



# TG-02M Specification

Version V1.0.0

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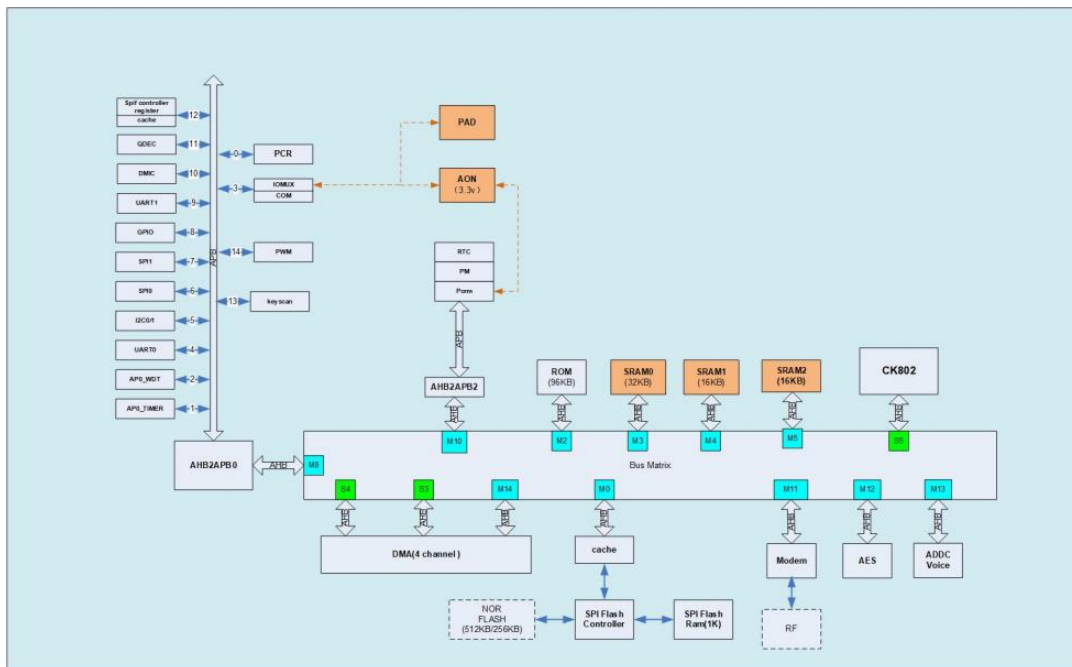
# 1. Product Overview

TG-02M is a bluetooth module developed by Shenzhen Ai-Thinker Technology Co., LTD. The core processor chip TG7120B(SOP16) is a highly integrated bluetooth System-level chip (SoC) with low power consumption, designed for Internet of Things (IoT), mobile devices, wearable electronic devices, smart home and other applications.

TG-02M module features a high-performance low-power 32-bit CK802 processor, 64KB SRAM, 512KB Flash, 96KB ROM, and 256 bit efuse. In addition, The TG-02M module supports security mechanisms, applications and OTA upgrades under THE BLE protocol. It has a variety of unique hardware security mechanisms, and hardware encryption supports AES algorithm.

TG-02M module offers a wealth of peripherals including UART, PWM, ADC, I2C, SPI, PDM, DMA and up to 11 IO ports.

TG-02M module supports low power Bluetooth: BLE 5.1, BLE Mesh. Bluetooth speed support: 125Kbps, 500Kbps, 1Mbps, 2Mbps. Support broadcast extension, multi - broadcast, channel selection.



**Figure 1 Main chip architecture diagram**

## 1.1. Characteristic

- Support BLE5.1, Speed Support: 125Kbps,500Kbps,1Mbps,2Mbps
- 64 KB SRAM, 512KB flash, 96 KB ROM, 256 bit efuse
- Support UART/GPIO/ADC/PWM/I2C/SPI/PDM/DMA
- The package is DIP-18 Gold finger plug-in package
- Multiple sleep modes are supported and the deep sleep current is less than 1uA
- Fixed universal AT instruction for quick use
- Support secondary development, integrated Windows development environment

## 2. Main parameters

**Table 1 Description of the main parameters**

Model	TG-02M
Package	DIP-18 Goldfinger plug-in
Size	18.0*18.0*2.8( $\pm 0.2$ )mm
Antenna	On-board antenna
Frequency	2400 ~ 2483.5MHz
Operating temperature	-40 °C ~ 85 °C
Storage temperature	-40 °C ~ 125 °C , < 90%RH
Power supply	Support voltage 2.7V ~ 3.6V, supply current $\geq 200$ mA
Interface	UART/GPIO/ADC/PWM/I2C/SPI/PDM/DMA
IO	11
UART rate	Default 115200 bps
Bluetooth	BLE 5.1
Security	AES-128
SPI Flash	512KB

## 2.1. Static electricity requirements

TG-02M module is an electrostatic sensitive device. Therefore, you need to take special precautions when carrying it.



