

FC30R Hardware Design

Wi-Fi Module Series

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About the Document

History

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1 Introduction

This document defines the FC30R module and describes its air interface and hardware interfaces which are connected with the customers' applications.

The document can help customers quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. Through using in combination with Quectel EC2x modules, customers can use FC30R module to design and set up LTE+Wi-Fi applications easily.

NOTE

¹⁾ EC2x in this document refers to Quectel EC21, EC25, EC20 R2.0 and EC20 R2.1 modules.

1.1. 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 FC30R module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel, and incorporate these guidelines into all manuals supplied with the product. If not so, 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 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 the device offers an Airplane Mode, then it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on boarding the 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 signals and cellular network cannot be guaranteed to connect in all possible conditions (for example, with unpaid bills or with an invalid (U)SIM card). When emergent help is needed in such conditions, please remember using emergency call. 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.



The cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.



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

2 Product Concept

2.1. General Description

FC30R is a cost-effective 2.4GHz Wi-Fi module with low power consumption.

- Supports 1x1 IEEE 802.11 b/g/n WLAN standards
- Provides SDIO 3.0 interface, compatible with SDIO 1.1 and SDIO 2.0 for WLAN

2.2. Key Features

The following table describes the detailed features of FC30R module.

Table 1: Key Features

Features	Description
Power Supply	Main supply voltage: 3.0V~3.6V, typ. 3.3V SDIO supply voltage: 1.8V
Data Rate	<ul style="list-style-type: none"> ● 802.11b: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps ● 802.11g: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps ● 802.11n: 6.5Mbps, 13Mbps, 19.5Mbps, 26Mbps, 39Mbps, 52Mbps, 58.5Mbps, 65Mbps
Transmitting Power	<ul style="list-style-type: none"> ● 802.11b/11Mbps: 16dBm ● 802.11g/54Mbps: 14dBm ● 802.11n/HT20 MCS7: 13dBm
WLAN Protocol Features	IEEE 802.11b/g/n
Operation Mode	AP
Modulation	BPSK, QPSK, CCK, 16QAM, 64QAM
WLAN Interface	SDIO 3.0

Antenna Interface	<ul style="list-style-type: none"> ● Wi-Fi antenna interface ● 50Ω impedance
Physical Characteristics	Size: (12.0±0.15)mm × (12.0±0.15)mm × (1.95±0.2)mm Package: LCC Weight: TBD
Temperature Range	Operating temperature range: -35°C ~ +75°C ¹⁾ Extended temperature range : -40°C ~ +85°C ²⁾ Storage temperature range: -40°C ~ +90°C
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTES

- ¹⁾ Within operation temperature range, the module is IEEE compliant.
- ²⁾ Within extended temperature range, the module remains the ability for data transmission. There is no unrecoverable malfunction. There are also no effects on radio spectrum and no harm to radio network. Only one or more parameters like P_{out} might reduce in their value and exceed the specified tolerances. When the temperature returns to the normal operating temperature levels, the module will meet IEEE specifications again.
- “*” means under development.

2.3. Functional Diagram

The following figure shows a block diagram of FC30R module and illustrates the major functional parts.

- Power supply
- SDIO interface
- RF antenna

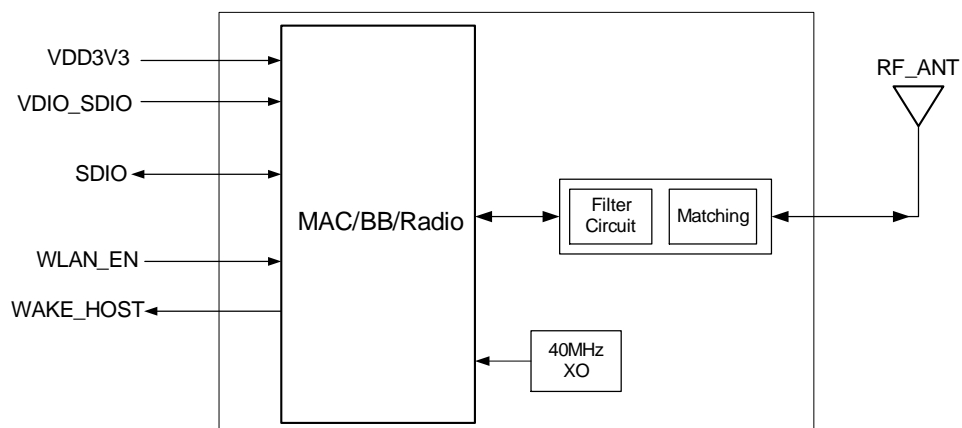


Figure 1: Functional Diagram of FC30R Module

2.4. Evaluation Board

In order to help customers to develop applications with FC30R module, Quectel supplies an evaluation board (EVB), a RS-232 to USB cable, a USB data cable, a power adapter, 4 antennas and other peripherals to control or test the module. For details, please refer to **document [1]**.

3 Application Interfaces

3.1. General Description

FC30R module is equipped with 22 LCC pads and 12 LGA pads that can be connected to application platforms. The subsequent chapters will provide a detailed introduction on the following module interfaces:

- Power supply
- WLAN interface
- Antenna interface

3.2. Pin Assignment

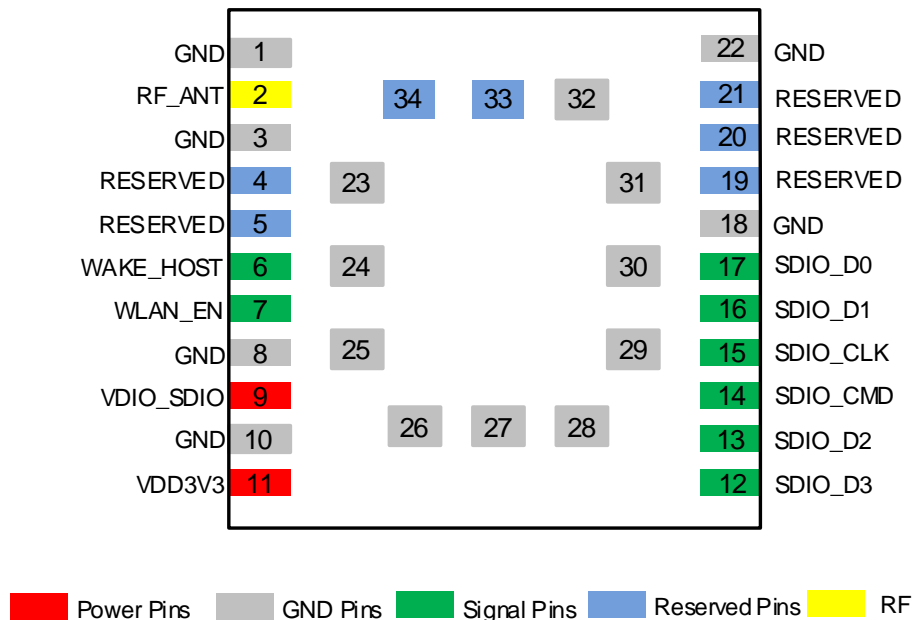


Figure 2: Pin Assignment of FC30R Module

NOTE

Please keep all RESERVED pins open.

3.3. Pin Description

The following tables show the pin definition of FC30R module.

Table 2: I/O Parameters Definition

Type	Description
DI	Digital input
DO	Digital output
IO	Bidirectional
PI	Power input

Table 3: Pin Description of FC30R Module

Power Supply					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
VDD3V3	11	PI	Main power supply for the module	V _{max} =3.6V V _{min} =3.0V V _{norm} =3.3V	It must be provided with sufficient current up to 0.6A.
VDIO_SDIO	9	PI	Power supply for SDIO interface	V _{norm} =1.8V	
GND	1, 3, 8, 10, 18, 22~32		Ground		
WLAN Interface					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
WAKE_HOST	6	DO	Wake up the host	V _{OLmax} =0.33V V _{OHmin} =2.97V	3.3V power domain. Active low. If unused, keep this

					pin open.
WLAN_EN	7	DI	WLAN chip enable control	V _{IL} min=0V V _{IL} max=0.9V V _{IH} min=2V V _{IH} max=3.6V	3.3V power domain. Active high.
SDIO_D3	12	IO	SDIO data signal - bit 3	V _{OL} max=0.18V V _{OH} min=1.62V V _{IL} min=-0.3V V _{IL} max=0.54V V _{IH} min=1.26V V _{IH} max=2.0V	1.8V power domain
SDIO_D2	13	IO	SDIO data signal - bit 2	V _{OL} max=0.18V V _{OH} min=1.62V V _{IL} min=-0.3V V _{IL} max=0.54V V _{IH} min=1.26V V _{IH} max=2.0V	1.8V power domain.
SDIO_D1	16	IO	SDIO data signal - bit 1	V _{OL} max=0.18V V _{OH} min=1.62V V _{IL} min=-0.3V V _{IL} max=0.54V V _{IH} min=1.26V V _{IH} max=2.0V	1.8V power domain
SDIO_D0	17	IO	SDIO data signal - bit 0	V _{OL} max=0.18V V _{OH} min=1.62V V _{IL} min=-0.3V V _{IL} max=0.54V V _{IH} min=1.26V V _{IH} max=2.0V	1.8V power domain
SDIO_CLK	15	DI	SDIO clock signal	V _{IL} min=-0.3V V _{IL} max=0.54V V _{IH} min=1.26V V _{IH} max=2.0V	1.8V power domain
SDIO_CMD	14	IO	SDIO command signal	V _{OL} max=0.18V V _{OH} min=1.62V V _{IL} min=-0.3V V _{IL} max=0.54V V _{IH} min=1.26V V _{IH} max=2.0V	1.8V power domain

RF Interface

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
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RF_ANT	2	IO	Wi-Fi antenna interface		50Ω impedance.
RESERVED Pins					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
RESERVED	4, 5, 19~21, 33, 34		Reserved		Keep these pins open.

NOTE

Keep all RESERVED and unused pins open.

3.4. Power Supply

The following table shows the power supply pins and the ground pins of FC30R. The VDIO_SDIO power should be later than VDD3V3 power.

Table 4: Power Supply Pins and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VDD3V3	11	Main power supply for the module	3.0	3.3	3.6	V
VDIO_SDIO	9	Power supply for the module's SDIO interface		1.8		V
GND	1, 3, 8, 10, 18, 22~32	Ground				

FC30R is powered by VDD3V3, and it is recommended to use a power supply chip with maximum output current more than 0.6A.

The following figure shows a reference design for VDD3V3. Pulling PM_ENABLE to a high voltage level will enable VDD3V3 power output. And this pin should be connected to pin 127 of EC2x. For more details, please refer to **document [2]**.

