Ai-M62-13 Specification

Version V1.0.1

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Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2023.02.28	First Edition	Chaomei Deng	Ning Guan
V1.0.1	2023.11.17	1、Update the chip block diagram and the supported peripheral interfaces; 2、Add important statements	Ning Guan	Hong Xu

Content

1. Product Overview

Ai-M62-13 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-M62-13 module has rich peripheral interfaces, including USB2.0, SDU, SD / MMC (SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPADC, 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-M62-13 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.

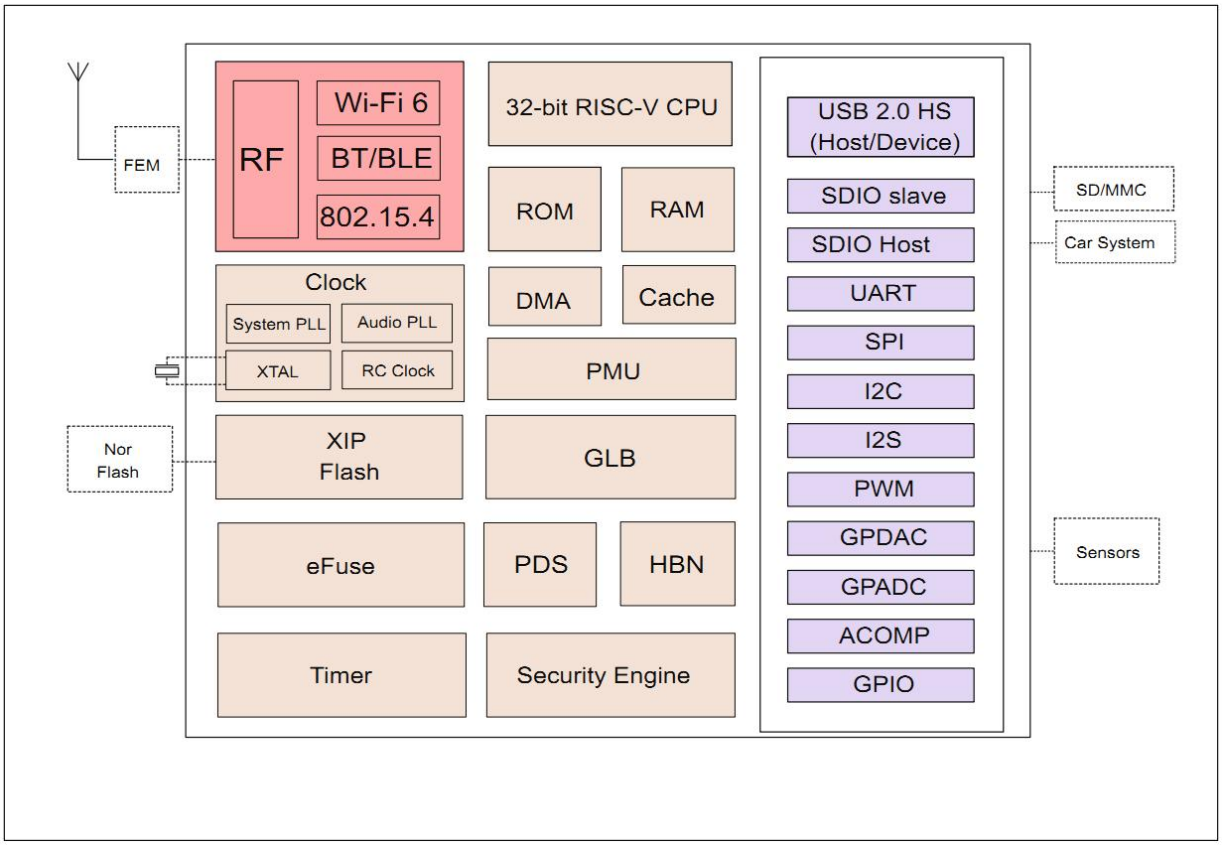


Figure 1 Main chip architecture diagram

1.1. Characteristics

- SMD-18 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 USB2.0, SDU, SD / MMC (SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPADC, 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-M62-13
Package	SMD-18
Size	20*18.0*3.2(±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 2.97V ~ 3.6V, supply current ≥500mA
Interface	USB2.0, SDU, SD / MMC (SDH), SPI, UART, I2C, I2S, PWM, GPDAC, GPADC, ACOMP, GPIO and so on
IO	11
UART rate	Default 115200 bps
Security	WPS/WEP/WPA/WPA2/WPA3
Flash	Default 4MByte ,maximum support 16MByte

