ANS-BT103S

Specification Version V2.0

5.2 BLE Bluetooth Module

Revision Record

edition	date	take notes	author
1.0	2024/6/18	Initial Version	QZY
2.0	2025/12/12	Update the document table of contents and pin descriptions	ANS

CATALOGUE

1 Introduce

1. 1 Summary

The ANS-BT103S is a BLE Bluetooth 5.2 module that supports HID, GATT, ATT, and other profiles, with UART serving as the programming interface. Users can read or write module configurations via UART using AT commands; refer to the User Programming Guide for detailed instructions.

1. 2 Characteristic

- BLE Bluetooth 5.2
- Postage stamp hole encapsulation
- Low power consumption
- Default transmission power: 0 dBm
- The default UART baud rate is 115,200 bps, supporting rates from 1,200 bps to 921.6 kbps.
- UART hardware interface
- Support serial port upgrade
- Bluetooth profile support: HID, GATT, ATT, GAP
- Power consumption in working mode (VDD_3V3 at 3.3V)
- RX mode: 4.5 mA @ 3.3 V, 0 dBm
- TX mode: 4.3 mA @ 3.3 V, 0 dBm
- Deep sleep mode: 2.2 2.2 uA (RTC wake-up + GPIO wake-up)
- Supports Bluetooth SIG Mesh
- Support Private Mesh
- Supports one-to-many and multiple connections
- Supports primary mode with integrated master-slave configuration
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1. 3 Apply

- Industrial Data Transmission
- Health and Medical Equipment
- Measurement and Monitoring System
- Industrial Sensors and Controls
- Bluetooth car key
- scanner gun
- Bluetooth MESH networking
- Lamp Lighting
- Wireless transmission for home appliances

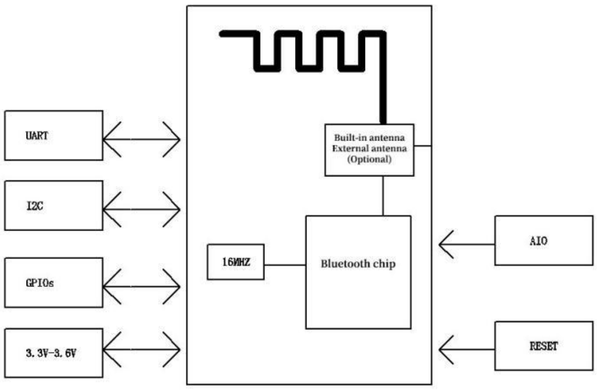
2 General requirements

Table 1:

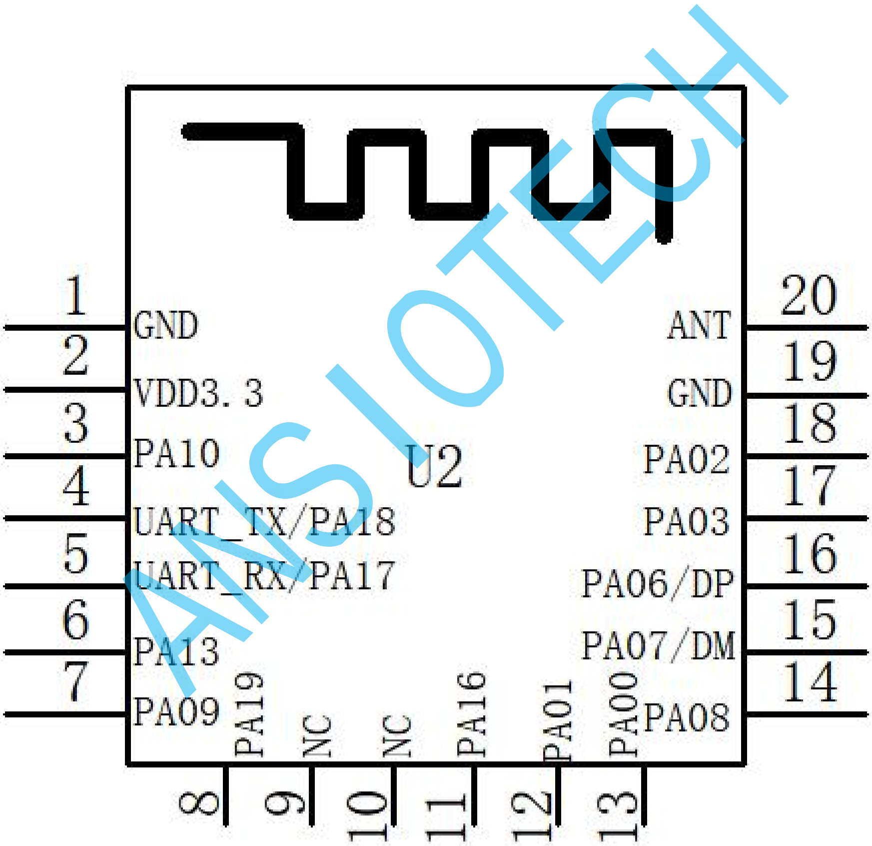
feature	detailed information
model	ANS-BT103S
size	10.0mm(W) X 16.0mm(L) X 2.0mm(H)
Bluetooth specifications	Bluetooth BLE 5.2
Working voltage range	3.0 ~ 3.6V
transmitting power	Maximum 6 dBm
sensitivity	-92dBm@0.1%BER
frequency range	2400 ~ 2483.5MHz ISM band
modulation mode	GFSK, π/4-DQPSK, 8-DPSK
Baseband crystal oscillator	16MHz
Frequency hopping and channels	1600 hops/sec, 1 MHz channel bandwidth, 80 channels
Radio frequency input impedance	50 ohms
Antenna type	PCB-mounted antenna
hardware interface	UART/I²S
protocol	HID, GATT, ATT
Other Features	Supports low power consumption
working temperature	-40°C to +80°C
Storage temperature	-40°C to +105°C
humidity	10% to 95% non-condensing
environment	accord with RoHS

3 Hardware Specifications

3.1 Block diagram and pin definition diagram



ANS-BT103S block diagram (top view)



ANS-BT103S Pin Definition Diagram (Top View)

3. 2 Pin Definition Explanation

Table 2:

pin	Pin name	type	Pin Description
1	GND	VSS	Power supply location
2	3.3V	VDD	power input
3	PA10	I/O	The external IO control module supports UART transparent transmission/instruction transmission modes (Note: This IO function requires module commands to enable; it is disabled by default). After establishing a Bluetooth connection, a high voltage indicates

			the instruction mode, while a low voltage indicates the transparent transmission mode.
4	PA18	I/O	UART Data Output
5	PA17	I/O	UART Data Input
6	PA13	I/O	Programmable input/output pin
7	PA09	I/O	The external IO controls the disconnection of the Bluetooth connection (Note: This IO function requires a module command to enable; it is disabled by default). After establishing the Bluetooth connection, the connection is terminated upon the rising edge.
8	PA19_RESET	I	External reset input: low level active
9	NC	NC	The pin is floating and not connected to any circuit.
10	NC	NC	The pin is floating and not connected to any circuit.
11	PA16	I/O	Programmable input/output pin
12	PA01	I/O	UART_RTS request is sent; low-level active, defaults to regular GPIO.
13	PA00	I/O	UART_CTS: Clear and send; valid at low level; defaults to regular GPIO.
14	PA08	I/O	Programmable input/output pin
15	PA07_DM	I/O	Software burning port
16	PA06_DP	I/O	Software burning port
17	PA03	I/O	Programmable input/output pin
18	PA02	I/O	Programmable input/output pin
19	GND	VSS	Power supply location
20	ANT		Connect the external antenna

4 Ghysical interface

4. 1 General Digital IO Port

The module defines 12 universal GPIO pins. All these GPIO pins can be configured via software to perform various functions, such as button control, LED driving, or interrupt signals for the main controller. When not in use, they remain idle and require no circuit connection. The I/O type of each pin can be individually configured by software to operate in either input or output mode.

