



Ai-WB2-05W Specification

Version V1.1.2

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1. Product Overview

Ai-WB2-05W is a Wi-Fi & BLE module developed by Shenzhen Ai-Thinker Technology Co., Ltd. This module is equipped with BL602 chip as the core processor and supports Wi-Fi 802.11b/g/n protocol and BLE 5.0 protocol. The BL602 chip has a built-in 32-bit RISC CPU with low power consumption, 276KB RAM, and a wide range of peripheral interfaces, including SDIO, SPI, UART, VDC, IR remote, PWM, ADC, DAC, PIR, and GPIO. It can be widely used in Internet of Things (IoT), mobile devices, wearable electronic devices, smart home and other fields.

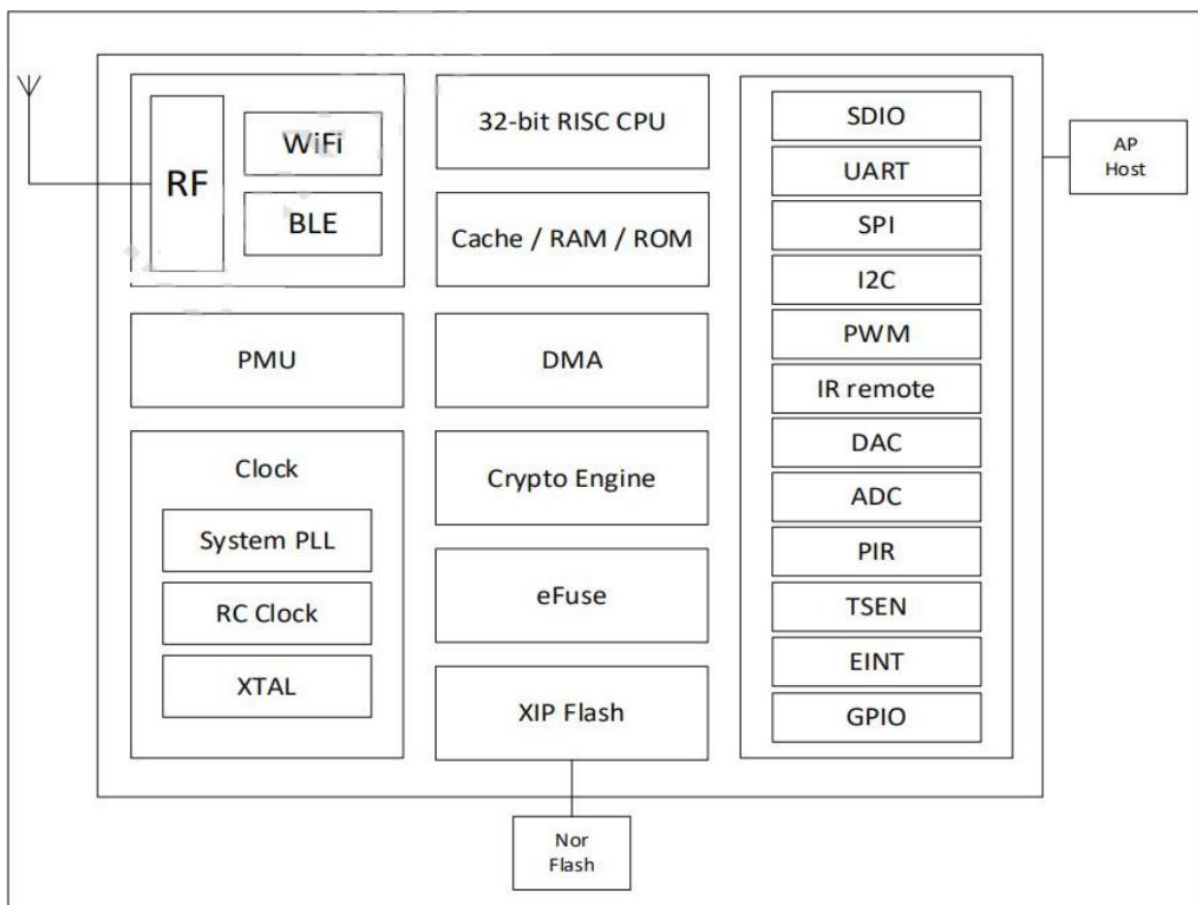


Figure 1 architecture of main chip

1.1. Characteristic

- SMD-22 encapsulation
- Supports IEEE 802.11 B/g/n protocol
- Wi-Fi security supports WPS/WEP/WPA/WPA2 Personal/WPA3
- Supports 20MHz bandwidth with a maximum speed of 72.2 Mbps
- Bluetooth 5.0, Bluetooth Mesh
- Supports Station + BLE mode, Station + SoftAP + BLE mode
- Supports 32-bit RISC CPU and 276KB RAM
- Secure Startup, supports Images with ECC-256 signatures
- Supports real-time AES decryption (OTFAD) in QSPI and SPI Flash, and supports AES 128 CTR mode
- Supports AES 128, 192, and 256-bit encryption engines
- Supports SHA-1/224/256
- Support True Random Number Generator (TRNG)
- Public Key Accelerator (PKA), support large number basic operations, software provides signature, verification and other application program interface
- Supports SDIO, SPI, UART, VDC, IR remote, PWM, ADC, DAC, PIR, GPIO etc
- Integrated Wi-Fi MAC/BB/RF/PA/LNA/BT
- Supports multiple sleep modes with a deep sleep current of 12 μ A
- Universal AT instruction for quick start
- Supports secondary development and integrates Windows and Linux development environments

