Testing Tomorrow's Technology

Application

For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

And

RSS-247 Issue 1 For Industry Canada

For the

QMotion Incorporated

Model: 150404Z
QMotion Router

FCC ID: 2ABLX-150404Z
IC: 8832A-150404Z

UST Project: 15-0218
Issue Date: September 4, 2015

Total Pages in This Report: 53

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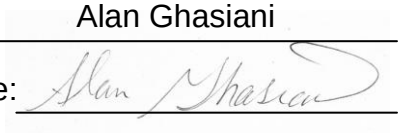
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date September 4, 2015

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: QMotion Incorporated

MODEL: 150404Z

FCC ID: 2ABLX-150404Z

IC: 8832A-150404Z

DATE: September 4, 2015

This report concerns (check one): Original grant [X]
Class II change

Equipment type: 2405-2475 MHz Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until: _____N/A_____
date

agrees to notify the Commission by N/A
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of conveying test results and information concerning the suitability of this exact product for public distribution according to the FCC Rules and Regulations Part 15, Section 247 and IC RSS 247 Issue 1.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on August 31, 2015 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the QMotion Incorporated QMotion Router, Model 150404Z. The EUT is an intelligent repeater for the extension of IEEE802.15.4 networks.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2009, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2009/2014)*, ANSI C63.10.2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and per FCC KDB Publication number 558074 D01 v03r03 D01 v03r03 for Digital Transmission Systems Operation Under section 15.247.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittals

The EUT is subject to the following FCC authorizations:

a) Certification under section 15.247 as a transmitter.
b) Verification under 15.101 as a digital device and receiver.

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (part 15.107 and 15.109) for the EUT is included herein.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID: IC:	CABLES P/D
Wireless Transmitter QMotion Incorporated	150404Z	Engineering Sample	FCC ID: 2ABLX-150404Z (pending) IC: 8832A-150404Z (pending)	1 m U P
Power Adapter with USB cable V-infinity	3A-031WU05	None	None	1 m U P
Antenna See antenna details	--	--	--	--

U= Unshielded
S= Shielded
P= Power
D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	1/6/2015
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	1/28/2015
LOOP ANTENNA	SAS-200/562	A.H. Systems	142	9/12/2013 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9306-1708	11/24/2014 2 yr.
LOG PERIODIC ANTENNA	3146	EMCO	9110-3236	11/19/2014 2 yr.
HORN ANTENNA	3115	EMCO	9107-3723	7/8/2014 2 yr.
PRE-AMPLIFIER	8449B	HEWLETT-PACKARD	3008A00480	12/5/2014
PRE-AMPLIFIER	8477E	HEWLETT-PACKARD	1145A00307	11/21/2014
PRE-AMPLIFIER	8447D	HEWLETT-PACKARD	1937A02980	12/4/2014
LISN x 2	9247-50-TS-50-N	SOLAR ELECTRONICS	955824 and 955825	12/30/2014

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates at 2405 MHz to 2475 MHz, 3 test frequencies were used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to 5 times the highest internal clock frequency.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

NOTE: If the transmitter was programmed to transmit at >98% duty cycle, then, wherever applicable (where the detection mode was AVG) the duty cycle factor calculated will be applied.

2.6 EUT Antenna Requirements (CFR 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

The EUT uses an inverted, meandering, etched antenna on FR4. The ground plane is backed off such that performance is maximized; the design considers this clearance. The impedance is matched to 50 ohm. Approximate gain is 3.3dBi.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
1	Q motion	PCB Trace Antenna	Trace	3.3	Integral

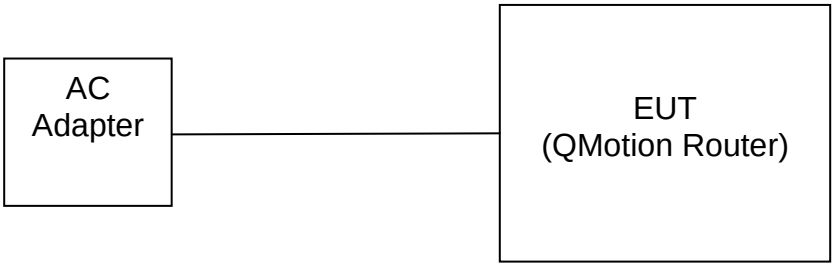


Figure 1. Block Diagram of Test Configuration

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other Spurious are examined for this requirement see paragraph 2.1

2.8 Transmitter Duty Cycle (CFR 35 (c))

Duty Cycle from Manufacture (see Theory of Operation)=66% = 0.66
Duty Cycle = 20 Log (0.66) = -3.6 dB

NOTE: The transmitter was programmed to transmit at >98% duty cycle, therefore wherever applicable (where the detection mode was AVG) the duty cycle factor calculated above will be applied.

2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

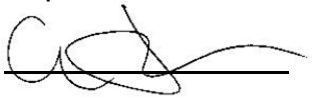
The EUT was connected to the Mains through an AC adaptor. Power line conducted emissions testing was performed to ensure that with the EUT in operation (exercising all transmitter functions); the complete system continues to meet the applicable requirements for CFR 15.207. These measurements were completed and are displayed below.

Table 5. Power Line Conducted Emissions 15.207

150KHz to 30 MHz						
Test: Power Line Conducted Emissions				**Client:** QMotion Incorporated		
Project: 15-0218				**Model:** 150404Z		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
120 VAC, 60 Hz Phase						
0.15	50.10	1.40	51.50	55.9	4.4	**PK**
0.58	41.10	0.26	41.36	46.0	4.6	**PK**
1.30	37.00	0.26	37.26	46.0	8.7	**PK**
5.04	35.60	0.31	35.91	50.0	14.1	**PK**
17.88	31.40	0.50	31.90	50.0	18.1	**PK**
29.13	31.60	0.69	32.29	50.0	17.7	**PK**
120VAC, 60 Hz Neutral						
0.40	41.90	0.26	42.16	47.9	5.8	**PK**
0.53	34.40	0.22	34.62	46.0	11.4	**PK**
1.55	32.40	0.26	32.66	46.0	13.3	**PK**
7.95	34.20	0.42	34.62	50.0	15.4	**PK**
19.93	31.00	0.47	31.47	50.0	18.5	**PK**
24.33	30.80	0.55	31.35	50.0	18.7	**PK**

SAMPLE CALCULATION at .15 MHz:

Magnitude of Measured Frequency	50.10	dBuV
+ Cable Loss+ LISN Loss	1.40	dB
=Corrected Result	51.50	dBuV
Limit	55.90	dBuV
-Corrected Result	51.50	dBuV
Margin	4.40	dB

Test Date: September 1, 2015
Tested By
Signature:  Name: Carrie Ingram

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 247, 5.4)

Radiated Spurious measurements: the EUT was placed into a continuous transmit mode of operation (>98% duty cycle) and tested per FCC KDB Publication 558074 D01 v03r03 and ANSI C63.10:2013. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the device. To obtain worse case results the EUT was tested in X, Y, and Z axes or in the orientation of normal operation if the device is designed to operation in a fixed position.

Radiated measurements were then conducted between the frequency range of 9KHz (or lowest frequency used/generated by the device) up to the tenth harmonic of the device (no greater than 40 GHz). In the band below 30 MHz a resolution bandwidth (RBW) of 9 kHz was used, emissions below 1 GHz were tested with a RBW of 120 KHz and emissions above 1 GHz were tested with a RBW of 1 MHz. All video bandwidth settings were at least three times the RBW value.

The EUT was investigated to CFR 15.209, General requirements for unwanted spurious emissions. The conducted spurious method as described below was use to investigate all other emissions emanating from the antenna port.

Conducted Spurious measurements: the EUT was put into a continuous-transmit mode of operation (>98% duty cycle) and tested per FCC KDB Publication 558074 D01 v03r03 for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz to 25 GHz. A conducted scan was performed on the EUT to identify and record spurious signals that were related to the transmitter. All spurious emission found must comply with the requirements of 15.247(d).

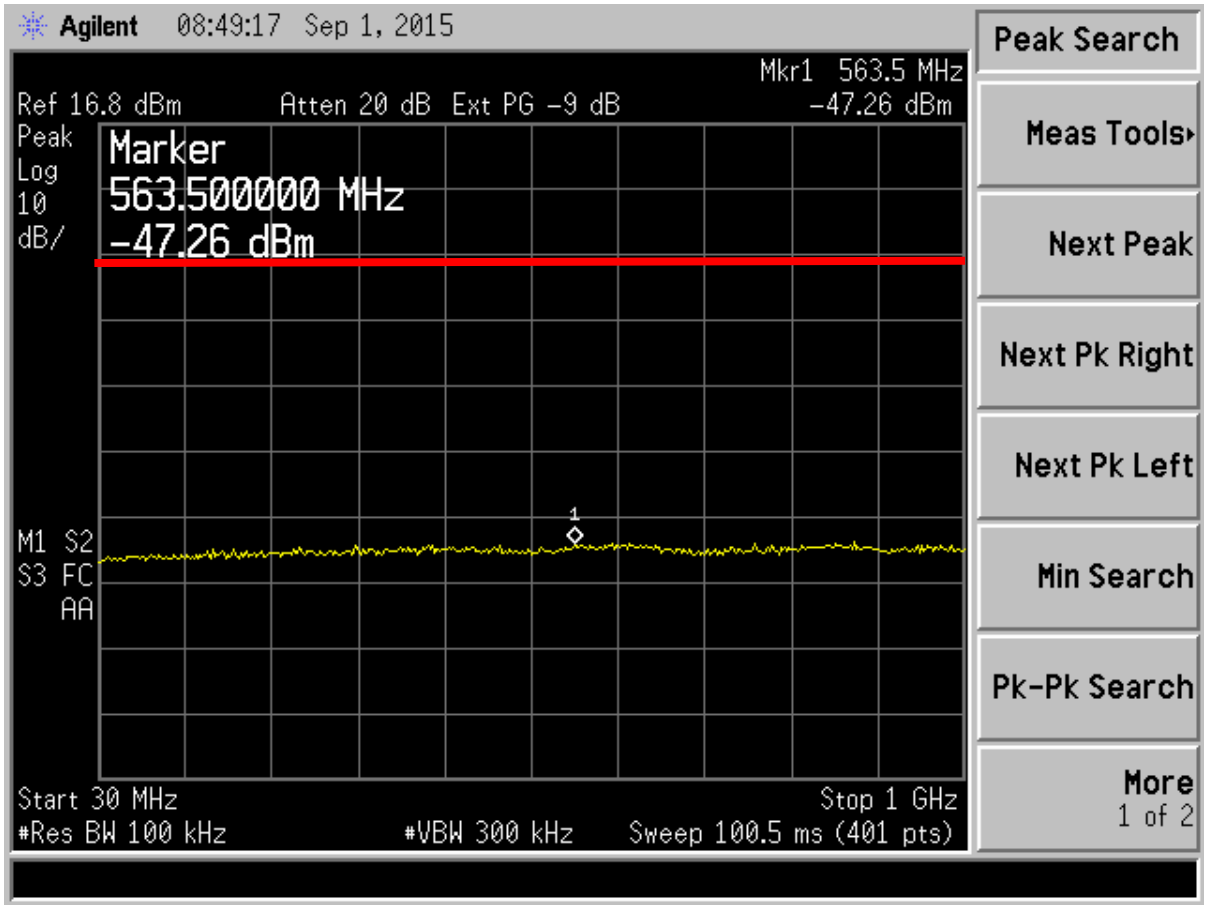


Figure 2. Antenna Conducted Emissions Low Channel, Part 1

Note: The Ext PG is used to correct for cable loss and attenuator used. The reference level was set to the PSD value of the fundamental with a 100 kHz RBW. The red line is 20 dB down from the measured fundamental.

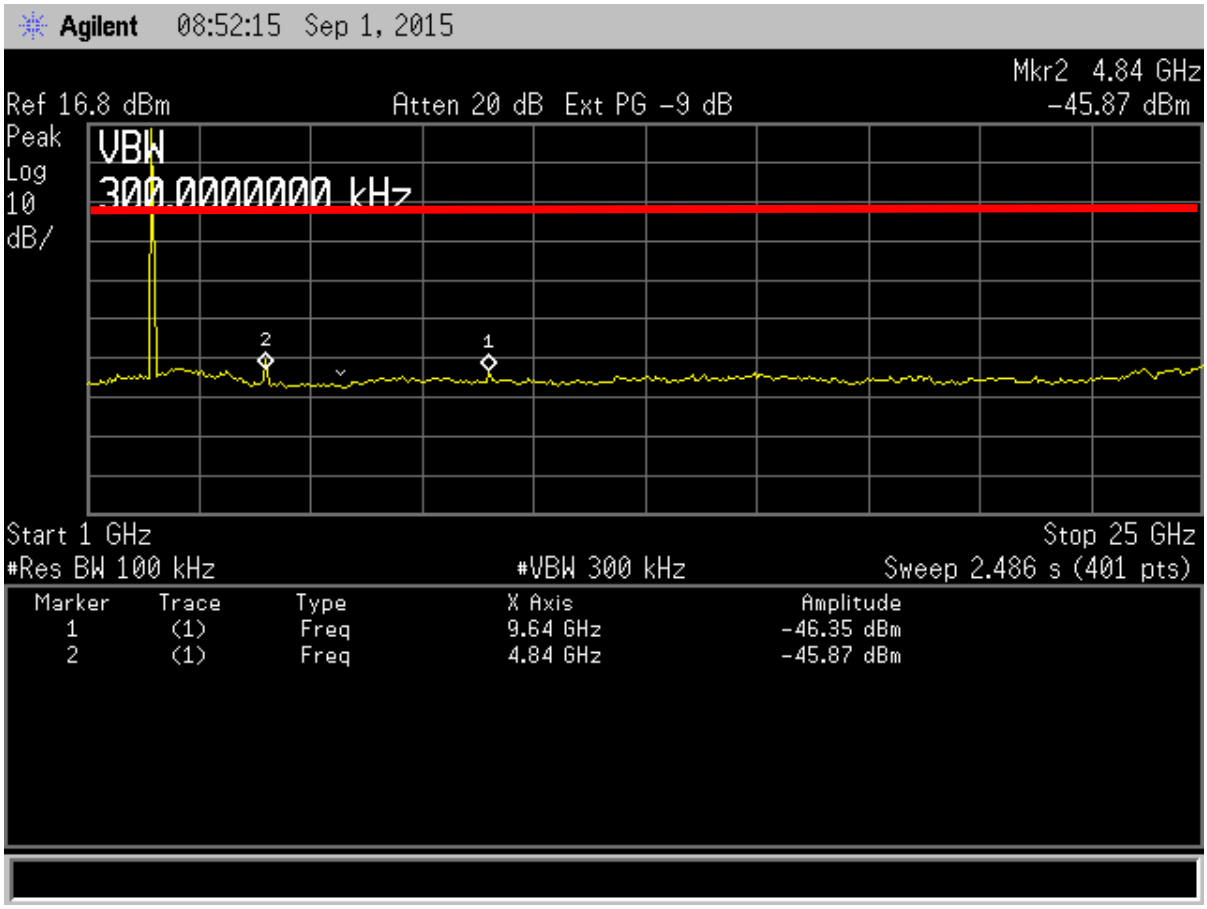


Figure 3. Antenna Conducted Emissions Low, Part 2

Note: The Ext PG is used to correct for cable loss and attenuator used. The reference level was set to the PSD value of the fundamental with a 100 kHz RBW. The red line is 20 dB down from the measured fundamental.

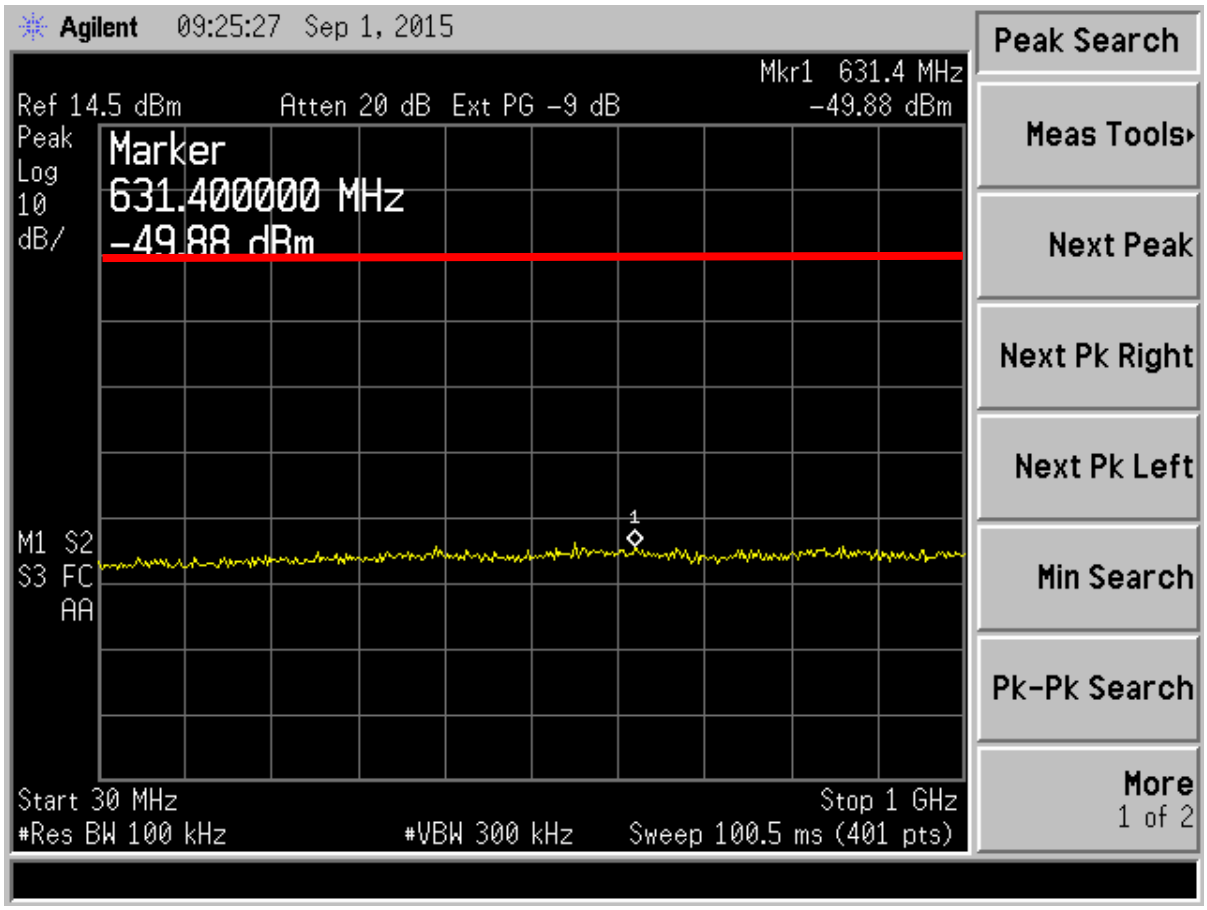


Figure 4. Antenna Conducted Emissions Mid, Part 1

Note: The Ext PG is used to correct for cable loss and attenuator used. The reference level was set to the PSD value of the fundamental with a 100 kHz RBW. The red line is 20 dB down from the measured fundamental.

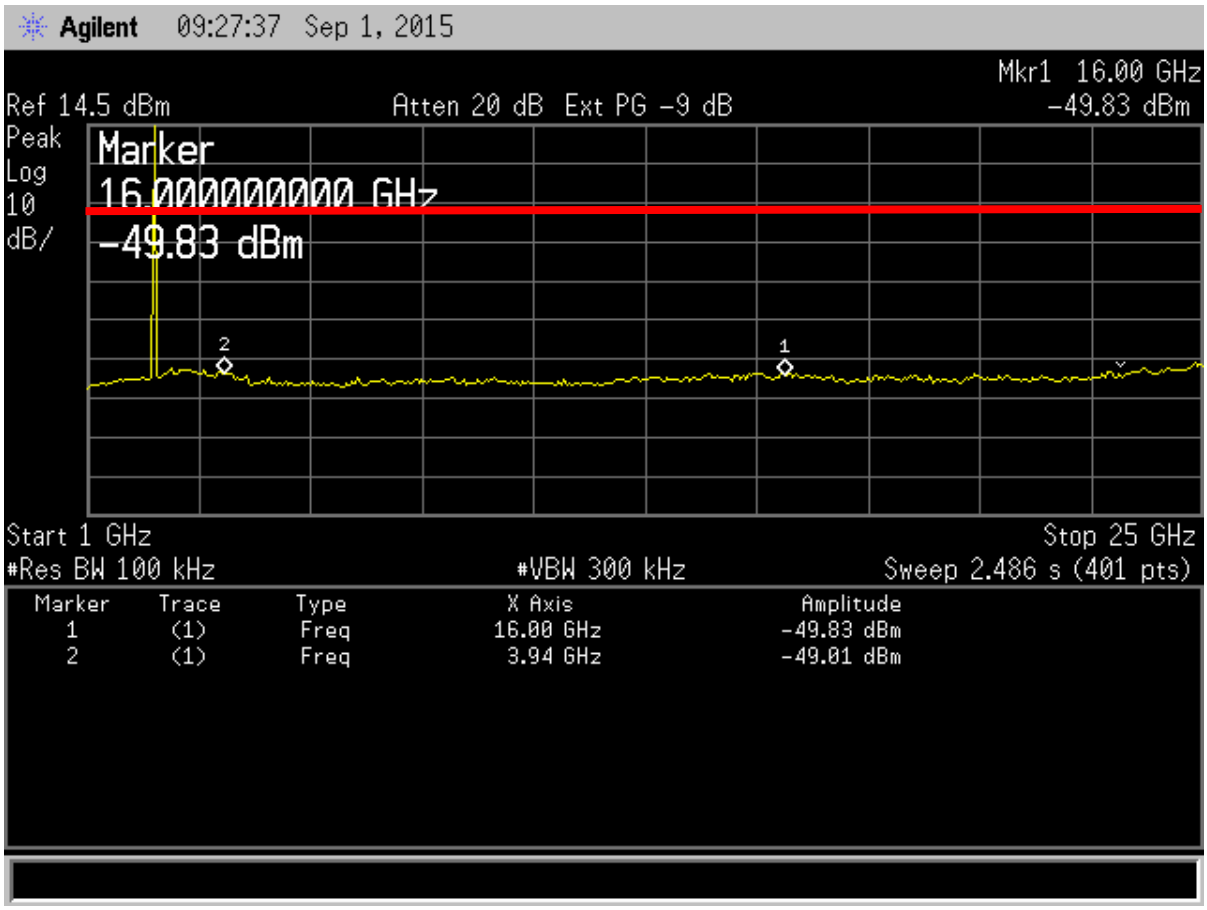


Figure 5. Antenna Conducted Emissions Mid, Part 2

Note: The Ext PG is used to correct for cable loss and attenuator used. The reference level was set to the PSD value of the fundamental with a 100 kHz RBW. The red line is 20 dB down from the measured fundamental.

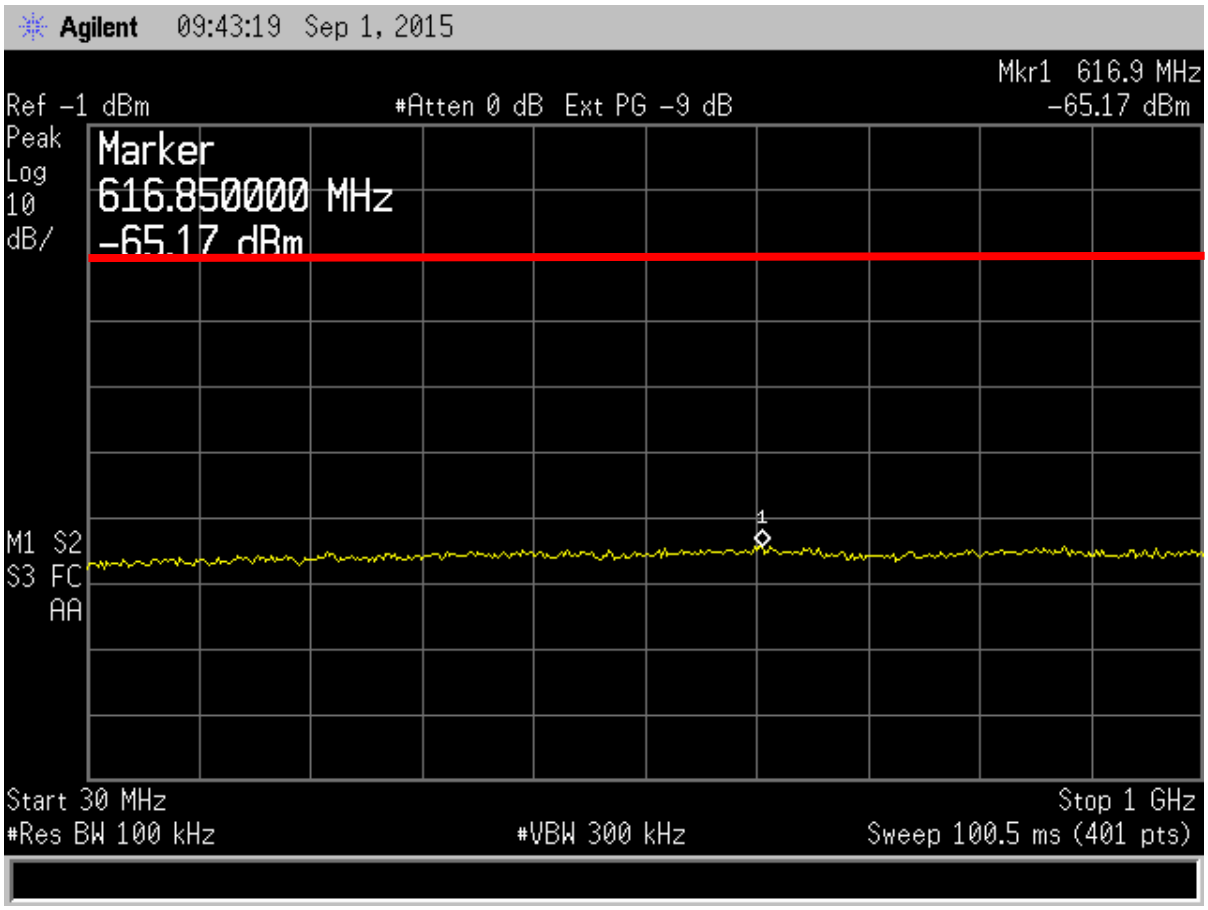


Figure 6. Antenna Conducted Emissions High, Part 1

Note: The Ext PG is used to correct for cable loss and attenuator used. The reference level was set to the PSD value of the fundamental with a 100 kHz RBW. The red line is 20 dB down from the measured fundamental.

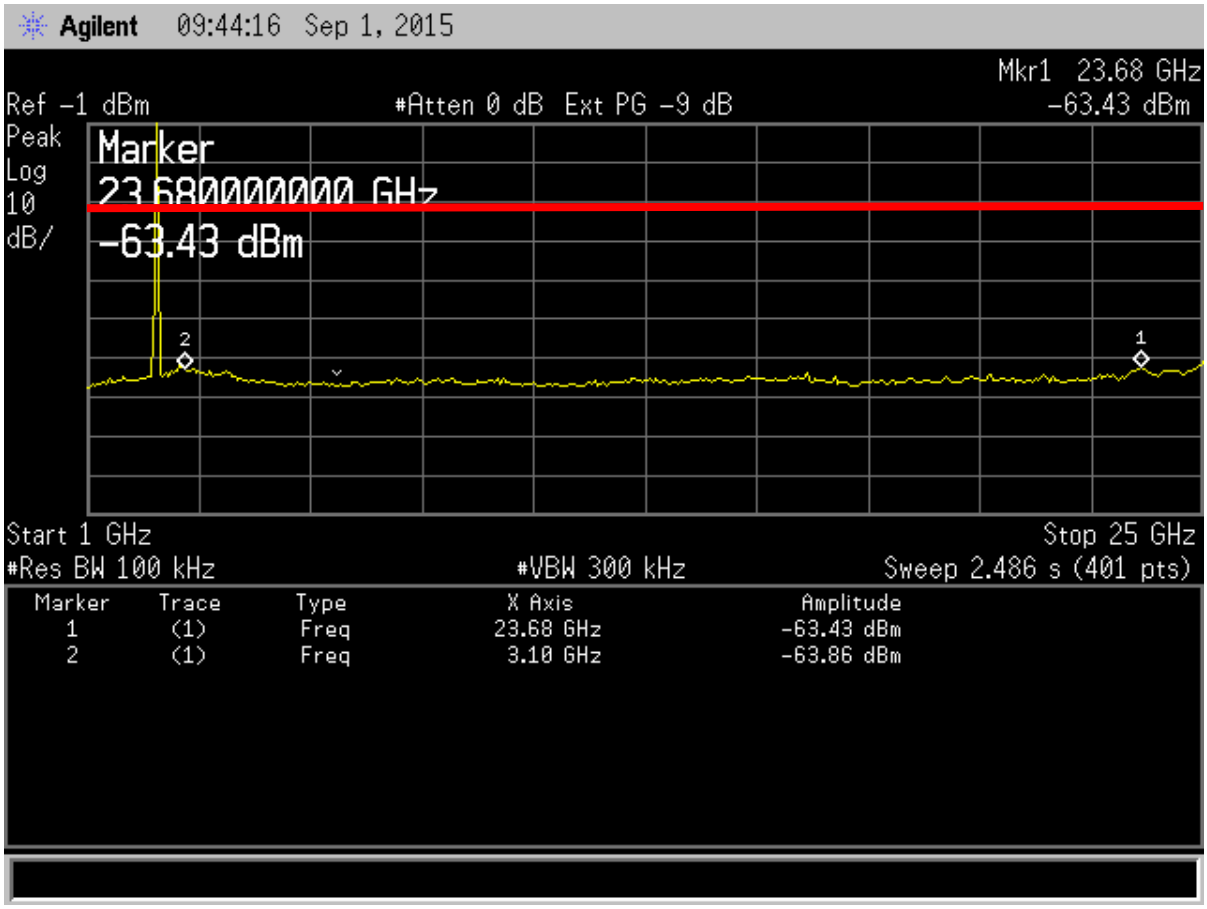


Figure 7. Antenna Conducted Emissions High, Part 2

Note: The Ext PG is used to correct for cable loss and attenuator used. The reference level was set to the PSD value of the fundamental with a 100 kHz RBW. The red line is 20 dB down from the measured fundamental.

Table 6. Spurious Radiated Emissions below 30 MHz

20 MHz to 30 MHz, 15.209 limits							
Test: Radiated Emissions				**Client:** QMotion Incorporated			
Project: 15-0218				**Model:** 150404Z			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
No emissions higher than 20 dB from the applicable limit between the lowest clock frequency (20 MHz) and 30 MHz were detected.							

SAMPLE CALCULATION: N/A

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

Table 7. Spurious Radiated Emissions 30 MHz to 1000 MHz

30 MHz to 1000 MHz, 15.209 limits							
Test: Radiated Emissions				**Client:** QMotion Incorporated			
Project: 15-0218				**Model:** 150404Z			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
No emissions higher than 20 dB from the applicable limit were detected.							

SAMPLE CALCULATION: N/A

Test Date: September 1, 2015
Tested By
Signature: _____ Name: Robert Nevels

Table 8. Peak Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.247(d)					**Client:** QMotion Incorporated			
Project: 15-0218					**Model:** 150404Z			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low Channel								
2405.00	85.37	-	31.03	116.40	-	3.0m./HORZ	-	**PK**
4810.00	49.85	-	2.67	52.52	74.0	3.0m./VERT	21.5	**PK**
7215.00	60.61	-	8.10	68.71	96.4	3.0m./VERT	27.7	**PK**
9620.00	60.35	-	9.42	69.77	96.4	3.0m./VERT	26.6	**PK**
Mid Channel								
2440.00	83.33	-	31.03	114.36	-	3.0m./HORZ	-	**PK**
4880.00	49.48	-	2.49	51.97	74.0	3.0m./VERT	22.0	**PK**
7320.00	50.94	-	8.09	59.03	74.0	3.0m./VERT	14.9	**PK**
9760.00	55.43	-	9.66	65.09	94.4	3.0m./VERT	29.3	**PK**
High Channel								
2475.00	70.54	-	31.03	101.57	-	3.0m./HORZ	-	**PK**
4950.00	43.84	-	2.64	46.48	74.0	3.0m./HORZ	27.5	**PK**
7425.00	43.24	-	7.95	51.19	74.0	3.0m./HORZ	22.8	**PK**
9900.00	44.52	-	10.38	54.90	81.6	3.0m./HORZ	26.7	**PK**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~)Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 9620.00 MHz:

Magnitude of Measured Frequency	60.35	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	9.42	dB/m
Corrected Result	69.77	dBuV/m

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

Table 9. Average Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.247(d)					**Client:** QMotion Incorporated			
Project: 15-0218					**Model:** 150404Z			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low Channel								
2405.00	76.12	-	31.03	107.15	-	3.0m./HORZ	-	**AVG**
4810.00	39.20	-	2.67	41.87	54.0	3.0m./VERT	12.1	**AVG**
7215.00	52.39	-	8.10	60.49	87.1	3.0m./VERT	26.7	**AVG**
9620.00	49.51	-	9.42	58.93	87.1	3.0m./VERT	28.2	**AVG**
Mid Channel								
2440.00	80.99	-	31.03	112.02	-	3.0m./HORZ	-	**AVG**
4880.00	38.72	-	2.49	41.21	54.0	3.0m./VERT	12.8	**AVG**
7320.00	38.84	-	8.09	46.93	54.0	3.0m./VERT	7.0	**AVG**
9760.00	50.95	-	9.66	60.61	92.0	3.0m./VERT	31.4	**AVG**
High Channel								
2475.00	62.69	-	31.03	93.72	-	3.0m./HORZ	-	**AVG**
4950.00	29.51	-	2.64	32.15	54.0	3.0m./HORZ	21.8	**AVG**
7425.00	28.78	-	7.95	36.73	54.0	3.0m./HORZ	17.3	**AVG**
9900.00	30.09	-	10.38	40.47	73.7	3.0m./HORZ	33.3	**AVG**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~)Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
4. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 9620.00 MHz:

Magnitude of Measured Frequency	49.51	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	9.42	dB/m
Corrected Result	58.93	dBuV/m

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

2.11 Band Edge Measurements – (CFR 15.247 (d))

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 D01 v03r03 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Radiated measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge set the Spectrum Analyzer frequency span set to 2 MHz to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW = 100 kHz. In all cases, the VBW is set ≥ RBW. See figure and calculations below for more detail.

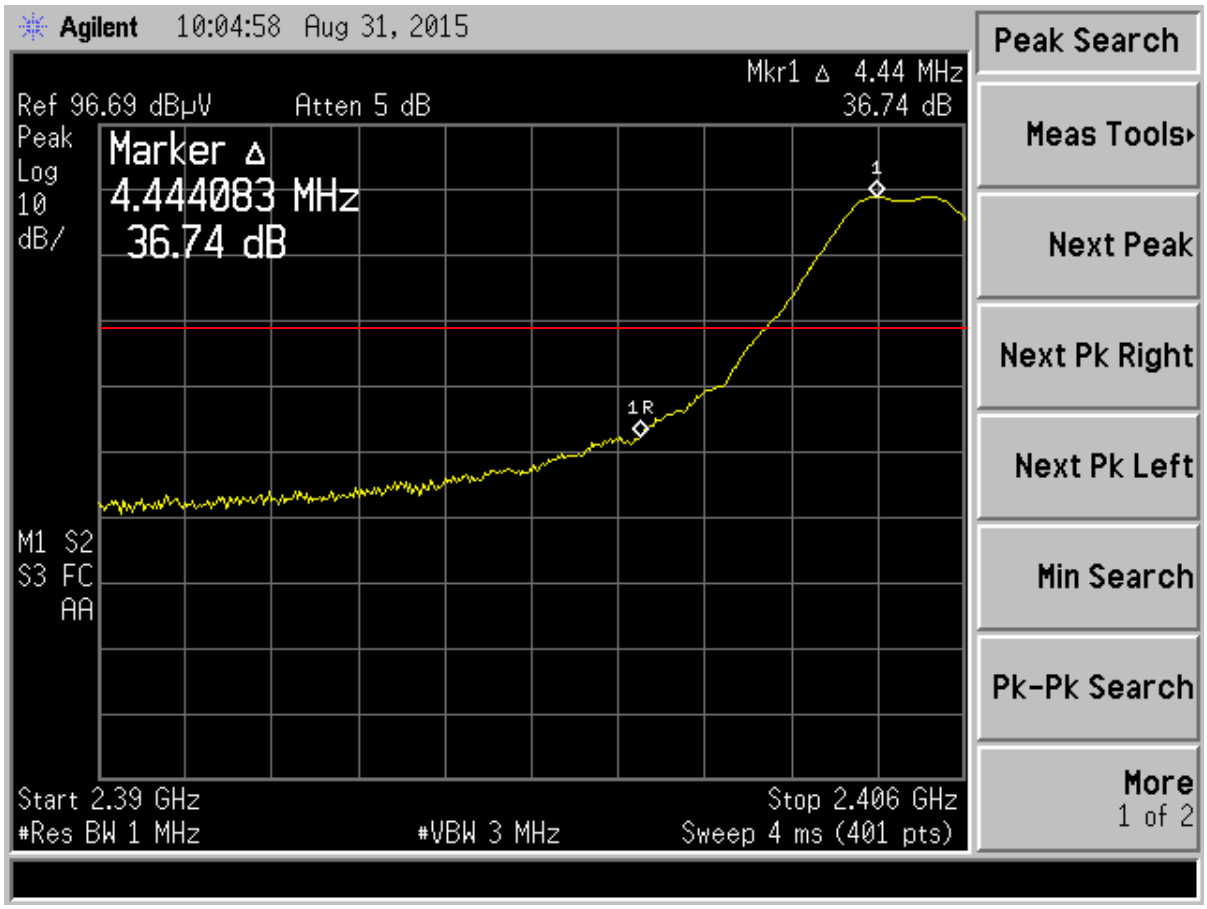


Figure 8. Band Edge Compliance, Low Channel Delta - Peak

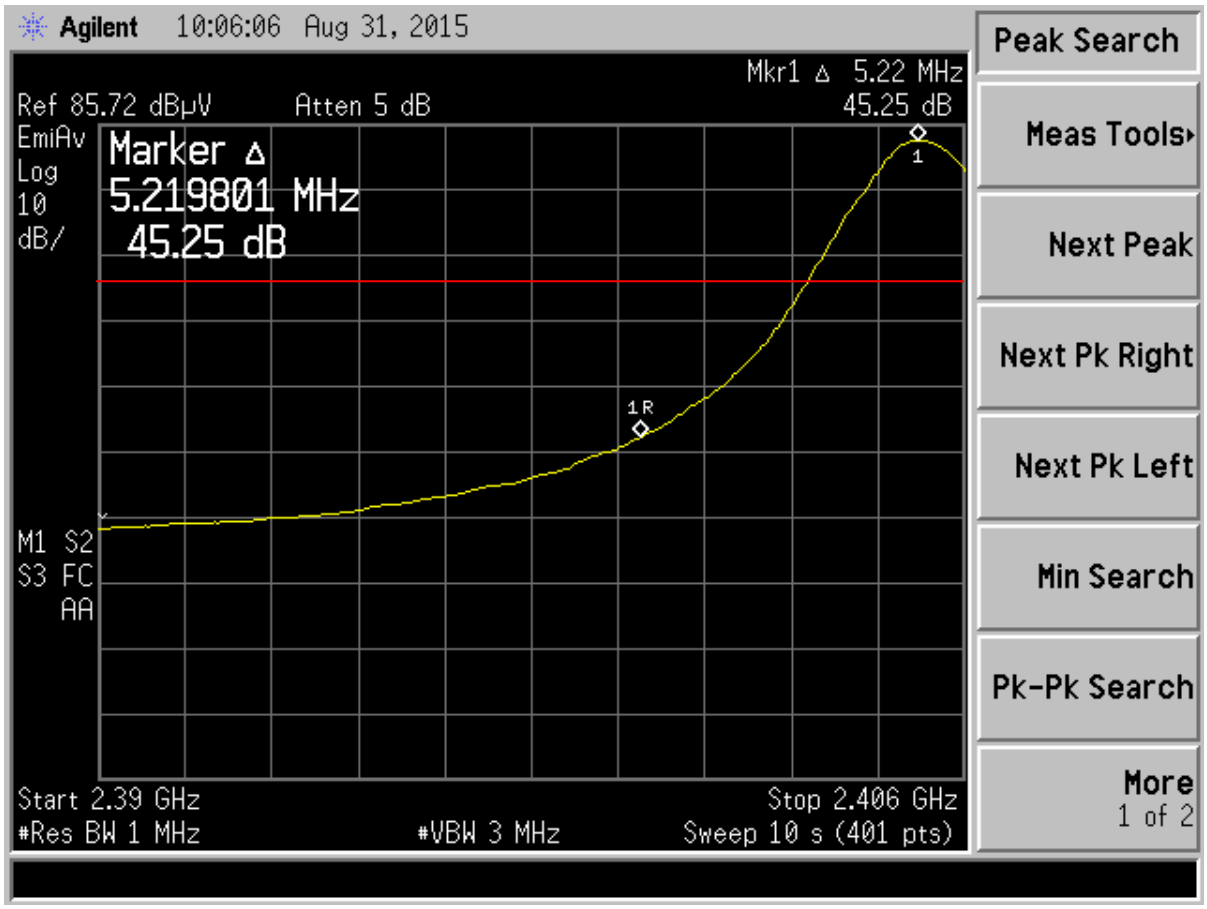


Figure 9. Band Edge Compliance, Low Channel Delta - Average

Calculation of worst case lower band edge measurement:

Band Edge Calculated Results	36.74	dB
Band Edge Limit (20 dB form Fundmental)	20.00	dB
Band Edge Margin	16.74	dB

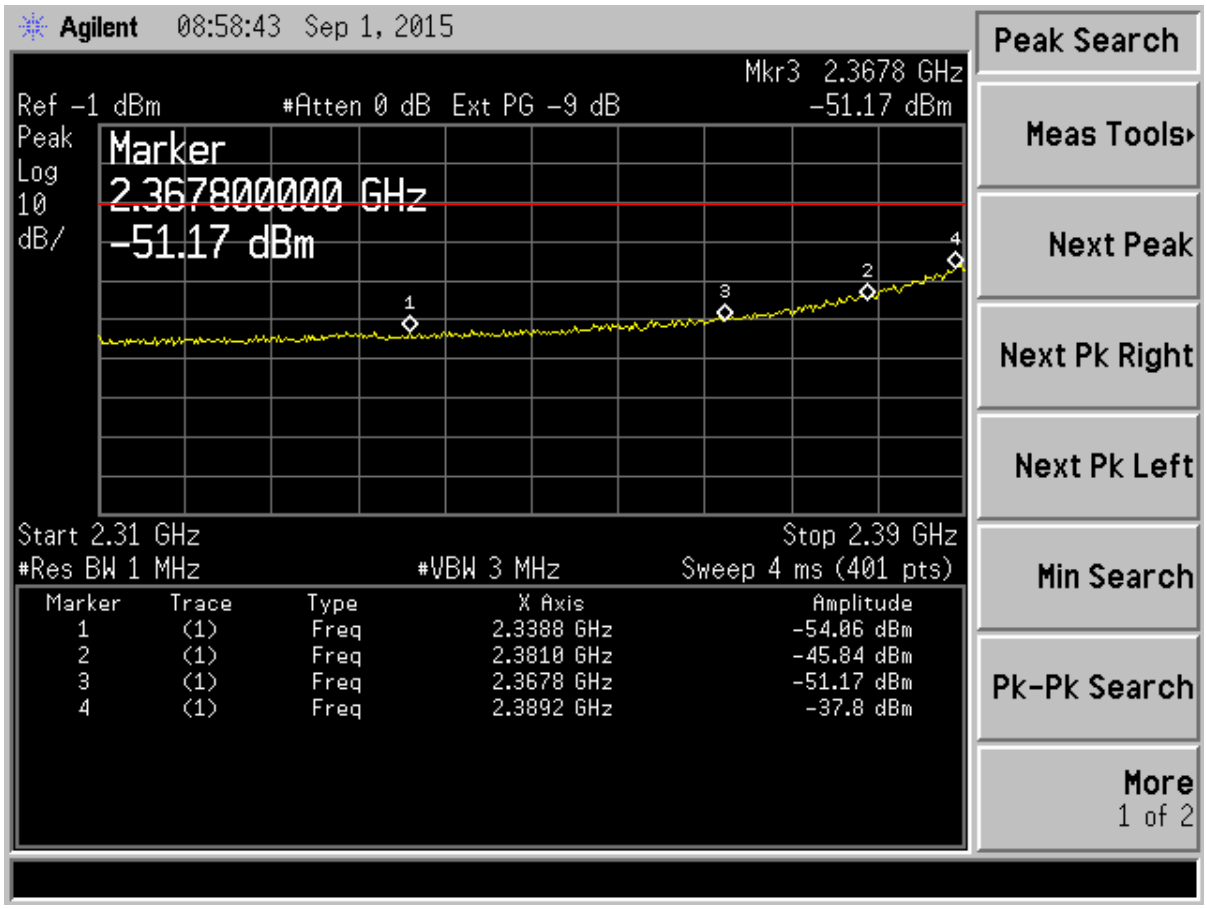


Figure 10.Condcuted Restricted Band 2310 MHz to 2390 MHz - Peak

Table 10. Conducted Restricted Band 2310 MHz to 2390 MHz - Peak

Frequency (MHz)	Test Data (dBm)	EIRP level	Electric field conversion	Result	Limit	Margin
2338.8	-54.06	-50.76	95.26	44.5	74.0	29.5
2381.0	-45.84	-42.54	95.26	52.7	74.0	21.3
2367.8	-51.17	-47.87	95.26	47.4	74.0	26.6
2389.2	-37.80	-34.50	95.26	60.8	74.0	13.2

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

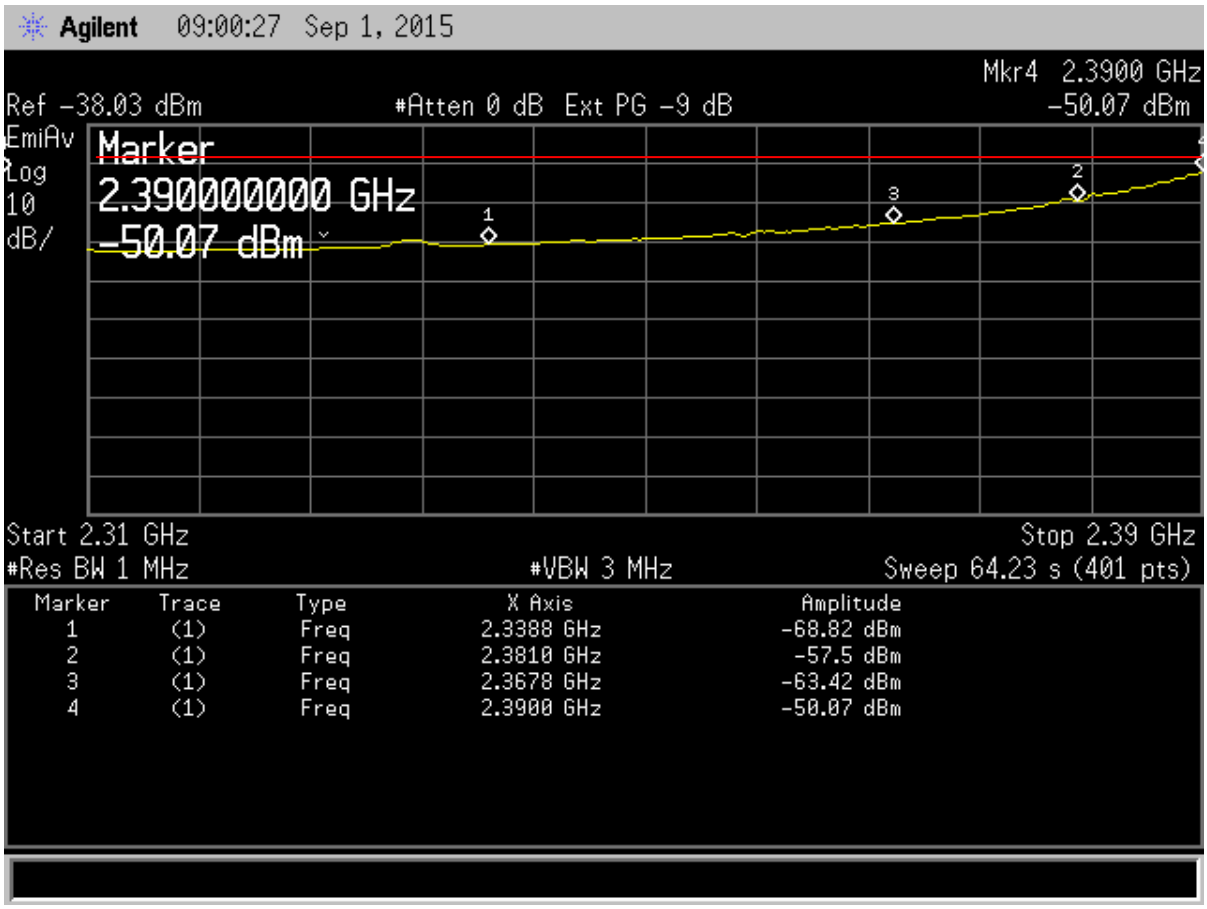


Figure 11.Condcuted Restricted Band 2310 MHz to 2390 MHz - Average

Table 11. Conducted Restricted Band 2310 MHz to 2390 MHz - Average

Frequency (MHz)	Test Data (dBm)	EIRP level	Electric field conversion	Result	Limit	Margin
2338.8	-68.82	-65.52	95.26	29.7	54.0	24.3
2381.0	-57.50	-54.20	95.26	41.1	54.0	12.9
2367.8	-63.42	-60.12	95.26	35.1	54.0	18.9
2390.0	-50.07	-46.77	95.26	48.5	54.0	5.5

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

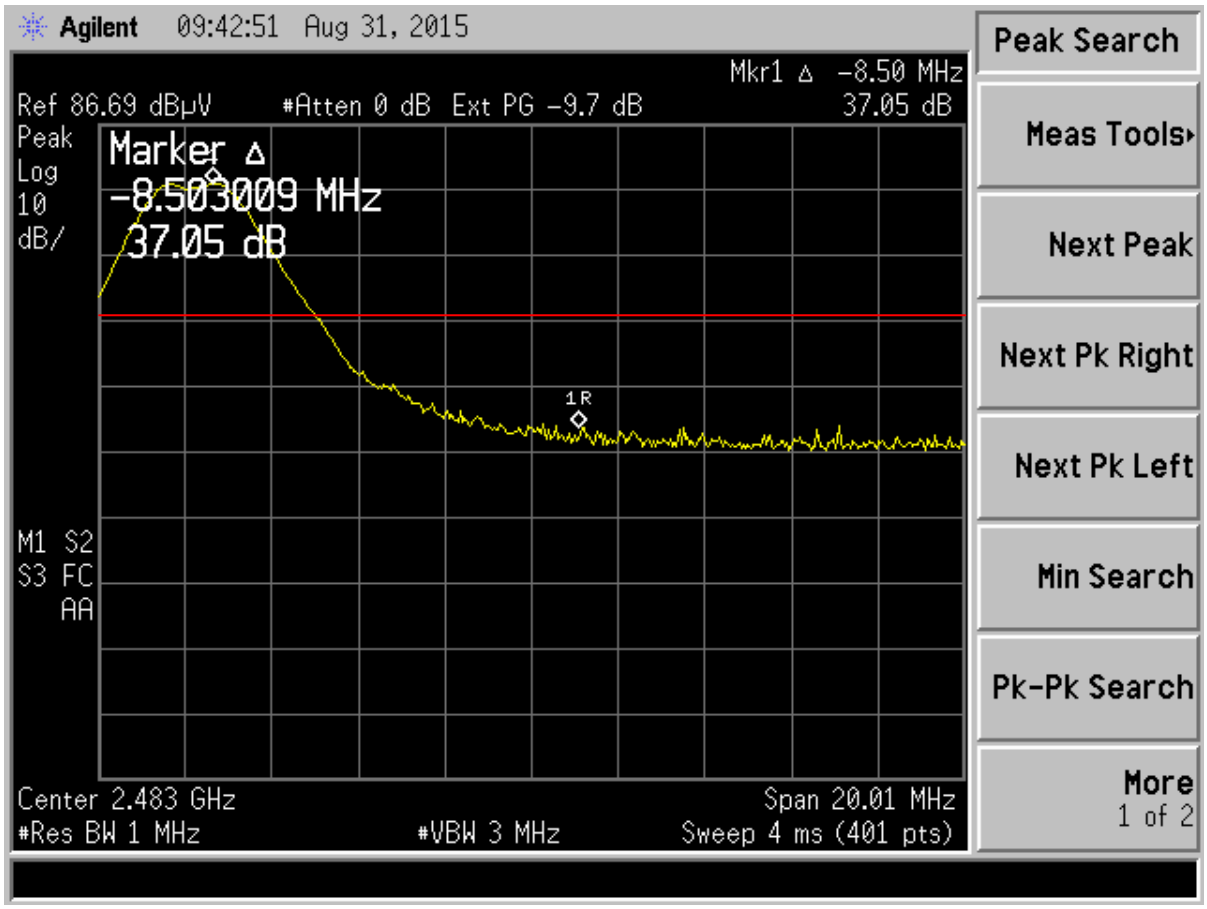


Figure 12. Band Edge Compliance, High Channel Delta – Peak

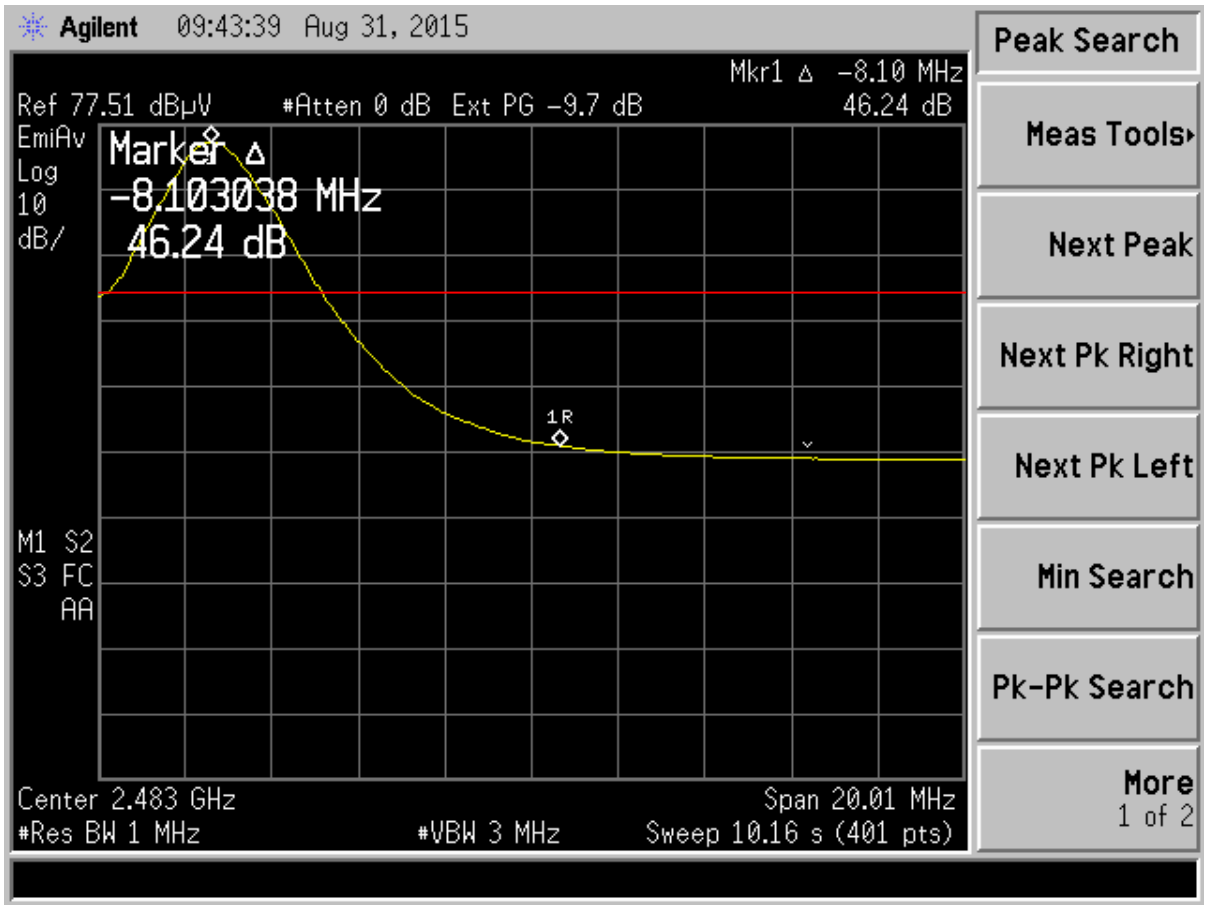


Figure 13. Band Edge Compliance, High Channel Delta – Average

Calculation of worst case lower band edge measurement:

Band Edge Calculated Results	37.05	dB
Band Edge Limit (20 dB form Fundmental)	20.00	dB
Band Edge Margin	17.05	dB

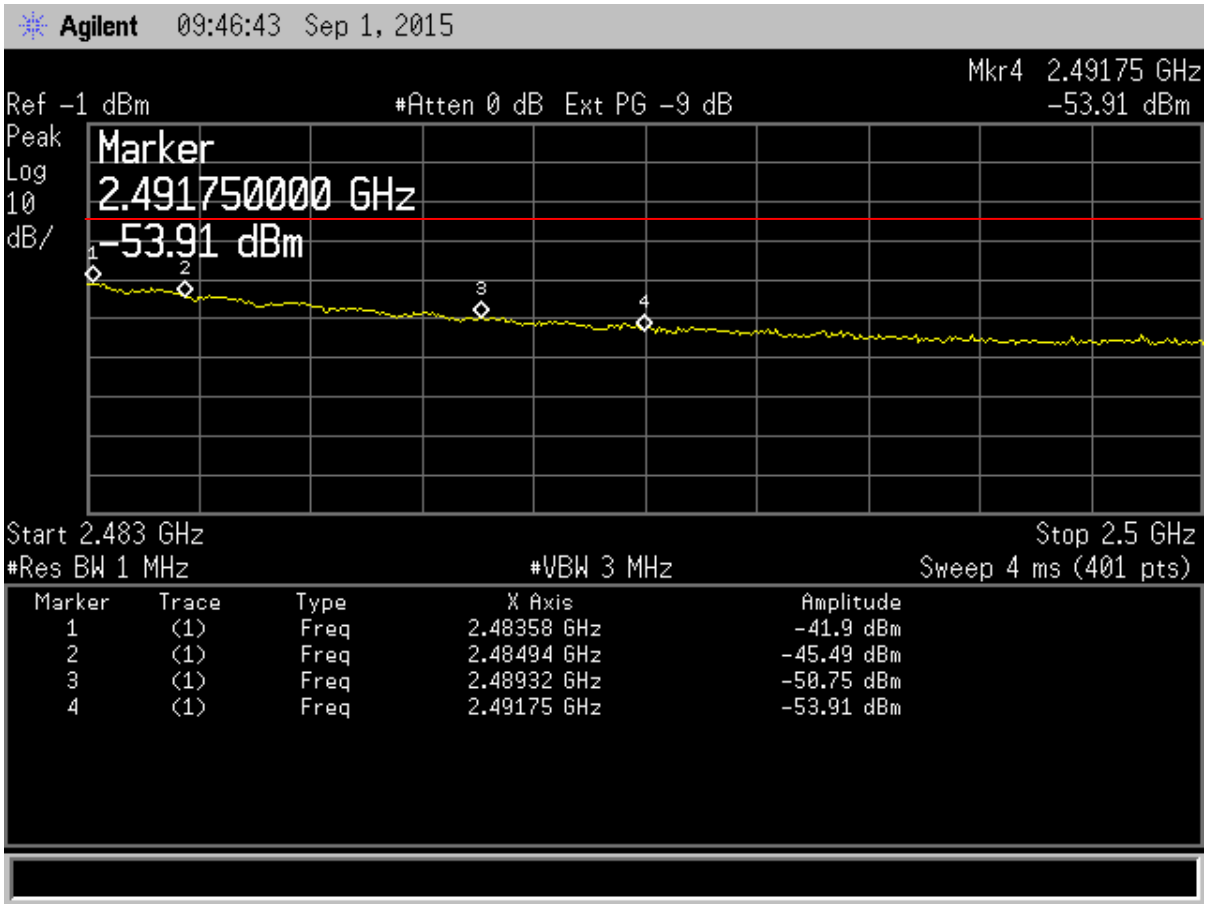


Figure 14.Condcuted Restricted Band 2483.5 MHz to 2500 MHz - Peak

Table 12. Conducted Restricted Band 2483.5 MHz to 2500 MHz - Peak

Frequency (MHz)	Test Data (dBm)	EIRP level	Electric field conversion	Result	Limit	Margin
2483.58	-41.90	-38.60	95.26	56.7	74.0	17.3
2494.94	-45.49	-42.19	95.26	53.1	74.0	20.9
2489.32	-50.75	-47.45	95.26	47.8	74.0	26.2
2491.75	-53.91	-50.61	95.26	44.7	74.0	29.3

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

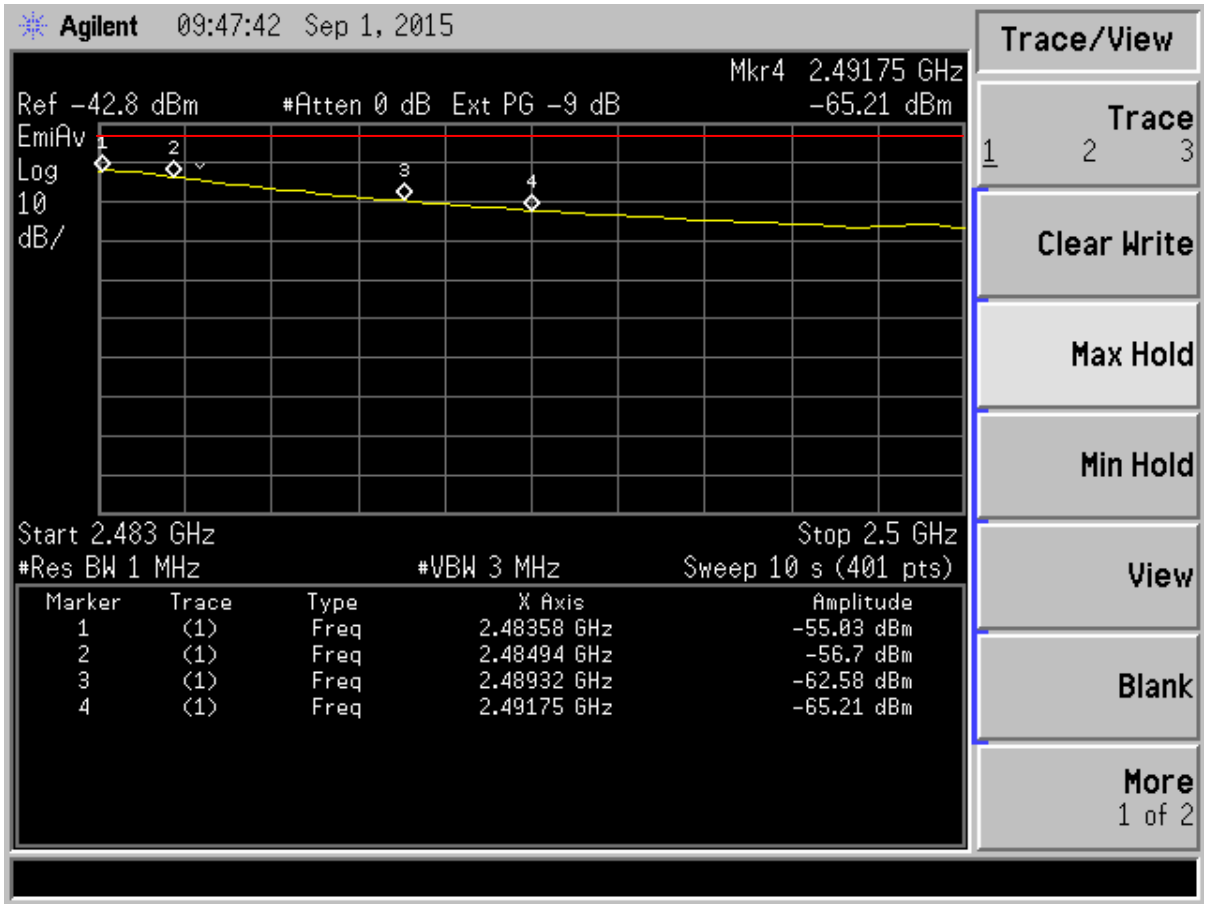


Figure 15.Condcuted Restricted Band 2483.5 MHz to 2500 MHz - Average

Table 13. Conducted Restricted Band 2483.5 MHz to 2500 MHz - Average

Frequency (MHz)	Test Data (dBm)	EIRP level	Electric field conversion	Result	Limit	Margin
2483.58	-55.03	-51.73	95.26	43.5	54.0	10.5
2484.94	-56.70	-52.77	95.26	42.5	54.0	11.5
2498.32	-62.58	-59.28	95.26	36.0	54.0	18.0
2491.75	-65.21	-61.91	95.26	33.4	54.0	20.6

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

2.12 Six (6) dB Bandwidth per CFR 15.247(a)(2)

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. 558074 D01 v03r03 for a bandwidth of 6 dB. The RBW was set to 100 kHz and with the VBW ≥ 3* RBW. The results of this test are given in the table 11 below and Figures 16 -18 below.

Table 14. Six (6) dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)
2405	1.621	0.500
2440	1.599	0.500
2475	1.599	0.500

Test Date: September 1, 2015
Tested By
Signature: _____ Name: Carrie Ingram

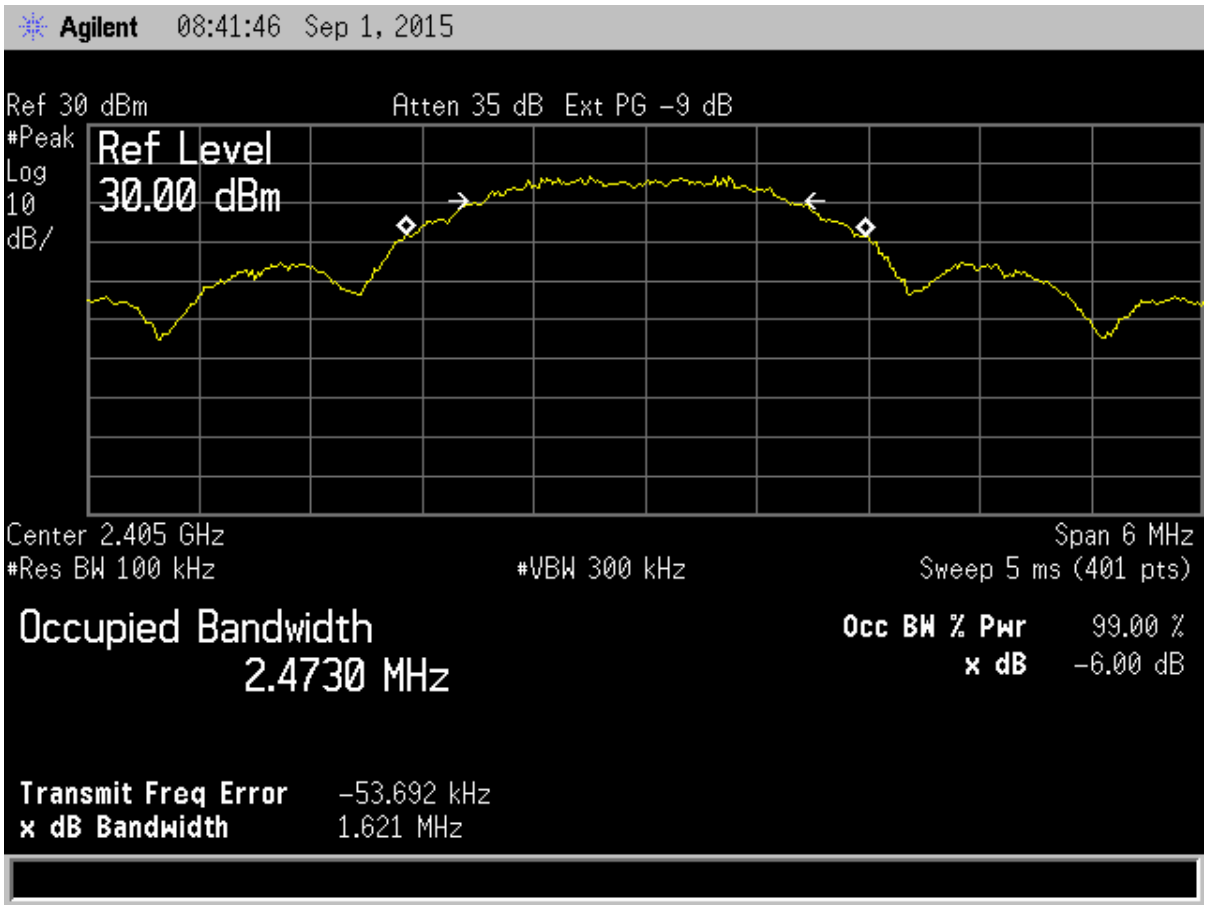


Figure 16. Six dB Bandwidth - 15.247 - Low Channel

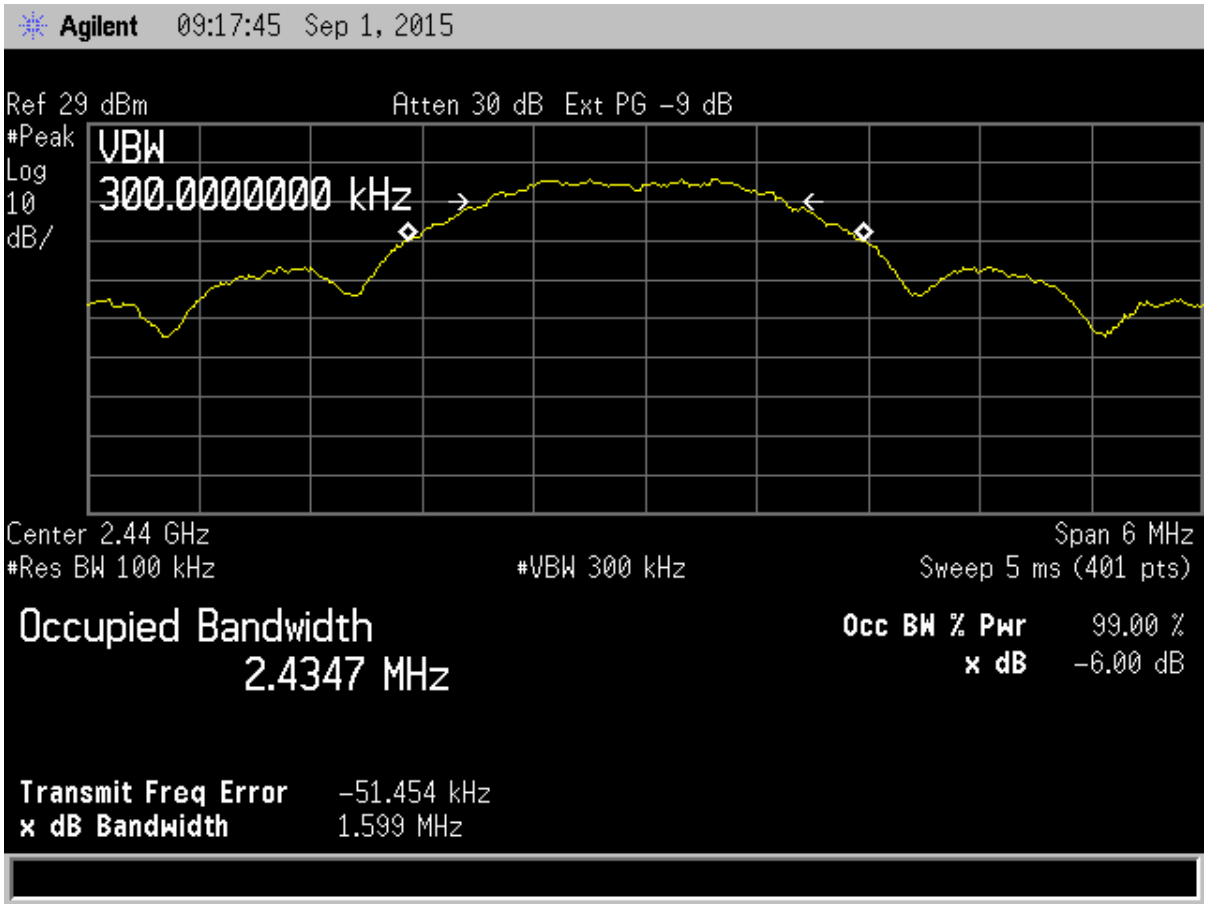


Figure 17. Six dB Bandwidth - 15.247 - Mid Channel

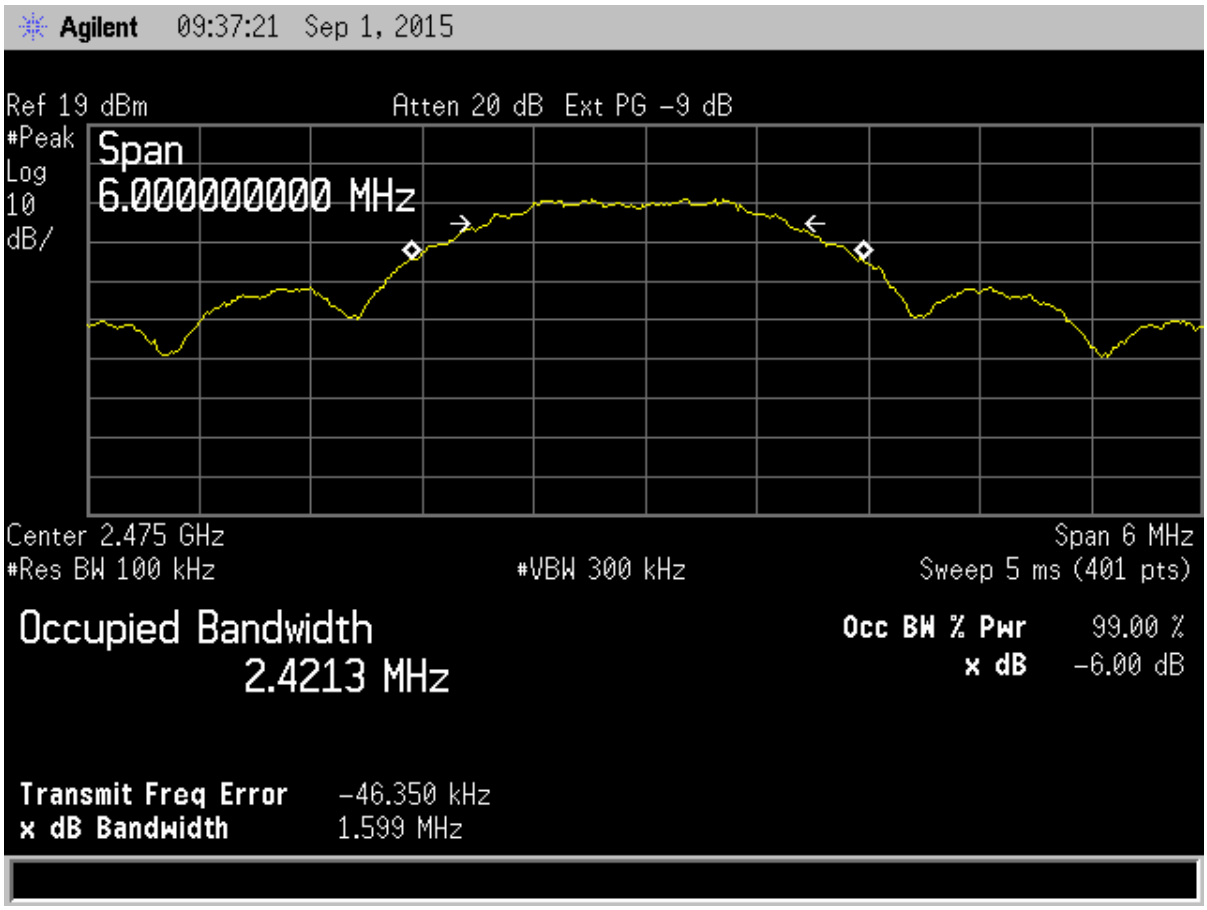


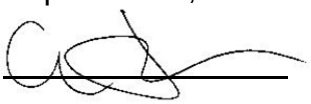
Figure 18. Six dB Bandwidth - 15.247 - High Channel

2.13 99% Occupied Bandwidth (IC RSS 247 5.7 & 5.2)

These measurements were performed while the EUT was in a constant transmit mode. A method similar to the marker delta method was used to capture the points. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ 3* RBW. The results of this test are given in Table 15 and Figures 16-18 above.

Table 15. 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)
2405	2.473
2440	2.435
2475	2.421

Test Date: September 1, 2015
Tested By
Signature:  Name: Carrie Ingram

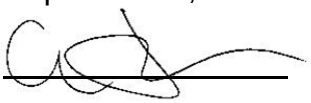
2.14 Maximum Peak Conducted Output Power (CFR 15.247 (b) (3))

The transmitter was programmed to operate at a maximum output power across the bandwidth.

Peak power within the band 2405 MHz to 2475 MHz was measured per FCC KDB Publication 558074 D01 v03r03 as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, and attenuators to the antenna output terminals on the EUT. The spectrum analyzer was set for an impedance of 50 Ω with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW ≥ RBW. Peak antenna conducted output power is tabulated in the table below.

Table 16. Peak Antenna Conducted Output Power per Part 15.247 (b) (3)

Frequency of Fundamental (MHz)	Raw Test Data dBm	Converted Data (W)	FCC Limit (W Maximum)
2405	20.5	.112	1
2440	18.0	.063	1
2475	3.4	.002	1

Test Date: September 1, 2015
Tested By
Signature:  Name: Carrie Ingram

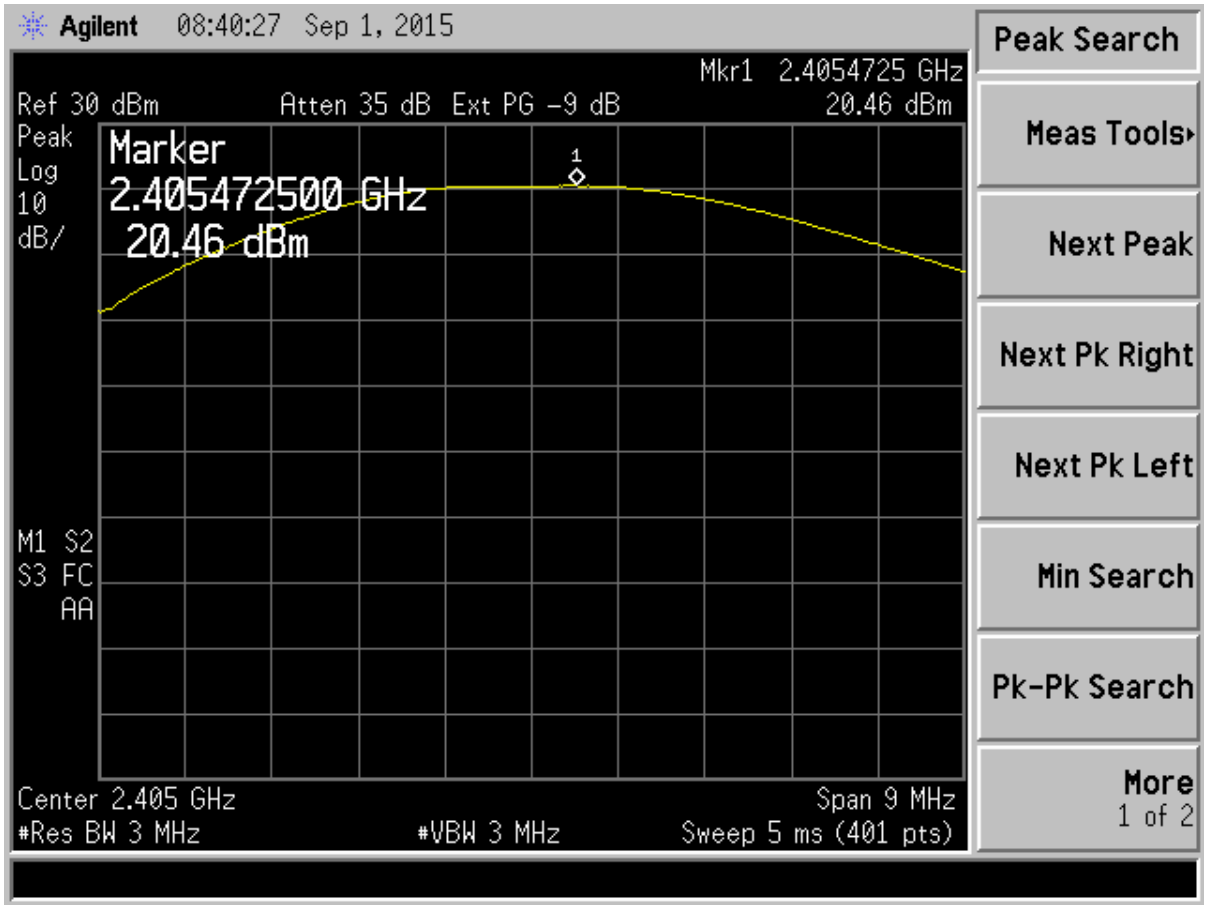


Figure 19. Peak Antenna Conducted Output Power, Low Channel

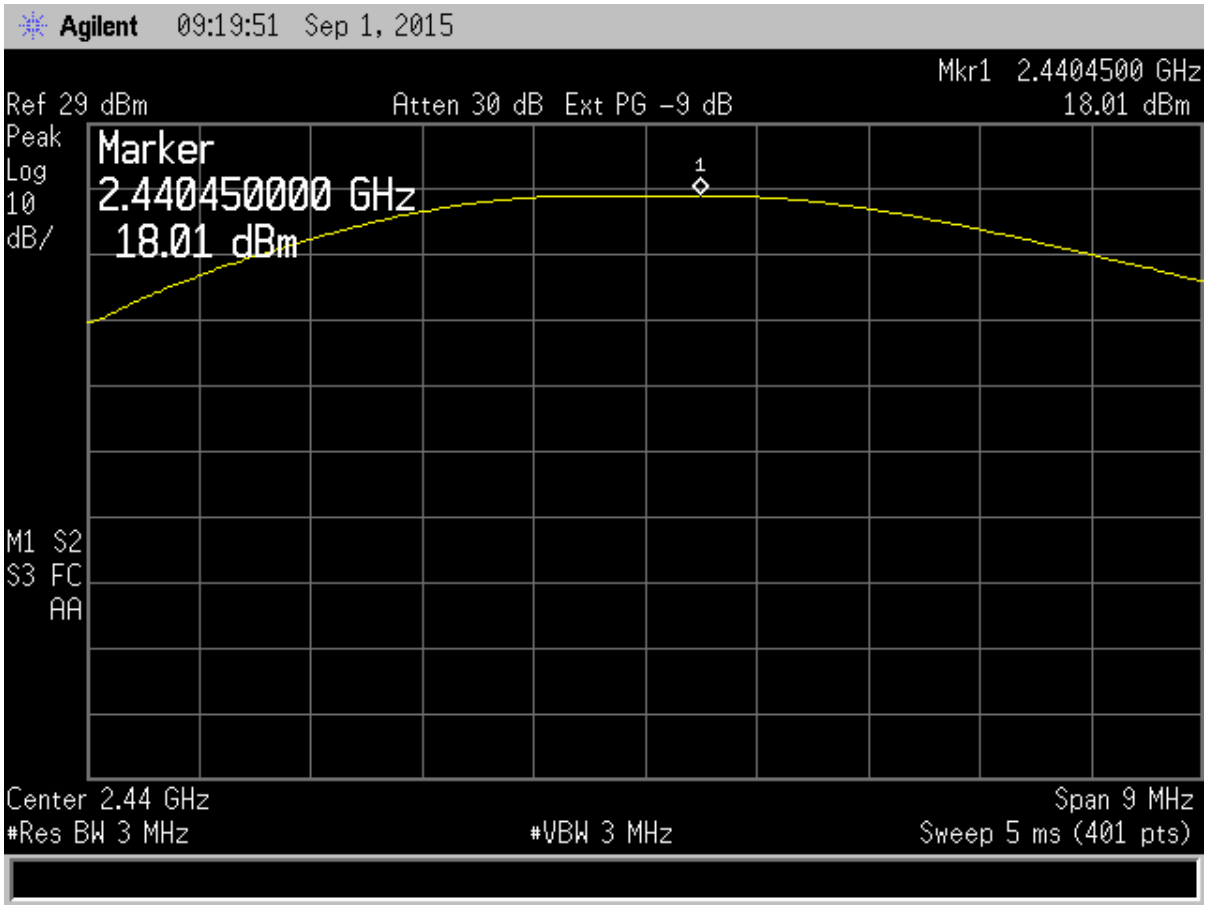


Figure 20. Peak Antenna Conducted Output Power, Mid Channel

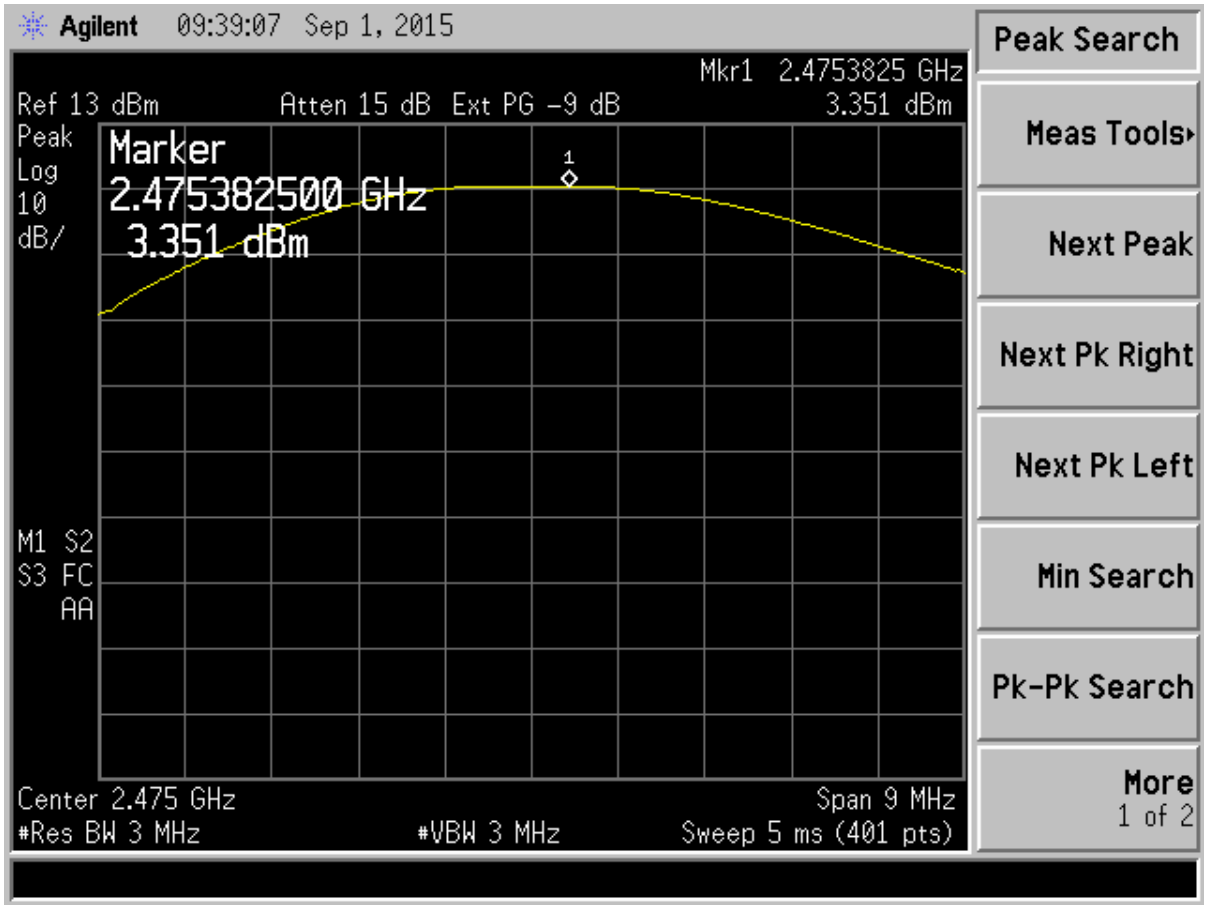


Figure 21. Peak Antenna Conducted Output Power, High Channel

2.15 Power Spectral Density (CFR 15.247(e)) (IC RSS 247 5.1 & 5.2)

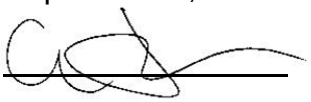
The transmitter was placed into a continuous mode of operation at all applicable frequencies. The measurements were performed per the procedures of FCC KDB Procedure 558074 D01 v03r03. The RBW was set to 3 kHz and the Video Bandwidth was set to ≥ 3 x RBW. The span was set to 1.5 times the DTS OBW.

In accordance with 15.247 (e), the power spectral density shall be no greater than +8 dBm per any 3 kHz band.

The following results show that all are less than +8 dBm per 3 kHz band.

Table 17. Power Spectral Density for Low, Mid and High Bands

Frequency (MHz)	Test Data (dBm/3 KHz)	FCC Limit (dBm/3 kHz)
2405	5.5	+8.0
2440	3.1	+8.0
2475	-11.8	+8.0

Test Date: September 1, 2015
Tested By
Signature:  Name: Carrie Ingram

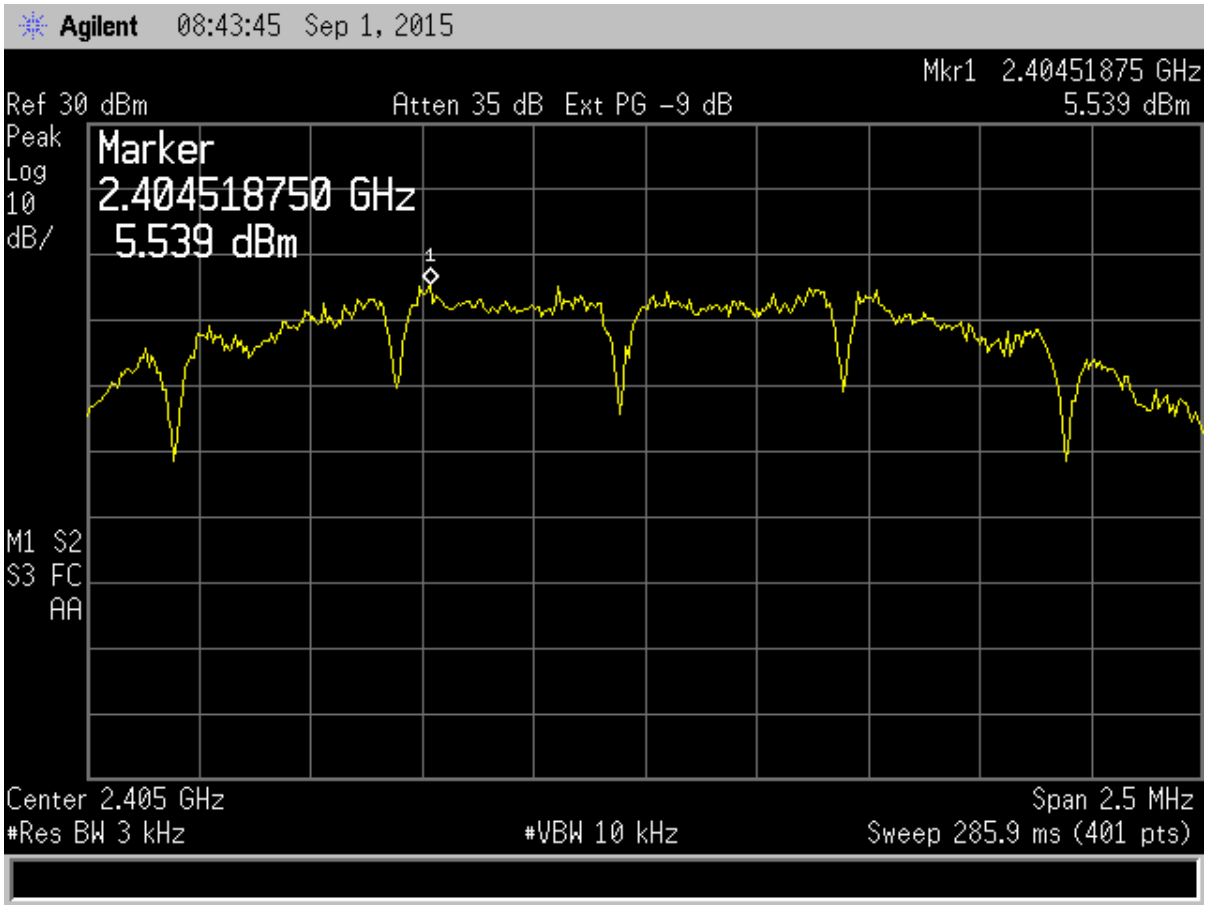


Figure 22. Peak Power Spectral Density, Low Channel

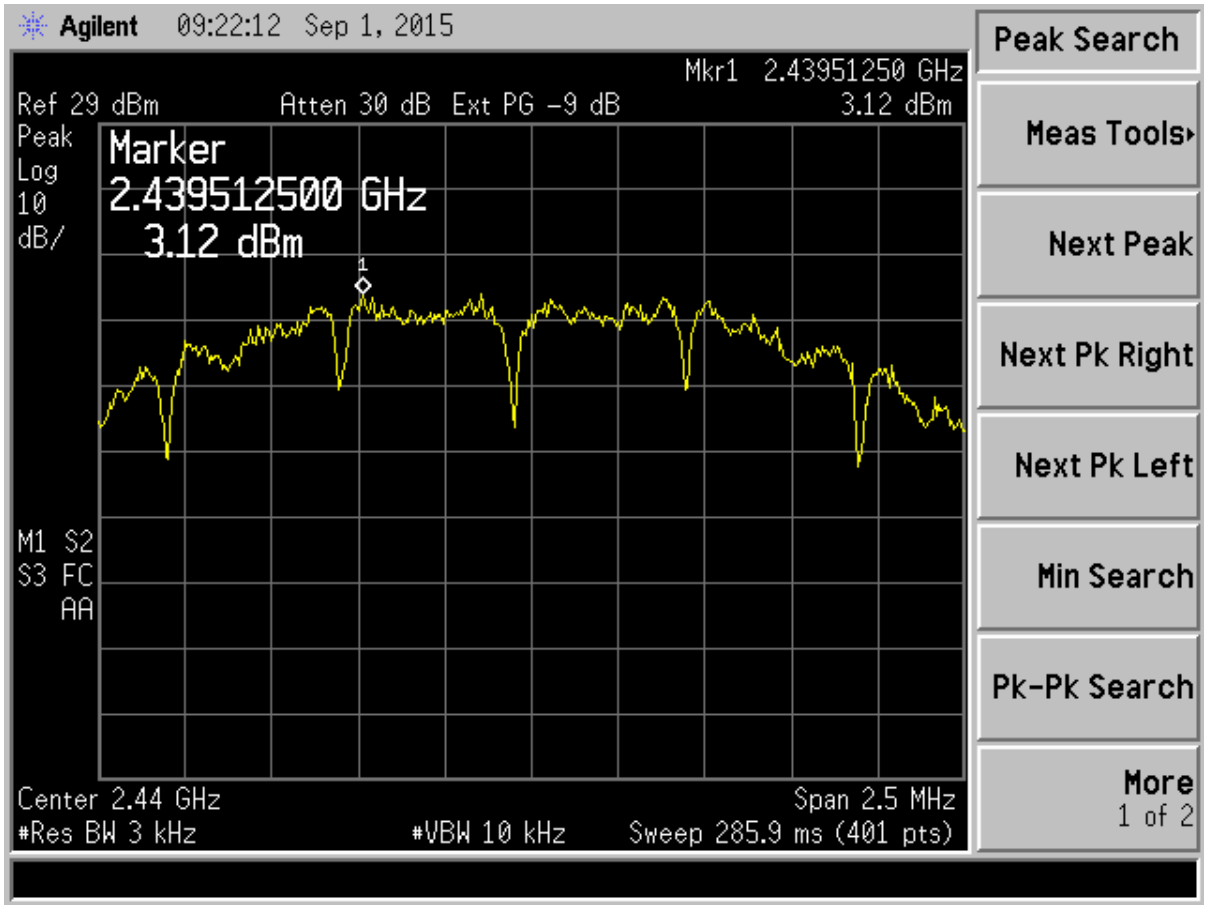


Figure 23. Peak Power Spectral Density, Mid Channel

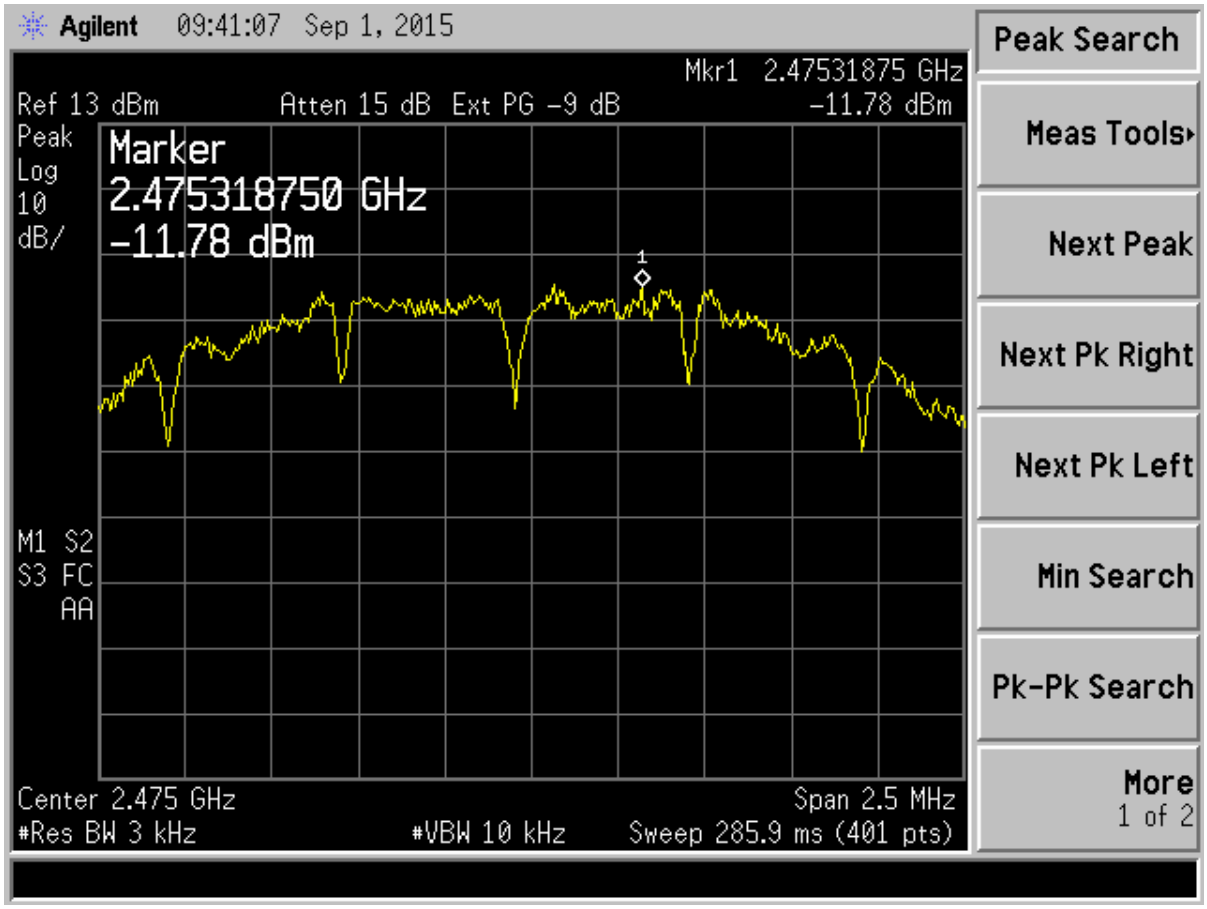


Figure 24. Peak Power Spectral Density, High Channel

2.16 Unintentional Radiator, Powerline Emissions (CFR 15.107)

The power line conducted voltage emission measurements have been carried out in accordance with CFR 15.107, per ANSI C63.4:2009 & ANSI C63.4:2014, Paragraph 7, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission.

The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission. The worst case measurement occurred on the Phase line at .15 MHz. The emission level was 4.4 dB from the applicable limit. All other emissions were at least 4.6 dB from the limit. Those results are given in the table following.

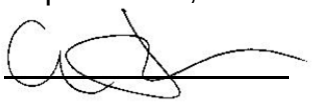
NOTE: The test data provided in this section is to support the Verification requirement for the digital apparatus and the radios within.

Table 18. Transmitter Power Line Conducted Emissions Test Data, Part 15.107

150KHz to 30 MHz with Class B Limits						
Test: Power Line Conducted Emissions				**Client:** QMotion Incorporated		
Project: 15-0218				**Model:** 150404Z		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
120 VAC, 60 Hz Phase						
0.15	50.10	1.40	51.50	55.9	4.4	**PK**
0.58	41.10	0.26	41.36	46.0	4.6	**PK**
1.30	37.00	0.26	37.26	46.0	8.7	**PK**
5.04	35.60	0.31	35.91	50.0	14.1	**PK**
17.88	31.40	0.50	31.90	50.0	18.1	**PK**
29.13	31.60	0.69	32.29	50.0	17.7	**PK**
120VAC, 60 Hz Neutral						
0.40	41.90	0.26	42.16	47.9	5.8	**PK**
0.53	34.40	0.22	34.62	46.0	11.4	**PK**
1.55	32.40	0.26	32.66	46.0	13.3	**PK**
7.95	34.20	0.42	34.62	50.0	15.4	**PK**
19.93	31.00	0.47	31.47	50.0	18.5	**PK**
24.33	30.80	0.55	31.35	50.0	18.7	**PK**

SAMPLE CALCULATION at .15 MHz:

Magnitude of Measured Frequency	50.10	dBuV
+ Cable Loss+ LISN Loss	1.40	dB
=Corrected Result	51.50	dBuV
Limit	55.90	dBuV
-Corrected Result	51.50	dBuV
Margin	4.40	dB

Test Date: September 1, 2015
Tested By
Signature:  Name: Carrie Ingram

2.17 Unintentional Radiator, Radiated Emissions (CFR 15.109)

Radiated emissions disturbance Measurements were performed with an instrument having both peak and quasi-peak detectors over the frequency range of 30 MHz to 15 GHz. Measurements of the radiated emissions were made with the receiver antenna at a distance of 3 m from the boundary of the test unit.

The test antenna was varied from 1 m to 4 m in height while watching the analyzers' display for the maximum magnitude of the signal at the test frequency. The antenna polarization (horizontal or vertical) and test sample azimuth were varied during the measurements to find the maximum field strength readings to record.

The worst-case radiated emission in the range of 30 MHz to 15 GHz was 5.7 dB below the limit at 15635 MHz. This signal is found in Table 17. All other radiated emissions were 8.1 dB or more below the limit.

NOTE: The test data provided in this section is to support the Verification requirement for the digital apparatus and the radios within.

Table 19. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109), 30 MHz to 1000 MHz

30 MHz to 1000 MHz with Class B Limits							
Test: Radiated Emissions				**Client:** QMotion Incorporated			
Project: 15-0218				**Model:** 150404Z			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or QP**
62.40	49.40	-17.50	31.90	40.0	3m./Horz	8.1	**PK**
62.51	48.40	-17.50	30.90	40.0	3m./Horz	9.1	**PK**
42.21	49.00	-16.71	32.29	40.0	3m./Vert	7.7	**PK**
59.55	50.30	-17.47	32.83	40.0	3m./Vert	7.2	**PK**
59.65	49.80	-17.47	32.33	40.0	3m./Vert	7.7	**PK**

Tested from 30 MHz to 1 GHz

SAMPLE CALCULATION at 62.40 MHz:

Magnitude of Measured Frequency	49.40	dBuV
+ Antenna Factor + Cable Loss-Amp Gain	-17.50	dB
=Corrected Result	31.90	dBuV/m
Limit	40.00	dBuV/m
-Corrected Result	31.90	dBuV
Margin	8.1	dB

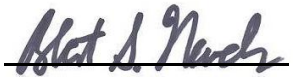
Test Date: September 1, 2015
Tested By
Signature:  Name: Robert Nevels

Table 20. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109), 1 GHz to 15 GHz

1 GHz to 15 GHz with Class B Limits							
Test: Radiated Emissions				**Client:** QMotion Incorporated			
Project: 15-0218				**Model:** 150404Z			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
15635.00	42.55	5.70	48.25	54.0	3m./Vert	5.7	**AVG**

Tested from 1 GHz to 15 GHz

SAMPLE CALCULATION at 15635 MHz:

Magnitude of Measured Frequency	42.55	dBuV
+ Antenna Factor + Cable Loss-Amp Gain	5.70	dB
=Corrected Result	48.25	dBuV/m
Limit	54.00	dBuV/m
-Corrected Result	48.25	dBuV
Margin	5.7	dB

Test Date: August 31, 2015
Tested By
Signature: _____ Name: Carrie Ingram

2.18 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.18.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.78 dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. Therefore, the EUT unconditionally meets this requirement.

2.18.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.39 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.18 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.21dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. Therefore, the EUT unconditionally meets this requirement.