TG-02 Specification

Version V1.0.1

Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2022.4.25	First Edition	ShengXin Zhou	NingGuan
V1.0.1	2022.6.14	Added high temperature version	ShengXin Zhou	NingGuan

Content

1. Product Overview

TG-02 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-02 module features a high-performance low-power 32-bit CK802 processor, 64KB SRAM, 512KB Flash, 96KB ROM, and 256 bit efuse. In addition, TG-02 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-02 module offers a wealth of peripherals including UART, PWM, ADC, I2C, SPI, PDM, DMA and up to 11 IO ports.

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

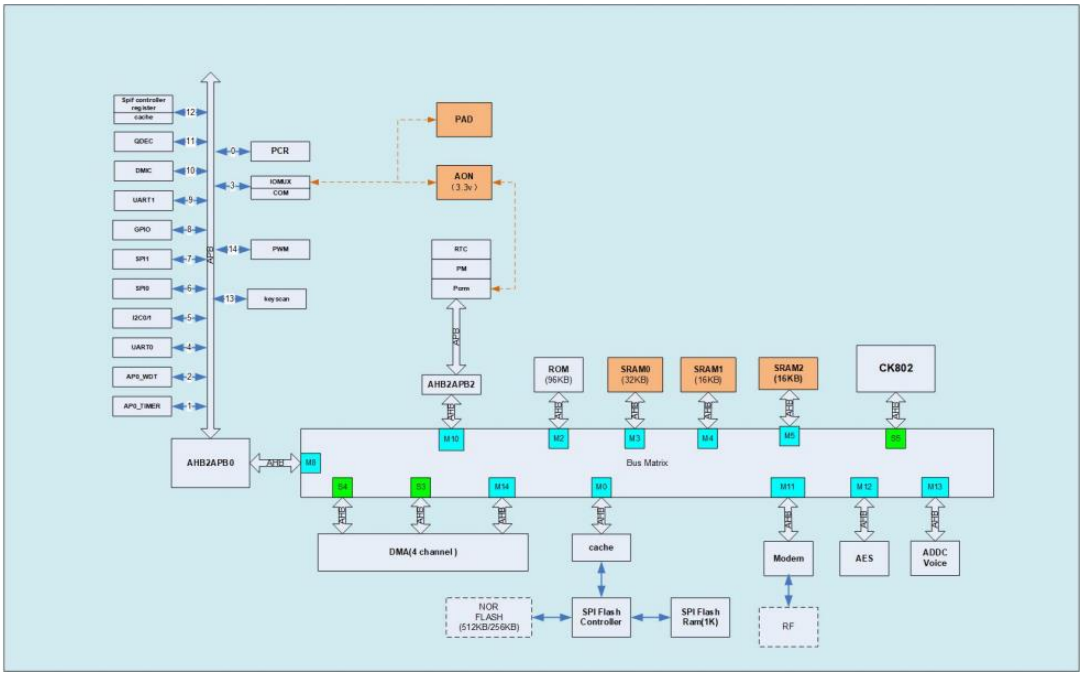


Figure 1 Main chip architecture diagram

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 SMD-20
- 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
- PCB on-board antenna is used by default; At the same time reserved half hole pad and antenna hole, half hole pad can lead the antenna to the motherboard, antenna hole can be directly welded on the module spring antenna

2. Main parameters

Table 1 Description of the main parameters

Model	TG-02
Package	SMD-20
Size	18.6*12.2*2.8(±0.2)mm
Antenna	Default on-board antenna Optional external spring antenna
Frequency	2400 ~ 2483.5MHz
Operating temperature	-40 ℃ ~ 85 ℃(Normal temperature version) / -40 ℃ ~ 105 ℃(high temperature version)
Storage temperature	-40 ℃ ~ 125 ℃ , < 90%RH
Power supply	Support voltage 2.7V ~ 3.6V,supply current ⩾200mA
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-02 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_{IL}/V_{IH}	-	-0.3/0.75VDD	-	0.25VDD/VDD+0.3	V
	V_{OL}/V_{OH}	-	N/0.8VIO	-	0.1VIO/N	V
	I_{MAX}	-	-	-	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

2.4. Power

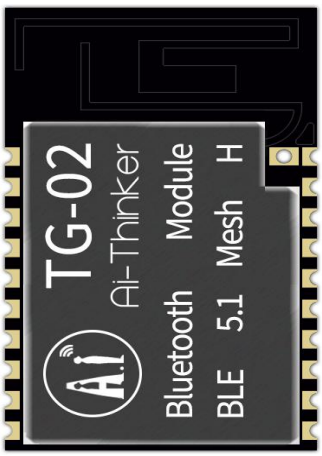
The following power consumption figures are based on a 3.3V power supply, an ambient temperature of 25℃, and an internal voltage regulator.

