RF-BM-ND09 nRF52805

Bluetooth 5.0 Low Energy Module

Version 1.0

Shenzhen RF-star Technology Co., Ltd.

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Nordic BLE Module List

➢ nRF51 Series

Chipset	Core	Flash (kB)	RAM (kB)	TX Power (dBm)	Model	Antenna	Dimension (mm)	Range (m)	Photo
nRF51822	M0	256	16	4	RF-BM-ND01	PCB	15 × 24.8	100	
					RF-BM-ND02	PCB	13.5 × 16.2	80	
					RF-BM-ND02I	IPEX	13.5 × 16.2	100	Contact me
nRF51802	M0	256	16	4	RF-BM-ND01C	PCB	15 × 24.8	100	
					RF-BM-ND02C	PCB	13.5 × 16.2	80	
					RF-BM-ND02CI	IPEX	13.5 × 16.2	100	Contact me

Note:

1. The communication distance is the longest distance obtained by testing the module's maximum transmission power in an open and interference-free environment in sunny weather.
2. Click the picture to buy modules.

➢ **nRF52 Series**

Chipset	Core	Flash (kB)	RAM (kB)	TX Power (dBm)	Model	Antenna	Dimension (mm)	Range (m)	Photo
nRF52832	M4F	512	64	4	RF-BM-ND04	PCB	15 × 24.8	100	
					RF-BM-ND04I	IPEX/Half-hole	15 × 24.8	100	
					RF-BM-ND08	PCB/Half-hole	15.2 × 11.2	80	
					RF-BM-ND08I	IPEX/Half-hole	15.2 × 11.2	100	Contact me
nRF52810	M4	192	24	4	RF-BM-ND04C	PCB	15 × 24.8	100	
					RF-BM-ND04CI	IPEX/Half-hole	15 × 24.8	100	
					RF-BM-ND08C	PCB/Half-hole	15.2 × 11.2	80	
					RF-BM-ND08CI	IPEX/Half-hole	15.2 × 11.2	100	Contact me
nRF52811	M4	192	24	4	RF-BM-ND04A	PCB	15 × 24.8	100	

					RF-BM-ND08A	PCB/Half-hole	15.2 × 11.2	80	
nRF52833	M4	512	128	8	RF-BM-ND07	Chip/IPEX/Pad	12.2 × 17	300	
nRF52840	M4F	1024	256	8	RF-BM-ND05	PCB	15 × 24.8	500	
					RF-BM-ND05I	IPEX/Half-hole	15 × 24.8	500	
					RF-BM-ND06	PCB/Pad	20.5 × 24	500	
nRF52805	M4	192	24	4	RF-BM-ND09	Pad	7 × 7	100	
	M4	192	24	4	RF-BM-ND09A	PCB/Pad	7 × 9	80	

Note:

1. The communication distance is the longest distance obtained by testing the module's maximum transmission power in an open and interference-free environment in sunny weather.
2. Click the picture to buy modules.

1 Device Overview

1.1 Description

RF-BM-ND09 is an RF BLE module based on Nordic Semiconductor nRF52805 with ARM® Cortex®-M4 32-bit processor, clocked at 64 MHz. It has 192 kB Flash and 24 kB RAM and integrates a range of analog and digital interfaces such as a 2-channel 12-bit ADC, SPI, UART, I2C and QDEC. The PAD interface output way makes the module achieve more applications with a relatively long transmission range. The TX power has up to +4 dBm and the sensitivity (1 Mbps Bluetooth Low Energy) is -97 dBm. The Bluetooth high-throughput 2 Mbps makes ND09 transfer data faster and more efficiently, improve coexistence and reduce interference. RF-BM-ND09 is in a DFN package for small PCB designs, ideal for cost-constrained applications.

