



RSBRS02ABR(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

RSBRS02ABR(I) is a compact size, cost-effective Bluetooth low energy module based on RF-star 256 KB flash SoC RS02A1-B 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 (RSBRS02ABR) or an IPEX connector (RSBRS02ABRI). 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 and extended ADV payload
 - Frequency: 2402 MHz ~ 2480.0 MHz
 - TX power: -20.0 dBm ~ +5.0 dBm
 - Receiving Sensitivity: -94 dBm @ 1 Mbps
- CPU
 - 32-bit ARM Cortex-M0+ @ 48 MHz
 - Single-cycle multiplier
 - 65 μ A/MHz running from SRAM
 - Serial wire debug
- Memory
 - ROM 80 KB
 - SRAM 36 KB, 4 KB Cache
 - Flash 256 KB
 - 32B eFuse
- Wide Operation Range
 - Power supply range: 2.3 V ~ 3.6 V
 - Operating temperature: -40 °C to +85 °C
 - Storage temperature: -40 °C to +125 °C
- Rich Peripherals
 - 11 general purpose I/Os. Function IO any-route support
 - 2 x UART with CTS/RTS
 - SPI with master/slave configurable
 - I²C with master/slave configurable
 - 7816 T-0 master interface
 - 4-channel 9-bit general purpose ADC
 - 2-channel DMA
 - Infra-red generator
 - 4 x PWM
 - Quadrature decoder (QDEX) interface
 - 12 MHz clock output
 - 2-channel DMA
 - 5 x 16-bit timer
 - Real timer clock (RTC)
 - Watchdog
- Transmission range:
 - RSBRS02ABR: 130 m
 - RSBRS02ABRI: 190 m (@external PCB antenna)
- Dimension:
 - RSBRS02ABR: 15.2 mm x 11.2 mm x 2.0 mm
 - RSBRS02ABRI: 15.2 mm x 11.2 mm x 2.2 mm
- RSBRS02ABR Certificates:
 - FCC
 - SRRC
 - RoHS
 - Reach
- RSBRS02ABRI Certificates:
 - RoHS

1.3 Applications

- Smart toys
- Gaming controller
- E-lock
- Smart lighting
- Electronic shelf label
- Location-based service
- Medical devices
- Fitness equipment
- Environmental sensor nodes
- Passive keyless entry (PKE)
- Phone accessories
- Health-care equipment
- Energy harvesting
- Thermometer
- Human input devices
- Wearable

1.4 Functional Block Diagram

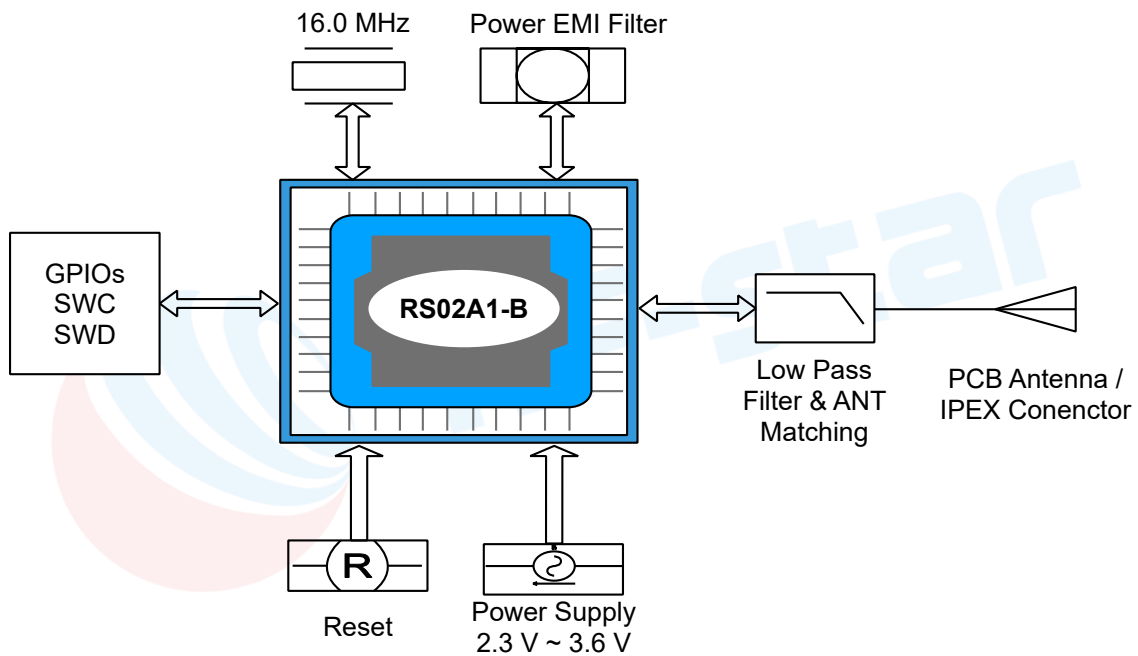


Figure 1. Functional Block Diagram of RSBRS02ABR(I)

1.5 Part Number Conventions

The part numbers are of the form of RSBRS02ABR(I) where the fields are defined as follows:

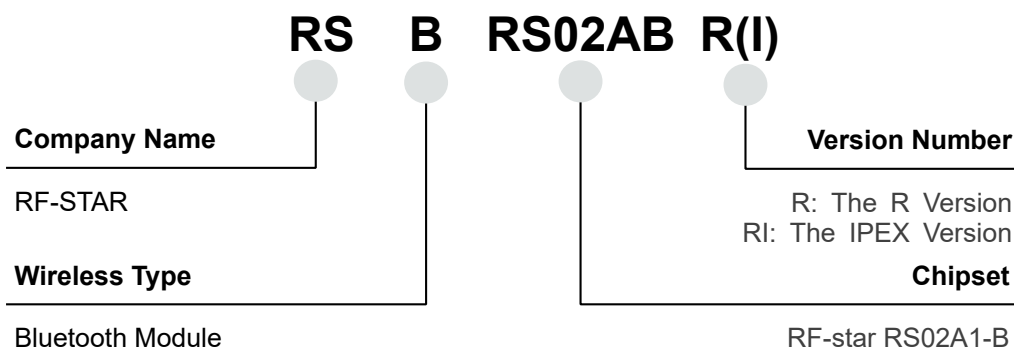


Figure 2. Part Number Conventions of RSBRS02ABR(I)

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2 Module Configuration and Functions

2.1 Module Parameter

Table 1. Parameters of RSBRS02ABR(I)

Chipset	RS02A1-B
Supply Power Voltage	2.3 V ~ 3.6 V, recommended to 3.3 V
Modulation	GFSK
Frequency	2402 MHz ~ 2480.0 MHz
Transmit Power	-20.0 dBm ~ +5.0 dBm (typical: 0 dBm)
Receiving Sensitivity	-94 dBm @ 1 Mbps PHY
GPIO	11
Crystal	16 MHz
ROM	80 KB
SRAM	36 KB, 4 KB Cache
Flash	256 KB
Package	SMT Packaging (1.27-mm half-hole pitch stamp stick)
Frequency Error	±24 kHz
Dimension	RSBRS02ABR: 15.2 mm x 11.2 mm x 2.0 mm RSBRS02ABRI: 15.2 mm x 11.2 mm x 2.2 mm
Type of Antenna	RSBRS02ABR: PCB antenna RSBRS02ABRI: IPEX connector
Transmission Range in Open Air	RSBRS02AA: 130 m (@ PCB antenna) RSBRS02AI: 190 m (@ external PCB antenna)
Operating Temperature	-40 °C ~ +85 °C
Storage Temperature	-40 °C ~ +125 °C

2.2 Module Pin Diagram

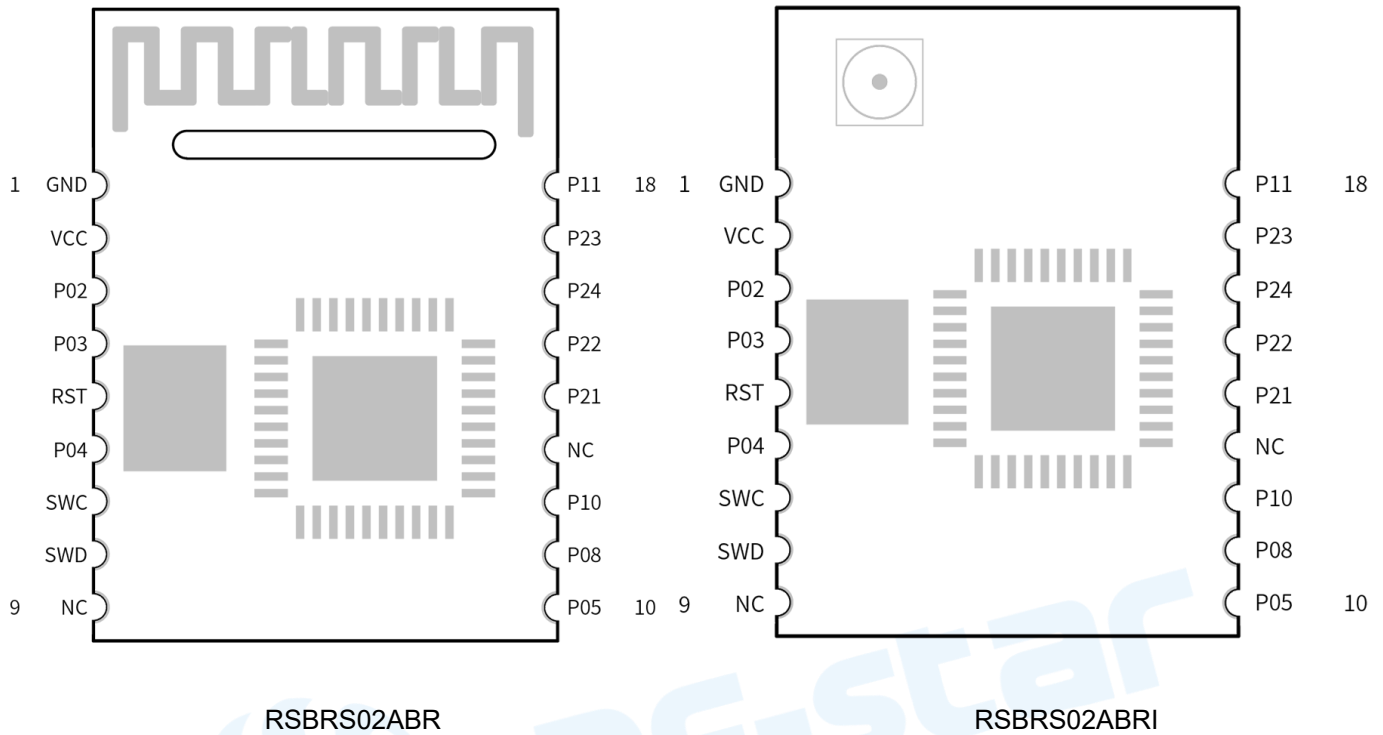


Figure 3. Pin Diagram of RSBRS02ABR(I)

2.3 Pin Functions

Table 2. Pin Functions of RSBRS02ABR(I)

