Spruce Environmental Technologies, Inc.

TEST REPORT

SCOPE OF WORK
EMISSIONS TESTING – RADSTAR ALPHA SERIES

REPORT NUMBER
103933459BOX-002

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DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. December 2017

EMISSIONS TEST REPORT

(FULL COMPLIANCE)

Report Number: 103933459BOX-002
Project Number: G103933459

Report Issue Date: 08/06/2019

Model(s) Tested: RadStar Alpha Series
Model(s) Partially Tested: None
Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 15.247 Subpart C:2019,
CFR47 FCC Part 15 Subpart B:2019,
RSS-247 Issue 2 February 2017,
ISED ICES-003 Issue 6 Published: January 2016 Updated: April 2019,
RSS-Gen Issue 5 April 2018,
RSS-102 Issue 5 March 2015,
KDB 558074 D01 15.247 Meas Guidance v05r02

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Spruce Environmental Technologies, Inc.
3 Saber Way
Ward Hill, MA 01835
USA

Report prepared by

Vathana Ven/EMC Staff Engineer

Report reviewed by

Kouma Sinn/EMC Staff Engineer

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	---
6	Maximum Peak Output Power and Human RF exposure CFR47 FCC Part 15 Subpart C:2019, Section 15.247 (b)(3) RSS-247 Issue 2 February 2017, RSS-102 Issue 5 March 2015	Pass
7	6 dB Bandwidth and Occupied Bandwidth CFR47 FCC Part 15 Subpart C:2019, Section 15.247 (a)(2) RSS-247 Issue 2 February 2017	Pass
8	Maximum Power Spectral Density CFR47 FCC Part 15 Subpart C: 02/2018, Section 15.247 (e) RSS-247 Issue 2 February 2017	Pass
9	Band Edge Compliance CFR47 FCC Part 15 Subpart C:2019, Section 15.247 (d) RSS-247 Issue 2: 02/2017)	Pass
10	Transmitter spurious emissions CFR47 FCC Part 15 Subpart C: 2019, Section 15.247 (d) RSS-247 Issue 2 February 2017	Pass
11	Digital Device and Receiver Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B 15.109: 06/2018, ISED ICES-003 Issue 6 Published: January 2016 Updated: April 2017	Pass
12	AC Mains Conducted Emissions FCC 47CFR Part 15.107:2019 ISED ICES-003 Issue 6 Published: January 2016 Updated: April 2017	Pass
13	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: Spruce Environmental Technologies, Inc.
3 Saber Way
Ward Hill, MA 01835
USA

Contact: John Dechristopher
Telephone: +1 800-355-0901 ext. 565
Email: jdechristopher@spruce.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Spruce Environmental Technologies, Inc.
3 Saber Way
Ward Hill, MA 01835
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Radon Monitor	Spruce Environmental	RadStar Alpha	51009
Radon Monitor	Spruce Environmental	RadStar Alpha	51012
AC Adapter	ANKER	A2013	BOX1905231311-002*

* - No serial number listed on unit, an Intertek number was put on the device and listed above.

Receive Date:	05/23/2019
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The EUT is a Radon monitor.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
100-240VAC	1A	50/60Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Tx mode
2	Rx mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Nordic Softdevice S132 version

Radio/Receiver Characteristics	
Frequency Band(s)	2402-2480 MHz
Modulation Type(s)	GFSK
Maximum Output Power	Low Channel (2402 MHz): -6.50 dBm Mid Channel (2440 MHz): -6.43 dBm High Channel (2480 MHz): -4.79 dBm
Test Channels	Low Channel (2402 MHz) Mid Channel (2440 MHz) High Channel (2480 MHz)
Occupied Bandwidth	Low Channel (2402 MHz): 1.90 MHz Mid Channel (2440 MHz): 1.86 MHz High Channel (2480 MHz): 1.84 MHz
6 dB Bandwidth	Low Channel (2405 MHz): 0.520 MHz Mid Channel (2440 MHz): 0.520 MHz High Channel (2475 MHz): 0.520 MHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
ETSI LBT/Adaptivity	Non-Adaptive
ETSI Adaptivity Type	N/A
ETSI Temperature Category (I, II, III)	N/A
ETSI Receiver Category (1, 2, 3)	N/A
Antenna Type and Gain	Integrated, +1 dBi

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

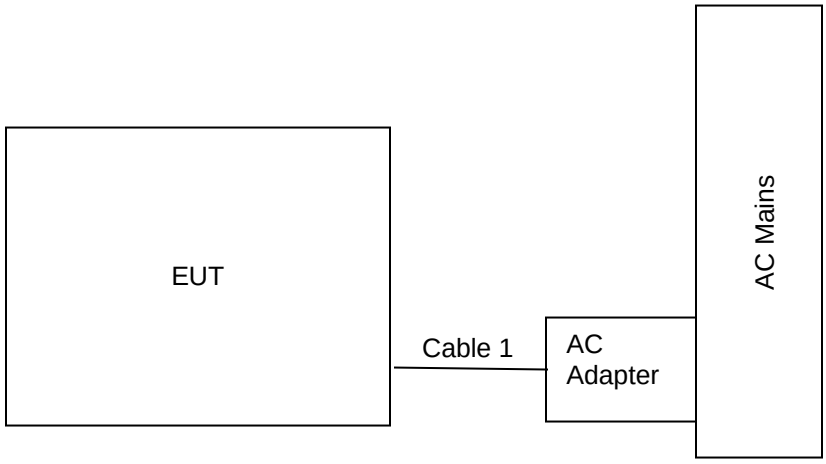
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	None	--	--	--	--

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	Dell	LATITUDE E5440	Not labeled

5.1 Method:

Configuration as required by Configuration as required by FCC Part 15 Subpart C 15.247: 2019, FCC Part 15 Subpart B: 2019, RSS 247 Issue 2: 02/2017, ICES 003 Issue 6: 01/2016 updated 06/2016, RSS-Gen Issue 5 April 2018, RSS-102 Issue 5 March 2015, ANSI C 63.10: 2013, and ANSI C 63.4: 2014, KDB 558074 D01 15.247 Meas Guidance v05r02.

5.2 EUT Block Diagram:



6 Maximum Peak Output Power and Human RF exposure

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, RSS-102, ANSI C63.10, and KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.9 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.4 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.9 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.6 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.6 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	08/16/2018	08/16/2019
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019

Software Utilized:

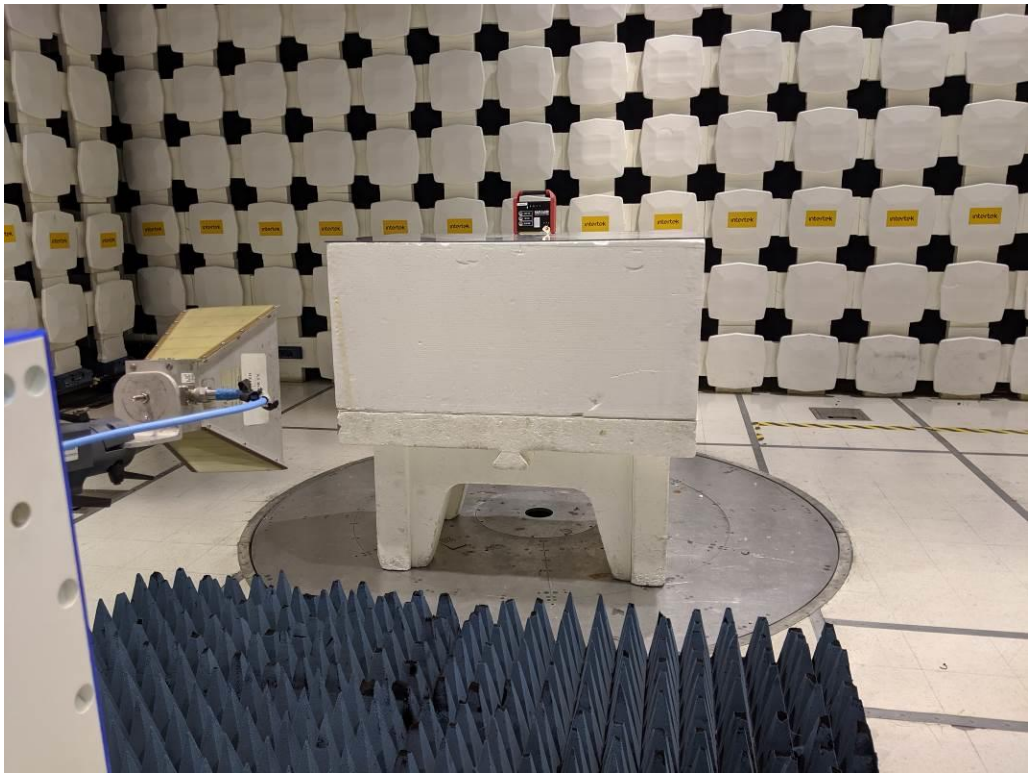
Name	Manufacturer	Version
None		

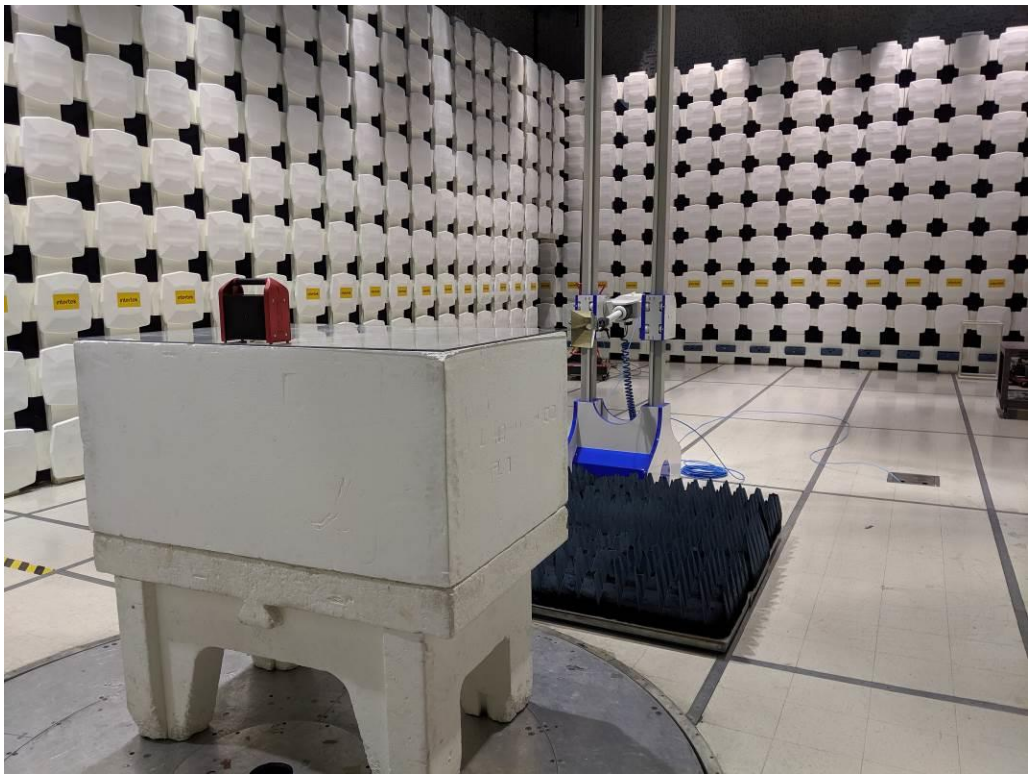
6.3 Results:

The sample tested was found to Comply.

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt or 30 dBm.

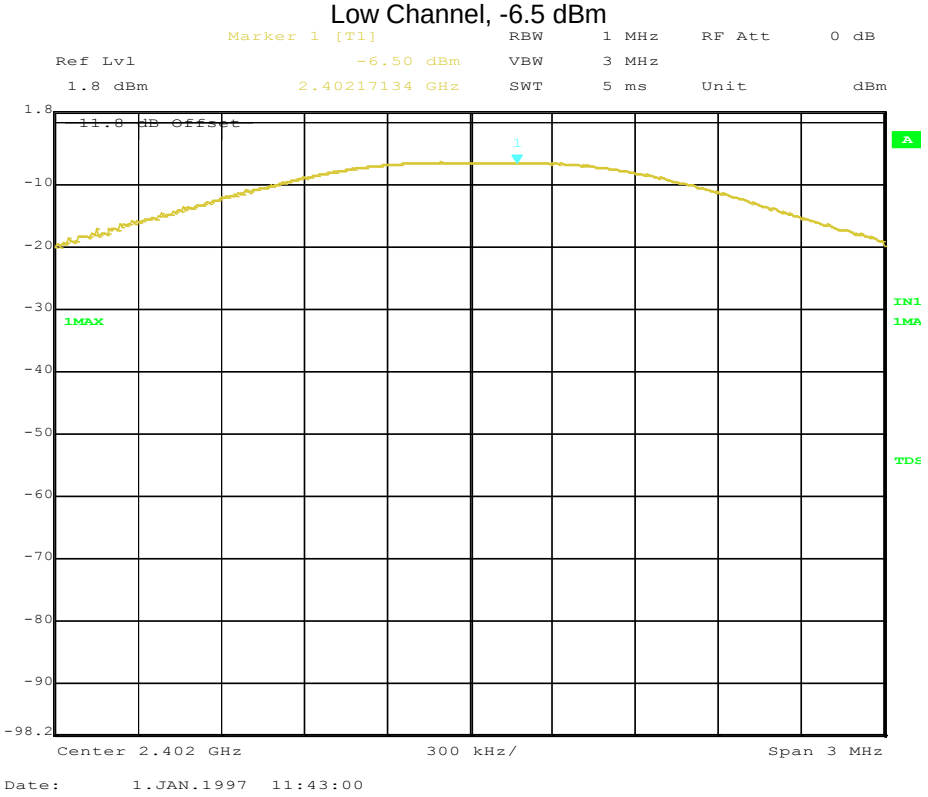
6.4 Setup Photographs:



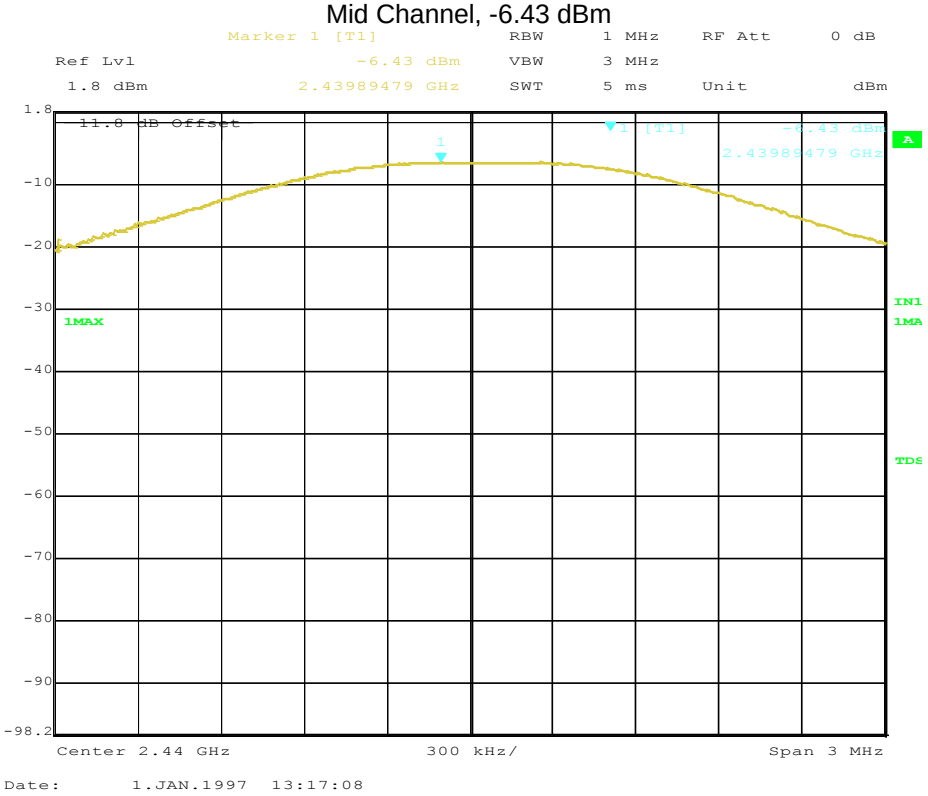


6.5 Plots/Data:

Low Channel, -6.5 dBm

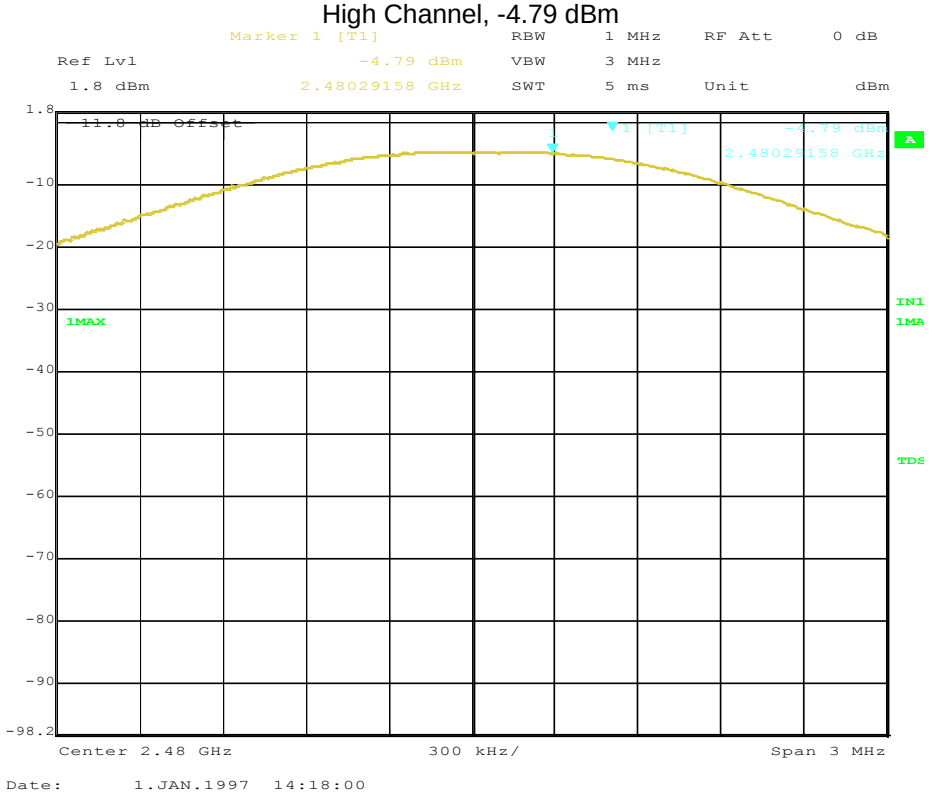


Mid Channel, -6.43 dBm



Note: The antenna and cable factors were included in the reading. The 11.0 dB offset was included to convert field strength to EIRP.

High Channel, -4.79 dBm



Note: The antenna and cable factors were included in the reading. The 11.0 dB offset was included to convert field strength to EIRP.

MPE Calculation

§ 1.1310: The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

RSS-102 Issue 5 Exposure Limits:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

1.1 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with §2.1091. The maximum power density was calculated for each transmitter at a separation distance of 20cm.

$$S = \frac{PG}{4\pi R^2} \qquad 3)$$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

or:

$$S = \frac{EIRP}{4\pi R^2} \qquad (4)$$

where: EIRP = equivalent (or effective) isotropically radiated power

1.2 Results:

- EIRP = -4.79 dB(m) = 0.331895 mW = 0.000332 W

Power Density = 0.331895 / 5025.6

Power Density = 0.000066 mW/cm^2

Limit at 2.480 GHz = 1mW/cm^2

RSS-102 Issue 5 Exposure Limit at 2.480GHz = 5.47 W/m^2

Power Density = 0.00066 W/m^2
The calculated maximum power density at 20cm distance is less than the limit for general population / uncontrolled exposure.

