E95 Series

Product Specification

Product Name：E95 BLE Module

Model No. ：LSD4BT-E95

Document Version：Rev02

Document revision history

No	Change Log	Author	Reviewer	Version	Date
01	initial version	杨彬	孙香涛	Rev01	2019-8-23
02	Add module physical map, broadcast power map	杨彬	孙香涛	Rev02	2019-12-4

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Chapter 1 Overview

The E95 standard hardware module is a high-performance IoT Bluetooth transceiver based on the NORDIC Bluetooth SOC nRF52 series chip. The module uses a stamp-type interface; the package is compatible with the E92 module Pin-to-Pin and supports external antennas and on-board antennas. The product has the characteristics of low power consumption, small size and strong anti-interference ability.

Table 1-1 Model description

Model No.	Description
LSD4BT-E95ASTD001	External antenna and on-board antenna, this model does not include software, if it is a software product, please communicate with the specific model and MPQ information

1.1 E95A Module Features

- Support Bluetooth 5
- ARM® Cortex®-M4 32-bit processor, 64 MHz
- 192 KB Flash + 24 KB RAM
- LE Mode ： 1 Mbps、2 Mbps
- Link budget：99dB
- Receive Sensitivity：-95dB
- Transmit power：MAX 4dBm
- RSSI Resolution：1dB
- Operation Voltage：1.7-3.6V
- Configurable GPIO quantity：10
- ADC accuracy ： 12bits/200 ksps
- 50Ω RF Interface
- Programmable peripheral interface-PPI
- DC-DC Operation mode

1.2 Applications

- 2.4GHz Bluetooth low energy system;
- PC, tablet, mobile phone, handheld, and other low-power peripheral devices (HID, remote control, etc.);
- Sports, healthcare and other consumer electronics;
- Smart sensor, data acquisition and other wireless sensor networks;

- Intelligent cloud platform and ecological access
- Smart home, local area network, interactive equipment, beacon lights.

Chapter 2 Specifications

Table 2-1 Product limit parameters

The main parameters			performance		Remark
			Min	Max	
Supply Voltage VDD（V）			-0.3	3.9	
IO Voltage（V）			-0.3	VDD+0.3	<3.9
Maximum RF input power（dBm）			/	10	
Store Temperature（℃）			-40	+125	
Operation Temperature（℃）			-40	+85	
Humidity sensitivity level (MSL)			1		
V_{ESD}	Electrostatic discharge(ESD) performance	Human Body Model(HBM),CLASS 2	2000V		
		Charged Device Model(CDM)	1000V		
FLASH Erase times			10000		

Table 2-2 Module working parameters @ 25 ℃

Main Parameter	Performance			Remark
	Min	Typical	Max	
Operation Voltage（V）	1.7	3.3	3.6	Ripple requirement: peak-to-peak value is less than 30mV
Time for operating voltage to rise from 0V to 1.7V			60ms	
Operating frequency (MHz)	2402	/	2480	
Payload Length（bytes）	0	37	251	Payload length defaults to 37 and use length expansion to 251
Operation Mode	1 Mbps/2 Mbps			Default 1Mbps
Communication protocol	Bluetooth 5.0			
Quantity of Channel	40			
Modulation	GFSK			

Transmit Power(dBm)	/	0	/	@ 3.3V; software configurable -20dBm to + 4dBm
Receive Sensitivity (dBm)	/	-95	/	@BLE mode； 1Mbps； Payload≤37
Distance	40m indoor / 100m outdoor			See 4.3 Distance Test Instructions for details