- All measurements were made at the antenna interface without SAW filter.
- All emission data are measured in TX_Burst_Test & RX_Burst_Test mode.

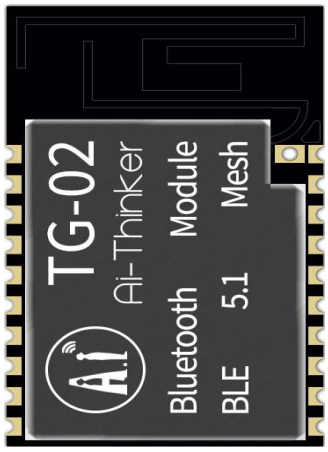
Table 4 Power consumption table

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)	-	12.45	-	uA
Sleep(with 32KHz RTC and all SRAM retention)	-	16.31	-	uA
Power ON	-	6.24	-	mA

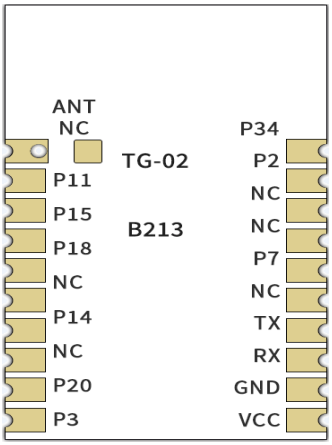
3. Appearance Dimensions



Front(High temperature version)

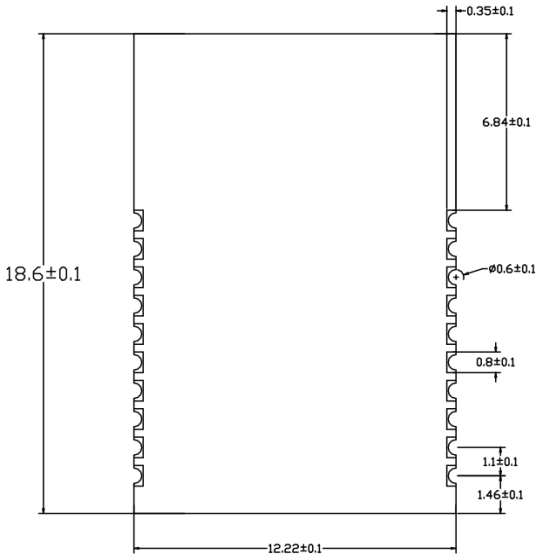


Front(Normal version)

