RF Exposure Exhibit

EUT Name: Luxury Audio Integrated Amplifier

Model No.: No5805 & No5802

CFR Part 1.1310 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^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)**
$0.003\text{-}10^{21}$	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	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

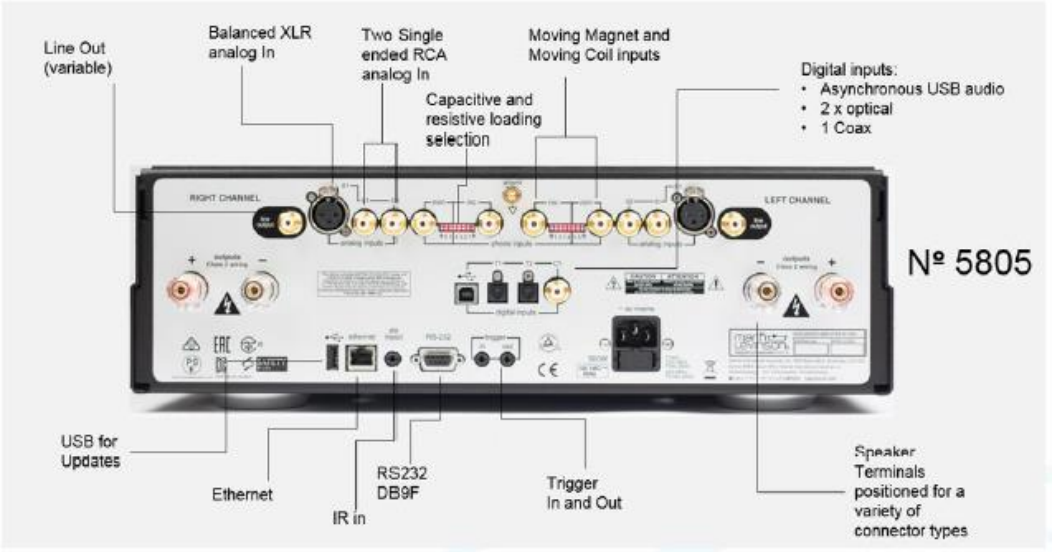
1.2 EUT Operating Condition

The Model No5805 & No5802 is Mark Levinson Luxury Audio Integrated Amplifier. It has wireless capability, Bluetooth, operating in the band 2.4 GHz.

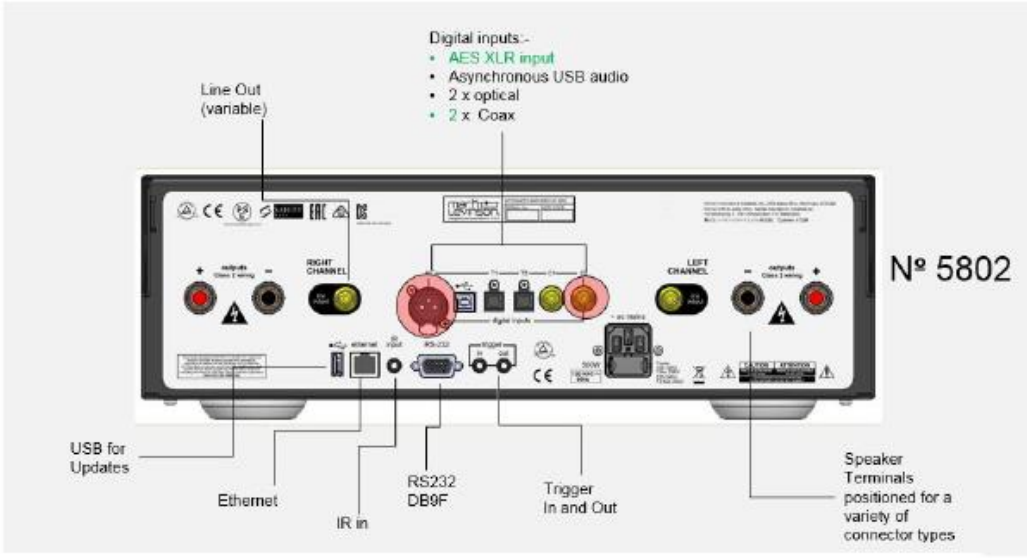
Model differences are:
No5805 – connect to analog and digital audio sources.
No5802 – interfaces with digital sources only.

The Model No5805 was used for final evaluation.

No5805 rear panel overview:



No5802 rear panel overview:



1.3 MPE calculation

1.3.1 Antenna Gain

Bluetooth 2.4 GHz Chip Antenna peak gain: +1.7 dBi or 1.5 (numeric).

1.3.2 Conducted Output Power

Bluetooth maximum peak power: 7.33 dBm (5.41 mW)

1.3.3 Output Power into Antenna & RF Exposure value

Calculations for this report are based on highest power measurement and its antenna gain, therefore 2.48 GHz. Results are below.

FCC:

Corrected (including cal factors) Measurment:	7.33	dBm
The Gain of the antenna:	1.70	dBi
Type of Measurment:	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:	0.005407543	Watts
or:	5.40754	mW
or:	5407.54	µW
or:	7.33	dBm

Frequency range from 10 MHz to 40 GHz:

Frequency:	2.48	GHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	9.03
Power (mW):	7.998
Power (W):	0.007998

R = distance in	20	cm

FCC:		
Controlled Exposures - Limit =	5	mW/cm^2
Uncontrolled Exposures - Limit =	1	mW/cm^2
Pd =	0.0015912	mW/cm^2
Controlled Margin to Limit =	4.9984	mW/cm^2
Uncontrolled Margin to Limit =	0.9984	mW/cm^2

Note: * = Plane-wave equivalent power density

ISED:

Corrected (including cal factors) Measurment:	7.33	dBm	
The Gain of the antenna:	1.70	dBi	
Type of Measurment:	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:	0.005407543	Watts
or:	5.40754	mW
or:	5407.54	µW
or:	7.33	dBm

Frequency range from 10 MHz to 40 GHz:

Frequency:	2.48	GHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	9.03
Power (mW):	7.998
Power (W):	0.007998

R = distance in	20	cm

IC:

Controlled Exposures to Limit =	32.14564076	W/m^2
Uncontrolled Exposures Limit =	5.468947787	W/m^2
Pd =	0.015912	W/m^2
Controlled Margin to Limit =	32.1297	W/m^2
Uncontrolled Margin to Limit =	5.4530	W/m^2

1.3.4 Sample Calculation

The Friss transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in mW/cm^2
Pout = 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).