Compliance Testing, LLC
Previously Flom Test Lab
EMI, EMC, RF Testing Experts Since 1963

toll-free: (866) 311-3268
fax: (480) 926-3598
http://www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: Emotiv Inc.

Model: Emotiv EPOC Model 1.1

Description: EEG Neuroheadset for consumer use - Trademarked as EPOC+

Serial Number: N/A

FCC ID: 2ADIH-EPOC02

To

FCC Part 15.247 DTS

Date of Issue: April 10, 2015

On the behalf of the applicant:	**Emotiv Inc.** **490 Post Street** **Suite 824** **San Francisco, CA 94102**
Attention of:	**Geoffrey Mackellar, CTO** **Ph: (415) 828-9895** **E-Mail: geoff@emotiv.co**

Prepared By
Compliance Testing, LLC
1724 S. Nevada Way
Mesa, AZ 85204
(480) 926-3100 phone / (480) 926-3598 fax
www.compliancetesting.com
Project No: p14a0008

Alex Macon
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	November 1, 2014	Alex Macon	Original Document
2.0	April 9, 2015	Alex Macon	Included Power Spectral Density data

Table of Contents

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 (ºC)	**Humidity (%)**	**Pressure (mbar)**
25.1 – 25.7	40.2 – 47.6	965.2 – 968.3

EUT Description
Model: Emotiv EPOC Model 1.1
Description: EEG Neuroheadset for consumer use - Trademarked as EPOC+
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
3	USB Dongle	Emotiv	1.0	N/A
1	Bluetooth Dongle	Nordic Semiconductor	PCA10000	N/A

Cables: None

Modifications: None

15.203: Antenna Requirement:

X	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 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	

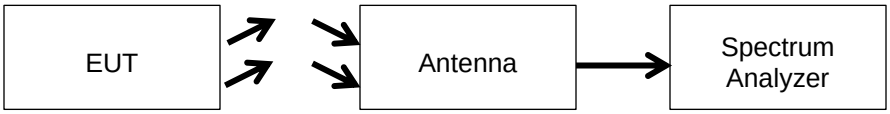
Peak Output Power

Name of Test:	Peak Output Power	**Engineer:**	Alex Macon
Test Equipment Utilized:	i00103, i00271, i00379, i00428	**Test Date:**	10/14/14

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 antenna, amplifier and cable correction factors were input into the spectrum analyzer before recording the Measured Level to ensure accurate readings.

Test Setup



Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2402	-15.2	1 W (30 dBm)	Pass
2442	-16.1	1 W (30 dBm)	Pass
2480	-17.5	1 W (30 dBm)	Pass

Radiated Spurious Emissions

Name of Test:	Radiated Spurious Emissions	**Engineer:** Alex Macon
Test Equipment Utilized:	i00103, i00267, i00271, i00379, i00428	**Test Date:** 10/14/14

Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

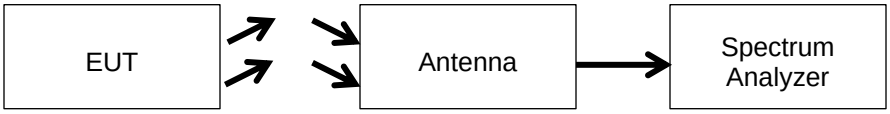
The EUT was tested in a semi anechoic chamber set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 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 = 89.5 dBuV
Limit = 69.5 dBuV

Test Setup



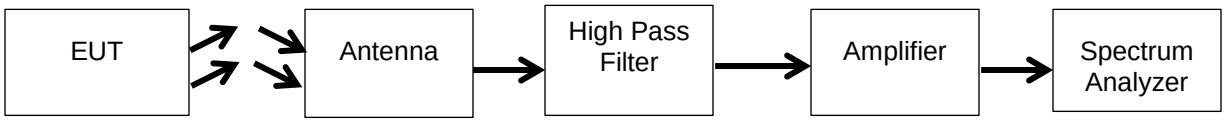
Radiated Spurious Emissions Test Data: 30 MHz – 1000 MHz

Frequency (MHz)	Measured Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity H or V
30.4785	44.38	69.5	-25.12	V
34.174	40.87	69.5	-28.63	V
55.965	45.01	69.5	-24.49	V
66.950	34.03	69.5	-35.47	V
90.851	29.98	69.5	-39.52	V
159.165	15.11	69.5	-54.39	V

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, 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 Measured Value (dBuV/m)	Average Limit (dBuV/m)	Result
2402	4804	44.68	74.0	35.41	54.0	Pass
2441	4884.2	46.21	74.0	40.38	54.0	Pass
2480	4960.2	42.73	74.0	38.34	54.0	Pass

No other emissions were detectable. All emissions were more than -20 dBc.

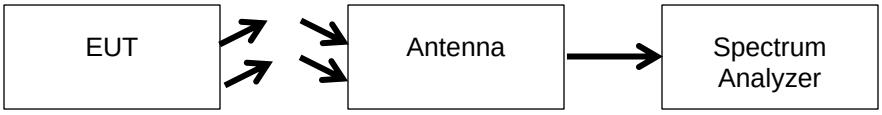
Emissions at Band Edges

Name of Test:	Emissions at Band Edges	**Engineer:** Alex Macon
Test Equipment Utilized:	i00103, i00271, i00379, i00428	**Test Date:** 10/14/14

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.