Chapter 3 Hardware Layout and Interface Description

3.1 Physical and dimensional drawings

LSD4BT-E95ASTD001 The physical picture is as follows

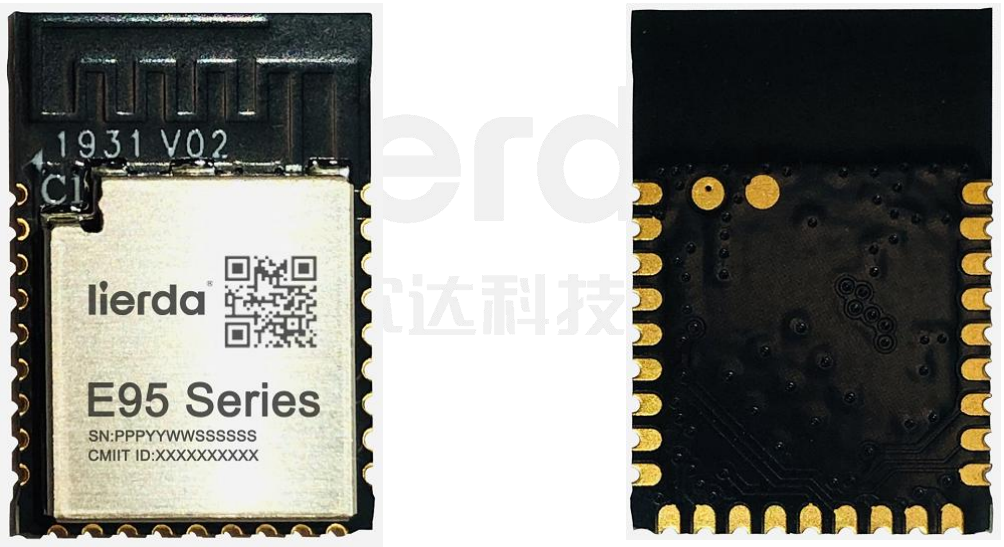


Figure 3-1 E95 series module physical map

When designing this product, there are alternative material models for resistance-capacitance sensors and PCBs. The appearance color may be different under the premise of performance. The actual product shall prevail. There is no replacement model for the main materials (main chip, crystal, etc.) Changes will be notified in advance.

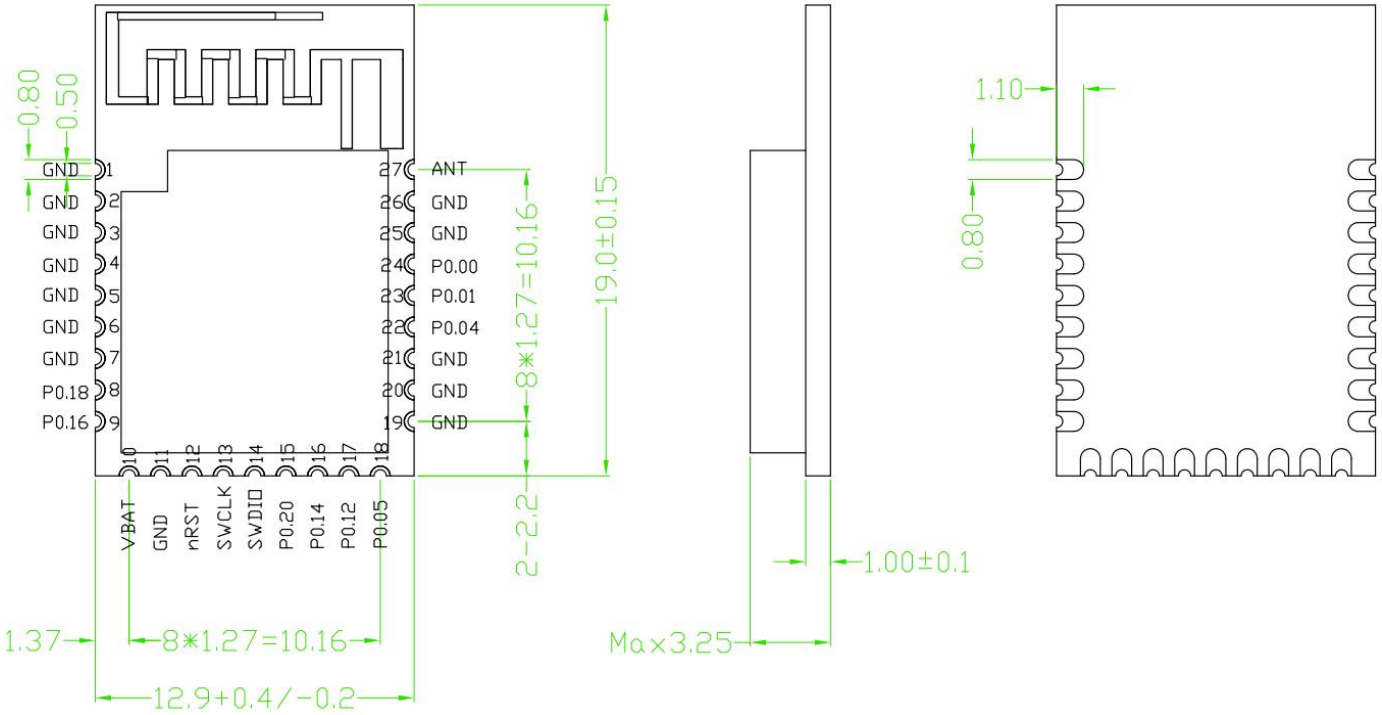


Figure 3-2 Dimensions of E95 series modules

* Dimensional tolerances not shown in the picture are in accordance with GB / T1804-m standard

