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Report On

EMC Evaluation of
Novatel Wireless Inc.
USB620L MC620 USB Modem

FCC Part 15 Subpart B
ICES-003 Issue 5

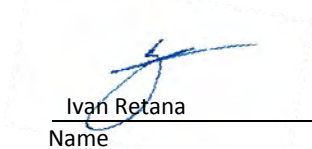
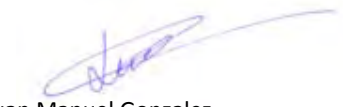
Report No. SD72104197-0315C

May 2015



America

TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121
Tel: (858) 678-1400. Website: www.TUVamerica.com

REPORT ON	Radio Testing of the Novatel Wireless Inc. USB620L USB Modem
TEST REPORT NUMBER	SD72104197-0315C
PREPARED FOR	Novatel Wireless Inc. 9645 Scranton Road San Diego, CA 92121
CONTACT PERSON	Roman Olmos Hardware Engineer II & ISO-17025 Technical Manager (858) 812-3400 rolmos@nvtl.com
PREPARED BY	 Ivan Retana Name Title: EMC/Wireless Test Engineer
APPROVED BY	 Juan Manuel Gonzalez Name Authorized Signatory Title: Commercial/Wireless EMC Lab Manager
DATED	May 5, 2015



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Revision History

SD72104197-0315C Novatel Wireless Inc. USB Modem MC620 USB Modem					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
5/5/2015	Initial Release				Juan Manuel Gonzalez



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SECTION 1

REPORT SUMMARY

EMC Evaluation of the
Novatel Wireless Inc.
USB620L MC620 USB Modem



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the USB620L MC620 USB Modem 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	Novatel Wireless Inc.
Model Name	USB620L
Model Number(s)	MC620
Serial Number(s)	SP070315900035
Number of Samples Tested	1
Highest Frequency Generated or Used	>108 MHz
Test Specification/Issue/Date	• FCC Part 15 Subpart B (October 01, 2014) • Spectrum Management and Telecommunications Interference-Causing Equipment Standard ICES-003 Information Technology Equipment (ITE) — Limits and methods of measurement (Issue 5 August 2012).
Start of Test	April 1, 2015
Finish of Test	April 1, 2015
Name of Engineer(s)	Ivan Retana
Related Document(s)	None



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 Emission	Compliant	Class B requirement
§15.109	Radiated Emission	Compliant	Class B requirement



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Novatel Wireless Inc. USB620L USB Modem. The EUT is a Wireless USB Broadband Modem supporting 2G/3G/4G Technologies. The EUT comes with a USB Port.



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>

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	EUT connected to a laptop computer through a USB port.

1.4.2 EUT Exercise Software

None. No special software used to exercise the EUT.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Sony	VPCYB33KX	Laptop PC

1.4.4 Simplified Test Configuration Diagram



For Illustration Purpose Only
 Image presented may not represent the actual EUT
 or support equipment.



1.5 DEVIATIONS FROM THE STANDARD

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

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: SP070315900035		
-	-	-

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.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.4-2009, 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 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 C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 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.

1.8.2 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.

1.9 TEST FACILITY REGISTRATION

1.9.1 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.



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

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

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

TÜV 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.

1.9.4 VCCI – Registration No. A-0132

TÜV SÜD 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
Novatel Wireless Inc.
USB620L MC620 USB Modem

2.1 CONDUCTED EMISSION

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: SP070315900035 / Default Test Configuration

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

April 1, 2015 / IR

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	23.8 °C
Relative Humidity	47.0 %
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.



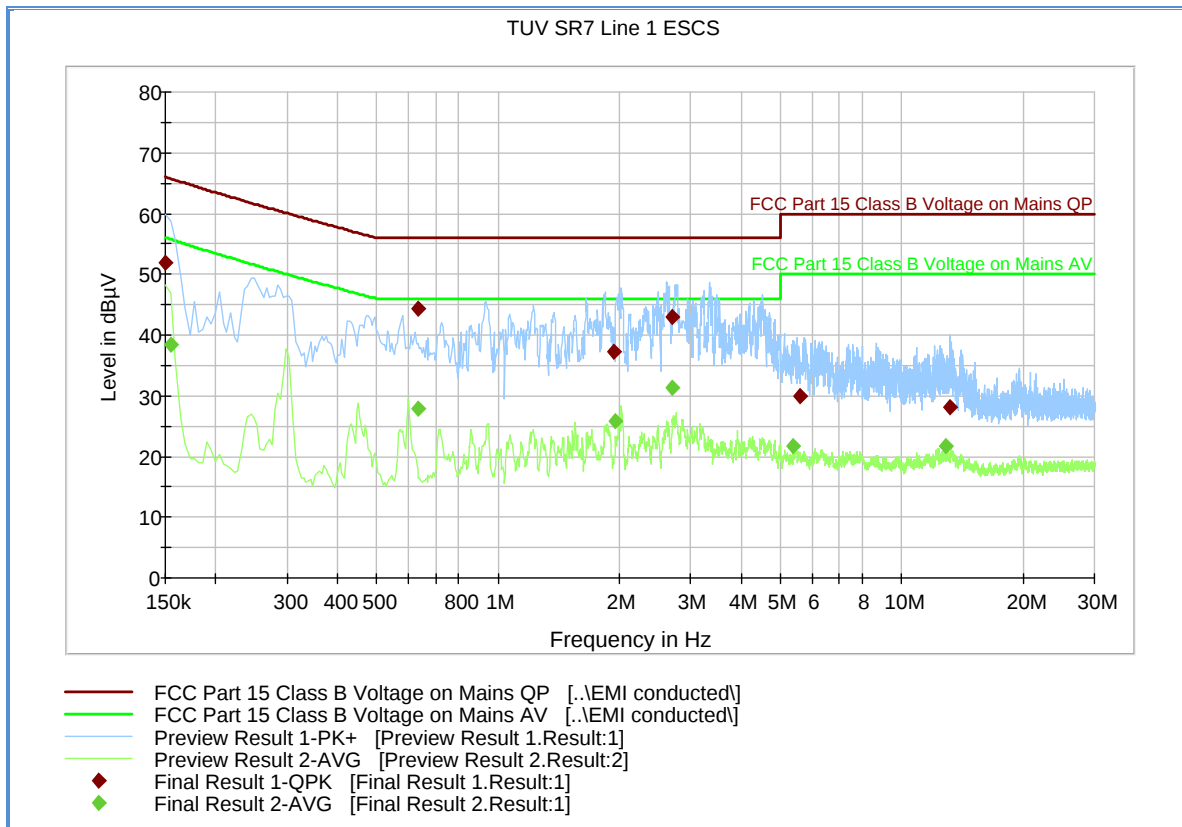
2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (db μ V) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7568 (LISN)	0.30	
Reported QuasiPeak Final Measurement (db μ V) @ 150kHz			26.2

2.1.9 Test Results

Compliant. See attached plots and tables.

2.1.10 FCC Class B 120VAC - 60Hz (Line 1 – Hot)



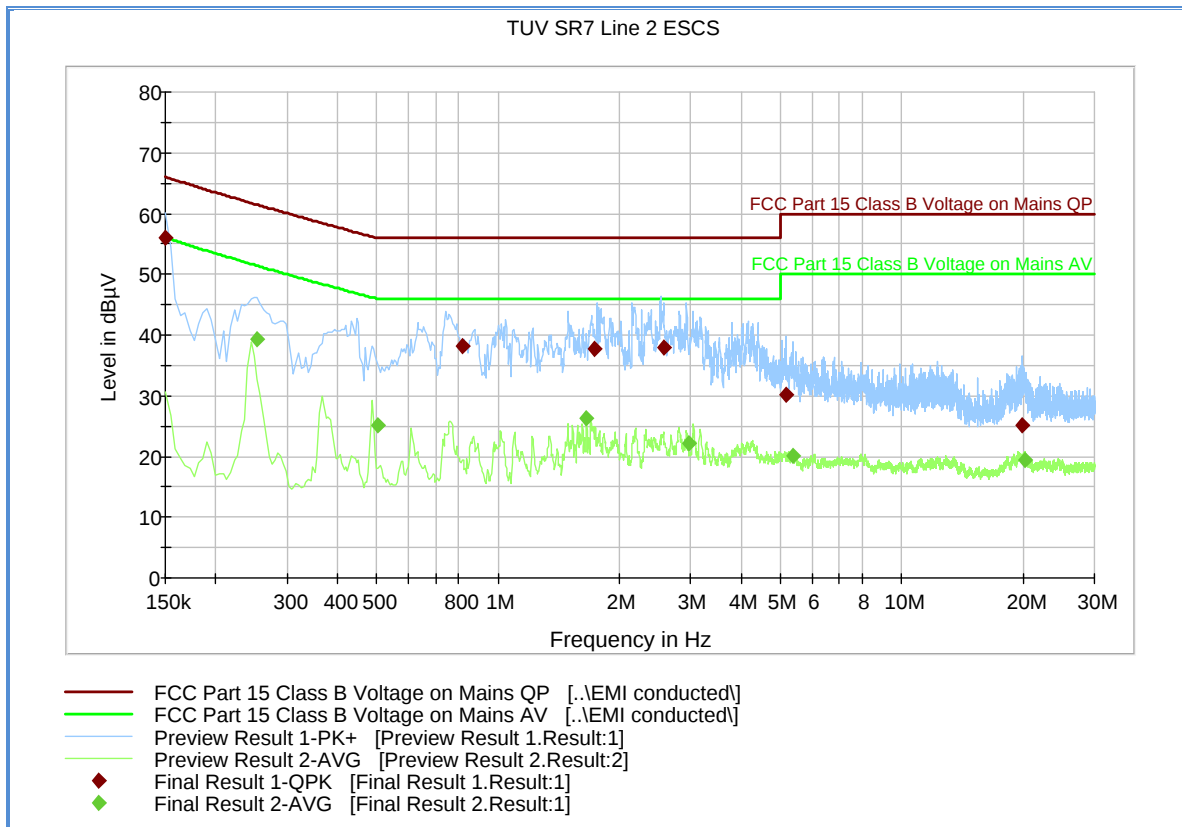
Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)
0.150000	51.8	1000.0	9.000	Off	L1	20.1	14.2	66.0
0.636000	44.4	1000.0	9.000	Off	L1	20.2	11.6	56.0
1.941000	37.2	1000.0	9.000	Off	L1	20.2	18.8	56.0
2.692500	42.9	1000.0	9.000	Off	L1	20.5	13.1	56.0
5.586000	30.0	1000.0	9.000	Off	L1	20.7	30.0	60.0
13.204500	28.1	1000.0	9.000	Off	L1	20.7	31.9	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBμV)
0.154500	38.4	1000.0	9.000	Off	L1	20.1	17.3	55.7
0.631500	27.9	1000.0	9.000	Off	L1	20.2	18.1	46.0
1.959000	25.8	1000.0	9.000	Off	L1	20.2	20.2	46.0
2.692500	31.4	1000.0	9.000	Off	L1	20.5	14.6	46.0
5.374500	21.8	1000.0	9.000	Off	L1	20.6	28.2	50.0
12.822000	21.7	1000.0	9.000	Off	L1	20.7	28.3	50.0

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



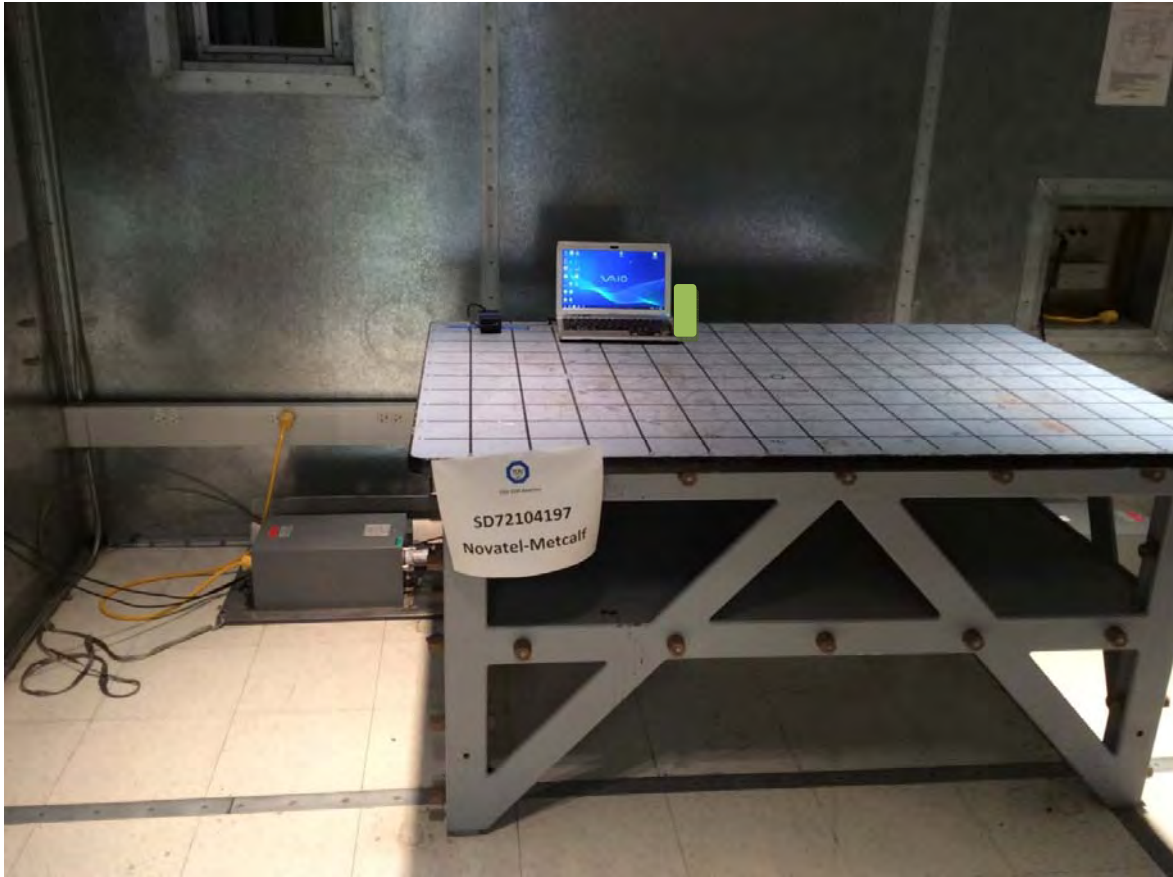
Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)
0.150000	56.0	1000.0	9.000	Off	N	20.1	10.0	66.0
0.816000	38.1	1000.0	9.000	Off	N	20.2	17.9	56.0
1.734000	37.8	1000.0	9.000	Off	N	20.2	18.2	56.0
2.575500	37.9	1000.0	9.000	Off	N	20.5	18.1	56.0
5.158500	30.2	1000.0	9.000	Off	N	20.6	29.8	60.0
19.896000	25.1	1000.0	9.000	Off	N	20.9	34.9	60.0

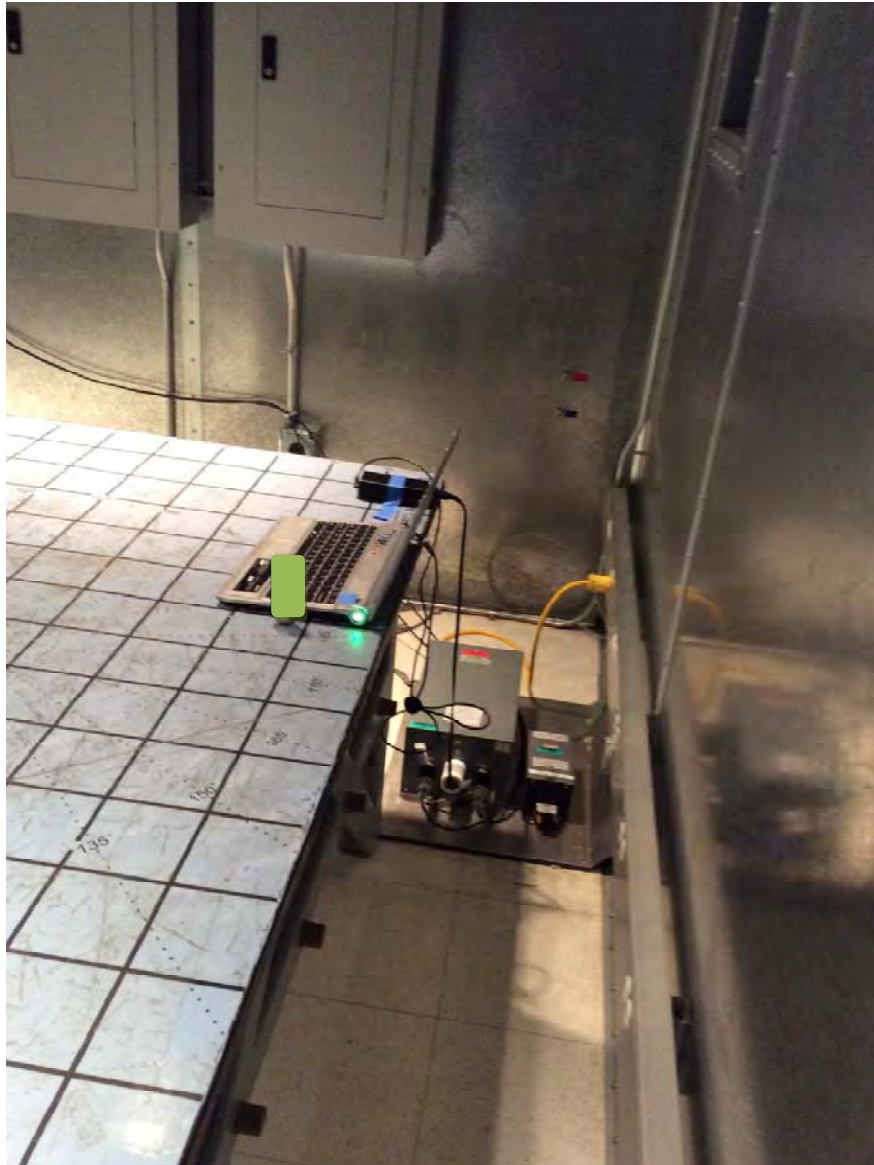
Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBμV)
0.253500	39.4	1000.0	9.000	Off	N	19.9	12.0	51.4
0.505500	25.2	1000.0	9.000	Off	N	20.1	20.8	46.0
1.657500	26.3	1000.0	9.000	Off	N	20.2	19.7	46.0
2.967000	22.2	1000.0	9.000	Off	N	20.4	23.8	46.0
5.361000	20.1	1000.0	9.000	Off	N	20.6	29.9	50.0
20.121000	19.5	1000.0	9.000	Off	N	20.9	30.5	50.0

2.1.12 Test Setup Photo (Front)



2.1.13 Test Setup Photo (Back)





2.2 RADIATED EMISSION

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: SP070315900035 / Default Test Configuration

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

April 1, 2015 / IR

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	23.8 °C
Relative Humidity	47.0 %
ATM Pressure	99.5 kPa

2.2.7 Additional Observations

- The spectrum was searched from 30MHz to the 5th harmonic (up to 18GHz presented) and verified to Class B limits.
- 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.



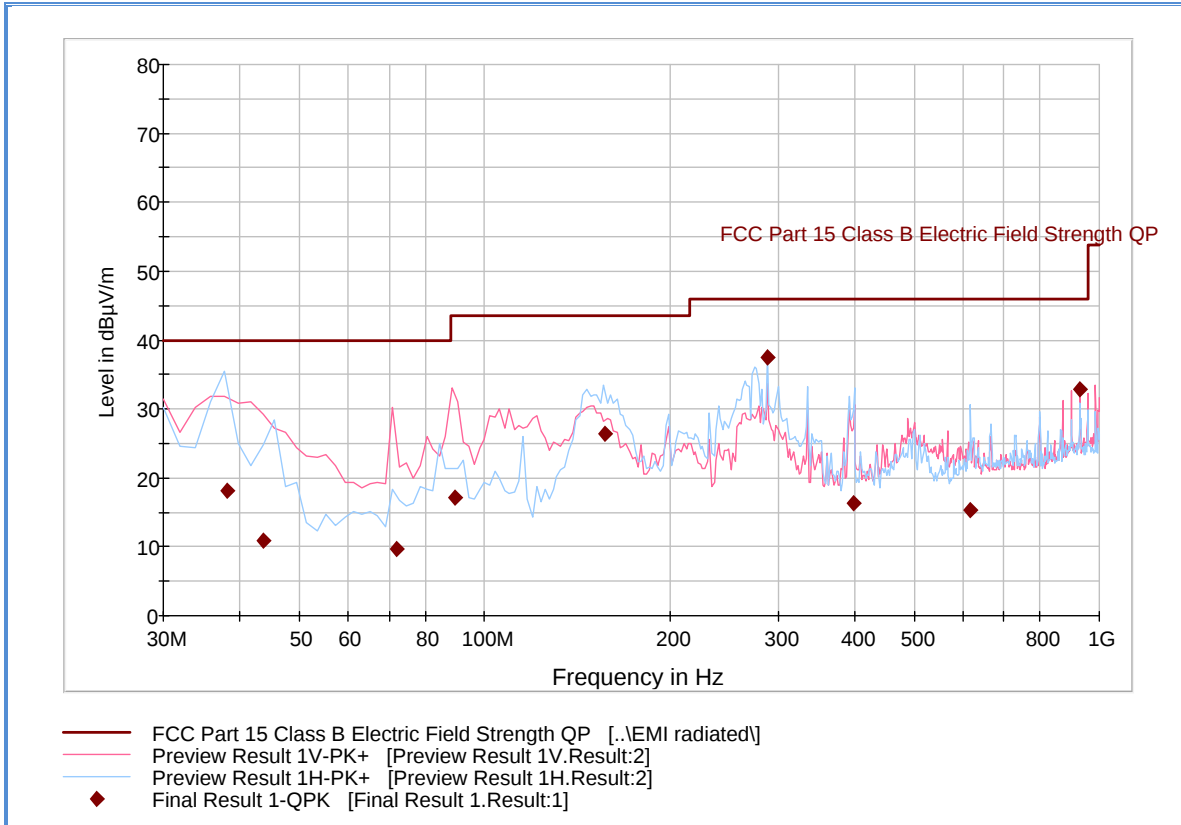
2.2.8 Sample Computation (Radiated Emission)

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# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (db μ V/m) @ 30MHz			11.8

2.2.9 Test Results

Compliant. See attached plots.

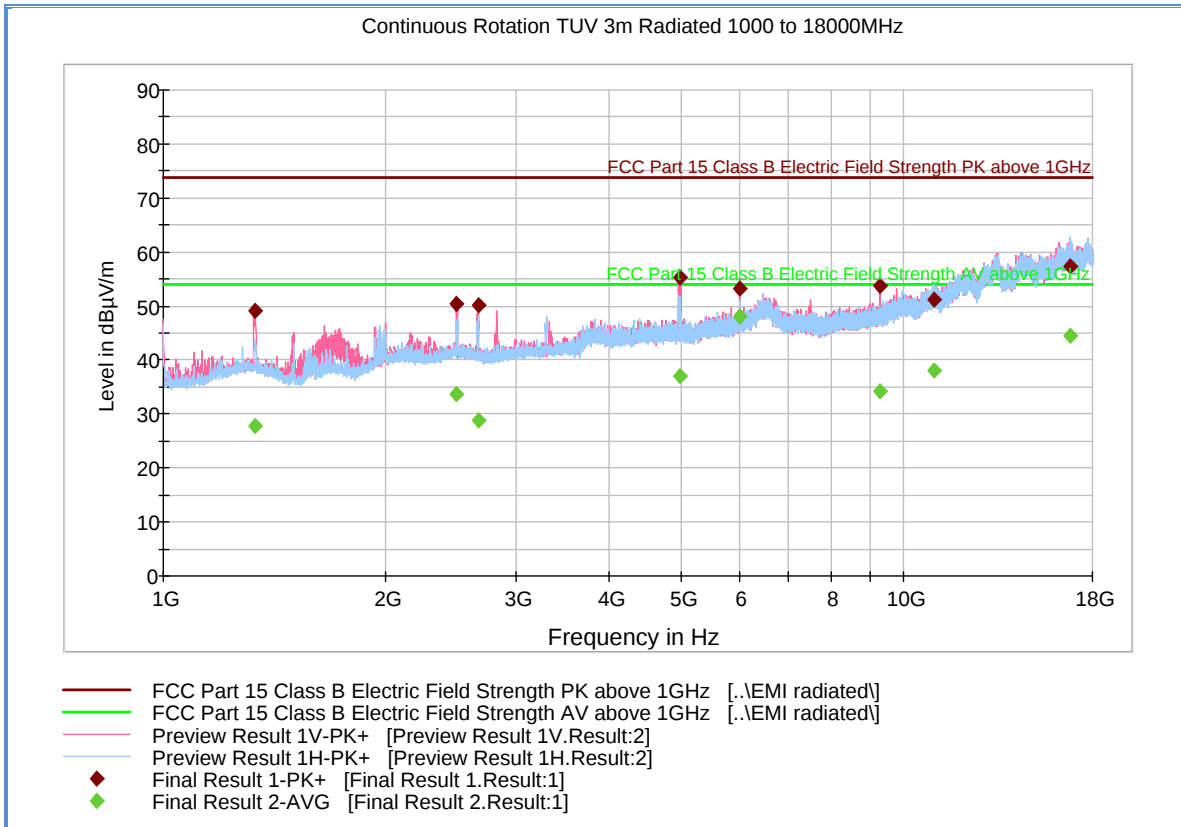
2.2.10 Below 1GHz Radiated Emission Test



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)
38.015551	18.1	1000.0	120.000	250.0	H	171.0	-15.7	21.9	40.0
43.631102	10.9	1000.0	120.000	150.0	H	82.0	-18.2	29.1	40.0
71.741643	9.6	1000.0	120.000	400.0	V	31.0	-22.3	30.4	40.0
89.316633	17.1	1000.0	120.000	100.0	V	1.0	-20.9	26.4	43.5
156.912705	26.5	1000.0	120.000	202.0	H	171.0	-18.3	17.0	43.5
288.017074	37.4	1000.0	120.000	100.0	H	281.0	-13.4	8.6	46.0
399.138677	16.3	1000.0	120.000	100.0	H	198.0	-9.0	29.7	46.0
617.774108	15.3	1000.0	120.000	350.0	H	-2.0	-3.9	30.7	46.0
928.860040	32.8	1000.0	120.000	100.0	V	247.0	1.4	13.2	46.0

2.2.11 Above 1GHz Radiated Emission Test



Peak Data

Frequency (MHz)	Max Peak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1329.933333	49.2	1000.0	1000.000	148.7	V	16.0	-5.5	24.7	73.9
2492.233333	50.4	1000.0	1000.000	103.7	V	21.0	-0.1	23.5	73.9
2664.666667	50.1	1000.0	1000.000	99.8	V	58.0	-0.2	23.8	73.9
4987.300000	55.4	1000.0	1000.000	101.7	V	300.0	6.4	18.5	73.9
5999.900000	53.2	1000.0	1000.000	172.6	V	4.0	8.7	20.7	73.9
9301.666667	53.6	1000.0	1000.000	100.8	V	58.0	11.1	20.3	73.9
10996.40000	51.2	1000.0	1000.000	102.8	H	-4.0	14.9	22.7	73.9
16824.73333	57.4	1000.0	1000.000	115.8	H	26.0	23.4	16.5	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)
1329.933333	27.9	1000.0	1000.000	148.7	V	16.0	-5.5	26.0	53.9
2492.233333	33.7	1000.0	1000.000	103.7	V	21.0	-0.1	20.2	53.9
2664.666667	28.9	1000.0	1000.000	99.8	V	58.0	-0.2	25.0	53.9
4987.300000	37.1	1000.0	1000.000	101.7	V	300.0	6.4	16.8	53.9
5999.900000	48.0	1000.0	1000.000	172.6	V	4.0	8.7	5.9	53.9
9301.666667	34.3	1000.0	1000.000	100.8	V	58.0	11.1	19.6	53.9
10996.40000	38.1	1000.0	1000.000	102.8	H	-4.0	14.9	15.8	53.9
16824.73333	44.5	1000.0	1000.000	115.8	H	26.0	23.4	9.4	53.9

2.2.12 Test Setup Photo (Below 1GHz Front)



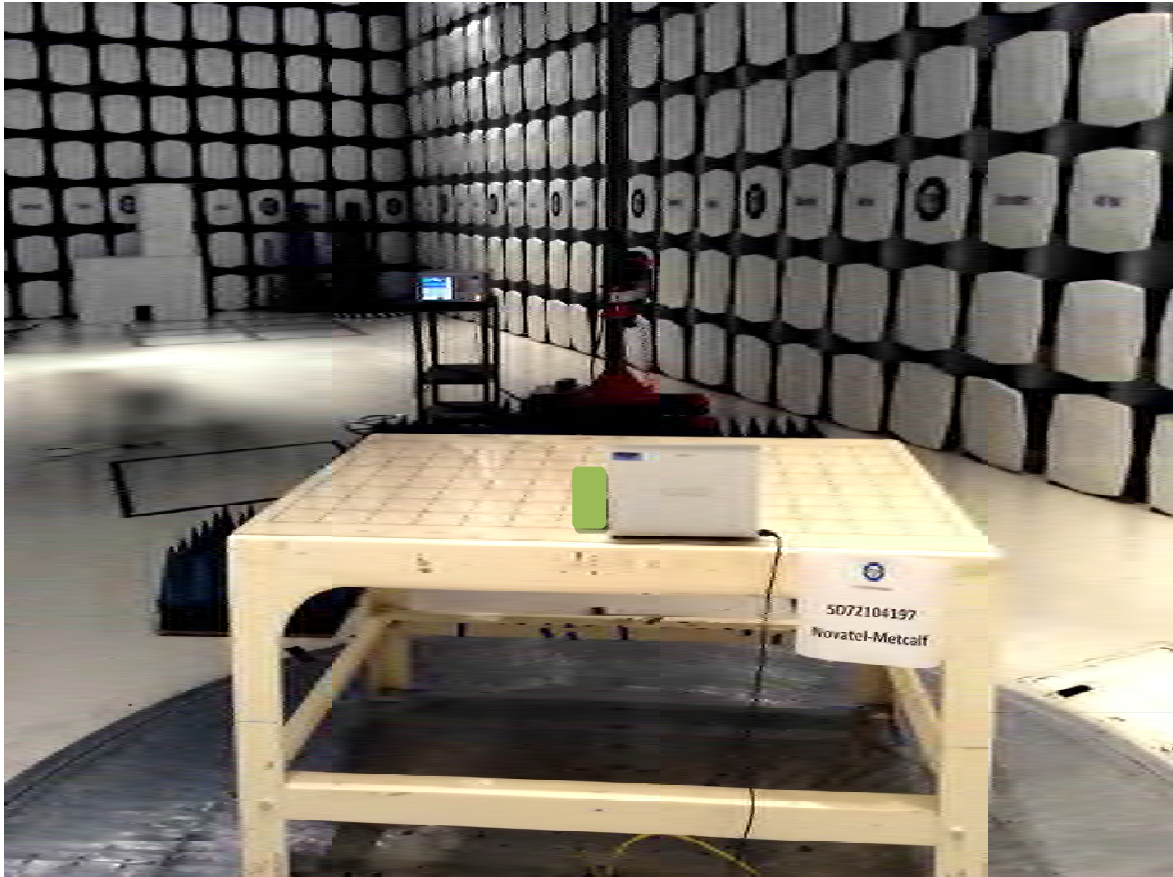
2.2.13 Test Setup Photo (Below 1GHz Back)



2.2.14 Test Setup Photo (Above 1GHz Front)



2.2.15 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	04/05/14	04/05/15
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	09/02/14	09/02/15
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						
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	08/29/14	08/29/15
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
1016	Pre-amplifier	PAM-0202	187	PAM	05/05/14	05/05/15
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	04/08/14	04/08/15
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	04/03/14	04/03/15
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/11/15	03/11/16
Miscellaneous						
	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 Radiated Emission 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

3.2.2 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

3.2.3 Conducted Emissions Measurement

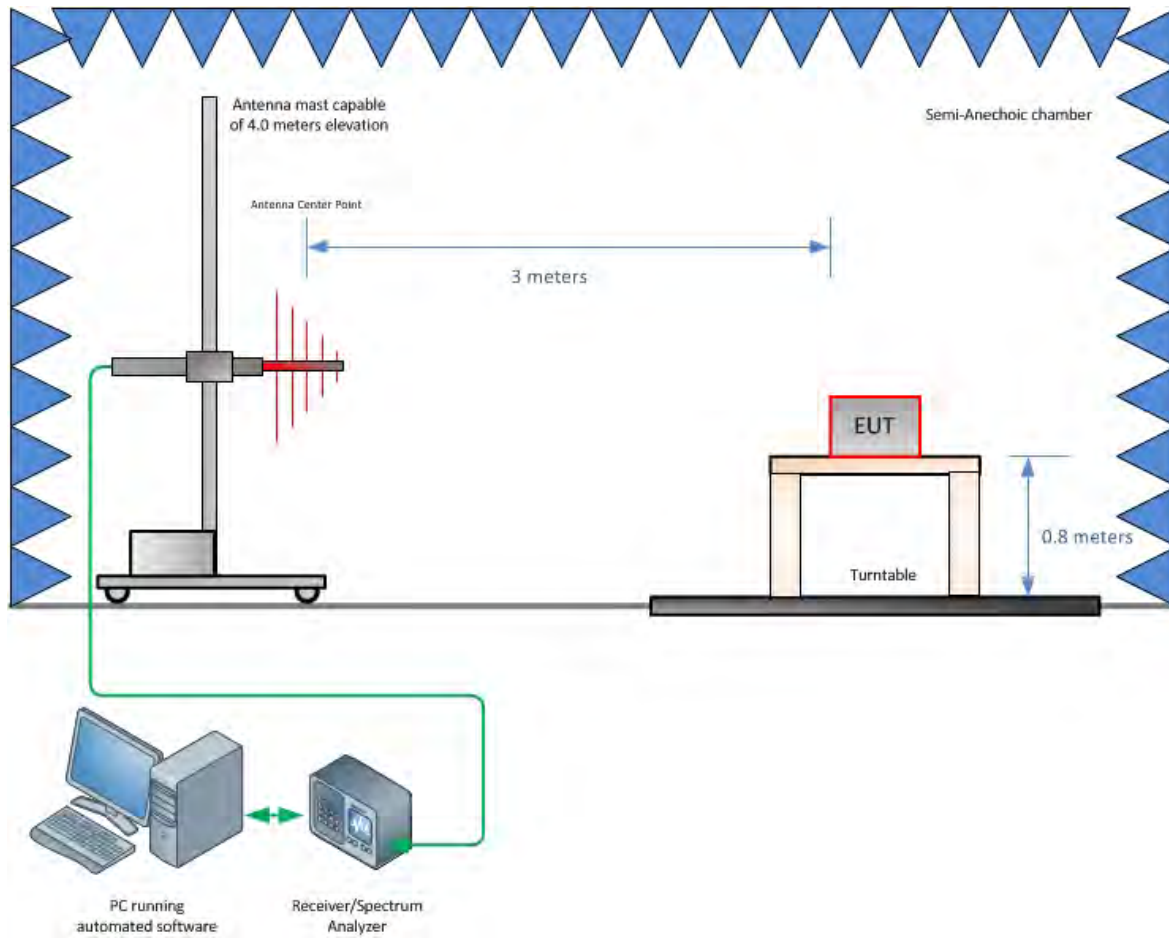
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
	Attenuator	Rectangular	0.30	0.17	0.03
Combined Uncertainty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



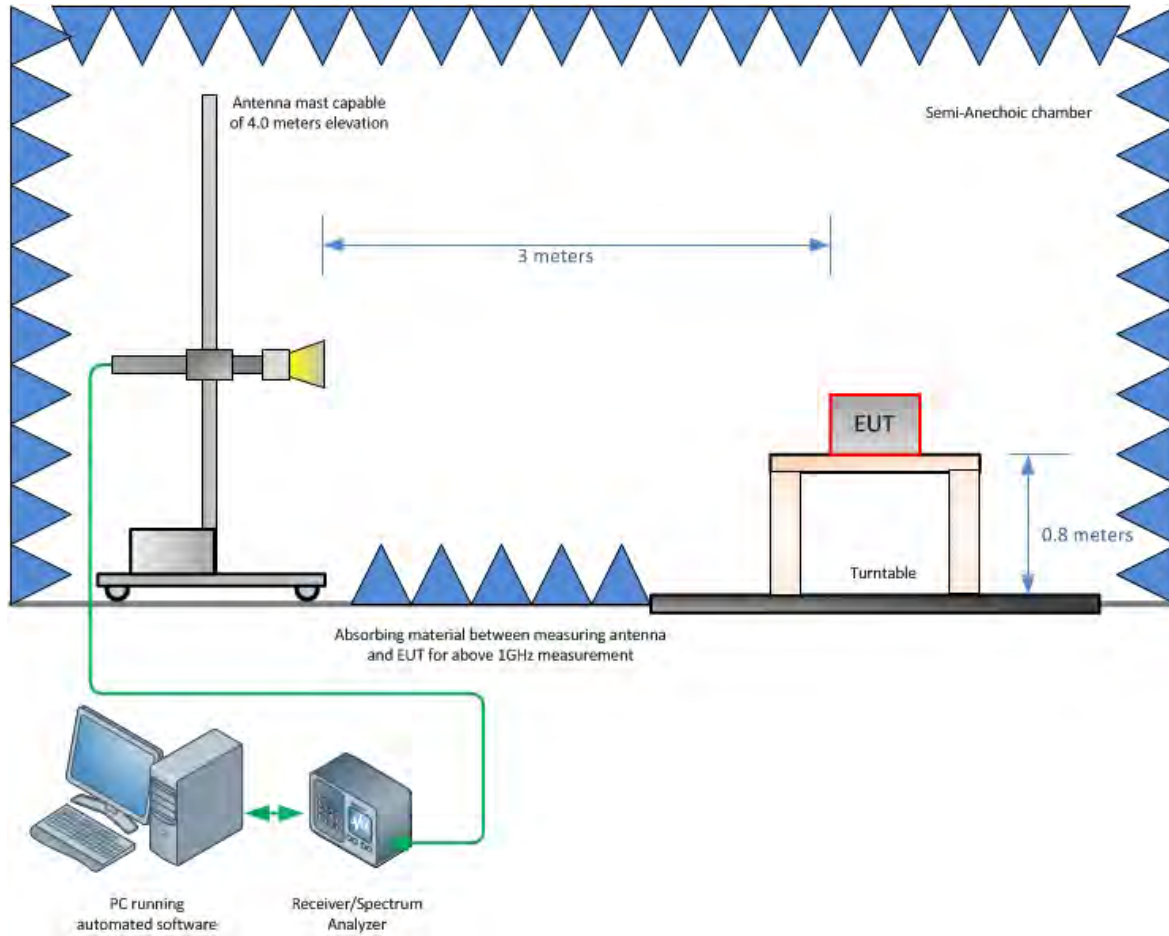
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)





SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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