



RF-BM-2755D1 Bluetooth 6.0 Low Energy Module

For Channel Sounding

Version 1.0

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1 Device Overview

1.1 Description

RF-BM-2755D1 is a wireless connectivity module based on TI CC2755R10. It integrates a 48 MHz crystal and a 32.768 kHz crystal, up to 1 MB programmable flash, and 162 KB SRAM making it possible in many complex applications. Its 96 MHz ARM® Cortex®-M33 core can operate at an extremely low current at flexible power modes. Its multiprotocol 2.4 GHz RF transceiver is compatible with Bluetooth® 6.0 Low Energy of Channel Sounding, and 2.4 GHz Proprietary. Up to optional 10 dBm TX power enables it in long-range requirement applications. It features a small size, robust connection distance, and rigid reliability. The dual onboard PCB antenna makes it perfect in directing applications with a higher accuracy and higher security.

1.2 Key Features

- RF Features
 - Bluetooth® 6.0 Low Energy for Channel Sounding
 - Matter
 - ZigBee® 3.0
 - Proprietary
 - Multi-Protocol
- TX power: up to +10 dBm
- RF sensitivity
 - -103.5 dBm sensitivity @ 125 kbps GFSK
 - -97.0 dBm sensitivity @ 1 Mbps GFSK
 - -103.0 dBm sensitivity @ IEEE 802.15.4(2.4 GHz)
- Low Power Consumption
 - RX current: 6.1 mA
 - TX current at 0 dBm: 7.7 mA
 - TX current at +10 dBm: 24.5 mA
 - Active mode MCU 96 MHz (CoreMark®): 6.8 mA
 - Standby: 0.9 µA (low power mode, RTC on, full SRAM retention)
 - Shutdown: 160 nA
- Microcontroller
 - Powerful 96 MHz ARM® Cortex®-M33 with FPU (floating point unit), TrustZone®-M support and CDE (custom datapath extension) for machine learning acceleration
- Algorithm Processing Unit (APU) (96 MHz)
 - ♦ Mathematical accelerator for efficient vector and matrix operations
 - ♦ Bluetooth® Channel Sounding post-processing support for IFFT and advanced super-resolution algorithms such as Multiple Signal classification (MUSIC)
- Memory
 - 1 MB of in-syste programmable flash
 - 162 KB of SRAM
 - 32 KB of System ROM with secure boot root of trust (RoT) and a serial (SPI/UART) bootloader
 - Serial wire debug (SWD)
- Support OTA upgrade
- Wide Operation Range
 - Power supply: 1.71 V ~ 3.8 V
 - Operating temperature: -40 °C to +85 °C
 - Storage temperature: -40 °C to +125 °C
- Wide Peripherals
 - 21 GPIOs, digital peripherals can be routed to

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- multiple GPIOs:
 - ♦ 2 SWD IO pads, multiplexed with GPIOs
 - ♦ 19 DIOs (analog or digital IOs)
- All GPIOs with wakeup and interrupt capabilities
- 3 × 16-bit and 1 × 32-bit general-purpose timers, quadrature decode mode support
- Real-time clock (RTC)
- Watchdog timer
- System timer for radio, RTOS, and application operations for Bluetooth® channel sounding
- Postprocessing
- 12-bit ADC, up to 1.2MSPS, eight external inputs
- Temperature sensor and battery monitor
- 1× low-power comparator
- 2× UART with LIN capability
- 2× SPI
- 1× I2C
- 1× I2S
- Security Vault
 - Hardware Security Module (HSM) with proprietary controller and dedicated memories supporting accelerated cryptographic operations and secure key storage:
 - ♦ AES (up to 256 bits) crypto accelerator
 - ♦ ECC (up to 521 bits), RSA (up to 3072 bits) public key accelerator
 - ♦ SHA-2 (up to 512 bits) accelerator
 - ♦ True random number generator
 - ♦ HSM firmware update support
 - ♦ Differential power analysis (DPA) countermeasures for AES and ECC
 - Separate AES 128-bit cryptographic accelerator (LAES) for latency-critical link-layer operations
 - Secure boot and secure firmware updates
 - Secure boot root of trust (RoT)
 - Cortex®-M33 TrustZone-M, MPU, memory firewalls for software isolation
 - Voltage glitch monitor (VGM)
- Dimension: 32.5 mm × 32.0 mm × 0.8 mm

1.3 Applications

- Proximity Awareness
 - Geofencing
 - Door lock
 - Keyless entry
- Locating Solutions
 - Warehouse management
 - Pet tracking
 - Item Tracking
- Vehicle Access Entry
- Indoor Ranging

