S95 Series products

Product Specification

Product name: S95 BLE StandardModule

Model：LSD4BT-S95ALSP001

File Version：Rev01

File Rivision History

Serial number	Modify log	Modifier	Reviewer	File version	Modified date
01	Initial version	杨彬	孙香涛	Rev01	2020-5-28

Catalog

Chapter 1 Overview

The S95 standard hardware module is a high-performance IoT Bluetooth transceiver based on the NORDIC Bluetooth SOC nRF52 series (supporting Bluetooth 5.0). The module uses a stamp-type interface; the package is compatible with the E66 module (Pin-to-Pin) and supports both external antennas and on-board antennas. The product has the characteristics of low power consumption, small size and strong anti-interference ability.

Based on the optimized Bluetooth SDK provided by Lierda, users can easily develop Bluetooth applications, shorten the development cycle, and help you seize market opportunities.

Table 1-1 Model Description

Model	Description
LSD4BT-S95	nRF52805, external antenna and on-board antenna, this model does not include software. For software product, please confirm the model and MPQ information with the sales.

1.1 E91A module features

- Bluetooth 5
- ARM® Cortex®-M4 32-bit processor, 64 MHz
- 192 KB Flash + 24 KB RAM
- LEmode：1 Mbps
- Link Budget：98dB
- Receive sensitivity：-94dB
- Output power：MAX 4dBm
- RSSI accuracy：1dB
- Working voltage：1.7-3.6V
- Number of configurable GPIO ：10
- ADC accuracy：12bit / 200 ksps
- 50Ω RF port1
- Programmable peripheral interface-PPI
- DC-DC work mode

1.2 Application

- 2.4GHz low power Bluetooth system;
- Low-power peripherals such as PC, tablet, mobile phone, and handset(HID, remote controler, etc.);
- Comsumer eletronics such as sport and health care;
- Wireless sensor networks such as smart metes and data acquisition;
- Intelligent cloud platform and ecologic access(WeChat, QQ IOT, Jingdong, Ali, Xiaomi, etc.);
- Smart home, LAN, interactive devices, beacon lights.

Chapter 2 Specifications

Table 2-1 Product limit parameters

The main parameters			Performance		Remarks
			Minimum	Maximum	
Power supply voltage(V)			-0.3	3.9	
IO voltage(V)			-0.3	VDD+0.3	Not more than 3.9
Maximum RF input power(dBm)			/	10	
Storage voltage(℃)			-40	+125	
Working temperature(℃)			-40	+85	
VESD	Electrostatic discharge(ESD) performance	Human Body Model(HBM),CLASS 2	/	2000V	
		Charged Device Model(CDM)	/	1000V	

Table 2-2 Module working temperature@25℃

The main parameters	Performance			Remarks
	Minimum	Typical	Maximum	
Working voltage(V)	1.7	3.3	3.6	Ripple requirements：peak to peak voltage < 30mV
Power supply rise time(ms)	/	/	60	Supply voltage should rise to 1.7V in 60ms
Working frequency(MHz)	2402	/	2480	
Payload length(bytes)	0	37	251	The default payload length is 37, and can be extended to 251
Working mode	1 Mbps/2 Mbps			1Mbps by default
Communication protocol	Bluetooth 5.0			
Number of channels	40			
Modulation type	GFSK			
Transmit power(dBm)	/	0	/	@3.3V ; Software configurable from

				-20dBm to +4dBm
Receive sensitivity(dBm)	/	-96	/	@BLE mode-1Mbps;Payload=37
Communication distance[1]	30m indoor/90m outdoor			See 4.3 distance test instructions for details antenna

Chapter 3 Hardware layout and interface description

3.1 Dimensional drawing

The physical picture of LSD4BT-S95 is as follows:

Figure 3-1 S95

When designing this product, there are alternative material types for Secondary components and PCB. The appearance color may be different under the premise of Performance. The main material (main chip, crystal oscillator, etc.) has no replacement model, but changes will be notified in advance.

