FC64E

Hardware Design

Wi-Fi&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 cellular terminal or mobile incorporating the module. Manufacturers of the cellular 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 cellular 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.

Cellular 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 cellular 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 cellular 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 cellular terminals. Areas with explosive or potentially explosive atmospheres include fuelling 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
-	2021-01-19	Soni RAO/Lucas HUANG	Creation of the document
1.0.0	2021-01-19	Soni RAO/Lucas HUANG	Preliminary
1.0.1	2021-09-08	Soni RAO/Lucas HUANG	Preliminary: 1. Updated power consumption data. 2. Updated RF indicators.

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1 Introduction

This document defines the FC64E module and describes its air interfaces and hardware interfaces which are connected with your application.

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.

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

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

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.

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in 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 Wireless Solutions Co., Ltd 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 (new application) 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: XMR202209FC64E”

The FCC ID can be used only when all FCC 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.

(4) The max allowed antenna gain is WIFI 2.4G/BT 0.73dBi; WIFI 5G 1.14 dBi for external antenna.

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC 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.

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 device complies with ISED’s licence-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d’ ISED applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes : (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

Radiation Exposure Statement:
This equipment complies with ISED 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 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.

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 co- location 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-2022FC64E”.

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-2022FC64E ".

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.

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.

Caution:

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) where applicable, antenna type(s), antenna models(s), and worst-case tilt angle(s) necessary to remain compliant with the e.i.r.p. elevation mask requirement set forth in section 6.2.2.3 shall be clearly indicated.

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.

Avertissement:

i) 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;

ii) lorsqu’il y a lieu, les types d’antennes (s’il y en a plusieurs), les numéros de modèle de l’antenne et les pires angles d’inclinaison nécessaires pour rester conforme à l’exigence de la

p.i.r.e. applicable au masque d’élévation, énoncée à la section 6.2.2.3, doivent être clairement indiqués.

i. for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the e.i.r.p. limit

ii. for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the

band 5725-5850 MHz shall be such that the equipment still complies with the e.i.r.p. limits as appropriate; and

iii. where applicable, antenna type(s), antenna models(s), and worst-case tilt angle(s) necessary to remain compliant with the e.i.r.p. elevation mask requirement set forth in section 6.2.2.3 shall be clearly indicated.

1.1. Special Mark

Table 1: Special Mark

Mark	Definition
*	When an asterisk (*) is used after a function, feature, interface, pin name, AT command, or argument, it indicates that the function, feature, interface, pin name, AT command, or argument is under development and currently not supported, unless otherwise specified.

2 Product Overview

2.1. General Description

The module is a Wi-Fi and Bluetooth module with low power consumption. It is a single-die WLAN (Wireless Local Area Network) and Bluetooth combo solution supporting IEEE 802.11a/b/g/n/ac/ax 2.4/5 GHz WLAN standards and Bluetooth 5.1 standard, which enables seamless integration of WLAN and Bluetooth low energy technologies.

With a low-power PCIe Gen 3 interface for WLAN, a UART and PCM* interface for Bluetooth, FC64E can provide WLAN and Bluetooth functions.

2.2. Key Features

The following table describes the key features of the module.

Table 2: Key Features

Features	Details
Power Supply	● Core supply voltage: 0.95 V, 1.35 V, 1.95 V ● I/O supply voltage: 1.8 V ● RF supply voltage: 2.2 V, 3.3 V (optional)
Operating Frequency	● 2.4 GHz WLAN: 2.400–2.4835 GHz ● 5 GHz WLAN: 5.150–5.850 GHz ● Bluetooth: 2.402–2.480 GHz
WLAN Features	**FC62E:** ● Compliant with IEEE 802.11a/b/g/n/ac/ax ● Dual band 2.4/5 GHz chains: 20/40 MHz channel bandwidth for 2.4 GHz and 20/40/80 MHz channel bandwidth for 5 GHz ● Supports 2 × 2 Multi-User Multiple-Input Multiple-Output (MU-MIMO) ● up to 1200 Mbps data rate (2 × 2 11ax) **FC64E:**

	• Compliant with IEEE 802.11a/b/g/n/ac/ax • Dual band 2.4/5 GHz chains: 20/40 MHz channel bandwidth for 2.4 GHz and 20/40/80 MHz channel bandwidth for 5 GHz • Supports 2 × 2 Multi-User Multiple-Input Multiple-Output (MU-MIMO), Dual Band Simultaneous (DBS) with dual MAC, up to 1783 Mbps data rate (2 × 2 + 2 × 2 11ax DBS)
Bluetooth Features	• Adaptive frequency hopping (AFH) for reducing radio frequency interference • Complies with *Bluetooth Core Specification Version 5.1* with provisions for supporting future specifications. With Bluetooth Class 1 or Class2 transmitter operation. • Supports 2 Mbps Bluetooth Low Energy (BLE), BLE long range
Transmission Data Rates	• 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 (MCS0–7), HT40 (MCS0–7) • 802.11ac: VHT20 (MCS0–8), VHT40 (MCS0–9), VHT80 (MCS0–9) • 802.11ax: HE20 (MCS0–11), HE40 (MCS0–11), HE80 (MCS0–11)
Transmitting Power	**2.4 GHz:** 802.11b @ 11 Mbps: 17 dBm 802.11g @ 54 Mbps: 14 dBm 802.11n, HT20 @ MCS7: 14 dBm 802.11n, HT40 @ MCS7: 14 dBm 802.11ax, HE20 @ MCS11: 12 dBm 802.11ax, HE40 @ MCS11: 11 dBm **5 GHz:** 802.11a @ 54 Mbps: 13 dBm 802.11n, HT20 @ MCS7: 12 dBm 802.11n, HT40 @ MCS7: 12 dBm 802.11ac, VHT20 @ MCS8: 12 dBm 802.11ac, VHT40 @ MCS9: 11 dBm 802.11ac, VHT80 @ MCS9: 11 dBm 802.11ax, HE20 @ MCS11: 11 dBm 802.11ax, HE40 @ MCS11: 10 dBm 802.11ax, HE80 @ MCS11: 9 dBm
Operation Mode	AP, STA
Modulation	CCK, BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
WLAN Application Interface	PCIe
Bluetooth Application Interface	UART and PCM*

RF Antenna Interfaces	● ANT_WIFI0, ANT_WIFI1, ANT_BT ● 50 Ω impedance
Physical Characteristics	● Size: (18 ±0.15) mm × (19.9 ±0.15) mm × (2.1 ±0.2) mm ● Package: LCC ● Weight: TBD
Temperature Range	● Operating temperature range: -30 °C to +75 °C [1] ● Storage temperature range: -40 °C to +95 °C
RoHS	All hardware components are fully compliant with EU RoHS directive

2.3. Functional Diagram

[1] Within operating temperature range, the module is IEEE compliant.

NOTE

Bluetooth dedicated antenna is optional according to the module order code.

2.4. EVB

To help customers develop applications with FC64E module conveniently, Quectel supplies the evaluation board (FC6xE-M.2), Antenna cable, antenna and others to control or test the module. For more details, see ***document [1]*** and ***document [2].***

3 Application Interfaces

3.1. General Description

The module is equipped with 52 LCC pins and 28 LGA pins. The subsequent chapters will provide a detailed introduction to the following interfaces and pins of the module:

- Power supply
- WLAN application interfaces
- Bluetooth application interfaces
- Other interfaces
- RF antenna interfaces

3.2. Pin Assignment

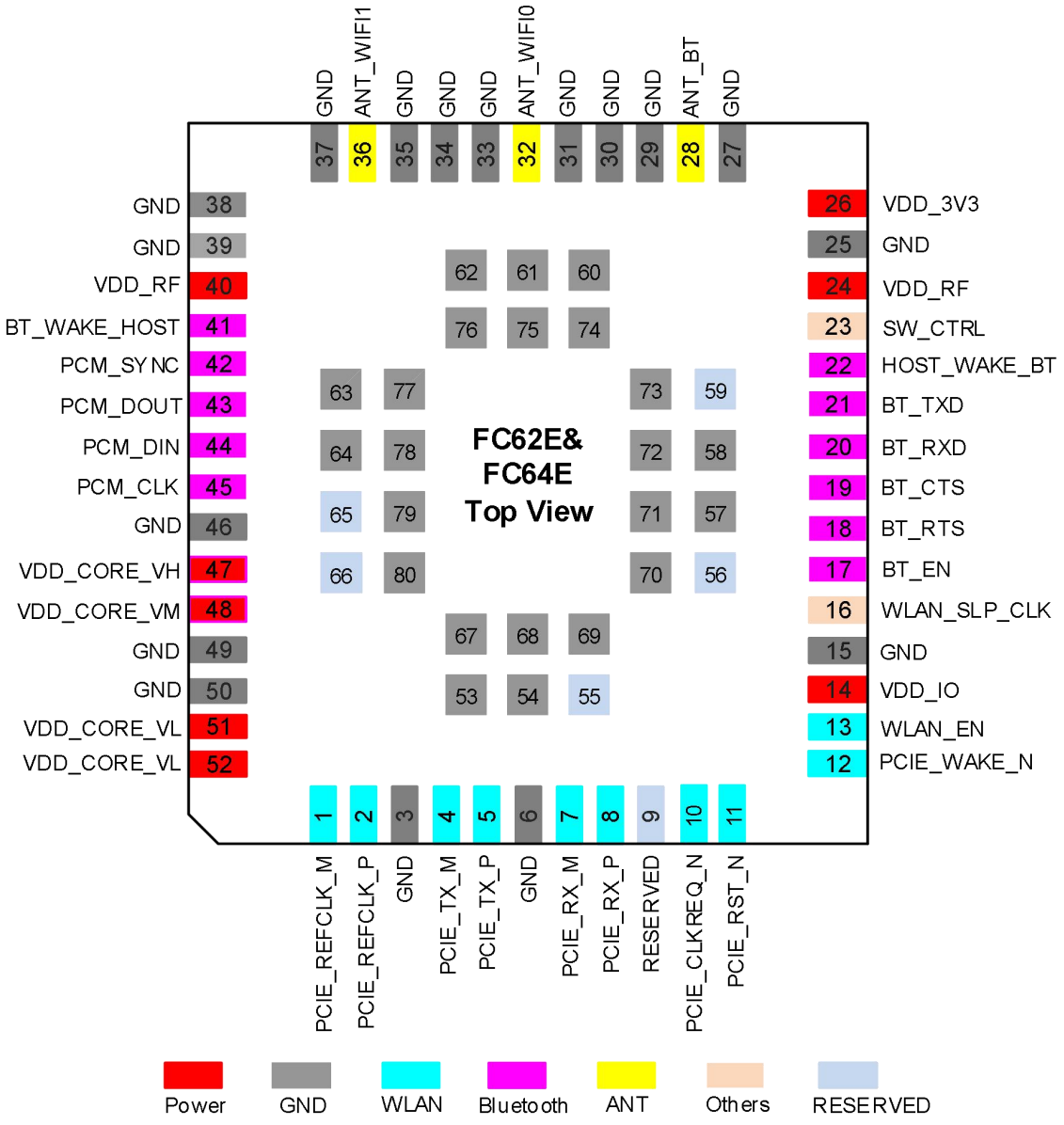


Figure 2: Pin Assignment (Top View)

