



RSBRS02AA/I

Bluetooth 5.0 Low Energy Module

Version 1.1

Shenzhen RF-star Technology Co., Ltd.

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1 Device Overview

1.1 Description

RSBRS02AA/I is a compact size, cost-effective single-mode Bluetooth low energy module based on RF-star 256 KB flash SoC RS02A1-A chip with super low power consumption, good noise reduction, better sensitivity, robust transmission distance, and high reliability. The module integrates a 16 MHz crystal, an RF matching filter, a power filter, and a meander line inverted-F PCB antenna (RSBRS02AA) or an IPEX connector (RSBRS02AI). It supports BLE stack v5.0 and is preprogrammed with an easy-to-integrate serial interface communication protocol.

1.2 Key Features

- RF Features
 - Bluetooth 5.0 low energy, support 2 Mbps data rate
- Frequency: 2402 MHz ~ 2480.0 MHz
- TX power: -20.0 dBm ~ +7.0 dBm
- Receiving Sensitivity: -95 dBm @ 1 Mbps
- CPU
 - ARM Cortex-M0+ @ 48 MHz
 - Single-cycle multiplier
 - 32 interrupts
- Memory
 - ROM 64 KB
 - SRAM 32 KB
 - Flash 256 KB
- Wide Operation Range
 - Power supply range: 1.8 V ~ 3.6 V
 - Operating temperature: -40 °C to +85 °C
 - Storage temperature: -40 °C to +125 °C
- Wide Peripherals
 - 13 general purpose I/Os.
 - 2×UART with hardware flow control
 - 2×SPI with master/slave configurable
 - 2×I²C with master/slave configurable
 - I²S data in interface
 - 7816 T-0 master interface
 - Keyboard interface
 - 8-channel 10-bit ADC
 - Temperature sensor
 - 5-channel DMA
 - 32-bit timer
 - Six 16-bit general purpose timers (PWM/Infra-Red generator)
 - Real timer clock
 - Watchdog
- Transmission range:
 - RSBRS02AA: 150 m
 - RSBRS02AI: 180 m (@external PCB antenna)
- Dimension:
 - RSBRS02AA: 15.2 mm x 11.2 mm x 1.5 mm
 - RSBRS02AI: 15.2 mm x 11.2 mm x 1.7 mm
- RSBRS02AA Certificates:
 - SRRC
 - RoHS

1.3 Applications

- Smart toys
- Fitness equipment
- Environmental sensor nodes
- Passive keyless entry (PKE)
- Smart door locks
- Phone accessories

- Health-care equipment
- Smart lighting
- Energy harvesting
- Thermometer
- Human input devices
- Sports equipment
- Wearable

1.4 Functional Block Diagram

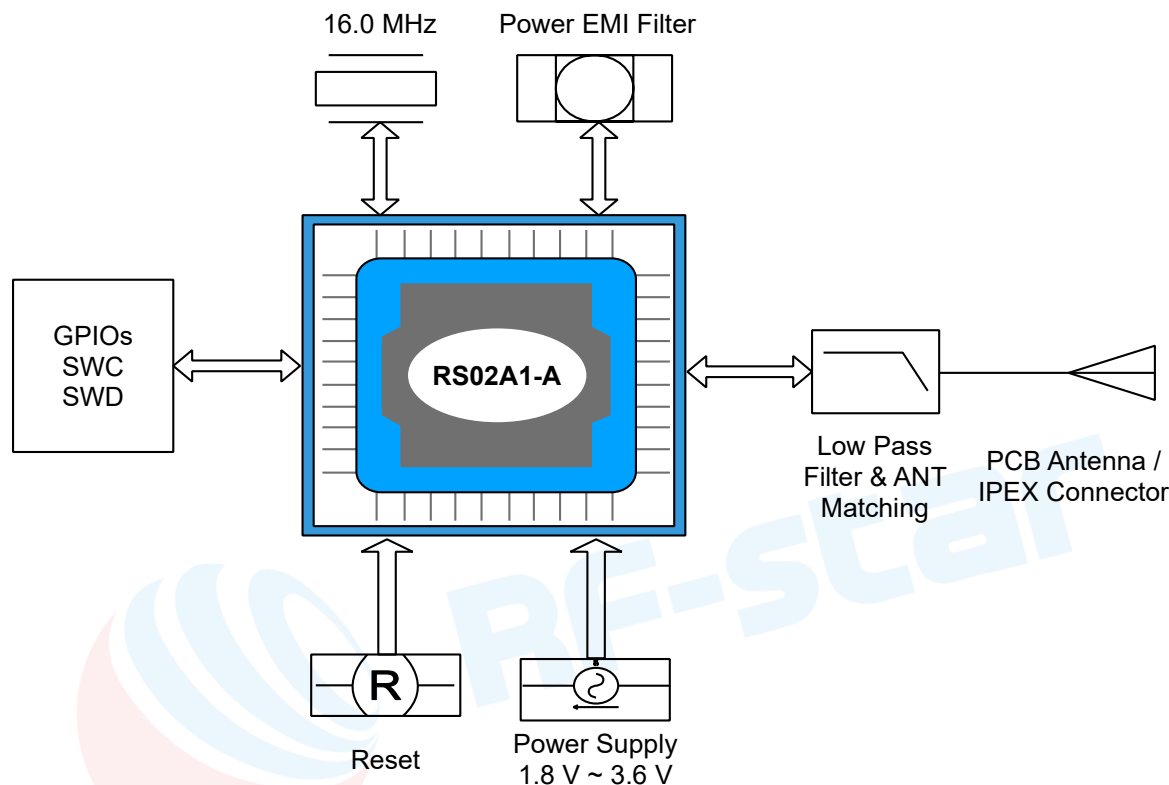


Figure 1. Functional Block Diagram of RSBRS02AA/I

1.5 Part Number Conventions

The part numbers are of the form of RSBRS02AA/I where the fields are defined as follows:

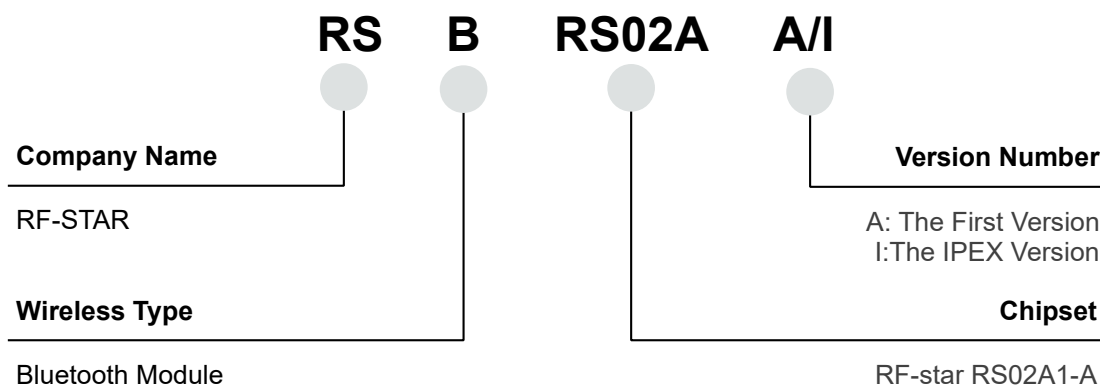


Figure 2. Part Number Conventions of RSBRS02AA/I

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2 Module Configuration and Functions

