E160-RxFS2 User Manual

OOK/ASK Superheterodyne 315/433.92MHz Learning-type Four-output Receiver Module



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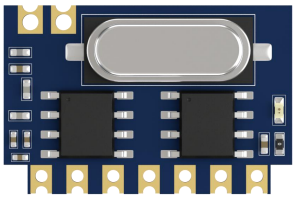
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Chapter 1 Product Overview

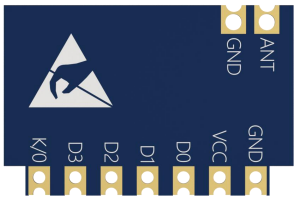
1.1 Product Introduction

The E160-RxFS2 is a 315MHz/433.92MHz OOK/ASK modulated learning wireless receiver module with 4 outputs. It utilizes a high-performance chip, offering excellent anti-interference capabilities . It features 4 output ports and 1 input port (settings), enabling functions such as jogging, flipping, and interlocking. It is compatible with various encoding chips including PT2262, PT2260, SC2260, SC1527, EV1527, RT1527, HS1527, and EV527 , supporting learning from up to 40 remote controls . It boasts a small size, high performance, wide voltage range, and good compatibility . It is FCC and CE certified and suitable for simple control applications such as small appliance remote control, toy remote control, access control system remote control, and electric bicycle remote control .

** It cannot be used directly from the factory and needs to be paired with a transmitting device/product that meets the encoding rules (e.g., E160-TxFS1) .*



Front (E160-RxFS2)



Back (E160-RxFS2)

1.2 Features and Functions

- Small dimensions: 20.3 × 13.3 × 3.0 mm (L × W × H) ;
- Wide operating voltage: 2.0V ~ 5.5V;
- Low receive current: <5.1mA (433.92MHz, supply voltage at 5.0V) ;
- ESD HBM electrostatic discharge protection capability: ±8KV ;
- It is compatible with various encoding chips such as PT2262, PT2260, SC2260, SC1527, EV1527, RT1527, HS1527, and EV527.
- Supports learning up to 40 remote controls (can be paired with 40 different remote controls).
- It has 4 independent level output pins (capable of jogging, reversing, and interlocking) and 1 input setting button pin;
- Receiving distance: 280m (clear, open environment, transmitter power 12dBm, spring antenna gain 1.5dBi, height 2m);

1.3 Application scenarios

- Remote control for small home appliances (fan, lighting)
- Toy remote control
- Access control system remote control
- electric bicycle

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Chapter 2 Specifications

2.1 RF parameters

RF parameters	Parameter value	Remark
Operating frequency (MHz)	315/433.92	E160-R3FS2(315MHz)/E160-R4FS2(443.92MHz)
Modulation method	ASK/OOK	Amplitude keying/on/off keying
Blocking power (dBm)	10	-
Maximum transmit power (dBm)	-	The receiving module does not have this parameter.
Receiver sensitivity (dBm)	-115	@315MHz/433.92MHz
Receive bandwidth (dBc)	±300	-
Transmission rate (kbps)	10	This specifically refers to the rate supported by the radio frequency unit, not the actual transmission rate of the module.
Frequency offset (MHz)	±0.05	-
Antenna impedance (Ω)	50	-
Reference communication distance (m)	280	In a clear, open environment, the transmitting power is 12 dBm, the spring antenna gain is 1.5 dBi, and the height is 2 m.

2.2 Electrical parameters

Electrical parameters	Minimum value	Typical values	Maximum value	Remark
Operating voltage (V)	2.0	-	5.5	≥ 5.0 V ensures optimal performance .
Communication level (V)	2.0	-	5.5	Based on the power supply voltage
Emitting current (mA)	-	-	-	The receiver module has no transmit current.
Received current (mA)	4.3	-	5.1	Within the rated power supply range
Dormant current (μA)	-	-	-	Normal receiving state, which is equal to the received current.
Startup time (ms)	-	3.0	-	The time it takes for the module to enter normal working state after power-on.
ESD protection (KV)	-8		+8	ESD HBM electrostatic discharge human model
Operating temperature (°C)	-40	-	+85	Industrial-grade design
Operating humidity (%rh)	10	-	90	-
Storage temperature (°C)	- 55	-	+125	-

