

MuYu

MY-BT501

BLE 5.2+2.4G Data Module

Version 1.0

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1.0	2020/06/01	Initial version

Shenzhen Muyu Technology Co., Ltd

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1 Introduction

1.1 Overview

MY-BT501 is a Bluetooth Low energy 5.2+2.4G module from Shenzhen Muyu Technology Co., Ltd., which supports HID, GATT, ATT and other profiles. MY-BT501 uses UART as a programming interface, users can use AT commands to read or write the configuration of the module through UART.

1.2 Features

- BLE 5.2+2.4G (private protocol) SoC
- Stamp hole package
- Support serial port upgrade
- Support UART Communication
- The default UART baud rate is 115200bps, which can support 4800bps to 921.6Kbps
- Support BLE speed: 125kbps、125kbps、500kbps、1Mbps、2Mbps
- TX transmit power: -40dBm to 14dBm
- Work Temperature: -40°C ~ 125°C
- Operating Voltage Range: 2.3V~3.6V
- Automatic Low Power Mode DC/DC and LDO Regulators
- In Power Off mode, 1.8 uA @3.3V
- In BLE/2.4G mode, Tx peak current 7.8mA (with DCDC @3.3V, @ 0 dBm, XOSC 16MHz)
- In BLE/2.4G mode, Rx peak current 7.8mA (with DCDC @3.3V, XOSC 16MHz)

1.3 Application

- Bluetooth printer
- Health and medical equipment
- Wireless POS
- Measuring and monitoring system
- Industrial sensors and controls
- Bluetooth Digital Key

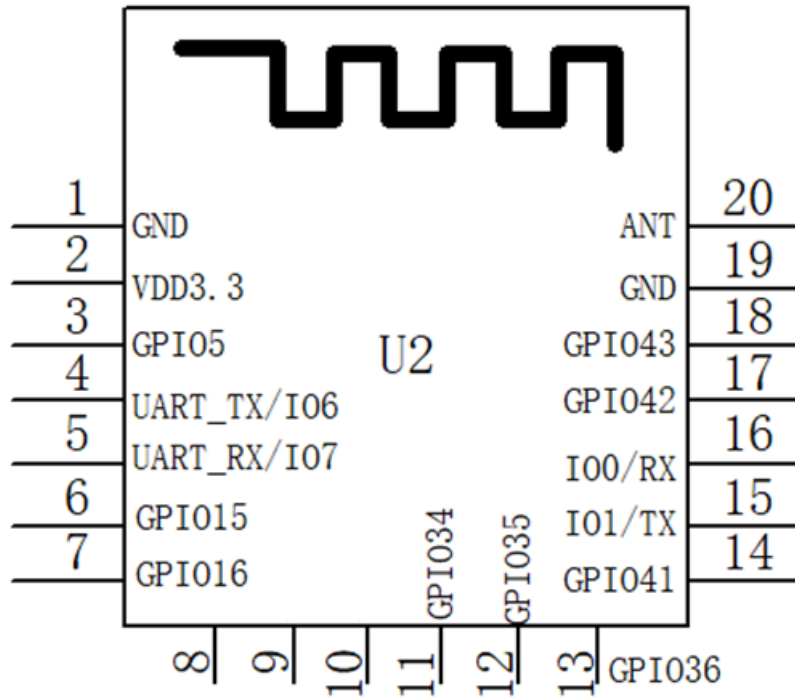
2 General Specification

Table1:

Feature	Specification
Model	MY-BT501
Dimensions	10mm(W) X 16mm(L) X 2.2mm(H)
Bluetooth Version	Bluetooth 5.2 Low Energy
Operating Voltage Range	2.3 ~ 3.6V
Transmit Power	14 dBm (Max)
Receive Sensitivity	-100 dBm @1Mbps BLE -97.5 dBm @2Mbps BLE -102 dBm @500kbps BLE
Frequency	2.402GHz -2.483GHz ISM band
Modulation	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Crystal	24MHz
Hopping & Channels	1600hops / sec 1MHz channel space 80 Channels
RF Input Impedance	50 Ω
Antenna	PCB Antenna (Support external antenna)
Interface	UART/I ² S
Profile	HID, GATT, ATT
Other	Low Energy
Work Temperature	-40°C to +125°C
Storage Temperature	-40°C to +105°C
Humidity	10%~95% Non-Condensing
Environmental	RoHS Compliant

