FSC-BT2004TV

DATASHEET V1.0

Revision History

Version	Data	Notes	Author
V1.0	2025-03-21	Initial Version	Ma

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1 INTRODUCTION

Overview

The FSC-BT2004TV is an AEC-Q100-compliant wireless microcontroller (MCU) designed for Bluetooth 6.0 Low Energy automotive applications. It is optimized for low-power wireless communication in use cases such as vehicle access systems—including Passive Entry Passive Start (PEPS) and Remote Keyless Entry (RKE)—battery management systems (BMS), car sharing, automated parking, cable replacement, and smartphone connectivity. Key features of this device include:

- Supports Bluetooth 6.0 features including LE Coded PHY (long-range), LE 2M PHY (high-speed), advertising extensions, multiple advertising sets, Channel Selection Algorithm #2 (CSA#2), as well as backward compatibility with and support for main functions from Bluetooth 5.4 and earlier Low Energy specifications. A standard Bluetooth 6.0 protocol stack is included, with support for Angle of Arrival (AoA).
- Optimized for extended battery life in wireless applications, featuring an ultra-low standby current of just 3 µA.
- AEC-Q100 compliant, meeting Grade 2 temperature range (-40°C to +85°C).
- Offers excellent Bluetooth Low Energy RF performance, with high sensitivity and strong robustness (selectivity and blocking), achieving -100±2dBm sensitivity on 125 kbps LE Coded PHY.

It supports GAP, ATT/GATT, SMP, and L2CAP profiles. The baseband controller is integrated into a compact package with a built-in chip antenna, providing designers with greater flexibility in product design and form factor.

Features

- 2.4-GHz RF Transceiver Compatible With Bluetooth 6.0 Low Energy and earlier LE Specifications
- Excellent receiver sensitivity:
  – Bluetooth® LE 125kbps: -100±2dBm
  – Bluetooth® LE 1Mbps: -95±2dBm
- Qualified for automotive applications
- AEC-Q100 qualified with the following results:
  – Device temperature grade 2: -40℃ to +85℃ ambient operating temperature range
  – Device HBM ESD Classification Level 2
  – Device CDM ESD Classification Level C3
- Integrate MCU to execute Bluetooth protocol stack
- Postage stamp sized form factor
- Low power
- Output power up to 10dBm， minimum not less than 8 dBm
- The default UART Baud rate is 115.2Kbps and can support from 1200bps to 921.6Kbps
- UART, I2C, SPI, 12-bit ADC (200 Ks/s) peripheral interfaces
- CAN-FD controller with CAN/CAN-FD ISO16845-1:2016 certification compliance
- Support the OTA upgrade

- Support BLE protocols
- Support eight capacitance sensor button
- Integrated temperature sensor

Application

- Home and Building Automation
  - – Connected Appliances
  - – Lighting
  - – Locks
  - – Gateways
  - – Security Systems
- Industrial
  - – Logistics
  - – Production and Manufacturing Automation
  - – Asset Tracking and Management
  - – HMI and Remote Display
  - – Access Control
- Retail
  - – Beacons
  - – Advertising
  - – ESL and Price Tags
  - – Point of Sales and Payment Systems
- Health and Medical
  - – Thermometers
  - – SpO2
  - – Blood Glucose and Pressure Meters
  - – Weight Scales
  - – Hearing Aids
- Sports and Fitness
  - – Activity Monitors and Fitness Trackers
  - – Heart Rate Monitors
  - – Running and Biking Sensors
  - – Sports Watches
  - – Gym Equipment
  - – Team Sports Equipment
- HID
  - – Voice Remote Controls
  - – Gaming
  - – Keyboards and Mice
- Automotive
  - – Car access and security systems
    - Passive entry passive start (PEPS)
    - Phone as a key (PaaK)
    - Remote keyless entry (RKE)
  - – Battery management system (BMS)
  - – Advanced driver assistance systems (ADAS)

