



# Ai-WB1-A1S Specification

Version V1.1.1

Copyright ©2022

## Document resume

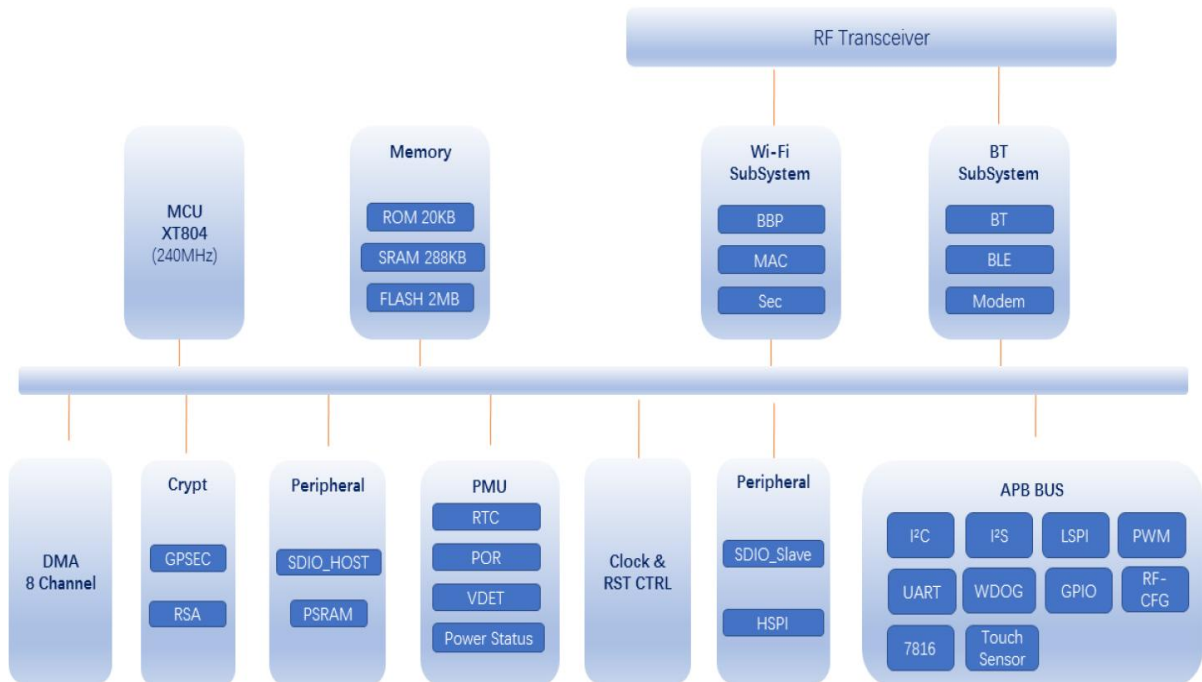
Version	Date	Develop/revise content	Edition	Approve
V1.1.0	2022.8.26	First Edition	ChaoMei Deng	Ning Guan
V1.1.1	2022.10.31	Add RF OTA parameters	ChaoMei Deng	Ning Guan

## Content

1. Product Overview .....	4
1.1. Characteristic .....	5
2. Main parameters .....	6
2.1. Static electricity requirement .....	6
2.2. Electrical characteristics .....	7
2.3. Wi-Fi RF Performance .....	7
2.4. BLE RF Performance .....	8
2.5. Power consumption .....	8
3. Appearance Dimensions .....	9
4. Pin Definition .....	10
5. Schematic .....	12
6. Antenna parameters .....	13
6.1. Schematic diagram of the antenna test prototype .....	13
6.2. Antenna S parameter .....	14
6.3. Antenna Gain and Efficiency .....	14
6.4. Antenna pattern .....	15
6.5. RF OTA parameters .....	16
7. Design Guidance .....	17
7.1. Application Guidance Circuit .....	17
7.2. Recommended PCB package size .....	18
7.3. Antenna Layout Requirements .....	18
7.4. Power supply .....	19
7.5. GPIO .....	20
8. Storage conditions .....	21
9. Reflow welding curve diagram .....	21
10. Product Packaging Information .....	22
11. Contact us .....	22
Disclaimer and copyright notice .....	23
Notice .....	23

# 1. Product Overview

Ai-WB1-A1S is a Wi-Fi&BLE voice module developed by Shenzhen Ai-Thinker Technology Co., Ltd. The module is equipped with W800 chip as the core processor, supports Wi-Fi 802.11b/g/n protocol, and supports BLE 1M rate Working mode, support BLE4.2 protocol, the module also integrates ES8311 voice codec chip. The W800 chip used by the module has a built-in low-power 32-bit XT804 CPU, operating frequency of 240MHz, built-in 2MB Flash, and 288KB RAM. Ai-WB1-A1S provides rich peripheral interfaces, including SDIO, PSRAM, SPI, UART, I2C, PWM, ADC, Touch sensor, Duplex I2S and GPIO, MIC, Speak interface, etc. Ai-WB1-A1S supports the expansion of PSRAM and FLASH. When the PSRAM or Flash module is expanded, some interfaces cannot be used. For details, see the remarks below the pin function definition table. The Ai-WB1-A1S module can be widely used in intelligent voice, Internet of Things (IoT), mobile devices, smart home and other fields.



**Figure 1 Main chip architecture diagram**

## 1.1. Characteristic

- The package is SMD-38
- Support IEEE 802.11 b/g/n protocol
- Wi-Fi Security Support Wi-Fi WMM/WMM-PS/WPA/WPA2 /WPS
- Support 20/40MHz bandwidth, the highest rate is 150 Mbps
- Support BLE 1M rate working mode, support BLE4.2 protocol
- Support Station, Station + SoftAP , SoftAP mode
- Integrated ES8311 voice codec chip
- Support 32-bit XT804 CPU, 288KB RAM
- The MCU has a built-in Tee security engine, and the code can distinguish between security events and non-security events
- Integrated SASC/TIPC, memory and internal modules/interfaces can be configured with security attributes to prevent non-secure code access
- Enable firmware signature mechanism for secure Boot/upgrade
- With firmware encryption function to enhance code security
- Firmware encryption keys are distributed using asymmetric algorithms for enhanced key security
- Hardware encryption module: RC4256, AES128, DES/3DES, SHA1/MD5, CRC32, 2048RSA, true random number generator
- Support SDIO, PSRAM, SPI, UART, I2C, PWM, ADC, Touch sensor, Duplex I2S and GPIO, microphone, speaker and other interfaces
- Integrated Wi-Fi MAC/BB/RF/PA/LNA/Bluetooth
- Supports multiple sleep modes
- Support secondary development, integrated Windows, Linux development environment