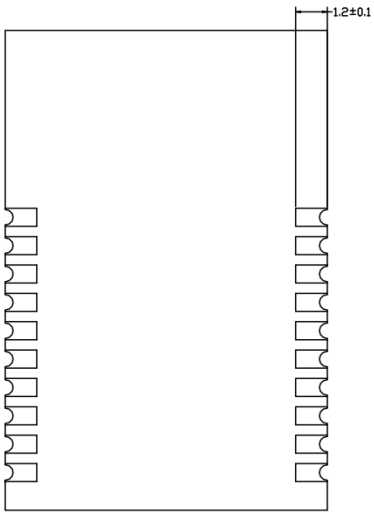


Back

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



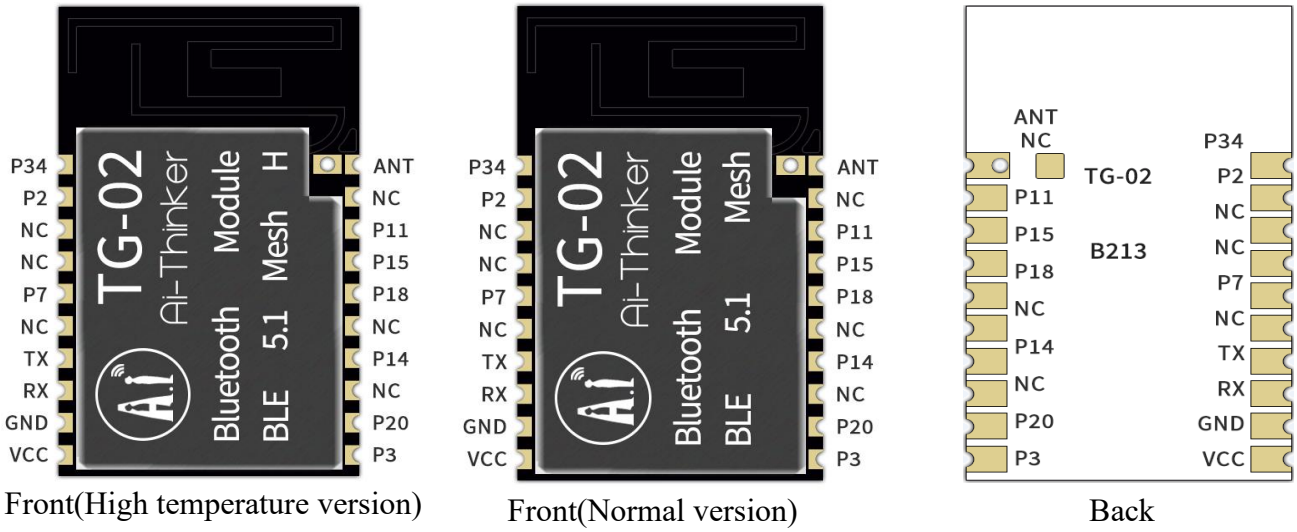
Front



Back

4. Pin definition

TG-02 module is connected with a total of 20 pins, as shown in the schematic diagram of pins, pin function definition table is the interface definition.



Front(High temperature version) Front(Normal version) Back

Figure 5 Schematic diagram of module pins(top view)

- Front diagram of high temperature plate H represents high temperature plate.

Table 6 Pin function definition table

No.	Name	Function
1	P34	GPIO34
2	P2	GPIO2
3	NC	NC
4	NC	NC
5	P7	GPIO7
6	NC	NC
7	TX	TXD/GPIO9
8	RX	RXD/GPIO10
9	GND	Ground(Power negative electrode)
10	VCC	Power access (positive pole of power supply)
11	P3	GPIO3
12	P20	GPIO20/ ADC input 9 / PGA positive input
13	NC	NC
14	P14	GPIO14/ADC input 3
15	NC	NC
16	P18	GPIO18/ ADC input 7 / PGA negative input
17	P15	GPIO15/ ADC input 4 / micbias output
18	P11	GPIO11/ADC input 0
19	NC	NC
20	ANT	RF antenna

