



DX-BT33

One master multi slave Bluetooth module technical manual

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V1.1	2024/08/20	Add module size chart	SZY

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1. The module is introduced

1.1. Overview

DX-BT33 bluetooth module is made by SHEN ZHEN DX-SMART TECHNOLOGY CO.,LTD, using NORDIC nRF52833 chip, chip architecture as ARM architecture (M4, frequency is 64 MHz, follow the bluetooth BLE 5.1 protocol protocols. Support the AT command, the user can according to need to change the baud rate of serial port, name of equipment parameters, such as flexible use. This module supports UART, SPI, I2C and other interfaces, supports IO port control and ADC acquisition. It has the advantages of low cost, low power consumption and high receiving sensitivity. It only needs to be equipped with a few peripheral components to realize its powerful functions, and can be customized to develop various projects according to customer needs.

1.2. Functions

Bluetooth:

- Bluetooth BLE 5.1 protocol

The core and memory:

- 512 kB flash and 128 kB RAM
- Supports 2 Mbps, 1 Mbps, 500 kbps, and 125 kbps
- ARM Cortex-M4 with 64 MHz main frequency

Peripheral interface:

- Support ADC, UART, IIC, SPI, GPIO hardware interface

Module parameters:

- Voltage range: 2.8~3.6V(typical value: 3.3V)



- Can connect up to 8 from the module
- Connect one slave module visible distance: 233.4m
- Connection from eight modules visual range: 84.6 m
- Onboard antenna or external antenna can be selected
- Working temperature: - 40 ~ + 105 °C

1.3. Applications

- Advanced computer mouse/keyboard/multi-touch trackpad
- Health/fitness sensors and monitoring devices
- Support wireless equipment
- Smart home sensor and controller
- Industrial IoT sensor and controller
- Remote control
- Game controller

1.4. Functional block diagram

Below for DX - BT33 bluetooth module function block diagram, expounds the main functions as follows:

- Power supply part
- Baseband part
- Memory
- Rf part
- Peripheral interface

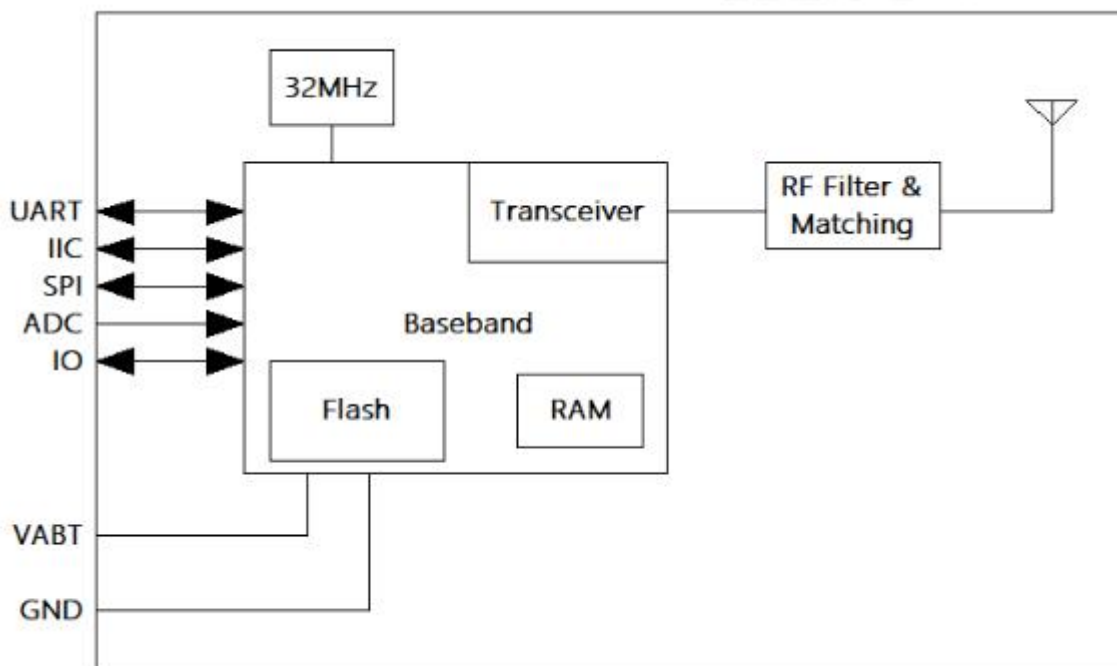


Figure 1: Functional block diagram1

1.5. Basic parameters

Table 1: Table of basic parameters3

Parameter names	Details	Parameter name	Details
chip	nRF52833	Module	DX-BT33
Bluetooth protocols	BLE 5.1	Module size	26.6(L) x 13.0(W) x 0.8(H) mm
working voltage	3.3 V	Work current	20mA
Agreement	GATT, ATT, GAP	MTU values	244 bytes
sensitivity	- 96 - dbm@0.1% BER	Transmit power	22dBm
Modulation	GFSK	Frequency band	2.402GHz -2.480GHz ISM band
Rf input impedance	50 Ω	Frequency hopping and channel	1600hops/s 2MHz space 40 channels
Antenna interface	Onboard antenna/external antenna (optional)	Hardware interface	UART, I2C, SPI, GPIO
working temperature	MIN:-40°C - MAX:+105°C	Humidity	10%-95% non-condensing



