E330-400T13S User Manual

433/470MHz 20mW wireless module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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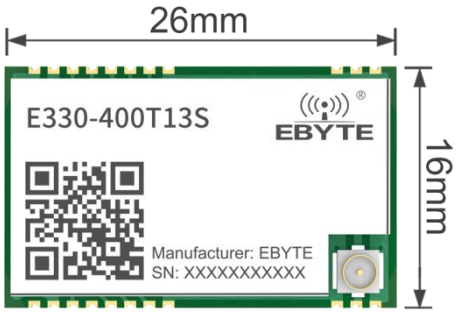
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1. Overview

1.1 Product Introduction



E330-400T13S is a small size, low power consumption, low cost, ultra-high cost-effective serial port module, integrated transceiver, covering 433MHz and 470MHz frequency bands. The module supports transparent transmission and fixed-point transmission mode, supports LDC single-point wake-up, software multi-level airspeed adjustable, and can be applied to a variety of wireless transmission applications. At the same time, the module is simple and easy to use, and you can get started quickly without complicated configuration, so that it can be used immediately.

1.2 Features

- Small size: 16*26mm;
- Low power consumption: LDC ultra-low power consumption receiving mode;
- Support transparent transmission and fixed-point transmission;
- Single-point wake-up: The module can support low-power single-point wake-up to solve the problem of false wake-up at the same frequency and reduce the overall power consumption of the system;
- Support 2~25kbps multi-level transmission rate adjustable;
- Multi-level adjustable output power;
- Support up to 164 physical channels configurable, covering 433MHz and 470MHz frequency bands;

1.3 Application

- Industrial intelligent gateway;
- Industrial sensors;
- Wireless alarm security system;
- Wireless remote control;
- Smart agriculture;
- Sensor to cloud;
- Intelligent light control system;

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2. Specifications

2.1 Limit parameters

main parameters	Minimum	Typical value	Max	Remark
voltage （V）	**3**	**3.3/5**	**5.5**	Over 5.5V may burn the module permanently (Consider wide-voltage power supply when designing)
Working frequency （MHz）	410	433	493	Channel spacing 0.5MHz
Emission current (mA)	-	32mA		433MHz@13dBm
Receive current （mA）		6mA		Regular receipt
Sleep current （uA）		1.6		
Maximum output power （dBm）	12	13	13	
Receiving sensitivity （dBm）	-	-119	-	-2Kbps
Air speed （bps）	2K	2K	25K	Multi-level adjustable

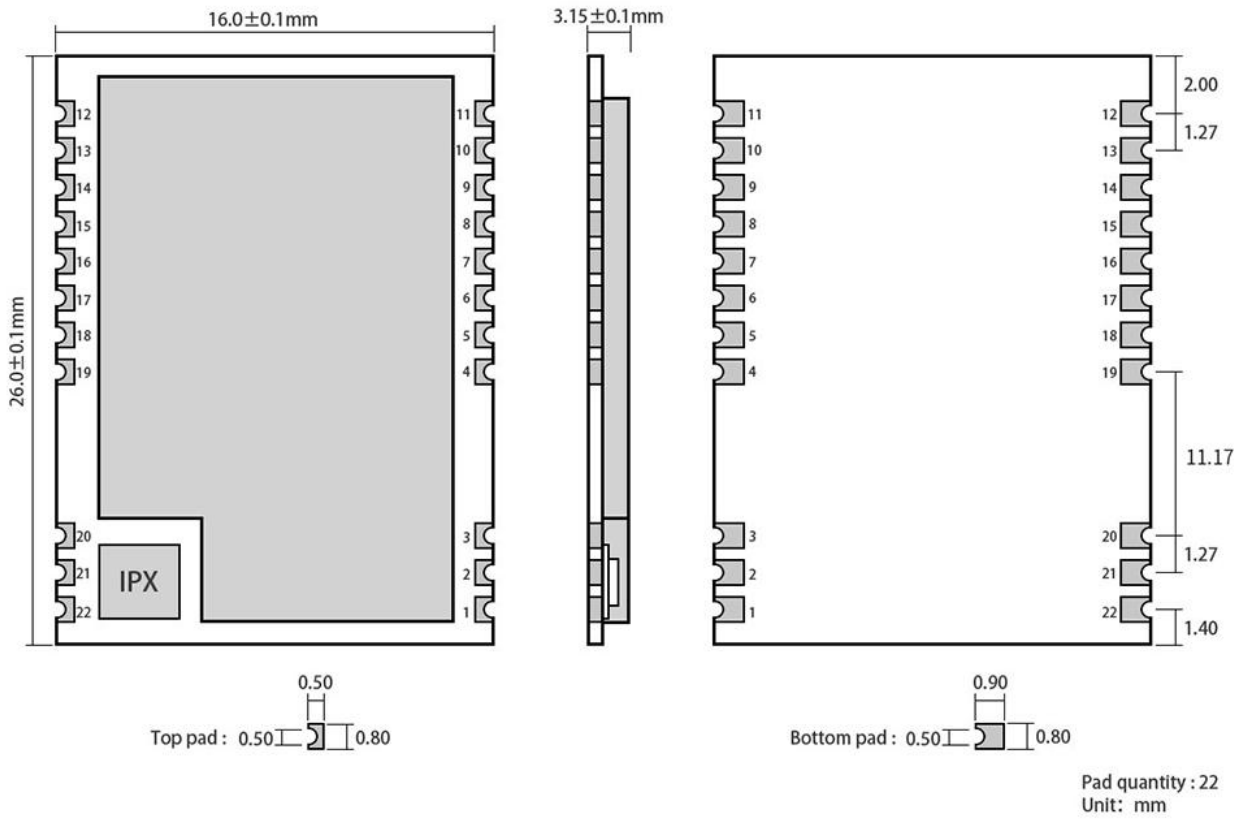
main parameters	describe	Remark
Reference distance	2.5km	
Send length	58 Byte	Maximum transmission bytes in a single time
Cache capacity	80Byte	Software actual debugging
Modulation	FSK	
Communication Interface	UART	8N1\8E1\EO1,1200~38400Multi-level adjustable
Encapsulation	SMD	
Interface	1.27	
Size	16*26	Actual layout
Antenna Interface	IPEX/Stamp hole	Equivalent impedance is about 50Ω