Test Personnel:	Kenneth Lee	Test Date:	07/01/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247, RSS-102	Limit Applied:	See report section 6.3
Input Voltage:	120VAC 60Hz		
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Ambient Temperature:	21 ºC
		Relative Humidity:	46 %
		Atmospheric Pressure:	1007 mbars

Deviations, Additions, or Exclusions: None

7 6 dB Bandwidth and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, RSS-102, ANSI C63.10, KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	08/16/2018	08/16/2019
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019

Software Utilized:

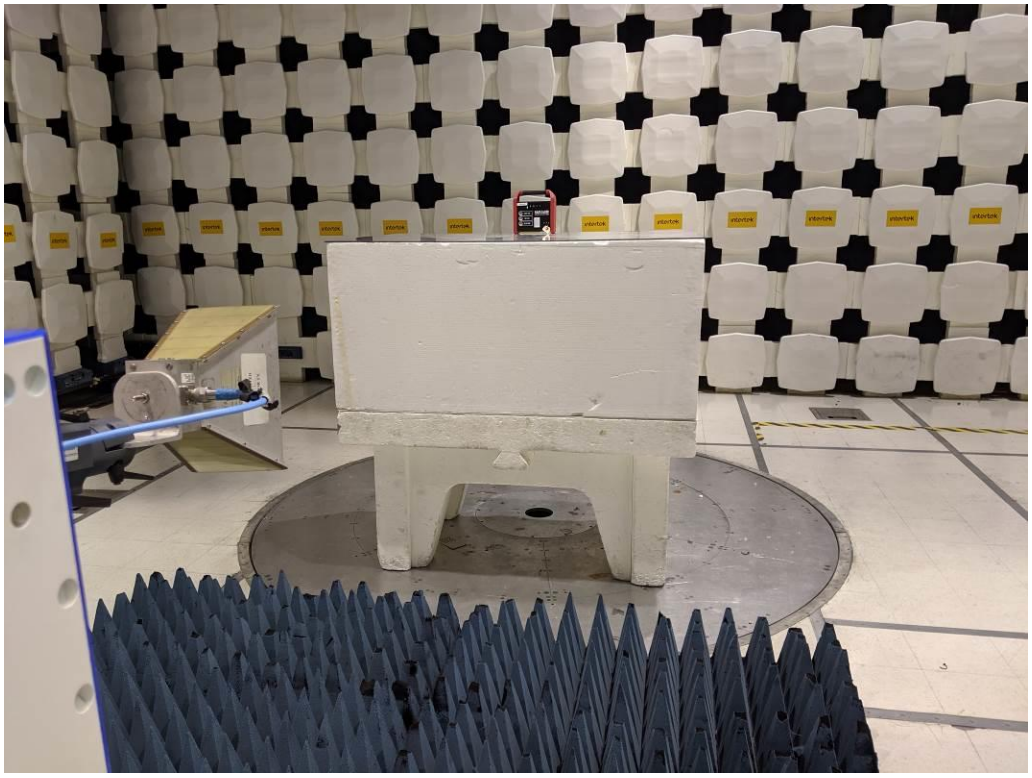
Name	Manufacturer	Version
None		

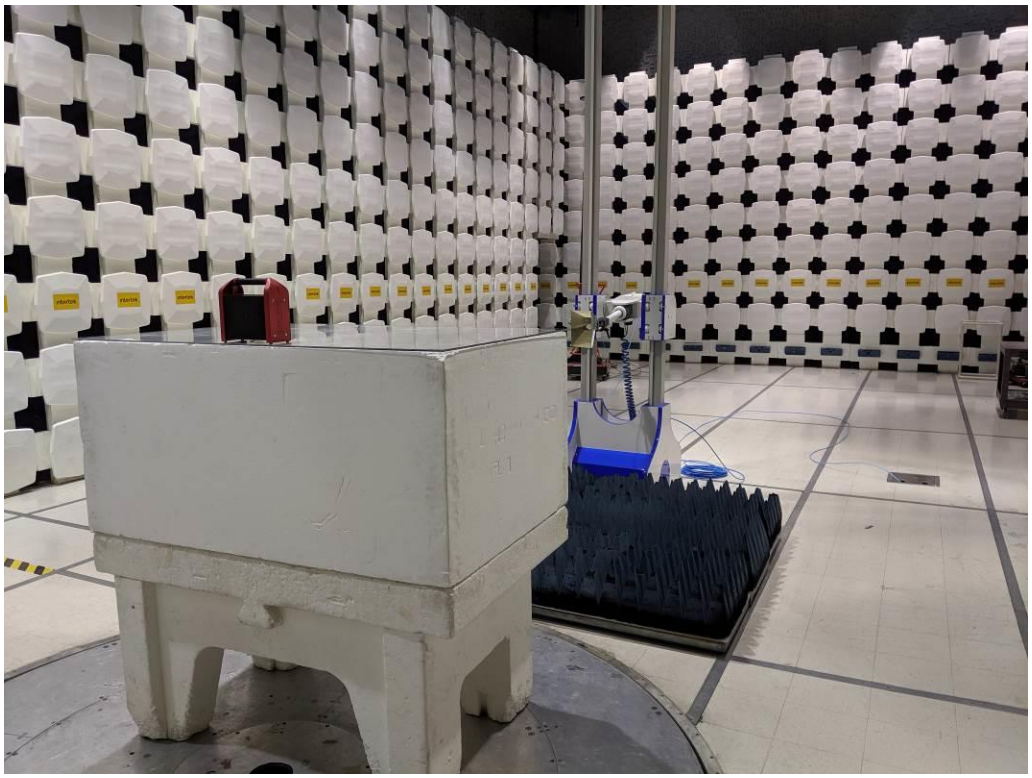
7.3 Results:

The sample tested was found to Comply.

§15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

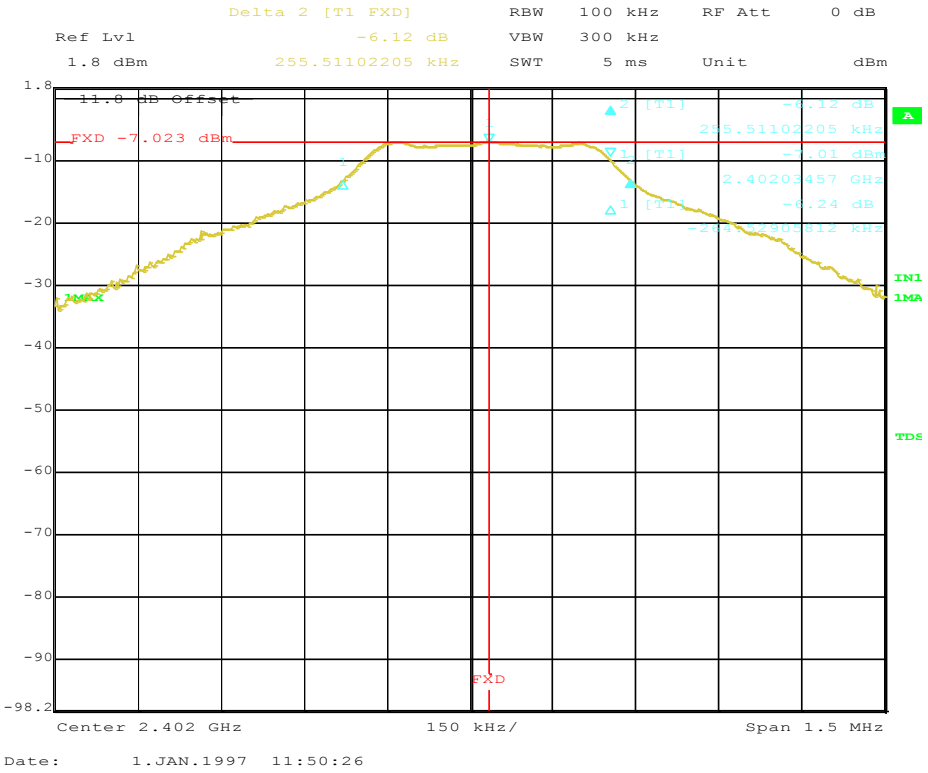
7.4 Setup Photographs:



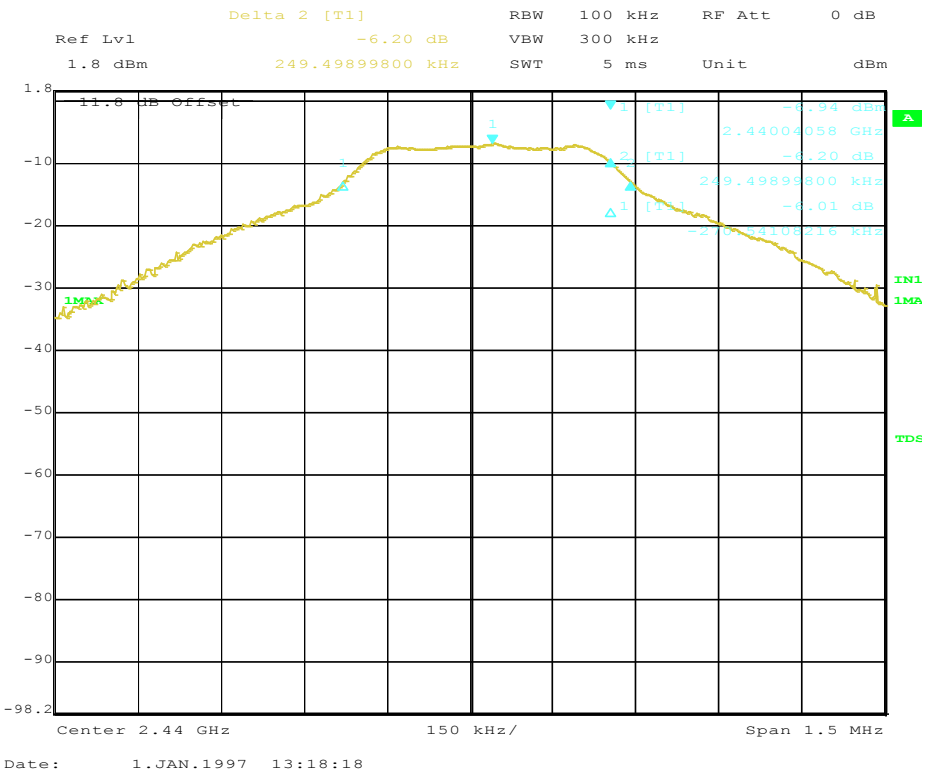


7.5 Plots/Data:

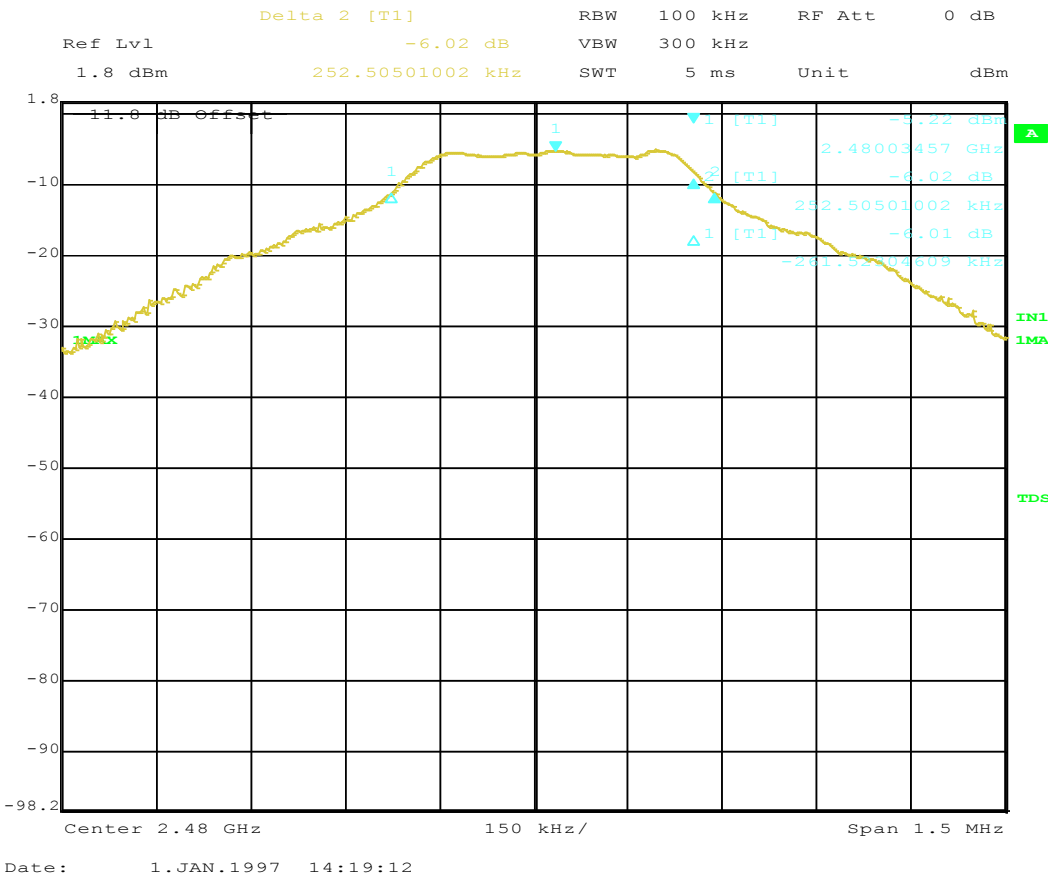
Low Channel 6dB Bandwidth: 520 kHz



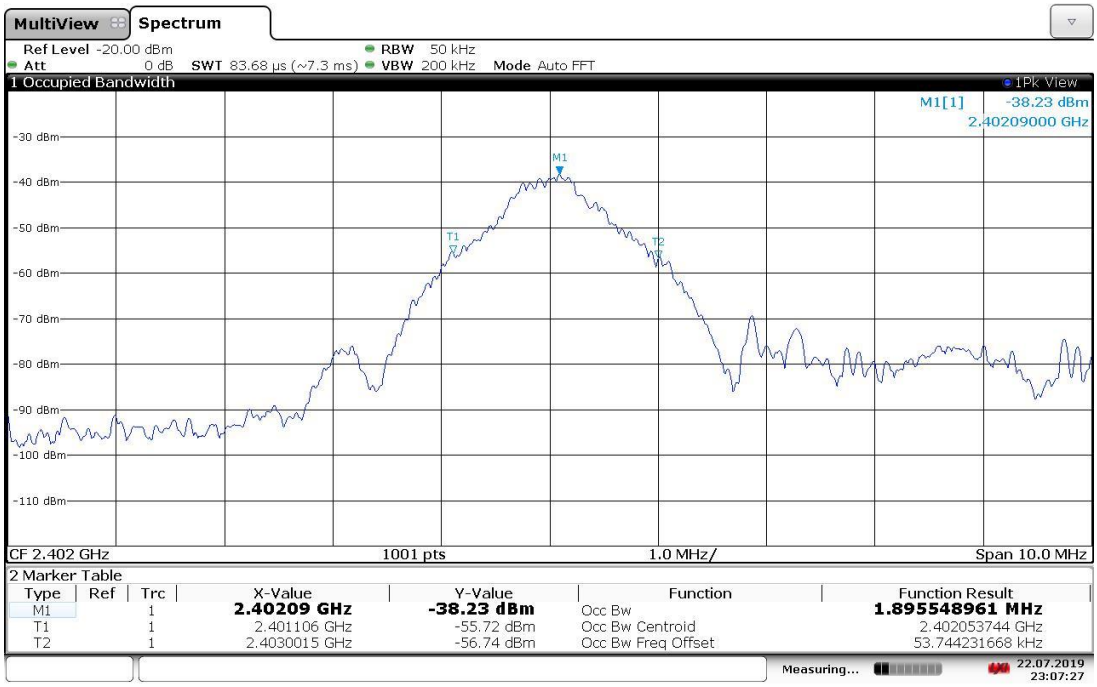
Mid Channel 6dB Bandwidth: 520 kHz



High Channel 6dB Bandwidth: 520 kHz

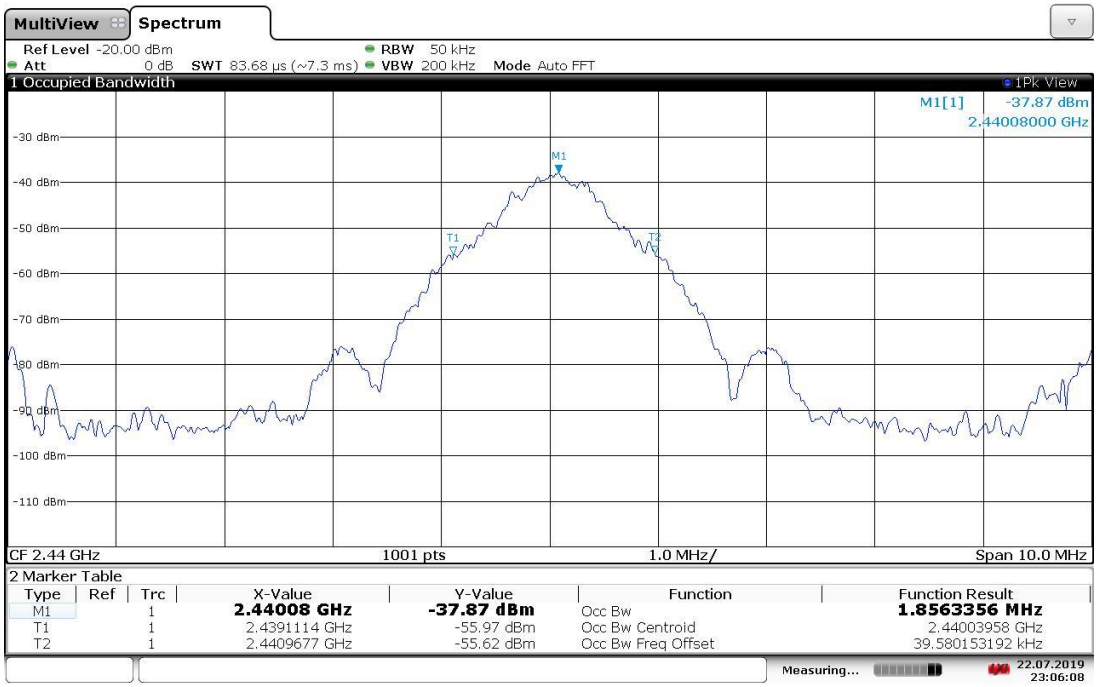


Low Channel Occupied Bandwidth: 1.90 MHz



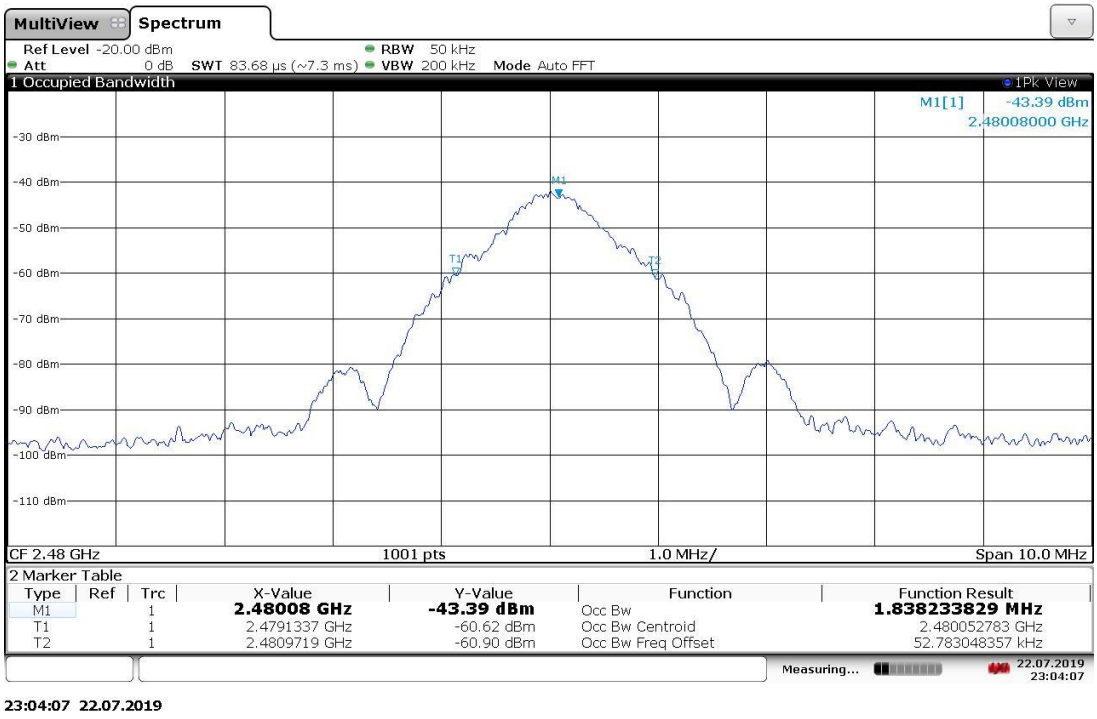
23:07:28 22.07.2019

Mid Channel Occupied Bandwidth: 1.86 MHz



23:06:09 22.07.2019

High Channel Occupied Bandwidth: 1.84 MHz



Test Personnel:	Vathana Ven VSV	Test Date:	07/22/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 7.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ Ambient Signals or BB Source:	**N/A**	Relative Humidity:	46 %
		Atmospheric Pressure:	1007 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, ANSI C63.10, and KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	08/16/2018	08/16/2019
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019

Software Utilized:

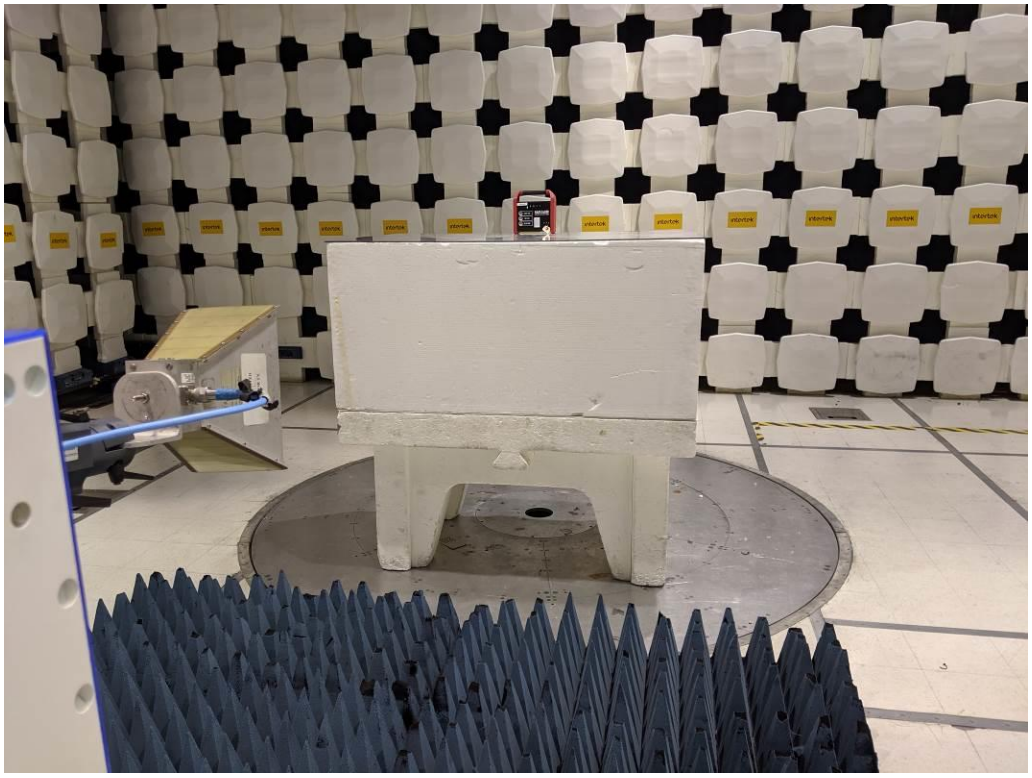
Name	Manufacturer	Version
None		

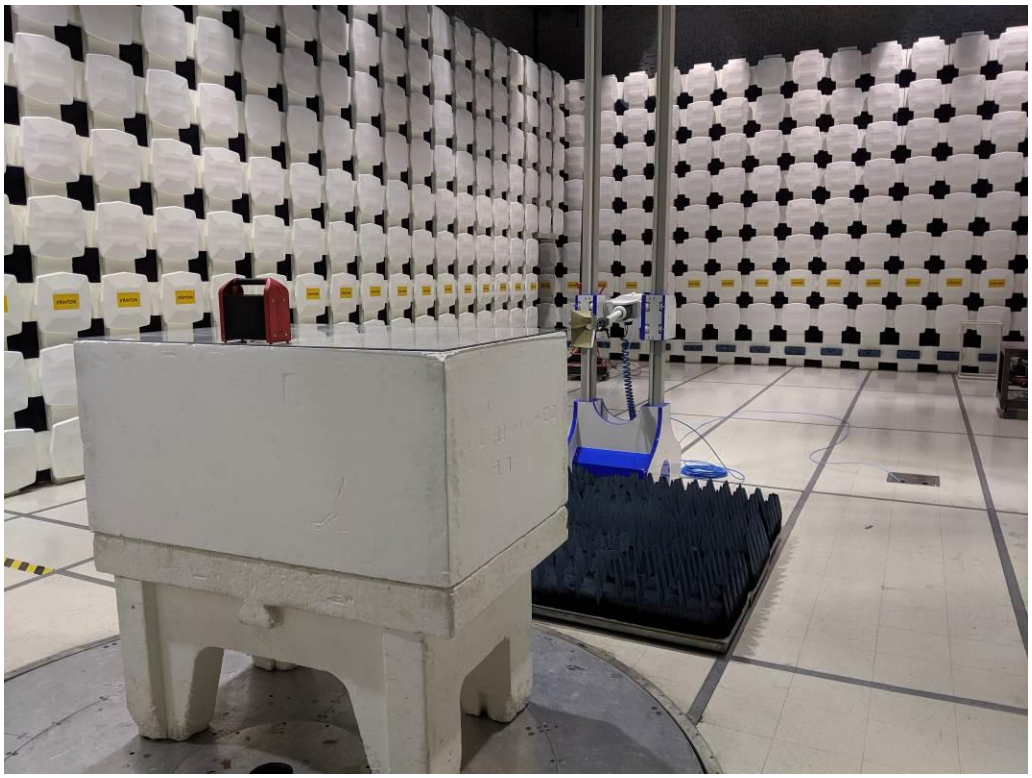
8.3 Results:

The sample tested was found to Comply.

§15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

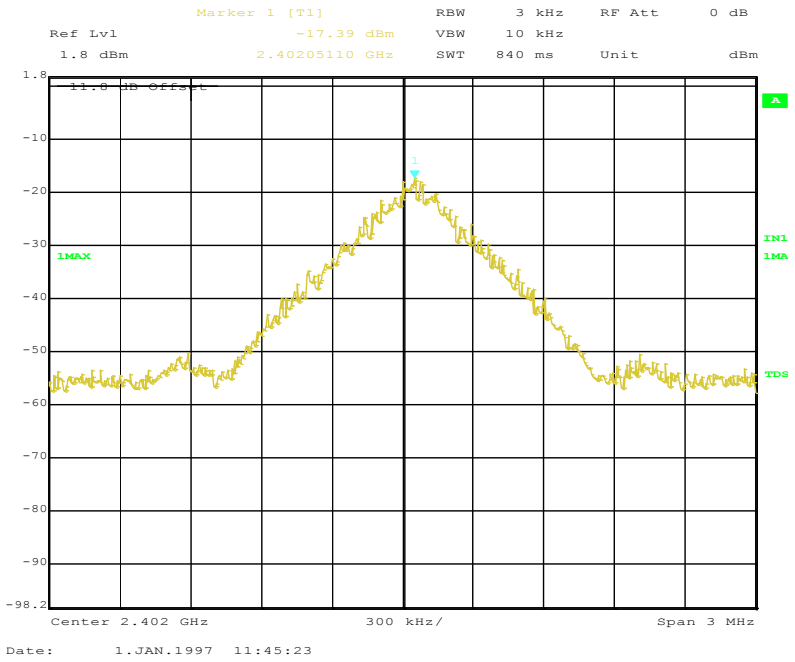
8.4 Setup Photographs:



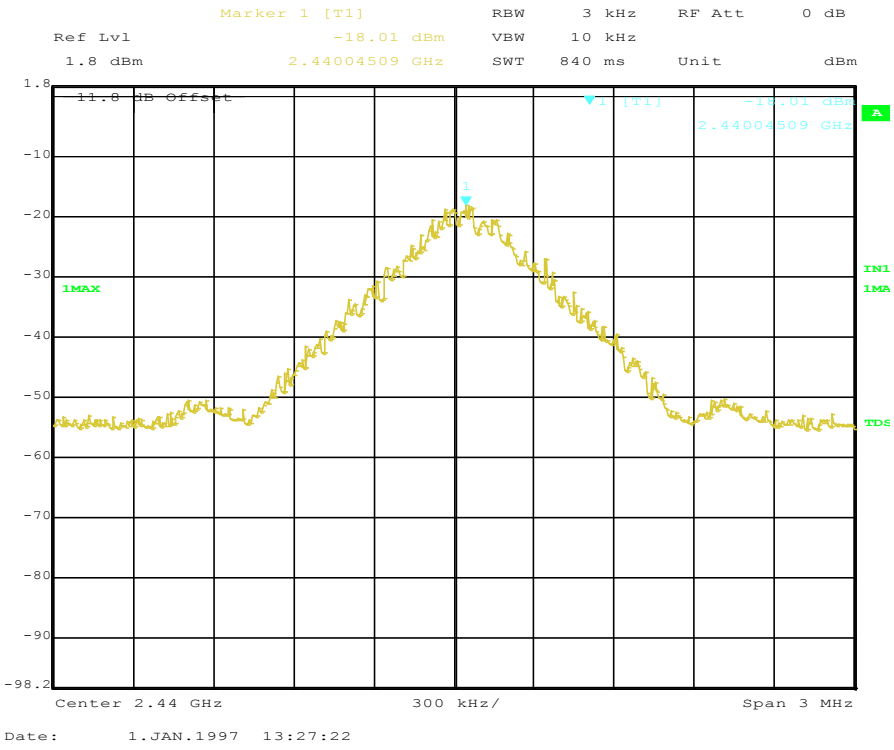


8.5 Plots/Data:

PSD Low Channel: -17.39 dBm

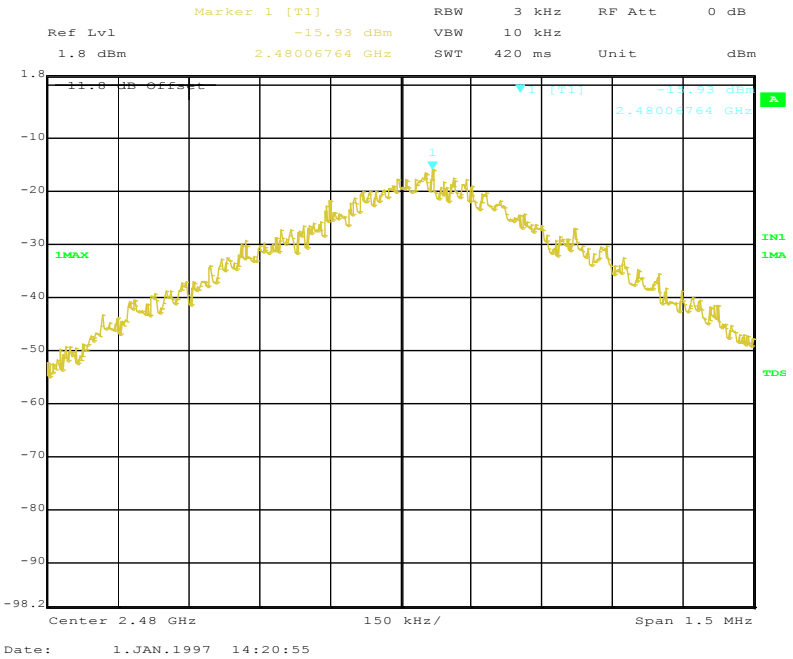


PSD Mid Channel: -18.01 dBm



Note: The antenna and cable factors were included in the reading. The 11.0 dB offset was included to convert field strength to EIRP.

PSD High Channel: -15.93 dBm



Note: The antenna and cable factors were included in the reading. The 11.0 dB offset was included to convert field strength to EIRP.

Test Personnel:	Kenneth Lee	Test Date:	07/01/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	CFR47 FCC Part 15.247 RSS-247	Limit Applied:	See report section 8.3
Input Voltage:	Internal Battery Powered		
Pretest Verification w/ Ambient Signals or BB Source:	N/A	Ambient Temperature:	21 ºC
		Relative Humidity:	46 %
		Atmospheric Pressure:	1007 mbars

Deviations, Additions, or Exclusions: None

9 Band Edge Compliance

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247 RSS 247, ANSI C 63.10, KDB 558074 D01 15.247 Meas Guidance v05r02, and ANSI C 63.4.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	08/16/2018	08/16/2019
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019

Software Utilized:

Name	Manufacturer	Version
None	--	--

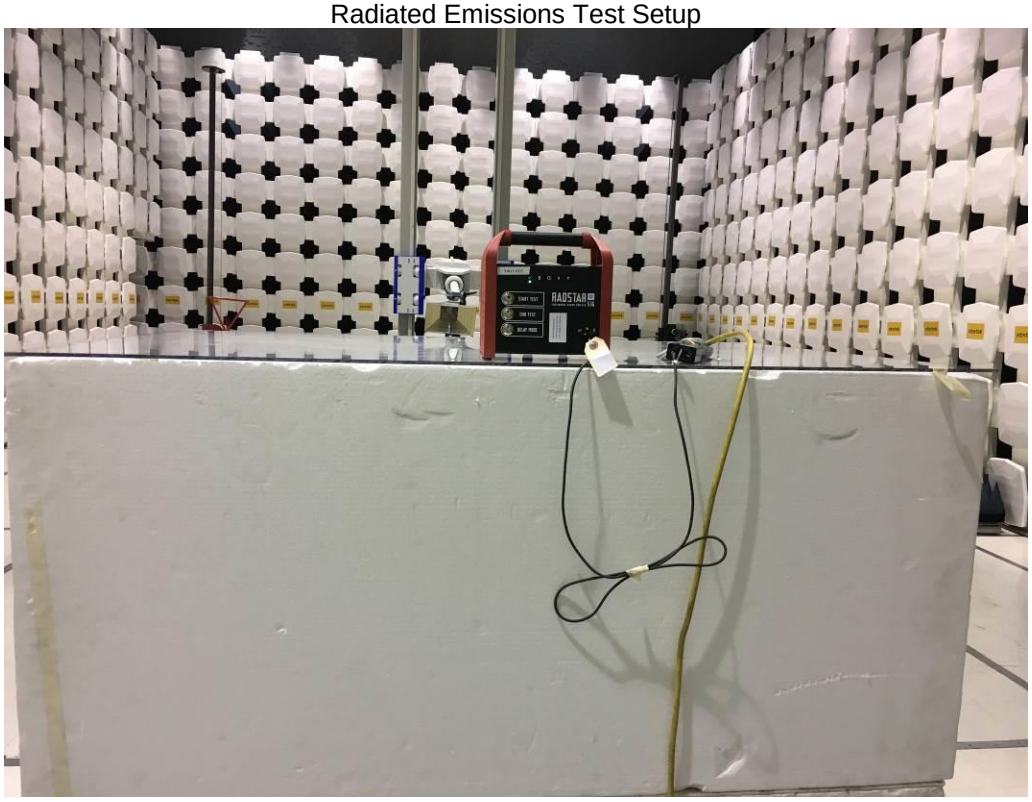
9.3 Results:

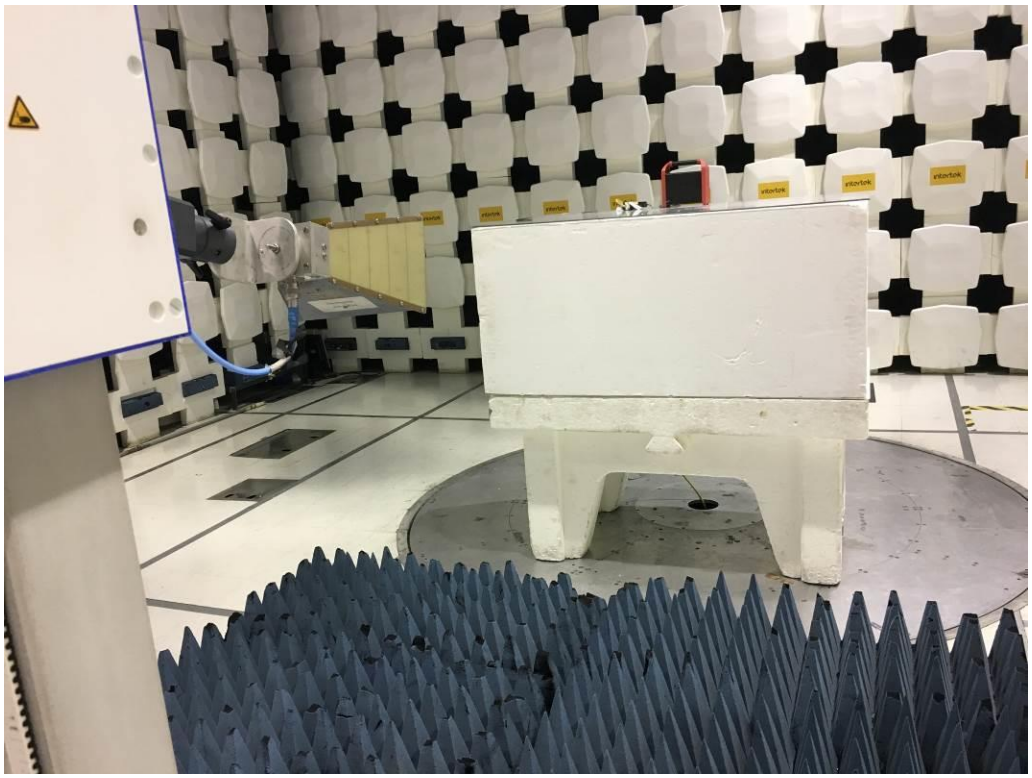
The sample tested was found to Comply.

