TEST REPORT

Report Number: 103243298MPK-001
Project Number: G103243298
October 11, 2017

Testing performed on
1322x USB Dongle/ Zniffer
Model: TSII-DONGLE2

FCC ID: U3D-TSIIDONGLE2
IC: 5349C-TSIIDONGLE2

to

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

For

S&C Electric Company

Test Performed by:	Test Authorized by:
Intertek	S&C Electric Company
1365 Adams Court	6601 N Ridge Blvd
Menlo Park, CA 94025 USA	Chicago, IL 60626-3904 USA

Prepared by: _____ **Date:** October 11, 2017
Todd Moy

Reviewed by: _____ **Date:** October 11, 2017
Krishna K Vemuri

Report No. 103243298MPK-001

Equipment Under Test:	1322x USB Dongle/ Zniffer
Trade Name:	S&C Electric Company
Model Number:	TSII-DONGLE2
Applicant:	S&C Electric Company
Contact:	Muhammand Tabani
Address:	S&C Electric Company 6601 N Ridge Blvd Chicago, IL 60626-3904
Country	USA
Tel. Number:	(773) 381-1501x4134
Email:	Muhammad.Tabani@sandc.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 2 FCC Part 15, Subpart B Industry Canada ICES-003
Date of Test:	October 2 to 9, 2017

We attest to the accuracy of this report:

Todd Moy
EMC Project Engineer

Krishna K Vemuri
Engineering Team Lead

TABLE OF CONTENTS

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
Radiated Emissions	15.109	ICES-003	Complies
AC Line Conducted Emission	15.107	ICES-003	Complies

EUT receive date: September 29, 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: October 2, 2017

Test completion date: October 9, 2017

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

2.0 General Information

2.1 Product Description

S&C Electric Company supplied the following description of the EUT:

The TSII-DONGLE2 is a Zigbee dongle.

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

Information about the Zigbee 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	S&C Electric Company
Model No.	TSII-DONGLE2
FCC Identifier	U3D-TSIIDONGLE2
IC Identifier	5349C-TSIIDONGLE2
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	3 dBm
Antenna(s) & Gain	Internal Antenna, Gain: 2.0 dBi
Frequency Range	2405 – 2480 MHz
Type of modulation/data rate	OQPSK / 250 kbit/s
Number of Channel(s)	16, Channel 11-26
Applicant Name & Address	S&C 6601 N Ridge Blvd Chicago, IL 60626-3904 USA

The following is the power settings for the EUT.

Channel	Power Setting	Channel	Power Setting
11	3dBm	19	3dBm
12	3dBm	20	3dBm
13	3dBm	21	3dBm
14	3dBm	22	3dBm
15	3dBm	23	3dBm
16	3dBm	24	3dBm
17	3dBm	25	3dBm
18	3dBm	26	m1dBm

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

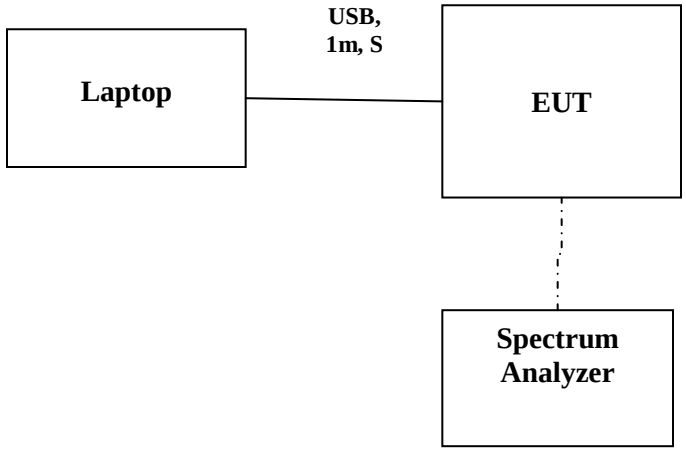
3.1 Support Equipment

Description	Manufacturer	Model Number
Laptop	Dell	Vostro 1440

3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	**Manufacturer**	**Model Number**	**Serial Number**
USB Dongle	S&C	TSII-DONGLE2	001001

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



S = Shielded	**F** = With Ferrite
U = Unshielded	**m** = Length in Meters

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table.

All tests were performed with the maximum power settings except for output power and band edge.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by S&C Electric Company.

3.5 Mode of Operation during Test

During transmitter testing, the transmitter was setup to transmit at maximum RF power on low, middle and high frequencies/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 5.2.1 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) ≥ 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.

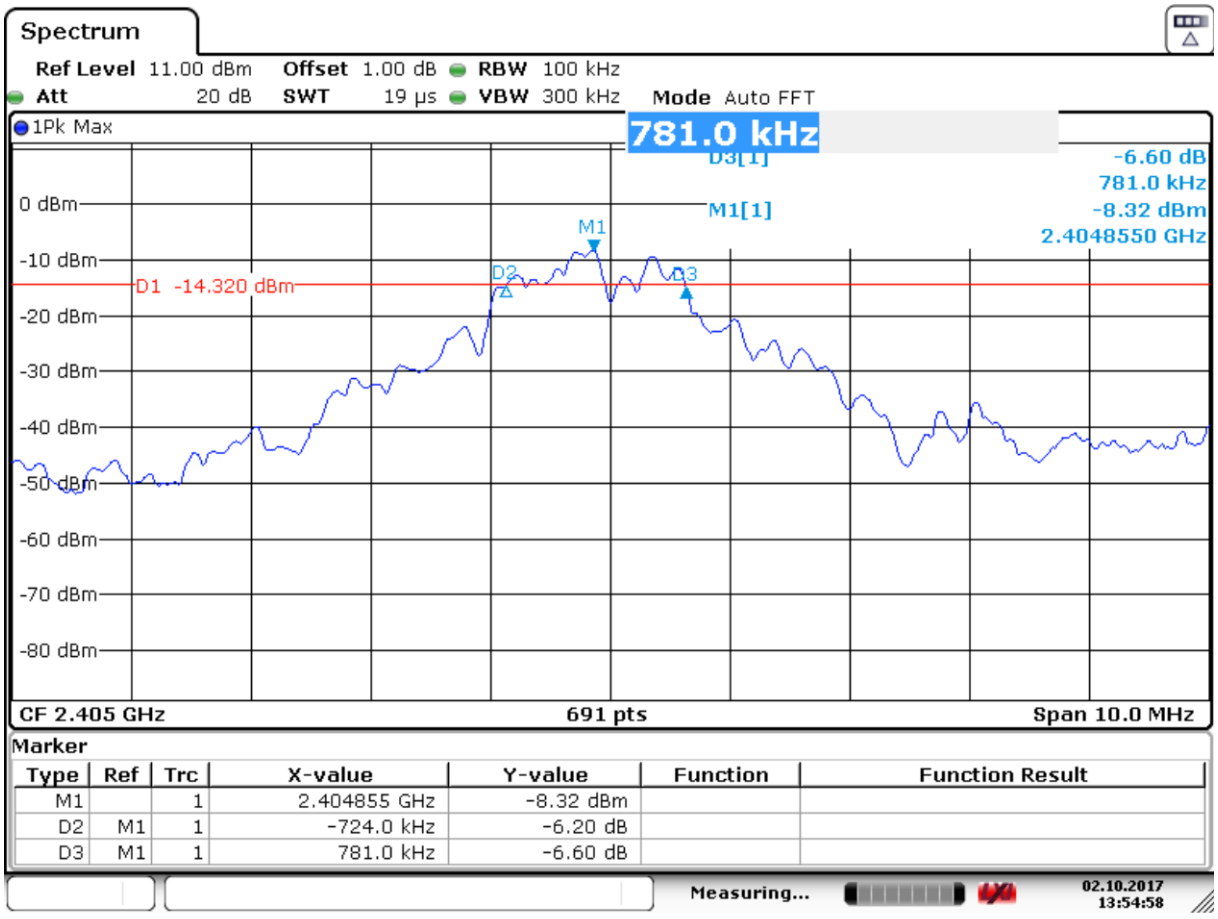
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

4.1.3 Test Result

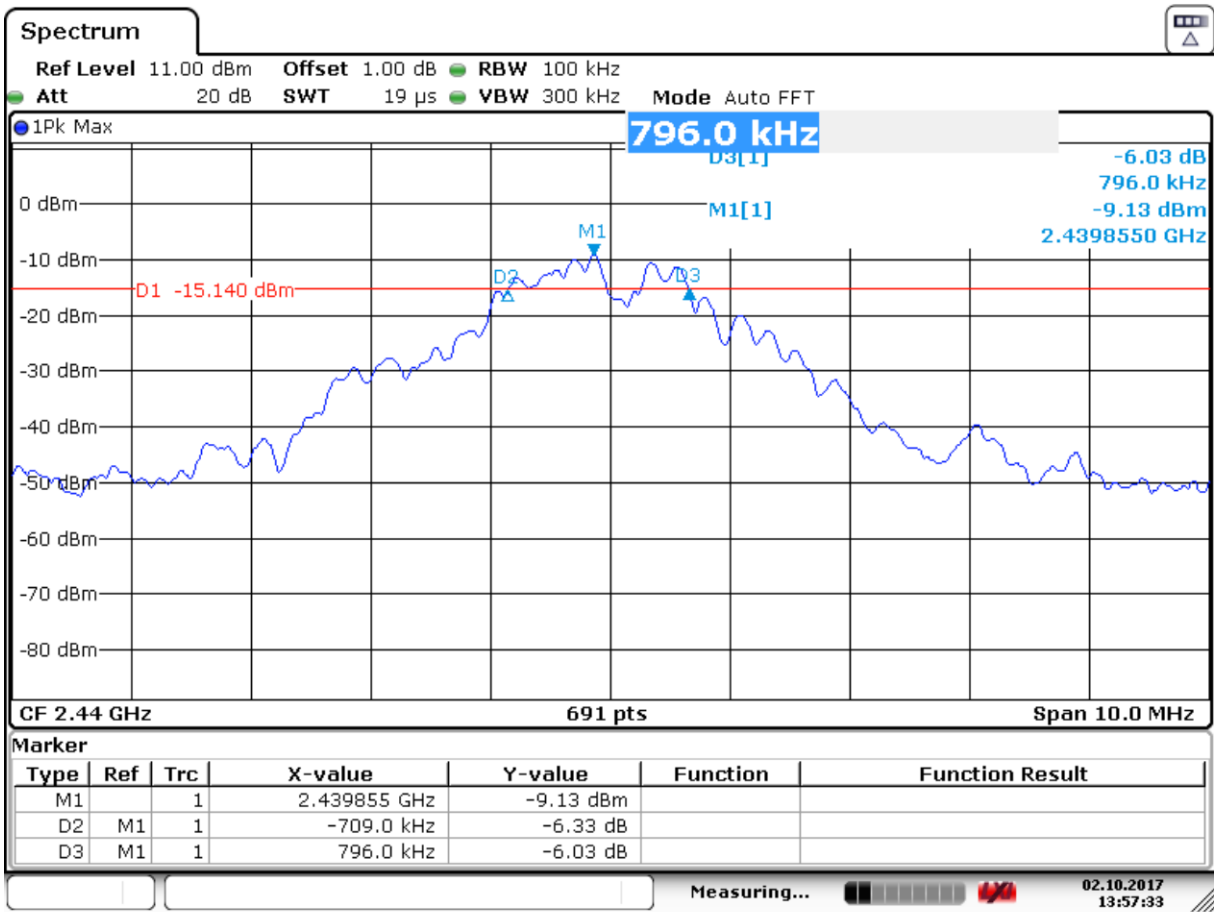
Frequency (MHz)	6-dB bandwidth FCC 15.247 & RSS-GEN, kHz	Occupied bandwidth, RSS-GEN, MHz	Plot
2405	1504	--	1.1
	--	3.27	1.4
2440	1505	--	1.2
	--	3.36	1.5
2480	1476	--	1.3
	--	3.31	1.6

Date of Test:	October 2, 2017
Results	**Complies**

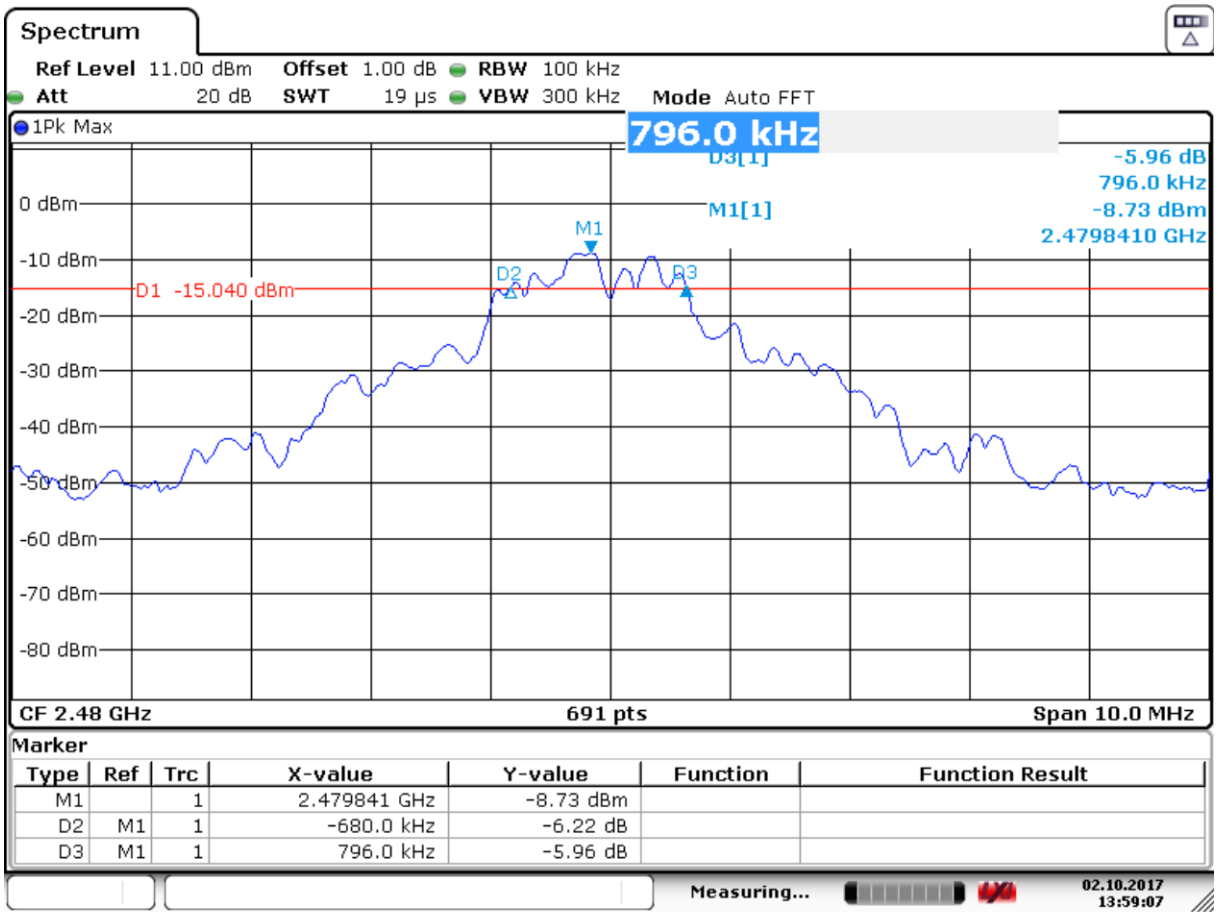
Plot 1. 1


Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 100 kHz
Att 20 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
781.0 kHz
D3[1]
-6.60 dB
781.0 kHz
M1[1]
-8.32 dBm
2.4048550 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D2
D3
D1 -14.320 dBm
CF 2.405 GHz
691 pts
Span 10.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.404855 GHz -8.32 dBm
D2 M1 1 -724.0 kHz -6.20 dB
D3 M1 1 781.0 kHz -6.60 dB
Measuring...
02.10.2017
13:54:58
Date: 20.OCT.2017 13:54:57

Plot 1. 2

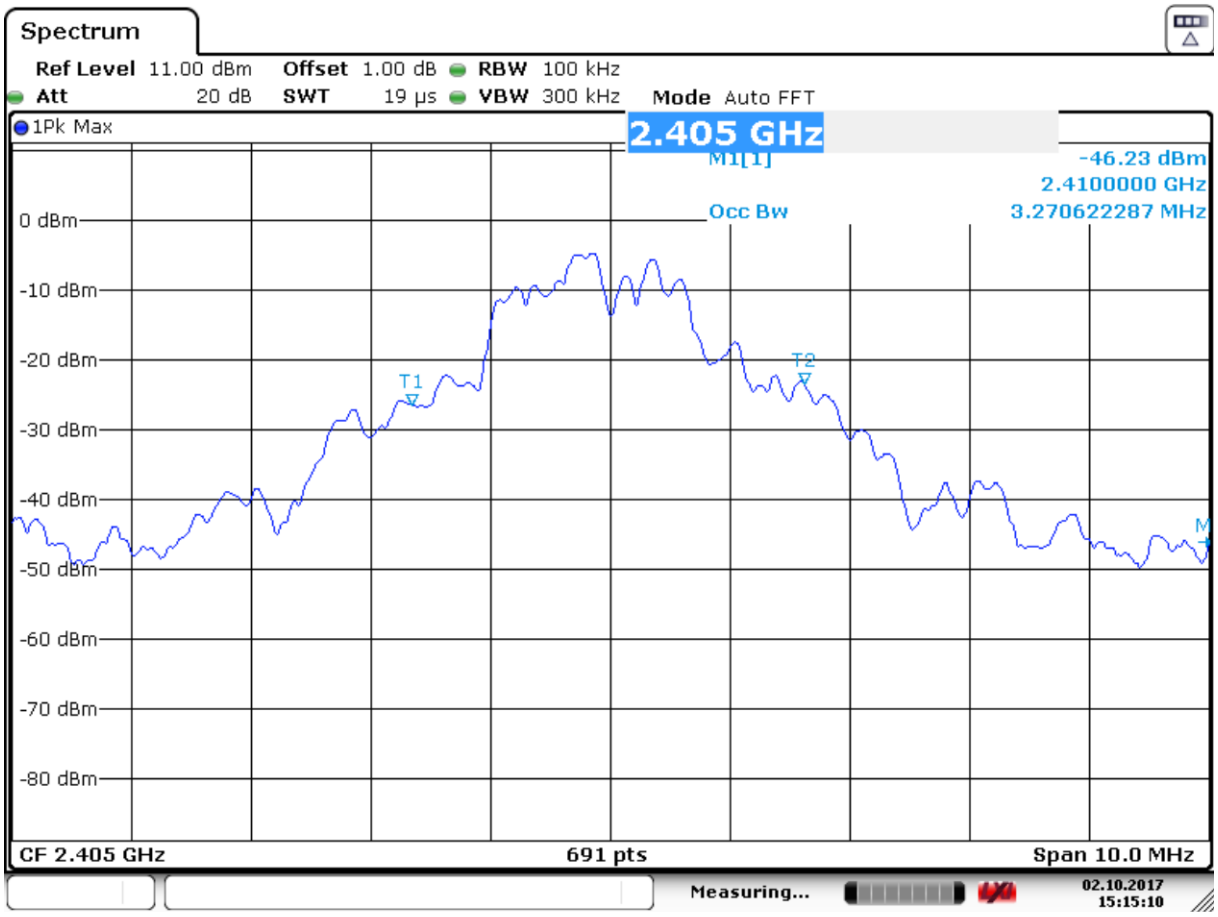

Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 100 kHz
Att 20 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
796.0 kHz
D3[1]
-6.03 dB
796.0 kHz
M1[1]
-9.13 dBm
2.4398550 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D2
D3
D1 -15.140 dBm
CF 2.44 GHz
691 pts
Span 10.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.439855 GHz -9.13 dBm
D2 M1 1 -709.0 kHz -6.33 dB
D3 M1 1 796.0 kHz -6.03 dB
Measuring...
02.10.2017
13:57:33
Date:20.OCT.2017 13:57:33

Plot 1. 3

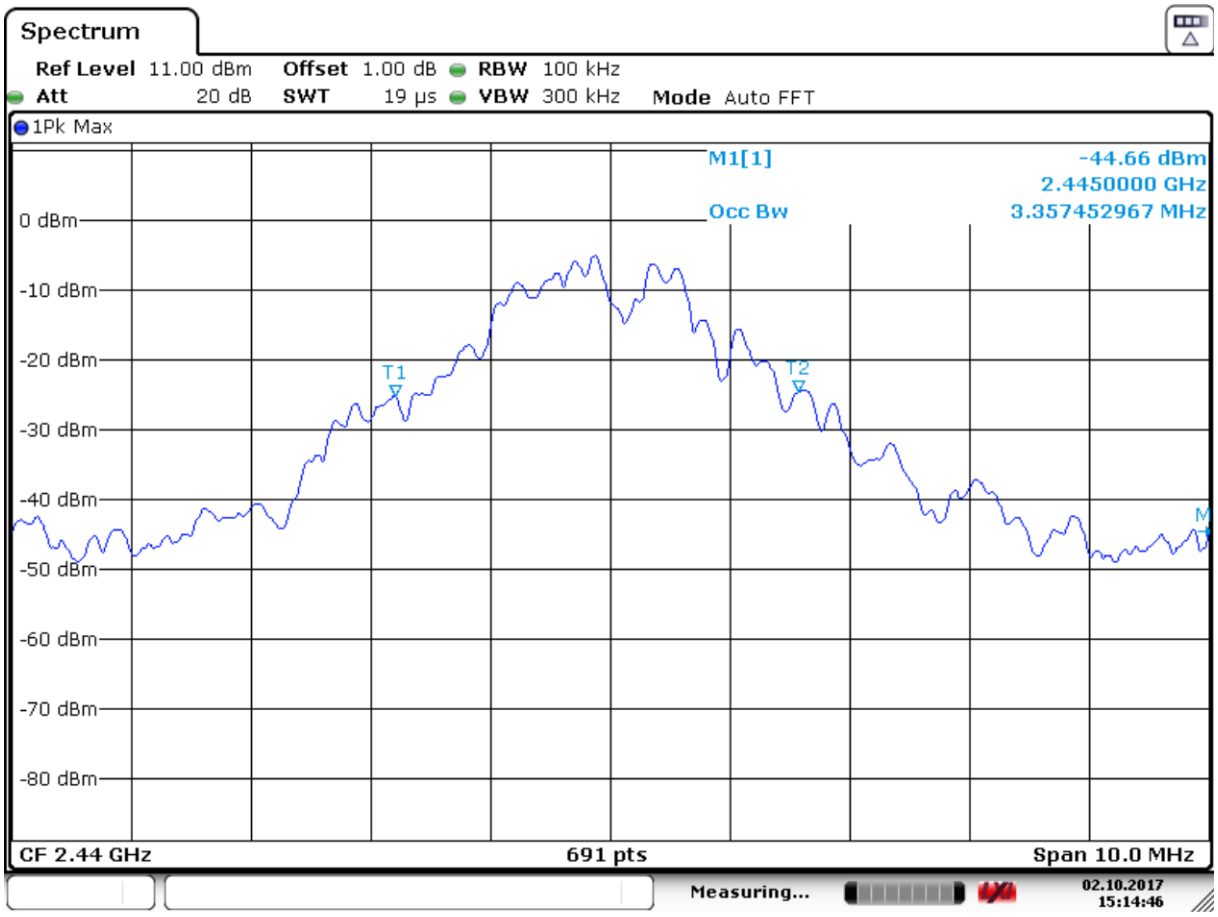


Date: 2.OCT.2017 13:59:07

Plot 1. 4

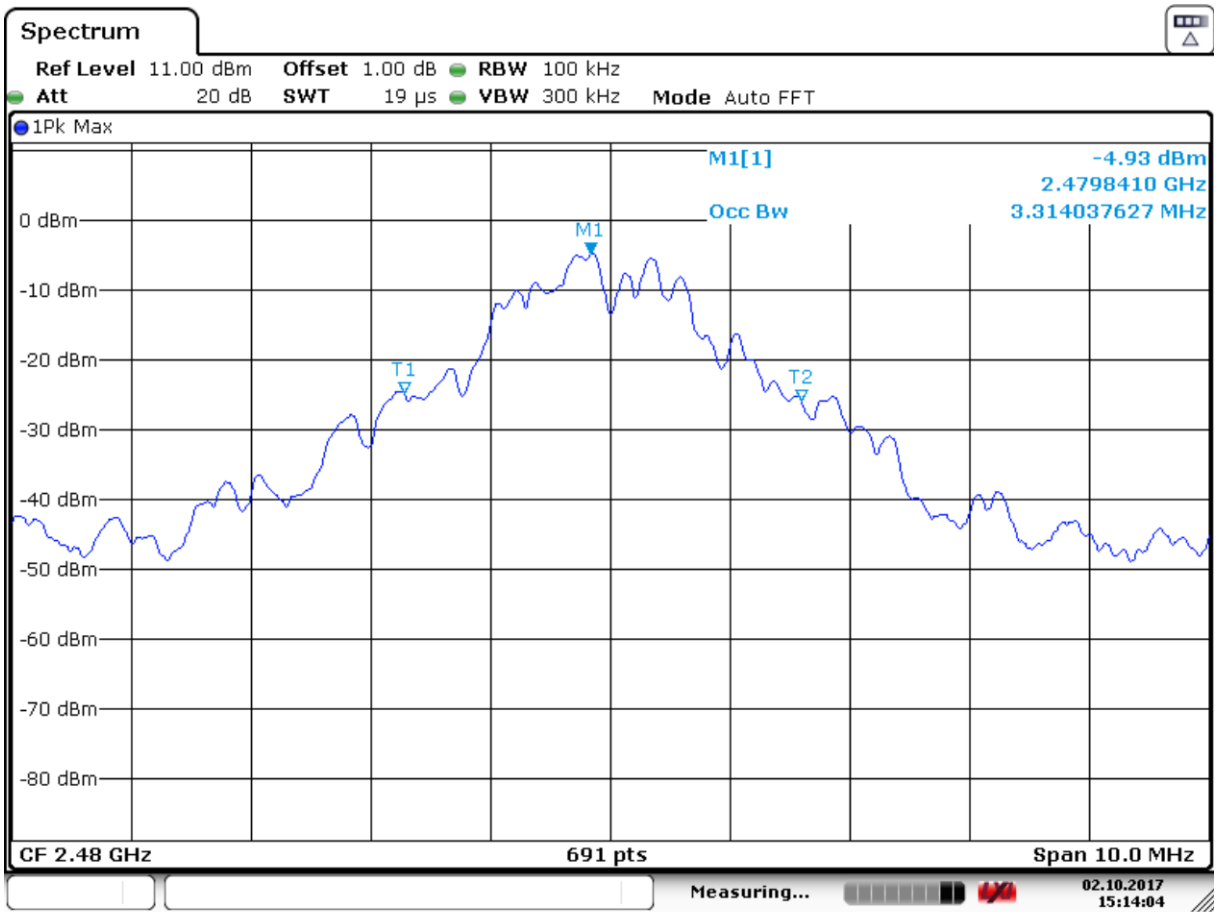

Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 100 kHz
Att 20 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
2.405 GHz
M1[1]
-46.23 dBm
2.4100000 GHz
Occ Bw
3.270622287 MHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
T1
T2
CF 2.405 GHz
691 pts
Span 10.0 MHz
Measuring...
02.10.2017
15:15:10
Date:20.OCT.2017 15:15:11

Plot 1.5



Date: 20.OCT.2017 15:14:47

Plot 1.6



Date: 20.OCT.2017 15:14:04

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

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 ≥ 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.

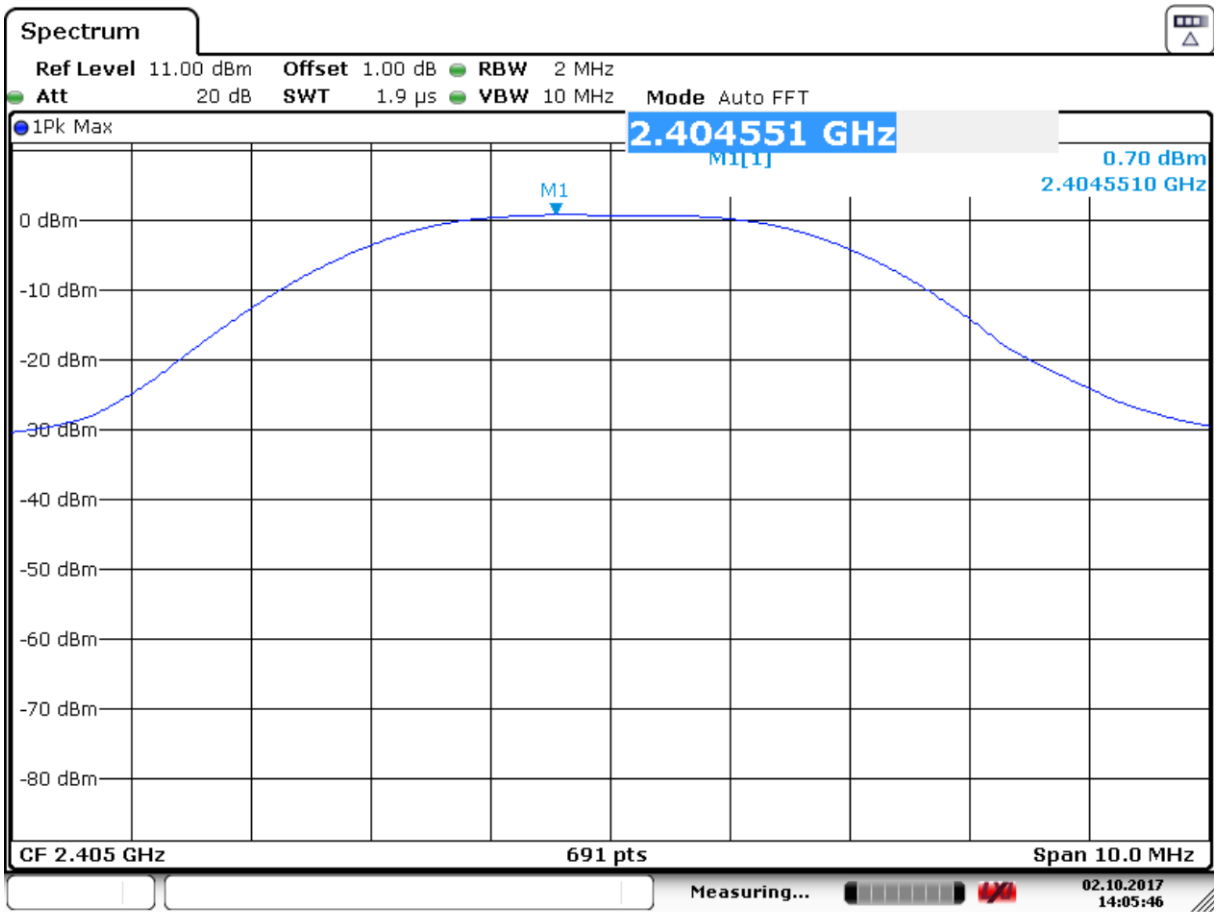
4.3.3 Test Result

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

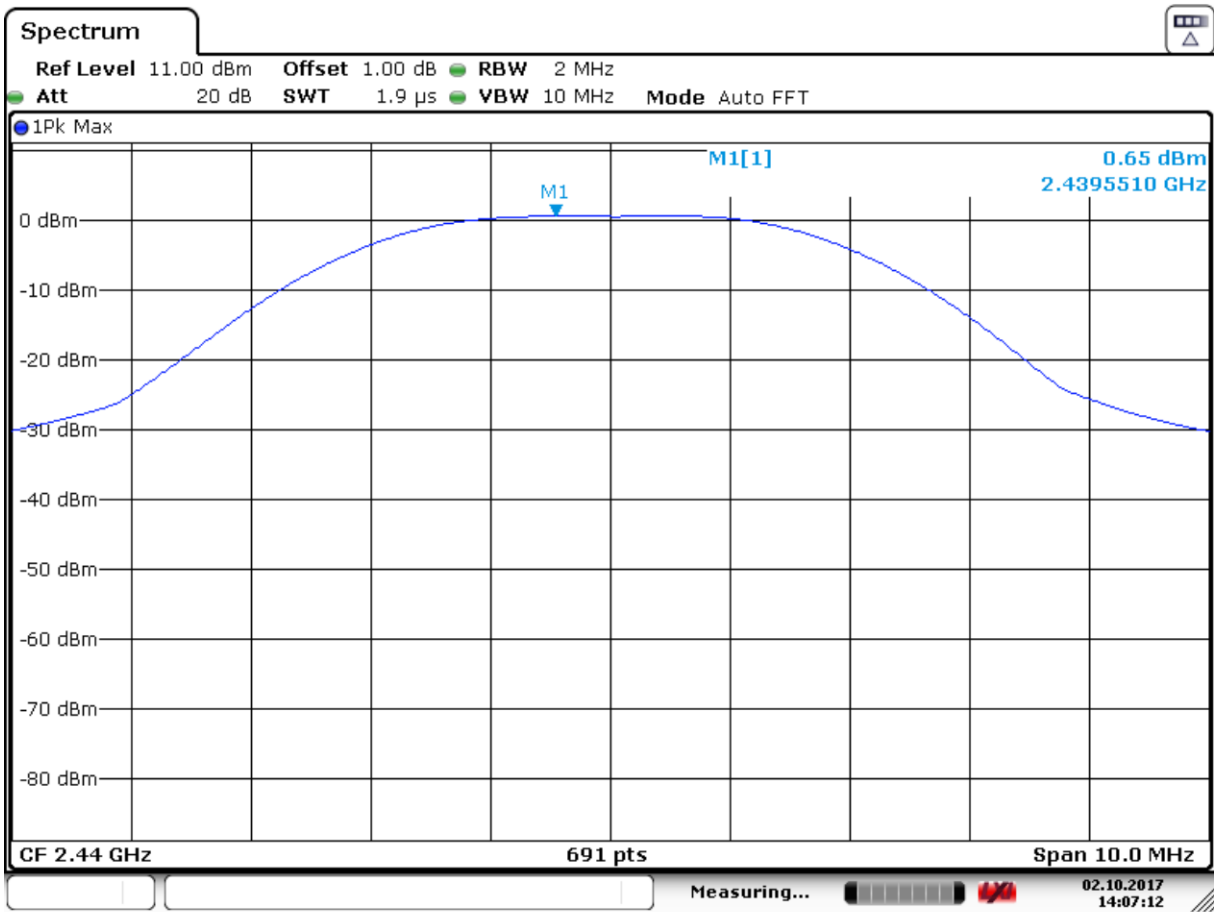
Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), mW	Plot
2405	0.70	1.175	2.1
2440	0.65	1.161	2.2
2475	-0.01	0.998	2.3
2480	-3.88	0.409	2.4

Date of Test:	October 2 & 5, 2017
Results	**Complies**

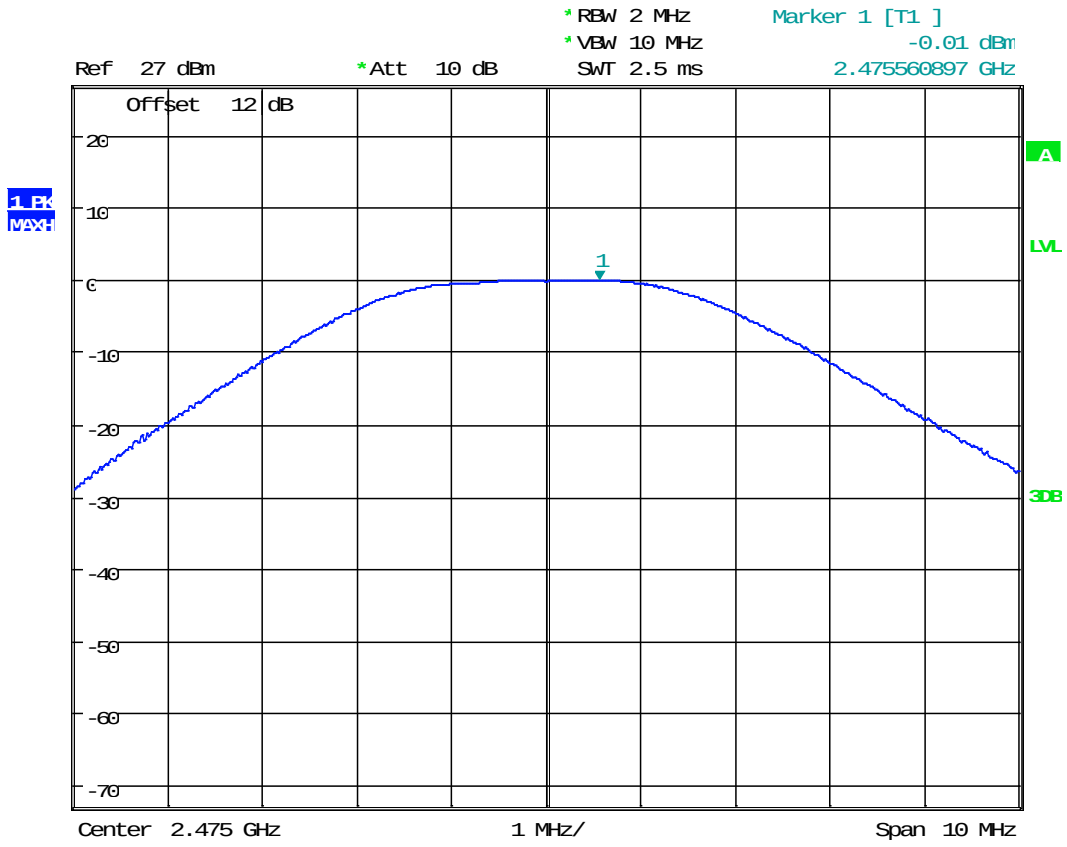
Plot 2. 1


Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 2 MHz
Att 20 dB SWT 1.9 µs VBW 10 MHz Mode Auto FFT
1Pk Max
2.404551 GHz
M1[1] 0.70 dBm
2.4045510 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.405 GHz
691 pts
Span 10.0 MHz
Measuring...
02.10.2017
14:05:46
Date: 20.OCT.2017 14:05:47

Plot 2. 2

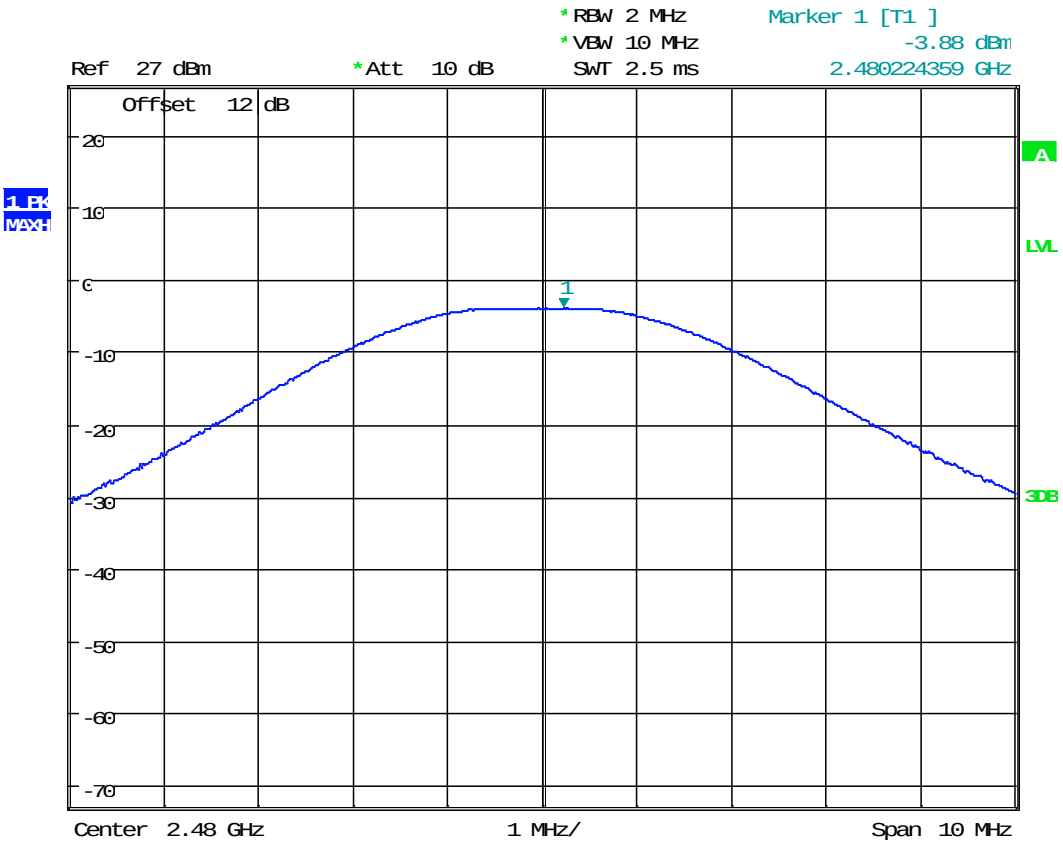

Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 2 MHz
Att 20 dB SWT 1.9 µs VBW 10 MHz Mode Auto FFT
1Pk Max
M1[1]
0.65 dBm
2.4395510 GHz
M1
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.44 GHz
691 pts
Span 10.0 MHz
Measuring...
02.10.2017
14:07:12
Date: 20.OCT.2017 14:07:12

Plot 2. 3



Date: 5.OCT.2017 11:01:00

Plot 2. 4


*RBW 2 MHz
*VBW 10 MHz
SWT 2.5 ms
Marker 1 [T1]
-3.88 dBm
2.480224359 GHz
Ref 27 dBm
*Att 10 dB
Offset 12 dB
20
10
0
-10
-20
-30
-40
-50
-60
-70
1
A
LVL
3DB
Center 2.48 GHz
1 MHz/
Span 10 MHz
Date: 5.OCT.2017 10:05:34

4.3 Maximum Power Spectral Density
FCC: 15.247 (e); RSS-247 5.2.2;

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 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.

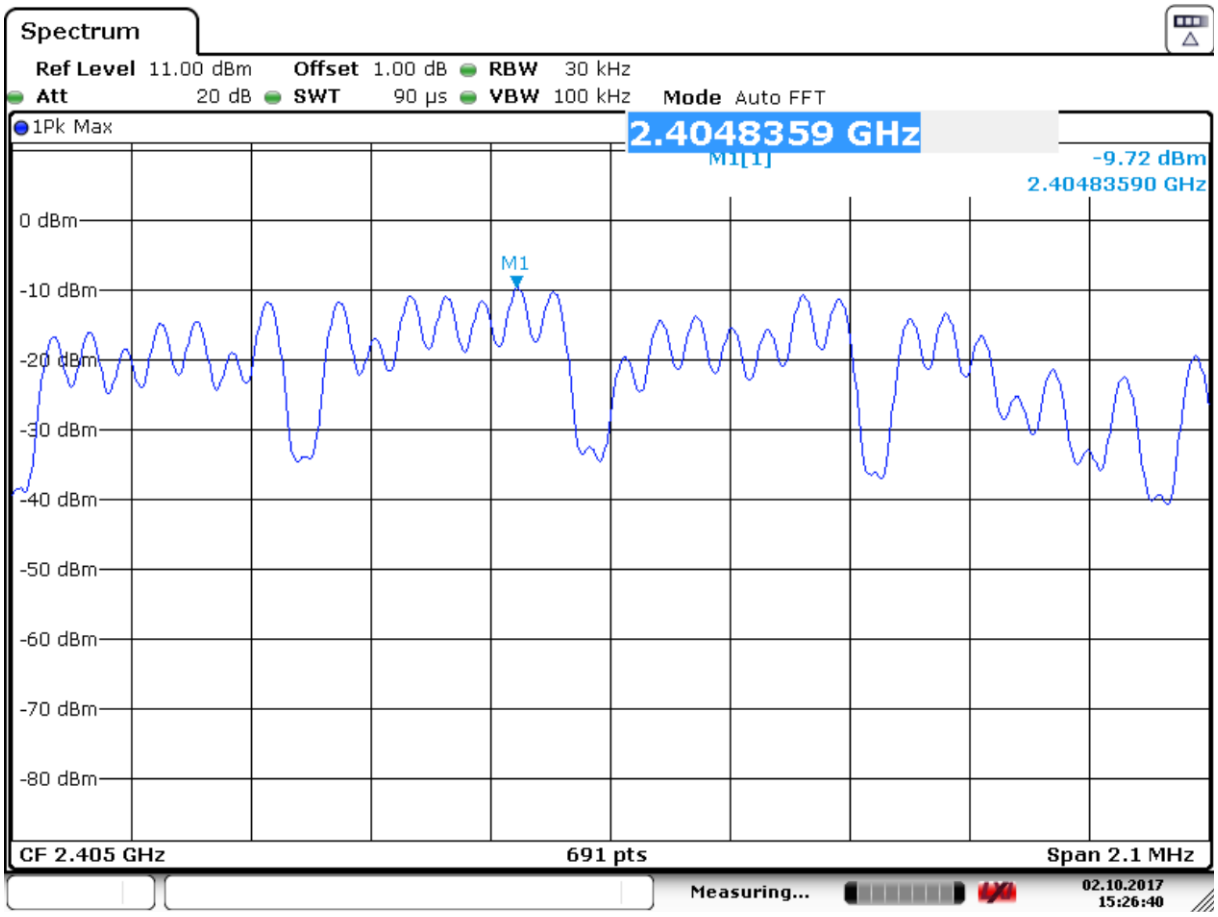
4.3.3 Test Result

Refer to the following plots for the test result

Frequency, MHz	**Maximum Power Spectral Density, dBm**	**Maximum Power Spectral Density Limit, dBm**	**Margin, dB**	**Plot**
2405	-9.72	8.00	-17.72	3.1
2440	-8.60	8.00	-16.60	3.2
2480	-10.02	8.00	-18.02	3.3

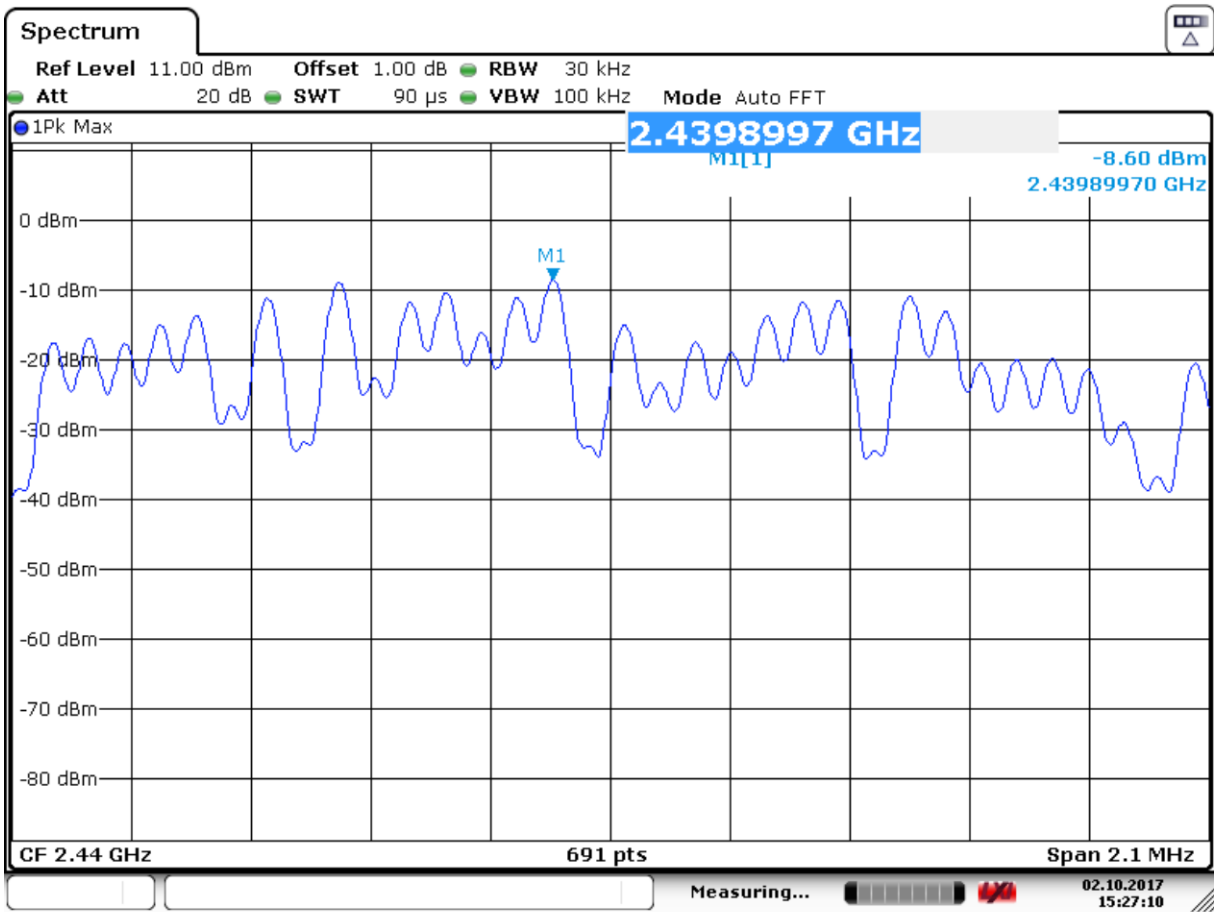
Date of Test:	October 2, 2017
Results	**Complies**

Plot 3. 1



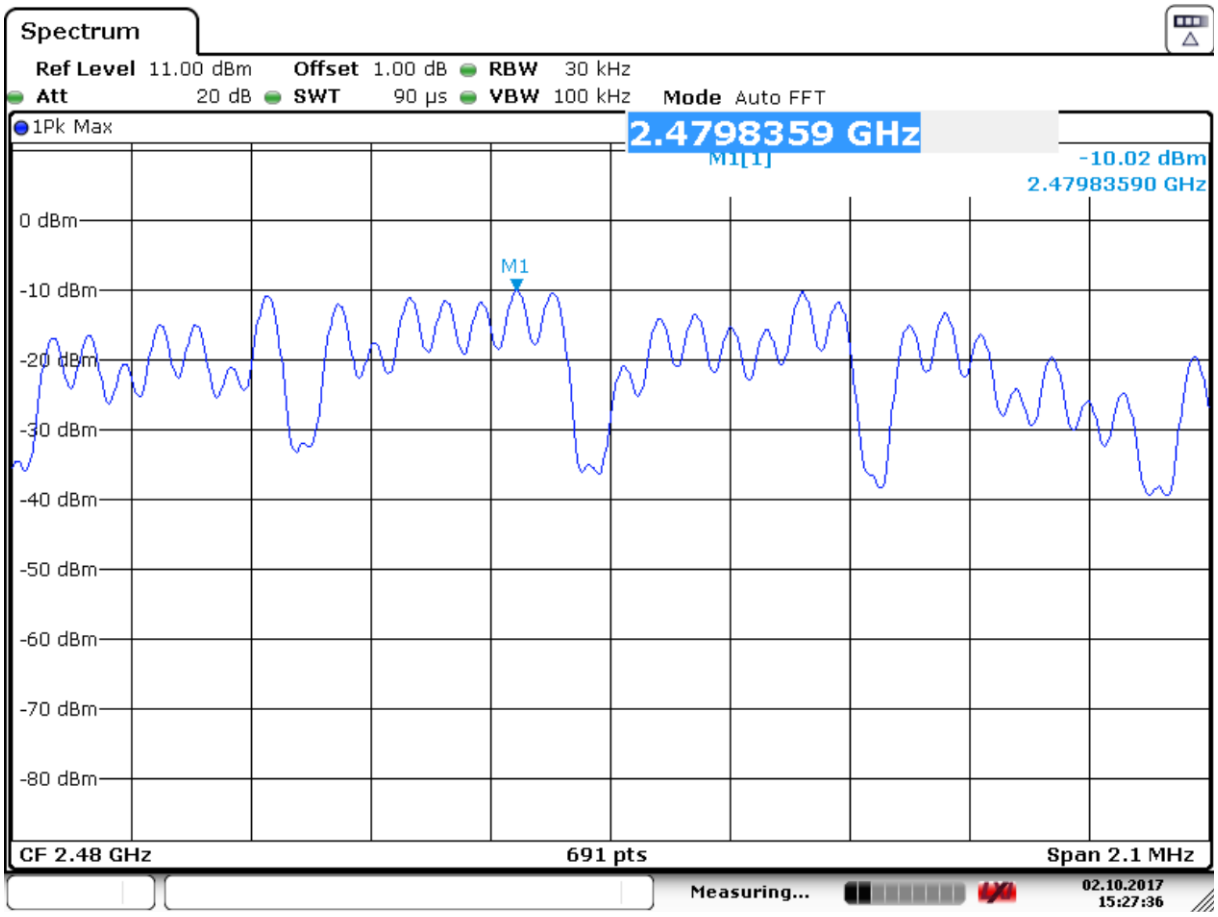
Date: 20.OCT.2017 15:26:40

Plot 3. 2



Date: 2.OCT.2017 15:27:10

Plot 3. 3



Date: 20.OCT.2017 15:27:37

4.4 Unwanted Conducted Emissions
FCC: 15.247(d); RSS-247 5.5;

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 ≥ 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.

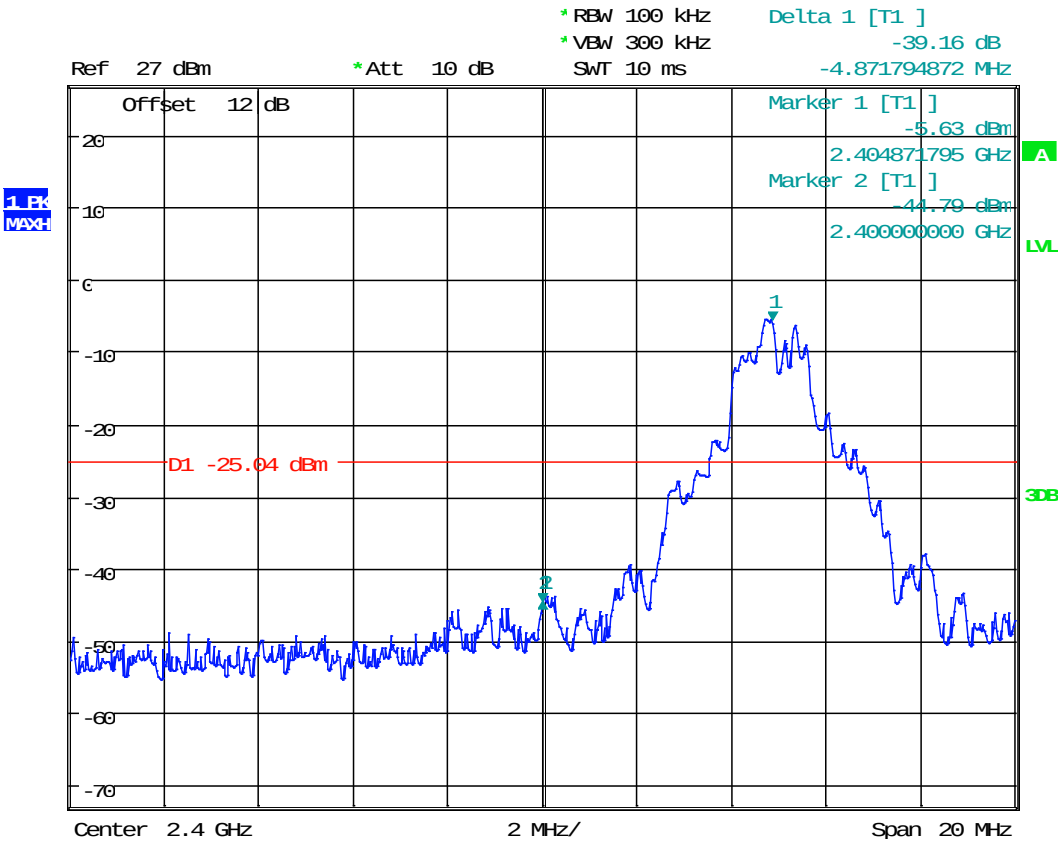
The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits.

4.4.3 Test Result

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

Date of Test:	October 5, 2017
Results	**Complies**

Tx @ Low Channel, 2400 MHz Band Edge
Plot 4.1

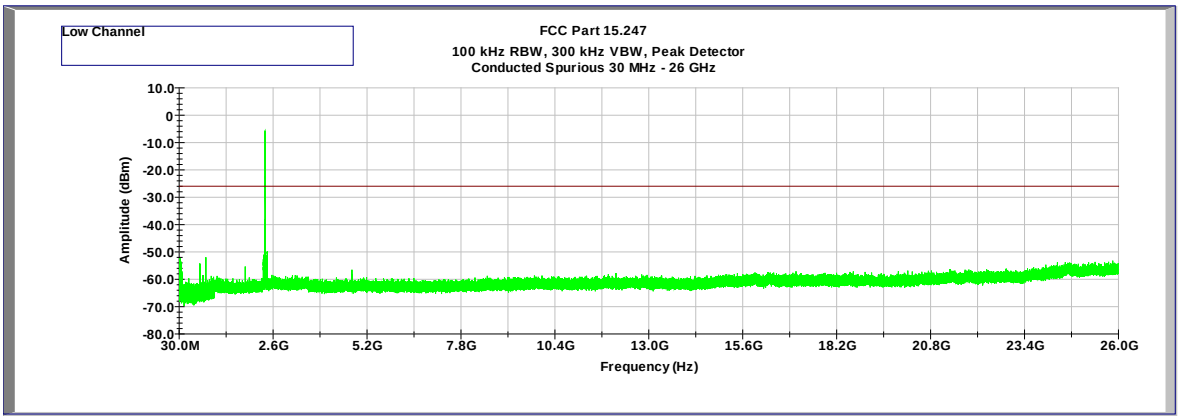


Date: 5.OCT.2017 10:12:08

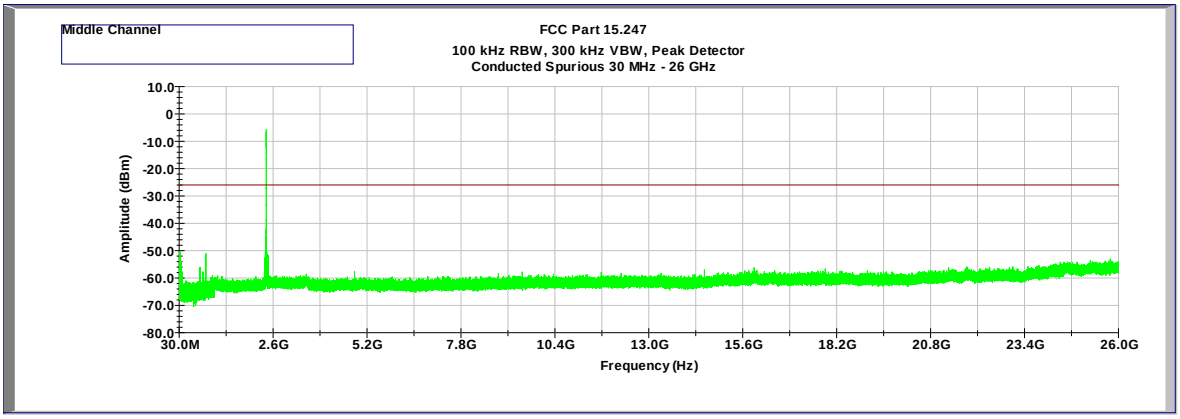
Tx @ Low Channel, 2483.5 MHz Band Edge
Plot 4.2

Date: 5.OCT.2017 10:09:31

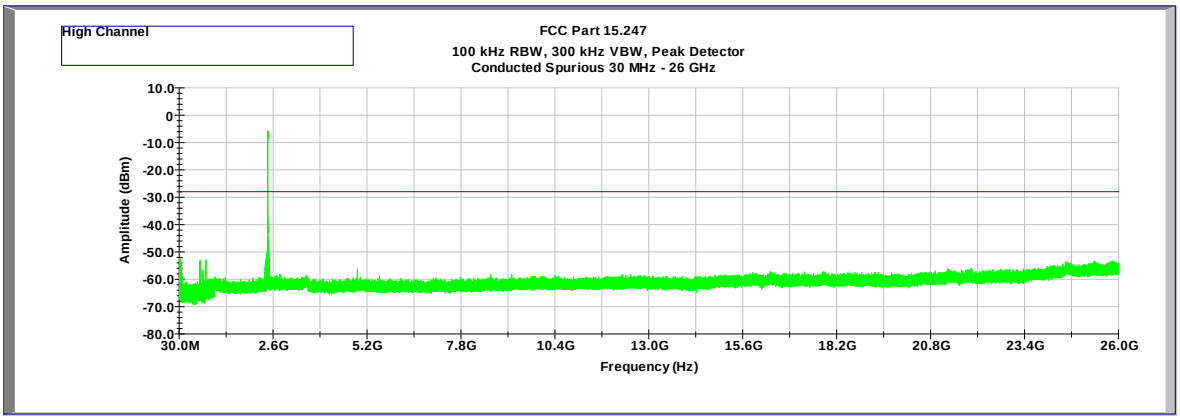
Tx @ Low Channel, 2405 MHz
30MHz -26GHz Conducted Spurious
Plot 4.3



Tx @ Mid Channel, 2440 MHz
30MHz -26GHz Conducted Spurious
Plot 4.4



Tx @ High Channel, 2480 MHz
30MHz -26GHz Conducted Spurious
Plot 4.5



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

4.4.1 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.

4.4.2 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).

4.4.3 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.

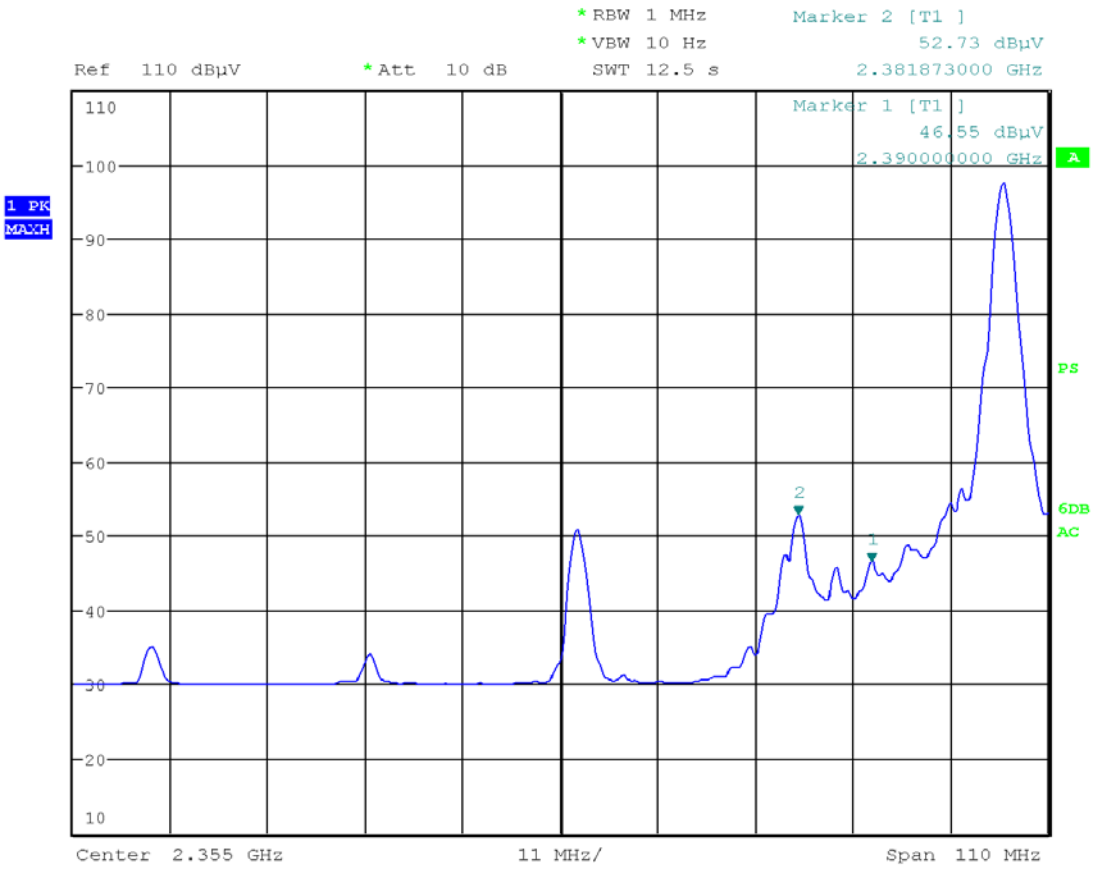
4.4.7 Test Results

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.

Date of Test:	October 4 to 6, 2017
Results	**Complies**

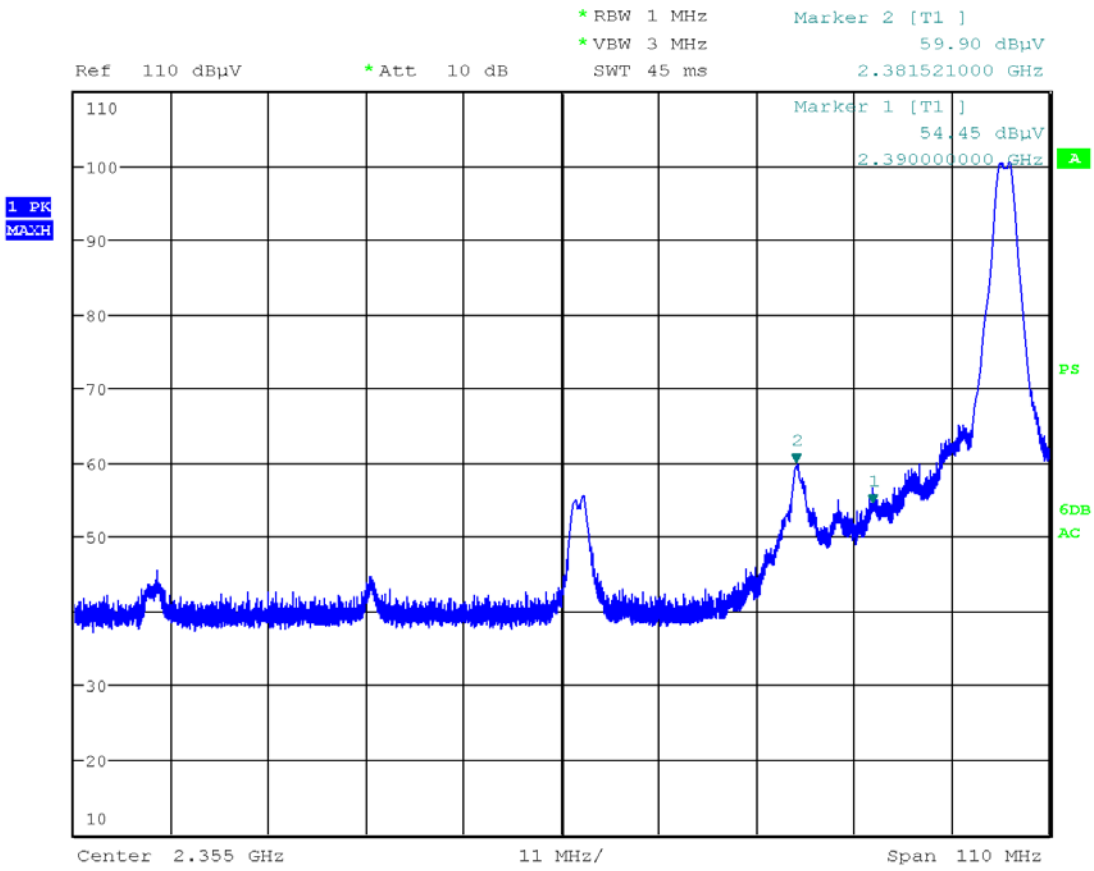
Test Results: 15.209/15.205 Restricted Band Emissions (Radiated Method)

Out-of-Band Spurious Emissions at the Band Edge – Tx @ 2405 MHz



Date: 4.OCT.2017 11:58:59

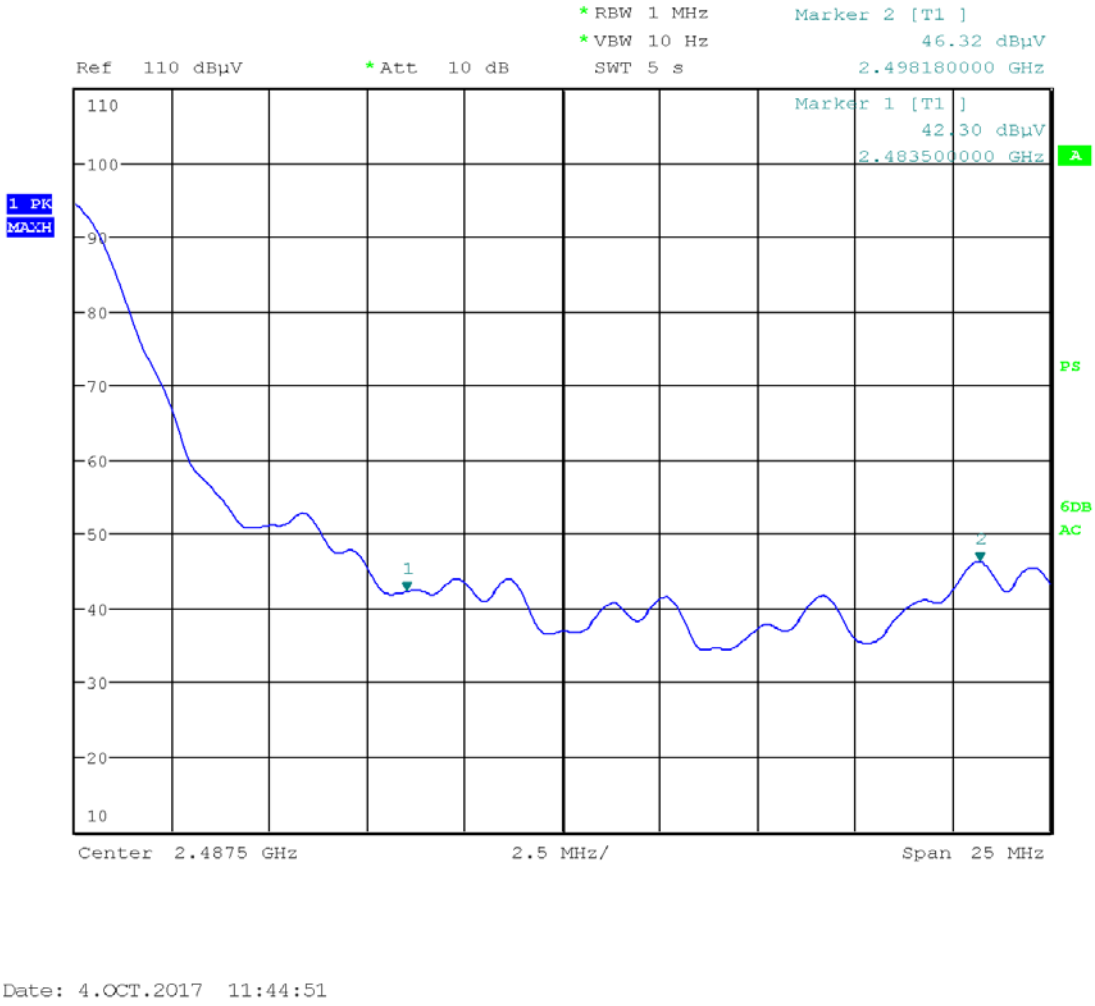
Frequency	Raw Amplitude at 3m	Correction Factor	Corrected Amplitude	Peak Limit	Margin	Detector	Results
GHz	dBµV/m	dB	dBµV/m	dBµV/m	dB	Avg	Pass
2382	52.73	-1.77264	50.96	54	-3.04		



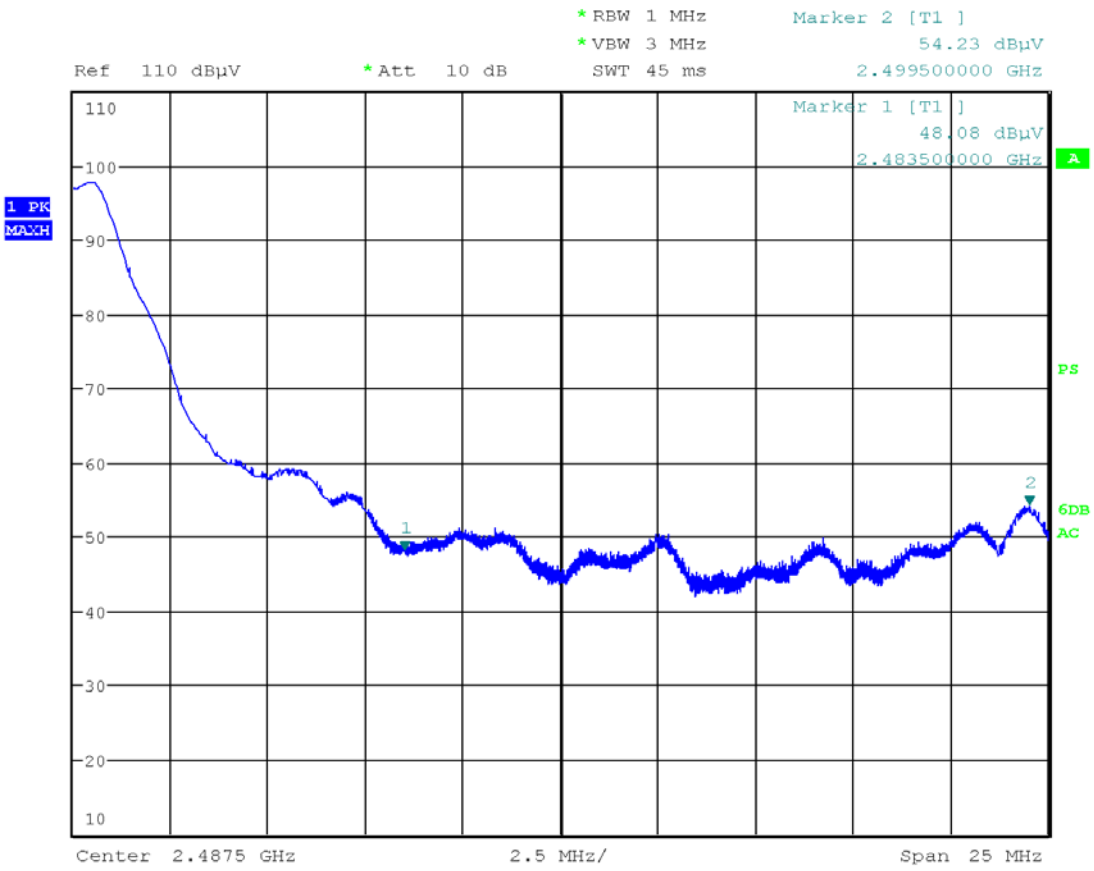
Date: 4.OCT.2017 11:57:24

Frequency	Raw Amplitude at 3m	Correction Factor	Corrected Amplitude	Peak Limit	Margin	Detector	Results
GHz	dBµV/m	dB	dBµV/m	dBµV/m	dB	Peak	Pass
2.382	59.9	-1.77264	58.13	74	-15.87		

Out-of-Band Spurious Emissions at the Band Edge – Tx @ 2475 MHz

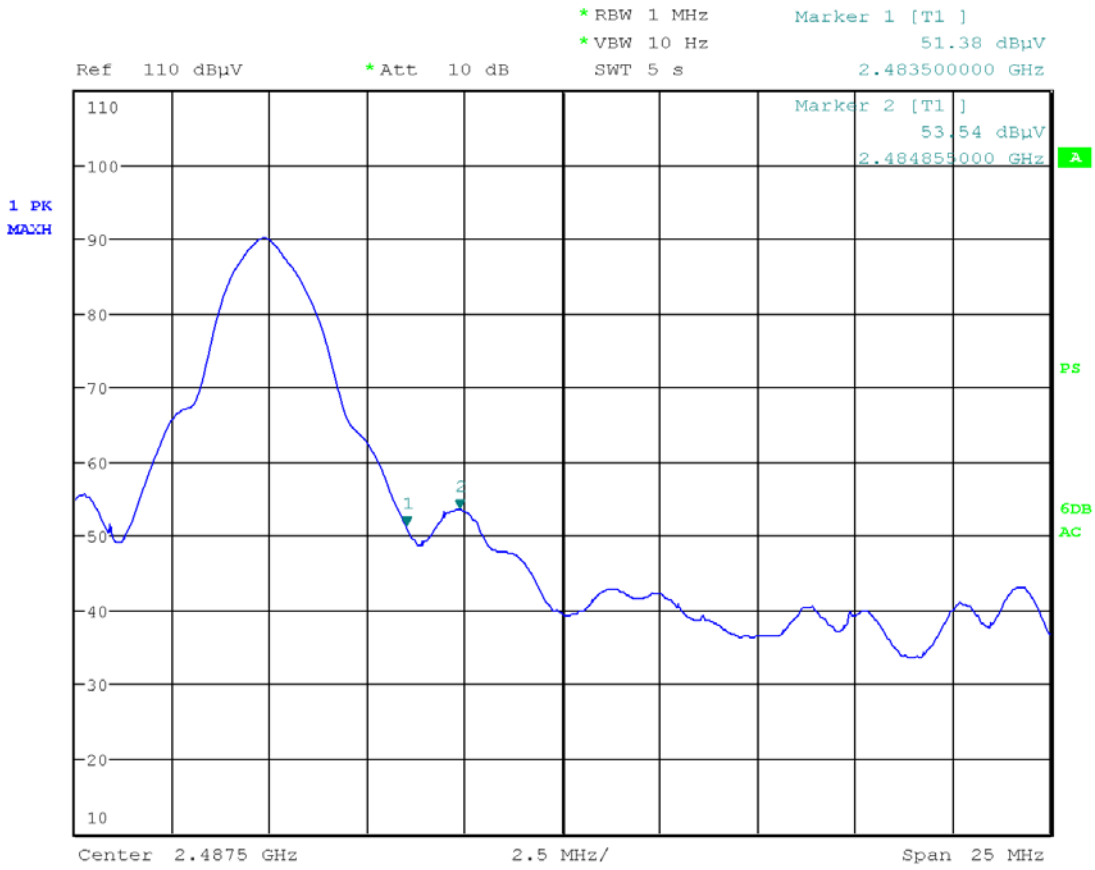


Frequency	Raw Amplitude at 3m	Correction Factor	Corrected Amplitude	Peak Limit	Margin	Detector	Results
GHz	dBµV/m	dB	dBµV/m	dBµV/m	dB	Avg	Pass
2.498	46.32	-1.47857	44.84	54	-9.16		

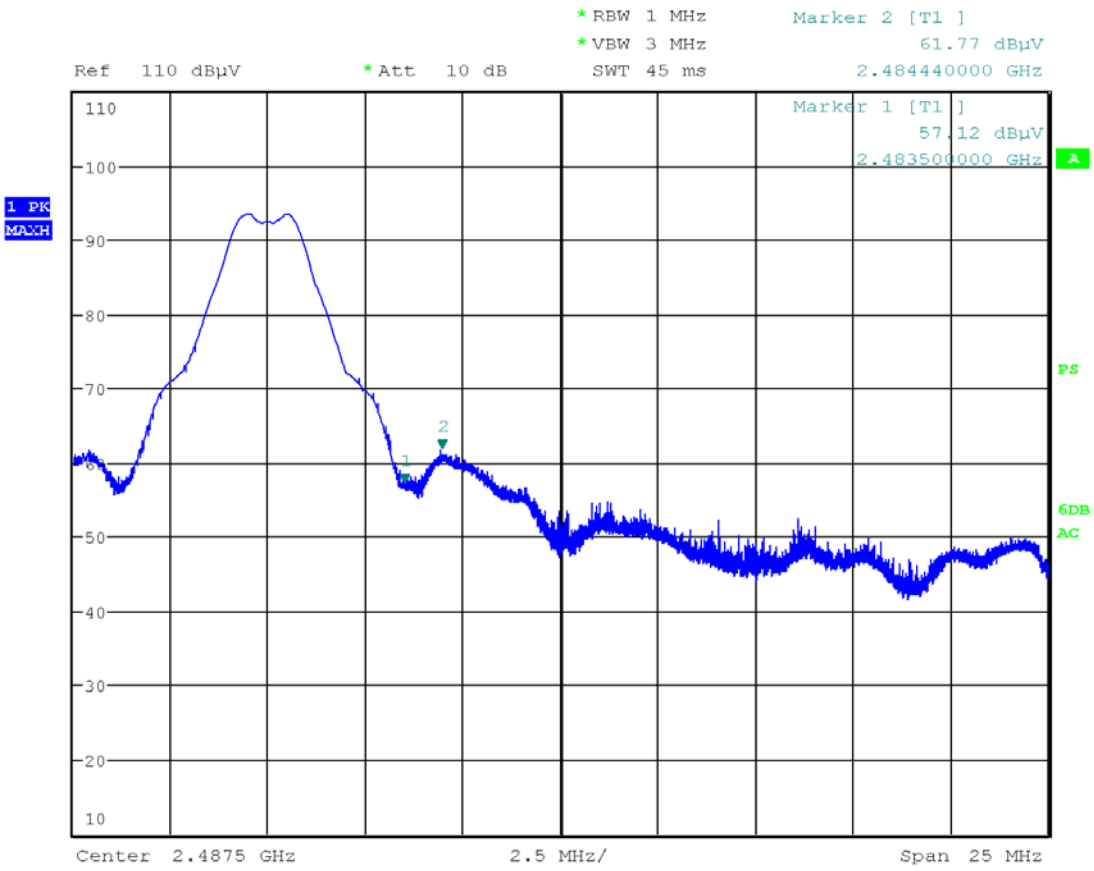


Frequency	Raw Amplitude at 3m	Correction Factor	Corrected Amplitude	Peak Limit	Margin	Detector	Results
GHz	dBµV/m	dB	dBµV/m	dBµV/m	dB	Peak	Pass
2.4995	54.23	-1.47857	52.75	74	-21.25		

Out-of-Band Spurious Emissions at the Band Edge – Tx @ 2480 MHz



Frequency	Raw Amplitude at 3m	Correction Factor	Corrected Amplitude	Peak Limit	Margin	Detector	Results
GHz	dBµV/m	dB	dBµV/m	dBµV/m	dB	Avg	Pass
2.485	53.51	-1.47857	52.03	54	-1.97		

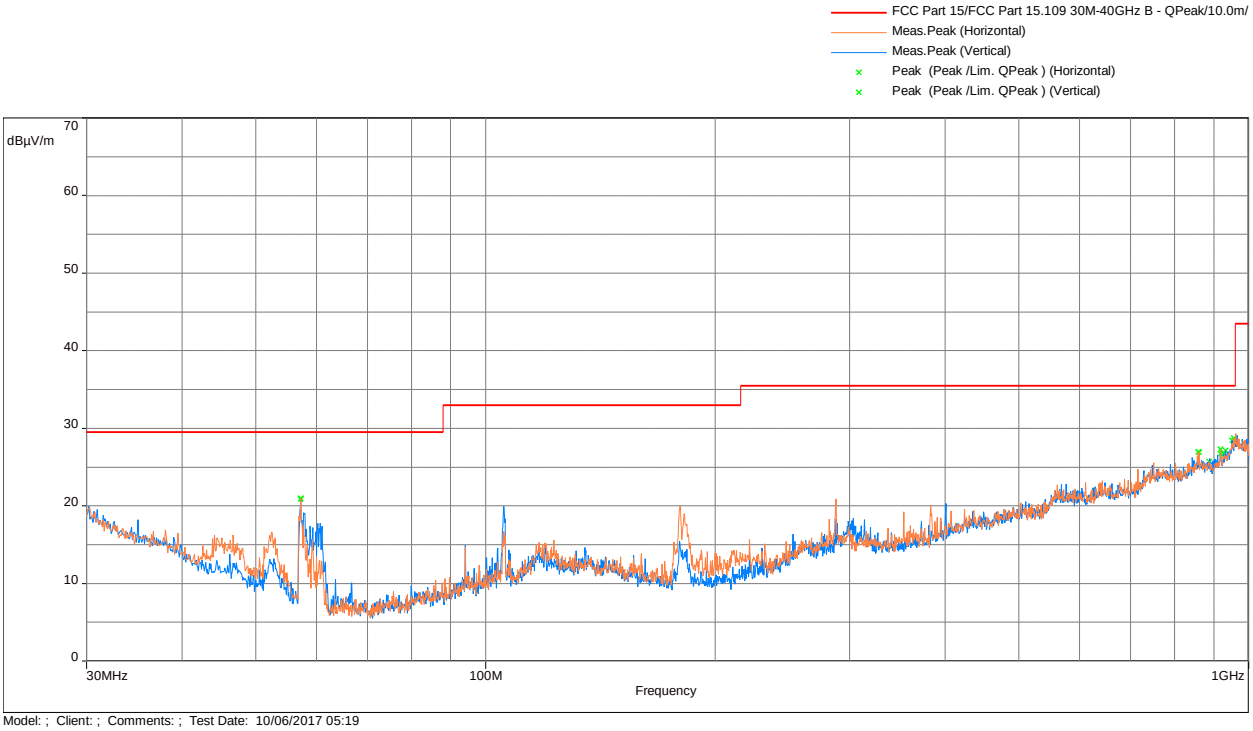


Frequency	Raw Amplitude at 3m	Correction Factor	Corrected Amplitude	Peak Limit	Margin	Detector	Results
GHz	dBµV/m	dB	dBµV/m	dBµV/m	dB	Peak	Pass
2.484	61.77	-1.47857	60.29	74	-13.71		

Out-of-Band Radiated Spurious Emissions (Cabinet Radiation)

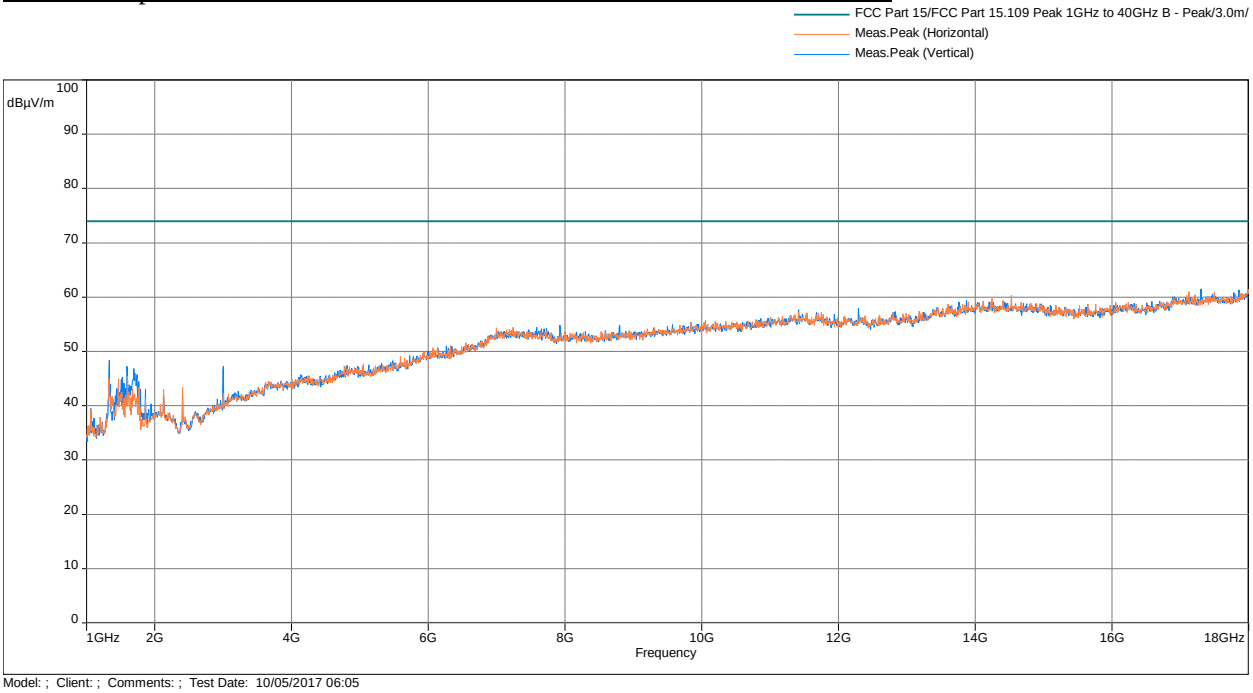
Test Results: 15.209 Radiated Spurious Emissions Low Channel, Tx at 2405MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



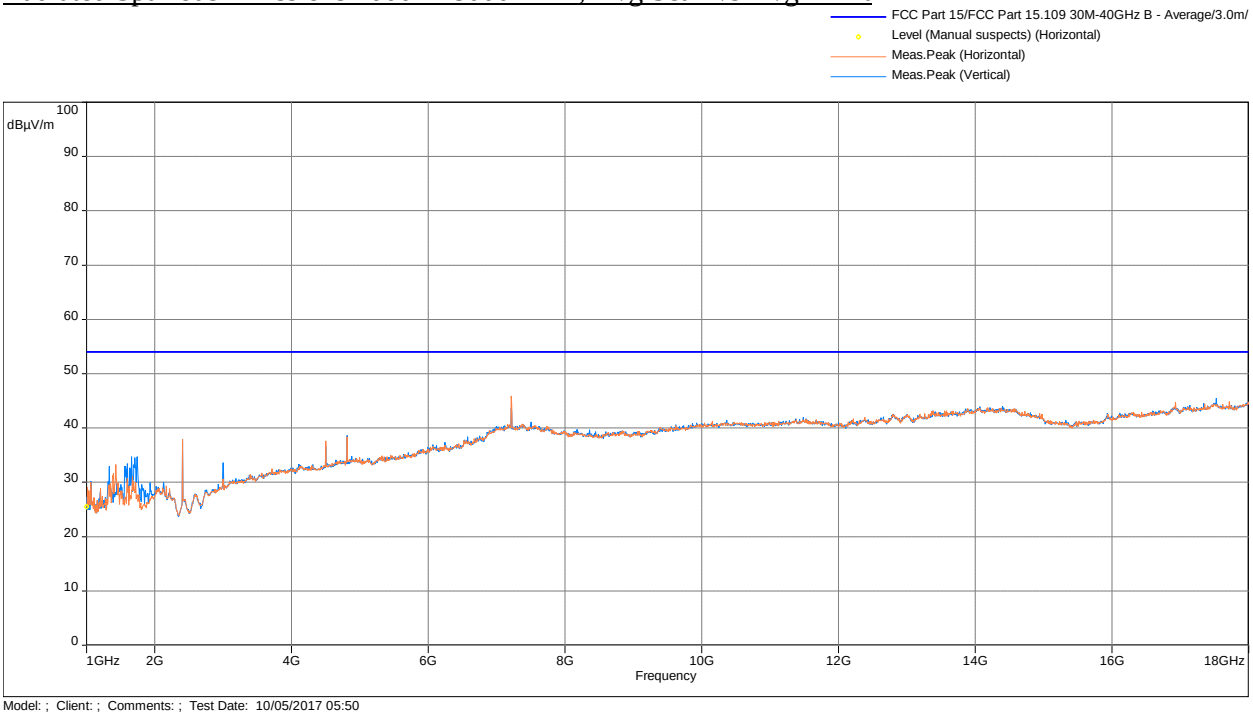
Model: ; Client: ; Comments: ; Test Date: 10/06/2017 05:19

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



Model: ; Client: ; Comments: ; Test Date: 10/05/2017 06:05

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



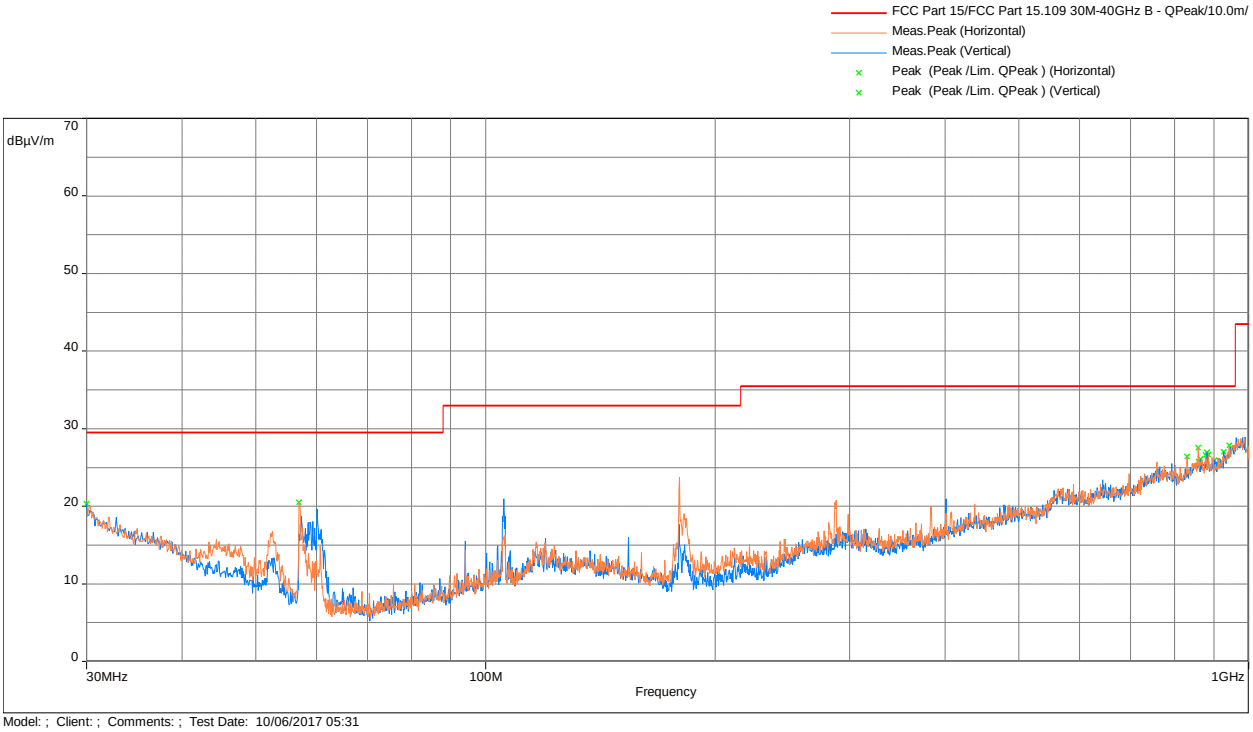
Model: ; Client: ; Comments: ; Test Date: 10/05/2017 05:50

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

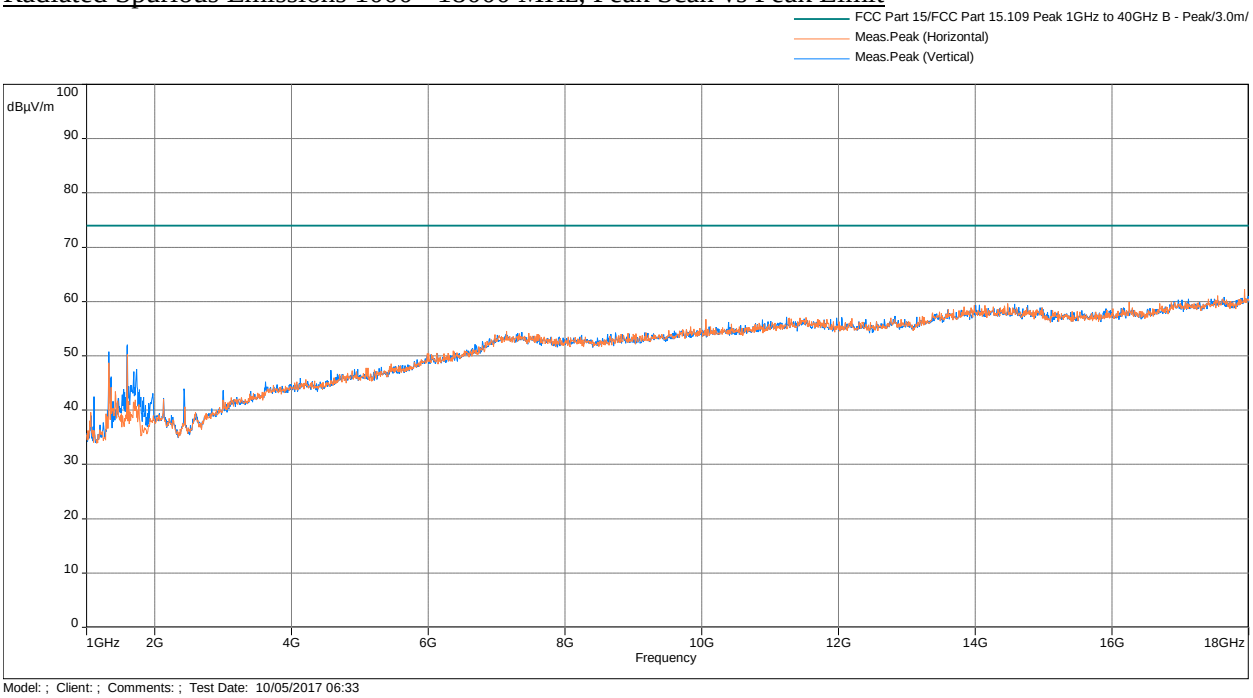
Results	**Complies**

Radiated Spurious Emissions 30 MHz - 1000 MHz



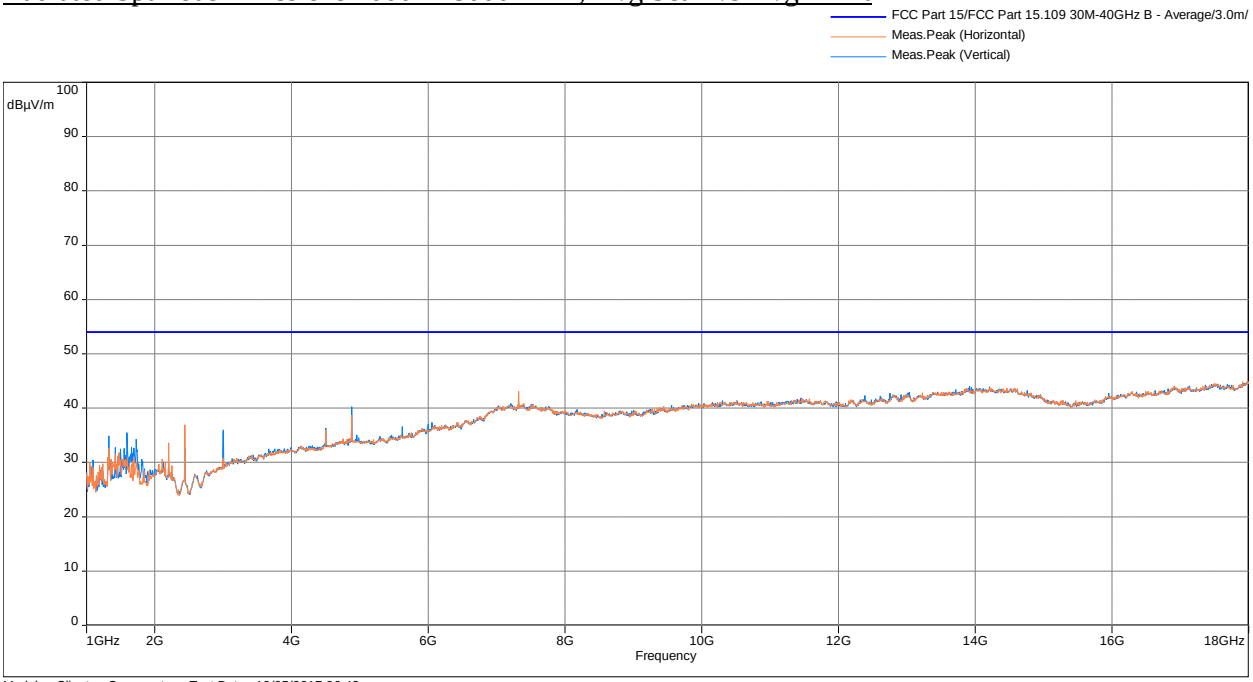
Model: ; Client: ; Comments: ; Test Date: 10/06/2017 05:31

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



Model: ; Client: ; Comments: ; Test Date: 10/05/2017 06:33

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



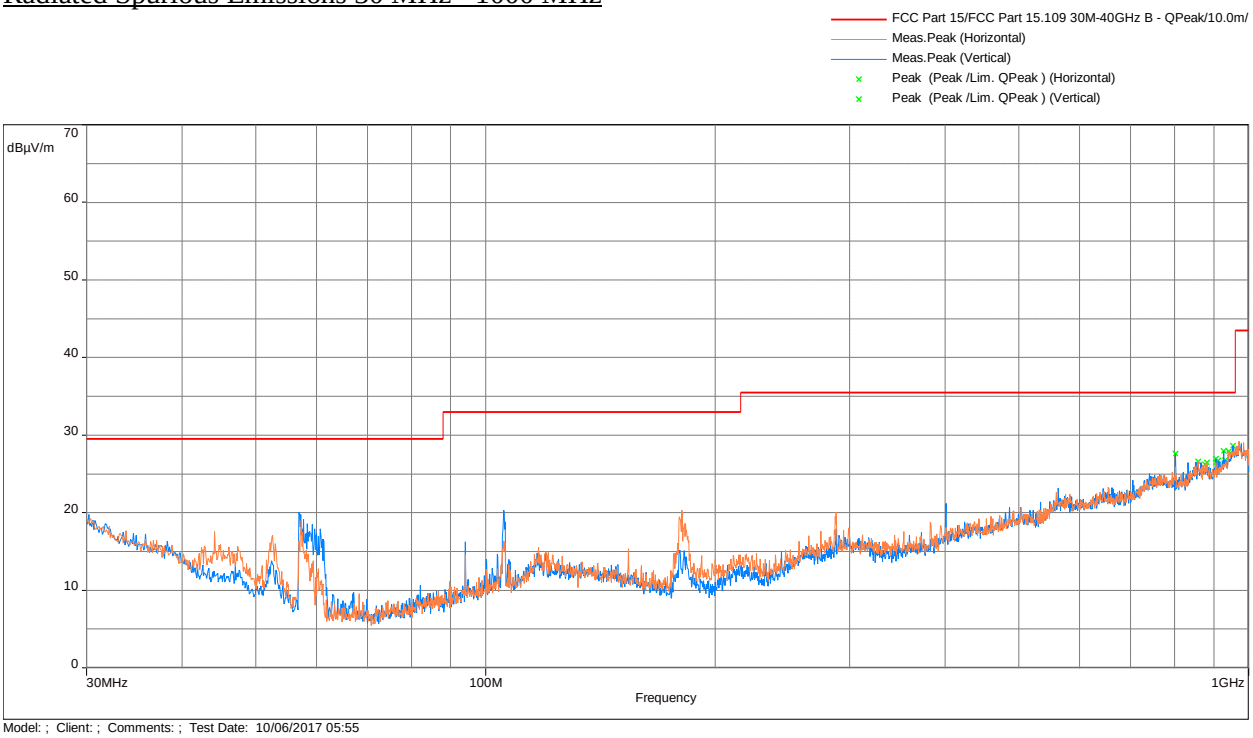
Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

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

Results	**Complies**

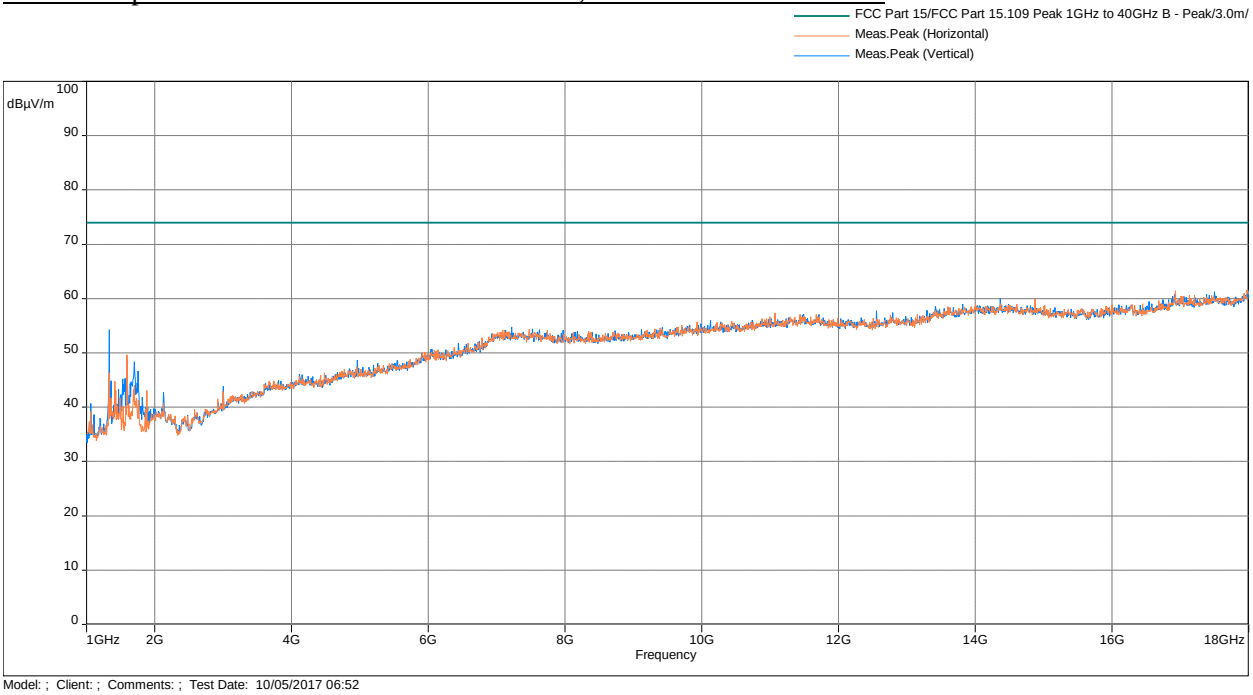
Test Results: 15.209 Radiated Spurious Emissions High Channel, Tx at 2480MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



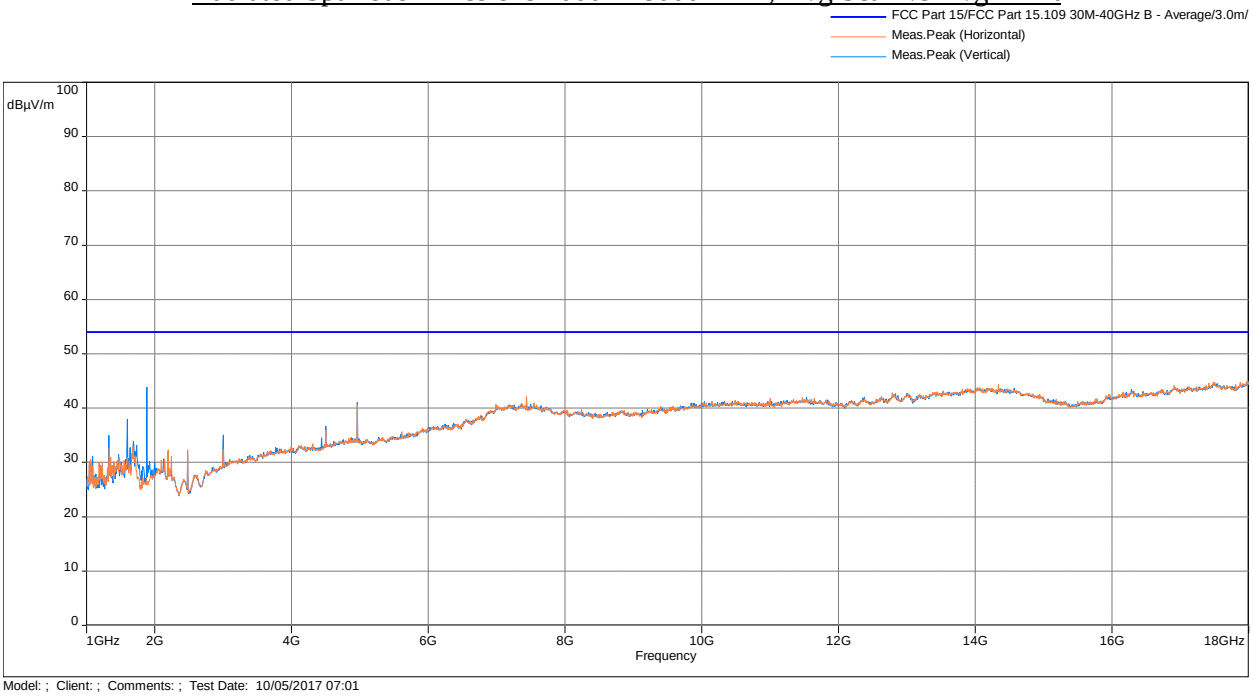
Model: ; Client: ; Comments: ; Test Date: 10/06/2017 05:55

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



Model: ; Client: ; Comments: ; Test Date: 10/05/2017 06:52

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



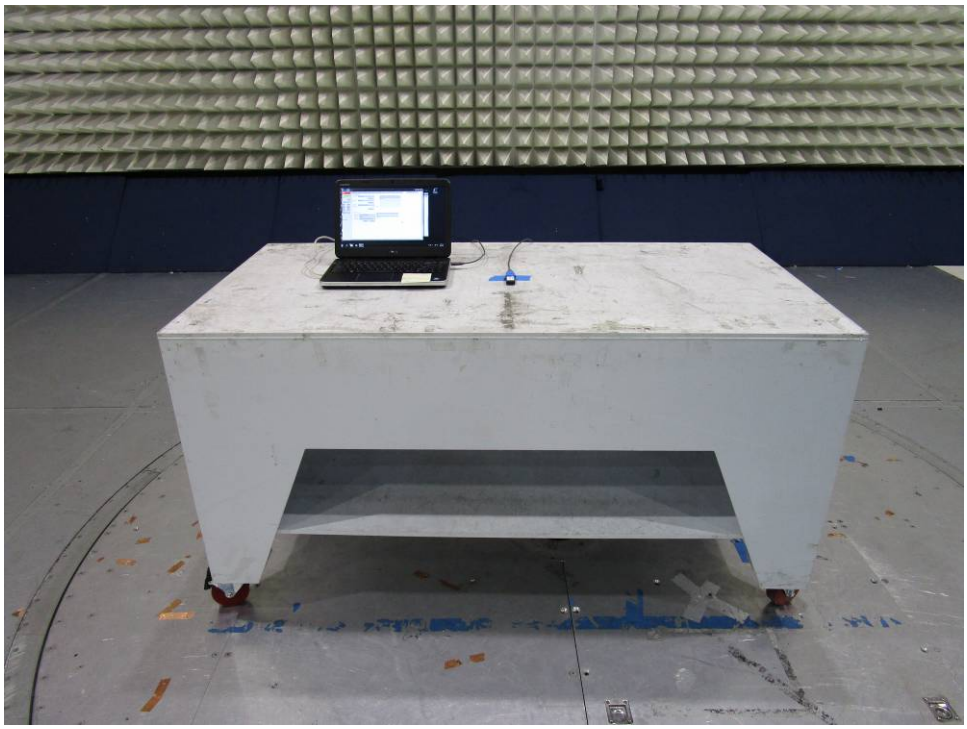
Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

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

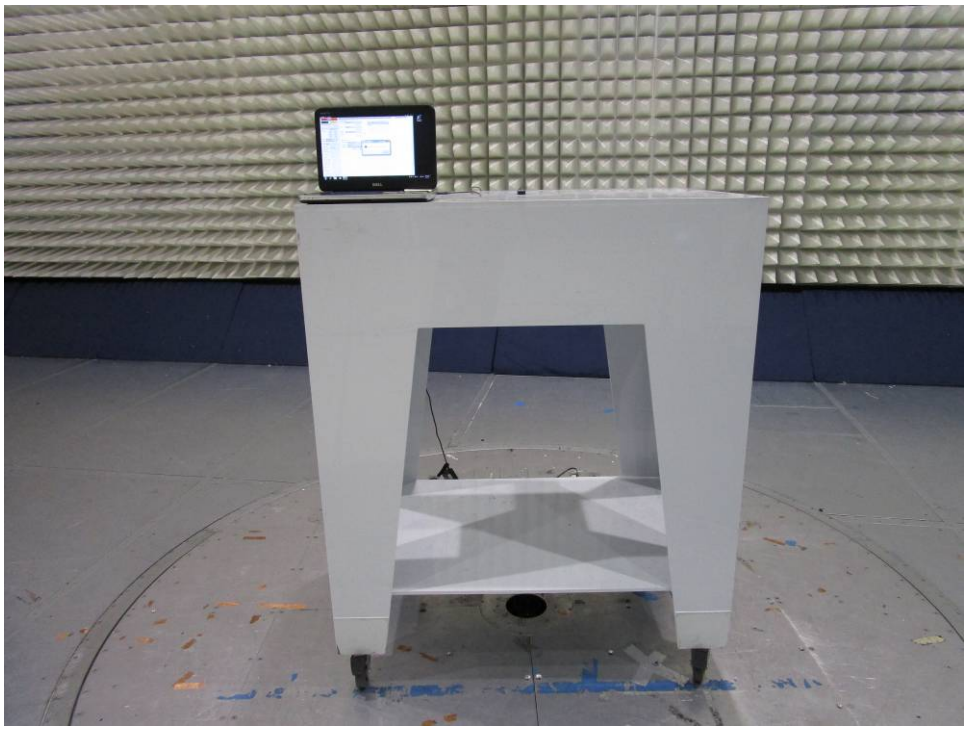
Results	**Complies**

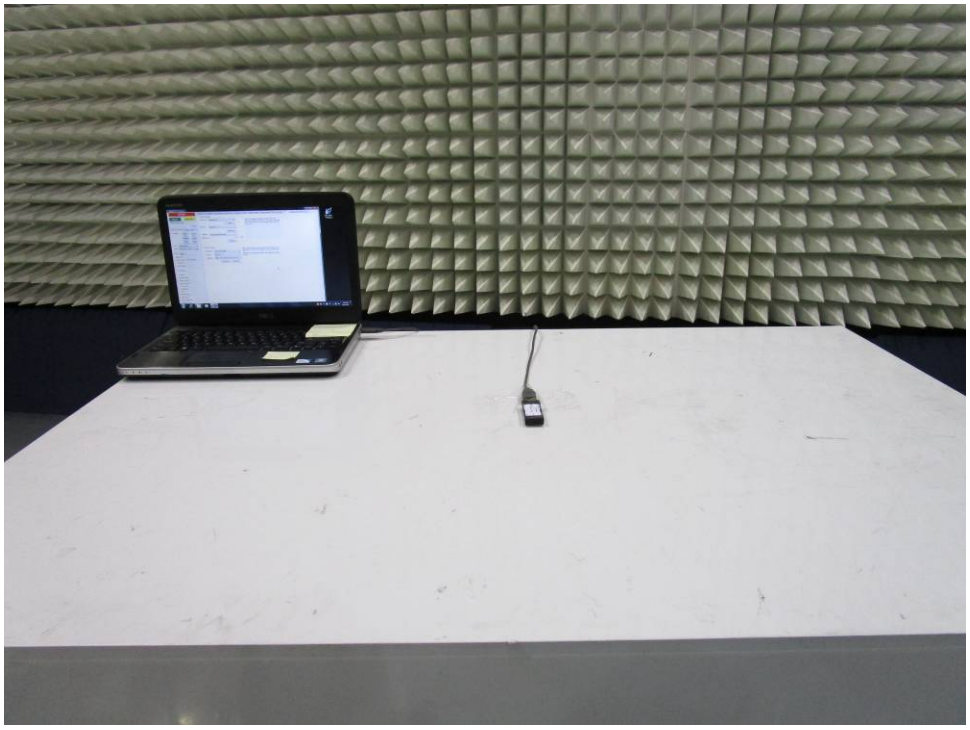
4.5.8 Test setup photographs

The following photographs show the testing configurations used.

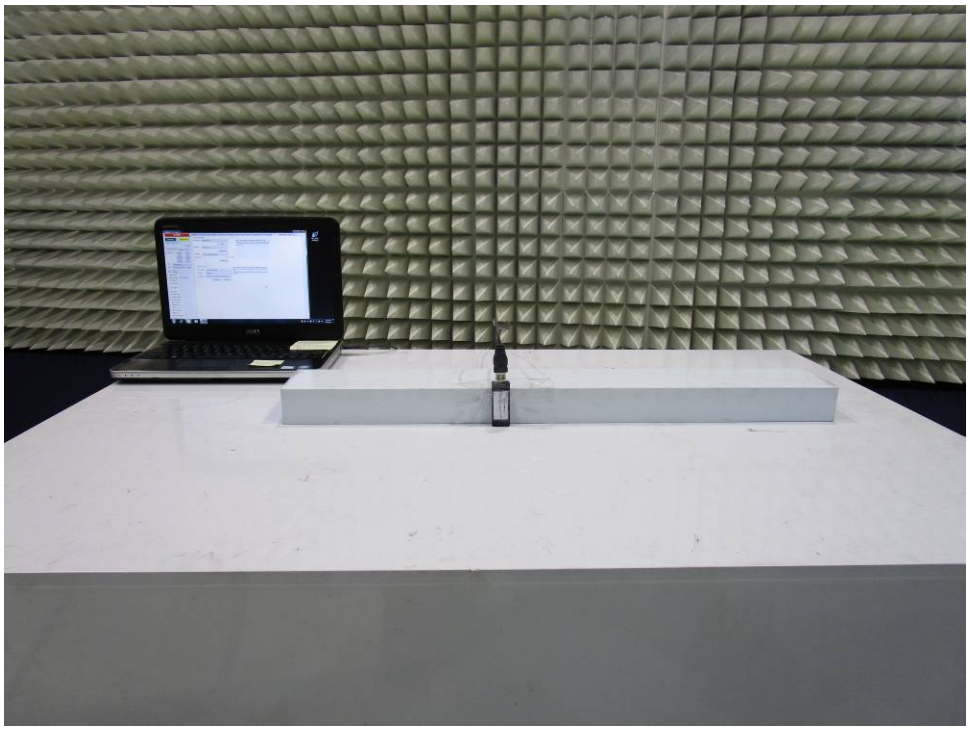


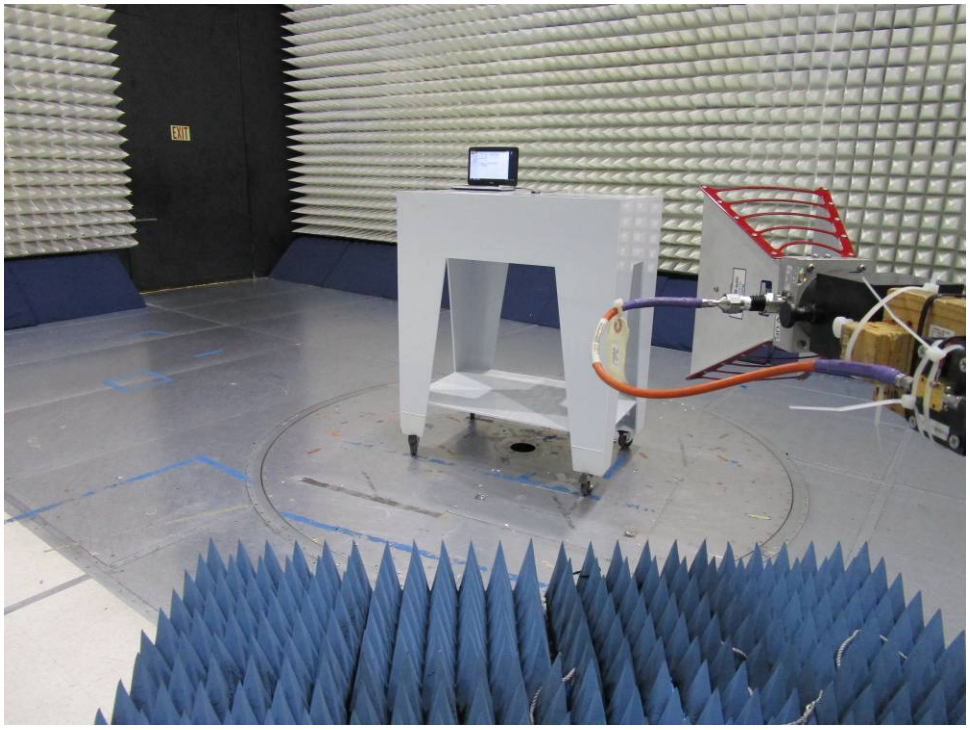
4.5.8 Test Setup Photographs (Continued)





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

* 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 or limit line 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: 2014

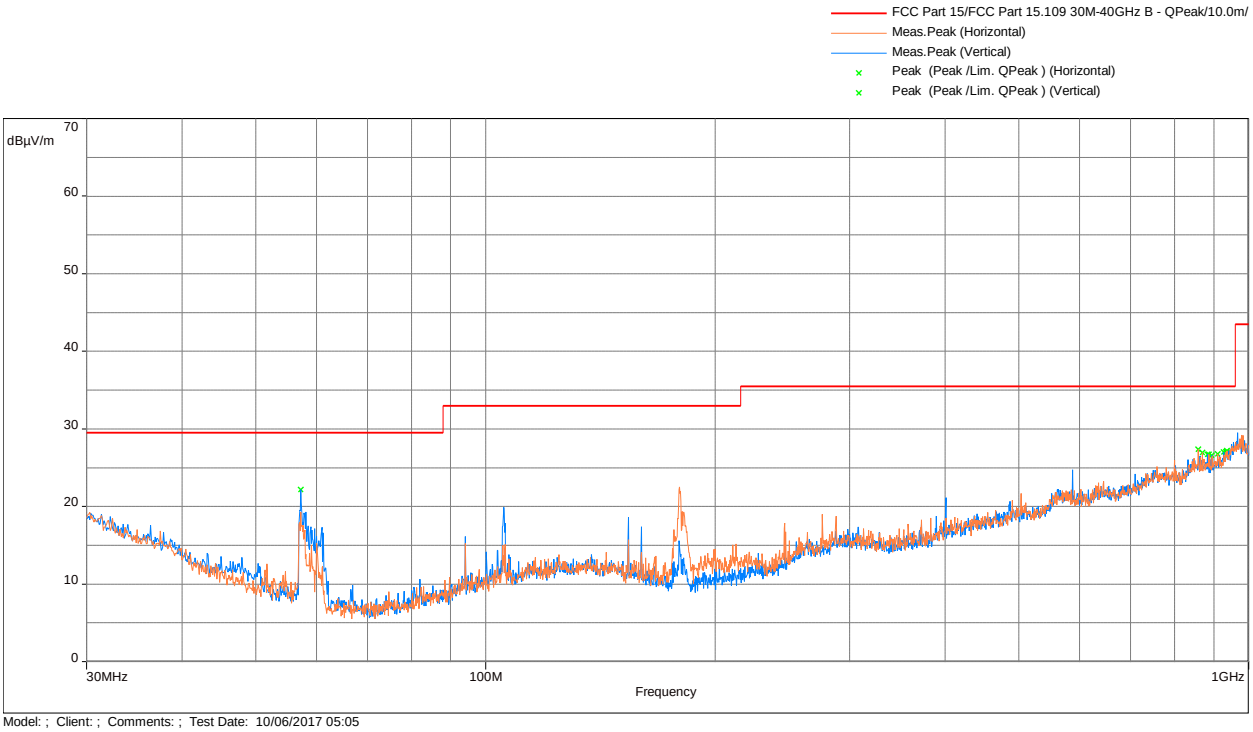
Radiated emission measurements were performed from 30 MHz to 10 GHz. The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

An inverse proportionality factor of 20 dB per decade was used to normalize the limit line of 30MHz to 1000MHz to the specified distance for determining compliance.

Date of Test:	October 4 to 6, 2017
Results	**Complies**

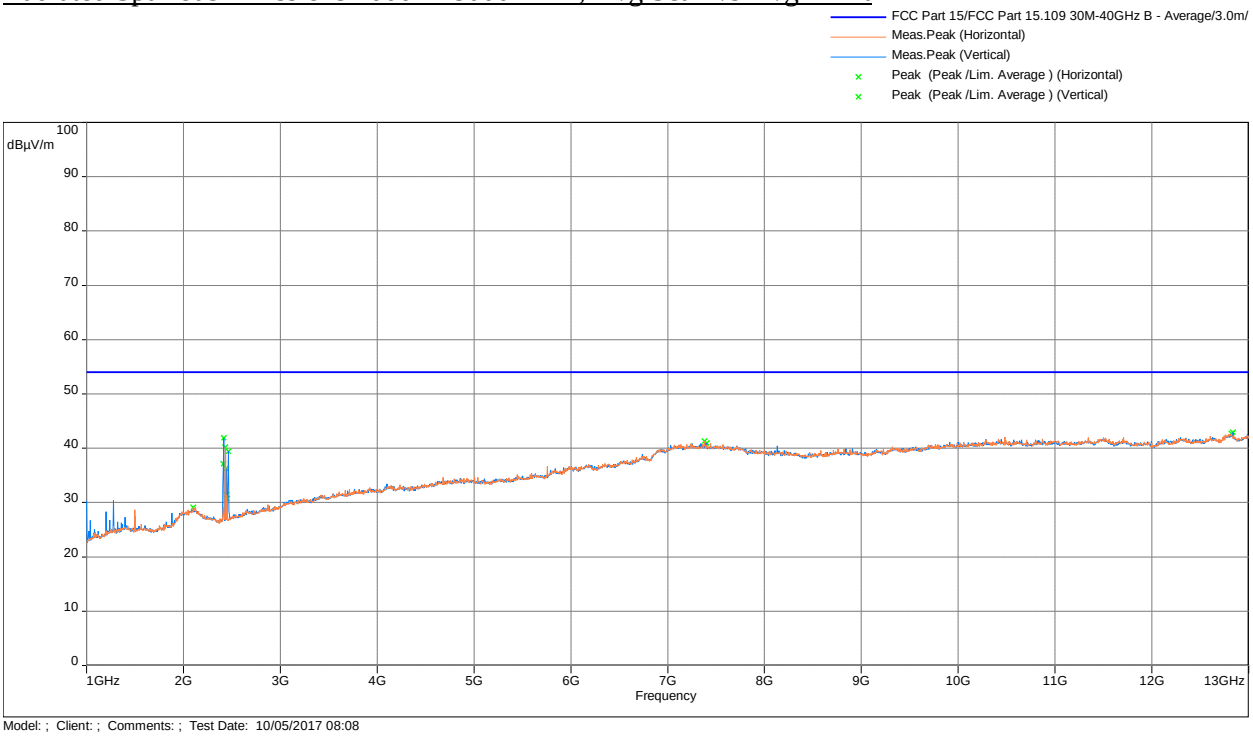
4.6.3 Test Results

Test Results: Radiated Emissions 30 MHz – 1000MHz



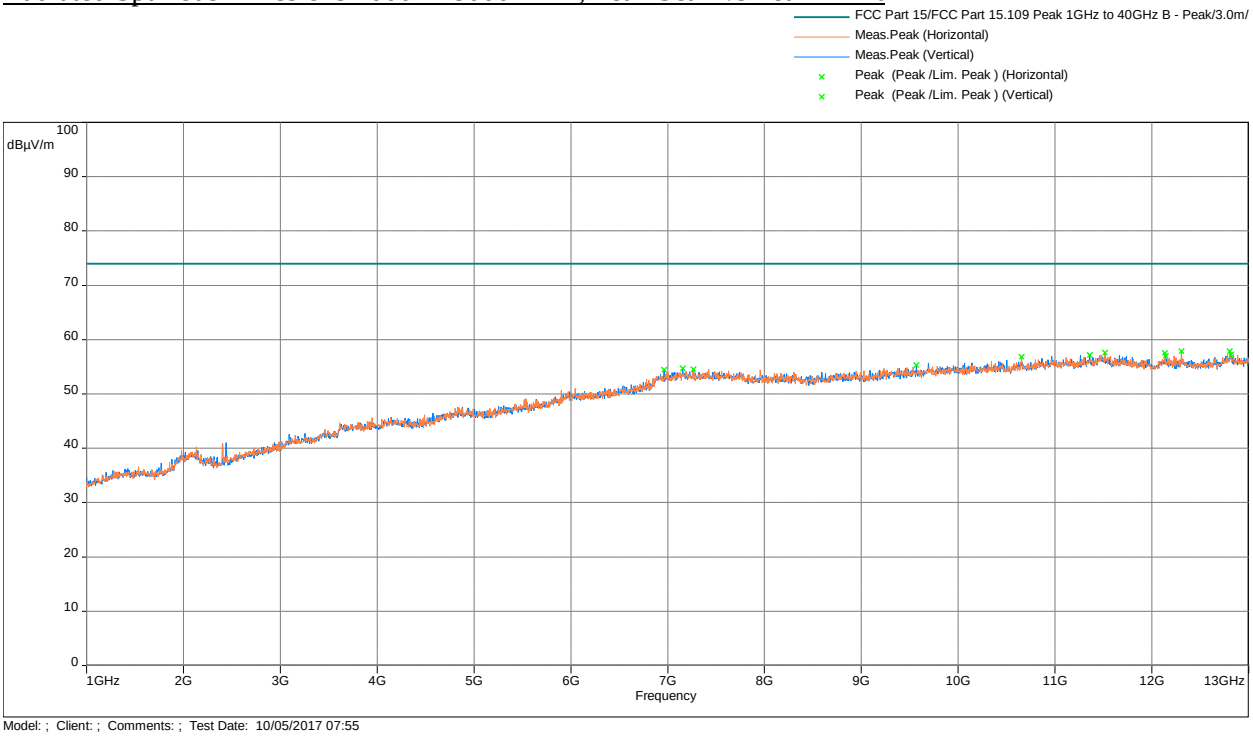
Model: ; Client: ; Comments: ; Test Date: 10/06/2017 05:05

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



Model: ; Client: ; Comments: ; Test Date: 10/05/2017 08:08

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

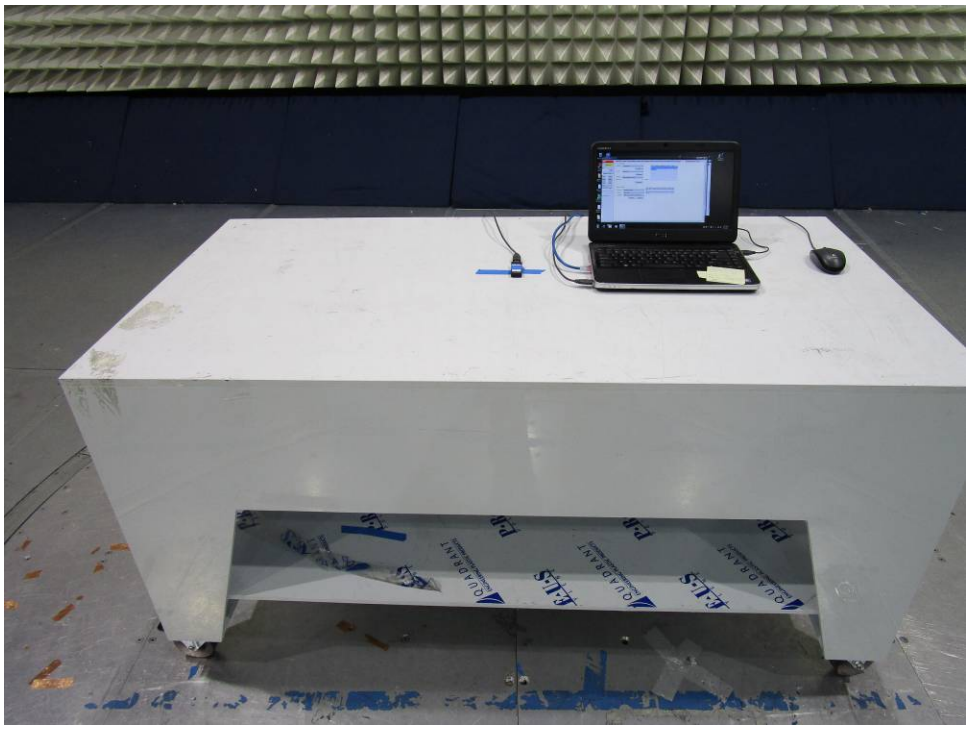


Model: ; Client: ; Comments: ; Test Date: 10/05/2017 07:55

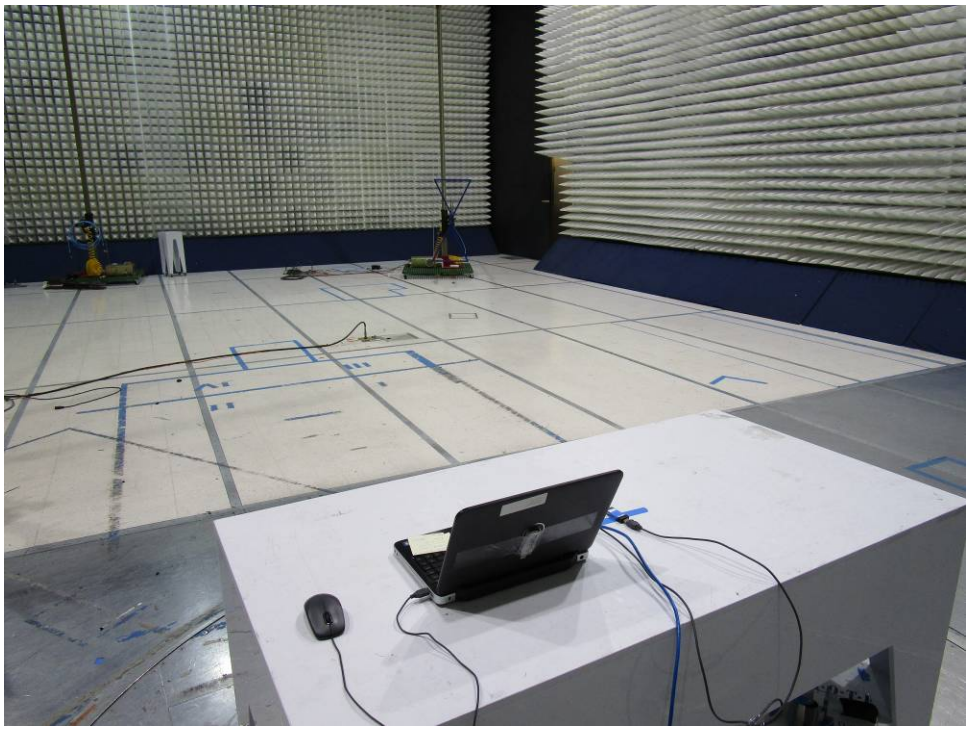
Result:	**Complies**

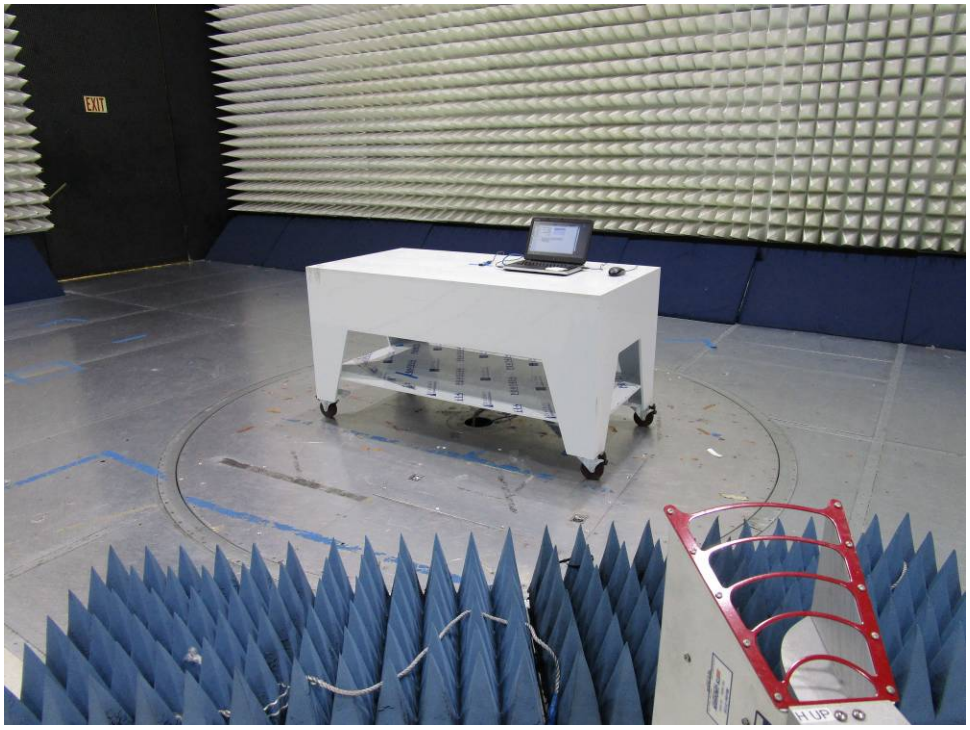
4.6.4 Test Configuration Photographs

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.

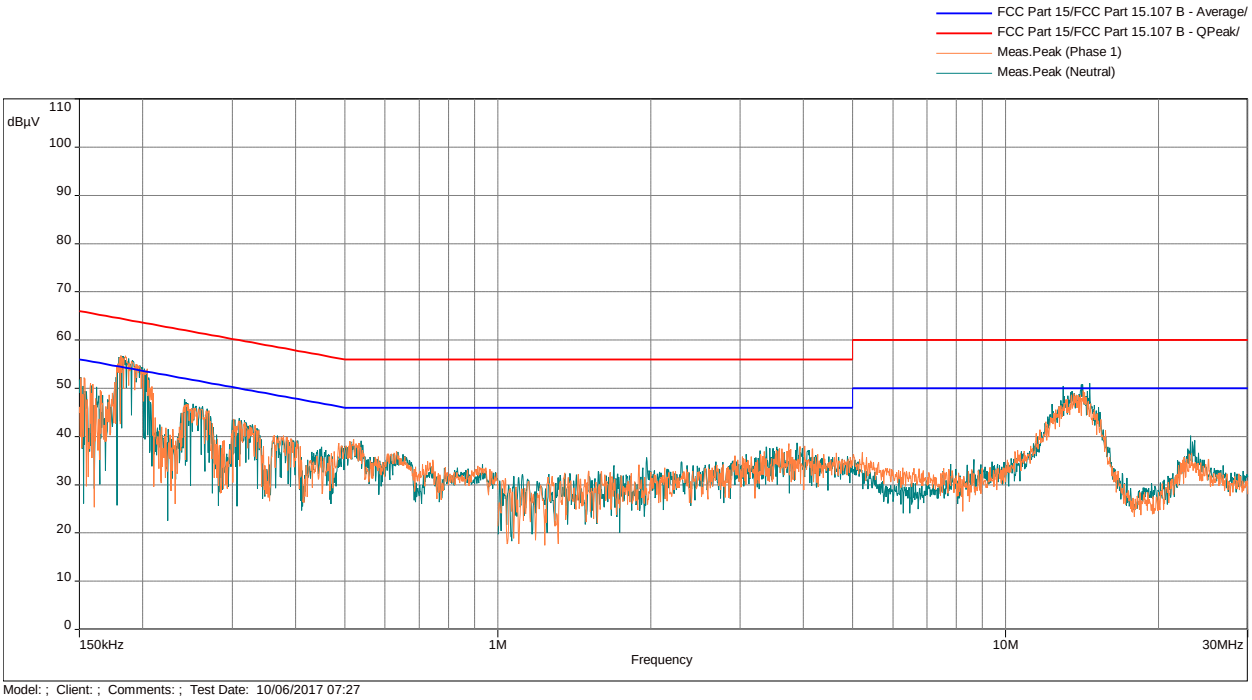
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

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

Date of Test:	October 6, 2017
Results	**Complies**

4.7.3 Test Results

Test Results: Transmitter Mode

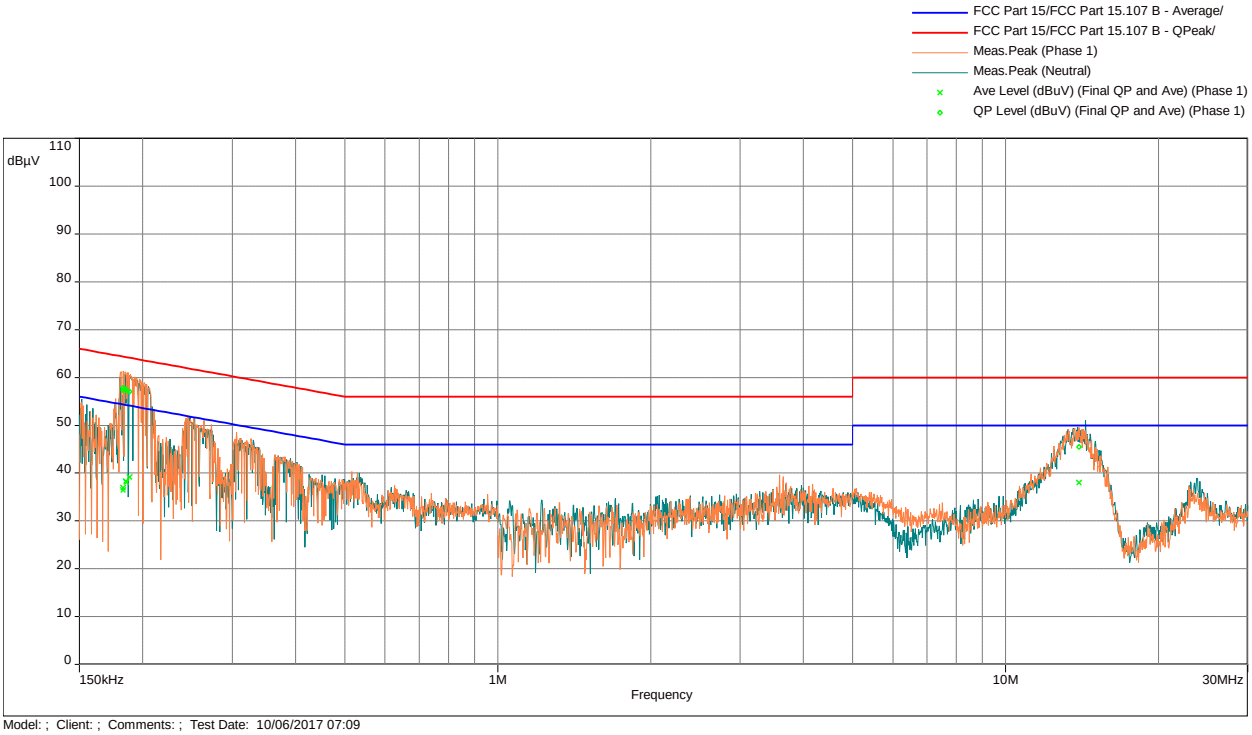


Model: ; Client: ; Comments: ; Test Date: 10/06/2017 07:27

All finals							
Frequency (MHz)	**Ave Level (dBuV)**	**QP Level (dBuV)**	**Ave Limit (dBuV)**	**QP Limit (dBuV)**	**Ave Margin (dB)**	**QP Margin (dB)**	**Line**
0.181583	33.05	54.15	54.41	64.41	-21.37	-10.26	Phase 1
0.18194	33.12	54.23	54.4	64.4	-21.28	-10.17	Phase 1
0.182182	33.83	54.24	54.38	64.38	-20.55	-10.14	Phase 1
0.182286	33.28	54.18	54.38	64.38	-21.1	-10.2	Phase 1
0.184194	34.7	54.05	54.3	64.3	-19.59	-10.25	Phase 1
14.23601	36.77	44.31	50	60	-13.23	-15.69	Phase 1
0.181498	32.09	53.55	54.42	64.42	-22.33	-10.86	Neutral
0.182044	32.87	53.71	54.39	64.39	-21.52	-10.68	Neutral
0.183948	33.93	53.42	54.31	64.31	-20.38	-10.89	Neutral
0.18531	34.67	53.46	54.25	64.25	-19.58	-10.79	Neutral
0.191981	33.61	52.4	53.95	63.95	-20.34	-11.55	Neutral
14.62308	37.95	45.12	50	60	-12.05	-14.88	Neutral

Result: Complies

Test Results: Receiver Mode



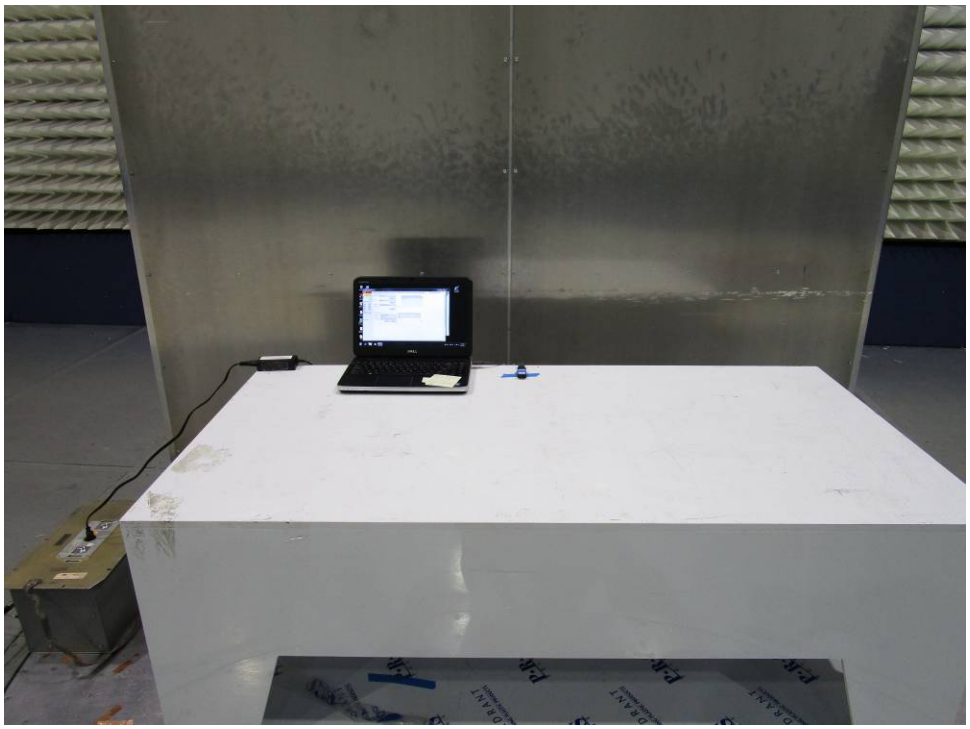
Model: ; Client: ; Comments: ; Test Date: 10/06/2017 07:09

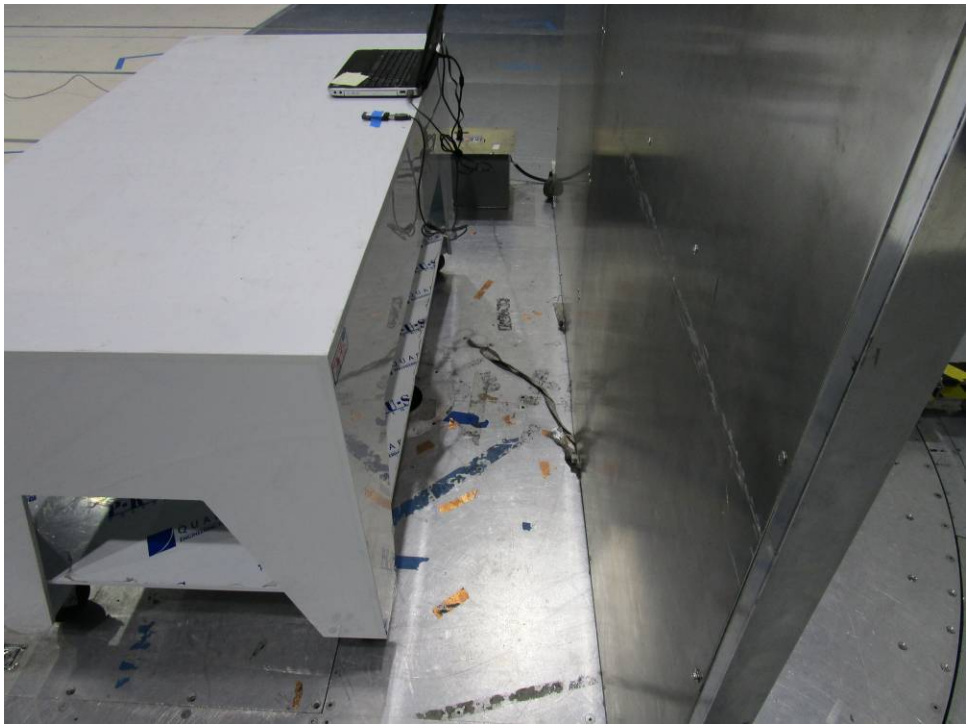
All finals							
Frequency (MHz)	**Ave Level (dBuV)**	**QP Level (dBuV)**	**Ave Limit (dBuV)**	**QP Limit (dBuV)**	**Ave Margin (dB)**	**QP Margin (dB)**	**Line**
0.182984	36.48	57.34	54.35	64.35	-17.87	-7.01	Phase 1
0.183097	36.97	57.86	54.35	64.35	-17.38	-6.49	Phase 1
0.18538	38.28	57.54	54.24	64.24	-15.96	-6.71	Phase 1
0.185475	38.07	57.23	54.24	64.24	-16.17	-7.01	Phase 1
0.188341	39.17	57.07	54.11	64.11	-14.94	-7.04	Phase 1
13.95937	38	45.53	50	60	-12	-14.47	Phase 1
0.182592	34.54	55.58	54.37	64.37	-19.83	-8.79	Neutral
0.184769	35.95	55.08	54.27	64.27	-18.32	-9.19	Neutral
0.185811	36.7	55.31	54.22	64.22	-17.52	-8.92	Neutral
0.185982	37.1	55.23	54.22	64.22	-17.12	-8.98	Neutral
0.193978	34.98	53.72	53.87	63.87	-18.88	-10.15	Neutral
13.86856	38.82	45.76	50	60	-11.18	-14.24	Neutral

Result: Complies

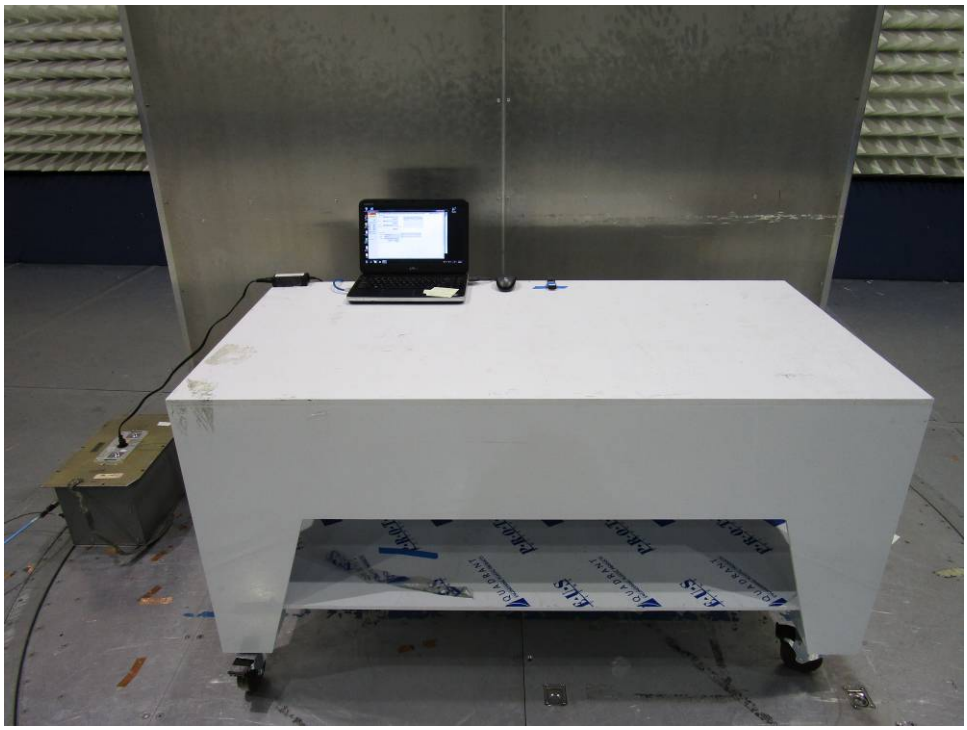
4.6.4 Test Configuration Photographs

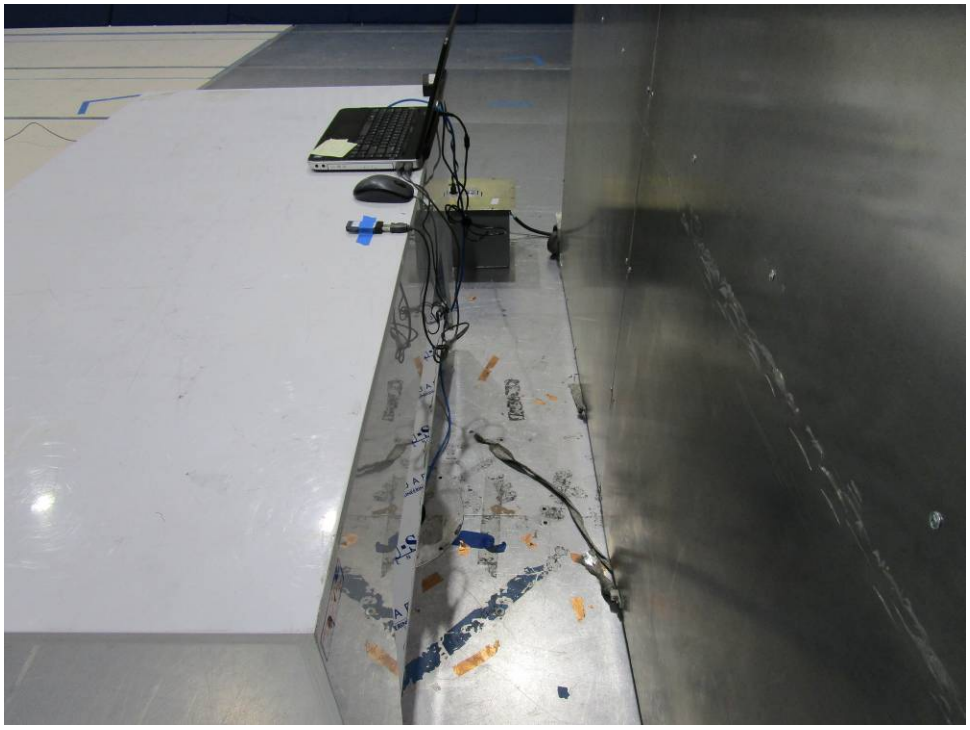
The following photographs show the testing configurations used.





4.6.4 Test Configuration Photographs (continued)





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 & Schwarz	FSV40	ITS 01534	12	05/16/18
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	01/04/18
Horn Antenna	ETS-Lindgren	3117-PA	ITS 01365	12	08/21/18
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	07/10/18
BI-Log Antenna	Teseq	CBL6111D	ITS 01505	12	11/10/17
Pre-Amplifier	Sonoma Instrument	310	ITS 00942	12	01/19/18
RF Cable	TRU Corporation	TRU CORE 300	ITS 01462	12	08/19/18
Notch Filter	Micro-Tronics	BRM50702	ITS 01166	12	02/08/18
RF Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	08/19/18
RF Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	08/19/18
Attenuator	Mini Circuits	BW-N3W5+	ITS 01315	12	10/19/17
Attenuator	Narda	FSCM99899	ITS 01583	12	08/31/18
RF Cable	Megaphase	EMC1-K1K1-236	ITS 01538	12	06/13/18
RF Cable	Megaphase	TM40-K1K1-19	ITS 01154	12	01/26/18
Transient Limiter	COM-POWER	LIT-153A	ITS 01452	12	06/19/18
RF Cable	Megaphase	TM40-K1K1-59 RF	ITS 01156	12	01/26/18
LISN	FCC	FCC-LISN-50-50-M-H	ITS 00552	12	10/24/17
RF Cable	TRU Corporation	TRU Core 300	ITS 01335	12	11/23/17
RF Cable	TRU Corporation	TRU Core 300	ITS 01337	12	11/23/17
RF Cable	TRU Corporation	TRU Core 300	ITS 01339	12	11/23/17

No Calibration required

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
TripSaver 2 Control App	S&C Electric	-	SMAC_TEST_MODE_CONTINUOUS_TX_MOD SMAC_TEST_MODE_CONTINUOUS_RX
BAT-EMC	Nexio	3.17.0.10	S&C October 4, 2017 Radiated Emissions.vpp
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 / G103243298	TM	KV	October 11, 2017	Original document