# Ai-M62-M2-I  Specification

Version   V1.0.0

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# Document resume

| Version | Date | Develop/revise content | Edition | Approve |
|---------|------|------------------------|---------|---------|
| V1.0.0 | 2023.03.21 | First Edition | Chaomei Deng | Ning Guan |
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# Content

# 1.  Product Overview

Ai-M62-M2-I is a Wi-Fi 6 + BLE5.3 module developed by Shenzhen Ai-Thinker Technology Co., Ltd. The module is equipped with BL616 chip as the core processor, supports Wi-Fi 802.11b/g/n/ax protocol and BLE protocol, and supports Thread protocol. The BL616 system includes a low-power 32-bit RISC-V CPU with floating-point unit, DSP unit, cache and memory, with a maximum dominant frequency of 320M.

The Ai-M62-M2-I module has rich peripheral interfaces, including Audio Codec, USB2.0, SDU, SD/MMC(SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPDC, ACOMP, GPIO, etc. It can be widely used in audio and video multimedia, Internet of Things (IoT), mobile devices, wearable electronic devices, smart homes and other fields.

The Ai-M62-M2-I module Sec Eng module supports AES/SHA/PKA/TRNG and other functions, supports image encryption and signature startup, and meets various security application requirements in the Internet of Things field.
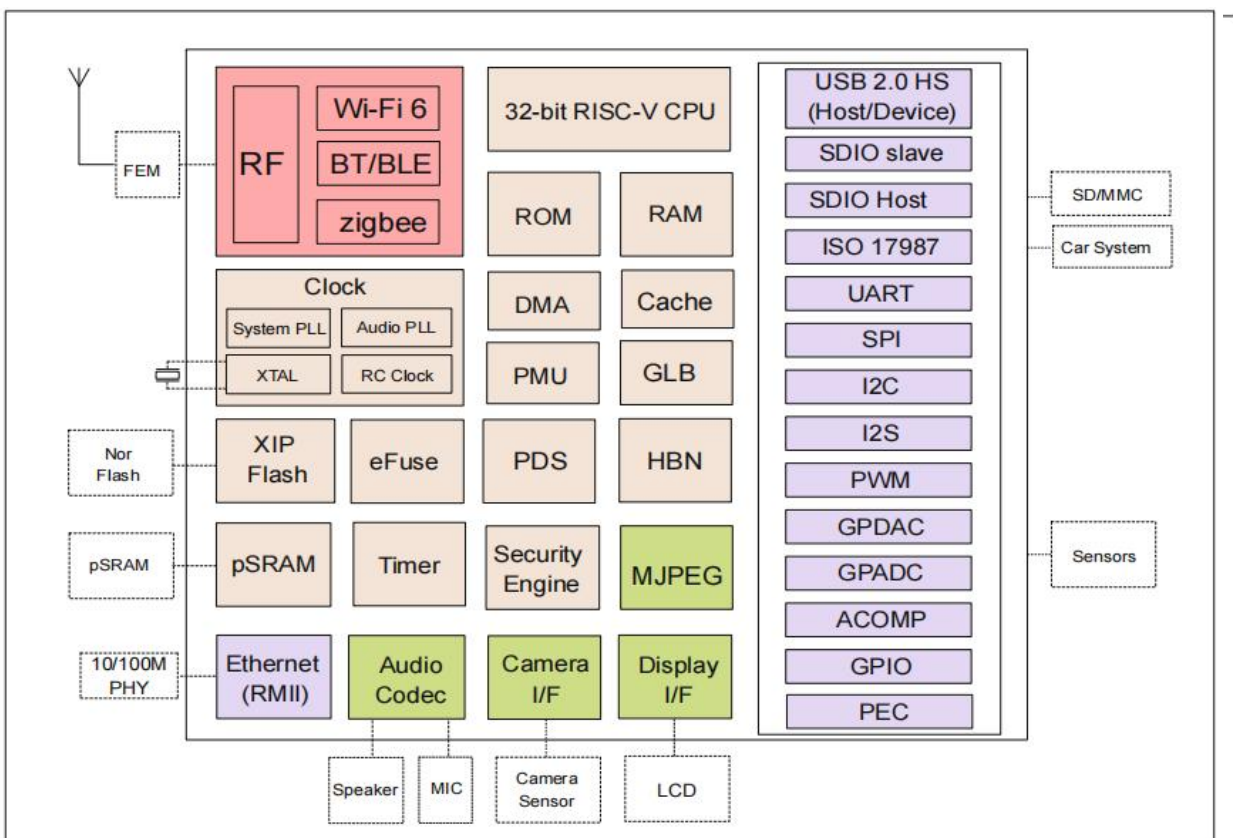


**Figure 1 Main chip architecture diagram**

## 1.1. Characteristics

■ SMD-30 package

■ Supports 2.4GHz operating frequency band

■ Support IEEE 802.11 B/g/n/ax

■ Support BLE5.3

■ Support Thread

■ Support Wi-Fi/BLE/Thread coexistence

■ Wi-Fi security support WPS/WEP/WPA/WPA2/WPA3

■ Supports 20/40MHz bandwidth, 1T1R, maximum rate 229.4 Mbps

■ Support STA, SoftAP, STA + SoftAP and sniffer modes

■ 32-bit RISC-V CPU with FPU and DSP, with a maximum dominant frequency of 320M

■ 532KB SRAM,128KB ROM,4Kb eFuse

■ Support Audio Codec, USB2.0, SDU, SD/MMC(SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPDC, ACOMP, GPIO, etc.