Pin	Name	Chip Pin	Pin Type	Remarks
1	GND	GND	Ground	Ground
2	VCC	VCC	VCC	Power supply: 2.3 V ~ 3.6 V, Recommended to 3.3 V
3	P02	P02	I/O	
4	P03	P03	I/O	
5	RST	RST	RESET	Reset, active low
6	P04	P04	I/O	
7	SWC	SWC	SWCLK	Connect J-Link SWCLK
8	SWD	SWD	SWDIO	Connect J-Link SWDIO
9	NC	NC	NC	
10	P05	P05	I/O	
11	P08	P08	I/O	
12	P10	P10	I/O	

13	NC	NC	NC	
14	P21	P21	I/O	
15	P22	P22	I/O	
16	P24	P24	I/O	
17	P23	P23	I/O	
18	P11	P11	I/O	



3 Specifications

3.1 Absolute Maximum Ratings

Table 3. Absolute Maximum Ratings

Identification	Condition	Min.	Typ.	Max.	Unit
Source & IO	Battery mode	2.3	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 RSBRS02ABR(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 RSBRS02ABR(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

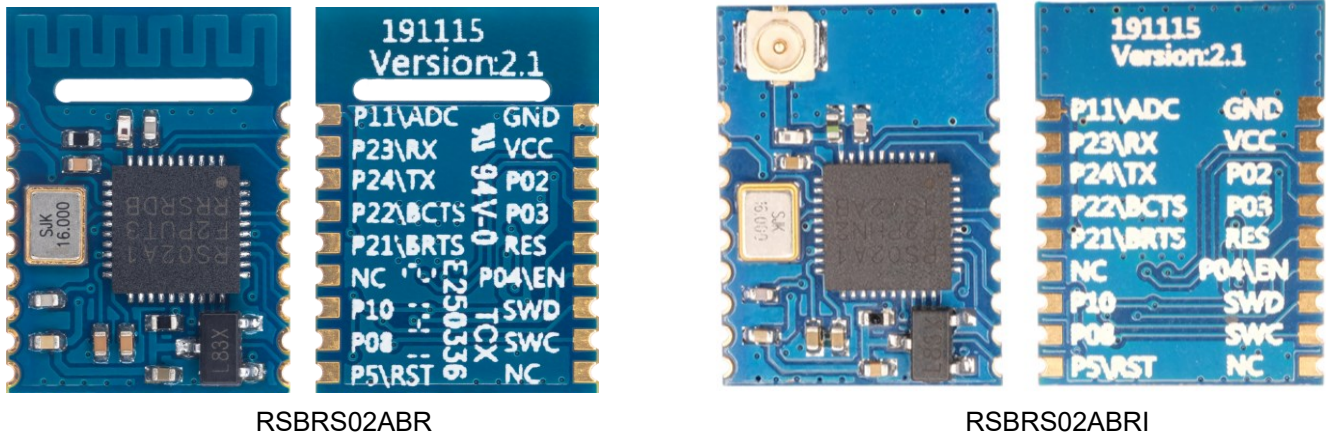
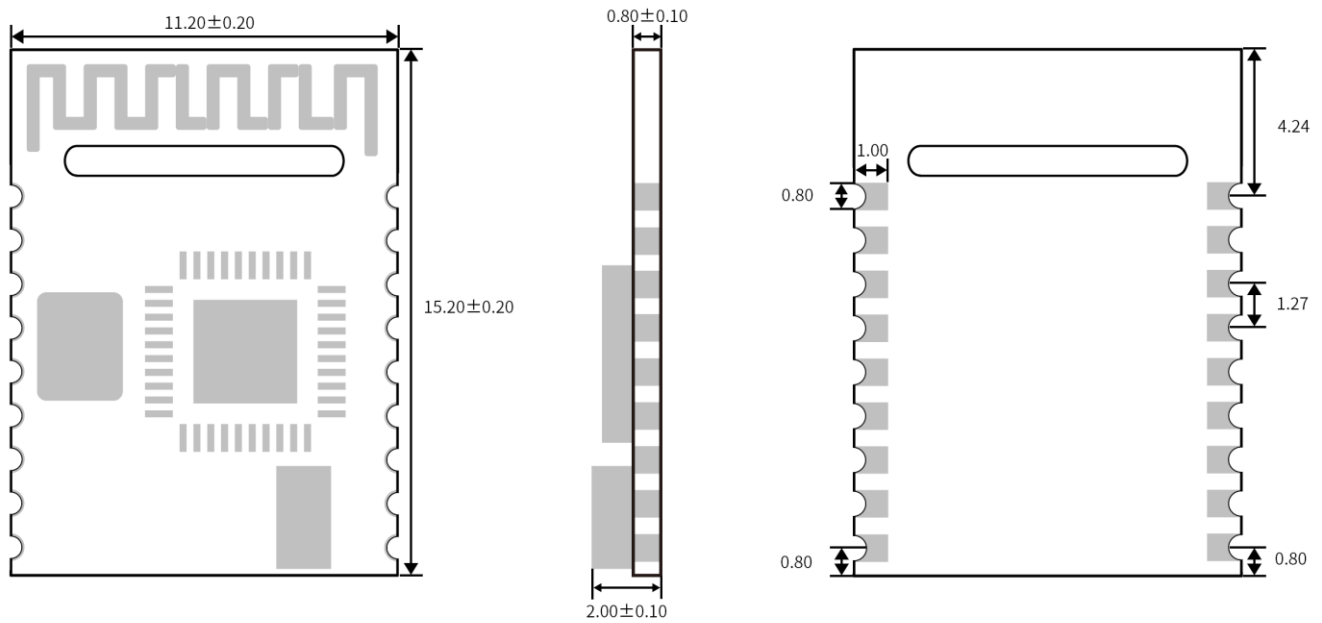


Figure 4. Photos of RSBRS02ABR(I)

