Ai-WB1-12F Specification

Version V1.1.1

Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.1.0	2022.6.20	First Edition	ChaoMei Deng	Ning Guan
V1.1.1	2022.10.31	Add RF OTA parameters	ChaoMei Deng	Ning Guan

Content

1. Product Overview

Ai-WB1-12F is a Wi-Fi&Bluetooth 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 working mode, support 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.

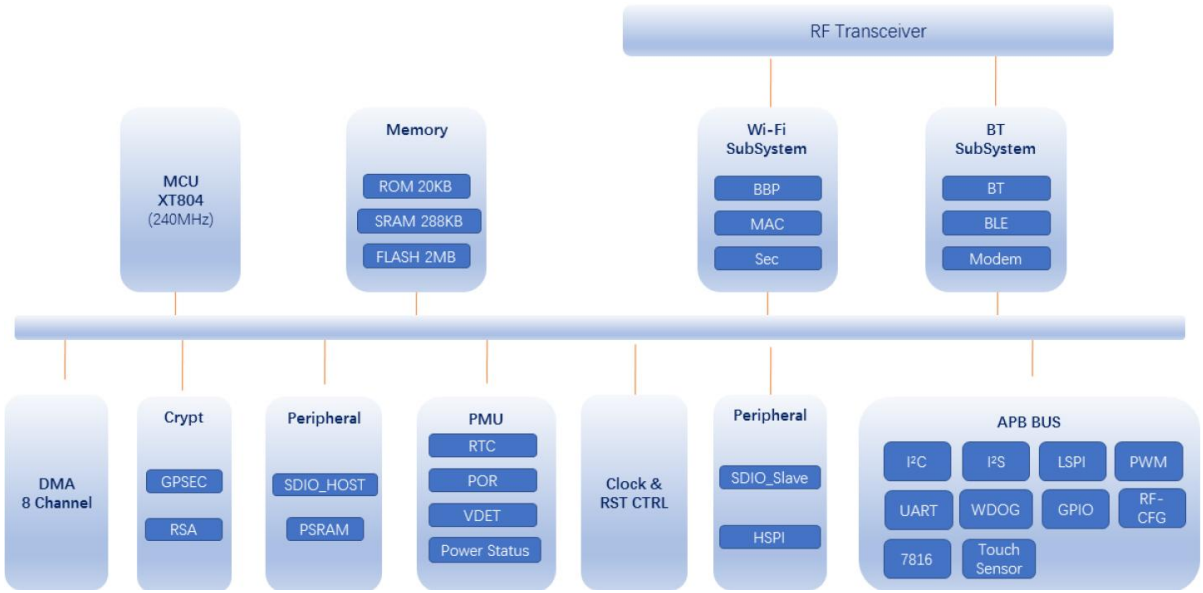


Figure 1 Main chip architecture diagram

1.1. Characteristic

- The package is SMD-22
- 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 working mode, support 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 20 μA
- 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-WB1-12F
Package	SMD-22
Size	24.0*16.0*3.1(±0.2)mm
Antenna	on-board PCB antenna
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-WB1-12F 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		Condition	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**	**Max.**	**Unit**
1Mbps	-	4	6	dBm
Receive Sensitivity				
Rate Mode	**Min.**	**Typical**	**Max.**	**Unit**
1Mbps sensitivity@30.8%PER	-	-92	-	dBm

2.5. Power

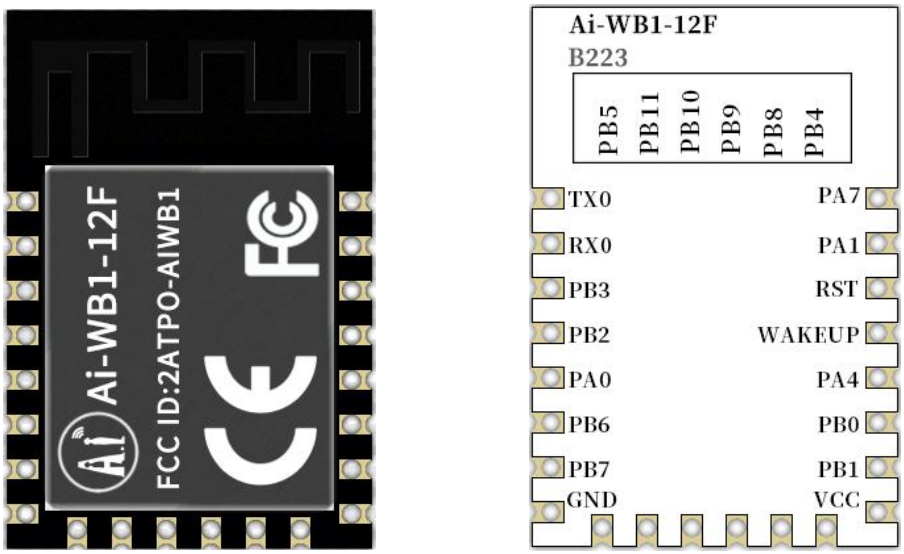
The following power consumption figures are based on a 3.3V supply, 25° C ambient temperature, and are measured using the internal voltage regulator.

