Ai-WB1-32S Specification

Version V1.1.0

Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.1.0	2022.6.29	First Edition	ChaoMei Deng	Ning Guan

Content

1. Product Overview

Ai-WB1-32S is a Wi-Fi&BT 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 BT/BLE dual Mode working mode, support BT/BLE4.2 protocol. W800 chip has built-in low-power 32-bit XT804 CPU, operating frequency 240MHz, built-in 2MB Flash, 288KB RAM and rich peripheral interfaces, including SDIO, PSRAM, SPI, UART, I2C, PWM, ADC, Touch sensor, Duplex I2S and GPIO Wait. It can be widely used in the Internet of Things (IoT), mobile devices, wearable electronic devices, smart home and other fields.

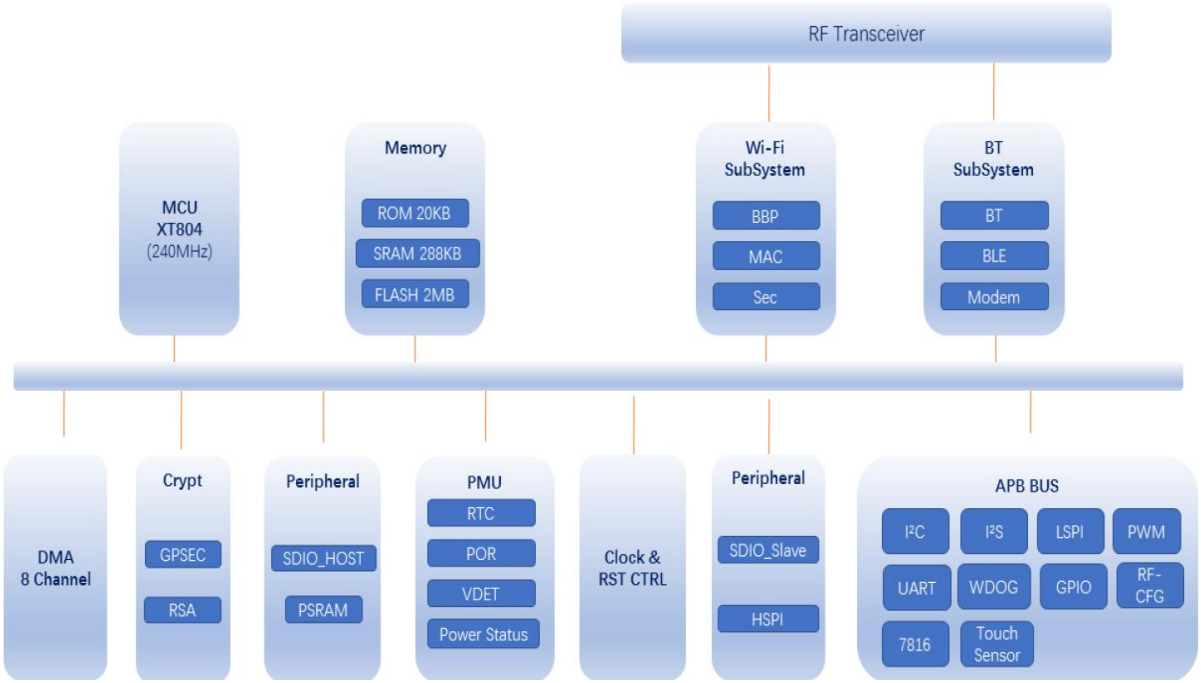

Figure 1 Main chip architecture diagram

1.1. Characteristic

- The package is SMD-38
- Support IEEE 802.11 b/g/n protocol
- Wi-FiSecurity Support Wi-Fi WMM/WMM-PS/WPA/WPA2 /WPS
- Support 20/40MHz bandwidth, the highest rate is 150 Mbps
- Support BT/BLE dual-mode working mode, support BT/BLE4.2 protocol
- Support Station 、Station + SoftAP 、SoftAP mode
- 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 senser，Duplex I2S and GPIO
- Integrated Wi-Fi MAC/BB/RF/PA/LNA/Bluetooth
- Support a variety of sleep modes, standby power consumption current 10 μ A
- Universal AT instruction for quick start
- Support secondary development, integrated Windows, Linux development environment

2. Main parameters

Table 1 Description of the main parameters

Model	Ai-WB1-32S
Package	SMD-38
Size	25.5*18.0*3.1(±0.2)mm
Antenna	Default onboard PCB antenna/compatible IPEX base
Frequency	2400 ~ 2483.5MHz
Operating temperature	-40℃ ~ 85℃
Storage temperature	-40℃ ~ 125℃, < 90%RH
Power supply	Support voltage 3.0V ~ 3.6V， supply current ⩾500mA
Interface	UART/GPIO/ADC/PWM/I2C/SPI/Touch senser/PSRAM/SDIO/Duplex I2S
IO	18
UART rate	Default 115200 bps
Security	Wi-Fi WMM/WMM-PS/WPA/WPA2 /WPS
Flash	Default 2MByte

2.1. Static electricity requirement

Ai-WB1-32S 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	mA

2.3. Wi-Fi RF Performance

Table 3 Wi-Fi RF performance table

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

2.5. Power

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 byte SRAM retention	-	96	-	mA
Deep-Sleep	-	10	-	μA