5. Schematic

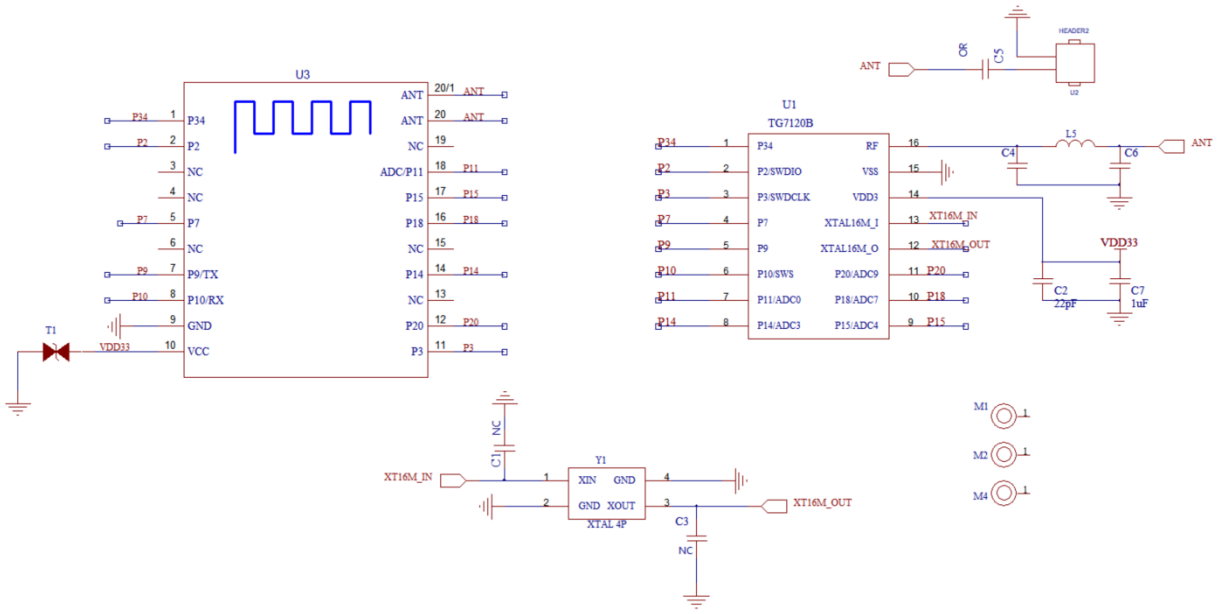


Figure 6 Module schematic

6. Antenna parameters

6.1. Test conditions for the antenna

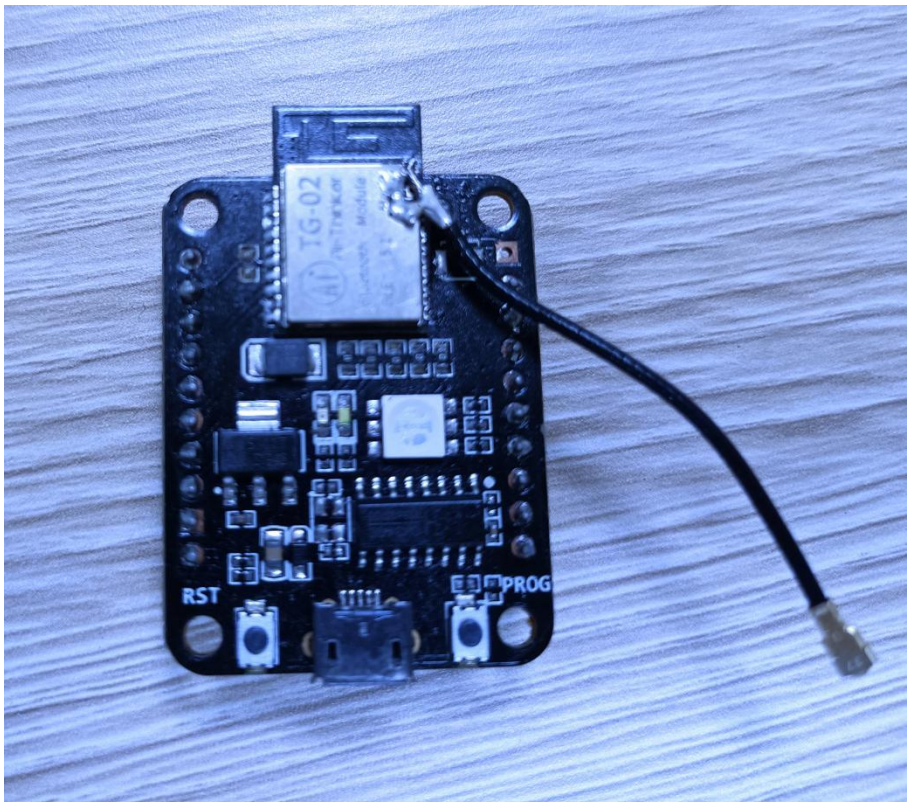


Figure 7 A schematic diagram of the user welding the module to the motherboard