NOTE

1. VDD_3V3 is optional according to module OC.
2. Please keep all RESERVED pins open.

3.3. Pin Description

The following tables show the pin description of FC64E module.

Table 3: I/O Parameters Definition

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

Table 4: Pin Description

Power Supply					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VDD_CORE_VL	51, 52	PI	Provide 0.95 V for the module's main part	Vmin = 0.9 V Vnom = 0.95 V Vmax = 1.0 V	
VDD_CORE_VM	48	PI	Provide 1.35 V for the module's main part	Vmin = 1.3 V Vnom = 1.35 V Vmax = 1.42 V	
VDD_CORE_VH	47	PI	Provide 1.95 V for the module's main part	Vmin = 1.85 V Vnom = 1.95 V Vmax = 2.05 V	
VDD_IO	14	PI	Provide 1.8 V for the module's I/O pins	Vmin = 1.71 V Vnom = 1.8 V Vmax = 1.89 V	
VDD_RF	24, 40	PI	Provide 2.2 V for external RF circuit	Vmin = 1.9 V Vnom = 2.2 V Vmax = 2.4 V	

VDD_3V3	26	PI	Provide 3.3 V for the module's discrete Bluetooth part	Vmin = 3.0 V Vnom = 3.3 V Vmax = 3.6 V	If unused, keep this pin open.
GND	3, 6, 15, 25, 27, 29–31, 33–35, 37–39, 46, 49, 50, 53, 54, 57, 58, 60–64, 67–80				
WLAN Application Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
WLAN_EN	13	DI	WLAN function enable control	V_{IL}min = -0.3 V V_{IL}max = 0.63 V V_{IH}min = 1.17 V V_{IH}max = 2.1 V	1.8 V power domain. Active high. Do not float this pin.
PCIE_REFCLK_M	1	AI	PCIe reference clock (-)		Require differential impedance of 85 Ω.
PCIE_REFCLK_P	2	AI	PCIe reference clock (+)		
PCIE_TX_M	4	AO	PCIe transmit (-)		
PCIE_TX_P	5	AO	PCIe transmit (+)		
PCIE_RX_M	7	AI	PCIe receive (-)		
PCIE_RX_P	8	AI	PCIe receive (+)		
PCIE_CLKREQ_N	10	DO	PCIe clock request	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	1.8 V power domain. Active low.
PCIE_RST_N	11	DI	PCIe reset	V_{IL}min = -0.3 V V_{IL}max = 0.63 V V_{IH}min = 1.17 V V_{IH}max = 2.1 V	
PCIE_WAKE_N	12	DO	PCIe wake up	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	
Bluetooth Application Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
BT_EN	17	DI	Bluetooth enable control	V_{IL}min = -0.3 V V_{IL}max = 0.63 V V_{IH}min = 1.17 V V_{IH}max = 2.1 V	1.8 V power domain. Active high. Do not float this pin.
PCM_DIN*	44	DI	PCM data input		1.8 V power domain.
PCM_SYNC*	42	DI	PCM data frame sync		

PCM_CLK*	45	DI	PCM clock	
PCM_DOUT*	43	DO	PCM data output	V_{OL}max = 0.45 V V_{OH}min = 1.35 V
BT_RTS	18	DO	Bluetooth UART request to send	
BT_CTS	19	DI	Bluetooth UART clear to send	V_{IL}min = -0.3 V V_{IL}max = 0.63 V V_{IH}min = 1.17 V V_{IH}max = 2.1 V
BT_RXD	20	DI	Bluetooth UART receive	V_{OL}max = 0.45 V V_{OH}min = 1.35 V
BT_TXD	21	DO	Bluetooth UART transmit	V_{IL}min = -0.3 V V_{IL}max = 0.63 V V_{IH}min = 1.17 V V_{IH}max = 2.1 V
BT_WAKE_HOST*	41	DO	Bluetooth wakes up host	V_{OL}max = 0.45 V V_{OH}min = 1.35 V
HOST_WAKE_BT*	22	DI	Host wakes up Bluetooth	V_{IL}min = -0.3 V V_{IL}max = 0.63 V V_{IH}min = 1.17 V V_{IH}max = 2.1 V

RF Antenna Interfaces

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
ANT_WIFI0	32	AIO	Wi-Fi0 antenna interface		50 Ω impedance.
ANT_WIFI1	36	AIO	Wi-Fi1 antenna interface		
ANT_BT*	28	AIO	Bluetooth antenna interface		

Other Interfaces

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
WLAN_SLP_CLK	16	DI	WLAN sleep clock	V_{IL}min = -0.3 V V_{IL}max = 0.63 V V_{IH}min = 1.17 V V_{IH}max = 2.1 V	1.8 V power domain. If unused, keep this pin open.
SW_CTRL*	23	DO	VDD_RF control	V_{OL}max = 0.45 V V_{OH}min = 1.35 V	1.8 V power domain. Active high. If unused, keep this pin open.

RESERVED Interfaces		
Pin Name	**Pin No.**	**Comment**
RESERVED	9, 55, 56, 59, 65, 66	Keep them open.

3.4. Power Supply

The following table shows the power supply pins and ground pins of the module.

Table 5: Definition of Power Supply and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VDD_CORE_VL	51, 52	Provide 0.95 V for the module's main part	0.9	0.95	1.0	V
VDD_CORE_VM	48	Provide 1.35 V for the module's main part	1.3	1.35	1.42	V
VDD_CORE_VH	47	Provide 1.95 V for the module's main part	1.85	1.95	2.05	V
VDD_IO	14	Provide 1.8 V for the module's I/O pins	1.71	1.8	1.89	V
VDD_RF	24, 40	Provide 2.2 V for external RF circuit	1.9	2.2	2.4	V
VDD_3V3	26	Provide 3.3 V for the module's discrete Bluetooth part	3.0	3.3	3.6	V
GND	3, 6, 15, 25, 27, 29–31, 33–35, 37–39, 46, 49, 50, 53, 54, 57, 58, 60–64, 67–80					

The module can be powered by discrete power supply chips. The following figure shows a reference design block diagram for power design.

The 3.3 V power source is recommended to output current 2.0 A at least. For three antennas version module, VDD_3V3 should be powered.

Figure 3: Power Supply Block Diagram

The following figure shows the recommended turn-on and turn-off sequence of the module.

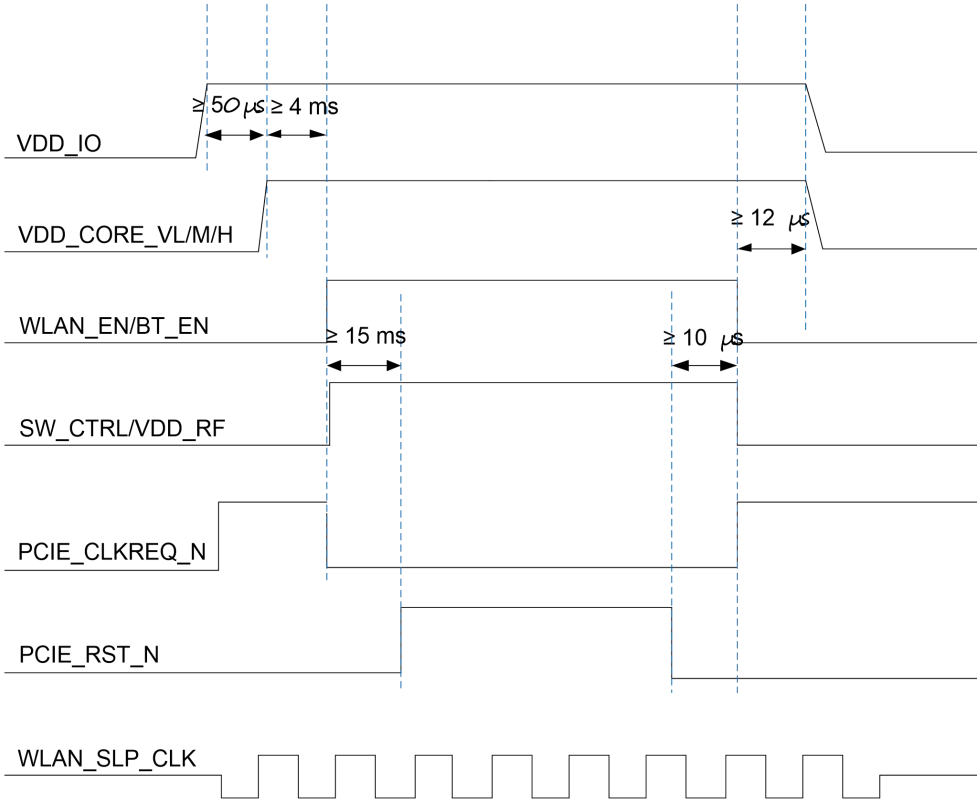


Figure 4: Turn-on and Turn-off Sequence

3.5. WLAN Application Interface

The following figure shows the WLAN application interface connection between the module and the host. If you need WLAN wakeup function, connect the pin 9 of module with the host corresponding pin first and contact Quectel Technical Support if necessary.