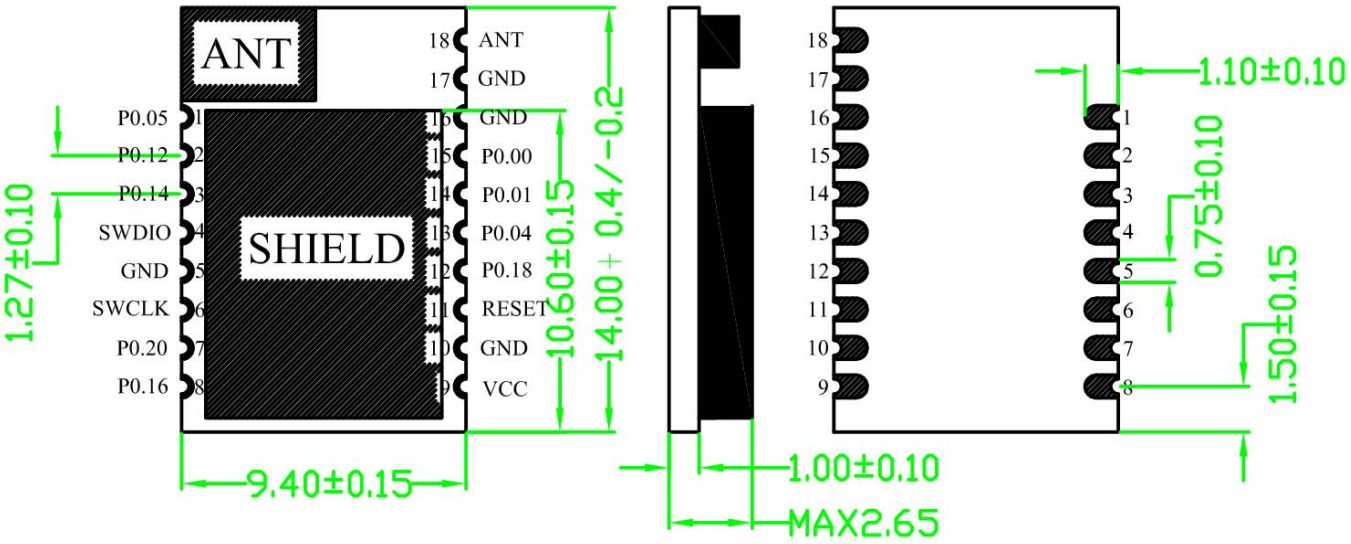


Figure 3-2 S95 series module outline drawing

* The dimensional tolerances not shown in the figure are in accordance with the GB/T1804-m standard.

