BT5.0-E92 Series

Product Specification

Product Name: E92 BLE Standard Module

Product Model: LSD4BT-E92

Version: Rev01

Revision History

Serial No.	Revision Log	Revised by	Reviewed by	Version	Revision Date
00	Initial version	Sun Xin	Sun Xiangtao	Rev00	2019-6-4
01	Update NFC function, adjust pin 17, 18, 19, 20	Sun Xin	Sun Xiangtao	Rev01	2019-7-16

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Chapter 1 Overview

E92 series of Bluetooth module is high-performance Bluetooth module which is based on the low power consumption NORDIC Bluetooth SOC chip nRF52 series (support BLE 5.0) . The module adopts stamp hole-type interface, and with two antenna options : PCB antenna and external antenna, which is compatible with E66 series module . The key features of the module is low-power consumption, small size and high anti-interference ability.

Based on the optimized Bluetooth SDK provided by Lierda, users can easily realize development of Bluetooth applications, shorten research and development cycle.

Table 1-1 Model Description

Part number	Description
LSD4BT-E92ASTD001	nRF52832, PCB antenna and external antenna. For the module with software, please communicate with the salesman over the specific part number, MPQ and other information.

1.1 Functional Characteristics

- Bluetooth 5
  2 Mbps
  CSA #2
  Advertising Extensions
  Data Length Extension
- 64 MHz ARM® Cortex-M4F
- 512 KB Flash + 64 KB RAM
- LE mode：1 Mbps、2 Mbps
- Link budget：100dB
- Receiving sensitivity：-96dB
- output power：MAX 4dBm
- RSSI ：1dB
- Working voltage：1.7-3.6V
- Available GPIO quantity：19
- ADC：12 bits /200 ksps
- 50ΩRF Port
- programmable peripheral interface (PPI)

- DC-DC working mode
- Support user defined download protocol
- NFC
- 3 SPIs
- 2 TWIs
- 1 UART
- 3 PWMs
- 8 10/12bit ADCs

1.2 Application Occasions

- 2.4GHz low-power consumption Bluetooth system;
- PC,Tablet,smart phone,handset and low-power consumption Bluetooth devices (such as HID, remote controller) ;
- Consumer electronics such as sports, health care ;
- Wireless sensor for smart meters, data collection;
- Smart cloud platform integration(such as Wechat, QQ ToT, JD, Alibaba,Xiaomi);
- Smart home, LAN,Interactive devices , beacon lights

Chapter 2 Specification & Parameters

Table 2-1 Limit Parameters

Main Parameters			Performance		Remarks
			Minimum Value	Maximum Value	
Power supply voltage（V）			-0.3	3.9	
IO voltage（V）			-0.3	VDD+0.3	No more than 3.9
Maximum RF input （dBm）			/	10	
NFC maximum current（mA）			/	80	
Storage temperature（℃）			-40	+125	
Operating temperature（℃）			-40	+85	
V_{ESD}	Electrostatic discharge(ESD) performance	Human Body Model(HBM),per ANSI/ESDA/JEDEC/JS001(1)	/	4000V	All pins
		Charged Device Model(CDM),per JESd22-C101(2)	/	1000V	RF pins
			/	1000V	Non-RF pins
(1)JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process (2)JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process					

Table 2-2 Working Parameters of the Module @25℃

Main Parameters	Performance			Remarks
	Minimum Value	Typical Value	Maximum Value	
Working voltage（V）	1.7	3.3	3.6	The ripple of the power supply requires the peak value to be within 30mV
Power supply voltage rising time（ms）	/	/	60	Power supply voltage rises to 1.7V within 60ms
Working frequency (MHz)	2402	/	2480	
Payload length (bytes)	0	37	255	Default payload length is 37, extension length is 255
Working mode	1 Mbps/2 Mbps			Default value is 1Mbps
Communication	BLE 5.0			

protocol				
Number of channels	40			
Modulation type	GFSK			
Communication distance[1]	100m			@3.3V;4dBm;BLE mode-1M ;PCB antenna
Connection distance[2]	50m			@3.3V;4dBm;BLE mode-1M ;PCB antenna
Transmittance power (dBm)	/	0	/	@3.3V ;software can be set -20dBm to +4dBm
Receiving sensitivity (dBm)	/	-96	/	@BLE mode-1Mbps; Payload=37
Receiving sensitivity (dBm)	/	-95	/	@BLE mode-1Mbps; Payload=255
NFC working frequency (MHz)	/	13.56	/	
NFC rate (kbps)	/	106	/	

1. "Communication distance" is affected by the measuring environment, air humidity and other factors around, and only for reference.