## 2. Main parameters

**Table 1 Description of the main parameters**

<b>Model</b>	Ai-WB1-A1S
<b>Package</b>	SMD-38
<b>Size</b>	31.5*19.0*3.1(±0.2)mm
<b>Antenna</b>	Default on-board PCB antenna/compatible IPEX base
<b>Frequency</b>	2400 ~ 2483.5MHz
<b>Operating temperature</b>	-40°C ~ 85°C
<b>Storage temperature</b>	-40°C ~ 125°C, < 90%RH
<b>Power supply</b>	Support voltage 3.0V ~ 3.6V, supply current ≥500mA
<b>Interface</b>	UART/GPIO/ADC/PWM/I2C/SPI/Touch sensor/PSRAM/SDIO/Duplex I2S/Microphone/Speaker
<b>IO</b>	11
<b>UART rate</b>	Default 115200 bps
<b>Security</b>	Wi-Fi WMM/WMM-PS/WPA/WPA2 /WPS
<b>Flash</b>	Default 2MByte, Maximum support 16MByte
<b>PSRAM</b>	None by default, can support expansion, maximum support 64Mbyte

### 2.1. Static electricity requirement

Ai-WB1-A1S 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**

Parameters	Conditio	Min.	Typical value	Max.	Unit
Voltage Supply	VDD	3.0	3.3	3.6	V
I/O	VIL	-	0.3	0.8	V
	VIH	-	2.0	VDD+0.3	V
	VOL	-	-	0.4	V
	VOH	-	2.4	-	V
	IMAX	-	-	-	24

## 2.3. Wi-Fi RF Performance

**Table 3 Wi-Fi RF performance table**

Description	Typical value			Unit
Frequency range	2400 ~ 2483.5MHz			MHz
<b>Output Power</b>				
Mode	Min.	Typical	Max.	Unit
11n Mode HT20, PA output power	-	12	-	dBm
11g Mode, PA output power	-	13	-	dBm
11b Mode, PA output power	-	18	-	dBm
<b>Receive Sensitivity</b>				
Mode	Min.	Typical	Max.	Unit
11b, 1 Mbps	-	-95	-	dBm
11b, 11 Mbps	-	-85	-	dBm
11g, 6 Mbps	-	-89	-	dBm
11g, 54 Mbps	-	-72	-	dBm
11n, HT20 (MCS7)	-	-69	-	dBm

## 2.4. BLE RF Performance

**Table 4 BLE RF performance table**

Description	Typical value			Unit
Frequency range	2400 ~ 2483.5MHz			MHz
Output Power				
Rate Mode	Min.	Typical	Max.	Unit
1Mbps	-	4	6	dBm
Receive Sensitivity				
Rate Mode	Min.	Typical	Max.	Unit
1Mbps sensitivity@30.8%PER	-	-92	-	dBm

## 2.5. Power consumption

The following power consumption figures are based on a 3.3V supply, 25° C ambient temperature, and are measured using the internal voltage regulator.

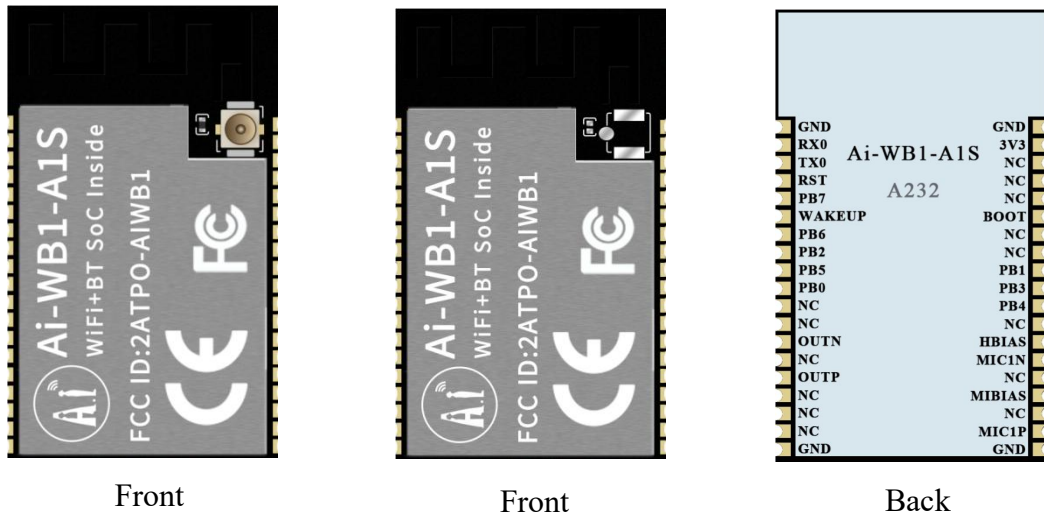
- All measurements are made at the antenna interface with filters.
- All transmit data is based on 100% duty cycle, measured in continuous transmit mode.