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

9.4 Setup Photograph:

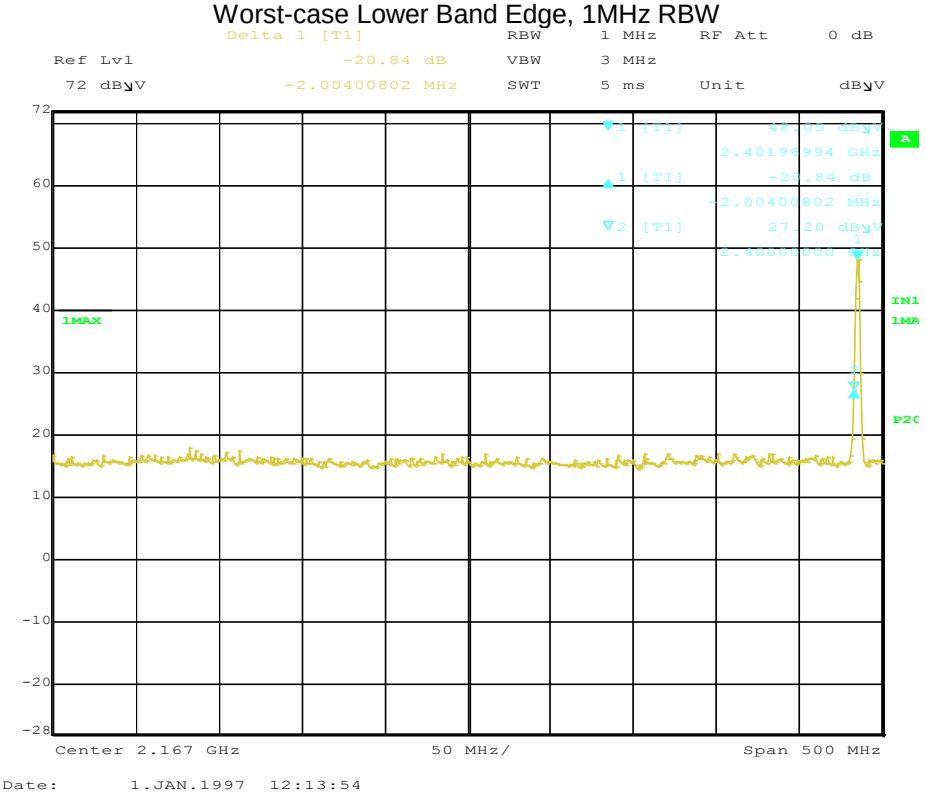
Radiated Emissions Test Setup



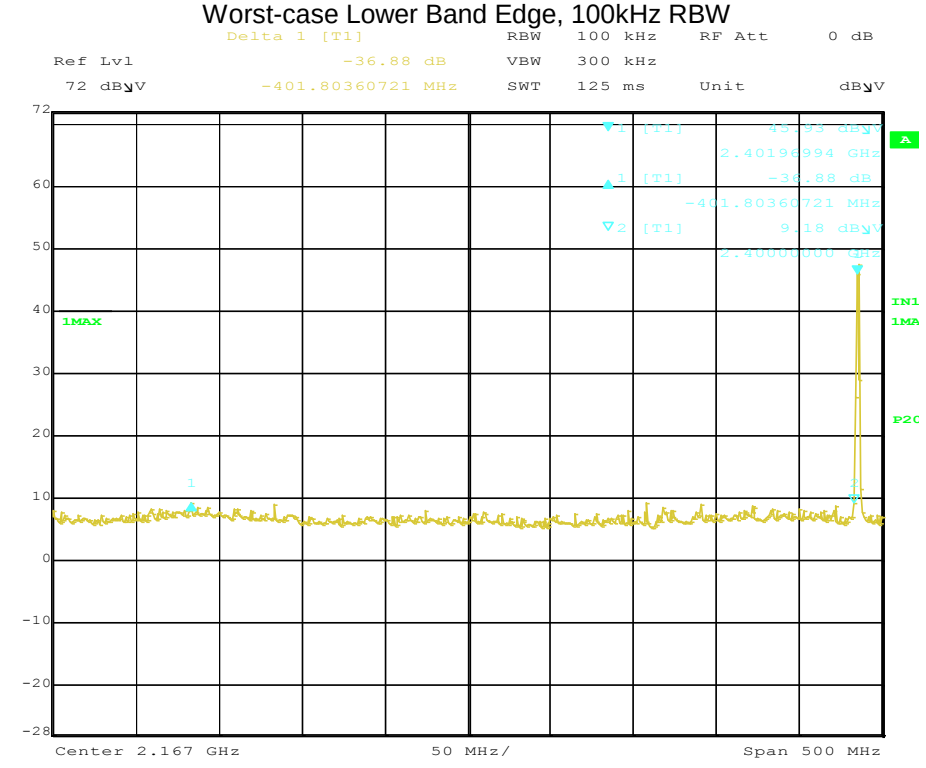


9.5 Plots/Data:

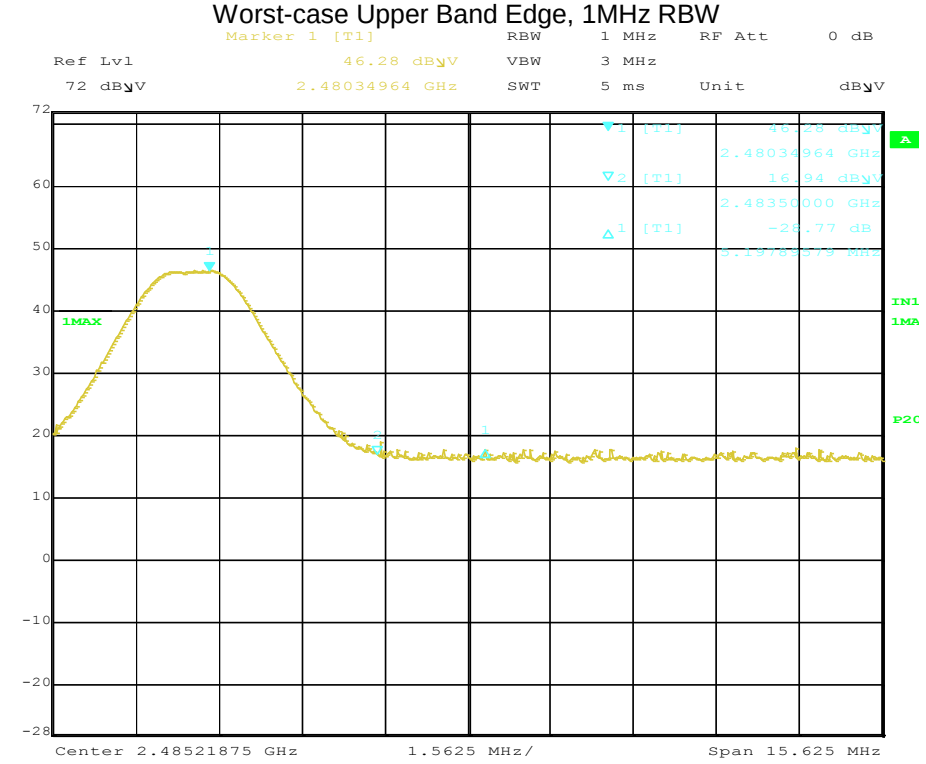
Worst-case Lower Band Edge, 1MHz RBW



Worst-case Lower Band Edge, 100kHz RBW

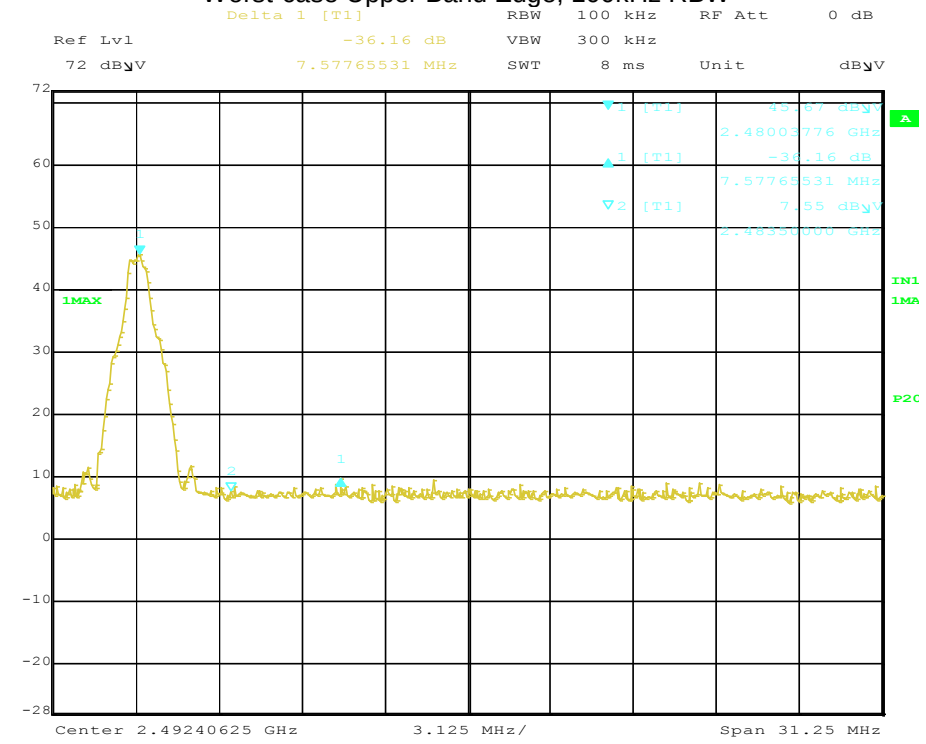


Worst-case Upper Band Edge, 1MHz RBW



Date: 1.JAN.1997 12:04:20

Worst-case Upper Band Edge, 100kHz RBW



Date: 1.JAN.1997 12:05:48

Radiated Emissions

Company: Spruce Environmental
Model #: RadStar Alpha Series
Serial #: 51012FCC
Engineers: Vathana Ven
Project #: G103933459
Standard: FCC Part 15 Subpart B Class B
Receiver: R&S ESI (145-128) 03-28-2019
PreAmp: NONE.
PreAmp Used? (Y or N): N
Date(s): 07/11/19
Location: 10M
Limit Distance (m): 3
Test Distance (m): 3
Voltage/Frequency: 120VAC 60Hz
Antenna & Cables: HF
Antenna: EMC02_08-16-2019.txt
Cable(s): 145-416__7-25-19.txt
Barometer: DAV001
Temp/Humidity/Pressure: 24 deg C
Bands: N, LF, HF, SHF
EMC02_08-16-2019.txt
NONE.
Filter: NONE
53%
1002 mB
Frequency Range: See below

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC	IC
Lower BEC													
PK	H	2390.000	15.58	28.42	6.49	0.00	0.00	50.49	74.00	-23.51	1/3 MHz	RB	RB
AVG	H	2390.000	2.39	28.42	6.49	0.00	0.00	37.30	54.00	-16.70	1/3 MHz	RB	RB
Upper BEC													
PK	H	2483.500	16.67	28.52	6.44	0.00	0.00	51.63	74.00	-22.37	1/3 MHz	RB	
AVG	H	2483.500	3.12	28.52	6.44	0.00	0.00	38.08	54.00	-15.92	1/3 MHz	RB	

Test Personnel: Vathana Ven VSV
Test Date: 07/11/2019
Supervising/Reviewing Engineer: (Where Applicable) N/A
Product Standard: CFR47 FCC Part 15.247 RSS-247
Limit Applied: See report section 9.3
Input Voltage: 120VAC 60Hz
Pretest Verification w/ Ambient Signals or BB Source: BB Source
Ambient Temperature: 24 ºC
Relative Humidity: 53 %
Atmospheric Pressure: 1002 mbars

Deviations, Additions, or Exclusions: None

10 Transmitter spurious emissions

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247, FCC Part 15 Subpart B, RSS 247 ICES 003, ANSI C 63.10, ANSI C 63.4, KDB 558074 D01 15.247 Meas Guidance v05r02.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2018	07/25/2019
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	10/27/2018	10/27/2019
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/12/2019	06/12/2020
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	08/16/2018	08/16/2019
BON001'	METER, POWER	Boonton	4232A	55601	01/23/2019	01/23/2020
REA008'	band reject filter 2.4GHz	Reactel, Inc	12RX7-2441.75-x140 S	17-01	07/11/2019	07/11/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019
EMC04'	ANTENNA, RIDGED GUIDE, 18-40 GHZ	EMCO	3116	2090	10/26/2018	10/26/2019
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/25/2019	02/25/2025
CBLSHF103'	Cable, SMA - SMA, < 18GHz	Sucoflex (Huber Suhn	104PE	CBLSHF103	10/06/2010	10/06/2011
CBLSHF102'	Cable, SMA - SMA, 9kHz-40GHz (Cable Kit 5)	Sucoflex (Huber Suhn	104PE	CBLSHF102	08/25/2017	10/25/2019
PRE8'	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	10/25/2018	10/25/2019

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.3
EMI Boxborough.xls	Intertek	08/27/2010

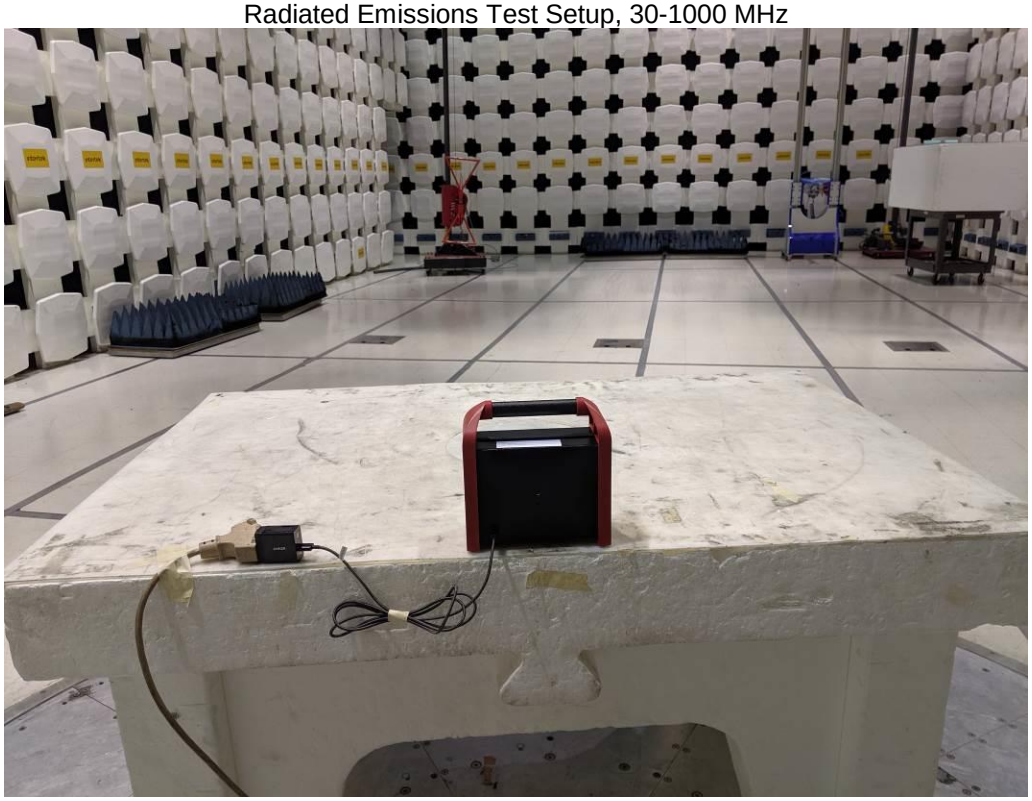
10.3 Results:

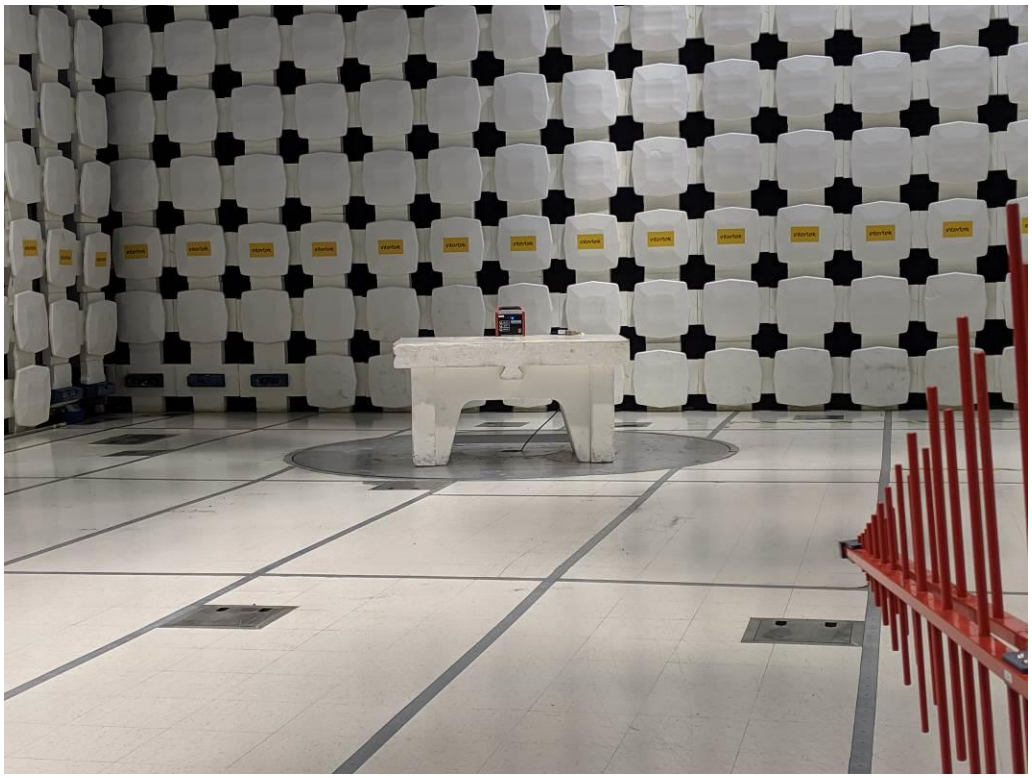
The sample tested was found to Comply.

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

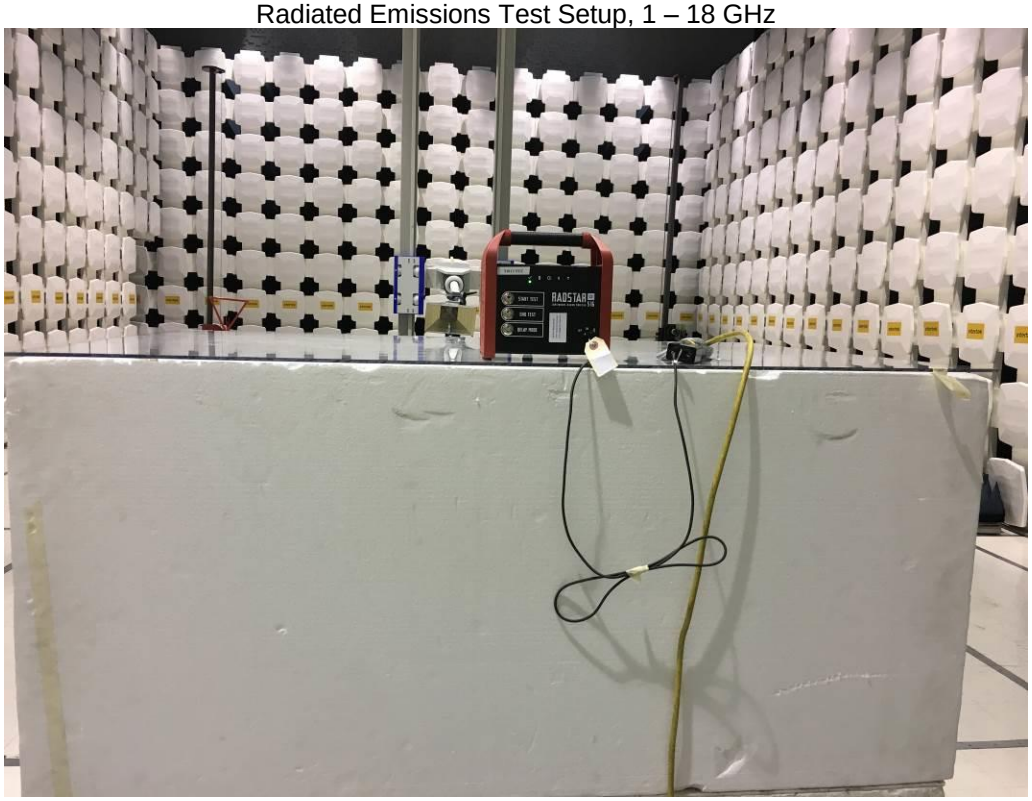
10.4 Setup Photographs:

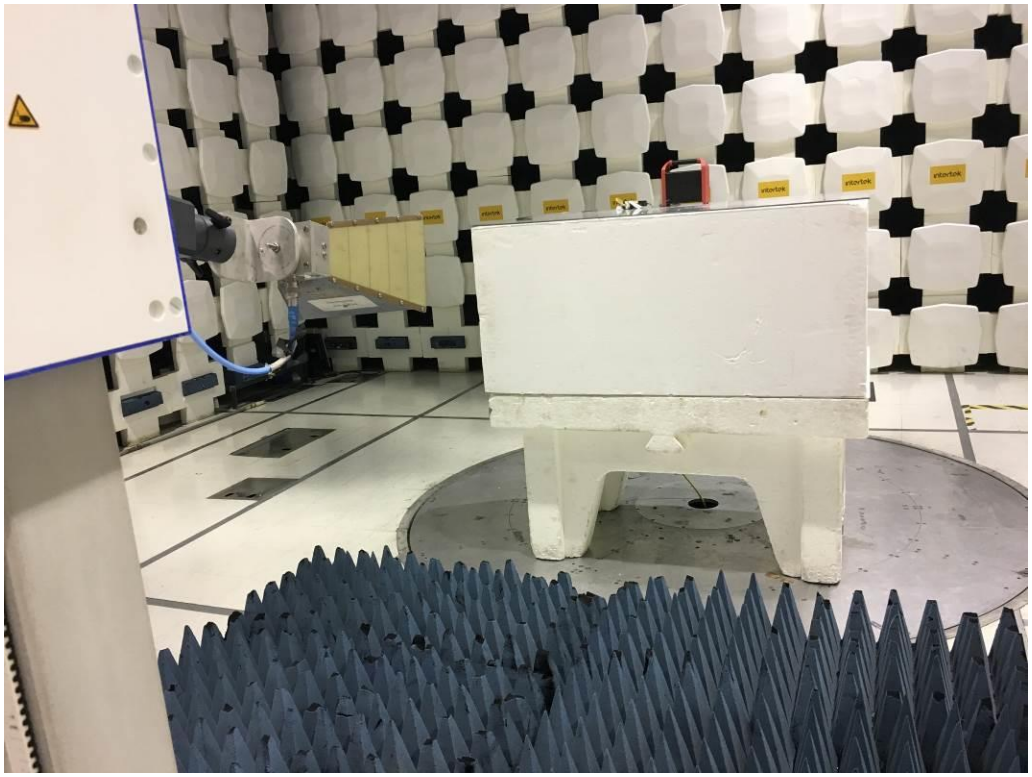
Radiated Emissions Test Setup, 30-1000 MHz