- 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

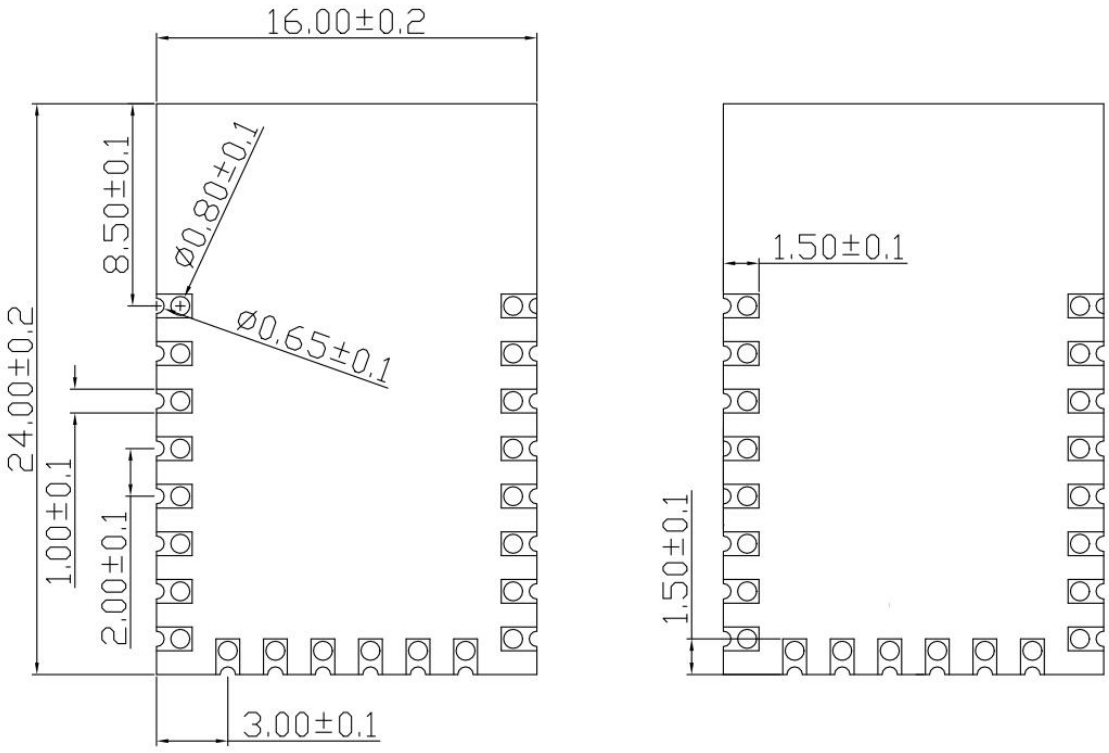
Mode	Min.	AVG	Max.	Unit
Tx 802.11b，11Mbps，POUT=+19dBm	-	348	-	mA
Tx 802.11g， 54Mbps， POUT =+15dBm	-	190	-	mA
Tx 802.11n， MCS7， POUT =+12dBm	-	190	-	mA
Rx 802.11b，packet length 1024 byte	-	96	-	mA
Rx 802.11g，packet length 1024 byte	-	96	-	mA
Rx 802.11n，packet length 1024 byte SRAM retention	-	96	-	mA
Deep-Sleep	-	20	-	μA

3. Appearance Dimensions



Front Back

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



Front Back

Figure 4 Dimension diagram

4. Pin Definition

Ai-WB1-12F module has a total of 22 pins, as shown in the pin diagram, the pin function definition table is the interface definition.