2. Communication distance is the maximum communication distance after connection, connection distance is the maximum distance that connection can be created.

Table 2-3 Power Consumption of the Module @25℃

Main Parameters	Performance			Remarks
	Minimum Value	Typical Value	Maximum Value	
Transmitting current (mA)	/	7.5	/	@3.3V (DCDC-Mode) ;4dBm
	/	16.6	/	@3.3V (LDO-Mode) ;4dBm
	/	5.3	/	@3.3V (DCDC-Mode) ;0dBm
	/	11.6	/	@3.3V (LDO-Mode) ;0dBm
Receiveing current (mA)	/	5.4	/	@3.3V (DCDC-Mode) ;1Mbps
	/	11.7	/	@3.3V (LDO-Mode) ;1Mbps
	/	5.8	/	@3.3V (DCDC-Mode) ;2Mbps
	/	12.9	/	@3.3V (LDO-Mode) ;2Mbps
Sleep mode current (uA)	/	0.3	/	System OFF current, no RAM retention
	/	1.2	/	System ON base current, no RAM retentio

				n
RAM current (nA)	/	20	/	per 4 KB RAM section
CPUcurrent[1](mA)	/	7.4	/	running from flash, cache enabled, LDO
	/	3.7	/	running from flash, cache enabled, DCDC

1. CPU clock speed is 64MHz, set external as idle status, supply voltage is 3.3V

Chapter 3 Hardware Layout and Interface Description

3.1 Dimensions

When this product is designed, the tantalum capacitors and PCBs have optional material models. On the premise that the performance requirements are met, the appearance color may be different, and the actual product shall prevail. The main materials (main chips, crystal oscillators, etc.) do not have any substitutional models. Any change will be notified in advance.

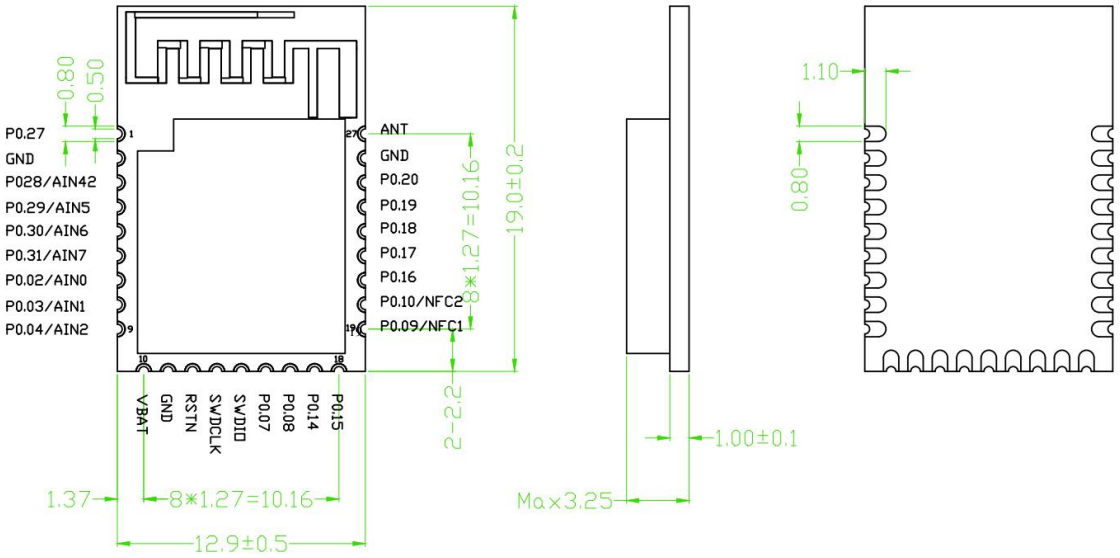


Fig. 3-1 The dimensions of the module E92

*The dimensional tolerance which is not marked in the figure is subject to the standard GB/T1804-m.

