E22-xxxT37S User Manual

230/433/470MHz 5W LoRa Wireless Module

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Contents

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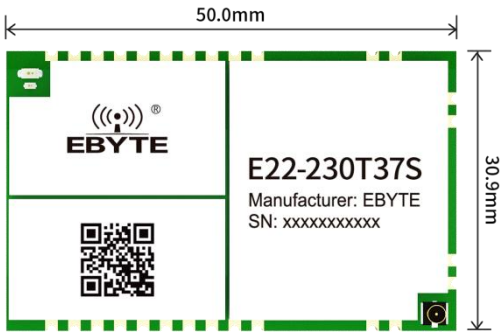
1 Product Overview

1.1 Product Introduction

E22-xxxT37S is a new generation of LoRa wireless data transmission module. This series (UART) module is developed based on SEMTECH high-performance RF chip . Its maximum transmission power is 37 dBm, with multiple transmission modes, working frequency bands in 230 band and 400 band , LoRa spread spectrum technology, TTL level output, and supports 4.5V - 15V wide voltage power supply.

E22-xxxT37S adopts the new generation of LoRa spread spectrum technology, supports air wake-up, wireless configuration, carrier monitoring, automatic relay, communication key and other functions, supports packet length setting, and can provide customized development services . The following two products only have different frequency bands and the same package size.



1.2 Features

- Adopting the new LoRa spread spectrum modulation technology, it brings a longer communication distance and stronger anti-interference ability;
- Supports automatic relay networking, multi-level relay is suitable for ultra-long-distance communication , and multiple networks can run simultaneously in the same area;
- Supports users to set communication keys by themselves, which cannot be read, greatly improving the confidentiality of user data;
- Supports LBT function, which monitors the channel environment noise before sending, and can greatly improve the communication success rate of the module in harsh environments;
- Supports RSSI signal strength indication function to evaluate signal quality and improve communication network;
- Supports wireless parameter configuration, remotely configure or read wireless module parameters by sending command data packets wirelessly;
- Supports wake-up on the air, an ultra-low power consumption feature suitable for battery-powered applications;
- Supports fixed-point transmission, broadcast transmission, and channel monitoring;
- Supports deep sleep in the full power supply range, and the power consumption of the whole machine is less than 10uA in this mode;
- Supports the global license-free ISM 433MHz frequency band and the 470MHz meter reading frequency band;
- Supports wireless meter reading frequency band 230MH band;

- 20 km under ideal conditions ;
- The parameters are saved when power is off, and the module will work according to the set parameters after power is turned on again;
- Efficient watchdog design, once an abnormality occurs, the module will automatically restart and continue to work according to the previous parameter settings;
- Supports data transmission rates of 2.4kbps to 62.5 kbps;
- Supports 4.5 ~ 1.5 V wide voltage power supply, and can guarantee 37dBm power output in the full power supply range;
- Industrial-grade standard design, supports long-term use at -40～+85℃;
- The maximum module power can reach 5W (37dBm), and the transmission is farther and more stable.
- The module has built-in undervoltage and overvoltage warning functions and a built-in warning LED.
- The module has a built-in over-temperature protection function, which will automatically stop sending when the maximum temperature of the module is exceeded.
- A matrix pad is reserved at the bottom of the module to facilitate heat dissipation for secondary development.

1.3 Application Scenario

- Home security alarm and remote keyless entry;
- Smart home and industrial sensors, etc.
- Wireless alarm security system ;
- Building automation solutions;
- Wireless industrial remote control;
- Healthcare products;
- Advanced Metering Infrastructure (AMI);
- Automotive industry applications.

2 Specifications

2.1 Limit parameters

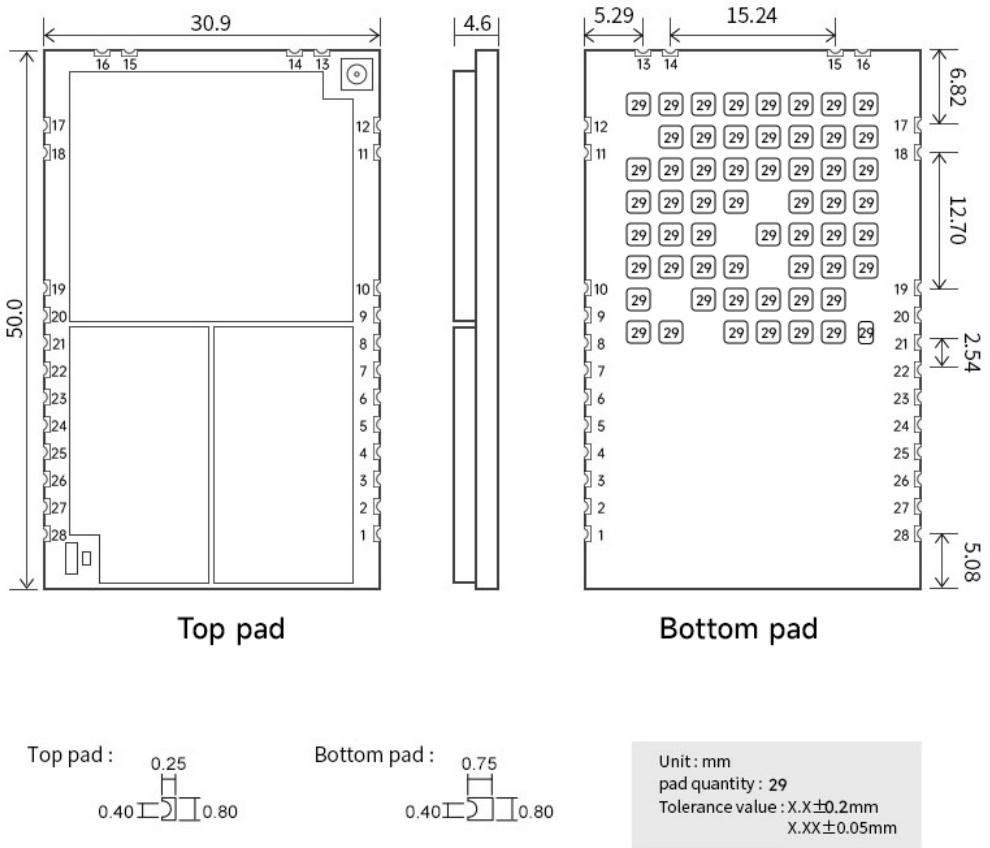
Main parameters	Performance		Remark
	Minimum	Maximum	
Supply voltage (V)	4. 5	1 5	Exceeding 15 V may permanently burn the module
Blocking power (dBm)	-	10	Do not communicate at close range with high-power radio frequency
Operating temperature (℃)	-40	+ 85	Industrial Grade

