



Compliance Testing, LLC

Previously Flom Test Lab

EMI, EMC, RF Testing Experts Since 1963

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Test Report

Prepared for: Emotiv Inc.

Model: Insight

Description: Wireless Neurological Headset

Serial Number: N/A

FCC ID: 2ADIH-INSIGHT01

IC: 12769A-INSIGHT01

To

FCC Part 15.247 DTS

Date of Issue: April 30, 2015

On the behalf of the applicant:

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Attention of:

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Alex Macon
Project Test Engineer

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	April 9, 2015	Alex Macon	Original Document

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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.

Testing Certificate Number: **2152.01**



FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2009 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (°C)	Humidity (%)	Pressure (mbar)
24.2 – 25.3	28.7 – 32.4	964.5 – 967.7

EUT Description

Model: Insight

Description: Wireless Neurological Headset

Serial Number: N/A

Software: Nordic Semiconductor Master Control Panel

Additional Information:

The device is a Wireless Neurological Headset transceiver, which communicates to a USB transceiver connected to a personal computer. The link between the headset transceiver and USB transceiver transmits data continuously and is required for proper operation of the product. The device incorporates an integral antenna; all measurements are done by radiated means.

EUT Operation during Tests

The Client has provided several dongles to place the EUT in High Mid and Low channels and also a dongle for normal operation

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Bluetooth Dongle	Nordic Semiconductor	PCA10000	N/A

Cables: None

Modifications: None

15.203: Antenna Requirement:

- The antenna is permanently attached to the EUT
- The antenna uses a unique coupling
- The EUT must be professionally installed
- The antenna requirement does not apply

Test Reports Summary

Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)(3)	Peak Output Power	Pass	
15.247(b)	Conducted Spurious Emissions	N/A	All measurements are taken by radiated means
15.247(d), 15.209(a), 15.205	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Emissions At Band Edges	Pass	
15.247(a)(2)	Occupied Bandwidth	Pass	
15.247(e)	Transmitter Power Spectral Density	Pass	
15.207	A/C Powerline Conducted Emissions	Pass	
RSS-Gen 6(b)	Receiver Spurious Emission Limits	Pass	

Peak Output Power
Name of Test:

Peak Output Power

Engineer: Alex Macon

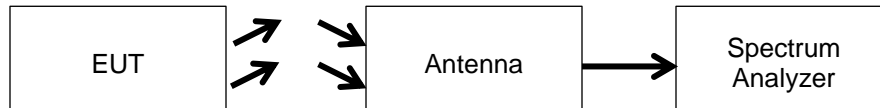
Test Equipment Utilized:

i00271,i00331, i00428

Test Date: 4/6/15

Test Procedure

The EUT was tested in a semi anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements. The peak readings were taken and the result was then compared to the limit.

Test Setup

Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2402	-16.21	1 W (30 dBm)	Pass
2442	-17.7	1 W (30 dBm)	Pass
2480	-19.52	1 W (30 dBm)	Pass

Radiated Spurious Emissions
Name of Test:

Radiated Spurious Emissions

Engineer: Alex Macon

Test Equipment Utilized:

i00271, i00273, i00331, i00349, i00428

Test Date: 4/7/15

Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was tested in a semi anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized. All emissions from 30 MHz to 1 GHz were examined.

Measured Level includes antenna and receiver cable correction factors.

Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz

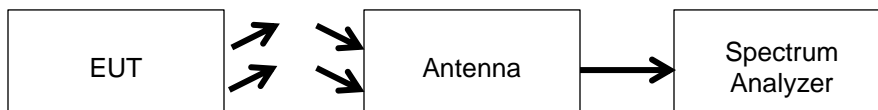
VBW = 300 KHz

Detector – Quasi Peak

Limit = -20dBc

Lowest fundamental power = 87.47 dBuV

Limit = 67.7 dBuV

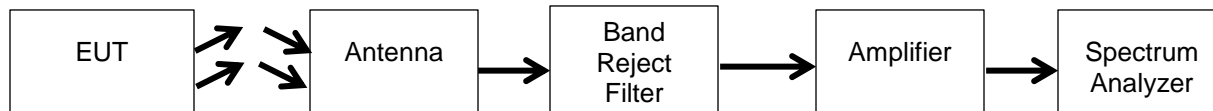
Test Setup

Radiated Spurious Emissions Test Data: 30 MHz – 1000 MHz

Frequency (MHz)	Measured Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity (H or V)
186.98	25.08	67.7	-41.92	V
290.030	22.99	67.7	-44.01	H
253.410	22.13	67.7	-44.87	H
187.800	19.82	67.7	-47.18	H
257.270	18.38	67.7	-48.62	V
30.870	20.22	67.7	-46.78	H

Test Procedure for Radiated Spurious Emissions above 1 GHz

The EUT was tested in a semi anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. The antenna, band reject filter, amplifier and cable correction factors were input into the spectrum analyzer before recording the Measured Level to ensure accurate readings. The spectrum for each tuned frequency was examined to the 10th harmonic.