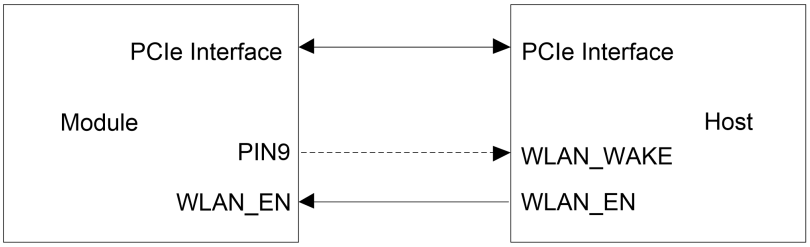


Figure 5: WLAN Application Interface Connection

3.5.1. WLAN_EN

WLAN_EN is used to control the WLAN function of the module. WLAN function will be enabled when WLAN_EN is at high level.

Table 6: Pin Definition of WLAN_EN

Pin Name	Pin No.	I/O	Description	Comment
WLAN_EN	13	DI	WLAN function enable control	1.8 V power domain. Active high. Do not float this pin.

3.5.2. PCIe Interface

The module provides a PCIe interface with key features listed as below:

- *PCI Express Specification Revision 3.0* compliance.
- X1 link width, transmission rate up to 8 Gbps.
- As Wi-Fi function interface to connect to a host.

Table 7: Pin Definition of PCIe Interface

Pin Name	Pin No.	I/O	Description	Comment
PCIE_REFCLK_M	1	AI	PCIe reference clock (-)	Require differential impedance of 85 Ω.
PCIE_REFCLK_P	2	AI	PCIe reference clock (+)	
PCIE_TX_M	4	AO	PCIe transmit (-)	
PCIE_TX_P	5	AO	PCIe transmit (+)	
PCIE_RX_M	7	AI	PCIe receive (-)	
PCIE_RX_P	8	AI	PCIe receive (+)	
PCIE_CLKREQ_N	10	DO	PCIe clock request	1.8 V power domain. Active low.
PCIE_RST_N	11	DI	PCIe reset	
PCIE_WAKE_N	12	DO	PCIe wakes up	

The following figure shows the PCIe interface connection between the module and the host.

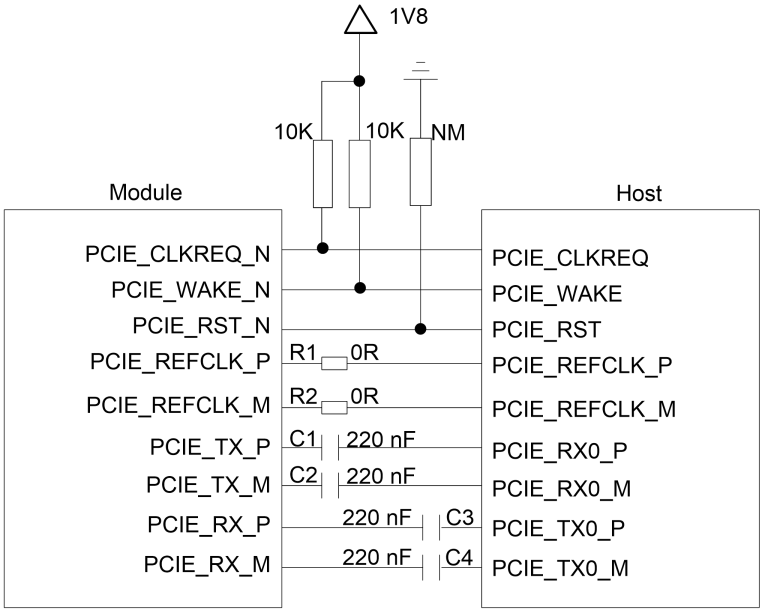


Figure 6: PCIe Interface Connection

To ensure the signal integrity of PCIe interface, C1 and C2 should be placed close to the module, and C3 and C4 should be placed close to the host. The extra stubs of traces must be avoided.

The following principles of PCIe interface design should be complied with, so as to meet *PCIe Gen3 specifications*.

- It is important to route PCIE_TX_P/M, PCIE_RX_P/M, and PCIE_REFCLK_P/M as differential pairs with total grounding. And the differential impedance should be 85 Ω ±10 %.
- The maximum trace length of each differential pair (PCIE_TX_P/M, PCIE_RX_P/M, and PCIE_REFCLK_P/M) should be less than 200 mm, and trace length matching within each differential pair should be less than 0.5 mm.
- Space between PCIe signals and all other signals (inter-interface) should be four times the trace width.
- Do not route signal traces under crystals, oscillators, magnetic devices, or RF signal traces. It is important to route the PCIe differential traces in inner-layer of the PCB and surround the traces with ground on that layer and with ground planes above and below.

3.6. Bluetooth Application Interface

The following figure shows the block diagram of Bluetooth application interface connection between the module and the host.

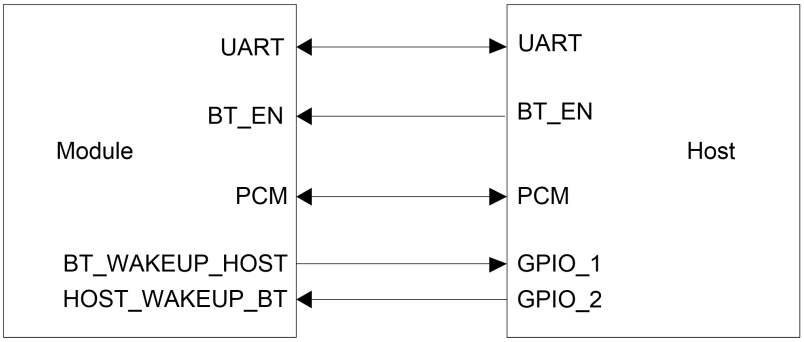


Figure 7: Block Diagram of Bluetooth Application Interface Connection

NOTE

The GPIO1 connected to BT_WAKEUP_HOST must be interruptible.

3.6.1. BT_EN

BT_EN is used to control the Bluetooth function of the module. Bluetooth function will be enabled when BT_EN is at high level. If Bluetooth function is not necessary, pull BT_EN down with 10 K resistor.

Table 8: Pin Definition of BT_EN

Pin Name	Pin No.	I/O	Description	Comment
BT_EN	17	DI	Bluetooth enable control	1.8 V power domain. Active high. Do not float this pin.

3.6.2. UART Interface

The module supports an HCI UART as defined in *Bluetooth Core Specification Version 4.0*. The UART supports hardware flow control, and it is used for data transmission with host. It supports up to 3.2 Mbps baud rates.

The following table shows the pin definition of UART interface.

Table 9: Pin Definition of UART Interface

Pin Name	Pin No.	I/O	Description	Comment

BT_RTS	18	DO	Bluetooth UART request to send	1.8 V power domain.
BT_CTS	19	DI	Bluetooth UART clear to send	
BT_TXD	21	DO	Bluetooth UART transmit	
BT_RXD	20	DI	Bluetooth UART receive	

The module provides 1.8 V UART interfaces. A level translator should be used if customers' application is equipped with a 3.3 V UART interface. A level translator TXS0104 provided by Texas Instruments is recommended. The following figure shows a reference design.

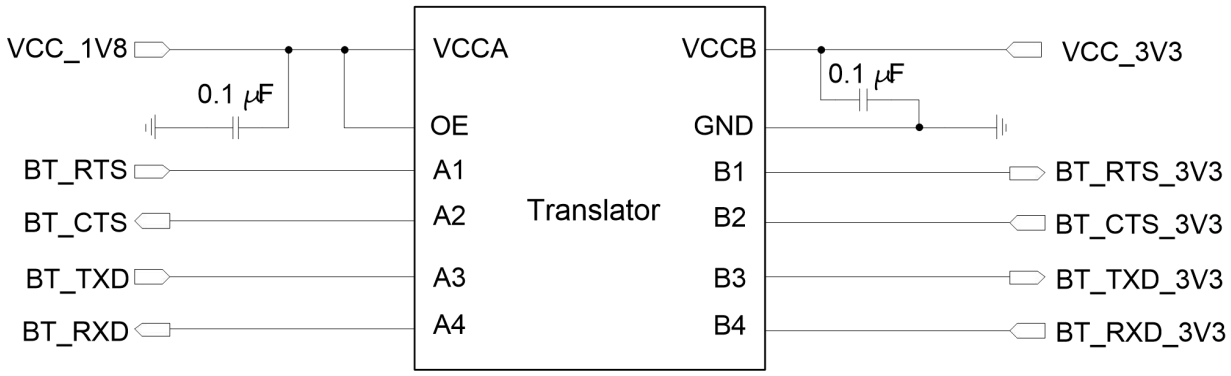


Figure 8: Reference Circuit with Translator Chip

3.6.3. BT_WAKEUP_HOST* and HOST_WAKEUP_BT*

BT_WAKEUP_HOST and HOST_WAKEUP_BT are used to wake up the host and the module.

Table 10: Pin Definition of BT_WAKEUP_HOST and HOST_WAKEUP_BT

Pin Name	Pin No.	I/O	Description	Comment
BT_WAKE_HOST	41	DO	Bluetooth wakes up host	1.8 V power domain.
HOST_WAKE_BT	22	DI	Host wakes up Bluetooth	

3.6.4. PCM Interface*

The PCM interface is for audio over Bluetooth. The following table shows the pin definition of PCM interface.