1.2 Key Features

- RF features
  - Bluetooth® 5.0 low energy: 2 Mbps, 1 Mbps
  - 2.4 GHz proprietary: 2 Mbps, 1 Mbps
- TX power: -20 dBm to +4 dBm, configuration in 4 dB steps
- Receiving sensitivity: -97 dBm in 1 Mbps BLE mode
- ARM® Cortex®-M4 32-bit processor, 64 MHz
- On-air compatible with nRF52, nRF51, nRF24L, and nRF24AP series
- Supply voltage range 1.7 V ~ 3.6 V
- Memory
  - 192 kB flash
  - 24 kB RAM
- Rich peripherals
  - 12-bit, 200 ksps ADC
  - 10 GPIOs
  - PWM
  - SPI master/slave
  - I^2C master/slave
  - I^2S
  - UART (CTS/RTS)
- Transmission Range: 100 m
- Dimension: 7.0 mm x 7.0 mm x 2.0 mm

1.3 Applications

- Proprietary protocol devices
- Network processor
- Beacons
- Smart Home sensors
- Presenters / Stylus
- Health monitoring
- Drug delivery
- Asset tags
- Toys
- Retail tags and labels

1.4 Functional Block Diagram

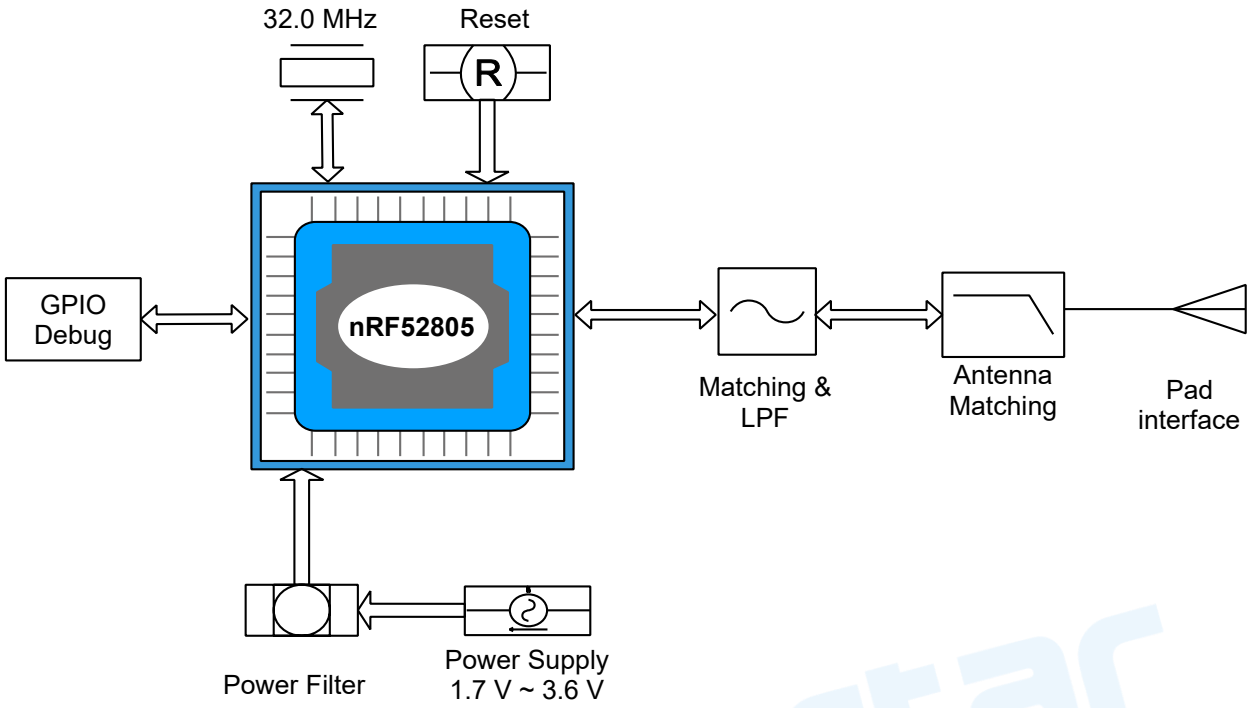

Figure 1. Functional Block Diagram of RF-BM-ND09

1.5 Part Number Conventions

The part numbers are of the form of RF-BM-ND08A where the fields are defined as follows:

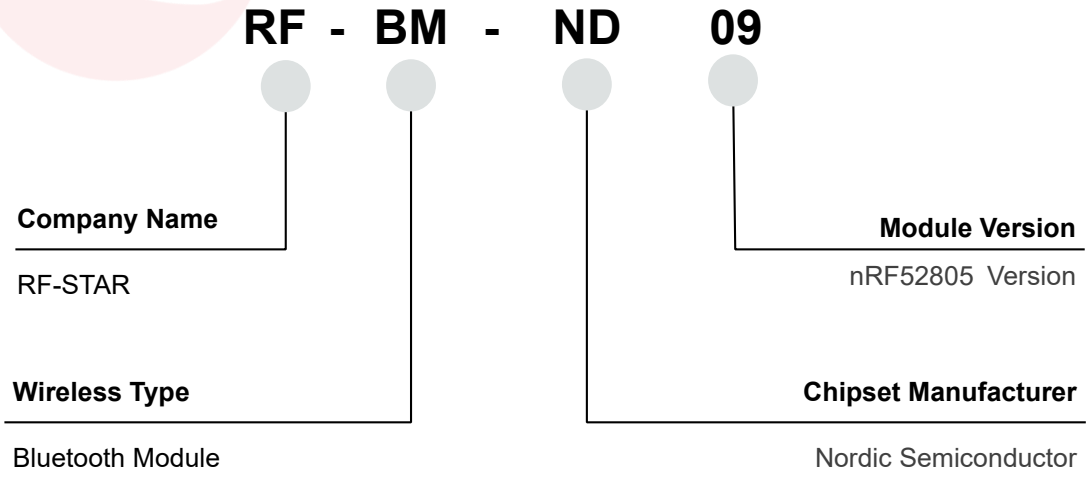

Figure 2. Part Number Conventions of RF-BM-ND09

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2 Module Configuration and Functions

2.1 Module Parameters

Table 1. Parameters of RF-BM-ND09

Chipset	nRF52805
Supply Power Voltage	1.7 V ~ 3.6 V, recommended to 3.3 V
Frequency	2402 MHz ~ 2480 MHz
Transmit Power	-20.0 dBm ~ +4.0 dBm
Receiving Sensitivity	-97 dBm sensitivity in 1 Mbps Bluetooth® low energy mode
GPIO	10
Crystal	32 MHz
RAM	24 kB
Flash	192 kB
Package	DFN
Frequency Error	±20 kHz
Antenna	Pad antenna interface
Dimension	7.0 mm x 7.0 mm x 2.0 mm (Including shield cover)
Operating Temperature	-40 ℃ ~ +85 ℃
Storage Temperature	-40 ℃ ~ +125 ℃

2.2 Module Pin Diagram

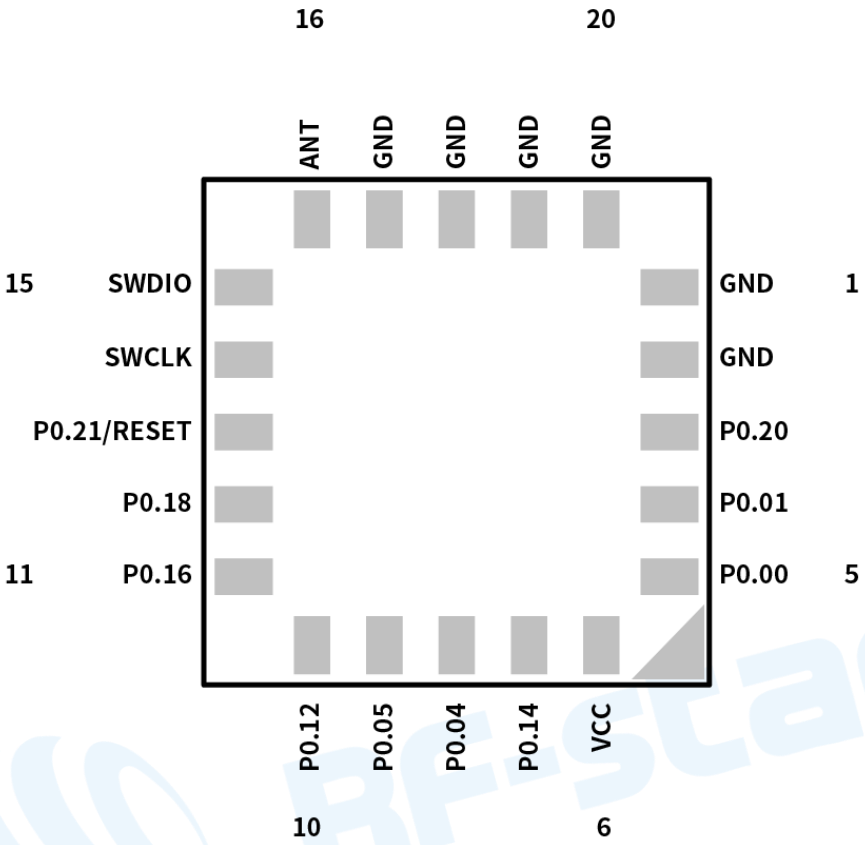

Figure 3. Pin Diagram of RF-BM-ND09 (Bottom view)