2.1. Static electricity requirement

Ai-M62-13 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		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 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

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

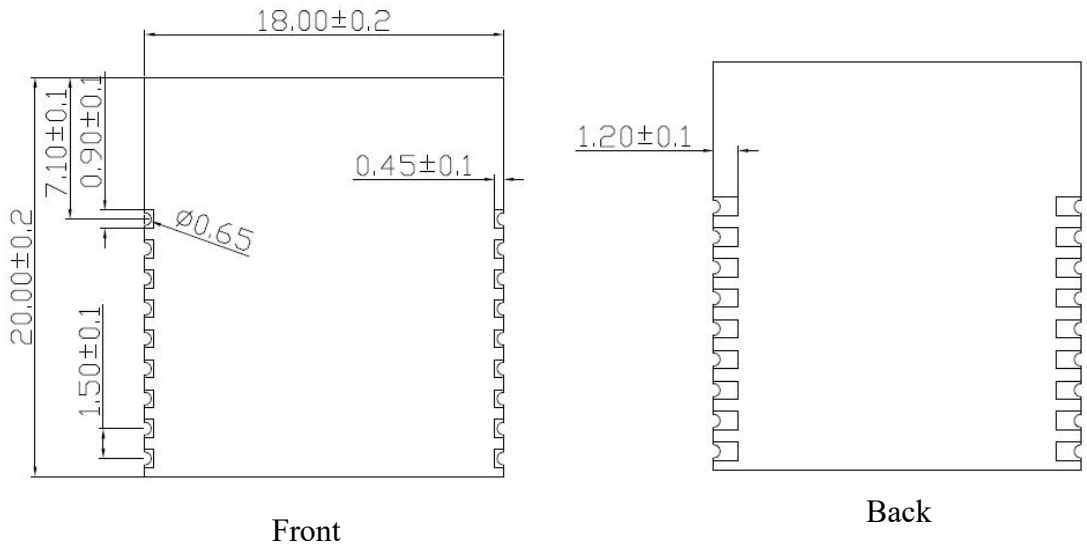


Figure 4 Dimension diagram

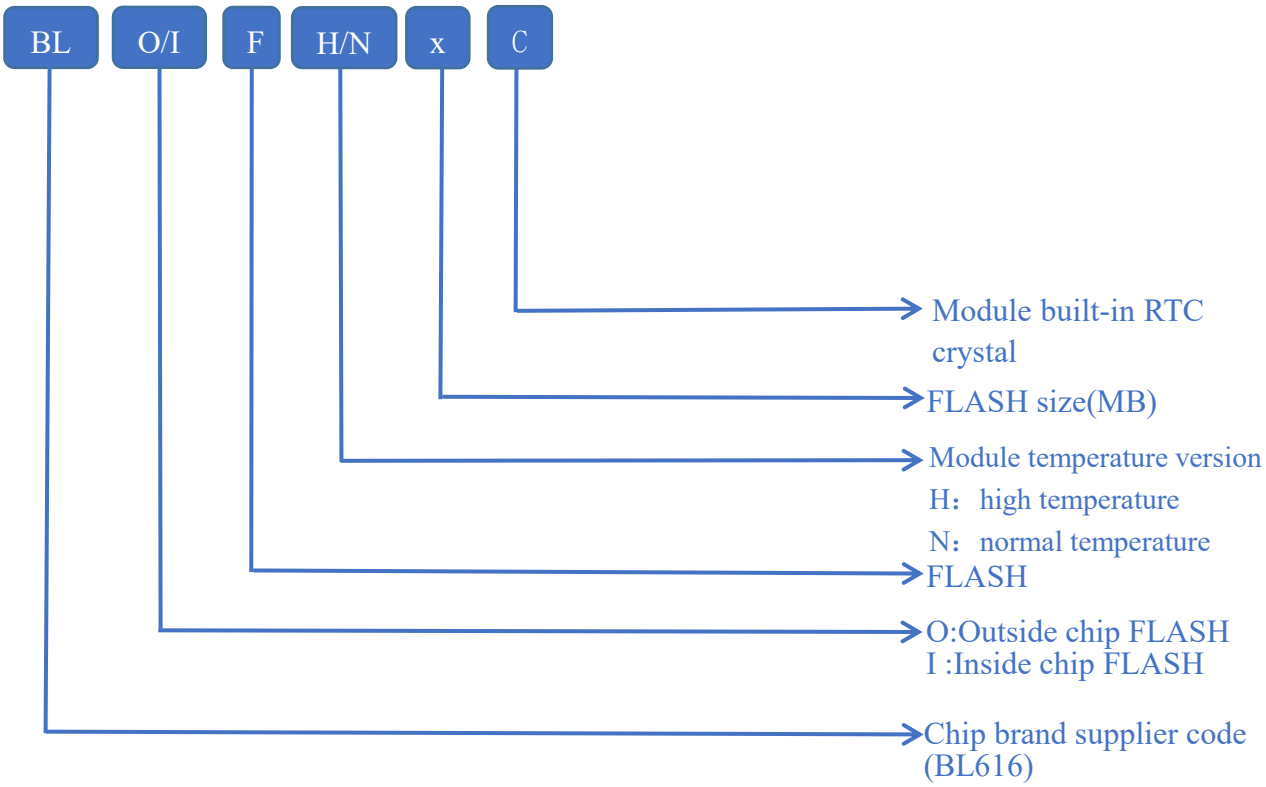
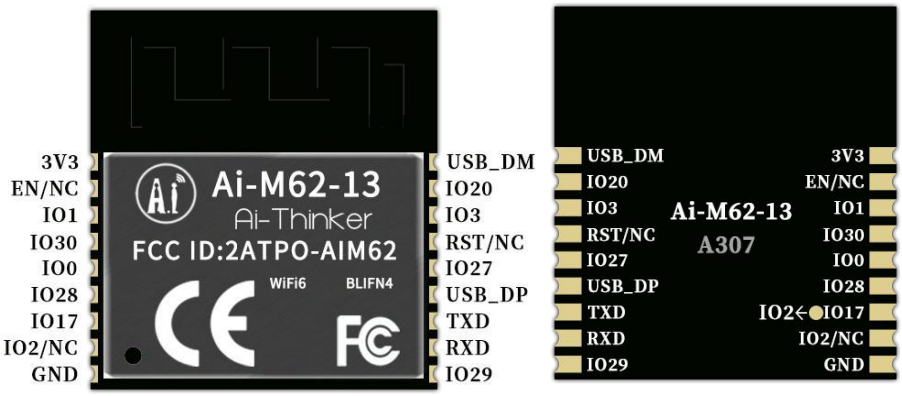


