FSC-BT2054RI

DATASHEET V1.1

Revision History

Version	Data	Notes	Author
V1.0	2025-05-06	Initial Version	Ma
V1.1	2025-10-17	Summary of Revisions and Update to Product Packaging Information	Ma

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1 INTRODUCTION

Overview

The FSC-BT2054RI is a highly integrated module for BR/EDR/BLE. It allows one active link in either slave mode or master mode. For low energy consumption, it supports multiple states and allows an active link to be in slave mode. BR/EDR link and an LE link can be active at the same time.

The communication between Host and module is facilitated through UART port, and with FeasyBlue Bluetooth stack, users can control all Bluetooth audio and data transmission through simple API functions.

Therefore, FSC-BT2054RI provides an ideal solution for developers who wish to integrate Bluetooth wireless technology into their design.

Features

- **Bluetooth 5.3 specification compliant**
  - Bluetooth classic (BDR/EDR)
  - Bluetooth low energy (BLE)
    - Generic access service
    - Device information service
    - LE Isochronous Channel(CIS/BIS/ISOAL)
    - Support LE Audio CIS/BIS Auracast
- **High speed digital peripheral interfaces: UART**
- **Integrated 32K oscillator for power management**
- **Bluetooth Controller**
  - Compatible with Bluetooth v2.1 and v3.0 systems
  - Supports Bluetooth 5.3 Low Energy (BLE)
  - HS-UART interface for Bluetooth data transmission compliant with H4 specification
  - Integrates MCU to execute Bluetooth protocol stack
  - Supports all packet types in basic rate and enhanced data rate
  - Supports legacy pairing and secure simple pairing in BR/EDR and BLE
  - Supports Low Power Mode (Sniff mode)
  - Enhanced BT/Wi-Fi Coexistence Control to improve transmission quality in different profiles
  - Bluetooth 5.3 Dual Mode support simultaneous BLE and BR/EDR
  - Supports multiple Low Energy States

Applications

- Bluetooth KEY
- Smart home
- Data transmission module

2 GENERAL SPECIFICATIONS

Table 2-1：General Specifications

Categories	Features	Implementation
Chip Type		RTL8761CTV-CG
Bluetooth		
	Bluetooth Standard	Bluetooth V5.3
	Frequency Band	2402MHz ~ 2480MHz
	Interface	UART/I²S/I²C
	Transmit Power	+10 dBm (Max.)
	Receiver	-95dBm (Min.) @BLE 1Mbps
Profile		BLE/SPP/A2DP/HFP/AVRCP/PBAP/HICAR/AAP
Size		12mm × 17 mm × 2.2mm
Operating temperature		-40°C ~+85°C
Storage temperature		-40°C ~+85°C
Supply Voltage		3.3V（Typical）
Miscellaneous	Lead Free Warranty	Lead-free and RoHS compliant One Year
Humidity		10% ~ 90% non-condensing
MSL grade		MSL 3
ESD grade		Human Body Model: Pass ±2000 V Charge Device Model: Pass ±500 V