2. Main parameters

Table 1 main parameters

Model	Ai-WB2-05W
Package	SMD-22
Size	13.0*19.0*2.4(±0.2)mm
Antenna	on-board PCB antenna
Frequency	2400 ~ 2483.5MHz
Operating temperature	-40°C ~ 85°C
Storage temperature	-40°C ~ 125°C, < 90%RH
Power supply	Power supply voltage 2.7V ~ 3.6V, power supply current ≥ 500mA
Interface	UART/GPIO/ADC/PWM/I2C/SPI
IO	15
UART rate	Default value: 115200 bps
Security	WPS/WEP/WPA/WPA2 Personal/WPA3
Flash	Default 2MByte,Support expansion

2.1. Static electricity requirement

Ai-WB2-05W are electrostatic sensitive equipment, special precautions should be taken during handling.



Figure 2 ESD anti-static diagram

2.2. Electrical characteristics

Table 2 Electrical Characteristics Table

Parameter	Conditio	Minimum	Typical value	Maximum	Com
Supply voltage	VDD	2.7	3.3	3.6	V
I/O	VIL	-	-	0.3*VDDIO	V
	VIH	-	0.7*VDDIO	-	V
	VOL	-	-	0.1*VDDIO	V
	VOH	-	-	0.9*VDDIO	V
	IMAX	-	-	-	15

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 value	Max.	Unit
11n mode HT20,PA output power	-	16	-	dBm
11G mode, PA output power	-	17	-	dBm
11b mode, PA output power	-	19	-	dBm
Receiving sensitivity				
Mode	Min.	Typical value	Max.	Unit
11b, 1 Mbps	-	-98	-	dBm
11b, 11 Mbps	-	-90	-	dBm
11g, 6 Mbps	-	-93	-	dBm
11g, 54 Mbps	-	-76	-	dBm
11n, HT20 (MCS7)	-	-73	-	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	-	9	15	dBm
Receiving sensitivity				
Rate Mode	Min.	Typical value	Max.	Unit
1Mbps sensitivity @ 30.8% PER	-	-96	-	dBm

2.5. Power

The following power consumption data is based on a 3.3V power supply, 25°C ambient temperature, and measured using an internal regulator

- All measurements are made at the antenna interface with a filter.
- All transmission data are based on 100% duty cycle in continuous transmission mode

Table 5 Power Consumption Table

Mode	Min.	Average	Max.	Comp
Tx 802.11b, 11Mbps, POUT=+21dBm	-	300	-	mA
Tx 802.11g, 54Mbps, POUT =+18dBm	-	246	-	mA
Tx 802.11n, MCS7, POUT =+17dBm	-	219	-	mA
Rx 802.11b, packet length 1024 byte	-	60	-	mA
Rx 802.11g, packet length 1024 byte	-	60	-	mA
Rx 802.11n, Packet length 1024 byte	-	60	-	mA
Deep-Sleep	-	12	-	μA

3. Appearance size

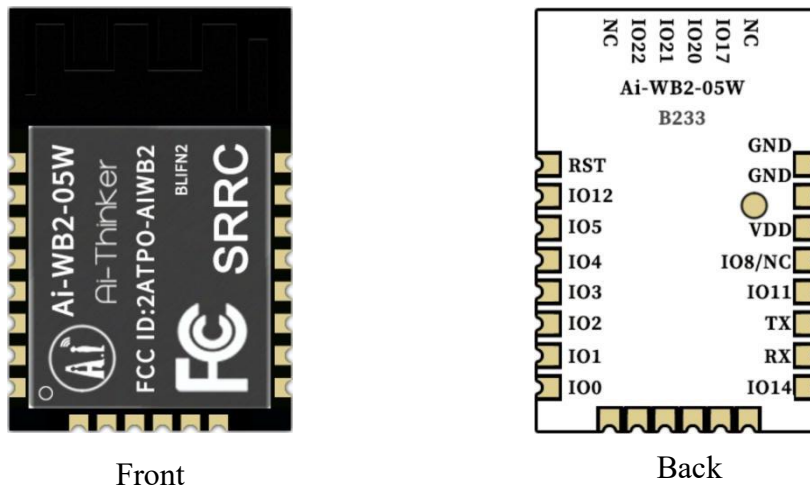


Figure 3 External view (for reference only)

