

FGS060N Hardware Design

Short-Range Module Series

Version: 1.0.0

Date: 2024-02-23

Status: Preliminary



At Quectel, our aim is to provide timely and comprehensive services to our customers. If you require any assistance, please contact our headquarters:

Quectel Wireless Solutions Co., Ltd.

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

Tel: +86 21 5108 6236

Email: info@quectel.com

Or our local offices. For more information, please visit:

<http://www.quectel.com/support/sales.htm>.

For technical support, or to report documentation errors, please visit:

<http://www.quectel.com/support/technical.htm>.

Or email us at: support@quectel.com.

Legal Notices

We offer information as a service to you. The provided information is based on your requirements and we make every effort to ensure its quality. You agree that you are responsible for using independent analysis and evaluation in designing intended products, and we provide reference designs for illustrative purposes only. Before using any hardware, software or service guided by this document, please read this notice carefully. Even though we employ commercially reasonable efforts to provide the best possible experience, you hereby acknowledge and agree that this document and related services hereunder are provided to you on an “as available” basis. We may revise or restate this document from time to time at our sole discretion without any prior notice to you.

Use and Disclosure Restrictions

License Agreements

Documents and information provided by us shall be kept confidential, unless specific permission is granted. They shall not be accessed or used for any purpose except as expressly provided herein.

Copyright

Our and third-party products hereunder may contain copyrighted material. Such copyrighted material shall not be copied, reproduced, distributed, merged, published, translated, or modified without prior written consent. We and the third party have exclusive rights over copyrighted material. No license shall be granted or conveyed under any patents, copyrights, trademarks, or service mark rights. To avoid ambiguities, purchasing in any form cannot be deemed as granting a license other than the normal non-exclusive, royalty-free license to use the material. We reserve the right to take legal action for noncompliance with abovementioned requirements, unauthorized use, or other illegal or malicious use of the material.

Trademarks

Except as otherwise set forth herein, nothing in this document shall be construed as conferring any rights to use any trademark, trade name or name, abbreviation, or counterfeit product thereof owned by Quectel or any third party in advertising, publicity, or other aspects.

Third-Party Rights

This document may refer to hardware, software and/or documentation owned by one or more third parties ("third-party materials"). Use of such third-party materials shall be governed by all restrictions and obligations applicable thereto.

We make no warranty or representation, either express or implied, regarding the third-party materials, including but not limited to any implied or statutory, warranties of merchantability or fitness for a particular purpose, quiet enjoyment, system integration, information accuracy, and non-infringement of any third-party intellectual property rights with regard to the licensed technology or use thereof. Nothing herein constitutes a representation or warranty by us to either develop, enhance, modify, distribute, market, sell, offer for sale, or otherwise maintain production of any our products or any other hardware, software, device, tool, information, or product. We moreover disclaim any and all warranties arising from the course of dealing or usage of trade.

Privacy Policy

To implement module functionality, certain device data are uploaded to Quectel's or third-party's servers, including carriers, chipset suppliers or customer-designated servers. Quectel, strictly abiding by the relevant laws and regulations, shall retain, use, disclose or otherwise process relevant data for the purpose of performing the service only or as permitted by applicable laws. Before data interaction with third parties, please be informed of their privacy and data security policy.

Disclaimer

- a) We acknowledge no liability for any injury or damage arising from the reliance upon the information.
- b) We shall bear no liability resulting from any inaccuracies or omissions, or from the use of the information contained herein.
- c) While we have made every effort to ensure that the functions and features under development are free from errors, it is possible that they could contain errors, inaccuracies, and omissions. Unless otherwise provided by valid agreement, we make no warranties of any kind, either implied or express, and exclude all liability for any loss or damage suffered in connection with the use of features and functions under development, to the maximum extent permitted by law, regardless of whether such loss or damage may have been foreseeable.
- d) We are not responsible for the accessibility, safety, accuracy, availability, legality, or completeness of information, advertising, commercial offers, products, services, and materials on third-party websites and third-party resources.

Copyright © Quectel Wireless Solutions Co., Ltd. 2024. All rights reserved.

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 given 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
-	2023-10-23	Michael DU/Adam ZENG/ Lidong ZHOU	Creation of the document
1.0.0	2024-02-23	Michael DU/Adam ZENG/ Lidong ZHOU	Preliminary

Contents

Safety Information.....	3
About the Document.....	4
Contents.....	5
Table Index.....	7
Figure Index.....	8
1 Introduction.....	9
1.1. Special Mark	9
2 Product Overview	10
2.1. Key Features.....	11
3 RF Performances.....	12
3.1. Wi-Fi Performances	12
3.2. Bluetooth Performances	14
3.3. 802.15.4 Performances.....	15
4 Application Interfaces	16
4.1. Pin Assignment.....	16
4.2. Pin Description.....	17
4.3. Power Supply	20
4.4. Wi-Fi Application Interfaces	22
4.4.1. SDIO Interface.....	22
4.5. Bluetooth Application Interfaces	24
4.5.1. UART Interface.....	24
4.5.2. PCM Interface.....	25
4.5.3. I2S Interface	25
4.6. 802.15.4 Application Interfaces	26
4.6.1. SPI Interface.....	26
4.7. RF Antenna Interface.....	27
4.7.1. Reference Design.....	27
4.7.2. Requirements for Antenna Design	28
4.7.3. RF Routing Guidelines	28
4.7.4. RF Connector Recommendation.....	30
5 Electrical Characteristics & Reliability.....	33
5.1. Absolute Maximum Ratings	33
5.2. Power Supply Ratings.....	33
5.3. Power Consumption.....	34
5.3.1. Wi-Fi Power Consumption.....	34
5.3.2. Bluetooth Power Consumption.....	36
5.3.3. 802.15.4 Power Consumption.....	36

5.4. Digital I/O Characteristics	37
5.5. ESD Protection	38
5.6. Thermal Dissipation	38
6 Mechanical Information	40
6.1. Mechanical Dimensions	40
6.2. Recommended Footprint	42
6.3. Top and Bottom Views.....	43
7 Storage, Manufacturing & Packaging.....	44
7.1. Storage Conditions	44
7.2. Manufacturing and Soldering.....	45
7.3. Packaging Specification.....	47
7.3.1. Carrier Tape	47
7.3.2. Plastic Reel.....	48
7.3.3. Mounting Direction	48
7.3.4. Packaging Process.....	49
8 Appendix References	50

Table Index

Table 1 : Special Mark	9
Table 2 : Basic Information	10
Table 3 : Key Features	11
Table 4 : Wi-Fi Performances	12
Table 5 : Bluetooth Performances	14
Table 6 : 802.15.4 Performances.....	15
Table 7 : Parameter Definition	17
Table 8 : Pin Description	17
Table 9 : Timing Parameters.....	21
Table 10 : The internal SDIO signal trace length of the module (Unit: mm).....	23
Table 11 : Pin Definition of I2S Interface	26
Table 12 : Requirements for Antenna Design.....	28
Table 13 : Absolute Maximum Ratings (Unit: V).....	33
Table 14 : Module Power Supply Ratings (Unit: V)	33
Table 15 : Wi-Fi Power Consumption in Non-signalling Mode (Unit: mA).....	34
Table 16 : Bluetooth Power Consumption in Non-signalling Mode (Unit: mA).....	36
Table 17 : 802.15.4 Power Consumption in Non-signalling Mode (Unit: mA).....	36
Table 18 : VDD_IO I/O Requirements (Unit: V)	37
Table 19 : VDDIO_RF I/O Requirements (Unit: V)	37
Table 20 : SDIO_VDD I/O Requirements (Unit: V).....	37
Table 21 : Electrostatics Discharge Characteristics (Unit: kV)	38
Table 22 : Recommended Thermal Profile Parameters	46
Table 23 : Carrier Tape Dimension Table (Unit: mm).....	47
Table 24 : Plastic Reel Dimension Table (Unit: mm)	48
Table 25 : Related Documents.....	50
Table 26 : Terms and Abbreviations	50

Figure Index

Figure 2 : Pin Assignment (Top View)	16
Figure 3 : Reference Circuit of Power Supply.....	21
Figure 4 : Power-up Timing.....	21
Figure 5 : Wi-Fi Application Interface Connection	22
Figure 6 : SDIO Interface Connection.....	22
Figure 7 : Bluetooth Application Connection.....	24
Figure 8 : UART Connection	24
Figure 9 : PCM Connection (Master Mode)	25
Figure 10 : PCM Connection (Slave Mode)	25
Figure 11 : 802.15.4 Application Connection	26
Figure 12 : SPI Connection	27
Figure 13 : Reference Circuit for RF Antenna Interface	28
Figure 14 : Microstrip Design on a 2-layer PCB	29
Figure 15 : Coplanar Waveguide Design on a 2-layer PCB	29
Figure 16 : Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground).....	29
Figure 17 : Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground).....	30
Figure 18 : Dimensions of the Receptacle (Unit: mm)	31
Figure 19 : Specifications of Mated Plugs	31
Figure 20 : Space Factor of Mated Connectors (Unit: mm).....	32
Figure 21 : Placement and Fixing of the Heatsink	39
Figure 22 : Top and Side Dimensions.....	40
Figure 23 : Bottom Dimensions (Bottom View).....	41
Figure 24 : Recommended Footprint	42
Figure 25 : Top and Bottom Views.....	43
Figure 26 : Recommended Reflow Soldering Thermal Profile	45
Figure 27 : Carrier Tape Dimension Drawing (Unit: mm)	47
Figure 28 : Plastic Reel Dimension Drawing	48
Figure 29 : Mounting Direction	48
Figure 30 : Packaging Process	49

1 Introduction

This document defines the FGS060N and describes its air interfaces and hardware interfaces which are connected with your applications. With this document, you can quickly understand module interface specifications, RF performance, electrical and mechanical details, as well as other related information of the module.

1.1. Special Mark

Table 1: Special Mark

Mark	Definition
[...]	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

FGS060N is a low-power, high-performance IEEE 802.11 a/b/g/n/ac/ax Wi-Fi 6, Bluetooth 5.2 and 802.15.4 module. It supports 2.4 GHz and 5 GHz dual-band and 1T1R mode with maximum data transmission rate of 600.4 Mbps. It provides SDIO 3.0 interface for Wi-Fi, UART and PCM/I2S for Bluetooth and SPI for 802.15.4.

The module is an SMD module with compact packaging.

