

Lierda L-BTMEB26 Module Hardware Design Manual

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Status: Released

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Revision History

Document Version	Change date	Reviser	Reviewer	Change content
Rev1.0	24-02-24	CJH	YB	Initial version

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Safety Instructions

Users are responsible for complying with the relevant regulations on wireless communication modules and devices in other countries and specific environmental regulations. By following the following safety principles, personal safety can be ensured and help protect products and work environments from potential damage. Our company is not responsible for any losses related to customers' failure to comply with these regulations.



Safety first on the road! Do not use handheld mobile devices while driving unless they have hands-free functionality. Please pull over before making a call!



Please turn off your mobile devices before boarding. The wireless function of mobile devices is prohibited from being turned on in the aircraft to prevent interference with the aircraft communication system. Ignoring this prompt may compromise flight safety and even violate the law.



When in a hospital or health care facility, pay attention to whether there are restrictions on the use of mobile terminal devices. RF interference can cause medical devices to malfunction, so it may be necessary to turn off mobile terminal devices.



Mobile terminal devices do not guarantee effective connection in all situations, such as when there is no airtime on the mobile terminal device or the SIM card is invalid. In case of emergency situations with the above conditions, please remember to use emergency calls, ensuring that your device is powered on and in an area with sufficient signal strength.



Your mobile terminal device will receive and emit radio frequency signals when it is turned on, which may cause radio frequency interference when near a television, radio, computer, or other electronic devices.



Please keep mobile terminal devices away from flammable gases. When you are near gas stations, oil depots, chemical plants, or explosive operation sites, please turn off the mobile terminal devices. Operating electronic devices in any potentially explosive environment poses a safety hazard.

Module selection for application

Serial number	Module model	Support frequency band	Dimensions (mm)	Module introduction
1	L-BTMEB26	2.4 GHz ISM Band	19×12.9×3.1	Transmit firmware from the machine/onboard antenna

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1 Introduction

L-BTMEB26 Bluetooth module is a high-performance IoT Bluetooth transceiver developed based on the OM6626 chip platform. The module is packaged in a stamp type package with a built-in PCB antenna design. The product also features low power consumption, small size, rich resources, and strong anti-interference capability.



Figure 1.1 Module Diagram

2 Product Overview

2.1 Key Features

Parameters	Explanation
Wireless standards	BLE 5.4
Working frequency band	2400~2483.5MHz(2.4GHz ISM Band)
Antenna	Onboard PCB antenna
External Dimensions	19 mm × 12.9 mm × 3.1 mm
Operating voltage	2.0V to 3.6V, typical value is 3.3V
Launch current	4.6 mA@0 dBm, 3.3V, Typ
Receive current	3.8 mA@1M, 3.3V, Typ
Hibernate current	1.2 uA@3.3V, Typ
Transmission power	-30 ~ +8dBm
Operating temperature	-40 ~ +85°C
Storage temperature	-40 ~ +125°C
Communication interface	UART
Internal storage	1MB Flash +80KB RAM

2.2 Application Scenarios

- 2.4GHz low power Bluetooth system;
- PC, tablet, mobile phone, handheld devices, etc., low-power peripheral devices (HID, remote controls, etc.);
- Sports, healthcare and other consumer electronics products;
- Intelligent meters, data collection, and other wireless sensor networks;
- Photovoltaic, charging piles, industrial instruments, and other industries;

- Smart home, LAN, interactive devices, beacon lights.

2.3 Function Block Diagram

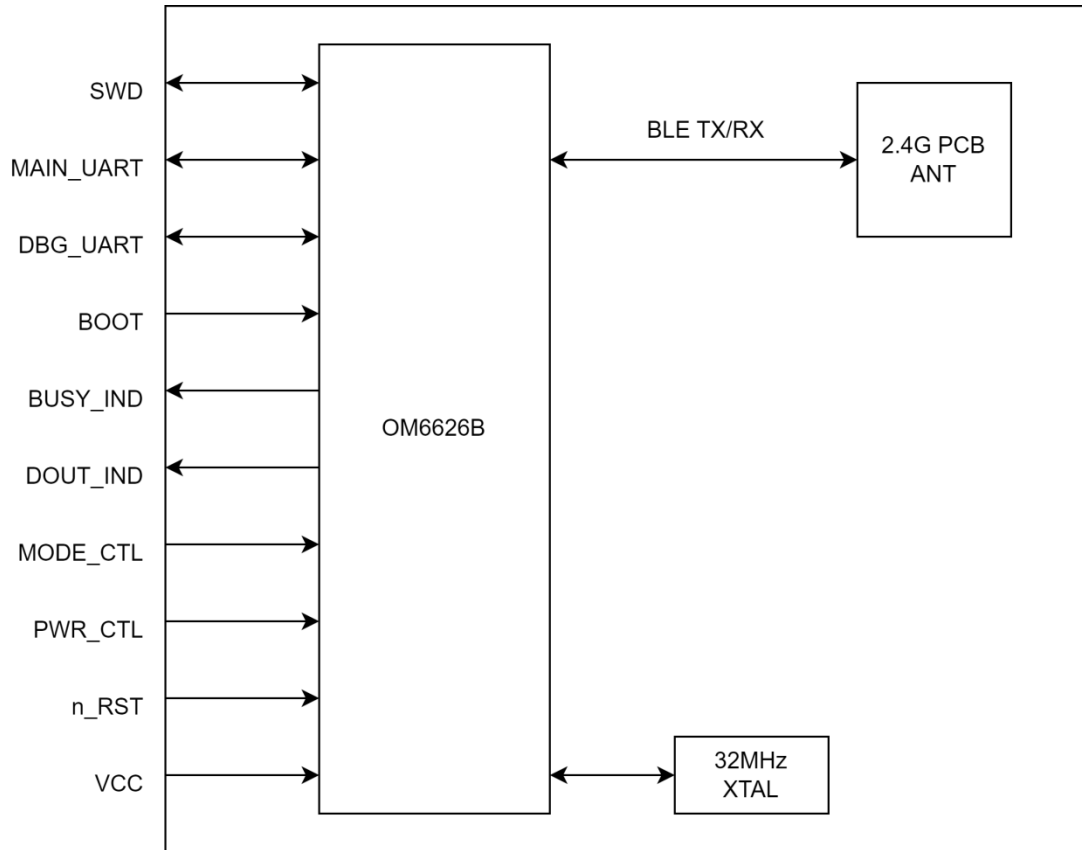


Figure 2.1 Functional Block Diagram

Note

(1) The antenna design of this model module is in the form of an onboard PCB antenna;

(2) This model module is designed without an external 32.768KHz crystal oscillator, using an internal RC form in the chip.

