



RF Exposure Evaluation Declaration

FCC ID: R68NTC551
Applicant: Lantronix, Inc.
Product: 5G Industrial IOT Router
Model No.: NTC-551
Brand Name: Lantronix
FCC Rule Part(s): FCC Part 2.1091
Result: Complies
Evaluation Date: 2024-02-02

Reviewed By:

Sunny Sun

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
2310RSU045-U10	V01	Initial Report	2024-02-02	Invalid
2310RSU045-U10	V02	Updated the cellular antenna gain	2024-02-07	Invalid
2310RSU045-U10	V03	Modify applicant & manufacturer information	2025-06-17	Valid

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1.4. Product Information

Product Name	5G Industrial IOT Router
Model No.	NTC-551
IMEI	863109050035497
GNSS Specification	GPS/Galileo/GLONASS/BDS
Bluetooth Specification	V4.0 single mode
Wi-Fi Specification	802.11a/b/g/n/ac/ax
3GPP Specification	LTE Band 2/4/5/7/12/13/14/17/25/26/29/30/38/41/42/43/46/48/66/71 NR SA/NSA Band n2/5/7/12/13/14/25/26/29/30/38/41/48/66/70/71/77/78
Temperature Operating Range	-30 ~ 70 °C
Power Supply Rating	8 ~ 40Vdc
Integrated WWAN Modular Information	
Modular Name	5G Sub-6 GHz LGA Module
Mode No.	RG520N-NA
FCC ID	XMR2023RG520NNA
Manufacturer	QUECTEL
Integrated Wi-Fi Modular Information	
Modular Name	Wi-Fi & Bluetooth Module
Mode No.	FC64E
FCC ID	XMR202208FC64E
Manufacturer	QUECTEL
Accessories	
AC/DC adapter	Model No.: AD0361-1203000F Input: 100V-240V~50-60Hz 1.0A Max Output: 12.0V=3.0A 36.0W
Remark:	
1. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	
2. The Bluetooth BLE function of the device is implemented by ESP32-D0WDQ6-V3 chipset.	

1.5. Antenna Details

■ WWAN Antenna

Technology	Frequency Range (MHz)	Antenna Type	Max Peak Gain (dBi)
LTE/NR Band 2	1850 ~ 1910	Dipole	-0.5
LTE Band 4	1710 ~ 1755		-0.5
LTE/NR Band 5	824 ~ 849		0.9
LTE/NR Band 7	2500 ~ 2570		-1.1
LTE/NR Band 12	699 ~ 716		-5.0
LTE/NR Band 13	777 ~ 787		-5.0
LTE/NR Band 14	788 ~ 798		0.9
LTE Band 17	704 ~ 716		-5.0
LTE/NR Band 25	1850 ~ 1915		-0.5
LTE/NR Band 26	814 ~ 849		0.9
LTE/NR Band 30	2305 ~ 2315		0.1
LTE/NR Band 38	2570 ~ 2620		-1.1
LTE/NR Band 41	2496 ~ 2690		-1.1
LTE Band 42	3450 ~ 3600		-2.4
LTE Band 43	3600 ~ 3800		-2.4
LTE/NR Band 48	3550 ~ 3700		-2.4
LTE/NR Band 66	1710 ~ 1780		-0.5
n70	1695 ~ 1710		-0.5
LTE/NR Band 71	663 ~ 698		-5.0
NR n77	3450 ~ 3980		-2.4
NR n78	3450 ~ 3800		-2.4

Note 1: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer, and the antenna does not market with device.

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

■ Wi-Fi Antenna

Technology	Frequency Range (MHz)	Antenna Type	Max Peak Gain (dBi)
2.4GHz Wi-Fi	2412 ~ 2462	Omni-Directional	9.0
5GHz Wi-Fi	5180 ~ 5825		9.0
BLE	2402 ~ 2480		5.0

Note: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer, and the antenna does not market with device.

1.6. Device Classification

According to the user manual, 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

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. Calculated Result

Product	5G Industrial IOT Router
Test Item	RF Exposure Evaluation

Test Mode	Frequency Band (MHz)	Tune-up Conducted Power (dBm)	Antenna Gain (dBi)	ERP (dBm)
LTE Band 2	1850 ~ 1910	25.0	-0.5	22.35
LTE Band 4	1710 ~ 1755	25.0	-0.5	22.35
LTE Band 5	824 ~ 849	25.0	0.9	23.75
LTE Band 7	2500 ~ 2570	25.0	-1.1	21.75
LTE Band 12	699 ~ 716	25.0	-5.0	17.85
LTE Band 13	777 ~ 787	25.0	-5.0	17.85
LTE Band 14	788 ~ 798	25.0	-5.0	17.85
LTE Band 17	704 ~ 716	25.0	-5.0	17.85
LTE Band 25	1850 ~ 1915	25.0	-0.5	22.35
LTE Band 26	814 ~ 824	25.0	0.9	23.75
LTE Band 30	2305 ~ 2315	25.0	0.1	22.95
LTE Band 38	2570 ~ 2620	28.0	-1.1	24.75
LTE Band 41	2496 ~ 2690	28.0	-1.1	24.75
LTE Band 42	3450 ~ 3550	22.5	-2.4	17.95
	3550 ~ 3600	25.0	-2.4	20.45
LTE Band 43	3600 ~ 3700	22.5	-2.4	17.95
	3700 ~ 3800	25.0	-2.4	20.45
LTE Band 48	3550 ~ 3700	22.5	-2.4	17.95
LTE Band 66	1710 ~ 1780	25.0	-0.5	22.35
LTE Band 71	663 ~ 698	25.0	-0.5	22.35
NR n2	1850 ~ 1910	25.0	-0.5	22.35
NR n5	824 ~ 849	25.0	0.9	23.75
NR n7	2500 ~ 2570	25.0	-1.1	21.75
NR n12	699 ~ 716	25.0	-5.0	17.85
NR n13	777 ~ 787	25.0	-5.0	17.85
NR n14	788 ~ 798	25.0	-5.0	17.85
NR n25	1850 ~ 1915	25.0	-0.5	22.35
NR n26	814 ~ 849	25.0	0.9	23.75
NR n30	2305 ~ 2315	25.0	0.1	22.95
NR n38	2570 ~ 2620	28.0	-1.1	24.75
NR n41	2496 ~ 2690	31.0	-1.1	27.75