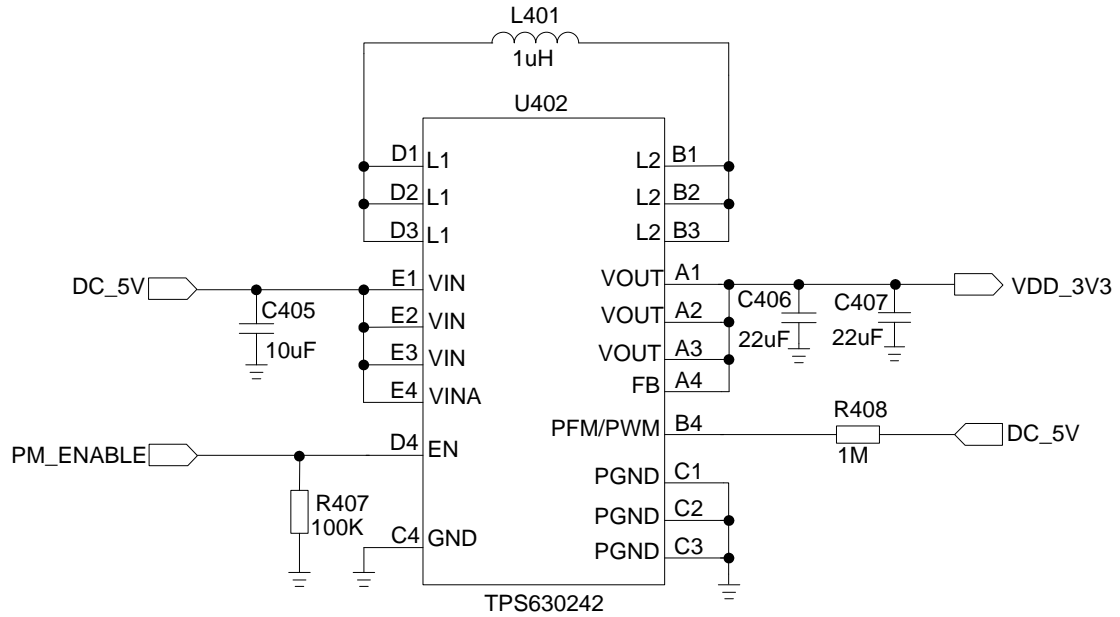


Figure 3: Reference Circuit for VDD3V3

The following figure shows the recommended power on/off sequences for FC30R.

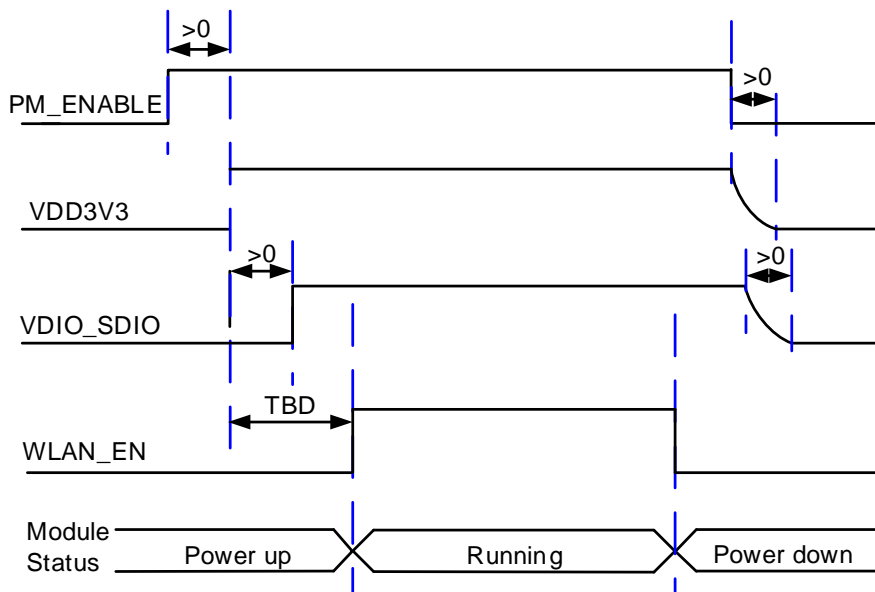


Figure 4: Power ON/OFF Timing of FC30R Module

3.5. WLAN Interface

The following figure shows the WLAN interface connection between FC30R and EC2x.

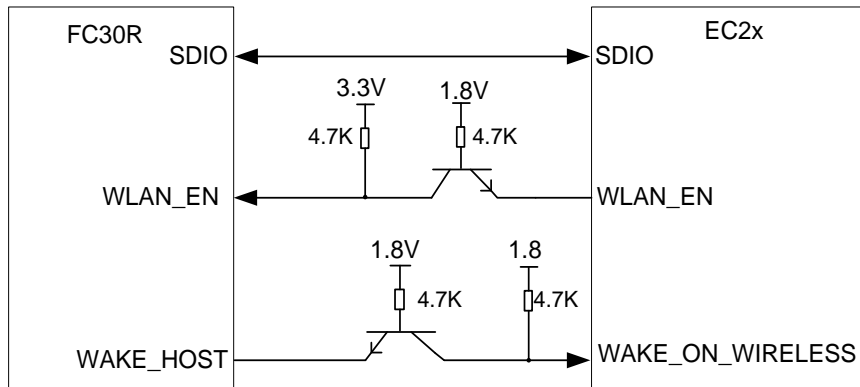


Figure 5: WLAN Interface Connection

NOTE

WLAN_EN and WAKE_HOST of FC30R provide 3.3V power domain. A voltage level shifting circuit should be added between FC30R and EC2x module.

3.5.1. WAKE_HOST*

WAKE_HOST is used to wake up the EC2x module. When the pin is pulled down, EC2x can be woken up.

Table 5: Pin Definition of WAKE_HOST

Pin Name	Pin No.	I/O	Description	Comment
WAKE_HOST	6	DO	Wake up the host	3.3V power domain. Active low. If unused, keep this pin open.

NOTE

“*” means the pin function is still under development.

3.5.2. WLAN_EN

WLAN_EN is used to enable the WLAN chip of FC30R. When WLAN_EN is at high level voltage, WLAN function will be enabled.

Table 6: Pin Definition of WLAN_EN

Pin Name	Pin No.	I/O	Description	Comment
WLAN_EN	7	DI	WLAN enable control	3.3V power domain. Active high.

NOTE

WLAN_EN is a sensitive signal, and thus should be ground-shielded and routed as close as possible to FC30R module.

3.5.3. SDIO Interface

The following table shows the pin definition of SDIO interface.

Table 7: Pin Definition of SDIO Interface

Pin Name	Pin No.	I/O	Description	Comment
SDIO_D3	12	IO	SDIO data signal - bit 3	1.8V power domain
SDIO_D2	13	IO	SDIO data signal -bit 2	1.8V power domain.
SDIO_D1	16	IO	SDIO data signal -bit 1	1.8V power domain
SDIO_D0	17	IO	SDIO data signal -bit 0	1.8V power domain
SDIO_CLK	15	DI	SDIO clock signal	1.8V power domain
SDIO_CMD	14	IO	SDIO command signal	1.8V power domain

The following figure shows the SDIO interface connection between FC30R and EC2x.