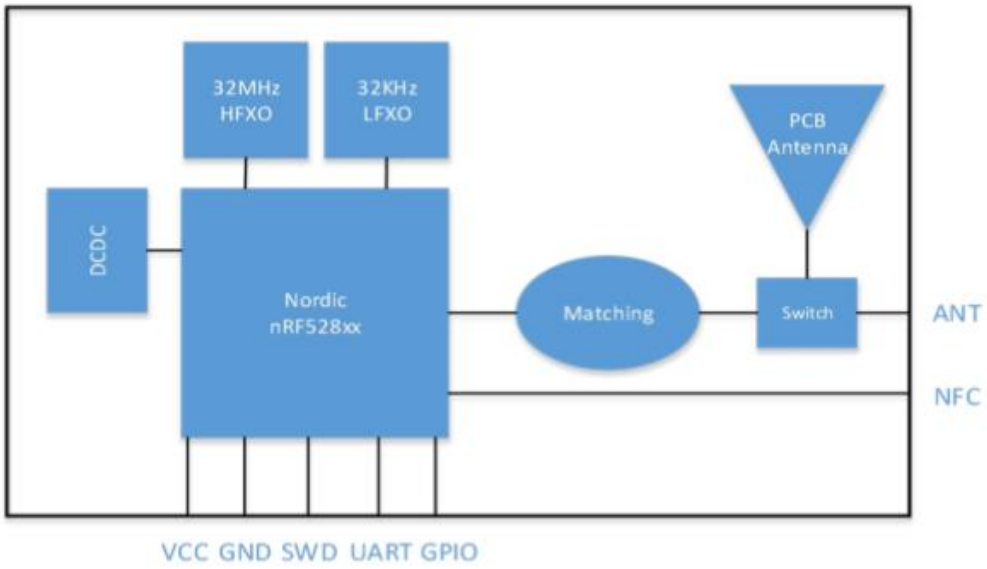


Fig. 3-2 E92 module internal diagram

3.2 Interface Description

Table 3-1 Functional Description of Pins of E92 Series of Module

Module Pin	Chip Pin	Remarks
1	P0.27	Digital I/O pin
2	GND	PWR GND
3	P0.28/AIN4	Digital I/O pin; analog I/O pin
4	P0.29/AIN5	Digital I/O pin; analog I/O pin
5	P0.30/AIN6	Digital I/O pin; analog I/O pin
6	P0.31/AIN7	Digital I/O pin; analog I/O pin
7	P0.02/AIN0	Digital I/O pin; analog I/O pin
8	P0.03/AIN1	Digital I/O pin; analog I/O pin
9	P0.04/AIN2	Digital I/O pin; analog I/O pin
10	VBAT	Power supply
11	GND	PWR GND
12	RSTN	RESET
13	SWDCLK	Clock debugging pin
14	SWDIO	Data debugging pin
15	P0.07	Digital I/O pin
16	P0.08	Digital I/O pin
17	P0.14/UART_TX	Digital I/O pin; serial data TXD pin

18	P0.15/UART_RX	Digital I/O pin; serial data RXD pin
19	P0.09/NFC1	Digital I/O pin; NFC antenna pin; using NFC need to reserve tuned-circuit
20	P0.10/NFC2	Digital I/O pin; NFC antenna pin; using NFC need to reserve tuned-circuit
21	P0.16	Digital I/O pin
22	P0.17	Digital I/O pin
23	P0.18	Digital I/O pin
24	P0.19	Digital I/O pin
25	P0.20	Digital I/O pin
26	GND	PWR GND
27	ANT	External antenna interface; when using need to reserve π matching circuit

For detail pin descriptions, please refer to nRF52832 data sheet.

Note: When customizing software, user can keep the original configuration of P 0.25 and P 0.26 without change, or you can set pull-down.