Name	Modul	Remark
RF crystal oscillator (MHz)	--	16M（Built-in load capacitance ）

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3. Mechanical properties



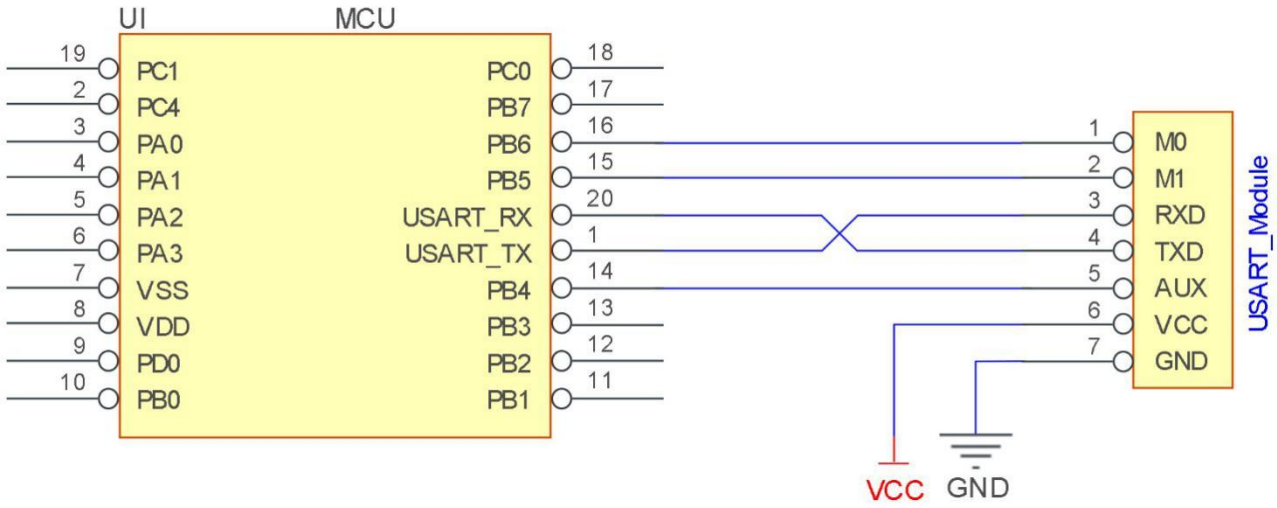
No.	Name	Direction	Function
1	GND	-	Module ground
2	GND	-	Module ground
3	GND	-	Module ground
4	GND	-	Module ground
5	M0	Input (very weak pull-up)	Cooperate with M1 to determine the 4 working modes of the module. (Can not be suspended, if not used, it can be grounded)
6	M1	Input (very weak pull-up)	Cooperate with M0 to determine the 4 working modes of the module. (Can not be suspended, if not used, it can be grounded)
7	RXD	Input	TTL serial port input, connected to the external TXD output pin;
8	TXD	Output	TTL serial port output, connected to the external RXD input pin;
9	AUX	Output	Used to indicate the working status of the module; the user wakes up the external MCU, and outputs low level during power-on self-check initialization; (can be left floating)
10	VCC	-	Module power supply positive reference, voltage range: 3~5.5V DC
11	GND	-	Module ground
12	NC	Reserved	（OCDSCK）
13	GND	-	Module ground (GND)