3 Hardware Specification

3.1 Pin Definition Diagram



3.2 PIN Definition Descriptions

Table2:

Pin	Pin Name	Type	Pin Descriptions
1	GND	GND	Power Ground
2	VDD	VDD	3.3V
3	GPIO5	I/O	Established Bluetooth, High level is Command Mode; low level is throughput mode
4	UART_RX	I/O	Module's RX Connect to Host's TX
5	UART_TX	I/O	Module's TX Connect to Host's RX
6	GPIO15	I/O	Programmable input/ output line
7	GPIO16	I/O	The rising edge disconnects the Bluetooth connection
8	PWRKEY		Reset: Active Low

9	NC		
10	NC		
11	GPIO34	I/O	Programmable input/ output line
12	GPIO35	I/O	Programmable input/ output line
13	GPIO36	I/O	Programmable input/ output line
14	GPIO41	I/O	Low level: operation mode; high level: sleep mode
15	UART2_TX	I	Debugging through the clk line (Default)
16	UART2_RX	I	Debugging through the clk line (Default)
17	GPIO42	I/O	Bluetooth LED
18	GPIO43	I/O	High level: Bluetooth connected; low level: Bluetooth is not connected
19	GND	GND	Antenna's GND
20	ANT	ANT	External Antenna Port

4 Physical Interface

4.1 General Purpose Analog IO

13 general-purpose GPIOs are defined in the module. All these GPIOs can be configured through firmware to realize various functions, such as button control, LED drive or interrupt signal of the main controller. Hang in the air when not in use, no need to connect to any circuit. The I/O type of each I/O pin can be individually configured as input or output mode by firmware

4.2 RF Interface

- 2402–2480 MHz Bluetooth 5.0
- Maximum transmit power: 14dBm
- RX Sensitivity -100 dBm@1Mbps BLE -97.5 dBm@2Mbps BLE -102 dBm@500kbps BLE -107 dBm@125kbps BLE

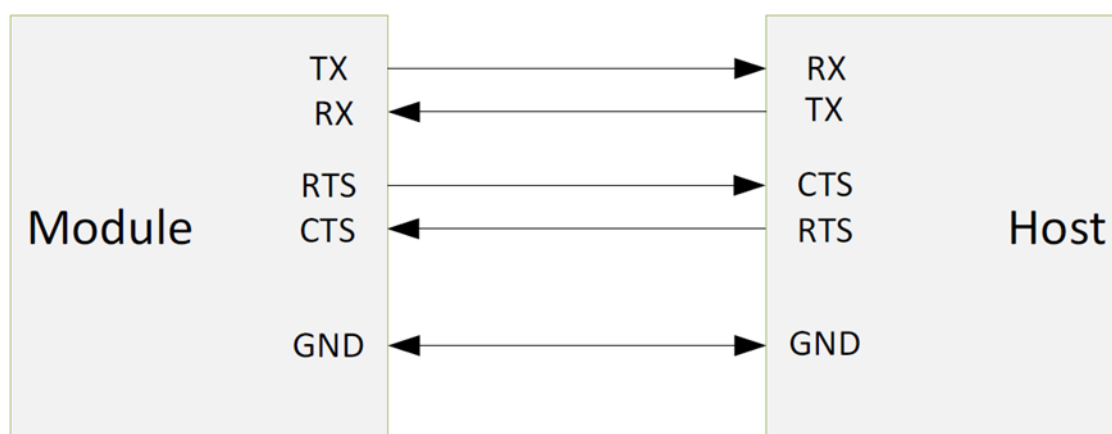
4.3 UART Interface

The four signal pins are used to implement the UART function. When MY-BT501 is connected to another digital device, UART_RX and UART_TX transfer data between the two devices. The remaining two pins, UART_CTS and UART_RTS, can be used to implement RS232 hardware flow control, and they are both active at low level, that is, transmission is allowed at low level and stops at high level

