

FLM540R

Hardware Design

WiFi&Bluetooth Module Series

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Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any terminal or mobile incorporating the module. Manufacturers of the terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.



Full attention must be paid to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.



Switch off the terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft.



Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.



Terminals or mobiles operating over radio signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergency help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the terminal or mobile must be switched on in a service area with adequate cellular signal strength. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances.



The terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.



In locations with explosive or potentially explosive atmospheres, obey all posted signs and turn off wireless devices such as mobile phone or other terminals. Areas with explosive or potentially explosive atmospheres include fueling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders.

About the Document

Revision History

Version	Date	Author	Description
-	2024-01-07	Janson CHEN/Yuan ZHANG	Creation of the document

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1 Introduction

This document introduces FLM540R and its hardware and air interfaces connected to customer applications, which can help customers quickly understand the WiFi and Bluetooth characteristics, hardware interface characteristics, electrical characteristics, mechanical specifications, and other related information of the module.

Hereby, Quectel Wireless Solutions Co., Ltd. declares that the radio equipment type FLM540R is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address:
<http://www.quectel.com/support/technical.htm>

Disposal of old electrical appliances



The European directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), requires that old household electrical appliances must not be disposed of in the normal unsorted municipal waste stream. Old appliances must be collected separately in order to optimize the recovery and recycling of the materials they contain, and reduce the impact on human health and the environment.

The crossed out “wheeled bin” symbol on the product reminds you of your obligation, that when you dispose of the appliance, it must be separately collected.

Consumers should contact their local authority or retailer for information concerning the correct disposal of their old appliance.

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	UK(NI)

This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

The device is restricted to indoor use only when operating in the 5150 to 5350 MHz frequency range.

1.1. Special Marks

Table 1: Special Marks

Mark	Definition
*	Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, argument, and so on, it indicates that the function, feature, interface, pin, AT command, argument, and so on, is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable.
[...]	Brackets ([...]) used after a pin enclosing a range of numbers indicate all pins of the same type. For example, SDIO_DATA[0:3] refers to all four SDIO pins: SDIO_DATA0, SDIO_DATA1, SDIO_DATA2, and SDIO_DATA3.

2 Product Overview

FLM540R is a low-power, cost-effective MCU WiFi and Bluetooth module, which supports IEEE 802.11a/b/g/n and Bluetooth 5.0 standard protocols. The module provides UART to enable Wi Fi and Bluetooth application functionality.

FLM540R have two packaging forms: DIP and SMT(LCC+LGA), and customers can choose according to actual scenarios. The basic information of the two packaging modules is as follows.

Table 1: Basic Information

FLM540R DIP module	
Packaging type	DIP
Pin counts	10
Dimensions	(15 ±0.2) mm × (23 ±0.2) mm × (8.45 ±0.6) mm
Weight	Approx. 1.32 g
FLM540R SMT module	
Packaging type	LCC+LGA
Pin counts	10
Dimensions	(15 ±0.2) mm × (23 ±0.2) mm × (2.2 ±0.2) mm
Weight	Approx. 1.06 g

2.1. Key Features

Table 2: Key Features

Basic Information	
Protocols and Standards	● Wi-Fi Protocols: IEEE 802.11a/b/g/n ● Bluetooth protocol: Bluetooth 5.0 ● All hardware components are fully compliant with EU RoHS directive
Power Supply	VBAT Power Supply: ● 3.0–3.6 V ● Typ.: 3.3 V
Temperature Ranges	● Operating temperature¹: -40°C~+85°C ● Storage temperature: -45°C~+95°C
EVB Kit	FLM540R TE-B ²
RF Antenna Interface	
Antenna Interface	● PCB antenna ● 50 Ω impedance
Application Interface ³	
Application Interface	UART、PWM*

¹ Within the operating temperature range, the module's related performance meets IEEE and Bluetooth specifications.

² For more details about the EVB, see **document** 错误!未找到引用源。.

³ For more details about the interfaces, see **Chapter** 错误!未找到引用源。 and **Chapter** 错误!未找到引用源。.

2.2. Functional Diagram

The following diagram shows the functional block diagram of the module.

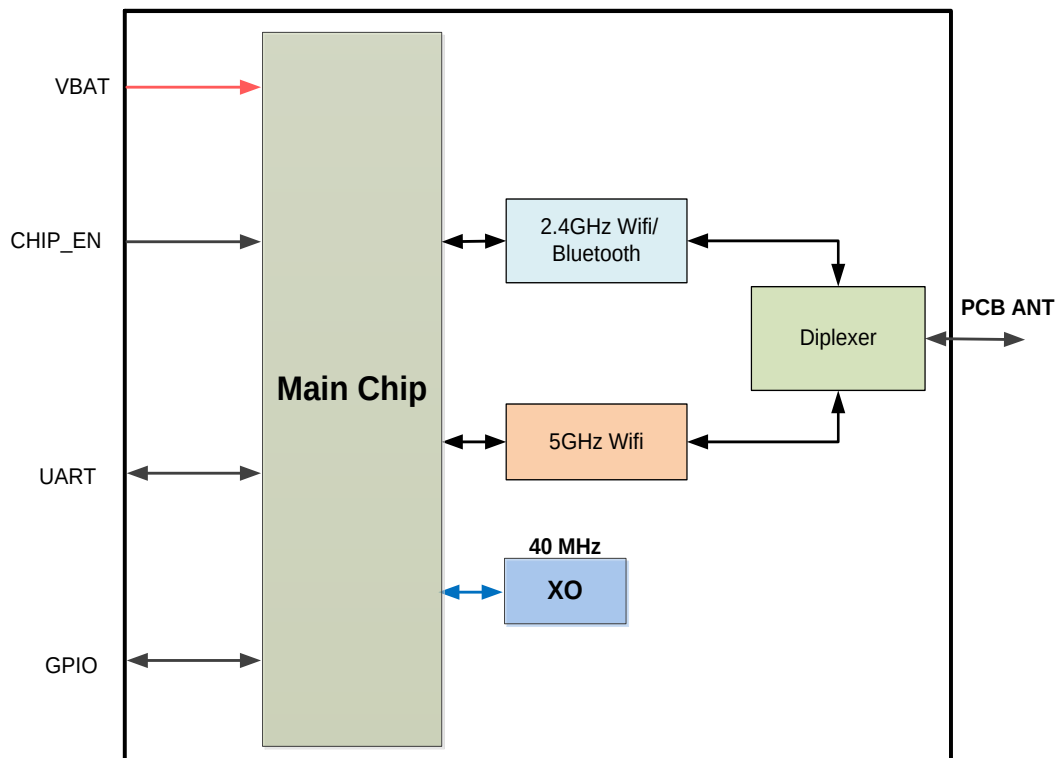


Figure 1: Functional Diagram

NOTE

- 1、 There are two UARTs, namely Main UART and Debug UART. For detailed information on UART, please refer to Chapter 3.4.
- 2、 CHIP_EN、 GPIO and Debug UART (DBG_TXD、 DBG_RXD) are all test pins.

