



E70-915T14S User Manuel

CC1310 915MHz SMD Wireless Module



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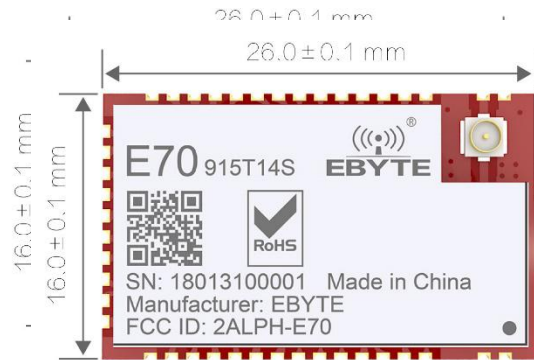
1.Overview

1.1 Introduction

E70-915T14S wireless transceiver modules, operating at 907~922.5MHz (Default: 915MHz), is based on originally imported CC1310 from TI, with TTL level output, 3.3V IO port voltage, 24MHz industrial high-precision low-temperature drift crystal vibration; Ensure its industrial ability and stability.

The module features FEC (Forward Error Correction) algorithm, which ensure its 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. But without FEC, those data packets can only be dropped.

Factory has built-in low power multifunctional wireless serial program, users can also according to the need for secondary development.



1.2 Features

- Communication distance tested is up to 1.5km
- Maximum transmission power of 25mW, software multi-level adjustable;
- Support the global license-free ISM 915MHz band;
- Support air data rate of 2.5kbps~168kbps;
- Low power consumption for battery supplied applications;
- Can achieve up to 115200bps continuous frame unlimited-packet length transmission
- Support 2.2V~3.8V power supply, power supply over 3.3V can guarantee the best performance;
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time;
- IPEX access point, stamp hole is optional, facilitate user secondary development, facilitate integration.

1.3 Application

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

2. Specification and parameter

2.1 Limit parameter

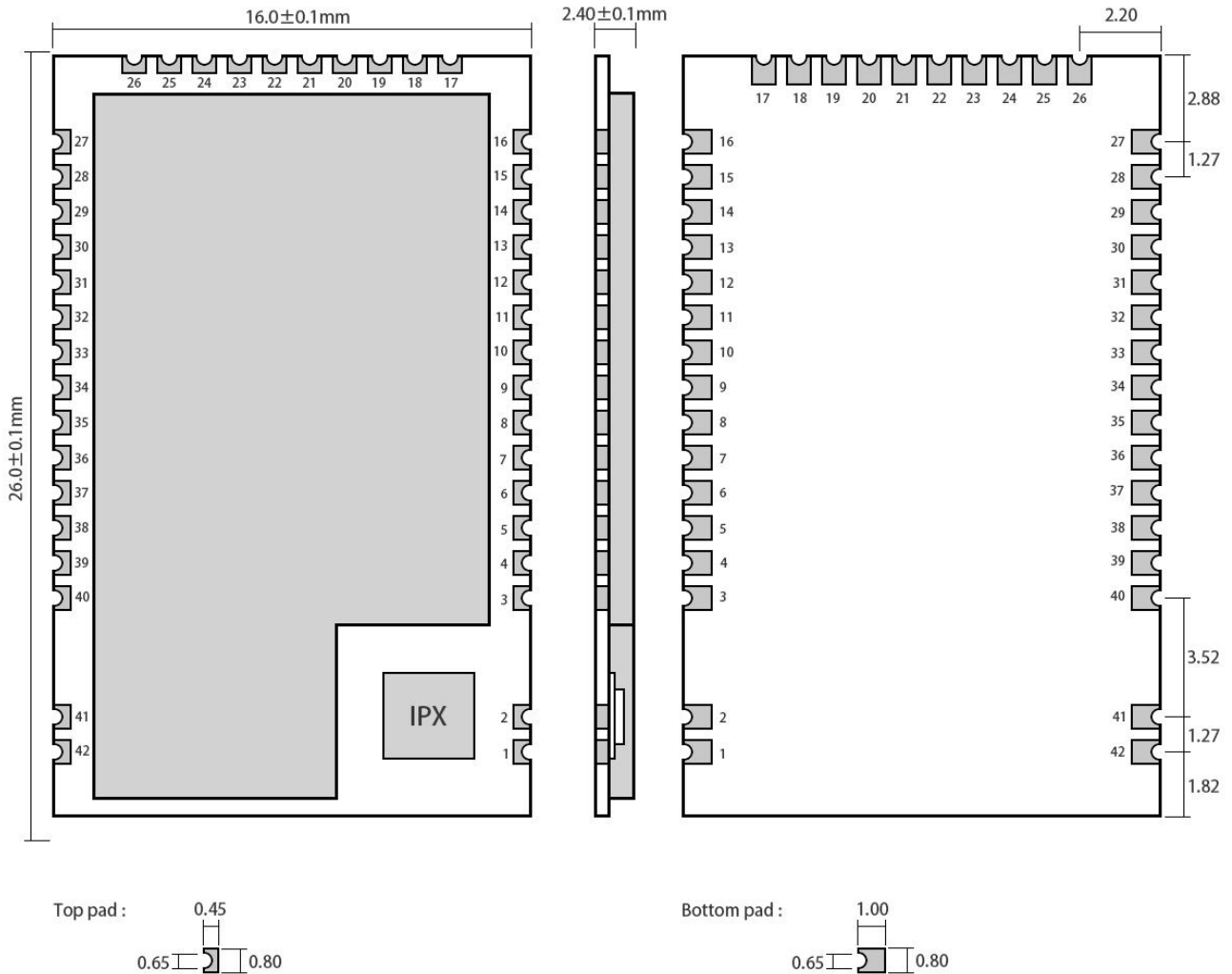
Main parameter	Performance		Remarks
	Min.	Max.	
Power supply (V)	0	3.8	Voltage over 3.8V will cause permanent damage to module
Blocking power (dBm)	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature (°C)	-40	85	-