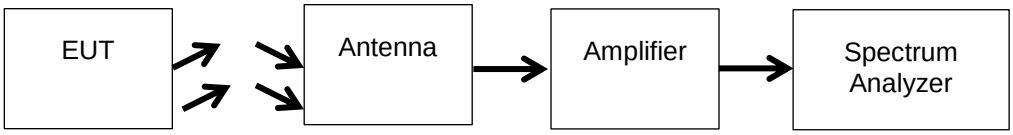
Band Edge Test Setup



Band Edge Emissions Summary

Tuned Frequency (MHz)	Emission Frequency (MHz)	Measured Value (dBc)	Detector	Limit (dBc)	Result
2402	2400	-45.17	Peak	-20	Pass
2480	2485.2	-39.35	Peak	-20	Pass

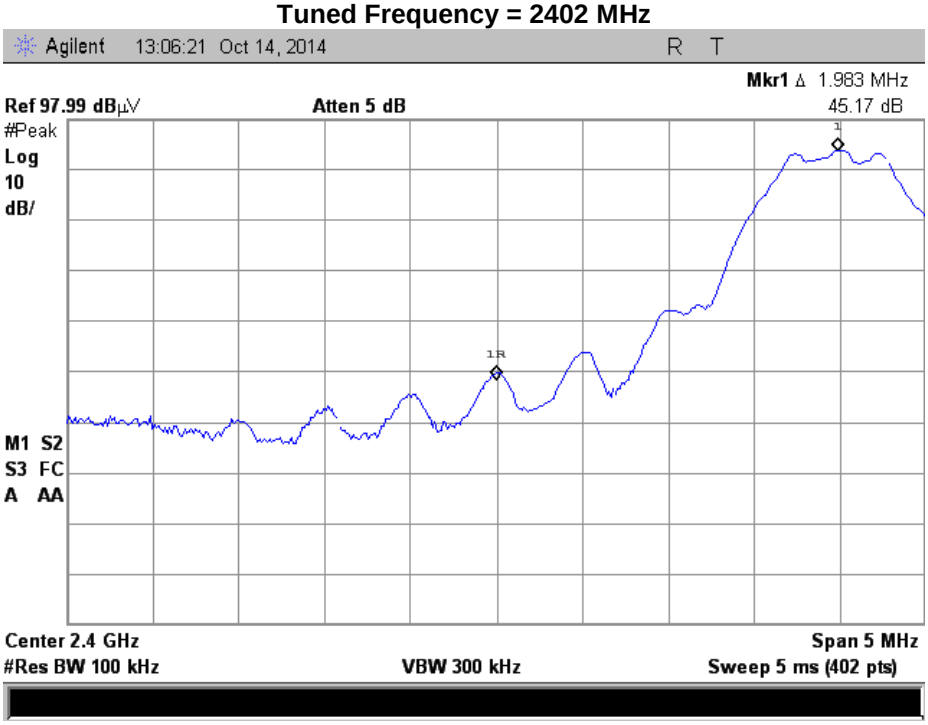
Restricted Band Test Setup



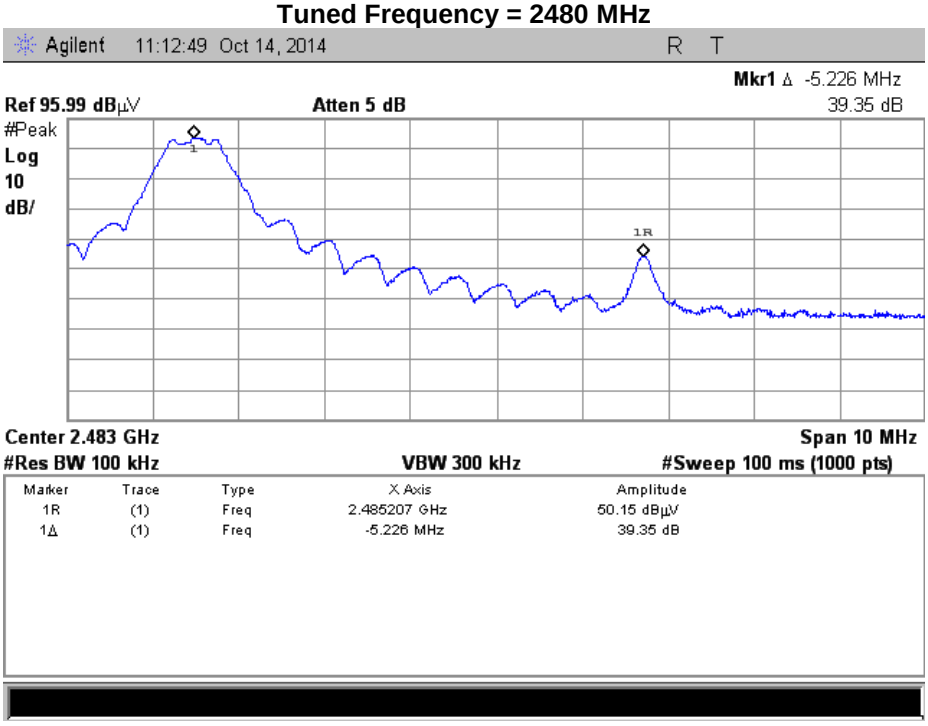
Restricted Band Emissions Summary

Restricted Band (MHz)	Emission Frequency (MHz)	Measured Value (dBuV/m)	Detector	Limit (dBuV/m)	Result
2310 – 2390	2376.27	54.96	Peak	74	Pass
2310 – 2390	2376.05	52.6	Average	54	Pass
2483.5 - 2500	2486.43	65.29	Peak	74	Pass
2483.5 - 2500	2484.16	48.38	Average	54	Pass

Band Edge 2400 MHz
Tuned Frequency = 2402 MHz



Band Edge 2483.5 MHz
Tuned Frequency = 2480 MHz



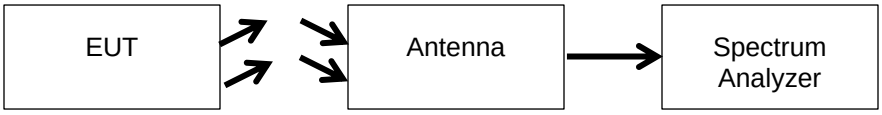
Occupied Bandwidth

Name of Test:	Occupied Bandwidth	**Engineer:** Alex Macon
Test Equipment Utilized:	i00103, i00271, i00345, i00379, i00428	**Test Date:** 11/18/14