Table 2: Basic Information

FGS060N	
Packaging type	LGA
Pin counts	84
Dimensions	(14 ±0.2) mm × (13 ±0.2) mm × (2 ±0.2) mm
Weight	approx. 0.7 g

2.1. Key Features

Table 3: Key Features

Basic Information	
Protocols and Standard	● Wi-Fi protocols: IEEE 802.11a/b/g/n/ac/ax ● Bluetooth protocol: Bluetooth 5.2 ● Thread protocol: IEEE 802.15.4 ● All hardware components are fully compliant with EU RoHS directive
Power Supply	VBAT_3V3 Power Supply: ● 3.14–3.46 V; Typ.:3.3 V VBAT_1V8 Power Supply: ● 1.71–1.89 V; Typ.:1.8 V VDD_IO Power Supply: ● 3.14–3.46 V; Typ.:3.3 V ● 1.71–1.89 V; Typ.:1.8 V VDDIO_RF Power Supply: ● 3.14–3.46 V; Typ.:3.3 V SDIO_VDD Power Supply: ● 3.14–3.46 V; Typ.:3.3 V ● 1.71–1.89 V; Typ.:1.8 V
Temperature Ranges	● Operating temperature ¹: -40 °C to +85 °C ● Storage temperature: -45 °C to +95°C
EVB Kit	FGS060N-M.2
RF Antenna Interface	
Wi-Fi/Bluetooth/802.15.4 Antenna Interface	● ANT_WIFI/BT ● 50 Ω characteristic impedance
Application Interface	
Wi-Fi Application Interface	SDIO 3.0
Bluetooth Application Interface	● UART ● PCM/I2S
802.15.4 Application Interface	SPI

¹ To meet the normal operating temperature range requirements, it is necessary to ensure effective thermal dissipation, e.g., by adding passive or active heatsinks, heat pipes, vapor chambers, etc. Within this range, the module's indicators comply with IEEE, Bluetooth and 802.15.4 specification requirements.

3 RF Performances

3.1. Wi-Fi Performances

Table 4: Wi-Fi Performances

Operating Frequency			
● 2.4 GHz: 2.400–2.4835 GHz ● 5 GHz: 5.150–5.850 GHz			
Modulation			
DSSS, OFDM, DBPSK, DQPSK, CCK, BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM			
Encryption Mode			
WPA2, WPA3			
Operating Mode			
● AP ● STA ● P2P			
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) ● 802.11ac: VHT20 (MCS 0–8), VHT40 (MCS 0–9), VHT80 (MCS 0–9) ● 802.11ax: HE20 (MCS 0–11), HE40 (MCS 0–11), HE80 (MCS 0–11)			
Condition (VBAT_3V3 = VDDIO_RF = VDD_IO = 3.3 V; VBAT_1V8 = SDIO_VDD = 1.8 V; Temp.: 25 °C)		Typ.; Unit: dBm; Tolerance: ±2 dB	
EVM		Transmitting Power	Receiver Sensitivity
2.4 GHz	802.11b @ 1 Mbps	16	-96
	802.11b @ 11 Mbps	16	-87
	802.11g @ 6 Mbps	16	-90

5 GHz	802.11g @ 54 Mbps	≤ -25 dB	14	-74
	802.11n, HT20 @ MCS 0	≤ -5 dB	14	-90
	802.11n, HT20 @ MCS 7	≤ -27 dB	14	-71
	802.11n, HT40 @ MCS 0	≤ -5 dB	14	-87
	802.11n, HT40 @ MCS 7	≤ -27 dB	14	-69
	802.11ax, HE20 @ MCS 0	≤ -5 dB	14	-90
	802.11ax, HE20 @ MCS 11	≤ -35dB	8	-61
	802.11ax, HE40 @ MCS 0	≤ -5 dB	14	-87
	802.11ax, HE40 @ MCS 11	≤ -35 dB	8	-59
	802.11a @ 6 Mbps	≤ -5 dB	15	-90
	802.11a @ 54 Mbps	≤ -25 dB	15	-74
	802.11n, HT20 @ MCS 0	≤ -5 dB	14	-90
	802.11n, HT20 @ MCS 7	≤ -27 dB	14	-71
	802.11n, HT40 @ MCS 0	≤ -5 dB	14	-87
	802.11n, HT40 @ MCS 7	≤ -27 dB	14	-69
	802.11ac, VHT20 @ MCS 0	≤ -5 dB	14	-90
	802.11ac, VHT20 @ MCS 8	≤ -30 dB	13	-68
	802.11ac, VHT40 @ MCS 0	≤ -5 dB	14	-87
	802.11ac, VHT40 @ MCS 9	≤ -32 dB	12	-64
	802.11ac, VHT80 @ MCS 0	≤ -5 dB	14	-83
	802.11ac, VHT80 @ MCS 9	≤ -32 dB	11	-60
	802.11ax, HE20 @ MCS 0	≤ -5 dB	14	-91
	802.11ax, HE20 @ MCS 11	≤ -35 dB	7	-62
	802.11ax, HE40 @ MCS 0	≤ -5 dB	14	-88
	802.11ax, HE40 @ MCS 11	≤ -35 dB	7	-59
	802.11ax, HE80 @ MCS 0	≤ -5 dB	14	-84

802.11ax, HE80 @ MCS 11	≤ -35 dB	7	-57
-------------------------	----------	---	-----

3.2. Bluetooth Performances

Table 5: Bluetooth Performances

Operating Frequency		
2.400–2.4835 GHz		
Modulation		
GFSK, $\pi/4$ -DQPSK, 8DPSK		
Operating Mode		
- Classic Bluetooth (BR + EDR) - Bluetooth Low Energy (BLE)		
Condition (VBAT_3V3 = VDDIO_RF = VDD_IO = 3.3 V; VBAT_1V8 = SDIO_VDD = 1.8 V; Temp.: 25 °C)	Typ.; Unit: dBm, Tolerance: ± 2 dB	
	Transmitting Power	Receiver Sensitivity
BR	16	-92
EDR ($\pi/4$ -DQPSK)	7	-93
EDR (8-DPSK)	7	-88
BLE (1 Mbps)	16	-96
BLE (2 Mbps)	16	-94
BLE Long Range (S = 8) 125 kbps	14	-103
BLE Long Range (S = 2) 500 kbps	14	-98

3.3. 802.15.4 Performances

Table 6: 802.15.4 Performances

Operating Frequency		
2.400–2.4835 GHz		
Modulation		
OQPSK		
Condition (VBAT_3V3 = VDDIO_RF = VDD_IO = 3.3 V; VBAT_1V8 = SDIO_VDD = 1.8 V; Temp.: 25 °C)	Typ.; Unit: dBm, Tolerance: ±2 dB	
	Transmitting Power	Receiver Sensitivity
2405 MHz	18	-99
2440 MHz	18	-99
2480 MHz	0 ²	-93

² Due to the limitations of software, the transmitting power of the high channel is lower than that of the low and middle channels.

4 Application Interfaces

4.1. Pin Assignment

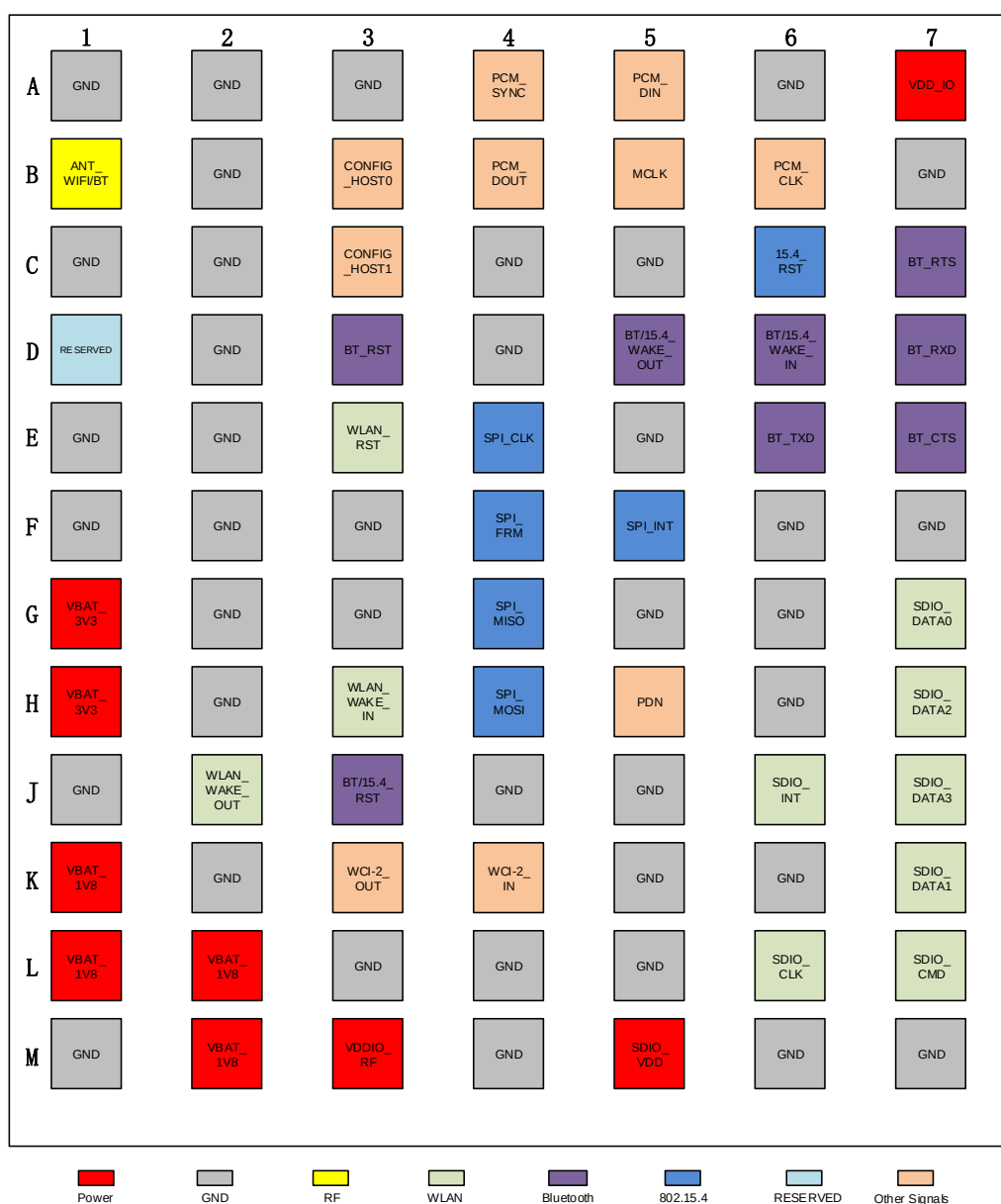


Figure 1: Pin Assignment (Top View)

NOTE

1. Keep all RESERVED and unused pins unconnected.
2. All GND pins should be connected to ground.

4.2. Pin Description

Table 7: Parameter Definition

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

DC characteristics include power domain and rated current.