3. Appearance Dimensions

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

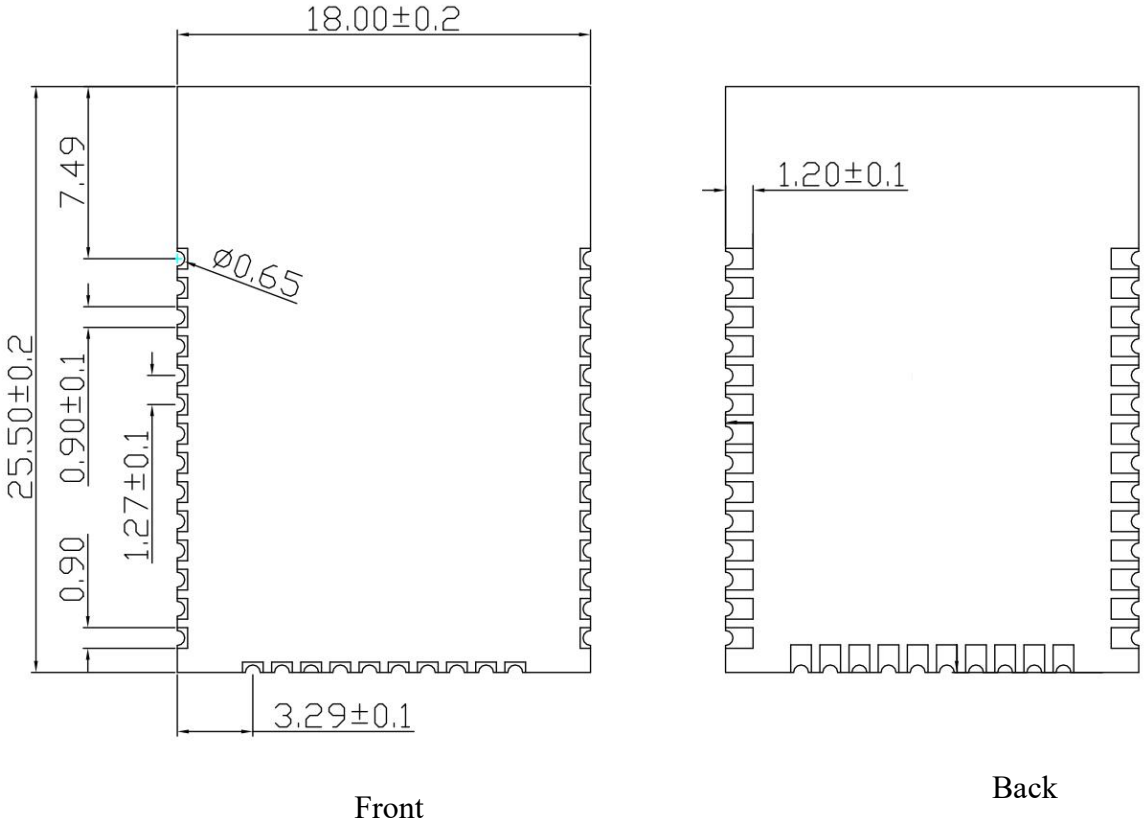

Figure 4 Dimension diagram

4. Pin Definition

Ai-WB1-32S module has a total of 38 pins, as shown in the pin diagram, the pin function definition table is the interface definition.

