Ra-05 Specification

Version V1.0.0

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Document resume

Version	Date	Develop/revise content	Edition	Approval
V1.0.0	2024.11.14	First Edition	Rongxin Qiao	Ning Guan

Content

1. Product overview

Ra-05 is a 2.4GHz RF transceiver module developed by Shenzhen Ai-Thinker Technology Co., Ltd. The module is equipped with Semtech's SX1281 RF chip as the core processor, supports multiple modulation methods such as LoRa, FLRC, GFSK and is compatible with Bluetooth protocol. This module is a pure RF transceiver module and needs to be driven by MCU or a dedicated SPI debugging tool.

LoRa direct sequence spread spectrum technology will bring a longer communication distance, and has the advantages of a wider power spectrum and strong anti-interference ability. The module has a hardware FEC forward error correction algorithm, which has high coding efficiency and strong error correction ability. In the case of sudden interference, it can actively correct the interfered data packets, greatly improving reliability and transmission distance.

The module has high transmission power and receiving sensitivity, and has good performance in spectrum characteristics, harmonic spurious, channel crosstalk, etc. In addition, the module is small in size and has strong packaging compatibility.

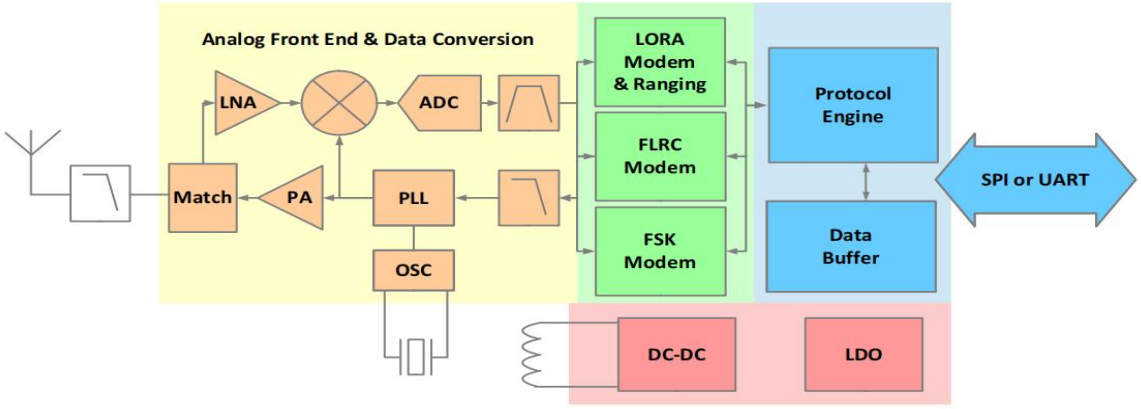


Figure 1 Main chip architecture diagram

1.1. Characteristic

- Support unlicensed ISM 2.4GHz frequency band;
- Support 1kbps～2Mbps data air transmission rate;
- Maximum transmission power 12.5dBm, software adjustable in multiple levels;
- Receiver sensitivity (chip manual) LoRa mode can reach -132dBm;
- Support 1.8～3.6VDC power supply, and power supply greater than 3.3V can guarantee the best performance;
- Industrial standard design, supports long-term use at -40～85℃;
- Support multiple modulation modes (GFSK Mode, FLRC Mode, LoRa Mode);
- Excellent anti-blocking characteristics;
- The antenna uses onboard antenna and is compatible with IPEX connector

2. Main parameters

Table 1 Description of the main parameters

Model	Ra-05
Package	SMD-14
Size	15.0*24.0*3.1(±0.2)mm
Antenna	On-board PCB antenna（Compatible with IPEX connector）
Frequency	2400 ~ 2500MHz
Operating temperature	-40℃~ 85℃
Storage temperature	-40℃~ 125℃, < 90%RH
Power supply	Supply voltage 1.8V ~ 3.6V
Interface	SPI or UART
IO	3

2.1. Static electricity requirement

Ra-05 is an electrostatic sensitive device. Therefore, you need to take special precautions when carrying it.

