




RF EXPOSURE REPORT



Report No.: 16050024-FCC-H

| | | |
|--|---|---|
| Applicant | Quectel Wireless Solutions Co., Ltd. | |
| Product Name | GSM/GPRS/GNSS Module | |
| Model No. | MC60 | |
| Serial No. | N/A | |
| Test Standard | FCC 2.1091:2015 | |
| Test Date | August 24 to September 22, 2016 | |
| Issue Date | October 7, 2016 | |
| 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 Luo 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 |
|----------------|----------------|-------------------------------------|--------------------|
| 16050024-FCC-H | NONE | Original | September 23, 2016 |
| 16050024-FCC-H | V1 | Added the describes of antenna type | September 30, 2016 |
| 16050024-FCC-H | V2 | Re-evaluating of BT MPE | October 7, 2016 |
| | | | |
| | | | |

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: | GSM/GPRS/GNSS Module |
| Main Model: | MC60 |
| Serial Model: | N/A |
| Antenna Gain: | <p>GSM850: 1dBi PCS1900: 1dBi (Note: The GSM radio module will be sold without antenna, this antenna only used limited to ERP/EIRP or radiated spurious emission test.) Bluetooth:1dBi</p> |
| Antenna Type : | <p>GSM : External antenna BT: Chip antenna</p> |
| Input Power: | Spec: DC 4.0V |
| Trade Name : | Quectel |
| Type of Modulation: | <p>GSM / GPRS: GMSK Bluetooth: GFSK, π /4DQPSK, 8DPSK</p> |
| RF Operating Frequency (ies): | <p>GSM850 TX: 824.2 ~ 848.8 MHz; RX: 869.2 ~ 893.8 MHz PCS1900 TX: 1850.2 ~ 1909.8 MHz; RX: 1930.2 ~ 1989.8 MHz Bluetooth: 2402-2480 MHz</p> |
| Number of Channels: | <p>GSM 850: 124CH PCS1900: 299CH Bluetooth: 79CH</p> |
| FCC ID: | XMR201609MC60 |

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

6.1 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

| 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

6.2 Test Result

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)

GSM Mode:

| Burst Average Power (dBm); | | | | | | | | |
|---|--------|--------------|-------|---------------------------|---------|--------------|--------|------------------------------|
| Band | GSM850 | | | | PCS1900 | | | |
| Channel | 128 | 190 | 251 | Tune up Power tolerant | 512 | 661 | 810 | Tune up Power tolerant |
| Frequency (MHz) | 824.2 | 836.6 | 848.8 | / | 1850.2 | 1880 | 1909.8 | / |
| GSM Voice (1 uplink),GMSK | 31.22 | 31.38 | 31.25 | 31.75±0.75 | 28.66 | 28.69 | 28.64 | 28.75±0.75 |
| GPRS Multi-Slot Class 8 (1 uplink),GMSK | 31.22 | 31.37 | 31.23 | 31.75±0.75 | 28.66 | 28.67 | 28.64 | 28.75±0.75 |
| GPRS Multi-Slot Class 10 (2 uplink) GMSK | 30.51 | 31.31 | 31.19 | 30.5±1 | 28.6 | 28.6 | 28.53 | 28.75±0.75 |
| GPRS Multi-Slot Class 12 (4 uplink) GMSK | 30.2 | 30.01 | 29.90 | 29.5±1 | 28.51 | 28.52 | 28.45 | 28.75±0.75 |

Remark :

GPRS, CS1 coding scheme.

Multi-Slot Class 8 , Support Max 4 downlink, 1 uplink , 5 working link

Multi-Slot Class 10 , Support Max 4 downlink, 2 uplink , 5 working link

Multi-Slot Class 12 , Support Max 4 downlink, 4 uplink , 5 working link

| Band | Source Based time Average Power (dBm) | | | | | | | | | |
|--|---------------------------------------|-------|-------|---------------------|------------------------|---------|-------|--------|---------------------|------------------------|
| | GSM850 | | | | | PCS1900 | | | | |
| Channel | 128 | 190 | 251 | Time Average factor | Tune up Power tolerant | 512 | 661 | 810 | Time Average factor | Tune up Power tolerant |
| Frequency (MHz) | 824.2 | 836.6 | 848.8 | / | / | 1850.2 | 1880 | 1909.8 | / | / |
| GSM Voice (1 uplink),GMSK | 22.19 | 22.35 | 22.22 | -9.03 | 22.75±0.75 | 19.63 | 19.66 | 19.61 | -9.03 | 19.75±0.75 |
| GPRS Multi-Slot Class 8 (1 uplink),GMSK | 22.19 | 22.34 | 22.20 | -9.03 | 22.75±0.75 | 19.63 | 19.64 | 19.61 | -9.03 | 19.75±0.75 |
| GPRS Multi-Slot Class 10 (2 uplink) GMSK | 24.49 | 25.29 | 25.17 | -6.02 | 24.5±1 | 22.58 | 22.58 | 22.51 | -6.02 | 22.75±0.75 |
| GPRS Multi-Slot Class 12 (4 uplink) GMSK | 27.19 | 27.00 | 26.89 | -3.01 | 26.5±1 | 25.50 | 25.51 | 25.44 | -3.01 | 25.75±0.75 |

Remark :

GPRS, CS1 coding scheme.

