Ai-SG01 Specification

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Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2025.10.16	First Edition	Rongxin Qiao	Ning Guan

Content

1. Product Overview

Ai-SG01 is an ultra-high-performance RF front-end module based on PANCHIP's next-generation PAN3210 RF chip, designed for the **Internet of Things, short-range wireless communications, and Industry 4.0 wireless sensor networks**. Its core advantage lies in its **extremely small package, achieving extreme RF performance**. By optimizing the coordinated design of the power amplifier, low-noise amplifier, filter, and peripheral matching network, it achieves high output power, low loss, and strong anti-interference capabilities, while also meeting mainstream global regulatory certifications.

The Ai-SG01 module supports flexible multi-band configuration (420-445MHz and 470-510MHz optional) and is suitable for scenarios with dual requirements for size and performance, such as wireless sensors, smart home terminals, industrial monitoring, and medical wearables.
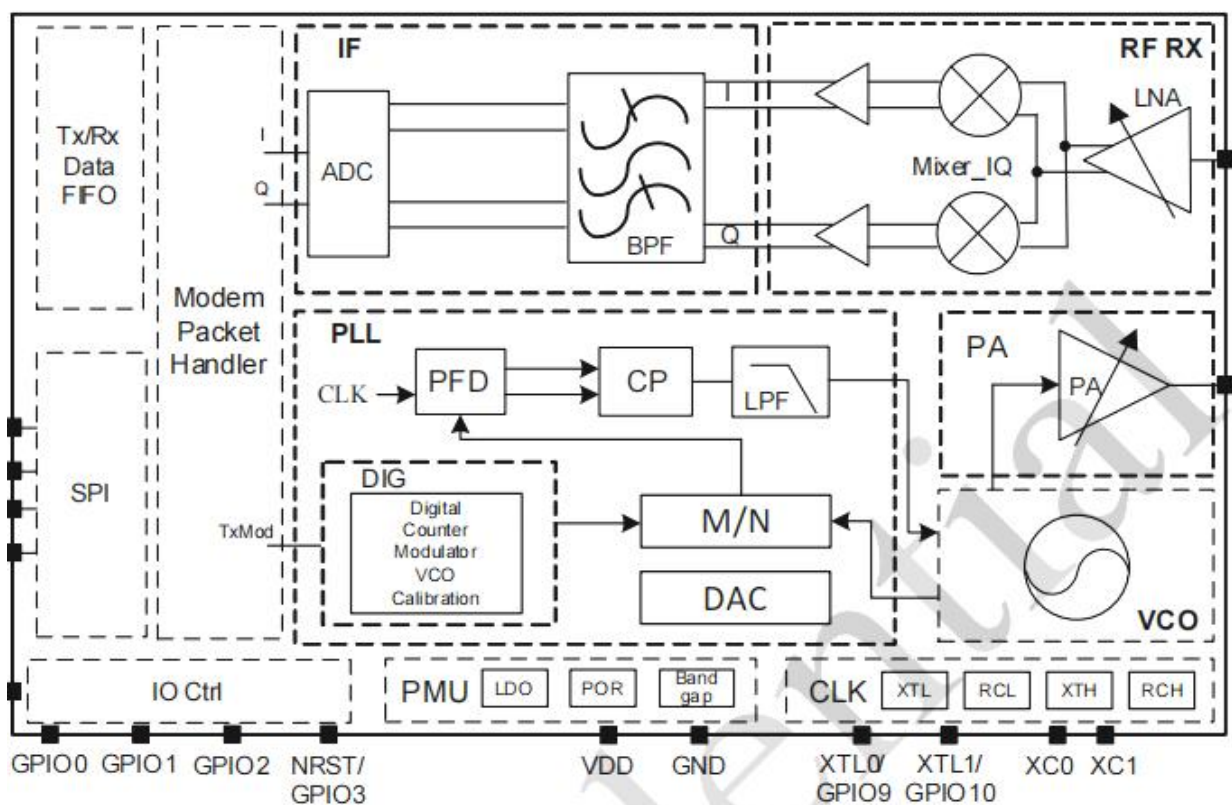

Figure 1 Main chip architecture diagram

1.1. Characteristic

■ Ultra-compact 12mm*13mm*2.4mm SMD-16 package

■)Operating frequency bands: 420-445MHz, 470-510MHz (band selectable, switchable via software and hardware configuration)

■ Maximum transmit power of the module reaches 20dBm (100mW), supporting DPC (-20 to 20dBm) in 1dB increments

■ Module receive sensitivity: -121dBm @ 2.4kbps, -107dBm @ 50kbps, -103dBm @ 100kbps, -94dBm @ 500kbps

■ Low spurious design: Harmonic suppression ≤-60dBc (2nd/3rd harmonics) at full load transmission, meeting CE, FCC, and other regulations.

