E21-xxxG37S User Manual

ISM Band 230/433/470MHz

SMD PA/LNA Amplifier Module



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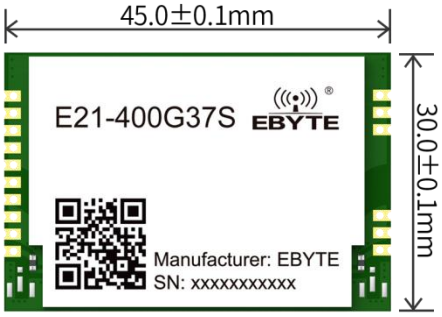
1 Overview

1.1 Introduction

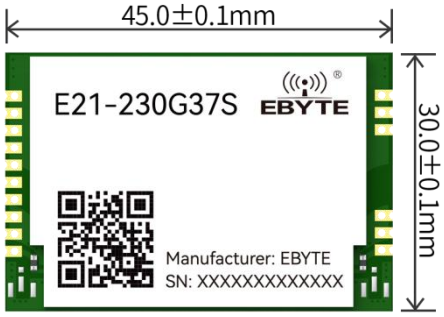
E21-xxxG37S is a pure hardware RF medium power amplifier (PA) launched by Chengdu Ebyte, with a maximum output power of 37dBm. The frequency range covered is 220~ 236MHz and 410 ~493MHz. The corresponding models for the frequency bands are: E21-230G37S and E21-400G37S . The module has a built-in LNA low noise amplifier, which greatly improves the communication distance between wireless devices.

The use of imported high-quality PA chips + our company's unique design greatly improves PA working efficiency and lowers the working temperature. It can continuously transmit data at an ambient temperature of -40 to +85 degrees. Built-in LNA low-noise amplifier, filter, limiter device, and low noise coefficient improve the receiving sensitivity, and expand the communication distance.

Ultra-low power consumption design, standby current is only 3uA, simple control method, only two I/O ports are needed for transceiver control switching, SOP patch design method, ultra-small size, very easy to embed, the whole solution is designed according to industrial grade, large area of bare copper on the back, customers can simply and reasonably add appropriate heat dissipation treatment according to their needs. Ultra-high stability, suitable for a variety of application scenarios, now widely used in various industries, with stable performance, long transmission distance, strong penetration and diffraction ability, etc.



E21-400G37S



E21-230G37S

1.2 Features

- Maximum transmit power 37dBm;
- The operating frequency range of E21-230G37S is: 220～236MHz;
- The operating frequency range of E21-400G37S is: 410～493MHz;
- High-efficiency PA power amplifier, PA efficiency over 40%;
- LNA low noise amplifier, sensitivity improved by 14-17dB;
- Built-in limiting device to limit the input power amplitude of the receiving channel;
- Ultra-low power consumption design, standby current is only 3uA;
- Supports 4.5 ~ 5.5 V internal control power supply and PA power supply 7.5V;
- Industrial standard design, supports long-term use at -40 ~ + 85 ℃;
- Stamp hole patch installation facilitates integration and mass production.

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2 Specifications

Note: The E21-230G37S and E21-400G37S packages are compatible, but their operating frequency bands are different.

2.1 Limit parameters

Main parameters	Performance		Remark
	Minimum	Maximum	
Supply voltage (V)	4.5	5.5	Over 6V will permanently burn out the module
PA driving voltage (V)	7	8	The default 7.5V power supply can output full power
Blocking power (dBm)	-	10 dBm	There is a risk of burning when using high-power modules at close range
Operating temperature (℃)	-40	+ 85	Industrial Grade

