DX-BT27

MODULE SPECIFICATION

Version：1.0

Date：2022-04-26

深圳大夏龙雀科技有限公司

Update record

Version	Date	Illustrate	Author
V1.0	2022/04/26	initial version	DL

Contact Us

Shenzhen DX-SMART Technology Co., Ltd.

Email：sales@szdx-smart.com

Tel：0755-29978125

Web：www.szdx-smart.com

Add：Room 601, Block A1, Huafeng Zhigu, Hangkong Road, Baoan District, Shenzhen

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1. Introduction

1.1. Overview

DX-BT27 Bluetooth module is built by Shenzhen DX-SMART Technology Co., Ltd. for intelligent wireless data transmission, It uses the DIALOG 14531 chip+PA amplifier and follows the Bluetooth BLE 5.1 specification. Support AT commands, users can change the serial port baud rate, device name and other parameters according to their needs, flexible to use。This module supports UART, SPI, I2C and other interfaces, supports IO port control, ADC acquisition， It has the advantages of low cost, long distance, high receiving sensitivity, etc， Only a few peripheral components are required to realize its powerful functions, and various projects can be customized and developed according to customer needs.

1.2. Key Features

- DIALOG 14531 main control chip+PA amplifier
- Bluetooth BLE 5.1
- Visual connection distance: master-slave 580M，For other data refer to Table 2
- Transmission rate 10K Byte/s
- Optional on-board antenna or external antenna
- Working temperature -40-+85 ℃
- Support UART, IIC, SPI, GPIO hardware interface
- Have CE, FCC, SRRC certification
- Optional iBeacon mode program
- Optional direct drive mode program
- Optional single master mode program
- Optional one-master multi-slave mode program
- Customizable Bluetooth gateway

1.3. Application

- Smart home

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- Smart education equipment
- Medical equipment monitoring and wireless control
- Measurement and monitoring system
- Industrial sensors and controls
- Tracking and positioning

1.4. Block Diagram

The following figure shows the functional block diagram of the DX-BT27 Bluetooth module, Explains the following main functions:

- Power section
- Baseband part
- Memory
- RF part
- Peripheral interface

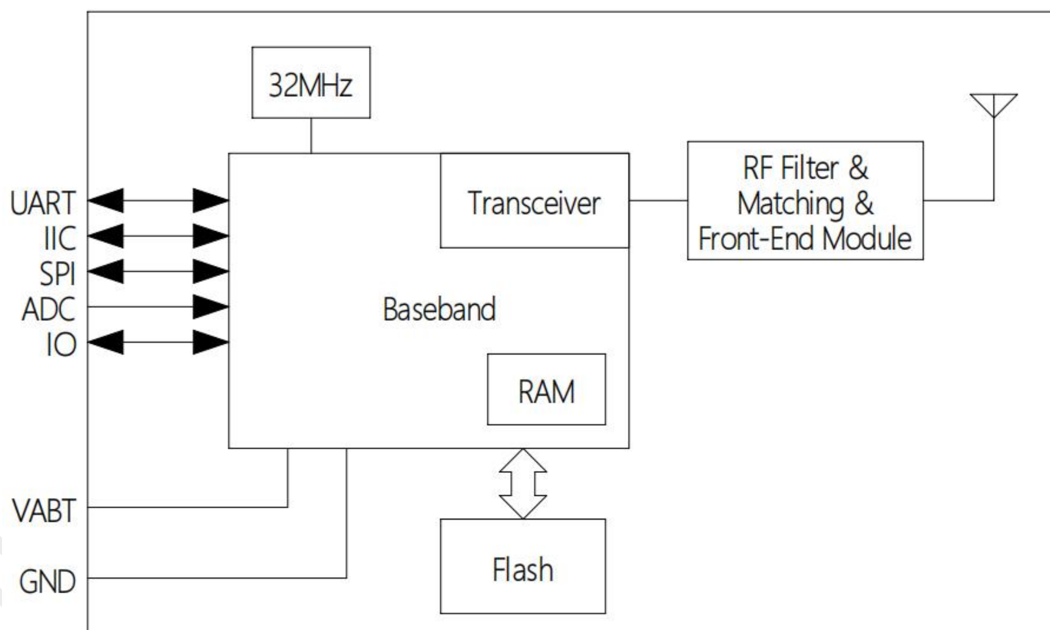

Figure 1: Functional block diagram

1.5. Basic Parameters

Table 1: Basic parameter table

Parameter	Details	Parameter	Details

Chip model	DA14531	Module model	DX-BT27
Bluetooth specifications	BLE 5.1	Module size	26.6(L) x 12.8 (W) x 2.3(H) mm
Operating Voltage	3.3V	Working current	270 uA
protocol	GATT，ATT，GAP	MTU value	253 bytes
Sensitivity	-95dBm@0.1%BER	Transmit power	-8.5~+13.5dBm
Modulation	GFSK	Frequency band	2.402GHz -2.480GHz ISM band
RF input impedance	50Ω	Frequency hopping and channel	1600hops/s 2MHz space 40 channels
Antenna interface	Onboard antenna / external antenna (optional)	Hardware interface	UART I2C GPIO
Operating temperature	MIN:-40℃ - MAX:+85℃	Humidity	10%-95% non-condensing

Table 2：Module visual connection distance reference table

Slave device	Master device	Visual connection distance (unit: m)
BT27	iPHONE 11	240
BT27	HUAWEI nova 4e	230
BT27	BT27	580
BT27	BT24	70
BT24	BT27	70

Remark

The distance parameters in this table are obtained from our actual test and are for reference only, and the actual situation shall prevail. The Bluetooth transmission power of each mobile phone is different, and the distance is different. The actual measurement shall prevail.

