E49-400T30S Specifications

433MHz SMD Wireless Module



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Ⅰ Overview

1.1 Introduction



E49-400T30S is a super cost-effective wireless data transmission module launched by Chengdu Ebyte. It has 4 working modes. Each transmission method has its own characteristics and can be applied to various application scenarios. E49-400T30S can perfectly support industrial-grade applications, and has undergone rigorous testing at the factory to ensure its industrial reliability and batch consistency.

E49-400T30S supports a maximum transmit power of 20dBm. Users can set lower output power to save power consumption. The module works in the 433MHz frequency band, with TTL level output, and is compatible with 3.3V IO port voltage.

The module has data encryption function. The data transmitted by the module in the air has randomness. Through strict encryption and decryption algorithm, the data interception is meaningless, the probability of interference is reduced, and the reliability and transmission efficiency are improved. And it is a low-cost wireless serial transceiver module.

1.2 Features

- The measured communication distance can reach 5.6km;
- The maximum transmit power is 30 dB, and the software is multi-level adjustable;
- Support global license-free ISM 433MHz frequency band;
- Support data transmission rate of 1.2Kbps～200Kbps;
- Support low power consumption mode, suitable for battery applications;
- Support advanced ultra-narrowband GFSK modulation;
- Support 2.6V~5.5V power supply;
- Industrial-grade standard design, support long-term use at -40 ~ 85° C;
- Support stamp hole and IPEX interface, users can choose to use according to their own needs.

1.3 Application scenarios

- Wearable devices;
- Smart home and industrial sensors, etc.;
- Security system, positioning system;
- Wireless remote control, drone;
- Wireless game remote control;
- Healthcare products;
- Wireless voice, wireless headset;
- Automotive industry applications.

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Ⅱ Specifications

2.1 Limit parameters

Main parameters	Performance		Remark
	Minimum	Maximum	
Supply voltage (V)	0	5.5	More than 5.5V will permanently burn the module
Blocking power (dBm)	-	10	It is less likely to burn when used at close range.
Working temperature (℃)	-40	85	

2.2 Working parameters

Main parameters		Performance			Remark
		Minimum	Typical	Maximum	
Working voltage (V)		2.6	5	5.5	
Communication level (V)			3.3		Risk of burnout with 5V TTL
Working temperature (℃)		-40	-	85	Industrial grade design
Working frequency band (MHz)		410	433	510	upport ISM band
Power consumption	Emission current (mA)		550		Instantaneous power consumption
	Receive current (mA)		18		
	Sleep current (μA)		1.2		software shutdown
Maximum transmit power (dBm)		-	-	30.0	
Receive Sensitivity (dBm)		-119	-120	-121	The air rate is 1.2kbps
Air rate (bps)		1.2k	2.4k	200k	User programming control

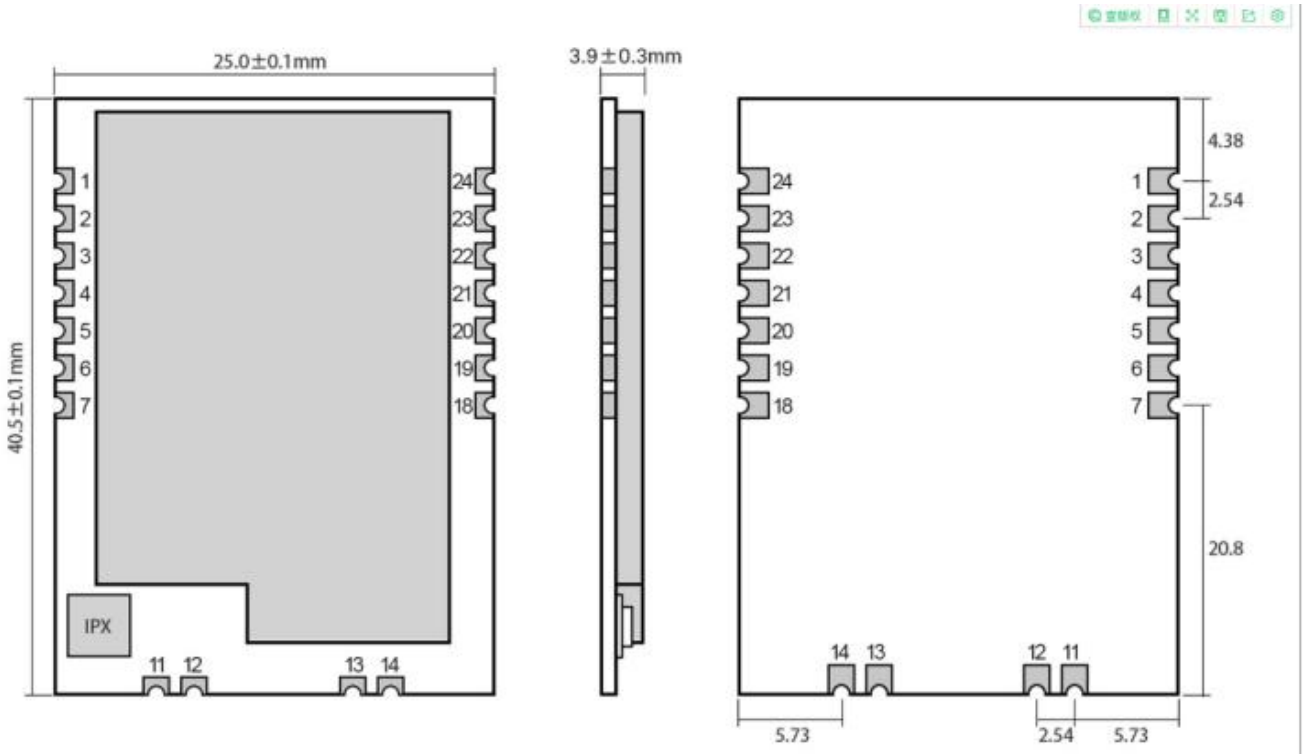
Main parameters	Description	Remark
Reference distance	5.6Km	Clear and open environment, antenna gain 5dBi, antenna height 2.5m, air rate 1.2kbp
Subcontracting method	54 Btye	The maximum capacity of a single package, it will be automatically sub-packaged when it exceeds.
Cache capacity	500 Btye	
Modulation method	GFSK	
Communication Interface	UART serial port	
Packaging method	SMD	
Interface	1.27mm	

