



DX-BT31

Bluetooth Module

Technical Document

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1. Introduction

1.1. Overview

The DX-BT31 is a dual-mode (BR/EDR and LE) Bluetooth 5.0 module developed by Shenzhen Daxia Longque Technology Co., Ltd. for intelligent wireless data transmission. It supports profiles such as SPP, HID, GATT, ATT, and others. The module uses UART as the default programming interface and supports AT commands, allowing users to adjust parameters like serial baud rate, device name, etc., based on their needs. It is cost-effective, offers high data transfer rates, and has excellent receiving sensitivity. With only a few additional components, it can achieve its powerful functionality and can be custom-developed for various projects according to customer requirements.

1.2. Features

- Dual-mode Bluetooth V5.0
- Transmit power level Class 2
- default UART baud rate is 115200bps , and can support 4800bps to 4000000bps
- Support serial port upgrade
- Bluetooth profile support: SPP, HID, GATT, ATT, GAP
- Slave module visual distance 90 M
- Transmission rate SPP 60 K Byte s /s
- Transmission rate BLE 20 K Bytes / s
- Onboard antenna or external antenna can be selected
- Working temperature -40-+ 80 °C
- Support UART hardware interface

1.3. Application

- Smart Home
- Smart education equipment
- Medical equipment monitoring and wireless control
- Measuring and monitoring systems
- Industrial Sensors and Controls
- Tracking and positioning

1.4. Functional Block Diagram

The figure below is the functional block diagram of the DX- BT31 Bluetooth module, which explains its main functions as follows:

- Power supply
- Baseband
- Memory
- RF Part
- Peripheral Interface

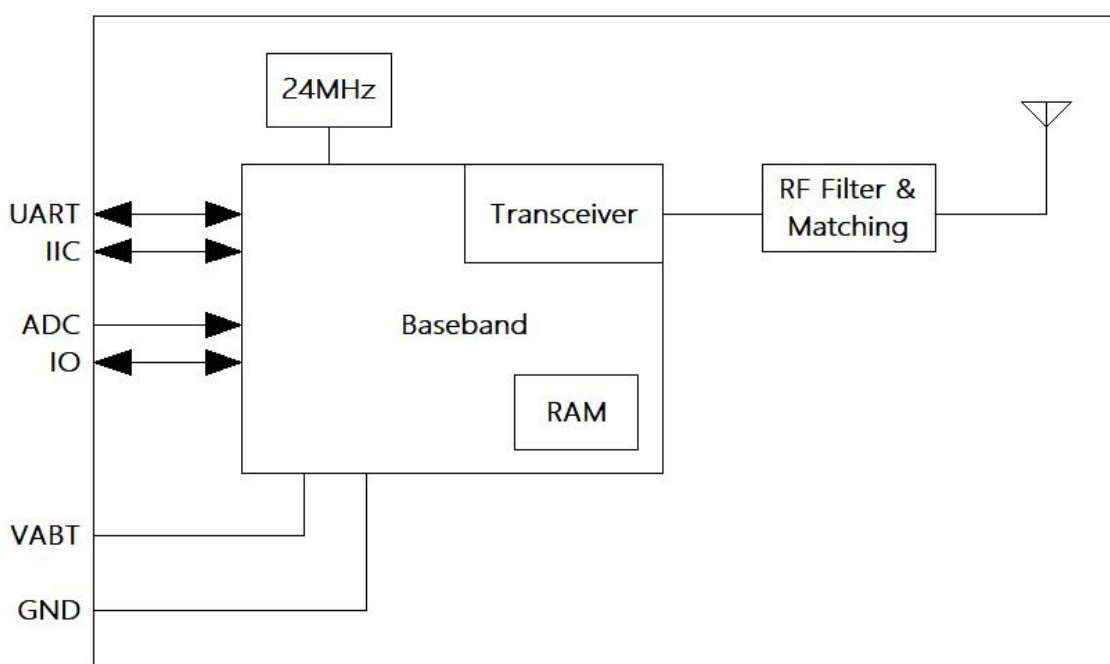


Figure 1: Functional Block Diagram

1.5. Basic parameters

Table 1: Basic parameter table

Parameter name	Details	Parameter name	Details
Module Model	DX- BT31	Module size	26.7 (L) x 13 (W) x 2.3 (H) mm
Bluetooth Specifications	Bluetooth dual-mode 5.0	Working current	16.76mA
Operating voltage	3.3V	Transmit power	6 dBm max
protocol	GATT, ATT, GAP	Frequency band	2.402GHz -2.480GHz ISM band
Sensitivity	-90 dBm@0.1%BER	Frequency Hopping and	1600 hops/s 2MHz space 40 channels



		Channels	
Modulation	GFSK	Hardware Interface	UART
RF input impedance	50Ω	humidity	10%-95% non-condensing
Antenna interface	Onboard antenna/External antenna (optional)	Operating temperature	MIN:-40℃ - MAX:+ 80 ℃