2. Application Interface

2.1. Module Pin Definition

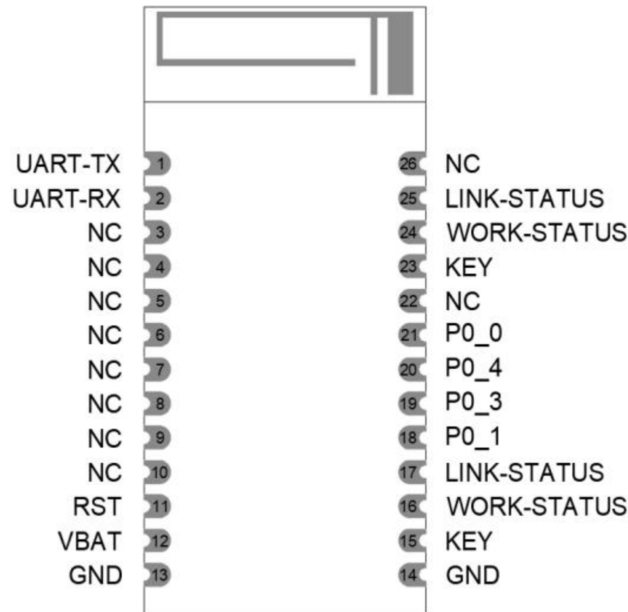

Figure 2：Module pin definition

2.2. Pin Definition Description

Table 3：Pin definition description table

<table>
<tr><th>Pin number</th><th>Pin name</th><th>Pin function</th><th colspan="2">illustrate</th></tr>
<tr><td>1</td><td>UART-TX</td><td>Serial data output</td><td colspan="2"></td></tr>
<tr><td>2</td><td>UART-RX</td><td>Serial data input</td><td colspan="2"></td></tr>
<tr><td>3,4,5,6,7,8,
9,10,22,26</td><td>NC</td><td>NC</td><td colspan="2"></td></tr>
<tr><td>11</td><td>RST</td><td>Reset</td><td colspan="2"></td></tr>
<tr><td>12</td><td>VBAT</td><td>Power input pin</td><td colspan="2">3.3V(Typical value)</td></tr>
<tr><td>13,14</td><td>GND</td><td>Power Ground</td><td colspan="2"></td></tr>
<tr><td rowspan="2">15</td><td rowspan="2">KEY</td><td>Disconnect pin</td><td colspan="2">For details, please refer to 2.3.5</td></tr>
<tr><td>Enter pairing mode</td><td colspan="2">For details, please refer to 2.3.5</td></tr>
<tr><td rowspan="2">16</td><td rowspan="2">WORK-STATUS</td><td rowspan="2">Module working status output pin</td><td>slave module</td><td>Not connected: 1s high 1s low
Connection Status：3s high 50ms low</td></tr>
<tr><td>Master module</td><td>Searching and connecting: 300ms high 300ms low
Connection status: always high</td></tr>
</table>

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17	LINK-STATUS	Bluetooth connection status pin	Not connected：Output low level Connection Status：output high level
18,19,20,21	P0_1,P0_3,P0_4, P0_0	NC	Can only be left floating
23	KEY	Connect to pin 15	Programmable input/output line
24	WORK-STATUS	Connect to pin 16	Programmable input/output line
25	LINK-STATUS	Connect to pin 17	Programmable input/output line

2.3. Power Design

2.3.1. Power Interface

Table 4：Power interface pin definition table

Pin name	Pin number	describe	Minimum	Typical value	Max	unit
VBAT	12	Module power	2.8	3.3	3.6	V
GND	13,14	Land	-	0	-	V

2.3.2. Power Supply Stability Requirements

The power supply range of DX-BT27 is 2.8~3.6V. It is necessary to ensure that the input voltage is not lower than 2.8V. The following figure shows the voltage drop of VBAT during radio frequency burst transmission.

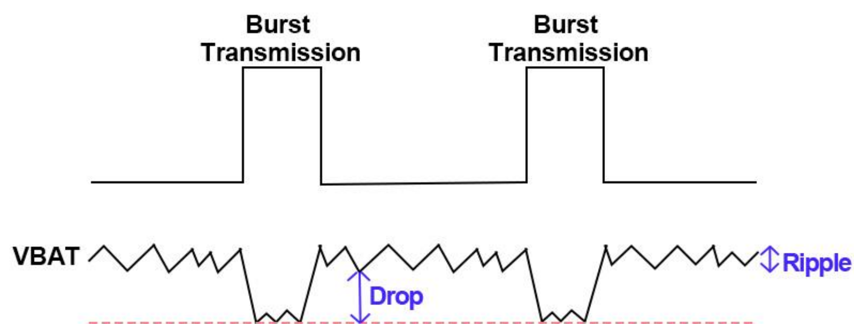

Figure 3：Burst transmission power supply requirements

In order to reduce the voltage drop, it is recommended to reserve 2 (22uF, 0.1uF) chip multilayer ceramic capacitors (MLCC) with the best ESR performance for VBAT, and the capacitors should be placed close to the VBAT pin. The reference circuit is as follows:

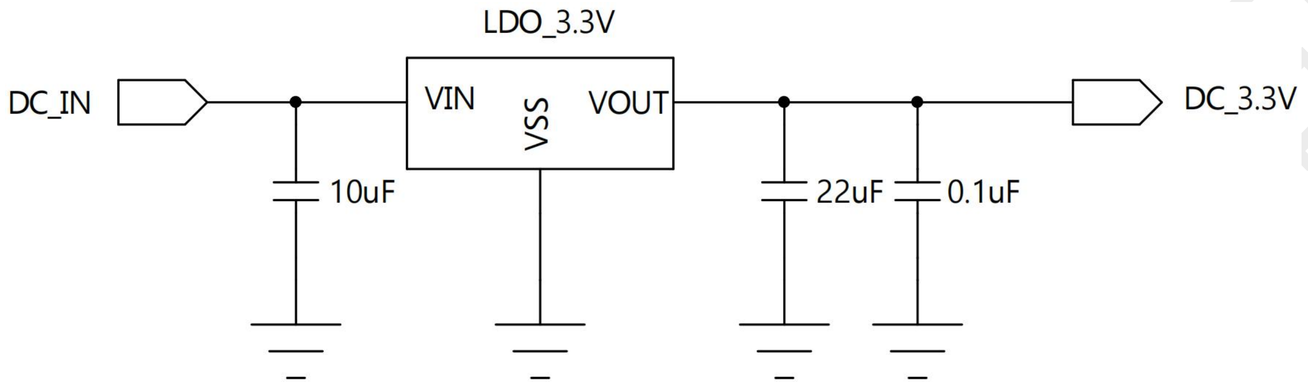

Figure 4: powered reference circuit

2.3.3. Power Down Requirements

Since the working current of the chip of this module is very low, when the power is disconnected, if the IO port of the peripheral MCU has a weak current supplying the module, the module is likely to be in an abnormal working state at this time, so after disconnecting the power of the module, the MCU is connected to the module All IO ports must be configured as pull-down.

2.3.4. RST Reset Pin Description

Table 5: RST pin definition table

Pin name	Pin number	I/O	describe	Remark
RST	11	DI	Module reset	Active low; NC if not used

Remark

The RST signal is more sensitive to interference, so it is recommended that the trace should be as short as possible, and it needs to be handled with ground.