1.4 Functional Block Diagram

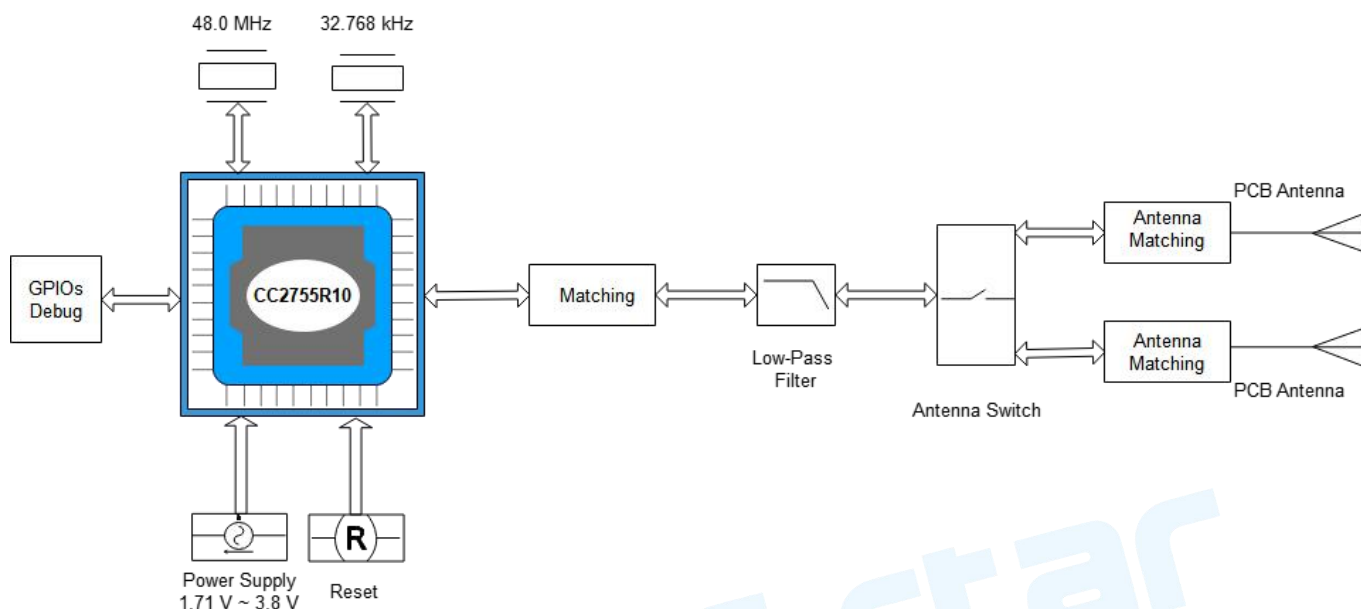


Figure 1. Functional Block Diagram of RF-BM-2755D1

1.5 Part Number Conventions

The part numbers are of the form of RF-BM-2755D1 where the fields are defined as follows:

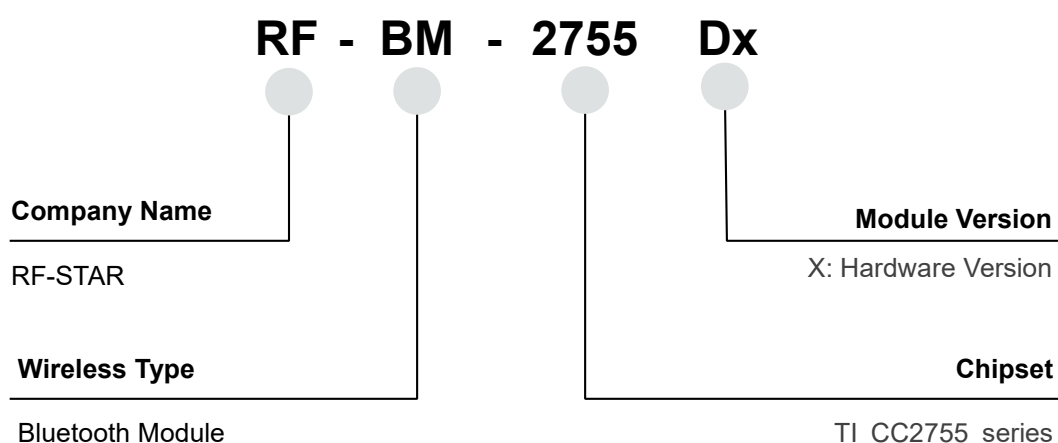


Figure 2. Part Number Conventions of RF-BM-2755D1

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2 Module Configuration and Functions