2.4 Pinout diagram

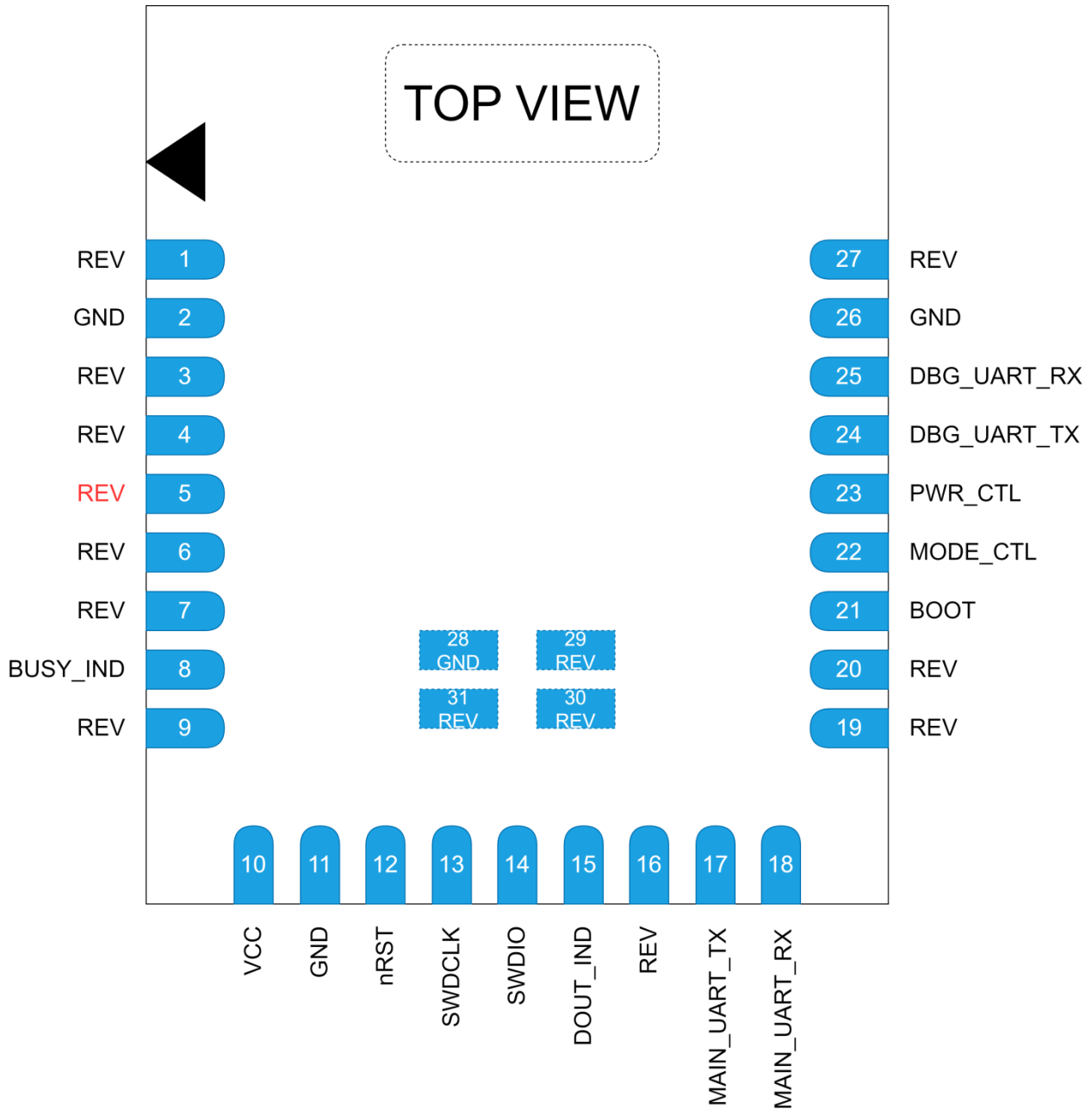


Figure 2.2 Pinout Diagram

2.5 Pin Description Table

Pins	Pin definition	I/O Type	Voltage	Function Description
1	REV	-	-	Reserved, suspended
2	GND	G	-	GND

3	REV	-	-	Reserved, suspended
4	REV	-	-	Reserved, suspended
5	REV	-	-	Floating (During product production testing, entering production test mode by powering on with low level at the test pin, users are prohibited from using)
6	REV	-	-	Reserved, suspended
7	REV	-	-	Reserved, suspended
8	BUSY_IND	IO	VCC	GPIO
9	REV	-	-	Reserved, suspended
10	VCC	P	3.3V	Main power input
11	GND	G	-	GND
12	nRST	IO	VCC	Low-level reset
13	SWDCLK	IO	VCC	SWD clock signal, debugging online in SWD mode with Jlink or Stlink.
14	SWDIO	IO	VCC	SWD data signal, debugging in SWD mode with Jlink or Stlink.
15	DOUT_IND	IO	VCC	Serial data indicator pin
16	REV	-	-	Reserved, suspended
17	MAIN_UART_TX	IO	VCC	Main serial port transmission pin, which is used for command configuration and data transmission.
18	MAIN_UART_RX	IO	VCC	Main serial port receive pin, which is used for command configuration and data transmission.
19	REV	-	-	Reserved, suspended
20	REV	-	-	Reserved, suspended
21	BOOT	IO	VCC	Burn the BOOT port. Before powering on, pull down the BOOT pin to enter the burning mode.
22	MODE_CTL	IO	VCC	Mode control pin (must not float)
23	PWR_CTL	IO	VCC	Hibernate control pin (must not be left floating)

24	DBG_UART_TX	IO	VCC	Debugging serial port burning, debugging information printing
25	DBG_UART_RX	IO	VCC	Debugging serial port burning
26	GND	G	-	GND
27	REV	-	-	Reserved, suspended
28	GND	G	-	GND
29	REV	-	-	Reserved, suspended
30	REV	-	-	Reserved, suspended
31	REV	-	-	Reserved, suspended

“P”:POWER “IO”:INPUT or OUTPUT “G”:GND

3 Job Characteristics

3.1 Power supply design

3.1.1 Power interface

The VCC pin is used to connect an external power supply, the interface description is as follows:

Table 3-1 Power Supply Pin Definitions

Pin number	Pin definition	Describe	Minimum value V	Typical value V	Maximum value V
10	VCC	Module power	2.0	3.3	3.6

The module's power supply range is 2.0~3.6V, ensuring that the voltage is not lower than 2.0V during operation.