Figure 2 ESD preventive measures

## 2.2. Electrical characteristics

Table 2 Electrical characteristics table

Parameters	Conditions	Min.	Typical value	Max.	Unit	
Power Supply	VDD	2.7	3.3	3.6	V	
I/O	V <sub>IL</sub> /V <sub>IH</sub>	-	-0.3/0.75VDD	-	0.25VDD/VDD+0.3	V
	V <sub>OL</sub> /V <sub>OH</sub>	-	N/0.8VIO	-	0.1VIO/N	V
	I <sub>MAX</sub>	-	-	-	12	mA

## 2.3. Bluetooth Rf Performance

Table 3 Bluetooth RF performance Table

Description	Typical value			Unit
Working Central Frequency	2400 - 2483.5			MHz
Output Power				
Model	Min.	Typical value	Max.	Unit
BLE 2Mbps	-20	8	10	dBm
BLE 1Mbps	-20	8	10	dBm
BLE 500Kbps	-20	8	10	dBm
BLE 125kbps	-20	8	10	dBm
Receive Sensitivity				
Model	Min.	Typical value	Max.	Unit
BLE 2Mbps	-	-94	-	dBm

BLE 1Mbps	-	-95	-	dBm
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## 2.4. Power

The following power consumption figures are based on a 3.3V power supply, an ambient temperature of 25°C, and an internal voltage regulator.

- All measurements were made at the antenna interface without SAW filter.
- All emission data are measured in TX\_Burst\_Test & RX\_Burst\_Test mode.

**Table 4 Power consumption table**

Model	Min.	AVG	Max.	Unit
TX_Burst_Test Power output 8dBm	-	11.5	-	mA
TX_Burst_Test Power output 5dBm	-	9.6	-	mA
TX_Burst_Test Power output 0dBm	-	8.6	-	mA
RX_Burst_Test	-	8	-	mA
Sleep (IO wake up only)	-	0.3	-	uA
Sleep(with 32KHz RTC and all SRAM retention)	-	6.5	-	uA
Power ON	-	6.24	-	mA





### 3. Appearance Dimensions

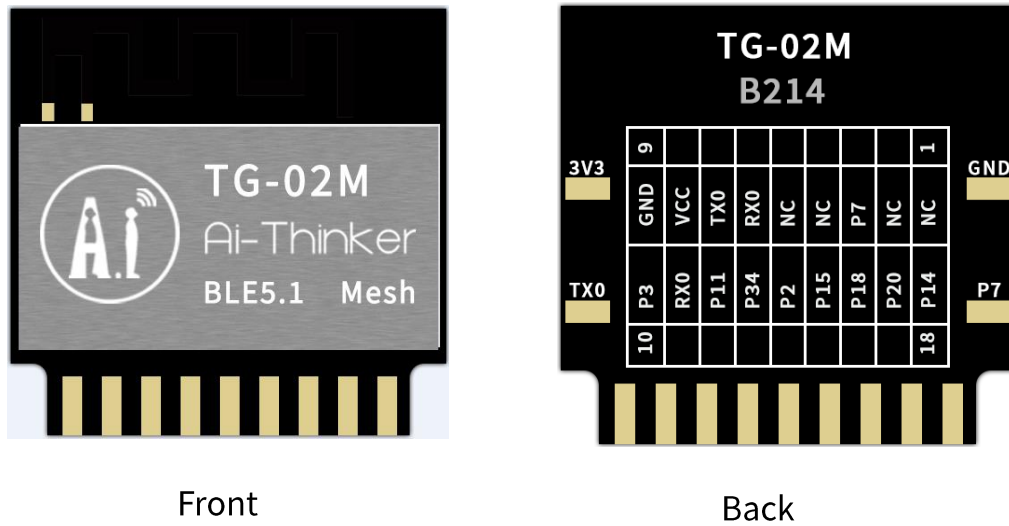


Figure 3 Appearance diagram pictures is for reference only,subject to physical objects)

