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Ai Thinker TB-05 BLE5.0 Mesh Bluetooth Module Owner's Manual

TB-05 Specification
Version V1.0.0
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Contents

TB-05 BLE5.0 Mesh Bluetooth Module

Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2022.11.8	First Edition	Jingran Xiao	Ning Guan

Product overview

TB-05 is a BLE5.0 low-power consumption Tmall Genie Mesh Bluetooth module based on TLSR8250 chip. The Bluetooth module supports the direct control of Tmall Genie and has the function of Bluetooth mesh networking. The devices communicate through peer-to-peer star network and Bluetooth broadcast, which can ensure timely response in case of multiple devices. It is mainly used in intelligent light control, which can meet the requirements of low power consumption, low delay and short-range wireless data communication.

1.1. Characteristics

- It can be directly controlled by the Tmall Genie without a gateway
- 1.1mm pitch SMD-20 package
- 6 PWM outputs
- Onboard antenna, compatible with half-hole pad/through-hole pad
- Brightness (duty cycle) adjustment range 5%-100%
- Factory default cold color warm color duty cycle 50%
- PWM output frequency 1KHz
- With night light function
- Color temperature switching function with wall switch

Main parameters

Table 1 Description of Main Parameters

Model	TB-05
Size	12.2*18.6*2.8(±0.2)MM
Package	SMD-20
Wireless standard	Bluetooth 5.0
Frequency	2400~2483.5MHz
Maximum Tx power	Maximum 10.5dBm
Receiving Sensitivity	-93dBm
Interface	GPIO/PWM/SPI/ADC
Operating temperature	-40 ℃ ~ 85 ℃
Storage environment	-40 ℃ ~ 125 ℃ , < 90%RH
Power supply	The power supply voltage is 2.7V ~ 3.6V, and the power supply current is ≥ 50mA
Power consumption	Deep sleep pattern: 0.8 µA
	Sleep mode: 1.8 µA
	TX:21.56mA
Transmission distance	Outdoor open sight distance: ≥ 100 m

2.1. Static electricity requirements
TB-05 is an electrostatic sensitive equipment and requires special precautions during handling

Figure 2 ESD anti-static diagram

2.2. Electrical characteristics
Table 2 Table of Electrical Characteristics

Parameters		Condition	Min.	Typical value	Max.	Unit
Supply voltage		VDD	2.7	3.3	3.6	V
I/O supply voltage		VCCIO	-0.3	–	3.6	V
I /O	VIL	–	–	–	0.3*VDDIO	V
	VIH	–	0.7*VDDIO	–	VDDIO	V
	VOL	–	–	–	0.1*VDDIO	V
	VOH	–	0.9*VDDIO	–	VDDIO	V
Operating			-40	–	+85	°C
Storage			-40	–	+125	°C

2.3. BLE RF performance
Table 3 BLE RF Performance Table

Description	Typical value			Unit
Spectrum range	2400~2483.5MHz			MHz
Output power				
Rate mode	**Min.**	**Typical value**	**Max.**	**Unit**
1Mbps	7.1	8.5	10.5	dBm
Receiving sensitivity				
Rate mode	**Min.**	**Typical value**	**Max.**	**Unit**
1Mbps sensitivity @ 30.8% PER	–	-93	–	dBm

2.4. Power consumption
The following power consumption data is based on a 3.3V power supply, ambient temperature of 25°C, and measured using an internal voltage regulator.

- All measurements are completed at the antenna interface with a filter.
- All transmission data are measured in the continuous transmission mode based on the duty cycle of the 100%.