4. 2 RF Interface

- 2400–2483.5 MHz Bluetooth LE 5.2
- The maximum output power of TX is 6 dBm.
- Maximum RX sensitivity: -92 dBm@0.1% BER

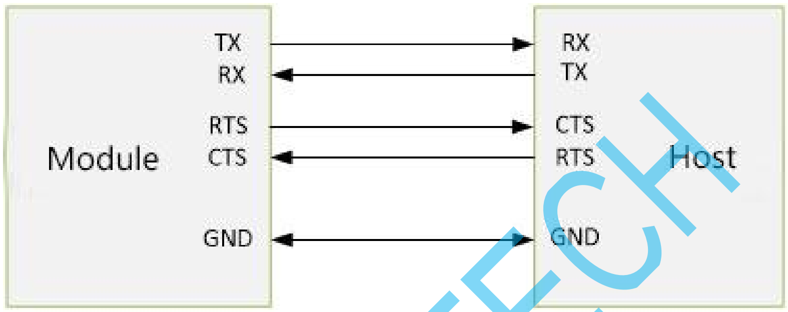
4. 3 UART Interface

Four signal pins are used to implement the UART functionality. When the ANS-BT103S is connected to another digital device, UART RX and UART TX transmit data between the two devices. The remaining two pins, UART CTS and UART RTS, are used for hardware flow control; both are active at low level—meaning transmission occurs when the level is low and stops when the level is high.

Table 3:

parameter	probable value	
Baud rate	Minimum	1200 baud (≤2%Error)
	standard	115200bps(≤1%Error)
	maximum	921600bps(≤1%Error)
flow control	RTS/CTS	
even-odd check	None, odd or even	
Number of stop positions	1	
Number of bits per channel	8	

Schematic diagram of the UART connection between the module and the host:



Module and Host Connection Diagram

4. 4 analog-digital converter ADC

Supports a 12-bit SAR ADC engine with a conversion rate of up to 1 MSPS; conversion range: VSSA to VDDA (3.0 to 3.6 V). In addition to the IO ADC channel, there are three internal channels: the chip operating temperature channel ADC_CH_9; the chip operating voltage VBAT channel ADC_CH10; and the chip internal ADC reference voltage (standard 1.4 V) channel ADC_CH11.

5 Electrical character

5. 1 maximum rating

The following lists the absolute maximum rated power supply voltages for the digital and analog pins of the module. Exceeding these values will cause permanent damage. The average GPIO pin output current is defined as the average current value flowing through any given pin over a 100-mS cycle. The total average GPIO pin output current is defined as the average current value flowing through all corresponding pins over the same 100-mS cycle. The maximum output current is defined as the peak current value flowing through any given pin.

Table 4:

parameter	least value	crest value	unit
VIN-I/O power supply voltage (VDDIO)	-0.3	+3.6	V
VIN – Analog/Digital Power Supply Voltage (VDD)	-0.3	+3.6	V

TOT-Operating temperature	-40	+80	°C
TST – Storage Temperature	-40	+105	°C

5. 2 Recommended working conditions

Table 5:

parameter	least value	typical case	crest value	unit
VIN – Core supply voltage (VDD)	3.0	3.3	3.6	V
VIN-I/O port power supply voltage (VDDIO)	3.0	3.3	3.6	V

6 Humidity sensitivity level & Anti-static level

Table 6:

parameter	price
Humidity sensitivity level:	Level 3
Antistatic rating:	Human discharge pattern: Class-2 Machine discharge mode: Class-B

7 Reflow soldering

Before performing any reflow soldering, ensure the module is packaged moisture-proof. The packaging contains desiccant (to absorb moisture) and a humidity indicator card showing the dryness level maintained during storage and transportation. If baking the module is required, refer to the table below and follow the instructions specified in IPC/JEDEC J-STD-033.