3 Application Interfaces

3.1. Application pin/Debug pin(point) assignment diagram

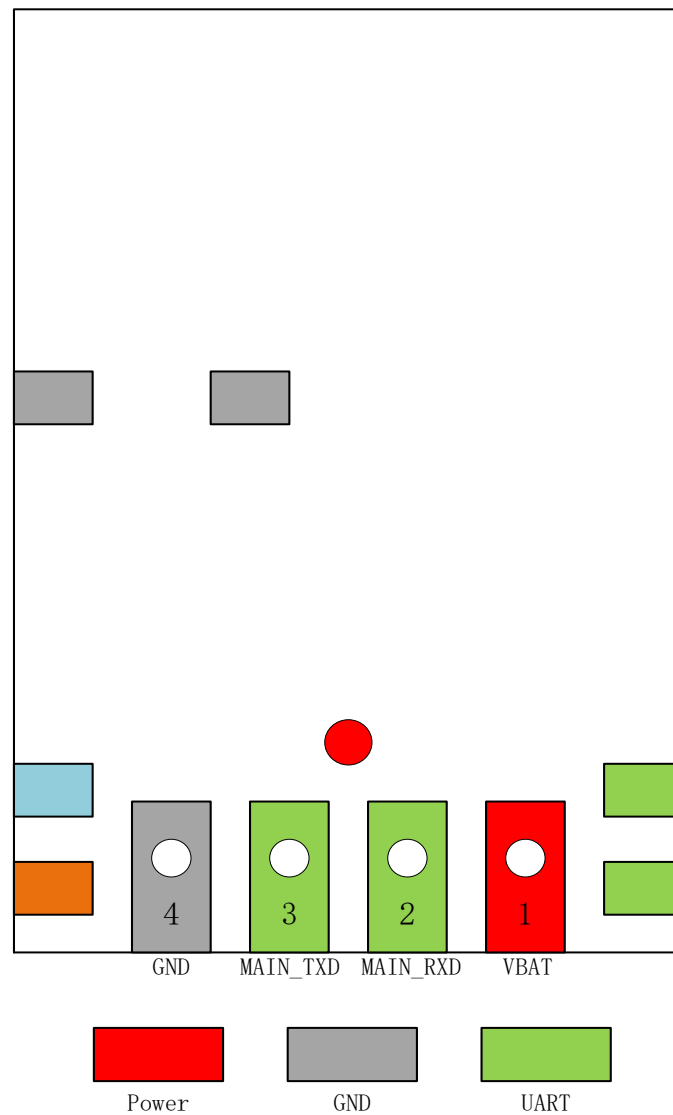
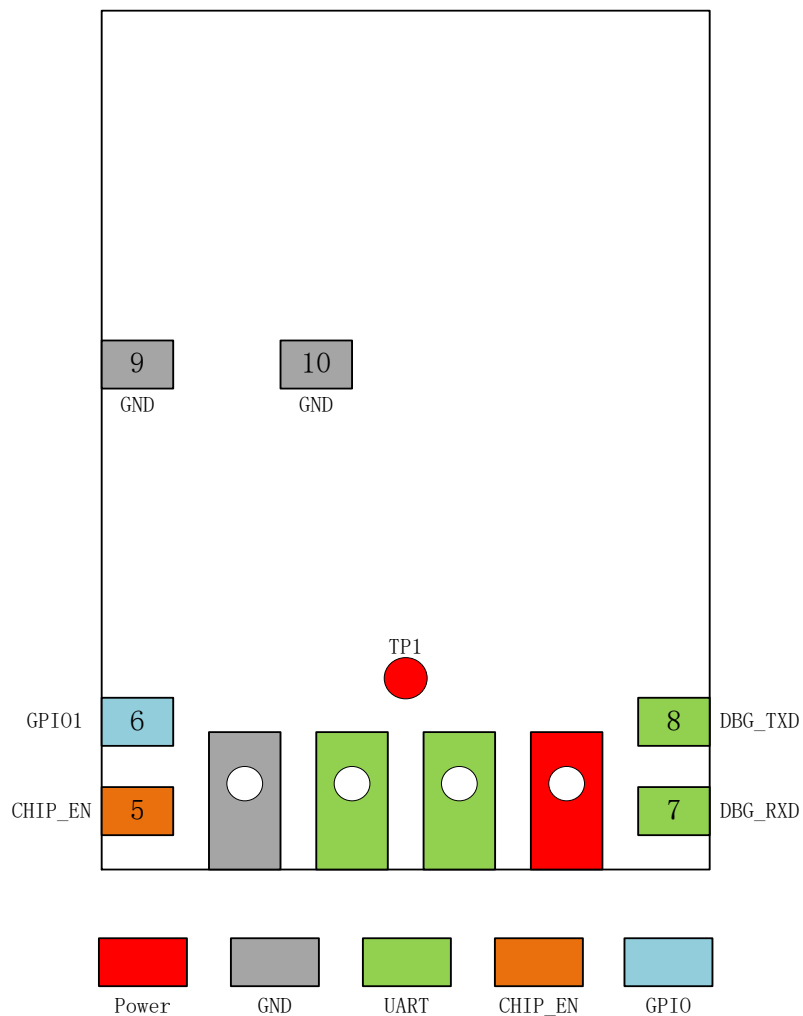


Figure 2: Application Pin Assignment (Top View)



NOTE

1. The module can use one GPIO interface, and can support one PWM * interface under multiplexing. For detailed information on reuse functions, please refer to Chapter 3.3 and Chapter 3.4.
2. The debug pin (point) can be suspended if not in use.

3.2. Pin Description

Table 4: I/O Parameter Definition

Parameter	Description
AI	Analog Input
AO	Analog Output
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
PI	Power Input

DC characteristics include voltage domain, rated current information, etc.

Table 5: Application Pin Description

Power Supply					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
VBAT	1	PI	Main power supply for the module	Vmax = 3.6 V Vmin = 3.0 V Vnom = 3.3 V	It must be provided with sufficient current up to 0.4 A.
GND	4				
Main UART					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
MAIN_RXD	2	DI	Main uart receive	VBAT	
MAIN_TXD	3	DO	Main uart transmit		

Table 6: Debug Pin(point) Description

Control Signal				
Pin Name	Pin No.	I/O	Description	Comment
CHIP_EN	5	DI	Chip enable (default)	HW enable; Internal pull-up to VBAT; Active high level.
			Chip reset	HW reset; Active low level.
GPIO				
Pin Name	Pin No.	I/O	Description	Comment
GPIO1	6	DI	General-purpose input/output	GPIO1
Debug UART				
Pin Name	Pin No.	I/O	Description	Comment
DBG_RXD	7	DI	Debug uart receive	
DBG_TXD	8	DO	Debug uart transmit	
GND				
Pin Name	Pin No.	I/O	Description	Comment
GND	9, 10			Balance pins on the upper part of the module PCB, mainly used to assist fixed module.
Other Signal				
Test point	Test point No.	I/O	Description	Comment
TP1	-	PI	VBAT test point	Used for contacting with the thimble of jigs during production test.

NOTE

The voltage range of pins 5~8 are VBAT.

3.3. GPIO Multiplexing

The module provides 1 GPIO interfaces by default. Pin is defined as follows:

Table 7: **GPIO Multiplexing**

Pin Name	Pin No.	Multiplexing Function 0 (GPIO No.)	Multiplexing Function 1	Multiplexing Function 2	Multiplexing Function 3
GPIO1	6	GPIO1	PWM*	/	/

NOTE

GPIO can be configured as an interrupt source to interrupt the system in normal operating mode.

3.4. Application Interface

3.4.1. UART

The module supports two UARTs by default: Main UART and Debug UART. The pin definitions are shown in the table below.

Table 9: Pin Definition of UART

Pin Name	Pin No.	I/O	Description	Comment
MAIN_RXD	2	DI	Main uart receive	
MAIN_TXD	3	DO	Main uart transmit	
DBG_RXD	7	DI	Debug uart receive	Can be suspended without use.
DBG_TXD	8	DO	Debug uart transmit	Can be suspended without use.

Main UART is mainly used for communication with customer MCU, supporting AT command application and data transmission. The serial baud rate can be configured, with a default of 115200 bps.

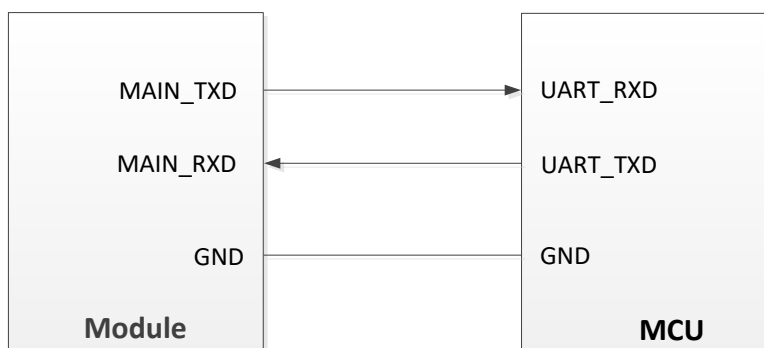


Figure 4: Main UART Connection Diagram

Debug UART is mainly used for system debugging and firmware version local burning and upgrading, supporting chip manufacturer and some AT application debugging command input, and supporting log printing output .

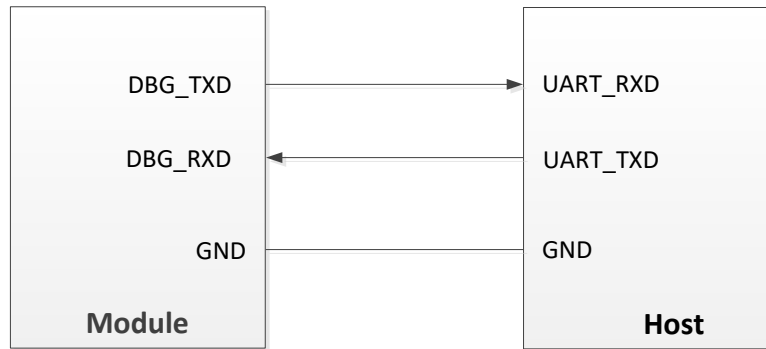


Figure 5: Debug UART Connection Diagram

3.4.2. PWM* Interface

In the case of multiplexing, the module supports up to 1 PWM interface, the pin definitions are shown in the table below.

Table 10: Pin Definition of PWM

Pin Name	Pin No.	I/O	Description	Comment
GPIO1	6	PWM2	DO	PWM2 output

4 Operating Characteristics

4.1. Power Supply

Power supply pin and ground pins of the module are defined in the following table.