Table 4 Power consumption table

Mode	Min.	Average	Max.	Unit
Tx power consumption (10.5dBm)	–	21.56	–	mA
Rx consumption	–	6.4	–	mA
Standby power consumption	–	3	–	mA
Superficial sleep	–	1.8	–	µA
Deep sleep	–	0.8	–	µA

Appearance dimensions
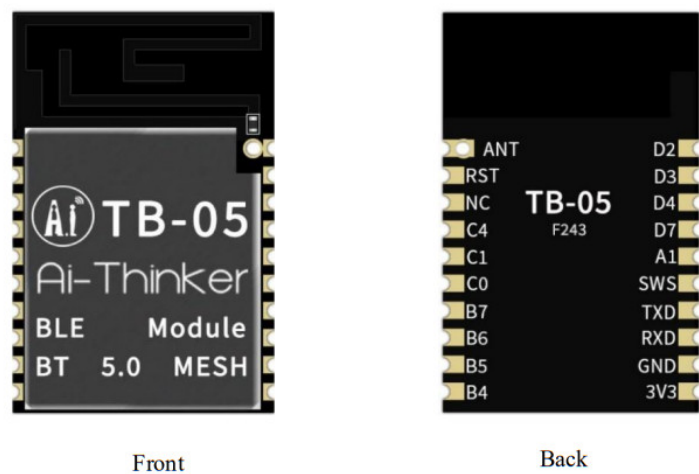

Front   Back
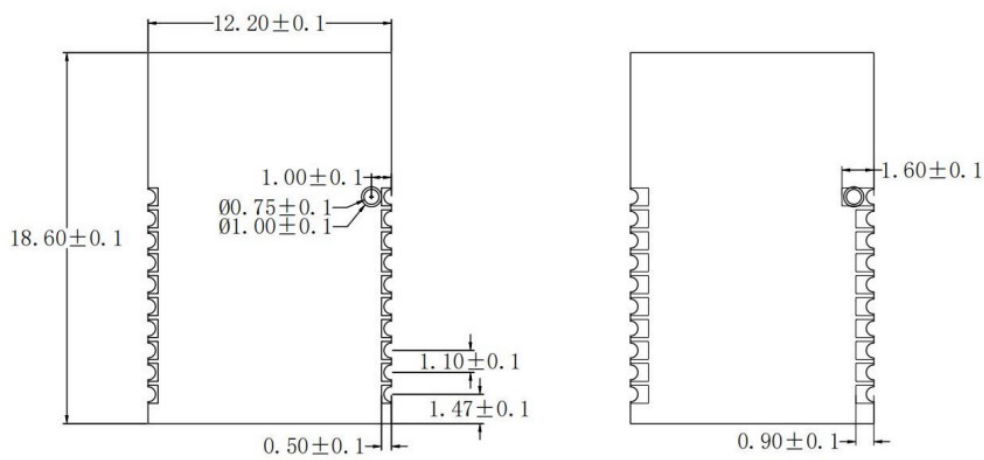
Figure 3 (for reference only)

Figure 4 dimension diagram (unit: mm)

Pin definition

TB-05 module has a total of 20 interfaces. As shown in below pin diagram, the pin function definition table is the interface definition.
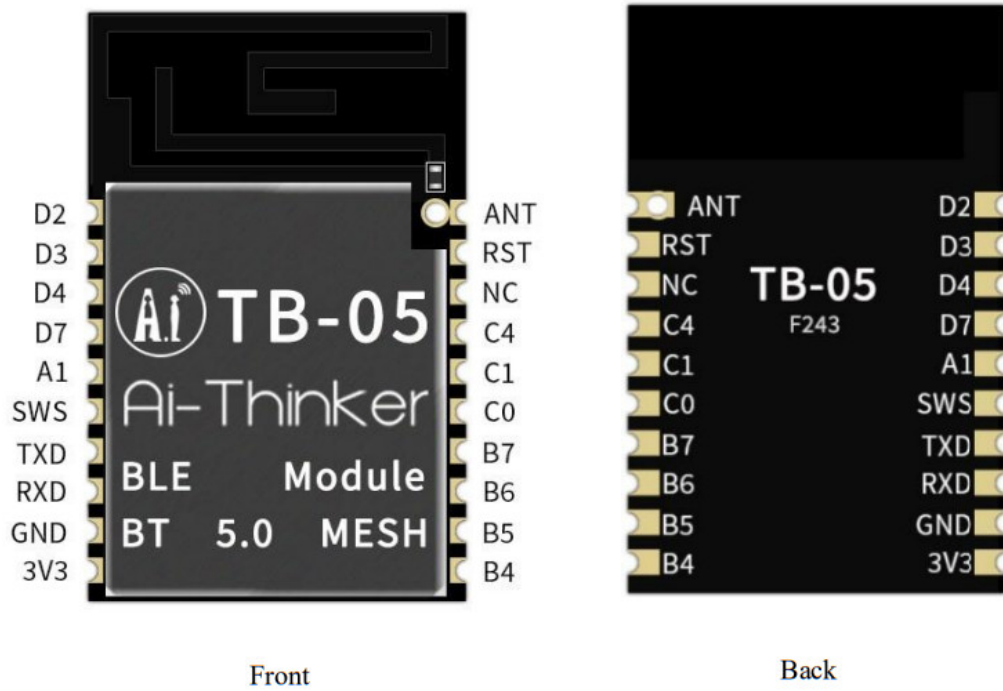
Front   Back