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14	NC	Reserved	(OCDSDA)
15	NC	Reserved	(VDD)
16	NC	Reserved	PA4
17	NC	Reserved	PA2
18	NC	Reserved	GPIO3
19	GND	-	Module ground
20	GND	-	Module ground
21	ANT	-	antenna
22	GND	-	Module ground

4. Connection diagram



No.	Brief description of the connection between the module and the single-chip microcomputer (the above figure takes the STM8L single-chip microcomputer as an example)
1	The wireless serial port module is TTL level, please connect with TTL level MCU.
2	For some 5V microcontrollers, it may be necessary to add 4-10K pull-up resistors to the TXD and AUX pins of the module.

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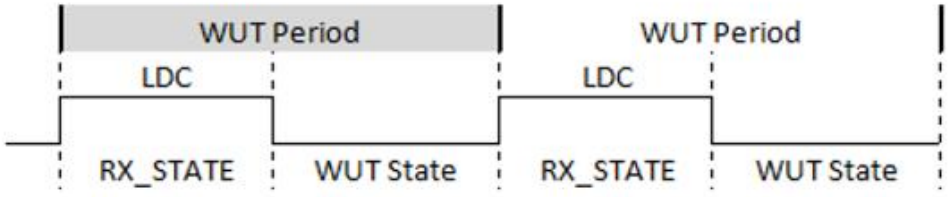
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5. Detailed function

5.1 LDC reception

E330-400T13S module receives in LDC mode. The module is in the LDC (Low Duty Cycle) ultra-low power receiving mode when powered on. The specific working mechanism is that the module periodically wakes up from sleep to detect the wireless wake-up code. If there is a valid wake-up code, turn on RX Windows, otherwise, it will restart again after timeout. Go to sleep.

As shown below:



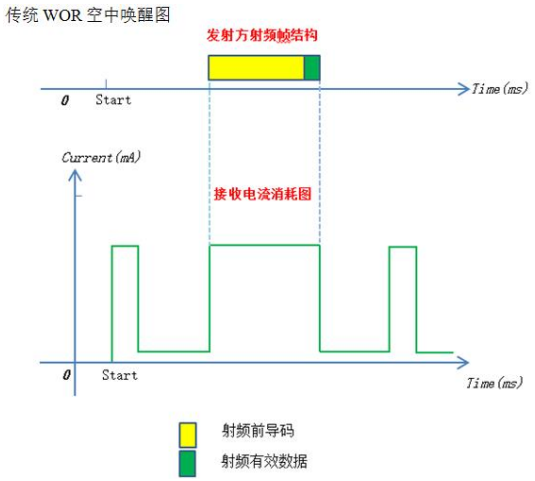
LDC cycle is software configurable

Sending mode. When the module sends data, it can automatically load the wake-up code corresponding to the LDC cycle.

Both sender and receiver need to configure the same LDC cycle.