6.2. Antenna S parameter

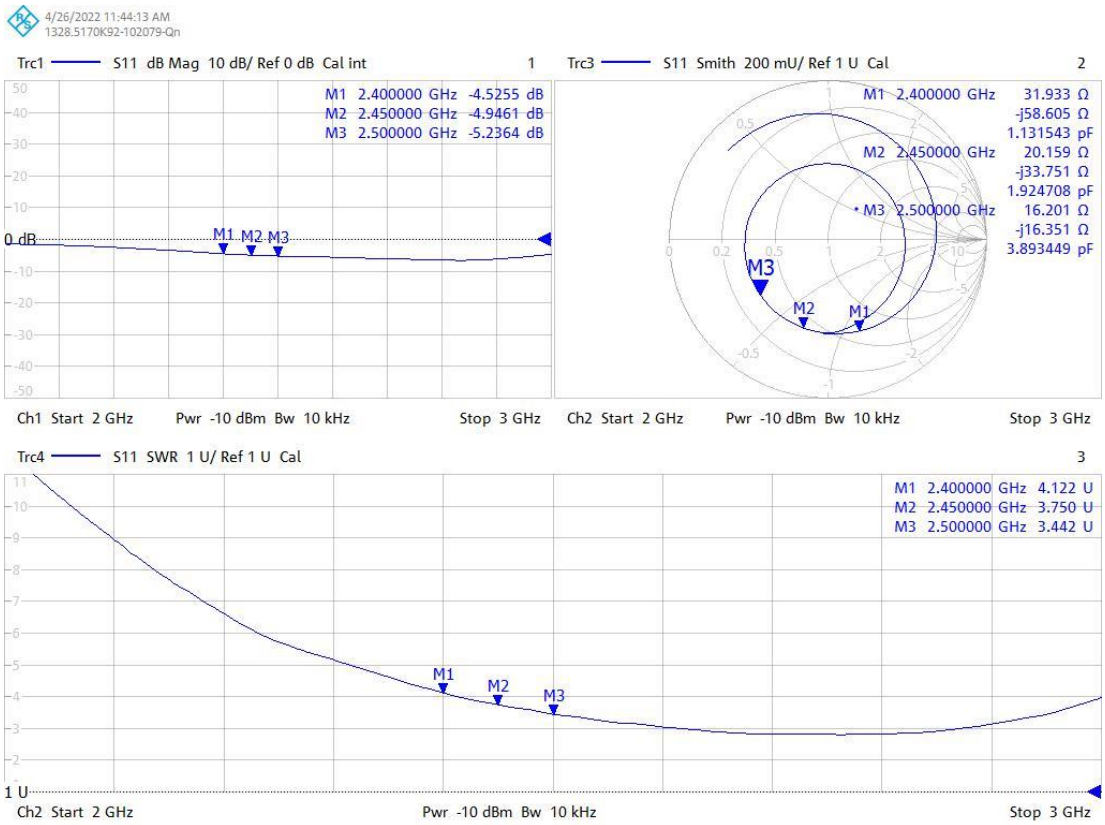


Figure 8 Antenna S parameters

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)	1.99	1.84	2.15	1.68	1.70	1.52	1.38	1.45	1.78	1.47	1.62
Efficiency (%)	31.15	32.28	31.72	33.99	33.38	40.96	44.40	46.94	48.13	49.17	48.35