Table 11: Pin Definition of PCM Interface

Pin Name	Pin No.	I/O	Description	Comment
PCM_DIN	44	DI	PCM data input	1.8 V power domain.
PCM_SYNC	42	DI	PCM data frame sync	
PCM_CLK	45	DI	PCM clock	
PCM_DOUT	43	DO	PCM data output	

The following figure shows the PCM interface connection between the module and the host.

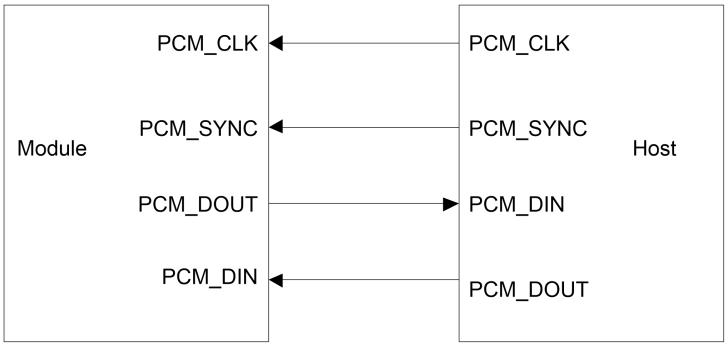


Figure 9: PCM Interface Connection

3.7. Other Interfaces

3.7.1. WLAN_SLP_CLK

The 32.768 kHz clock is used in low power modes, such as IEEE power saving mode and sleep mode. It serves as a timer in various power saving schemes, and to maintain basic logic operations when the module is in sleep mode.

Figure and table below show the sleep clock reference input clock requirements.

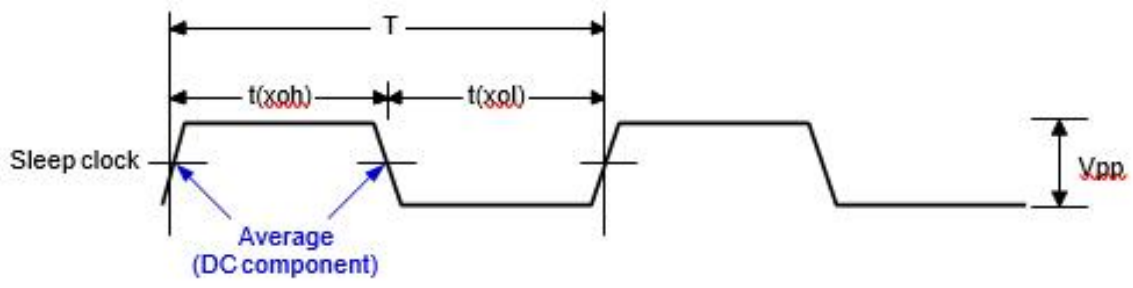


Figure 10: Requirements of WLAN_SLP_CLK

Table 12: Parameter of WLAN_SLP_CLK

Parameter	Comments	Min	Typ	Max	Unit
t(xoh)	Sleep-clock logic high	4.58	4.58	25.94	μs
t(xol)	Sleep-clock logic low	4.58	4.58	25.94	μs
T	Sleep-clock period		30.5208		μs
F	Sleep-clock frequency (F = 1/T)		32.7645		kHz
Vpp	Peak-to-peak voltage		1.8		V

3.7.2. SW_CTRL*

SW_CTRL can be used to control external VDD_RF power supply chip. The following table shows the pin definition of SW_CTRL.

Table 13: Pin Definition of SW_CTRL

Pin Name	Pin No.	I/O	Description	Comment
SW_CTRL	23	DO	VDD_RF control	1.8 V power domain. Active high. If unused, keep this pin open.

3.8. RF Antenna Interfaces

This information will be included in future revisions of this document.

Table 14: Pin Definition of RF Antenna Interfaces

Pin Name	Pin No.	I/O	Description	Comment
ANT_WIFI0	32	AIO	Wi-Fi0 antenna interface	50 Ω impedance
ANT_WIFI1	36	AIO	Wi-Fi1 antenna interface	
ANT_BT*	28	AIO	Bluetooth antenna interface	

3.8.1. Operating Frequency

Table 15: Operating Frequency of the Module

Feature	Frequency	Unit
2.4 GHz Wi-Fi	2.400–2.4835	GHz
5 GHz Wi-Fi	5.150–5.850	GHz
Bluetooth	2.402–2.480	GHz

3.8.2. Reference Design

FC64E provides three RF antenna interfaces for antenna connection. The following reference circuit design shows an example with ANT_WIFI0. For other RF antenna interfaces, the reference design is the same.

It is recommended to reserve a Π-type matching circuit for better RF performance, and the Π-type matching components (C1, C2, R1) should be placed as close to the antenna as possible. The capacitors are not mounted by default.

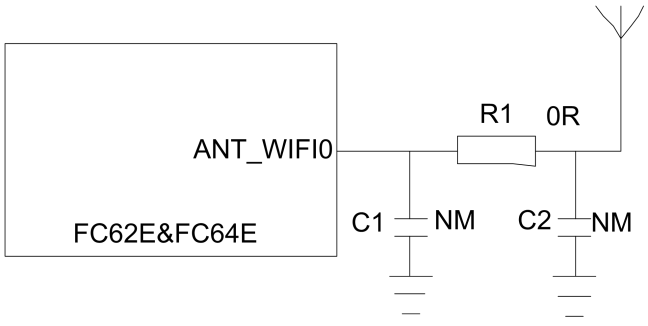


Figure 11: Reference Circuit for RF Antenna Interfaces

3.8.3. Reference Design of RF Routing

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.

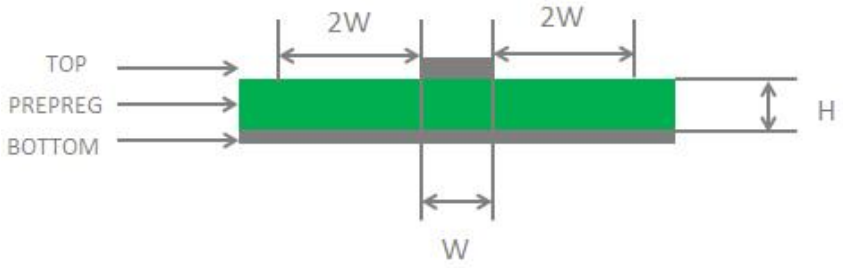


Figure 12: Microstrip Design on a 2-layer PCB

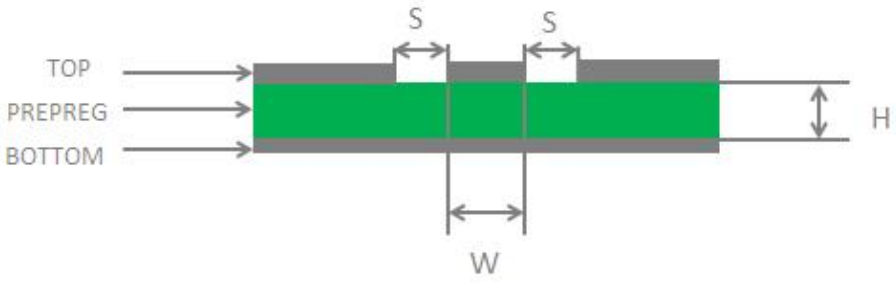


Figure 13: Coplanar Waveguide Design on a 2-layer PCB

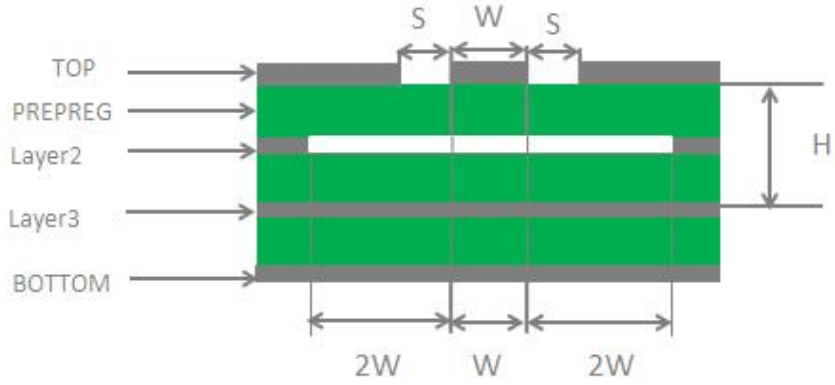


Figure 14: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

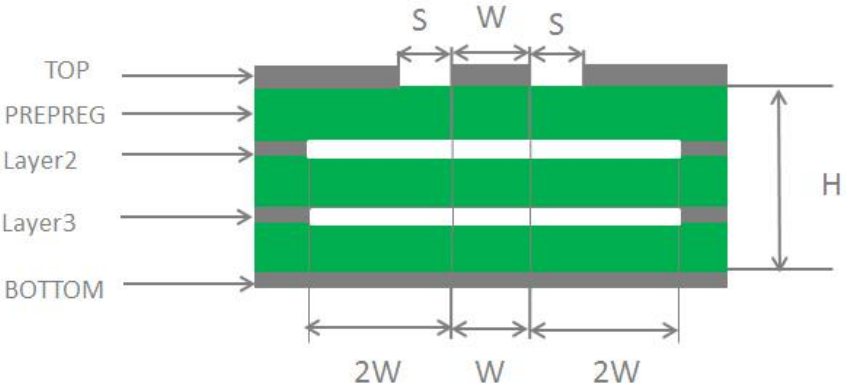


Figure 15: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

To ensure RF performance and reliability, the following principles should be complied with 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 no less than two times the width of RF signal traces (2 × 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 [3]***.

3.8.4. Requirements for Antenna Design

The following table shows the requirements for antennas.