Table 12: Pin Definition of Power Supply and GND Pins

Pin Name	Pin No.	I/O	Description	Min.	Typ.	Max.	Unit
VBAT	6	PI	Power supply for the module	3.0	3.3	3.6	V
GND	4						

4.1.1. Reference Design for Power Supply

The module is powered by VBAT, and it is recommended to use a power supply chip that can provide more than 0.4A output current. For better power supply performance, it is recommended to parallel a 22 μ F decoupling capacitor, and two filter capacitors (1 μ F and 100 nF) near the module's VBAT pin. C4 is reserved for debugging and not mounted by default. In addition, it is recommended to add a TVS near the VBAT to improve the surge voltage bearing capacity of the module. In principle, the longer the VBAT trace is, the wider it should be.

VBAT reference circuit is shown below:

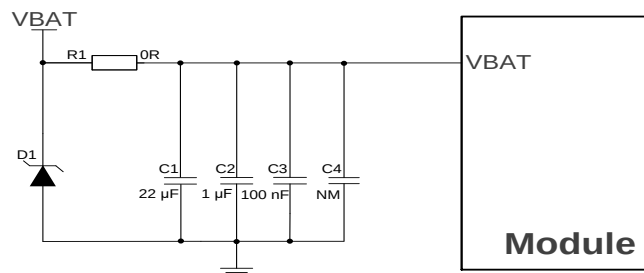


Figure 2: VBAT Reference Circuit

4.2. Turn On

The module can automatically start up after the VBAT is powered on, and the timing is as follows.

Table 14: Pin Definition of CHIP_EN

Pin Name	Pin No.	I/O	Description	Comment
CHIP_EN	5	DI	Chip enable	HW enable; Internal pull-up to VBAT; Active high level.

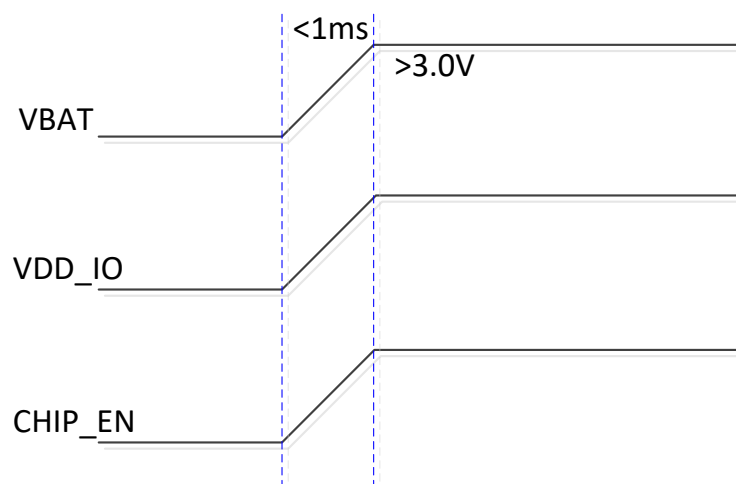


Figure 7: Startup timing diagram

4.3. Reset

Pull down the CHIP_EN voltage to less than $0.2 * V_{BAT}$ and maintaining it for at least 1ms can reset the module.

The hardware reset reference circuit is shown in the following figure. It is recommended to use an open set drive circuit to control CHIP_EN pin.

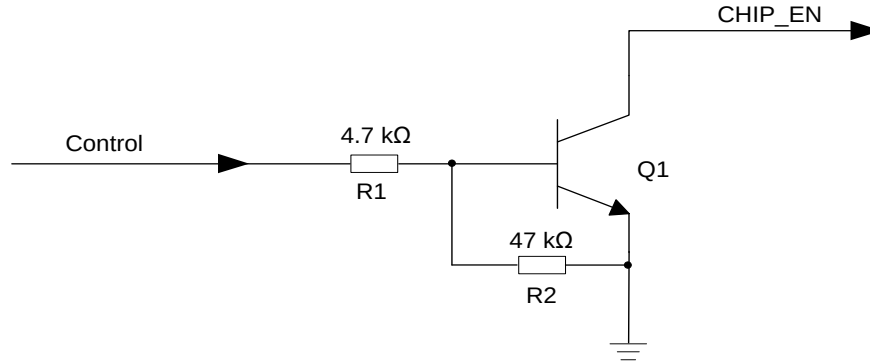


Figure 8: Open set drive reset reference circuit

Another way to control the CHIP pin is directly through a button switch. When pressing a button, static electricity may be generated, so a TVS tube should be placed near the button for ESD protection. The reference circuit is as follows:

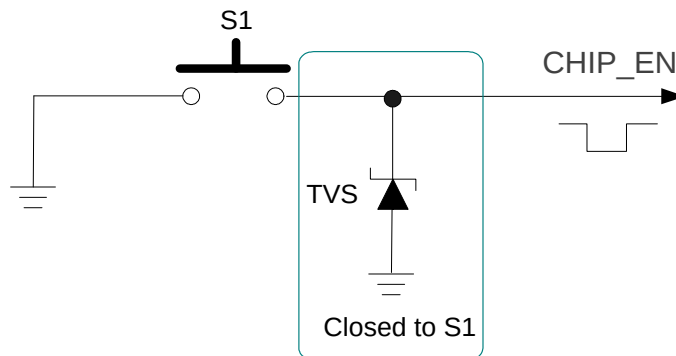


Figure 9: Button reset reference circuit

The module reset timing is shown in the following figure:

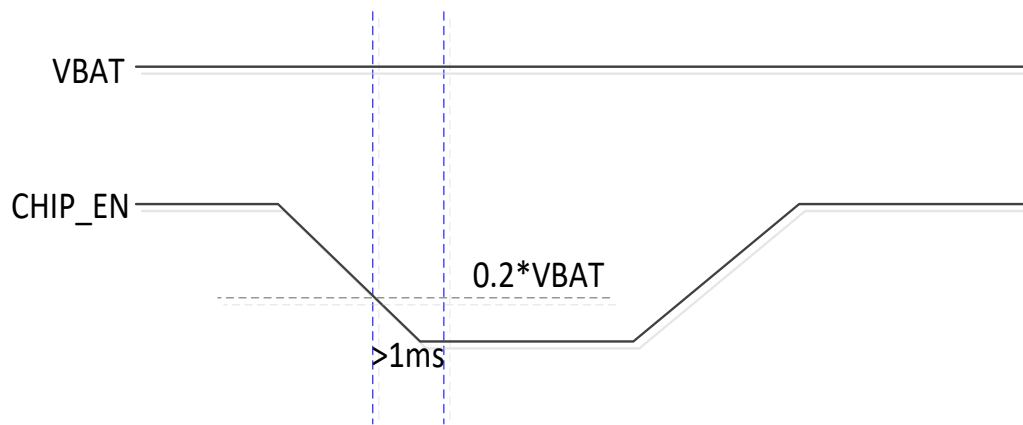


Figure 10: Reset timing diagram

4.4. Download Mode

After powering on the non empty module, the firmware can be downloaded directly through Debug UART. After powering on the empty chip module, it is necessary to pull down the CHIP_EN and DBG_TXD level for at least 1ms, then gradually release CHIP_EN and DBG_TXD, the module will enter download mode and download firmware through Debug UART

The timing of the empty module entering download mode is shown in the following figure:

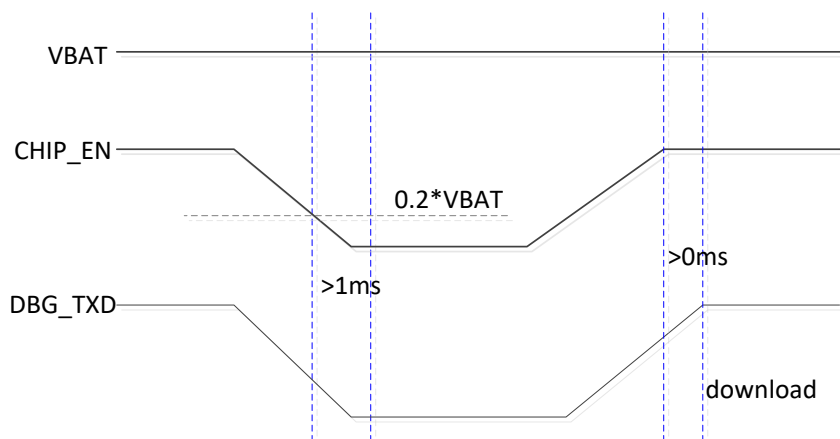


Figure 11: Empty chip enter download mode timing diagram

5 RF Performances

5.1 Wi-Fi Performances

Table 3: Wi-Fi Performances

Operating Frequency			
● 2.4 GHz: 2.400~2.4835 GHz ● 5 GHz: 5.150~5.850 GHz			
Modulation			
CCK、BPSK、QPSK、16QAM、64QAM			
Operating Mode			
● AP ● STA			
Transmission Data Rate			
● 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps ● 802.11a/g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps ● 802.11n: HT20 (MCS 0~7)、 HT40 (MCS 0~7)			
Condition	EVM	Unit: dBm, Tolerance: ± 2 dB	
		Transmitting Power @ Typ.	Receiving Sensitivity @ Typ.
2.4 GHz	802.11b @ 1 Mbps	15	-98
	802.11b @ 11 Mbps	15	-91
	802.11g @ 6 Mbps	15	-95
	802.11g @ 54 Mbps	13	-77
	802.11n, HT20 @ MCS 0	15	-95
	802.11n, HT20 @ MCS 7	13	-75