Test Setup



Detector Settings	RBW	VBW	Span
Peak	1 MHz	3 MHz	As Necessary
Average	1 MHz	3 MHz	As Necessary

Radiated Spurious Emissions

Tuned Frequency (MHz)	Emission Frequency (MHz)	Peak Measured Value (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
2402	4804	52.94	74.0	54.0	Pass
2441	4884.2	50.29	74.0	54.0	Pass
2480	4960.2	44.27	74.0	54.0	Pass

All peak readings were below the average limits
 No other emissions were detectable. All emissions were more than -20 dBc.

Emissions at Band Edges

Name of Test:

Emissions at Band Edges

Engineer: Alex Macon

Test Equipment Utilized:

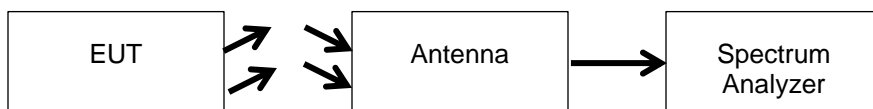
i00271, i00331, i00349, i00428

Test Date: 4/6/15

Test Procedure

The EUT was tested in a semi-anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for band edge and restricted band for both peak and average measurements. The cable and antenna correction factors were input into the analyzer as a reference level offset to ensure accurate readings. For the restricted band the amplifier and band reject filter correction factors were also input to the spectrum analyzer.

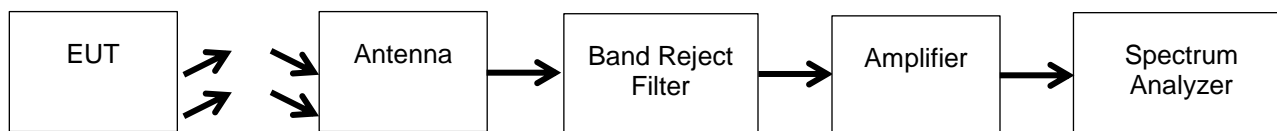
Band Edge Test Setup



Band Edge Emissions Summary

Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBc)	Detector	Limit (dBc)	Result
2402	2397.8	-39.61	Peak	-20 dBc	Pass
2480	2488.7	-41.4	Peak	-20dBc	Pass