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Dimensions	26*16mm	
Antenna interface	IPEX/ Stamp hole	Equivalent impedance is about 50 ohms

III Dimensions and Pin Definitions



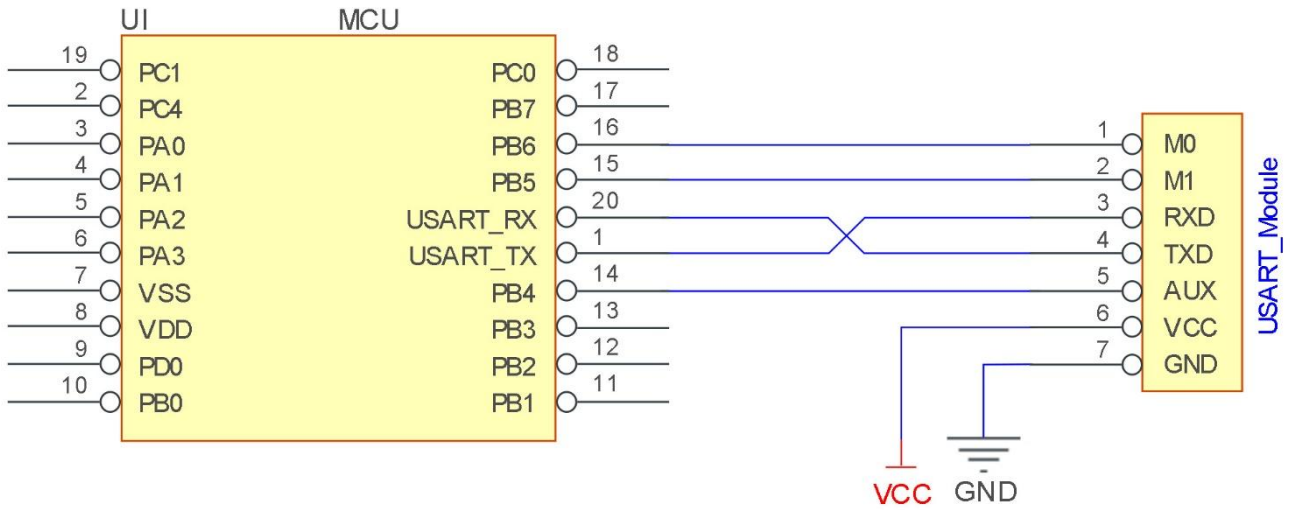
Pin number	Pin name	Pin Orientation	Pin Usage
1	GND	Input	Module ground
2	VCC	Input	DC Module power positive reference, voltage range: 3.3 ~ 5.5V DC
3	AUX	Output	Used to indicate the working state of the module; the user wakes up the external MCU, and outputs a low level during the power-on self-test initialization; (can be left floating)
4	TXD	Output	TTL serial output, connected to external RXD input pin;
5	RXD	Input	TTL serial port input, connected to the external TXD output pin;
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	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)
11	ANT	Output	Antenna interface (high frequency signal output, 50 ohm characteristic impedance)
12	GND		Fixedly
13	GND		Fixedly
14	GND		Fixedly
18	NC	Input/Output	NC pin, this pin needs to be left floating (for subsequent expansion)
19	NC	Input/Output	NC pin, this pin needs to be left floating (for subsequent expansion)

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20	NC	Input/Output	NC pin, this pin needs to be left floating (for subsequent expansion)
21	NC	Input	download port --VCC (Hanging, users do not need to pay attention)
22	NC	Input	download port - SWDIO (Hanging, users do not need to pay attention)
23	GND	Input	download port --GND (Hanging, users do not need to pay attention)
24	NC	Input	download port --SWCLK (Hanging, users do not need to pay attention)

Ⅳ Recommended wiring diagram



Serial Number	A brief description of the connection between the module and the microcontroller (the above picture takes the STM8L microcontroller as an example)
1	The wireless serial port module is TTL level, please connect with TTL level MCU.
2	Some 5V microcontrollers may need to add 4~10K pull-up resistors to the TXD and AUX pins of the module.

