RD400D User Manual

410-470MHz Data transmission module (radio)

TRIMTALK/TRIMMARK3/TRANSEOT



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Contents

Disclaimer 2
Chapter 1 Product Overview 3
1.1 Product Introduction 3
1.2 Features and Functions 3
1.3 Application scenarios 3
Chapter II: Specification Parameters 4
2.1 Limit parameters 4
2.2 Working parameters 4
Chapter 3 Mechanical Dimensions and Pin Definition 6
Chapter 4 Wiring diagrams are recommended 7
Chapter 5 Working mode 7
5.1 Configuration Mode 7
5.2 Data transmission mode 7
Chapter 6 Operation instructions 7
6.1 Transmit frequency configuration 8
6.2 Transmit frequency query 8
6.3 Receive frequency configuration 9
6.4 Receive frequency query 9
6.5 Protocol configuration 9
6.6 Protocol Inquiry 10
6.7 Air Rate Configuration 10
6.8 Air Rate Query 10
6.9 Power Mode Configuration 11
6.10 Power Mode Query 11
6.11 Hardware version number query 11
6.12 SN Code Query 12
6.13 Software Version Number Query 12
6.14 Serial port baud rate configuration 12
6.15 Serial port baud rate query 13
Chapter 7 Quick to use 13
7.1 Radio parameter configuration 13
7.2 Communication test 13
IAP Online Firmware Upgrade 14
Chapter 8 Hardware design 15
Chapter 9 Frequently Asked Questions 16
9.1 The transmission distance is not ideal 16
9.2 Modules are easily damaged 17
9.3 The bit error rate is too high 17
Chapter 10 Welding Work Instructions 17
10.1 Reflow temperature 17
10.2 Reflow curve 18
Chapter 11 Related Models 19
Revision history 19

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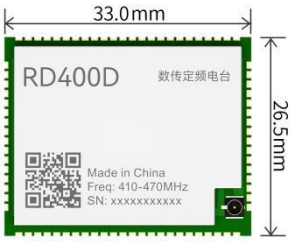
Chapter 1 Product Overview

1.1 Product Introduction



RD400D is a table mounted built-in fixed-frequency transceiver-transmitter data transmission module (radio), working in the 410MHz~470MHz frequency band, focusing on surveying and mapping, precision agriculture, drones and the Internet of Things The application environment has the characteristics of light weight, small size, low power consumption and superior reception performance. It supports a variety of power gear selection, free switching of air baud rate, rich serial port baud rate selection, and easy operation. SUPPORT FOR TRIMTALK, TRIMMARK3, TRANSEOT (OR PCC OR TRANSPARENT PROTOCOL). and other mainstream transmission protocols in the industry, supporting a variety of serial port baud rate options: 9600bps, 19200bps, 38400bps, 57600bps 、115200bps；

1.2 Features and Functions

- Ultra-small size, only 33x26.5mm;
- Maximum transmit power 30dBm;
- Built-in 40MHz temperature compensated crystal oscillator;
- Support 3.3~3.6V power supply, greater than 3.3V power supply can ensure the best performance;
- Support frequency band 410MHz~470MHz;
- IPEX antenna interface design is used to facilitate built-in integration；
- Air speed support4800bps、9600bps, 19200bps;
- Support a variety of serial port baud rate options: 9600bps, 19200bps, 38400bps, 57600bps, 115200bps（default）;
- Support serial port IAP online firmware upgrade;
- Under ideal conditions, the communication distance can reach 5.6Km;
- Support compatible with a variety of data transmission protocols in the industry: support TRIMTALK, TRIMMARK3, TRANSEOT (or PCC or transparent protocol) and other mainstream transmission protocols in the industry.
- Support point-to-point and point-to-multipoint communication;
- Built-in watchdog and hardware reset function to prevent system crash;
- Industrial-grade standard design, support long-term use at -40~+85°C;

1.3 Application scenarios

- surveying and precision agriculture;
- Drone;
- IoT applications;
- Driving test driving training.