■ Integrated RF Balun, PA/LNA

■ Support for safe startup and safe debugging

■ Support XIP QSPI On-The-Fly AES decryption (OTFAD)

■ Support TrustZone

■ Support AES-CBC/CCM/GCM/XTS mode

■ Support MD5, SHA-1/224/256/384/512

■ TRNG (True Random Number Generator) is supported

■ Support PKA (Public Key Accelerator) for RSA/ECC

■ BLE-enabled Wi-Fi fast connection

■ Universal AT command can be used quickly.

■ Supports secondary development and integrates Windows and Linux development environments

# 2. Main parameters

**Table 1 Description of the main parameters**

| Model | Ai-M62-M2-I |
|---|---|
| Package | SMD-30 |
| Size | 13.2*13.6*3.0($\pm$0.2)mm |
| Antenna | IPEX connector |
| Frequency | 2400 ~ 2483.5MHz |
| Operating temperature | -40℃ ~ 85℃ |
| Storage temperature | -40℃ ~ 125℃, < 90%RH |
| Power supply | Support voltage 2.97V ~ 3.6V, supply current≥500mA |
| Interface | Audio Codec, USB2.0, SDU, SD/MMC(SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPADC, ACOMP, GPIO and so on |
| IO | 18 |
| UART rate | Default 115200 bps |
| Security | WPS/WEP/WPA/WPA2/WPA3 |
| Flash | Default 4MByte |

## 2.1. Static electricity requirement

Ai-M62-M2-I is an electrostatic sensitive device. Therefore, you need to take special precautions when carrying it.

**Figure 2 ESD preventive measure**

## 2.2.  Electrical characteristics

**Table 2 Electrical characteristics table**

| Parameters | | Conditio | Min. | Typical value | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply voltage | | VDD | 2.97 | 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 | 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 value | Max. | Unit |
|---|---|---|---|---|
| 11ax mode HE40,PA output power | - | 16 | - | dBm |
| 11ax mode HE20,PA output power | - | 17 | - | dBm |
| 11n mode HT40,PA output power | - | 19 | - | dBm |
| 11n mode HT20,PA output power | - | 19 | - | dBm |
| 11g mode, PA output power | - | 19 | - | dBm |
| 11b mode, PA output power | - | 22 | - | dBm |
| **Output Power** | | | | |
| 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 |
| 11ax，HE20 (MCS9) | - | -70 | - | dBm |
| 11ax，HE40 (MCS9) | - | -67 | - | 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 | - | 10 | 15 | dBm |
| 2Mbps | - | 10 | 15 | dBm |
| **Receive Sensitivity** | | | | |
| **Rate Mode** | **Min.** | **Typical value** | **Max.** | **Unit** |
| 1Mbps sensitivity@30.8%PER | - | -99 | - | dBm |
| 2Mbps sensitivity@30.8%PER | - | -97 | - | dBm |

## 2.5. Power

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

| Mode | Min. | AVG | Max. | Unit |
|---|---|---|---|---|
| Tx 802.11b，11Mbps，POUT=+22dBm | - | 415 | - | mA |
| Tx 802.11g， 54Mbps， POUT =+19dBm | - | 298 | - | mA |
| Tx 802.11n， MCS7， POUT =+19dBm | - | 300 | - | mA |
| Tx 802.11ax， MCS9， POUT =+17dBm | - | 280 | - | mA |
| Rx 802.11b,packet length 1024 byte | - | 59 | - | mA |
| Rx 802.11g,packet length 1024 byte | - | 59 | - | mA |
| Rx 802.11n,Packet length 1024 byte | - | 59 | - | mA |
| Rx 802.11b,packet length 1024 byte | - | 59 | - | mA |

