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Report On

EMC Evaluation of
Oculus VR, LLC
Oculus Rift Virtual Reality Headset System

FCC Part 15 Subpart B
ICES-003 Issue 5

Report No. SD72112194-1215H

December 2015



America

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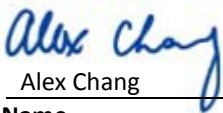
REPORT ON EMC Evaluation of the
Oculus VR, LLC
Oculus Rift Virtual Reality Headset System

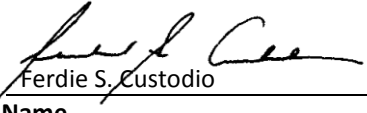
TEST REPORT NUMBER SD72112194-1215H

TEST REPORT DATE December 2015

PREPARED FOR Oculus VR, LLC
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Revision History

SD72112194-1215H Oculus VR, LLC Oculus Rift Virtual Reality Headset System					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
10/21/2015	Initial Release				Ferdinand Custodio

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SECTION 1

REPORT SUMMARY

EMC Evaluation of the
Oculus VR, LLC
Virtual Reality Headset System



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Oculus VR, LLC Oculus Rift Virtual Reality Headset System to the requirements of FCC Part 15 Subpart B and Industry Canada ICES-003.

Objective	To perform EMC Evaluation to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Oculus VR, LLC
Model Name	Oculus Rift
Model Number(s)	CV1
Serial Number(s)	N/A
Number of Samples Tested	1 set
Date sample(s) received	October 06, 2015
Highest Frequency Generated or Used	2478 MHz
Test Specification/Issue/Date	- FCC Part 15 Subpart B (October 1, 2014) - Spectrum Management and Telecommunications Interference-Causing Equipment Standard ICES-003 Information Technology Equipment (ITE) — Limits and methods of measurement (Issue 5 August 2012 updated November 2014).
Start of Test	October 09, 2015
Finish of Test	October 12, 2015
Name of Engineer(s)	Ferdie Custodio
Related Document(s)	setup and connection.txt



1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart B is shown below. Test results from these tests are deemed satisfactory evidence of compliance with Industry Canada Interference-Causing Equipment Standard ICES-003.

Part 15	Test Description	Result	Comments/Base Standard
§15.107	Conducted Limits	Compliant	Class B requirement
§15.109	Radiated Emission Limits	Compliant	Class B requirement

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an Oculus VR, LLC Oculus Rift Virtual Reality Headset System as shown in the following photographs. The system is comprised of the Oculus Virtual Reality Headset (HM-A), the Oculus Constellation Sensor (3P-A) and the Oculus Remote (Simple Input Device RE-A).



Equipment Under Test (HMD/HM-A, 1 of 3)



Equipment Under Test (SID/RE-A, 2 of 3)



Equipment Under Test (Tracker/3P-A, 3 of 3)



1.3.2 Labelling Requirement for Industry Canada

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section for every ITE unit:

- (i) Prior to marketing in Canada, for ITE manufactured in Canada, and;
- (ii) Prior to importation into Canada, for imported ITE.

The presence of the label on the ITE represents the manufacturer's or importer's Self-Declaration of Compliance (SDoC) to Industry Canada ICES-003. Each unit of an ITE model shall bear a label indicating the model's compliance with ICES-003.

The label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. When the dimension of the device is too small or it is otherwise not practical to place the label on the ITE, the label shall be placed in a prominent location in the user manual supplied with the ITE. The user manual may be in an electronic format and must be readily available.

Industry Canada ICES-003 Compliance Label

CAN ICES-3 (B)/NMB-3(B)

1.3.3 Labelling Requirement for Part 15 (Verification) Device

See FCC Publication Number: 784748 for details:

<https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=27980&switch=P>

1.3.4 Test Configuration Description

Test Configuration	Description
Default	HMD and Tracker in Demo Scene test mode with tracker bounds activated (normal operating mode). HMD sample received for verification doesn't have a separate "Receive" mode and will default to normal operating mode (hopping). SID is on standby mode with fresh battery installed for each test.

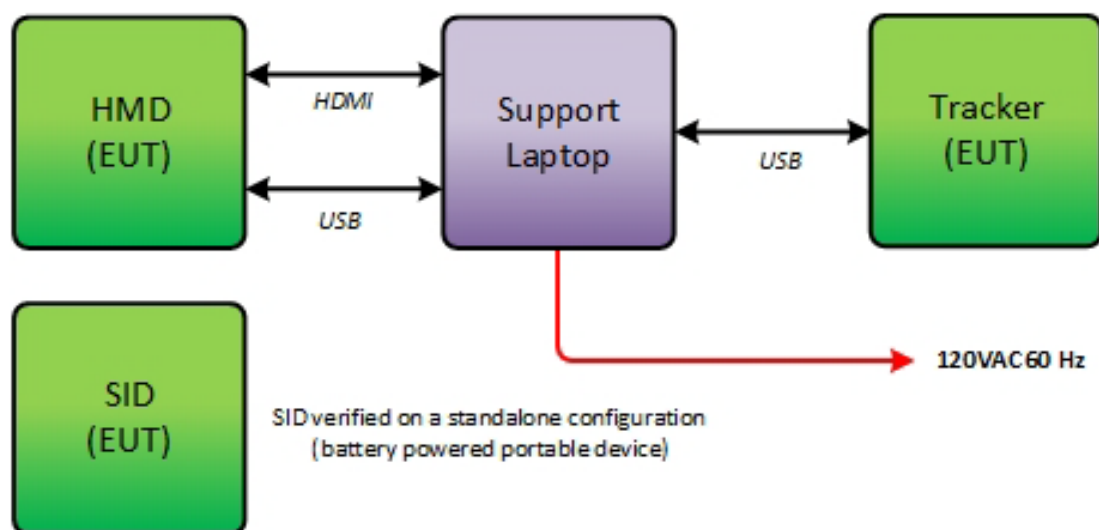
1.3.5 EUT Exercise Software

Oculus Configuration Utility Version 1.9 (SDK 0.7.0.4)

1.3.6 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Apple Inc.	Support laptop	Model MacBookPro 11.3 S/N: C02LX29CFR1M
LiteOn Technology Corporation	AC Adapter for Support Laptop	Model PA-1850-7 NSW25679

1.3.7 Simplified Test Configuration Diagram





1.4 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.5 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: N/A		
N/A		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.6 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2014. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.7 TEST FACILITY LOCATION

1.7.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 Fax: 858 546 0364.

1.7.2 TÜV SÜD America Inc. (Rancho Bernardo)

Sony Electronics Inc., Building #8, 16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 Fax: 858 546 0364.

1.8 TEST FACILITY REGISTRATION

1.8.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.



1.8.2 Industry Canada (IC) Registration No.: 3067A

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.