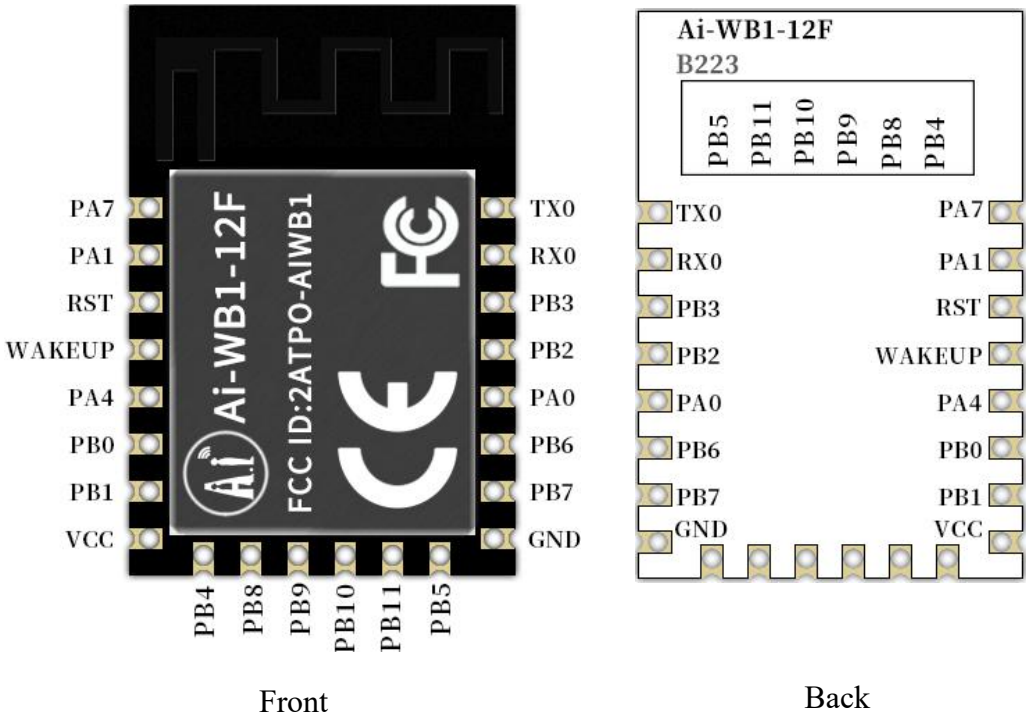


Figure 5 Schematic diagram of module pins

Table 6 Pin function definition table

No.	Name	Function
1	PA7	PWM4/LSPI_MOSI/I2S_MCK/I2S_DI/Touch0/GPIO
2	PA1	JTAG_CK/I2C_SCL/PWM3/I2S_LRCK/ADC0
3	RST	As a chip enable, active low
4	WAKE	Wakeup function
5	PA4	JTAG_SWO/I2C_SDA/PWM4/I2S_BCK/ADC1
6	PB0	PWM0/LSPI_MISO/UART3_TX/PSRAM_CK/Touch3/GPIO
7	PB1	PWM1/LSPI_CLK/UART3_RX/PSRAM_CS/Touch4/GPIO
8	VCC	3.3V power supply; the output current of the external power supply is recommended to be above 500mA
9	PB4	LSPI_CS/UART2_RTS/UART4_TX/PSRAM_D2/Touch7/GPIO
10	PB8	I2S_BCK/MMC_D0/PWM_BREAK/SDIO_D0/Touch11/GPIO
11	PB9	I2S_LRCK/MMC_D1/HSPI_CS/SDIO_D1/Touch12/GPIO
12	PB10	I2S_DI/MMC_D2/HSPI_DI/SDIO_D2/GPIO
13	PB11	I2S_DO/MMC_D3/HSPI_DO/SDIO_D3/GPIO
14	PB5	LSPI_MOSI/UART2_CTS/UART4_RX/PSARM_D3/Touch8/GPIO
15	GND	Ground
16	PB7	UART1_RX/MMC_CMD/HSPI_INT/SDIO_CMD/Touch10/GPIO
17	PB6	UART1_TX/MMC_CLK/HSPI_CK/SDIO_CK/Touch9/GPIO
18	PA0	I2S_MCLK/LSPI_CS/PWM2/I2S_DO/BOOTMODE
19	PB2	PWM2/LSPI_CK/UART2_TX/PSRAM_D0/Touch5/GPIO
20	PB3	PWM3/LSPI_MISO/UART2_RX/PSRAM_D1/Touch6/GPIO
21	RX0	UART0_RX/PWM1/UART1_CTS/I2C_SCL
22	TX0	UART0_TX/PWM0/UART1_RTS/I2C_SDA