Table 3: UART Parameter

Parameter	Value	
Baudrate	Minimum	4800 baud ($\leq 2\%$ Error)
	Default	115200bps($\leq 1\%$ Error)
	Max	921600bps($\leq 1\%$ Error)
Flow control	RTS/CTS, (Default none)	
Parity	None, Odd or Even	
Number of stop bits	1	
Bits per Channel	8	

When connecting the module to a host, please make sure to follow



UART Connection

4.4 Analog to Digital Converter (ADC)

12-bit SAR ADC engine with conversion rate up to 1 MSPS

Conversion range: VSSA to VDDA (2.3 to 3.6V)

Temperature sensor

The device integrates a 12-bit 1us multi-channel ADC. The conversion range is 2.3 V < VDDA < 3.6 V. The analog watchdog module can be used to detect channels that need to be kept within a specific threshold window. The configurable channel management module of analog input can also be used to perform conversion in single, continuous, scan or discontinuous mode to support more advanced usage. The ADC can be triggered by events generated by the universal timer (TMx) and the advanced control timer (TM1) with internal connections. The temperature sensor can be used to generate a voltage that varies linearly with temperature. Each device is factory calibrated to improve accuracy, and the calibration data is stored in the system storage area.

5 Electrical Characteristics

5.1 Absolute Maximum Ratings

The absolute maximum ratings of the supply voltage and voltage on the digital and analog pins of the module are listed below. Exceeding these values will cause permanent damage. The average GPIO pin output current is defined as the average current value flowing through any corresponding pin in a 100ms period. The total average GPIO pin output current is defined as the average current value flowing through all corresponding pins in a 100ms period. The maximum output current is defined as the peak current value flowing through any corresponding pin.

Table4: Maximum Ratings

Parameter	Min	Max	Unit
V _{IN} - I/O (VDDIO)	-0.3	+3.6	V
V _{IN} - (VDD)	-0.3	+3.6	V
T _{OT} – Operating Temperature	-40	+80	°C
T _{ST} - Storage Temperature	-40	+105	°C

5.2 Recommended Operating Conditions

Table5

Parameter	Min	Typ	Max	Unit
V _{IN} - Terminal voltages (VDD)	2.3	3.3	3.6	V
V _{IN} - I/O Voltages (VDDIO)	2.3	3.3	3.6	V

6 ESD & MSL

Table5

Parameter	Value
MSL:	Grade: 3
ESD:	HBM: Class-2
	CDM: Class-B

7 Recommended Temperature Reflow Profile

Prior to any reflow, it is important to ensure the modules were packaged to prevent moisture absorption. New packages contain desiccant (to absorb moisture) and a humidity indicator card to display the level maintained during storage and shipment. If directed to bake units on the card, please check the Picture below and follow instructions specified by IPC/JEDEC J-STD-033.

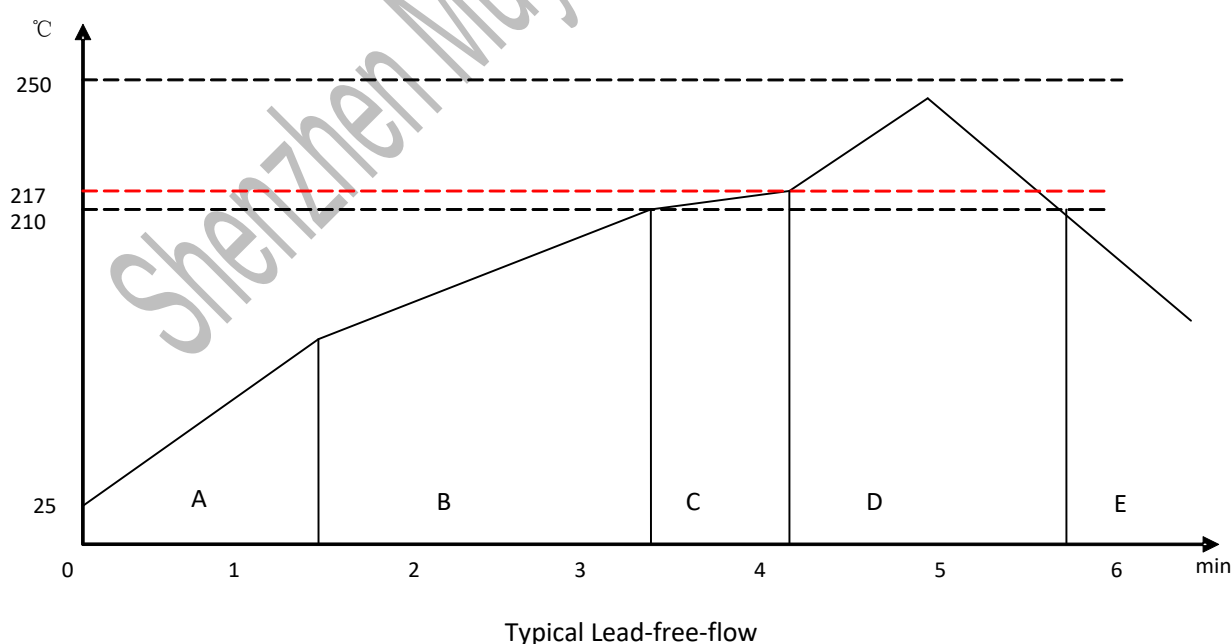
Note: The shipping tray cannot be heated above 65°C. If baking is required at the higher temperatures displayed in the Picture below, the modules must be removed from the shipping tray.

