E43-900T13S3 User Manual

900MHz Small SMD Wireless Module



成都亿佰特电子科技有限公司

Chengdu Ebyte Electronic Technology Co.,Ltd.

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1. Overview

1.1 Introduction



E43-900T13S3 is an ultra-high performance-to-price wireless data transmission module launched by Ebyte. It has four working modes and two transmission modes. Each transmission mode has its own characteristics and can be applied to various application scenarios. E43-900T13S3 can perfectly support industrial applications, and the factory has been strictly tested to ensure its industrial reliability.

E43-900T13S3 supports the maximum 13dBm transmission power. Users can set lower output power to save power. The module works in 900MHz band, TTL level output, compatible with 3.3V IO port voltage.

The module has the functions of data encryption and compression. Modules transmit data in the air, which is random. Through strict encryption and decryption algorithm, data interception is meaningless. The data compression function has the probability to reduce the transmission time, reduce the probability of interference, improve reliability and transmission efficiency. And it is a low-cost wireless serial transceiver module.

1.2 Features

- Ultra-small size, only 16x26mm；
- Cost-effective solution for high-volume, cost-critical applications;
- Under ideal conditions, the measured communication distance can reach 1500m;
- Maximum transmission power is 20mW, software multi-stage adjustable;
- Support for the global license-free ISM 900MHz band;
- Supports data transfer rates of 1.2k, 4.8k, and 9.6kbps;
- Support fixed-point transmission, broadcast transmission, channel monitoring;
- Support 2.3 ~ 5.5V power supply, greater than 3.3V power supply can guarantee the best performance;
- Industrial grade standard design, support long-term use from -40 to +85 ° C;
- Support stamp hole and IPEX interface, users can choose to use according to their needs

1.3 Application

- Wearable device；
- Smart homes, industrial sensors, etc;
- Security system、 positioning system;
- Wireless remote control, drone;
- Wireless game remote control;

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- Health care products;
- Wireless voice, wireless headset;
- Automotive industry applications.

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2. Specification and parameter

2.1 limit parameter

Main parameter	Performance		Remark
	Min	Max	
Power supply （V）	0	5.5	Voltage over 5.5V will cause permanent damage to module
Blocking power（dBm）	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature（℃）	-40	+85	Industrial grade

2.2 Operating parameter

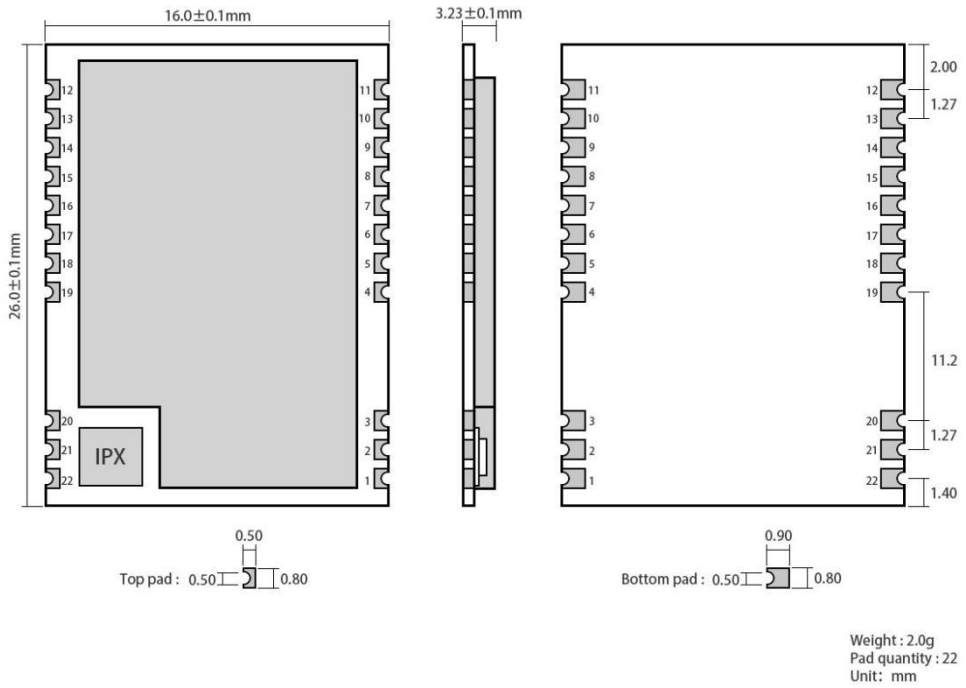
Main parameter		Performance			Remark
		Min	Type	Max	
Operating voltage（V）		2.3	5.0	5.5	≥3.3 V ensures output power
Communication level （V）			3.3		For 5V TTL, it may be at risk of burning down
Operating temperature（℃）		-40	-	+85	Industrial grade
Operating frequency（GHz）		855	900	931.5	Support ISM band
Power Consum-ption	TX current （mA）		33.092		Instant power consumption
	RX current （mA）		12.7634		
	Sleep current （μA）		1.9962		Shut down by software
Max TX power（dBm）		12.0	13.0	14.0	
Receiving sensitivity（dBm）		-125	-126	-127	Air data rate is 2.4kbps
Air data rate（bps）		1.2k	2.4k	9.6k	User programming to control