Figure 5 Pin Top View

Table 5 Pin Function Definition Table

| No.	Name	Function
1	D2	SPI chip selection (active low)/PWM3 output/GPIO PD2
2	D3	PWM1 reverse output/GPIO PD3
3	D4	GPIO PD4/single-wire host/PWM2 reverse output
4	D7	GPIO PD7/SPI clock (I2C_SCK)
5	A1	GPIO PA1
6	SWS	Single-wire slave
7	TXD	PWM4 output/UART_TX/SAR ADC input/GPIO PB1
8	RXD	PWM0 reverse output/UART_RX/GPIO PA0
9	GND	Ground
10	3V3	3.3V power supply
11	B4	PWM4 output/SAR ADC input/GPIO PB4
12	B5	PWM5 output/SAR ADC input/GPIO PB5
13	B6	SPI data input (I2C_SDA)/UART_RTS/SAR ADC input/GPIO PB6
14	B7	SPI data output/UART_RX/SAR ADC input/GPIO PB7
15	C0	I2C serial data/PWM4 reverse output/UART_RTS / GPIO PC0
16	C1	I2C serial clock/PWM1 reverse output/pwm0 output/GPIO PC1
17	C4	PWM2 output/UART_CTS/PWM0 reverse output/SAR ADC input
18	NC	NOT CONNECTED
19	RST	Reset pin
20	ANT	Antenna interface