**Table 5 Power consumption**

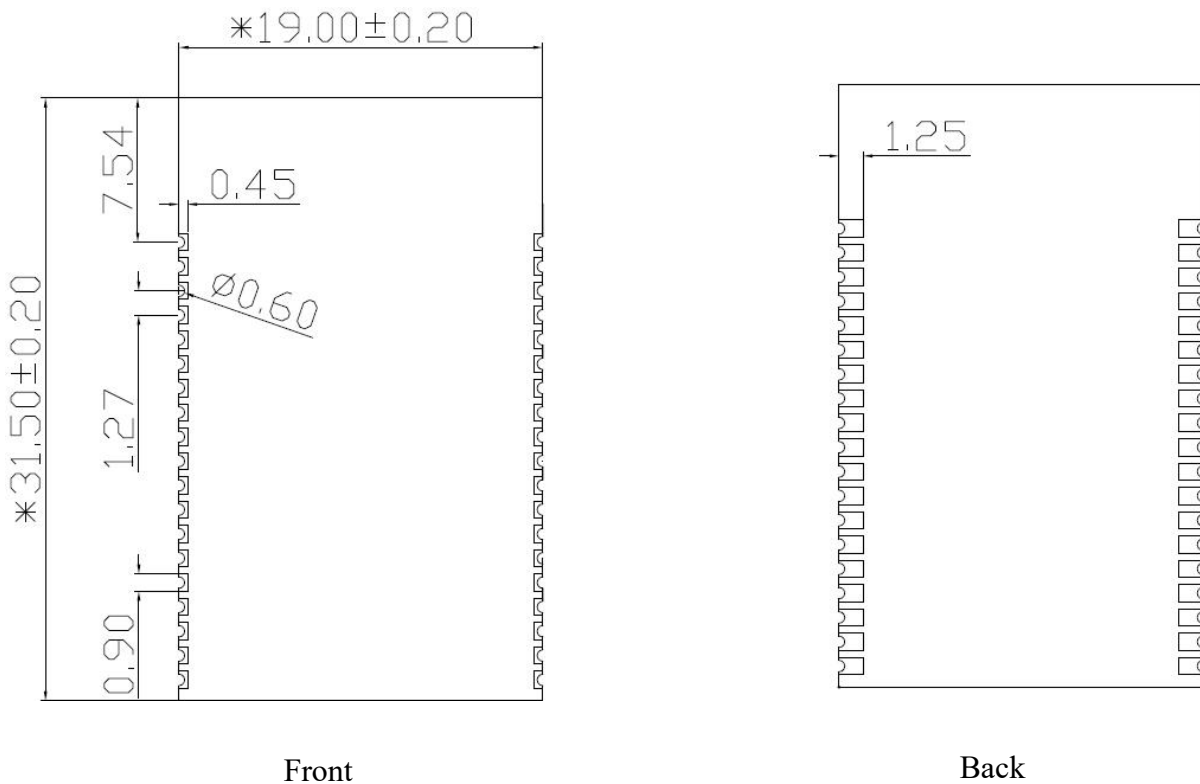
Mode	Min.	AVG	Max.	Unit
Tx 802.11b, 11Mbps, POUT=+19dBm	-	348	-	mA
Tx 802.11g, 54Mbps, POUT =+15dBm	-	190	-	mA
Tx 802.11n, MCS7, POUT =+12dBm	-	190	-	mA
Rx 802.11b, packet length 1024 byte	-	96	-	mA
Rx 802.11g, packet length 1024 byte	-	96	-	mA
Rx 802.11n, packet length 1024 byteSRAM	-	96	-	mA



### 3. Appearance Dimensions



**Figure 3 Appearance diagram (pictures is for reference only,subject to physical objects)**



**Figure 4 Dimension diagram**

## 4. Pin Definition

Ai-WB1-A1S module has a total of 38 pins, as shown in the pin diagram, the pin function definition table is the interface definition.

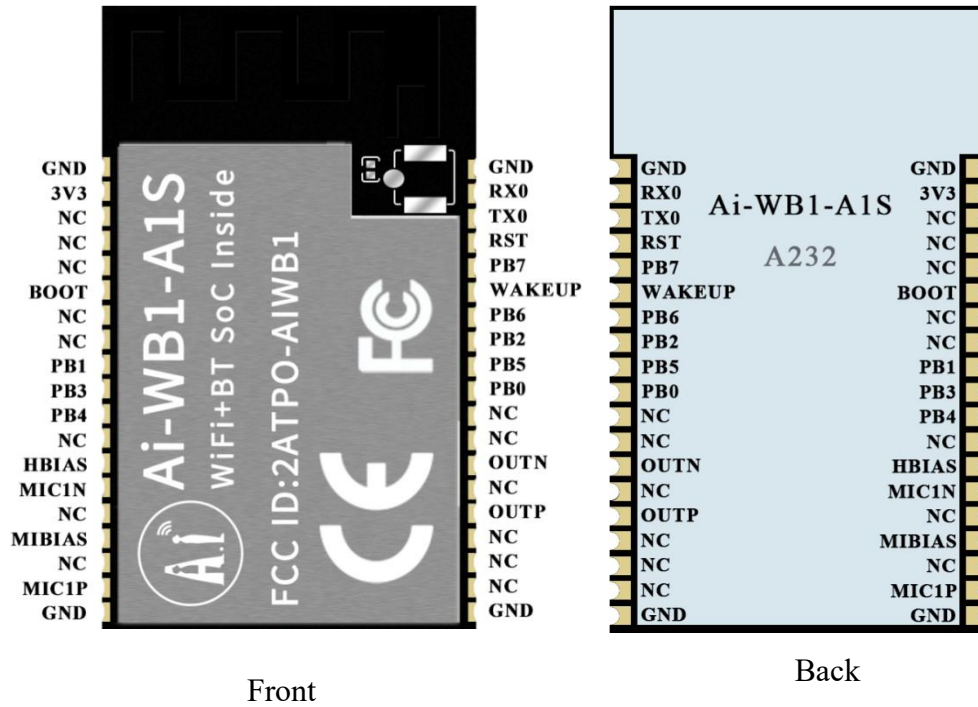


Figure 5 Schematic diagram of module pins

**Table 6 Pin function definition table**

No.	Name	Function
1,19,20,38	GND	Ground
2	3V3	3.3V power supply; the output current of the external power supply is recommended to be above 500mA
3,4,5,7,8,12,15,17,21,22,23,25,27,28	NC	NC is unavailable.
6	BOOT	I2S_MCLK/LSPI_CS/PWM2/I2S_DO/BOOTMODE
9	PB1	PWM1/LSPI_CLK/UART3_RX/PSRAM_CS/Touch4/GPIO
10	PB3	PWM3/LSPI_MISO/UART2_RX/PSRAM_D1/Touch6/GPIO
11	PB4	LSPI_CS/UART2_RTS/UART4_TX/PSRAM_D2/Touch7/GPIO
13	HBIAS	Internal 1K resistor pull up to AVCC (3.3V)
14	MIC1N	Audio chip RIN1
16	MBIAS	Internal 1K resistor pull up to AVCC (3.3V)
18	MIC1P	Audio chip LIN1 channel
24	OUTP	Audio chip ROUT1 channel
26	OUTN	Audio chip LOUT1 channel
29	PB0	PWM0/LSPI_MISO/UART3_TX/PSRAM_CK/Touch3/GPIO
30	PB5	LSPI_MOSI/UART2_CTS/UART4_RX/PSARM_D3/Touch8/GPIO
31	PB2	PWM2/LSPI_CK/UART2_TX/PSRAM_D0/Touch5/GPIO
32	PB6	UART1_TX/MMC_CLK/HSPI_CK/SDIO_CK/Touch9/GPIO
33	WAKEUP	WAKEUP weak-up founction
34	PB7	UART1_RX/MMC_CMD/HSPI_INT/SDIO_CMD/Touch10/GPIO
35	RST	Default as chip enable, active high.
36	TX0	UART0_TX/PWM0/UART1_RTS/I2C_SDA
37	RX0	UART0_RX/PWM1/UART1_CTS/I2C_SCL

Note: When the module is equipped with PSRAM, the module pins 9, 10, 11, 29, 30, and 31 cannot be used; when the module is equipped with an external Flash, the module pins 11, 29, 30, and 31 cannot be used. For specific models of modules that can use these pins, please consult Ai-Thinker Technology.