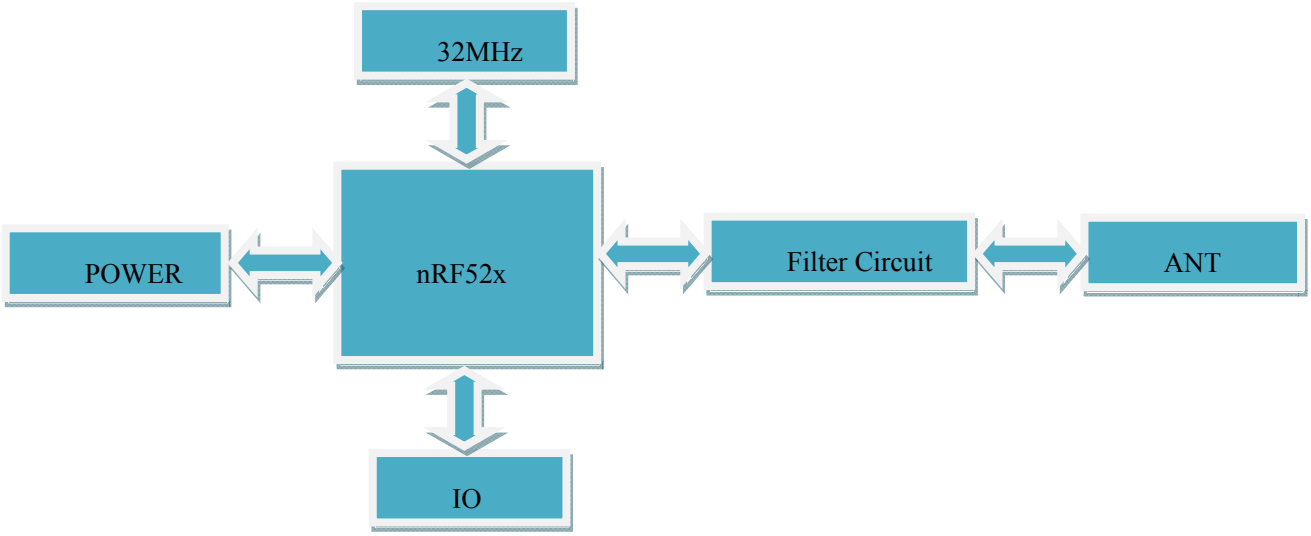


Figure 3-3 Internal block diagram of the S95 series module.

3.2 Dimensional drawing

Table 3-1 Module Pin Function Description

Module Pin	Chip Pin	Remarks
1	P0.05	Digital I/O Pin
2	P0.12	Digital I/O Pin
3	P0.14	Digital I/O Pin
4	SWDIO	Debug Data Pin
5	GND	Power Ground
6	SWDCLK	Debug Clock Pin
7	P0.20	Digital I/O Pin
8	P0.16	Digital I/O Pin
9	VCC	Power Supply
10	GND	Power Ground
11	RESET	Reset Pin
12	P0.18	Digital I/O Pin ;
13	P0.04	Digital I/O Pin ;
14	P0.01	Digital I/O Pin ;
15	P0.00	Digital I/O Pin ;
16	GND	Power Ground

17	GND	Power Ground
18	ANT	External antenna interface; need to reserve π-type matching circuit when using

For detailed Pin descriptions, please refer to the nRF52805 chip data sheet.

Chapter 4 Application note

4.1 Antenna design guide

If you have high requirements for communication distance, an external antenna can be used. The IO port required to use the external antenna is PIN18 (ANT). The original antenna position under the module must be completely copper。

The figure below shows the circuit from the module ANT Pin to the external antenna. The red thick line should guarantee 50Ω impedance control. Keep the line as short as possible, do not hit the hole, do not take the acute line. Place more GND vias around the RF traces.

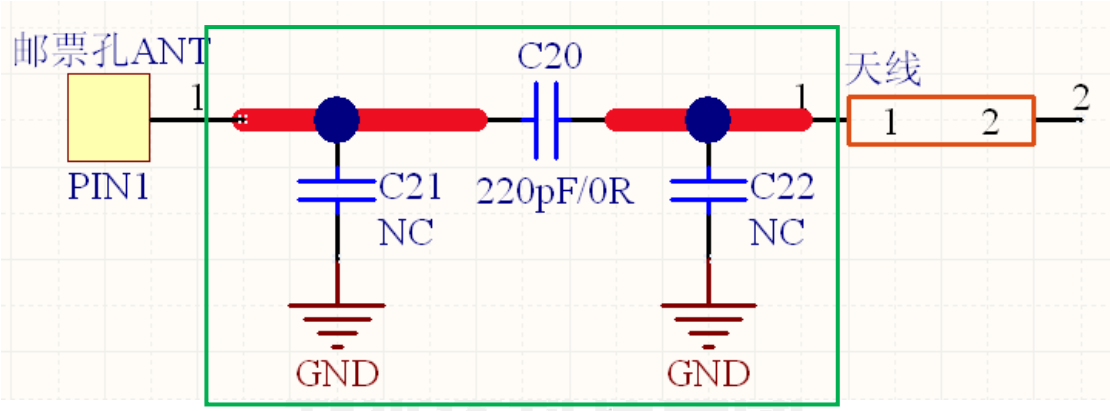


Figure 4-1 Schematic diagram of external antenna impedance matching circuit

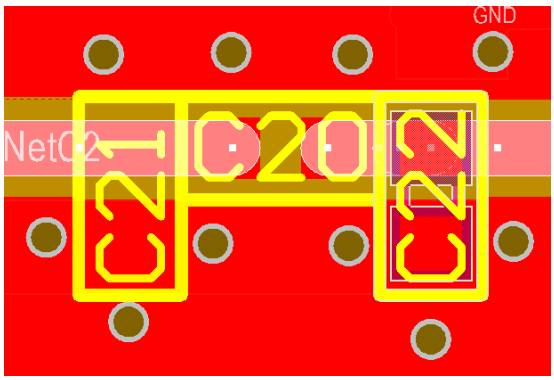


Figure 4-2 External antenna impedance matching circuit PCB schematic and routing instructions