3 HARDWARE SPECIFICATIONS

3.1 Block Diagram and PIN Diagram

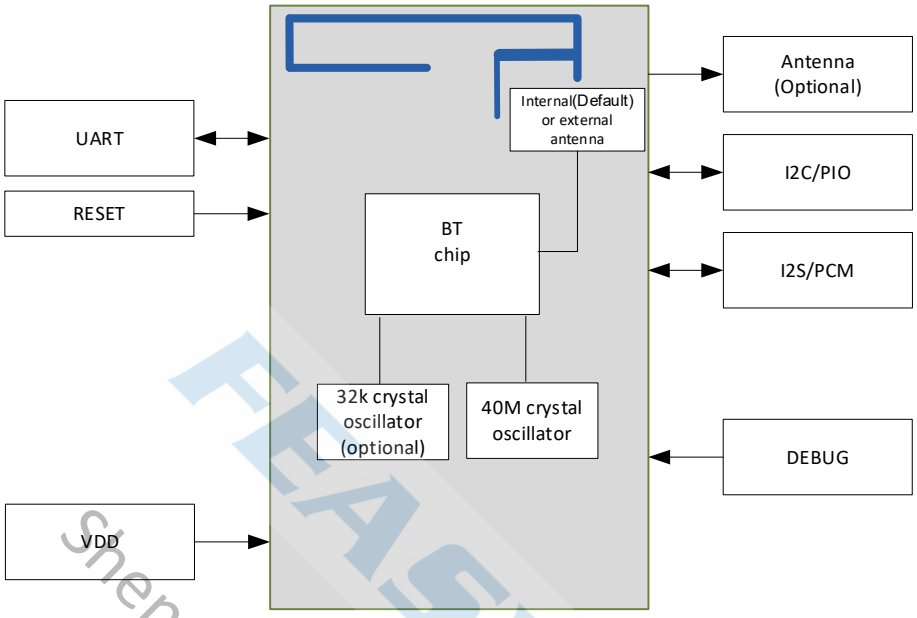

Figure 3-1-1: FSC-BT2054RI Block Diagram

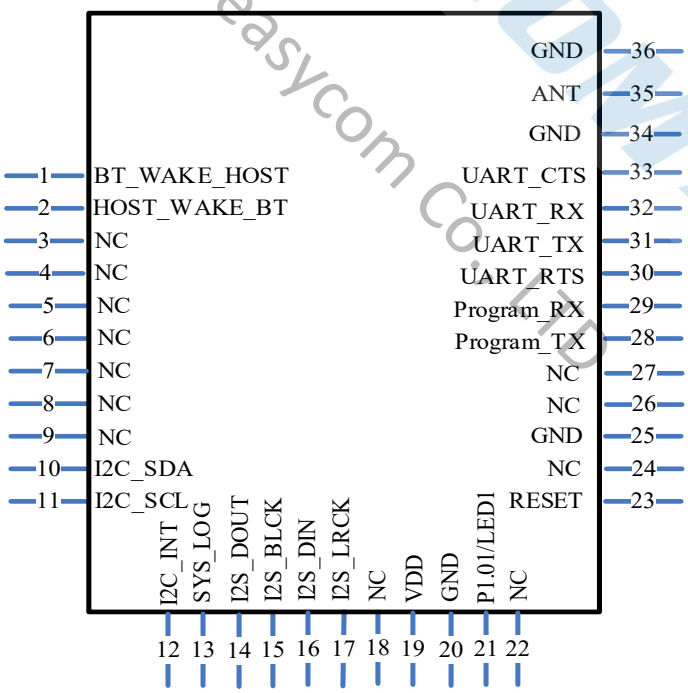

Figure 3-1-2: FSC-BT2054RI PIN Diagram (Top View)

3.2 Module Package Type

LCC package, as shown in the figure below.

Figure 3-2: FSC-BT2054RI Package Module Appearance

3.3 PIN Definitions

Table 3-3：Pin definitions

Pin	Pin Name	Type	Pin Descriptions	Notes
1	BT_WAKE_HOST	I/O	Programmable I/O	
2	HOST_WAKE_BT	I/O	Programmable I/O	
3	NC			
4	NC			
5	NC			
6	NC			
7	NC			
8	NC			
9	NC			
10	I2C_SDA	I/O	I2C_SDA Alternative function: Programmable I/O	
11	I2C_SCL	I/O	I2C_SCL Alternative function: Programmable I/O	
12	I2C_INT	I/O	I2C_INT Alternative function: Programmable I/O	
13	SYS_LOG	I/O	SYS_LOG Alternative function: Programmable I/O	
14	I2S_DOUT	I/O	Programmable I/O	

			Alternative function: I2S_DOUT/PCM_OUT
15	I2S_BLCK	I/O	Programmable I/O Alternative function: I2S_BLCK/PCM_CLK
16	I2S_DIN	I/O	Programmable I/O Alternative function:I2S_DIN/ PCM_IN
17	I2S_LRCK	I/O	Programmable I/O Alternative function: I2S_LRCK/PCM_SYNC
18	NC		
19	VDD	VDD	3.2V~3.6V
20	GND	Vss	Power Ground
21	P1.01/LED1	I/O	LED1 Alternative function: Programmable I/O
22	NC		
23	RESET	I	RESET System rest input with pull high, low active with at least 8ms low to trigger system rest
24	NC		
25	GND	Vss	Power Ground
26	NC		
27	NC		
28	Program_TX	I/O	Program_IO2(Program_TX): Download program port
29	Program_RX	I/O	Program_IO1(Program_RX): Download program port
30	UART_RTS	I/O	UART_RTS Alternative function 1: Programmable I/O
31	UART_TXD	O	UART_TXD Alternative function 1: Programmable I/O
32	UART_RXD	I	UART_RXD Alternative function 1: Programmable I/O
33	UART_CTS	I/O	UART_CTS Alternative function 1: Programmable I/O
34	GND	Vss	Power Ground
35	ANT	RF	Bluetooth transmit/receive(Optional)
36	GND	Vss	Power Ground

Note: PWR=Power Input(3.2V~3.6V); I/O=Bi-directional(3.2V~3.6V); I=Input; O=Output; RF=RF Pin; GND=Ground; F=Floating (Not Connected)

4 ELECTRICAL CHARACTERISTICS

4.1 UART Interface

The FSC-BT2054RI UART interface is a standard 4-wire interface with RX, TX, CTS, and RTS. It supports H4 HCI interface.

The default baud rate is 115.2k baud. In order to support high and low speed baud rates, FSC-BT2054RI provides multiple UART clocks.

