



# BR2551e(-s,-sc)

## Datasheet

Nov 4, 2024

Version 1.4



## Declaration

All other trademarks, brand names, product names and titles, copyrights and other intellectual property rights used in this work or works are trademarks, brand names, product names, copyrights or other intellectual property rights of their respective rights holders. Permission to reproduce such material must be obtained from the relevant rights holders concerned.

The contents of this publication are intended to be a general guide and cannot be a substitute for professional advice. Neither the authors nor Barrot Technology Co.,Ltd. accept any responsibility for loss occasioned to any person or business acting or refraining from acting as a result of material contained in this work.

Applications for the copyright owner's permission to reproduce any part of this work should be addressed to email address: [marketing@barrot.com.cn](mailto:marketing@barrot.com.cn) or company address: A1009, Block A, Jia Hua Building, No.9 Shangdi Third Street, Haidian District, Beijing, China.

## Version History

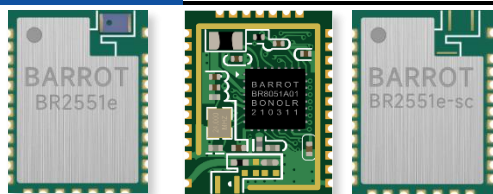
Revision	Amendment	Date	Author
1.0	Initial version	2021-03-18	Baoqiang Huang
1.1	Update module block diagram size	2021-06-05	Baoqiang Huang
1.2	Update document format	2023-06-05	Chunli Liu
1.3	ADD Declaration	2023-10-26	Kaiyue Wu
1.4	Update document format	2024-11-4	Lisa

Barrot Confidential

# Contents

1. Block Diagram and Descriptions .....	8
2. Product Specifications .....	9
3. PIN Diagram and Description .....	11
3.1 PIN Diagram .....	11
3.2 PIN Description .....	12
3.3 PIN assignment .....	15
4. Electrical Characteristics .....	17
4.1 Recommended Operating Conditions .....	17
4.2 Digital IO DC Characteristics .....	17
5. Interfaces .....	18
5.1 Startup Signal Sequence .....	18
5.2 VCC .....	18
5.3 RESET .....	18
5.4 BOOT .....	18
5.5 UART .....	18
5.6 I2C .....	19
5.7 GPIO .....	19
5.8 USB .....	19
6. RF Specifications .....	19
6.1 RF Characteristics .....	19

6.2 Power Consumption .....	20
7. Module Package Information .....	20
8. Layout Note .....	23
8.1 Layout .....	23
8.2 Schematic Design Notes .....	23
8.3 PCB Layout Design Notes .....	24
8.4 Module Placement Examples .....	24
9. MOQ .....	25
9.1 Package .....	25
9.2 Storage Conditions .....	27
10. Package .....	27
11. Contacts .....	28
12. Company Profile .....	28
13. Copyright .....	29
Appendix Module storage and SMT guide .....	30
Appendix 2 Order Information .....	49



## BR2551e(left) & BR2551e-s(middle) & BR2551e-sc(right)

### Bluetooth module Introduction

BR2551e (-s, -sc) is Bluetooth 5.2 BR/EDR BLE Dual Mode SOC module. A highly integrated SOC for Bluetooth data stream process, BR2551e (-s, -sc) integrates a low power MCU, RF transceiver, Baseband, Modem, USB Device, SARADC and up to 16 GPIOs in the module. BR2551e (-s, -sc) offers low cost, low power consumption, flexible and more powerful Bluetooth application.

BR2551e (-s, -sc) operates with a widely power supply range from 1.9V to 3.6V and has very low power consumption in both TX and RX modes, enabling long lifetimes in battery-operated systems while maintaining excellent RF performance. The device can enter an ultra-low power sleep mode in BT sniff mode and BLE connection interval.

## Module Specifications

### Stack Features

- ◆ Support Bluetooth v5.2 specification compliant
- ◆ Compatible with V2.1 + EDR
- ◆ Support the Bluetooth smart firmware includes Security Manager (SM), Attribute Protocol (ATT), the Generic Attribute Profile (GATT) and Generic Access Profile (GAP)
- ◆ High speed UART or USB port for BT HCI and AT commands

- ◆ Support up to 7 ACLs and 1 SCO/eSCO link for BR/EDR.
- ◆ Support up to 4 BLE links (Up to 3 links in slave mode)

### Hardware Features

- ◆ 32-bit RISC processor up to 96MHz with on-chip ROM (384Kbytes) and RAM (96Kbytes)
- ◆ Operating temperature: -40 to +85°C
- ◆ 1.9V to 3.6V power supply
- ◆ 512Kbytes build in flash
- ◆ Power modes included shutdown/deep sleep/light sleep/active
- ◆ Wake up by UART/GPIO (light sleep), and RTC (deep sleep)
- ◆ High speed UART port for BT HCI and Data interface, up to 4Mbps
- ◆ Single pin RF connection (50 ohm impedance in TX and Rx modes)
- ◆ High performance on-chip RF transceiver with integrated balun
- ◆ Integrated Power amplifier with maximum +6dbm transmit power output, support Bluetooth class 1 application without external PA
- ◆ -94dbm receive sensitivity for LE (1Mbps) mode and 92dbm for BR/EDR mode
- ◆ Up to +6dBm RF transmit power
- ◆ GFSK/ $\pi$ /4-DQPSK/8DPSK modulator
- ◆ GFSK/ $\pi$ /4-DQPSK/8DPSK demodulator
- ◆ RF/Analog Control (AGC, PA, Ramp up/down timer, Low power)
- ◆ Embedded high speed and low power CPU with on-chip ROM (384Kbytes) and RAM (96Kbytes)
- ◆ Embedded 4 channel 11bit 1Mbps SARADC for peripheral controls

- ◆ Built-in PLL, support system run up to 96MHz, and built-in crystal oscillator 24MHz
- ◆ Embedded PMU for efficient power management
- ◆ I2C master/slave, support standard and fast mode
- ◆ 4 sets PWM interface
- ◆ 4-wire SPI (master and slave) interface, up to 12MHz
- ◆ 8x channels DMA for peripheral interface (UART, USB, I2C, SPI)
- ◆ WDT/RTC/8x Timers
- ◆ 2x UARTs (uart0 has CTS/RTS)
- ◆ Various (total 16) GPIOs for various purposes

- ◆ Embedded SPI flash support XIP mode, Facilitate customer application development
- ◆ Support firmware upgrade over UART/USB or Air (OTA)

## Applications

- ◆ Printer
- ◆ Bluetooth HID
- ◆ Free drive dongle
- ◆ TV remote controller
- ◆ Toys
- ◆ Data communication application