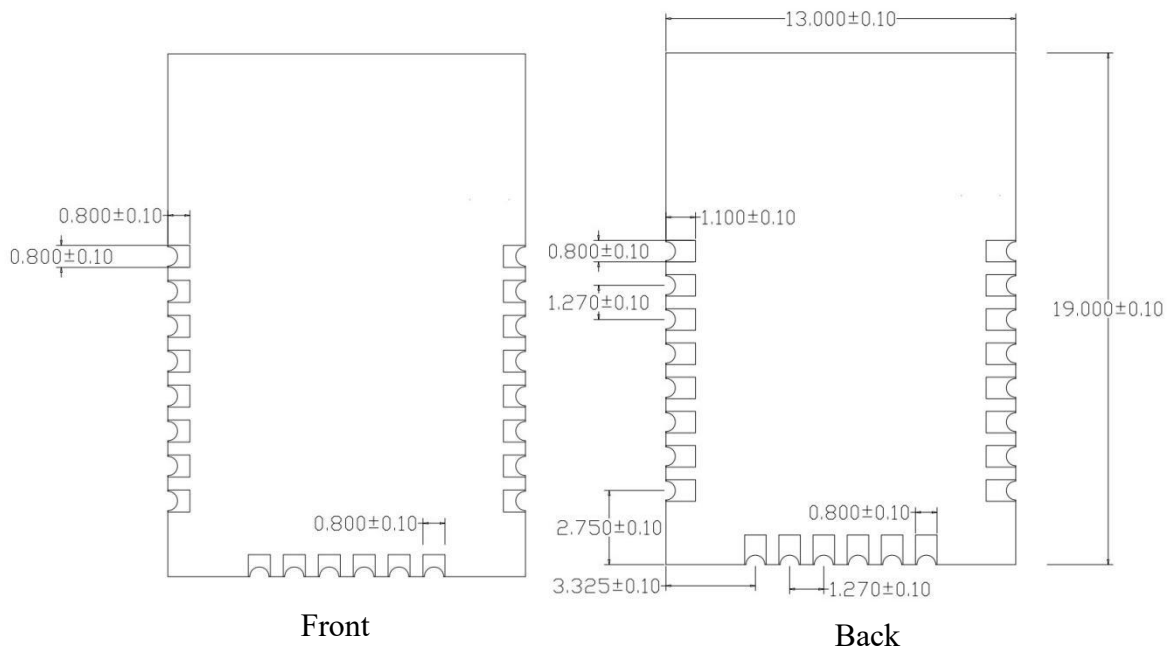


Figure 4 Dimension diagram (unit: mm)

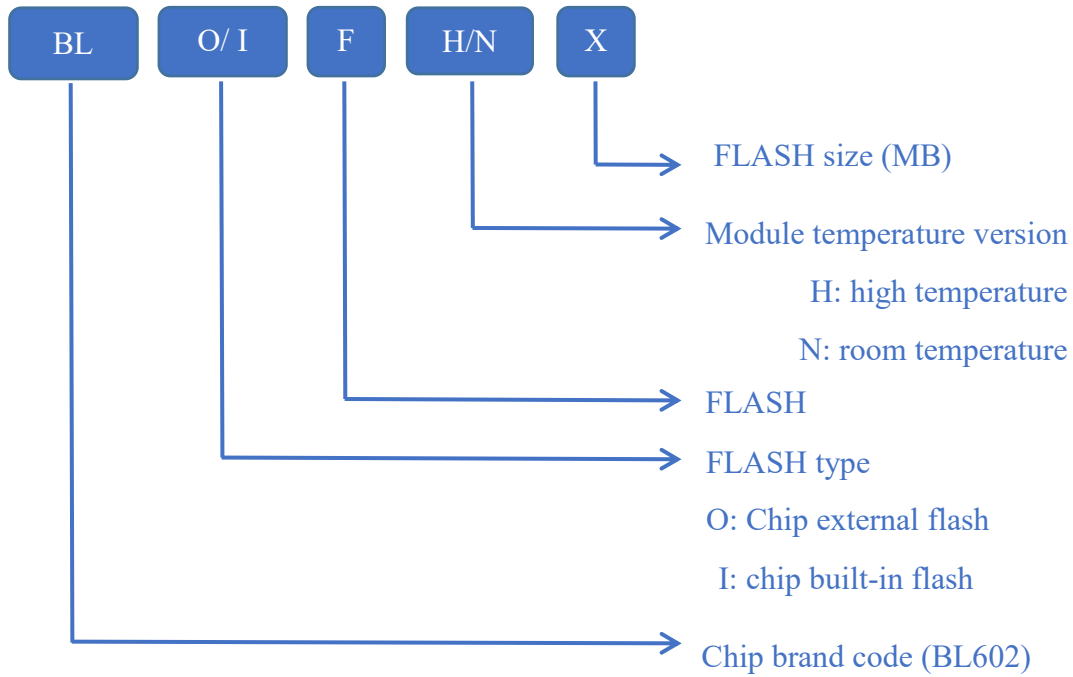


Figure 5 the representative information of screen printing of Shield

4. Pin definition

Ai-WB2-05W module is connected with a total of 22 pins, as shown in the pin schematic diagram, pin function definition table is the interface definition.

