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Report On

EMC Evaluation of
Piper Networks, Inc.
Piper Sensor Model SG1001

FCC Part 15 Subpart B
ICES-003 Issue 6

Report No. SD72120112-0916C

February 2017



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REPORT ON EMC Evaluation of the
Piper Networks, Inc.
Piper Sensor

TEST REPORT NUMBER SD72120112-0916C

TEST REPORT DATE February 2017

PREPARED FOR Piper Networks, Inc.
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Title: EMC/Wireless Test Engineer

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DATED February 22, 2017



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Revision History

SD72120112-0916C Piper Networks, Inc. Piper Sensor					
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02/22/2017	Initial Release				Ferdinand Custodio

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SECTION 1

REPORT SUMMARY

EMC Evaluation of the
Piper Networks, Inc.
Piper Sensor SG1001

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Piper Networks, Inc. Piper Sensor Piper Sensor 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	Piper Networks, Inc.
Model Name	Piper Sensor
Model Number(s)	SG1001
Serial Number(s)	90004024
Number of Samples Tested	1
Date sample(s) received	January 18, 2017
Highest Frequency Generated or Used	2.480 GHz
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	January 18, 2017
Finish of Test	January 18, 2017
Name of Engineer(s)	Nikolay Shitn
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	N/A	Class B requirement
§15.109	6.2	Radiated Emission Limits	Compliant	Class B requirement

N/A Not performed. EUT is a PoE powered device having no direct connection to the AC mains.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Piper Networks, Inc. Piper Sensor Model SG1001 as shown in the photographs below.



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	The EUT was powered from PoE Ethernet switch with WLAN radio set in transmit mode. Support laptop connected to the switch was sending/receiving data to/from the EUT.

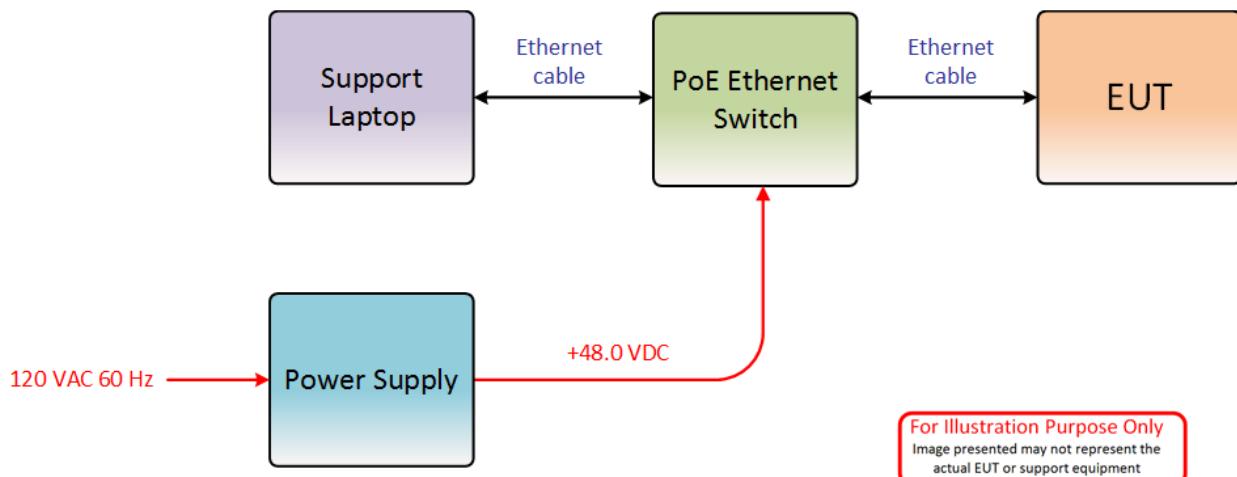
1.4.2 EUT Exercise Software

EUT was loaded with FW version 1.0.149. EUT Radio was configured in the 802.11g mode (worst case configuration) using wlan_radio.sh Script.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Apple	Support Laptop	Mac Book Pro Model: A1398
Trendnet	Ethernet Switch	Model TPE-S44 S/N: C21546P400047
I. T. E	Power Supply (Input: 100-240V 50/60 Hz 1.0A Output: 48V 0.8A)	Model NU38-1480080-12
	Ethernet (EUT to Support PC)	CAT6 Ethernet Cable 2m

1.4.4 Simplified Test Configuration Diagram



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: 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.

1.7 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 SUD 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 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
Piper Networks, Inc.
Piper Sensor SG1001

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

Not performed. EUT is a PoE powered device having no direct connection to the AC mains.

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: 90004024 /Default Test Configuration

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

January 18, 2017/NS

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	24.2 °C
Relative Humidity	48.1 %
ATM Pressure	99.1 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 V9.26.0 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.

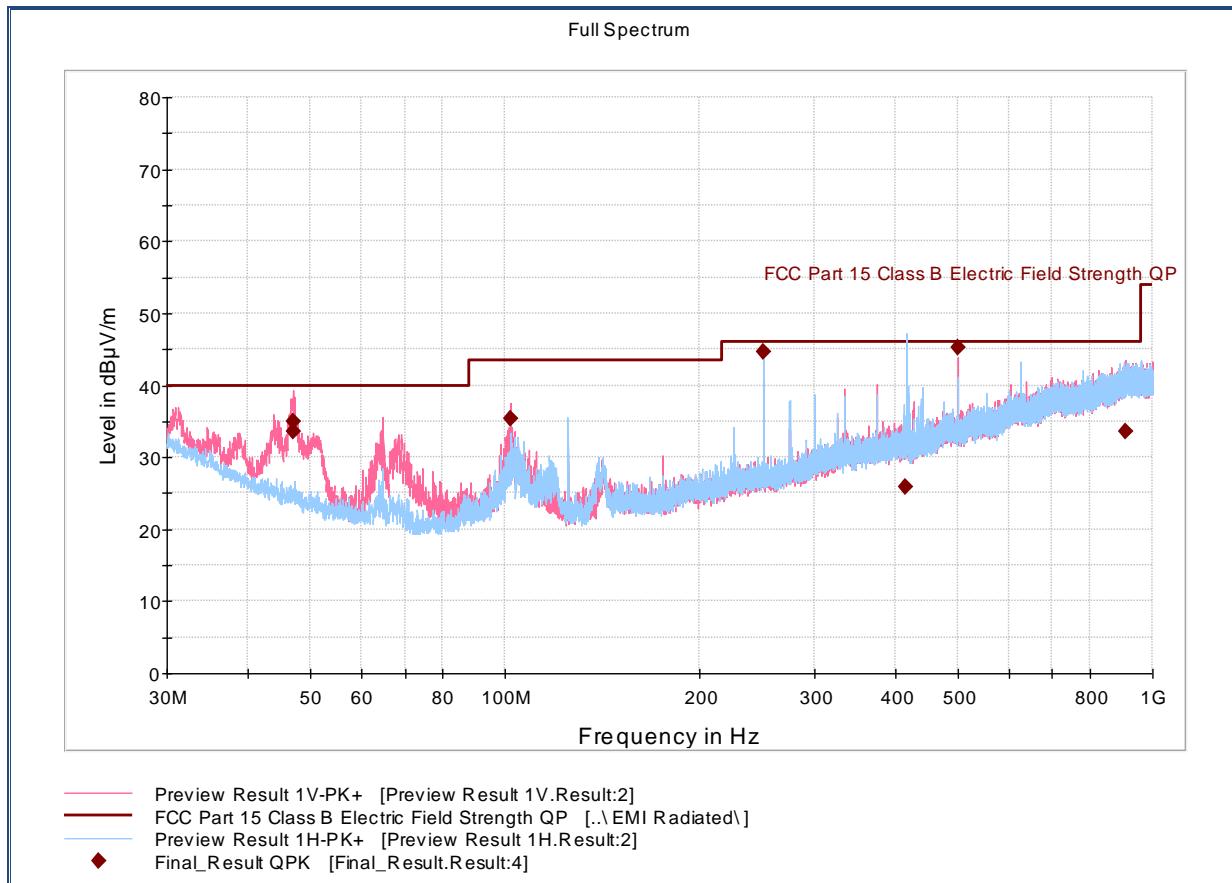
2.2.8 Sample Computation (Radiated Emission)

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.

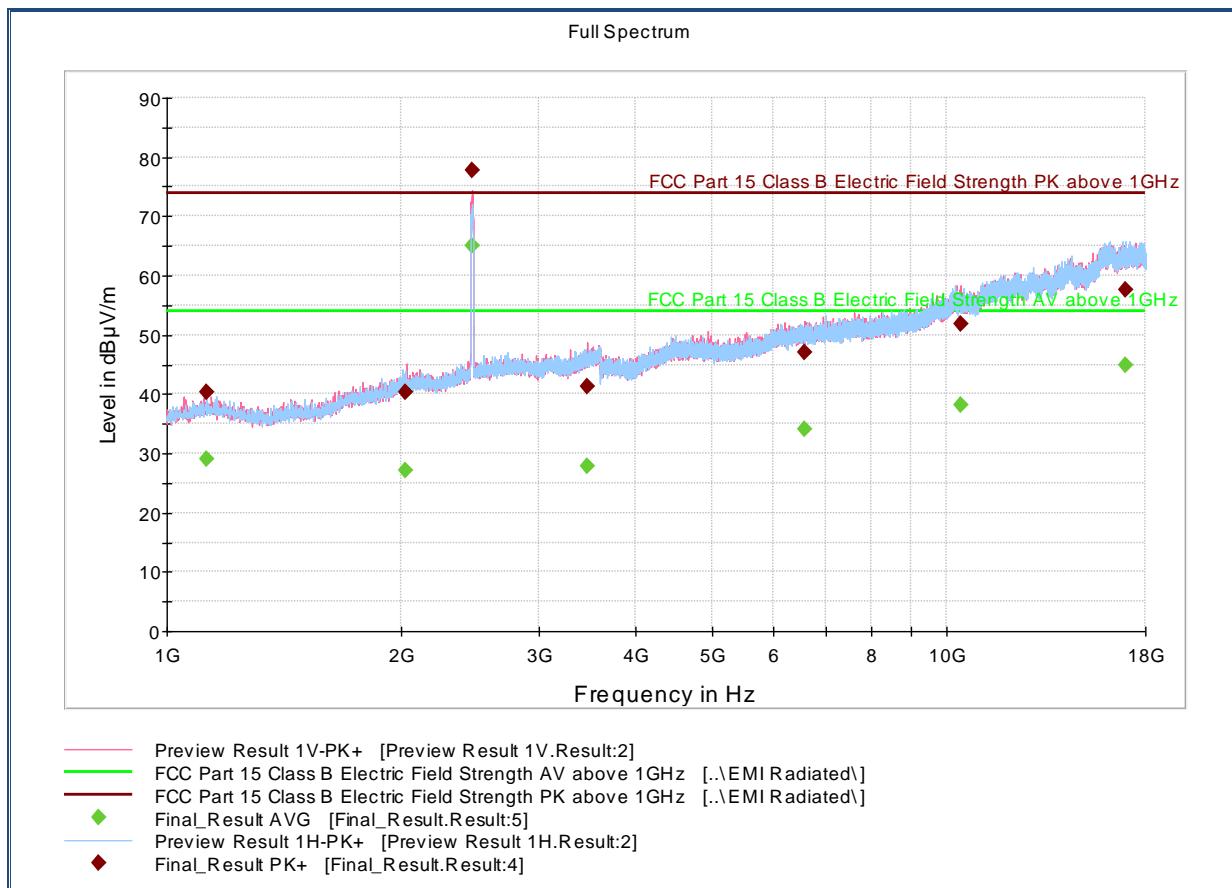
2.2.9.1 Below 1GHz Radiated Emission Test



Quasi-Peak Data

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
46.979667	34.87	40.00	5.13	1000.0	120.000	99.8	V	290.0	17.1
47.101333	33.55	40.00	6.45	1000.0	120.000	99.8	V	121.0	17.0
101.864667	35.33	43.50	8.17	1000.0	120.000	99.8	V	241.0	16.0
250.016000	44.61	46.00	1.40	1000.0	120.000	142.1	H	267.0	20.3
416.178667	25.95	46.00	20.05	1000.0	120.000	158.0	H	204.0	25.2
500.017333	45.20	46.00	0.80	1000.0	120.000	106.8	V	104.0	27.1
906.747667	33.52	46.00	12.48	1000.0	120.000	136.6	V	245.0	33.6

2.2.9.2 Above 1GHz Radiated Emission Test



Peak Data

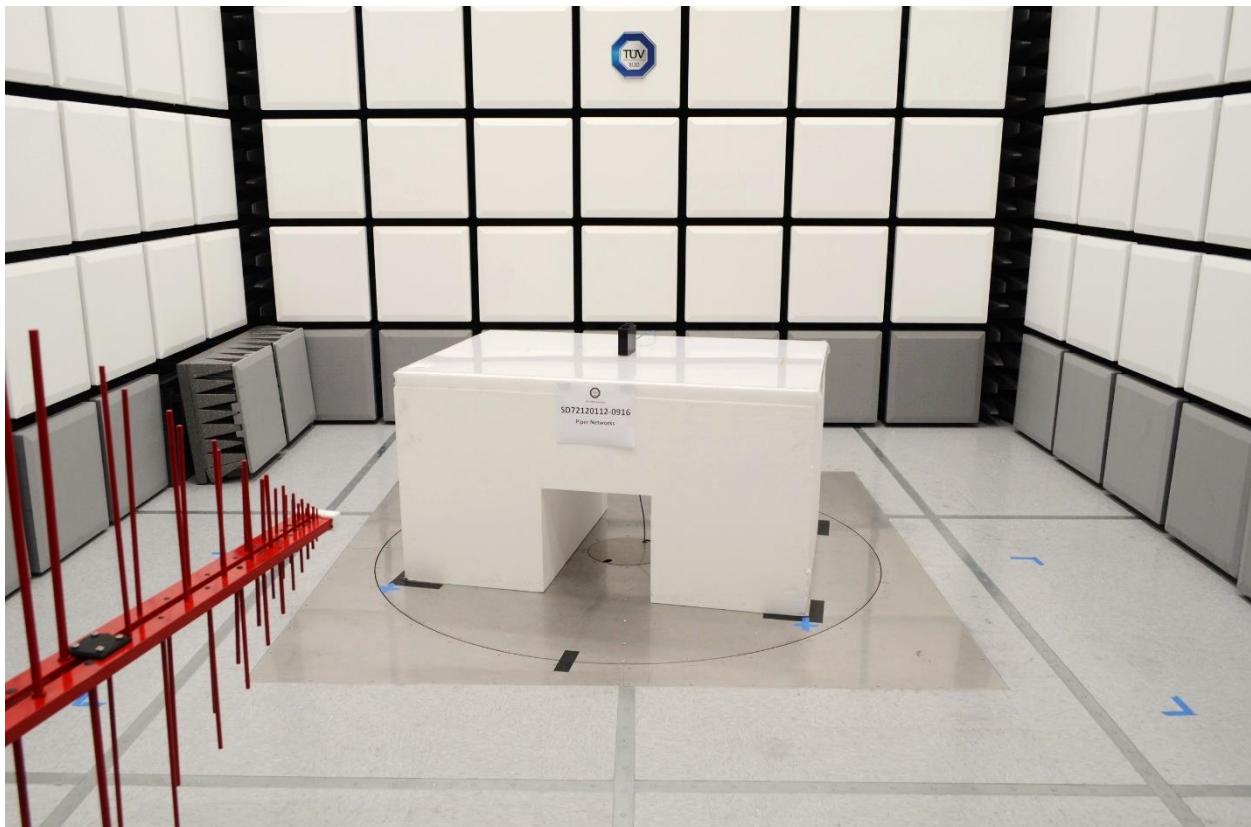
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1125.009091	40.35	73.90	33.55	1000.0	1000.000	385.0	H	93.0	-1.0
2022.190909	40.40	73.90	33.50	1000.0	1000.000	410.2	V	117.0	3.7
2461.772727	77.69	N/A (see test note)	1000.0	1000.000	299.0	V	230.0	4.7	
3461.227273	41.37	73.90	32.53	1000.0	1000.000	371.3	V	2.0	6.8
6570.790909	46.93	73.90	26.97	1000.0	1000.000	386.1	V	50.0	14.6
10414.090909	51.89	73.90	22.01	1000.0	1000.000	126.0	V	134.0	19.7
16973.381818	57.65	73.90	16.25	1000.0	1000.000	250.1	H	132.0	26.7

Average Data

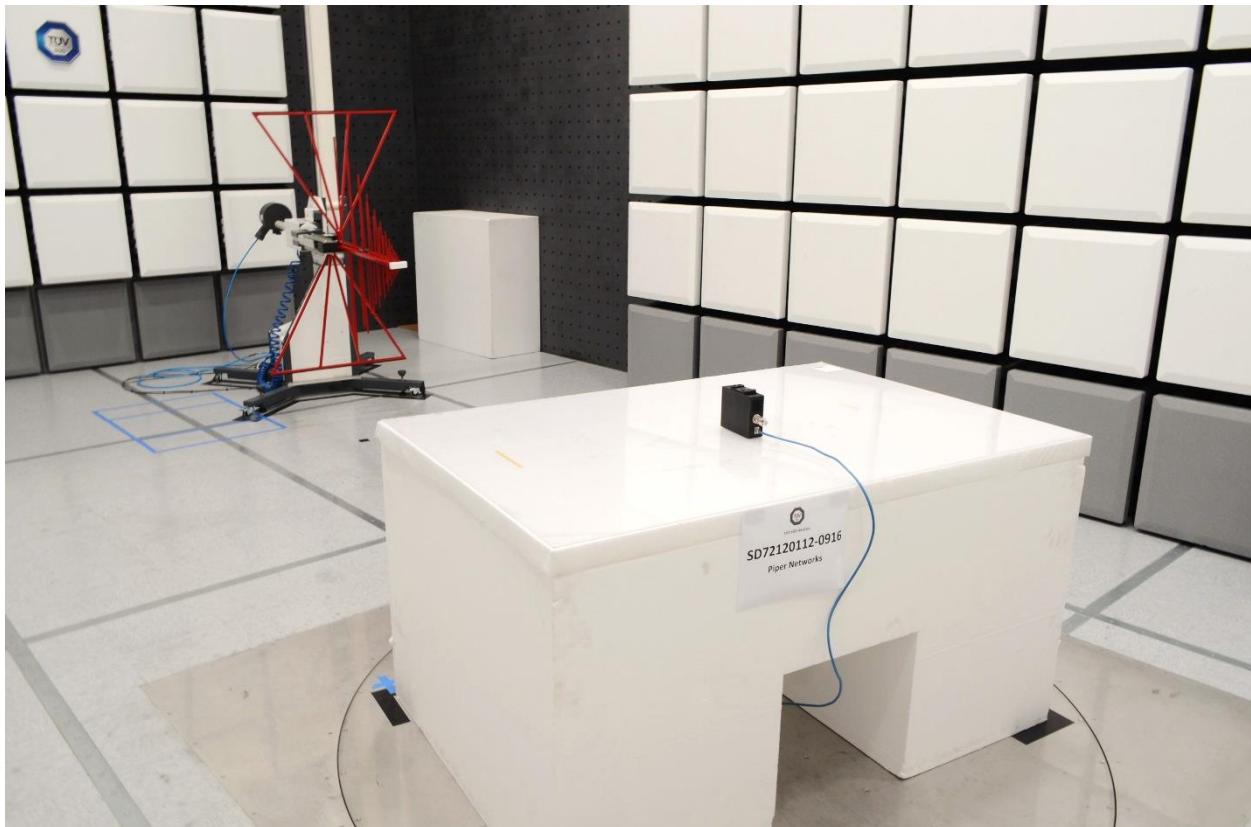
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1125.009091	28.98	53.90	24.92	1000.0	1000.000	385.0	H	93.0	-1.0
2022.190909	27.13	53.90	26.77	1000.0	1000.000	410.2	V	117.0	3.7
2461.772727	65.13	N/A (see test note)	1000.0	1000.000	299.0	V	230.0	4.7	
3461.227273	27.78	53.90	26.12	1000.0	1000.000	371.3	V	2.0	6.8
6570.790909	34.03	53.90	19.87	1000.0	1000.000	386.1	V	50.0	14.6
10414.090909	38.05	53.90	15.85	1000.0	1000.000	126.0	V	134.0	19.7
16973.381818	44.79	53.90	9.11	1000.0	1000.000	250.1	H	132.0	26.7

Test Notes: Emissions from the EUT Radio and its harmonics will be ignored for this test. Measurements above 10GHz were noise floor figures that were verified using lower RBW settings. Noise floor was more than 6 dB below the applicable limits.