■ Low ACPR design: Built-in predistortion engine achieves ≤-55dBc (50kbps FSK) at +20dBm output

■ The module's default data rate range is 2 to 500kbps, with optional settings of 2kbps to 2Mbps and 2kbps to 4Mbps (three speed ranges, switchable via software and hardware configuration)

■ Industrial-grade standard design, operating temperature range -40°C to 85°C (optional -40°C to 105°C)

■ Rich interfaces, including support for 4-wire SPI, 3-wire SPI, and 5 GPIO

■ Wide voltage supply, supports 1.8V to 3.8V (LDO mode)

■ Sleep current as low as 300nA

■ Special features: Supports RSSI and LQI, automatic frequency control (AFC), built-in 32K RC clock and external 32K crystal oscillator, duty cycle receive and transmit, and automatic ACK

■ Supports whitening, FEC, CRC, Manchester code, and other functions

■ Stamp hole interface, facilitating integration

2. Main parameters

Table 1 Description of the main parameters

Model	Ai-SG01
Package	SMD-16
Size	12.0*13.0*2.4（mm）
Antenna	External antenna
Frequency	420-445MHz or 470-510MHz
Operating temperature	-40~85℃
Storage temperature	-40 ℃ ~ 125 ℃ , < 90%RH
Power supply	Support 1.8 ~ 3.8V power supply (LDO mode), supply current ≥ 500mA
Interface	SPI
IO	5
SPI rate	Default 4.5MHz

2.1. Static electricity requirement

Ai-SG01 is an electrostatically sensitive device and requires special precautions when handling. These should generally be applied to ESD-sensitive components. Proper ESD handling and packaging procedures must be employed throughout the handling, transportation, and operation of any application incorporating the Ai-SG01 module. Do not touch the module with your hands or use a non-antistatic soldering iron for soldering, as this may damage the module.

Figure 2 ESD preventive measures

2.2. Electrical characteristics

Table 2 Electrical characteristics table

Parameters		Name	Min.	Typical value	Max.	Unit
Internal LDO mode supply voltage		3V3	1.8	3.3	3.8	V
Power supply	Full load mode（TX:20dBm）	433MHz		116		mA
		470MHz		100		mA
		490MHz		110		mA
		510MHz		115		mA
	Sleep			800		nA
	Deep Sleep			300		nA

2.3. RF Performance

Table 3 RF performance

Output Power				
Mode	Min.	Typical	Max.	Unit
433MHz		20		dBm
470MHz		20		dBm
490MHz		20		dBm
510MHz		20		dBm
Receive Sensitivity				
Mode	Min.	Typical	Max.	Unit
433.9MHz@50kbps		-108		dBm
470.9MHz@50kbps		-108		dBm
490.9MHz@50kbps		-108		dBm
505.9MHz@50kbps		-108		dBm