2.3 Pin Functions

Table 2. Pin Functions of RF-BM-ND09

Pin	Name	Chip Pin	Pin Type	Description
1	GND	GND	GND	
2	GND	GND	GND	
3	P0_20	P0_20	Digital I/O	General purpose I/O
4	P0_01	P0_01	Digital I/O	General purpose I/O
5	P0_00	P0_00	Digital I/O	General purpose I/O
6	VCC	VDD	VCC	Power supply 1.7 V ~ 3.6 V, Recommend 3.3 V
7	P0_14	P0_14	Digital I/O	General purpose I/O
8	P0_04	P0_04 / AIN2	Digital I/O	General purpose I/O
9	P0_05	P0_05 / AIN3	Digital I/O	General purpose I/O

10	P0_12	P0_12	Digital I/O	General purpose I/O
11	P0_16	P0_16	Digital I/O	General purpose I/O
12	P0_18	P0_18	Digital I/O	General purpose I/O
13	P0_21 / RESET	P0_21 / RESET	Digital I/O	General purpose I/O, Configurable as pin reset
14	SWDCLK	SWDCLK	Debug	Serial wire debug clock input for debugging and programming
15	SWDIO	SWDIO	Debug	Serial wire debug I/O for debugging and programming
16	ANT	ANT	RF	Single-ended radio antenna connection
17	GND	GND	-	
18	GND	GND	-	
19	GND	GND	-	
20	GND	GND	-	

Note:

SWD debugging ports are on the bottom side of the module, which is not pulled out in the stamp half hole way, please refer to the module pin diagram for details.

3 Specifications

3.1 Recommended Operating Conditions

The functional operation does not guarantee performance beyond the limits of the conditional parameter values in the table below. Long-term work beyond this limit will affect the reliability of the module more or less.

Table 3. Recommended Operating Conditions of RF-BM-ND09

Items	Condition	Min.	Typ.	Max.	Unit
Operating Supply Voltage	Battery Mode	1.7	3.3	3.6	V
Operating Temperature	/	-40	+25	+85	℃
Environmental Hot Pendulum	/	-20		+20	℃/min

3.2 Handling Ratings

Table 4. Handling Ratings of RF-BM-ND09

Items	Condition	Min.	Typ.	Max.	Unit
Storage Temperature	Tstg	-40	+25	+125	℃
Human Body Model	HBM		±4000		V
Moisture Sensitivity Level			2		
Charged Device Model			±750		V