## 1. Block Diagram and Descriptions

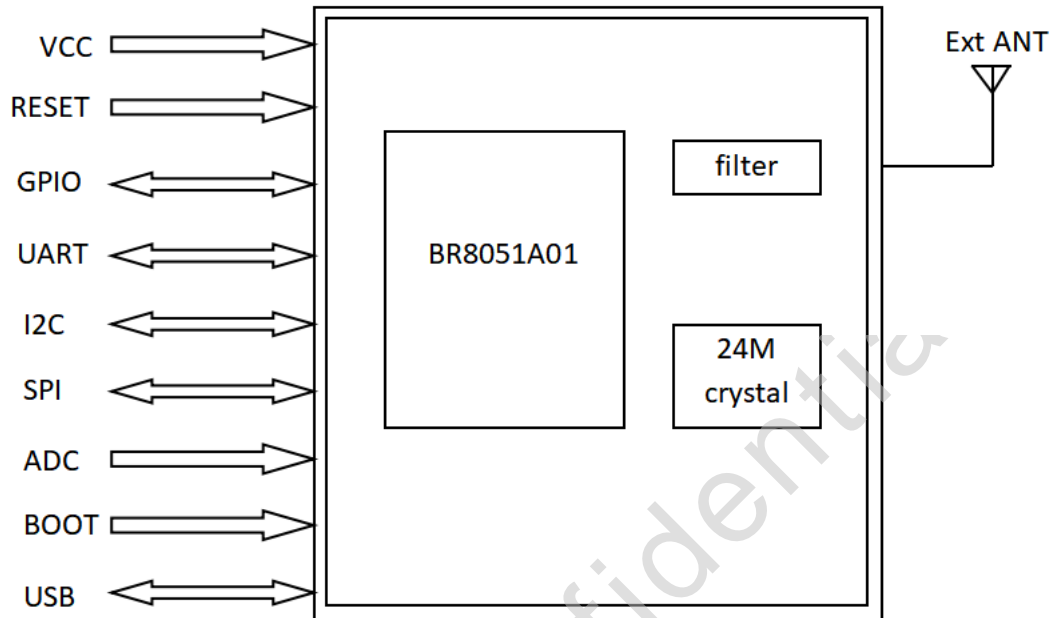


Figure 1 BR2551e-s(c) Block Diagram

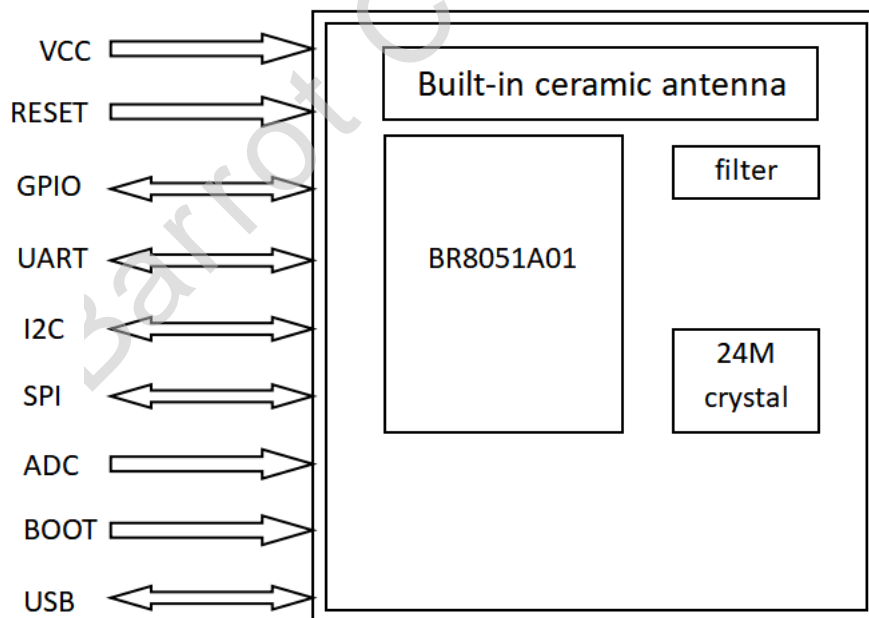


Figure 2 BR2551e Block Diagram



## 2. Product Specifications

Table 1 Product Specifications

Product specification	BR2551e, BR2551e-s, BR2551e-sc
Bluetooth Specification	Dual-module, Bluetooth V2.1+EDR and V5.2
Bluetooth Class	Class 1
Distance	50m (open area)
Antenna	BR2551e: internal BR2551e-s(c): external
Transmit Power	6dBm
Receiver Sensitivity	-94dbm receive sensitivity for LE(1Mbps) mode -92dbm for BR/EDR mode
Modulation	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Hardware Interfaces	RESET, GPIO, UART, I2C, SPI, BOOT, ADC, USB
Working voltage	1.9V~3.6V
Working power consumption	7mA
Idle power consumption	2mA
Deep sleep power consumption	-

Operating temperature	-40 to +85°C
Storage temperature	-55 to +125°C
shield	BR2551e-s: No BR2551e(-sc): Yes
Size	15mm*12mm*1.8mm (Tolerance $\pm 0.2$ mm No shield) 15mm*12mm*2.4mm (Tolerance $\pm 0.2$ mm with Shield)

## 3. PIN Diagram and Description

### 3.1 PIN Diagram

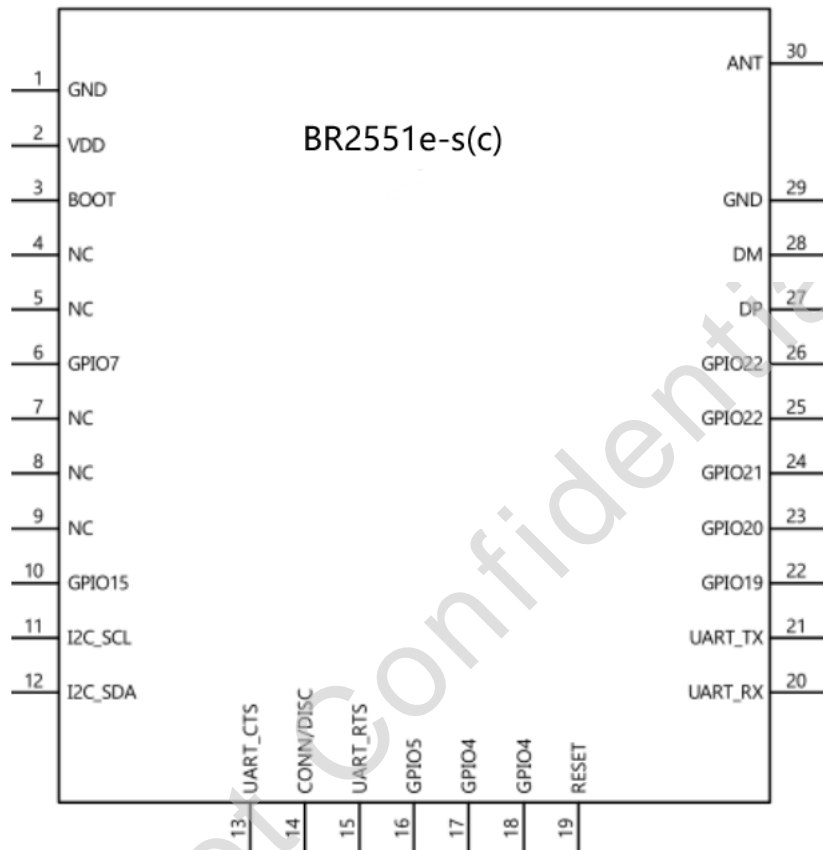


Figure 3 BR2551e-s, BR2551e-sc PIN diagram

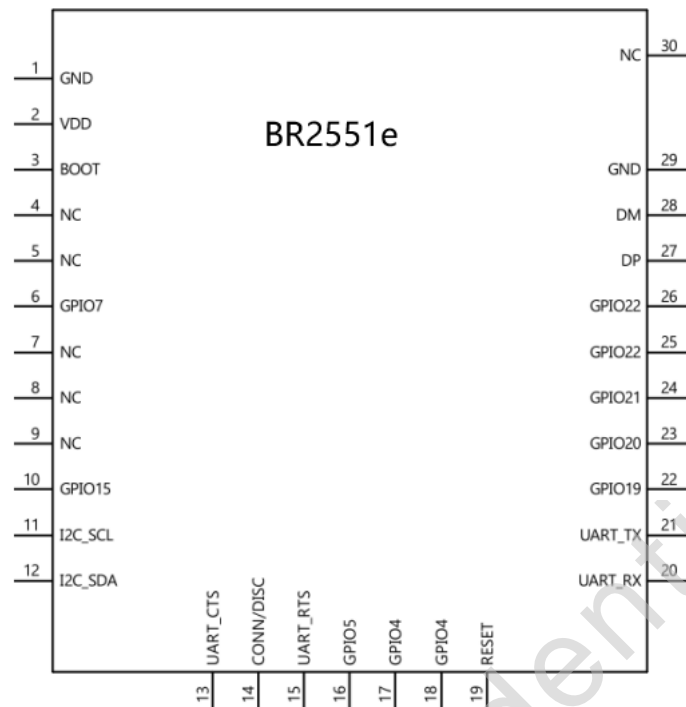


Figure 4 BR2551e PIN diagram

## 3.2 PIN Description

Table 2 PIN Description

PIN No	Pin Name	Description
1	GND	Power ground.
2	VDD	1.9V to 3.6V power supply, 3.3V recommended. Need external 10uF and 0.1uF capacitor connected to this pin.
3	BOOT	Pull down when firmware upgrade, pull up or NC when normal working.
4	NC	No Connect

5	NC	No Connect
6	GPIO7	Configurable GPIO, NC if not used.
7	NC	No Connect
8	NC	No Connect
9	NC	No Connect.
10	GPIO15	Configurable GPIO, NC if not used.
11	I2C_SCL	I2C Clock GPIO17 NC if not used.
12	I2C_SDA	I2C DATA GPIO18 NC if not used.
13	UART_CTS	UART flow control, input, Clear To Send, Pull up prohibited sending data, pull down to send. Pull down if not used. GPIO3
14	CONN/DISC	Configurable GPIO, Default DICS PIN Pull up into working mode. Pull down more than 100mS to disconnect the Bluetooth

		connection. NC if not used.  GPIO16
15	UART_RTS	<p>UART flow control, output, Request To Send.</p> <p>When the Bluetooth serial port buffer is full, this pin will be pulled up, notify the master computer to stop serial port sending; When the buffer is sufficient, this pin will be pulled down and allow the master computer to continue to send data through the serial port. NC if not used.</p> <p>GPIO2</p>
16	GPIO5	<p>Configurable GPIO, Default conn_status PIN</p> <p>Bluetooth Connected is high, unconnected is low. NC if not used.</p>
17/18	GPIO4	Configurable GPIO, NC if not used.
19	RESET	<p>Hardware reset</p> <p>NC if not used; pull down time&gt; 50ms if used.</p>

20	UART_RX	UART0 data receive GPIO1
21	UART_TX	UART0 data send GPIO0
22	GPIO19	Configurable GPIO, NC if not used.
23	GPIO20	Configurable GPIO, NC if not used.
24	GPIO21	Configurable GPIO, NC if not used.
25/26	GPIO22	Configurable GPIO, NC if not used.
27	DP	USB DP, NC if not used.
28	DM	USB DM, NC if not used.
29	GND	Ground
30	BR2551e-s(c): ANT	BR2551e-s, BR2551e-sc: External antenna
	BR2551e:NC	BR2551e: Built-in ceramic antenna

### 3.3 PIN assignment

Table 3 PIN assignment

PIN Name	Function0 mode	Function1 mode	Function2 mode	Function3 mode
UART_TX	UART0_TX	GPIO0	TX_EN	UART0_TX (output)

UART_RX	UART0_RX	GPIO1	RX_EN	UART0_RX (input)
UART_RTS	UART0_RTS	GPIO2	PWM1	N/A
UART_CTS	UART0_CTS	GPIO3	PWM2	N/A
BOOT	BOOT Mode	N/A	N/A	N/A
GPIO7	GPIO7	CLK_EXT_32K_IN (ext clock source)	PWM1	N/A
GPIO4	SWD_CLK	GPIO4	PWM3	I2C_SCLK
GPIO5	SWD_DIO	GPIO5	PWM4	I2C_SDA
GPIO15	GPIO15	UART1_TX	SPIM_CLK	SPIS_CLK
CONN/DISC	GPIO16	UART1_RX	SPIM_CSN	SPIS_CSN
I2C_SCL	GPIO17	I2C_SCLK	SPIM_MISO	SPIS_MISO
I2C_SDA	GPIO18	I2C_SDA	SPIM_MOSI	SPIS_MOSI
GPIO19	GPIO19	(BB)PCM_CLK	I2S_CLK	UART1_TX
GPIO20	GPIO20	(BB)PCM_SYNC	I2S_FS	UART1_RX
GPIO21	GPIO21	(BB)PCM_IN	I2S_IN	TX_EN
GPIO22	GPIO22	(BB)PCM_OUT	I2S_OUT	RX_EN