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Chapter II: Specification Parameters

2.1 Limit parameters

Main parameters	performance		remark
	minimum	maximum	
Supply voltage (V).	3.3	3.6	More than 3 6V permanently burns out the module
Operating temperature(°C)	-40	+85	Industrial grade
Storage temperature (°C).	-40	+125	-

2.2 Working parameters

Main parameters		performance			remark
		minimum	Typical value	maximum	
Normal voltage mode		-	3.3	3.6	≥3.3V guarantees output power
Communication level (V).		-	3.3	-	There is a risk of burning out with 5V TTL
Operating frequency band (MHz).		410	450	470	-
Transmit power (dBm).	High power	-	30	-	±0.5dBm@3.3V DC
	Low power	-	27	-	
Receive sensitivity (dBm).		-	-115	-	@BER 10^{-3}，9600bps
power consumption	Transmit current (mA).	-	1066	-	@30dBm
	Receive current (mA).	-	50	-	-

Transmitter performance specifications		
Main parameters	**description**	**remark**
RF power stability	±1dB	-
Adjacent channel power	>50dB	-
Second harmonic	<-25dBm	-
Receiver performance specifications		
Main parameters	**description**	**remark**
Common-channel rejection	>-12dB	-
Adjacent channel selectivity	>50dB@25KHz	-
Stray immunity	>50dB	-
Air rate	4800bps、9600bps、19200bps	TRIMTALK supports 4800bps,

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		9600bps, TRIMMARK3 supports 19200bps, TRANSEOT supports 4800bps and 9600bps.

Main parameters		description	remark
Reference distance		5.6Km	Clear and open environment, height 2.0 meters, @ 30dBm, airspeed 9600bps
Modulation mode		GMSK/4FSK	-
transmission rate	TRIMTALK	950 bytes/s	@Serial port baud rate 115200, air baud rate 9600
	TRIMMARK3	1300 bytes/（750ms）	@Serial port baud rate 115200, air baud rate 19200
	TRANSEOT	600 bytes/s	@Serial port baud rate 115200, air baud rate 9600
Communication interface		UART	-
Frequency stability		≤±1.0ppm	-
Working mode		Half duplex	-
Encapsulation method		SMD	-
Form factor		33*26.5*3.7mm	±0.1mm
Antenna interface		Stamp hole, IPEX	The equivalent impedance is about 50Ω
Number of pins		80	-
Product weight		4.8g	±0.1g

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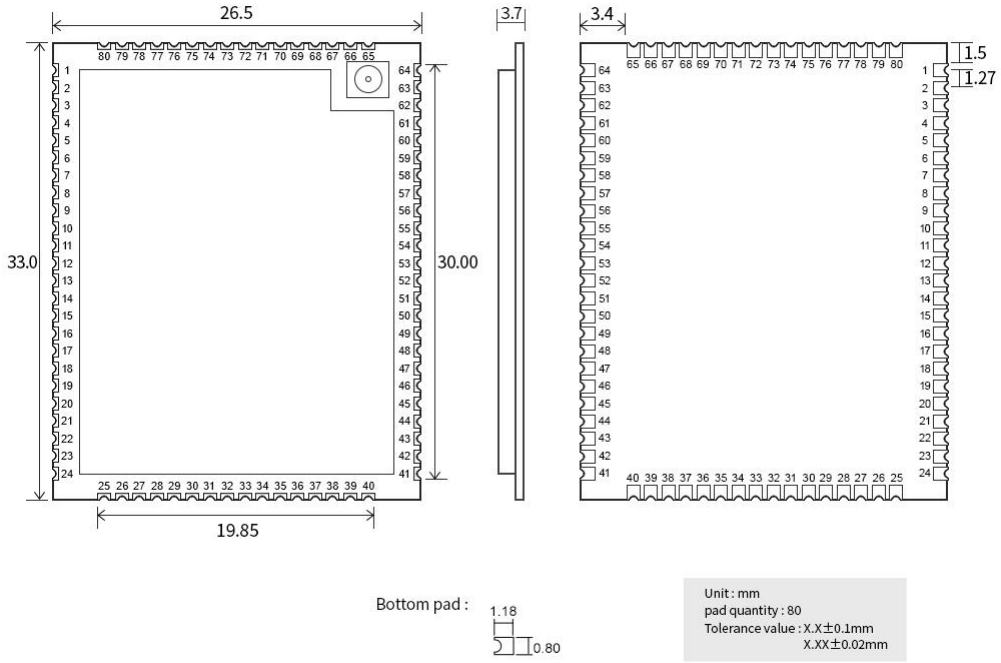
Chapter 3 Mechanical Dimensions and Pin Definition