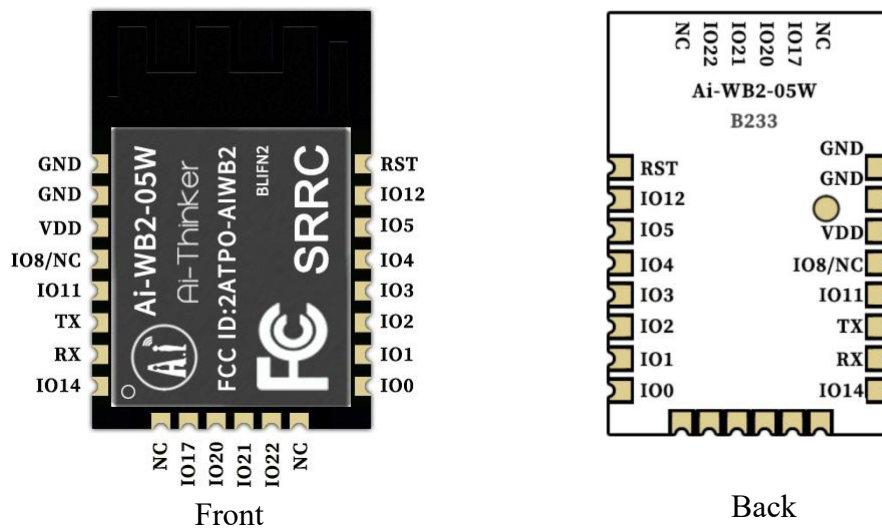


Figure 6 pin diagram

Table 6 Definition table of pin functions

No.	Name	Description
1	GND	Ground
2	GND	Ground
3	VDD	3.3V power supply. It is recommended that the output current of the external power supply be higher than 500mA
4	IO8/NC	NC, unavailable. If you need to use it, please contact Ai-Thinker. Bootstrap/GPIO8/SPI_MOSI/MISO/IIC_SCL/PWM_CH3
5	IO11	GPIO11/SPI_SCLK/IIC_SDA/ADC_CH10
6	TX	TXD/GPIO16/SPI_MOSI/MISO/IIC_SCL/PWM_CH1
7	RX	RXD/GPIO7/SPI_SCLK/IIC_SDA/PWM_CH2
8	IO14	GPIO14/SPI_SS/IIC_SCL/PWM_CH4/ADC_CH2
9	NC	NC, not available
10	IO17	GPIO17/SPI_MOSI/MISO/IIC_SDA/PWM_CH2
11	IO20	GPIO20/SPI_MOSI/MISO/IIC_SCL/PWM_CH0
12	IO21	GPIO21/SPI_MOSI/MISO/IIC_SDA/PWM_CH1
13	IO22	GPIO22/SPI_SS/IIC_SCL/PWM_CH2
14	NC	NC, not available
15	IO0	GPIO0/SPI_MOSI/MISO/IIC_SCL/PWM_CH0
16	IO1	GPIO1/SPI_MOSI/MISO/IIC_SDA/PWM_CH1
17	IO2	GPIO2/SPI_SS/IIC_SCL/PWM_CH2
18	IO3	GPIO3/SPI_SCLK/IIC_SDA/PWM_CH3
19	IO4	GPIO4/SPI_MOSI/MISO/IIC_SCL/PWM_CH4/ADC_CH1
20	IO5	GPIO5/SPI_MOSI/MISO/IIC_SDA/PWM_CH0/ADC_CH4
21	IO12	GPIO12/SPI_MOSI/MISO/IIC_SCL/PWM_CH2/ADC_CH0
22	RST	By default, the chip is reset and triggered at a low level

Note:

- At the moment of power-on, if Bootstrap GPIO8 is high, the module enters the programming mode; if Bootstrap GPIO8 is low, the module starts normally.