Table 8: Pin Description

Power Supply					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
VBAT_3V3	G1, H1	PI	Power supply for the module	Vmin = 3.14 V Vnom = 3.3 V Vmax = 3.46 V	It must be provided with sufficient current of at least 0.5 A.
VBAT_1V8	K1, L1, L2, M2	PI	Power supply for the module	Vmin = 1.71 V Vnom = 1.8 V Vmax = 1.89 V	It must be provided with sufficient current of at least 1 A.
VDD_IO	A7	PI	Power supply for the module's digital I/O pins	Vmin = 1.71 V Vnom = 1.8/3.3 V Vmax = 3.46 V	

VDDIO_RF	M3	PI	Power supply for the module's digital I/O pins of RF	Vmin = 3.14 V Vnom = 3.3 V Vmax = 3.46 V
SDIO_VDD	M5	PI	Power supply for the module's digital I/O pins of SDIO	Vmin = 1.71 V Vnom = 1.8/3.3 V Vmax = 3.46 V
GND	A1–A3, A6, B2, B7, C1, C2, C4, C5, D2, D4, E1, E2, E5, F1–F3, F6, F7, G2, G3, G5, G6, H2, H6, J1, J4, J5, K2, K5, K6, L3–L5, M1, M4, M6, M7			

Wi-Fi Application Interfaces

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
WLAN_RST	E3	DI	Independent software reset for WLAN	VDD_IO	Active low.
WLAN_WAKE_IN	H3	DI	Host wakes up WLAN		
WLAN_WAKE_OUT	J2	DO	WLAN wakes up host		
SDIO_INT	J6	DO	SDIO interrupt	SDIO_VDD	50 Ω characteristic impedance; SDIO 3.0 compliant.
SDIO_CMD	L7	DIO	SDIO command		
SDIO_CLK	L6	DI	SDIO clock		
SDIO_DATA3	J7	DIO	SDIO data bit 3		
SDIO_DATA2	H7	DIO	SDIO data bit 2		
SDIO_DATA0	G7	DIO	SDIO data bit 0		
SDIO_DATA1	K7	DIO	SDIO data bit 1		

Bluetooth Application Interfaces

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
BT_RST	D3	DI	Independent software reset for Bluetooth	VDD_IO	The request to reset either Bluetooth or 802.15.4 radio leads to reinitialization of both radios; Active low.
BT/15.4_RST	J3	DO	Bluetooth/802.15.4 independent software reset		

indicator to host					
BT/15.4_WAKE_OUT	D5	DO	Bluetooth/802.15.4 wakes up host		
BT/15.4_WAKE_IN	D6	DI	Host wakes up Bluetooth/802.15.4		
BT_TXD	E6	DO	Bluetooth UART transmit		
BT_RXD	D7	DI	Bluetooth UART receive		
BT_CTS	E7	DI	Clear to send signal to the module		
BT_RTS	C7	DO	Request to send signal from the module		
PCM_SYNC	A4	DIO	PCM data frame sync	VDD_IO	In master mode, it is an output signal; In slave mode, it is an input signal.
PCM_DIN	A5	DI	PCM data input		
PCM_DOUT	B4	DO	PCM data output		
PCM_CLK	B6	DIO	PCM clock		In master mode, it is an output signal; In slave mode, it is an input signal.
MCLK	B5	DO	PCM clock output		Optional clock used for some codecs; If unused, keep it open.
802.15.4 Application Interfaces					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
15.4_RST	C6	DI	Independent software reset for 802.15.4	VDD_IO	The request to reset either Bluetooth or 15.4 radio leads to reinitialization of both radios; Active low.
SPI_CLK	E4	DI	SPI clock		Only slave mode is supported.
SPI_MOSI	H4	DI	SPI master-out slave-in		

SPI_MISO	G4	DO	SPI master-in slave-out		
SPI_FRM	F4	DI	SPI chip select		
SPI_INT	F5	DO	SPI interrupt		
RF Antenna Interface					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
ANT_WIFI/BT	B1	AIO	Wi-Fi/Bluetooth/802.15.4 antenna interface		50 Ω characteristic impedance.
Other Interfaces					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
CONFIG_HOST0	B3	DI	Host configuration selection	VBAT_1V8	Keep them open.
CONFIG_HOST1	C3	DI			
WCI-2_OUT	K3	DO	WCI-2 transmit	VDD_IO	WCI-2 interface is used for the coexistence with an external radio.
WCI-2_IN	K4	DI	WCI-2 receive		
PDN	H5	DI	Power down input	VBAT_3V3	Active low; Keep it high for normal operation.
RESERVED Pin					
Pin Name	Pin No.				Comment
RESERVED	D1				Keep it open.

4.3. Power Supply

The module is powered by VBAT_3V3 with sufficient current of at least 0.5 A and VBAT_1V8 with sufficient current of at least 1 A. For better power supply performance, it is recommended to parallel a 47 μ F decoupling capacitor and two filter capacitors of 1 μ F and 100 nF close to the module's voltage pins. C4 is reserved for debugging and not mounted by default. Meanwhile, it is recommended to add a TVS near the voltage pins to improve the surge voltage bearing capacity of the module. In principle, the longer the voltage trace is, the wider it should be.

The reference design for module's power supply (with VBAT_3V3 as an example) is shown in the figure

below.

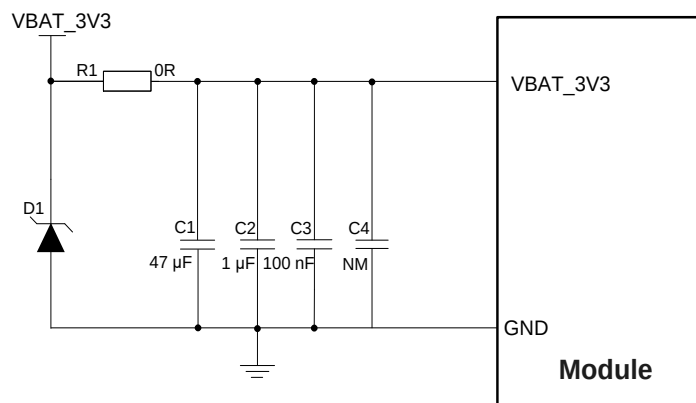


Figure 2: Reference Circuit of Power Supply

The power-up timing of the module is shown below.

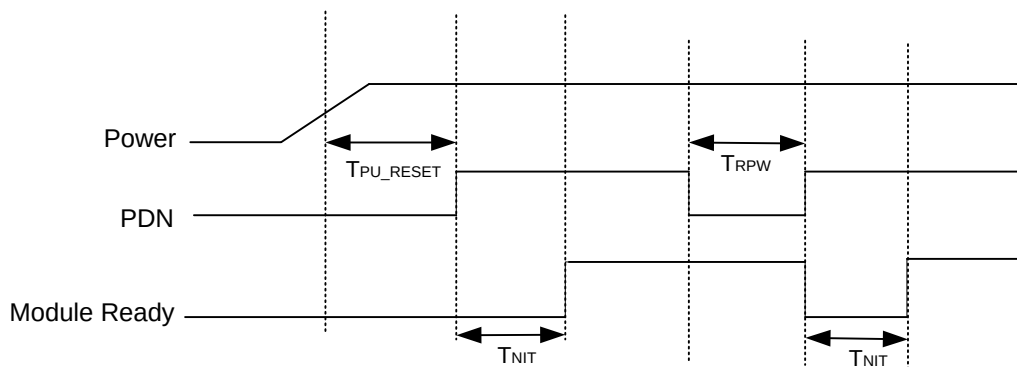


Figure 3: Power-up Timing

Table 9: Timing Parameters

Symbol	Parameter	Min.	Typ.	Max.	Unit
T _{PU_RESET}	Valid power to PDN drive high	0	-	-	ms
T _{RPW}	PDN pulse width	1	-	-	μs
T _{NIT}	PDN drive high to module ready (SDIO bus enumeration)	20	-	-	ms
V _{IH}	Input high voltage	1.4	-	4.5	V
V _{IL}	Input low voltage	-0.4	-	0.5	V

4.4. Wi-Fi Application Interfaces

Wi-Fi application interface connection between the module and the host is illustrated in the figure below.

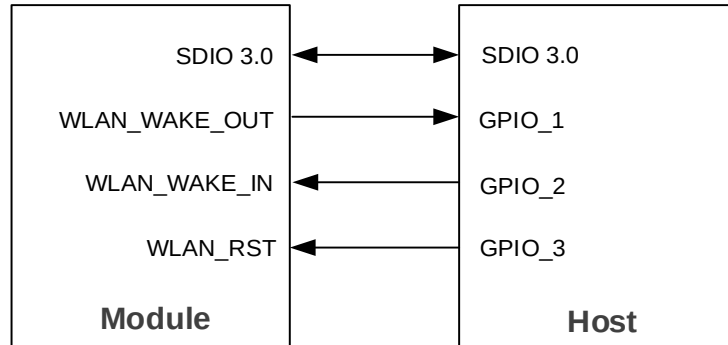


Figure 4: Wi-Fi Application Interface Connection

4.4.1. SDIO Interface

The module supports SDIO 3.0 interface for Wi-Fi applications. The SDIO interface connection between the module and the host is illustrated in the figure below.

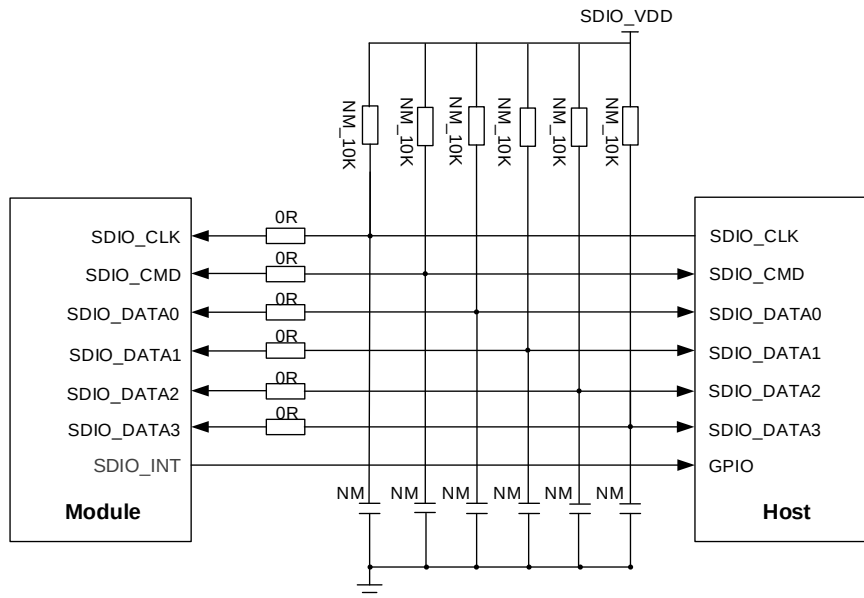


Figure 5: SDIO Interface Connection

To ensure compliance of interface design with the SDIO 3.0 specification, it is recommended to adopt the following principles:

- To avoid the impact of jitter, reserve pull-up resistors with value of 10–100 kΩ (recommended value

is 10 k Ω) on the SDIO_CMD, SDIO_DATA[0:3], and SDIO_CLK signal traces, and pull them up to SDIO_VDD of the module.

