# Ai-M62-M01L Specification

Version  V1.0.0

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# Document resume

| Version | Date | Develop/revise content | Edition | Approve |
|---------|------|------------------------|---------|---------|
| V1.0.0 | 2023.11.22 | First Edition | Shengzin Zou | NingGuan |
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# Content

# 1. Product Overview

Ai-M62-M01L is a Wi-Fi 6+BLE5.3 module developed by Shenzhen Ai-Thinker Technology Co. The module is equipped with BL616 chip as the core processor, which supports Wi-Fi 802.11b/g/n/ax protocols and BLE protocols, and supports the Thread protocol.The BL616 system contains a floating-point unit, a DSP unit, a cache and memory, cache and memory, and a low-power 32-bit RISC-V CPU with a maximum main frequency of 320 M. The BL616 system contains a low-power 32-bit RISC-V CPU with a floating point unit, DSP unit, cache and memory.

Ai-M62-M01L module has rich peripheral interfaces, including USB2.0, SDU, SD/MMC(SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPADC, ACOMP and GPIO. They can be widely used in audio/video multimedia, Internet of Things (IoT), mobile devices, wearable electronic devices, smart home and other fields.

Ai-M62-M01L module Sec Eng module supports AES/SHA/PKA/TRNG etc. It supports mirror encryption and signature activation, which meets the needs of various security applications in the field of IoT.
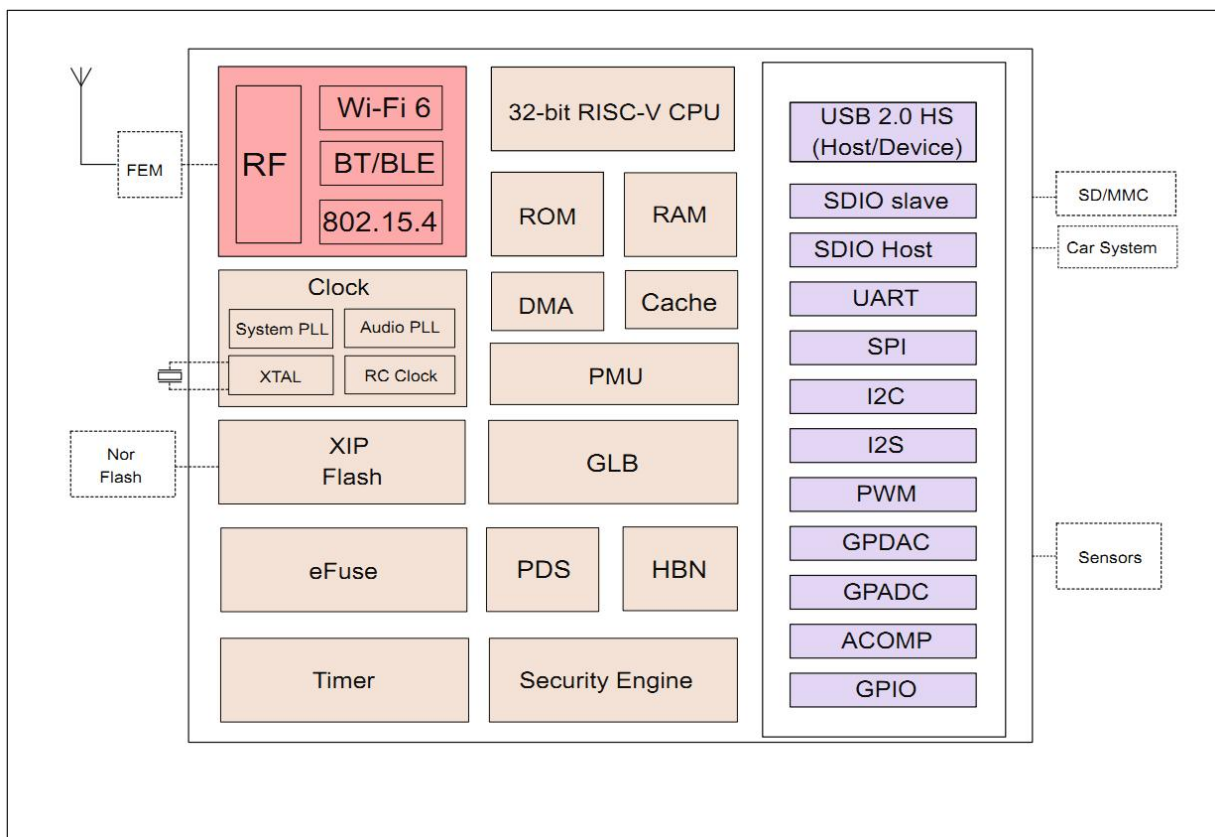


**Figure 1 Main chip architecture diagram**

## 1.1. Characteristics

- SMD-36 package

- Supports 2.4GHz operating band

- Support IEEE 802.11 b/g/n/ax

- Support BLE5.3

- Thread support

- Supports Wi-Fi/BLE/Thread coexistence

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

- Supports 20/40MHz bandwidth, 1T1R, up to 229.4 Mbps

- Supports STA, SoftAP, STA+SoftAP, and sniffer modes.

