

# User Manual



**Product Name: E92 BLE Module**

**Product Model: LSD4BT-E92ASTD001**

**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	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 optimizations, shorten research and development cycle.

FCC ID: 2A0FDLSD4BT-E9X

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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
  - CSA #2
  - Advertising Extensions
  - Data Length Extension
- 64 MHz ARM® Cortex-M4F
- 512 KB Flash + 64 KB RAM
- LE mode: 1 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
- 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	
Storage temperature (°C)			-40	+125	
Operating temperature (°C)			-40	+85	
V <sub>ESD</sub>	Electrostatic discharge(ESD) performance	Human Body Model(HBM),per ANSI/ESDA/JEDEC/JS001 <sup>(1)</sup>	/	4000V	All pins
		Charged Device Model(CDM),per JESd22-C101 <sup>(2)</sup>	/	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°C

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 protocol	BLE 5.0			

Number of channels	40			
Modulation type	GFSK			
Communication distance <sup>1</sup>	100m			@3.3V;4dBm;BLE mode-1M ;PCB antenna
Connection distance <sup>2</sup>	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

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°C

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
Receiving current (mA)	/	5.4	/	@3.3V (DCDC-Mode) ;1Mbps
	/	11.7	/	@3.3V (LDO-Mode) ;1Mbps
	/	0.3	/	System OFF current, no RAM retention
	/	1.2	/	System ON base current, no RAM retention
Sleep mode current (uA)	/	20	/	per 4 KB RAM section
	/	7.4	/	running from flash, cache enabled, LDO
RAM current (nA)	/	3.7	/	running from flash, cache enabled, DCDC
CPU current <sup>1</sup> (mA)				

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.

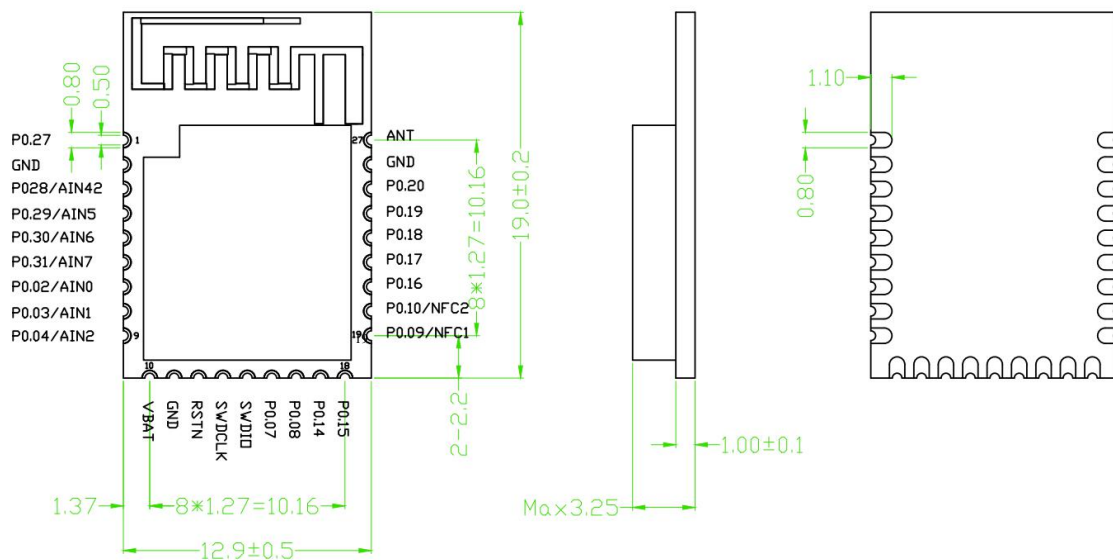


Fig. 3-1 The dimensions of the module E92

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

### 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	Digital I/O pin;
20	P0.10	Digital I/O pin;
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 $\pi$ 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.

## 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  $50\Omega$ . The routing should be as short as possible, without punching holes and taking sharp corners. More GND holes are punched around the RF routing.

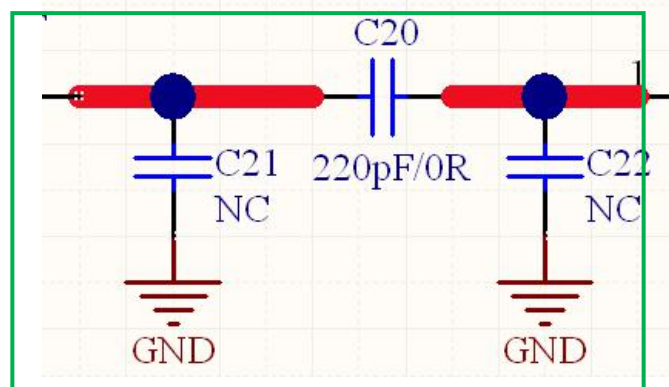


Fig. 4.1 Schematic diagram of impedance matching circuit for external antenna

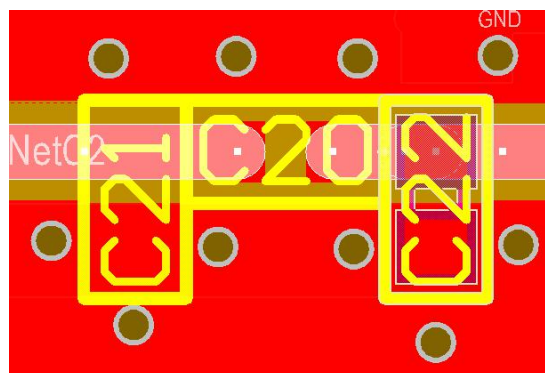


Fig. 4.2 PCB schematic diagram and route description of impedance matching circuit for external antenna

