FSC-BT1046

Bluetooth 5.3 Dual Mode Module Datasheet

Version 1.2

Revision History

Version	Data	Notes	
1.0	2022/04/02	Initial Version	Marsh
1.1	2023/06/01	Up Pin Description	Marsh
1.2	2024/06/13	Bluetooth version changed to 5.3	Qin

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Contents

1. INTRODUCTION

Overview

FSC-BT1046 it is a Bluetooth dual-mode module series. It supports a Bluetooth Low Energy and compliant system for audio and data communication.

FSC-BT1046 integrates an ultra-low-power DSP and application processor with embedded flash memory, a high-performance stereo codec, a power management subsystem, I^2S, LED drivers and ADC I/O.

Both cores use external flash to execute code, making it easy for user to differentiate products from new features without delaying the development

By default, FSC-BT1046 module is equipped with powerful and easy-to-use Feasycom firmware. It's easy to use and completely encapsulated. Feasycom firmware enables users to access Bluetooth functionality with simple ASCII commands delivered to the module over serial interface - it's just like a Bluetooth modem.

Therefore, FSC-BT1046 provides an ideal solution for developers who want to integrate Bluetooth wireless technology into their design.

Features

- Qualified to Bluetooth® v5.3 specification
- 120 MHz Qualcomm® Kalimba™ audio DSP
- 32/80 MHz Developer Processor for applications
- High-performance 24-bit audio interface
- Active Noise Cancellation: Hybrid, Feedforward, and Feedback modes, using Digital or Analog Mics, enabled using license keys available from Qualcomm®
- Analog Audio: Differential Class AB/D Outputs
- aptX, aptX HD Audio
- Serial interfaces: UART, Bit Serializer (I^2C/SPI), USB 2.0
- Integrated Li-ion battery charger(Max 200mA)
- Low power modes to extend battery life

Bluetooth subsystem

- Qualified to Bluetooth v5.3 specification including 2 Mbps Bluetooth Low Energy and Bluetooth Low Energy Isochronous Channels
- Qualcomm® Bluetooth High Speed Link
- Single ended antenna connection with on-chip balun and Tx/Rx switch
- Bluetooth, Bluetooth Low Energy, and mixed topologies supported
- Class 1 support

Applications

- TrueWireless™ stereo earbuds
- USB to Bluetooth dongle
- Bluetooth Speaker
- HD Audio Transmitter/Receiver

2. GENERAL SPECIFICATIONS

Table 2: General Specifications

Categories	Features	Implementation
Wireless Specification	Chip	QCC3056
	Bluetooth Version	V5.3
	Frequency	2.402 - 2.480 GHz
	Transmit Power （Basic Rate）	+10 dBm (Typ VBAT=3.7V)
	Receive Sensitivity (Basic Rate, VBAT=3.7V)	2402GHz: -95.5 dBm (Typ) 2441GHz: -96 dBm (Typ) 2480GHz: -96 dBm (Typ)
Supply Voltage	Supply	VDD_IO: 1.7 ~ 3.3V; VBAT_IN: 2.8V~ 4.3V
Power Consumption （Load=10KΩ,VBAT_IN=3.3V）		Play：<5mA ---*Average
		Pairing： <5mA ---*Average
		OFF： <100uA ---*Average
Physical	Dimensions	12.4mm(W) X 12.4mm(L) X 1.8mm(H)
Environmental	Operating	-40°C to +85°C
	Storage	-40°C to +85°C
Miscellaneous	Lead Free	Lead-free and RoHS compliant
	Warranty	One Year
Humidity		10% ~ 90% non-condensing
MSL grade:		MSL 3
ESD grade:		Human Body Model: Class 2 2KV
		Charged Device Model: Class III 500 V