Table 4-1： Possible UART Settings

Parameter	Possible Values
Baud rate	Minimum - 4M bps
	Standard 115.2k bps
	Minimum - 1.2K bps
Flow control	Supports Automatic Flow Control (CTS and RTS lines)
Parity	None, Odd or Even
Number of stop bits	1
Bits per channel	8

5 MSL & ESD

Table 5-1: MSL and ESD

Parameter	Value
MSL grade	MSL 3
ESD grade	Electrostatic discharge
ESD – Human-body model (HBM) rating, JESD22-A114-F (Total samples from one wafer lot)	Pass ±2000 V, all pins
ESD – Charge-device model (CDM) rating, JESD22-C101-D (Total samples from one wafer lot)	Pass ±500 V, all pins

6 RECOMMENDED TEMPERATURE REFLOW PROFILE

Prior to reflow, it is crucial to ensure that the modules are properly packaged to prevent moisture absorption. The new packages are equipped with desiccants to absorb moisture, and a humidity indicator card is included to indicate the moisture level maintained during storage and shipment. If the card indicates the need to bake the units, please refer to the instructions specified by IPC/JEDEC J-STD-033 and follow them accordingly. It is important to adhere to these instructions to prevent any potential moisture-related issues during the reflow process.

Note: The shipping tray should not be exposed to temperatures exceeding 65°C. If baking is necessary at higher temperatures indicated below, it is essential to remove the modules from the shipping tray. This precaution is important to avoid any potential damage or deformation to the tray caused by excessive heat.

Any module that exceeds its floor life but has not yet been manufactured should be repackaged by using new desiccants and humidity indicator cards. For devices with a Moisture Sensitivity Level (MSL) of 3, the floor life is 168

hours in an environment with 30℃/60%RH.

Floor life refers to the maximum allowable time a moisture-sensitive device can be exposed to ambient conditions without risking moisture absorption and potential damage during soldering.

Notice (注意)：

The Feasycom's module must be used with a Step-Stencil. It is suggested to use a stencil thickness of approximately 0.16-0.2mm, which can be modified according to the product.

使用我司模块，须使用阶梯钢网，建议阶梯钢网厚度0.16-0.20mm，可根据自己产品适应性，进行相应调整.

Table 6-1: Recommended baking times and temperatures

MSL	125°C Baking Temp.		90°C/≤ 5%RH Baking Temp.		40°C/ ≤ 5%RH Baking Temp.	
	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%
3	9 hours	7 hours	33 hours	23 hours	13 days	9 days

Feasycom surface mount modules are designed to facilitate easy manufacturing, including reflow soldering onto a PCB. However, it is the customer's responsibility to select the suitable solder paste and ensure that the oven temperatures during reflow meet the requirements specified by the solder paste manufacturer. Feasycom surface mount modules comply with the J-STD-020D1 standards for reflow temperatures.

The soldering profile may vary depending on different parameters, requiring a specific setup for each application. The data provided here is only intended as a general guideline for solder reflow and should be used as a reference.

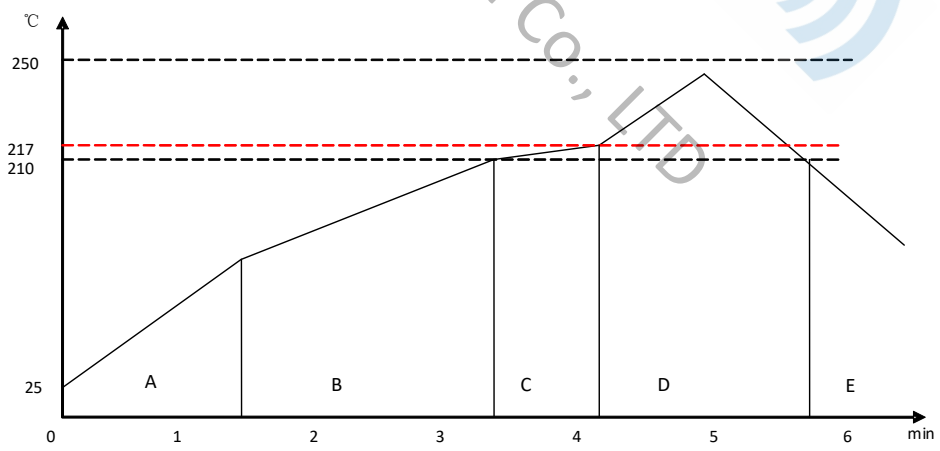

Figure6-1-1： Typical Lead-free Re-flow

Pre-heat zone (A) — This zone gradually increases the temperature at a controlled rate, usually **ranging from 0.5 to 2 °C/s**. Its purpose is to preheat the PCB board and components to a temperature of 120-150 °C. This stage is necessary to ensure the even distribution of heat across the PCB board and to remove any remaining solvents

completely, minimizing the risk of heat shock to the components.

Equilibrium Zone 1 (B) — In this stage, the flux undergoes softening and uniformly covers the solder particles, as well as spreading over the PCB board. This process helps prevent re-oxidation of the solder particles. Additionally, as the temperature rises and the flux liquefies, each activator and rosin component become activated. They work together to eliminate any oxide film formed on the surface of the solder particles and PCB board. **For this zone, it is recommended to maintain a temperature range of 150 to 210 °C for a duration of 60 to 120 seconds.**

Equilibrium Zone 2 (C) (optional) — To address the issue of upright components, it is recommended to maintain a temperature range of 210 to 217 °C for a duration of approximately 20 to 30 seconds. This will help ensure proper soldering and alignment of the components on the PCB board.