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Main parameter	Description	Remark
Reference distance	1500m	Test condition：clear and open area, antenna gain: 5dBi，antenna height：2.5m air data rate:1.2kbps
Subcontracting method	40Btye	Maximum capacity of single package , Automatic subcontracting after exceeding.
Cache capacity	80Btye	
Modulation	GFSK	
Communication interface	UART	TTL level
Package	SMD	
Connector	1.27mm	
Size	16*26mm	
Antenna	IPEX/Stamps	50 ohm impedance

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3. Size and pin definition

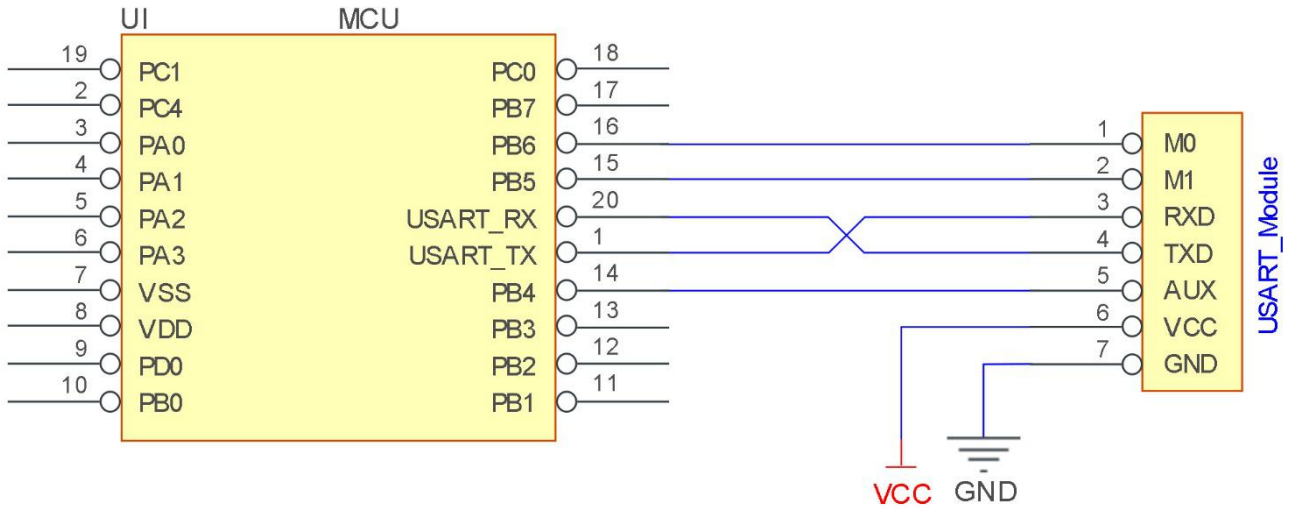


No.	Name	Direction	Function
1	GND		Ground wire
2	GND		Ground wire
3	GND		Ground wire
4	GND		Ground wire
5	M0	Input（weak pull-up）	Work with M1 & decide the four operating modes. Floating is not allowed, can be ground.
6	M1	Input（weak pull-up）	Work with M0 & decide the four operating modes. Floating is not allowed, can be ground.
7	RXD	Input	TTL UART inputs, connects to external TXD output pin. Can be configured as open-drain or pull-up input. See details in parameters setting.
8	TXD	Output	TTL UART outputs, connects to external RXD input pin. Can be configured as open-drain or push-pull output. See details in parameters setting.
9	AUX	Output	To indicate module's working status & wakes up the external MCU. During the procedure of self-check initialization, the pin outputs low level. Can be configured as open-drain output or push-pull output (floating is allowed).
10	VCC		Power supply reference: 2.3V~5.5V DC
11	GND		Ground wire
12	NC		
13	GND		Ground wire
14	NC		
15	NC		
16	NC		

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17	NC		
18	NC		
19	GND		Ground wire
20	GND		Ground wire
21	ANT		Antenna
22	GND		Ground wire

4. Recommended wiring diagram



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

5. Functional Details

5.1 Module Reset

- 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 M1 and M0. Therefore, the user needs to wait the AUX rising edge as the starting point of module's normal work..