Ⅴ Detailed function

5.1 Module reset

After the module is powered on, AUX will output a low level immediately, perform hardware self-test, and set the working mode according to user parameters. During this process, the AUX keeps the low level, and after the completion, the AUX outputs the 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.

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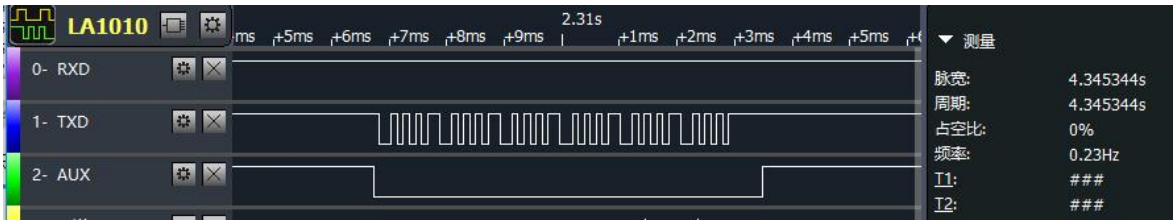
5.2 AUX detailed explanation

AUX is used for wireless transceiver buffer indication and self-check indication.

It indicates whether the module has data that has not been transmitted wirelessly, or whether the wireless data has been received and not all sent through the serial port, or the module is in the process of initializing and self-checking.

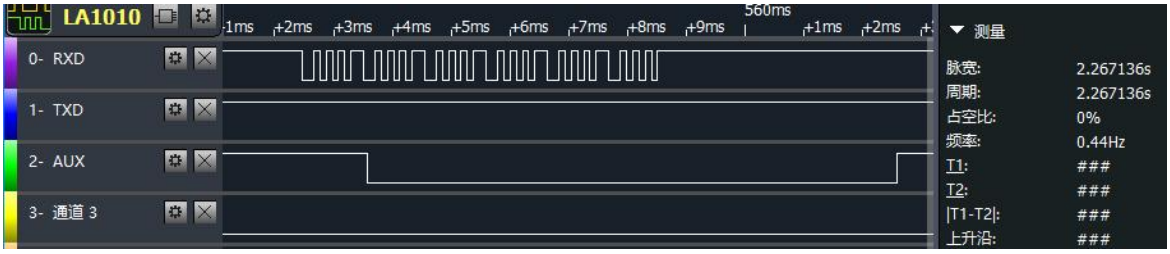
5.2.1 Wireless reception indication

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



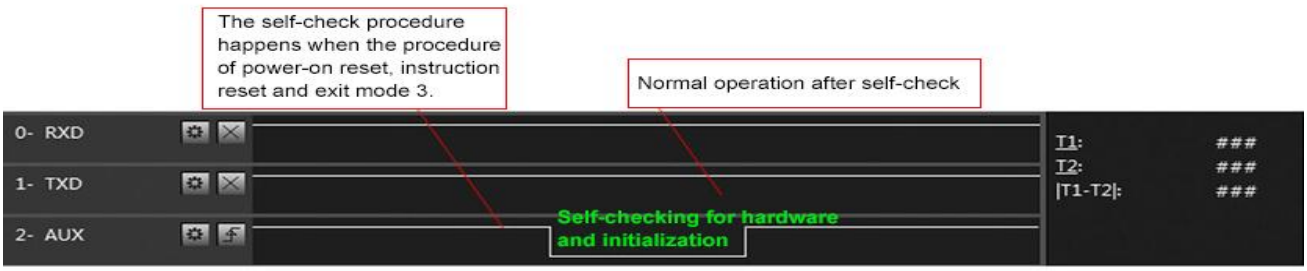
5.2.2 Wireless transmission indication

After the module receives the serial port data, it will pull down AUX immediately and start sending data wirelessly. After all data is sent, pull up AUX again.



5.2.3 Resetting and exiting sleep mode

Only at reset and when exiting sleep mode



Timing Sequence Diagram of AUX when self-check

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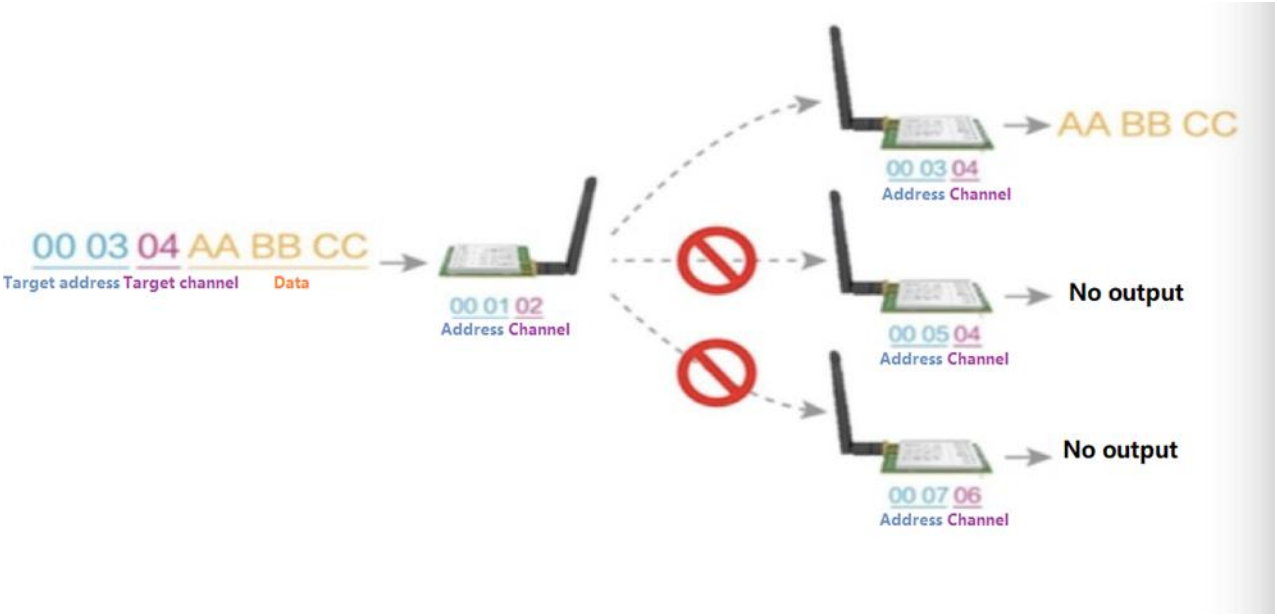
5.3.4 AUX Notes