5. Schematic

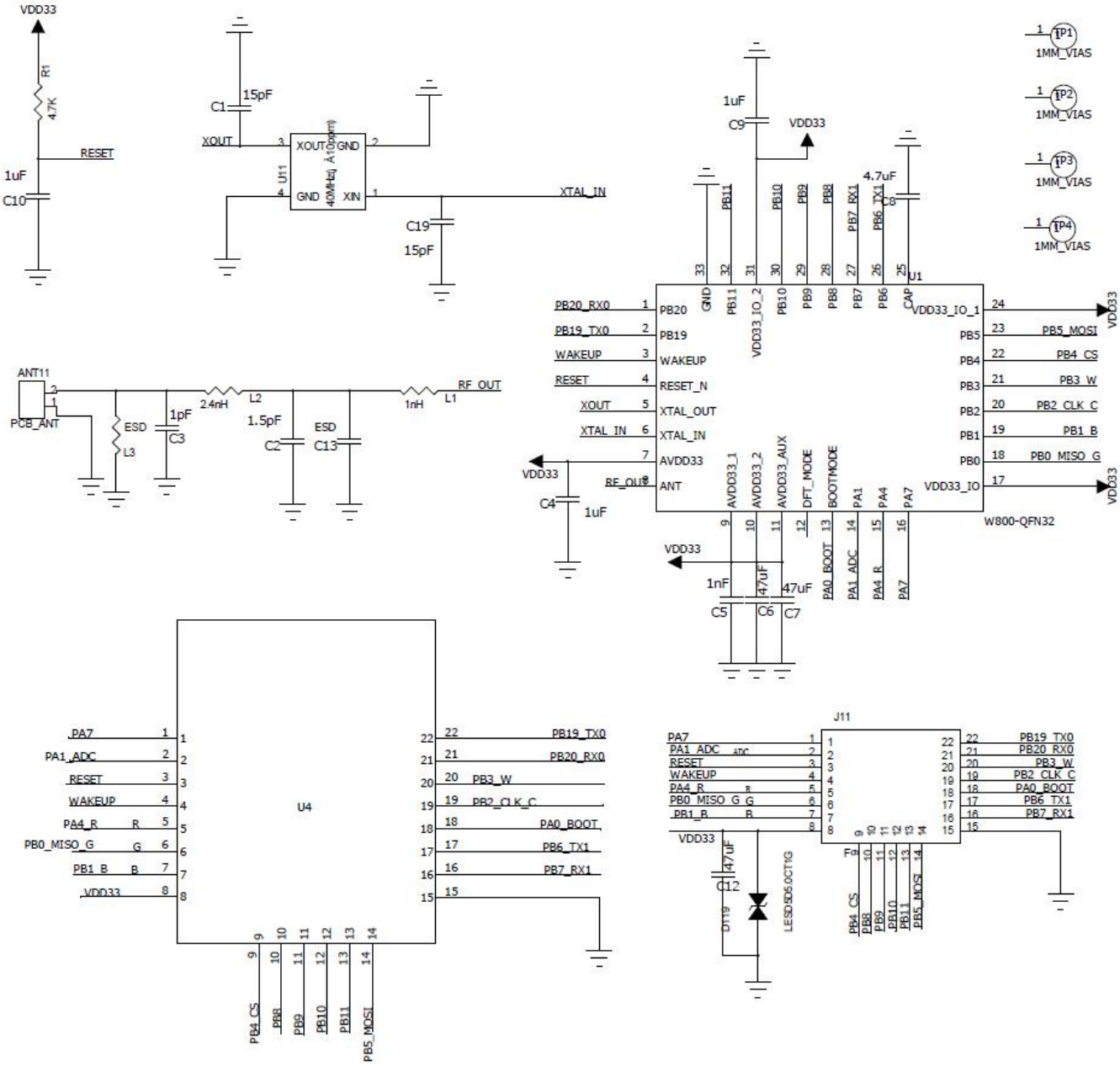


Figure 6 Schematic

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

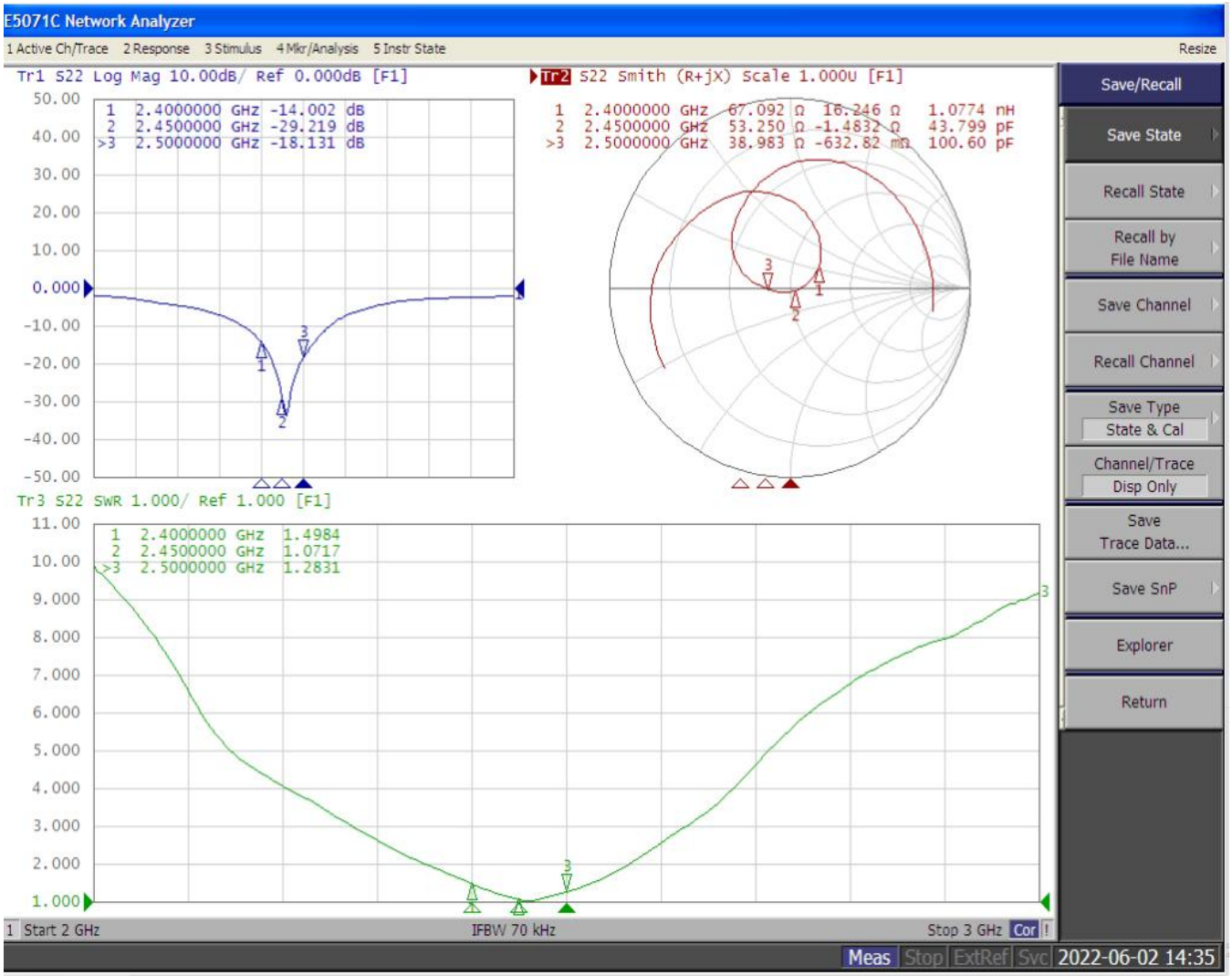


Figure 8 Antenna S parameters

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)	1.63	1.49	1.61	1.90	2.09	2.22	2.15	2.04	1.80	1.78	1.60
Efficiency (%)	54.1	54.57	56.92	58.90	61.35	63.54	63.64	62.99	61.33	60.62	59.16