- 32-bit RISC-V CPU with FPU and DSP up to 320M

- 532KB SRAM, 128KB ROM, 4Kb eFuse

- Support USB2.0, SDU, SD/MMC(SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPADC, ACOMP and GPIO, etc

- Integrated RF Balun, PA/LNA

- Supports secure boot; secure debugging

- Supports XIP QSPI On-The-Fly AES Decryption (OTFAD)

- TrustZone Support

- Support AES-CBC/CCM/GCM/XTS mode

- Support MD5, SHA-1/224/256/384/512

- Support for TRNG (True Random Number Generator)

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

- BLE-enabled Wi-Fi fast connectivity

- Generic AT commands to get started quickly

- Support for secondary development, integrated Windows, Linux development environment

# 2. Main parameters

**Table 1 Description of Main Parameters**

| Model | Ai-M62-M01L |
|---|---|
| **Package** | SMD-36 |
| **Size** | 20.0*16.0*2.4($\pm$0.2)mm |
| **Antenna** | Compatible Half Hole Pad/IPEX |
| **Frequency** | 2400～2483.5MHz |
| **Operating temperature** | -40℃～85℃ |
| **Storage temperature** | -40℃～125℃,＜90%RH |
| **Power supply** | The power supply voltage is 2.97V～3.6V，supply current ≥ 500mA |
| **Interface** | USB2.0, SDU, SD/MMC(SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPADC, ACOMP and GPIO, etc |
| **IO** | 19 |
| **UART rate** | Default 115200 bps |
| **Security** | WPS/WEP/WPA/WPA2/WPA3 |
| **Flash** | Default 4MByte |

## 2.1. Static requirements

The Ai-M62-M01L is static sensitive equipment and requires special precautions when handling.



**Figure 2 ESD anti-static diagram**

## 2.2.  Electrical characteristics

**Table 2 Electrical characteristics**

| Parameters | | Condition | 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 radio frequency performance table**

| Description | Typical value | Unit |
|---|---|---|
| spectral range | 2400 ~ 2483.5 | 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 |
| In 11g mode, PA output power | - | 19 | - | dBm |
| In 11b mode, PA output power | - | 22 | - | 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 |
| 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 |
|---|---|---|---|---|
| Spectrum range | 2400 ~ 2483.5MHz | | | MHz |
| **Output power** | | | | |
| **Mode** | **Min.** | **Typical value** | **Max.** | **Unit** |
| 1Mbps | - | 10 | 15 | dBm |
| 2Mbps | - | 10 | 15 | dBm |
| **Receiving sensitivity** | | | | |
| **Mode** | **Min.** | **Typical value** | **Max.** | **Unit** |
| 1Mbps sensitivity@30.8%PER | - | -99 | - | dBm |
| 2Mbps sensitivity@30.8%PER | - | -97 | - | dBm |

## 2.5. Power consumption

The following power consumption data is based on a 3.3V power supply and measured at an ambient temperature of 25°C.

◼ The POUT power for all transmit modes is the measured value at the antenna interface.

◼ All transmission data are measured in the continuous transmission mode based on a duty cycle of 100%.
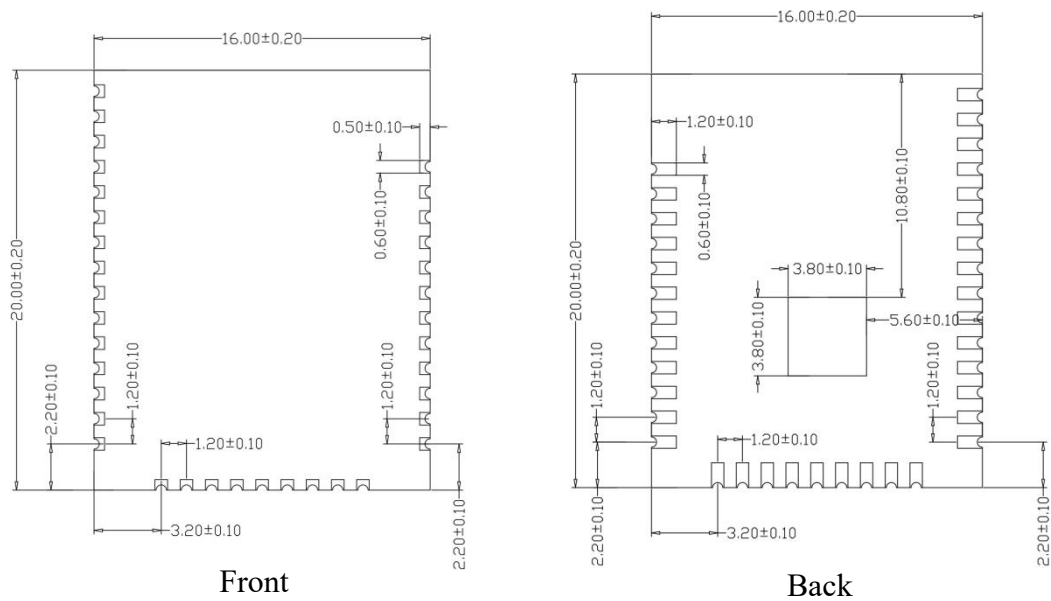
**Table 5 Power consumption table**