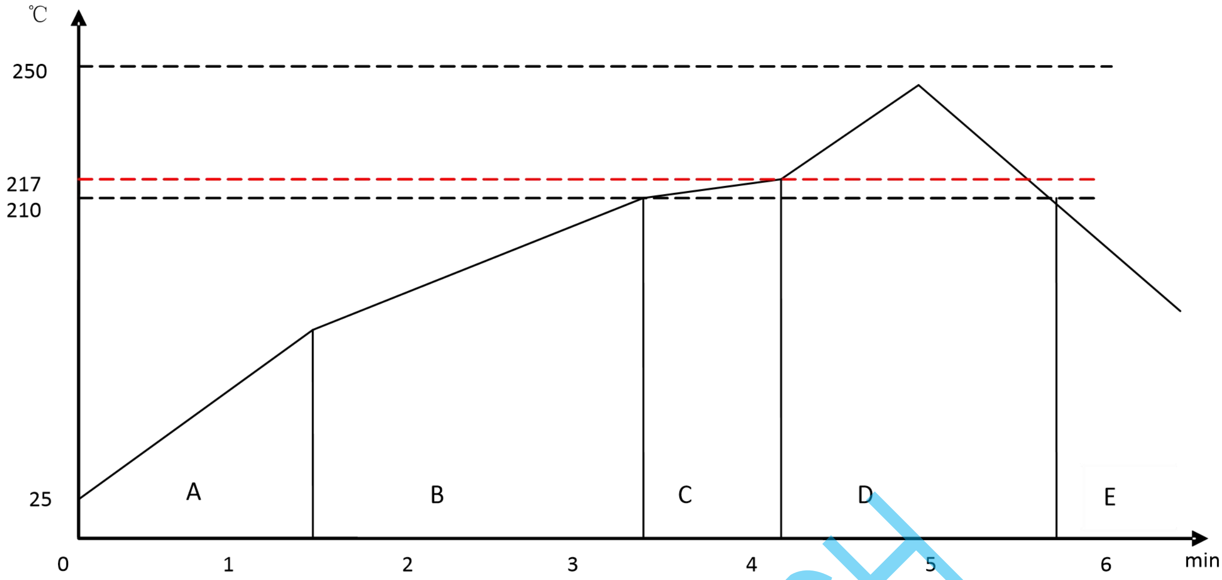
Note: The tray must not be heated above 65°C. If the high-temperature baking method specified in the table below (above 65°C) is used, the module must be removed from the transport tray.

Any opened-packaged modules that have not been shipped within the specified timeframe should be repackaged, with effective desiccant and temperature/humidity indicator cards placed inside the packaging. Under ambient conditions of 30°C/60% RH, MSL (Humidity-Sensitive Level) 3 modules shall not be stored in air for more than 168 hours. The recommended baking duration and temperature are as follows:

Table 7:

MSL	Baking temperature: 125°C		Baking temperature: 90°C/≤ 5% RH		Baking temperature: 40°C/≤ 5% RH	
	Saturated at 30°C/85%	Minimum limit + 72 hours @ 30°C/60%	Saturated at 30°C/85%	Minimum limit + 72 hours @ 30°C/60%	Saturated at 30°C/85%	Minimum limit + 72 hours @ 30°C/60%
3	9 hours	7 hours	33 hours	23 hours	13 days	9 days

Surface-mount modules are designed for easy manufacturing, including reflow soldering onto the PCB motherboard. Ultimately, customers are responsible for selecting the appropriate solder paste and ensuring that the furnace temperature during reflow meets the paste's specifications. Surface-mount modules comply with the J-STD-020D1 standard for reflow soldering temperatures. The soldering configuration depends on various parameters required for each application. The provided data serves solely as guidance for reflow soldering.



Typical lead-free reflux

Preheating Zone (A) – This zone is heated at a controlled rate, typically 0.5–2°C/s. Its purpose is to preheat the PCB board and components to 120–150°C. During this stage, heat must be evenly distributed across the PCB board, and all solvents must be completely removed to minimize thermal shock to the components.

Balancing Zone 1 (B) – At this stage, the flux softens and uniformly encapsulates the solder particles, distributing them across the PCB board to prevent re-oxidation. As the temperature rises and the flux liquefies, each activator and rosin is activated, beginning to remove the oxide film formed on each solder particle and the PCB surface. For this zone, the recommended temperature range is 150°–210°, with a treatment duration of 60–120 seconds.