3.1.2 Power supply design

Module EB26 recommends using 10uF and 0.1uF decoupling capacitors for the power supply pins. The capacitors should be placed as close as possible to the VBAT (VCC) power supply pin. The power supply voltage range is required to be 2.0 to 3.6V, typically powered by 3.3V. It is recommended to control the power ripple within 1% of VCC to avoid performance degradation due to excessive ripple.

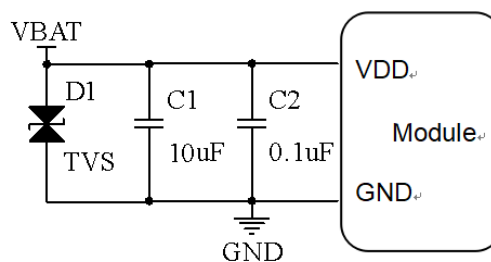


Figure 3.1 Power Supply Recommended Circuit

Note

(1) D1 is used for electrostatic protection. Users need to pay attention to the

electrostatic requirements of the product during design, as shown in Table 6-1 Product Absolute Maximum Ratings. If higher protection requirements are needed, it is recommended to externally place TVS diodes for electrostatic protection.

(2) When the module is completely without power and powered on, a transient high current of about 160mA may occur due to charging the internal capacitors of the module. If the power supply end of the module cannot provide a current higher than 160mA, it is recommended not to solder the 10uF and 0.1uF capacitors. Adding capacitors will increase the transient current during power-on.

3.2 Reset interface

Table 3-2 Reset Pin Definition

Pin number	Pin definition	Function Description
12	nRST	Reset pin, internally with 10KΩ pull-up.

3.2.1 Reset reference design

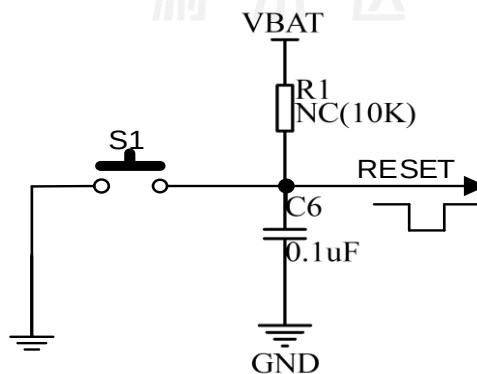


Figure 3.2 Reset Reference Circuit

Note

- ◆ The RESET pin is active low, and the low level should be held for more than 40us to take effect.
- ◆ The reset line should not be too long, pay attention to grounding protection, and

keep away from RF, VCC power sources, and strong signal interference sources.

◆ It is recommended to reserve a 10K pull-up resistor on the RESET pin of the module by default without soldering.

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4 Application Interface

The EB26 module provides the following application interfaces:

- ◆ 2-way control signal interface
- ◆ 2-channel status indicator interface
- ◆ 2-channel UART serial port
- ◆ 1. BOOT enters the burning mode interface.
- ◆ 1 SWD interface

4.1 Control signal

Table 4-1 Definition of Control Signal Pins

Serial number	Pin definition	Direction	Function Description
23	PWR_CTL	I	Hibernate control pin (must not be left floating)
22	MODE_CTL	I	Mode control pin (must not be left floating)

4.1.1 Hibernate control pin PWR_CTL

Table 4-2 Definition of Sleep Control Pins

Serial number	Voltage level logic	Status indicator
23	0	Wake up the module and do not allow it to enter sleep mode.
	1	Allow the module to enter sleep mode.

4.1.2 Mode control pin MODE_CTL

Table 4-3 Definition of Mode Control Pins

Serial number	Level logic	Status indicator
22	0	Enter and maintain command mode.
	1	Enter and maintain transparent mode.

4.2 Status indicator signal

Table 4-4 Definition of Status Indicator Signal Pins

Serial number	Pin definition	Direction	Function Description
15	DOUT_IND	O	Serial data indicator pin
8	BUSY_IND	O	Data congestion indication pin

4.2.1 Serial data indicator pin DOUT_IND

Table 4-5 Serial Data Indication Pin Definitions

Serial number	Voltage level logic	Status indicator
15	0	The module is about to send or is sending data to the MCU.
	1	The module has no data to send to the MCU at this time.

4.2.2 Data congestion indication pin BUSY_IND

Table 4-6 Data Congestion Indication Pin Definitions

Serial number	Voltage level logic	Status indicator
8	0	The MCU cannot continue to write data to the module, otherwise there is a risk of packet loss.
	1	MCU can continue to write up to 200 bytes of data to the module.

Note

The data congestion indication pin is only meaningful in transparent mode and meaningless in command mode.

4.3 UART communication

The EB26 module provides two UART communication interfaces, the main serial port and the debug interface. The main serial port is used for command communication and data transmission; the debug serial port is used for printing debug information and can also be used for firmware burning.