| Mode | Min. | Average | Max. | Unit |
|---|---|---|---|---|
| Transmit 802.11b，11Mbps，POUT=+22dBm | - | 423 | - | mA |
| Transmit 802.11g，  54Mbps，  POUT | - | 331 | - | mA |
| Transmit 802.11n， MCS7，POUT =+19dBm | - | 328 | - | mA |
| Transmit 802.11ax，MCS7，POUT =+17dBm | - | 293 | - | mA |
| Receive 802.11B, packet length 1024 bytes | - | 59 | - | mA |
| Receive 802.11g, packet length 1024 bytes | - | 59 | - | mA |
| Receive 802.11n, packet length 1024 bytes | - | 59 | - | mA |
| Receive 802.11ax, packet length 1024 bytes | - | 59 | - | mA |

# 3. Appearance size



Front      Front      Back
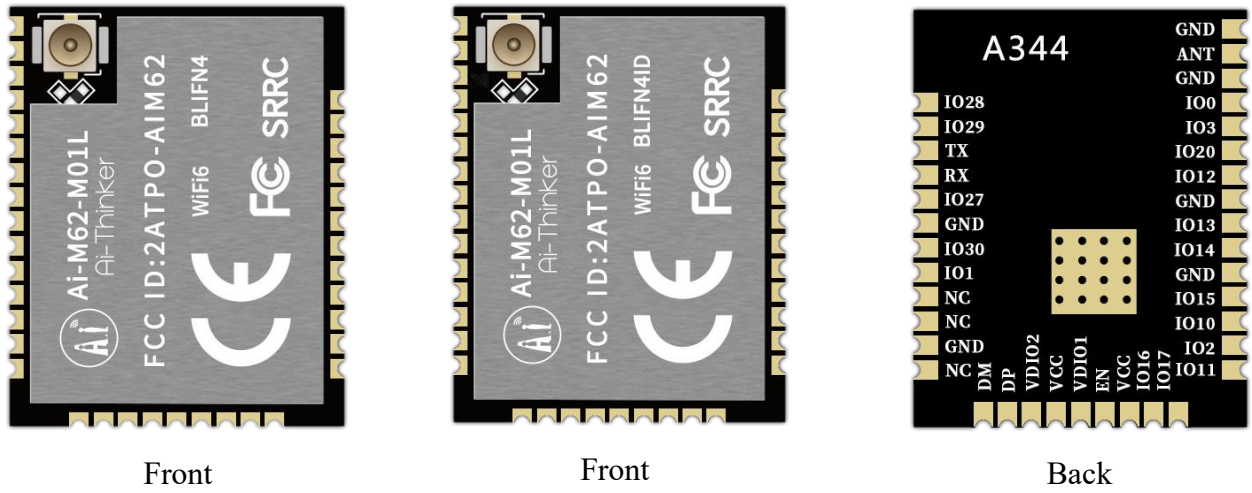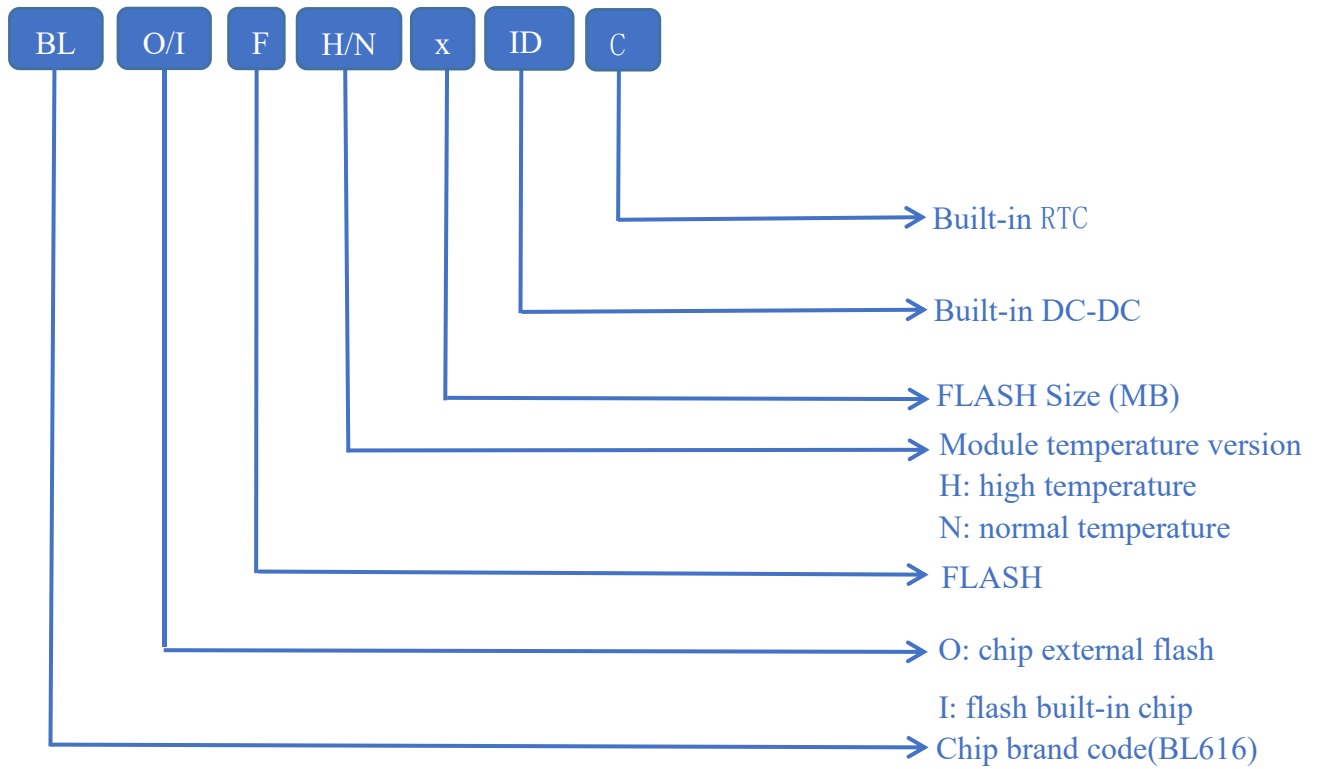
**Figure 3 appearance diagram (Rendering diagram is for reference only, subject to actual objects)**



