



Ai-WB2-01S Specification

Version V1.0.1

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1. Product Overview

Ai-WB2-01S 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 and 276KB RAM. It can be widely used in Internet of Things (IoT), mobile devices, wearable electronic devices, smart home and other fields.

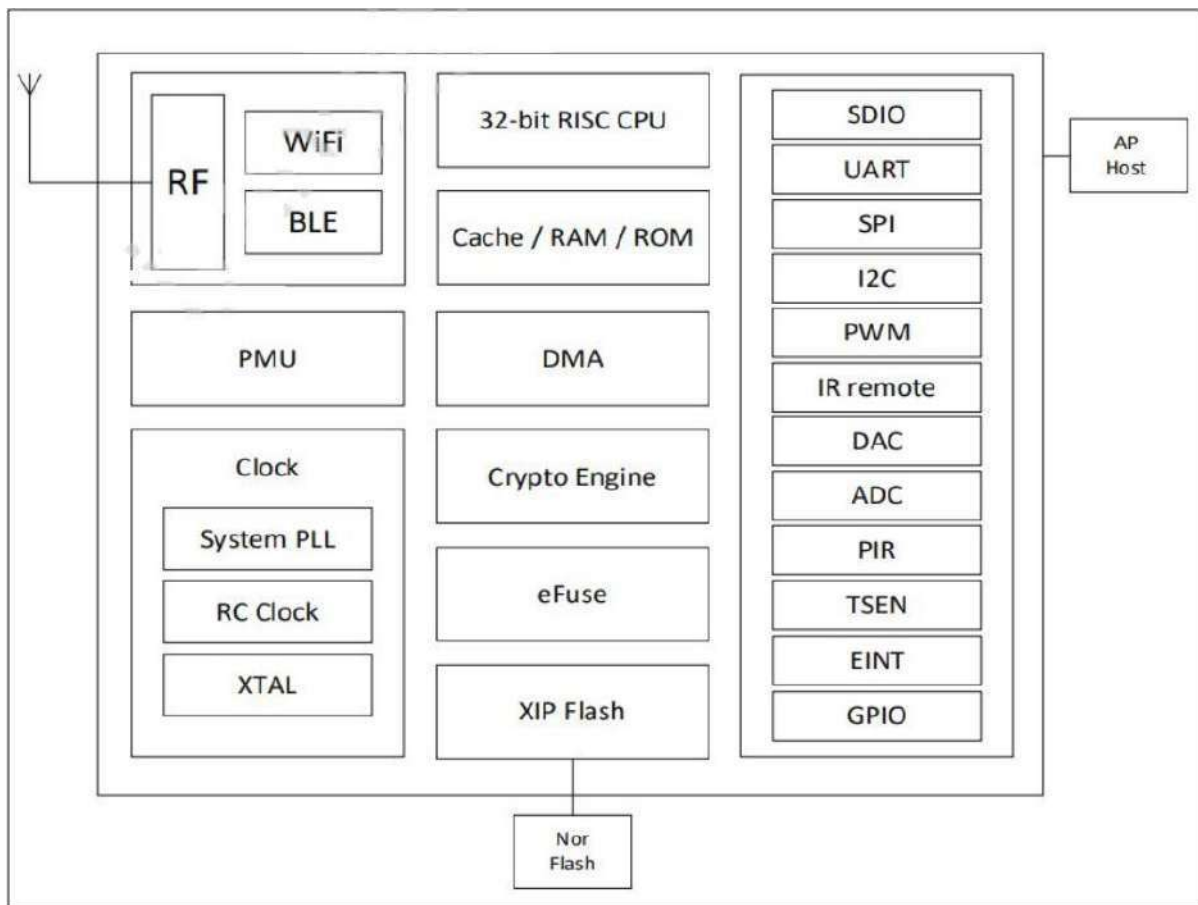


Figure 1 architecture of main chip

1.1. Characteristic

- DIP-8 package
- Supports IEEE 802.11 B/g/n protocol
- Wi-Fi security supports WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/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 UART,PWM,ADC, and GPIO
- 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-WB2-01S |
| Package | DIP-8 |
| Size | 14.5*24.5*11.2(±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 |
| IO | 3 |
| UART rate | Default value: 115200 bps |
| Security | WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3 |
| Flash | Default 2MByte Support expansion |