3. HARDWARE SPECIFICATION

3.1 Block Diagram and PIN Diagram

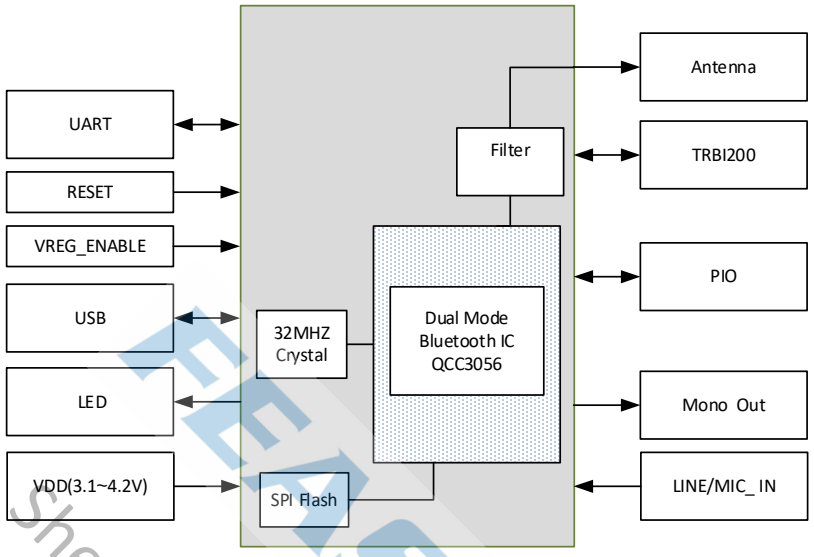

Figure 3.1: Block Diagram

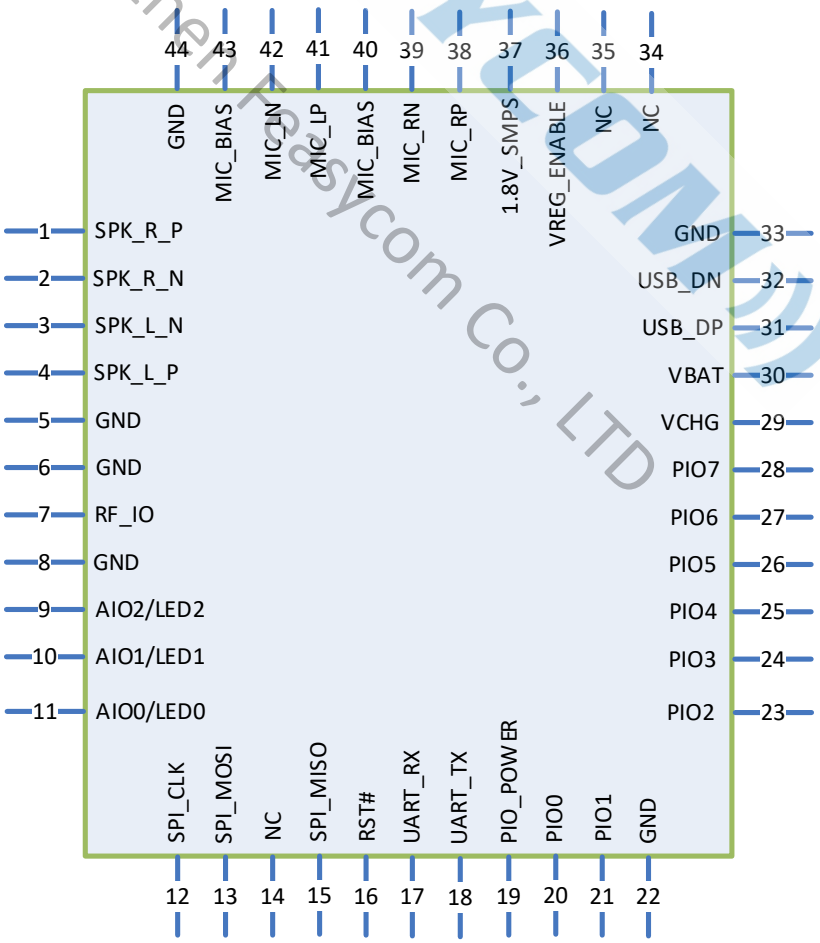

Figure 3.2: FSC-BT1046 PIN Diagram(Top View)