2.1 Module Parameters

Table 1. Parameters of RSBRS02AA/I

Chipset	RS02A1-A
Supply Power Voltage	1.8 V ~ 3.6 V, recommended to 3.3 V
Modulation	GFSK
Frequency	2402 MHz ~ 2480.0 MHz
Transmit Power	-20.0 dBm ~ +7.0 dBm
Receiving Sensitivity	-95 dBm @ 1 Mbps PHY
GPIO	13
Crystal	16 MHz
ROM	64 KB
SRAM	32 KB
Flash	256 KB
Package	SMT Packaging (1.27-mm half-hole pitch stamp stick)
Frequency Error	±24 kHz
Dimension	RSBRS02AA: 15.2 mm x 11.2 mm x 1.50 mm RSBRS02AI: 15.2 mm x 11.2 mm x 1.70 mm
Type of Antenna	RSBRS02AA: PCB antenna RSBRS02AI: IPEX connector
Transmission Range in Open Air	RSBRS02AA: 150 m (@ PCB antenna) RSBRS02AI: 180 m (@ external PCB antenna)
Operating Temperature	-40 °C ~ +85 °C
Storage Temperature	-40 °C ~ +125 °C

2.2 Module Pin Diagram

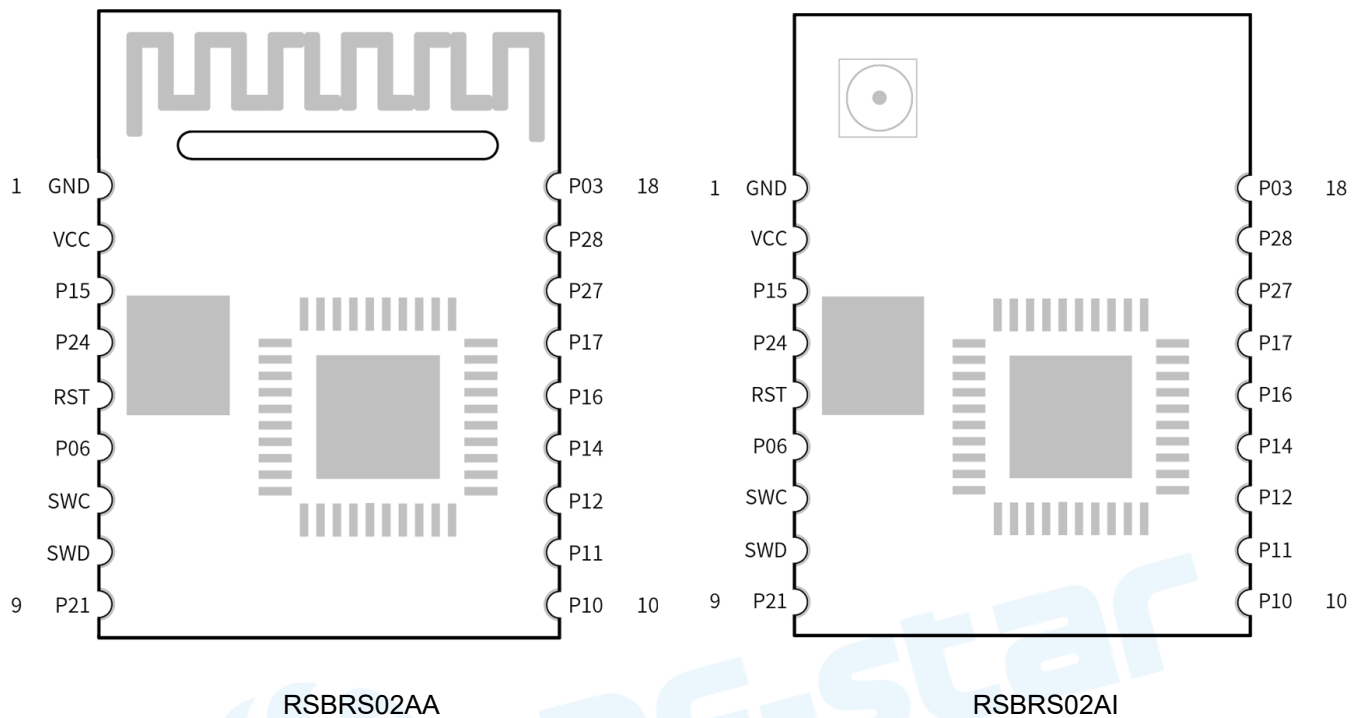


Figure 3. Pin Diagram of RSBRS02AA/I

2.3 Pin Functions

Table 2. Pin Functions of RSBRS02AA/I

Pin	Name	Chip Pin	Pin Type	Remarks
1	GND	GND	Ground	Ground
2	VCC	VCC	VCC	Power supply: 1.8 V ~ 3.6 V; Recommended to 3.3 V
3	P15	P15	I/O	
4	P24	P24	I/O	
5	RST	RST	RESET	Active low
6	P06	P06	I/O	
7	SWC	SWCLK	SWCLK	Connect J-Link SWCLK
8	SWD	SWD	SWDIO	Connect J-Link SWDIO
9	P21	P21	I/O	
10	P10	P10	I/O	
11	P11	P11	I/O	
12	P12	P12	I/O	

13	P14	P14	I/O	
14	P16	P16	I/O	
15	P17	P17	I/O	
16	P27	P27	I/O	
17	P28	P28	I/O	
18	P03	P03	I/O	



3 Specifications

3.1 Absolute Maximum Ratings

Table 3. Absolute Maximum Ratings

Identification	Condition	Min.	Typ.	Max.	Unit
Source & IO	Battery mode	1.8	3.3	3.6	V
Operating Temperature	/	-40	+25	+85	°C
Environmental Hot Pendulum	/	-20		+20	°C / Min

3.2 Handling Ratings

Table 4. Handling Ratings of RSBRS02AA/I

Items	Condition	Min.	Typ.	Max.	Unit
Storage Temperature	Tstg	-40	+25	+125	°C
Human Body Model	HBM		±2000		V
Moisture Sensitivity Level			3		
Charged Device Model			±250		V

3.3 RF Characteristics

When measured on the RSBRS02AA/I with T A = 25 °C, V BAT = 3.3 V with DC/DC, the channel of 39th (2442 MHz) enabled unless otherwise noted.

