TEST REPORT

Report Number: 102780674MPK-002
Project Number: G102780674
November 17, 2016

Testing performed on
GoTenna Mesh
Model: 80085
FCC ID: 2ABVK80085
IC: 21842-GTISM01

to

FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247 Issue 1
FCC Part 15, Subpart B
Industry Canada ICES-003

For

goTenna Inc.

Test Performed by:	Test Authorized by:
Intertek	goTenna Inc.
1365 Adams Court	81 Willoughby Street, Suite 302
Menlo Park, CA 94025 USA	Brooklyn, NY 11201

Prepared by: _____ **Date:** November 17, 2016
Minh Ly

Reviewed by: _____ **Date:** November 17, 2016
Krishna K Vemuri

Report No. 102780674MPK-002

Equipment Under Test:	GoTenna Mesh
Trade Name:	GoTenna Mesh
Model Number:	80085
Serial Number:	MPK1610261216-002 MPK1610261216-005
Applicant:	goTenna Inc.
Contact:	Mick Tinker
Address:	goTenna Inc. 81 Willoughby Street, Suite 302 Brooklyn, NY 19805
Country	USA
Telephone:	(302) 540-2246
Email:	mick@gotenna.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 1 FCC Part 15, Subpart B Industry Canada ICES-003
Date of Test:	October 24 – November 16, 2016

We attest to the accuracy of this report:

Minh Ly
Project Engineer

Krishna K Vemuri
Engineering Team Lead

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1.0 Summary of Tests

Test	Reference FCC	Reference Industry Canada	Result
RF Output Power	15.247(b)(3)	RSS-247, 5.4.4	Complies
6 dB Bandwidth	15.247(a)(2)	RSS-247, 5.2.1	Complies
Power Density	15.247(e)	RSS-247, 5.2.2	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
Antenna Requirement	15.203	RSS-GEN	Complies (Internal Antenna & Unique connector)
Radiated Emissions	15.109	ICES-003	Complies
AC Line Conducted Emission	15.107	ICES-003	Complies

EUT receive date: October 24, 2016
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: October 24, 2016
Test completion date: November 16, 2016
The test results in this report pertain only to the item tested.

2.0 General Information

2.1 Product Description

goTenna Inc supplied the following description of the EUT:

GoTenna is a device that pair with the smart phone and use the goTenna app to communicate off-grid. The unit is battery powered and it charged through USB port.

Information about the Bluetooth radio is presented below:

Applicant	goTenna Inc.
Model No.	80085
FCC Identifier	2ABVK80085
IC Identifier	21842-GTISM01
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	-1.57 dBm (0.697 mW)
Antenna(s) & Gain	Internal Antenna, 0 dBi peak gain
EIRP	-1.57 dBm
Frequency Range	2402 – 2480 MHz
Type of modulation/data rate	GFSK / 1Mbps
Number of Channel(s)	40
Applicant Name & Address	goTenna Inc. 81 Willoughby Street, Suite 302 Brooklyn, NY 19805 USA

2.2 Related Submittal(s) Grants

None.

2.3 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.

2.4 Test Methodology

Antenna conducted measurements were performed according to the FCC documents "Guidance for Performing Compliance Measurement on Digital Transmission Systems (DTS) Operating under §15.247" (KDB 558074 D01 DTS Meas Guidance v03r05 April 8, 2016), and RSS-247, RSS-GEN.

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10-2013 & ANSI C63.4-2014. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account the measurement uncertainty.

Estimated Measurement Uncertainty

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 1 GHz	1 GHz – 2.5 GHz	> 2.5 GHz
RF Power and Power Density – antenna conducted	-	0.7 dB	-
Unwanted emissions - antenna conducted	1.1 dB	1.3 dB	1.9 dB
Bandwidth – antenna conducted	-	30 Hz	-

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 30MHz	30 MHz – 1 GHz	1 GHz – 18 GHz
Radiated emissions	-	4.5	5.9 dB
AC mains conducted emissions	2.1 dB	-	-

3.0 System Test Configuration

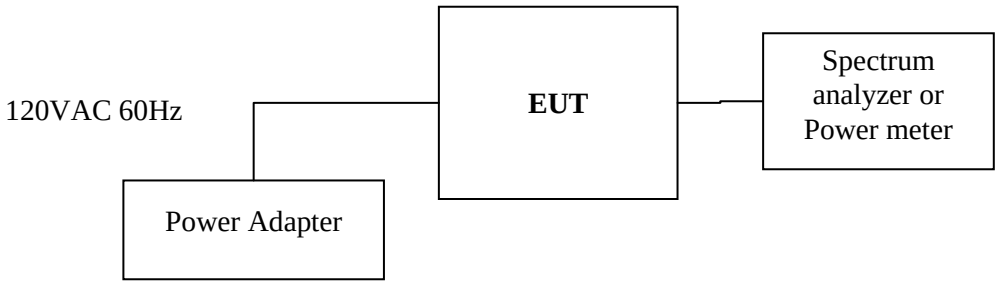
3.1 Support Equipment

Description	Manufacturer	Model No./ Part No.
Power Adapter	Pantech	PTA-5010MU1US

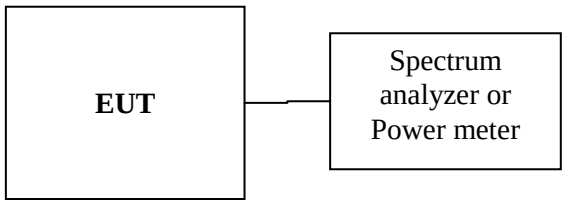
3.2 Block Diagram of Test Setup

Charging Mode:

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



Battery Mode:



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 programmed to transmit full power with 100% duty cycle. The highest clock frequency of the EUT is 2.4GHz, it was investigated up to 25GHz for Unintentional Radiated Emission.

This test report covers only the Bluetooth radio. A separate test report, report #102780674MPK-001, covers the 900MHz FHSS radio. Both 900MHz radio and BLE radio were active to ensure there were no adverse effects when both radios were simultaneously transmitting. Radiated Emission was investigated up to 26GHz and showed compliant in report #102780674MPK-001.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by goTenna Inc.

3.5 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.

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 Measurement Results

4.1 6-dB Bandwidth and Occupied Bandwidth
FCC Rule: 15.247(a)(2); RSS-247 A8.2 and RSS-GEN;

4.1.1 Requirement

The minimum 6-dB bandwidth shall be at least 500 kHz

4.1.2 Procedure

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

For FCC 6dB Channel Bandwidth the Procedure described in the FCC Publication 558074 D01 DTS Meas Guidance v03r05 April 8, 2016 was used to determine the DTS occupied bandwidth. Section 8.1 Option 1 was used.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

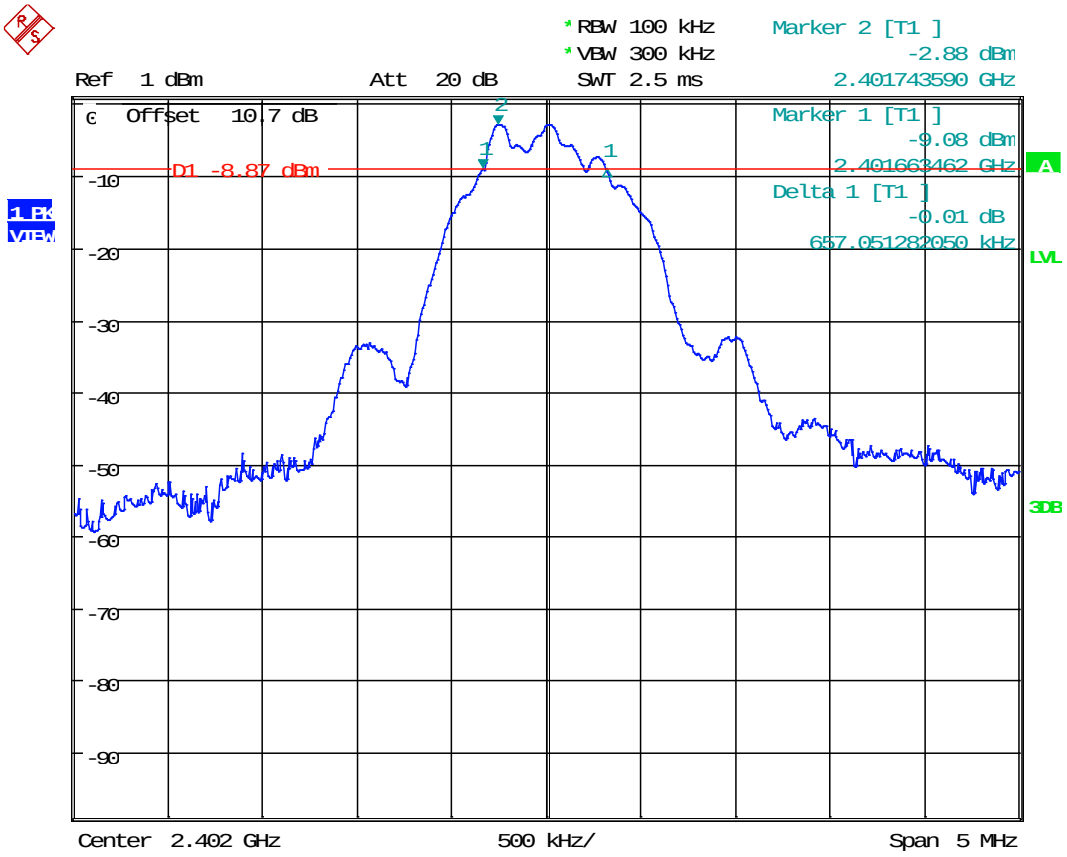
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

4.1.3 Test Result

Frequency (MHz)	6-dB bandwidth FCC 15.247 MHz	Plot	6-dB bandwidth RSS-247 MHz	Plot	99% Bandwidth MHz	Plot
2402	0.657	1.1	0.512	1.4	1.033	1.4
2440	0.657	1.2	0.600	1.5	1.041	1.5
2480	0.697	1.3	0.528	1.6	1.033	1.6

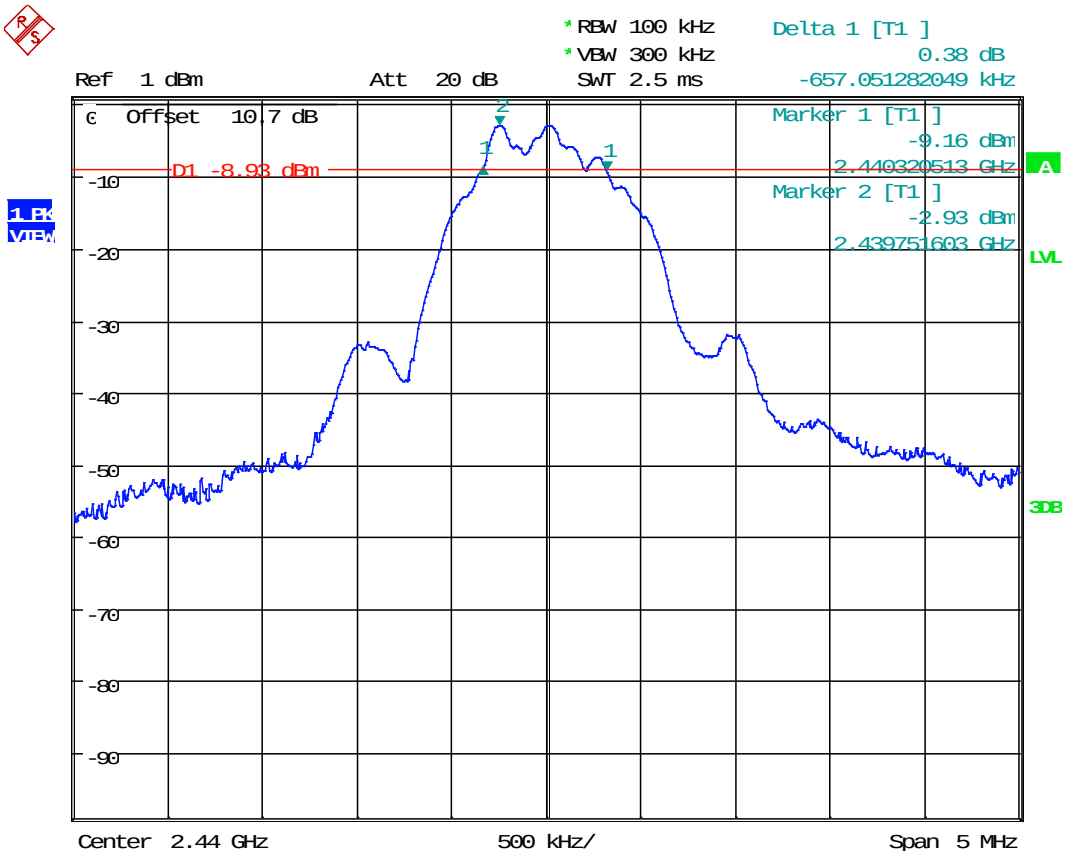
Date of Test:	October 26, 2016
Results	**Complies**

Plot 1. 1 6dB Bandwidth (FCC)



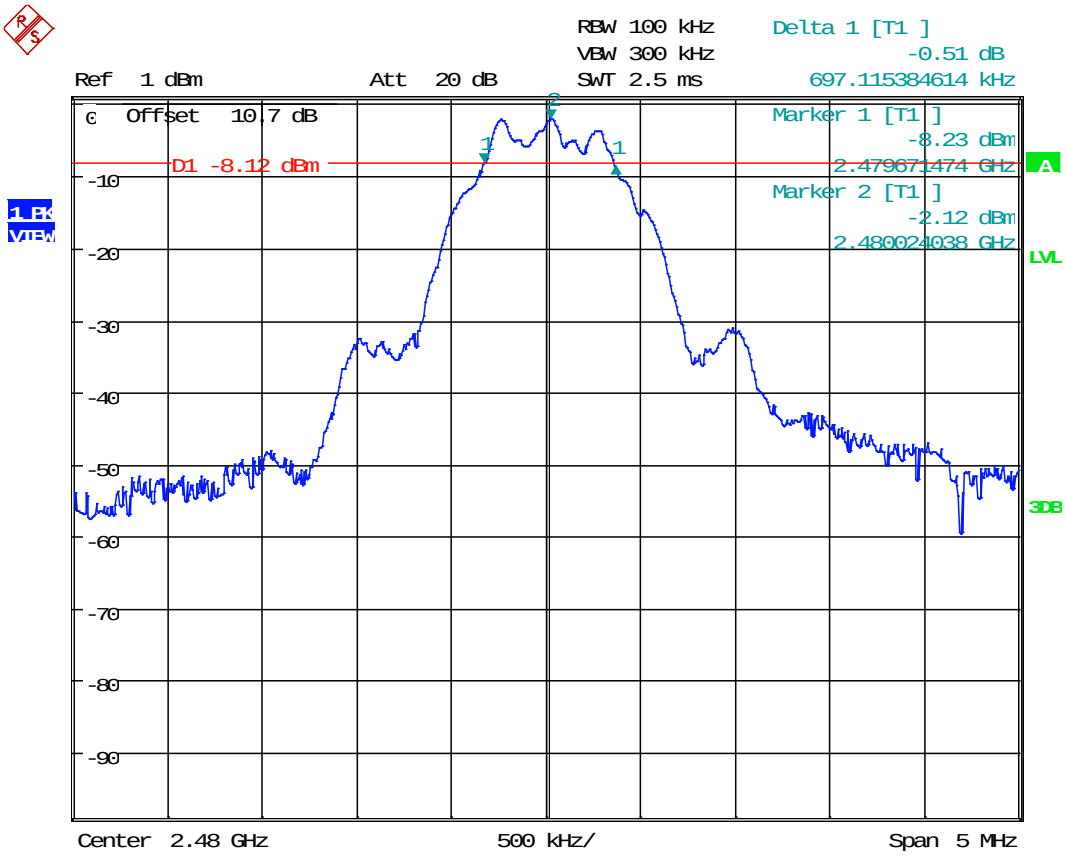
Date: 24.OCT.2016 10:49:25

Plot 1. 2 6dB Bandwidth (FCC)



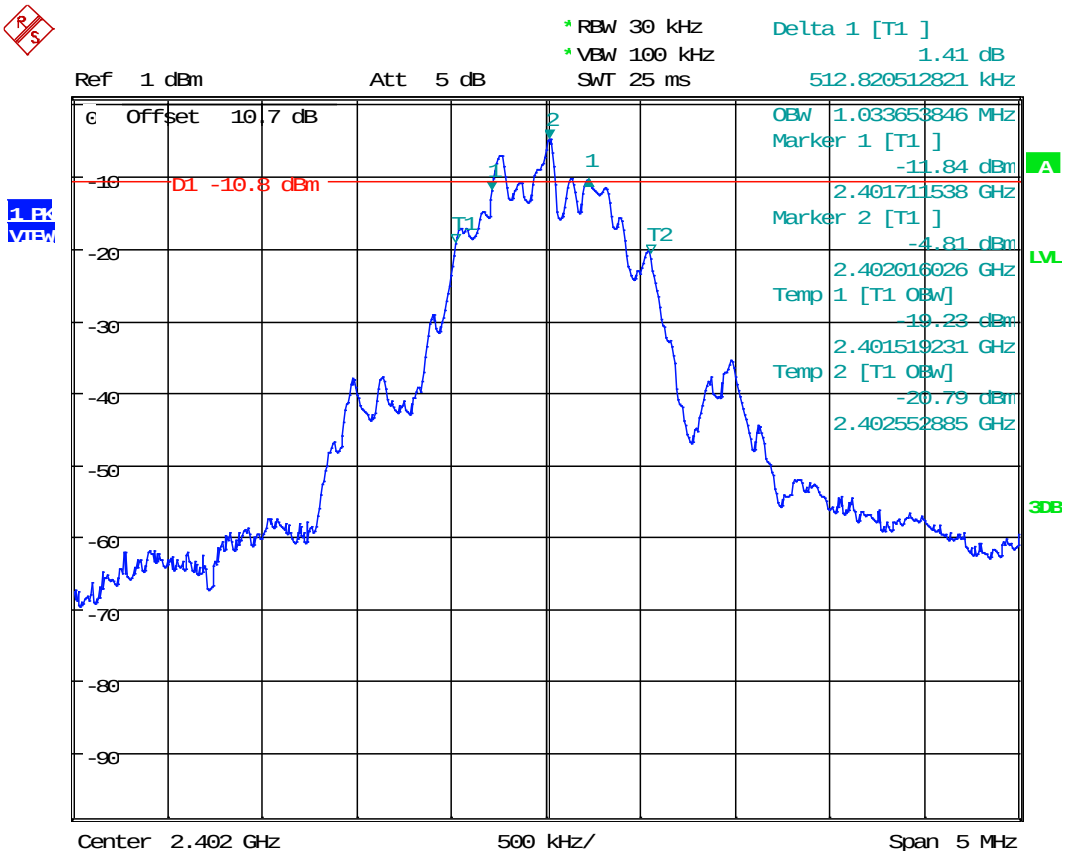
Date: 24.OCT.2016 10:52:53

Plot 1. 3 6dB Bandwidth (FCC)



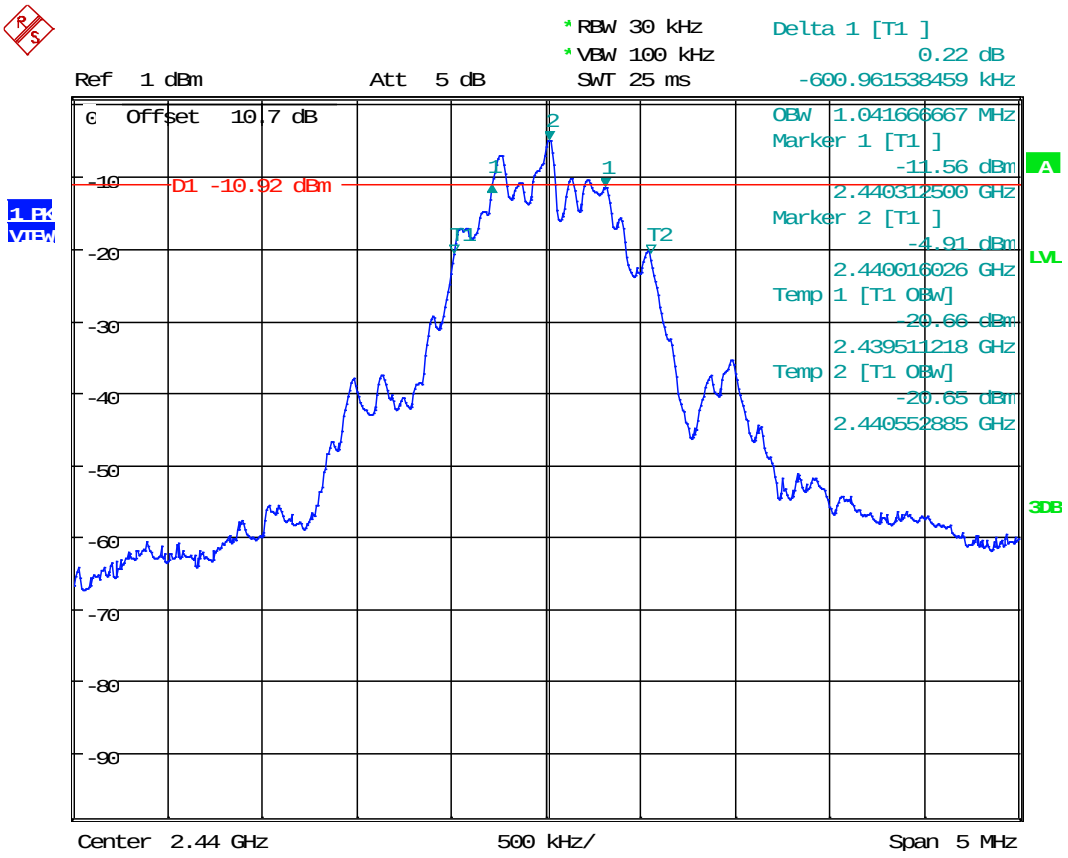
Date: 26.OCT.2016 13:50:03

Plot 1. 4 6dB Bandwidth & 99% Bandwidth (RSS)