2. Application Interface

2.1. Module Pin Definition

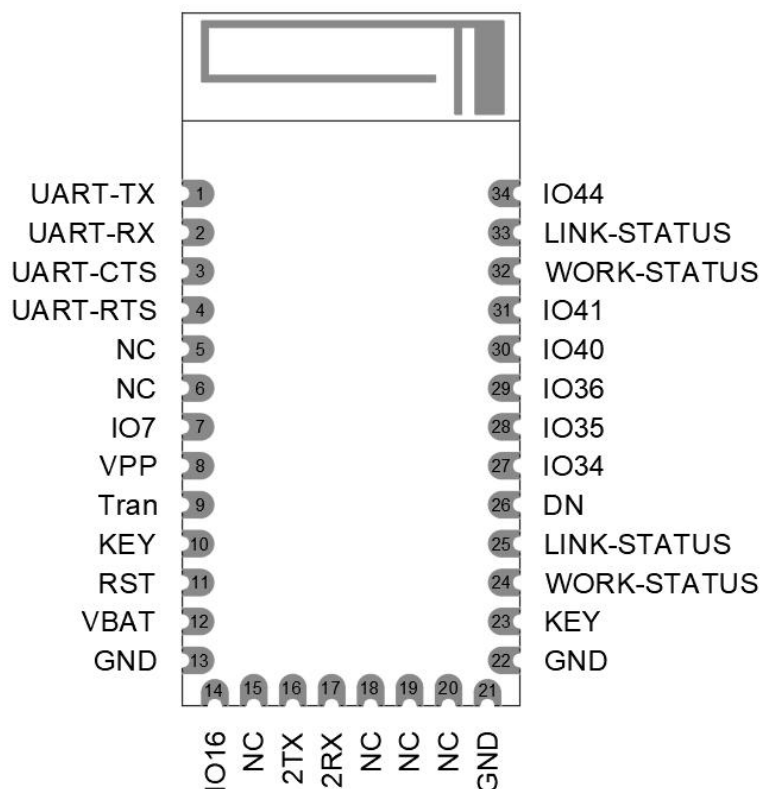


Figure 2: Module pin definition

2.2. Pin Definition

Table 2: Pin definition table

Pin number	Pin Name	Pin Function	illustrate
1	UART-TX	Serial data output	



2	UART-RX	Serial data input	
3	UART-CTS	UART Clear Send, Active Low	
4	UART-RTS	UART Request Send, Active Low	
5,6, 15,18 19,20	NC	Floating	
7	IO7	I/O	Programmable input/output pin
8	VPP	Write OTP power input	
9	Tran	NC	
10	KEY	I/O	Disconnect
11	RST	Reset	Low level is effective
12	VBAT	Power input pin	3.3V (typical)
13	GND	Power Ground	
14	IO16	I/O	Programmable input / output pins
16	2TX	I/O	Software burning port TX
17	2RX	I/O	Software burning port RX
21	GND	Power Ground	
22	GND	Power Ground	
23	KEY	I/O	Disconnect
24	WORK-STATUS	Module working status output pin	Not connected: Flashing Connection status: always on
25	LINK-STATUS	Bluetooth connection status pin	Unconnected state: output low level Connection status: output high level
26	DN	DN	USB DN
27	IO 34	I/O	Programmable input / output pins
28	IO 35	NC	
29	IO 36	I/O	Programmable input / output pins
30	IO 40	I/O	Programmable input / output pins
31	IO 41	NC	
32	WORK-STATUS	Connected to pin 24	Programmable input/output pins
33	LINK-STATUS	Connected to pin 25	Programmable input/output pins
34	IO 44	I/O	Programmable input / output pins

2.3. Power Design

2.3.1. Power interface

Table 3: Power interface pin definition table

Pin Name	Pin Number	Describe	Minimum	Typical Value	Maximum	Unit
VBAT	12	Module power supply	3.0	3.3	3.6	V
GND	13 ,21 , 22	land	-	0	-	V

2.3.2. Power Stability Requirements

The power supply range of DX-BT31 is 3.0~3.6V, and it is important to ensure that the input voltage does not fall below 3.0V. The following image shows the voltage drop of VBAT during RF burst transmission.

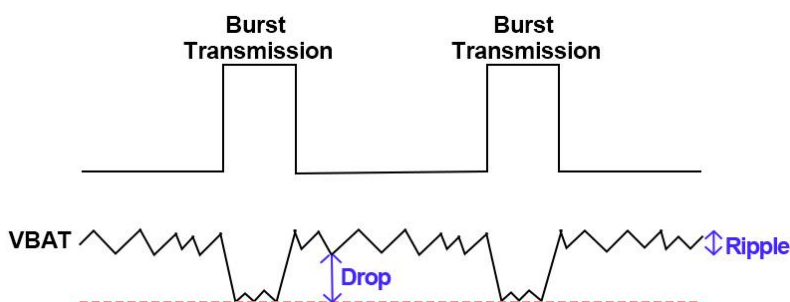


Figure 3: Burst transmission power requirements

To reduce voltage drop, it is recommended to reserve two surface-mount multi-layer ceramic capacitors (MLCC) with optimal ESR performance (22 μ F and 0.1 μ F) for VBAT, and place the capacitors close to the VBAT pin. The reference circuit is shown below:

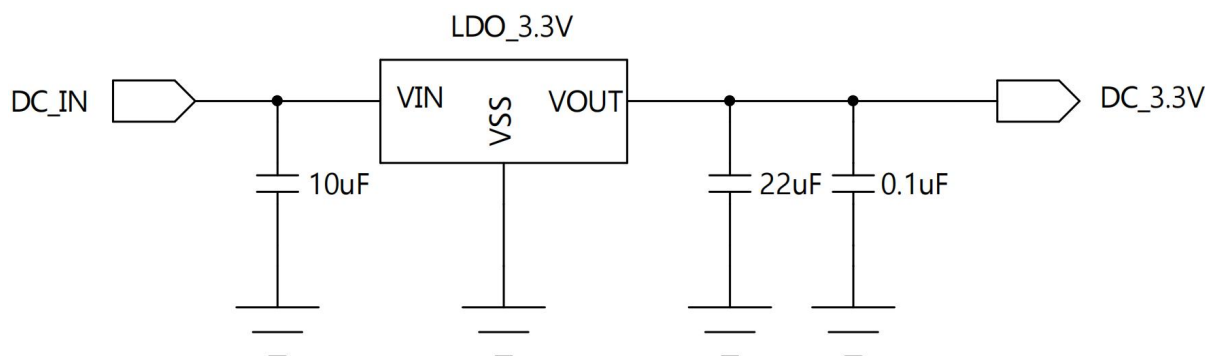


Figure 4: Power supply reference circuit

2.3.3. Rst Reset Pin Description

Table 4: RST pin definition table

Pin Name	Pin Number	I/O	Describe	Remark
RST	11	DI	Module reset	Active low. Leave it floating if not used.