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



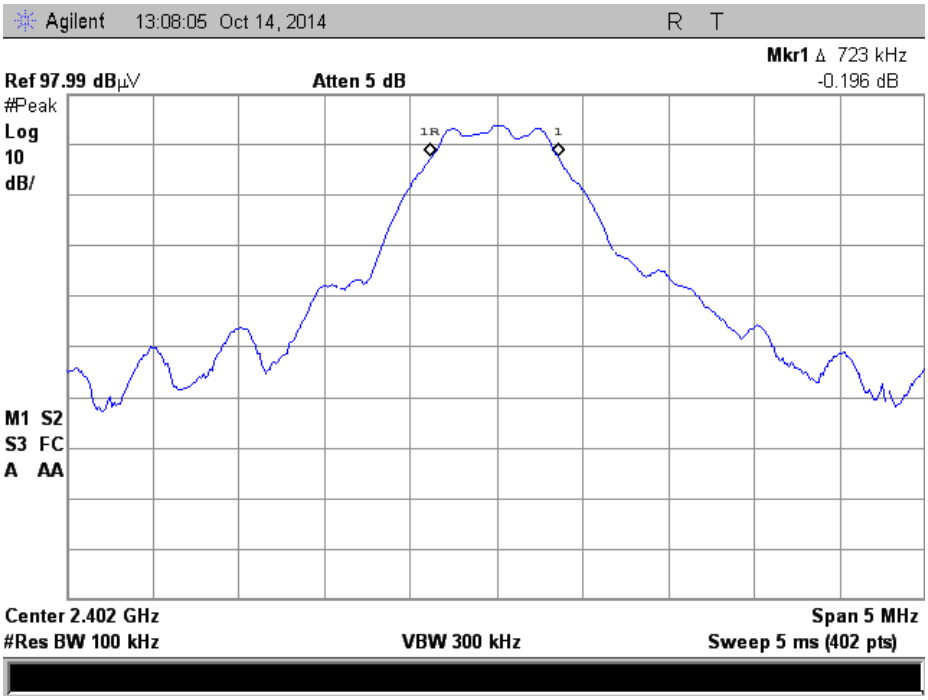
6 dB Occupied Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (kHz)	Specification Limit (kHz)	Result
2402	723	≥ 500	Pass
2442	752	≥ 500	Pass
2480	731	≥ 500	Pass

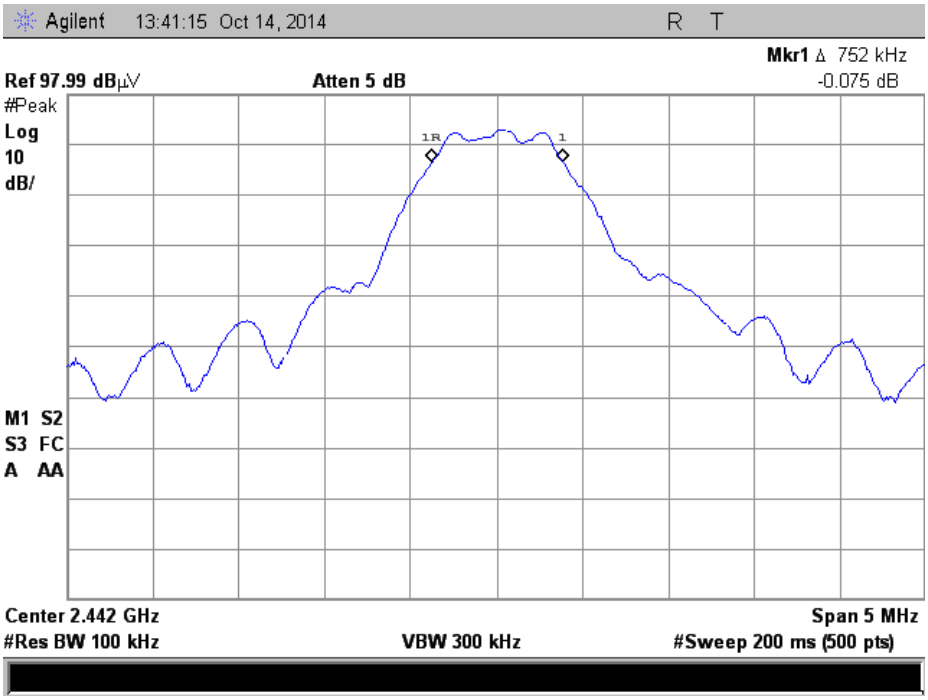
99% Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Result
2402	1.0676	Pass
2442	1.03475	Pass
2480	1.06122	Pass