5.2 Single point wakeup

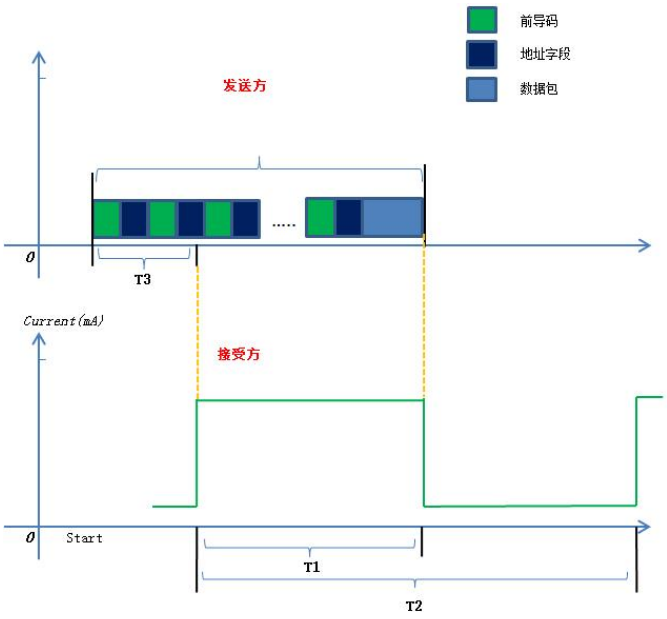
The module has a single-point wake-up function, which can effectively suppress the problem of false wake-ups between devices with the same frequency and different addresses; in the internal design, the module address will be configured as the SYNC address of the hardware radio frequency chip, which is used to synchronize the receiving process and send The receiver chip will automatically filter this data packet if it does not match the receiving synchronization word; the sender uses the short preamble + synchronization word when sending the wake-up code;



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Single point wake-up mode:



5.3 Module reset

After the module is powered on, AUX will immediately output low level, perform hardware self-check, and set the working mode according to user parameters;During this process, AUX maintains low level, and after completion, AUX outputs high level, and starts to work normally according to the working mode formed by the combination of M1 and M0;

Therefore, the user needs to wait for the rising edge of AUX as the starting point for the normal operation of the module.

5.4 AUX

AUX is used for wireless transmission and reception buffering instructions and self-checking instructions.

It indicates whether the module has data that has not been sent out through wireless transmission, or whether it has received wireless data that has not been sent out through the serial port, or whether the module is in the process of initializing self-checking.

5.5 Matters needing attention

No.	AUX considerations
1	The above function 1 and function 2, output low level priority, that is: if any one of the output low level conditions is met, AUX will output low level; When all low-level conditions are not met, AUX outputs a high level.
2	When AUX outputs low level, it means that the module is busy, and the working mode detection will not be performed at this time; When the module AUX outputs high level within 1ms, the mode switching will be completed.
3	After the user switches to the new working mode, at least 2ms after the rising edge of AUX, the module will actually enter this mode; If AUX is always at high level, the mode switch will take effect immediately.
4	When the user enters other modes from mode 3 (sleep mode) or is in the reset process, the module will reset the user parameters, during which AUX outputs low level.

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6. Operating mode

The module has four working modes, which are set by pins M1 and M0; the details are shown in the following table:

Mode (0-3)	M1	M0	Mode introduction	Remark
Send mode (0)	0	0	The serial port is turned on, the wireless is turned on, and the wake-up code is automatically added before sending the data packet;	Use with mode 1
Receive mode (1)	0	1	The serial port reception is closed, and the wireless is periodically awakened to listen to air data. After receiving the data, open the serial port to output data;	Use with mode 0
Configuration mode (2)	1	0	Deep sleep mode, configuration commands can be sent through the serial port, the serial port fixed parameters 9600, 8N, 1	
Sleep mode (3)	1	1	Module deep sleep mode, both serial port and wireless are closed	

6.1 Mode switch

No	Remark
1	● Users can combine high and low levels of M1 and M0 to determine the working mode of the module. Two GPIOs of MCU can be used to control mode switching ● After changing M1 and M0: If the module is idle, it can start to work according to the new mode after 1ms; ● If the module has serial port data that has not been transmitted wirelessly, the new working mode can be entered after the transmission is completed; ● If the module receives wireless data and sends out data through the serial port, it must be sent to the new working mode; ● Therefore, the mode switching can only be effective when AUX outputs 1, otherwise the switching will be delayed.
2	● For example: the user continuously inputs a large amount of data and performs mode switching at the same time, the switching mode operation at this time is invalid; the module will process all user data before proceeding to the new mode detection ● So the general suggestion is: check the output status of the AUX pin, wait for 2ms after outputting the high level, and then switch.
3	● When the module is switched from other modes to sleep mode, if there is data that has not yet been processed; ● After the module processes these data (including receiving and sending), it can enter the sleep mode. This feature can be used for fast sleep, thereby saving power consumption; for example: the transmitter module works in mode 0, the user initiates serial data "12345", and then does not need to wait for the AUX pin to be idle (high level), and can directly switch to sleep mode. And the user's main MCU will go to sleep immediately, and the module will automatically send all user data wirelessly, and it will automatically go to sleep within 1ms. ● Thereby saving MCU working time and reducing power consumption.
4	● Similarly, this feature can be used in any mode switching. After the module processes the current mode event, it will automatically enter a new mode within 1ms; thus eliminating the need for users to query AUX and achieving the purpose of fast switching ; ● For example, switching from the transmitting mode to the receiving mode; the user MCU can also go to sleep before the mode switching, and use the external interrupt function to obtain the AUX changes, thereby performing the mode switching.