Table 5: RST pin function definition table

Module Status	Operate Method	result
Other Status	Pull the RST pin low for at least 200ms and then release it	Reset

Remark

The RST signal is sensitive to interference, so it is recommended to keep the trace as short as possible and ensure proper ground shielding.

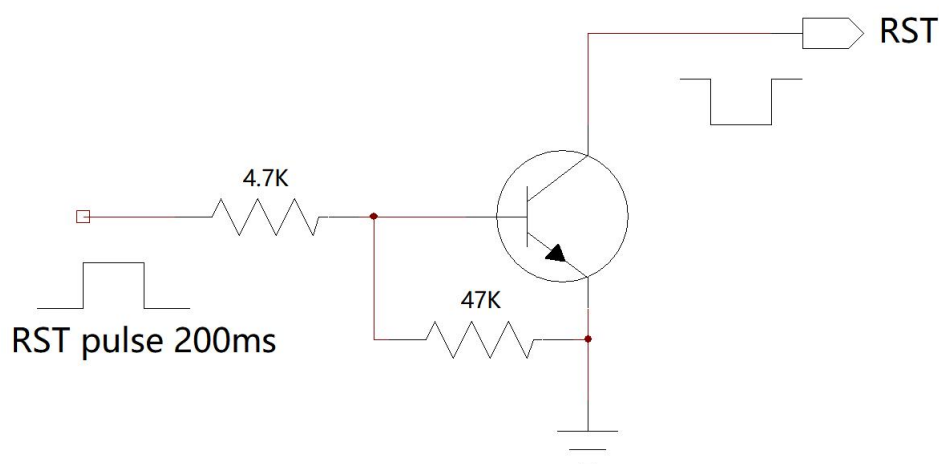


Figure 5: Reset reference circuit

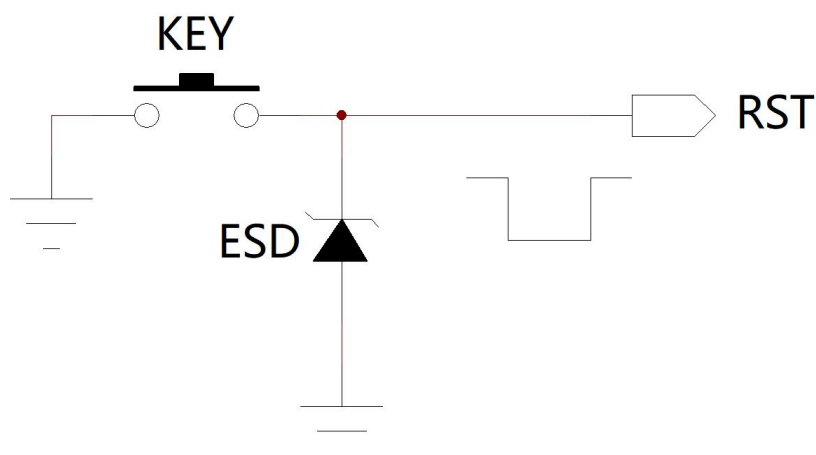


Figure 6: Push button reset reference circuit

2.3.4. KEY Pin Description

Table 6: KEY pin definition table

Pin Name	Pin Number	I/O	Describe	Remark
KEY	10,23	DI		

Table 7: KEY pin function definition table

Module Program	Module Status	Operate Method	Result
From the module	Connection Status	Pull the KEY pin low for at least 200ms and then release it	Disconnect

2.4. Hardware Physical Interface

2.4.1. UART Interface

Four signal pins are used to implement UART functions. When the DX- BT31 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, can be used to implement RS232 hardware flow control, and both are active at low levels, that is, low levels allow transmission and high levels stop transmission.

Possible UART settings

Parameter	Possible Value	
Baud Rate	Minimum	1200 baud ($\leq 1\%$ Error)
	Standard	115200 baud ($\leq 1\%$ Error)
	maximum	4000000 baud ($\leq 1\%$ Error)
Flow Control	RTS/CTS , or none	
Parity	None, Odd or Even	
Number of stop bits	1/2	
Number of bits per channel	8	

2.4.2. General Digital IO Port

20 general-purpose digital IO ports are defined in the module . All of these IO ports can be configured by software to implement various functions, such as button control, LED drive or interrupt signal of the main controller. Keep them floating when not in use.