1.8.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.8.4 VCCI – Registration No. A-0230

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.



SECTION 2

TEST DETAILS

EMC Evaluation of the
Oculus VR, LLC
Virtual Reality Headset System

2.1 CONDUCTED LIMITS (CONDUCTED EMISSIONS VERIFICATIONS)

2.1.1 Specification Reference

Part 15 Subpart B §15.107(a)

2.1.2 Standard Applicable

Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

2.1.3 Equipment Under Test and Modification State

Serial No: N/A /Default Test Configuration

2.1.4 Date of Test/Initial of test personnel who performed the test

October 09, 2015/FSC

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	25.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.5 kPa

2.1.7 Additional Observations

- EUT is an USB powered device. Verification performed on a representative support laptop.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.1.8 for sample computation.

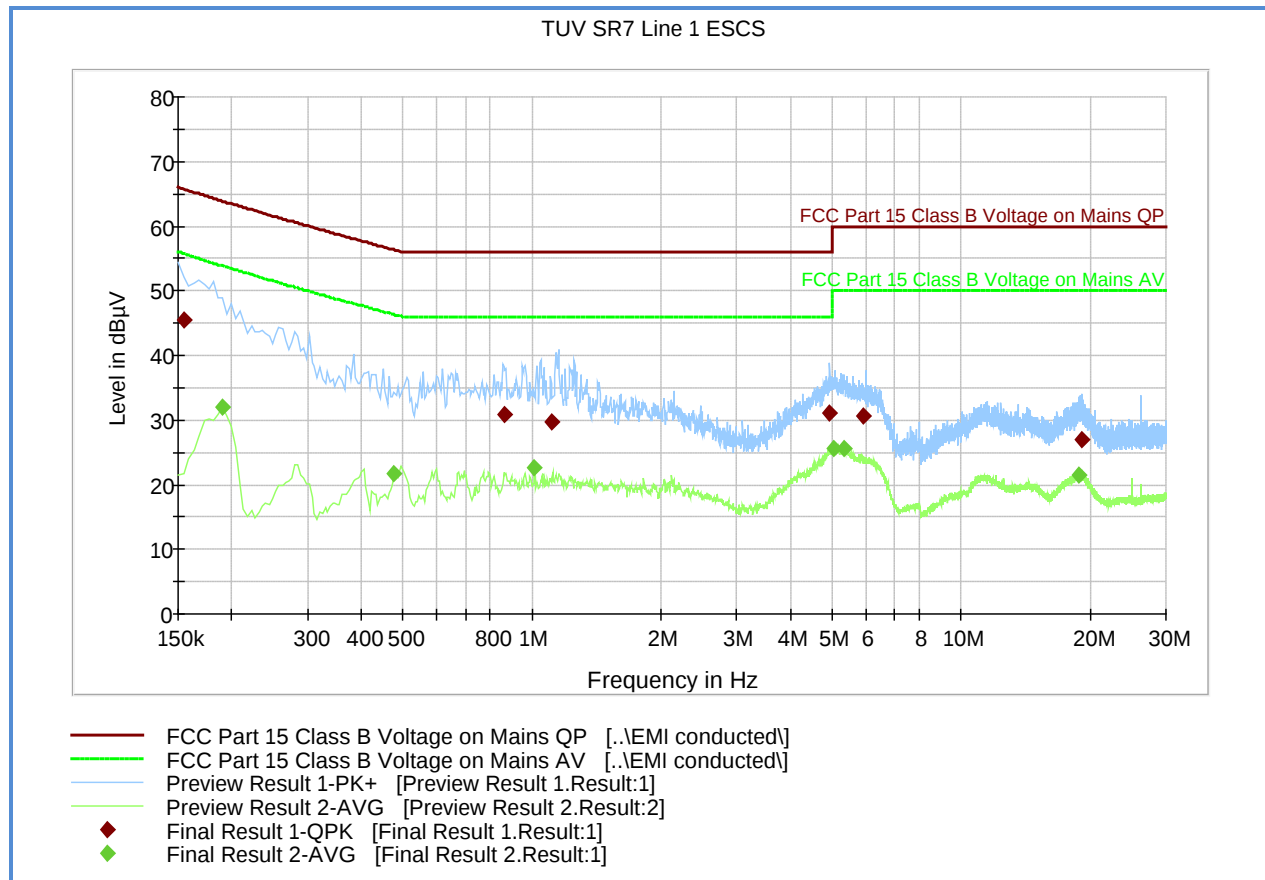
2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (db μ V) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8822(20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7567(LISN)	0.30	
Reported QuasiPeak Final Measurement (db μ V) @ 150kHz			26.2

2.1.9 Test Results

Compliant. See attached plots and tables.