2.2 Working Parameters

Main parameters		Performance			Remark
		Minimum	Typical Value	Maximum	
Operating voltage (V)		4. 5	5 ~ 12V	15	≥ 5 V can guarantee output power, the lower the voltage, the greater the supply current
Communication level (V)		-	3. 3	-	Using 5V level may cause burnout risk, so a level conversion circuit is required
Operating temperature (℃)		-40	-	85	Industrial-grade design
Working frequency band (MHz)		410.125	-	493.125	Applicable to E22-400T37S, supports ISM band
		220.125	-	236.125	Applicable to E22-230T37S, supports 230MHz meter reading frequency band
Power consumption	5V emission current (mA)	2900	3100	3300	Tested under 50 ohm impedance. Impedance mismatch may result in excessive current. When using 5V power supply, please provide a power supply with at least 3.5A output.
	12V emission current (mA)	900	1100	1300	Tested under 50 ohm impedance. Impedance mismatch may cause excessive current. When using 12V power supply, please provide a power supply with at least 1.5A output
	Receive current (mA)	-	43	-	@DC 12V power supply
	Sleep current (uA)	-	2	-	Software shutdown
Maximum transmit power (dBm)		36	37	37.5	-
Receiving sensitivity (dBm)		- 125	- 126	- 127	Air data rate 2.4 kbps
Air data rate (bps)		0.3 k	2.4k	62.5k	User programmable control
Reference distance		20 km			Clear and open air, antenna gain 5dBi, antenna height 2.5 meters, air data rate 2.4kbps.

TX length	240 Bytes	The command can be set to send packets of 32/64/128/240 bytes
Cache capacity	1000 Byte	-
Modulation	LoRa	New generation LoRa modulation technology
Communication interface	UART Serial Port	TTL level
Packaging	SMD	
Interface	2.54mm stamp hole	
Dimensions	50*30.9mm	±0.1mm
RF Interface	IPEX generation /stamp hole	Characteristic impedance is about 50 ohms

3 Mechanical dimensions and pin definitions

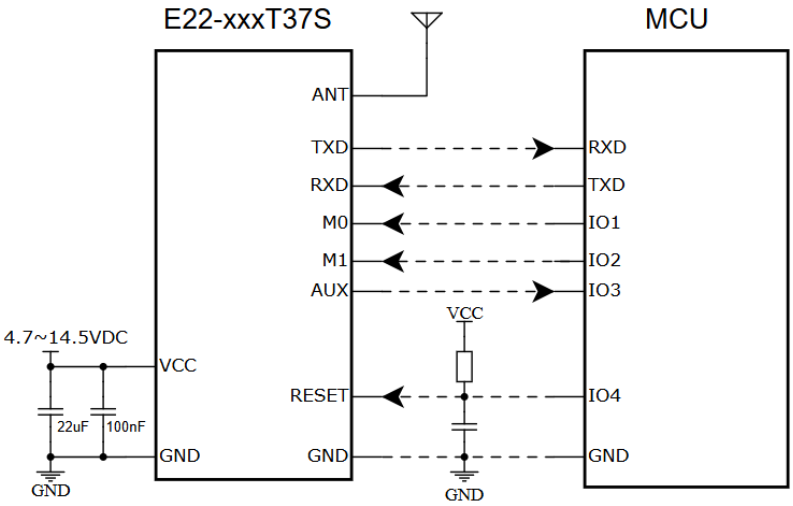


Serial number	Pinout	Pin Direction	Remark
1	GND	Input	Module ground wire
2	GND	Input	Module ground wire
3	VCC	Input	Module power positive reference, voltage range: 4.5 ~ 15 V DC
4	VCC	Input	Module power positive reference, voltage range: 4.5 ~ 15 V DC
5	RESET	Input	Module reset pin
6	AUX	Output	Used to indicate the working status of the module; the user wakes up the external MCU, and outputs a

			low level during the power-on self-test initialization period ; (can be left floating)
7	TXD	Output	TTL serial port output, connected to external RXD input pin;
8	RxD	Input	TTL serial port input, connected to external TXD output pin;
9	M1	Input (very weak pull-up)	Cooperate with M0 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used)
10	M0	Input (very weak pull-up)	Cooperate with M1 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used)
11	GND	Input	Module ground wire
12	GND	Input	Module ground wire
13	ANT	Output	Antenna interface (high frequency signal output, 50 ohm characteristic impedance)
14	GND	Input	Module ground wire
15	GND	Input	Module ground wire
16	GND	Input	Module ground wire
17	GND	Input	Module ground wire
18	GND	Input	Module ground wire
19	GND	Input	Module ground wire
20	STATE	Output	Module status indication output, if not used, just leave it unconnected
21	NC	-	No need to care, floating
22	NC	-	No need to care, floating
23	NC	-	No need to care, floating
24	NC	-	No need to care, floating
25	NC	-	No need to care, floating
26	NC	-	No need to care, floating
27	GND	Input	Module ground wire
28	NC	-	Floating
29	NC	-	The bottom of the module is reserved with matrix solder pads. Users need to ground them to assist in the heat dissipation of the module. For detailed dimensions, please refer to the PCB packaging diagram in the relevant download section of the Ebyte official website.

Note: The module must be connected to a 50 ohm impedance antenna when sending. No-load transmission may cause permanent damage to the module!!!