**Note:** need to customize the program to modify the pin assignment.



## 4. Electrical Characteristics

### 4.1 Recommended Operating Conditions

Table 4 Recommended Operating Conditions

Rating	Min	Typical	Max	Unit
Storage temp.	-55	-	125	°C
Operating temp.	-40	-	85	°C
VDD power supply	1.9	3.3	3.6	V

### 4.2 Digital IO DC Characteristics

Table 5 Digital IO DC Characteristics (VDD=3.3V)

Symbol	Parameter	Min	Typical	Max	Unit
VIL	Low-level input voltage	-	0	0.9	V
VIH	High-level input voltage	2.0	3.3	-	V
VOL	Low-level output voltage	0	-	0.33	V
VOH	High-level output voltage	2.97	-	3.3	V
IOL	Low-level output current	-	8	-	mA
IOH	High-level output current	-	8	-	mA
Rpull	internal Pull up resistance	30K	50K	70K	Ω

## 5. Interfaces

### 5.1 Startup Signal Sequence

Please meet the following conditions when the power supply is powered on and off:

- ▶ The recommended active low reset time  $Trst1 \geq 50ms$
- ▶  $Trst1 \geq T_{gpio} > 0ms$
- ▶ The boot high level time is the same as the VDD power supply
- ▶  $Trst2 > 0ms$
- ▶  $T_{pd} > 0ms$



Figure 5 Power sequence diagram

### 5.2 VCC

Standard 1.9 to 3.6V power supply power ripple  $\leq 50mV$ , 3.3V recommended.

### 5.3 RESET

Support hardware reset.

### 5.4 BOOT

Pull down when firmware upgrade, pull up or NC when normal working.

### 5.5 UART

The module's UART is a standard four lines interface (RX/TX/RTS/CTS). Its baud rate can be selected via UART AT command.

Support hardware flow control.

Support speed of up to 4Mbit/s.

Uart0 can be served by the DMA controller.

## 5.6 I2C

I2C interface supports standard mode (100kbit/s) and fast mode (400kbit/s). The I2C work as either master or slave mode.

## 5.7 GPIO

Floating level on input signals will cause unstable device operation and abnormal current consumption. Pull-up or Pull-down resistors should be used appropriately for input or bidirectional pins.

## 5.8 USB

Support USB 2.0 full speed mode.

# 6. RF Specifications

## 6.1 RF Characteristics

Table 6 RF Characteristics

Parameter	Conditions	Min	Typical	Max	Unit
Frequency Range	-	2400	-	2484	MHZ
RX Sensitivity@1Mbps BLE	PER=30.8%	-70	-94	-	dBm
RX Sensitivity@1Mbps BT	BER=0.1%	-70	-91.5	-	dBm
RX Sensitivity@ EDR 2Mbps	BER=0.01%	-70	-92	-	dBm
RX Sensitivity@ EDR 3Mbps	BER=0.01%	-70	-85	-	dBm
Transmit Output Power	BR(GFSK)	-30	-	6	dBm
	EDR2( $\pi/4$ -DQPSK)	-30	-	2	dBm

	EDR3(8-DPSK)	-30	-	2	dBm
	BLE	-30	0	6	dBm

## 6.2 Power Consumption

Table 7 Power Consumption(3.3V, 25°C, 6dB TX)

Operation Mode	Min	Typical	Max	Unit
Pairable/Discoverable Mode	-	2.78	-	mA
Activated stateafter connecting the device (SPP)	-	4.68	-	mA
TX(SPP)	-	5.68	-	mA
RX(SPP)	-	6.83	-	mA
Activated stateafter connecting the device (BLE)	-	5.13	-	mA
TX(BLE)	-	5.71	-	mA
RX(BLE)	-	6.8	-	mA

## 7. Module Package Information

Table 8 Package dimensions (top view)

Module	PCB Package	Mechanical Size	Process Type	Remark
BR2551e	Stamp	BR2551e, BR2551e-sc:	SMD	-
BR2551e-s	holes	Size:15mm(L)x12mm(W)x2.4mm(H) (±		

BR2551e-sc		0.2mm) With shield		
		BR2551e-s :  Size:15mm(L)x12mm(W)x1.8mm(H) (±0.2mm) NO shield		

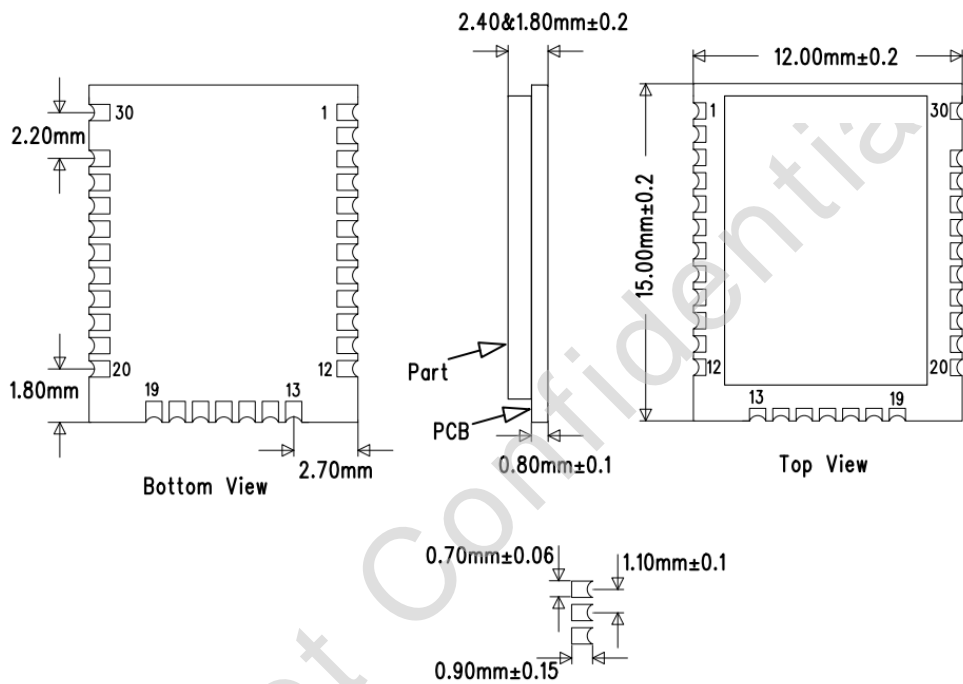


Figure 6 BR2551e (-sc) Size Information

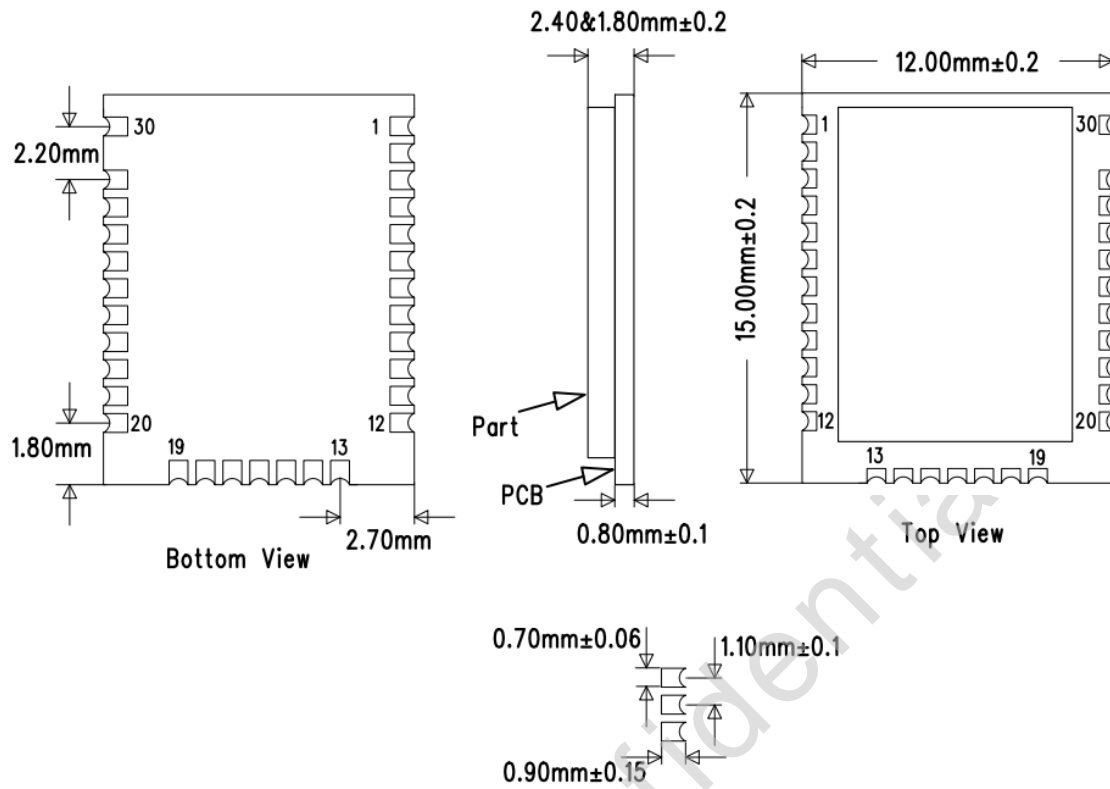


Figure 7 BR2551e-s Size Information

## 8. Layout Note

### 8.1 Layout

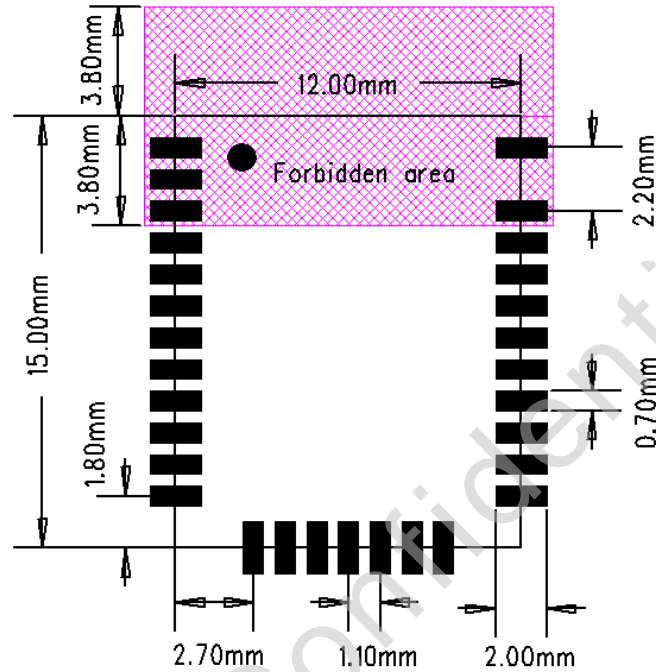


Figure 8 PCB Package Size

### 8.2 Schematic Design Notes

- ▶ The power input pin of the module needs two decoupling capacitor.