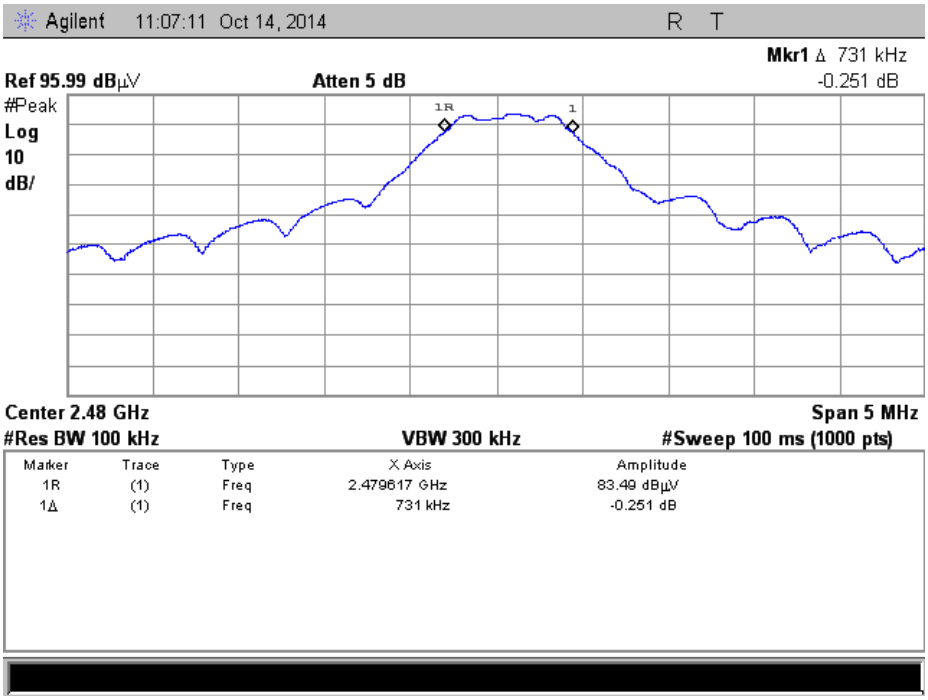
6dB Bandwidth 2402 MHz



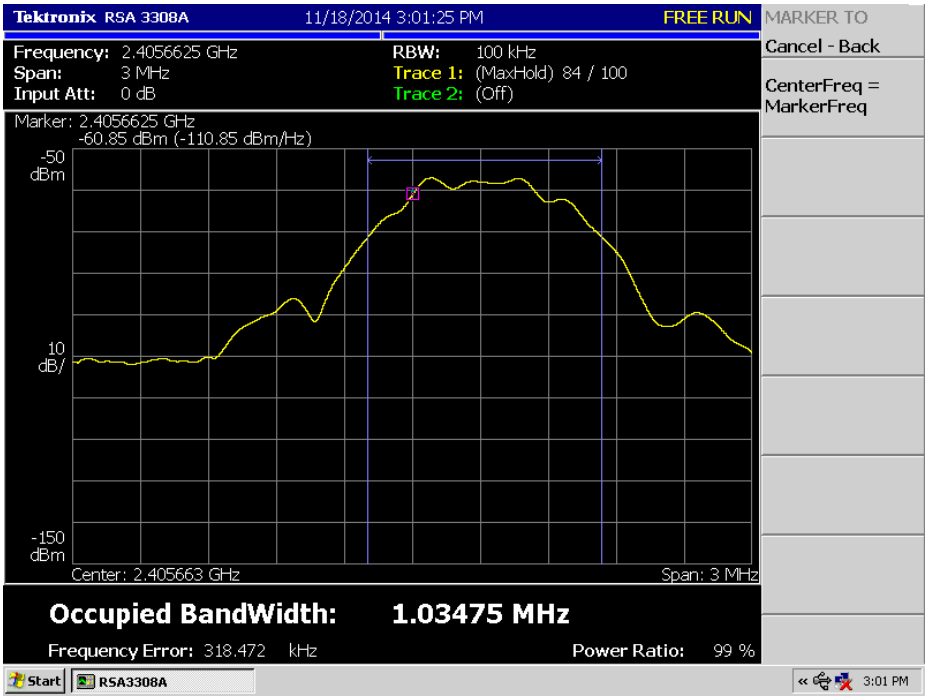
6dB Bandwidth 2442 MHz



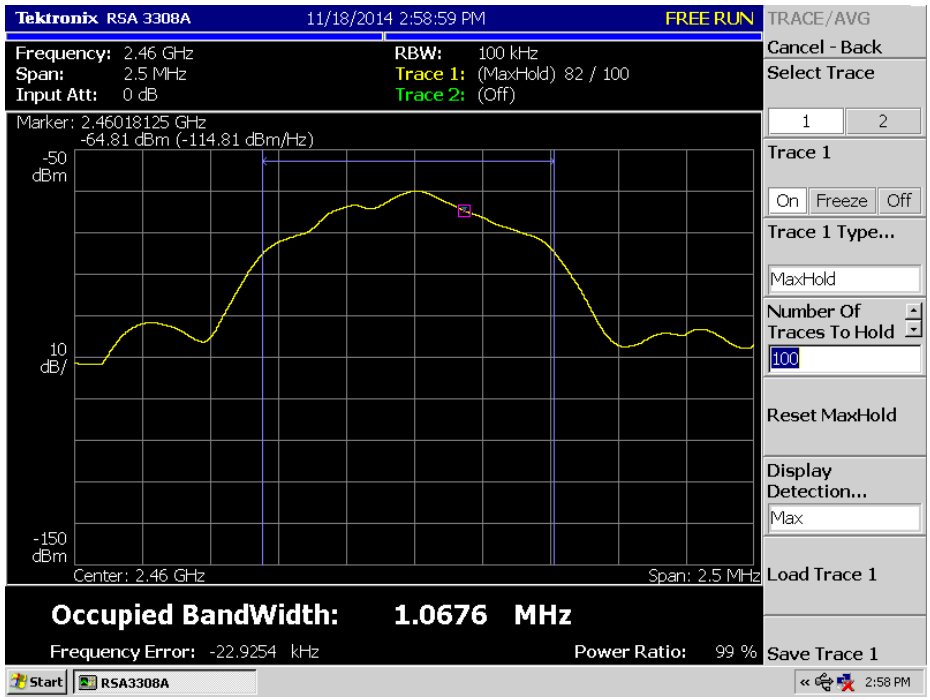
6dB Bandwidth 2480 MHz



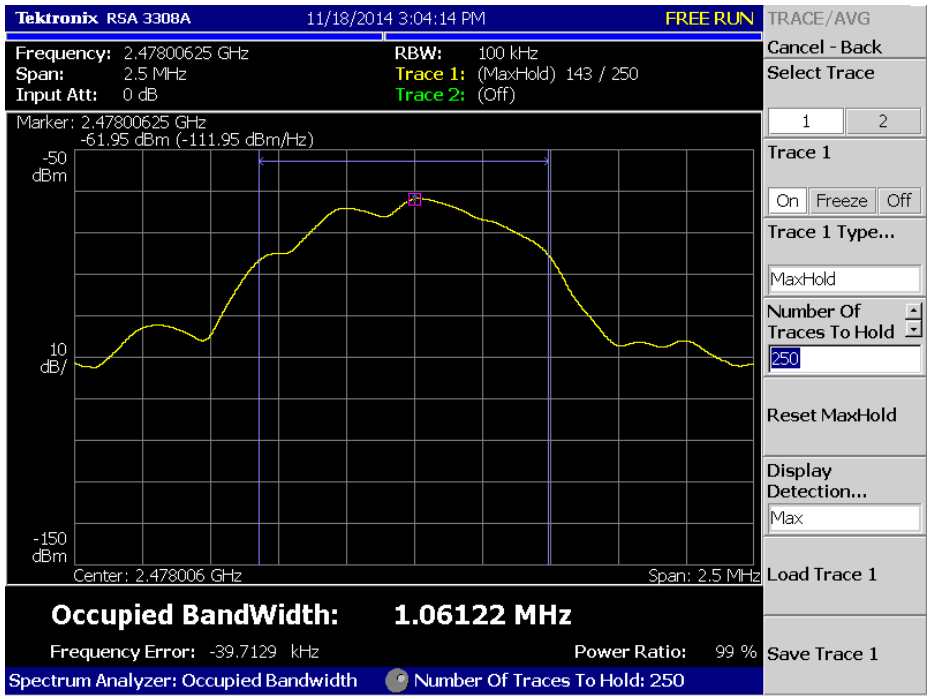
99% Bandwidth 2402 MHz



99% Bandwidth 2441 MHz



99% Bandwidth 2480 MHz



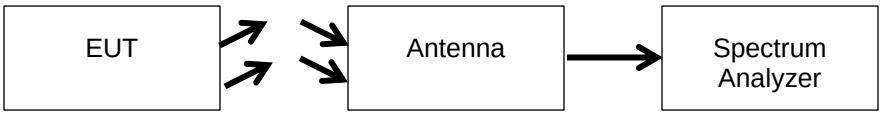
Transmitter Power Spectral Density (PSD)

Name of Test: Transmitter Power Spectral Density (PSD) **Engineer:** Alex Macon