- Route the SDIO traces in inner layer of the PCB, and surround the traces with ground on that layer and with ground planes above and below. And the SDIO_CLK signal trace should be routed with ground surrounded separately. The impedance of SDIO signal trace is 50 $\Omega \pm 10\%$
- Keep SDIO signals far away from power supply traces, crystal-oscillators, magnetic devices, sensitive signals such as RF signals, analog signals, as well as noise signals generated by clock and DC-DC.
- The distance between SDIO signals and other signals must be greater than twice the trace width, and the bus load capacitance must be less than 15 pF.
- Route SDIO traces on the same layer of the PCB as much as possible, keeping them parallel and ensuring that there are enough ground vias around the SDIO traces and connecting them to a ground plane.
- According to the transmission rate, the trace length has the following requirements:
 - 1) As for SDR104 mode, the recommended bus length is less than 50 mm.
 - 2) As for other modes, such as DDR50, SDR50, etc., the recommended bus length is less than 150 mm.
- SDIO signal traces (SDIO_CLK and SDIO_DATA [0:3]/SDIO_CMD) need to be equal in length (less than 1 mm distance between the traces). The internal trace length of the module is as below:

Table 10: The internal SDIO signal trace length of the module (Unit: mm)

Pin No.	Pin Name	Length
L7	SDIO_CMD	6.1129
L6	SDIO_CLK	6.106
J7	SDIO_DATA3	6.1219
H7	SDIO_DATA2	6.1172
G7	SDIO_DATA0	6.1173
K7	SDIO_DATA1	6.1184

4.5. Bluetooth Application Interfaces

Bluetooth application interface connection between the module and the host is illustrated in the figure below.

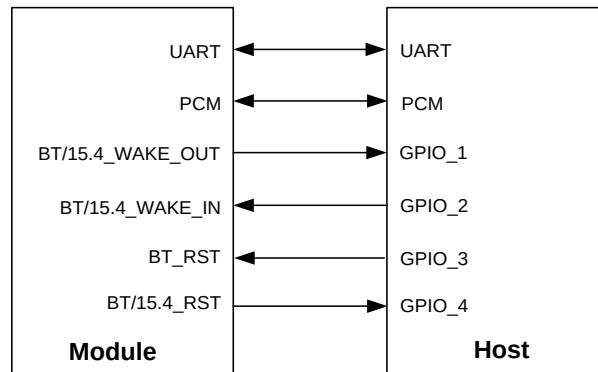


Figure 6: Bluetooth Application Connection

NOTE

The GPIO_1 connected from the host to the module's BT/15.4_WAKE_OUT must be interruptible.

4.5.1. UART Interface

The module supports an HCI (Host Controller Interface) UART. It supports hardware flow control and can be used for data transmission with the host. It supports up to 3.0 Mbps baud rates.

The UART connection between the module and the host is illustrated in the figure below.

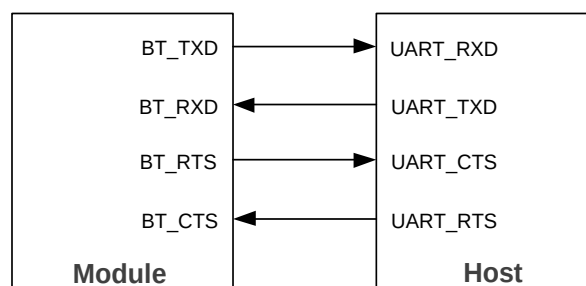


Figure 7: UART Connection

NOTE

To increase the stability of UART communication, it is recommended to add UART hardware flow control design.

4.5.2. PCM Interface

The module provides a PCM interface specialized for Bluetooth audio application and it is only available for Classic Bluetooth.

The PCM interface supports both master and slave modes, and the PCM connections are illustrated in the figures below.

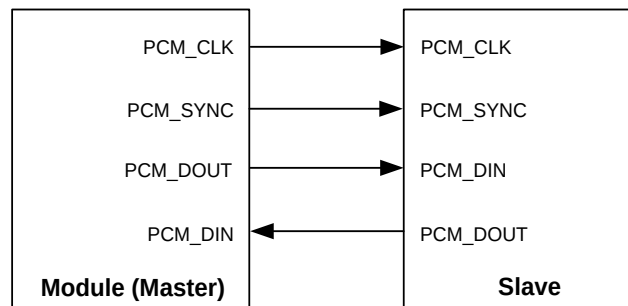


Figure 8: PCM Connection (Master Mode)

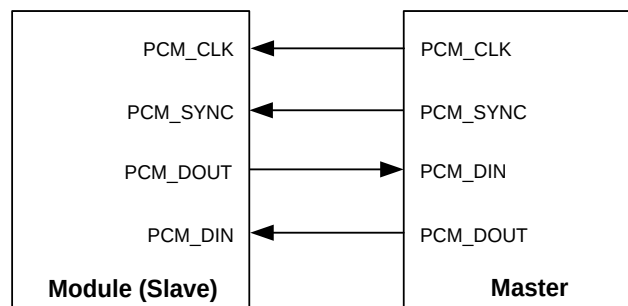


Figure 9: PCM Connection (Slave Mode)

4.5.3. I2S Interface

The module provides an I2S interface which is multiplexed with PCM interface for Bluetooth audio application, and it is only available for Classic Bluetooth.

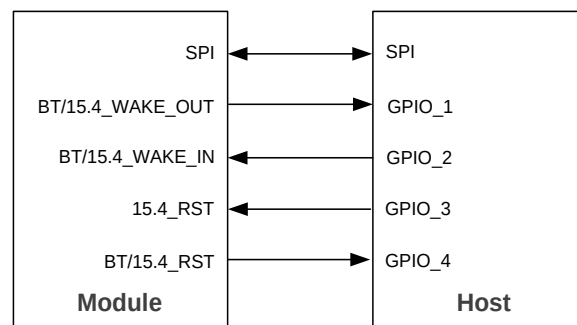
The pin definition of I2S is shown below.

Table 11: Pin Definition of I2S Interface

Pin Name	Pin No.	Multiplexing Function	I/O	Description	Comment
PCM_SYNC	A4	I2S_LRCLK	DIO	I2S left/right clock	In master mode, it is an output signal; In slave mode, it is an input signal.
PCM_DIN	A5	I2S_DIN	DI	I2S data input	
PCM_DOUT	B4	I2S_DOUT	DO	I2S data output	
PCM_CLK	B6	I2S_BCLK	DIO	I2S bit clock	In master mode, it is an output signal; In slave mode, it is an input signal.
MCLK	B5	I2S_CCLK	DO	I2S clock output	Optional clock used for some codecs; If unused, keep it open.

4.6. 802.15.4 Application Interfaces

802.15.4 application interface connection between the module and the host is illustrated in the figure below.


Figure 10: 802.15.4 Application Connection

4.6.1. SPI Interface

The module supports an SPI interface which only supports slave mode. The SPI is used for data transmission with the host.

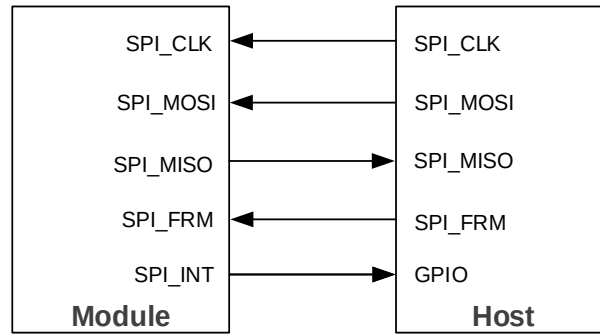


Figure 11: SPI Connection

4.7. RF Antenna Interface

The module supports pin antenna. It is required to perform a comprehensive functional test for the RF design before mass production of terminal products. The entire content of this chapter is provided for illustration only. Analysis, evaluation and determination are still necessary when designing target products.

The module supports an antenna pin antenna (ANT_WIFI/BT). And the RF port of the module requires 50 Ω characteristic impedance.

4.7.1. Reference Design

A reference circuit for the RF antenna interface is shown below. It is recommended to reserve a π -type and a LC matching circuits for better RF performance, and also reserve a TVS for ESD protection. Reserved matching components (R1, C1, C2, C3, D1 and L1) shall be placed as close to the antenna as possible. C1, C2, C3, D1 and L1 are not mounted by default. The parasitic capacitance of TVS should be less than 0.05 pF and R1 is recommended to be 0 Ω .

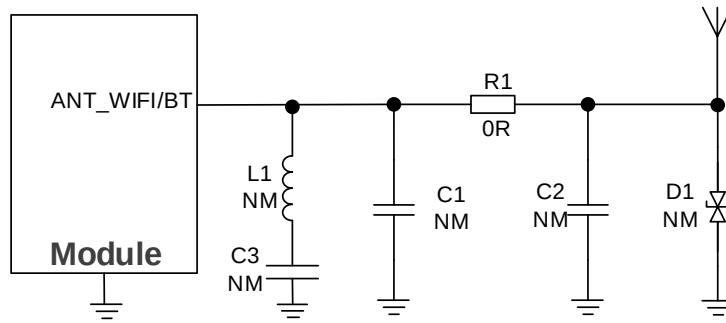


Figure 12: Reference Circuit for RF Antenna Interface

4.7.2. Requirements for Antenna Design

Table 12: Requirements for Antenna Design

Parameter	Requirement ³
Frequency Ranges (GHz)	● 2.4 GHz: 2.400–2.4835 ● 5 GHz: 5.150–5.850
Cable Insertion Loss (dB)	< 1
VSWR	≤ 2 (Typ.)
Gain (dBi)	1 (Typ.)
Max Input Power (W)	50
Input Impedance (Ω)	50
Polarization Type	Vertical

4.7.3. RF Routing Guidelines

For user's PCB, the characteristic impedance of all RF traces should be controlled to 50 Ω. The impedance of the RF traces is usually determined by the trace width (W), the materials' dielectric constant, the height from the reference ground to the signal layer (H), and the spacing between RF traces and grounds (S). Microstrip or coplanar waveguide is typically used in RF layout to control characteristic impedance. The following are reference designs of microstrip or coplanar waveguide with different PCB structures.

