




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

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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 ²) | Averaging Time (minutes) |
| 0.3-1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34-30 | 824/f | 2.19/f | *(180/f ²) | 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/cm²)

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)

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/cm²)

MPE limit for general population exposure at prediction frequency: 1.0 (mW/cm²)

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

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% |

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|--------|---------------|-------------|----|---------|----|------|
| 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/cm²).

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 ²) | FCC MPE Limit (mW/cm ²) |
|--------------|--------------|-----------------|-------------------------------|---------------------|----------------------------|------------|--------------------|------------------|--|-------------------------------------|
| 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 ²) | FCC MPE Limit (mW/cm ²) | (WLAN Pd) / (MPE Limit) | 850 MHz WWAN Pd (mW/cm ²) | FCC MPE Limit (mW/cm ²) | (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 |