2.1 Module Parameters

Table 1. Parameters of RF-BM-2755D1

Chipset	CC2755R105E0WRHAR
Supply Power Voltage	1.71 V ~ 3.8 V, 3.3 V is recommended
Frequency	2360 MHz ~ 2500 MHz
Maximum Transmit Power	+10.0 dBm
Receiving Sensitivity	-103.5 dBm sensitivity @ 125 kbps GFSK -97.0 dBm sensitivity @ 1 Mbps GFSK -103.0 dBm sensitivity @ IEEE 802.15.4(2.4 GHz)
GPIO	21
Flash	1 MB
SRAM	162 KB
ROM	32 KB of System ROM with secure boot root
Power Consumption	RX current: 6.1 mA TX current at 0 dBm: 7.7 mA TX current at +10 dBm: 24.5 mA Active mode MCU 96 MHz (CoreMark®): 6.8 mA Standby: 0.9 μ A (low power mode, RTC on, full SRAM retention) Shutdown: 160 nA
Support Protocol	Bluetooth® 6.0 Low Energy for Channel Sounding, Matter, ZigBee® 3.0, Proprietary, Multi-Protocol
Crystal	48 MHz, 32.768 kHz
Package	SMT packaging (1.27-mm half-hole pitch stamp stick)
Dimension	32.5 mm × 32.0 mm × 0.8 mm ($\pm$ 0.2)
Type of Antenna	Dual PCB antenna
Operating Temperature	-40 °C ~ +85 °C
Storage Temperature	-40 °C ~ +125 °C

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2.2 Module Pin Diagram

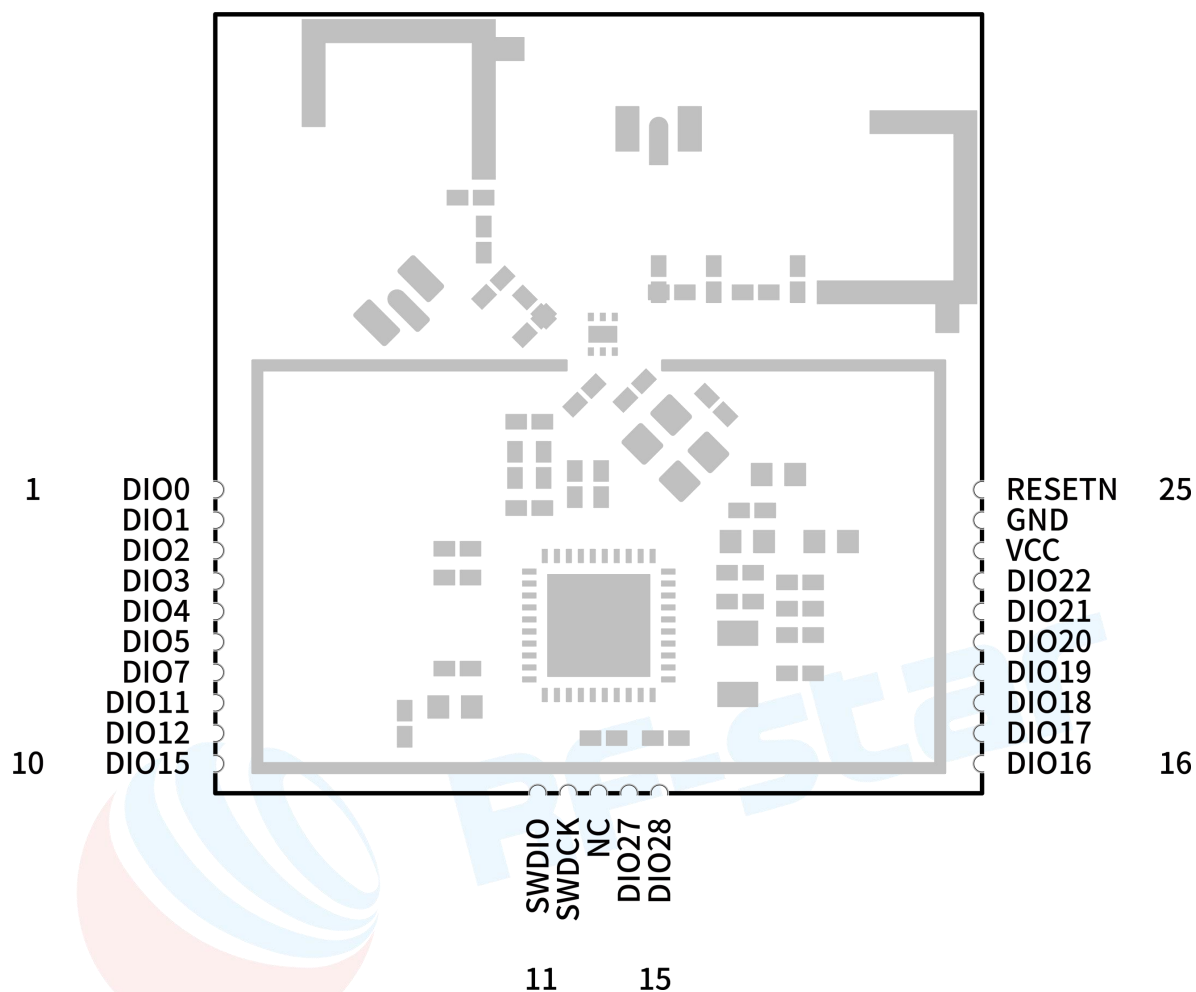


Figure 3. Pin Diagram of RF-BM-2755D1

2.3 Pin Functions

Table 2. Pin Functions of RF-BM-2755D1

Pin	Name	Chip Pin	Type	Description
1	DIO0	DIO0	Digital	GPIO
2	DIO1	DIO1	Digital	GPIO
3	DIO2	DIO2	Digital	GPIO, high-drive capability
4	DIO3	DIO3	Digital	GPIO, high-drive capability
5	DIO4	DIO4	Digital	GPIO
6	DIO5	DIO5	Digital	GPIO
7	DIO7	DIO7	Digital	GPIO
8	DIO11	DIO11	Digital	GPIO