Figure 2 ESD preventive measures

2.2. Electrical characteristics

Table 2 Electrical characteristics table

Main Parameters		Condition	Min.	Typical value	Max.	Unit
Power supply voltage		VDD	1.8	3.3	3.6	V
I/O	VIL	-	-	-	0.2*VDDIO	V
	VIH	-	0.8*VDDI	-	-	V
	VOL	-	-	0.1*VDDIO	-	V
	VOH	-	-	0.12*VDDIO	-	V
	Ileak	-	-1	-	1	uA

Table 3 SPI interface characteristics

Symbol	Description	Min.	Typical value	Max.	Unit
T1	NSS falling edge to SCK setup time	25	-	-	ns
T2	SCK cycle time	55	-	-	ns
T3	SCK high level time	25	-	-	ns
T4	MOSI to SCK hold time	5	-	-	ns
T5	MOSI to SCK setup time	5	-	-	ns
T6	NSS falling edge to MISO setup time	0	-	15	ns
T7	SCK falling edge to MISO falling edge time	0	-	15	ns
T8	SCK falling edge to NSS rising edge hold time	25	-	-	ns
T9	NSS high level hold time	100	-	-	ns
T10	NSS falling edge to SCK setup time when switching from sleep mode to STDBY_RC mode	125	-	-	ns

2.3. Working Parameters

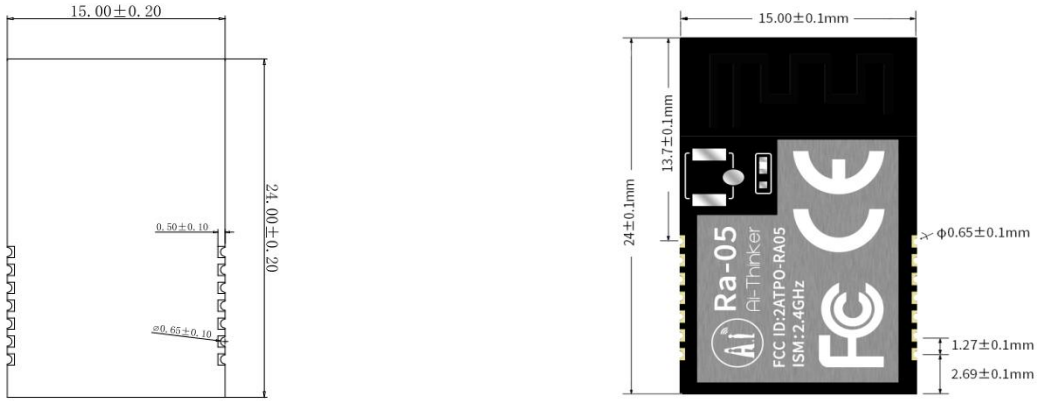
Table 4 Working parameters

Main Parameters		Min.	Typical value	Max.	Unit
Operating frequency band		2400	-	2500	MHz
Maximum transmit power		-	12.5	-	dBm
Receive sensitivity (chip manual)		-	-132	-	dBm
Power consumption	Transmitting current (mA)	-	50	-	mA
	Receiving current (mA)	-	10	-	mA
	Sleeping current (uA)	-	1	-	uA
Air speed LoRa（bps）		1K	1K	2M	bps
Operating temperature		-40	-	+85	℃

3. Appearance dimensions

Front Back

Figure 3 Appearance(rendering is for reference only, the actual object shall prevail)