2.5. Reference connection circuit

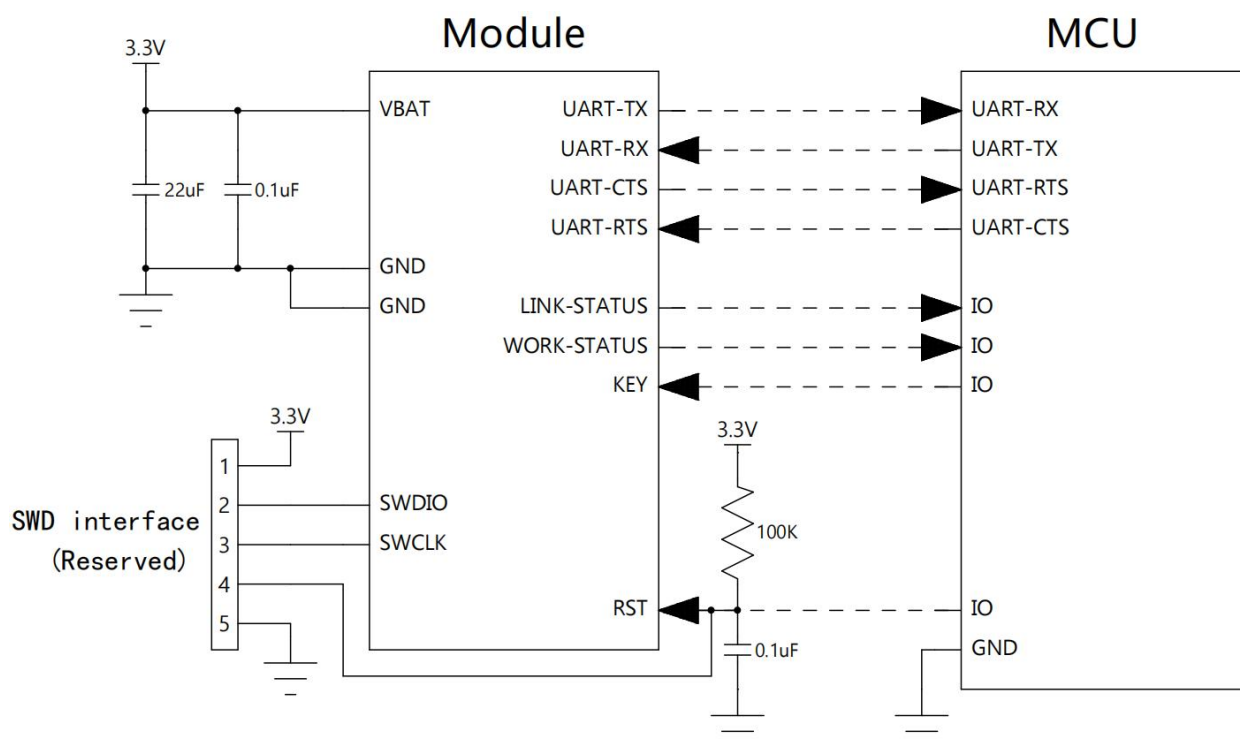


Figure 7: Typical application circuit

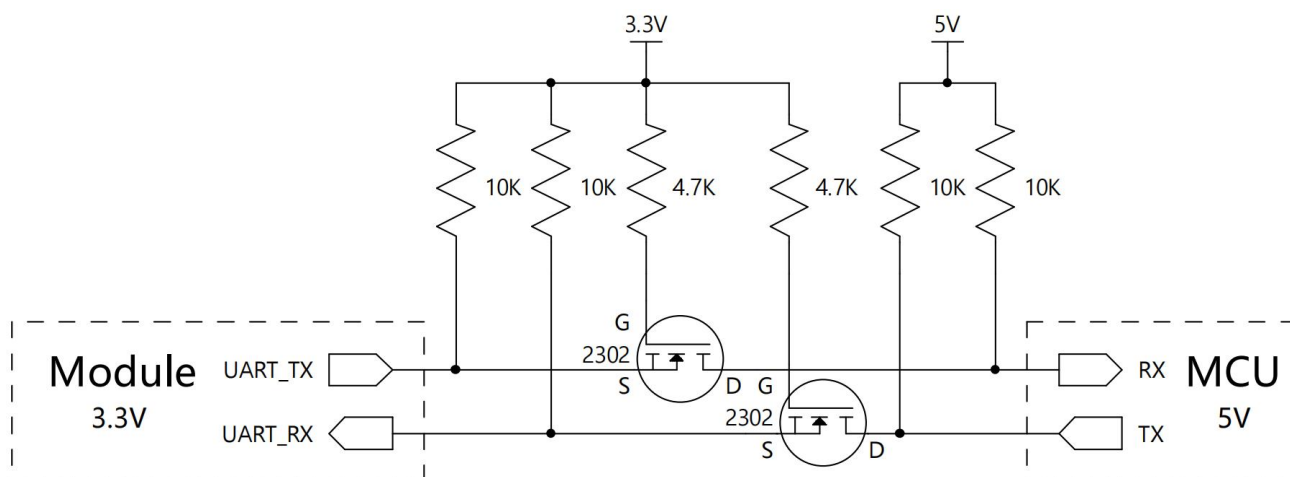


Figure 8: Serial port level conversion reference circuit

3. Electrical Characteristics and Reliability

3.1. Maximum Ratings

The absolute maximum ratings for the power 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 one corresponding pin during a 100ms period. The total average GPIO pin output current is defined as the average current value flowing through all corresponding pins during a 100ms period. The maximum output current is defined as the peak current value flowing through any one corresponding pin.

Table 8: Absolute Maximum Ratings Table

Absolute Maximum Ratings			
Parameter	Minimum	Maximum	Unit
V_{IN} - I/O supply voltage (VDDIO)	-0.3	+3.6	V
V_{IN} - Analog digital power supply/voltage (VDD)	-0.3	+3.6	V

Table 9: Operating voltage table

Operating Voltage				
Parameter	Minimum	Typical	Maximum	Unit
V_{IN} - Core supply voltage (VDD)	3.0	3.3	3.6	V
V_{IN} - I/O port power supply/voltage (VDDIO)	3.0	3.3	3.6	V

3.2. Operating And Storage Temperature

Table 10: Operating and storage temperature table

Parameter	Minimum	Typical	Maximum	Unit
Normal operating temperature	-40	-	80	°C
Storage temperature	-50	-	150	°C

3.3. Current consumption

Table 11: Power consumption

Slave Mode Power Consumption			
Model	State	Current	Unit
Normal working mode	Not connected	19.93	mA
	Connected	16.76	mA
When transparently transmitting data	Connected	MIN: 16.76 mA MAX: 23.02mA	MIN is the power consumption when no data is being transmitted. MAX is the power consumption when the module is transmitting 80-100 bytes/s.