The highlight of the trace sould control the impedance of 50Ω, the relationship between board thickness and line width, line spacing can be referred to:

Recommended value of FR4 Double panel:

(H=plate thickness，W=line width，D= Trace and copper spacing)

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)

(More design support is available to Lierda Technology Consulting)

4.2 Backplane layout considerations

A large clearance area is required around the antenna. Clearance refers to the open area in the projected area of the vertical plane of the antenna (both upper and lower ranges must be considered). In the range of the projection area of the antenna, whether it is patch or side-insertion, do not lay the ground (especially the on-board antenna), do not have metal or devices, and keep the antenna clearance to improve the radiation efficiency of the antenna.

The height (distance) between the antenna and the motherboard is also an important consideration. In general, the antenna needs to be at least 10mm above the main board, and at least 5mm in extreme environments. When the height of the antenna is less than 8 mm, the radiation efficiency of the antenna is limited.

The RF part of the module should not be avoided by the metal cavity. The distance between the RF part and the interference source should be more than 10mm. Common sources of interference are: battery (including electrical connection), capacitor, inductor, button, oscillator, power cord, Metal-containing screws or nuts, CPU, LCD, transformer, speaker, camera, product communication interface cable, power circuit, motor, etc.

If the PCB antenna is used, the PCB antenna should be on the edge of the PCB on the entire substrate. The spacing around the PCB antenna should be 10mm. The layers around the antenna should not be copper, trace or arranged. If there are multiple antennas, the distance between the antennas should be as far as possible to avoid co-channel interference and intermodulation interference;

Users should pay attention to the design. In the area where the Bottom layer has window opening for the antenna pad, no via hole can be placed to prevent short circuit.

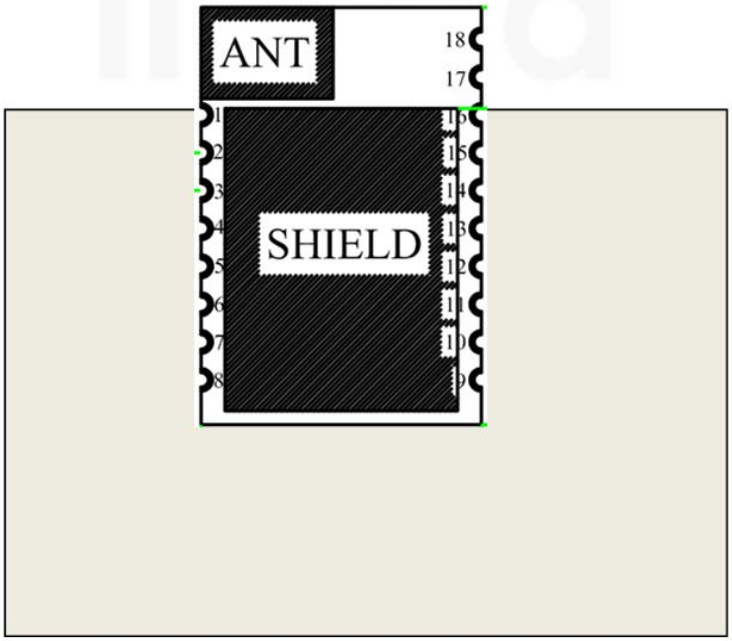


Figure 4-3 Module recommended reference placement

Note: When designing, users should pay attention to that there is a window opening area (that is, exposed copper) in the test pad for testing the RF performance of the Bottom layer of the module product. . As shown in the picture, the position of the green box is the position of the test point, and the specific size refers to the actual object

4.3 Distance test instructions

① Indoor distance test: test the distance in the office of Lierda Park, the module is 1 meter above the ground, the broadcast power is 0dBm, and 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 30 meters. The following figure is the number of Bluetooth devices in the test environment, where the device information Nordic_Blinky is the device under test.