2.1.1.10 FCC Class B 120V 60Hz (Line 1 – Hot)



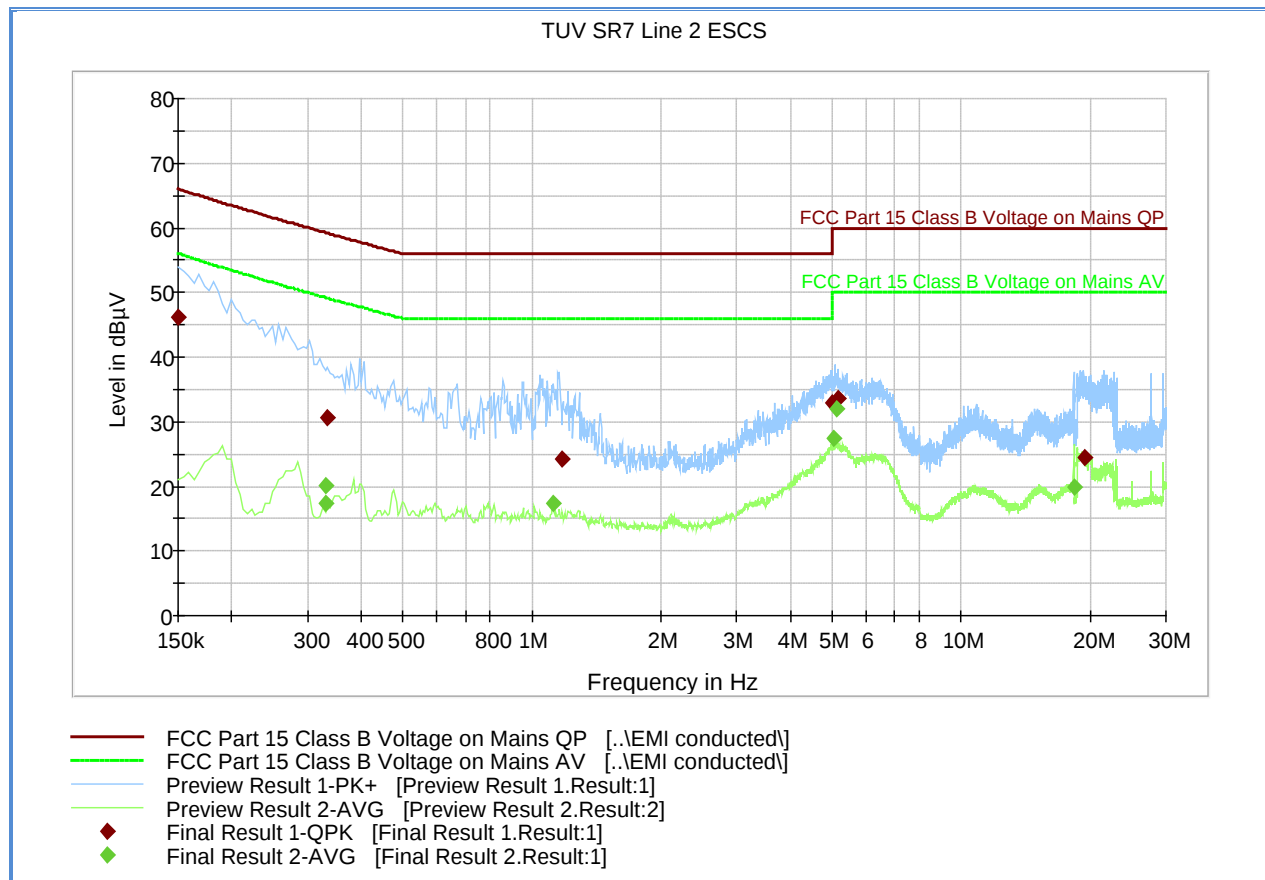
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.154500	45.5	1000.0	9.000	Off	L1	20.1	20.2	65.7
0.865500	30.8	1000.0	9.000	Off	L1	20.1	25.2	56.0
1.108500	29.8	1000.0	9.000	Off	L1	20.3	26.2	56.0
4.915500	31.1	1000.0	9.000	Off	L1	20.6	24.9	56.0
5.910000	30.6	1000.0	9.000	Off	L1	20.6	29.4	60.0
19.090500	27.0	1000.0	9.000	Off	L1	21.1	33.0	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.190500	32.0	1000.0	9.000	Off	L1	20.1	21.9	53.9
0.478500	21.8	1000.0	9.000	Off	L1	20.1	24.5	46.3
1.014000	22.5	1000.0	9.000	Off	L1	20.2	23.5	46.0
5.032500	25.5	1000.0	9.000	Off	L1	20.6	24.5	50.0
5.347500	25.6	1000.0	9.000	Off	L1	20.6	24.4	50.0
18.825000	21.4	1000.0	9.000	Off	L1	21.0	28.6	50.0

2.1.11 FCC Class B 120V 60Hz (Line 2 – Neutral)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	46.1	1000.0	9.000	Off	N	20.1	19.9	66.0
0.334500	30.7	1000.0	9.000	Off	N	20.2	28.5	59.2
1.171500	24.3	1000.0	9.000	Off	N	20.2	31.7	56.0
5.028000	32.9	1000.0	9.000	Off	N	20.5	27.1	60.0
5.176500	33.7	1000.0	9.000	Off	N	20.6	26.3	60.0
19.387500	24.5	1000.0	9.000	Off	N	20.9	35.5	60.0

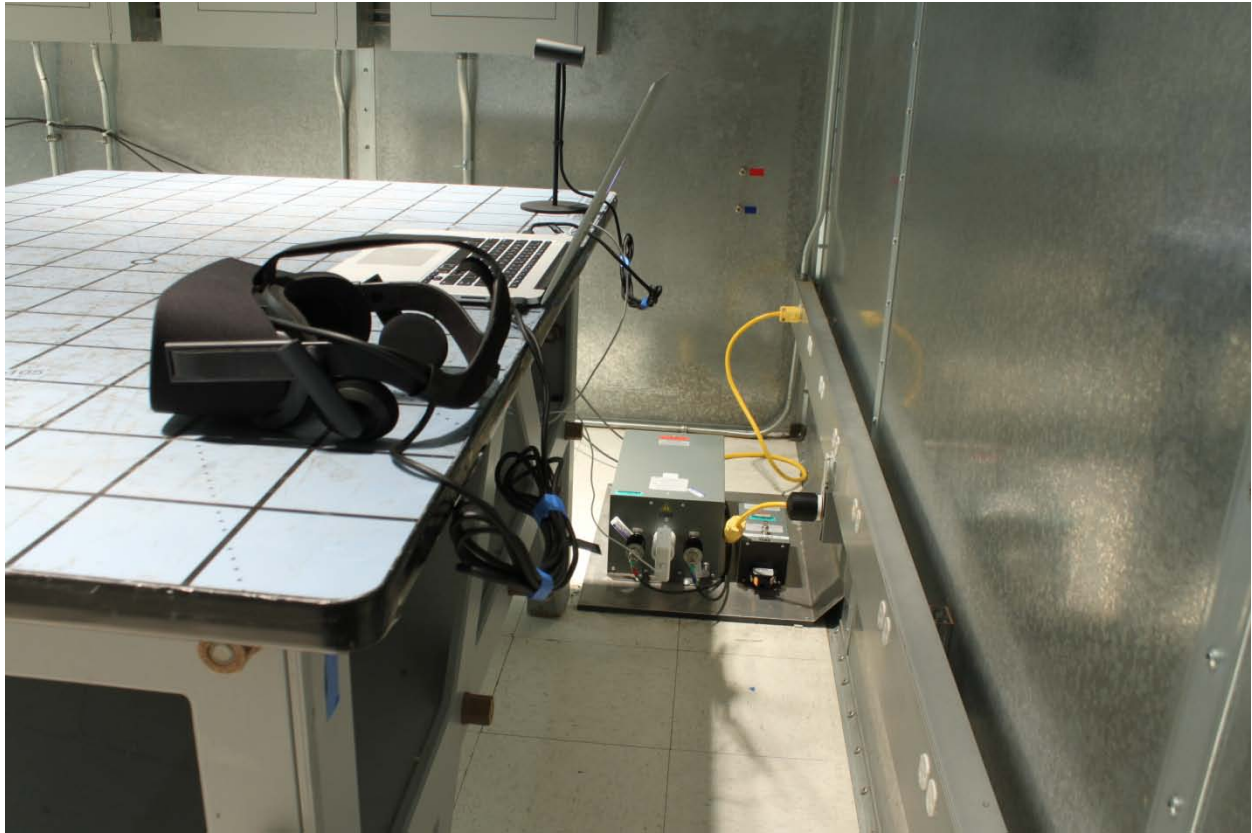
Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.330000	17.5	1000.0	9.000	Off	N	20.2	31.8	49.2
0.330000	20.1	1000.0	9.000	Off	N	20.2	29.2	49.2
1.117500	17.5	1000.0	9.000	Off	N	20.2	28.5	46.0
5.041500	27.3	1000.0	9.000	Off	N	20.5	22.7	50.0
5.118000	32.0	1000.0	9.000	Off	N	20.6	18.0	50.0
18.298500	19.9	1000.0	9.000	Off	N	20.9	30.1	50.0