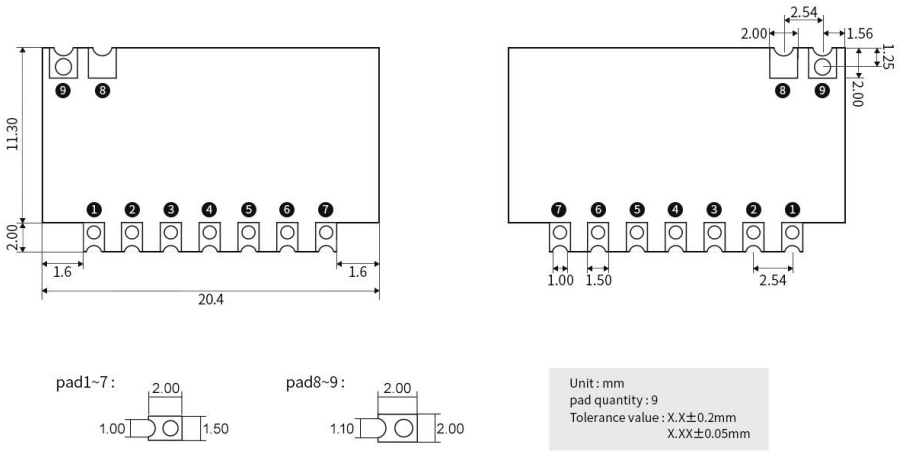
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2.3 Hardware Parameters

Hardware parameters	Parameter value	Remark
Crystal oscillator frequency (MHz)	4.8970	E160-R3FS2 (315MHz)
	6.7458	E160-R4FS2 (443.92MHz)
Module dimensions (mm)	20.4*11.3*3.0	Length * Width * Height
Antenna type	stamp perforation	-
Communication interface	GPIO	Based on the supplied voltage
Packaging	Perforated/stamp hole	The pin pitch is 2.54mm. Detailed dimensional information can be found in Chapter 3.
Weight (g)	3.85	-

Chapter 3 Mechanical Dimensions and Pin Definitions



Pin number	Pin Name	Pin direction	Pin Applications
1	GND	-	Power ground;
2	VCC	power supply	DC 2.0 ~ 5.5V;
3	D0	Output	Maximum output current 20mA; Corresponds to pin 10 of PT2262-R4 chip and pin 5 of EV1527 chip;
4	D1	Output	Maximum output current 20mA; Corresponds to pin 11 of the PT2262-R4 chip and pin 6 of the EV1527 chip;
5	D2	Output	Maximum output current 20mA; Corresponds to pin 12 of the PT2262-R4 chip and pin 7 of the EV1527 chip;
6	D3	Output	Maximum output current 20mA; Corresponds to pin 13 of the PT2262-R4 chip and pin 8 of the EV1527 chip;
7	K/O	Input/Output	The input is active low. During output, the LED on the driver module is active low, and the maximum sink current is 20mA;
8	GND	-	Power ground;
9	ANT	-	Antenna pin (receiver module, receive only, no transmit);

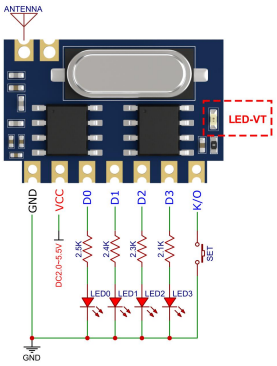
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Chapter 4 Development and use

The E160-RxFS2 four-output learning receiver module can be directly used with our E160-TxFS1 transmitter module, or with other OOK/ASK modulated transmitters that conform to encoding rules such as PT2262, PT2260, SC2260, SC1527, EV1527, RT1527, HS1527, and EV527. The E160-RxFS2 has four high and low level output ports, enabling jogging, toggling, and interlocking logic control, making it convenient for use in small home appliances with simple control logic.