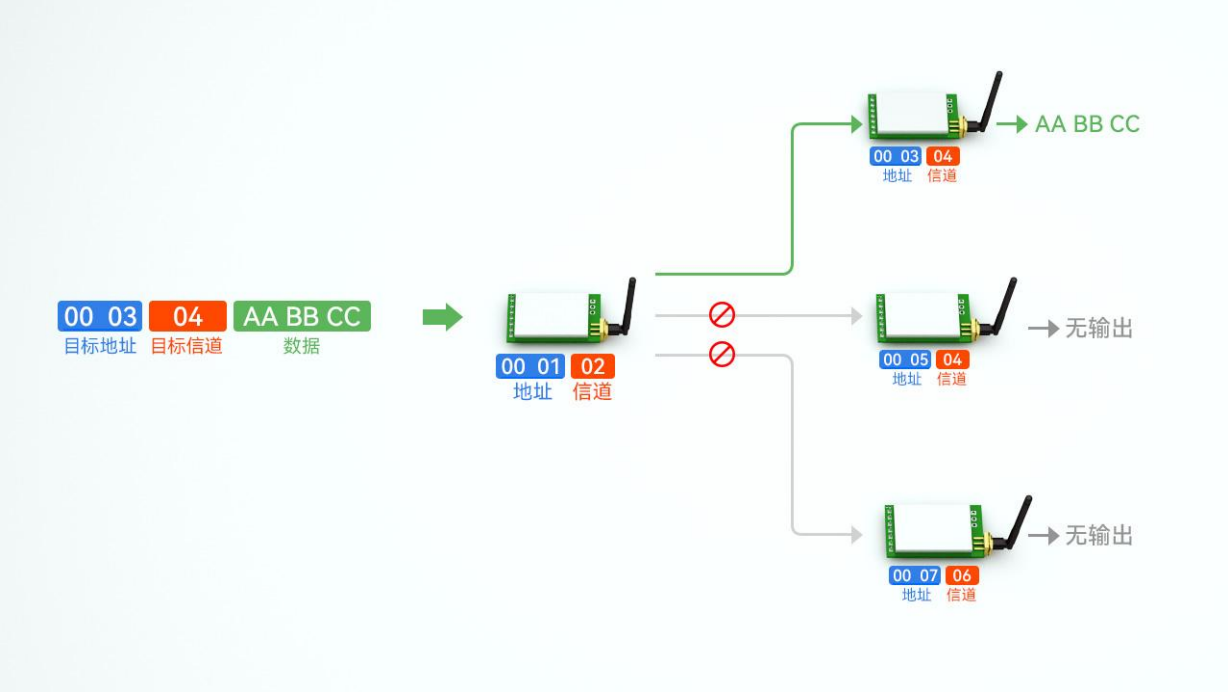
4 Recommended connection diagram



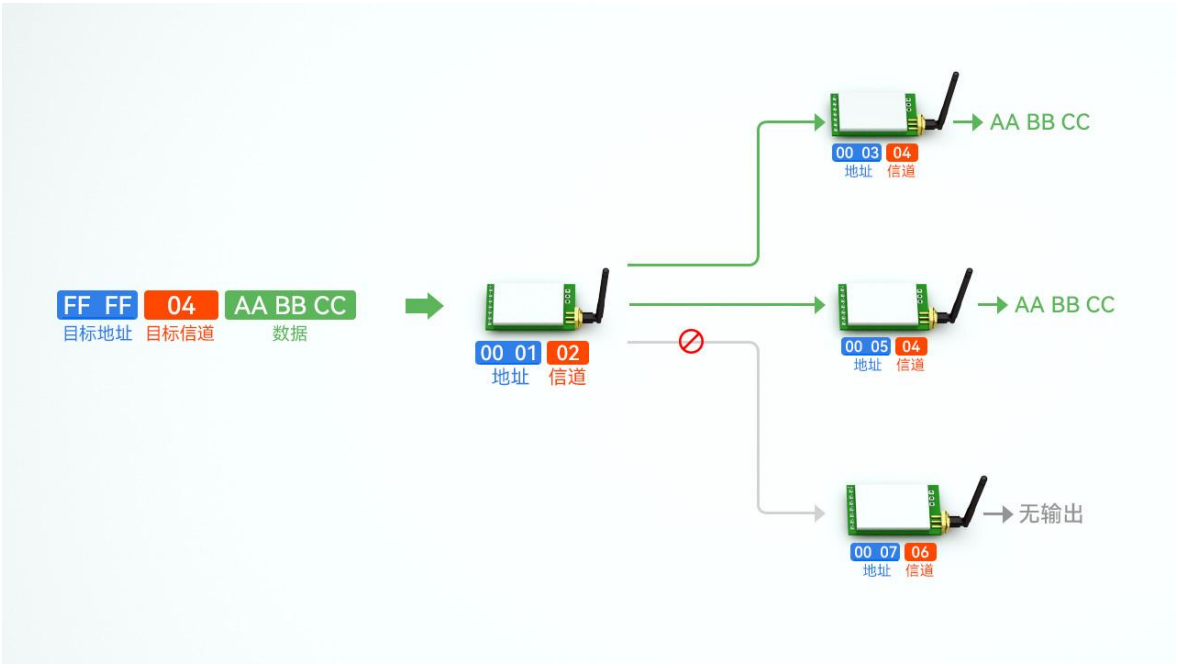
Serial number	Brief connection instructions between the module and the MCU (the above figure takes the STM8L MCU as an example)
1	The wireless serial port module is TTL level, please connect it to the TTL level MCU .
2	When using a 5V microcontroller, please perform level conversion.
3	A capacitor of no less than 47uF needs to be added to the power input end, and the capacitor ESR should be as low as possible to increase the stability of the module.
4	Power protection devices can be added according to actual needs.

5. Functional Details

5.1 Fixed - point transmission



5.2 Broadcast transmission



5.3 Broadcast Address

- For example: Set the module A address to 0xFFFF and the channel to 0x04.
- When module A is used as a transmitter (same mode, transparent transmission), all receiving modules under channel 0x04 can receive data, thus achieving the purpose of broadcasting.

5.4 Listening address

- For example: Set the module A address to 0xFFFF and the channel to 0x04.
- When module A is used as a receiver, it can receive all the data under channel 0x04 to achieve the purpose of monitoring.

