

# RF Exposure Exhibit

**EUT Name:** Wireless Audio Transmitter

**Model No.:** Elite 800X RX

CFR Part 2.1093 and RSS 102

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# 1 Test Methodology

In this document, we evaluate the RF Exposure to human body due the intentional transmission from the transmitter (EUT). The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

## 1.1 RF Exposure Limit

According to FCC 1.1310 table 1: 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)

### LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (minutes)
<b>(A)Limits For Occupational / Control Exposures</b>				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
30-1500	...	...	F/300	6
1500-100000	...	...	1.0	6
<b>(B)Limits For General Population / Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
30-1500	...	...	F(MHz)/1500MHz	30
1500-100000	...	...	1.0	30

F = Frequency in MHz

\*=Plane wave equivalent density

According to RSS-102 Issue 5: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation

**RF FIELD STRENGTH LIMITS FOR DEVICES USED BY THE GENERAL PUBLIC  
 (UNCONTROLLED ENVIRONMENT)**

<b>Frequency Range (MHz)</b>	<b>Electric Field (V/m rms)</b>	<b>Magnetic Field (A/m rms)</b>	<b>Power Density (W/m<sup>2</sup>)</b>	<b>Reference Period (minutes)</b>
0.003-10 <sup>21</sup>	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> <sup>0.5</sup>	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> <sup>0.25</sup>	0.1540/ <i>f</i> <sup>0.25</sup>	8.944/ <i>f</i> <sup>0.5</sup>	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> <sup>0.3417</sup>	0.008335 <i>f</i> <sup>0.3417</sup>	0.02619 <i>f</i> <sup>0.6834</sup>	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> <sup>1.2</sup>
150000-300000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616000/ <i>f</i> <sup>1.2</sup>
<p><b>Note:</b> <i>f</i> is frequency in MHz.            *Based on nerve stimulation (NS).            ** Based on specific absorption rate (SAR).</p>				

## **1.2 EUT Operating Condition**

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

## **1.3 Classification**

The antenna of the product, under normal use condition, is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20 cm or more separation distance with the antenna should be included in user's manual. So, this device is classified as a **Mobile Device**.

## **1.4 MPE calculation**

### **1.4.1 Antenna Gain**

1. Bluetooth 2.441 GHz Integrated Antenna peak gain: +2.8 dBi or 1.91 (numeric).
2. Wifi 5.24 GHz Integrated Antenna peak gain: +1.3 dBi or 1.35 (numeric).

### **1.4.2 Conducted Output Power**

1. Bluetooth 2.441 GHz, TUV Test Report 31563522.001, max power: 4.75 dBm (2.985 mW).
2. Wifi 5.24 GHz, TUV Test Report 31563519.001, max power: 7.34 dBm (5.420 mW).

### 1.4.3 Output Power into Antenna & RF Exposure value at distance 2cm

Calculations for this report are based on highest power measurement, therefore 2.441 GHz.

Corrected (including cal factors) Measurement:	4.75	dBm	
The Gain of the antenna:	2.80	dBi	
Type of Measurement:	Conducted		Direct measurement at Antenna Port
Impedance:	50.00	$\Omega$	
Measuring Distance:	0.00	m	Not used for Direct measurements.
Time weighted Duty Cycle:	100.00	%	

The Power Out would be: 0.002985383 Watts  
 or: 2.98538 mW  
 or: 2985.38  $\mu$ W  
 or: 4.75 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency:	2.441	GHz
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Power output with DC and antenna Gain (EiRP):

Power (dBm):	7.55
Power (mW):	5.689
Power (W):	0.005689

R = distance in	2	cm
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FCC:

Controlled Exposures - Limit =	5	mW/cm <sup>2</sup>
Uncontrolled Exposures - Limit =	1	mW/cm <sup>2</sup>
Pd =	0.1131697	mW/cm <sup>2</sup>
Controlled Margin to Limit =	4.8868	mW/cm <sup>2</sup>
Uncontrolled Margin to Limit =	0.8868	mW/cm <sup>2</sup>

Note: \* = Plane-wave equivalent power density

IC:

Controlled Exposures to Limit =	31.8918811	W/m <sup>2</sup>
Uncontrolled Exposures Limit =	5.410025584	W/m <sup>2</sup>
Pd =	1.131697	W/m <sup>2</sup>
Controlled Margin to Limit =	30.7602	W/m <sup>2</sup>
Uncontrolled Margin to Limit =	4.2783	W/m <sup>2</sup>

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Calculations for this report are based on highest power measurement, therefore 5.24 GHz.

Corrected (including cal factors) Measurement:	7.34	dBm	
The Gain of the antenna:	1.30	dBi	
Type of Measurement:	Conducted		Direct measurement at Antenna Port
Impedance:	50.00	$\Omega$	
Measuring Distance:	0.00	m	Not used for Direct measurements.
Time weighted Duty Cycle:	100.00	%	

The Power Out would be: 0.005420009 Watts  
 or: 5.42001 mW  
 or: 5420.01  $\mu$ W  
 or: 7.34 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 5.24 GHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	8.64
Power (mW):	7.311
Power (W):	0.007311

R = distance in 2 cm

FCC:

Controlled Exposures - Limit =	5	$mW/cm^2$
Uncontrolled Exposures - Limit =	1	$mW/cm^2$
Pd =	0.1454555	$mW/cm^2$
Controlled Margin to Limit =	4.8545	$mW/cm^2$
Uncontrolled Margin to Limit =	0.8545	$mW/cm^2$

Note: \* = Plane-wave equivalent power density

IC:

Controlled Exposures to Limit =	46.72635348	$W/m^2$
Uncontrolled Exposures Limit =	9.118565036	$W/m^2$
Pd =	1.454555	$W/m^2$
Controlled Margin to Limit =	45.2718	$W/m^2$
Uncontrolled Margin to Limit =	7.6640	$W/m^2$

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

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#### 1.4.4 Sample Calculation

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

Where;

$P_d$  = power density in mW/cm<sup>2</sup>

$P_{out}$  = output power to antenna in mW

$G$  = gain of antenna in linear scale

$\pi \approx 3.1416$

$R$  = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).