The block diagram inside the module is as follows:

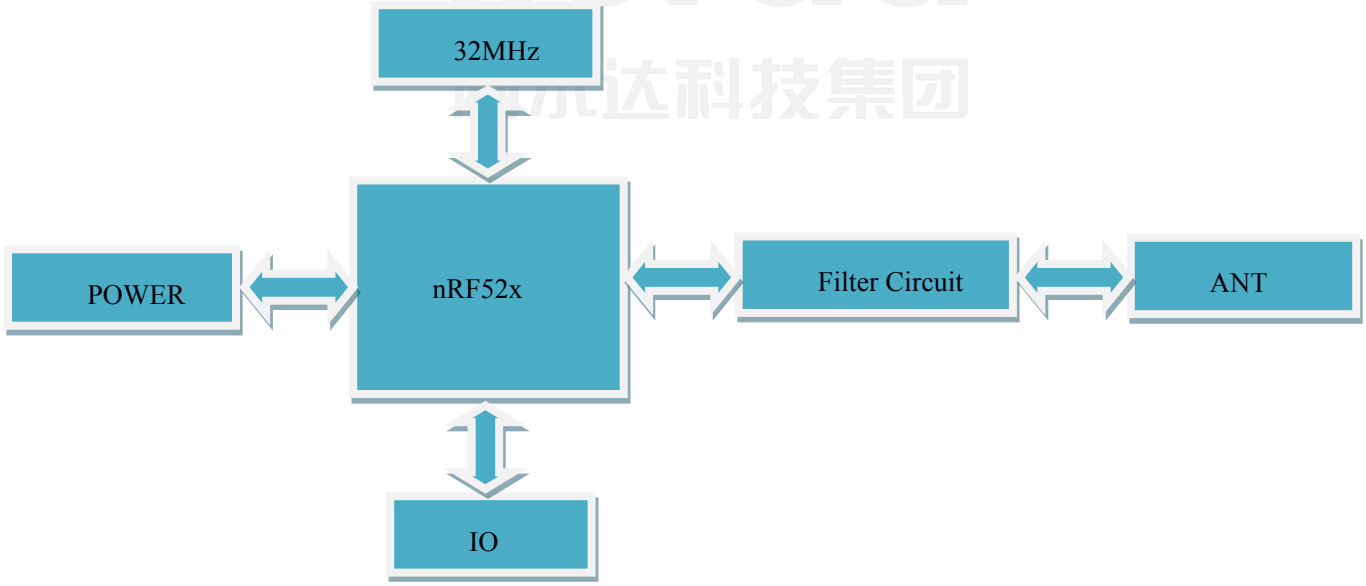


Figure 3-3 E95 series module block diagram

3.2 Interface Description

Table 3-1 Pin functions of E95 series modules

Module Pin	Chip Pin	Remark
1	GND	Power ground
2	GND	Power ground
3	GND	Power ground
4	GND	Power ground
5	GND	Power ground
6	GND	Power ground
7	GND	Power ground
8	P0.18	Digital I / O pins
9	P0.16	Digital I / O pins
10	VBAT	Power
11	GND	Power ground
12	nRST	Reset
13	SWDCLK	Debug clock pin
14	SWDIO	Debug data pin
15	P0.20	Digital I / O pins
16	P0.14	Digital I / O pins
17	P0.12	Digital I / O pins
18	P0.05	Digital I / O pins；ADC
19	GND	Power ground
20	GND	Power ground
21	GND	Power ground
22	P0.04	Digital I / O pins；ADC
23	P0.01	Digital I / O pins
24	P0.00	Digital I / O pins
25	GND	Power ground
26	GND	Power ground
27	ANT	External antenna interface; need to reserve π-type matching circuit when using