Table 16: Antenna Requirements

Type	Requirements
Frequency Range	2.400–2.4835 GHz 5.180–5.825 GHz
VSWR	< 2:1 (Recommended)
Gain	1 dBi (Typ.)
Max. Input Power	50 W
Input Impedance	50 Ω
Polarization Type	Vertical
Cable insertion loss	< 1 dB

3.8.5. RF Connector Recommendation

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

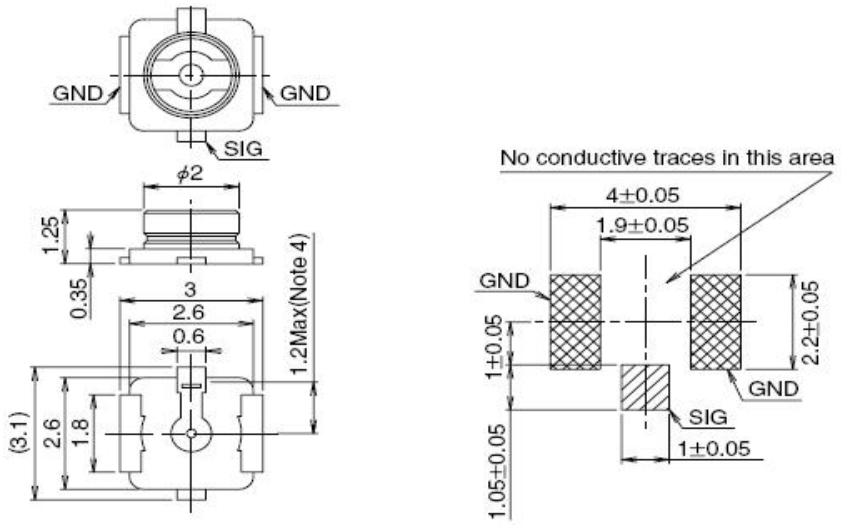


Figure 16: Dimensions of the U.FL-R-SMT Connector (Unit: mm)

U.FL-LP serial connectors listed in the following figure can be used to match the U.FL-R-SMT.

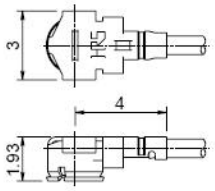
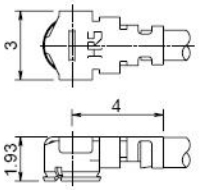
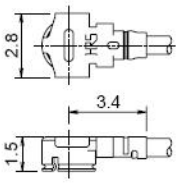
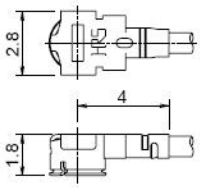
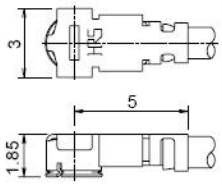
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 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 17: Mechanicals of U.FL-LP Connectors (Unit: mm)

The following figure describes the space factor of mated connector.

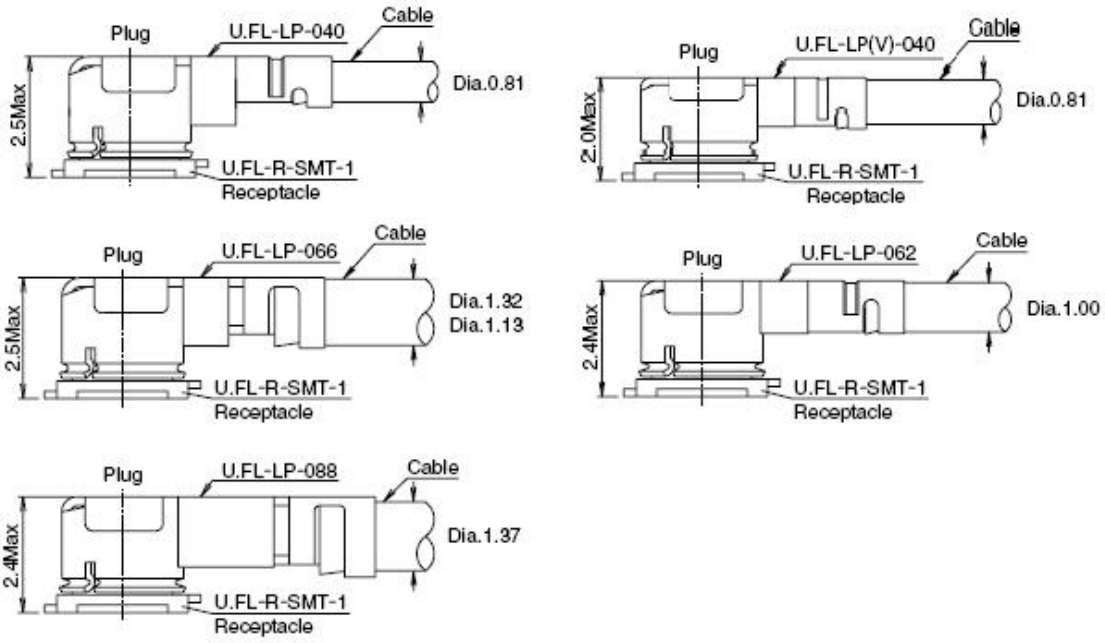


Figure 18: Space Factor of Mated Connector (Unit: mm)

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

4 Electrical Characteristics & Reliability

4.1. General Description

This chapter mainly introduces electrical and radio characteristics of FC64E module. The details are listed in the subsequent chapters.

4.2. Electrical Characteristics

The following table shows the absolute maximum ratings.

Table 17: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VDD_CORE_VL	-0.3	V_{DDX} + 0.2	V
VDD_CORE_VM	-0.3	V_{DDX} + 0.2	V
VDD_CORE_VH	-0.3	V_{DDX} + 0.2	V
VDD_IO	-0.3	V_{DDX} + 0.2	V
VDD_RF	-0.3	V_{DDX} + 0.2	V
Digital I/O input voltage	-0.3	VDD_IO + 0.2	V

NOTE

V_{DDX} is the external supply voltage for the corresponding power input pins.

The following table shows the recommended operating conditions of the module.

Table 18: Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
VDD_CORE_VL	0.9	0.95	1.0	V
VDD_CORE_VM	1.3	1.35	1.42	V
VDD_CORE_VH	1.85	1.95	2.05	V
VDD_IO	1.71	1.8	1.89	V
VDD_RF	1.9	2.2	2.4	V
VDD_3V3	3.0	3.3	3.6	V

4.3. I/O Interface Characteristics

The following table shows the general DC electrical characteristics over recommended operating conditions (unless otherwise specified).

Table 19: General DC Electrical Characteristics

Symbol	Parameter	Min.	Max.	Unit
V_{IH}	High-level Input Voltage	0.65 × VDD_IO	VDD_IO + 0.3	V
V_{IL}	Low-level Input Voltage	-0.3	0.35 × VDD_IO	V
V_{OH}	High-level Output Voltage	VDD_IO - 0.45	VDD_IO	V
V_{OL}	Low-level Output Voltage	0	0.45	V

4.4. Operating and Storage Temperatures

Table 20: Operating and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Operating Temperature Range [2]	-30	25	+85	ºC
Storage Temperature Range	-40		+95	ºC

4.5. Power Consumption

The following tables show the power consumption of the module in different modes.

4.5.1. Power Consumption in Low Power Modes

Table 21: Power Consumption of the Module (Low Power Modes, unit: mA)

Module State	Wi-Fi State	VDD_CORE_ VL (0.95 V)	VDD_CORE_ VM (1.35 V)	VDD_CORE_ VH (1.95 V)	VDD_IO (1.8 V)	VDD_RF (2.2 V)
OFF [3]	Wi-Fi disabled	0.12	0.08	0.07	2.1	0.2
Idle [4]	Wi-Fi disconnect	257.84	104.27	46.99	2.2	30.33

4.5.2. Power Consumption

Table 22: TX Power Consumption (Unit: mA)

Description	Conditions	VDD_CORE_ VL (0.95 V)	VDD_CORE_ VM (1.35 V)	VDD_CORE_ VH (1.95 V)	VDD_IO (1.8 V)	VDD_RF (2.2 V)
1 × 1	2G 802.11b 1Mbps	300.42	136.38	93.6	2.93	366.89

[2] Within operating temperature range, the module is IEEE compliant.
[3] In OFF state, the Wi-Fi driver is uninstalled and WLAN_EN is pulled down.
[4] In Idle state, the Wi-Fi is enable but not connected.

	2G 802.11g 6Mbps	299.17	136.37	93.61	2.92	352.65
	2G 802.11n HT20 (MCS0)	300.62	136.09	93.35	2.7	345.94
	2G 802.11ax HE40 (MCS11)	322.96	143.7	92.72	2.83	304.95
	5G 802.11a 6Mbps	316.01	162.62	107.6	2.64	312.3
	5G 802.11n HT20 (MCS0)	309.07	163.07	104.23	2.83	316.67
	5G 802.11ac VHT40 (MCS9)	326.02	165.52	103.38	2.9	370.09
	5G 802.11ax HE80 (MCS11)	409.37	168.34	99.36	2.56	455.29
2 × 2	2G 802.11n HT20 (MCS0)	386.73	173.39	123.84	2.92	717.42
	2G 802.11n HT40 (MCS7)	394.78	179.08	118.99	2.83	606.19
	2G 802.11ax HE40 (MCS11)	390.55	185.37	117.55	2.9	554.28
	5G 802.11n HT20 (MCS0)	402.2	260.99	143.97	2.84	663.39
	5G 802.11ac VHT40 (MCS9)	439.5	264.94	141.83	2.91	552.6
	5G 802.11ax HE80 (MCS11)	583.84	268.09	151.57	2.95	540.68
	5G 802.11ax HE80 (MCS0)	563.83	273.32	153.62	2.91	630.2
2 × 2 + 2 × 2	11n MCS0 HT20	417.56	303.69	222.21	2.92	1336

	11n MCS7 HT40	526.4	316.91	218.83	2.91	1087
	11n MCS0 HT20 + 11ac MCS0 VHT20	424.04	306.3	223.24	2.91	1342
	11n MCS7 HT40 + 11ac MCS9 VHT80	672.59	319.42	218.2	2.9	1127
	11ax MCS0 HE20	429.49	311.57	232.78	2.91	1355
	11ax MCS11 2G HE40 + 5G HE80	674.75	324.69	228.4	2.92	1111

4.6. RF Performances

The following tables summarize the transmitting and receiving performances of FC64E.

