



RF Exposure Evaluation Declaration

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 Classification: Digital Transmission System
FCC Rule Part(s): FCC Part 2.1091
Evaluation Date: 2024-01-30
Result: Complies

Reviewed By:

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Approved By:

Robin Wu



The test results relate only to the samples tested.
The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.
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Revision History

Report No.	Version	Description	Issue Date	Note
2401RSU007-U4	V01	Initial Report	2024-01-30	Valid

CONTENTS

Description	Page
1. General Information	4
1.1. Applicant.....	4
1.2. Manufacturer	4
1.3. Testing Facility.....	4
1.4. Product Information	5
1.5. Antenna Details.....	6
1.6. Device Classification	6
1.7. Applied Standards	6
2. RF Exposure Evaluation.....	7
1.8. Test Limits	7
1.9. MPE Exemptions.....	8
1.10. Calculated Result	11

1.4. Product Information

Product Name	LTE-A Cat 16 M.2 Module
Model No.	EM160R-GL
Brand Name	QUECTEL
3GPP Specification	WCDMA: Band II/IV/V LTE: 2/4/5/7/12/13/14/25/26/30/38/41/42/43/48/66
Operating Temperature	-25 ~ 75 °C
Supply Voltage	3.1 ~ 4.4Vdc, typical 3.7Vdc
Remark: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	

1.5. Antenna Details

Technology	Frequency Range (MHz)	Antenna Type	Model	Max Peak Gain (dBi)
WCDMA & LTE Band 2	1850 ~ 1910	PIFA	Y0QUE00ABAA	3.87
WCDMA & LTE Band 4	1710 ~ 1755		Y0QUE00ABAA	3.91
WCDMA & LTE Band 5	824 ~ 849		Y0QUE00ABBA	3.32
LTE Band 7	2500 ~ 2570		Y0QUE00ABBA	3.16
LTE Band 12	699 ~ 716		Y0QUE00ABDA	3.19
LTE Band 13	777 ~ 787		Y0QUE00ABBA	3.28
LTE Band 14	788 ~ 798		Y0QUE00ABBA	3.25
LTE Band 25	1850 ~ 1915		Y0QUE00ABAA	3.87
LTE Band 26	814 ~ 849		Y0QUE00ABBA	3.32
LTE Band 30	2305 ~ 2315		Y0QUE00ABCA	0.98
LTE Band 38	2570 ~ 2620		Y0QUE00ABBA	3.07
LTE Band 41	2496 ~ 2690		Y0QUE00ABBA	3.16
LTE Band 42	3400 ~ 3600		Y0QUE00ABDA	2.35
LTE Band 43	3600 ~ 3800		Y0QUE00ABDA	1.94
LTE Band 48	3550 ~ 3700		Y0QUE00ABCA	1.00
LTE Band 66	1710 ~ 1780		Y0QUE00ABAA	3.91

Note 1: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer.

Note 2: The typical antennas used to calculate the ERP (EIRP).

1.6. 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.

1.7. 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

1.8. 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.

1.9. 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:

$$P_{th}(mW) = \{ERP_{20cm}(d / 20cm)^x \quad d \leq 20cm$$

$$P_{th}(mW) = \{ERP_{20cm} \quad 20cm < d \leq 40cm$$

Where

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

and

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

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

(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 $\lambda/2\pi$, 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 $\lambda/4$ 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 in 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.

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).

$P_{th,i}$ = 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 $\lambda/2\pi$ 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.

1.10. 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 II	1850 ~ 1910	25.0	469.8941	3060.0	12.0
WCDMA IV	1710 ~ 1755	25.0	474.2420	3060.0	12.0
WCDMA V	824 ~ 849	25.0	413.9997	1681.0	9.4
LTE Band 2	1850 ~ 1910	25.0	469.8941	3060.0	12.0
LTE Band 4	1710 ~ 1755	25.0	474.2420	3060.0	12.0
LTE Band 5	824 ~ 849	25.0	413.9997	1681.0	9.4
LTE Band 7	2500 ~ 2570	25.0	399.0249	3060.0	12.0
LTE Band 12	699 ~ 716	25.0	401.7908	1426.0	8.7
LTE Band 13	777 ~ 787	25.0	410.2041	1585.1	9.2
LTE Band 14	788 ~ 798	25.0	407.3803	1607.5	9.2
LTE Band 25	1850 ~ 1915	25.0	469.8941	3060.0	12.0
LTE Band 26	814~849	25.0	413.9997	1660.6	9.4
LTE Band 30	2305 ~ 2315	23.0	152.4053	3060.0	14.0
LTE Band 38	2570 ~ 2620	25.0	390.8409	3060.0	12.0
LTE Band 41	2496 ~ 2690	26.5	563.6377	3060.0	10.5
LTE Band 42	3450 ~ 3550	22.0	165.9587	3060.0	15.0
LTE Band 43	3700 ~ 3800	22.0	149.9685	3060.0	15.0
LTE Band 42	3550 ~ 3600	22.0	165.9587	3060.0	15.0
LTE Band 43	3600 ~ 3700	22.0	149.9685	3060.0	15.0
LTE Band 48	3550 ~ 3700	22.0	121.6186	3060.0	15.0
LTE Band 66	1710 ~ 1780	25.0	474.2420	3060.0	12.0
WiFi 2.4GHz	2412 ~ 2462	20.0	192.7525	3060.0	17.0
WiFi 5GHz	5150 ~ 5825	25.0	609.5369	3060.0	12.0
Bluetooth	2402 ~ 2480	15.0	60.9537	3060.0	22.0

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 Tune-up Power (dBm) + Antenna Gain (dBi) - 2.15.
4. This product does not support WiFi, BLE, the report is only used for calculation.

For multiple RF sources

The EUT supports WWAN + Wi-Fi 2.4GHz or Wi-Fi 5GHz + BLE simultaneous transmissions. The worst-case combination is WWAN + Wi-Fi 5GHz + BLE.

So, the Max Simultaneous Transmission = $563.6377/3060$ (WANN) + $609.5369/3060$ (NII) + $60.9537/3060$ (BLE) = $0.4033 < 1$

Therefore, the device qualifies for RF exposure test exemption.

The End