2.2 Operating parameter

Main parameter		Performance			Remark
		Min	Typ.	Max.	
Operating voltage (V)		2.2	3.3	3.8	≥3.3 V ensures output power
Communication level (V)		-	3.3	-	For 5V TTL, it may be at risk of burning down
Operating temperature (°C)		-40	-	85	Industrial design
Operating frequency (MHz)		907	-	922.5	Support ISM band
Power consumption	Transmitting current [mA]	-	27	-	Instant power consumption
	Receiving current [mA]	-	8	-	-
	Turn-off current [μA]	-	1	-	Software is shut down
Max Tx power (dBm)		13.6	14.0	15.3	-
Receiving sensitivity (dBm)		-109	-110	-111	Air data rate is 5kbps
Air data rate (bps)		2.5k	2.5k	168k	Controlled via user's programming

Main parameter	Description	Remark
Distance for reference	1500m	Test condition: clear and open area, antenna gain: 5dBi, antenna height: 2.5m, air data rate: 2.5kbps
TX length	Transmission mode specification	See transmission mode for details
Buffer	2048Byte	-
Modulation	GFSK	-
Communication interface	UART	-
Package	SMD	-
Connector	1.27mm	-
Size	16*26mm	-
Antenna	IPX/Stamp hole	50 ohm impedance

3. Dimension/Pin definition



Pad quantity : 42
Unit: mm

No.	Pin item	Pin direction	Application
1	GND	Ground	Ground electrode
2	ANT		Antenna (50Ω characteristic impedance)
3	NC	Reserved pin	Reserved, to be floated
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

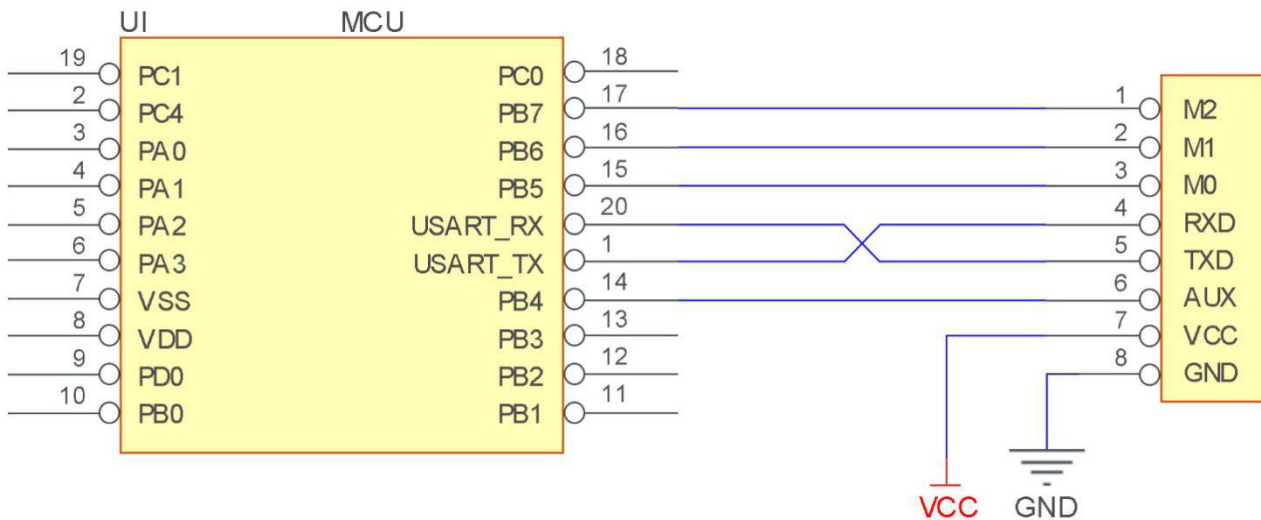
11	NC	Reserved pin	Reserved, to be floated
12	NC	Reserved pin	Reserved, to be floated
13	NC	Reserved pin	Reserved, to be floated
14	NC	Reserved pin	Reserved, to be floated
15	M2	Input	M2, M1, M0 jointly decide the 8 working modes; An external 1k protective resistor shall be connected in series when in 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		voltage: 2.1V ~ 3.8V DC
27	GND	Ground	Ground electrode
28	NC	Reserved pin	Reserved, to be floated
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

- This product can achieve Pin compatibility, Pin to Pin replacement
- The single-chip microcomputer control PA LNA truth value table is as follows:

	PA_EN	LNA_EN
Transmitting	1	0
Receiving	0	1
Sleeping	0	0

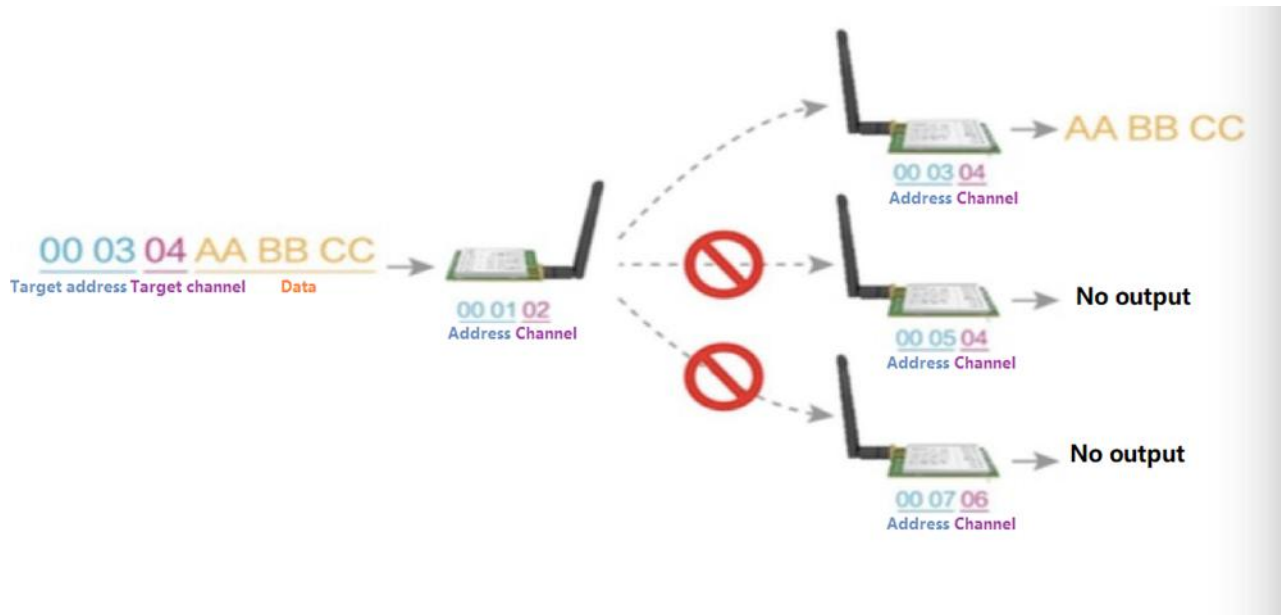
4 Connect to MCU



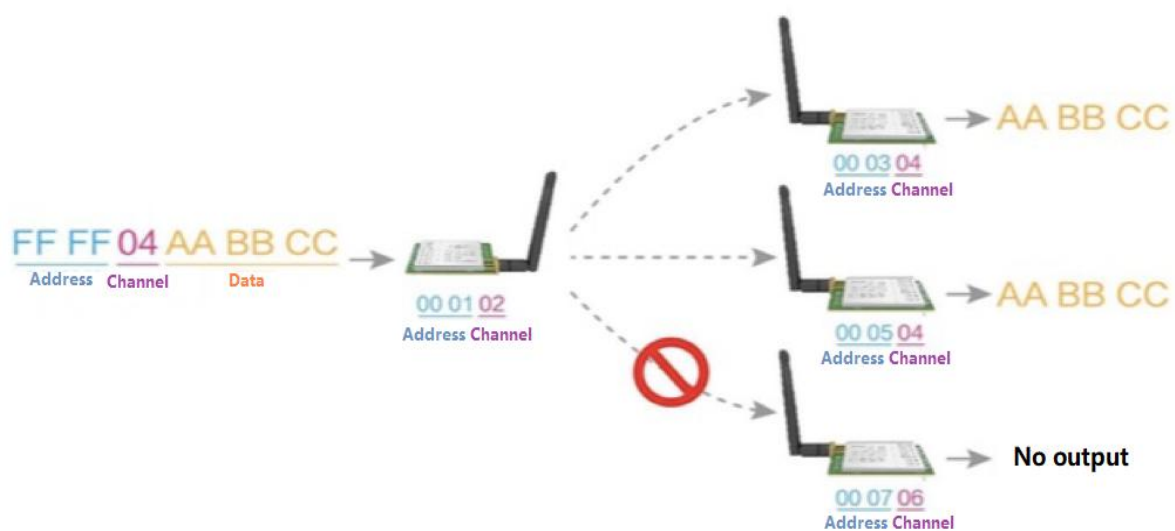
No.	Description (STM8L MCU)
1	The UART module is TTL level., please collect with MCU.
2	For some MCU works at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin.

5 Function description

5.1 Fixed transmission



5.2 Broadcasting transmission



5.3 Broadcasting address

- For example: Set the address of module A as 0xFFFF or 0x0000, and the channel as 0x04;
- When module 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

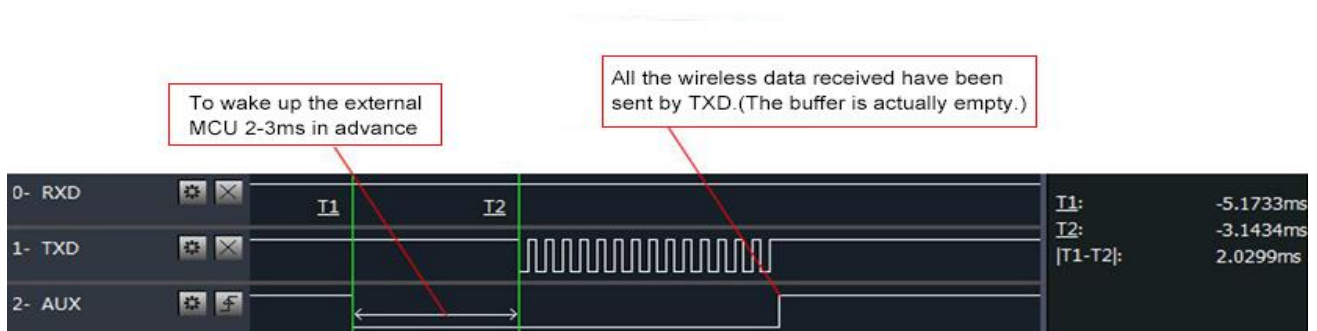
- When the module is powered, AUX outputs low level immediately, conducts hardware self-check and sets the operating mode based on user's parameters. During the process, the AUX remains low level. After the process completed, the AUX outputs high level and starts to work as per the operating mode combined by M1 and M0. Therefore, users need to wait the AUX rising edge as the start of module's normal work.