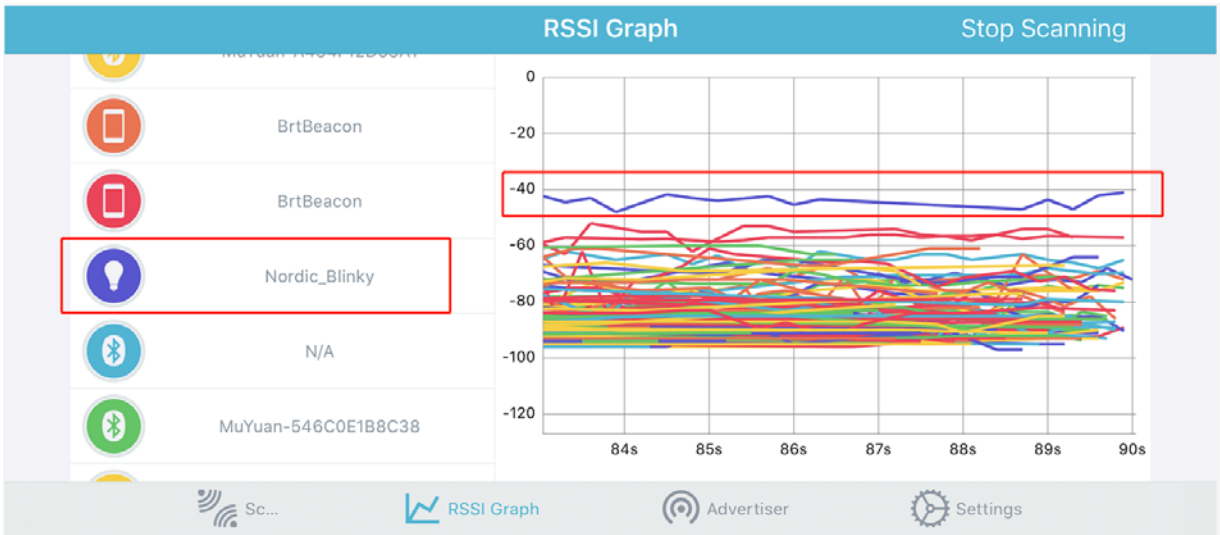


Figure 4-4 Number of Bluetooth devices in the test environment

② Outdoor distance test: the distance is measured at the straight line of 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 it can be connected normally at a distance of 90 meters. The following picture shows the location of the test point on the map.

Figure 4-5 Module pull test position

4.4 Broadcast and connection power test

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

mode	Broadcast 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

Figure 4-6 Module broadcast and connection power consumption table

4.5 Precautions

1. Power supply

It is recommended to use the DC stabilized power supply to supply power to the module. The power supply ripple is as small as possible. Generally, the ripple is less than 30mV. Excessive ripple may cause low sensitivity and poor connection quality. And the Bluetooth transmit signal will be coupled into the interference signal, causing the RF indicator to exceed the Bluetooth specification. In severe cases, it will be unable to connect and communicate. Try to use LDO to supply power to the module. The LDO should be away from the DC-DC power supply and inductance to prevent DC-DC radiation from contaminating the LDO's power supply. The module needs to be grounded reliably, and please pay attention to the correct connection of the positive and negative poles of the power supply. If a reversed connection is made, the module may be permanently damaged.

2. ESD electrostatic protection

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

Chapter 5 Production guidance

5.1 Production guide

It is recommended to use SMT machine patch, and the patch should completed within 24 hours after unpacking, otherwise it is necessary to re-vacuate the package to avoid the bad condition caused by moisture.。

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 indication. The conditions for baking are as follows:

Baking temperature：125° C±5° C;

Set alarm temperature to 130° C;

After cooling <36 ° C under natural conditions, the SMT patch can be performed;

If the unpacking time is more than 3 months, special attention should be paid to whether the product is damp or not. Because the PCB immersion gold process may cause the pad to oxidize for more than 3 months, it may cause problems such as rosin joint and dry joint.