5.2 AUX description

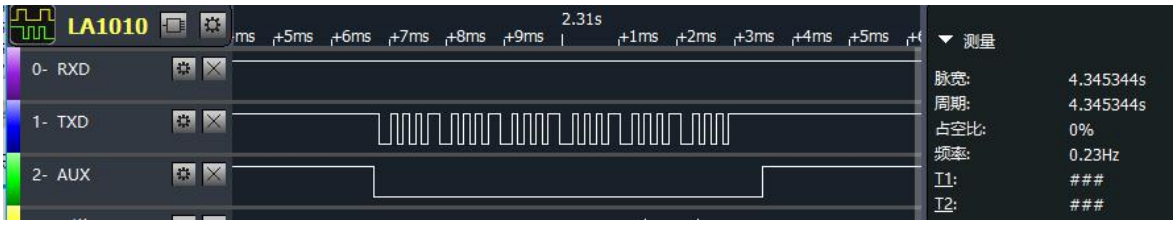
- AUX Pin can be used as indication for wireless send & receive buffer and self-check.

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- It can indicate whether there are data that are yet to send 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.

5.2.1 Indication of wireless reception

- After the module receives valid wireless data, it will immediately pull down AUX and start the serial port output data. After the data output is completed, AUX is pulled. high.

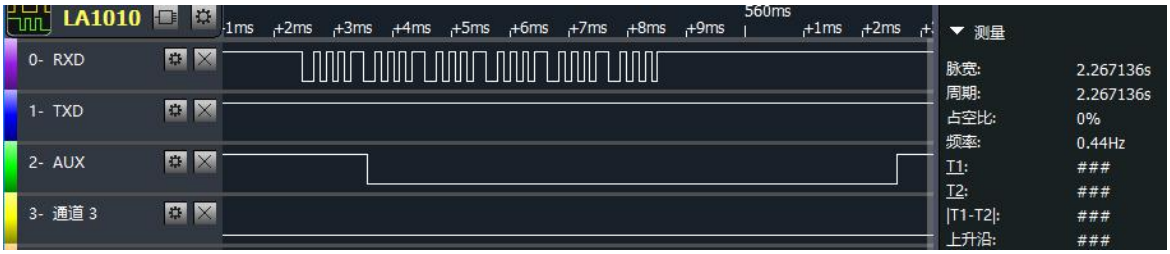


5.2.2 Indication of wireless transmitting

Buffer (empty): the internal 80 bytes data in the buffer are written to the RFIC (Auto subpackage). When AUX=1, the user can input data less than 80 bytes continuously without overflow.

Buffer (not empty): when AUX=0, the internal 80 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 subpackage.

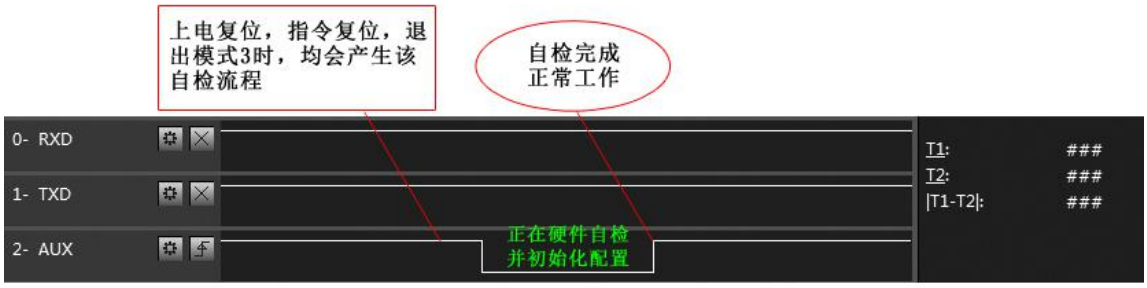
- Notes: When AUX = 1, it does not mean that all the UART data of the module have been transmitted already, perhaps the last packet of data is still in transmission.