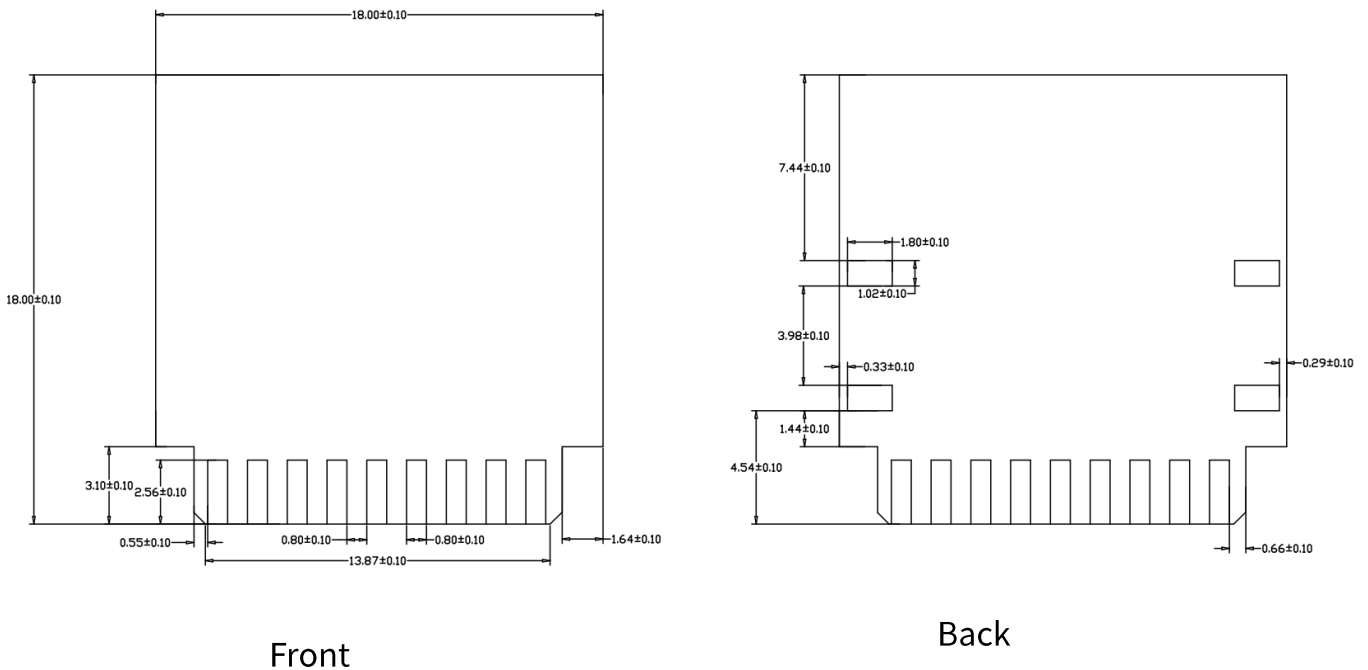


Figure 4 module size diagram



**Table 6 Pin function definition table**

No.	Name	Function
1	NC	NC
2	NC	NC
3	P7	GPIO7
4	NC	NC
5	NC	NC
6	RX0	RXD/GPIO10
7	TX0	TXD/GPIO9
8	VCC	Power access (positive pole of power supply)
9	GND	Ground(Power negative electrode)
10	P3	Power access (positive pole of power supply)
11	RX0	RXD/GPIO10
12	P11	GPIO11/ADC input 0
13	P34	GPIO34
14	P2	GPIO2
15	P15	GPIO15/ ADC input 4 / micbias output
16	P18	GPIO18/ ADC input 7 / PGA negative input
17	P20	GPIO20/ ADC input 9 / PGA positive input
18	P14	GPIO14/ADC input 3
19	GND	Ground(Power negative electrode)
20	P7	GPIO7
21	TX0	RXD/GPIO10
22	3V3	Power access (positive pole of power supply)