Any modules not manufactured before exceeding their floor life should be re-packaged with fresh desiccant and a new humidity indicator card. Floor life for MSL (Moisture Sensitivity Level) 3 devices is 168 hours in ambient environment 30°C/60%RH.

Table7: Recommended baking times and temperatures

MSL	125°C Baking Temp		90°C/≤ 5%RH Baking Temp		40°C/ ≤ 5%RH Baking Temp	
	Saturated @ 30°C/85%	Floor Life Limit + 72 hours@ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72 hours@ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72hours@ 30°C/60%
3	9 hours	7 hours	33hours	23 hours	13 days	9 days

The design of the surface mount module is easy to manufacture, including reflow soldering to the PCB motherboard. Ultimately, it is the customer's responsibility to choose a suitable solder paste and ensure that the furnace temperature during reflow meets the requirements of the solder paste. The surface mount module complies with the J-STD-020D1 standard for reflow soldering temperature. The welding profile depends on the various parameters that need to be set for each application. The data here is only for the guidance of reflow soldering



Preheating zone (A)-This zone heats up at a controlled rate, with a typical value of 0.5-2°C/s. The purpose of this area is to preheat the PCB board and components to 120~150°C. At this stage, the heat needs to be evenly distributed to

the PCB board, and the solvent is completely removed to reduce the thermal shock of the components.

Equilibrium Zone 1 (B)-At this stage, the flux becomes soft and evenly encapsulates the solder particles and spreads them on the PCB board to prevent them from being re-oxidized. As the temperature rises and the flux is liquefied, each activator and rosin are activated and begin to eliminate the oxide film formed on the surface of each solder particle and PCB board. For this area, the recommended temperature is 150° to 210°, and the time is 60 to 120 seconds.

Equilibrium zone 2 (C) (optional)-In order to solve the problem of upright parts, it is recommended to keep the temperature at 210-217°C for about 20 to 30 seconds.

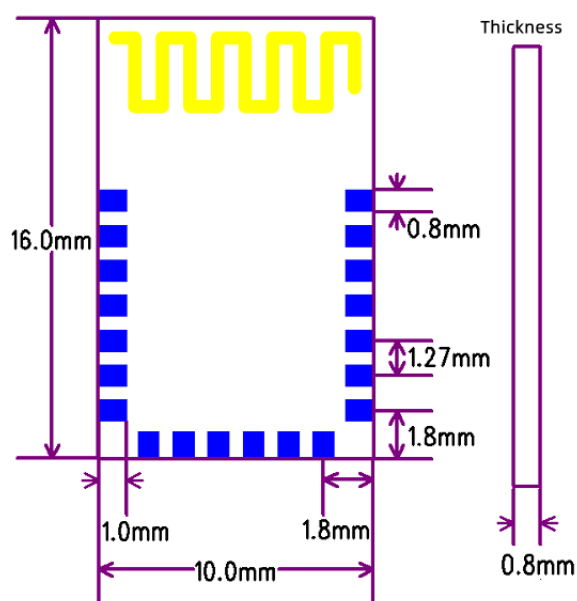
Reflow zone (D)-The curve in the figure is designed for Sn / Ag3.0 / Cu0.5. It can be a reference for other lead-free solders. The peak temperature should be high enough to achieve good wettability, but not too high to cause discoloration or damage to the component. Excessive welding time will lead to intermetallic growth, leading to brittle solder joints. The recommended peak temperature (Tp) is 230~250°C. When the temperature is higher than 217°C, the welding time should be 30 to 90 seconds.