4.3.1 Main serial port MAIN_UART

Table 4-7 Main Serial Port Pin Definitions

Pin number	Pin definition	Function Description
17	MAIN_UART_TX	Serial data output pin
18	MAIN_UART_RX	Serial data input pin

The schematic diagram of the main serial port connection is as follows:

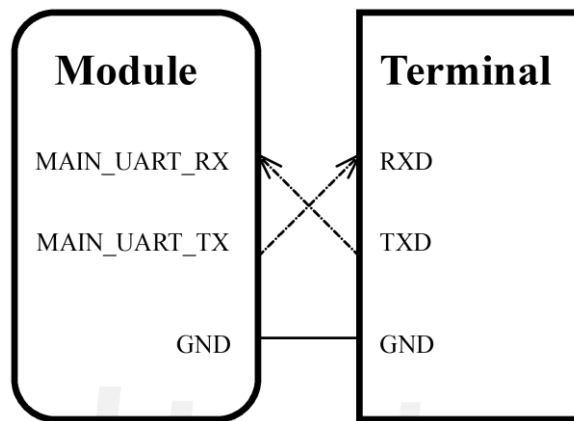


Figure 4.1 Schematic Diagram of the Main Serial Port Connection

4.3.2 Debugging serial port DBG_UART

Table 4-8 Debug Serial Port Pin Definitions

Pin number	Pin definition	Function Description
21	BOOT	Before powering on, pull down the BOOT pin to enter the burning mode.
24	DBG_UART_TX	LOG data output pin / serial programming output pin
25	DBG_UART_RX	Serial burning input pin

Debugging serial port characteristics:

- ◆ Printing for debugging information, fixed baud rate 921600bps;
- ◆ It can also be used for firmware burning, and the baud rate can be modified.

Burning serial port connection diagram is as follows:

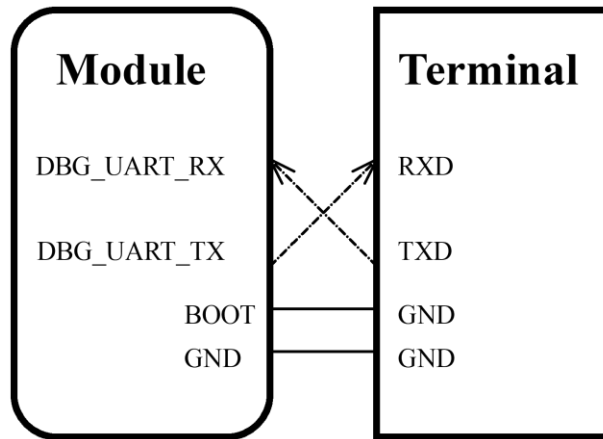


Figure 4.2 Debugging Serial Port Connection Diagram

Steps for firmware burning using serial port:

- ◆ First connect BOOT to GND;
- ◆ Connect UART_TX, UART_RX, and GND to the RXD, TXD, and GND of the communication partner;
- ◆ Then the module is powered on normally;
- ◆ Open the upper computer software, connect to the corresponding COM port, and the connection operation needs to be completed within 20 seconds after power-on.
- ◆ After the host computer is successfully connected, you can proceed with the burning operation.
- ◆ After burning, BOOT is suspended, then power on again, and the module enters normal working mode.

Note

Debugging function is for internal use only.

4.4 SWD debugging interface

4.4.1 SWD interface

Table 4-9 SWD Pin Definitions

Serial number	Pin definition	Function Description
21	BOOT	Before powering on, the BOOT pin needs to be pulled low to enter the burning mode.
13	SWDCLK	Clock pin in SWD mode
14	SWDIO	SWD mode data pin

Modules can be directly connected to the SWD interface for debugging and firmware burning using Jlink.

Note

(1)When using SWD for debugging, it is necessary to connect the reset pin for convenient debugging.

(2)When performing firmware burning operations, after connecting the SWD interface, you need to ground the BOOT first, then power on for firmware burning. After the burning is completed, power on again, and the module will enter the normal operating state.

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5 Radio Frequency Characteristics

The module has an on-board PCB antenna.

5.1 Radio Frequency Performance

The module supports BLE mode.

Table 5-1 BLE Performance Parameters

Performance	Description
Bluetooth standard	BLE5.4
Working frequency	2.4GHz ~ 2.4835GHz
Channel	LE: Ch0 ~ Ch39
Modulation method	GFSK
Transmit Power	-30dBm~8dBm
Sensitivity @ PER=30.8% for LE(1Mbps)	-98dBm
Sensitivity @ PER=30.8% for LE(2Mbps)	-95dBm
Maximum received signal level	0dBm

Note

- (1) Test conditions for Table 5-1: Temperature 25°C, power supply voltage 3.3V;
- (2) The transmission power of the module under different voltages at 25° C is shown in Figure 5.1 and Figure 5.2.
- (3) The transmission power under the extreme conditions of -40° C and +85° C, 2.0V and 3.6V can be seen in Figure 5.3.