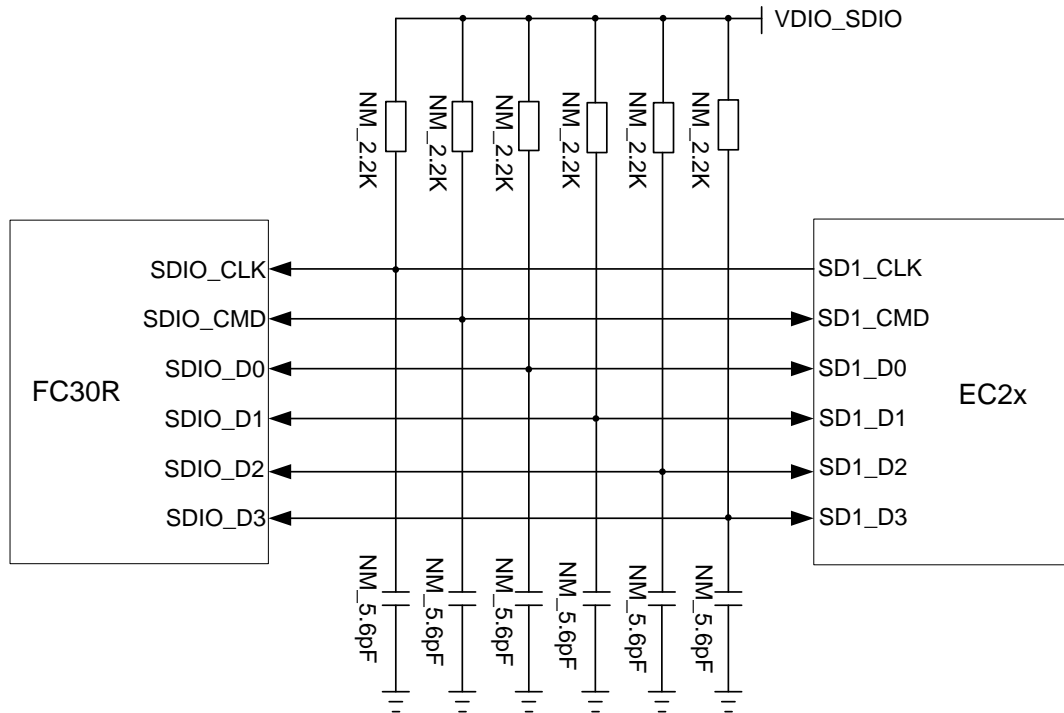


Figure 6: SDIO Interface Connection

In order to ensure the performance of SDIO, please comply with the following principles:

- SDIO signals are very high-speed signals. Please prevent crosstalk among them and other sensitive signals.
- Keep SDIO traces as parallel as possible in the same layer. Make sure SDIO lines are guarded by ground vias and not crossed.
- Do not route SDIO signal traces under crystals, oscillators, magnetic devices and RF signal traces.
- Keep SDIO traces as short as possible with equal length, and impedance control as 50Ω.
- The spacing to all other signals is greater than 2 times of the trace width.

3.6. Antenna Interface

The pin 2 is the RF antenna pad. And the RF port has an impedance of 50Ω.

3.6.1. Pin Definition of RF Antenna Interface

Table 8: Pin Definition of RF Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
GND	1		Ground	
RF_ANT	2	IO	Wi-Fi antenna interface	50Ω impedance
GND	3		Ground	

3.6.2. Operating Frequency

Table 9: Operating Frequency of FC30R

Feature	Frequency	Unit
2.4GHz WLAN	2.412~2.472	GHz

3.6.3. Reference Designs

FC30R module provides an RF antenna pad for Wi-Fi antenna connection. The RF trace in host PCB connected to the module's RF antenna pad should be microstrip line or other types of RF trace, with characteristic impedance close to 50Ω. FC30R module comes with grounding pads which are next to the antenna pad in order to give a better grounding.

A reference circuit for the RF antenna interface is shown below. It is recommended to reserve a π -type matching circuit for better RF performance. The capacitors are not mounted by default.

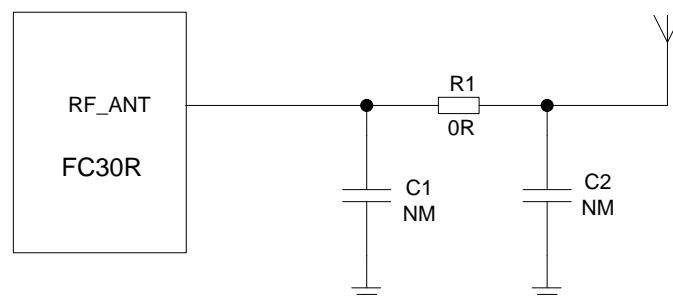


Figure 7: Reference Circuit for RF Antenna Interface

Another type of reference circuit for the RF antenna interface is shown below. It is designed for vehicle applications. It is recommended to reserve two notch filter circuits and a π -type matching circuit for better RF performance. C2/L1 and L3/C3 comprise two notch filter circuits for filtering out interference caused by a particular frequency. When L3/C3/L1/C2 is NC, C1/R1/C4 comprise a π -type matching circuit. Capacitors C1/C2/C3/C4 and inductors L1/L3 are not mounted by default, and R1 is 0 Ω by default.

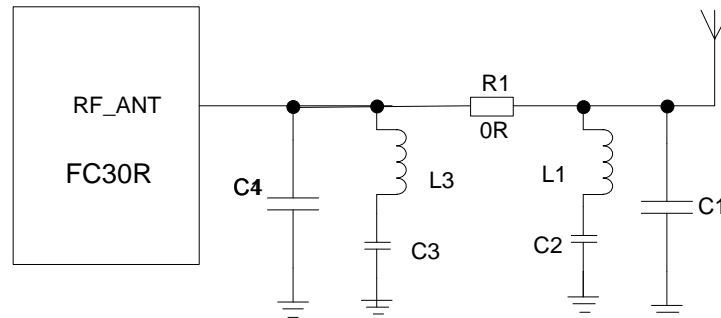


Figure 8: Reference Circuit for RF Antenna Interface (Vehicle Applications)

3.6.4. Antenna Requirements

The following table shows the requirements on RF antenna.