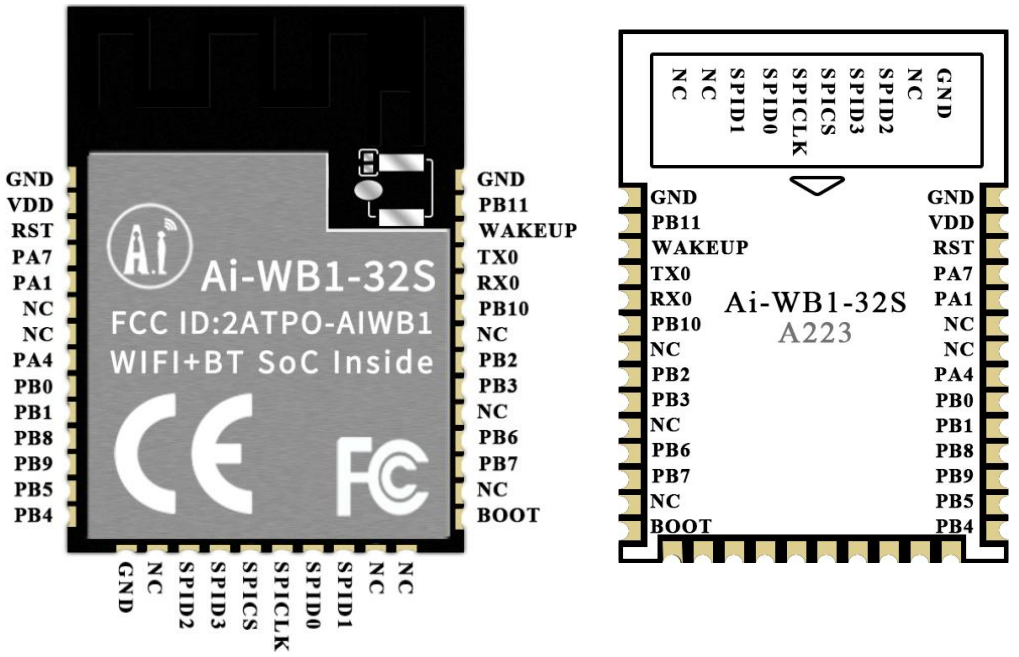

Figure 5 Schematic diagram of module pins

Table 6 Pin function definition table

No.	Name	Function
1,15,38	GND	Ground
2	VDD	3.3V power supply; the output current of the external power supply is recommended to be above 500mA
3	RST	Default as chip enable, active high.
6,7,16,23,24,26,29，32	NC	NC is unavailable.
4	PA7	PWM4/LSPI_MOSI/I2S_MCK/I2S_DI/Touch0/GPIO
5	PA1	JTAG_CK/I2C_SCL/PWM3/I2S_LRCK/ADC0
8	PA4	JTAG_SWO/I2C_SDA/PWM4/I2S_BCK/ADC1
9	PB0	PWM0/LSPI_MISO/UART3_TX/PSRAM_CK/Touch3/GPIO
10	PB1	PWM1/LSPI_CLK/UART3_RX/PSRAM_CS/Touch4/GPIO
11	PB8	I2S_BCK/MMC_D0/PWM_BREAK/SDIO_D0/Touch11/GPIO
12	PB9	I2S_LRCK/MMC_D1/HSPI_CS/SDIO_D1/Touch12/GPIO
13	PB5	LSPI_MOSI/UART2_CTS/UART4_RX/PSARM_D3/Touch8/GPIO
14	PB4	LSPI_CS/UART2_RTS/UART4_TX/PSRAM_D2/Touch7/GPIO
17	SPID2	The functions of SPID2 and PB4 are the same, and only one of them can be used.
18	SPID3	The functions of SPID3 and PB5 are the same, and only one of them can be used.
19	SPICS	The functions of SPICS and PB1 are the same, and only one of them can be used.
20	SPICLK	SPICLK and PB0 have the same function, only one of them can be used
21	SPID0	SPICLK has the same function as PB2, only one of them can be used
22	SPID1	The functions of SPID1 and PB3 are the same, and only one of them can be used.

25	BOOT	I2S_MCLK/LSPI_CS/PWM2/I2S_DO/BOOTMODE
27	PB7	UART1_RX/MMC_CMD/HSPI_INT/SDIO_CMD/Touch10/GPIO
28	PB6	UART1_TX/MMC_CLK/HSPI_CK/SDIO_CK/Touch9/GPIO
30	PB3	PWM3/LSPI_MISO/UART2_RX/PSRAM_D1/Touch6/GPIO
31	PB2	PWM2/LSPI_CK/UART2_TX/PSRAM_D0/Touch5/GPIO
33	PB10	I2S_DI/MMC_D2/HSPI_DI/SDIO_D2/GPIO
34	RX0	UART0_RX/PWM1/UART1_CTS/I2C_SCL
35	TX0	UART0_TX/PWM0/UART1_RTS/I2C_SDA
36	WAKEUP	Wakeup function
37	PB11	I2S_DO/MMC_D3/HSPI_DO/SDIO_D3/GPIO

