# RF Exposure Evaluation Declaration

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|---|---|
| **FCC ID:** | XMR2023EM160RGL |
| **Applicant:** | Quectel Wireless Solutions Co., Ltd |
| **Product:** | LTE-A Cat 16 M.2 Module |
| **Model No.:** | EM160R-GL |
| **Brand Name:** | Quectel |
| **FCC Rule Part(s):** | FCC Part 2.1091 |
| **Result:** | Complies |

**Reviewed By:** Sunny Sun

**Approved By:** Robin Wu

## Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 2306RSU048-U13 | Rev. 01 | Initial Report | 2023-07-14 | Valid |
| | | | | |

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# 1. General Information

## 1.1. Applicant

Quectel Wireless Solutions Co., Ltd

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

## 1.2. Manufacturer

Quectel Wireless Solutions Co., Ltd

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

## 1.3. Testing Facility

| | | | | | |
|---|---|---|---|---|---|
| ☒ | **Test Site – MRT Suzhou Laboratory** | | | | |
| | **Laboratory Location (Suzhou - Wuzhong)**<br>D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China<br>**Laboratory Location (Suzhou - SIP)**<br>4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China | | | | |
| | **Laboratory Accreditations** | | | | |
| | A2LA: 3628.01 | | CNAS: L10551 | | |
| | FCC: CN1166 | | ISED: CN0001 | | |
| | VCCI: | ☐R-20025 | ☐G-20034 | ☐C-20020 | ☐T-20020 |
| | | ☐R-20141 | ☐G-20134 | ☐C-20103 | ☐T-20104 |
| ☐ | **Test Site – MRT Shenzhen Laboratory** | | | | |
| | **Laboratory Location (Shenzhen)**<br>1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China | | | | |
| | **Laboratory Accreditations** | | | | |
| | A2LA: 3628.02 | | CNAS: L10551 | | |
| | FCC: CN1284 | | ISED: CN0105 | | |
| ☐ | **Test Site – MRT Taiwan Laboratory** | | | | |
| | **Laboratory Location (Taiwan)**<br>No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) | | | | |
| | **Laboratory Accreditations** | | | | |
| | TAF: L3261-190725 | | | | |
| | FCC: 291082, TW3261 | | ISED: TW3261 | | |

### 1.4. Product Information

| | |
|---|---|
| Product Name: | LTE-A Cat 16 M.2 Module |
| Model No.: | EM160R-GL |
| Brand Name: | Quectel |
| IMEI: | 86292050003514 |
| WCDMA Band: | Band II, Band IV, Band V |
| Single Band: | Band 2, 4, 5, 7, 12, 13, 14, 25, 26, 30, 38, 41, 48, 66 |
| Intra-Band: | CA_41C |
| Category: | Category 16 |
| Operating Temperature: | -25 ~ 75 °C |
| Power Type: | 3.1 ~ 4.4Vdc, typical 3.7Vdc |
| Remark: The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. | |

### 1.5. Description of Available Antennas

| Technology | Frequency Range (MHz) | Antenna Type | Max Peak Gain (dBi) |
|---|---|---|---|
| WCDMA & LTE Band 2 | 1850 ~ 1910 | Dipole | 1.15 |
| WCDMA & LTE Band 4 | 1710 ~ 1755 | | -0.50 |
| WCDMA & LTE Band 5 | 824 ~ 849 | | 1.85 |
| LTE Band 7 | 2500 ~ 2570 | | 1.32 |
| LTE Band 12 | 699 ~ 716 | | -2.43 |
| LTE Band 13 | 777 ~ 787 | | -0.10 |
| LTE Band 14 | 788 ~ 798 | | 2.40 |
| LTE Band 25 | 1850 ~ 1915 | | 1.15 |
| LTE Band 26 | 814 ~ 849 | | 1.85 |
| LTE Band 30 | 2305 ~ 2315 | | -3.64 |
| LTE Band 38 | 2570 ~ 2620 | | 0.93 |
| LTE Band 41 | 2496 ~ 2690 | | 0.93 |
| LTE Band 48 | 3550 ~ 3700 | | -3.37 |
| LTE Band 66 | 1710 ~ 1780 | | -0.50 |

Note: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer.

### 1.6. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 2.1091 & KDB 447498 D04 Interim General RF Exposure Guidance v01

# 2. RF Exposure Evaluation

## 2.1. Test Limits

According to FCC §1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in §1.1307(b)

Limits For Maximum Permissible Exposure (MPE)

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density ($mW/cm^2$) | Average Time (Minutes) |
|---|---|---|---|---|
| (A) Limits for Occupational/ Control Exposures | | | | |
| 0.3-3.0 | 614 | 1.63 | *(100) | ≤6 |
| 3.0-30 | 1842/f | 4.89/f | *($900/f^2$) | <6 |
| 30-300 | 61.4 | 0.163 | 1.0 | <6 |
| 300-1,500 | -- | -- | f/300 | <6 |
| 1,500-100,000 | -- | -- | 5 | <6 |
| (B) Limits for General Population/ Uncontrolled Exposures | | | | |
| 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 |
| 300-1,500 | -- | -- | f/1500 | <30 |
| 1,500-100,000 | -- | -- | 1.0 | <30 |

f= frequency in MHz. * = Plane-wave equivalent power density.