2.2.10 Test Setup Photo (Below 1GHz Front)



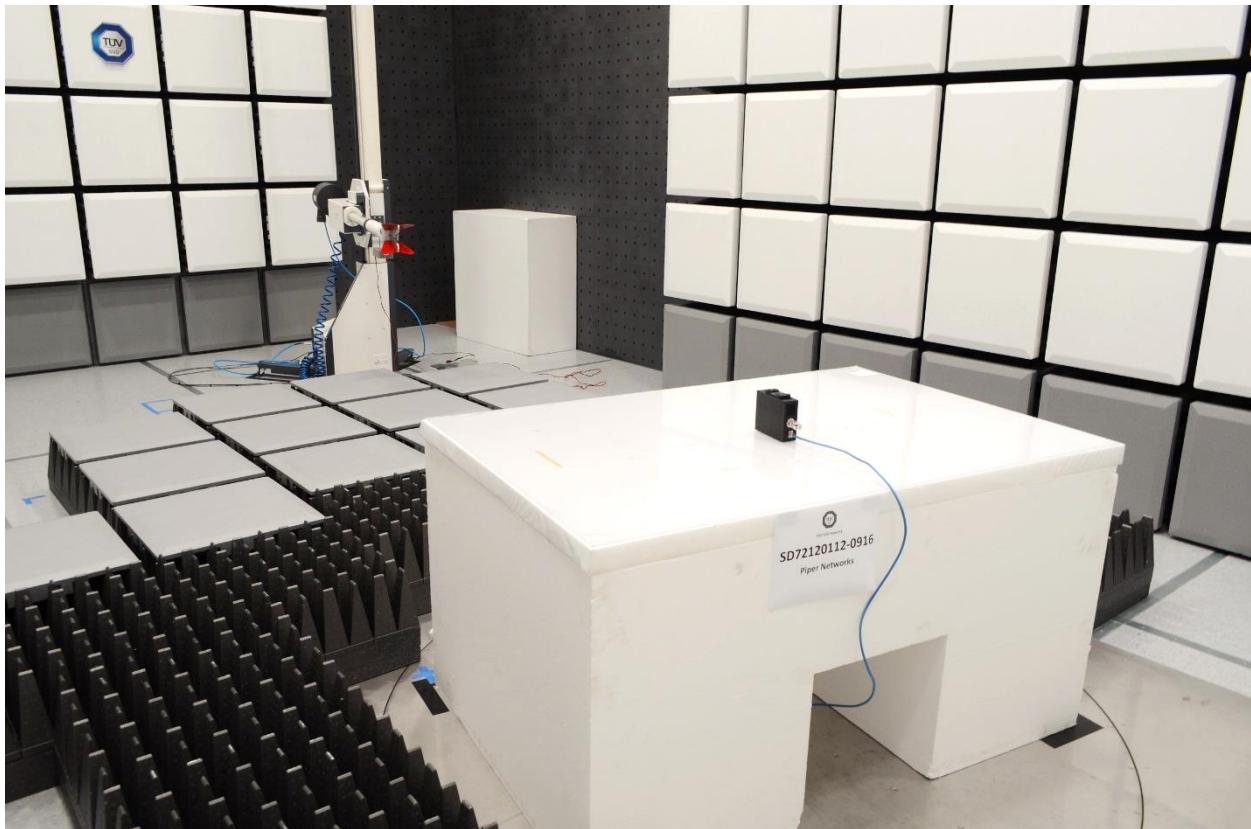
2.2.11 Test Setup Photo (Below 1GHz Back)