Table 10: Antenna Cable Requirements

Type	Requirements
2.412GHz~2.472GHz	Cable insertion loss <1dB

Table 11: Antenna Requirements

Type	Requirements
Frequency Range	2.412GHz~2.472GHz
VSWR	< 2:1 recommended
Gain (dBi)	1 typical
Max Input Power (W)	50
Input Impedance (Ω)	50
Polarization Type	Vertical

3.6.5. Recommended RF Connector for Antenna Installation

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

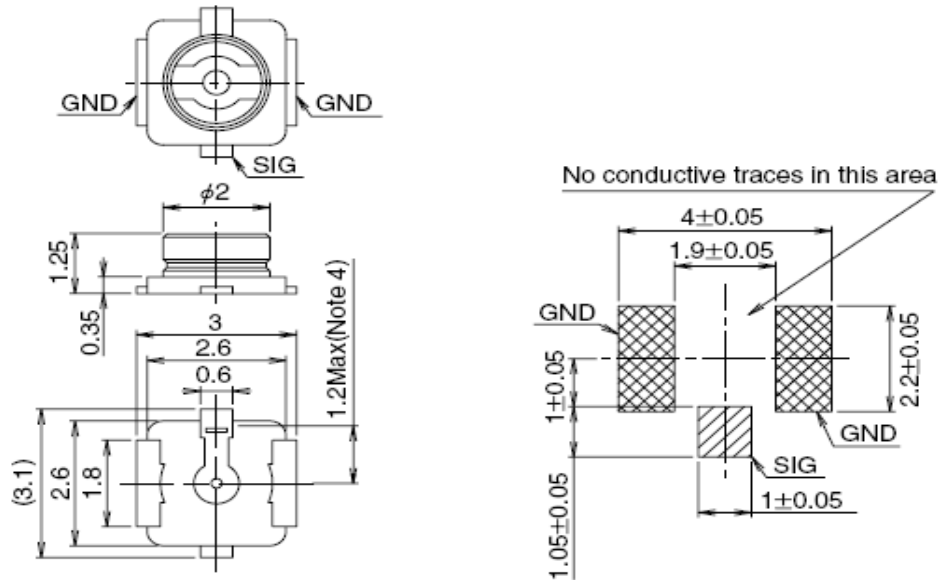


Figure 9: Dimensions of the U.FL-R-SMT Connector (Unit: mm)

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

	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
Part No.					
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 10: Mechanicals of U.FL-LP Connectors

The following figure describes the space factor of mated connector

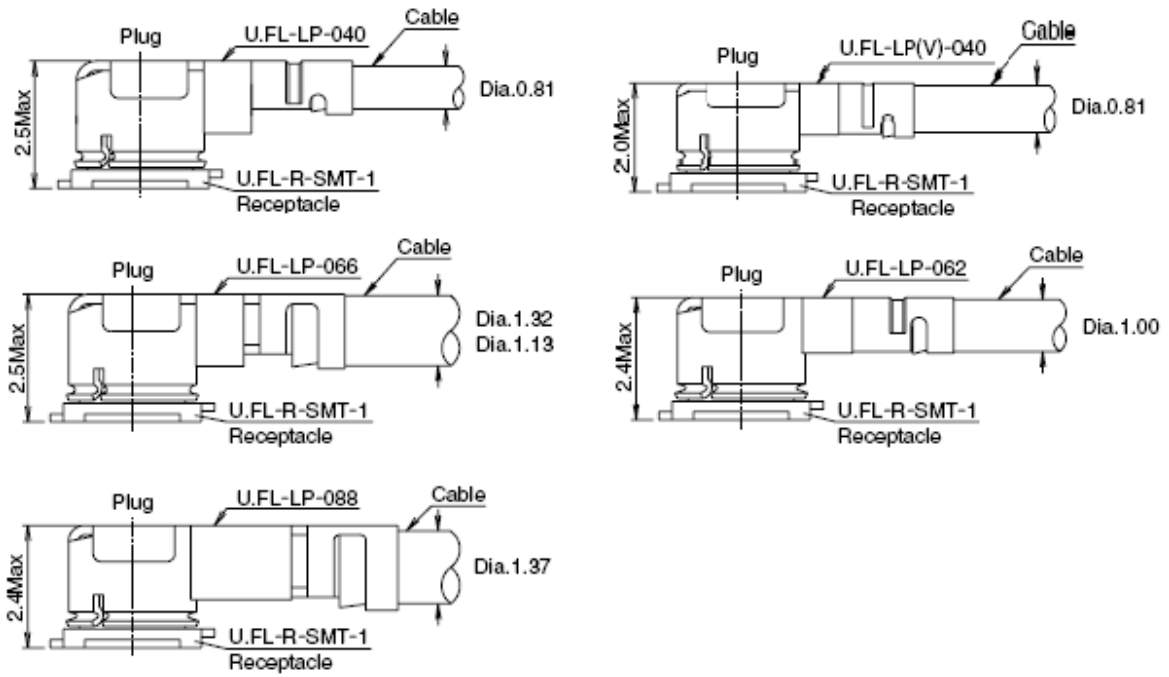


Figure 11: Space Factor of Mated Connector (Unit: mm)

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

4 Electrical, Reliability and Radio Characteristics

4.1. General Description

This chapter mainly introduces the electrical and the radio frequency characteristics of FC30R module, which are listed in detail in the following chapters:

- Electrical characteristics
- I/O interface characteristics
- Current consumption
- RF performance
- Electrostatic discharge

4.2. Electrical Characteristics

The following table shows the absolute maximum ratings.

Table 12: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VDD3V3	0	3.6	V
VDIO_SDIO	0	3.6	V
Digital I/O Input Voltage	0	3.6	V

The following table shows the recommended operating conditions for FC30R module.