3.2 PIN Definition Descriptions

Table 3.2: Pin definitions

Pin	Pin Name	Type	Pin Descriptions	Notes
1	SPK_R_P	O	Positive right	八重洲様指定
2	SPK_R_N	O	Negative right	八重洲様指定
3	SPK_L_N	O	Negative left	八重洲様指定
4	SPK_L_P	O	Positive left	八重洲様指定
5	GND	Vss	Power Ground	
6	GND	Vss	Power Ground	
7	RF_IO	RF	Bluetooth transmit/receive.(Connect 50 ohm Antenna)	
8	GND	Vss	Power Ground	
9	AIO2/LED2	I/O	General-purpose analog input /LED Driver	
10	AIO1/LED1	I/O	General-purpose analog input /LED Driver	
11	AIO0/LED0	I/O	General-purpose analog input /LED Driver	
12	SPI_CLK	I/O	SPI clock	
13	SPI_MOSI	I/O	SPI data input	
14	NC			
15	SPI_MISO	I/O	SPI data output	
16	RST#	I/O	System Reset.(active low)	
17	UART_RX	I/O	UART data input	
18	UART_TX	I/O	UART data output	
19	PIO_POWER	VDD	PIO supply(1.8 V~3.3V)	
20	PIO0	I/O	Programmable I/O line 0	
21	PIO1	I/O	Programmable I/O line 1	
22	GND	Vss	Power Ground	
23	PIO2	I/O	Programmable I/O line 2	
24	PIO3	I/O	Programmable I/O line 3	
25	PIO4	I/O	Programmable I/O line 4	
26	PIO5	I/O	Programmable I/O line 5	
27	PIO6	I/O	Programmable I/O line 6	
28	PIO7	I/O	Programmable I/O line 7	
29	VCHG	Vdd	Charger input to Bypass regulator.	
30	VBAT	Vdd	Battery voltage input.	
31	USB_DP	I/O	USB Full Speed device D+ I/O. IEC-61000-4-2 (device level) ESD Protection	
32	USB_DN	I/O	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection	
33	GND	Vss	Power Ground	
34	NC			
35	NC			
36	VREG_ENABLE	I	Regulator enable input	
37	1.8V_SMPS	VDD	1.8V ouput	
38	MIC_RP	I	Microphone differential 2 input, positive.	

			Alternative function: Differential audio line input right, positive
39	MIC_RN	I	Microphone differential 2 input, negative. Alternative function: Differential audio line input right, negative
40	MIC_BIAS	Vdd	Mic bias output.
41	MIC_LP	I	Microphone differential 1 input, positive. Alternative function: Differential audio line input left, positive
42	MIC_LN	I	Microphone differential 1 input, negative. Alternative function: Differential audio line input left, negative
43	MIC_BIAS	Vdd	Mic bias output.
44	GND	Vss	Power Ground

4. ELECTRICAL CHARACTERISTICS

4.1 Absolute Maximum Ratings

Absolute maximum ratings for supply voltage and voltages on digital and analogue pins of the module are listed below. Exceeding these values causes permanent damage.

The average PIO pin output current is defined as the average current value flowing through any one of the corresponding pins for a 100mS period. The total average PIO pin output current is defined as the average current value flowing through all of the corresponding pins for a 100mS period. The maximum output current is defined as the value of the peak current flowing through any one of the corresponding pins.

Table 4.1: Absolute Maximum Rating

Parameter	Min	Max	Unit
5V (VCHG)	-0.4	+5.75 / 6.50 [a]	V
LED	-0.4	+4.8	V
VBAT_IN	-0.4	+4.8	V
SYS_CTRL	-0.4	+4.8	V
PIO-POWER	-0.4	+3.6	V
Other terminal voltages	VSS-0.4	VDD+0.4≤3.60 [b]	V
T_{ST} - Storage Temperature	-40	+85	°C

(a) Standard maximum input voltage is 5.75V, a 6.50V maximum depends on firmware version and implementation of over-temperature protection software, for more information contact Feasycom.
(b) VDD is the VDD_IO supply domain for this I/O. Voltage must not exceed 3.6 V on any I/O.