3. Appearance Dimensions

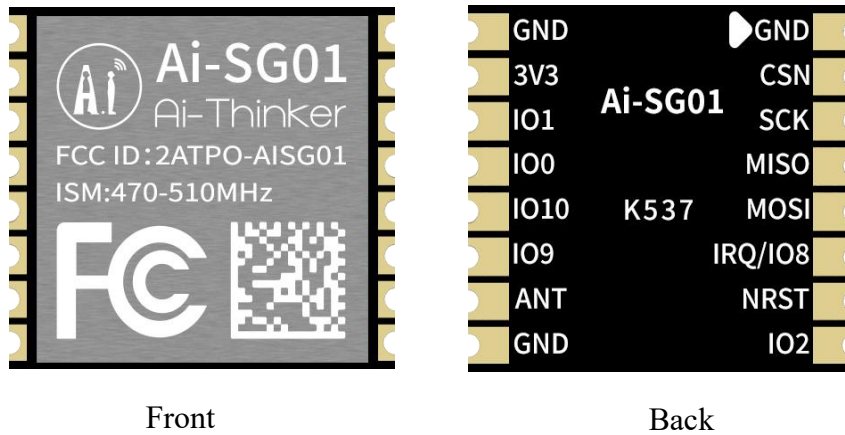Front   Back

Figure 3: Appearance of the 470-510MHz module (rendering is for reference only, the actual product shall prevail)
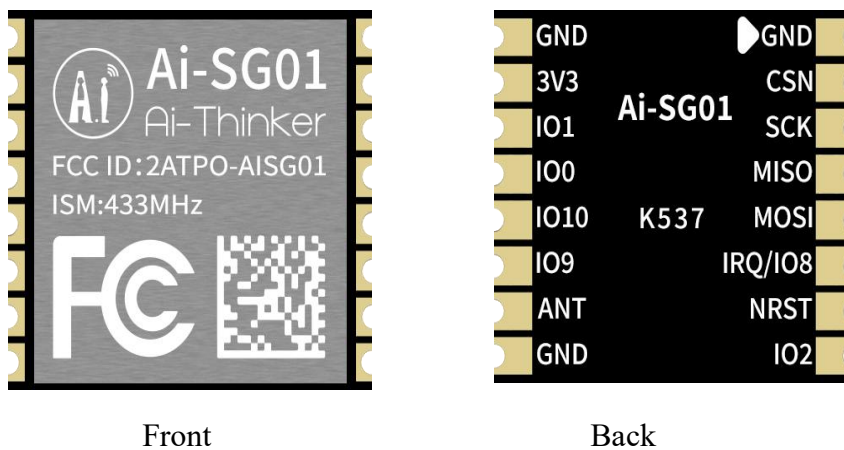

Front   Back

Figure 4: Appearance of the 433MHz module (rendering is for reference only, the actual product shall prevail)

Front   Side   Back
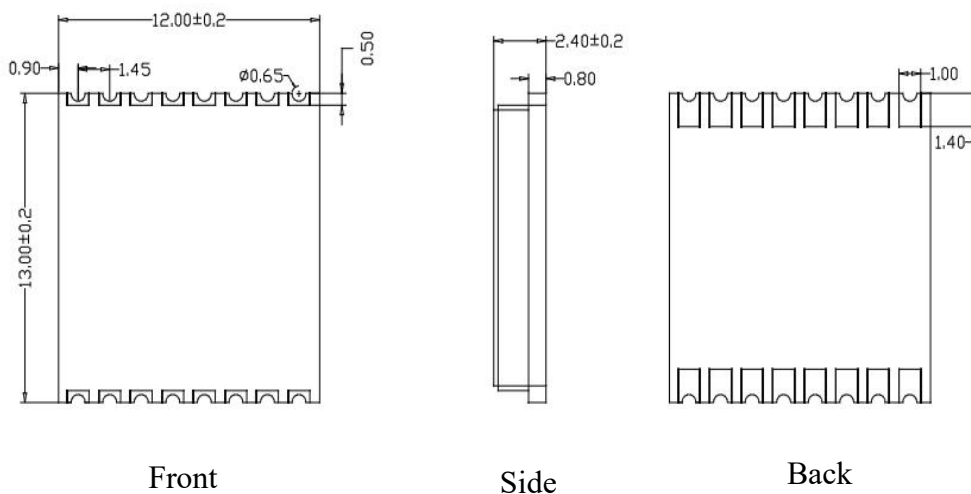
Figure 5 Dimensions

4. Pin Definition

Ai-SG01 module has a total of 16 pins, as shown in the pin diagram. The pin function definition table is the interface definition.
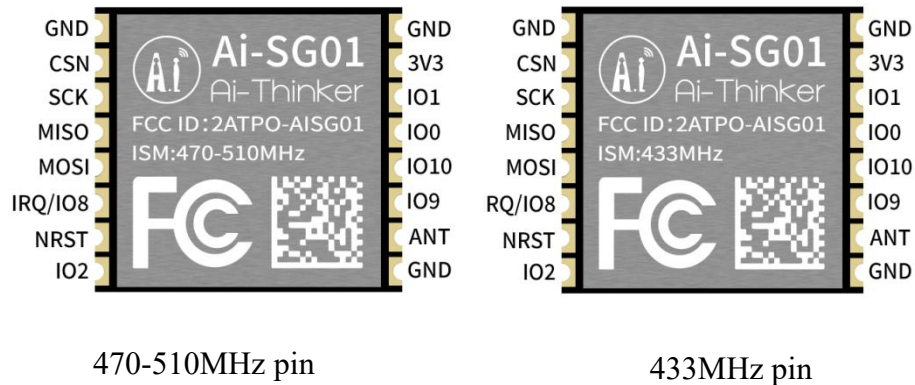