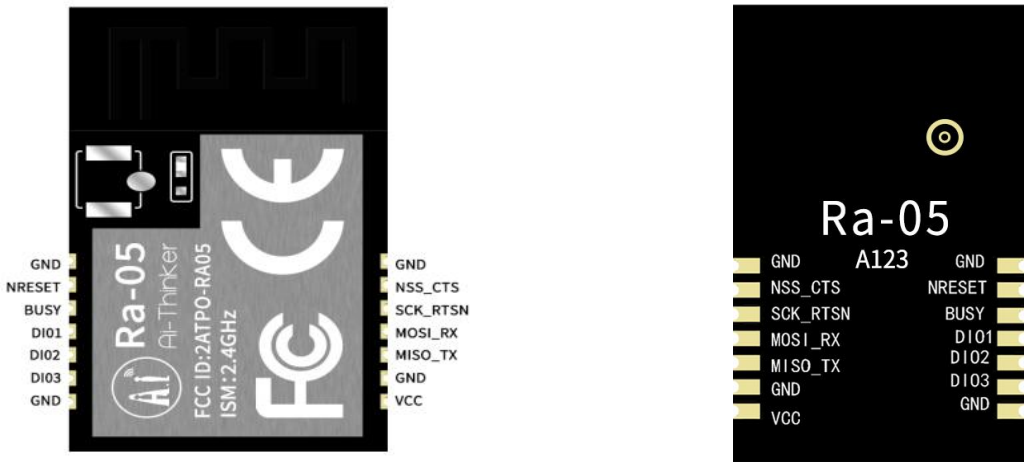


Front Back

Figure 4 Dimensions (unit: mm)

4. Pin definition

The Ra-05 module has 14 pins in total, as shown in the pin diagram. The pin function definition table is the interface definition.



Front Back

Figure 5 Pin diagram

Table 5 Pin function definition table

No.	Name	Function
1	VCC	Power supply, range 1.8~3.6V (it is recommended to add ceramic filter
2	GND	Ground wire, connected to power reference ground
3	MISO_TX	SPI data output pin; can also be used for UART transmit pin
4	MOSI_RX	SPI data input pin; can also be used for UART receive pin
5	SCK_RTSN	SPI clock input pin; can also be used for UART request transmit pin
6	NSS_CTS	Module chip select pin
7	GND	Ground wire, connected to power reference ground
8	GND	Ground wire, connected to power reference ground
9	NRESET	Chip reset
10	BUSY	Used for status indication
11	DIO1	General IO port
12	DIO2	General IO port
13	DIO3	General IO port
14	GND	Ground wire, connected to power reference ground