4.1 Operation and Use



Operation diagram

1. **Enter learning (code pairing) mode** :
   - In any working mode, press and hold the SET button for 1 second and then release the button. The LED-VT light will turn on. Press any button on the remote control that you want to learn, and the LED-VT light will turn off. The learning is complete.
   - Each operation can only learn one remote control; repeating the above operation can learn multiple remote controls.
   - If no valid code is received within 10 seconds, the LED-VT light will flash 3 times and then automatically exit the learning (pairing) mode.
   - Remote controls that have been trained (paired) can be trained again, but each training session counts as one remote control.
   - If the remote control has the same address code, then no further learning is required;
   - The learned (paired) remote control data will not be lost after power failure, and up to 40 remote control data can be saved;
   - When learning (pairing), it is recommended to use the single-button mode. If it is a multi-button remote control with more than 4 buttons, it is recommended to use the "8421 code" rule for learning (pairing).
2. **Switch port output mode** :
   - When the module is powered off, press and hold the SET button and then power it on. Hold for 1 second and then release the button. If the LED-VT light flashes once, it indicates that the interlocked output is set.
   - When the module is powered off, press and hold the SET button and then power it on. Hold for 1 second and then release the button. If the LED-VT light flashes twice, it indicates that it is set to jog output.
   - When the module is powered off, press and hold the SET button and then power it on. Hold for 1 second and then release the button. If the LED-VT light flashes 3 times, it indicates that the output is set to self-locking.
   - Repeated operations will cause the pattern to cycle repeatedly;
   - This setting is not lost when power is off, nor is it lost when all remote control data is cleared.
   - This module defaults to self-locking mode upon power-on. Bulk customers can consult our sales/customer service to customize other default power-on modes.
3. **Port output mode description (D0, D1, D2, D3)** :
   - Interlock mode: When the module receives a data signal from remote control D1, LED1 lights up and remains lit; when

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the module receives a data signal from remote control D2, LED1 turns off, and LED2 lights up and remains lit; only one of LED0, LED1, LED2, and LED3 can output at a time.

- In jog mode: LED1 lights up after the module receives the data signal from remote control D1 (press the relevant button on the remote control), and LED1 turns off after the module stops sending the data signal from remote control D1 (release the relevant button on the remote control).
- Self-locking mode: LED1 lights up after the module receives a data signal from remote controller D1, and remains lit even after the module stops sending data signals from remote controller D1; LED1 will only turn off when it receives another data signal from remote controller D1; in this mode, LED0, LED1, LED2, and LED3 are controlled separately and do not affect each other, and can be lit or turned off one by one.

4. **Switch button output mode (recognize remote control button data):**
   - Power off the module, press and hold the SET button and then power on, hold for more than 10 seconds and release the button. The LED-VT light will flash once, indicating that it is now set to the combination key output mode.
   - When the module is powered off, press and hold the SET button and then power it on. Hold the button for more than 10 seconds and then release it. The LED-VT light will flash twice, indicating that it is now set to single-button output mode.
   - Power off the module, press and hold the SET button and then power on. Hold for more than 10 seconds and release the button. The LED-VT light will flash 3 times. At this time, it is set to any key learning mode.
   - Repeated operations will cause the pattern to cycle repeatedly;
   - This setting is not lost when power is off, nor is it lost when all remote control data is cleared.
   - This module defaults to the combination key output mode upon power-on. Bulk customers can consult our sales/customer service to customize other default power-on modes.
5. **Key output mode description (Users need to completely understand EV1527 encoding rules and hexadecimal "8421 code" rules):**
   - Combination key output mode:
     (1) Press and hold multiple buttons on the learned remote control at the same time, and the corresponding data port of the module will output a high level (LEDx will light up). For example, if three buttons are pressed and held at the same time on the remote control, the module will output a high level in parallel on the data ports of the three buttons.
     (2) When learning in combination key output mode, simply press any button on the remote control to respond to all buttons on that remote control; that is, the D0 button corresponds to the D0 output port, the D1 button to the D1 output port, the D2 button to the D2 output port, and the D3 button to the D3 output port. If there are combination keys, press the combination keys to output in parallel.
     (3) Remote controls learned in this mode can operate in both single-button output mode and this mode, but not in any-button learning mode. However, remote controls learned in any-button learning mode can operate in this mode. If a remote control learned in combination-button output mode is then learned in any-button learning mode, it will respond to the output functions learned in any-button learning mode.
   - Single-button output mode:
     (1) In this mode, only the signal when a single data key is pressed (e.g., the key value "0001, 0010, 0100, 1000" encoded in 1527) can be decoded, and a decoding success indication and a high level output are output from the corresponding data port.
     (2) If a combination key signal cannot be decoded in this mode (e.g., 1527 encoded key values "0011, 1010, 1110, ..."), the data port cannot output a high level;
     (3) The remote control and combination key output modes used in this mode are interchangeable and do not require relearning.