Cooling zone (E)-The cooling rate should be fast to keep the solder particles small, which will provide a longer lasting solder joint. The typical cooling rate should be 4°C.

8 Mechanical Detail

8.1 Physical Dimensions

- Dimension: 10mm(W) x 16mm(L) x 2.2 mm(H) Tolerance: ±0.2mm
- Pad size: 1.6mmX0.8mm Tolerance: ±0.1mm
- Pad pitch: 1.5mm Tolerance: ±0.1mm



9 Hardware Integration Suggestions

9.1 Soldering Recommendations

MY-BT501 compatible with the industry standard reflow profile of lead-free solder. The reflow profile used depends on the thermal quality of the entire assembled PCB, the heat transfer efficiency of the oven, and the specific type of solder paste used. Please refer to the data sheet of the specific solder paste for the profile configuration.

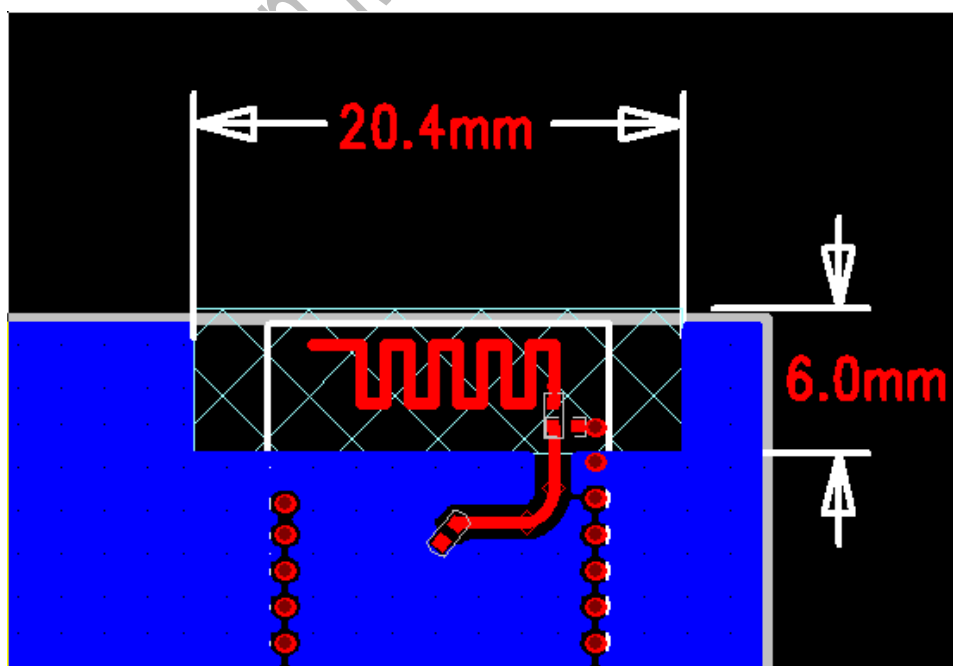
Muyu will provide the following suggestions for welding modules to ensure the reliability of the solder joints and operations of the modules after welding. Since the reflow profile used is dependent on the process and layout, the best reflow profile should be studied on a case-by-case basis. Therefore, the following recommendations should be used as a starting point.

9.2 Layout Guidelines (Internal Antenna)

It is strongly recommended to use good layout practices to ensure the normal operation of the module. Placing copper or any metal close to the antenna will affect the performance of the antenna, thereby deteriorating the working efficiency of the antenna. The metal shield around the antenna will prevent signal radiation, so the metal casing should not be used with the module. Please use more grounding vias at the edge of the grounding area.