5. Schematic

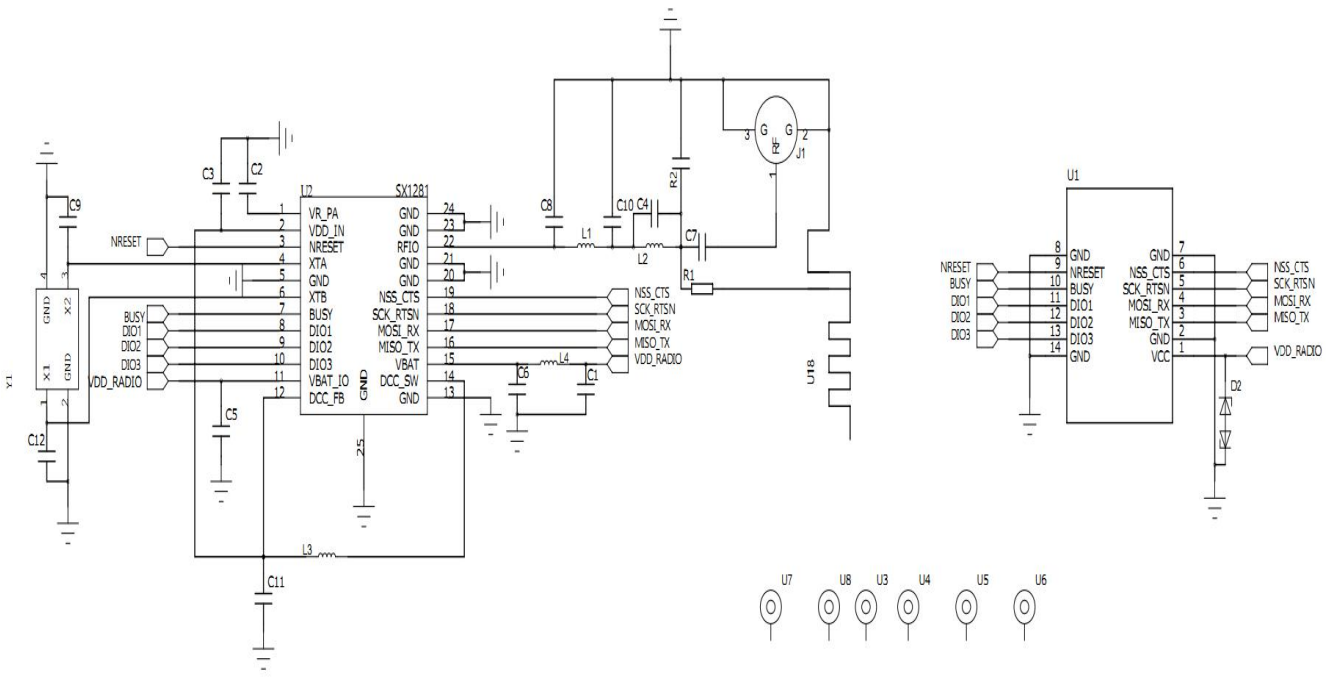


Figure 6 Schematic diagram

6. Design guidance

6.1. Application Guide Circuit

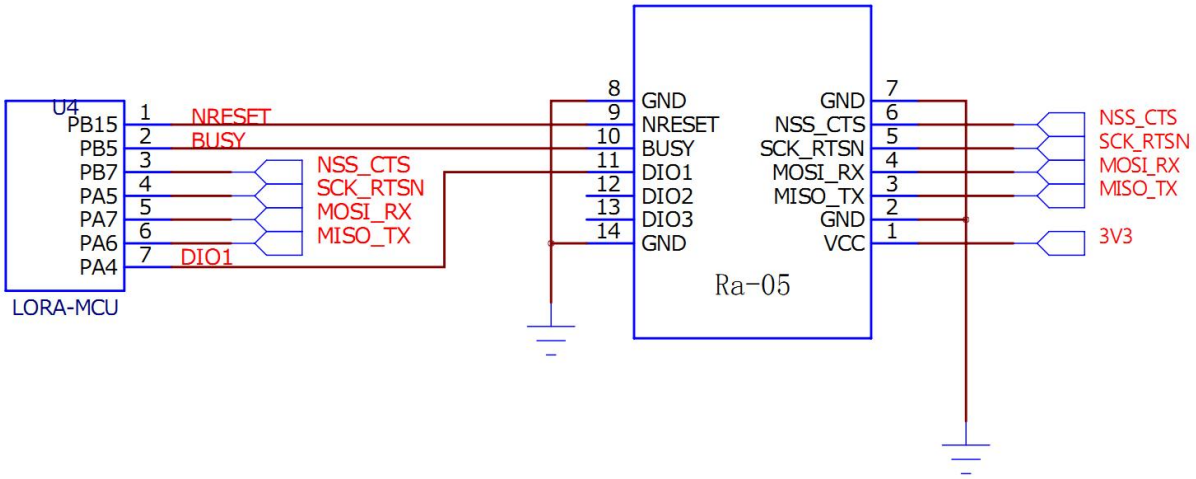


Figure 7 Application guidance circuit

Note: In addition to the SPI interface, the communication interface with the main control MCU also needs to connect BUSY/DIO1 to the IO port of the main control MCU.