470-510MHz pin   433MHz pin

Figure 6 Pin diagram

Table 4 Pin function definition table

No.	Name	Function
1	GND	GND
2	CSN	SPI interface chip select input
3	SCK	SPI interface clock input
4	MISO	SPI interface MISO data output
5	MOSI	SPI interface MOSI data input
6	IRQ/IO8	Interrupt signal pin, directly connected to chip GPIO8
7	NRST	Chip hardware reset pin
8	IO2	Digital IO, software configurable, directly connected to chip GPIO2
9	GND	GND
10	ANT	RF signal input/output, connects to a 50Ω antenna
11	IO9	Digital IO, software-configurable, directly connected to the chip: GPIO9
12	IO10	Digital IO, software-configurable, directly connected to the chip: GPIO10
13	IO0	Digital IO, software-configurable, directly connected to the chip: GPIO0
14	IO1	Digital IO, software-configurable, directly connected to the chip: GPIO1
15	3V3	Module power supply, LDO mode, voltage range: 1.8V~3.6V
16	GND	GND

5. Schematic

Figure 7 Module schematic

6. Design Guidance
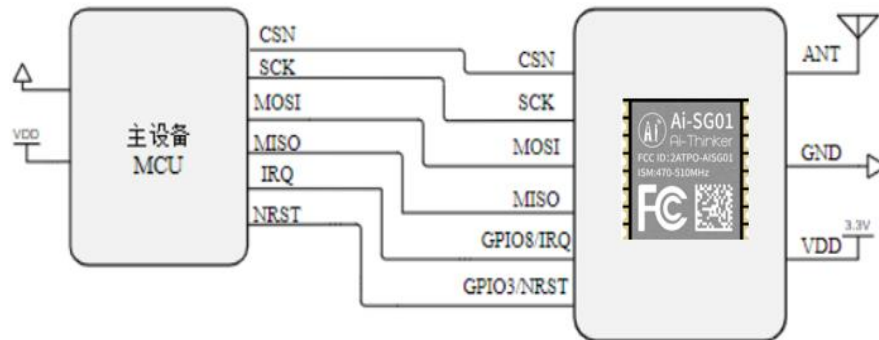
6.1. Application Guidance Circuit

Figure 8 Application guidance circuit

■ If the communication interface uses 3-wire SPI, the MISO pin can be left unconnected.

■ The VDD power supply in the figure is typically 3.3V. The module's power supply range is as follows:

■ a. In LDO mode, 1.8V to 3.8V

■ b. In DCDC mode, 2.0V to 3.8V

■ Supply current > 500mA
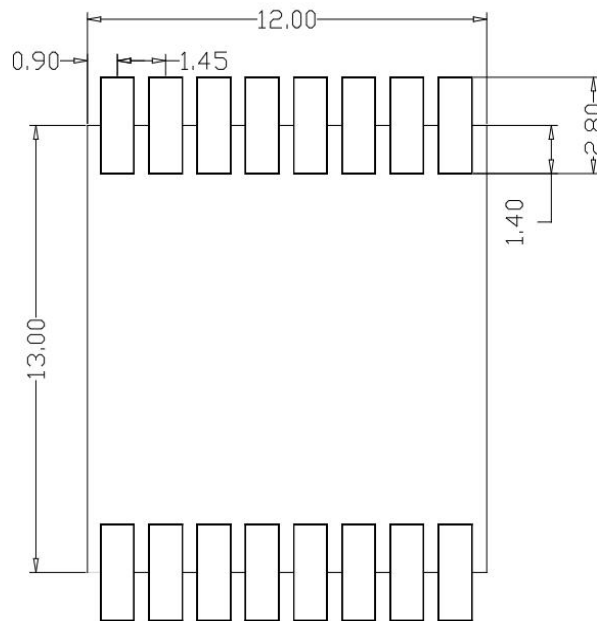
6.2. Recommended PCB package size

Figure 9 Recommended PCB package size

6.3. Antenna Layout Requirements

■ This module requires an external antenna. The following two methods are recommended for antenna installation on the motherboard:

 Solution 1: Place the module on the edge of the motherboard, with the antenna extending beyond the edge.