Test Equipment Utilized: i00271, i00379, i00428 **Test Date:** 10/14/15

Test Procedure

The EUT was tested in a semi-anechoic chamber set 3m from the receiving antenna. The test was performed per section 6.11.2.3 of C63.10 - 2009 “Procedure for determining PSD for DTS devices”.

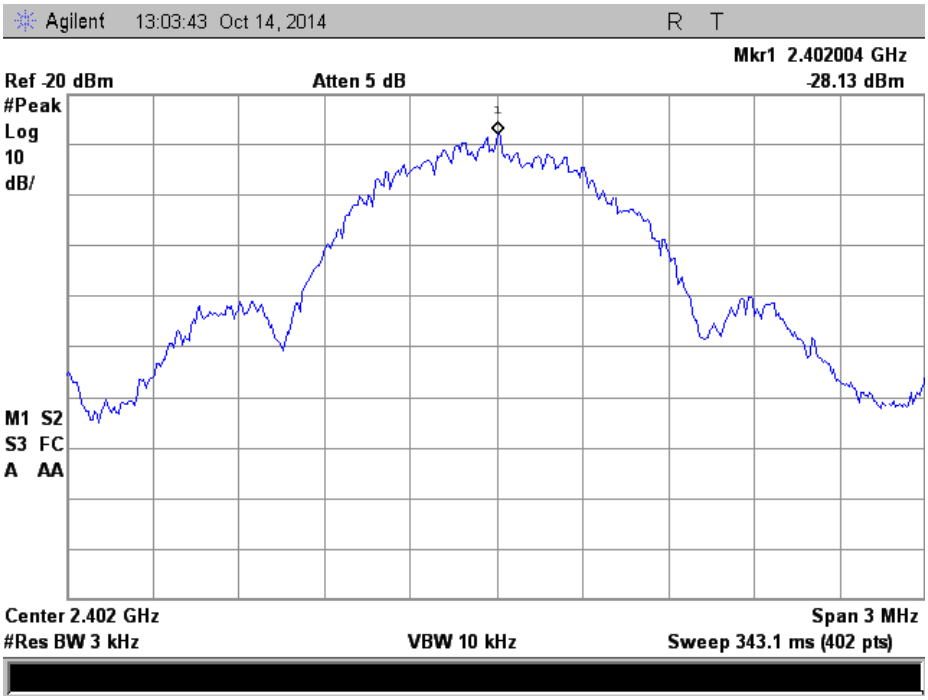
Test Setup



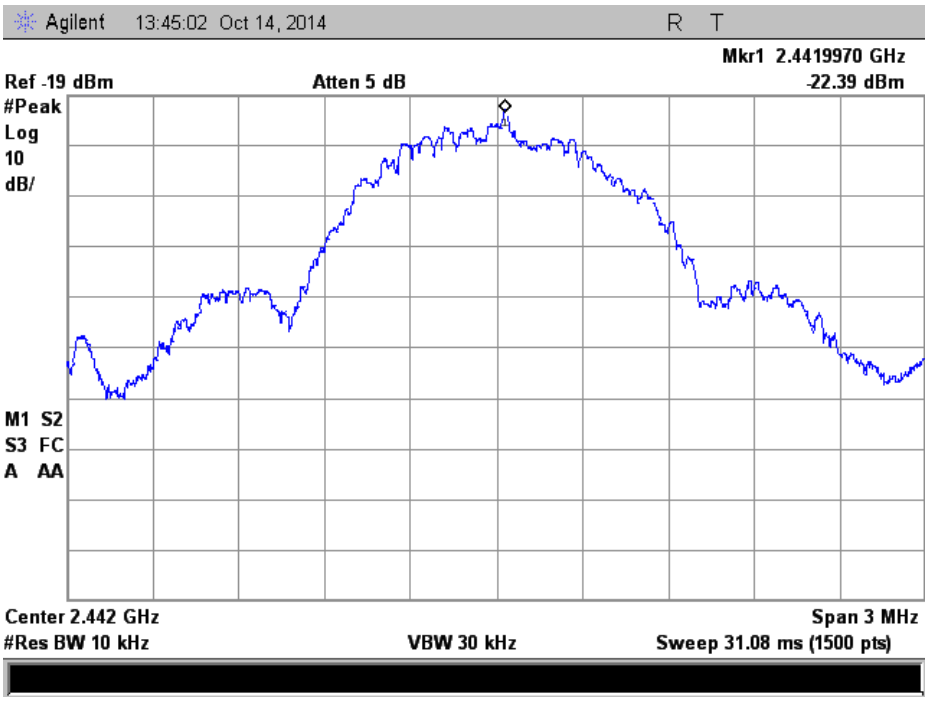
PSD Summary

Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2402	-28.13	8	Pass
2442	-22.39	8	Pass
2480	-30.7	8	Pass