2. Application interface

2.1. Module pin definition

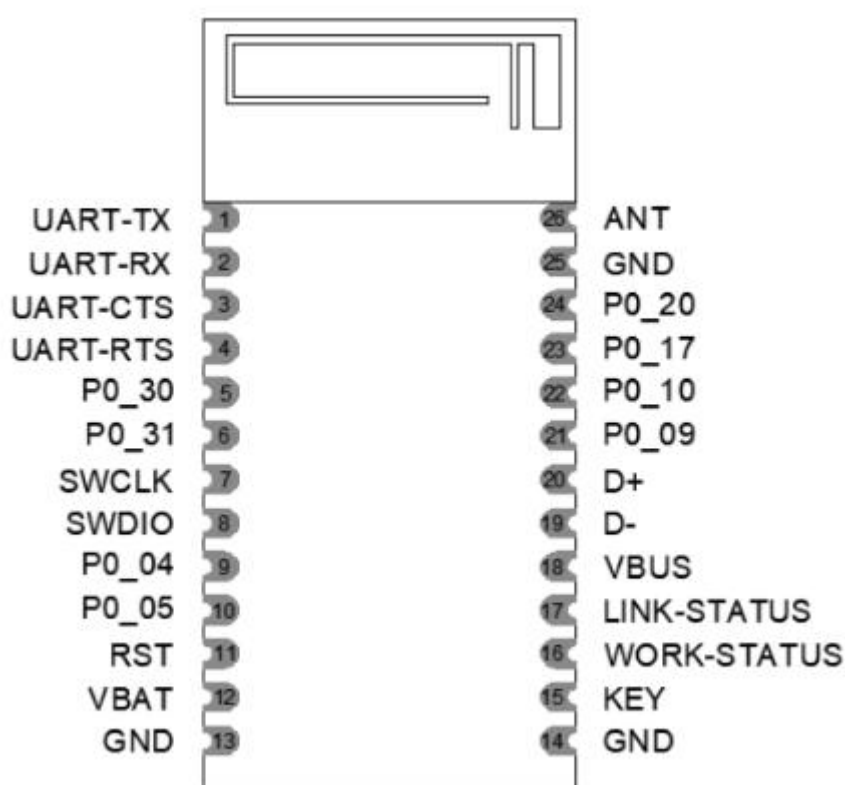


Figure 2: Module pin definition2

2.2. Illustration of the pin definition

Table 2: Pin Definition Instructions Table4

Pin serial number	Pin name	Pin function	Instructions
1	UART-TX	Serial data output	-
2	UART-RX	Serial port data input	-



3	UART-CTS	UART CTS, low level effectively	-
4	UART-RTS	UART request sent, low valid	-
5/6/9/10/21/ 22/23/24	P0_30/P0_31/P0_04/ P0_05/P0_09/P0_10/ P0_17/P0_20	I/O	Programmable input/output feet
7	SWCLK	Debug the clock mouth	Programmable input/output pin
8	SWDIO	Debugging data port	Programmable input/output pin
11	RST	Reset	-
12	VBAT	Power input pin	3.3V(typical value)
13/14/25	GND	Power ground	-
15	KEY	Disconnect	See 2.3.5 for details
		factory data reset	See 2.3.5 for details
16	WORK-STATUS	Module work status output foot	Search and connection: 300ms high 300ms low Connection status: Always high
17	LINK-STATUS	Bluetooth connection status foot	Unconnected state: Output low Connected state: 200ms high level 200ms low level, high and low level change N times and output 1s low level (N is the number of connected Bluetooth)
18	VBUS	USB power input pin	5V(typical value)
19	D-	USB D-	-
20	D+	USB D+	-
26	ANT	Antenna	-

2.3. Power supply design

2.3.1. Power port

Table 3: Power interface pin definition Table5

Pin name	Pin number	Description	Minimum	Typical value	Maximum value	Units
VBAT	12	Module power supply	2.8	3.3	3.6	V
GND	13/14/25	Ground	-	0	-	V

2.3.2. Power supply stability Requirements

DX - BT33 power supply in the range of 2.8 ~ 3.6 V, the need to ensure that not less than 2.8 V input voltage. The following figure shows the VBAT voltage sag during RF burst transmission.

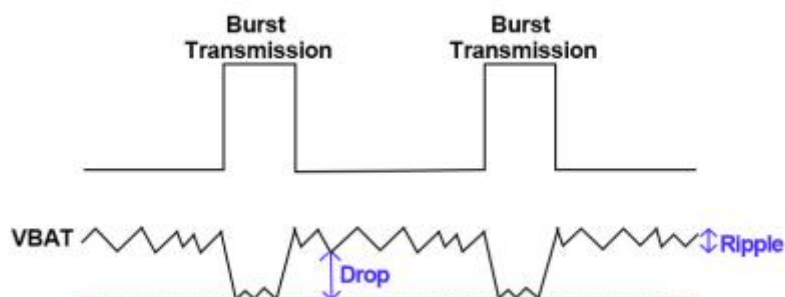


Figure 3: Burst transmission power requirements3

In order to reduce the voltage drop, it is recommended that the reserved for VBAT 2 (22 uF, 0.1 uF) which has the best ESR performance of chip multilayer ceramic capacitors (MLCC), and capacitance placed close to the VBAT pin. The reference circuit is as follows:

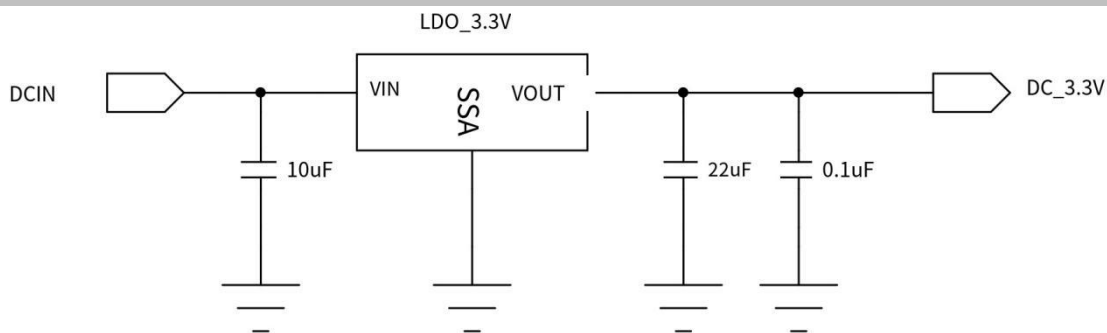


Figure 4: Power supply reference circuit4

2.3.3. Power outage requirement

Because the working current module chip is very low, when power off, peripheral MCU IO mouth if there is a weak current supply module, the module easily in abnormal working state, so disconnect power supply module, MCU all IO port connected to the module must be configured to drop down.

2.3.4. RST reduction and feet

Table 4: RST pin definition table6

Pin names	Pin number	I/O	Description	Notes
RST	11	DI	Module reset	Low is effective It hung up

note

RST signal is sensitive to interference, so it should be short, as far as possible and processing package.

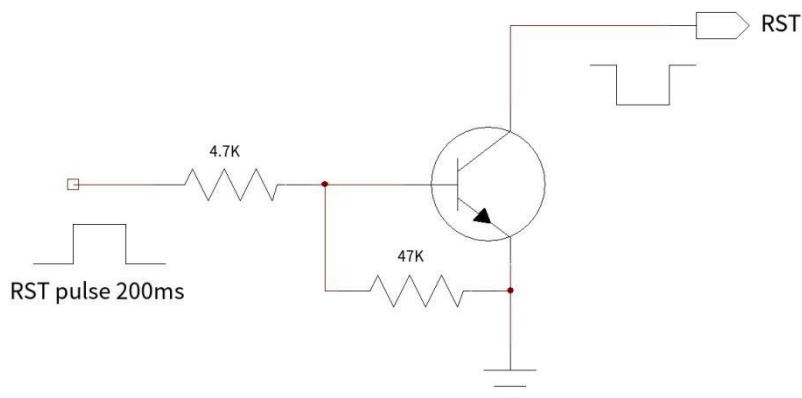


Figure 5: reset the reference circuit5

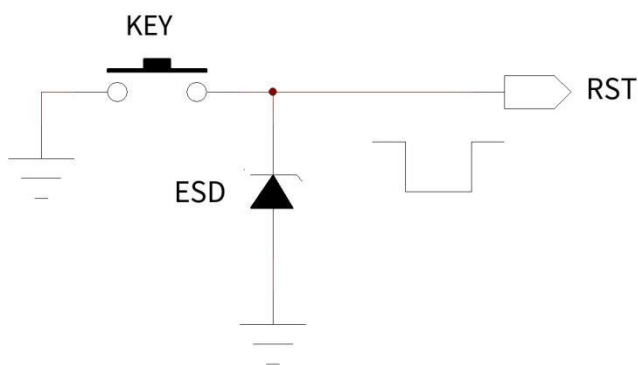


Figure 6: Key reset reference circuit6

2.3.5. KEY pin Description

Table 5: the KEY 7

Pin names	Pin number	I/O	Description	Notes
KEY	15	DI		

Table 6: the KEY pin function definition table8

State of the module	Operation method	Results
Connection status	Lower KEY pin at least 200 ms after release	Disconnect
Standby mode	Lower KEY pin at least 200 ms after release	Restore the default Settings

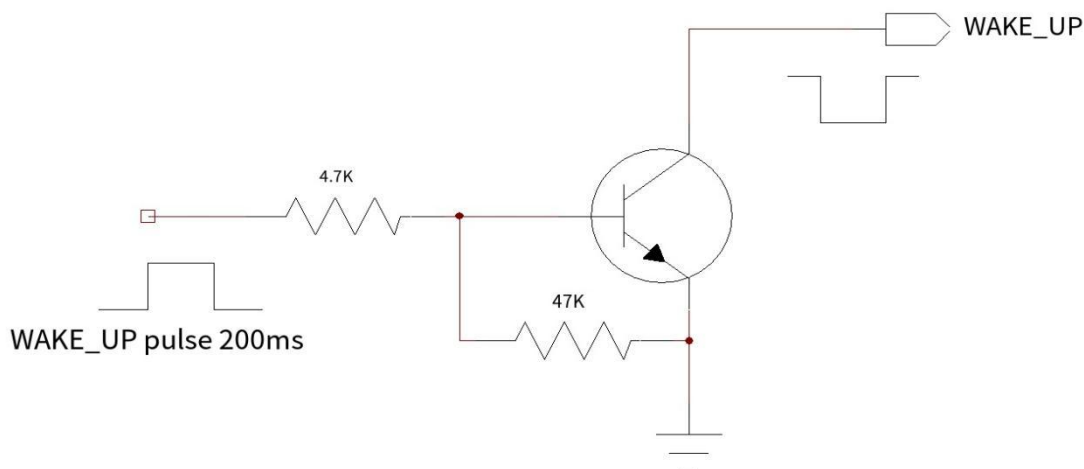


Figure 7: open set drive awoken reference circuit7

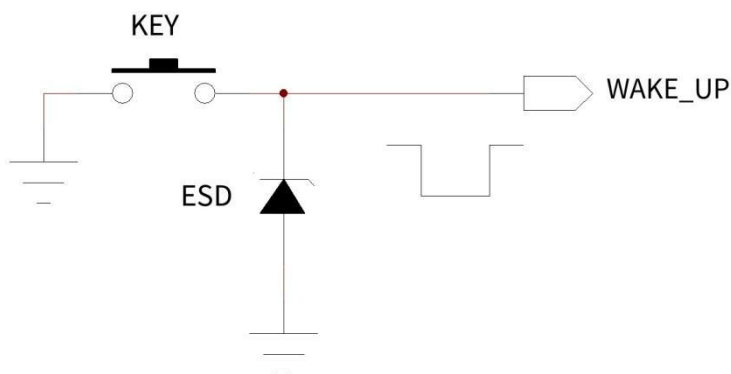


Figure 8: Key reset reference circuit8

2.4. The physical interface to the hardware

2.4.1. General purpose digital IO port

In the module defines the eight general digital IO. All these I/o port can be configured by the software, realize the various functions, such as button control, LED driver or interrupt signal of main controller, etc. Keep them dangling when not in use.

2.4.2. UART interface

UART realized the support for the following Functions:

- Full-duplex operation
- Automatic flow control

UART uses TXD and RXD registers directly to send and receive data. UART uses a stop bit.

Note: The external crystal oscillator must be enabled to obtain sufficient clock accuracy to stabilize communication.

Four signal pins are used to implement the UART function. When the DX-BT33 is connected to another digital device, UART_RX and UART_TX transmit data between the two devices. UART_CTS and the remaining two pin UART_RTS can be used to implement RS232 hardware flow control, and all are low level effectively, which allows the transmission, low levels of high electricity at ordinary times to stop transmission.

Possible UART settings		
Parameters	Possible values	
Baud rate	A minimum	1200baud ($\leq 1\%$ Error)
	standard	9600baud ($\leq 1\%$ Error)
	The biggest	115,200baud ($\leq 1\%$ Error)
Flow control	RTS/CTS, or none	
Parity check	None, odd or even	
The number of stop bits	1/2	
Number of bits per channel	8	

2.4.3. I2C interface

- 2-wire I2C serial interface consisting of serial data line (SDA) and serial clock (SCL)
- Two speeds are supported

Standard mode 0-100Kbit/s

Fast mode ≤ 400 Kbit/s

- Transmit and receive FIFO depth of 32 positions (32x8-bit Rx and 32x 10-bit Tx)

- 7-bit and 10-bit addressing modes as well as regular call addressing modes are supported.

The I2C interface is the internal circuit, allowed to communicate with external I2C interface, external I2C interface is the two-wire serial interface, the industry standard for connecting external hardware. These two serial lines are called Serial Data Line (SDA) and Serial Clock Line (SCL). The I2C module provides two kinds of data transfer rate: standard mode for 100 KHZ to 400 KHZ, fast mode. I2C module also has the function of arbitration test, in order to prevent multiple host trying at the same time to transmit the data to I2C bus.

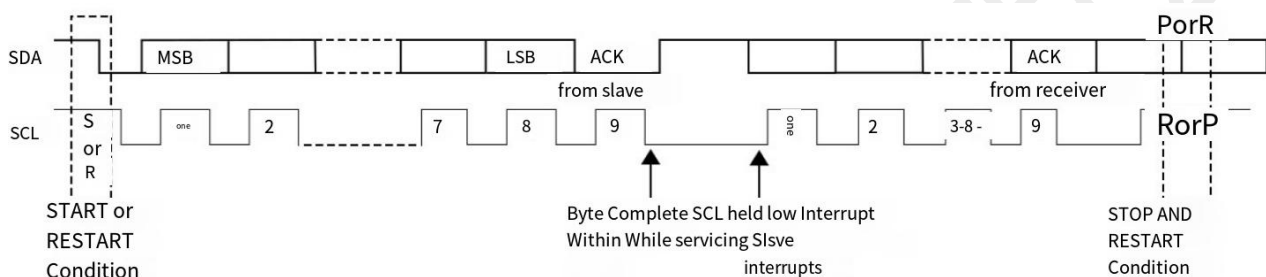


Figure 9: IIC communication timing diagram9

2.4.4. SPI interface

The SPI host provides a simple CPU interface that includes a TXD register for sending data and an RXD register for receiving data. Rxd-1 and TXD+1 are double buffered versions of RXD and TXD, respectively.

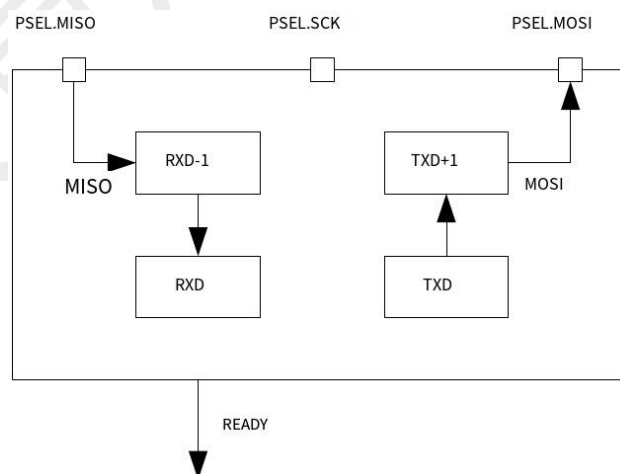


Figure 10: SPI master10



TXD and RXD registers are double buffer so that to some extent allowed continuous flow of data in and out of the SPI hosts.

SPI master not directly implement support for chip select. Therefore, the CPU must use the available GPIO to select the correct slave station and control it independently of the SPI master. The SPI master supports SPI modes 0 to 3.

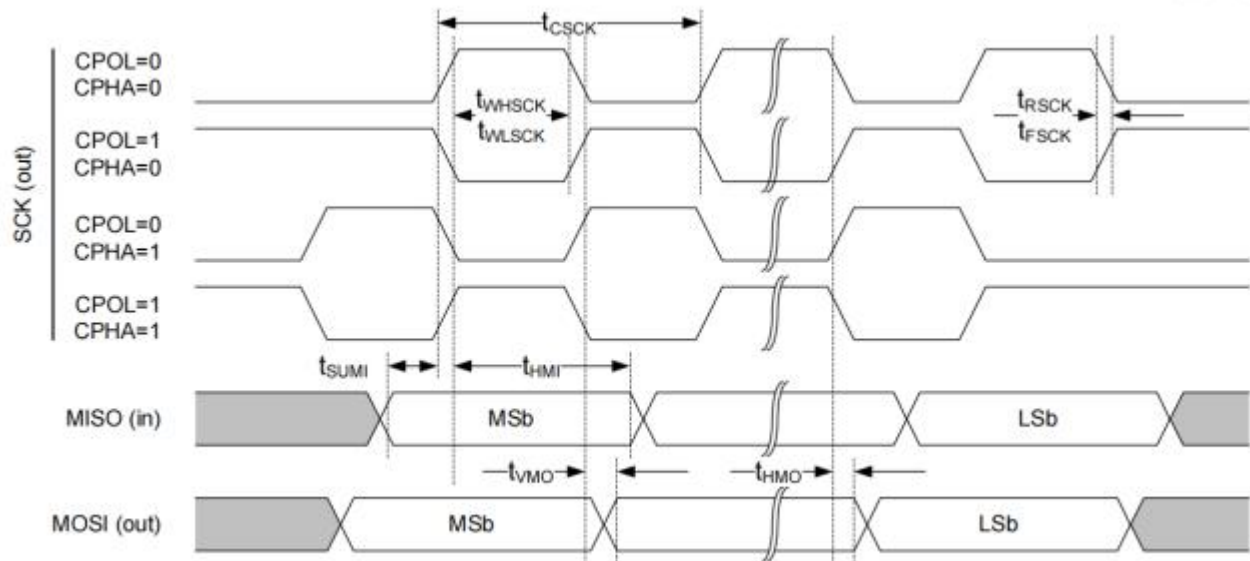


Figure 11: SPI master timing diagram11

2.4.5. Successive approximation adc (SAADC)

SAADC successive approximation register (SAR) is a kind of difference of adc. It supports up to 8 external analog input channels.

The following is a SAADC key Functions:

- More input channel
Each channel can be used to pin AIN0 AIN7, as input or VDDH VDD pin pin
8 channels are for single-ended inputs and 4 channels are for differential inputs
- Full range input range
- Separate reference selection for each channel
VDD
Internal reference



- Continuous sampling
- Automatic writing RAM using EasyDMA output sample
- The sample is stored as a 16 bit 2's complement value
- 8/10/12 bit resolution, 14 bit resolution with oversampling

2.5. Reference connection circuit

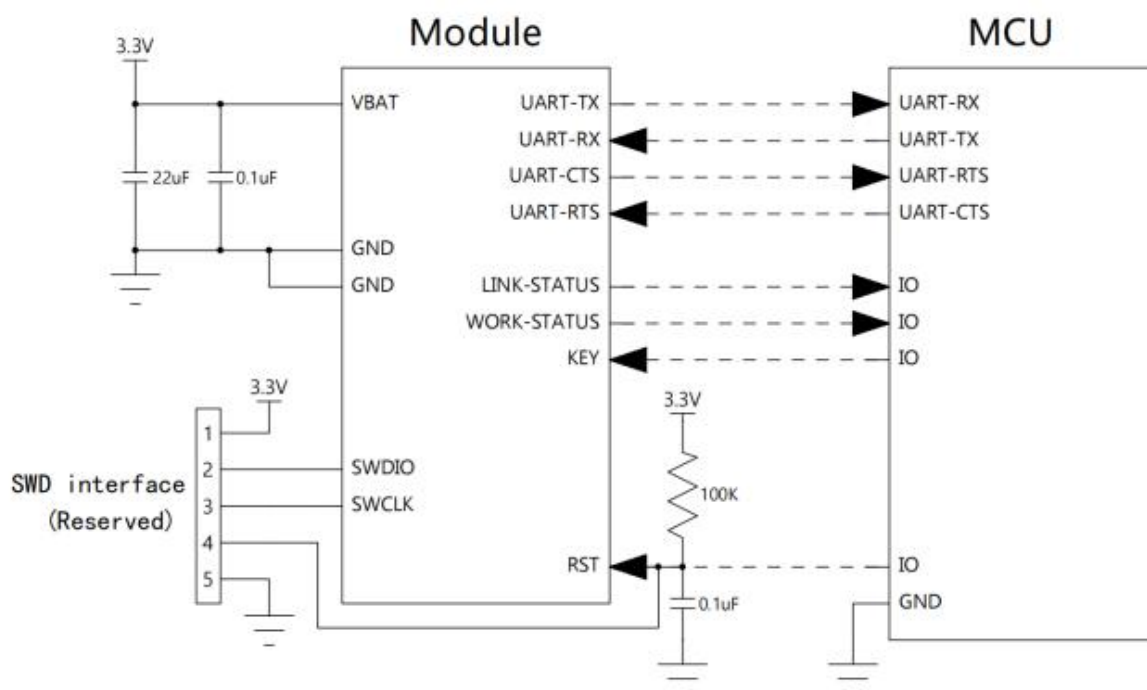


Figure12:Typical application circuit12

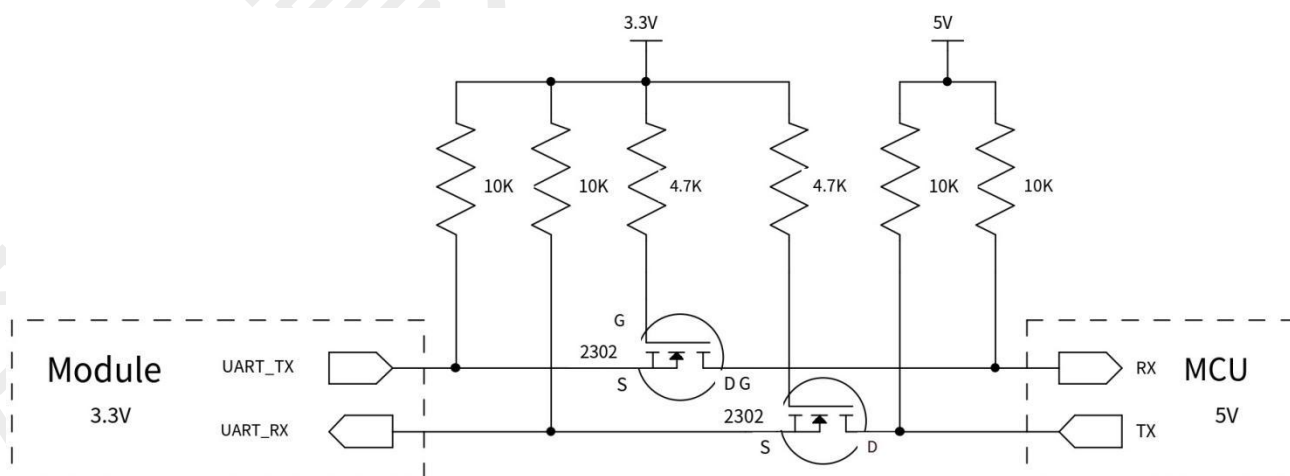


Figure 13: Serial port level conversion reference circuit13

3. Electrical characteristics and reliability

3.1. Maximum rating

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

Table 7: Table of absolute maximum ratings⁹

Absolute maximum rating			
Parameters	Minimum	Maximum	Units
$V_{-IN }$ /O supply voltage (VDDIO)	-0.3	+3.6	V
V_{IN-} Analog Digital Power/Voltage (VDD)	-0.3	+3.6	V

Table 8: Working voltmete table¹⁰

Voltage of operation				
Parameters	Minimum	Typical	Max	Units
V_{IN-} Core supply voltage (VDD)	2.8	3.3	3.6	V
$V_{-IN }$ /O port Power/voltage (VDDIO)	2.8	3.3	3.6	V

3.2. Working and storage temperature

Table 9: Working and Storage thermometer¹¹

Parameters	Minimum	Typical	Max	unit
Normal working temperature	-40	-	105	°C
Storage temperature	-40	-	125	°C



3.3. Current consumption

Table 10: Power consumption table12

Modes	State	Current	Unit
Mode of work	Standby	834.6	uA
	Connect 1 slave module	2.44	mA
	Connect 2 slave modules	4.01	mA
	Connect 3 slave modules	4.01	mA
	Connect 4 slave modules	4.06	mA
	Connect 5 slave modules	4.87	mA
	Connect 6 slave modules	4.59	mA
	Connect 7 slave modules	4.58	mA
	Connect 8 slave modules	4.1	mA
Data transparent transmission	Connect 1 slave module	6.06	mA
	Connect 2 slave modules	10.66	mA
	Connect 3 slave modules	13.48	mA
	Connect 4 slave modules	16.4	mA
	Connect 5 slave modules	19.41	mA
	Connect 6 slave modules	22.83	mA
	Connect 7 slave modules	25.56	mA
	Connect 8 slave modules	29.4	mA

3.4. Rf characteristics

Table 11: Table of RF characteristics13

Functions	Taking values
BLE transmit power	22dBm
BLE sensitivity	- 96 - dbm@0.1% BER

3.5. ESD protection

In the application of modules, due to the static electricity generated by human body static electricity and charged friction between microelectronics, it may cause some damage to the module through various ways, so ESD protection should be paid attention to. ESD protection measures should be taken in the process of research and development, production, assembly and testing, especially in product design. For example, at the interface of the circuit design and the point susceptible to electrostatic discharge damage or influence, anti-static protection should be increased, and anti-static gloves should be worn in production.

Table 12: Table of ESD tolerant voltage of module pins14

Test interface	Contact discharge	Air discharge	Units
VBAT and GND	+4	+8	kV
Main antenna interface	+2.5	+4	kV

4. Mechanical dimensions and layout suggestions

This section describes the mechanical dimensions of the module, all dimensions are in millimeters; All dimensions not marked with tolerances with tolerances of ± 0.3 mm



4.1. Modular mechanical ruler

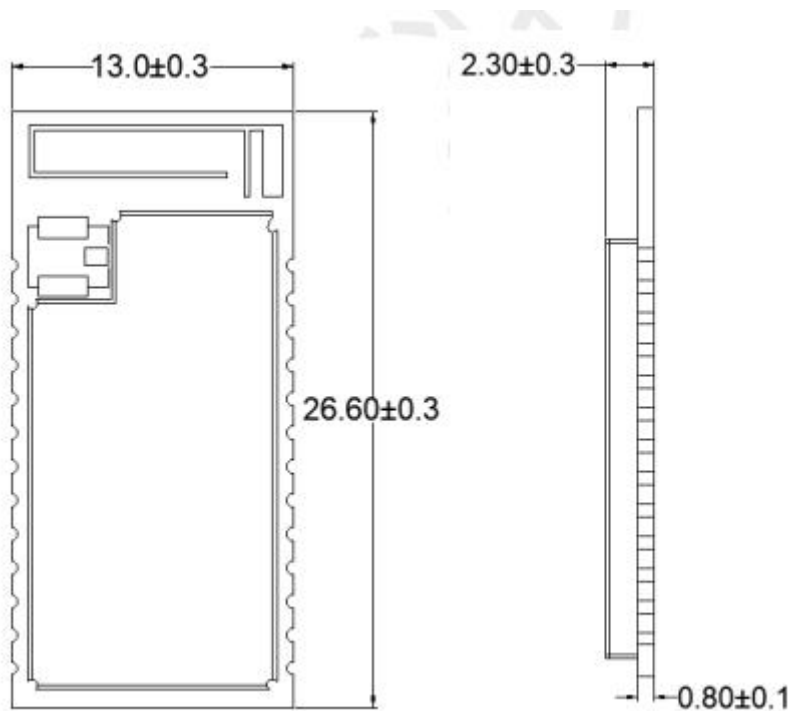


Figure 14: Front and side view dimensions of the module14

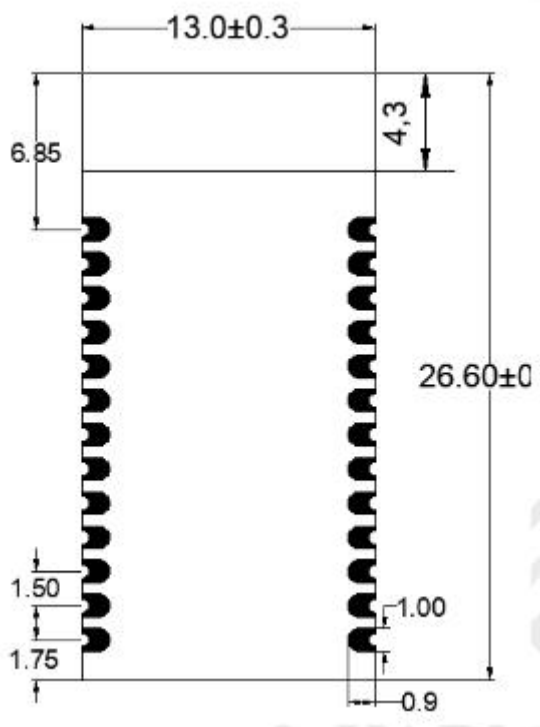
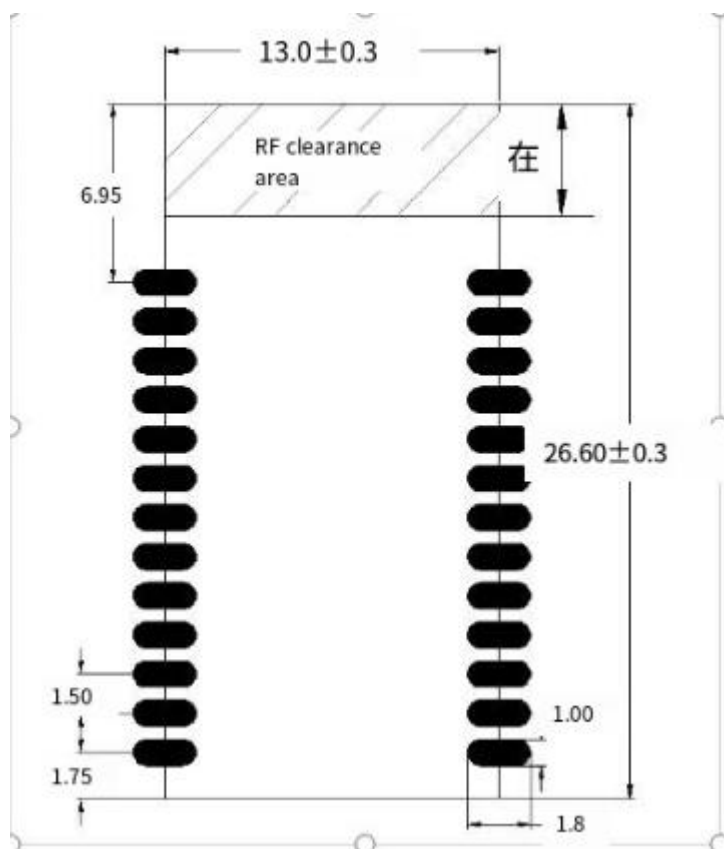


Figure 15: Module bottom view size diagram15



4.2. Recommended packaging





4.3. Top/bottom view of the module

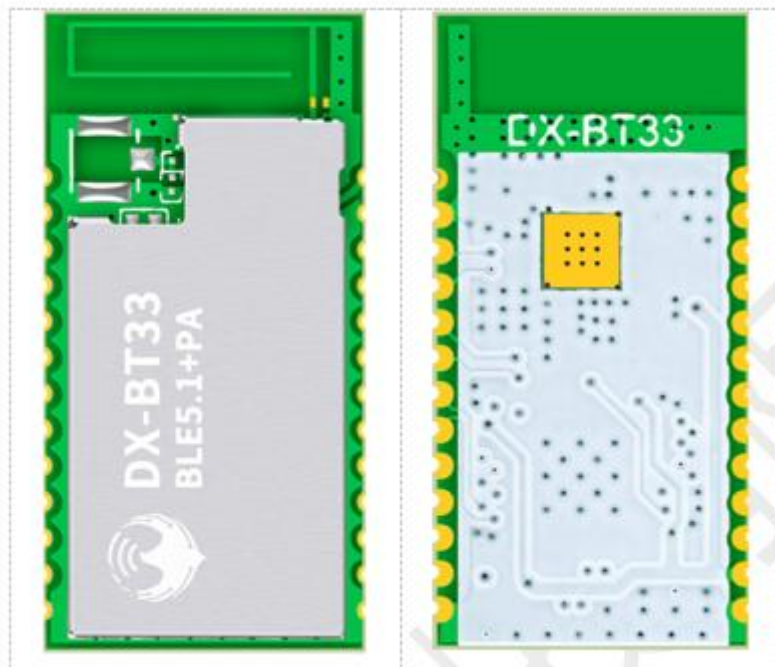


Figure 17: Module top view and bottom view17

Notes

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

4.4. Hardware design layout suggestions

The DX-BT33 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 position of the patch. The influence of various factors on the wireless receiving and transmitting signals should be avoided as much as possible.

1. Avoid the use of metal in the product shell surrounding Bluetooth. When using part of the metal shell, try to keep the module antenna part away from the metal part. Product internal metal connection wire or metal screws, should be as far away from the module antenna part.

2. The module antenna part should be placed on the PCB edge of the carrier board 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 free space in the direction of the antenna, and the carrier board is milled empty below the antenna, and copper laying and wiring 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 putting a whole screen print (TopOverLay) at the position.

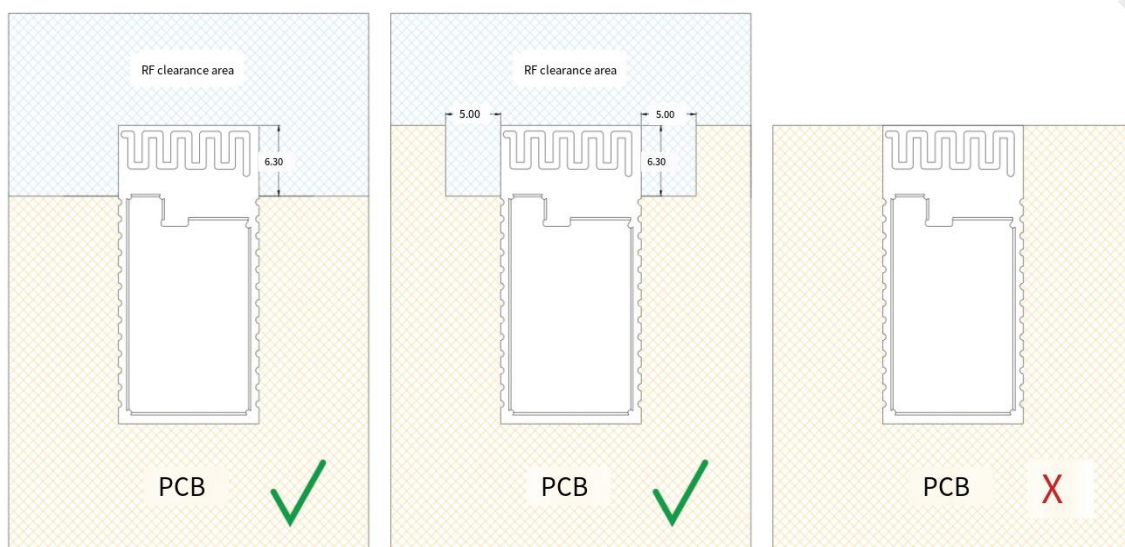


Figure 18: Reference position for module placement

5. Storage, production and packaging

5.1. Storage conditions

Modules are shipped in vacuum-sealed bags. The module has a humidity sensitivity class of 3 (MSL 3), and its storage is subject to the following conditions:

1. Recommended storage conditions: temperature $23\pm 5^{\circ}\text{C}$ and relative humidity of 35~60%.
2. Under the recommended storage conditions, the module can be stored in a vacuum sealed bag for 12 months.

3. The unsealed workshop life of the module is 168 hours under workshop conditions of $23\pm 5^{\circ}\text{C}$ and relative humidity below 60%. Under these conditions, the module can be directly used for

reflux production or other high temperature operation. Otherwise, it is necessary to store the module in an environment with relative humidity less than 10% (for example, a moistureproof cabinet) to keep the module dry.

4. If the module is under the following conditions, it is necessary to pre-bake the module to prevent the PCB blistering, cracking and delamination after the module is hygro-absorbed and then welded at high temperature:

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

5.2. Module baking treatment

- It needs to be baked at $120\pm 5^{\circ}\text{C}$ for 8 hours at high temperature;
- The second baking module must be completed within 24 hours after baking welding, otherwise still need to be stored in the drying oven;

Notes

1. In order to prevent and reduce the occurrence of bad welding such as foaming and delimitation caused by moisture, the module should be strictly controlled. It is not recommended to be exposed to the air for a long time after opening the vacuum package.
2. Before baking, it is necessary to remove the module from the package and place the bare module on the high temperature resistant appliance to avoid high temperature damage to the plastic tray or reel; The second baking module must be completed within 24 hours after baking welding, otherwise it needs to be stored in the drying oven. 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 scraper to print solder paste on the screen plate, so that the solder paste is leaked to the PCB through the opening of the screen plate, and the printing scraper strength needs to be adjusted appropriately. In order to ensure the quality of the module paste, the thickness of the steel mesh corresponding to the module pad part is recommended to be 0.1~0.15mm.

The recommended reflow soldering temperature is 235~250 °C, and the maximum temperature should not exceed 250 °C. To avoid damage to the module due to repeated heat exposure, it is highly recommended that customers do not attach the module until the first side of the PCB has been reflow soldered. The recommended furnace temperature curve (lead-free SMT reflow soldering) and related parameters are shown in the following chart:

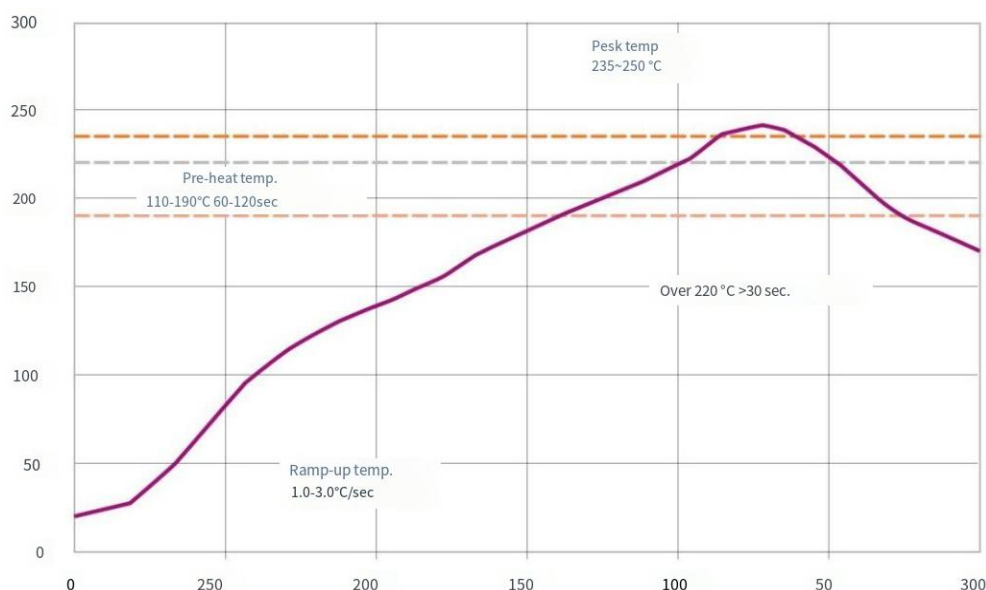


Figure 19: Recommended reflow soldering temperature curve19

Table 13: Recommended reflow soldering temperature15

Statistical Name	Lower limit	Upper limit	Units
Slope 1 (target =2.0) is between 30.0 and 70.0	1	3	Degrees/SEC
Slope 2 (target =2.0) is between 70.0 and 150.0	1	3	Degrees per second
Slope 3 (target =-2.8) is between 220.0 and 150.0	-5	-0.5	Degrees/SEC
Constant temperature time 110-190 ° C	60	120	seconds
@220C reflux time	30	65	seconds
Peak temperature	235	250	Celsius
@235C total time	10	30	seconds



