



RF Exposure Evaluation Declaration

FCC ID: XMR2022RG520NNA
Applicant: Quectel Wireless Solutions Co., Ltd
Product: 5G Sub-6 GHz LGA Module
Model No.: RG520N-NA
Brand Name: Quectel
FCC Rule Part(s): FCC Part 2.1091
Result: Complies

Reviewed By:

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Approved By:

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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
2209RSU052-U2	Rev. 01	Initial Report	2022-10-23	Valid

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1.4. Product Information

Product Name	5G Sub-6 GHz LGA Module
Model No.	RG520N-NA
Brand Name	Quectel
E-UTRA Band	Band 2, 4, 5, 7, 12, 13, 14, 17, 25, 26, 30, 38, 41, 48, 66, 71
5G NR Band	n2, n5, n7, n12, n13, n14, n25, n26, n30, n38, n41, n48, n66, n71, n77, n78
Operating Temperature	-30 ~ 75 °C
Power Type	3.3 ~ 4.4Vdc, typical 3.8Vdc
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. Antenna Details

Technology	Frequency Range (MHz)	Antenna Type	Max Peak Gain (dBi)
Band 2	1850 ~ 1910	Dipole	1.37
Band 4	1710 ~ 1755		1.37
Band 5	824 ~ 849		1.18
Band 7	2500 ~ 2570		2.07
Band 12	699 ~ 716		1.18
Band 13	777 ~ 787		1.18
Band 14	788 ~ 798		1.18
Band 17	704~ 716		1.18
Band 25	1850 ~ 1915		1.37
Band 26	814~849		1.18
Band 30	2305 ~ 2315		1.11
Band 38	2570 ~ 2620		2.07
Band 41	2496 ~ 2690		2.07
Band 48	3550 ~ 3700		0.58
Band 66	1710 ~ 1780		1.37
Band 71	663 ~ 698		1.18
Band 77/78	3450 ~ 3550		0.58
	3700 ~ 3980		

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:

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

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

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.

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	5G Sub-6 GHz LGA Module
Test Item	RF Exposure Evaluation

Test Mode	Frequency Band (MHz)	Max Conducted Power (dBm)	Antenna Gain (dBi)	Max ERP (dBm)
LTE / NR Band 2	1850 ~ 1910	25.00	1.37	24.22
LTE Band 4	1710 ~ 1755	25.00	1.37	24.22
LTE / NR Band 5	824 ~ 849	25.00	1.18	24.03
LTE / NR Band 7	2500 ~ 2570	25.00	2.07	24.92
LTE / NR Band 12	699 ~ 716	25.00	1.18	24.03
LTE / NR Band 13	777 ~ 787	25.00	1.18	24.03
LTE / NR Band 14	788 ~ 798	25.00	1.18	24.03
LTE Band 17	704~ 716	25.00	1.18	24.03
LTE / NR Band 25	1850 ~ 1915	25.00	1.37	24.22
LTE / NR Band 26	814~849	25.00	1.18	24.03
LTE / NR Band 30	2305 ~ 2315	25.00	1.11	23.96
LTE / NR Band 38	2570 ~ 2620	28.00	2.07	27.92
LTE / NR Band 41	2496 ~ 2690	28.00	2.07	27.92
LTE / NR Band 48	3550 ~ 3700	25.00	0.58	23.43
LTE / NR Band 66	1710 ~ 1780	25.00	1.37	24.22
LTE / NR Band 71	663 ~ 698	25.00	1.18	24.03
n77/78	3450 ~ 3550 3700 ~ 3980	28.00	0.58	26.43

Remark:

1. The Max Conducted power was extracted from the Modular tune-up power.
2. The Max ERP (dBm) = Max Conducted Total Power (dBm) + Antenna Gain (dBi) - 2.15.