³ For more information about RF characteristics, see **Chapter 3**.

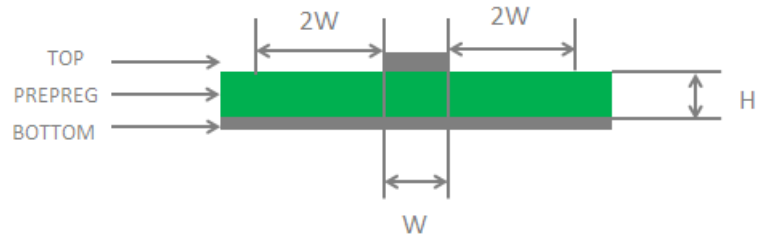


Figure 13: Microstrip Design on a 2-layer PCB

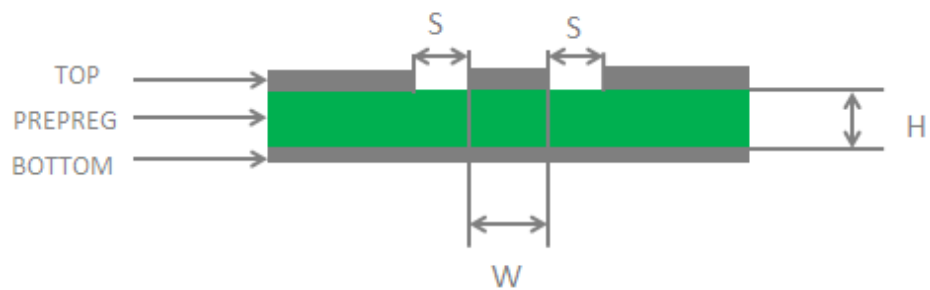


Figure 14: Coplanar Waveguide Design on a 2-layer PCB

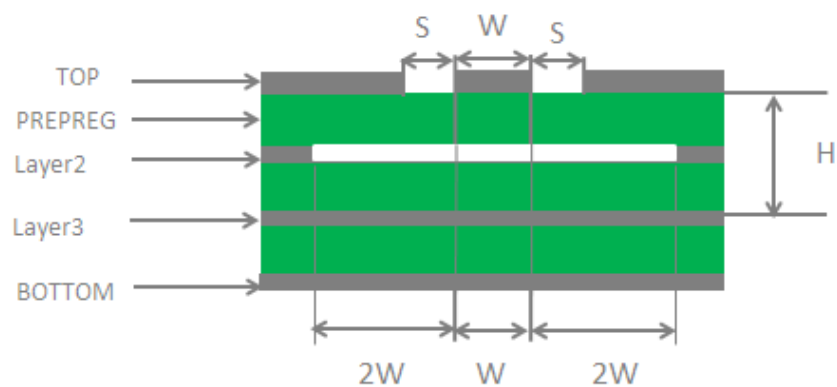


Figure 15: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

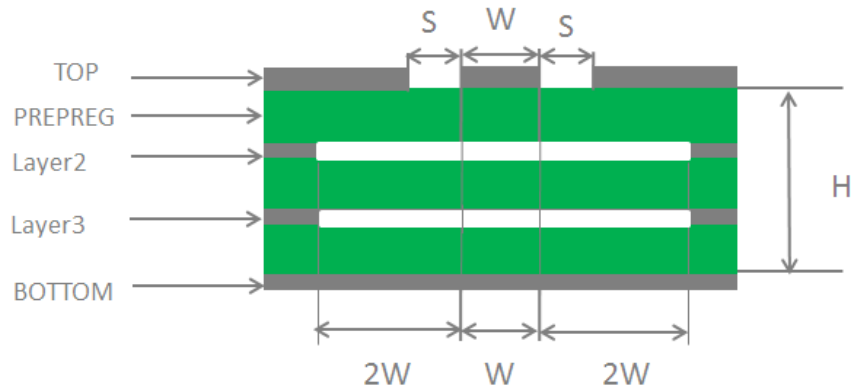


Figure 16: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

To ensure RF performance and reliability, follow the principles below in RF layout design:

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω .
- The GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- The distance between the RF pins and the RF connector should be as short as possible and all the right-angle traces should be changed to curved ones. The recommended trace angle is 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, adding some ground vias around RF traces and the reference ground could help to improve RF performance. The distance between the ground vias and RF traces should be at least twice the width of RF signal traces ($2 \times W$).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see **document [1]**.

4.7.4. RF Connector Recommendation

If RF connector is used for antenna connection, it is recommended to use the U.FL-R-SMT connector provided by Hirose.

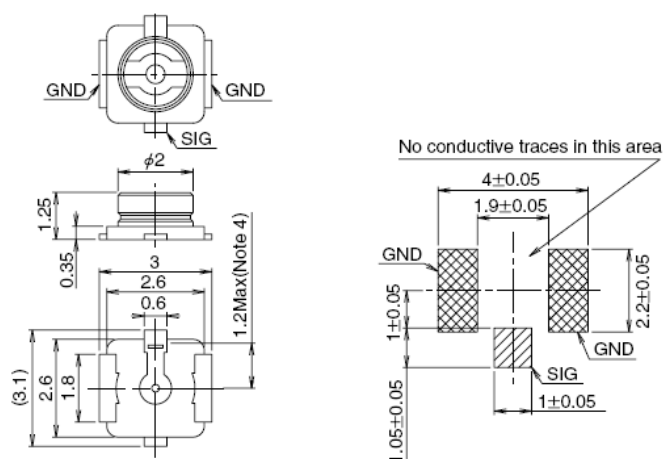


Figure 17: Dimensions of the Receptacle (Unit: mm)

U.FL-LP series mated plugs listed in the following figure can be used to match the U.FL-R-SMT connector.

Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 0.81mm Coaxial cable	Dia. 1mm Coaxial cable	Dia. 1.37mm Coaxial cable
Weight (mg)	53.7	59.1	34.8	45.5	71.7
RoHS	YES				

Figure 18: Specifications of Mated Plugs

The following figure describes the space factor of mated connectors.

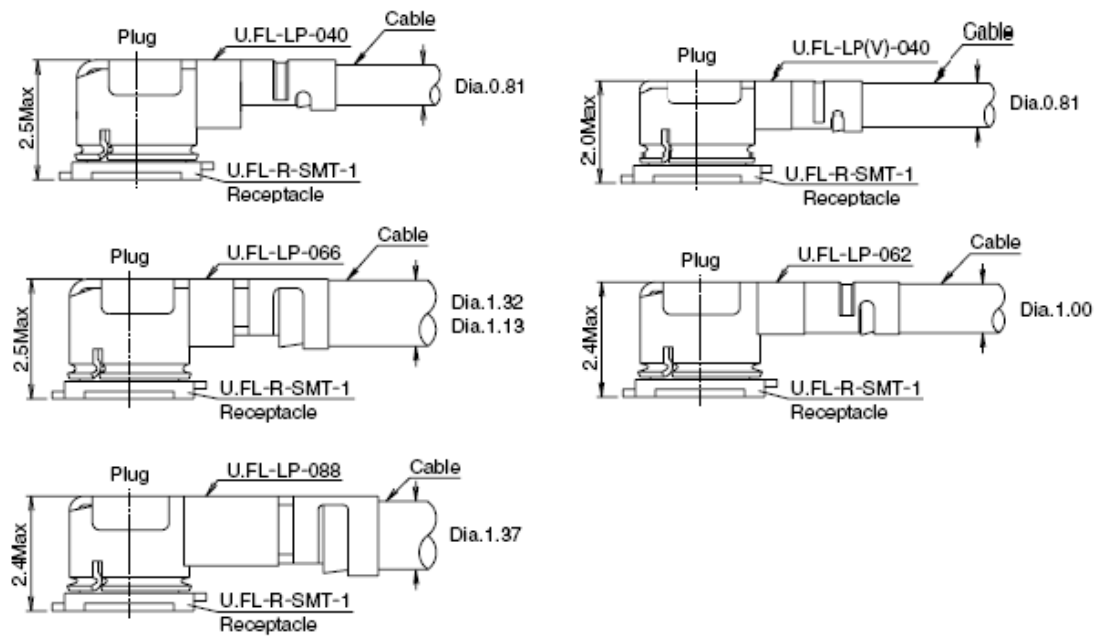


Figure 19: Space Factor of Mated Connectors (Unit: mm)

For more details, please visit <http://www.hirose.com>.

5 Electrical Characteristics & Reliability

5.1. Absolute Maximum Ratings

Table 13: Absolute Maximum Ratings (Unit: V)

Parameter	Min.	Max.
VBAT_3V3	-	3.96
VBAT_1V8	-	2.16
VDD_IO	-	3.96
	-	2.16
VDDIO_RF	-	3.96
SDIO_VDD	-	3.96
	-	2.16

5.2. Power Supply Ratings

Table 14: Module Power Supply Ratings (Unit: V)

Parameter	Description	Condition	Min.	Typ.	Max.
VBAT_3V3	Power supply for the module	The actual input voltages must be kept between the minimum and maximum values.	3.14	3.3	3.46
VBAT_1V8	Power supply for the module	The actual input voltages must be kept between the minimum and maximum values.	1.71	1.8	1.89

VDD_IO	Power supply for the module's digital I/O pins	3.3 V power supply	3.14	3.3	3.46
		1.8 V power supply	1.71	1.8	1.89
VDDIO_RF	Power supply for the module's digital I/O pins of RF	3.3 V power supply	3.14	3.3	3.46
SDIO_VDD	Power supply for the module's digital I/O pins of SDIO	3.3 V power supply	3.14	3.3	3.46
		1.8 V power supply	1.71	1.8	1.89

5.3. Power Consumption

The Wi-Fi, Bluetooth and 802.15.4 power consumption are tested when VBAT_3V3 = VDDIO_RF = VDD_IO = 3.3 V; VBAT_1V8 = SDIO_VDD = 1.8 V under 25 °C.