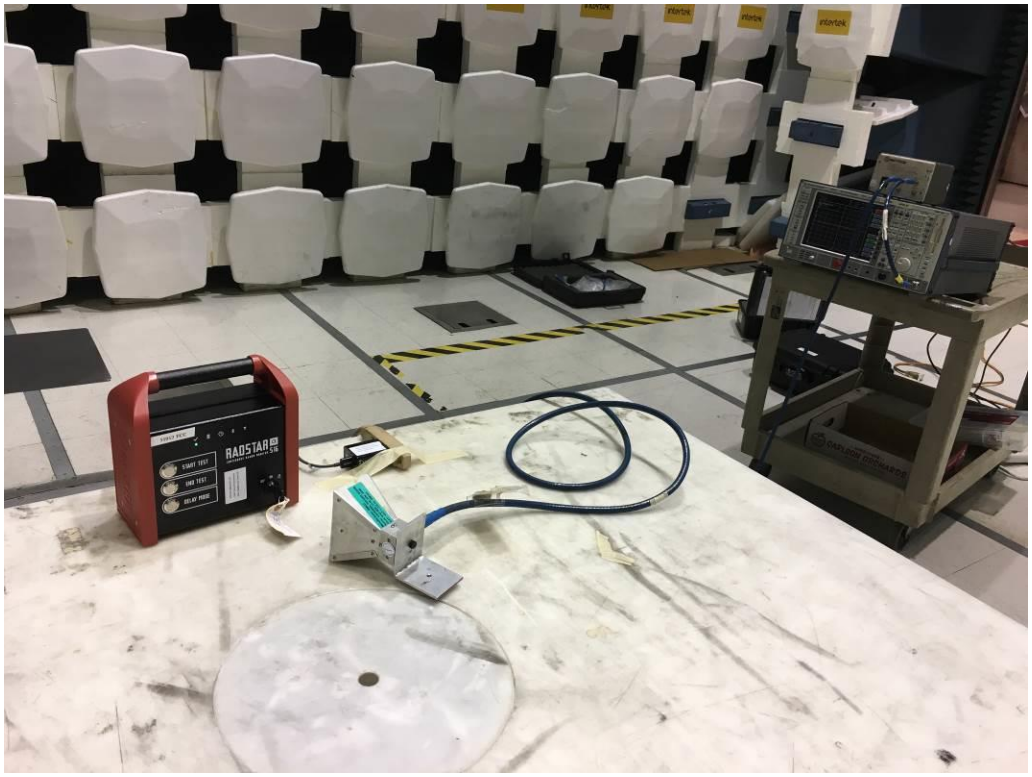


Radiated Emissions Test Setup, 1 – 18 GHz





Manual Testing From 18-25 GHz



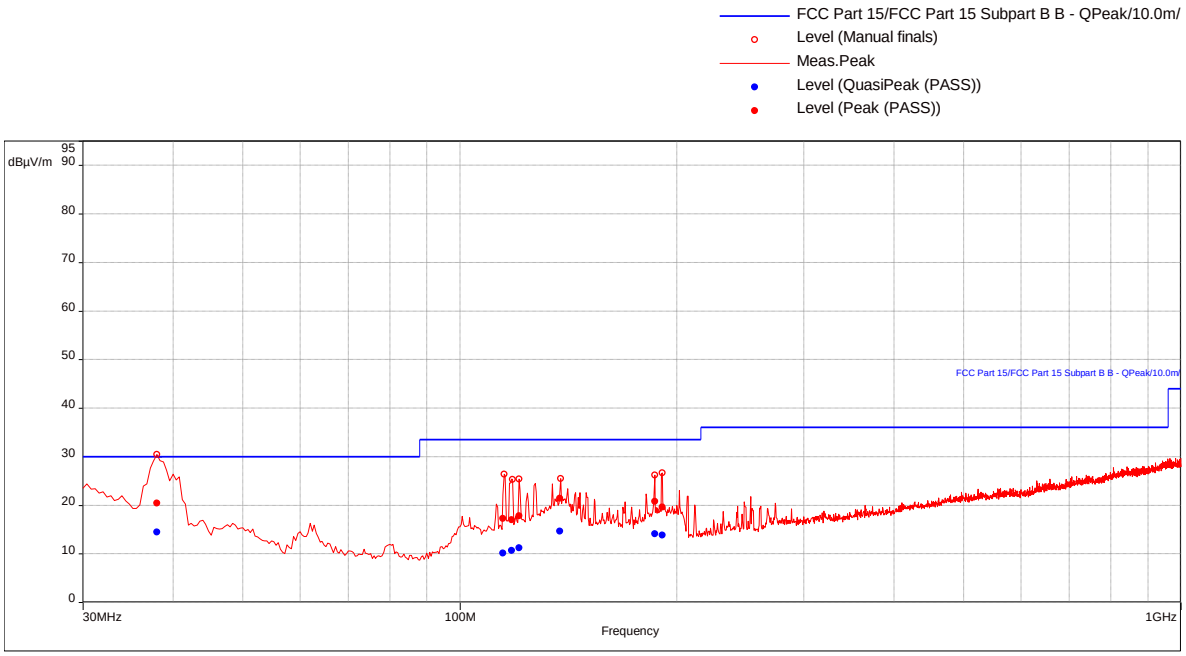
10.5 Plots/Data:

30-1000 MHz

Test Information:

Date and Time	5/24/2019 8:02:31 AM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	23
Humidity	46
Atmospheric Pressure	994
Comments	120 VAC @ 60 Hz - RE 30-1000MHz SA mode

Graph:



Results:

QuasiPeak (PASS) (7)

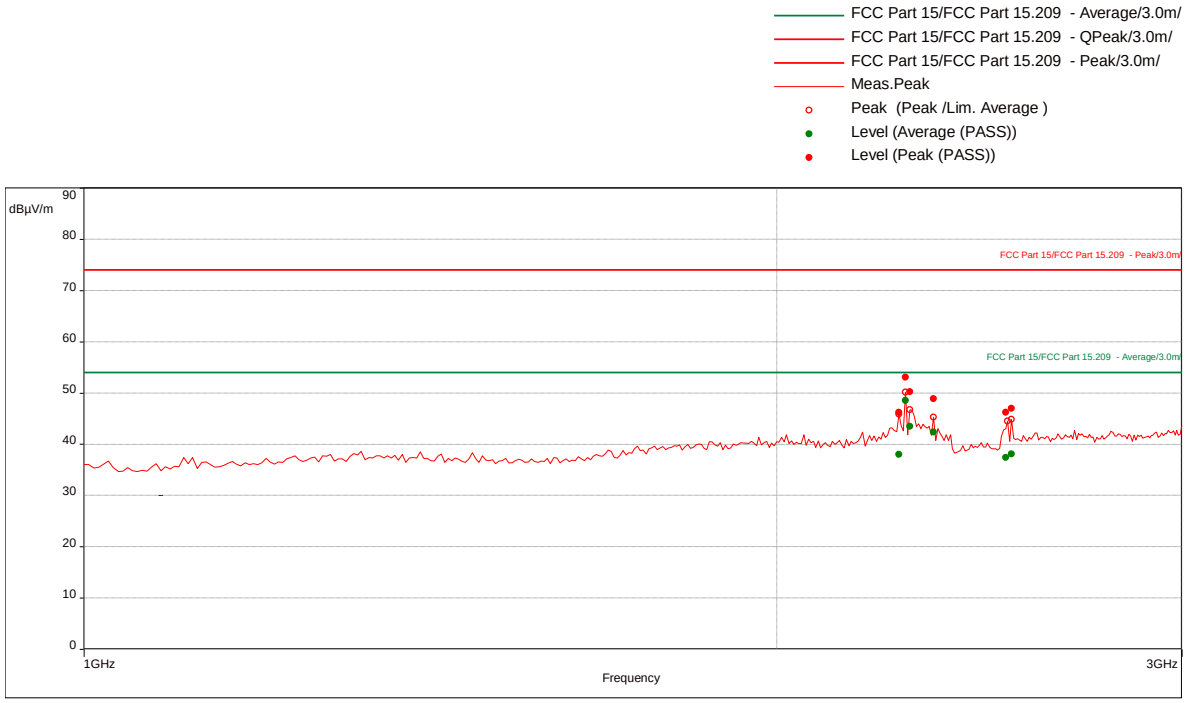
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
38.03157895	14.42	30.00	-15.58	54.00	1.91	Vertical	120000.00	-17.47
114.7578947	10.13	33.50	-23.37	1.00	3.17	Horizontal	120000.00	-19.60
117.8947368	10.62	33.50	-22.88	70.00	2.22	Vertical	120000.00	-19.20
120.7368421	11.20	33.50	-22.30	270.00	2.87	Vertical	120000.00	-19.04
137.6526316	14.68	33.50	-18.82	254.00	1.76	Vertical	120000.00	-18.94
186.5263158	14.06	33.50	-19.44	269.00	1.88	Vertical	120000.00	-20.79
190.9578947	13.83	33.50	-19.67	268.00	2.40	Vertical	120000.00	-20.44

Low Channel, 1-3 GHz

Test Information:

Date and Time	7/1/2019 2:01:51 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	
Humidity	
Atmospheric Pressure	
Comments	Low Ch - RE 1 to 3 GHz SA mode

Graph:



Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2261.052632	46.19	74.00	-27.81	62.00	1.25	Vertical	1000000.00	-18.39
2274.210526	53.05	74.00	-20.95	198.00	1.45	Horizontal	1000000.00	-18.37
2285.263158	50.19	74.00	-23.81	197.00	1.70	Horizontal	1000000.00	-18.34
2337.894737	48.85	74.00	-25.15	55.00	1.60	Vertical	1000000.00	-18.24
2517.105263	46.19	74.00	-27.81	42.00	1.30	Horizontal	1000000.00	-17.52
2530.263158	46.95	74.00	-27.05	333.00	1.05	Horizontal	1000000.00	-17.51

Average (PASS) (6)

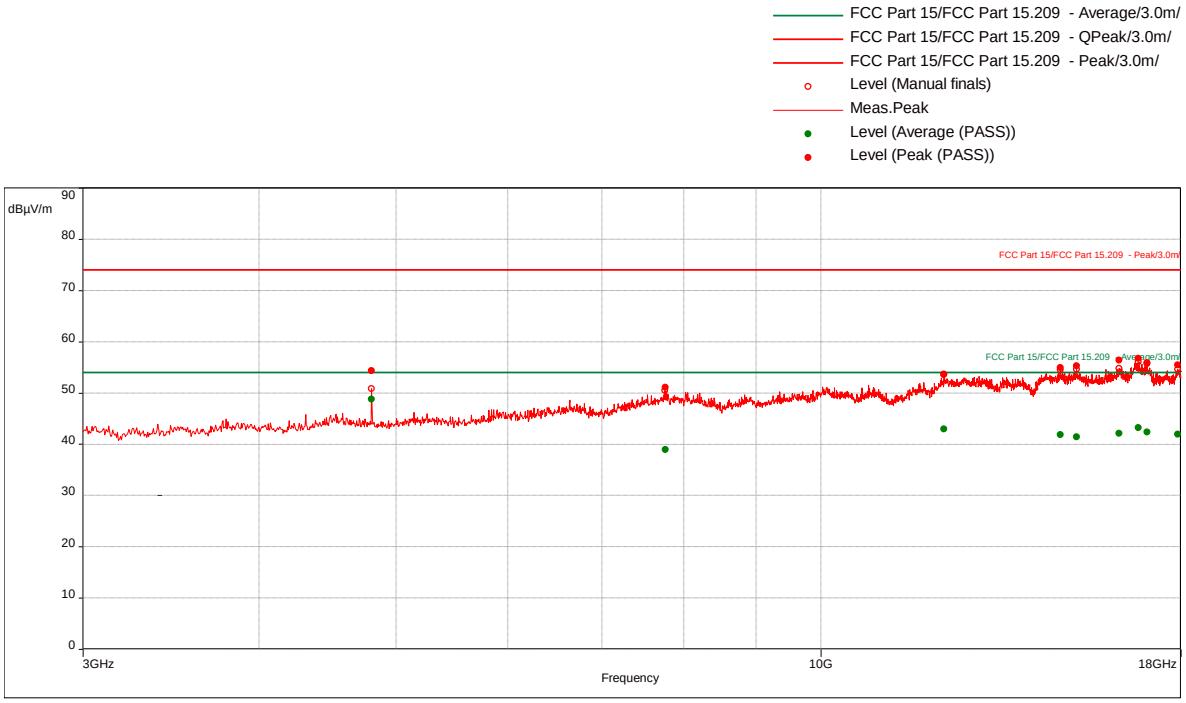
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2261.052632	38.03	54.00	-15.97	62.00	1.25	Vertical	1000000.00	-18.39
2274.210526	48.53	54.00	-5.47	198.00	1.45	Horizontal	1000000.00	-18.37
2285.263158	43.47	54.00	-10.53	197.00	1.70	Horizontal	1000000.00	-18.34
2337.894737	42.38	54.00	-11.62	55.00	1.60	Vertical	1000000.00	-18.24
2517.105263	37.38	54.00	-16.62	42.00	1.30	Horizontal	1000000.00	-17.52
2530.263158	38.11	54.00	-15.89	333.00	1.05	Horizontal	1000000.00	-17.51

Low Channel, 3-18 GHz

Test Information:

Date and Time	7/1/2019 2:26:04 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	
Humidity	
Atmospheric Pressure	
Comments	Low Ch - RE 3 to 18 GHz SA mode

Graph:



Results:

Peak (PASS) (9)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4803.947368	54.31	74.00	-19.69	295.00	1.45	Horizontal	1000000.00	-11.45
7759.736842	51.07	74.00	-22.93	55.00	3.69	Vertical	1000000.00	-4.85
12226.57895	53.66	74.00	-20.34	42.00	3.98	Vertical	1000000.00	1.15
14785	54.91	74.00	-19.09	320.00	3.54	Horizontal	1000000.00	3.21
15184.47368	55.24	74.00	-18.76	358.00	1.95	Horizontal	1000000.00	3.27
16273.15789	56.36	74.00	-17.64	10.00	1.00	Horizontal	1000000.00	2.92
16790.78947	56.75	74.00	-17.25	236.00	2.25	Vertical	1000000.00	3.69
17033.68421	55.66	74.00	-18.34	165.00	2.75	Vertical	1000000.00	3.15
17904.47368	55.43	74.00	-18.57	288.00	2.50	Vertical	1000000.00	3.06

Average (PASS) (9)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4803.947368	48.74	54.00	-5.26	295.00	1.45	Horizontal	1000000.00	-11.45
7759.736842	38.96	54.00	-15.04	55.00	3.69	Vertical	1000000.00	-4.85
12226.57895	42.98	54.00	-11.02	42.00	3.98	Vertical	1000000.00	1.15
14785	41.81	54.00	-12.19	320.00	3.54	Horizontal	1000000.00	3.21
15184.47368	41.40	54.00	-12.60	358.00	1.95	Horizontal	1000000.00	3.27
16273.15789	42.10	54.00	-11.90	10.00	1.00	Horizontal	1000000.00	2.92
16790.78947	43.20	54.00	-10.80	236.00	2.25	Vertical	1000000.00	3.69
17033.68421	42.39	54.00	-11.61	165.00	2.75	Vertical	1000000.00	3.15
17904.47368	41.91	54.00	-12.09	288.00	2.50	Vertical	1000000.00	3.06

Mid channel, 1-3 GHz

Test Information:

Date and Time	7/1/2019 1:36:25 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	
Humidity	
Atmospheric Pressure	
Comments	Mid Ch - RE 1 to 3 GHz SA mode

Graph:

Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2311.842105	49.77	74.00	-24.23	192.00	1.95	Horizontal	1000000.00	-18.29
2327.894737	47.77	74.00	-26.23	42.00	1.45	Vertical	1000000.00	-18.26
2345.789474	49.10	74.00	-24.90	36.00	1.60	Horizontal	1000000.00	-18.22
2355.263158	49.25	74.00	-24.75	23.00	1.55	Horizontal	1000000.00	-18.19
2376.052632	44.91	74.00	-29.09	158.00	3.89	Horizontal	1000000.00	-18.06
2568.157895	49.21	74.00	-24.79	341.00	1.50	Horizontal	1000000.00	-17.41

Average (PASS) (6)

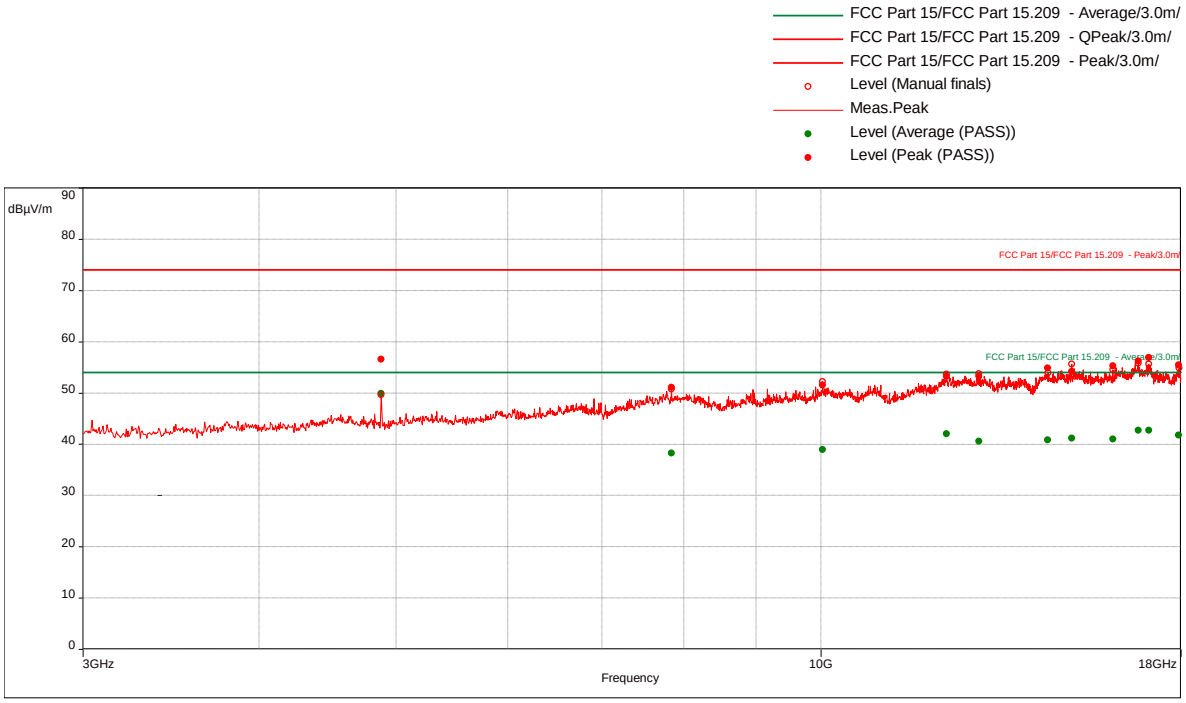
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2311.842105	44.03	54.00	-9.97	192.00	1.95	Horizontal	1000000.00	-18.29
2327.894737	39.45	54.00	-14.55	42.00	1.45	Vertical	1000000.00	-18.26
2345.789474	41.57	54.00	-12.43	36.00	1.60	Horizontal	1000000.00	-18.22
2355.263158	41.50	54.00	-12.50	23.00	1.55	Horizontal	1000000.00	-18.19
2376.052632	33.53	54.00	-20.47	158.00	3.89	Horizontal	1000000.00	-18.06
2568.157895	43.17	54.00	-10.83	341.00	1.50	Horizontal	1000000.00	-17.41

Mid channel, 3-18 GHz

Test Information:

Date and Time	7/1/2019 12:40:14 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	
Humidity	
Atmospheric Pressure	
Comments	Mid Ch - RE 3 to 18 GHz SA mode

Graph:



Results:

Peak (PASS) (11)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4879.736842	56.60	74.00	-17.40	327.00	3.39	Horizontal	1000000.00	-11.70
7838.684211	51.11	74.00	-22.89	140.00	3.10	Vertical	1000000.00	-5.07
10033.94737	51.47	74.00	-22.53	101.00	1.01	Horizontal	1000000.00	-3.40
12283.68421	53.25	74.00	-20.75	10.00	2.31	Vertical	1000000.00	0.88
12948.42105	53.22	74.00	-20.78	211.00	2.90	Horizontal	1000000.00	1.52
14490.78947	54.86	74.00	-19.14	113.00	3.15	Vertical	1000000.00	2.35
15066.31579	54.13	74.00	-19.87	309.00	1.20	Vertical	1000000.00	2.96
16108.15789	55.31	74.00	-18.69	282.00	1.25	Vertical	1000000.00	2.26
16799.47368	56.18	74.00	-17.82	16.00	2.70	Horizontal	1000000.00	3.67
17080.26316	56.88	74.00	-17.12	223.00	2.55	Vertical	1000000.00	3.44
17940.26316	55.45	74.00	-18.55	120.00	2.85	Vertical	1000000.00	2.67

Average (PASS) (11)

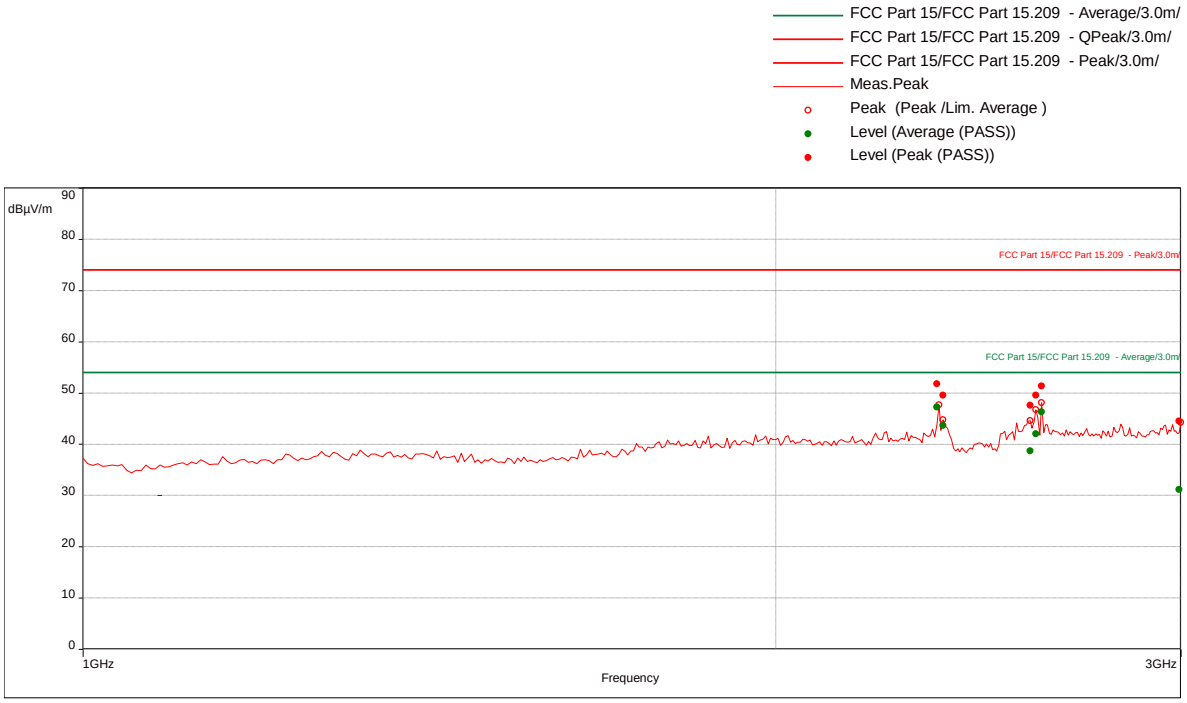
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4879.736842	49.89	54.00	-4.11	327.00	3.39	Horizontal	1000000.00	-11.70
7838.684211	38.22	54.00	-15.78	140.00	3.10	Vertical	1000000.00	-5.07
10033.94737	38.95	54.00	-15.05	101.00	1.01	Horizontal	1000000.00	-3.40
12283.68421	42.01	54.00	-11.99	10.00	2.31	Vertical	1000000.00	0.88
12948.42105	40.60	54.00	-13.40	211.00	2.90	Horizontal	1000000.00	1.52
14490.78947	40.83	54.00	-13.17	113.00	3.15	Vertical	1000000.00	2.35
15066.31579	41.15	54.00	-12.85	309.00	1.20	Vertical	1000000.00	2.96
16108.15789	40.98	54.00	-13.02	282.00	1.25	Vertical	1000000.00	2.26
16799.47368	42.70	54.00	-11.30	16.00	2.70	Horizontal	1000000.00	3.67
17080.26316	42.72	54.00	-11.28	223.00	2.55	Vertical	1000000.00	3.44
17940.26316	41.76	54.00	-12.24	120.00	2.85	Vertical	1000000.00	2.67

