

TEST REPORT

Report Number: 103088018MPK-005

Project Number: G103088018

August 20, 2017

Testing performed on

K-SMART3

Model: K-SMART3

FCC ID: WFW-KSMART3

IC: 5241A-KSMART3

to

FCC Part 15 Subpart C (15.247)

Industry Canada RSS-247 Issue 2

FCC Part 15, Subpart B

Industry Canada ICES-003

For

Dormakaba Electronic Access & Data - Keyscan, Inc.

Test Performed by:

Intertek

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Test Authorized by:

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Date: August 20, 2017

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Date: August 20, 2017

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Report No. 103088018MPK-005

Equipment Under Test:	K-SMART3
Model Number:	K-SMART3
Applicant:	Dormakaba Electronic Access & Data - Keyscan, Inc.
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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:	July 24 to August 04, 2017

We attest to the accuracy of this report:


Minh Ly
Project Engineer


Krishna K Vemuri
Engineering Team Lead

TABLE OF CONTENTS

1.0	Summary of Tests	5
2.0	General Information.....	6
2.1	Product Description	6
2.2	Related Submittal(s) Grants.....	7
2.3	Test Facility	7
2.4	Test Methodology	7
2.5	Measurement Uncertainty.....	7
3.0	System Test Configuration.....	8
3.1	Support Equipment	8
3.2	Block Diagram of Test Setup.....	8
3.3	Justification.....	9
3.4	Software Exercise Program.....	9
3.5	Mode of Operation during Test.....	9
3.5	Modifications Required for Compliance	9
3.6	Additions, Deviations and Exclusions from Standards.....	9
4.0	Measurement Results.....	10
4.1	6-dB Bandwidth and 99% Occupied Bandwidth	10
4.1.1	Requirement.....	10
4.1.2	Procedure	10
4.1.3	Test Result	10
4.2	Maximum Peak Conducted Output Power at Antenna Terminals	17
4.2.1	Requirement.....	17
4.2.2	Procedure	17
4.3.3	Test Result	17
4.3	Maximum Power Spectral Density	21
4.3.1	Requirement.....	21
4.3.2	Procedure	21
4.3.3	Test Result	21
4.4	Unwanted Conducted Emissions	25
4.4.1	Requirement.....	25
4.4.2	Procedure	25
4.4.3	Test Result	25
4.5	Transmitter Radiated Emissions	28
4.5.1	Requirement.....	28
4.5.2	Procedure	28
4.5.3	Field Strength Calculation	29
4.5.4	Test Results.....	30
4.5.8	Test setup photographs	42
4.6	Radiated Emissions.....	44
4.6.1	Requirement.....	44
4.6.2	Procedures.....	45
4.6.3	Test Results.....	46
4.6.4	Test Configuration Photographs	49
4.7	AC Line Conducted Emission	51
4.7.1	Requirement.....	51

4.7.2	Procedure	51
4.7.3	Test Result	52
4.7.3	Test Result (Continued)	53
4.7.4	Test Configuration Photographs	54
5.0	List of Test Equipment	55
6.0	Document History	56

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)
RF Exposure	15.247(i), 2.1093(d)	RSS-102	Complies

EUT receive date: July 24, 2017

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: July 24, 2017

Test completion date: August 04, 2017

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

2.0 General Information

2.1 Product Description

Dormakaba Electronic Access & Data - Keyscan, Inc. supplied the following description of the EUT:

The K-SMART3 is a combination Smart Card Reader and BLE Mobile Access Credential Reader (hereafter referred to a “Reader”) device. The Reader is epoxy sealed, suitable for outdoor use and provided with an approved UL Style 2576, 9-conductor, 26-AWG, shielded cable for connection to a Door Access Control Unit.

The Reader is a key component of a physical security access control system, a Reader is based on dual use operating at 13.56 MHz to read RFID technology, and 2.45GHz to read a BLE enabled smartphone. In operation the Reader is capable of reading data stored on smartcard credentials via radio frequency without physical contact, also read data stored on the BLE enabled smartphone with a specialized application program and then passing the data obtained to the physical access control system. Access control systems typically manage and record the movement of individuals through a protected area, such as a locked door.

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

Information about the 2.4 GHz radio is presented below:

Applicant	Dormakaba Electronic Access & Data - Keyscan, Inc.
Model No.	K-SMART3
FCC Identifier	WFW-KSMART3
IC Identifier	5241A-KSMART3
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	1.57 dBm
Antenna(s) & Gain	Internal Antenna, Gain: 2.1 dBi
Frequency Range	2402 – 2480 MHz
Type of modulation/data rate	GFSK / 1Mbaud
Number of Channel(s)	40, Channel 0-39
Applicant Name & Address	Dormakaba Electronic Access & Data - Keyscan, Inc. 901 Burns St. E., Whitby Ontario, Canada L1N 0E6

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 v04), and RSS-247, RSS-GEN Issue 4.

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.

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 – 200 MHz	200 MHz – 1 GHz	1 GHz – 18 GHz
Radiated emissions	-	4.7	4.6	5.1 dB
AC mains conducted emissions	2.1 dB	-	-	-

3.0 System Test Configuration

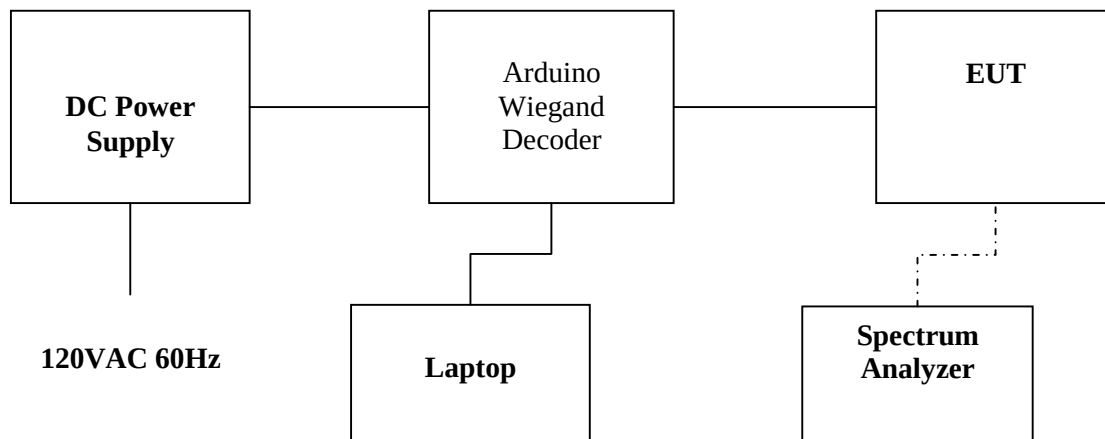
3.1 Support Equipment

Support Equipment			
Type	Model #	Quantity	S/N
DC Power Supply	Extech	1	D30030012
Laptop	HP Elitebook	1	N/A
Arduino Wiegand Decoder	Not Listed	1	MPK1707241613-007

3.2 Block Diagram of Test Setup

Equipment Under Test			
Type	Model #	Quantity	S/N
K-SMART3	K-SMART3	2	MPK1707241613-001 (Conducted Unit) MPK1707241613-002 (Radiated Unit)

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.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by Dormakaba Electronic Access & Data - Keyscan, Inc.

3.5 Mode of Operation during Test

Mode of operation during the tests was setup using a laptop which allows controlling the radio by test software. During the transmitter tests, the transmitter was setup to transmit maximum communication and RF power levels.

EUT was placed into transmit mode at the lowest (2402MHz) middle (2440MHz), and highest (2480MHz) channels

3.5 Modifications Required for Compliance

No modifications were made by the manufacturer or Intertek to the EUT in order to bring the EUT 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 99% 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 v04 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) $\geq 3 \times$ 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.

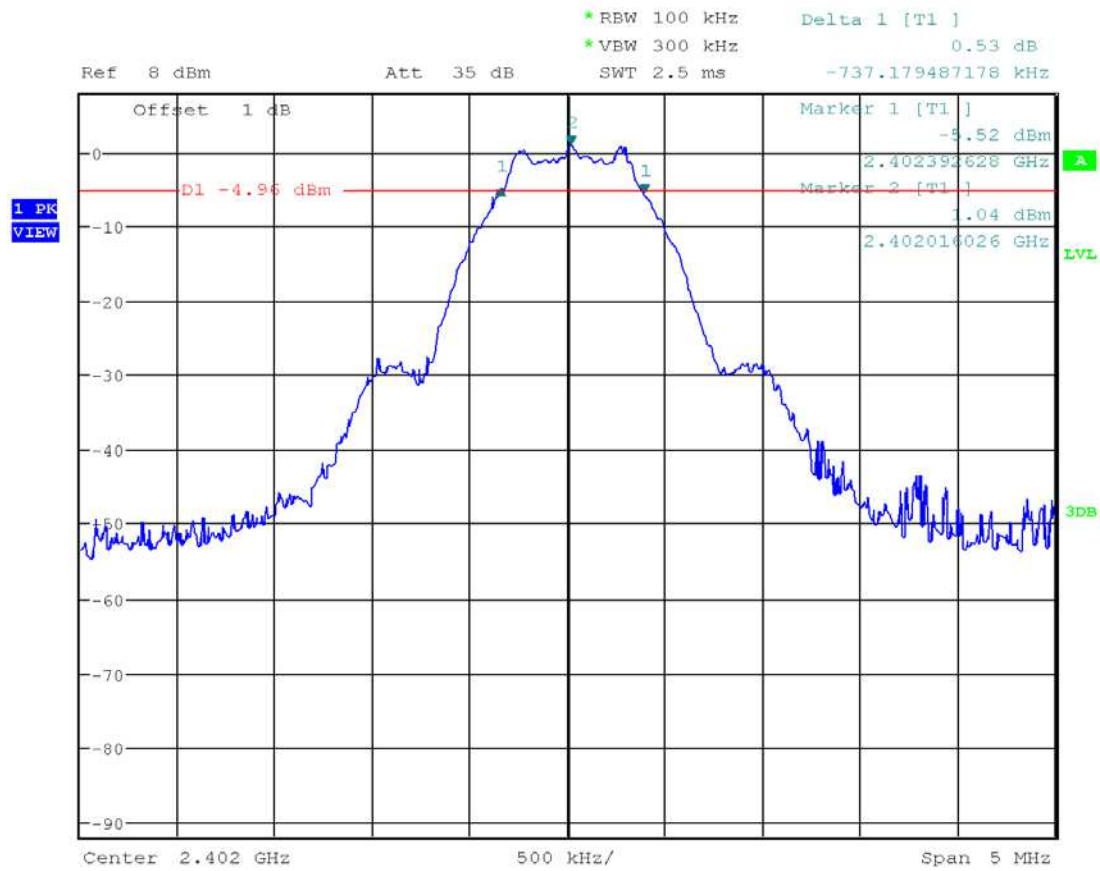
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

4.1.3 Test Result

Frequency (MHz)	6-dB bandwidth FCC 15.247 & RSS-GEN, kHz	Occupied bandwidth, RSS-GEN, MHz	Plot
2402	737.179	--	1.1
	--	1.049	1.4
2440	753.205	--	1.2
	--	1.065	1.5
2480	745.192	--	1.3
	--	1.057	1.6

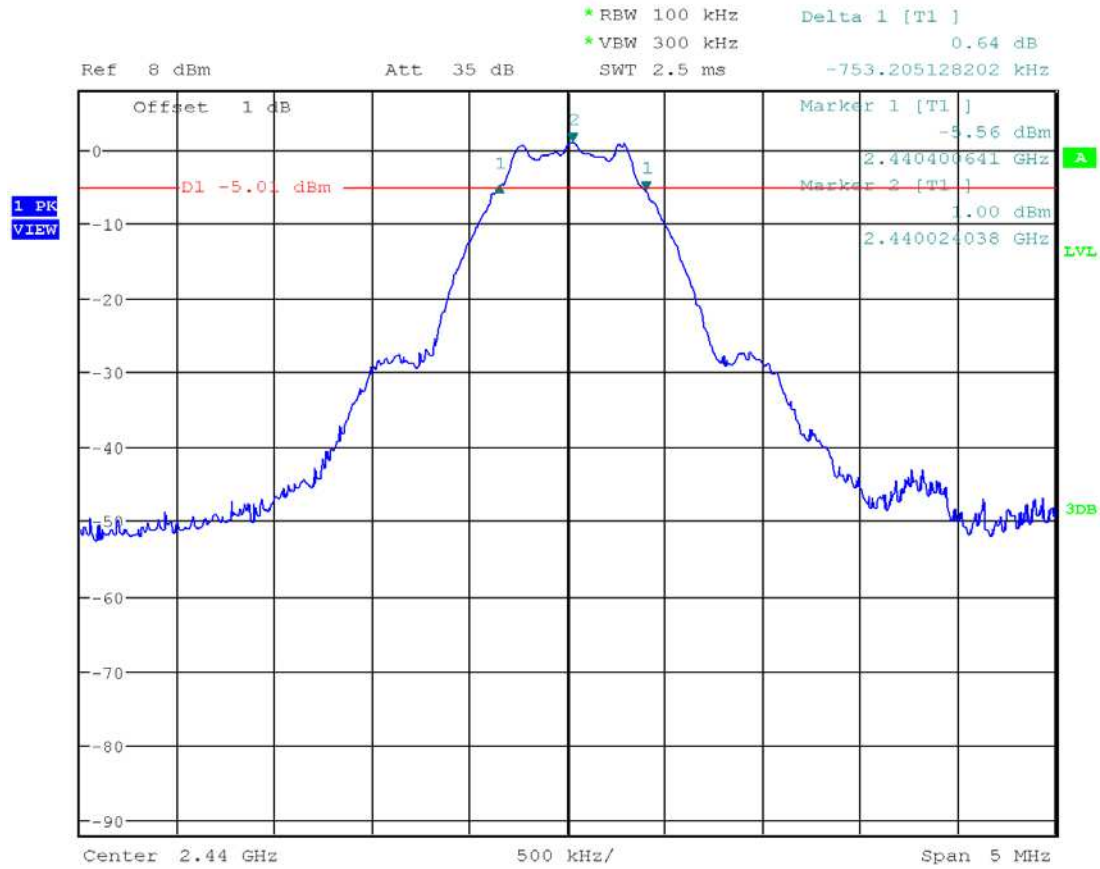
Date of Test:	July 24, 2017
Results	Complies