2.1.12 Test Setup Photo (Front)



2.1.13 Test Setup Photo (Back)



2.2 RADIATED EMISSION LIMITS (RADIATED EMISSIONS VERIFICATION)

2.2.1 Specification Reference

Part 15 Subpart B §15.109(a)

2.2.2 Standard Applicable

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field Strength (microvolts/meter)
30-88	100
88-216	150
216-960	200
Above 960	500

2.2.3 Equipment Under Test and Modification State

Serial No: N/A /Default Test Configuration

2.2.4 Date of Test/Initial of test personnel who performed the test

October 12, 2015/FSC

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.6 °C
Relative Humidity	48.2 %
ATM Pressure	98.7 kPa

2.2.7 Additional Observations

- The spectrum was searched from 30MHz to 18GHz.
- Verification was performed at 3 meters.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.2.8 for sample computation.

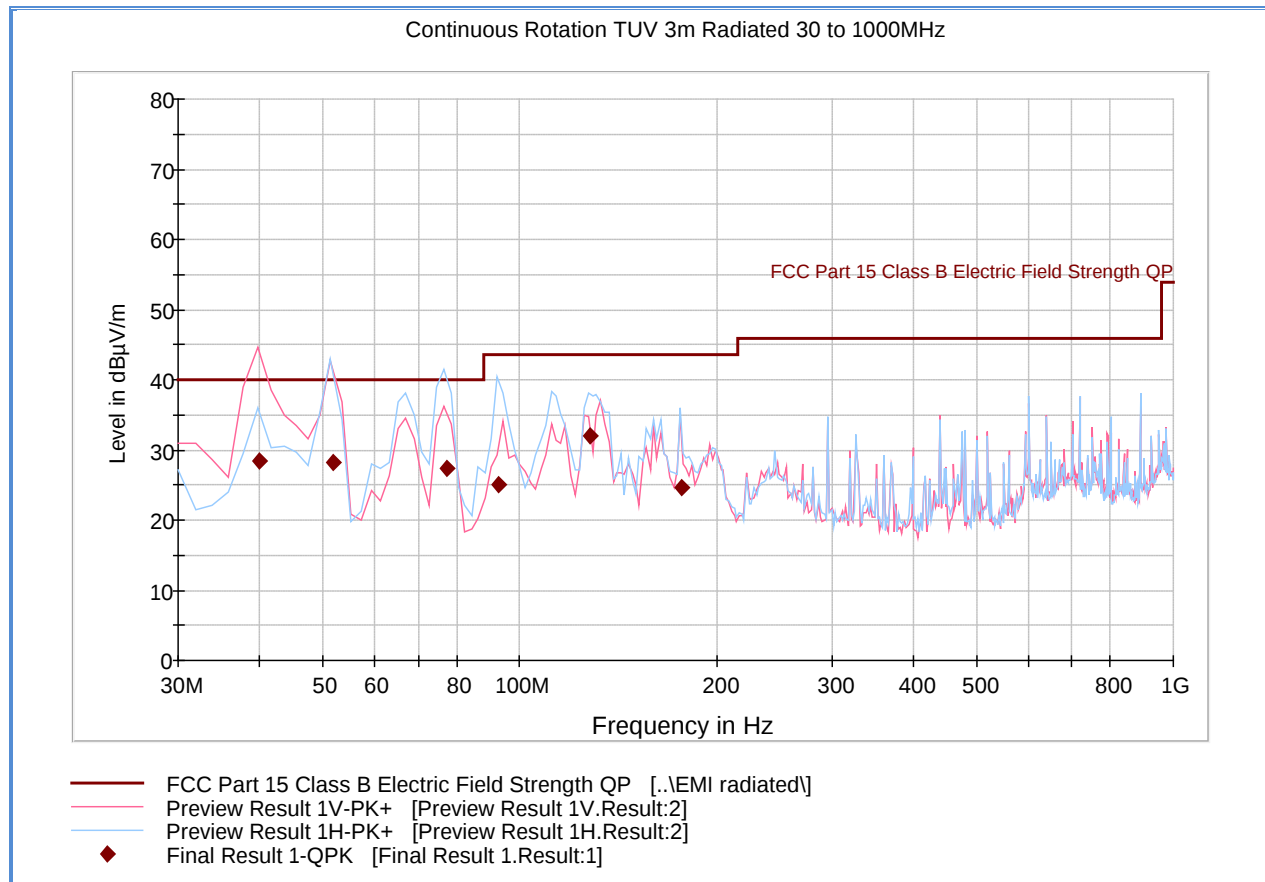
2.2.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1033 (antenna)	17.2	
Reported QuasiPeak Final Measurement (db μ V/m) @ 30MHz			11.8

2.2.9 Test Results

See attached plots.

