



# **DX-BT39**

## **One master multi slave**

## **Bluetooth module**

## **technical manual**

Version: 1.2

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## Updated records

Version	Date	Instructions	Author
V1.0	2024/04/26	The initial release	SML
V1.1	2024/05/11	Add power meter	SML
V1.2	2024/07/26	Add the module size chart	SML

## Contact Us

**SHEN ZHEN DX-SMART TECHNOLOGY CO.,LTD,**

Email: [manager@szdx-smart.com](mailto:manager@szdx-smart.com)

Tel: 0755-2997 8125

Whatsapp: +86 15798463070

Website: [en.szdx-smart.com](http://en.szdx-smart.com)

Address: 601, A1 Block, Huafengzhigu, Hang Kong Road, Hang Cheng Street, Baoan District, Shenzhen



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# 1. Module Introduction

## 1.1. Overview

DX -BT39 bluetooth module is developed 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 specification. 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 interface, support IO port control, ADC acquisition, has advantages of low cost, low power consumption and high receiving sensitivity, just with a few peripheral components can realize its powerful function, and can customize according to customer requirements to develop a variety of projects.

## 1.2. Characteristics of

Bluetooth:

- Bluetooth BLE 5.1 protocol

The core and memory:

- 512 kB flash and 128 kB RAM
- Support 2 Mbps, 1 Mbps, 500 KBPS and 125 KBPS
- The ARM architecture (M4, frequency is 64 MHz

A peripheral interface:

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

Module parameters:

- Voltage range: 2.8 ~ 3.6 V (typical values: 3.3 V)
- Can connect up to 8 from the module
- Connection from eight modules visual range: 87.6 m
- Can choose the onboard antenna or external antenna
- working temperature: -40~+105 ° C

## 1.3. application

- Health/fitness sensors and monitoring devices



- Support wireless equipment
- Smart home sensor and controller
- Industrial IoT sensors and controllers
- The remote control
- Game controller

## 1.4. Functional block diagram

Below for DX - BT39 bluetooth module function block diagram, expounds the main functions as follows:

- The power part
- Baseband part
- memory
- The radio frequency part
- Peripheral interface

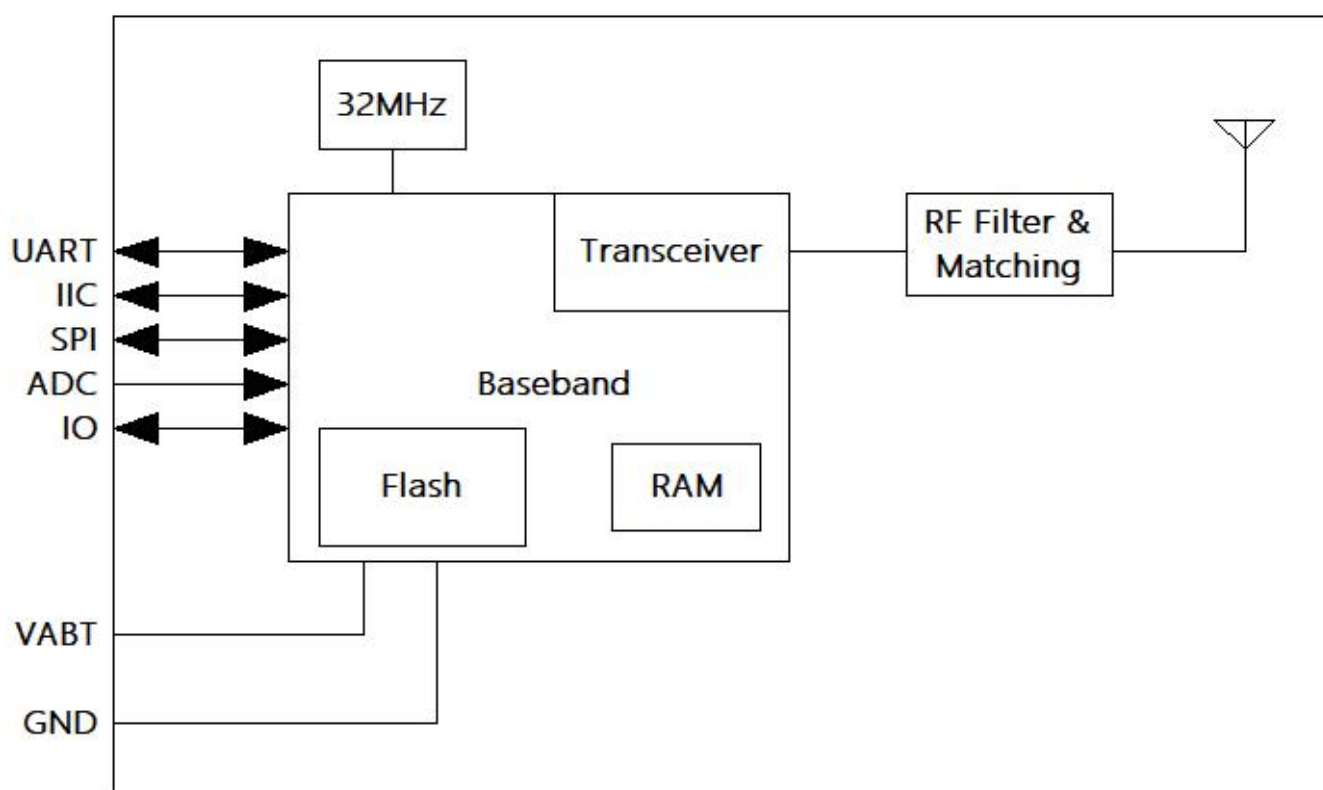


Figure 1: the function block diagram

## 1.5. Basic parameters

**Table 1: basic parameter list**

The parameter name	details	Parameter names	Details
Chip model	nRF52833	Module model number	DX-BT39
Bluetooth Specifications	BLE 5.1	Module Dimensions	26.6 (L) x 13.0 (W) x 0.8 mm (H)
working voltage	3.3 V	Working current	37ma
agreement	GATT, ATT, GAP	MTU value	244 bytes
Sensitivity	- 96 - dbm@0.1% BER	Transmit power	-20~8dBm
Modulation method	GFSK	spectrum	2.402GHz -2.480GHz ISM band
Rf input impedance	50 $\Omega$	Frequency hopping and channels	1600 hops/s 2 MHZ space 40 channels
The 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