Plot 1. 1



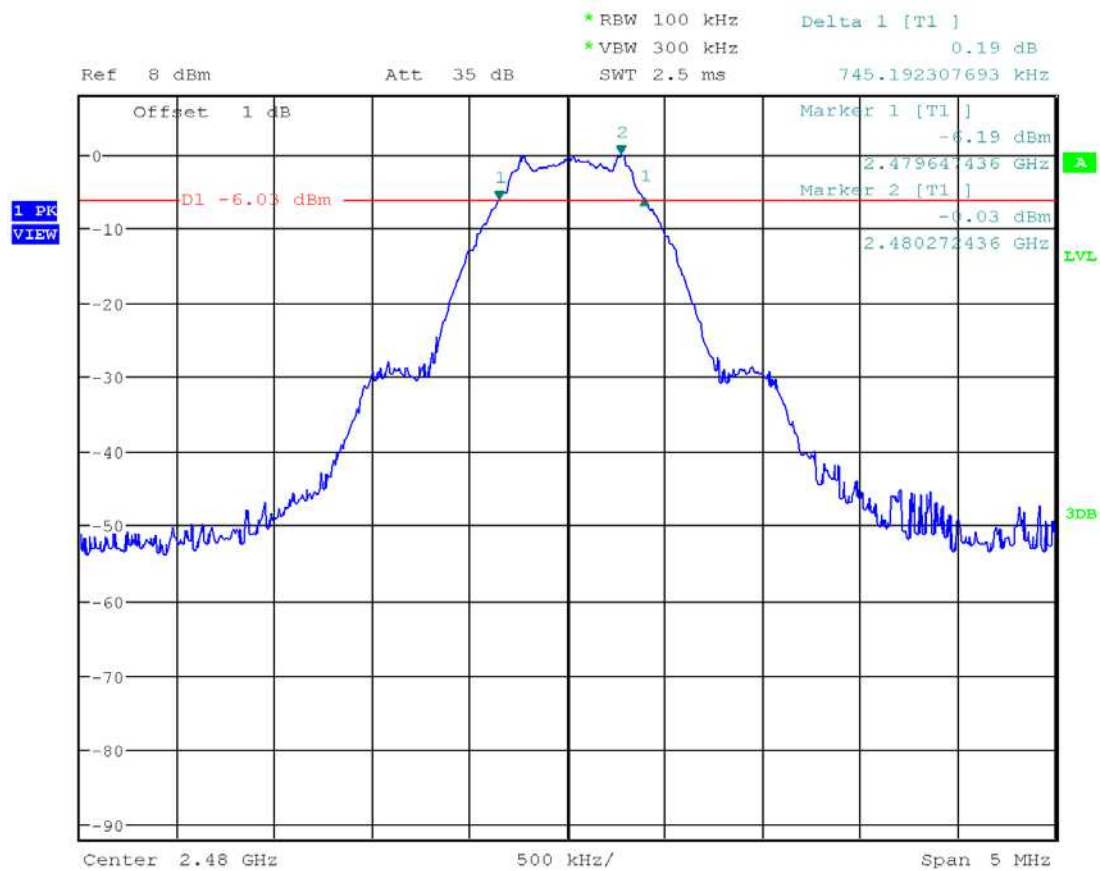
Date: 24.JUL.2017 14:44:03

Plot 1. 2



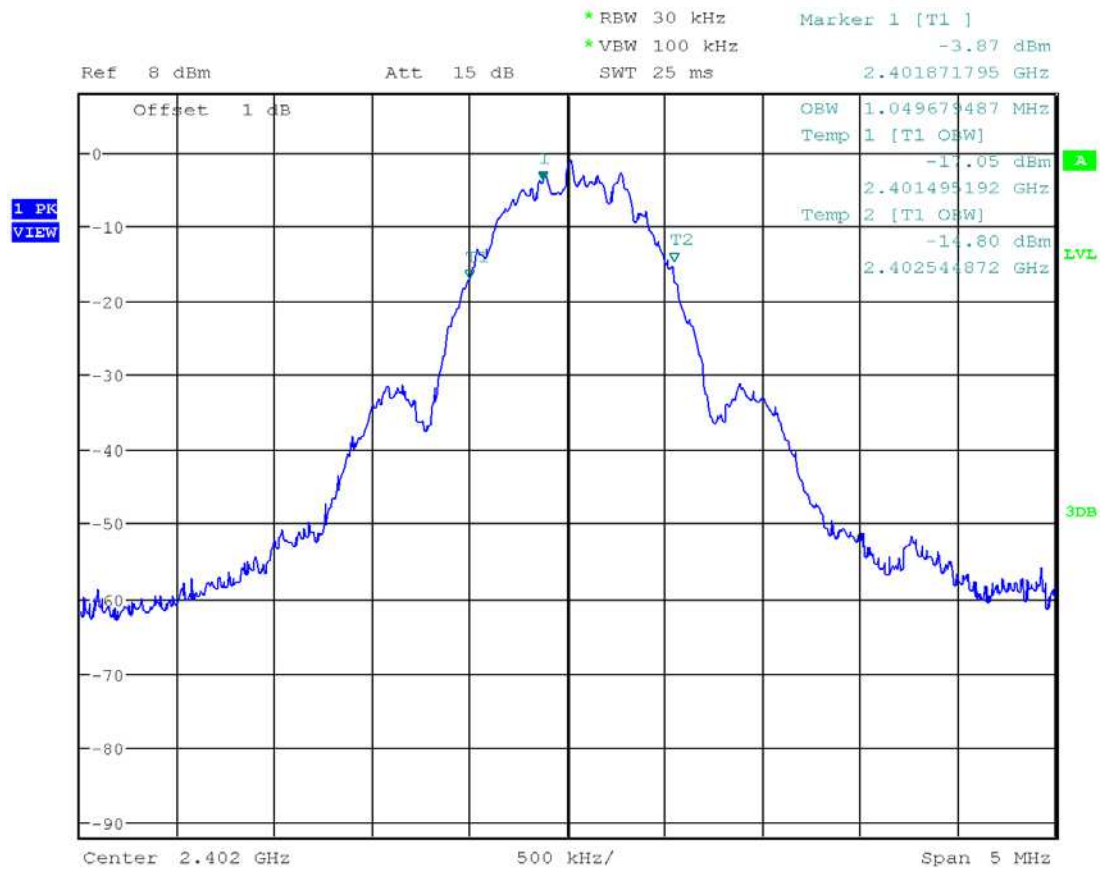
Date: 24.JUL.2017 14:41:17

Plot 1.3



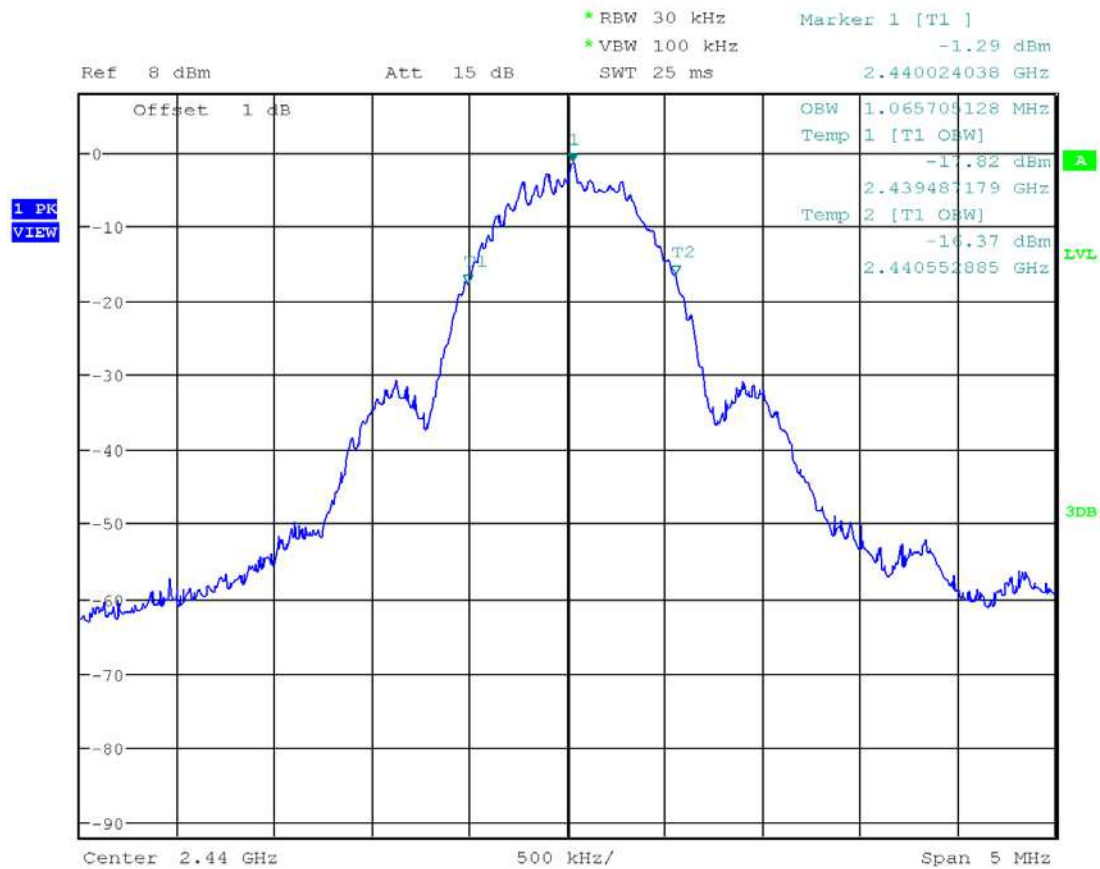
Date: 24.JUL.2017 14:42:36

Plot 1. 4



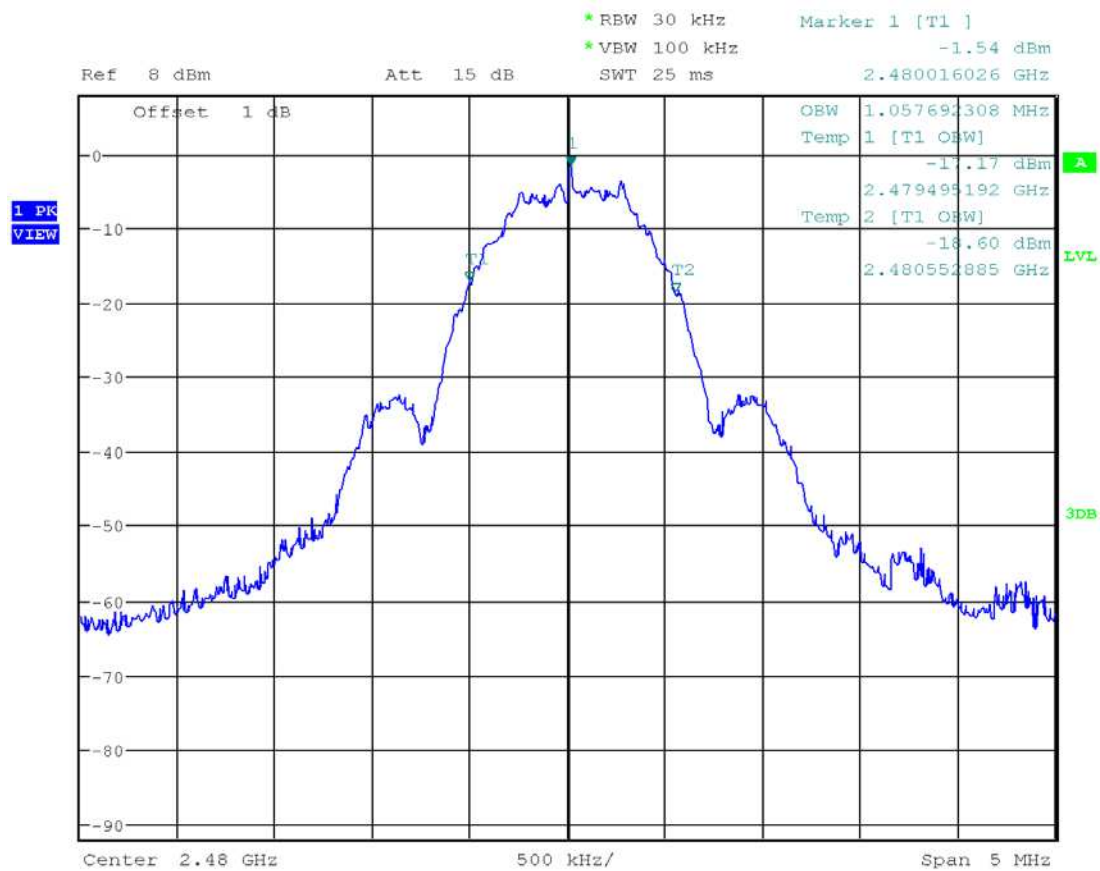
Date: 24.JUL.2017 14:48:11

Plot 1.5



Date: 24.JUL.2017 14:49:10

Plot 1.6



Date: 24.JUL.2017 14:49:52

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 v04 was used.

Specifically, section 9.1.1 RBW $\geq$ DTS Bandwidth was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

1. Set the RBW $\geq$ DTS Bandwidth
2. Set the VBW $\geq 3 \times$ RBW
3. Set the span $\geq 3 \times$ 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.