The following suggestions can help avoid EMC problems in the design. Please note that each design is unique, and the following description does not consider all basic design rules, such as avoiding capacitive coupling between signal lines. The following description aims to avoid EMC problems caused by the RF part of the module. Please consider carefully to avoid problems with the digital signal in the design.

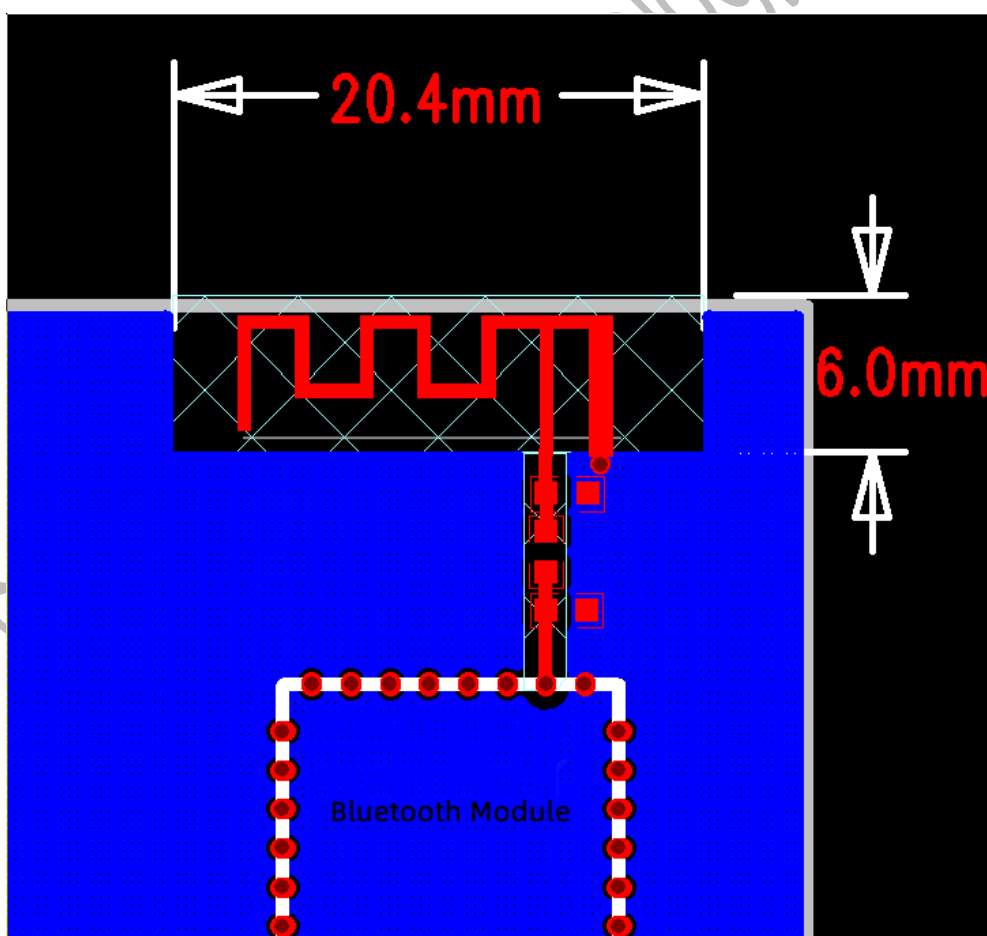
Make sure that the loop of the signal wire is as short as possible. For example, if the signal enters the inner layer through vias, always use ground vias around the pad. And place them closely and symmetrically around the signal vias. Any sensitive signal traces and loops should be completed on the inner layer of the PCB as much as possible. Sensitive signal lines should have an area surrounded by ground wires above and below. If this is not possible, make sure that the return path is shortest (for example, use the ground wire next to the signal wire)



9.3 Layout Guidelines (External Antenna)

In the absence of on-board antenna design, module placement and PCB layout are critical to optimizing module RF performance.