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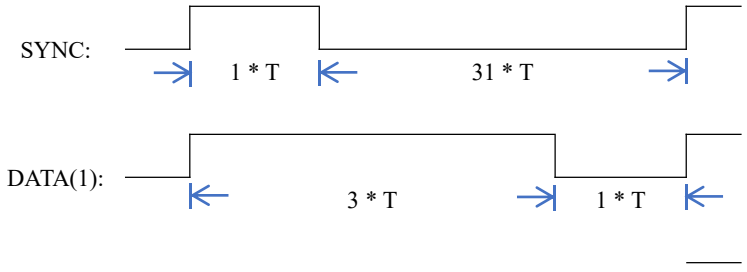
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- Any key learning mode:
  (1) The arbitrary key learning mode allows remote control to be used even when the remote control buttons do not correspond to the output port codes of the module. By pressing any key in this learning mode, the buttons can be reordered, thus achieving the goal of remote control without changing the correspondence between the remote control's transmitter port and the button numbers.
  (2) In this mode, only one button can be learned at a time, occupying one remote control data storage slot. A maximum of four buttons can be learned. After four buttons are learned, the function from the first learning cycle will be repeated. The first learned remote control button controls the D0 output port of this module, the second learner controls the D1 output port, the third learner controls the D2 output port, and the fourth learner controls the D3 output port. If a port's remote control is not needed, no remote control button can be pressed, causing it to time out and automatically exit the learning state before learning the remote control function of the next port. If the power is turned off and then on again, it will start from the first button function again. After more than four learning cycles, it will also automatically return to the first button function and start again.
  (3) This is a learning mode. Remote controls learned in this mode can work normally in combination key output mode, while remote controls learned in combination key output mode cannot work in this mode. After learning in this mode is complete, turn off the power, press and hold the SET button, then turn the power on and wait for more than 10 seconds before releasing the SET button. The LED-VT will flash once, and the system will switch back to combination key output mode for operation.

6. **Restore factory settings :**
   - In any working mode, press and hold the SET button for more than 10 seconds and then release the button. The LED-VT light will flash 5 times quickly. At this time, all learned remote control data has been cleared and needs to be relearned.
   - This operation does not affect the port output mode setting;
   - This operation does not affect the button output mode settings.
7. **The number of learning (code pairing) codes supported**:
   - It can store data for up to 40 remote controls;
   - Learning operation in any mode will consume 1 remote control data storage unit for each successful learning.

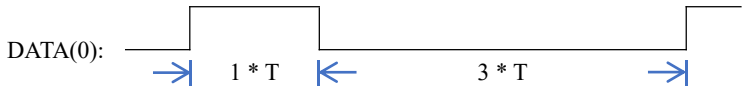
4.2 Software Development

If users want to use their own transmitters in conjunction with our E160-RxFS2 module, then we must understand the data frame structure that the E160-RxFS2 module can recognize. We will use the 1527 encoding rule as an example (users should search for and understand other encoding rules on the Internet; they will not be explained here): The 1527 encoding rule data frame structure consists of a "synchronization code", a 20-bit "address code", and a 4-bit "key value code", and the basic unit of time is T (ms), with a timing of T=0.1ms (the E160-RxFS2 can recognize the minimum pulse width time, 1/10kbps). The data bits consist of 4 Ts, where " DATA(1) " consists of 3 * T high level plus 1 * T low level; " DATA(0) " consists of 1 * T high level plus 3 * T low level.



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The E160-RxFS2 module can store 40 remote control data entries and recognize four single-key values: “0001”, “0010”, “0100”, and “1000”. These values correspond to the “D0”, “D1”, “D2”, and “D3” pins of the E160-RxFS2 module, respectively. It can also recognize 11 combination keys: “0011”, “1110”, “1011”, and “1010”. These values correspond to the “D1|D0”, “D3|D2|D1”, “D3|D1|D0”, and “D3|D1” pins of the E160-RxFS2 module, respectively.