Schematic
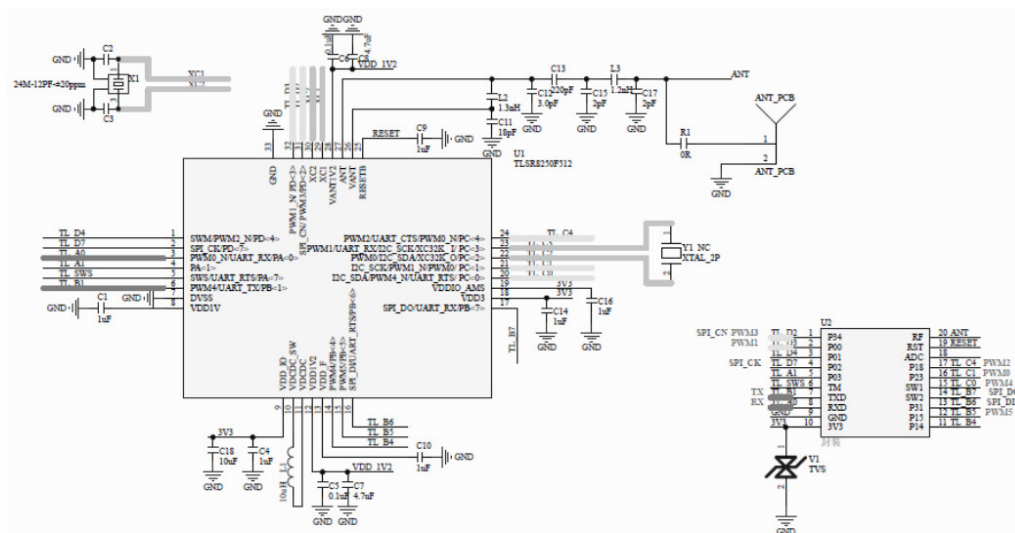
Figure 6 Schematic diagram

Antenna parameters

6.1. Schematic of Antenna Test Prototype

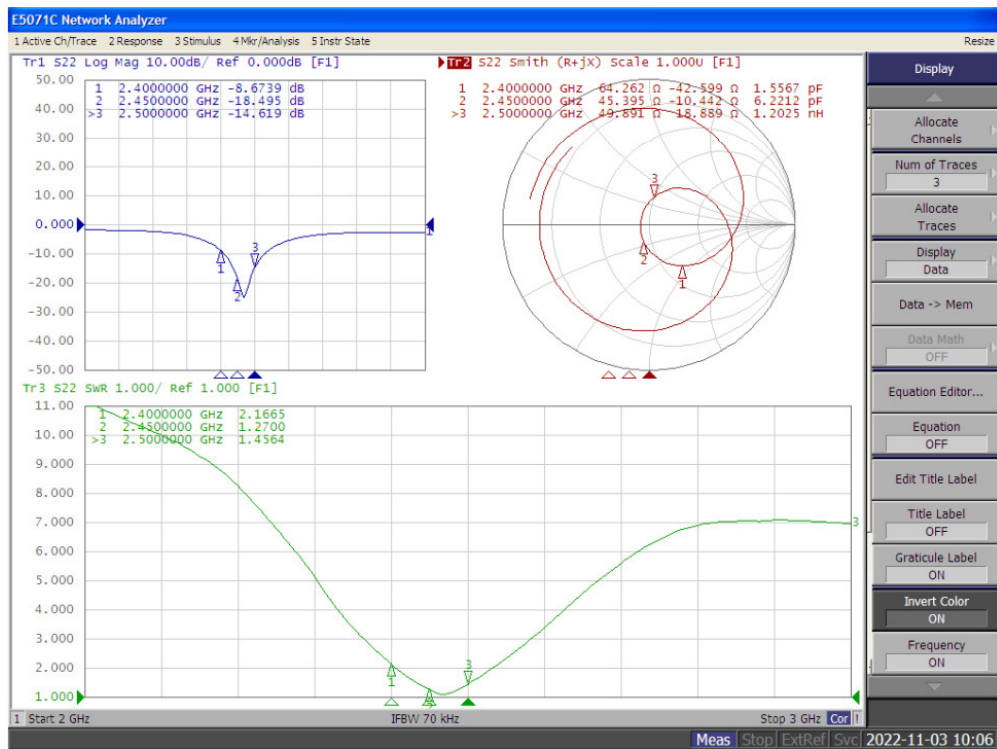**Figure 7 schematic diagram of antenna test prototype**