3.3 PCB packaging

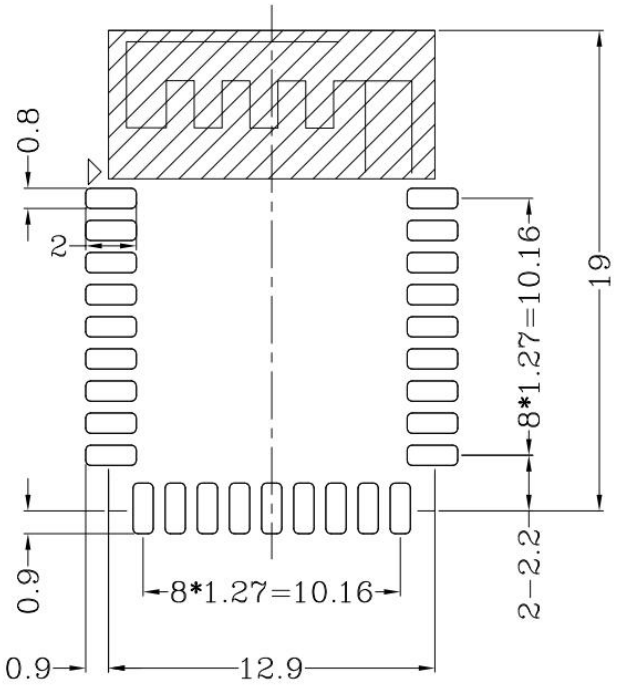


Fig. 3-3 E92series module PCB packaging-Top View

Note: The shaded area is PCB antenna. No copper or devices can be placed on either floor of the base plate in this area.

Chapter 4 Application Instructions

4.1 Antenna design guide

If customers have high requirements for distance, they can use an external antenna, and the IO port for using an external antenna is PIN27 (ANT). The bottom of the module, including the original antenna position, should be completely covered with copper.

The following figure shows the circuit from the module ANT pin to the external antenna. The red thick wire should ensure the impedance control of 50Ω. The routing should be as short as possible, without punching holes and taking sharp corners. More GND holes are punched around the RF routing.

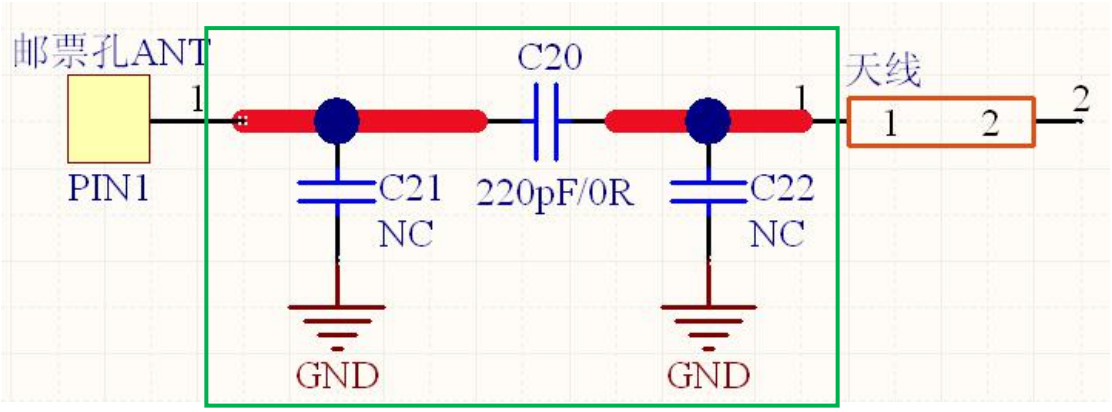


Fig. 4.1 Schematic diagram of impedance matching circuit for external antenna

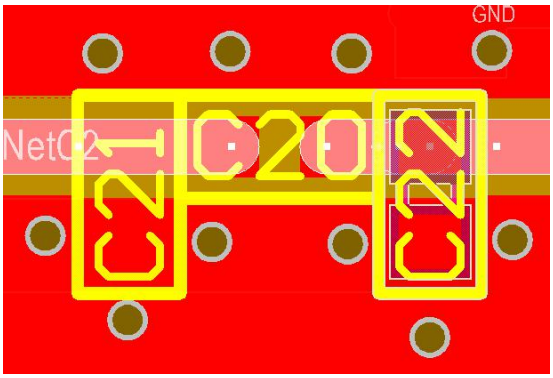


Fig. 4.2 PCB schematic diagram and route description of impedance matching circuit for external antenna

The wiring of the highlight part is to control the impedance of 50Ω. The relationship

between plate thickness, line width and line spacing can be referred as following:

FR4 double-sided boards recommended value

（H=Board thickness， W=Line width， D=Spacing between wiring and copper-clad）

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）

（Ask Lierda engineer for more design support）

4.2 Notice for base board layout

Save enough clearance zone for antenna . Clearance refers to the space area in the projection area of the vertical plane of the antenna (both upper and lower areas should be considered). In the projection area of the antenna, whether patch or side insertion, do not lay the ground (especially for PCB antenna), do not have metal or devices, and keep enough clearance to improve the radiation efficiency of the antenna.

The height (distance) between the antenna and the motherboard also need to be taken into consideration. Generally , the height of the antenna from the motherboard should be at least 10 mm, and at least 5 mm in extreme conditions. When the antenna height is less than 8 mm, the radiation efficiency of the antenna will be limited.