2.1. Static electricity requirement

Ai-WB2-01S 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 | - | 320 | - | mA |
| Tx 802.11g, 54Mbps, POUT=+18dBm | - | 269 | - | mA |
| Tx 802.11n, MCS7, POUT=+16dBm | - | 240 | - | mA |
| Rx 802.11b, packet length 1024 byte | - | 63 | - | mA |
| Rx 802.11g, packet length 1024 byte | - | 63 | - | mA |
| Rx 802.11n, Packet length 1024 byte | - | 63 | - | mA |
| Deep-Sleep | - | 12 | - | μA |

3. Appearance size

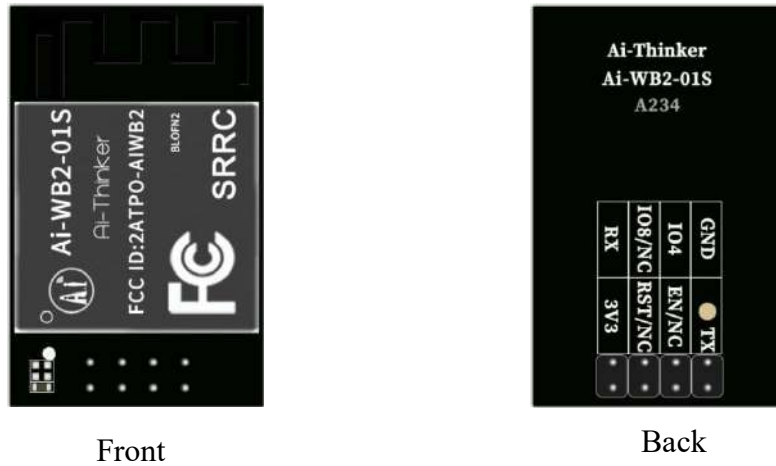


Figure 3 External view (for reference only)

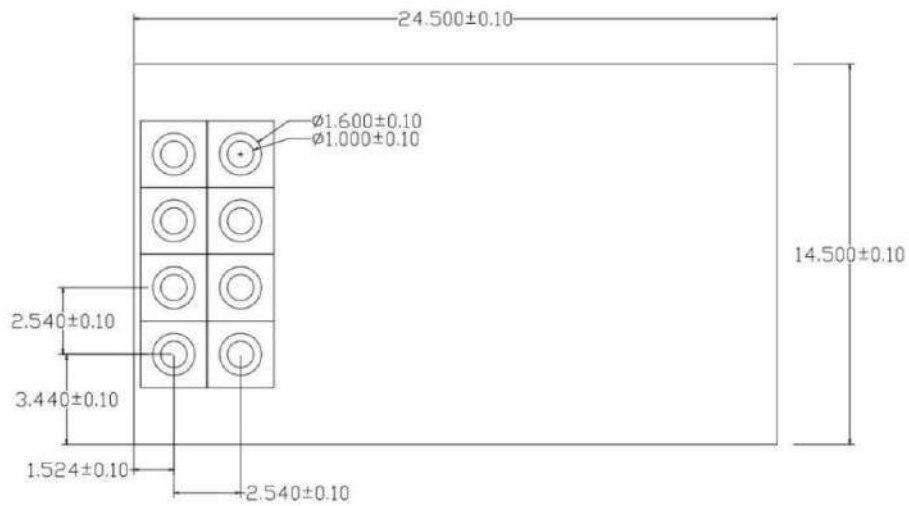


Figure 4 Dimension diagram (unit: mm)