Front          Back

**Figure 4 dimension diagram**

**Figure 5 Screen Representative Information of Shields**

The diagram shows the naming format breakdown: BL, O/I, F, H/N, x, ID, C

- Built-in RTC
- Built-in DC-DC
- FLASH Size (MB)
- Module temperature version
  H: high temperature
  N: normal temperature
- FLASH
- O: chip external flash
  I: flash built-in chip
- Chip brand code(BL616)

# 4. Pin definition

A total of 36 pins are connected to the Ai-M62-M01Lmodule, as shown in the pin diagram, the pin function definition table is an interface definition.



Front                                                    Back
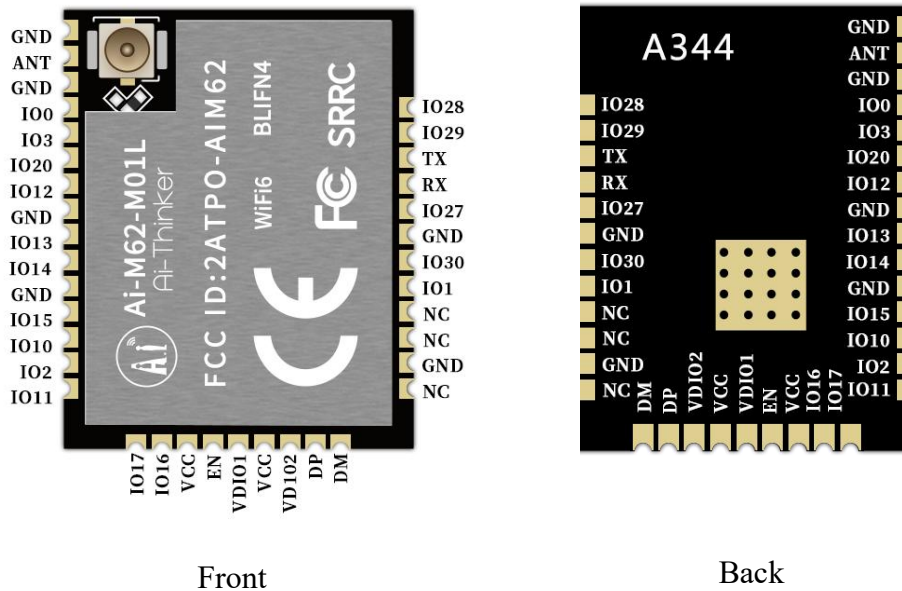
**Figure 6 pin diagram**

**Table 6 Pin function definition table**

| No. | Name | Functional description |
|-----|------|------------------------|
| 1 | IO0 | GPIO0/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH9/PWM0 |
| 2 | IO3 | GPIO3/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/ADC_CH3/PWM0 |
| 3 | IO20 | GPIO20/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH0/PWM0 |
| 4 | IO12 | GPIO12/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH6/PWM0 |
| 5 | GND | Grounding |
| 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 | GND | Grounding |
| 9 | IO15 | GPIO15/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/PWM0 |
| 10 | IO10 | GPIO10/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/ADC_CH7/PWM0 |
| 11 | IO2 | Bootstrap/GPIO2/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/ADC_CH2/PWM0 |
| 12 | IO11 | GPIO11/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/PWM0 |