6.2. Recommended PCB package size

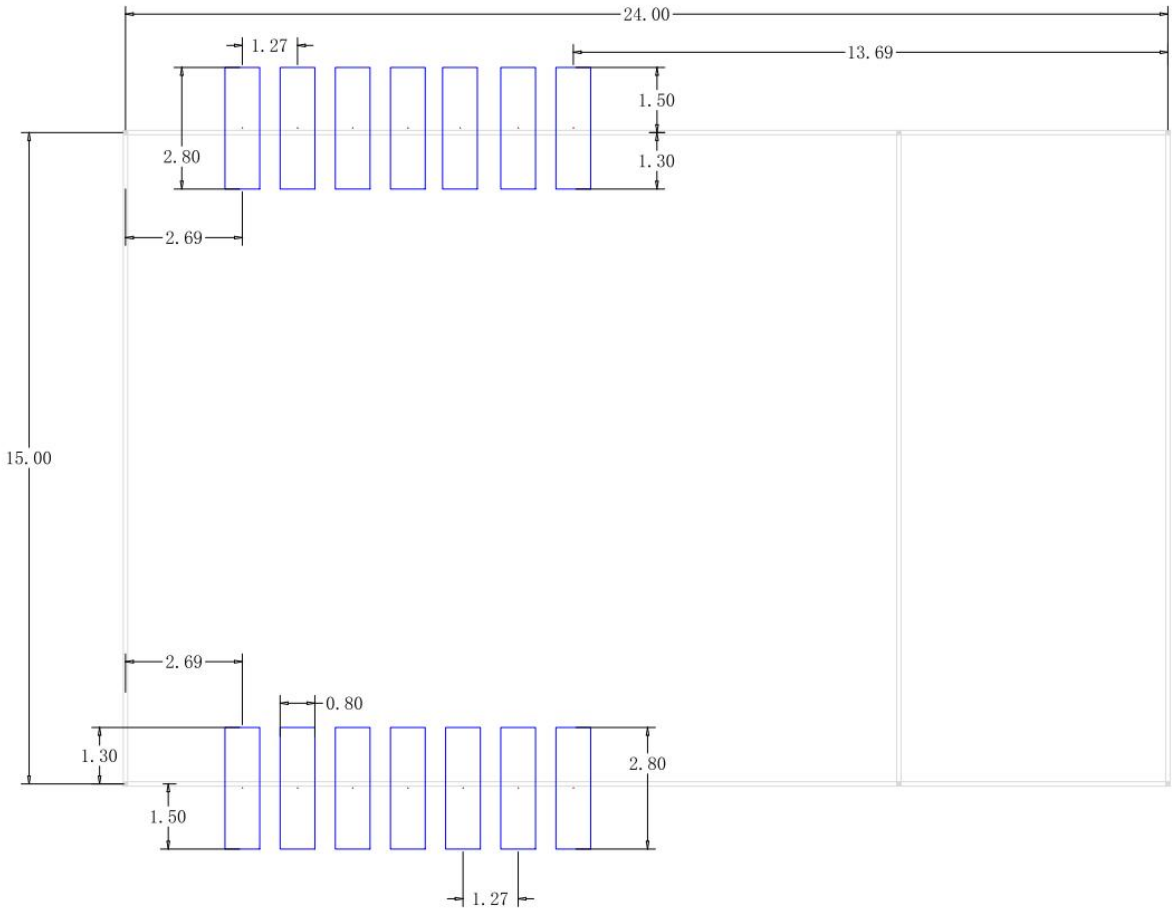


Figure 8 Recommended PCB package dimensions (unit: mm)

6.3. Power supply

- 3.3V voltage and peak current of more than 500mA are recommended.
- It is recommended to use LDO for power supply; if DC-DC is used, it is recommended to control the ripple within 100mV.
- It is recommended to reserve a position for dynamic response capacitors in the DC-DC power supply circuit, which can optimize the output ripple when the load changes greatly.
- It is recommended to add ESD devices to the 3.3V power supply interface.