4.2 Recommended PCB Footprin



RSBRS02ABR

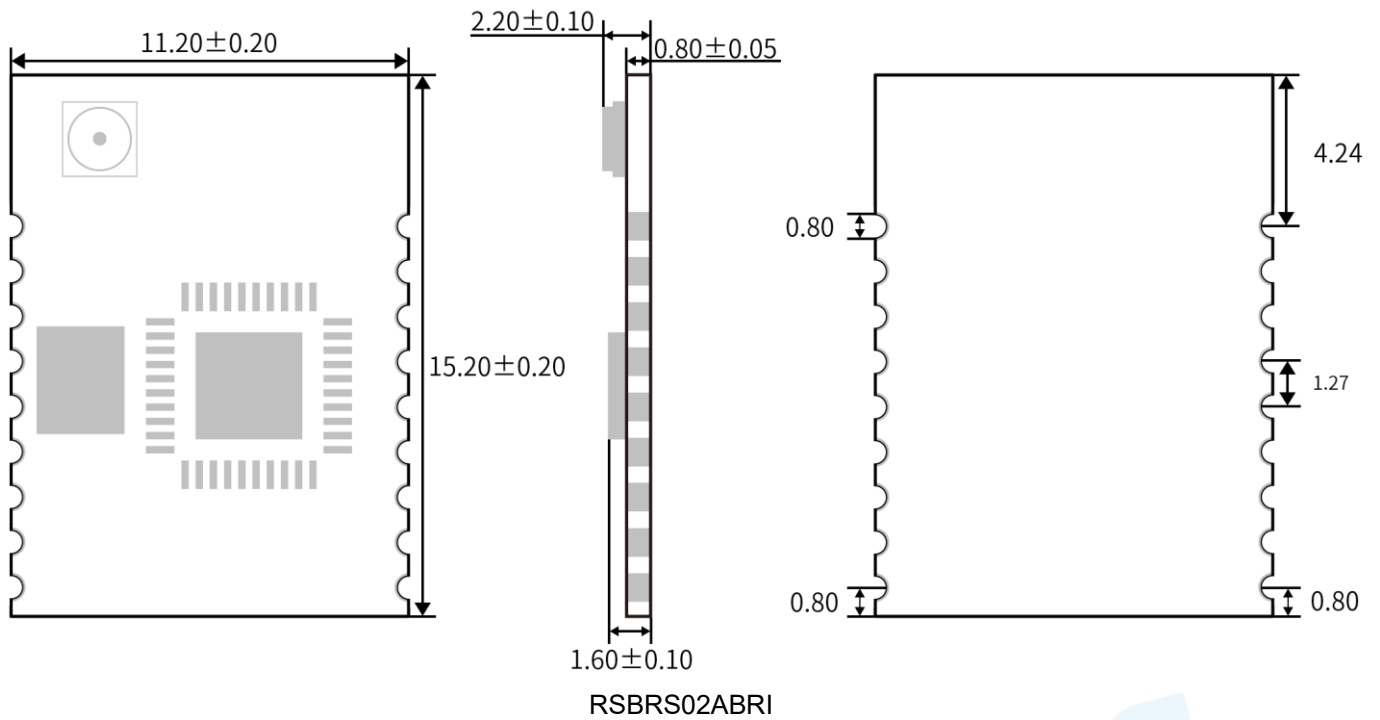


Figure 5. Recommended PCB Footprint of RSBRS02ABR(I) (mm)