3.4. RF Characteristics

Table 12: RF characteristics

Function	Value
Transmit Power	dBm max
Receiving Sensitivity	-90 dBm@0.1%BER

3.5. Electrostatic Protection

In module applications, static electricity generated by human body electrostatic discharge, friction between microelectronics, and other sources may discharge into the module through various pathways, potentially causing damage. Therefore, ESD protection should be taken seriously. During the research and development, production assembly, testing, and especially in the product design phase, ESD protection measures should be implemented. For example, at the interface points of

circuit designs and areas susceptible to electrostatic discharge damage or influence, anti-static protection should be added. During production, anti-static gloves should also be worn.

Table 13: ESD withstand voltage of module pins

Test Interface	Contact Discharge	Air Discharge	Unit
VBAT and GND	+4	+8	kV
Main Antenna Interface	+2.5	+4	kV

4. Mechanical Dimensions And Layout

Recommendations

This section describes the mechanical dimensions of the module. All dimensions are in millimeters. All dimensions without tolerances are ± 0.3 mm.

4.1. Modular Mechanical Ruler

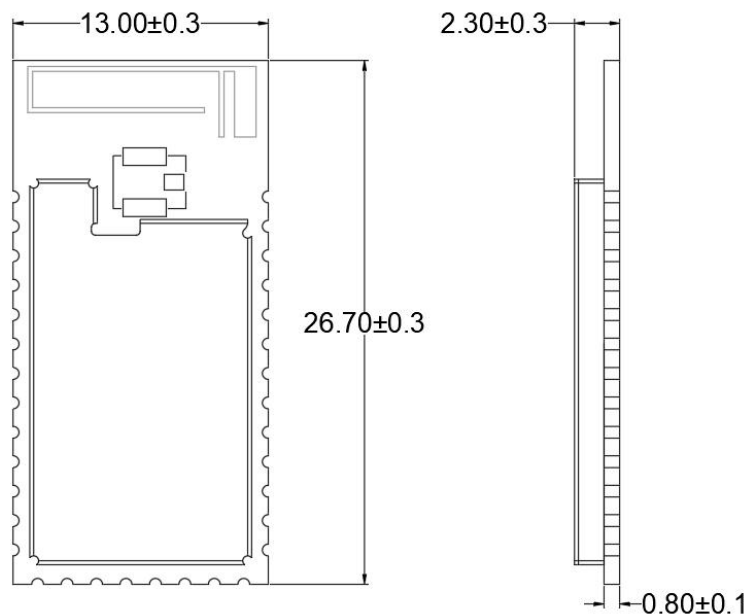


Figure 9: Module top and side view dimensions

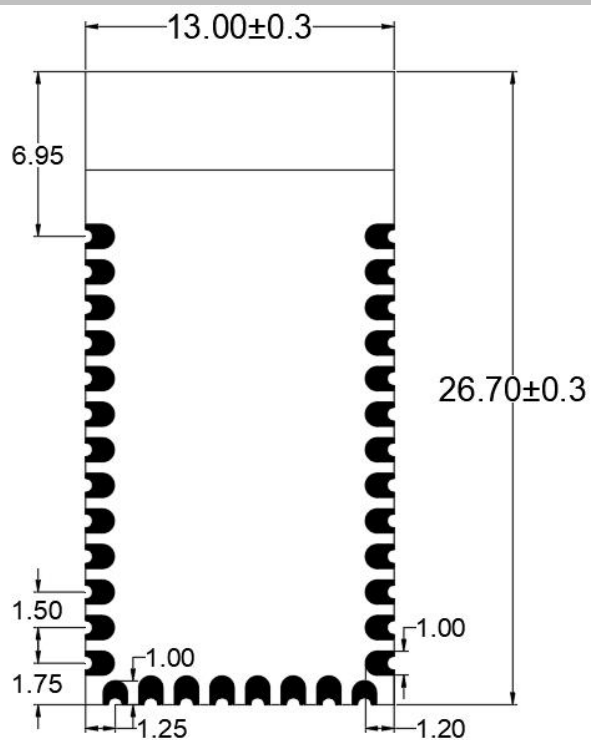


Figure 10: Module bottom view dimensions

4.2. Recommended Package

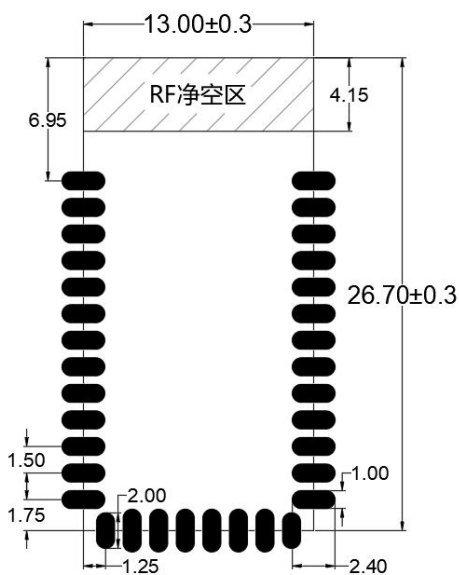


Figure 11: Recommended package dimensions

4.3. Module Top View/Bottom View

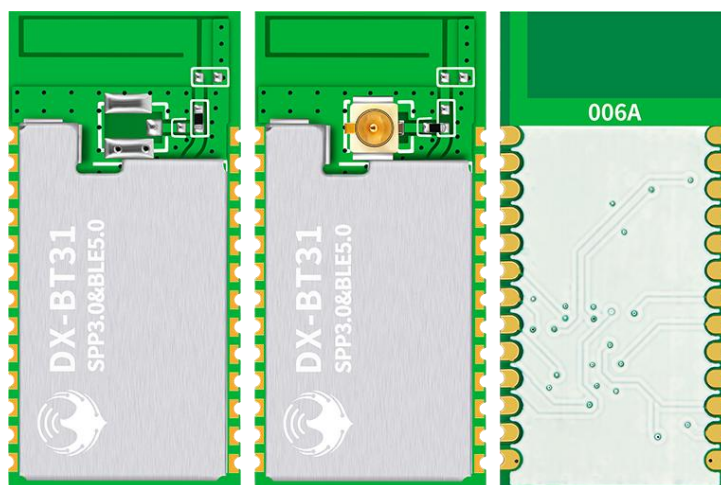


Figure 12: Module top and bottom views

Remark

The above picture is for reference only. For the actual product appearance and label information, please refer to the actual module.

4.4. Hardware Design Layout Recommendations

The DX- BT31 Bluetooth module works in the 2.4G wireless frequency band and uses an onboard antenna. The antenna's standing wave ratio (VSWR) and efficiency depend on the patch position . Various factors that affect the wireless transceiver signal should be avoided as much as possible.

Note the following points:

1. Avoid using metal for the product shell surrounding the Bluetooth. When using a partial metal shell, keep the module antenna away from the metal part as much as possible. The metal connecting wires or metal screws inside the product should be kept away from the module antenna as much as possible.
2. The module antenna should be placed against the edge of the PCB or directly exposed from the PCB. It is not allowed to be placed in the middle of the board. There should be at least 5mm of free space in the direction of the antenna, and the PCB under the antenna should be milled out. Copper laying and routing are not allowed in the direction parallel to the antenna.