2 General Specification

Table 2-1：General Specifications

Categories	Features	Implementation
Wireless Specification		
	Chip	TI CC2745R10-Q1
	Bluetooth Version	Bluetooth 6.0 Low Energy(BLE)
	Frequency	2.402 - 2.480 GHz
	Transmit Power	Max. 10 dBm, Min. ≥ 8 dBm
	Receive Sensitivity	-95±2dBm for 1-Mbps PHY -100±2dBm for 125-kbps LE Coded PHY
	Raw Data Rate (Air)	2 Mbps
	Modulation	GFSK
	UART Interface	TX, RX, CTS, RTS General Purpose I/O Default 115200,N,8,1 Baudrate support from 1200 to 921600 5, 6, 7, 8 data bit character
	GPIO	23(maximum – configurable) lines
	I2C Interface	1 (configurable from GPIO total). Up to 400 kbps
	SSI Interface	Up to 2 SSI interfaces with a frequency of up to 4 MHz Support both master and slave mode SPI, MICROWIRE, TI
	Wireless MCU	4 General-Purpose Timer Modules Arm® Cortex®-M33 processor (96MHz) with FPU (floating point unit), TrustZone®-M support and CDE (custom datapath extension) for machine learning acceleration
	CAN-FD	controller with CAN/CAN-FD ISO16845-1:2016 certification compliance
Profiles	Class Bluetooth	No Support
	Bluetooth Low Energy	GATT Client & Peripheral - Any Custom Services BT6.0 Specifications MFI Support
Maximum Connections	Classic Bluetooth	No Support
	Bluetooth Low Energy	1 Clients
FW upgrade		Over the Air Xds
Supply Voltage	Supply	3.2V ~ 3.6V
Power Consumption		RX current: ≤6.1mA TX current at 0dBm: ≤7.7mA TX current at 10dBm: ≤24.5 mA

		Active mode MCU 96MHz (CoreMark®): 6.8mA Standby Current : ≤3uA Shutdown : ≤160nA
Physical	Dimensions	13mm X 26.9mm X 2.2mm; Pad Pitch 1mm
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 2
ESD grade	Human Body Model	Pins (except ANT): ±2000V ANT Pins: ±1000V
	Charged device model	pins (except ANT): ±500V ANT Pins: ±250V

