

CLASS II PERMISSIVE CHANGE TEST REPORT

Report Number: 103645080MPK-016

Project Number: G103645080

December 18, 2018

**Testing performed on the
Medical Compression Device
Model: Cirvo C2**

FCC ID: 2AOQW-FG-0053

to

**FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247 Issue 2
FCC Part 15, Subpart B
Industry Canada ICES-003**

For

Radial Medical, Inc

Test Performed by:

Intertek

1365 Adams Court

Menlo Park, CA 94025 USA

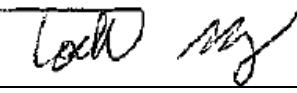
Test Authorized by:

Radial Medical, Inc

2500 Grant Road G01

Mountain View, CA 94040 USA

Prepared by:


Todd Moy

Date: December 18, 2018

Reviewed by:


Krishna K Vemuri

Date: December 18, 2018

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Report No. 103645080MPK-016

Equipment Under Test:

Radial Medical Compression Device

Trade Name:

Radial Medical, Inc

Model Number:

Cirvo C2

Applicant:

Radial Medical, Inc

Contact:

Viet Le

Address:

Radial Medical, Inc
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USA

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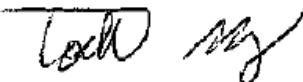
Applicable Regulation:

FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247 Issue 2
FCC Part 15, Subpart B
Industry Canada ICES-003 Issue 6

Date of Test:

November 28-29, 2018

We attest to the accuracy of this report:



Todd Moy
Project Engineer



Krishna K Vemuri
Engineering Team Lead

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1.0 Introduction

This report is designed to show compliance of the Bluetooth 4.0 (BLE) transceiver with the requirements of FCC Part 15 Subpart C (15.247), RSS-247 Issue 2 & FCC Part 15 Subpart B & ICES-003. This test report covers only the BLE radio.

1.1 Summary of Tests

Test	Reference FCC	Reference Industry Canada	Result
RF Output Power	15.247(b)(3)	RSS-247, 5.4.4	Complies
Out of Band Antenna Conducted Emission	15.247(d)	RSS-247, 5.5	Complies
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-247, 5.5	Complies
AC Line Conducted Emission	15.207	RSS-GEN	Complies
Radiated Emissions	15.109	ICES-003	Complies
AC Line Conducted Emission	15.107	ICES-003	Complies
Antenna Requirement	15.203	RSS-GEN	Complies (Internal Antenna)
RF Exposure	15.247(i), 2.1093(d)	RSS-102	Complies

2.0 General Description

2.1 Product Description

Radial Medical, Inc. supplied the following description of the EUT:

The Radial Medical Compression System consists of a portable, battery powered compression unit placed on the calf, secured around the shin with a shin pad and hook and loop fasteners.

The compression unit can be controlled wirelessly using a smartphone via BLE connection or directly on the device. When used for prescriptive applications, only the physician is able to control the treatment parameters and can monitor the patient's compliance and therapy progress remotely. The patient is able to turn the device on and off and monitor the progress of their therapy with the smartphone application.

For more information, see user's manual provided by the manufacturer.

Information about the Compression System DTS radio is presented below:

For more information, refer to the following product specification, declared by the manufacturer.

Information about the 2.4 GHz radio is presented below:

Applicant	Radial Medical Inc.
Model Numbers	Cirvo C2
FCC Identifier	2AOQW-FG-0053
Type of Transmission	Digital Transmission System (DTS)
Rated RF Output	-2.68 dBm
Antenna(s) & Gain	Internal Antenna, Gain: -1.5 dBi
Frequency Range	2402-2480 MHz
Number of Channel(s)	40, Channel 0-39
Modulation Type	GFSK/ 1Mbits/s
Applicant Name & Address	Radial Medical Inc. 2500 Grant Road G01 Mountain View, CA 9404 USA

EUT receive date: November 6, 2018

EUT receive condition: The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.

Test start date: November 28, 2018

Test completion date: November 29, 2018

The test results in this report pertain only to the item tested.

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Antenna conducted measurements were performed according to the FCC documents "Guidance for Performing Compliance Measurement on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System devices Operating under §15.247" (KDB 558074 D01 Meas Guidance v05), RSS-247 Issue 2, ANSI C63.10: 2013 and RSS-GEN Issue 5.

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10: 2013. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

Following is the channel test plan:

Channels in 2.4 GHz band		
Test Channel	Frequency, MHz	Tested
Low	2402	✓
Middle	2440	✓
High	2480	✓

2.4 Test Facility

The test site used to collect the radiated data is site 1 (10-m semi-anechoic chamber). This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

3.0 System Test Configuration

3.1 Support Equipment

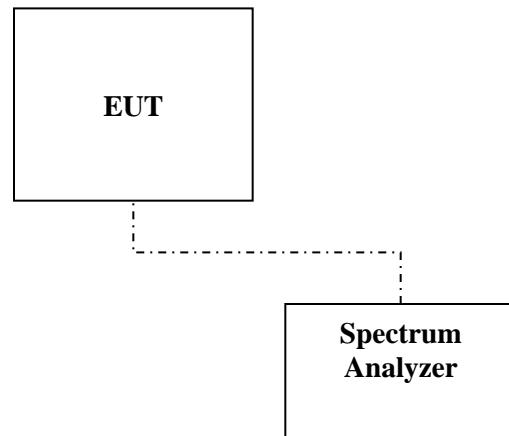
EUT is a standalone equipment.

3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Radial Medical Compression Device	Radial Medical, Inc	Cirvo C2	001
AC Power Adaptor	Amazon	B016EAYM01	-

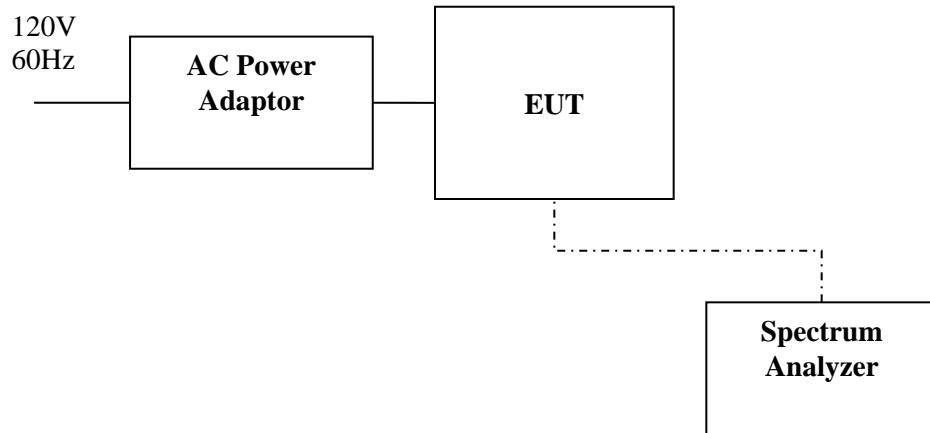
Battery Powered

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements.



Charging Mode

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements.



S = Shielded
U = Unshielded

F = With Ferrite
m = Length in Meters

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT is attached to peripherals and they are connected and operational (as typical as possible). The EUT is wired to transmit full power. During testing, all cables are manipulated to produce worst-case emissions.

The Cirvo C2 Model were previously certified under FCC ID: 2AOQW-FG-0053.

The Cirvo C2 are compression systems that contain the same transceiver circuitry as the FG-0053. The enclosure of the Cirvo C2 is different from the FG-0053.

3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power on the low channel, middle channel, high channel and with hopping channels enabled.

3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

4.0 Transmitter Emissions Measurement Results

4.1 Conducted Output Power at Antenna Terminals FCC Rule: 15.247(b)(3); RSS-247 5.4.4;

4.1.1 Requirement

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm. For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.1.2 Procedure

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v05 was used. Specifically, section 11.9.1.1 $\text{RBW} \geq \text{DTS Bandwidth}$ of ANSI 63.10 was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

1. Set the $\text{RBW} \geq \text{DTS Bandwidth}$
2. Set the $\text{VBW} \geq 3 \times \text{RBW}$
3. Set the span $\geq 3 \times \text{RBW}$
4. Detector = Peak
5. Sweep time = Auto couple
6. Trace mode = Max Hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

A spectrum analyzer was connected to the antenna port of the transmitter.

Tested By:	Todd Moy
Test Date:	November 28, 2018

4.1.3 Test Result

Refer to the following plots for the test result:

Battery Mode

Frequency MHz	Conducted Peak Power dBm	Conducted Peak Power mW	Plot #
2402	-2.68	0.540	1.1
2440	-2.98	0.504	1.2
2480	-3.84	0.413	1.3

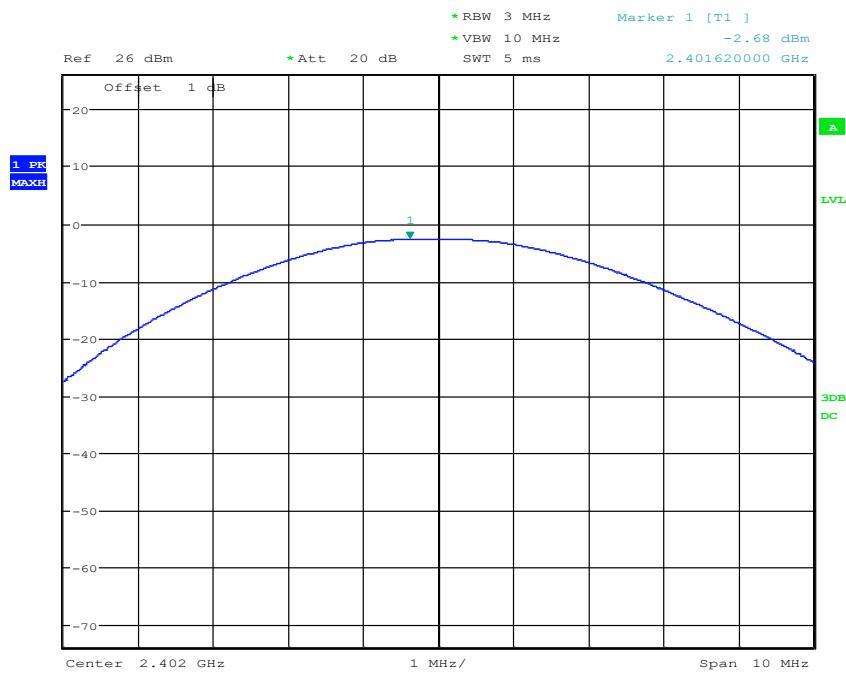
Charging Mode

Frequency MHz	Conducted Peak Power dBm	Conducted Peak Power mW	Plot #
2402	-3.11	0.489	1.4
2440	-2.93	0.509	1.5
2480	-3.60	0.437	1.6

Results

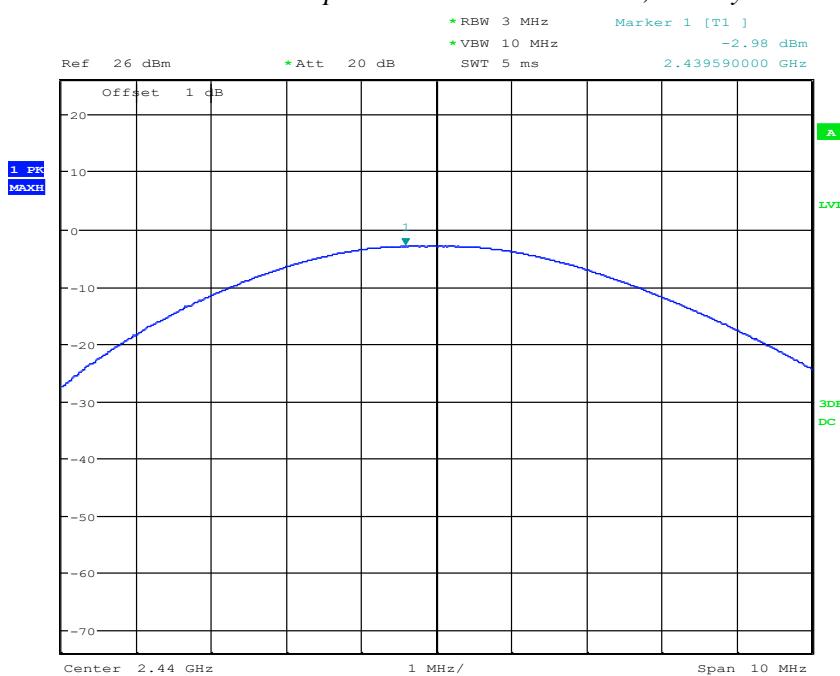
Complies

Plot 1. 1 – Output Power Low Channel, Battery Mode



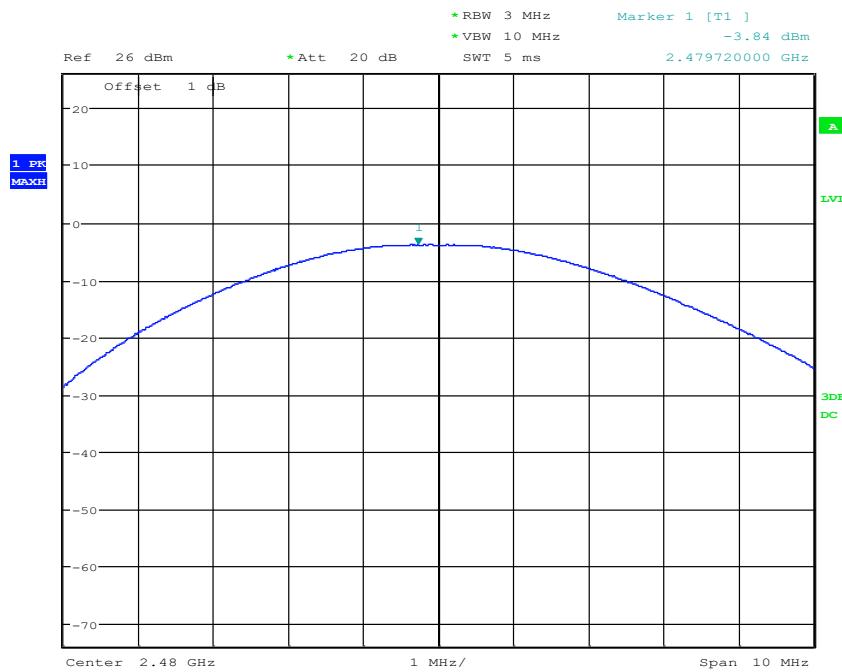
Date: 28.NOV.2018 09:12:32

Plot 1.2 – Output Power Middle Channel, Battery Mode



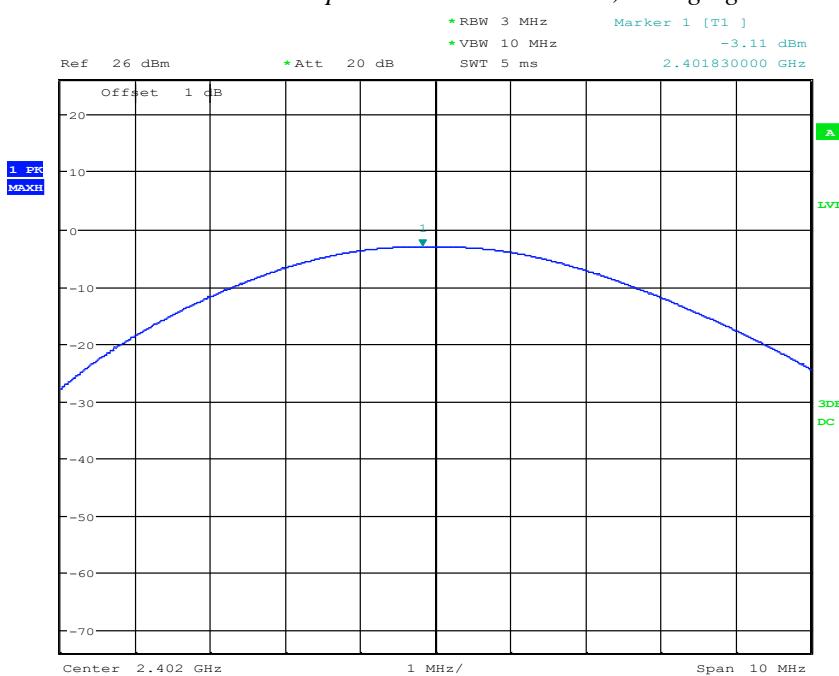
Date: 28.NOV.2018 09:07:31

Plot 1. 3 – Output Power High Channel, Battery Mode



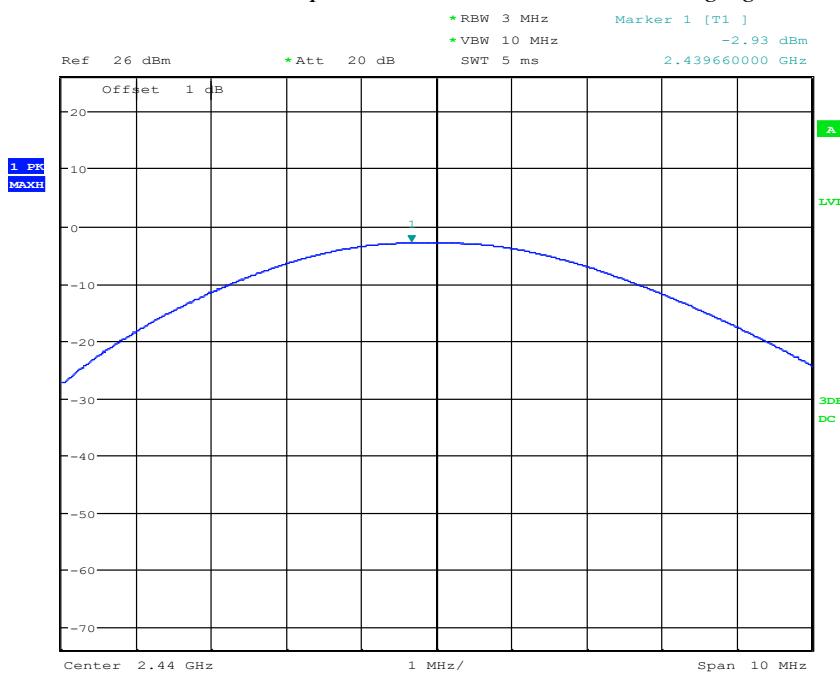
Date: 28.NOV.2018 09:17:52

Plot 1. 4 – Output Power Low Channel, Charging Mode



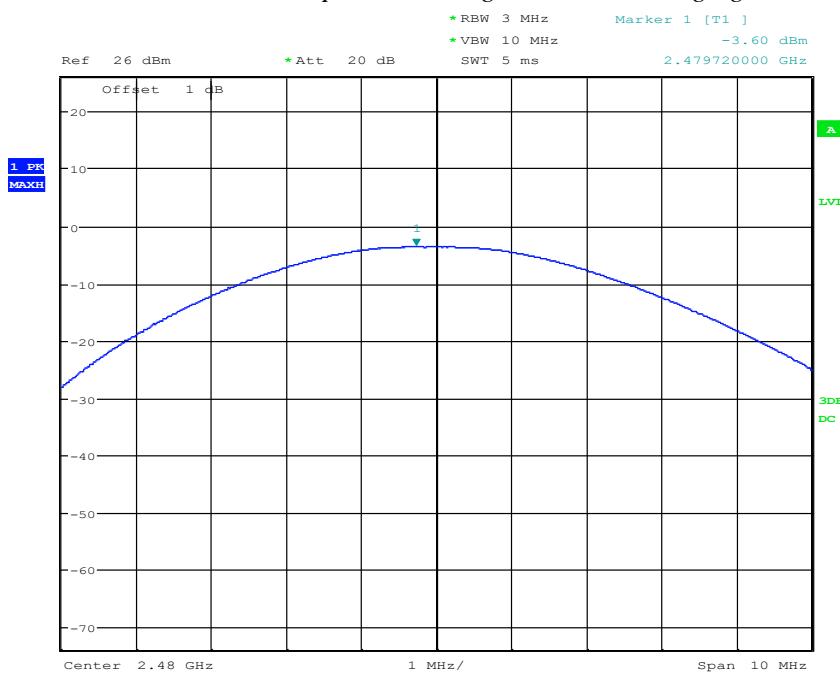
Date: 28.NOV.2018 09:13:36

Plot 1. 5 – Output Power Middle Channel, Charging Mode



Date: 28.NOV.2018 09:08:22

Plot 1.6 – Output Power High Channel, Charging Mode



Date: 28.NOV.2018 09:19:01

4.2 Transmitter Radiated Emissions
FCC Rules: 15.247(d), 15.209, 15.205; RSS-247 5.5;

4.2.1 Requirement

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)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.2.2 Procedure

Radiated emission measurements were performed from 30 MHz to 26 GHz according to the procedure described in ANSI C63.10: 2013. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz. Above 1000 MHz Peak and Average measurements were performed.

The EUT is placed on a plastic turntable that is 80 cm in height for below 1000MHz and 1.5m in height for above 1GHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies above 1 GHz and at 10 meters for frequencies below 1 GHz.

All measurements were made with a Peak Detector and compared to QP limits for 30MHz – 1GHz and Average or Peak limits for 1GHz – 26GHz where applicable.

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels).

EUT was tested with Internal Antenna.

4.2.3 Field Strength Calculation

Field Strength 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; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μ V/m)

RA = Receiver Amplitude (including preamplifier) in dB(μ V); AF = Antenna Factor in dB(1/m)

CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μ V) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μ V/m). This value in dB(μ V/m) was converted to its corresponding level in μ V/m.

RA = 52.0 dB(μ V)

AF = 7.4 dB(1/m)

CF = 1.6 dB

AG = 29.0 dB

FS = 52.0 + 7.4 + 1.6 - 29.0 = 32 dB(μ V/m).

Level in μ V/m = Common Antilogarithm [(32 dB μ V/m)/20] = 39.8 μ V/m.

4.2.4 Test Results

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

All radiated measurements were conducted in different orientation. The worst-case data was reported.

