

Datasheet

MS-BTD020R

Industrial Dual-Mode Bluetooth Module

Based on classic Bluetooth EDR2.0+BLE5.0

industrial grade low power Bluetooth chip

Version V1.1

1 Module Introduction

1.1 General Description

MS-BTD020R industrial grade dual-mode Bluetooth module is developed based on dual-mode BR/ EDR and LE series industrial grade low-power Bluetooth chips, which supports SPP, HID, GATT, ATT and other profiles. MS-BTD020R defaults to use UART as the programming interface, and the user can use the AT commands to read or write the configuration of the module via UART.

1.2 Key Features

- Fully compatible with low-power Bluetooth 5.0 and below standards
- Based on EDR+LE dual mode Bluetooth processor
- 2.4GHz Bluetooth RF Transceiver
- Peripheral Interface:
 - UART x2 (Supports up to 4M baud rate)
 - PWM x9
 - I2C x1
- Supports online simulation and debugging
- Protocols supported: SPP, HID, GATT, ATT, GAP
- Maximum transmit power 6dbm
- Maximum data transfer 50Kbyte/s
- Standby power consumption 2.0uA

1.3 Applications

- Industrial Instrumentation
- Bluetooth® printer
- Bluetooth POS

- Handheld terminals
- Medical devices
- Automotive electronics

Parameters	MS-BTD020R
Bluetooth® version	BR / EDR & LE5.0
Antennas	Ceramic Antenna / External Antenna
Frequency ranges	2.402 ~ 2.480 GHz
Throughput	50Kbyte/s
Autput power	+6dBm
Reception sensitivity	1/2/3Mbps:- 93dBm
RF Transmitter Current @0 dBm	VDD=3.3V, 17.9mA
Radio Frequency Receiver Current	VDD=3.3V, 18.5mA
Peripheral interfaces	GPIO:20 ADC: 5-channel 10-bit precision PWM:9 UART up to 4M baud rate
Flash	512 KB
Supply Voltage	3.0~3.6V
Operating temperatures	-40 to+85 °C (industrial grade)
Package Size	15mm*12mm*2mm

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2 Product Features

2.1 System Block Diagram

MS-BTD020R industrial dual-mode Bluetooth module is an embedded wireless communication module based on dual-mode BR / EDR and LE industrial-grade low-power Bluetooth chip development, can simultaneously support SPP, HID, GATT, ATT protocols, UART master-slave serial port through the UART, SPP transmission speed of up to 50KB / s; with low-power, strong signal, high reliability, It is characterized by low power consumption, strong signal, high reliability, high cost-effectiveness and so on. This module integrates MCU, wireless RF transceiver, Bluetooth 5.0 and other protocols, users only need to provide 3.3v power supply to the Bluetooth module to run independently.

MS-BTD020R industrial-grade dual-mode Bluetooth module provides a variety of standard interfaces for user convenience, including GPIO, UART, SPI, I2C, PWM, etc., and also provides AT commands for easy user operation and integration into the final product; suitable for use in industrial instrumentation, Bluetooth printers, scanner guns smart home, industrial Internet of Things and other applications.