4.2 Recommended Operating Conditions

Table 4.2: Recommended Operating Conditions

Parameter	Min	Type	Max	Unit
5V (VCHG)	4.75 / 3.10 (a)	5	5.75 / 6.50 (b)	V
LED	1.10	3.30	4.30	V
VBAT_IN	3.1	3.3	4.30	V
SYS_CTRL	0	3.3	4.25	V
PIO-POWER	1.7	1.8	3.6	V
T_A - Operating Temperature	-40	25	+85	°C

(a) Minimum input voltage of 4.75V is required for full specification, regulator operates at reduced load current from3.1V
(b) Standard maximum input voltage is 5.75V, a 6.50V maximum depends on firmware version and implementation of over-temperature protection software, for more information contact Feasycom.

5. MSL &ESD Protection

Table 5: MSL and ESD

Parameter	Class	Max Rating
MSL grade(with JEDEC J-STD-020)		MSL 3
Human Body Model Contact Discharge per ANSI/ESDA/JEDEC JS-001	2	2KV
Charged Device Model Contact Discharge per JEDEC/EIA JESD22-C101	III	500V

6. RECOMMENDED TEMPERATURE REFLOW PROFILE

Prior to any reflow, it is important to ensure the modules were packaged to prevent moisture absorption. New packages contain desiccate (to absorb moisture) and a humidity indicator card to display the level maintained during storage and shipment. If directed to bake units on the card, please check the below **Table 19**and follow instructions specified by IPC/JEDEC J-STD-033.

Note: The shipping tray cannot be heated above 65°C. If baking is required at the higher temperatures displayed in the below **Table 19**, the modules must be removed from the shipping tray.

Any modules not manufactured before exceeding their floor life should be re-packaged with fresh desiccate and a new humidity indicator card. Floor life for MSL (Moisture Sensitivity Level) 3 devices is 168 hours in ambient environment 30°C/60%RH.

Table 6: 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 be easily manufactured, including reflow soldering to a PCB. Ultimately it is the responsibility of the customer to choose the appropriate solder paste and to ensure oven temperatures during reflow meet the requirements of the solder paste. Feasycom surface mount modules conform to J-STD-020D1 standards for reflow temperatures.

The soldering profile depends on various parameters necessitating a set up for each application. The data here is given only for guidance on solder reflow.

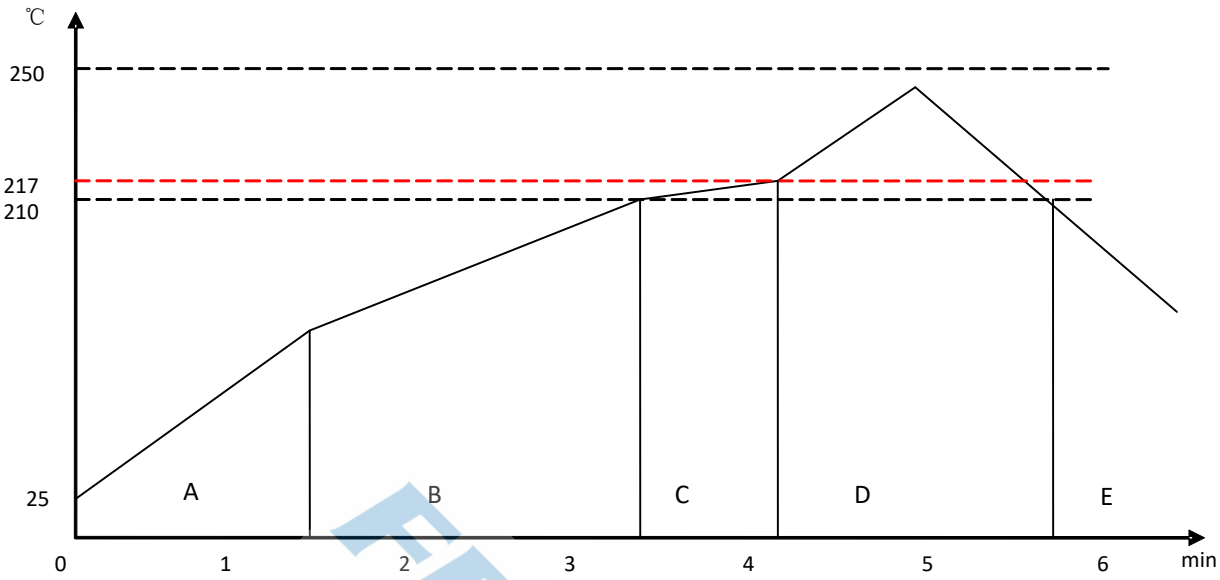

Figure 6: Typical Lead-free Re-flow

Pre-heat zone (A) — This zone raises the temperature at a controlled rate, **typically 0.5 – 2 °C/s**. The purpose of this zone is to preheat the PCB board and components to 120 ~ 150 °C. This stage is required to distribute the heat uniformly to the PCB board and completely remove solvent to reduce the heat shock to components.