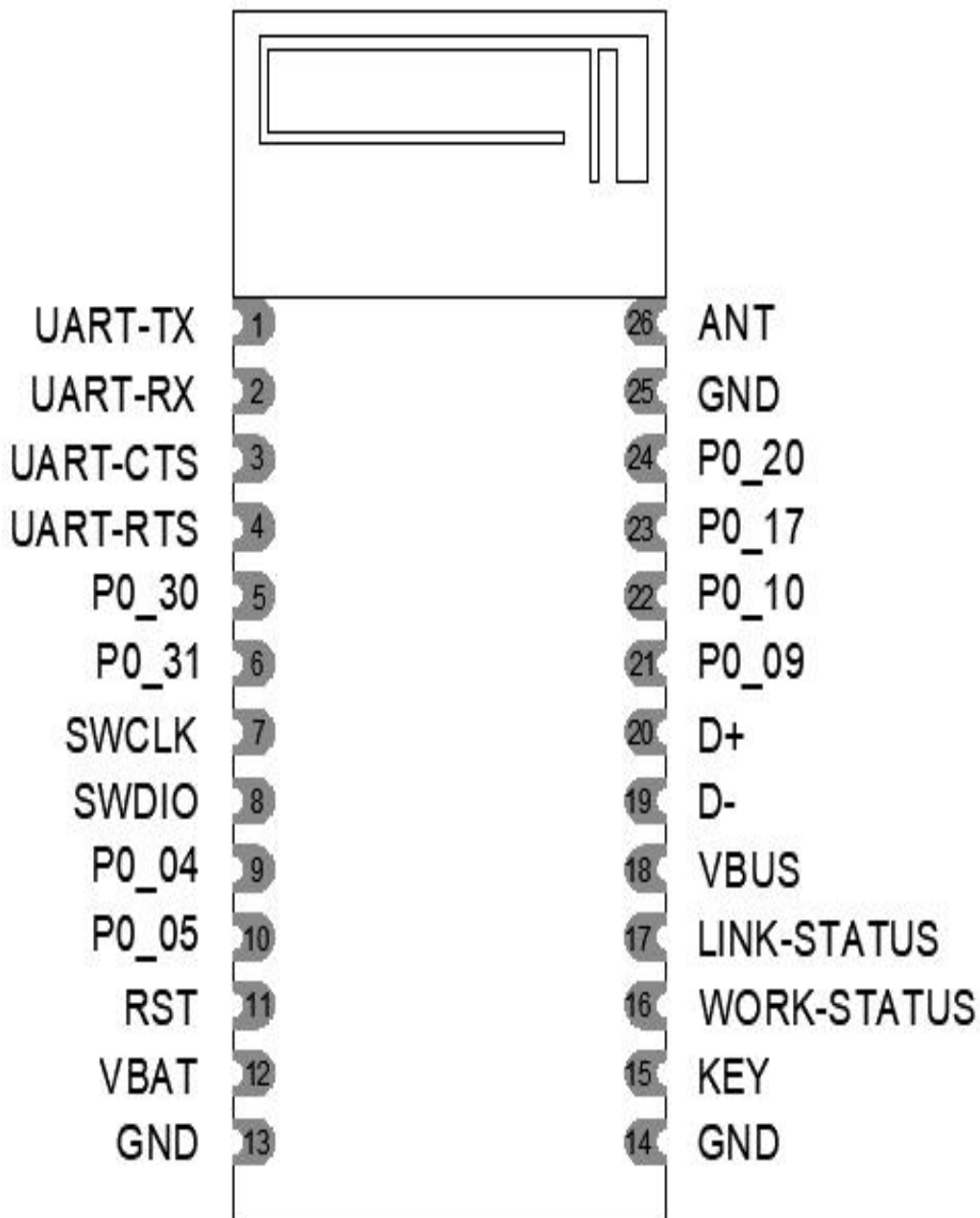


Figure 2: the module's pin definition

## 2.2. Illustration of the pin definition

**Table 2: pin definition**

Pin serial number	Pin name	Pin function	instructions
1	UART-TX	Serial port data output	-
2	UART-RX	Serial port data input	-
3	UART-CTS	UART CTS, low level effectively	-
4	UART-RTS	UART requests, low level effectively	-
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 pin
7	SWCLK	Debug clock port	Programmable input/output pin
8	SWDIO	Debug data port	Programmable input/output pins
11	RST	Reset	-
12	VBAT	Power input pin	3.3V(typical value)
13/14/25	GND	Power ground	-
15	KEY	Disconnect factory data reset	reference 2.3.5 for details reference 2.3.5 for details
16	WORK-STATUS	Module work status output foot	Search and connection: 300ms high 300ms low Connection status: Always high Unconnected state: Output low Connection status: 200 ms high level 200 ms low level, low level changes after N 1 s output low level (N number) for the connection of the bluetooth
17	LINK-STATUS	Bluetooth connection status foot	
18	VBUS	USB power input pin	5 v (typical)
19	D-	USB D-	-
20	D+	USB D+	-
26	ANT	The antenna	-

## 2.3. Power supply design

### 2.3.1. Power supply interface

Table 3: Power interface pin definition Table

Pin name	Pin number	Description	Minimum	Typical value	Maximum value	Units
VBAT	12	Power supply module	2.8	3.3	3.6	V
GND	13/14/25	to	-	0	-	V

### 2.3.2. Power stability requirements

DX - BT39 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.

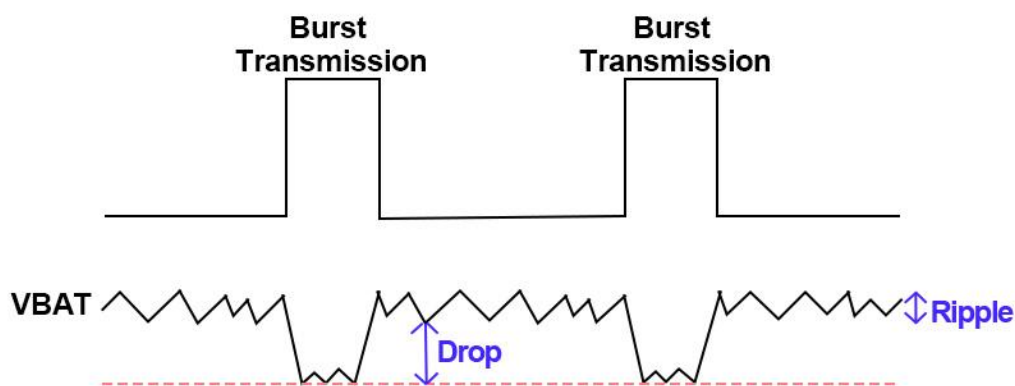


Figure 3: sudden transmission power requirements

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:

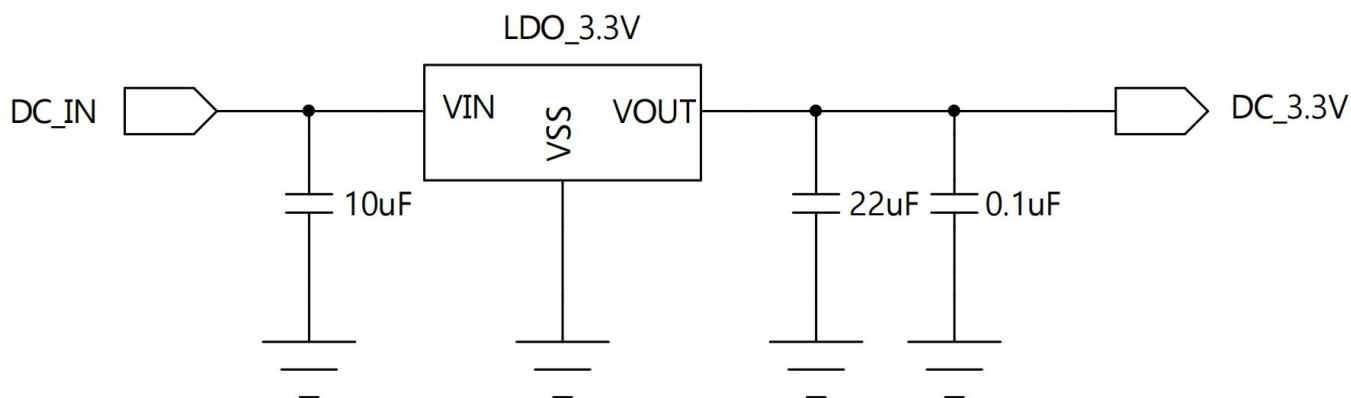


Figure 4: the power supply reference circuit

### 2.3.3. Power outage requirements

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. Description of RST reset foot

Table 4: RST pin definition

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

#### note

The RST signal is sensitive to interference, so it is recommended that the line should be as short as possible, and the need for packet processing.

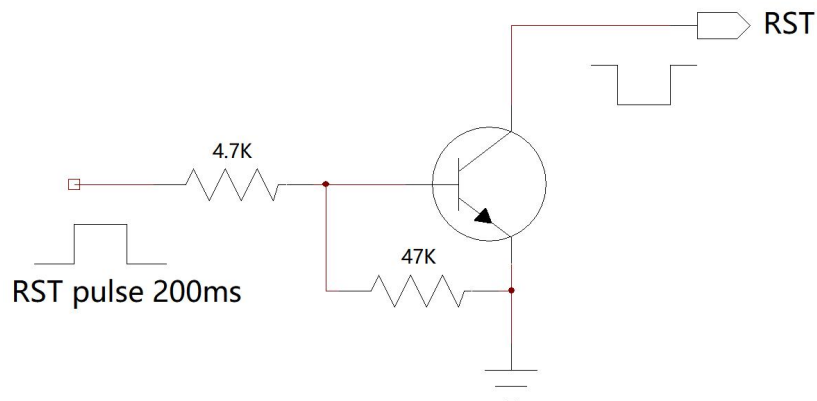


Figure 5: reset the reference circuit

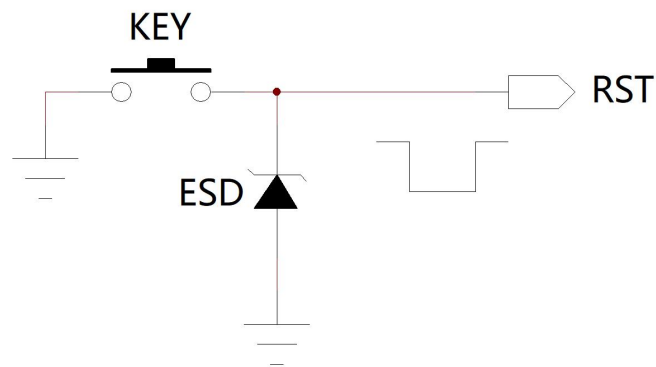


Figure 6: button reset reference circuit

### 2.3.5. The KEY that foot

Table 5: KEY Pin Definition Table

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

Table 6: KEY pin function definition table

State of the module	How to operate	Results
Connection status	Release the KEY pin after pulling it down for at least 200ms	Disconnect
Standby mode	Lower KEY pin at least 200 ms after release	Restore the default Settings