Balancing Zone 2 (C) (Optional) – To address the upright component issue, it is recommended to maintain the temperature at 210–217 for approximately 20–30 seconds.

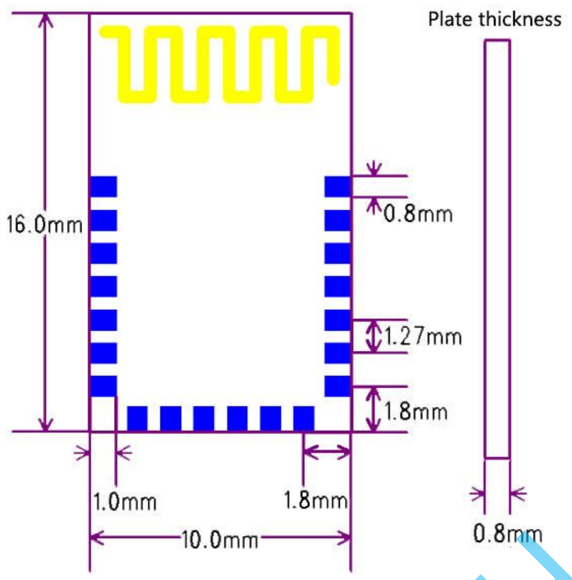
Reflow Zone (D) – The curve in the diagram is designed for Sn/Ag3.0/Cu0.5 and serves as a reference for other lead-free solder formulations. The peak temperature should be sufficiently high to ensure good wettability, but not so high as to cause component discoloration or damage. Excessively long soldering time can lead to intermetal growth, resulting in brittle solder joints. The recommended peak temperature (Tp) ranges from 230 to 250°C. When temperatures exceed 217°C, the soldering time should be 30 to 90 seconds.

Cooling zone (E) – The cooling rate should be rapid to maintain small solder particles, resulting in a more durable solder joint. The typical cooling rate is 4°C.

8 Module structure parameters

8. 1 Physical Dimension

- Module nominal dimensions: 10.0 mm (W) x 16.0 mm (L) x 2.0 mm (H) Tolerance: ±0.2 mm
- Pland dimensions: 1.6 mm × 0.8 mm; Tolerance: ±0.1 mm
- Pland spacing: 1.27 mm Tolerance: ±0.1 mm



ANS-BT103S package (

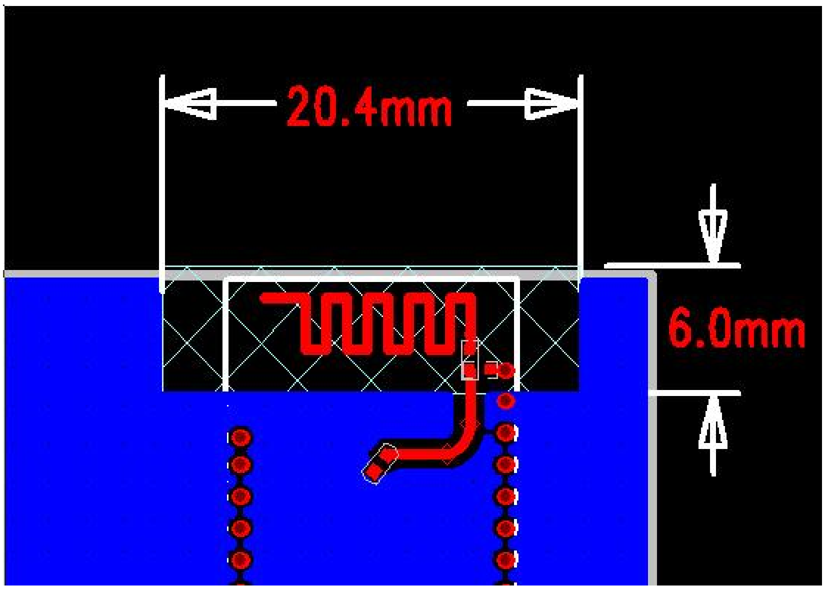
9 Hardware Design Recommendations

9.1 Welding Recommendations

The ANS-BT103S is compatible with the industrial standard reflow curves for lead-free solder. The specific reflow curve employed depends on the thermal mass of the entire assembled PCB, the heat transfer efficiency of the oven, and the particular type of solder paste used. Refer to the data sheet of the specific solder paste for details on the profile configuration. The following recommendations for soldering modules are provided to ensure the reliability of solder joints and operations after soldering. Since the reflow soldering curve depends on the process and layout, the optimal reflow curve should be determined case-by-case.