Pin serial number	Pin name	Input/output	Pin usage
1	GND	Input/output	Power ground
2	RSSI	output	Analog voltage output, indicating received signal strength, voltage output range: 0.5V-2.5V 。 The higher the voltage, the stronger the signal reception.
3-6	NC	input	Dangling (for internal testing use)
7-9	NC	NC	
10-13	I/O	Input/output	obligate
14-16	NC	NC	
17	GND	Input/output	Power ground
18-19	NC	NC	
20-24	I/O	obligate	obligate
25-26	GND	Input/output	Power ground
27	NC	NC	
28	RXD	input	Serial port receiving interface
29	TXD	output	Serial port send interface
30-36	NC	NC	
37-38	NC	input	obligate
39-41	GND	Input/output	Power ground

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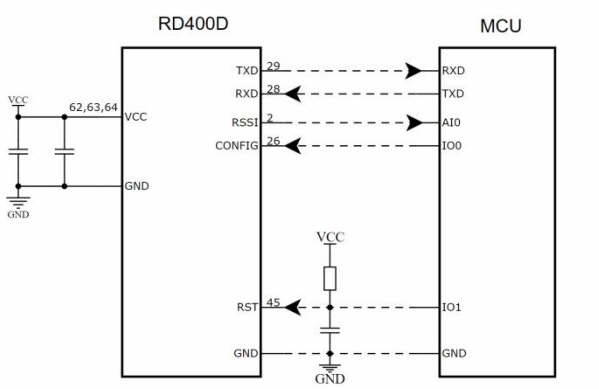
42-44	NC	NC	
45	RST	input	Module reset pin, active low
46	CONFIG	input	Module parameter configuration mode control pin, low level into parameter configuration mode, High level exits parameter configuration mode
47-61	NC	NC	
62-64	VCC	input	Power input pin (3.3-3.6V), the use of the need to 62, 63, 64 pin all connected.
65-67	GND	Input/output	Power ground
68-77	NC	NC	
78-80	GND	Input/output	Power ground

Chapter 4 Wiring diagrams are recommended



Chapter 5 Working mode

5.1 Configuration Mode

Configure the configuration pin CONFIG(pin 46) to low level (that is, connect to GND), then the module enters the parameter configuration mode, in which the module (radio) parameters can be configured.

5.2 Data transmission mode

Configure the configuration pin CONFIG(pin 46) to high level (that is, connect to 3.3V), then exit the module parameter configuration mode (that is, enter the data transmission mode), in which the module (radio) can send and receive data.

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Chapter 6 Operation instructions

Note:

- **The module (radio) should be in configuration mode when sending operation instructions.**
- **All commands need to be followed by a carriage return.**
- **Commands and parameters are separated by 1 space symbol.**
- **Module (radio) factory default parameters:**

Protocol	Emission Frequency	Received Frequency	Air wave rate	Power mode	Serial port Baud rate
TRIMTALK	450.500	450.500	9600	H	115200

6.1 Transmit frequency configuration

directives	illustrate
TX XXX.XXX	“XXX.XXX”Frequency parameters, frequency range410.000≤XXX.XXX＜470.000unitMHz。
RETURN PROGRAMMED OK > Explanation: The receive frequency configuration was successful. For example: Send TX 463.125 RETURN PROGRAMMED OK > The receiving frequency of the module (radio) is configured to be 463.125MHz.	

6.2 Transmit frequency query

directives	illustrate
TX	Send command "TX" can query the current module (radio) working transmit frequency.
返回 TX XXX. XXX00 MHz > Explanation: "XXX XXX00 MHz is the current transmit frequency parameter. For example: Send TX Returns T x 463.12500 MHz > The receiving frequency of the module (radio) is 463.12500MHz.	

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6.3 Receive frequency configuration

directives	illustrate
RX XXX.XXX	“XXX.XXX”Frequency parameters, frequency range410.000≤XXX.XXX＜470.000unitMHz。
RETURN PROGRAMMED OK > Explanation: The receive frequency configuration was successful. For example: Send Rx 463.125 RETURN PROGRAMMED OK > The receiving frequency of the module (radio) is configured to be 463.125MHz.	