5.2.3 Configuration procedure of module

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

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自检期间，AUX引脚时序图

5.3.4 Notes for AUX

- For function 1 & function 2 mentioned above, the priority should be given to the one with low level output, which means if it meets each of any low level output condition, AUX outputs low level, if none of the low level condition is met, AUX outputs high level.
- When AUX outputs low level, it means the module is busy & cannot conduct operating mode checking. Within 1ms since AUX outputs high level, the mode switch will be completed.
- When the user switches to other operating modes from mode 3 (sleep mode) or it's still in reset process, the module will reset user parameters, during which AUX outputs low level.

6. Operating mode

The module has 4 operation mode, which decided by the status of M1 & M0. Below are the details:

Mode (0-3)	M1	M0	Description	Remark
Mode 0 Transmission Mode	0	0	UART and wireless channel are open,， The module performs data transmission and reception according to the set transmission mode.	The transmission mode of both senders and receivers must be the same.
Mode 1 RSSI Mode	0	1	UART is open, the module will output the RSSI signal strength value at 100ms timing.	Relative strength only
Mode 2 Configuration Mode	1	0	The module can receive serial instructions, check instruction list for details, fixed baud rate 9600, 8N1	Parameter configuration
Mode 3 Sleep Mode	1	1	The module enters sleep standby, and both the serial port and wireless are turned off.	

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6.1 Mode switching

- The user can decide the operating mode by the combination of M1 and M0. The two GPIO of MCU can be used to switch mode. After modifying M1 or M0, it will start to work in new mode 1 ms 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 0, 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 the output status of AUX pin and wait 2ms after AUX outputs high level before switching the mode.
- When the module is switched from other mode to sleep mode, if the data has not been processed yet, the module will process the data (including the receive and send) before entering the sleep mode. This feature can be used for fast dormancy to save power. For example, the transmitting module works in mode 0, the user initiates the serial port data "12345", and then does not have to wait for the AUX pin to be idle (high level), It can be switched to the sleep mode,and immediately sleeps the users' main MCU. The module will automatically transmit the user data through the wireless, and automatically enters sleep mode within 1ms; thus saving the working time of the MCU and reducing power consumption.
- Similarly, any mode switch can use this feature. After the module processes the current mode event, it will automatically enter the new mode within 1ms. Thereby eliminating the user's work of querying AUX, and achieving the purpose of fast switching. For example, switching from the transmit mode to the receive mode; the user MCU can also enter sleep before the mode switch, and use the external interrupt function to acquire the AUX change, thereby performing mode switching.
- This operation is very flexible and efficient, and is designed according to the user's MCU's operation convenience, and can reduce the workload of the entire system as much as possible, improve system efficiency, and reduce power consumption.

6.2 Transmission Mode (Mode)

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Type	When M1 = 0 & M0 = 0, module works in mode 0
Transmitting	The module can receive the user data via serial port, and transmit wireless data package of 40 bytes. When the data inputted by user is up to 40 bytes, the module will start wireless transmission. During which the user can input data continuously for transmission. When the required transmission bytes are less than 40 bytes, the module will wait 3-byte time and treat it as data termination unless continuous data inputted by user. Then the module will transmit all the data through wireless channel. When the module receives the first data packet from user, the AUX outputs low level. After all the data are transmitted into RF chip and transmission is started, AUX outputs high level. At this time, it means that the last wireless data package transmission is started, users can continue to enter data up to 80 bytes. The data package transmitted from the module working in mode 0 can only be received by the module working in mode 0.
Receiving	The wireless receiving function of the module is on, the data packet transmitted from the module working in mode 0 can be received.After receiving the data packet, the AUX outputs low level, the module starts to transmit wireless data through serial port TXD pin. After all the wireless data have been transmitted via serial port, the AUX outputs high level.

6.3 RSSI Mode (Mode 1)

Type	When M1 = 0 & M0 = 1, module works in mode 1.
Transmitting	N/A, the received serial data will be discarded.
Receiving	N/A, only scan the signal strength of the current channel, and output an intensity value (relative value) through the serial port every 100ms： $RSSI_{dBm} = \frac{RSSI_{value}}{2} - 130$

6.4 Configuration Mode (Mode 2)

Type	When M1=1, M0=1, module works in mode 3
N/A	N/A
Receiving	N/A
Configuration	Can be used for module parameter setting, using serial port 9600, setting module working parameters through specific instruction format.
Note	When entering the other mode from the setup mode, the module will reconfigure the parameters. During the configuration process, AUX remains low; After the completion of the output high level, it is recommended that the user detect the AUX rising edge.