Table 5. Table of RF Test

Test Item	Parameter	Test Value	Unit
Transmitter	Power	0.42	dBm
	Frequency Deviation	2.168	kHz
Receiver	Sensitivity (8% PER)	-93.5	dBm

4 Application, Implementation, and Layout

4.1 Module Photos

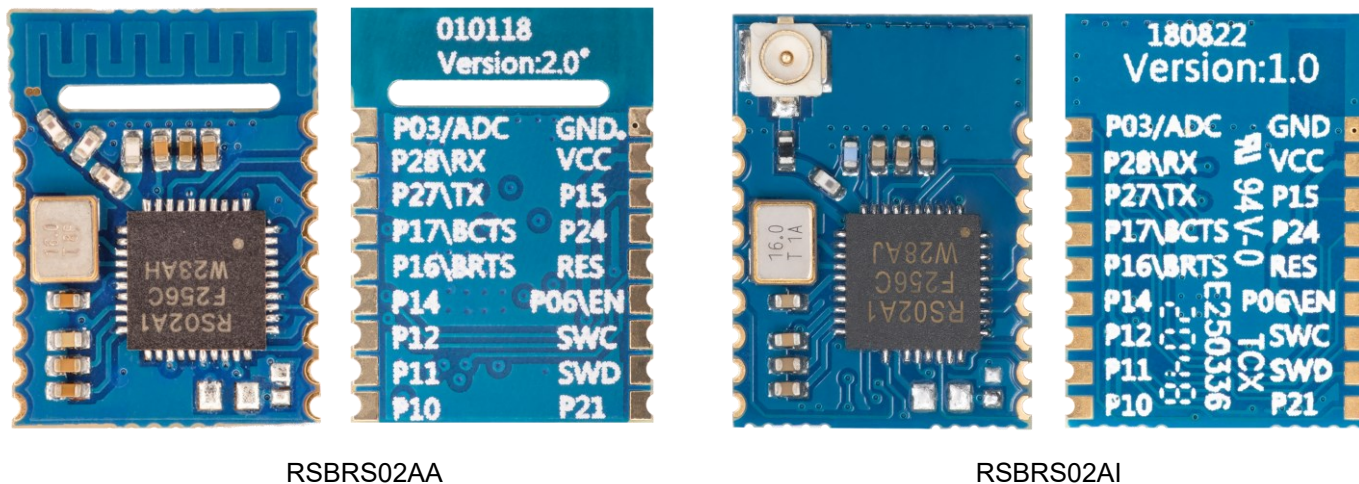
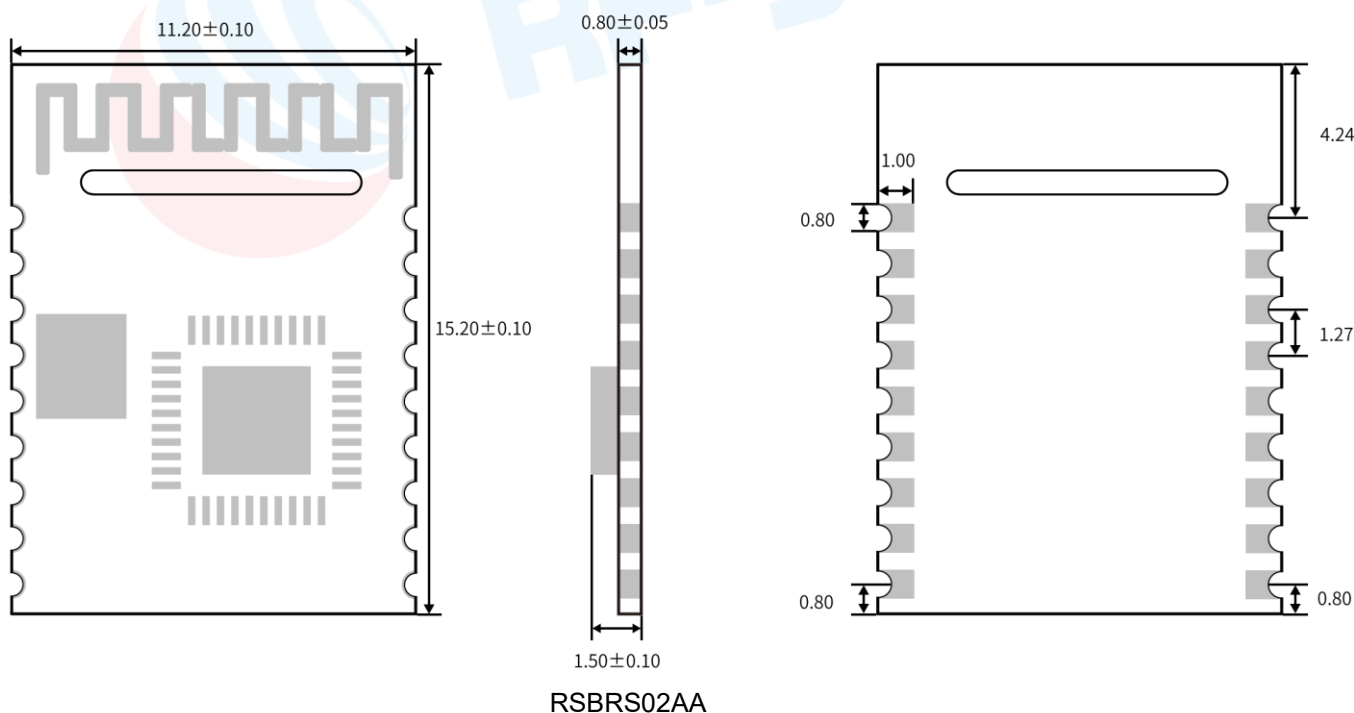