5.6 AUX description

- AUX Pin can be used as indication for wireless send & receive buffer and self-check.
- It can indicate whether there are data that are not sent yet via wireless way, or whether all wireless data has been sent through UART, or whether the module is still in the process of self-check initialization.

5.6.1 Indication of UART output

- To wake up external MCU

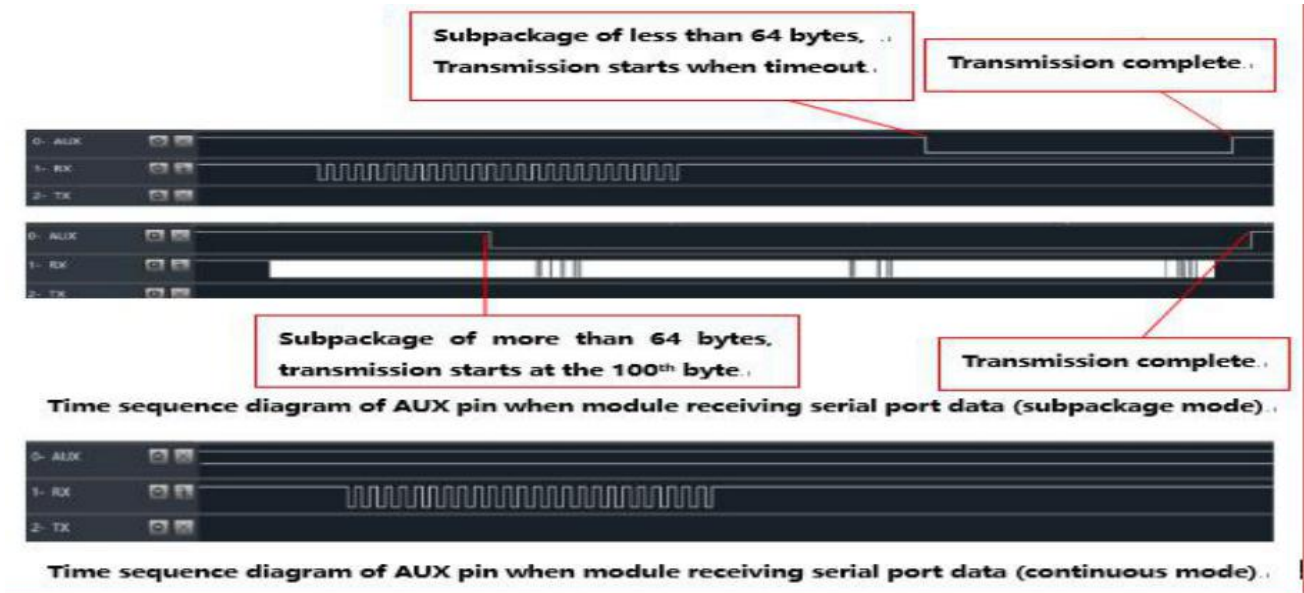


Timing Sequence Diagram of AUX when TXD pin transmits

5.6.2 Indication of wireless transmitting

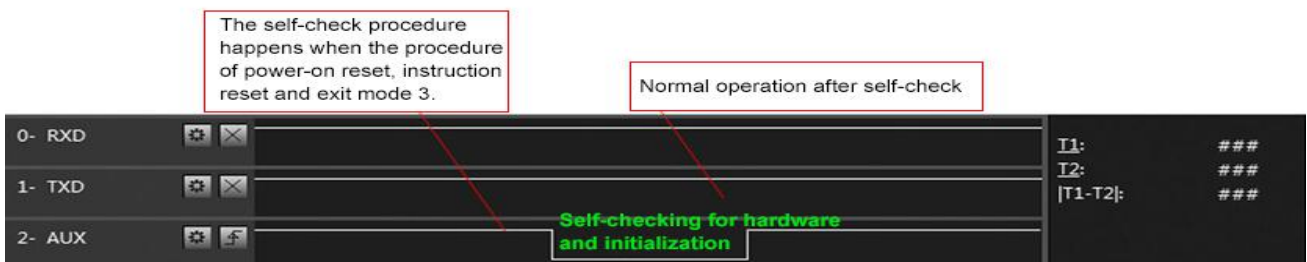
- Buffer (empty): the internal 1024 bytes data in the buffer are written to the RFIC (Auto sub-packaging).

- When AUX=1, the user can input data less than 1024 bytes continuously without overflow. Buffer (not empty): when AUX=0, the internal 1024 bytes data in the buffer have not been written to the RFIC completely. If the user starts to transmit data at this circumstance, it may cause overtime when the module is waiting for the user data, or transmitting wireless sub package.
- When AUX = 1, it does not mean that all the UART data of the module have been transmitted already, perhaps the last packet of data is still in transmission.