6.2. Antenna S parameter

Figure 8 Antenna S parameters

6.3. Antenna Gain and Efficiency
Table 6 Antenna Gain and Efficiency

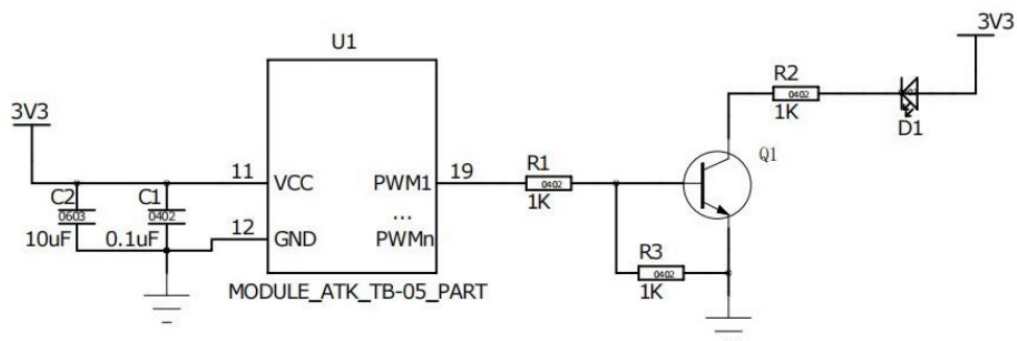| Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency(MHz)	2400	2410	2420	2430	2440	2450	2460	2470	2480	2490	2500
Gain(dBi)	0.11	0.19	0.53	0.66	0.90	1.31	1.52	1.60	1.64	1.51	1.28
Efficiency(%)	27.64	28.55	31.13	32.06	33.47	36.26	36.85	37.13	36.93	36.74	35.69

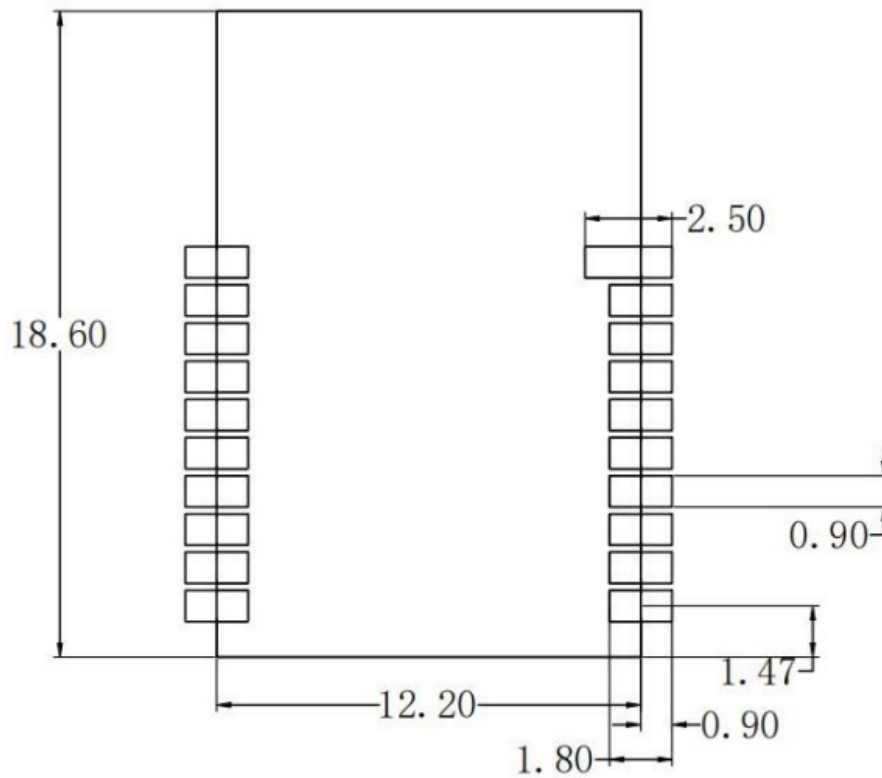## 6.4. Antenna field type diagram
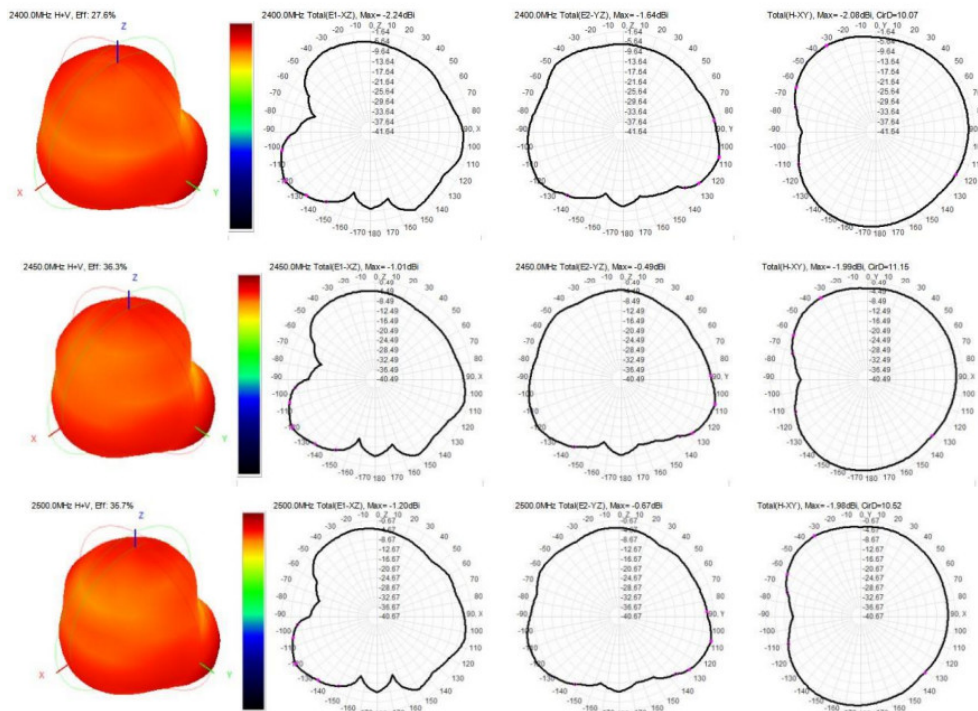
Figure 9 antenna field type diagram