## 5. Schematic

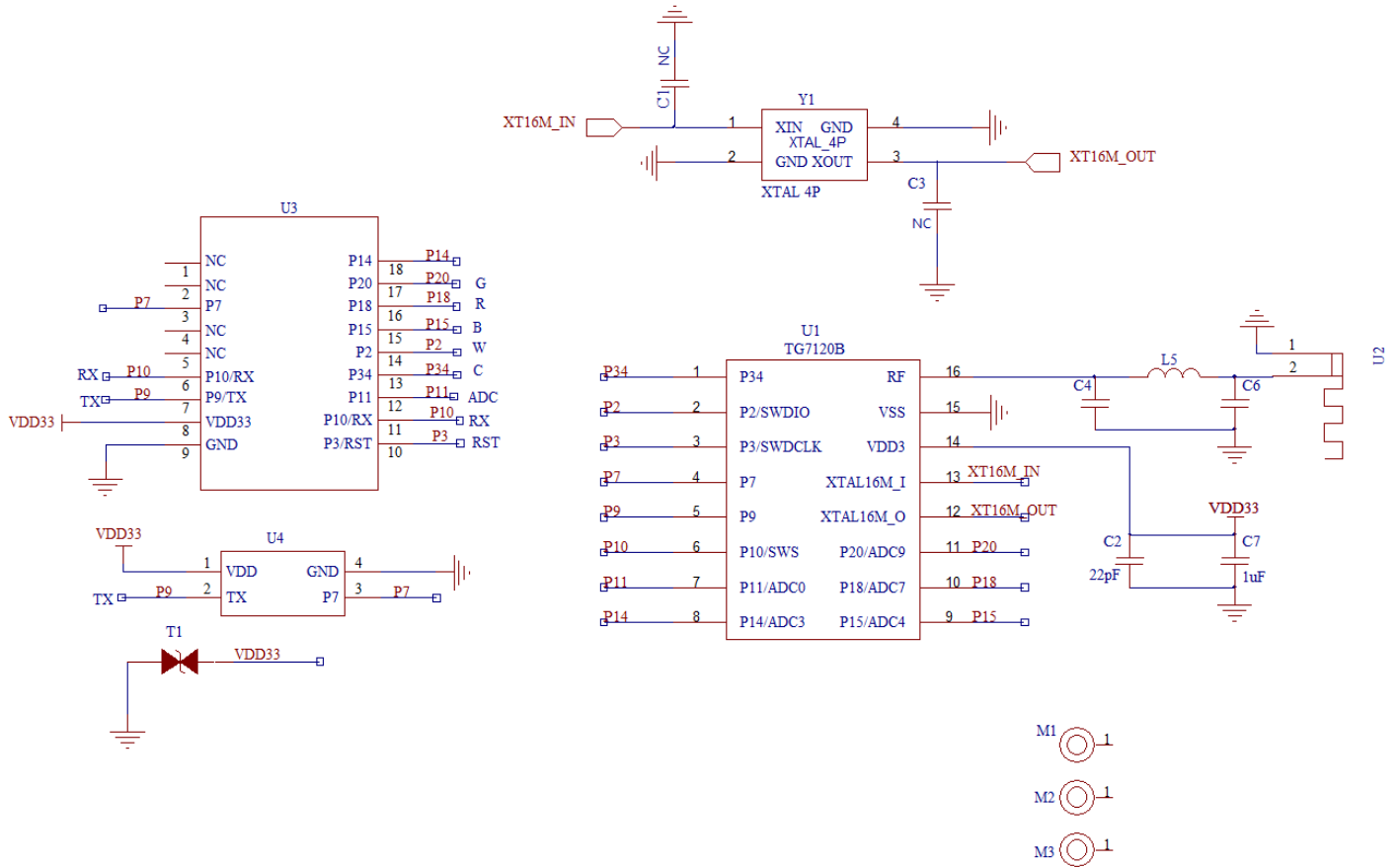
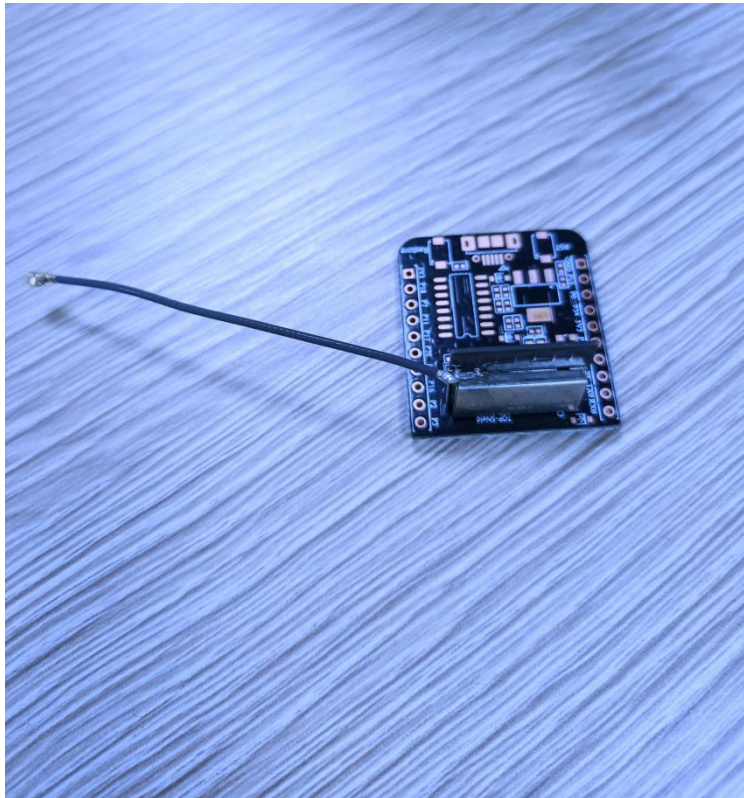