5.5 Module Reset

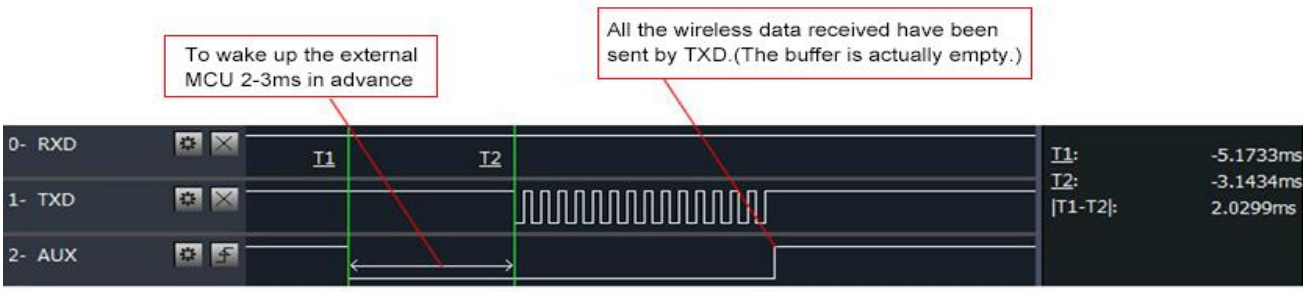
- After the module is powered on, AUX will immediately output a low level, perform a hardware self-check, and set the working mode according to user parameters;
  During this process, AUX maintains a low level. After completion, AUX outputs a high level and starts working normally according to the working mode composed of M1 and M0.
  Therefore, the user needs to wait for the AUX rising edge as the starting point for the module to work normally.

5.6 AUX Detailed Explanation

- AUX is used for wireless transceiver buffer indication and self-test indication.
- It indicates whether the module has data that has not been transmitted wirelessly, or whether the received wireless data has not been sent out through the serial port, or the module is in the process of initializing self-test.

5.6.1 Serial port data output indication

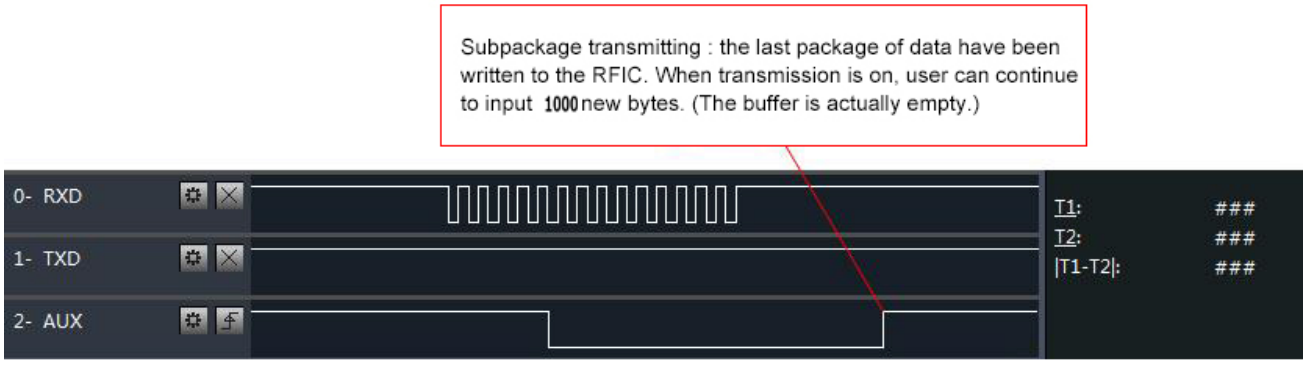
- Used to wake up the external MCU in sleep mode;



Timing Sequence Diagram of AUX when TXD pin transmits

5.6.2 Wireless transmission indication

- Buffer empty: data in the internal 1000-byte buffer are all written to the wireless chip (automatically divided into packets) ;
  When AUX=1, the user can continuously send data less than 1000 bytes without overflow ;
  When AUX=0, the buffer is not empty: the data in the internal 1000-byte buffer has not been fully written to the wireless chip and the transmission has not yet started. At this time, the module may have timed out waiting for the end of user data, or is transmitting wireless packets .
  【Note】: When AUX=1, it does not mean that all serial port data of the module has been transmitted wirelessly. It is also possible that the last packet of data is being transmitted.



Timing Sequence Diagram of AUX when RXD pin receives

5.6.3 The module is being configured

- Only when resetting and exiting sleep mode;

Timing Sequence Diagram of AUX when self-check

5.6.4 Notes

Serial number	AUX Notes
1	For the above functions 1 and 2, the output low level is given priority, that is, if any output low level condition is met, AUX will output low level; When all low-level conditions are not met, AUX outputs a high level.
2	When AUX outputs a low level, it means the module is busy and no working mode detection will be performed at this time; When the module AUX outputs a high level within 1ms, the mode switching will be completed.

3	After the user switches to a new working mode, the module will not actually enter this mode until at least 2ms after the AUX rising edge. If AUX is always at a high level, the mode switch will take effect immediately.
4	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	Due to the characteristics of the LoRa modulation method, the information transmission delay is much longer than that of FSK. It is recommended that customers do not transmit large amounts of data at low airspeeds to avoid data loss and communication abnormalities caused by data accumulation.

5.7 Detailed explanation of abnormal working status log printing

1. The S T ATE indicator light/status indication pin will flash/level according to the specific abnormal working status according to the table below.

Abnormal working status	Threshold for judging abnormal status	Indicator light flashing
Undervoltage	Supply voltage <4.5V	Flash once every 500ms/level flip
Overpressure	Supply voltage>15V	Flash once every 1s/level flip
Overheat	Module temperature>120°C	Flashes once every 2s/level flips
Overpressure and overheating	Supply voltage>15V and module temperature>120°C	Always on

2. The module will temporarily shut down the RF transmission function when it is in an abnormal working state, and will restart the transmission after it returns to normal working state.