The wiring of the highlight part is to control the impedance of  $50\Omega$ . 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 Notices

### 1. Power Supply

It is suggested supplying power to the module with DC regulated power supply. The ripple of power supply should be 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, it needs to be repackaged 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:  $125^{\circ}\text{C}\pm 5^{\circ}\text{C}$ ;

The alarm temperature is set to be  $130^{\circ}\text{C}$ ;

SMT mounting can be carried out after the temperature cools down to be  $<36^{\circ}\text{C}$  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;

## Chapter 6 Product Package

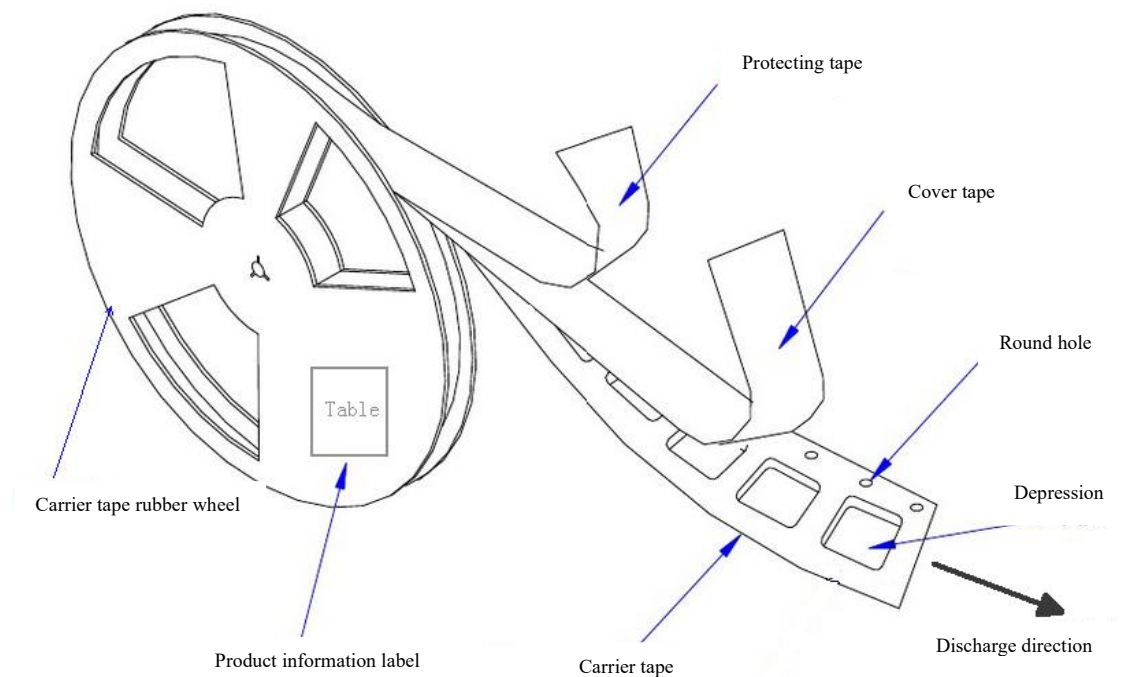
### 6.1 Packaging Method

■ Tape                                      □ Foam                                      □ Electrostatic bag

### 6.2 Strip Size

### 6.3 Product Direction

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



## Notice To users

Welcome to use the products of Lierda Science & Technology Group Co., Ltd.. Prior to the use of our products, please first read this notice; if you have started using our products, you will be considered as having read and accepted the notice.

Lierda Science & Technology Group Co., Ltd. reserves the final interpretation and revision rights over all attached materials, and any modification of them will not be further notified.

## Regulatory Conformance (RED)

Hereby, **Zhejiang Lierda Internet of Things Technology Co.,Ltd** declares that the radio equipment type LSD4BT-E9x is in compliance with Directive 2014/53/EU.



The full text of the EU declaration of conformity is available at the following website:<https://www.lierda.com/>

### Radio specification

Frequency Range	Max.RF power
2402-2480MHz	7.4 dBm

### FCC Statement:

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.

#### **RF Exposure Information and Statement :**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter





## Instructions to the OEM/Integrator:

This module has been granted modular approval for mobile applications. OEM integrators for host products may use the module in their final products without additional FCC certification if they meet the following conditions. Otherwise, Additional FCC approvals must be obtained.

- The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2AOFDLSD4BT-E9X, Additionally, the following statement should be included on the label and in the final product's user manual:  
"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 interferences, and (2) this device must accept any interference received, including interference that may cause undesired operation."
- The user's manual for the host product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.
- The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.
- This Module is full modular approval, it is limited to OEM installation ONLY.
- The module is limited to installation in mobile application.
- A separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and difference antenna configurations.
- The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.
- The Grantee will provide guidance to the Host Manufacturer for compliance with the Part 15B requirements if requested.