Design guidance

7.1. Application guidance circuit

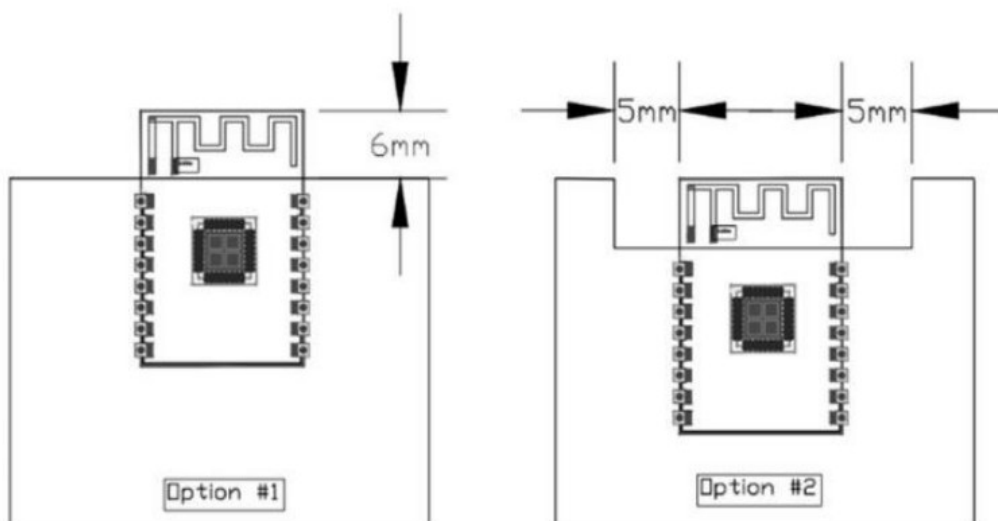Figure 10 Application Guidance Circuit

7.2. Recommended PCB package size

Figure 11 Recommended PCB Package Size (Unit: mm)

7.3. Antenna layout requirements

- In the installation position on the motherboard, the following 2 methods are recommended:

  Scheme 1: Place the module on the edge of the main board, and the antenna area extends out of the edge of the main board

  Scheme 2: Place the module on the edge of the motherboard, and the edge of the motherboard hollowed out an area at the antenna position

- In order to meet the performance of the on-board antenna, it is forbidden to place metal parts around the antenna, away from high-frequency devices