6.4. Antenna pattern

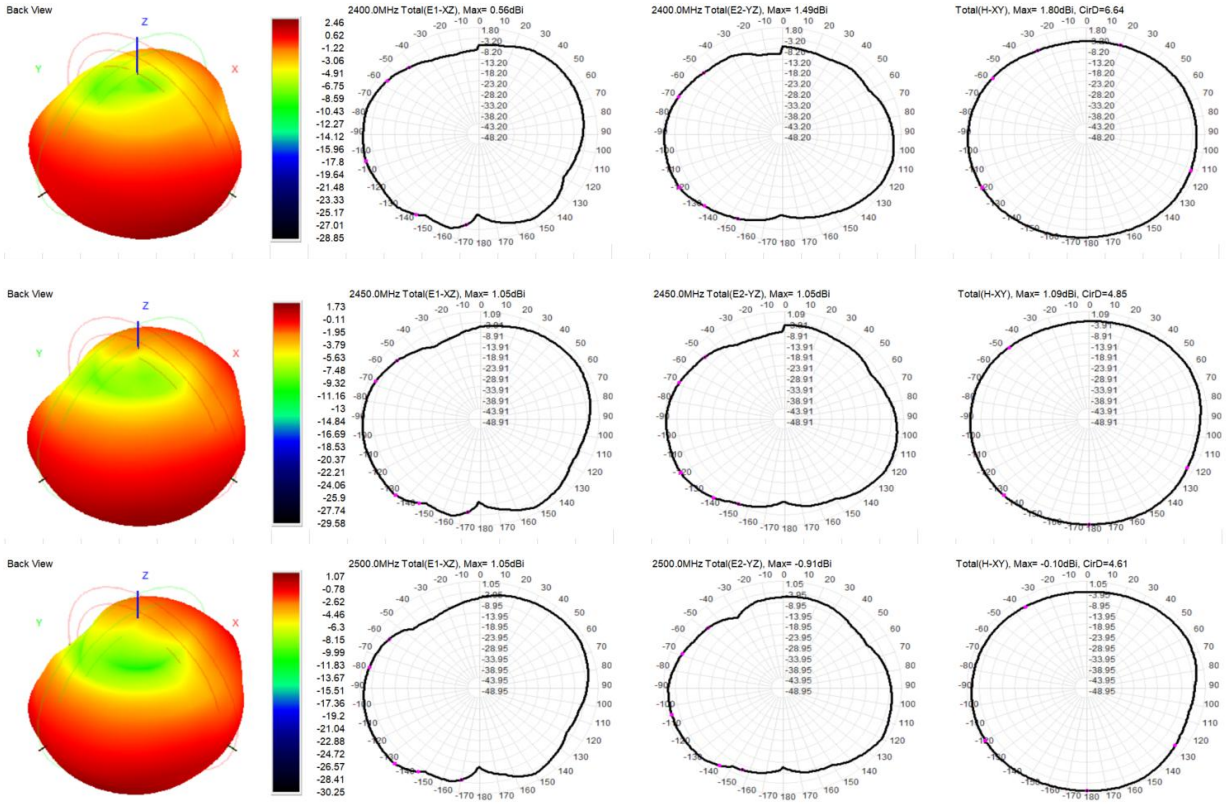


Figure 9 Antenna pattern

6.5. RF OTA parameters

Table 8 RF OTA parameters

Item	Mode	Rate(Mbps)	Channel	Fre.(MHz)	Data(dBm)
TRP	11b	11	1	2412	17.4
			6	2437	17.3
			13	2472	17.2
	11g	54	1	2412	13.6
			6	2437	13.2
			13	2472	12.7
	HT20	MCS7	1	2412	10.2
			6	2437	10.0
			13	2472	9.5
TIS	11b	11	1	2412	-82.2
			6	2437	-81.1
			13	2472	-82.0
	11g	54	1	2412	-68.1
			6	2437	-67.8
			13	2472	-69.3
	HT20	MCS7	1	2412	-62.4
			6	2437	-61.2
			13	2472	-62.4