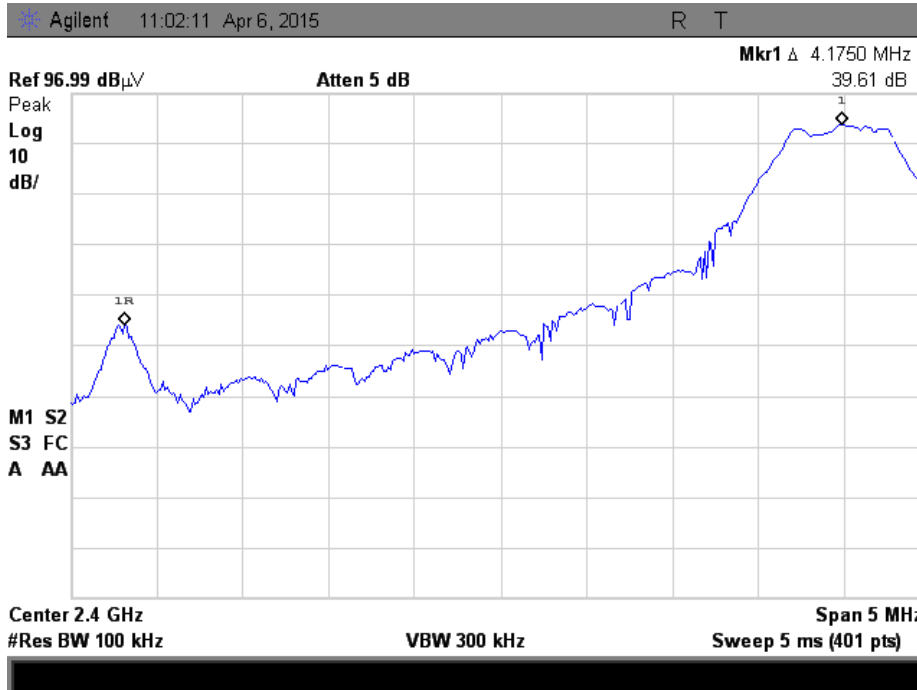
Restricted Band Test Setup



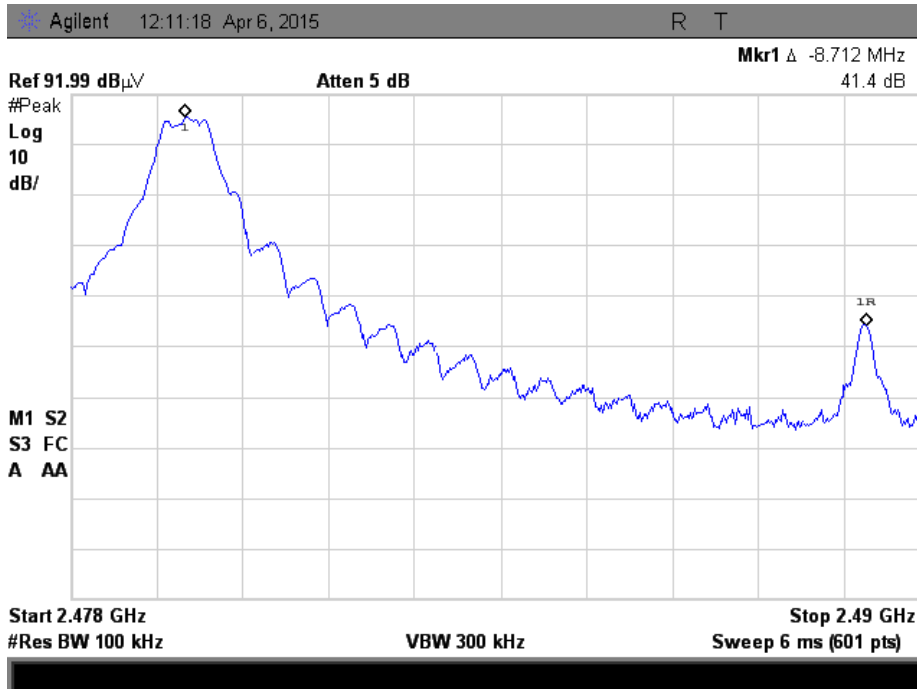
Restricted Band Emissions Summary

Restricted Band (MHz)	Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBuV/m)	Detector	Limit (dBuV/m)	Result
2300 – 2390	2402	2368.4	51.61	Peak	74	Pass
2300 – 2390	2402	2362.8	46.59	Average	54	Pass
2483.5 - 2500	2480	2483.5	59.53	Peak	74	Pass
2483.5 - 2500	2480	2483.5	51.57	Average	54	Pass