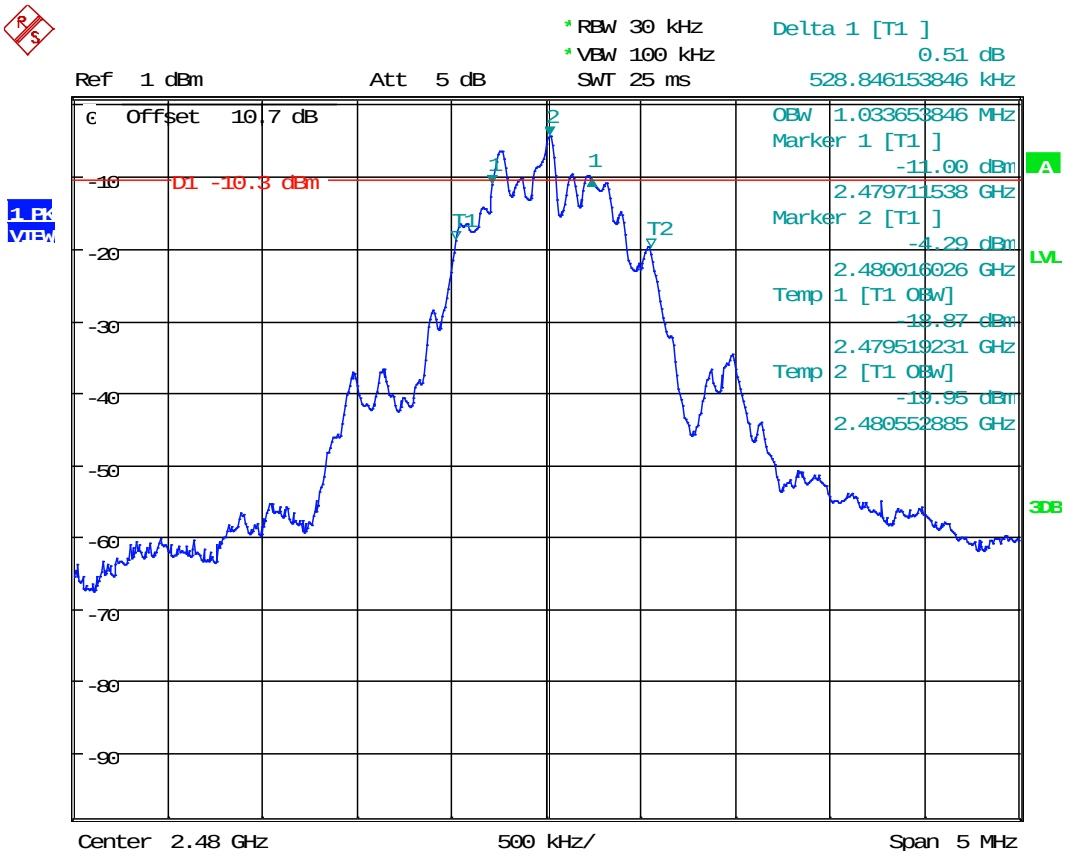
Date: 26.OCT.2016 14:00:26

Plot 1.5 6dB Bandwidth & 99% Bandwidth (RSS)



Date: 26.OCT.2016 14:01:24

Plot 1.6 6dB Bandwidth & 99% Bandwidth (RSS)



Date: 26.OCT.2016 13:58:57

4.2 Maximum Peak Conducted Output Power at Antenna Terminals
FCC Rule: 15.247(b)(3); RSS-247 A8.4;

4.2.1 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.

4.2.2 Procedure

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v03r05 April 8, 2016 was used. Specifically, section 9.1.1 RBW ≥ DTS Bandwidth was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

1. Set the RBW ≥ DTS Bandwidth
2. Set the VBW ≥ 3 x RBW
3. Set the span ≥ 3 x 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.

4.3.3 Test Result

Refer to the following plots 2.1 – 2.6 for the test details.

Charging Mode:

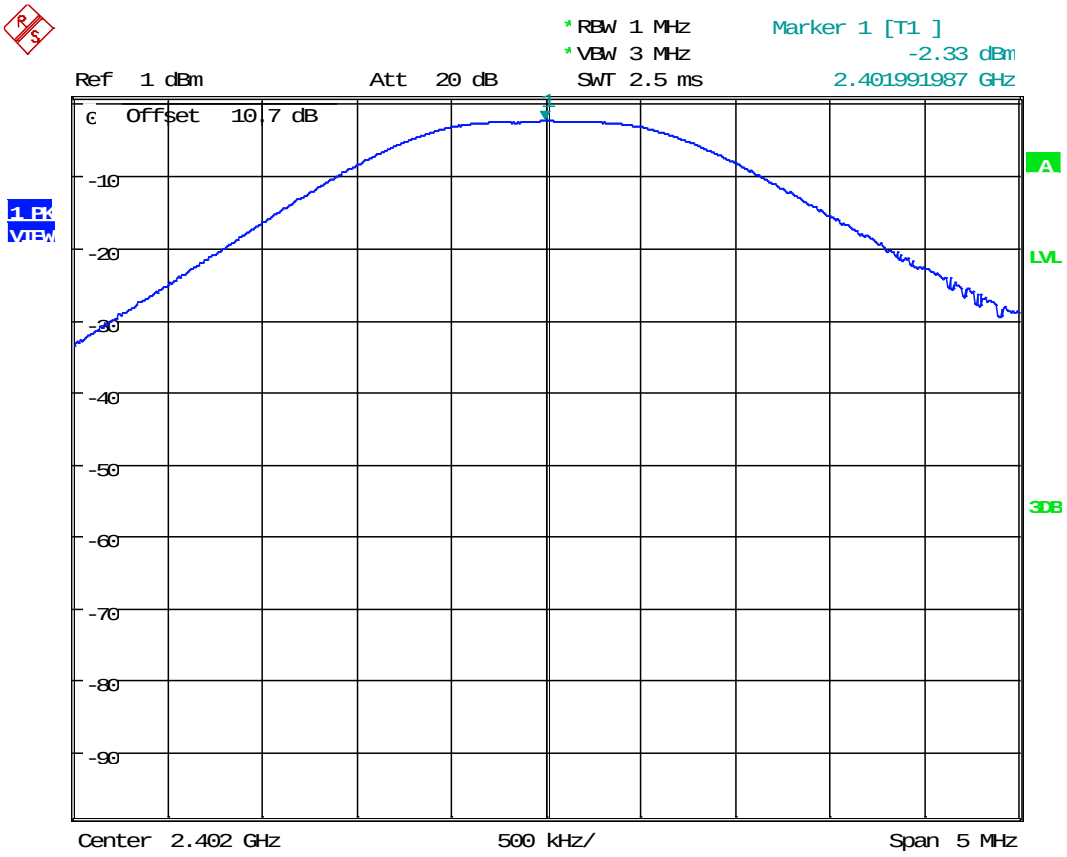
Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), mW	Plot
2402	-2.33	0.586	2.1
2440	-2.43	0.572	2.2
2480	-1.80	0.662	2.3

Battery Power:

Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), mW	Plot
2402	-1.99	0.633	2.4
2440	-2.06	0.623	2.5
2480	-1.57	0.697	2.6

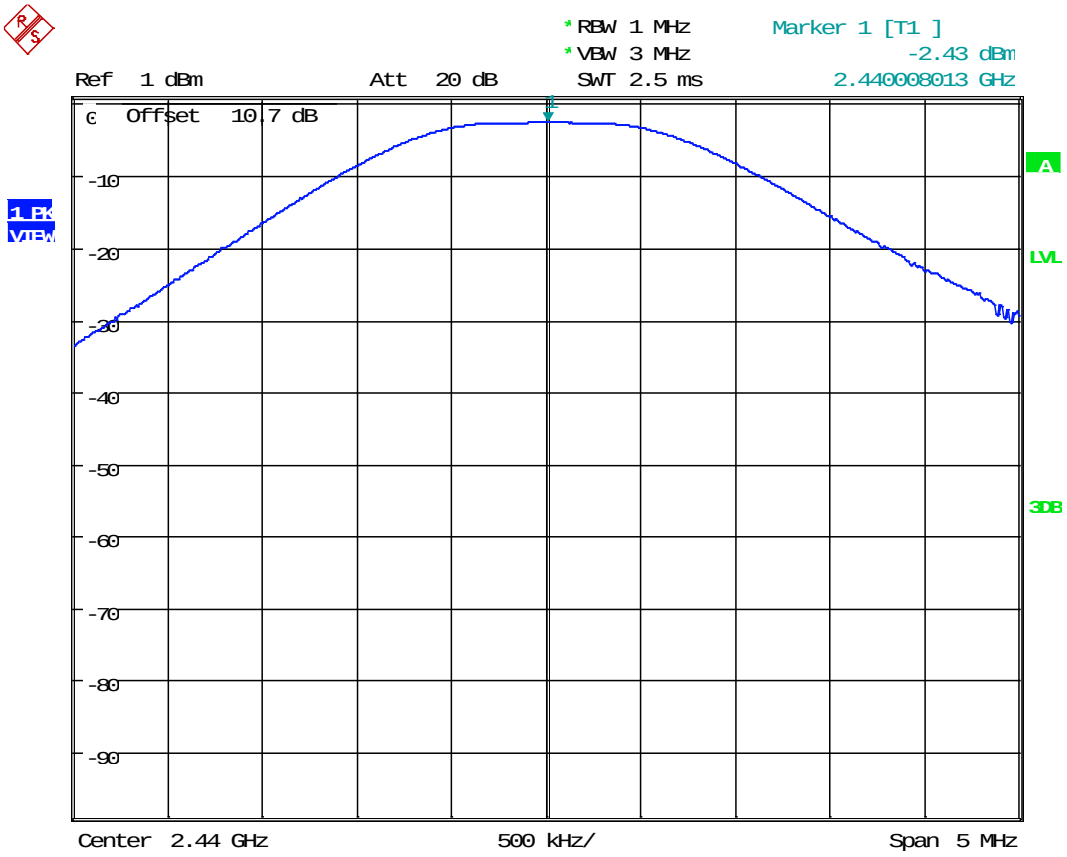
Date of Test:	October 26 & November 10, 2016
Results	**Complies**

Plot 2.1



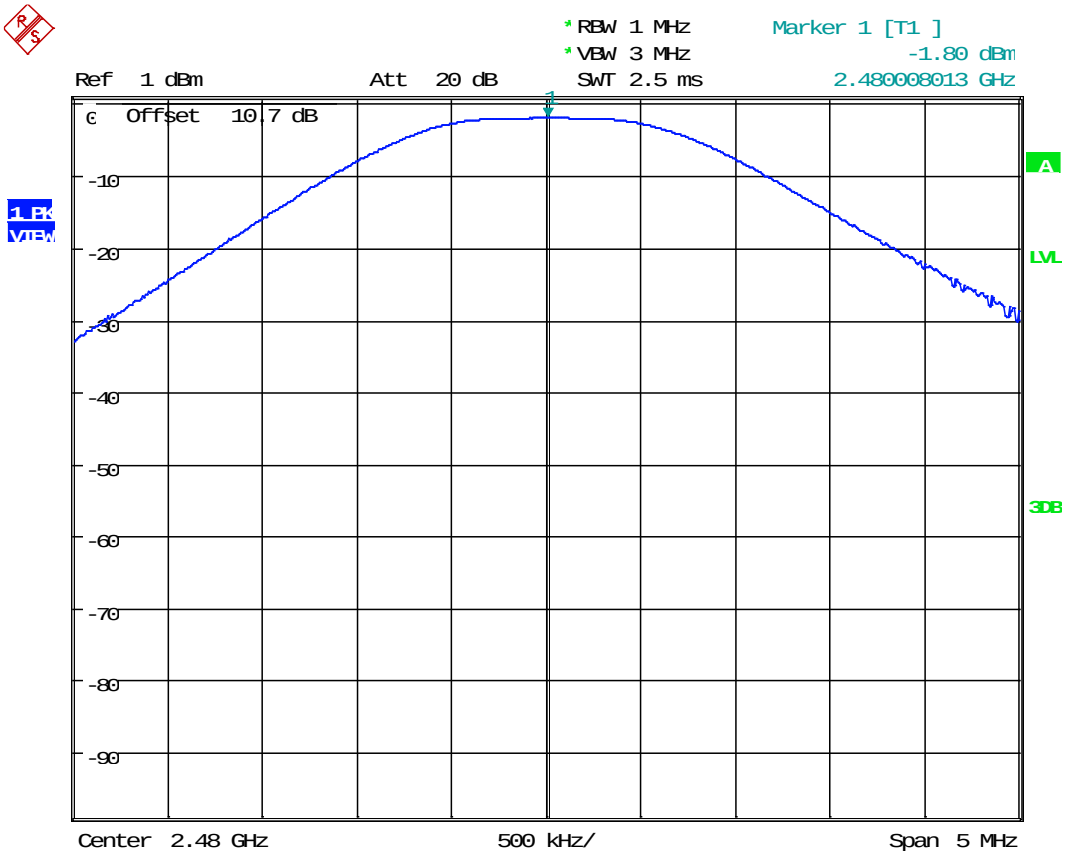
Date: 26.OCT.2016 14:04:19

Plot 2.2



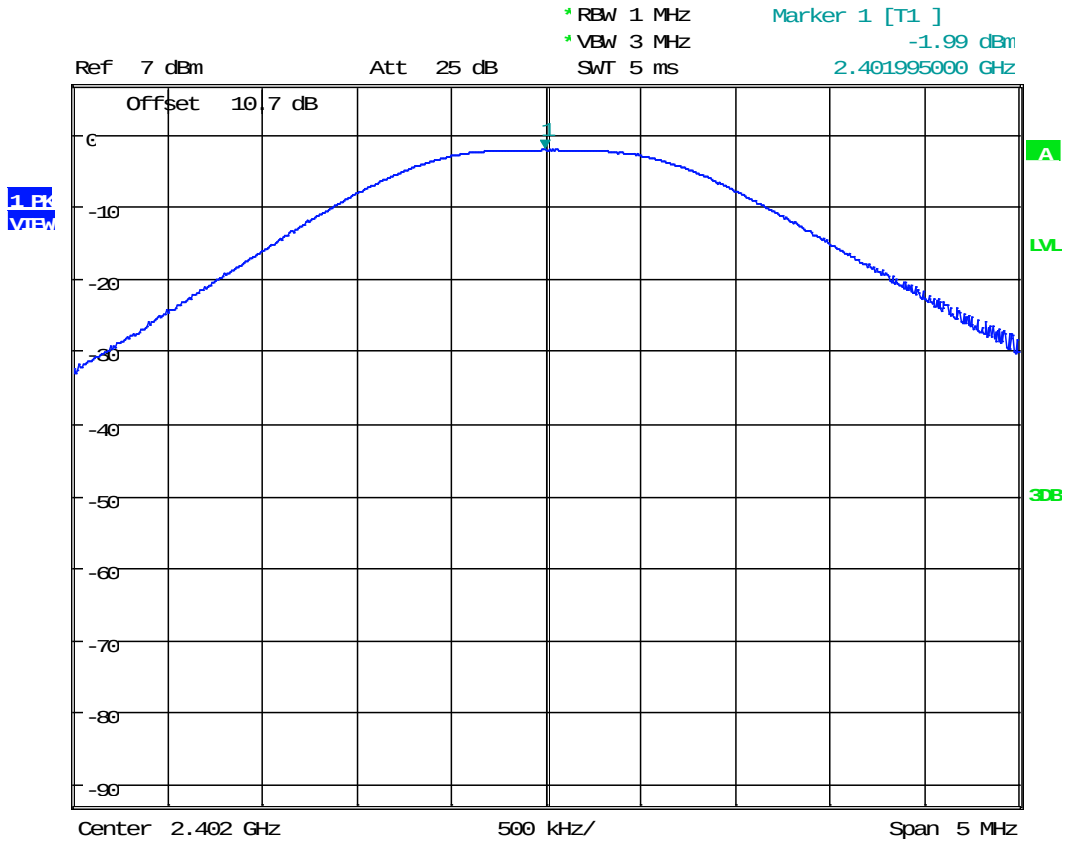
Date: 26.OCT.2016 14:03:13

Plot 2.3



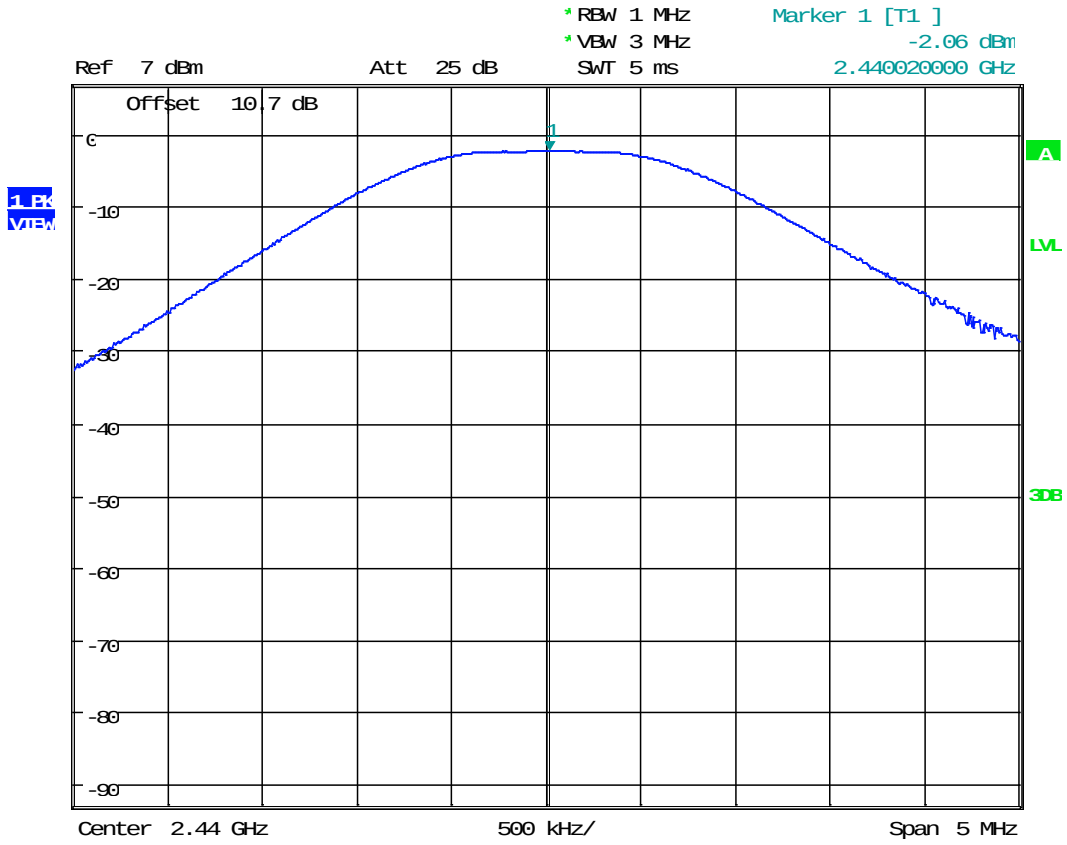
Date: 26.OCT.2016 14:03:52

Plot 2.4



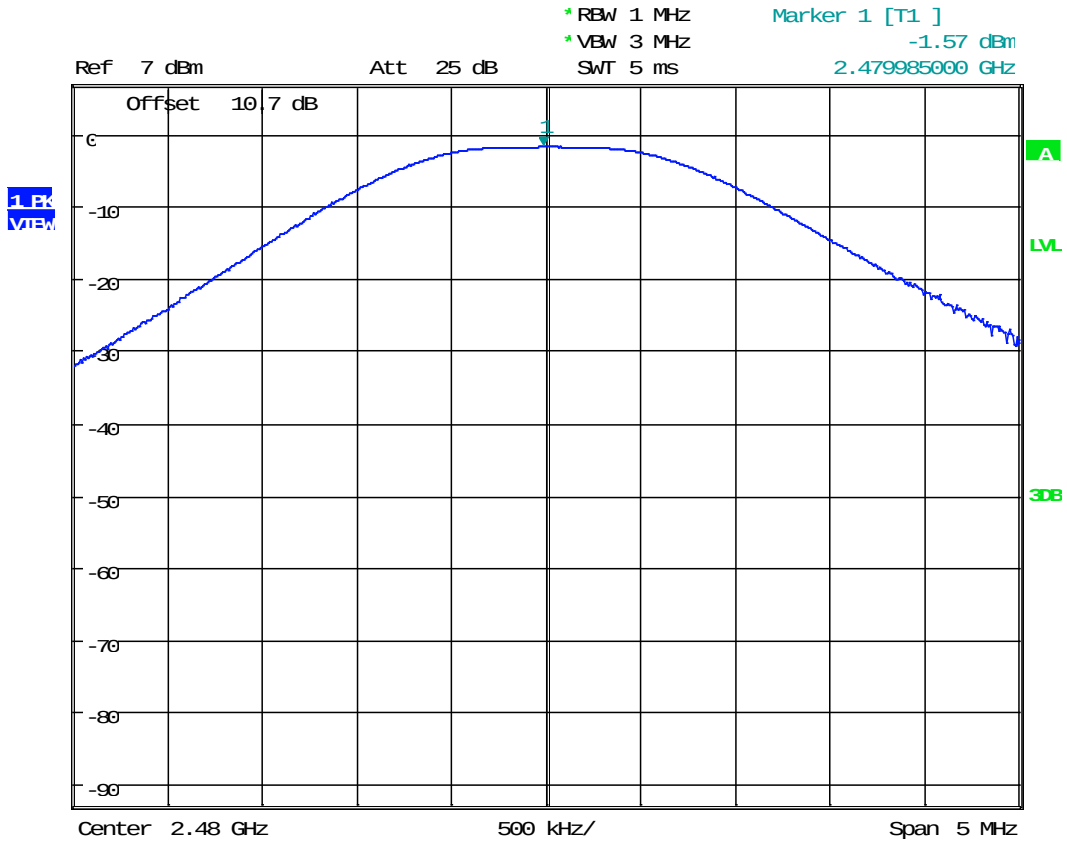
Date: 10.NOV.2016 10:53:11

Plot 2.5



Date: 10.NOV.2016 10:53:47

Plot 2.6



Date: 10.NOV.2016 10:54:19

4.3 Maximum Power Spectral Density
FCC: 15.247 (e); RSS-247 A8.2b;

4.3.1 Requirement

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

4.3.2 Procedure

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

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v03r05 April 8, 2016, specifically section 10.2 Method PKPSD (peak PSD).