# 3. Appearance Dimensions



Front                                    Back
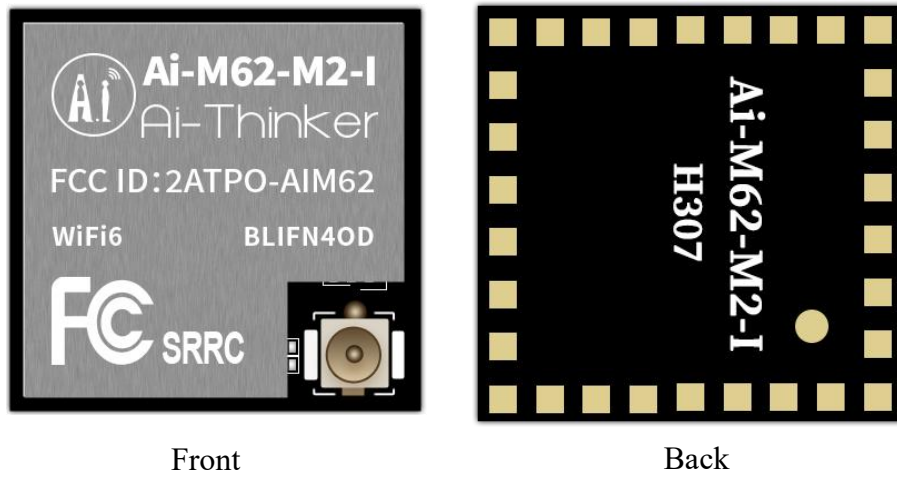
**Figure 3 Appearance diagram (Rendering figure is for reference only,subject to physical objects)**
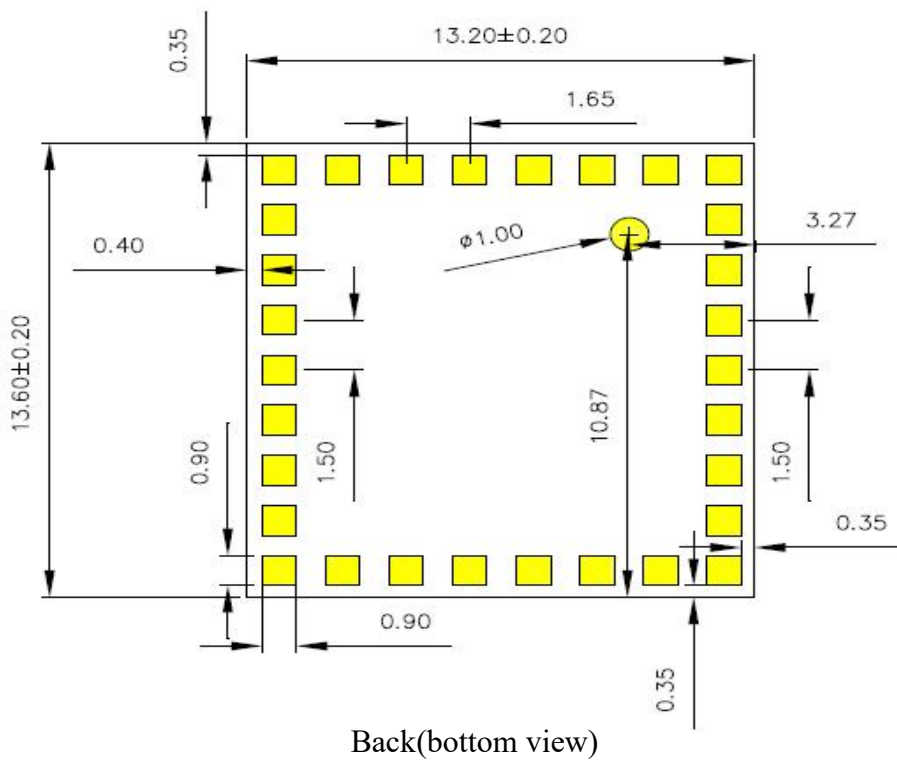


Back(bottom view)