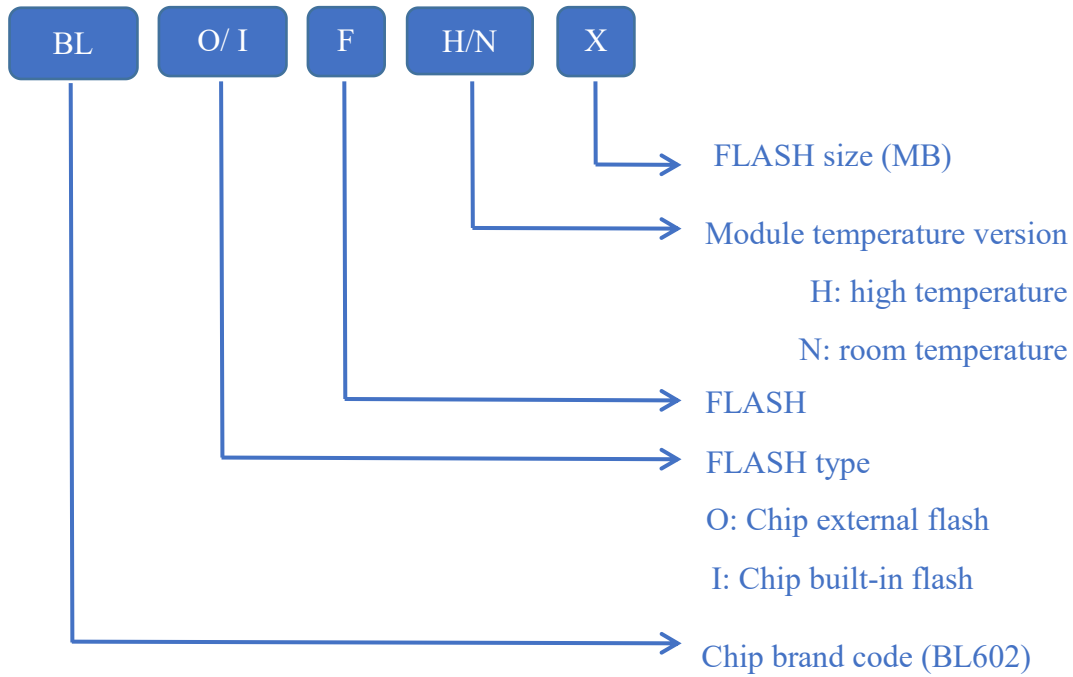
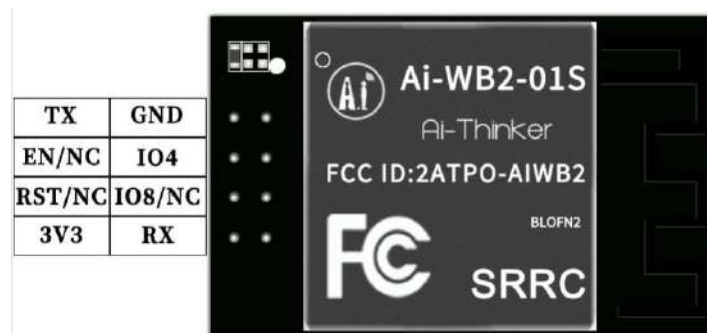


Figure 5 the representative information of screen printing of Shield

4. Pin definition

Ai-WB2-01S module is connected with a total of 8 pins, as shown in the pin schematic diagram, pin function definition table is the interface definition.



Front

Figure 6 pin diagram

Table 6 Definition table of pin functions

| No. | Name | Description |
|-----|--------|---|
| 1 | GND | Ground |
| 2 | IO4 | GPIO4/SPI MOSI/MISO/IIC SCL/PWM CH4/ADC CH4 |
| 3 | IO8/NC | NC, unavailable. If you need to use it, please contact Ai-Thinker. Bootstrap/GPIO8/SPI_MOSI/MISO/IIC_SCL/PWM_CH3 |
| 4 | RX | RXD/GPIO7/SPI_SCLK/IIC_SDA/PWM_CH2 |
| 5 | TX | TXD/GPIO16/SPI_MOSI/MISO/IIC_SCL/PWM_CH1 |
| 6 | EN/NC | By default, it is enabled as a chip and is effective at a high level |
| 7 | RST/NC | The default NC is unavailable |
| 8 | 3V3 | 3.3V power supply. It is recommended that the output current of the external power supply be higher than 500mA |

Note:

1. 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

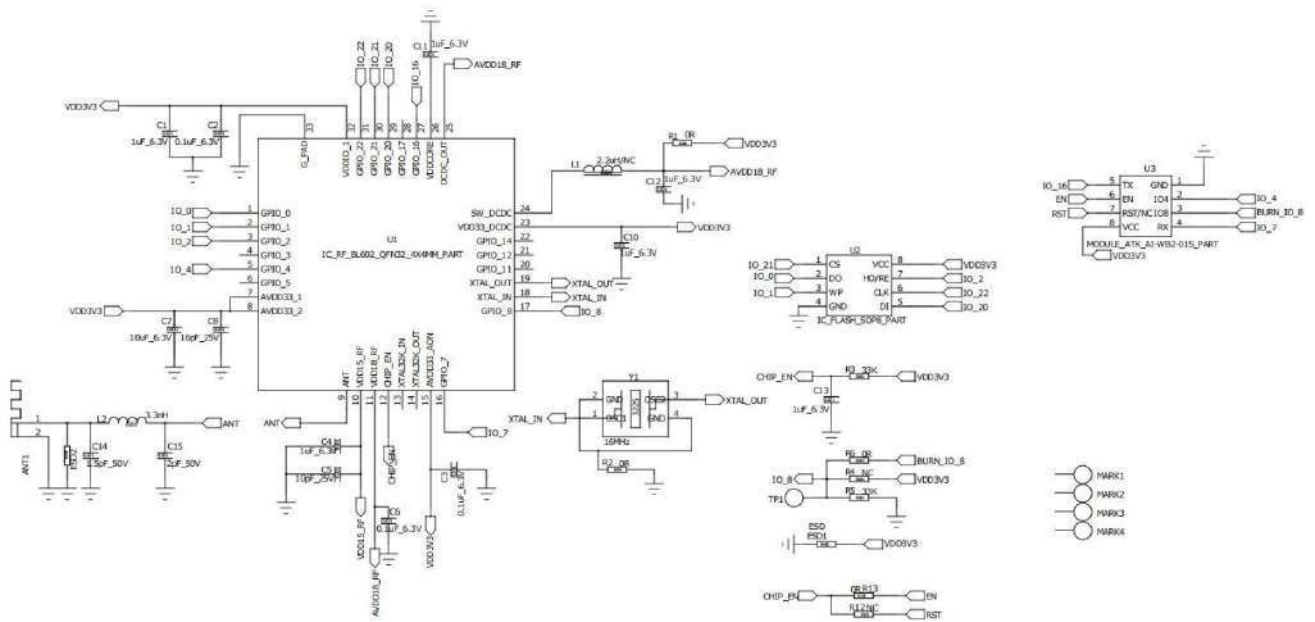


Figure 7 schematic diagram

6. Antenna parameters

6.1. Antenna Test prototype



Figure 8 antenna Test prototype sketch Map

6.2. Antenna S parameters

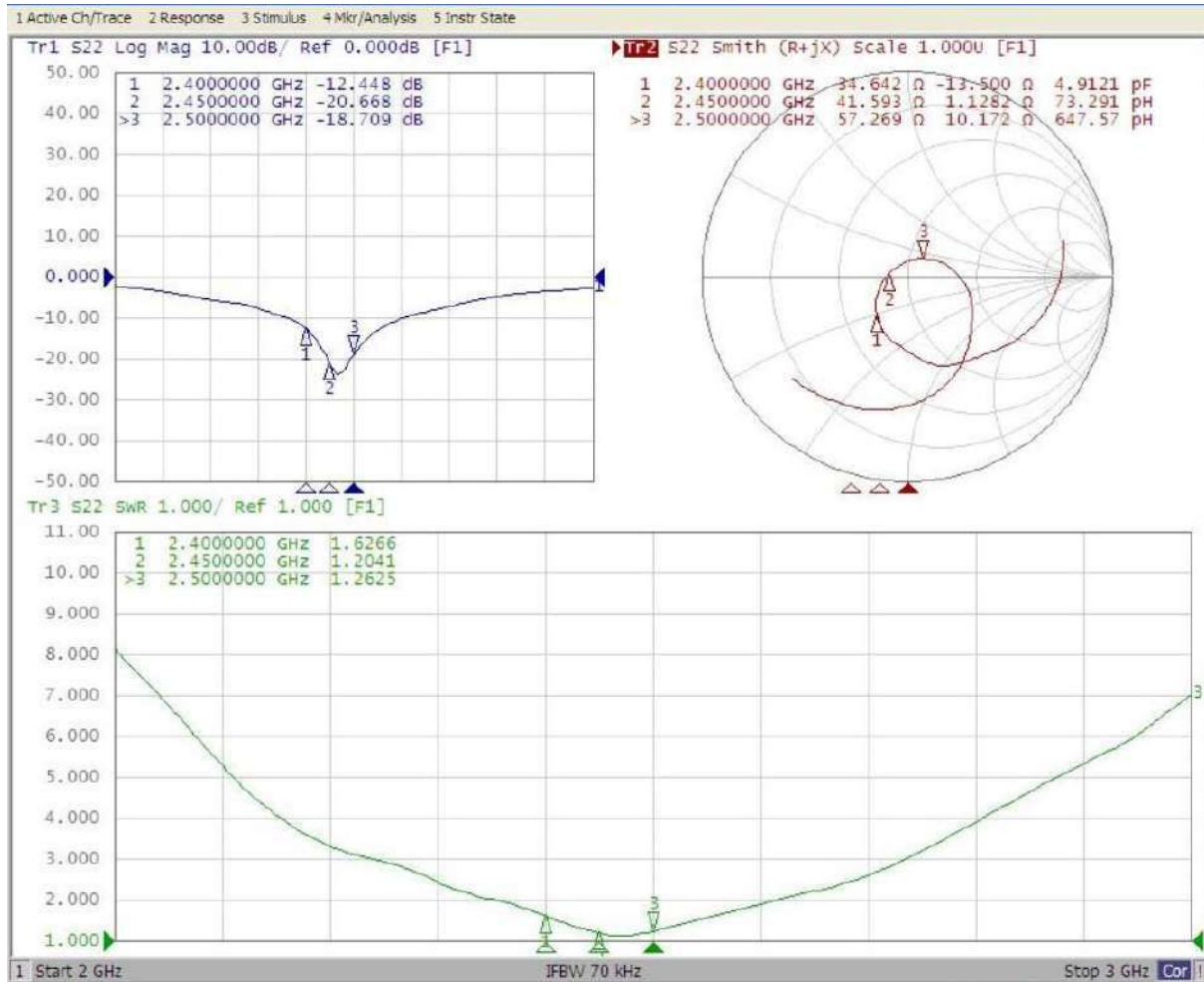


Figure 9 antenna S parameters

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) | 0.22 | 0.46 | 0.84 | 1.21 | 1.39 | 1.61 | 1.71 | 1.72 | 1.67 | 1.70 | 1.84 |
| Efficiency (%) | 41.43 | 42.58 | 44.95 | 47.63 | 49.55 | 53.10 | 54.63 | 55.26 | 55.00 | 54.57 | 54.22 |