Figure 4. Photos of RSBRS02AA/I

4.2 Recommended PCB Footprint



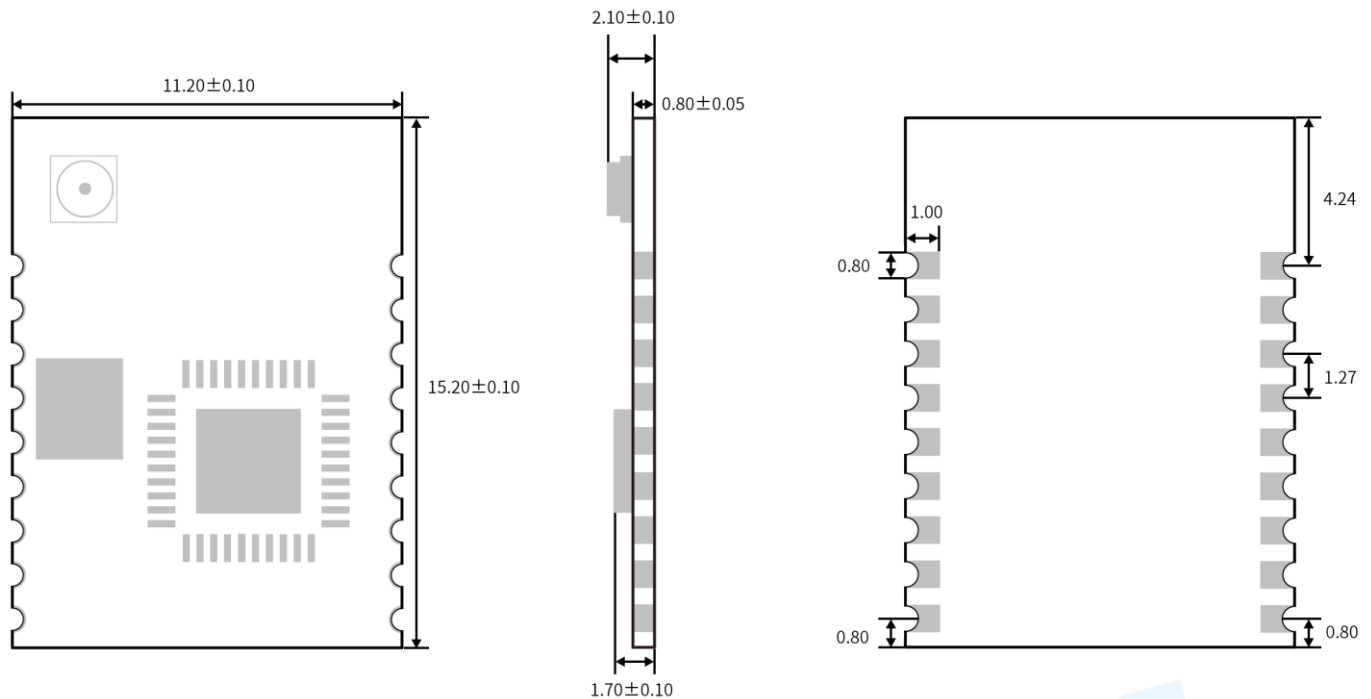
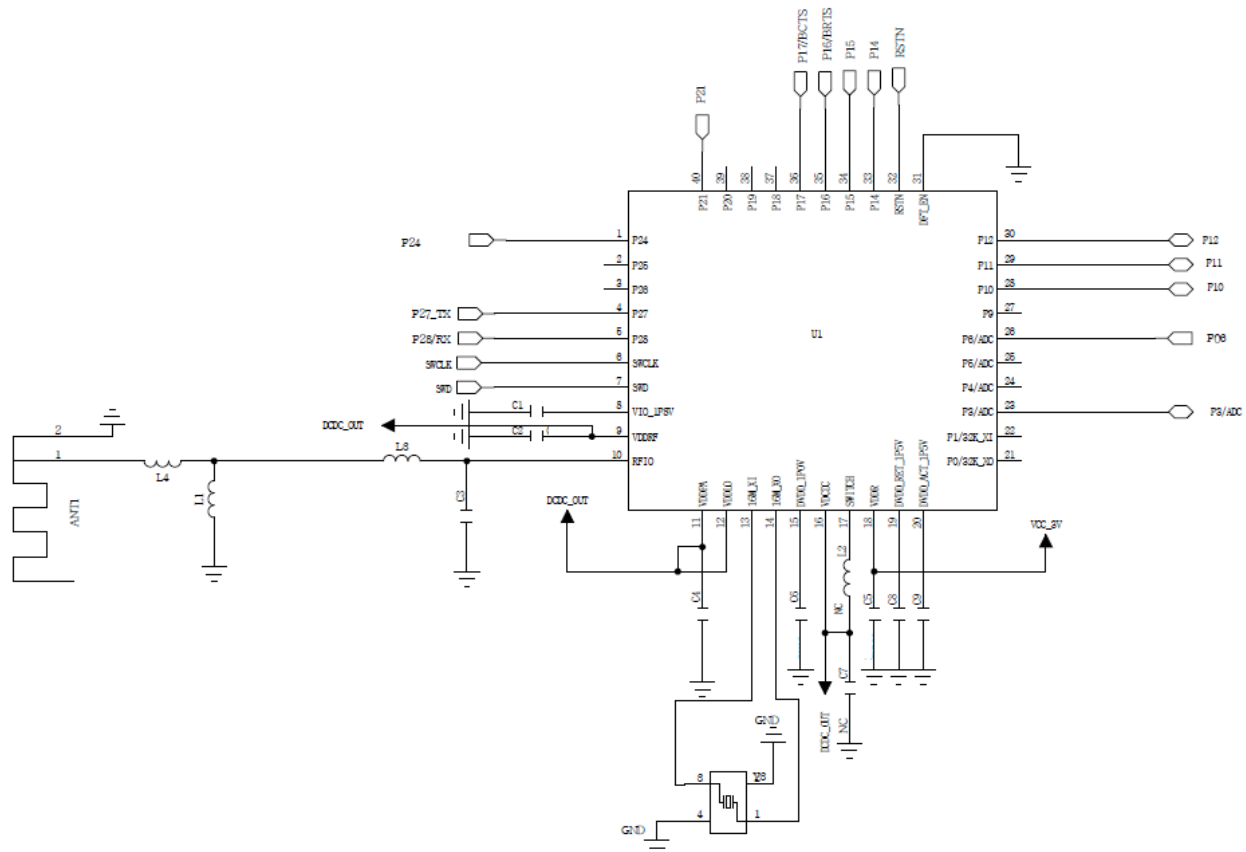

RSBRS02AI

Figure 5. Recommended PCB Footprint of RSBRS02AA/I (mm)