## 5. Schematic

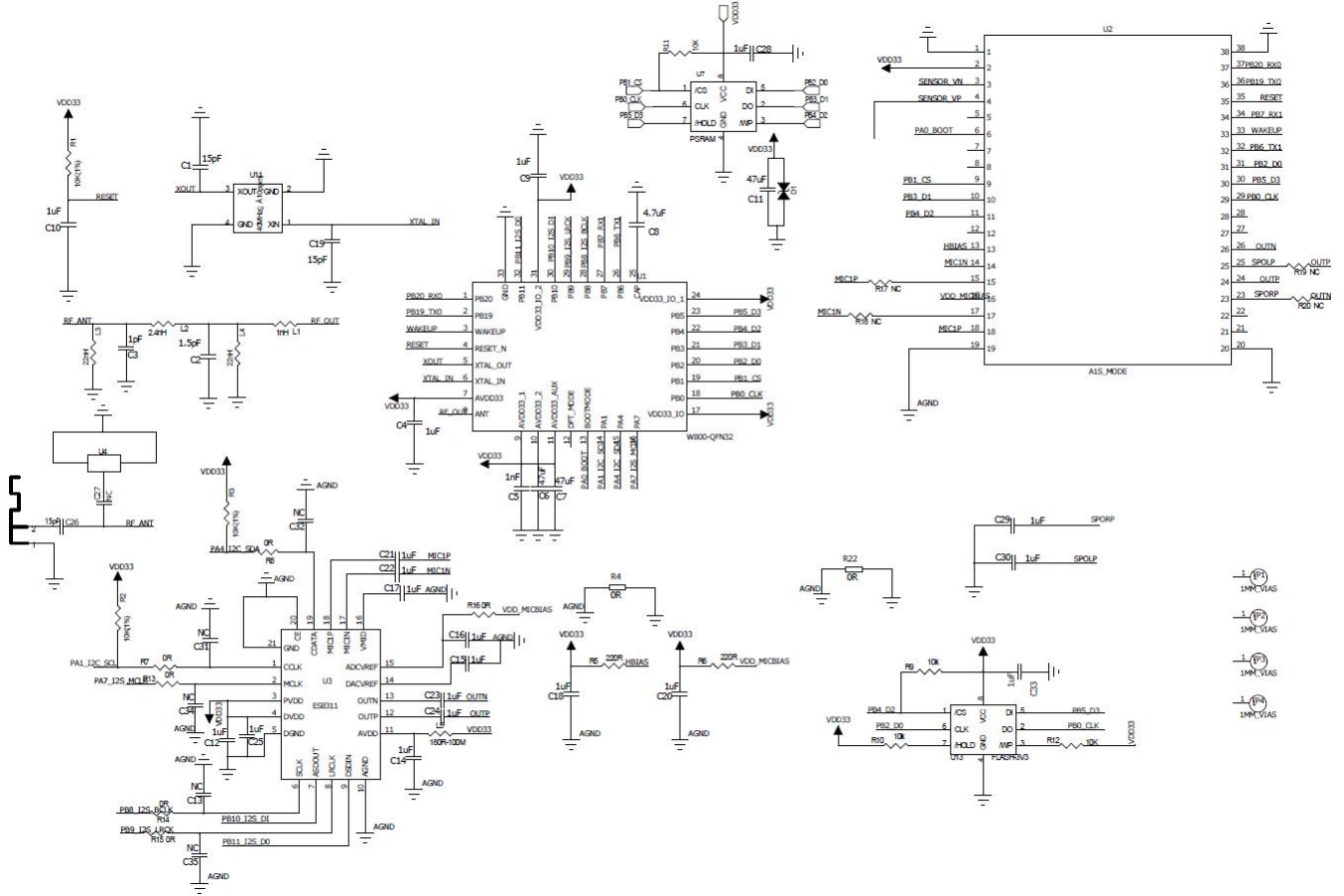
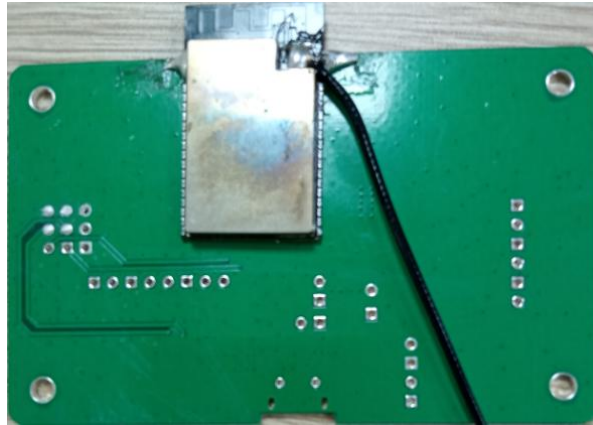