1. The microstrip line (the wiring from the antenna to the EXT_ANT port on the module end) should be 50Ω;
2. The microstrip line should be as straight as possible and as short as possible. When it is necessary to turn, it should be as arc as possible;
3. The width of the microstrip line is about 0.5mm, and the distance between the copper coating and the microstrip line is about 0.5mm;
4. To avoid interference to the module signal; the location of the external antenna and the EXT_ANT port of the module should be far away from any noise sources and digital lines, the antenna should be placed close to the board, no components and copper should be placed around, and no wiring should be placed as far as possible, Keep it intact;
5. A Π -type matching network circuit is needed between the microstrip lines, and placed as close to the antenna as possible to better match the impedance;
6. The RF key circuit of the module should be clearly separated from any digital circuit on the system board



9.4 External Antenna Suggestion

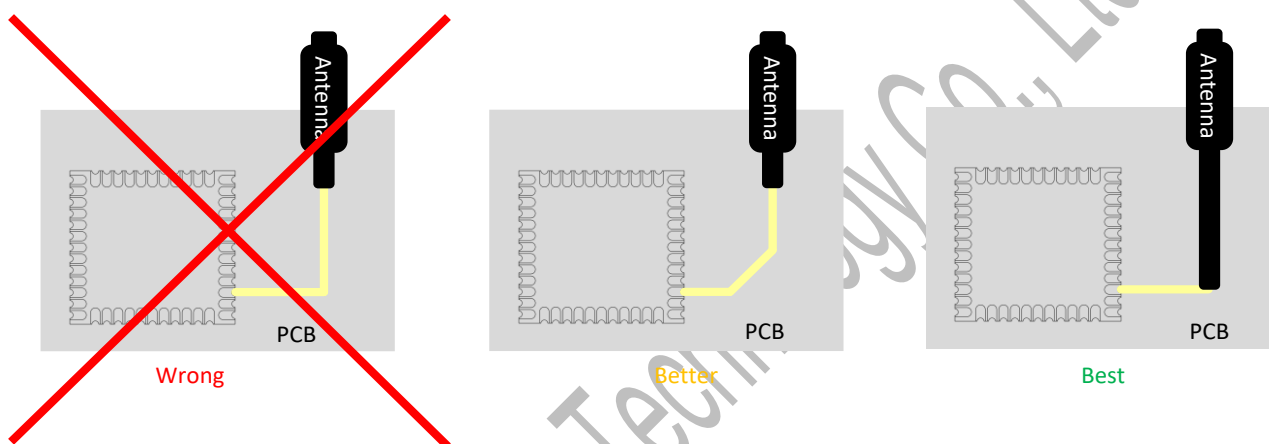
Wireless products are not suitable for the use of external metal casings and large metal components around them

The length of PCB traces or wires should be as short as possible.

The distance between the connection on the top layer and the ground area should be at least as large as the thickness of the dielectric.

Avoid placing RF close to the digital part of the system board.

In order to reduce signal loss, avoid wiring the microstrip line in sharp corners. Chamfered or rounded wiring is preferred to rectangular wiring; 45-degree oblique wiring is better than pure 90-degree wiring.