3. It is recommended to use insulating materials to isolate the module mounting position on the substrate, such as placing a whole piece of silk screen (TopOverLay) at this position.

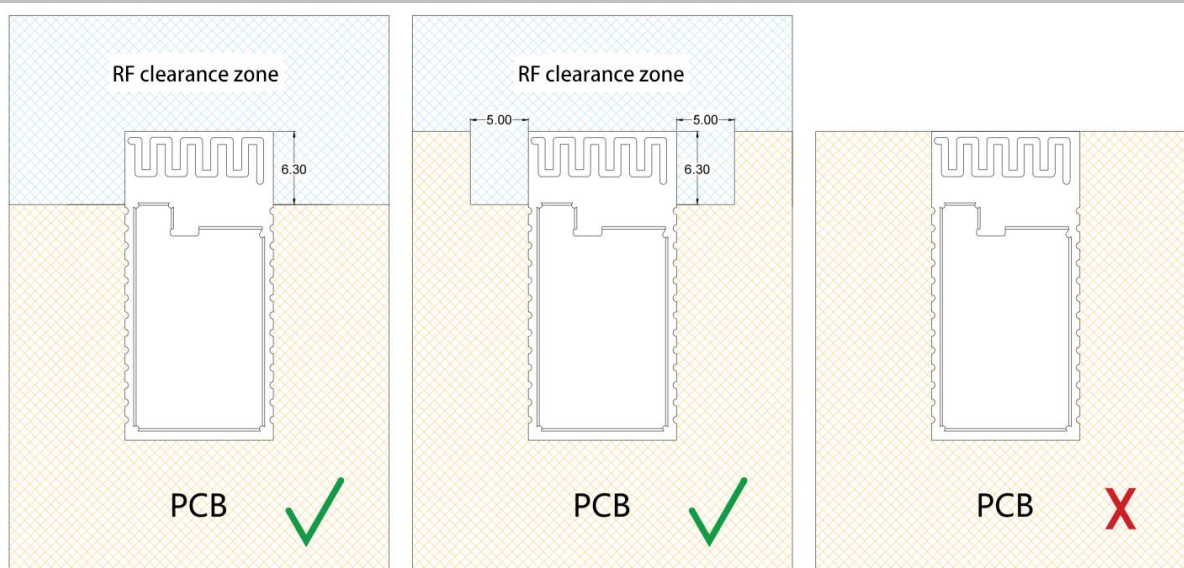


Figure 13: Module placement reference position

5. Storage, Production And Packaging

5.1. Storage Conditions

The module is shipped in a vacuum sealed bag. The module has a moisture sensitivity level of 3 (MSL 3) and its storage must comply with the following conditions:

1. Recommended storage conditions: temperature $23\pm5^{\circ}\text{C}$ and relative humidity 35~60%.
2. Under recommended storage conditions, modules can be stored in vacuum sealed bags for 12 months.
3. Under workshop conditions of $23\pm5^{\circ}\text{C}$ and relative humidity below 60%, the workshop life of the module after unpacking is 168 hours. Under this condition, the module can be directly subjected to reflow production or other high-temperature operations. Otherwise, the module needs to be stored in an environment with a relative humidity of less than 10% (for example, a moisture-proof cabinet) to keep the module dry.
4. If the module is in the following conditions, it is necessary to pre-bake the module to prevent the module from absorbing moisture and then causing PCB blistering, cracks and delamination after high-temperature soldering:
 - The storage temperature and humidity do not meet the recommended storage conditions;
 - The module fails to be manufactured or stored in accordance with the above clause 3 after being unpacked;

- Vacuum packaging leaks, materials are in bulk;
- Before module repair ;

5.2. Module Baking Process

- It needs to be baked at $120\pm 5^{\circ}\text{C}$ for 8 hours;
- 24 hours after baking , otherwise they still need to be stored in a drying oven ;

Remark

1. In order to prevent and reduce the occurrence of poor welding such as blistering and delamination of the module due to moisture, strict control should be exercised. It is not recommended to expose the module to the air for a long time after opening the vacuum packaging.
2. Before baking, the module needs to be taken out of the package and placed on a high temperature resistant device to prevent high temperature from damaging the plastic tray or reel; the module for secondary baking must be soldered within 24 hours after baking, otherwise it needs to be stored in a drying oven. Please pay attention to ESD protection when unpacking and placing the module, for example, wear anti-static gloves .

