial port input connecting to external TXD pin. It can be configured as open-drain or high pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use.
21	TXD	Output	TTL serial port output connecting to external RXD input pin. It can be configured as open-drain or push-pull input, please refer to Parameter setting. An external 1k protective resistor shall be connected in series when in use.
22	TCKC	Input	JTAG TCKC
23	TMSC	Input	JTAG TMSC
24	RESET	Input	Reset pin, valid in low level
25	NC	Reserved pin	Reserved, to be floated
26	NC	Reserved pin	Reserved, to be floated

27	AUX	Output	It is used to indicate the operation status of module, for user to wake up the external MCU, the module outputs low level during self-checking and initialization at power on, it can be configured as open-drain output or pull-up output, please refer to parameter setting par. An external 1k protective resistor shall be connected in series while using (can be floated)
28	VCC	-	Power positive reference, Power supply 2.6V ~ 5.5V DC
29	VCC	-	Power positive reference, Power supply 2.6V ~ 5.5V DC
30	GND	Ground	Ground electrode
31	GND	Ground	Ground electrode
32	NC	Reserved pin	Reserved, to be floated
33	NC	Reserved pin	Reserved, to be floated
34	NC	Reserved pin	Reserved, to be floated
35	NC	Reserved pin	Reserved, to be floated
36	NC	Reserved pin	Reserved, to be floated
37	NC	Reserved pin	Reserved, to be floated
38	NC	Reserved pin	Reserved, to be floated
39	NC	Reserved pin	Reserved, to be floated
40	NC	Reserved pin	Reserved, to be floated
41	NC	Reserved pin	Reserved, to be floated
42	NC	Reserved pin	Reserved, to be floated
43	NC	Reserved pin	Reserved, to be floated
44	LNA_EN	Input	Internal LNA pin, valid in high level, connect to pin 11
45	PA_EN	Input	Internal PA pin, valid in high level, connect to pin 12
46	GND	Ground	Ground electrode
47	GND	Ground	Ground electrode
48	ANT	-	Antenna (50Ω characteristic impedance)

All E70 series are compatible with their pins.

Real values of MCU controlled PA and LNA are as follows:

No.	PA_EN	LNA_EN	Notes
1	1	0	In transmitting
2	0	1	In receiving
3	0	0	In sleeping mode

4.Recommended Circuit Diagram

4.1. E70 (433T14S2)/ E70 (868T14S2)/ E70 (915T14S2)
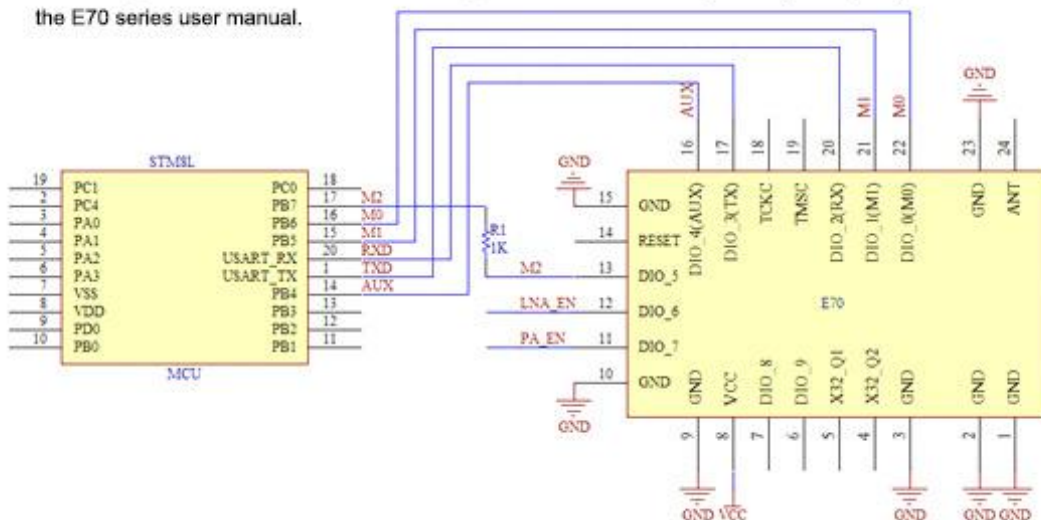
4.2 General Circuit Diagram
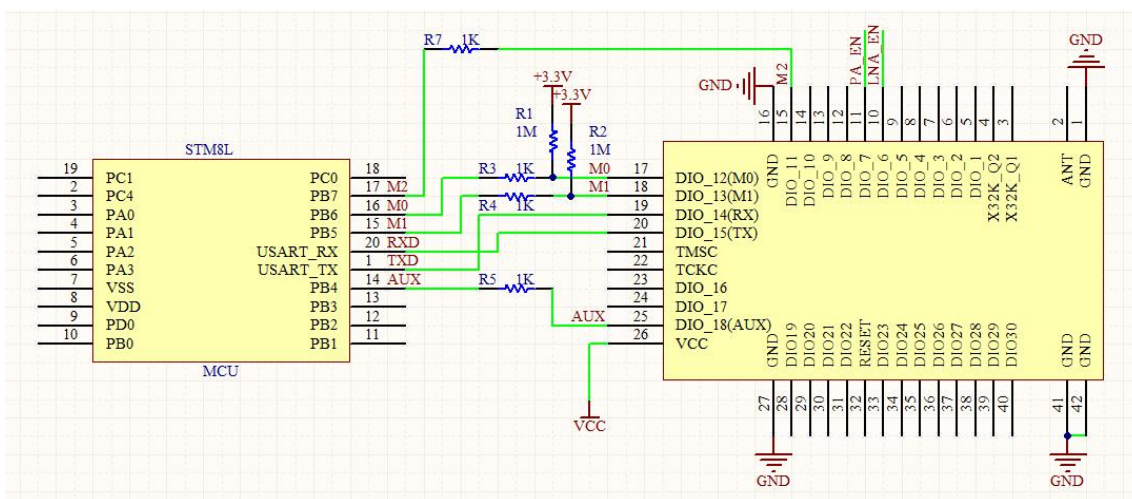
No.	Description （STM8L MCU）
1	The UART module is TTL level. Please connect to MCU of TTL level.
2	For some MCU working at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin.