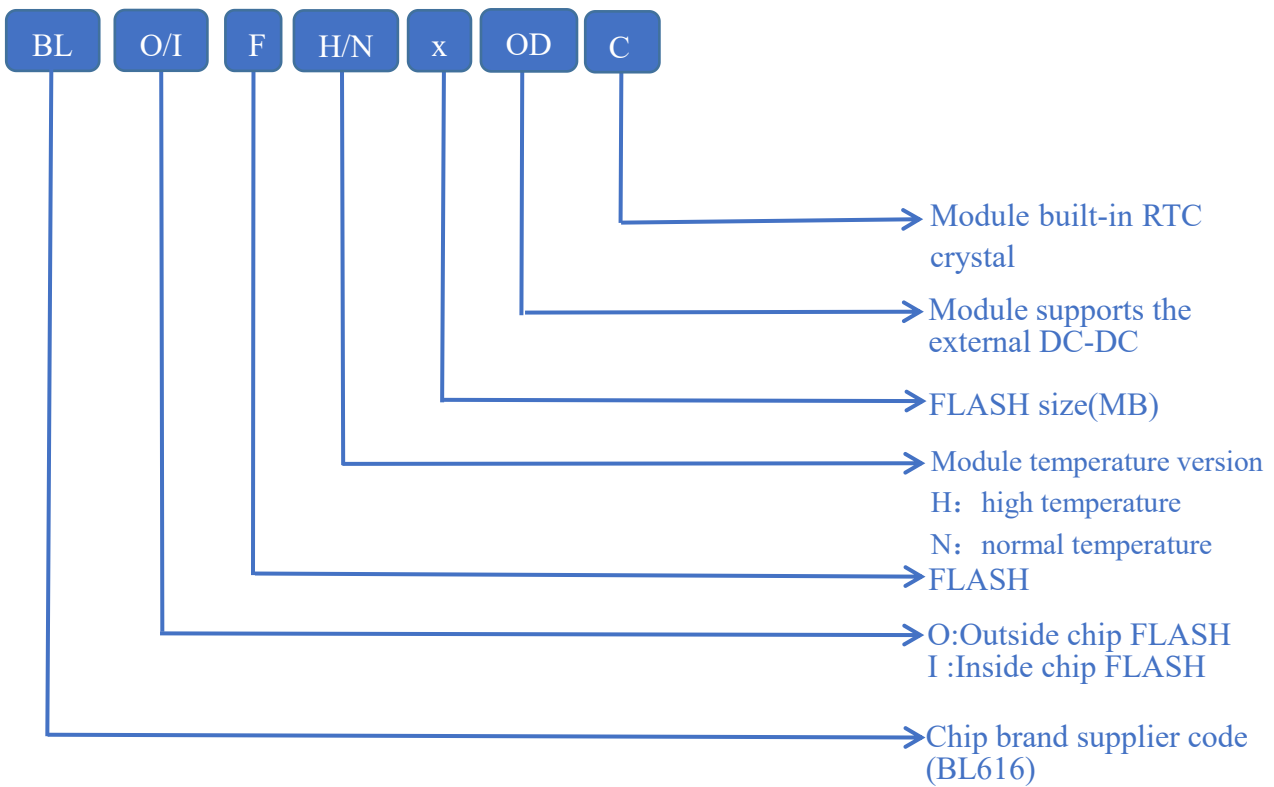**Figure 4 Dimension diagram**

**Figure 5 Shield printing information**

# 4. Pin Definition

Ai-M62-M2-I module is connected with a total of 30 pins, as shown in the pin schematic diagram, pin function definition table is the interface definition.
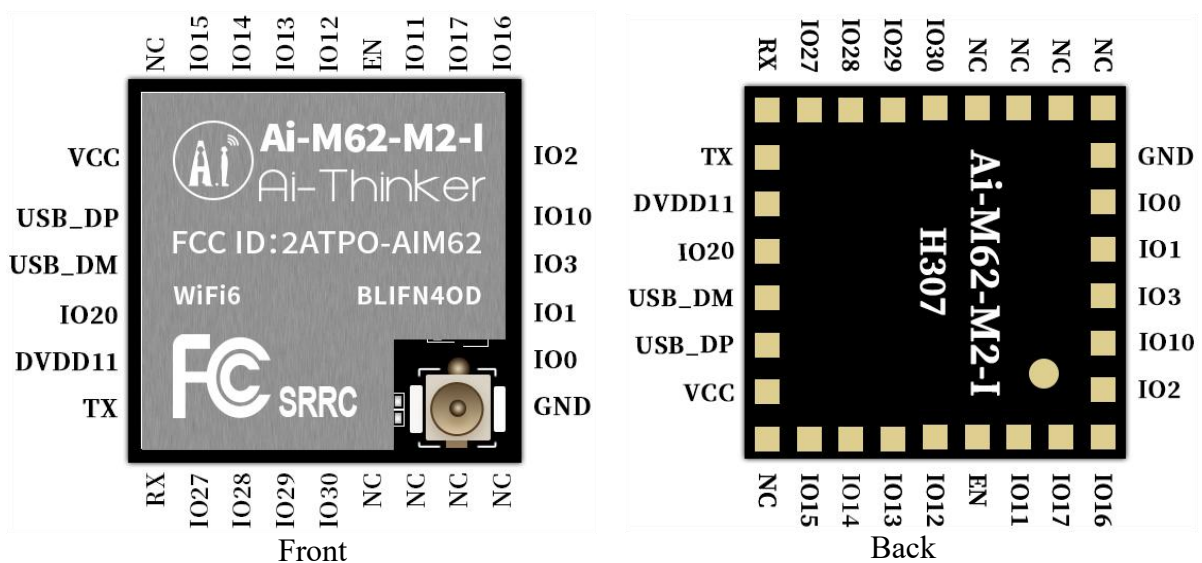


**Figure 6 Schematic diagram of module pins**

**Table 6 Pin function definition table**

| No. | Name | Function |
|---|---|---|
| 1 | IO16 | Available by default, the IO port is shared with the PIN pin of the 32.768KHz crystal oscillator input inside the module. If the module of the internal patch 32.768KHz crystal oscillator is customized, the IO is in NC state.<br>GPIO16/SPI_SS/I2S_BCLK/I2C_SCL/XTAL_32K_IN/PWM0 |
| 2 | IO17 | Available by default, the IO port is shared with the 32.768KHz crystal output PIN pin inside the module. If the module of the internal patch 32.768KHz crystal oscillator is customized, the IO is in NC state.<br>GPIO17/SPI_SCLK/I2S_FS/I2C_SDA/XTAL_32K_OUT/PWM0 |
| 3 | IO11 | GPIO11/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/PWM0 |
| 4 | EN | Default as chip enable, high level valid |
| 5 | IO12 | GPIO12/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH6/PWM0 |
| 6 | IO13 | GPIO13/SPI_SCLK/I2S_FS/I2C_SDA/ADC_CH5/PWM0 |
| 7 | IO14 | GPIO14/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/ADC_CH4/PWM0 |
| 8 | IO15 | GPIO15/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/PWM0 |
| 10 | VCC | 3.3V power supply; The output current of external power supply is |
| 11 | USB_DP | USB_DP |
| 12 | USB_DM | USB_DM |
| 13 | IO20 | GPIO20/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH0/PWM0 |
| 14 | DVDD11 | DVDD11 power supply; Ultra-low power consumption usage scenarios require external power supply of 1.1V; Non-ultra-low power consumption usage scenarios, suspended processing |
| 15 | TX | TXD/GPIO21/SPI_SCLK/I2S_FS/I2C_SDA/ADC_RCAL_VOUT/PWM0 |
| 16 | RX | RXD/GPIO22/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/PWM0 |
| 17 | IO27 | GPIO27/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/ADC_CH10/PWM0 |
| 18 | IO28 | GPIO28/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH11/PWM0 |
| 19 | IO29 | GPIO29/SPI_SCLK/I2S_FS/I2C_SDA/PWM0 |
| 20 | IO30 | GPIO30/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/PWM0 |
| 25 | GND | GND |
| 26 | IO0 | GPIO0/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH9/PWM0 |