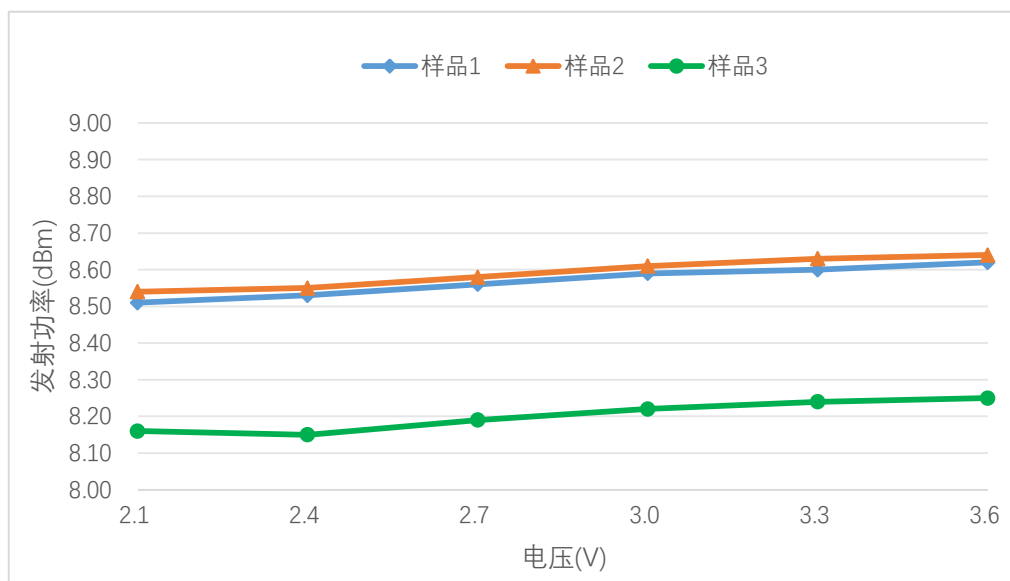


Figure 5.1 Transmit Power vs. Supply Voltage @ Power Configuration 8dBm, 25°C

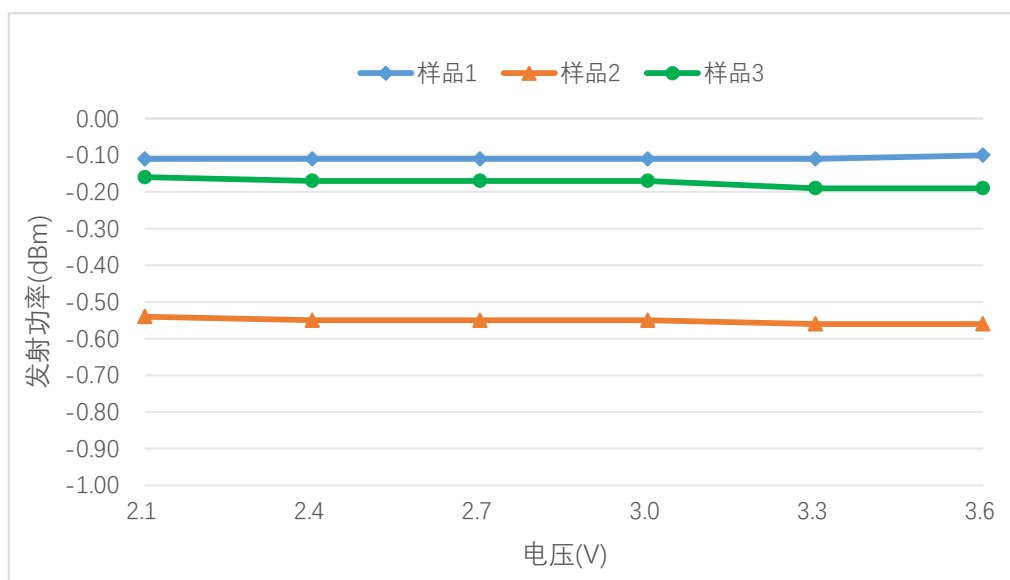


Figure 5.2 Transmit Power vs. Supply Voltage @ Power Configuration 0dBm, 25°C

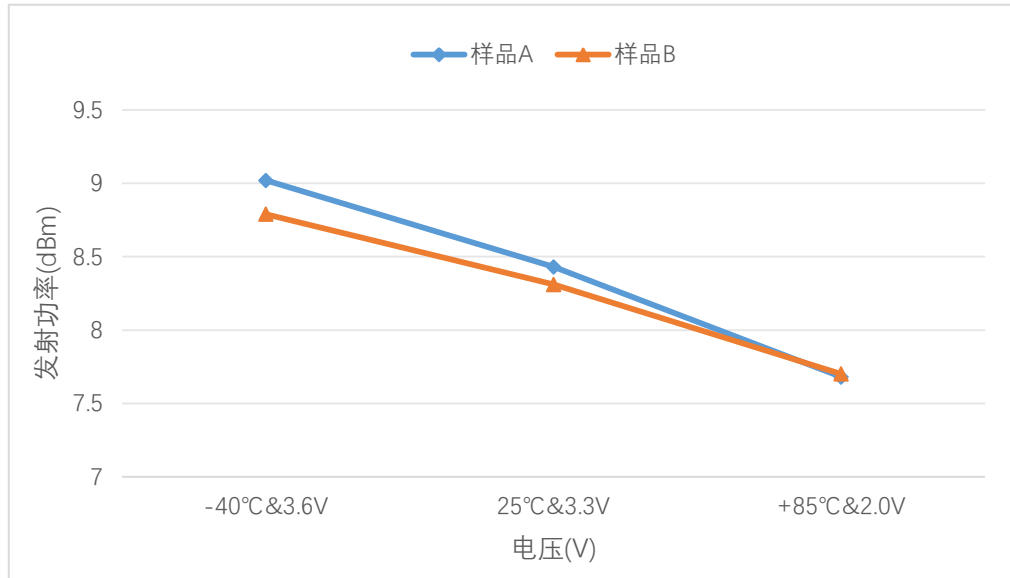


Figure 5.3 shows the curve of the transmitted power variation of the module under extreme conditions when the power configuration is 8dBm.

5.2 Onboard Antenna Application Instructions

There should be the largest possible clearance around the antenna. Clearance refers to the open area within the vertical projection area of the antenna (considering both top and bottom ranges). Within the antenna's projection area, whether it is a patch or side-insertion method, do not lay ground (especially for onboard antennas), do not have metal components, maintain the antenna's clearance to improve antenna radiation efficiency. The RF part of the module should be avoided from being enclosed by metal cavities as much as possible, and the distance between the RF part and the interference source should be at least 10mm (the larger the better if conditions permit). Common interference sources include: batteries (including battery connectors), capacitors, inductors, buttons, oscillators, power lines, screws or nuts containing metal, CPUs, LCDs, transformers, speakers, cameras, ribbon cables of internal communication interfaces, power circuits, motors, etc.

Layout requirements for the motherboard:

The PCB antenna of the module should be placed at the edge of the entire bottom PCB, with a 10mm spacing around the PCB antenna, and no copper, traces, or components should be placed around the antenna. If there are multiple antennas, the distance between antennas should be as far apart as possible to avoid co-frequency interference and intermodulation interference. If there are metal components within the vertical range around the antenna as shown in the figure, it is recommended to hollow out this area if pasted on the bottom board. The recommended copper area size in the yellow area in the figure should be at least 4cm×6cm.