Equilibrium Zone 1 (B) — In this stage the flux becomes soft and uniformly encapsulates solder particles and spread over PCB board, preventing them from being re-oxidized. Also with elevation of temperature and liquefaction of flux, each activator and rosin get activated and start eliminating oxide film formed on the surface of each solder particle and PCB board. **The temperature is recommended to be 150° to 210° for 60 to 120 second for this zone.**

Equilibrium Zone 2 (C) (optional) — In order to resolve the upright component issue, it is recommended to keep the temperature in 210 – 217 ° for about 20 to 30 second.

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: 12.4mm(W) x 12.4mm(L) x 1.8mm(H) Tolerance: ± 0.2mm
- Module size: 12.4mm X 12.4mm Tolerance: ± 0.2mm
- Pad size: 0.6mmX0.7mm Tolerance: ± 0.2mm
- Pad pitch: 1.0mm Tolerance: ± 0.1mm

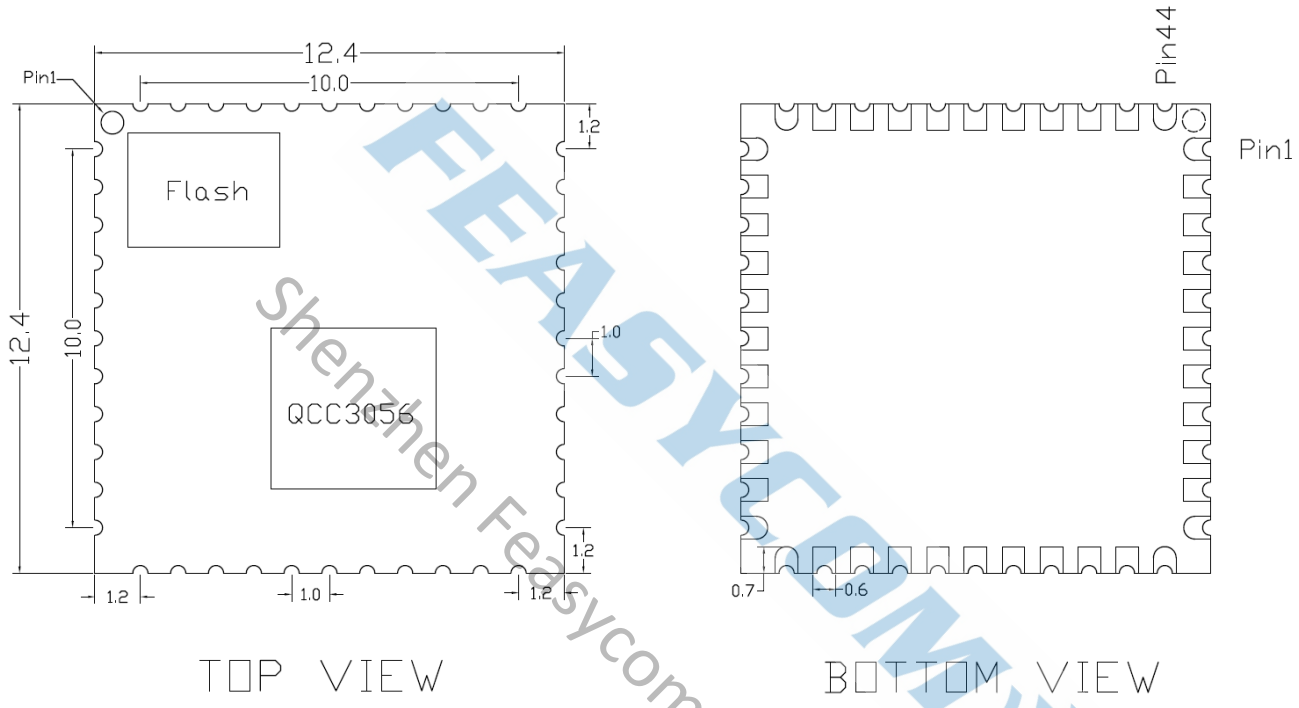

Figure 7.1: FSC-BT1046 footprint

8. HARDWARE INTEGRATION SUGGESTIONS

8.1 Soldering Recommendations

FSC-BT1046 is compatible with industrial standard reflow profile for Pb-free solders. The reflow profile used is dependent on the thermal mass of the entire populated PCB, heat transfer efficiency of the oven and particular type of solder paste used. Consult the datasheet of particular solder paste for profile configurations.

Feasycom will give following recommendations for soldering the module to ensure reliable solder joint and operation of the module after soldering. Since the profile used is process and layout dependent, the optimum profile should be studied case by case. Thus following recommendation should be taken as a starting point guide.

8.2 Layout Guidelines(External Antenna)

Placement and PCB layout are critical to optimize the performances of a module without on-board antenna designs. The trace from the antenna port of the module to an external antenna should be 50Ω and must be as short as possible to avoid any interference into the transceiver of the module. The location of the external antenna and RF-IN port of the module should be kept away from any noise sources and digital traces. A matching network might be needed in between

the external antenna and RF-IN port to better match the impedance to minimize the return loss.

As indicated in **Figure16** below, RF critical circuits of the module should be clearly separated from any digital circuits on the system board. All RF circuits in the module are close to the antenna port. The module, then, should be placed in this way that module digital part towards your digital section of the system PCB.