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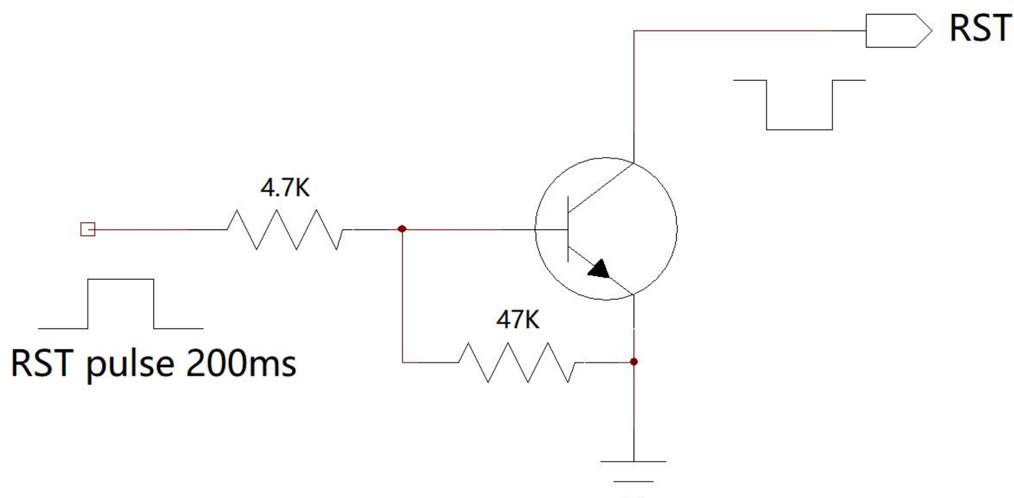


Figure 5: Reset reference circuit

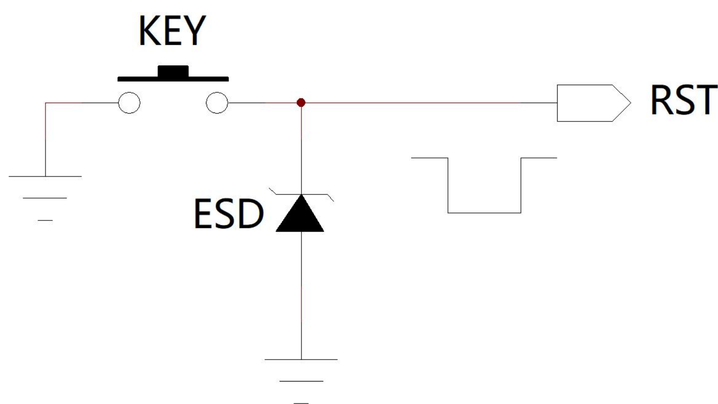


Figure 6: Key reset reference circuit

2.3.5. KEY Pin Definition

Table 7: KEY Pin definition table

Pin name	Pin number	I/O	describe	Remark
KEY	15	DI		

Table 8: KEY pin function definition table

Program	State	Method of operation	result
slave module	Connection Status	Pull down the KEY pin for at least 200ms and then release	disconnect
	standby	Pull the KEY pin low for at least 100ms	pairing

	mode	(can be released after being connected)	mode
master module	Connection Status	Pull down the KEY pin for at least 200ms and then release	disconnect
	standby mode	Pull down the KEY pin for at least 200ms and then release	Clear memory address code

Remark

Pairing mode: After the slave module enters pairing mode, after the search mode of the master module is set to pairing mode, the master module will automatically connect to the slave module.This pairing mode is only valid for our main module.

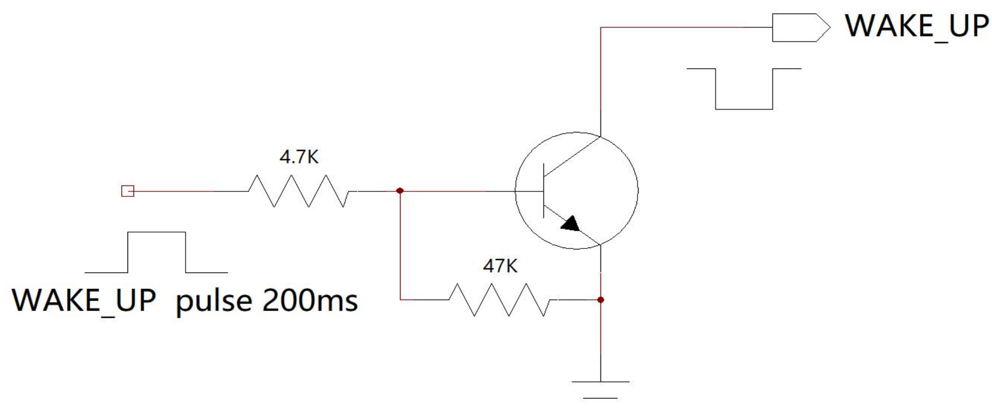


Figure 7: Open-collector drive wake-up reference circuit

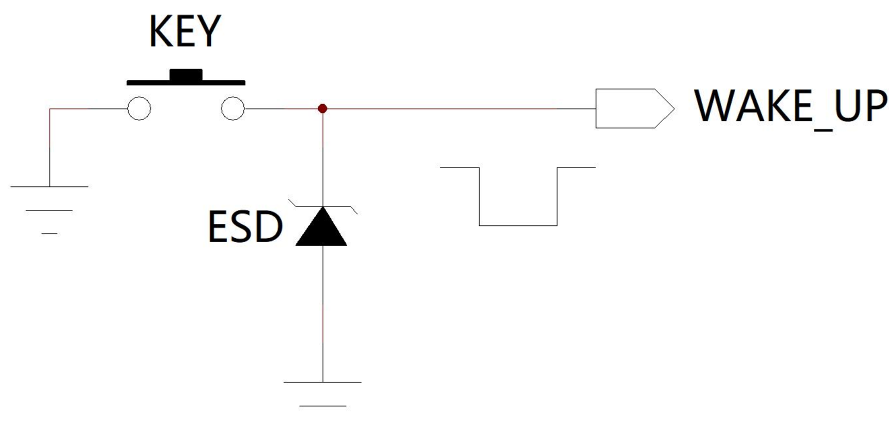


Figure 8：Key reset reference circuit

2.4. Hardware Physical Interface

2.4.1. UART Interface

Four signal pins are used to realize UART function. When DX-BT27 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 transmission is stopped at high level.

Possible UART settings

parameter	probable value	
BAUD	minimum	2400baud（≤1%Error）
	standard	9600baud（≤1%Error）
	maximum	115200baud（≤1%Error）
flow control	RTS/CTS，or none	
Parity check	None, odd or even	
Number of stop bits	1/2	
Number of bits per channel	8	

2.4.2. Universal Digital IO Port

Five general digital IO ports are defined in the module. All these IO ports can be configured through software to realize various functions, such as button control, LED drive or interrupt signal of the main controller, etc. Keep floating when not in use

2.4.3. I2C Interface

- Two-wire I2C serial interface composed of serial data line (SDA) and serial clock (SCL)
- Support two speeds

  standard mode 0-100Kbit/s

  Fast mode ≤400Kbit/s

- 32-position sending and receiving FIFO depth (32x8-bit Rx & 32x 10-bit Tx)
- Support 7-bit and 10-bit addressing mode and regular call addressing mode.