Band Edge 2400 MHz
Tuned Frequency= 2402 MHz



Band Edge 2483.5 MHz
Tuned Frequency= 2480 MHz

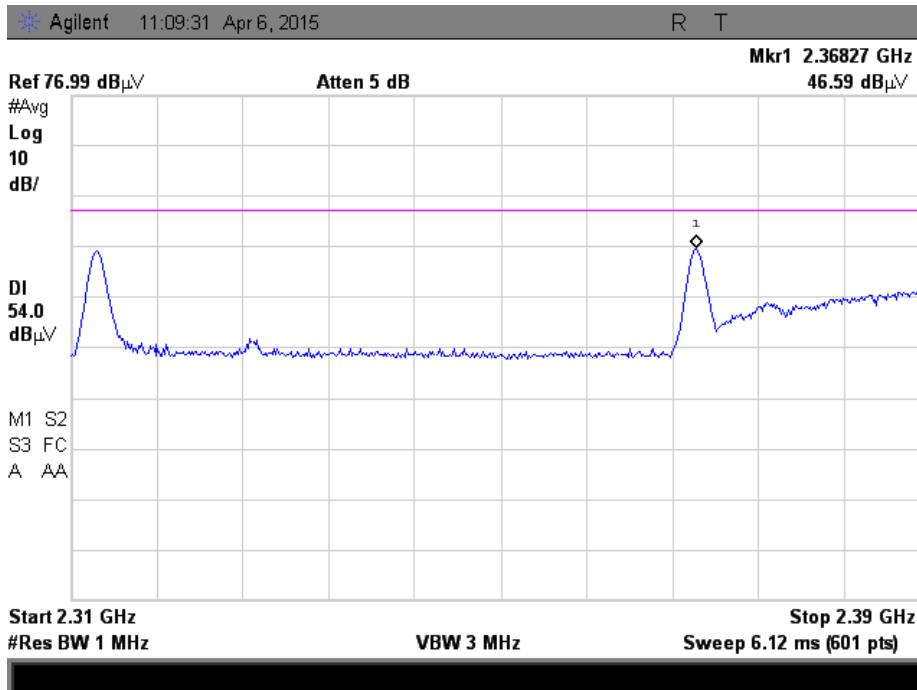




Restricted Band 2300 – 2390 MHz – Peak Tuned Frequency= 2402MHz

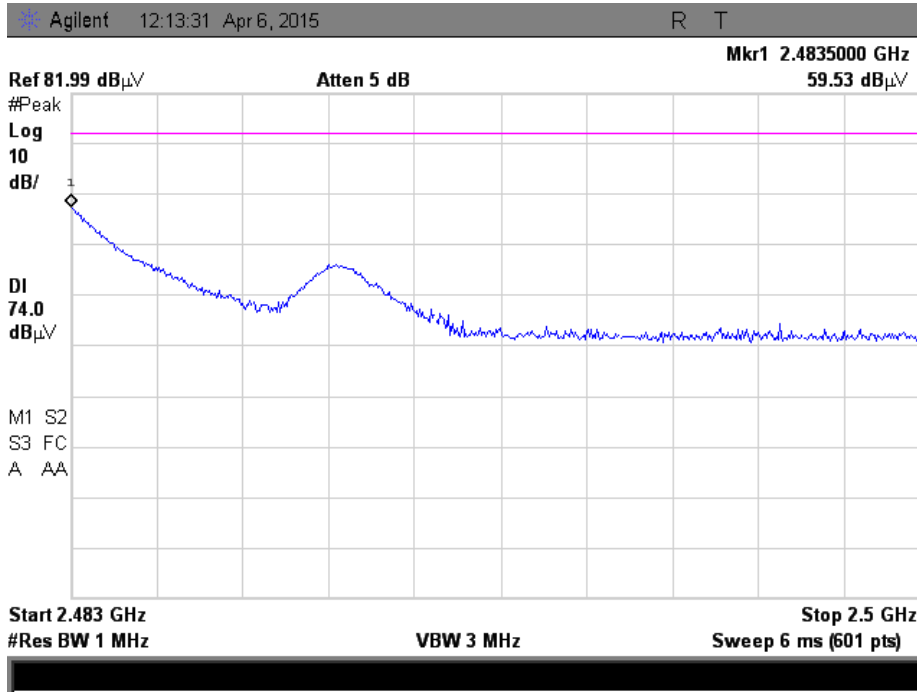


Restricted Band 2300 – 2390 MHz – Avg Tuned Frequency= 2402 MHz

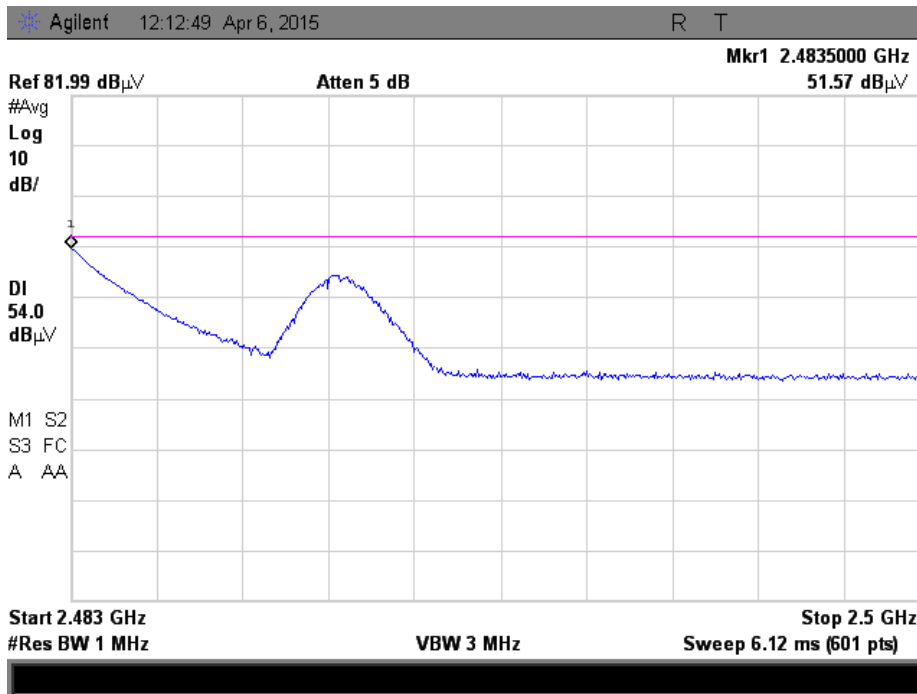




Restricted Band 2483.5 – 2500 MHz – Peak Tuned Frequency= 2480 MHz



Restricted Band 2483.5 – 2500 MHz – Avg Tuned Frequency= 2480 MHz



Occupied Bandwidth

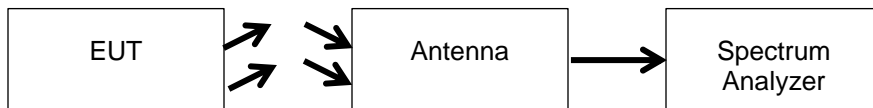
Name of Test: Occupied Bandwidth
Test Equipment Utilized: i00271, i00331, i00428

Engineer: Alex Macon
Test Date: 4/6/15

Test Procedure

The EUT was tested in a semi-anechoic chamber set 3m from the receiving antenna. The Span was set wide enough to capture the entire transmit spectrum and the resolution bandwidth was set to at least 1% of the span. The analyzer was set to max hold and when the entire spectrum was captured the 6dB and 99% bandwidths were measured to verify the bandwidth met the specification.