4 Application, Implementation, and Layout

4.1 Module Photos

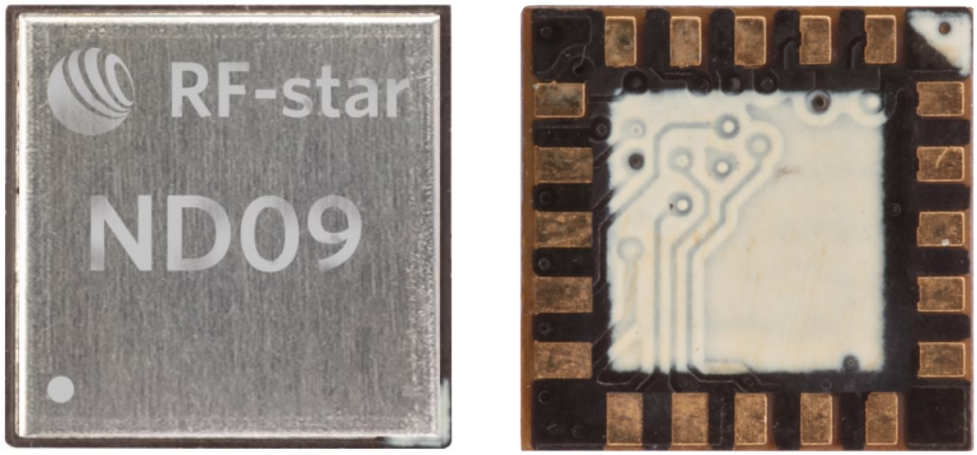

Figure 4. Photos of RF-BM-ND09

4.2 Recommended PCB Footprint

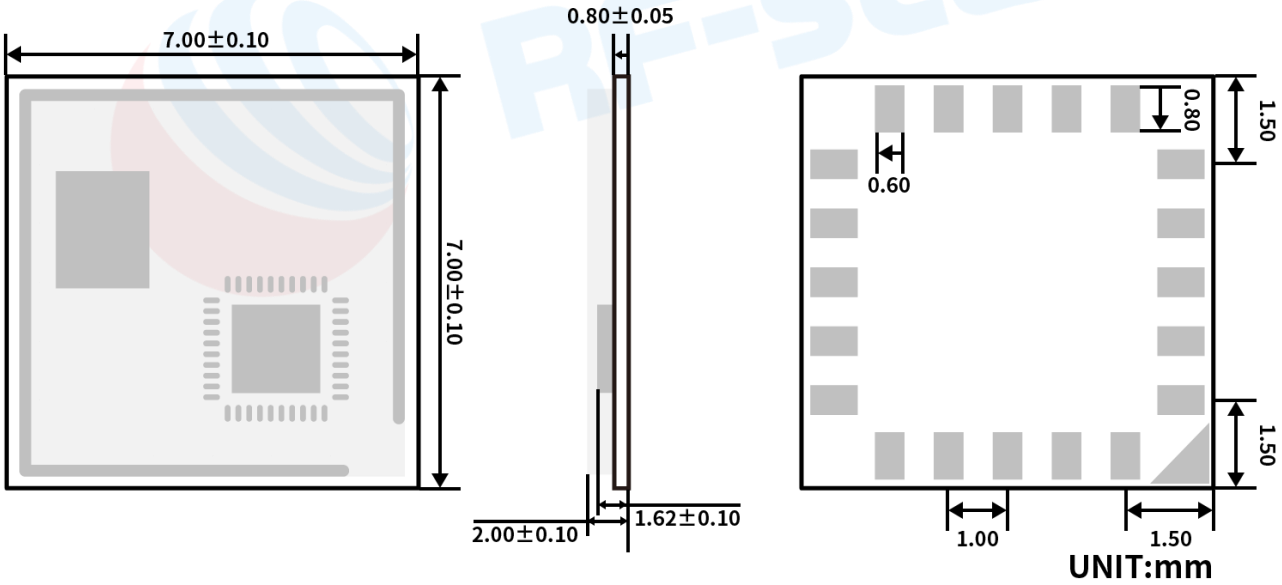

Figure 5. Recommended PCB Footprint of RF-BM-ND09 (mm)