The I2C interface is an internal circuit that allows communication with an external I2C interface. The external I2C interface is an industry standard two-wire serial interface for connecting external hardware. These two serial lines are called serial data line (SDA) and serial clock line (SCL). The I2C module provides two data transmission rates: 100kHz in standard mode and 400kHz in fast mode. The I2C module also has an arbitration detection function to prevent multiple hosts from attempting to transmit data to the I2C bus at the same time.

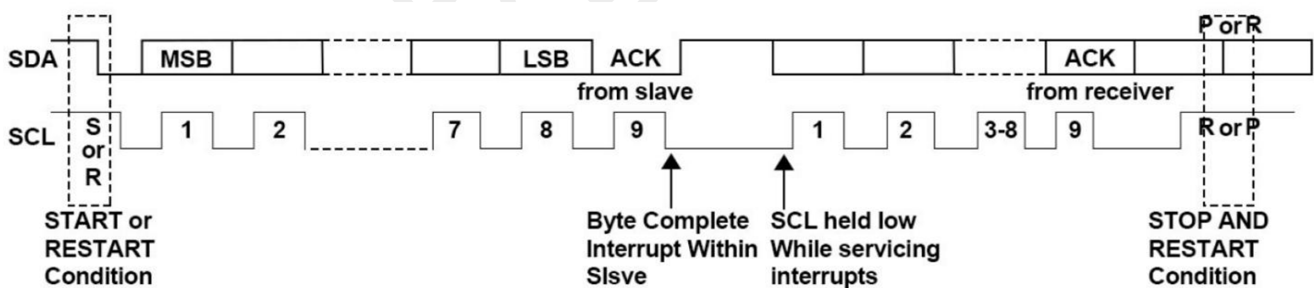


Figure 9：IIC communication sequence diagram

2.4.4. SPI Interface

- Master and slave mode
- From 4bit to 32bit operation
- Main clock up to 32MHz
- Support DMA

This controller implements serial peripheral interface (SPI™) in master-slave mode. The serial interface can transmit and receive from 4-bit to 32-bit in master/slave mode. The controller includes separate TX and RXFIFOs and DMA handshake support. From the mode clock speed is independent of the system clock speed. In addition, the master clock speed can be as fast as the system clock speed. The controller can generate an interrupt when X or RXFIFOs reach the data threshold.

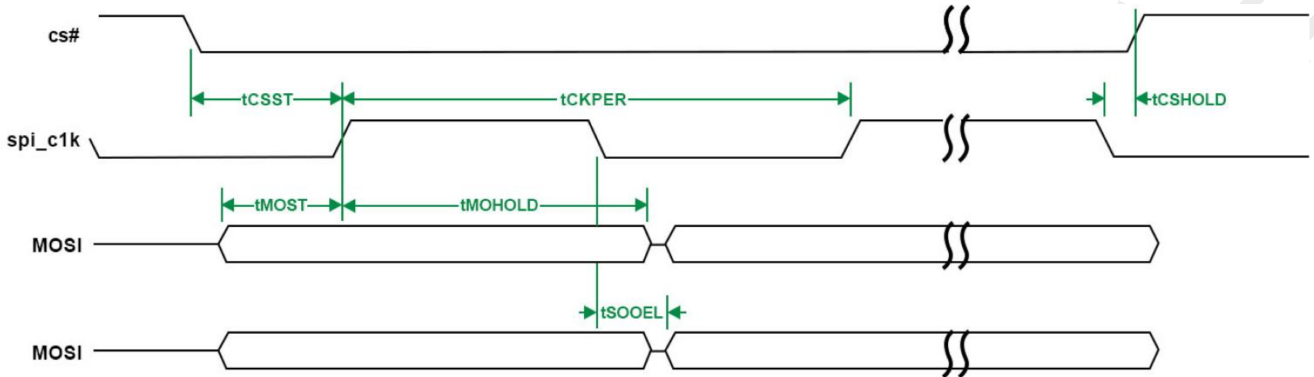


Figure 10：SPI communication timing diagram

2.4.5. Analog-to-digital Converter（ADC)

- Typical 10-bit dynamic ADC of 125 ns
- Maximum sampling rate was 1 Msample/s
- Ultra-low power consumption (20 uA Typical power supply current, 100 ksample/s)
- Configurable attenuator: 1x, 2x,3x, 4x

The device integrates a 10-bit high-speed and ultra-low-power general-purpose analog-to-digital converter (ADC). It can operate in unipolar (single-ended> mode and bipolar (differential) mode. ADC has its own 0.9v regulator (LDO), which represents the full-scale reference voltage