5.Function Description

5.1 Fixed Transmission
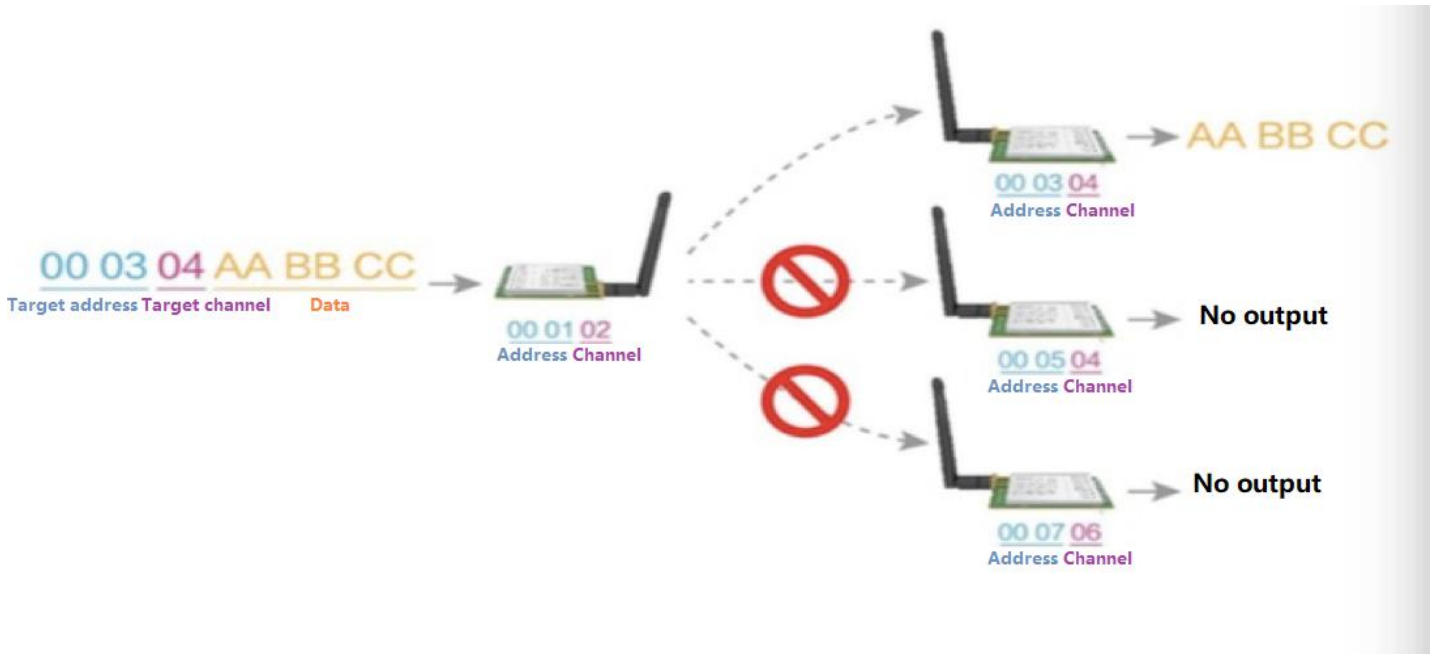
5.2 Broadcast Transmission
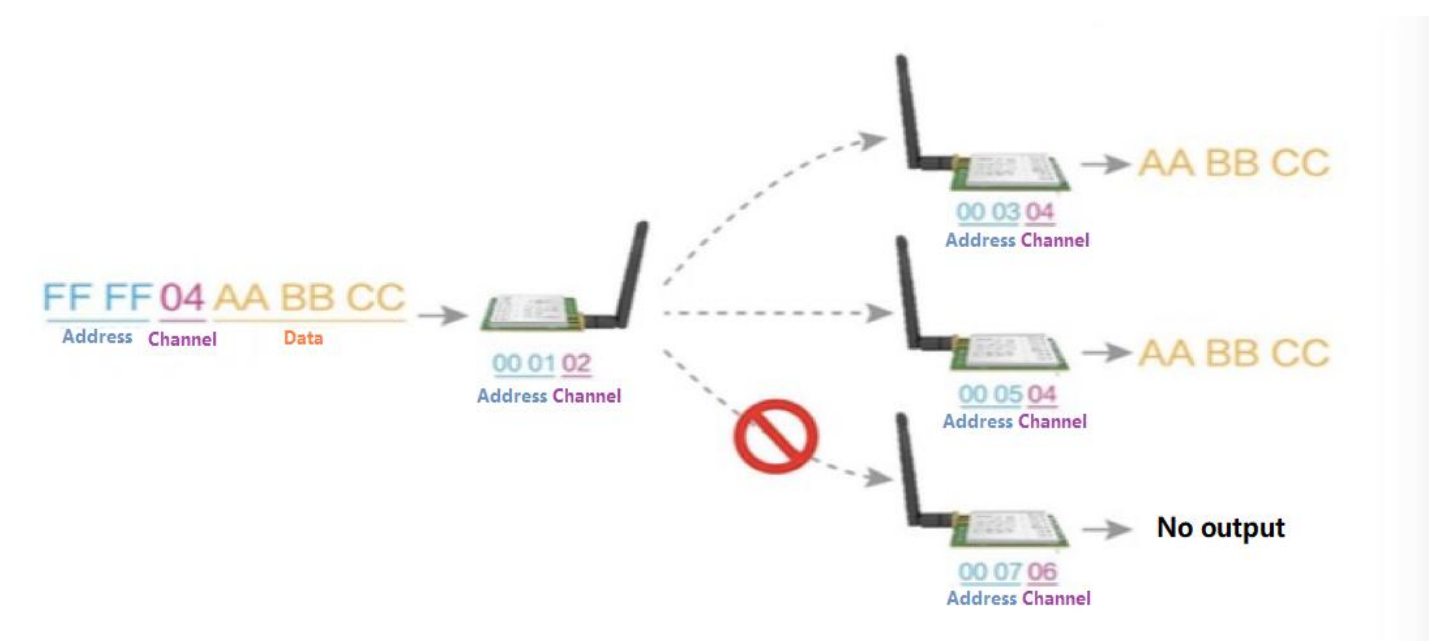
5.3 Broadcast Address

- For example: Set the address of module A as 0xFFFF or 0x0000, and the channel as 0x04;
- When module A is the transmitter (transparent transmission), all modules under channel 0x04 will receive the data, the purpose of broadcast is realized.

5.4 Monitor Address

- For example: Set the address of module A as 0xFFFF or 0x0000, and the channel as 0x04;
- When module A is the receiver, it can receive the data sent from all modules under channel 0x04, the purpose of monitor is realized.

5.5 Reset

No.	Description
1	When the module is powered, AUX outputs low level immediately, conducts hardware self-check and sets the operating mode on the basis of the user parameters. During the process, the AUX keeps low level. After the process completed, the AUX outputs high level and starts to work as per the operating mode combined by M2, M1 and M0. Therefore, the user needs to wait the AUX rising edge as the starting point of module's normal work.

5.6 AUX Description

5.6.1 Indication of UART Output

To wake up external MCU:
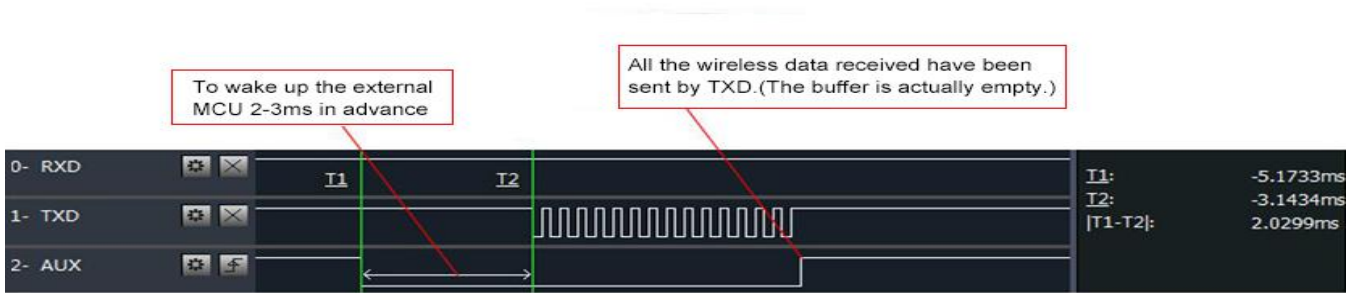
Timing Sequence Diagram of AUX when TXD pin transmits

5.6.2 Indication of Wireless Transmitting

Sub-package mode: the length of the buffer is determined by the length of sub-packages. If the packet is set as

1024 bytes, the buffer is 1024 bytes too. When Aux=1, users can transmit data continuously within 1024 bytes.

Continuous mode: When Aux=1, the length of packet is unlimited.

WOR mode: When Aux=1, users can send continuous data packet within 84 bytes.

When AUX = 1, it means that all the UART data of the module have been transmitted already.

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).
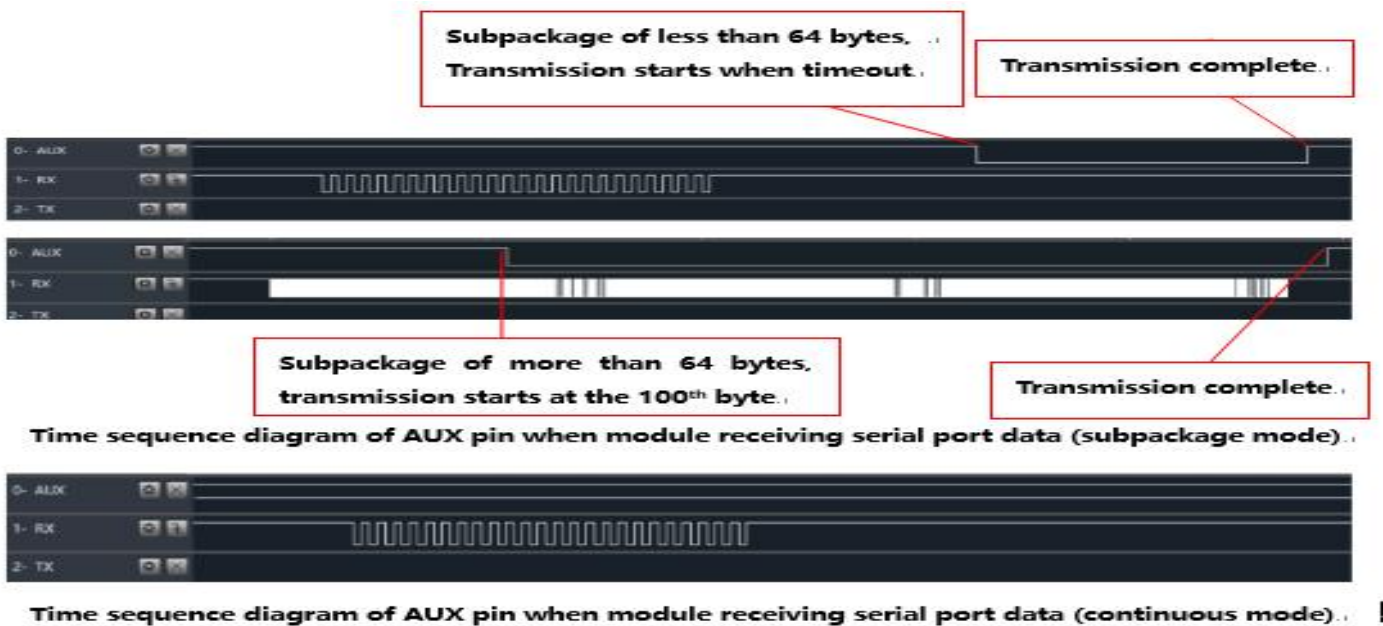
5.6.3 Configuration Procedure of Module

Only happened when power-on resetting or exiting sleep mode.

Timing Sequence Diagram of AUX when self-check

6.Operating Mode

The table below shows the status of corresponding modes:

Mode (0-7)	M2	M1	M0	Mode introduction	Remark
0 RSSI mode	0	0	0	UART opens. Wireless closes and transmission is unavailable.	Module outputs RSSI value each 100ms through UART
1 Continuous mode	0	0	1	UART opens. Wireless closes and continuous transparent transmission is available.	Air data rate can be adjusted automatically according to baud rate. The baud rate must be same on both receiver and transmitter. It is applicable for high speed continuous data transmission.
2 Sub-package mode	0	1	0	UART opens. Wireless closes and sub-package transparent transmission is available.	Air data rate and baud rate can be adjusted separately. It is applicable for data packet transmission.
3 Configuration mode	0	1	1	UART opens. Wireless closes and parameter can be configured.	Baud rate is fixed as 9600 8N1.
4 WOR mode	1	0	0	UART opens. Wireless closes and subpackage transparent transmission is available.	Receiving is not available under this mode. Preamble code will be added proactively before transmission to wake up the receiver under mode 6.
5 Configuration mode (Same as Mode 3)	1	0	1	-	-
6 Power saving mode	1	1	0	UART closes. Wireless works at WOR power saving mode. Multiple time grades can be configured.	Transmission is not available under this mode. It can be woken up by transmitter under mode 4 to achieve low power consumption receiving.
7 Sleep mode	1	1	1	UART closes, wireless transmitting is available and sleep mode is on.	It can be woken up by any falling edge of M2, M1, M0.

6.1 Mode Switch

● The user can decide the operating mode by the combination of M0, M1 and M2. The two GPIOs of MCU can be used to switch mode. After modifying M0, M1 or M2, it will start to work in new mode 1ms later if the module is free. If there are any serial data that are yet to finish wireless transmitting, it will start to work in new mode after the UART transmitting finished. After the module receives the wireless data & transmits the data through serial port, it will start to work in new mode after the transmitting finished. Therefore, the mode-switch is only valid when AUX outputs 1, otherwise it will delay.

● For example, in mode 2 or mode 4, if the user inputs massive data consecutively and switches operating mode at the same time, the mode-switch operation is invalid. New mode checking can only be started after all the user's data process completed. It is recommended to check AUX pin out status and wait 2ms after AUX outputs high level before switching the mode.

● If the module switches from other modes to stand-by mode, it will work in stand-by mode only after all the remained data process completed. The feature can be used to save power consumption. For example, when the transmitter works in mode 0, after the external MCU transmits data "12345", it can switch to sleep mode immediately without waiting the rising edge of the AUX pin, also the user's main MCU will go dormancy immediately. Then the module will transmit all the data through wireless transmission & go dormancy 1ms later automatically, which reduces MCU working time & save power.

● Likewise, this feature can be used in any mode-switch. The module will start to work in new mode within 1ms after completing present mode task, which enables the user to omit the procedure of AUX inquiry and switch mode swiftly. For example, when switching from transmitting mode to receiving mode, the user MCU can go dormancy before mode-switch, using external interrupt function to get AUX change so that the mode-switch can be realized.

● This operation is very flexible and efficient. It is totally designed on the basis of the user MCU's convenience, at the same time the work load and power consumption of the whole system has been reduced and the efficiency of whole system is largely improved.

6.2 RSSI Mode (Mode 0)

Status	M0=1 M1=0 M2=0
Transmitting	Wireless data transmission is not available
Receiving	Wireless data receiving is not available
Baud rate & air data rate	Current baud rate
Advantage	RSSI value of one byte output every 100ms can indicate the noise value of current environment.
Disadvantage	Data transmission and receiving are not available
Applications	For monitoring environmental noise
Note	-

6.3 Continuous Mode (Mode 1)

Status	M0=1 M1=0 M2=0
Transmitting	Wireless data transmission is available.
Receiving	Wireless data receiving is available.
Baud rate & air data rate	Module will calculate the minimum air data rate according to the configured baud rate. Since the modules with different air data rate cannot communicate, the serial port parameters must be the same on both receiver and transmitter.
Advantage	The data output on the receiver is continuous, it meets the requirements for MODBUS continuous transmission and low latency.
Disadvantage	The baud rates on both receiver and transmitter must be same. The module will raise its air data when the baud rate is raised, thus the receiving sensitivity will be lowered and operation range will be shorter.
Applications	Applicable for those applications not requiring distance but continuous data and response time.
Note	1. The "wireless air data rate" in the configuration commands is invalid (SPED.210 bits) and software will calculate automatically. 2. 0000 and FFFF are the broadcast addresses, which can be used to monitor and broadcast. 3. The addresses and baud rates must be same on both receiver and transmitter. 4. In continuous mode, both transmitter and receiver must be same model. For example, E70 (868T14S) and E70 (868T30S) cannot communicate in continuous mode.

6.4 Sub-package Mode (Mode 2)

Status	M0=0 M1=1 M2=0
Transmitting	Wireless data transmission is available.
Receiving	Wireless data receiving is available.
Baud rate & air data rate	Under this mode, the baud rate and air data rate are independent, both receiver and transmitter can have different baud rate but same air data rate.
Advantage	Very low air data rate can be configured for longer distance, the data continuousness between output data depends on the data packet length.
Disadvantage	Since the air data rate is low and the receiver needs to wait for the data packet length or timeout byte numbers, it may cause some delay, which depends on the actual value as set.
Applications	Applicable for those applications requiring distance and continuous data while not requiring transmission speed.
Note	1. Air data rate and baud rate are not relative; the values are valid. 2. 0000 and FFFF are the broadcast addresses, which can be used to monitor and broadcast. 3. The addresses and air data rates must be same, but baud rates can be different on both receiver and transmitter. 4. The size of individual data packet depends on the subpackage size CHAN [7:5] (excluding address and channel for directional transmission)

6.5 Configuration Mode (Mode 3)

Status	M0=1 M1=1 M2=0
Transmitting	Transmission not available, serial data received will be discarded.
Receiving	Receiving is not available.
Configuring	Parameter configuration can be made in configuration mode with specific instruction format and UART 9600, 8N1.
Note	When entering other modes from configuration mode, the module will reconfigure parameters, AUX keeps low level during configuration; After configuration completed, it outputs high level, so users are recommended to check the AUX rising edge.

6.6 Wake-up Mode (Mode 4)

Status	M0=0 M1=0 M2=1
Transmitting	Transmission is available.
Receiving	Receiving is not available.
Baud rate & air data rate	Under this mode, the baud rate and air data rate are independent, both receiver and transmitter can have different baud rate but same air data rate.
Advantage	It can wake up the receiver under mode 6; wake up code will be added automatically before transmitting, the code number depends on the wake up time.
Disadvantage	The transmission time is long, only applicable to wake up the receiver, not applicable for common data transmission.
Applications	For waking up the receiver under WOR mode.
Note	Under wake up mode, the single data packet length is 84 bytes (excluding the address and channel for directional transmission).

6.7 Configuration Mode (Mode 5)

Status	M0=1 M1=0 M2=1
Transmitting	Transmission is not available. Serial data received are considered as configuration command.
Receiving	Receiving is not available.
Configuration	Parameter configuration can be made in configuration mode with specific instruction format and UART 9600, 8N1.
Note	When entering other modes from configuration mode, the module will reconfigure parameters, AUX keeps low level during configuration; After configuration completed, it outputs high level, so users are recommended to check the AUX rising edge.

6.8 Power Saving Mode (Mode 6)

Status	M0=0 M1=1 M2=1
Transmitting	Transmission is not available.
Receiving	Receiving is available.
Baud rate & air data rate	Under this mode, the baud rate and air data rate are independent, both receiver and transmitter can have different baud rate but same air data rate.
Advantage	The module works under WOR status, it wakes up periodically and monitors the wireless data packets, when data packet monitored, the module enters receiving mode and receives complete data packets, and outputs the data through serial port, and then enters WOR status again, which can save power consumption significantly.
Disadvantage	Transmission is not available under this mode, the module must be switched to other mode for data transmission.
Applications	Applicable for those devices which have requirement on power consumption and need to receive data.
Note	It can only receive the data sent from the transmitter under mode 4.

6.9 Sleep Mode (Mode 7)

Status	M0=1 M1=1 M2=1
Transmitting	Transmitting is not available.
Receiving	Receiving is not available.
Others	Other functions of the module are closed, only can quit sleep mode by switching the M0, M1 and M2 status.

7.Instruction Format

In configuration mode（Mode 3：M0=1, M1=1, M2=0），it supports instructions below.

(**Only support 9600 and 8N1 format when setting**)

No.	Instruction format	Illustration
1	C0 + working parameters	C0 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be sent in succession. (Save the parameters when power-down)
2	C1+C1+C1	Three C1 are sent in hexadecimal format. The module returns the saved parameters and must be sent in succession.
3	C2 + working parameters	C2 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be sent in succession. (Do not save the parameters when power-down)
4	C3+C3+C3	Three C3 are sent in hexadecimal format. The module returns the version information and they must be sent in succession.
5	C4+C4+C4	Three C4 are sent in hexadecimal format. The module will reset one time and they must be sent in succession.

7.1 Default Parameter

7.1.1. Working frequency 433MHz

	Default parameter values：C0 00 00 18 44 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (433T14S2)	433MHz	0x0000	0x04	2.5K	9600	8N1	25mW

	Default parameter values：C0 00 00 18 44 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (433T14S)	433MHz	0x0000	0x04	2.5K	9600	8N1	25mW

	Default parameter values：C0 00 00 18 4E 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (433T30S)	433MHz	0x0000	0x0E	2.5K	9600	8N1	1W

7.1.2. Working frequency 868MHz

	Default parameter values：C0 00 00 18 4E 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (868T14S2)	868MHz	0x0000	0x0E	2.5K	9600	8N1	25mW

	Default parameter values：C0 00 00 18 4E 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (868T14S)	868MHz	0x0000	0x0E	2.5K	9600	8N1	25mW

	Default parameter values：C0 00 00 18 4E 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (868T30S)	868MHz	0x0000	0x0E	2.5K	9600	8N1	1W

7.1.3. Working frequency 915MHz

	Default parameter values：C0 00 00 18 50 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (915T14S2)	915MHz	0x0000	0x10	2.5K	9600	8N1	25mW

	Default parameter values：C0 00 00 18 50 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (915T14S)	915MHz	0x0000	0x10	2.5K	9600	8N1	25mW

Default parameter values：C0 00 00 18 50 1C						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70 (915T30S)	915MHz	0x0000	0x10	2.5K	9600	8N1	1W

7.2 Reading Operating Parameters

Instruction format	Description
C1+C1+C1	In configuration mode（M0=1, M1=1, M2=0）， User gives the module instruction (HEX format): C1 C1 C1, Module returns the present configuration parameters. For example, C0 00 00 18 4E 1C.

7.3 Reading Version Number

Instruction format	Description
C3+C3+C3	In configuration mode（M0=1, M1=1, M2=0）， User gives the module instruction (HEX format): C3 C3 C3, Module returns its present version number, for example C3 0071 XX1 XX2 XX3 XX4 XX5. 70 here means the module model (E70 series); xx1 is the version number and XX2 XX3 XX4 XX5 refers to the other module features.

7.4 Reset Instruction

Instruction format	Description
C4+C4+C4	In configuration mode（M0=1, M1=1, M2=0）， User gives the module instruction (HEX format): C4 C4 C4, the module resets for one time. During the reset process, the module will conduct self-check, AUX outputs low level. After reset completed, the AUX outputs high level, then the module starts to work regularly when the working mode can be switched or be given another instruction.

7.5 Parameter Setting Instruction

No.	Item	Description				Notes
0	HEAD	Fix 0xC0 or 0xC2, it means this frame data is control command				• Must be 0xC0 or 0xC2 • C0: Save the parameters when power-down • C2: Do not save the parameters when power-down
1	ADDH	High address byte of module（the default 00H）				• 00H-FFH
2	ADDL	Low address byte of module（the default 00H）				• 00H-FFH
3	SPED	7	6		UART parity bit	• UART mode can be different between communication parties
		0	0		8N1（Default ）	
		0	1		8O1	
		1	0		8E1	
		1	1		8N1（equal to 00）	
		5	4	3	TTL UART baud rate（bps）	• UART baud rate can be different between communication parties • The UART baud rate has nothing to do with wireless transmission parameters & won't affect the wireless transmit / receive features.
		0	0	0	1200bps	
		0	0	1	2400bps	
		0	1	0	4800bps	
		0	1	1	9600bps（Default)	
		1	0	0	19200bps	
		1	0	1	38400bps	
		1	1	0	57600bps	
		1	1	1	115200bps	

		2	1	0	Air data rate（bps）	
		0	0	0	2.5kbps	● The lower the air data rate, the longer the transmitting distance, better anti-interference performance and longer transmitting time
		0	0	1	5kbps	
		0	1	0	12kbps（Default）	
		0	1	1	28kbps	
		1	0	0	64kbps	● The air data rate must keep the same for both communication parties.
		1	0	1	168kbps	
		1	1	0	168kbps	
		1	1	1	168kbps	
4	CHAN	7	6	5	Packet length (only for subpackage mode)	
		0	0	0	16 bytes	
		0	0	1	32 bytes	
		0	1	0	64 bytes（Default）	● Under continuous transmitting mode (M0=1 M1=0 M2=0), this parameter is invalid
		0	1	1	128 bytes	
		1	0	0	256 bytes	
		1	0	1	512 bytes	
		1	1	0	1024 bytes	
		1	1	1	2048 bytes	
		Communication Channel				
		00H~1FH, 431~446.5MHz, （Default）04H（433M）				● Model: E70 (433T14S2)/ E70 (433T14S)/ E70 (433T30S)
		00H~1FH, 861~876.5MHz, （Default）0EH（868M）				● Model: E70 (868T14S2)/ E70 (868T14S)/ E70 (868T30S)
		00H~1FH, 907~922.5MHz, （Default）10H（915M）				● Model: E70 (915T14S2)/ E70 (915T14S)/ E70 (915T30S)
5	OPTION	7			Fixed transmission (similar to MODBUS)	● When it is 1, the first three bytes of each user data frame can be used as high/low address and channel. The module changes its address and channel when transmitting. And it will revert to original setting after the process is completed.
		0			Transparent transmission mode (Default)	
		1			Fixed transmission mode	● It is transparent transmission under continuous mode.
		6	5	4	wireless wake-up time	● This parameter is only valid for mode 4, 6.
		0	0	0	500ms	● For mode 6, the wake-up time will affect the WOR cycle of the module, and affect the power consumption.
		0	0	1	1000ms(Default)	
		0	1	0	1500ms	● For mode 4, the wake-up time decides the number of wake-up code before transmission so as to ensure the wake up the module in mode 6.
		0	1	1	2000ms	
		1	0	0	2500ms	
		1	0	1	3000ms	● Generally, mode 4 and 6 shall be used jointly and the wake-up time on both modules shall be the same.
		1	1	0	3500ms	
		1	1	1	4000ms	
		3			FEC switch	● After turn off FEC, the actual data transmission rate increases while anti-interference ability decreases. Also, the transmission distance is relatively short.
		0			Turn off FEC	
		1			Turn on FEC (Default)）	● Both communication parties must keep on the same pages about turn-on or turn-off FEC.
		2			IO drive mode	● This bit is used to the internal pull-up resistor. It also increases the level's adaptability in case of open drain. But
		0			TXD and AUX push-pull outputs, RXD pull-up inputs	

| | | 1 | TXD、AUX open-collector outputs, RXD open-collector inputs | | | | in some cases, it may need external pull-up resistor. |

1	0	transmission power (approximation)
0	0	14dBm (Default)
0	1	10dBm
1	0	7dBm
1	1	4dBm

- The external power must ensure that the ability of current output is more than 1A and the power supply ripple is within 100mV.
- Low power transmission is not recommended due to its low power supply efficiency.

1	0	transmission power (approximation)
0	0	30dBm (Default)
0	1	27dBm
1	0	24dBm
1	1	21dBm

- The external power must ensure that the ability of current output is more than 1A and the power supply ripple is within 100mV.
- Low power transmission is not recommended due to its low power supply efficiency.

For example: The meaning of No.3 "SPED" byte：							
The binary bit of the byte	7	6	5	4	3	2	1	0
The specific value (configured by user)	0	0	0	1	1	0	1	0
Meaning	UART parity bit 8N1		UART baud rate is 9600		Air data rate is 2.4k			
Corresponding hexadecimal	1		A					

8.Parameter Setting

When the module is in Mode 3 (M0=1 M1=1 M2=0) or Mode 5 (M0=1 M1=0 M2=1), the parameter can be set by instruction or software in PC. Please visit www.cdebyte.com to download the software.
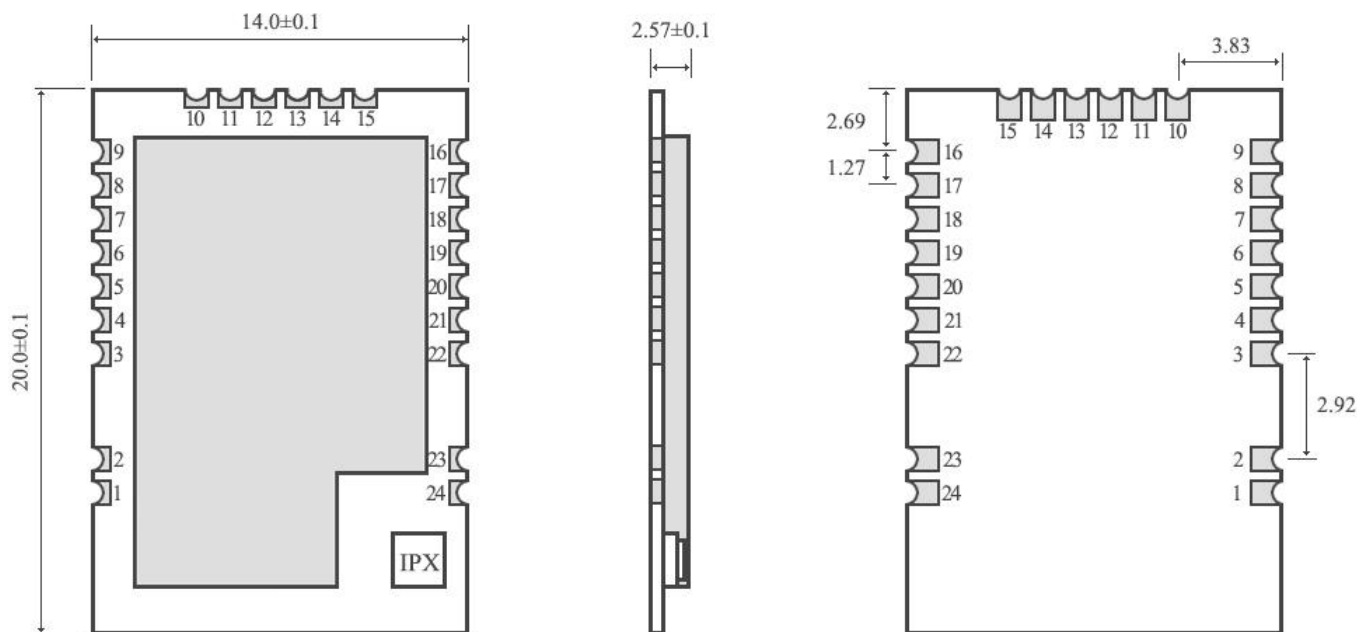

9.Secondary Development

E70 series have built-in CC1310 SoC chip. Users can conduct the development according to pin description below. Meanwhile, Ebyte can develop the customized software for customers. Please contact us for more details.

9.1 E70 (433T14S2)/ E70 (868T14S2)/ E70 (915T14S2)
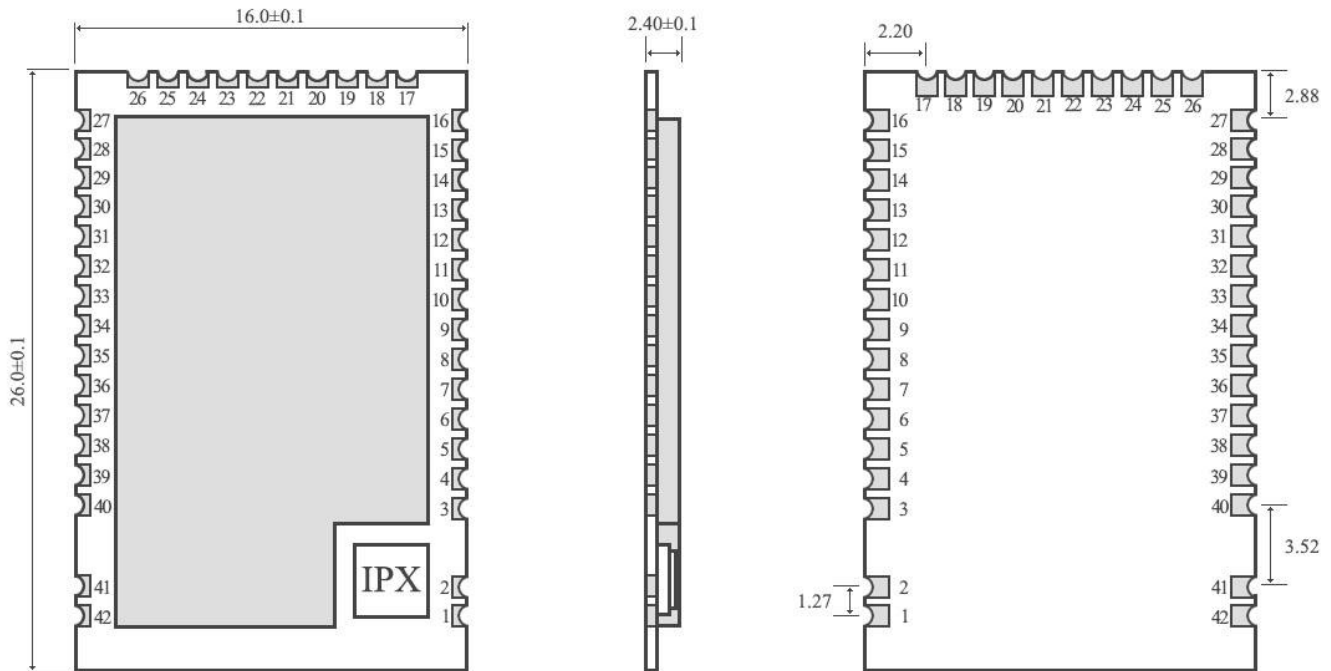
9.1.1 Secondary Development Dimension

9.1.2 The Pin Definition

Pin No.	Pin item	Pin direction	Pin application
1、2、3	GND	Reference ground	Ground electrode
4	X32K_Q1	Input/Output	Connect to 32.768K quartz crystal with pin 5
5	X32K_Q2	Input/Output	Connect to 32.768K quartz crystal with pin 4
6	DIO_9	Input/Output	MCU GPIO
7	DIO_8	Input/Output	MCU GPIO
8	VCC		Positive power reference, voltage range：2.2V ~ 3.8V DC
9	GND	Reference ground	Ground electrode
10	GND	Reference ground	Ground electrode
11	DIO_7	Input/Output	MCU GPIO
12	DIO_6	Input/Output	MCU GPIO
13	DIO_5	Input/Output	MCU GPIO
14	RESET	Input	Reset pin
15	GND	Reference ground	Ground electrode
16	DIO_4	Input/Output	MCU GPIO
17	DIO_3	Input/Output	MCU GPIO
18	TCKC	Input	JTAG TCKC
19	TMSC	Input	JTAG TMSC
20	DIO_2	Input/Output	MCU GPIO
21	DIO_1	Input/Output	MCU GPIO
22	DIO_0	Input/Output	MCU GPIO
23	GND	Reference ground	Ground electrode
24	ANT		Antenna（50Ω characteristic impedance)

9.2 E70 (433T14S)/ E70 (868T14S)/ E70 (915T14S)
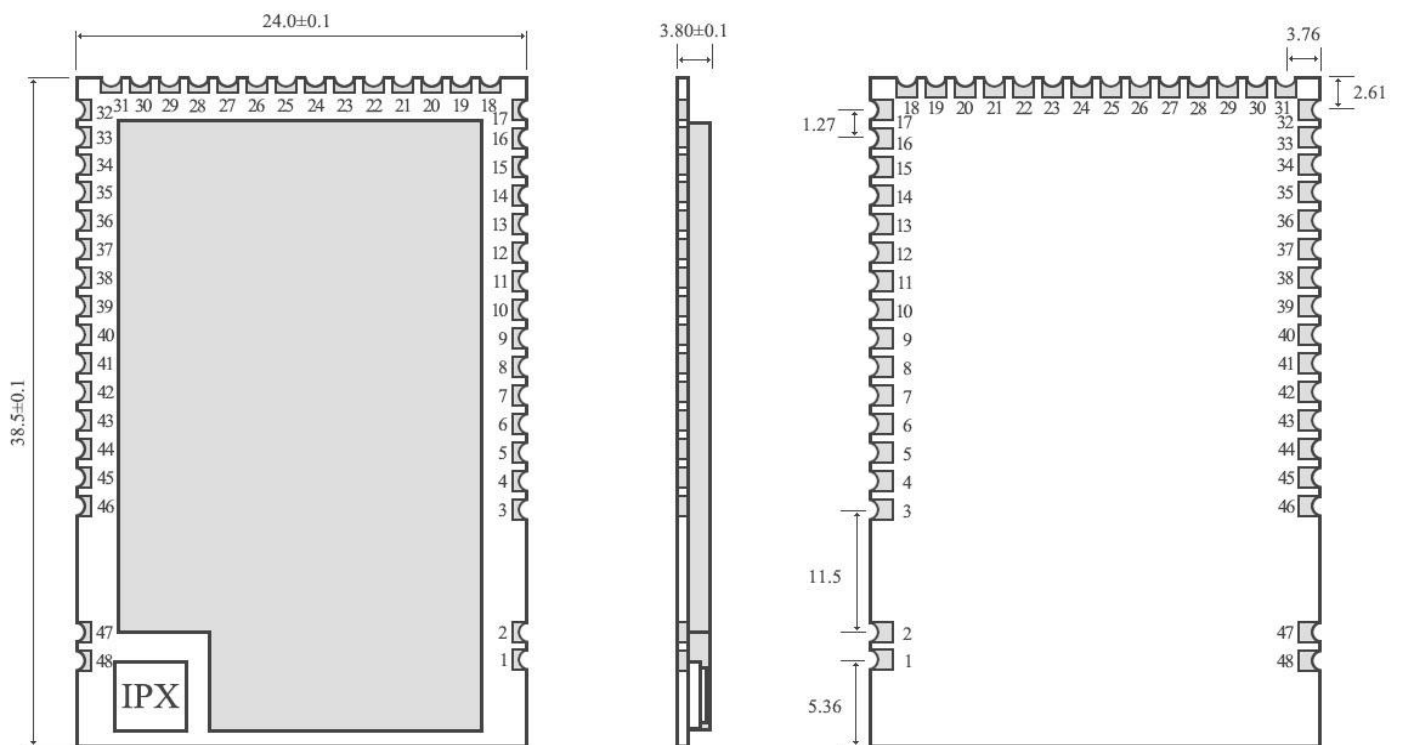
9.2.1 Secondary Development Dimension

9.2.2 The Pin Definition

Pin No.	Pin item	Pin direction	Pin application
1、16、27、41、42	GND	Reference ground	Ground electrode
2	ANT		Antenna（50Ω characteristic impedance）
3	X32K_Q1	Input/Output	Connect to 32.768K quartz crystal with pin 4
4	X32K_Q2	Input/Output	Connect to 32.768K quartz crystal with pin 3
5	DIO_1	Input/Output	MCU GPIO
6	DIO_2	Input/Output	MCU GPIO
7	DIO_3	Input/Output	MCU GPIO
8	DIO_4	Input/Output	MCU GPIO
9	DIO_5	Input/Output	MCU GPIO
10	DIO_6	Input/Output	MCU GPIO
11	DIO_7	Input/Output	MCU GPIO
12	DIO_8	Input/Output	MCU GPIO
13	DIO_9	Input/Output	MCU GPIO
14	DIO_10	Input/Output	MCU GPIO
15	DIO_11	Input/Output	MCU GPIO
17	DIO_12	Input/Output	MCU GPIO
18	DIO_13	Input/Output	MCU GPIO
19	DIO_14	Input/Output	MCU GPIO
20	DIO_15	Input/Output	MCU GPIO
21	TMSC	Input	JTAG TMSC
22	TCKC	Input	JTAG TCKC

23	DIO_16	Input/Output	MCU GPIO
24	DIO_17	Input/Output	MCU GPIO
25	DIO_18	Input/Output	MCU GPIO
26	VCC		Positive power reference, voltage range：2.2V ~ 3.8V DC
28	DIO_19	Input/Output	MCU GPIO
29	DIO_20	Input/Output	MCU GPIO
30	DIO_21	Input/Output	MCU GPIO
31	DIO_22	Input/Output	MCU GPIO
32	RESET	Input	Reset pin
33	DIO_23	Input/Output	MCU GPIO
34	DIO_24	Input/Output	MCU GPIO
35	DIO_25	Input/Output	MCU GPIO
36	DIO_26	Input/Output	MCU GPIO
37	DIO_27	Input/Output	MCU GPIO
38	DIO_28	Input/Output	MCU GPIO
39	DIO_29	Input/Output	MCU GPIO
40	DIO_30	Input/Output	MCU GPIO

9.3   E70 (433T30S)/ E70 (868T30S)/ E70 (915T30S)
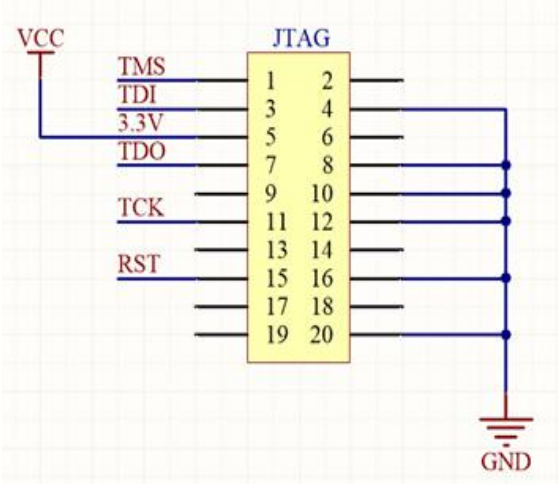
9.3.1 Secondary Development Dimension

9.3.2 The Pin Definition

Pin No.	Pin item	Pin direction	Pin application
1	GND	Reference ground	Ground electrode
2	GND	Reference ground	Ground electrode

3	GND	Reference ground	Ground electrode
4	X32K_Q1	Input/Output	Connect to 32.768K quartz crystal with pin 5
5	X32K_Q2	Input/Output	Connect to 32.768K quartz crystal with pin 4
6	DIO_1	Input/Output	MCU GPIO
7	DIO_2	Input/Output	MCU GPIO
8	DIO_3	Input/Output	MCU GPIO
9	DIO_4	Input/Output	MCU GPIO
10	DIO_5	Input/Output	MCU GPIO
11	DIO_6	Input/Output	MCU GPIO
12	DIO_7	Input/Output	MCU GPIO
13	DIO_8	Input/Output	MCU GPIO
14	DIO_9	Input/Output	MCU GPIO
15	DIO_10	Input/Output	MCU GPIO
16	DIO_11	Input/Output	MCU GPIO
17	GND	Reference ground	Ground electrode
18	DIO_12	Input/Output	MCU GPIO
19	DIO_13	Input/Output	MCU GPIO
20	DIO_14	Input/Output	MCU GPIO
21	DIO_15	Input/Output	MCU GPIO
22	TCKC	Input	JTAG TCKC
23	TMSC	Input	JTAG TMSC
24	RESET	Input	Reset pin, valid in low level
25	DIO_16	Input/Output	MCU GPIO
26	DIO_17	Input/Output	MCU GPIO
27	DIO_18	Input/Output	MCU GPIO
28	VCC		Positive power reference，voltage range：2.6V ~ 5.5V DC
29	VCC		Positive power reference，voltage range：2.6V ~ 5.5V DC
30	GND	Reference ground	Ground electrode
31	GND	Reference ground	Ground electrode
32	DIO_19	Input/Output	MCU GPIO
33	DIO_20	Input/Output	MCU GPIO
34	DIO_21	Input/Output	MCU GPIO
35	DIO_22	Input/Output	MCU GPIO
36	DIO_23	Input/Output	MCU GPIO
37	DIO_24	Input/Output	MCU GPIO
38	DIO_25	Input/Output	MCU GPIO
39	DIO_26	Input/Output	MCU GPIO
40	DIO_27	Input/Output	MCU GPIO
41	DIO_28	Input/Output	MCU GPIO
42	DIO_29	Input/Output	MCU GPIO
43	DIO_30	Input/Output	MCU GPIO
44	LNA_EN	Input	Internal MCU controlled LNA pin, valid in high level，(to be floated)
45	PA_EN	Input	Internal MCU controlled PA pin, valid in high level， (to be floated)
46	GND	Reference ground	Ground electrode
47	GND1	Reference ground	Ground electrode
48	ANT		Antenna（50Ω characteristic impedance)

9.4 Download Program

| Key word	Notes
Input program	The module is SOC with GPIO port. For program downloading, please use the special downloader of CC series: JTAG (or the original CC1310 board from TI), any other serial port or ISP, ICP are unavailable to download. Below is the connection diagram of JTAG（XDS100）. See more details in TI official document. (TDI and TDO pin can be unconnected) Connection diagram of JTAG downloader

10. Production Guidance

10.1 Reflow Soldering Temperature

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

10.2 Reflow Soldering Curve
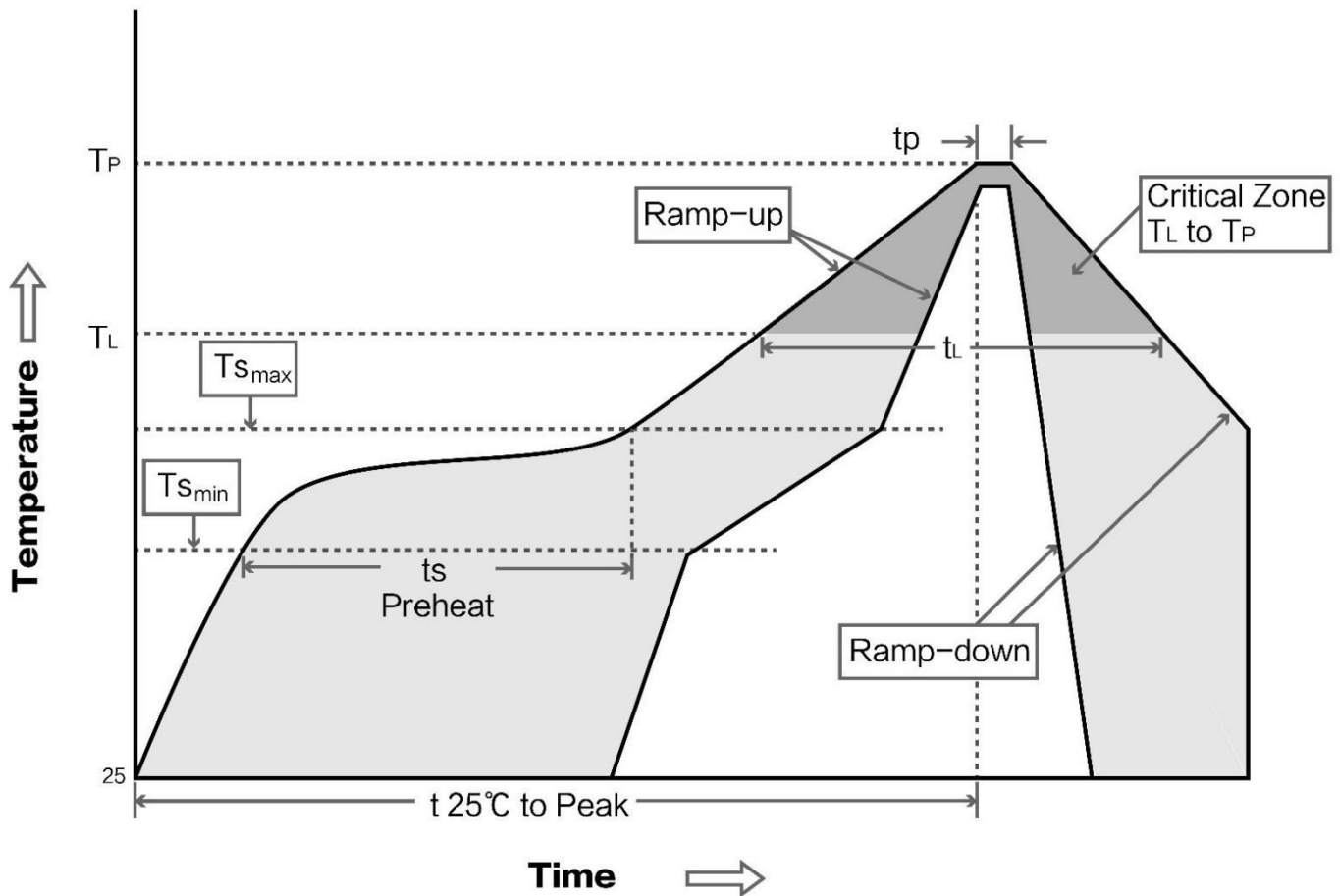
11.FAQ

11.1 Communication range is too short

- The communication distance will be affected when obstacle exists.
- Data lose rate will be affected by temperature, humidity and co-channel interference.
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground.
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea.
- The signal will be affected when the antenna is near metal object or put in a metal case.
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance).
- The power supply low voltage under room temperature is lower than 2.5V, the lower the voltage, the lower the transmitting power.
- Due to antenna quality or poor matching between antenna and module.

11.2 Module is easy to damage

- Please check the power supply source, ensure it is 2.0V~3.6V, voltage higher than 3.6V will damage the module.
- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure antistatic measure are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range, some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

12.Important Notes

- All rights to interpret and modify this manual belong to Ebyte.
- This manual will be updated based on the upgrade of firmware and hardware, please refer to the latest version.
- Please refer to our website for new product information

13.About Us

Technical support: support@cdebyte.com

Documents and RF Setting download link: www.cdebyte.com/en/

成都亿佰特电子科技有限公司
Chengdu Ebyte Electronic Technology Co.,Ltd.

Tel：+86-28-61399028

Fax：028-64146160

Web：www.cdebyte.com/en/

Address：Innovation Center D347, 4# XI-XIN Road,Chengdu, Sichuan, China