3.3 PCB Package

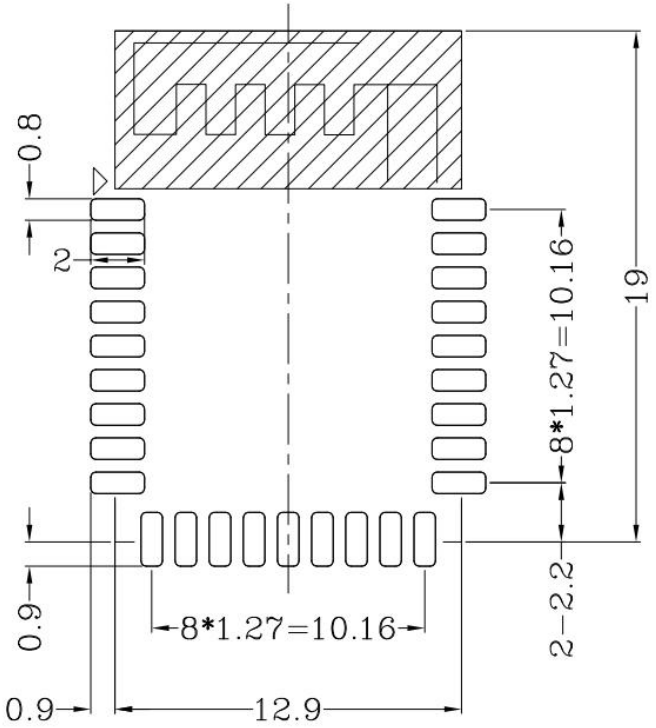


Figure 3-3 E95 series module PCB package-Top View

Chapter 4 Application note

4.1 Antenna Design Guide

If the customer has a high requirement for distance, an external antenna can be used. The IO port required to use the external antenna is PIN27 (ANT). The bottom of the module, including the original antenna position, must be completely copper-plated.

The figure below is the circuit from the ANT pin of the module to the external antenna. The thick red line must ensure 50Ω impedance control. Keep the traces as short as possible without punching holes or sharp corners. Make more GND vias around RF traces.

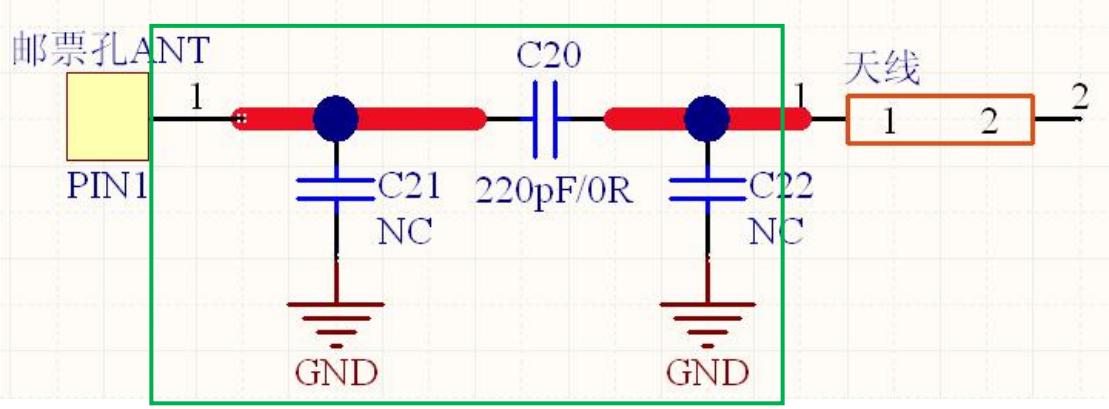


Figure 4-1 Principle of external antenna impedance matching circuit

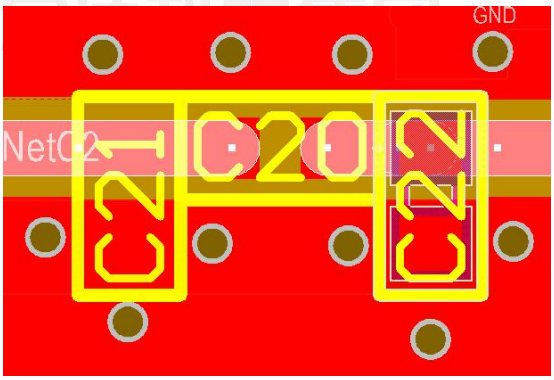


Figure 4-2 Schematic PCB and wiring description of external antenna impedance matching circuit