5.3. Reflow

Use a printing squeegee to print solder paste onto the stencil, allowing the solder paste to pass through the openings on the stencil and onto the PCB. The pressure applied by the squeegee needs to be adjusted appropriately. To ensure the quality of the solder paste printing on the module, the recommended thickness of the stencil corresponding to the module's pads is 0.1~0.15mm.

The recommended reflow soldering temperature is $235\sim 250^{\circ}\text{C}$, and it should not exceed 250°C . To prevent the module from being damaged due to repeated heating, it is strongly recommended that the module be applied after completing the reflow soldering of the first side of the PCB. The recommended reflow oven temperature profile (for lead-free SMT reflow soldering) and related parameters are shown in the chart below:

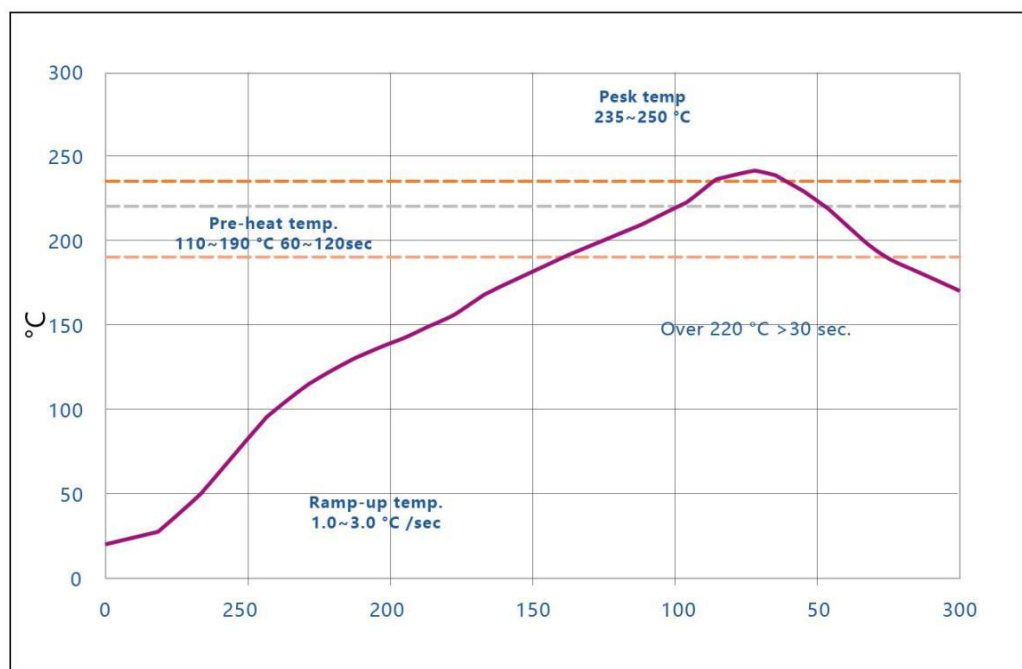


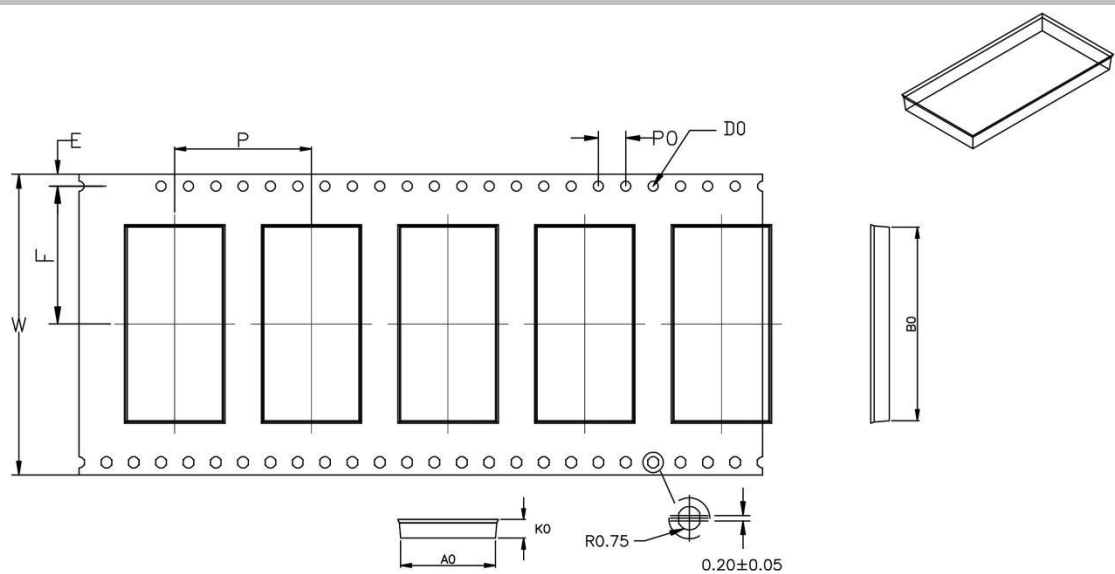
Figure 14: Recommended reflow temperature profile