 Solution 2: Place the module on the edge of the motherboard, with a hollowed-out area at the antenna location.

■ To ensure optimal antenna performance, avoid placing metal objects around the antenna and keep it away from high-frequency components.

6.4. Power supply

■ Recommended VDD voltage: 3.3V, peak current: 500mA or higher.

■ Recommended power supply: LDO. If using a DC-DC converter, ripple should be kept within 30mV.

■ In the DC-DC converter circuit, it is recommended to reserve space for dynamic response capacitors to optimize output ripple under large load fluctuations.
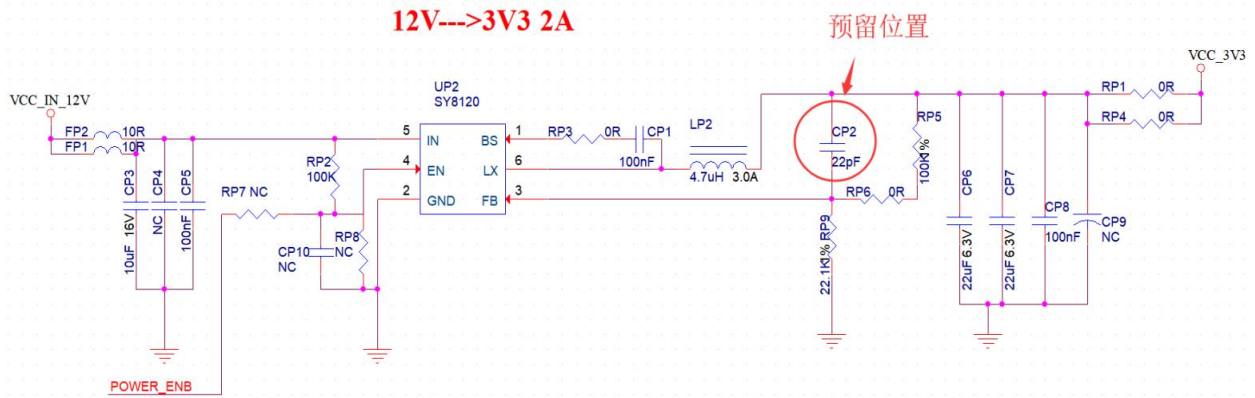
Figure 10 DC-DC buck circuit diagram

6.5. GPIO

- The module's external IO ports are connected. If you need to use them, it's recommended to connect a 10-100 ohm resistor in series with the IO ports. This can suppress overshoot and stabilize the voltage levels on both sides. This helps with both EMI and ESD.

- For pull-up and pull-down configurations on specific IO ports, please refer to the datasheet, as this will affect the module's startup configuration.

- If the module's IO ports are 3.3V, adding a level shifter is necessary if the voltage levels of the main controller and module's IO ports don't match.

- If the IO ports are directly connected to peripheral connectors or pin headers, it's recommended to place ESD devices near the terminals along the IO port traces.
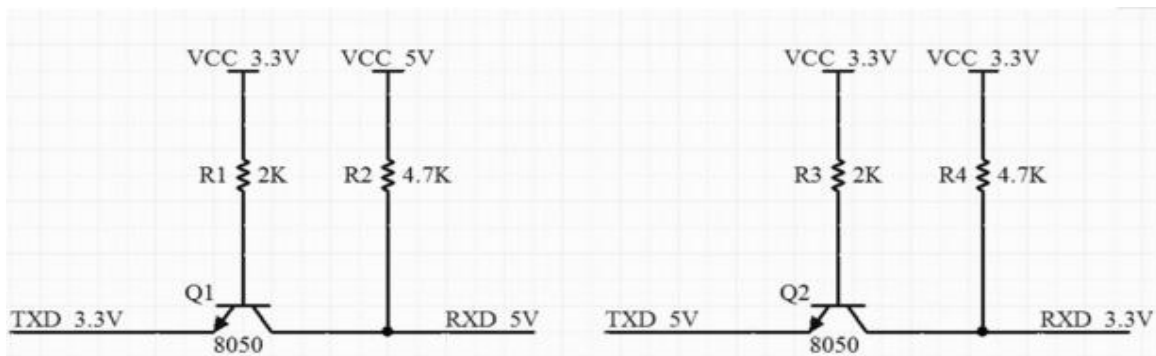

Figure 11 Level conversion circuit

7. Storage conditions

Products sealed in moisture-proof bags should be stored in a non-condensing environment at temperatures below 40°C/90% RH.