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5	● This operation mode is very flexible and efficient. It is designed in accordance with the user's MCU's operating convenience, and can reduce the workload of the entire system as much as possible, improve system efficiency, and reduce power consumption.

6.2 Normal mode (mode 0)

Type	When M0 = 0 and M1 = 0, the module works in mode 0
Send	Before sending data, the module will automatically add a wireless wake-up code internally to wake up the receiving module in the corresponding wake-up cycle.
Receive	The wireless receiving function of the module is turned on, and the wireless data will be output through the serial port TXD pin after receiving the wireless data.

6.3 Receiving mode (mode 1)

Type	When M0 = 1, M1 = 0, the module works in mode 1
Send	When the LDC period is 0, data can be sent, which is equivalent to mode 0, otherwise data cannot be sent.
Receive	The module can periodically wake up to receive data, and the wake-up cycle can be configured through commands

6.4 Configuration mode (mode 2)

Type	The working parameters of the module can be configured through the serial port (M0 = 0, M1 = 1). Serial parameters: 9600, 8N1
Send	Cannot send data wirelessly
Receive	Cannot receive data wirelessly
Configuration	Module working parameters can be set through special command format

6.5 Deep sleep mode (mode 3)

Type	Module deep sleep mode (M0 = 1, M1 = 1)

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Send	Cannot send data wirelessly
Receive	Cannot receive data wirelessly
Other	All related functions of the module are closed, and the sleep mode can only be exited through the M1M0 pin

7. Register read and write control

7.1 Instruction format

In configuration mode (mode 2: M1=1, M0=0), the supported command list is as follows (when setting, only 9600, 8N1 format is supported):

No	Instruction format	Detailed description
1	C0+ working parameters	Send C0+5 bytes of working parameters in hexadecimal format, a total of 6 bytes, must be sent continuously (save when power off)
2	C1+C1+C1	Three C1s are sent in hexadecimal format, and the module returns the saved parameters, which must be sent continuously.
3	C2+Working parameters	Send C2+5 bytes in hexadecimal format. Working parameters, 6 bytes in total, must be sent continuously (not saved after power failure)
4	C3+C3+C3	Three C3s are sent in hexadecimal format, and the module returns version information, which must be sent continuously.

7.2 Working parameter reading

Instruction format	Detailed description
C1+C1+C1	In sleep mode (MOD=2), send a command to the module serial port (HEX format): C1 C1 C1, The module will return the current configuration parameters, such as: C0 00 00 10 52 34.

7.3 Version number read

Instruction format	Detailed description
C3+C3+C3	In sleep mode (MOD=2), send a command to the module serial port (HEX format): C3 C3 C3, The module will return the current configuration parameters, such as: C3 00 0X XX1 XX2 XX3 XX4 XX5; Here, 00 0X represents the model of the module, XX1 is the version number, and XX2 XX3 XX4 XX5 refer to other features of the module.

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7.4 Reset command

Instruction format	Detailed description
C4+C4+C4	In sleep mode (MOD=2), send a command to the module serial port (HEX format): C4 C4 C4, The module will generate a reset; During the reset process, the module performs self-check, and AUX outputs low level. After resetting, AUX outputs high level, and the module starts to work normally. At this point, you can switch the mode or initiate the next instruction.