Figure 6 Schematic diagram of module

## 6. Antenna parameters

### 6.1. Test conditions for the antenna



**Figure 7 Antenna test conditions**

## 6.2. Antenna S parameter

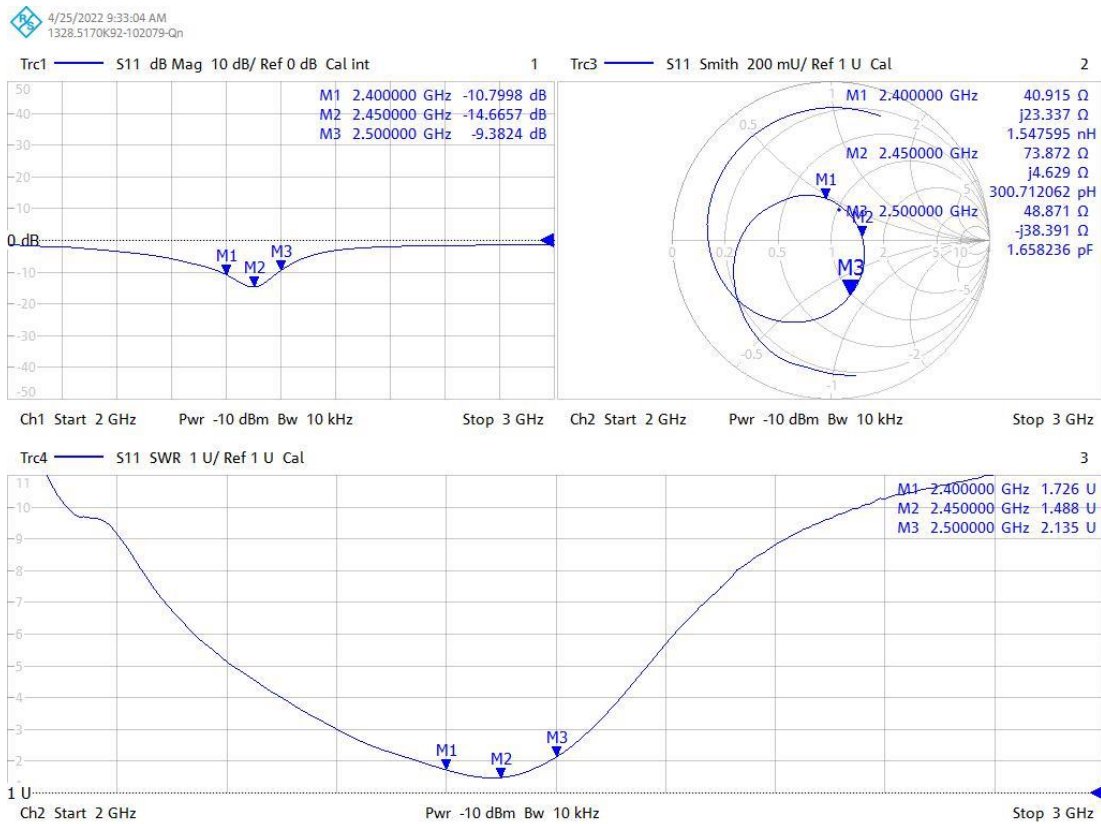


Figure 8 Antenna S parameters

## 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)	2400.0	2410.0	2420.0	2430.0	2440.0	2450.0	2460.0	2470.0	2480.0	2490.0	2500.0
Gain (dBi)	3.81	3.85	3.86	3.71	3.31	3.35	3.24	3.16	3.09	2.67	2.71
Efficiency (%)	55.91	56.24	55.93	53.63	49.69	50.61	49.07	48.51	48.78	44.69	45.39

## 6.4. Antenna Field Type Diagram

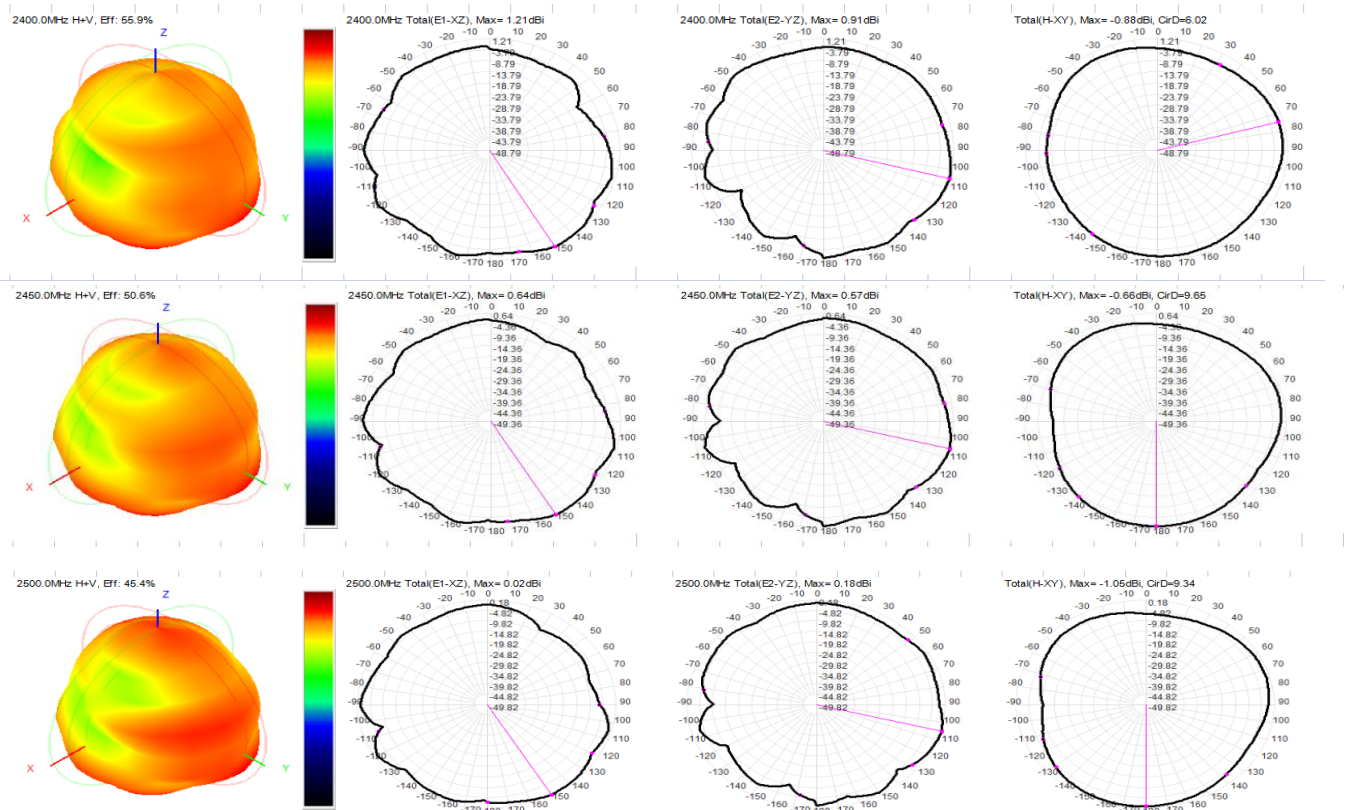
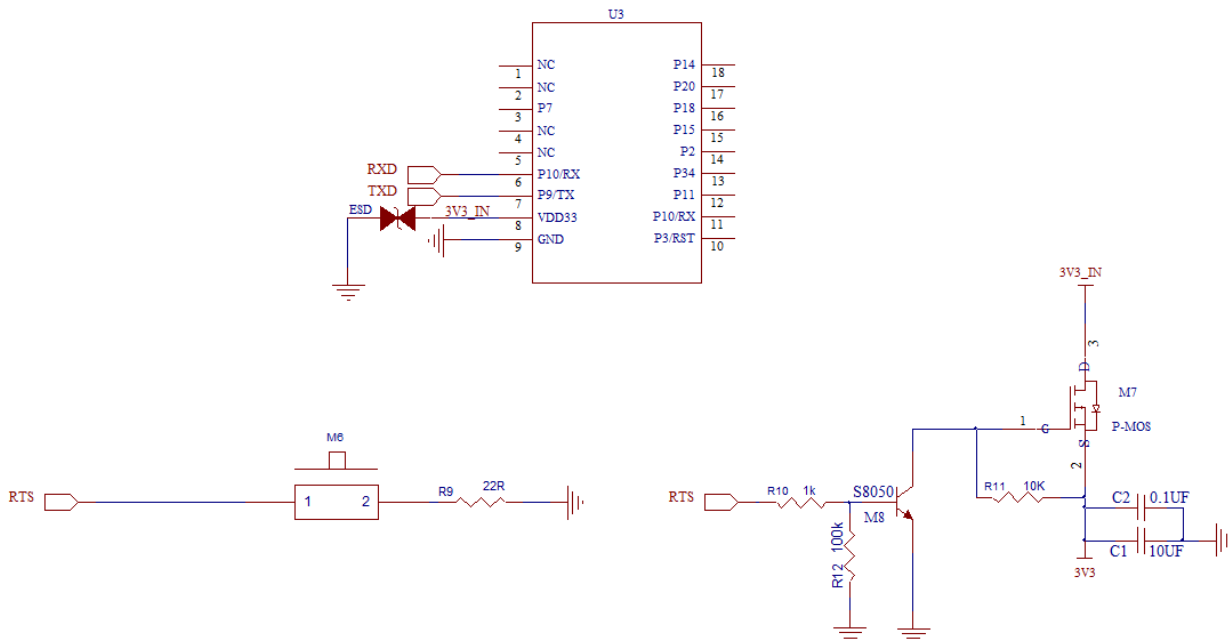