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9	DIO12	DIO12	Digital	GPIO
10	DIO15	DIO15	Digital	GPIO
11	SWDIO	DIO9_SWDIO	Digital	GPIO, SWD interface: mode select or SWDIO, high-drive capability
12	SWDCK	DIO10_SWDCK	Digital	GPIO, SWD interface: serial wire clock, high-drive capability
13	NC	NC	None connect	None connect
14	DIO27	DIO27_A1	Digital or Analog	GPIO, analog capability
15	DIO28	DIO28_A0	Digital or Analog	GPIO, analog capability
16	DIO16	PA09	Digital	GPIO
17	DIO17	DIO17_A8	Digital or Analog	GPIO, analog capability, high-drive capability
18	DIO18	DIO18_A7	Digital or Analog	GPIO, analog capability, high-drive capability
19	DIO19	DIO19_A6	Digital or Analog	GPIO, analog capability
20	DIO20	DIO20_A5	Digital or Analog	GPIO, analog capability
21	DIO21	DIO21_A4	Digital or Analog	GPIO, analog capability
22	DIO22	DIO22_A3	Digital or Analog	GPIO, analog capability
23	VCC	-	Power	Power supply: 1.71 V ~ 3.8 V
24	GND	-	Ground	Ground
25	RESETN	-	Digital	Reset, active low. Internal pullup resistor.

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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-2755D1

Items	Condition	Min.	Typ.	Max.	Unit
Operating Supply Voltage	/	1.71		3.8	V
Operating Temperature	/	-40	+25	+85	℃

3.2 Handling Ratings

Table 4. Handling Ratings of RF-BM-2755D1

Items	Condition	Min.	Typ.	Max.	Unit
Storage Temperature	Tstg	-40	+25	+125	℃
Human Body Model	HBM		±1000		V
Moisture Sensitivity Level			3		
Charged Device Model			±250		V