Table 13: Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
VDD3V3	3	3.3	3.6	V
VDIO_SDIO	1.75	1.8	1.89	V

4.3. I/O Interface Characteristics

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

Table 14: General DC Electrical Characteristics

Symbol	Parameter	Min.	Max.	Unit
V _{IH}	High Level Input Voltage	2.0	3.6	V
V _{IL}	Low Level Input Voltage	0	0.9	V
V _{OH}	High Level Output Voltage	2.97	3.3	V
V _{OL}	Low Level Output Voltage	0	0.33	V

4.4. Current Consumption

Table 15: Current Consumption of the Module (Low Power Modes)

Description	Conditions	I _{WLAN_3V3}	I _{VIO}	Unit
OFF State ¹⁾	AT+QWIFI=0	0	0	uA
Idle ²⁾	AT+QWIFI=1	TBD	TBD	mA

NOTES

- ¹⁾ OFF state: Executing **AT+QWIFI=0** command will make the module enter into this state (Wi-Fi disabled). Under the state, the sleep clock is disabled and no data is saved.

2. ²⁾ Idle state: Wi-Fi function enabled via **AT+QWIFI=1**, but without any device connected to the AP.

Table 16: Current Consumption of the Module (Normal Operation)

Standard	Data Rate	I _{WLAN_3V3}	Unit
802.11b	TX 1Mbps @17.5dBm	TBD	mA
	TX 11Mbps @17.2dBm	TBD	mA
	RX 1Mbps	TBD	mA
	RX 11Mbps	TBD	mA
802.11g	TX 6Mbps @16dBm	TBD	mA
	TX 54Mbps @14.8dBm	TBD	mA
	RX 6Mbps	TBD	mA
	RX 54Mbps	TBD	mA
802.11n	TX HT20-MCS0 @15.8dBm	TBD	mA
	TX HT20-MCS7 @13.5dBm	TBD	mA
	TX HT40-MCS0 @14.5dBm	TBD	mA
	TX HT40-MCS7 @12.5dBm	TBD	mA
	RX HT20-MCS0	TBD	mA
	RX HT20-MCS7	TBD	mA
	RX HT40-MCS0	TBD	mA
	RX HT40-MCS7	TBD	mA

4.5. RF Performance

The following tables summarize the transmitting and receiving characteristics of FC30R.

4.5.1. Conducted RF Output Power

Table 17: Conducted RF Output Power at 2.4GHz

Standard	Data Rate	Typ.	Unit
802.11b	1Mbps	TBD	dBm
802.11b	11Mbps	TBD	dBm
802.11g	6Mbps	TBD	dBm
802.11g	54Mbps	TBD	dBm
802.11n, HT20	MCS0	TBD	dBm
802.11n, HT20	MCS7	TBD	dBm
802.11n, HT40	MCS0	TBD	dBm
802.11n, HT40	MCS7	TBD	dBm

4.5.2. Conducted RF Receiving Sensitivity

Table 18: Conducted RF Receiving Sensitivity at 2.4GHz

Standard	Data Rate	Typ.	Unit
802.11b	1Mbps	TBD	dBm
802.11b	11Mbps	TBD	dBm
802.11g	6Mbps	TBD	dBm
802.11g	54Mbps	TBD	dBm
802.11n, HT20	MCS0	TBD	dBm
802.11n, HT20	MCS7	TBD	dBm
802.11n, HT40	MCS0	TBD	dBm
802.11n, HT40	MCS7	TBD	dBm

4.6. Electrostatic Discharge

The module is not protected against Electrostatic Discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be followed throughout the processing, handling and operation of any application that involves the module.

5 Mechanical Dimensions

This chapter describes the mechanical dimensions of FC30R module. All dimensions are measured in mm. The tolerances for dimensions without tolerance values are $\pm 0.05\text{mm}$.