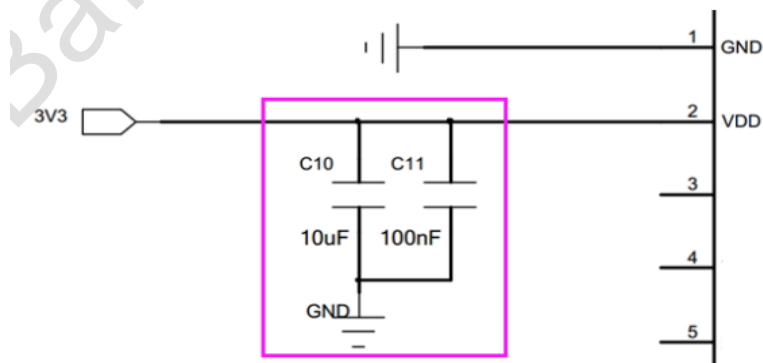


Figure 9 Bluetooth Power

- ▶ Add test points on PCB for the following net: VDD, GND, BOOT, UART\_TX, UART\_RX.

- ▶ Before the module is powered on and enters the normal working mode, the boot pin cannot be pulled down to the low level.

### 8.3 PCB Layout Design Notes

- ▶ Bluetooth Power Layout

The power filter capacitor shall be placed as close to the power pin as possible. And the trace width should be over 20mil.

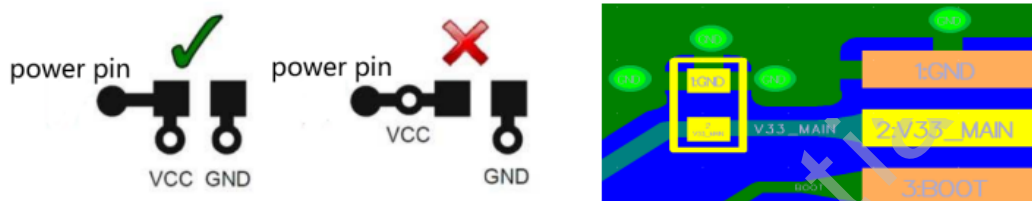


Figure 10 Bluetooth Power Layout

- ▶ The module should be placed as much as close to PCB's edge. The module internal antenna should be close to PCB's edge as much as possible. The module antenna area's all layers are copper prohibited.
- ▶ No power supply or other wiring should pass through antenna bottom.
- ▶ The antenna should be placed far away from interference (such as crystal) as much as possible.

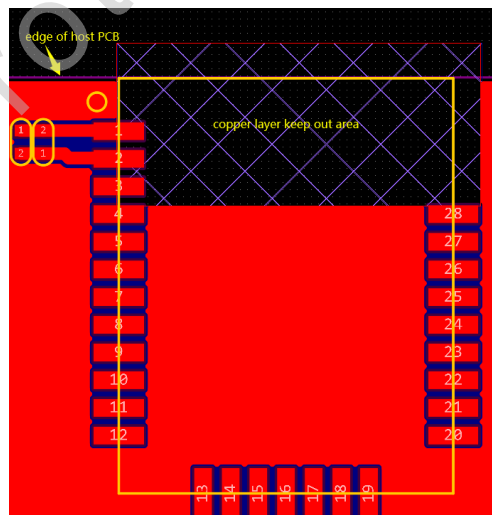


Figure 11 Internal RF Antenna Layout

### 8.4 Module Placement Examples

For a Bluetooth wireless product, the antenna placement affects the performance of the



whole system. The antenna requires free space to radiate the RF signal and it cannot be surrounded by the ground plane.

Barrot recommends that the areas underneath the antenna on the host PCB should not contain copper on top, inner, or bottom layer.

The ground plane can be extended beyond the minimum recommended as required for the main PCB EMC noise reduction. For the best range performance, keep all external metal away from the ceramic chip antenna that is minimum 15 mm away.

Figure 9 illustrates an example of good and poor antenna placement on a host PCB with ground plane.

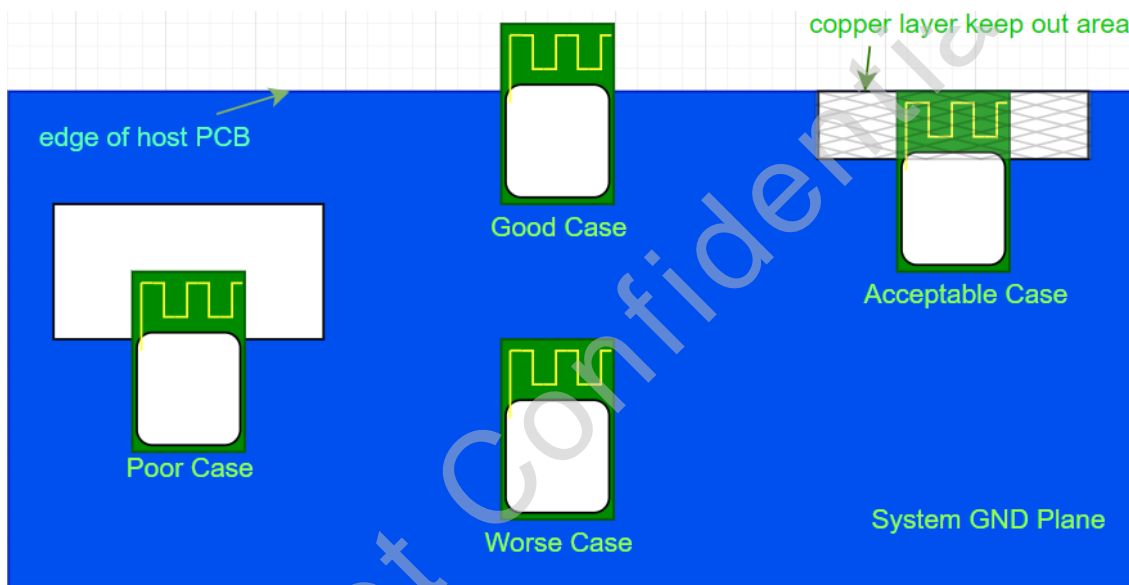
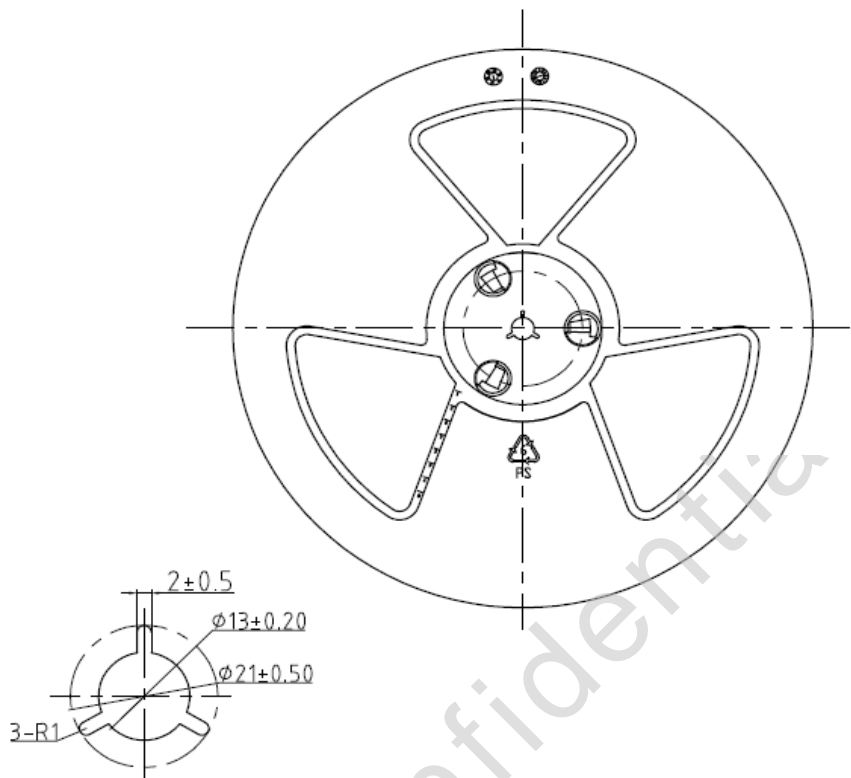