5.4. Packing protocols

The DX-BT33 module is packaged in roll tape and enclosed in a vacuum sealed bag with desiccants and humidity cards. Each carrier is 20 meters long, contains 1,000 modules, and the reel is 330 mm in diameter. The protocols are as follows:

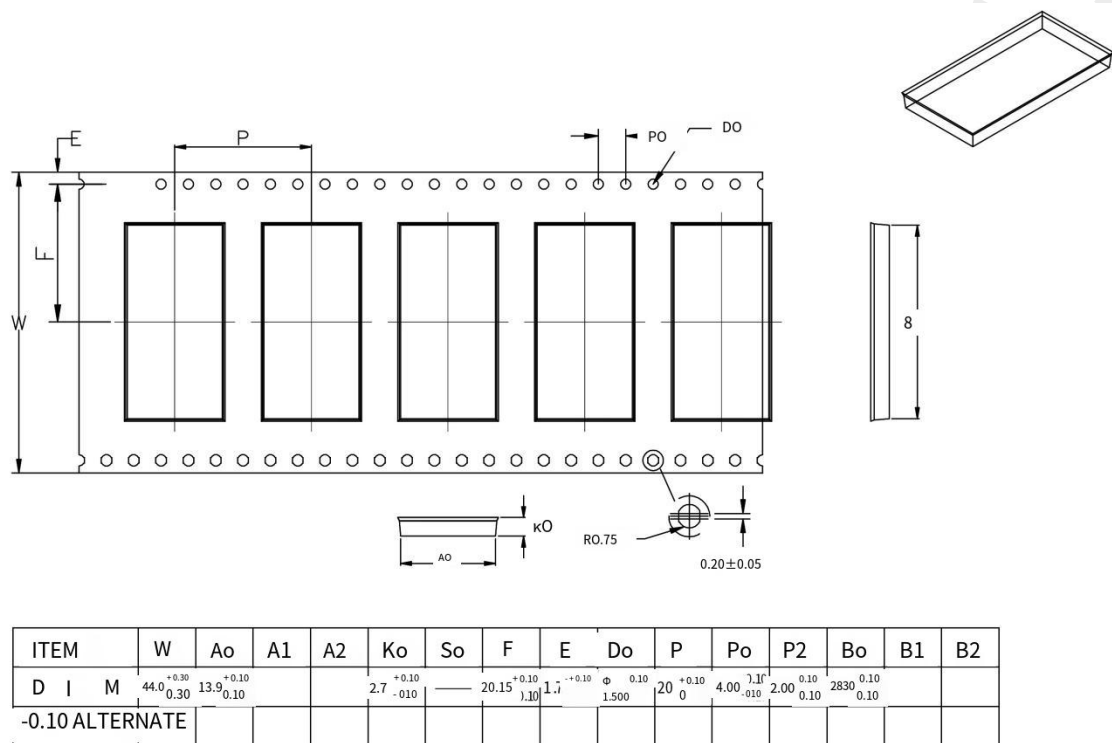


Figure 20: Strap size (unit: mm)20

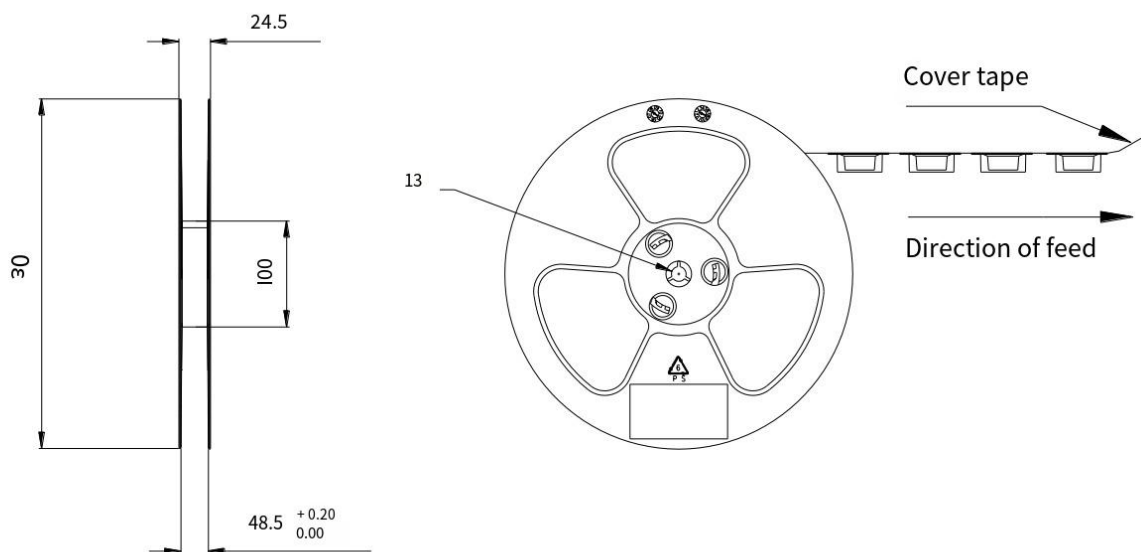


Figure 21: Reel size (unit: mm)21

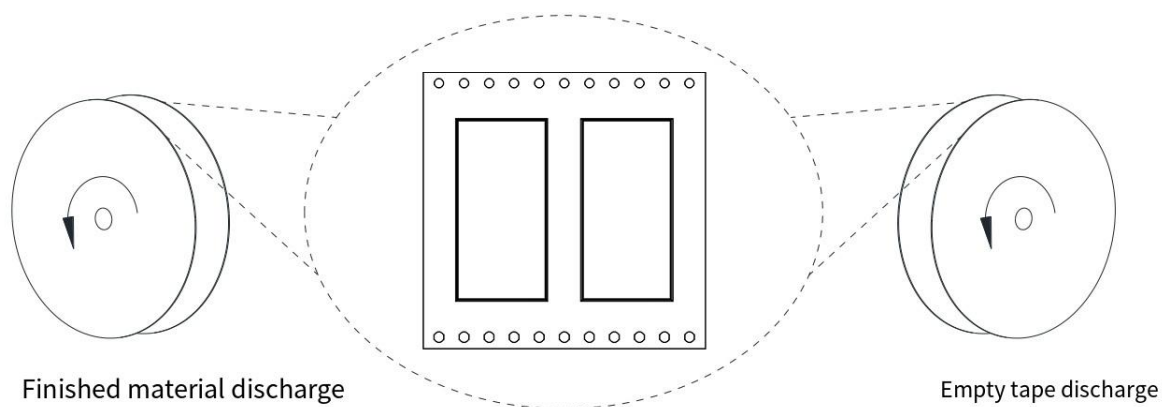


Figure 22: Reel orientation22