Reflow Zone (D) — The profile in the figure is designed for Sn/Ag3.0/Cu0.5. It can be a reference for other lead-free solder. The peak temperature should be high enough to achieve good wetting but not so high as to cause component discoloration or damage. Excessive soldering time can lead to intermetallic growth which can result in a brittle joint. The recommended peak temperature (Tp) is 230 ~ 250 °C. The soldering time should be 30 to 90 second when the temperature is above 217 °C.

Cooling Zone (E) — The cooling ate should be fast, to keep the solder grains small which will give a longer-lasting joint. **Typical cooling rate should be 4 °C.**

7 MECHANICAL DETAILS

7.1 Mechanical Details

- Dimension: 12mm(W) x 17mm(L) x 2.2mm(H) Tolerance: ±0.2mm
- Module size: 12mm X 17mm Tolerance: ±0.2mm
- Pad size: 1.7mmX0.5mm Tolerance: ±0.2mm
- Pad pitch: 0.9mm Tolerance: ±0.1mm
- **(Residual plate edge error: < 0.5mm)**

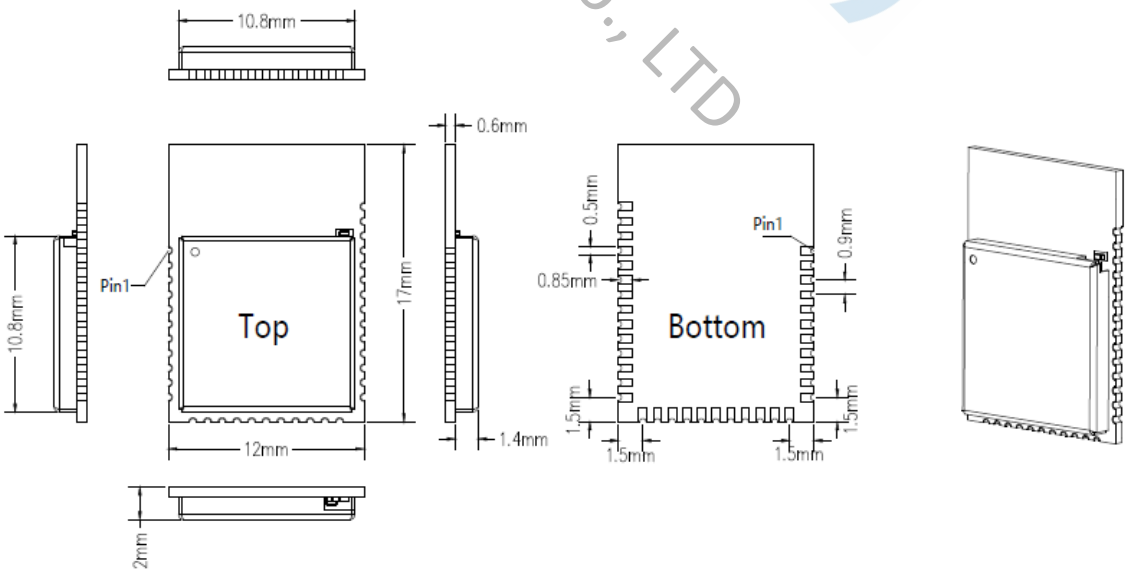

Figure 7-1-1： FSC-BT2054RI package dimensions diagram

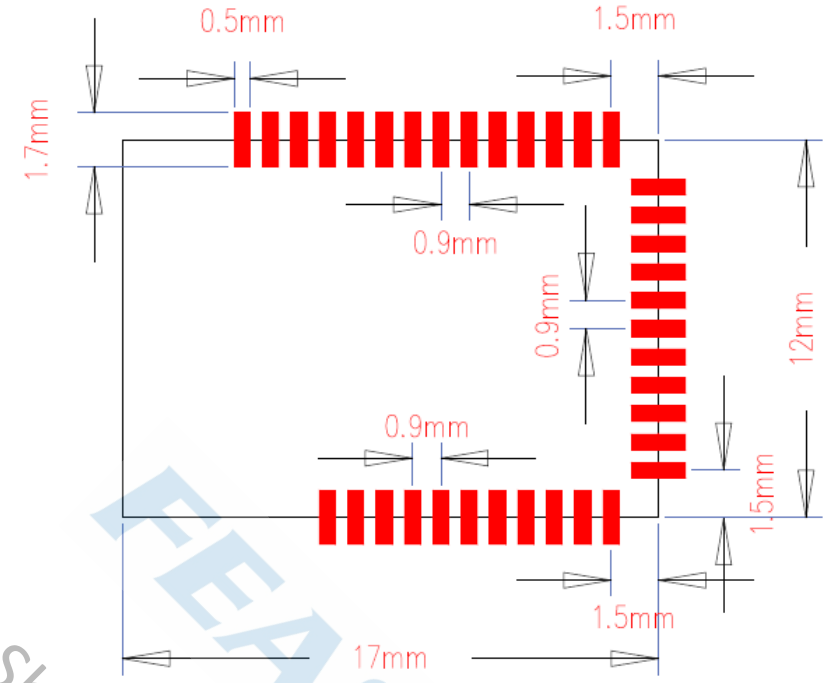

Figure 7-1-2： FSC-BT2054RI footprint Layout Guide (Top View)

8 HARDWARE INTEGRATION SUGGESTIONS

8.1 Soldering Recommendations

FSC-BT2054RI is compatible with the industrial standard reflow profile for Pb-free solders. The specific reflow profile used depends on many factors such as the thermal mass of the populated PCB, heat transfer efficiency of the oven and the type of solder paste used. It is advised to refer to the datasheet of the specific solder paste for profile configurations.