Figure 6 Schematic

## 6. Antenna parameters

### 6.1. Schematic diagram of the antenna test prototype



**Figure 7 Schematic diagram of the antenna test prototype**

## 6.2. Antenna S parameter

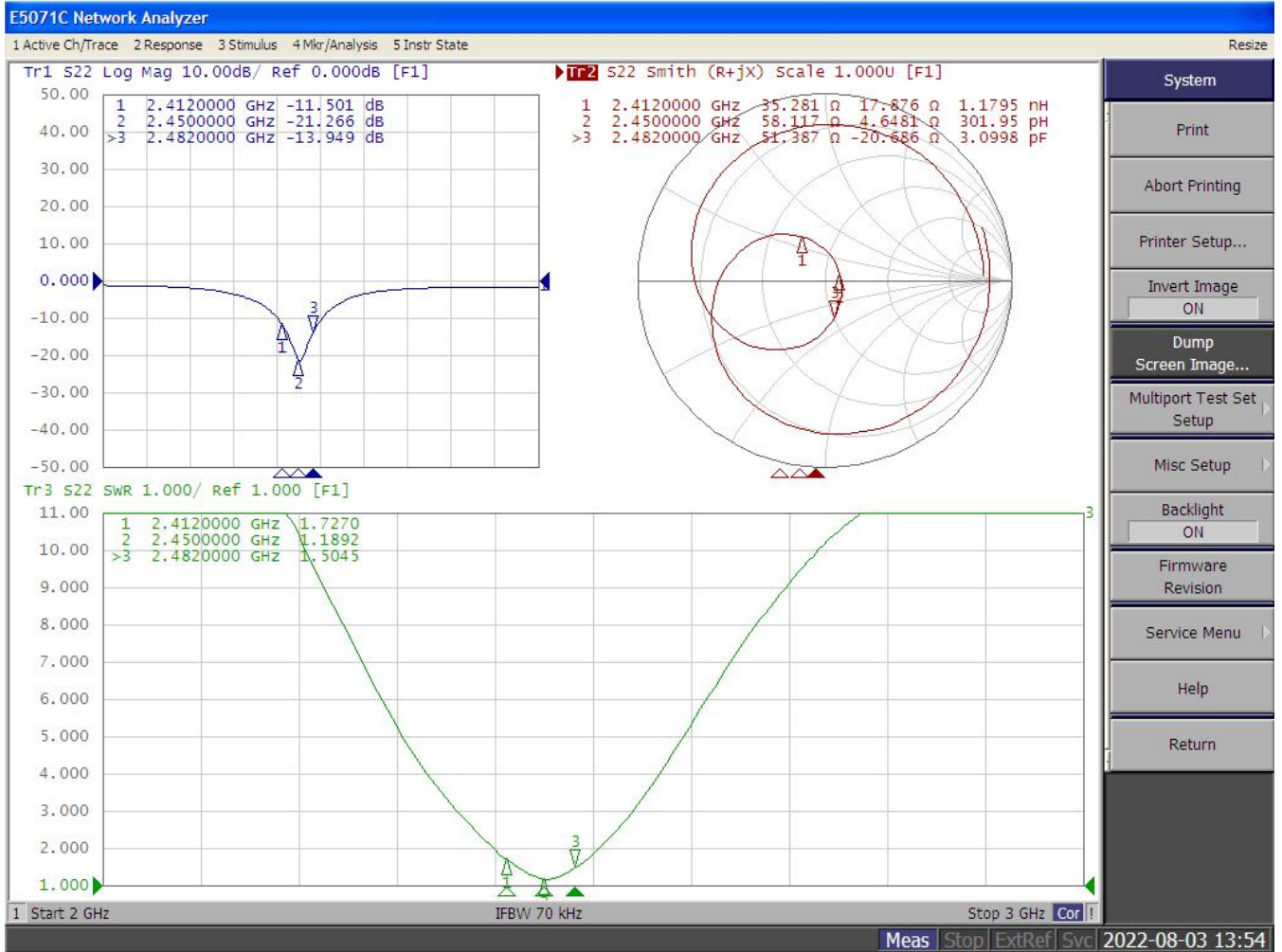


Figure 8 Antenna S parameters

## 6.3. Antenna Gain and Efficiency

Table 7 Antenna Gain and efficiency

Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency(MHz)	2400	2410	2420	2430	2440	2450	2460	2470	2480	2490	2500
Gain (dBi)	1.68	1.80	1.79	1.98	2.02	2.18	2.34	2.30	2.07	1.84	1.45
Efficiency (%)	58.02	59.61	59.35	61.98	63.29	65.57	66.48	66.05	63.62	62.08	57.91