Tested By:	Todd Moy
Test Date:	November 28, 2018

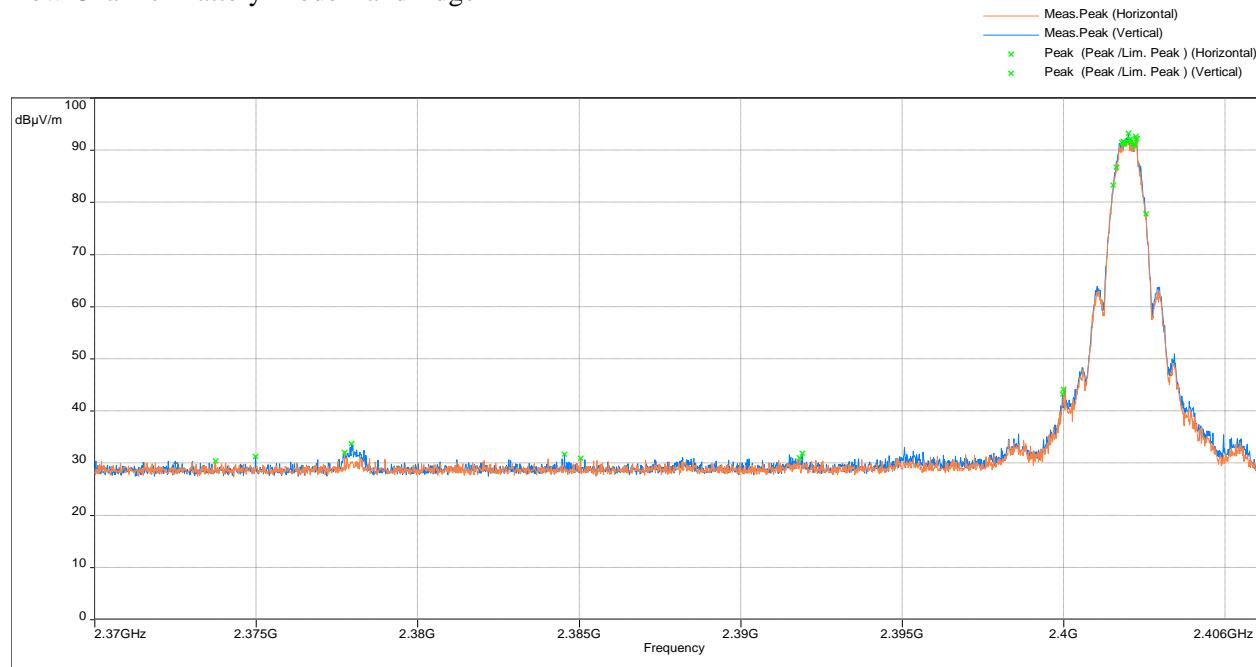
4.2.4 Test Results: 15.209 Out-of-Band Radiated Spurious Emissions:

TABLE 4.2

Mode	Frequency MHz	Fundamental Field Strength at 3m dB(uV/m), measured in 100 kHz RBW
Battery	2402	92.59
	2440	86.66
	2480	86.96
Charging	2402	89.79
	2440	87.33
	2480	86.76

Band Edge measurements in 100 kHz RBW @ 3m distance

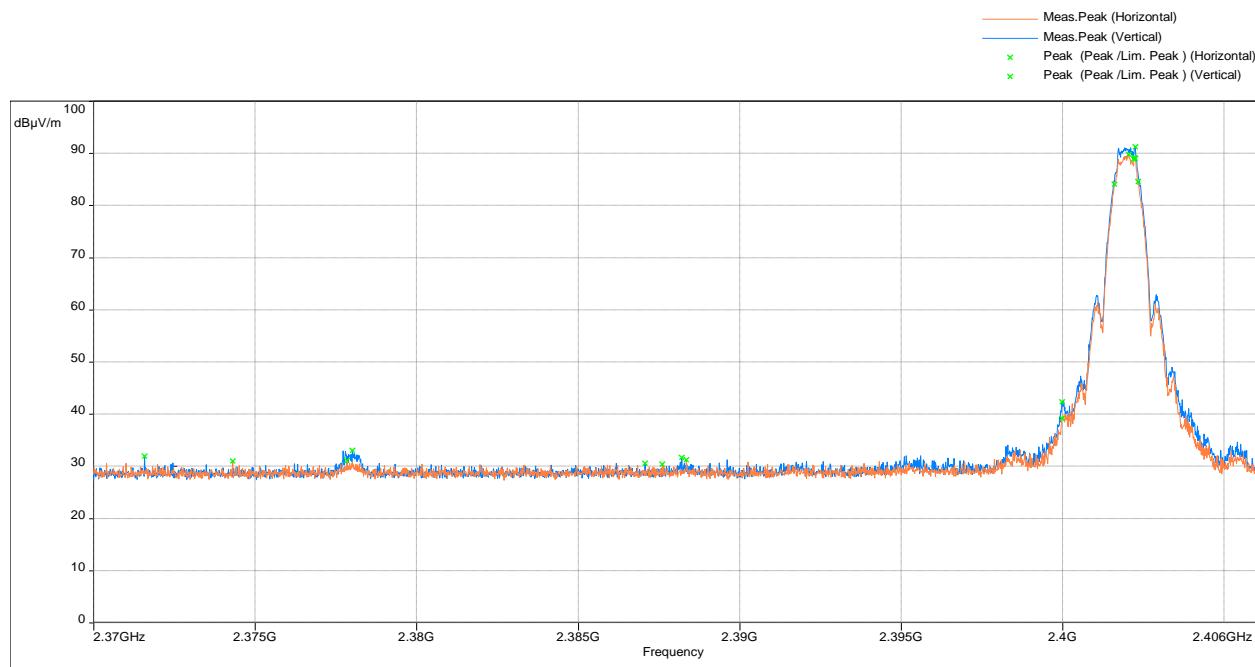
Low Channel Battery Mode Band Edge



Frequency (MHz)	Peak dB(μV/m)	Margin from 20dBc (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2400	44.12	-28.47	9.75	2.02	Horizontal	58.29	-14.17

Band Edge measurements in 100 kHz RBW @ 3m distance

Low Channel Charging Mode Band Edge

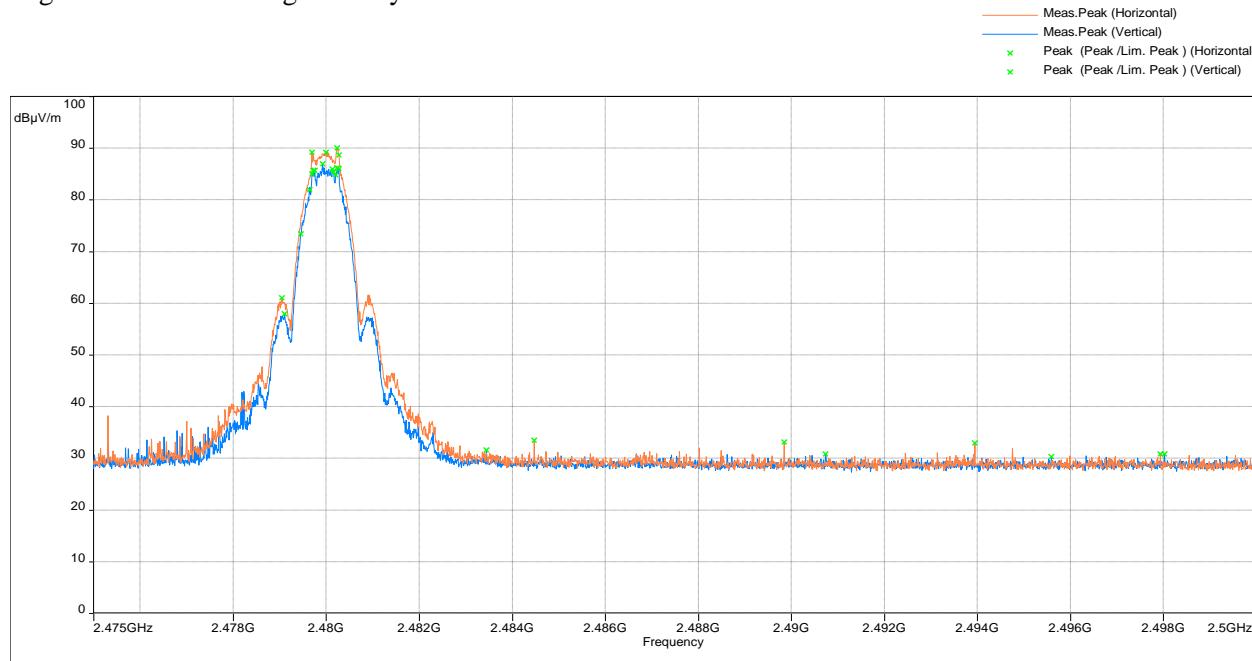


Model: ; Client: ; Comments: ; Test Date: 11/29/2018 12:43

Frequency (MHz)	Peak dB(μ V/m)	Margin from 20dBc (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2400	42.35	-27.44	322.75	1.99	Horizontal	56.52	-14.17

Band Edge measurements in 100 kHz RBW @ 3m distance

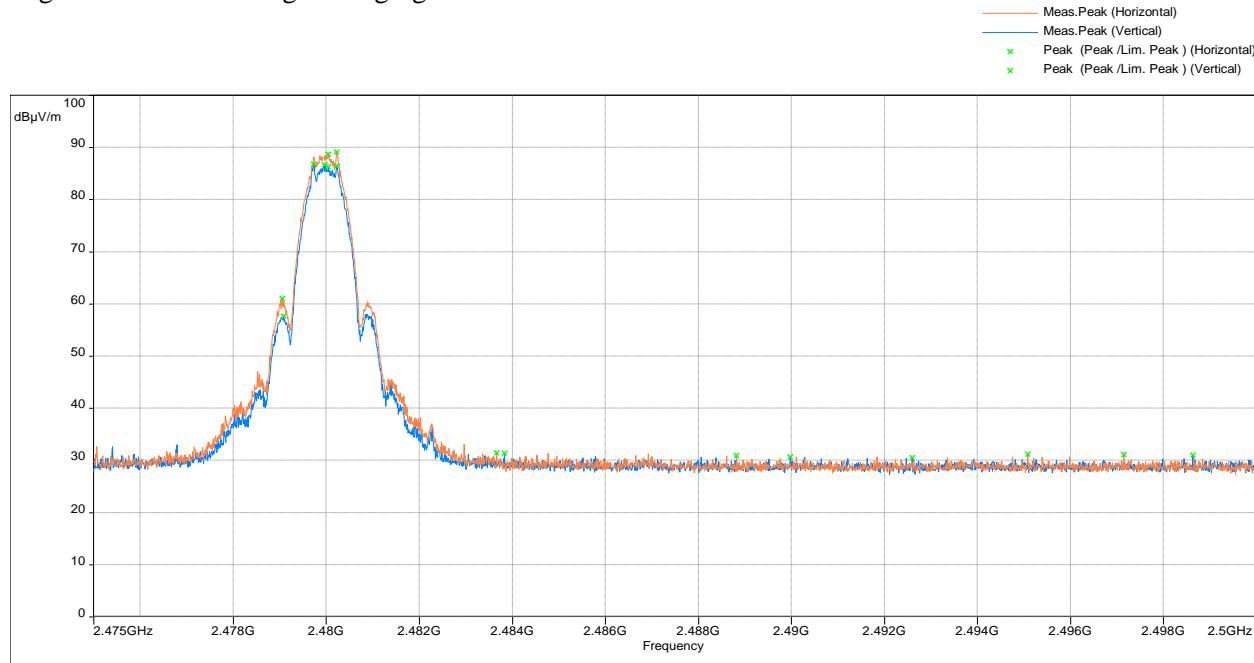
High Channel Band Edge Battery Mode



Frequency (MHz)	Peak dB(μ V/m)	Margin from 20dBc (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2484.48	33.47	-33.49	305.5	3.98	Horizontal	47.38	-13.91

Band Edge measurements in 100 kHz RBW @ 3m distance

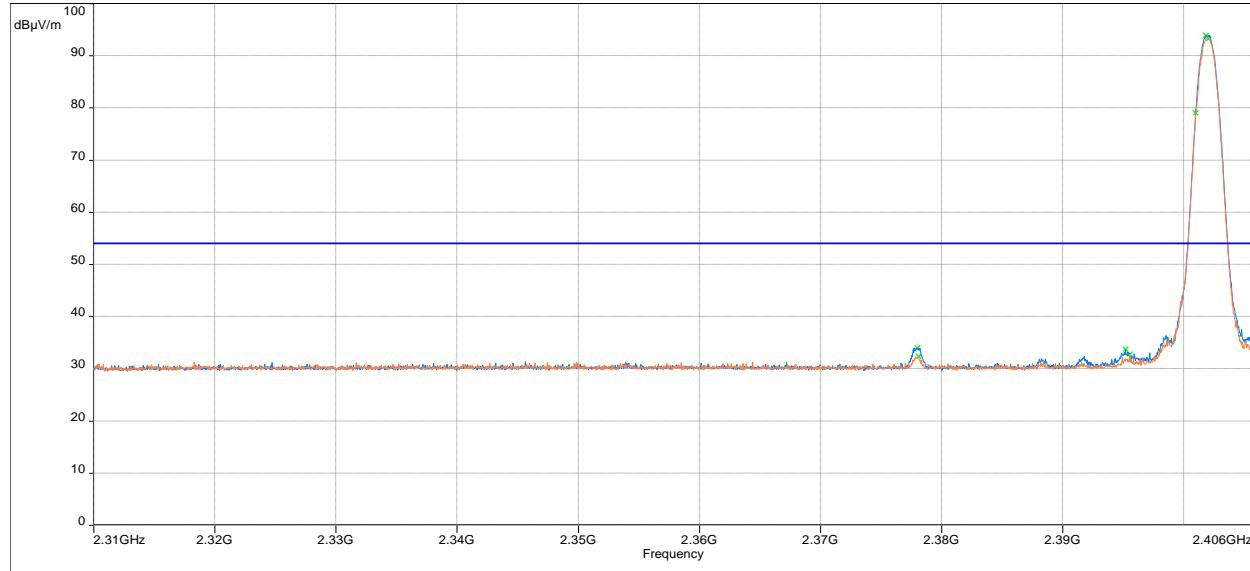
High Channel Band Edge Charging Mode



Frequency (MHz)	Peak dB(μV/m)	Margin from 20dBc (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2484.48	33.47	-33.49	305.5	3.98	Horizontal	47.38	-13.91

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2310–2390 MHz with Average Limit, EUT in Battery Mode**

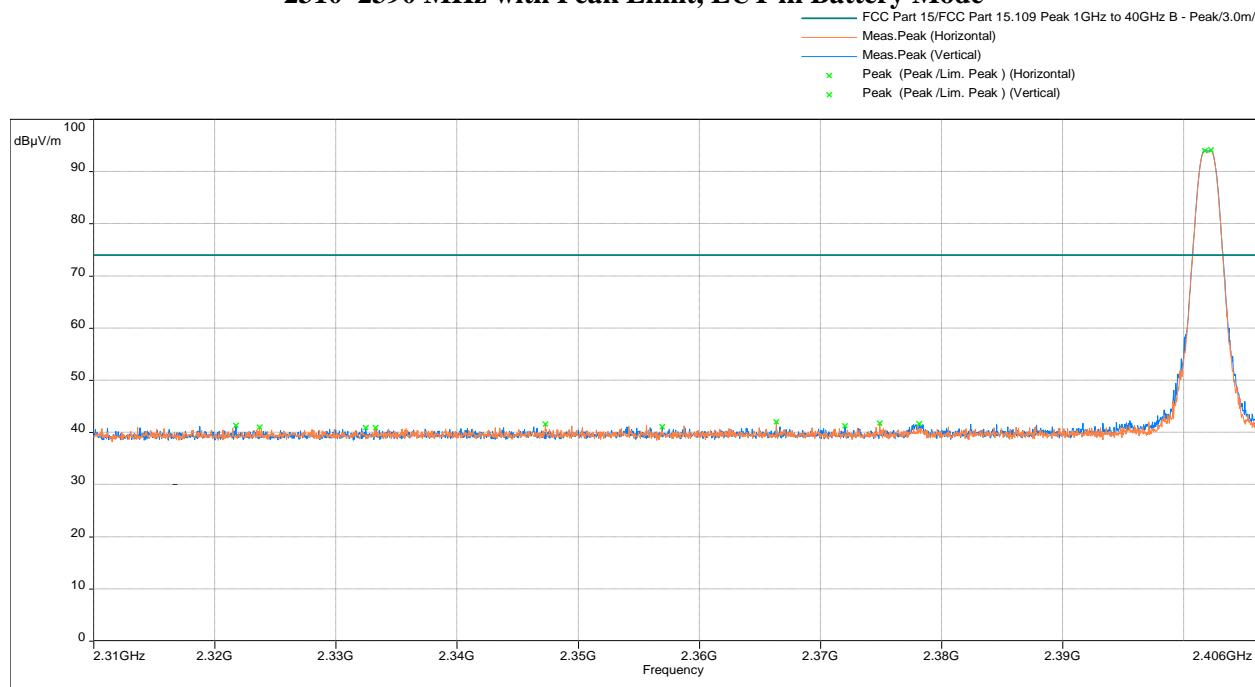
— FCC Part 15/FCC Part 15.109 30M-40GHz B - Average/3.0m/
— FCC Part 15/FCC Part 15.109 30M-40GHz B - QPeak/3.0m/
— Meas.Peak (Horizontal)
— Meas.Peak (Vertical)
x Peak (Peak /Lim. Average) (Horizontal)
x Peak (Peak /Lim. Average) (Vertical)



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 12:02

Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2377.994	33.98	54	-20.02	50	3.01	Vertical	48.18	-14.2

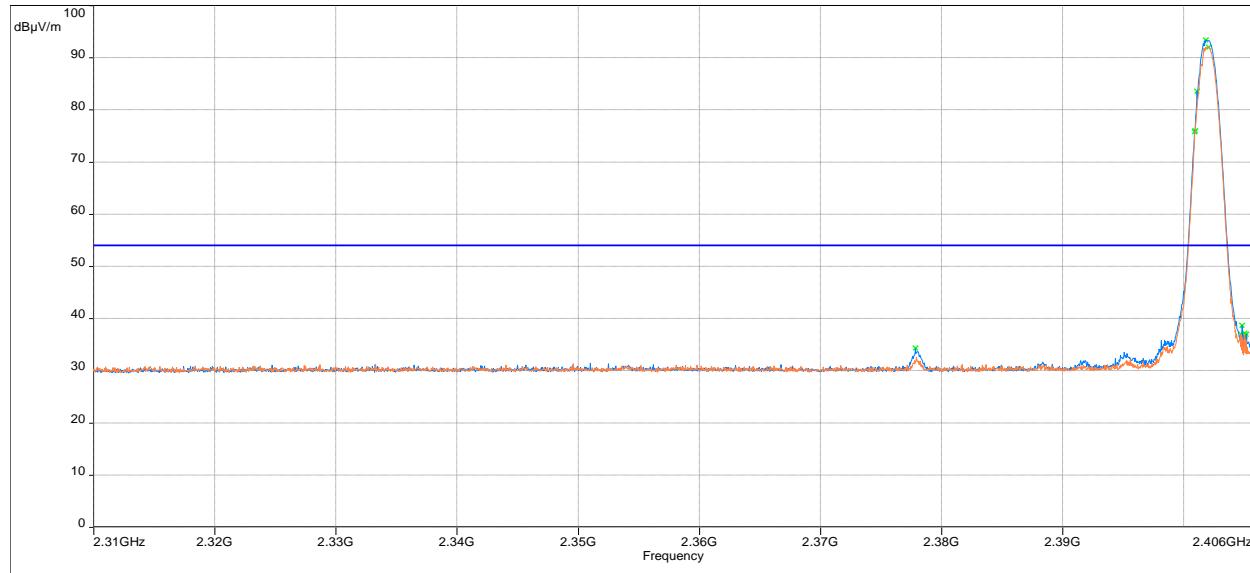
**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2310–2390 MHz with Peak Limit, EUT in Battery Mode**



Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2366.365	41.94	74	-32.06	120.3	1.01	Horizontal	56.16	-14.2

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2310–2390 MHz with Average Limit, EUT in Charging Mode**

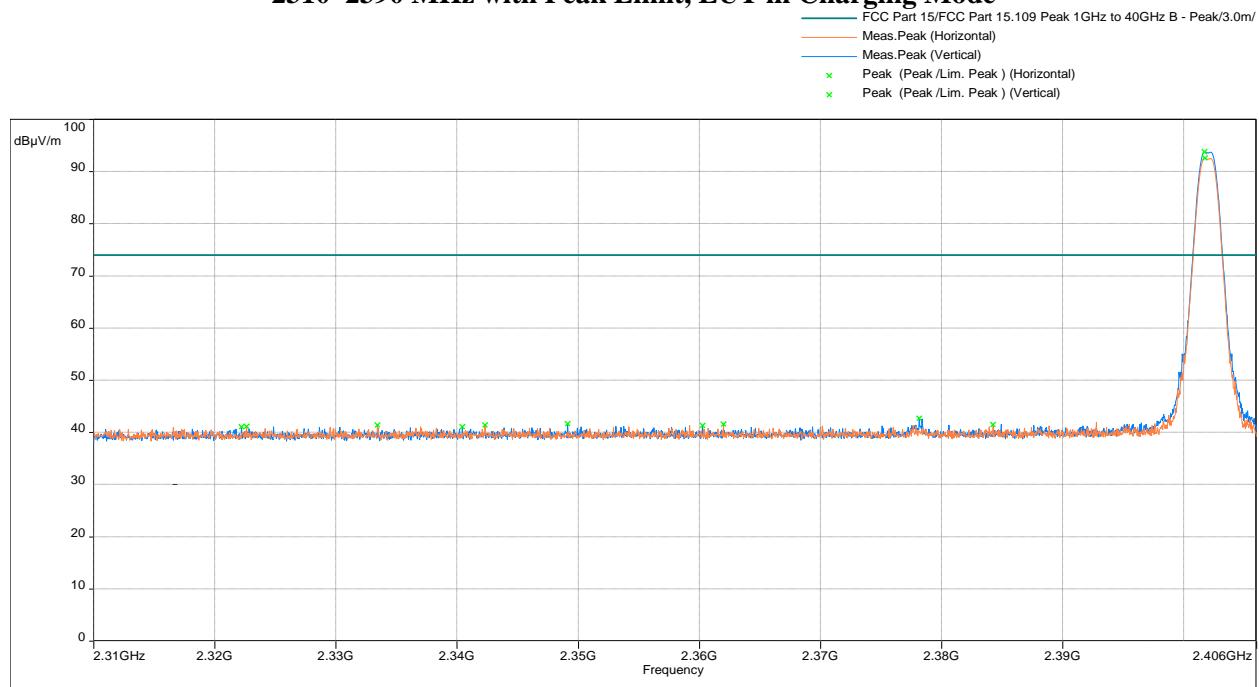
— FCC Part 15/FCC Part 15.109 30M-40GHz B - Average/3.0m/
 — FCC Part 15/FCC Part 15.109 30M-40GHz B - QPeak/3.0m/
 — Meas.Peak (Horizontal)
 — Meas.Peak (Vertical)
 ✕ Peak (Peak /Lim. Average) (Horizontal)
 ✕ Peak (Peak /Lim. Average) (Vertical)



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 12:57

Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2377.853	34.27	54	-19.73	35.5	3.01	Vertical	48.47	-14.2

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2310–2390 MHz with Peak Limit, EUT in Charging Mode**

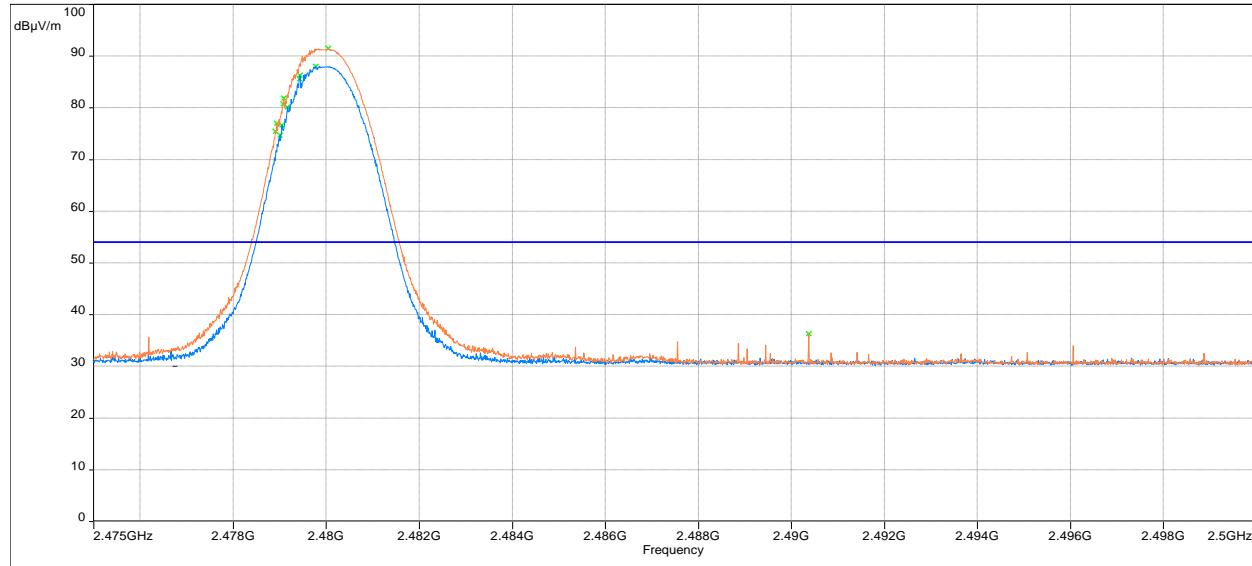


Model: ; Client: ; Comments: ; Test Date: 11/29/2018 13:09

Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2362.01	41.53	74	-32.47	205	2.98	Horizontal	55.75	-14.22

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5-2500 MHz with Average Limit, EUT in Battery Mode**