For the above functions 1 and 2, the output low level has priority, that is, if any one of the output low level conditions is satisfied, the AUX outputs the low level; when all the low level conditions are not satisfied, the AUX outputs the high level.

When AUX outputs a 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 a high level, the mode switching will be completed.

When the user enters other modes from mode 3 (sleep mode) or during the reset process, the module will reset the user parameters, during which AUX outputs a low level.

5.3.5 Detailed explanation of fixed-point mode



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5.3.6 Broadcast transmission



5.3.7 Broadcast address

Example: Set the address of module A to 0xFFFF and the channel to 0x04.

When module A is used as a transmitter (same mode, transparent transmission mode), all receiving modules under the 0x04 channel can receive data to achieve the purpose of broadcasting.

5.3.8 Listen address

Example: Set the address of module A to 0xFFFF and the channel to 0x04.

When module A is used as a receiver, it can receive all the data under the 0x04 channel to achieve the purpose of monitoring.

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VI Operating mode

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

Mode (0-3)	M1	M0	Mode Introduction	Remark
0 transfer mode	0	0	The serial port is opened, the wireless is opened, and the module sends and receives data according to the set transmission mode.	The transmission method of the sender and receiver must be the same
1 RSSI mode	0	1	When the wireless is turned off and the serial port is turned on, the module will output the RSSI signal strength value every 100ms.	Relative intensity values only
2 set mode	1	0	Wireless off, can receive serial commands, see command list, baud rate fixed 9600, 8N1	parameter configuration
3 sleep mode	1	1	The module goes to sleep standby, and the serial port and wireless are closed.	Ultra-low power sleep

6.1 Mode switch

- Users can combine M0 and M1 with high and low levels to determine the working mode of the module. The 2 GPIOs of the MCU can be used to control the mode switching; when M0 and M1 are changed: the module is idle, and after 1ms, it can start to work according to the new mode; if the module has serial port data that has not been transmitted wirelessly, after the transmission is completed, can enter the new working mode; if the module receives the wireless data and sends out the data through the serial port, it needs to send the data to enter the new working mode; so the mode switching can only be valid when the AUX output is 1, otherwise it will be delayed switch.
- For example: in mode 0, the user continuously inputs a large amount of data and performs mode switching at the same time, and the switching mode operation is invalid at this time; the module will only perform new mode detection after processing all user data; therefore, it is generally recommended to be : Detect the output state of the AUX pin, wait 2ms after the AUX output is high, and then switch.
- When the module is switched from other modes to sleep mode, if there is data that has not been processed yet; the module can only enter sleep mode after processing these data (including receiving and sending). This feature can be used for fast sleep to save power consumption; for example: the transmitter module works in mode 0, the user initiates serial port 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, The main MCU of the user is put to sleep immediately, and the module will automatically go to sleep within 1ms after sending all the user data wirelessly, thereby saving the working time of the MCU and reducing power consumption.
- Similarly, any mode switching can use this feature. After the module processes the current mode event, it will automatically enter the new mode within 1ms; thus saving the user's work of querying AUX, and achieving the purpose of fast switching , such as switching from transmit mode to setting mode; the user MCU can also go to sleep in advance before mode switching, and use the external interrupt function to obtain AUX changes to perform mode switching.
- This operation mode is very flexible and efficient. It is completely designed according to the user's MCU operation convenience, and can reduce the workload of the entire system as much as possible, improve system efficiency, and reduce power consumption.

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6.2 Transmission Mode (Mode 0)

Type	When M0 = 0, M1 = 0, the module works in mode 0
emission	The module receives user data from the serial port, and the maximum length of the wireless data packet transmitted by the module is 54 bytes. When the amount of data input by the user reaches 54 bytes, the module will start wireless transmission, and the user can continue to input the data to be transmitted. When the bytes that the user needs to transmit is less than 54 bytes, the module waits for about 20ms. If no user data continues to be input, the data is considered to be terminated, and the module sends all data wirelessly. When the module receives the first user data, it will output the AUX low level, when the module put all the data into the RF chip and start the transmission, the AUX output will be high level. At this point, it indicates that the transmission of the last packet of wireless data has been started, and the user can continue to input data. Data packets sent through mode 0 can only be received by the receiving module in mode 0.
receive	The module has always turned on the wireless receiving function, and can receive data packets from mode 0. After receiving the data packet, after the module AUX outputs low level, it starts to send wireless data through the serial port TXD pin. After all wireless data is output through the serial port, the module outputs AUX high level.