Multi-Slot Class 8 , Support Max 4 downlink, 1 uplink , 5 working link

Multi-Slot Class 10 , Support Max 4 downlink, 2 uplink , 5 working link

Multi-Slot Class 12 , Support Max 4 downlink, 4 uplink , 5 working link

Bluetooth Mode:

| Type | Test mode | CH | Freq (MHz) | Conducted Power (dBm) | Tune Up Power (dBm) |
|--------------|------------|------|------------|-----------------------|---------------------|
| Output power | GFSK | Low | 2402 | 5.938 | 6.5±1 |
| | | Mid | 2441 | 5.976 | 6.5±1 |
| | | High | 2480 | 5.770 | 6.5±1 |
| | π /4 DQPSK | Low | 2402 | 5.092 | 5±1 |
| | | Mid | 2441 | 5.102 | 5±1 |
| | | High | 2480 | 4.796 | 5±1 |
| | 8DPSK | Low | 2402 | 5.082 | 5±1 |
| | | Mid | 2441 | 5.270 | 5±1 |
| | | High | 2480 | 5.099 | 5±1 |

For Max allowed antenna calculate

Step 1 ERP/EIRP calculate:

| Frequency bands | Max Turn-up Conducted power (dBm) | ERP/EIRP Limit (dBm) | Margin (dB) |
|-----------------|-----------------------------------|----------------------|-------------|
| GSM 850 | 32.5 | 38.45 | 5.95 |
| PCS 1900 | 29.5 | 33.00 | 3.50 |

Step 2 MPE calculate:

| Frequency bands | Max Turn-up Conducted Source Based time Average Power (dBm) | Max Turn-up Conducted Source Based time Average Power (mw) | Distance (cm) | Power Density Limit (mW/cm ²) | Max allow antenna gain (dBi) |
|-----------------|---|--|---------------|---|------------------------------|
| GSM 850 | 27.5 | 562.34 | 20 | 0.549 | 6.91 |
| PCS 1900 | 26.5 | 446.68 | 20 | 1 | 10.51 |

Step 3:

If meet above step 1 and 2, the Max allows antenna gain show is below:

| Frequency bands | Max allow antenna gain (dBi) |
|-----------------|------------------------------|
| GSM 850 | 5.95 |
| PCS 1900 | 3.50 |

Note:

Single Modular Approval.

Output power is conducted. This device is to be used in mobile or fixed applications only. Antenna gain including cable loss must not exceed 5.95dBi of 824.2 ~ 848.8 MHz and 3.50dBi of 1850.2 ~ 1909.8 MHz for the purpose of satisfying the requirements of 2.1043 and 2.1091. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operated in conjunction with any antenna or transmitter not described under this FCC ID. The final product operating with this transmitter must include operating instructions and antenna installation instructions, for end-users and installers to satisfy RF exposure compliance requirements. Compliance of this device in all final product configurations is the responsibility of the Grantee. Installation of this device into specific final products may require the submission of a Class II permissive change application containing data pertinent to RF Exposure, spurious emissions, ERP/EIRP, and host/module authentication, or new application if appropriate. Installation of this device into specific final products may require the submission of a Class II permissive change application containing data pertinent to RF Exposure, spurious emissions, ERP/EIRP, and host/module authentication, or new application if appropriate.

MPE:

| Frequency bands | Max. Turn-up Conducted power (dBm) | Max. allow antenna gain (dBi) | Max. ERP/EIRP | Exemption Limit of RF Exposure Evaluation | Result(if Exemption or not) |
|-----------------|--|-------------------------------------|---------------|---|-----------------------------------|
| GSM 850 | 32.5 | 5.95 | 38.45 | 31.76 | NO |
| PCS 1900 | 29.5 | 3.50 | 33 | 34.77 | Yes |

FCC Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

(c)(1) Mobile devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Services pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if:

(i) They operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or

(ii) They operate at frequencies above 1.5 GHz and their ERP is 3 watts or more

MPE:

GSM850

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

Max Turn-up Conducted Source Based time Average Power (dBm) at antenna input terminal:
27.5 (dBm)

Maximum output power at antenna input terminal: 562.4(mW)

Prediction distance: >20 (cm)

Predication frequency: 824.2 (MHz) Low frequency

Antenna Gain (typical): 5.95 (dBi)

Antenna Gain (typical): 3.936 (numeric)

The worst case is power density at predication frequency at 20 cm: 0.44(mW/cm²)

MPE limit for general population exposure at prediction frequency: 0.56(mW/cm²)

$0.44(\text{mW}/\text{cm}^2) < 0.56 (\text{mW}/\text{cm}^2)$

Result: Pass

BT

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: 7.5 (dBm)

Maximum output power at antenna input terminal: 5.62 (mW)

Prediction distance: >20 (cm)

Predication frequency: 2441 (MHz) Low frequency

Antenna Gain (typical): 1.0 (dBi)

Antenna Gain (typical): 1.259 (numeric)

The worst case is power density at predication frequency at 20 cm: 0.0014 (mW/cm²)

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

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0.0014 (mW/cm²) < 1.0 (mW/cm²)

Result: Pass