2.5. Reference Connection Circuit

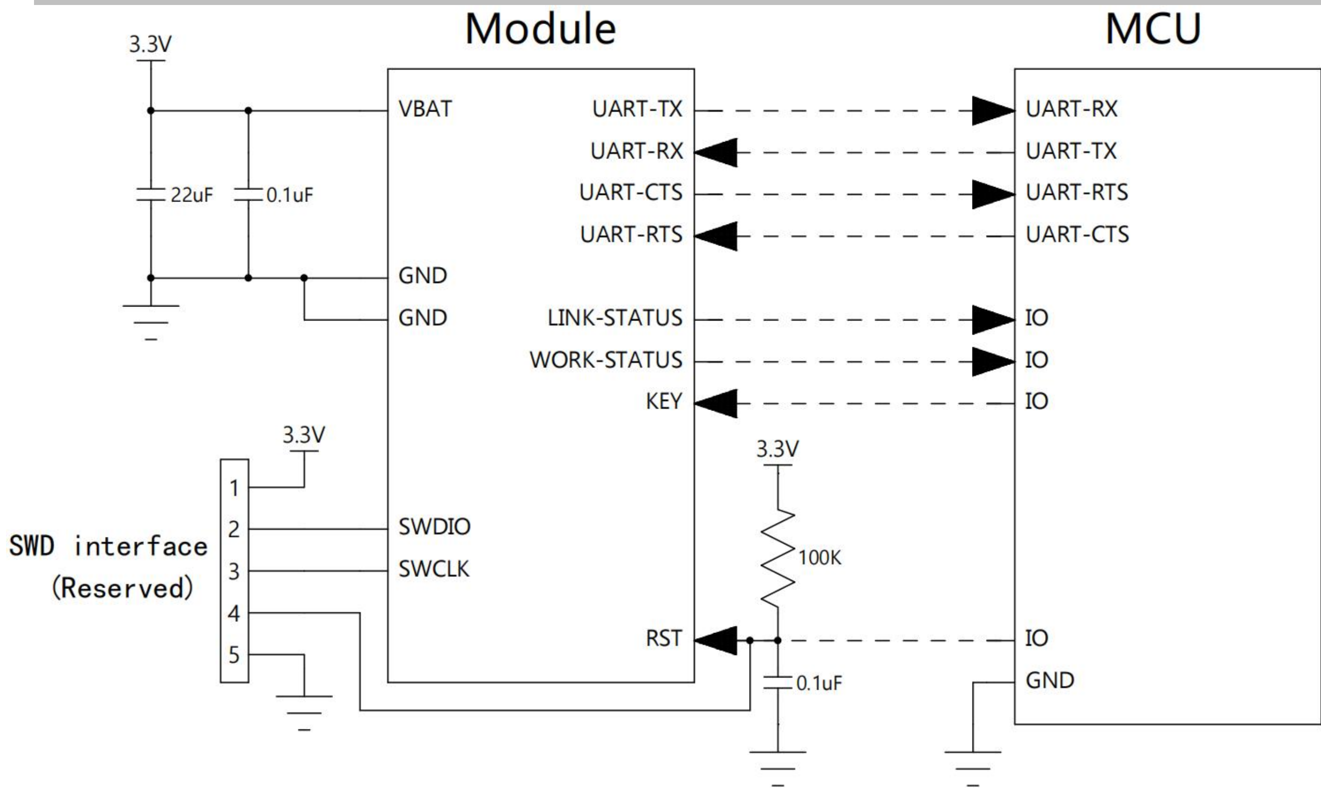


Figure 11: Typical application circuit

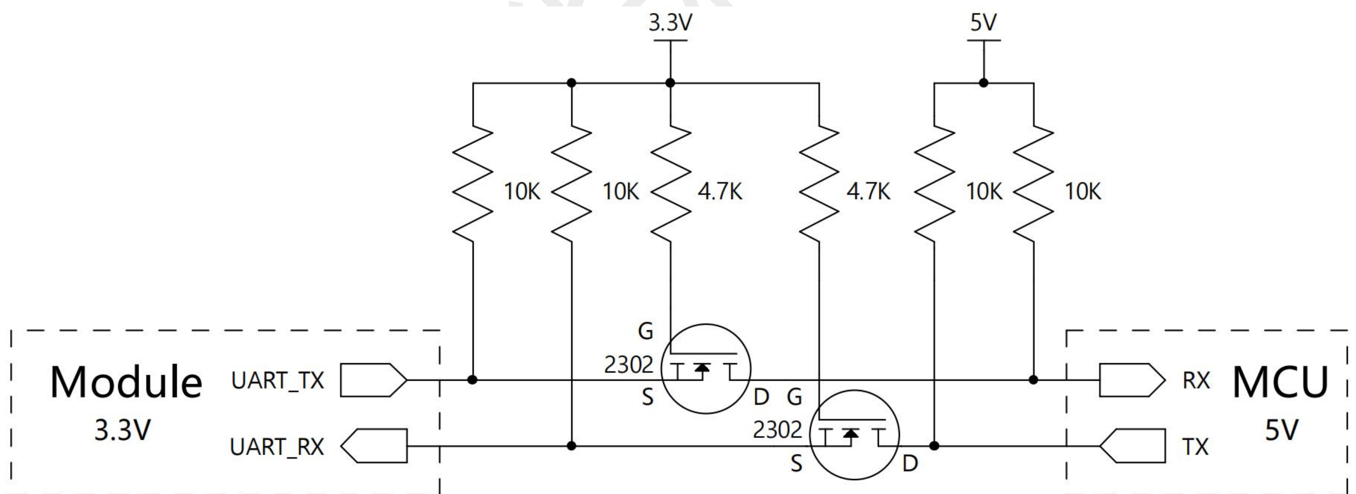


Figure 12: Reference circuit for serial port level conversion

3. Electrical Characteristics & Reliability

3.1. Maximum Rating

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.

Table 9: Absolute maximum rating table

Absolute maximum rating			
parameter	**Minimum**	**Max**	**unit**
V_{IN}- I/O power supply voltage（VDDIO）	-0.1	+3.6	V
V_{IN}- Analog digital power/voltage（VDD）	-0.1	+3.6	V

Table 10: Working voltage table

Operating Voltage				
parameter	**Minimum**	**Typical**	**Max**	**unit**
V_{IN}- Core supply voltage（VDD）	2.8	3.3	3.6	V
V_{IN}- I/O power supply/voltage（VDDIO）	2.8	3.3	3.6	V

3.2. Working And Storage Temperature

Table 11: Working and storage temperature table

parameter	Minimum	Typical	Max	unit
Normal working temperature	-40	-	85	ºC

storage temperature	-50	-	150	ºC

3.3. Power Consumption

Table 12: Power consumption table

mode	state	Current	Unit
working mode	not connected	10	mA
	connected	10	mA
When transparently transmitting data	connected	MIN: 10mA MAX: 10mA	MIN is the power consumption when not sending data MAX is the power consumption when the data volume sent by the module is 10626bytes/s

Remark

The power consumption in the above table is measured at a broadcast interval of 540ms, for reference only. The power consumption of this module in different broadcast intervals is different, the specific power consumption is subject to the actual.

3.4. RF Characteristics

Table 13: RF characteristics table

Function	Value
BLE transmit power	-8.5~13.5dBm
BLE sensitivity	-95dBm@0.1%BER

3.5. Static Protection

In the application of the module, due to the static electricity generated by human body static electricity and charged friction between microelectronics, it is discharged to the module through various ways, which may cause certain damage to the module, so ESD protection should be taken seriously. In the process of R&D, production, assembly and testing, especially in product design,

ESD protection measures should be taken. For example, at the interface of the circuit design and the points that are easily damaged or affected by electrostatic discharge, anti-static protection should be added; anti-static gloves should be worn during production.

Table 14: Table of ESD withstand voltage of module pins

Test interface	Contact discharge	Air discharge	unit
VBAT & GND	+4	+8	kV
Main antenna interface	+2.5	+4	kV

4. Mechanical Size And Layout Recommendations

This section introduces the mechanical dimensions of the module, all dimensions are in millimeters; for all tolerances that are not marked, the tolerance is ±0.3 mm