6.4. Antenna pattern

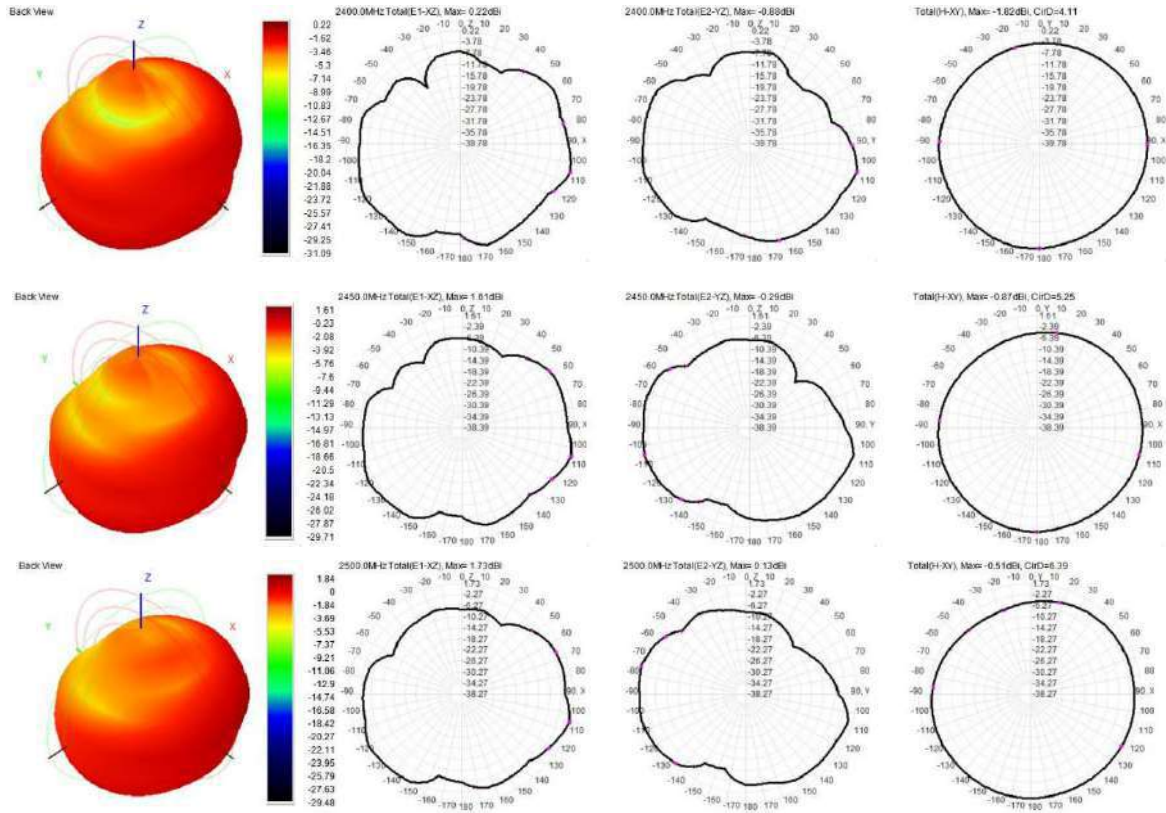


Figure 10 Antenna pattern

6.5. RF OTA parameters

Table 8 RF OTA parameters

| Item | Mode | Rate(Mbps) | Channel | Fre.(MHz) | Data(dBm) |
|------|------|------------|---------|-----------|-----------|
| TRP | 11b | 11 | 1 | 2412 | 13.92 |
| | | | 6 | 2437 | 13.97 |
| | | | 13 | 2472 | 13.49 |
| | 11g | 54 | 1 | 2412 | 11.7 |
| | | | 6 | 2437 | 11.69 |
| | | | 13 | 2472 | 11.23 |
| | HT20 | MCS7 | 1 | 2412 | 11.61 |
| | | | 6 | 2437 | 11.68 |
| | | | 13 | 2472 | 11.47 |
| TIS | 11b | 11 | 1 | 2412 | -85.02 |
| | | | 6 | 2437 | -83.16 |