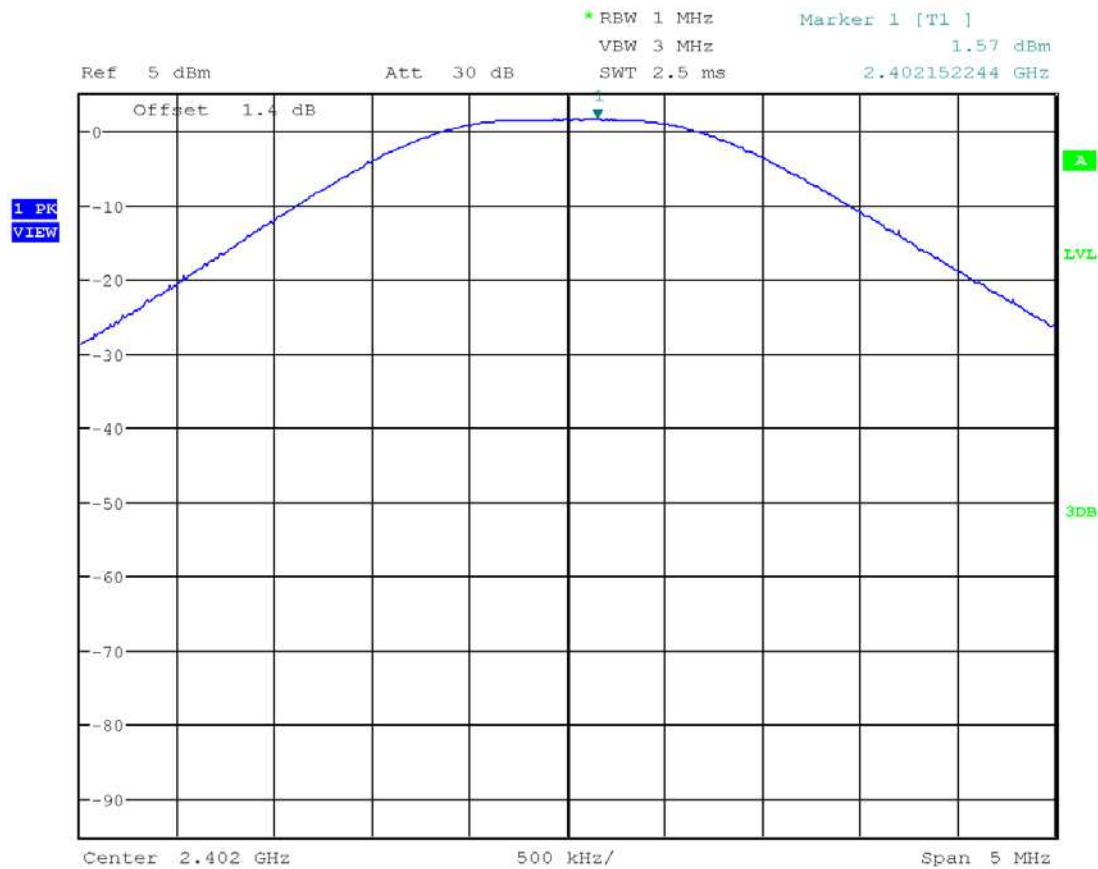
4.3.3 Test Result

Refer to the following plots 2.1 – 2.3 for the test details.

Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), mW	Plot
2402	1.57	1.439	2.1
2440	1.38	1.377	2.2
2480	1.32	1.358	2.3

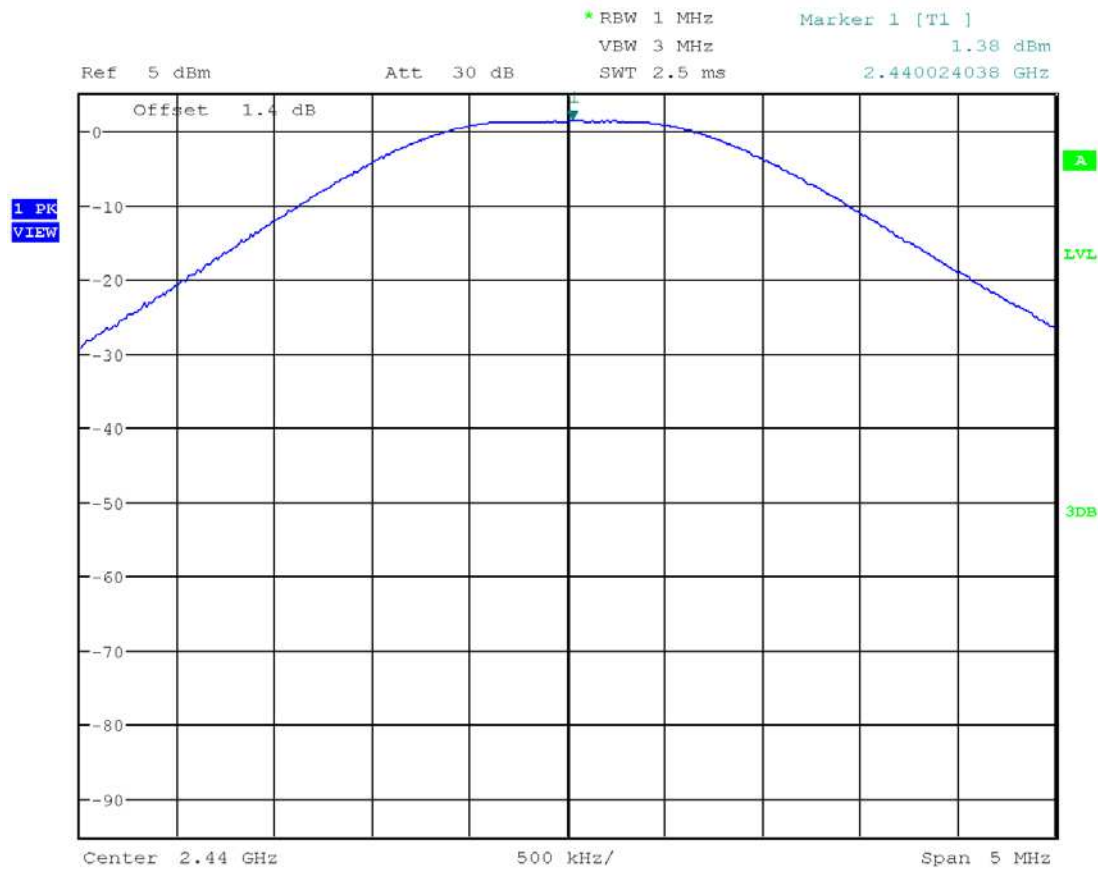
Date of Test:	August 1, 2017
Results	Complies

Plot 2. 1



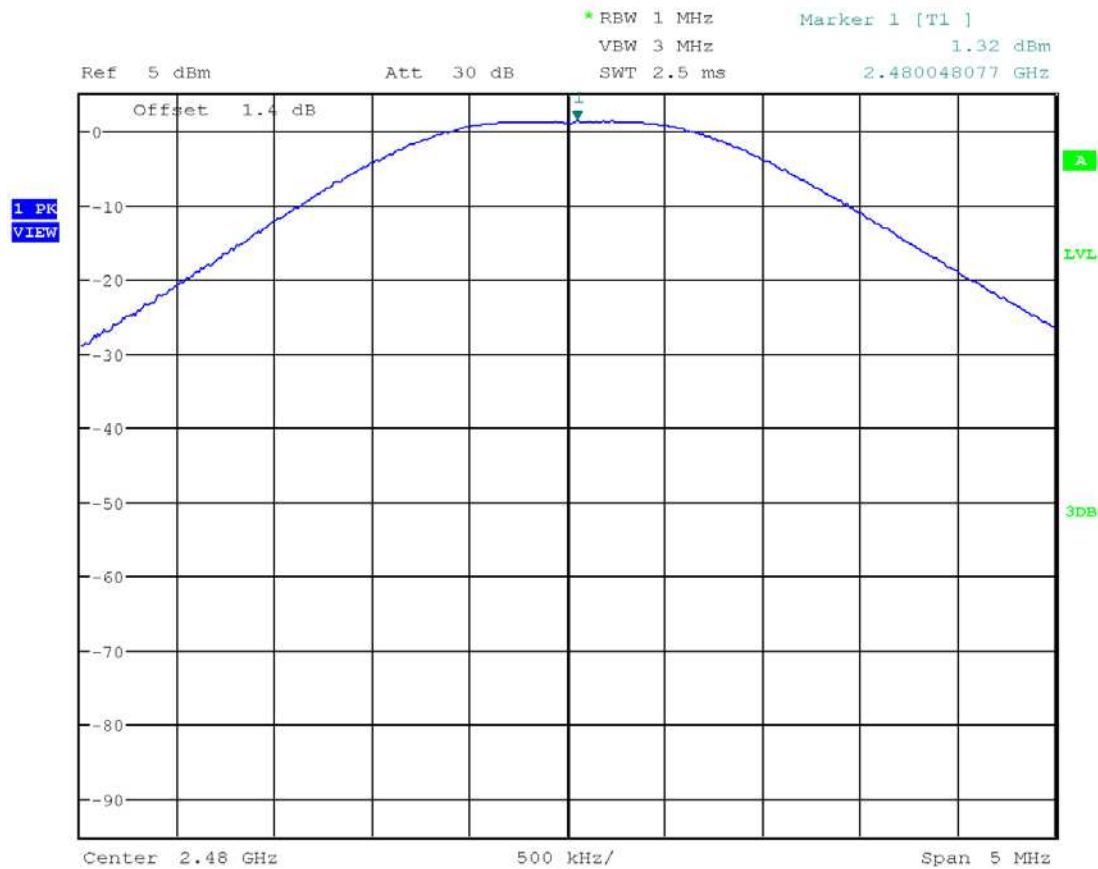
Date: 1.AUG.2017 15:56:29

Plot 2. 2



Date: 1.AUG.2017 15:57:36

Plot 2.3



Date: 1.AUG.2017 15:58:22

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 v04, 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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
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.

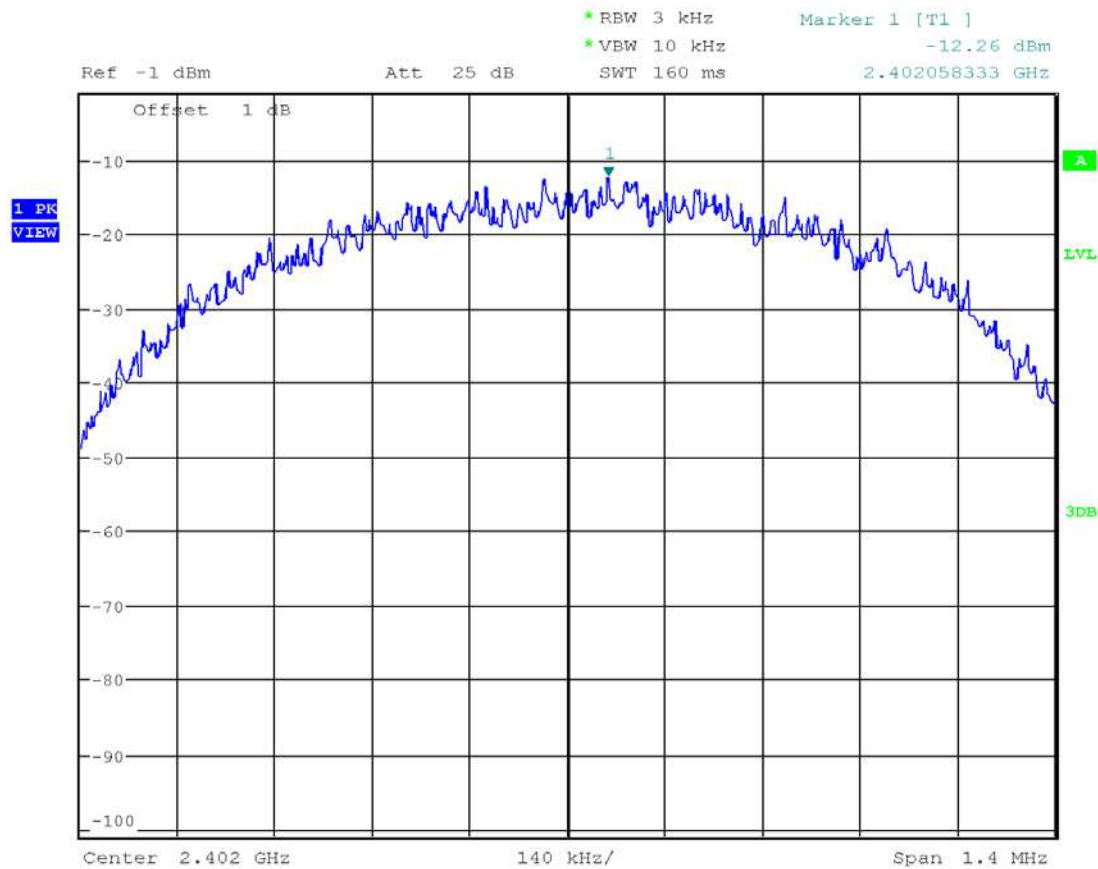
4.3.3 Test Result

Refer to the following plots for the test result

Frequency, MHz	Maximum Power Spectral Density, dBm	Maximum Power Spectral Density Limit, dBm	Margin, dB	Plot
2402	-12.3	8.0	-20.3	3.1
2440	-12.2	8.0	-20.2	3.2
2480	-12.8	8.0	-20.8	3.3

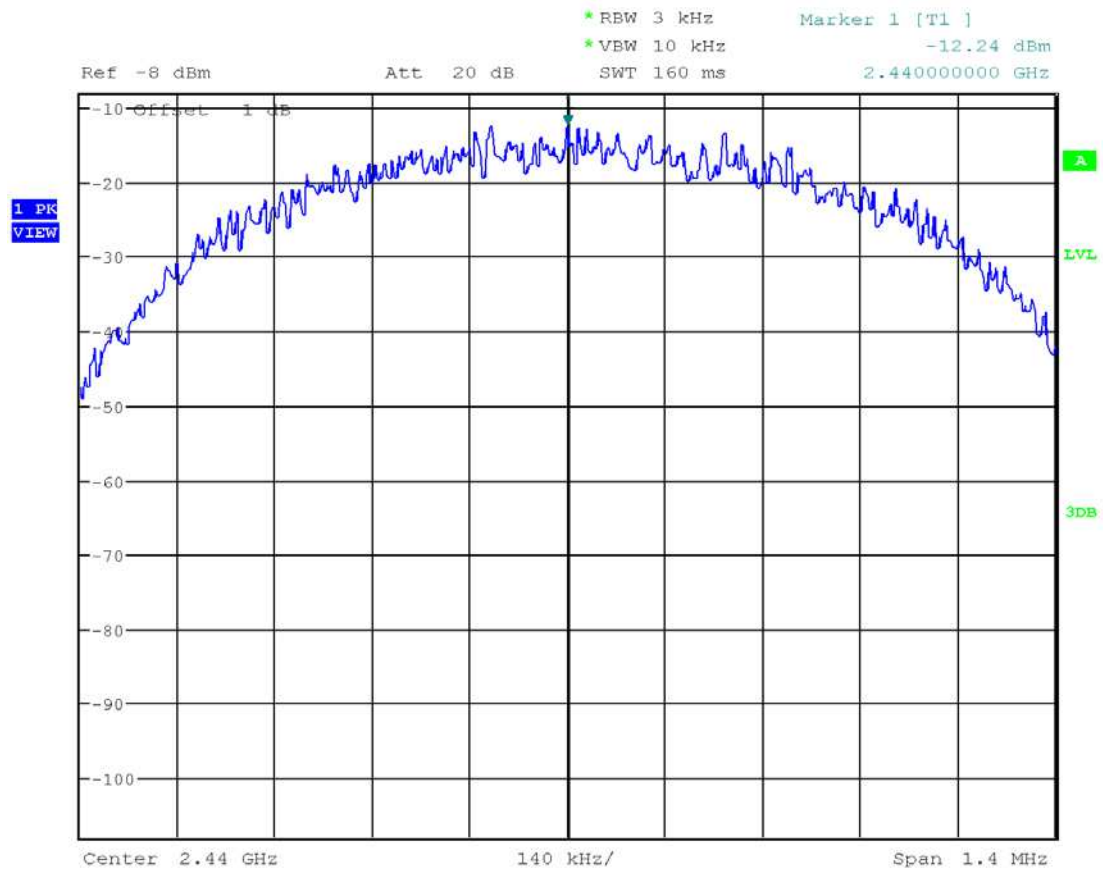
Date of Test:	July 24, 2017
Results	Complies