2.2.9.1 Below 1GHz Radiated Emission Test

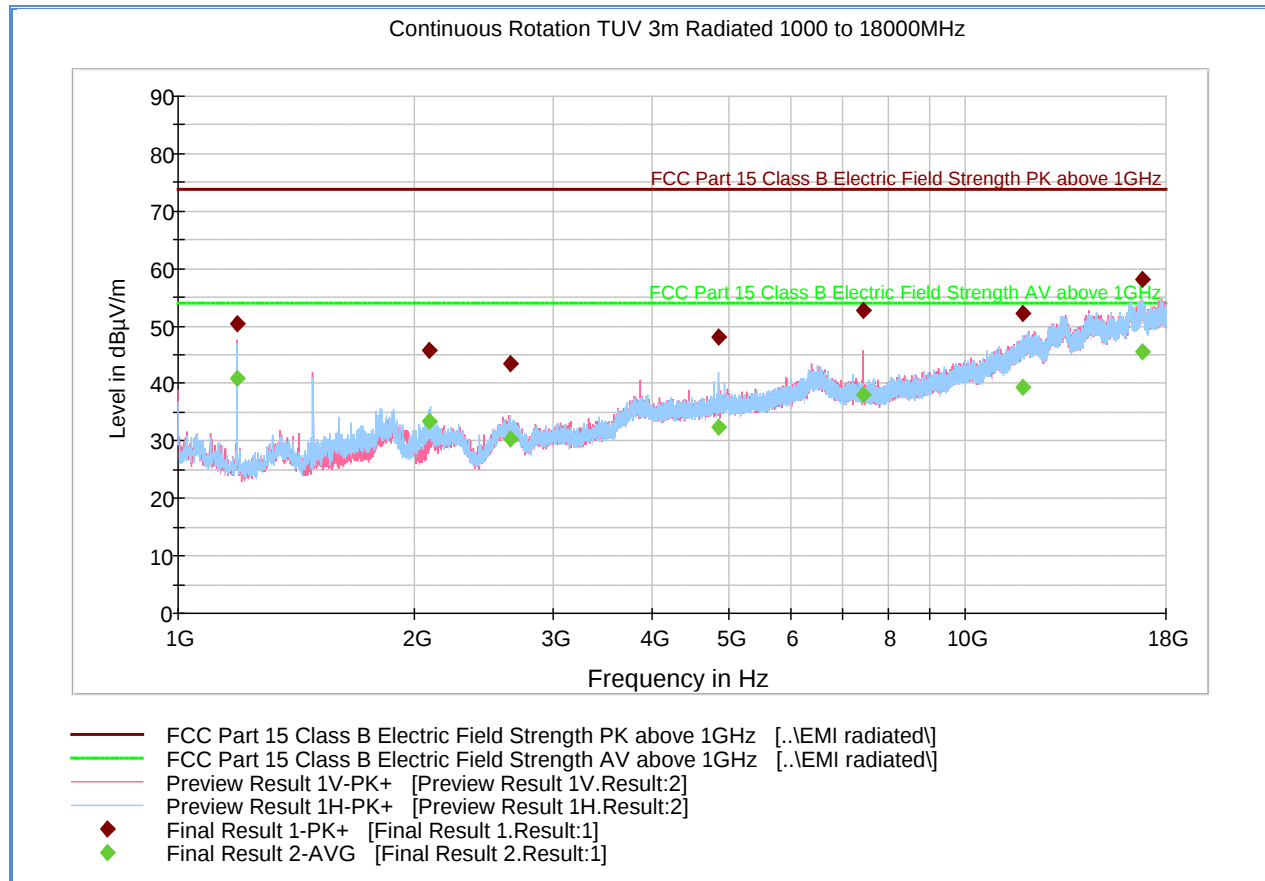


Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
39.959439	28.4	1000.0	120.000	167.0	V	267.0	-16.6	11.6	40.0
51.742766	28.2	1000.0	120.000	250.0	H	327.0	-20.3	11.8	40.0
77.413307	27.4	1000.0	120.000	244.0	H	133.0	-22.2	12.6	40.0
93.004409	25.1	1000.0	120.000	198.0	H	-15.0	-20.3	18.4	43.5
127.994389	31.9	1000.0	120.000	250.0	H	272.0	-21.1	11.6	43.5
176.831583	24.6	1000.0	120.000	150.0	H	15.0	-18.0	18.9	43.5

Test Notes: EUT does not have a separate “Receive” mode. Verification performed when the EUT is on Normal mode (hopping).

2.2.9.2 Above 1GHz Radiated Emission Test



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1187.766667	50.3	1000.0	1000.000	205.5	V	154.0	-6.3	23.6	73.9
2088.533333	45.9	1000.0	1000.000	153.7	H	201.0	-1.5	28.0	73.9
2640.900000	43.4	1000.0	1000.000	264.3	H	170.0	-0.2	30.5	73.9
4856.033333	48.2	1000.0	1000.000	171.6	H	16.0	6.0	25.7	73.9
7423.933333	52.7	1000.0	1000.000	151.6	V	202.0	9.6	21.2	73.9
11823.300000	52.1	1000.0	1000.000	185.5	H	201.0	17.0	21.8	73.9

Average Data

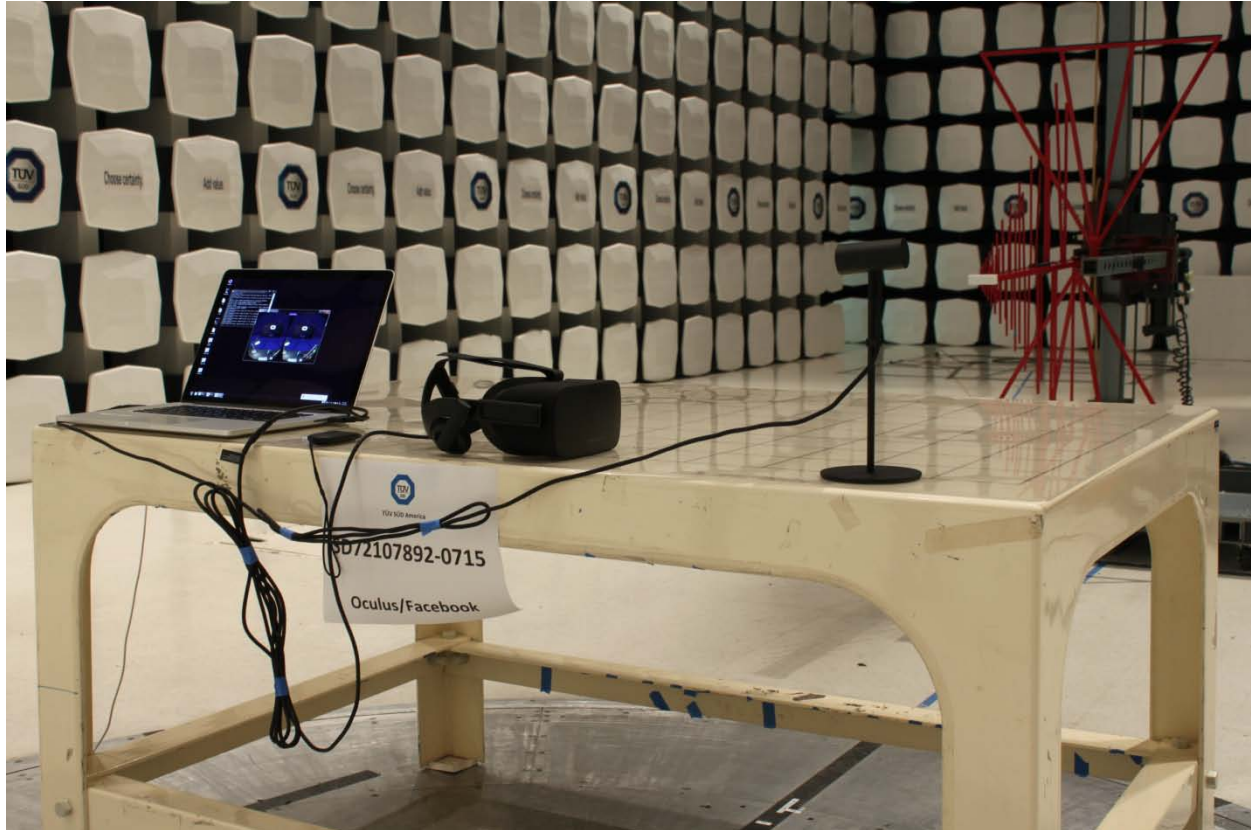
Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1187.766667	40.8	1000.0	1000.000	205.5	V	154.0	-6.3	13.1	53.9
2088.533333	33.3	1000.0	1000.000	153.7	H	201.0	-1.5	20.6	53.9
2640.900000	30.4	1000.0	1000.000	264.3	H	170.0	-0.2	23.5	53.9
4856.033333	32.4	1000.0	1000.000	171.6	H	16.0	6.0	21.5	53.9
7423.933333	38.1	1000.0	1000.000	151.6	V	202.0	9.6	15.8	53.9
11823.300000	39.2	1000.0	1000.000	185.5	H	201.0	17.0	14.7	53.9

Test Notes: EUT does not have a separate "Receive" mode. Testing performed when the EUT is on Normal mode (hopping). A 2.4GHz notch filter was used during verification.