9.2 Layout Guide (Module Built-in Antenna)

It is strongly recommended to adopt sound layout practices to ensure proper module operation. Placing copper or any metal near the antenna can impair antenna performance, thereby reducing its efficiency. Metal shielding around the antenna blocks signal radiation; therefore, metal enclosures should not be used with modules. Instead, employ multiple grounding vias at the edges of the ground area. The following recommendations help prevent EMC issues in designs, as each design is unique and does not cover all fundamental design principles (e.g., avoiding capacitive coupling between signal lines). These guidelines aim to mitigate EMC problems caused by the module's RF components, prevent digital signal interference, and minimize signal line loops. For instance, when signals enter via internal layers, always use grounding vias around pads and arrange them symmetrically around signal vias. All sensitive signal traces and loops should be routed within the PCB's inner layers whenever possible. Sensitive signal lines should be surrounded by ground planes above and below; if this is impractical, ensure the return path is as short as possible (e.g., by using a ground trace adjacent to the signal line).



9.3 Layout Guide (External Antenna)

In the absence of an onboard antenna design, the placement of modules and PCB layout are critical for optimizing their RF performance.

1、The microstrip line (the path from the antenna to the EXT_ANT port on the module) should have a 50-ohm impedance.

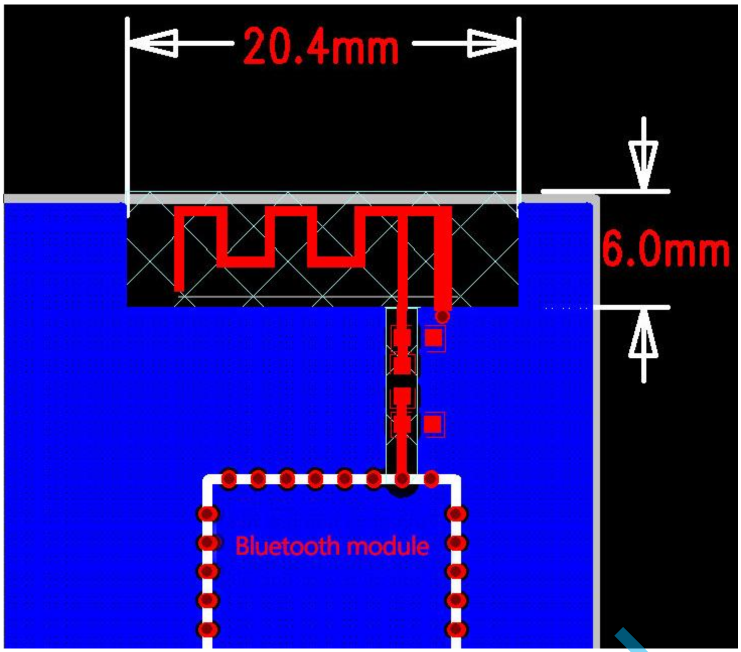
2、The microstrip line should be as straight and as short as possible; when a turn is unavoidable, it should follow an arc.

3、The microstrip line width is approximately 0.5 mm, and a distance of about 0.5 mm between the copper cladding and the microstrip line is optimal.

4、To avoid interference with module signals, the external antenna and the EXT_ANT port of the module should be positioned away from any noise sources and digital circuits. The antenna should be placed along the board edge, with no components or copper-clad layers nearby, and traces should be minimized to maintain structural integrity.