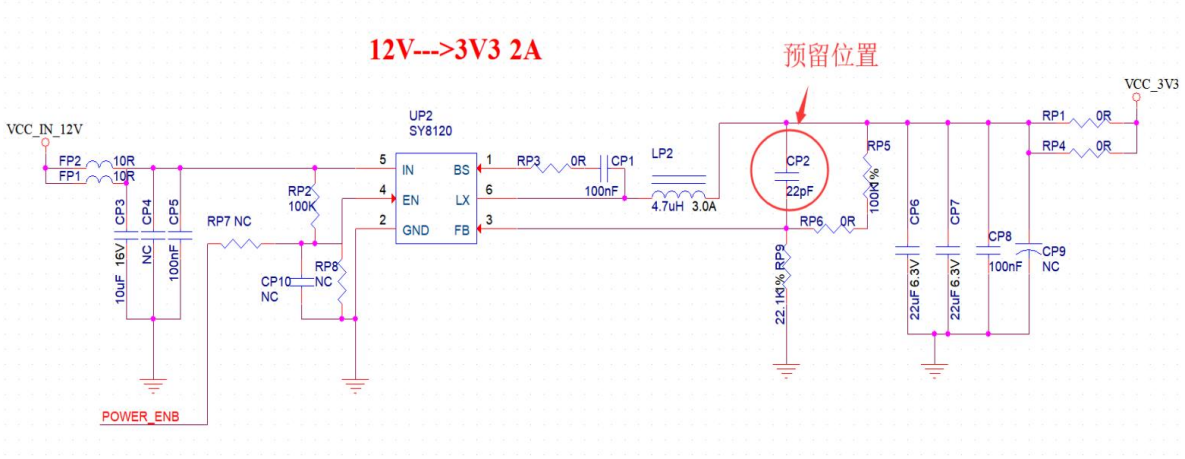


Figure 9 DC-DC buck circuit

6.4. GPIO

- Some IO ports are led out from the periphery of the module. If you need to use them, it is recommended to connect a 10-100 ohm resistor in series on the IO port. This can suppress overshoot and make the levels on both sides more stable. It is helpful for EMI and ESD.
- For the pull-up and pull-down of special IO ports, please refer to the instructions in the specification, which will affect the startup configuration of the module.
- Some IO ports of the module are 3.3V. If the IO port levels of the main control and the module do not match, a level conversion circuit needs to be added.
- If the IO port is directly connected to the peripheral interface, or terminals such as pin headers, it is recommended to reserve ESD devices near the terminals of the IO port routing.

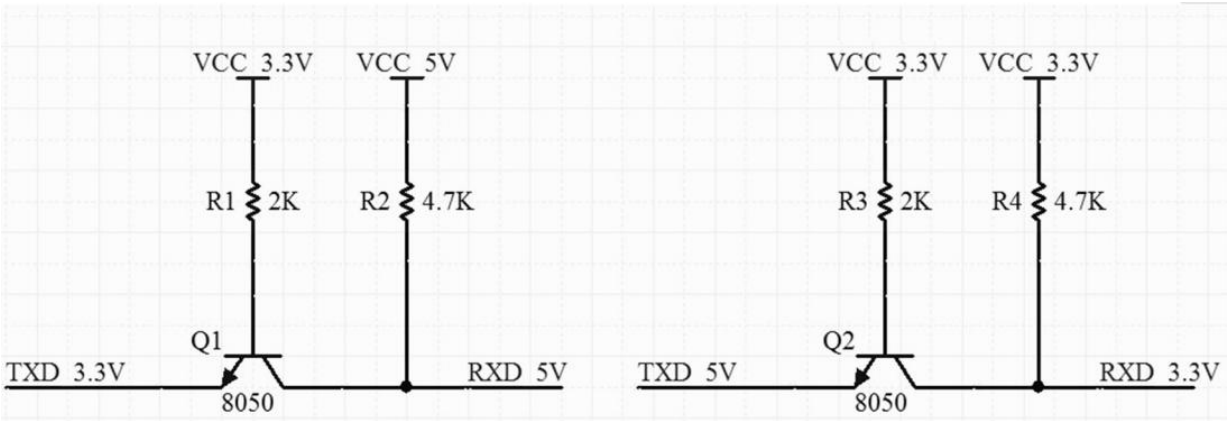


Figure 10 Level conversion circuit

7. Storage conditions

Products sealed in moisture-proof bags should be stored in a non-condensing atmosphere of <40℃/90%RH.

The module's moisture sensitivity level MSL is level 3.