Feasycom provides the following recommendations for soldering the module to ensure reliable solder joints and proper module operation. However, since the optimal profile can vary based on the specific process and layout, these recommendations should be considered as a starting point guide and further study of the case is necessary.

8.2 Layout Recommendations for Product Design Structure

The onboard antenna of this module is a specially designed antenna. Its optimal performance characteristics are highly dependent on the actual product's structure, materials, module placement, the shape of the baseboard, and even the thickness and dimensions of the baseboard. Therefore, the customer's baseboard design must strictly adhere to this guide to achieve the best RF performance and complete real-world distance testing and validation.

8.2.1 Module Layout Recommendations

Recommendation 1: Place the module in the middle of the main board **(the customer's baseboard must be hollowed out)**. The TOP layer layout is shown in Figure 8-2-1:

- The upper edge of the module should align with the edge of the baseboard.
- The left edge of the module should be 11.1mm from the board edge, and the right edge of the module should be 12.1mm from the hollowed edge of the baseboard.

- No copper pour or traces are allowed on any layers beneath the IPEX connector.
- The hollowed-out area on the baseboard should measure 35.2x3.3mm.
- The clearance area on the baseboard should measure 21.3x2.0mm.

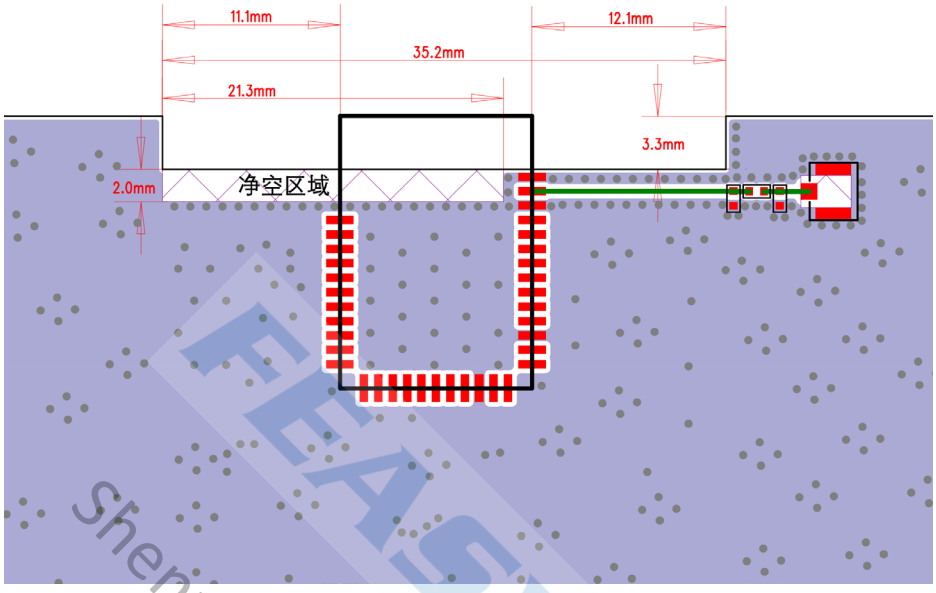

Figure 8-2-1： Module Layout - Baseboard TOP Layer

When the module is placed in the middle of the baseboard, the L2/L3/Ln...../Bottom layer layout is shown in Figure 8-2-2:

- The clearance area on L2/L3/Ln...../Bottom layers should measure 21.3x2.0mm.
- No copper pour or traces are allowed on any layers beneath the IPEX connector.