3 HARDWARE SPECIFICATION

3.1 Block Diagram and PIN Diagram

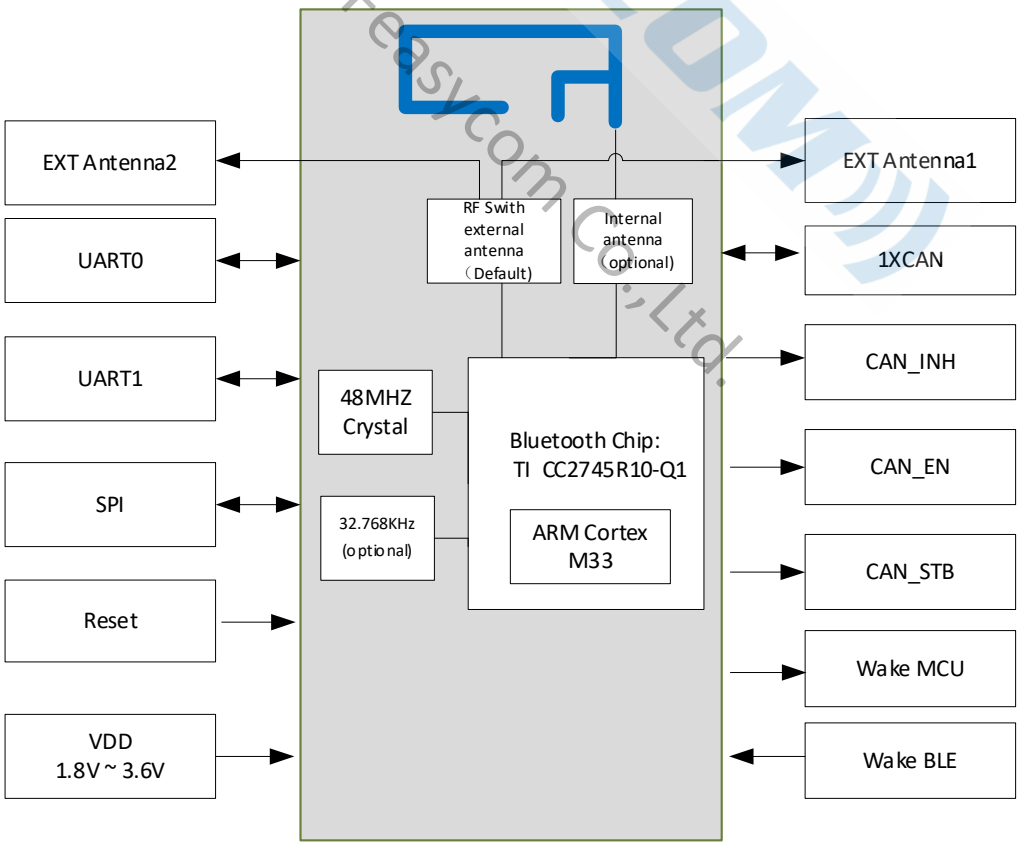

Figure 3-1-1: FSC-BT2004TV Block Diagram

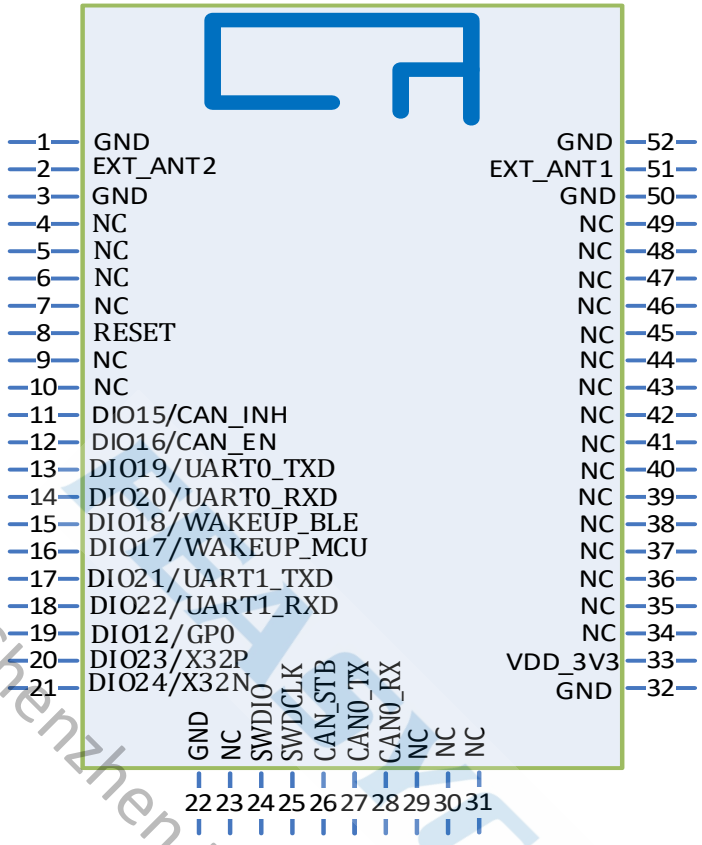

Figure 3-1-2: FSC-BT2004TV PIN Diagram (Top View)

3.2 PIN Definition Descriptions

Table 3-2： Pin definition

Pin	Pin Name	Type	Pin Descriptions	Notes
1	GND	VSS	Power Ground	
2	EXT_ANT2	I	Bluetooth transmit/receive（external2 antenna must be connected）	
3	GND	VSS	Power Ground	
4	NC		NC	
5	NC		NC	
6	NC		NC	
7	NC		NC	
8	RESET	I	Automatically defaults to RESET# mode when the device is unpowered, or in off modes.	
9	NC		NC	
10	NC		NC Alternative function: Programmable I/O	
11	DIO15/CAN_INH	I/O	DIO15/CAN_INH Alternative function: Programmable I/O	
12	DIO16/CAN_EN	I/O	DIO16/CAN_EN	

			Alternative function 1: Programmable I/O
13	DIO19/UART0_TXD	O	UART0_TXD Alternative function 1: Programmable I/O
14	DIO20/UART0_RXD	I	UART0_RXD Alternative function 1: Programmable I/O
15	DIO18/WAKEUP_BLE	I	DIO18/WAKEUP_BLE Alternative function 1: Programmable I/O
16	DIO17/WAKEUP_MCU	O	DIO17/WAKEUP_MCU Alternative function 1: Programmable I/O
17	DIO21/UART1_TXD	O	UART1_TXD Alternative function 1: Programmable I/O
18	DIO22/UART1_RXD	I	UART1_RXD Alternative function 1: Programmable I/O
19	DIO12/GPO	I/O	Alternative function: Programmable I/O
20	DIO23/X32P	I	32P When pin 13 is used, or an internal 32K crystal is used, this pin can only be NC
21	DIO24/X32N	O	32N When pin 13 is used, or an internal 32K crystal is used, this pin can only be NC Alternative function 1: Programmable I/O
22	GND	VSS	Power Ground
23	NC		NC
24	SWDIO	I/O	DEBUG: SWDIO Alternative function 1: Programmable I/O
25	SWDCLK	I	DEBUG: SWDCLK Alternative function 1: Programmable I/O
26	CAN_STB	O	DIO0/CAN_STB Alternative function 1: Programmable I/O
27	CAN0_TX	O	CAN0 transmit data output
28	CAN0_RX	I	CAN0 receive data input
29	NC		NC
30	NC		NC
31	NC		NC
32	GND	VSS	Power Ground
33	VDD	VDD	3V3
34	NC		NC
35	NC		NC
36	NC		NC
37	NC		NC
38	NC		NC
39	NC		NC
40	NC		NC