5. Schematic

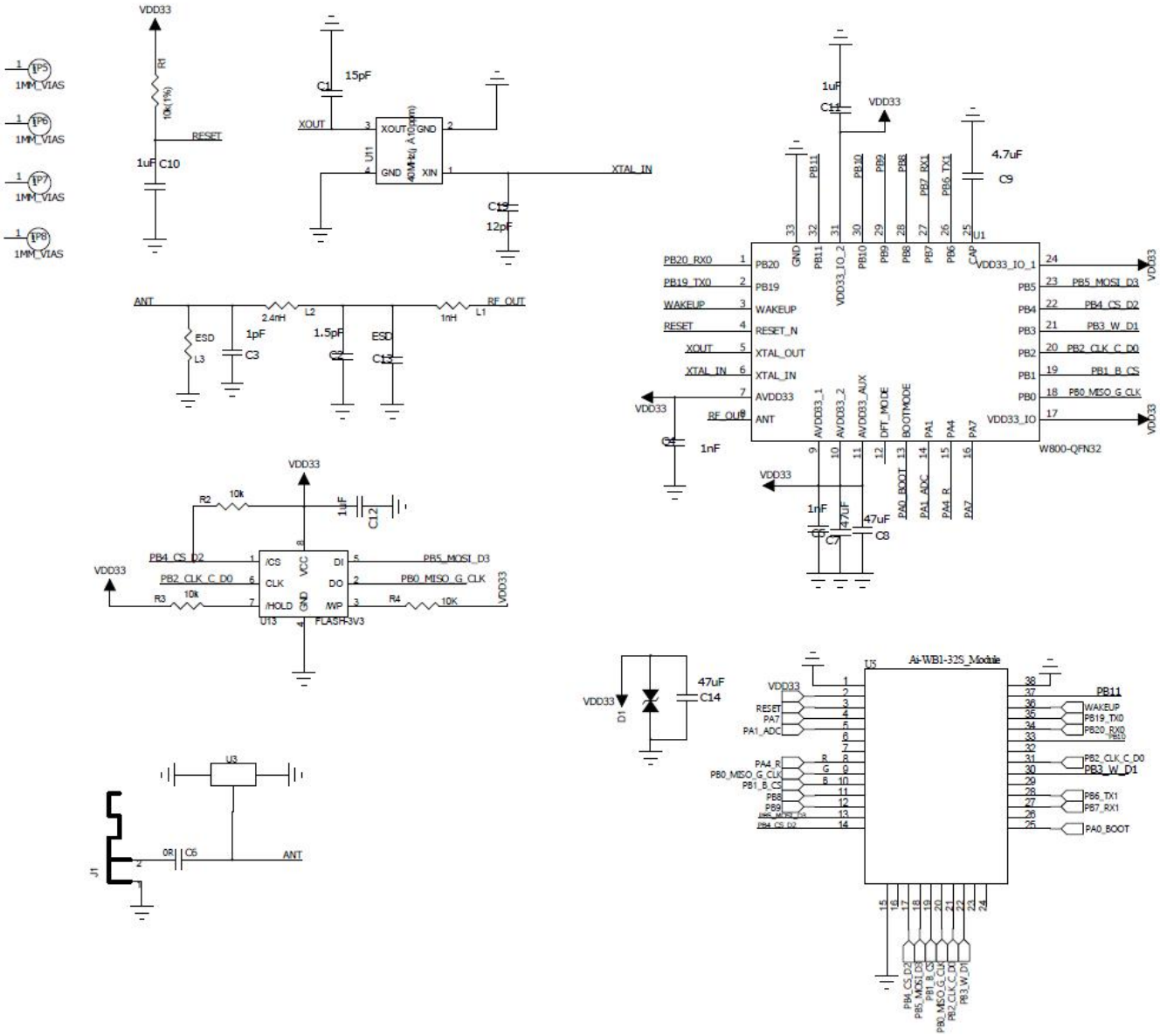

Figure 6 Schematic

6. Antenna parameters

6.1. Schematic diagram of the antenna test prototype

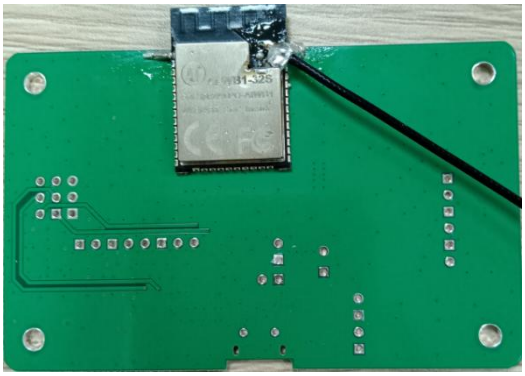

Figure 7 Schematic diagram of the antenna test prototype

6.2. Antenna S parameter

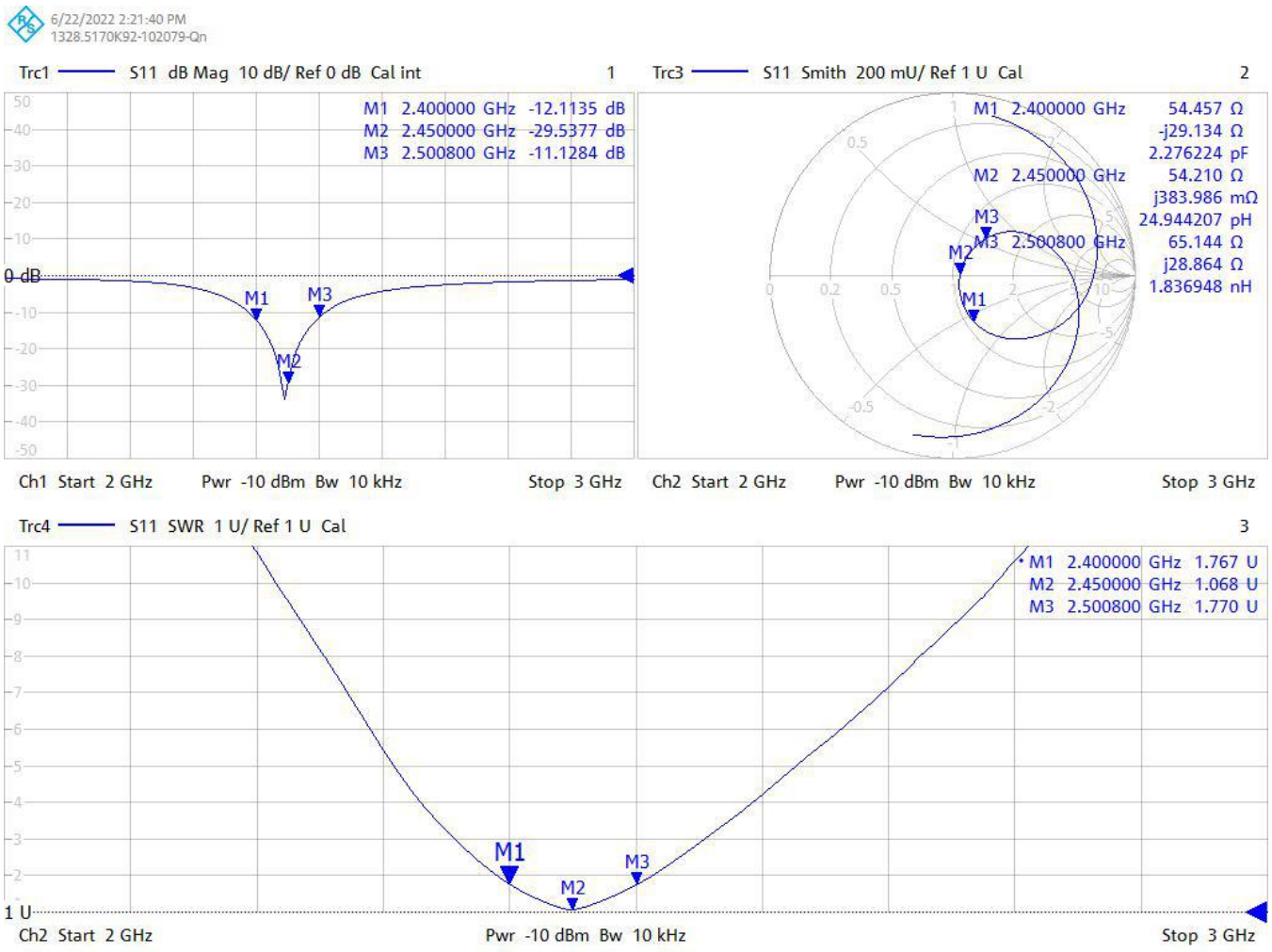

Figure 8 Antenna S parameters

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)	0.96	1.14	1.37	1.69	1.91	2.13	2.29	2.32	2.19	2.00	1.85
Efficiency (%)	47.66	49.80	52.36	56.63	60.58	63.67	64.71	64.31	62.38	60.55	58.55