2.2 Working Parameters

Main parameters		Performance			Remark
		Minimum	Typical Value	Maximum	
Supply voltage (V)		4.5	5	5.5	≥ 4.7V to ensure output power
PA control voltage (V)		7	7.5	8	7.5V is recommended to ensure the best performance
Operating temperature (℃)		-40	25	+ 85	Industrial-grade design
Working frequency band (MHz)		220	-	236	The default frequency band is 230MHz, and the corresponding module model is E21-230G37S
		410	-	493	ISM frequency band , the corresponding module model is E21-400G37S
Power consumption	Emission current (mA)	1200	1300	1400	Instantaneous power 37dBm (tested at power supply voltage 5V, PA voltage 7.5V)
	Receive current (mA)	6.5	8	-	Tested at input signal strength -100dBm
	Sleep current (μA)		3.0		T/RX_EN = 0
Maximum transmit power (dBm)		36	37	38	The pre-stage input power is greater than 20dBm to ensure full power output
Receive gain (dB)		14	15	17	Tested at input signal strength -100dBm
Transmitting gain (dB)		30	32	34	The corresponding module model is E21-230G37S. with the pre-stage input 5dBm, module can stably output 37dBm .
Transmitting gain (dB)		15	17	19	The corresponding module model is E21-400G37S. with the pre-stage input 20dBm, module can stably output 37dBm .

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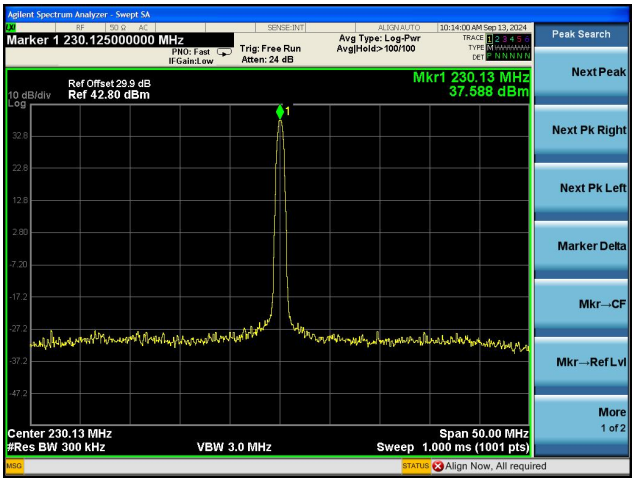
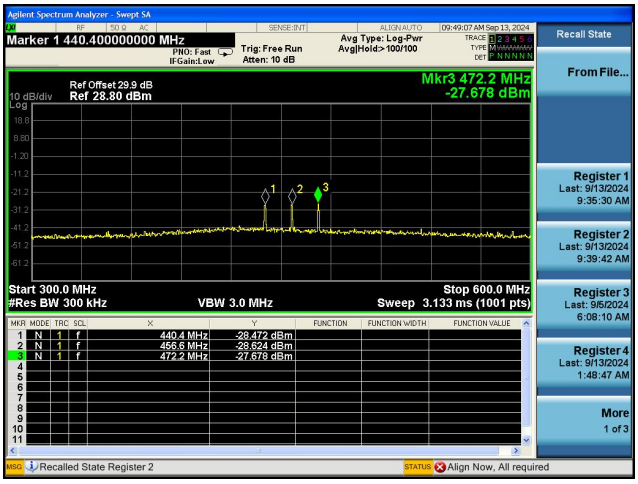
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2.3 Parameter curve

Main parameters	describe	Remark
Packaging	SMD	/
Interface	1.5 mm	Stamp Holes
Dimensions	45 * 30 mm	/
RF input and output interface	Stamp Holes	Equivalent impedance is about 50 Ω

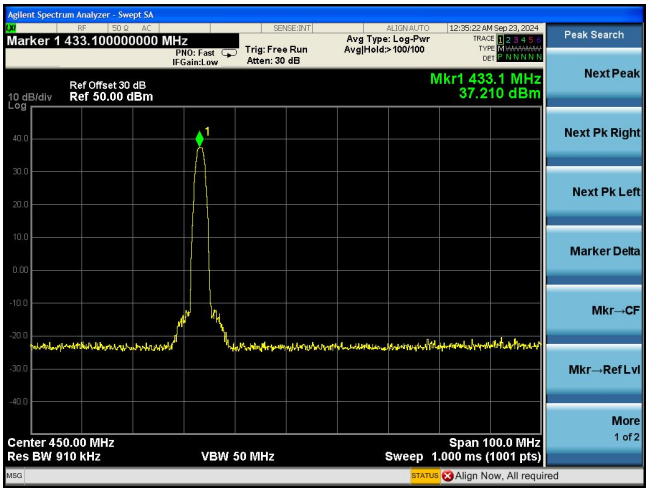
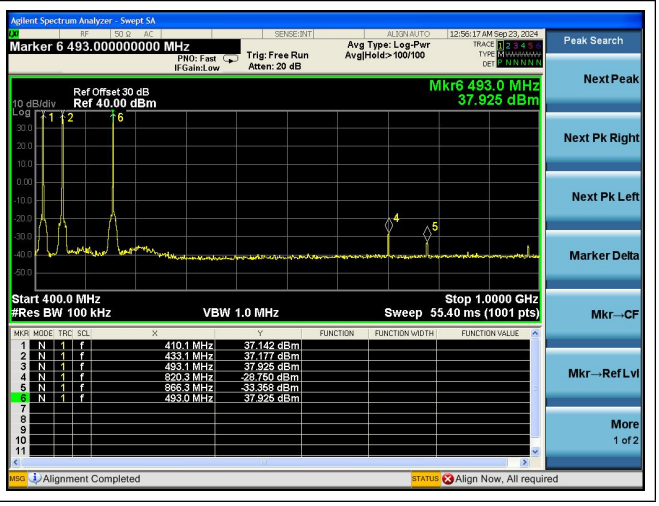
2.4 Power and second harmonic