41	NC		NC
42	NC		NC
43	NC		NC
44	NC		NC
45	NC		NC
46	NC		NC
47	NC		NC
48	NC		NC
49	NC		NC
50	GND	VSS	Power Ground
51	EXT_ANT1	I	Bluetooth transmit/receive（external1 antenna must be connected）
52	GND	VSS	Power Ground

4 ELECTRICAL CHARACTERISTICS

4.1 UART Interface

The FSC-BT2004TV UART interface features a standard 4-wire configuration comprising RX, TX, CTS, and RTS pins. It supports the H4 HCI interface or direct raw UART communication to applications. The default baud rate is set at 115.2k baud. To accommodate both high and low-speed baud rates, the FSC-BT2004TV offers multiple UART clock options.

Table 4-1：Possible UART Settings

Parameter	Possible Values
Baud rate	Standard 115200bps
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°C/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):

When using our modules, it is recommended to use a step steel mesh with a thickness of 0.16-0.20mm. However, the thickness can be adjusted according to the adaptability of your own 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 simplify manufacturing processes, such as reflow soldering on a PCB. However, Customers are responsible for selecting the appropriate solder paste and confirming that the oven temperatures during reflow meet with the specifications provided by the solder paste manufacturer. Notably, Feasycom surface mount modules adhere to 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.

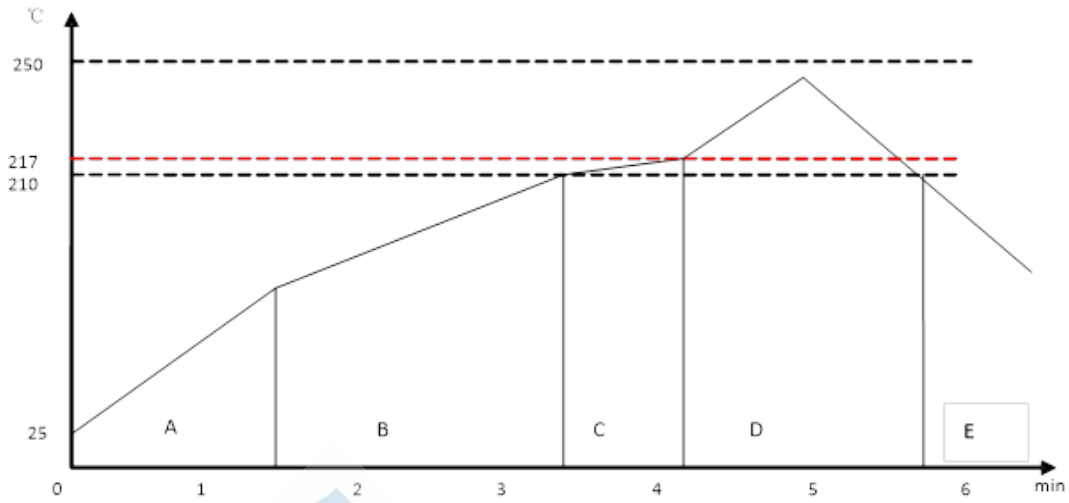

Figure6-1：Typical Lead-free Re-flow

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: 13mm(W) x 26.9mm(L) x 2.2mm(H) Tolerance: ±0.2mm
- Module size: 13mm X 26.9mm Tolerance: ±0.2mm
- Pad size: 1.6mmX0.6mm Tolerance: ±0.2mm
- Pad pitch: 1.0mm Tolerance: ±0.1mm
- **(Residual plate edge error: < 0.5mm)**