6.4 Receive frequency query

directives	illustrate
RX	Sending the command "RX" can query the receiving frequency at which the current module (radio) is working.
返回 RX XXX. XXX00 MHz > Explanation: "XXX XXX00 MHz is the current receive frequency parameter. For example: Send RX Returns RX 463.12500 MHz > The receiving frequency of the module (radio) is 463.12500MHz.	

6.5 Protocol configuration

directives	illustrate
PRT XXX	"XXX" communication protocol parameters, the list of currently supported communication protocols is as follows: TRIMTALK, TRIMMK3, TRANSEOT, etc.
RETURN PROGRAMMED OK > Explanation: The configuration was successful For example: SEND PRT TRIMTALK RETURN PROGRAMMED OK >	

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The communication protocol is configured successfully.

6.6 Protocol Inquiry

directives	illustrate
PRT	Query the communication protocol that the current module (radio) is working on.
Returns PRT XXX > Explanation: "XXX" is a communication protocol parameter. For example: Send PRT RETURNS PRT TRIMTALK > The communication protocol of the module (radio) is TRIMTALK.	

6.7 Air Rate Configuration

directives	illustrate
BAUD XXX	"XXX" air rate parameter, different protocols support different air rates: TRIMTALK SUPPORTS 9600 bps, TRIMMARK3 SUPPORTS 19200bps, and Transeot bps。
RETURN PROGRAMMED OK > Explanation: The air rate configuration was successful. Send BAUD 9600 RETURN PROGRAMMED OK > The air baud rate of the module (radio) is configured to be 9600bps.	

6.8 Air Rate Query

directives	illustrate
BAUD	Query the current module (radio) working air baud rate
RETURNS BAUD XXX > Explanation: "XXX" refers to the air rate parameter For example: Send BAUD Returns BAUD 9600 >	

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The module (radio) has an air baud rate of 9600bps.

6.9 Power Mode Configuration

directives	illustrate
PWR XXX	"XXX" transmit power mode parameters, support three modes: H, M, L. H is the high power mode, M is the normal power mode, and L is the low power mode.
RETURN PROGRAMMED OK > Explanation: When this command is returned, the configuration is successful. For example: Send PWR H RETURN PROGRAMMED OK > The power mode configuration is successful.	

6.10 Power Mode Query

directives	illustrate
PWR	Query the current module (radio) power mode.
Returns PWR XXX > Explanation: "XXX" is the power mode For example, sending PWR Returns PWR H > The current module (radio) is in high power mode.	

6.11 Hardware version number query

directives	illustrate
EVERY	Query the current module (radio) hardware version number
Returns HVER XXX > Explanation: "XXX" represents the version number For example: Send HVER	

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Returns HVER V0R1 > The current hardware version is VOR1 version.

6.12 SN Code Query

directives	illustrate
SER	Query module (radio) SN code
Returns SN: XXXXXXX > Explanation: "XXXXXXX" is the 14-bit SN code For example: Send SER Returns SN: S3200291S00009 > The SN code of the module (radio) is S3200291S00009.	

6.13 Software Version Number Query

directives	illustrate
SREV	Query the current module (radio) software version number
返回 SREV XXXX. XX. XX > Explanation: "XXXX XX. XX" identifies the version number For example: Send SREV Returns SREV A001.02.01 > The current software is version A001.02.01.	

6.14 Serial port baud rate configuration

directives	illustrate
SBAUD XXX	"XXX" serial port baud rate parameter, the list of supported serial port baud rate is as follows: 9600,19200,38400,57600,115200
RETURN PROGRAMMED OK > For example: send SBAUD 115200 RETURN PROGRAMMED OK >	

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The serial port baud rate is configured successfully.

6.15 Serial port baud rate query

directives	illustrate
SBAUD	Query current module (radio) serial port baud rate.
Returns SBAUD XXX > Explanation: "XXX" is the serial port baud rate parameter For example: Send SBAUD Returns SBAUD 115200 > The current module (radio) serial port baud rate is 115200bps.	

Chapter 7 Quick to use

Using two RD400D modules, for ease of description, RD400D Module 1 is named Radio A, RD400D Module 2 Named Radio B.

Notes:

(1) The radio only supports half-duplex communication, that is, two modules cannot send data at the same time;

(2) The radio station must work in data transmission mode;

Note: After the radio is turned on, the following message "into boot" will be output, if you do not receive this message, you need to check whether the serial port connection is correct.