1527 encoding rules					
32 *T	80 *T (20 bits)	4 *T (1 bit)	4 *T (1 bit)	4 *T (1 bit)	4 *T (1 bit)
Synchronization code	Address codes C0~C19 (millions of entries)	D0	D1	D2	D3

Chapter 5 Hardware Design

5.1 Explanation of the matching oscillation resistor at the transmitter

This receiver module can automatically match the wide range of oscillation resistance of the transmitter (remote control) chip. If the transmitter's oscillation resistance changes, this module can automatically identify and decode the output. However, the oscillation resistance at the transmitter should not be adjusted too low. An excessively low oscillation resistance will increase the data rate. In this case, during our testing, we found that common transmitter/remote control and receiver modules on the market would cause serious data loss or decoding errors, resulting in unstable reception or failure to receive data.

The following are the transmitting chips we have tested, and their oscillation resistor values range that achieve good communication results with this receiving module. This information is for reference only:

Chip Model	Minimum resistance value (KΩ)	Recommended resistance value (KΩ)	Maximum resistance (KΩ)
PT2262-R4	1000	2200-5600	10000
PT2264-R4	1000	2200-5600	10000
PT2260-R4	470	820-2200	4700
PT22 40B - S	390	1500 - 3600	10000
SC2262-R4	1000	4700-7500	20000
CS521BGO	1000	1800-3600	10000
EV1527	100	220-390	1500
HS1527	100	220-390	1500
SC1527	100	220-390	1500
LX1527	1000	2000-3300	10000
SCL527	100	220-390	1500
EV527	100	220-390	1500

5.2 Other Design Considerations

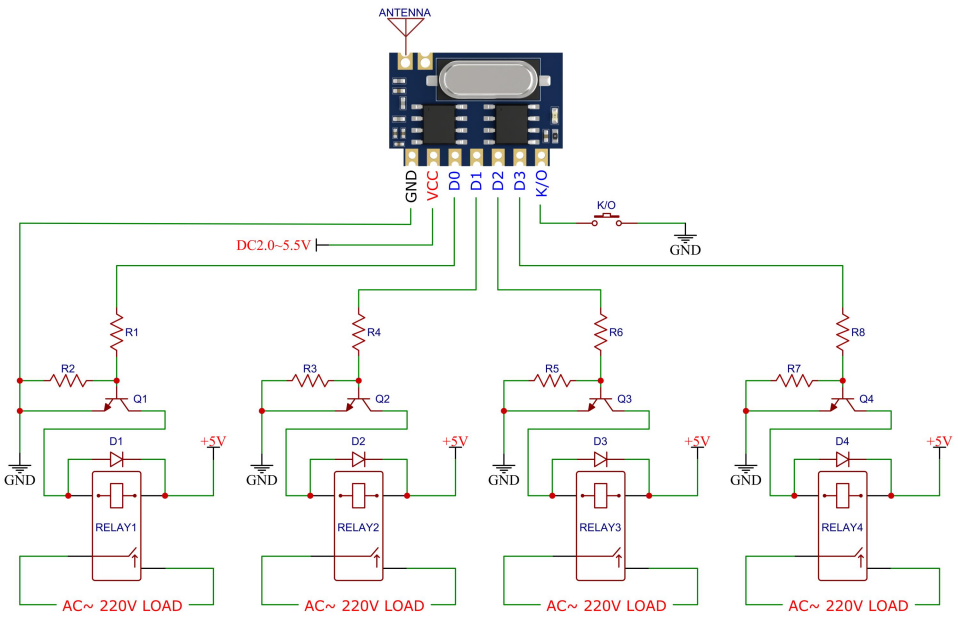
- It is recommended to use a DC regulated power supply to power this module, with the power supply ripple factor as small as possible (less than 100mV) , and the module must be reliably grounded;
- Please ensure the correct connection of the positive and negative power terminals. Reversing the connection may cause permanent damage to the module.