| 27 | IO1 | GPIO1/SPI_SCLK/I2S_FS/I2C_SDA/ADC_CH8/PWM0 |
|---|---|---|
| 28 | IO3 | GPIO3/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/ADC_CH3/PWM0 |
| 29 | IO10 | GPIO10/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/ADC_CH7/PWM0 |
| 30 | IO2 | The default NC is not available. If you need to use it, please contact Anxin. If elicited, support Bootstrap/GPIO2/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/ADC_ |
| 9,21,22,23,24 | NC | NC |
| Note: 1. GPIO2 is used as a Bootstrap. When the power-on moment is high, the module enters the burning mode. When the power-on moment is low, the module starts normally. | | |

# 5. Schematic
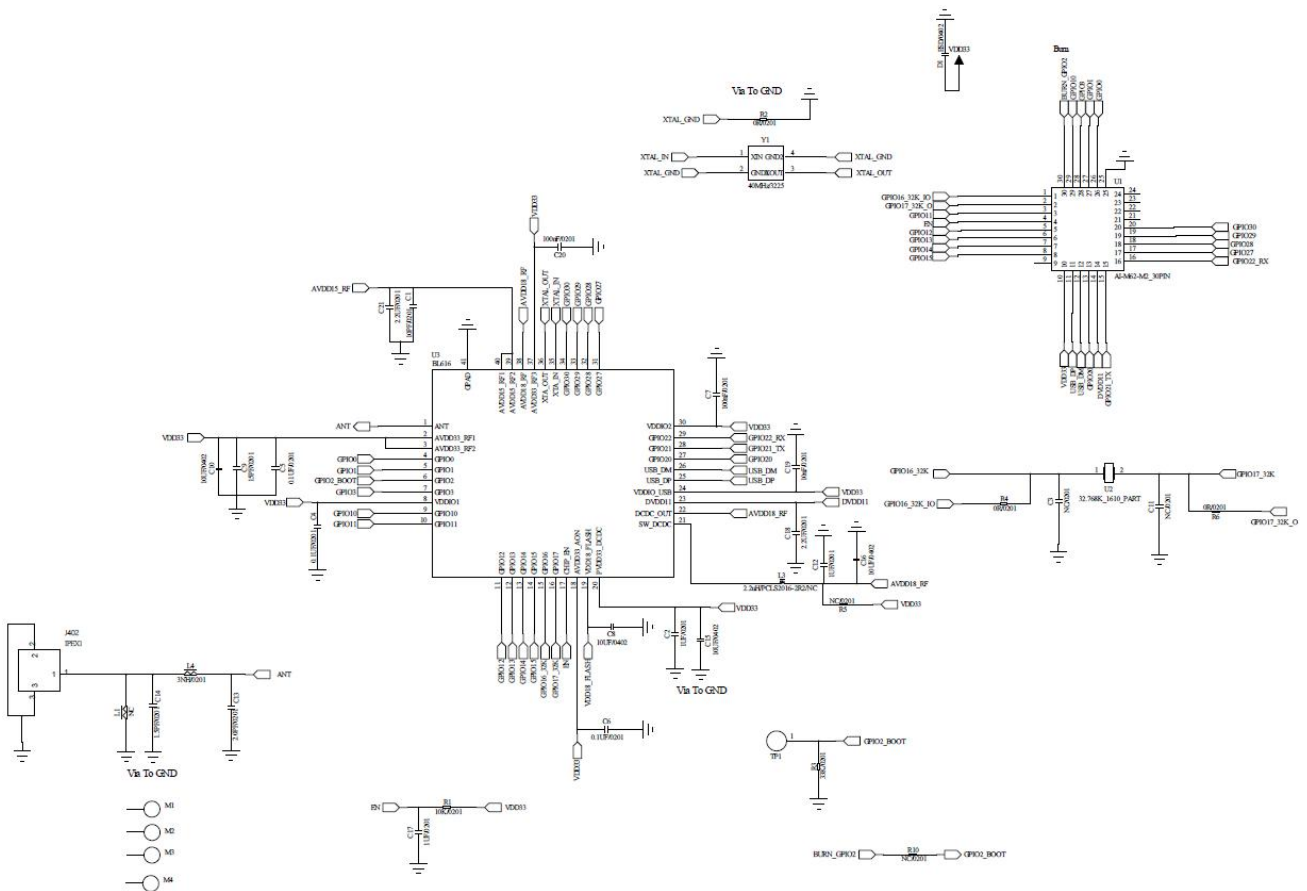