Figure 5 Shield printing information

4. Pin Definition

Ai-M62-13 module is connected with a total of 16 pins, as shown in the pin schematic diagram, pin function definition table is the interface definition.



Front Back

Figure 6 Schematic diagram of module pins

Table 6 Pin function definition table

No.	Name	Function
1	VCC	3.3V power supply; The output current of external power supply is recommended to be above 500mA.
2	EN/NC	The default is chip enabled, high level is valid, and RST cannot be used at the same time.
3	IO1	GPIO1/SPI_SCLK/I2S_FS/I2C_SDA/ADC_CH8/PWM0
4	IO30	GPIO30/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/PWM0
5	IO0	GPIO0/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH9/PWM0
6	IO28	GPIO28/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH11/PWM0
7	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. GPIO17/SPI_SCLK/I2S_FS/I2C_SDA/XTAL_32K_OUT/PWM0
8	IO2/NC	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_CH2/PWM0
9	GND	Grounding

10	IO29	GPIO29/SPI_SCLK/I2S_FS/I2C_SDA/PWM0
11	RXD	RXD/GPIO22/SPI_MISO/I2S_DI/I2S_RCLK_O/I2C_SCL/PWM0
12	TXD	TXD/GPIO21/SPI_SCLK/I2S_FS/I2C_SDA/ADC_RCAL_VOUT/PWM0
13	USB_DP	USB_DP
14	IO27	GPIO27/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/ADC_CH10/PWM0
15	RST/NC	The default is suspended, can be customized as reset pin, low level is valid, if you need to use it, please contact Anxin
16	IO3	GPIO3/SPI_MOSI/I2S_DO/I2S_RCLK_O/I2C_SDA/ADC_CH3/PWM0
17	IO20	GPIO20/SPI_SS/I2S_BCLK/I2C_SCL/ADC_CH0/PWM0
18	USB_DM	USB_DM
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