3. The module will print a cyclic log every 500ms (can be turned on/off) in an abnormal state to inform the user of the current abnormal working state. The print log format is shown in the table below:

Abnormal working status	Print log format
Undervoltage	FF FF FF 01
Overpressure	FF FF FF 02
overheat	FF FF FF 03
Overpressure and overheating	FF FF FF 04

Exception log printing enable bit (bit 2 of instruction register 0 4H) 0: Disable 1: Enable The default value is 0 (disabled)

6 Working 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
0 Transfer Mode	0	0	Serial port open, wireless open, transparent transmission	Support special command air configuration
1 WOR mode	0	1	Can be defined as WOR sender and WOR receiver	Support air wake-up
2 Configuration Mode	1	0	Users can access the registers through the serial port to control the working status of the module	
3 Deep Sleep	1	1	The module enters sleep mode	

6.1 Mode Switching

SN	Remark
1	● The user can combine M1 and M0 with high and low levels to determine the module working mode. The MCU's two GPIOs can be used to control the mode switching; ● After changing M1 and M0: if the module is idle, it can start working in the new mode after 1ms; ● If the module has serial port data that has not been transmitted wirelessly, it can enter a new working mode only after the transmission is completed; ● If the module receives wireless data and sends data out through the serial port, it needs to finish sending before entering the new working mode; ● Therefore, mode switching is only effective when AUX output is 1, otherwise the switching will be delayed.
2	● For example, if a user continuously inputs a large amount of data and switches modes at the same time, the mode switching operation is invalid. The module will only detect a new mode after processing all user data. ● Therefore, the general recommendation is: detect the output status of the AUX pin and wait for 2ms after the output is high before switching.
3	● When the module is switched from other modes to sleep mode, if there is data that has not been processed; ● The module will enter sleep mode only after processing these data (including receiving and sending). This feature can be used for fast sleep, thus saving power consumption; for example: the transmitting module works in mode 0, the user initiates the serial port data "12345", and then there is no need to wait for the AUX pin to be idle (high level), it can directly switch to sleep mode and put the user's main MCU to sleep immediately. The module will automatically send all the user data wirelessly and automatically enter sleep within 1ms; ● This saves MCU working time and reduces power consumption.
4	● 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 eliminating the need for users to query AUX and achieving the purpose of fast switching. ● For example, switching from transmit mode to receive mode; the user MCU can also enter sleep mode in advance before the mode switch, and use the external interrupt function to obtain AUX changes to switch the mode.
5	● This operation mode is very flexible and efficient, designed entirely according to the operational convenience of the user's MCU, 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, M1 = 0, the module works in mode 0
Transmitting	The user can input data through the serial port, and the module will start wireless transmission.
Receiving	The module's wireless receiving function is turned on, and after receiving wireless data, it will be output through the serial port TXD pin.

6.3 WOR mode (mode 1)

Type	When M0 = 1, M1 = 0, the module works in mode 1
Transmitting	When defined as a transmitter, a wake-up code will be automatically added for a certain period of time before transmission.
Receiving	Data can be received normally, and the receiving function is equivalent to mode 0

6.4 Configuration mode (mode 2)

Type	When M0 = 0, M1 = 1, the module works in mode 2
Transmitting	Wireless Transmit Off
Receiving	Wireless reception off
Configuration	Users can access registers to configure module operating status

6.5 Deep sleep mode (mode 3)

Type	When M0 = 1, M1 = 1, the module works in mode 3
Transmitting	Unable to transmit wireless data.
Receiving	Unable to receive wireless data.
Notice	When entering other modes from sleep mode, the module will reconfigure parameters. During the configuration process, A UX remains at a low level. After completion, it outputs a high level, so it is recommended that users detect the rising edge of AUX.

7 Register read and write control

7.1 Instruction format

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

Serial number	Instruction Format	Detailed description
1	Setting Registers	Instruction: C0+starting address+length+parameter Response: C1+starting address+length+parameters Example 1: Configure the channel to 0x09 Instruction start address length parameter Send: C0 05 01 09 Return: C1 05 01 09 Example 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4K) at the same time Send: C0 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61
2	Read Register	Instruction: C1+starting address+length Response: C1+starting address+length+parameters Example 1: Reading a channel Instruction start address length parameter Send: C1 05 01 Return: C1 05 01 09 Example 2: Read module address, network address, serial port, and airspeed simultaneously Send: C1 00 04 Return: C1 00 04 12 34 00 61
3	Setting up temporary registers	Instruction: C2 + starting address + length + parameter Response: C1 + start address + length + parameter Example 1: Configure the channel to 0x09 Instruction start address length parameter Send: C2 05 01 09 Return: C1 05 01 09 Example 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4K) at the same time Send: C2 00 04 12 34 00 61 Return: C1 00 04 12 34 00 61
5	Wireless Configuration	Instruction: CF CF + regular instruction Response: CF CF + normal response Example 1: The wireless configuration channel is 0x09 Wireless command header command start address length parameter Send: CF CF C0 05 01 09 Return: CF CF C1 05 01 09 Example 2: Wireless simultaneous configuration module address (0x1234), network address (0x00), serial port (9600 8N1), airspeed (2.4K) Send: CF CF C0 00 04 12 34 00 61 Return: CF CF C1 00 04 12 34 00 61

6	Format Error	Format Error Response FF FF FF

7.2 Register Description

Serial number	Read and Write	Name	Describe					Remark
00H	Read/ Write	ADDH	ADDH (default 0)					Module address high byte and low byte ; Note: When the module address is equal to FFFF, it can be used as a broadcast and monitoring address, that is, the module will not perform address filtering at this time
01H	Read/ Write	ADDL	ADDL (default 0)					
02H	Read/ Write	NETID	NETID (default 0)					Network address, used to distinguish networks ; When communicating with each other, they should be set to the same.
0 3H	Read/ Write	REG0	7	6	5	UART serial port rate (bps)		The two modules that communicate with each other can have different serial port baud rates and verification methods ; When transmitting large data packets continuously, users need to consider data blocking or even data loss caused by the same baud rate ; It is generally recommended that both parties in communication have the same baud rate.
			0	0	0	The serial port baud rate is 1200		
			0	0	1	The serial port baud rate is 2400		
			0	1	0	The serial port baud rate is 4800		
			0	1	1	The serial port baud rate is 9600 (default)		
			1	0	0	The serial port baud rate is 19200		
			1	0	1	The serial port baud rate is 38400		
			1	1	0	The serial port baud rate is 57600		
			1	1	1	The serial port baud rate is 115200		
			4	3	Serial port check digit			The serial port modes of the two communicating parties can be different ;
			0	0	8 N1 (default)			
			0	1	8 O1			
			1	0	8 E1			
			1	1	8 N1 (equivalent to 0 0)			
			2	1	0	Wireless air rate (bps)		The air rate of both communicating parties must be the same ; air rate, the smaller the delay and the shorter the transmission distance.
						E22-400T37S	E22-230T37S	
			0	0	0	Air rate 2.4k	Air rate 2.4k	
			0	0	1	Air speed 2.4k	Air speed 2.4k	

