

TEST REPORT

Report Number: 103592127MPK-022

Project Number: G103592127

March 11, 2019

**Testing performed on
Cala Base Station
Marketing Name: TWO (Base Station)**

FCC ID: 2AT2D-BASE0017

to

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

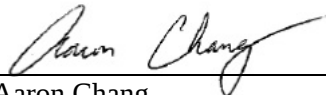
For

Cala Health, Inc.

Test Performed by:
Intertek
1365 Adams Court
Menlo Park, CA 94025 USA

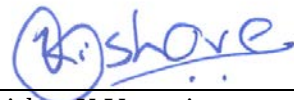
Test Authorized by:
Cala Health, Inc.
875 Mahler Road Suite 175
Burlingame, CA 94010 USA

Prepared by:


Aaron Chang

Date: March 11, 2019

Reviewed by:

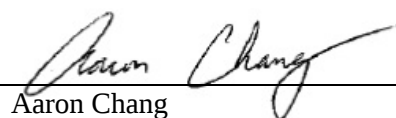

Krishna K Vemuri

Date: March 11, 2019

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program. This report must not be used to claim product endorsement by A2LA, NIST nor any other agency of the U.S. Government.

Report No. 103592127MPK-022	
Equipment Under Test:	Cala Base Station
Trade Name:	Cala Health, Inc.
Marketing Name:	TWO (Base Station)
Applicant:	Cala Health, Inc.
Contact:	Mark Shughart
Address:	Cala Health, Inc. 875 Mahler Road Suite 175 Burlingame, CA 94010
Country:	USA
Tel. Number:	(415) 890-3961
Email:	mark@calahealth.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 2
Date of Test:	February 27 – March 4, 2019

We attest to the accuracy of this report:



Aaron Chang
Project Engineer



Krishna K Vemuri
Engineering Team Lead

TABLE OF CONTENTS

1.0	Summary of Tests	4
2.0	General Information.....	5
2.1	Product Description	5
2.2	Related Submittal(s) Grants.....	6
2.3	Test Facility	6
2.4	Test Methodology	6
2.5	Measurement Uncertainty	6
3.0	System Test Configuration.....	7
3.1	Support Equipment	7
3.2	Block Diagram of Test Setup.....	7
3.3	Justification	8
3.4	Software Exercise Program.....	8
3.5	Mode of Operation during Test.....	8
3.6	Modifications Required for Compliance	8
3.7	Additions, Deviations and Exclusions from Standards.....	8
4.0	Measurement Results.....	9
4.1	6-dB Bandwidth and 99% Occupied Bandwidth	9
4.2	Maximum Peak Conducted Output Power at Antenna Terminals	16
4.3	Maximum Power Spectral Density	20
4.4	Out of Band Antenna Conducted Emission	24
4.5	Transmitter Radiated Emissions	29
4.6	AC Line Conducted Emission	46
5.0	List of Test Equipment	50
6.0	Document History	51

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)

EUT receive date: February 27, 2019

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: February 27, 2019

Test completion date: March 4, 2019

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

2.0 General Information

2.1 Product Description

Cala Health, Inc. supplied the following description of the EUT:

The Cala Base Station provides charging and connectivity to the Cala Trio wrist-worn stimulator.

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

Information about the Cala Base Station 2.4 GHz radio is presented below:

Applicant	Cala Health, Inc.
Marketing Name	TWO (Base Station)
FCC Identifier	2AT2D-BASE0017
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	-2.01 dBm
Antenna(s) & Gain	Chip antenna, Peak Gain: 3.19 dBi
Frequency Range	2402 – 2480 MHz
Type of modulation/data rate	GFSK / 1Mbit/s
Number of Channel(s)	40
Applicant Name & Address	Cala Health, Inc. 875 Mahler Road Suite 175 Burlingame, CA 94010 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, Frequency Hopping Spread Spectrum System, and Hybrid System devices Operating under §15.247” (KDB 558074 D01 Meas Guidance v05), RSS-247 Issue 2, ANSI C63.10: 2013 and RSS-GEN Issue 5.

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

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

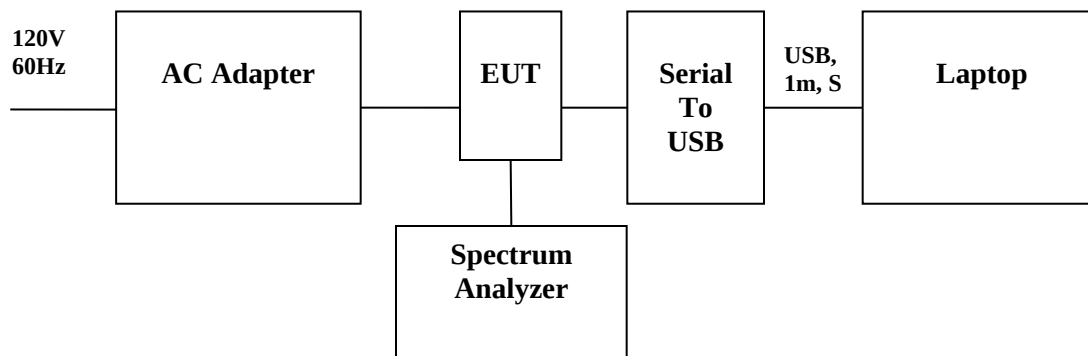
3.1 Support Equipment

Support Equipment		
Description	Manufacturer	Model Number
Laptop	HP	EliteBook 840
Serial to USB board	Sparkfun	DEV-14050

3.2 Block Diagram of Test Setup

Equipment Under Test			
Description	Manufacturer	Marketing Name	Serial Number
Conducted Sample of Cala Base Station	Cala Health, Inc.	TWO (Base Station)	DEV-009

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.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by Cala Health, Inc.

3.5 Mode of Operation during Test

As instructed by the manufacturer, the EUT's power setting was set to 0 on the low, middle and high frequencies/channels.

3.6 Modifications Required for Compliance

No modifications were made by the manufacturer or Intertek to the EUT in order to bring the EUT into compliance.

3.7 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 KDB 558074 D01 Meas Guidance v05 was used to determine the DTS occupied bandwidth. Section 11.8.1 Option 1 of ANSI 63.10 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.

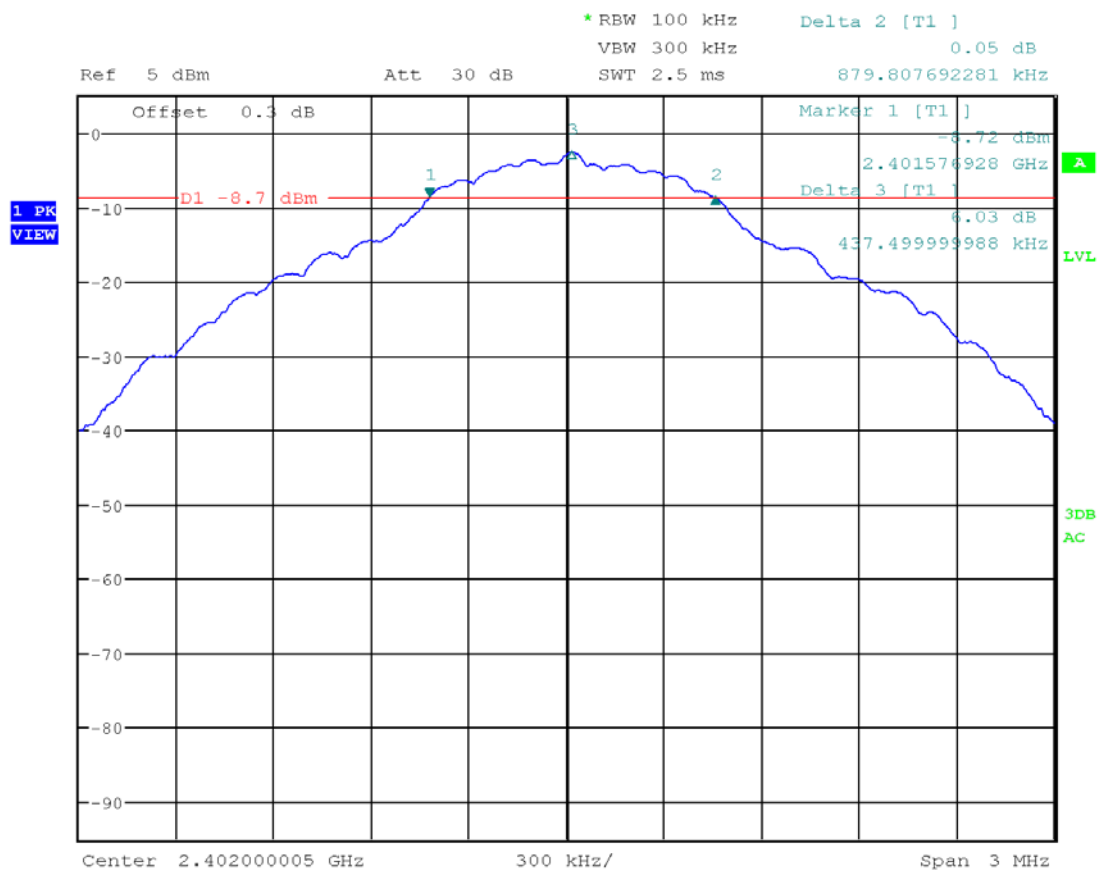
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

4.1.3 Test Result

Frequency (MHz)	6-dB bandwidth FCC 15.247 & RSS-GEN	Occupied bandwidth, RSS-GEN	Plot
MHz	kHz	MHz	
2402	879.808	--	1.1
	--	1.750	1.4
2440	865.385	--	1.2
	--	1.808	1.5
2480	846.154	--	1.3
	--	1.856	1.6

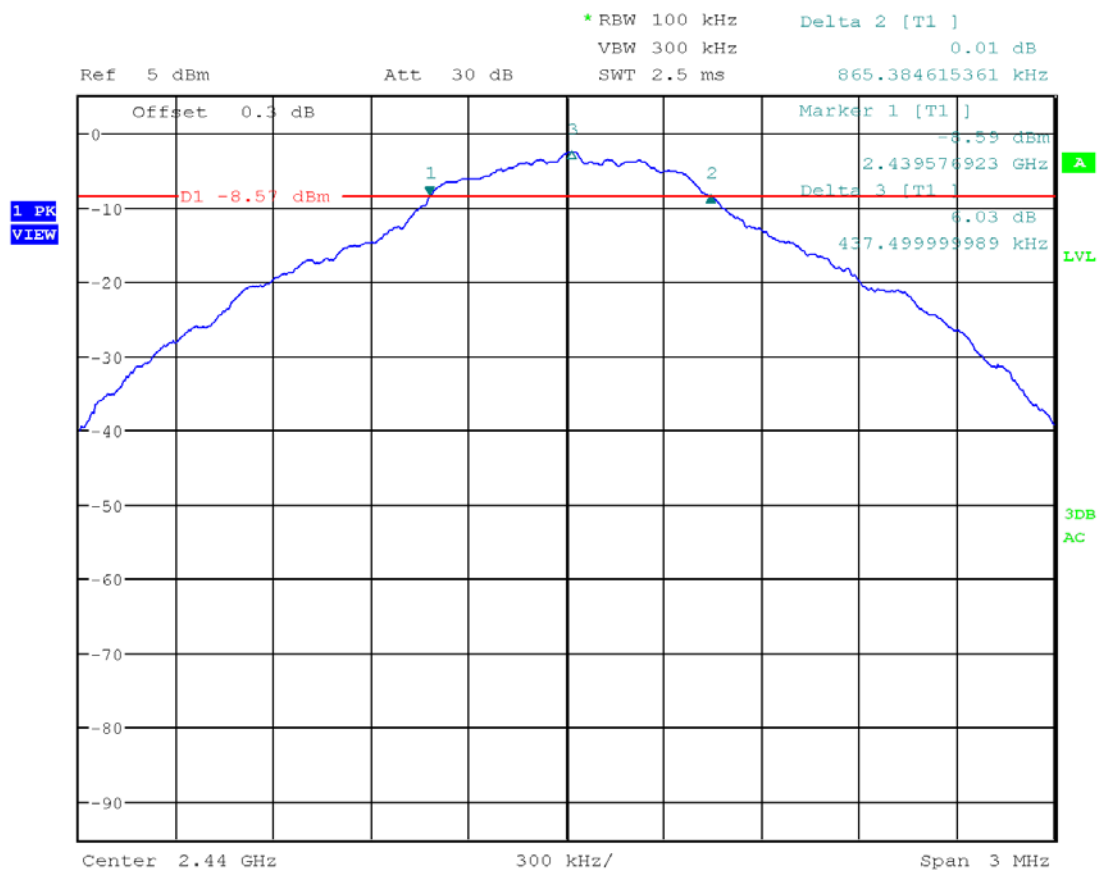
Tested By	Test Date
Aaron Chang	February 28, 2019