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the *DTS bandwidth*.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

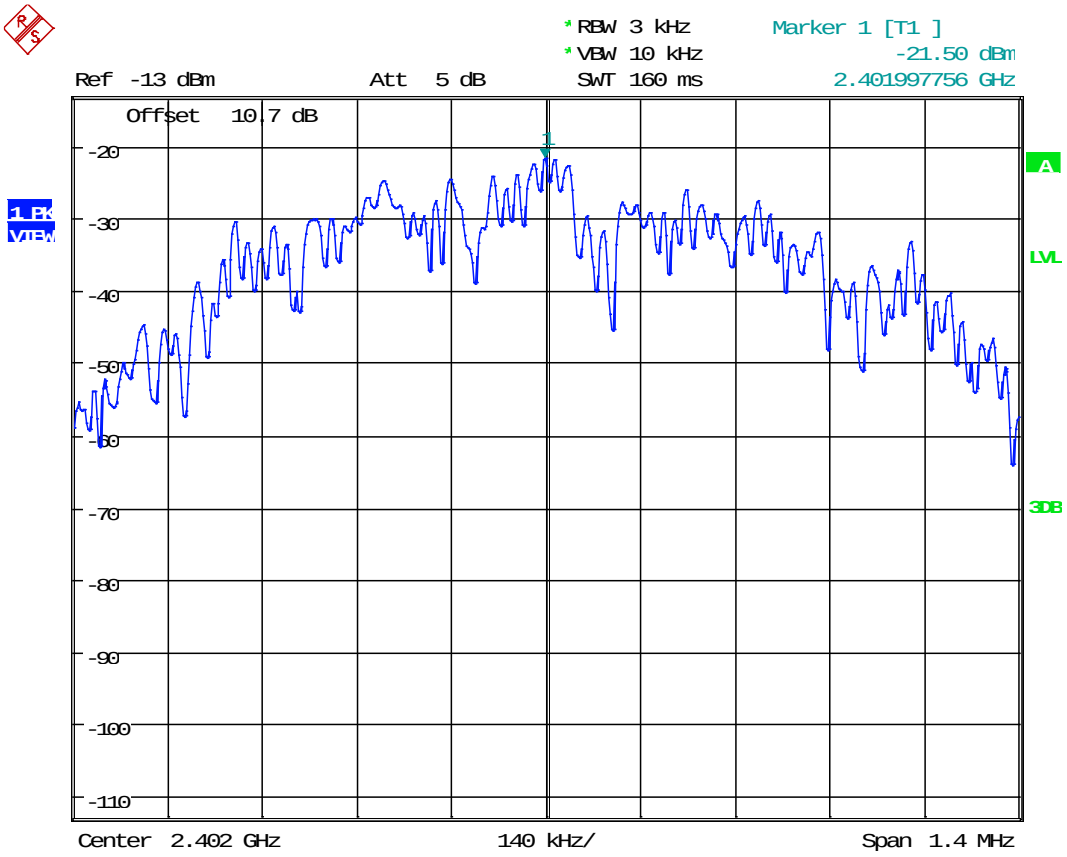
4.3.3 Test Result

Refer to the following plots 3.1 – 3.6 for the test result

Frequency, MHz	Maximum Power Spectral Density, dBm	Maximum Power Spectral Density Limit, dBm	Margin, dB	Plot
2402	-21.50	8.0	-29.5	3.1
2440	-21.56	8.0	-29.56	3.2
2480	-20.97	8.0	-28.97	3.3

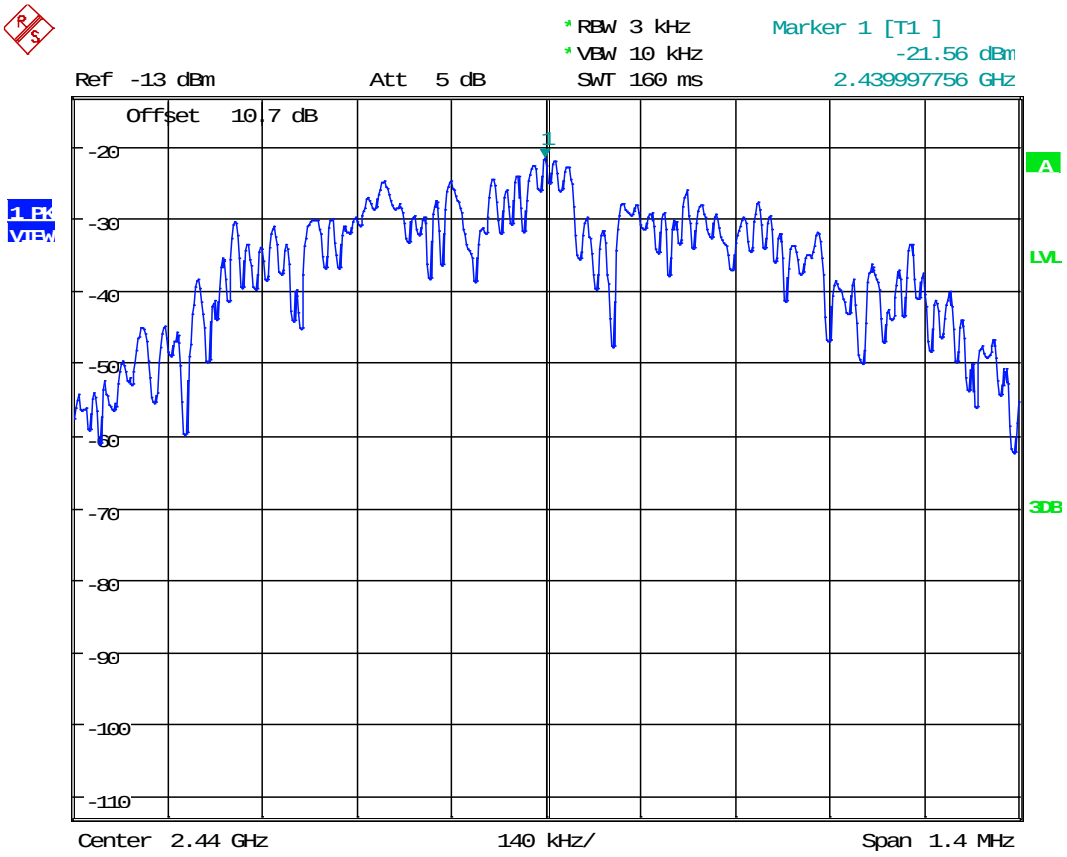
Date of Test:	October 26, 2016
Results	**Complies**

Plot 3.1



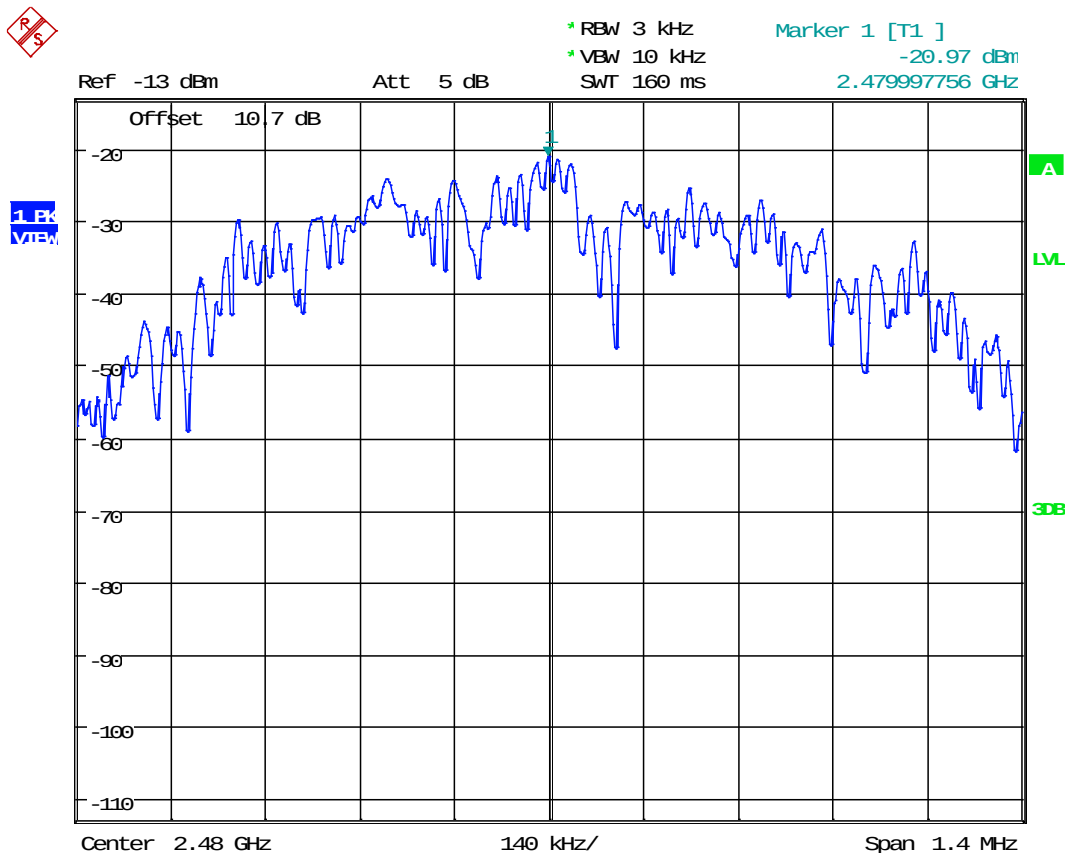
Date: 26.OCT.2016 14:08:16

Plot 3.2



Date: 26.OCT.2016 14:08:55

Plot 3.3


RBW 3 kHz
VBW 10 kHz
SWT 160 ms
Marker 1 [T1]
-20.97 dBm
2.479997756 GHz
Ref -13 dBm
Att 5 dB
Offset 10.7 dB
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
A
LVL
3DB
Center 2.48 GHz
140 kHz/
Span 1.4 MHz
Date: 26.OCT.2016 14:09:21

4.4 Unwanted Conducted Emissions
FCC: 15.247(d); RSS-247 A8.5;

4.4.1 Requirement

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be below the maximum in-band 100 kHz emissions by at least 20 dB (if peak power of in-band emission is measured) or 30 dB (if average power of in-band emission is measured).

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)

4.4.2 Procedure

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v03r05 April 8, 2016, specifically section 11.0 Emissions in non-restricted frequency bands.

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

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 3 x RBW.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

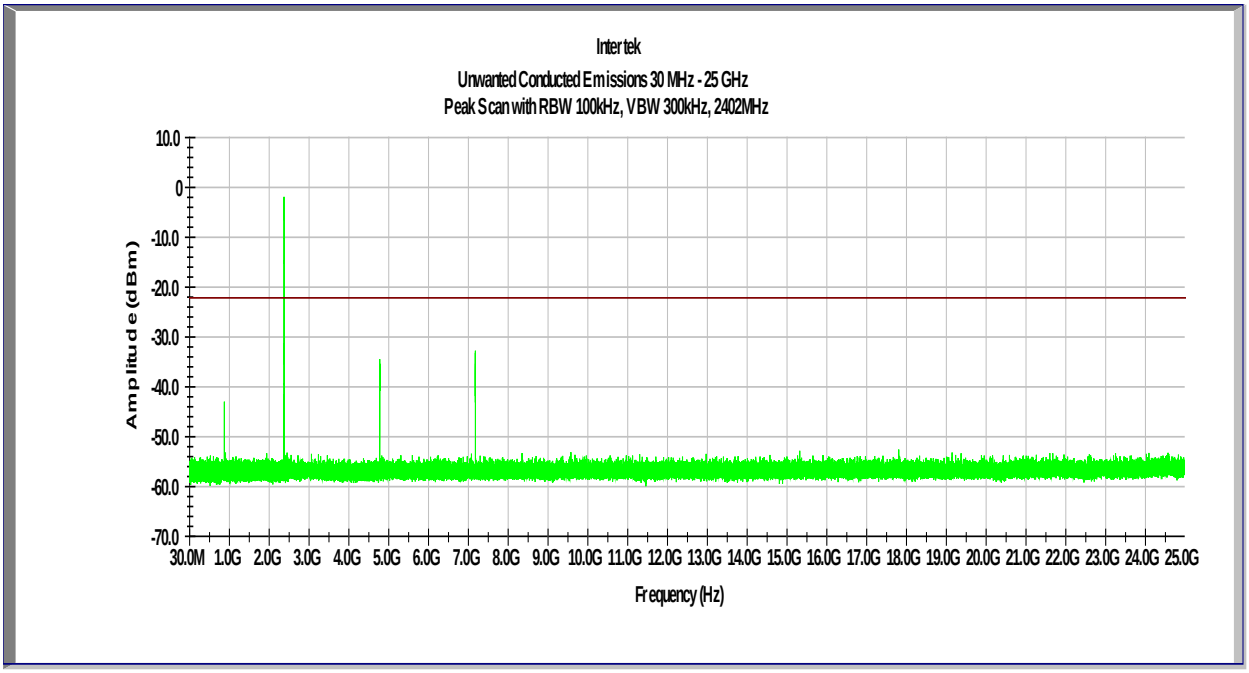
The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits.

4.4.3 Test Result

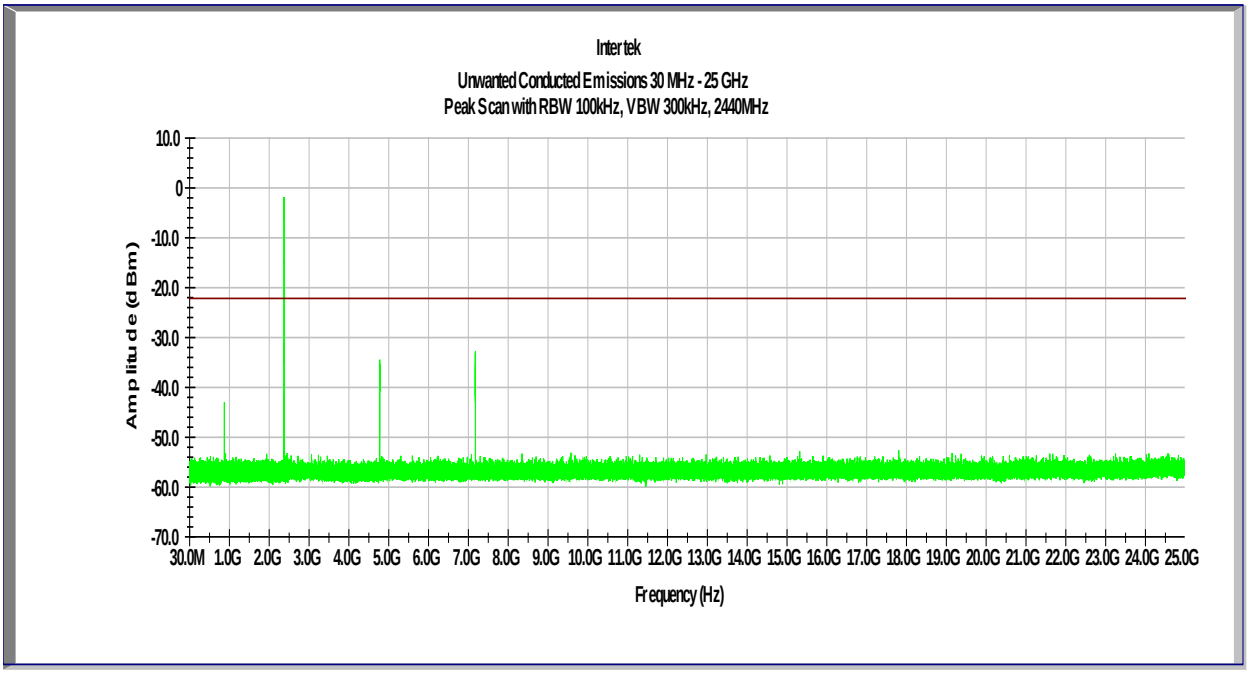
Refer to the following plots 4.1 – 4.3 for unwanted conducted emissions. The plot shows -20dB attenuation limit line.

Date of Test:	October 27, 2016
Results	**Complies**

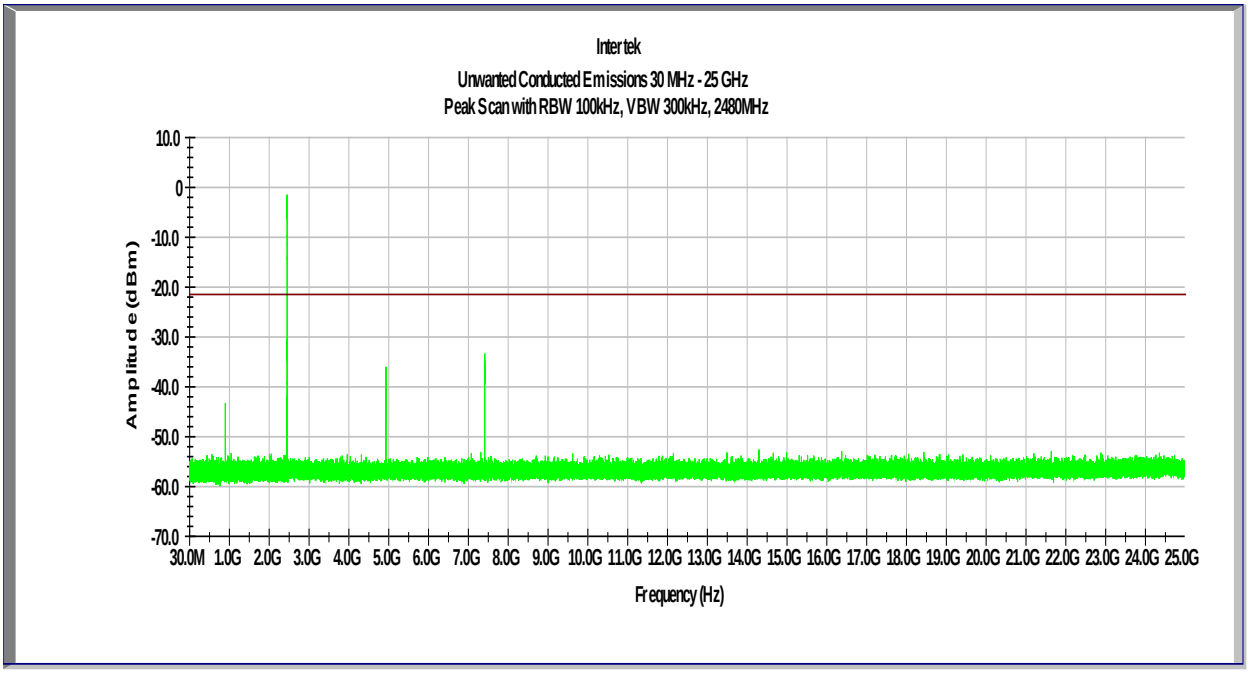
Tx @ Low Channel, 2402 MHz
30MHz -26GHz Conducted Spurious
Plot 4.1



Tx @ Mid Channel, 2440 MHz
30MHz -26GHz Conducted Spurious
Plot 4.2



Tx @ High Channel, 2480 MHz
30MHz -26GHz Conducted Spurious
Plot 4.3



4.5 Transmitter Radiated Emissions

FCC Rules: 15.247(d), 15.209, 15.205; RSS-247;

4.5.1 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.

4.5.2 Procedure

Radiated emission measurements were performed from 30 MHz to 18 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.

A preamp was used from 30MHz to 26GHz.

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

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

4.5.3 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(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV); 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(μV) 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(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
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(μV/m).
Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m.