4.3 Schematic Diagram

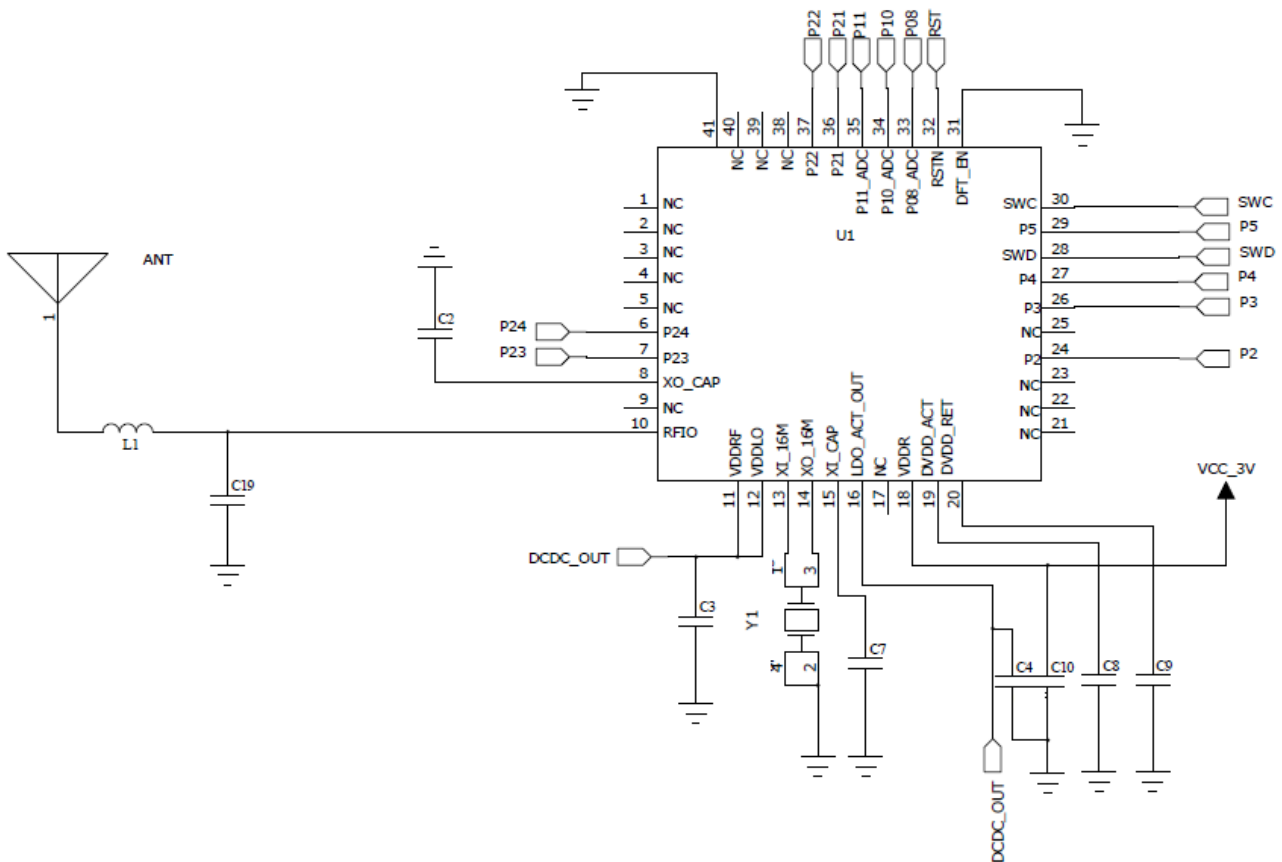


Figure 6. Schematic Diagram of RSBRS02ABR(I)

4.4 Reference Design

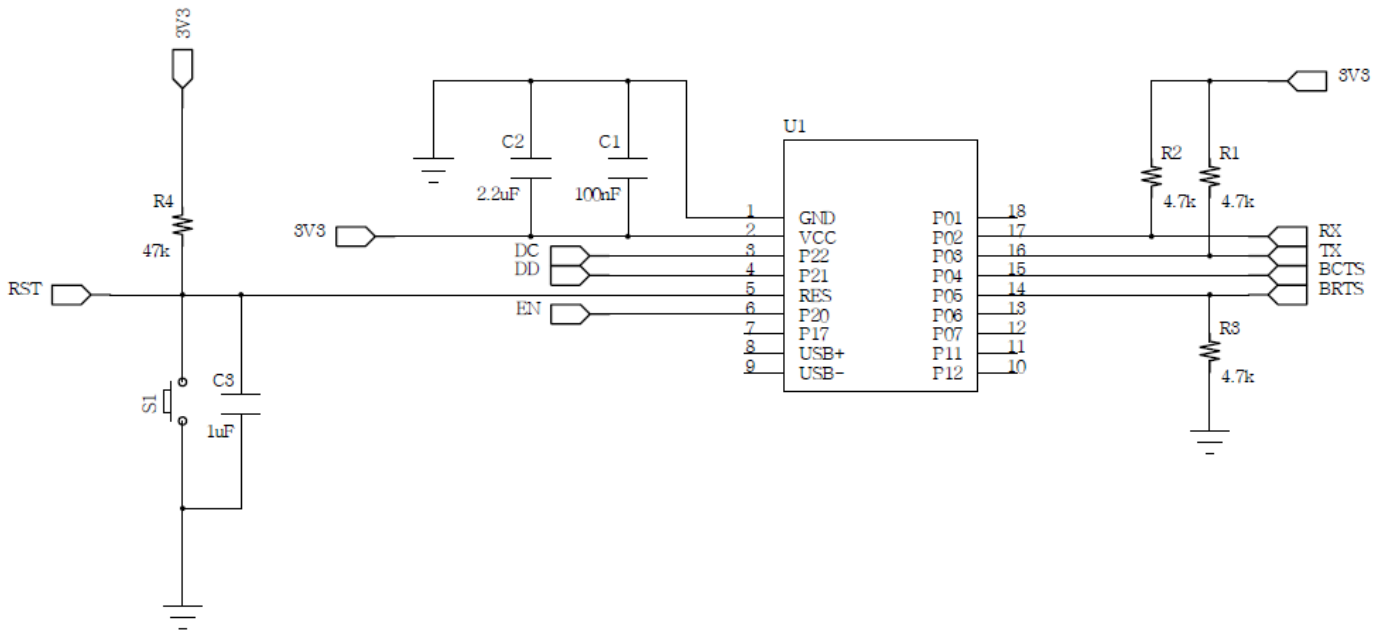


Figure 7. Reference Design of RSBRS02ABR(I)

4.5 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.