Plot 3. 1



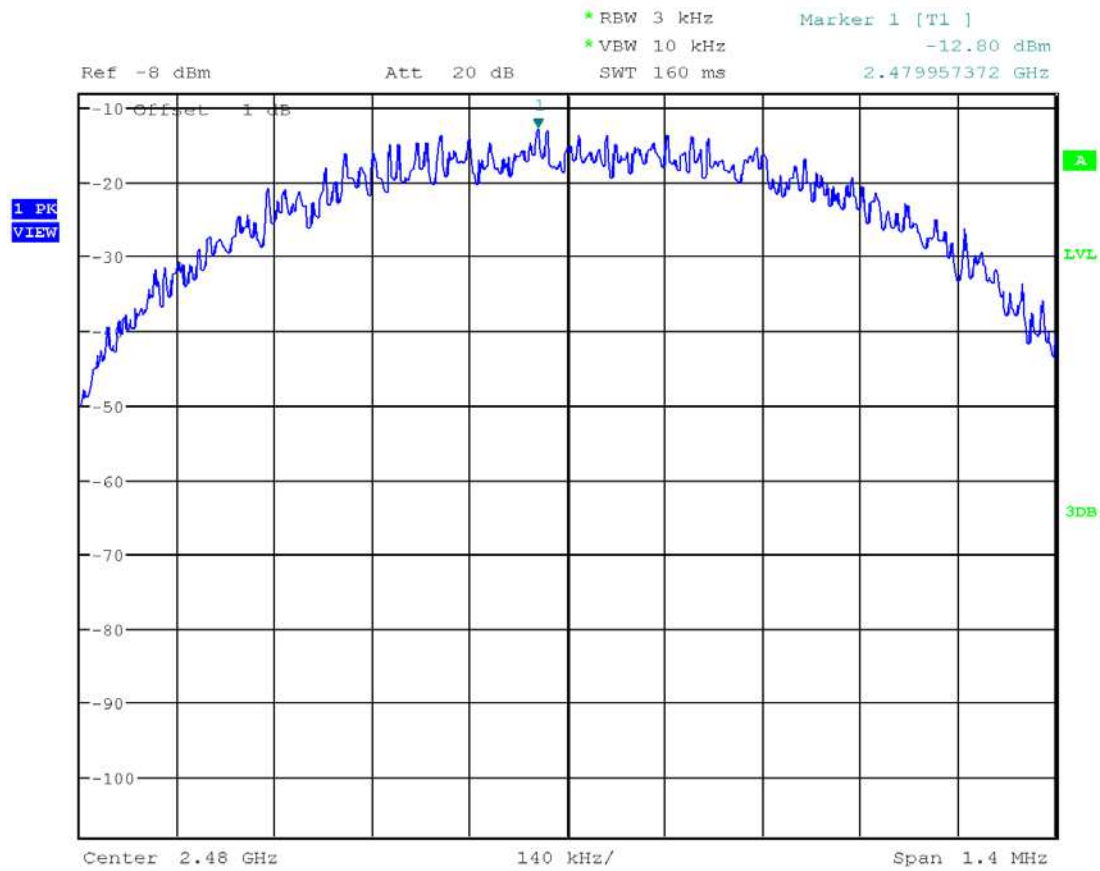
Date: 24.JUL.2017 14:54:15

Plot 3.2



Date: 24.JUL.2017 14:53:26

Plot 3.3



Date: 24.JUL.2017 14:52:26

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 v04, 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 $\geq 3 \times$ 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.

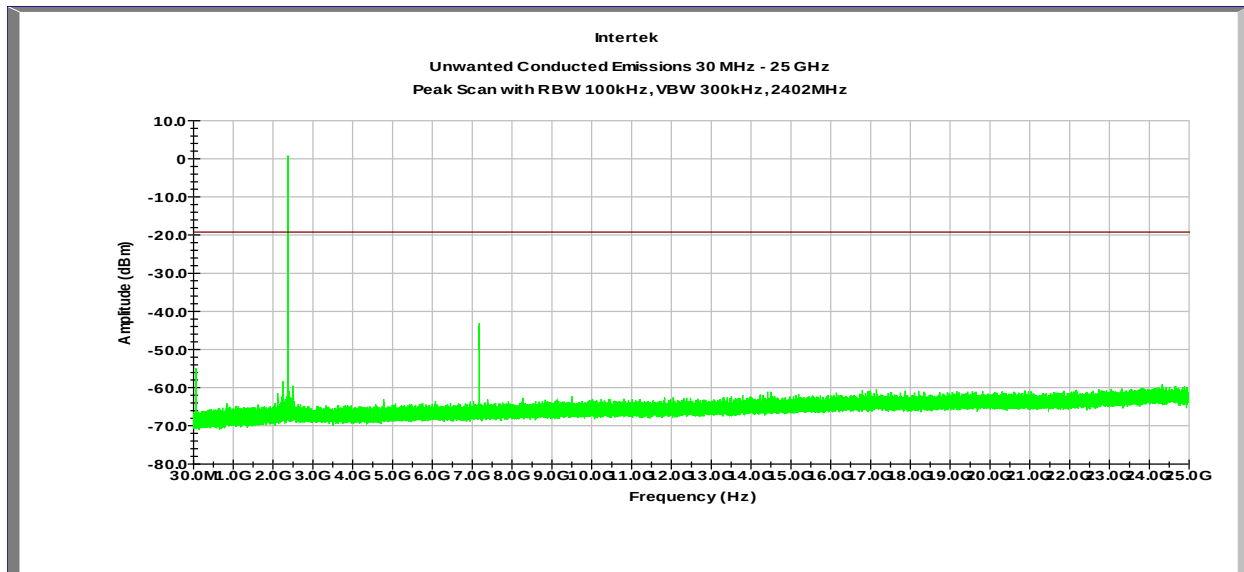
The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits.

4.4.3 Test Result

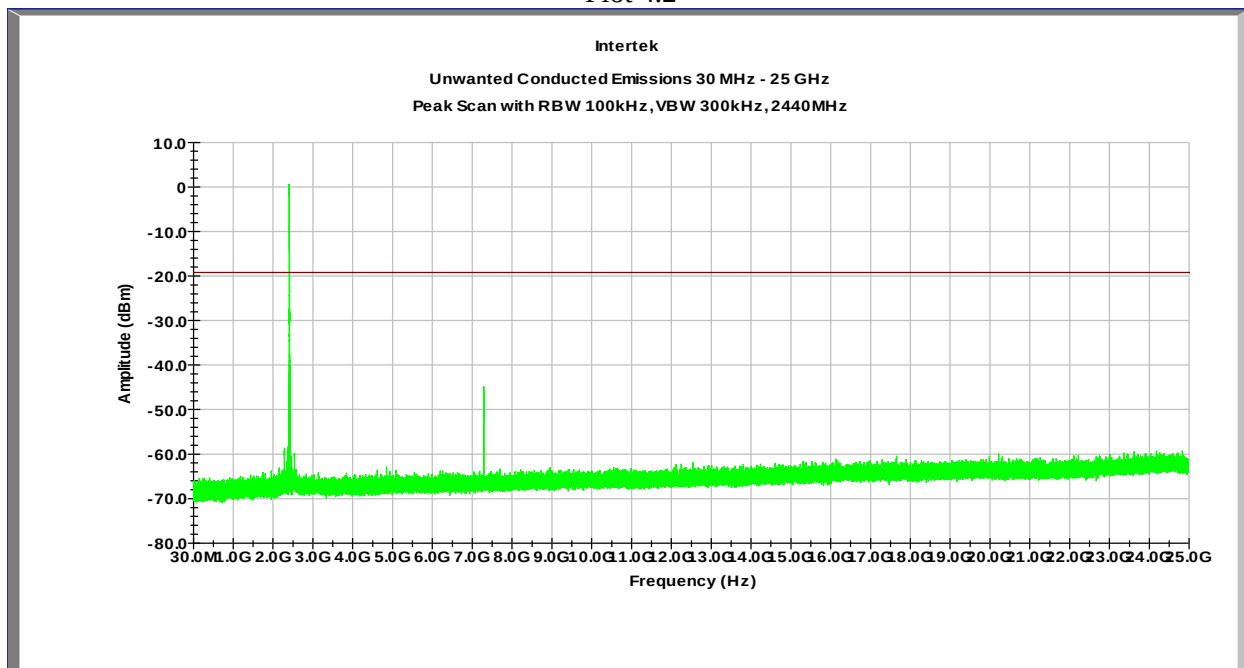
Refer to the following plots 4.1 – 4.5 for unwanted conducted emissions. The plot shows -20dB attenuation limit line.

Date of Test:	August 01, 2017
Results	Complies

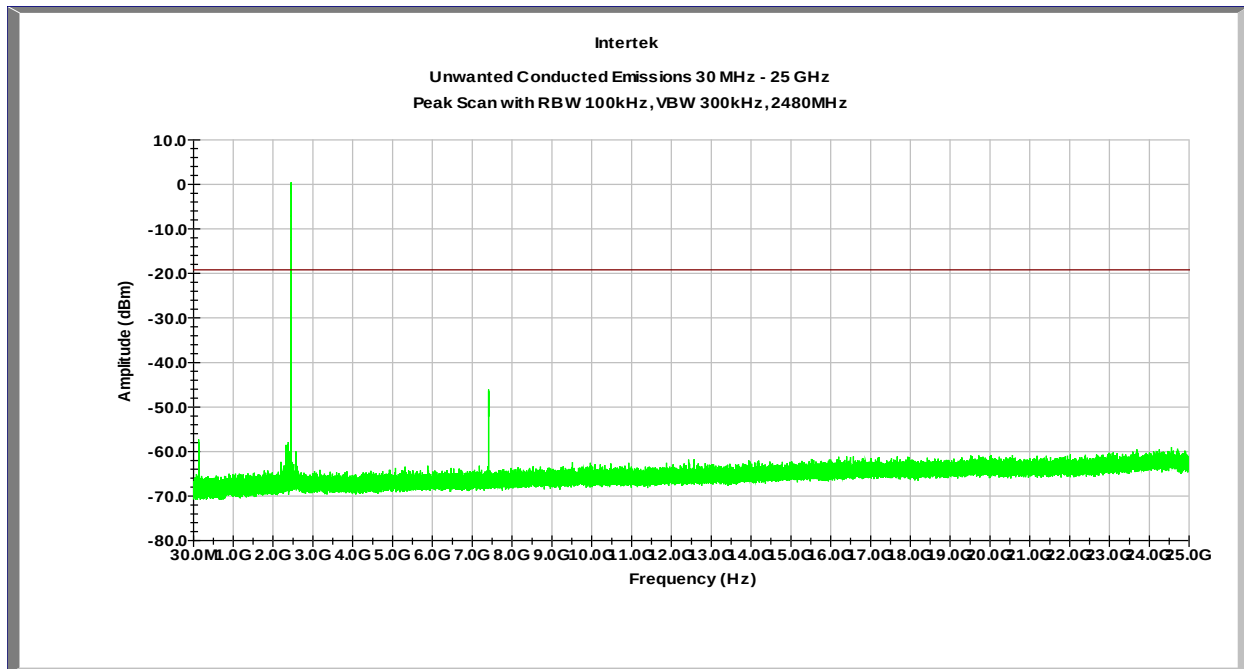
Tx @ Low Channel, 2402 MHz
30MHz -26GHz Conducted Spurious
Plot 4.1



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 25 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.

Measurements made from 1 GHz to 18GHz had a 2.4-2.5GHz notch filter in place. 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).

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 [$(32 \text{ dB}\mu\text{V/m})/20$] = 39.8 μ V/m.



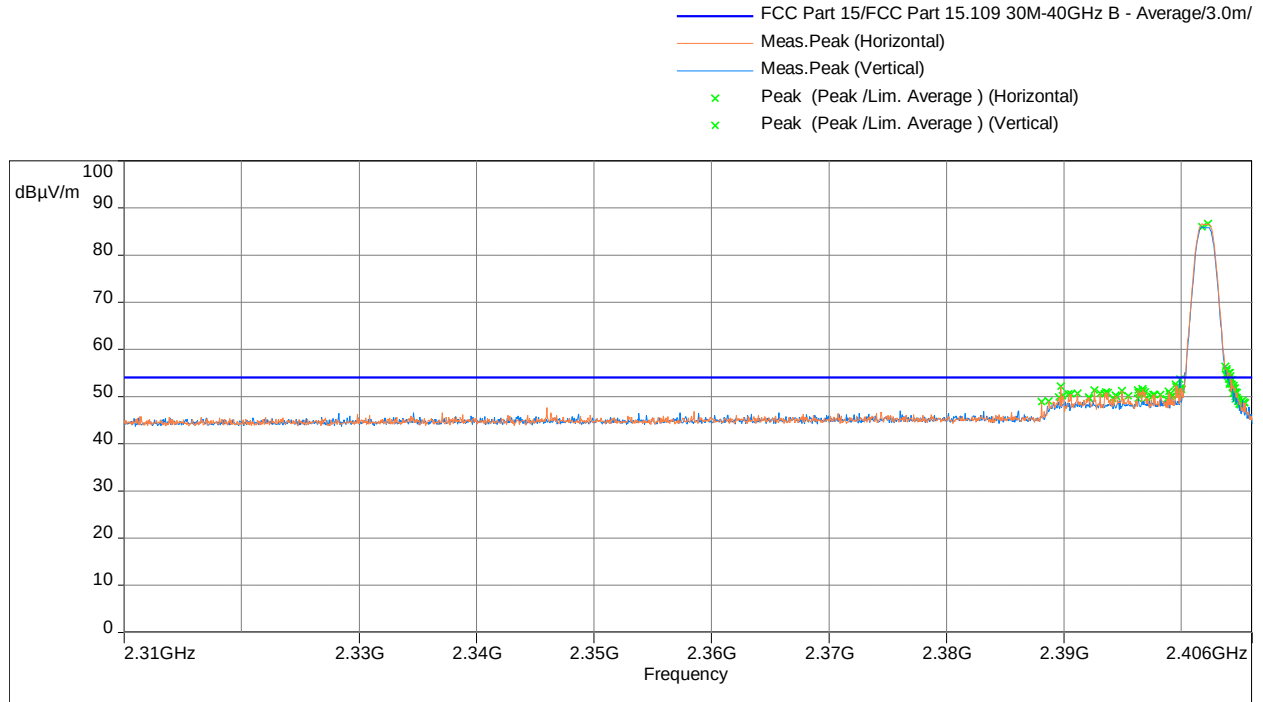
Total Quality. Assured.

4.5.4 Test Results

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

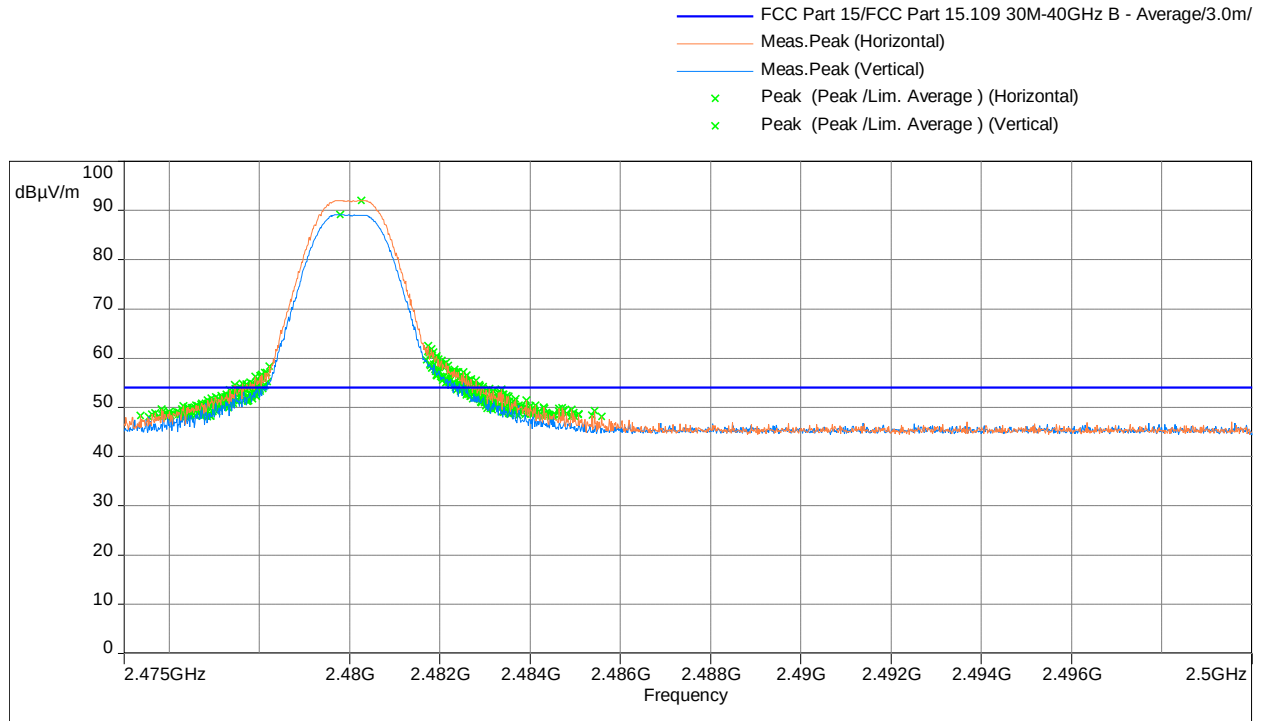
Date of Test:	July 28 - 31, 2017
Results	Complies

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



Frequency	Corrected Amplitude	Avg Limit	Margin	Detector	Polarity	Results
GHz	dBμV/m	dBμV/m	dB			
2.390	50.6	54	-3.4	Peak	Horizontal	Pass

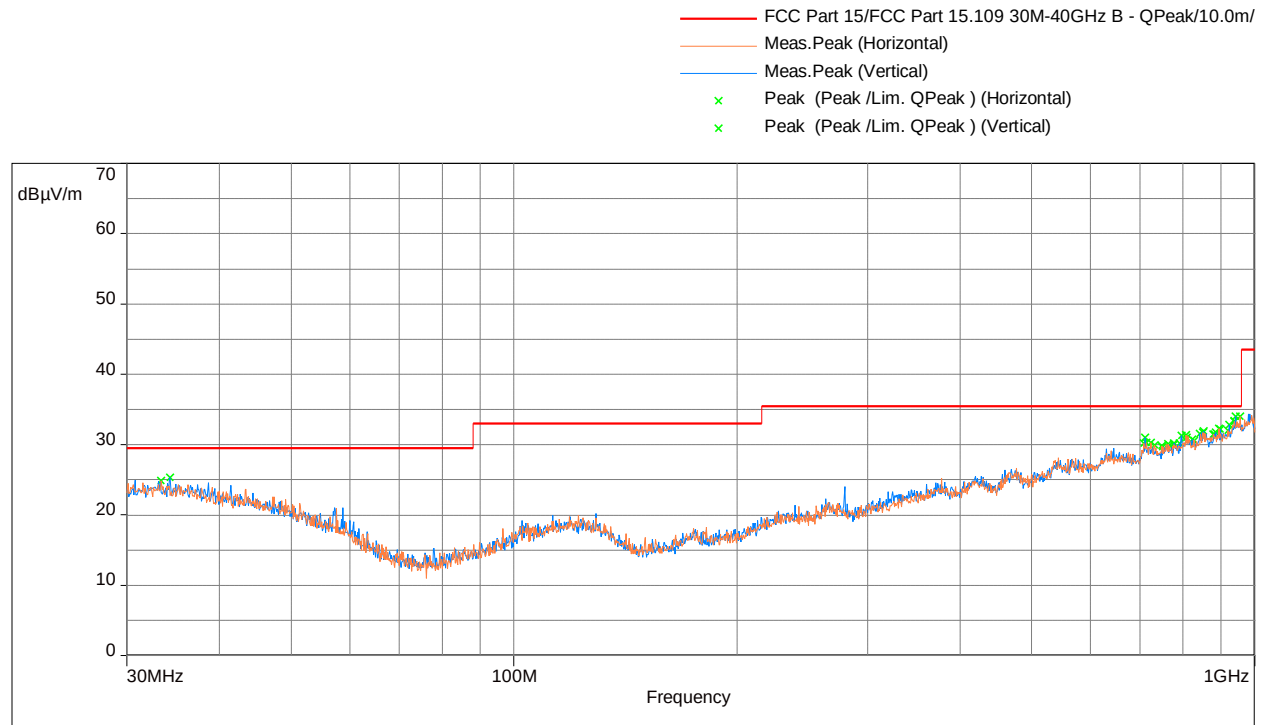
Out-of-Band Radiated spurious emissions at the Band-edge 2483.5–2500 MHz, Peak Scan with Average Limit



Frequency	Corrected Amplitude	Avg Limit	Margin	Detector	Polarity	Results
GHz	dBμV/m	dBμV/m	dB			
2.4835	52.3	54	-1.73	Peak	Horizontal	Pass

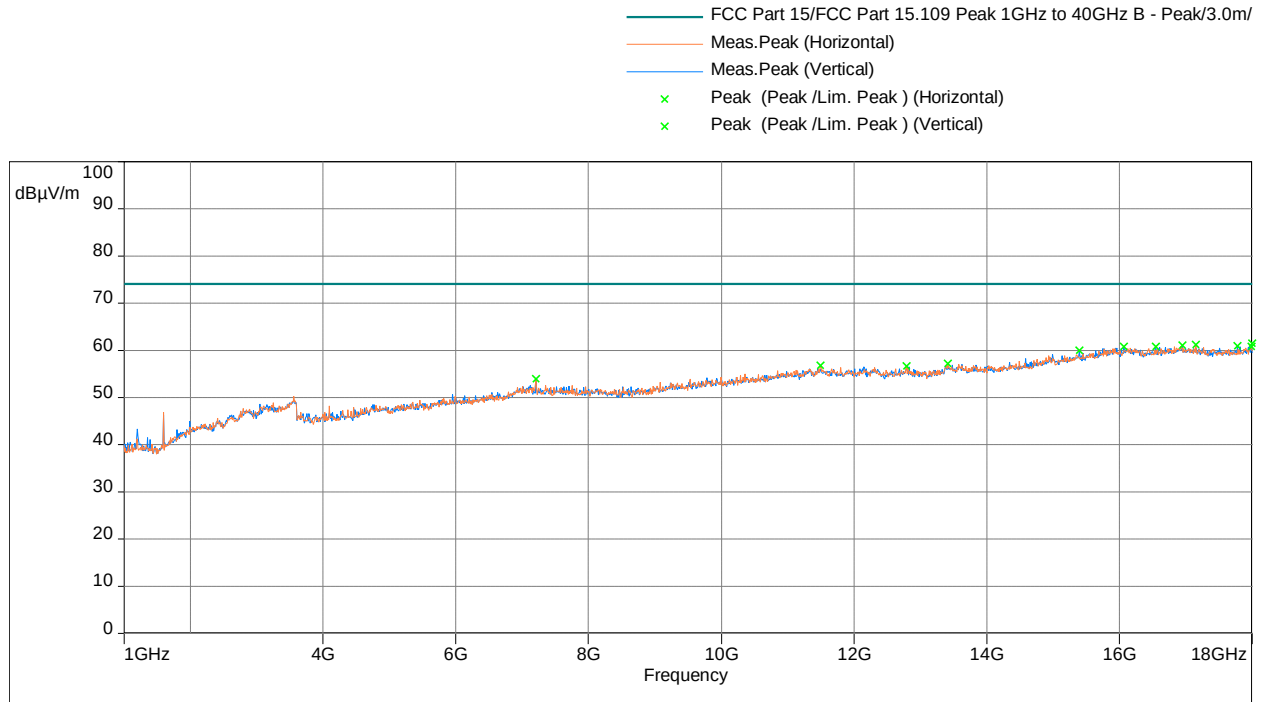
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 2402MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



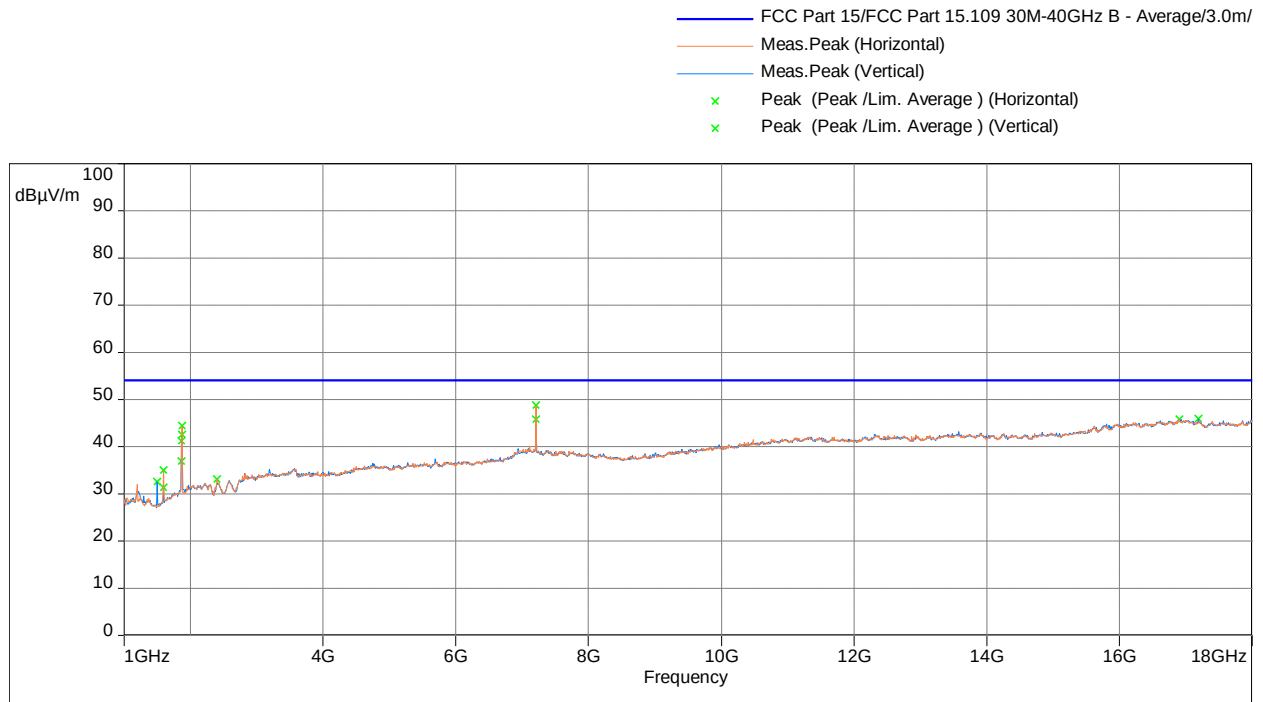
Frequency	Peak	Limit	Margin	Azimuth	Height	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	deg	cm		dB(uV/m)	dB
954.895	33.98	35.5	-1.52	14.5	3.98	Horizontal	29.1	4.83

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit



Model: ; Client: ; Comments: ; Test Date: 08/03/2017 10:34

Radiated Spurious Emissions 1000 - 18000 MHz, Avg Scan vs Avg Limit



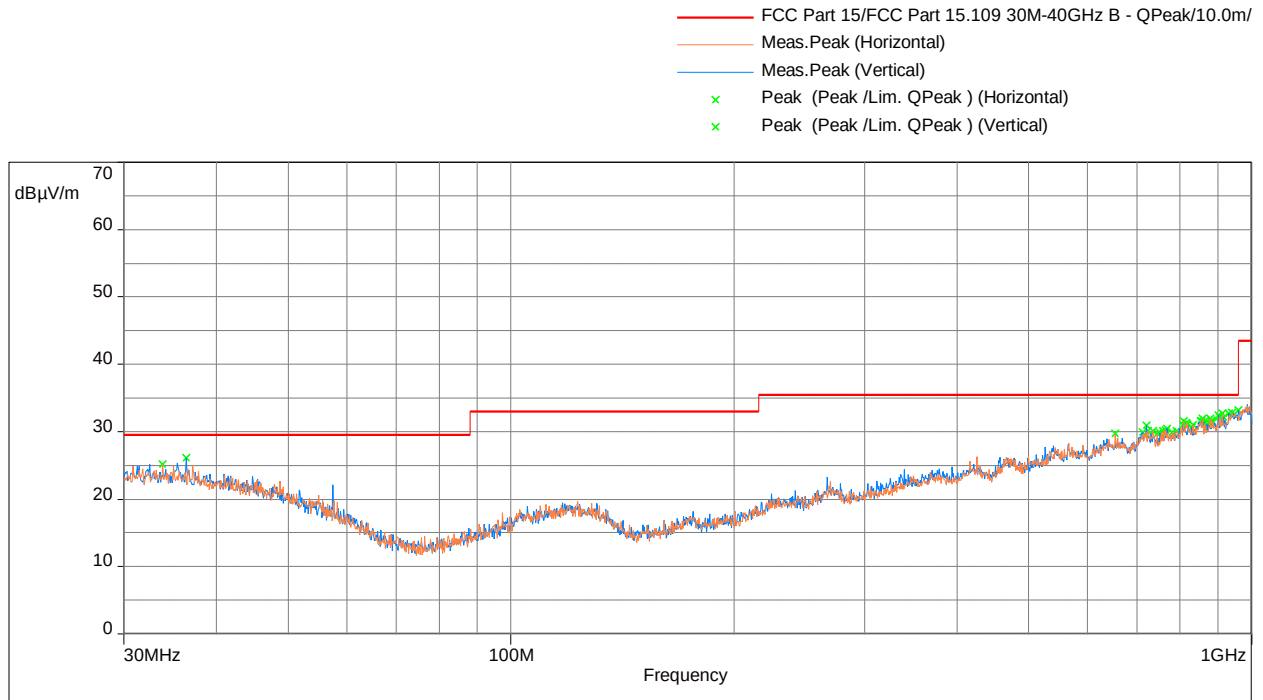
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
1877.200	44.5	54.0	-9.5	295	4.0	Horizontal	42.8	1.7
7206.000	48.8	54.0	-5.2	309	1.9	Horizontal	35.8	12.9

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

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

Results	Complies
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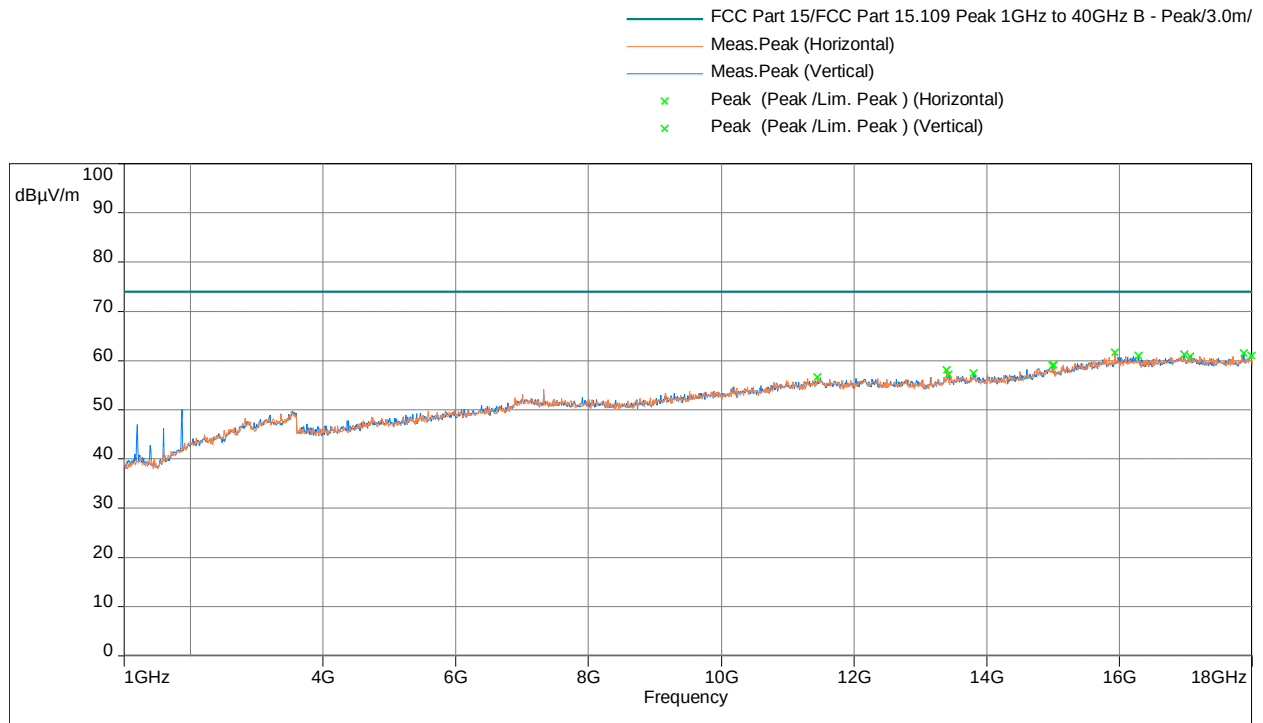
Radiated Spurious Emissions 30 MHz - 1000 MHz



Model: ; Client: ; Comments: ; Test Date: 07/31/2017 11:19

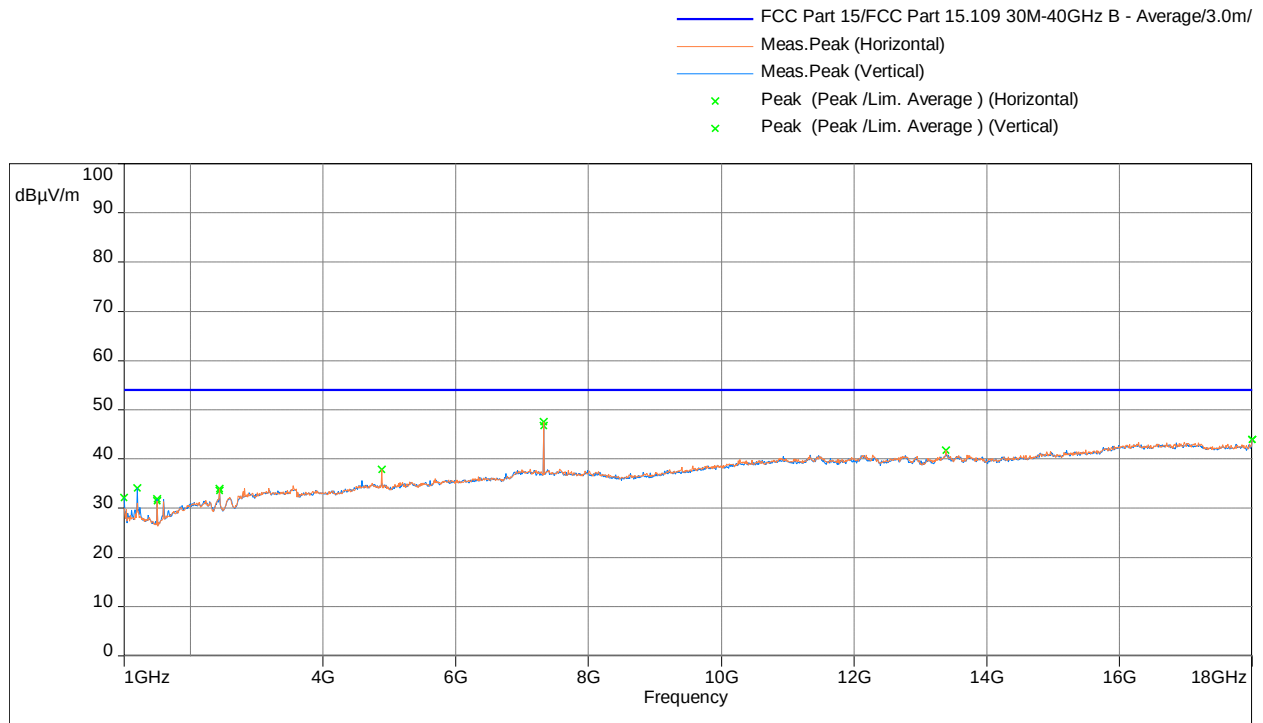
Frequency	Peak	Limit	Margin	Azimuth	Height	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	deg	cm		dB(uV/m)	dB
947.523	32.69	35.5	-2.81	83	1	Horizontal	27.7	5.03

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit



Model: ; Client: ; Comments: ; Test Date: 08/03/2017 11:34

Radiated Spurious Emissions 1000 - 18000 MHz, Avg Scan vs Avg Limit



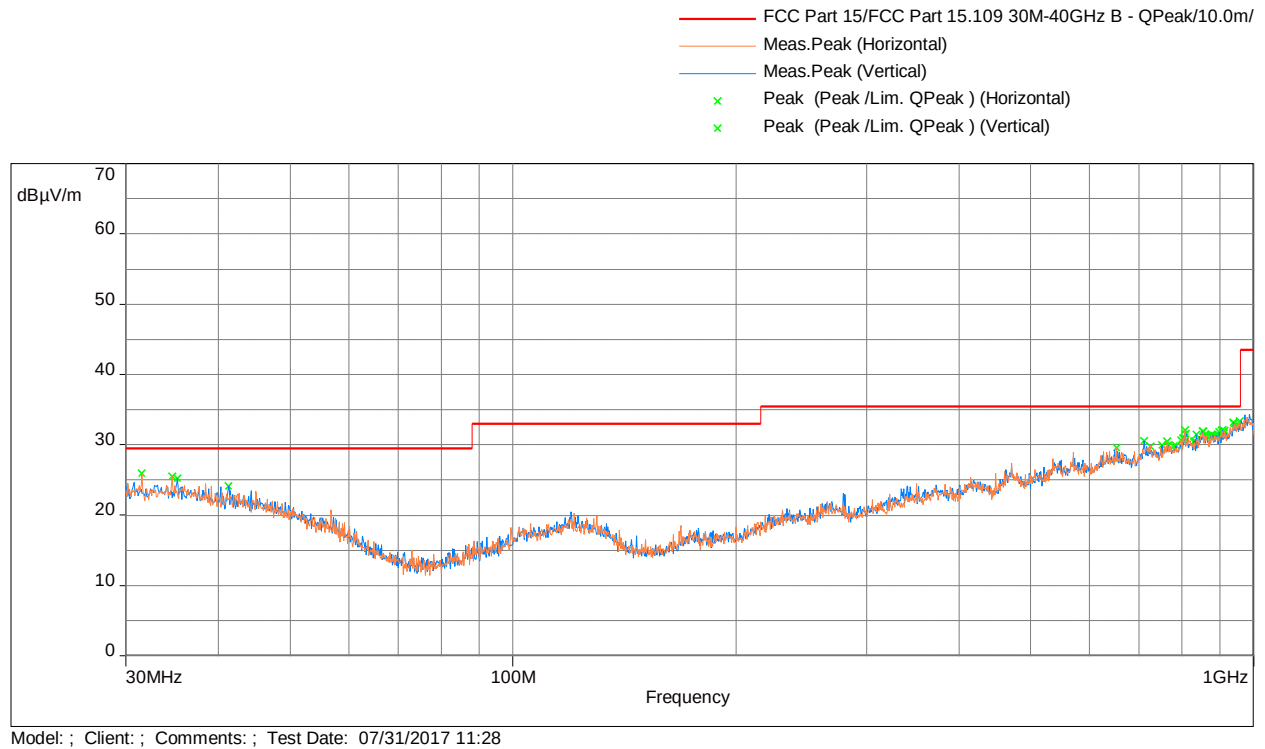
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
7320.000	47.5	54.0	-6.5	308	1.9	Horizontal	35.05	12.45

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

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

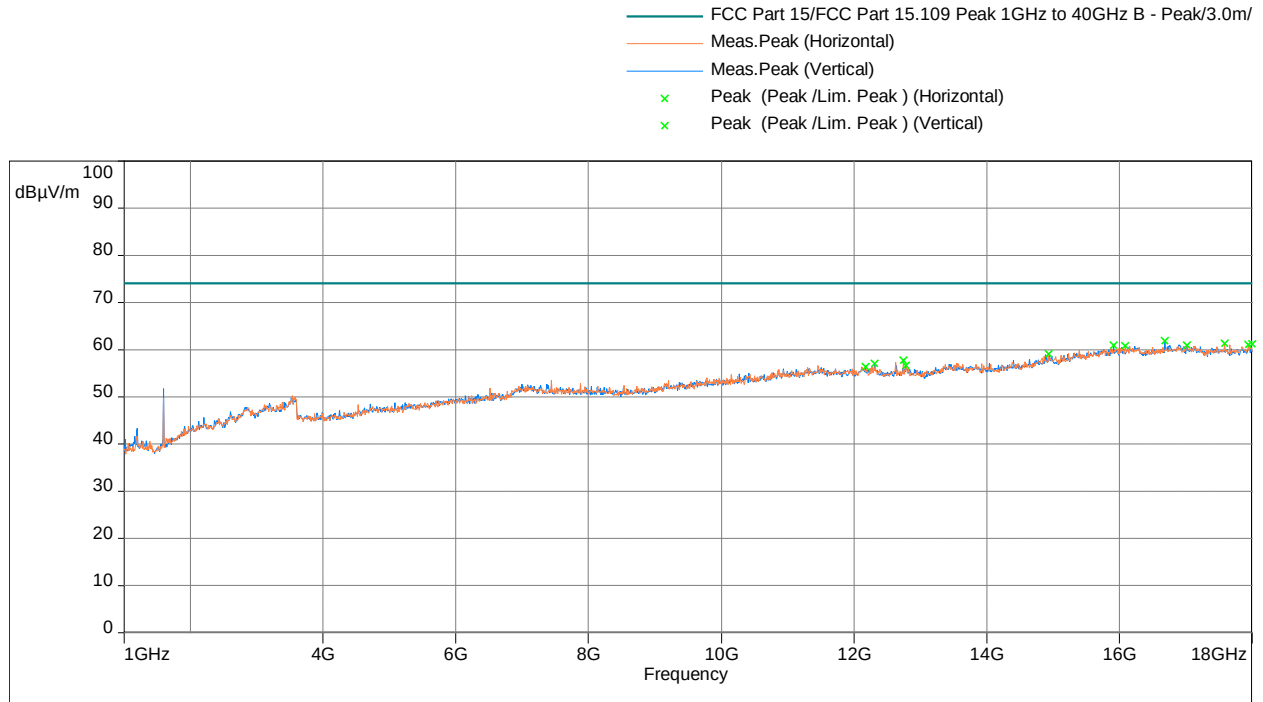
Results	Complies
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Radiated Spurious Emissions 30 MHz - 1000 MHz



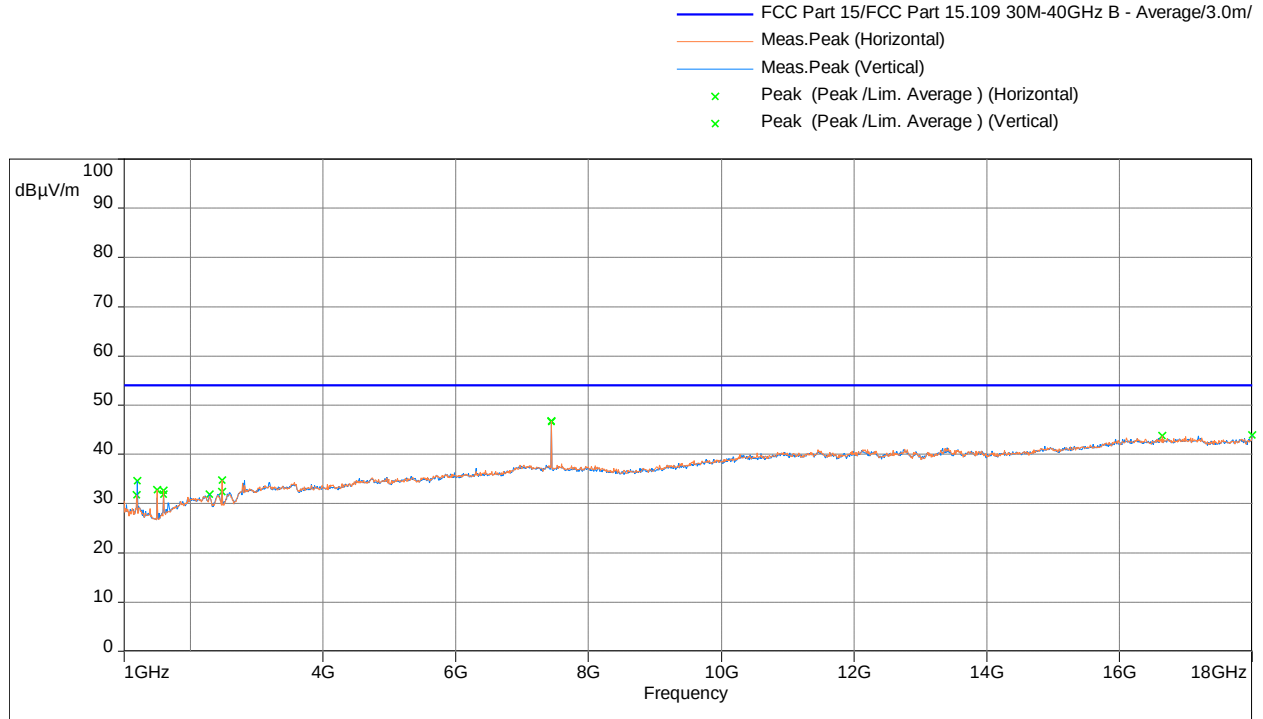
Frequency	Peak	Limit	Margin	Azimuth	Height	Polarity	Raw	Correction
MHz	dB(uV/m)	dB(uV/m)	dB	deg	cm		dB(uV/m)	dB
957.611	33.37	35.5	-2.13	45	1.0	Horizontal	28.6	4.8

Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan vs Peak Limit



Model: ; Client: ; Comments: ; Test Date: 08/03/2017 11:52

Radiated Spurious Emissions 1000 - 18000 MHz, Avg Scan vs Avg Limit



Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Angle (°)	Height (m)	Polarity	Raw (dBuV)	Correction (dB)
7440.000	46.7	54.0	-7.2	23	1	Horizontal	34.3	12.4

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

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

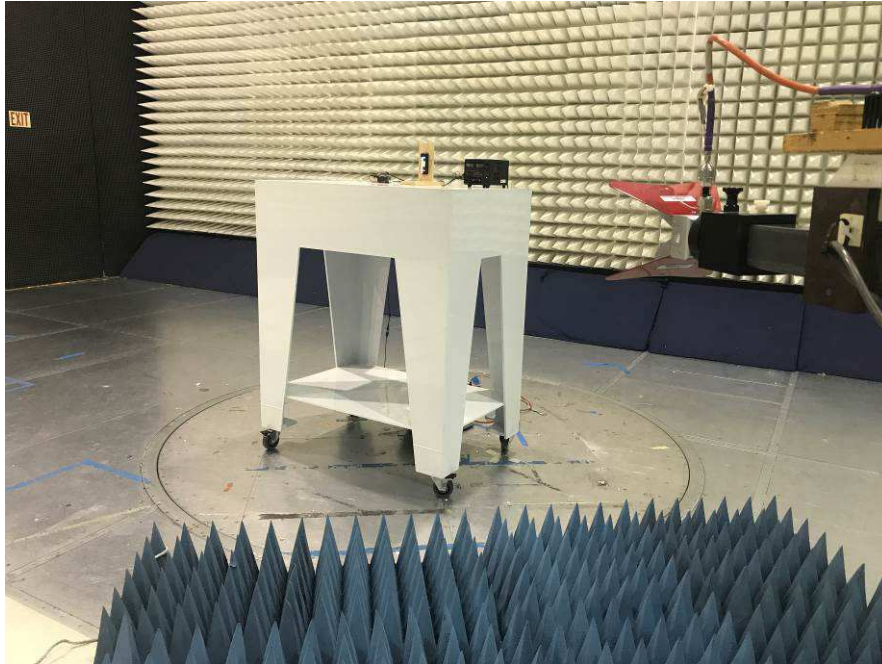
Results	Complies
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4.5.8 Test setup photographs

The following photographs show the testing configurations used.



4.5.8 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

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.

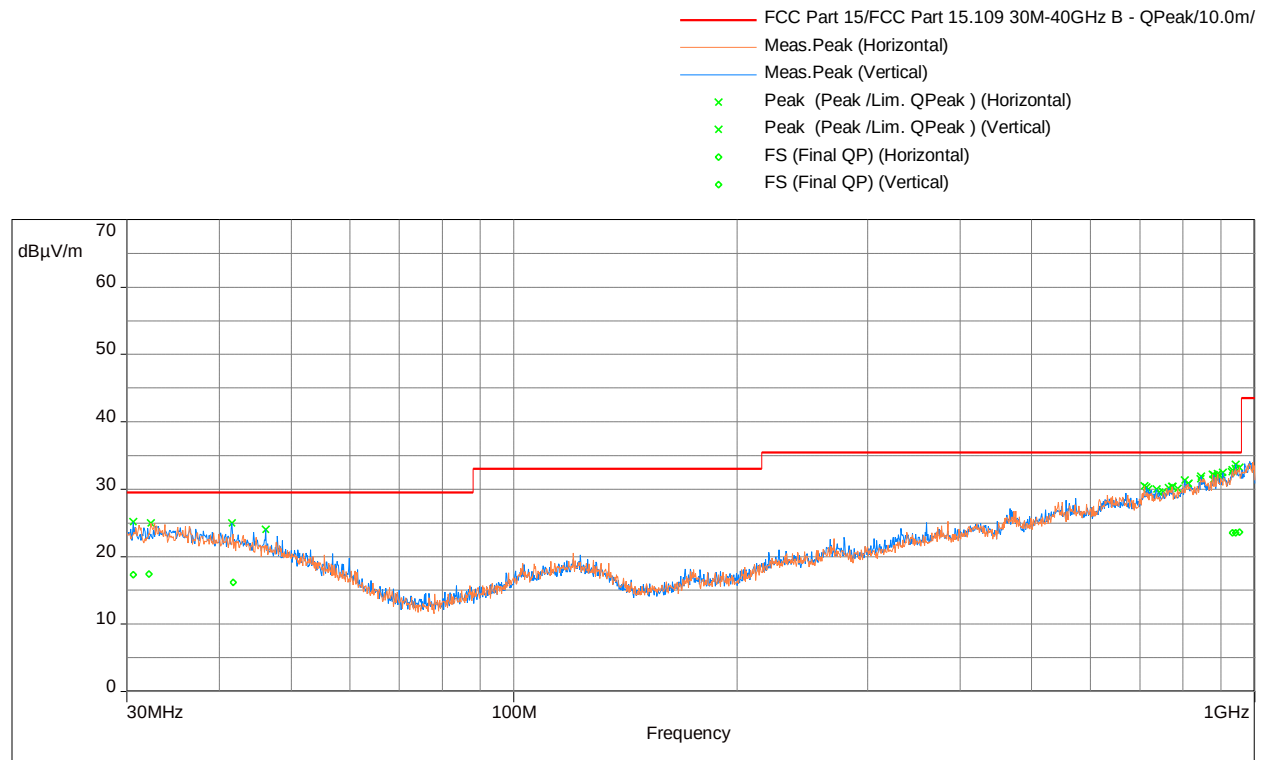
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material.

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

4.6.3 Test Results

Date of Test:	July 31, 2017
Results	Complies

Test Results: Radiated Emissions 30 MHz – 1000 MHz

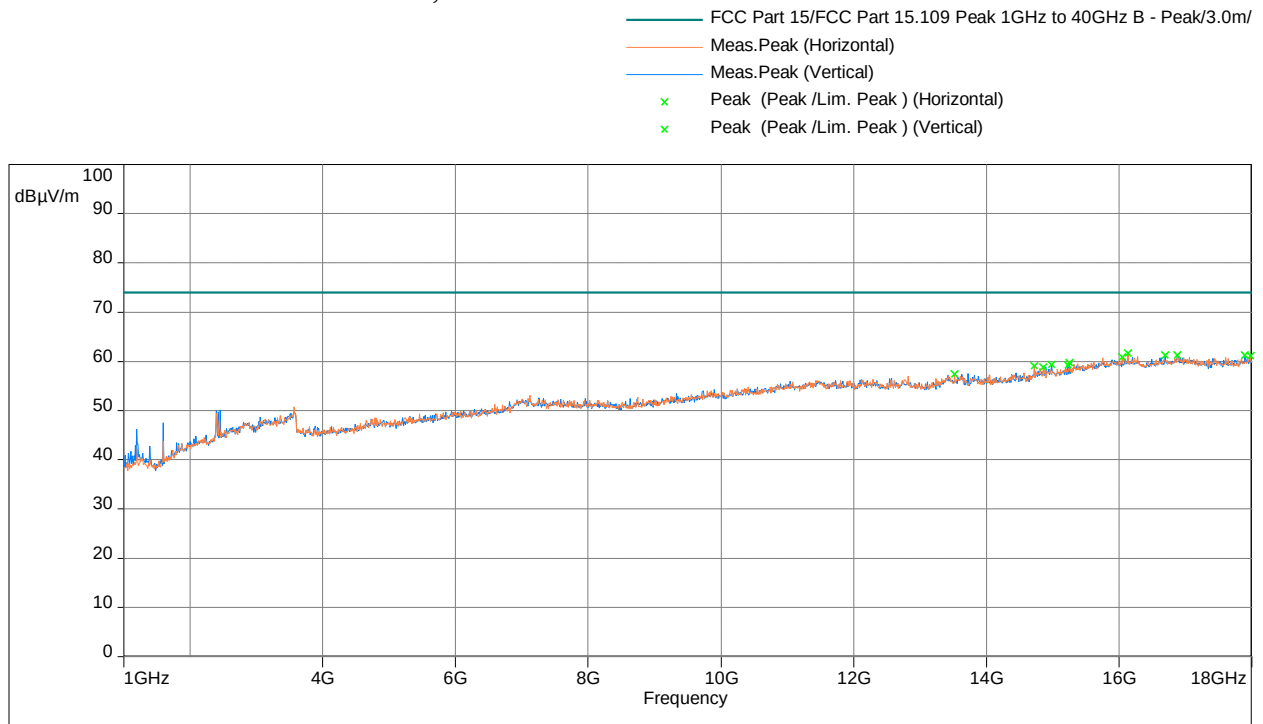


Model: ; Client: ; Comments: ; Test Date: 07/31/2017 12:01

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
30.561	17.3	30.0	-12.7	237.0	1.2	Vertical	21.3	-4.1
32.145	17.4	30.0	-12.6	97.8	3.9	Horizontal	21.5	-4.2
41.714	16.2	30.0	-13.8	162.3	3.8	Vertical	21.4	-5.2
933.806	23.5	37.0	-13.5	88.3	3.4	Horizontal	19.0	4.5
941.446	23.6	37.0	-13.4	107.3	1.7	Vertical	18.7	4.9
953.712	23.6	37.0	-13.4	153.3	3.5	Horizontal	18.7	4.9

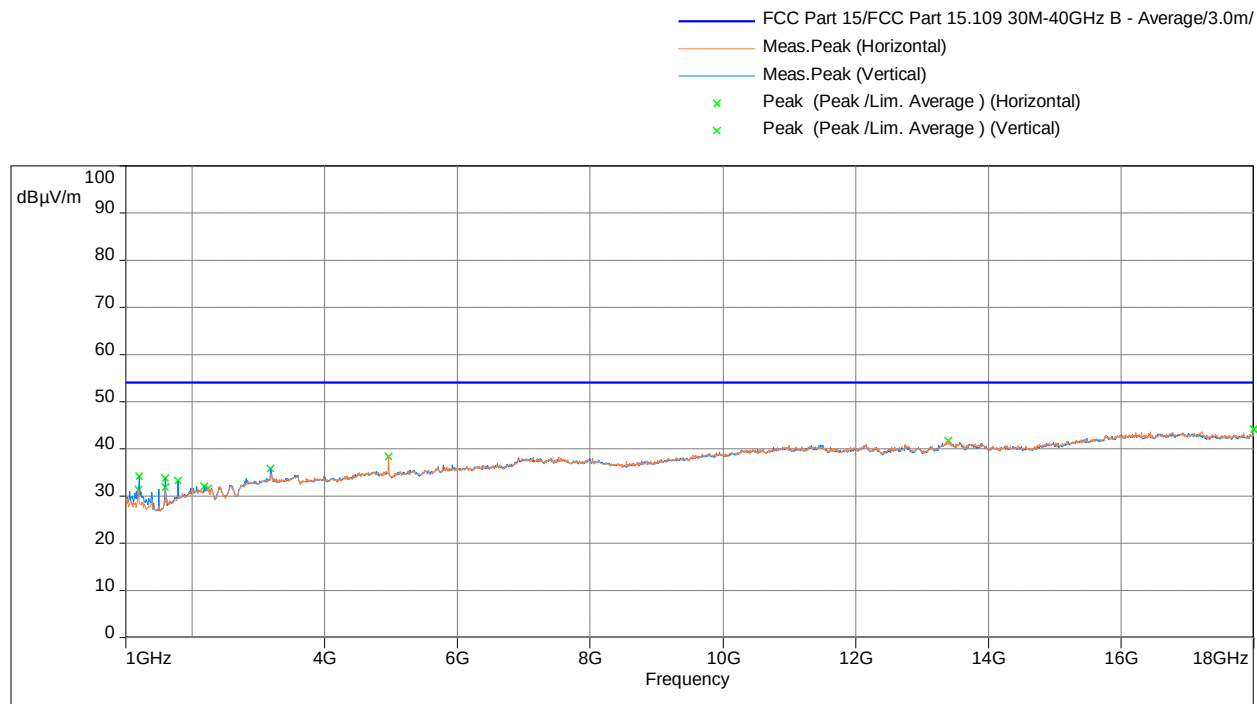
4.6.3 Test Results (Continued)

Radiated Emissions 1GHz – 18GHz, Peak



Model: ; Client: ; Comments: ; Test Date: 08/03/2017 10:06

Radiated Emissions 1GHz – 18GHz, Average



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

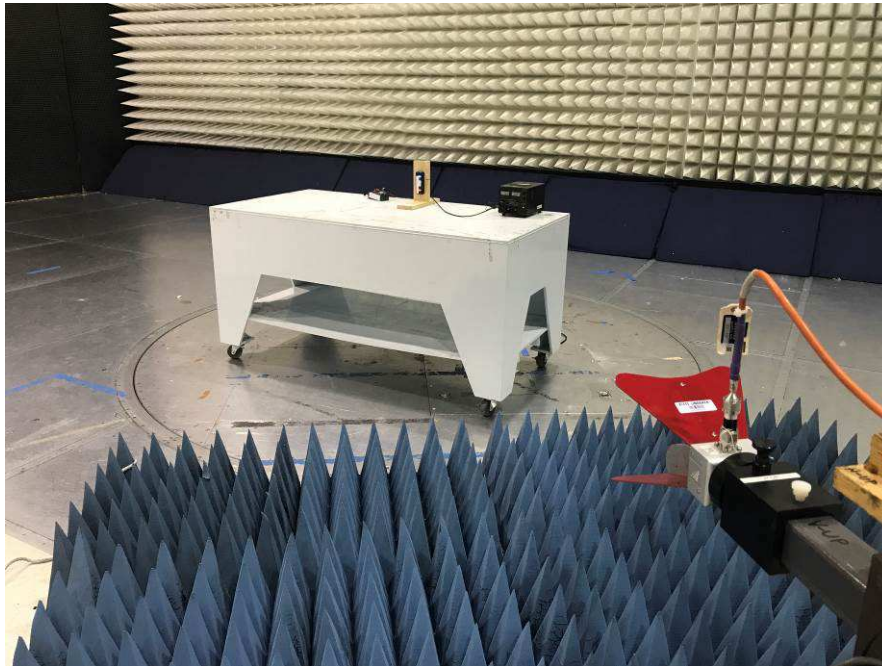
Result:	Complies by 12.6 dB
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4.6.4 Test Configuration Photographs

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.

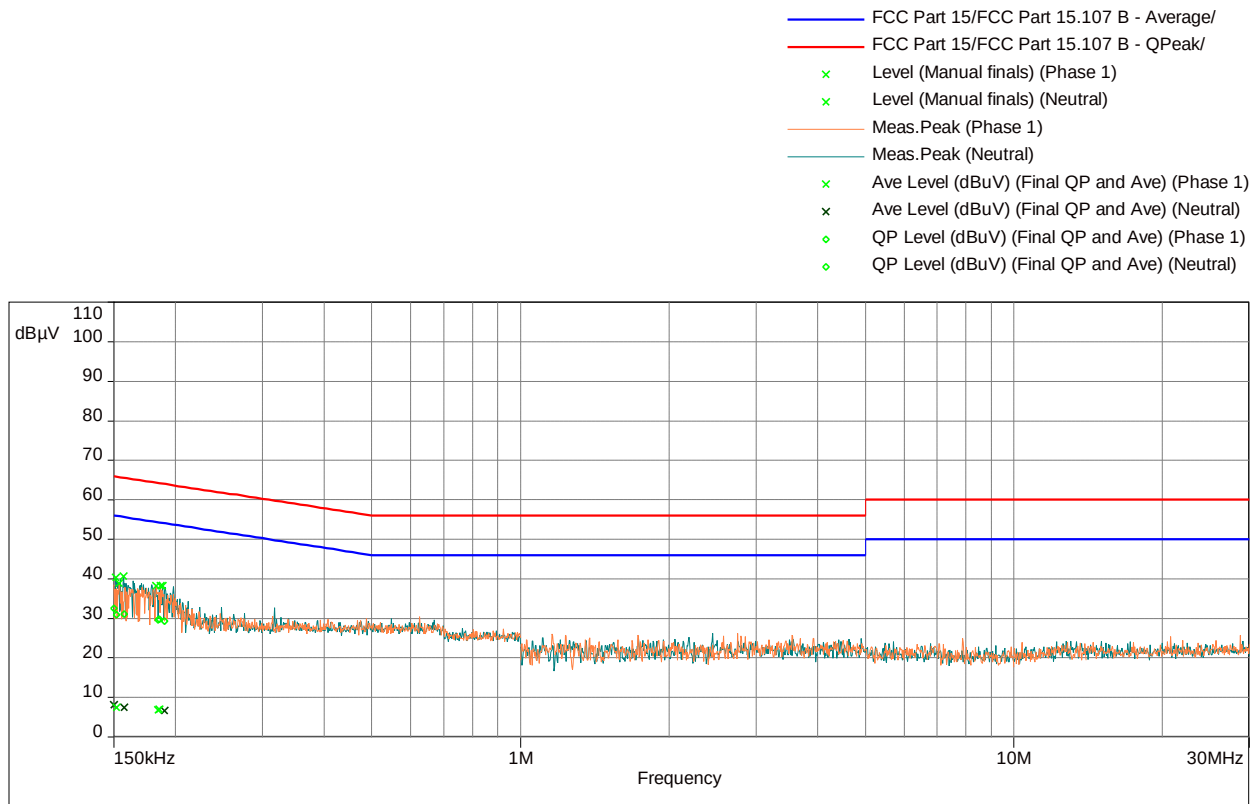
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

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:	August 02, 2017
Results	Complies

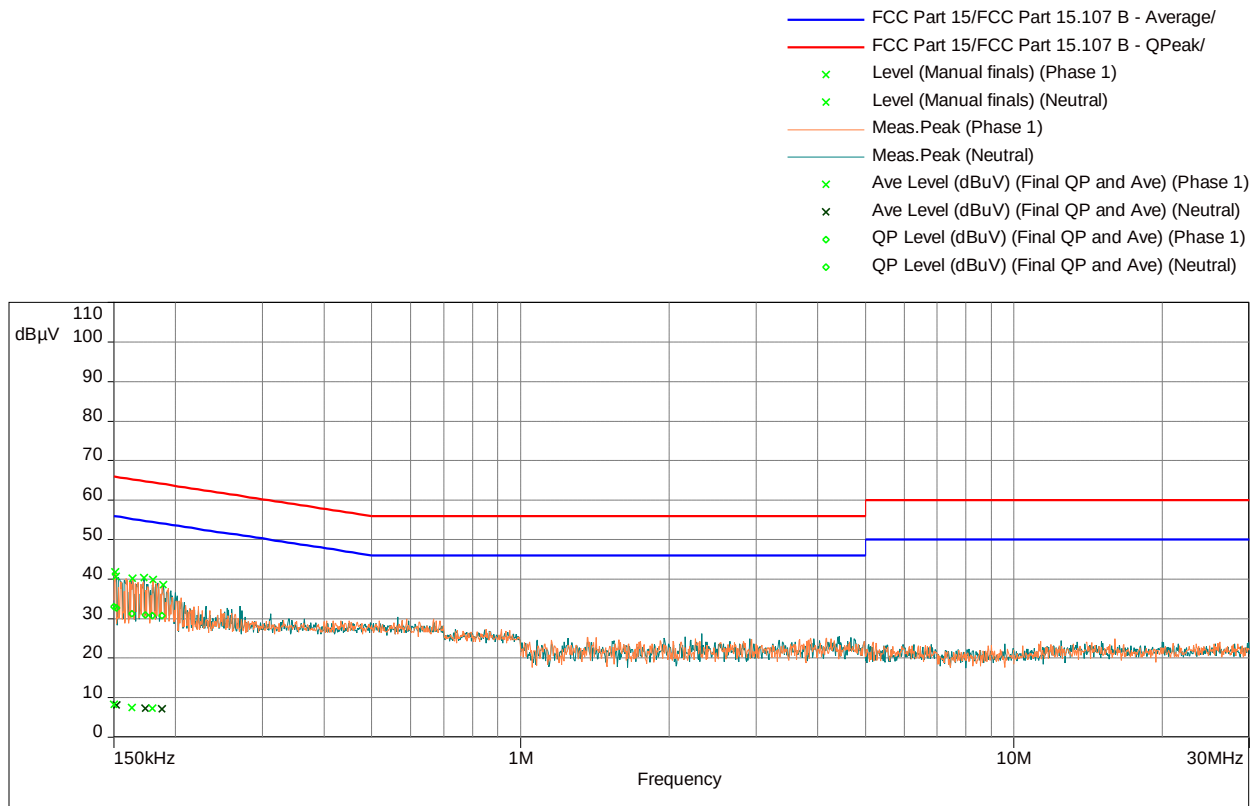
AC Line Conducted Emission Data, Digital



Frequency (MHz)	Ave Level (dBuV)	QP Level (dBuV)	Ave Limit (dBuV)	QP Limit (dBuV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.151620	7.5	31.0	55.9	65.9	-48.4	-35.0	Phase 1	11.0
0.184419	6.8	29.6	54.3	64.3	-47.5	-34.7	Phase 1	11.0
0.185595	6.9	29.8	54.2	64.2	-47.3	-34.4	Phase 1	11.0
0.150000	8.1	32.5	56.0	66.0	-47.9	-33.5	Neutral	11.0
0.157137	7.5	31.1	55.6	65.6	-48.1	-34.5	Neutral	11.0
0.189683	6.7	29.4	54.1	64.1	-47.4	-34.7	Neutral	11.0

4.7.3 Test Result (Continued)

AC Line Conducted Emission Data, Tx On



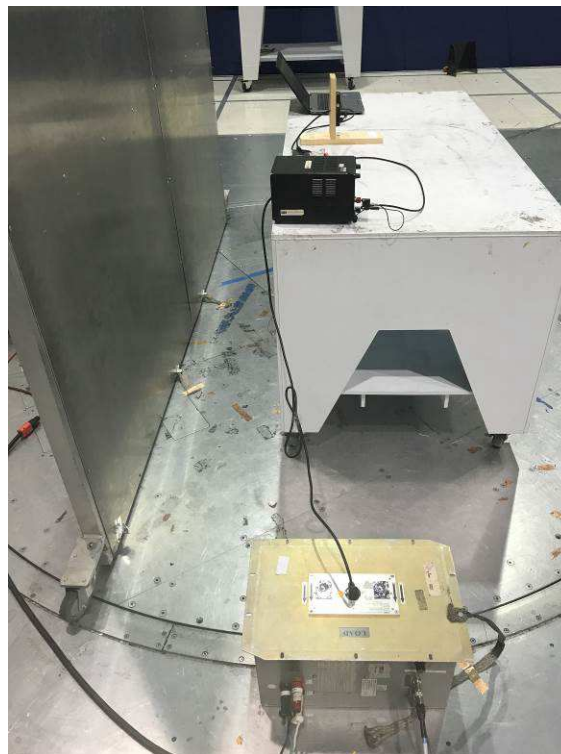
Model: ; Client: ; Comments: ; Test Date: 08/02/2017 15:14

Frequency (MHz)	Ave Level (dBuV)	QP Level (dBuV)	Ave Limit (dBuV)	QP Limit (dBuV)	Ave Margin (dB)	QP Margin (dB)	Line	Correction (dB)
0.150081	8.3	32.9	56.0	66.0	-47.7	-33.1	Phase 1	11.0
0.163119	7.5	31.2	55.3	65.3	-47.8	-34.1	Phase 1	11.0
0.179680	7.2	30.7	54.5	64.5	-47.3	-33.8	Phase 1	11.0
0.151831	8.1	32.7	55.9	65.9	-47.8	-33.2	Neutral	11.0
0.173610	7.3	30.9	54.8	64.8	-47.5	-33.9	Neutral	11.0
0.187691	7.1	30.8	54.1	64.1	-47.0	-33.4	Neutral	11.0

Results **Complies** by 33.2dB

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	ITS 00913	12	01/12/18
Pyramidal Horn Antenna	EMCO	3160-09	ITS 00571	#	#
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	04/18/18
Pre-Amplifier (1-18GHz)	Miteq	AMF-4D-001180-24-10P	ITS 00526	12	09/29/17
Horn Antenna	ETS-Lindgren	3117	ITS 01325	12	09/07/17
Notch Filter	Micro-Tronics	BRM50702	ITS 01166	12	02/08/18
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	07/10/18
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	09/09/17
Pre-Amplifier	Sonoma Instrument	310	ITS 01493	12	09/28/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1462	12	08/24/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1465	12	08/24/17
RE Cable	TRU Corporation	TRU CORE 300	ITS 1470	12	08/24/17
Attenuator	Mini Circuits	BW-N3W5+	ITS 1315	12	10/19/17
Notch Filter	MICRO-TRONICS	BRM50702	ITS 1166	12	12/08/18
RE Cable	Megaphase	EMC1-K1K1-236	IT 1538	12	06/13/18
RE Cable	Megaphase	EMC1-K1K1-19	ITS 1482	12	08/25/17
RE Cable	Megaphase	TM40-K1K1-19	ITS 1154	12	01/26/18
Transient Limiter	COM-POWER	LIT-153A	ITS 1452	12	06/19/18
RE Cable	TRU Corporation	TRU CORE 300	ITS 1462	12	08/24/17

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	3.16.0.64	Farpointe_07-28-2017
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 / G103088018	ML	KV	August 20, 2017	Original document