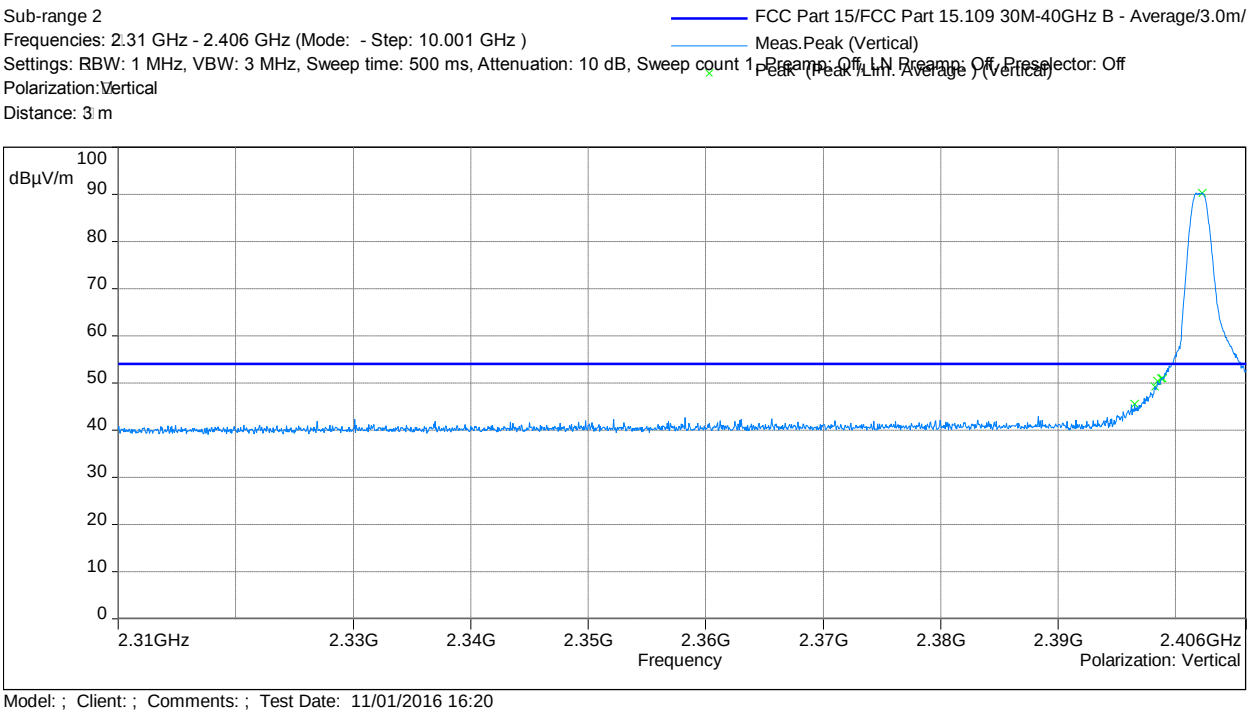
4.5.4 Test Results

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance where emissions are within 3dB of the limit.

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

Test Results: 15.209/15.205 Restricted Band Emissions

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

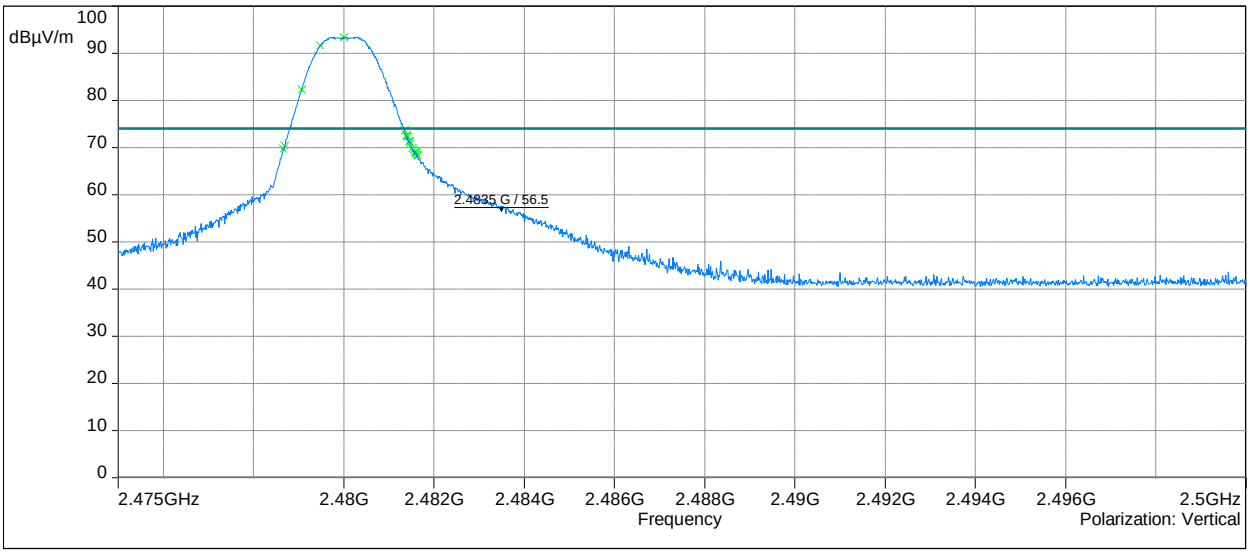


Model: ; Client: ; Comments: ; Test Date: 11/01/2016 16:20

Out-of-Band Radiated spurious emissions at the Band-edge, Charging Mode
2483.5–2500 MHz, Peak Scan

Sub-range 2
Frequencies: 2.475 GHz - 2.5 GHz (Mode: - Step: 10.001 GHz)
Settings: RBW: 1 MHz, VBW: 3 MHz, Sweep time: 500 ms, Attenuation: 10 dB, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: Off
Polarization: Vertical
Distance: 3 m

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

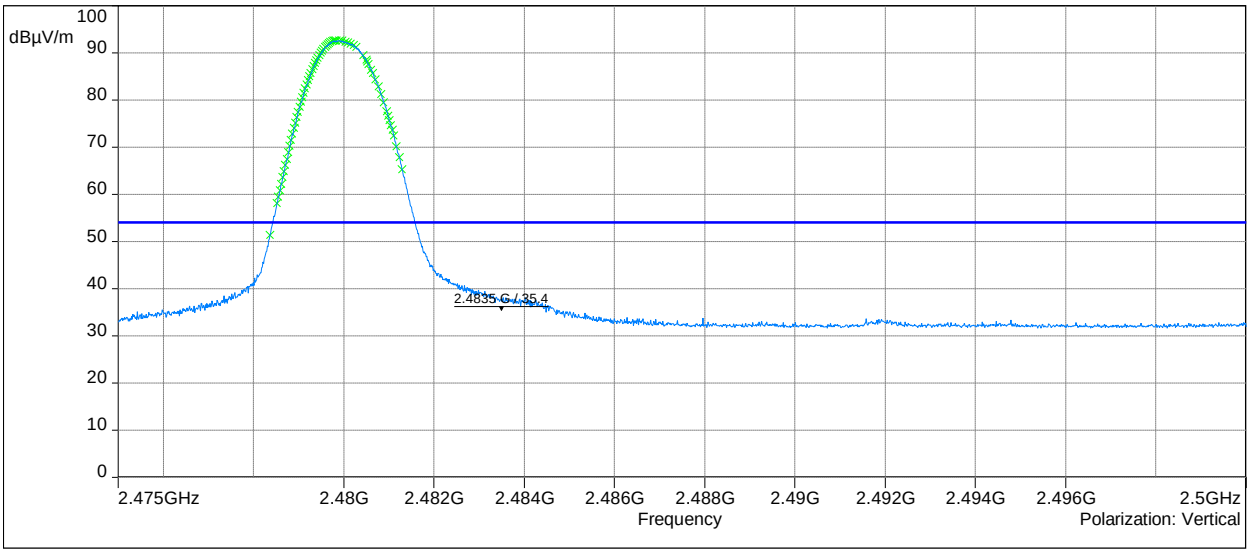


Model: ; Client: ; Comments: ; Test Date: 11/01/2016 16:52

Out-of-Band Radiated spurious emissions at the Band-edge, Charging Mode
2483.5–2500 MHz, Average Scan

Sub-range 2
Frequencies: 2.475 GHz - 2.5 GHz (Mode: - Step: 10.001 GHz)
Settings: RBW: 1 MHz, VBW: 10 kHz, Sweep time: 500 ms, Attenuation: 10 dB, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: Off
Polarization: Vertical
Distance: 3 m

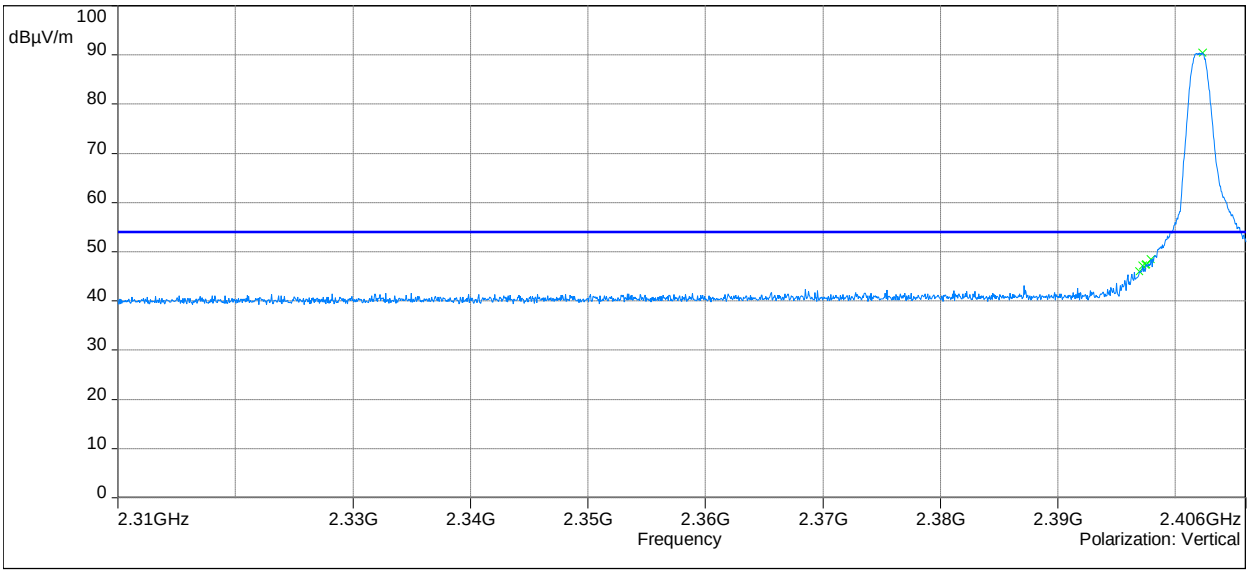
FCC Part 15/FCC Part 15.109 30M-40GHz B - Average/3.0m/
Meas.Peak (Vertical)
Peak (Peak / Lim: Average) (Vertical)



Model: ; Client: ; Comments: ; Test Date: 11/01/2016 16:59

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

Sub-range 2
Frequencies: 2.31 GHz - 2.406 GHz (Mode: - Step: 10.001 GHz)
Settings: RBW: 1 MHz, VBW: 3 MHz, Sweep time: 500 ms, Attenuation: 10 dB, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: Off
Polarization: Vertical
Distance: 3 m

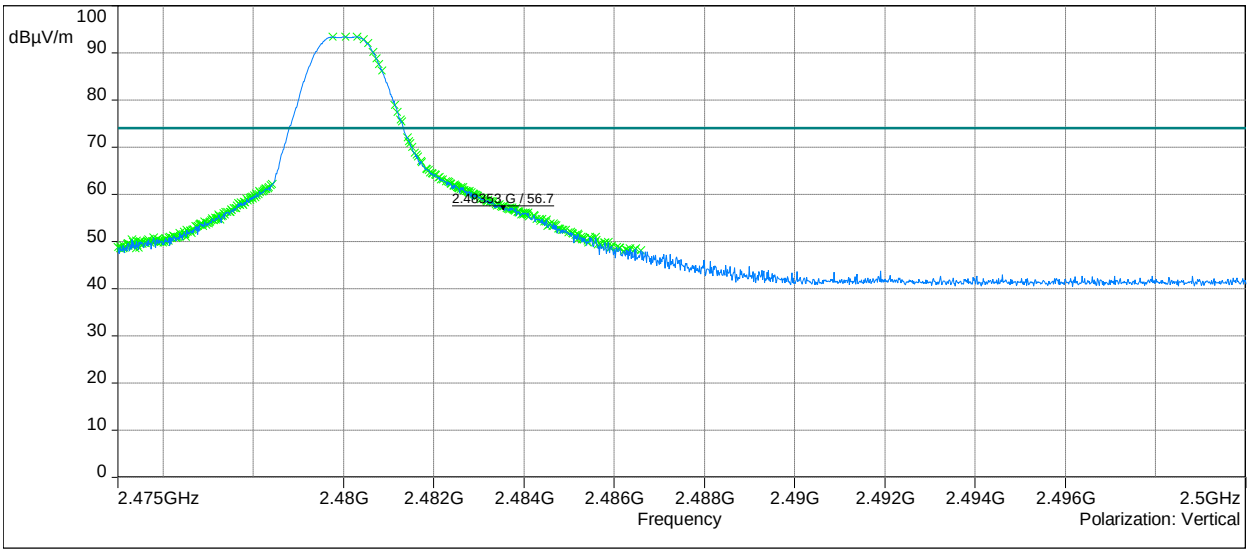


Model: ; Client: ; Comments: ; Test Date: 11/01/2016 16:27

Out-of-Band Radiated spurious emissions at the Band-edge, Battery Mode
2483.5–2500 MHz, Peak Scan

Sub-range 2
Frequencies: 2.475 GHz - 2.5 GHz (Mode: - Step: 10.001 GHz)
Settings: RBW: 1 MHz, VBW: 3 MHz, Sweep time: 500 ms, Attenuation: 10 dB, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: Off
Polarization: Vertical
Distance: 3 m

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

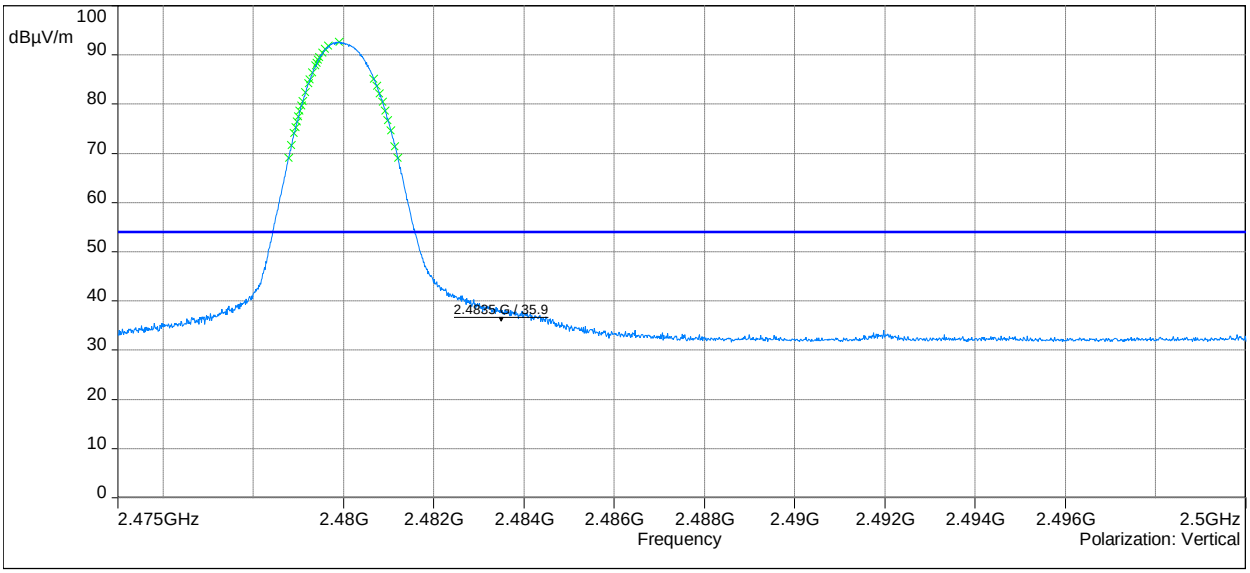


Model: ; Client: ; Comments: ; Test Date: 11/01/2016 16:35

Out-of-Band Radiated spurious emissions at the Band-edge, Battery Mode
2483.5–2500 MHz, Average Scan

Sub-range 2
Frequencies: 2.475 GHz - 2.5 GHz (Mode: - Step: 10.001 GHz)
Settings: RBW: 1 MHz, VBW: 10 kHz, Sweep time: 500 ms, Attenuation: 10 dB, Sweep count 1, Preamp: Off, LN Preamp: Off, Preselector: Off
Polarization: Vertical
Distance: 3 m

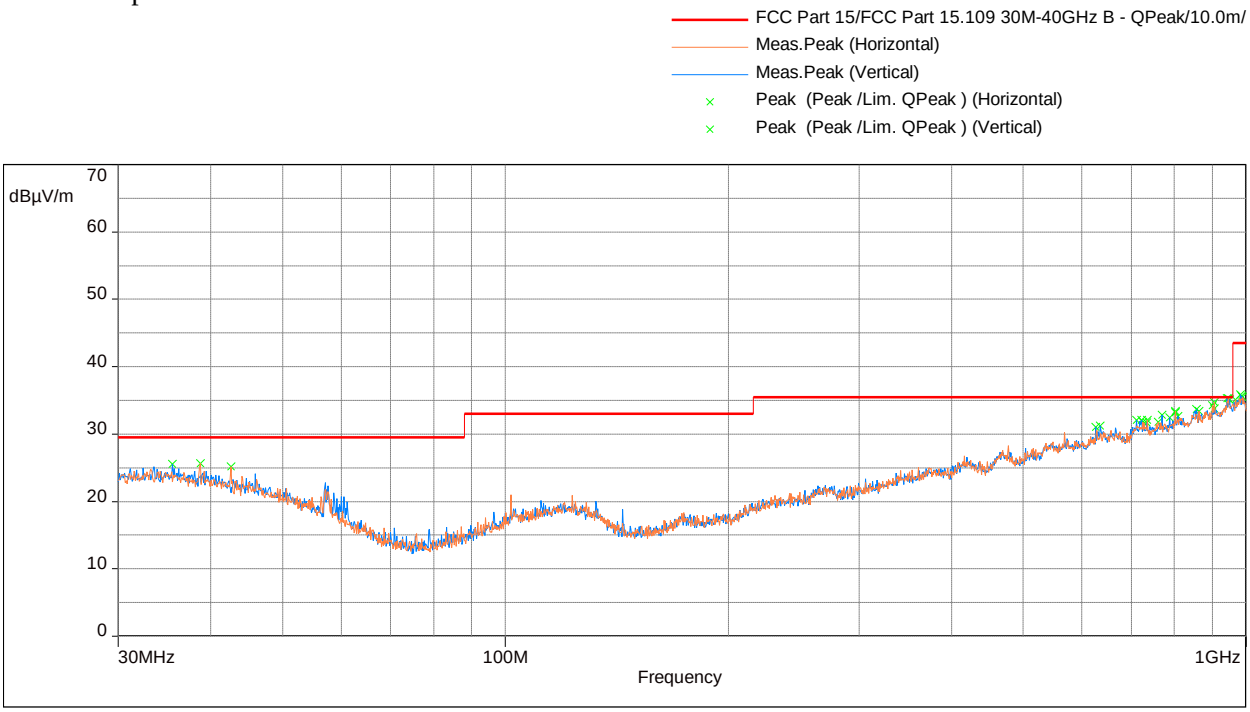
FCC Part 15/FCC Part 15.109 30M-40GHz B - Average/3.0m/
Meas.Peak (Vertical)
Peak (Peak / Lim. Peak) (Vertical)



Model: ; Client: ; Comments: ; Test Date: 11/01/2016 16:42

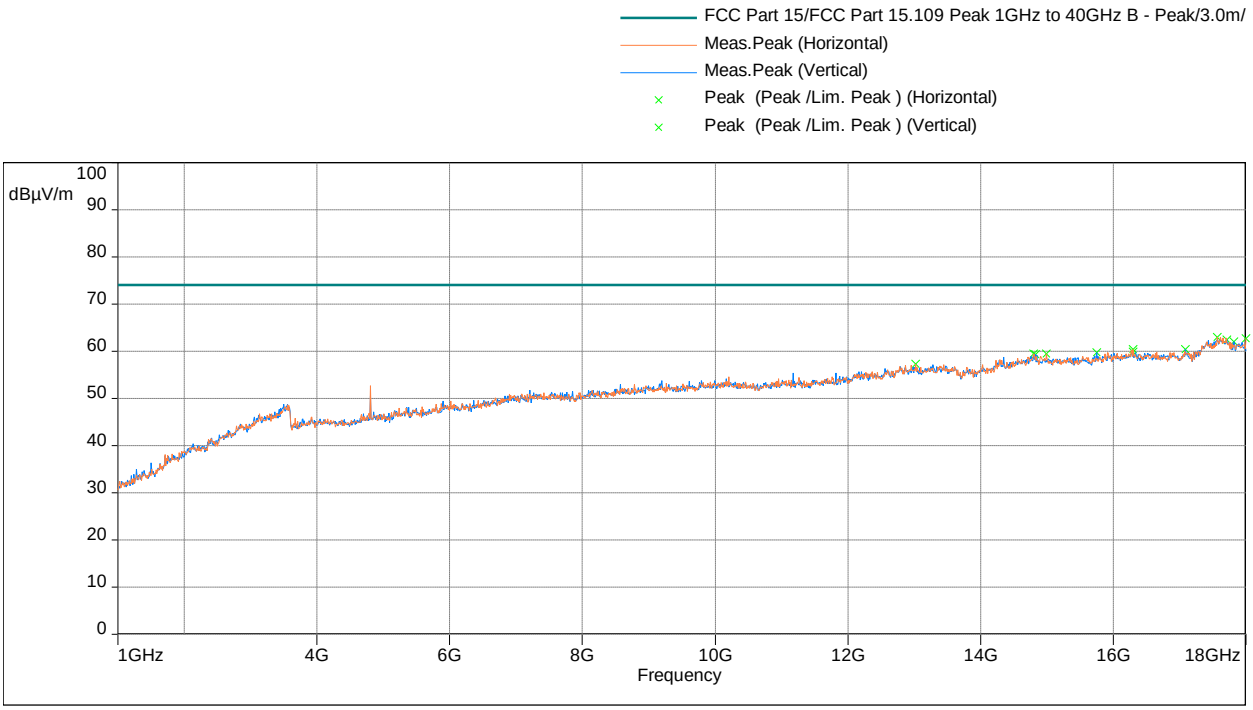
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 2402MHz, Charging Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