4 Application, Implementation, and Layout

4.1 Module Photos

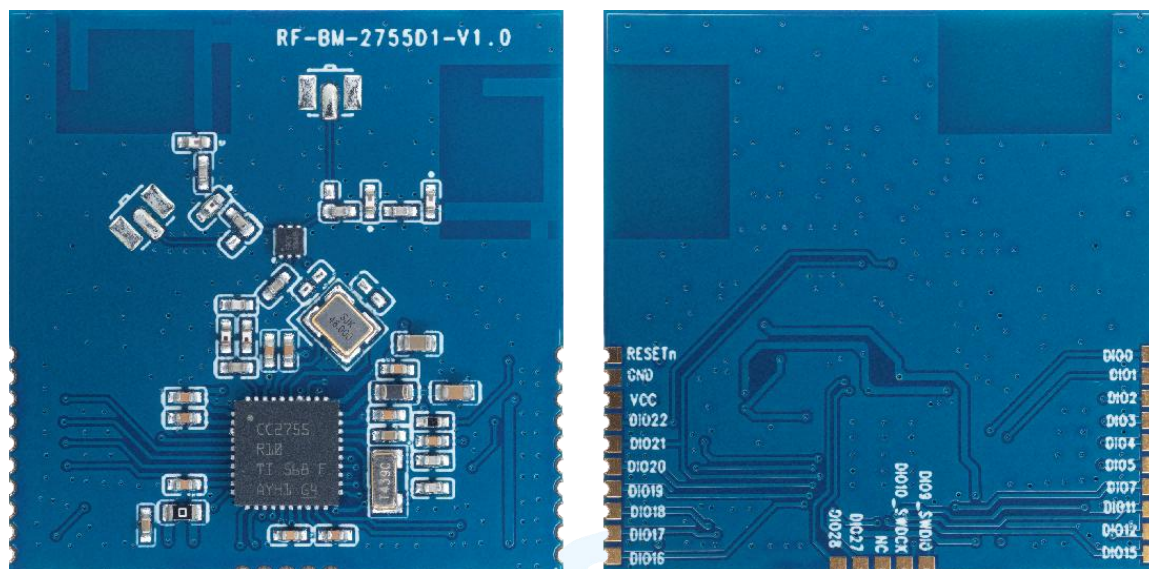


Figure 4. Photos of RF-BM-2755D1

4.2 Recommended PCB Footprint

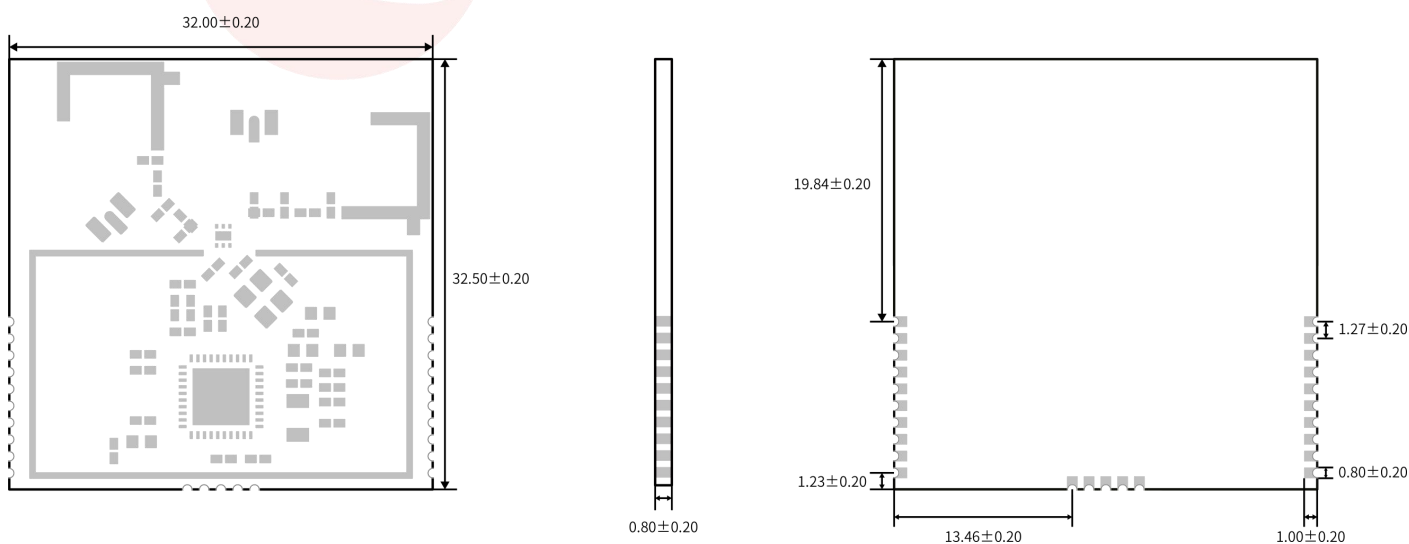


Figure 5. Recommended PCB Footprint of RF-BM-2755D1 (mm)