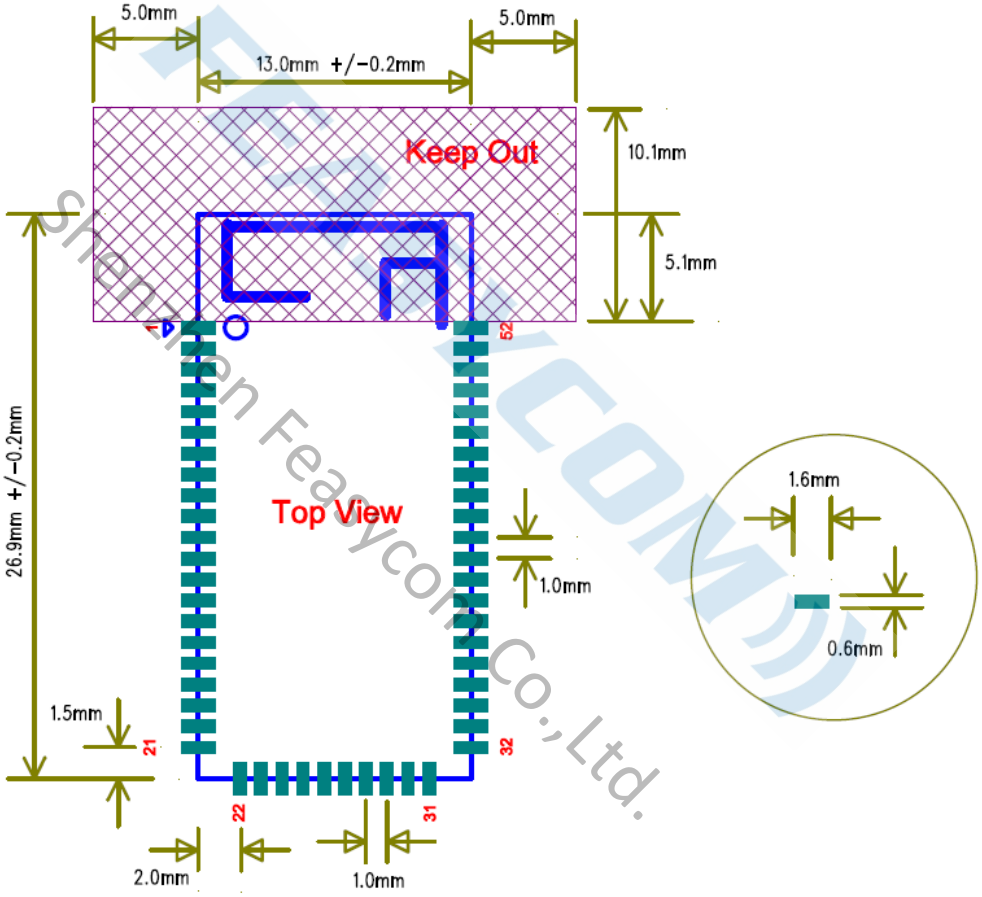

Figure 7-1-1： FSC-BT2004TV footprint Layout Guide (Top View)

8 HARDWARE INTEGRATION SUGGESTIONS

8.1 Soldering Recommendations

FSC-BT2004TV 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 Guidelines (Internal Antenna)

It is strongly recommended to follow good layout practices in order to ensure proper operation of the module. Placing copper or any metal near the antenna can negatively impact its performance by affecting the matching properties. To prevent radiation, a metal shield should not be used with the module. It is advised to use grounding vias, spaced a maximum of 3 mm apart, at the edge of grounding areas to prevent RF penetration inside the PCB and unintentional resonator formation. Additionally, GND vias should be distributed all around the PCB edges.

In the restricted area where the on-board antenna is located, the motherboard should not have any bare conductors or vias. This area is not covered by stop mask print, so no copper (planes, traces, or vias) should be present in this area to avoid mismatching with the on-board antenna.