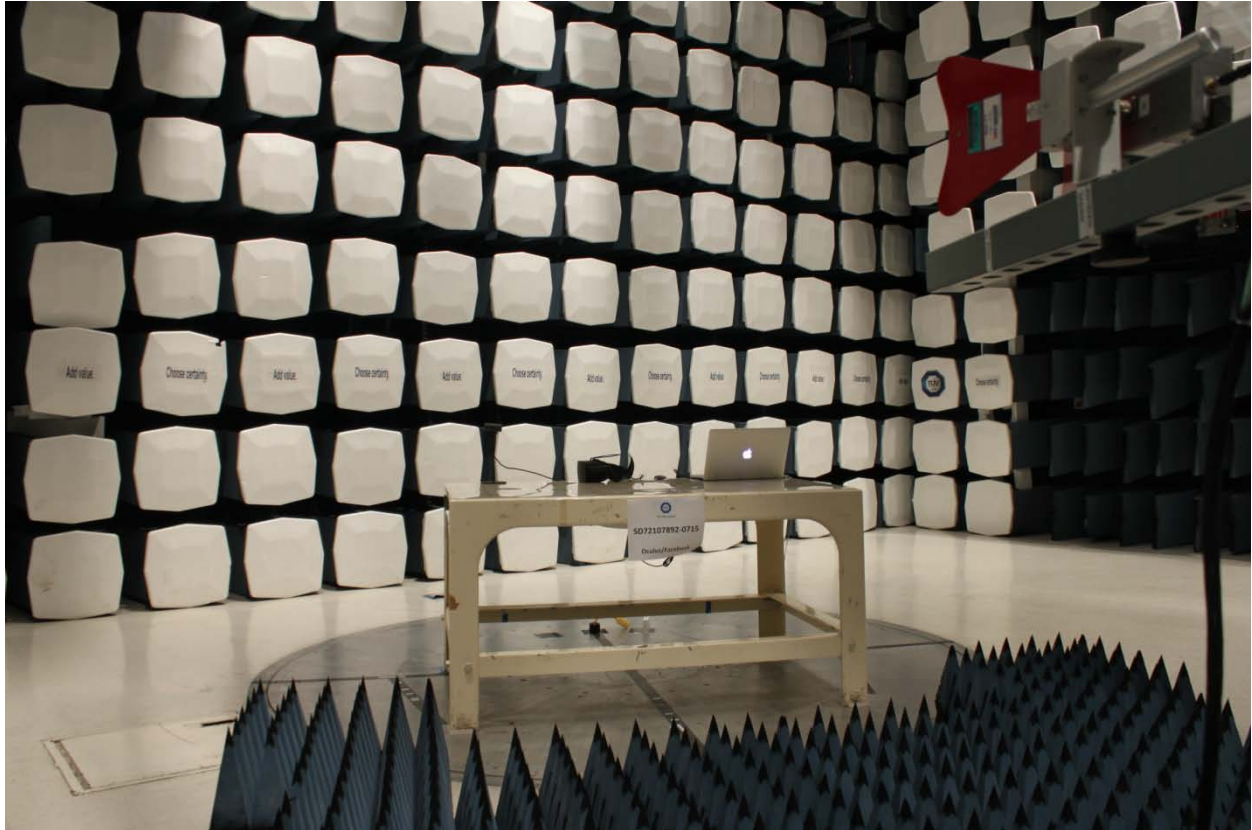
2.2.10 Test Setup Photo (Below 1GHz Front)



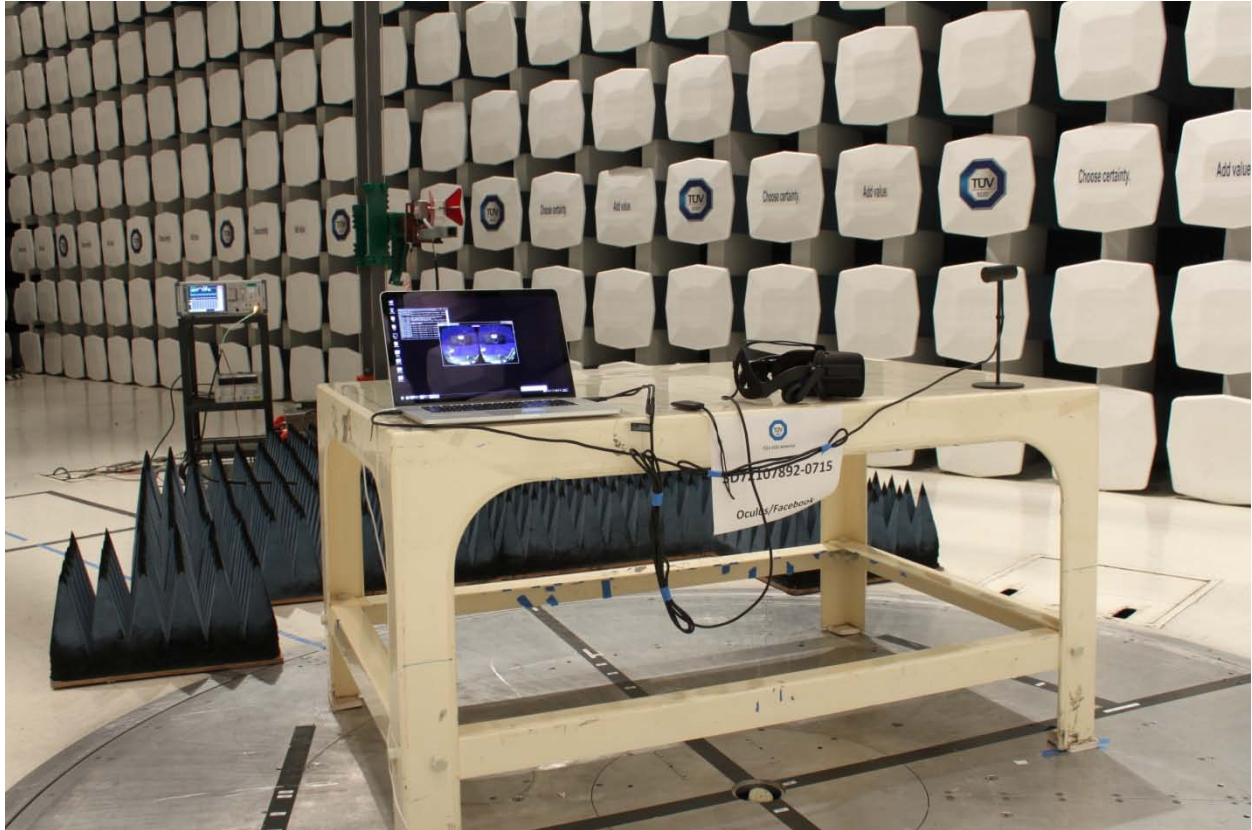
2.2.11 Test Setup Photo (Below 1GHz Back)



2.2.12 Test Setup Photo (Above 1GHz Front)



2.2.13 Test Setup Photo (Above 1GHz Back)





SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Conducted Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	04/10/15	04/10/16
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	07/14/15	07/14/16
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/20/15	02/20/16
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/20/15	02/20/16
Radiated Emissions						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	09/29/15	09/29/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/10/14	12/10/15
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	02/28/14	02/28/16
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/11/15	03/11/16
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	03/20/15	03/20/16
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	04/03/15	04/03/16
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1003 and 7611	
Miscellaneous						
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	04/29/15	04/29/16
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	03/25/15	03/25/16
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/14/15	08/14/16
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	04/09/15	04/09/16
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Conducted Measurements

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.80
Coverage Factor (k):					2
Expanded Uncertainty:					1.59

3.2.2 Radiated Measurements (Below 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.41
Coverage Factor (k):					2
Expanded Uncertainty:					4.82

3.2.3 Radiated Emission Measurements (Above 1GHz)

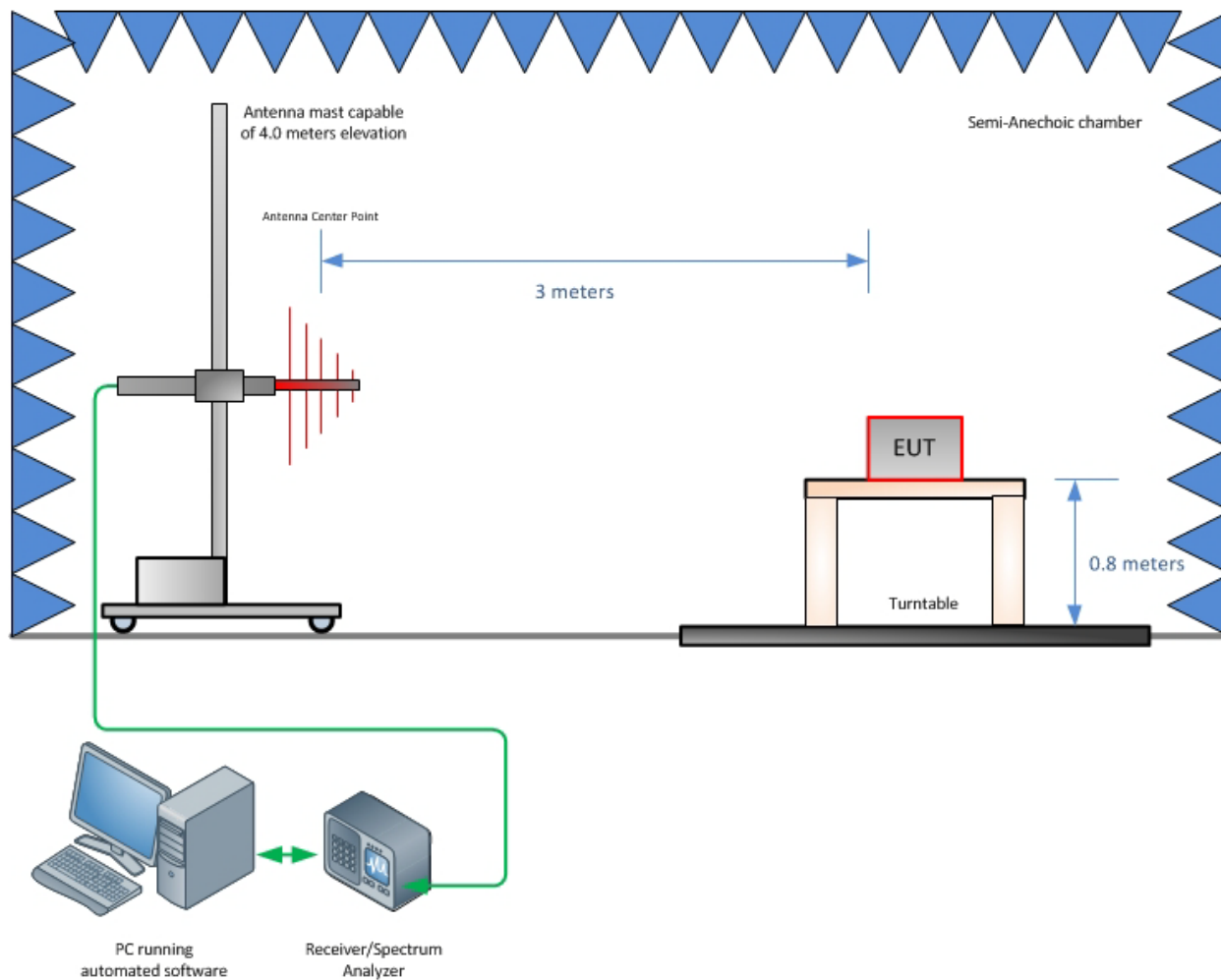
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.40
Coverage Factor (k):					2
Expanded Uncertainty:					4.81