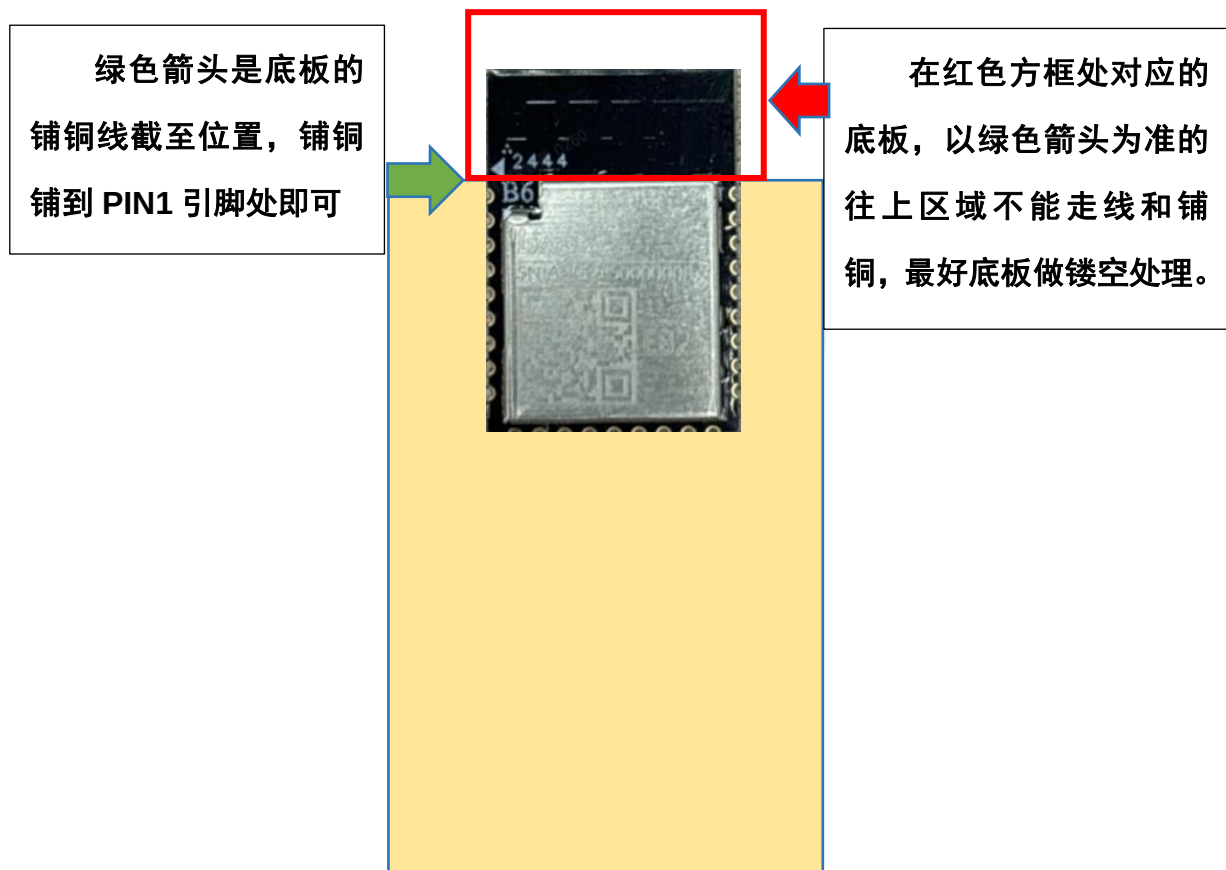


Figure 5.4 Module Placement Suggestion

Test points and interface solder pad description on the bottom layer of the module:

RF performance testing includes areas with exposed copper in the solder pads and some IO interfaces (i.e., exposed copper). No vias or exposed copper are allowed in the locations mapped to the bottom plate. Test points and unused IO interfaces should be covered with white oil to prevent short circuits. It is recommended that the routing or exposed copper on the bottom plate avoid the red boxed areas in the diagram below.

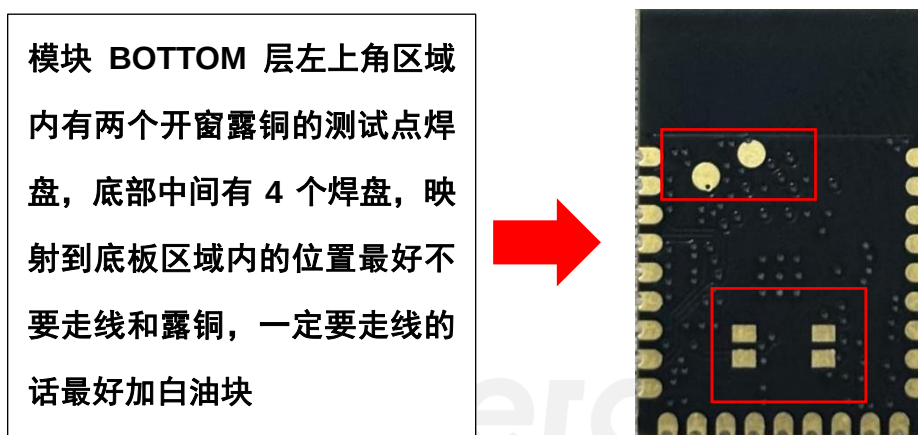


Figure 5.5 Position of test points solder pads on the module bottom

Layout requirements for the motherboard:

There are no high-speed or sensitive signal traces on the BOTTOM layer of the module, but it is still recommended to route the traces on the TOP layer of the baseboard away from the module to avoid unexpected influencing factors.

There are not many requirements for hollowing out in the bottom plate design, except for the general requirement mentioned earlier to avoid interference sources, the bottom plate can be almost fully covered with copper.

6 Electrical performance and reliability

6.1 Absolute maximum rating

Table 6-1 Product Maximum Ratings

Main Parameters	Performance		Note
	Minimum value	Maximum value	
Voltage (V)	2.0	3.6	-
IO Voltage (V)	-0.3	VCC	-
Storage Temperature (°C)	-40	125	-
Operating temperature (°C)	-40	85	-
V _{ESD}	±2KV		VCC&ANT ESD performance

Note

Exceeding the absolute maximum ratings may cause permanent damage to the device.