Figure 9 Antenna field pattern diagram

## 7. Design Guidance

### 7.1. Module application circuit

( $\geq 200\text{mA}$ , DC-DC or LDO independent power supply is recommended)



**Figure 10 Application circuit diagram**

Note:

- Because THERE is no reset pin for TG-02M, we realize the reset by cutting off power. A triode and PMOS can be used at the power input end to realize the reset of the module.

### 7.2. Antenna layout requirements

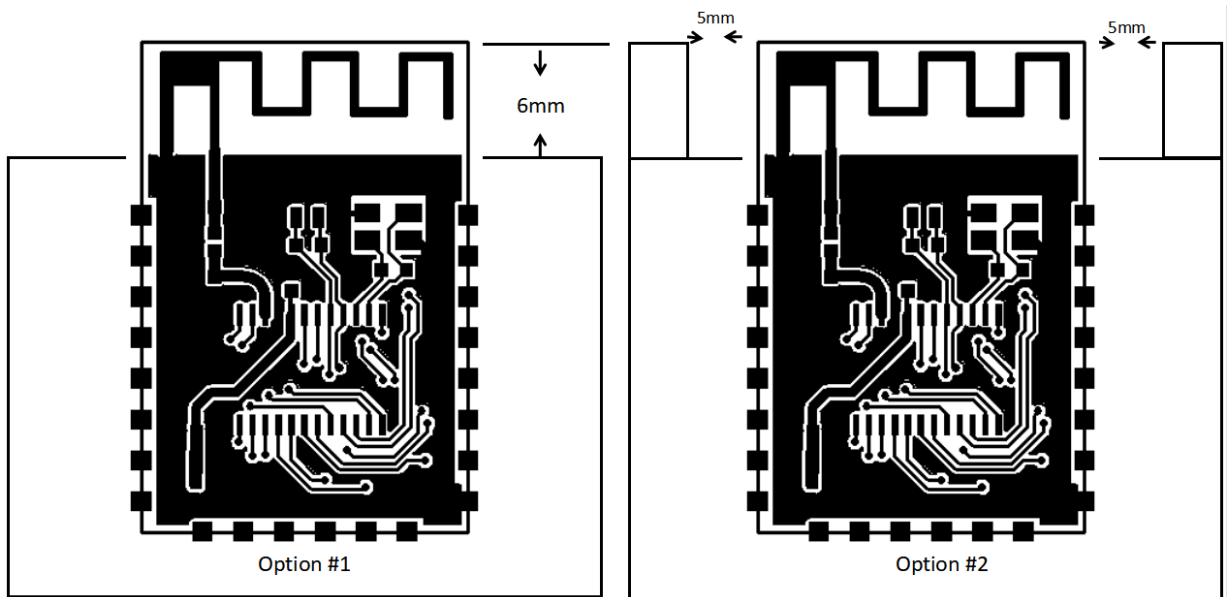
- The installation position on the motherboard suggests the following 2 ways:

Scheme 1: Put the module on the edge of the motherboard, And the antenna area extends out the edge of the motherboard.

Scheme 2: Put the module on the edge of the motherboard, and empty an area along the antenna position.

- To meet the performance of the on-board antenna, metal parts are not placed around the antenna, away from the high-frequency device.

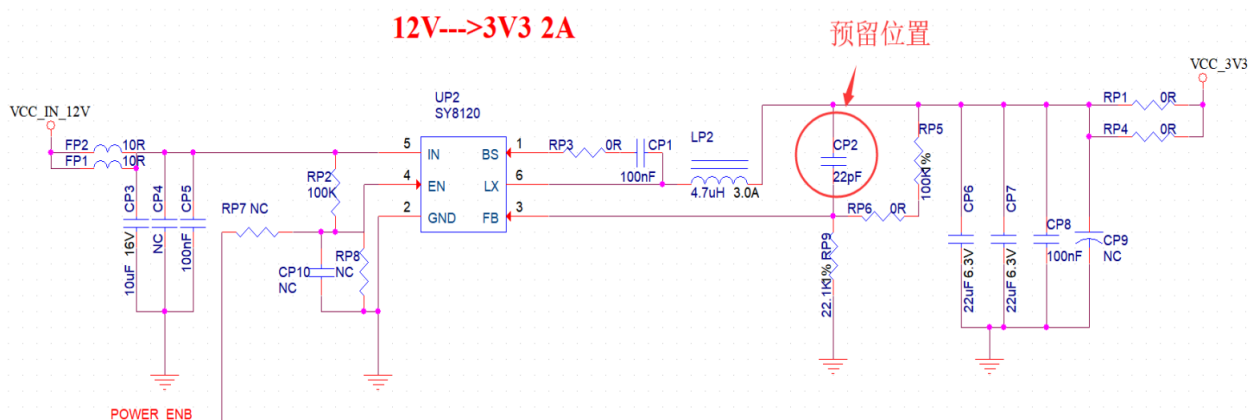




**Figure 11 Antenna layout diagram**

### 7.3. Power supply

- Recommended 3.3V voltage, peak current over 200mA.
- 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.
- 3.3V power interface it is recommended to add ESD devices.



**Figure 12 DC-DC step-down circuit diagram**

## 7.4. GPIO

- Some IO ports are introduced outside the module. If necessary, it is recommended to use a resistor of 10-100 ohms in series on the IO ports. 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.