6.4. Antenna Field Type Diagram

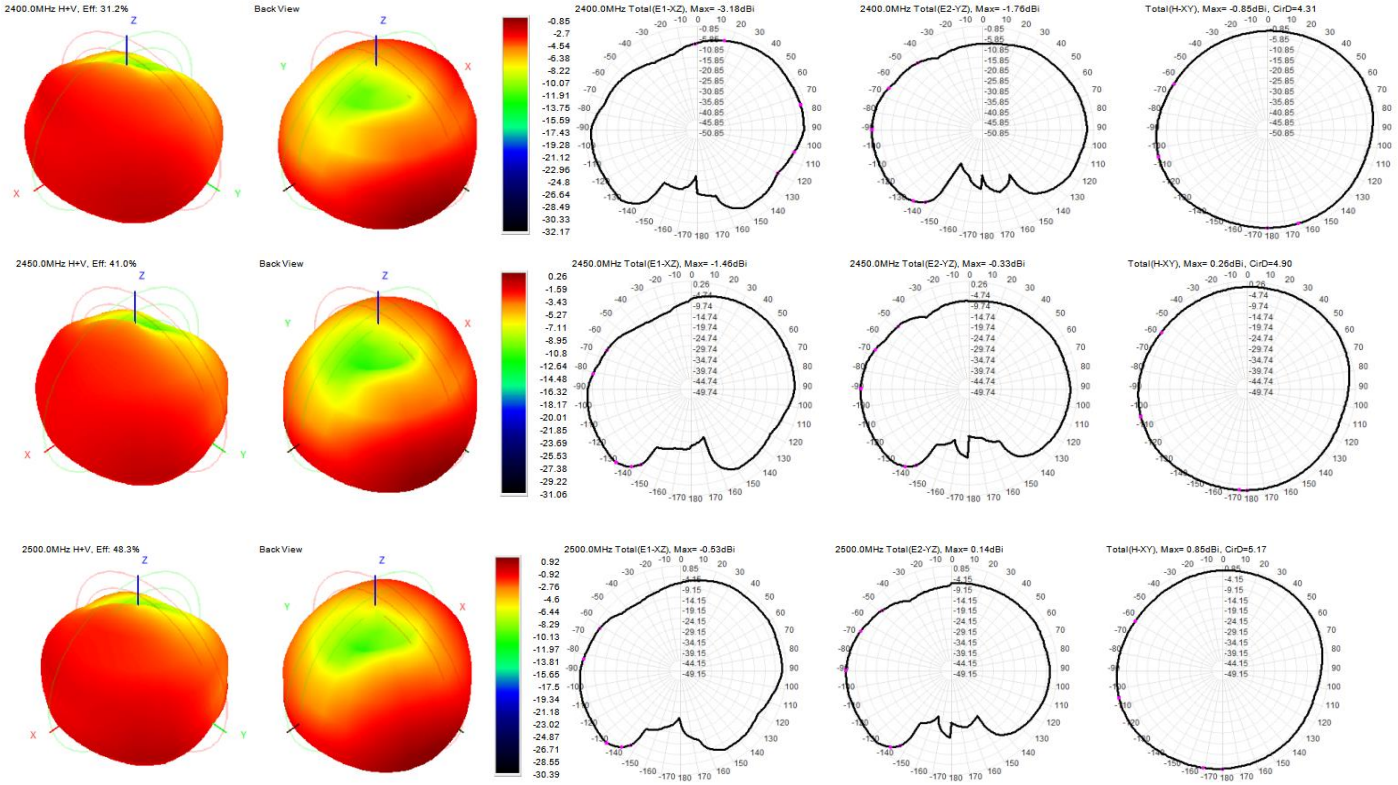


Figure 9 Antenna field type diagram

7. Design Guidance

7.1. Module application circuit

(≥200mA,suggest use DC-DC or LDO independent power supply)

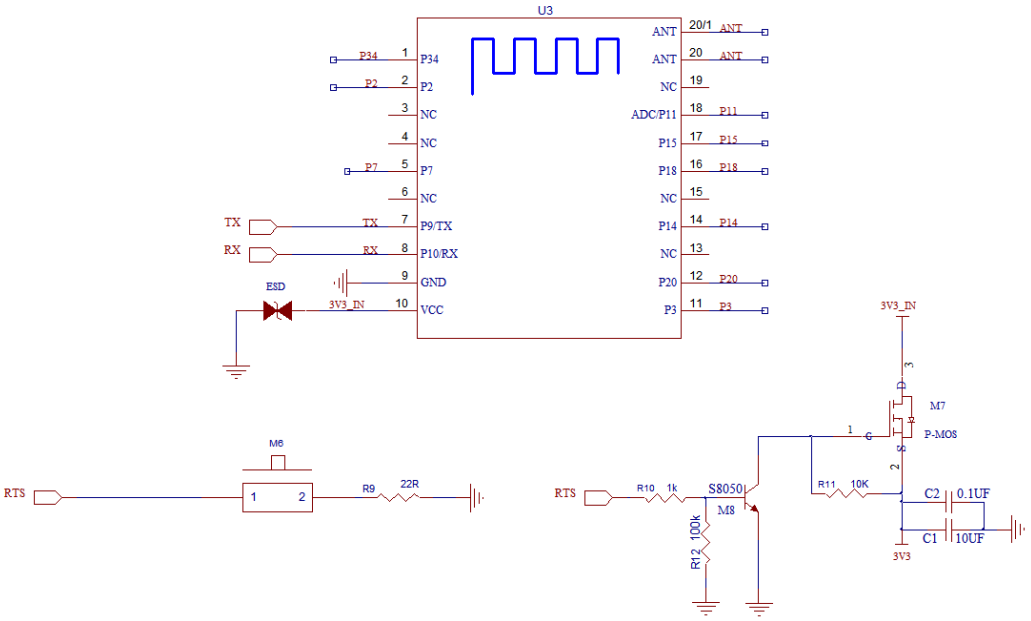


Figure 10 Application circuit diagram

Note：

- Because THERE is no reset pin for TG-02, 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.

