




# RF EXPOSURE REPORT



Report No.: 16050031-FCC-H-V3

Applicant	Quectel Wireless Solutions Co., Ltd.	
Product Name	WiFi Module	
Model No.	FC20-N	
Serial No.	N/A	
Test Standard	FCC 2.1091: 2016	
Test Date	February 07 to March 01, 2017	
Issue Date	May 10, 2017	
Test Result	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail	
Equipment complied with the specification	<input checked="" type="checkbox"/>	
Equipment did not comply with the specification	<input type="checkbox"/>	
		
Loren Test Engineer	David Huang Checked By	
This test report may be reproduced in full only Test result presented in this test report is applicable to the tested sample only		

Issued by:

**SIEMIC (SHENZHEN-CHINA) LABORATORIES**

Zone A, Floor 1, Building 2 Wan Ye Long Technology Park

South Side of Zhoushi Road, Bao' an District, Shenzhen, Guangdong China 518108

Phone: +86 0755 2601 4629801 Email: [China@siemic.com.cn](mailto:China@siemic.com.cn)

## Laboratories Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.



In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

### Accreditations for Conformity Assessment

Country/Region	Scope
USA	EMC, RF/Wireless, SAR, Telecom
Canada	EMC, RF/Wireless, SAR, Telecom
Taiwan	EMC, RF, Telecom, SAR, Safety
Hong Kong	RF/Wireless, SAR, Telecom
Australia	EMC, RF, Telecom, SAR, Safety
Korea	EMI, EMS, RF, SAR, Telecom, Safety
Japan	EMI, RF/Wireless, SAR, Telecom
Singapore	EMC, RF, SAR, Telecom
Europe	EMC, RF, SAR, Telecom, Safety

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## 1. Report Revision History

Report No.	Report Version	Description	Issue Date
16050031-FCC-H	NONE	Original	March 02, 2017
16050031-FCC-H-V1	V1	P9 Change 2412(MHz)high frequency into 2412(MHz)low	April 12, 2017
16050031-FCC-H-V2	V2	Changed the antenna type	April 18, 2017
16050031-FCC-H-V3	V3	Adding collocated MPE Calculation	May 10, 2017

## 2. Customer information

Applicant Name	Quectel Wireless Solutions Co., Ltd.
Applicant Add	RM501,Building 13,No.99 TianZhou Road,Xuhui District,Shanghai,China
Manufacturer	Quectel Wireless Solutions Co., Ltd.
Manufacturer Add	RM501,Building 13,No.99 TianZhou Road,Xuhui District,Shanghai,China

## 3. Test site information

Lab performing tests	SIEMIC (Shenzhen-China) LABORATORIES
Lab Address	Zone A, Floor 1, Building 2 Wan Ye Long Technology Park South Side of Zhoushi Road, Bao' an District, Shenzhen, Guangdong China 518108
FCC Test Site No.	718246
IC Test Site No.	4842E-1
Test Software	Labview of SIEMIC version 2.0

## 4. Equipment under Test (EUT) Information

Description of EUT:	WiFi Module
Main Model:	FC20-N
Serial Model:	N/A
Equipment Category :	DTS
Antenna Gain:	3dBi
Antenna Type:	Fixed external antenna
Input Power:	Main supply voltage: 3.3V, 500mA IO supply voltage: 1.8V
Trade Name :	Quectel
FCC ID:	XMR201703FC20N
Type of Modulation:	802.11b/g/n: DSSS, OFDM
RF Operating Frequency (ies):	WiFi: 802.11b/g/n(20M): 2412-2462 MHz WiFi: 802.11n(40M): 2422-2452 MHz
Number of Channels:	WiFi :802.11b/g/n(20M): 11CH WiFi :802.11n(40M): 7CH
Port:	N/A
Date EUT received:	February 06, 2017
Test Date(s):	February 07 to March 01, 2017

## 5. FCC §2.1091 - Maximum Permissible exposure (MPE)

### 5.1 Applicable Standard

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission' s guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Table 1