Figure 12 module placement

## 9. MOQ

### 9.1 Package

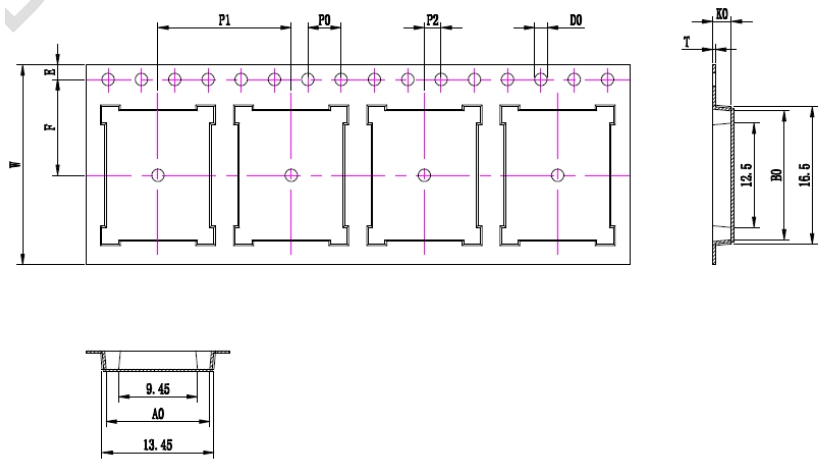
Reel package: 1500pcs/reel



MATERIAL ; PS COLOR : BLUE

Width	12mm	16mm	24mm	32mm	44mm	56mm	72mm	88mm
W1	13.5	17.5	25.5	33.5	45.5	57.5	74.0	90
W2	17.5	21.5	29.5	37.5	49.5	61.5	78.0	94

Figure 13 Reels



A0	B0	K0	P0	P1	P2
12.45±0.1	15.5±0.1	2.2±0.1	4.0±0.1	16.0±0.1	2.0±0.1
W	T	E	F	D0	D1
24.0±0.1	0.3±0.02	1.75±0.1	11.5±0.1	∅ 1.5 <sup>+0.1</sup> <sub>-0</sub>	∅ 1.5 <sup>+0.1</sup> <sub>-0</sub>

Figure 14 Taping

## 9.2 Storage Conditions

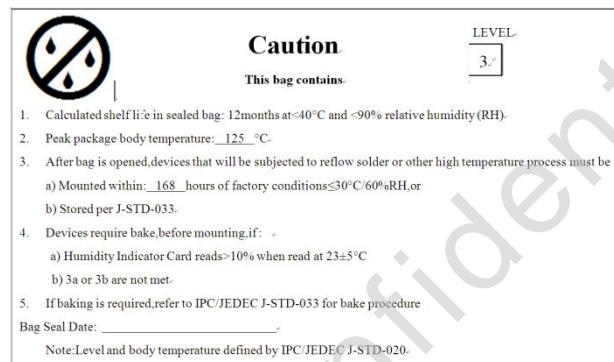


Figure 15 Storage Conditions

## 10. Package

Module net weight:

BR2551e: 0.748g±0.02g;

BR2551e-s: 0.46g±0.02g;

BR2551e-sc: 0.76g±0.02g.

## 11. Contacts



**Beijing (Headquarter)**

- ☎ : +86 10 82702580
- 📠 : +86 10 82898219
- 📍 : A1009, Block A, Jia Hua Building, No.9 Shangdisanjie St, Haidian District, Beijing

**Shanghai**

- 📍 : 2rd Floor, No. 500, Bibo Road, Zhangjiang Gaoke, Pudong New Area, Shanghai

**Shenzhen**

- ☎ : +86 755 27885822-603
- 📍 : Floor 5, building 1, COFCO business park, district 67, Xingdong community, Xin'an street, Bao'an District, Shenzhen City, Guangdong Province
- ✉ : [marketing@barrot.com.cn](mailto:marketing@barrot.com.cn)
- 📠 : [support@barrot.com.cn](mailto:support@barrot.com.cn)
- 🌐 : [www.barrot.com.cn](http://www.barrot.com.cn)

## 12. Company Profile

Barrot Technology Co.,Ltd. is a worldwide leading provider of wireless connectivity modules and one-stop solutions for Automotive, IoT and Audio markets. As Bluetooth core specification contributor and with multiple dimensional abilities of wireless stack

(Linux\Android), audio codec, algorithms, chipset and hardware design, Barrot is committed to the development of Automotive ecosystem and wireless technologies. Barrot is serving world-leading Tier1 enterprises in China and abroad, and have successful stories in In-Vehicle Infotainment, RSE(Rear Seat Entertainment) system, HUD(head-up display), T-box, PaaS system, Electrical equipment, Printers, Healthcare devices, Portable devices, Smart lock, Mesh lighting, TWS, Soundbar, dongle and etc.

## 13. Copyright

© Copyright 2024 Barrot Technology Co.,Ltd. All Rights Reserved.

The Bluetooth trademark is owned by The Bluetooth SIG, and the usage of this trademark is licensed to BARROT Technology Co.,Ltd .

Other trademarks included in this document are owned by their respective owners.

Barrot Confidential

## Appendix Module storage and SMT guide

### 1. Introduction

This document is used for supporting customer SMT process and modules storage management. Customers should design products according to specifications and parameters provided in this document. The company does not assume any responsibility for personal injury or property damage caused by improper operations. BARROT reserves the right to update this document before declaration.

This document describes the SMT process and welding process for BARROT module products. This document applies to all BARROT wireless modules.

### 2. Module Information

#### 2.1 Package

Package type:

- 1) LCC package, similar to IC LCC package, refer to Figure 1 below.



Figure 1 LCC package 3D view

- 2) LGA package, refer to Figure 2 below.

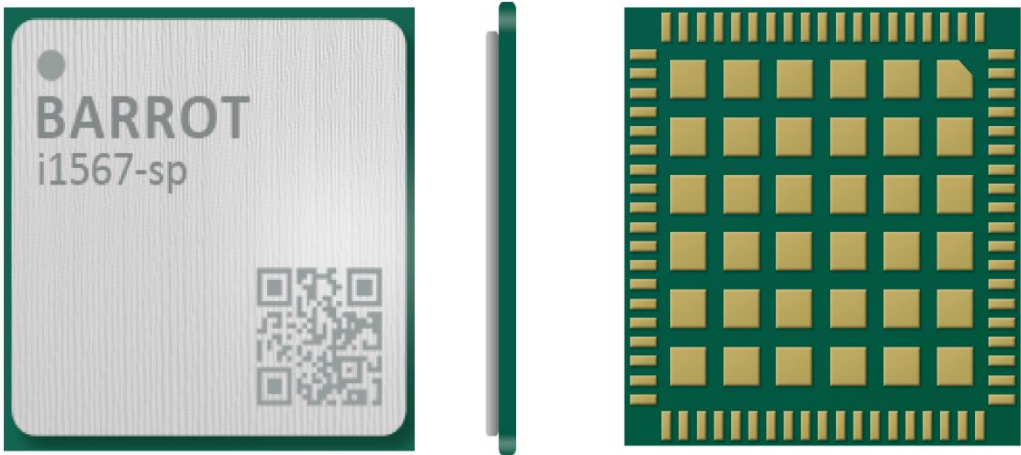




Figure 2 LGA package 3D view




2.2 Packaging Type

There are two packaging types:tape & reel and tray. The tape & reel packaging is recommended as first choice.

Table 1 . Packaging Type

Type	before sealed	After sealed (Humidity card & desiccant inside vacuum bag)
tape & reel		



tray		
		

3. Environment Requirements

3.1 Temperature and humidity

Recommended storage condition: temperature 23°C±5°C, relative humidity is 35%~60%;

Shelf life (with sealed vacuum packaging) :12 months shelf life under recommended storage conditions

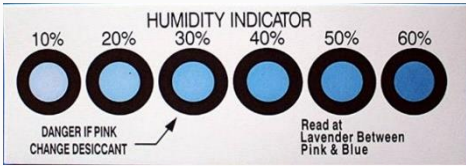
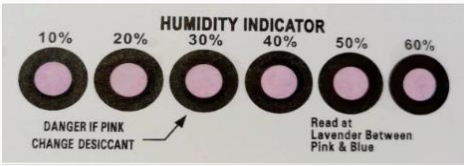
3.2MSL

The modules provided by BARROT are humidity sensitive products. According to IPC-JEDEC standard, BARROT modules are defined as MSL3 (Moisture Sensitivity Level). Before using the module, it is necessary to confirm whether the package is in good condition; After unpacking, check the humidity card status inside the vacuum bag. If humidity card turns pink, it is necessary to bake the module before use.

Table 2 Humidity card

Item	Dry	Damp
------	-----	------



Humidity card		
Note	Blue	Pink

After unpacking, modules should be surface mounted within 168 hours under conditions of temperature 22-28 °C and relative humidity <60% (RH). If the production line stops and modules are not used, modules should be stored in the drying oven in time, or re-vacuumed for storage; If the above conditions are not met, the module needs to be baked.

Table 3 Baking reference conditions for mounted or unmounted SMD packages

Baked under 125°C		Baked under 90°C, ≤5%RH		Baked under 40°C, ≤5%RH	
Beyond shop life >72hours	Beyond shop life ≤72 hours	Beyond shop life >72 hours	Beyond shop life ≤72 hours	Beyond shop life >72 hours	Beyond shop life ≤72 hours
9 hours	7 hours	33 hours	23 hours	13 hours	9 hours

Note:

1. User baking: After baked, the shop life starts, time = 0.
2. Carry, storage and SMT process must follow IPC/JEDECJ-STD-033 standard.

## 4. SMT

### 4.1 Equipment Requirements

Setup feeder: Modules are packed with either tape & reel or ESD trays. The SMT cable body should support reels and trays.

### 4.2 Reflow Equipment Requirements

LCC modules is recommended to use 7 or above temperature zones reflow oven.

LGA modules is recommended to use 10 or above temperature zones reflow oven.

## 5. Module PCB Design Instruction

### 5.1 PCB pad surface treatment

It suggests to use either ENIG (Chemistry Ni/Au) or OSP. ENIG (Chemistry Ni/Au) is recommended as the first choice.