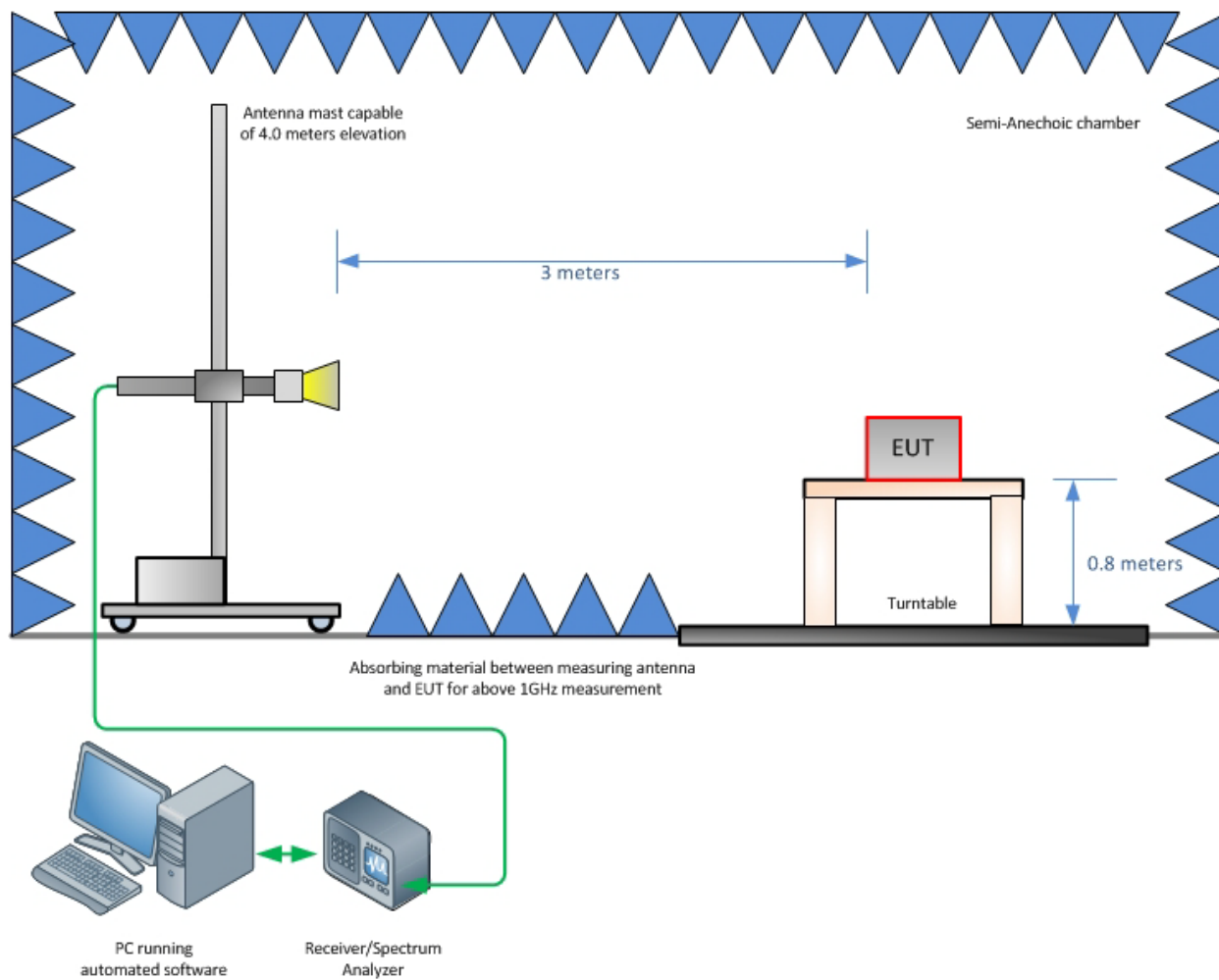
SECTION 4

DIAGRAM OF TEST SETUP

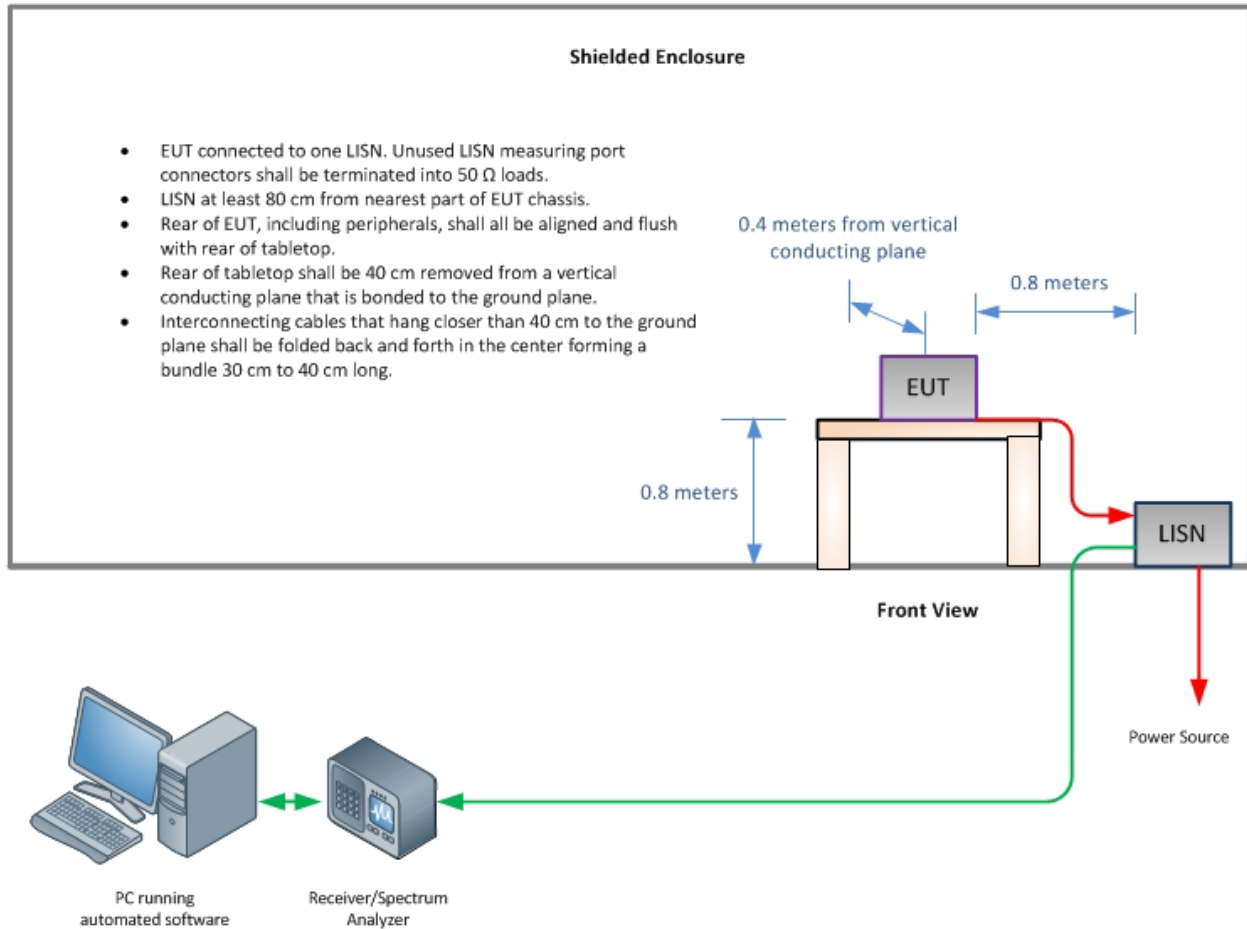
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Conducted Emission Test Setup



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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