The radio frequency part of the module should avoid being covered by metal cavity. The distance between the radio frequency part and the interference source should be more than 10 mm. Common interference sources include battery (including electrical connection base), capacitance, inductance, buttons, oscillator, power cord, metal screw or nut, CPU, LCD, transformer, horn, camera and products internal communication interface, power supply circuit, motor, etc.

If PCB antenna is used in the module, the PCB antenna should be on the edge of the PCB on the whole base board. The distance between the PCB antenna and other parts should be kept at 10 mm. No copper, wiring or components can be arranged in all layers around the antenna. If there are multiple antennas, the distance between the antenna and the antenna should be as far as possible to avoid co-frequency interference and cross-modulation interference.

Users should pay attention to the design, leave windowing area for the antenna pad in the product bottom layer, and can not be placed through the hole so that to prevent short circuit.

4.3 NFC design guide

The design of NFC antenna is rather complex. It is not recommended that customers without antenna design experience design their own antenna. It is suggested that the NFC antenna be designed by referring to the NFC reference design provided by Lierda or by professional antenna designers.

Note: When using NFC antenna, tuning circuit should be reserved on the bottom board. If the antenna needs to be assembled or exposed to the outside of the product, it is necessary to add two TVS diodes to the circuit at the antenna entrance. If the antenna is exposed to a strong NFC magnetic field, the current may flow backwards on the power supply. If the power supply cannot withstand the back flow, current needs to be protected by a diode in series between the power supply and the module.

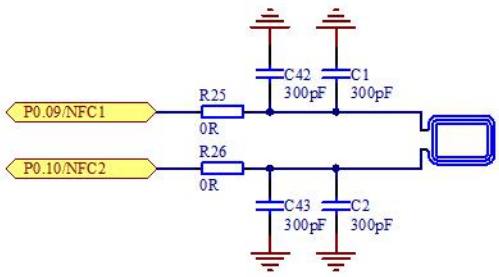


Fig. 4.3 Tuning circuit

Tuning method: Network analyzer is used to test the echo loss of antenna at 13.56 MHz frequency. The test requires two antennas, one antenna connected to the module's NFC interface, and the module does not need to be connected to power supply. Another test antenna port is directly connected to the network analyzer. The distance between the test antenna and the antenna connected to the module should not be less than 1 cm, and the distance should not be too far, at least to ensure that the echo loss can be seen on the network analyzer. The resonant frequency of the antenna corresponds to the frequency at the deepest point of the echo loss. Adjust the tuning capacitance value on the board so that the resonance frequency falls near 13.56 MHz. If the frequency is low, the tuning capacitance value can be reduced, and if the frequency is high, the tuning capacitance value

can be increased. Note that the tuning capacitance of both sides should be equal.

4.4 Notices

1. Power Supply

It is suggested supplying power to the module with DC regulated power supply. The ripple of power supply should as small as possible. Usually the ripple is less than 30 mV. Excessive ripple will lead to poor sensitivity and other connection abnormalities. At the same time, the transmitting signal of Bluetooth will be coupled into the interference signal, which will cause the radio frequency to exceed the Bluetooth specification, and even will result in failed connection and communication. It is recommended to use LDO as power supply for the module. At the same time, LDO should be far away from DC-DC power supply and inductance to prevent DC-DC radiation from polluting LDO power supply. The module should be grounded reliably, and pay attention to the correct connection of the positive and negative poles of the power supply, and reverse connection may cause permanent damage to the module.

2. Electro-static discharge notices

The user shall pay attention to the electrostatic requirements (as shown in Table 2-1) of the product, and add the electrostatic prevention measures when designing the end products.

Chapter 5 Production Guidance

5.1 Production Guide

It is suggested the stamp hole packaging module mounted by an SMT machine, and the mounting shall be finished within 24 hours after unpacking. Otherwise, its need to repackage by vacuumizing, so as to prevent poor mounting effect due to damp.

If the package includes a humidity indicator card, it is suggested judging if the module needs to be baked according to the indication of the humidity indicator card. The baking conditions are as follows:

Baking temperature: 125℃±5℃;

The alarm temperature is set to be 130℃;

SMT mounting can be carried out after the temperature cools down to be <36℃ under natural conditions;

If the product is unpacked for over 3 months, please pay special attention if the product is affected with damp, because the PCB gold immersion process may lead to the oxidation of the land after more than 3 months, and may lead to such problems as false welding and missing welding during the mounting process.