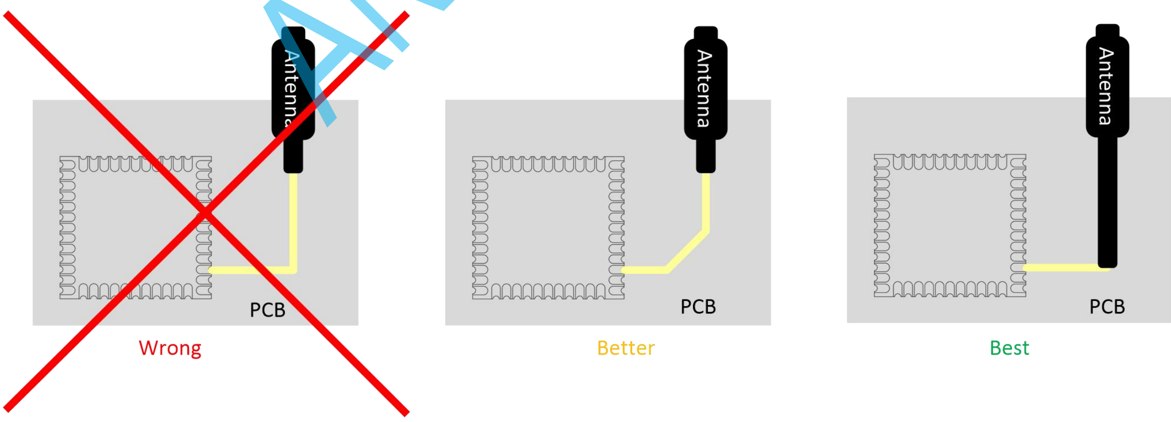
5、A π-type matching network circuit is required between the microstrip lines, and it should be positioned as close as possible to the antenna to achieve optimal impedance matching.

6、The RF key circuit of the module must be clearly separated from any digital circuit on the system board.



9.4 External Antenna

Generally, wireless products are not suitable for external metal enclosures during design. Additionally, the length of peripheral metal components, PCB traces, or connections should be minimized. The distance between top-layer connections and ground areas should be at least equal to the dielectric thickness, and RF components should be kept away from the digital sections of the system board. To reduce signal loss, avoid routing microstrip lines at sharp angles; chamfered or rounded traces are preferable to rectangular ones, and 45-degree beveled routing is better than pure 90-degree routing. RF connections should not be placed on the opposite side of the module. The distance between microstrip lines and the ground plane at the receiver's bottom is extremely small and has significant tolerance, making impedance control for this section challenging; therefore, via connections should be used extensively to link to the ground plane.