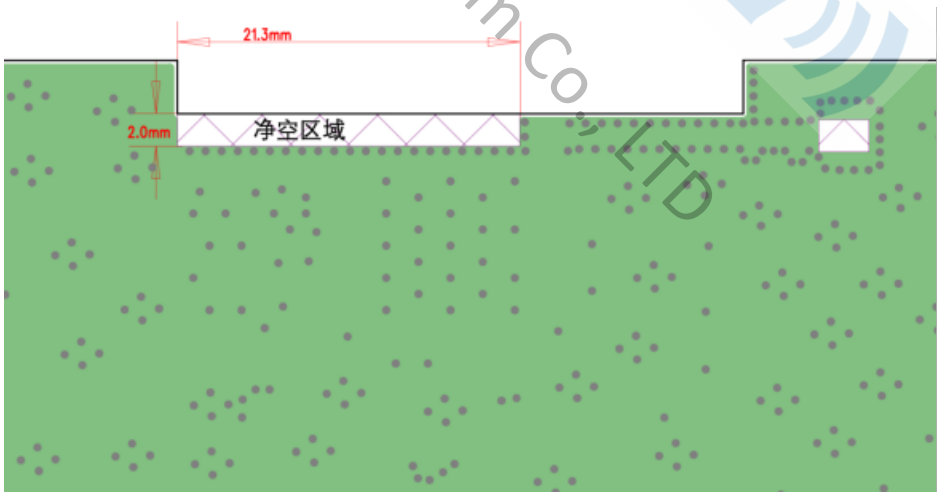

Figure 8-2-2： Module Layout - Baseboard L2/L3/BOTTOM Layers

Recommendation 2: Similar to Recommendation 1, place the module at the edge of the baseboard **(the customer's baseboard must be hollowed out)**. The TOP layer layout is shown in Figure 8-2-3:

- The upper edge of the module should align with the edge of the baseboard.

- The left edge of the module should be 11.1mm from the board edge, and the right edge of the module should be 12.1mm from the hollowed edge of the baseboard.
- No copper pour or traces are allowed on any layers beneath the IPEX connector.
- The hollowed-out area on the baseboard should measure 35.2x3.3mm.
- The clearance area on the baseboard should measure 21.3x2.0mm.

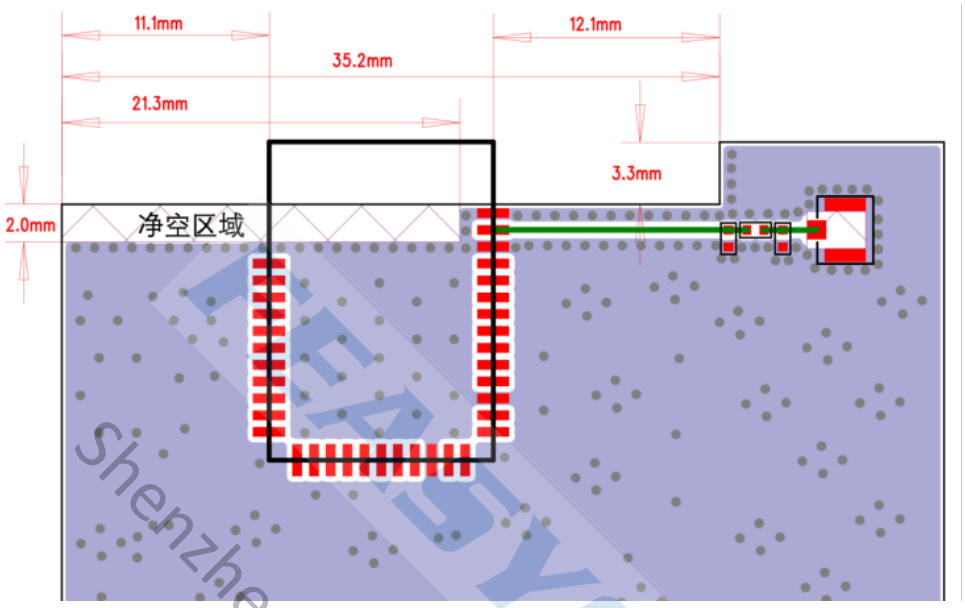

Figure 8-2-3： Module Layout - Baseboard TOP Layer

When the module is placed at the corner of the main board, the L2/L3/Ln...../Bottom layer layout is shown in Figure 8-2-4:

- The clearance area on L2/L3/Ln...../Bottom layers should measure 21.23x2.0mm.
- No copper pour or traces are allowed on any layers beneath the IPEX connector.