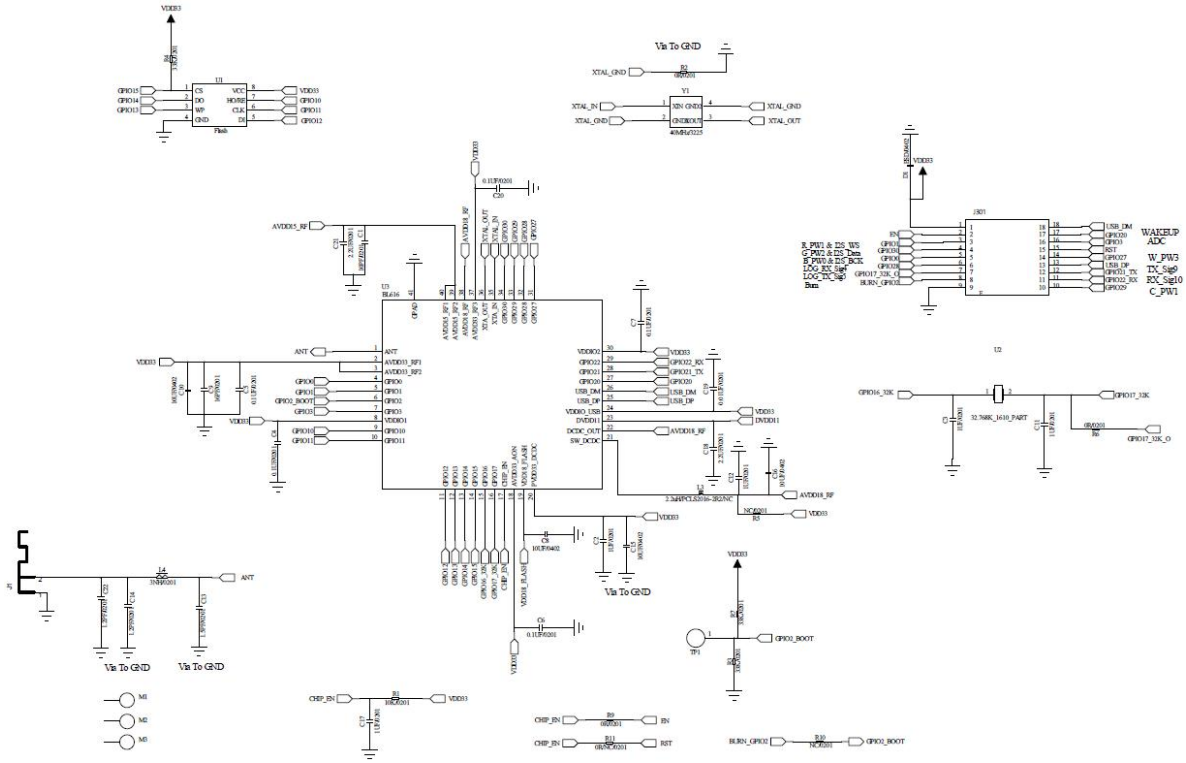


Figure 7 Module schematic

6. Antenna parameters

6.1. Schematic diagram of the antenna test prototype

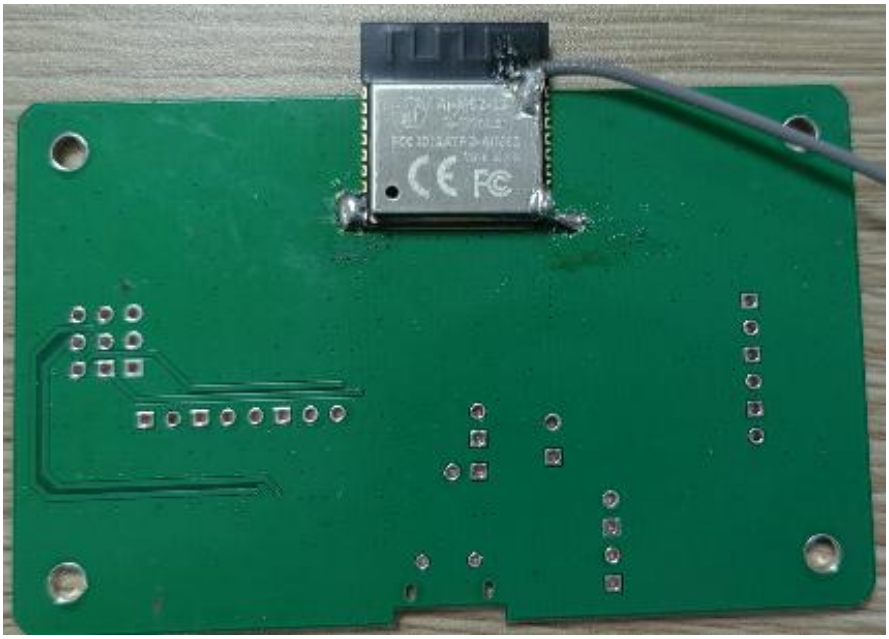


Figure 8 Schematic diagram of the antenna test prototype

6.2. Antenna S parameter