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

## 5.2 Test Result

Table 2

Type	Test mode	CH	Freq (MHz)	Conducted Power (dBm)	Tune Up Power (dBm)
Output power	802.11b	Low	2412	15.91	15.5±1
		Mid	2437	15.82	15.5±1
		High	2462	15.74	15.5±1
	802.11g	Low	2412	13.60	14±1
		Mid	2437	13.76	14±1
		High	2462	13.71	14±1
	802.11n (20M)	Low	2412	13.71	14±1
		Mid	2437	13.81	14±1
		High	2462	13.71	14±1
	802.11n (40M)	Low	2422	12.92	13±1
		Mid	2437	12.75	13±1
		High	2452	12.78	13±1

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

Where: S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For the antenna manufacturer provide only used limited to ERP/EIRP or radiated spurious emission test. The MPE evaluation as below:

Maximum output power at antenna input terminal: 16.5 (dBm)

Maximum output power at antenna input terminal: 79.43(mW)

Prediction distance: >20 (cm)



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Predication frequency: 2412 (MHz) Low frequency

Antenna Gain (typical): 3 (dBi)

Antenna Gain (typical): 1.995 (numeric)

The worst case is power density at predication frequency at 20 cm: 0.0177(mW/cm<sup>2</sup>)

MPE limit for general population exposure at prediction frequency: 1.0 (mW/cm<sup>2</sup>)

$0.0177(\text{mW}/\text{cm}^2) < 1.0 (\text{mW}/\text{cm}^2)$

**Result: Pass**

## 6 Introduction

Quectel Wireless Solutions Co., Ltd. seeks modular approval for the FC20-N Wifi Module for use in mobile configuration. This Maximum Permissible Exposure (“ MPE” ) report demonstrates compliance for FC20-N Wifi& BT Module with FCC CFR 47 §1.1310 and 2.1091 for standalone and collocated simultaneous transmission in mobile exposure conditions. The MPE analysis is valid for transmitters operating within the parameters defined in Table 4 used for analysis.

Any collocated transmitter must have a valid FCC ID documenting equivalent or degraded RF characteristics with the collocated parameters defined in this MPE analysis.

The mobile classification applies when 20 cm or more separation distance is maintained between the end user and both WLAN and WWAN transmission antennas.

Portable user conditions or additional collocated modules not allowed based on this RF exposure analysis require a Class II permissive change and updated MPE or SAR report.

## 7 Product Transmitter Parameters Summary:

Table 7 summarizes transmitter parameters Summary

**Table 3 WWAN Transmitter**

Technology	Max Transmitter Duty Cycle	Transmitter Range (MHz)	Maximum Conducted Power		Max Antenna Gain (dBi)
			(dBm)	(W)	
2.4G WIFI	100%	2412 ~ 2462	16.5	0.04467	3

## 8. Collocated Transmitters

This MPE analysis is applicable to any collocated transmitters with transmit power less than or equal to 29.0 dBm for WWAN. Specific FCC IDs for those devices are not necessary or identified in this analysis providing they are classified as mobile transmitters. A 100% duty cycle is used for calculations to present a worst-case analysis.

## 9 Transmitter Summary

Table 8 summarizes transmitter parameters.

The 2.4G WIFI modes of operation reflect the FC20-N Wifi Module parameters associated with this FCC ID: XMR201703FC20N.

The WWAN transmit power and antenna gain parameters represent a maximum transmit power for a given frequency band.

Integration of a WWAN module that exceeds the parameters requires a new FCC authorization or permissive change application.

**Table 4 WLAN and WWAN Declared Transmitter Parameters**

Module Model	Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (W)	Maximum Antenna Gain (dBi)	Duty Cycle
FC20-N	2.4G WIFI	2412 ~ 2462	16.5	0.04467	3	100%
EC25-A	UMTS Band II	1850 – 1910	24	0.25119	12	100%
	UMTS Band IV	1710 – 1755	24	0.25119	12	100%
	UMTS Band V	824 – 849	24	0.25119	10	100%
	LTE Band II	1850 – 1910	24	0.25119	12	100%
	LTE Band IV	1710 – 1755	24	0.25119	12	100%
	LTE Band XII	2500 – 2570	24	0.25119	12	100%
EC21-A	UMTS Band II	1850 – 1910	24	0.25119	12	100%
	UMTS Band IV	1710 – 1755	24	0.25119	12	100%
	UMTS Band V	824 – 849	24	0.25119	10	100%
	LTE Band II	1850 – 1910	24	0.25119	12	100%
	LTE Band IV	1710 – 1755	24	0.25119	12	100%
	LTE Band XII	2500 – 2570	24	0.25119	12	100%