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
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
8891	Pre-amplifier (1-18 GHz)	PE15A3262	1012	Pasternack	04/29/16	04/29/17
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	07/05/16	07/05/17
8878	High-frequency cable	R90-088-240	N/A	Teledyne/Storm Microwave	03/16/16	03/16/17
8879	High-frequency cable	084-0505-100	N/A	Teledyne/Storm Microwave	03/16/16	03/16/17
Miscellaneous						
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	08/22/16	08/22/17
	Test Software	EMC32	V9.26.0	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 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

3.2.2 Radiated Measurements (Above 1GHz)

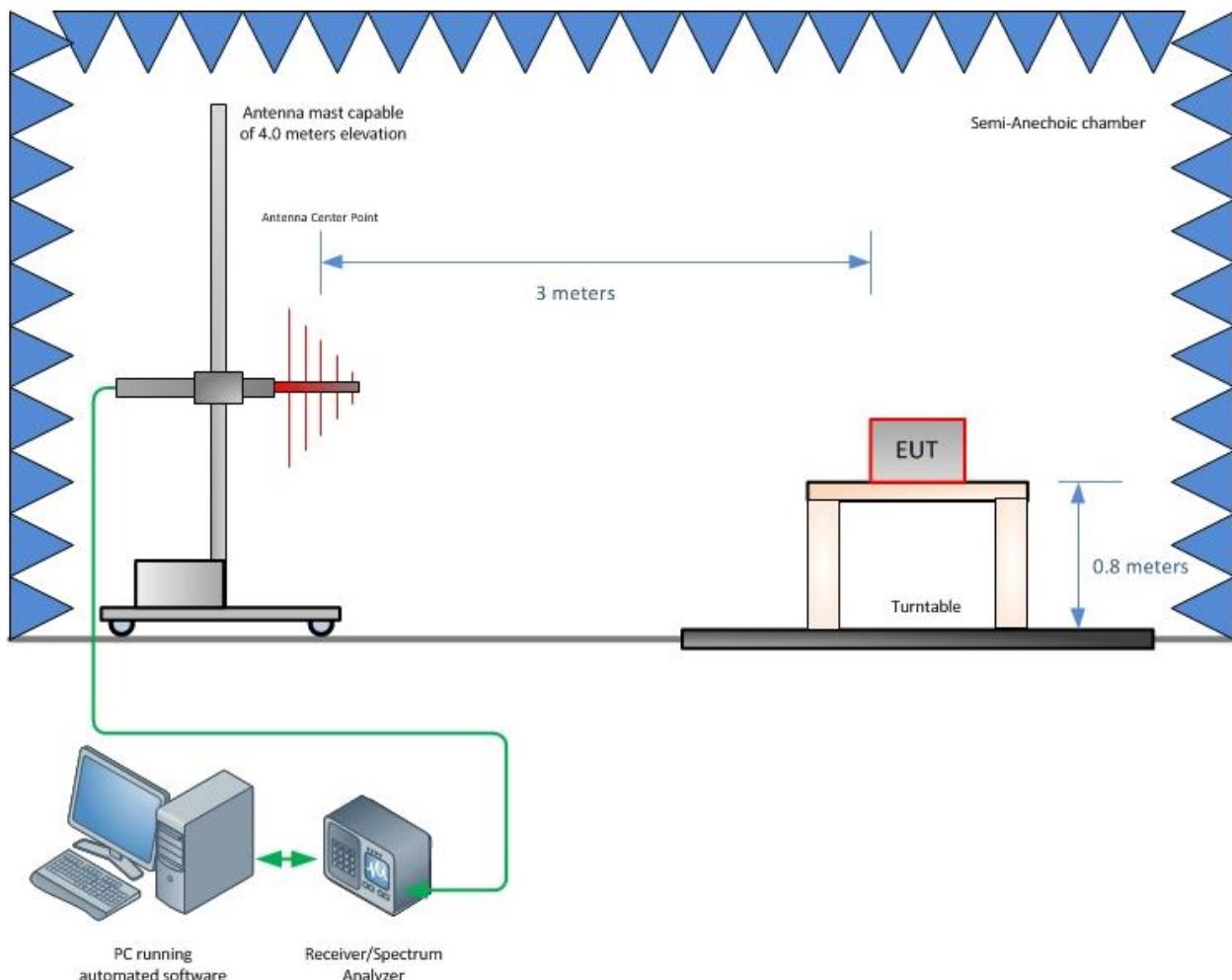
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	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



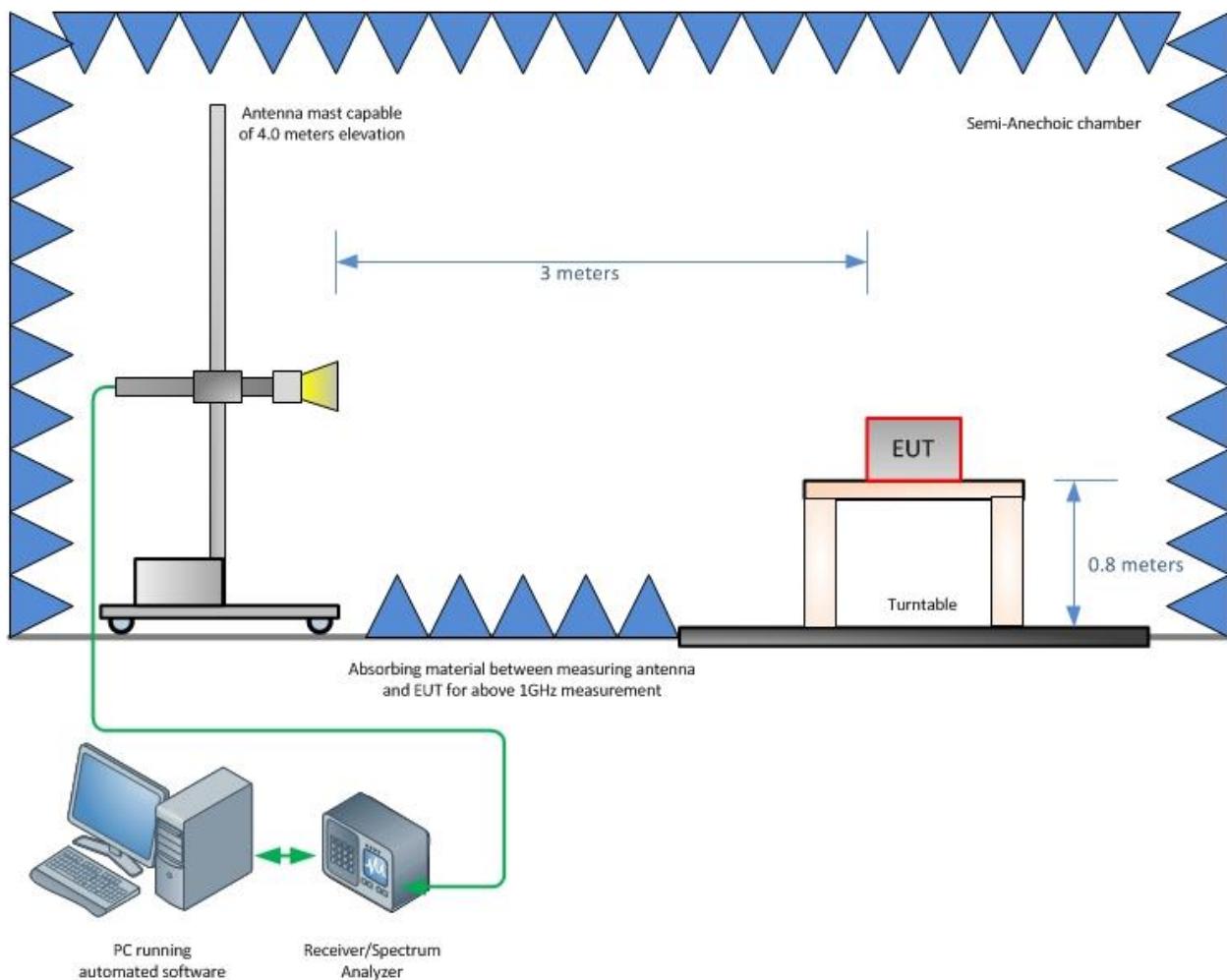
SECTION 4

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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