7.1 Radio parameter configuration

Configure the parameters of station A and station B as shown in the following table

Module	Communication protocol	Emission frequency	Receiving frequency	Air rate	Power mode	Serial port baud rate
Radio A	TRIMTALK	463.125	463.125	9600	L	115200
Radio B	TRIMTALK	463.125	463.125	9600	L	115200

7.2 Communication test

Configure the communication mode of station A and station B as data transmission mode, connect station A and station B to the serial port debugging assistant, station A and radio station B sends data to each other, you can see the data reception of station A and station B, as shown in the following figure

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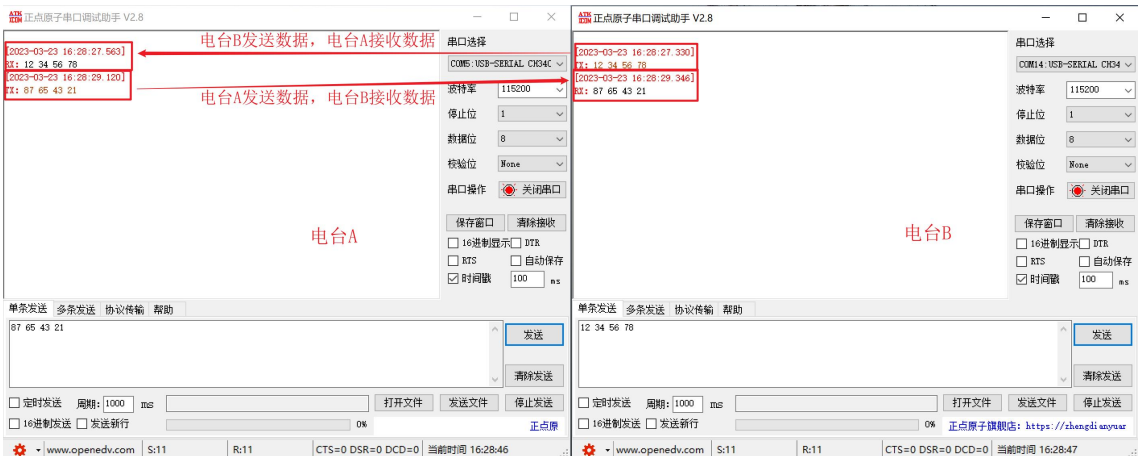

Data sending and receiving diagram

IAP Online Firmware Upgrade

IAP (In Application Programming) is online application programming, this module uses this method to upgrade the firmware serial port online.

- **The host computer command is upgraded**

1、Configure the radio configuration pin CONFIG (pin 46) to high (that is, connected to 3.3V), then exit the module parameter configuration mode (that is, enter the data transmission mode);

2、Open the "Radio Upgrade Tool" downloaded from the official website, select Serial Port > Open the serial port;



3、Click Click Click to open the file (select Firmware. DWN file) > Click to start the update;

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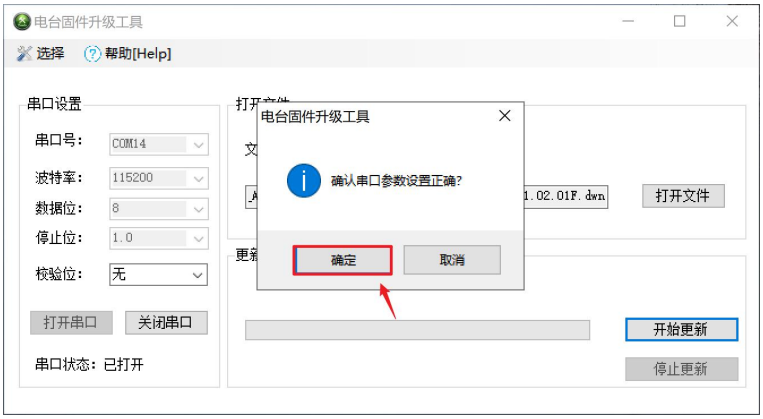
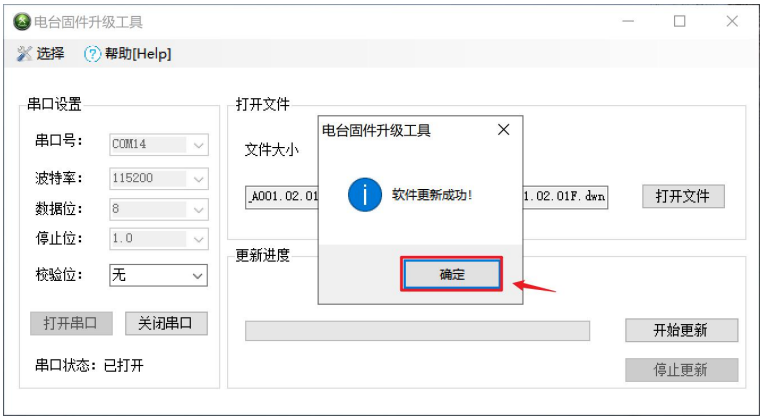
4、Click OK to confirm that the serial port parameters are set correctly;



