

# RF Exposure Exhibit

**EUT Name:** Wireless Audio Amplifier

**Model No.:** Elite SuperAmp X (TB300-0085-01)

**PMN:** Elite SuperAmp X

**HVIN:** SuperAmp X

CFR Part 1.1310 and RSS 102 Iss. 5 March 2015

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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/ $f$	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10 <sup>-4</sup> $f^{0.5}$	6.67 x 10 <sup>-5</sup> $f$	616000/ $f^{1.2}$
<b>Note:</b> $f$ is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

## **1.2 EUT Operating Condition**

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

The Elite SuperAmp X (TB300-0085-01)X, is a Bluetooth device with integrated PCB antenna

## **1.3 MPE calculation**

### **1.3.1 Antenna Gain**

The antenna used is 1.6 dBi / 1.45 (numeric).

### **1.3.2 Conducted Output Power**

The 2.4 GHz, TUV Test Report 31861558.001, maximum output power: 4.34 dBm (2.72 mW)

### 1.3.3 2.4 GHz Output Power into Antenna & RF Exposure value at distance 20cm

Calculations for this report are based on highest power measurement.

Enter the following highlighted variables:  
Corrected (including cal factors) Measurement: 4.34 dBm  
The Gain of the antenna: 1.60 dBi  
Type of Measurement: Conducted Direct measurement at Antenna Port  
Impedance: 50.00  $\Omega$   
Measuring Distance: 3.00 m  
Time weighted Duty Cycle: 100.00 %

The Power Out would be: 0.002716439 Watts  
or: 2.71644 mW  
or: 2716.44  $\mu$ W  
or: 4.34 dBm

Frequency range from 10 MHz to 40 GHz:  
Frequency: 2.44 GHz

Power output with DC and antenna Gain (EIRP):

Power (dBm):	5.94
Power (mW):	3.926
Power (W):	0.003926

R = distance in 20 cm

FCC:

Controlled Exposures - Limit =	5	mW/cm <sup>2</sup>
Uncontrolled Exposures - Limit =	1	mW/cm <sup>2</sup>
Pd =	0.0007811	mW/cm <sup>2</sup>
Controlled Margin to Limit =	4.9992	mW/cm <sup>2</sup>
Uncontrolled Margin to Limit =	0.9992	mW/cm <sup>2</sup>

Note: \* = Plane-wave equivalent power density

IC:

Controlled Exposures to Limit =	31.88534789	W/m <sup>2</sup>
Uncontrolled Exposures Limit =	5.408510856	W/m <sup>2</sup>
Pd =	0.007811	W/m <sup>2</sup>
Controlled Margin to Limit =	31.8775	W/m <sup>2</sup>
Uncontrolled Margin to Limit =	5.4007	W/m <sup>2</sup>

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

### 1.3.4 Sample Calculation

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

Where;

$P_d$  = power density in  $\text{mW}/\text{cm}^2$

$P_{out}$  = 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).