5. Schematic

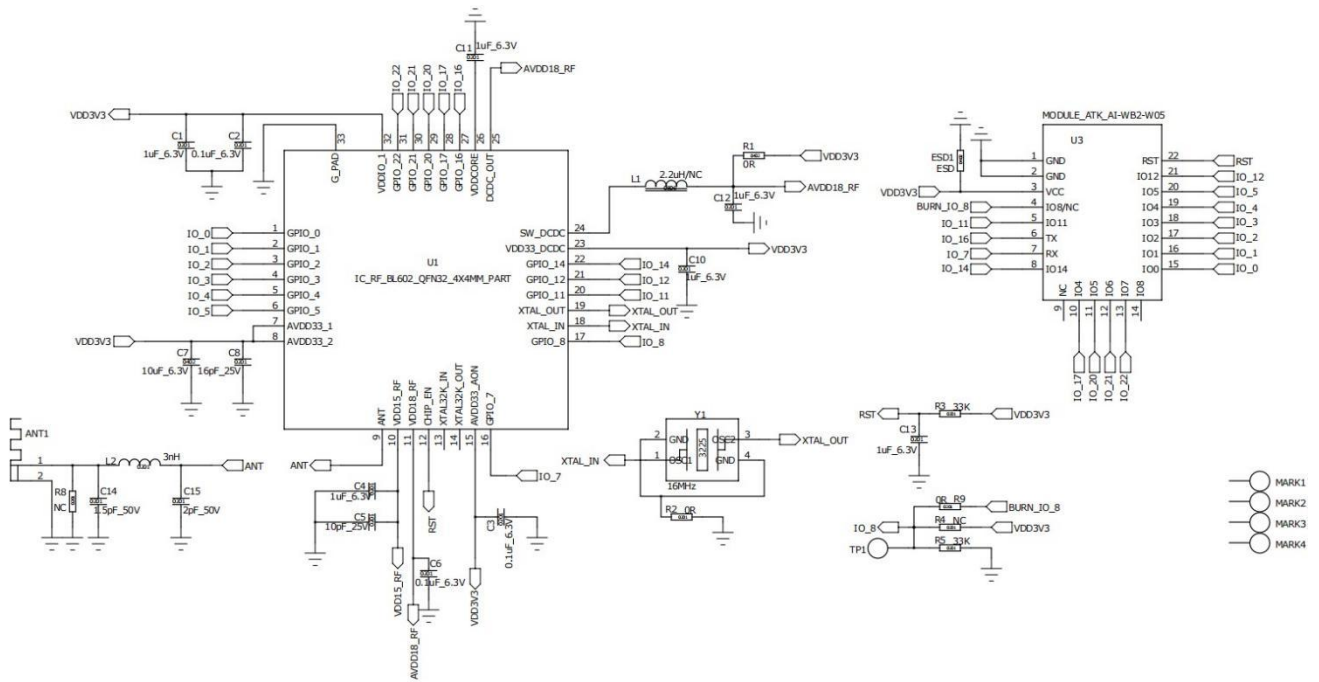


Figure 7 schematic diagram

6. Antenna parameters

6.1. Antenna Test prototype

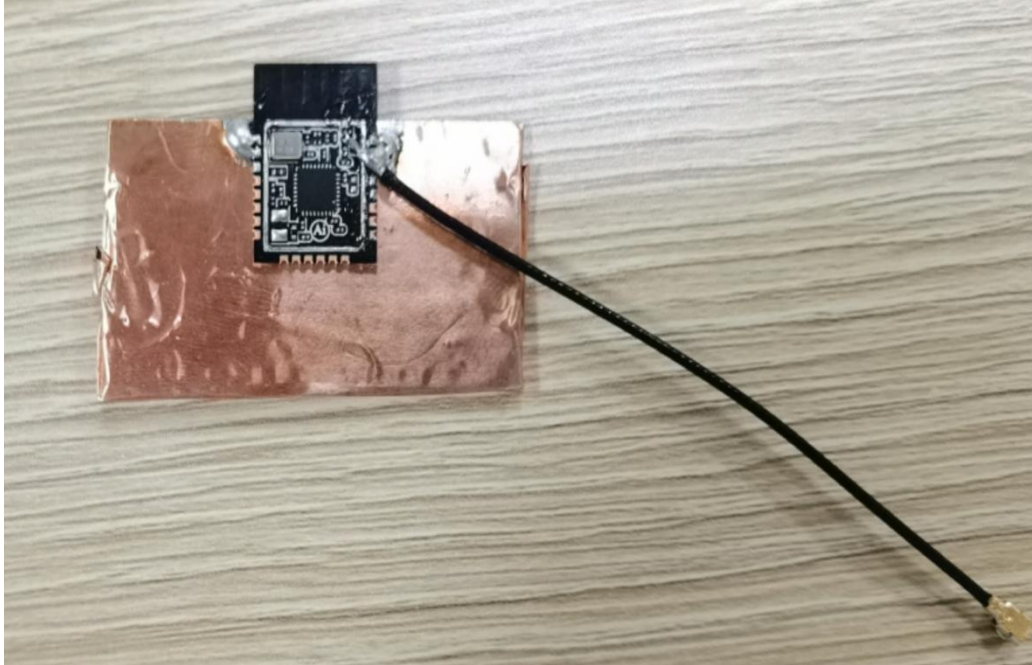


Figure 8 antenna Test prototype sketch Map

6.2. Antenna S parameters

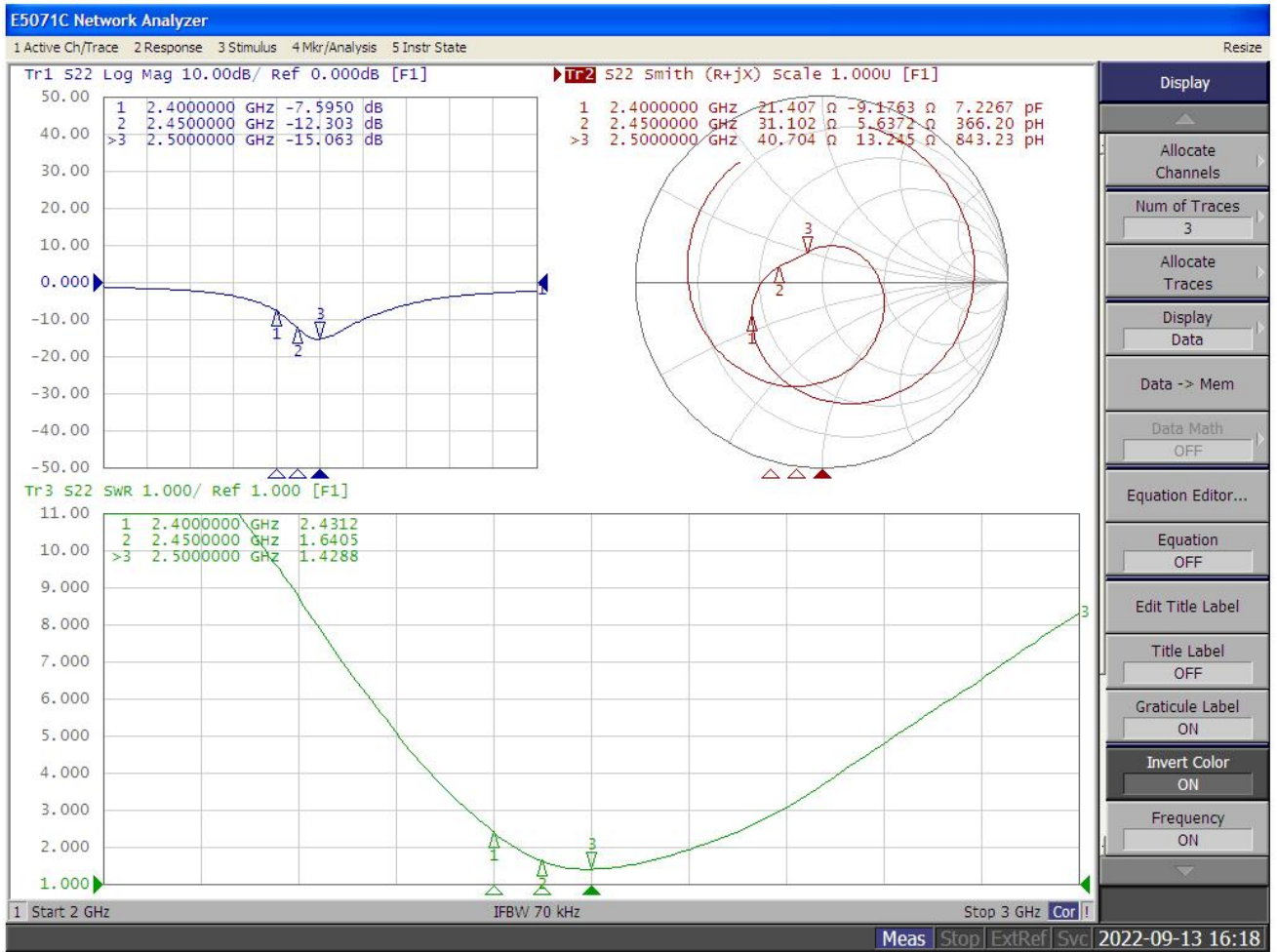


Figure 9 antenna S parameters

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)	-0.60	-0.41	-0.32	-0.44	-0.73	-0.73	-0.67	-0.54	-0.34	-0.26	-0.32
Efficiency (%)	42.68	43.47	44.50	44.75	42.81	43.16	42.06	41.34	40.37	40.25	40.05