| 13 | IO17 | Available by default, this IO port is shared with the internal 32.768KHz crystal output PIN pin of the module. This IO is not available if the module is customised with an internal chip 32.768KHz crystal.<br>GPIO17/SPI_SCLK/I2S_FS/I2C_SDA/XTAL_32K_OUT/PWM0 |
|----|------|------|
| 14 | IO16 | Available by default, this IO port is shared with the internal 32.768KHz crystal output PIN pin of the module. This IO is not available if the module is customised with an internal chip 32.768KHz crystal.<br><br>GPIO16/SPI_SS/I2S_BCLK/I2C_SCL/XTAL_32K_IN/PWM0 |
| 15 | VCC | 3.3V power supply input pin; external power supply output current is recommended to be more than 500mA |
| 16 | EN | Chip enable, active high |
| 17 | VDIO1 | GPIO power supply pin input, must supply 3.3V or 1.8V to the module |
| 18 | VCC | 3.3V power supply input pin; external power supply output current is recommended to be more than 500mA |
| 19 | VDIO2 | GPIO power input pin, must supply 3.3V or 1.8V to the module |
| 20 | DP | USB_DP |
| 21 | DM | USB_DM |
| 22 | NC | Vacant |
| 23 | GND | Grounding |
| 24 | NC | Vacant |
| 25 | NC | Vacant |
| 26 | IO1 | GPIO1/SPI_SCLK/I2S_FS/I2C_SDA/ADC_CH8/PWM0 |
| 27 | IO30 | GPIO30/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/PWM0 |
| 28 | GND | Grounding |
| 29 | IO27 | GPIO27/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/ADC_CH10/PWM0 |
| 30 | RXD | RXD/GPIO22/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/PWM0 |
| 31 | TXD | TXD/GPIO21/SPI_SCLK/I2S_FS/I2C_SDA/ADC_RCAL_VOUT/PWM0 |
| 32 | IO29 | GPIO29/SPI_SCLK/I2S_FS/I2C_SDA/PWM0 |
| 33 | IO28 | GPIO28/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH11/PWM0 |
| 34 | GND | Grounding |
| 35 | ANT | RF |
| 36 | GND | Grounding |