2.4.1 E21-230G37S

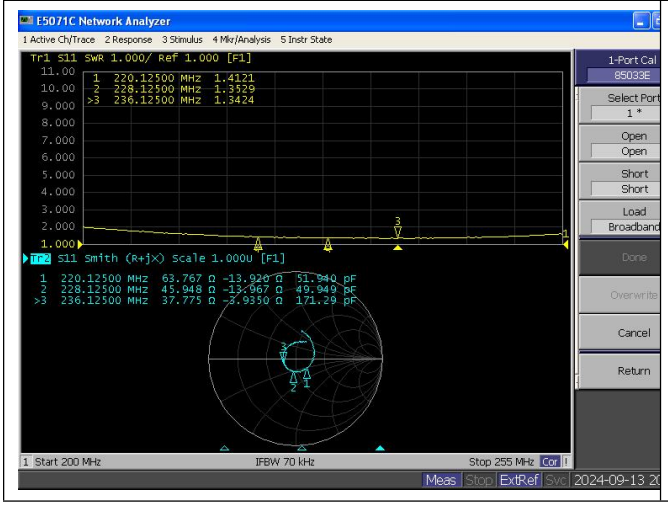
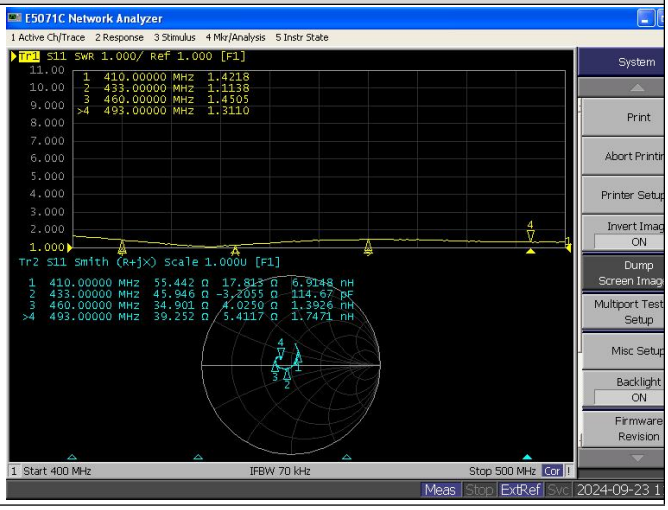
power	Second Harmonic
	