Test Setup



6 dB Occupied Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
2402	720.1	≥ 500	Pass
2442	717.8	≥ 500	Pass
2480	722.2	≥ 500	Pass

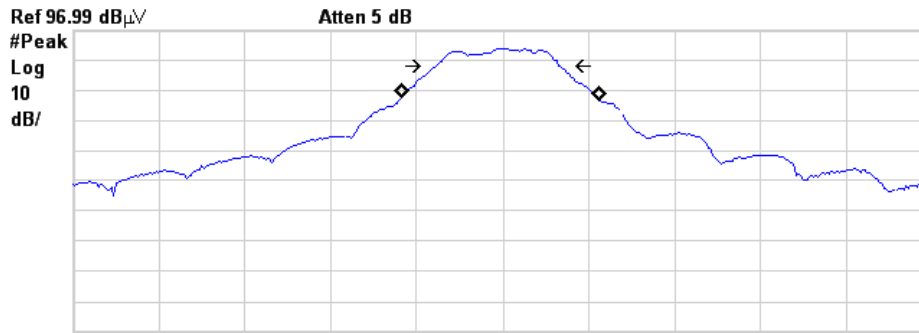
99% Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Result
2402	1.143	Pass
2442	1.221	Pass
2480	1.304	Pass



Occupied Bandwidth 2402 MHz

Agilent 10:58:20 Apr 6, 2015 R T



Center 2.402 GHz #Res BW 100 kHz #VBW 300 kHz Span 5 MHz Sweep 5 ms (401 pts)

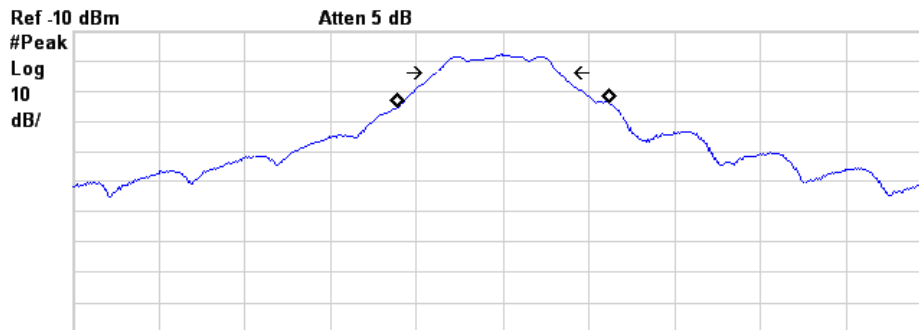
Occupied Bandwidth
1.1435 MHz

Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error -13.734 kHz
x dB Bandwidth 720.106 kHz

Occupied Bandwidth 2442 MHz

Agilent 11:41:29 Apr 6, 2015 R T



Center 2.442 GHz #Res BW 100 kHz #VBW 300 kHz Span 5 MHz Sweep 6 ms (601 pts)

Occupied Bandwidth
1.2214 MHz

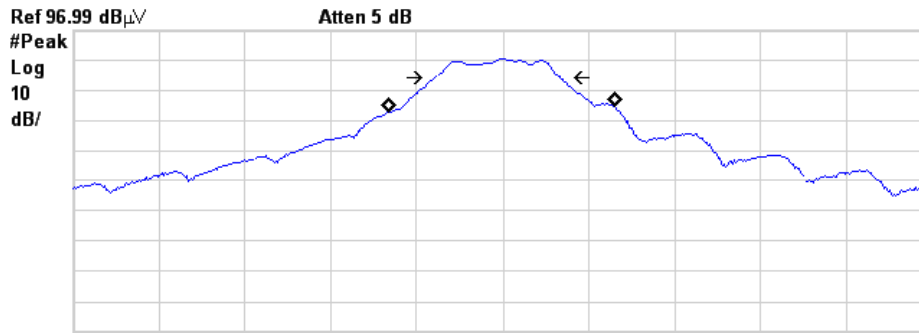
Occ BW % Pwr 99.00 %
x dB -6.00 dB

Transmit Freq Error 5.171 kHz
x dB Bandwidth 717.812 kHz



Occupied Bandwidth 2480 MHz

Agilent 12:06:41 Apr 6, 2015 R T



Center 2.48 GHz Span 5 MHz
#Res BW 100 kHz #VBW 300 kHz Sweep 6 ms (601 pts)

Occupied Bandwidth
1.3045 MHz

Occ BW % Pwr 99.00 %
x dB -6.00 dB

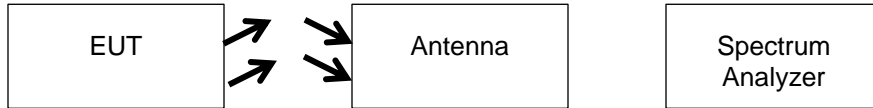
Transmit Freq Error -3.033 kHz
x dB Bandwidth 722.238 kHz