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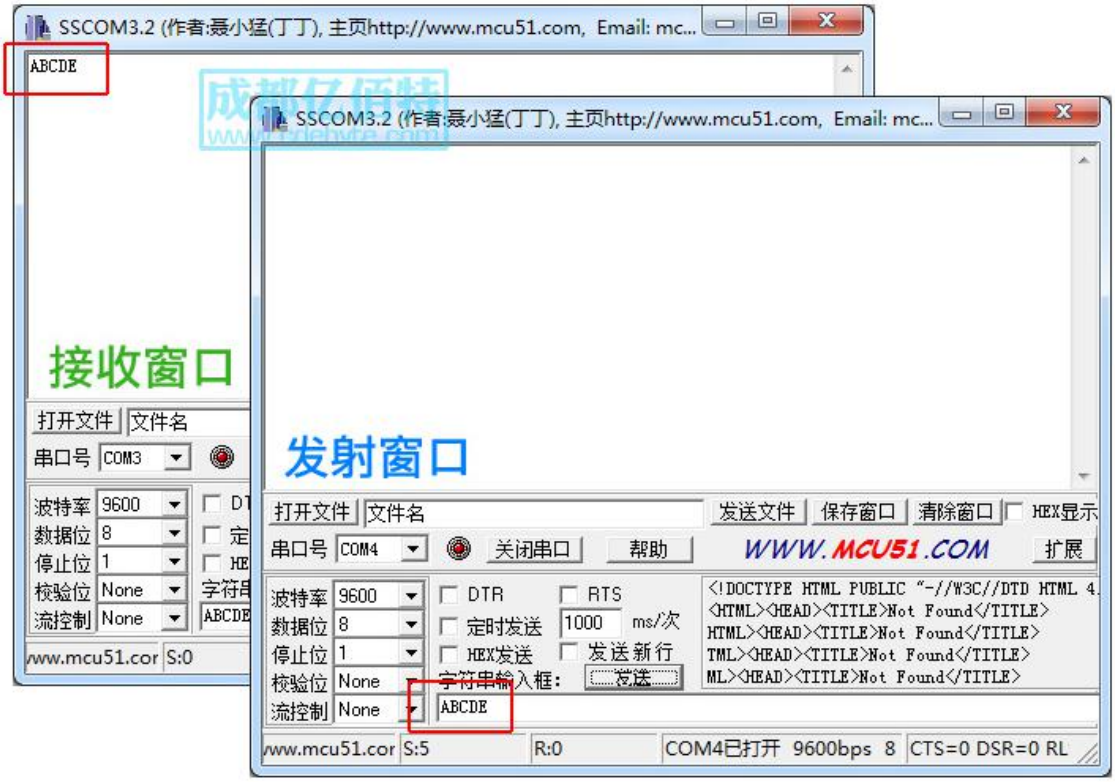
6.5 Sleep mode (Mode 3）

Type	When M1=1, M0=1, module works in mode 3
Transmitting	N/A
Receiving	N/A
Note	All other functions of the module are turned off, and the sleep mode can only be exited by the M1M0 state switch.

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6.6 Quick communication test

Steps	Operation
1	Plug the USB test board (E15-USB-T2) into computer, make sure the driver is installed correctly. Plug mode-select jumper in the USB test board (M1 = 0 , M0 = 0).
2	Choose 5V. (Module supports 2.3～5.5V） 。
3	Operate AccessPort software and select the correct serial port code, observe the send window and the corresponding receive window.



7. Instruction format

In configuration mode（mode 2：M1=1, M0=0）, it supports below instructions on list.

(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 send 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 send in succession.

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3	C2 + working parameters	C2 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be send in succession. (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 must be send in succession.

7.1 Default parameter

	Default parameter values：C0 00 00 18 20 00					
Model	Frequency	Address	Channel	Air data rate	Baud rate	Transmitting Powr
E43-900T13S3	868.8MHz	0x0000	0x2E	1.2kbps	9600	13dBm

7.2 Reading operating parameters

Instruction format	**Description**
C1+C1+C1	In sleep mode（M0=0，M1=1），User gives the module instruction (HEX format): C1 C1 C1, Module returns the present configuration parameters.，For example：C0 00 00 18 2E 00。

7.3 Reading version number

Instruction format	**Description**
C3+C3+C3	In setting mode（M0=0，M1=1），User gives the module instruction (HEX format): C3 C3 C3， Module returns its present version number, for example：C3 43 xx yy； 43 here means the module model (E43 series); xx is the version number and yy refers to the other module features.