5、After the firmware upgrade is complete, click OK to complete the firmware upgrade.



Chapter 8 Hardware design

- It is recommended to use a DC regulated power supply to supply the module, the power 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, such as reverse polarity may cause permanent damage to the module;
- Please check the power supply to ensure that between the recommended supply voltage, if the maximum value is exceeded, it

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will cause permanent damage to the module;

- Please check the stability of the power supply, the voltage cannot fluctuate greatly and frequently;
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, which is conducive to long-term stable work of the whole machine;
- The module should be 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 bottom of the module, if it is really necessary to pass under the module, assuming that the module is welded in the Top Layer, the Top Layer of the module contact part of the copper (all copper is paved and well grounded), must be close to the module digital part and routed in Bottom Layer;
- Assuming that the module is soldered or placed in the Top Layer, it is also wrong to route the wires at will in the Bo ttom Layer or other layers, which will affect the spurious and receiving sensitivity of the module to varying degrees;
- Assuming that there are devices with large electromagnetic interference around the module, it will also greatly affect the performance of the module, and it is recommended to stay away from the module appropriately according to the intensity of interference, and 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) will also greatly affect the performance of the module, it is recommended to stay away from the module appropriately according to the intensity of interference, and appropriate isolation and shielding can be done if the situation allows;
- If the communication line uses 5V level, 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);
- The antenna installation structure has a great impact on the performance of the module, and it is important to ensure that the antenna is exposed, preferably vertically upward. When the module is installed inside the chassis, a high-quality antenna extension cable can be used to extend the antenna to the outside of the chassis;
- The antenna must not be installed inside the metal case, which will greatly weaken the transmission distance.

Chapter 9 Frequently Asked Questions

9.1 The transmission distance is not ideal

- When there is a straight-line communication barrier, the communication distance will be attenuated accordingly;
- Temperature, humidity, and co-channel interference will lead to an increase in the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect near 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 placed in a metal case, the signal attenuation will be very serious;
- the power register is set incorrectly, 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 smaller the power;
- The antenna used is poorly matched to the module or the quality of the antenna itself.

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9.2 Modules are easily damaged

- Please check the power supply to ensure that between the recommended supply voltages, exceeding the maximum value will cause permanent damage to the module;
- Please check the stability of the power supply, the voltage cannot fluctuate greatly and frequently;
- Please ensure that the installation and use process of anti-static operation, high-frequency devices electrostatic sensitivity;
- Please ensure that the humidity during installation and use should not be too high, and some components are humidity sensitive devices;
- If there is no special need, it is not recommended to use it at too high or too low temperature.

9.3 The bit error rate is too high

- There is co-channel 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 characters, be sure to ensure the reliability of the power supply;
- Poor or long quality extension wires and feeders can also cause high bit error rates.

Chapter 10 Welding Work Instructions

10.1 Reflow temperature

In reflow soldering, all temperatures refer to the core temperature of the package and are measured on the upward surface of the package (leads facing down, i.e. the live worm is facing). If reflow soldering does not measure the temperature of the module in the direction of the live worm (the lead is placed up, that is, the dead worm is facing), the measured Tp temperature is within ±2°C of the measured Tp temperature in the direction of the live worm, which still meets the requirements of Tc. Otherwise, the temperature curve should be adjusted to meet the requirements of Tc, and in order to accurately measure the actual peak temperature of the package body, it is recommended to use the method recommended by JEP140 for furnace temperature testing.