| | | | 13 | 2472 | -84.78 |
| | 11g | 54 | 1 | 2412 | -70 |
| | | | 6 | 2437 | -70.42 |
| | | | 13 | 2472 | -70.35 |
| | HT20 | MCS7 | 1 | 2412 | -65.52 |
| | | | 6 | 2437 | -65.79 |
| | | | 13 | 2472 | -64.12 |

7. Design Guidance

7.1. Application Guide circuit

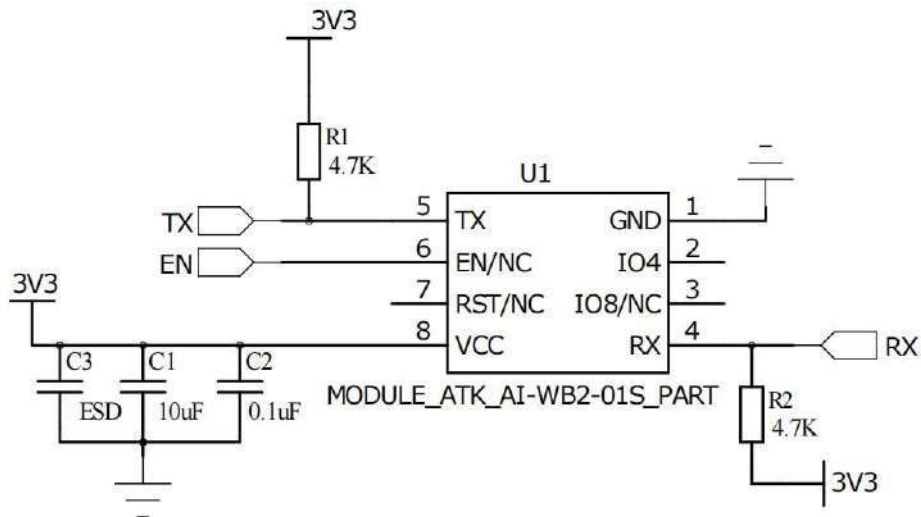


Figure 11 Application circuit diagram

- 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, RST/NC, which are not available by default. If you need to use it, please contact Ai-Thinker

7.2. Recommend PCB package size

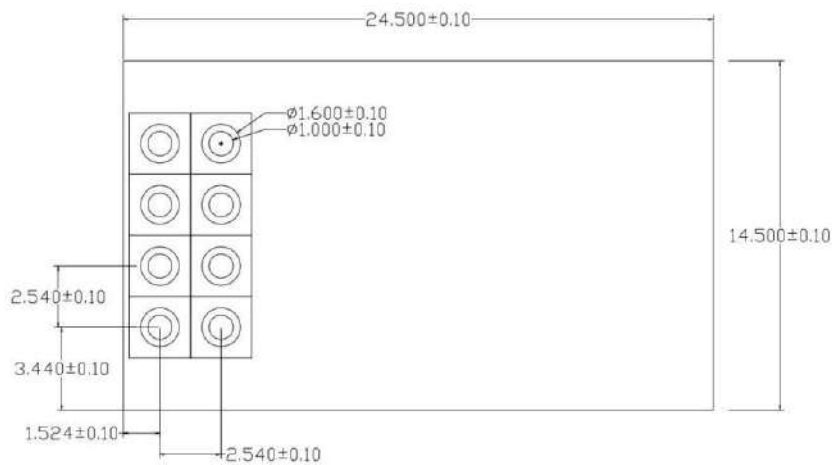


Figure 12 recommended PCB package size (unit: mm)