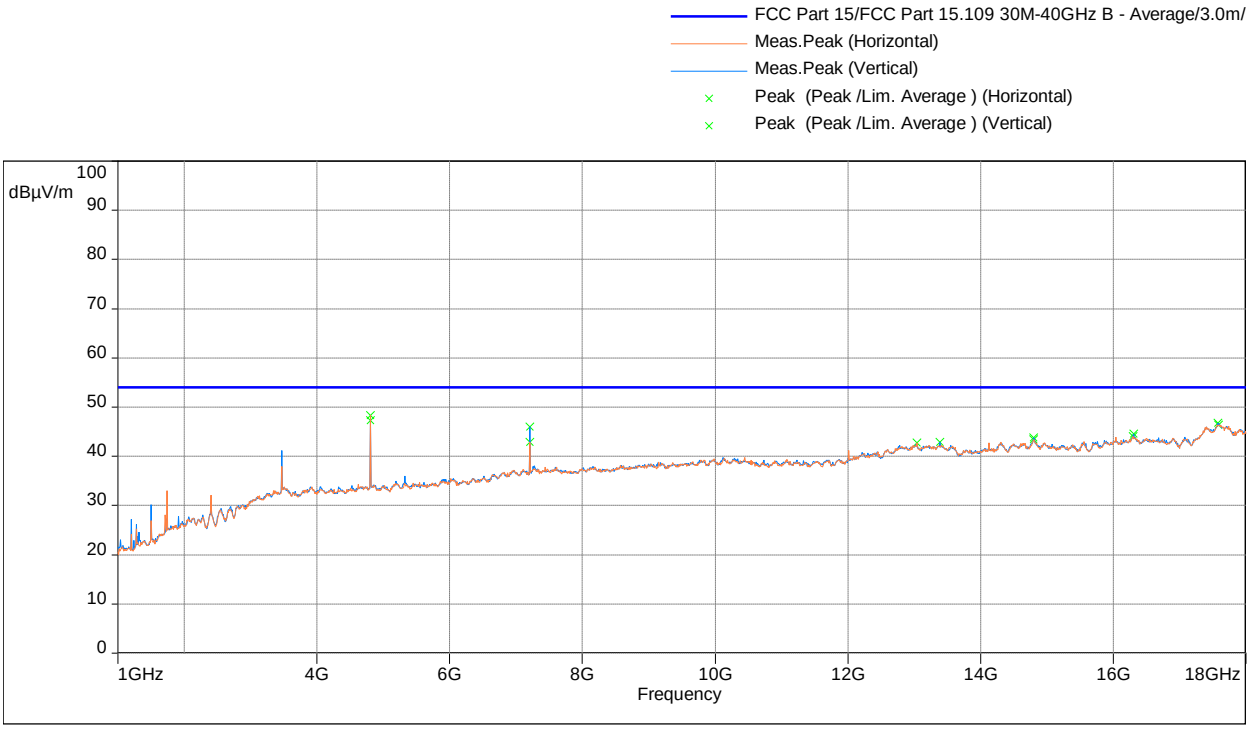
Model: ; Client: ; Comments: ; Test Date: 10/25/2016 16:44

Frequency	Peak	QP Limit	Margin	Azimuth	Height	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	deg	cm		dB(uV/m)	dB
946.456	26.35	35.5	-9.15	161	1.98	Horizontal	20.6	5.75
950.142	26.08	35.5	-9.42	8	1.02	Vertical	20.3	5.78



Model: ; Client: ; Comments: ; Test Date: 10/27/2016 10:11

Radiated Spurious Emissions 1000 - 18000 MHz, Average Scan

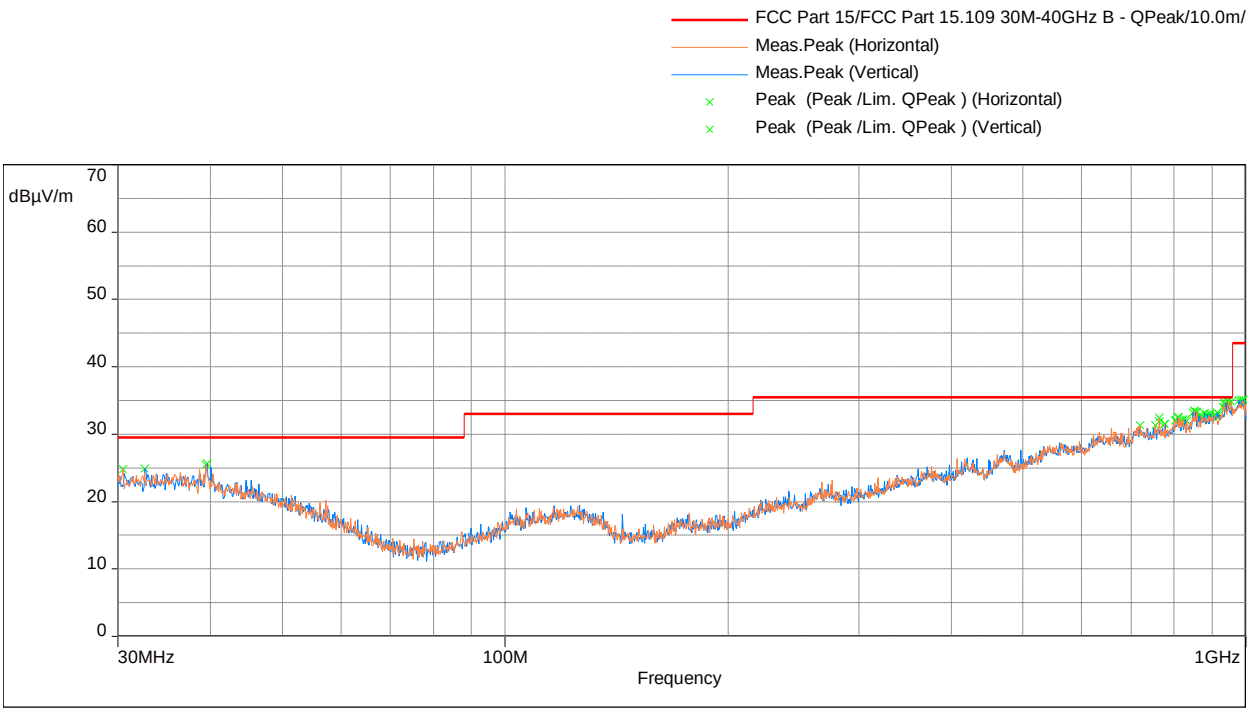


Model: ; Client: ; Comments: ; Test Date: 10/27/2016 10:00

Frequency	Pk FS	Average Limit	Margin	Height	Azimuth	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	m	deg		dB(uV/m)	dB
4804	48.4	54.0	-5.6	2.0	265	Horizontal	42.5	5.9
7206	42.9	54.0	-11.1	2.0	91	Horizontal	31.7	11.2
4804	47.3	54.0	-6.7	1.0	208	Vertical	41.5	5.9
7206	46.0	54.0	-8.1	4.0	0	Vertical	34.7	11.2

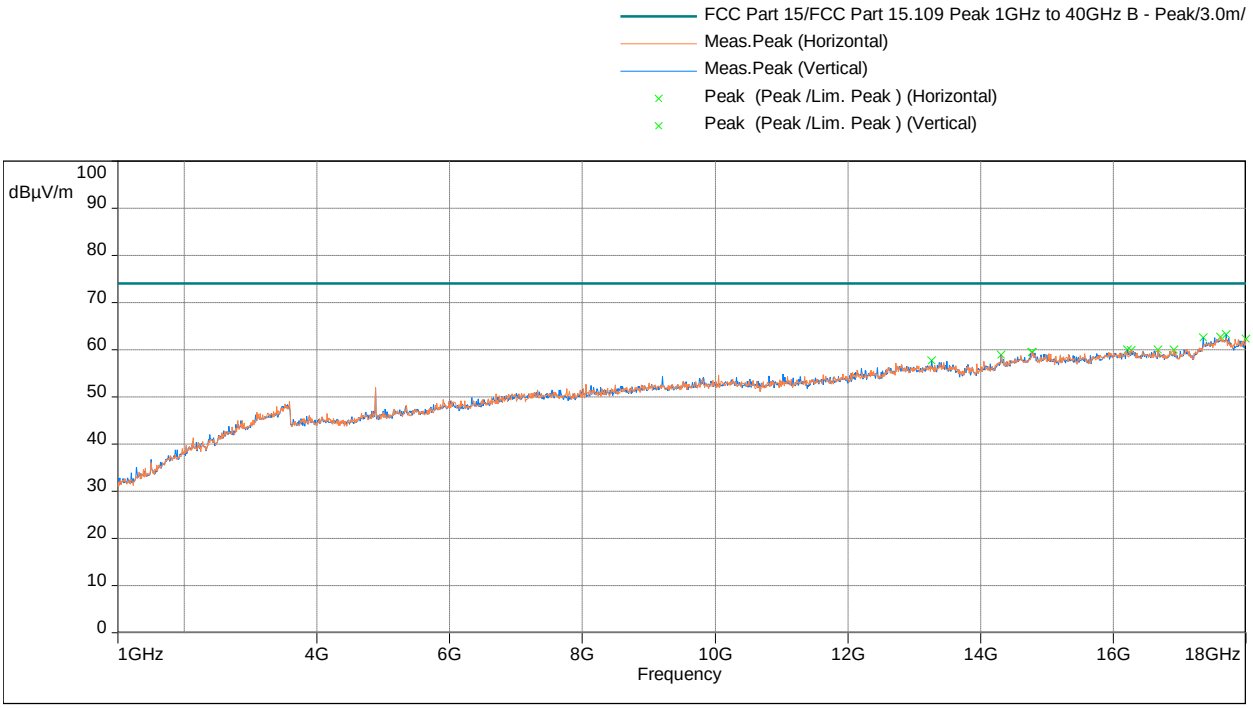
Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 2440MHz, Charging Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



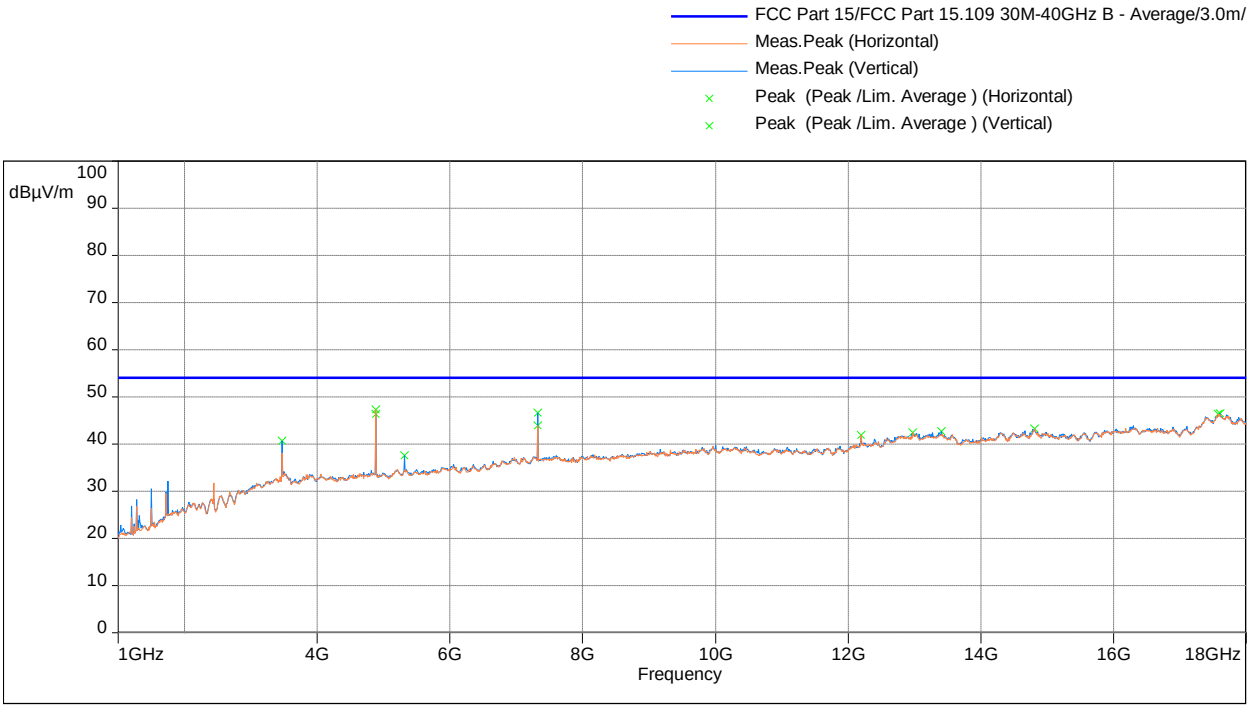
Model: ; Client: ; Comments: ; Test Date: 10/31/2016 05:48

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan



Model: ; Client: ; Comments: ; Test Date: 10/27/2016 10:23

Radiated Spurious Emissions 1000 - 18000 MHz, Average Scan

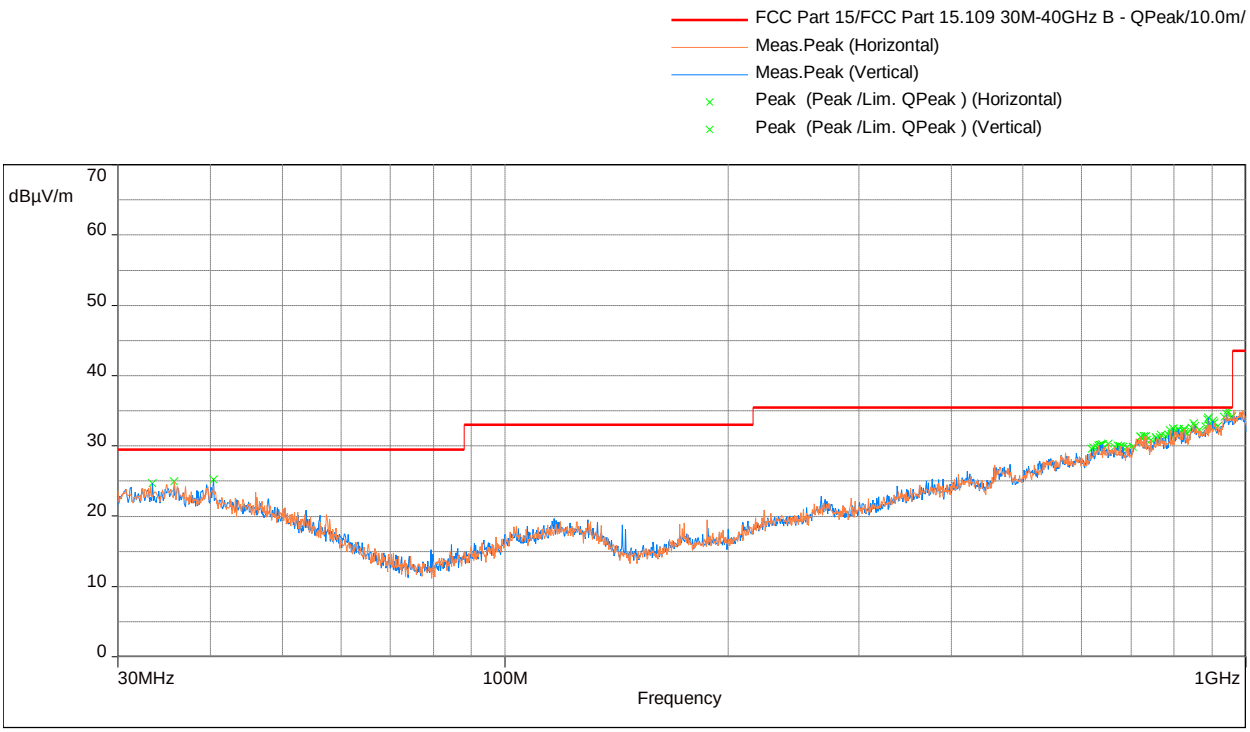


Model: ; Client: ; Comments: ; Test Date: 10/27/2016 10:47

Frequency	Pk FS	Average Limit	Margin	Height	Azimuth	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	m	deg		dB(uV/m)	dB
4880	47.3	54.0	-6.7	2.0	265	Horizontal	41.4	6.0
7320	44.0	54.0	-10.0	2.0	116	Horizontal	32.5	11.5
4880	46.4	54.0	-7.6	1.0	218	Vertical	40.4	6.0
7320	46.7	54.0	-7.3	4.0	240	Vertical	35.2	11.5

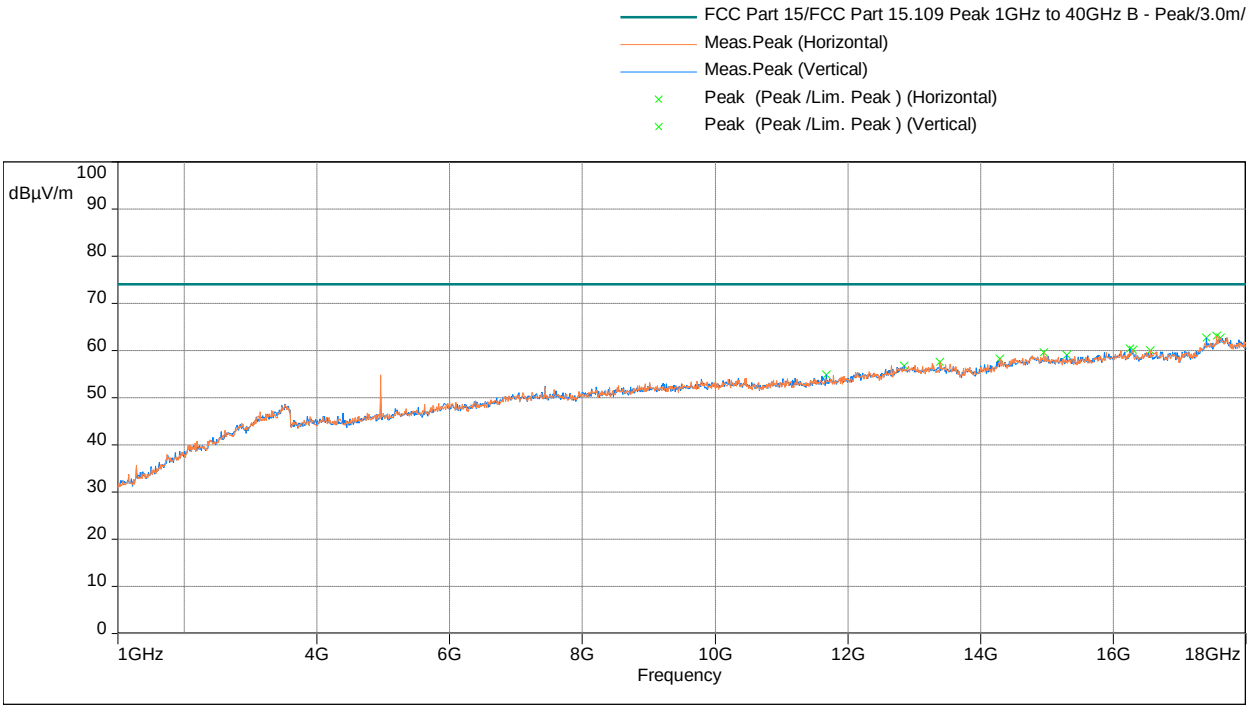
Test Results: 15.209 Radiated Spurious Emissions High Channel, Tx at 2480MHz, Charging Mode