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2.4.2 E2 1-400G37S

power	Second Harmonic
	

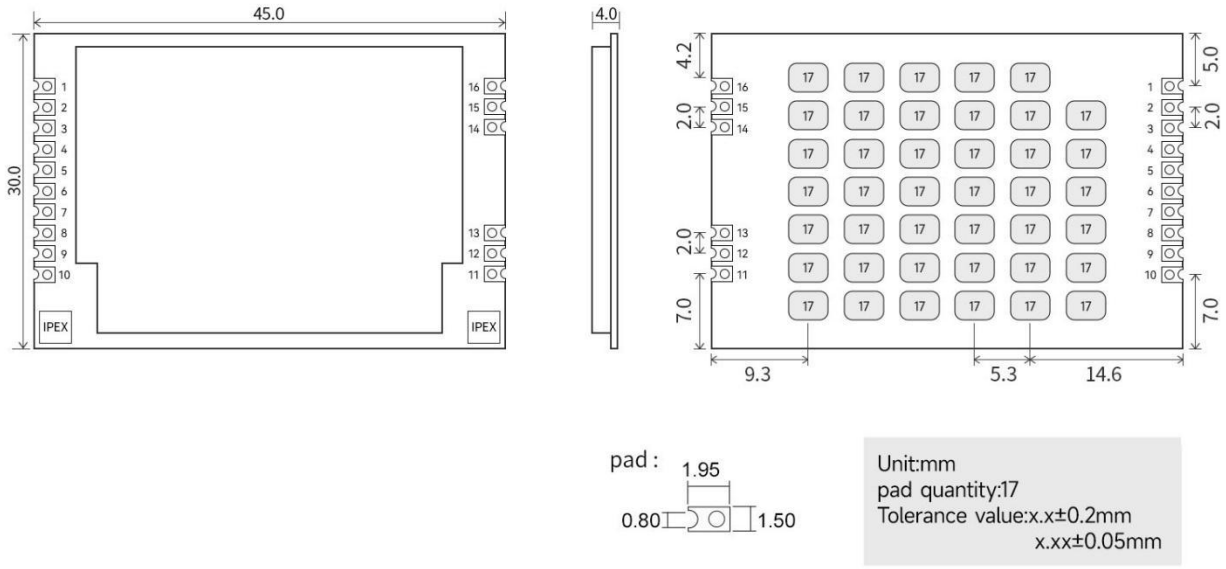
2.5 Smith and SWR

E21-230G37S	E21-400G37S
	

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3 Mechanical Dimensions and Pin Definition



Pin number	Pin Name	Pin Direction	Pin Purpose
1	GND		Ground wire, connected to the reference ground
2	+ 7.5V		PA drive power supply VCC1
3	+7.5V		PA drive power supply VCC1
4	GND		Ground wire, connected to the reference ground
5	+5V		Control power supply VCC2
6	GND		Ground wire, connected to the reference ground
7	TXEN	enter	Transmit mode enabled, high level valid (supports 3.3V/5V level)
8	RXEN	enter	Receive mode enabled, high level valid (supports 3.3V/5V level)
9	GND		Ground wire, connected to the reference ground
10	PIN	Input/Output	Transmit mode: RF signal input / Receiving mode: RF signal output
11	POUT	Output/Input	Transmitting mode: RF signal output / Receiving mode: RF signal input
12	GND		Ground wire, connected to the reference ground
13	GND		Ground wire, connected to the reference ground
14	GND		Ground wire, connected to the reference ground
15	GND		Ground wire, connected to the reference ground
16	GND		Ground wire, connected to the reference ground
17	GND		Bottom heat dissipation pad, connected to module GND

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Note: 1. TXEN and RXEN cannot be turned on at the same time at any time. Turning them on at the same time will cause direct damage to the PA module.
2. The bottom pad is connected to the internal GND and needs to be coated with silicone grease for heat dissipation or soldered to the bottom plate to enhance heat dissipation.

4 Basic Operations

4.1 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. The module needs to be reliably grounded. It is recommended to use a power supply of 20W or more.
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module.
- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, 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.
- The antenna installation structure has a great impact on the performance of the module. Make sure the antenna is exposed and preferably vertically upward. When the module is installed inside the housing, use a high-quality antenna extension cable to extend the antenna to the outside of the housing;
- The antenna must not be installed inside a metal shell, as this will greatly reduce the transmission distance.
- Pay attention to good grounding, large area of paving, small power ripple, and add filter capacitors as close to the module VCC and GND pins as possible;