In order to obtain better welding results, the production workshop recommends controlling the constant temperature condition of 25°C.

When the welded part needs to reset the temperature profile, a load-bearing fixture of the same construction should be used to pass reflow soldering, or it has been verified to have an equivalent thermal load.

The reflow curves in this document are specific to the recommendations provided for only soldering Ebaite modules, and cannot be used to confirm the user's actual assembly curve. The actual production process of the user should develop the actual production assembly curve according to the specific production process, needs and circuit board design, and should not exceed the parameters in the following table.

Reflow curve characteristics		There is a lead process assembly	Lead-free process assembly
Preheat/inhold	Minimum Temperature (Tsmin)	100°C	150°C

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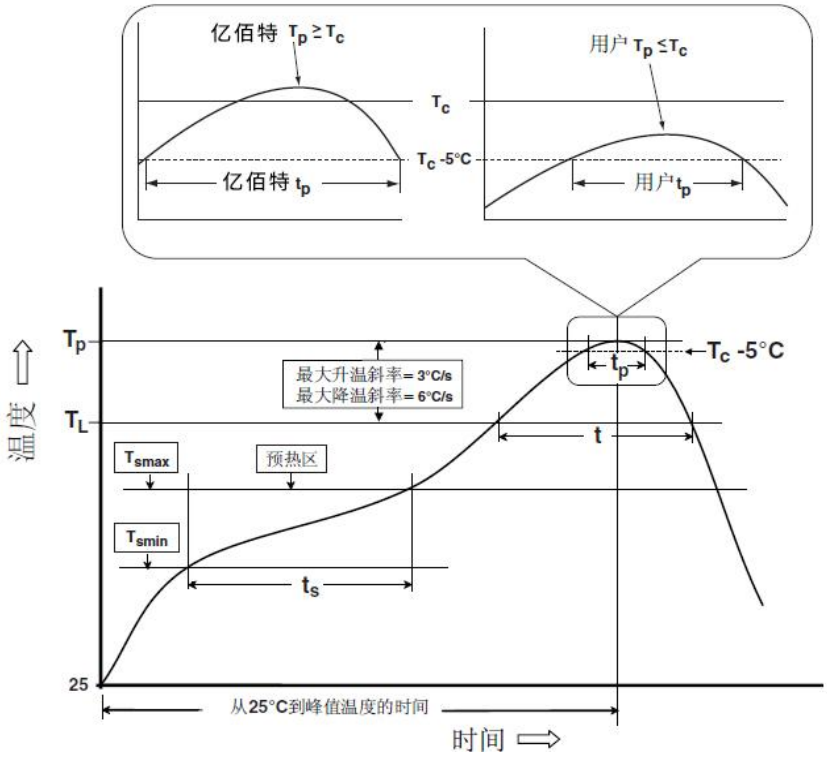
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin ~ Tsmin).	60-120 seconds	60-120 seconds
Heating slope (TL~Tp).		3°C/sec, max	3°C/sec, max
Liquid phase temperature (TL).		183℃	217℃
TL above hold time		60~90 seconds	60~90 seconds
Package body peak temperature Tp		The user must not exceed the temperature indicated on the product's "Moisture Susceptibility" label.	The user must not exceed the temperature indicated on the product's "Moisture Susceptibility" label.
The time (Tp) within 5°C of the specified classification temperature (Tc) is shown in the figure below		20 seconds	30 seconds
Cooling slope (Tp~TL).		6°C/sec, max	6°C/sec, max
The time from room temperature to peak temperature		6 minutes, the longest	8 minutes, the longest
※The peak temperature (Tp) tolerance definition of the temperature curve is the upper limit of the user			

10.2 Reflow curve



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Chapter 11 Related Models

Product model	Chip solution	Carrier frequency Hz	Transmit power dBm	Product size mm	Package form	Antenna form
E610-433T20S	-	410～441M	20	16*26	SMD	IPX
E610-433T30S	-	410～441M	30	25*40.5	SMD	Stamp hole/IPX

Revision history

version	Revision date	Revision Instructions	Maintainers
1.0	2023-03-22	Initial version	Bin
1.1	2023-05-22	Error corrected	Bin
1.2	2024-03-27	Error corrected	Bin

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