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4.3 Schematic Diagram

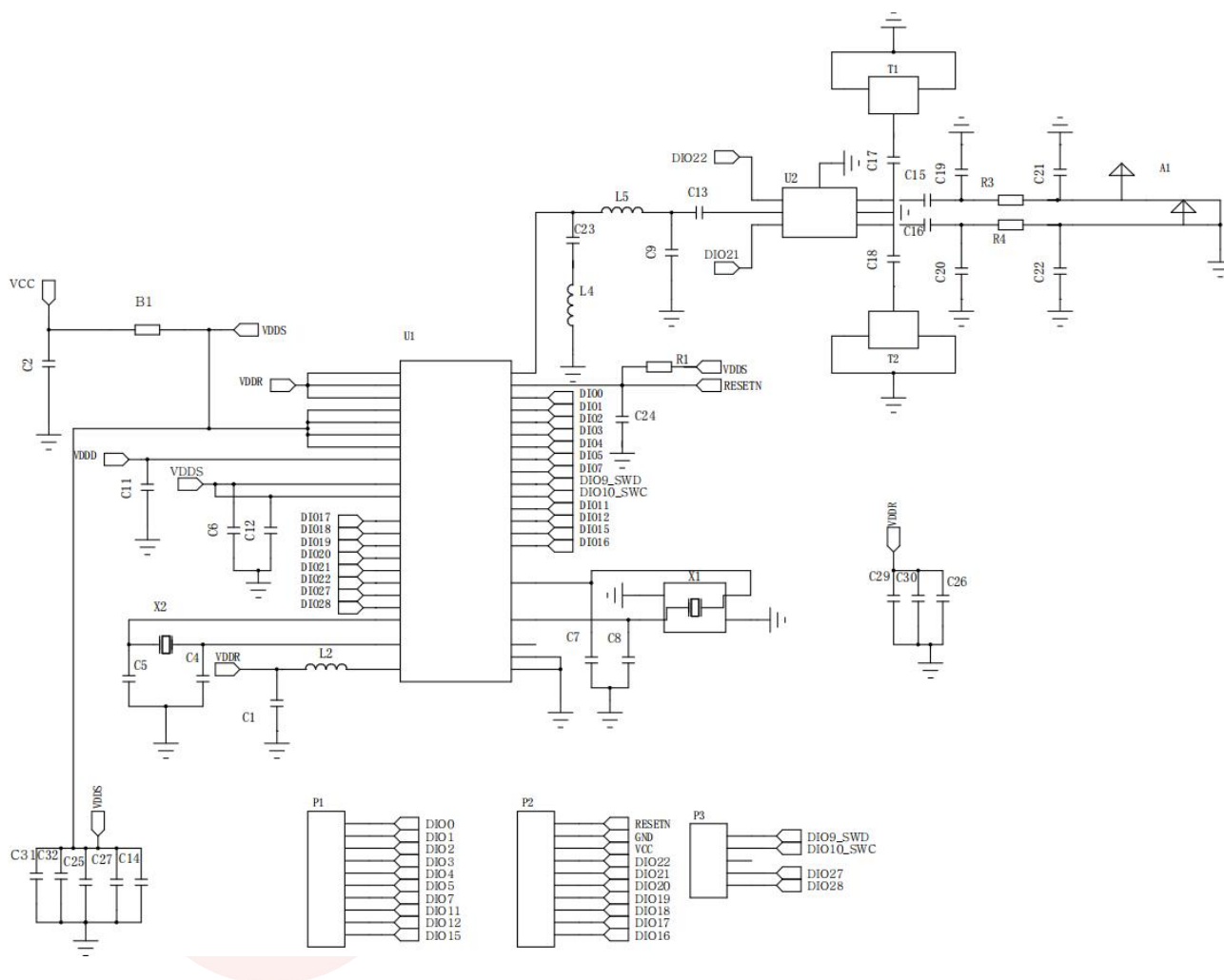


Figure 6. Schematic Diagram of RF-BM-2755D1

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 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:

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- (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.

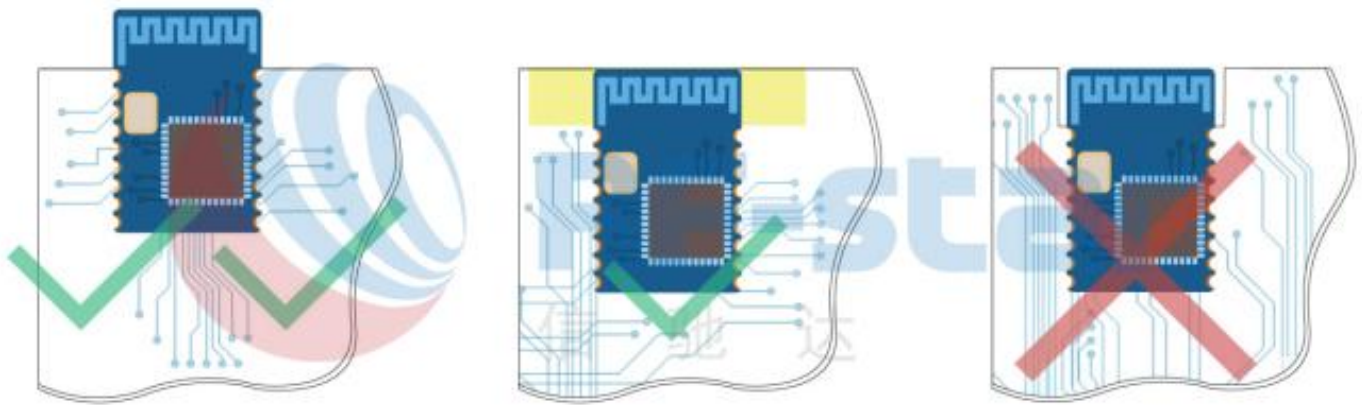


Figure 7. Recommendation of Antenna Layout

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 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.

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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 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 the communication packet loss rate. The performance 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 unmatched antennas and modules or the poor quality of 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 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.

4.6.3 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.

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- 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 by the discharge of static. RF-star suggests that all modules should follow the 3 precautions below:

- According to the anti-static measures, bare hands are not allowed to touch modules.
- Modules must be placed in anti-static areas.
- 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.

4.8 Soldering and Reflow Condition

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

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 °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