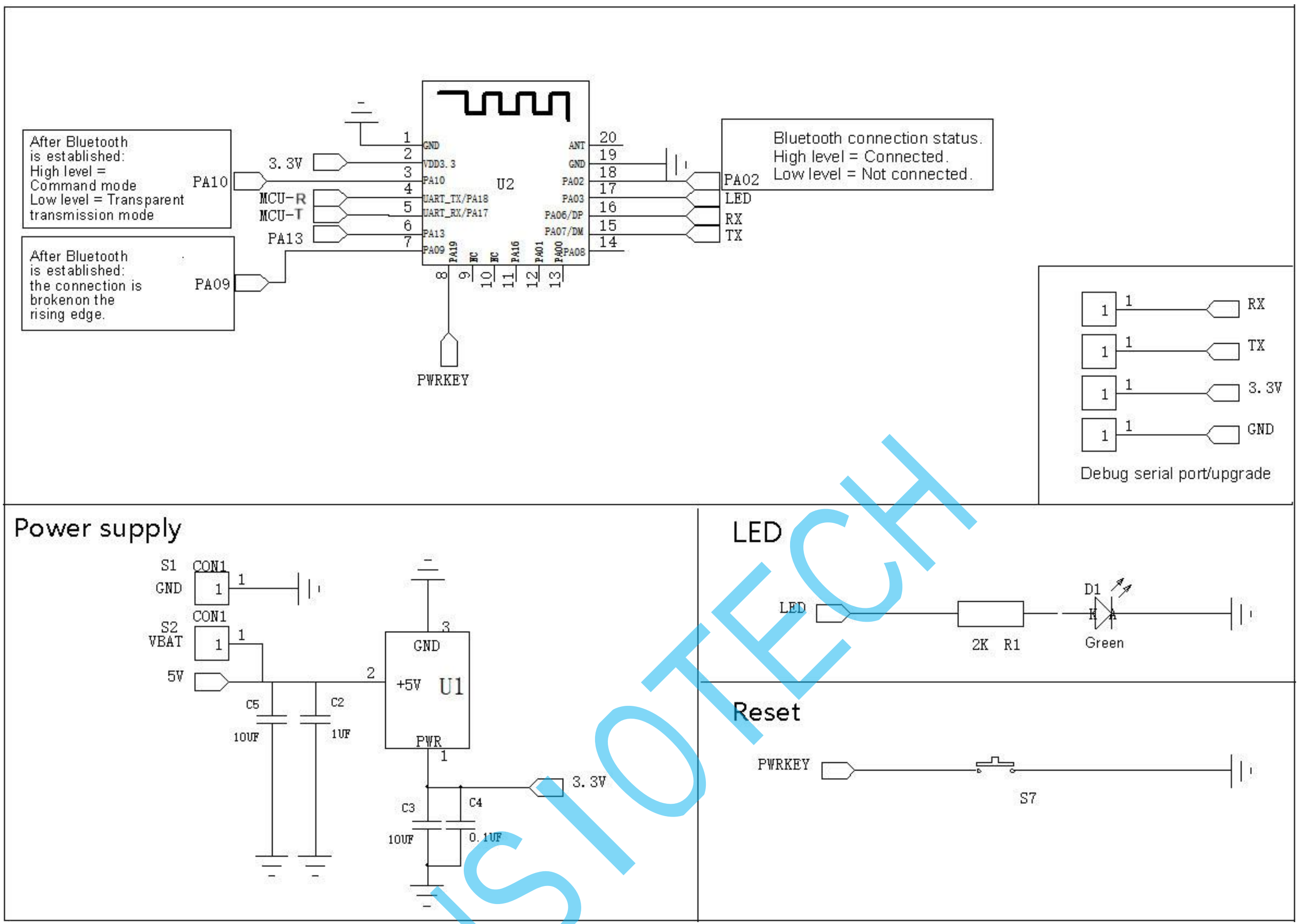
Recommended wiring connection for the antenna and module

10 Product packaging information

- pallet packing
- Tray dimensions: 270mm × 220mm

- 120 pieces per tray
- Minimum packaging: 2400 pieces

11 Application Circuit Diagram



remarks ：

1. Pin 3 serves as the input pin for switching between UART transparent transmission and command transmission modes (if only transparent transmission is required, this pin can remain unactive under standard operating conditions). The command must be executed to activate this IO function (default is disabled; refer to the AT+GPIOCFG{=param1{param2}} command). After establishing the Bluetooth connection, the high level corresponds to the command mode, while the low level corresponds to the transparent transmission mode.

2. Pin 7 is the input pin for the Bluetooth connection disconnection function (if the transparent mode disconnection function is not required, this pin can remain unactive under standard operating conditions). The IO function must be enabled via the corresponding command (default disabled; refer to the AT+GPIOCFG{=param1{param2}} command). After establishing the Bluetooth connection, the connection is terminated upon the rising edge.

3. PIN17 is the output pin for operational status, typically connected to an LED indicator. When Bluetooth is active but not connected, the LED flashes; when connected, it remains illuminated.

4. PIN18 is the output pin indicating the Bluetooth connection status, typically connected to the MCU's IO port. The MCU determines Bluetooth connectivity based on the signal level: low level indicates no connection, while high level indicates a connected state. This function may be left inactive when not in use.

5. GPI0 configuration: Leave unused PIN pins vacant.

6. PCB design requirements: Ensure sufficient clearance around the module antenna (no copper plating or traces), and avoid placing copper or metal materials nearby to prevent signal shielding.