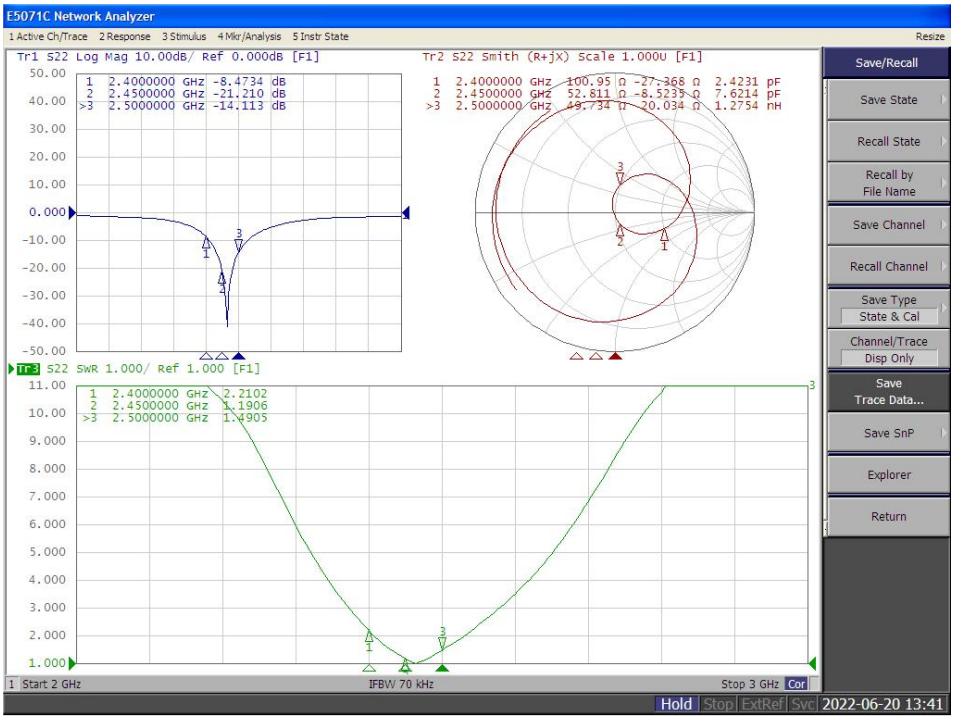


Figure 9 Antenna S parameters

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)	0.96	1.14	1.37	1.69	1.91	2.13	2.29	2.32	2.19	2.00	1.85
Efficiency (%)	47.66	49.80	52.36	56.63	60.58	63.67	64.71	64.31	62.38	60.55	58.85