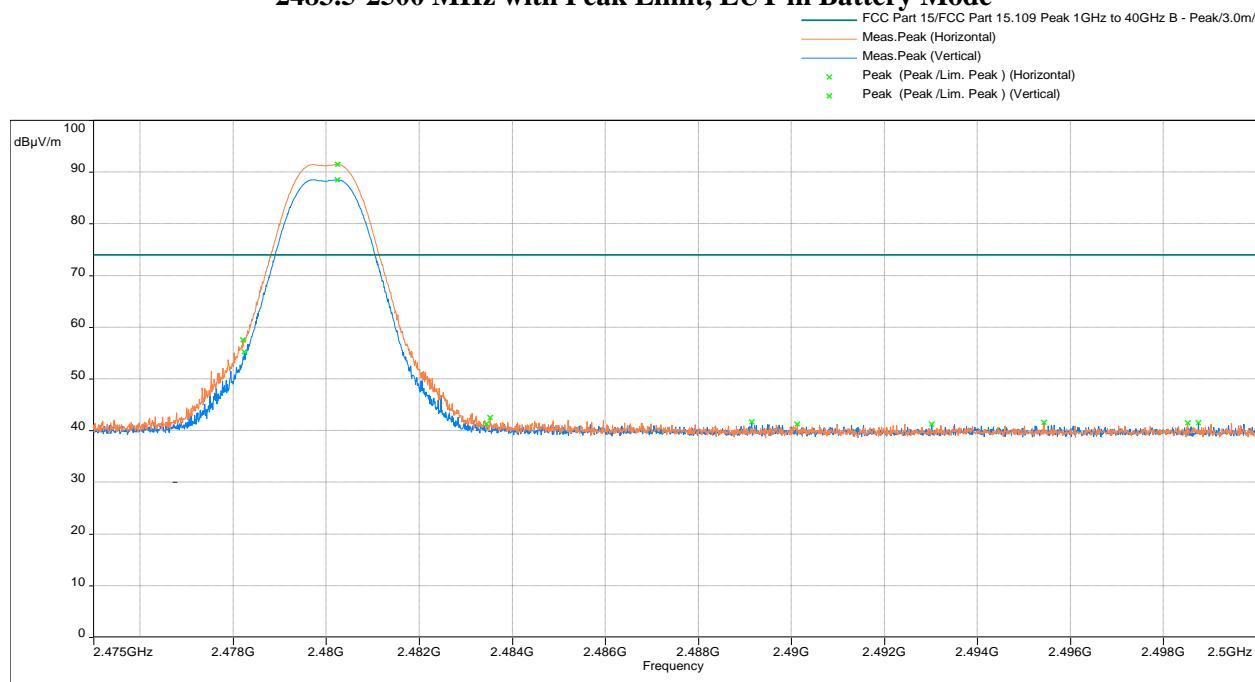
— FCC Part 15/FCC Part 15.109 30M-40GHz B - Average/3.0m/
— FCC Part 15/FCC Part 15.109 30M-40GHz B - QPeak/3.0m/
— Meas.Peak (Horizontal)
— Meas.Peak (Vertical)
x Peak (Peak /Lim. Average) (Horizontal)
x Peak (Peak /Lim. Average) (Vertical)



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 10:32

Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2490.38	36.25	54	-17.75	228	1.01	Horizontal	50.17	-13.92

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5-2500 MHz with Peak Limit, EUT in Battery Mode**

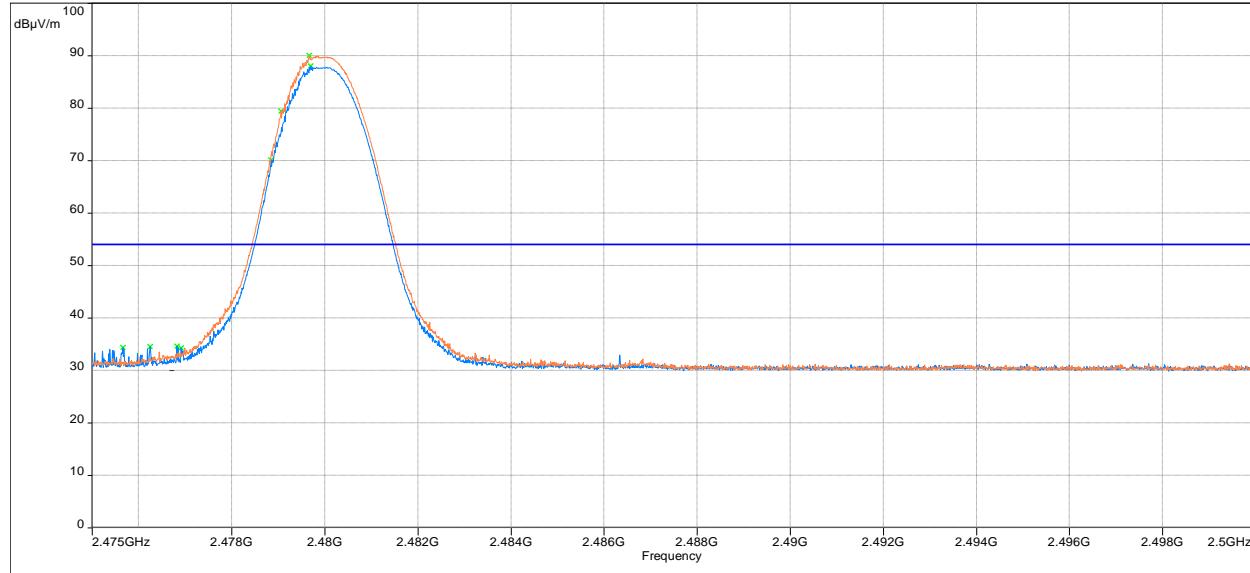


Model: ; Client: ; Comments: ; Test Date: 11/29/2018 10:46

Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2483.525	42.52	74	-31.48	323	2.02	Horizontal	56.43	-13.91

**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5-2500 MHz with Average Limit, EUT in Charging Mode**

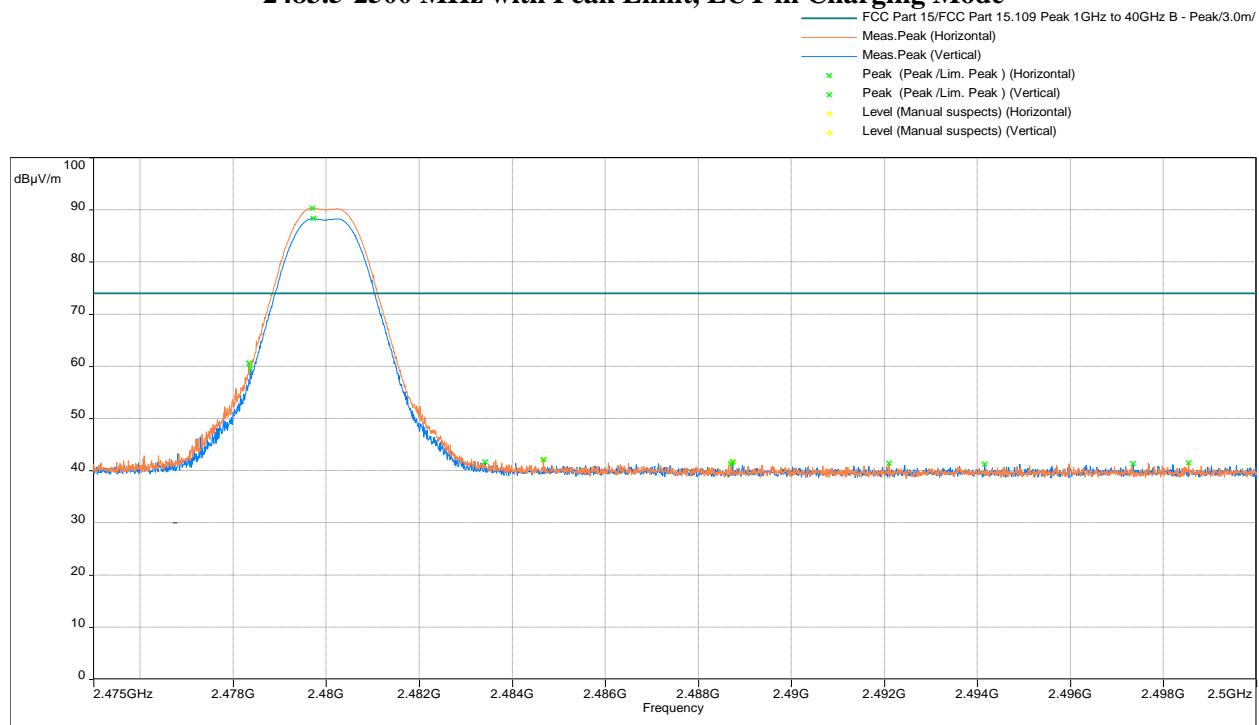
FCC Part 15/FCC Part 15.109 30M-40GHz B - Average/3.0m/
 FCC Part 15/FCC Part 15.109 30M-40GHz B - QPeak/3.0m/
 Meas.Peak (Horizontal)
 Meas.Peak (Vertical)
 Peak (Peak /Lim. Average) (Horizontal)
 Peak (Peak /Lim. Average) (Vertical)



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 11:19

Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2483.5	32.53	54	-21.47	192.5	3.99	Vertical	46.44	-13.91

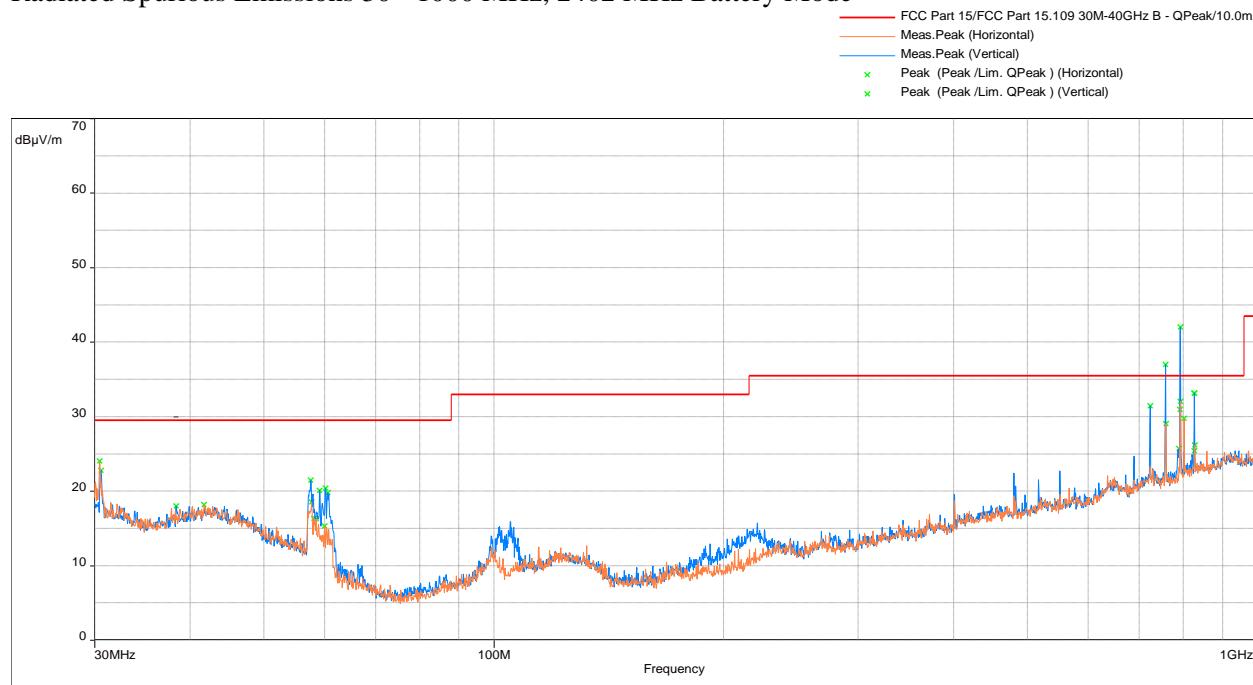
**Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5-2500 MHz with Peak Limit, EUT in Charging Mode**



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 11:32

Frequency (MHz)	Peak dB(μV/m)	Ave Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
2484.67	42.1	74	-31.9	188.8	3.02	Horizontal	56.01	-13.91

Radiated Spurious Emissions 30 - 1000 MHz, 2402 MHz Battery Mode

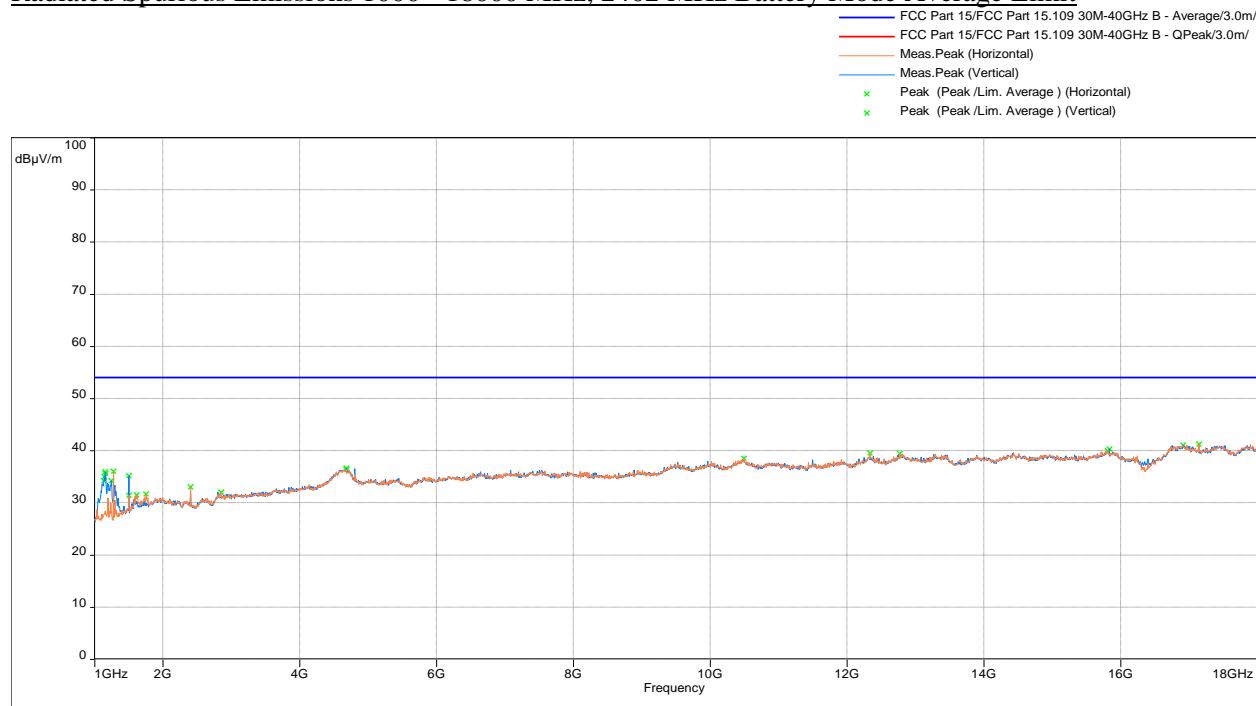


Frequency (MHz)	FS@10m dB(µV/m)	Limit dB(µV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
758.147	36.99	62.09*	-25.1	269.0	2.00	Vertical	41.25	-4.26
758.826	29.06	62.09*	-33.03	140.3	1.00	Horizontal	33.31	-4.25
792.323	41.99	62.09*	-20.1	269.0	2.00	Vertical	45.41	-3.42
792.840	32.01	62.09*	-30.08	320.5	1.00	Horizontal	35.43	-3.42
801.829	29.73	62.09*	-32.36	263.8	1.00	Horizontal	32.87	-3.14
826.790	33.15	62.09*	-28.94	240.3	2.00	Vertical	36	-2.85
827.049	33.09	62.09*	-29.0	273.8	2.00	Vertical	35.94	-2.85

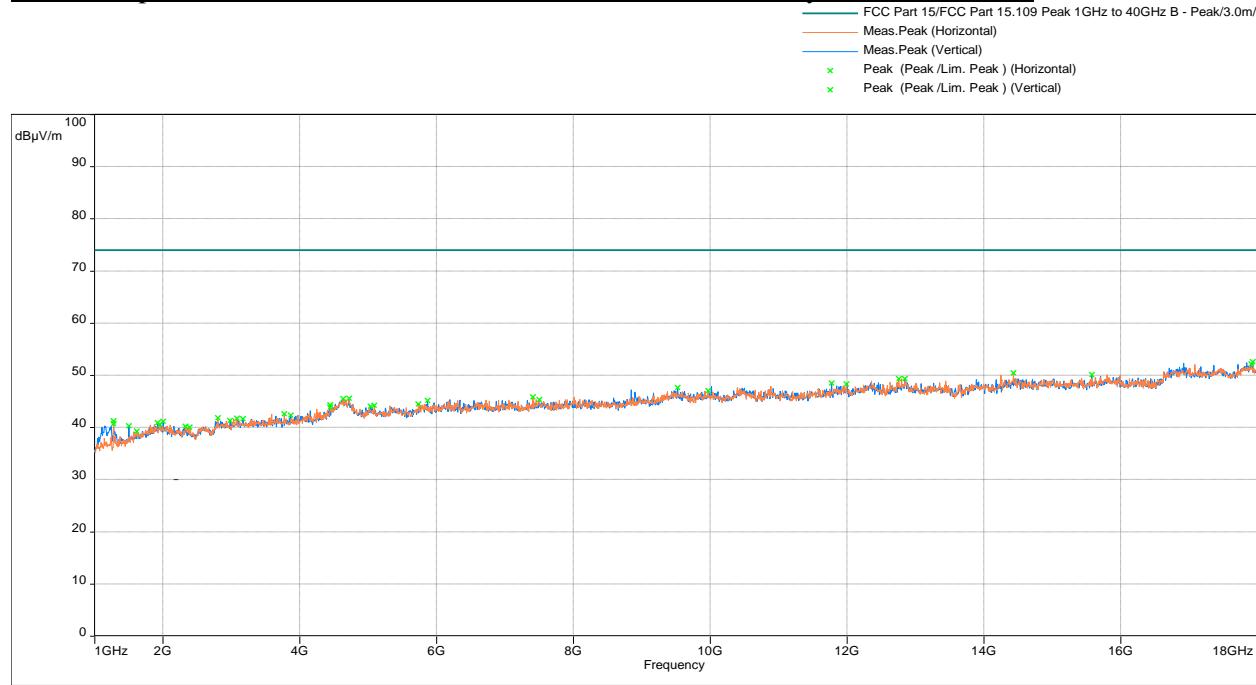
*These frequencies do not fall under restricted band per FCC 15.205. The fundamental field strength measurement at 2402 MHz at 3m is 92.59 dB(µV/m). Therefore, the fundamental field strength at 10m is 82.09 dB(µV/m). The 20dBc limit per 15.247(d) is 62.09 dB(µV/m).

Note: FS@3m = RA + Correction

Correction = AF + CF - Preamp

Radiated Spurious Emissions 1000 - 18000 MHz, 2402 MHz Battery Mode Average Limit


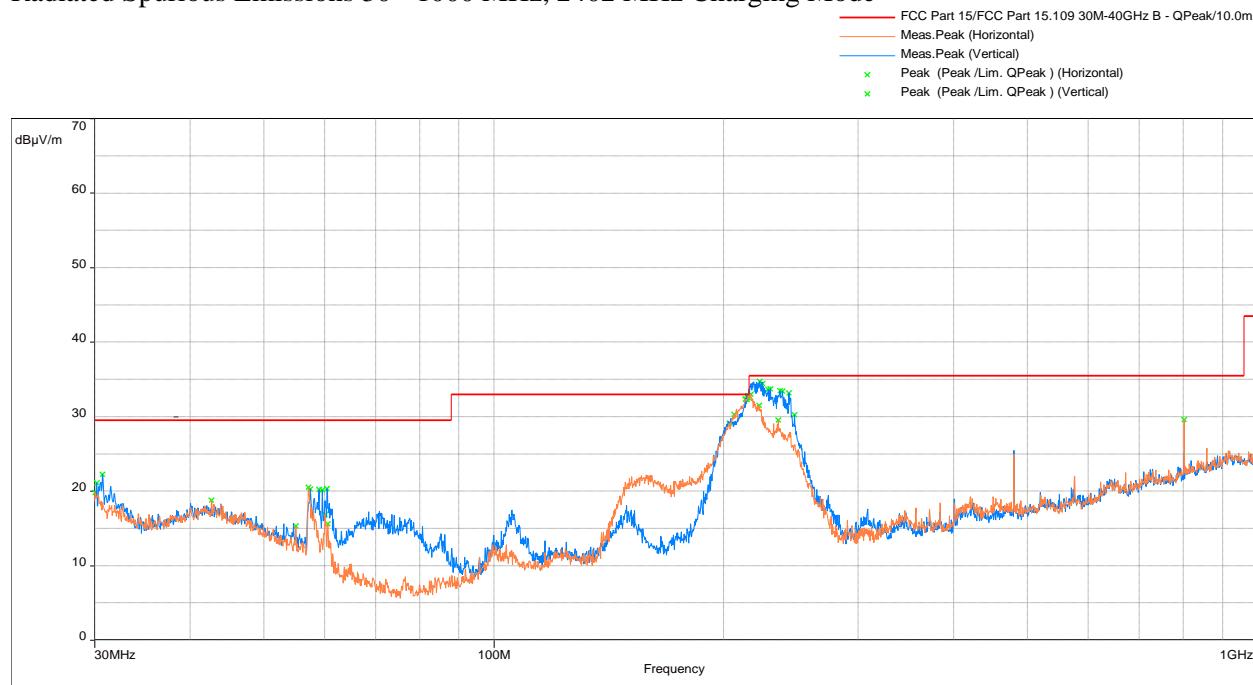
Model: ; Client: ; Comments: ; Test Date: 11/29/2018 15:12

Radiated Spurious Emissions 1000 - 18000 MHz, 2402 MHz Battery Mode Peak Limit


Model: ; Client: ; Comments: ; Test Date: 11/29/2018 15:25

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Radiated Spurious Emissions 30 - 1000 MHz, 2402 MHz Charging Mode

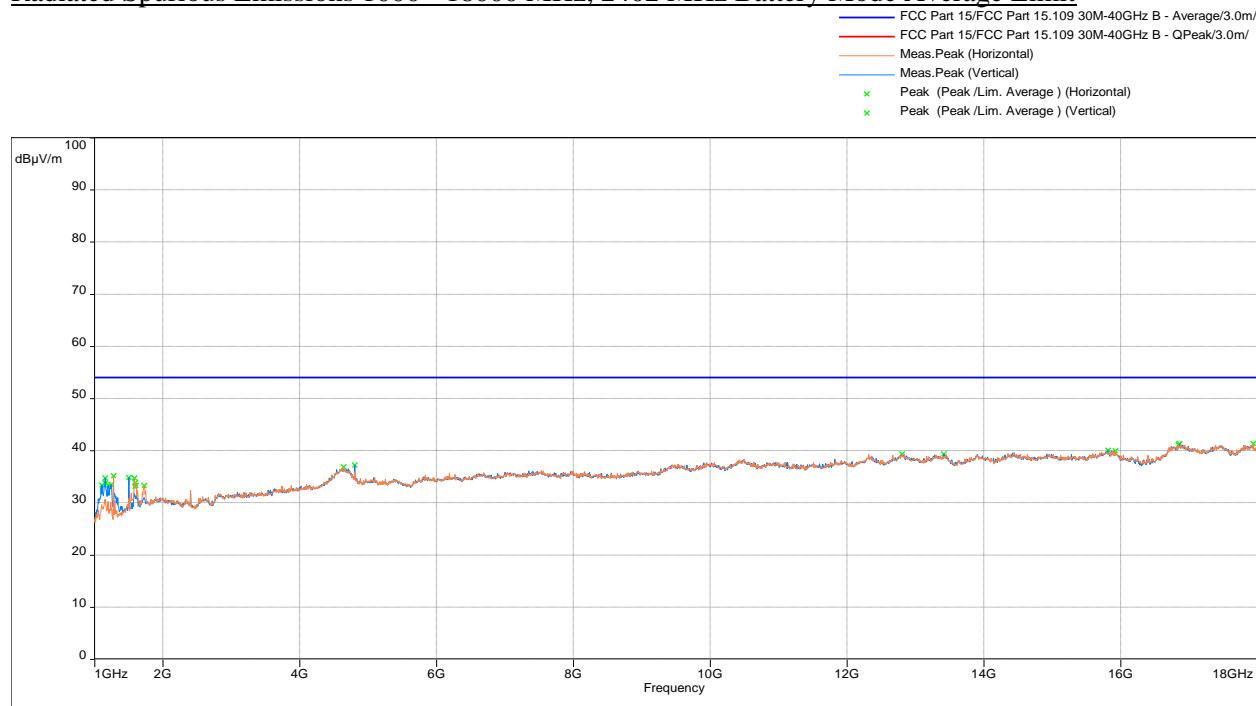
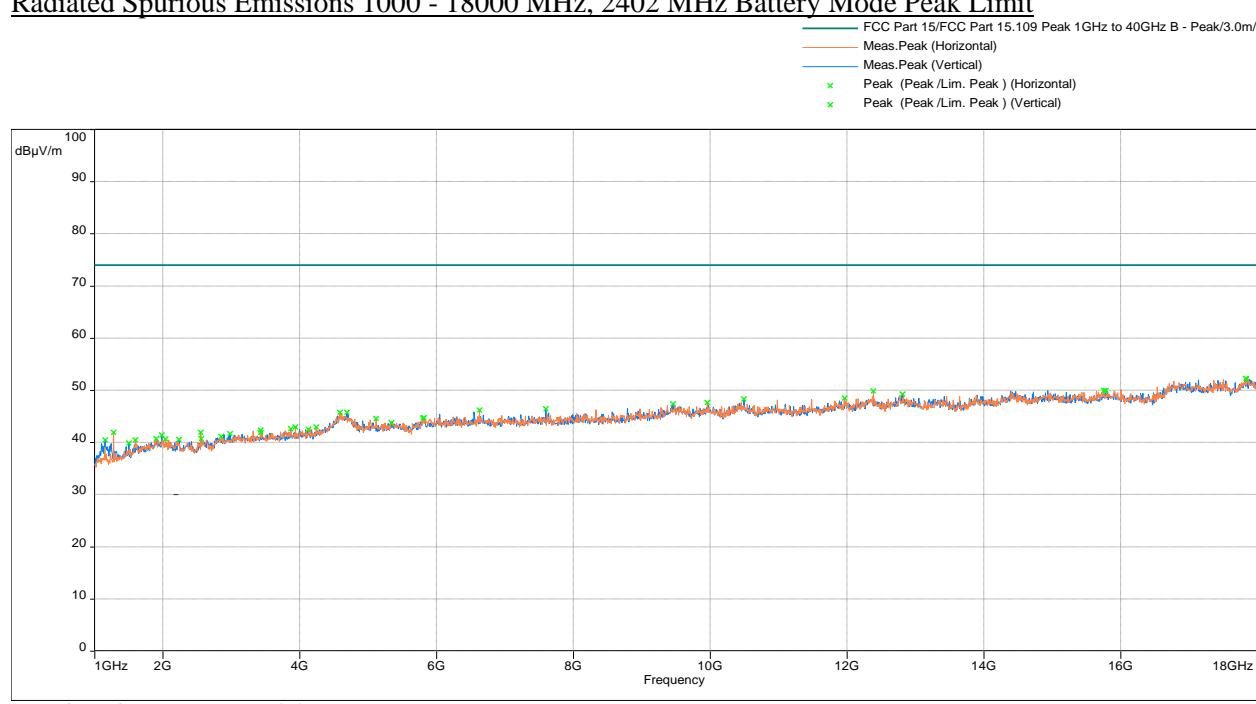


Frequency (MHz)	FS@10m dB(μV/m)	Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
220.7667	33.56	59.29*	-25.73	143.3	4	Horizontal	48.61	-15.05
238.162	28.84	59.29*	-30.45	193.3	4	Vertical	42.79	-13.95
801.829	29.94	59.29*	-29.35	97.3	1.02	Horizontal	33.08	-3.14

*These frequencies do not fall under restricted band per FCC 15.205. The fundamental field strength measurement at 2402 MHz at 3m is 89.79 dB(μV/m). Therefore, the fundamental field strength at 10m is 79.29 dB(μV/m). The 20dBc limit per 15.247(d) is 59.29 dB(μV/m).

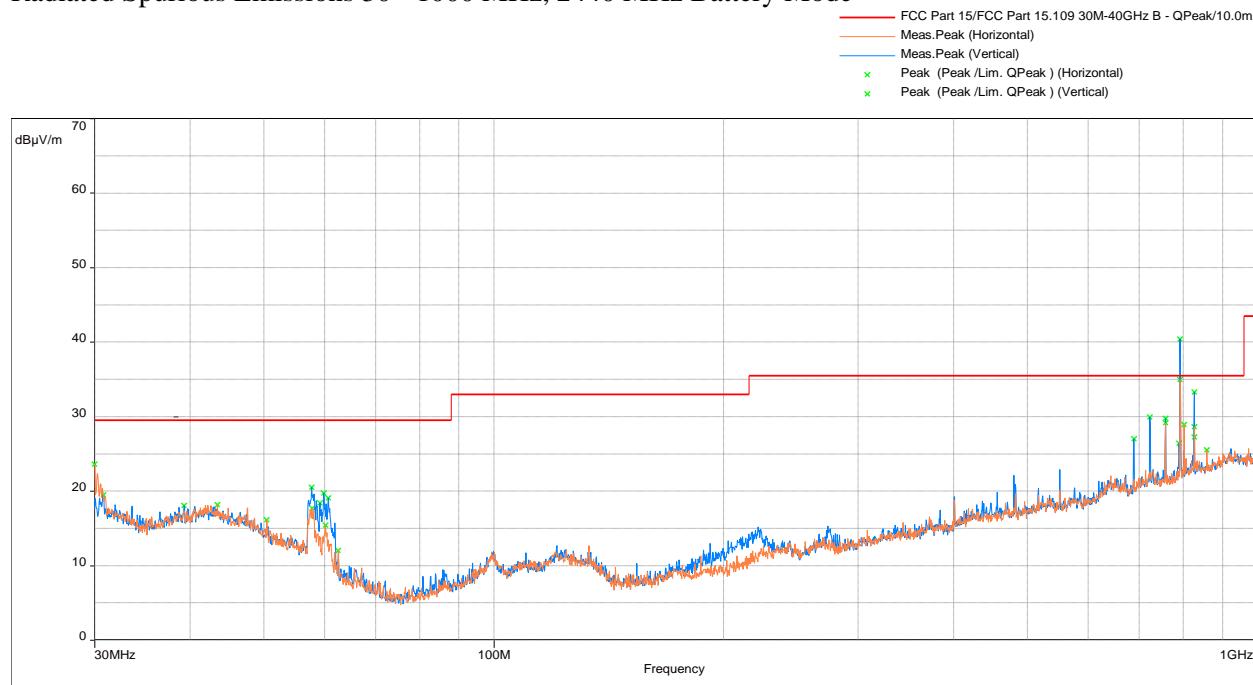
Note: FS@3m = RA + Correction

Correction = AF + CF - Preamp

Radiated Spurious Emissions 1000 - 18000 MHz, 2402 MHz Battery Mode Average Limit

Radiated Spurious Emissions 1000 - 18000 MHz, 2402 MHz Battery Mode Peak Limit


Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Radiated Spurious Emissions 30 - 1000 MHz, 2440 MHz Battery Mode

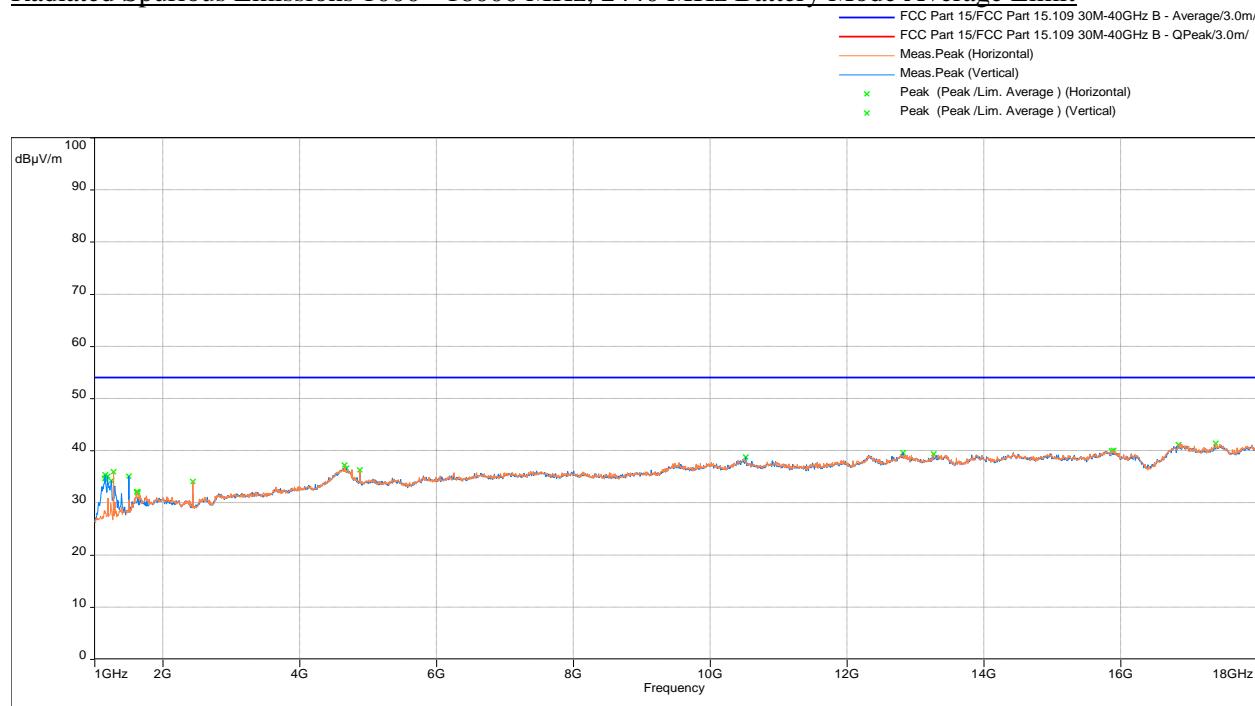


Frequency (MHz)	FS@10m dB(μV/m)	Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
723.453	29.91	56.16*	-26.25	282.3	2.00	Vertical	34.4	-4.49
757.888	29.76	56.16*	-26.4	278.3	2.00	Vertical	34.02	-4.26
758.179	29.17	56.16*	-26.99	264.8	1.00	Horizontal	33.43	-4.26
792.032	40.37	56.16*	-15.79	278.3	2.00	Vertical	43.8	-3.43
792.226	34.94	56.16*	-21.22	135.5	1.00	Horizontal	38.36	-3.42
826.467	33.27	56.16*	-22.89	274.3	2.00	Vertical	36.13	-2.86
826.7257	28.59	56.16*	-27.58	184.8	1.00	Horizontal	31.44	-2.85

*These frequencies do not fall under restricted band per FCC 15.205. The fundamental field strength measurement at 2440 MHz at 3m is 86.66 dB(μV/m). Therefore, the fundamental field strength at 10m is 76.16 dB(μV/m). The 20dBc limit per 15.247(d) is 56.16 dB(μV/m).

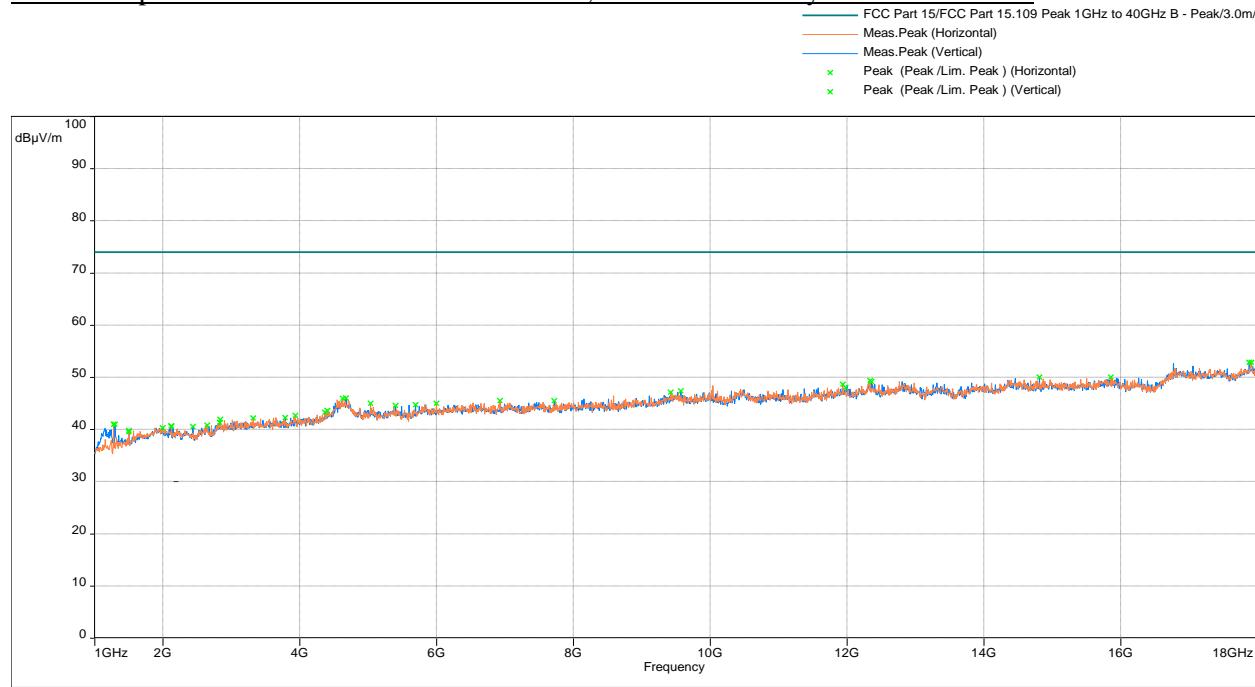
Note: FS@3m = RA + Correction
Correction = AF + CF - Preamp

Radiated Spurious Emissions 1000 - 18000 MHz, 2440 MHz Battery Mode Average Limit



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 14:45

Radiated Spurious Emissions 1000 - 18000 MHz, 2440 MHz Battery Mode Peak Limit



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 14:55

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Radiated Spurious Emissions 30 - 1000 MHz, 2440 MHz Charging Mode



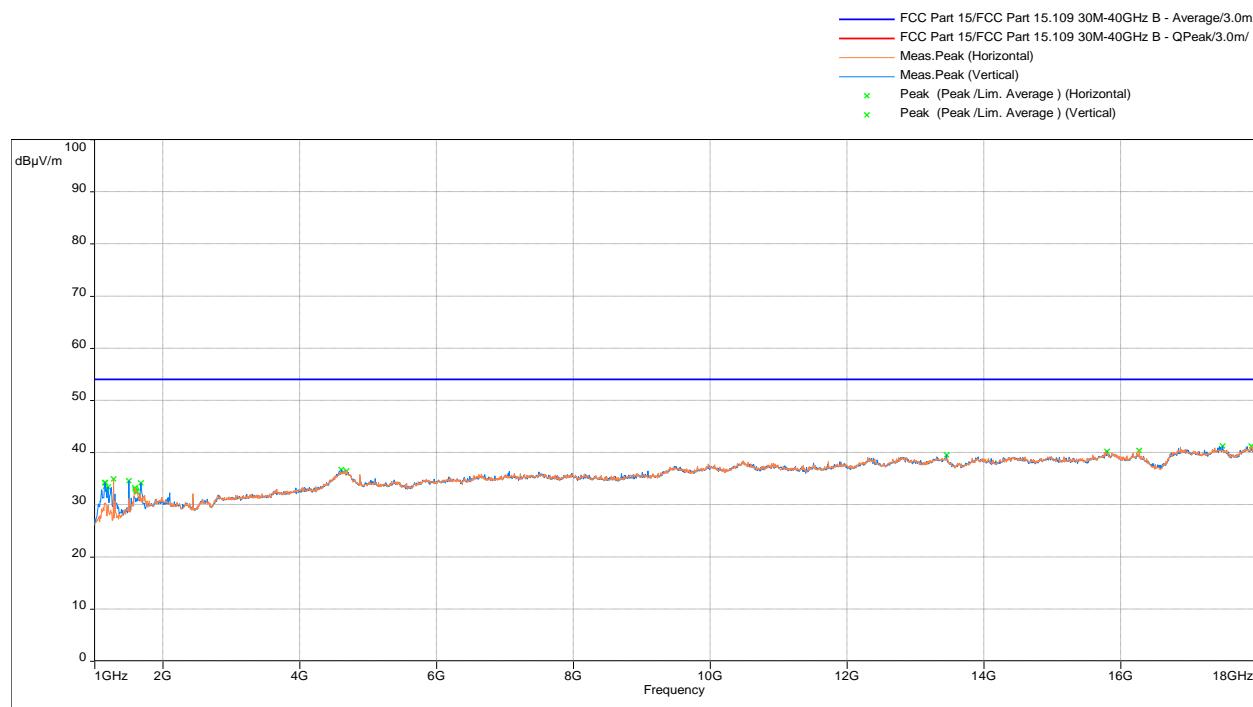
Frequency (MHz)	FS@10m dB(μV/m)	Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
218.212	28.96	56.83*	-27.88	25.3	1	Vertical	44.28	-15.32
220.767	33.56	56.83*	-23.28	143.3	4	Horizontal	48.61	-15.05
801.829	29.94	56.83*	-26.89	97.3	1.02	Horizontal	33.08	-3.14

*These frequencies do not fall under restricted band per FCC 15.205. The fundamental field strength measurement at 2440 MHz at 3m is 87.33 dB(μV/m). Therefore, the fundamental field strength at 10m is 76.83 dB(μV/m). The 20dBc limit per 15.247(d) is 56.83 dB(μV/m).

Note: FS@3m = RA + Correction

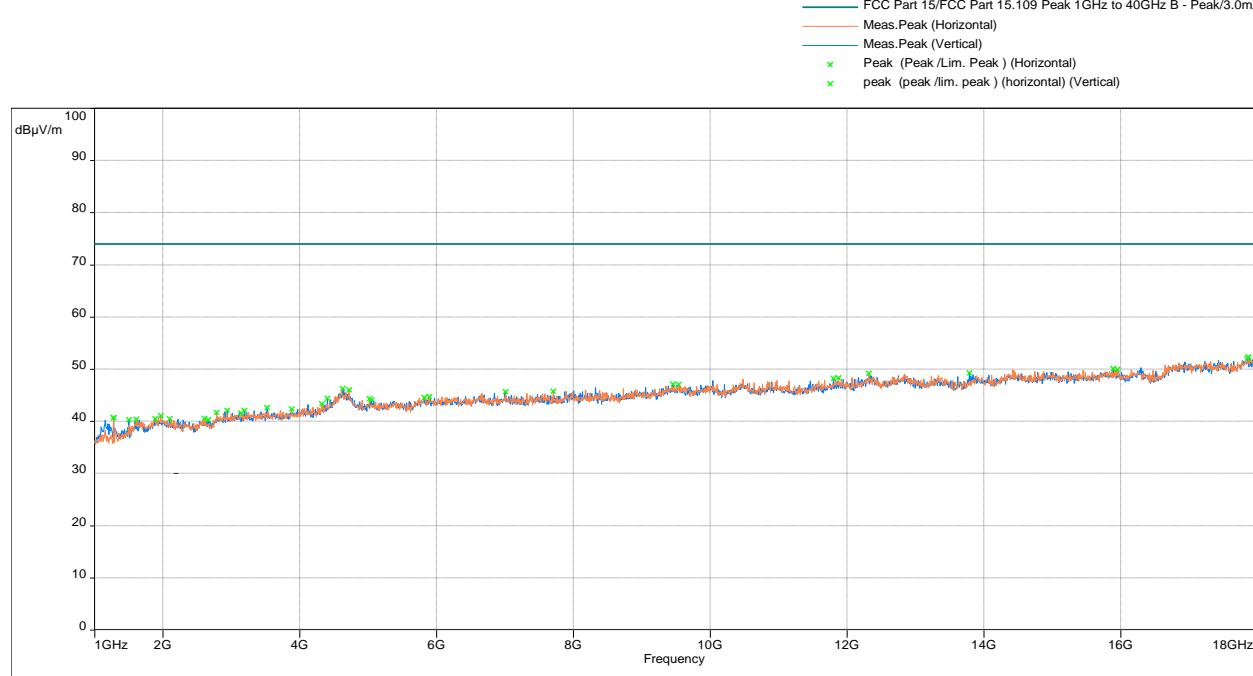
Correction = AF + CF - Preamp

Radiated Spurious Emissions 1000 - 18000 MHz, 2440 MHz Charging Mode Average Limit



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 13:59

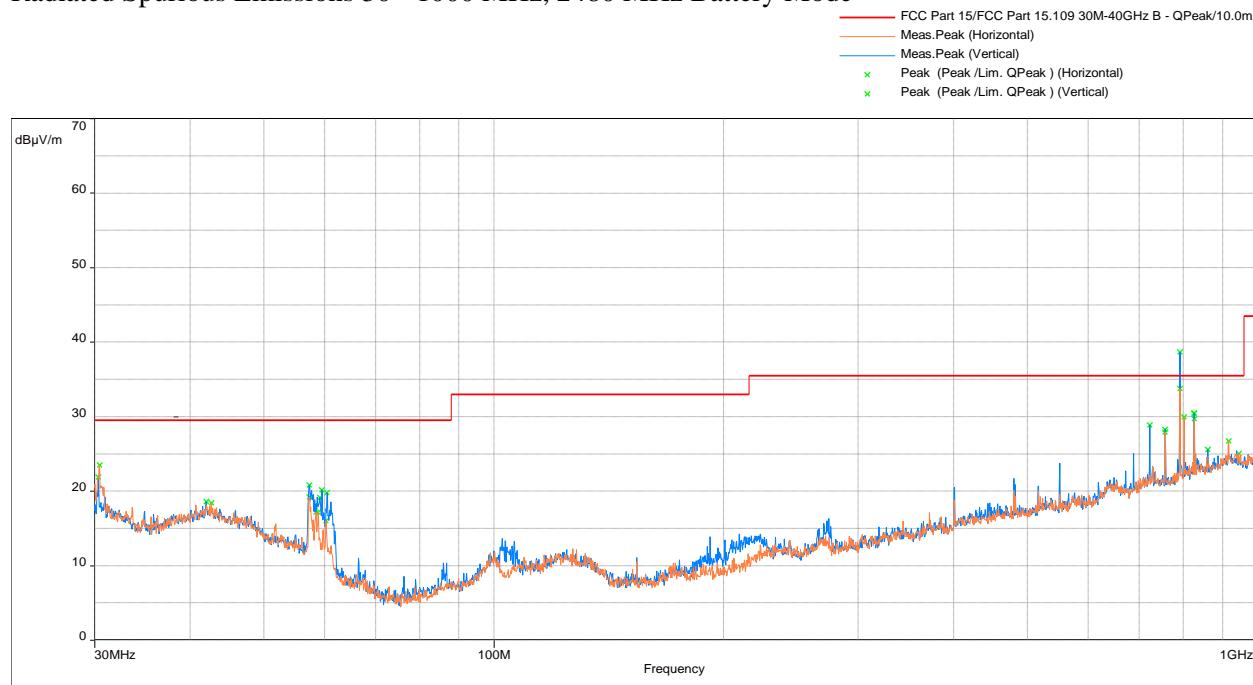
Radiated Spurious Emissions 1000 - 18000 MHz, 2440 MHz Charging Mode Peak Limit



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 14:17

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Radiated Spurious Emissions 30 - 1000 MHz, 2480 MHz Battery Mode



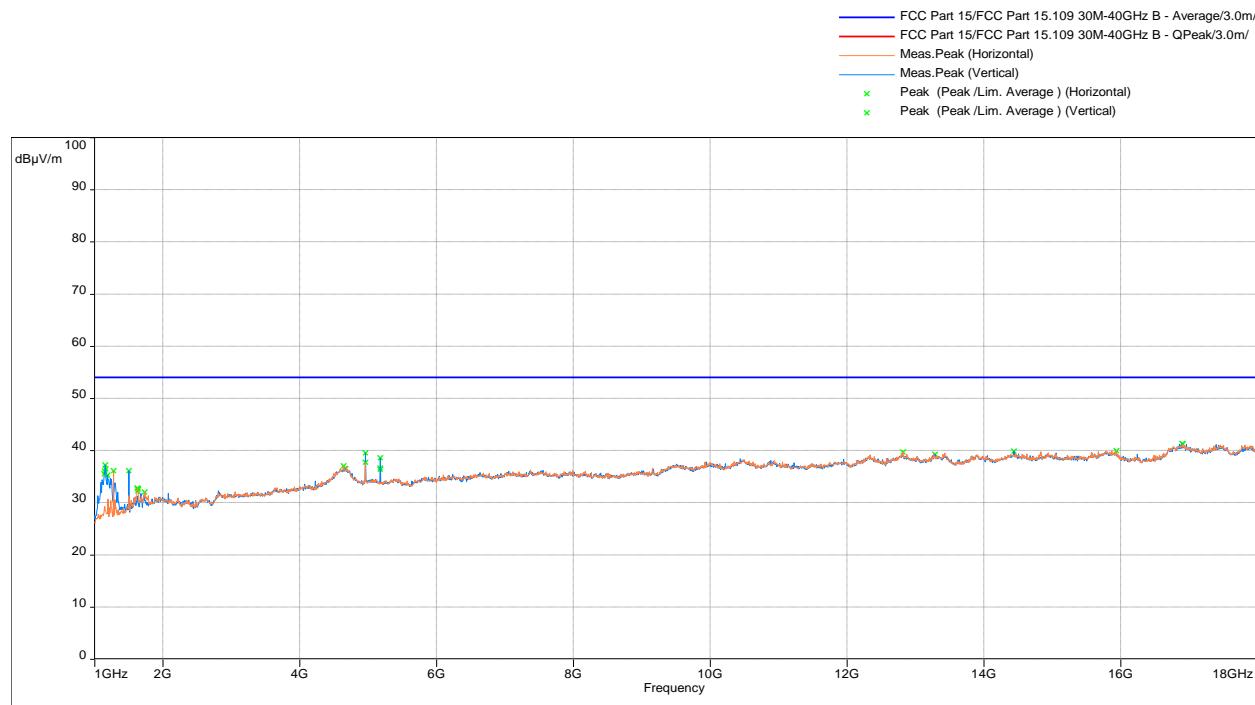
Frequency (MHz)	FS@10m dB(μV/m)	Limit dB(μV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
757.371	28.26	56.46*	-7.2	275.0	2.00	Vertical	32.52	-4.26
757.500	27.87	56.46*	-7.59	268.8	1.00	Horizontal	32.13	-4.26
791.579	38.65	56.46*	3.11	253.8	2.00	Vertical	42.12	-3.47
791.709	33.73	56.46*	-1.73	232.0	1.00	Horizontal	37.19	-3.46
826.273	30.45	56.46*	-5.01	258.0	2.00	Vertical	33.31	-2.86
826.338	29.69	56.46*	-5.78	311.0	1.00	Horizontal	32.55	-2.86
916.386	26.7	56.46*	-8.76	355.8	1.00	Horizontal	27.65	-0.95

*These frequencies do not fall under restricted band per FCC 15.205. The fundamental field strength measurement at 2480 MHz at 3m is 86.96 dB(μV/m). Therefore, the fundamental field strength at 10m is 76.46 dB(μV/m). The 20dBc limit per 15.247(d) is 56.46 dB(μV/m).

Note: FS@3m = RA + Correction

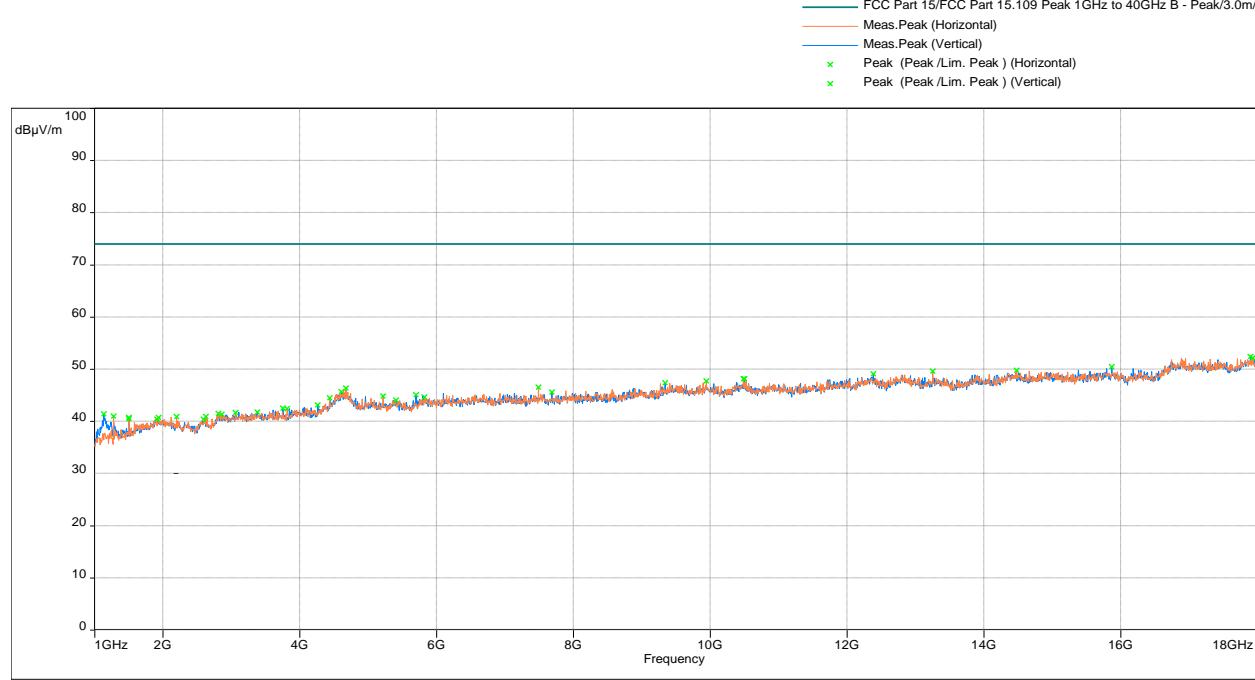
Correction = AF + CF - Preamp

Radiated Spurious Emissions 1000 - 18000 MHz, 2480 MHz Battery Mode Average Limit



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 15:59

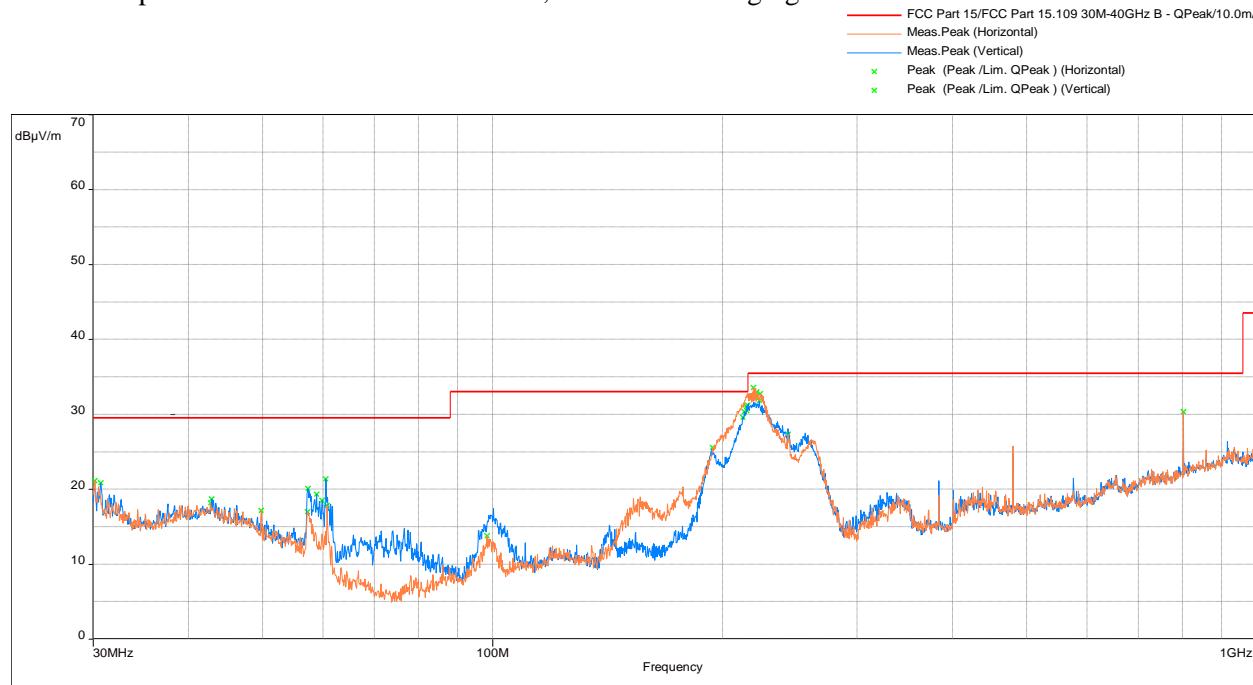
Radiated Spurious Emissions 1000 - 18000 MHz, 2480 MHz Battery Mode Peak Limit



Model: ; Client: ; Comments: ; Test Date: 11/29/2018 16:12

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Radiated Spurious Emissions 30 - 1000 MHz, 2480 MHz Charging Mode



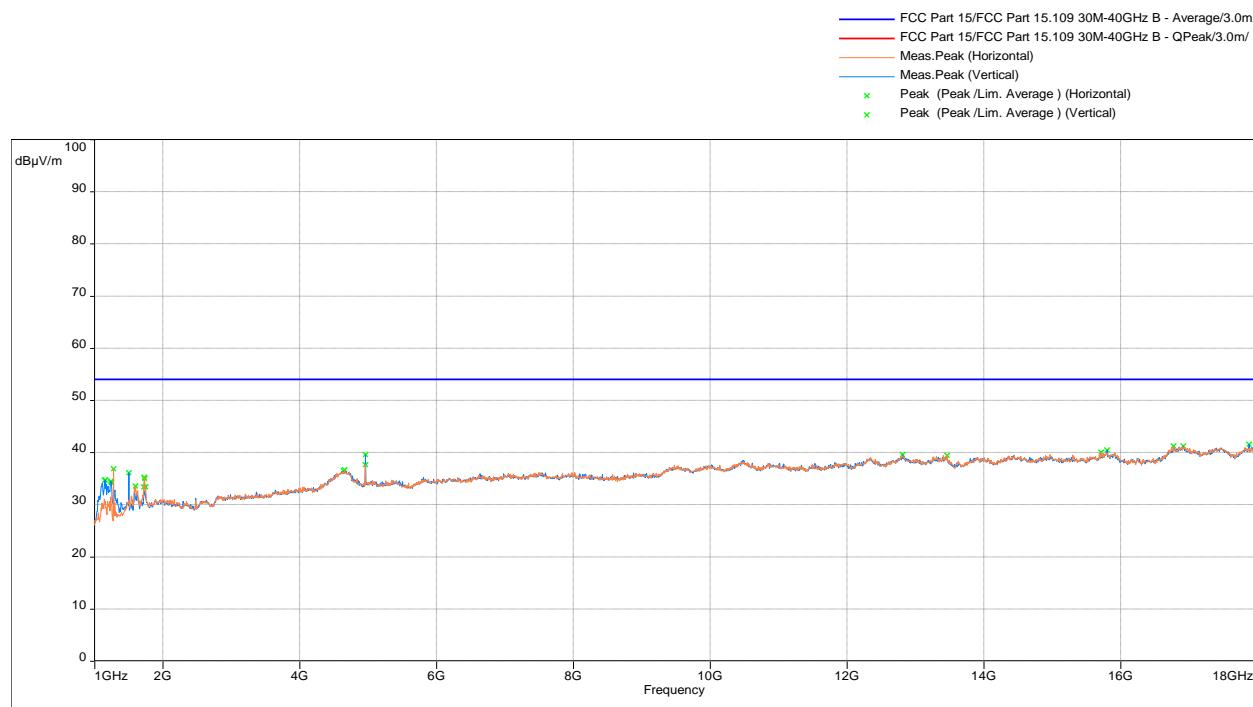
Frequency (MHz)	FS@10m dB(µV/m)	Limit dB(µV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
215.626	31.21	56.26*	-25.05	355.3	1.00	Vertical	46.8	-15.59
219.538	33.52	56.26*	-22.74	169.0	4.00	Horizontal	48.7	-15.18
801.829	30.31	56.26*	-25.95	37.5	1.02	Horizontal	33.45	-3.14

*These frequencies do not fall under restricted band per FCC 15.205. The fundamental field strength measurement at 2480 MHz at 3m is 86.76 dB(µV/m). Therefore, the fundamental field strength at 10m is 76.26 dB(µV/m). The 20dBc limit per 15.247(d) is 56.26 dB(µV/m).

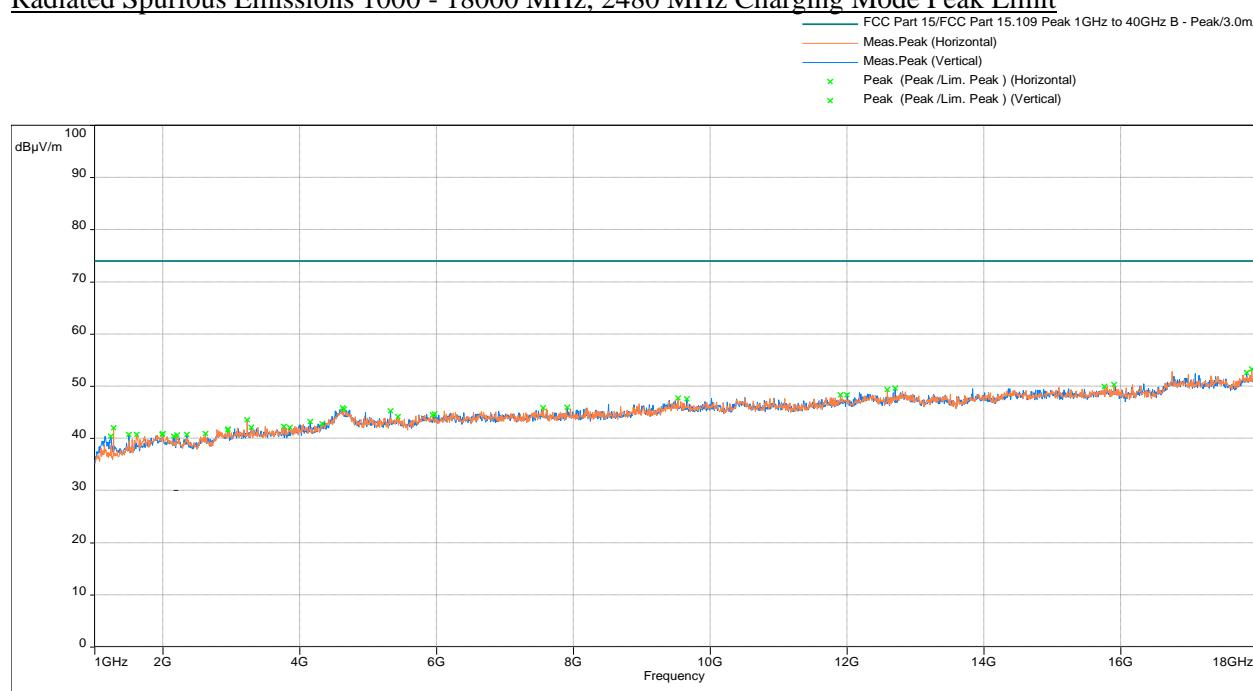
Note: FS@3m = RA + Correction

Correction = AF + CF - Preamp

Radiated Spurious Emissions 1000 - 18000 MHz, 2480 MHz Charging Mode Average Limit



Radiated Spurious Emissions 1000 - 18000 MHz, 2480 MHz Charging Mode Peak Limit



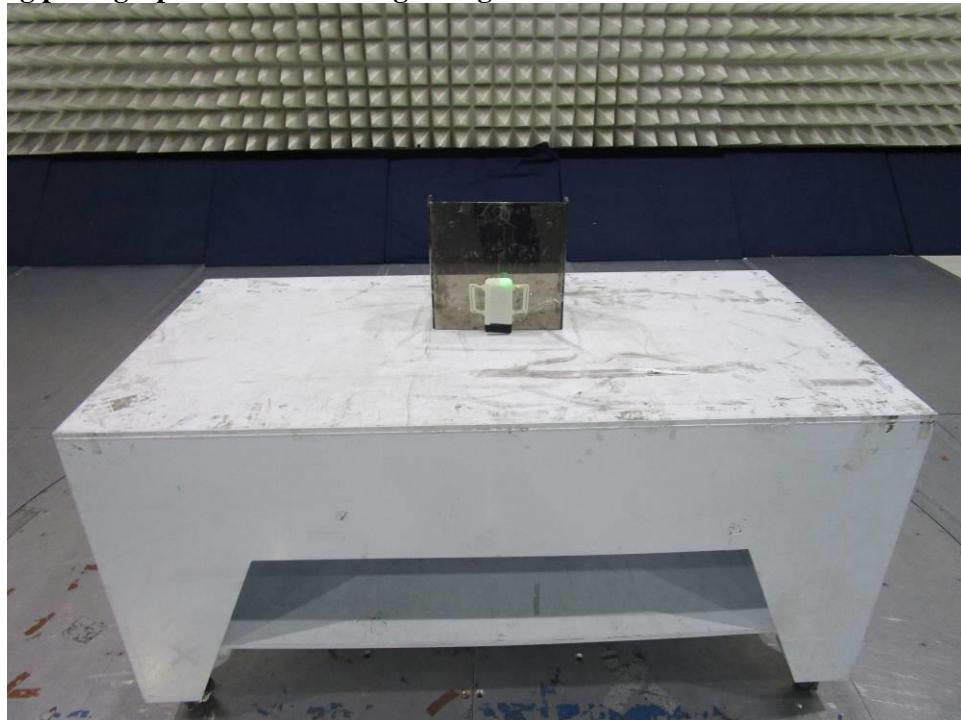
Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Results

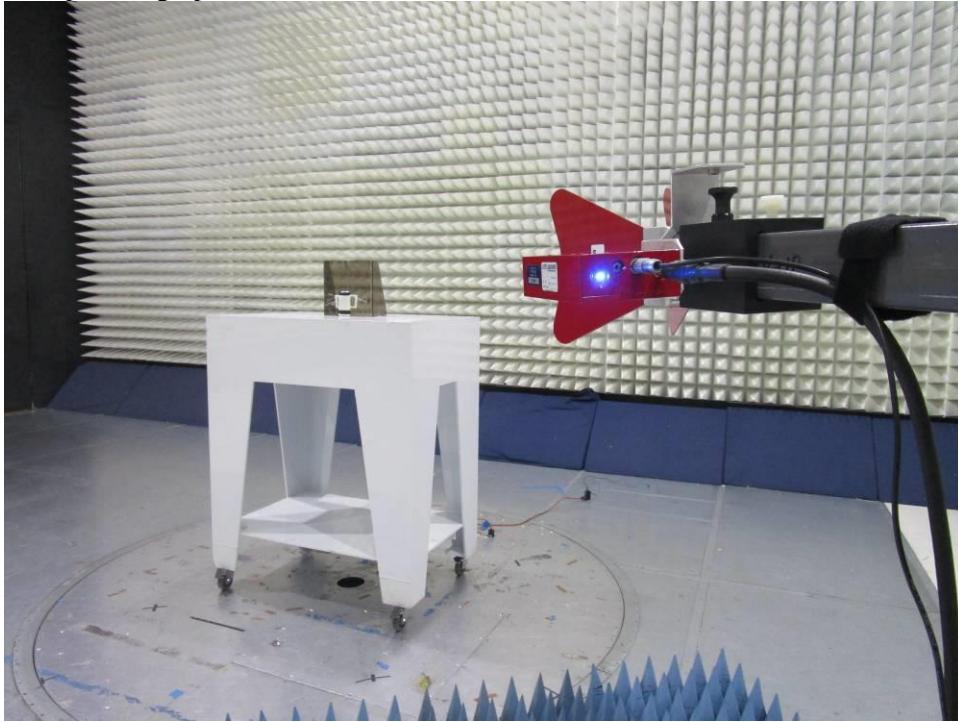
Complies

4.2.5 Test Setup Photographs

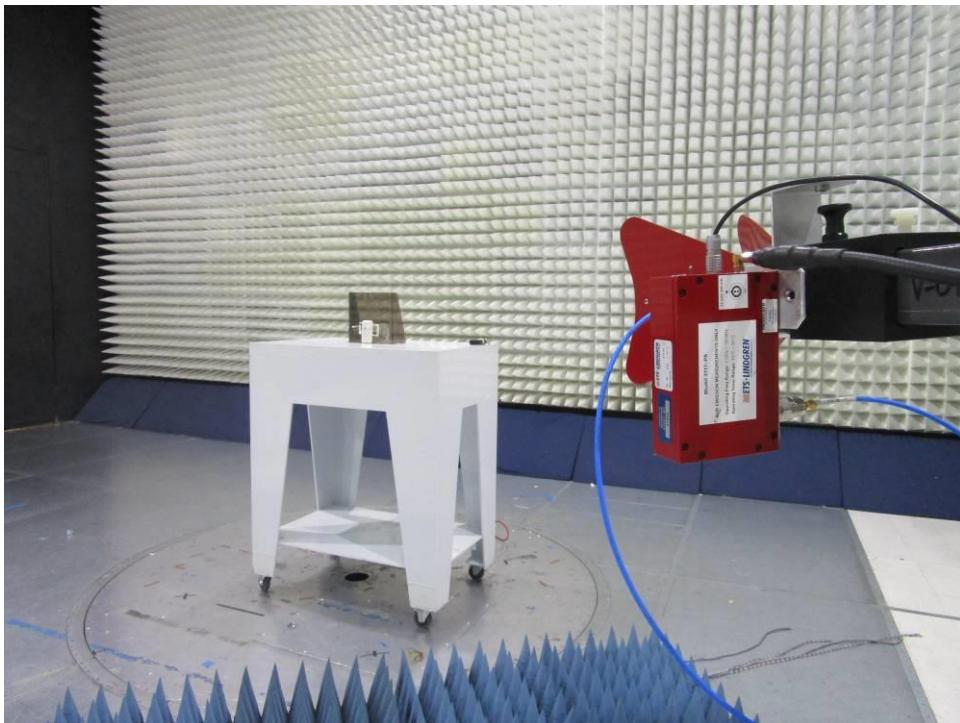
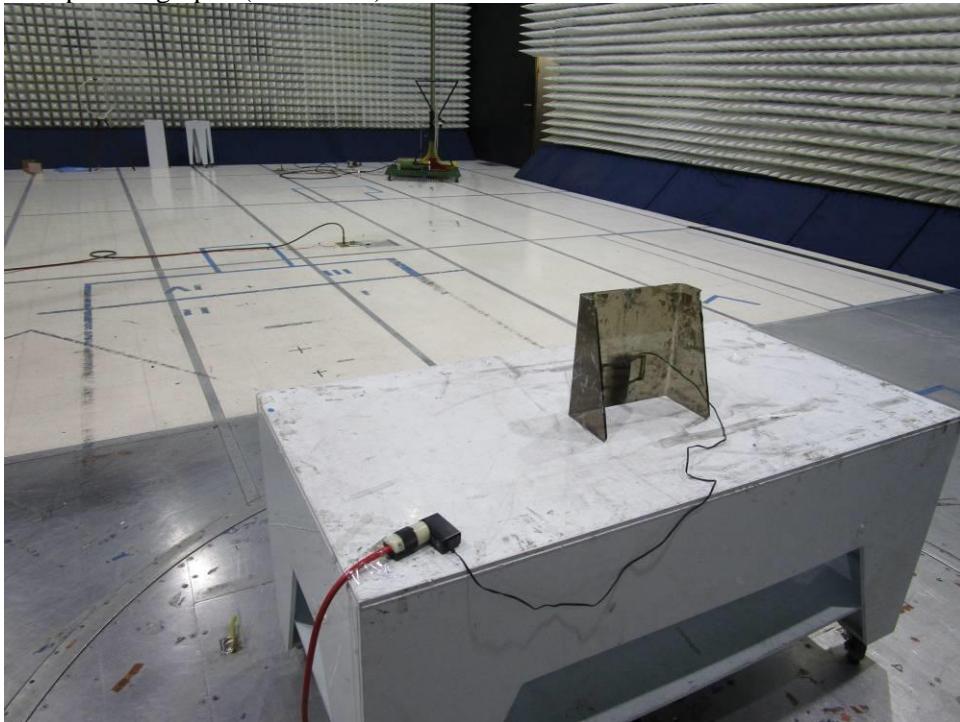
The following photographs show the testing configurations used.



4.7.5 Test Setup Photographs (Continued)



4.7.5 Test Setup Photographs (Continued)



4.3 Radiated Emissions on Digital Parts

FCC Ref: 15.109, ICES 003, RSS Gen

4.3.1 Requirement

Limits for Electromagnetic Radiated Emissions FCC Section 15.109(b), ICES 003*, RSS GEN

Frequency (MHz)	Class A at 10m dB(µV/m)	Class B at 3m dB(µV/m)
30-88	39	40.0
88-216	43.5	43.5
216-960	46.4	46.0
Above 960	49.5	54.0

* According to FCC Part 15.109(g) an alternative to the radiated emission limits shown above, digital devices may be shown to comply with the limit of CISPR Pub. 22

4.3.2 Procedures

Measurements are conducted with a quasi-peak detector instrument in the frequency range of 30 MHz to 1000 MHz and with the average detector instrument in the frequency range above 1000 MHz. The measuring receiver meets the requirements of Section One of CISPR 16 and the measuring antenna correlates to a balanced dipole.

Measurements of the radiated field are made with the antenna located at a distance of 10 meters from the EUT. If the field-strength measurements at 10m cannot be made because of high ambient noise level or for other reasons, measurements of Class B equipment may be made at a closer distance, for example 3m.

An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance.

The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.

The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.

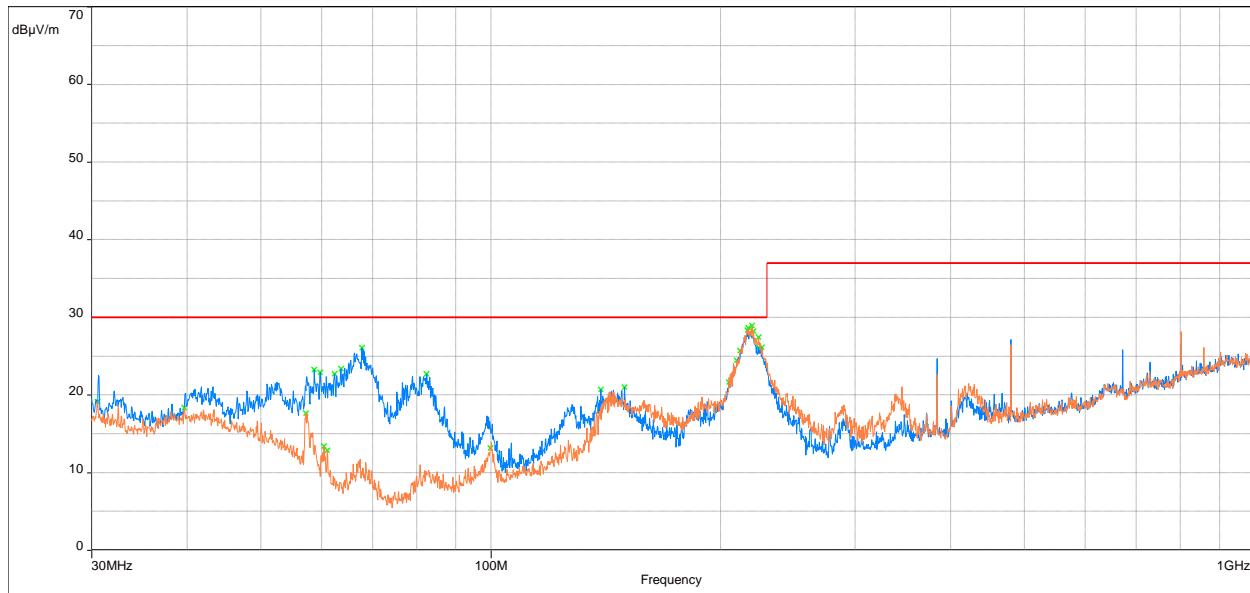
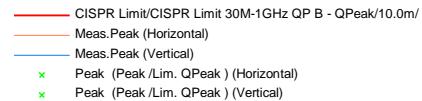
The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for a larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4.

4.3.3 Test Results

Date of Test:	November 12, 2018
Results	Complies

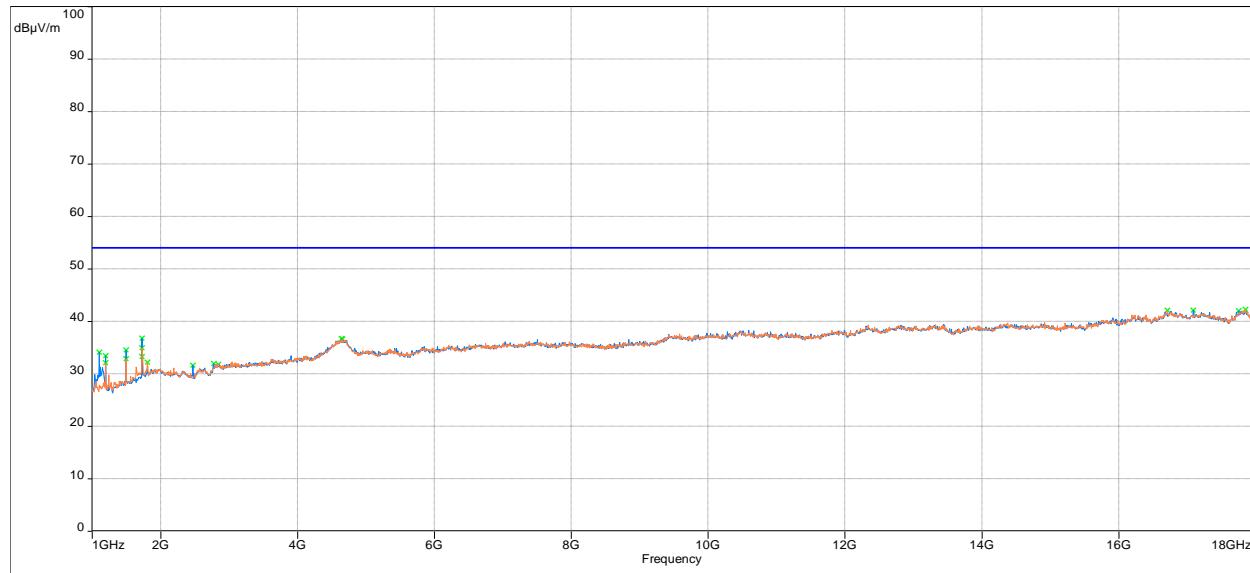


Model: ; Client: ; Comments: ; Test Date: 11/13/2018 09:25

Freq (MHz)	FS @10m (dB(uV/m))	Limit (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
57.279	11.9	30	-18.1	295.75	1.83	Horizontal	27.4	-15.5
66.987	20.8	30	-9.2	313.75	2.18	Vertical	40.3	-19.3
82.373	16.7	30	-13.3	112.75	2.51	Vertical	36.8	-20.2
217.017	23.9	30	-6.1	200.5	3.88	Vertical	39.4	-15.4
220.135	25.4	30	-4.6	157	3.01	Horizontal	40.5	-15.1
479.993	25.8	37	-11.3	151.75	1.94	Horizontal	34.5	-8.8
479.998	26.3	37	-10.7	189.25	3.26	Vertical	35.1	-8.8
801.838	28.0	37	-9.1	282.25	1.4	Horizontal	31.1	-3.1

1-18GHz @ 120Vac 60Hz Charging Mode, EUT Vertical Orientation Average Limit

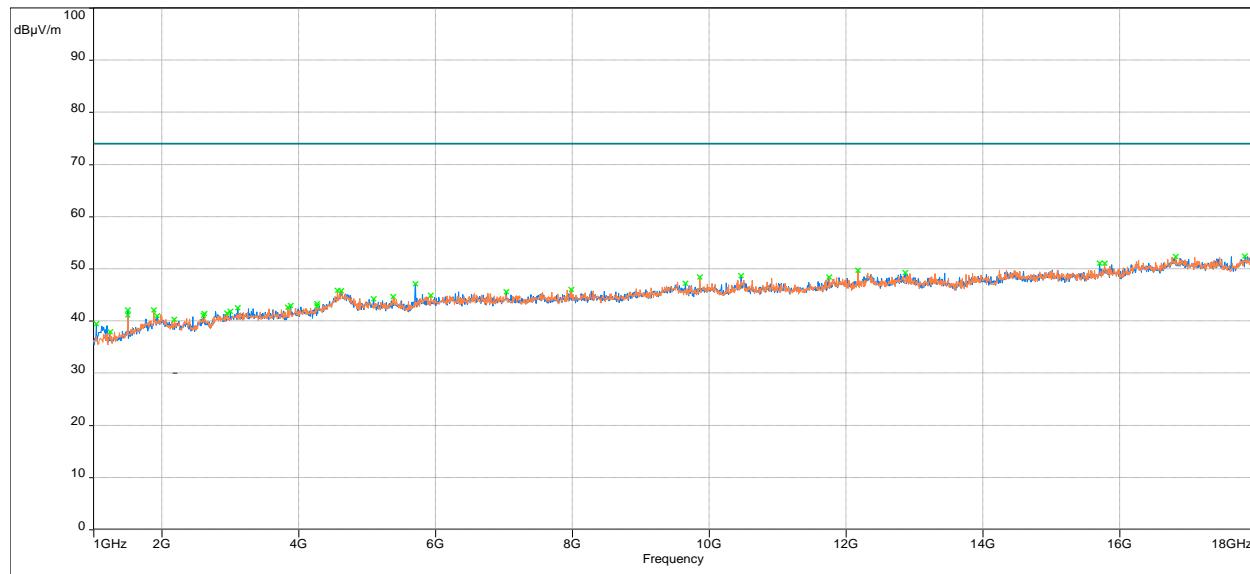
FCC Part 15/FCC Part 15.109 30M-40GHz B - Average/3.0m/
 FCC Part 15/FCC Part 15.109 30M-40GHz B - QPeak/3.0m/
 Meas.Peak (Horizontal)
 Meas.Peak (Vertical)
× Peak (Peak /Lim. Average) (Horizontal)
× Peak (Peak /Lim. Average) (Vertical)



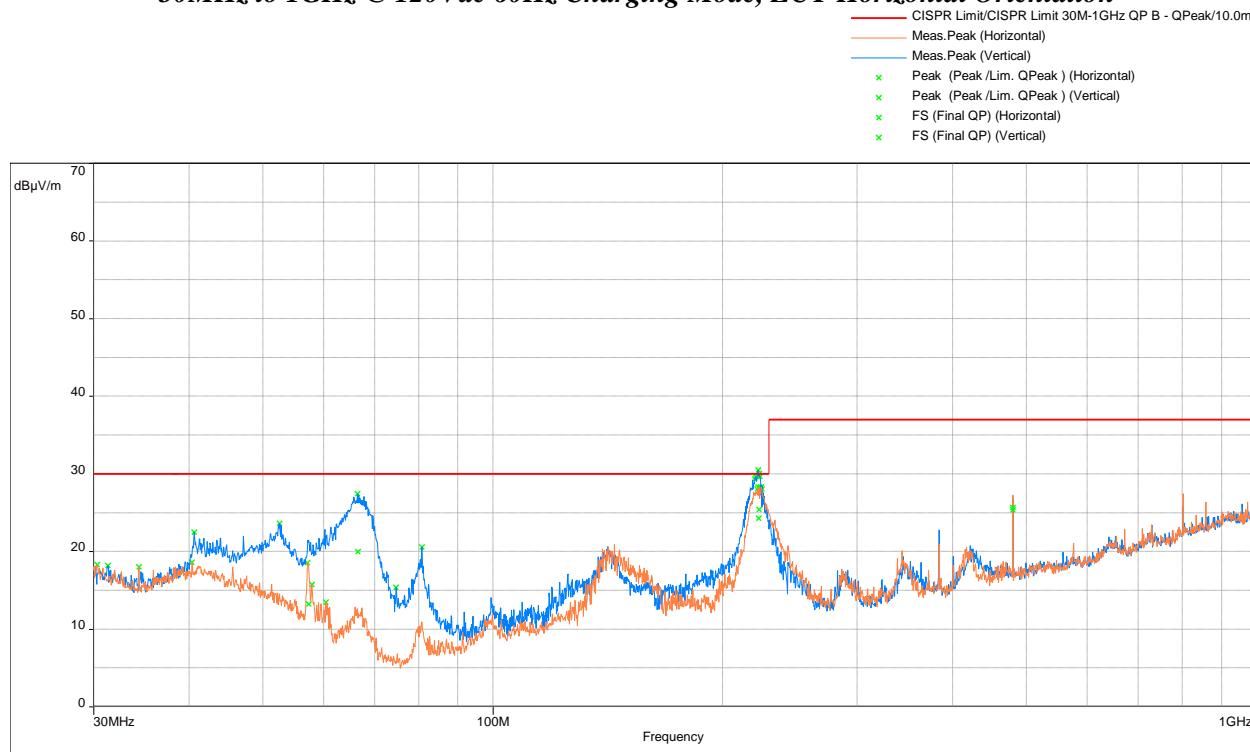
Model: ; Client: ; Comments: ; Test Date: 11/13/2018 15:12

1-18GHz @ 120Vac 60Hz Charging Mode, EUT Vertical Orientation Peak Limit

FCC Part 15/FCC Part 15.109 Peak 1GHz to 40GHz B - Peak/3.0m/
 Meas.Peak (Horizontal)
 Meas.Peak (Vertical)
× Peak (Peak /Lim. Peak) (Horizontal)
× Peak (Peak /Lim. Peak) (Vertical)

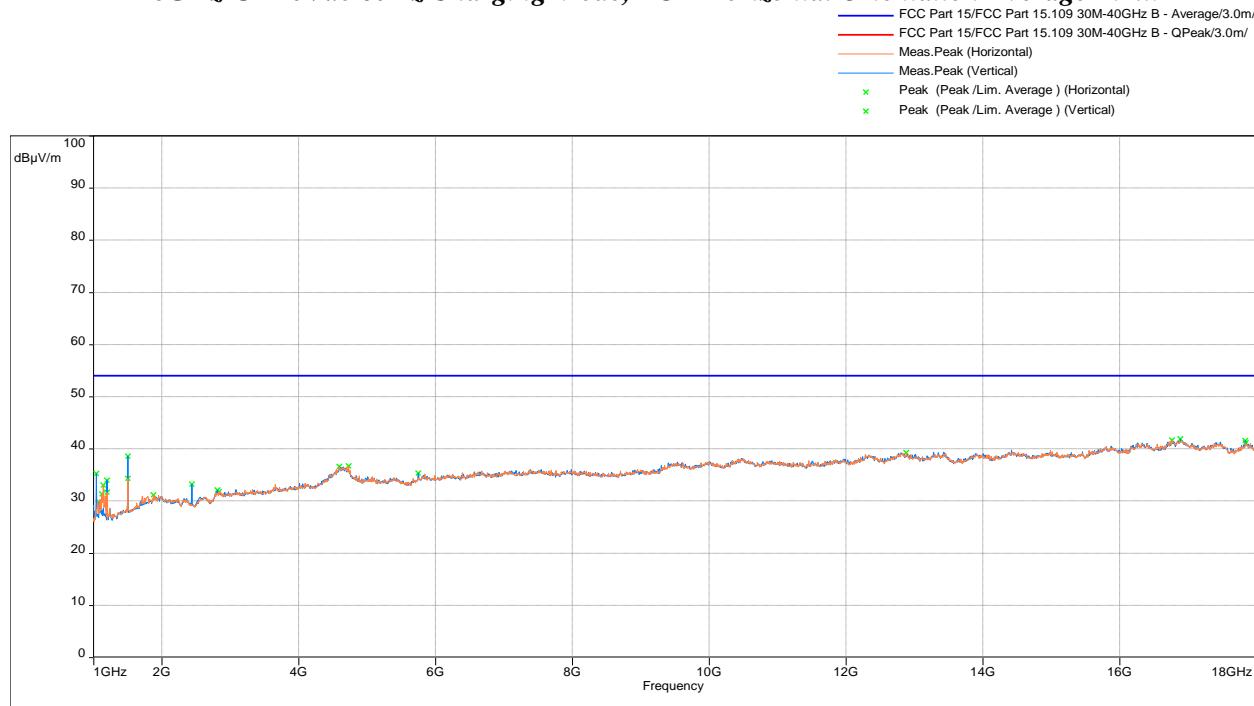
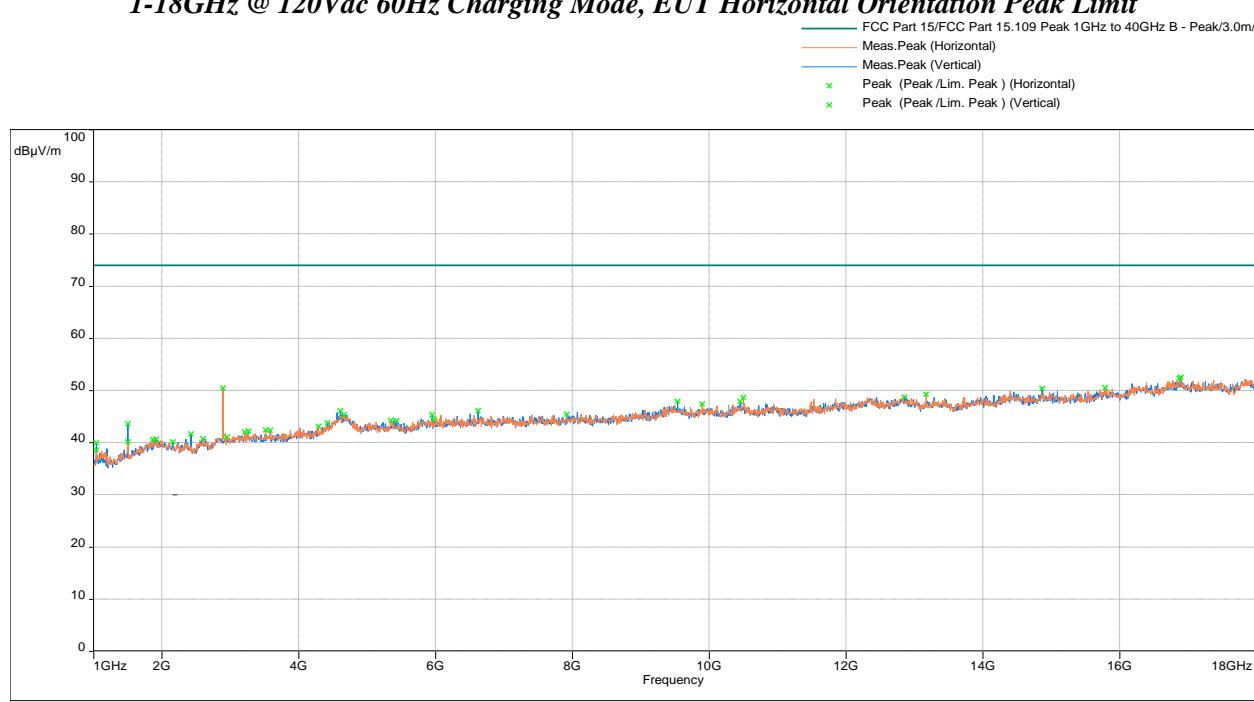


Model: ; Client: ; Comments: ; Test Date: 11/14/2018 13:23

30MHz to 1GHz @ 120Vac 60Hz Charging Mode, EUT Horizontal Orientation


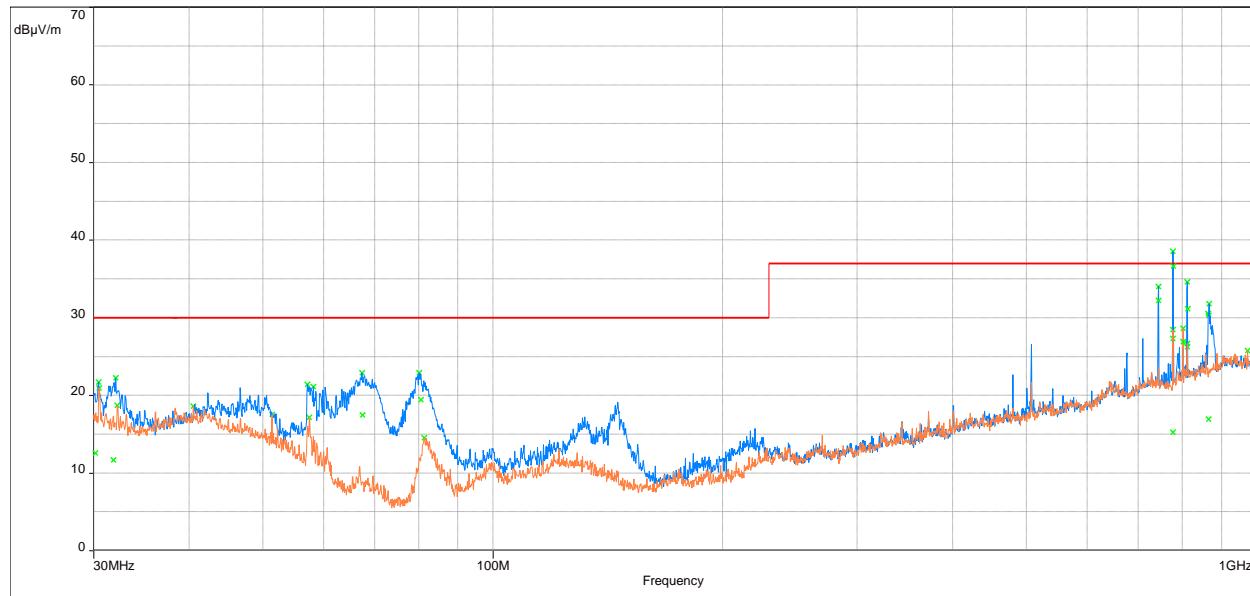
Model: ; Client: ; Comments: ; Test Date: 11/12/2018 12:24

Freq (MHz)	FS @10m (dB(uV/m))	Limit (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
57.408	13.2	30	-16.8	154.75	3.88	Horizontal	28.7	-15.6
66.594	20.0	30	-10.0	4	2.88	Vertical	39.2	-19.3
222.833	24.2	30	-5.8	80	3.35	Horizontal	39.0	-14.7
223.194	25.4	30	-4.6	238.25	1.04	Vertical	40.2	-14.7
479.995	25.7	37	-11.4	226.75	3.96	Horizontal	34.4	-8.8
480.010	25.3	37	-11.7	331.25	2.78	Vertical	34.1	-8.8

1-18GHz @ 120Vac 60Hz Charging Mode, EUT Horizontal Orientation Average Limit

1-18GHz @ 120Vac 60Hz Charging Mode, EUT Horizontal Orientation Peak Limit


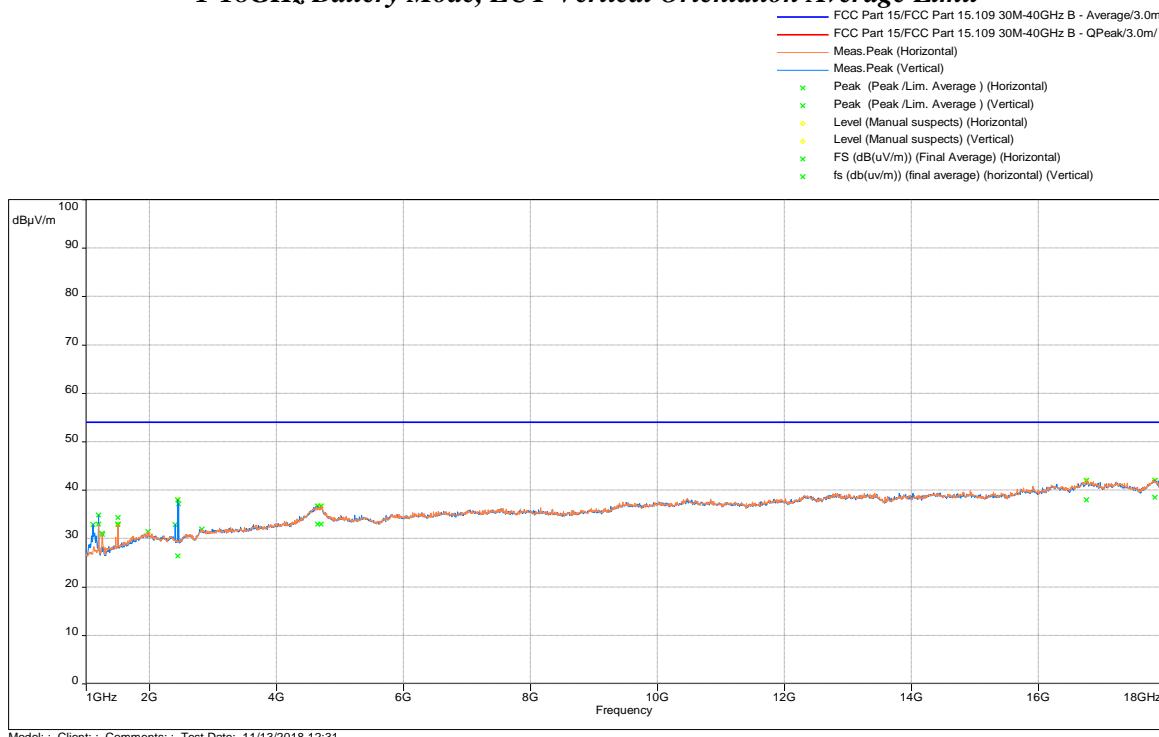
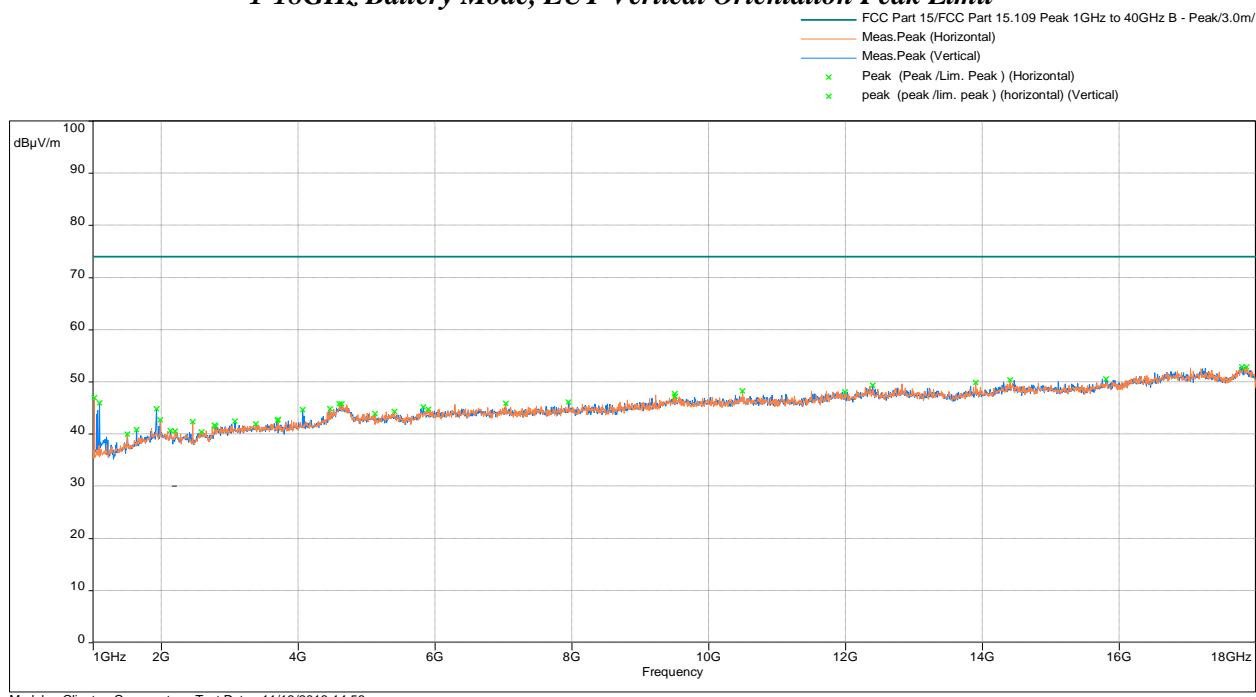
30MHz to 1GHz Battery Mode, EUT Vertical Orientation

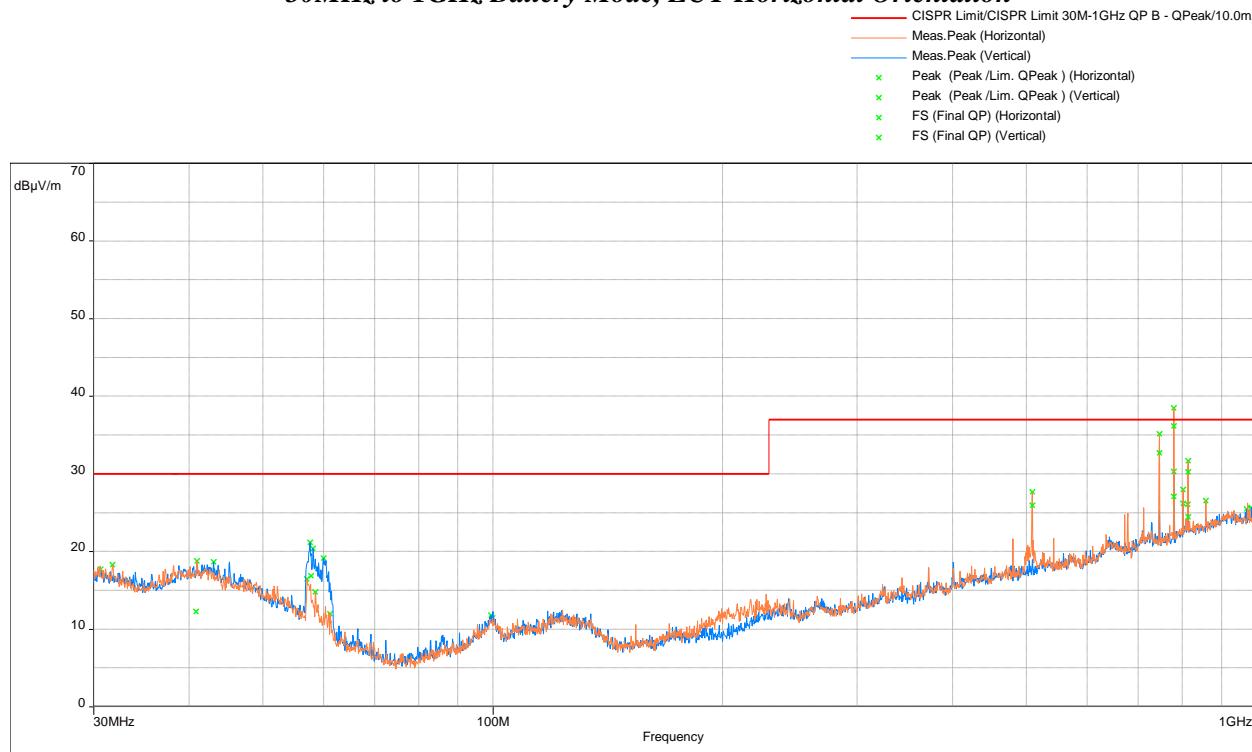
CISPR Limit/CISPR Limit 30M-1GHz QP B - QPeak/10.0m/
 Meas.Peak (Horizontal)
 Meas.Peak (Vertical)
 Peak (Peak /Lim. QPeak) (Horizontal)
 Peak (Peak /Lim. QPeak) (Vertical)
 FS (Final QP) (Horizontal)
 FS (Final QP) (Vertical)



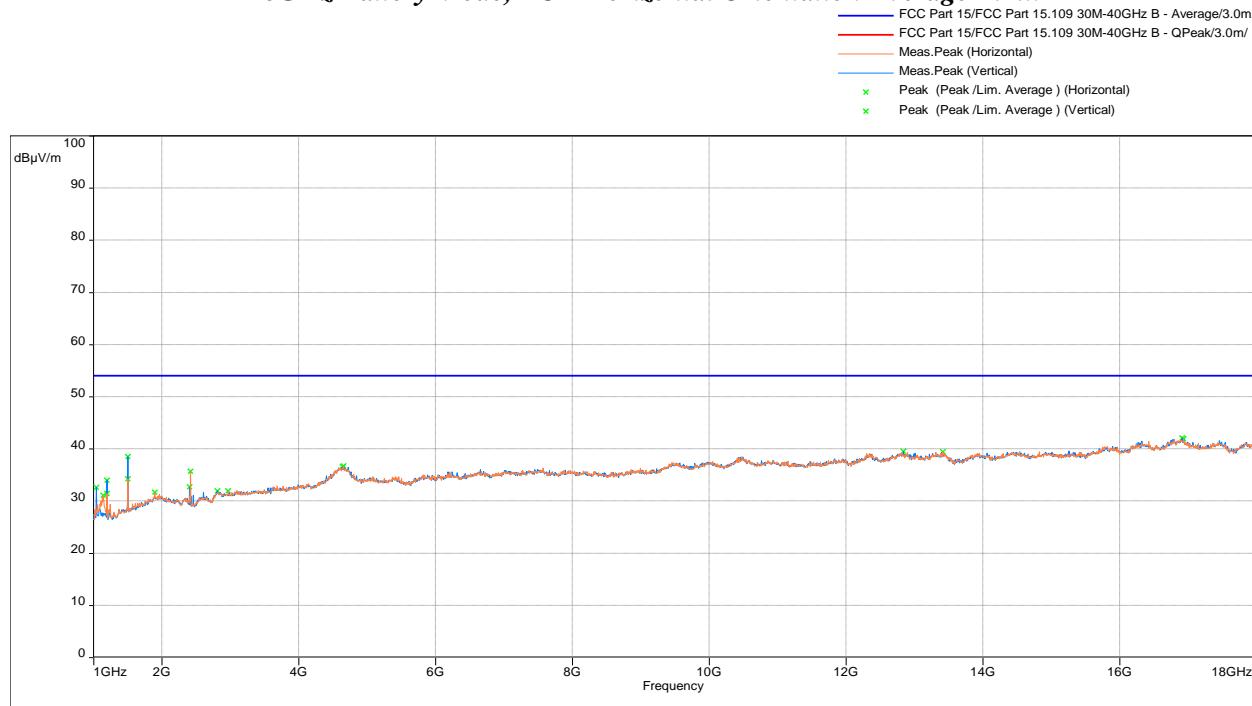
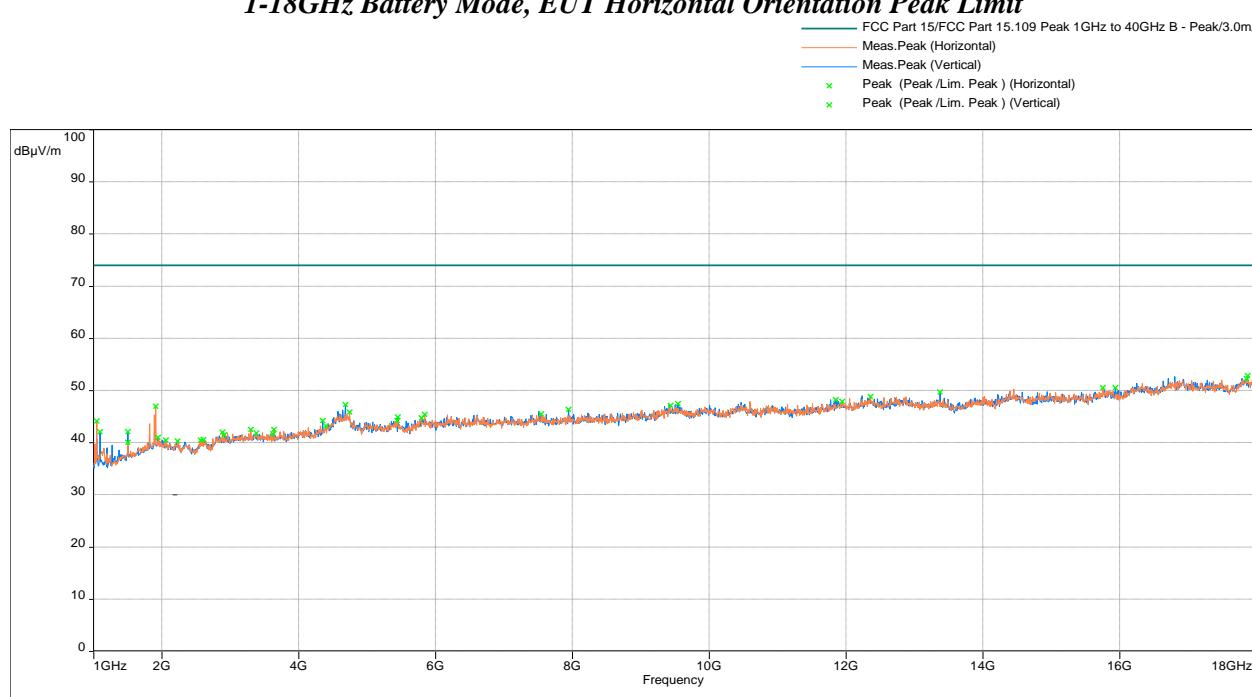
Model: ; Client: ; Comments: ; Test Date: 11/13/2018 08:26

Freq (MHz)	FS @10m (dB(uV/m))	Limit (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
30.172	12.5	30	-17.5	180.5	2.02	Horizontal	22.2	-9.7
31.878	11.7	30	-18.3	174.75	3.62	Vertical	21.2	-9.5
67.501	17.4	30	-12.6	161.25	3.41	Vertical	36.9	-19.5
80.517	19.4	30	-10.6	94.5	1.7	Vertical	39.9	-20.5
744.914	32.2	37	-4.8	350	1.87	Vertical	36.5	-4.3
777.053	15.3	37	-21.8	351	2.68	Horizontal	19.4	-4.2
778.597	36.6	37	-0.4	7	1.77	Vertical	40.8	-4.2
801.823	26.9	37	-10.1	6	1.29	Horizontal	30.0	-3.1
812.556	31.1	37	-5.9	32.5	1.62	Vertical	33.9	-2.7
866.223	16.9	37	-20.1	350.25	1.94	Vertical	19.1	-2.3

1-18GHz Battery Mode, EUT Vertical Orientation Average Limit

1-18GHz Battery Mode, EUT Vertical Orientation Peak Limit


30MHz to 1GHz Battery Mode, EUT Horizontal Orientation


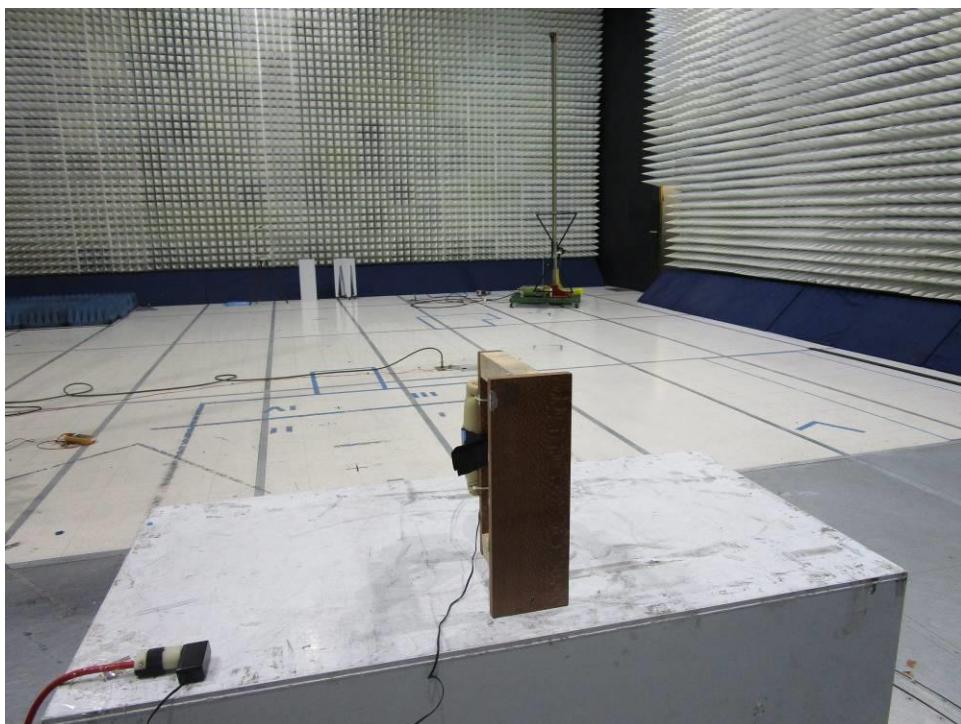
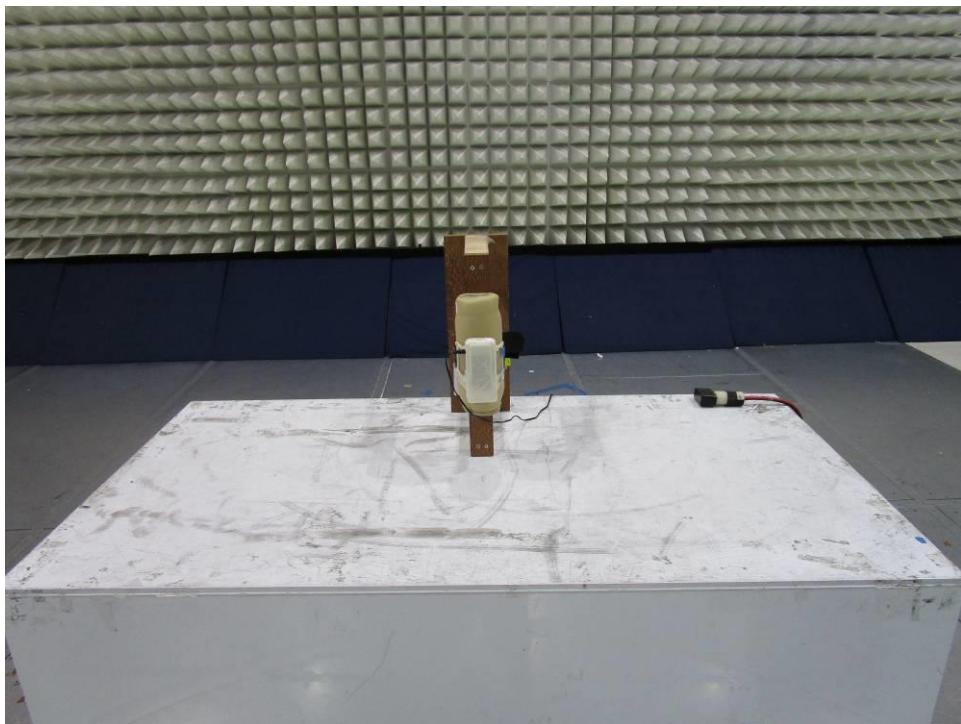
Freq (MHz)	FS @10m (dB(uV/m))	Limit (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
40.850	12.2	30	-17.8	16.5	3.64	Horizontal	21.7	-9.5
57.795	16.9	30	-13.2	18.5	1.04	Vertical	32.5	-15.7
508.952	25.9	37	-11.1	159	3.96	Horizontal	34.2	-8.3
746.439	32.7	37	-4.3	201	1	Horizontal	36.9	-4.2
780.070	27.1	37	-9.9	281.5	3.68	Vertical	31.3	-4.2
780.149	36.1	37	-0.9	207.5	1	Horizontal	40.3	-4.2
814.309	24.5	37	-12.6	284.75	3.5	Vertical	27.2	-2.8
814.409	30.2	37	-6.8	226.75	2.38	Horizontal	33.0	-2.8

1-18GHz Battery Mode, EUT Horizontal Orientation Average Limit

1-18GHz Battery Mode, EUT Horizontal Orientation Peak Limit


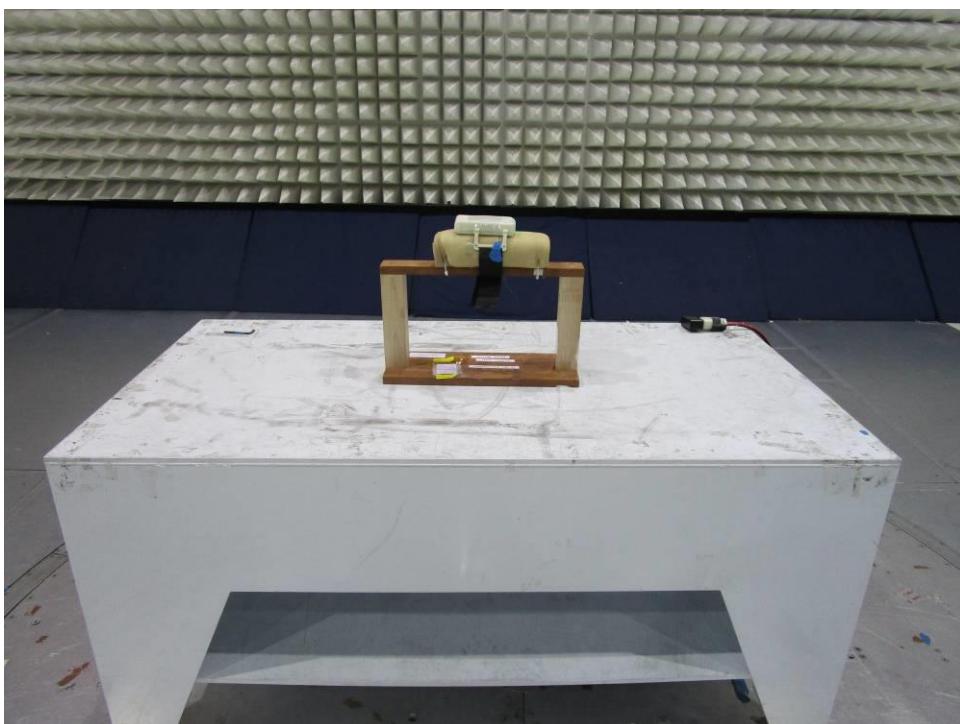
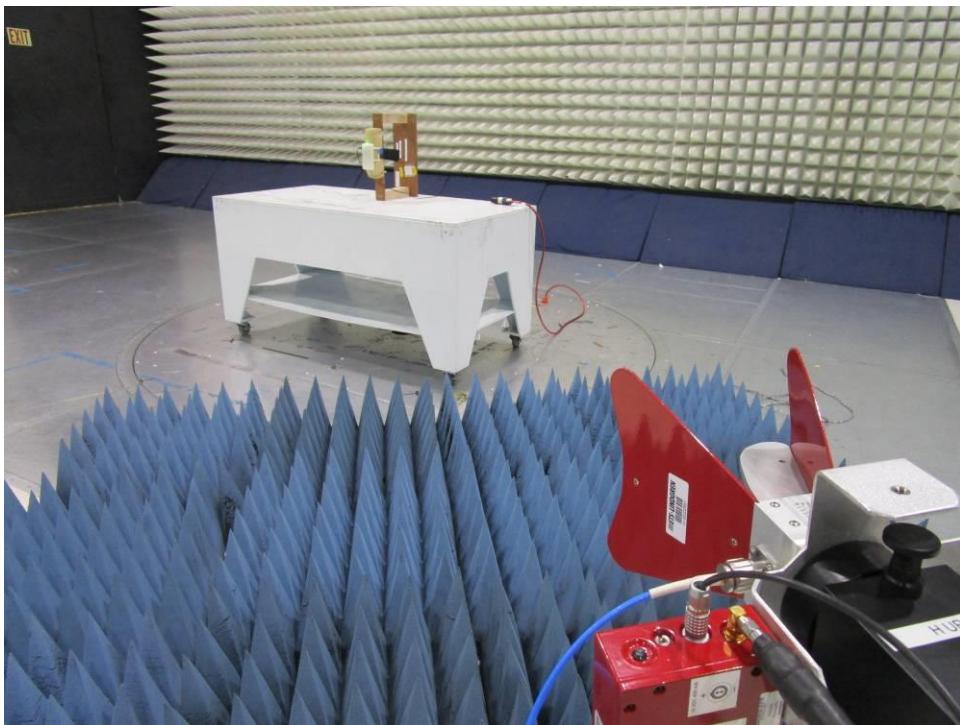
Result:	Complies
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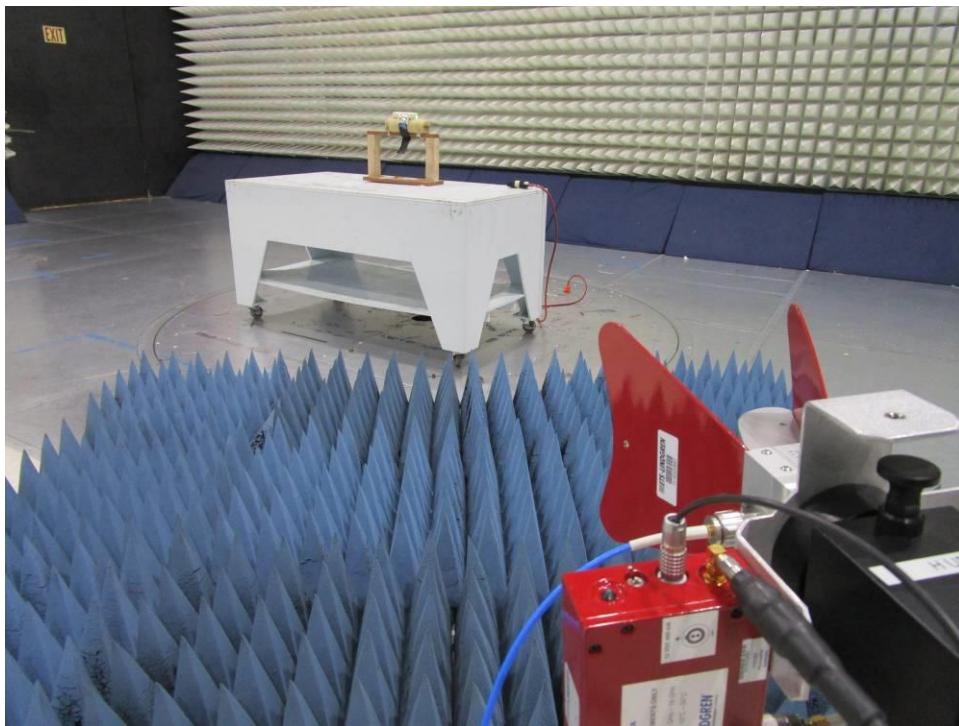
4.3.4 Test Configuration Photographs

The following photographs show the testing configurations used.