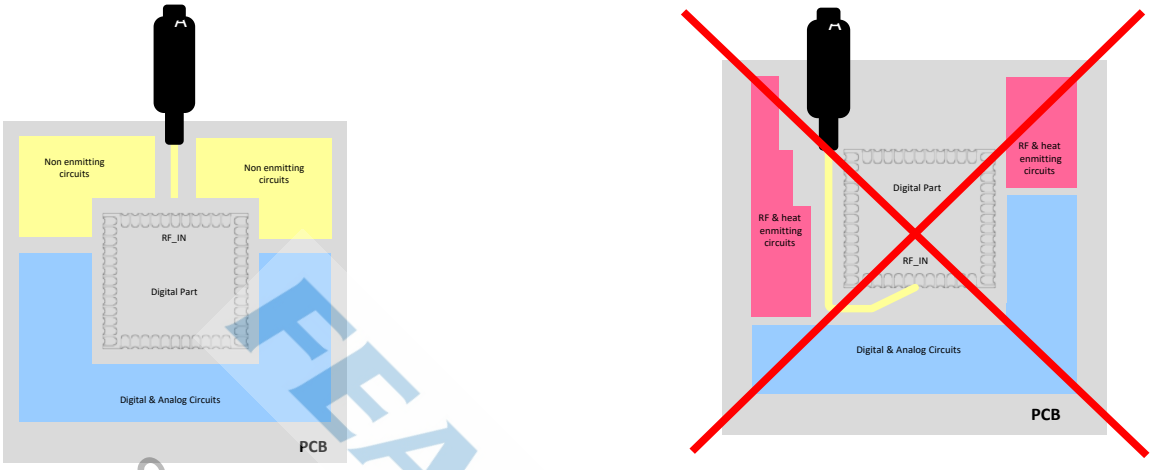

Figure 8.2: Placement the Module on a System Board

8.3.1 Antenna Connection and Grounding Plane Design

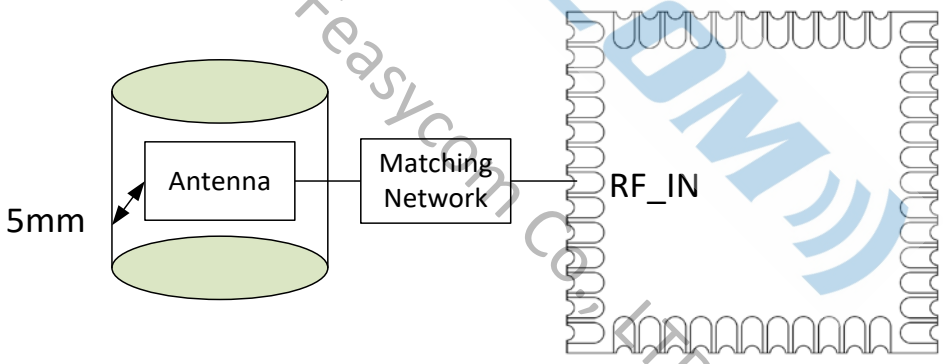

Figure 8.3.1: Leave 5mm Clearance Space from the Antenna

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 at least be 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.

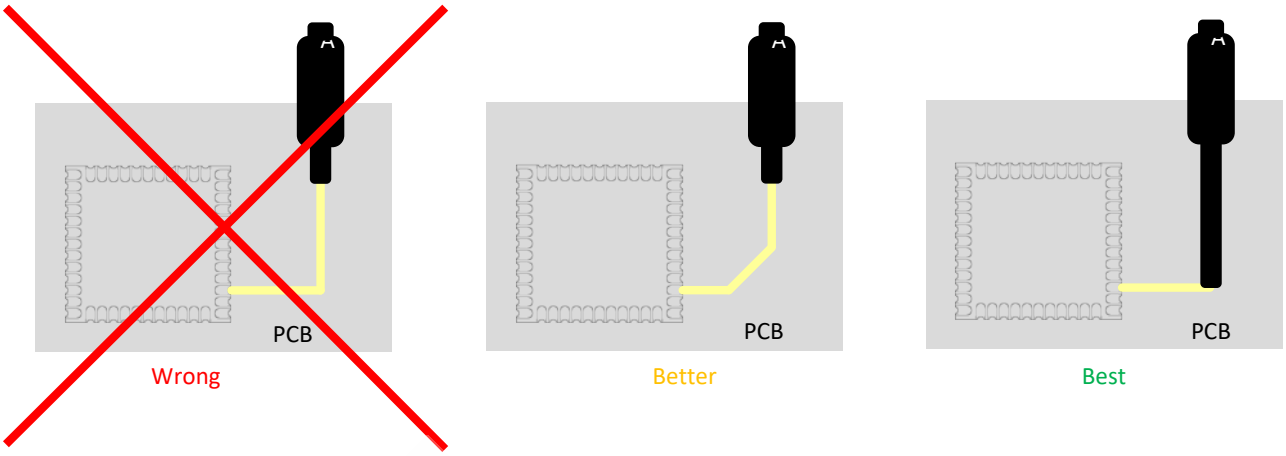