5 GHz	802.11n, HT40 @ MCS 0	≤ -5 dB	15	-93
	802.11n, HT40 @ MCS 7	≤ -27 dB	13	-72
	802.11a @ 6 Mbps	≤ -5 dB	16	-95
	802.11a @ 54 Mbps	≤ -25 dB	14	-76
	802.11n, HT20 @ MCS 0	≤ -5 dB	16	-93
	802.11n, HT20 @ MCS 7	≤ -27 dB	13	-74
	802.11n, HT40 @ MCS 0	≤ -5 dB	16	-91
	802.11n, HT40 @ MCS 7	≤ -27 dB	13	-71

5.2 Bluetooth Performances

Table 4: Bluetooth Performances

Operating Frequency		
2.402~2.480 GHz		
Modulation		
GFSK		
Operating Mode		
BLE		
Mode	Transmitting Power	Receiving Sensitivity
BLE (1 Mbps)	≤ 10 dBm	-99dbm $\pm$ 2dB
BLE (2 Mbps)	≤ 10 dBm	-96dbm $\pm$ 2dB

5.3 PCB Antenna

Table 5: PCB Antenna Specifications

Parameter	Specification
Frequency Range (GHz)	2.4G Band: 2.400~2.4835 5G Band: 5.150~5.850
Input Impedance (Ω)	50
VSWR	≤ 2
Gain (dBi)	2.4G Band: 3 (type) 5G Band: 2 (type)
Efficiency	2.4G Band: 43% 5G Band: 46%

The module provides a PCB antenna, which is shared between 2.4GHz and 5GHz. Before mass production of terminal product, comprehensive performance testing of RF antenna design is required. The entire content of this chapter is for reference only. When designing the target product, independent analysis and evaluation should still be conducted based on the actual situation of the product's structure, materials, form, and application scenarios.

Module placement on the motherboard and motherboard handling rules:

- 1) The module is placed at the corner or edge of the motherboard PCB board, and the PCB antenna is suspended. The radiation side of the antenna is completely open, and the signal is not affected by obstruction. As shown in Figure 12, points A, B, C, and D are the preferred recommended placement locations.
- 2) If the above placement conditions cannot be met, the module should be placed on the edge of the board as much as possible. The area below the PCB antenna, 16mm on the radiation side, and 5mm near the feed point should be clear on the motherboard to ensure that the antenna signal is not affected as much as possible, as shown in Figure 12, where point F is placed.
- 3) It is not recommended to place the module in the middle area of the motherboard, as shown in Figure 7 at point E, as the signal may be affected.
- 4) Wiring is prohibited in the motherboard area below the RF test point of the SMT module, as shown in Figure 13.

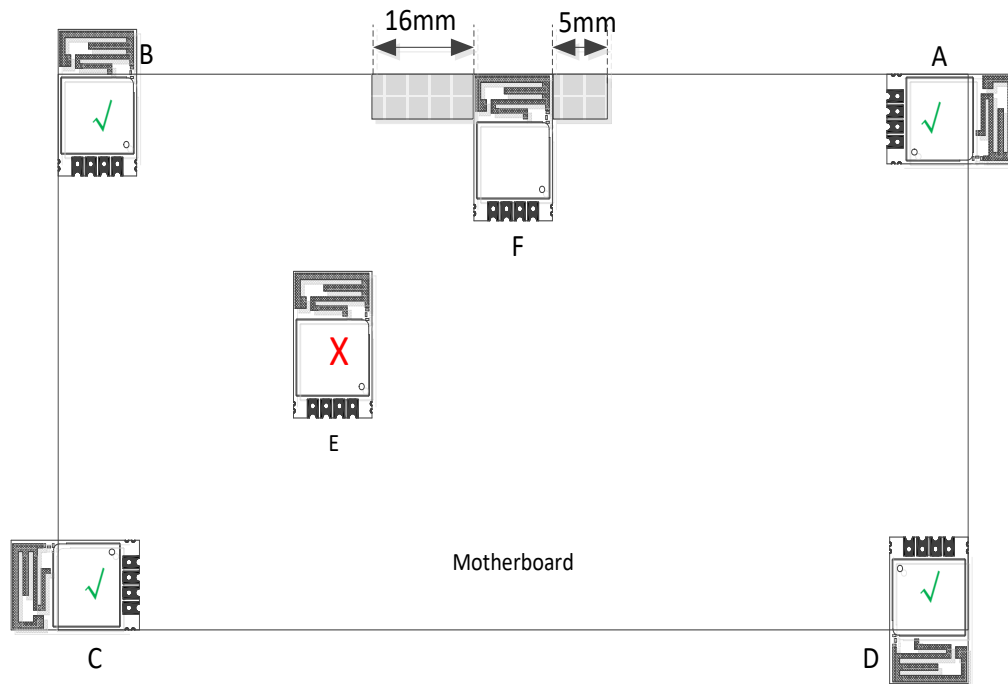


Figure 12: Module placement position

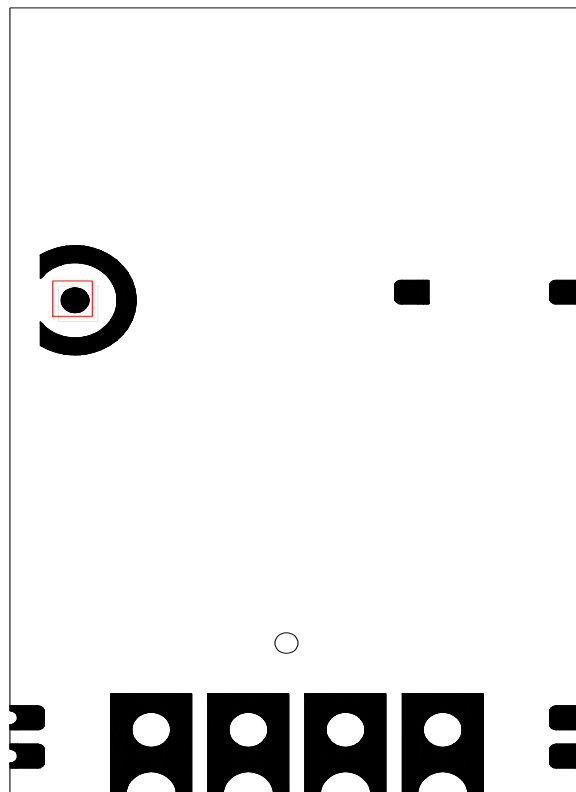


Figure 13: Prohibited wiring area at the bottom

6 Electrical Characteristics & Reliability

6.1 Absolute Maximum Ratings

Absolute maximum ratings for power supply and voltage on digital pins of the module are listed in the following table.

Table 6: Absolute Maximum Ratings (Unit: V)

Parameter	Min.	Max.
VBAT	-0.3	3.6
Voltage at Digital Pins	-0.3	3.6

6.2 Power Supply Ratings

Table 7: Module Power Supply Ratings (Unit: V)

Parameter	Description	Condition	Min.	Typ.	Max.
VBAT	Power supply for the module	The actual input voltages must be kept between the minimum and maximum values.	3.0	3.3	3.6

6.3 Power Consumption

Table 8: Wifi Power Consumption(Unit: mA)

Mode		I _V BAT (type.)	
2.4 GHz	802.11b	Tx 1 Mbps @ 15 dBm	208.7
		Tx 11 Mbps @ 15 dBm	193.8
	802.11g	Tx 6 Mbps @ 15 dBm	192.5
		Tx 54 Mbps @ 13 dBm	143.5
	802.11n	Tx HT20 MCS 0 @ 15 dBm	191.5
		Tx HT20 MCS 7 @ 13 dBm	140.8
		Tx HT40 MCS 0 @ 15 dBm	184.2
		Tx HT40 MCS 7 @ 13 dBm	123.7
5 GHz	802.11a	Tx 6 Mbps @ 16 dBm	284.9
		Tx 54 Mbps @ 14 dBm	199.1
	802.11n	Tx HT20 MCS 0 @ 16 dBm	283.8
		Tx HT20 MCS 7 @ 13 dBm	198.1
		Tx HT40 MCS 0 @ 16 dBm	266.3
		Tx HT40 MCS 7 @ 13 dBm	166.8

Table 9: Bluetooth Power Consumption(Unit: mA)

Mode	Type	Max
BLE 1 Mbps @ Tx 10 dBm	-	89.6
BLE 2 Mbps @ Tx 10 dBm	-	65.2

6.4 Digital I/O Characteristics

Table 10: VBAT I/O Characteristics (Unit: V)

Parameter	Description	Min.	Max.
V _{IH}	High-level input voltage	2.0	-
V _{IL}	Low-level input voltage	-	0.8
V _{OH}	High-level output voltage	2.4	-
V _{OL}	Low-level output voltage	-	0.4

6.5 ESD Protection

Static electricity occurs naturally and may damage the module. Therefore, applying proper ESD countermeasures and handling methods is imperative. For example, wear anti-static gloves during the development, production, assembly and testing of the module; add ESD protection components to the ESD sensitive interfaces and points in the product design.