6.4. Antenna pattern

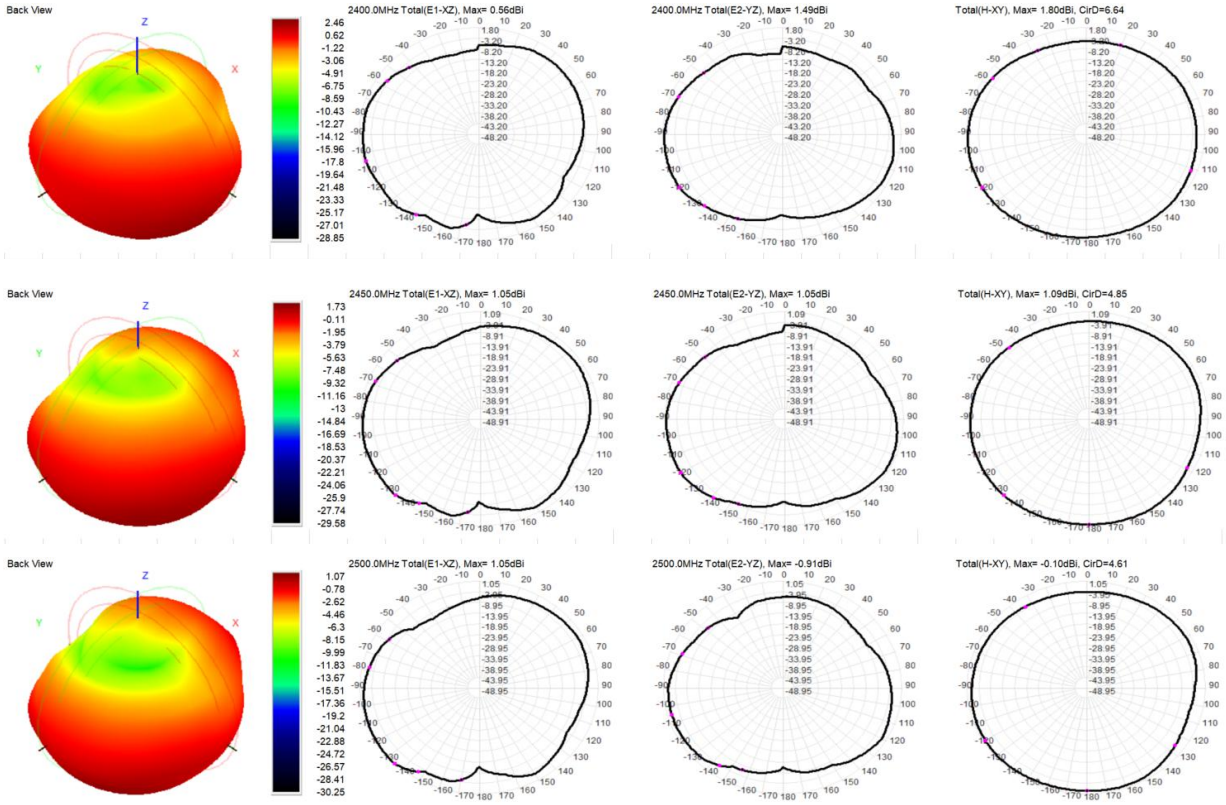

Figure 9 Antenna pattern

7. Design Guidance

7.1. Application Guidance Circuit

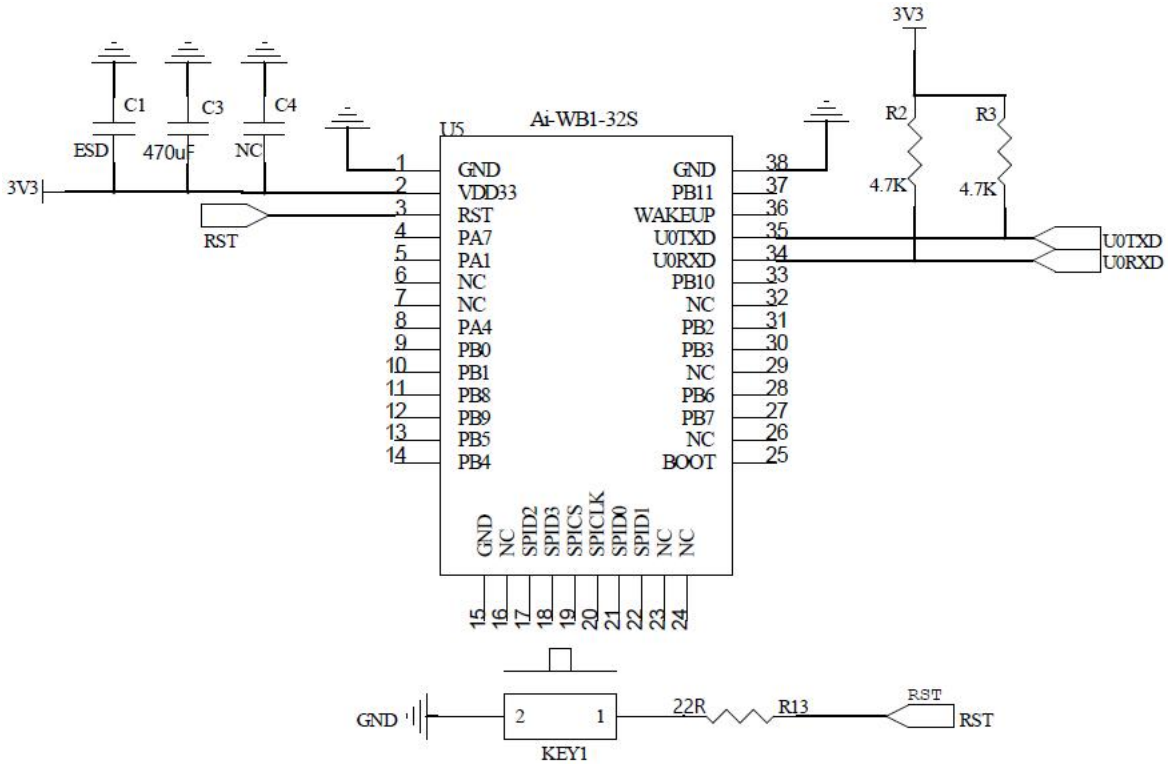

Figure 10 Application circuit diagram