7.4 Parameter setting instruction

No.	**Item**	**Description**	**Remark**
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-off C2: Do not save the parameters when power-off.
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	Rate parameters, including serial port rate and air data rate 7, 6: reserved bit, It's recommend to write 0	---------- ● UART baud rate can be different

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		---------- 5，4，3 TTL serial port rate（bps） 000：serial port baud rate is 1200 001：serial port baud rate is 2400 010：serial port baud rate is 4800 011：serial port baud rate is 9600（default） 100：serial port baud rate is 19200 101：serial port baud rate is 38400 110：serial port baud rate is 57600 111：serial port baud rate is 115200 ---------- 2， reserved bit，It’s recommend to write 0 ---------- 1，0 Wireless air data rate（bps） 00：air data rate is 1.2k（default） 01：air data rate is 4.8k 10：air data rate is 9.6k	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 farther the distance, the stronger the anti-interference performance and the longer the transmission time. ● The wireless transmission rate of both sides must be same.
4	CHAN	5，4，3，2，1，0 Communication channel Communication frequency（855MHz+ CHAN * 0.3M） Default 2EH:868.8MHz	● 00H-FFH， ● Correspondnig to 855.0～931.5MHz
5	OPTION	7， Fixed transmission enable bit（similar to MODBUS） 0： Transparent transmission mode（default） 1： Fixed transmission mode ---------- 6，5，4，3，2 reserved bit，It’s recommend to write 0 ---------- 1, 0 transmitting power（Approximate value） 00： 13dBm（default） 01： 10dBm 10： 7dBm 11： 3dBm	● When It’s 1, the first 3 bytes of each user data frame as the channel, high and low addresses. Change its own address and channel when transmitting, and restore the original settings after completion. ---------- ---------- ● The external power supply must provide more than 100mA current output capability. And ensure that the power supply ripple is less than 100mV. ● It is not recommended to use a smaller power transmission, and its power utilization efficiency is not high.

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 (user configures)	0	0	0	1	1	0	0	0
Meaning	reserved bit		UART baud rate is 9600			Air data rate is 1.2k		
Corresponding hexadecimal	1				8			

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8. Configuration on Computer Description

- The following figure is E43-900T13S3 configuration host computer display interface. Users can switch to setting mode through M0 and M1 (M0 = 0, M1 = 1), and quickly configure and read parameters on the computer.

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In the configuration PC, the module address and frequency channel are displayed in decimal mode, and the range of parameters is:

Module Address：0 ～ 65535

Frequency Channel：0 ～ 255

9. Hardware Design

- It is recommended to use DC stabilized power supply to supply power to the module. The power supply ripple coefficient is as small as possible, and the module needs to be reliably grounded.
- Please pay attention to the correct connection of the positive and negative poles of the power supply. If the reverse connection is connected, the module may be permanently damaged.
- Please check the power supply to ensure that between the recommended supply voltage, if exceeding the maximum, the module will be permanently damaged.
- Please check the stability of the power supply, the voltage can not be significantly frequent.
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, and 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 traces, high-frequency analog traces, and power traces 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

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spread on the Top Layer of the module contact part(All copper-covered and well grounded), and must be close to the digital part of the module and routed in the Bottom Layer.

- Assuming the module is soldered or placed in the Top Layer, it is also wrong to randomly route the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees.
- Assuming that there are devices with large electromagnetic interference around the module, the performance of the module will also be greatly affected. According to the intensity of the interference, it is suggested to stay away from the module appropriately. If circumstances permit, appropriate isolation and shielding can be done.
- Assume that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power trace), which 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 and also have a 2.4GHz TTL protocol, for example: USB3.0.
- The antenna mounting structure 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 of the case.
- The antenna must not be installed inside the metal case, which will greatly reduce the transmission distance.

10. FAQ

10.1 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).
- When the power supply at room temperature is lower than the recommended low voltage, the lower the voltage is,

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the lower the transmitting power is.

- Due to antenna quality or poor matching between antenna and module.