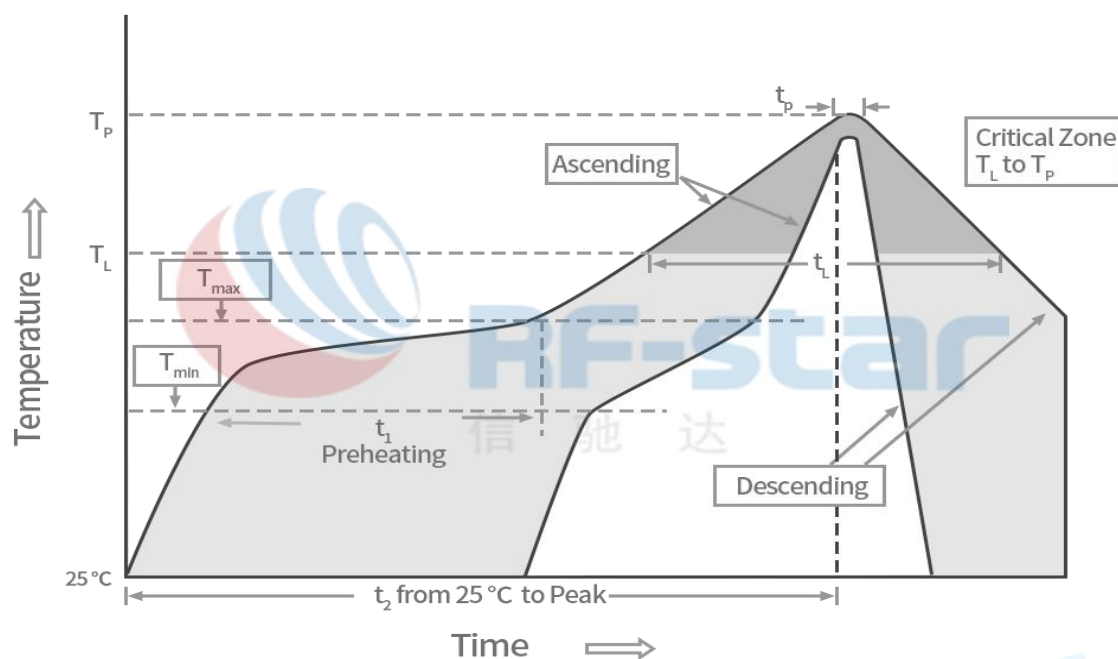


Figure 8. Recommended Reflow for Lead-Free Solder

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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.