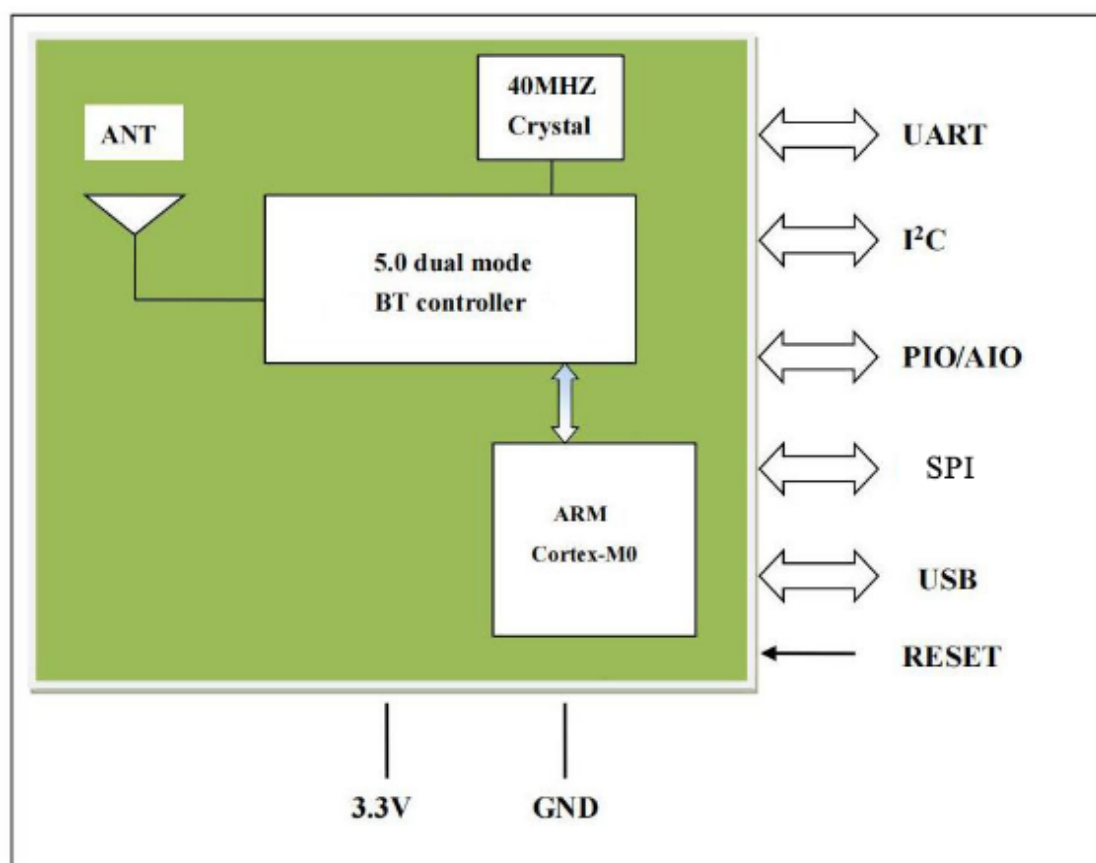


Figure 1 Functional module architecture diagram

2.2 Pin Characteristics

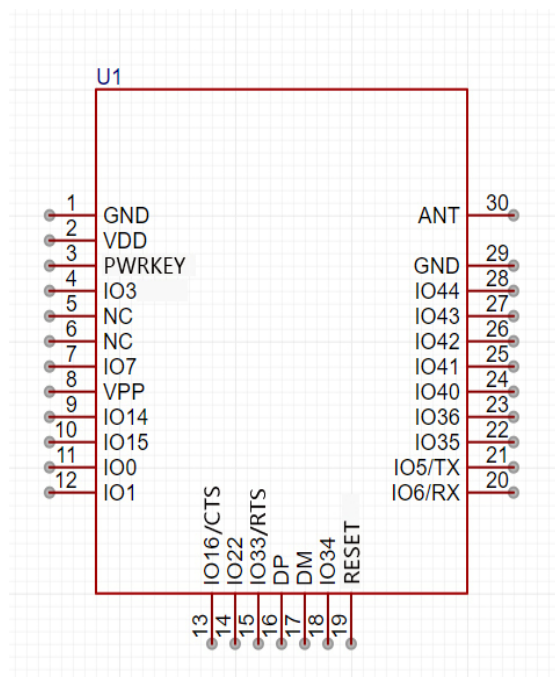


Figure 2 Bluetooth module pin diagram

Pin	Name	Type	Description
1	GND	V _{ss}	Power Ground
2	VDD	Power	Power Supply 1.8~3.6V
3	PWRKEY	—	—
4	IO3	GPIO	General Purpose I/O
5	NC	—	—
6	NC	—	—
7	IO7	GPIO	General Purpose I/O
8	VPP	—	—
9	IO14	GPIO	General Purpose I/O
10	IO15	GPIO	General Purpose I/O
11	IO0	GPIO	General Purpose I/O
12	IO1	GPIO	General Purpose I/O
13	CTS	Flow control	—
14	IO22	GPIO	General Purpose I/O
15	RTS	Flow control	—
16	DP	Burn Firmware	—
17	DM	Burn Firmware	—
18	IO34	GPIO	General Purpose I/O
19	RESET	RST	Power-on Reset
20	IO6/RX	Input	Uart Data Input 3.3TTL
21	IO5/TX	Output	Uart Data Output 3.3TTL
22	IO35	GPIO	General Purpose I/O