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 sub-package 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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

Default parameter values: C0 00 00 18 44 1C							
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E70-915T14S	915MHz	0x0000	0x10	2.5K	9600	8N1	25mW

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	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 00H-FFH 																																																																																								
2	ADDL	Low address byte of module (the default 00H)	<ul style="list-style-type: none"> 00H-FFH 																																																																																								
3	SPED	<table> <tr> <td>7</td><td>6</td><td colspan="2">UART parity bit</td></tr> <tr> <td>0</td><td>0</td><td colspan="2">8N1 (Default)</td></tr> <tr> <td>0</td><td>1</td><td colspan="2">8O1</td></tr> <tr> <td>1</td><td>0</td><td colspan="2">8E1</td></tr> <tr> <td>1</td><td>1</td><td colspan="2">8N1 (equal to 00)</td></tr> <tr> <td>5</td><td>4</td><td>3</td><td>TTL UART baud rate (bps)</td></tr> <tr> <td>0</td><td>0</td><td>0</td><td>1200bps</td></tr> <tr> <td>0</td><td>0</td><td>1</td><td>2400bps</td></tr> <tr> <td>0</td><td>1</td><td>0</td><td>4800bps</td></tr> <tr> <td>0</td><td>1</td><td>1</td><td>9600bps (Default)</td></tr> <tr> <td>1</td><td>0</td><td>0</td><td>19200bps</td></tr> <tr> <td>1</td><td>0</td><td>1</td><td>38400bps</td></tr> <tr> <td>1</td><td>1</td><td>0</td><td>57600bps</td></tr> <tr> <td>1</td><td>1</td><td>1</td><td>115200bps</td></tr> <tr> <td>2</td><td>1</td><td>0</td><td>Air data rate (bps)</td></tr> <tr> <td>0</td><td>0</td><td>0</td><td>2.5kbps</td></tr> <tr> <td>0</td><td>0</td><td>1</td><td>5kbps</td></tr> <tr> <td>0</td><td>1</td><td>0</td><td>12kbps (Default)</td></tr> <tr> <td>0</td><td>1</td><td>1</td><td>28kbps</td></tr> <tr> <td>1</td><td>0</td><td>0</td><td>64kbps</td></tr> <tr> <td>1</td><td>0</td><td>1</td><td>168kbps</td></tr> <tr> <td>1</td><td>1</td><td>0</td><td>168kbps</td></tr> </table>	7	6	UART parity bit		0	0	8N1 (Default)		0	1	8O1		1	0	8E1		1	1	8N1 (equal to 00)		5	4	3	TTL UART baud rate (bps)	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	0	0	1	5kbps	0	1	0	12kbps (Default)	0	1	1	28kbps	1	0	0	64kbps	1	0	1	168kbps	1	1	0	168kbps	<ul style="list-style-type: none"> UART mode can be different between communication parties 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. The lower the air data rate, the longer the transmitting distance, better anti-interference performance and longer transmitting time The air data rate must keep the same for both communication parties.
7	6	UART parity bit																																																																																									
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		1	1	1	168kbps		
4	CHAN	7	6	5	Packet length (only for subpackage mode)	<ul style="list-style-type: none">Under continuous transmitting mode (M0=1 M1=0 M2=0), 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	256 bytes		
		1	0	1	512 bytes		
		1	1	0	1024 bytes		
		1	1	1	2048 bytes		
		Communication Channel					
	00H~1FH,907~922.5MHz, (Default) 10H (4915M)						
	5	OPTION	7	Fixed transmission (similar to MODBUS)			<ul style="list-style-type: none">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.It is transparent transmission under continuous mode.
0			Transparent transmission mode (Default)				
1			Fixed transmission mode				
6			5	4	wireless wake-up time	<ul style="list-style-type: none">This parameter is only valid for mode 4, 6.For mode 6, the wake-up time will affect the WOR cycle of the module, and affect the power consumption.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.Generally, mode 4 and 6 shall be used jointly and the wake-up time on both modules shall 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			<ul style="list-style-type: none">After turn off FEC, the actual data transmission rate increases while anti-interference ability decreases. Also, the transmission distance is relatively short.Both communication parties must keep on the same pages about turn-on or turn-off FEC.	
0			Turn off FEC				
1			Turn on FEC (Default))				
2			IO drive mode				<ul style="list-style-type: none">This bit is used to the internal pull-up

		0	TXD and AUX push-pull outputs, RXD pull-up inputs			<p>resistor. It also increases the level's adaptability in case of open drain. But in some cases, it may need external pull-up resistor.</p> <ul style="list-style-type: none">● The external power must ensure that the ability of current output is more than 80mA and the power supply ripple is within 100mV.● Low power transmission is not recommended due to its low power supply efficiency.				
		1	TXD、AUX open-collector outputs, RXD open-collector inputs							
		1	0	transmission power (approximation)						
		0	0	14dBm (Default)						
		0	1	10dBm						
		1	0	7dBm						
		1	1	4dBm						
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					