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4.2 Software Writing

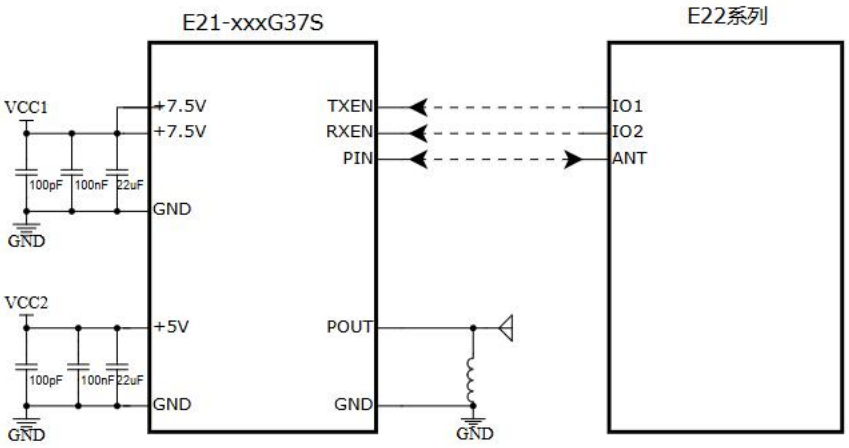
1. Mode Description

Note: Turn on TX_EN 2ms before sending data to reserve startup time;

Pin Name		Model	Remark
TXEN	RXEN		External input high and low level, select mode (support 3.3/5V level)
L	L	Sleep Mode	The module enters sleep mode, PA and LNA do not work
L	H	Receiving Mode	The module enters receiving mode, PA does not work, LNA works
H	L	Transmit Mode	The module enters the transmit mode, PA works, LNA does not work
H	H	Not allowed	TXEN and RXEN cannot be high at the same time, including during program initialization, otherwise the module will be permanently damaged.

5 Basic Applications

5.1 Recommended circuit diagram



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6 Frequently Asked Questions

6.1 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.

6. 2 Modules are 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 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.

7 Welding Operation Instructions

7.1 Reflow temperature

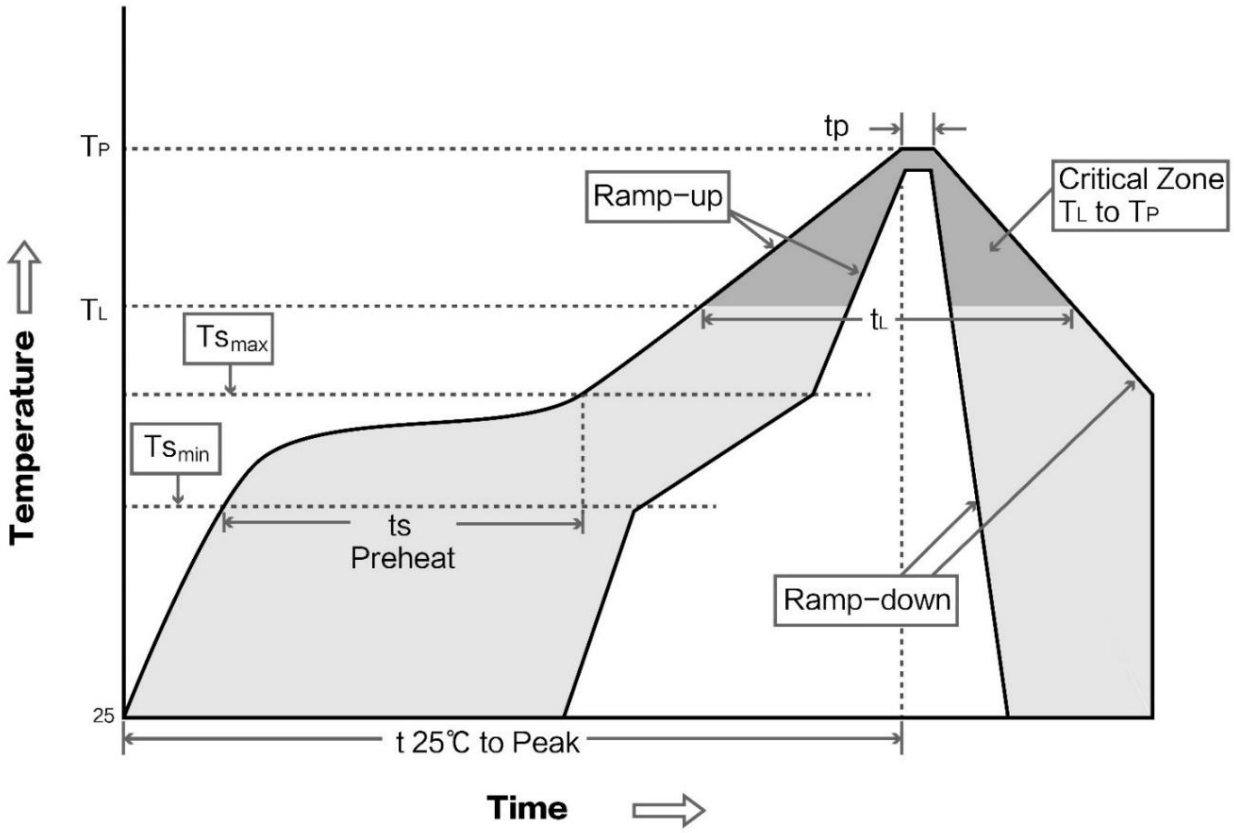
Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	Minimum preheating temperature	100 ℃	150 ℃
Preheat temperature max (Tsmax)	Maximum preheating temperature	150 ℃	200 ℃
Preheat Time (Tsmin to Tsmax)(ts)	Warm-up time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ascent rate	3 ℃ /second max	3 ℃ /second max
Liquid 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 ℃