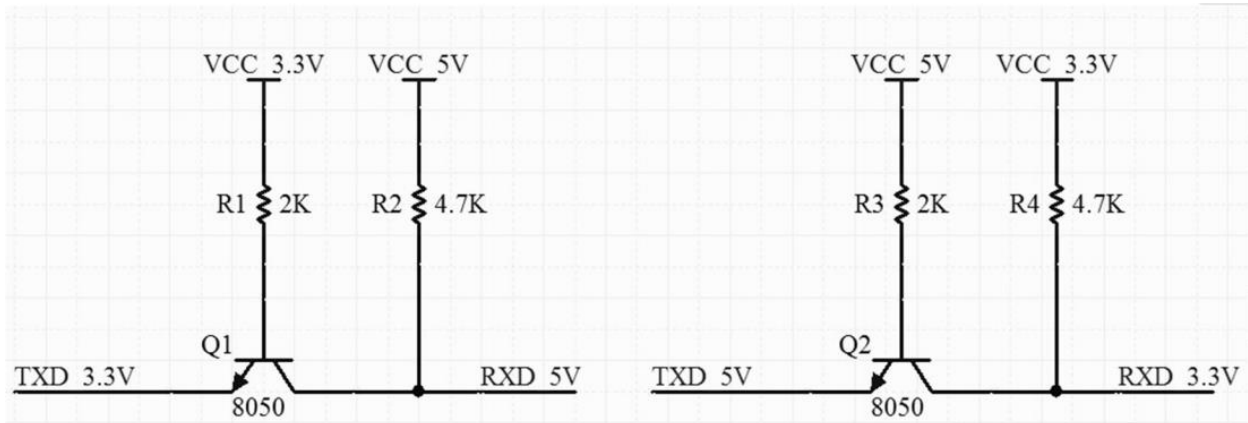


Figure 13 Level convert circuit

## 8. Flow welding curve diagram

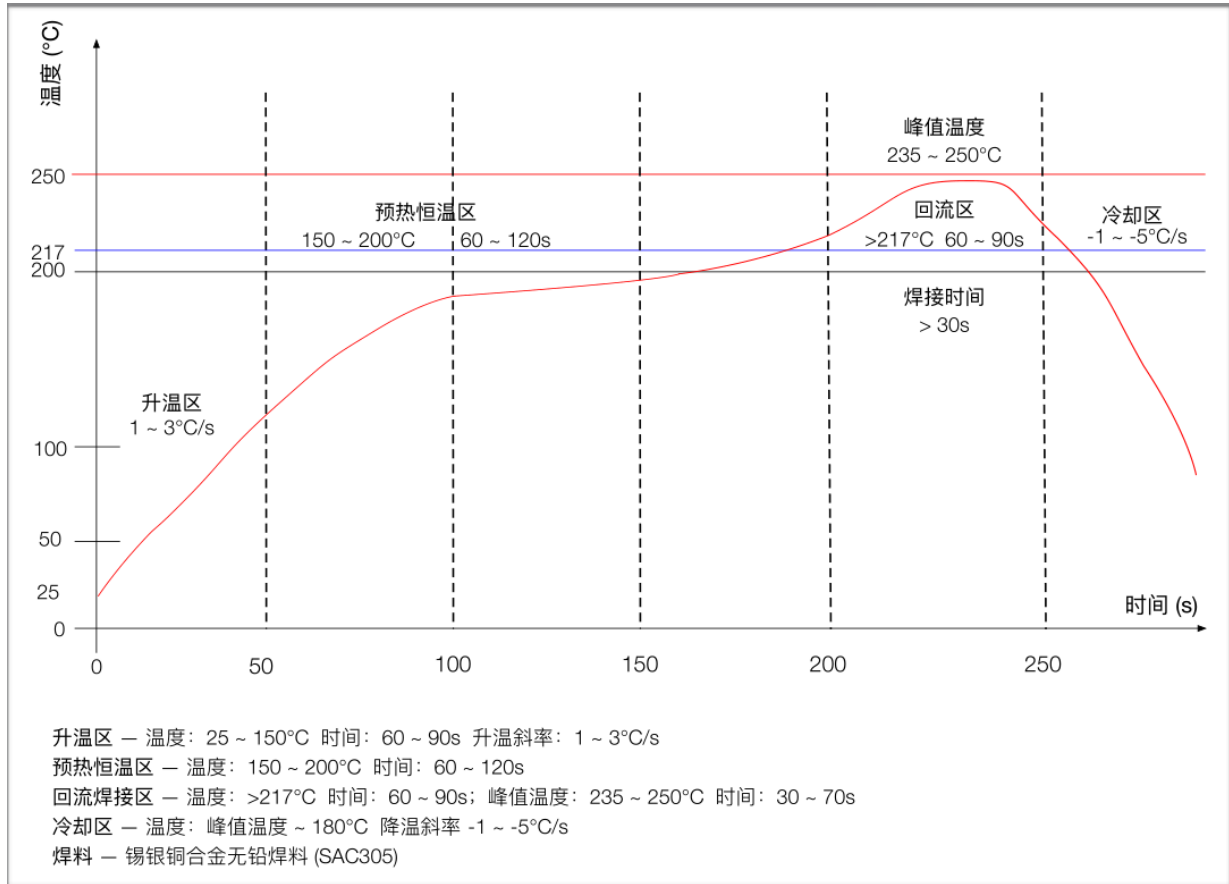


Figure 14 Flow welding diagram

## 9. Product related models

**Table 8 Product related model list**

Model	Power Supply	Package	Size	Antenna
TG-02F	2.7V ~ 3.6V, $I \geq 200\text{mA}$	SMD-22	24.0*16.0*3.1( $\pm 0.2$ )mm	Default on-board PCB antenna Optional external spring antenna
TG-02M	2.7V ~ 3.6V, $I \geq 200\text{mA}$	DIP-18 Gold finger plug-in	18.0*18.0*2.8( $\pm 0.2$ )mm	On-board PCB antenna
TG-02	2.7V ~ 3.6V, $I \geq 200\text{mA}$	SMD-20	18.6*12.2*2.8( $\pm 0.2$ )mm	On-board PCB antenna
TG-02F-Kit	5V, $I > 200\text{mA}$	DIP-30	49.66*25.40( $\pm 0.2$ )mm	On-board PCB antenna
TG-02M-Kit	5V, $I > 200\text{mA}$	DIP-20	32.73*28.45( $\pm 0.2$ )mm	On-board PCB antenna
TG-02-Kit	5V, $I > 200\text{mA}$	DIP-19	45.54*29.93( $\pm 0.2$ )mm	On-board PCB antenna
Product related information : <a href="https://docs.ai-thinker.com">https://docs.ai-thinker.com</a>				

## 10. Product Packaging Information

TG-02M module was packaged in a tape, 800pcs/reel. As shown in the below image:



Figure 15 Package and packing diagram

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