Transmitter Power Spectral Density (PSD)

Name of Test: Transmitter Power Spectral Density (PSD) **Engineer:** Alex Macon
Test Equipment Utilized: i00271, i00331, i00428 **Test Date:** 4/6/15

Test Procedure

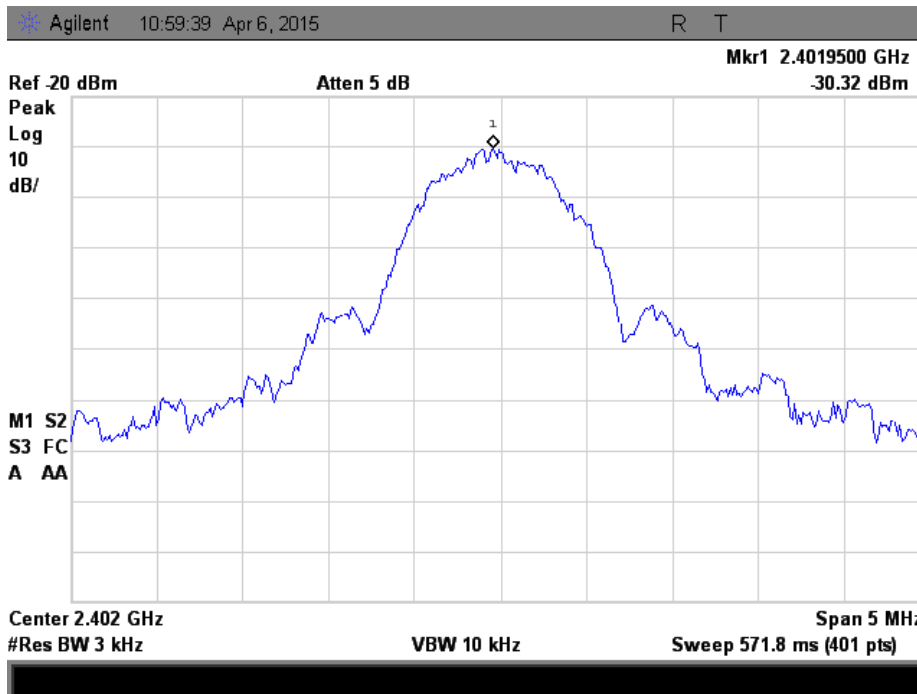
The EUT was connected directly to a spectrum analyzer. The test was performed per section 6.11.2.3 of C63.10 - 2009 "Procedure for determining PSD for DTS devices".

Test Setup

PSD Summary

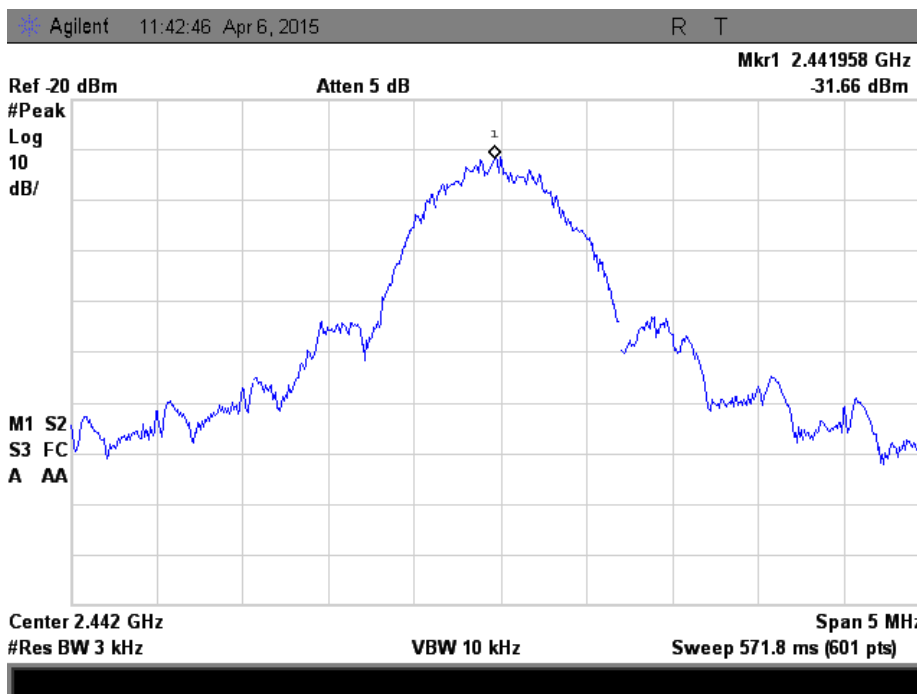
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2402	-30.32	8	Pass
2442	-31.66	8	Pass
2480	-33.07	8	Pass