- 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

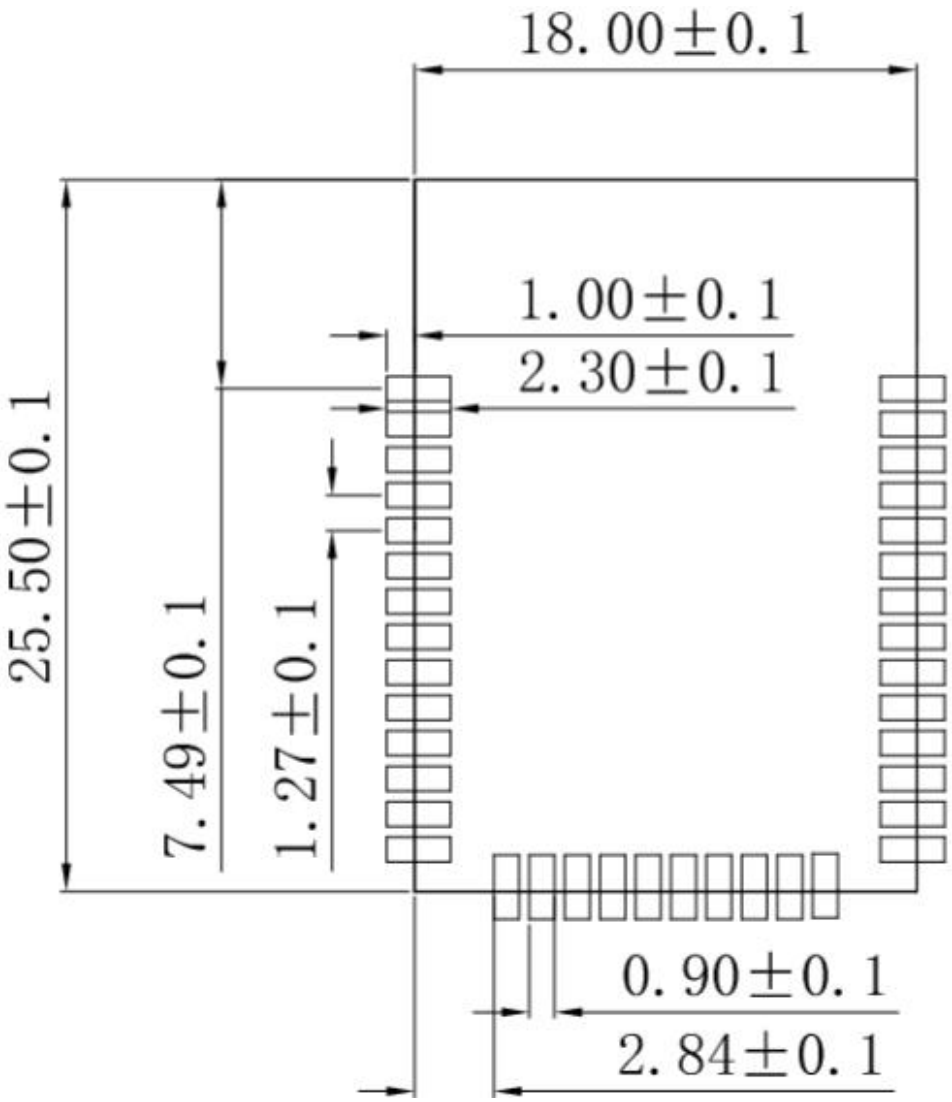

Figure 11 Recommended PCB package size (top view)

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.

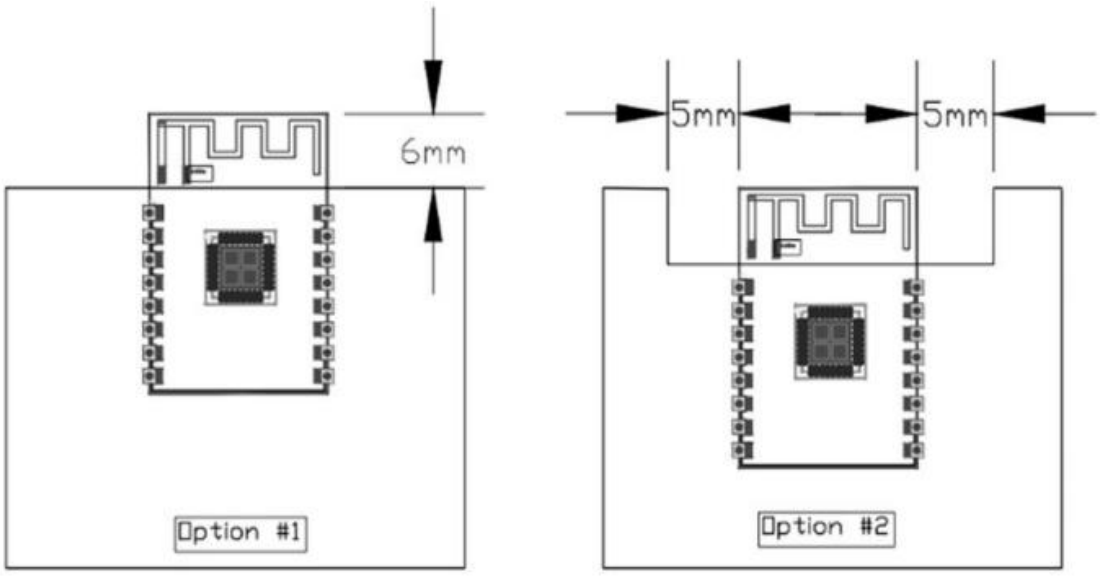

Figure 12 Schematic diagram of antenna layout

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.

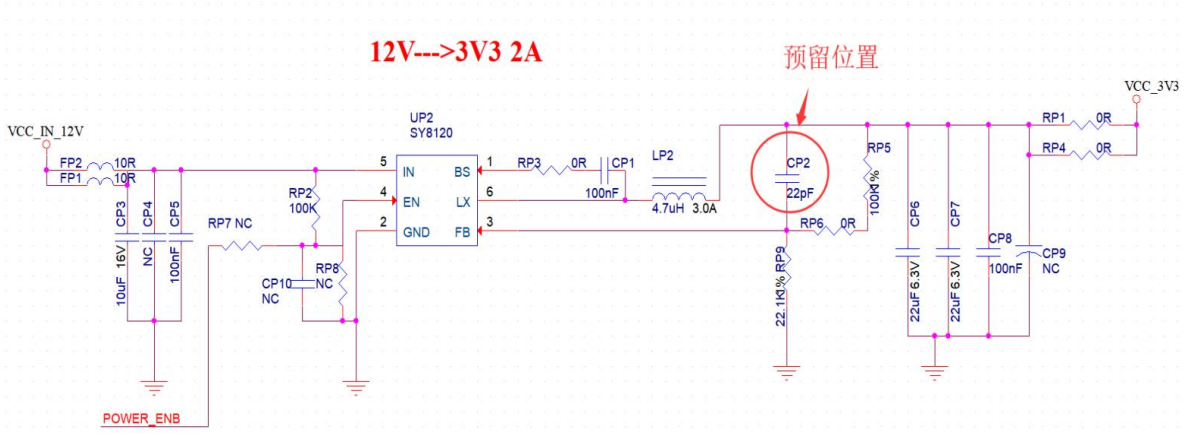

Figure 13 DC-DC step-down circuit diagram

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.

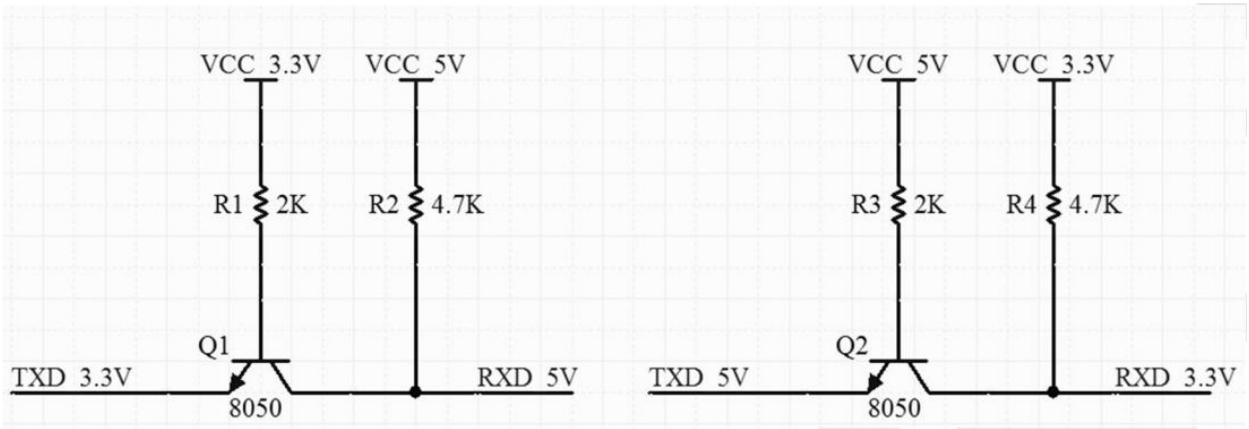

Figure 14 Level convert circuit

8. Storage conditions

Products sealed in moisture-proof bags should be stored in a non-condensing atmosphere <40° C/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 will need to be baked before going online again.