7. Design Guidance

7.1. Application Guidance Circuit

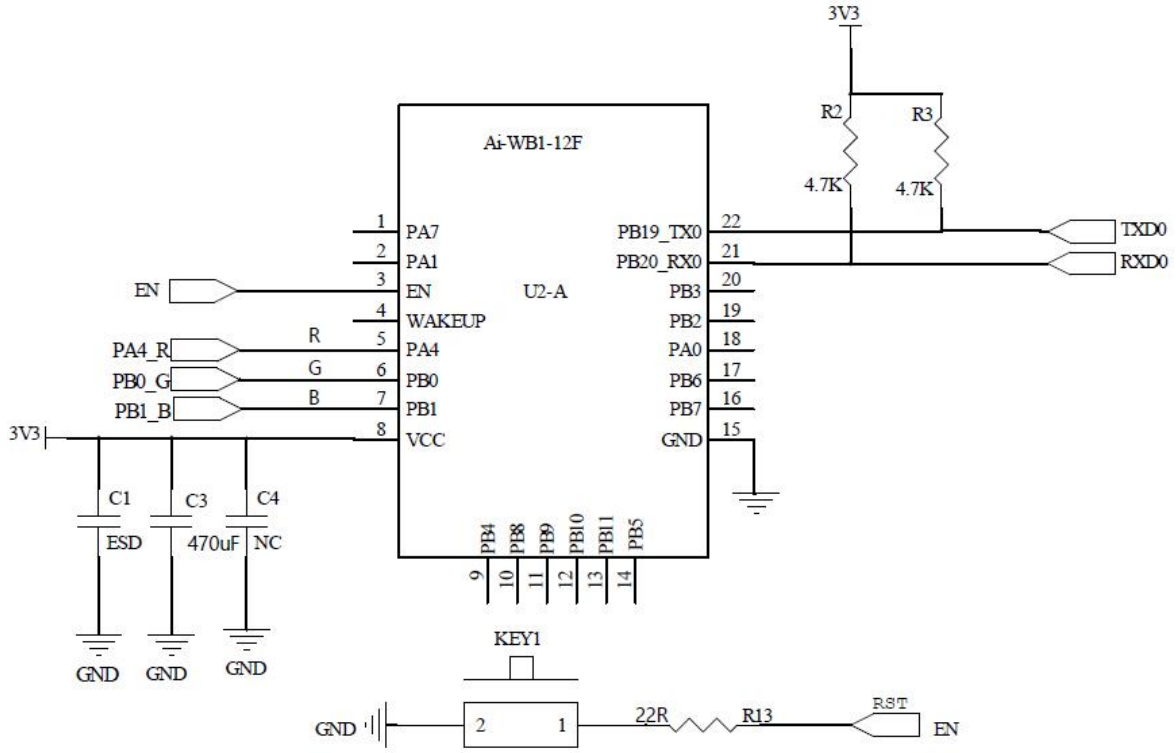


Figure 10 Application circuit diagram

- 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

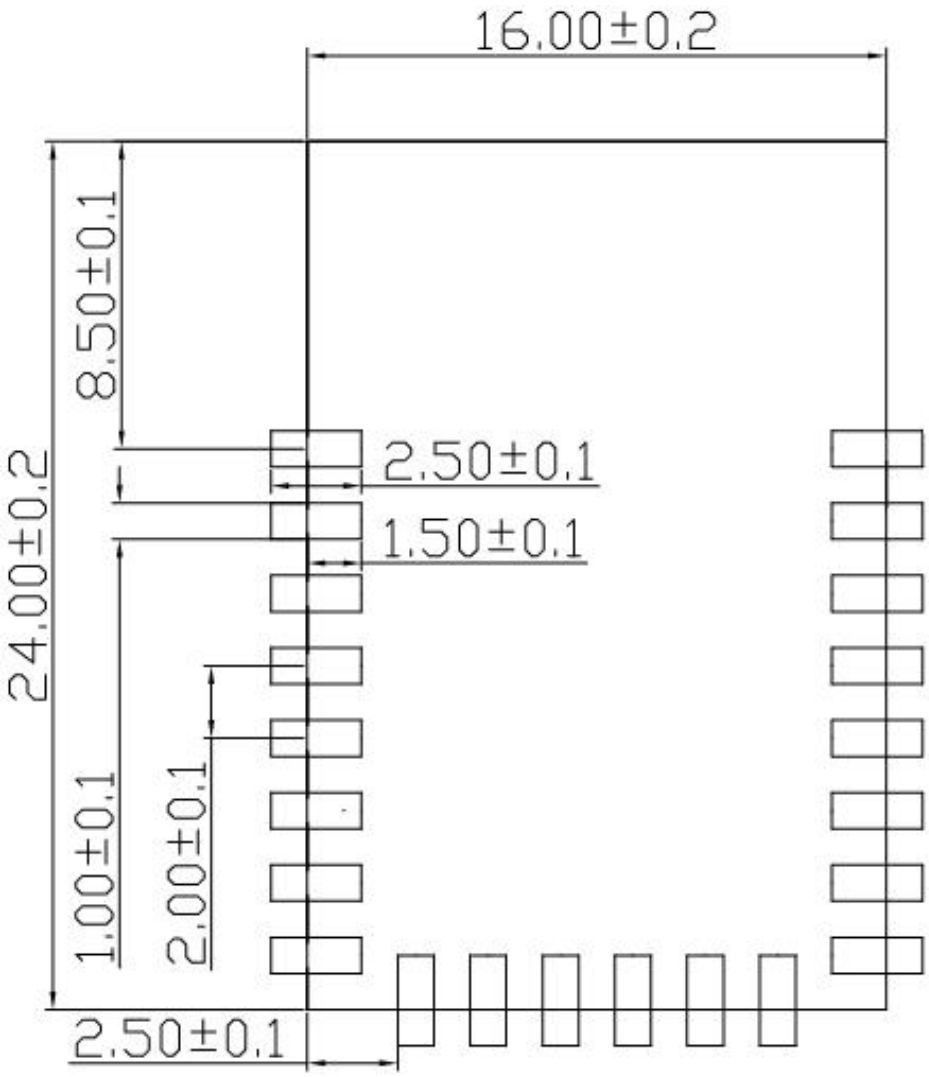


Figure 11 Recommended PCB package size (top view)

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.