4.6.1. Conducted RF Output Power

Table 23: Conducted RF Output Power at 2.4 GHz

Description	Min.	Typ.	Unit
802.11b @ 1 Mbps	15	17	dBm
802.11b @ 11 Mbps	15	17	dBm
802.11g @ 6 Mbps	14	16	dBm
802.11g @ 54 Mbps	12	14	dBm
802.11n, HT20 @ MCS0	14	16	dBm
802.11n, HT20 @ MCS7	12	14	dBm
802.11n, HT40 @ MCS0	14	16	dBm
802.11n, HT40 @ MCS7	12	14	dBm

802.11ax, HE20 @ MCS0	14	16	dBm
802.11ax, HE20 @ MCS11	10	12	dBm
802.11ax, HE40 @ MCS0	14	16	dBm
802.11ax, HE40 @ MCS11	9	11	dBm

Table 24: Conducted RF Output Power at 5 GHz

Description	Min.	Typ.	Unit
802.11a @ 6 Mbps	13	15	dBm
802.11a @ 54 Mbps	11	13	dBm
802.11n, HT20 @ MCS0	13	15	dBm
802.11n, HT20 @ MCS7	10	12	dBm
802.11n, HT40 @ MCS0	13	15	dBm
802.11n, HT40 @ MCS7	10	12	dBm
802.11ac, VHT20 @ MCS0	13	15	dBm
802.11ac, VHT20 @ MCS8	10	12	dBm
802.11ac, VHT40 @ MCS0	12	14	dBm
802.11ac, VHT40 @ MCS9	9	11	dBm
802.11ac, VHT80 @ MCS0	12	14	dBm
802.11ac, VHT80 @ MCS9	9	11	dBm
802.11ax, HE20 @ MCS0	13	15	dBm
802.11ax, HE20 @ MCS11	9	11	dBm
802.11ax, HE40 @ MCS0	12	14	dBm
802.11ax, HE40 @ MCS11	8	10	dBm
802.11ax, HE80 @ MCS0	12	14	dBm
802.11ax, HE80 @ MCS11	7	9	dBm

4.6.2. Conducted RF Receiving Sensitivity

Table 25: Conducted RF Receiving Sensitivity at 2.4 GHz

Description	Receiving Sensitivity (Typ.)
802.11b @ 1 Mbps	-96 dBm
802.11b @ 11 Mbps	-87.5 dBm
802.11g @ 6 Mbps	-91.5 dBm
802.11g @ 54 Mbps	-72.5 dBm
802.11n, HT20 @ MCS0	-92 dBm
802.11n, HT20 @ MCS7	-72 dBm
802.11n, HT40 @ MCS0	-89 dBm
802.11n, HT40 @ MCS7	-69 dBm
802.11ax, HE20 @ MCS0	-92 dBm
802.11ax, HE20 @ MCS11	-62 dBm
802.11ax, HE40 @ MCS0	-89 dBm
802.11ax, HE40 @ MCS11	-59 dBm

Table 26: Conducted RF Receiving Sensitivity at 5 GHz

Description	Receiving Sensitivity (Typ.)
802.11a @ 6 Mbps	-89 dBm
802.11a @ 54 Mbps	-72 dBm
802.11n, HT20 @ MCS0	-89 dBm
802.11n, HT20 @ MCS7	-70 dBm
802.11n, HT40 @ MCS0	-87 dBm
802.11n, HT40 @ MCS7	-68 dBm
802.11ac, VHT20 @ MCS0	-89 dBm

802.11ac, VHT20 @ MCS8	-66 dBm
802.11ac, VHT40 @ MCS0	-87 dBm
802.11ac, VHT40 @ MCS9	-62 dBm
802.11ac, VHT80 @ MCS0	-84 dBm
802.11ac, VHT80 @ MCS9	-58 dBm
802.11ax, HE20 @ MCS0	-90 dBm
802.11ax, HE20 @ MCS11	-60 dBm
802.11ax, HE40 @ MCS0	-87 dBm
802.11ax, HE40 @ MCS11	-57 dBm
802.11ax, HE80 @ MCS0	-84 dBm
802.11ax, HE80 @ MCS11	-55 dBm

4.7. Bluetooth RF Performances

The following tables summarize the transmitting and receiving performances of FC64E.

4.7.1. Conducted RF Output Power

Table 27: Conducted RF Output Power

Description	Min.	Typ.	Unit
GFSK	TBD	TBD	dBm
Π/4-DQPSK	TBD	TBD	dBm
8-DQPSK	TBD	TBD	dBm
BLE_1M	TBD	TBD	dBm
BLE_2M	TBD	TBD	dBm

4.7.2. Conducted RF Receiving Sensitivity

Table 28: Conducted RF Receiving Sensitivity at 2.4 GHz

Description	Receiving Sensitivity (Typ.)
GFSK	TBD
Π/4-DQPSK	TBD
8-DQPSK	TBD
BLE_1M	TBD
BLE_2M	TBD

4.8. ESD

If the static electricity generated by various ways discharges to the module, the module maybe damaged to a certain extent. Thus, please take proper ESD countermeasures and handling methods. For example, wearing anti-static gloves during the development, production, assembly and testing of the module; adding ESD protective component to the ESD sensitive interfaces and points in the product design of the module.

The following table shows the electrostatic discharge characteristics of the module.

Table 29: Electrostatic Discharge Characteristics

Tested Points	Contact Discharge	Air Discharge	Unit
Antenna Interfaces	TBD	TBD	kV
Other Interfaces	TBD	TBD	kV

5 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.

5.1. Mechanical Dimensions

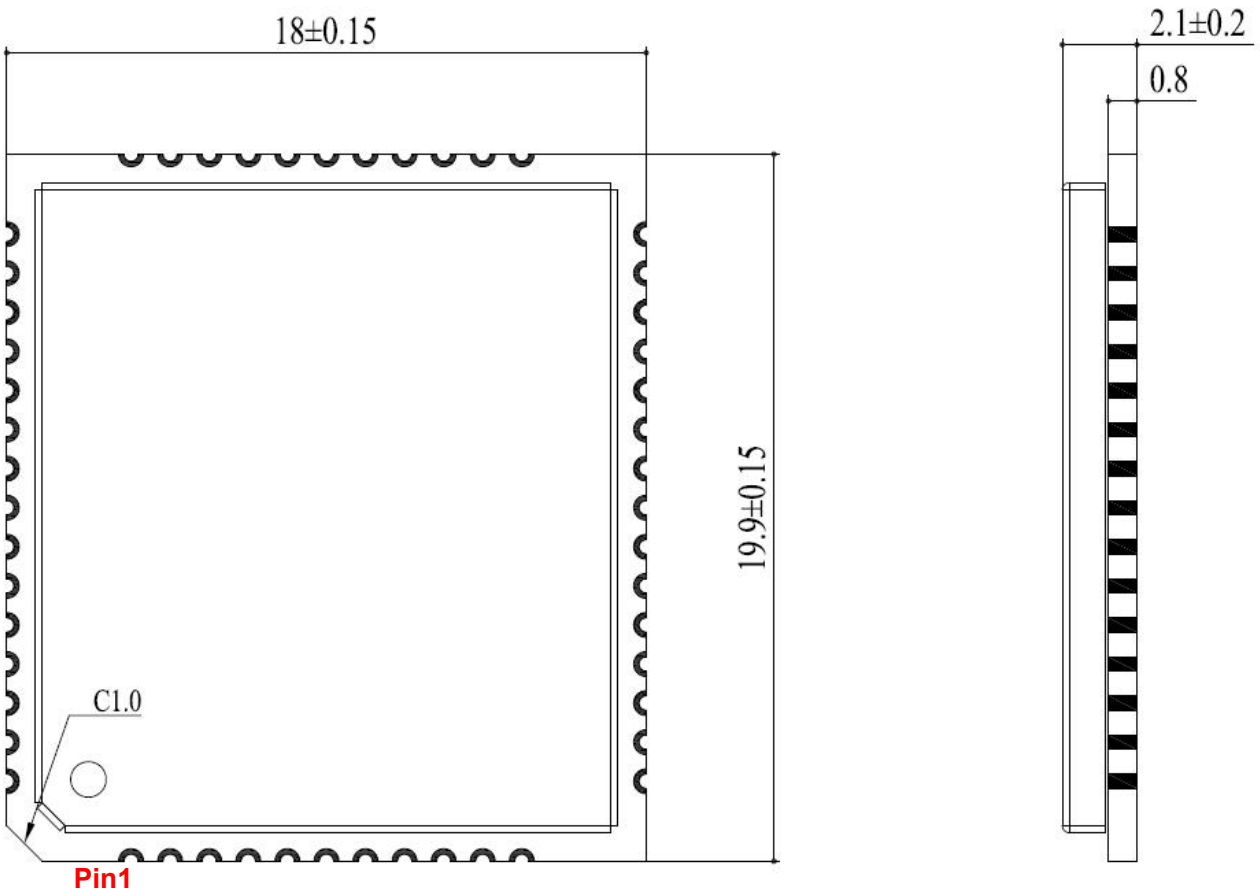


Figure 19: Module Top and Side Dimensions (Top and Side View)