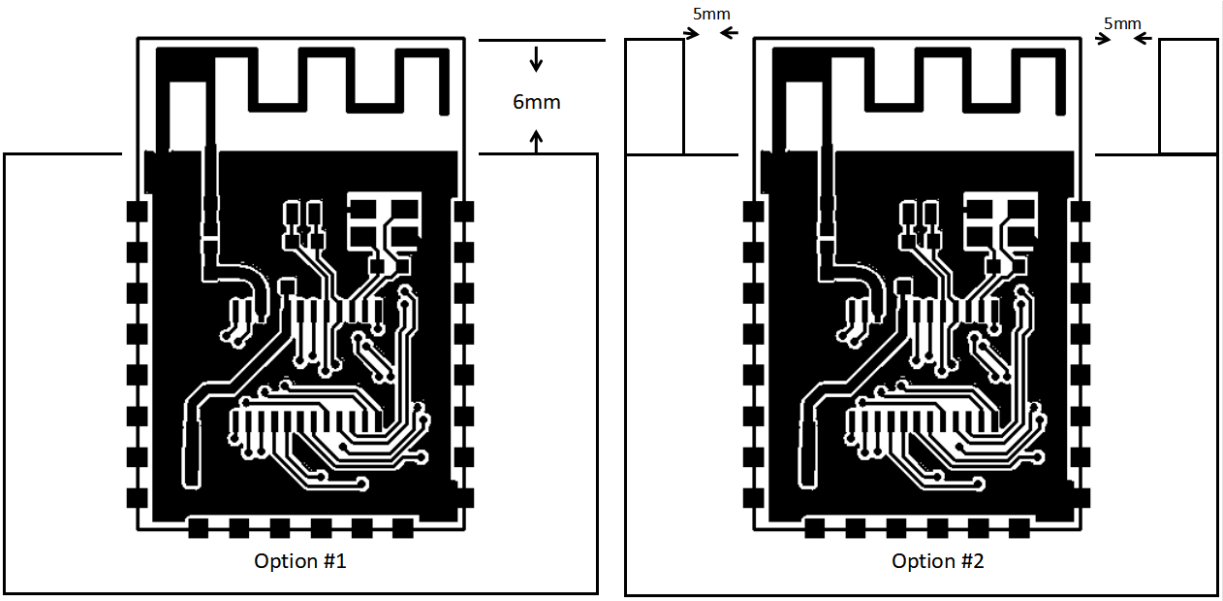


Figure 11 Antenna layout diagram

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.

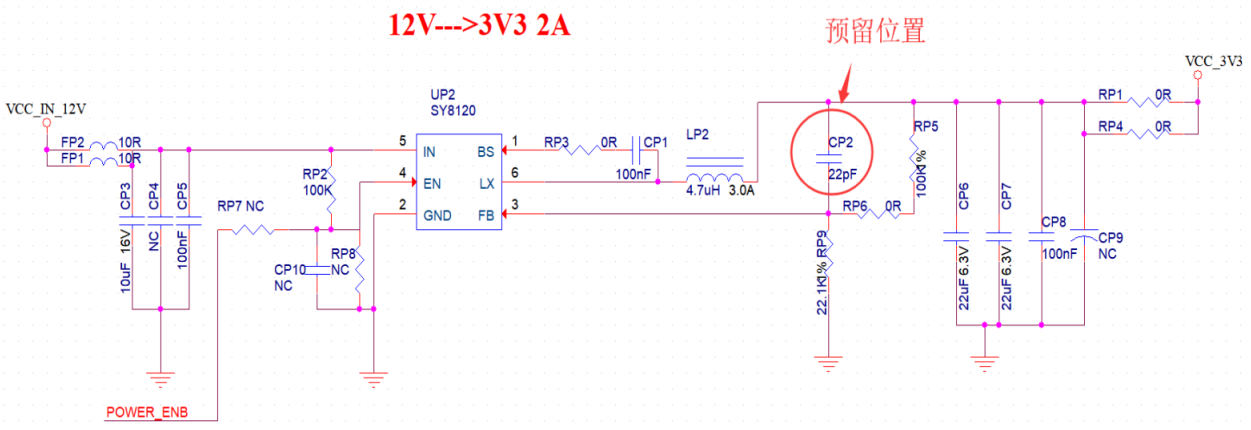


Figure 12 Dc-dc step-down circuit diagram

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.