23	I036	GPIO	General Purpose I/O
24	I040	GPIO	General Purpose I/O
25	I041	GPIO	General Purpose I/O
26	I042	GPIO	General Purpose I/O
27	I043	GPIO	General Purpose I/O
28	I044	GPIO	General Purpose I/O
29	GND	Vss	Power Ground
30	ANT	Antennas	—

Table 1 Pin Description

3 Electrical Characteristics

3.1 Maximum Operation Rating

Parameters	Symbol	Min.	Typical	Max.	Unit	Notes
VDD voltage	VDD	3.0	3.3	3.6	V	
Operating temperature	TOT	-40	25	+85	° C	

Table 2 Absolute max. operating ratings

Note:

1. At room temperature.
2. Maximum Ratings are those values beyond which damage to the device may occur.
3. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability.
4. Functional operation under absolute maximum-rated conditions is not implied and should be restricted to the Recommended Operating Conditions.

Parameters	Symbol	Min.	Typical	MAX.	Unit	Notes
TX RF Current @Pout = 0dBm			17.9		mA	VDD = 3.3V
RX RF Current @Sensitivity level			18.5		mA	VDD = 3.3V
Supply Current @ Sleep	ISLEEP	—	100	—	μA	
Supply Current @ Deep Sleep	IPD	—	2.0	—	μA	

Table 3 DC characteristics

Parameters	Symbol	Min.	Typical	MAX.	Unit	Notes
Storage Temperatures	TS	-40	—	1	° C	
Lead-free Solder Temperature	TP	—	—	2	° C	

Table 4 Temperature range

3.2 Recommended Operating Conditions

Parameters	Symbol	Min.	Typical	MAX.	Unit	Notes
Ambient Temperature	TA	-40	25	85	° C	
Power Supply Voltage	VDD	3.0	3.3	3.6	V	Buck DCDC Power input supply

Table 5 Recommended Operating Conditions

Note: It does not guarantee the performance if the operating temperature is beyond the specified

3.3 RF

Parameters	Numerical Values
Antennae	PCB on board antenna
Frequency range	2.402 ~ 2.480 GHZ
Data transfer rate	1Mbps, 2Mbps , 3Mbps
Maximum data transfer volume	SPP 50KB/s
RF reception sensitivity	1/2/3Mbps:-93dBm
RF maximum output power	Max.6dBm+

4 Hardware Design

Do not place metal objects or route around the antenna 2mm, it is recommended to hollow out the underside of the antenna. As metal has a shielding effect on electromagnetic signals, try to avoid using metal enclosures.

4.1 Reference Schematics

4.2 Power Supply Design

Note: MS-BTD020R-L Bluetooth module has certain requirements for the power supply circuit.

The ripple coefficient of the 3.3V supply voltage should be less than 200mV, the minimum output current should be greater than 20mA (the choice of the 3.3V regulator needs to be determined by the actual circuit current).