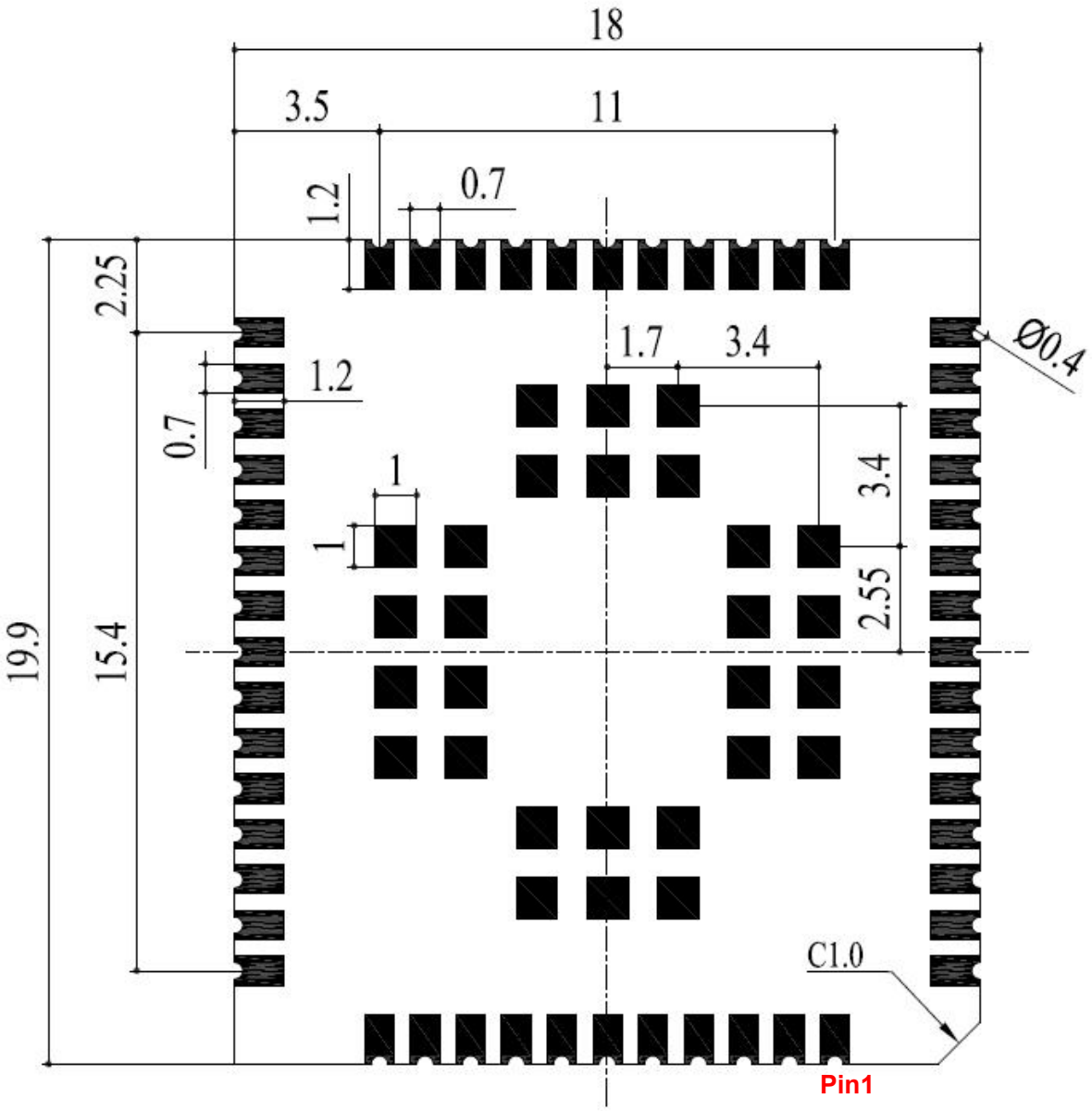


Figure 20: Module Bottom Dimension (Bottom View)

NOTE

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

5.2. Recommended Footprint

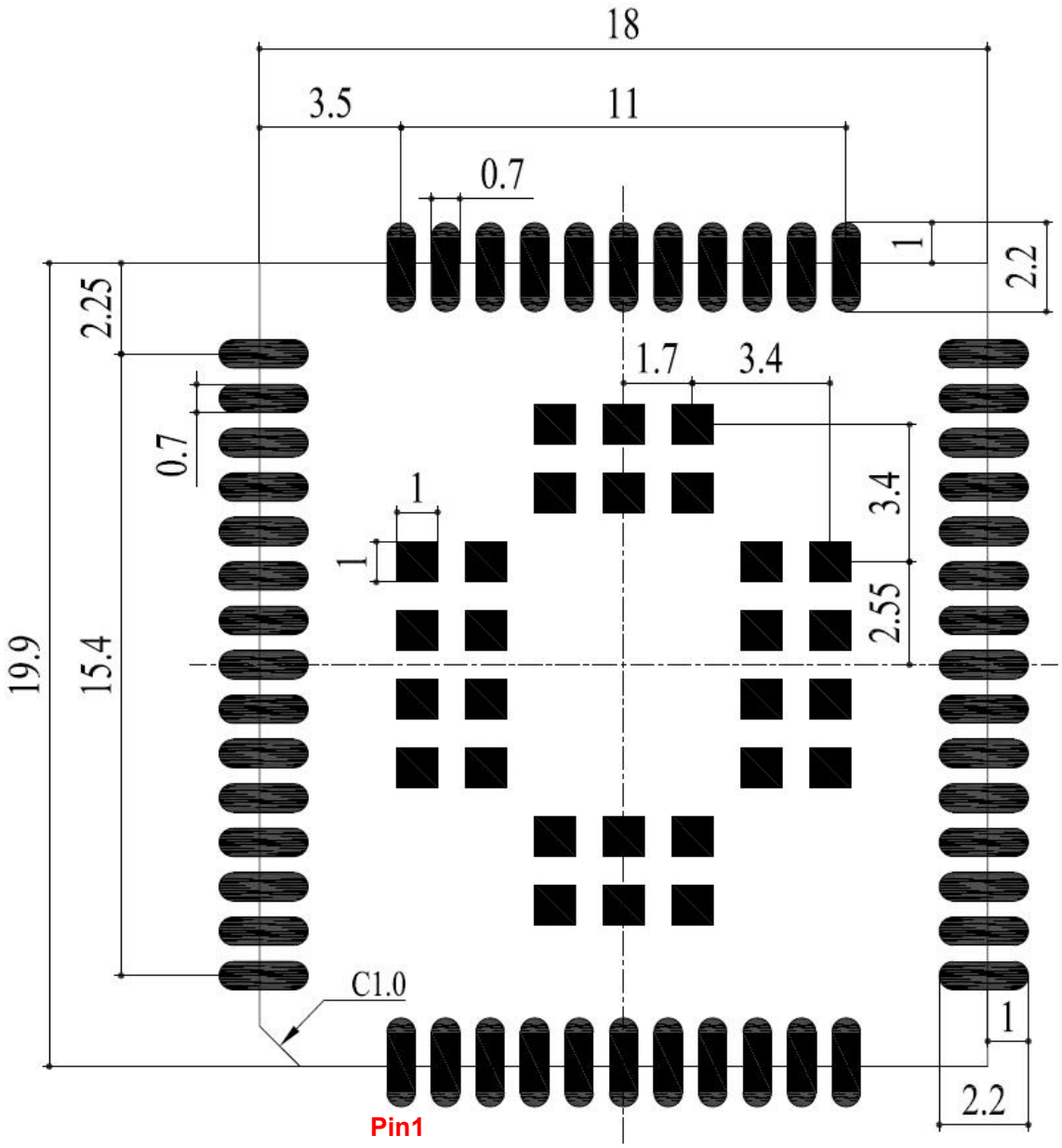


Figure 21: Recommended Footprint (Top View)

NOTE

1. Keep at least 3 mm between the module and other components on the motherboard to improve soldering quality and maintenance convenience.
2. To keep the reliability of the mounting and soldering, keep the motherboard thickness as at least 1.2 mm.

5.3. Top and Bottom Views

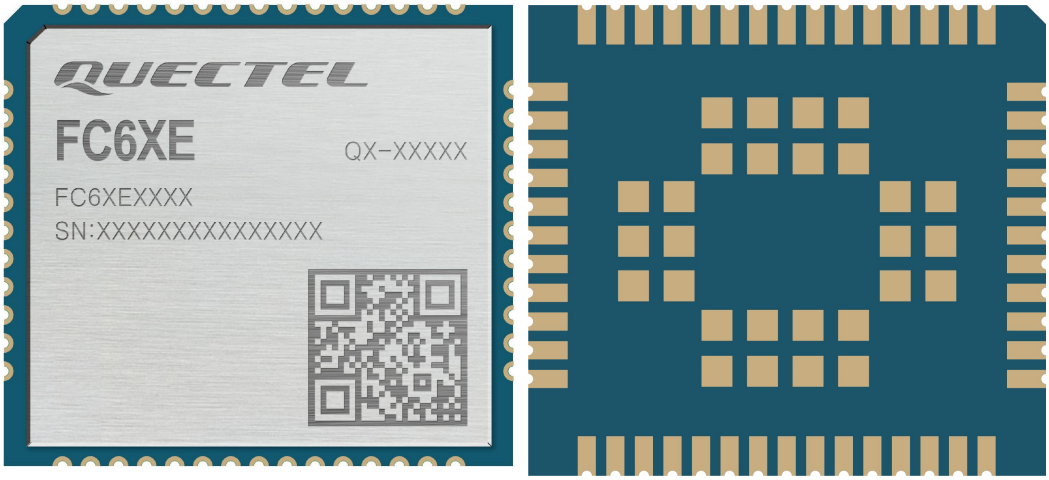


Figure 22: Top & Bottom View of FC64E

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.

6 Storage, Manufacturing and Packaging

6.1. 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. The storage life (in vacuum-sealed packaging) is 12 months in Recommended Storage Condition.

