

RF Exposure Exhibit

EUT Name: Audio Player

Model No.: No.519

CFR Part 1.1310 and RSS 102

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Appendix A

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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 ²)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
30-1500	...	...	F/300	6
1500-100000	...	...	1.0	6
(B)Limits For General Population / Uncontrolled Exposure				
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
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)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	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 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$
Note: 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 lowest, middle and highest channel individually.

The Model No.519, is an Audio Player for the home capable of operating in the 2.4 GHz and 5 GHz frequency bands over 20 MHz and 40 MHz channels.

1.3 MPE calculation

1.3.1 Antenna Gain

The antenna used are:

1. The 2.4 GHz transmitting antenna gain: +3.0 dBi or 1.995 (numeric).
2. The 5 GHz transmitting antenna gain: +5.0 dBi or 3.16 (numeric).

1.3.2 Conducted Output Power

1. The 2.4 GHz, TUV Test Report 31660720.001, maximum power : 17.1 dBm (51.286 mW)
2. The 5 GHz, TUV Test Report 31661072.001, maximum power: 14.35 dBm (27.227 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, therefore **2.437 GHz**.

Corrected (including cal factors) Measurement:	17.10	dBm
The Gain of the antenna:	3.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measuring Distance:	0.00	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.051286138 Watts
or: 51.28614 mW
or: 51286.14 μ W
or: 17.10 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 2.437 GHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	20.10
Power (mW):	102.329
Power (W):	0.102329

R = distance in 20 cm

FCC:

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.0203578	mW/cm ²
Controlled Margin to Limit =	4.9796	mW/cm ²
Uncontrolled Margin to Limit =	0.9796	mW/cm ²

Note: * = Plane-wave equivalent power density

IC:

Controlled Exposures to Limit =	31.86574021	W/m ²
Uncontrolled Exposures Limit =	5.403965492	W/m ²
Pd =	0.203578	W/m ²
Controlled Margin to Limit =	31.6622	W/m ²
Uncontrolled Margin to Limit =	5.2004	W/m ²

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

1.3.4 5 GHz Output Power into Antenna & RF Exposure value at distance 20cm

Calculations for this report are based on highest power measurement, therefore **5.7 GHz**.

Corrected (including cal factors) Measurement:	14.35	dBm
The Gain of the antenna:	5.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measuring Distance:	0.00	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.027227013 Watts
or: 27.22701 mW
or: 27227.01 μ W
or: 14.35 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 5.7 GHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	19.35
Power (mW):	86.099
Power (W):	0.086099



R = distance in 20 cm

FCC:

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.0171289	mW/cm ²
Controlled Margin to Limit =	4.9829	mW/cm ²
Uncontrolled Margin to Limit =	0.9829	mW/cm ²

Note: * = Plane-wave equivalent power density

IC:

Controlled Exposures to Limit =	48.73418128	W/m ²
Uncontrolled Exposures Limit =	9.658292967	W/m ²
Pd =	0.171289	W/m ²
Controlled Margin to Limit =	48.5629	W/m ²
Uncontrolled Margin to Limit =	9.4870	W/m ²

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

1.3.5 Sample Calculation

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

Where;

P_d = power density in mW/cm²

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).