			0	1	0	Air rate 2.4k (default)	Air speed 2.4k	
			0	1	1	Air speed 4.8k	Air rate 2.4k (default)	
			1	0	0	Air speed 9.6k	Air speed 4.8k	
			1	0	1	Air speed 1 9.2k	Air speed 9.6k	
			1	1	0	Air speed 38.4 k	Air speed 15.6 k	
			1	1	1	Air speed 62.5 k	Air speed 15.6 k	
0 4H	Read/ Write	REG1	7	6	Subcontracting settings			The data sent by the user is smaller than the packet length, and the serial port output at the receiving end appears as uninterrupted continuous output ; If the data sent by the user is larger than the packet length, the receiving serial port will output it in packets.
			0	0	2 40 bytes (default)			
			0	1	1 28 bytes			
			1	0	6 4 bytes			
			1	1	3 2 bytes			
			5	RSSI Ambient Noise Enable				Enable command (packet setting, transmit power as default parameters, configuration mode): C0 04 01 20 ; After enabling, you can send instructions C0 C1 C2 C3 in transfer mode or WOR send mode to read registers ; Register 0x00: Current ambient noise RSSI ; Register 0X01: RSSI when receiving data last time (Current channel noise is: dBm = -(256 - RSSI)) ; Instruction format: C0 C1 C2 C3 + starting address + read length ; Return: C1 + address + read length + read valid value; such as: send C0 C1 C2 C3 00 01 Return C1 00 01 RSSI **(address can only start from 00)**
			0	Disabled (default)				
			1	Enable				
			4	3	reserve			Print logs in different formats according to different abnormal working status. For details, see Chapter 5.7 , Detailed Explanation of Printing Logs in Abnormal Working Status.
			2	Enable abnormal working status log printing				
			0	Disabled (default)				
			1	Enable				
			1	0	Transmit power			**This module has no power levels**
			0	0	37 dBm (default)			
			0	1	37 dBm			
			1	0	37 dBm			
			1	1	37 dBm			
0 5H	Read/ Write	REG2	Channel control (CH) 0-64 represent a total of 65 channels (applicable to					Actual frequency = 220.125 + CH *0.25M Actual frequency = 410.125 + CH *

<table>
<tr><td></td><td></td><td></td><td colspan="4">230 frequency band)
0-83 represent a total of 84 channels (applicable to 400 frequency band)</td><td>1M</td></tr>
<tr><td rowspan="20">0 6H</td><td rowspan="20">Read/ Write</td><td rowspan="20">REG3</td><td>7</td><td colspan="3">Enable RSSI Byte</td><td rowspan="3">After enabling, the module receives wireless data and outputs it through the serial port TXD, followed by an RSSI strength byte.
The current data packet RSSI is: dBm = -(256 - RSSI)</td></tr>
<tr><td>0</td><td colspan="3">Disabled (default)</td></tr>
<tr><td>1</td><td colspan="3">Enable</td></tr>
<tr><td>6</td><td colspan="3">Transmission method</td><td rowspan="3">During fixed-point transmission, the module will recognize the first three bytes of serial port data as: address high + address low + channel, and use it as the wireless transmission target.</td></tr>
<tr><td>0</td><td colspan="3">Transparent transmission (default)</td></tr>
<tr><td>1</td><td colspan="3">Fixed-point transmission</td></tr>
<tr><td>5</td><td colspan="3">Relay function</td><td rowspan="3">After the relay function is enabled, if the destination address is not the module itself, the module will initiate a forwarding ;
To prevent data from being transmitted back, it is recommended to use it in conjunction with fixed-point mode ; that is, the target address and source address are different.</td></tr>
<tr><td>0</td><td colspan="3">Disable relay functionality (default)</td></tr>
<tr><td>1</td><td colspan="3">Enable relay function</td></tr>
<tr><td>4</td><td colspan="3">L BT Enable</td><td rowspan="3">When enabled, wireless data will be monitored before transmission, which can avoid interference to a certain extent, but may cause data delays ;

The maximum stay time of LBT is 2 seconds, and it will be forcibly issued after 2 seconds.</td></tr>
<tr><td>0</td><td colspan="3">Disabled (default)</td></tr>
<tr><td>1</td><td colspan="3">Enable</td></tr>
<tr><td>3</td><td colspan="3">WOR mode transceiver control</td><td rowspan="3">Only valid for mode 1;
1. In the receiving mode of wor, the module can modify the delay time after wake-up, the default time is 0;
2. The receiving end needs to send the command C0 09 02 03 E8 in the configuration mode (C0 is the write command, 09 is the register start address, 02 is the length, 03 E8 is the set delay, the maximum FFFF is 65535ms, and setting it to 0 turns off the wake-up delay.)
3. Data can be sent within the delay</td></tr>
<tr><td>0</td><td colspan="3">W OR Receiver (Default)
Working in WOR monitoring mode, the monitoring cycle is shown below (WOR cycle), which can save a lot of power consumption.</td></tr>
<tr><td>1</td><td colspan="3">W OR transmitter
The module is turned on for transmission and reception, and a wake-up code is added for a certain period of time when transmitting data.</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>WOR Cycle</td><td rowspan="10">Only valid for mode 1;

Period T = (1+WOR) *500ms , maximum 4000ms , minimum 500ms ;

The longer the WOR monitoring interval is, the lower the average power consumption is, but the greater the data delay is;