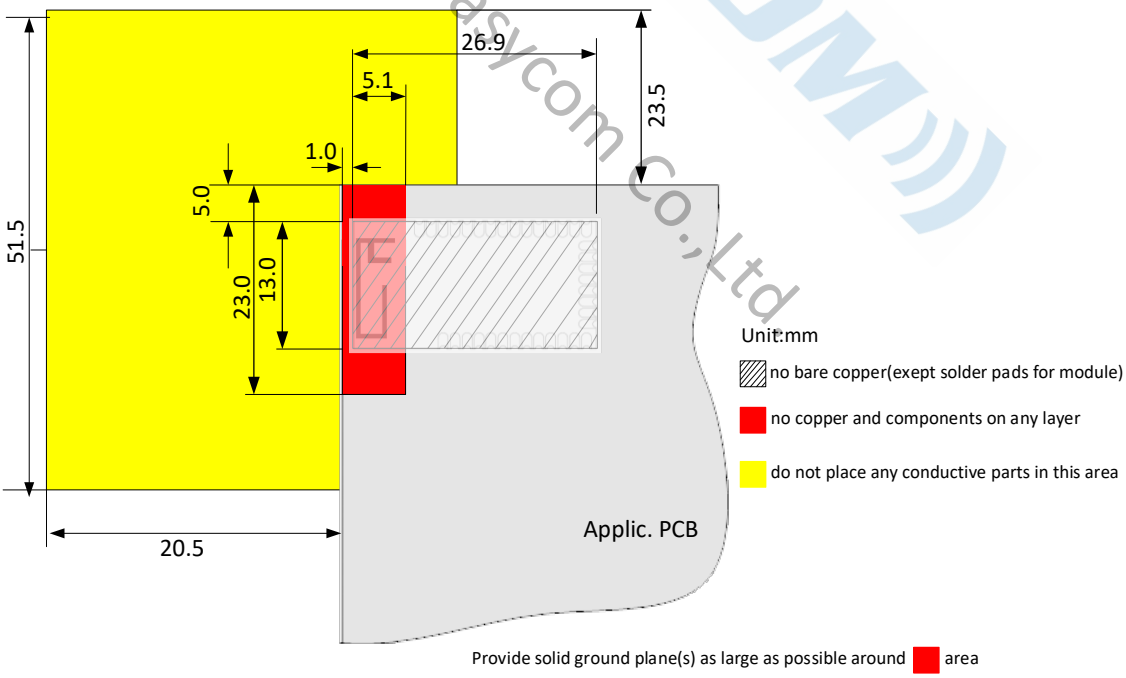

Figure 8-2-1： Restricted Area (Design schematic, for reference only. Unit: mm)

The following recommendations are aimed at avoiding EMC problems caused by the RF part of the module. It is important to note that each design is unique, and this list does not cover all basic design rules, such as avoiding

capacitive coupling between signal lines. Additionally, it is crucial to consider potential problems arising from digital signals in the design.

To mitigate EMC issues, it is advisable to ensure that signal lines have return paths that are as short as possible. For instance, if a signal passes through a via to an inner layer, always use ground vias around it. These ground vias should be located tightly and symmetrically around the signal vias. Routing of sensitive signals should be done in the inner layers of the PCB. Sensitive traces should have a ground area both above and below the line. If this is not feasible, make sure to keep the return path short by employing alternative methods, such as placing a ground line next to the signal line.

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.