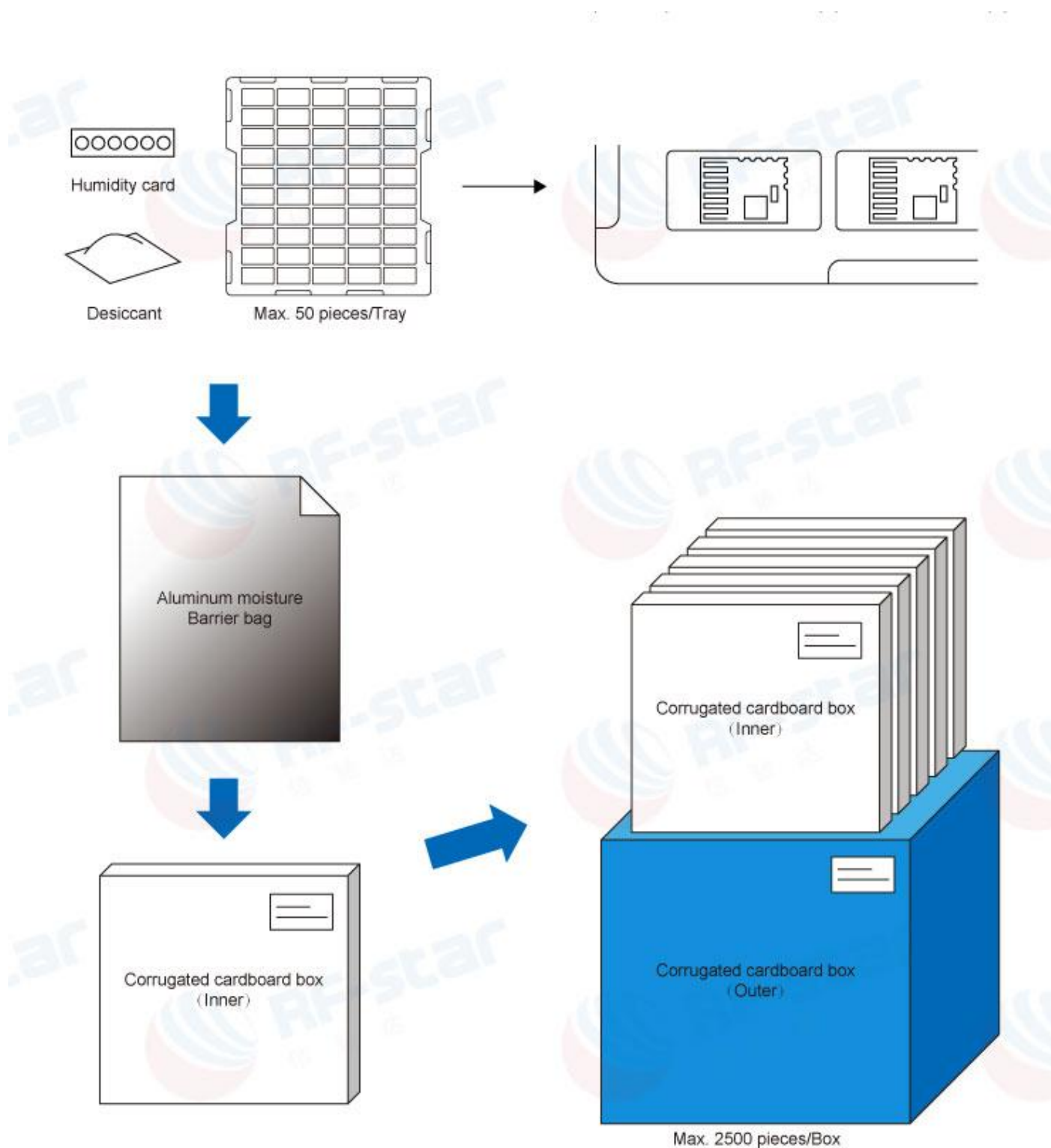


Figure 9. Default Package by Tray

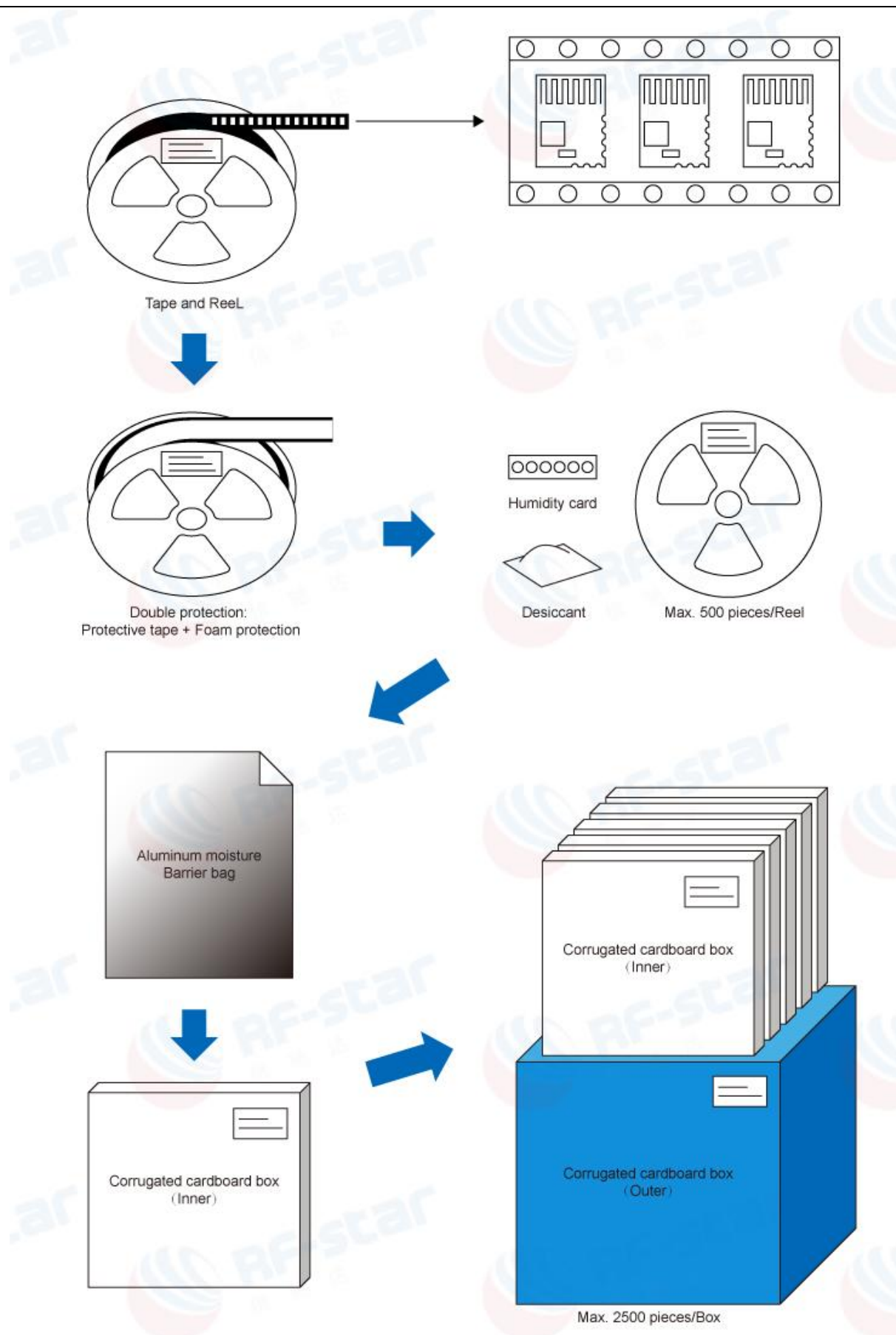


Figure 10. Package by Tape & Reel

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6 Revision History

Date	Version No.	Description
2026.02.03	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.rfstariot.com and www.szrfstar.com.



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