- Recommended 2.54mm 2*4 row needle base

7.3. Antenna layout requirements

- The installation position on the motherboard is recommended in the following two ways:

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 onboard antenna, it is forbidden to place metal parts around the antenna and keep away from high frequency devices

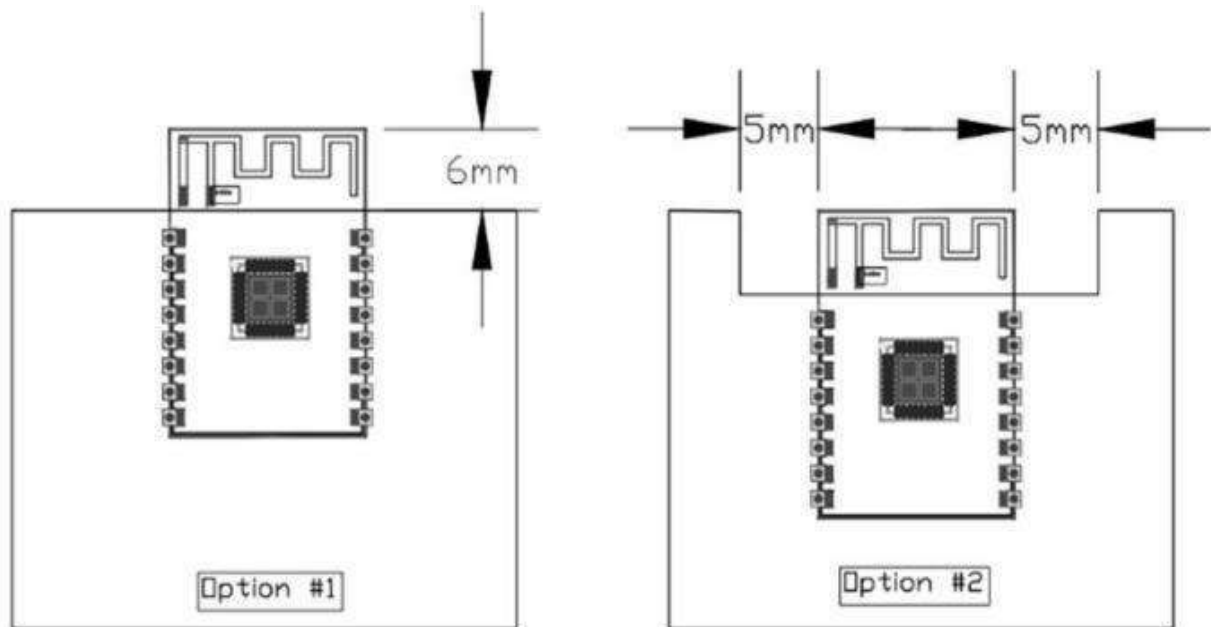


Figure 13 Antenna layout diagram

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.