5.3.1. Wi-Fi Power Consumption

Table 15: Wi-Fi Power Consumption in Non-signalling Mode (Unit: mA)

Condition			I _{3.3 V}	I _{1.8 V}
2.4 GHz	802.11b	Tx 1 Mbps @ 16dBm	253.8	151.8
		Tx 11 Mbps @ 16dBm	253.7	151.9
	802.11g	Tx 6 Mbps @ 16dBm	275.6	193.2
		Tx 54 Mbps @ 14dBm	213.1	163.4
	802.11n	Tx HT20 MCS 0 @ 14dBm	224.5	167.0
		Tx HT20 MCS 7 @ 14dBm	212.5	162.9
		Tx HT40 MCS 0 @ 14dBm	222.4	175.0
		Tx HT40 MCS 7 @ 14dBm	202.6	168.4
	802.11ax	Tx HE20 MCS 0 @ 14dBm	227.0	168.3
		Tx HE20 MCS 11 @ 8dBm	158.1	145.6

5 GHz		Tx HE40 MCS 0 @ 14dBm	226.1	176.2
		Tx HE40 MCS 11 @ 8dBm	154.0	152.5
	802.11a	Tx 6 Mbps @ 15dBm	271.2	236.2
		Tx 54 Mbps @ 15dBm	254.7	229.0
	802.11n	Tx HT20 MCS 0 @ 14dBm	247.1	221.3
		Tx HT20 MCS 7 @ 14dBm	232.1	213.4
		Tx HT40 MCS 0 @ 14dBm	245.8	229.8
		Tx HT40 MCS 7 @ 14dBm	221.8	217.6
	802.11ac	Tx VHT20 MCS 0 @ 14dBm	247.1	220.7
		Tx VHT20 MCS 8 @ 13dBm	217.8	210.6
		Tx VHT40 MCS 0 @ 14dBm	245.7	230.1
		Tx VHT40 MCS 9 @ 12dBm	198.4	215.1
		Tx VHT80 MCS 0 @ 14dBm	244.9	244.4
		Tx VHT80 MCS 9 @ 11dBm	183.2	225.6
	802.11ax	Tx HE20 MCS 0 @ 14dBm	248.9	219.0
		Tx HE20 MCS 11 @ 7dBm	178.4	175.6
		Tx HE40 MCS 0 @ 14dBm	248.8	230.7
		Tx HE40 MCS 11 @ 7dBm	172.7	181.9
		Tx HE80 MCS 0 @ 14dBm	248.3	245.3
		Tx HE80 MCS 11 @ 7dBm	171.5	198.2

5.3.2. Bluetooth Power Consumption

Table 16: Bluetooth Power Consumption in Non-signalling Mode (Unit: mA)

Condition	I _{3.3 V}	I _{1.8 V}
BR @ 3 dBm	22.7	239.9
EDR ($\pi/4$ -DQPSK) @ 0 dBm	22.7	152.6
EDR (8-DPSK) @ 0 dBm	22.7	153.4
BLE (1 Mbps) @ 3 dBm	22.7	174.1
BLE (2 Mbps) @ 3 dBm	22.7	150.3
BLE Long Range (S = 8) 125 kbps @ 3 dBm	22.7	191.7
BLE Long Range (S = 2) 500 kbps @ 3 dBm	22.7	195.4

5.3.3. 802.15.4 Power Consumption

Table 17: 802.15.4 Power Consumption in Non-signalling Mode (Unit: mA)

Channel	I _{3.3 V}	I _{1.8 V}
2405 MHz @ 18 dBm	TBD	TBD
2440 MHz @ 18 dBm	TBD	TBD
2480 MHz @ 0 dBm	TBD	TBD

5.4. Digital I/O Characteristics

Table 18: VDD_IO I/O Requirements (Unit: V)

Parameter	Description	Min.	Max.
V _{IH}	High-level input voltage	$0.7 \times VDD_IO$	$VDD_IO + 0.4$
V _{IL}	Low-level input voltage	-0.4	$0.3 \times VDD_IO$
V _{OH}	High-level output voltage	$VDD_IO - 0.4$	-
V _{OL}	Low-level output voltage	-	0.4

Table 19: VDDIO_RF I/O Requirements (Unit: V)

Parameter	Description	Min.	Max.
V _{IH}	High-level input voltage	$0.7 \times VDDIO_RF$	$VDDIO_RF + 0.4$
V _{IL}	Low-level input voltage	-0.4	$0.3 \times VDDIO_RF$
V _{OH}	High-level output voltage	$VDDIO_RF - 0.4$	-
V _{OL}	Low-level output voltage	-	0.4

Table 20: SDIO_VDD I/O Requirements (Unit: V)

Parameter	Description	Min.	Max.
V _{IH}	High-level input voltage	$0.7 \times SDIO_VDD$	$SDIO_VDD + 0.4$
V _{IL}	Low-level input voltage	-0.4	$0.3 \times SDIO_VDD$
V _{OH}	High-level output voltage	$SDIO_VDD - 0.4$	-
V _{OL}	Low-level output voltage	-	0.4

5.5. ESD Protection

Static electricity occurs naturally and it 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 21: Electrostatics Discharge Characteristics (Unit: kV)

Model	Test Result	Standard
Human Body Model (HBM)	± 2	ANSI/ESDA/JEDEC JS-001
Charged Device Model (CDM)	± 0.5	ANSI/ESDA/JEDEC JS-002

5.6. Thermal Dissipation

The module offers the best performance when all internal IC chips are working within their operating temperatures. When the IC chip reaches or exceeds the maximum junction temperature, the module may still work but the performance and function (such as RF output power, data rate, etc.) will be affected to a certain extent. Therefore, the thermal design should be maximally optimized to ensure all internal IC chips always work within the recommended operating temperature range.

The following principles for thermal consideration are provided for reference:

- Keep the module away from heat sources on your PCB, especially high-power components such as processor, power amplifier, and power supply.
- Maintain the integrity of the PCB copper layer and drill as many thermal vias as possible.
- Follow the principles below when the heatsink is necessary:
 - Do not place large size components in the area where the module is mounted on your PCB to reserve enough place for heatsink installation.
 - Attach the heatsink to the shielding cover of the module; In general, the base plate area of the heatsink should be larger than the module area to cover the module completely;
 - Choose the heatsink with adequate fins to dissipate heat;
 - Choose a TIM (Thermal Interface Material) with high thermal conductivity, good softness and good wettability and place it between the heatsink and the module;
 - Fasten the heatsink with four screws to ensure that it is in close contact with the module to prevent the heatsink from falling off during the drop, vibration test, or transportation.