6.3 RSSI Mode (Mode 1)

Type	When M0 = 1, M1 = 0, the module works in mode 1
emission	Wireless transmission is not possible, and the received serial data will be discarded.
receive	Can not receive air wireless data, only scan the signal strength of the current channel, output a strength value (relative value) through the serial port every 100ms. Numerical calculation method: signal strength = -(256(decimal) - data(decimal)) dBm If the hexadecimal value output by the serial port is 0x91, the actual signal strength is: -(256(decimal) - 145(decimal))=-111dBm

6.4 Setup Mode (Mode 2)

Type	When M0 = 0, M1 = 1 the module works in mode 2
emission	Wireless transmission is not possible, and the received serial data will be discarded.
receive	Wireless reception is not possible
set	Can be used for module parameter setting, using serial port 9600, 8N1, setting module working parameters through specific command format
note	When entering other modes from the setting mode, the module will reconfigure the parameters. During the configuration process, AUX remains low; After completion, it outputs a high level, so it is recommended that the user detect the rising edge of AUX.

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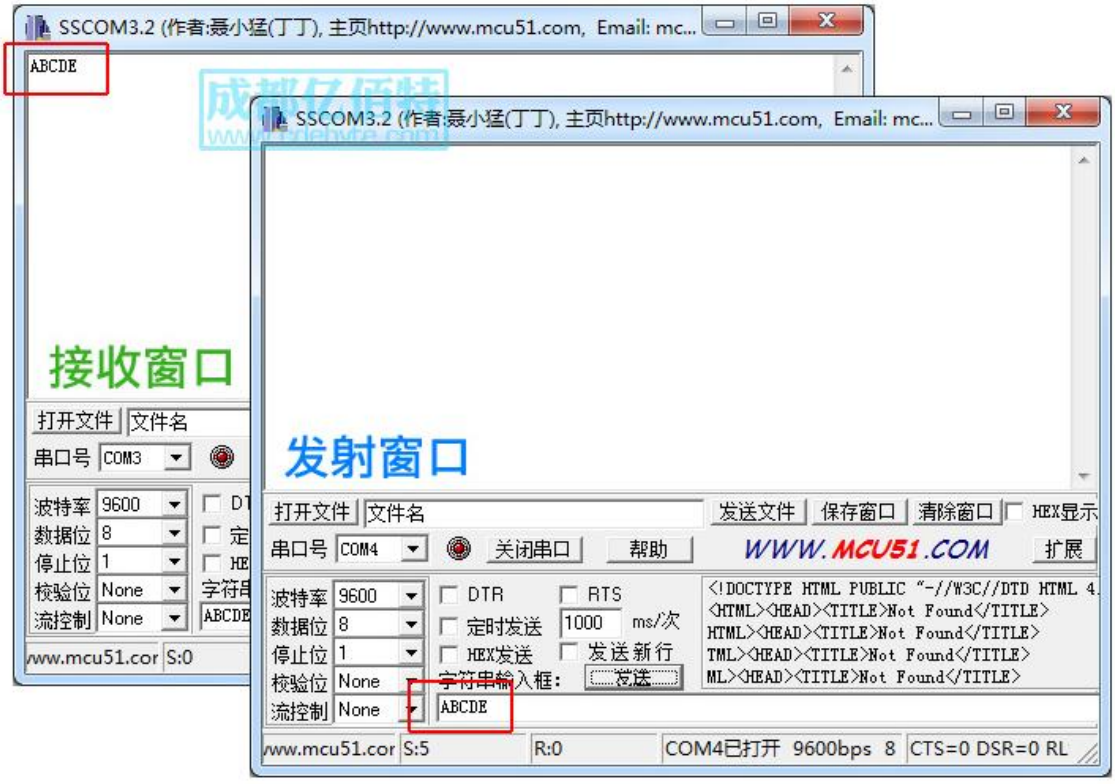
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6.5 Sleep Mode (Mode 3)

Type	When M0 = 1, M1 = 1, the module works in mode 3
emission	Unable to transmit wireless data.
receive	Unable to receive wireless data.
other	In the ultra-low power consumption state, all other functions of the module are turned off, and the sleep mode can only be exited by switching the state of M1M0.

6.6 Quick communication test

Step	Specific operation
1	Connect the E49-400T30S module to the E49-TBL backplane, then plug it into the USB test board (E15-USB-T2), plug it into the computer, and make sure the driver has been installed correctly; Plug in the mode selection jumper cap on the USB test board (ie M1=0, M0=0),
2	Select 5V (module supports 2.6~5.5V).
3	Run the "Serial port debugging assistant" software, select the correct serial port number, and observe the sending window and the corresponding receiving window.