The routing of the highlighted part is to control the impedance of 50Ω. For the relationship between board thickness and line width and line distance, please refer to:

FR4 dual panel recommended value

(H = board thickness, W = line width, D = distance between trace and copper)

H = 1.0mm, W = 0.8mm, D = 0.2mm

H = 1.0mm, W = 1.0mm, D = 0.254mm (recommended)

H = 1.2mm, W = 1.0mm, D = 0.2mm (recommended)

H = 1.6mm, W = 1.0mm, D = 0.2mm (recommended)
(For more design support, please contact Lierda Technology)

4.2 Precautions for floor layout

There should be as much headroom as possible around the antenna. Headroom refers to the empty area in the projection area of the vertical plane of the antenna (both upper and lower ranges must be considered). Within the projection area of the antenna, no matter whether it is a surmount or a side-insertion method, do not lay the ground (especially the on-board antenna). There must be no metal devices. Keep the antenna's headroom to improve the antenna radiation efficiency.

The RF part of the module should be avoided by metal cavity as much as possible. The distance between the RF part and the interference source should be more than 10mm (the larger the better, the better). Common sources of interference are: batteries (including electrical connectors), capacitors, inductors, buttons, oscillators, power cords, metal screws or nuts, CPUs, LCDs, transformers, speakers, cameras, product internal communication interface cables, Power circuits, motors, etc.

If the module uses a PCB antenna, the PCB antenna should be at the edge of the PCB on the entire bottom plate, and the PCB antenna should be kept at a distance of 10mm. The layers around the antenna should not be copper, wiring, and components; The distance from the antenna should be as far away as possible to avoid co-frequency interference and intermodulation interference.

As shown in the figure below, there should be no metal components around the antenna in the vertical area, including the vertical range. If it is recommended to stick it on the baseboard, this part of the area is hollowed out.

The copper size in the gray area as shown below is recommended to be 4 * 4cm.

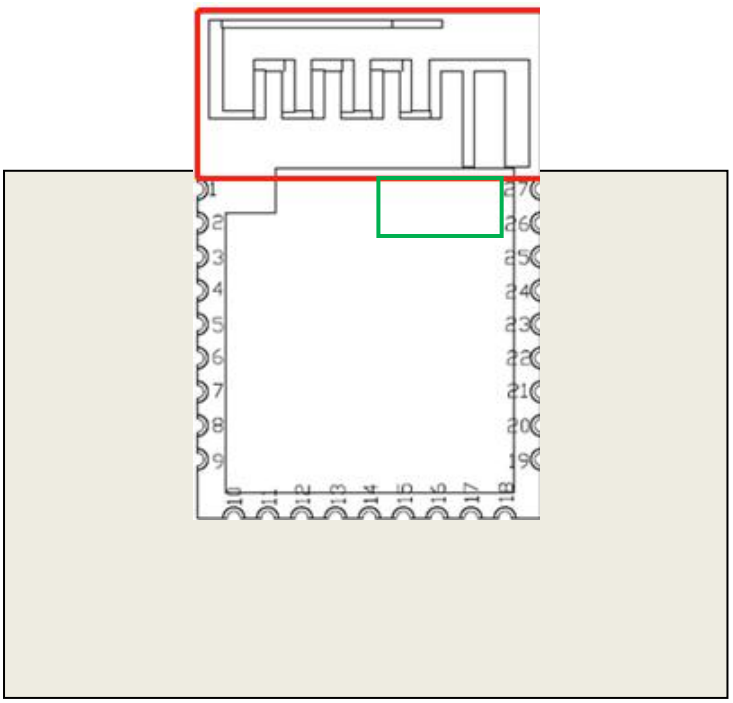


Figure 4-3 Module recommended reference placement

Note: When designing, users should pay attention to the area where the test pad for testing the RF performance of the module's Bottom layer has an open window area (that is, exposed copper). Do not place vias in this position, and add white oil to prevent short circuits . As shown in the picture, the location of the green box is the location of the test point. For specific dimensions, refer to the actual product.