The sender and receiver must be consistent (very important)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>500 ms</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1000 ms</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1500 ms</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>2000 ms</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>2500 ms</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>3000 ms</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>3500 ms</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>4000 ms</td></tr>
<tr><td>0 7H</td><td>Write</td><td>CRYPT_H</td><td colspan="4">Key high byte (default 0)</td><td rowspan="2">Write only, read returns 0 ;
Used for encryption to prevent wireless data from being intercepted by similar modules ;</td></tr>
<tr><td>0 8H</td><td>Write</td><td>CRYPT_L</td><td colspan="4">Key low byte (default 0)</td></tr>
</table>

				The module will use these two bytes as calculation factors to transform and encrypt the wireless signal in the air.
8 0H ～8 6H	read	PID	Product information 7 bytes	Product information 7 bytes

7.3 Factory default parameters

Model	Factory default parameter values						
Module Model	Frequency	Address	Channel	Air speed	Baud rate	Serial port format	Transmit power
E22-400T37S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	37dbm
E22-230T37S	230.125MHz	0x0000	0x28	2.4kbps	9600	8N1	37dbm

8 Relay Network Mode Usage

Serial number	Relay Mode Description
1	After setting the relay mode through the configuration mode, switch to the general mode and the relay starts working.
2	In relay mode, ADDH and ADDL are no longer used as module addresses, but are forwarded and paired with NETID respectively. If a signal is received from one network, it will be forwarded to the other network . The repeater's own network ID is invalid.
3	In the relay mode, the relay module cannot send and receive data and cannot perform low-power operation.
4	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.

Relay networking rules:

1、Forwarding rules, the relay can forward data bidirectionally between two NETIDs.

2、In relay mode, ADDH\ADDL is no longer used as the module address, but as NETID for forwarding pairing.

As shown in the figure:

①First -level relay

"Node 1" NETID is 08.

"Node 2" NETID is 33.

The ADDH\ADDL of relay 1 are 08 and 33 respectively.

So the signal sent by node 1 (08) can be forwarded to node 2 (33)

At the same time, the addresses of node 1 and node 2 are the same, so the data sent by node 1 can be received by node 2.

② Secondary relay

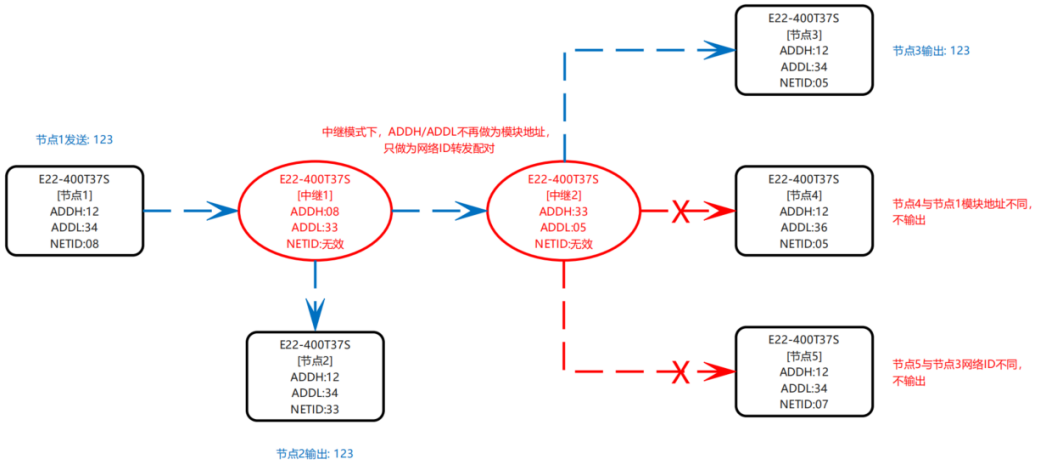
The ADDH\ADDL of relay 2 are 33, 05 respectively.

So relay 2 can forward the data of relay 1 to network NETID:05.

Therefore, nodes 3 and 4 can receive data from node 1. Node 4 outputs data normally, but node 3 does not output data because its address is different from that of node 1.

③Two -way relay

As shown in the configuration figure: the data sent by node 1 can be received by nodes 2 and 4, and the data sent by nodes 2 and 4 can also be received by node 1.



9 Host computer configuration instructions

- The figure below shows the E22-xxxT37S configuration host computer display interface. Users can switch to command mode through M0 and M1 to quickly configure and read parameters on the host computer.

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

  Network address: 0-65535

  Frequency channel: 0～83 (0～ 64 for E22-230T37S)

  Network ID: 0-255

  Key: 0-65535

- When users use the host computer to configure the relay mode, they need to pay special attention to the fact that since the parameters in the host computer are displayed in decimal mode, the module address and network ID need to be converted when filling in the decimal system.

  If the network ID input by the transmitter A is 02 and the network ID input by the receiver B is 10, when the relay R sets the module address, the hexadecimal value 0X020A is converted to the decimal value 522 as the module address filled in by the relay R;

  That is, the module address value that needs to be filled in at the relay end R is 522.

10 Hardware Design

- It is recommended to use a DC regulated power supply to power the module. The power supply ripple coefficient should be as small as possible and the module should be reliably grounded.
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection will directly cause permanent damage to the module. It is recommended to add an anti-reverse connection circuit in the design.
- 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 or 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 operation of the whole machine;

- The module should be kept as far away as possible from parts with large electromagnetic interference, such as power supplies, transformers, and high-frequency wiring;
- High-frequency digital routing, high-frequency analog routing, and power routing must avoid the bottom of the module. If it is necessary to pass under the module, assuming that the module is soldered on the Top Layer, ground copper should be laid on the Top Layer of the module contact part (all copper should be laid and well grounded), and it must be close to the digital part of the module and routed on the Bottom Layer ;
- Assuming 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 module's spurious signal and receiving sensitivity to varying degrees ;
- If there are devices with large electromagnetic interference around the module, it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power traces), it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If the communication line uses 5V level, a 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 module performance. Make sure the antenna is exposed and preferably vertically upward;
- When the module is installed inside the case, you can use a high-quality antenna extension cable to extend the antenna to the outside of the case;
- The antenna must not be installed inside a metal shell, as this will greatly reduce the transmission distance.