Radiated Spurious Emissions 30 MHz - 1000 MHz



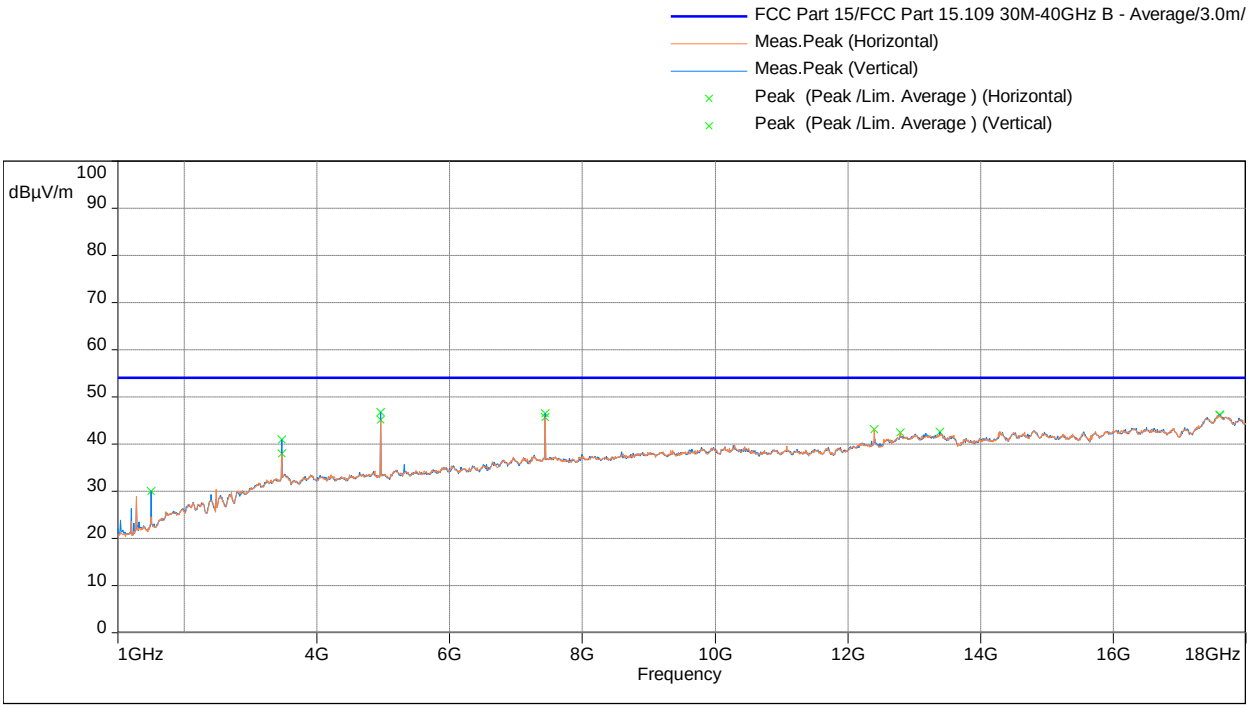
Model: ; Client: ; Comments: ; Test Date: 10/31/2016 05:59

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan



Model: ; Client: ; Comments: ; Test Date: 10/27/2016 10:58

Radiated Spurious Emissions 1000 - 18000 MHz, Average Scan

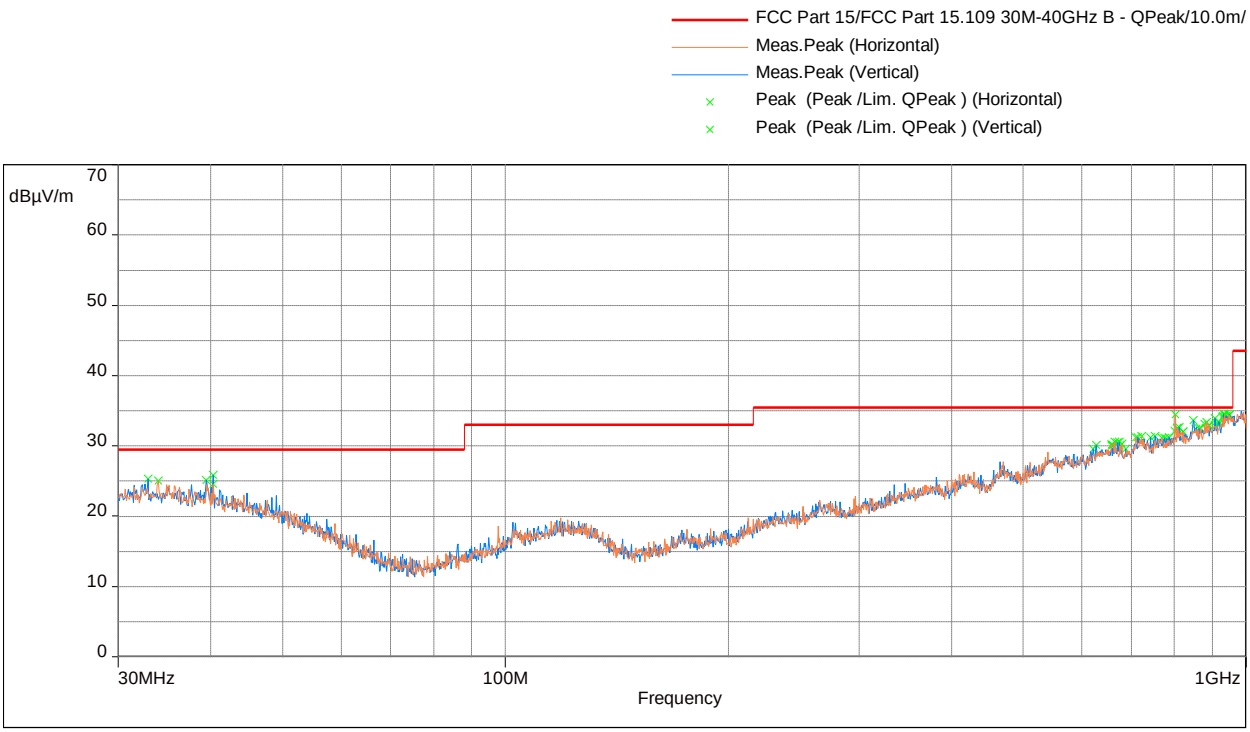


Model: ; Client: ; Comments: ; Test Date: 10/27/2016 11:05

Frequency	Pk FS	Average Limit	Margin	Height	Azimuth	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	m	deg		dB(uV/m)	dB
4960	45.2	54.0	-8.8	1.0	218	Horizontal	39.1	6.1
7440	45.7	54.0	-8.3	2.0	314	Horizontal	34.4	11.3
4960	46.7	54.0	-7.3	1.0	70	Vertical	40.6	6.1
7440	46.4	54.0	-7.6	2.0	17	Vertical	35.1	11.3

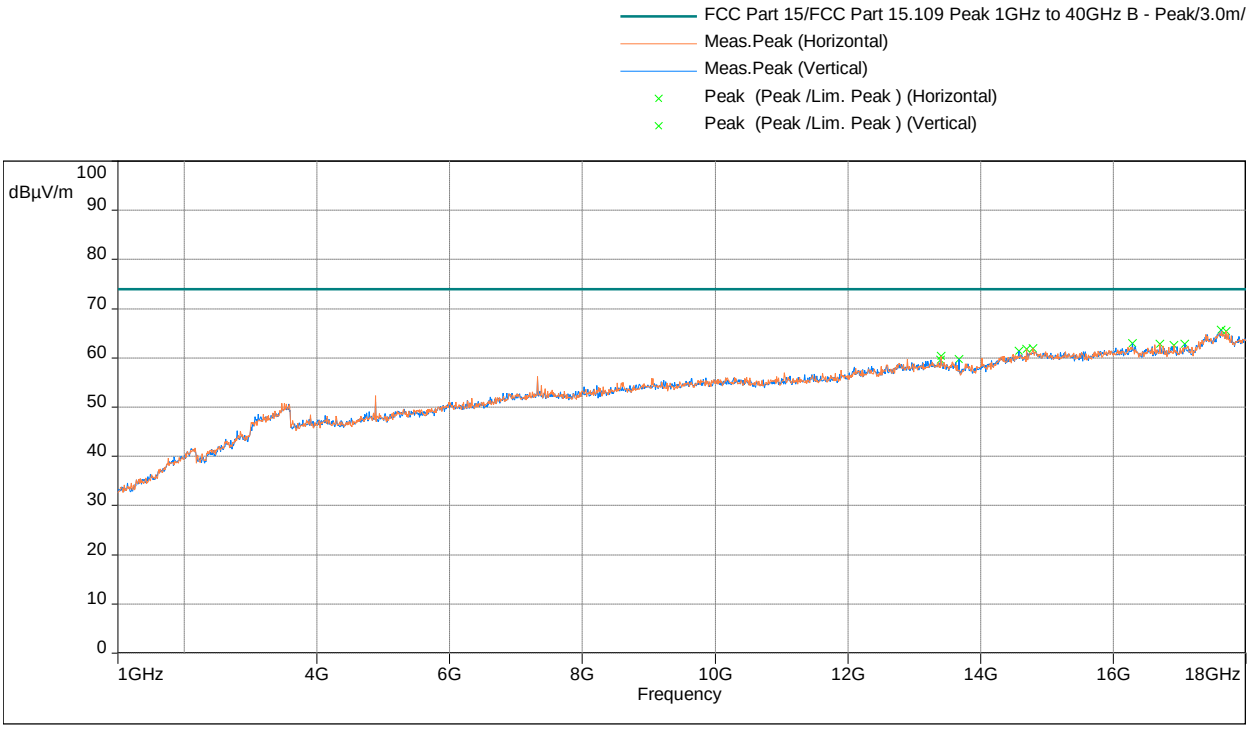
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 2402MHz, Battery Power

Radiated Spurious Emissions 30 MHz - 1000 MHz



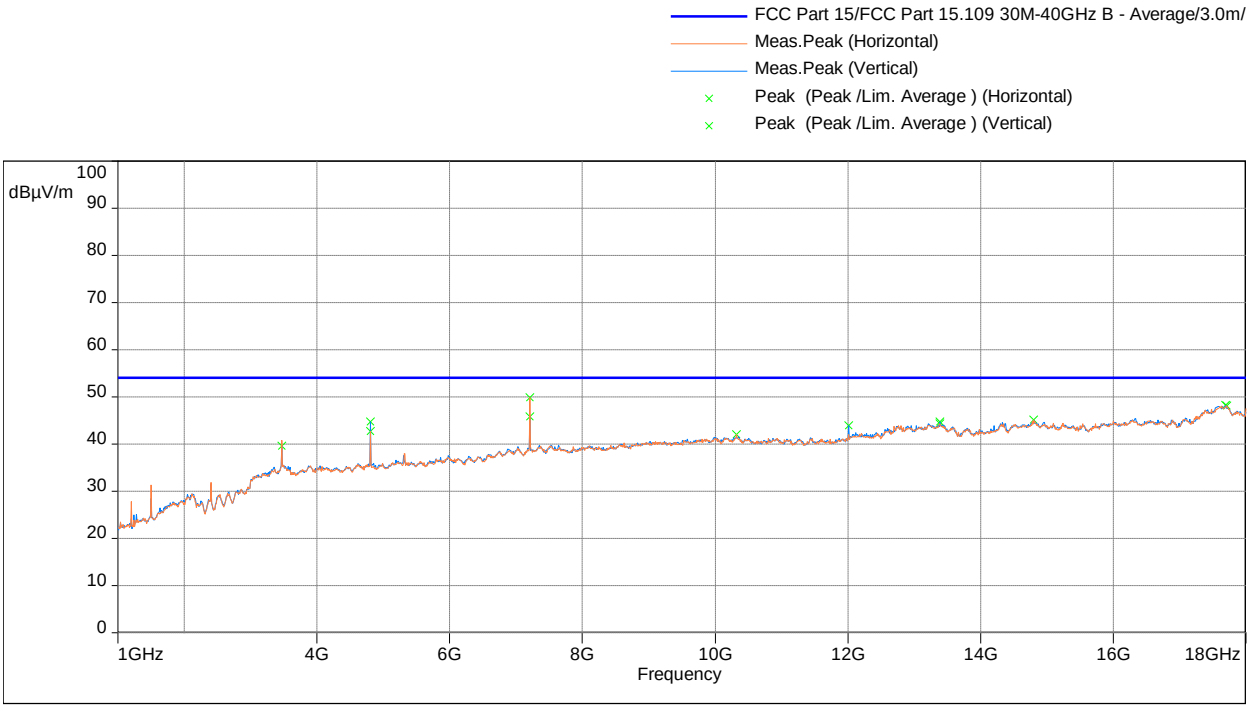
Model: ; Client: ; Comments: ; Test Date: 10/31/2016 06:23

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 10:29

Radiated Spurious Emissions 1000 - 18000 MHz, Average Scan

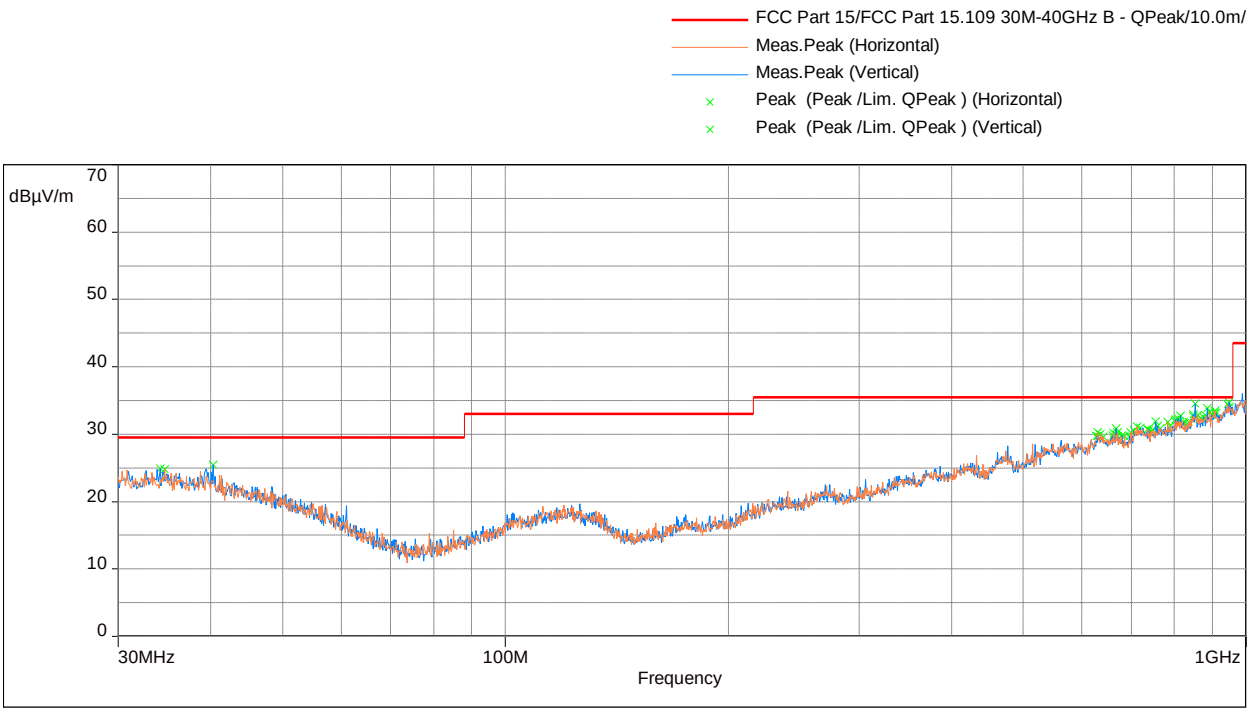


Model: ; Client: ; Comments: ; Test Date: 10/31/2016 10:18

Frequency	Pk FS	Average Limit	Margin	Height	Azimuth	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	m	deg		dB(uV/m)	dB
4804	42.7	54.0	-11.3	2.0	339	Horizontal	34.7	8.0
7206	49.9	54.0	-4.2	2.0	0	Horizontal	36.3	13.5
4804	44.69	54	-9.3	2.9	292	Vertical	36.7	8
7206	45.76	54	-8.2	2.9	0	Vertical	32.2	13.5

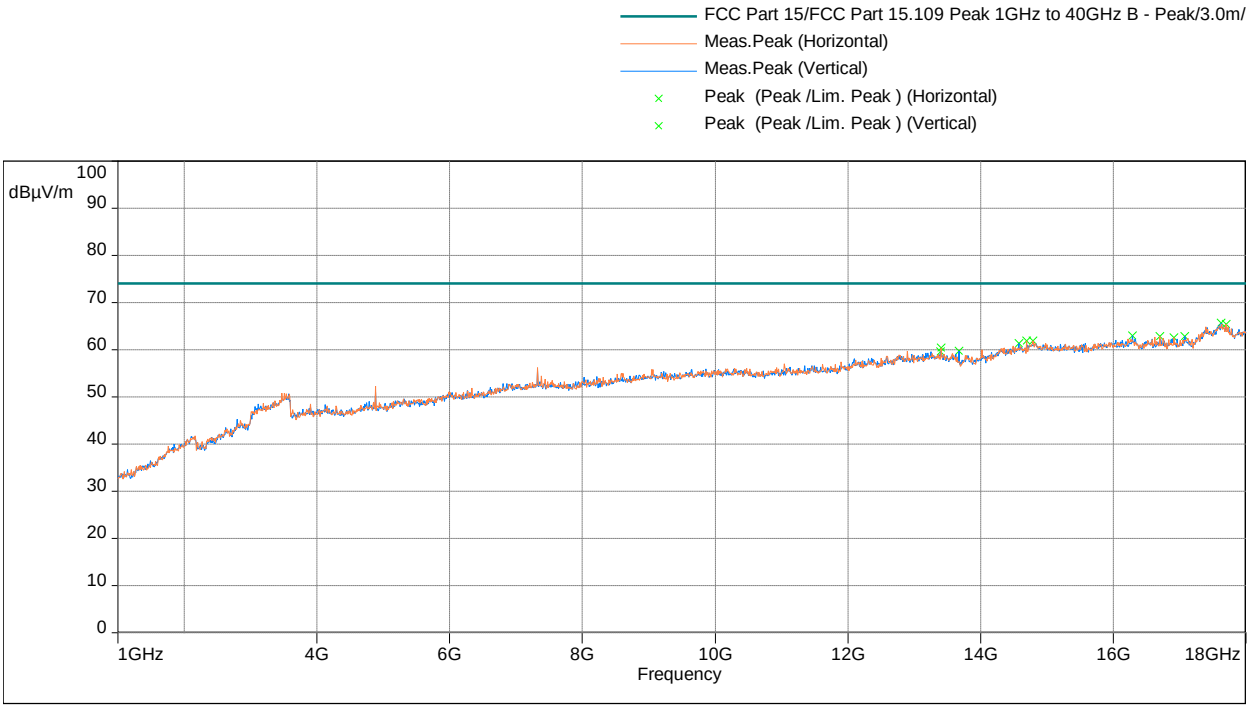
Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 2440MHz, Battery Power

Radiated Spurious Emissions 30 MHz - 1000 MHz



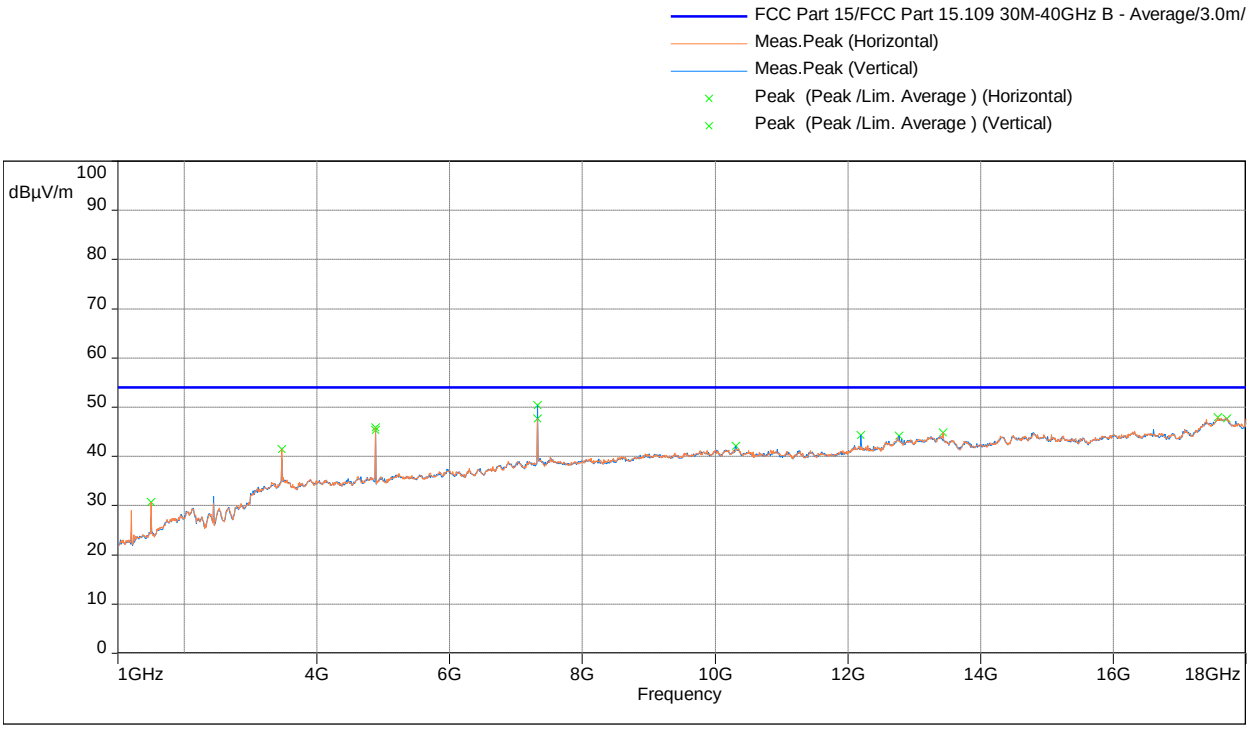
Model: ; Client: ; Comments: ; Test Date: 10/31/2016 06:31