Note: 1. GPIO2 is used as Bootstrap, when the power-on moment is high, the module enters the burn-in mode; when the power-on moment is low, the module starts normally.
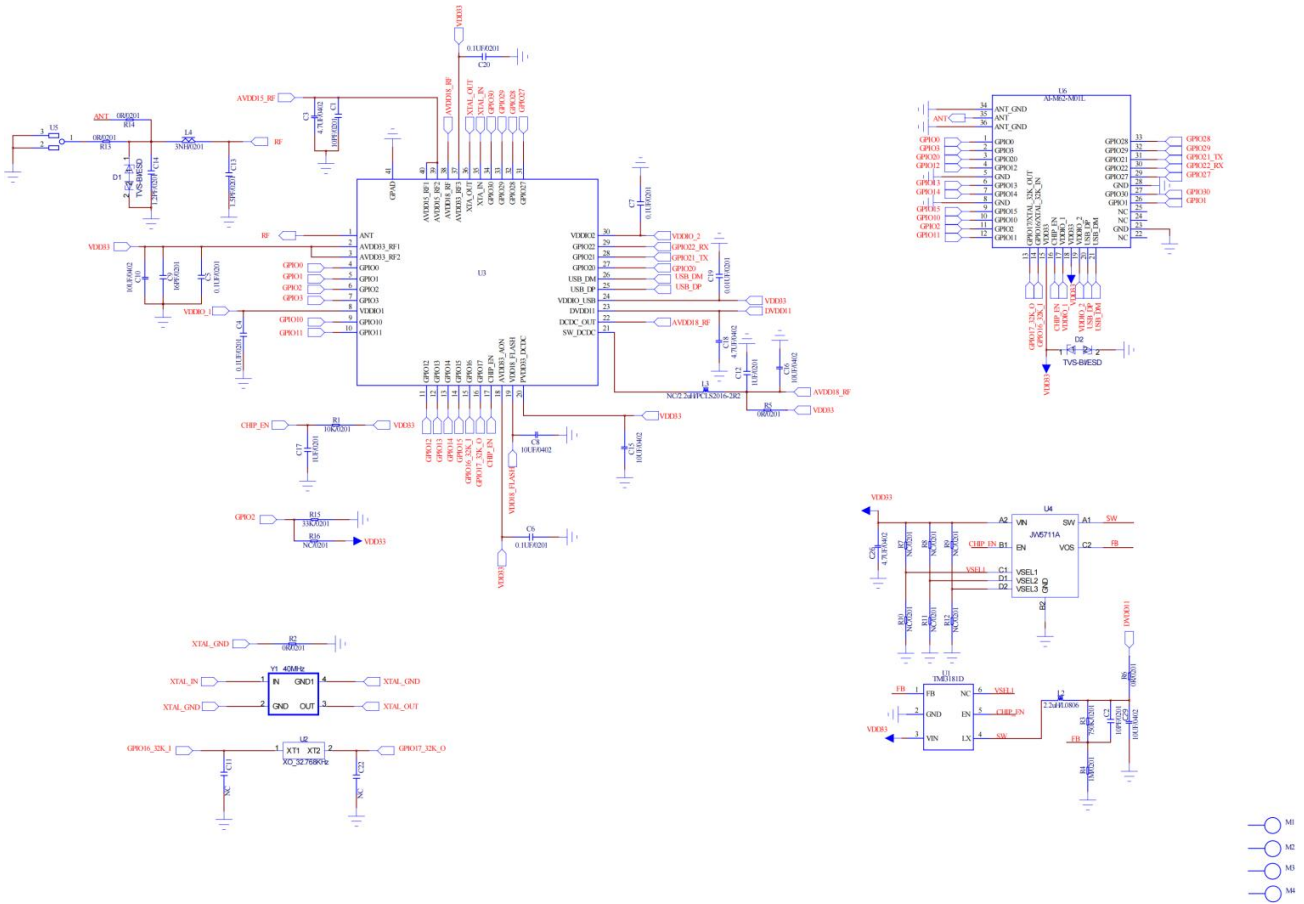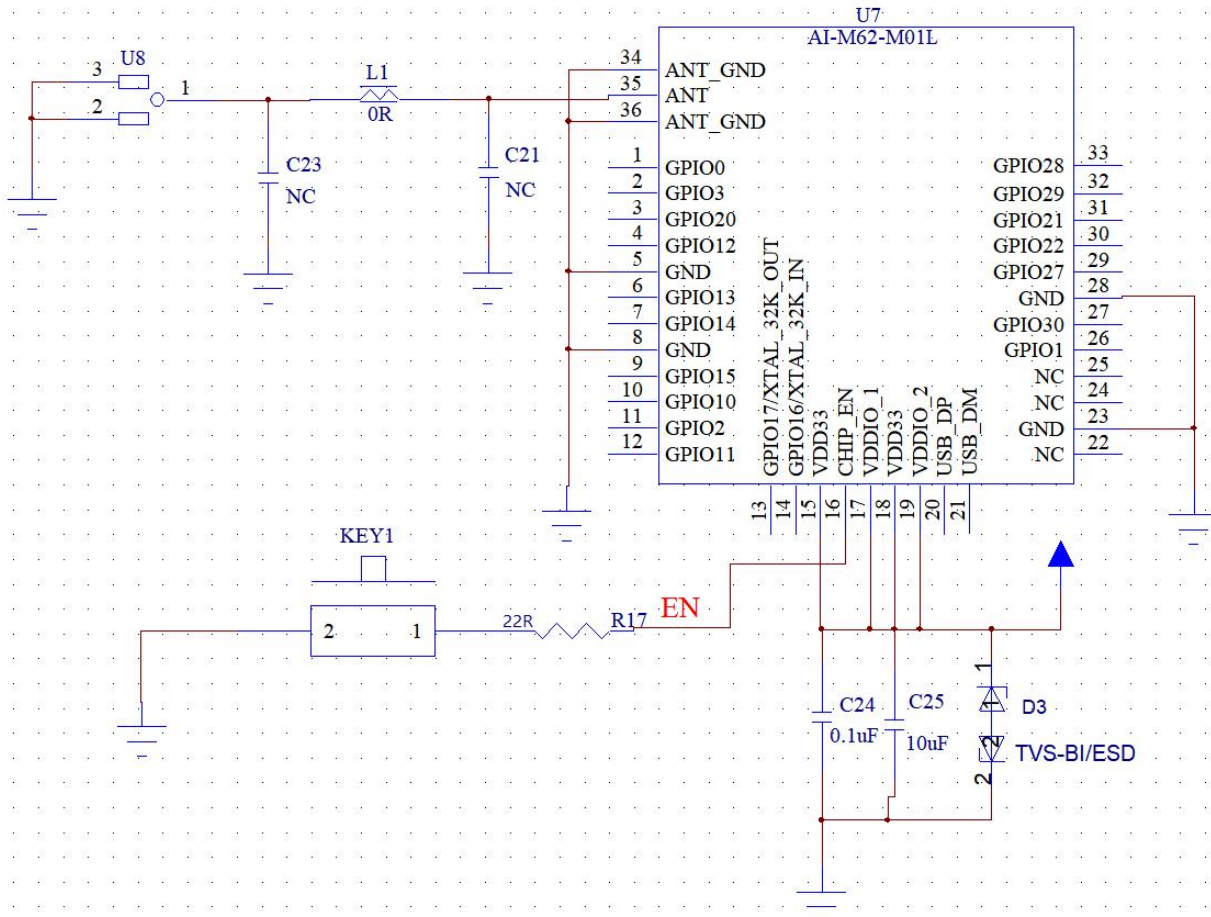
# 5. Schematic



**Figure 7 Schematic**

# 6. Design direction

## 6.1. Application guidance circuit



**Figure 8 Application Guidance Circuit**

■ Module PIN15/PIN18 is the main power supply pin, PIN17/PIN19 is the chip GPIO port power supply pin, these four PIN pins must be externally powered to the module.

■ IO2 is the module startup control pin, which is in normal operation mode when low and in firmware burning mode when high. The module internal default pull-down processing.

■ GPIO16/GPIO17, available by default. These IO ports are shared with the PIN pin of the module's internal 32.768KHz crystal. This IO is not available if the module is customised with an internal SMD 32.768KHz crystal.