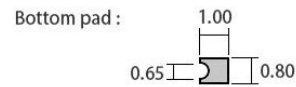
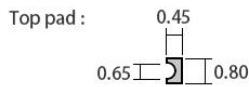
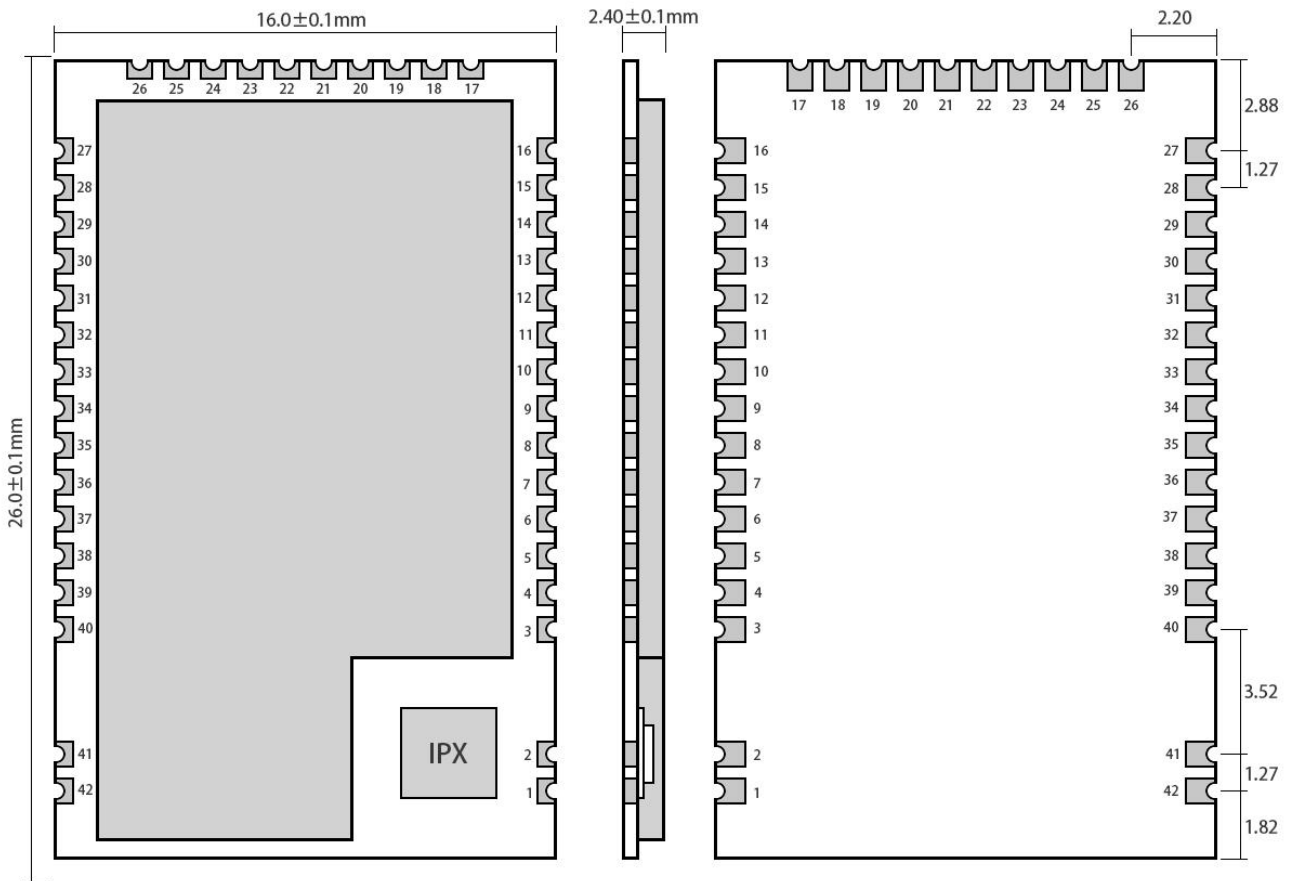
8.Parameter Setting

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.

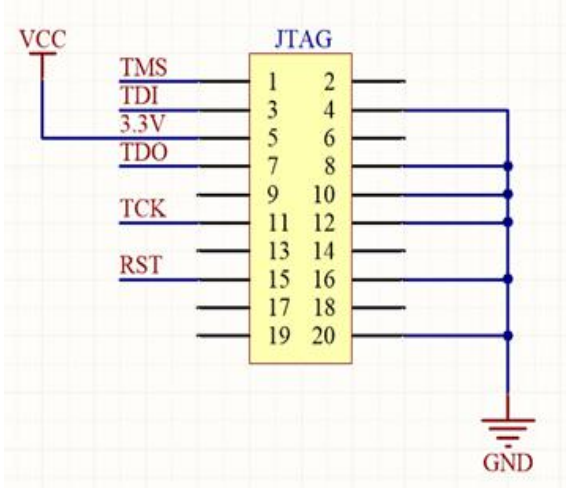


Pad quantity : 42
Unit: mm

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

9.1 Download Program

Key word	Notes
Input program	<p>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)</p>  <p>The diagram shows a 20-pin JTAG connector. The connections are as follows:</p> <ul style="list-style-type: none"> Pin 1: TMS Pin 2: (unconnected) Pin 3: TDI Pin 4: (unconnected) Pin 5: 3.3V Pin 6: TDO Pin 7: (unconnected) Pin 8: (unconnected) Pin 9: TCK Pin 10: (unconnected) Pin 11: (unconnected) Pin 12: (unconnected) Pin 13: RST Pin 14: (unconnected) Pin 15: (unconnected) Pin 16: (unconnected) Pin 17: (unconnected) Pin 18: (unconnected) Pin 19: (unconnected) Pin 20: (unconnected) <p>VCC is connected to pins 5 and 19. GND is connected to pins 4, 8, 12, 16, and 20.</p>

Connection diagram of JTAG downloader

10. Hardware design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible, and the module needs to be reliably grounded.;
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure it is within the recommended voltage otherwise when it exceeds the maximum value the module will be permanently damaged;
- Please check the stability of the power supply, the voltage can not be fluctuated frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so the whole machine is beneficial for long-term stable operation.;
- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and other parts with large electromagnetic interference.;
- High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;
- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees;
- It is assumed that there are devices with large electromagnetic interference around the module that will greatly

affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;

- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done.
- If the communication line uses a 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);
- Try to stay away from some physical layers such as TTL protocol at 2.4GHz, for example: USB3.0;
- The mounting structure of antenna has a great influence on the performance of the module. It is necessary to ensure that the antenna is exposed, preferably vertically upward. When the module is mounted inside the case, use a good antenna extension cable to extend the antenna to the outside;
- The antenna must not be installed inside the metal case, which will cause the transmission distance to be greatly weakened.

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.

11.3 BER(Bit Error Rate) is high

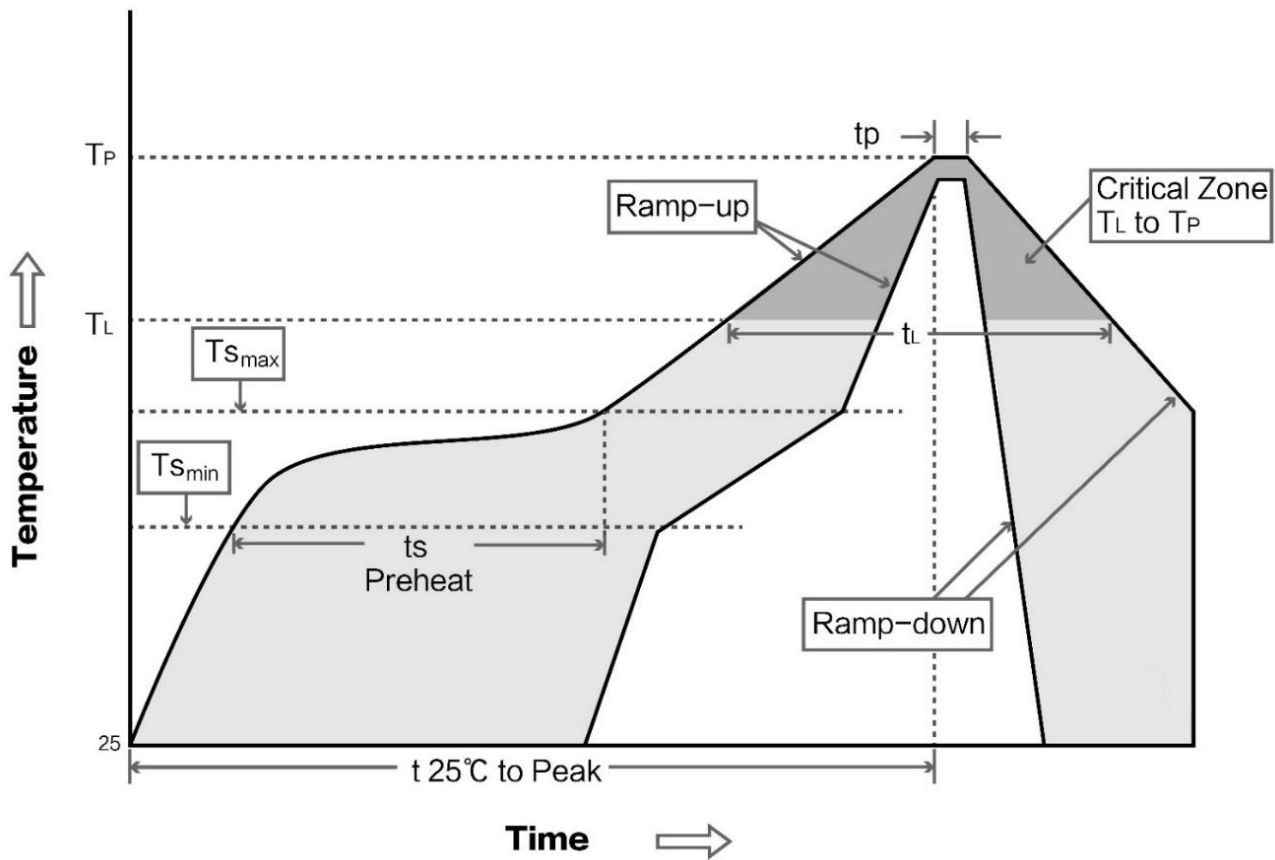
- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- Poor power supply may cause messy code. Make sure that the power supply is reliable.
- The extension line and feeder quality are poor or too long, so the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

12.Production guidance

12.1 Reflow soldering temperature

Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (T _{min})	100°C	150°C
Preheat temperature max (T _{max})	150°C	200°C
Preheat Time (T _{min} to T _{max})(ts)	60-120 sec	60-120 sec
Average ramp-up rate(T _{max} to T _p)	3°C/second max	3°C/second max
Liquidous Temperature (TL)	183°C	217°C
Time (tL) Maintained Above (TL)	60-90 sec	30-90 sec
Peak temperature (T _p)	220-235°C	230-250°C
Average ramp-down rate (T _p to T _{max})	6°C/second max	6°C/second max
Time 25°C to peak temperature	6 minutes max	8 minutes max