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 10:29

Radiated Spurious Emissions 1000 - 18000 MHz, Average Scan

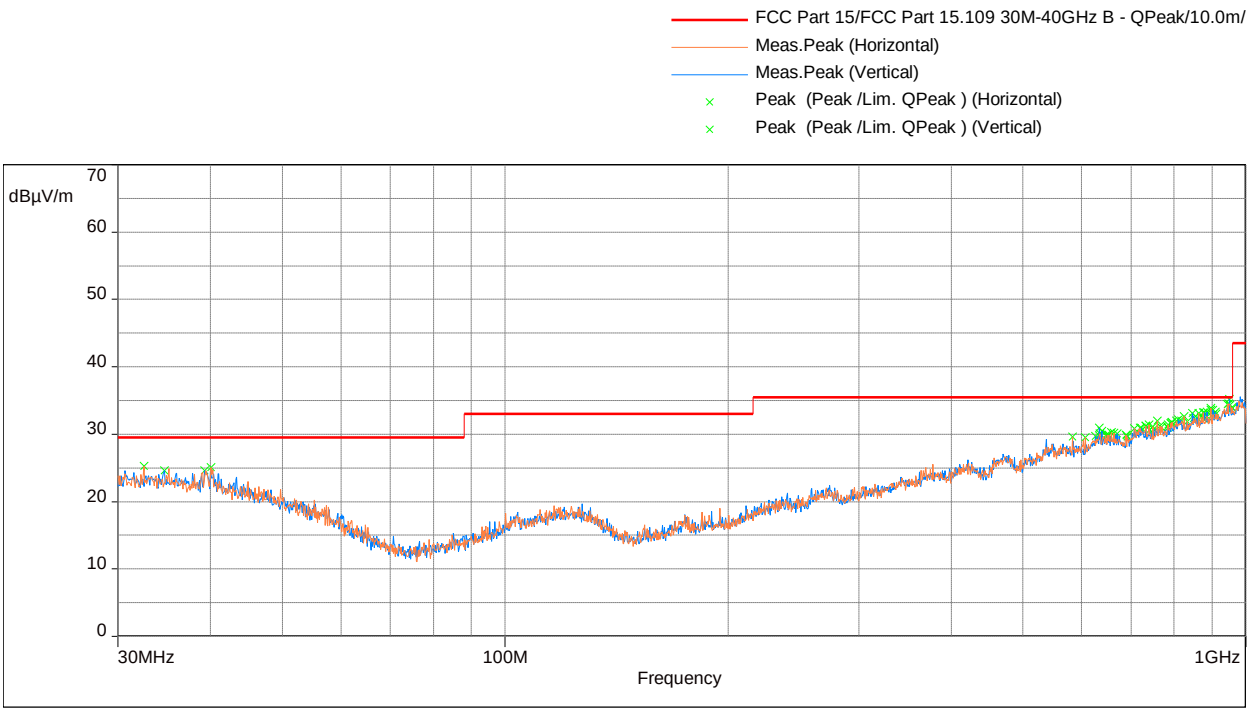


Model: ; Client: ; Comments: ; Test Date: 10/31/2016 10:36

Frequency	Pk FS	Average Limit	Margin	Height	Azimuth	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	m	deg		dB(uV/m)	dB
4880	45.9	54.0	-8.1	2.0	215	Horizontal	37.8	8.1
7320	47.6	54.0	-6.4	2.0	339	Horizontal	33.8	13.8
4880	45.3	54.0	-8.7	2.0	0	Vertical	37.2	8.1
7320	50.4	54.0	-3.6	2.0	0	Vertical	36.6	13.8

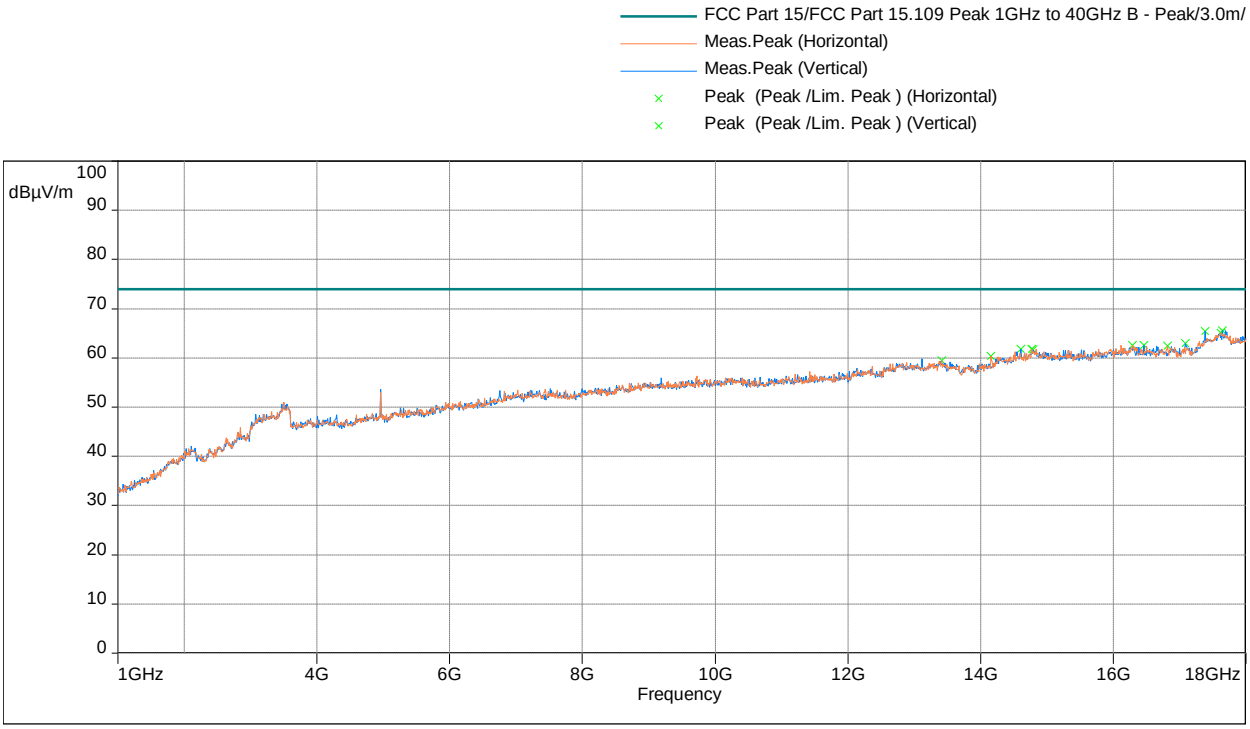
Test Results: 15.209 Radiated Spurious Emissions High Channel, Tx at 2480MHz, Battery Power

Radiated Spurious Emissions 30 MHz - 1000 MHz



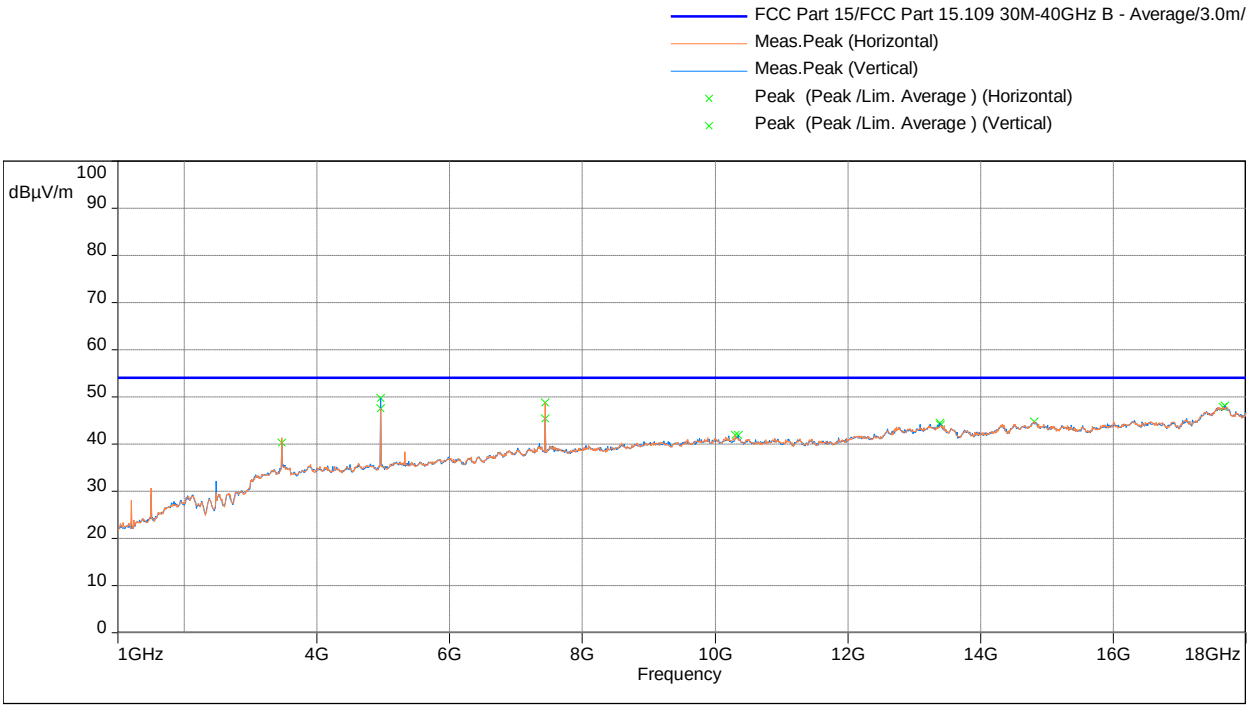
Model: ; Client: ; Comments: ; Test Date: 10/31/2016 06:15

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 10:45

Radiated Spurious Emissions 1000 - 18000 MHz, Average Scan



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 10:53

Frequency	Pk FS	Average Limit	Margin	Height	Azimuth	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	m	deg		dB(uV/m)	dB
4960	47.5	54.0	-6.5	2.0	66	Horizontal	39.3	8.3
7440	48.7	54.0	-5.3	1.0	0	Horizontal	35.1	13.7
4960	49.8	54.0	-4.2	2.0	0	Vertical	41.5	8.3
7440	45.5	54.0	-8.6	2.0	91	Vertical	31.8	13.7

Results	**Complies by 3.6dB**

4.5.8 Test setup photographs

The following photographs show the testing configurations used.

4.5.5 Test setup photographs (Continued)

4.6 Radiated Emissions

FCC Ref: 15.109, ICES 003

4.6.1 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

4.6.2 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.

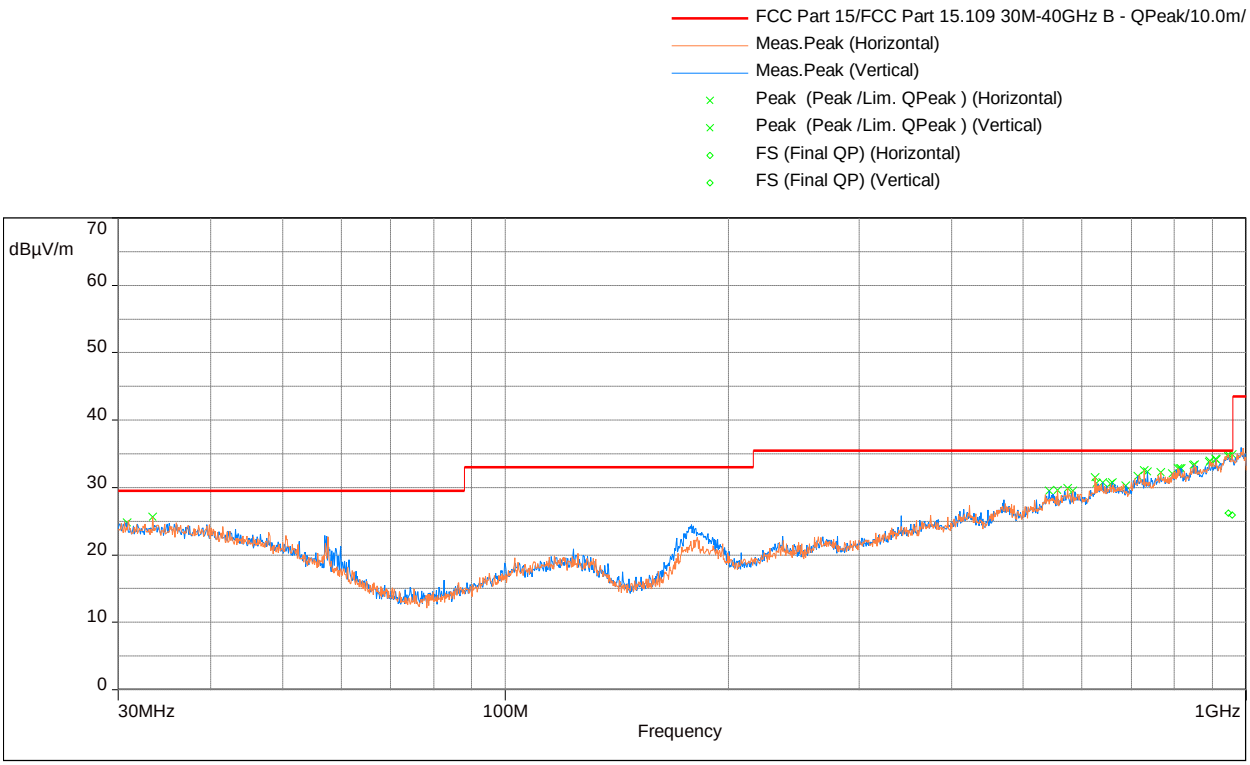
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4 and EN 55022.

4.6.3 Test Results

Date of Test:	October 25 & November 16, 2016
Results	**Complies**

Test Results: Radiated Emissions 30 MHz – 1000 MHz, Charging mode

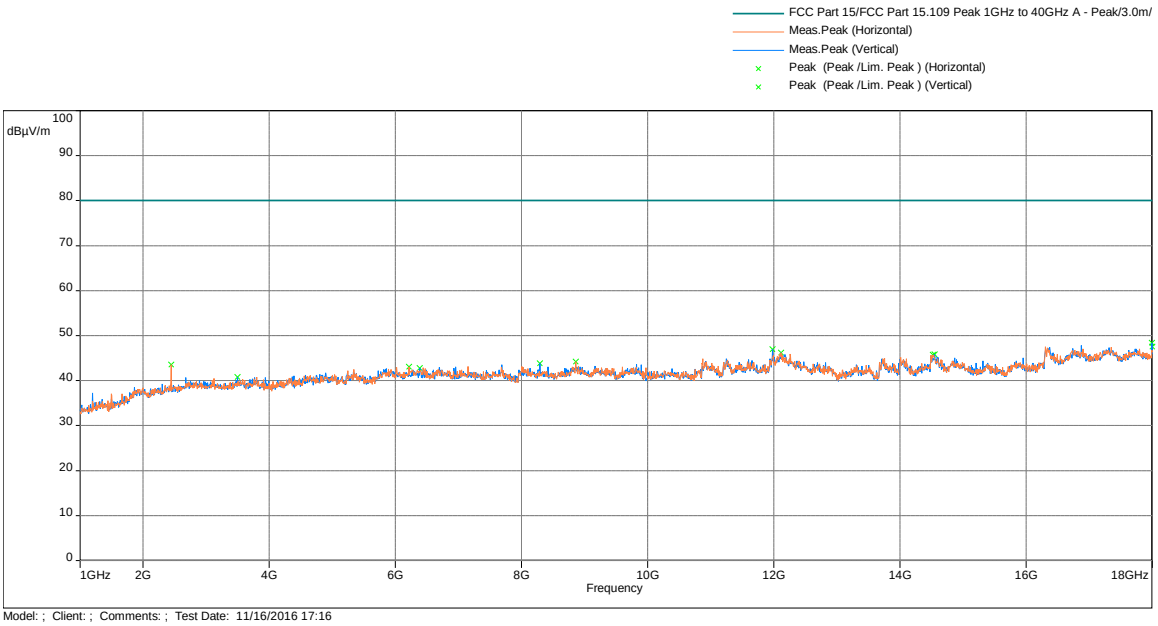


Model: ; Client: ; Comments: ; Test Date: 10/25/2016 09:33

Frequency	Quasi Pk FS	Limit	Margin	Azimuth	Height	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	deg	cm		dB(uV/m)	dB
30.873	24.8	29.5	-4.7	23.3	1.0	Vertical	28.8	-4.1
33.395	18.0	29.5	-11.5	35.3	2.9	Horizontal	22.2	-4.2
808.328	23.8	35.5	-11.7	94.3	1.0	Horizontal	20.5	3.3
813.372	23.9	35.5	-11.6	163.8	2.0	Vertical	20.6	3.3
946.394	26.2	37.0	-10.8	3.0	3.0	Vertical	20.4	5.8
957.790	25.9	37.0	-11.1	98.5	2.0	Horizontal	20.5	5.5

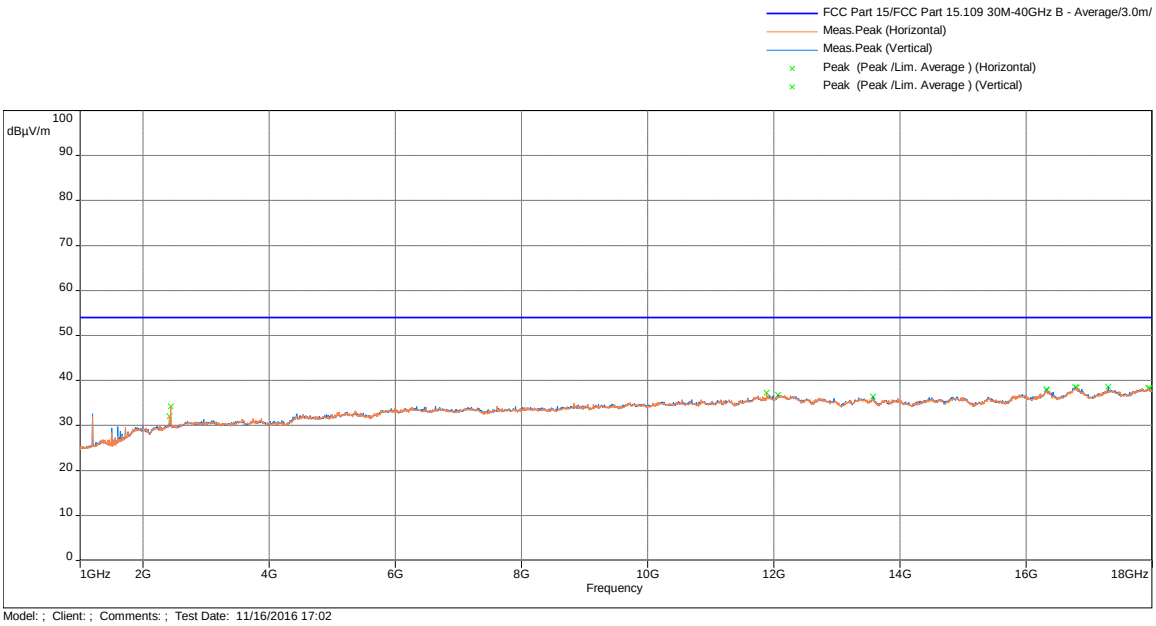
4.6.3 Test Results (Continued)

Radiated Emissions 1GHz – 18GHz, Peak, Charging mode



Model: ; Client: ; Comments: ; Test Date: 11/16/2016 17:16

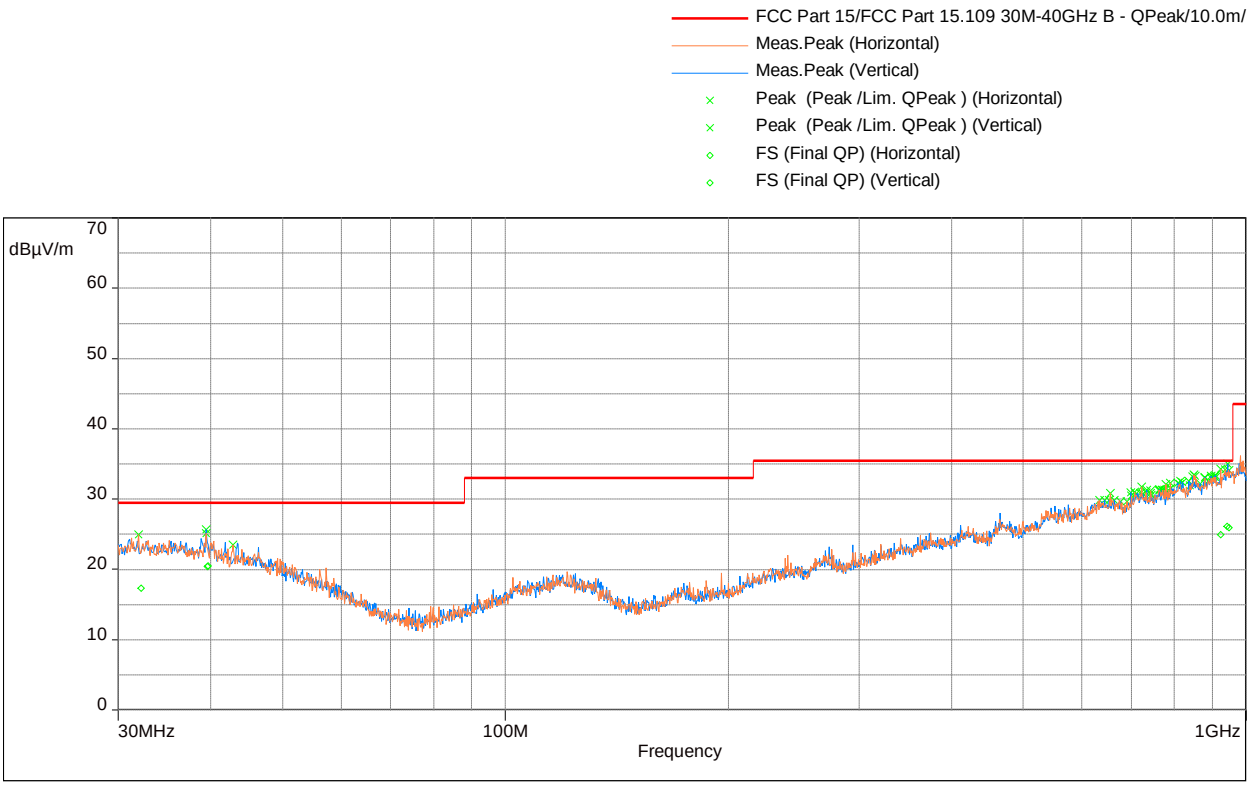
Radiated Emissions 1GHz – 18GHz, Average, Charging mode