7.5 Parameter setting instruction

No	Name	Describe	Remark
0	HEAD	Fixed 0xC0 or 0xC2, indicating that this frame data is a control command	Must be 0xC0 or C2 C0: The set parameters will be saved after power-off. C2: The set parameters will not be saved after power-off.
1	ADDH	Module address high byte (default 00H)	00H-FFH
2	ADDL	Module address low byte (default 00H)	00H-FFH
3	SPED	Speed parameters, including serial port speed and air speed 7，6： Serial port check digit 00: 8N1 (default) 01: 8O1 10: 8E1 11: 8N1 (equivalent to 00) ---------- 5，4，3 TTL serial port rate (bps) 000: The baud rate of the serial port is 1200 001: The serial port baud rate is 2400 010: The serial port baud rate is 4800 011: The baud rate of the serial port is 9600 (default) 100: The serial port baud rate is 19200 101: The serial port baud rate is 38400 ---------- 2, Keep unused ---------- 1，0 Wireless air rate (bps) 00: The air rate is 2.0k (default) 01: The air speed is 5.0k 10: The air speed is 10.0k 11: The air speed is 25.0k	● The serial port mode of the two communication parties can be different ---------- ● The baud rate of the communication parties can be different ● The serial port baud rate has nothing to do with wireless transmission parameters, and does not affect the wireless transceiver characteristics. ---------- ● The lower the air speed, the longer the distance, and the longer the sending time. ● The wireless transmission rate in the air must be the same for both parties.
4	CHAN	---------- 7 - 0： Communication channel, default 28H (433MHz)	---------- 00H-A8H, corresponding to 410~493MHz The corresponding frequency is: 410+CH[7:0]*05 MHz
5	OPTION	7：Fixed-point transmission enable bit (like MODBUS) 0: Transparent transmission mode (default) 1: Fixed-point transmission mode 6，Keep unused ---------- 5，4 LDC cycle 00：0ms 01：1000ms（default ） 10：2000ms 11：3000ms ---------- 3， Keep unused ---------- 2 IO drive mode (default 1)	● When is 1, the first 3 bytes of each user data frame are used as high and low addresses and channels. When transmitting, the module changes its own address and channel, and restores the original settings after completion ---------- ● The larger the LDC period, the lower the power consumption, but the greater the receiving delay ● The wake-up time set by both parties must be consistent; ---------- ● This bit is used to enable the internal pull-up resistor of the module. The open-drain method has stronger level adaptability, and in some cases, an external pull-up resistor may be required ---------- ● The greater the output power of the transmitter, the greater the communication distance and the corresponding transmission power consumption.

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		1: TXD, AUX push-pull output, RXD pull-up input 0: TXD, AUX open circuit output, RXD open circuit input ---------- 1, 0 Transmitting power (approximate value) 00: 13dBm (default) 01：10dBm 10： 7dBm 11： 4dBm	

For example (the meaning of the "SPED" byte of sequence number 3):

The binary bits of the byte	7	6	5	4	3	2	1	0
Specific value (user configuration)	0	0	0	1	1	0	0	0
Representative meaning	Serial port parity 8N1		The serial port baud rate is 9600			The air speed is 1.2k		
Corresponding hexadecimal	1				8			

7.6 Factory default parameters

Type	Factory default parameter value: C0 00 00 18 2E 14						
Module model	Frequency	Address	Channel	Air speed	Baud rate	Serial format	Transmit power
E330-400T13S	433MHz	0x0000	46	2.0Kbps	9600	8N1	13dBm

When the factory settings are restored, the module wake-up time is 1000ms, and the reception will have a delay of about 1.2S 。

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8. Host computer configuration instructions

The following figure shows the display interface of the E330-400T13S configuration host computer. The user can switch to the command mode through M0 and M1, and quickly configure and read the parameters on the host computer.



In the configuration of the upper computer, the module address, frequency channel, network ID, and key are all displayed in decimal mode; the value range of each parameter:

Baud rate: 1200~38400

Network address: 0 ~ 65535

Frequency channel: 0 ~ 166

When using the host computer to configure the relay mode, the user needs to pay special attention. Since each parameter in the host computer is in the decimal display mode, the module address needs to be converted by conversion.

9. Hardware design

- It is recommended to use a DC stabilized power supply to supply power to the module, and the power ripple coefficient should be as small as possible, and the module must 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 that it is within the recommended power supply voltage. If it exceeds the maximum value, it will cause permanent damage to the module;
- Please check the stability of the power supply, and the voltage should not fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% margin, and the whole machine is conducive to long-term stable operation;
- The module should be as far away as possible from the power supply, transformer, high-frequency wiring and other parts with

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large electromagnetic interference;