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Ⅶ Instruction format

In command mode (mode 2: M0=0, M1=1), the list of supported commands is as follows (when setting, only 9600 and 8N1 formats are supported):

serial number	Instruction format	Detailed description
1	C0+ Working parameters	Send C0+5 bytes working parameters in hexadecimal format, a total of 6 bytes, must be sent continuously (power-off save)
2	C1+C1+C1	Send three C1s in hexadecimal format, and the module returns the saved parameters, which must be sent continuously.
3	C2+ Working parameters	Send C2+5 bytes working parameters in hexadecimal format, a total of 6 bytes, must be sent continuously (not saved when power off)
4	C3+C3+C3	Three C3s are sent in hexadecimal format, and the module returns version information, which must be sent continuously.

7.1 Factory default parameters

model	Factory default parameter values:C0 00 00 19 2E 00					
Module model	frequency	address	channel	air speed	baud rate	transmit power
E49-400T20S	433MHz	0x0000	0x2E	2.4kbps	9600	30

7.2 Reading of working parameters

Instruction format	Detailed description
C1+C1+C1	In the setting mode (M0=0, M1=1), send a command (HEX format) to the module serial port: C1 C1 C1, The module will return the current configuration parameters, for example: C0 00 00 18 20 00.

7.3 Reading of version number

Instruction format	Detailed description
C3+C3+C3	In the setting mode (M0=0, M1=1), send a command (HEX format) to the module serial port: C3 C3 C3, The module will return the current configuration parameters, such as: C3 49 xx yy; 49 here represents the module model (E49 series), xx is the version number, and yy refers to other features of the module (users can ignore).

7.4 Parameter setting instructions

serial	name	description	remark

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number			
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	Rate parameters, including serial rate and air rate 7, 6: serial port check digit 00: 8N1 (default) 01: 8O1 10:8E1 11: 8N1 ---------- 5, 4, 3 TTL serial port rate (bps) 000: The serial port baud rate is 1200 001: The serial port baud rate is 2400 010: The serial port baud rate is 4800 011: The serial port baud rate is 9600 (default) 100: The serial port baud rate is 19200 101: The serial port baud rate is 38400 110: The serial port baud rate is 57600 111: The serial port baud rate is 115200 ---------- 2, 1, 0 Wireless air rate (bps) 000: air rate is 1.2k 001: Air rate is 2.4k (default) 010: Air rate is 4.8k 011: Air rate is 9.6k 100: 19.2k air rate 101: Air rate is 50k 110: Air rate is 100k 111: Air rate is 200k	---------- ● The baud rate of both 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 rate, the longer the distance, the stronger the anti-interference performance and the longer the sending time. ● The air wireless transmission rate of both parties must be the same.
4	CHAN	7, 6, 5, 4, 3, 2, 1, 0 Communication channel Communication frequency (410M + CHAN * 0.5M) (default 0x2E: 433M)	---------- ● 00H-C8H, ● Corresponding to 410~510 MHz
5	OPTION	7. Fixed-point transmission enable bit (like MODBUS) 0: Transparent transmission mode (default) 1: Fixed point transmission mode ---------- 6, 5, 4, 3, 2 Reserved bits, write 0 ---------- 1, 0 transmit power (approximate) 00: 20 dBm (default) 01: 17dBm 10: 14dBm 11: 10dBm	● When it is 1, the first 3 bytes of each user data frame are used as 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 a current output capability of more than 100mA. And ensure that the power supply ripple is less than 100mV. ● It is not recommended to use low power transmission, and its power utilization efficiency is not high.
For example (the meaning of the serial number 3 "SPED" byte):			

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the binary bit of the byte	7	6	5	4	3	2	1	0
Specific value (user configuration)	0	0	0	1	1	0	0	1
meaning	Serial check bit 8N1		Serial port baud rate is 9600			Air rate is 2.4k		
corresponding hexadecimal	1				9			

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Ⅷ Hardware design

- It is recommended to use a DC regulated power supply to supply power to the module, the power supply ripple coefficient should be as small as possible, and the module should be grounded reliably;
- Please pay attention to the correct connection of the positive and negative poles of the power supply, such as reverse connection may cause permanent damage to the module;
- Please check the power supply to ensure that it is between the recommended power supply voltages. If it exceeds the maximum value, the module will be permanently damaged;
- Please check the stability of the power supply, 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% of the margin, so that the whole machine can work stably for a long time;
- The module should be kept as far away as possible from the power supply, transformer, high-frequency wiring and other parts with large electromagnetic interference;
- High-frequency digital traces, high-frequency analog traces, and power traces must avoid the underside of the module. If it is absolutely necessary to pass under the module, assuming that the module is soldered on the Top Layer, lay copper on the Top Layer of the contact part of the module. Copper and well grounded), must be close to the digital part of the module and routed on the Bottom Layer;
- Assuming that the module is soldered or placed on the Top Layer, it is also wrong to arbitrarily route 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. It is recommended to stay away from the module according to the intensity of the interference. If the situation allows, appropriate 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 traces), the performance of the module will also be greatly affected. It is recommended to stay away from the module according to the intensity of the interference. Proper 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 some TTL protocols whose physical layer is also 2.4GHz, such as USB3.0;
- The antenna installation structure has a great influence on the performance of the module. Make sure that the antenna is exposed, preferably vertically upward. When the module is installed inside the casing, a high-quality antenna extension cable can be used to extend the antenna to the outside of the casing;
- The antenna must not be installed inside the metal shell, which will greatly reduce the transmission distance.