6.4. Antenna pattern

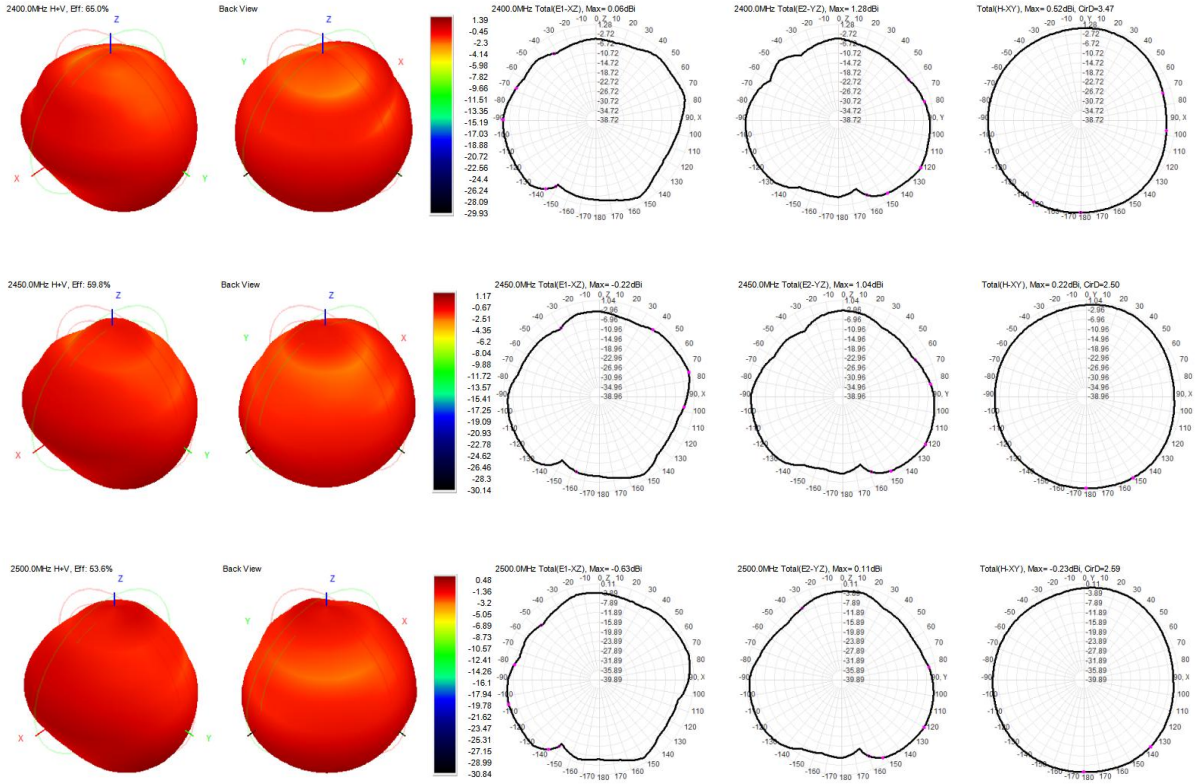


Figure 10 Antenna pattern

7. Design Guidance

7.1. Module application circuit

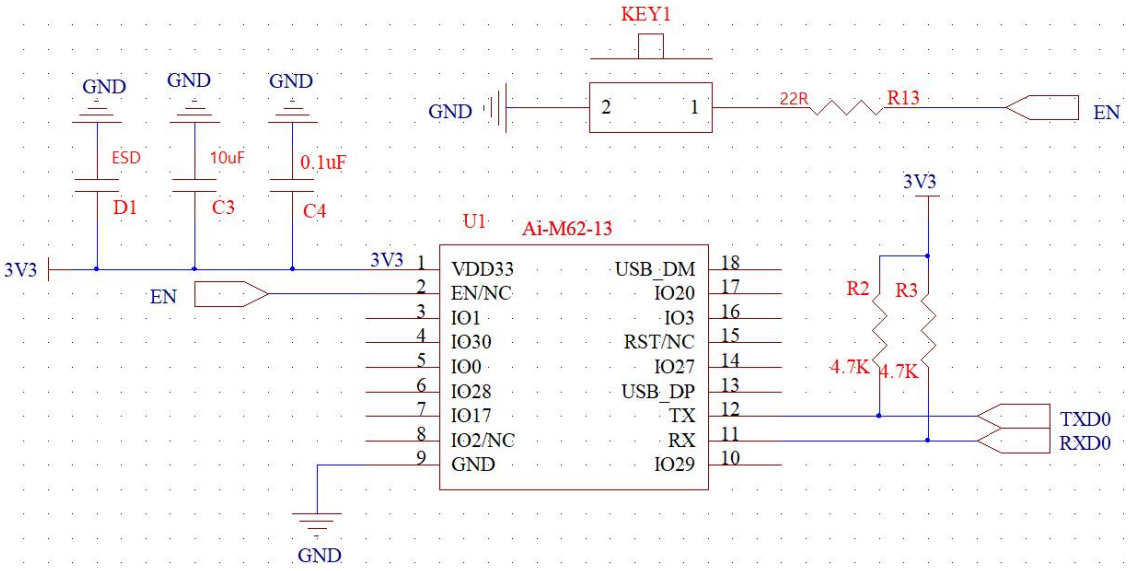


Figure 11 Application circuit diagram

- 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 chip.
- IO2/NC, not available by default.
- IO17/NC, 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.