### 6.4. Antenna pattern

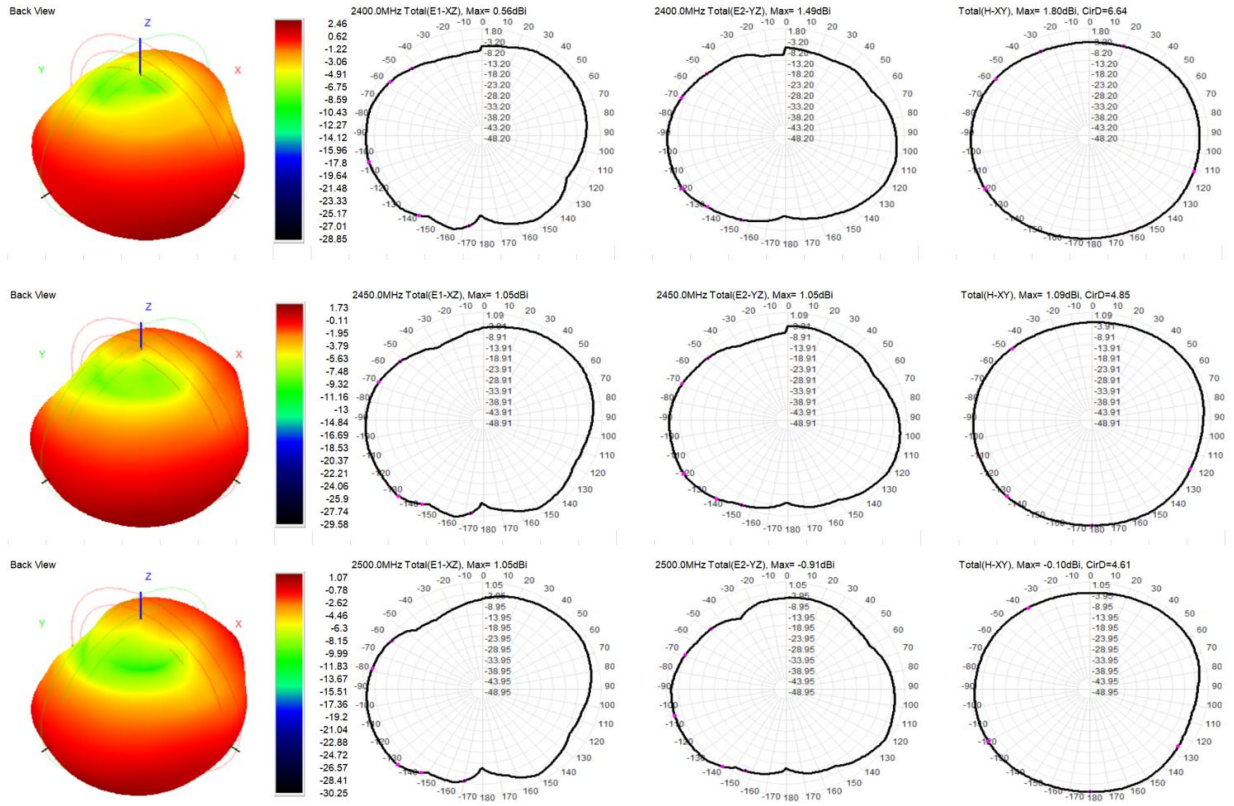


Figure 9 Antenna pattern

## 6.5. RF OTA parameters

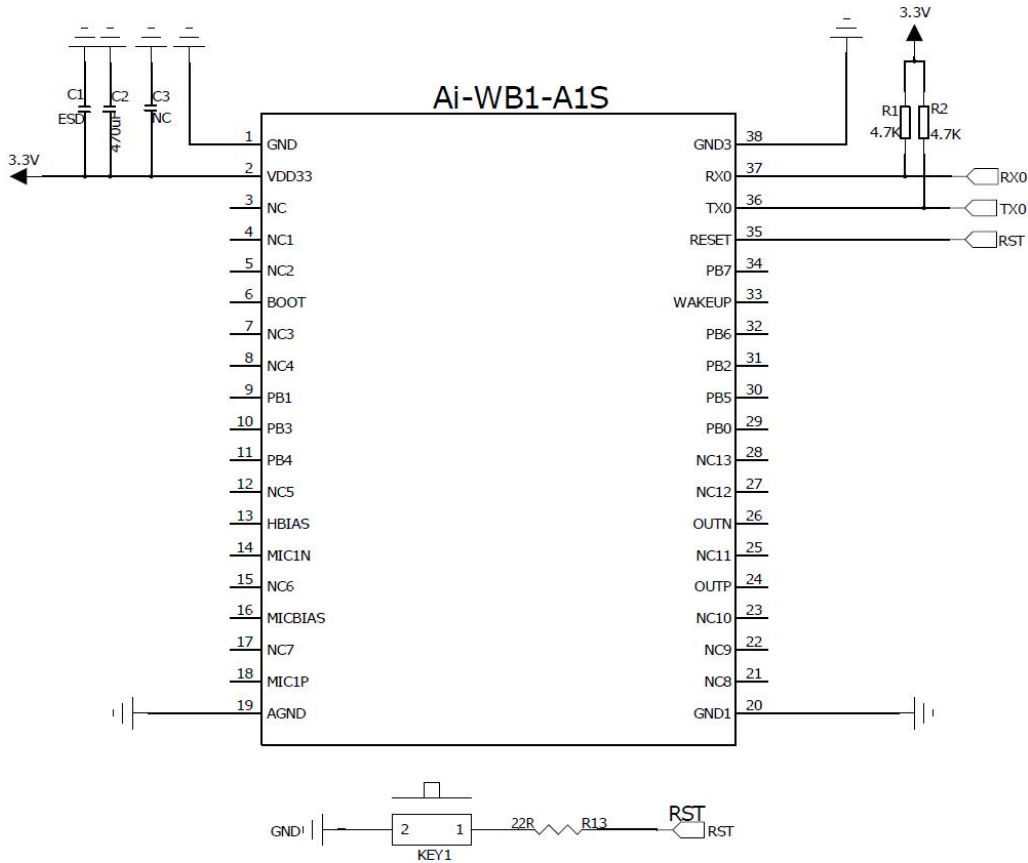
**Table 8 RF OTA parameters**

Item	Mode	Rate(Mbps)	Channel	Fre.(MHz)	Data(dBm)
TRP	11b	11	1	2412	17.5
			6	2437	17.4
			13	2472	17.2
	11g	54	1	2412	13.6
			6	2437	13.2
			13	2472	12.7
	HT20	MCS7	1	2412	10.7
			6	2437	10.1
			13	2472	9.61
TIS	11b	11	1	2412	-82.4
			6	2437	-82.1
			13	2472	-81.0
	11g	54	1	2412	-69.1
			6	2437	-67.2
			13	2472	-68.1
	HT20	MCS7	1	2412	-62.9
			6	2437	-62.1
			13	2472	-61.2



## 7. Design Guidance

### 7.1. Application Guidance Circuit



**Figure 10 Application circuit diagram**

- If the IO port is used as PWM, it is recommended to reserve a 4.7K pull-down resistor on the periphery of the module. Especially in the application of light control, it can prevent the flashing light phenomenon at the moment of power-on start.
- For power input, a 470uF capacitor needs to be added next to the VCC pin and placed close to the VCC pin, otherwise it will affect the RF EVM and other performance.

## 7.2. Recommended PCB package size

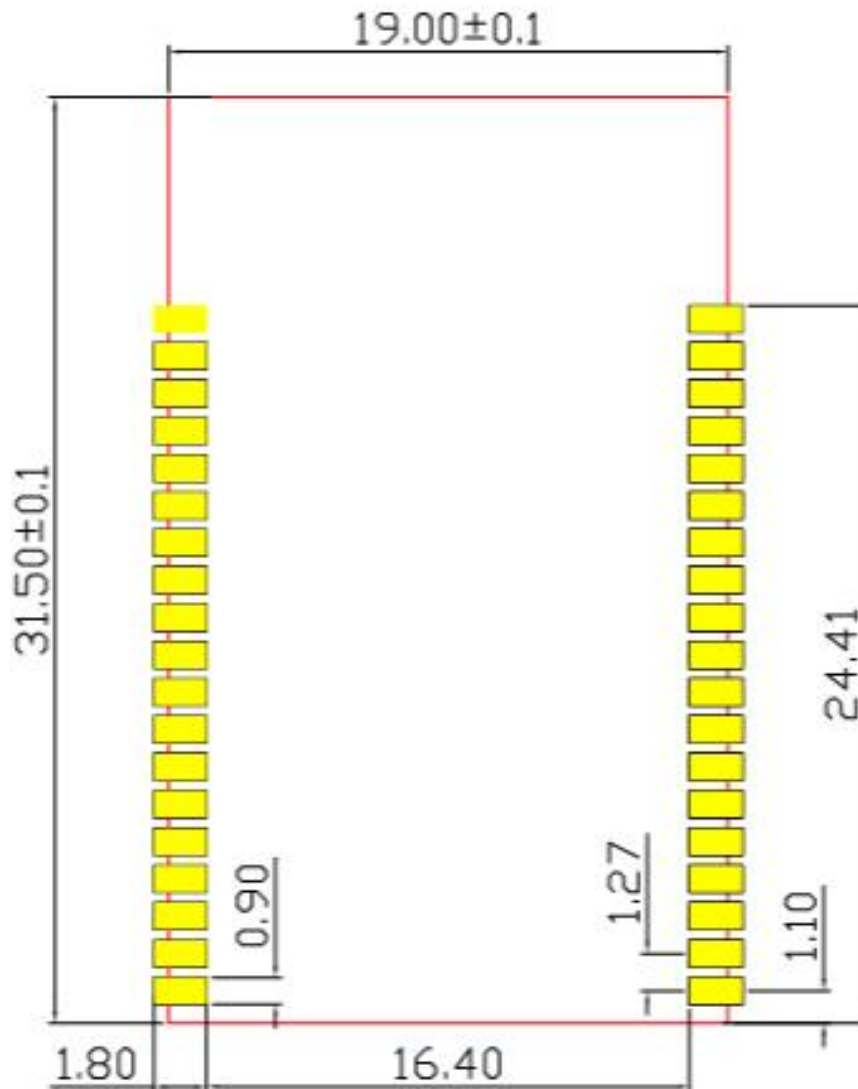


Figure 11 Recommended PCB package size (top view)