Plot 1. 1



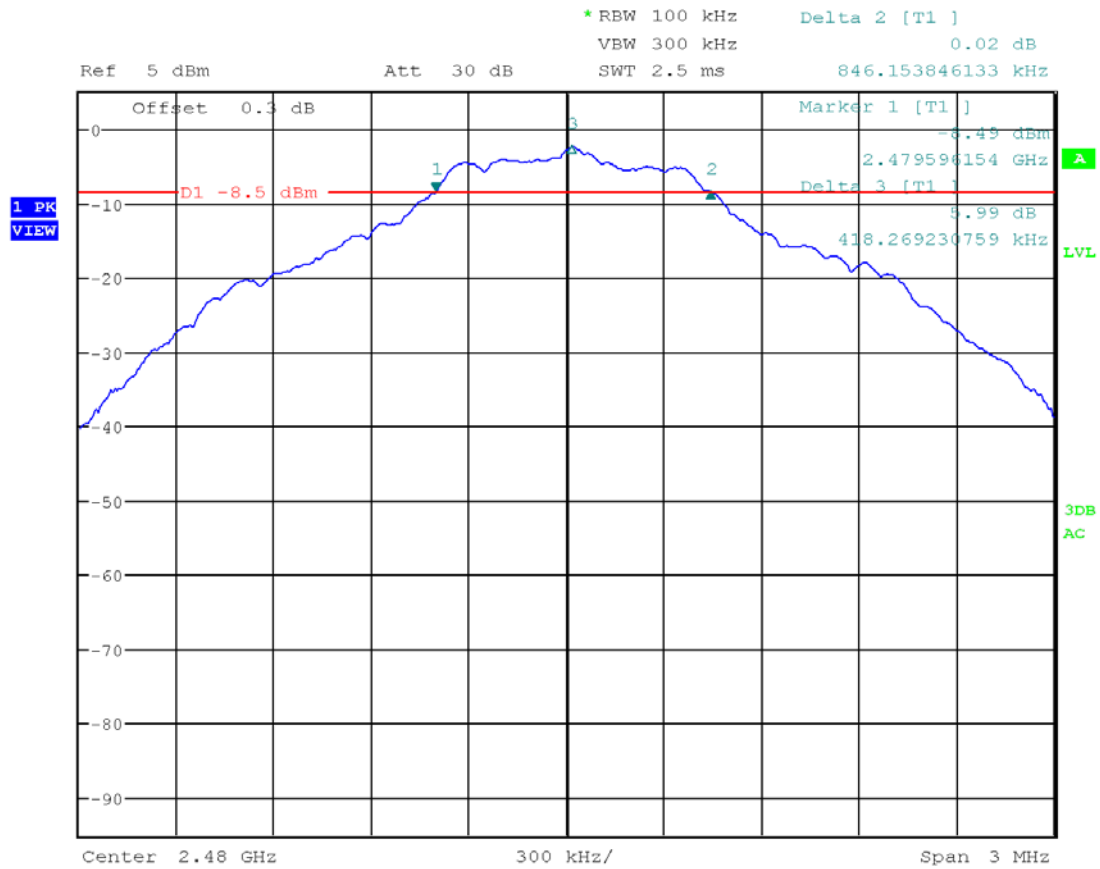
Date: 28.FEB.2019 21:38:00

Plot 1.2



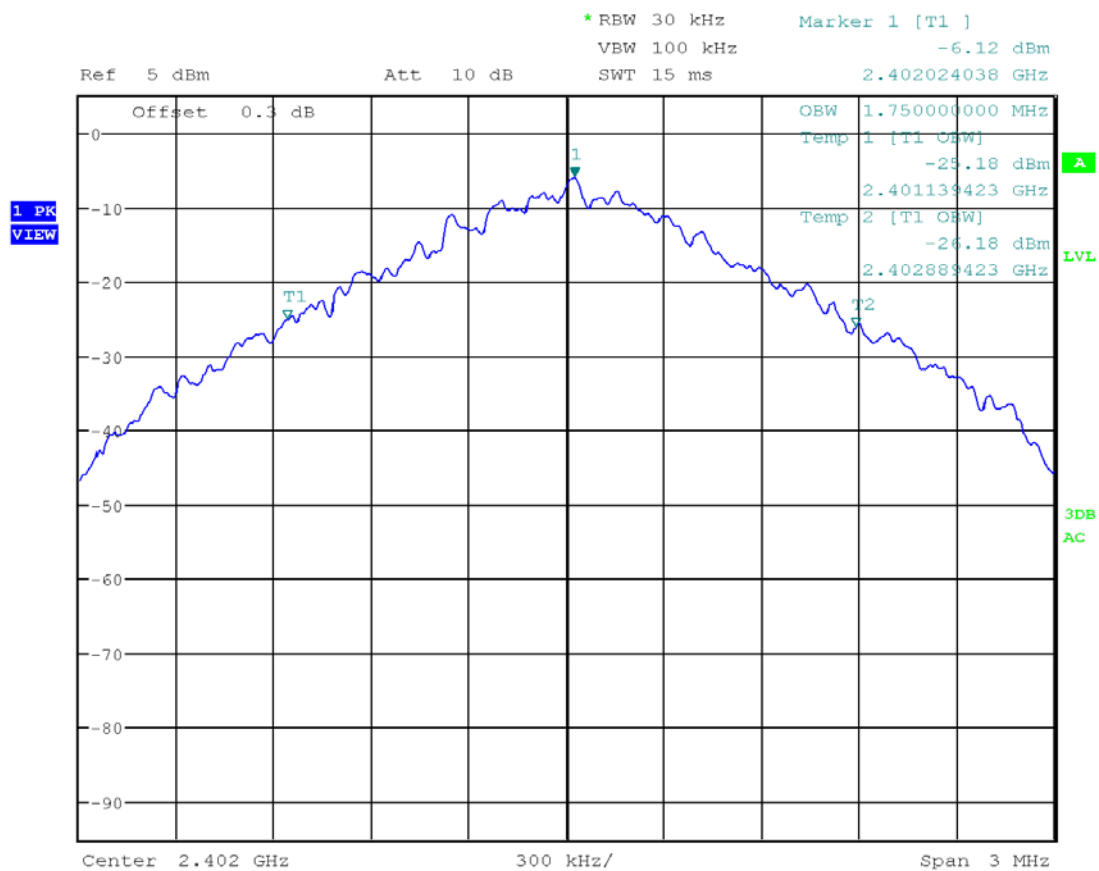
Date: 28.FEB.2019 22:12:37

Plot 1.3



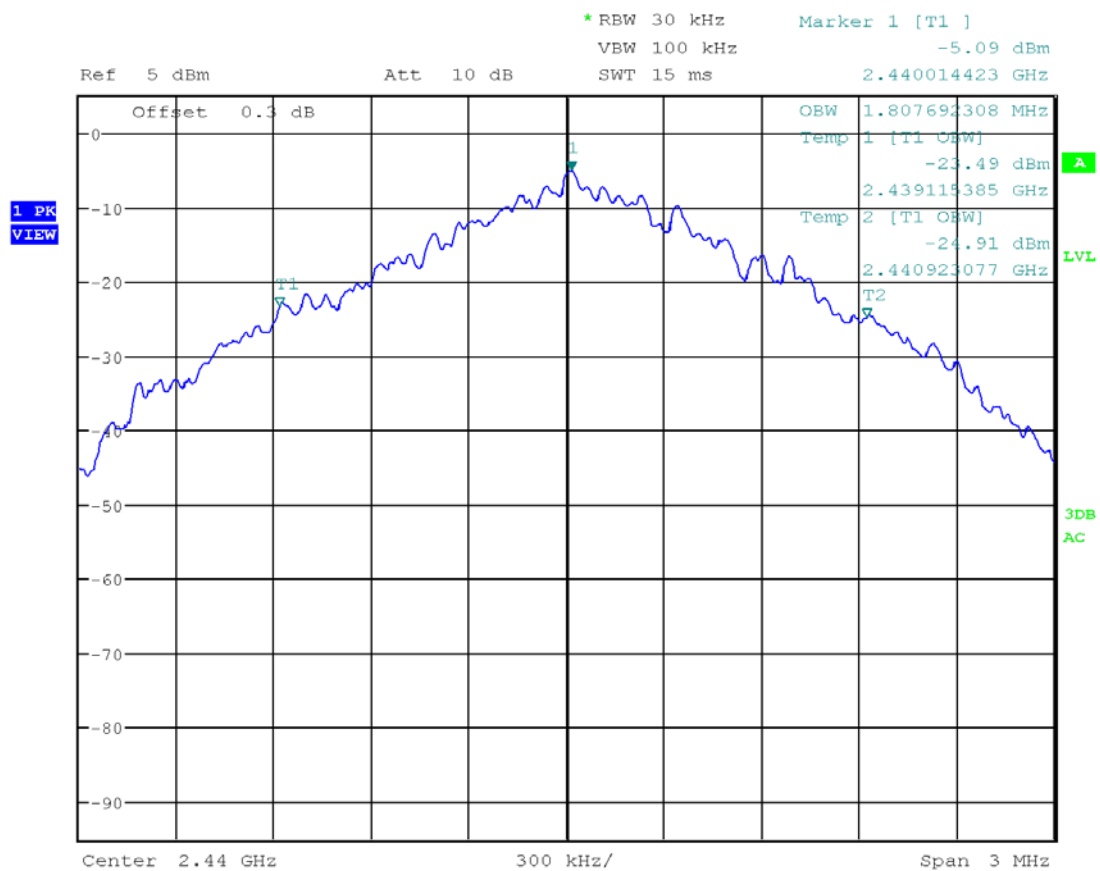
Date: 28.FEB.2019 22:14:07

Plot 1.4



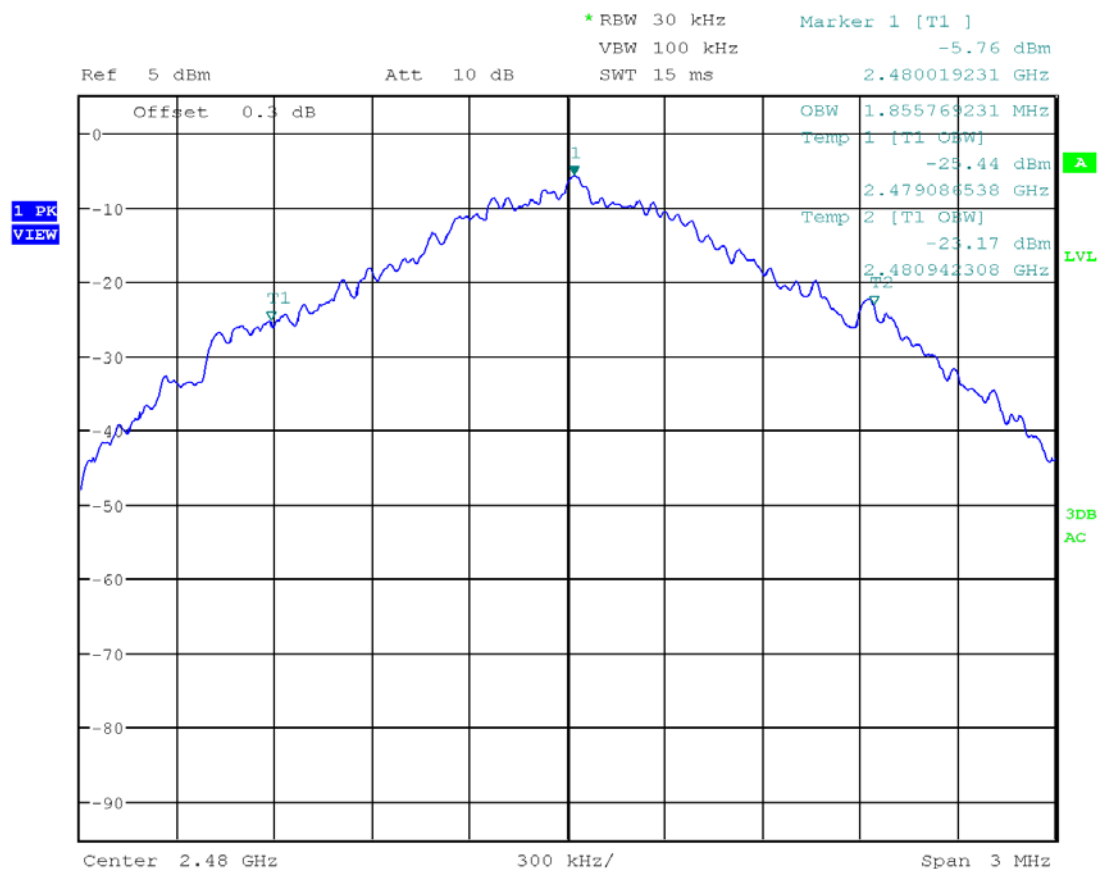
Date: 28.FEB.2019 22:16:53

Plot 1.5



Date: 28.FEB.2019 22:16:13

Plot 1.6



Date: 28.FEB.2019 22:15:26

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 KDB 558074 D01 Meas Guidance v05 was used. Specifically, section 11.9.1.1 $RBW \geq DTS$ bandwidth in ANSI 63.10.

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.

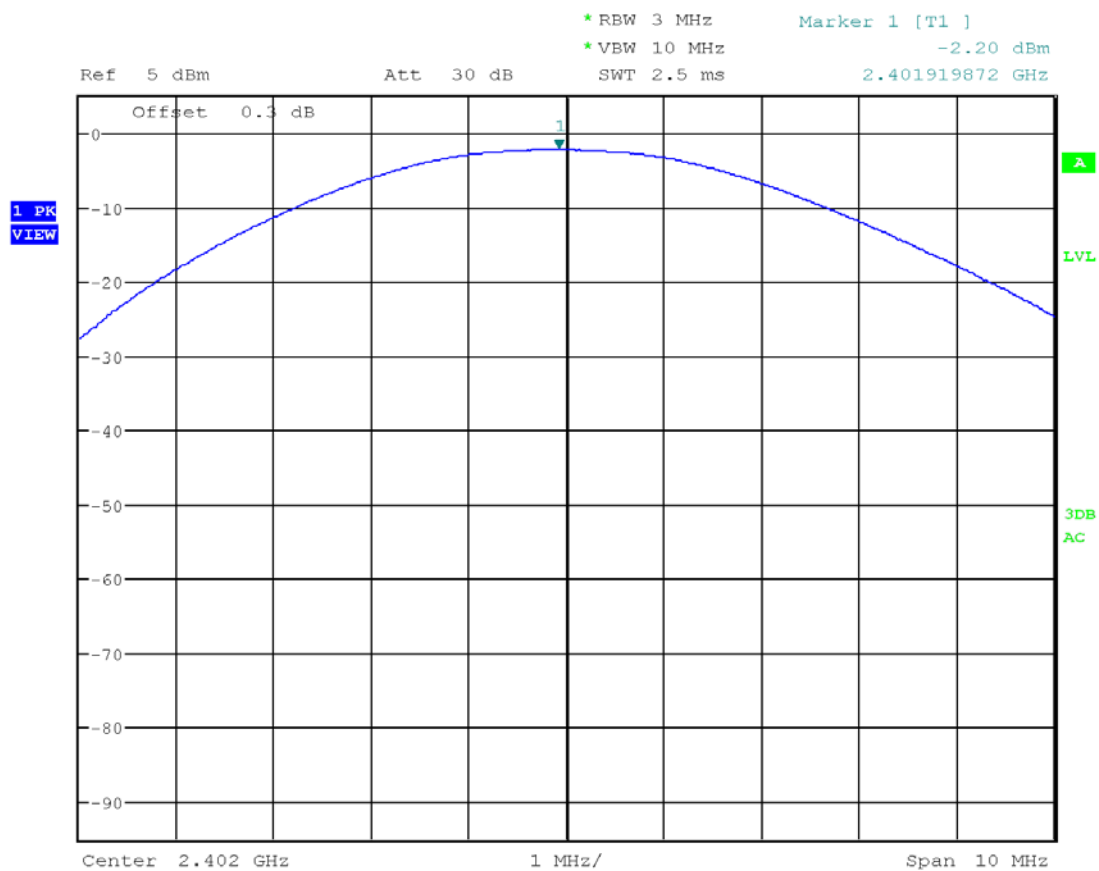
4.2.3 Test Result

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

Frequency,	Conducted Power (peak)	Conducted Power (peak)	Plot
MHz	dBm	mW	
2402	-2.20	0.603	2.1
2440	-2.02	0.628	2.2
2480	-2.01	0.630	2.3

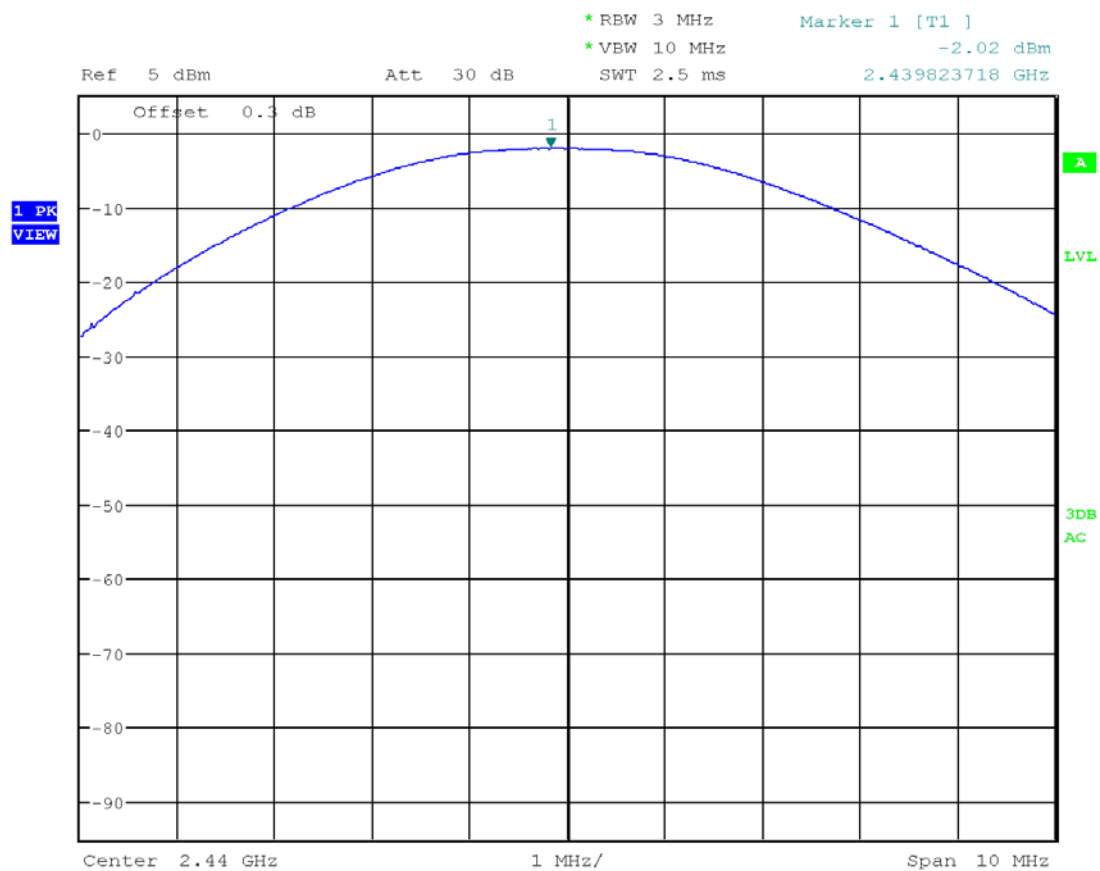
Tested By	Test Date
Aaron Chang	February 28, 2019

Plot 2. 1



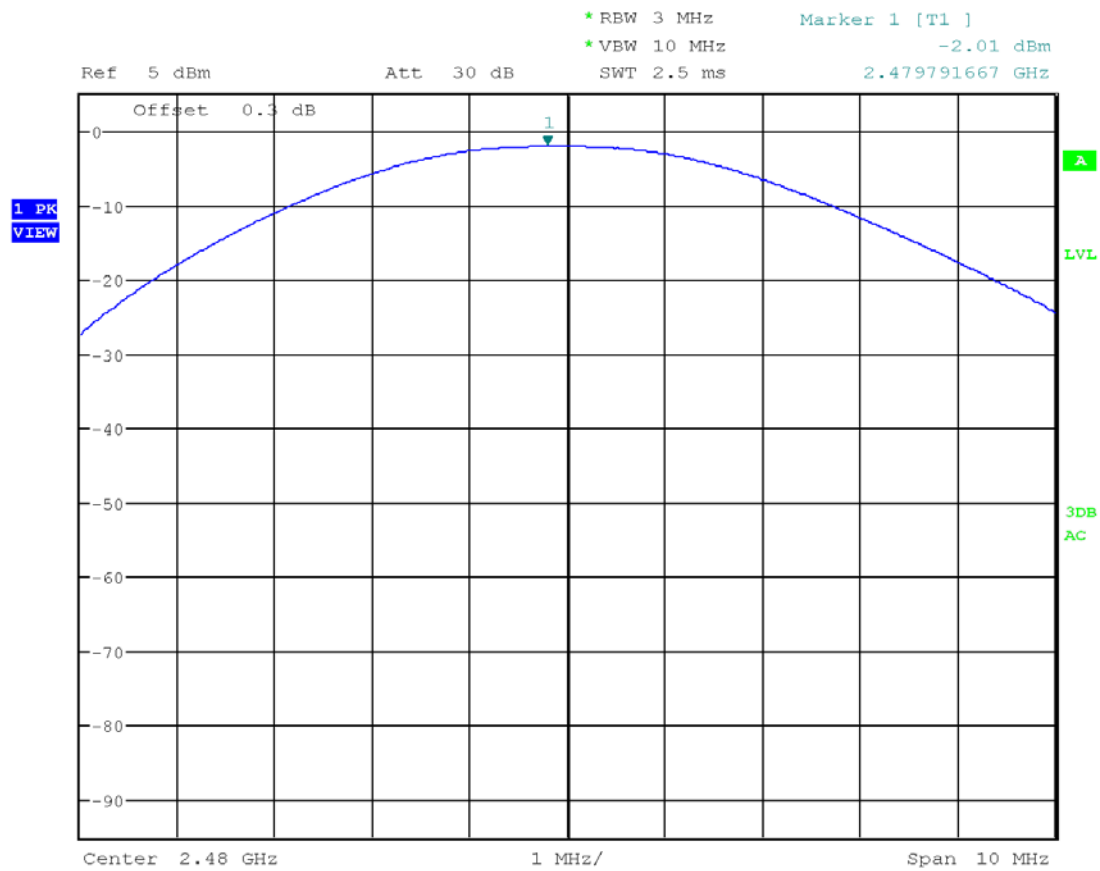
Date: 28.FEB.2019 22:21:22

Plot 2.2



Date: 28.FEB.2019 22:20:52

Plot 2.3



Date: 28.FEB.2019 22:20:19

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

The antenna port of the EUT was connected to the input of a spectrum analyzer to measure the Transmitter Power Density (PSD). The offset programmed on the analyzer is corrected to include cable loss, attenuator.

The procedure described in FCC Publication KDB 558074 D01 Meas Guidance v05, specifically section 11.10.2 Method PKPSD (peak PSD) of ANSI 63.10.

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.

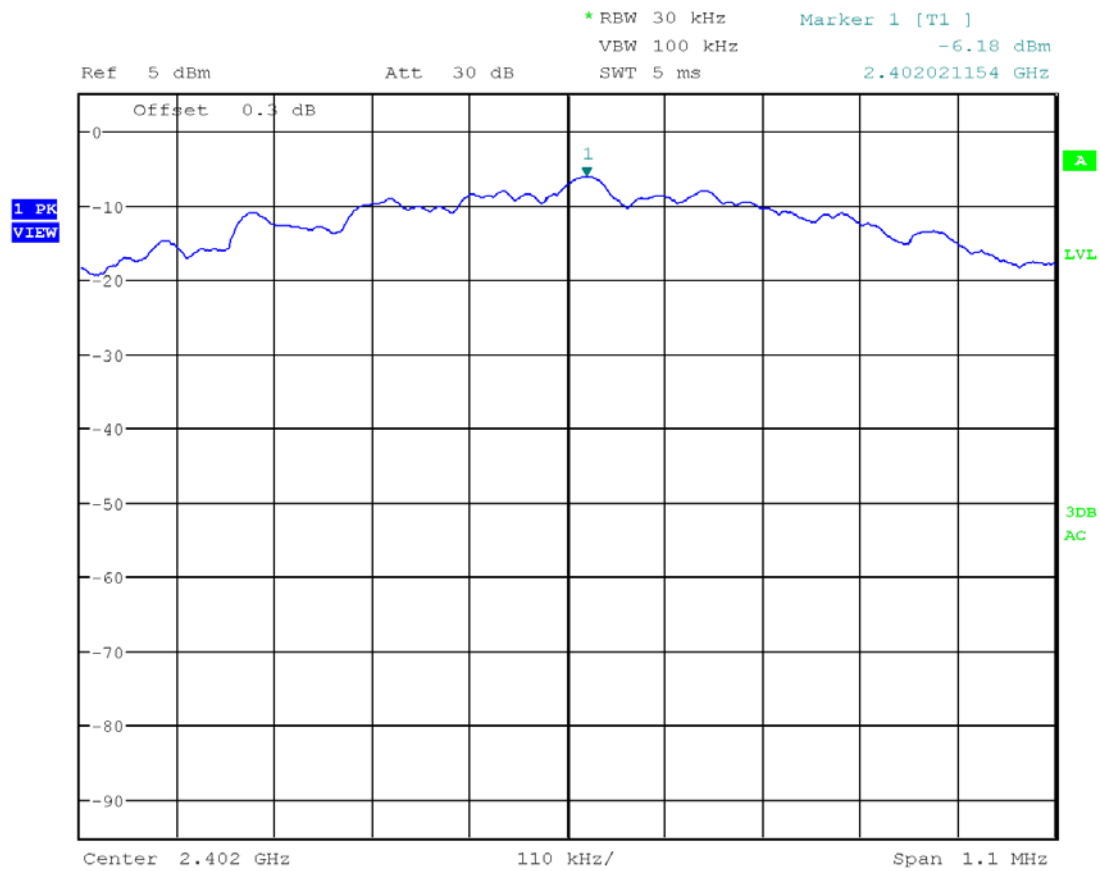
4.3.3 Test Result

Refer to the following plots for the test result

Frequency,	Maximum Power Spectral	Maximum Power Spectral	Margin	Plot
MHz	Density	Density Limit	dB	
	dBm	dBm		
2402	-6.18	8.0	-14.18	3.1
2440	-6.08	8.0	-14.08	3.2
2480	-4.17	8.0	-12.17	3.3

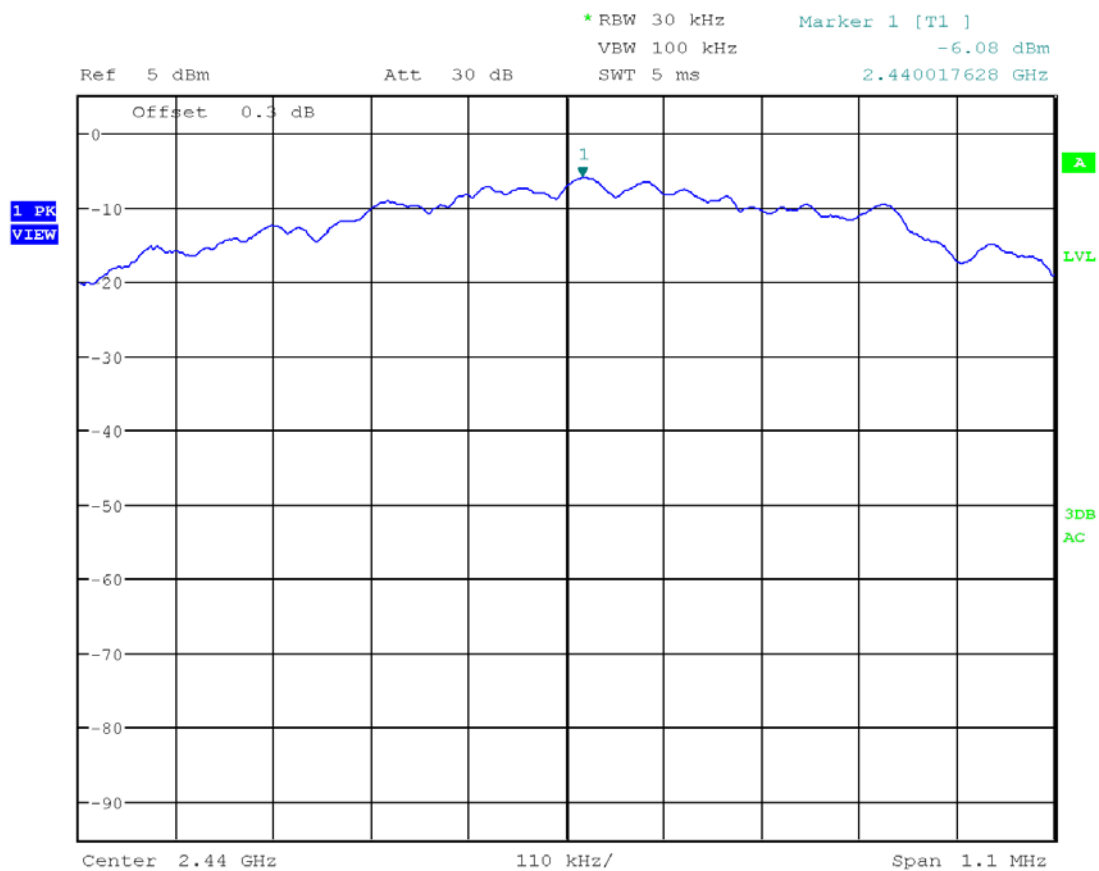
Tested By	Test Date
Aaron Chang	February 28, 2019

Plot 3. 1



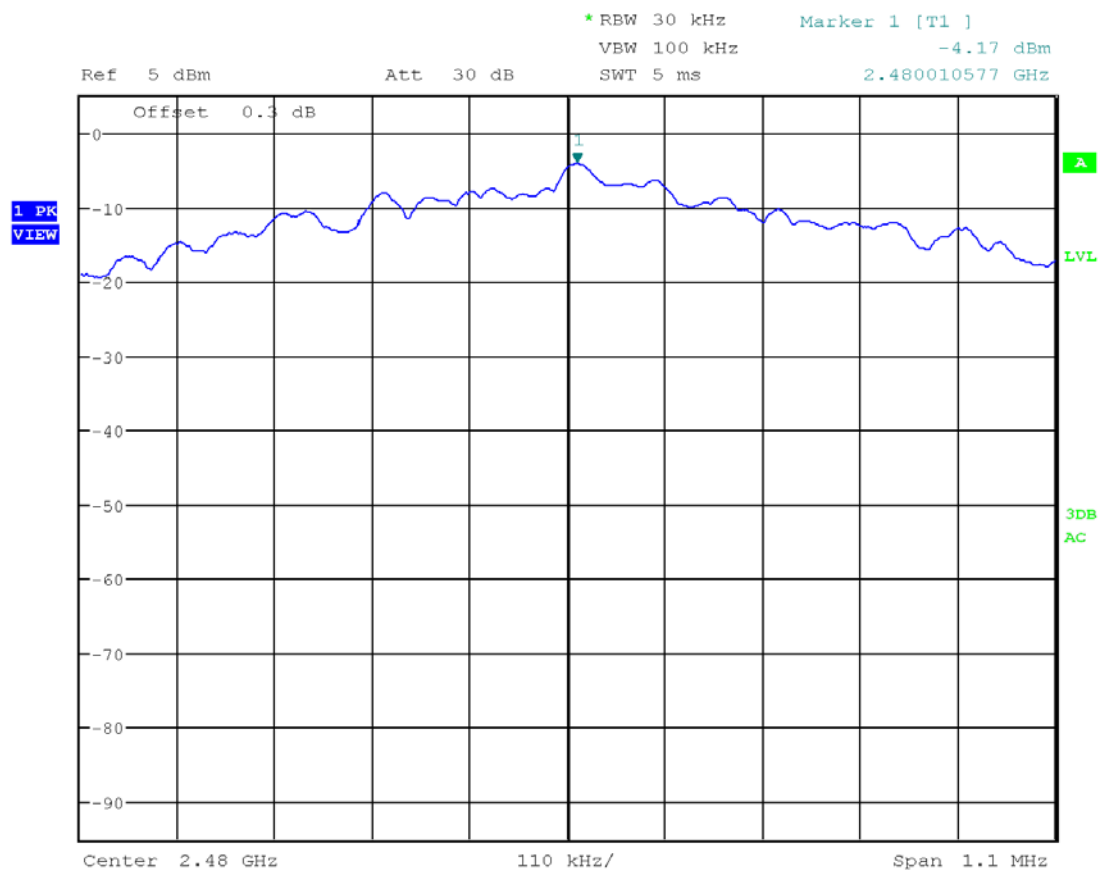
Date: 28.FEB.2019 22:18:01

Plot 3.2



Date: 28.FEB.2019 22:18:40

Plot 3.3



Date: 28.FEB.2019 22:19:16

4.4 Out of Band Antenna Conducted Emission 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 KDB 558074 D01 Meas Guidance v05, specifically section 11.11 DTS Emissions in non-restricted frequency bands of ANSI 63.10.

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

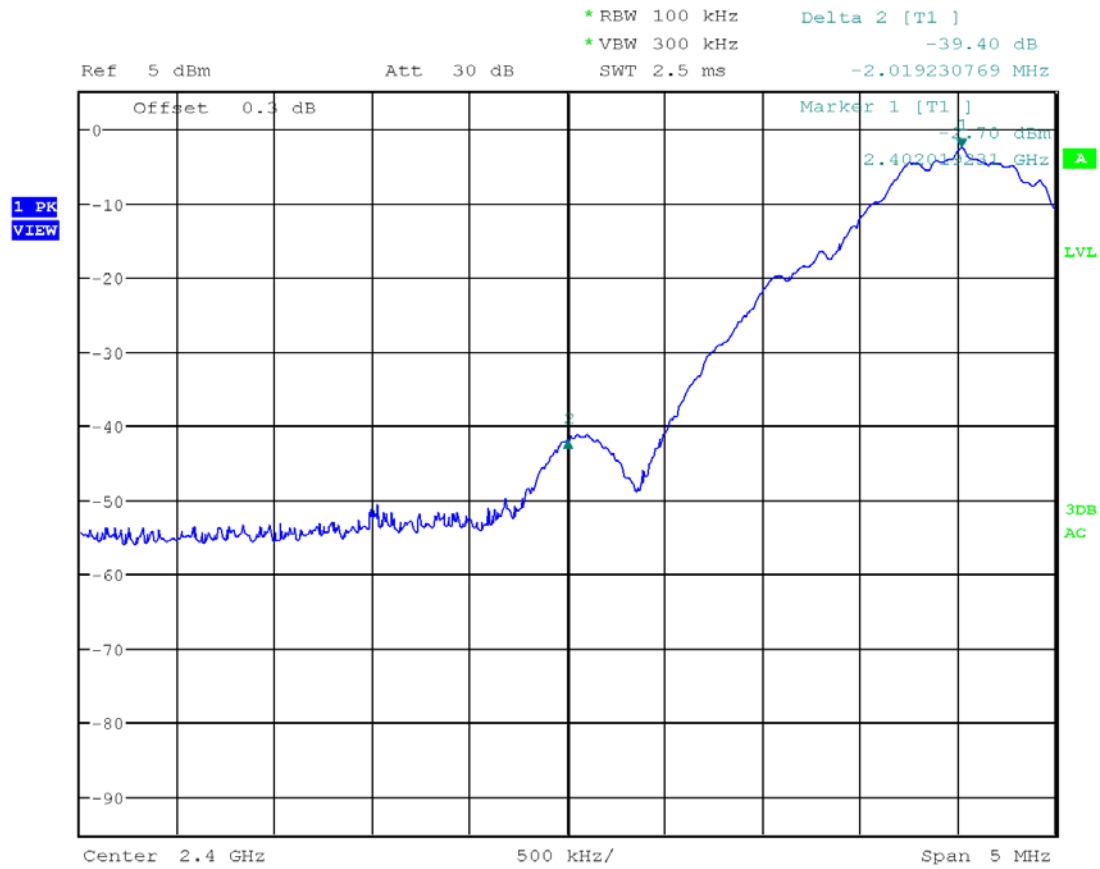
1. Set the RBW = 100 kHz.
2. Set the VBW $\geq 3 \times$ RBW.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

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

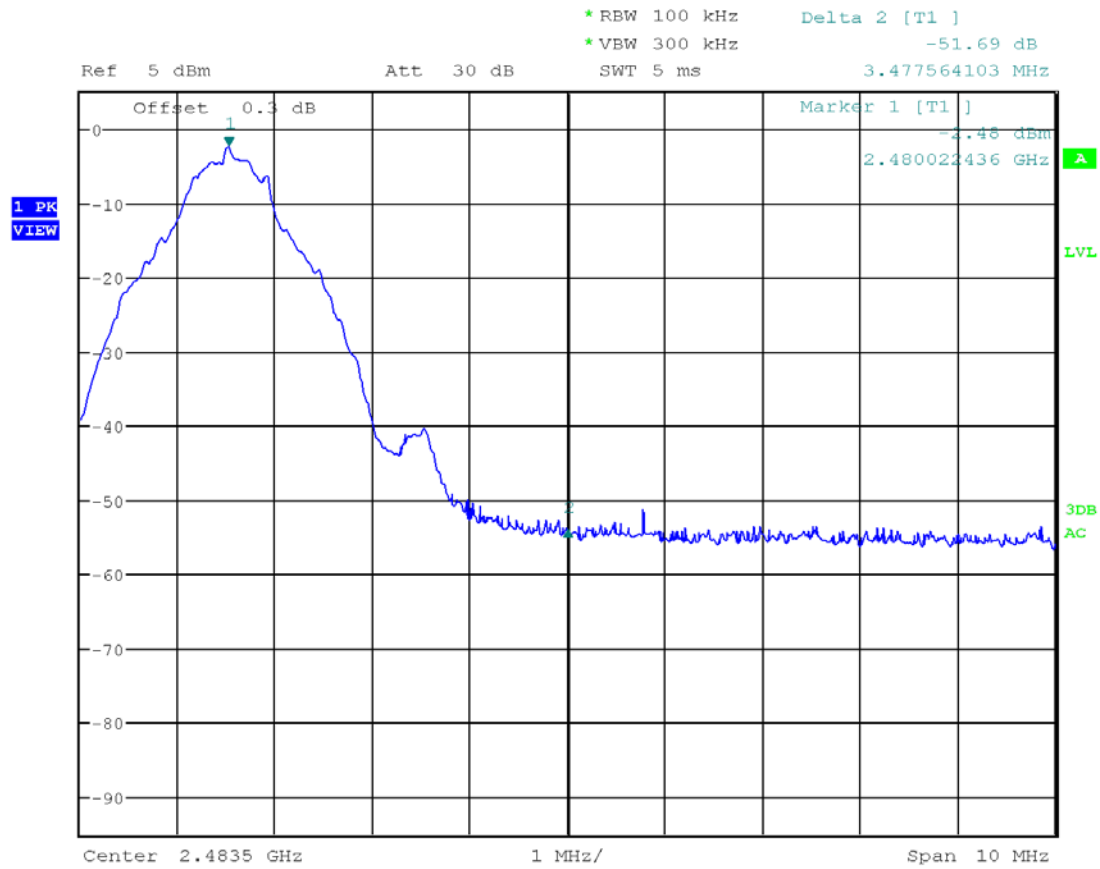
Tested By	Test Date
Aaron Chang	August 24, 2019

Tx @ Low Channel, 2400 MHz Band Edge
Plot 4.1



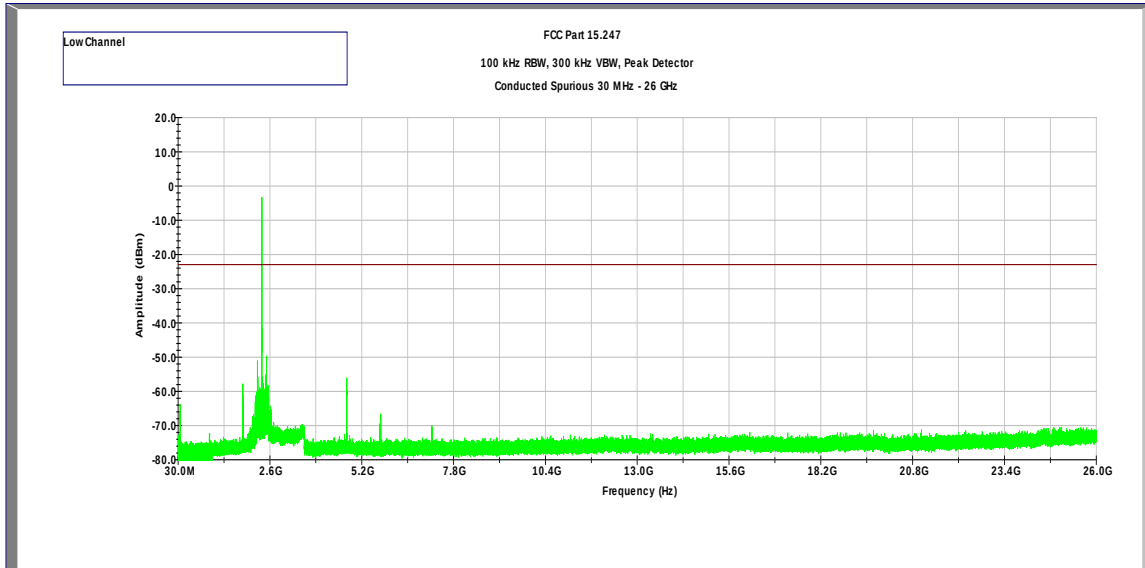
Date: 28.FEB.2019 22:22:38

Tx @ Low Channel, 2483.5 MHz Band Edge
Plot 4.2

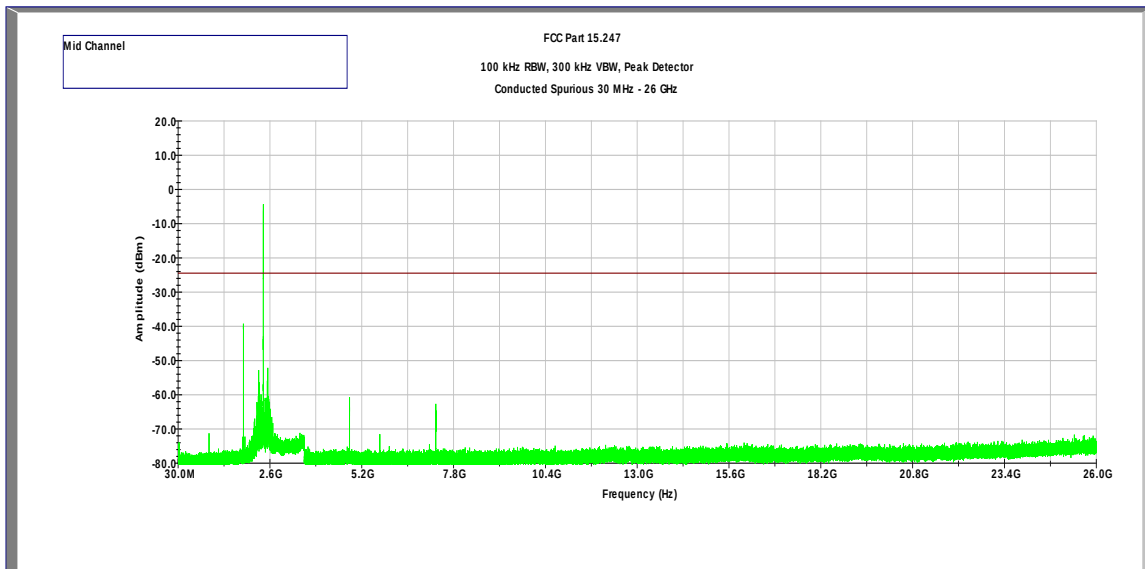


Date: 28.FEB.2019 22:23:56

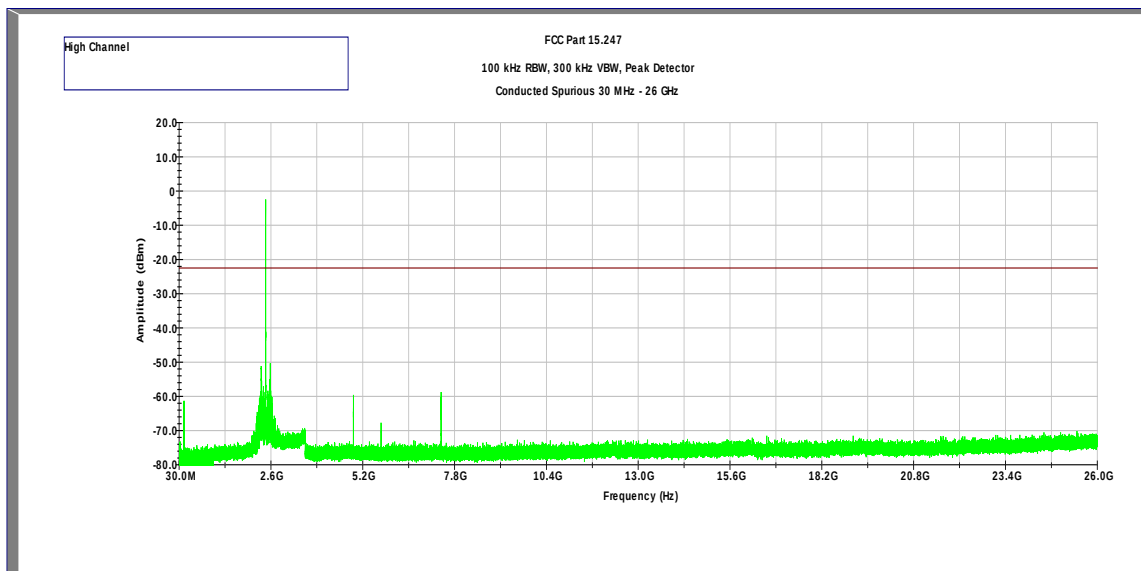
Tx @ Low Channel, 2402 MHz
30MHz -26GHz Conducted Spurious
Plot 4.3



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



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



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

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.

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(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.

4.5.4 Antenna-port conducted measurements

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

4.5.5 General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified for determining quasi-peak, peak, and average conducted output power, respectively.

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (*e.g.*, Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$$E = \text{EIRP} - 20\log D + 104.8 + \text{DCF} \quad (\text{DCF for Average measurements})$$

where:

E = electric field strength in dB μ V/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

DCF = Duty Cycle Correction Factor

f) Compare the resultant electric field strength level to the applicable limit.

g) Perform radiated spurious emission test

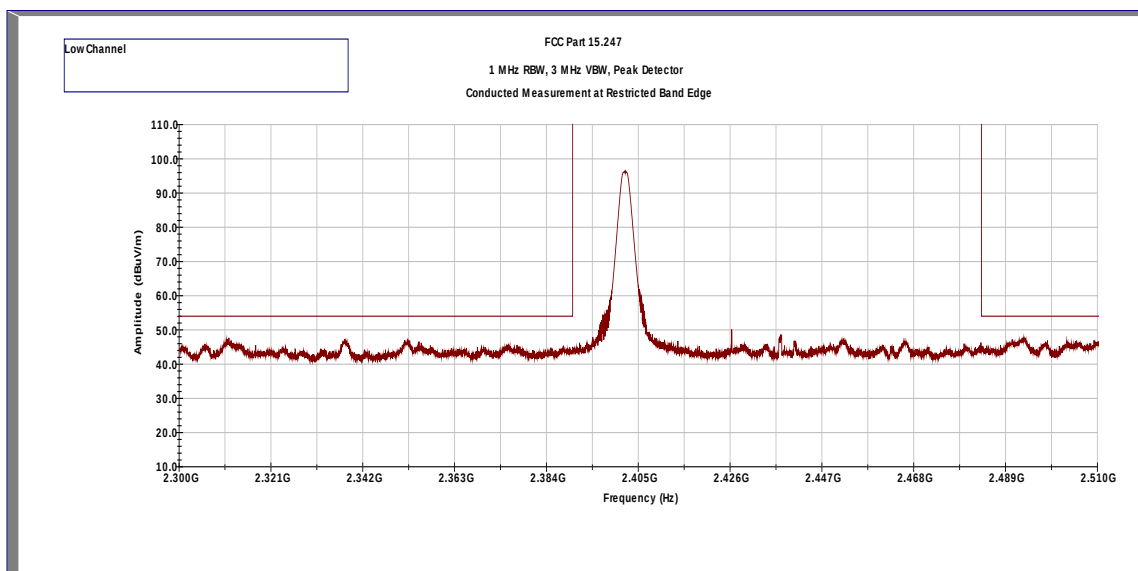
4.5.6 Test Results

Tested By	Test Date
Aaron Chang	February 29, 2019

Conducted Out-of-Band Spurious Emissions at the Band Edge were made with the consideration of cable loss and the addition of a 3.19 dBi Antenna.

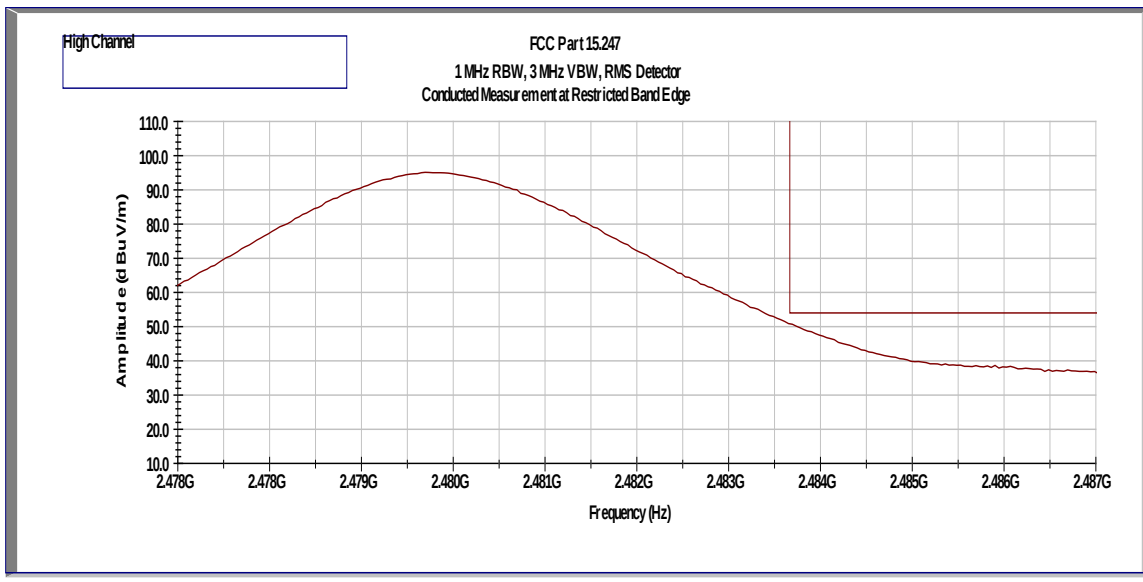
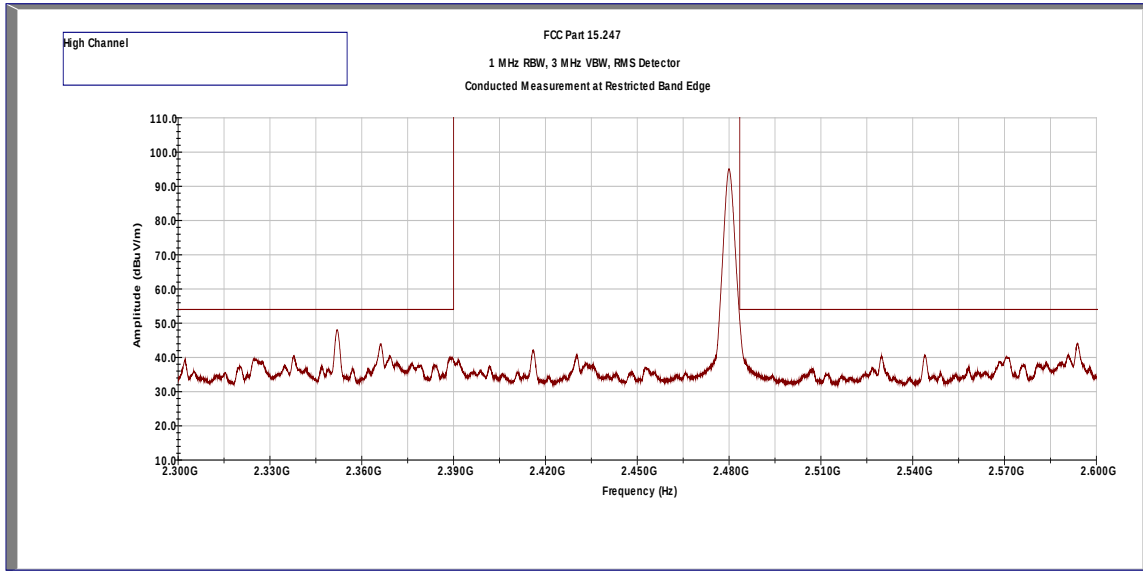
Test Results: 15.209/15.205 Radiated Restricted Band Emissions

Conducted Out-of-Band Spurious Emissions at the Band Edge – Tx @ 2402 MHz, Peak vs Average Limit



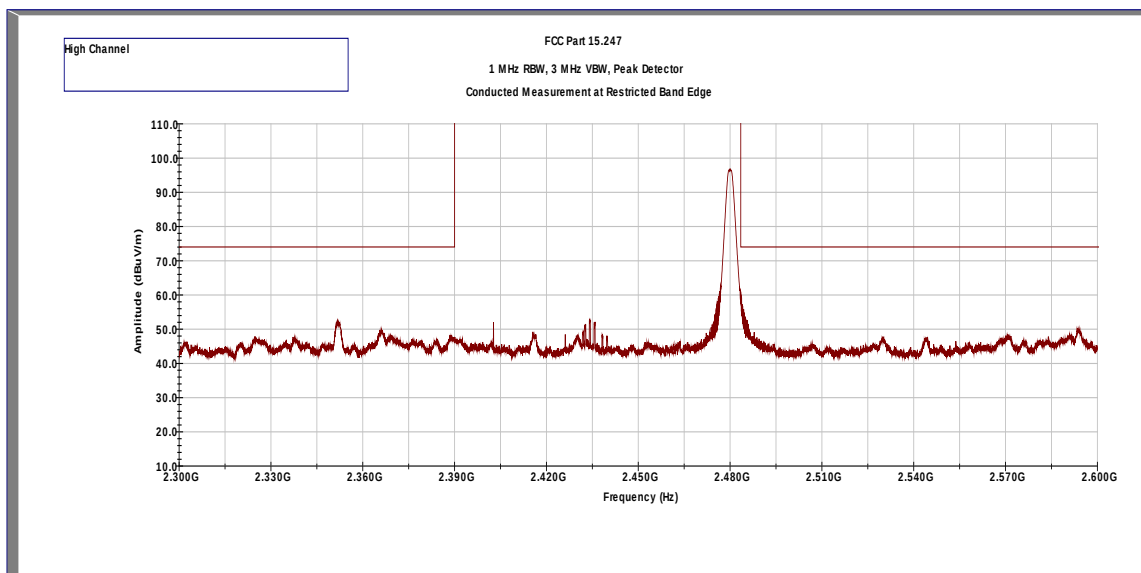
Frequency	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dB(μV/m)	dB(μV/m)	dB		
2.338	47.22	54	-6.78	Peak	Pass

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



Frequency	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dB(μV/m)	dB(μV/m)	dB		
2.4835	50.69	54	-3.31	RMS	Pass

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

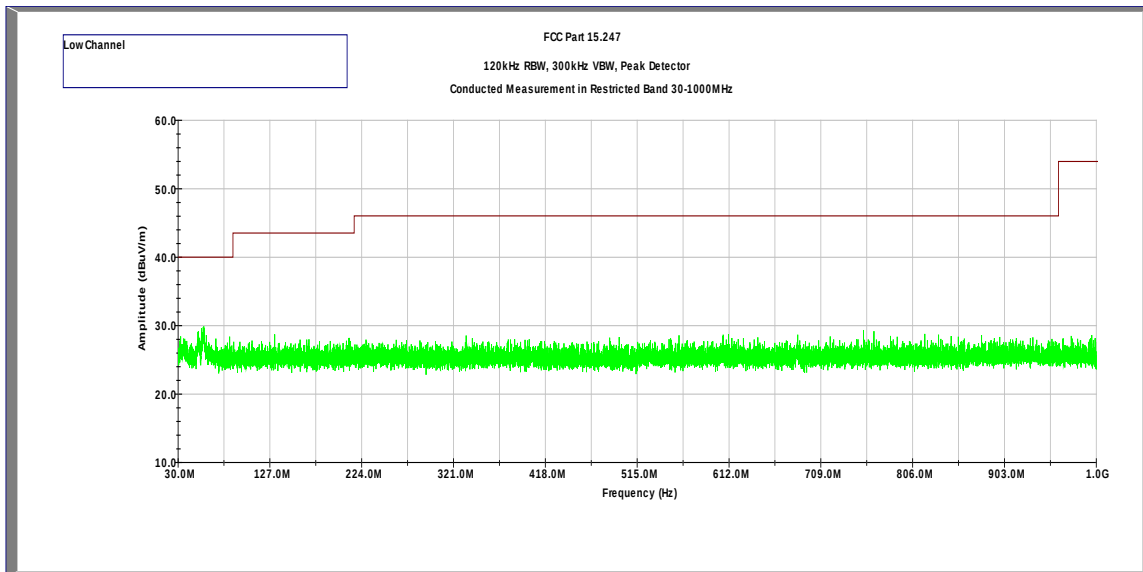


Frequency	Corrected Amplitude	Limit	Margin	Detector	Results
GHz	dB(μV/m)	dB(μV/m)	dB		
2.4835	60.00	74	-14.00	Peak	Pass

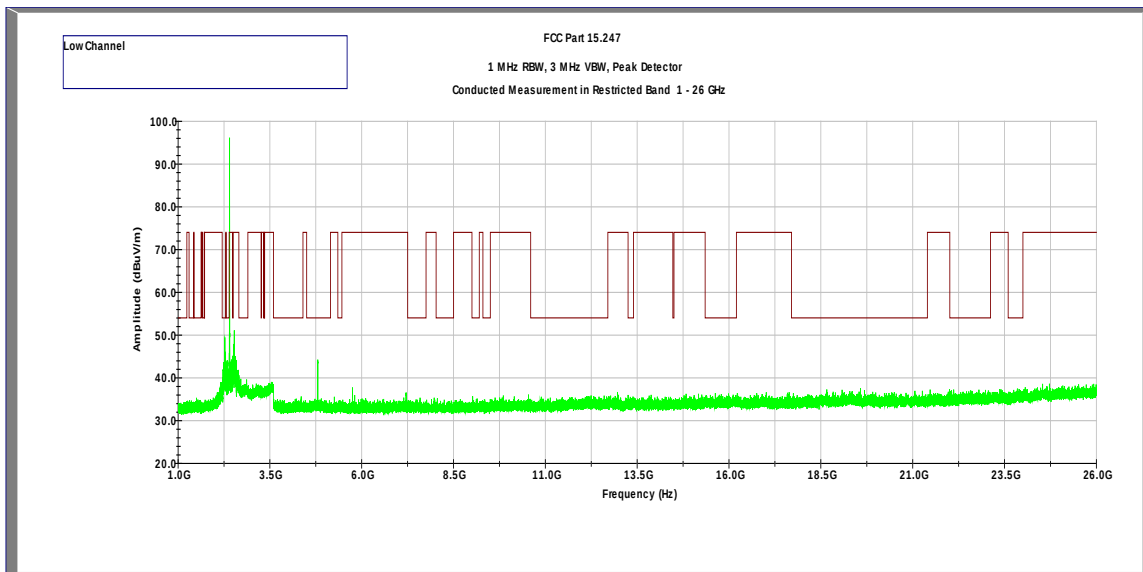
Out-of-Band Conducted Spurious Emissions (at Antenna Port)

Tx @ 2402MHz

Out-of-Band Spurious Emissions at Antenna Port - 30 MHz to 1 GHz



Out-of-Band Spurious Emissions at Antenna Port – 1 - 26 GHz Peak Detector vs Avg Limit

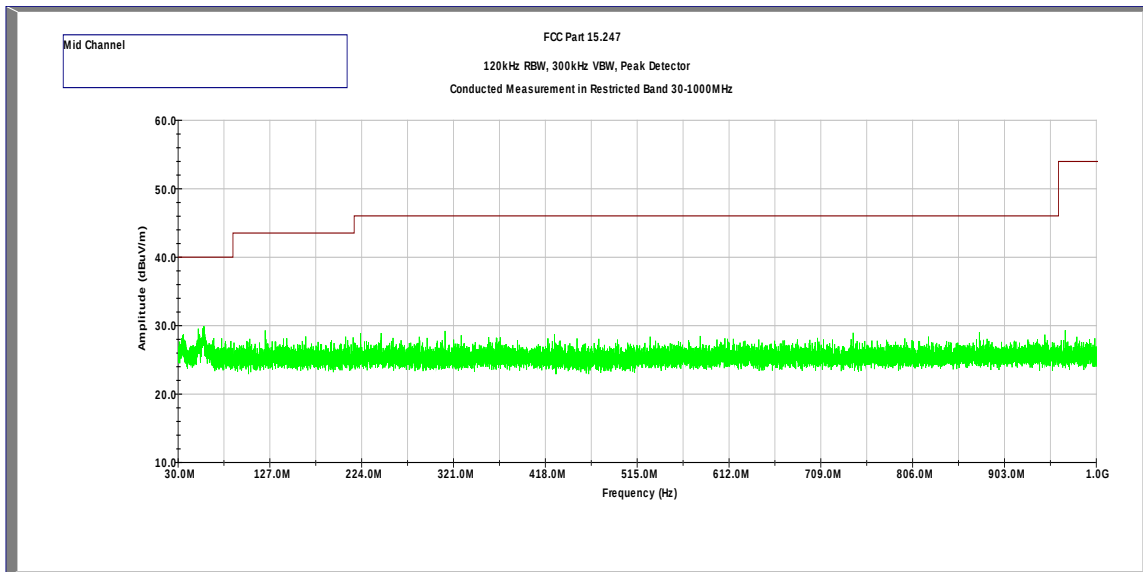


Frequency	Corrected Amplitude	Avg Limit	Margin	Detector	Results
GHz	dBuV/m	dBuV/m	dB		
4.804	44.25	54	-9.75	Peak	Pass

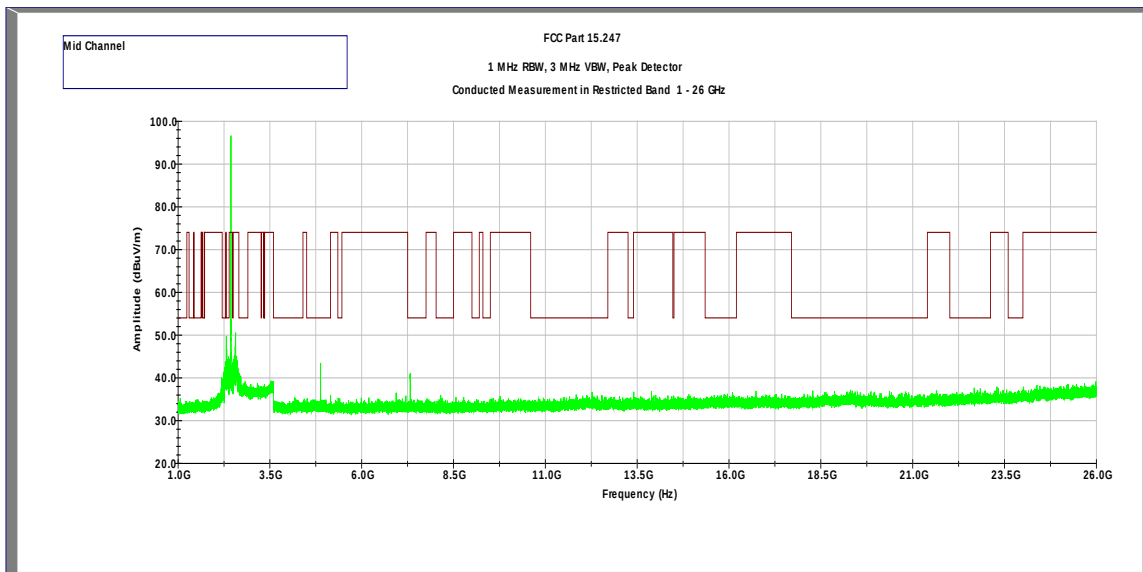
Out-of-Band Conducted Spurious Emissions (at Antenna Port)

Tx @ 2426MHz

Out-of-Band Spurious Emissions at Antenna Port - 30 MHz to 1 GHz



Out-of-Band Spurious Emissions at Antenna Port – 1 - 26 GHz Peak Detector vs Avg Limit

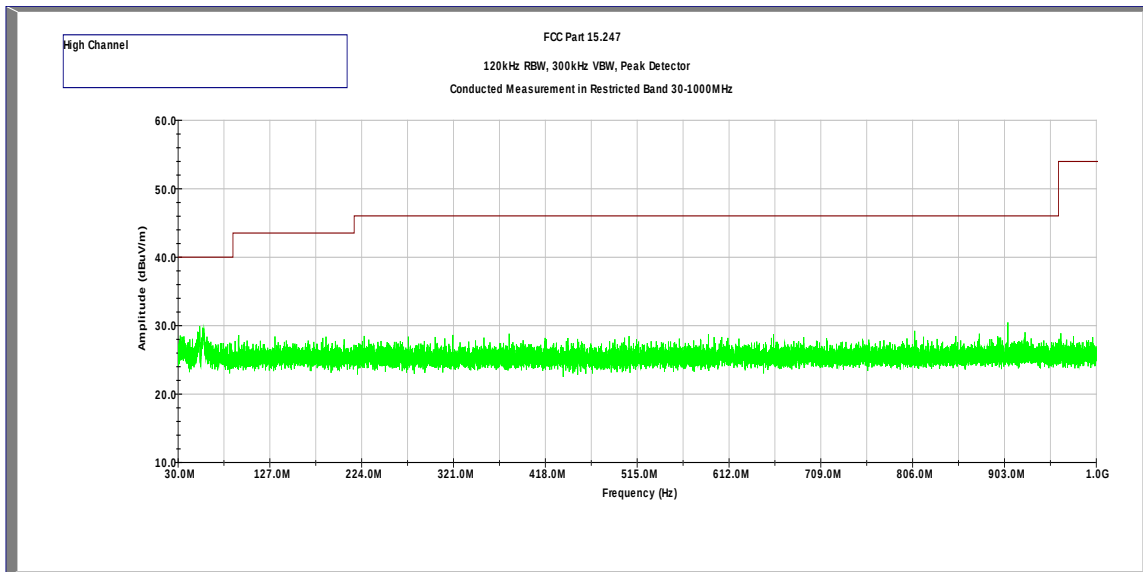


Frequency	Corrected Amplitude	Avg Limit	Margin	Detector	Results
GHz	dBuV/m	dBuV/m	dB		
4.880	43.50	54	-10.50	Peak	Pass

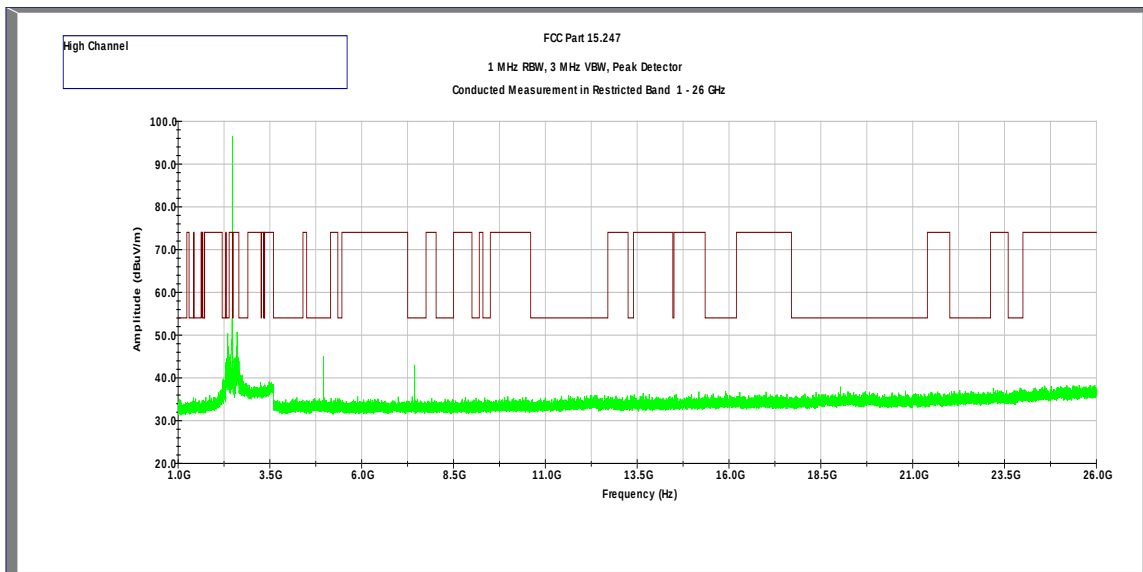
Out-of-Band Conducted Spurious Emissions (at Antenna Port)

Tx @ 2480MHz

Out-of-Band Spurious Emissions at Antenna Port - 30 MHz to 1 GHz



Out-of-Band Spurious Emissions at Antenna Port – 1 - 26 GHz Peak Detector vs Avg Limit



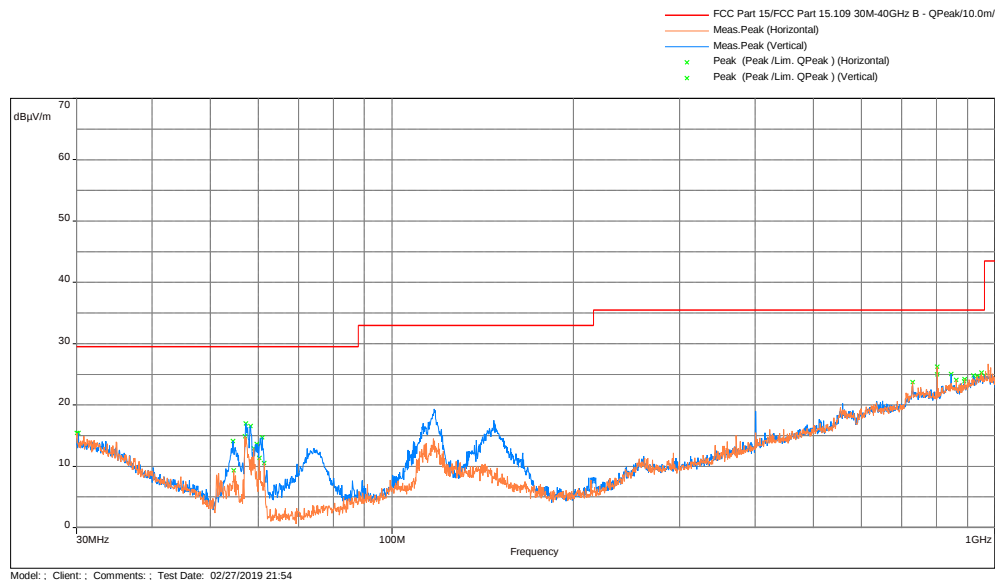
Frequency	Corrected Amplitude	Avg Limit	Margin	Detector	Results
GHz	dBuV/m	dBuV/m	dB		
4.960	45.10	54	-8.90	Peak	Pass

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

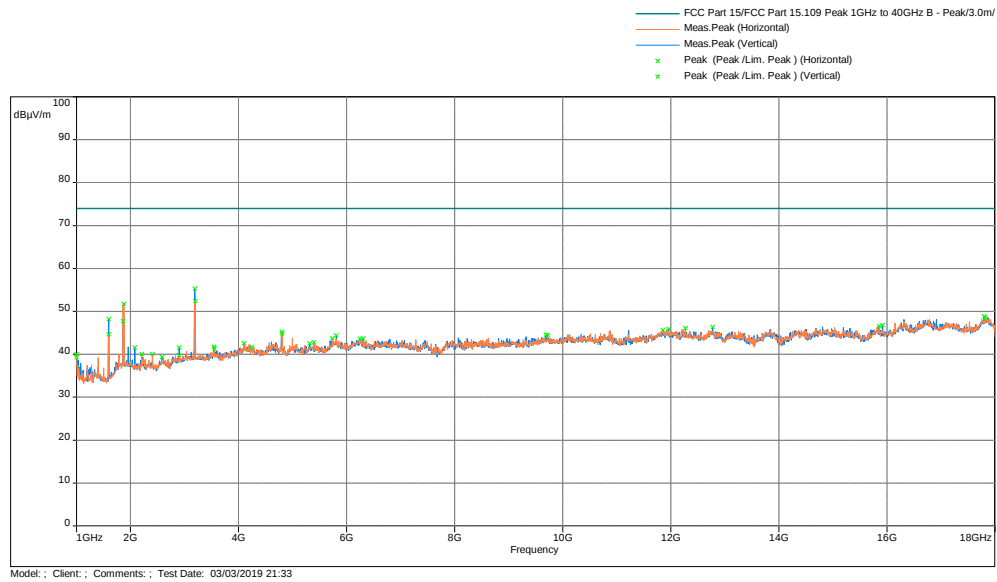
Test Results: 15.209 Radiated Spurious Emissions Low Channel

Tx at 2402MHz

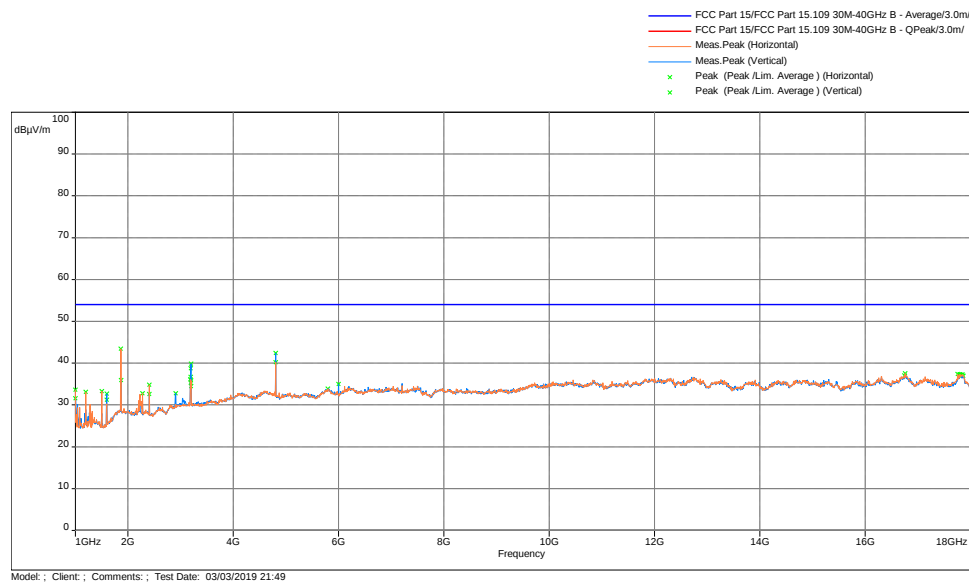
Radiated Spurious Emissions 30 MHz - 1000 MHz



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



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



Frequency	Avg	Lim.	Margin	Height	Angle	Comment	RA	Correction
MHz	dBμV/m	dBμV/m	dB	m	°		dBμV	dB
4804.00	42.41	54	-11.59	2.5	40.75	Vertical	51.55	-9.14

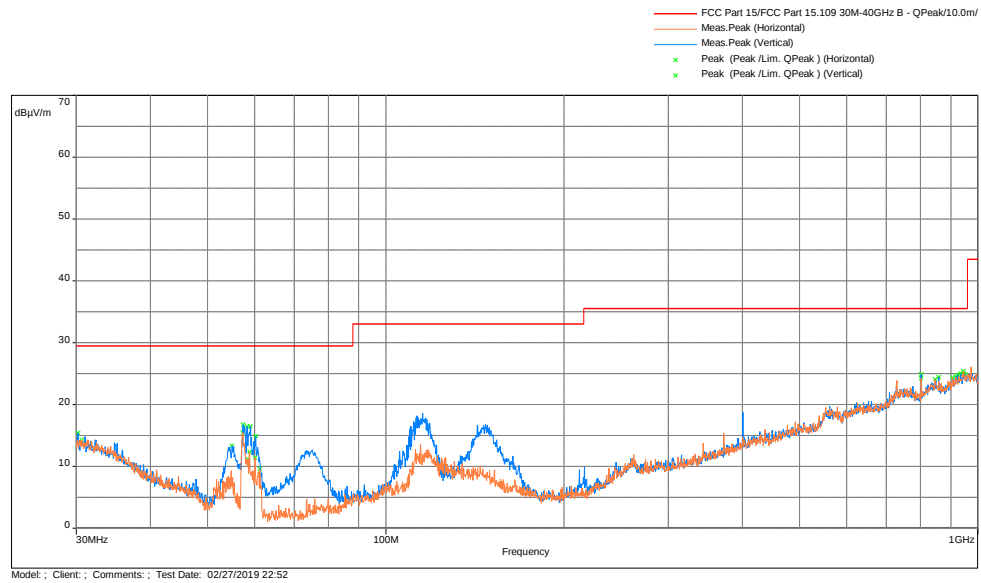
Results

Complies

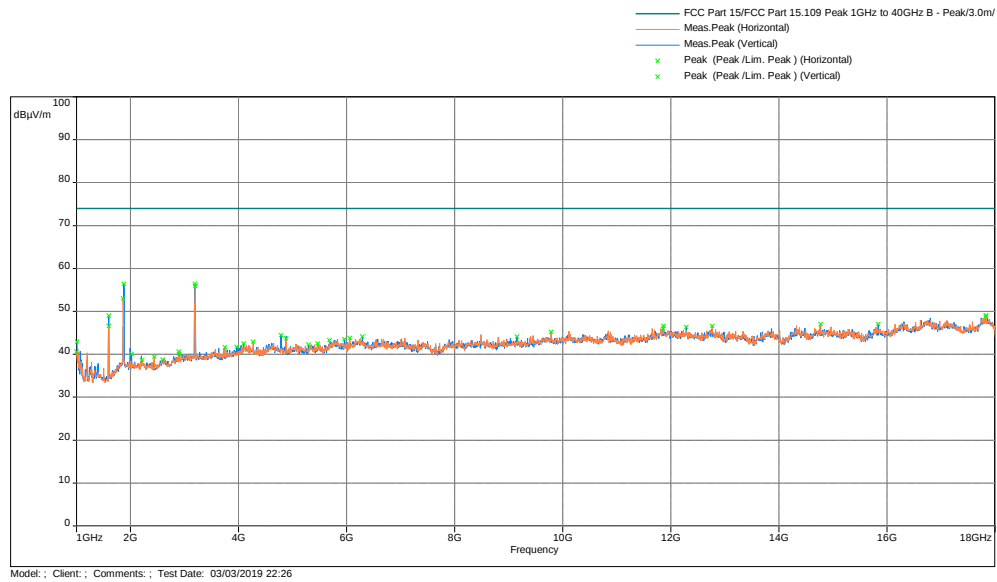
Note: Radiated emission measurements were performed up to 25GHz. No emissions were identified when scanned from 18-25 GHz.

Test Results: 15.209 Radiated Spurious Emissions Mid Channel
Tx at 2426MHz

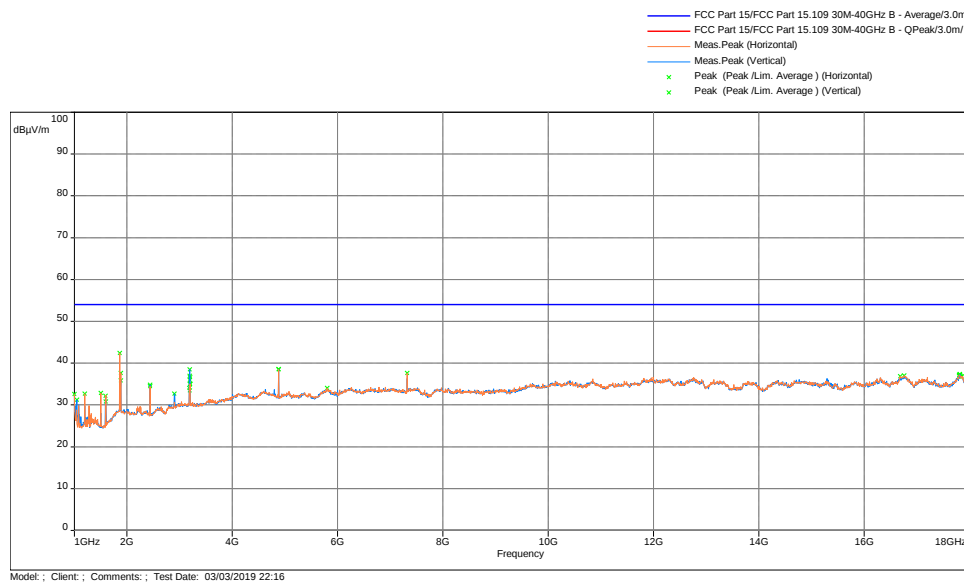
Radiated Spurious Emissions 30 MHz - 1000 MHz



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



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



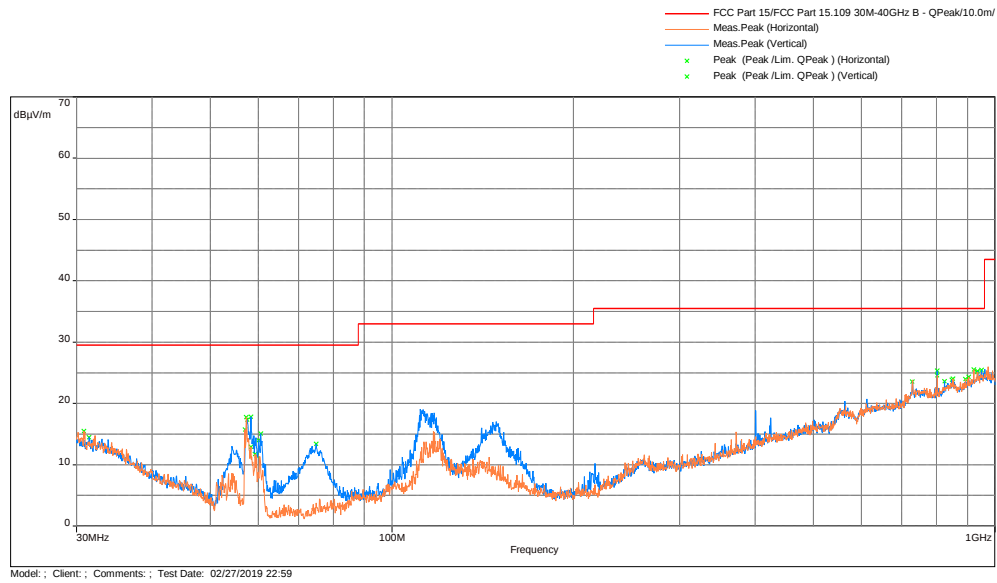
Frequency	Avg	Lim.	Margin	Height	Angle	Comment	RA	Correction
MHz	dBμV/m	dBμV/m	dB	m	°		dBμV	dB
4880.00	38.59	54	-15.41	2.5	43.75	Vertical	48.04	-9.45

Results **Complies**

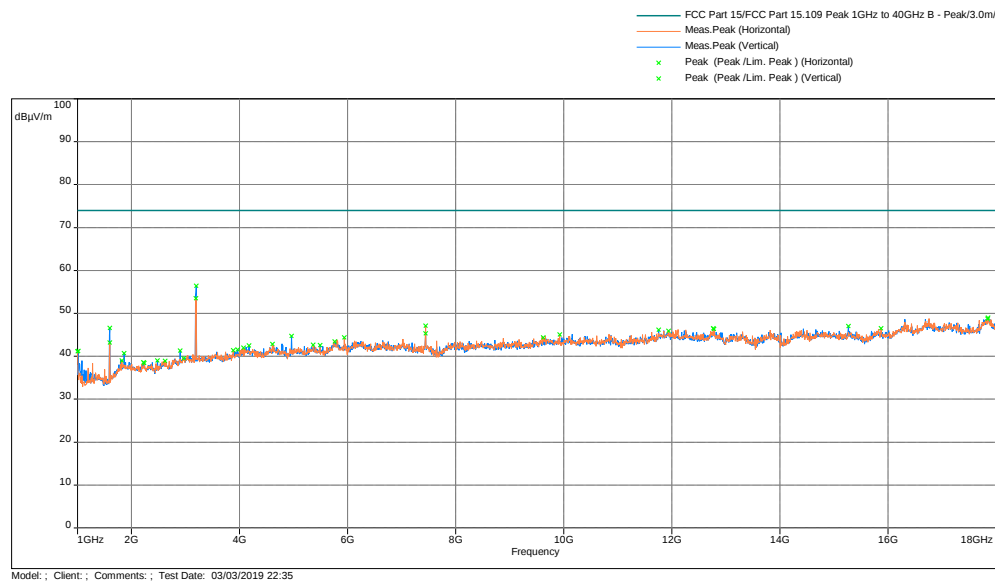
Note: Radiated emission measurements were performed up to 25GHz. No emissions were identified when scanned from 18-25 GHz.

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

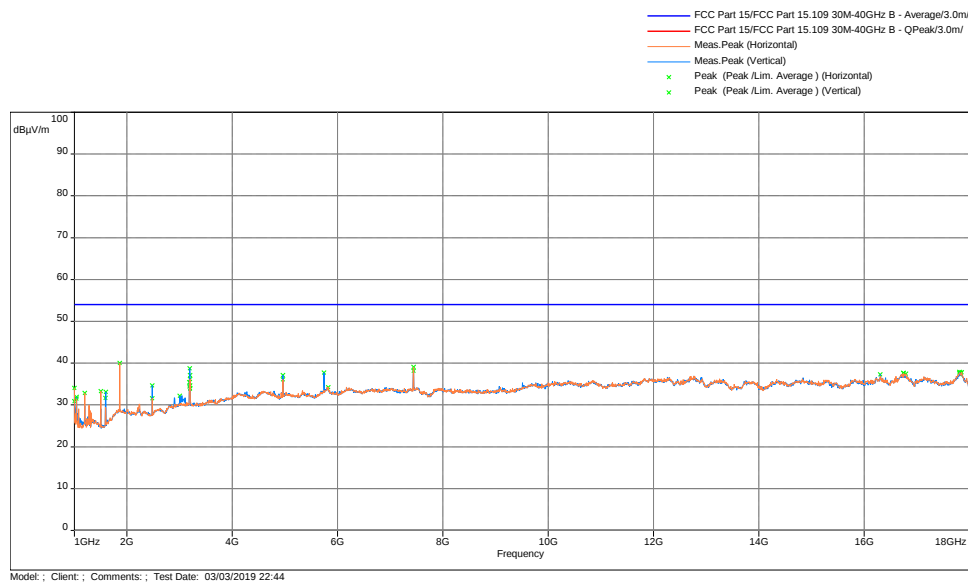
Radiated Spurious Emissions 30 MHz - 1000 MHz



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



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

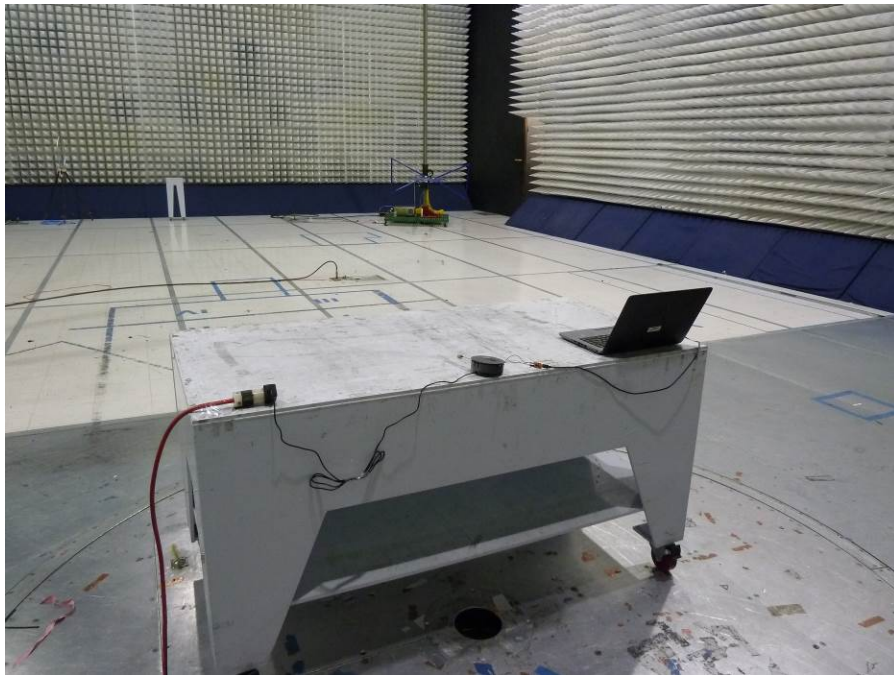
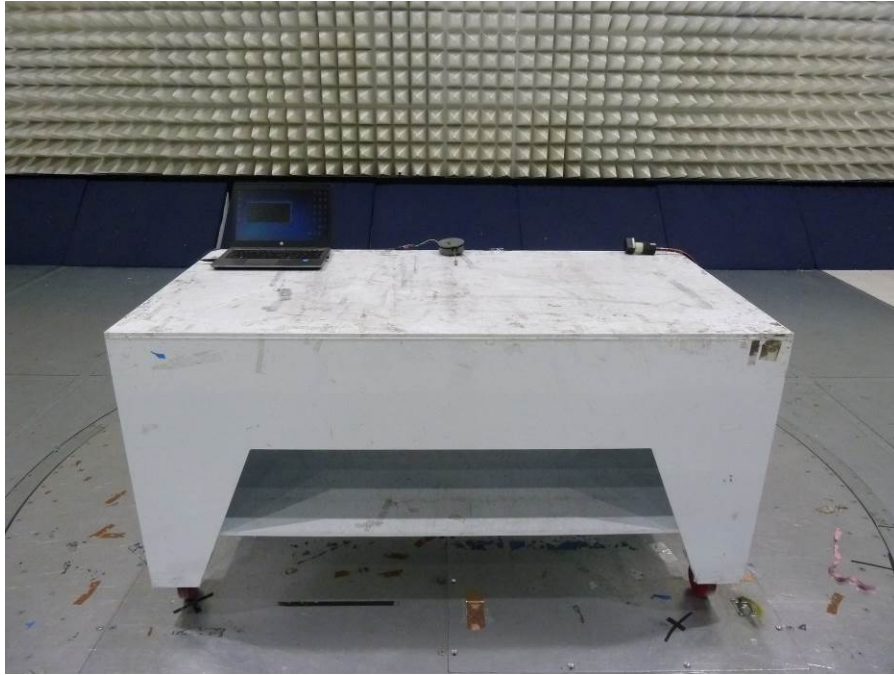


Frequency	Avg	Lim.	Margin	Height	Angle	Comment	RA	Correction
MHz	dBμV/m	dBμV/m	dB	m	°		dBμV	dB
4960.00	37.08	54	-16.92	2.5	269.5	Vertical	46.39	-9.31

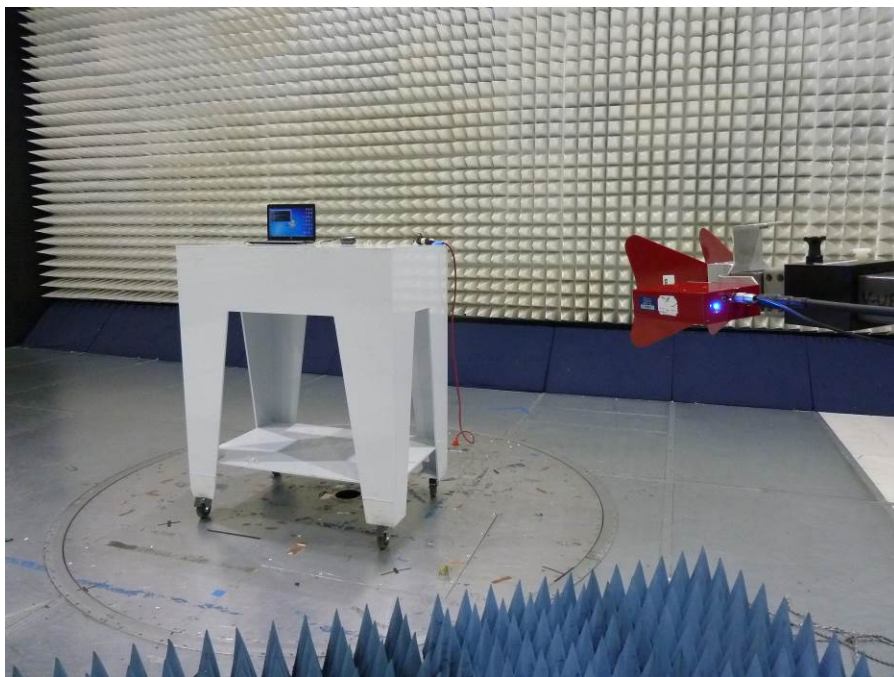
Results **Complies**

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

4.5.7 Test Configuration Photographs



Radiated Emissions Setup Photograph



Radiated Emissions Setup Photograph

4.6 AC Line Conducted Emission
FCC: 15.207; RSS-GEN;

4.6.1 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.*

4.6.2 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.

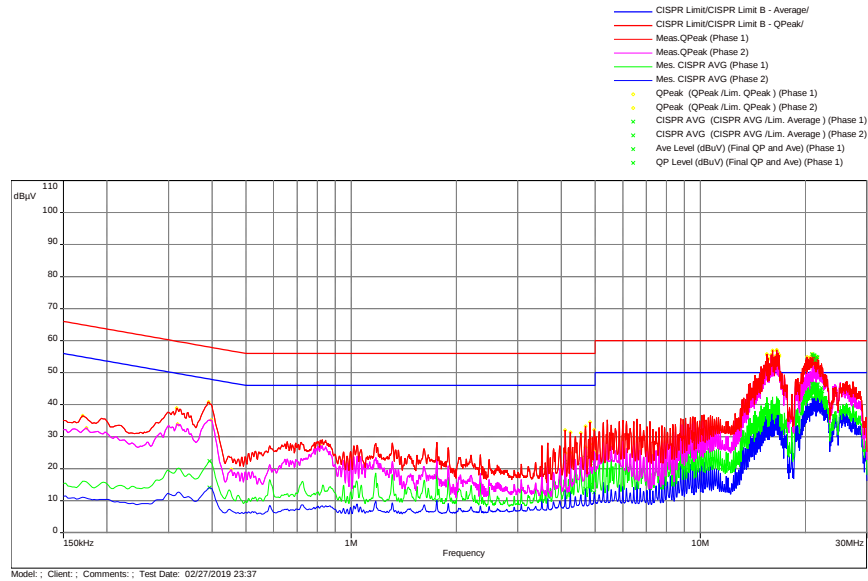
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

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

Tested By	Test Date
Aaron Chang	February 27, 2019

4.6.3 Test Results

FCC Part 15.207 Conducted Disturbances, 120V 60Hz

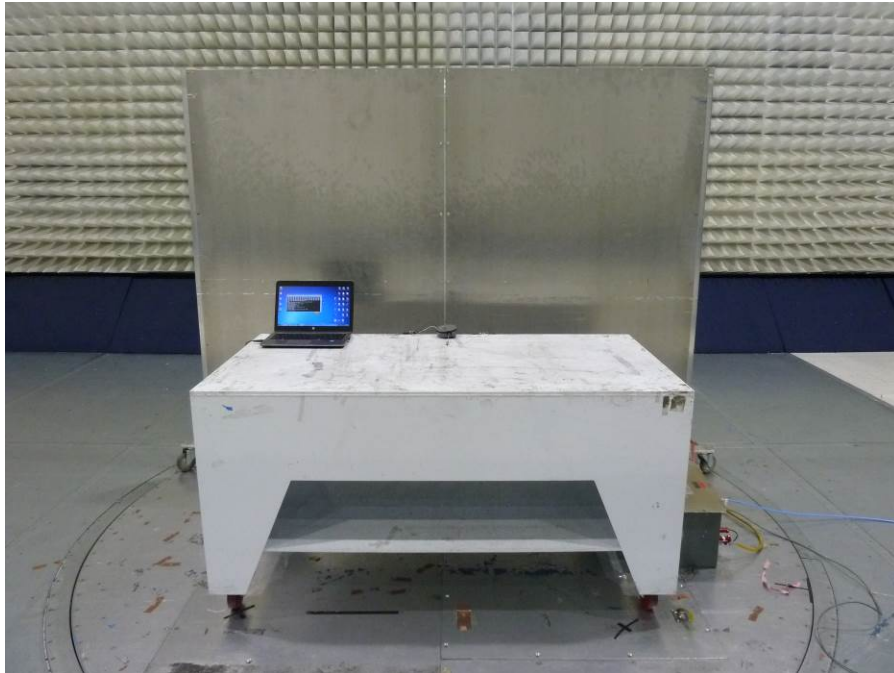


Frequency MHz	Ave Level dBμV	QP Level dBμV	Ave Limit dBμV	QP Limit dBμV	Ave Margin dB	QP Margin dB	Line	Correction dB
20.937	46.5	55.71	50	60	-3.5	-4.29	Phase 1	12.14
21.086	46.33	55.45	50	60	-3.67	-4.55	Phase 1	12.14
21.233	46.35	55.3	50	60	-3.65	-4.7	Phase 1	12.14
21.365	44.83	53.89	50	60	-5.17	-6.11	Phase 1	12.14
21.514	46.16	54.93	50	60	-3.84	-5.07	Phase 1	12.14
21.655	46.01	54.71	50	60	-3.99	-5.29	Phase 1	12.15

Results: **Complies** by 3.5 dB at 120V 60Hz

4.6.4 Test Configuration Photographs

The following photographs show the testing configurations used.



AC Mains Line-Conducted Disturbance Setup Photograph



AC Mains Line-Conducted Disturbance Setup Photograph

5.0 List of Test Equipment

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

Equipment	Manufacturer	Model/Type	Asset No.	Calibration Interval	Cal Due
Spectrum Analyzer	Rohde and Schwarz	ESU	ITS 00961	12	10/26/19
Pyramidal Horn Antenna	EMCO	3160-09	ITS 00571	#	#
Pre-Amplifier (18-40GHz)	Miteq	TTA1840-35-S-M	ITS 01393	12	02/08/20
Active Horn Antenna	ETS-Lindgren	3117-PA	ITS 01636	12	01/17/20
EMI Receiver	Rohde and Schwarz	ESR	ITS 01607	12	10/23/19
BI-Log Antenna	Teseq	CBL 6111D	ITS 01058	12	09/20/19
Pre-Amplifier	Sonoma Instrument	310N	ITS 00415	12	03/03/19
Pre-Amplifier	Com-Power	PAM-103	ITS 01644	12	02/19/20
Notch Filter	Micro-Tronics	BRM50702	ITS 01166	12	03/10/19
RF Cable	Megaphase	EMC1-K1K1-236	ITS 01538	12	06/25/19
RF Cable	Megaphase	TM40-K1K1-59	ITS 01657	12	06/26/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01320	12	12/06/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01465	12	08/16/19
RF Cable	TRU Corporation	TRU CORE 300	ITS 01470	12	08/16/19
Transient Limiter	COM-POWER	LIT-153A	ITS 01452	12	06/21/19
LISN	FCC	FCC-LISN-50-50-M-H	ITS 00552	12	12/07/19

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	Emissions 02-27-2019.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 / G103592127	AC	KV	March 11, 2019	Original document

END OF REPORT