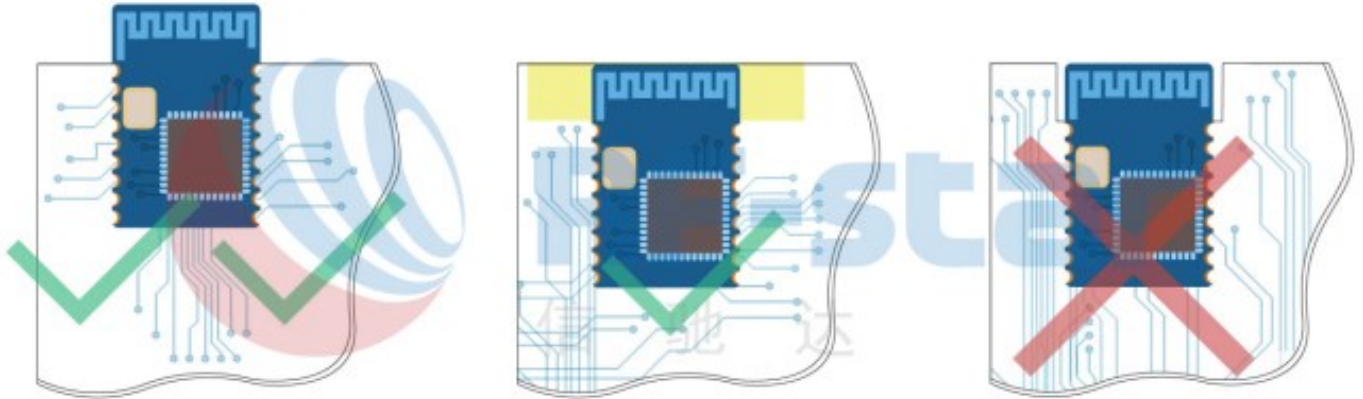


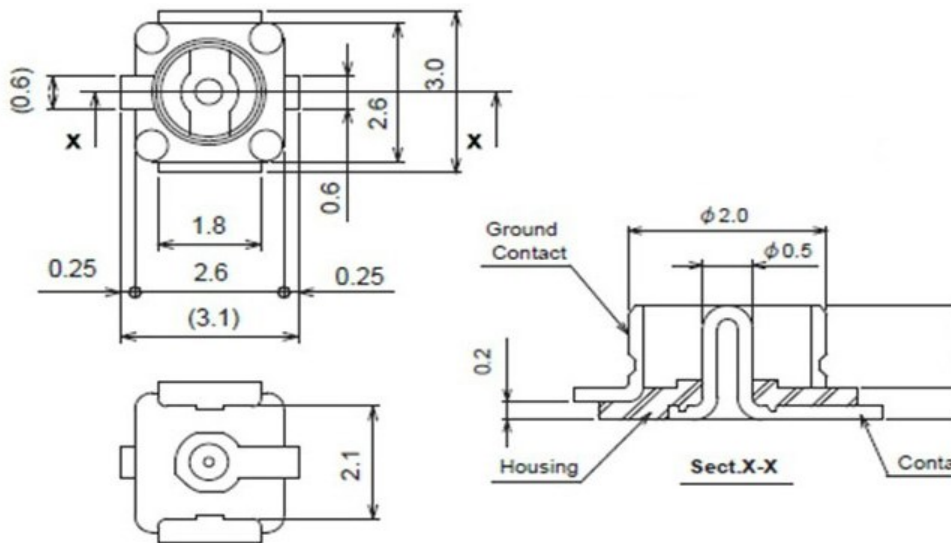
Figure 8. Recommendation of Antenna Layout

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

4.5.2 IPEX Connector Specification

RSBRS02ABRI 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:

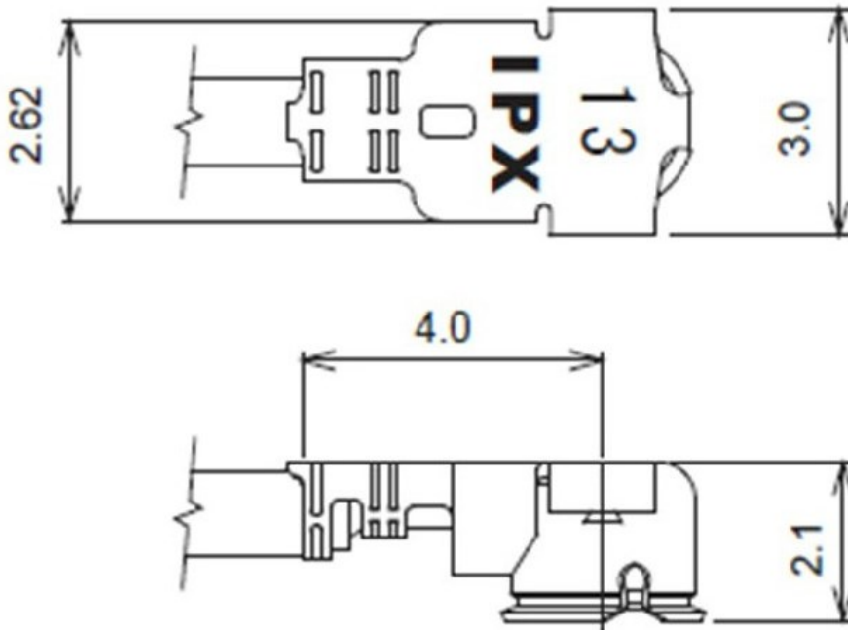


Figure 10. Specification of IPEX Wire

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

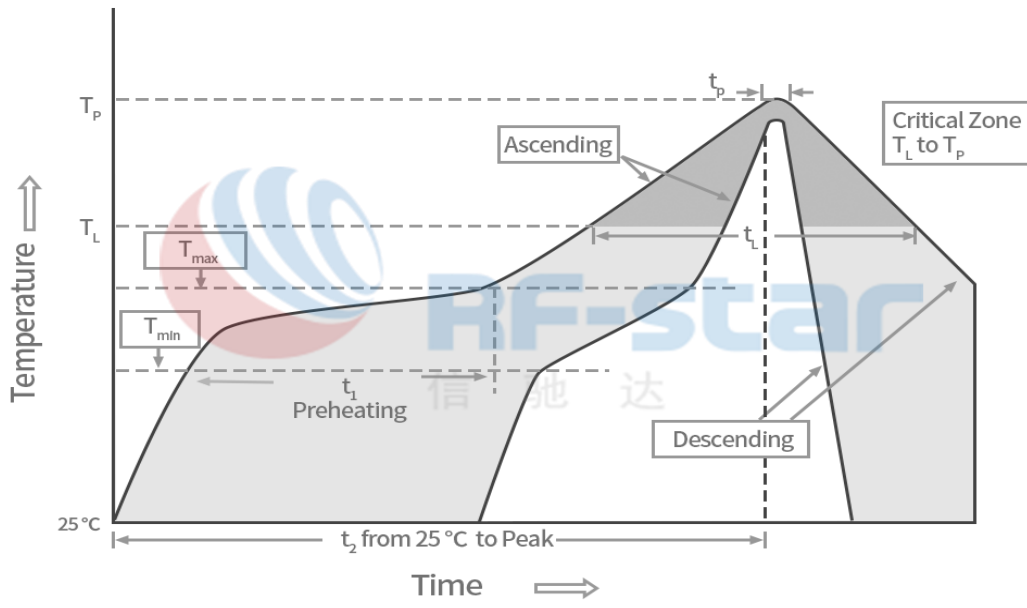


Figure 11. Recommended Reflow for Lead-Free Solder

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.