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IX Common problem

9.1 The transmission distance is not ideal

- When there is a straight line communication obstacle, the communication distance will be correspondingly attenuated;
- Temperature, humidity, and co-channel interference will increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect close to the ground is poor;
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor.
- If there is a metal object near the antenna, or is 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 output power;
- The antenna used is poorly matched with the module or the quality of the antenna itself is faulty.

9.2 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, the module will be permanently damaged.
- Please check the stability of the power supply, the voltage should not fluctuate greatly and frequently.
- Please ensure anti-static operation during installation and use, and high-frequency components are sensitive to static electricity.
- Please ensure that the humidity during installation and use should not be too high. Some components are humidity-sensitive devices.
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

9.3 Bit error rate too high

- There is co-frequency signal interference nearby, stay away from the interference source or modify the frequency and channel to avoid interference;
- If the power supply is not ideal, it may also cause garbled characters. Be sure to ensure the reliability of the power supply;
- Poor quality or too long extension lines and feeders will also cause a high bit error rate;

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X Welding work guide

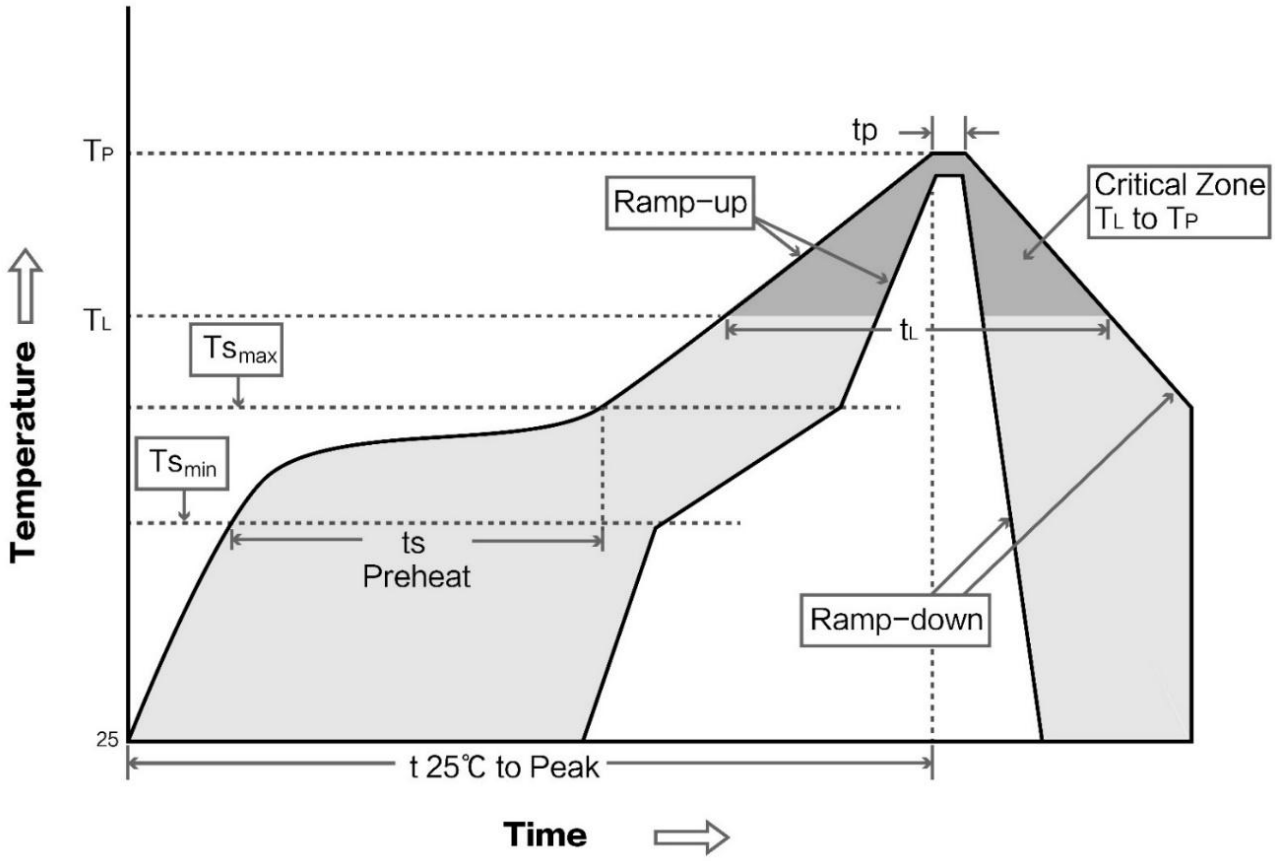
10.1 reflow temperature

Profile Feature	曲线特征 Curve feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	Minimum preheat temperature	100℃	150℃
Preheat temperature max (Tsmax)	maximum preheat temperature	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheat time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	average rate of ascent	3℃/second max	3℃/second max
Liquidous Temperature (TL)	liquidus 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 rate of descent	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time from 25°C to peak temperature	6 minutes max	8 minutes max