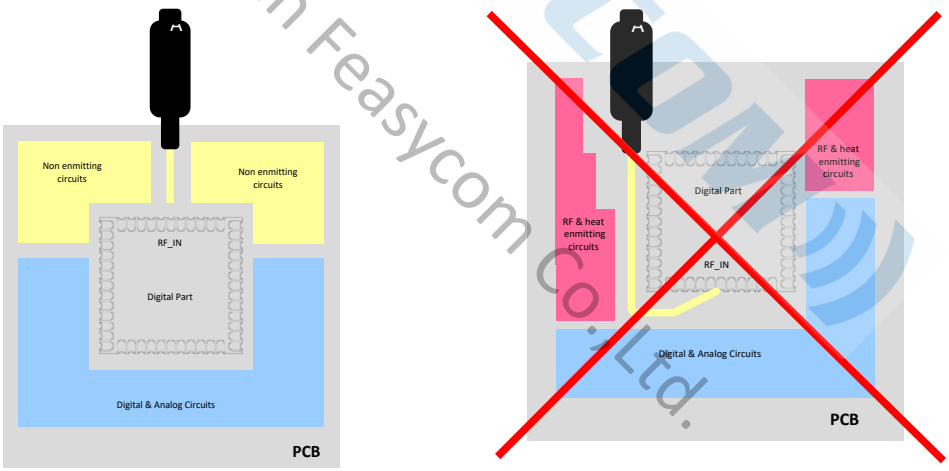

Figure 8-3-1: Placement the Module on a System Board

8.3.1 Antenna Connection and Grounding Plane Design

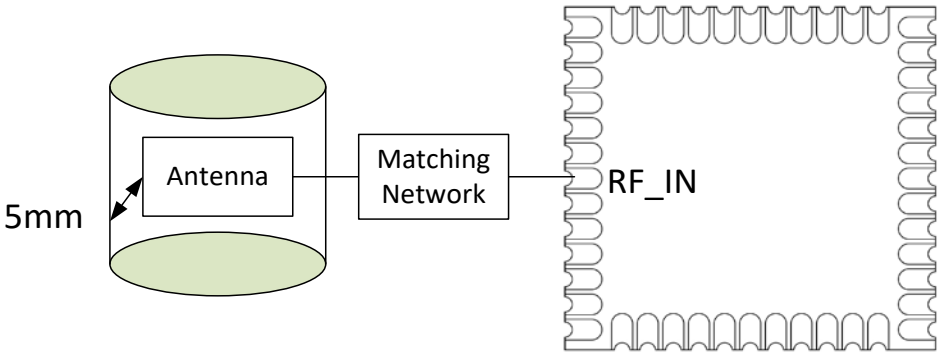

Figure 8-3-1-1: Leave 5mm Clearance Space from the Antenna

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.

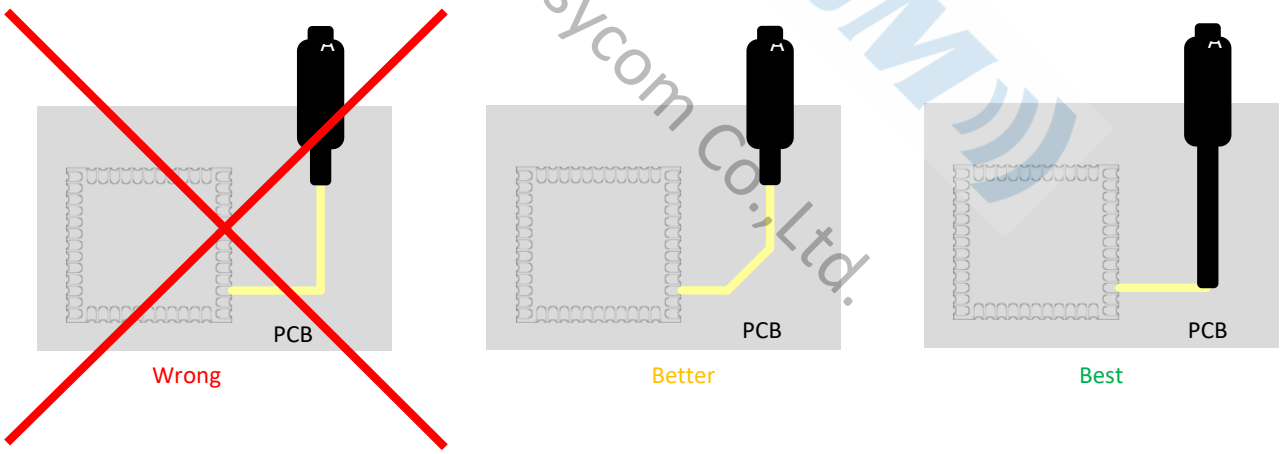

Figure 8-3-1-2: Recommended Trace Connects Antenna and the Module

- 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

Figure 9-1-1: Vacuum Tray

9.2 Packing box (Optional)

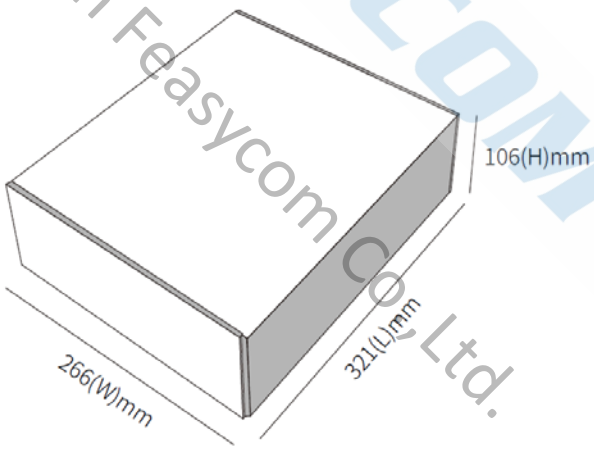

Figure 9-2-1: Packing box (Optional)

** 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