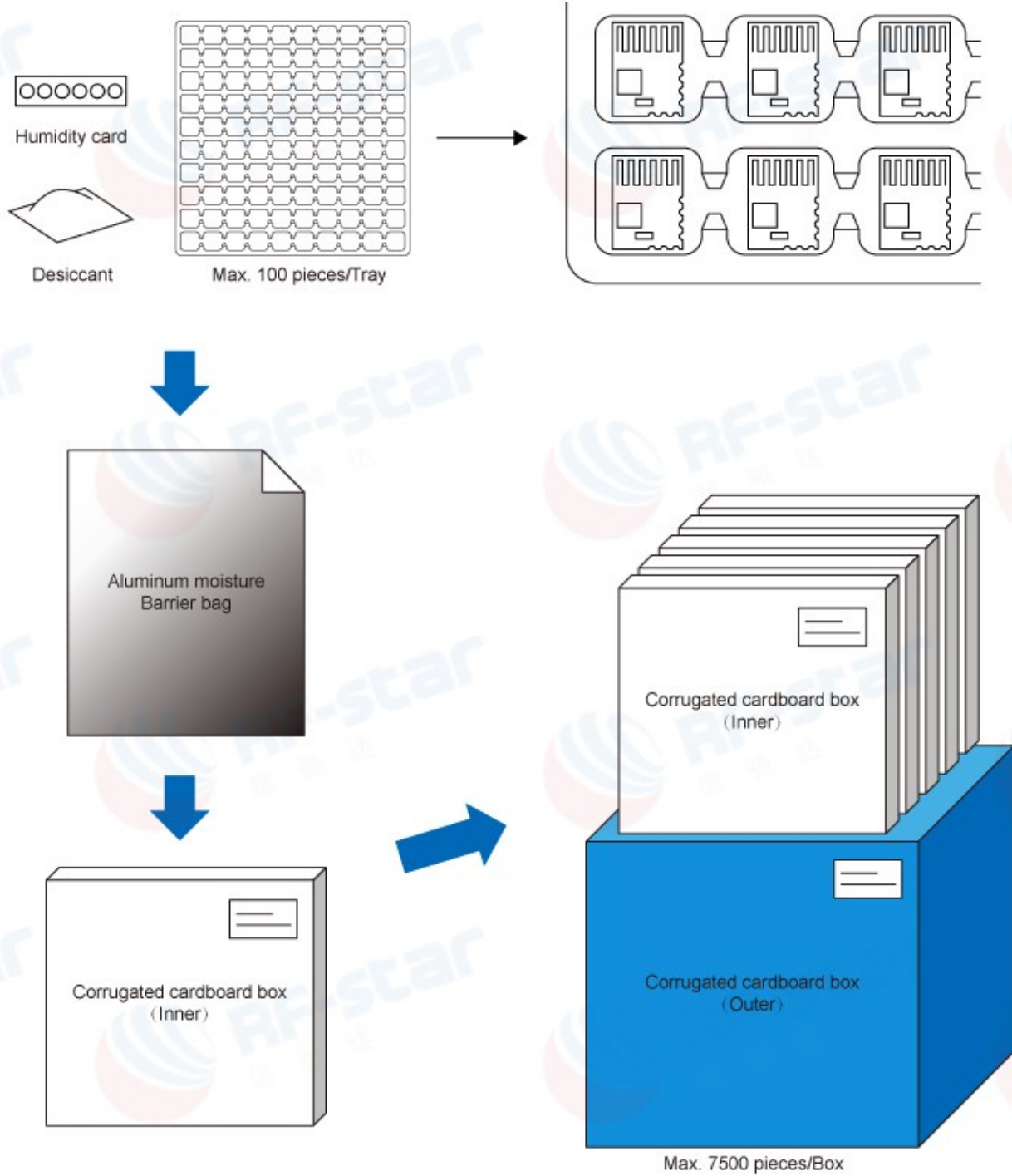


Figure 12. Default Package by Tray

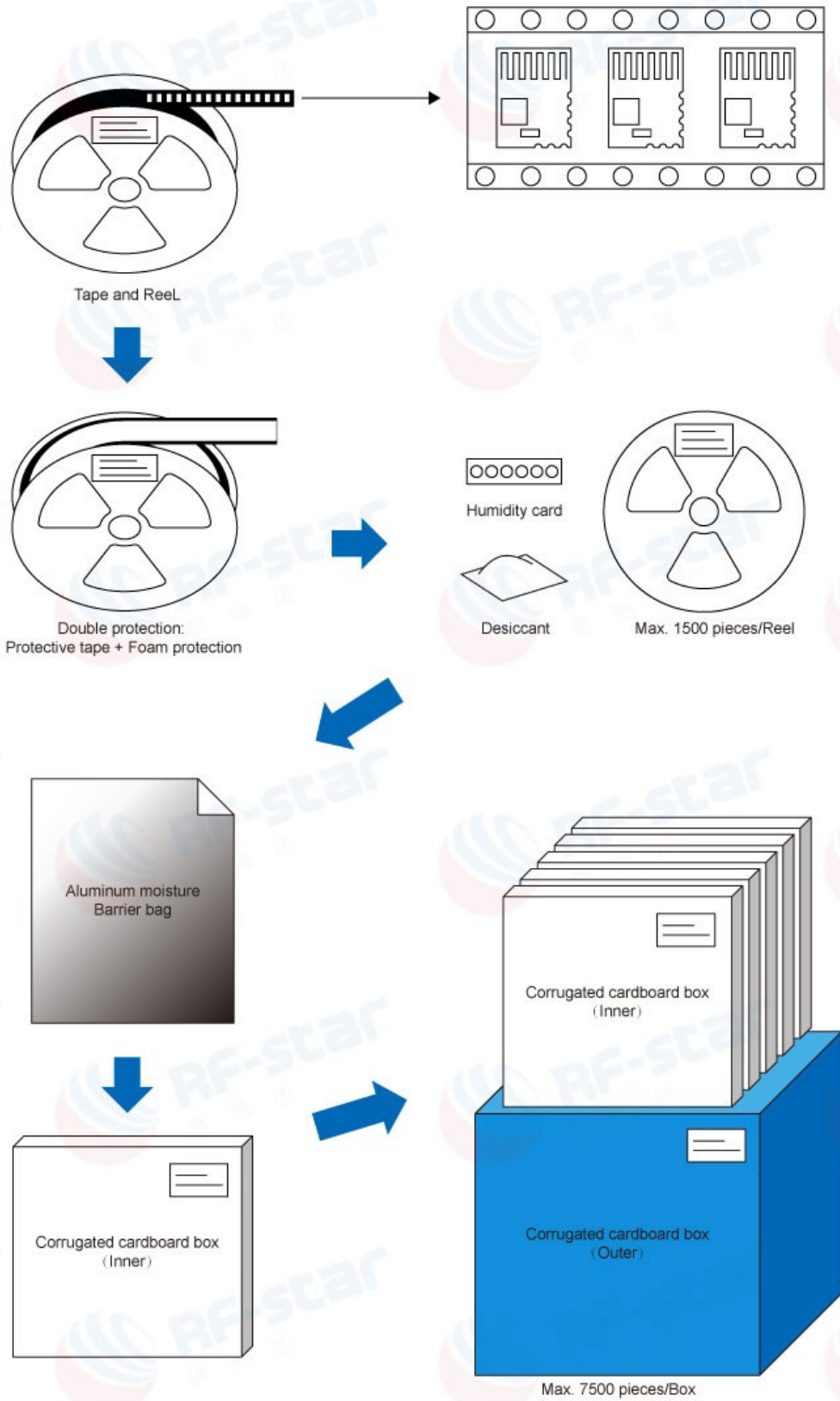


Figure 13. Package by Tape & Reel

6 Certification

6.1 RoHS

RoHS Report No.: U05102200529615E



Figure 14. RoHS certificate of RSBRS02ABR

Certificate number: DTI20200627C



Figure 15. RoHS of RSBRS02ABRI

6.2 FCC

Warnings:

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.

FCC ID.: 2ABN2-RSBRS02ABR(I)

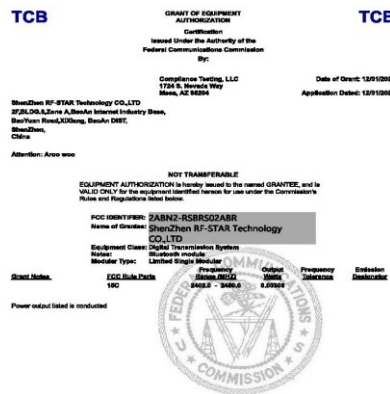


Figure 16. FCC certificate of RSBRS02ABR

6.3 SRRC

SRRC CMIT ID.: 2020DP11444(M)



Figure 17. SRRC certificate of RSBRS02ABR

6.4 REACH

Certificate No.: DSP23040203-1



Test Report

Report No.: DSP23040203-1 Date: Apr 13, 2023 Page 1 of 15

Applicant : Shenzhen RF-star Technology Co., Ltd.
 Address : Room 601, Block C, Skyworth Building, High-tech Park, Nanshan District, Shenzhen, Guangdong, China

Manufacturer : Shenzhen RF-star Technology Co., Ltd.
 Address : Room 601, Block C, Skyworth Building, High-tech Park, Nanshan District, Shenzhen, Guangdong, China

Sample Name : BT module
 Sample Model : RSBRS02ABR

Trade Name : RF-star

Receiving Date : Apr 07, 2023

Testing Period : Apr 07, 2023 to Apr 13, 2023

Test Requested : As requested by applicant, SVHC screening is performed according to Two hundred and thirty-three (233) substances in the Candidate List of Substances of Very High Concern (SVHC) for authorization published by European Chemicals Agency (ECHA) on and before Jan 17, 2023 regarding Regulation (EC) No 1907/2006 concerning the REACH.

Test Method : With reference to ZRLK In-House method, analysis was performed by ICP-OES, UV-VIS, GC-MS, HPLC-DAD/MS and Colorimetric Method.

Test Results : Please refer to next page(s)

Conclusion :	According to the specified scope and evaluation screening, the test results of SVHC are $\leq 0.1\%$ (w/w) in the submitted sample. REACH Regulation (EC) No 1907/2006	PASS
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Figure 18. SRRC certificate of RSBRS02ABR

7 Revision History

Date	Version No.	Description
2020.01.03	V1.0	The initial version is released.
2020.05.15	V1.0	Add RF-star BLE module list.
2022.07.11	V1.0	Add RSBRS02ABRI part. Modify the specifications.
2023.05.26	V1.0	Update MSL level. Update the Shenzhen office address.
2023.07.24	V1.1	Update the module photo. Update the PCB footprint.

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

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