High channel, 1-3 GHz

Test Information:

Date and Time	7/1/2019 10:40:51 AM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	
Humidity	
Atmospheric Pressure	
Comments	HighCh - RE 1 to 3 GHz SA mode

Graph:



Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2352.105263	51.81	74.00	-22.19	42.00	1.60	Horizontal	1000000.00	-18.20
2365	49.56	74.00	-24.44	37.00	1.65	Horizontal	1000000.00	-18.13
2577.894737	47.61	74.00	-26.39	0.00	1.40	Horizontal	1000000.00	-17.37
2595.263158	49.56	74.00	-24.44	358.00	1.40	Horizontal	1000000.00	-17.28
2608.157895	51.30	74.00	-22.70	358.00	1.35	Horizontal	1000000.00	-17.23
2995.131579	44.53	74.00	-29.47	294.00	3.69	Vertical	1000000.00	-15.89

Average (PASS) (6)

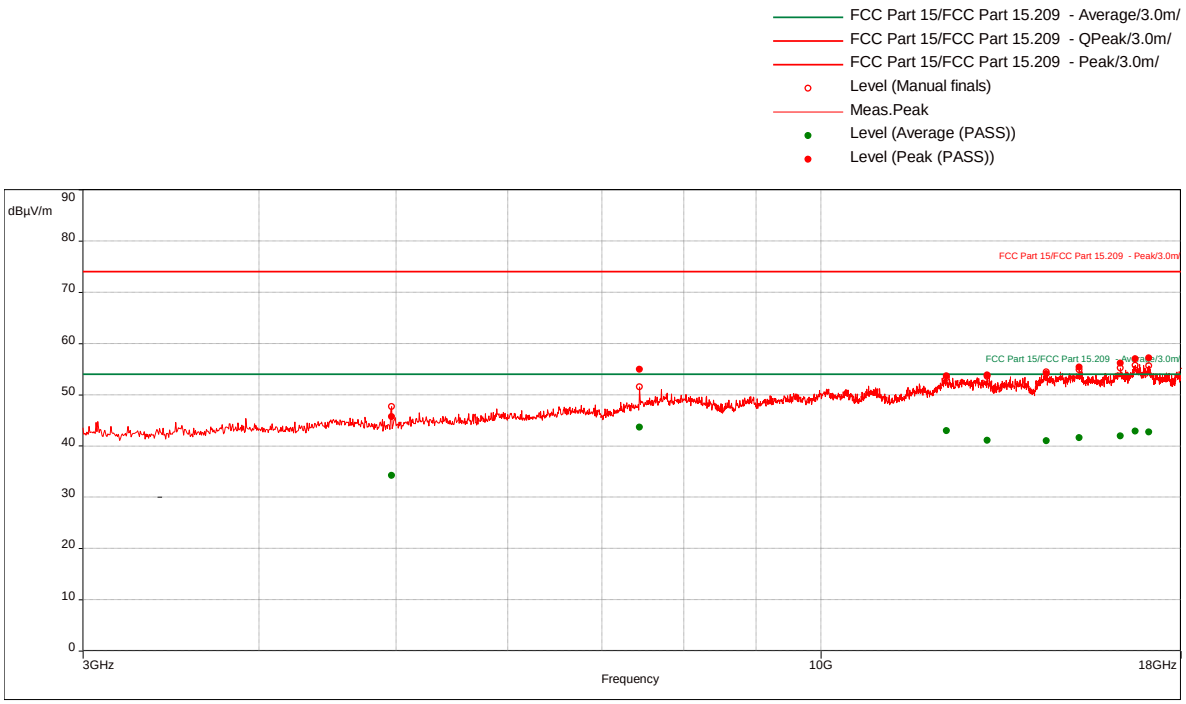
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
2352.105263	47.24	54.00	-6.76	42.00	1.60	Horizontal	1000000.00	-18.20
2365	43.67	54.00	-10.33	37.00	1.65	Horizontal	1000000.00	-18.13
2577.894737	38.70	54.00	-15.30	0.00	1.40	Horizontal	1000000.00	-17.37
2595.263158	42.02	54.00	-11.98	358.00	1.40	Horizontal	1000000.00	-17.28
2608.157895	46.31	54.00	-7.69	358.00	1.35	Horizontal	1000000.00	-17.23
2995.131579	31.18	54.00	-22.82	294.00	3.69	Vertical	1000000.00	-15.89

High channel, 3-18 GHz

Test Information:

Date and Time	7/1/2019 11:27:21 AM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	
Humidity	
Atmospheric Pressure	
Comments	HighCh - RE 3 to 18 GHz SA mode

Graph:



Results:

Peak (PASS) (9)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4966.842105	45.66	74.00	-28.34	16.00	2.75	Horizontal	1000000.00	-11.55
7440.789474	54.92	74.00	-19.08	76.00	2.55	Vertical	1000000.00	-6.51
12280.26316	53.68	74.00	-20.32	67.00	1.50	Horizontal	1000000.00	0.90
13120.78947	53.84	74.00	-20.16	42.00	1.50	Horizontal	1000000.00	1.88
14450	54.04	74.00	-19.96	81.00	2.30	Horizontal	1000000.00	2.34
15243.68421	55.39	74.00	-18.61	295.00	3.34	Vertical	1000000.00	3.01
16305.26316	56.15	74.00	-17.85	212.00	2.85	Horizontal	1000000.00	3.09
16712.89474	56.96	74.00	-17.04	121.00	3.30	Horizontal	1000000.00	3.90
17086.57895	57.18	74.00	-16.82	315.00	1.70	Vertical	1000000.00	3.48

Average (PASS) (9)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°) (dB)	Height (m) (dB)	Pol. (dB)	RBW (dB)	Correction (dB)
4966.842105	34.23	54.00	-19.77	16.00	2.75	Horizontal	1000000.00	-11.55
7440.789474	43.66	54.00	-10.34	76.00	2.55	Vertical	1000000.00	-6.51
12280.26316	42.95	54.00	-11.05	67.00	1.50	Horizontal	1000000.00	0.90
13120.78947	41.09	54.00	-12.91	42.00	1.50	Horizontal	1000000.00	1.88
14450	40.98	54.00	-13.02	81.00	2.30	Horizontal	1000000.00	2.34
15243.68421	41.56	54.00	-12.44	295.00	3.34	Vertical	1000000.00	3.01
16305.26316	41.94	54.00	-12.06	212.00	2.85	Horizontal	1000000.00	3.09
16712.89474	42.89	54.00	-11.11	121.00	3.30	Horizontal	1000000.00	3.90
17086.57895	42.69	54.00	-11.31	315.00	1.70	Vertical	1000000.00	3.48

18-25 GHz on Low, Mid, and High Channels Radiated Emissions

Company: Spruce Environment
Model #: RadStar Alpha Series
Serial #: 51012FCC
Engineers: Vathana Ven
Project #: G103875437
Standard: FCC Part 15.247 & RSS-247
Receiver: 145128
PreAmp: PRE8
Antenna & Cables: LF Bands: N, LF, HF, SHF
Antenna: EMC04
Cable(s): CBLSHF103 CBLSHF102
Location: 10m Chamber Barometer: BAR1 Filter: REA005
Date(s): 07/11/19
Temp/Humidity/Pressure: 21C 22% 1005mbar
Limit Distance (m): 3
Test Distance (m): 0.2
PreAmp Used? (Y or N): Y Voltage/Frequency: 120VAC 60Hz Frequency Range: 18-25 GHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Testing was performed manually at 10cm from the EUT. No emissions were detected at low, mid, and high channels on all axis											

Test Personnel: Vathana Ven VJV
Kenneth Lee
Test Date: 07/11/2019
07/01/2019

Supervising/Reviewing Engineer: (Where Applicable) N/A

Product Standard: CFR47 FCC Part 15.247
RSS-247

Limit Applied: See report section 10.3

Input Voltage: 120VAC 60Hz

Pretest Verification w/ Ambient Signals or BB Source: BB Source

Ambient Temperature: 21, 23 ºC

Relative Humidity: 22, 46 %

Atmospheric Pressure: 984, 994 mbars

Deviations, Additions, or Exclusions: None

11 Digital Device and Receiver Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, ICES 003, and ANSI C 63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV001'	Weather Station	Davis Instruments	7400	PE80519A61	01/23/2019	01/23/2020
145128'	EMI Receiver (20 Hz - 40 Ghz)	Rohde & Schwarz	ESIB 40	839283/001	03/28/2019	03/28/2020
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2018	07/25/2019
PRE11'	50dB gain pre-amp	Keith H	PRE11	PRE11	10/27/2018	10/27/2019
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/12/2019	06/12/2020
EMC02'	ANTENNA, RIDGED GUIDE, 1-18 GHZ	EMCO	3115	2784	08/16/2018	08/16/2019
BON001'	METER, POWER	Boonton	4232A	55601	01/23/2019	01/23/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2018	07/25/2019

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.3

11.3 Results:

The sample tested was found to Comply.

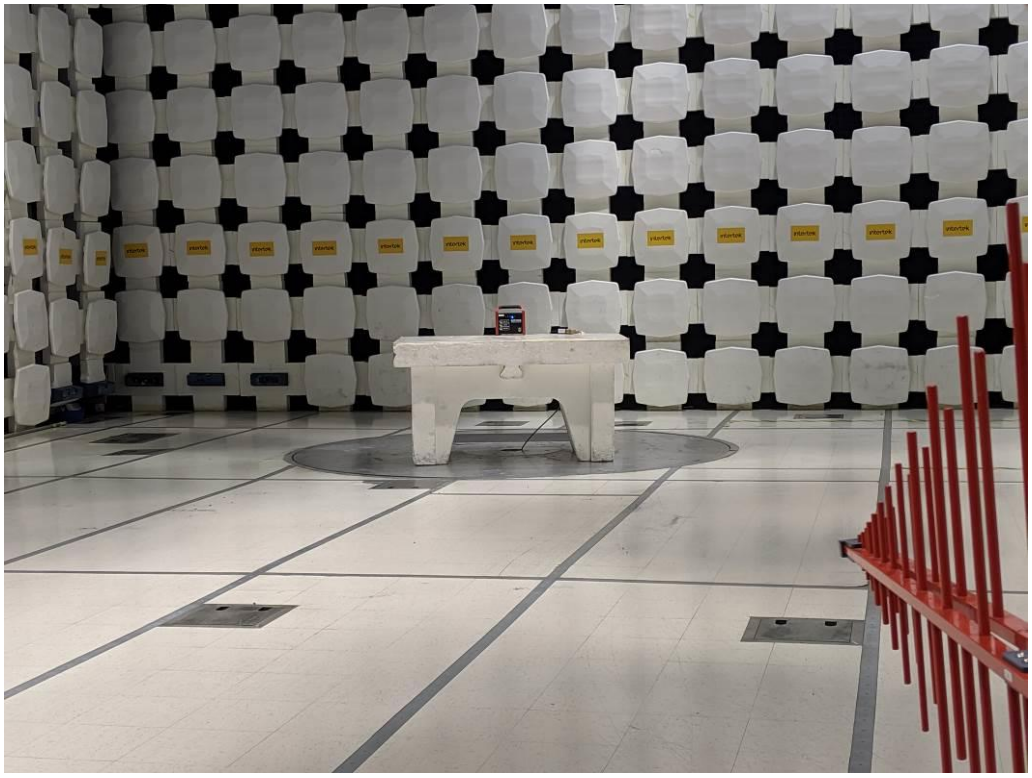
§15.109 Radiated emission limits.

The field strength of radiated emissions form unintentional radiators at a distance of 3 meters shall not exceed the following values.

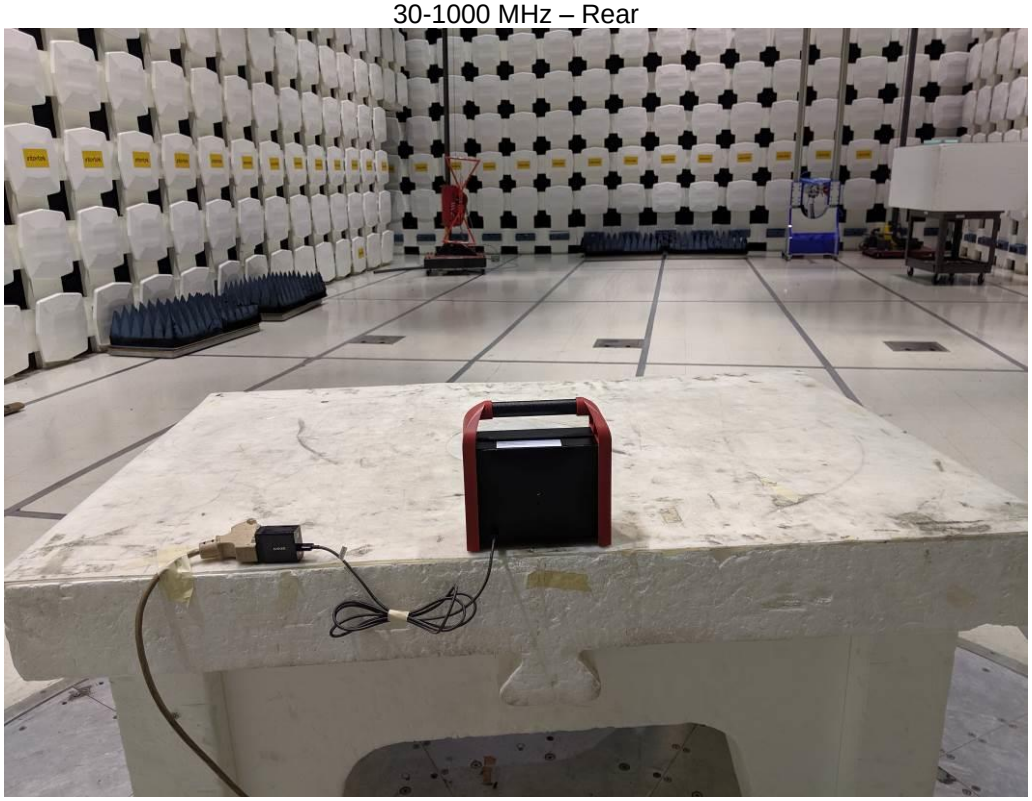
Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBµV/m)
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	54.00