## 6.2.  Recommended PCB Package Size
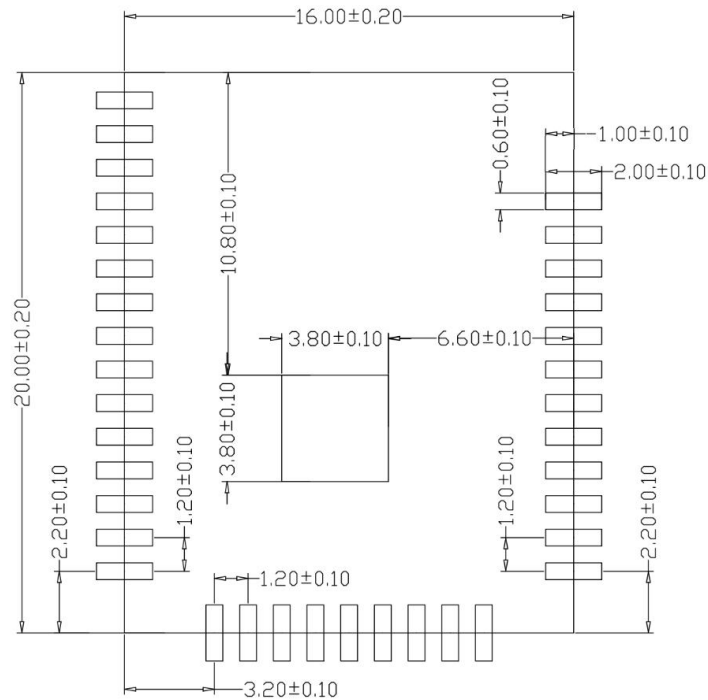


**Figure 9 Recommended PCB Package Size**

## 6.3.  Electricity supply

■  Recommended 3.3V voltage, peak 500mA or more current.

■  It is recommended to use LDO power supply; if using DC-DC it is recommended to control the ripple within 30mV.

■  The DC-DC power supply circuit is recommended to reserve a place for a dynamic response capacitor, which can optimise the output ripple when the load varies greatly.

■  Additional ESD devices are recommended for the 3.3V power interface.
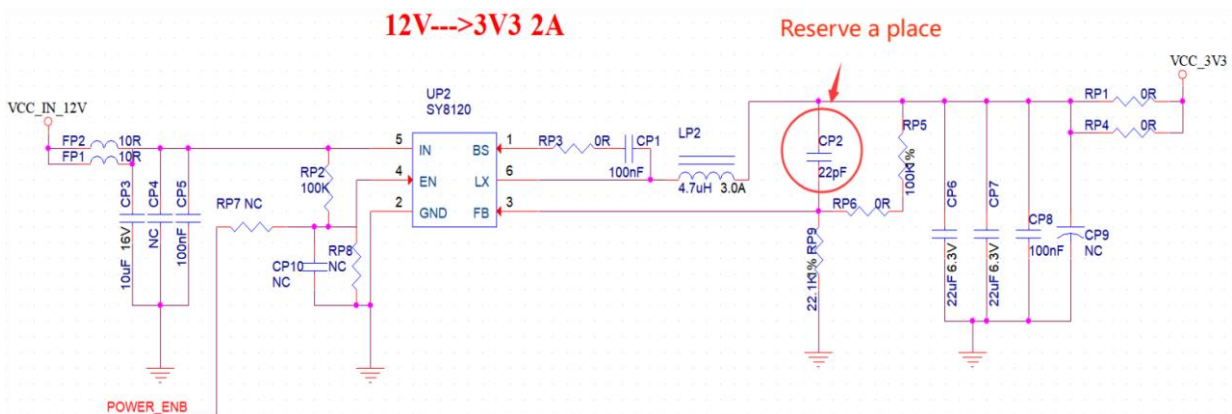


**Figure 10 DC-DC Buck Circuit Diagram**

## 6.4.  GPIO

■  There are some IO ports leading out of the periphery of the module, if you need to use it, it is recommended to connect 10-100 ohm resistors in series on the IO ports. This will suppress overshoot and make the level smoother on both sides. It is helpful for both EMI and ESD.

■  The pull-up and pull-down of special IO ports should be referred to the usage instructions in the datasheet, and the start-up configuration of the module will be affected here.

■  The IO port of the module is 3.3V If the IO port levels of the master and the module do not match, you need to add a level conversion circuit.