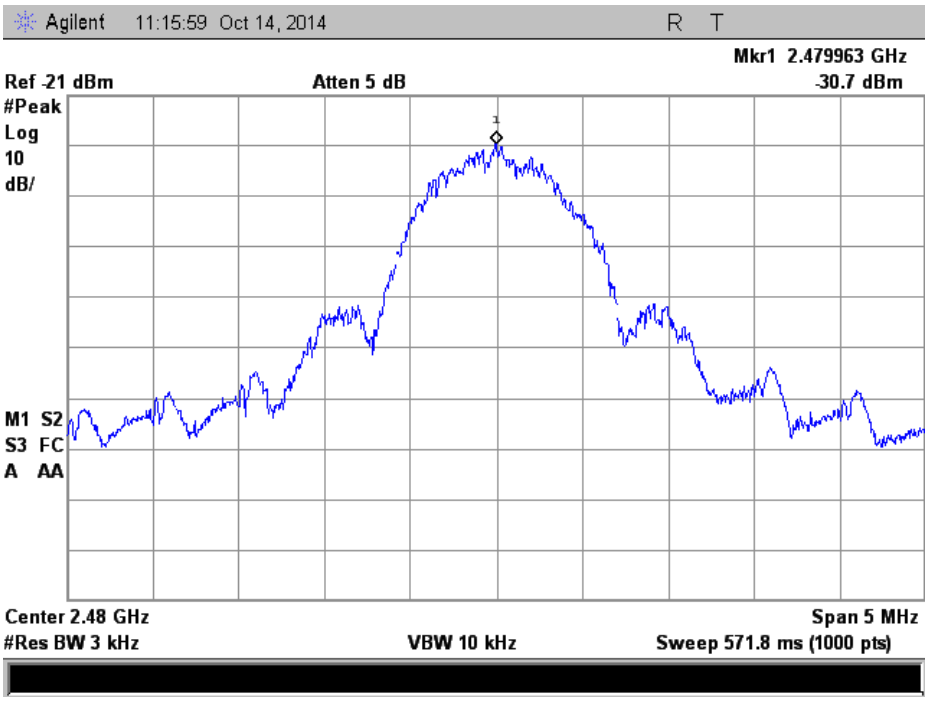
PSD 2402 MHz



PSD 2442 MHz



PSD 2480 MHz


Agilent 11:15:59 Oct 14, 2014
R T
Mkr1 2.479963 GHz
Ref 21 dBm
Atten 5 dB
-30.7 dBm
#Peak
Log
10
dB/
M1 S2
S3 FC
A AA
Center 2.48 GHz
Span 5 MHz
#Res BW 3 kHz
VBW 10 kHz
Sweep 571.8 ms (1000 pts)

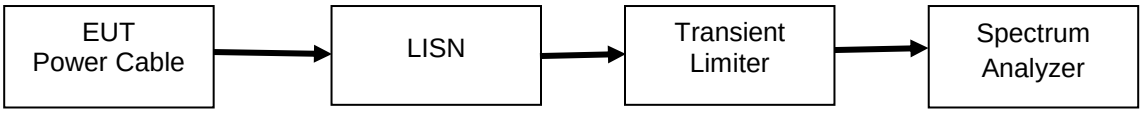
A/C Powerline Conducted Emission

Name of Test:	A/C Powerline Conducted Emissions	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00033, i00123, i00362, i00446, i00447	**Test Date:** 11/12/14

Test Procedure

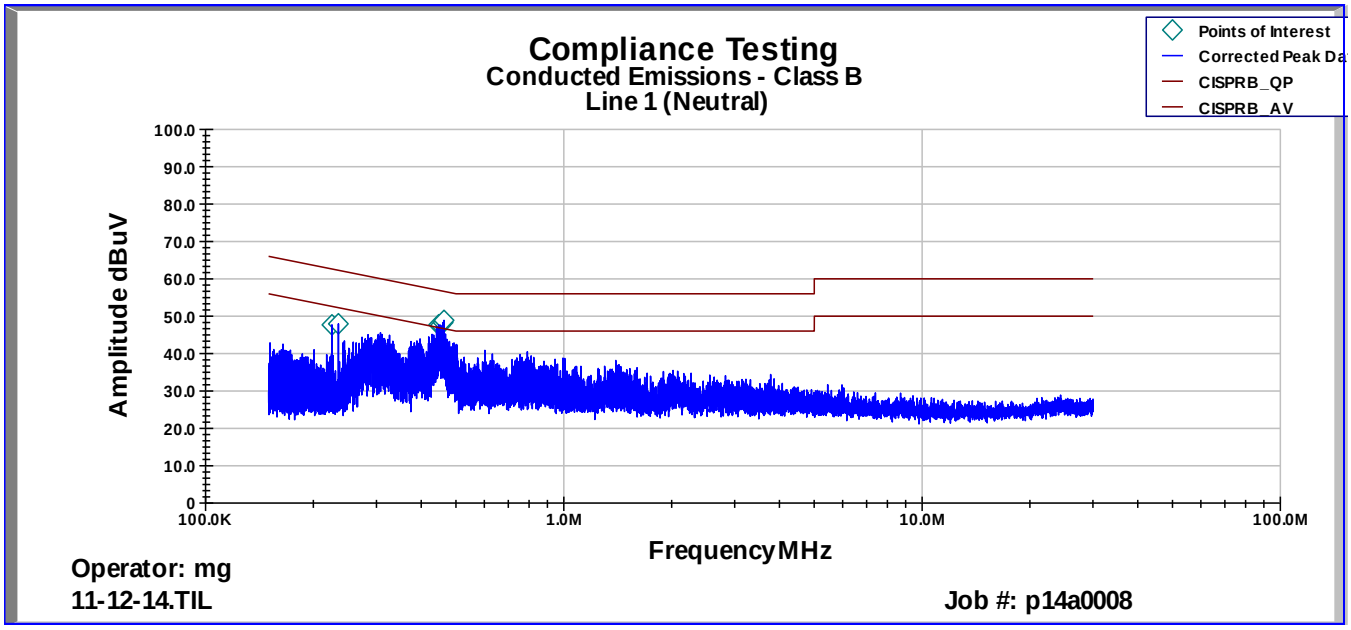
The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup

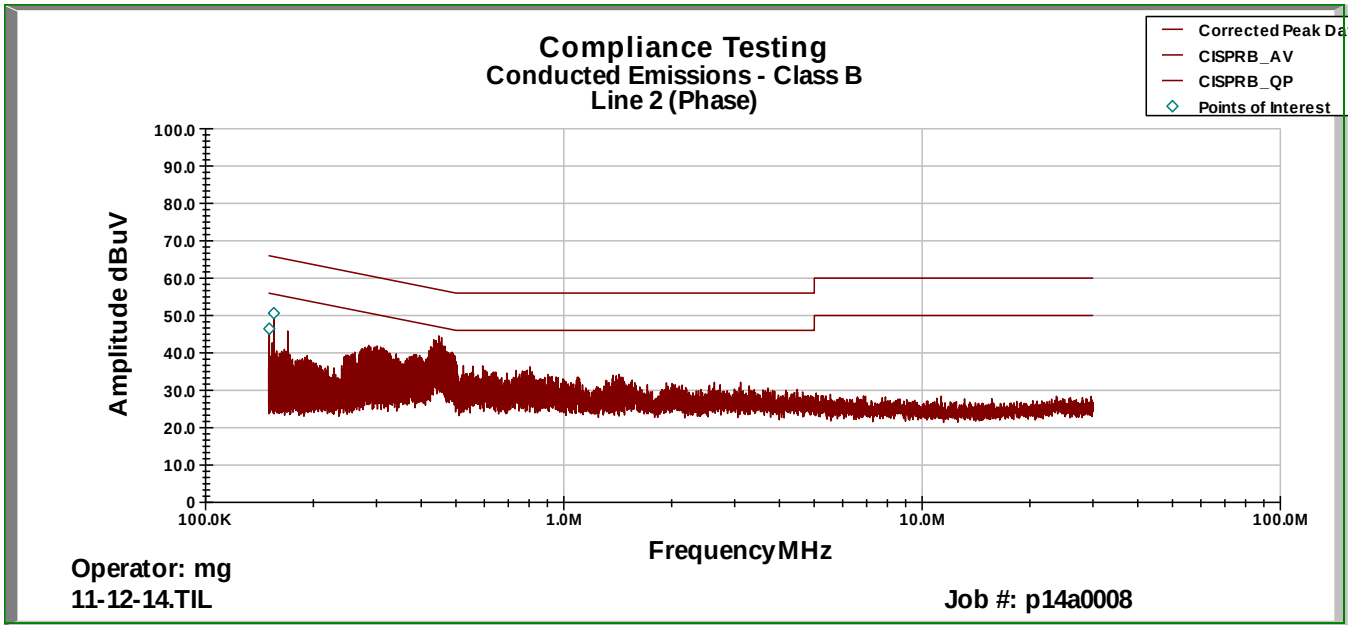


Conducted Emission Test Results

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)
458.78 KHz	13.97	0.1	0.03	10.1	24.2	47.178	-22.978
452.43 KHz	14.71	0.1	0.03	10.1	24.943	47.359	-22.416
450.2 KHz	14.55	0.1	0.03	10.1	24.783	47.423	-22.64
447.97 KHz	14.42	0.1	0.03	10.1	24.653	47.487	-22.833
251.32 KHz	8.03	0.17	0.023	10.1	18.33	53.105	-34.775
220.76 KHz	5.24	0.19	0.021	10.1	15.554	53.978	-38.424

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)
161.59 KHz	7.24	0.2	0.02	10.184	17.647	55.669	-38.021
159.8 KHz	6.85	0.2	0.02	10.2	17.275	55.72	-38.445

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)
458.78 KHz	30.05	0.1	0.03	10.1	40.28	57.178	-16.898
452.43 KHz	30.74	0.1	0.03	10.1	40.97	57.359	-16.389
450.2 KHz	30.96	0.1	0.03	10.1	41.19	57.423	-16.233
447.97 KHz	30.66	0.1	0.03	10.1	40.89	57.487	-16.597
251.32 KHz	23.55	0.174	0.023	10.1	33.847	63.105	-29.258
220.76 KHz	17.88	0.19	0.021	10.1	28.191	63.978	-35.788

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)
161.59 KHz	24.47	0.2	0.02	10.184	34.874	65.669	-30.795
159.8 KHz	24.75	0.2	0.02	10.2	35.172	65.72	-30.548

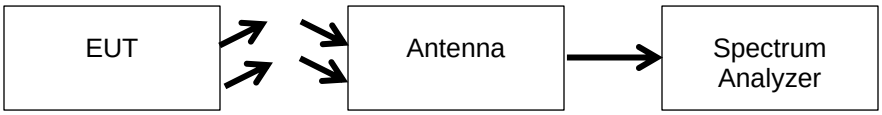
Receiver Spurious Emissions

Name of Test: Receiver Spurious Emissions **Engineer:** Alex Macon
Test Equipment Utilized: i00103, i00271, i00379, i00428 **Test Date:** 11/19/14

Test Procedure

The EUT was tested in a semi-anechoic chamber set 3m from the receiving antenna.. The receiver spurious emissions were measured from 30 MHz to greater than 3 times the highest tunable frequency.