NR n48	3550 ~ 3700	22.5	-2.4	17.95
NR n66	1710 ~ 1780	25.0	-0.5	22.35
NR n70	1695 ~ 1710	25.0	-0.5	22.35
NR n71	663 ~ 698	25.0	-0.5	22.35
NR n77/78	3450 ~ 3550	31.0	-2.4	26.45
NR n77/78	3700 ~ 3980	31.0	-2.4	26.45
802.11b/g/n/ax	2412 ~ 2462	27.0	9.0	33.85
802.11a/n/ac/ax	5180 ~ 5825	20.0	9.0	26.85
BLE	2402 ~ 2480	8.0	5.0	10.85

Note: Tune-up power was declared by manufacturer.

For single RF source, Option C

Test Mode	Frequency Band (MHz)	$\lambda / 2 \pi$ (m)	R (m)	ERP (mW)	Thresholds ERP (mW)
LTE Band 2	1850 ~ 1910	0.03	0.45	171.79	3888
LTE Band 4	1710 ~ 1755	0.03	0.45	171.79	3888
LTE Band 5	824 ~ 849	0.06	0.45	237.14	2136
LTE Band 7	2500 ~ 2570	0.02	0.45	149.62	3888
LTE Band 12	699 ~ 716	0.07	0.45	60.95	1812
LTE Band 13	777 ~ 787	0.06	0.45	60.95	2014
LTE Band 14	788 ~ 798	0.06	0.45	60.95	2042
LTE Band 17	704 ~ 716	0.07	0.45	60.95	1825
LTE Band 25	1850 ~ 1915	0.03	0.45	171.79	3888
LTE Band 26	814 ~ 824	0.06	0.45	237.14	2110
LTE Band 30	2305 ~ 2315	0.02	0.45	197.24	3888
LTE Band 38	2570 ~ 2620	0.02	0.45	298.54	3888
LTE Band 41	2496 ~ 2690	0.02	0.45	298.54	3888
LTE Band 42	3450 ~ 3600	0.01	0.45	110.92	3888
LTE Band 43	3600 ~ 3800	0.01	0.45	110.92	3888
LTE Band 48	3550 ~ 3700	0.01	0.45	62.37	3888
LTE Band 66	1710 ~ 1780	0.03	0.45	171.79	3888
LTE Band 71	663 ~ 698	0.07	0.45	171.79	1718
NR n2	1850 ~ 1910	0.03	0.45	171.79	3888
NR n5	824 ~ 849	0.06	0.45	237.14	2136
NR n7	2500 ~ 2570	0.02	0.45	149.62	3888
NR n12	699 ~ 716	0.07	0.45	60.95	1812
NR n13	777 ~ 787	0.06	0.45	60.95	2014
NR n14	788 ~ 798	0.06	0.45	60.95	2042
NR n25	1850 ~ 1915	0.03	0.45	171.79	3888
NR n26	814 ~ 849	0.06	0.45	237.14	2110
NR n30	2305 ~ 2315	0.02	0.45	197.24	3888
NR n38	2570 ~ 2620	0.02	0.45	298.54	3888
NR n41	2496 ~ 2690	0.02	0.45	595.66	3888
NR n48/77/78	3550 ~ 3700	0.01	0.45	62.37	3888
NR n66	1710 ~ 1780	0.03	0.45	171.79	3888
NR n70	1695 ~ 1710	0.03	0.45	171.79	3888
NR n71	663 ~ 698	0.07	0.45	171.79	1718
NR n77/78	3450 ~ 3550	0.01	0.45	441.57	3888
NR n77/78	3700 ~ 3980	0.01	0.45	441.57	3888

802.11b/g/n/ax	2412 ~ 2462	0.02	0.45	2426.61	3888
802.11a/n/ac/ax	5180 ~ 5825	0.01	0.45	484.17	3888
BLE	2402 ~ 2480	0.02	0.45	12.16	3888

Note: R is from user manual.

For multiple RF sources

The EUT supports LTE/NR + Wi-Fi 2.4GHz + Wi-Fi 5GHz + BLE.

So the Max Simultaneous Transmission Ratio = $595.66/3888 + 2426.61/3888 + 484.17/3888 + 12.16/3888 = 0.9050 < 1$

Therefore, the device qualifies for RF exposure test exemption.