

## RF EXPOSURE EVALUATION

### Maximum Permissible Exposure [MPE]

**Applicant Name:**

4RF Limited  
PO Box 13-506  
Wellington 6440  
New Zealand

**Date of Testing:**

02/22/2021- 04/09/2021

**Test Site/Location:**

PCTEST Lab. Columbia, MD, USA

**Test Report Serial No.:**

1M2103010013-02.UIP

**FCC ID:**

**UIP4RF55**

**APPLICANT:**

**4RF Limited**

**Application Type:**

Class II Permissive Change

**Model:**

Aprisa LTE

**EUT Type:**

LTE Module Integrated Into Multiservice Connect Router

**FCC Classification:**

PCS Licensed Transmitter (PCB)

**FCC Rule Part:**

FCC Part 1 (§1.1310) and Part 2 (§2.1091)

**Test Procedure(s):**

KDB 447498 D01

**Class II Permissive Change:**

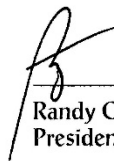
Adding LTE Band 8 Frequencies and co-locating with another FCC approved module as discussed in this filing

**Original Grant Date:**

03/05/2021

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in FCC KDB 447498 D01. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



\_\_\_\_\_  
Randy Ortanez  
President



<b>FCC ID:</b> UIP4RF55	 <b>PCTEST</b> Proud to be part of 	<b>MAXIMUM PERMISSIBLE EXPOSURE REPORT</b>	<b>Approved by:</b> Technical Manager
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## 1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### 1.1 Introduction

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations for the General Population Exposure scenario.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

**Table 1-1. Limits for Maximum Permissible Exposure (MPE)**

### 1.2 EUT Description

The EUT (FCC ID: UIP4RF55) is an LTE modem that is integrated into a host router device for LTE operation. This MPE evaluation will cover RF exposure for LTE Band 8 operation along with FCC certified 2.4GHz & 5GHz WiFi module (FCC ID: SQG-60SIPT).

The EUT can be installed with either a lower gain antenna for simultaneous LTE and WiFi operation or with a higher gain antenna for LTE operation only.

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### 1.3 Test Equipment

The following RF field probe and sensor were used to perform power density (MPE) testing.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
EMC Test Design	RFP-05M	Smart Fieldmeter	4/23/2018	Triennial	4/23/2021	627
EMC Test Design	PI-05	Ultra Broadband E-Field Probe (1MHz - 40GHz)	4/23/2018	Triennial	4/24/2021	627

**Table 1-2. Test Equipment List**

### 1.4 Procedure

RF Exposure is evaluated to the Mobile Device requirements for General Population/Uncontrolled Exposure. An evaluation is included in the form of MPE testing performed with a probe at various test distances to determine compliance. MPE testing is performed on a representative high gain antenna (12.15dBi) due to the requirements of 2.1091(c)(1)(i).

For the co-located antenna scenario for use by the General Population, the power generated by each transmitter used in this product was initially measured by a spectrum analyzer and the powers were recorded. Through use of the Friis transmission formula, the maximum power density is calculated with the LTE and WiFi antenna gain values provided by the host integrator to cover the co-located antenna installation case.

### 1.5 Test Results

#### Measured MPE

The following MPE evaluation is a measurement performed with an RF Probe with the EUT transmitting from a representative 10dBd (12.15dBi) gain antenna at multiple distances. Additional data is provided for reference to both the General Population and Controlled Exposure limits.

Frequency (MHz)	Distance (cm)	Measured Power Density (mW/cm <sup>2</sup> )	Scaled Power Density (mW/cm <sup>2</sup> )	General Pop. Exposure Limit (mW/cm <sup>2</sup> )	Occupational Exposure Limit (mW/cm <sup>2</sup> )
897.5	20	2.060	2.248	0.598	2.992
	50	1.390	1.517		
	100	1.027	1.121		
	107	0.646	0.705		
	108	0.626	0.683		
	109	0.588	0.642		
	110	0.557	0.608		
	120	0.512	0.559		

**Table 1-3. Measured MPE Data for 897.5MHz  
(General Population/Uncontrolled Exposure with High Gain Antenna)**

#### Note

All power density measurements are performed with an RF probe with a device operating at 23.62dBm output power. Based on the original filing for this module, the maximum power is 24dBm so the measured power density results are scaled up to account for the discrepancy.

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## Calculated MPE

### Friis Transmission Formula

Friis transmission formula:  $P_d = (P_{out} * G) / (4\pi r^2)$

Where,

$P_d$  = Power Density (mW/cm<sup>2</sup>)

$\pi$  = 3.1416

$P_{out}$  = output power to antenna (mW)

$r$  = distance between observation point and center of the radiator (cm)

$G$  = gain of antenna in linear scale

The following MPE evaluations are calculations based on maximum power and maximum antenna gain for the standalone and simultaneous transmission operation scenarios to the General Population RF Exposure limit. The antennas gains shown for the LTE and WiFi transmitters are per the manufacturer supplied antenna.

Frequency	897.5 MHz		
Limit	0.598 mW/cm <sup>2</sup>		
Distance (cm), R =	20 cm		
Power (dBm), P =	24 dBm	251.19 mW	
TX Ant Gain (dBi), G =	6 dBi		
Power Density (S) =	0.199 mW/cm <sup>2</sup>	(at 20cm)	
Minimum Distance =	11.5 cm		

Table 1-4. Calculated MPE Data for 899MHz  
(General Population/Uncontrolled Exposure)

Frequency:	2437 MHz		
Limit:	1.000 mW/cm <sup>2</sup>		
Distance (cm), R =	20 cm		
Power (dBm), P =	20.81 dBm	120.50 mW	
TX Ant Gain (dBi), G =	3 dBi		
Power Density (S) =	0.048 mW/cm <sup>2</sup>	(at 20cm)	
Minimum Distance =	4.4 cm		

Table 1-5. Calculated MPE Data for 2.4GHz  
(General Population/Uncontrolled Exposure)

Frequency	5200 MHz		
Limit	1.000 mW/cm <sup>2</sup>		
Distance (cm), R =	20 cm		
Power (dBm), P =	21.44 dBm	139.32 mW	
TX Ant Gain (dB), G =	5 dBi		
Power Density (S) =	0.088 mW/cm <sup>2</sup>	(at 20cm)	
Minimum Distance =	5.9 cm		

Table 1-6. Calculated MPE Data for 5GHz  
(General Population/Uncontrolled Exposure)

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	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Percent MPE Used (%)
Transmitter #1 (LTE)	0.199	0.598	33.25
Transmitter #2 (5GHz WiFi)	0.088	1.000	8.76
<b>Total</b>			<b>42.01</b>

**Table 1-7. Cumulative Results for Multiple Transmitters**

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## 2.0 CONCLUSION

This device meets the mobile General Population and Uncontrolled RF exposure limits with the antenna gains and at the distances specified in this report per §2.1091 of the FCC Rules and Regulations. An appropriate RF exposure compliance statement will be placed in the user's manual.

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