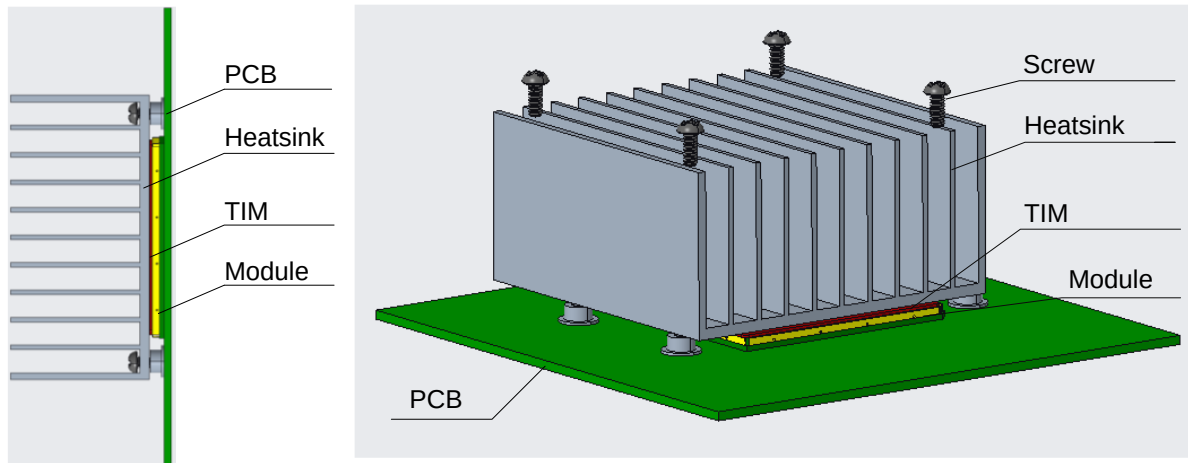


Figure 20: Placement and Fixing of the Heatsink

6 Mechanical Information

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

6.1. Mechanical Dimensions

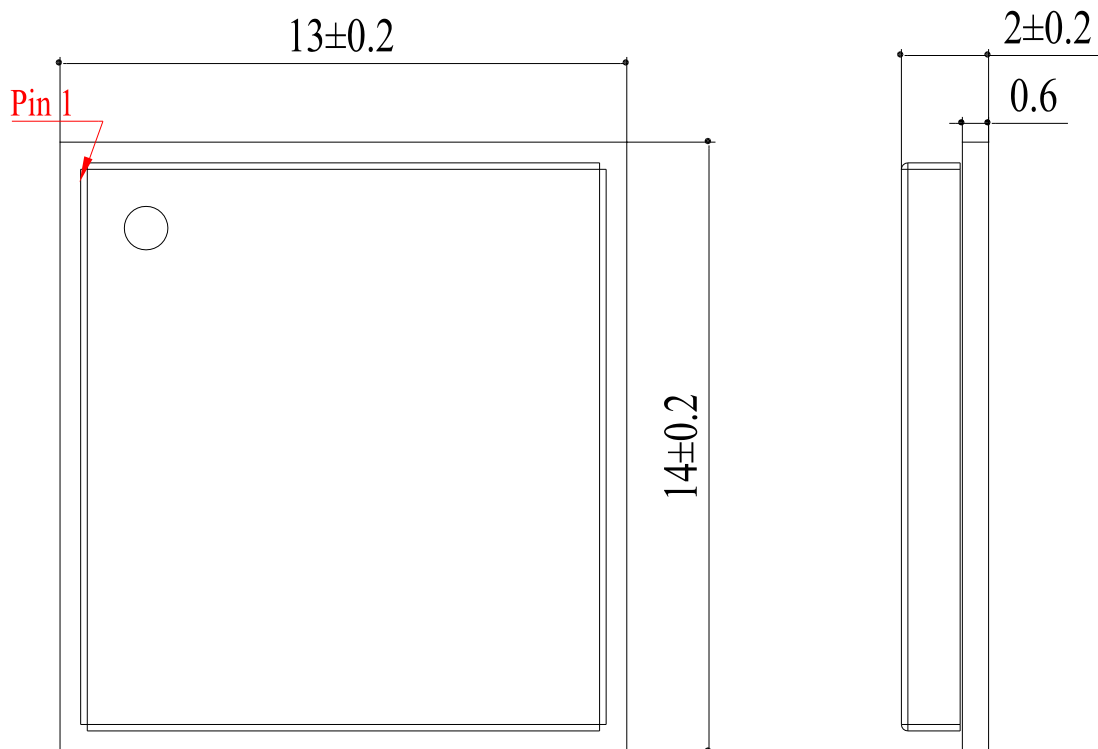


Figure 21: Top and Side Dimensions

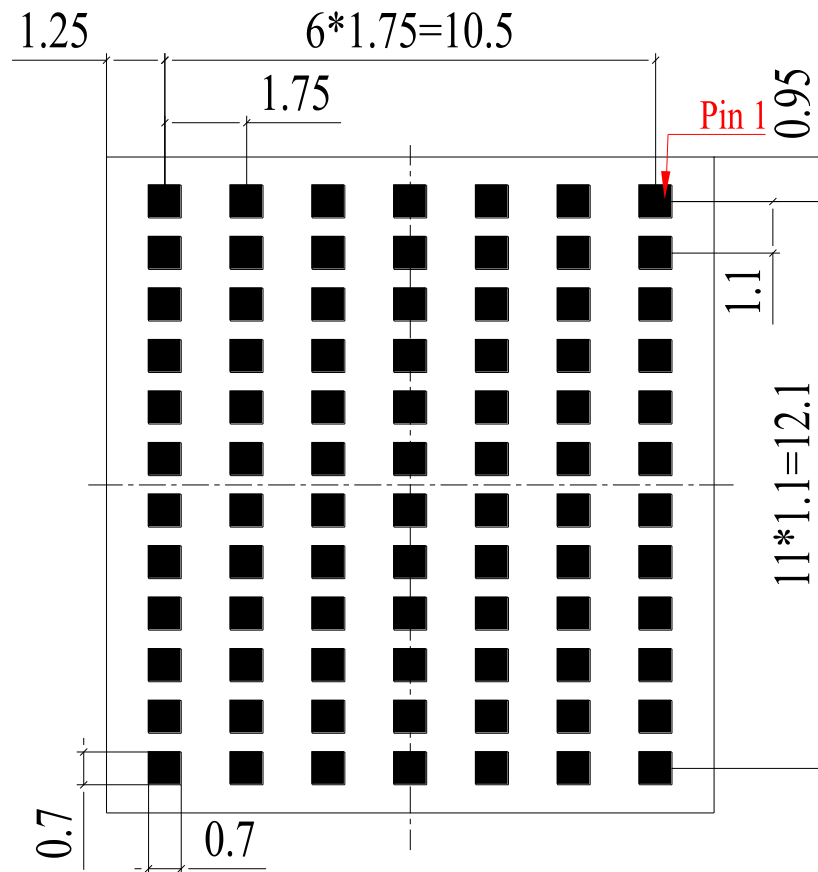


Figure 22: Bottom Dimensions (Bottom View)

NOTE

The package warpage level of the module refers to JEITA ED-7306 standard.

6.2. Recommended Footprint

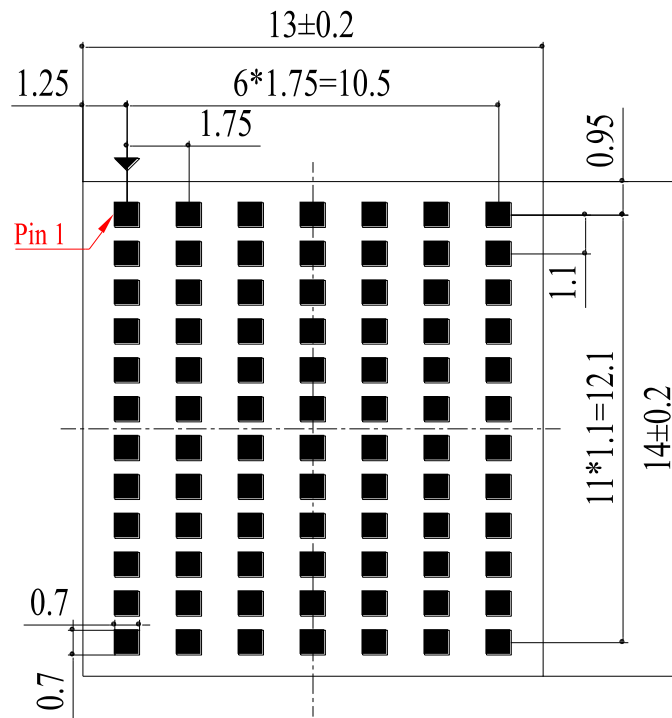


Figure 23: Recommended Footprint

NOTE

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

6.3. Top and Bottom Views

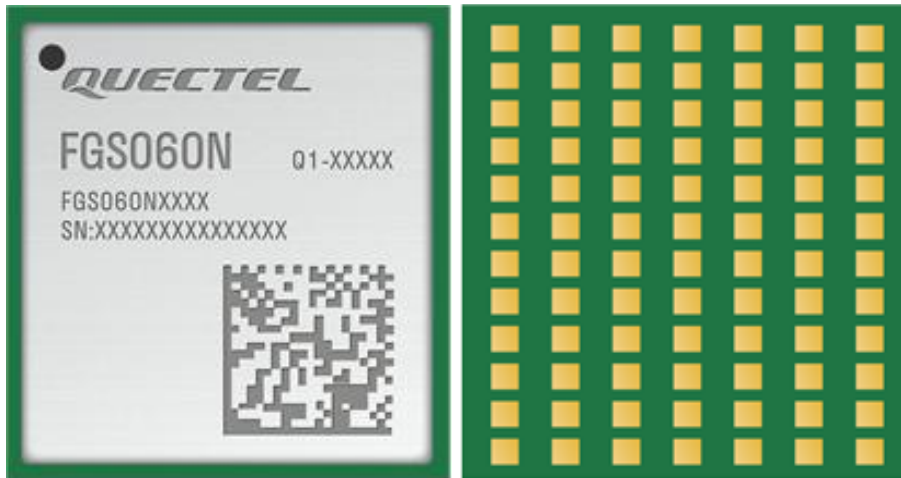


Figure 24: Top and Bottom Views

NOTE

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

7 Storage, Manufacturing & Packaging

7.1. 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 hours ⁴ 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*. Do not unpack the modules in large quantities until they are 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.

7.2. 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 0.13–0.15 mm. For more details, see **document [2]**.

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.

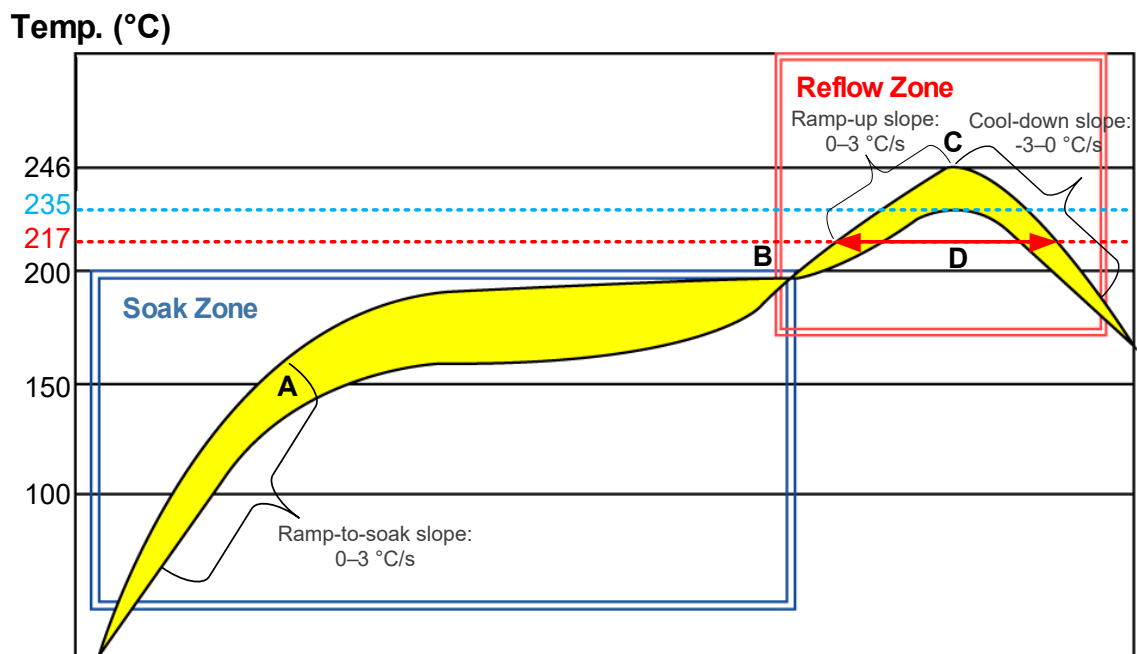


Figure 25: Recommended Reflow Soldering Thermal Profile

Table 22: 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. Avoid using materials that contain mercury (Hg), such as adhesives, for module processing, even if the materials are RoHS compliant and their mercury content is below 1000 ppm (0.1 %).
7. 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 [2]**.

7.3. Packaging Specification

This chapter outlines the key packaging parameters and processes. All figures below are for reference purposes only, as the actual appearance and structure of packaging materials may vary in delivery.

The modules are packed in a tape and reel packaging as specified in the sub-chapters below.

7.3.1. Carrier Tape

Carrier tape dimensions are illustrated in the following figure and table:

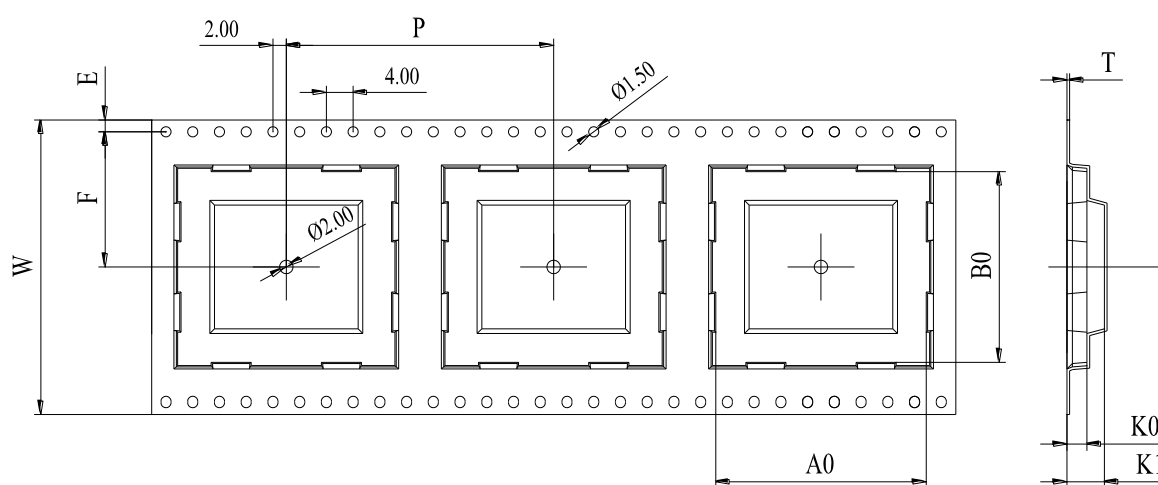


Figure 26: Carrier Tape Dimension Drawing (Unit: mm)

Table 23: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
32	24	0.4	14.4	13.4	2.5	4.6	14.2	1.75