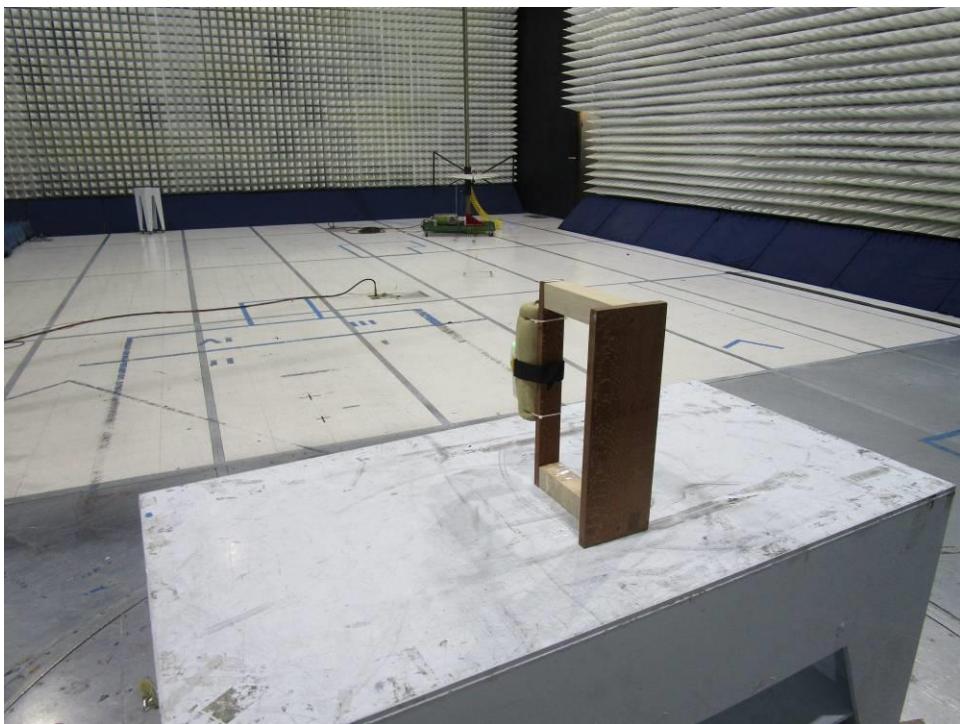
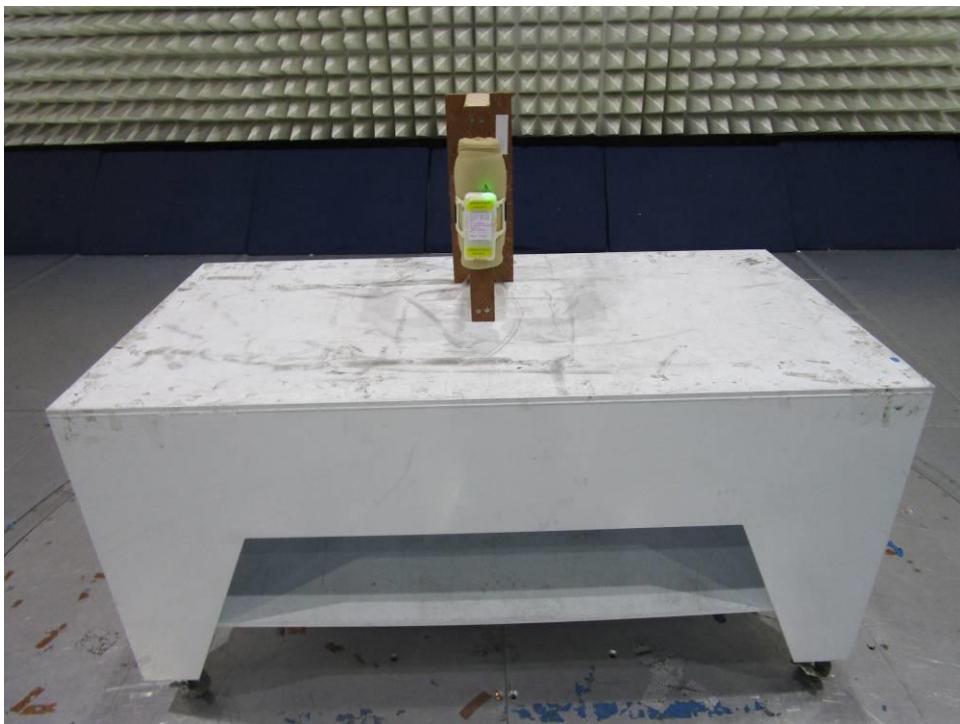


4.3.4 Test Configuration Photographs (continued):

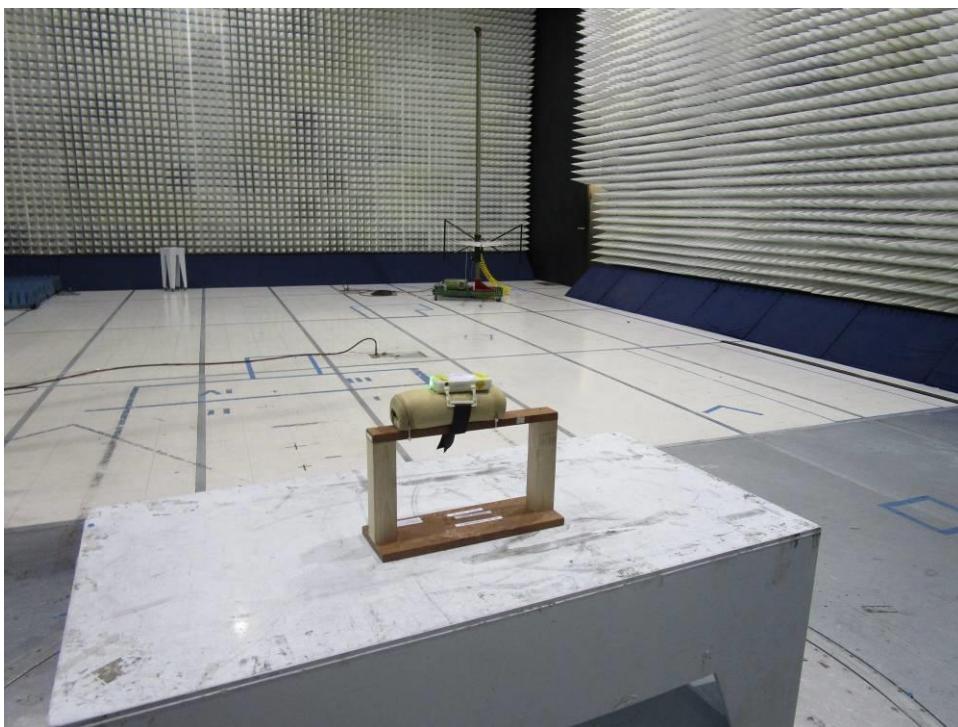
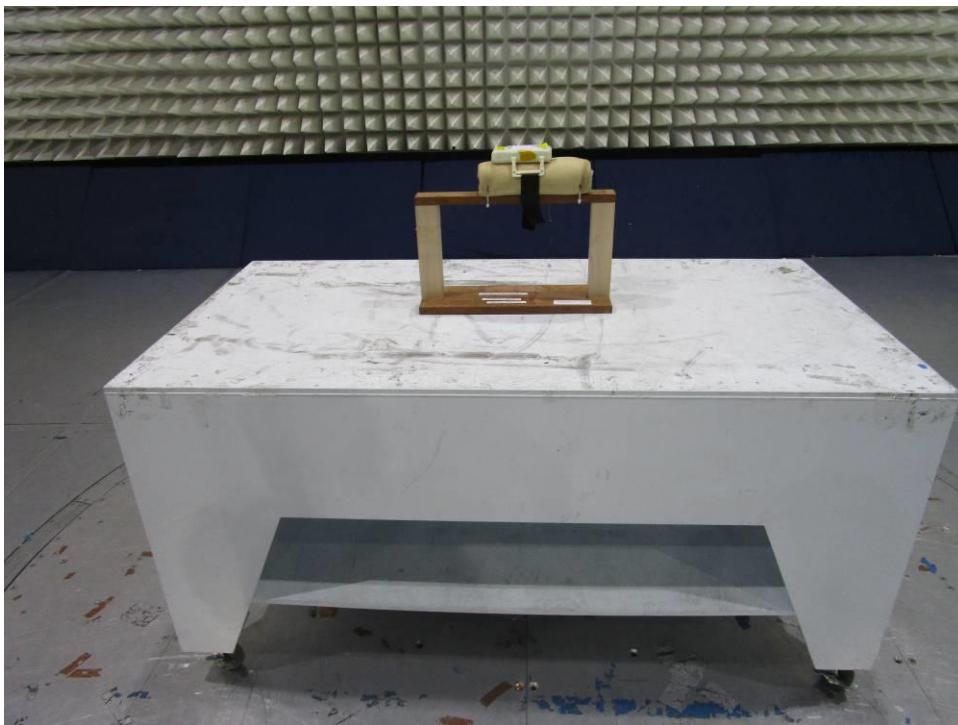




4.3.4 Test Configuration Photographs (continued):



4.3.4 Test Configuration Photographs (continued):



4.4 AC Line Conducted Emission
 FCC: 15.107, 15.207; RSS-GEN;

4.4.1 Requirement

Frequency Band MHz	Class B Limit dB(µV)		Class A Limit dB(µV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

*Note: *Decreases linearly with the logarithm of the frequency. At the transition frequency the lower limit applies.*

4.4.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

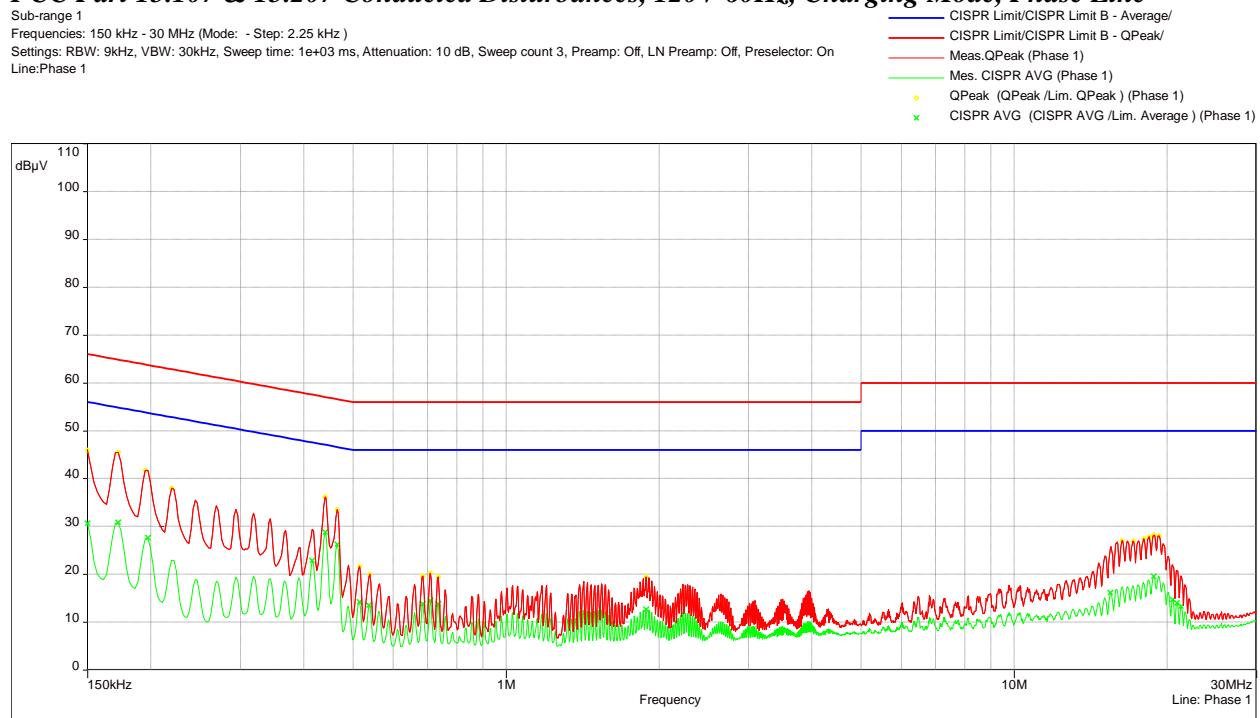
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4:2014 and ANSI C63.10-2013

Tested By:	Todd Moy
Test Date:	November 16, 2018

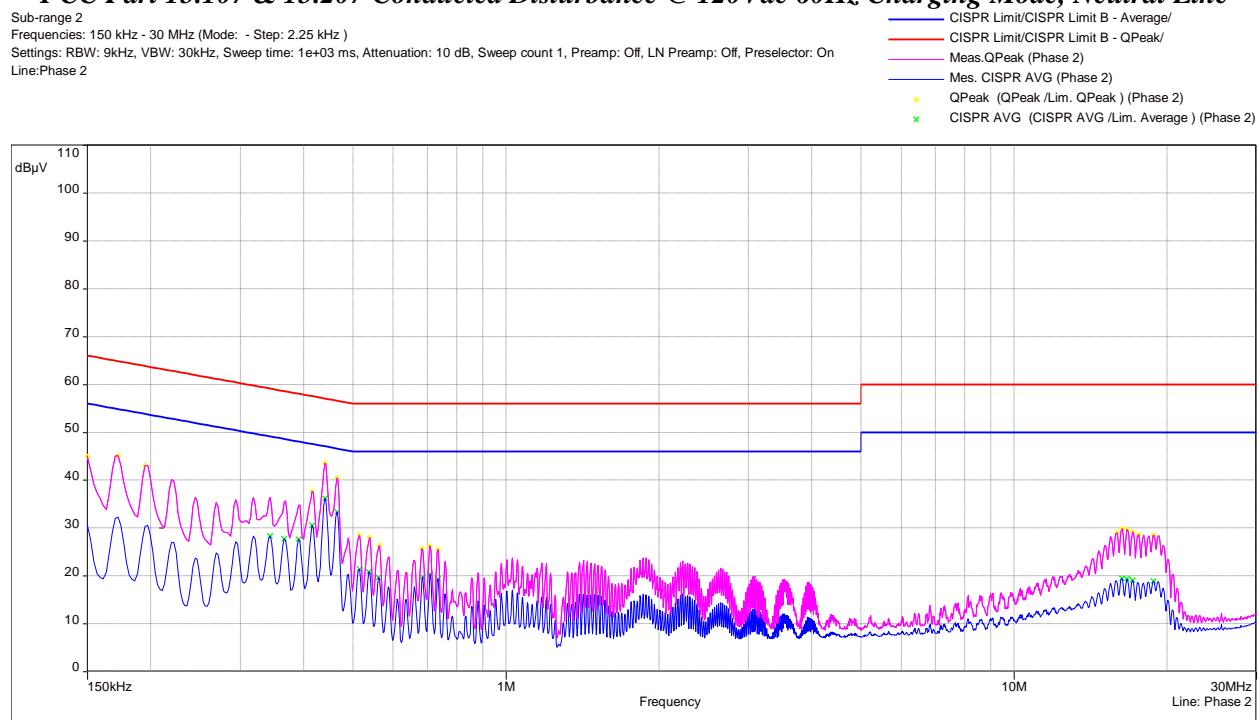
4.4.3 Test Results

FCC Part 15.107 & 15.207 Conducted Disturbances, 120V 60Hz, Charging Mode, Phase Line



Model: ; Client: ; Comments: ; Test Date: 11/16/2018 13:41

FCC Part 15.107 & 15.207 Conducted Disturbance @ 120Vac 60Hz Charging Mode, Neutral Line



Model: ; Client: ; Comments: ; Test Date: 11/16/2018 13:41

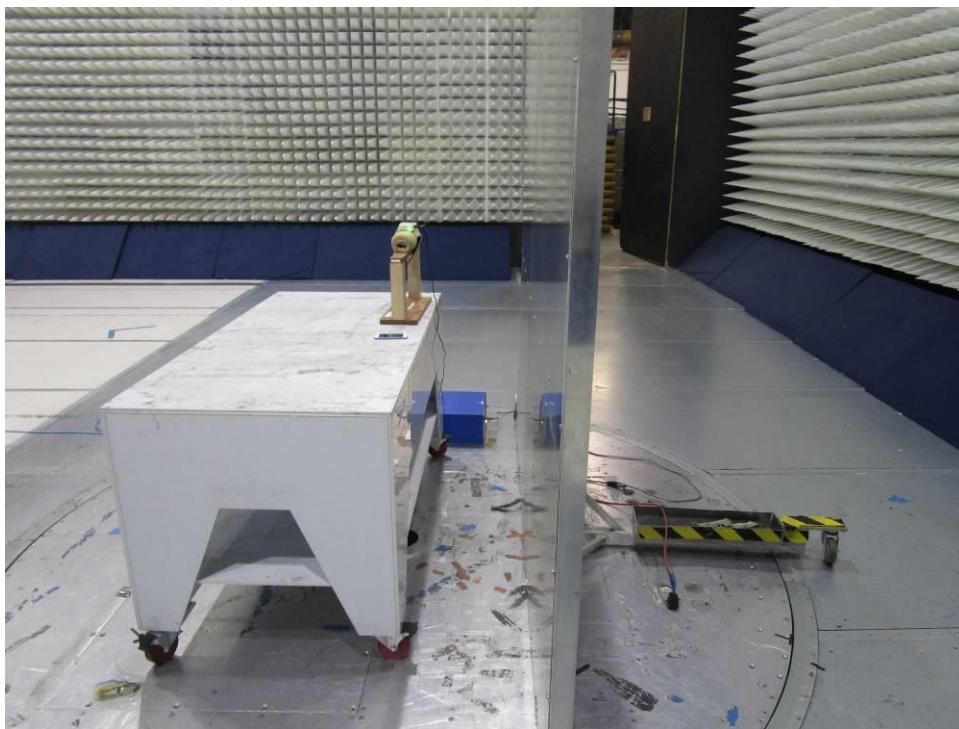
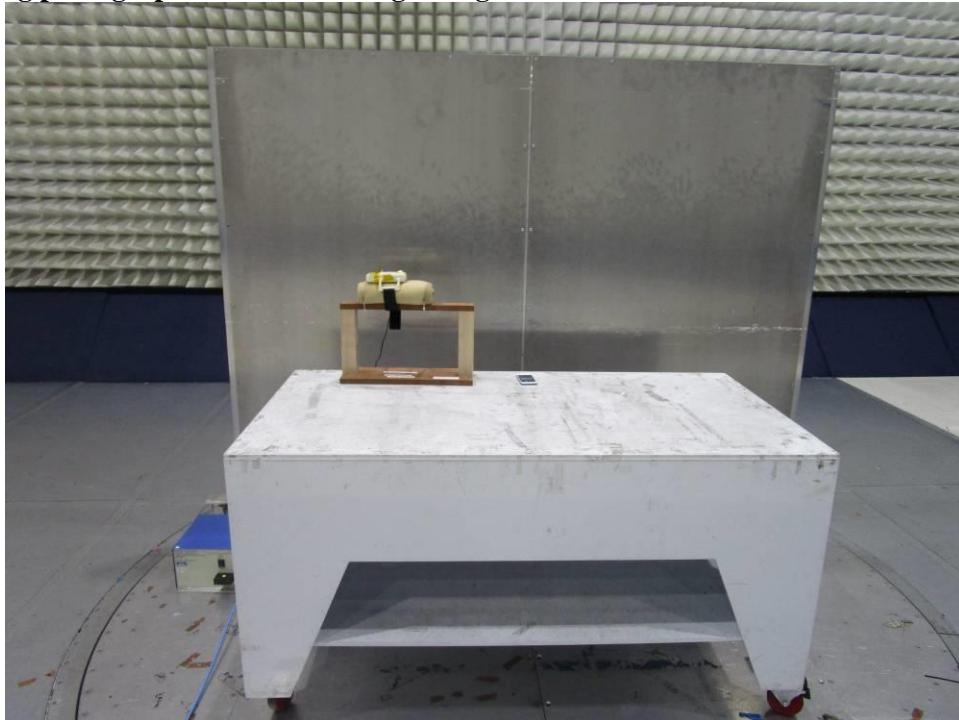
Frequency (MHz)	QP Level (dBuV)	QP Limit (dBuV)	QP Margin (dB)	Line	Correction (dB)
0.150	45.8	66	-20.2	Phase 1	11.6
0.150	44.9	66	-21.1	Phase 2	11.6
0.173	45.5	64.84	-19.4	Phase 1	11.6
0.173	45.1	64.84	-19.7	Phase 2	11.6
0.195	41.7	63.82	-22.1	Phase 1	11.6
0.195	43.1	63.82	-20.8	Phase 2	11.6
0.220	38.0	62.83	-24.8	Phase 1	11.6
0.416	37.6	57.54	-19.9	Phase 2	11.6
0.440	43.6	57.06	-13.5	Phase 2	11.6
0.440	36.2	57.06	-20.9	Phase 1	11.6
0.465	40.5	56.6	-16.1	Phase 2	11.6
0.465	33.5	56.6	-23.1	Phase 1	11.6
0.515	21.7	56	-34.3	Phase 1	11.6
0.515	28.5	56	-27.5	Phase 2	11.6
0.539	20.1	56	-35.9	Phase 1	11.6
0.539	28.0	56	-28.0	Phase 2	11.6
0.564	26.3	56	-29.7	Phase 2	11.6
0.683	25.7	56	-30.3	Phase 2	11.6
0.686	19.7	56	-36.3	Phase 1	11.6
0.708	26.2	56	-29.8	Phase 2	11.6
0.710	20.2	56	-35.8	Phase 1	11.6
0.735	19.5	56	-36.6	Phase 1	11.6
0.735	25.5	56	-30.5	Phase 2	11.6
1.887	19.4	56	-36.6	Phase 1	11.7
15.963	28.9	60	-31.1	Phase 2	12.1
16.330	27.0	60	-33.0	Phase 1	12.1
16.332	29.8	60	-30.2	Phase 2	12.1
16.699	29.6	60	-30.4	Phase 2	12.1
17.140	29.2	60	-30.9	Phase 2	12.1
17.165	27.0	60	-33.0	Phase 1	12.1
17.583	28.5	60	-31.5	Phase 2	12.1
17.999	27.4	60	-32.6	Phase 1	12.1
18.465	27.8	60	-32.2	Phase 1	12.1
18.834	28.5	60	-31.5	Phase 2	12.1
18.857	28.1	60	-31.9	Phase 1	12.1
19.298	28.0	60	-32.0	Phase 1	12.1

Frequency (MHz)	AVE Level (dBuV)	AVE Limit (dBuV)	AVE Margin (dB)	Line	Correction (dB)
0.150	30.6	56	-25.4	Phase 1	11.6
0.173	30.8	54.84	-24.0	Phase 1	11.6
0.197	27.6	53.73	-26.2	Phase 1	11.6
0.344	28.3	49.12	-20.8	Phase 2	11.6
0.366	27.7	48.59	-20.9	Phase 2	11.6
0.391	27.6	48.05	-20.4	Phase 2	11.6
0.416	30.5	47.54	-17.0	Phase 2	11.6
0.416	22.8	47.54	-24.7	Phase 1	11.6
0.440	36.2	47.06	-10.9	Phase 2	11.6
0.440	28.8	47.06	-18.3	Phase 1	11.6
0.465	26.2	46.6	-20.4	Phase 1	11.6
0.465	33.3	46.6	-13.3	Phase 2	11.6
0.515	14.2	46	-31.8	Phase 1	11.6
0.515	21.4	46	-24.6	Phase 2	11.6
0.537	13.5	46	-32.5	Phase 1	11.6
0.537	20.8	46	-25.2	Phase 2	11.6
0.562	19.6	46	-26.4	Phase 2	11.6
0.686	13.9	46	-32.2	Phase 1	11.6
0.686	19.7	46	-26.3	Phase 2	11.6
0.710	14.5	46	-31.5	Phase 1	11.6
0.710	20.3	46	-25.7	Phase 2	11.6
0.735	13.8	46	-32.2	Phase 1	11.6
0.735	19.3	46	-26.7	Phase 2	11.6
1.887	12.6	46	-33.4	Phase 1	11.7
15.486	16.1	50	-33.9	Phase 1	12.1
16.307	19.5	50	-30.6	Phase 2	12.1
16.697	19.3	50	-30.7	Phase 2	12.1
17.138	19.1	50	-31.0	Phase 2	12.1
18.812	18.9	50	-31.1	Phase 2	12.1
18.841	19.6	50	-30.4	Phase 1	12.1
20.531	14.7	50	-35.3	Phase 1	12.1
20.922	14.0	50	-36.0	Phase 1	12.1
21.338	13.3	50	-36.7	Phase 1	12.1

Results:	Complies by 10.9 dB at 120Vac 60Hz Charging Mode
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4.4.4 Test Configuration Photographs

The following photographs show the testing configurations used.



AC Mains Line-Conducted Disturbance Setup Photograph

5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
EMI Receiver	Rohde and Schwarz	ESR7	ITS 01607	12	10/09/19
Active Horn Antenna	ETS-Lindgren	3117-PA	ITS 01636	12	01/11/19
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	02/21/19
Pre-Amplifier	Sonoma Instrument	310	ITS 00942	12	01/26/19
LISN	COM-POWER	LIN-115A	ITS 01285	12	06/21/19
RF Cable	Megaphase	EMC1-K1K1-236	ITS 01538	12	06/25/19
RF Cable	Megaphase	TM40-K1K1-59	ITS 01657	12	06/26/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01330	12	11/29/18
RF Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	08/16/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	08/16/19
Notch Filter	Micro-tronics	BCR50722	ITS 01170	12	01/26/19

No Calibration required

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
BAT-EMC	Nexio	3.16.0.64	Simplex Time Recorder, G103645488.bpp
RS Commander	Rohde Schwarz	1.6.4	Not Applicable (Screen grabber)

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G103645080	TM	KV	December 18, 2018	Original document