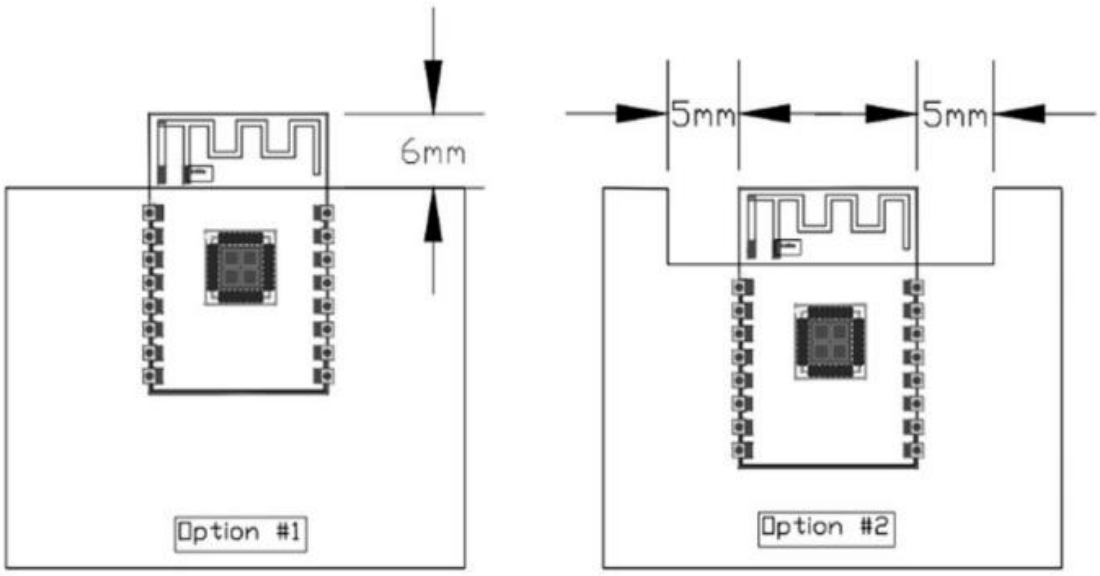


Figure 12 Schematic diagram of antenna layout

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.

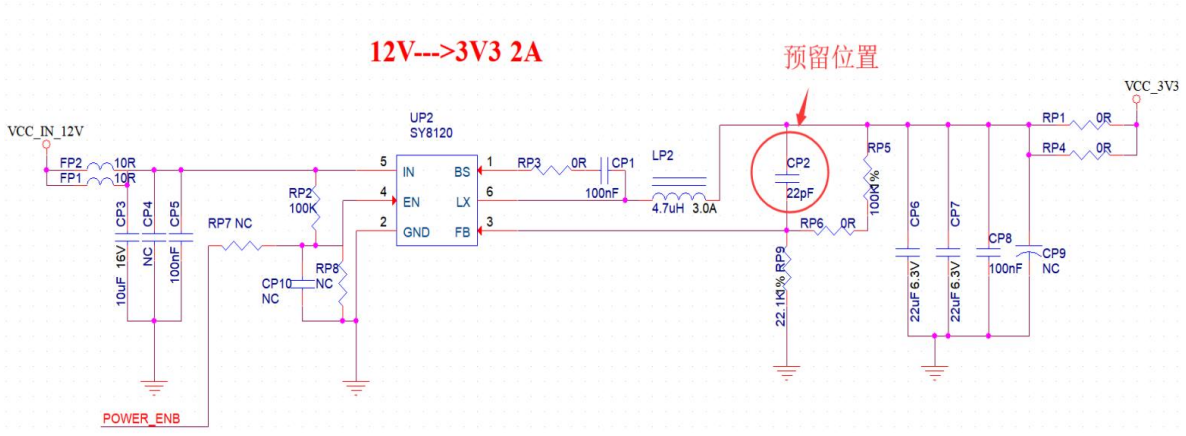


Figure 13 DC-DC step-down circuit diagram

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.