4.3 Schematic Diagram



4.4 Reference Design

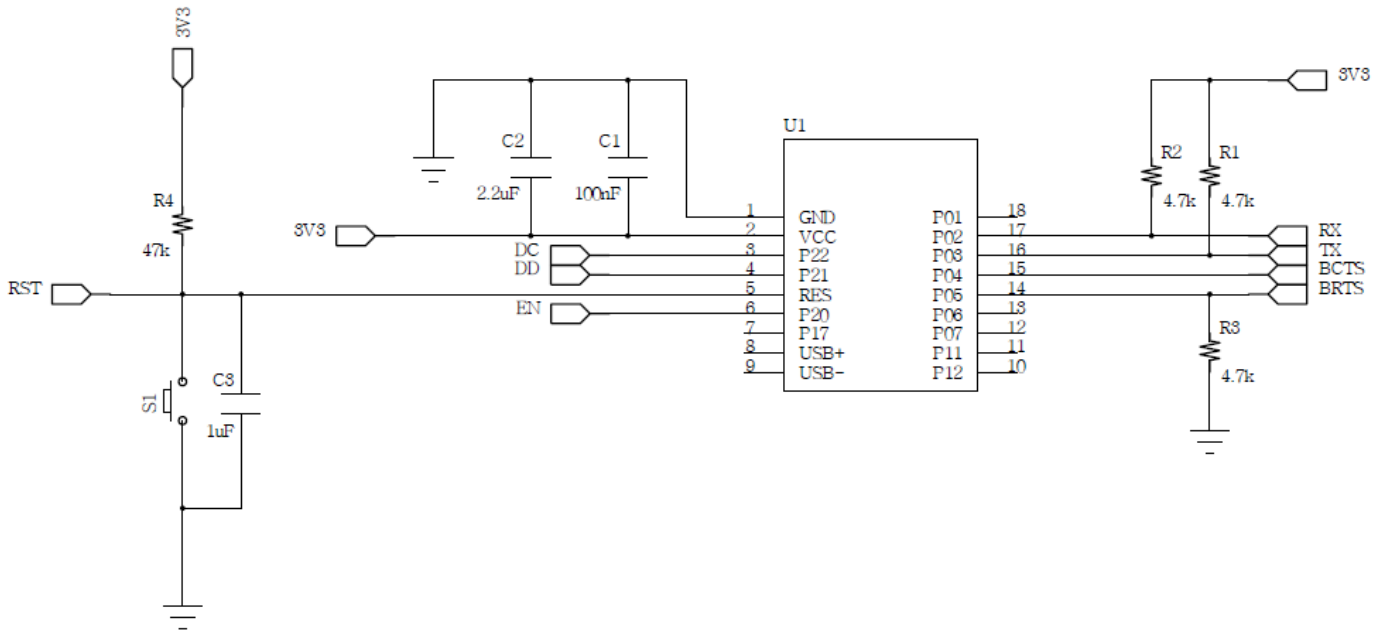


Figure 7. Reference Design of RSBRS02AA/I

4.4 Antenna

4.5.1 Antenna Design Recommendation

1. The antenna installation structure has a great influence on the module performance. It is necessary to ensure the antenna is exposed and preferably vertically upward. When the module is installed inside of the case, a high-quality antenna extension wire can be used to extend the antenna to the outside of the case.
2. The antenna must not be installed inside the metal case, which will cause the transmission distance to be greatly weakened.
3. The recommendation of antenna layout.

The inverted-F antenna position on PCB is free-space electromagnetic radiation. The location and layout of the antenna are key factors to increase the data rate and transmission range.

Therefore, the layout of the module antenna location and routing is recommended as follows:

- (1) Place the antenna on the edge (corner) of the PCB.
- (2) Make sure that there is no signal line or copper foil in each layer below the antenna.
- (3) It is best to hollow out the antenna position in the following figure to ensure that the S11 of the module is minimally affected.

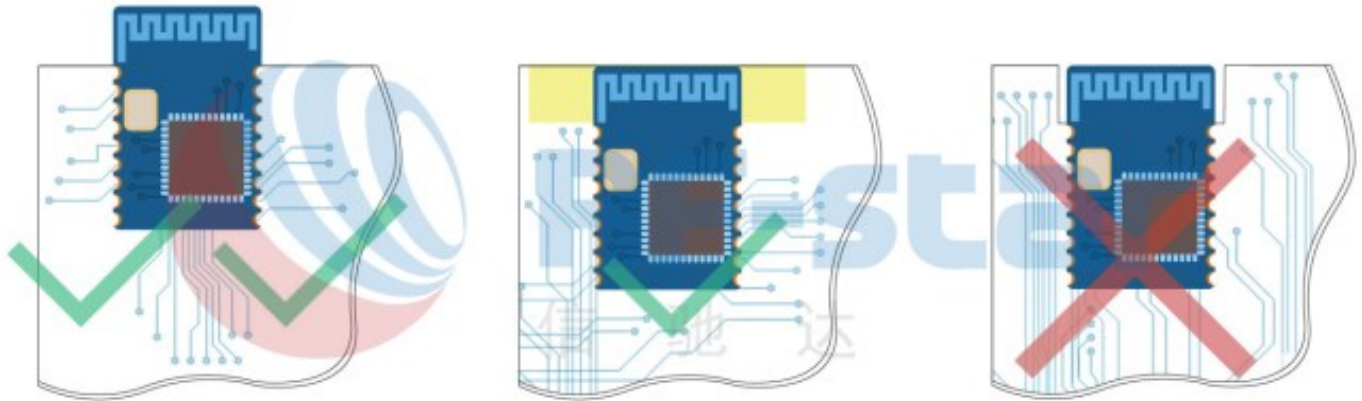


Figure 8. Recommendation of Antenna Layout

Note: The hollow-out position is based on the antenna used.

4.5.2 IPEX Connector Specification

RSBRS02AI module is integrated the IPEX version 1 antenna seat, the specification of the antenna seat is as follows:

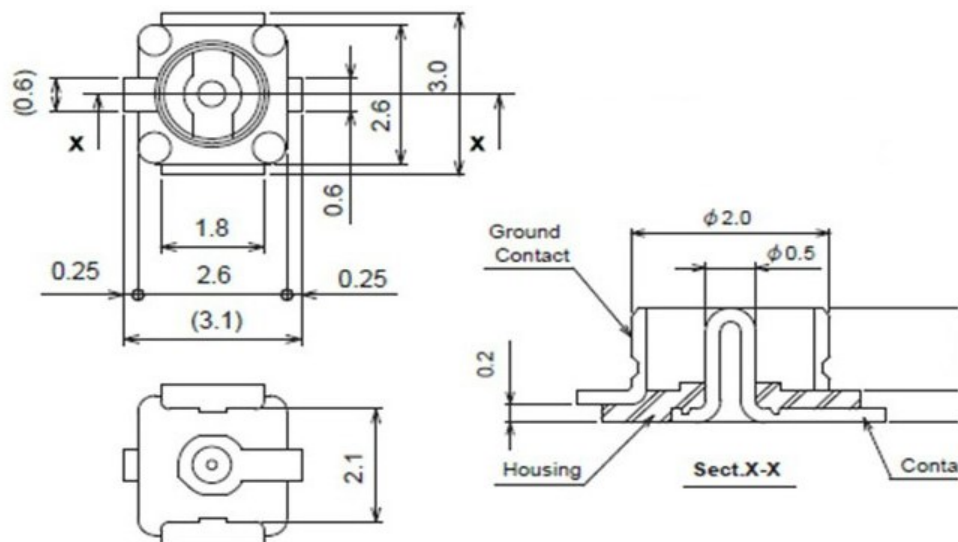


Figure 9. Specification of Antenna Seat

The specification of the IPEX wire end is as follows:

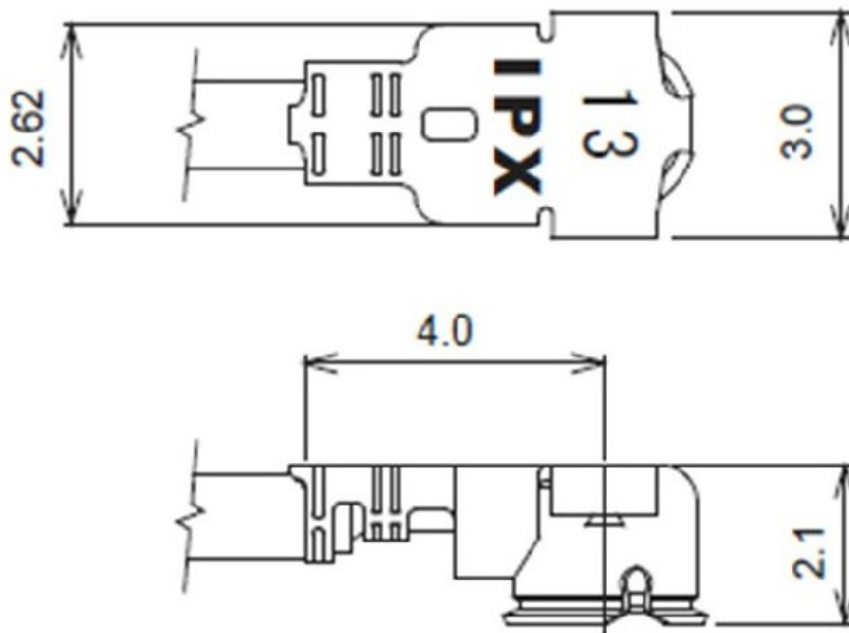


Figure 10. Specification of IPEX Wire

4.6 Basic Operation of Hardware Design

1. It is recommended to offer the module a DC stabilized power supply, a tiny power supply ripple coefficient, and reliable ground. Please pay attention to the correct connection between the positive and negative poles of the power supply. Otherwise, the reverse connection may cause permanent damage to the module;
2. Please ensure the supply voltage is between the recommended values. The module will be permanently damaged if the voltage exceeds the maximum value. Please ensure a stable power supply and no frequently fluctuating voltage.
3. When designing the power supply circuit for the module, it is recommended to reserve more than 30% of the margin, which is beneficial to the long-term stable operation of the whole machine. The module should be far away from the power electromagnetic, transformer, high-frequency wiring, and other parts with large electromagnetic interference.
4. The bottom of the module should avoid high-frequency digital routing, high-frequency analog routing, and power routing. If it has to route the wire on the bottom of the module, for example, it is assumed that the module is soldered to the Top Layer, the copper must be spread on the connection part of the top layer and the module, and be close to the digital part of the module and routed in the Bottom Layer (all copper is well-grounded).
5. Assuming that the module is soldered or placed in the Top Layer, it is also wrong to randomly route the Bottom Layer or other layers, which will affect the spurs and receiving sensitivity of the module to some degree;
6. Assuming that there are devices with large electromagnetic interference around the module, which will greatly affect the module performance. It is recommended to stay away from the module according to the strength of the interference. If circumstances permit, appropriate isolation and shielding can be done.
7. Assuming that there are routings of large electromagnetic interference around the module (high-frequency digital,

high-frequency analog, power routings), which will also greatly affect the module performance. It is recommended to stay away from the module according to the strength of the interference. If circumstances permit, appropriate isolation and shielding can be done.

8. It is recommended to stay away from the devices whose TTL protocol is the same 2.4 GHz physical layer, for example, USB 3.0.

4.7 Trouble Shooting

4.7.1 Unsatisfactory Transmission Distance

1. When there is a linear communication obstacle, the communication distance will be correspondingly weakened. Temperature, humidity, and co-channel interference will lead to an increase in the communication packet loss rate. The performances of ground absorption and reflection of radio waves will be poor when the module is tested close to the ground.
2. Seawater has a strong ability to absorb radio waves, so the test results by the seaside are poor.
3. The signal attenuation will be very obvious if there is metal near the antenna or if the module is placed inside the metal shell.
4. The incorrect power register set or the high data rate in the open air may shorten the communication distance. The higher the data rate, the closer the distance.
5. The low voltage of the power supply is lower than the recommended value at ambient temperature, and the lower the voltage, the smaller the power is.
6. The unmatchable antennas and modules or the poor quality of antenna will affect the communication distance.

4.7.2 Vulnerable Module

1. Please ensure the supply voltage is between the recommended values. The module will be permanently damaged if the voltage exceeds the maximum value. Please ensure a stable power supply and no frequently fluctuating voltage.
2. Please ensure the anti-static installation and the electrostatic sensitivity of high-frequency devices.
3. Due to some humidity-sensitive components, please ensure the suitable humidity during installation and application. If there is no special demand, it is not recommended to use at too high or too low temperature.

4.7.3 High Bit Error Rate

1. There are co-channel signal interferences nearby. It is recommended to be away from the interference sources or modify the frequency and channel to avoid interferences.
2. The unsatisfactory power supply may also cause garbled. It is necessary to ensure the power supply's reliability.
3. If the extension wire or feeder wire is of poor quality or too long, the bit error rate will be high.

4.8 Electrostatics Discharge Warnings

The module will be damaged by the discharge of static. RF-star suggests that all modules should follow the 3 precautions below:

1. According to the anti-static measures, bare hands are not allowed to touch modules.
2. Modules must be placed in anti-static areas.
3. Take the anti-static circuitry (when inputting HV or VHF) into consideration in product design.

Static may result in the degradation in performance of the module, even causing failure.

4.9 Soldering and Reflow Condition

1. Heating method: Conventional Convection or IR/convection.
2. Solder paste composition: Sn96.5/Ag3.0/Cu0.5
3. Allowable reflow soldering times: 2 times based on the following reflow soldering profile.
4. Temperature profile: Reflow soldering shall be done according to the following temperature profile.
5. Peak temperature: 245 °C.

Table 6. Temperature Table of Soldering and Reflow

Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63 / Pb37	Sn96.5 / Ag3.0 / Cu0.5
Min. Preheating Temperature (T_{min})	100 °C	150 °C
Max. Preheating Temperature (T_{max})	150 °C	200 °C
Preheating Time (T_{min} to T_{max}) (t_1)	60 s ~ 120 s	60 s ~ 120 s
Average Ascend Rate (T_{max} to T_p)	Max. 3 °C/s	Max. 3 °C/s
Liquid Temperature (T_L)	183 °C	217 °C
Time above Liquidus (t_L)	60 s ~ 90 s	30 s ~ 90 s
Peak Temperature (T_p)	220 °C ~ 235 °C	230 °C ~ 250 °C
Average Descend Rate (T_p to T_{max})	Max. 6 °C/s	Max. 6 °C/s
Time from 25 °C to Peak Temperature (t_2)	Max. 6 minutes	Max. 8 minutes
Time of Soldering Zone (t_p)	20±10 s	20±10 s