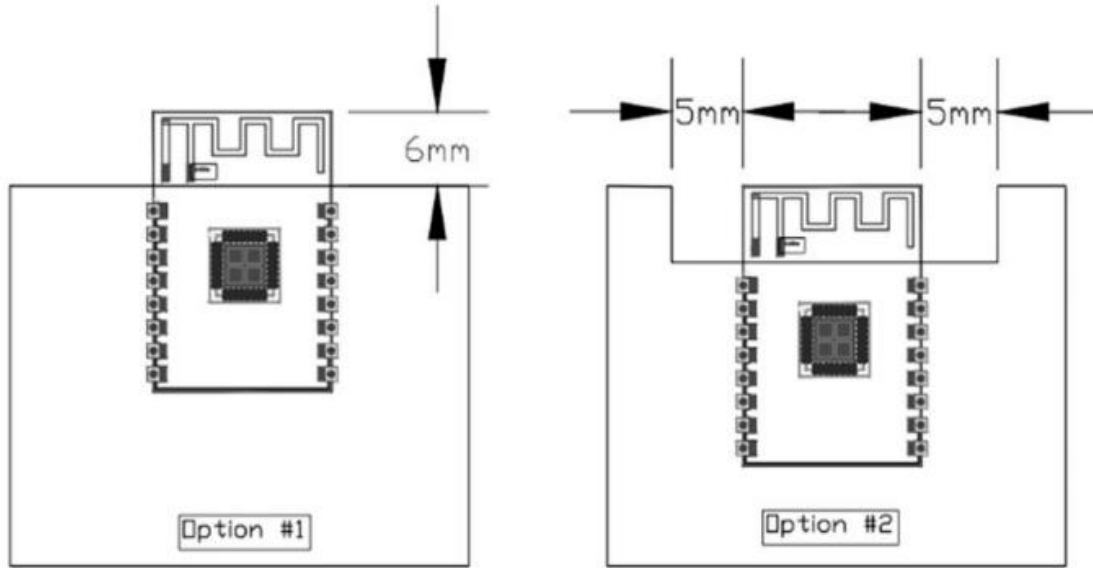
## 7.3. Antenna Layout Requirements

- In the installation position on the motherboard, the following two methods are recommended:

Option 1: Put the module on the edge of the motherboard, and the antenna area extends out of the edge of the motherboard.

Option 2: Put the module on the edge of the motherboard, and hollow out an area on the edge of the motherboard at the antenna position.

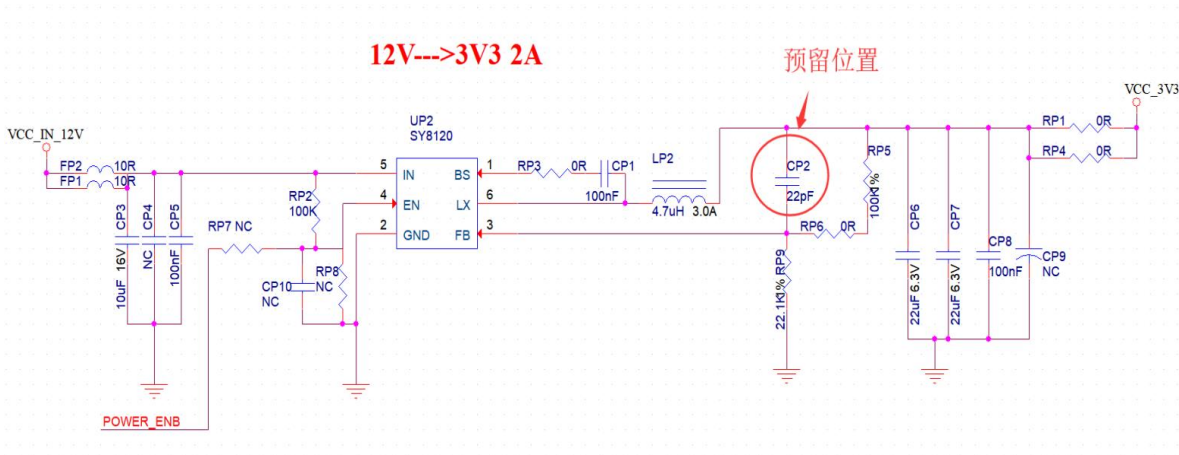
- In order to meet the performance of the on-board antenna, it is forbidden to place metal parts around the antenna and keep away from high-frequency devices.



**Figure 12 Schematic diagram of antenna layout**

### 7.4. Power supply

- Recommended 3.3V voltage, peak current above 500mA.
- It is recommended to use LDO for power supply; if DC-DC is used, it is recommended that the ripple be controlled within 30mV.
- It is recommended to reserve the position of the dynamic response capacitor for 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 interface.



**Figure 13 DC-DC step-down circuit diagram**

## 7.5. GPIO

- There are some IO ports on the periphery of the module. If you need to use it, it is recommended to connect a 10-100 ohm resistor in series with the IO port. This suppresses overshoot and makes the level on both sides smoother. Helps with both EMI and ESD.
- For the up-down and down-down of the special IO port, please refer to the instruction manual of the specification, which will affect the startup configuration of the module.
- The IO port of the module is 3.3V. If the level of the main control and the IO port of the module does not match, a level conversion circuit needs to be added.
- If the IO port is directly connected to a peripheral interface, or a terminal such as a pin header, it is recommended to reserve an ESD device near the terminal of the IO port trace.

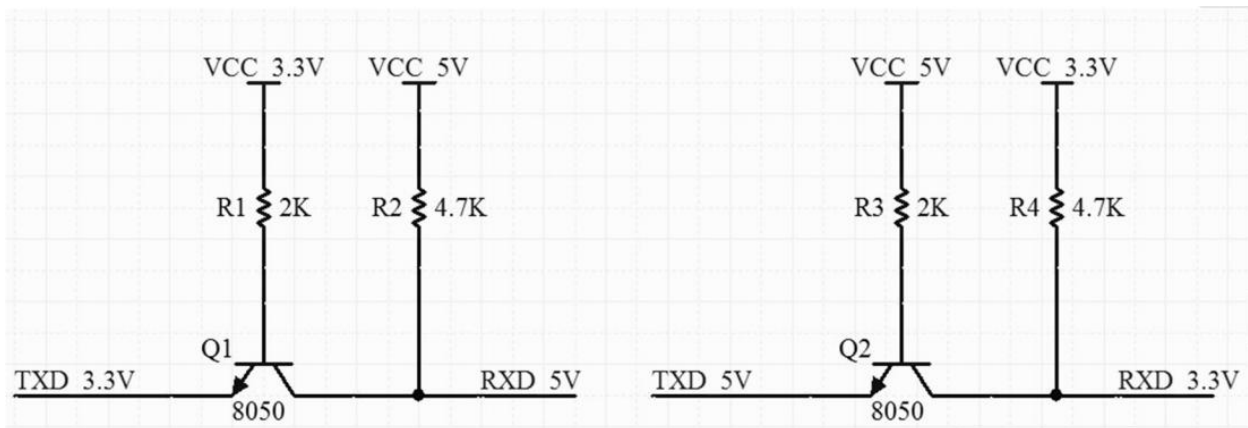


Figure 14 Level convert circuit

## 8. Storage conditions

Products sealed in moisture-proof bags should be stored in a non-condensing atmosphere <math><40^{\circ}\text{C}/90\%\text{RH}</math>.