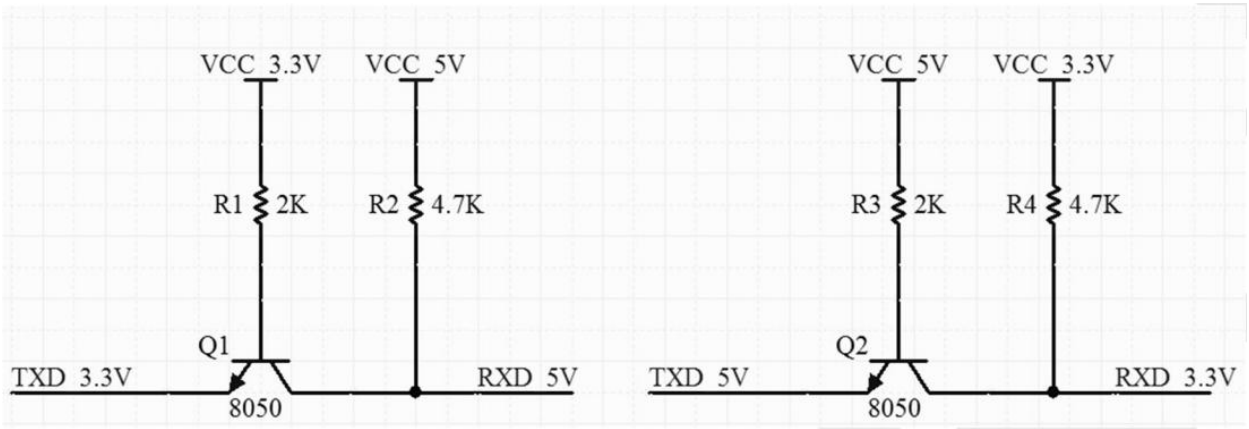


Figure 14 Level convert circuit

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.

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

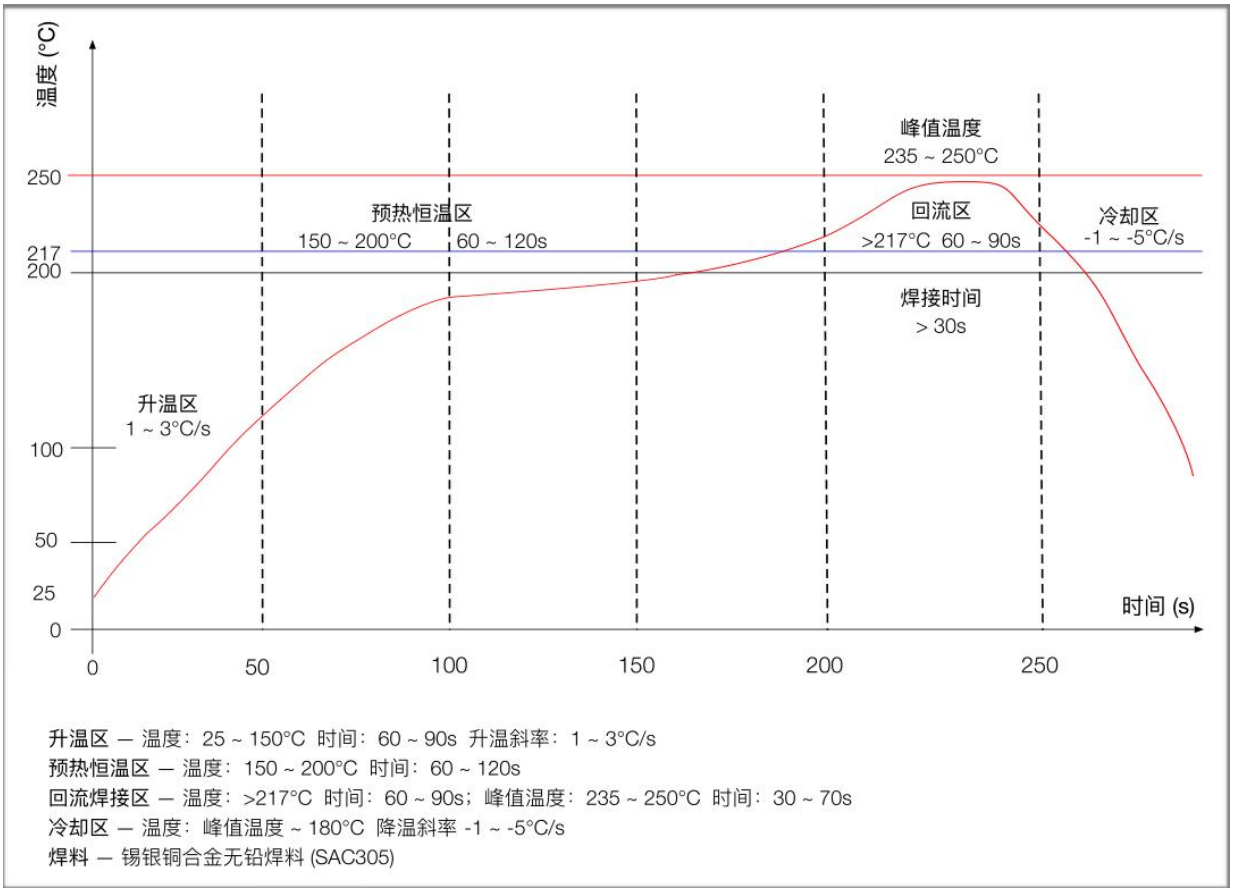


Figure 15 Reflow welding diagram

10.Product Packaging Information

Ai-WB1-12F module is packaged in a tape, 800pcs/reel.As shown in the below image:

Figure 16 Package and packing diagram

11.Contact us

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