**Figure 7 Module schematic**

# 6. Design Guidance

## 6.1. Module application circuit
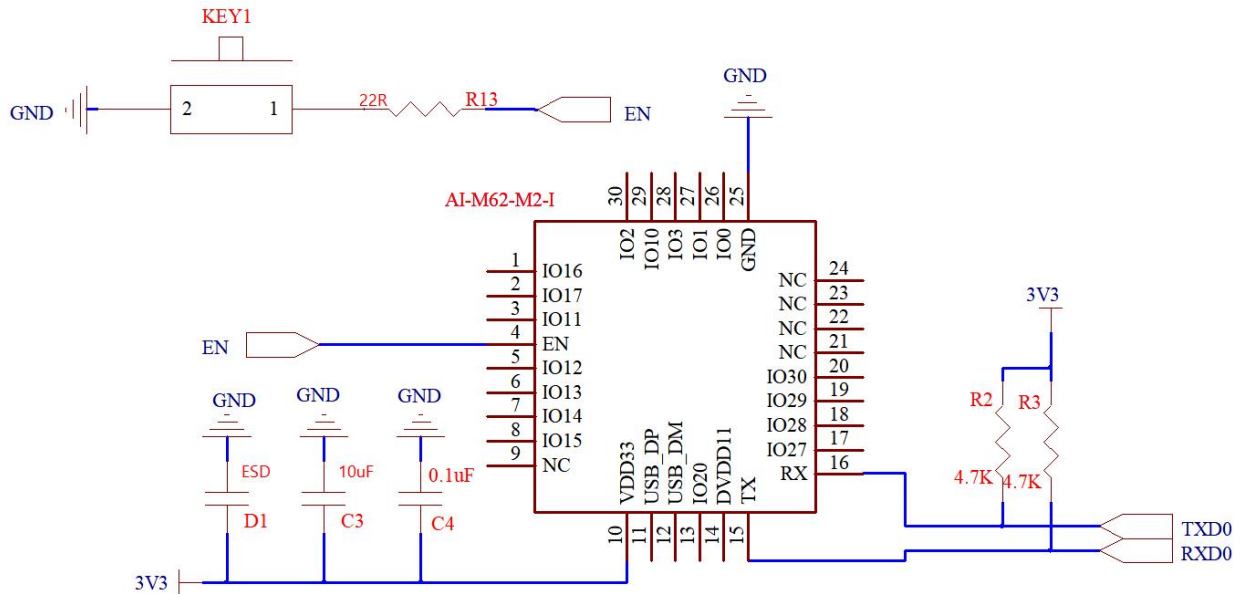


**Figure 8 Application circuit diagram**

- IO2 is the module start control pin, which is in normal working mode at low level and in firmware burning mode at high level. The default low level inside the module.

- IO2/NC, not available by default

- GPIO16/GPIO17, available by default. These IO ports are shared with the PIN pin of the 32.768KHz crystal oscillator inside the module. If the module of the internal patch 32.768KHz crystal oscillator is customized, the IO is in NC state
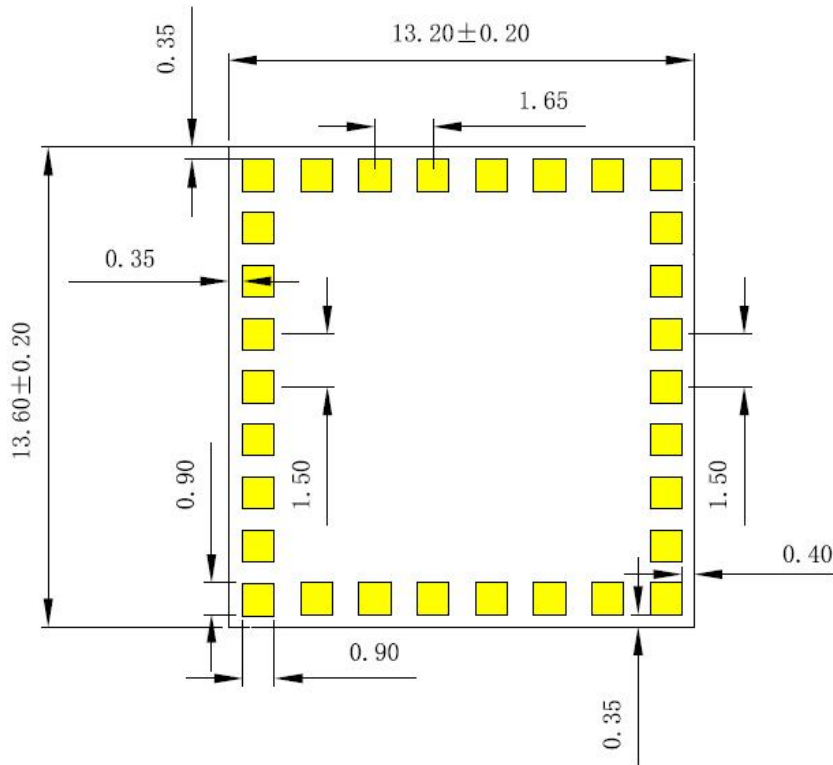
## 6.2. Recommend PCB footprint size