4.3 Distance test

Indoor distance test: The distance is tested in the office of Lierda Park. The module is 1 meter above the ground and the broadcast power is 0 dBm. Use the mobile phone LightBlue to test whether the module can be connected. The test results can be connected normally at a distance of about 40 meters. The figure below shows the number of Bluetooth devices in the test environment, where the device information Nordic_Blinky_1 is the device under test.

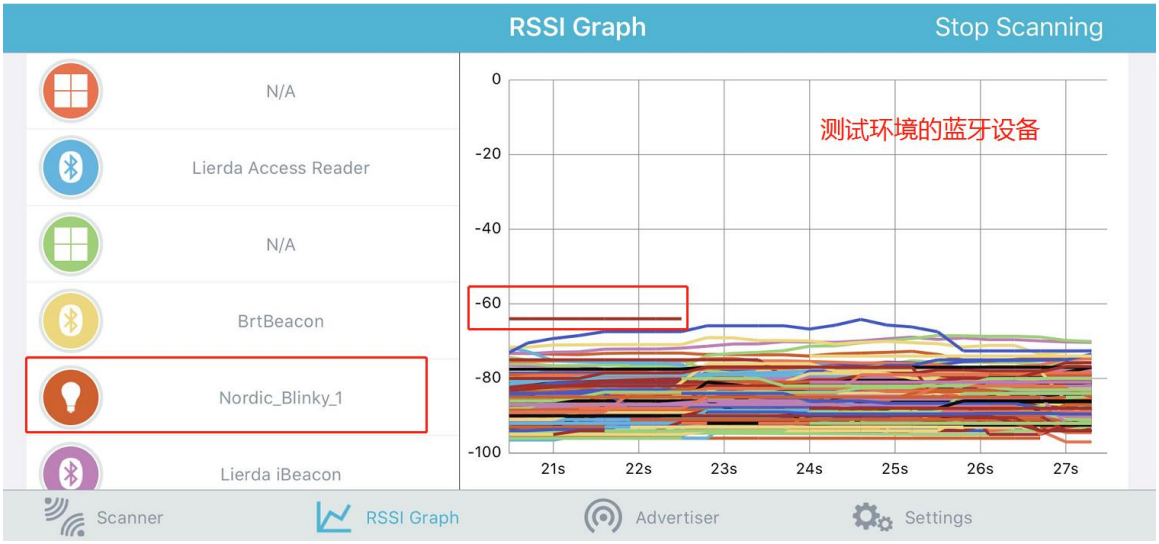


Figure 4-4 Number of Bluetooth devices in the test environment

Outdoor distance test: The test is performed at a straight distance from the east gate of Lierda Park. The module is 1 meter above the ground, the broadcast power equipment is 4dBm, and the mobile phone LightBlue is used to test whether the module can be connected. The test result is that a distance of 100 meters can be connected normally. The following figure shows the location of the test points on the map.

Figure 4-5 Module pull distance test position

4.4 Broadcast and connection power test

Mode	Interval ms	Average current uA
0dBm Broadcast mode	100	90.75
	200	45.87
	500	18.95
	600	15.96
	1000	9.97
	2000	5.49

模式	Connection interval ms	Average current uA
0dBm connect Mode	10	596.88
	20	298.94
	50	120.18
	100	60.59
	200	30.79
	500	12.92

Figure 4-6 Module broadcast and connection power consumption table

4.5 Precautions

1. Power supply

It is recommended to use a DC stabilized power supply to power the module. The power supply ripple is as small as possible. Generally, the ripple is required to be less than 30mV. Excessive ripple can cause poor sensitivity and other connection abnormalities. At the same time, the transmitted signal of Bluetooth will be coupled into the interference signal, causing the radio frequency index to exceed the Bluetooth specification, and in severe cases, it will cause failure to connect and communicate. Use the LDO to provide power to the module as much as possible. At the same time, the LDO should be kept away from the DC-DC power supply and inductance to prevent DC-DC radiation from contaminating the power supply of the LDO. The module must be reliably grounded, and please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module.

2. ESD Static Protection

Users should pay attention to the static electricity requirements of the product when designing, see Table 2-1, and add electrostatic protection measures when designing the end product.

Chapter 5 Production Guidance

5.1 Production guide

It is recommended that the stamp mouth packaging module use SMT machine chip, and the patch is completed within 24 hours after unpacking, otherwise the vacuum packaging must be re-evacuated to avoid moisture and cause bad patch.