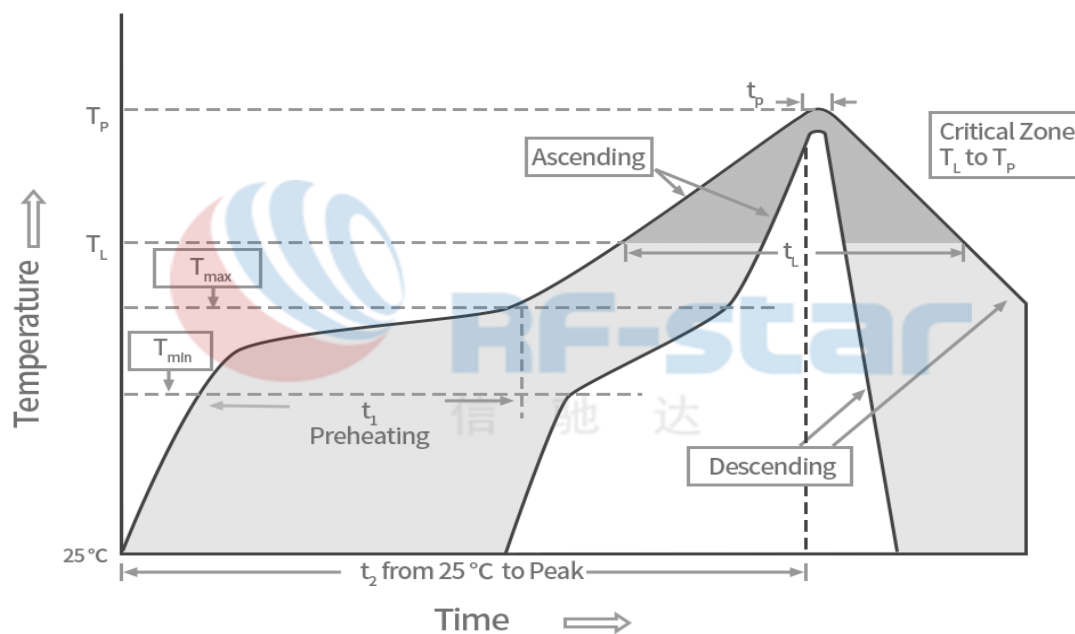


Figure 11. Recommended Reflow for Lead-Free Solder

5 Optional Package Specification

The default package method is **by tray**. If you need the modules to be shipped by tape & reel, pls contact us in advance.

