TEST REPORT

Report Number: 102028516MPK-001
Project Number: G102028516
June 22, 2015

Testing performed on
BB-8 App-Enabled Droid
Model: R001
FCC ID: SXO-RAV1
IC: 10016A-RAV1
to

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

For

Orbotix, Inc. dba Sphero

Test Performed by:	Test Authorized by:
Intertek	Orbotix, Inc. dba Sphero
1365 Adams Court	4772 Walnut Street, Suite 206
Menlo Park, CA 94025 USA	Boulder, CO 80301 USA

Prepared by: _____ **Date:** June 22, 2015
Anderson Soungpanya

Reviewed by: _____ **Date:** June 22, 2015
Krishna K Vemuri

Report No. 102028516MPK-001

Equipment Under Test:	BB-8 App-Enabled Droid
Trade Name:	sphero
Model Number:	R001
Serial Numbers:	EP-138 (Radiated Sample) EP-149 (Conducted Sample)
Applicant:	Orbotix, Inc. dba Sphero
Contact:	Gerald Wallner
Address:	Orbotix, Inc. dba Sphero 4772 Walnut Street, Suite 206 Boulder, CO 80301
Country	USA
Tel. Number:	(720) 340-2310
Email:	gerald@sphero.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247 Issue 1 FCC Part 15, Subpart B Industry Canada ICES-003
Date of Test:	June 1 – June 5, 2015

We attest to the accuracy of this report:

Anderson Soungpanya
Project Engineer

Krishna K Vemuri
EMC Senior Staff Engineer

TABLE OF CONTENTS

1.0 Summary of Tests

Test	Reference FCC	Reference Industry Canada	Result
Radiated Emissions	15.109	ICES-003	Complies
AC Line Conducted Emission	15.107	ICES-003	Complies
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: May 18, 2015
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: June 01, 2015
Test completion date: June 05, 2015
The test results in this report pertain only to the item tested.

2.0 General Information

2.1 Product Description

The BB-8 App-Enabled Droid is an app-controlled robot that works with iOS & Android devices. The unit is battery powered and it charged using a wireless inductive cradle.

Information about the 2.4 GHz radio is presented below:

Applicant	Orbotix, Inc. dba Sphero
Model No.	R001
FCC Identifier	SXO-RAV1
IC Identifier	10016A-RAV1
Type of transmission	Digital Transmission System (DTS)
Rated RF Output	9.55 dBm (9.02 mW)
Frequency Range	2402 – 2480 MHz
Type of modulation/data rate	GFSK 1Mb
Number of Channel(s)	40
Antenna(s) & Gain	Internal antenna, Gain: -2 dBi
Applicant Name & Address	Orbotix, Inc. dba Sphero 4772 Walnut Street, Suite 206 Boulder, CO 80301 USA

2.2 Related Submittal(s) Grants

None.

2.3 Test Facility

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

2.4 Test Methodology

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

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	-
Radiated emissions	4.2 dB	3.4 dB	4.4 dB
AC mains conducted emissions	2.4 dB	-	-

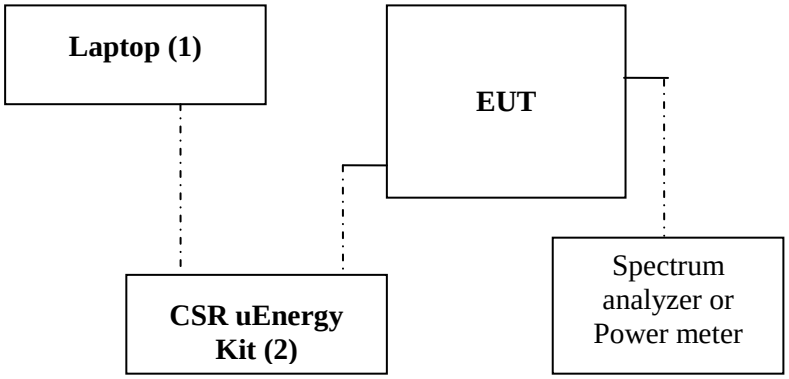
3.0 System Test Configuration

3.1 Support Equipment

Item #	Description	Model No./ Part No.	Serial No.
1	HP Laptop	EliteBook 2540P	CND11130WY
2	CSR uEnergy Development Kit	CSR1010	297518
3	EXTECH, DC Power Supply	Extech	EP-3003
4	iPod	Apple	5th Generation

3.2 Block Diagram of Test Setup

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



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

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT is programmed to transmit full power.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was provided by Orbotix, Inc. dba Sphero.

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

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

3.6 Additions, Deviations and Exclusions from Standards

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

4.0 Measurement Results

4.1 6-dB Bandwidth and Occupied Bandwidth
FCC Rule: 15.247(a)(2); RSS-247, 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 v03r02 June 5, 2014 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.

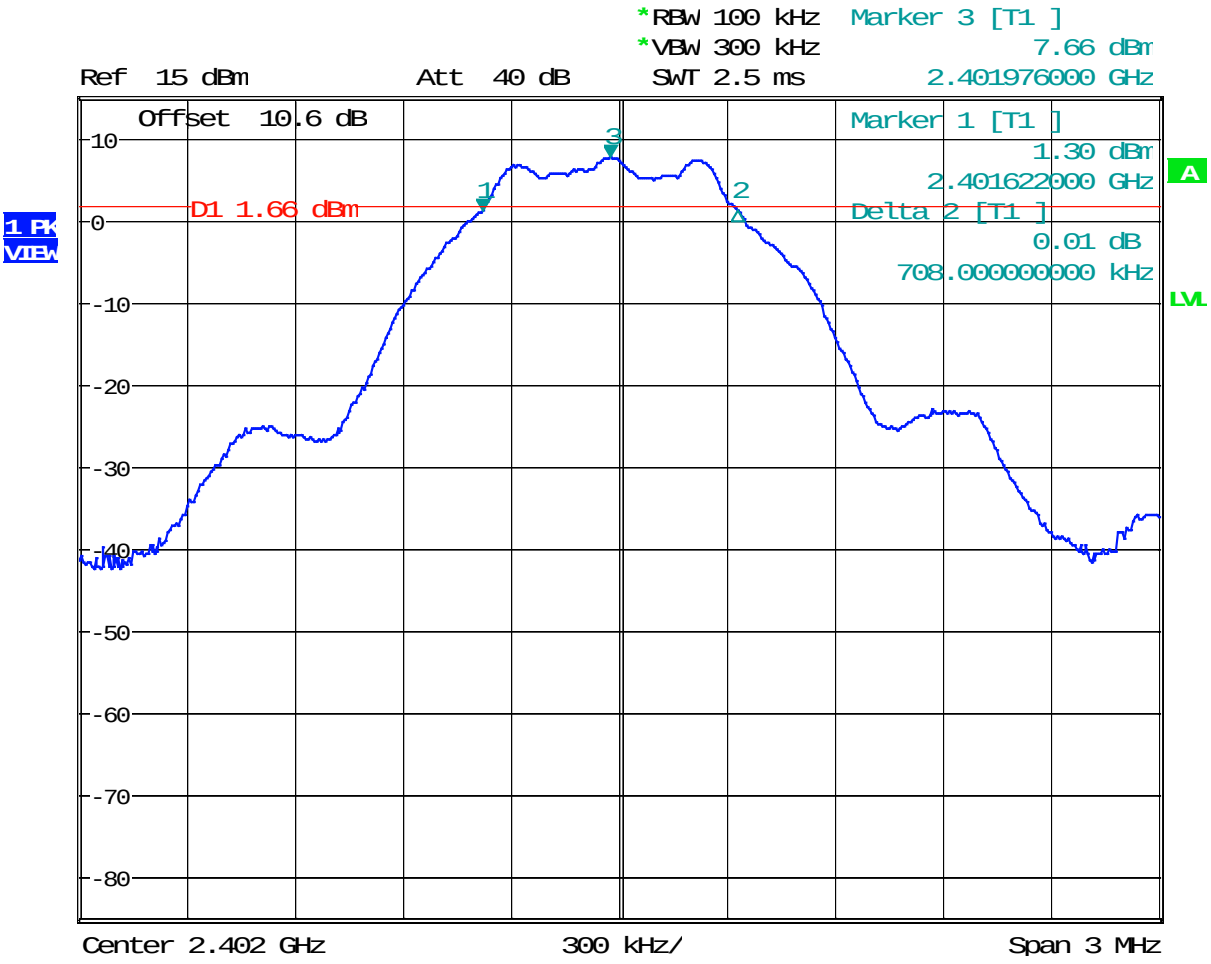
For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer. The resolution bandwidth is set to 1% of the selected span as is without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

4.1.3 Test Result

Frequency (MHz)	6-dB bandwidth FCC 15.247 & RSS-GEN, MHz	Occupied bandwidth, RSS-GEN, MHz	Plot
2402	0.708	--	1.1
	--	1.040	1.4
2442	0.708	--	1.2
	--	1.032	1.5
2480	0.708	--	1.3
	--	1.032	1.6

Date of Test:	June 2, 2015
Results	**Complies**

Plot 1. 1



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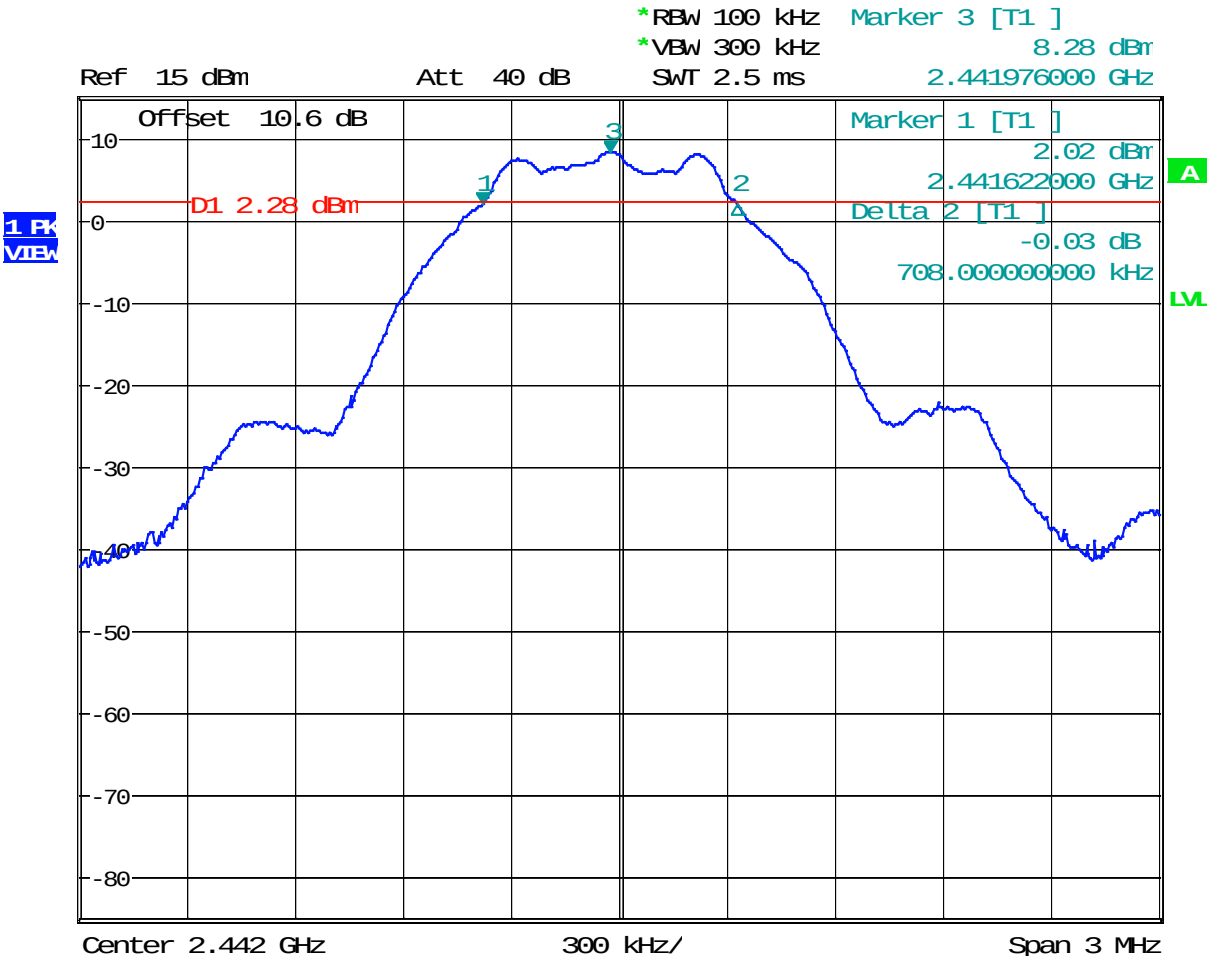
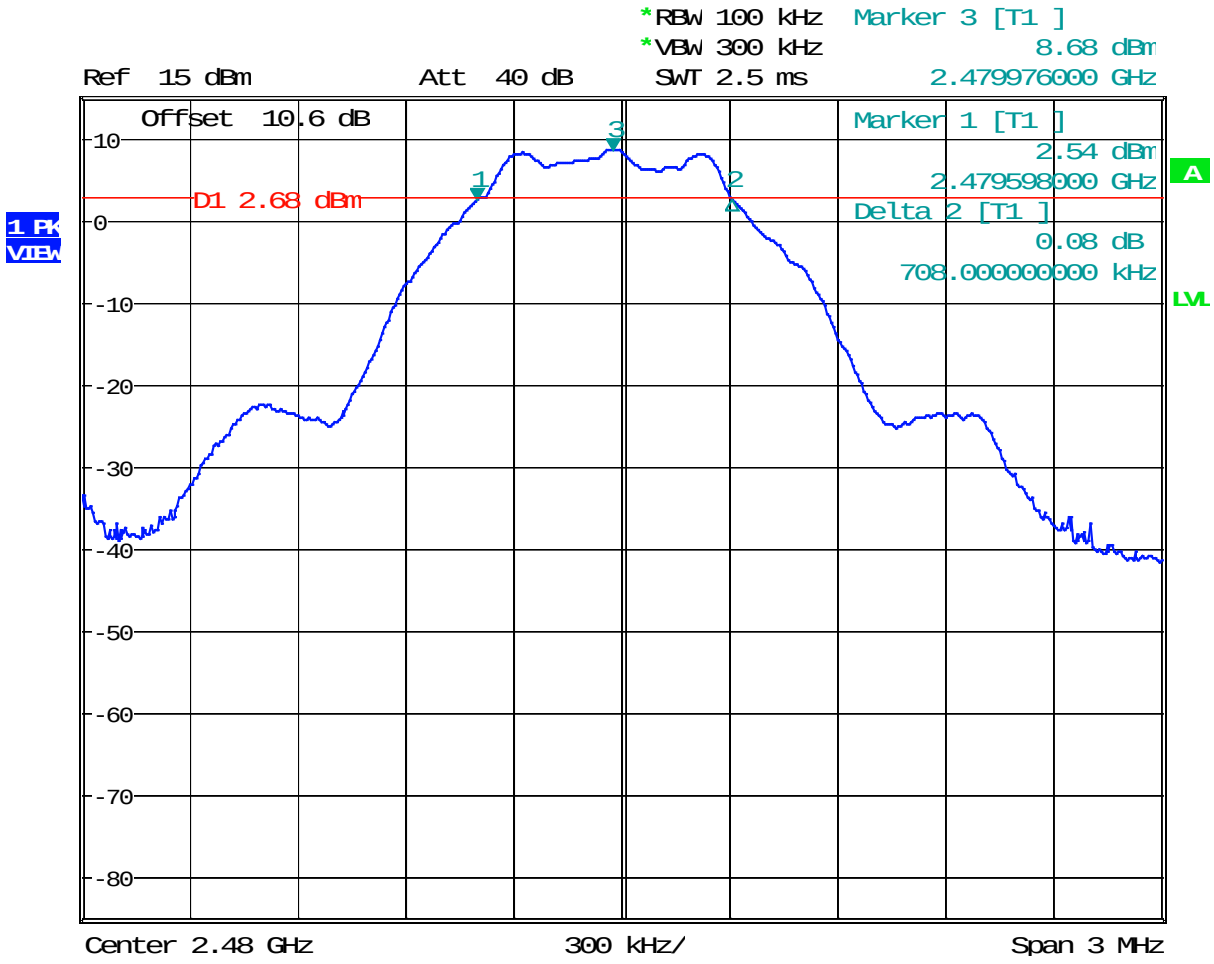
Plot 1. 2



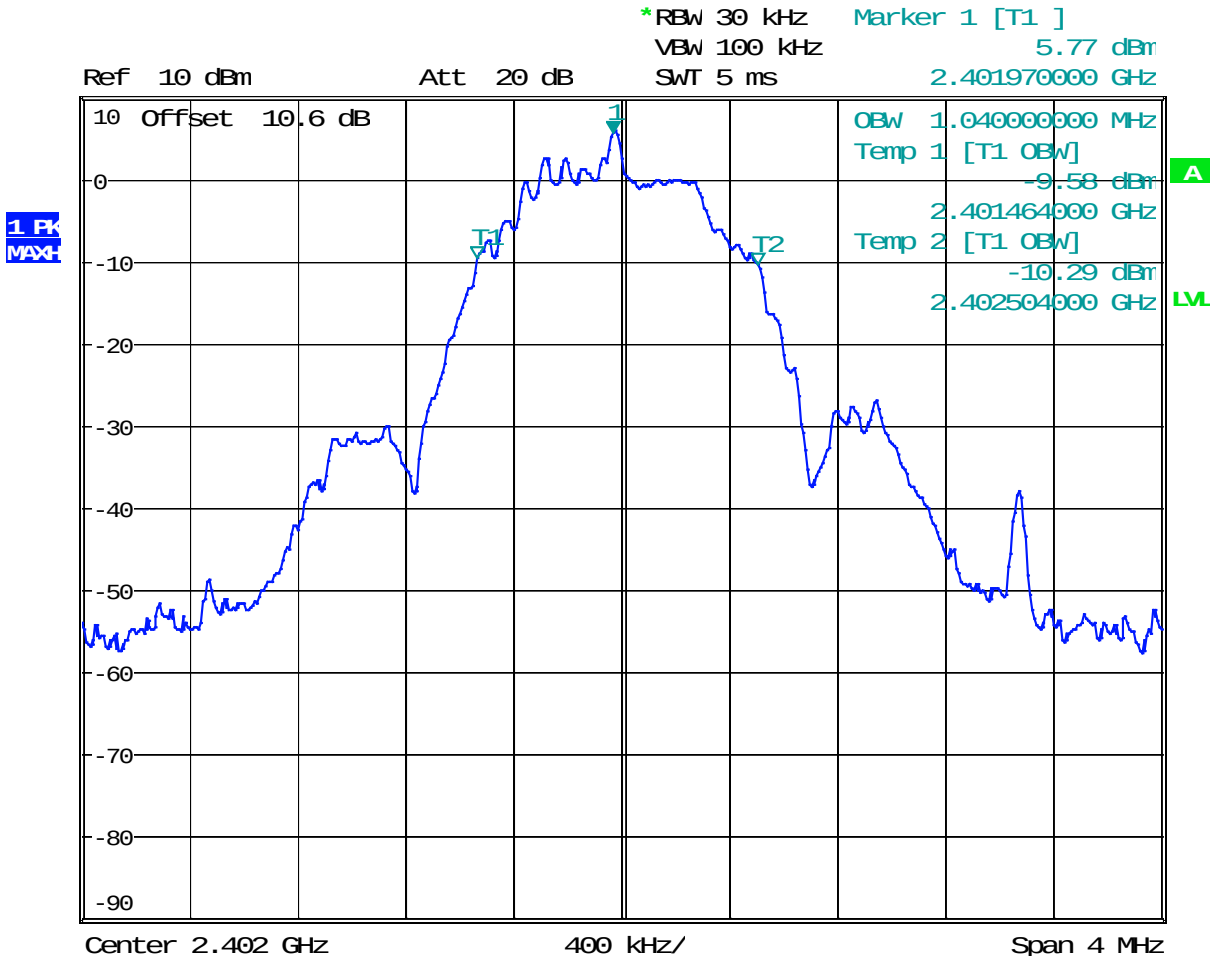
Date: 2.JUN.2015 12:27:19

Plot 1. 3



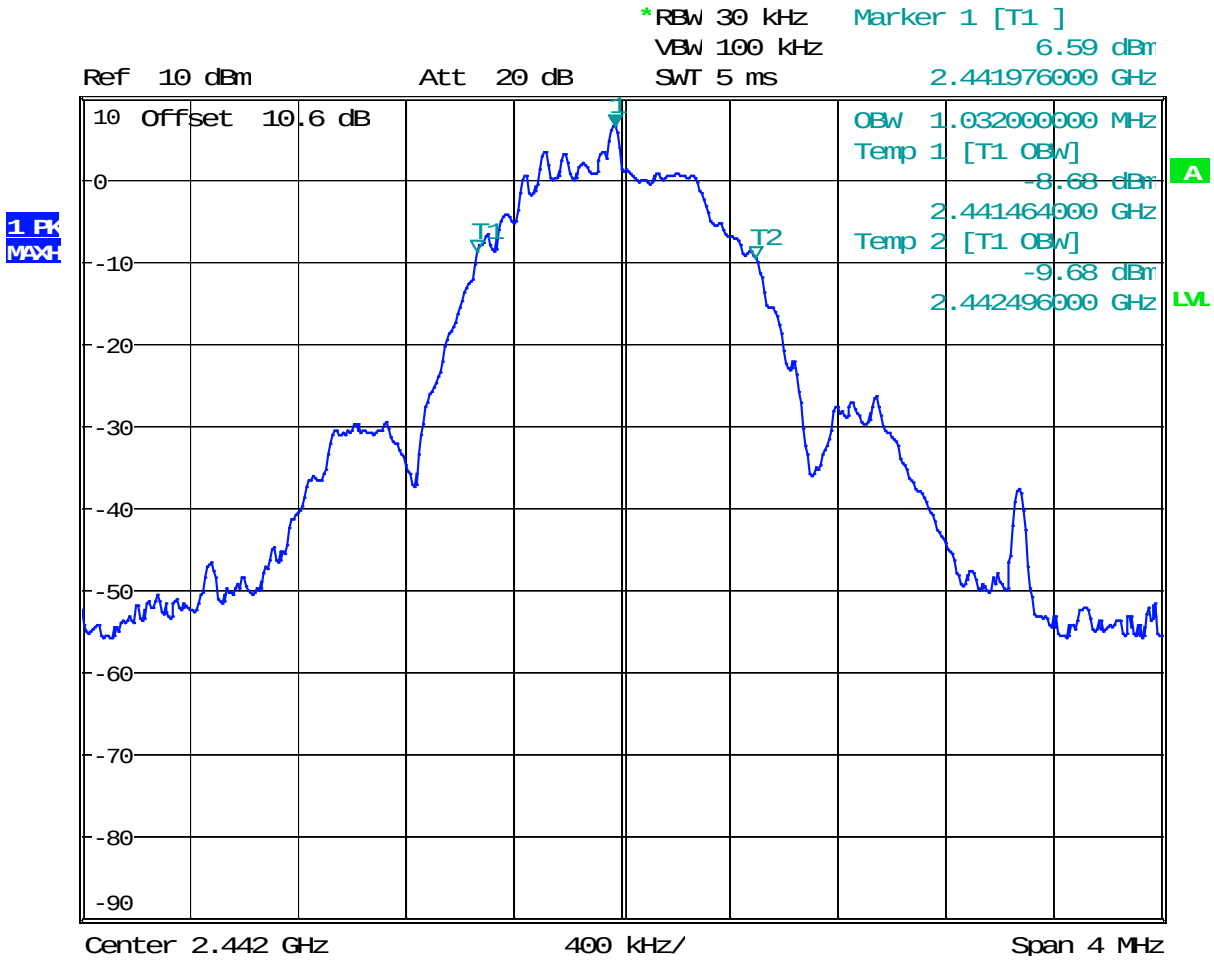
Date: 2.JUN.2015 12:25:07

Plot 1. 4



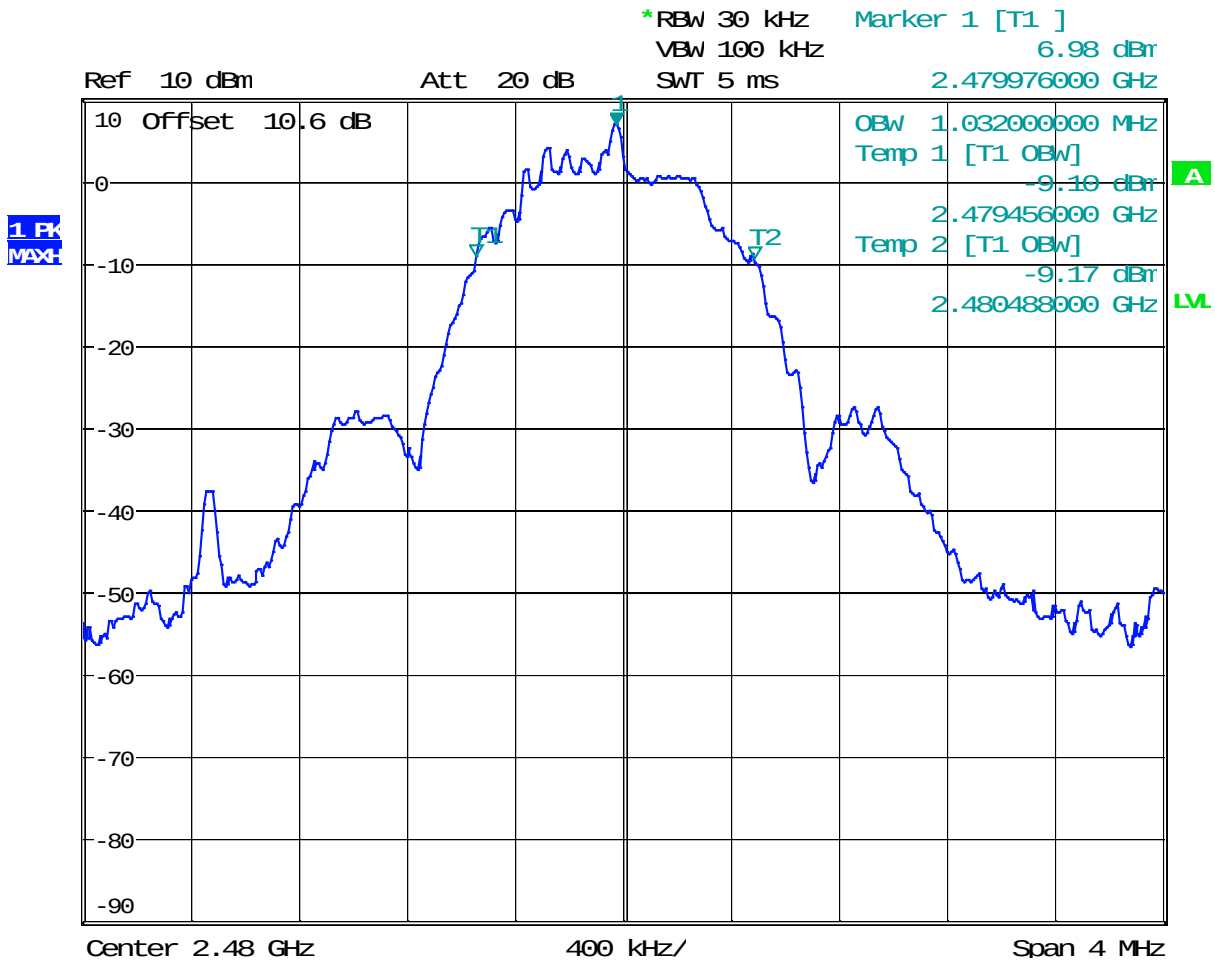
Date: 2.JUN.2015 12:52:22

Plot 1.5



Date: 2.JUN.2015 12:53:13

Plot 1.6



Date: 2.JUN.2015 12:53:57

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 v03r02 June 5, 2014 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.

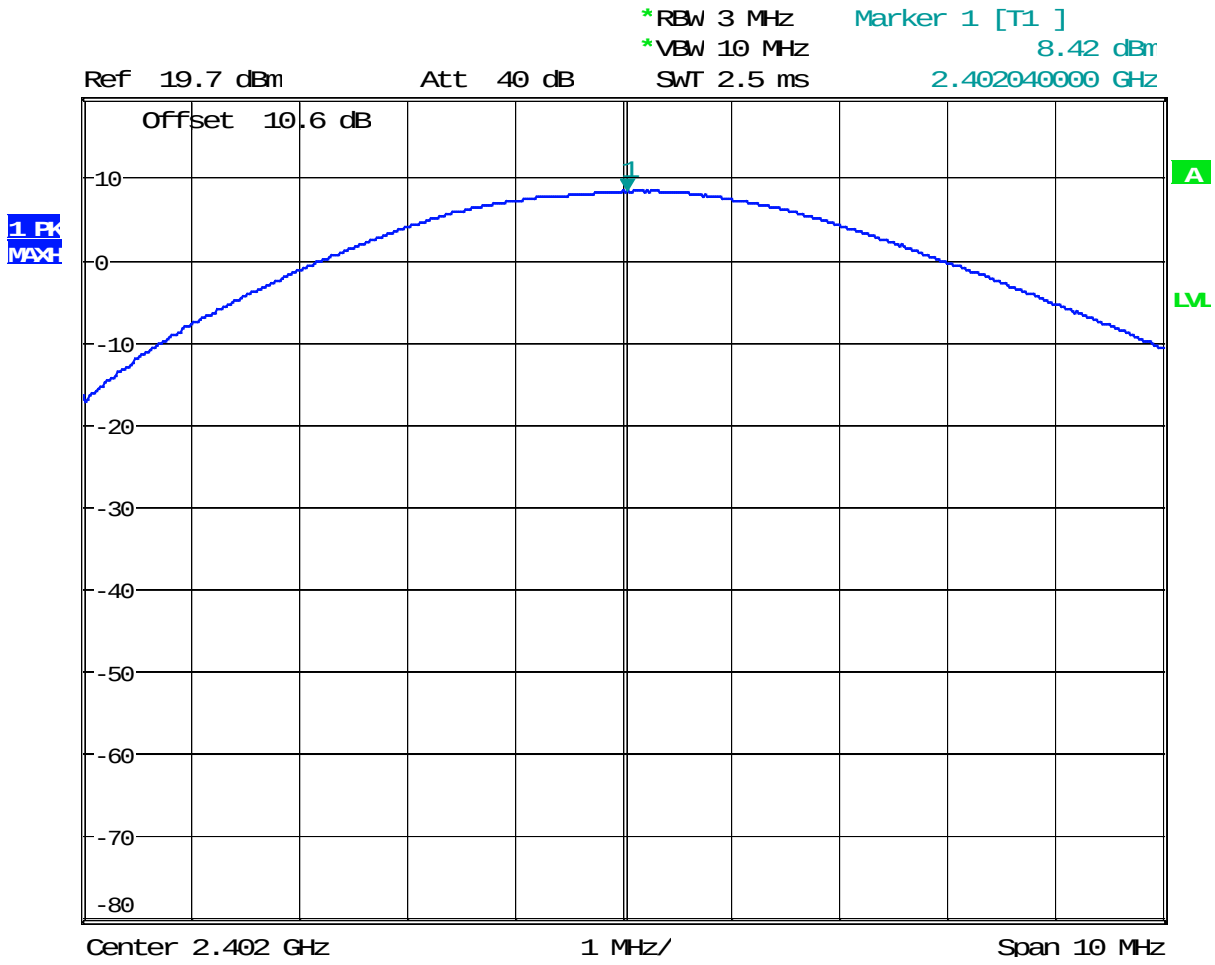
4.3.3 Test Result

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

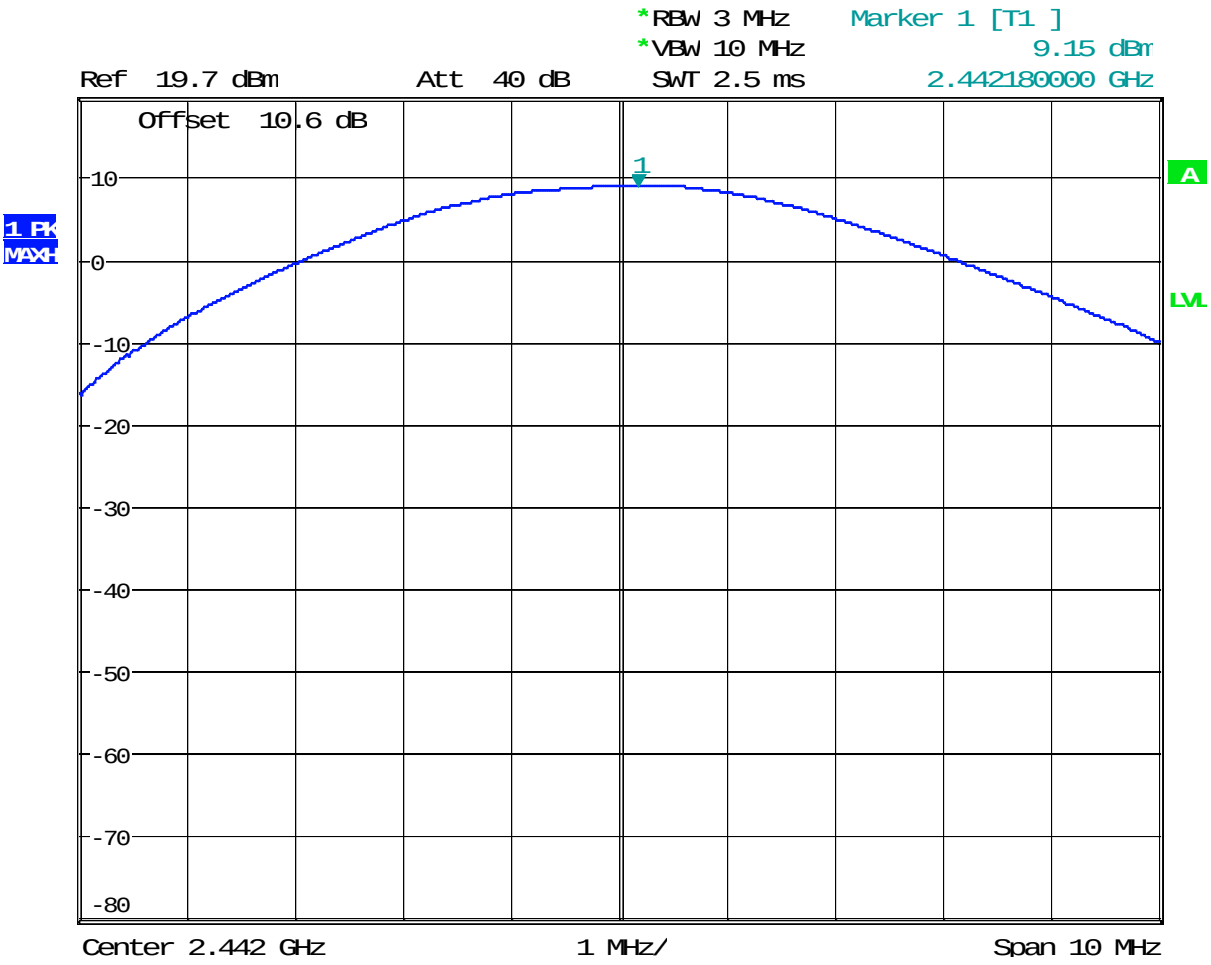
Frequency, MHz	Conducted Power (peak), dBm	Conducted Power (peak), mW	Plot
2402	8.42	6.950	2.1
2442	9.15	8.222	2.2
2480	9.55	9.016	2.3

Date of Test:	June 2, 2015
Results	**Complies**

Plot 2. 1

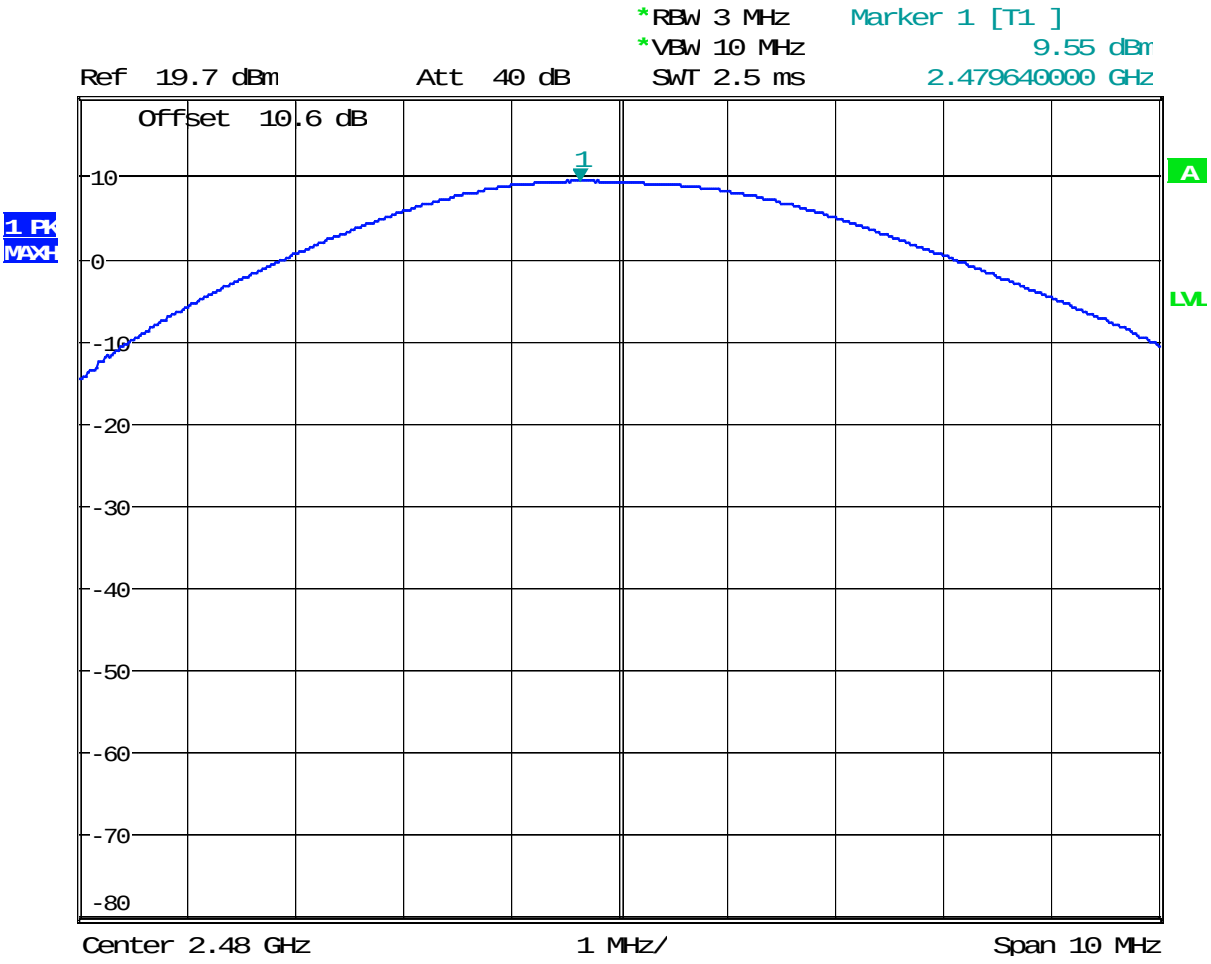

*RBW 3 MHz
*VBW 10 MHz
Marker 1 [T1]
8.42 dBm
2.402040000 GHz
Ref 19.7 dBm
Att 40 dB
SWT 2.5 ms
Offset 10.6 dB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
A
LVL
Center 2.402 GHz
1 MHz/
Span 10 MHz
Date: 2.JUN.2015 11:46:23

Plot 2. 2



Date: 2.JUN.2015 12:12:57

Plot 2. 3


*RBW 3 MHz
*VBW 10 MHz
Marker 1 [T1]
9.55 dBm
Ref 19.7 dBm
Att 40 dB
SWT 2.5 ms
2.479640000 GHz
Offset 10.6 dB
1
10
0
-10
-20
-30
-40
-50
-60
-70
-80
A
LVL
Center 2.48 GHz
1 MHz/
Span 10 MHz
Date: 2.JUN.2015 12:13:37

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 v03r02 June 5, 2014, 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.

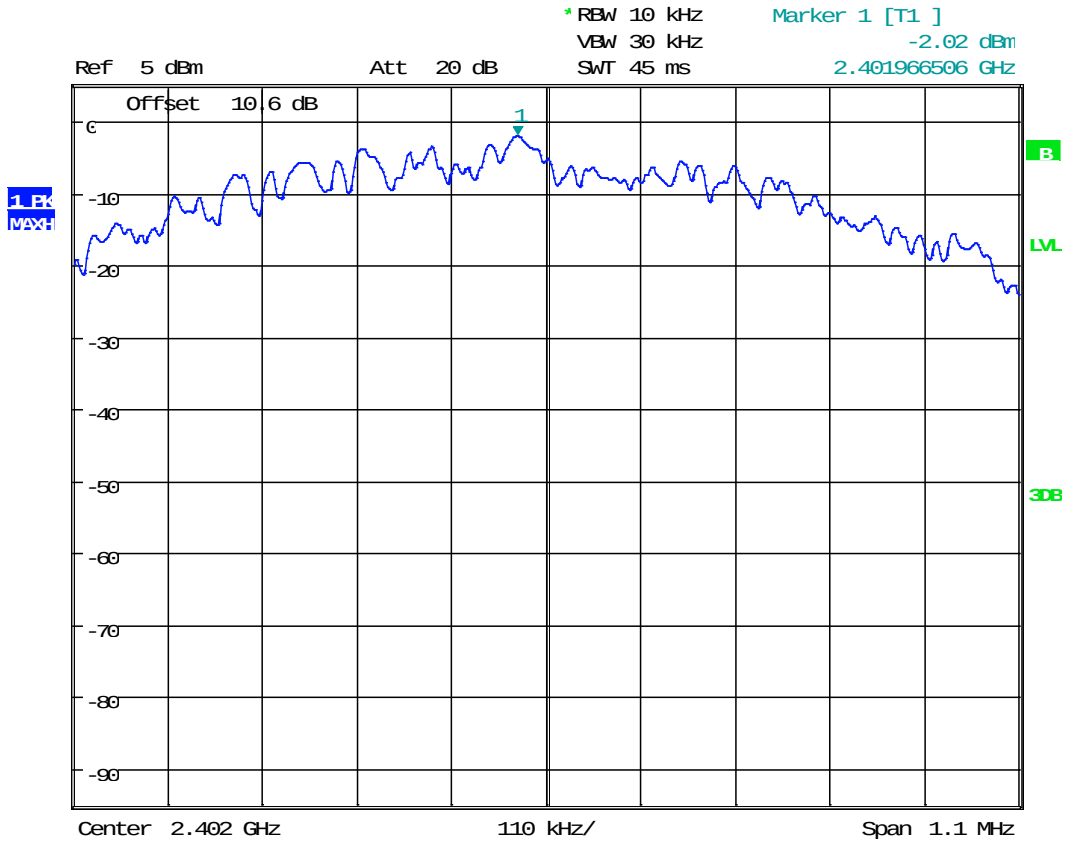
4.3.3 Test Result

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
2402	-2.02	8.0	-9.77	3.1
2442	-1.53	8.0	-8.92	3.2
2480	-1.01	8.0	-8.75	3.3

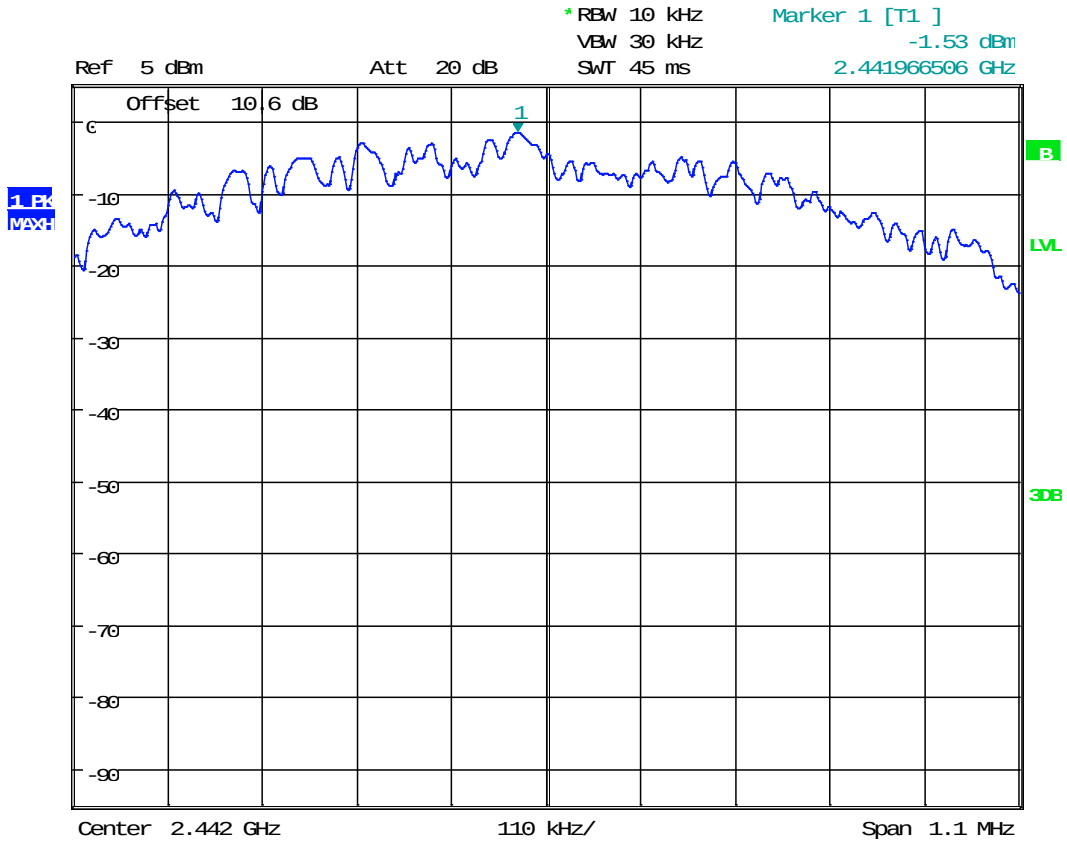
Date of Test:	June 3, 2015
Results	**Complies**

Plot 3. 1



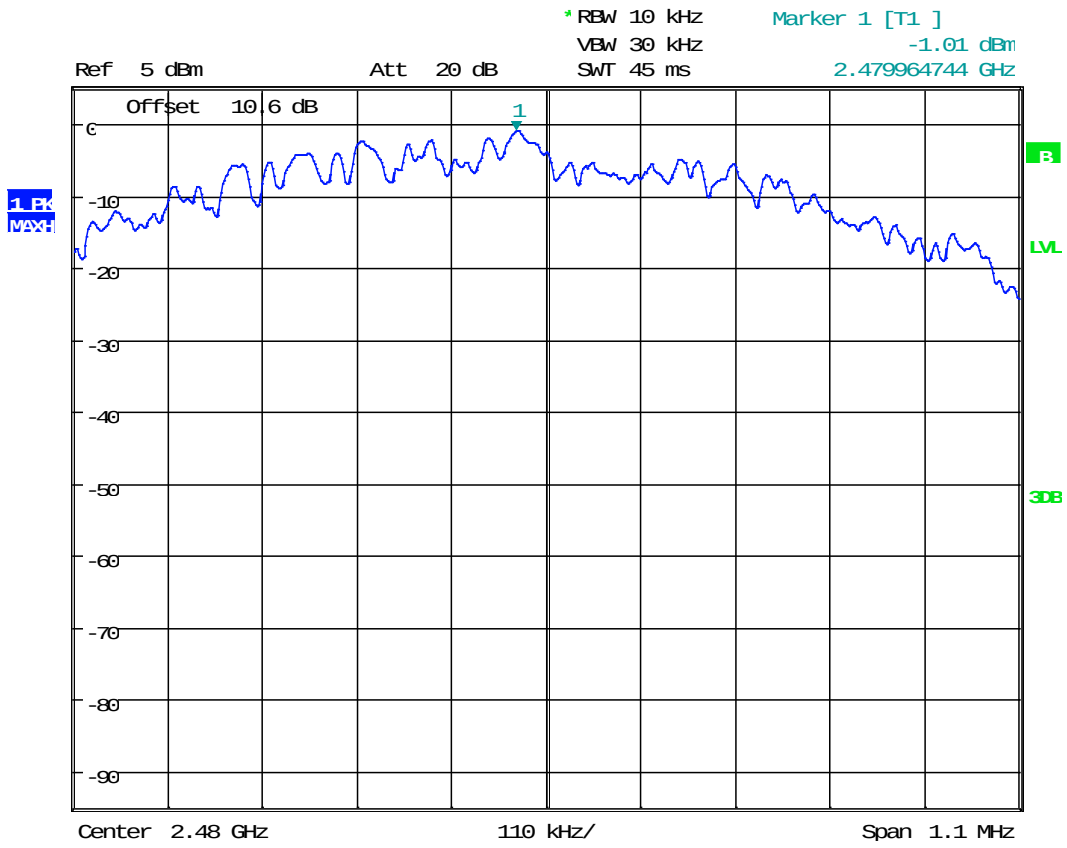
Date: 3.JUN.2015 07:12:13

Plot 3. 2



Date: 3.JUN.2015 07:13:11

Plot 3. 3



Date: 3.JUN.2015 07:14:06

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 v03r02 June 5, 2014, 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.

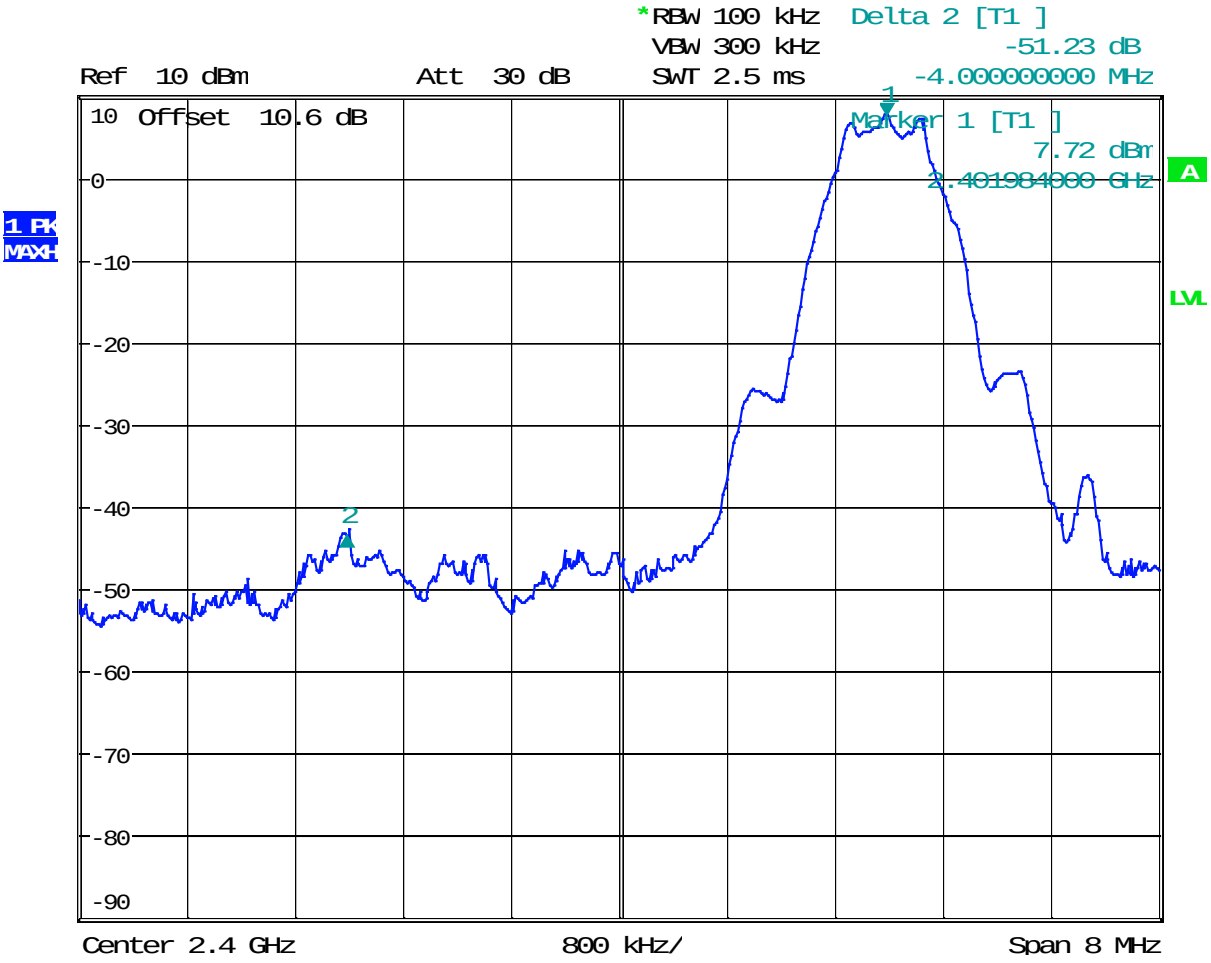
The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits.

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.

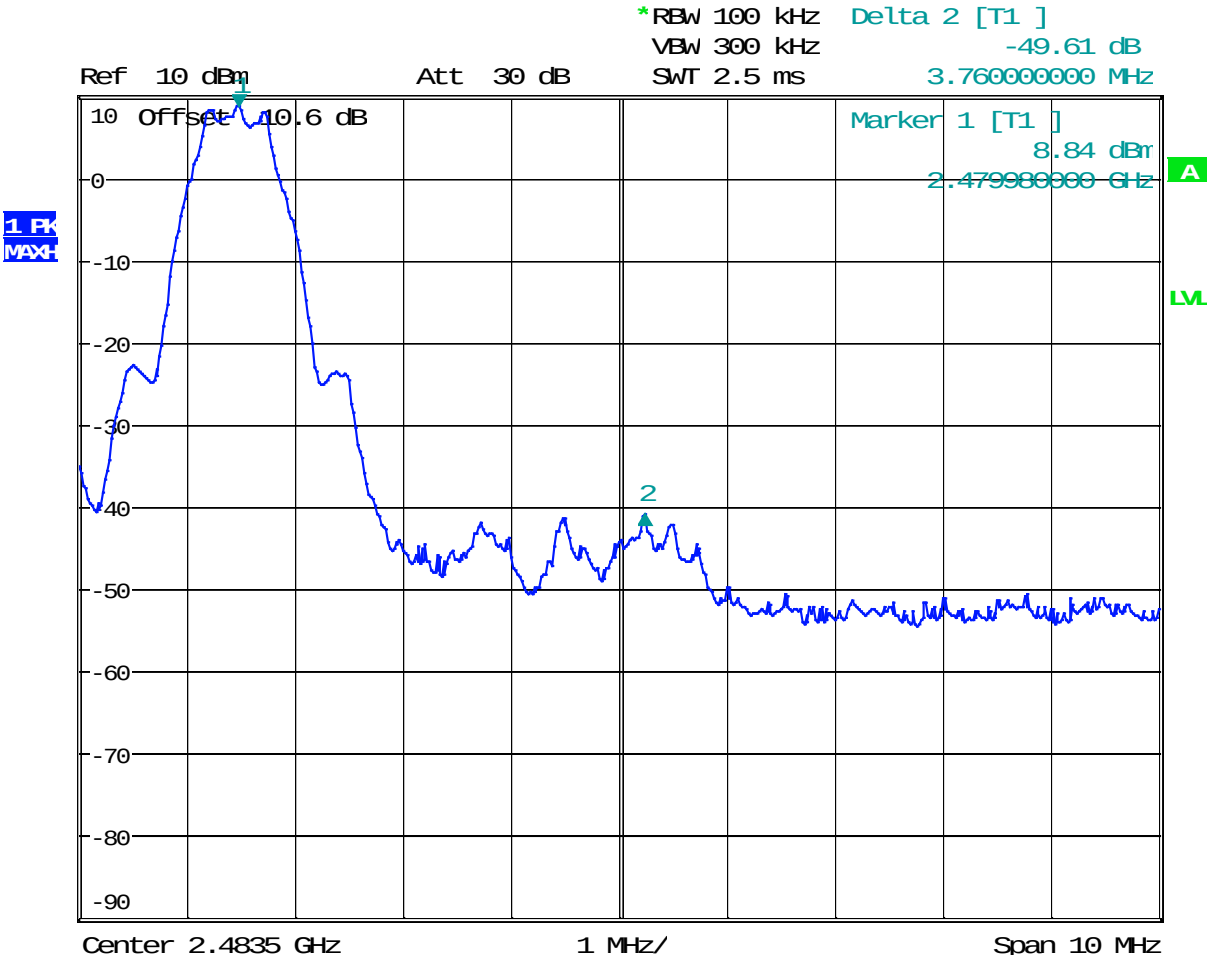
Date of Test:	June 2, 2015
Results	**Complies**

Tx @ Low Channel, 2400 MHz Band Edge
Plot 4.1

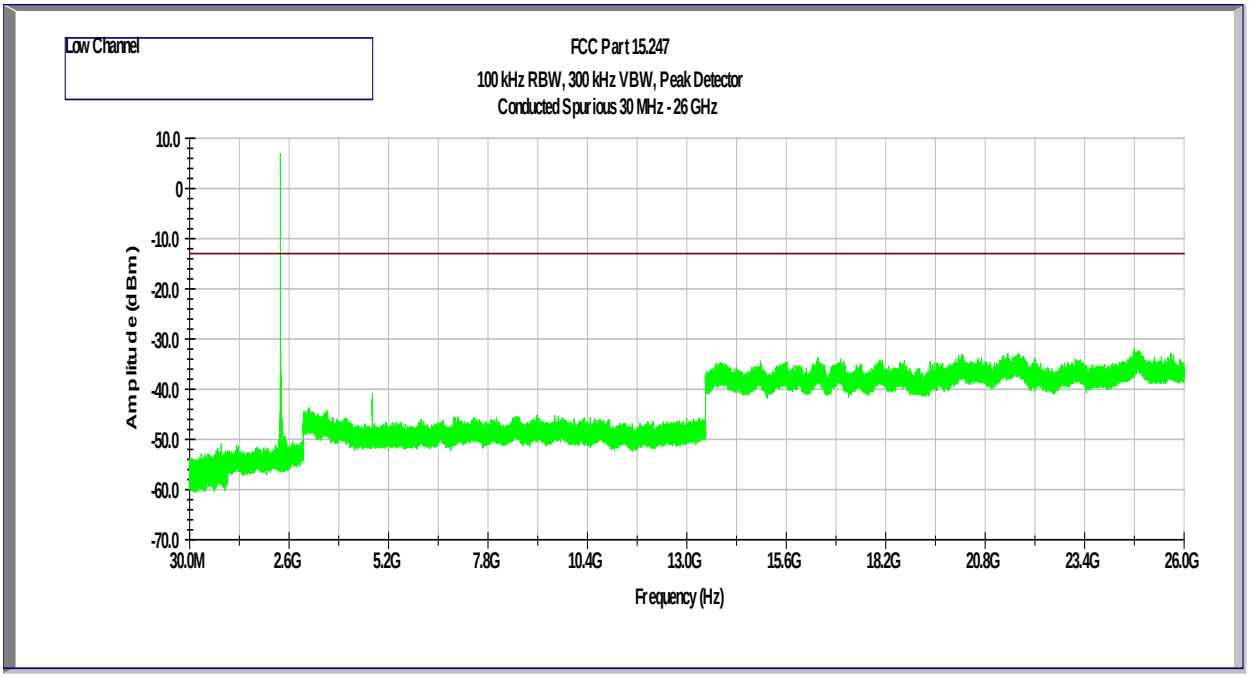


Date: 2.JUN.2015 13:04:50

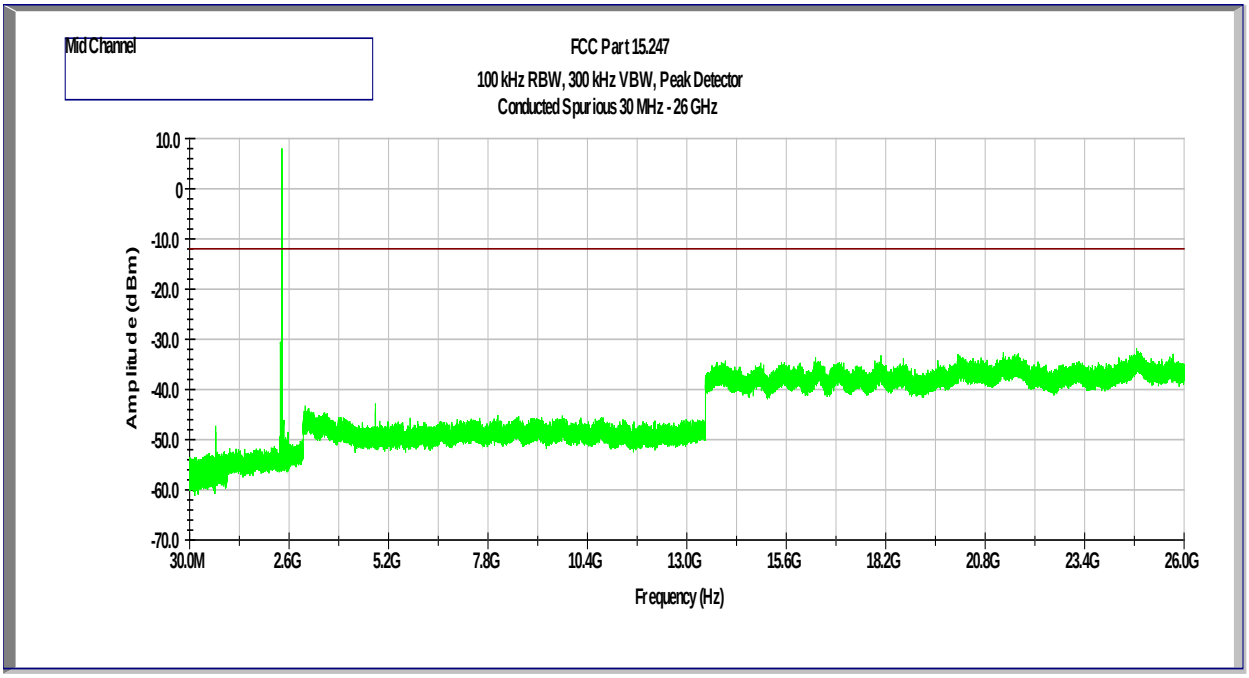
Tx @ Low Channel, 2483.5 MHz Band Edge
Plot 4.2



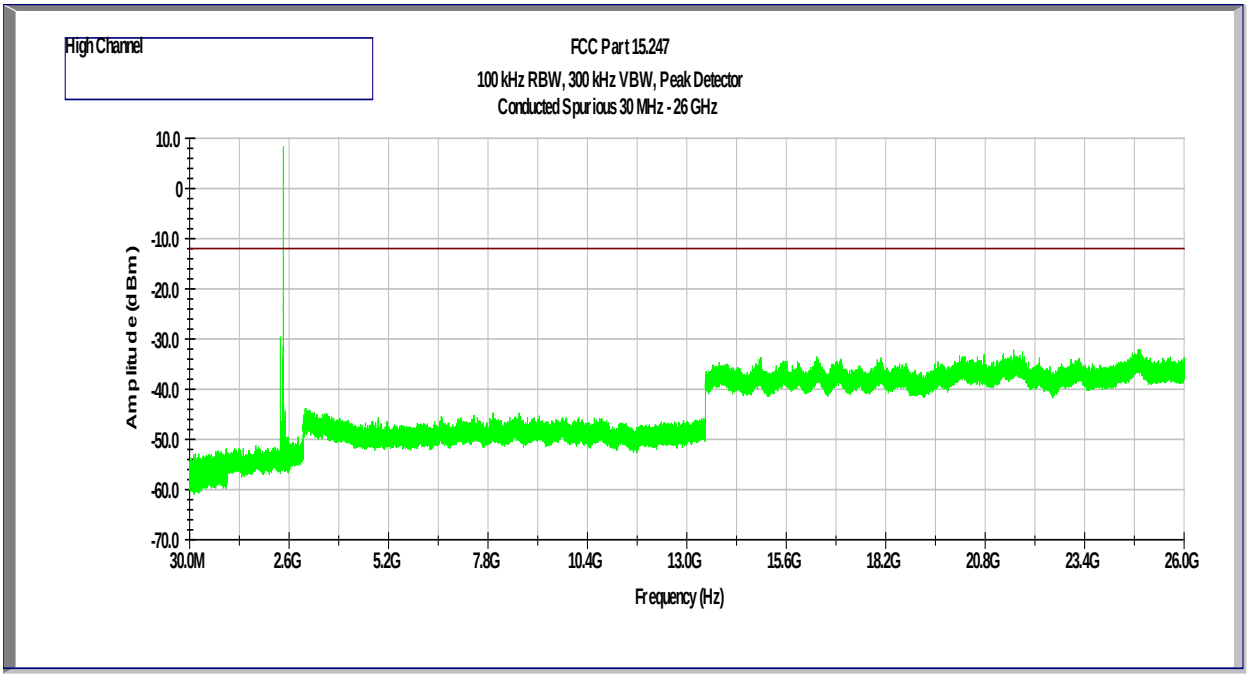
Tx @ Low Channel, 2402 MHz
30MHz -26GHz Conducted Spurious
Plot 4.3



Tx @ Mid Channel, 2442 MHz
30MHz -26GHz Conducted Spurious
Plot 4.5



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 comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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).

4.5.2 Procedure

Radiated emission measurements were performed from 30 MHz to 25 GHz according to the procedure described in ANSI C64.10. 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 1GHz scans & 1.5m for measurements made 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.

Guidance for Performing Compliance Measurements on DTS Operating under §15.247 refers to ANSI C63.10. In sec. 7.5 of ANSI C63.10 the procedure for determining the average value of pulsed emissions is described.
Following this procedure, the Peak Field Strength (FS_{peak}) is measured and the Duty Cycle Correction Factor (δ) is applied. The Duty Cycle is defined as transmitter time-on (t) in T=100 ms interval.

$$\delta = t/T \text{ or in decibels } \delta(dB) = 20 \text{ Log } \delta$$
$$FS_{average} \text{ [in dB}(\mu V/m)] = FS_{peak} \text{ [in dB}(\mu V/m)] + \delta(dB)$$

Unless other wises specified in test results below, radiated emissions are taken at 10 meters for frequencies below 1 GHz and at 3 meters for frequencies above 1 GHz.

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

4.5.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – AG; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV); AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μV) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m).
Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m.

4.5.4 Test Results

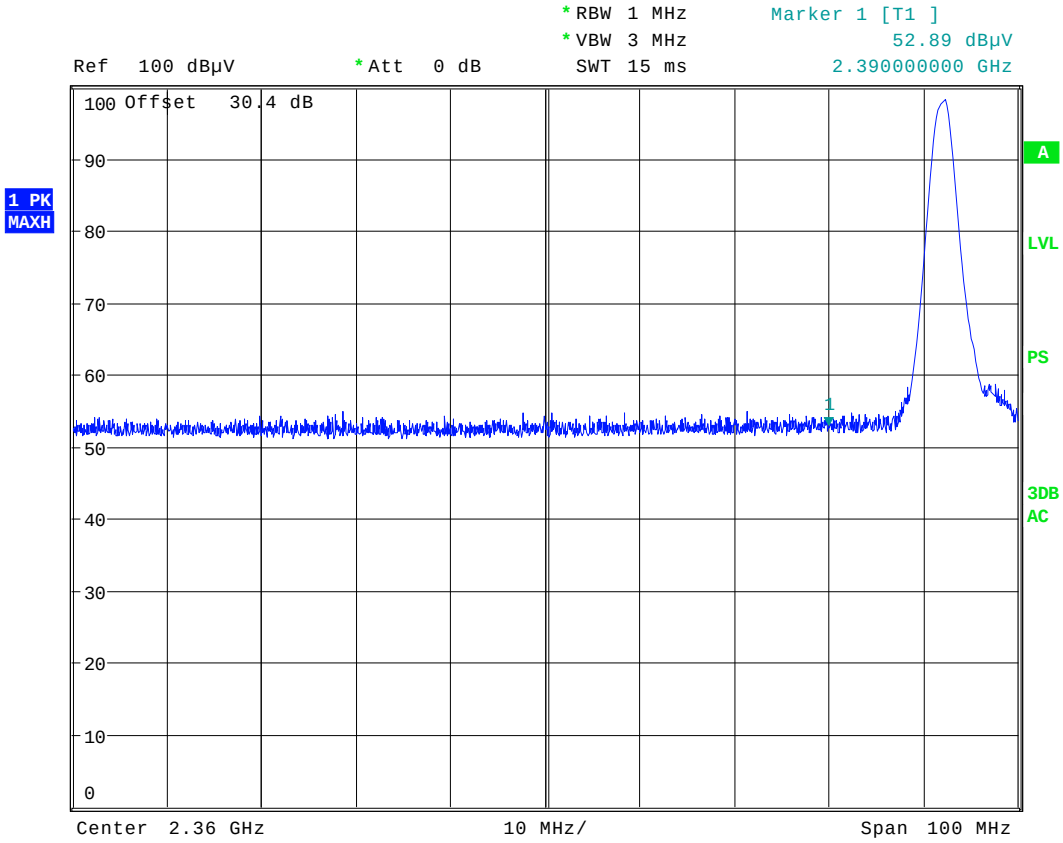
The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

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

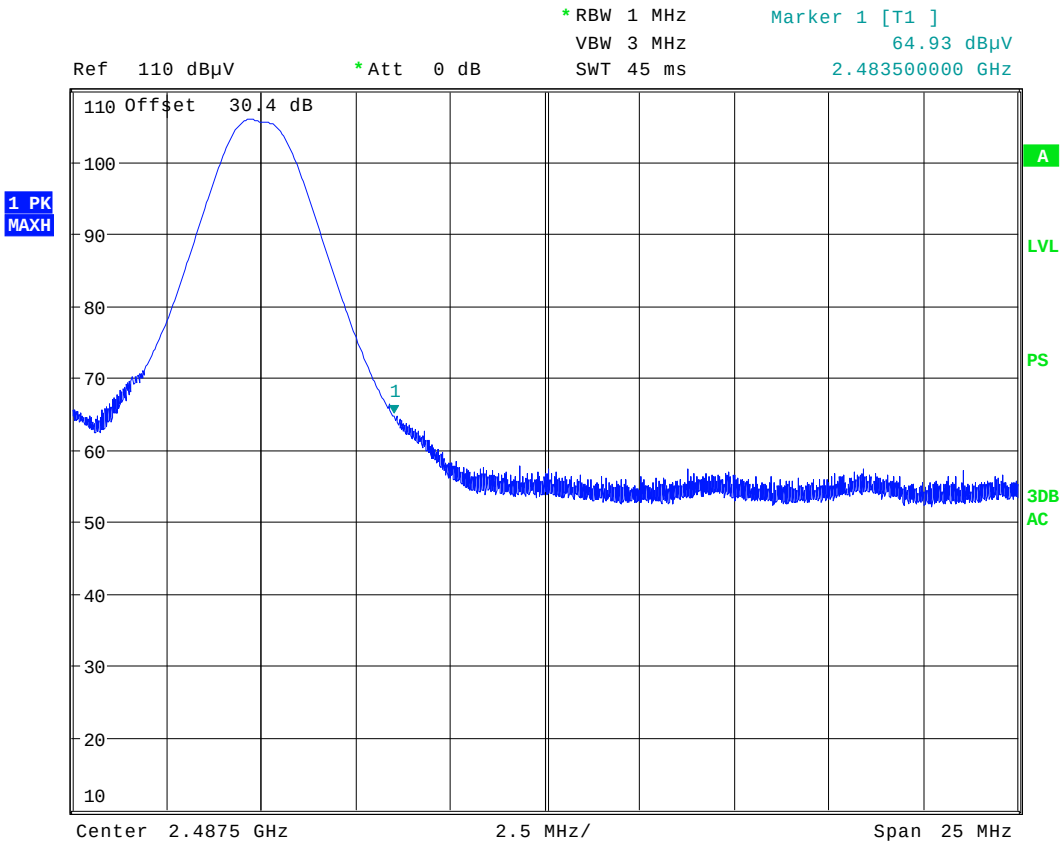
Date of Test:	June 4, 2015
Results	**Complies**

Test Results: 15.209/15.205 Restricted Band Emissions

Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2310–2390 MHz



Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5–2500 MHz



Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2310–2390 MHz

Tx at 2402MHz

Frequency	Corrected FS @ 3m	δ(dB)*	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB)	(Peak) / (Average)	(dBuV/m)	(dB)
2390.00	52.9	--	Peak	74.0	-21.1
	40.5	-12.4	Average	54.0	-13.5

* **δ(dB) -** Duty Cycle Correction Factor. See Appendix A for Duty Cycle measurement and calculation. Duty cycle Correction Factor was applied for Average Field Strength (FS).

Note: Peak FS@3m = Band Edge Plots incorporates the antenna factor and cable loss used in the offset.
Average FS@3m = Peak Measurement + **δ**

Out-of-Band Radiated spurious emissions at the Band-edge @3m distance
2483.5–2500 MHz

Tx at 2480MHz

Frequency	FS @ 3m	δ(dB)*	Detector	Limit @ 3 m	Margin
(MHz)	(dBuV/m)	(dB)	(Peak) / (Average)	(dBuV/m)	(dB)
2483.50	64.9	--	Peak	74.0	-9.1
	52.5	-12.4	Average	54.0	-1.5

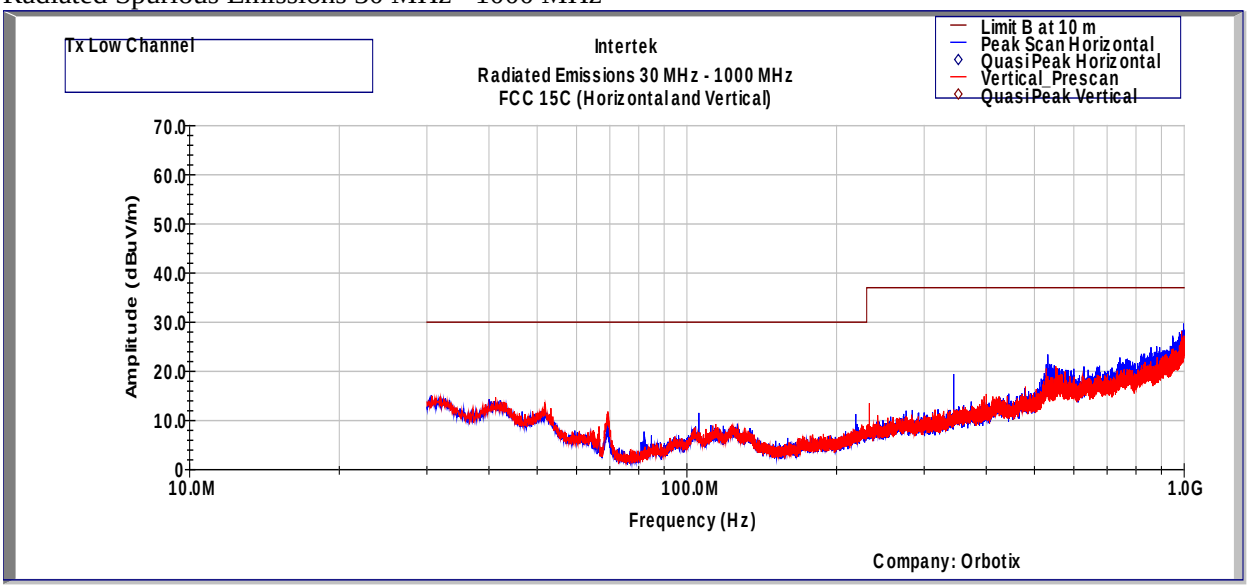
* **δ(dB) -** Duty Cycle Correction Factor. See Appendix A for Duty Cycle measurement and calculation. Duty cycle Correction Factor was applied for Average Field Strength (FS).

Note: Peak FS@3m = Band Edge Plots incorporates the antenna factor and cable loss used in the offset.
Average FS@3m = Peak Measurement + **δ**

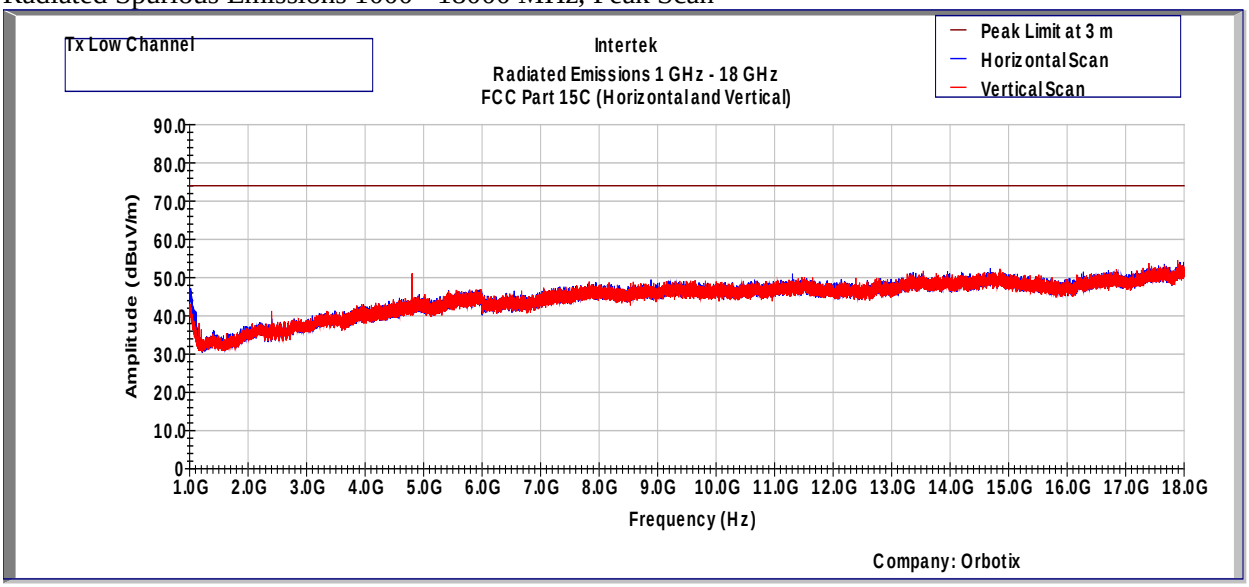
Results	**Complies**

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

Radiated Spurious Emissions 30 MHz - 1000 MHz



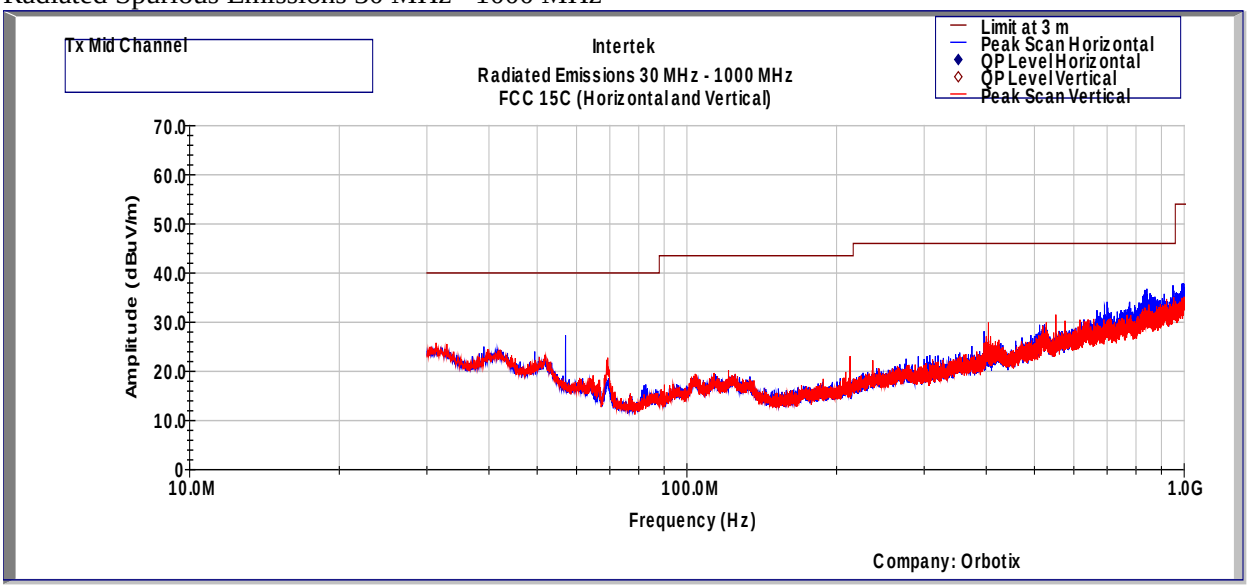
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan



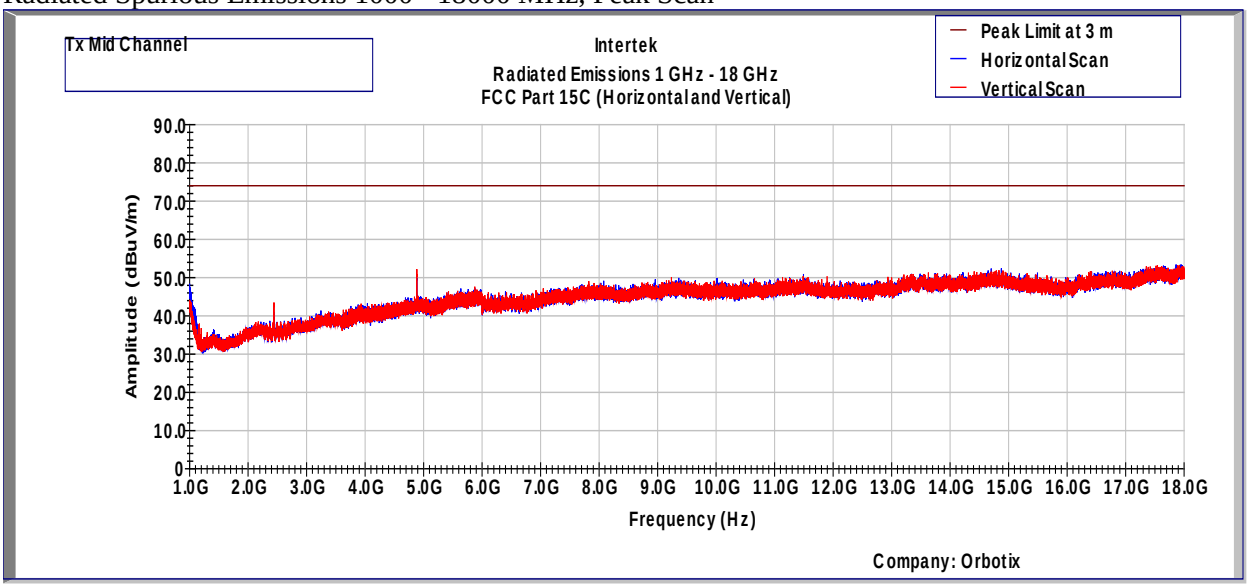
Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

Test Results: 15.209 Radiated Spurious Emissions Mid Channel, Tx at 2442MHz

Radiated Spurious Emissions 30 MHz - 1000 MHz



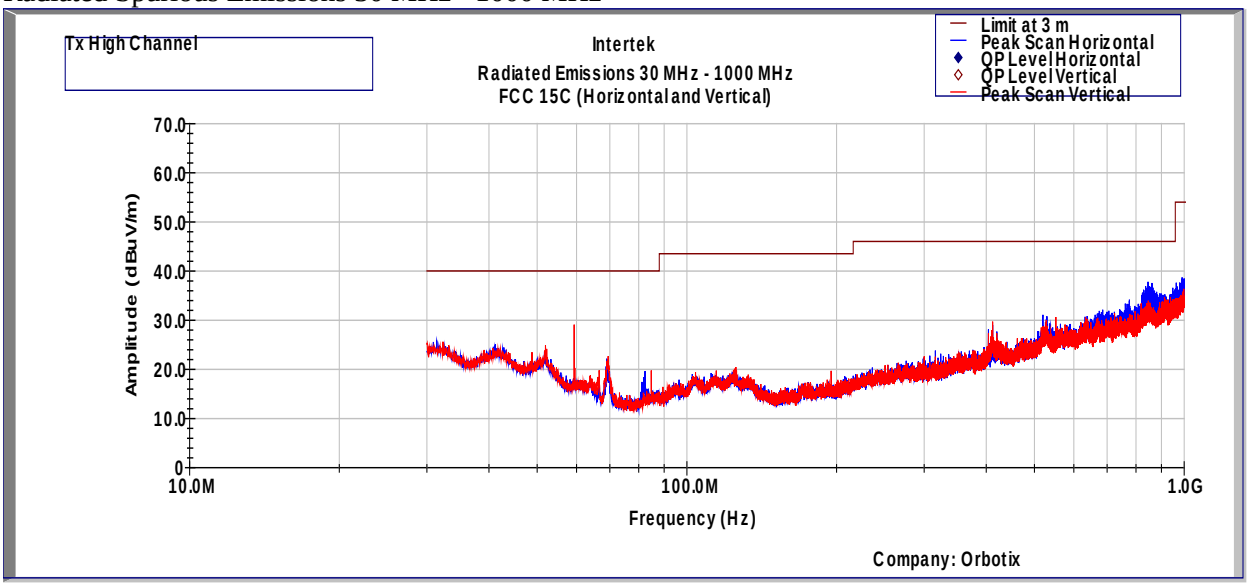
Radiated Spurious Emissions 1000 - 18000 MHz, Peak Scan



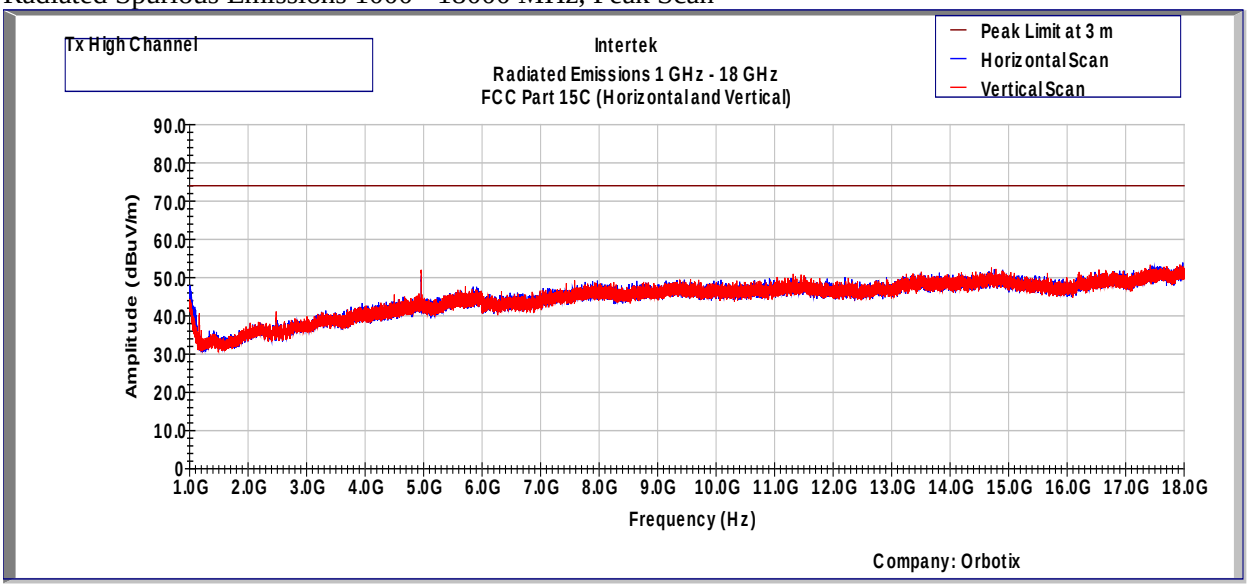
Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz

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



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

Transmitter Radiated Emissions

Frequency	Antenna Polarity	Detector	Raw Amplitude @ 3 m	Preamp	Antenna Factor	CF + Attenuator	δ(dB)*	Corr. FS @ 3 m	Average FS Limit @ 3 m	Margin
GHz	H/V	Peak / Avg	dB(uV)	dB	dB(1/m)	dB	dB	dB(uV/m)	dB(uV/m)	dB
Tx @ 2402 MHz										
4804.25	V	Peak	48.3	34.4	32.5	4.6	--	51.0	54	-3.0
Tx @ 2442 MHz										
4884.50	V	Peak	48.8	34.4	33	4.6	--	52.0	54	-2.0
Tx @ 2480 MHz										
4959.25	V	Peak	48.7	34.4	32.8	4.6	--	51.7	54	-2.3

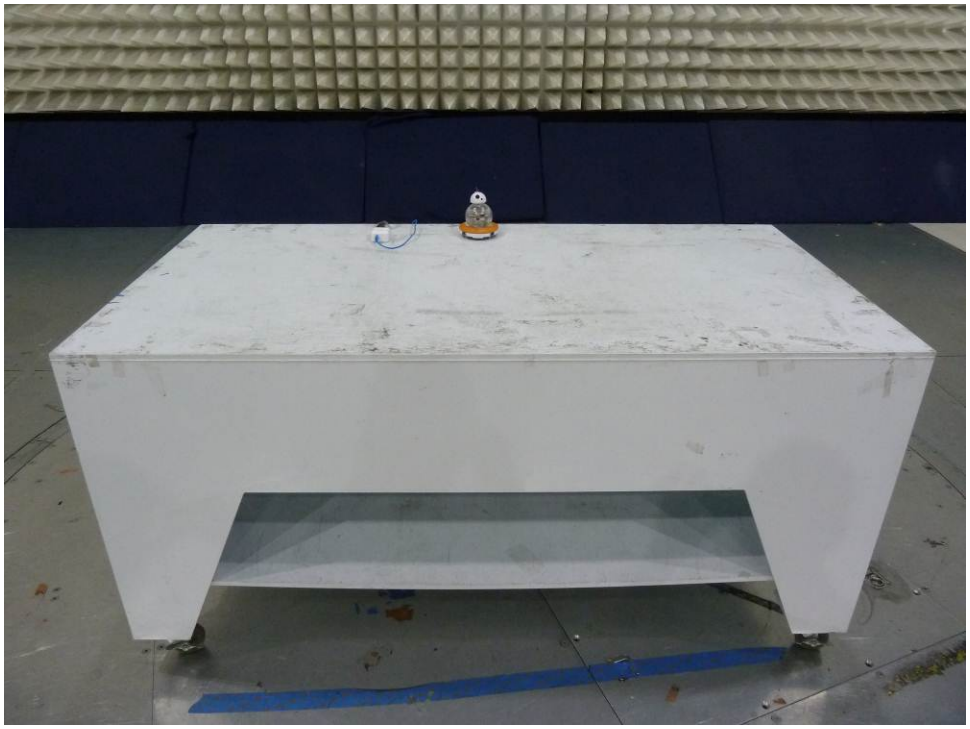
* **δ(dB) -** Duty Cycle Correction Factor. See Appendix A for Duty Cycle measurement and calculation. Duty cycle Correction Factor was applied for Average Field Strength (FS).

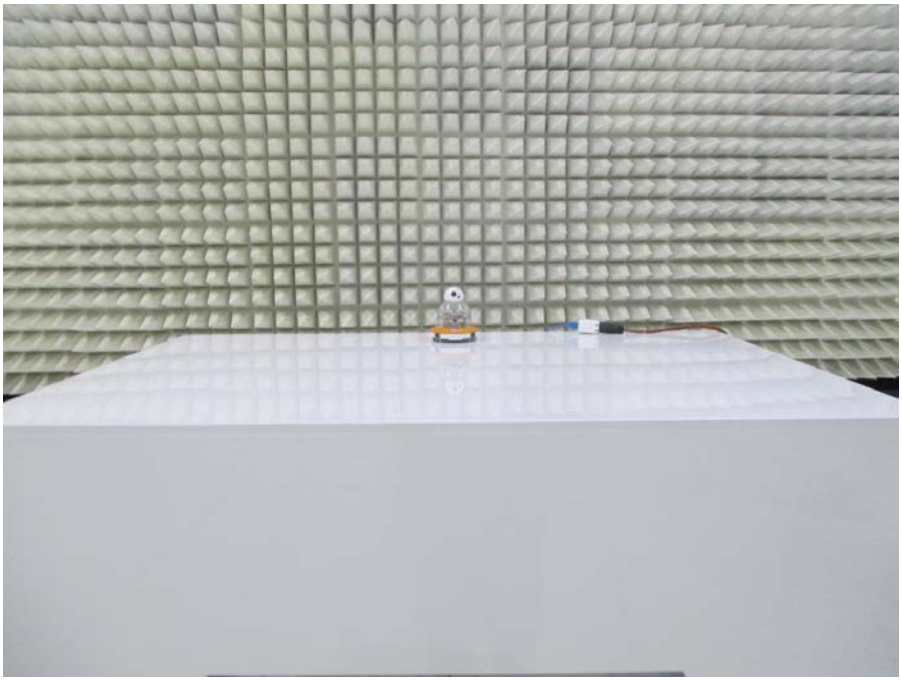
Note: FS@3m = RA + AF – DCF + CF, (Peak)
Corrected Peak Scans are under the Average Limit of 54.

Results	**Complies**

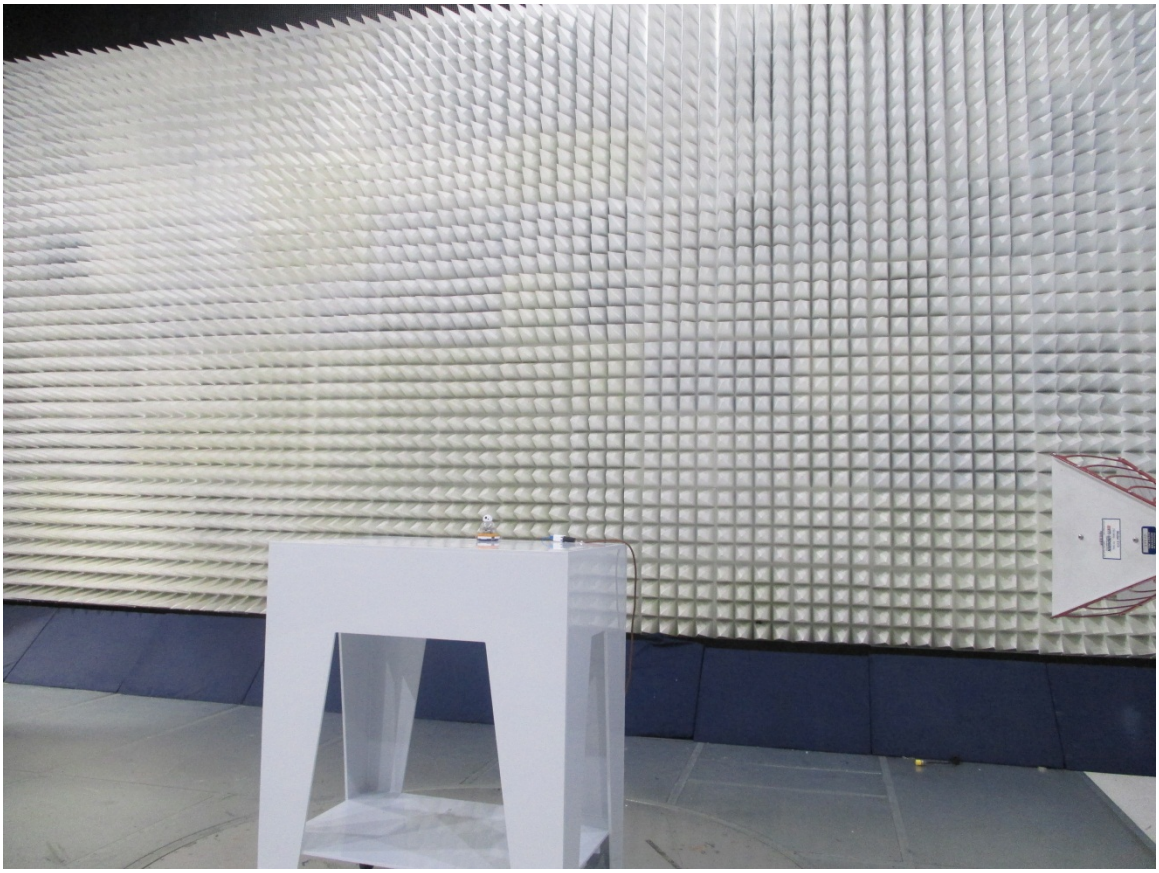
4.5.5 Test setup photographs

The following photographs show the testing configurations used.





4.5.5 Test setup photographs (Continued)



4.6 Radiated Emissions

FCC Ref: 15.109, ICES 003

4.6.1 Requirement

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

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

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

4.6.2 Procedures

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

Measurements of the radiated field are made with the antenna located at a distance of 10 meters from the EUT. If the field-strength measurements at 10m cannot be made because of high ambient noise level or for other reasons, measurements of Class B equipment may be made at a closer distance, for example 3m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance.

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

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

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

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

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

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

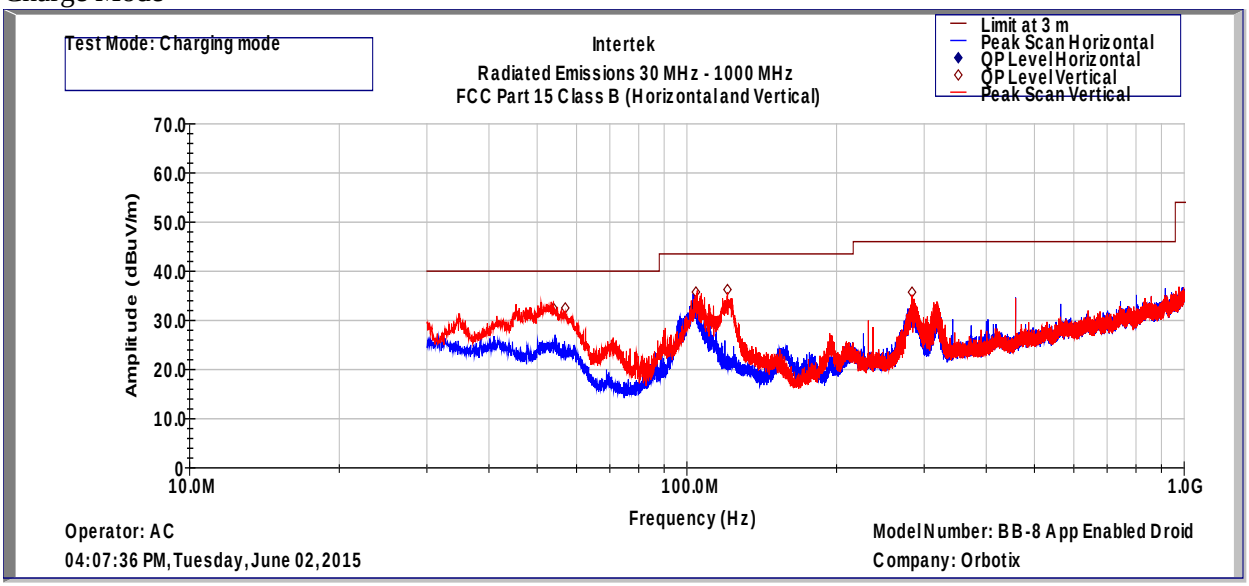
4.6.3 Test Results

The highest clock frequency used in the EUT is 72 MHz; therefor testing for Radiated Emissions need be tested up to 1 GHz for FCC 15B. Radiated emission measurements were performed from 30 MHz to 1000 MHz. The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Date of Test:	June 2, 2015
Results	**Complies**

Test Results: Radiated Emissions 30 MHz – 1000 MHz

Charge Mode



Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (QP-Vertical)

Model Number: BB-8 App-Enabled Droid
Company: Orbotix

FCC Part 15 Class B (QP-Vertical)										
Frequency	**Quasi Pk FS**	**Limit@3m**	**Margin**	**RA**	**Cable**	**AG**	**DCF**	**AF**	**Azimuth**	**Height**
MHz	**dB(uV/m)**	**dB(uV/m)**	**dB**	**dB(uV)**	**dB**	**dB**	**dB**	**dB(1/m)**	**deg**	**cm**
53.9	32.5	40	-7.5	39.8	0.9	32.1	10.5	13.4	200	100
56.95	32.5	40	-7.5	41.1	0.9	32.1	10.5	12.1	220	100
104.27	35.8	43.5	-7.7	45	1.2	32.1	10.5	11.1	208	100
120.7	36.3	43.5	-7.2	44.9	1.2	32	10.5	11.7	234	100
283.6	35.7	46	-10.3	42.7	1.7	32	10.5	12.8	198	100

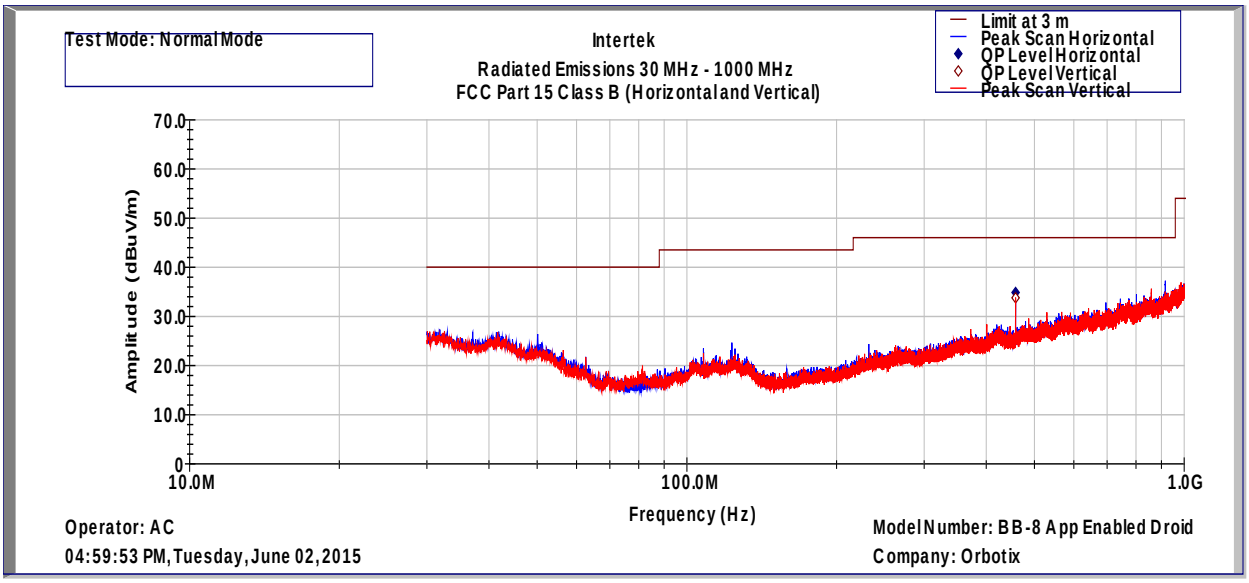
FCC Part 15 Class B (QP-Horizontal)										
Frequency	**Quasi Pk FS**	**Limit@3m**	**Margin**	**RA**	**CF**	**AG**	**DCF**	**AF**	**Azimuth**	**Height**
MHz	**dB(uV/m)**	**dB(uV/m)**	**dB**	**dB(uV)**	**dB**	**dB**	**dB**	**dB(1/m)**	**deg**	**cm**
103.5	32.8	43.5	-10.7	41.9	1.2	32.1	10.5	11.3	302	400

Test Mode: Charging Mode

Result: **Complies** by 7.2 dB

Test Results: Radiated Emissions 30 MHz – 1000 MHz

Normal Mode



Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (QP-Vertical)

Model Number: BB-8 App-Enabled Droid
Company: Orbotix

FCC Part 15 Class B (QP-Vertical)										
Frequency	**Quasi Pk FS**	**Limit@3m**	**Margin**	**RA**	**Cable**	**AG**	**DCF**	**AF**	**Azimuth**	**Height**
MHz	**dB(uV/m)**	**dB(uV/m)**	**dB**	**dB(uV)**	**dB**	**dB**	**dB**	**dB(1/m)**	**deg**	**cm**
458.17	33.8	46	-12.2	36.9	2.4	32	10.5	16.1	0	300

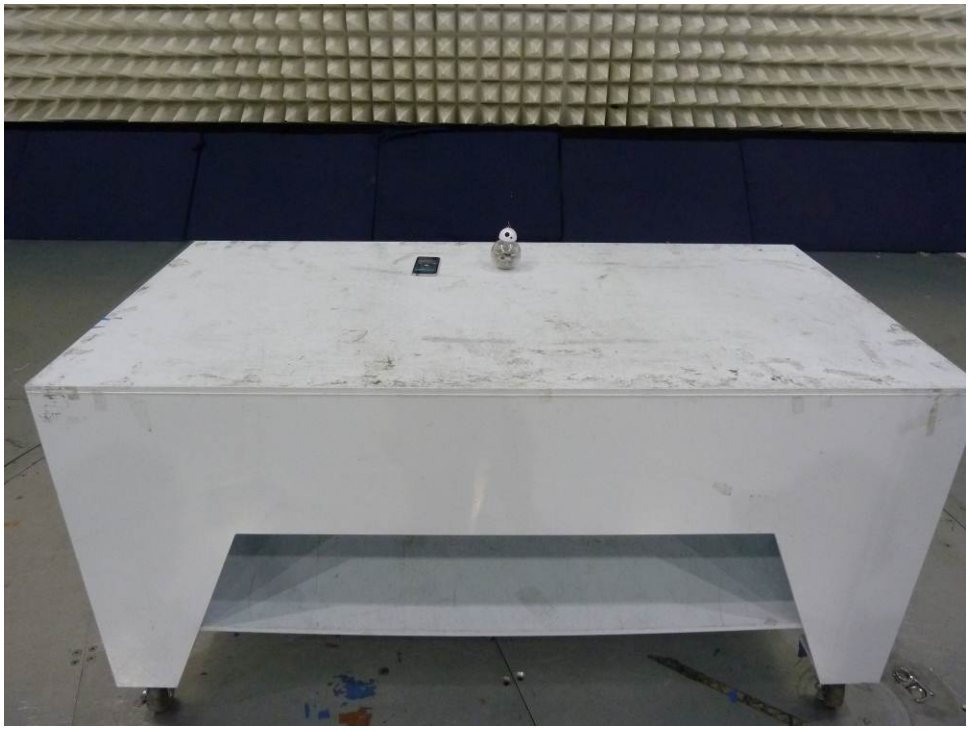
FCC Part 15 Class B (QP-Horizontal)										
Frequency	**Quasi Pk FS**	**Limit@3m**	**Margin**	**RA**	**CF**	**AG**	**DCF**	**AF**	**Azimuth**	**Height**
MHz	**dB(uV/m)**	**dB(uV/m)**	**dB**	**dB(uV)**	**dB**	**dB**	**dB**	**dB(1/m)**	**deg**	**cm**
458.17	34.9	46	-11.1	38	2.4	32	10.5	16.1	0	100

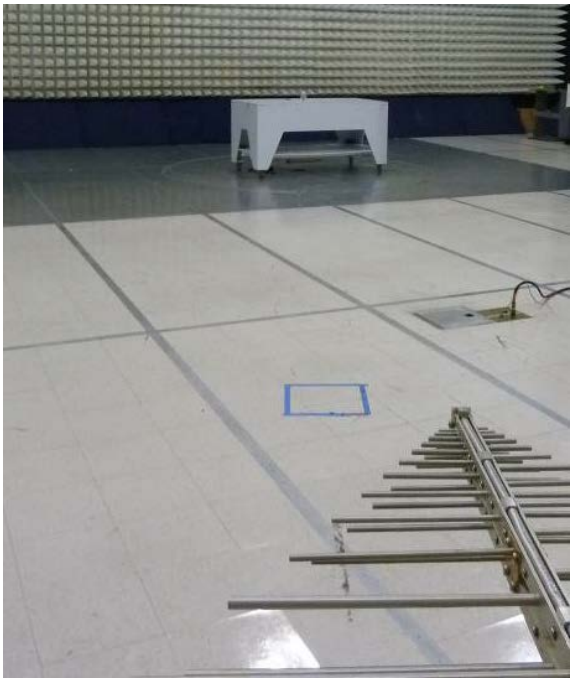
Test Mode: Normal Mode

Result: **Complies** by 11.1 dB

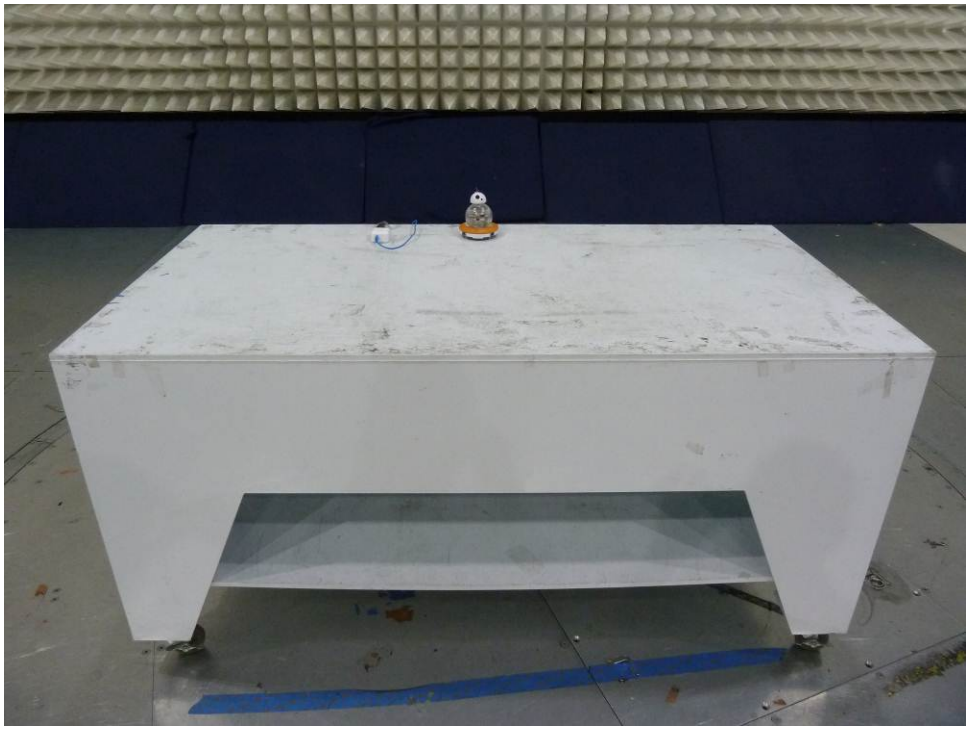
4.6.4 Test Configuration Photographs

The following photographs show the testing configurations used.





4.6.4 Test Configuration Photographs (Continued)



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

4.7.1 Requirement

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

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

4.7.2 Procedure

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

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

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

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

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

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

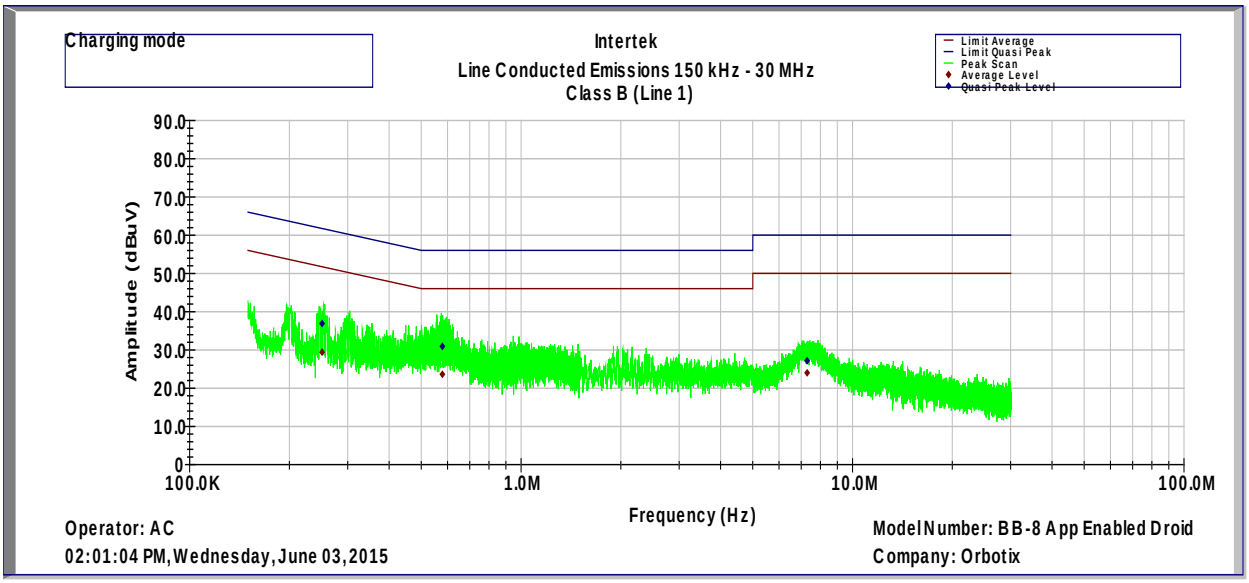
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

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

4.7.3 Test Result

Date of Test:	June 3, 2015
Results	**Complies**

AC Line Conducted Emission Data, EUT in transmitting mode



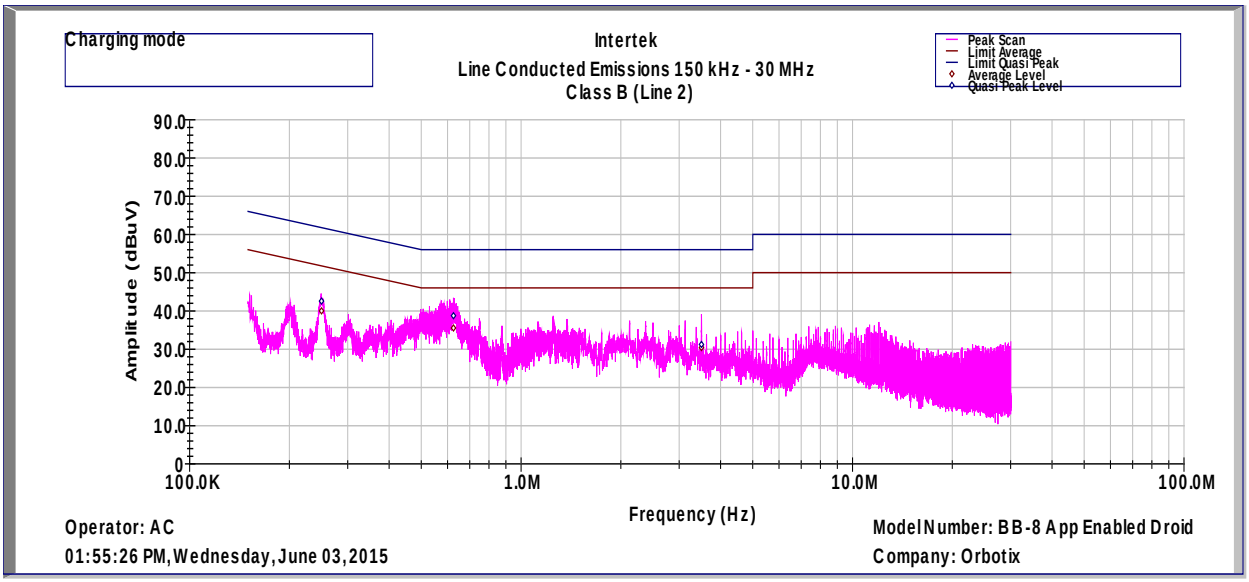
Intertek Testing Services
Line Conducted Emissions 150 kHz - 30 MHz
FCC Class B (Line 1)
Operator: AC

Model Number: BB-8 App-Enabled Droid
Company: Orbotix

Frequency	Av Level	QP Level	Av Limit	QP Limit	Av Margin	QP Margin
MHz	dBuV	dBuV	dBuV	dBuV	dB	dB
0.251	29.4	36.9	53.1	63.1	-23.7	-26.2
0.579	23.6	30.9	46	56	-22.4	-25.1
7.290	24.0	27.2	50	60	-26.0	-32.8

Test Mode: Transmitter On, EUT with USB Power Adapter, Model: A1357, Sl no. W010A051
Temp.: 22C
Humidity: 52.4%

AC Line Conducted Emission Data, EUT in transmitting mode



Intertek Testing Services
Line Conducted Emissions 150 kHz - 30 MHz
FCC Class B (Line 2)
Operator: AC

Model Number: BB-8 App-Enabled Droid
Company: Orbotix

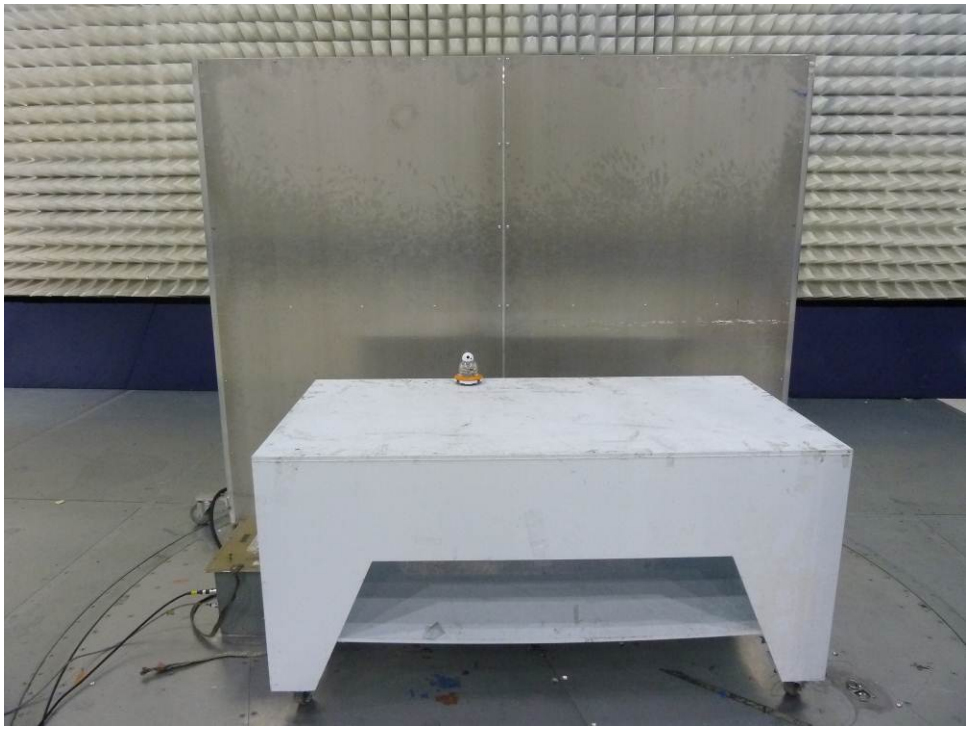
Frequency	Av Level	QP Level	Av Limit	QP Limit	Av Margin	QP Margin
MHz	dBuV	dBuV	dBuV	dBuV	dB	dB
0.250	40	42.5	53.1	63.1	-13.1	-20.6
0.625	35.5	38.7	46	56	-10.5	-17.3
3.500	30.4	31.2	46	56	-15.6	-24.8

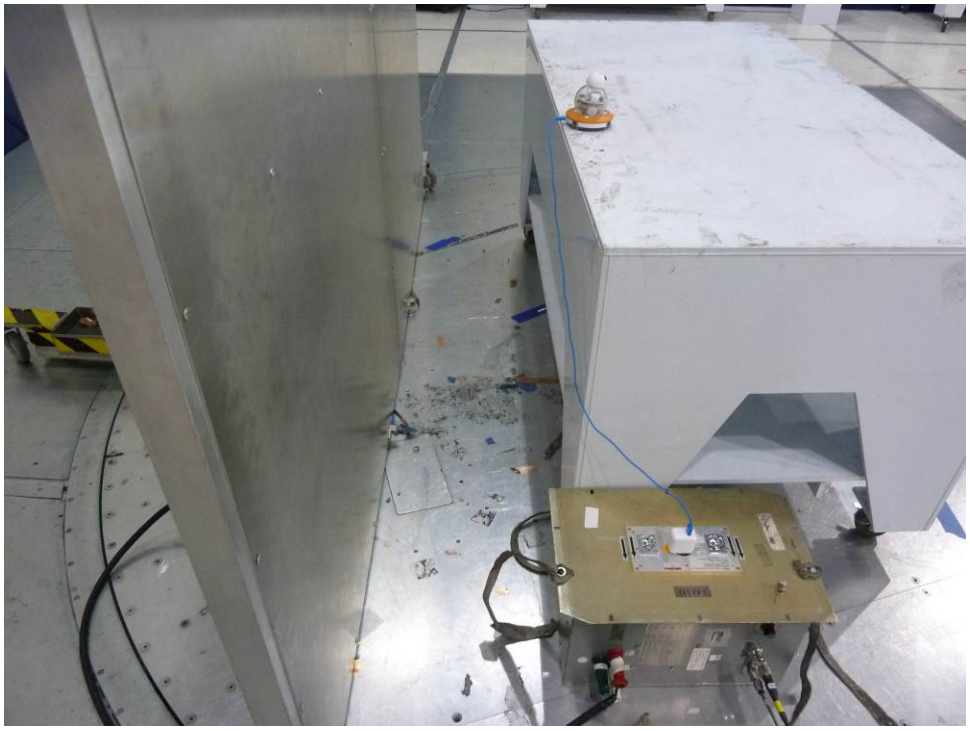
Test Mode: Transmitter On, EUT with USB Power Adapter, Model: A1357, Sl no. W010A051
Temp.: 22C
Humidity: 52.4%

Results	**Complies** by 10.5 dB

4.7.4 Test Configuration Photographs

The following photographs show the testing configurations used.





5.0 RF Exposure Evaluation

MPE Evaluation

The EUT is a wireless device used in a mobile application, at least 20 cm from any body part of the user or nearby persons.

The maximum Peak EIRP calculated is 7.55 dBm or 5.69 mW; therefore, to comply with RF Exposure Requirement, the MPE is calculated.

The Power Density can be calculated using the formula

$$S = EIRP/ 4\pi D^2$$

Where: S is Power Density in mW/cm^2
D is the distance from the antenna.

It is considered that 20 cm is the minimum distance that user can go closest to the EUT.

At 20 cm, S =0.01132 W/m^2, which is below the MPE Limit of 10 W/m^2

Date of Test:	June 2, 2015
Results	**Complies**

6.0 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	12/16/15
EMI Receiver	Rohde and Schwarz	ESU	ITS 00961	12	11/10/15
BI-Log Antenna	Antenna Research	LPB-2513	ITS 00355	12	08/21/15
Pyramidal Horn Antenna	EMCO	3160-09	ITS 00571	#	#
Pre-Amplifier	Sonoma Instrument	310	ITS 00942	12	11/26/15
Pre-Amplifier (1-18GHz)	Miteq	AMF-4D-001180-24-10P	ITS 00526	12	10/01/15
Pre-Amplifier (18-40GHz)	Miteq	JSD44-18004000-305P	ITS 00921	12	06/09/15
Horn Antenna	ETS Lindgren	3115	ITS 00982	12	11/21/15
LISN	FCC	FCC-LISN-50-50-M-H	ITS 00552	12	09/04/15

No Calibration required

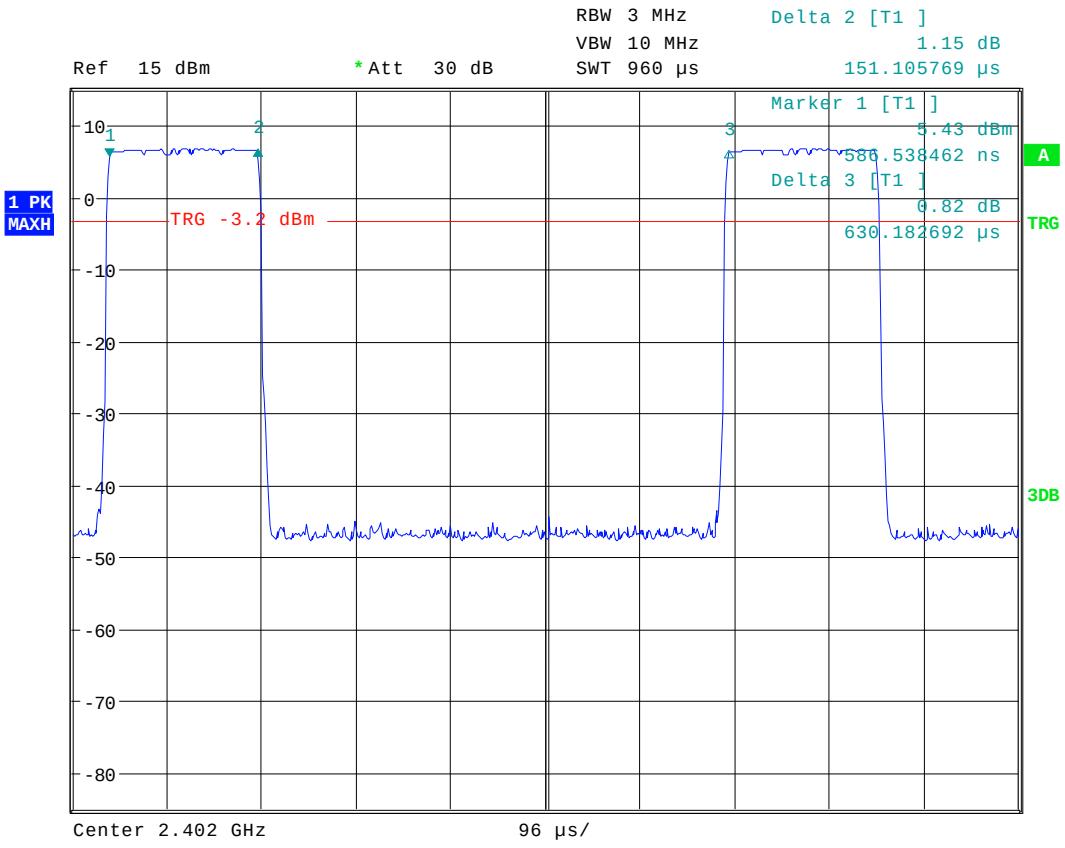
7.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G102028516	AS	KK	June 22, 2015	Original document

Annex A - Duty Cycle Measurement

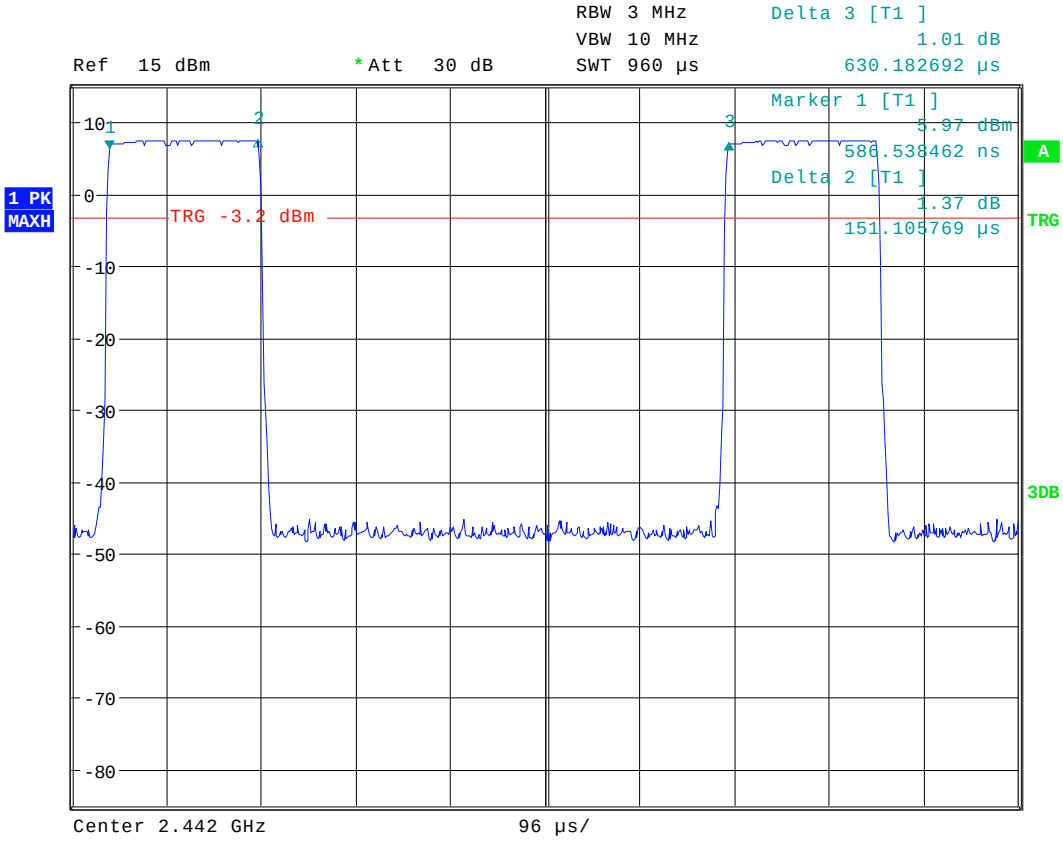
Date of Test:	June 4, 2015

Low Channel @ 2402 MHz



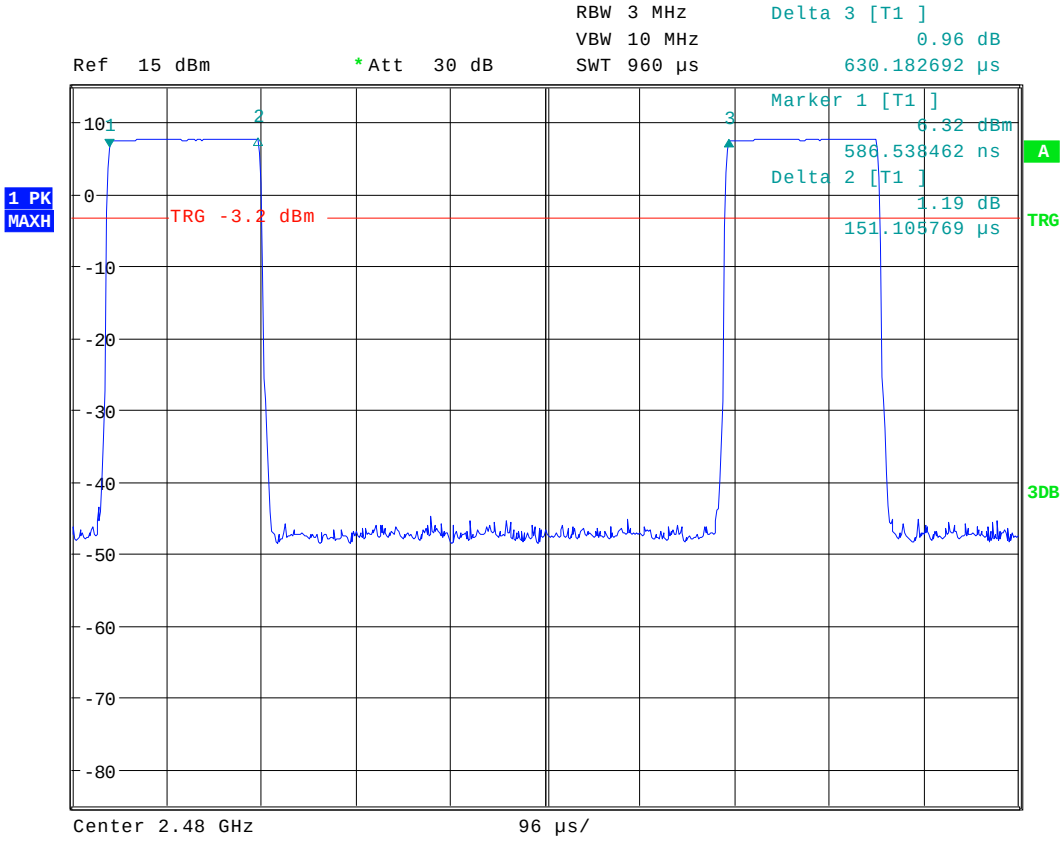
Duty Cycle: DC = 151.106 / 630.183 = 0.24 or 24.0%
Duty Cycle Correction Factor **δ(dB)** = 20 log (151.106 / 630.183) = -12.4dB

Mid Channel @ 2442 MHz



Duty Cycle: DC = 151.106 / 630.183 = 0.24 or 24.0%
Duty Cycle Correction Factor **δ(dB)** = 20 log (151.106 / 630.183) = -12.4dB

High Channel @ 2480 MHz



Duty Cycle: DC = 151.106 / 630.183 = 0.24 or 24.0%
Duty Cycle Correction Factor **δ(dB)** = 20 log (151.106 / 630.183) = -12.4dB