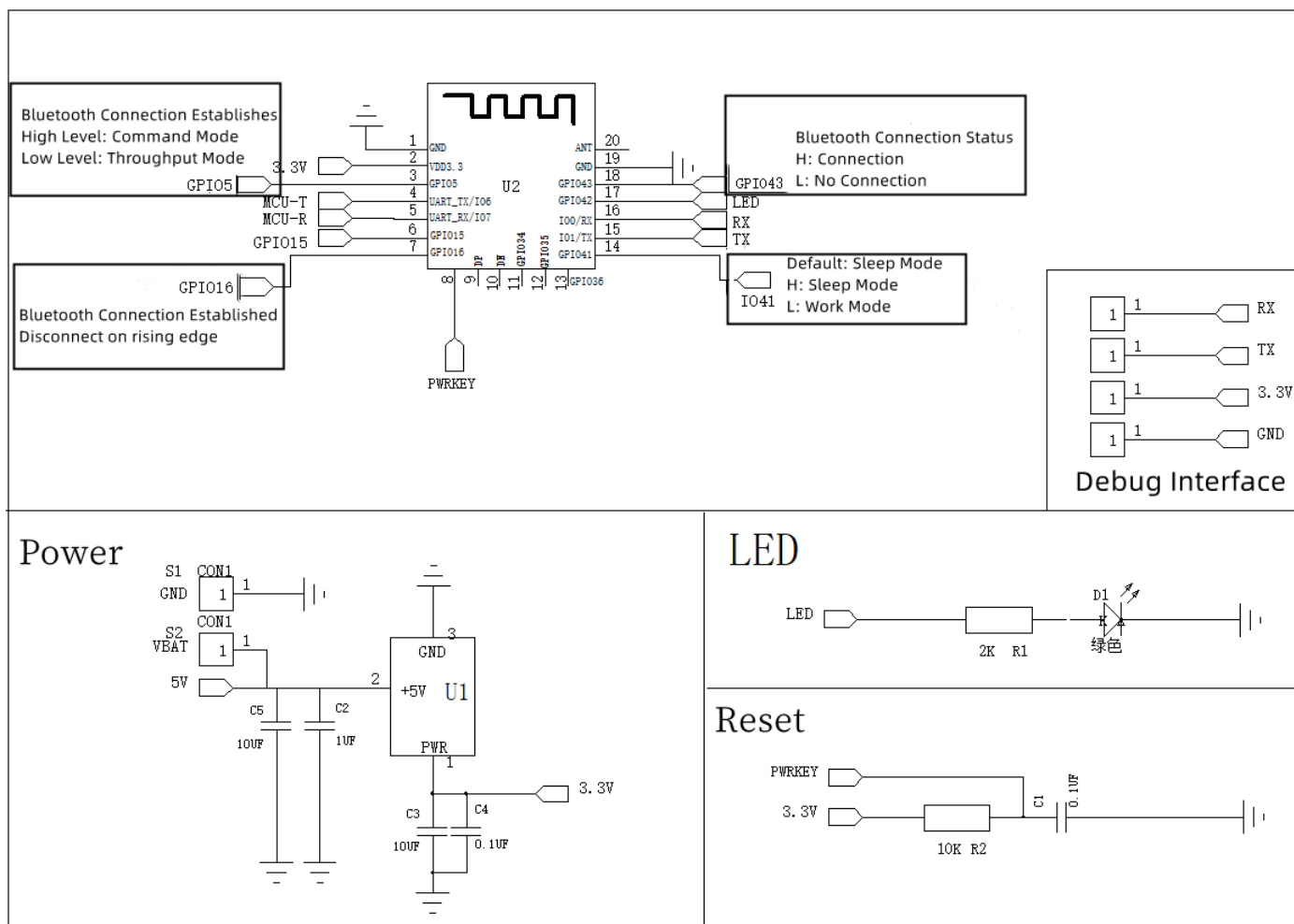
Recommended Trace Connects Antenna and the Module

Avoid routing RF connections on the other side of the module. The distance from the microstrip line to the ground plane at the bottom of the receiver is very small and has a huge tolerance. Therefore, the impedance of this part of the trace cannot be controlled. Use as many vias as possible to connect to the ground plane.

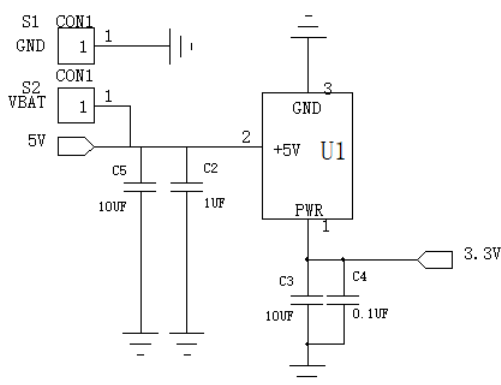
10 Product Packaging Information

- Pallet packaging
- Pallet Size: 270mm * 220mm
- 100pcs/Pallet
- MOQ:2000pcs

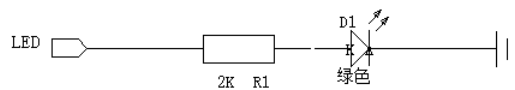
11 Application Schematic



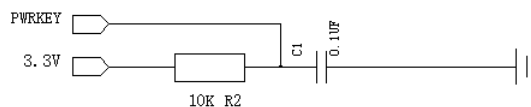
Power



LED



Reset



Shenzhen