### 5.2 PCB pad design

In order to ensure high production efficiency and high reliability of solder joints, it should follow the recommended PCB solder pad Size design in the corresponding product specification.

Even if only use parts of module PINs, PCB layout is recommended to do full pad design or symmetrical pad design. If using asymmetric pad design (refer to Figure 3 below), after the solder paste on the pad melts during reflow, the module is pulled with unbalanced force, the module deflects under the action of torque. It eventually forms a short circuit between PINs.

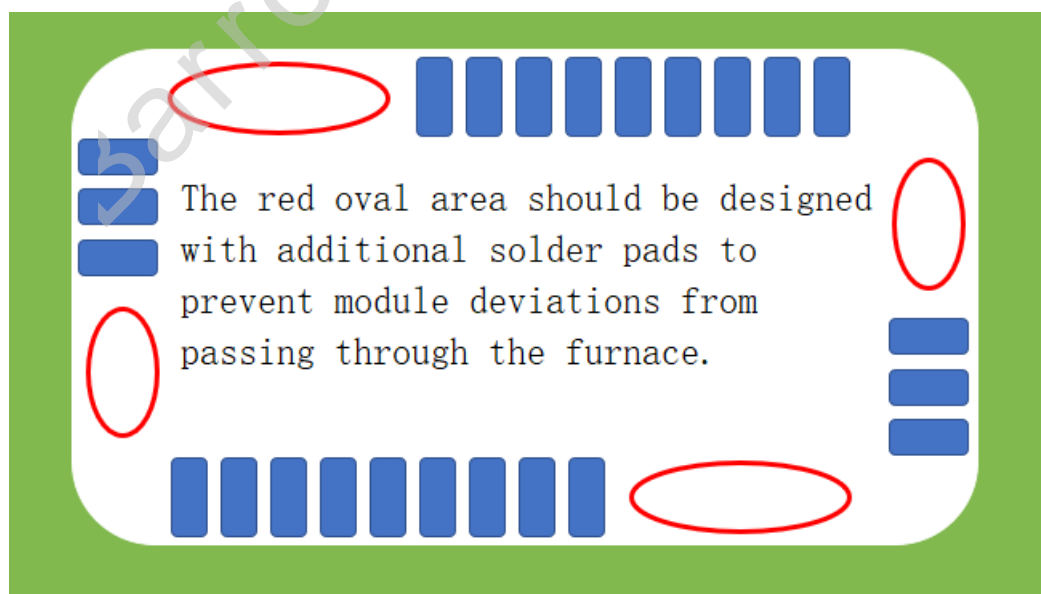


Figure 3 Asymmetric pad design

## 5.3 Layout Requirements

1. Module secondary reflow is now allowed. If case of special needs, it should inform BARROT in advance to avoid risks.
2. When designing PCB, the back of module should not be mounted with components in order to operate module back heating maintenance.
3. It should not have printing ink in the bottom area of the module to avoid height gap that affects the welding effect.
4. It should not mount components within the 1mm area at the very edge of the module pad. Other components should be as far away from the module body as possible. The minimum distance between the very edge of the module pad with PCB edge is 1.5mm.
5. The module should be mounted close to the edge of base PCB board in order to RF layout and reduce interference. It can also reduce the SMT impact of thermal deformation of base PCB board on module welding.

## 5.4 Compatibility Design

It is recommended that it should not make any pad design to be compatible with other components in the module SMT area ( the red box shown in Figure 4) in order to prevent unforeseen risks.

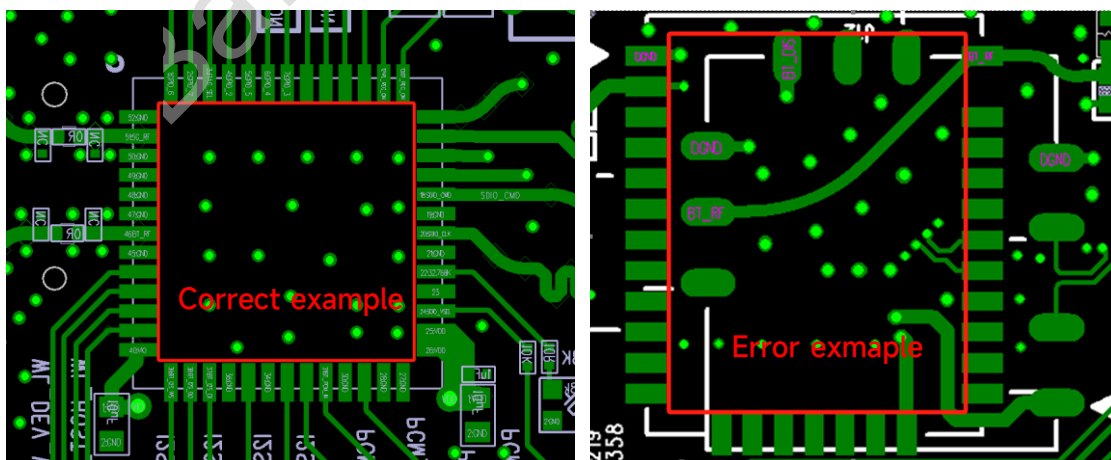


Figure 4 Module SMT Area

## 6. SMT Notes

### 6.1 Lead-free Module

All BARROT modules are lead-free modules. Customers are requested to use lead-free process for secondary SMT to avoid reducing module SMT reliability due to lead process.

### 6.2 Stencil Design

It is recommended to use stepped stencils. Opening requirements is shown below:

1) Module PIN area is recommended to use thickened stencils. For modules with different pitches (center distance), the recommended stencil thickness is summarized in Table 4. The thickened position should be at least 1mm apart from other components.

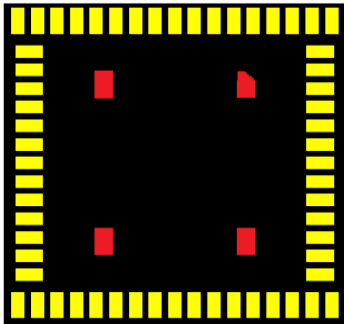
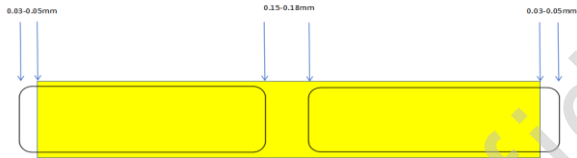
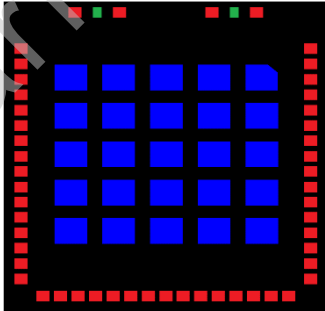
Table 4 Stepped stencil recommended Size

No.	Module Pitch	Stencil thickness	Note
1	0.5mm~0.9mm	0.13mm~0.15mm	If there is precision IC pad around the module, it is not recommended to exceed 0.15mm step thickness, and the square of the epitaxial stencils can be used to increase the solder paste amount.
2	1.0mm~1.5mm	0.18mm~0.20mm	

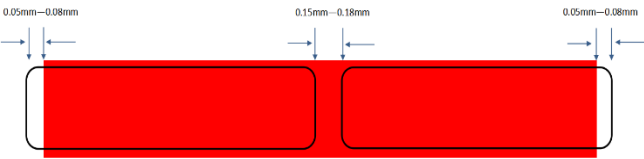
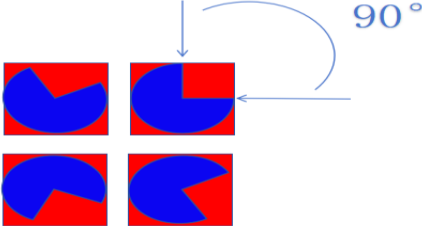
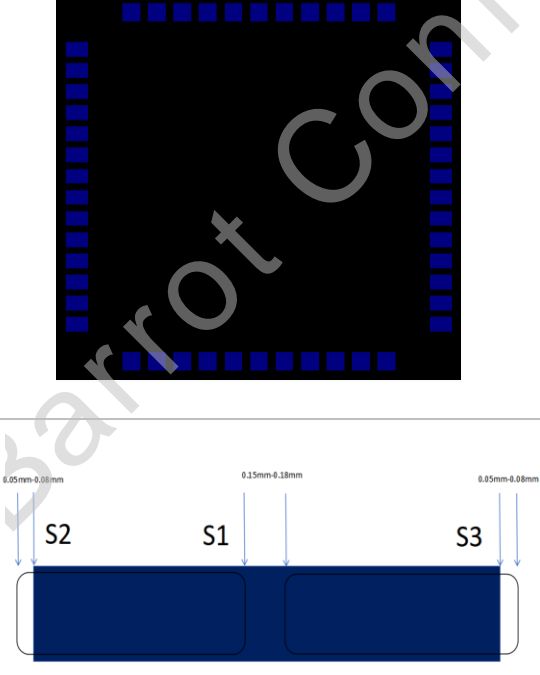
2) In real SMT process, the opening Size of stencil refers to Table 5 below:

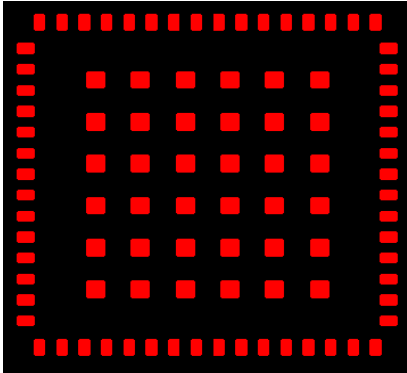
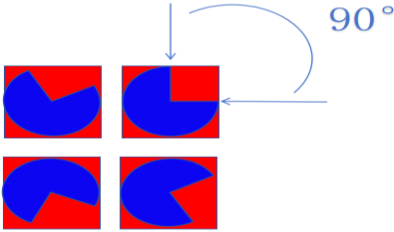
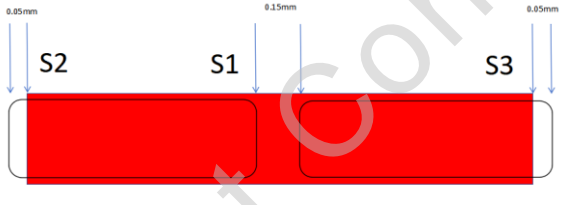
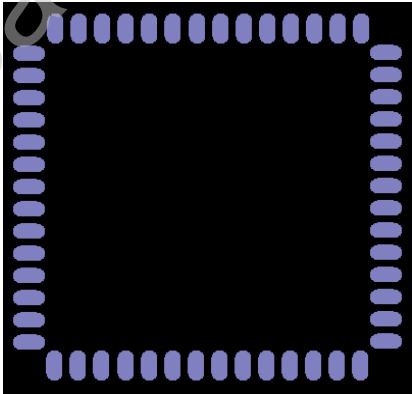
Table 6 Stencil design example

Module P/N	Example	Opening descriptions
------------	---------	----------------------


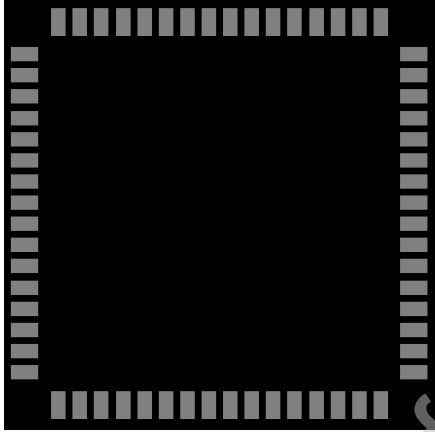
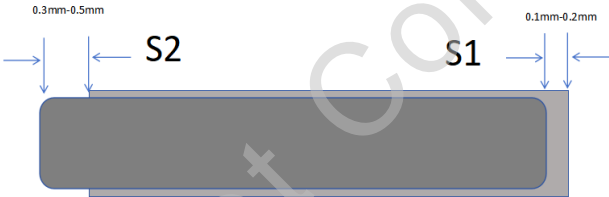
<div> i1552-s i1572-s i1571-s </div>	<div>   <div>PIN opening example</div> </div>	<div> 1.The recommended thickness of module stencils:0.13mm-0.15mm  2. Stencils PIN opening. The yellow part of the PIN is divided by a bridge in the middle of 0.15-0.18mm (S1), and the length of PIN extends both inside and outside with 0.03-0.05mm(S2,S3). (Refer to the PIN opening example below)  3. PIN width opening with 1:0.95, round off.  4. The ground part of the red PAD, according to a single PAD retraction center pad area 60%. (If no ground in base board, on need for opening) </div>
<div> i1570-sp i1465-sp </div>	<div>  </div>	<div> 1.The recommended thickness of module stencils: 0.18-0.20mm  2. The red pin opening is sector with diameter of 0.8mm. All sectors bridging angle should be 70°. The directions of all sector openings should be different. </div>

	<div data-bbox="411 600 960 855" data-label="Image"> <p>The image contains two diagrams. The left diagram, labeled 'PIN opening example', shows three yellow rectangular openings with red curved edges, with a 70° angle indicated. The right diagram, labeled 'Ground opening example', shows four blue square openings with red curved edges, with a 90° angle indicated.</p> </div>	<p>There is no fixed angle requirement, but the directions cannot be the same (as shown in the figure below).</p> <p>3. The green part of the pin is indented at 1:0.9, with a center opening.</p> <p>4. Blue PIN ground opening is sector with diameter of 2.0mm. All sectors bridging angle should be 90°. The directions of all sector openings should be different. There is no fixed angle requirement, but the directions cannot be the same (as shown in the figure below).</p>
i1568-sp i1569-sp i1495-sp i1496-sp i1890-sp	<div data-bbox="438 1305 833 1686" data-label="Image"> <p>The image shows a square grid pattern. The grid is composed of blue squares, with red squares forming the outer border and internal crosshairs. The grid is set against a black background.</p> </div>	<p>1. The recommended thickness of module stencils:0.18-0.20mm</p> <p>2. Red PIN middle bridging 0.15-0.18mm (S1), length extends outwards and inwards 0.05-0.08mm (S2, S3) (as shown in the figure below) .</p>

	 <p>PIN opening example</p>  <p>Ground opening example</p>	<p>3. PIN opening width ratio 1: 0.95, round off.</p> <p>4. Blue PIN ground opening is sector with diameter of 2.0mm. All sectors bridging angle should be 90°. The directions of all sector openings should be different. There is no fixed angle requirement, but the directions cannot be the same (as shown in the figure below).</p>
i1852-sp	 <p>PIN opening example</p>	<p>1. The recommended thickness of module stencils: 0.13mm-0.15mm</p> <p>2. PIN opening width ratio 1: 0.95, round off.</p> <p>3. Red PIN middle bridging 0.15-0.18mm (S1), length extends outwards and inwards 0.05-0.08mm (S2, S3) (as shown in the figure below) .</p>

i1495-spu1		<div> 1. The recommended thickness of module stencils:0.18-0.20mm 2. PIN middle bridging 0.15mm (S1), length extends outwards and inwards 0.05mm (S2, S3) (as shown in the figure below) . </div>
	<div>  <div>Ground opening example</div> </div>	<div> 3.PIN width 0.48mm, round off。 </div>
	<div>  <div>PIN opening example</div> </div>	<div> 4. PIN ground opening is sector with diameter of 1.0mm. The directions of all sector openings should be different. There is no fixed angle requirement, but the directions cannot be the same (as shown in the figure below). </div>
i1421-si i1410-si		<div> 1. The recommended thickness of module stencils:0.18-0.20mm 2. Regarding PINs, length internally tangent 0.1mm-0.3mm (S1) extend outwards 0.3mm-0.5mm (S2), length ratio 1: 0.90. all PINs round </div>



	 <p>PIN opening example</p>	off.
i1433-sp	 	<p>1. The recommended thickness of module stencils:0.18-0.20mm</p> <p>2.Regarding PINs, length internally tangent 0.1mm-0.3mm (S1) extend outwards 0.3mm-0.5mm (S2), length ratio 1: 0.90. all PINs round off.</p>

**Note:**

1. The modules in above list may have multiple hardware versions, please take module datasheet for reference.

2.Regarding to components within 1.0mm around the locally thickened area, the amount of tin increases due to stencil thickness when printing, so they should be carefully inspected during SMT processes. When it is necessary to make partially thickened stencil for the module, if there are 0201 fine components or 0.40mm and 0.50mm pin pitch ICs and components close to the module, the distance between the thicken area and those components should be kept at least 0.5mm, or in the different position parallel to module printing, in order to avoid the thickness of the solder paste for scraper printing resulting in short circuit of the nearby component pins.

3. The above suggestions are for reference only, and customers can optimize

according to the actual situation.

## 6.3 Feeding Notes

Single module SMT: For single module products that are unpacked and baked at high temperature, it is recommended to use special trays for SMT.

Module with tape & reel SMT: When feeding, it is necessary to set the feeding space on the feeder according to the actual modules.

## 6.4 Automatic SMT

Select the appropriate nozzle according to module Size.

Set the appropriate speed of the SMT machine in order to prevent instability when moving. Generally, the speed is set to medium.

After SMT, it should confirm that the each PIN of the module aligns with the solder paste center. The identifier of module first PIN corresponds to PCB marking identifier.

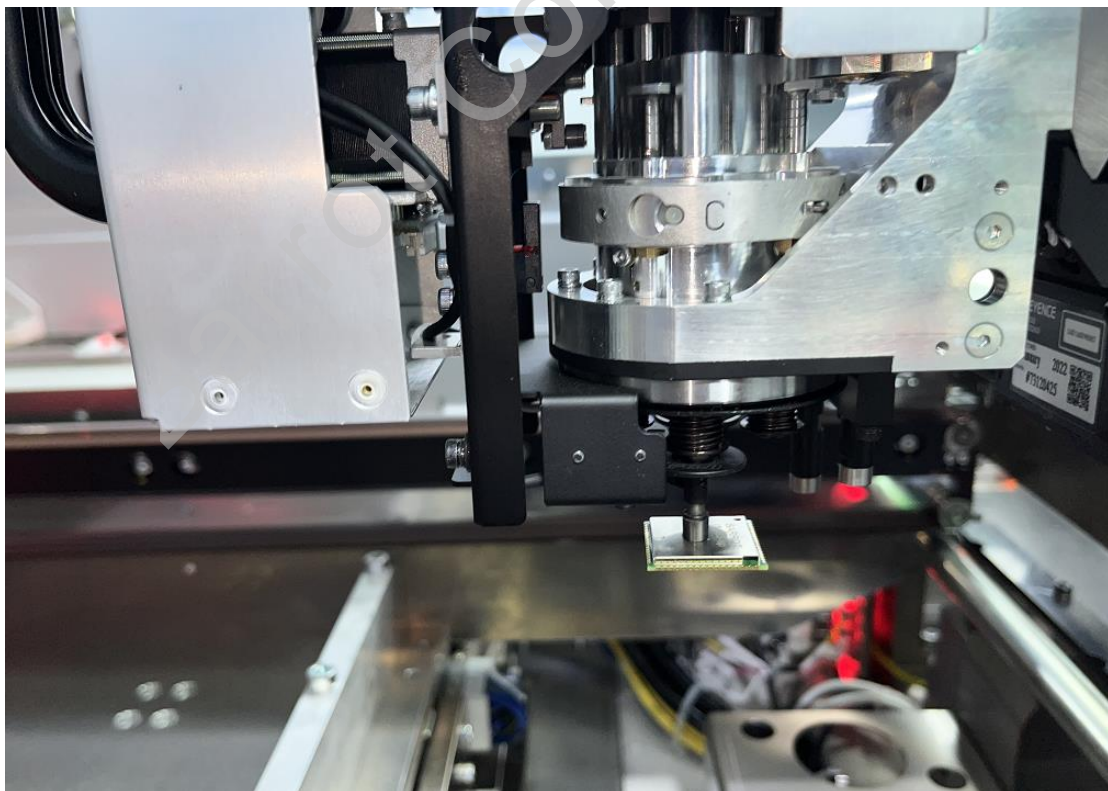


Figure 5 SMT



Figure 6 PIN1 identifier

## 6.5 Reflow Curve

It is recommended to use solid plate test for furnace temperature curve. When making furnace temperature plate, it is recommended to connect thermocouple temperature test points at the welding pad and pin at the bottom of the module to ensure that the pin of the module can reach the required welding temperature. The actual furnace temperature curve suggested by the production module is shown in Figure 7 below