- High-frequency digital wiring, high-frequency analog wiring, and power wiring must avoid the bottom of the module. If it is necessary to pass under the module, assuming that the module is soldered to the Top Layer, lay copper on the Top Layer of the contact part of the module (all copper And well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;
- Assuming that the module is soldered or placed on the Top Layer, it is also wrong to randomly route the wires on the Bottom Layer or other layers, which will affect the stray and receiving sensitivity of the module to varying degrees;
- Assuming that there are devices with large electromagnetic interference around the module, it will greatly affect the performance of the module. According to the intensity of the interference, it is recommended to stay away from the module. If the situation permits, proper isolation and shielding can be done;
- Assuming that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power wiring) will greatly affect the performance of the module, according to the intensity of the interference, it is recommended to stay away from the module, if the situation permits Appropriate isolation and shielding;
- 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 part of the physical layer that is also 2.4GHz TTL protocol, such as: USB3.0;
- The antenna installation structure has a great impact on the performance of the module. Make sure that the antenna is exposed and it is best to be vertically upward;
- When the module is installed inside the case, a high-quality antenna extension cable can be used to extend the antenna to the outside of the case;
- The antenna must not be installed inside the metal shell, which will greatly reduce the transmission distance.

10. Common problems

10.1 Transmission distance is not ideal

- When there is a straight line communication obstacle, the communication distance will be attenuated accordingly;
- Temperature, humidity, and co-frequency interference will increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect is poor when it is close to the ground;
- Sea water has a strong ability to absorb radio waves, so the seaside test effect is poor;
- If there are metal objects near the antenna or placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly, and the air rate is set too high (the higher the air rate, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value, and the lower the voltage, the lower the power output;
- The matching degree of the antenna and the module is poor or the quality of the antenna itself is problematic

10.2 Module is easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, it will cause permanent damage to the module;
- Please check the stability of the power supply, and the voltage should not fluctuate significantly and frequently;
- Please ensure that the installation and use process is anti-static, and high-frequency components are electrostatically sensitive;
- Please ensure that the humidity should not be too high during installation and use, and some components are humidity

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sensitive devices;

- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

10.3 Bit error rate is too high

- There is co-frequency signal interference nearby, stay away from the interference source or modify the frequency and channel to avoid interference;
- Unsatisfactory power supply may also cause garbled codes. Be sure to ensure the reliability of the power supply;
- Poor or too long extension cables and feeders can also cause high bit error rates.

11. Welding operation guidance

- This product is a SMD module. When soldering the module, the soldering personnel must work in accordance with the anti-static operation specification;
- This product is an electrostatic sensitive product. If the module is not welded in accordance with the specification, it may cause permanent damage to the module.

12. Antenna Guide

12.1 Antenna recommendation

Antennas are an important role in the communication process, and often inferior antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as supporting our company's wireless modules with excellent performance and reasonable prices.

SKU	Type	Frequency Hz	Interface	增益 dBi	高度 mm	馈线 cm	功能特点
TX433-NP-4310	Flexible antenna	433M	welding	2.0	43.8*9.5	-	Built-in flexible, FPC soft antenna
TX433-JZ-5	Rubber rod antenna	433M	SMA-J	2.0	52	-	Ultra-short straight, omnidirectional antenna
TX433-JZG-6	Rubber rod antenna	433M	SMA-J	2.5	62	-	Ultra-short straight, omnidirectional antenna
TX433-JW-5	Rubber rod antenna	433M	SMA-J	2.0	50	-	Bend Rubber rod antenna, omni antenna
TX433-JWG-7	Rubber rod antenna	433M	SMA-J	2.5	75	-	Bend Rubber rod antenna, omni antenna
TX433-JK-11	Rubber rod antenna	433M	SMA-J	2.5	110	-	Bend Rubber rod antenna, omni antenna
TX433-JK-20	Rubber rod antenna	433M	SMA-J	3.0	210	-	Bend Rubber rod antenna, omni antenna
TX433-XPL-100	Sucker antenna	433M	SMA-J	3.5	185	100	Small Sucker antenna
TX433-XP-200	Sucker	433M	SMA-J	4.0	190	200	Middle Sucker antenna

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	antenna						low loss
TX433-XPH-300	Sucker antenna	433M	SMA-J	6.0	965	300	Big Sucker antenna, High gain
TX490-JZ-5	Sucker antenna	470/490M	SMA-J	2.0	50	-	Ultra-short straight, omnidirectional antenna
TX490-XPL-100	Sucker antenna	470/490M	SMA-J	3.5	120	100	Small Sucker antenna

Revise history

Version	Revision date	Revision description	Maintenance man
1.0	2021-8-23	initial version	Linson
1.2	2022-7-25	Bug fixes	Yan

13. About us

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