6.4. Antenna pattern

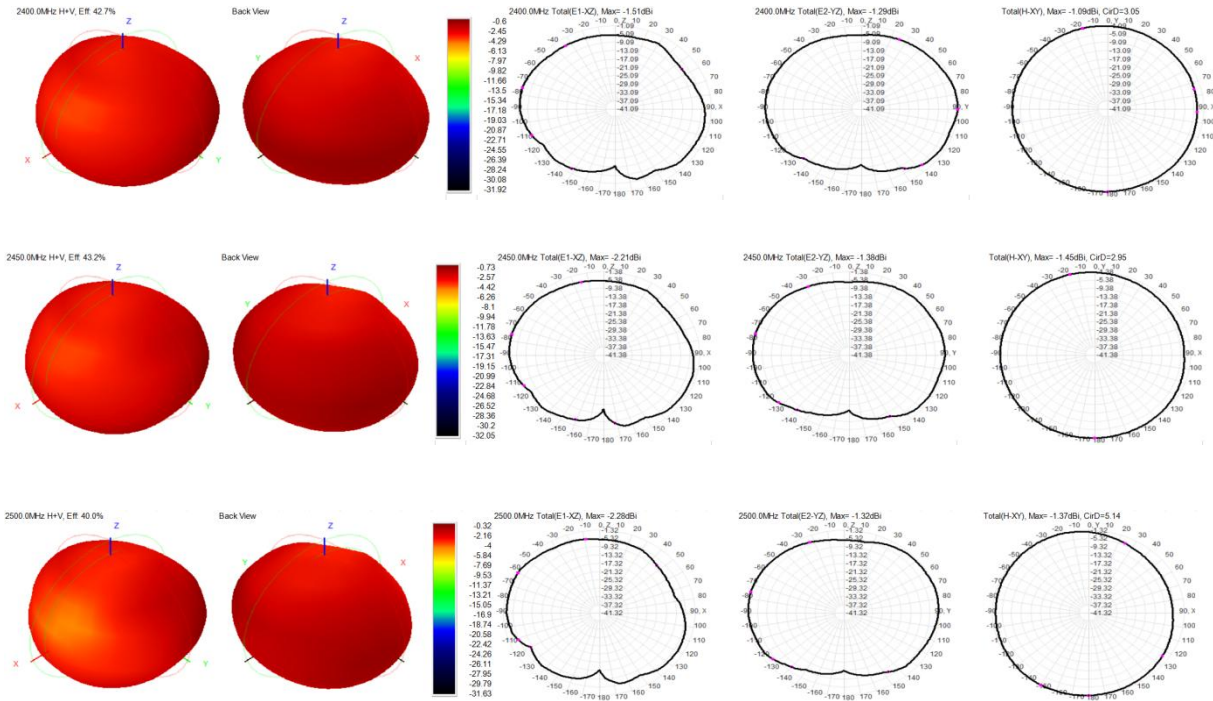


Figure 10 Antenna pattern

6.5. RF OTA parameters

Table 8 RF OTA parameters

Item	Mode	Rate(Mbps)	Channel	Fre.(MHz)	Data(dBm)
TRP	11b	11	1	2412	17.89
			6	2437	17.76
			13	2472	16.35
	11g	54	1	2412	15.47
			6	2437	15.43
			13	2472	14.01
	HT20	MCS7	1	2412	15.78
			6	2437	15.49
			13	2472	13.97
TIS	11b	11	1	2412	-86.02
			6	2437	-84.76
			13	2472	-85.68
	11g	54	1	2412	-71.74
			6	2437	-72.4
			13	2472	-71.14
	HT20	MCS7	1	2412	-67.05
			6	2437	-66.72
			13	2472	-65.37