Figure 12 Antenna Layout

7.4. Power supply

- Recommended 3.3V voltage, peak current above 50mA
- LDO is recommended for power supply; If DC-DC is used, it is recommended that the ripple be controlled within 30mV
- The DC-DC power supply circuit suggests to reserve the position of the dynamic response capacitor, which can optimize the output ripple when the load changes greatly
- It is recommended to add ESD devices to the 3.3V power interface

Figure 13 DC-DC Buck Circuit Diagram

7.5. GPIO

- Some IO ports are led out from the periphery of the module. If you need to use a resistor of 10-100 ohms in series on the IO port. This can suppress overshoot and make the level on both sides more stable. It is helpful for both EMI and ESD
- For the up and down of the special IO port, please refer to the instructions in the specification, which will affect the startup configuration of the module
- The IO port of the module is 3.3V. If the level of the IO port of the main control and the module does not match, a level conversion circuit needs to be added
- If the IO port is directly connected to the peripheral interface or terminals such as pins, it is recommended to reserve ESD devices at the IO port wiring close to the terminals

Figure 14 Level convert Circuit

Storage conditions

- The product sealed in the moisture-proof bag should be stored in a non-condensing atmosphere of <40°C/90% RH.
- The moisture sensitivity level MSL of the module is level 3.
- After the vacuum bag is unpacked, it must be used within 168 hours at 25±5°C/60% RH, otherwise it needs to

be baked before it can be put on line again.
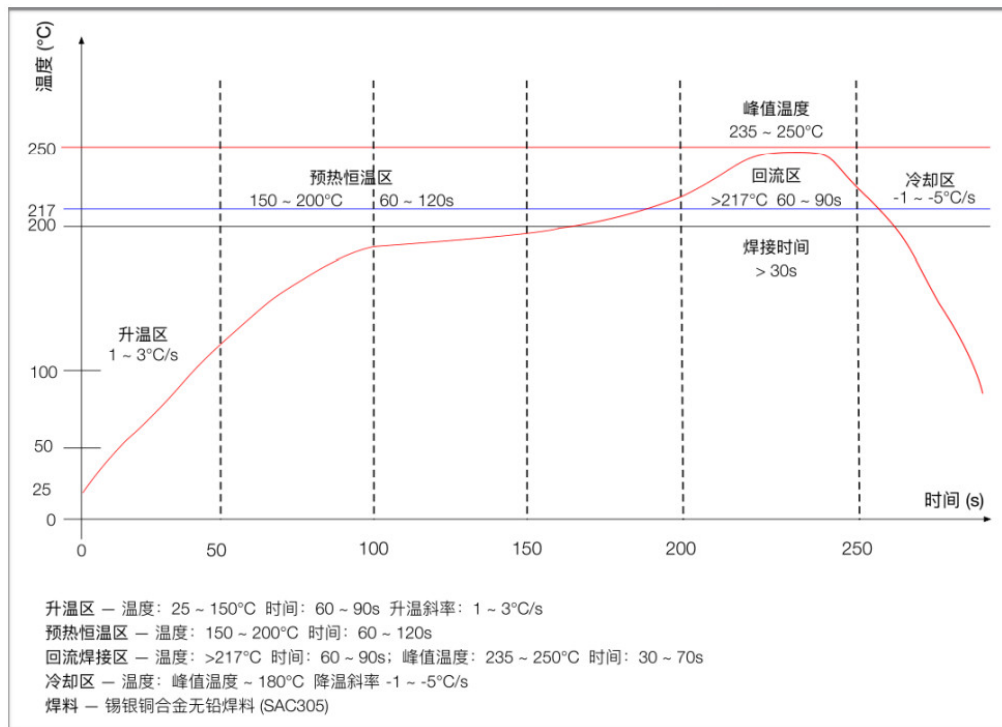
Reflow Welding Curve