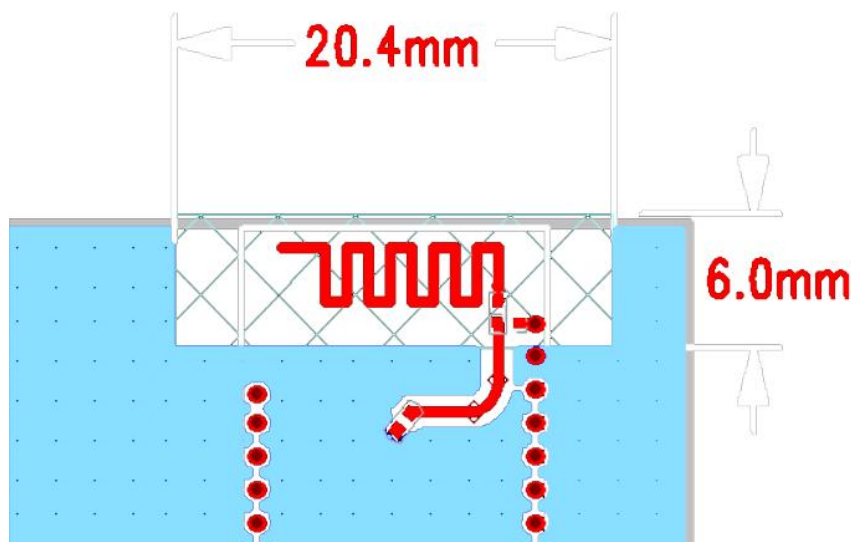
4.3 Layout Guidelines

It is strongly recommended to use good layout practices to ensure proper module operation, placing copper or any metal close to the antenna will affect antenna performance and thus deteriorate antenna efficiency.

The metal shielding around the antenna will stop the signal from radiating, therefore metal enclosures should not be used with the module, please use more ground over holes at the edge of the grounded area, the following recommendations will help to avoid EMC problems in the design.

Please note that each design is unique, the following descriptions do not take into account all basic design rules, such as avoiding capacitive coupling between signal lines; the following descriptions are intended to avoid EMC problems caused by the RF part of the module and should be considered with care, to avoid problems with the digital signals in the design. Ensure that the loops of the signal lines are as short as possible.

E.g.: If the signal enters the inner layer via the through-holes, always use ground through-holes around the pads. And place them closely and symmetrically around the signal through-holes. Any sensitive signal routing and loops should be done on the inner layer of the PCB as far as possible. Sensitive signal lines should have a ground surround above and below them. Make sure that the return path is the shortest possible (e.g. use a ground wire next to the signal wire).

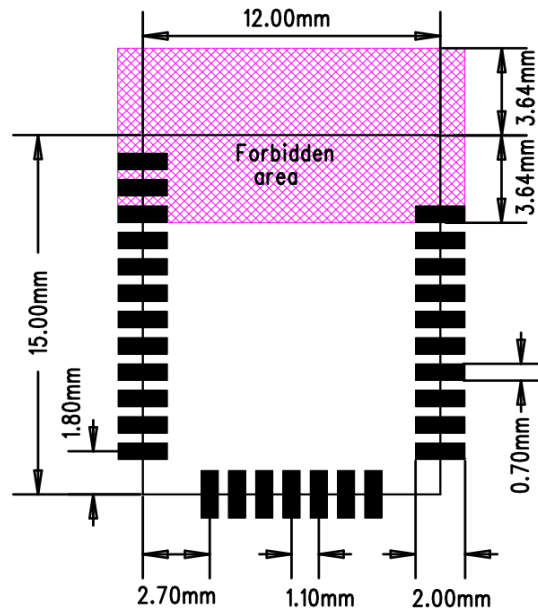


4.4 Mechanical Details

Module Nominal Size: 15mm (L) × 12mm (W) × 2mm (H) Tolerance: ±0.2mm

Pad radius R: 0.35mm

Pad pitch: 1.5mm



5 Product Treatment

5.1 Storage Conditions

Products sealed in moisture-proof bags (MBB) should be stored in a non-condensing atmosphere at <40 ° C/90% RH. The module has a moisture sensitivity class MSL of 3. After unpacking the vacuum bag, it must be used within 168 hours at 25±5 ° C and 60% RH, otherwise it needs to be baked before it can be put on line a second time.

5.2 Baking Conditions

Modules must be baked at 120+5° C for 8 hours, the second-baked module must be soldered within 24 hours after baking, otherwise they must still be stored in the drying oven.