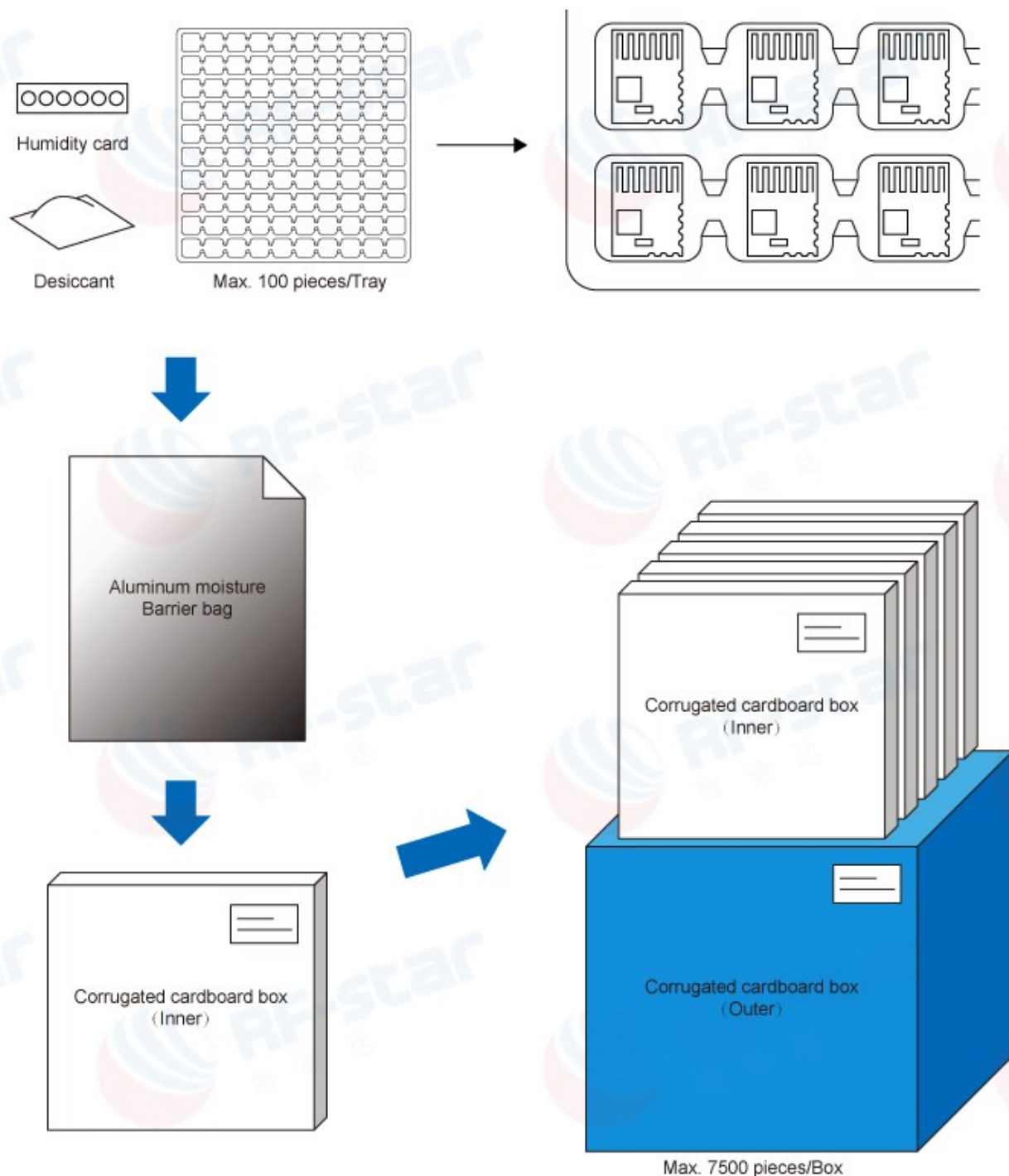


Figure 12. Default Package by Tray

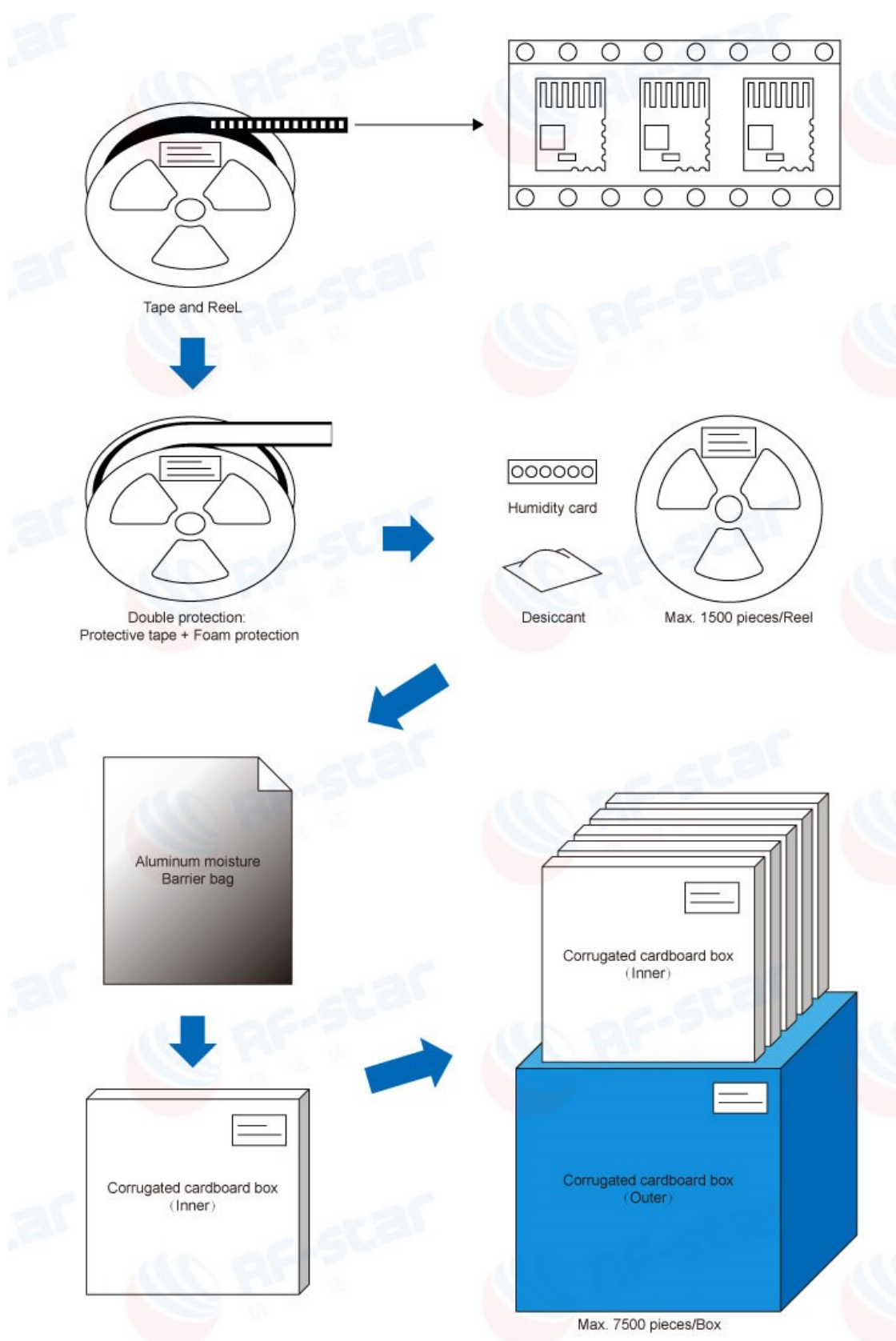
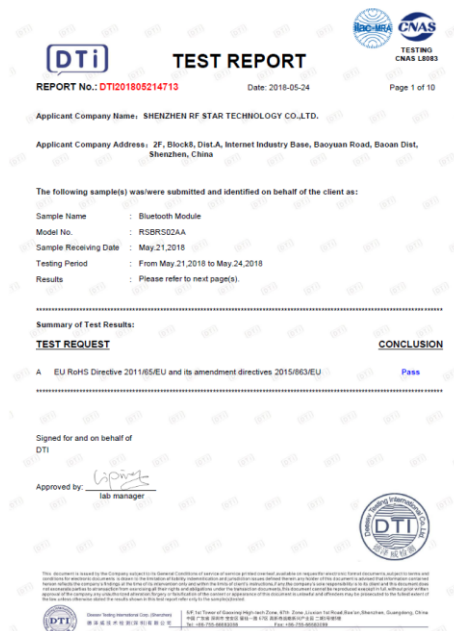


Figure 13. Package by Tape & Reel

6 Certification

6.1 RoHS

RoHS Report No.: DTI201805214713



DTI TEST REPORT
REPORT No.: DTI201805214713 Date: 2018-05-24 Page 1 of 10

Applicant Company Name: SHENZHEN RF STAR TECHNOLOGY CO.,LTD.
Applicant Company Address: 2F, Block8, Dist.A, Internet Industry Base, Baoyuan Road, Baoan Dist, Shenzhen, China

The following sample(s) was/were submitted and identified on behalf of the client as:

Sample Name : Bluetooth Module
Model No. : RSBRS02AA
Sample Receiving Date : May 21, 2018
Testing Period : From May 21, 2018 to May 24, 2018
Results : Please refer to next page(s).

Summary of Test Results:

TEST REQUEST	CONCLUSION
A EU RoHS Directive 2011/65/EU and its amendment directives 2015/863/EU	Pass

Signed for and on behalf of DTI
Approved by: [Signature] lab manager

DTI Testing International Co., (Shenzhen) Ltd. 10F, 10th Floor of Shenzhen Jiefang Road Zone, 8775 Zone, Luohu District, Shenzhen, Guangdong, China
Tel: +86-755-26661888 Fax: +86-755-26661889

Figure 14. RoHS certificate of RSBRS02AA

6.2 SRRC

SRRC CMIIT ID: 2019DP6696(M)



编号: 2019-5696
Number

设备名称: 蓝牙模块
Equipment Name

设备型号: RSBRS02AA
Equipment Type

主要功能: 数据传送
Main Functions

调制方式: GFSK
Modulation Mode

主要技术参数及其指标值:
Main Technical Parameters

频率范围: 2400-2483.5MHz
Frequency Range

频率容限: <±200m
Frequency Tolerance

占用带宽: <200m
Occupied Bandwidth

发射功率: <100mW(EIRP)
Transmitting Power

杂散发射限值: <-30dBm
Spurious Emission Limits

有效期: 五年
Validity

2019年 7月 8日
Year Month Date

Figure 15. SRRC Certificate of RSBRS02AA

7 Revision History

Date	Version No.	Description
2017.12.07	V1.0	The initial version is released.
2018.03.08	V1.1	Update module parameters.
2018.08.02	V1.1	Update module home page.
2019.07.30	V1.1	Update company address.
2020.05.15	V1.1	Add RF-star BLE module list.
2022.07.13	V1.1	Add RSBSR02AI part. Modify the specification.
2023.05.26	V1.1	Update MSL level. Update the Shenzhen office address.

Note:

1. The document will be optimized and updated from time to time. Before using this document, please make sure it is the latest version.
2. To obtain the latest document, please download it from the official website: www.rfstariot.com and www.szrfstar.com.

7 Contact Us

SHENZHEN RF-STAR TECHNOLOGY CO., LTD.

Shenzhen HQ:

Add.: Room 502, Podium Building No. 12, Shenzhen Bay Science and Technology Ecological Park, Nanshan District, Shenzhen, Guangdong, China, 518063

Tel.: 86-755-8632 9829

Chengdu Branch:

Add.: N2-1604, Global Center, North No. 1700, Tianfu Avenue, Hi-Tech District, Chengdu, Sichuan, China, 610095

Tel.: 86-28-8692 5399

Email: sunny@szrfstar.com, sales@szrfstar.com

Web.: www.rfstariot.com, www.szrfstar.com