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Aveage ramp-down rate（Tp to Tsmax）	Average descent rate	6 ℃ /second max	6 ℃ /second max
Time 25 ℃ to peak temperature	Time from 25 ℃ to peak temperature	6 minutes max	8 minutes max

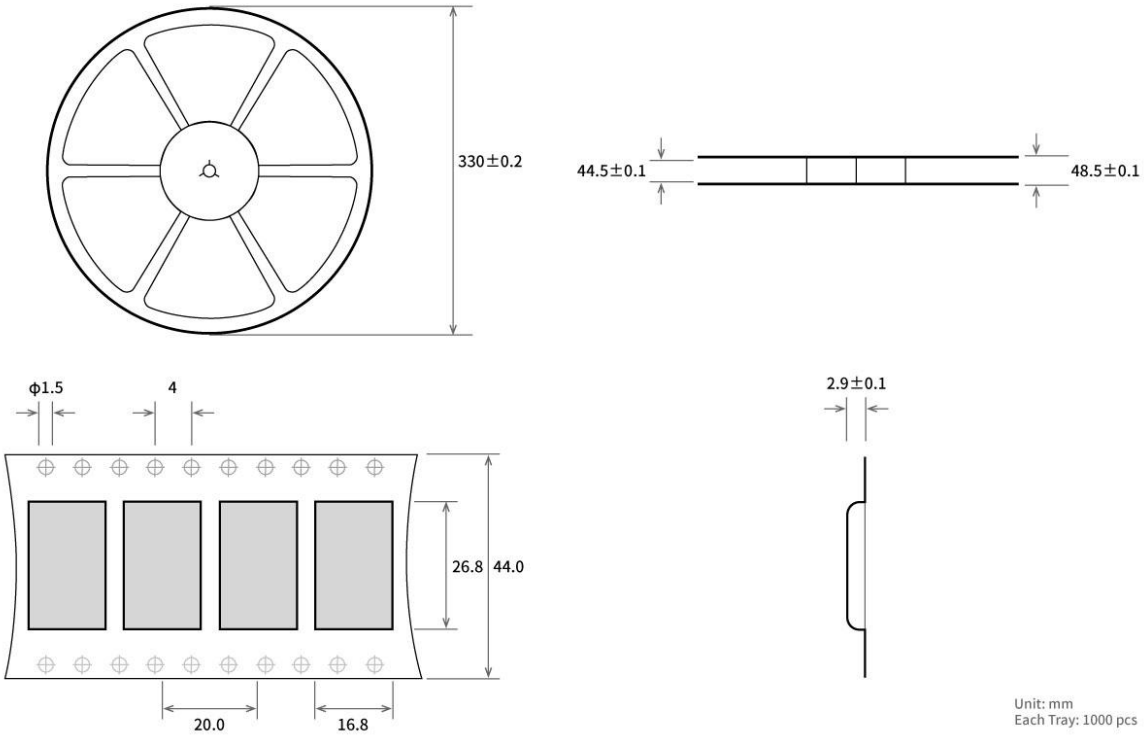
7.2 Reflow Oven Curve



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8 Bulk Packaging Methods



Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2024-10-11	Initial File	Hao
1.1	2026-3-16	Modification Content Description	Hao

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