9. Reflow welding curve diagram

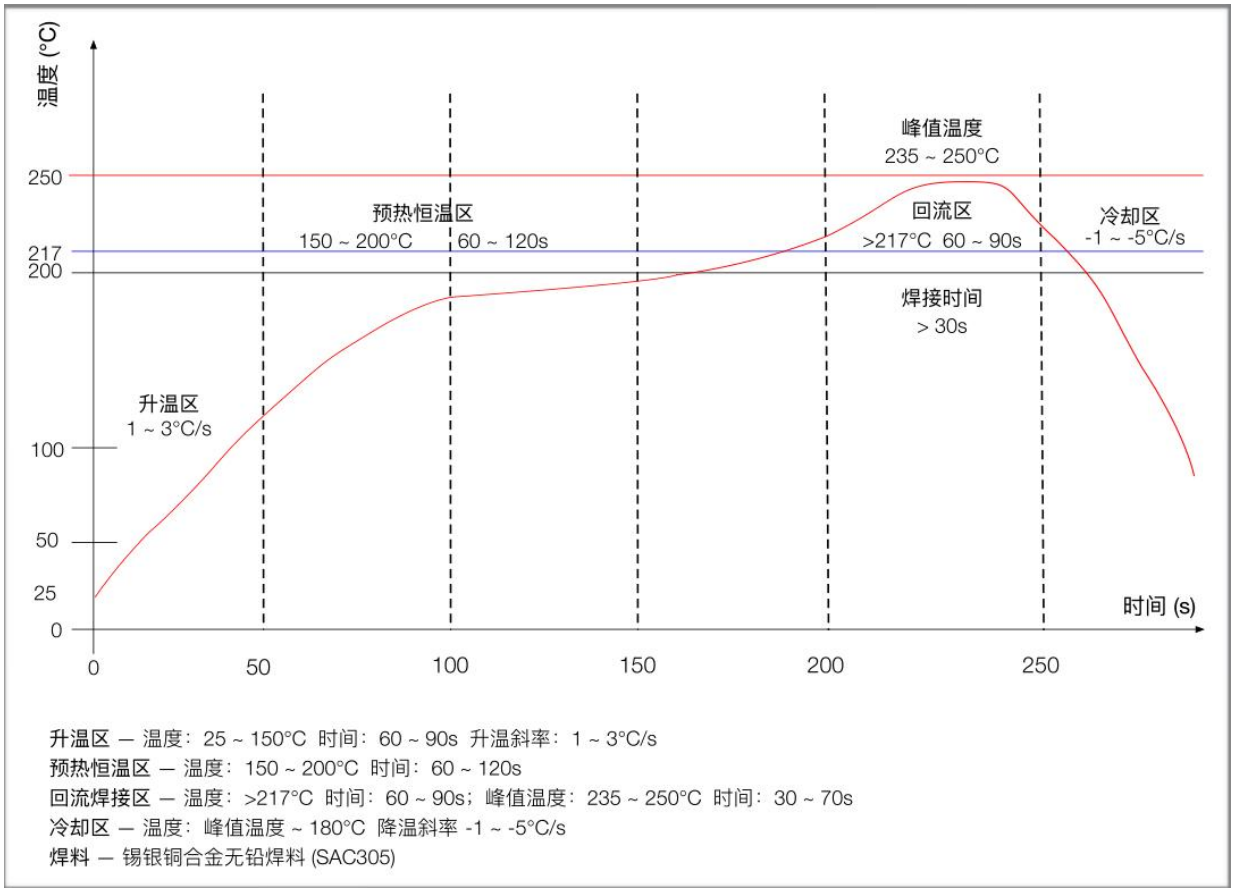

Figure 15 Reflow welding diagram

10.Product related models

Table 8 Product related model list

Model	Power Supply	Package	Size	Antenna
Ai-WB1-12F	3.0V ~ 3.6V，I≥500mA	SMD-22	24.0*16.0*3.1(±0.2)mm	on-board PCB antenna
Ai-WB1-32S	3.0V ~ 3.6V，I≥500mA	SMD-38	25.5*18.0*3.1(±0.2)mm	Default onboard PCB antenna/compatible IPEX interface
Ai-WB1-12F-Kit	3.3V or 5V, I>500mA	DIP-30	25.41*55.19(±0.2)mm	on-board PCB antenna
Ai-WB1-32S-Kit	3.3V or 5V, I>500mA	DIP-38	25.4*55.78(±0.2)mm	on-board PCB antenna
Product related information：https://docs.ai-thinker.com				

11.Product Packaging Information

Ai-WB1-32S module is packaged in a tape, 800pcs/reel.As shown in the below image:

Figure 16 Package and packing diagram

12.Contact us

Ai-Thinker official website　Office forum　Develop DOCS

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