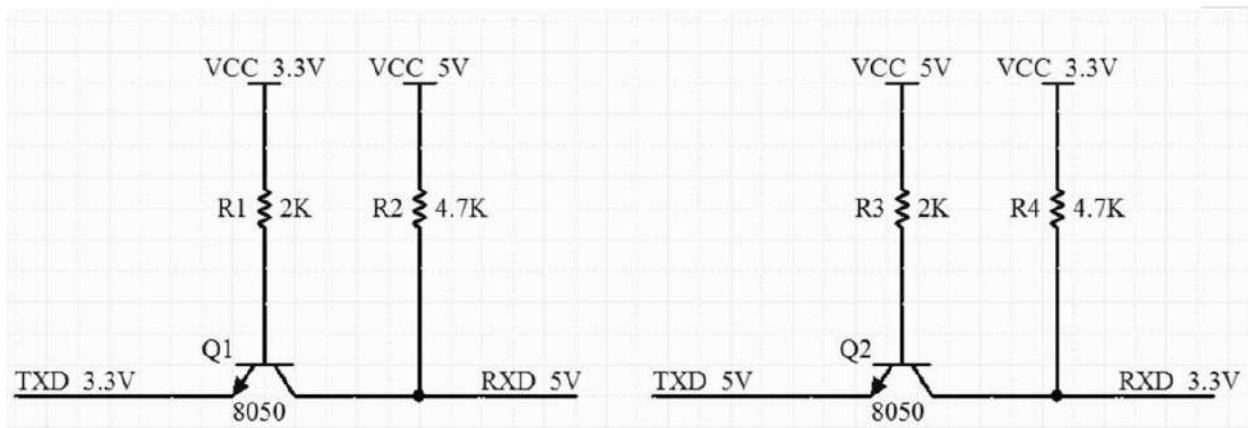


Figure 15 level conversion circuit

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 $25 \pm 5^{\circ}\text{C}/60\% \text{RH}$, otherwise it can be put on line again after baking.

9. Reflow welding curve diagram

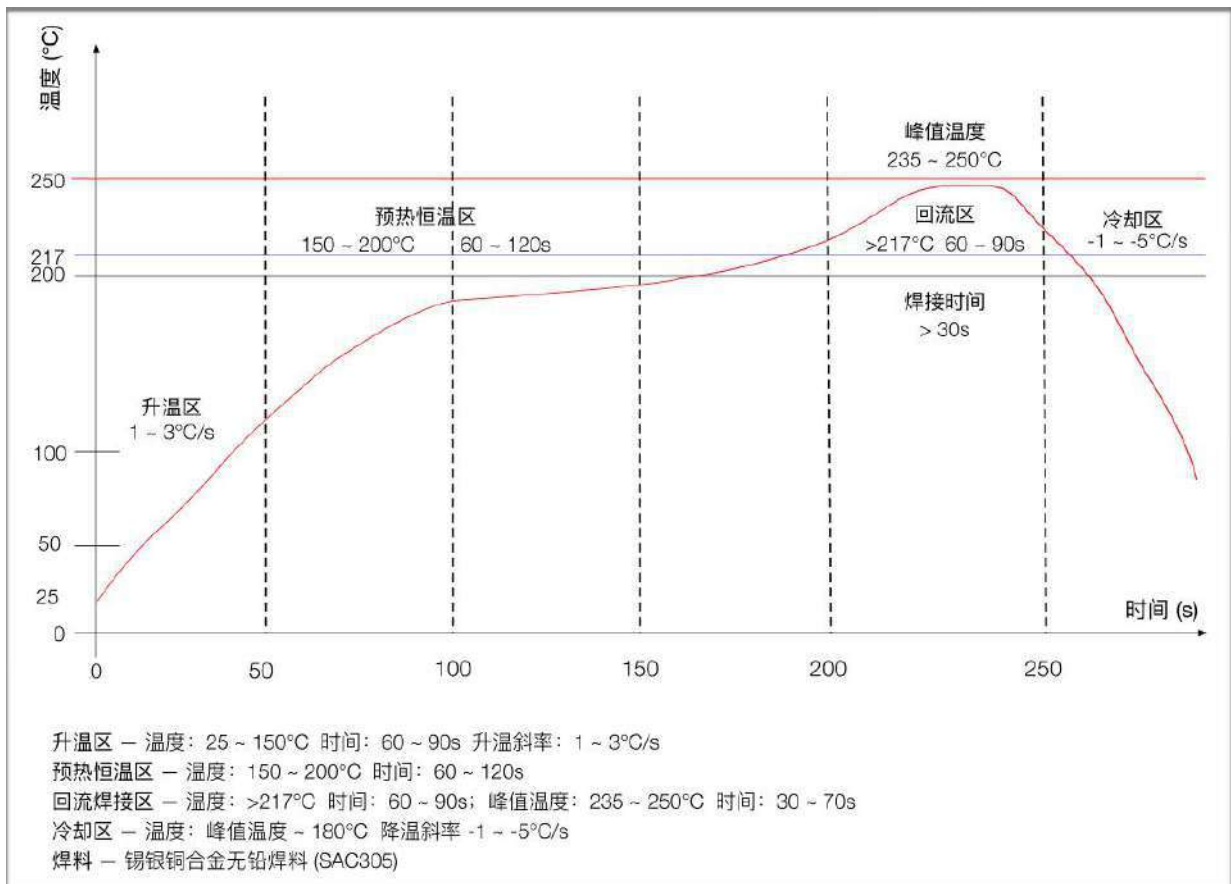


Figure 16 reflow soldering curve

10. Product packaging information

Ai-WB2-01S module was packaged in a tape, 200pcs/reel. As shown in the below image:



Figure 17 Package and packing diagram

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