6.2 DC characteristics

Table 6-2 Module Operating Parameters

Main Parameters	Performance			Note
	Minimum value	Typical value	Maximum value	
Operating voltage (V)	2.0	3.3	3.6	Recommend VPP of Ripple to be less than 1% of VCC.
Launch current (mA)	/	4.8	/	@1Mbps,0dbm
	/	4.8	/	@2Mbps,0dbm
Receive current (mA)	/	4.1	/	@1Mbps
	/	4.4	/	@2Mbps

Hibernate current (μA)	/	1.2	/	Ultra Sleep mode
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Note

The data in Table 6-2 is tested under normal temperature of 25°C with 3.3V power supply.

6.3 Power consumption during work.

Table 6-3 Module Application Power Consumption Parameters

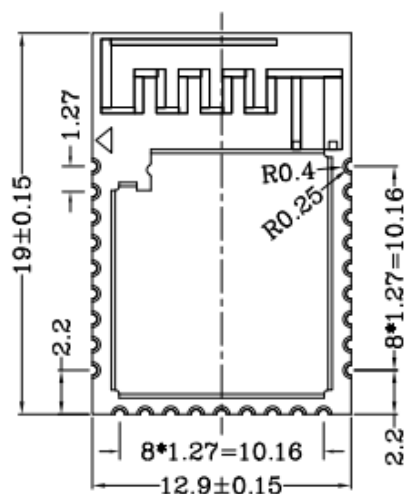
Working mode	Time interval (ms)	Power Consumption Data (uA)
Broadcast power consumption @1M, 0dBm	100	100.3
	500	22.9
	1000	13.1
	2000	7.4
	3000	5.8
Power consumption of connection @1M, 0dBm	100	57.3
	500	17.1
	1000	11.7
	2000	8.6

Note

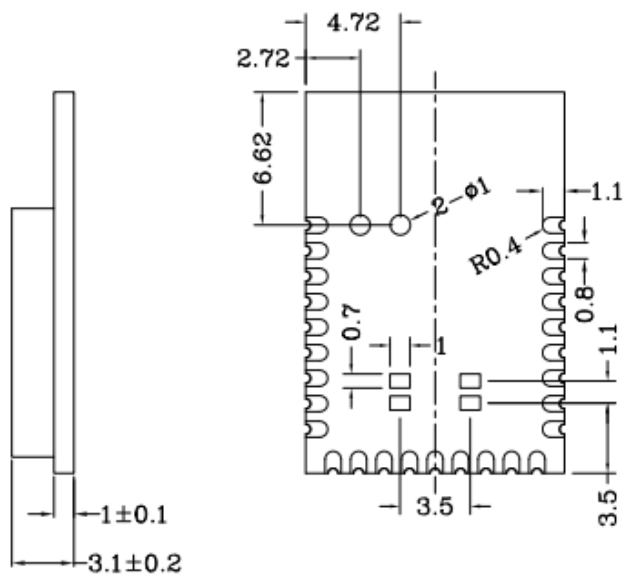
The data in Table 6-3 is tested under the condition of normal temperature 25° C and 3.3V power supply.

7 Mechanical dimensions

Dimensions	19 mm × 12.9 mm × 3.1 mm
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TOP Layer



BOTTOM Layer

Figure 7.1 Module Outline Dimensions

Note

The module has a lateral staggered rib cutting tolerance, and the module width ranges from 12.7mm to 13.1mm.

8 Production and packaging information

8.1 Production welding

8.1.1 Production guide

It is recommended to use SMT machine for patching the stamp mouth sealing module, and the patching should be completed within 24 hours after unpacking, otherwise, vacuum packaging needs to be re-drawn to avoid moisture causing poor patching.

If there is a humidity indicator card inside the package, it is recommended to determine whether the module needs to be baked based on the indication of the humidity card. The conditions for baking are as follows:

Baking temperature: $125^{\circ}\text{C} \pm 5^{\circ}\text{C}$;

The alarm temperature is set to 130°C .

After cooling to below 36°C under natural conditions, SMT placement can be carried out.

If the unpacking time exceeds 3 months, special attention should be paid to whether the product has been damp, because of the PCB immersion gold process, which may cause oxidation of the solder joints after more than 3 months, leading to problems such as false soldering and missed soldering during SMT.

To ensure the qualification rate of reflow soldering, it is recommended to randomly select 10% of the products for visual inspection and AOI detection during the first soldering process to ensure the rationality of furnace temperature control, component adsorption method, and placement method.

Operators at each workstation throughout the production process must wear antistatic gloves.

8.1.2 Module installation requirements on the baseboard

It is suggested that the green oil thickness of the bottom plate module position be less

than 0.02mm to avoid excessive thickness, which may cause the pad module to be unable to effectively contact the solder paste, affecting the welding quality. In addition, it is necessary to ensure that there are no other components within 2mm around the interface board module position to facilitate the maintenance of the module.

8.1.3 Steel mesh opening design

The thickness selection principle of the steel mesh on the bottom plate is generally selected based on the comprehensive consideration of the packaging type of the components inside the board, and the following requirements need to be focused on:

The module solder pad position can be locally thickened to 0.15~0.20mm to avoid voids in the solder joints.

8.1.4 Production notes

- During the production process, all operators must wear anti-static gloves.
- Baking should not exceed the specified baking time.
- Do not add explosive, flammable, or corrosive substances during baking;
- During baking, the modules should be placed in a high-temperature tray to ensure air circulation between the modules.
- When baking, make sure to close the oven door to ensure that the oven is sealed and prevent temperature leakage.
- Try not to open the oven door while it is running. If it is necessary to open it, try to shorten the door-opening time as much as possible.
- After baking, wait for the module to cool naturally to below 36°C before wearing electrostatic gloves to prevent scalding.
- Be careful not to let water or dirt get on the bottom of the module during operation.

8.1.5 Reflow soldering operation guide

Note: This assignment guide is only suitable for lead-free work and is for reference only.