In order to ensure the pass rate of reflow, it is suggested picking 10% of products for visual inspection and AOI detection in the first time of mounting, so as to ensure the reasonableness of the furnace temperature, device absorption method and placement method;

Operators at all stations must wear the anti-electrostatic gloves during the whole production process;

5.2 Requirements on Positions of Module on Backplane

It is suggested the green oil thickness at the module position of the backplane be less than 0.02mm, so as to prevent the phenomenon that the green oil is too thick, the module is blocked up and cannot be effectively contacted with solder paste, and the welding quality is affected.

In addition, please do not place other devices within 2mm around the module position on the interface board, so as to ensure the convenience for repairing the module.

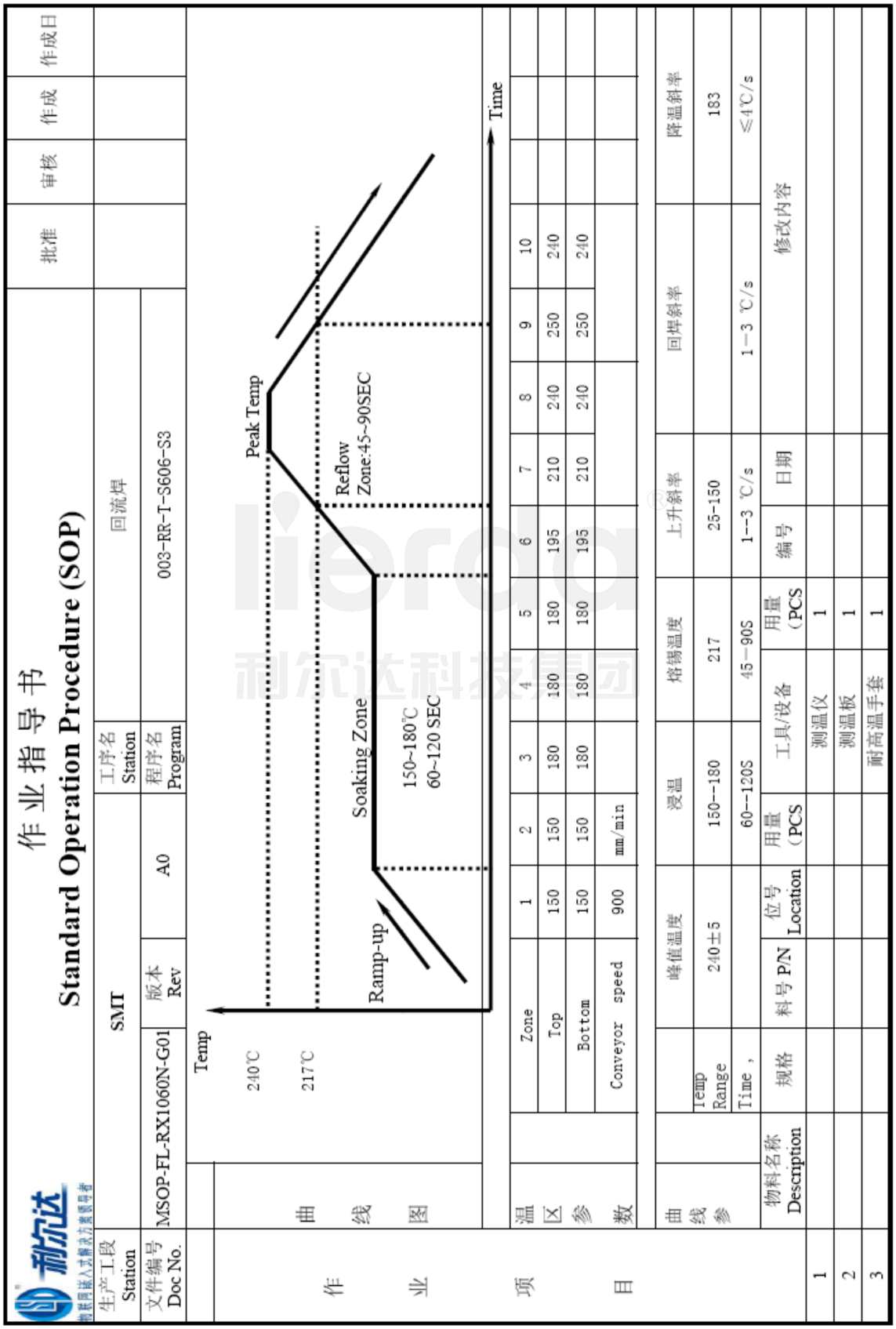
5.3 Opening Design of Steel Mesh

The thickness of the stencil on the backplane shall be selected by comprehensively considering the packaging type of the devices in the board, and special attention shall be paid to the following requirements:

The land position of the module can be locally thickened to 0.15~0.20mm, so as to prevent void solder;

5.4 Standard Operation Procedure (SOP) for Reflow

Note: This SOP is only applicable to lead-free operation, and only for reference.