10.2 Module is easy to damage

- Please check the power supply and ensure it is within the recommended range. Voltage higher than the peak will lead to a permanent damage to the module.
- Please check the stability of power supply and ensure the voltage not to fluctuate too much.
- Please make sure anti-static measures are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range for some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

10.3 High bit error rate

- There are co-channel signal interference nearby, keep away from interference sources or modify frequency, channel to avoid interference.
- Unsatisfactory power supply may also cause garbled characters, and ensure the reliability of the power supply.
- If the extension cable or feeder is of poor quality or too long, the bit error rate will be high.

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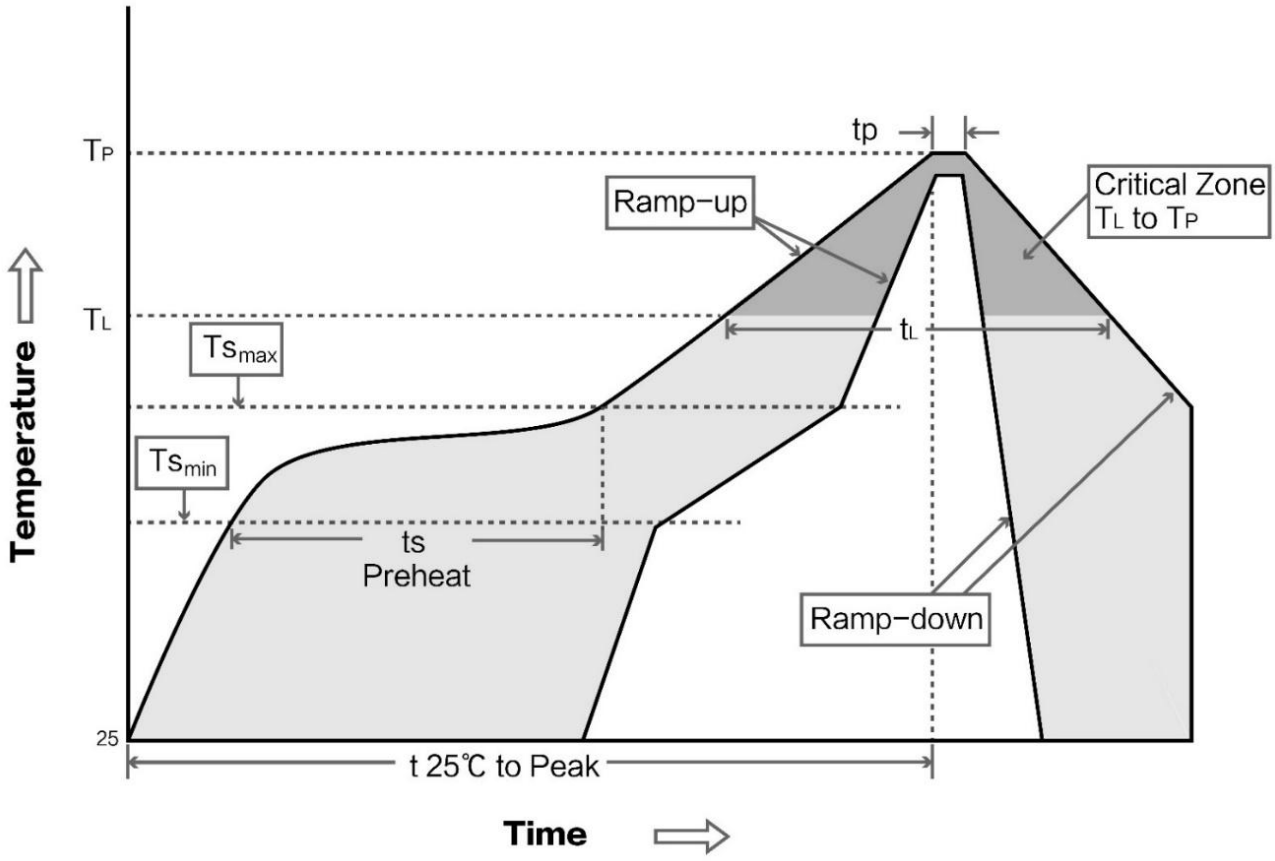
11. Welding operation guidance