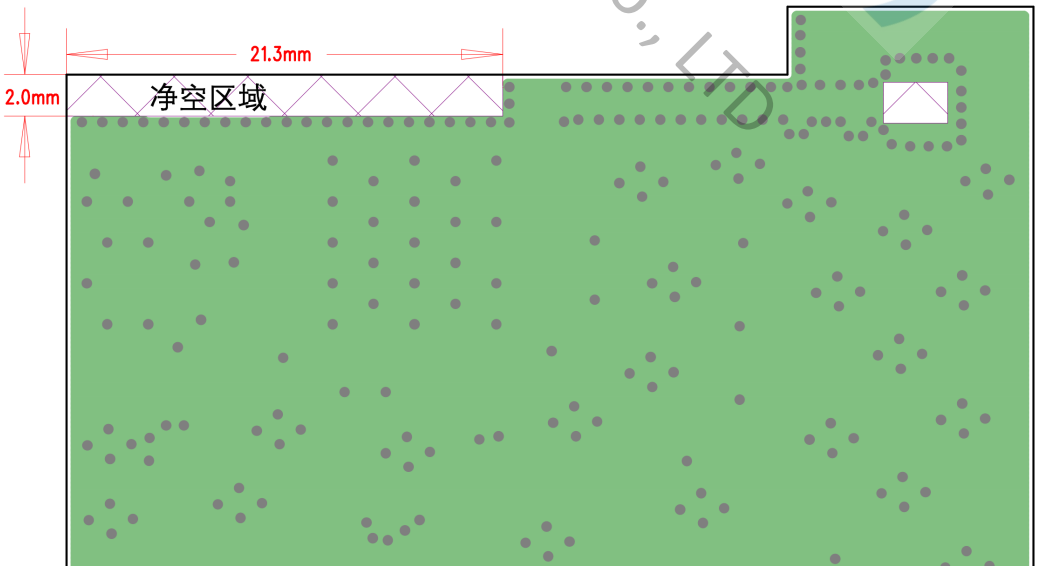

Figure 8-2-4： Module Layout - Main Board L2/L3/Ln...../BOTTOM Layers

8.2.2 Special Trace Recommendations

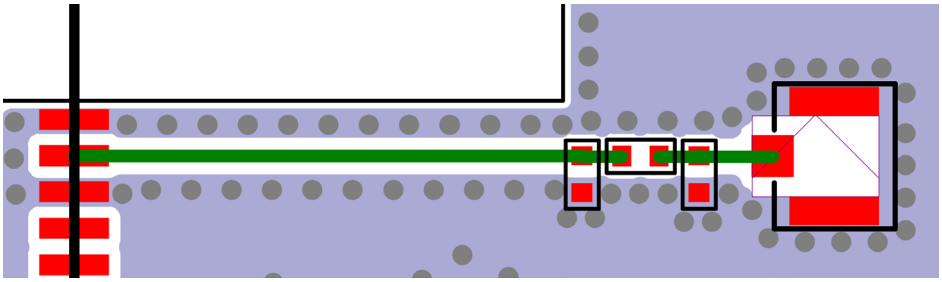

Figure 8-2-5： External Antenna Trace Schematic

The signal transmission line from the module to the antenna matching circuit should be a 50-ohm characteristic impedance microstrip line. The width of the microstrip line and the spacing from the ground copper must be determined based on the specific PCB layer stack-up. No intersecting lines are allowed between the microstrip line and the ground. All layers beneath the IPEX connector must be cleared (as shown by the purple cross-hatched area under the connector).

8.3 Layout Guidelines (External Antenna)

The placement and PCB layout play a critical role in optimizing the performance of modules without on-board antenna designs. The trace connecting the antenna port of the module to an external antenna should have a characteristic impedance of 50Ω and should be kept as short as possible to prevent interference into the transceiver of the module. When positioning the external antenna and RF-IN port of the module, it is important to keep them away from any sources of noise and digital traces. To minimize return loss and achieve better impedance matching, a matching network may be required between the external antenna and RF-IN port.

To ensure proper RF performance, it is recommended to clearly separate the RF critical circuits of the module from any digital circuits on the system board. The RF circuits within the module are located near the antenna port. Therefore, the module should be placed in such a way that the module's digital part faces the digital section of the system PCB.

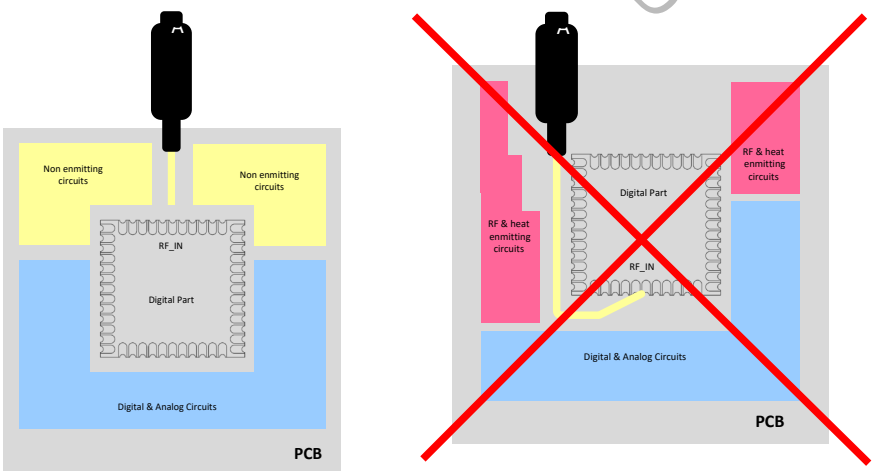

Figure 8-3-1: Placement the Module on a System Board

8.3.1 Antenna Connection and Grounding Plane Design

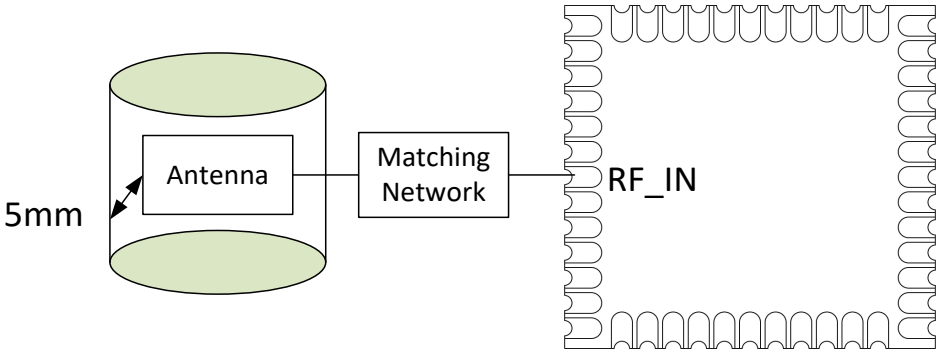

Figure 8-3-1-1: Leave 5mm Clearance Space from the Antenna

General design recommendations are:

- The length of the trace or connection line should be kept as short as possible.
- Distance between connection and ground area on the top layer should be at least as large as the dielectric thickness.
- Routing the RF close to digital sections of the system board should be avoided.
- To reduce signal reflections, sharp angles in the routing of the micro strip line should be avoided. Chamfers or fillets are preferred for rectangular routing; 45-degree routing is preferred over Manhattan style 90-degree routing.

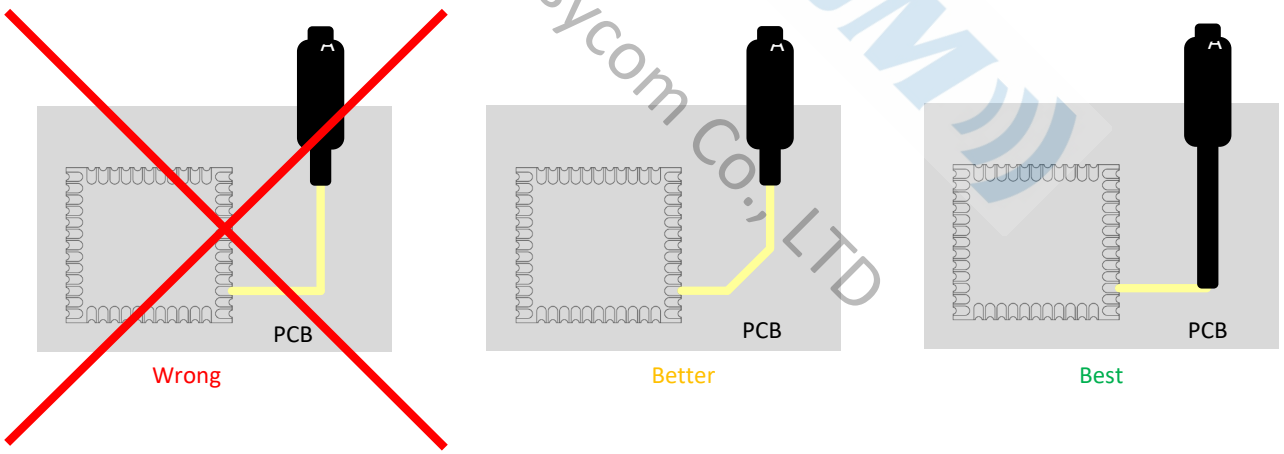

Figure 8-3-1-2: Recommended Trace Connects Antenna and the Module

- Routing of the RF-connection underneath the module should be avoided. The distance of the micro strip line to the ground plane on the bottom side of the receiver is very small and has huge tolerances. Therefore, the impedance of this part of the trace cannot be controlled.
- Use as many vias as possible to connect the ground planes.

9 PRODUCT PACKAGING INFORMATION

9.1 Default Packing

a, Tray vacuum

b, Tray Dimension: 230mm * 180mm* 8mm

Figure 9-1-1: Tray vacuum

9.2 Packing box (Optional)

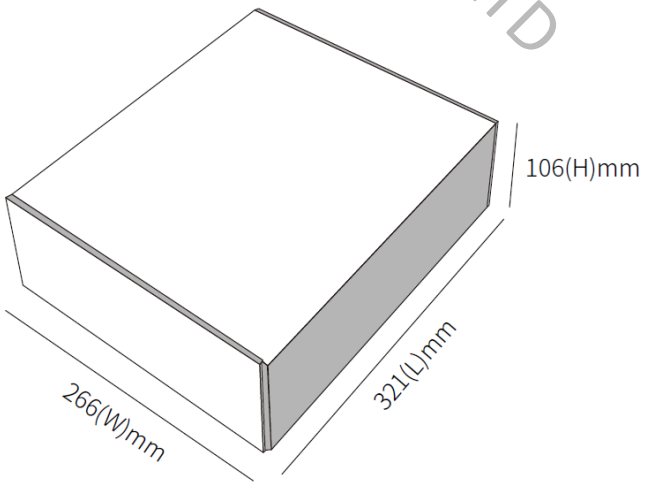

Figure 9-2-1: Packing box (Optional)

** If any packaging other than the package mentioned above is required, please confirm the packaging size again..*

** Packing: 1000pcs per carton (Minimum packing quantity).*

** The outer packing size provided above is for reference purposes only. For the actual dimensions of the product's packaging, please refer to the packaging of the actual goods.*

10 APPLICATION SCHEMATIC