■  If the IO port is directly connected to a peripheral interface, or a terminal such as a row of pins, it is recommended to reserve an ESD device in the IO port alignment near the terminal.
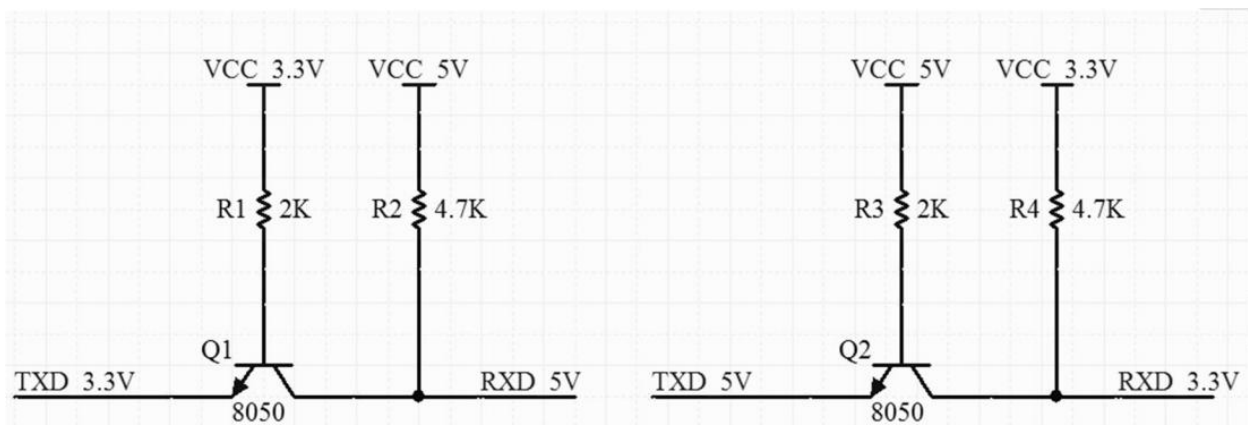


**Figure 11 Level Shift Circuit**

# 7. Storage condition

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

The moisture sensitivity class MSL of the module is 3.

After the vacuum bag is unpacked, it must be used within 168 hours at $25\pm5$°C/60%RH, otherwise it will need to be baked before it can be put on line a second time.

# 8. Reflow soldering curve
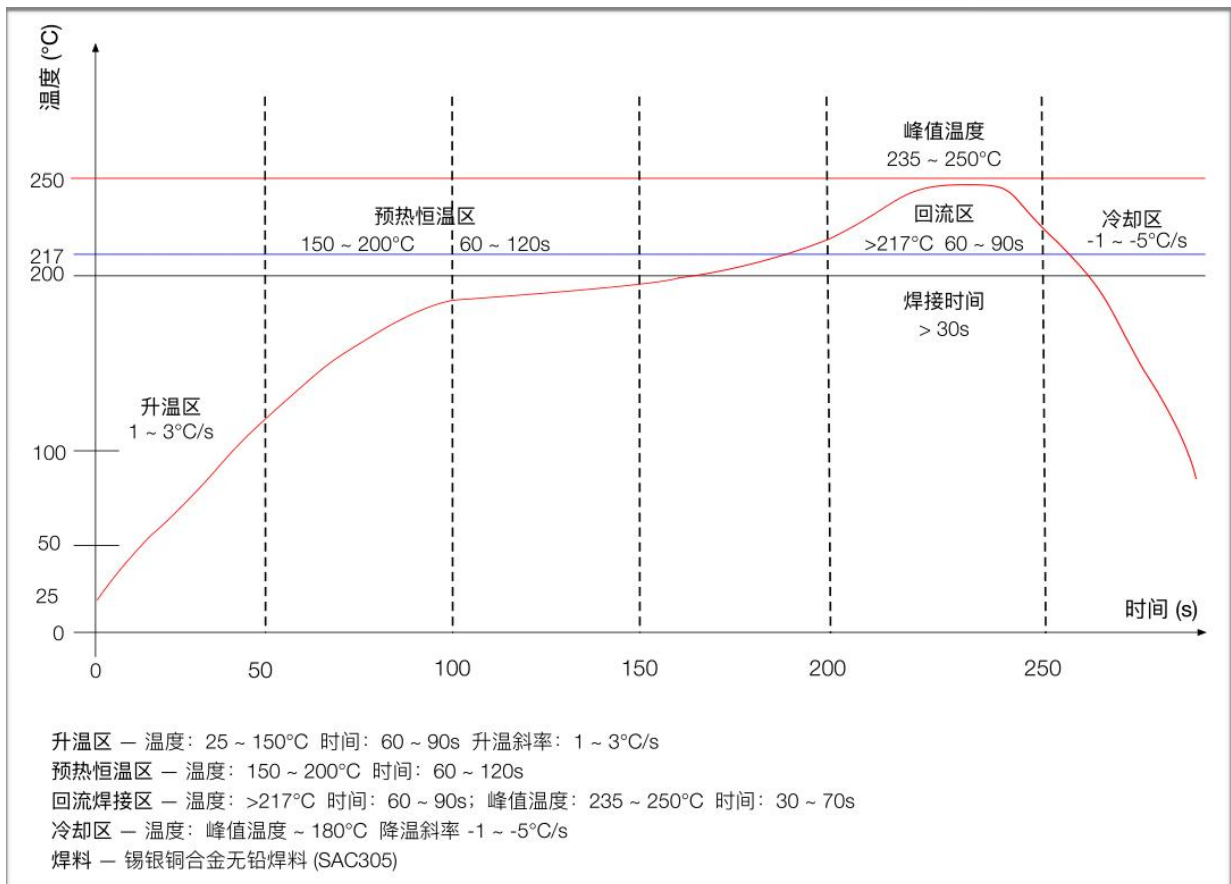


**Figure 12 Reflow soldering profile**

# 9. Product packaging information

Ai-M62-M01L module adopts braided packaging. As shown in the following figure:



**Figure 13 packing tape drawing**

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