5.1. Mechanical Dimensions of the Module

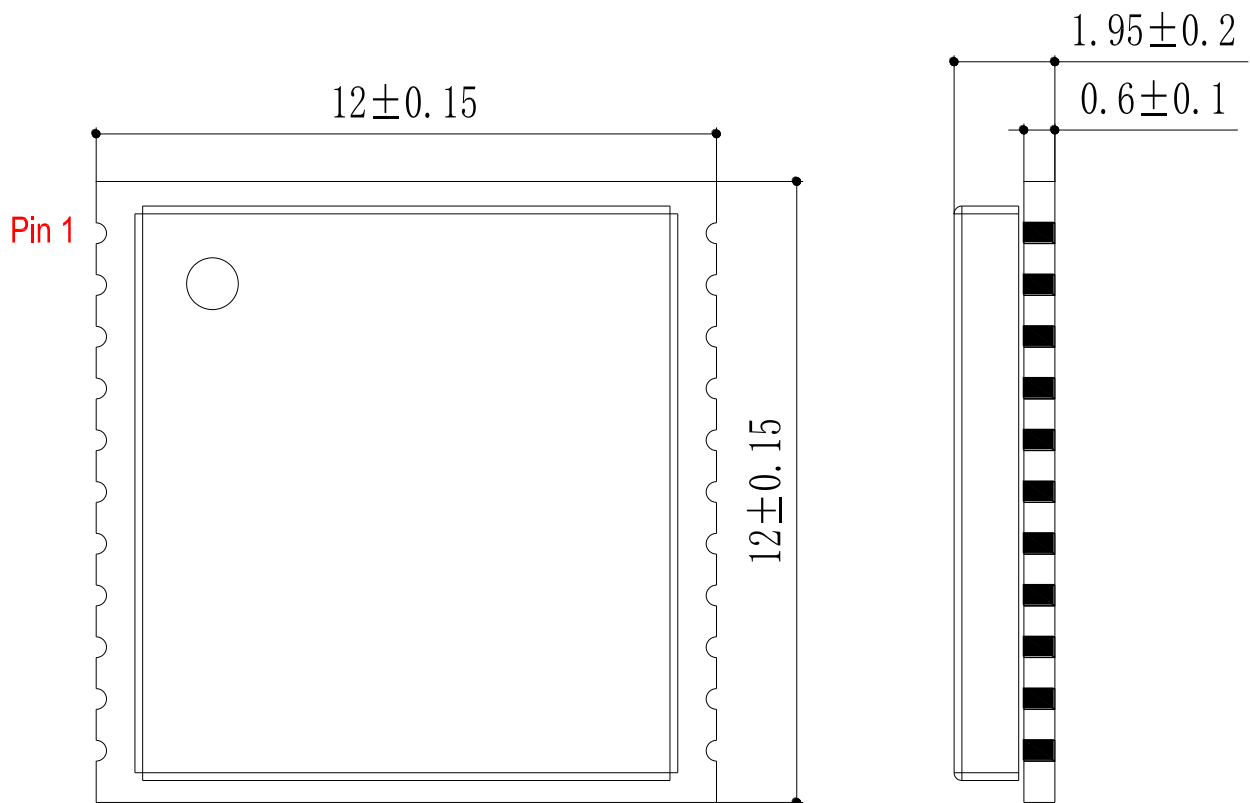


Figure 12: Top and Side Dimensions

5.2. Recommended Footprint

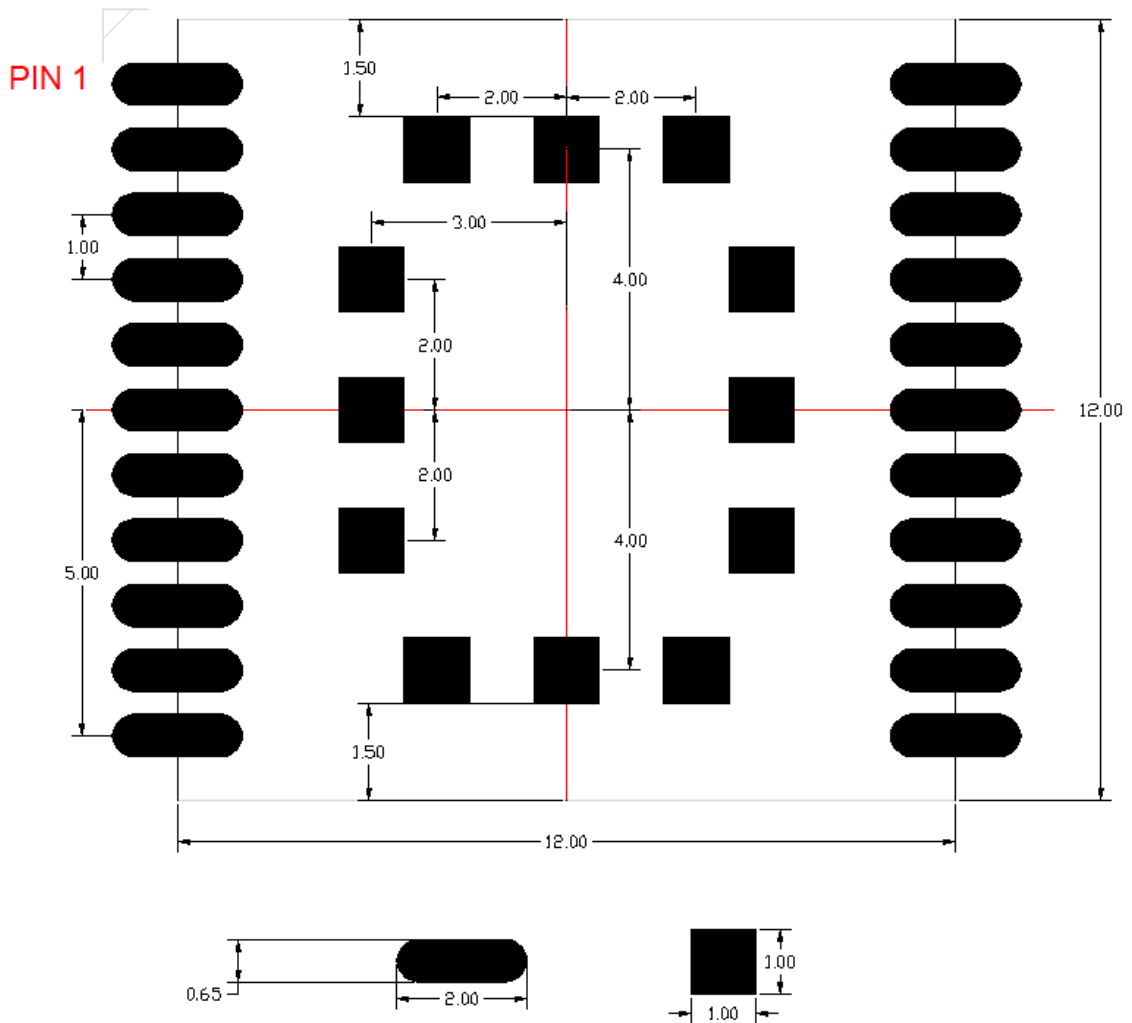


Figure 14: Recommended Footprint

6 Storage, Manufacturing and Packaging

6.1. Storage

FC30R module is stored in a vacuum-sealed bag. It is rated at MSL 3, and its storage restrictions are shown as below.

1. Shelf life in the vacuum-sealed bag: 12 months at <math><40^{\circ}\text{C}/90\%\text{RH}</math>.
2. After the vacuum-sealed bag is opened, devices that will be subjected to reflow soldering or other high temperature processes must be:
 - Mounted within 168 hours at the factory environment of $\leq 30^{\circ}\text{C}/60\%\text{RH}$.
 - Stored at <math><10\%\text{RH}</math>.
3. Devices require baking before mounting, if any circumstance below occurs.
 - When the ambient temperature is $23^{\circ}\text{C}\pm 5^{\circ}\text{C}$ and the humidity indication card shows the humidity is >10% before opening the vacuum-sealed bag.
 - Device mounting cannot be finished within 168 hours at factory conditions of $\leq 30^{\circ}\text{C}/60\%$.
4. If baking is required, devices may be baked for 8 hours at $120^{\circ}\text{C}\pm 5^{\circ}\text{C}$.