**Figure 9 Recommend PCB footprint size**

## 6.3.  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 2: put the module on the edge of the motherboard, the edge of the motherboard at the antenna position hollowed out an area.
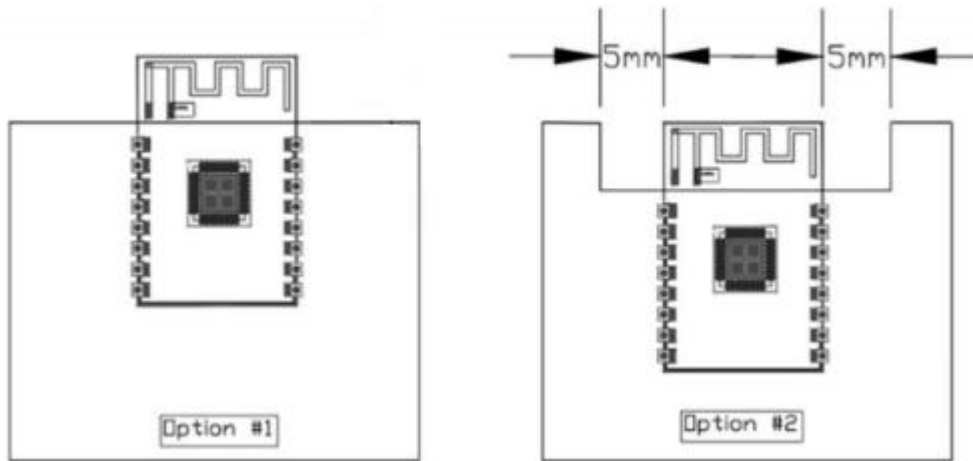
**Figure 10 Antenna layout diagram**

## 6.4. Power supply

- Recommended 3.3V voltage,peak current over 500mA.

- Power supply is recommend to use LDO; if the DC-DC is used, the ripple is recommended to be controlled within 30mV

- DC-DC power supply circuit proposes to reserve the dynamic response capacitance to optimize the output ripple with large load changes.

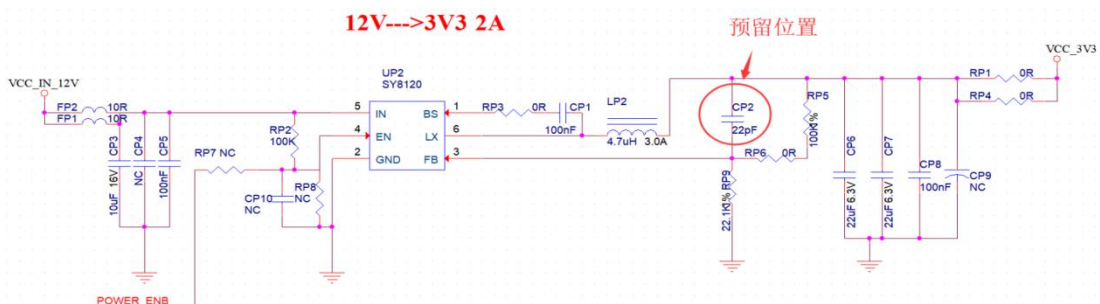- It is recommended to add ESD devices to the 3.3V power interface.



**Figure 11 DC-DC step-down circuit diagram**

## 6.5. 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 usage instructions in the specifications, which may affect the module startup configuration.

■ The IO port of the module is 3.3V. If the IO level of the main control and the module do not match, a level conversion circuit needs to be added.

■ If the I/O port is directly connected to a peripheral port or terminals, for example, a pin row, reserve an ESD device near the terminal of the I/O cable.
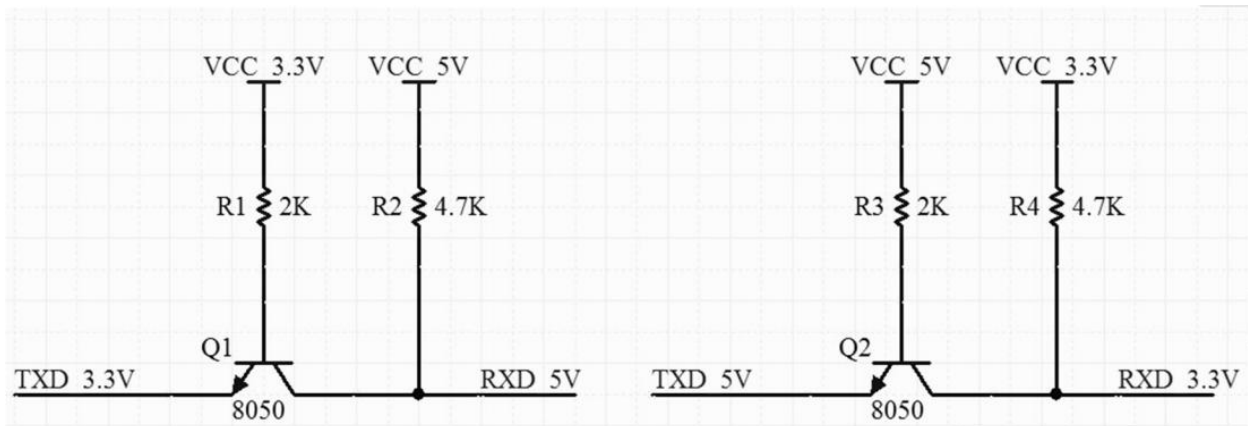