Table 11: ESD Characteristics (Unit: kV)

Model	Test Result	Standard
Human Body Model (HBM)	±4	ANSI/ESDA/JEDEC JS-001-2017
Charged Device Model (CDM)	±0.5	ANSI/ESDA/JEDEC JS-002-2018

7 Mechanical Information

This chapter describes the mechanical dimensions of the module. All dimensions are measured in millimeters (mm), and the dimensional tolerances are ± 0.2 mm unless otherwise specified.

7.1 Mechanical Dimensions

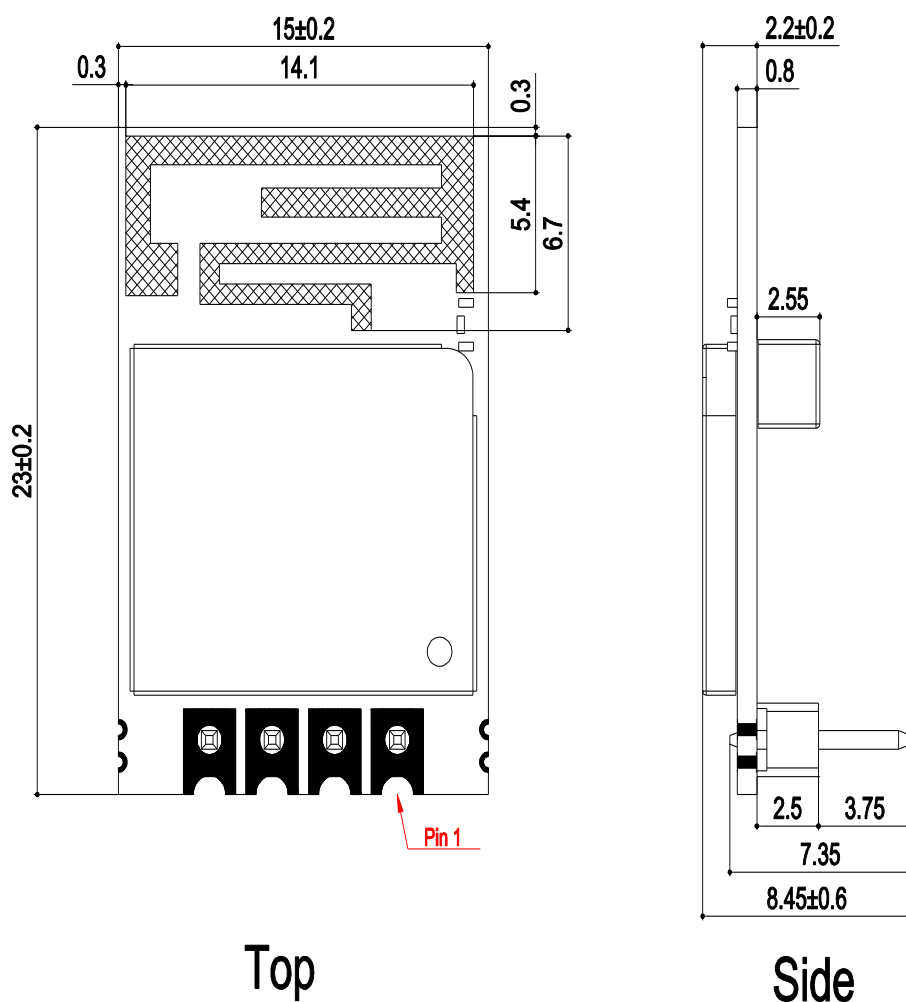


Figure 3: DIP Module Top and Side Dimensions

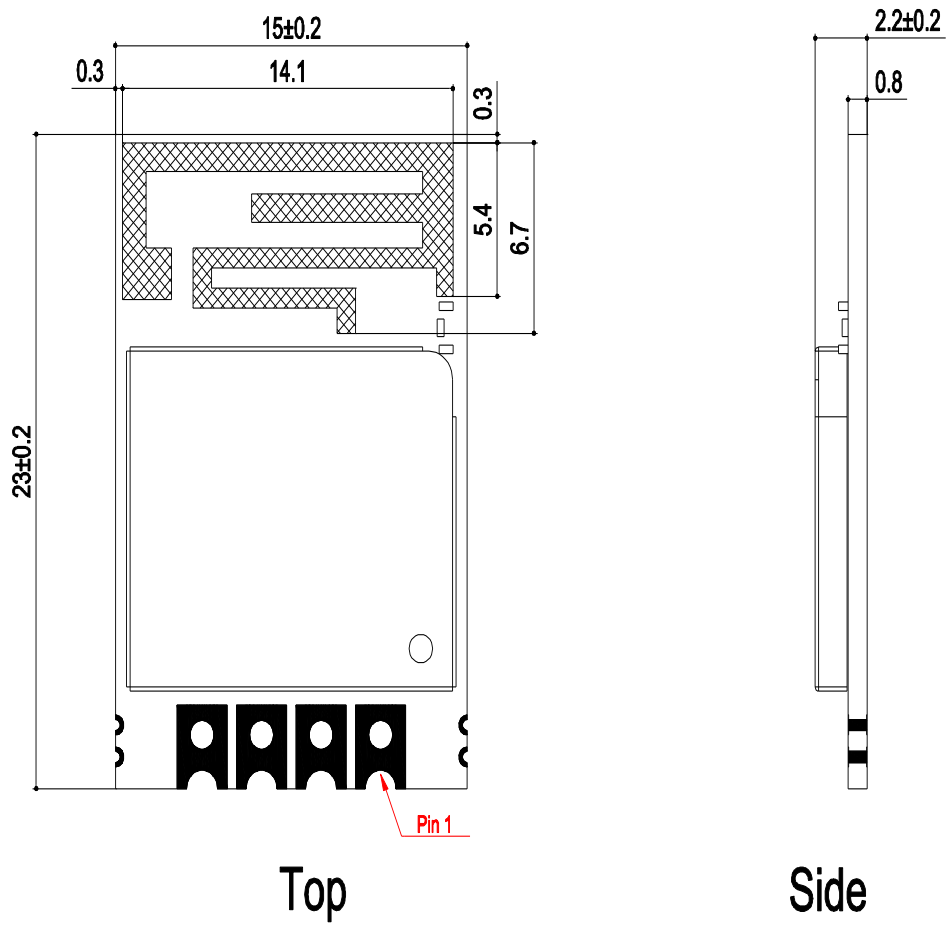


Figure 4: SMT Module Top and Side Dimensions

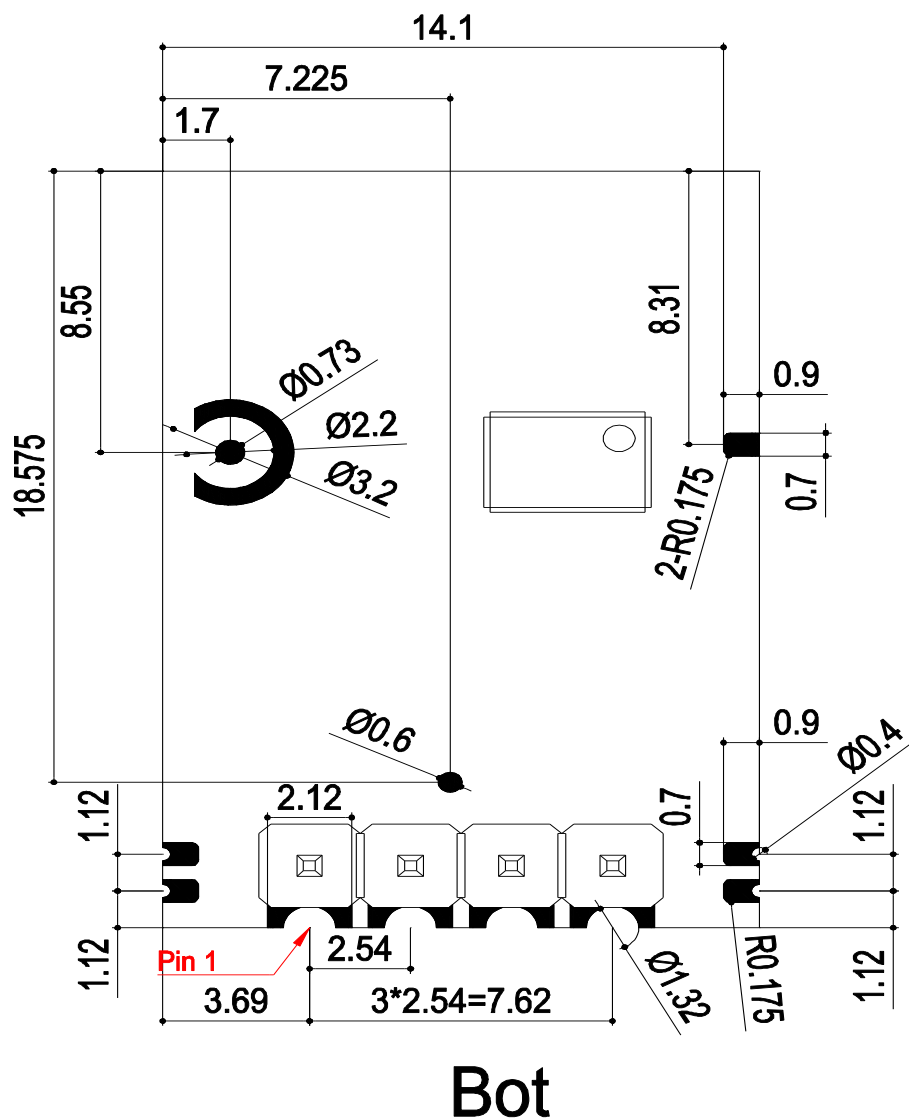