11.4 Setup Photographs:

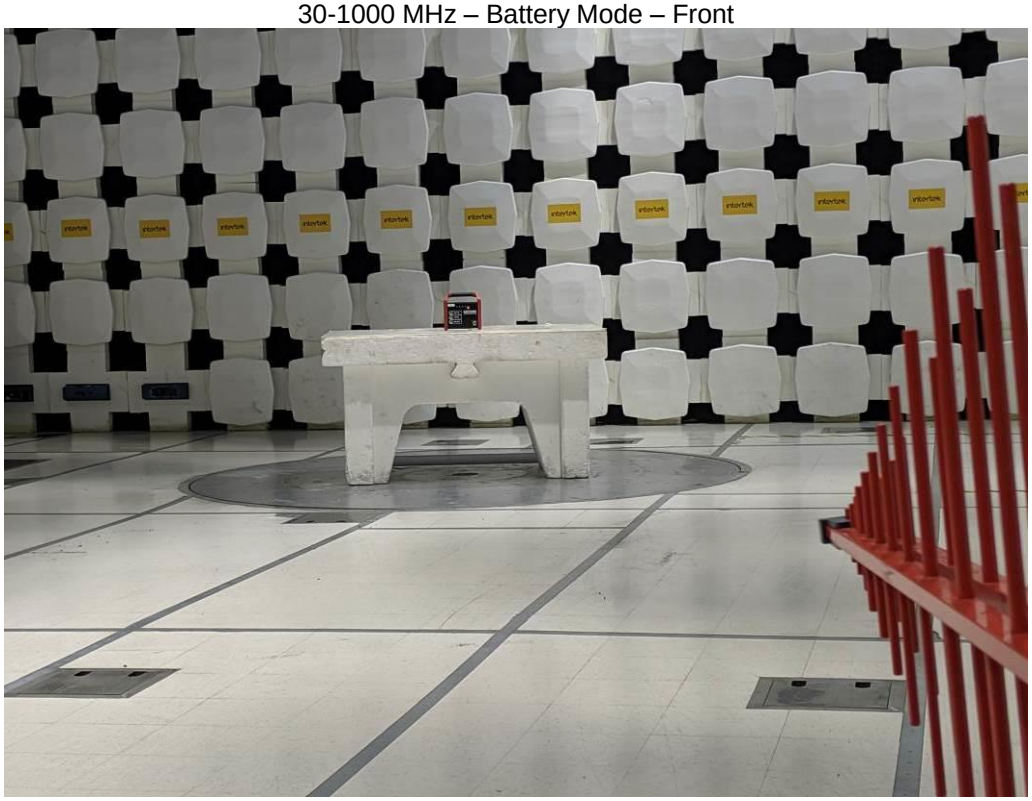
30-1000 MHz – Front



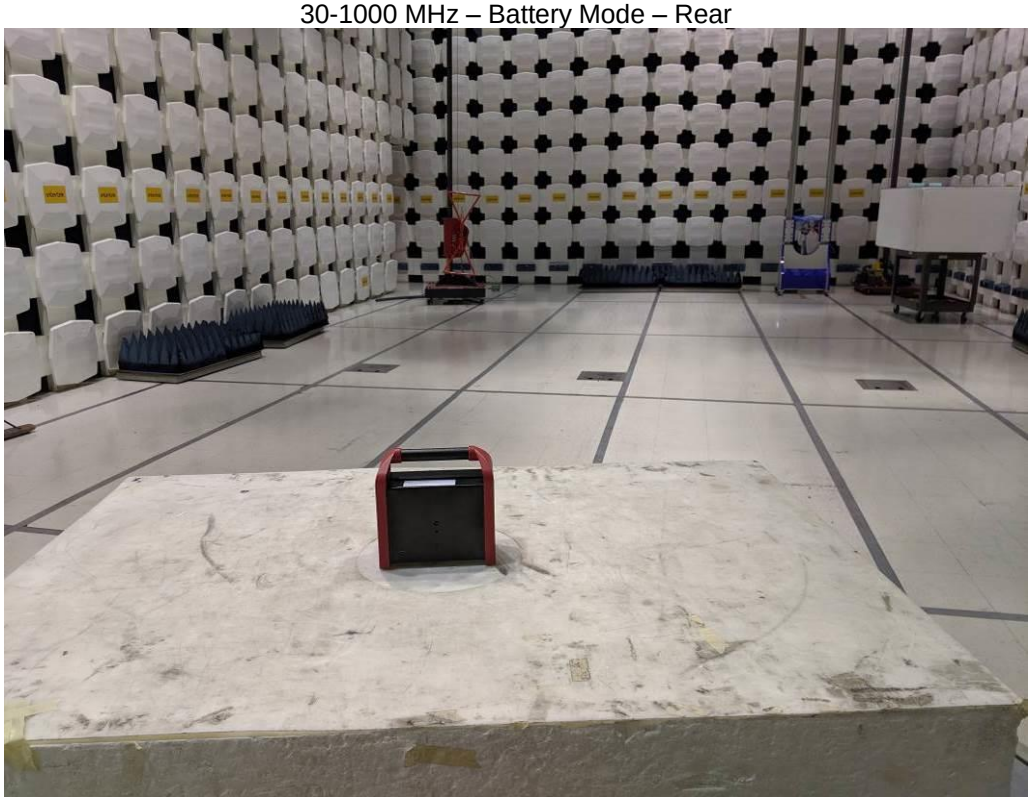
30-1000 MHz – Rear



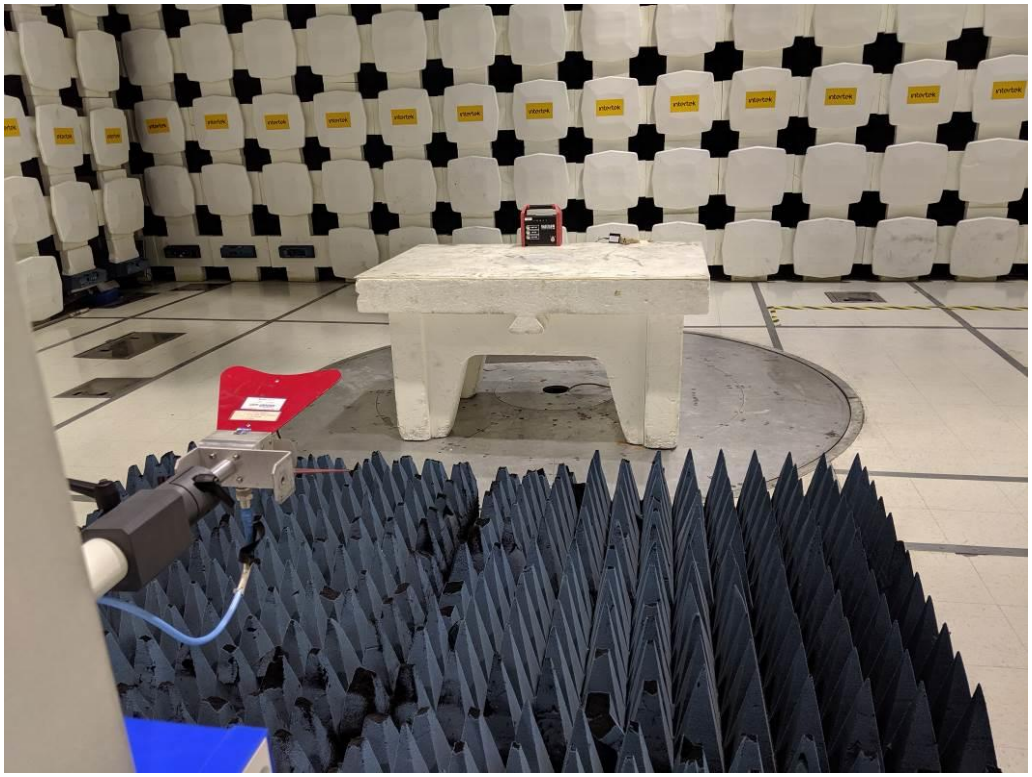
30-1000 MHz – Battery Mode – Front



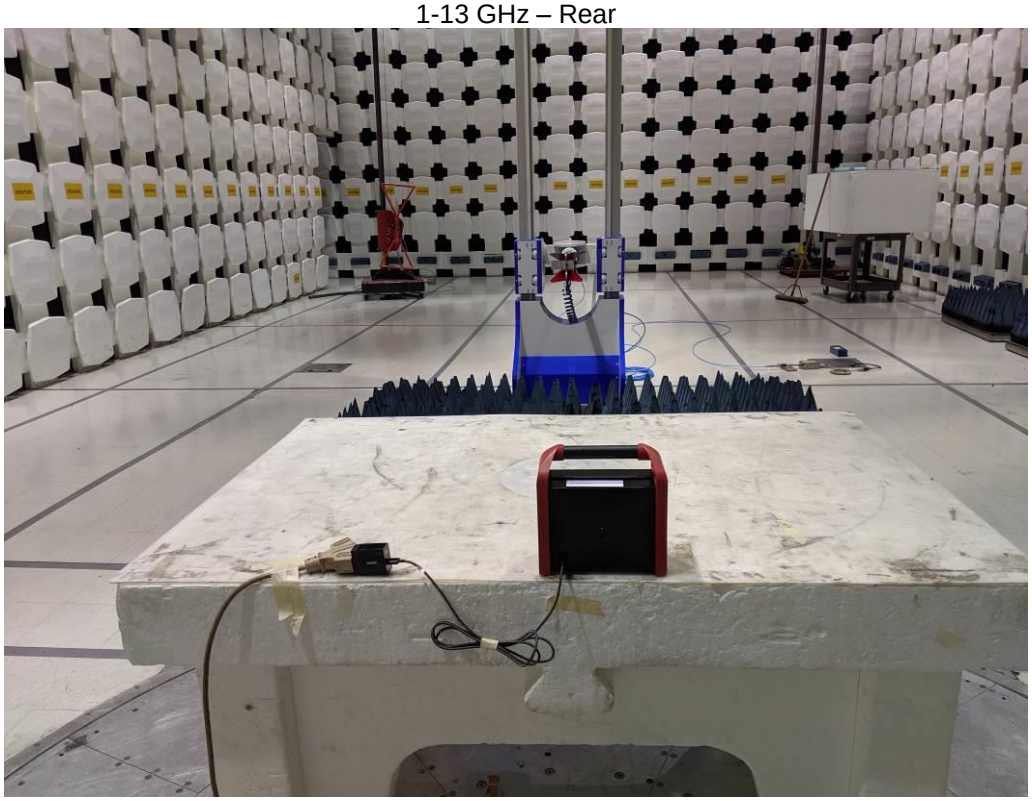
30-1000 MHz – Battery Mode – Rear



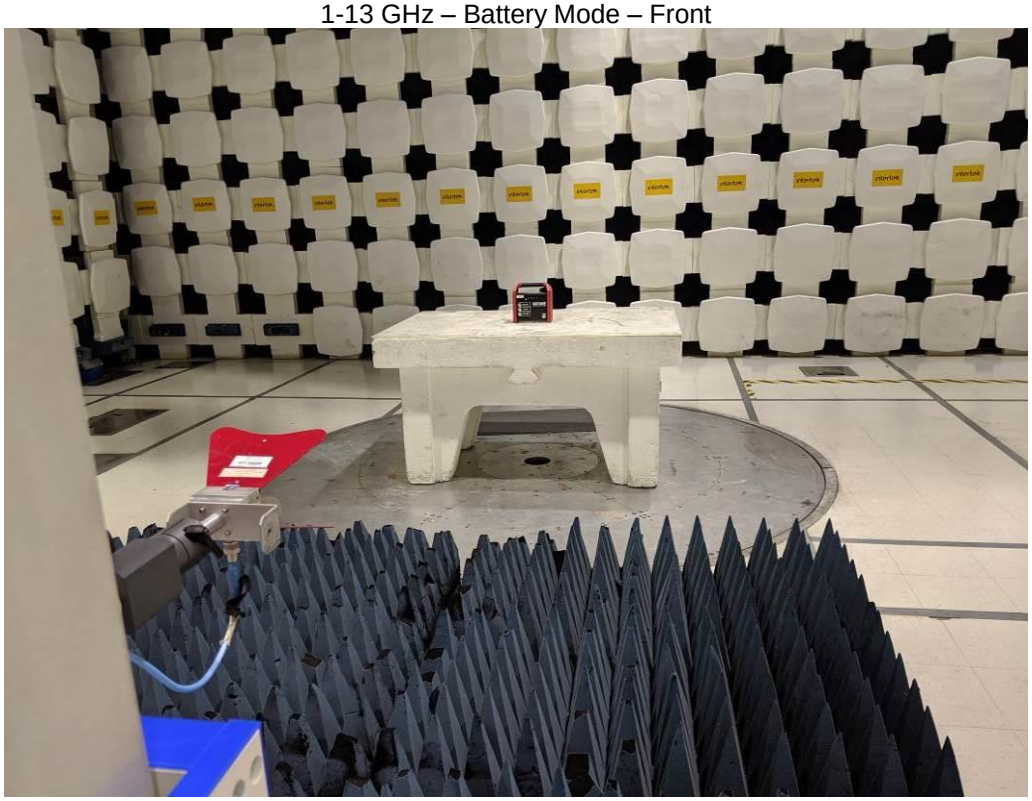
1-13 GHz – Front



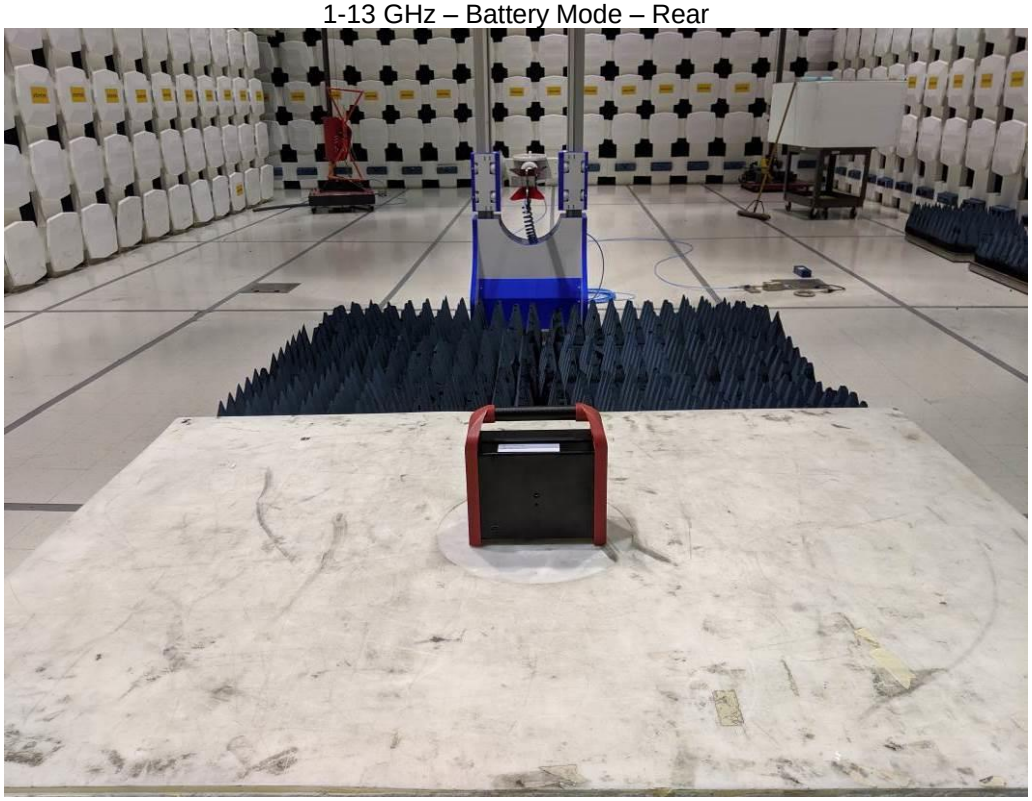
1-13 GHz – Rear



1-13 GHz – Battery Mode – Front



1-13 GHz – Battery Mode – Rear

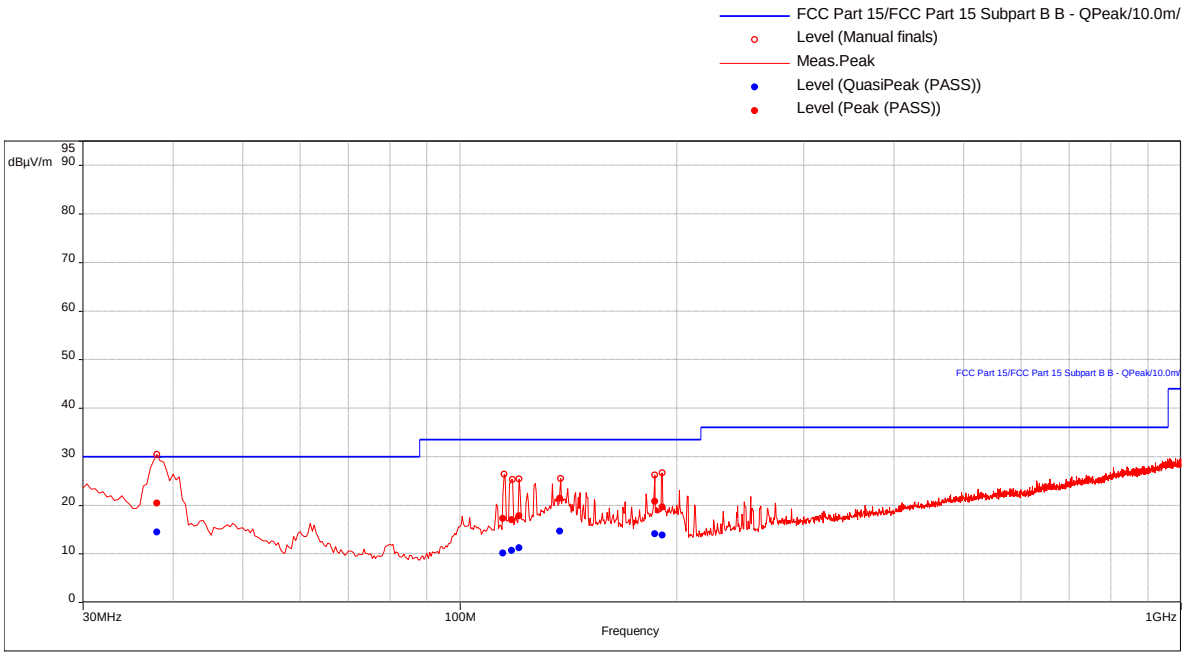


11.5 Plots/Data:

Test Information:

Date and Time	5/24/2019 8:02:31 AM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	23 °C
Humidity	46 %
Atmospheric Pressure	994 mbars
Comments	120 VAC @ 60 Hz - RE 30-1000MHz SA mode

Graph:



Results:

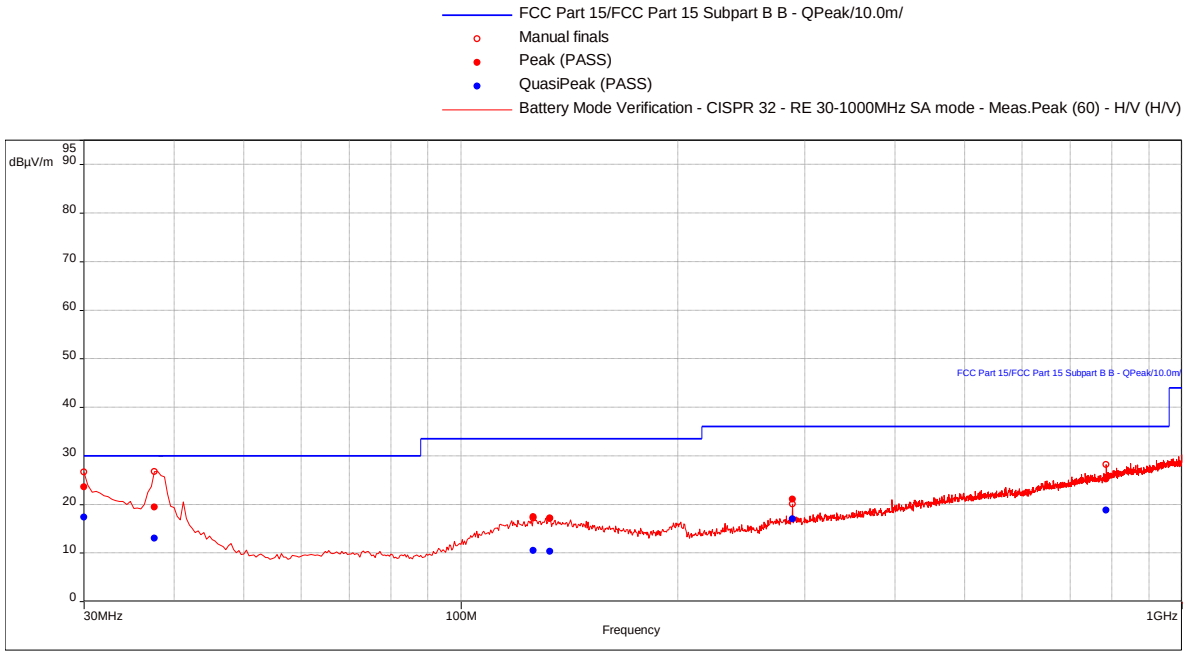
QuasiPeak (PASS) (7)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
38.03157895	14.42	30.00	-15.58	54.00	1.91	Vertical	120000.00	-17.47
114.7578947	10.13	33.50	-23.37	1.00	3.17	Horizontal	120000.00	-19.60
117.8947368	10.62	33.50	-22.88	70.00	2.22	Vertical	120000.00	-19.20
120.7368421	11.20	33.50	-22.30	270.00	2.87	Vertical	120000.00	-19.04
137.6526316	14.68	33.50	-18.82	254.00	1.76	Vertical	120000.00	-18.94
186.5263158	14.06	33.50	-19.44	269.00	1.88	Vertical	120000.00	-20.79
190.9578947	13.83	33.50	-19.67	268.00	2.40	Vertical	120000.00	-20.44

Test Information:

Date and Time	5/24/2019 12:19:59 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	23 °C
Humidity	46 %
Atmospheric Pressure	994 mbars
Comments	Battery Mode - FCC - RE 30-1000MHz SA mode

Graph:



Results:

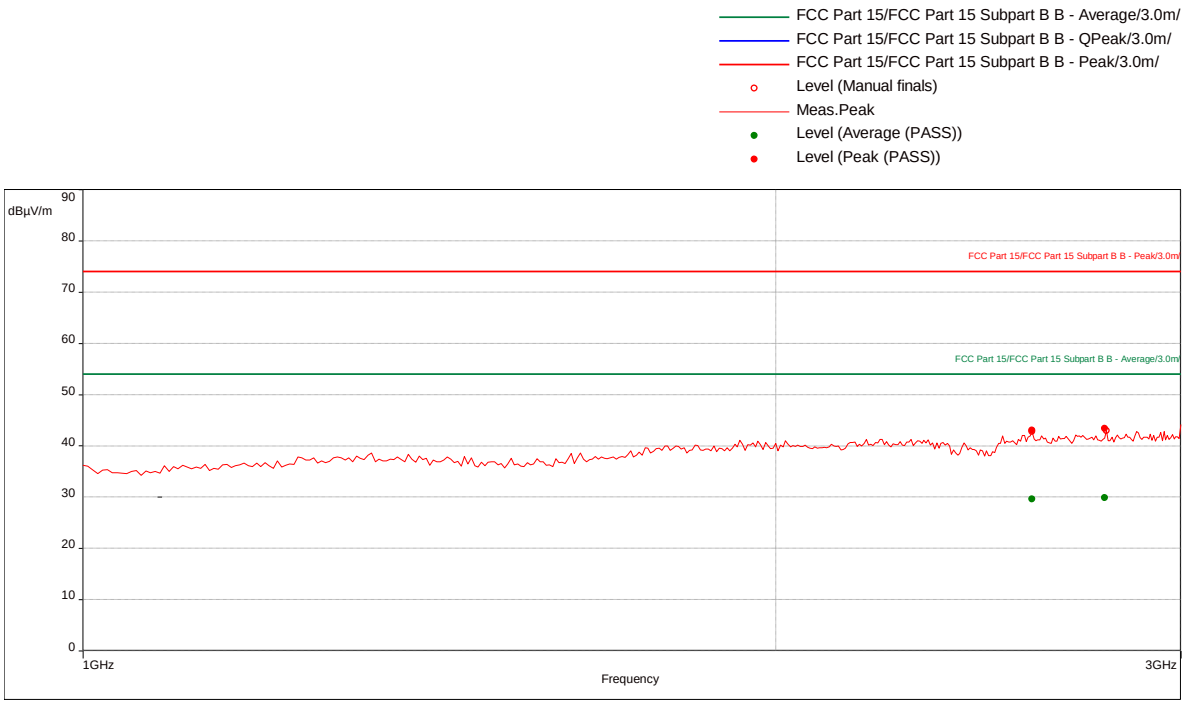
QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW
30	17.37	30.00	-12.63	277.00	3.93	Vertical	120000.00
37.6	12.97	30.00	-17.03	84.00	2.65	Vertical	120000.00
126	10.45	30.00	-19.55	18.00	3.99	Horizontal	120000.00
132.8	10.28	30.00	-19.72	135.00	2.58	Vertical	120000.00
288.4	17.02	37.00	-19.98	39.00	1.00	Vertical	120000.00
785.6	18.78	37.00	-18.22	357.00	3.10	Vertical	120000.00

Test Information:

Date and Time	5/24/2019 2:11:24 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	23
Humidity	46
Atmospheric Pressure	994
Comments	120 VAC @ 60 Hz - FCC - RE 1 to 3 GHz SA mode

Graph:



Results:

Peak (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2585.789474	43.05	74.00	-30.95	232.00	3.45	Horizontal	1000000.00	-17.33
2781.315789	43.36	74.00	-30.64	232.00	1.55	Vertical	1000000.00	-16.90