### 2.2. MPE Exemptions

**For single RF sources** (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph §1.1307(b)(2) of this section): A single RF source is exempt if:

**(Option A)** The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph §1.1307(b)(3)(ii)(A) of this section.
Medical implant devices may only use this exemption and that in paragraph §1.1307(b)(3)(ii)(A);

**(Option B)** Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P is given by:

$P\,th(mW) = \{ERP_{20cm}(d\ /\ 20cm)^{x}$ d ≤ 20cm

$P\,th(mW) = \{ERP_{20cm}$ 20cm < d ≤ 40cm

Where

$x = -log_{10}\left(\frac{60}{ERP_{20cm}\sqrt{f}}\right)$ and f is in GHz;

and

$ERP_{20cm}(mW) = \{2040f$ 0.3GHz ≤ f < 1.5GHz

$ERP_{20cm}(mW) = \{3060$ 1.5GHz ≤ f ≤ 6GHz

**(Option C)** Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to §1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

| RF Source Frequency (MHz) | Threshold ERP (watts) |
|---|---|
| 0.3-1.34 | $1920R^2$ |
| 1.34-30 | $3450R^2/f^2$ |
| 30-300 | $3.83R^2$ |
| 300-1,500 | $0.0128R^2/f$ |
| 1,500-100,000 | $19.2R^2$ |

**For multiple RF sources:** Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph §1.1307(b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph §1.1307(b)(3)(i)(A).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Where:

***a*** = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(B) of this section for $P_{th}$, including existing exempt transmitters and those being added.

***b*** = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

***c*** = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

$\boldsymbol{P_i}$ = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source *i* at a distance between 0.5 cm and 40 cm (inclusive).

$\boldsymbol{P_{th,i}}$ = the exemption threshold power ($P_{th}$) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed,

mobile, or portable RF source *i*.

***ERP$_j$*** = the ERP of fixed, mobile, or portable RF source *j*.

***ERP$_{th,j}$*** = exemption threshold ERP for fixed, mobile, or portable RF source *j*, at a distance of at least λ/2π according to the applicable formula of paragraph §1.1307(b)(3)(i)(C) of this section.

***Evaluated$_k$*** = the maximum reported SAR or MPE of fixed, mobile, or portable RF source *k* either in the device or at the transmitter site from an existing evaluation at the location of exposure.

***Exposure Limit$_k$*** = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source *k*, as applicable from §1.1310 of this chapter.

### 2.3. Device Classification

According to the user manual, the antenna of this device is at least 20cm away from the body of the user, this device is classified as a Mobile Device. So, the RF exposure evaluation requirements of § 2.1091 for mobile device exposure conditions subject to MPE limits.

### 2.4. Calculated Result

| | |
|---|---|
| Product | LTE-A Cat 16 M.2 Module |
| Test Item | RF Exposure Evaluation |

**For single RF source, Option B**

| Test Mode | Frequency Band (MHz) | Max Tune-up Power (dBm) | Max ERP (mW) | Threshold Power at 20cm (mW) | Max Antenna Gain per $P_{th}$ |
|---|---|---|---|---|---|
| WCDMA / LTE Band 2 | 1850 ~ 1910 | 25.00 | 251.1886 | 3060.0 | 12.0 |
| WCDMA / LTE Band 4 | 1710 ~ 1755 | 25.00 | 171.7908 | 3060.0 | 12.0 |
| WCDMA / LTE Band 5 | 824 ~ 849 | 25.00 | 295.1209 | 1681.0 | 9.4 |
| LTE Band 7 | 2500 ~ 2570 | 25.00 | 261.2161 | 3060.0 | 12.0 |
| LTE Band 12 | 699 ~ 716 | 25.00 | 110.1539 | 1426.0 | 8.7 |
| LTE Band 13 | 777 ~ 787 | 25.00 | 188.3649 | 1585.1 | 9.2 |
| LTE Band 14 | 788 ~ 798 | 25.00 | 334.9654 | 1607.5 | 9.2 |
| LTE Band 25 | 1850 ~ 1915 | 25.00 | 251.1886 | 3060.0 | 12.0 |
| LTE Band 26 | 814~849 | 25.00 | 295.1209 | 1660.6 | 9.4 |
| LTE Band 30 | 2305 ~ 2315 | 25.00 | 83.3681 | 3060.0 | 12.0 |
| LTE Band 38 | 2570 ~ 2620 | 25.00 | 238.7811 | 3060.0 | 12.0 |
| LTE Band 41 | 2496 ~ 2690 | 26.50 | 337.2873 | 3060.0 | 10.5 |
| LTE Band 48 | 3550 ~ 3700 | 25.00 | 88.7156 | 3060.0 | 12.0 |
| LTE Band 66 | 1710 ~ 1780 | 25.00 | 171.7908 | 3060.0 | 12.0 |

Remark:

1. The Max Tune-up power is extracted from the Modular tune-up power.
2. The compliance distance is extracted from the user manual.
3. The Max ERP (dBm) = Max Conducted Total Power (dBm) + Antenna Gain (dBi) - 2.15.

The End