7. Design Guidance

7.1. Application Guide circuit

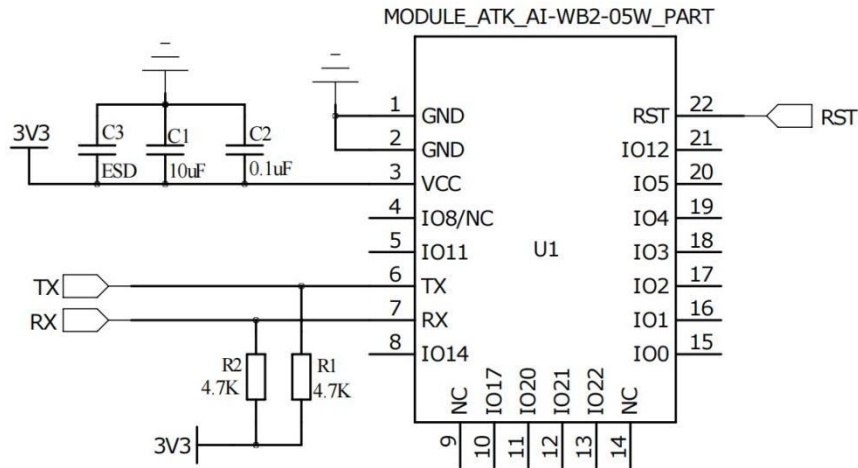


Figure 11 Application circuit diagram

- If the IO port is used as PWM, it is recommended to reserve a 4.7K pull-down resistor around the module. Especially in the application of light control, it can prevent the flashing light phenomenon at the moment of power-on start
- The IO8/NC pin, which are not available by default. If you need to use it, please contact Ai-Thinker

7.2. Recommend PCB package size

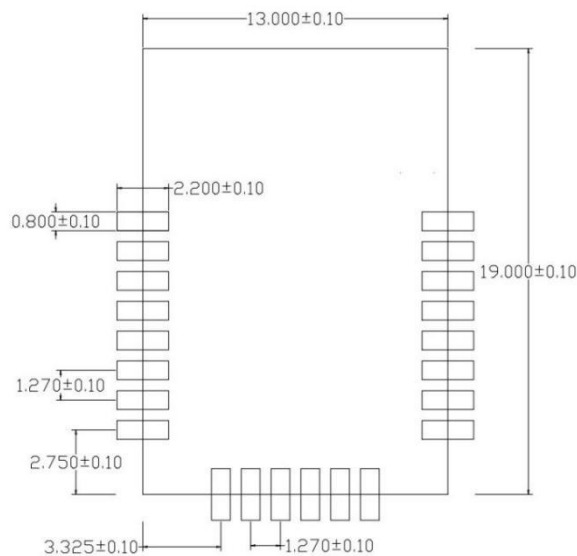


Figure 12 recommended PCB package size

7.3. Antenna layout requirements

- The following two methods are recommended for the installation position on the mainboard

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

Option : put the module on the edge of the motherboard, the edge of the motherboard at the antenna position hollowed out an area

- 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

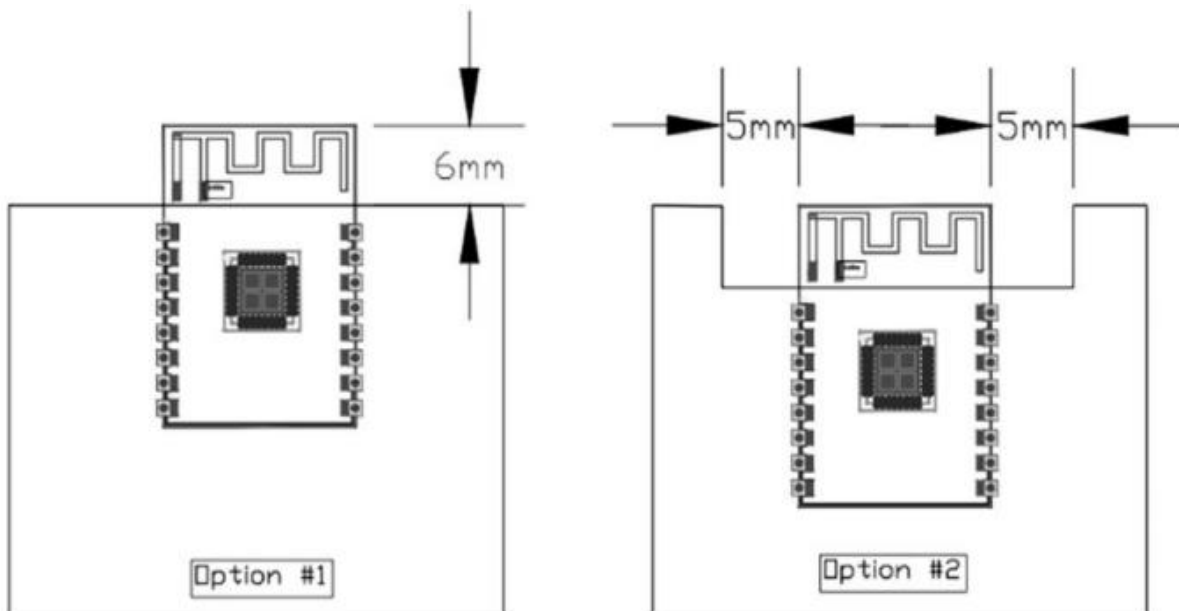


Figure 13 Antenna layout diagram

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 inhibits overshoot and makes both sides level more stable. It is helpful for EMI and ESD.
- For special I/O ports to be pulled up and down, refer to the direction for use in the specifications, which may affect the module start-up configuration.
- The I/O port of the module is 3.3V. If the main control does not match the I/O port level of the module, a level conversion circuit needs to be added.
- If the I/O port is directly connected to the peripheral interface, or the terminal such as the row pin, it is recommended to reserve ESD devices near the terminal of the I/O port.

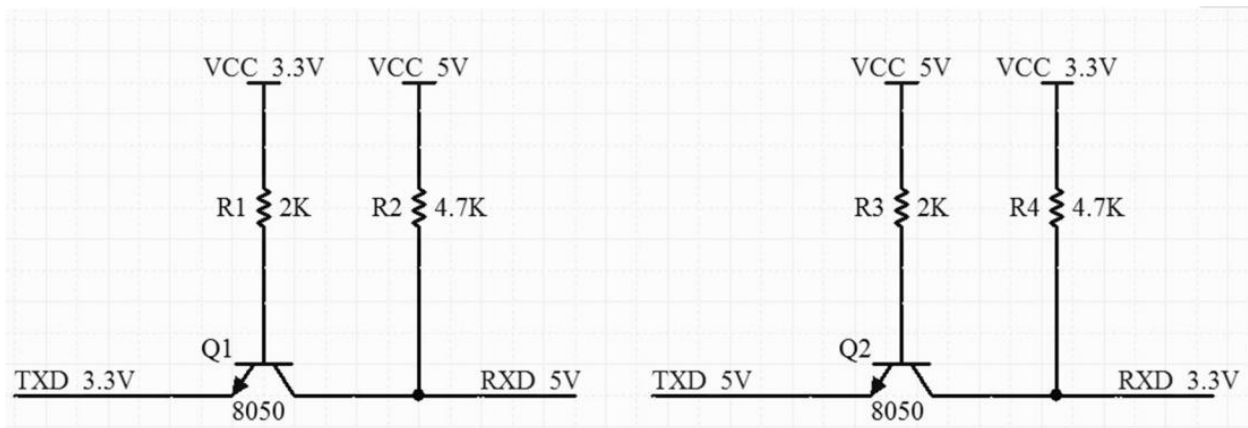


Figure 15 level conversion circuit

8. Storage Conditions

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

The humidity sensitivity level MSL of the module is Level 3.

After the vacuum bag is unpacked, it must be used up within 168 hours at $25 \pm 5^{\circ}\text{C}/60\% \text{ RH}</math>, otherwise it can be put on line again after baking.$

9. Reflow welding curve diagram

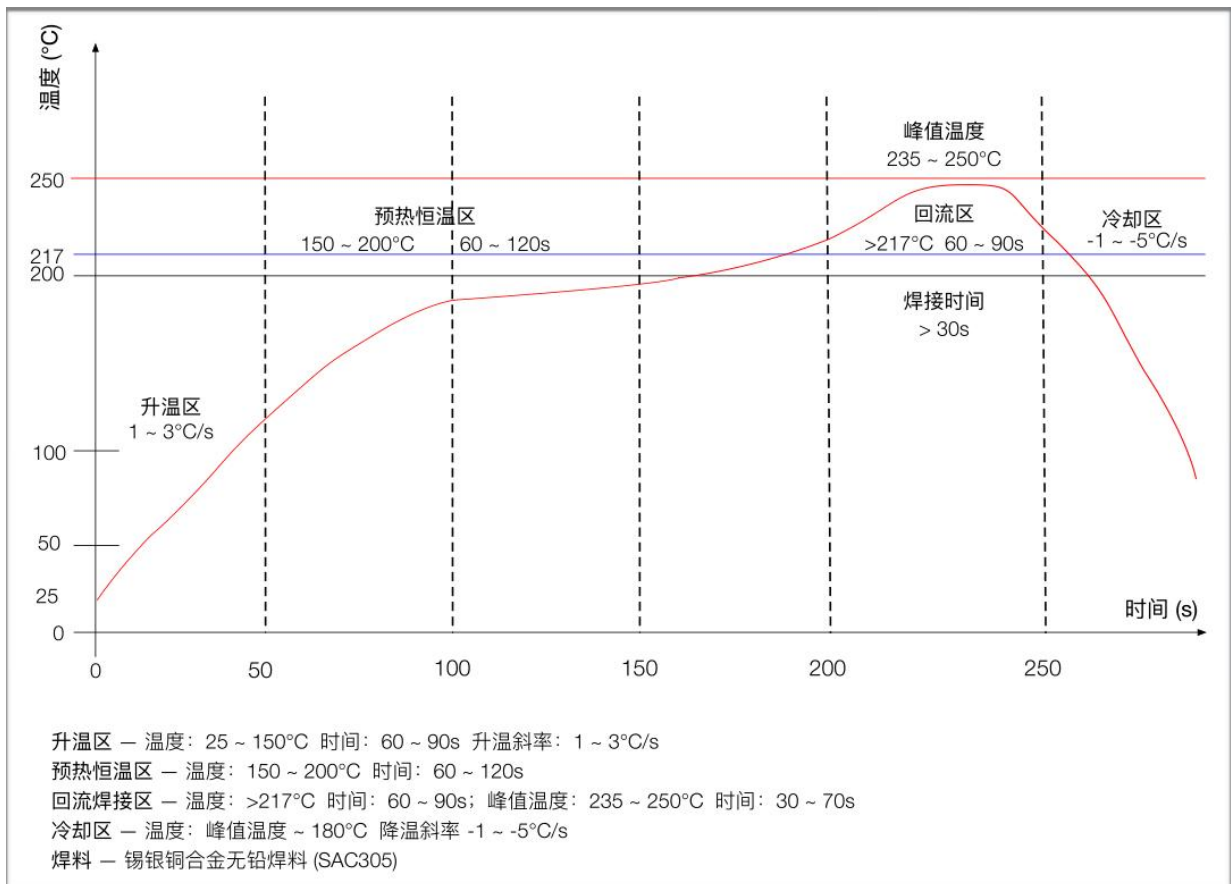


Figure 16 reflow soldering curve

10. Product packaging information

Ai-WB2-05W module was packaged in a tape, 1 000pcs/reel. As shown in the below image:



Figure 17 Package and packing diagram

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