If the package contains a humidity indicator card, it is recommended to judge whether the module needs to be baked according to the humidity card instruction. The conditions for baking are as follows:

Baking temperature: 125 ℃ ± 5 ℃;

The alarm temperature is set to 130 ° C;

After cooling under 36 ℃ under natural conditions, SMT placement can be performed;

If the unpacking time is more than 3 months, you need to pay special attention to whether the product is wet. Because of the PCB immersion process, more than 3 months may cause the pad to oxidize, and may cause problems such as false soldering and missing soldering when mounting.

In order to ensure the qualified rate of reflow soldering, it is recommended to take 10% of the products for visual inspection and AOI inspection for the first time to ensure the rationality of furnace temperature control, device adsorption method and placement method;

Operators at all stations must wear electrostatic gloves throughout the production process;

5.2 Module position requirements on the bottom plate

It is recommended that the thickness of the green oil at the bottom module position is less than 0.02mm, to avoid excessive thickness, and the pad module cannot effectively contact the solder paste to affect the soldering quality. In addition, it is necessary to consider that no other devices can be arranged within 2 mm of the position of the interface board module to ensure the maintenance of the module.

5.3 Stencil opening design

The selection of the thickness of the stencil on the base plate is based on the comprehensive consideration of the package types of the devices in the board.

The module pad position can be locally thickened to 0.15 ~ 0.20mm to avoid air soldering.

5.4 Reflow soldering instructions

Note: This work instruction is only suitable for lead-free operation and is for reference only.

Chapter 6 Product Packaging

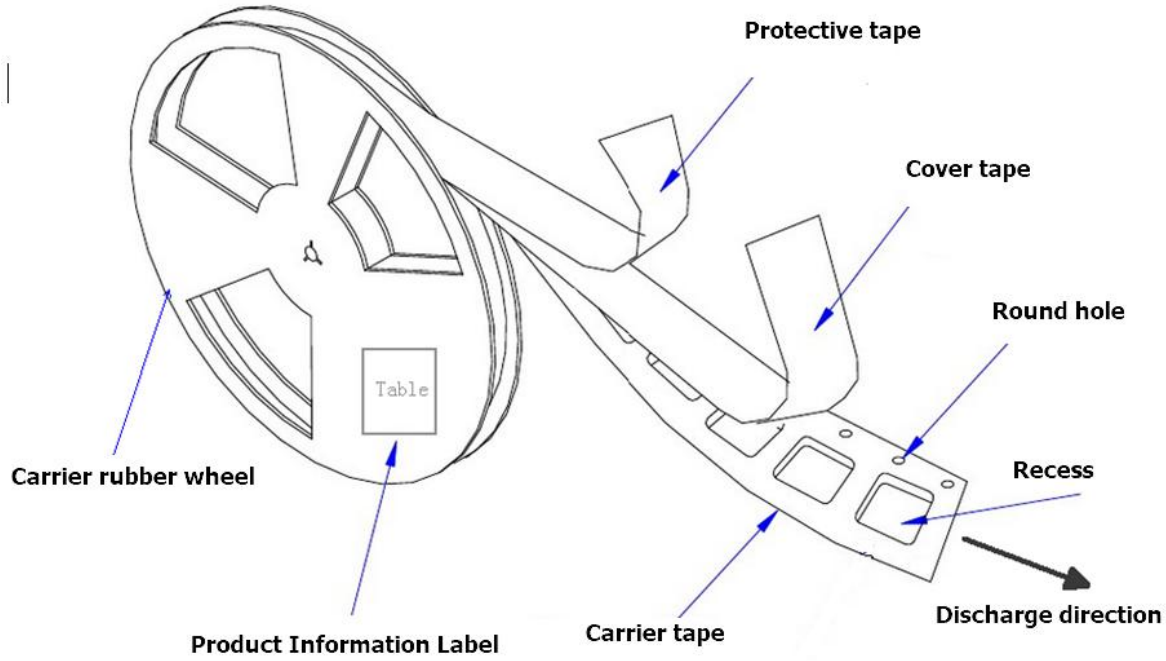
6.1 Packing

■ Tape ☐ Foam ☐ Electric bag

6.2 Strip size

6.3 Product direction

Schematic diagram of the tape packaging module placement direction:：



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