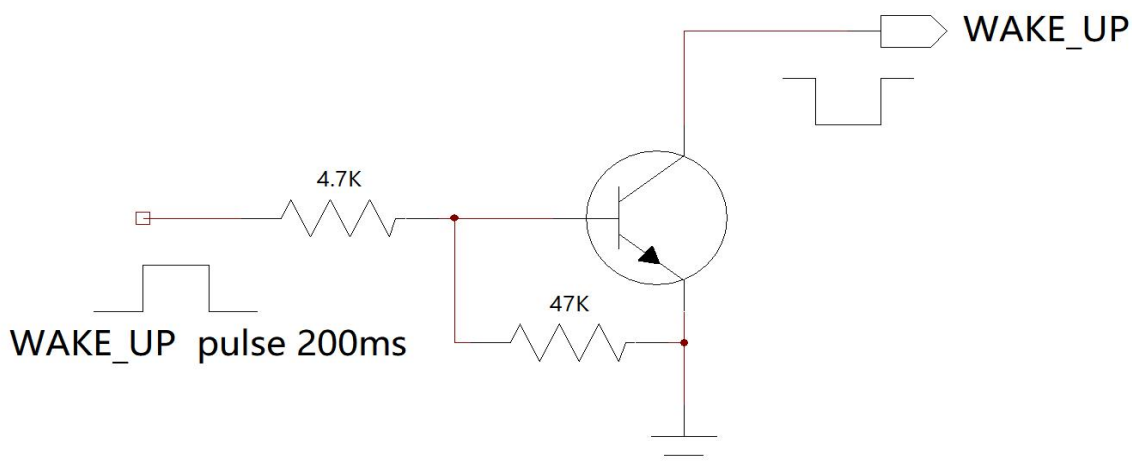


Figure 7: Open set drive wake up reference circuit

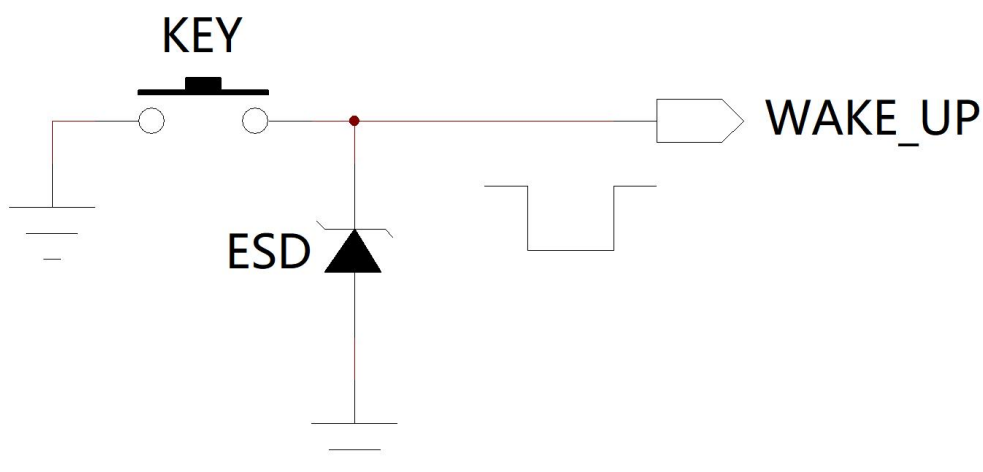


Figure 8: button reset reference circuit

## 2.4. Hardware physical interface

### 2.4.1. General purpose digital I/o port

Eight universal digital IO ports are defined in the module. 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 hung up when not in use.

## 2.4.2. UART interface

UART realized the support for the following features:

- Full-duplex operation
- Automatic flow control

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

Note: external crystal oscillator must be enabled to get enough clock precision, to stabilize the communication.

Four signal pin used to implement the function of UART. When DX - BT39 connected to another digital device, UART\_RX and UART\_TX transfer data between 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.

**May the UART Settings**

parameter	Possible values
Baud rate	A minimum 1200 baud (1% or less Error)
	standard 9600 baud (1% or less Error)
	Max 115200 baud (1% or less Error)
Flow control	The RTS/CTS, or no
parity	No, odd or even
The number of stop bits	1/2
The number of bits per channel	8

## 2.4.3. The I2C interface

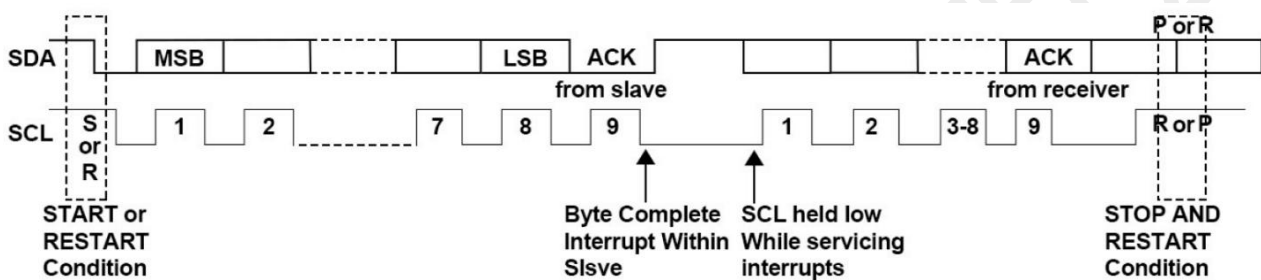
- By serial data line (SDA) and a serial clock (SCL) second-line I2C serial interface
- Supports two speed

Standard mode 0-100Kbit/s

Model mode 400≤400Kbit/s

- Sending and receiving FIFO depth of 32 position (32 by 8 - bit Rx and 32 x 10 - bit Tx)
- Support seven and ten addressing mode as well as regular call addressing mode.

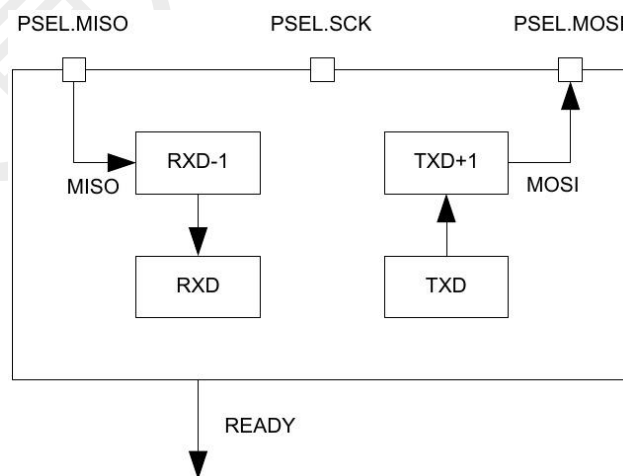
The I2C interface is the internal circuit, allowed to communicate with external I2C interface, external I2C interface is the two-wire serial interface, the industry standard for connecting external hardware. The two serial line known as the serial data line (SDA) and a serial clock line (SCL). The I2C 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 sequence diagram**

#### 2.4.4. SPI interface

The SPI host provides a simple CPU interface that includes the TXD register for sending data and the RXD register for receiving data. And TXD RXD -1+1 is RXD and TXD double-buffering version respectively.

