


RF Exposure Evaluation Declaration

FCC ID: 2AAJGR1510
Applicant: Guangzhou Robustel Co., Ltd.
Product: Industrial Cellular VPN Router
Model No.: R1510-4L
Brand Name: 
FCC Classification: Digital Transmission System (DTS)
FCC Rule Part(s): FCC Part 2.1091
Received Date: 2023-07-25
Evaluation Date: 2023-08-23
Result: Complies

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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
2307RSU053-U3	V01	Initial Report	2023-08-28	Valid

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1.4. Product Information

Product Name	Industrial Cellular VPN Router
Model No.	R1510-4L
Wi-Fi Specification	802.11b/g/n
GSM Operating Band(s)	GSM 850/900/1800/1900
WCDMA Operating Band(s)	WCDMA Band I / II / V / VIII
LTE Operating Band(s)	FDD Band 1/2/3/4/5/7/8/28 TDD Band 40
Antenna Information	Refer to Section 1.5
Power Type	AC/DC Adapter
Accessories	
AC/DC Adapter	Model: GQ24-120150-AX Input: 100-240V ~ 50/60Hz 1.0A Max Output: 12.0V = 1.5A 18.0W
Antennas	Wi-Fi Antenna Used: #1: Wi-Fi Rubber Antenna #2: Wi-Fi PCB Antenna WWAN Optional Antenna: #1: LTE Rubber Antenna #2: LTE Magnetic Antenna
<p>Note 1: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.</p> <p>Note 2: This device contains a certified WWAN module (FCC ID: XMR201805EC25AU), and only GSM 850/1900, WCDMA Band II/V and LTE Band 2/4/5/7 are used for US.</p>	

1.5. Antenna Details

Antenna Type	Frequency Band (MHz)	Tx Paths	Antenna Gain (dBi)	Directional Gain (dBi)	
				For Power	For PSD
Wi-Fi Antennas					
Antenna 0: Rubber Antenna Antenna 1: PCB Antenna	2400 ~ 2483.5	2	Antenna 0: 5.00 Antenna 1: 0.00	5.00	8.01
WWAN Antennas					
#1: LTE Rubber Antenna #2: LTE Magnetic Antenna	GSM 850 (824 ~ 849)	2	#1: 3.70 #2: 0.50	--	--
	GSM 1900 (1850 ~ 1910)	2	#1: 3.80 #2: 2.00	--	--
	WCDMA Band II (1850 ~ 1910)	2	#1: 3.80 #2: 2.00	--	--
	WCDMA Band V (824 ~ 849)	2	#1: 3.70 #2: 0.50	--	--
	LTE Band 2 (1850 ~ 1910)	2	#1: 3.80 #2: 2.00	--	--
	LTE Band 4 (1710 ~ 1755)	2	#1: 3.80 #2: 2.10	--	--
	LTE Band 5 (824 ~ 849)	2	#1: 3.70 #2: 0.50	--	--
	LTE Band 7 (2500 ~ 2570)	2	#1: 3.80 #2: 1.50	--	--

Note 1: The antenna gain is from antenna data sheet provided by the manufacturer.

Note 2: The EUT supports SISO mode for 802.11b/g and CDD mode for 802.11n.

Note 3: For CDD transmissions, Directional Gain is calculated as follows.

Directional Gain = $G_{ANT\ Max} + \text{Array Gain}$, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
Array Gain = $10 \log (N_{ANT} / N_{SS})$ dB;
- For power measurements on IEEE 802.11 devices,
Array Gain = 0 dB for $N_{ANT} \leq 4$

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

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	Industrial Cellular VPN Router
Test Item	RF Exposure Evaluation

Test Mode	Frequency Band (MHz)	Tune-up Power (dBm)	Max. Antenna Gain (dBi)	Tune-up EIRP (dBm)
SISO Mode - Ant 0				
802.11b	2412	13.00	5.00	18.00
	2437	14.50	5.00	19.50
	2462	12.50	5.00	17.50
802.11g	2412	14.50	5.00	19.50
	2437	15.50	5.00	20.50
	2462	12.50	5.00	17.50
SISO Mode - Ant 1				
802.11b	2412	13.50	0.00	13.50
	2437	13.50	0.00	13.50
	2462	14.50	0.00	14.50
802.11g	2412	17.00	0.00	17.00
	2437	18.50	0.00	18.50
	2462	16.00	0.00	16.00
MIMO Mode				
802.11n-HT20	2412	15.50	5.00	20.50
	2437	15.50	5.00	20.50
	2462	15.50	5.00	20.50
802.11n-HT40	2412	14.00	5.00	19.00
	2437	15.50	5.00	20.50
	2462	13.50	5.00	18.50
WWAN Mode				
GSM 850	824 ~ 849	25.97	3.70	29.67
GSM 1900	1850 ~ 1910	22.97	3.80	26.77
WCDMA Band II	1850 ~ 1910	25.00	3.80	28.80
WCDMA Band V	824 ~ 849	25.00	3.70	28.70
LTE Band 2	1850 ~ 1910	25.00	3.80	28.80
LTE Band 4	1710 ~ 1755	25.00	3.80	28.80
LTE Band 5	824 ~ 849	25.70	3.70	29.40
LTE Band 7	2500 ~ 2570	25.00	3.80	28.80

Note: The WWAN Tune-up Power refers to the module MPE report (Report No.: R1804A0154-M1).

For single RF source, Option B

Test Mode	$\lambda / 2 \pi$ (m)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (mW)	P_{th} (mW)
Wi-Fi (DTS)	0.0198	0.20	20.50	18.35	68.39	3060.00
GSM 850	0.0579	0.20	29.67	27.52	564.94	1680.96
GSM 1900	0.0258	0.20	26.77	24.62	289.73	3060.00
WCDMA Band II	0.0258	0.20	28.80	26.65	462.38	3060.00
WCDMA Band V	0.0579	0.20	28.70	26.55	451.86	1680.96
LTE Band 2	0.0258	0.20	28.80	26.65	462.38	3060.00
LTE Band 4	0.0279	0.20	28.80	26.65	462.38	3060.00
LTE Band 5	0.0579	0.20	29.40	27.25	530.88	1680.96
LTE Band 7	0.0191	0.20	28.80	26.65	462.38	3060.00

Note 1: R is from user manual.

Note 2: Tune-up ERP (dBm) = Tune-up EIRP (dBm) - 2.15 (dB).

Note 3: Tune-up ERP (mW) = $10^{\text{Tune-up ERP (dBm)/10}}$.

For multiple RF sources

The EUT supports Wi-Fi 2.4GHz + WWAN simultaneous transmissions. The worst-case combination is Wi-Fi 2.4GHz + GSM 850.

So the Max Simultaneous Transmission = $68.39/3060.00$ (Wi-Fi 2.4GHz) + $564.94/1680.96$ (GSM 850) = $0.3584 < 1$

Therefore, the device qualifies for RF exposure test exemption.

_____ The End _____