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- Please check the power supply and ensure it is within the recommended voltage range. Exceeding the maximum value will cause permanent damage to the module.
- Please check the power supply stability; the voltage should not fluctuate significantly or frequently.
- When designing power supply circuits for modules, it is often recommended to retain a margin of more than 30% to ensure long-term stable operation of the entire unit.
- The module should be kept as far away as possible from power supplies, transformers, high-frequency traces, and other parts with high electromagnetic interference.
- High-frequency digital traces, high-frequency analog traces, and power traces must avoid the area under the module. If it is absolutely necessary to run under the module, assuming the module is soldered on the Top Layer, lay ground copper on the Top Layer of the module contact area (all copper and well grounded), and run the traces close to the digital part of the module on the Bottom Layer.
- Assuming the module is soldered or placed in the Top Layer, it is also wrong to arbitrarily route traces in the Bottom Layer or other layers, as this will affect the module's stray emissions and reception sensitivity to varying degrees.
- If there are devices around the module that cause significant electromagnetic interference, it will greatly affect the module's performance. Depending on the intensity of the interference, it is recommended to keep them away from the module. If possible, appropriate isolation and shielding can be implemented.
- If there are traces around the module that cause significant electromagnetic interference (high-frequency digital, high-frequency analog, power supply traces), it will greatly affect the module's performance. Depending on the intensity of the interference, it is recommended to keep them away from the module. If possible, appropriate isolation and shielding can be implemented.
- Try to stay away from TTL protocols that also use a physical layer of 2.4GHz, such as USB 3.0;
- The antenna mounting structure has a significant impact on module performance; it is essential to ensure that the antenna is exposed and preferably vertically upward. When the module is installed inside the housing, a high-quality antenna extension cable can be used to extend the antenna to the outside of the housing.
- Antennas should never be installed inside a metal casing, as this will greatly reduce the transmission distance.

Chapter 6 Reference Circuits



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E 160-RxFS2 reference circuit

Chapter 7 FAQ

7.1 Transmission distance is not ideal

- When there are obstacles in line-of-sight communication, the communication distance will be reduced accordingly ;
- Temperature, humidity, and co-channel interference can all lead to increased packet loss rates in communications .
- The ground absorbs and reflects radio waves, and the test results are poor when the ground is close to the ground .
- Seawater has a strong ability to absorb radio waves, so testing results are poor at the seaside .
- If there are metal objects near the antenna, or if it is placed inside a metal casing, the signal attenuation will be very severe .
- Power register settings are incorrect; air speed is set too high (the higher the air speed, the shorter the distance) .
- At room temperature, the power supply voltage is lower than the recommended value; the lower the voltage, the lower the power output .
- The antenna may be poorly matched with the module or have quality issues.

7.2 Modules are vulnerable to damage

- Please check the power supply and ensure it is within the recommended voltage range. Exceeding the maximum value will cause permanent damage to the module .
- Please check the power supply stability; the voltage should not fluctuate significantly or frequently .
- Please ensure anti-static operation during installation and use, as high-frequency devices are sensitive to electrostatic discharge .
- Please ensure that the humidity is not too high during installation and use, as some components are humidity-sensitive .
- Unless there are special requirements, it is not recommended to use it at excessively high or low temperatures.

7.3 The bit error rate is too high

- If there is interference from a co-channel signal nearby, move away from the source of interference or change the frequency or channel to avoid the interference.
- An inadequate power supply can also cause garbled characters, so it is essential to ensure the reliability of the power supply.
- Poor quality or excessive length of extension lines or feeders can also lead to a high bit error rate.