作业指导书
Standard Operation Procedure (SOP)

生产工段 Station	SMT		工序名 Station	回流焊		批准	审核	作成	作成日
文件编号 Doc No.	MSOP-FL-RX1060N-G01	版本 Rev	A0	程序名 Program	003-RR-T-S606-S3				

作业图 曲线图

项目

温区参数

Zone	1	2	3	4	5	6	7	8	9	10
Top	150	150	180	180	180	195	210	240	250	240
Bottom	150	150	180	180	180	195	210	240	250	240
Conveyor speed	900	mm/min								

曲线参数

	峰值温度	浸温	熔锡温度	上升斜率	回焊斜率	降温斜率
Temp Range	240±5	150~180	217	25~150		183
Time ,		60~120S	45~90S	1~3 ℃/s	1~3 ℃/s	≤4℃/s

	物料名称 Description	规格	料号 P/N	位号 Location	用量（PCS	工具/设备	用量（PCS	编号	日期	修改内容
1						测温仪	1			
2						测温板	1			
3						耐高温手套	1			

Chapter 6 Product Package

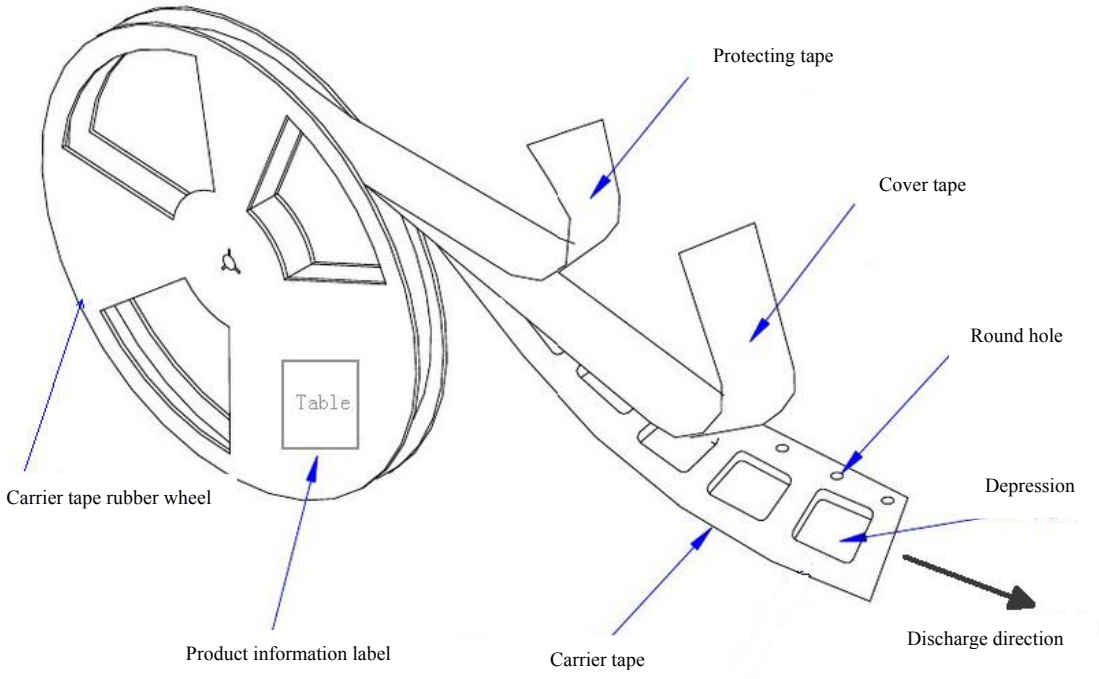
6.1 Packaging Method

■ Tape ☐ Foam ☐ Electrostatic bag

6.2 Strip Size

6.3 Product Direction

The placement direction of the tape packaging module is shown as following:



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