NOTE

As the plastic package cannot be subjected to high temperature, it should be removed from devices before high temperature (120°C) baking. If shorter baking time is desired, please refer to *IPC/JEDECJ-STD-033* for baking procedure.

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. The force on the squeegee should be adjusted properly so as to produce a clean stencil surface on a single pass. To ensure the module soldering quality, the thickness of stencil for the module is recommended to be 0.15mm~0.18mm. For more details, please refer to **document [3]**.

It is suggested that the peak reflow temperature is 238°C~245°C, and the absolute maximum reflow temperature is 245°C. To avoid damage to the module caused by repeated heating, it is strongly recommended that the module should be mounted 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.

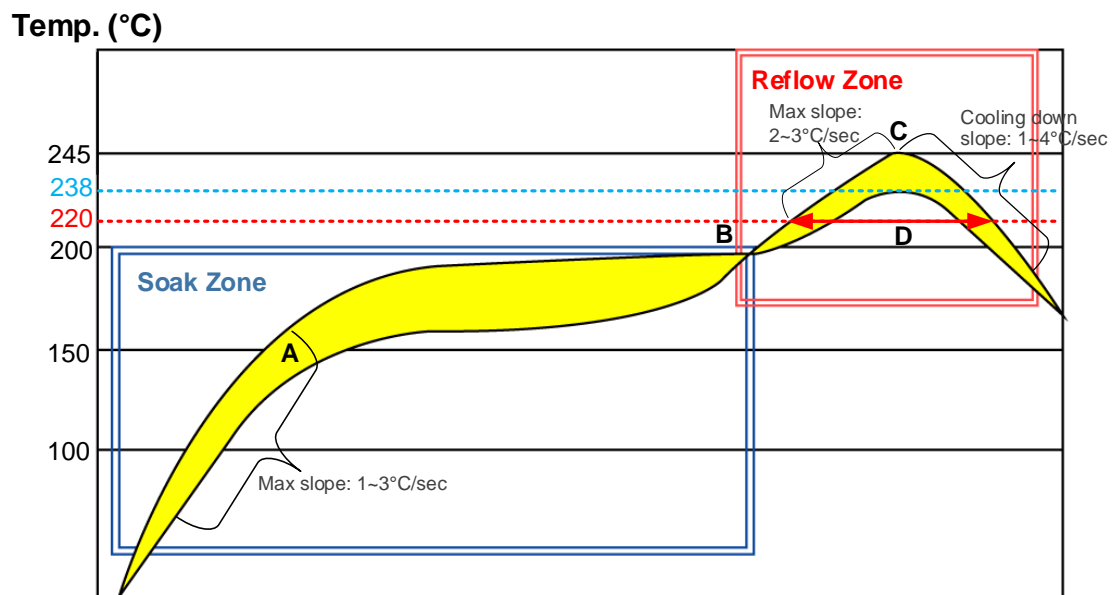


Figure 15: Recommended Reflow Soldering Thermal Profile

Table 19: Recommended Thermal Profile Parameters

Factor	Recommendation
Soak Zone	
Max slope	1 to 3°C/sec
Soak time (between A and B: 150°C and 200°C)	60 to 120 sec
Reflow Zone	

Max slope	2 to 3°C/sec
Reflow time (D: over 220°C)	40 to 60 sec
Max temperature	238°C ~ 245°C
Cooling down slope	1 to 4°C/sec
Reflow Cycle	
Max reflow cycle	1

6.3. Packaging

FC30R module is packaged in a vacuum-sealed bag which is ESD protected. The bag should not be opened until the devices are ready to be soldered onto the application.

6.3.1. Tape and Reel Packaging

FC30R module is packaged in tape and reel carriers. The packaging specifications will be added in a future release of this document.

Table 20: Reel Packaging

Model Name	MOQ for MP	Minimum Package: 250pcs	Minimum Package × 4=1000pcs
FC30R	250pcs	Size: TBD N.W: TBD G.W: TBD	Size: TBD N.W: TBD G.W: TBD

7 Appendix A References

Table 21: Related Documents

SN	Document Name	Remark
[1]	Quectel_UMTS<E_EVB_User_Guide	EVB user guide for Quectel UMTS, LTE and Wi-Fi/BT modules
[2]	Quectel_FC30R_Reference_Design	FC30R reference design
[3]	Quectel_Module_Secondary_SMT_User_Guide	Module secondary SMT user guide

Table 22: Terms and Abbreviations

Abbreviation	Description
AP	Access Point
BPSK	Binary Phase Shift Keying
CCK	Complementary Code Keying
ESD	Electrostatic Discharge
GND	Ground
HT	High Throughput
IEEE	Institute of Electrical and Electronics Engineers
I_{IL}	Input Leakage Current
I/O	Input/Output
LTE	Long Term Evolution
Mbps	Million Bits Per Second
MCS	Modulation and Coding Scheme
MOQ	Minimum Order Quantity

PCB	Printed Circuit Board
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RH	Relative Humidity
RoHS	Restriction of Hazardous Substances
RX	Receive Direction
SDIO	Secure Digital Input and Output Card
TX	Transmitting Direction
USB	Universal Serial Bus
VDD	Voltage Power for Digital Device
VHT	Very High Throughput
V _{IHmax}	Maximum Input High Level Voltage Value
V _{IHmin}	Minimum Input High Level Voltage Value
V _{ILmax}	Maximum Input Low Level Voltage Value
V _{ILmin}	Minimum Input Low Level Voltage Value
VIO	Voltage for Input/Output Port
V _{OLmax}	Maximum Output Low Level Voltage Value
V _{OHmin}	Minimum Output High Level Voltage Value
VSWR	Voltage Standing Wave Ratio
Wi-Fi	Wireless-Fidelity
WLAN	Wireless Local Area Networks