7.3.2. Plastic Reel

Plastic reel dimensions are illustrated in the following figure and table:

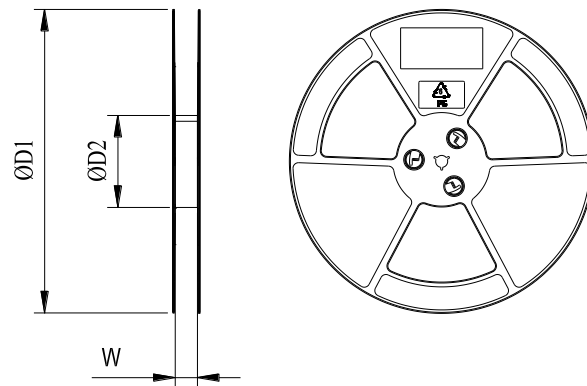


Figure 27: Plastic Reel Dimension Drawing

Table 24: Plastic Reel Dimension Table (Unit: mm)

ØD1	ØD2	W
330	100	32.5

7.3.3. Mounting Direction

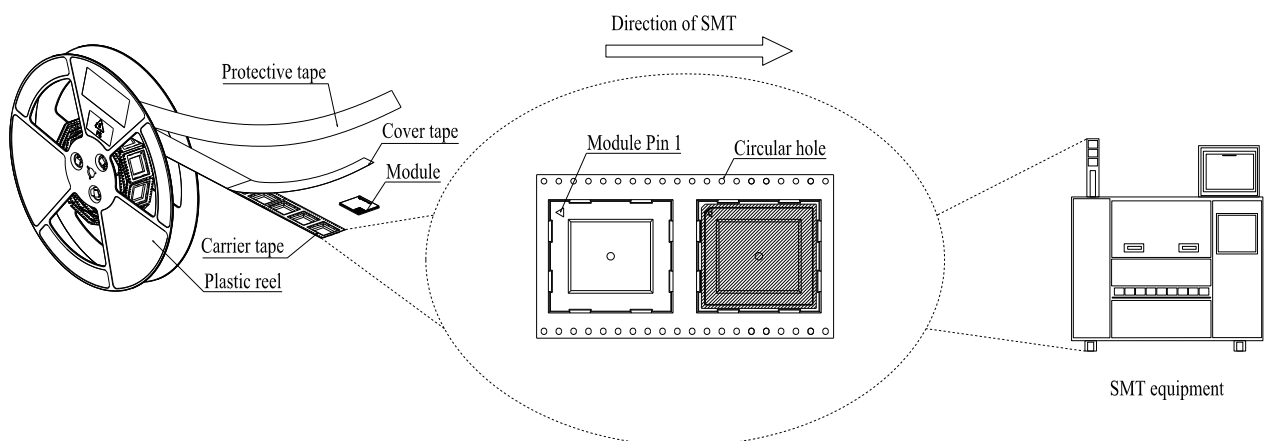
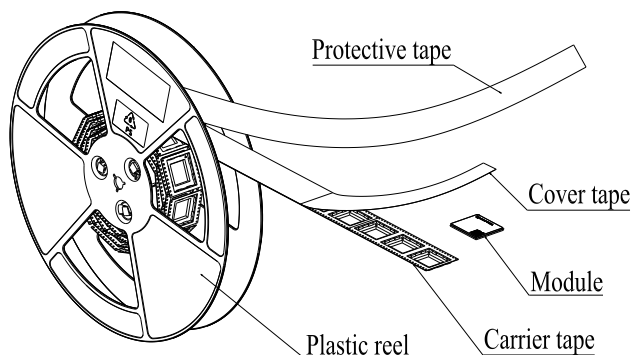


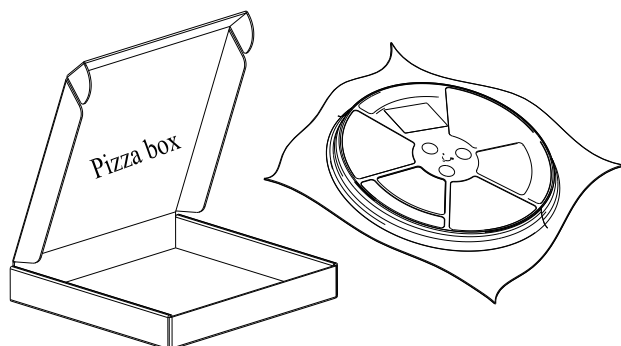
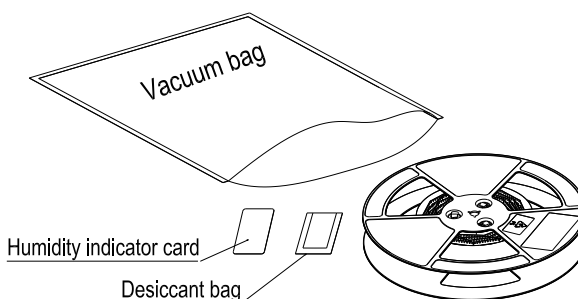
Figure 28: Mounting Direction

7.3.4. Packaging Process



Place the modules onto the carrier tape cavity and cover them securely with cover tape. Wind the heat-sealed carrier tape onto a plastic reel and apply a protective tape for additional protection. 1 plastic reel can pack 500 modules.

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



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

Place the 4 packaged pizza boxes into 1 carton and seal it. 1 carton can pack 2000 modules.

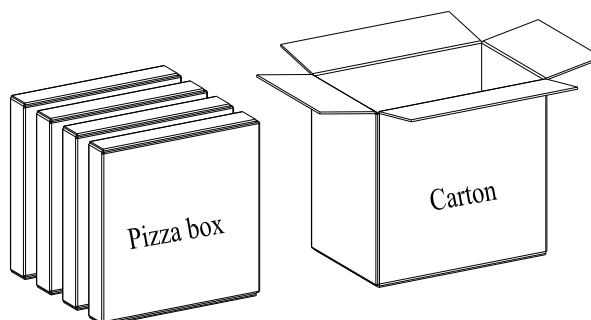


Figure 29: Packaging Process

8 Appendix References

Table 25: Related Documents

Document Name
[1] Quectel_RF_Layout_Application_Note
[2] Quectel_Module_SMT_Application_Note

Table 26: Terms and Abbreviations

Abbreviation	Description
1T1R	One Transmit One Receive
AP	Access Point
BLE	Bluetooth Low Energy
BPSK	Binary Phase Shift Keying
BR	Basic Rate
CCK	Complementary Code Keying
CDM	Charged Device Model
CTS	Clear To Send
DBPSK	Differential Binary Phase Shift Keying
DC	Direct Current
DDR	Double Data Rate
DPSK	Differential phase shift keying
DQPSK	Differential Quadrature Phase Shift Keying

DSSS	Direct Sequence Spread Spectrum
EDR	Enhanced Data Rate
ESD	Electrostatic Discharge
EVB	Evaluation Board
EVM	Error Vector Magnitude
GFSK	Gauss Frequency Shift Keying
GND	Ground
HBM	Human Body Model
HCI	Host Controller Interface
HE	High Efficiency
HT	High Throughput
I/O	Input/Output
I2S	Inter-IC Sound
IC	Integrated Circuit
IEEE	Institute of Electrical and Electronics Engineers
LGA	Land Grid Array
Mbps	Million Bits Per Second
MCS	Modulation and Coding Scheme
MISO	Host input/slave output
MOSI	Host output/slave input
MSL	Moisture Sensitivity Level
NM	Not Mounted
OFDM	Orthogonal Frequency-Division Multiplexing
OQPSK	Offset Orthogonal Quaternary Phase Shift Keying
P2P	Peer-to-Peer

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
Rx	Receive
SDIO	Secure Digital Input/Output
SDR	Single Data Rate
SMD	Surface Mounted Devices
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
STA	Station
TBD	To Be Determined
TIM	Thermal Interface Material
TVS	Transient Voltage Suppressor
Tx	Transmit
UART	Universal Asynchronous Receiver/Transmitter
(U)SIM	(Universal) Subscriber Identity Module
VHT	Very High Throughput
V _{IH}	High-level Input Voltage
V _{IL}	Low-level Input Voltage
V _{max}	Maximum Voltage
V _{min}	Minimum Voltage

V _{nom}	Nominal Voltage
V _{OH}	High-level Output Voltage
V _{OL}	Low-level Output Voltage
VSWR	Voltage Standing Wave Ratio
WCI	Wireless Coexistence Interface
WLAN	Wireless Local Area Network
WPA	Wi-Fi Protected Access

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s). The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to Quectel that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (XMR2024FGS060N) procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID: XMR2024FGS060N"

"Contains IC: 10224A-2024FGS060N"

The FCC ID/IC ID can be used only when all FCC/IC compliance requirements are met.

Antenna Installation

- (1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
- (2) The transmitter module may not be co-located with any other transmitter or antenna.
- (3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

Antenna type	2.4GHz band		5.2GHz band		5.3GHz band		5.5GHz band		5.8GHz band	
	Peak	Gain	Peak	Gain	Peak	Gain	Peak	Gain	Peak	Gain

	(dBi)	(dBi)	(dBi)	(dBi)	(dBi)
PCB	4.19	4.52	4.7	3.42	3.39

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID 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/IC authorization.

Manual Information to the End User

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 show in this manual.

Federal Communication Commission Interference Statement

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.

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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

List of applicable FCC rules

This module has been tested and found to comply with 15.247 and 15.407 requirements for Modular Approval.

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, 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.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 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.

Radiation Exposure Statement

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

IC**Industry Canada Statement**

This device complies with Industry Canada's licence-exempt RSSs. 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."

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 20 cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED 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.

RSS-247 Section 6.4 (5) (6) (for local area network devices, 5GHz)

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure. Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.

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;

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

The maximum antenna gain permitted for devices in the band 5725–5850 MHz shall comply with the e.i.r.p. limits specified for point-to-point and non point-to-point operation as appropriate.

L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par

la technologie.

Le dispositif utilisé dans la bande 5150-5250 MHz est réservé à une utilisation en intérieur afin de réduire le risque de brouillage préjudiciable aux systèmes mobiles par satellite dans le même canal;

Le gain d'antenne maximal autorisé pour les dispositifs dans les bandes 5250-5350 MHz et 5470-5725 MHz doit être conforme à la norme e.r.p. limite; et

Le gain d'antenne maximal autorisé pour les appareils de la bande 5725-5850 MHz doit être conforme à la norme e.i.r.p. les limites spécifiées pour un fonctionnement point à point et non point à point, selon le cas.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 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.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- 2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not 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 Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans

ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC:10224A-2024FGS060N".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 10224A-2024FGS060N".

Manual Information To the End User

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 show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.