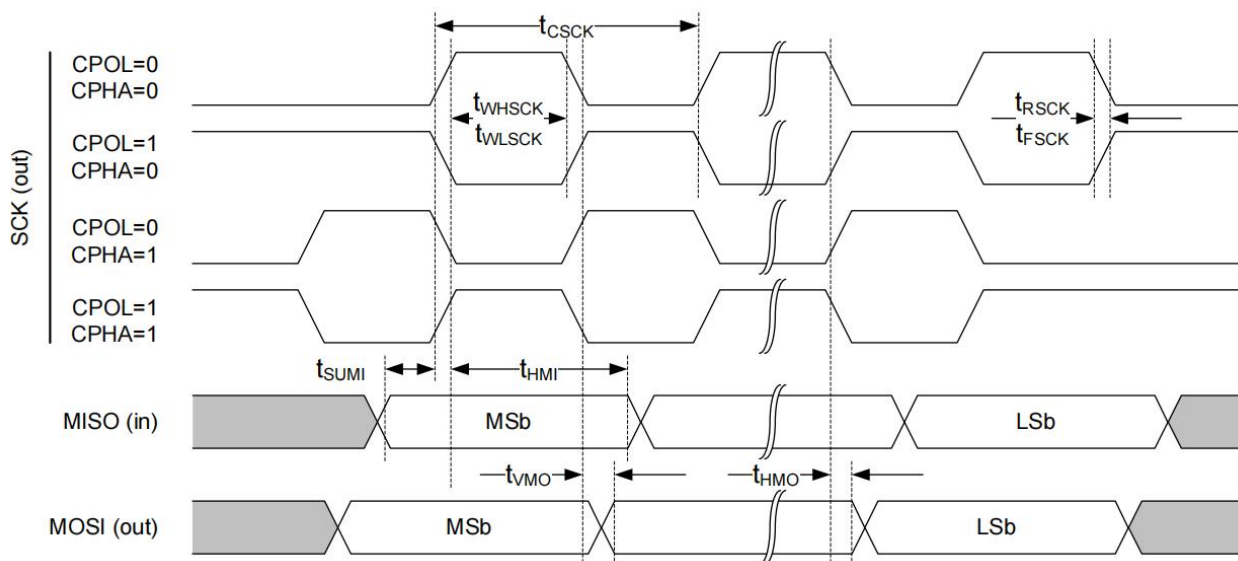


**Figure 10: SPI master**



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, must use the GPIO available CPU to choose the right from the station, and is independent of the SPI master station control. SPI hosts support SPI mode 0 ~ 3.



**Figure 11: SPI master sequence diagram**

#### 2.4.5. Successive Approximation Analog-to-Digital Converter (SAADC)

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

The following is a SAADC key features:

- More input channel  
Each channel can be used to pin AIN0 AIN7, as input or VDDH VDD pin pin  
Eight channels for single-ended input, four channels used in differential input
- Full range input range
- Separate reference selection for each channel  
VDD  
Internal reference
- Continuous sampling



- Output samples are automatically written to RAM using EasyDMA
- 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

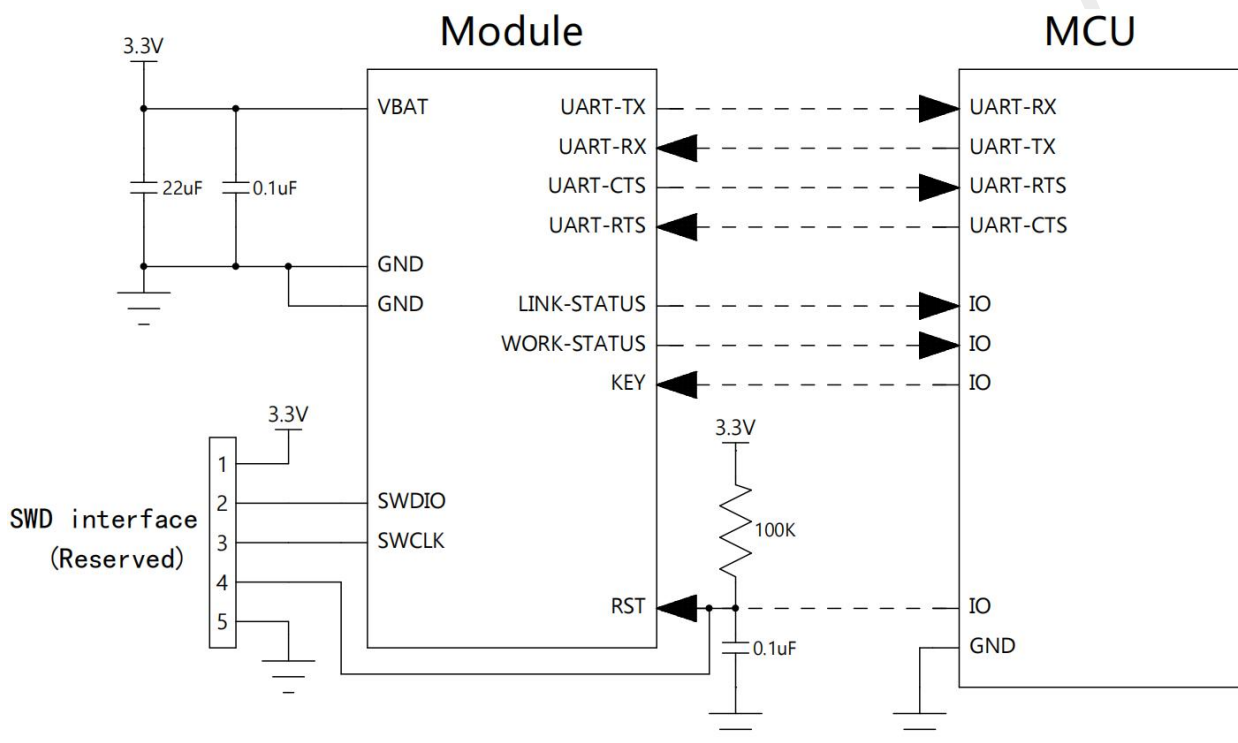


Figure 12: Typical application

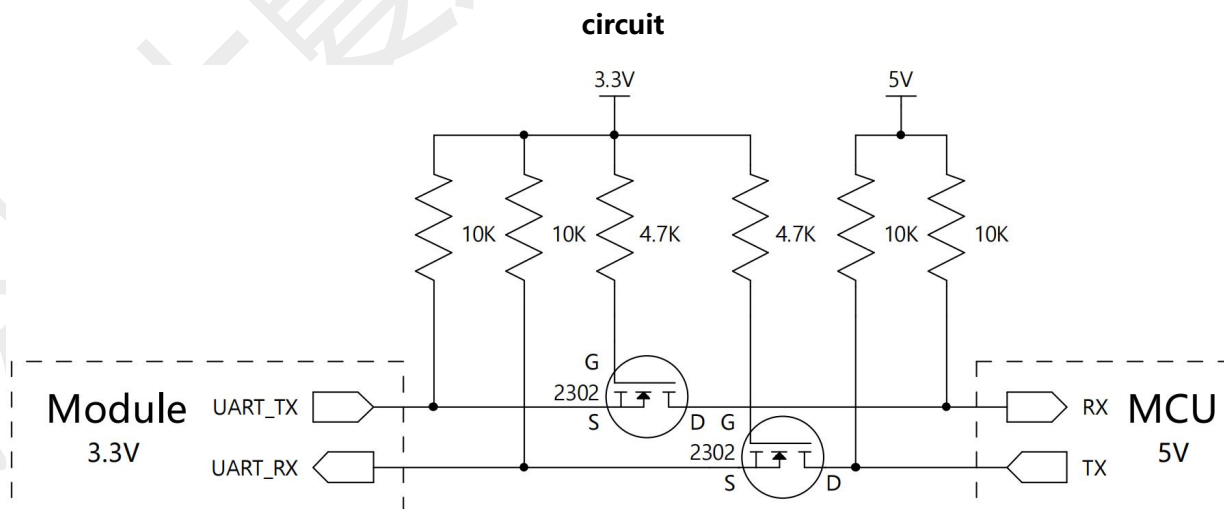


Figure 13: Serial port level conversion reference circuit

## 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. More than these values will 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 ratings**