11 FAQ

11.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly ;
- Temperature, humidity, and co-channel interference can increase the communication packet loss rate ;
- The ground absorbs and reflects radio waves, so the test results are poor when close to the ground ;
- Seawater has a strong ability to absorb radio waves, so the test effect at the seaside is poor ;
- If there are metal objects near the antenna, or the antenna is placed in a metal shell, the signal attenuation will be very serious ;
- The power register is set incorrectly, or the air rate is set too high (the higher the air rate, the closer the distance) ;
- The power supply voltage at room temperature is lower than the recommended value. The lower the voltage, the lower the power output .
- The antenna used does not match the module well or the antenna itself has quality issues.

11.2 Modules are vulnerable to damage

- 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 or frequently .
- Please ensure anti-static operation during installation and use, as high-frequency components are sensitive to static electricity ;
- Please ensure that the humidity is not too high during installation and use, as 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.

11.3 Bit Error Rate Too High

- There is interference from the same frequency signal nearby. Stay away from the interference source or change the frequency or channel to avoid interference.
- An unsatisfactory power supply may also cause garbled characters, so the reliability of the power supply must be ensured;
- Extension cables or feeder cables that are of poor quality or are too long can also cause a high bit error rate.

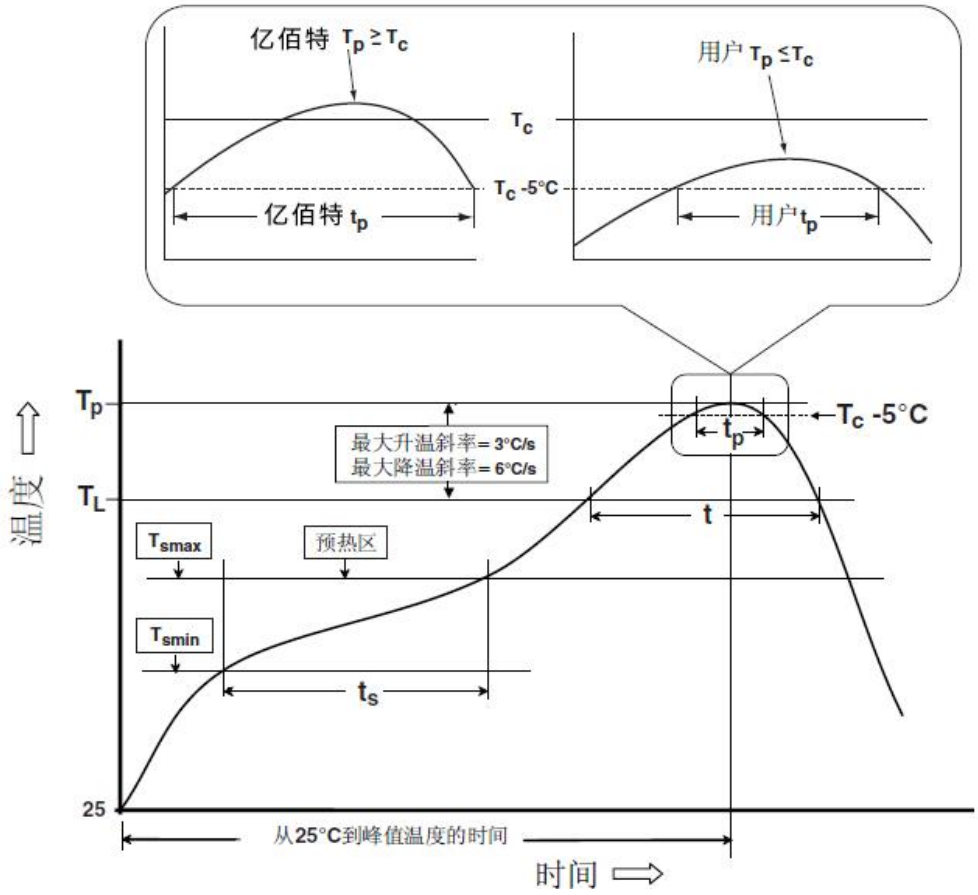
12 Welding Operation Instructions

12.1 Reflow Temperature

Reflow profile characteristics		Leaded process assembly	Lead-free assembly
Preheating /keeping	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (T smax)	150℃	200℃
	Time (T smin ~T smin)	60-120 seconds	60-120 seconds
Heating slope (T L ~T p)		3℃/sec, max.	3℃/sec, max.
Liquidus temperature (TL)		183℃	217℃
T L above the holding time		60~ 90 seconds	60~ 90 seconds
Package peak temperature Tp		Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.	Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.
The time (T p) within 5℃ of the specified classification temperature (Tc) is shown in the figure below.		20 seconds	30 seconds
Cooling slope (T p ~T L)		6℃/sec, max.	6℃/sec, max.
Time from room temperature to peak		6 minutes, longest	8 minutes, longest

temperature		
※The peak temperature (Tp) tolerance of the temperature curve is defined as the upper limit of the user		

12.2 Reflow Oven Curve



13 Related models

Product Model	Frequency Hz	Transmit power dBm	Test distance km	Package	Product size mm	Communication interface
E22-400T22S	433/470M	22	5	SMD	16*26	UART
E22-400T22D	433/470M	22	5	DIP	21*36	UART
E22-400T30S	433/470M	30	10	SMD	20*40.5	UART
E22-400T30D	433/470M	30	10	DIP	24*43	UART
E22-900T22S	868/915M	22	5	SMD	16*26	UART
E22-900T22D	868/915M	22	5	DIP	21*36	UART

E22-900T30S	868/915M	30	10	SMD	20*40.5	UART
E22-900T30D	868/915M	30	10	DIP	24*43	UART
E22-400T33D	433/470M	33	12	DIP	37*60	UART

Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2022-12-5	Initial release	Yan
1. 1	202 3 - 07 - 24	Error Correction	Bin
1. 2	202 3 - 09 - 13	Error Correction	Bin
1. 3	202 3 - 09 - 20	Error Correction	Bin
1.4	2025-4-22	Model Merge	Hao

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