5.3 Reflow Soldering

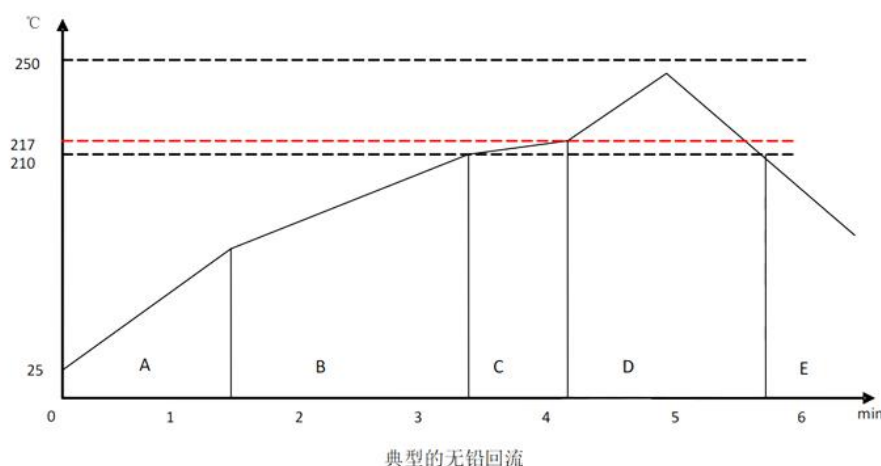
Before any reflow soldering is carried out, it is important to ensure the modules are packaged in moisture-proof package. The package contains a desiccant (to absorb moisture) and a humidity indicator card to show the level of dryness to be maintained during storage and shipment. If it is necessary to bake the module, please check the table below and follow the instructions specified in IPC / JEDEC J-STD-033.

MSL	125°C 烘烤温度		90°C/≤ 5%RH 烘烤温度		40°C/≤ 5%RH 烘烤温度	
	饱和的 @ 30°C/85%	最低的限制 + 72 小时@ 30°C/60%	饱和的@ 30°C/85%	最低的限制 + 72 小时@ 30°C/60%	饱和的@ 30°C/85%	最低的限制 + 72小时@ 30°C/60%
3	9 小时	7 小时	33 小时	23 小时	13 天	9 天

Note: The tray must not be heated above 65° C. If the high temperature baking method (above 65° C) in the table below is used, the module must be removed from the tray.

Any module that has been unpacked and not surface mounted within a specified time should be repackaged. Effective desiccants and humidity indicator cards should be placed inside the package. MSL (moisture sensitivity level) 3 modules should be stored in the air for less than 168 hours at an ambient temperature of 30° C / 60% RH. The recommended baking time and temperature are as follows:

The design of surface mount modules is easy to manufacture, including reflow soldering to the PCB main board. Ultimately, it is the responsibility of the customer to choose the appropriate solder paste and ensure that the furnace temperature during reflow meets the requirements of the solder paste. Surface mount modules conform to the J-STD-020D1 standard for reflow soldering temperatures. The soldering configuration file depends on the various parameters that need to be set for each application. The data here is only used for reflow soldering guidance.



Pre-heat zone (A) - This zone is heated up at a controlled rate, typically 0.5-2° C / s. The purpose of this zone is to preheat the PCB board and components to 120 to 150° C. This stage is required to distribute the heat evenly across the PCB board and to completely remove the solvent to reduce thermal shock to the component.

Equilibrium Zone 1 (B) – During this stage the flux becomes soft and evenly encapsulates the solder particles and spreads them across the PCB board to prevent them from being re-oxidized. As the temperature increases and the flux liquefies, each activator and rosin is activated and begins to remove the oxide film that has formed on each solder pellet and the PCB board surface. For this area, temperatures of 150° to 210° and times of 60 to 120 seconds are recommended.

Equilibrium zone 2 (C) (optional) – To solve the problem of upright parts it is recommended to keep the temperature at 210 – 217 for approximately 20 to 30 seconds.

Reflow zone (D) – The curve shown is designed for Sn / Ag3.0 / Cu0.5. It can be used as a reference for other lead-free solders. The peak temperature should be high enough to achieve good wettability, but not so high as to cause discoloration or damage to the component. Too long a soldering time can lead to intermetallic growth which can result in brittle solder joints. The recommended peak temperature (Tp) is 230 to 250° C. At temperatures above 217° C, the soldering time should be 30 to 90 seconds.

Cooling Zone (E) – The cooling rate should be very fast to keep the solder grains small, which will provide a longer lasting solder joint. A typical cooling rate should be 4° C.

5.4 Package Specifications

Tray package: Min. package 3000pcs

Tray size: 50pcs/tray

6 Release History

Version number	Date	description
1.0	2023.11.15	New construction
1.1	2024.09.03	Modifying Pin Definitions

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.

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.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

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 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.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