After the vacuum bag is unpacked, it must be used within 168 hours at 25±5℃/60%RH, otherwise it needs to be baked before it can be put online again.

8. Reflow soldering curve

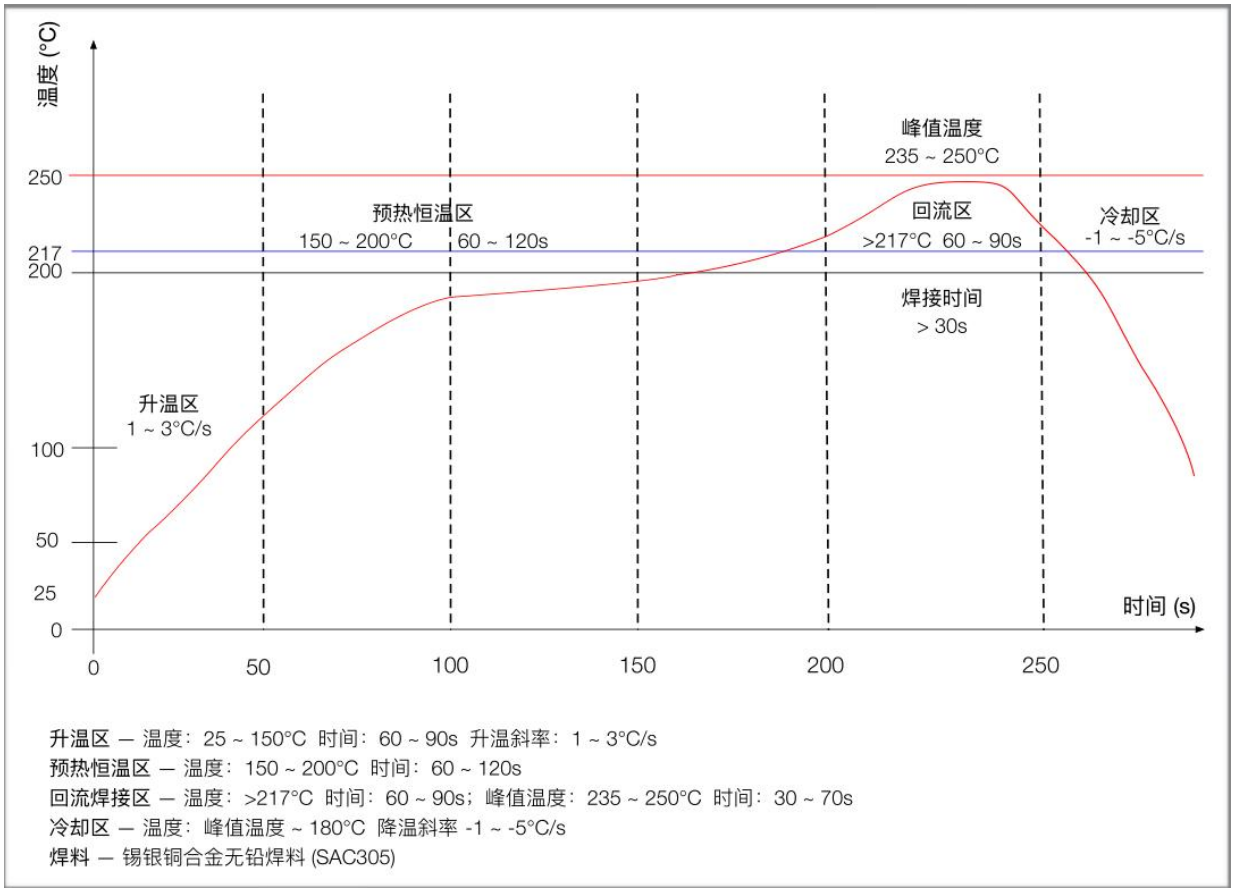


Figure 11 Reflow soldering curve

9. Product packaging information

Ra-05 module is packed in tape. As shown in the following figure:

Figure 12 Packaging and taping diagram

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