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

After the vacuum bag is unpacked, it must be used within 168 hours at  $25 \pm 5^{\circ}\text{C}/60\%\text{RH}$ , otherwise it will need to be baked before going online again.

## 9. Reflow welding curve diagram

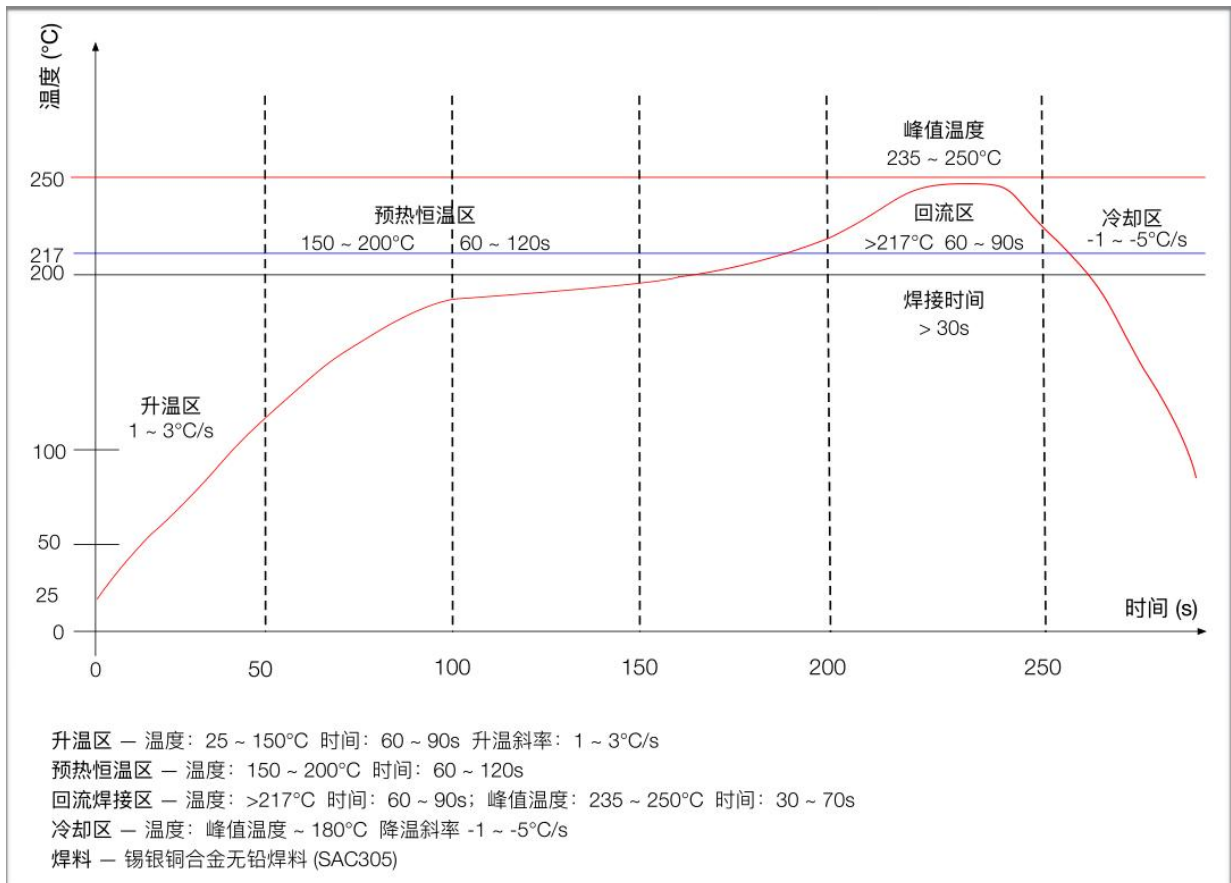


Figure 15 Reflow welding diagram

## 10. Product Packaging Information

Ai-WB1-A1S module is packaged with tape, 500pcs/disk. As shown below:



Figure 16 Package and packing diagram

## 11. Contact us

[Ai-Thinker official website](#)

[Office forum](#)

[Develop DOCS](#)

[LinkedIn](#)

[Tmall shop](#)

[Taobao shop](#)

[Alibaba shop](#)

[Technical support email: support@aithinker.com](mailto:support@aithinker.com)

[Domestic business cooperation: sales@aithinker.com](mailto:sales@aithinker.com)

[Overseas business cooperation: overseas@aithinker.com](mailto:overseas@aithinker.com)

Company Address: Room 403,408-410, Block C, Huafeng Smart Innovation Port, Gushu 2nd Road, Xixiang, Baoan District, Shenzhen.

Tel: +86-0755-2916299



WeChat mini program



WeChat official account

## Disclaimer and copyright notice

The information in this article, including the URL address for reference, is subject to change without notice.

The document is provided "as is" without any guarantee responsibility, including any guarantee for merchantability, suitability for a specific purpose, or non-infringement, and any guarantee mentioned elsewhere in any proposal, specification or sample. This document does not bear any responsibility, including the responsibility for infringement of any patent rights arising from the use of the information in this document. This document does not grant any license for the use of intellectual property rights in estoppel or other ways, whether express or implied.

The test data obtained in the article are all obtained from Ai-Thinker's laboratory tests, and the actual results may vary slightly.

All brand names, trademarks and registered trademarks mentioned in this article are the property of their respective owners, and it is hereby declared.

The final interpretation right belongs to Shenzhen Ai-Thinker Technology Co., Ltd.

## Notice

Due to product version upgrades or other reasons, the contents of this manual may be changed.

Shenzhen Ai-Thinker Technology Co., Ltd. reserves the right to modify the contents of this manual without any notice or prompt.

This manual is only used as a guide. Shenzhen Ai-Thinker Technology Co., Ltd. makes every effort to provide accurate information in this manual. However, Shenzhen Ai-Thinker Technology Co., Ltd. does not guarantee that the contents of the manual are completely free of errors. All statements and information in this manual And the suggestion does not constitute any express or implied guarantee.