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10.2 Reflow Soldering Curve



XI Related models

Product number	Chip	carrier frequency Hz	transmit power dBm	test distance km	air speed bps	Package form	Product Size mm	Antenna form
E49-400T20S	-	433M	20	1	1.2k~200k	SMD	26 * 16	IPEX/stamp hole

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XII Antenna Guide

12.1 Antenna recommendation

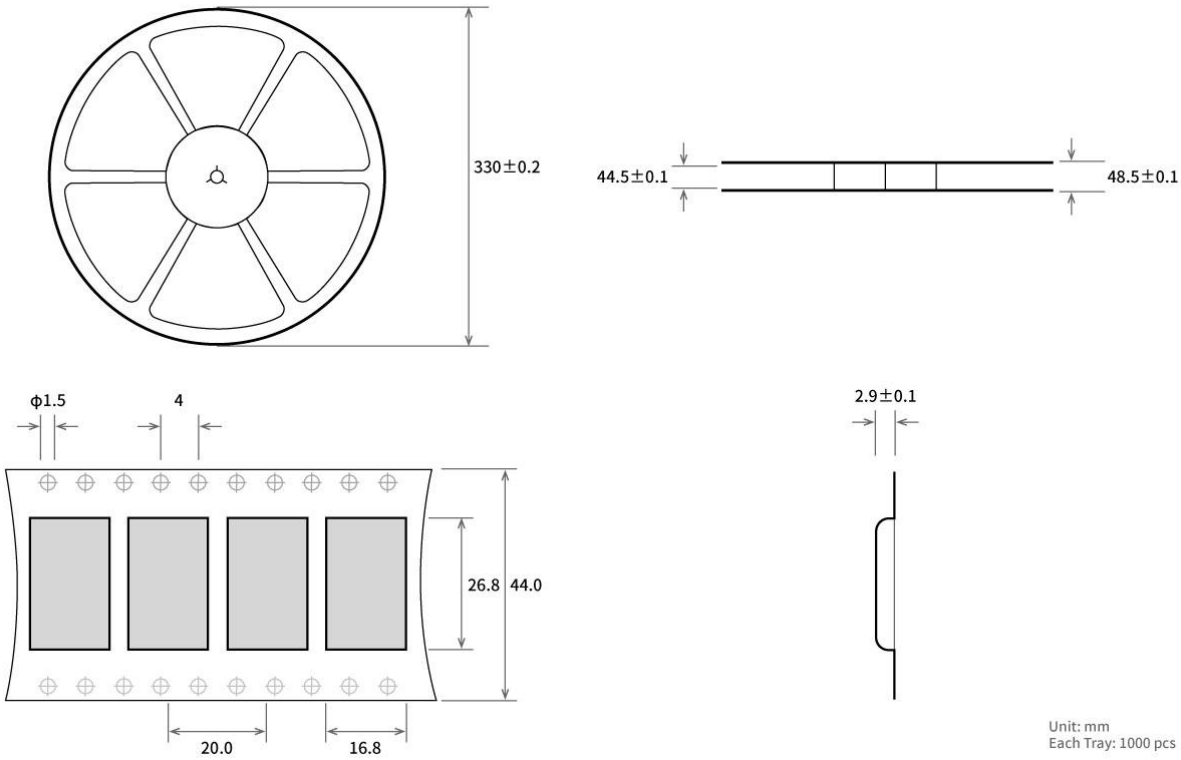
Antennas play an important role in the communication process, and often inferior antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as antennas with excellent performance and reasonable price for our wireless modules.

product model	Type	frequency band Hz	Interface	Gain dBi	Height	Feeder	Feature
TX433-NP-4310	flexible PCB Antenna	433M	SMA-J	2	43.8*9.5mm	-	Built-in flexible, FPC soft antenna
TX433-JW-5	glue stick antenna	433M	SMA-J	2	50mm	-	Bendable glue stick, omnidirectional antenna
TX433-JWG-7	glue stick antenna	433M	SMA-J	2.5	75mm	-	Bendable glue stick, omnidirectional antenna
TX433-JK-20	glue stick antenna	433M	SMA-J	3	210mm	-	Bendable glue stick, omnidirectional antenna
TX433-JK-11	glue stick antenna	433M	SMA-J	2.5	110mm	-	Bendable glue stick, omnidirectional antenna
TX433-XP-200	sucker antenna	433M	SMA-J	4	19cm	200cm	Suction cup antenna, high gain
TX433-XP-100	sucker antenna	433M	SMA-J	3.5	18.5cm	100cm	Suction cup antenna, high gain
TX433-XPH-300	sucker antenna	433M	SMA-J	6	96.5cm	300cm	Vehicle suction cup antenna, super high gain
TX433-JZG-6	glue stick antenna	433M	SMA-J	2.5	52mm	-	Ultra-short straight, omnidirectional antenna
TX433-JZ-5	glue stick antenna	433M	SMA-J	2	52mm	-	Ultra-short straight, omnidirectional antenna
TX490-XP-100	sucker antenna	490M	SMA-J	50	12cm	100cm	Suction cup antenna, high gain
TX490-JZ-5	glue stick antenna	490M	SMA-J	50	50mm	-	Ultra-short straight, omnidirectional antenna

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XIII Bulk packaging



Revise history

Version	Revise date	Revise instrucion	Maintainer

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