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Report On

EMC Evaluation of
Novatel Wireless
MC730 USB Modem

FCC Part 15 Subpart B
ICES-003 Issue 6



Report No. SD72123529-0117C

April 2017



America

TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121
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REPORT ON	EMC Evaluation of the Novatel Wireless MC730 USB Modem
TEST REPORT NUMBER	SD72123529-0117C
TEST REPORT DATE	April 2017
PREPARED FOR	Novatel Wireless 9606 Scranton Rd., Suite 300 San Diego, CA 92121
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APPROVED BY	 Juan Manuel Gonzalez Name Authorized Signatory Title: EMC SL Manager West Region
DATED	<u>April 10, 2017</u>



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Revision History

SD72123529-0117C Novatel Wireless MC730 USB Modem					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
04/10/2017	Initial Release				Juan Manuel Gonzalez



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SECTION 1

REPORT SUMMARY

EMC Evaluation of the
Novatel Wireless
MC730 USB Modem



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless USB730L USB Modem to the requirements of FCC Part 15 Subpart B and Innovation, Science and Economic Development 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
Product Marketing Name	USB730L
Model Number(s)	MC730
Serial Number(s)	1073-0319
Number of Samples Tested	1
Date sample(s) received	February 15, 2017
Highest Frequency Generated or Used	1909.8 MHz (GPRS1900)
Test Specification/Issue/Date	<ul style="list-style-type: none"> FCC Part 15 Subpart B (October 1, 2016) Spectrum Management and Telecommunications Interference-Causing Equipment Standard ICES-003 Information Technology Equipment (ITE) — Limits and methods of measurement (Issue 6 January 2016 updated June 30, 2016).
Start of Test	March 06, 2017
Finish of Test	March 06, 2017
Name of Engineer(s)	Ferdie Custodio
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 Innovation, Science and Economic Development Canada Interference-Causing Equipment Standard ICES-003.

Part 15	ICES-003	Test Description	Result	Comments/Base Standard
§15.107	6.1	Conducted Limits	Compliant	Class B requirement
§15.109	6.2	Radiated Emission Limits	Compliant	Class B requirement

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Novatel Wireless MC730 USB730L USB Modem as shown in the photograph below. The EUT supports 2G, 3G and 4G technologies.



Equipment Under Test



1.3.2 Labelling Requirement for Innovation, Science and Economic Development Canada

The manufacturer, importer or supplier shall meet the labelling requirements set out in this section and in Notice 2014-DRS1003 for electronic labelling for every unit:

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

Each unit of an ITE model shall bear a label (see below) that represents the manufacturer's or the importer's SDoC with Innovation, Science and Economic Development Canada's ICES-003. This label shall be permanently affixed to the ITE or displayed electronically and its text must be clearly legible. If the dimensions of the device are too small or if it is not practical to place the label on the ITE and electronic labelling has not been implemented, the label shall be, upon agreement with Innovation, Science and Economic Development Canada, 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.

Innovation, Science and Economic Development Canada ICES-003 Compliance Label

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

* Insert either "A" or "B" but not both to identify the applicable Class of ITE.

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	Standby Mode. The EUT was plugged into a USB port of the support laptop. Verified EUT was recognized and a driver was loaded by the operating system.

1.4.2 EUT Exercise Software

None. No special software was used during evaluation.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Lenovo	Support Laptop (T410S)	P/N 0A31972 S/N R9-92MH0 10/11
LiteOn Technology Corporation	AC Adapter for Support Laptop	Model 42T4430 S/N 11S42T4430Z1ZGWE27AA9X REV G

1.4.4 Simplified Test Configuration Diagram

Not required. The EUT was verified replicating normal usage and installation (plugged into a USB port of a representative laptop).



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: 1073-0319		
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.

1.7 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.

1.8 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)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678-1400 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 Innovation, Science and Economic Development 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 Innovation, Science and Economic Development 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-0230

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
MC730 USB Modem

2.1 CONDUCTED LIMITS (AC 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: 1073-0319/Default Test Configuration

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

March 06, 2017/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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.5 °C
Relative Humidity	34.4 %
ATM Pressure	99.7 kPa

2.1.7 Additional Observations

- Verification performed on the host 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



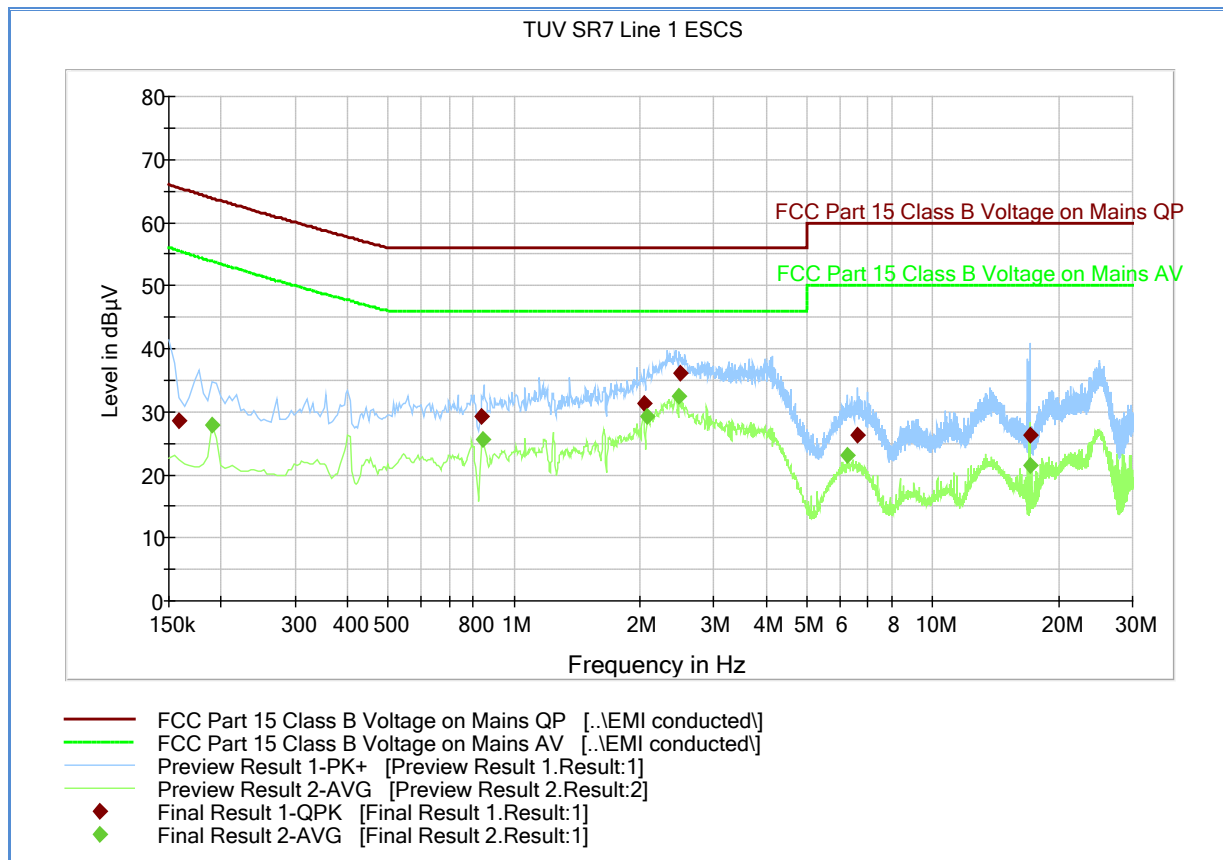
2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

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 120VAC 60Hz (Line 1)



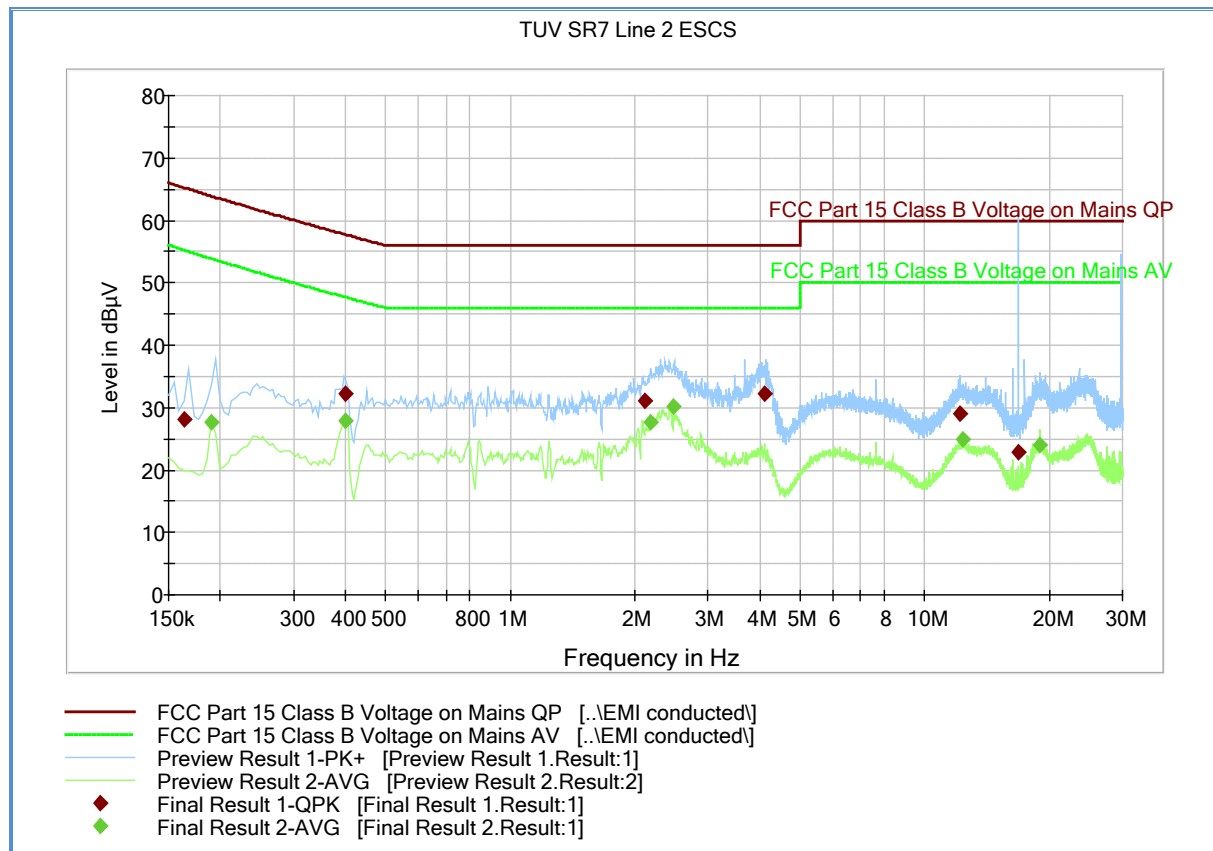
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.159000	28.6	1000.0	9.000	Off	L1	20.2	36.9	65.5
0.838500	29.4	1000.0	9.000	Off	L1	20.0	26.6	56.0
2.044500	31.4	1000.0	9.000	Off	L1	20.0	24.6	56.0
2.485500	36.2	1000.0	9.000	Off	L1	20.1	19.8	56.0
6.585000	26.4	1000.0	9.000	Off	L1	20.1	33.6	60.0
17.115000	26.4	1000.0	9.000	Off	L1	20.4	33.6	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.190500	27.8	1000.0	9.000	Off	L1	20.1	26.0	53.9
0.843000	25.6	1000.0	9.000	Off	L1	20.0	20.4	46.0
2.080500	29.3	1000.0	9.000	Off	L1	20.0	16.7	46.0
2.481000	32.5	1000.0	9.000	Off	L1	20.1	13.5	46.0
6.265500	23.1	1000.0	9.000	Off	L1	20.1	26.9	50.0
17.115000	21.6	1000.0	9.000	Off	L1	20.4	28.4	50.0

2.1.11 120VAC 60Hz (Line 2)



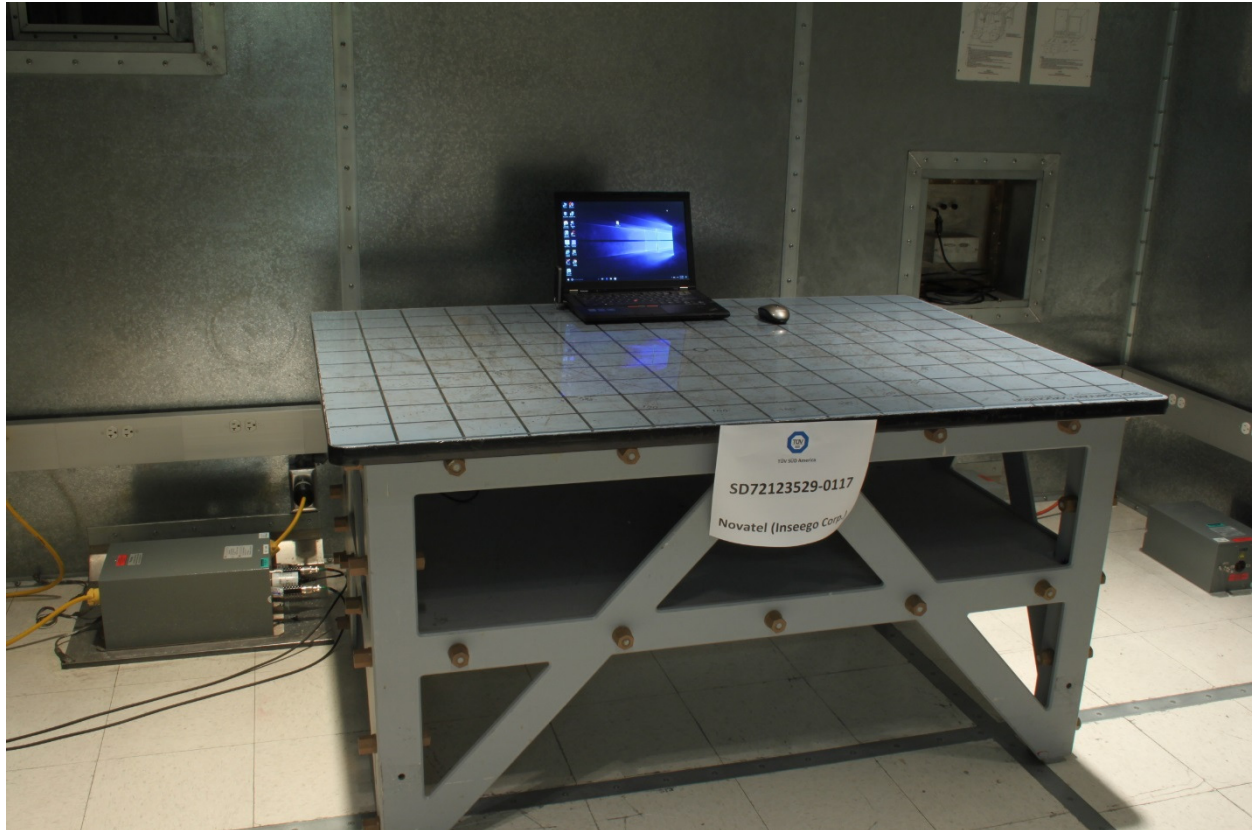
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.163500	28.0	1000.0	9.000	Off	N	20.1	37.2	65.2
0.402000	32.2	1000.0	9.000	Off	N	20.0	25.5	57.7
2.121000	31.1	1000.0	9.000	Off	N	20.0	24.9	56.0
4.110000	32.3	1000.0	9.000	Off	N	20.1	23.7	56.0
12.196500	29.1	1000.0	9.000	Off	N	20.2	30.9	60.0
16.849500	22.8	1000.0	9.000	Off	N	20.3	37.2	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.190500	27.7	1000.0	9.000	Off	N	20.1	26.2	53.9
0.402000	27.9	1000.0	9.000	Off	N	20.0	19.8	47.7
2.175000	27.7	1000.0	9.000	Off	N	20.1	18.3	46.0
2.481000	30.3	1000.0	9.000	Off	N	20.1	15.7	46.0
12.349500	24.9	1000.0	9.000	Off	N	20.2	25.1	50.0
18.973500	24.1	1000.0	9.000	Off	N	20.4	26.0	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: 1073-0319/Default Test Configuration

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

March 06, 2017/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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.5 °C
Relative Humidity	34.4 %
ATM Pressure	99.7 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.

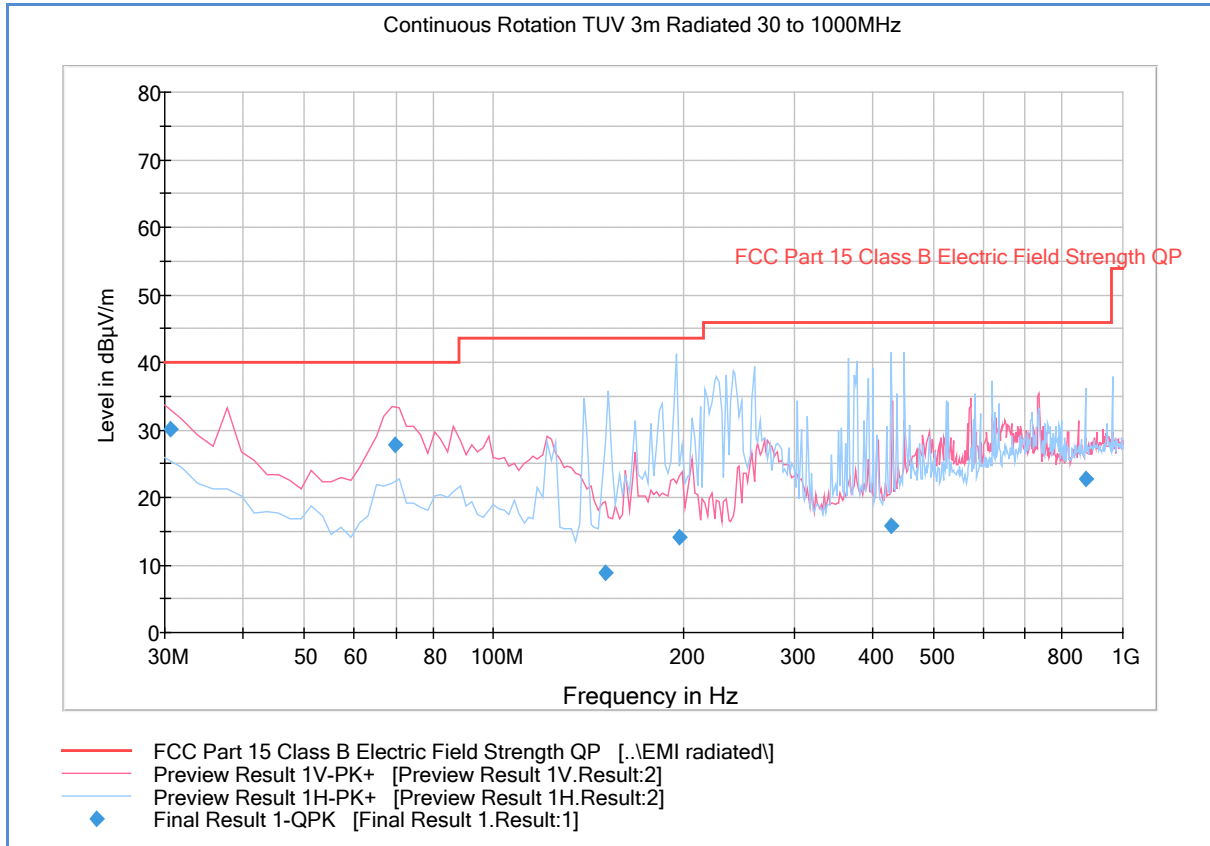
2.2.8 Sample Computation (Radiated Emission)

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.

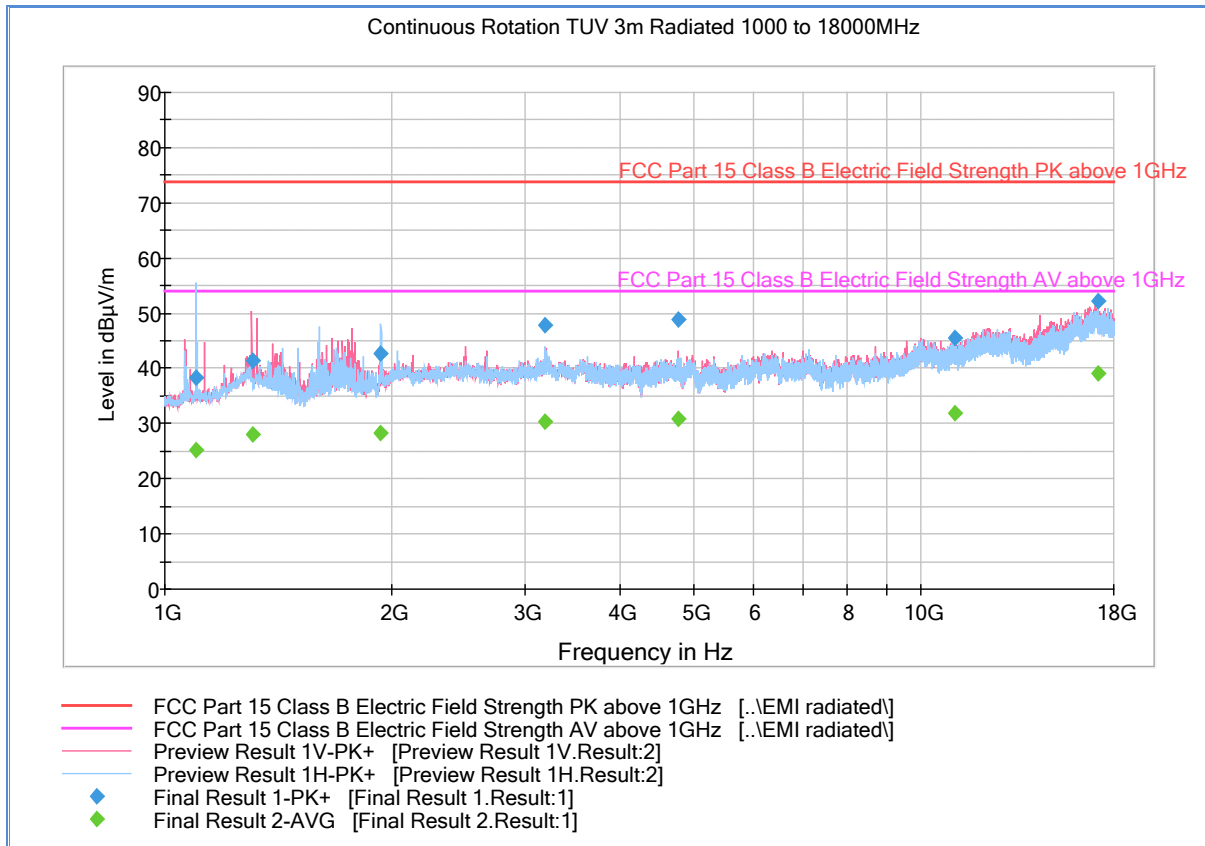
2.2.9.1 Below 1GHz Radiated Emission Test



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)
30.560000	30.1	1000.0	120.000	100.0	V	0.0	-7.3	9.9	40.0
69.837756	27.9	1000.0	120.000	110.0	V	343.0	-17.7	12.1	40.0
150.584930	8.8	1000.0	120.000	250.0	H	241.0	-14.2	34.7	43.5
197.230461	14.0	1000.0	120.000	250.0	H	193.0	-12.7	29.5	43.5
428.056994	15.9	1000.0	120.000	225.0	H	256.0	-4.5	30.1	46.0
873.103407	22.8	1000.0	120.000	295.0	H	228.0	4.7	23.2	46.0

2.2.9.2 Above 1GHz Radiated Emission Test



Peak Data

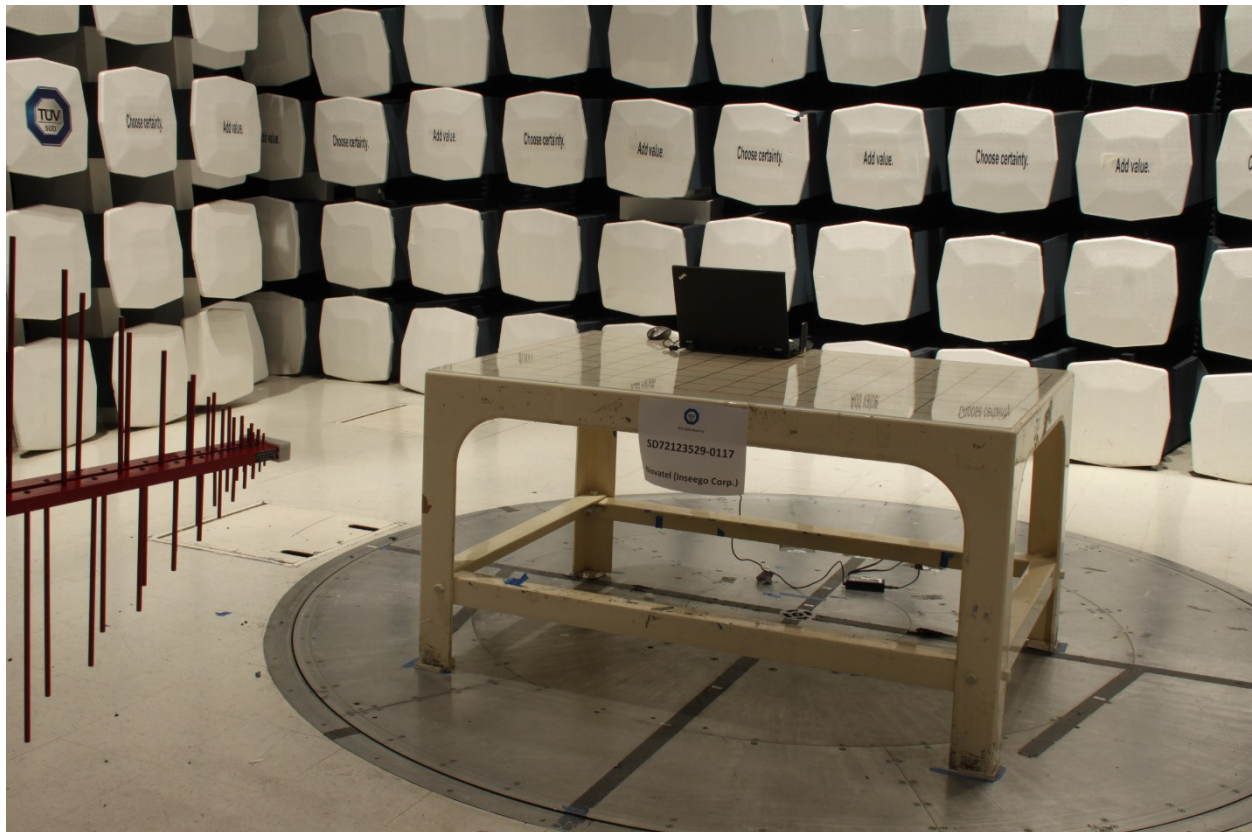
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1098.566667	38.4	1000.0	1000.000	326.2	H	184.0	-6.7	35.5	73.9
1304.500000	41.4	1000.0	1000.000	277.2	V	190.0	-4.2	32.5	73.9
1932.566667	42.8	1000.0	1000.000	332.2	H	327.0	-2.2	31.1	73.9
3186.566667	47.9	1000.0	1000.000	219.5	H	255.0	1.2	26.0	73.9
4778.533333	48.8	1000.0	1000.000	141.7	V	236.0	3.3	25.1	73.9
11112.933333	45.5	1000.0	1000.000	203.3	V	117.0	12.4	28.4	73.9
17153.600000	52.2	1000.0	1000.000	119.8	H	76.0	19.6	21.7	73.9

Average Data

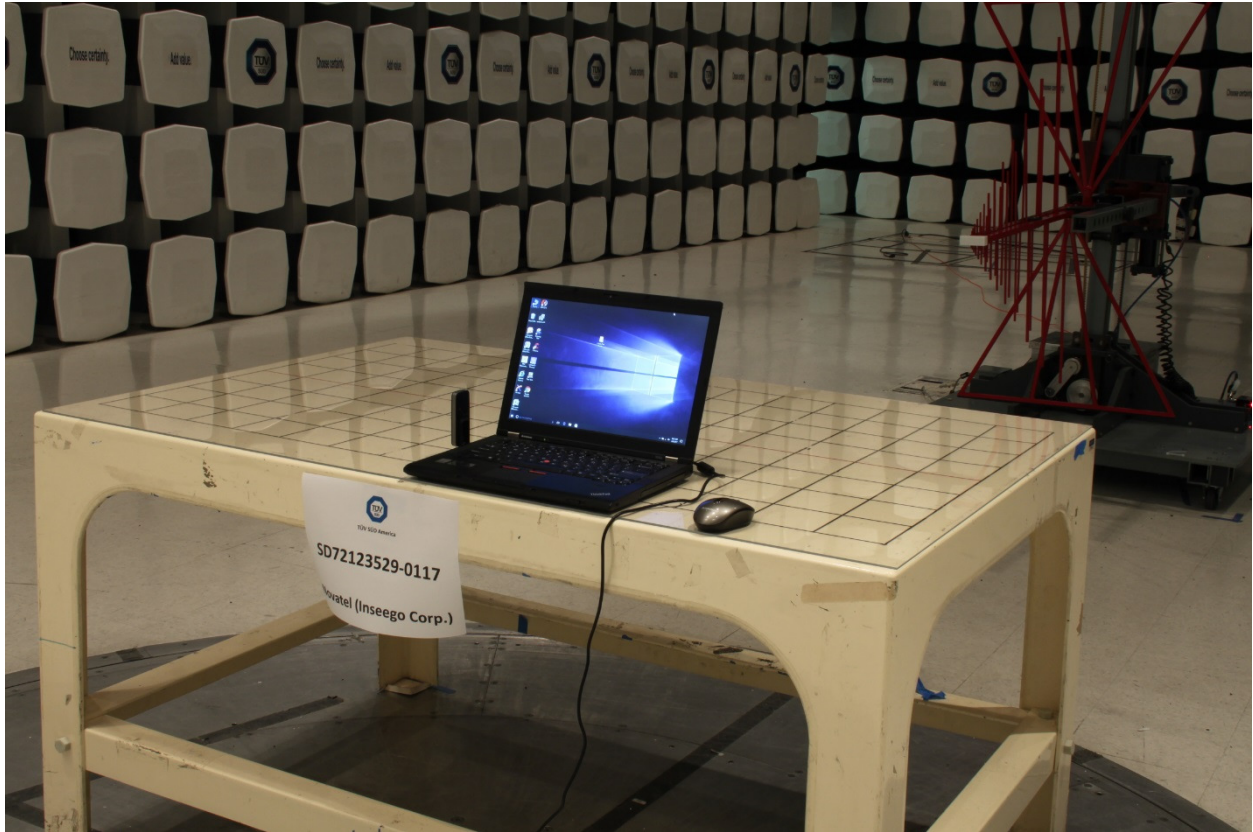
Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1098.566667	25.1	1000.0	1000.000	326.2	H	184.0	-6.7	28.8	53.9
1304.500000	28.0	1000.0	1000.000	277.2	V	190.0	-4.2	25.9	53.9
1932.566667	28.4	1000.0	1000.000	332.2	H	327.0	-2.2	25.5	53.9
3186.566667	30.2	1000.0	1000.000	219.5	H	255.0	1.2	23.7	53.9
4778.533333	30.9	1000.0	1000.000	141.7	V	236.0	3.3	23.0	53.9
11112.933333	31.9	1000.0	1000.000	203.3	V	117.0	12.4	22.0	53.9
17153.600000	39.0	1000.0	1000.000	119.8	H	76.0	19.6	14.9	53.9

Test Notes:

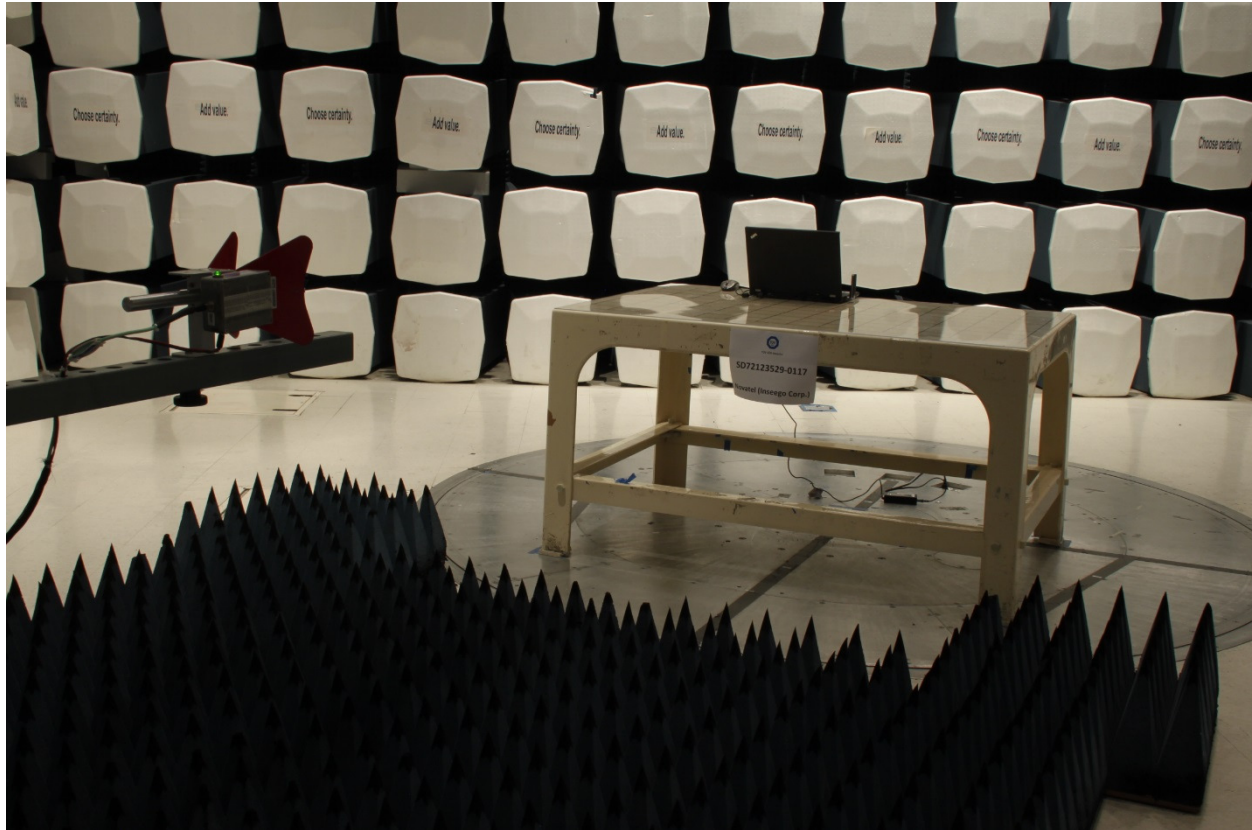
2.2.10 Test Setup Photo (Below 1GHz Front)



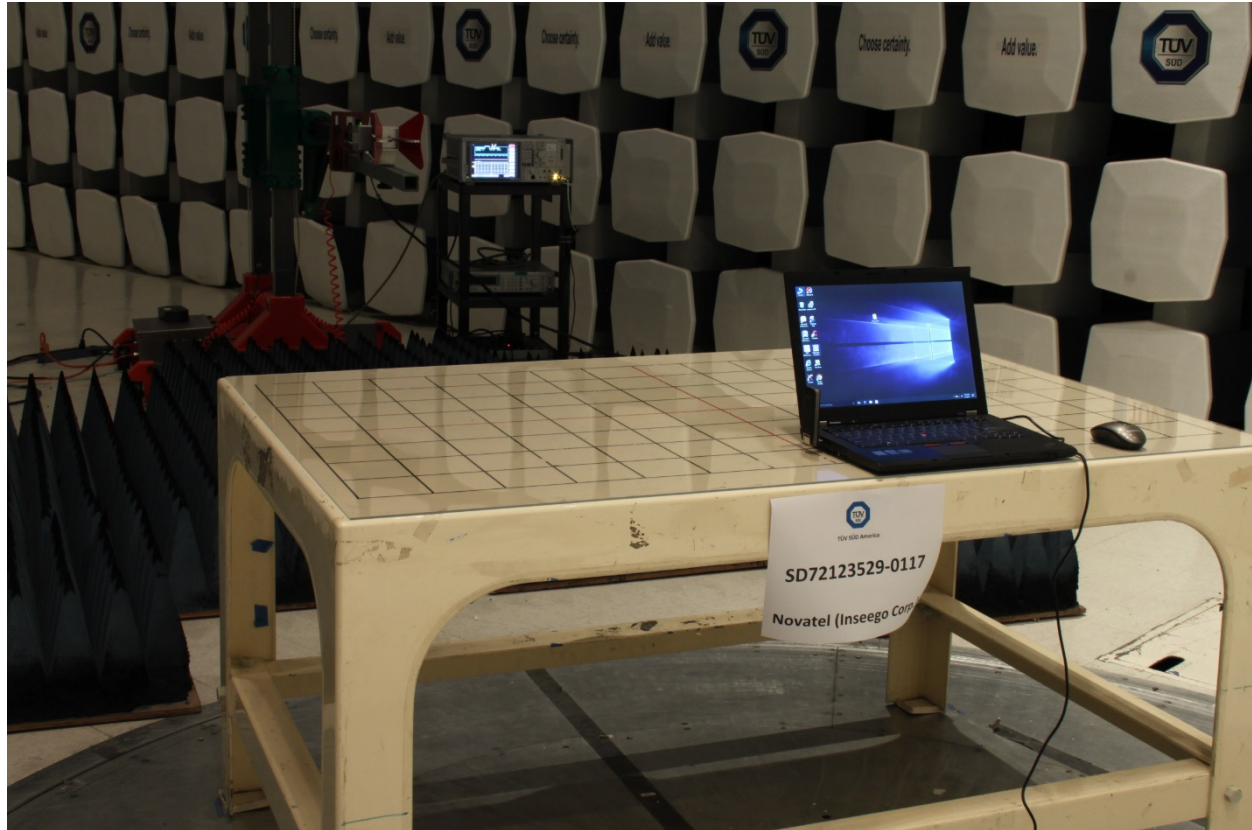
2.2.11 Test Setup Photo (Below 1GHz Back)



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	09/07/16	09/07/17
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	11/05/16	11/05/17
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	11/05/16	11/05/17
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	Verified by 7582 and 7608	
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	Verified by 7582 and 7608	
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	10/26/16	10/26/17
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/02/16	09/02/17
Radiated Emission						
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
1016	Pre-amplifier	PAM-0202	187	PAM	02/09/17	02/09/18
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	03/21/16	03/21/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/16/16	05/16/17
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	06/29/16	06/29/17
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 1003 and 7582	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 1003 and 7582	
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/29/17
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	08/22/16	08/22/17
	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 AC Conducted Emissions

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	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57

3.2.3 Radiated Measurements (Above 1GHz)

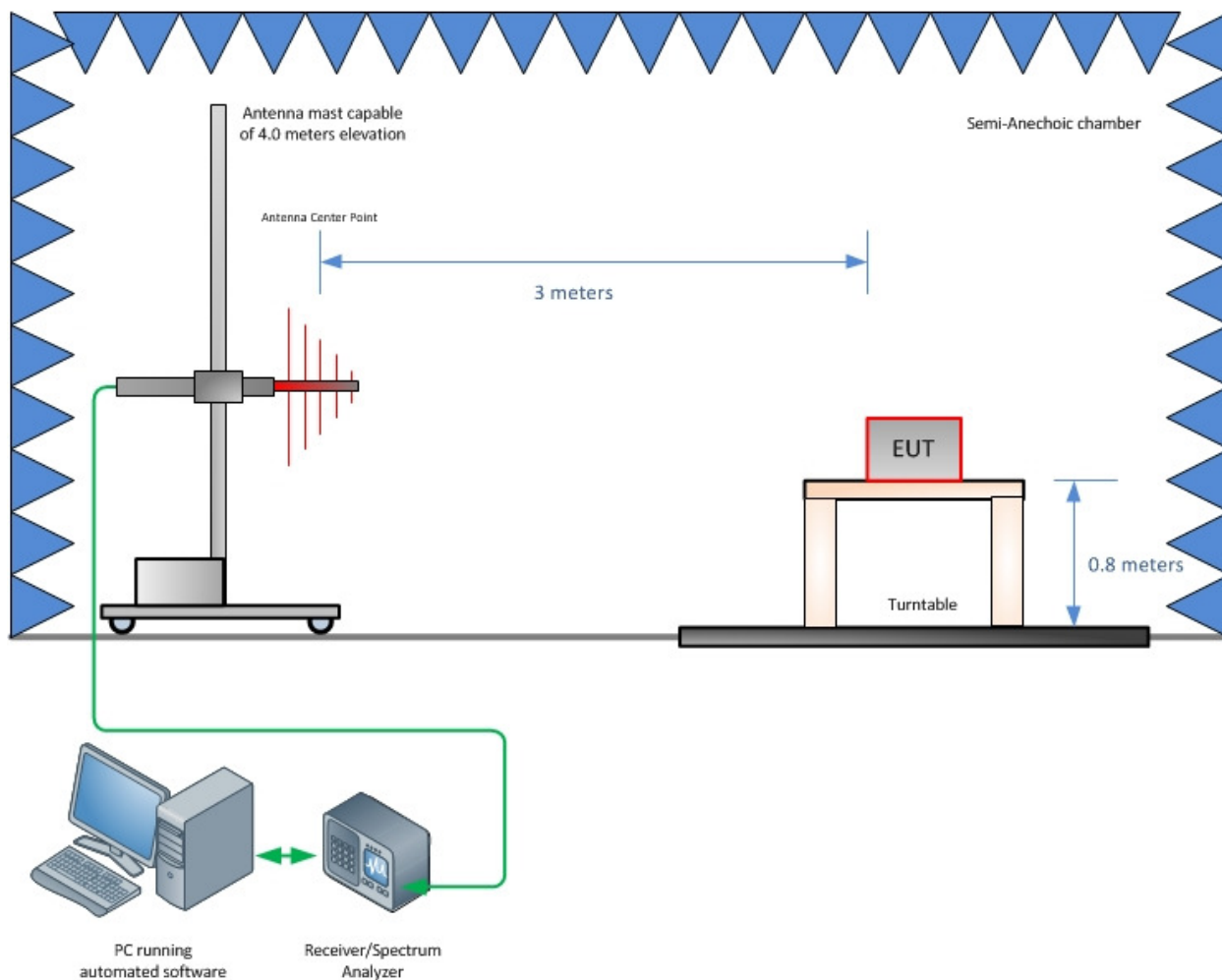
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57



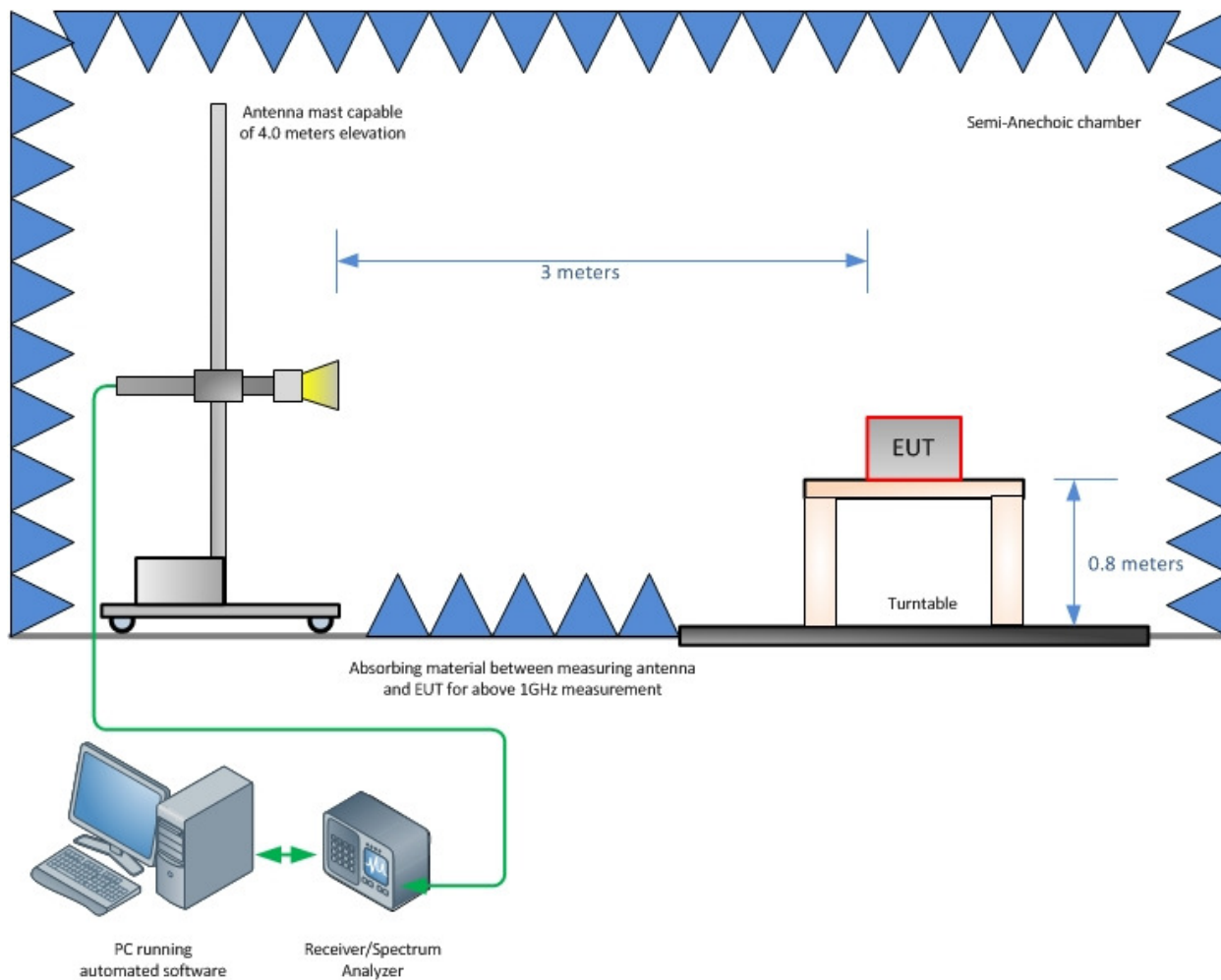
SECTION 4

DIAGRAM OF TEST SETUP

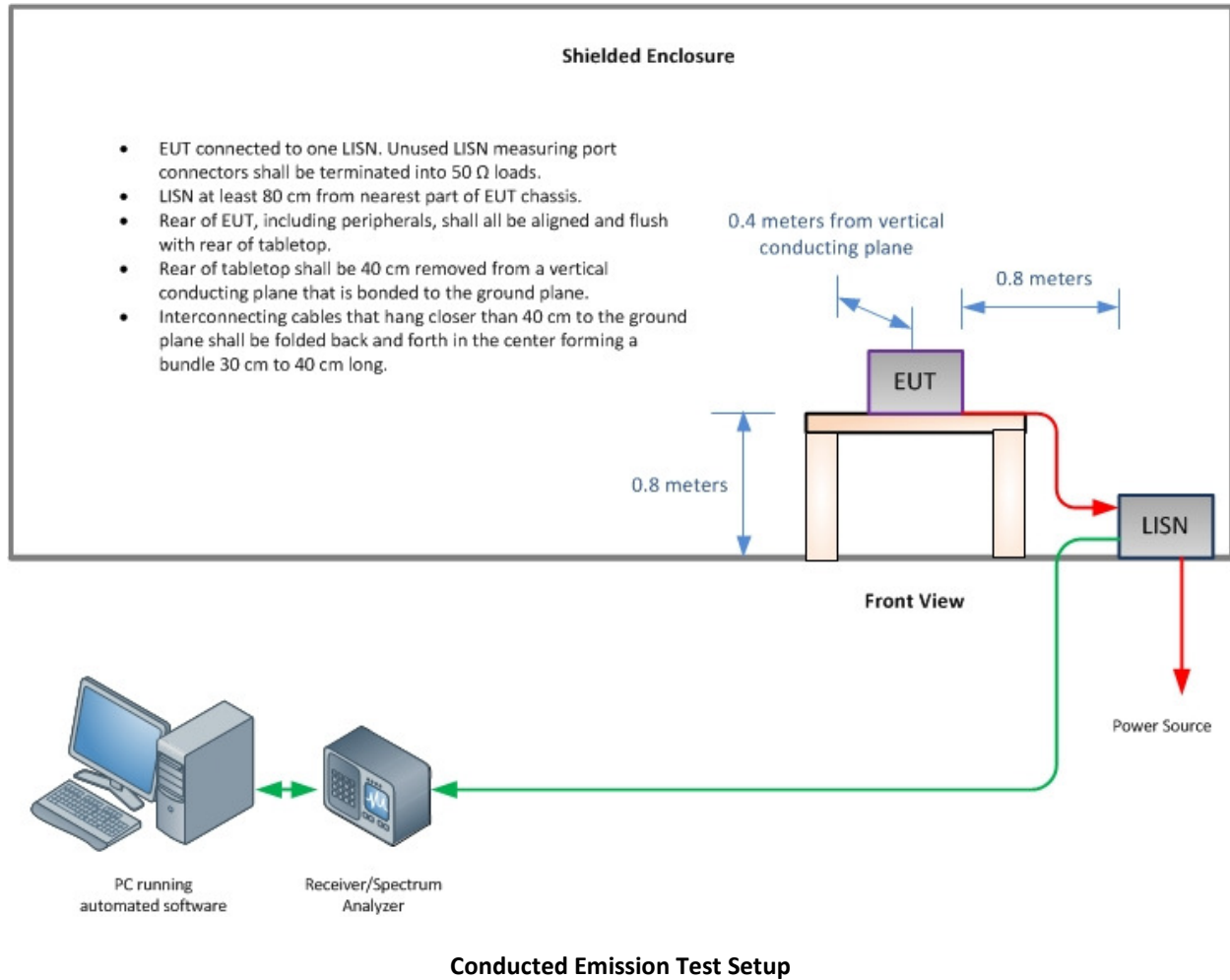
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)





SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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