12.2 Reflow soldering curve



13 E70 Series

Model No.	Core IC	Frequency Hz	Tx power dBm	Distance km	Data Rate	Package	Size mm	Interface
E70-433NW30S	-	433M	30	6.5	2.5k~168k	DIP	24 * 38.5	IPEX/Stamp hole
E70-433NW14S	-	433M	14	2.5	2.5k~168k	DIP	16 * 26	IPEX/Stamp hole
E70-915T14S2	CC1310	915M	14	1.5	2.5k~168k	DIP	14 * 20	IPEX/Stamp hole
E70-433T14S2	CC1310	433M	14	1.5	2.5k~168k	DIP	14 * 20	IPEX/Stamp hole
E70-915T14S	CC1310	915M	14	1.5	2.5k~168k	DIP	16 * 26	IPEX/Stamp hole
E70-868T14S	CC1310	868M	14	1.5	2.5k~168k	DIP	16 * 26	IPEX/Stamp hole
E70-915T30S	CC1310	915M	30	6	2.5k~168k	DIP	24 * 38.5	IPEX/Stamp hole
E70-868T30S	CC1310	868M	30	6	2.5k~168k	DIP	24 * 38.5	IPEX/Stamp hole
E70-433T30S	CC1310	433M	30	6	2.5k~168k	DIP	24 * 38.5	IPEX/Stamp hole
E70-433T14S	CC1310	433M	14	1.5	2.5k~168k	DIP	16 * 26	IPEX/Stamp hole
E70-868T14S2	CC1310	868M	14	1.5	2.5k~168k	DIP	14 * 20	IPEX/Stamp hole

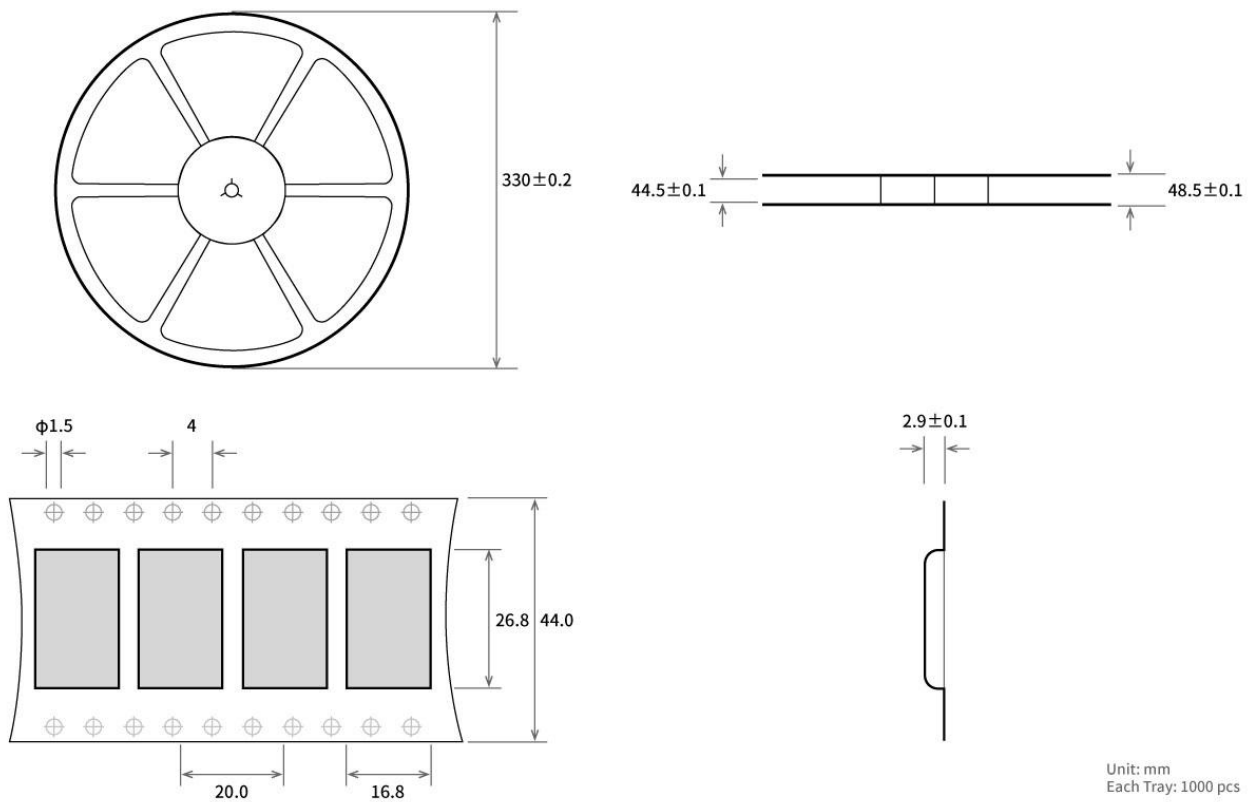
14. Antenna Guidance

14.1 Antenna recommendation

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

Model No.	Type	Frequency Hz	Interface	Gain dBi	Height	Cable	Function feature
TX915-XP-100	Sucker Antenna	915M	SMA-J	3.5	25cm	100cm	Sucker antenna, High gain
TX915-JK-20	Rubber antenna	915M	SMA-J	3	210mm	-	Flexible & omnidirectional
TX915-JK-11	Rubber antenna	915M	SMA-J	2.5	110mm	-	Flexible & omnidirectional
TX915-JZ-5	Rubber antenna	915M	SMA-J	2	50mm	-	Short straight & omnidirectional

15. Package for batch order



Revision history

version	Date	Description	Issued by
1.00	2018-01-08	Initial version	huaa
1.10	2018-04-16	Content updating	huaa
1.20	2018-05-24	Content updating	Huaa
1.21	2018-07-20	Name change	Huaa
1.30	2018-10-29	Module separating	Huaa
1.4	2019-12-06		Ren

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