Table 14: Recommended reflow temperature

Statistical Name	Lower Limit	Upper Limit	Unit
Slope 1 (target = 2.0) between 30.0 and 70.0	1	3	Degree/second
Slope 2 (target = 2.0) between 70.0 and 150.0	1	3	Degree/second
Slope 3 (target = -2.8) between 220.0 and 150.0	-5	-0.5	Degree/second
Constant temperature time 110-190°C	60	120	Second
@220°C reflow time	30	65	Second
Peak temperature	235	250	Celsius
Total time @ 235°C	10	30	Second

5.4. Packing Specifications

DX- BT31 modules are packaged in tape and reel and sealed in vacuum sealed bags with desiccant and humidity card. Each carrier tape is 20 meters long and contains 1000 modules. The reel diameter is 330 mm. The specific specifications are as follows:



ITEM	W	A ₀	A ₁	A ₂	K ₀	S ₀	F	E	D ₀	P	P ₀	P ₂	B ₀	B ₁	B ₂
D I M	44.0 ^{+0.30} _{-0.30}	13.9 ^{+0.10} _{-0.10}			2.7 ^{+0.10} _{-0.10}	—	20.15 ^{+0.10} _{-0.10}	1.75 ^{+0.10} _{-0.10}	1.50 ^{+0.10} _{-0.10}	20.0 ^{+0.10} _{-0.10}	4.00 ^{+0.10} _{-0.10}	2.00 ^{+0.10} _{-0.10}	28.30 ^{+0.10} _{-0.10}		
ALTERNATE															

Figure 15: Carrier tape dimensions (unit: mm)

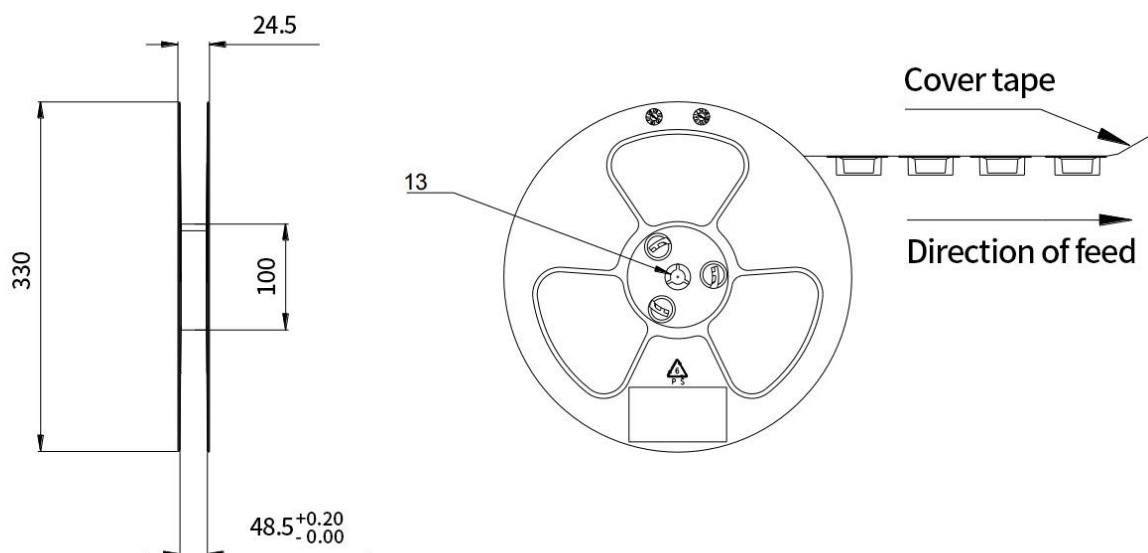


Figure 16: Reel dimensions (unit: mm)

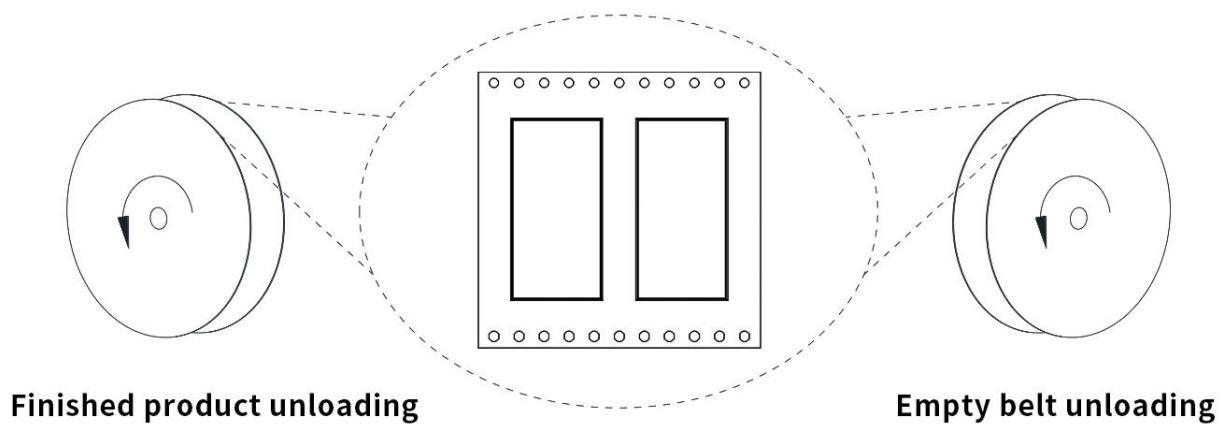


Figure 17: Tape Direction