7.2. Recommend PCB footprint size

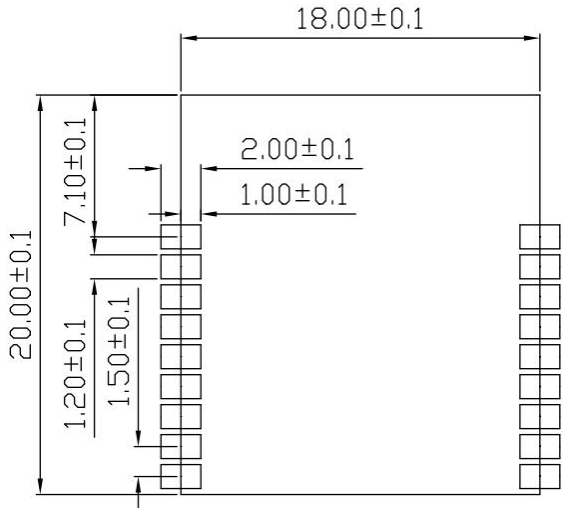


Figure 12 Recommend PCB footprint size

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

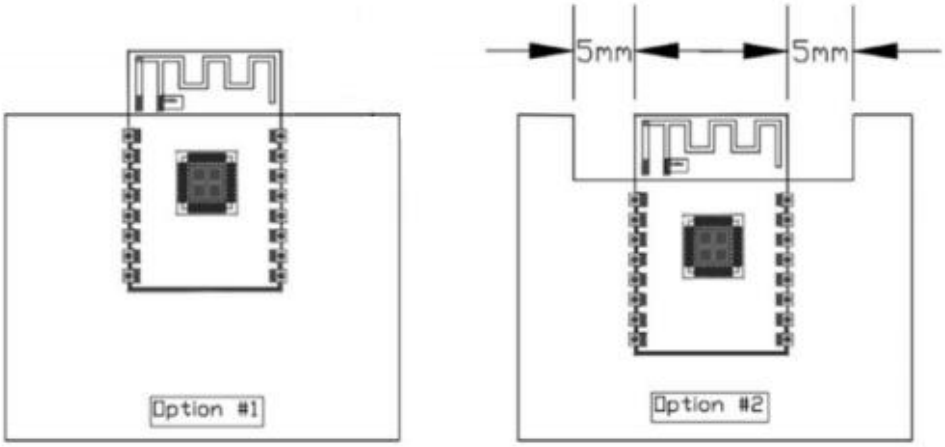


Figure 13 Antenna layout diagram

7.4. 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.

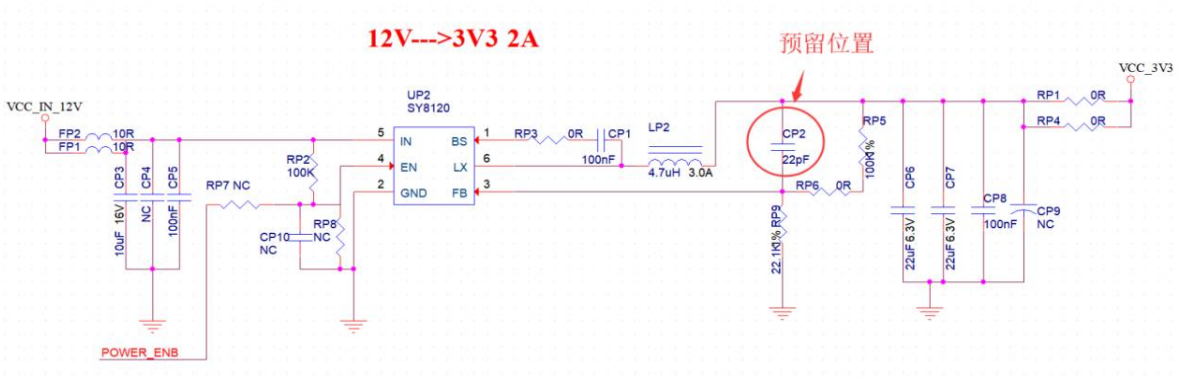


Figure 14 DC-DC step-down circuit diagram

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 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.

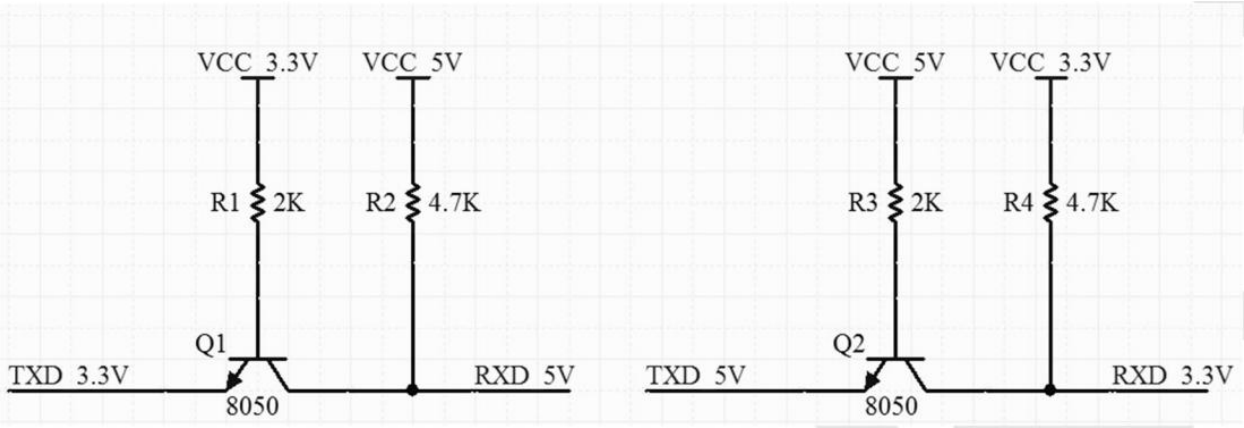


Figure 15 Level convert circuit

8. 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.