Figure 15: DIP Module Bottom Dimensions

7.2 Recommended Footprint

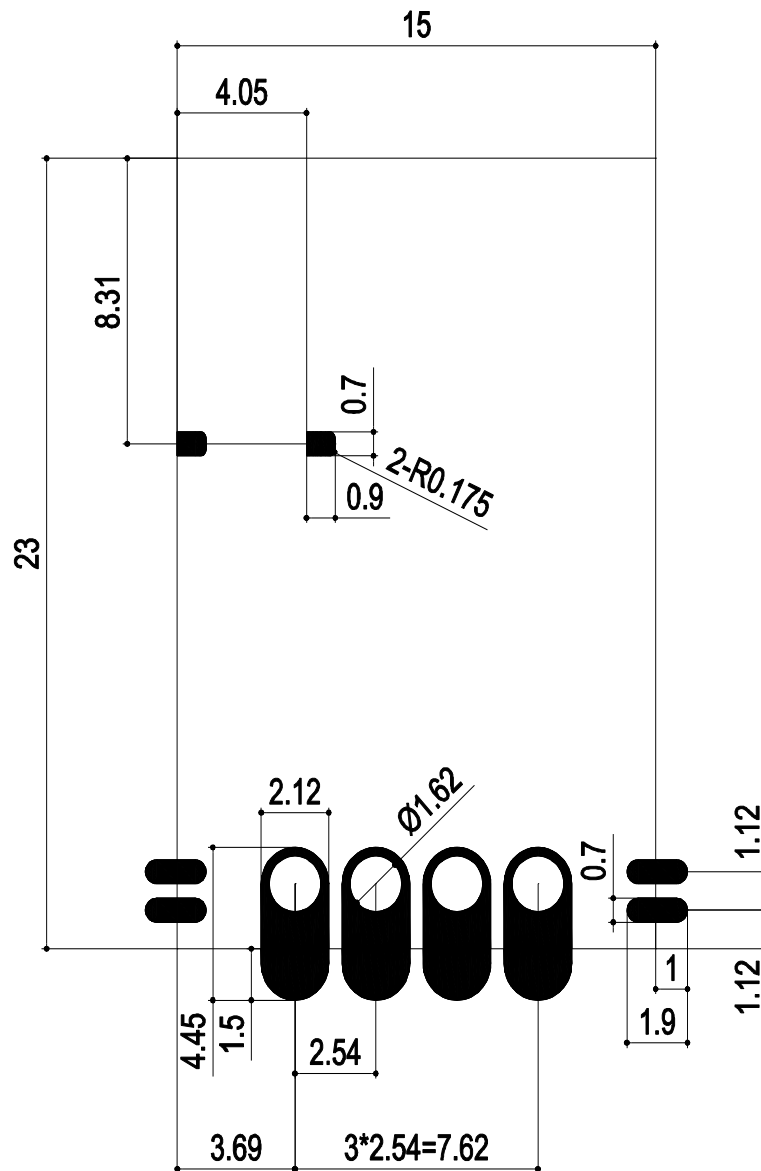


Figure 5: Recommended Footprint

NOTE

Keep at least 3 mm between the module and other components on the motherboard to improve soldering quality and maintenance convenience.

7.3 Top and Bottom Views

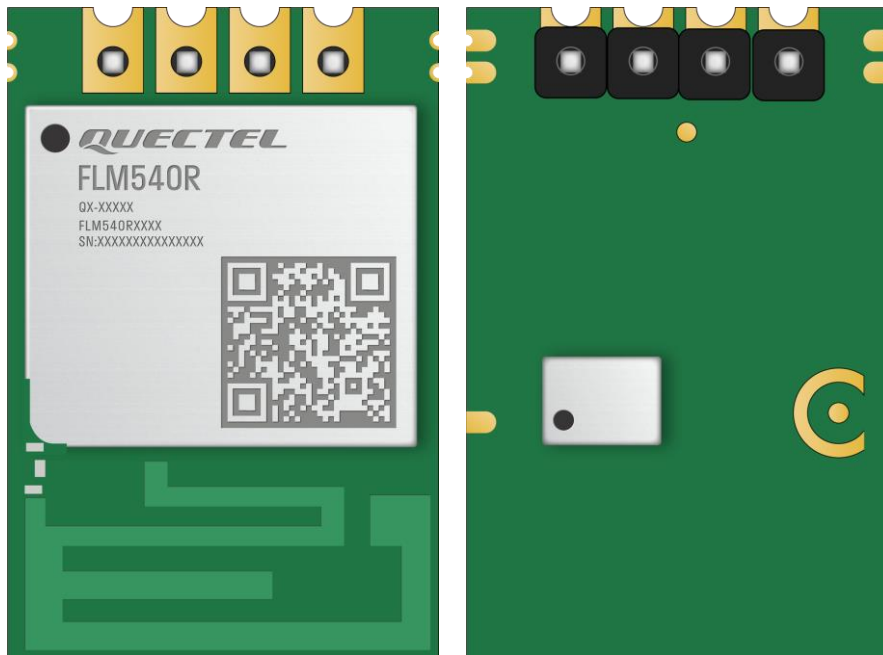


Figure 6: DIP Module Top and Bottom Views

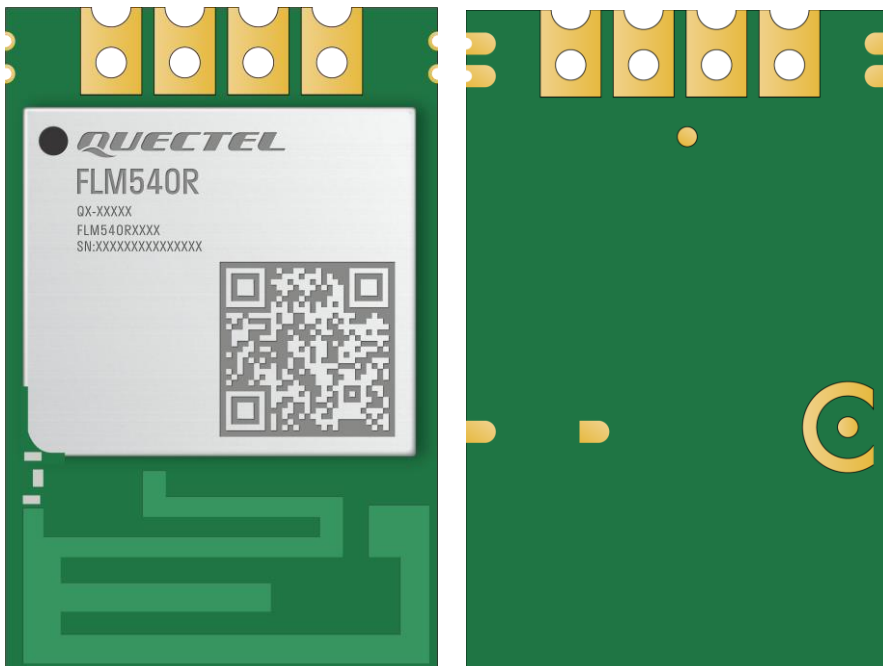


Figure 7: SMT Module Top and Bottom Views

NOTE

Images above are for illustration purpose only and may differ from the actual module. For authentic appearance and label, please refer to the module received from Quectel.

8 Storage, Manufacturing & Packaging

8.1 Storage Conditions

The module is provided with vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are shown below.

1. Recommended Storage Condition: the temperature should be 23 ± 5 °C and the relative humidity should be 35–60 %.
2. Shelf life (in a vacuum-sealed packaging): 12 months in Recommended Storage Condition.
3. Floor life: 168 hours⁴ in a factory where the temperature is 23 ± 5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g., a dry cabinet).
4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:
 - The module is not stored in Recommended Storage Condition;
 - Violation of the third requirement mentioned above;
 - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours;
 - Before module repairing.
5. If needed, the pre-baking should follow the requirements below:
 - The module should be baked for 8 hours at 120 ± 5 °C;
 - The module must be soldered to PCB within 24 hours after the baking, otherwise it should be put in a dry environment such as in a dry cabinet.

⁴ This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. And do not remove the packages of tremendous modules if they are not ready for soldering.

NOTE

1. To avoid blistering, layer separation and other soldering issues, extended exposure of the module to the air is forbidden.
2. Take out the module from the package and put it on high-temperature-resistant fixtures before baking. If shorter baking time is desired, see *IPC/JEDEC J-STD-033* for the baking procedure.
3. Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

8.2 Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.15–0.18 mm. For more details, see **document [3]**.

The recommended peak reflow temperature should be 235–246 °C, with 246 °C as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.

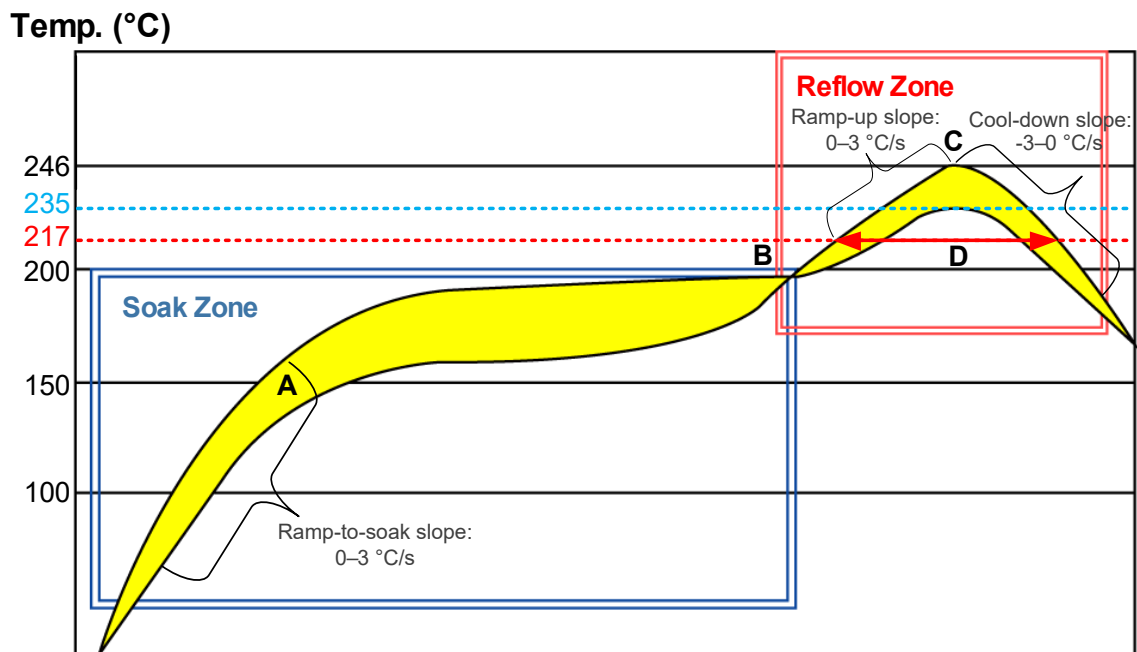


Figure 8: Recommended Reflow Soldering Thermal Profile

Table 2: Recommended Thermal Profile Parameters

Factor	Recommended Value
Soak Zone	
Ramp-to-soak slope	0–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Ramp-up slope	0–3 °C/s
Reflow time (D: over 217°C)	40–70 s
Max. temperature	235–246 °C
Cool-down slope	-3–0 °C/s
Reflow Cycle	
Max. reflow cycle	1

NOTE

1. The above profile parameter requirements are for the measured temperature of the solder joints. Both the hottest and coldest spots of solder joints on the PCB should meet the above requirements.
2. During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module's shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusted.
3. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours' Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.
4. If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.
5. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
6. Due to the complexity of the SMT process, please contact Quectel Technical Support in advance for any situation that you are not sure about, or any process (e.g. selective soldering, ultrasonic soldering) that is not mentioned in **document [3]**.

8.3 Packaging Specification

This chapter describes only the key parameters and process of packaging. All figures below are for reference only. The appearance and structure of the packaging materials are subject to the actual delivery.

The module adopts carrier tape packaging and details are as follow:

6.3.1. Carrier Tape

Dimension details are as follow:

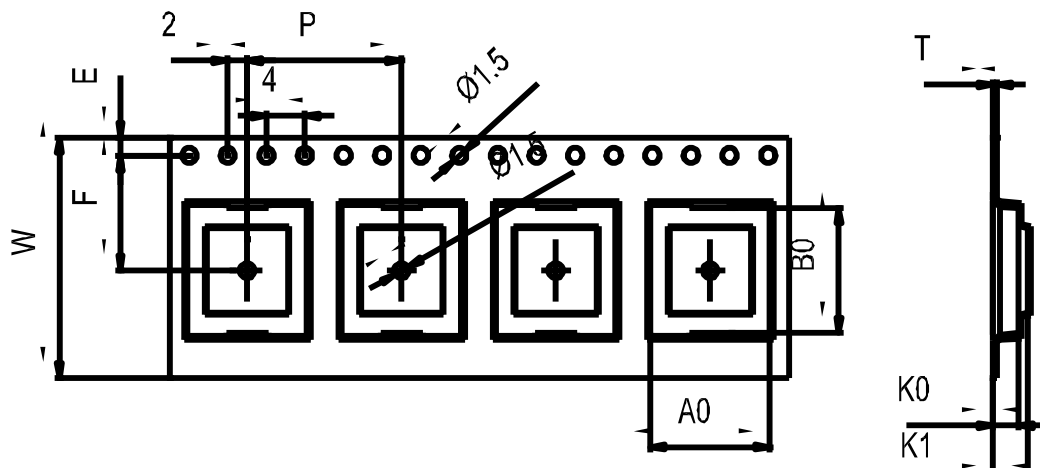


Figure 9: Carrier Tape Dimension Drawing

Table 3: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
24	16	0.35	12.4	12.4	2.6	3.6	11.5	1.75

6.3.2. Plastic Reel

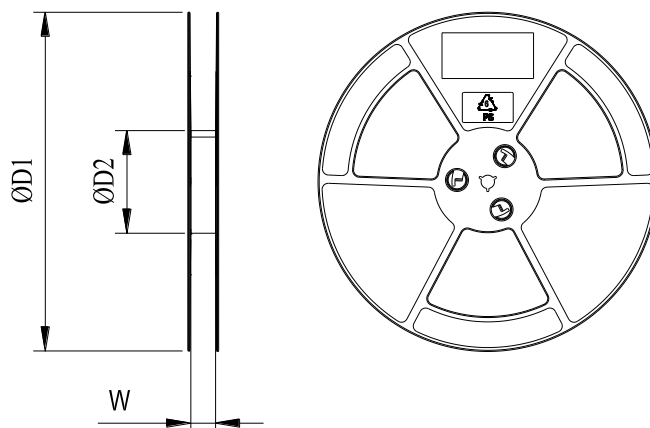


Figure 10: Plastic Reel Dimension Drawing

Table 4: Plastic Reel Dimension Table (Unit: mm)