4.3 Schematic Diagram

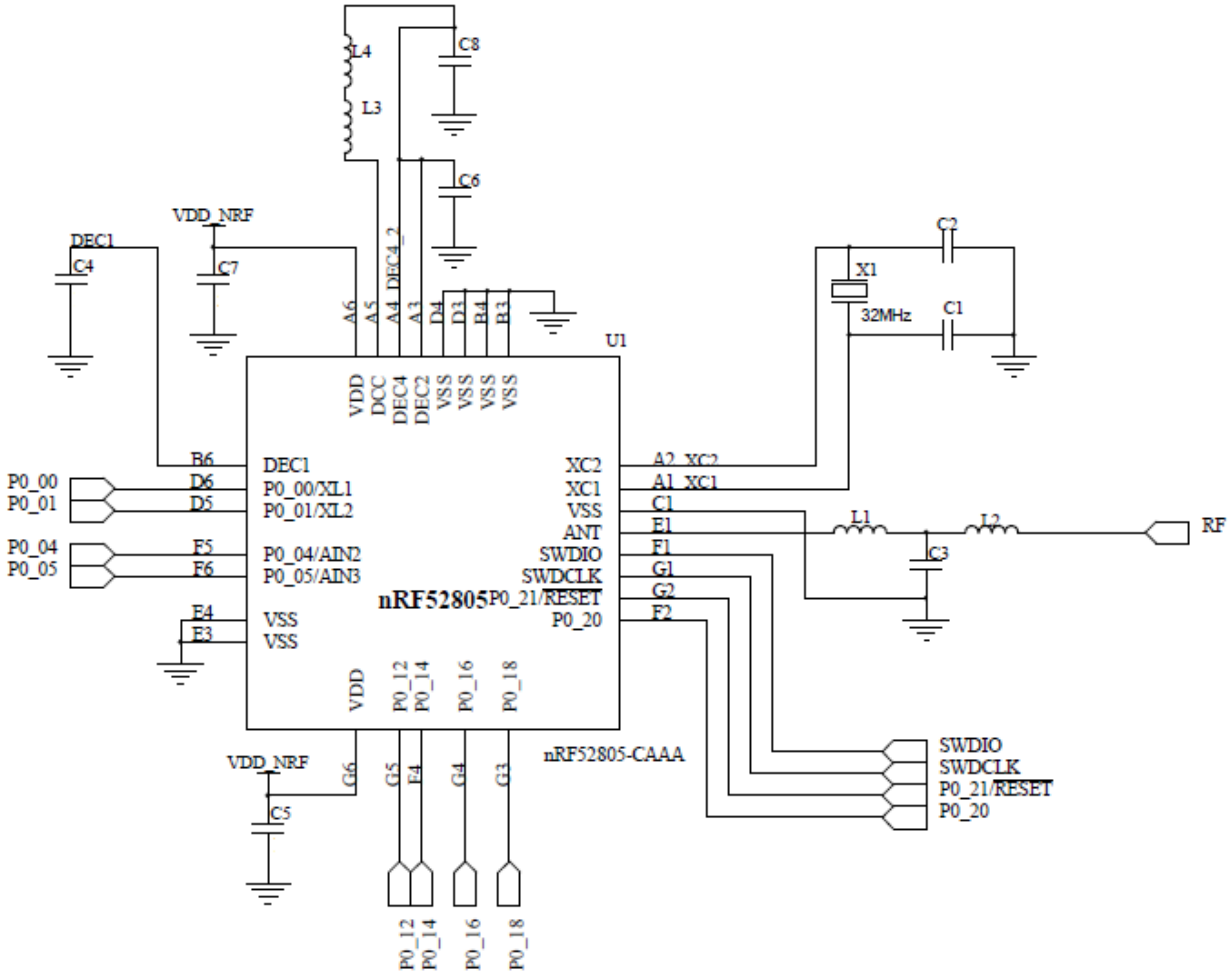

Figure 6. Schematic Diagram of RF-BM-ND09

4.4 Antenna

4.4.1 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 is a key factor 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.

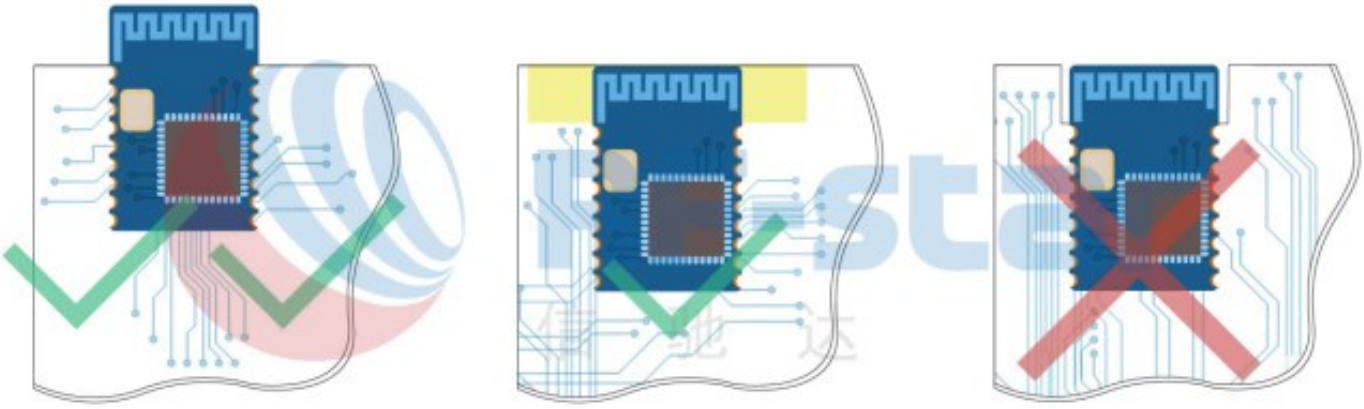

Figure 7. Recommendation of Antenna Layout

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

4.5 Basic Operation of Hardware Design

1. It is recommended to offer the module with 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 fluctuated 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 degrees;
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.

4.6 Trouble Shooting

4.6.1 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 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 a metal near the antenna or the module is placed inside the metal shell.
4. The incorrect power register set or the high data rate in an 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 the antenna will affect the communication distance.

4.6.2 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 fluctuated 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 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.

4.6.3 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.

4.7 Electrostatics Discharge Warnings

The module will be damaged for 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 the failure.

4.8 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 ℃.

Table 5. 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 ℃	150 ℃
Max. Preheating Temperature (T_{max})	150 ℃	200 ℃
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 ℃/s	Max. 3 ℃/s
Liquid Temperature (T_L)	183 ℃	217 ℃
Time above Liquidus (t_L)	60 s ~ 90 s	30 s ~ 90 s
Peak Temperature (T_p)	220 ℃ ~ 235 ℃	230 ℃ ~ 250 ℃
Average Descend Rate (T_p to T_{max})	Max. 6 ℃/s	Max. 6 ℃/s
Time from 25 ℃ to Peak Temperature (t_2)	Max. 6 minutes	Max. 8 minutes
Time of Soldering Zone (t_P)	20±10 s	20±10 s

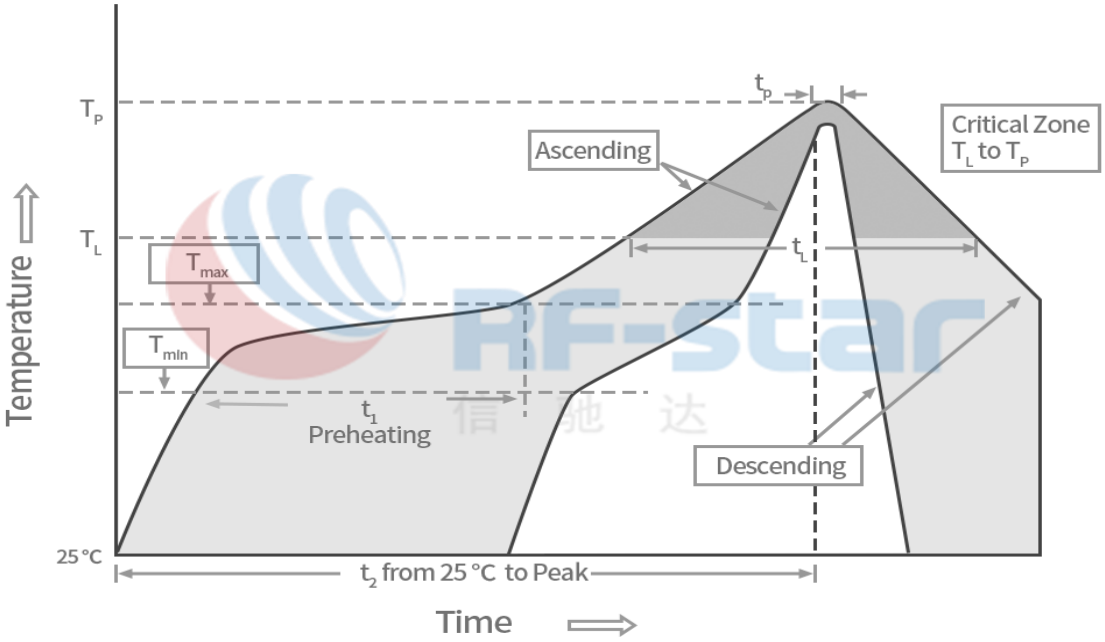

Figure 8. Recommended Reflow for Lead-Free Solder

4.9 Optional Packaging

Figure 9. Optional Packaging Mode

Note: Default tray packaging.

5 Revision History

Date	Version No.	Description
2020.11.02	V1.0	The initial version is released.

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.szrfstar.com.

6 Contact Us

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