3. The floor life of the module is 168 hours [5] in a plant 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 drying 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 above occurs;
   - 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;
   - All modules must be soldered to PCB within 24 hours after the baking, otherwise they should be put in a dry environment such as in a drying oven.

NOTE

[5] 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.

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. All modules must be soldered to PCB within 24 hours after the baking, otherwise put them in the drying oven. 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.

6.2. 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 [4]***.

The peak reflow temperature should be 235–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is strongly 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.

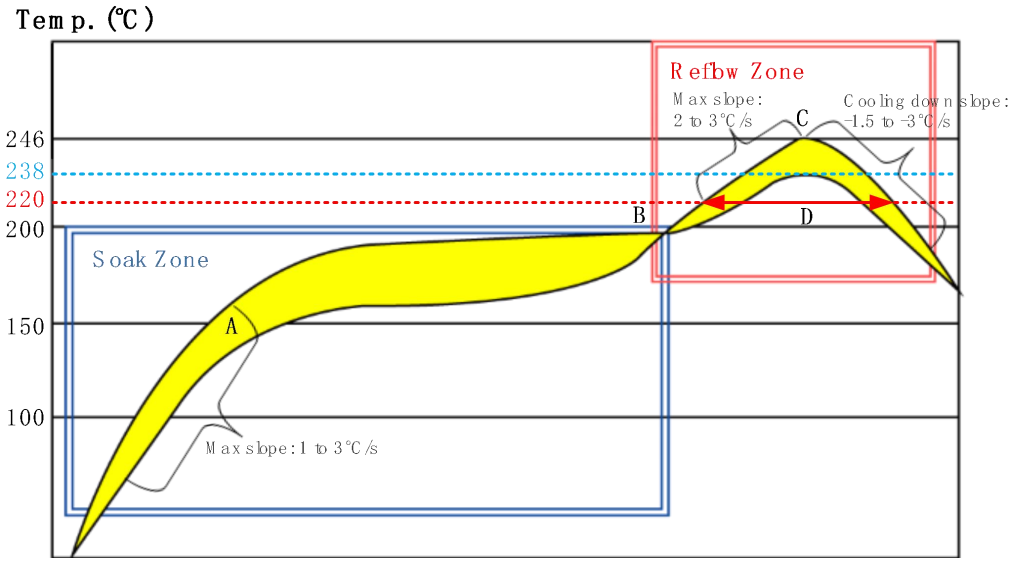


Figure 23: Recommended Reflow Soldering Thermal Profile

Table 30: Recommended Thermal Profile Parameters

Factor	Recommendation
Soak Zone	
Max slope	1–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Max slope	2–3 °C/s
Reflow time (D: over 217 °C)	40–70 s
Max temperature	235 °C to 246 °C
Cooling down slope	-1.5 to -3 °C/s
Reflow Cycle	
Max reflow cycle	1

NOTE

1. 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.
2. 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.
3. 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.
4. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
5. Due to the complexity of the SMT process, please contact Quectel Technical Supports 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 [4]***.

6.3. Packaging Specifications

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

6.3.1. Carrier Tape

Dimension details are as follow:

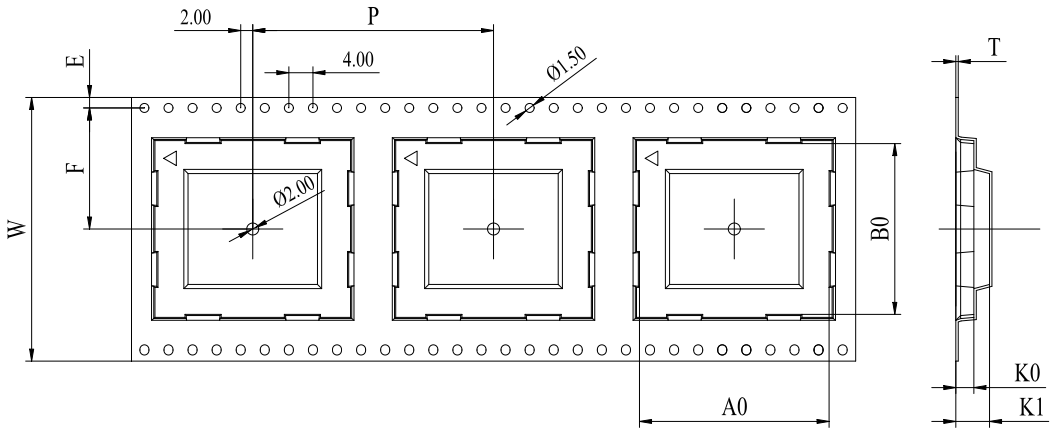


Figure 24: Carrier Tape Dimension Drawing

Table 31: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
44	32	0.4	18.5	20.5	3	6.8	20.2	1.75

6.3.2. Plastic Reel

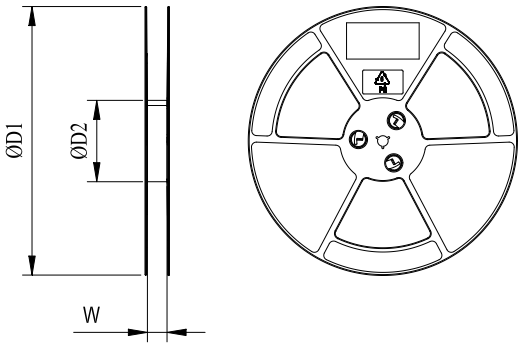
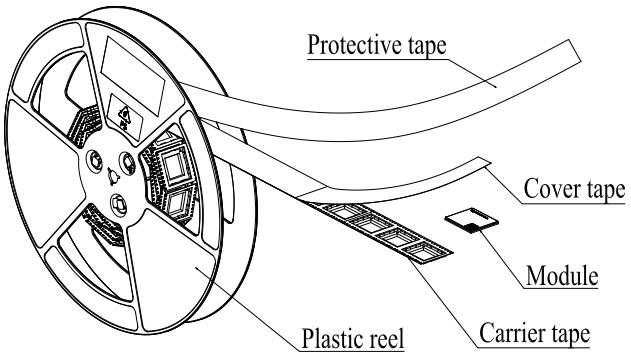


Figure 25: Plastic Reel Dimension Drawing

Table 32: Plastic Reel Dimension Table (Unit: mm)

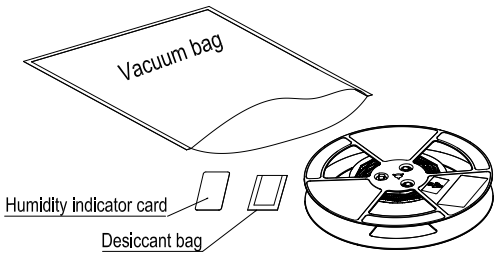
øD1	øD2	W
330	100	44.5

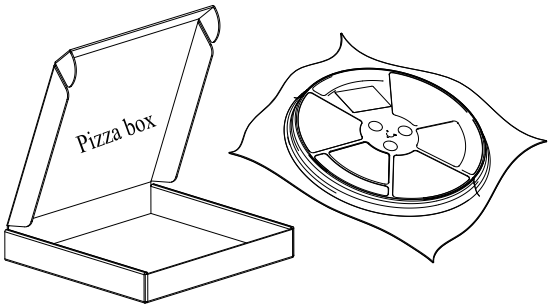
6.3.3. Packaging Process



Place the module into the carrier tape and use the cover tape to cover them; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. One plastic reel can load 250 modules.

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





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

Put 4 pizza boxes into 1 carton and seal it. One carton can pack 1000 modules.

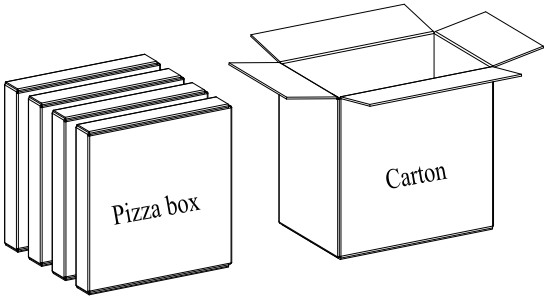


Figure 26: Packaging Process

7 Appendix References

Table 33: Related Documents

SN	Document Name
[1]	Quectel_Wi-Fi-M.2_EVB_User_Guide
[2]	Quectel_FC6xE_M.2_User_Guides
[3]	Quectel_RF_Layout_Application_Note
[4]	Quectel_Module_Secondary_SMT_Application_Note

Table 34: Terms and Abbreviations

Abbreviation	Description
AFH	Adaptive Frequency Hopping
AP	Access Point
BPSK	Binary Phase Shift Keying
Bluetooth	Bluetooth
CCK	Complementary Code Keying
CTS	Clear To Send
DBS	Dual Band Simultaneous
ESD	Electrostatic Discharge
EVB	Evaluation Board
GND	Ground
HCI	Host Controller Interface
HE	High Efficiency

HT	High Throughput
IEEE	Institute of Electrical and Electronics Engineers
I_{IL}	Input Leakage Current
I/O	Input/Output
LCC	Leadless chip carrier
LGA	Land Grid Array
LTE	Long Term Evolution
MAC	Medium Access Control
Mbps	Megabits per second
MCS	Modulation and Coding Scheme
MU-MIMO	Multi-User Multiple-Input Multiple-Output
PA	Power Amplifier
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
STA	Station
TBD	To Be Determined
TX	Transmit
UART	Universal Asynchronous Receiver/Transmitter
VHT	Very High Throughput

$V_{IH}max$	Maximum High-level Input Voltage
$V_{IH}min$	Minimum High-level Input Voltage
$V_{IL}max$	Maximum Low-level Input Voltage
$V_{IL}min$	Minimum Low-level Input Voltage
$V_{OL}max$	Maximum Low-level Output Voltage
$V_{OH}min$	Minimum Output High-level Output Voltage
VSWR	Voltage Standing Wave Ratio
Wi-Fi	Wireless-Fidelity
WLAN	Wireless Local Area Network