The module's Moisture Sensitivity Level (MSL) is 3.

After unsealing the vacuum bag, the product must be used within 168 hours at 25±5°C/60% RH. Otherwise, it must be baked before re-use.
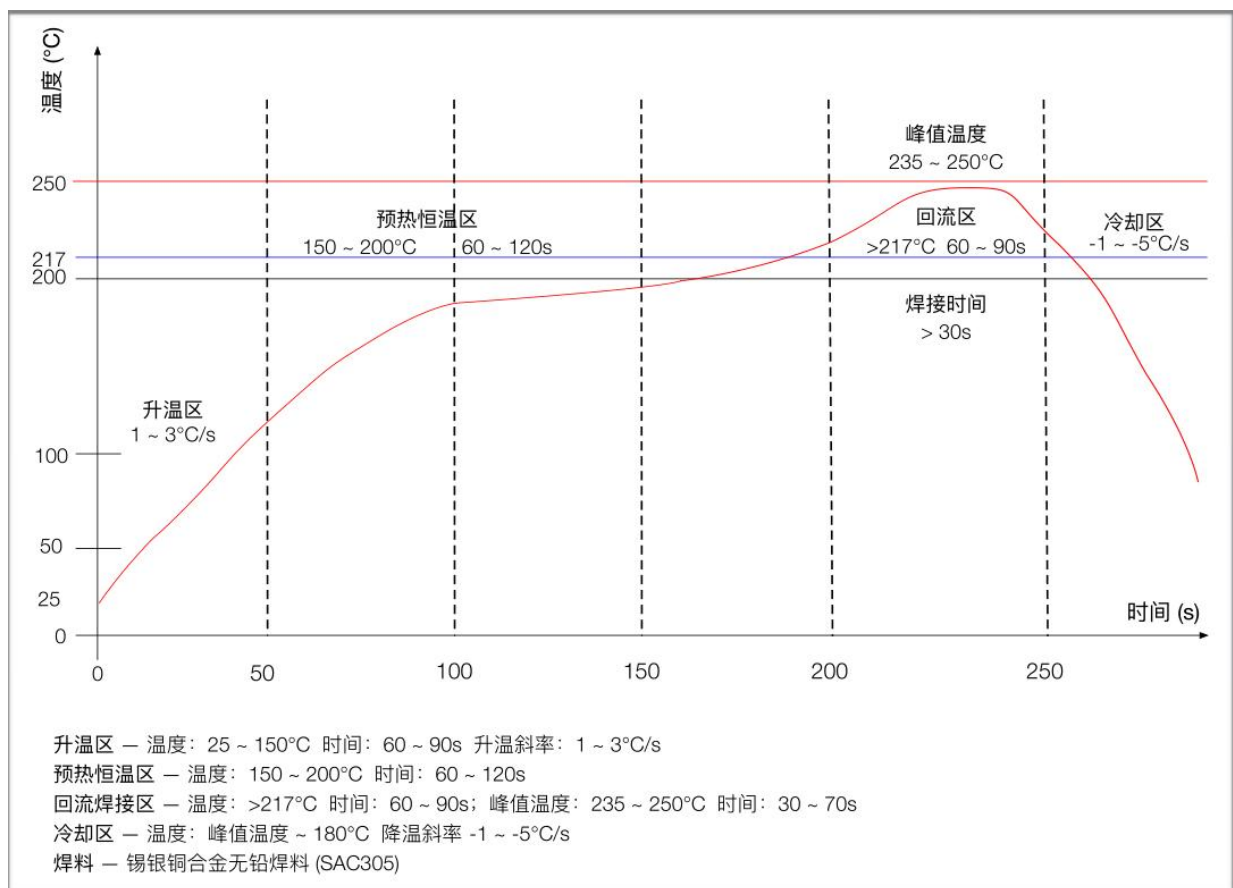
8. Reflow welding curve diagram

Figure 12 Reflow curve

9. Product Packaging Information

Ai-SG01 modules are packaged in tape, 1000 pieces per tray. As shown in the following figure:

Figure 13 Packaging tape diagram

10. Contact us

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