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 voltmeter**

working voltage				
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 thermometer**

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

### 3.3. Drain flow

**Table 10: Power consumption meter**

Modes	State	Current	Unit
Mode of work	Standby	913.92	uA
	Connect 1 slave module	1.14	mA
	Connect 2 slave modules	1.41	mA
	Connect 3 slave modules	1.43	mA
	Connect 4 slave modules	1.48	mA
	Connect 5 slave modules	1.54	mA
	Connect 6 slave modules	1.60	mA
	Connect 7 slave modules	1.65	mA
	Connect 8 slave modules	1.67	mA
Data pass-through	Connect 1 slave module	1.8	mA
	Connect 2 slave modules	2.26	mA
	Connect 3 slave modules	2.48	mA
	Connect 4 slave modules	2.84	mA
	Connect 5 slave modules	3.23	mA
	Connect 6 slave modules	3.35	mA
	Connect 7 slave modules	3.36	mA
	Connect 8 slave modules	3.39	mA

### 3.4. Rf characteristics

**Table 11: Table of RF characteristics**

Features	Taking values
BLE transmit power	-20~8dBm
BLE sensitivity	- 96 - dbm@0.1% BER

### 3.5. Static 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.

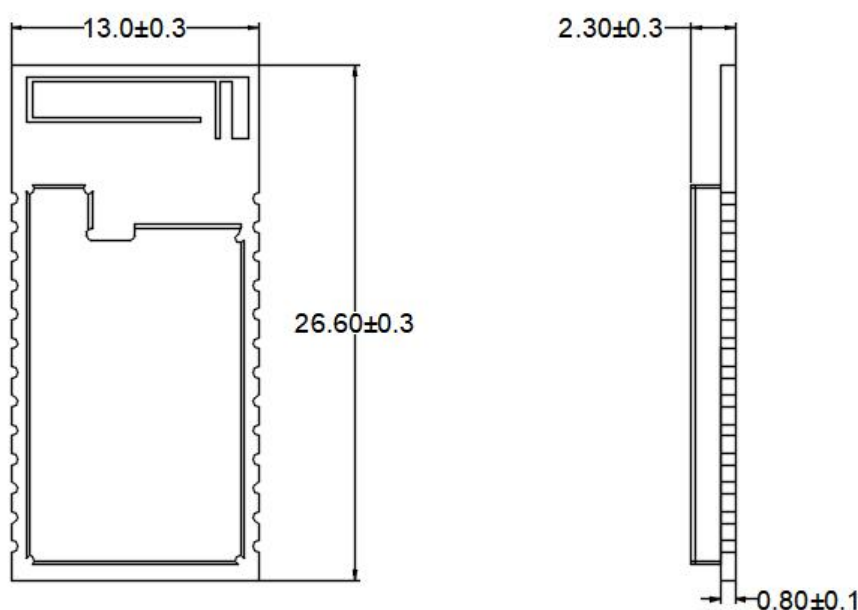
**Table 12: Table of ESD tolerant voltage of module pins**

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  $\pm 0.3$  mm

### 4.1. Modular mechanical ruler



**Figure 14: Top view and side view dimensions of the module**

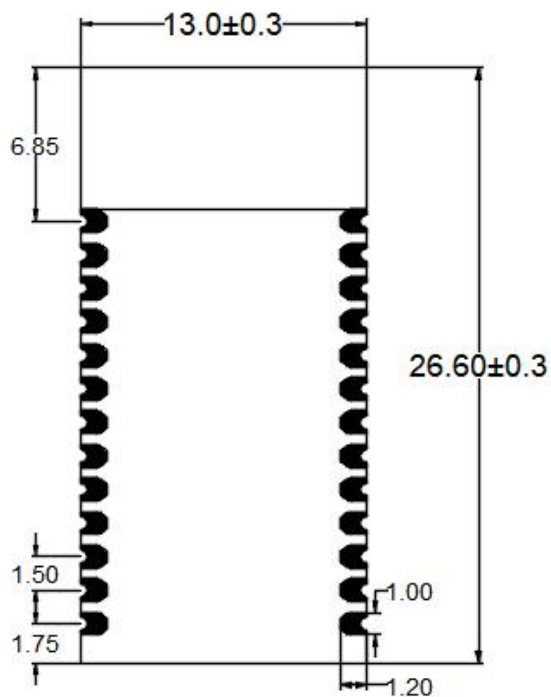


Figure 15: Bottom view size diagram of module

## 4.2. Recommended packaging

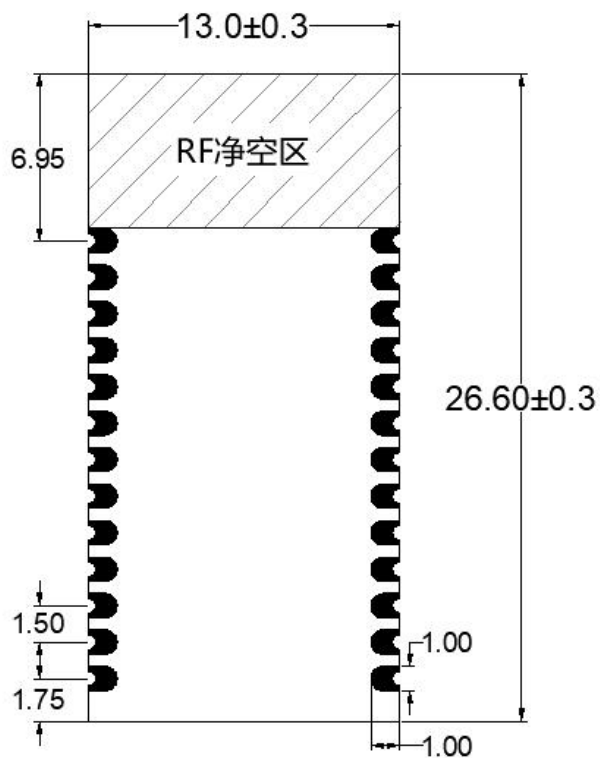


Figure 16: Proposed package size diagram



### 4.3. Top/bottom view of the module

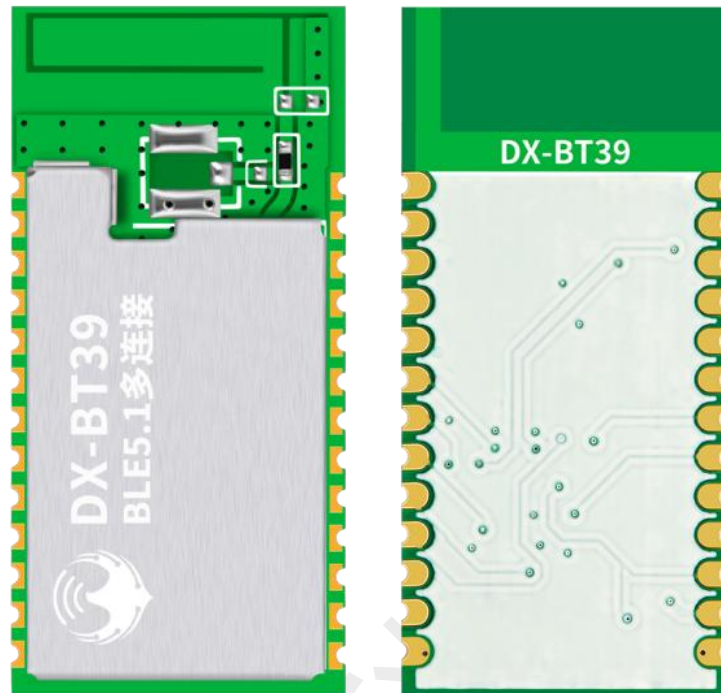


Figure 17: Module top view and bottom view

#### 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

DX - BT39 bluetooth module work in 2.4 G wireless spectrum, using the on-board antenna, the antenna standing wave ratio pattern (VSWR) and efficiency depends on the patch position, should try to avoid the influence of various factors on the wireless sending and receiving signals, pay attention to the following:

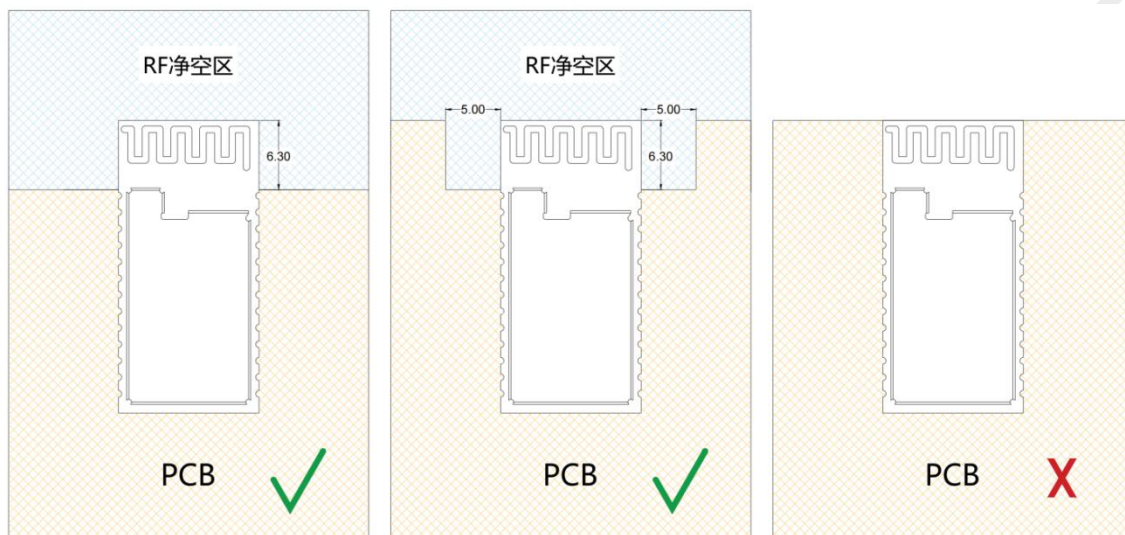
1. Avoid the use of metal in the product shell surrounding Bluetooth. When using part of the metal shell, try to keep the module antenna part away from the metal part. Metal wire or metal screws inside the product, should as far as possible away from the antenna module.

2. The module antenna part should be placed on the edge of the carrier board PCB or directly exposed to the carrier board, and 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 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;

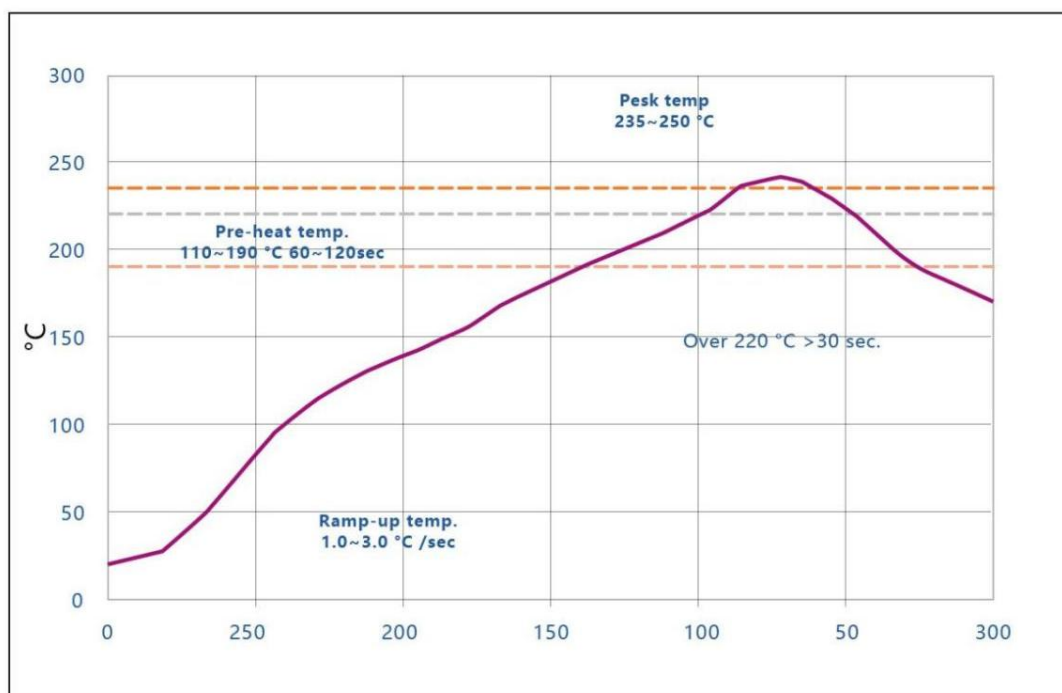
### Remarks

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 curve**

**Table 13: Recommended reflow soldering temperature**

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/SEC
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 specifications

The DX-BT39 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 specifications are as follows:

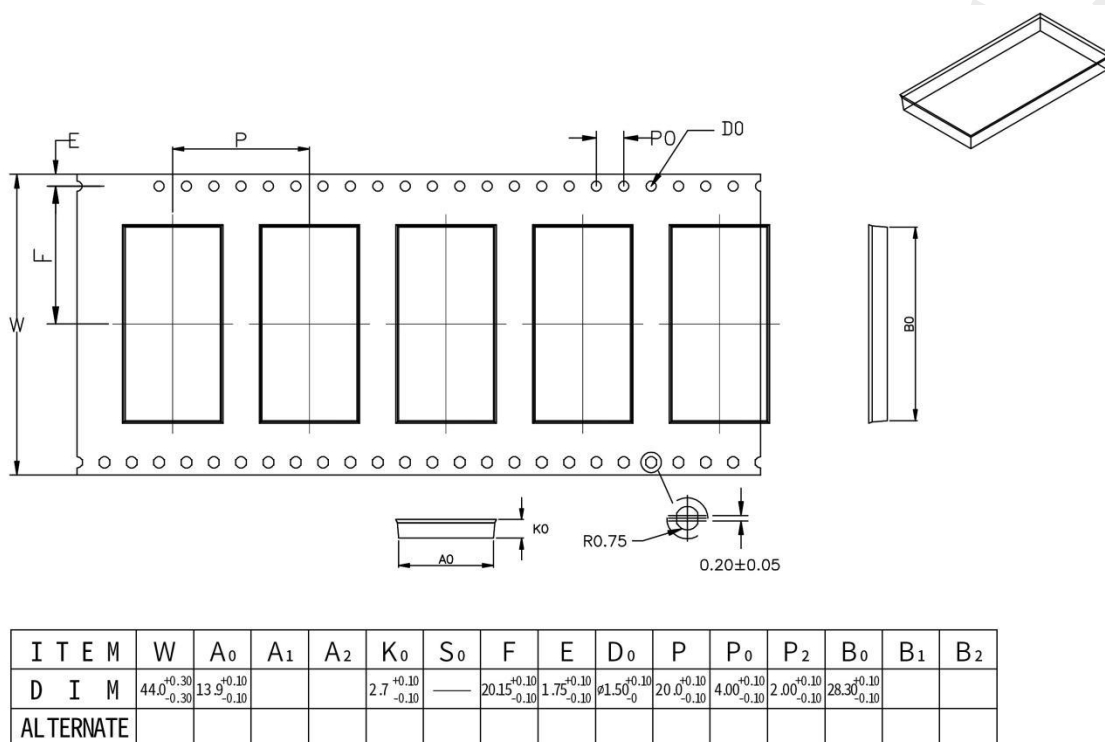


Figure 20: Strap size (unit: mm)

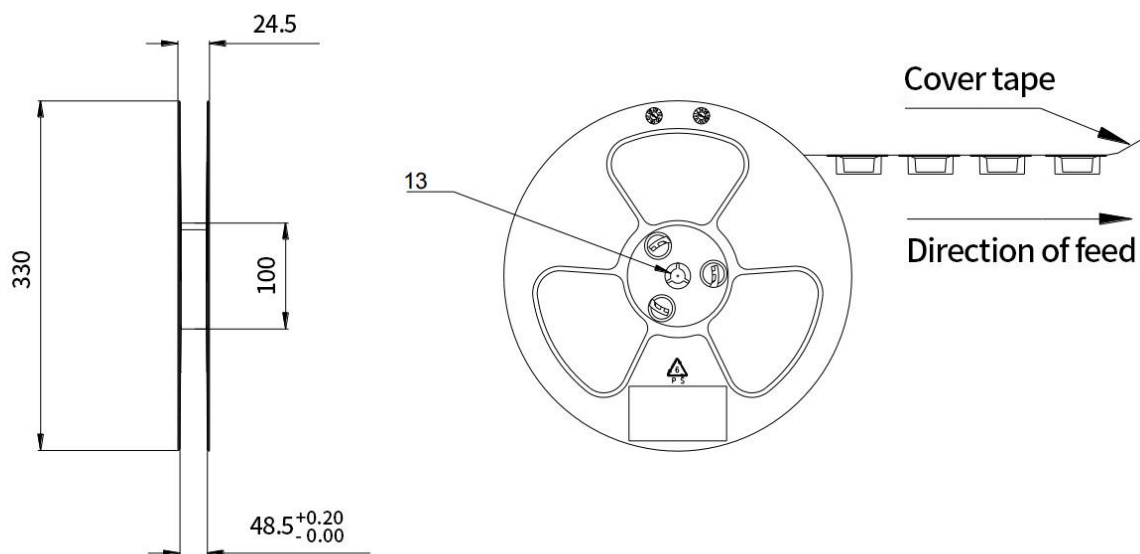


Figure 21: Reel size (unit: mm)

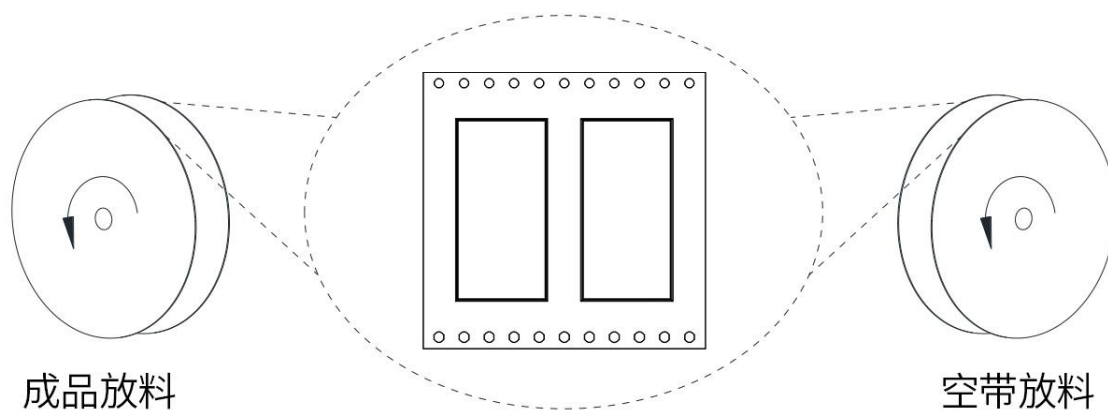


Figure 22: Reel orientation