Chapter 8 Welding Operation Instructions

8.1 Reflow temperature

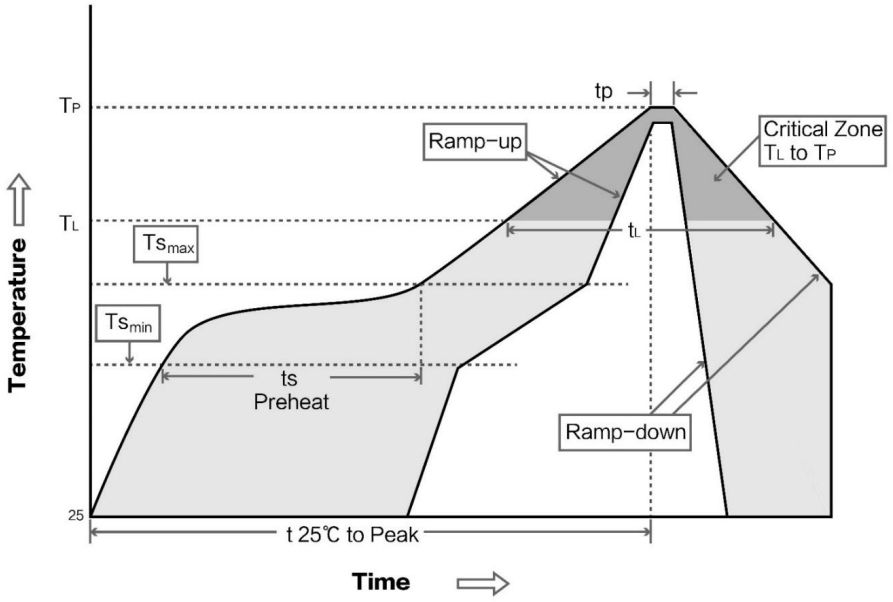
Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	Minimum preheating	100℃	150℃

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	temperature		
Preheat temperature max (Tsmax)	Maximum preheating temperature	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	preheating 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 the liquidus line	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℃ to peak temperature	6 minutes max	8 minutes max

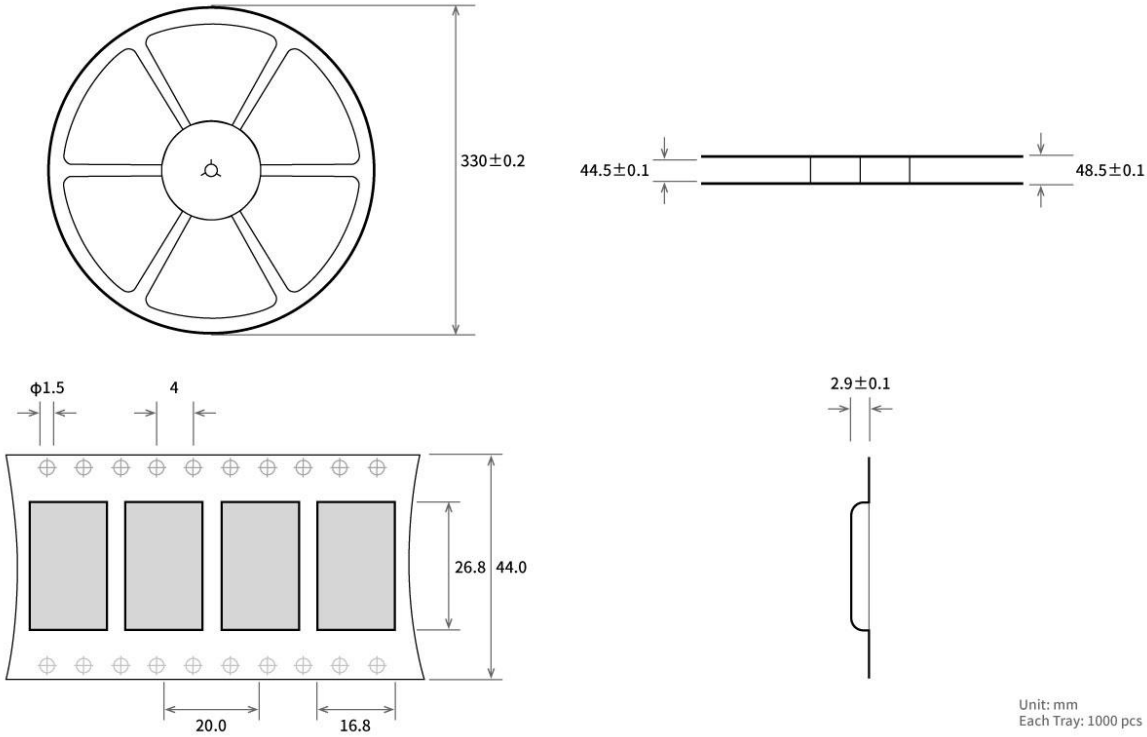
8.2 Reflow oven curve



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Chapter 9: Bulk Packaging Methods



Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2025-10-25	first edition	Ning

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