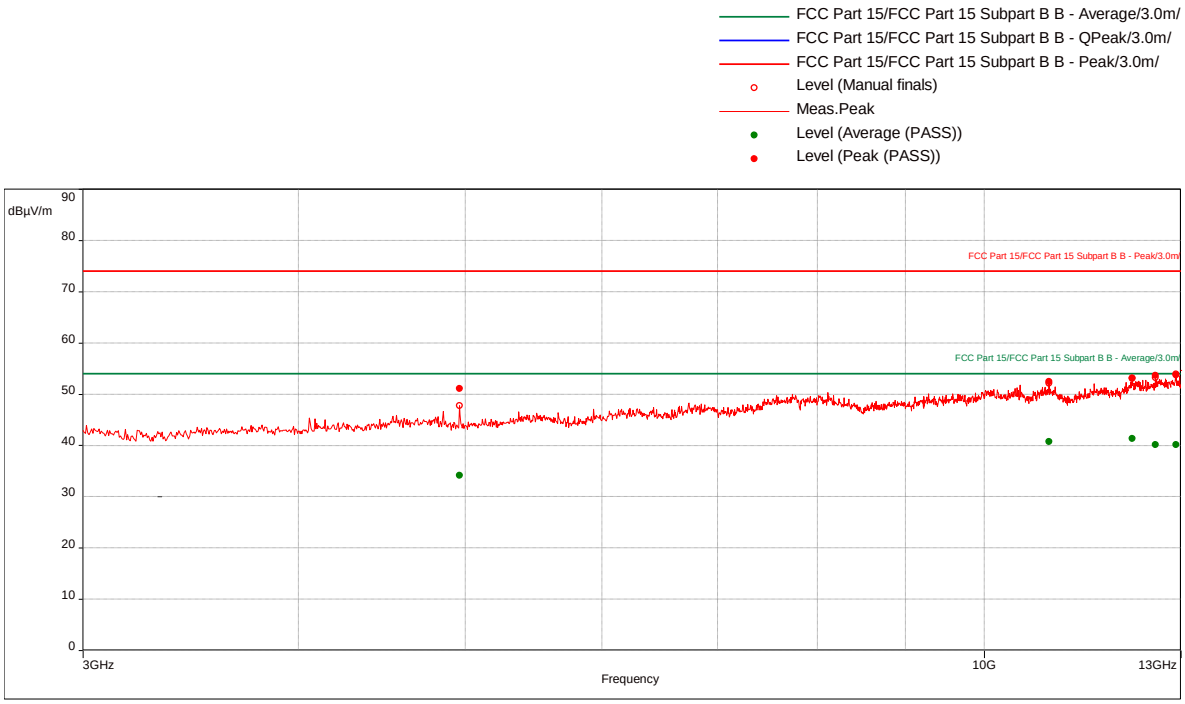
Average (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2585.789474	29.60	54.00	-24.40	232.00	3.45	Horizontal	1000000.00	-17.33
2781.315789	29.88	54.00	-24.12	232.00	1.55	Vertical	1000000.00	-16.90

Test Information:

Date and Time	5/24/2019 2:43:10 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	23
Humidity	46
Atmospheric Pressure	994
Comments	120 VAC @ 60 Hz - FCC - RE 3 to 13 GHz SA mode

Graph:



Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960.526316	51.08	74.00	-22.92	106.00	1.45	Vertical	1000000.00	-11.58
10898.42105	52.47	74.00	-21.53	157.00	2.70	Horizontal	1000000.00	-2.22
12183.42105	53.14	74.00	-20.86	10.00	3.49	Horizontal	1000000.00	1.10
12566.84211	53.67	74.00	-20.33	291.00	2.40	Horizontal	1000000.00	1.49
12917.10526	53.75	74.00	-20.25	0.00	2.85	Vertical	1000000.00	1.71

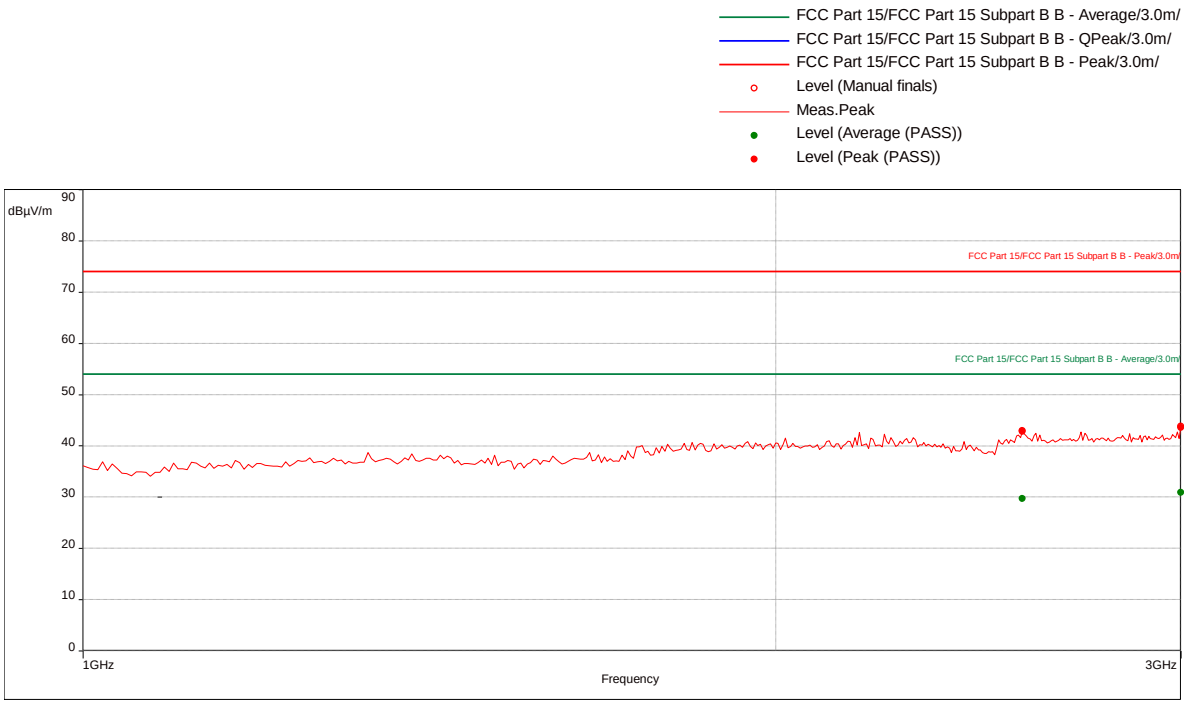
Average (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4960.526316	34.14	54.00	-19.86	106.00	1.45	Vertical	1000000.00	-11.58
10898.42105	40.75	54.00	-13.25	157.00	2.70	Horizontal	1000000.00	-2.22
12183.42105	41.35	54.00	-12.65	10.00	3.49	Horizontal	1000000.00	1.10
12566.84211	40.17	54.00	-13.83	291.00	2.40	Horizontal	1000000.00	1.49
12917.10526	40.16	54.00	-13.84	0.00	2.85	Vertical	1000000.00	1.71

Test Information:

Date and Time	5/24/2019 2:23:27 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	23
Humidity	46
Atmospheric Pressure	994
Comments	Battery - FCC - RE 1 to 3 GHz SA mode

Graph:



Results:

Peak (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2557.894737	42.92	74.00	-31.08	0.00	1.20	Horizontal	1000000.00	-17.46
2999.473684	43.57	74.00	-30.43	306.00	1.05	Vertical	1000000.00	-15.85

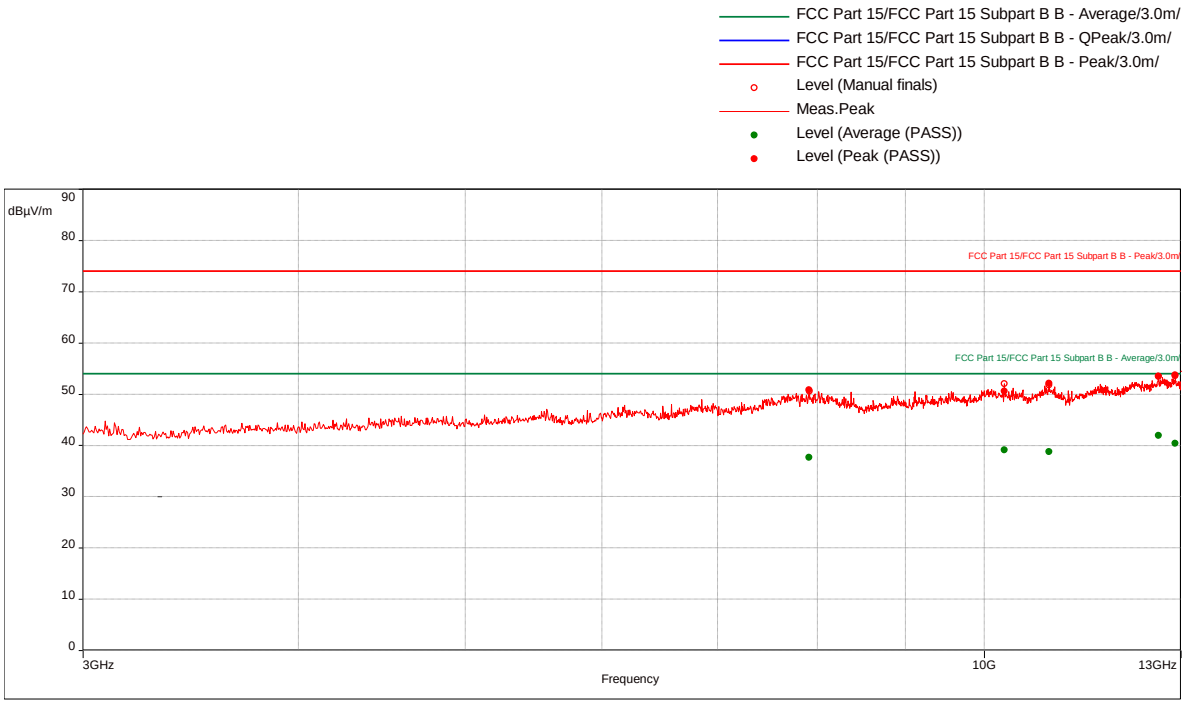
Average (PASS) (2)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2557.894737	29.65	54.00	-24.35	0.00	1.20	Horizontal	1000000.00	-17.46
2999.473684	30.85	54.00	-23.15	306.00	1.05	Vertical	1000000.00	-15.85

Test Information:

Date and Time	5/24/2019 1:14:34 PM
Client and Project Number	Spruce Environmental - G103993459
Engineer	Ken Lee
Temperature	23
Humidity	46
Atmospheric Pressure	994
Comments	Battery - FCC - RE 3 to 13 GHz SA mode

Graph:



Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
7911.578947	50.80	74.00	-23.20	98.00	2.45	Vertical	1000000.00	-5.31
10270	50.53	74.00	-23.47	173.00	2.25	Horizontal	1000000.00	-3.26
10899.73684	52.09	74.00	-21.91	78.00	3.44	Vertical	1000000.00	-2.21
12616.05263	53.47	74.00	-20.53	165.00	3.25	Horizontal	1000000.00	1.56
12902.36842	53.71	74.00	-20.29	238.00	2.45	Horizontal	1000000.00	1.80

Average (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
7911.578947	37.65	54.00	-16.35	98.00	2.45	Vertical	1000000.00	-5.31
10270	39.12	54.00	-14.88	173.00	2.25	Horizontal	1000000.00	-3.26
10899.73684	38.78	54.00	-15.22	78.00	3.44	Vertical	1000000.00	-2.21
12616.05263	41.90	54.00	-12.10	165.00	3.25	Horizontal	1000000.00	1.56
12902.36842	40.42	54.00	-13.58	238.00	2.45	Horizontal	1000000.00	1.80

Test Personnel:	Kenneth Lee 	Test Date:	05/24/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B ICES-003	Limit Applied:	All Class B
Input Voltage:	120VAC 60Hz Internal Battery		
Pretest Verification w/ Ambient Signals or BB Source:	**BB Source**	Ambient Temperature:	23 ºC
		Relative Humidity:	46 %
		Atmospheric Pressure:	994 mbars

Deviations, Additions, or Exclusions: None

12 AC Mains Conducted Emissions

12.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, ICES 003, and ANSI C 63.4.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	1.2 dB	3.4 dB
Telco Port Emissions	150 kHz - 30 MHz	2.8 dB	5.0 dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:
NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

Alternately, when C5 Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. “TF” is the Transducer Factor; in this case LISN or ISN loss.

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/06/2018	11/06/2019
CBLBNC2012-4'	50 Ohm Coaxial Cable	Pomona	RG58C/U	CBLBCN2012-4	05/07/2019	05/07/2020
DS27'	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS27	10/23/2018	10/23/2019
ROS002'	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	08/08/2018	08/08/2019
LISN34'	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191956	04/17/2019	04/17/2020

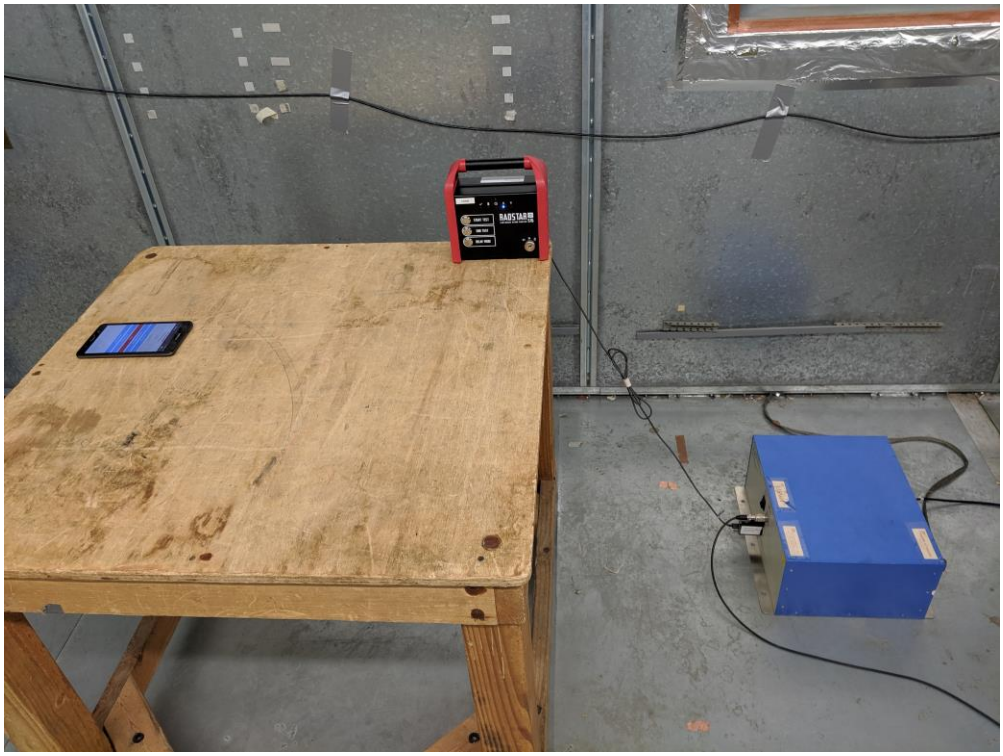
Software Utilized:

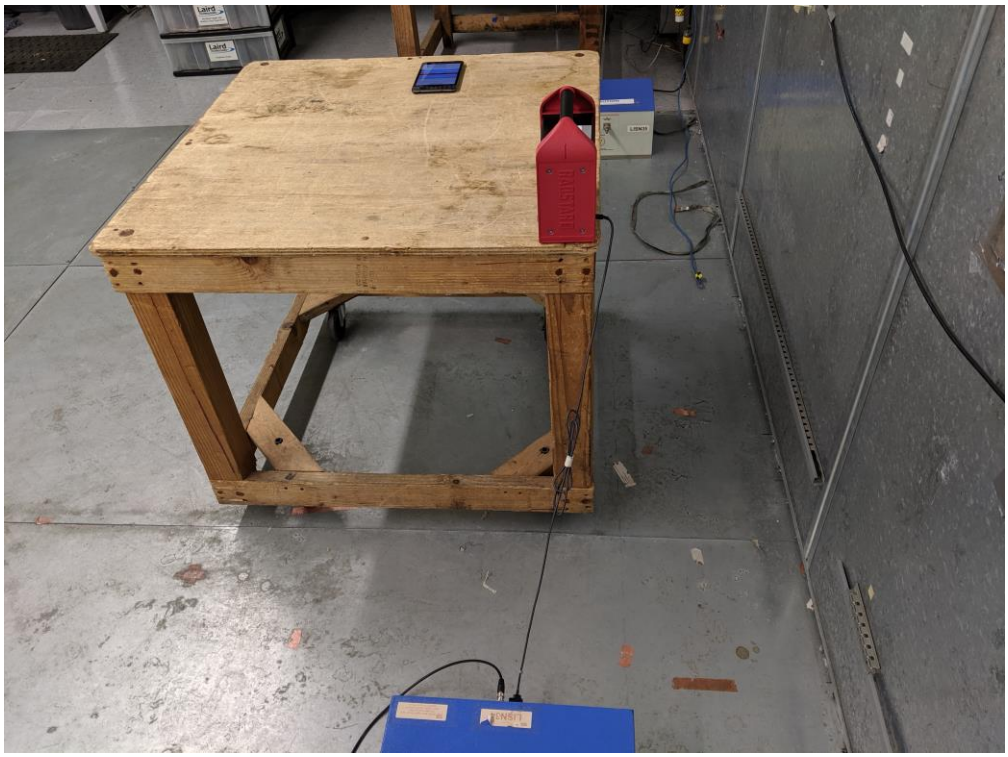
Name	Manufacturer	Version
Compliance 5	Teseq	5.26.46.46

12.3 Results:

The sample tested was found to Comply.

12.4 Setup Photographs:



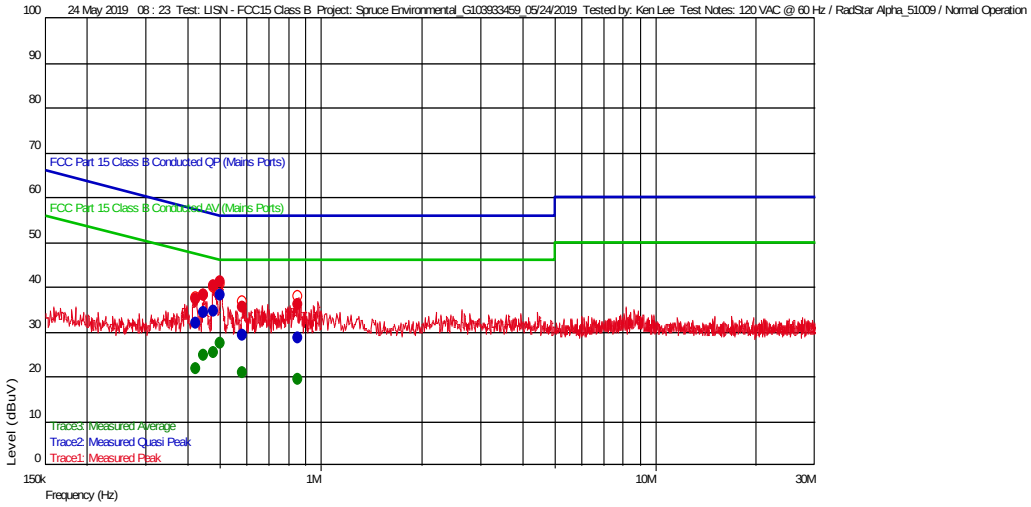


12.5 Plots/Data:

Test Information

Test Details	User Entry	Additional Information
Test:	LISN - FCC15 Class B	
Project:	Spruce Environmental_G103933459_05/24/2019	
Test Notes:	120 VAC @ 60 Hz / RadStar Alpha_51009 / Normal Operation	
Temperature:	21	
Humidity:	55	
Tested by:	Ken Lee	
Test Started:	24 May 2019 08 : 23	

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
859.75 k	28.54	0.040	20.232	56.000	-27.46	9 k		L1
585.2 k	29.22	0.040	20.177	56.000	-26.78	9 k		L1
424.55 k	31.79	0.046	20.141	57.359	-25.57	9 k		L1
450.05 k	34.03	0.045	20.147	56.874	-22.84	9 k		L1
478.95 k	34.58	0.044	20.154	56.357	-21.78	9 k		L1
502.75 k	38.15	0.043	20.160	56.000	-17.85	9 k		L1

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
859.75 k	19.34	0.040	20.232	46.000	-26.66	9 k		L1
424.55 k	21.67	0.046	20.141	47.359	-25.69	9 k		L1
585.2 k	20.75	0.040	20.177	46.000	-25.25	9 k		L1
450.05 k	24.65	0.045	20.147	46.874	-22.22	9 k		L1
478.95 k	25.34	0.044	20.154	46.357	-21.02	9 k		L1
502.75 k	27.46	0.043	20.160	46.000	-18.54	9 k		L1

Test Personnel:	Kenneth Lee 	Test Date:	05/24/2019
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B ICES-003	Limit Applied:	All Class B
Input Voltage:	120VAC 60Hz		
Pretest Verification w/ Ambient Signals or BB Source:	Signal Generator at -20 dBm	Ambient Temperature:	21 ºC
		Relative Humidity:	55 %
		Atmospheric Pressure:	1005 mbars

Deviations, Additions, or Exclusions: None

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	08/06/2019	103933459BOX-002	VFV	KPS	Original Issue