In order to ensure the reflow soldering pass rate, it is recommended to extract 10% of the products for visual inspection and AOI testing for the first time to ensure the correctness of furnace temperature control, device adsorption mode and placement method.

Operators at all stations in the entire production process must wear electrostatic gloves.

5.2 Module requirements for floor position

It is recommended that the green oil thickness of the bottom plate module position is less than 0.02mm, to avoid excessive thickness, and the high height module cannot effectively contact the solder paste to affect the welding quality.

In addition, the module needs to reserve 2mm space around to ensure the maintenance of it.

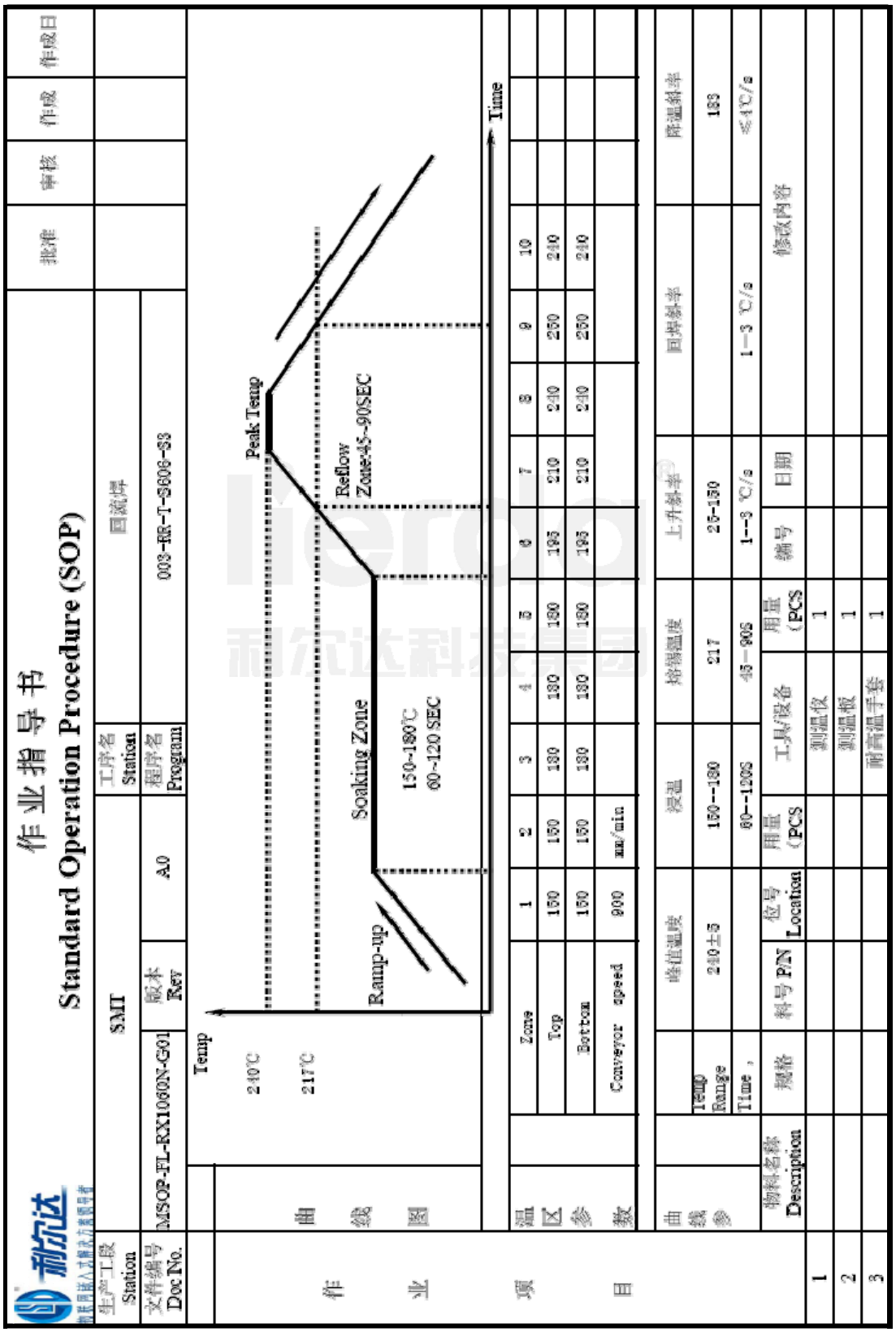
5.3 Steel stencil design

The thickness of the steel stencil is selected according to the package type of the device in the board. It is necessary to focus on the following requirements:

The module pad position can be locally thickened to 0.15~0.20mm to avoid rosin joint.