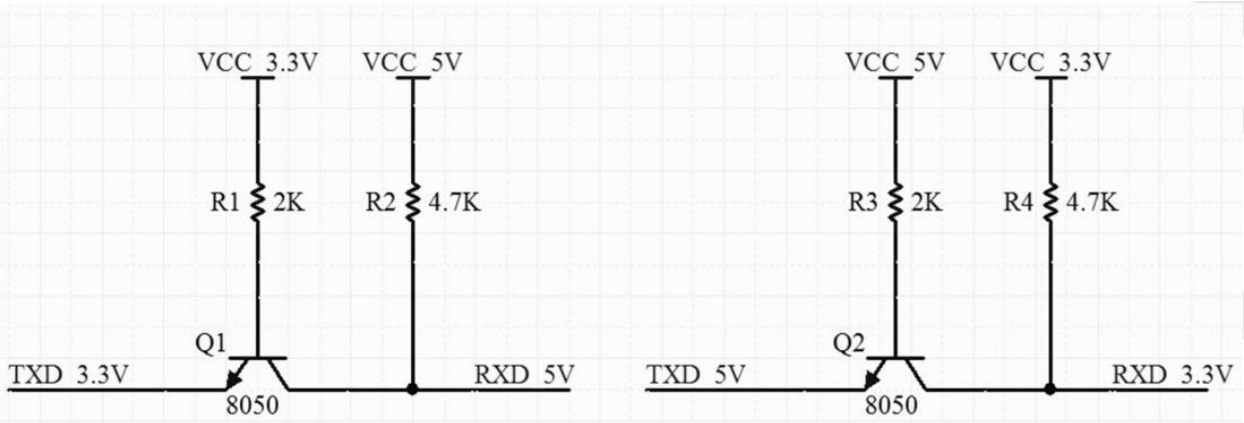


Figure 13 Level convert circuit

8. Flow welding curve diagram

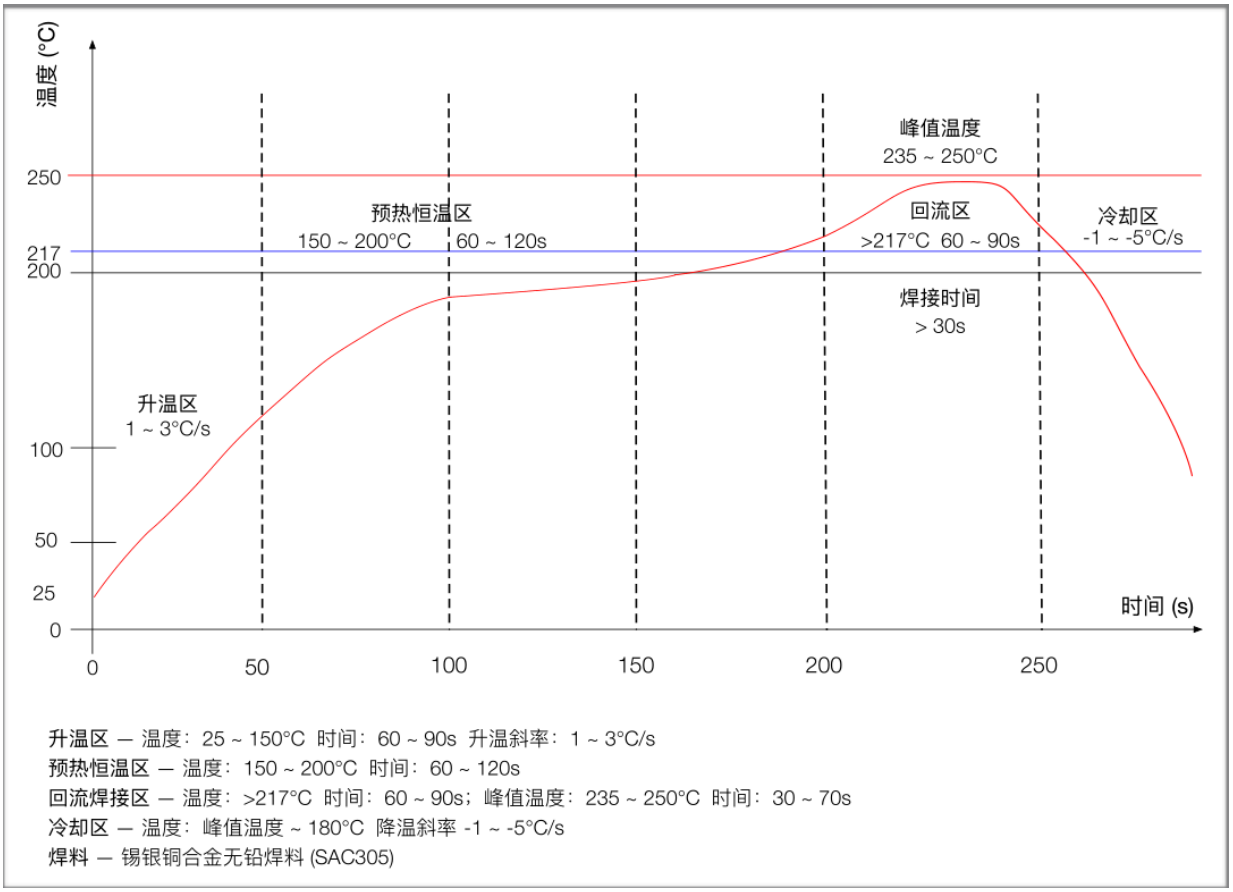


Figure 14 Flow welding diagram

9. Product related models

Table 8 Product related model list

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

10.Product Packaging Information

TG-02 module was packaged in a tape，1350pcs/reel. As shown in the below image:

Figure 15 Package and packing diagram

11.Contact us

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