Figure 15 reflow welding diagram

Product packaging information

TB-05 module is packaged in a tape, 1350pcs/reel. As shown in the below image

Figure 16 Package and packing diagram

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[Tmall shop](#)
[Taobao shop](#)
[Shenzhen Anxinke Technology Co., Ltd. – IoT wireless module, ESP8266/ESP32 modules (alibaba.com)](#)
Technic support email support@aithinker.com
Domestic business cooperation sales@aithinker.com

Wechat mini program

WeChat offical account

http://weixin.qq.com/r/Rjp4YNrExYe6rZ4D929U

Disclaimer and Copyright Notice

Notice

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01
2.2 List of applicable FCC rules
The TB-05 is an BT Module with GFSK modulation. It operates on the 2402MHz~2480MHz band and, therefore, is within U.S.
FCC part 15.247 standard
2.3 Specific operational use conditions
The EUT is a BT Module
BLE:
Operation Frequency: 2402-2480MHz for BLE;
Modulation Type: GFSK
Number Of Channel: 40 channels
Antenna Designation: PCB Antenna
Antenna Gain: 1.64dBi
Support BLE5.1,rate support: 1Mbps,2Mbps Own 64KB SRAM 256KB flash,96 KB ROM 256bit efuse

Support UART/GPIO/ADC/PWM/I2C/SPI/PDM/DMA interface Adopt SMD-22 package

Support multiple sleep modes,deep sleep current is less than 1uA

Support for serial local upgrade and remote Firmware upgrade(FOTA)

Universal AT instructions can be used easy and quickly

Support for secondary development, with an integrated Windows development environment

2.4 Limited module procedures

not applicable; Single Modular Approval Request

2.5 Trace antenna designs

Not applicable;

2.6 RF exposure considerations

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure

condition without restriction

2.7 Antennas

The TB-05 is an BT Module beams signals and communicates with its antenna, which is PCB Antenna. The PCB Antenna gain is 1.64dBi. Antenna could not be in no-load state when module is working. During debugging, it is suggested to add 50 ohms load to the antenna port to avoid damage or performance degradation of the module under long-time no-load condition.

2.8 Label and compliance information

The final end product must be label in a visible area with the following

Host must Contains FCC ID: 2ATPO-TB05. If the size of the end product is larger than 24x16mm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference and

2. this device must accept any interference received, including interference that may cause undesired operation.

2.9 Information on test modes and additional testing requirements

Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

2.10 Additional testing, Part 15 Subpart B disclaimer

The module without unintentional-radiator digital circuit, so the module does not required an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

ATTENTION

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 5 mm is maintained between the antenna and users, and

2. This device and its antenna(s) must not be co-located with any other transmitters except in accordance with FCC multi-transmitter product procedures. Referring to the multi-transmitter policy, multiple transmitter(s) and module(s) can be operated simultaneously without C2P.

3. For all products market in US, OEM has to limit the Operating Frequency: 2402-2480MHz by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the user manual of the end product, the end user has to be informed to keep at least 5mm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference and

2. this device must accept any interference received, including interference that may cause undesired operation.

FCC WARNING

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
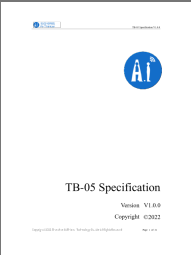
This equipment generate, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Documents / Resources

[**Ai Thinker TB-05 BLE5.0 Mesh Bluetooth Module**](#) [pdf] Owner's Manual
2ATPO-TB05, 2ATPOTB05, tb05, TB-05 BLE5.0 Mesh Bluetooth Module, TB-05, TB-05 Bluetooth Module, BLE5.0 Mesh Bluetooth Module, BLE5.0 Bluetooth Module, Mesh Bluetooth Module, Bluetooth Module, Module

References

- [🌐 _____ - ___](#)
- [🔶 **Shenzhen Anxinke Technology Co., Ltd. - IoT wireless module, ESP8266/ESP32 modules**](#)
- [🌐 ___ - ___](#)
- [🅐 **Hotspots | ___**](#)