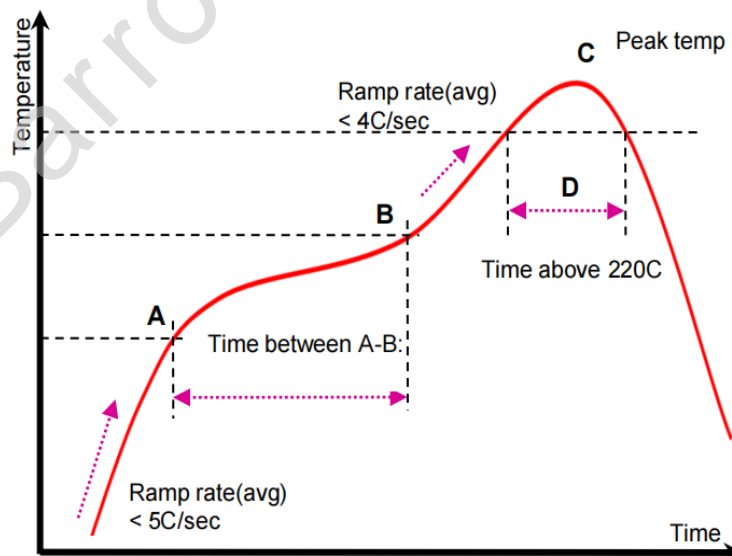


Figure 7 Reflow Curve Example

Table 6: Reflow Parameters

No.	Recommended Parameters
Pre-heating zone	Warming slope: 1~4°C/s
Constant temperature zone	Time between A and B (150~200°C) : 60~120s
Reflow zone	Reflow time (D:217°C above time) : 30~90s
	Maximum temperature: 240~250°C
Cooling zone	Cooling slope: -1.5~-4°C/s
Allowable reflow number	One time

Oven temperature:

The actual welding temperature is affected by other external factors, such as oven carriers, solder paste, the Size and thickness of the base board, the heat resistance requirements of components and PCBA design.

## 6.6 Reflow Welding

When the PCBA mounted on the module enters oven, it should strictly pass PCBA through the oven by rail. It strictly forbids pass through by the net cover of reflow oven. Because modules have BGA components, the jitter of the net cover may lead to a high ratio of BGA tin balls.

When customers conduct secondary SMT, if it is a double-Size board, it should not take the side on which the module mounts as the first side for production. It suggests to mount module when producing the second side. Note:If BGA components should face down, during secondary reflow, BGA solder joints stretch due to gravity. It may lead to weak solder joints. The solder joint may break under the influence of external forces or leading to other unknown dangers.

When designing reflow welding process (such as making fig), it should avoid interference design that causes any device deviation on the module

#### Oven carrier:

For motherboards which thickness is less than 1.0mm, it is necessary to use a high Tg value PCB board or add a furnace passed carrier to support the motherboard to prevent deformation.

## 6.7 Wave soldering of PCBA after SMT

For PCBA mounted with modules, if wave welding is required by the process, please give special protection to the module to prevent short circuit of components mounted on the module or other unpredictable hidden dangers caused by abnormal tin splashing during wave welding.

It is not recommended to conduct wave soldering on PCBA mounted with modules. Please consider manual welding of modules after wave soldering.

## 6.8 Other components manual welding after module SMT

After SMT, if it needs to mount other components to the PCBA by manual welding, such as welding cables, protect the module by shielding or covering it when manual welding, especially when the manual welding part is close to the module.

Before and after manual welding, PCBA should be placed at the upper part of the manual welding operation stand, or quickly pass to the next station stand for processing. PCBA should not be placed under the welding operation stand.

# 7. Repair Instructions

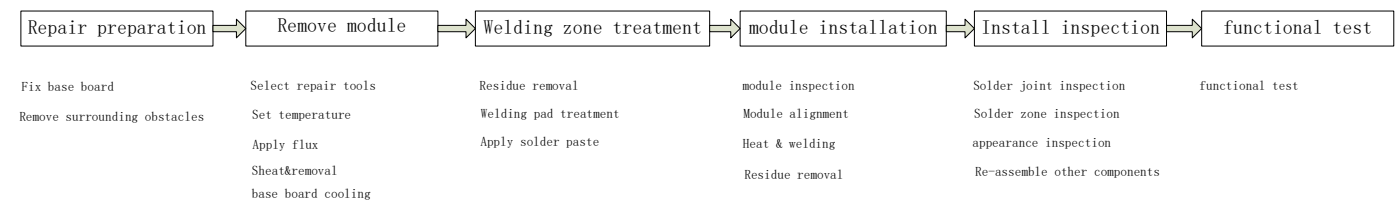
## 7.1 Repair Notes

The repair process depends on repair site. The recommended repair method is not the only method. The method can be selected according to the actual hardware conditions. The method must meet the basic process requirements of repairing.

It should inspect BGA welding status by X-ray before repairing. The X-ray image should be saved in order to avoid secondary defects, such as chip tinning or component displacement, that is caused by improper secondary heating temperature or methods after desoldering.

After-sale immediately stops if the internal components of the module body are disassembled.

## 7.2Repair Process



## 7.3Preparation

The base PCB board needs to be fixed.

Remove components and obstacles that cannot withstand high temperatures around the module.

If the repair module exceeds the storage period, it must be repaired after baking according to Table 1 in order to prevent PCB damage caused by welding due to moisture.

## 7.4Module Remove

Repair tool selection:If the number of repair module pads and the module Size is too large. The ordinary soldering iron is difficult to meet the repair requirements. Therefore, it needs to use a hot air gun (large outlet) or infrared repair stand.

Temperature setting:Set the heat gun temperature to around 320 ° C to 350 ° C. Adjusting the wind speed and distance according to the actual situation.

Heat removal:The module is heated quickly and evenly by heating. To achieve simultaneous melting of all solder joints, and then remove the module.

Table 7 Repair Tools

Repair Stand	Heat Air Gun
--------------	--------------



## 7.5 Welding Area Treatment

Remove residues: Use the soldering iron and wire to remove existing solder and keep the pad surface flat.

Pad treatment: Clean pad and remove flux residues.

Solder paste application: It is recommended to make fixtures and tin printing small stencil for repairing and printing solder paste.

## 7.6 Module Installation

Module inspection: Check whether or not the module appearance is in good condition and it is working normally.

Module alignment: When installing the module, ensure that the module is correctly oriented.

Heat welding: The module is heated quickly and evenly by heating in order to achieve the simultaneous melting of all solder joints and form better IMC.

Remove residues: Clean pad and remove flux residues.

## 7.7 Install inspection

Welding inspection: welding spot inspection, welding area inspection, appearance inspection.

Reinstall other components: Restore the peripheral components that are removed before.

## 7.8 Function Test

After SMT completes, it should conduct functional tests.

## Appendix A:List of Abbreviations

缩写	英文全称	中文全称
BGA	Ball Grid Array	球状栅格阵列
LCC	Leadless Chip Carriers	无引脚芯片封装
LGA	Land Grid Array	栅格阵列封装
MSL	Moisture Sensitivity Level	湿敏等级
PCB	Printed Circuit Board	印刷电路板
SMD	Surface Mount Device	表面贴装器件
SMT	Surface Mount Technology	表面贴装技术
Tg	Glass Transition Temperature	玻璃化温度



## Appendix 2 Order Information

### Version History

Revision <sup>2</sup>	Amendment	Date	Author
X.Y.1	Initial version	2024-11-4	Lisa

Table 2-1 Order Information

Order number(MPN)	Description
BR2551e-v12-BARROTV1.0	<p>HW Version: V1.2</p> <p>RF Configuration: Ceramic Antenna</p> <p>Shielding cover: Yes</p>
BR2551e-s-v12-BARROTV1.0	<p>HW Version: V1.2</p> <p>RF Configuration: External Antenna</p> <p>Shielding cover: No</p>
BR2551e-sc-v12-BARROTV1.0	<p>HW Version: V1.2</p> <p>RF Configuration: Ceramic Antenna</p> <p>Shielding cover: Yes</p>

BR2551e	v12	-BARROTV1.0	BR2551e-s	v12	-BARROTV1.0	BR2551e-sc	v12	-BARROTV1.0
Main Model of Module	Hardware Version	The name of software copyright	Main Model of Module	Hardware Version	The name of software copyright	Main Model of Module	Hardware Version	The name of software copyright

Table 2-2 software copyright

Company name	Full name of software copyright	Abbreviation of software copyright
--------------	---------------------------------	------------------------------------

Barrot Technology Co.,Ltd.	BARROT 软件 V1.0	BARROTV1.0
SHENZHEN BARROT TECHNOLOGY LIMITED	BARROT 通信系统 V1.0	BARROTV1.0
CHONGQING BARROT TECHNOLOGY LIMITED	BARROT 无线系统 V1.0	BARROTV1.0

Barrot Confidential