ØD1	ØD2	W
330	100	24.5

6.3.3. Mounting Direction

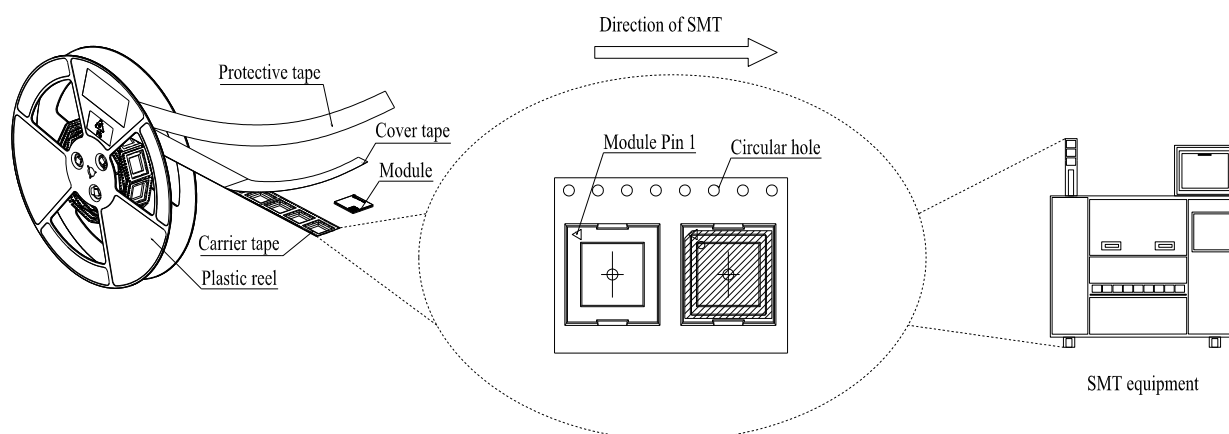
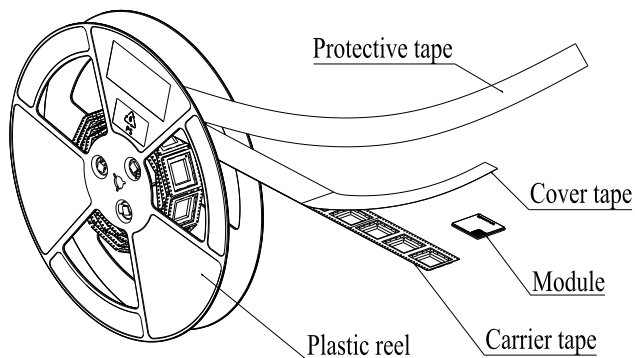


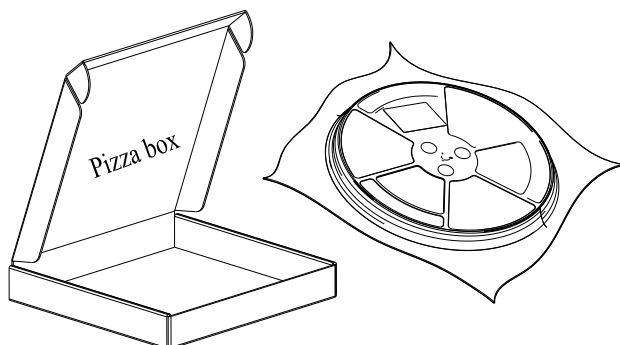
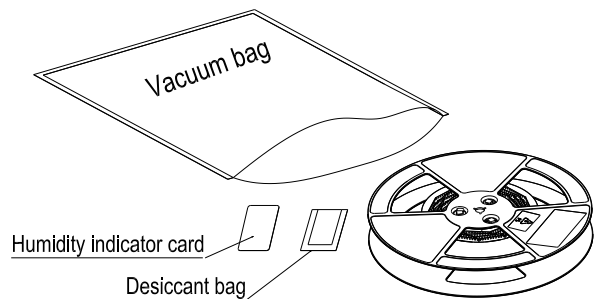
Figure 11: Mounting Direction

6.3.4. Packaging Process



Place the module into the carrier tape and use the cover tape to cover it; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. 1 plastic reel can load 500 modules.

Place the packaged plastic reel, 1 humidity indicator card and 1 desiccant bag into a vacuum bag, vacuumize it.



Place the vacuum-packed plastic reel into the pizza box.

Put 4 packaged pizza boxes into 1 carton box and seal it. 1 carton box can pack 2000 modules.

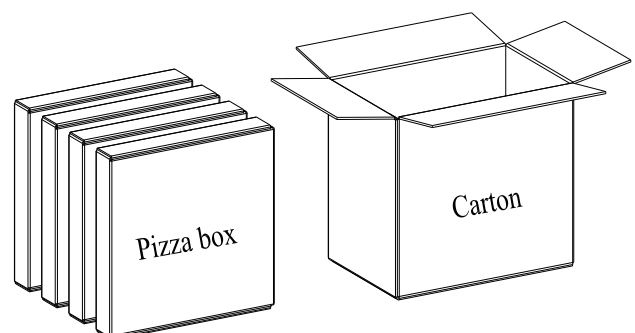


Figure 12: Packaging Process

9 Appendix References

Table 5: Related Documents

Document Name
[1] Quectel_UMTS<E_EVB_User_Guide
[2] Quectel_RF_Layout_Application_Note
[3] Quectel_Module_SMT_Application_Note

Table 6: Terms and Abbreviations

Abbreviation	Description
AP	Access Point
BLE	Bluetooth Low Energy
BPSK	Binary Phase Shift Keying
BR	Basic Rate
BT	Bluetooth
CCK	Complementary Code Keying
CTS	Clear To Send
DBPSK	Differential Binary Phase Shift Keying
DCE	Data Communication Equipment
DPSK	Differential Phase Shift Keying
DQPSK	Differential Quadrature Phase Shift Keying
DSSS	Direct Sequence Spread Spectrum
EDR	Enhanced Data Rate

ESD	Electrostatic Discharge
GATT	Generic Attribute Profile
GFSK	Gaussian Frequency Shift Keying
GND	Ground
GPIO	General-Purpose Input/Output
HCI	Host Controller Interface
HT	High Throughput
I/O	Input/Output
IEEE	Institute of Electrical and Electronics Engineers
IRQ	Interrupt Request
LCC	Leadless Chip Carrier (package)
Mbps	Million Bits Per Second
MCS	Modulation and Coding Scheme
MSL	Moisture Sensitivity Levels
NC	Not Connected
NM	Not Mounted
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
RTS	Request to Send
RXD	Receive Data
SDIO	Secure Digital Input/Output

STA	Station
TBD	To Be Determined
Tx	Transmit
TXD	Transmit Data
UART	Universal Asynchronous Receiver/Transmitter
VHT	Very High Throughput
V _{IHmax}	Maximum High-level Input Voltage
V _{IHmin}	Minimum High-level Input Voltage
V _{ILmax}	Maximum Low-level Input Voltage
V _{ILmin}	Minimum Low-level Input Voltage
V _{nom}	Nominal Voltage
V _{OHmin}	Minimum High-level Output Voltage
V _{OLmax}	Maximum Low-level Output Voltage
VSWR	Voltage Standing Wave Ratio

FCC Statement

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

The device must not be co-located or operating in conjunction with any other antenna or transmitter. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions : (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Radiation Exposure Statement

This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Does not comply with the use restrictions of the product:

Portable devices used close with human's body (within 20cm), Like Cell phone, Notebook etc.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.209 & 15.407.

2.3 Specific operational use conditions

The module can be used for mobile applications with a maximum 0.2dBi antenna. The host manufacturer installing this module into their product must ensure that the final product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules,

including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

2.4 Limited module procedures

Not applicable. The module is a Single module and complies with the requirement of FCC Part 15 212.

2.5 Trace antenna designs

Not applicable. The module has its own antenna, and doesn't need a host's printed board micro strip trace antenna etc.

2.6 RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and user's body; and if RF exposure statement or module layout is changed, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.7 Antennas

Antenna Specification are as follows:

Type: External Antenna

Gain: 2.4G:2.3dBi;5G:2.7dBi;

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna; The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a "unique" antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc).

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: XMR2024FLM540R" with their finished product.

2.9 Information on test modes and additional testing requirements

Host manufacturer must perform test of radiated & conducted emission and spurious emission, e.t.c according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.209 & 15.407 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Federal Communication Commission Statement (FCC, U S)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

IMPORTANT NOTES**Co-location warning:**

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM integration instructions:

This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance.

requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module **FCC ID: XMR2024FLM540R**"

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in this manual.

IC Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The device is compliance with RF field strength limits, users can obtain Canadian information on RF exposure and compliance.

IC Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

The user manual for local area network devices shall contain instructions related to the restrictions mentioned in the above sections, namely that:

- (i) the device for operation in the band 5150-5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;
- (ii) the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall comply with the e.i.r.p. limit; and
- (iii) the maximum antenna gain permitted for devices in the band 5725-5825 MHz shall comply with the e.i.r.p. limits specified for point-to-point and non point-to-point operation as appropriate.

(i) Les dispositifs fonctionnant dans la bande 5150-5250 MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux.

(ii) le gain d'antenne maximal autorisé pour les appareils dans les bandes 5250-5350 MHz et 5470-5725 MHz doivent respecter le pire limiter; et

(iii) le gain d'antenne maximal autorisé pour les appareils dans la bande 5725-5825 MHz doivent respecter le pire limites spécifiées pour le point-à-point et l'exploitation non point à point, le cas échéant.

Users should also be advised that high-power radars are allocated as primary users (i.e. priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

Les utilisateurs de radars de haute puissance sont désignés utilisateurs principaux (c.-à-d., qu'ils ont la priorité) pour les bandes 5250-5350 MHz et 5650-5850 MHz et que ces radars pourraient causer du brouillage et/ou des dommages aux dispositifs LAN-EL.