For single RF source, Option C

Test Mode	Frequency Band (MHz)	$\lambda / 2 \pi$ (m)	R (m)	Max ERP (W)	Threshold ERP (W)
LTE / NR Band 2	1850 ~ 1910	0.0258	0.30	0.2642	1.7280
LTE Band 4	1710 ~ 1755	0.0279	0.30	0.2642	1.7280
LTE / NR Band 5	824 ~ 849	0.0579	0.30	0.2529	0.9492
LTE / NR Band 7	2500 ~ 2570	0.0191	0.30	0.3105	1.7280
LTE / NR Band 12	699 ~ 716	0.0683	0.30	0.2529	0.8052
LTE / NR Band 13	777 ~ 787	0.0614	0.30	0.2529	0.8951
LTE / NR Band 14	788 ~ 798	0.0606	0.30	0.2529	0.9078
LTE Band 17	704 ~ 716	0.0678	0.30	0.2529	0.8110
LTE / NR Band 25	1850 ~ 1915	0.0258	0.30	0.2642	1.7280
LTE / NR Band 26	814 ~ 849	0.0587	0.30	0.2529	0.9377
LTE / NR Band 30	2305 ~ 2315	0.0207	0.30	0.2489	1.7280
LTE / NR Band 38	2570 ~ 2620	0.0186	0.30	0.6194	1.7280
LTE / NR Band 41	2496 ~ 2690	0.0191	0.30	0.6194	1.7280
LTE / NR Band 48	3550 ~ 3700	0.0134	0.30	0.2203	1.7280
LTE / NR Band 66	1710 ~ 1780	0.0279	0.30	0.2642	0.7638
LTE / NR Band 71	663 ~ 698	0.0720	0.30	0.2529	1.7280
n77/78	3450 ~ 3550 3700 ~ 3980	0.0129	0.30	0.4395	1.7280
Remark: R is from user manual.					

For multiple RF source, Option C

Test Mode	Frequency Band (MHz)	Max ERP (W)	Threshold ERP (W)	Exposure Ratio
LTE / NR Band 2	1850 ~ 1910	0.2642	1.7280	0.1529
LTE Band 4	1710 ~ 1755	0.2642	1.7280	0.1529
LTE / NR Band 5	824 ~ 849	0.2529	0.9492	0.2664
LTE / NR Band 7	2500 ~ 2570	0.3105	1.7280	0.1797
LTE / NR Band 12	699 ~ 716	0.2529	0.8052	0.3141
LTE / NR Band 13	777 ~ 787	0.2529	0.8951	0.2825
LTE / NR Band 14	788 ~ 798	0.2529	0.9078	0.2786
LTE Band 17	704 ~ 716	0.2529	0.8110	0.3118
LTE / NR Band 25	1850 ~ 1915	0.2642	1.7280	0.1529
LTE / NR Band 26	814 ~ 849	0.2529	0.9377	0.2697
LTE / NR Band 30	2305 ~ 2315	0.2489	1.7280	0.1440
LTE / NR Band 38	2570 ~ 2620	0.6194	1.7280	0.3584
LTE / NR Band 41	2496 ~ 2690	0.6194	1.7280	0.3584
LTE / NR Band 48	3550 ~ 3700	0.2203	1.7280	0.1275
LTE / NR Band 66	1710 ~ 1780	0.2642	0.7638	0.3459
LTE / NR Band 71	663 ~ 698	0.2529	1.7280	0.1464
n77/78	3450 ~ 3550 3700 ~ 3980	0.4395	1.7280	0.2543

Remark: R is from user manual.

Max LTE Exposure Ratio	Max NR Exposure Ratio	Σ (Exposure Ratio)
0.3584	0.3584	0.7168

Note:

1. For collocation analysis, LTE 41 / n41 is chosen for summation due to the highest (power density / limit) among all WWAN wireless modes.
2. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter / antenna included in the simultaneous transmission) / (corresponding MPE limit)], for LTE + NR.
3. Considering the WWAN module collocation with the LTE and NR transmitter at EN-DC mode of the EIRP performance listed in the table above, the aggregated (Exposure Ratio) is smaller than 1, and MPE of 3 collocated transmitters is compliant.
4. The device qualifies for RF exposure test exemption.