9. Reflow welding curve diagram

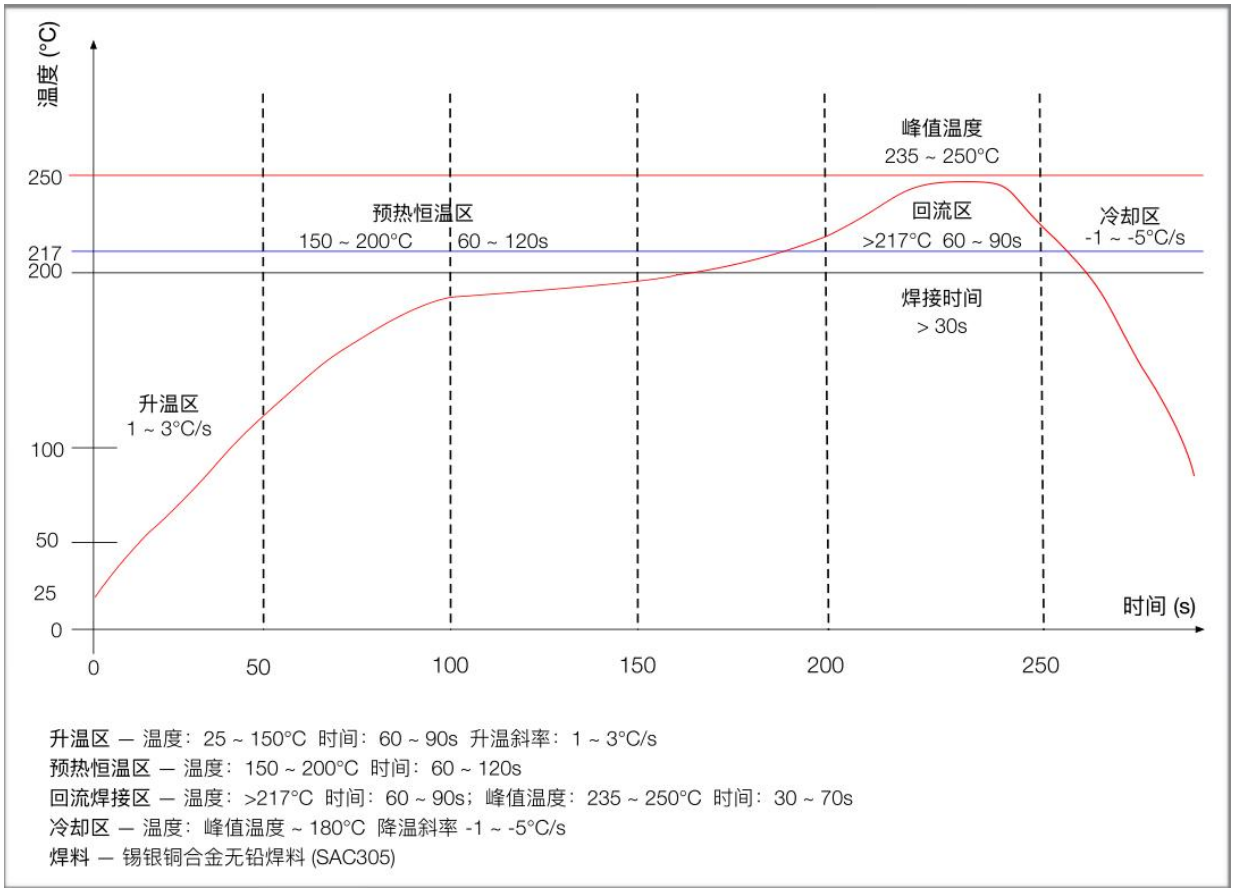


Figure 16 Reflow welding diagram

10.Product Packaging Information

Ai-M62-13 module was packaged in a tape, 650 pcs/reel.As shown in the below image:

Figure 17 Package and packing diagram

11.Contact us

Ai-Thinker official website　Office forum　Develop DOCS

LinkedIn　Tmall shop　Taobao shop　Alibaba shop

Technical support email：support@aithinker.com

Domestic business cooperation：sales@aithinker.com

Overseas business cooperation：overseas@aithinker.com

Company Address：Room 403-405,408-410, Block C, Huafeng Smart Innovation Port, Gushu 2nd Road, Xixiang, Baoan District, Shenzhen.

Tel：+86-0755-29162996

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