EC25-V	LTE Band IV	1850 – 1910	24	0.25119	12	100%
	LTE Band XIII	777 – 787	24	0.25119	10	100%
EC21-V	LTE Band IV	1850 – 1910	24	0.25119	12	100%
	LTE Band XIII	777 – 787	24	0.25119	10	100%

## 10 MPE Calculations

### 10.1 Stand Alone Transmitter Calculations

The power density calculations for standalone transmitters at an exposure separation distance of 20 cm are shown in Table 9 per the transmit power and antenna gain values declared in Table 8.

For frequency dependent limits, the lowest transmitter frequency was used to represent the lowest MPE limit (e.g. 826.6MHz = 0.551 mW/cm<sup>2</sup>).

The WWAN power levels listed represent the worst-case values for the corresponding frequency ranges given.

**Table 5 WWAN and WLAN Standalone MPE Calculations**

Module Model	Techno-logy	Frequency (MHz)	Maximum Conducted Power (dBm)	Conducted Power (W)	Maximum Antenna Gain (dBi)	Duty Cycle	Average EIRP (dBm)	Average EIRP (W)	Power Density @ 20cm (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )
FC20-N	2.4G WIFI	2412 ~ 2462	16.5	0.04467	3	100%	19.5	0.08913	0.018	1
EC25-A	UMTS Band II	1850 – 1910	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	UMTS Band IV	1710 – 1755	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	UMTS Band V	824 – 849	24.0	0.25119	10.0	100%	34.0	2.51189	0.500	0.549
	LTE Band II	1850 – 1910	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	LTE Band IV	1710 – 1755	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	LTE Band XII	2500 – 2570	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
EC21-A	UMTS Band II	1850 – 1910	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	UMTS Band IV	1710 – 1755	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1

	UMTS Band V	824 – 849	24.0	0.25119	10.0	100%	34.0	2.51189	0.500	0.549
	LTE Band II	1850 – 1910	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	LTE Band IV	1710 – 1755	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	LTE Band XII	2500 – 2570	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
EC25- V	LTE Band IV	1850 – 1910	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	LTE Band X III	777 – 787	24.0	0.25119	10.0	100%	34.0	2.51189	0.500	0.518
EC21- V	LTE Band IV	1850 – 1910	24.0	0.25119	12.0	100%	36.0	3.98107	0.792	1
	LTE Band X III	777 – 787	24.0	0.25119	10.0	100%	34.0	2.51189	0.500	0.518



## 10.2 Collocated MPE Calculations

Per OET 65, when RF sources have difference frequencies, the fraction of the FCC power density limit shall be determined and the sum of all fractional components shall be less than 1.

**Table 6 Collocation Power Density**

Module Model	Technology	Frequency Band	WLAN Pd (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	(WLAN Pd) / (MPE Limit)	850 MHz WWAN Pd (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	(WWAN 850 MHz) / MPE Limit	(850 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
EC25-A	UMTS Band II	1850 – 1910	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	UMTS Band IV	1710 – 1755	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	UMTS Band V	824 – 849	0.018	1	0.018	0.500	0.549	0.911	0.929	1	Pass
	LTE Band II	1850 – 1910	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	LTE Band IV	1710 – 1755	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	LTE Band XII	2500 – 2570	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
EC21-A	UMTS Band II	1850 – 1910	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	UMTS Band IV	1710 – 1755	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	UMTS Band V	824 – 849	0.018	1	0.018	0.500	0.549	0.911	0.929	1	Pass
	LTE Band II	1850 – 1910	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	LTE Band IV	1710 – 1755	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	LTE Band XII	2500 – 2570	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
EC25-V	LTE Band IV	1850 – 1910	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	LTE Band XIII	777 – 787	0.018	1	0.018	0.500	0.518	0.965	0.983	1	Pass
EC21-V	LTE Band IV	1850 – 1910	0.018	1	0.018	0.792	1	0.792	0.810	1	Pass
	LTE Band XIII	777 – 787	0.018	1	0.018	0.500	0.518	0.965	0.983	1	Pass