**Figure 12 Level convert circuit**

# 7. Storage conditions

Products sealed in moisture-proof bags should be stored in a non-condensing atmosphere of <40 ° C /90%RH.

The module has a moisture sensitivity rating of MSL 3.

After the vacuum bag is opened, it must be used within 168 hours at 25±5℃/60%RH, otherwise it needs to be baked before it can be put on line again.
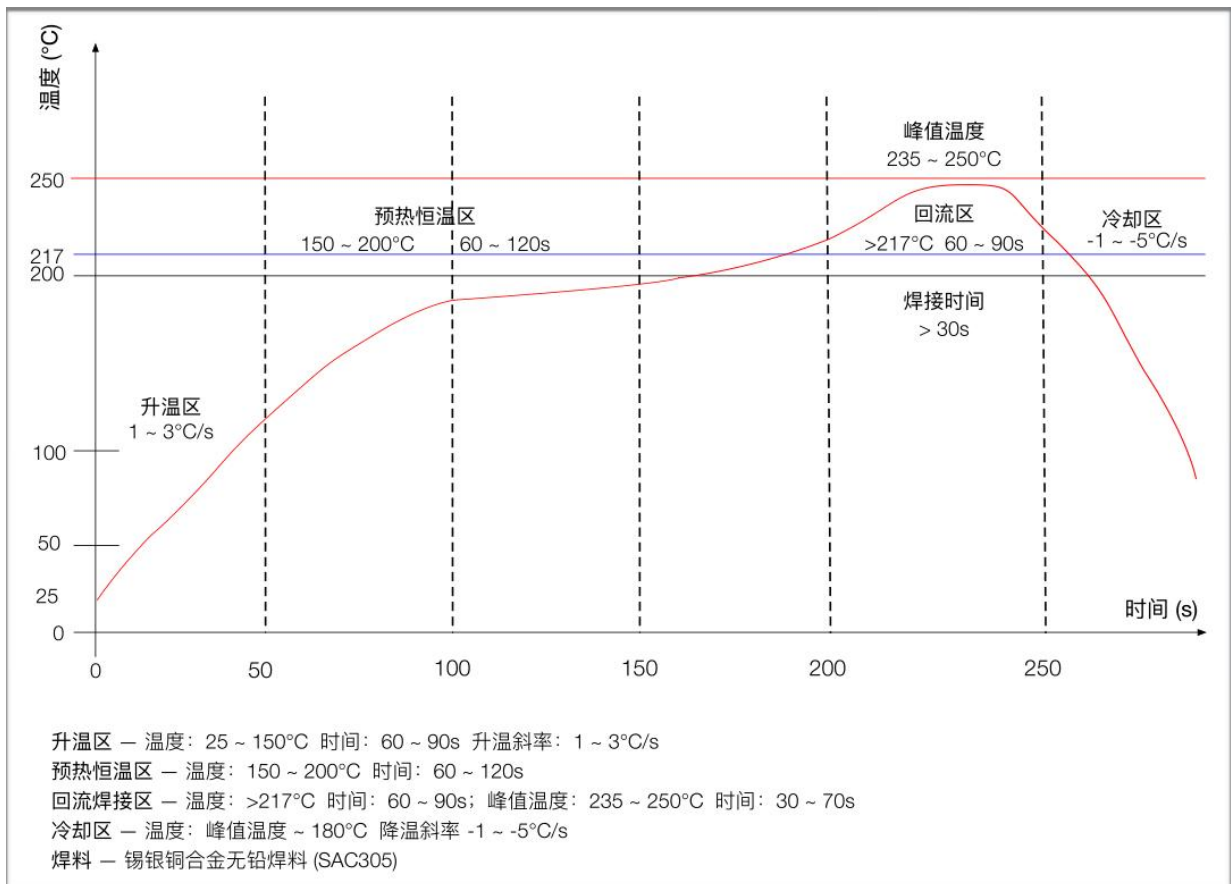
# 8. Reflow welding curve diagram



**Figure 13 Reflow welding diagram**

# 9. Product Packaging Information

Ai-M62-M2-I module was packaged in a tape, 900pcs/reel.As shown in the below image:



**Figure 14 Package and packing diagram**

# 10.Contact us

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WeChat mini program



WeChat official account

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