5.4 Reflow soldering instructions

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



Chapter 6 Product packaging

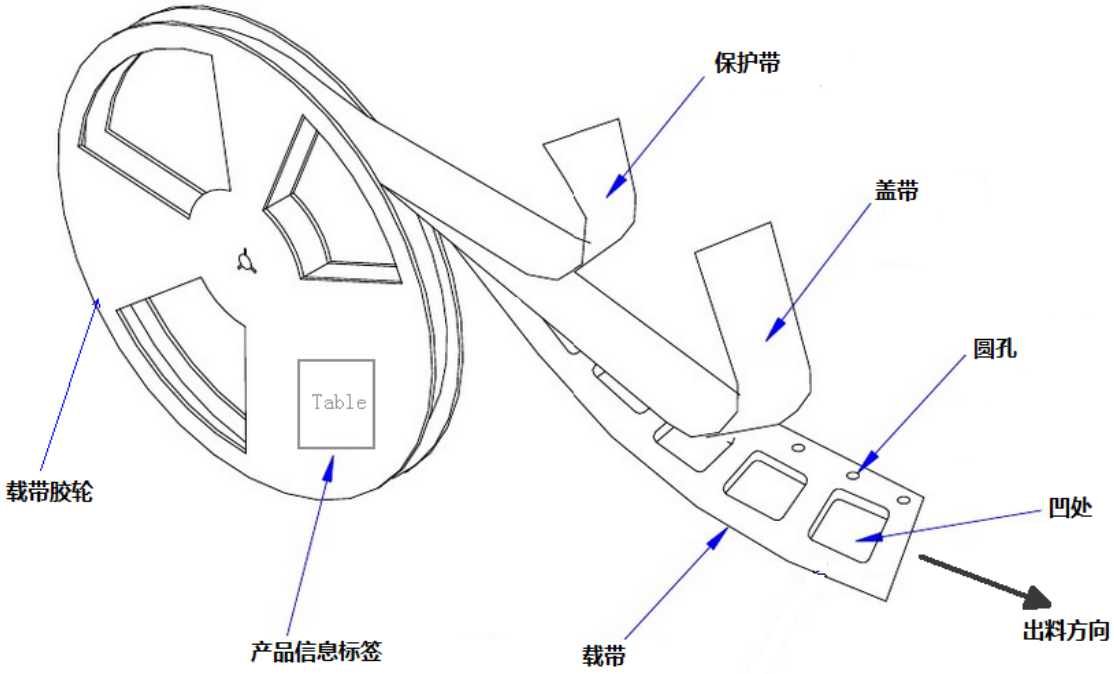
6.1 Packaging method

■ Tape ☐ Foam ☐ Electrostatic bag

6.2 Strip size

6.3 Product direction

Module roll tape packaging orientation：



Chapter 7 RF Exposure Information and Statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment.

This device complies with part 15 of the FCC rules . Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-Consult the dealer or an experienced radio/TV technician for help

- This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

Advise the user

Welcome to use the products of Lierda Technology Group Co., Ltd. Please read this warning before using our products. If you have started using the instructions, you have read and accepted this notice.

Lierda Technology Group Co., Ltd. reserves the right to interpret and modify all materials provided, and is subject to change without notice.