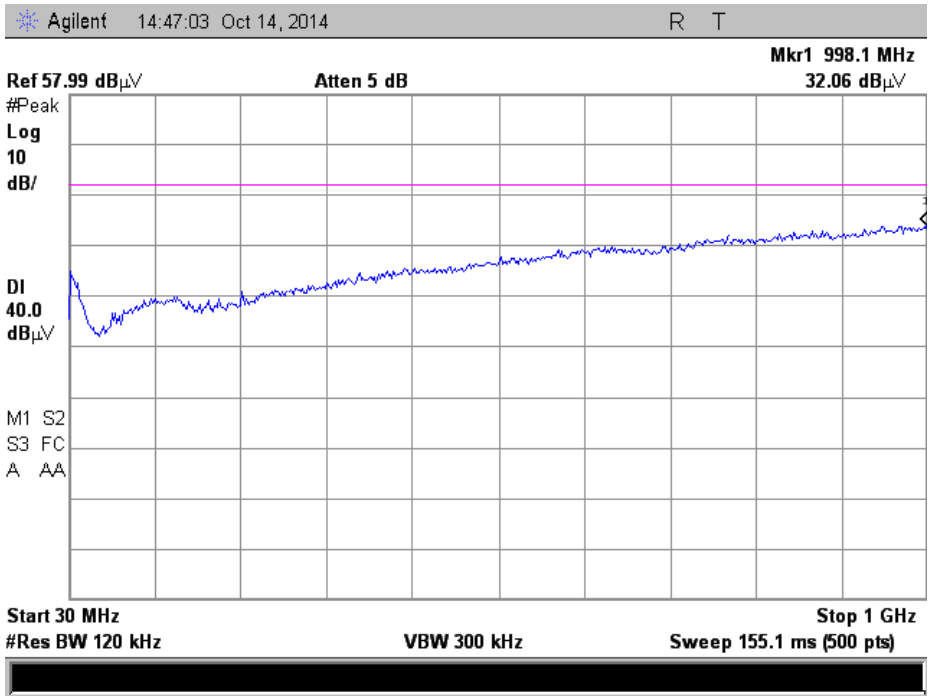
Test Setup



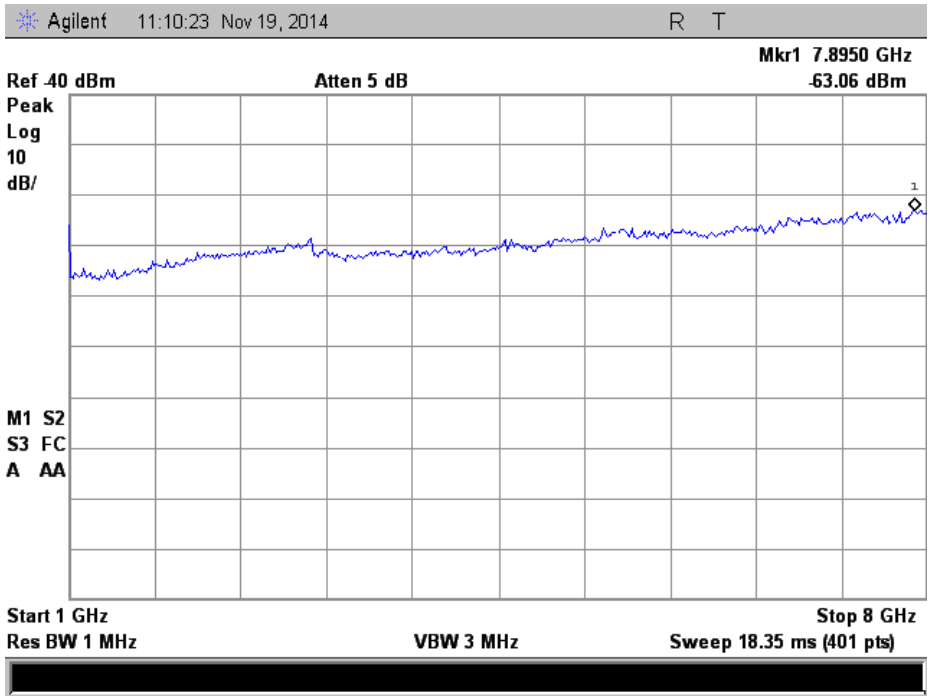
Receiver Spurious Emissions Summary

Frequency (MHz)	Recorded Measurement (dBuV/m)	Specification Limit (dBuV/m)	Result
998.1	32	54	Pass
1000 - 8000	44	54	Pass

Receiver Spurious Emissions 30 MHz – 1 GHz



Receiver Spurious Emissions 1 GHz – 8GHz



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Power Supply	Kenwood	PR18-3A	i00008	Verified on: 10/14/14	
EMI Receiver	HP	8546A	i00033	2/24/14	2/24/15
Horn Antenna	EMCO	3115	i00103	12/11/12	12/11/14
Transient Limiter	Com-Power	LIT-153	i00123	Verified on: 11/12/14	
High Pass Filter	Trilithic	4HX3400-3-XX	i00177	Verified on: 10/14/14	
Bi-Log Antenna	Schaffner	CBL611C	i00267	2/24/14	2/24/15
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	5/8/14	5/8/16
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	3/24/14	3/24/15
Voltmeter	Fluke	87III	i00319	2/22/14	2/22/15
Spectrum Analyzer	Tektronix	RSA3308A	i00345	3/18/14	3/18/15
AC Power Source	Behlman	BL 6000	i00362	Verified on: 11/12/14	
EMI Analyzer	Agilent	E7405A	i00379	1/14/14	1/14/15
Signal Generator	Rohde & Schwarz	SMU200A	i00405	12/11/13	12/11/14
Thermo Hygrometer	Omega	RH81	i00408	4/15/13	4/15/15
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