4.1. Module Mechanical Size

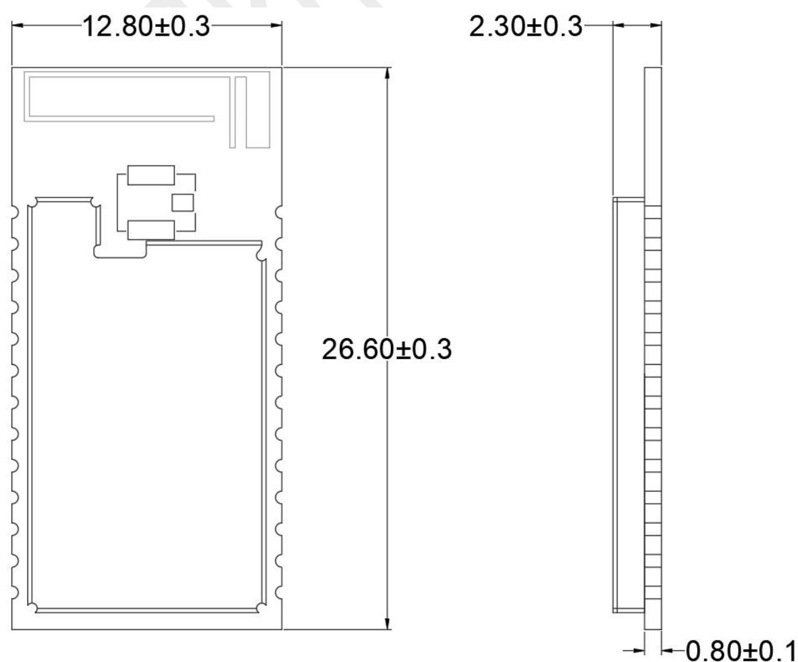


Figure 13: Module top and side dimension drawing

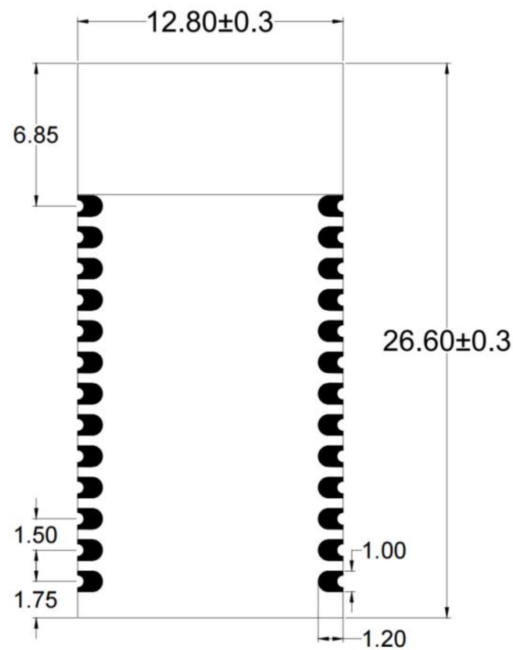


Figure 14：Bottom view size of the module

4.2. Recommend Encapsulation

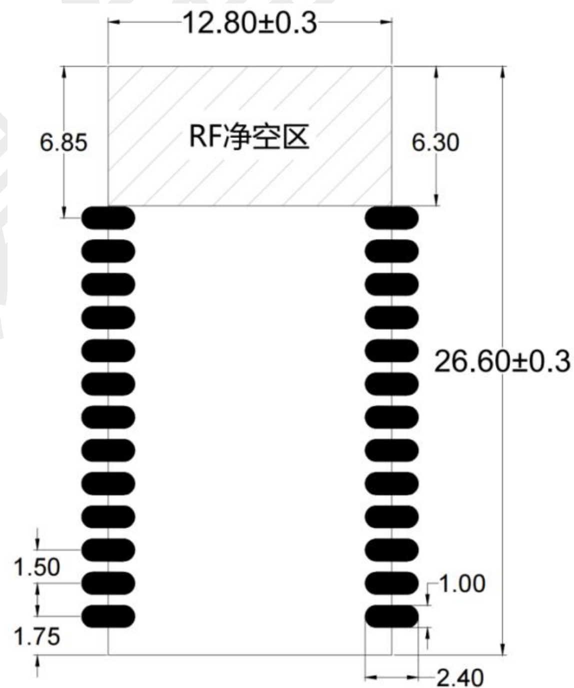


Figure 15：Recommended package dimensions

4.3. Module Top View & Bottom View

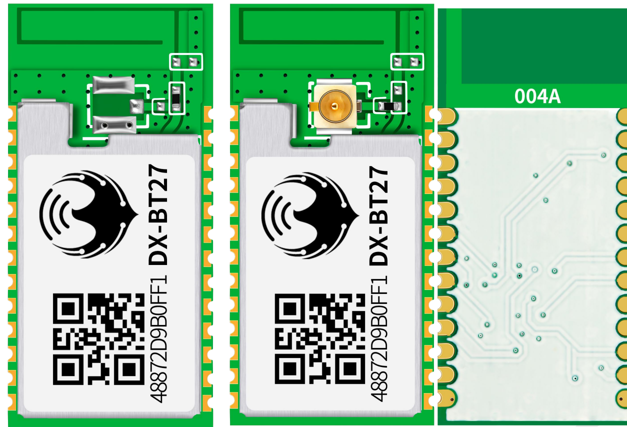


Figure 16：Top and bottom views of the module

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-BT27 Bluetooth module works in the 2.4G wireless frequency band and uses an on-board antenna. The standing wave ratio (VSWR) and efficiency of the antenna depend on the placement of the patch. Various factors should be avoided as far as possible to the wireless signal transmission and reception. Pay attention to the following What time is it：

1、Avoid using metal for the product shell surrounding the Bluetooth. When using a part of the metal shell, try to keep the antenna part of the module away from the metal part.The metal connecting wire or metal screw inside the product should be as far away as possible from the antenna part of the module。

2、The antenna part of the module should be placed against the edge of the carrier board PCB or directly exposed to the carrier board, and it is not allowed to be placed in the middle of the board，There is at least 5mm of free space in the antenna direction, and the carrier board under the antenna is milled out. Copper and wiring are not allowed in the direction parallel to the antenna。

3、It is recommended to use insulating material to isolate the module mounting position on the substrate, for example, put a whole piece of silk screen at this position（TopOverLay）

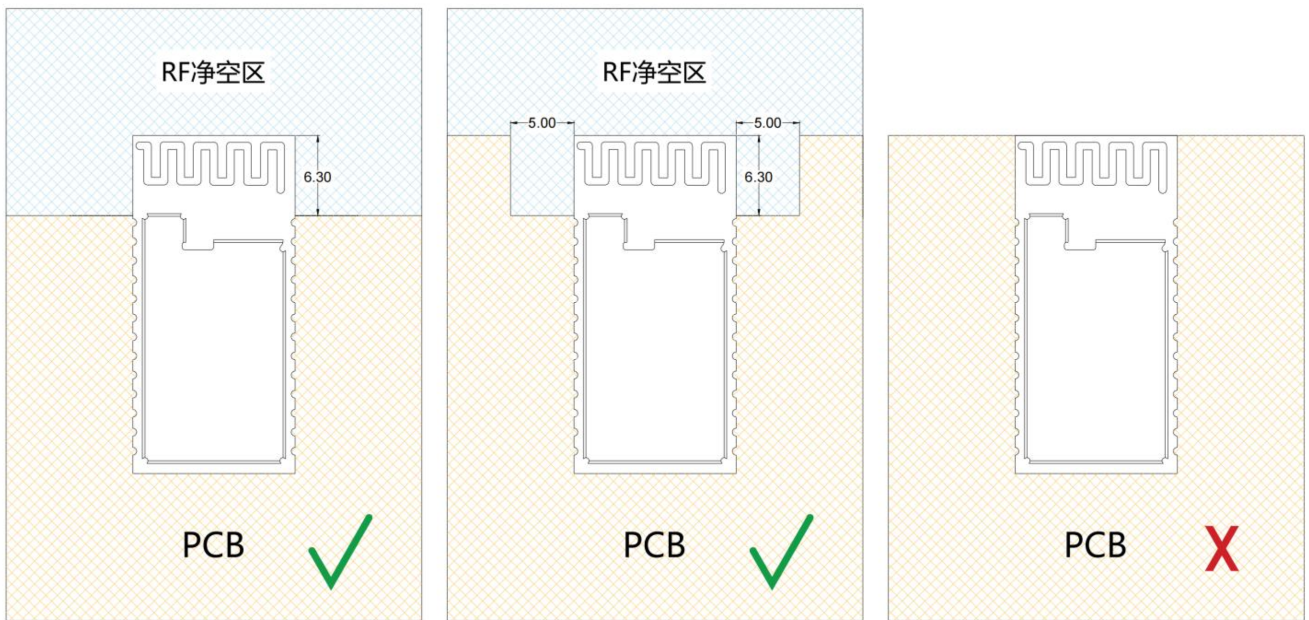


Figure 17：Reference position for module placement

5. Patch Requirements

5.1. Storage Conditions

Modules are shipped in vacuum sealed bags. The humidity sensitivity level of the module is 3 (MSL 3), and its storage must comply with the following conditions：

1. Recommended storage conditions: temperature 23±5°C, and relative humidity 35~60%.
2. Under the recommended storage conditions, the module can be stored in a vacuum sealed bag for 12 months.
3. Under workshop conditions with a temperature of 23±5°C and a relative humidity of less than 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 under the following conditions, the module needs to be pre-baked to prevent

the PCB from blistering, cracks and delamination that occurs after the module absorbs moisture and gets wet and then solders at a high temperature:

- Storage temperature and humidity do not meet the recommended storage conditions;
- The module failed to complete production or storage according to Article 3 above after unpacking;
- Vacuum packaging leaks, bulk materials;
- Before module repair;

5.2. Module Baking Treatment

- Requires high temperature baking at 120 ±5 °C for 8 hours;
- The second-baked module must be soldered within 24 hours after baking, otherwise it still needs to be stored in a dry box;

Remark

1. In order to prevent and reduce the occurrence of defective welding such as blistering and delamination caused by damp, strict control should be carried out. It is not recommended to expose to the air for a long time after unpacking the vacuum package.
2. Before baking, take the module out of the package and place the bare module on a high temperature resistant appliance to avoid high temperature damage to the plastic tray or reel; The second-baked module must be soldered within 24 hours after baking, otherwise it must be stored in a dry box. Please pay attention to ESD protection when unpacking and placing the module, for example, wear anti-static gloves。

5.3. Reflow Soldering

Use a printing squeegee to print the solder paste on the screen so that the solder paste is printed on the PCB through the opening of the screen. The force of the printing squeegee needs to be adjusted appropriately.In order to ensure the quality of the module printing paste, the thickness of the stencil corresponding to the module pad part is recommended to be 0.1~0.15mm .

The recommended reflow soldering temperature is 235~250 ℃, and the maximum should not exceed 250 ℃。In order to avoid damage to the module due to repeated heating, it is strongly

recommended that customers re-attach the module after completing the reflow soldering on the first side of the PCB board. The recommended furnace temperature curve (lead-free SMT reflow soldering) and related parameters are shown in the chart below:

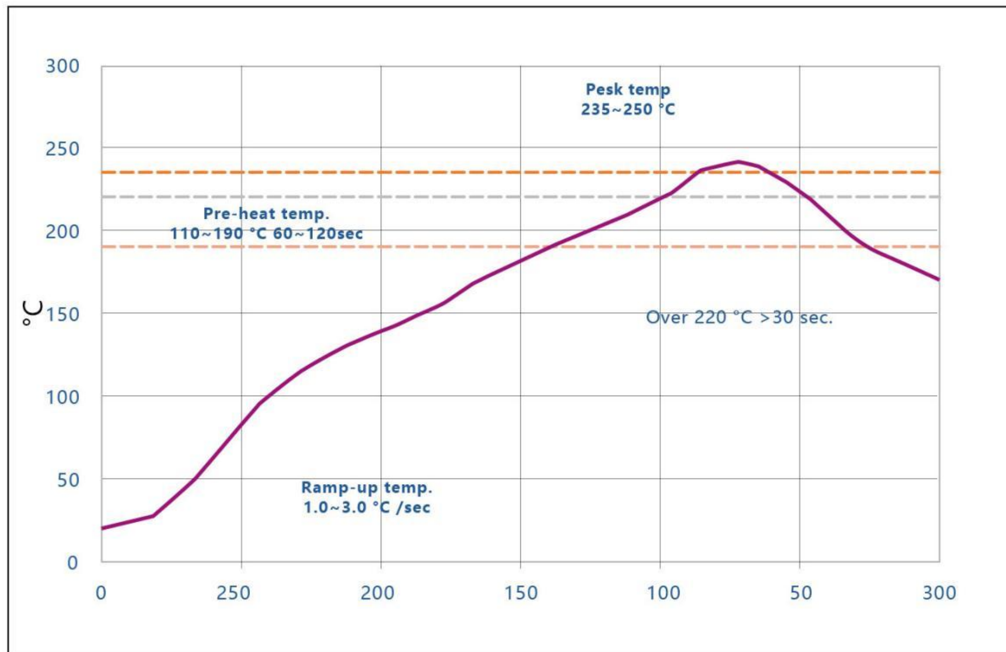


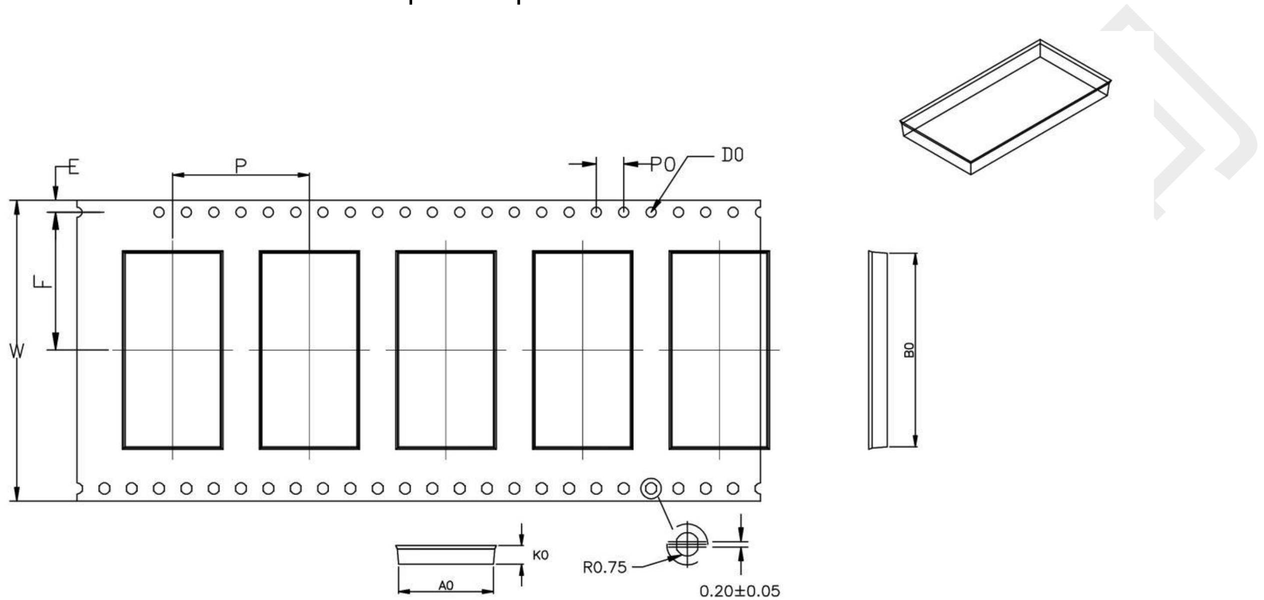
Figure 18: Recommended reflow soldering temperature profile

Table 15: Recommended reflow soldering temperature

Statistics name	Lower limit	Upper limit	unit
Slope 1 (target=2.0) is between 30.0 and 70.0	1	3	Degree/sec
Slope 2 (target=2.0) is between 70.0 and 150.0	1	3	Degree/sec
Slope 3 (target = -2.8) is between 220.0 and 150.0	-5	-0.5	Degree/sec
Constant temperature time 110-190℃	60	120	sec
@220℃ Reflow time	30	65	sec
Peak temperature	235	250	Celsius
@235℃ total time	10	30	sec

5.4. Packing Specification

The DX-BT27 modules are packaged on tape and reel and encapsulated in a vacuum-sealed bag with a desiccant and humidity card. Each carrier is 20 meters long, contains 1000 modules, and has a reel diameter of 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
DIM	$44.0^{+0.30}_{-0.30}$	$13.9^{+0.10}_{-0.10}$			$2.7^{+0.10}_{-0.10}$	——	$20.15^{+0.10}_{-0.10}$	$1.75^{+0.10}_{-0.10}$	$\varnothing 1.50^{+0.10}_{-0}$	$20.0^{+0.10}_{-0.10}$	$4.00^{+0.10}_{-0.10}$	$2.00^{+0.10}_{-0.10}$	$28.30^{+0.10}_{-0.10}$		
ALTERNATE															

Figure 19：Carrier tape size（Unit: mm）

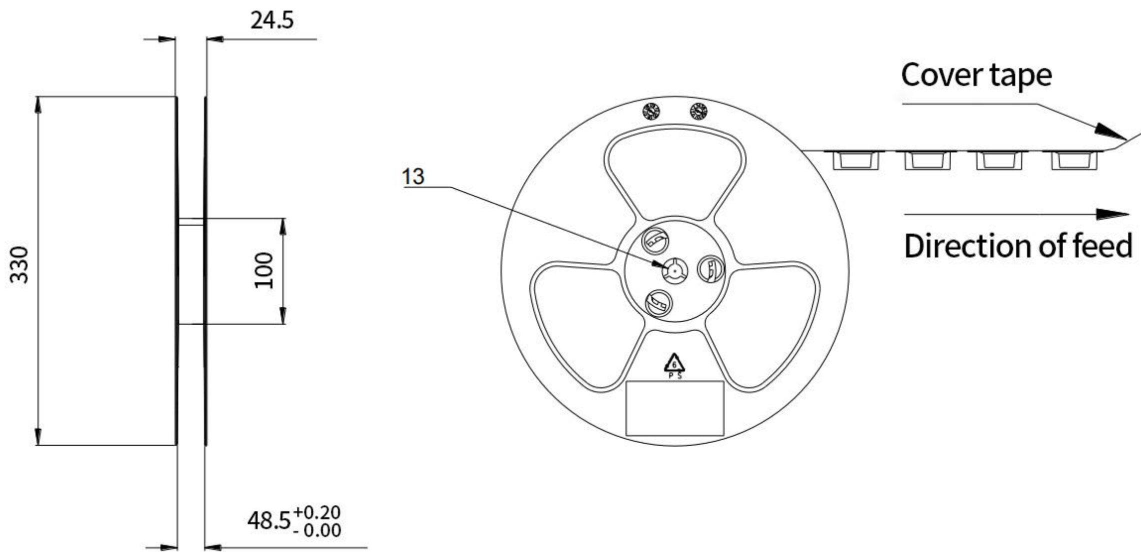


Figure 20：Reel size (unit: mm)

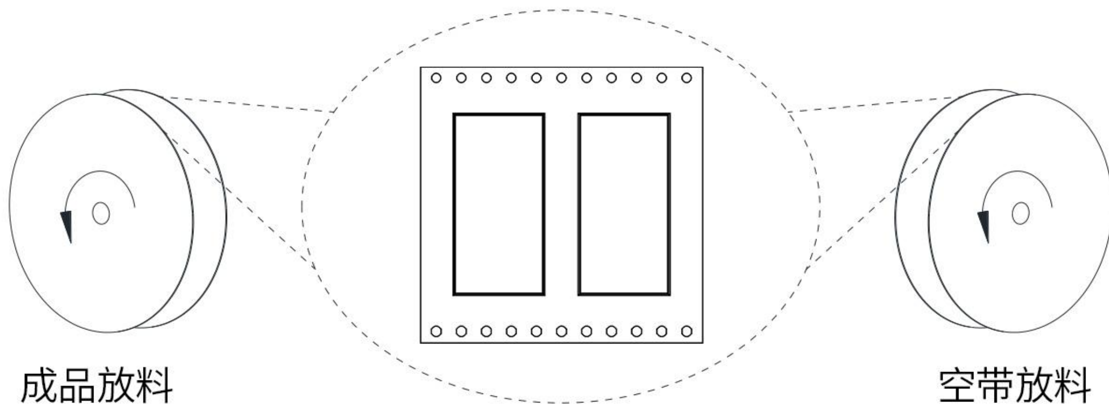


Figure 21：Tape direction