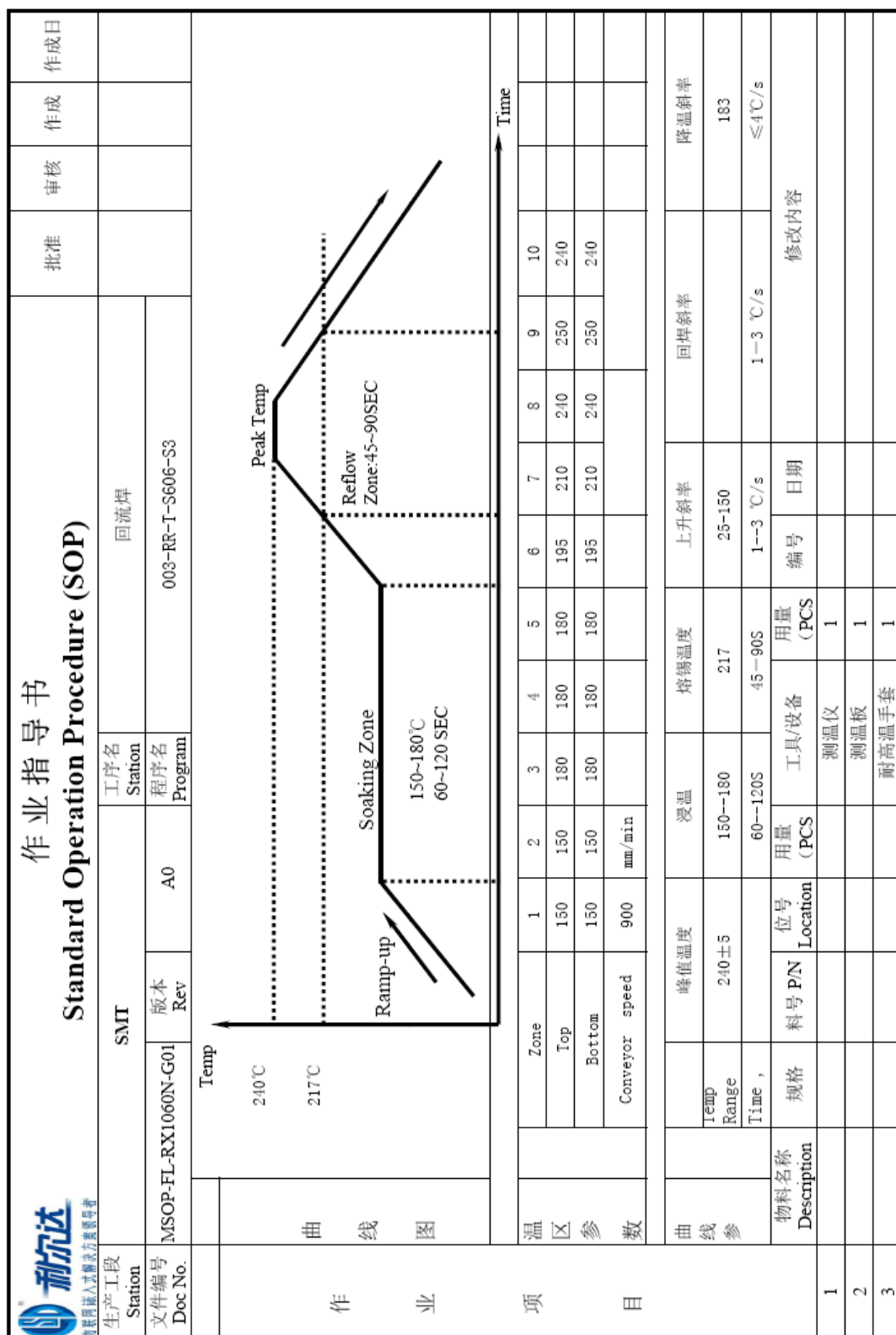


Figure 8.1 Reflow Soldering Operation Manual

8.2 Packaging specifications

8.2.1 Packaging method

Model	Packaging method	Carton (PCS)	Minimum packaging quantity (PCS)	Quantity per box of spools
L-BTMEB26	Roller belt	4000	800	5

8.2.2 Tape dimensions

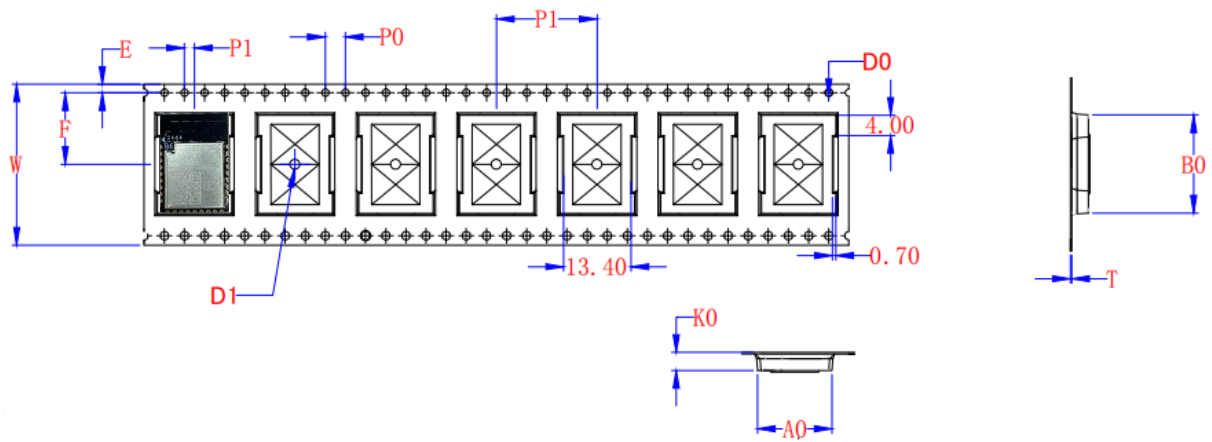


Figure 8.2: Tape Dimensions

FCC Warnings

This device complies with Part 15 of the 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.

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 generates, uses and can radiate radiofrequency 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.

The device has been evaluated to meet general RF exposure requirement, The device can be used in portable exposure condition without restriction. Federal Communication Commission (FCC) Radiation Exposure Statement Power is so low that no RF exposure calculation is needed.

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

ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2AOFDL-BTMEB26. Additionally, the following statement should be included on the label and in the final product's user manual: "This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interferences, and
- (2) this device must accept any interference received, including interference that may cause undesired operation."

The module is allowed to be installed in mobile and portable applications. A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.