Model: ; Client: ; Comments: ; Test Date: 11/16/2016 17:02

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

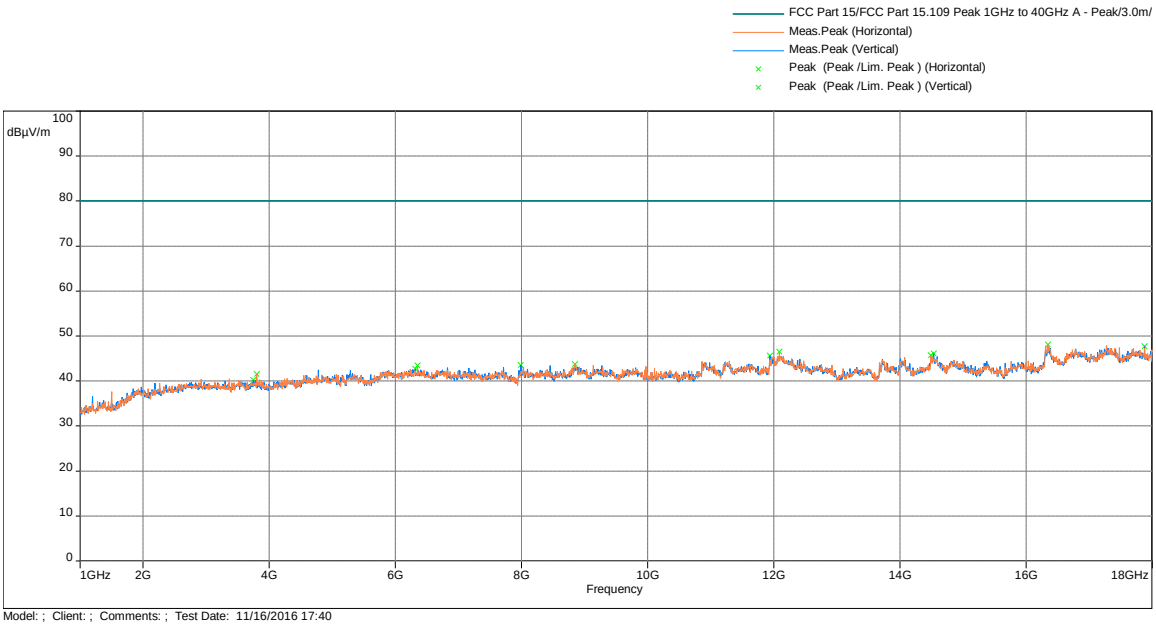
Test Results: Radiated Emissions 30 MHz – 1000 MHz, Battery Mode



Model: ; Client: ; Comments: ; Test Date: 10/31/2016 06:51

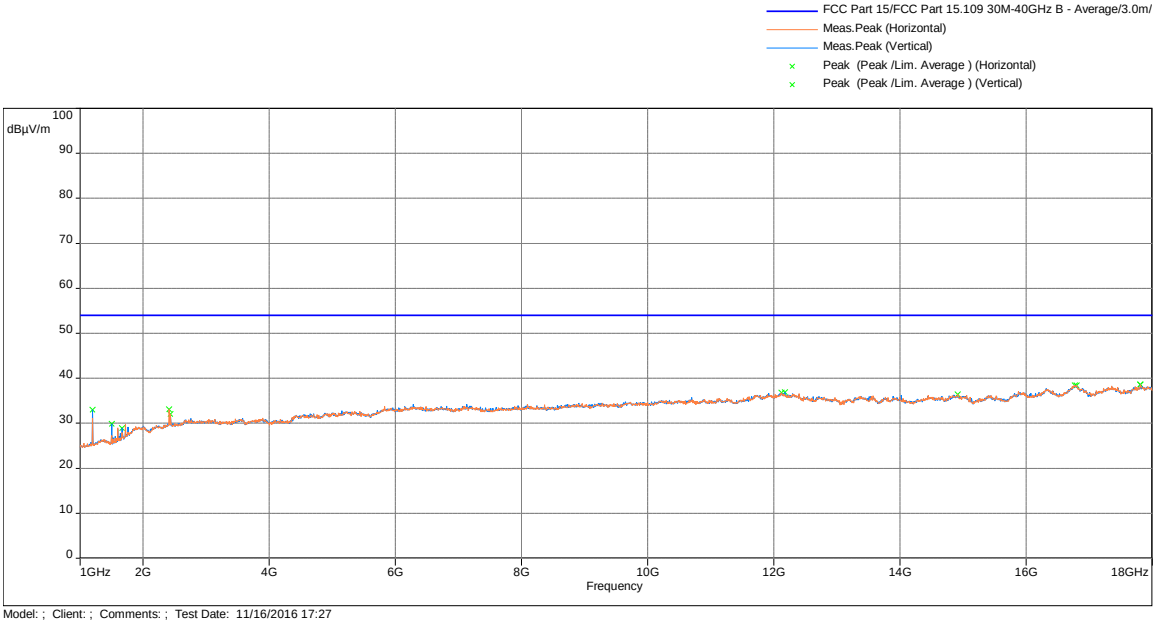
Frequency	Quasi Pk FS	Limit	Margin	Height	Azimuth	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	cm	deg		dB(uV/m)	dB
32.273	17.3	29.5	-12.2	3.0	3.0	Horizontal	21.6	-4.2
39.560	20.4	29.5	-9.1	15.0	2.0	Horizontal	25.5	-5.1
39.681	20.5	29.5	-9.1	45.8	1.9	Vertical	25.5	-5.1
923.407	25.0	35.5	-10.5	163.5	1.6	Horizontal	20.6	4.4
943.214	26.1	35.5	-9.4	227.3	1.9	Vertical	20.5	5.7
947.339	25.9	35.5	-9.6	132.5	2.6	Vertical	20.2	5.8

Radiated Emissions 1GHz – 18GHz, Peak, Battery Mode



Model: ; Client: ; Comments: ; Test Date: 11/16/2016 17:40

Radiated Emissions 1GHz – 18GHz, Average, Battery Mode



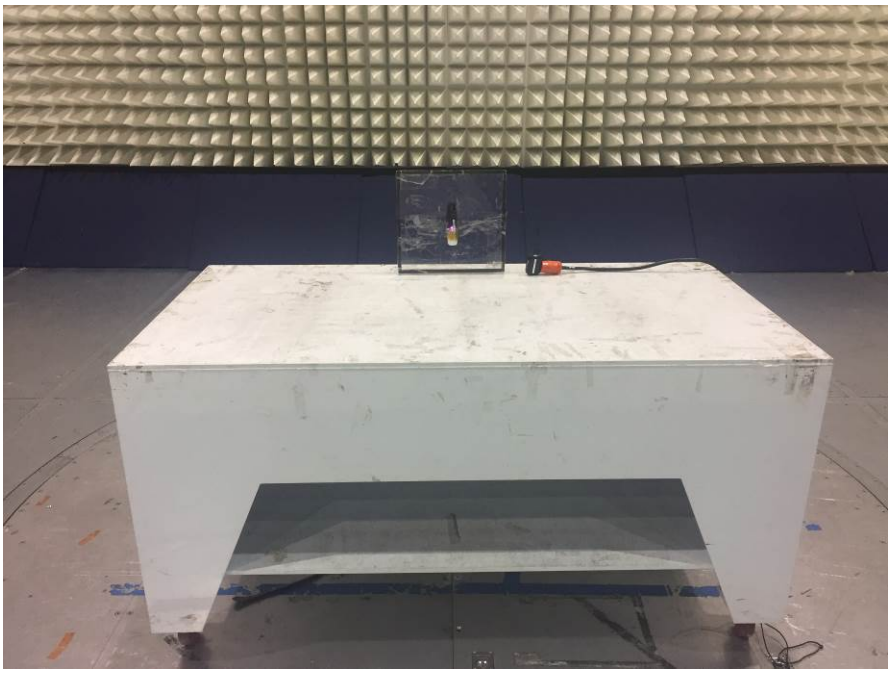
Model: ; Client: ; Comments: ; Test Date: 11/16/2016 17:27

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

Result:	**Complies** by 4.7 dB

4.6.4 Test Configuration Photographs

The following photographs show the testing configurations used.



4.6.4 Test Configuration Photographs (Continued)

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

4.7.1 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.*

4.7.2 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.

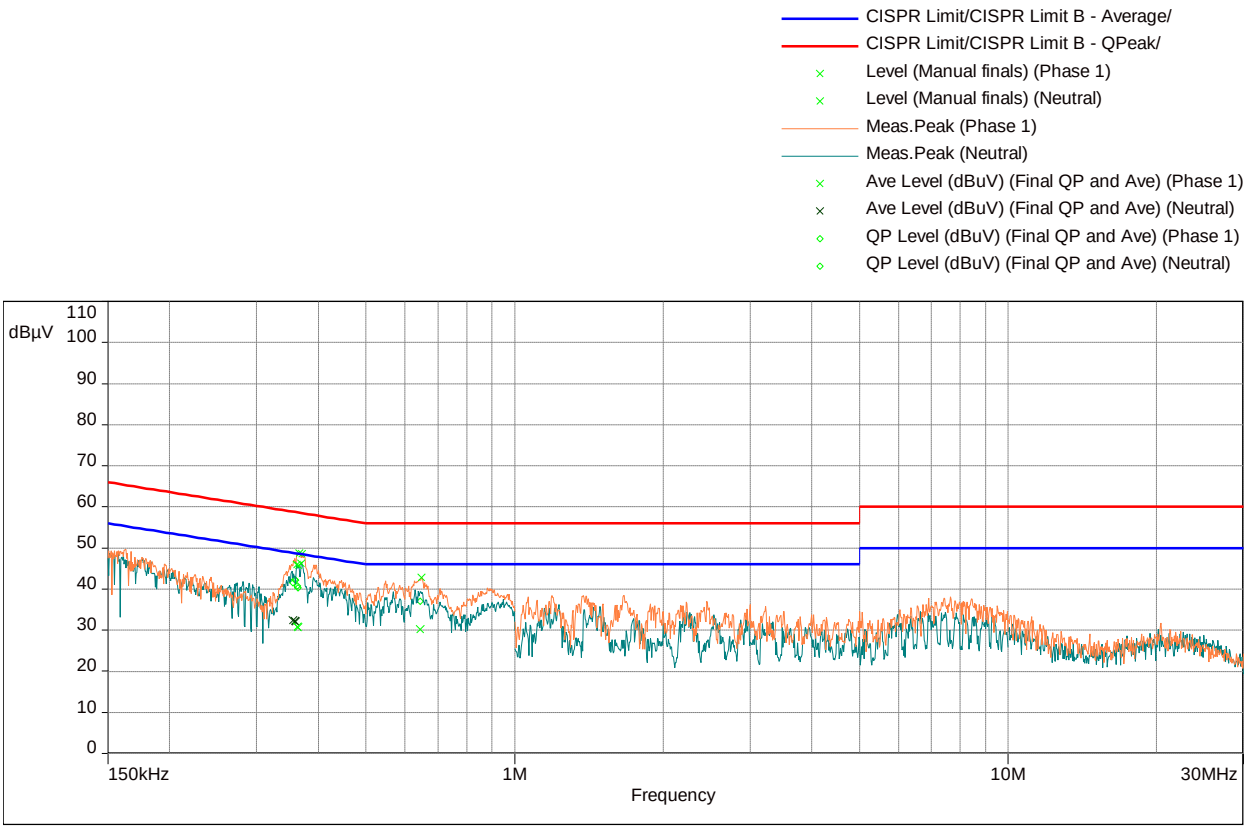
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

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

4.7.3 Test Result

Date of Test:	October 25, 2016
Results	**Complies**

AC Line Conducted Emission Data, Digital

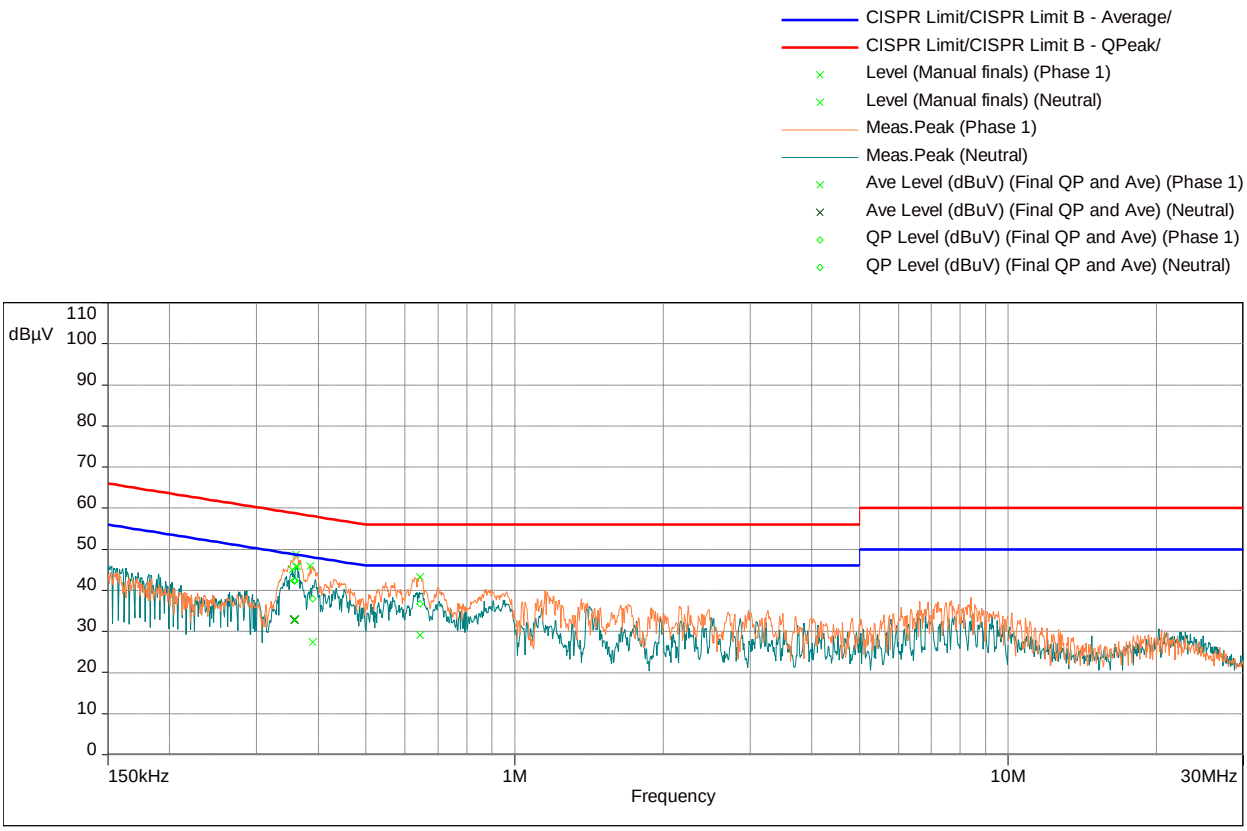


Model: ; Client: ; Comments: ; Test Date: 10/25/2016 13:39

Frequency (MHz)	Ave Level (dBuV)	QP Level (dBuV)	Ave Limit (dBuV)	QP Limit (dBuV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.363344	30.8	40.8	48.7	58.7	-17.9	-17.9	Phase 1	11.0
0.364253	30.7	40.4	48.6	58.6	-17.9	-18.3	Phase 1	11.0
0.642894	30.2	37.1	46.0	56.0	-15.8	-18.9	Phase 1	11.0
0.355946	32.4	41.6	48.8	58.8	-16.4	-17.3	Neutral	11.0
0.359183	32.2	42.3	48.8	58.8	-16.5	-16.5	Neutral	11.0
0.360220	32.0	42.1	48.7	58.7	-16.7	-16.6	Neutral	11.0

4.7.3 Test Result (Continued)

AC Line Conducted Emission Data, Tx On



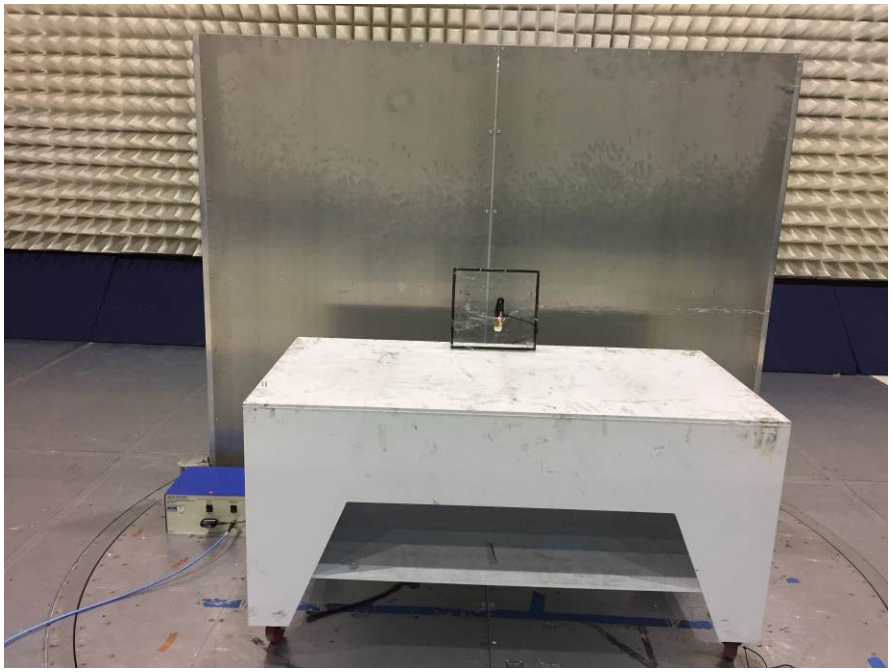
Model: ; Client: ; Comments: ; Test Date: 10/25/2016 13:47

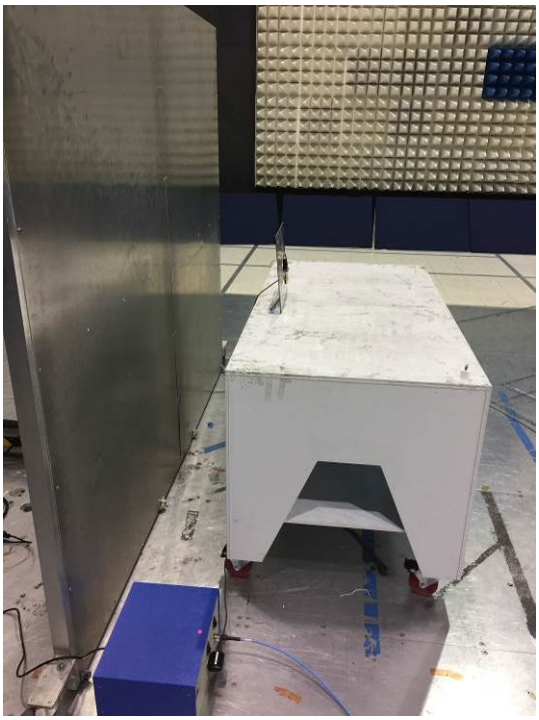
Frequency (MHz)	Ave Level (dBuV)	QP Level (dBuV)	Ave Limit (dBuV)	QP Limit (dBuV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.358909	32.8	42.4	48.8	58.8	-15.9	-16.4	Phase 1	11.0
0.389403	27.5	38.0	48.1	58.1	-20.6	-20.1	Phase 1	11.0
0.644243	29.1	36.8	46.0	56.0	-16.9	-19.2	Phase 1	11.0
0.358119	32.8	42.3	48.8	58.8	-16.0	-16.5	Neutral	11.0
0.358547	32.9	42.4	48.8	58.8	-15.9	-16.4	Neutral	11.0
0.359130	32.9	42.4	48.8	58.8	-15.9	-16.3	Neutral	11.0

Results	**Complies** by 15.8 dB

4.7.4 Test Configuration Photographs

The following photographs show the testing configurations used.





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
Spectrum Analyzer	Rohde and Schwarz	FSU	ITS00913	12	01/05/17
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	12/11/16
Pre-Amplifier	Sonoma Instrument	310N	ITS 00942	12	01/07/17
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	04/13/17
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	09/09/17
Pyramidal Horn Antenna	EMCO	3160-09	ITS 00571	#	#
Horn Antenna & Pre-Amplifier	ETS-Lindgren	3117 & 3117-PA	ITS 01365	12	08/09/17
LISN	Com-Power	LIN-115A	ITS 01288	12	06/25/16

No Calibration required

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
Tile	Quantum Change	3.4.K.22	Conducted Spurious_30M-26GHz
BAT-EMC	Nexio	3.16.0.44	Gotenna 10-25-16_ML.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 / G102780674	ML	KV	November 17, 2016	Original document