Figure 8.3.11: Recommended Trace Connects Antenna and the Module

- 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 DefaultPacking

a, Tray vacuum

b, Tray Dimension: 180mm * 195mm

Figure 9.1: Tray vacuum

9.2 Packing box(Optional)

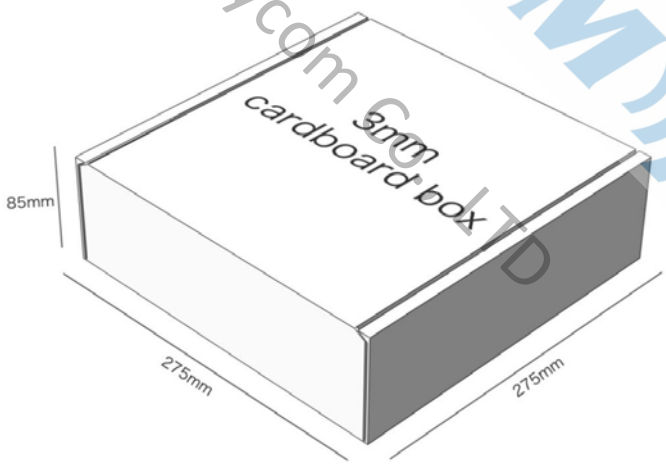

Figure 9.2: Packing Box

* If require any other packing, must be confirmed with customer

* Package: 2000PCS Per Carton (Min Carton Package)

10. APPLICATION SCHEMATIC