11.1 Reflow temperature

Profile Feature	Curve feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	Mini.preheating temperature	100℃	150℃
Preheat temperature max (Tsmax)	Max. preheating temperature	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating temperature	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average Rising Rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temperature	183℃	217℃
Time（tL）Maintained Above（TL）	Time above liquidus	60-90 sec	30-90 sec
Peak temperature（Tp）	Peak Temperature	220-235℃	230-250℃
Aveage ramp-down rate（Tp to Tsmax）	Average Decline Rate	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time from 25℃ to peak temperature	6 minutes max	8 minutes max

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11.2 Reflow Profile



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12. Antenna guide

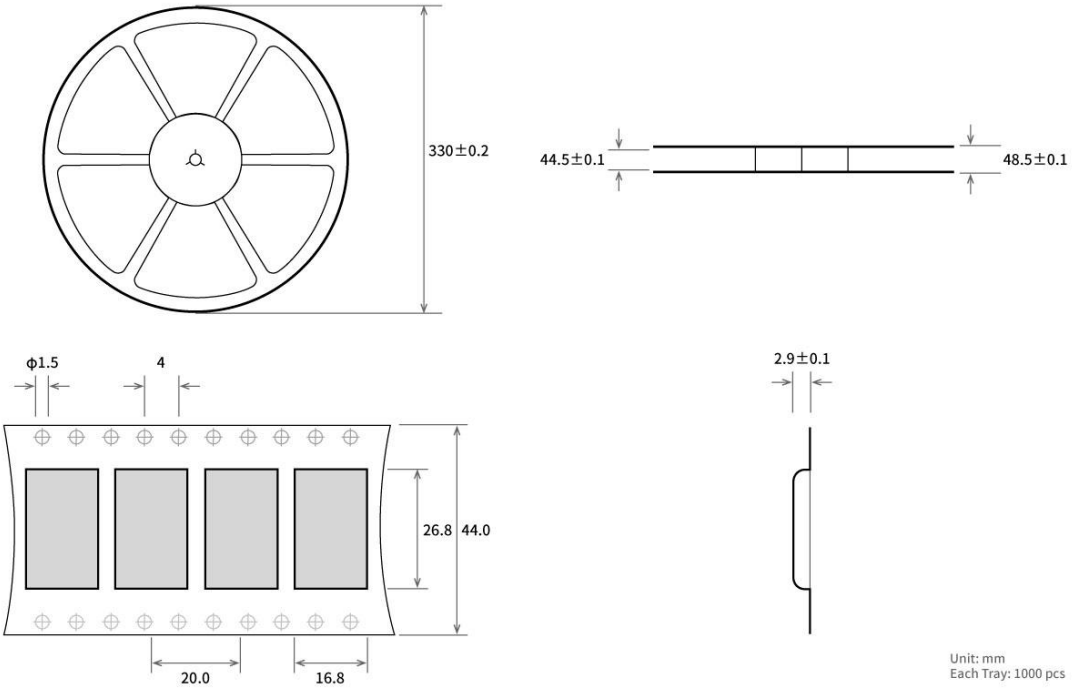
12.1 Antenna recommendation

Antenna is an important role in the communication process. Inferior antennas often have a great impact on the communication system. Therefore, we recommend some antennas as antennas that support our wireless modules and have excellent performance and reasonable price.

Product	Type	Frequency Hz	Interference	Gain dBi	Height	Feeder	Features
TX868-JZ-5	Rubber antenna	868M	SMA-J	2.0	52	-	Ultrashort Straight and Omnidirectional Antenna
TX868-JK-20	Rubber antenna	868M	SMA-J	3.0	210	-	Flexible omnidirectional Antenna
TX868-XPL-100	Sucker antenna	868M	SMA-J	3.5	290	100	Small Sucker antenna,cost-effective
TX915-JZ-5	Rubber antenna	915M	SMA-J	2.0	52	-	Ultrashort Straight and Omnidirectional Antenna
TX915-JK-11	Rubber antenna	915M	SMA-J	2.5	110	-	Flexible omnidirectional Antenna
TX915-JK-20	Rubber antenna	915M	SMA-J	3.0	210	-	Flexible omnidirectional Antenna
TX915-XPL-100	Sucker antenna	915M	SMA-J	3.5	290	100	Small Sucker antenna,cost-effective

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13 Batch packaging



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Revision history

Version	Date	Description	Issued by
1.0	2017-11-17	Original version	huaa
1.2	2018-01-29	Model consolidation	huaa
1.3	2018-10-24	new version update	huaa
1.4	2019-2-22	Bug fix	Ray
1.5	2019-7-25	Format revision	Lyl

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