PSD 2402 MHz

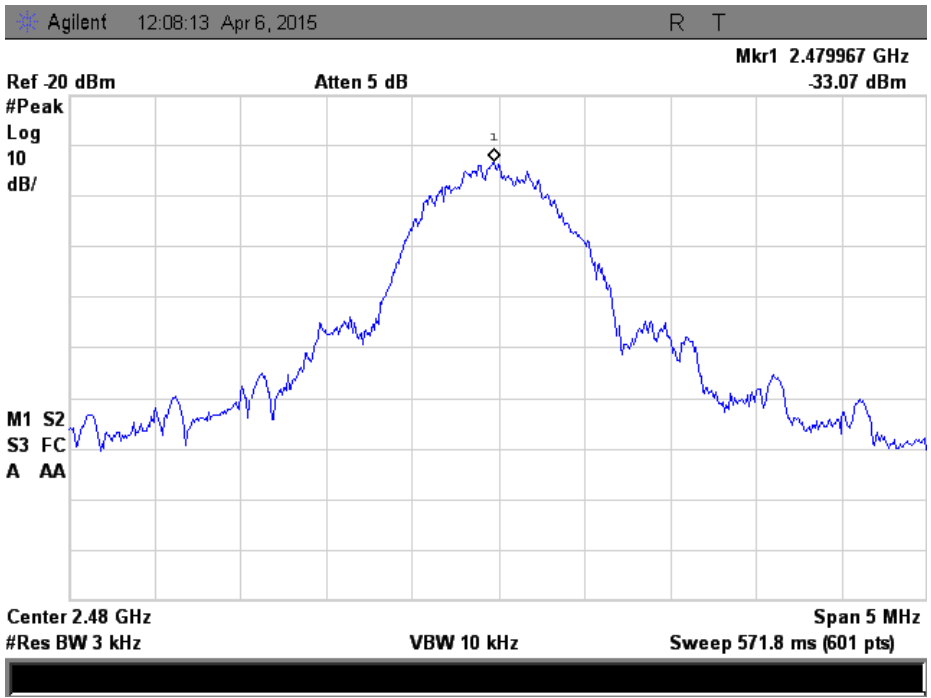


PSD 2442 MHz





PSD 2480 MHz



A/C Powerline Conducted Emission

Name of Test:

A/C Powerline Conducted Emissions

Engineer: Alex Macon

Test Equipment Utilized:

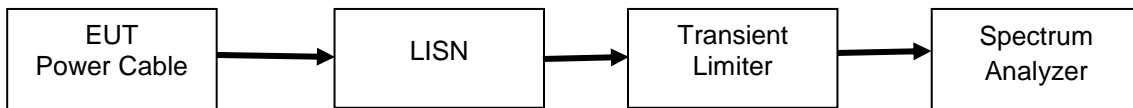
i00033, i00123, i00446 ,i00447

Test Date: 4/7/15

Test Procedure

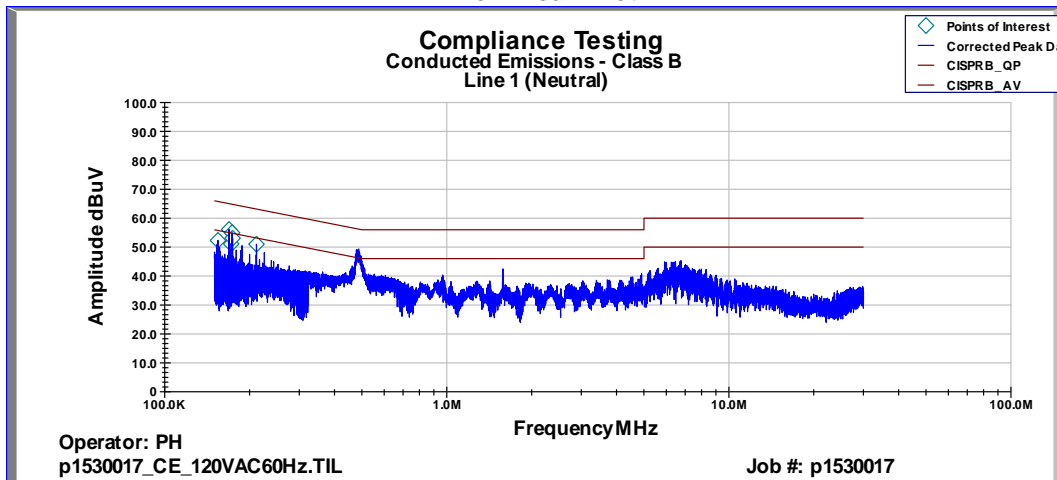
The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup

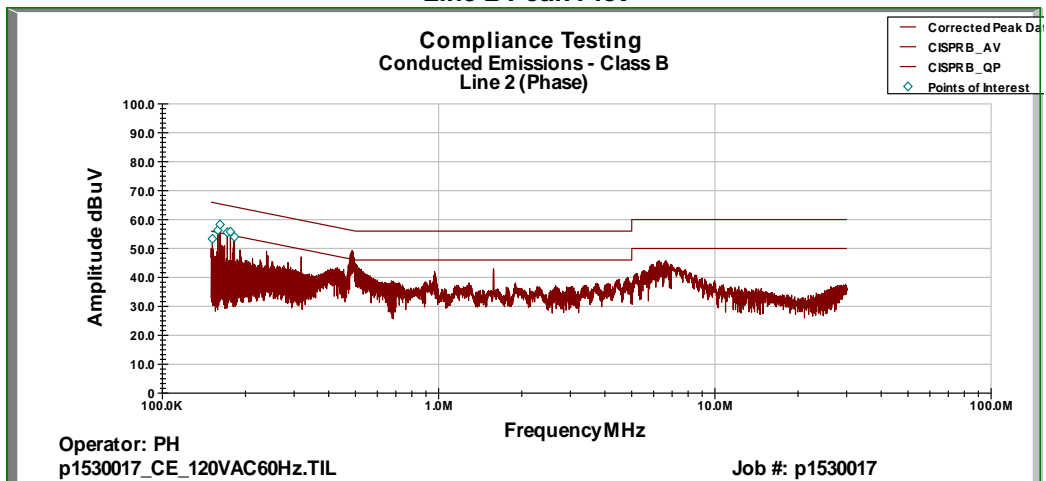


Conducted Emission Test Results

Line 1 Peak Plot



Line 2 Peak Plot



Line 1 Neutral AVG Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
519.96 KHz	18.78	0.1	0.03	10.1	29.013	46	-16.987
514.14 KHz	20.46	0.1	0.03	10.1	30.693	46	-15.307
506.85 KHz	22.8	0.1	0.03	10.1	33.033	46	-12.967
490.5 KHz	29.28	0.1	0.03	10.1	39.507	46.271	-6.765
488.2 KHz	29.82	0.1	0.03	10.1	40.05	46.337	-6.287
483.2 KHz	28.84	0.1	0.03	10.1	39.073	46.48	-7.407

Line 2 Phase AVG Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
511.78 KHz	15.82	0.1	0.03	10.1	26.053	46	-19.947
508.78 KHz	16.27	0.1	0.03	10.1	26.497	46	-19.503
502.67 KHz	18.49	0.1	0.03	10.1	28.72	46	-17.28
495.91 KHz	20.42	0.1	0.03	10.1	30.65	46.117	-15.467
492.3 KHz	22.23	0.1	0.03	10.1	32.46	46.22	-13.76
491.37 KHz	22.49	0.1	0.03	10.1	32.717	46.247	-13.53

Line 1 Neutral QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
519.96 KHz	26.88	0.1	0.03	10.1	37.11	56	-18.89
514.14 KHz	27.21	0.1	0.03	10.1	37.44	56	-18.56
506.85 KHz	27.57	0.1	0.03	10.1	37.8	56	-18.2
490.5 KHz	32.69	0.1	0.03	10.1	42.92	56.271	-13.351
488.2 KHz	33.18	0.1	0.03	10.1	43.41	56.337	-12.927
483.2 KHz	32.91	0.1	0.03	10.1	43.14	56.48	-13.34

Line 2 Phase QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
511.78 KHz	30.46	0.1	0.03	10.1	40.69	56	-15.31
508.78 KHz	30.48	0.1	0.03	10.1	40.71	56	-15.29
502.67 KHz	31.59	0.1	0.03	10.1	41.82	56	-14.18
495.91 KHz	32.09	0.1	0.03	10.1	42.32	56.117	-13.797
492.3 KHz	32.66	0.1	0.03	10.1	42.89	56.22	-13.33
491.37 KHz	32.68	0.1	0.03	10.1	42.91	56.247	-13.337



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
EMI Receiver	HP	8546A	i00033	2/26/15	2/26/16
Transient Limiter	Com-Power	LIT-153	i00123	Verified on:4/7/15	
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	5/8/14	5/8/16
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	4/9/12	4/9/2015
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	4/1/15	4/1/16
Voltmeter	Fluke	75III	i00320	3/24/15	3/24/16
Spectrum Analyzer	Agilent	E4407B	i00331	6/13/14	6/13/15
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/8/13	10/8/15
EMI Analyzer	Agilent	E7405A	i00379	2/5/15	2/5/16
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	11/26/13	11/26/15
LISN	COM-Power	LI-125A	i00446	7/25/14	7/25/15
LISN	COM-Power	LI-125A	i00447	7/25/14	7/25/15

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT