Testing Tomorrow's Technology

Application for

US Code Title 47, Part 2, Subpart J, Section 2.947, Certification
Per
Part 15, Subpart C, for Intentional Radiators, Section 15.249, Intentional Radiator Operating within the Band 2400 MHz to 2483.5 MHz

And

US Code Title 47, Part 2, Subpart J, Section 2.902, Verification
Per
Part 15, Subpart B, for Unintentional Radiators, section 15.101, 15.107 and 15.109

For the

Swirl Networks

Swirl
Model: 4XAA

Manufactured by

Swirl Networks

UST Project: 15-0230
Test Date(s): October 2 – November 20, 2015
Issue Date: November 30, 2015

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

I certify that I am authorized to sign for the test facility 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: 

Name: Alan Ghasiani

Title: Consulting Engineer - President

Date: November 30, 2015

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: Swirl Networks

MODEL(S): 4XAA
FCC ID: RMS0217644XAA
IC ID: 10872A-4XAA

DATE: November 30, 2015

This report concerns (check one): Original grant_X
Class II change_____

Equipment type: Intentional Radiator Operating within the bands 2400-2483.5 MHz

Deferred grant requested per 47 CFR 0.457(d) (1) (ii)? yes_____ No_X

If yes, defer until:_____
date

__N.A.__ 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

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

SUMMARY OF TEST REQUIREMENTS

FCC Requirement	Title	Disposition
15.205	Restricted Bands	Pass
15.207	Intentional Radiator Power Line Conducted Emissions	Pass
15.209	Intentional Radiator Radiated Emissions	Pass
15.249(a)	Fundamental Field Strength	Pass
15.107	Unintentional Radiator Power Line Conducted Emissions	N/A
15.109	Unintentional Radiator Radiated Emissions	Pass

N/A = Not applicable for this unit.

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of presenting test data to be used by a Telecom Certification Body in determination of whether this product is permitted for unlicensed dissemination to the general public according to the FCC Rules and Regulations for RF Devices - Intentional Radiators.

1.2 Product Description

The Equipment Under Test (EUT) is the Swirl Networks Swirl 4XAA. The EUT is an ISM band transceiver operating in the 2400-2483.5 MHz frequency band. Per 47 CFR Part 15.31(m) the EUT was evaluated at the low, middle and high channels for operation in this band. Test data for these channels is provided herein.

The EUT is a device micro-location positioning beacon.

1.3 Related Submittal(s)/Grant(s)

1.3.1 The EUT is subject to the following FCC authorizations:

a) Certification under section 15.249 as a transmitter.
b) Verification under 15.101 as a digital device and receiver.

1.3.2 Certification of the Transmitter

The EUT employs digital modulation, but is not being certified under CFR 15.247 because the field strength of the fundamental and its harmonics are within the limits specified in 47 CFR 15.249. Therefore the EUT is instead being presented under the requirements of CFR 15.249. The EUT will operate within the frequency band of 2400 MHz to 2483.5 MHz.

1.3.3 Verification of the Digital Apparatus

The EUT was tested as a complete end product and not a radio module assembly, therefore by meeting the requirements of 15.207 and 15.209; the EUT will have also met the requirements of 15.107 and 15.109 for verification of the digital apparatus.

2 Tests and Measurements

2.1 Configuration of Tested System

The sample was set up and tested per ANSI C63.4, Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz (2009/2014). Conducted and radiated emissions data were taken with the EMC test receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. A Block diagram of the tested system is shown in Figure 1. A listing of the EUT and its test peripherals is found in Table 1 below. Test configuration photographs for spurious and fundamental emissions measurements are in the attached appendices.

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

Figure 1. Test Configuration

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID: IC ID:	CABLES P/D
Beacon device (EUT) Swirl Networks	4XAA	Engineering Sample	Pending: FCC ID: RMS0217644XAA IC: 10872A-4XAA	N/A
Batteries (x4) Panasonic	Size AA	None	None	N/A

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

2.2 EUT Characterization

The sample used for testing was received by US Tech on September 30, 2015 in good operating condition.

2.3 Test Facility

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

2.4 Test Equipment

Table 2 describes test equipment used to evaluate this product.

Table 2. Test Instruments used for Evaluation

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	9/28/2015 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.
HORN ANTENNA	3116	EMCO	9505-2255	1/27/2015 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 is 12 months unless stated otherwise, and all calibrations are traceable to NIST/USA.

2.5 Modifications to EUT

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15, Subpart B, Class B Limits for the receiver and digital portion of the EUT or the Subpart C, Transmitter requirements.

2.6 Measurement Standards (CFR 15.31)

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 from 2400 MHz to 2483.5 MHz, 3 test frequencies were used.

2.7 Frequency Range of Radiated Measurements (CFR 15.33)

The frequency range is detailed below for intentional and unintentional radiators.

2.7.1 Frequency Range for Intentional Radiators

The spectrum was investigated from the lowest RF signal generated without going below 9 kHz to the 10th harmonic of the highest fundamental transmitter frequency.

2.7.2 Frequency Range for Unintentional Radiators

The spectrum was investigated from the lowest RF signal generated without going below the lowest frequency for which an emissions limit is specified (30 MHz) to the 5th harmonic of the highest fundamental frequency of the digital device (12.5 GHz maximum).

2.7.3 Measurement Detector Function and Bandwidth (CFR 15.35)

On any frequency below 1000 MHz, the limits shown are based upon measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths. On frequencies above 1000 MHz, the radiation limits are based upon the use of measuring instrumentation employing an average detector function.

When average detector measurements are specified for use, including emission measurements below 1000 MHz, there is also a corresponding limit for Peak detector measurements having a limit of 20 dB above the corresponding average limit unless a different peak emission limit is specified. Measurements above 1000 MHz utilize a minimum resolution bandwidth of 1 MHz.

When radiated emissions limits are expressed in terms of the average value of the emission and pulsed operation is employed, the measurement field strength is determined by averaging over one complete pulse train (Duty Cycle) including blanking intervals for pulse trains up to 0.1 second in duration. The exact method of calculating the average field strength is included in paragraph 2.11 of this report. Refer to Figures 2 and 3 for duty cycle measurement data.

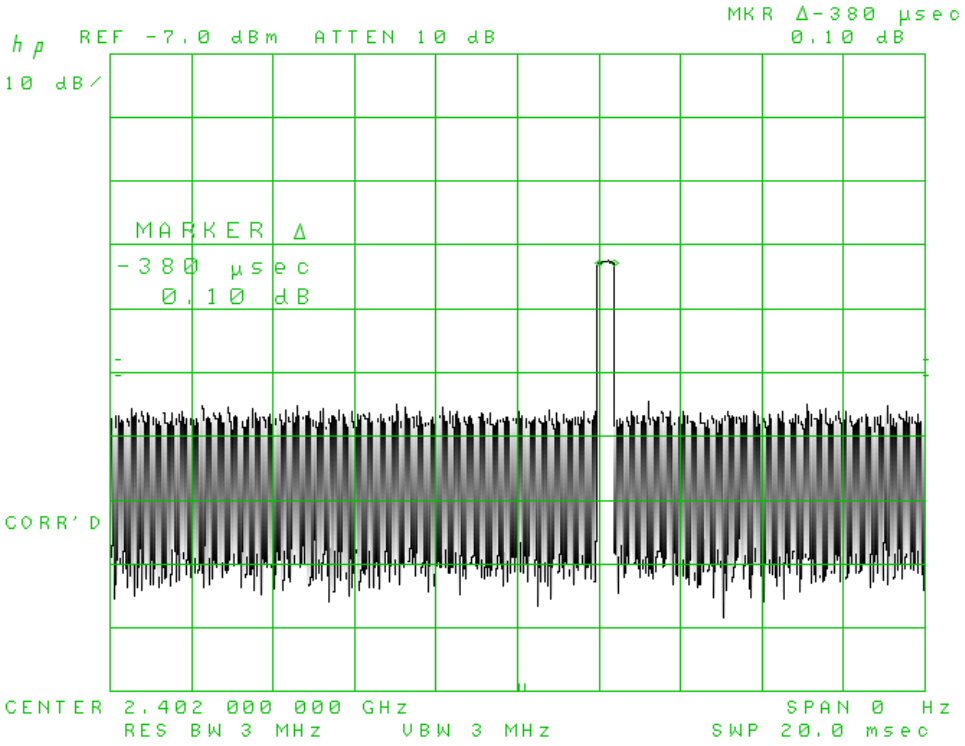

Figure 2. Transmitter Pulse Width (20ms)

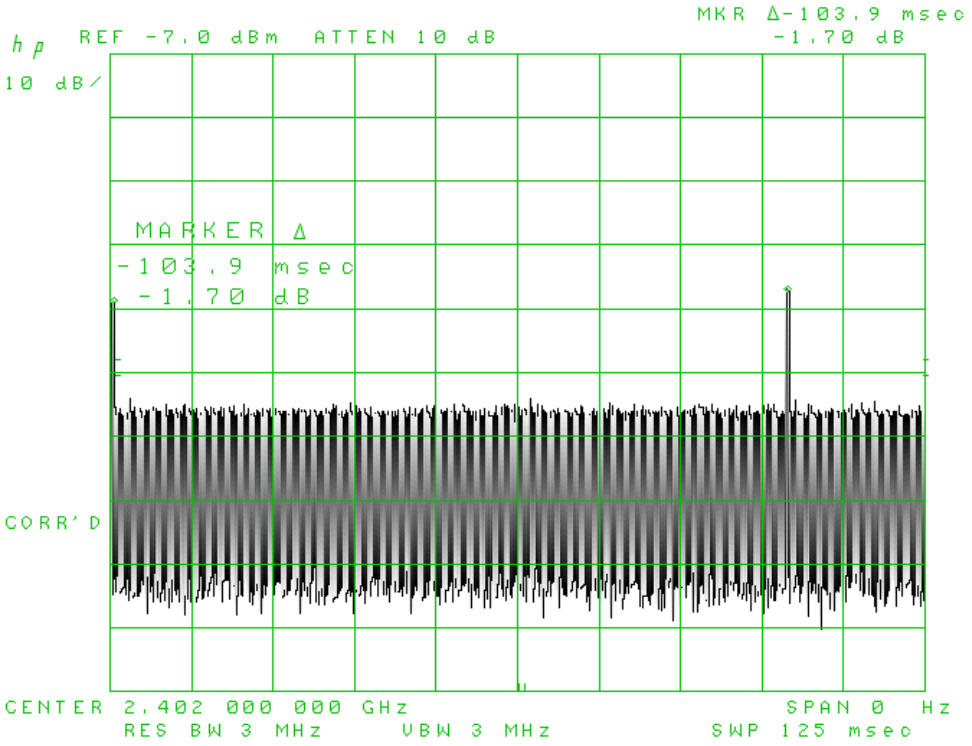

Figure 3. Transmitter Pulse Width (125ms)

(.380mS)/100mS = 0.0038 = 0.38% percent

Duty Cycle = 20 Log (0.0038) = -48.0 dB

The Duty Cycle applied in this test report is -20 dB.

2.8 Antenna Requirement (CFR 15.203)

The EUT has an internal radiator; there are no external antenna ports.

Table 4. Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	REPORT REFERENCE	GAIN dB_i	TYPE OF CONNECTOR
Swirl Networks	PCB Trace	Engineering Sample	Antenna	3.3	PCB Trace Antenna

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

The EUT is powered by four AA size 1.5VDC alkaline batteries. The test data is presented in section 2.13 below.

2.10 Intentional Radiator, Radiated Emissions (CFR 15.249 (a), (e))

The EUT was placed into a continuous transmit mode of operation. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product and to obtain the worse case result the EUT tested in all X, Y and Z axis. Radiated measurements below 30 MHz were tested with a RBW = 9 kHz; emissions below 1 GHz were tested with a RBW = 120 kHz and radiated measurements above 1 GHz were measured using a RBW =1 MHz VBW = 3 MHz.

Test data is found in Tables 5 and 6 below.

2.11 Restricted Bands of Operation (CFR 15.205)

Only radiated harmonics and other spurious signals can be permitted to fall into the restricted bands of 15.205. All signals found in paragraph 2.7 above shall be examined for this requirement. Limits are based upon the limits of paragraph 15.209. Above 1 GHz, the limits are for Average value. See Tables 5 and 6 below for peak and Average measurements. According to CFR 15.35, the peak limits can exceed the average limits by 20 dB.

Table 5. Peak Fundamental and Harmonics, (CFR15.249 (a))

Radiated Fundamental and Harmonics Emissions								
Tested By: CF	Test: Fundamental and Harmonics CFR 15.249 (a)				Client: Swirl Networks			
	Project: 15-0230		Class: N/A		Model: 4XAA			
Frequency (MHz)	**Test Data (dBuV)**	**DF+FL***	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Peak Limits (dBuV/m)**	**Distance / Polarity (Meters)**	**Margin (dB)**	**Det PK / QP**
2401.02	74.01	0.0	30.96	104.97	114.0	3.0m./VERT	9.0	**PK**
4801.90	57.70	0.0	1.98	59.68	74.0	3.0m./VERT	14.3	**PK**
7202.87	50.88	0.0	4.87	55.75	74.0	3.0m./VERT	18.2	**PK**
2402.00	71.88	0.0	30.96	102.84	114.0	3.0m./VERT	11.2	**PK**
4804.00	54.21	0.0	1.98	56.19	74.0	3.0m./VERT	17.8	**PK**
7206.00	50.11	0.0	4.87	54.98	74.0	3.0m./VERT	19.0	**PK**
2426.00	71.35	0.0	30.96	102.31	114.0	3.0m./VERT	11.7	**PK**
4852.00	52.19	0.0	1.95	54.14	74.0	3.0m./VERT	19.8	**PK**
7278.00	47.48	0.0	4.81	52.29	74.0	3.0m./VERT	21.7	**PK**
2480.00	70.74	0.0	30.96	101.70	114.0	3.0m./VERT	12.3	**PK**
4960.00	48.26	0.0	1.26	49.52	74.0	3.0m./VERT	24.5	**PK**
7440.00	44.09	0.0	5.14	49.23	74.0	3.0m./VERT	24.7	**PK**

All other emissions were at least 20 dB below the applicable limit.
*measurements at 1 meter were extrapolated to 3 meter using a factor of -9.5 dB.

Sample Calculation at 4804 MHz:

Magnitude of Measured Frequency	54.21	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	1.98	dB/m
Corrected Result	56.19	dBuV/m

Test Date: October 2, 2015
Tested By
Signature: _____ Name: Carrie Ingram

Table 6. Fund and Harmonics Average limits, (CFR 15.35(b), 15.249(a))

Radiated Fundamental and Harmonics Emissions								
Tested By: GY	Test: Fundamental and Harmonics CFR 15.249 (a)				Client: Swirl Networks			
	Project: 15-0230		Class: N/A		Model: 4XAA			
Frequency (MHz)	**Test Data (dBuV)**	**DF+FL**	**AF+CL-PA+DC (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarity (Meters)**	**Margin (dB)**	**Det PK / QP**
2401.02	74.01	-20.00	30.96	84.97	94.0	3.0m./VERT	9.0	**PK**
4801.90	57.70	-20.00**	1.98	39.68	54.0	3.0m./VERT	14.3	**PK**
7202.87	50.88	-20.00**	4.87	35.75	54.0	3.0m./VERT	18.2	**PK**
2402.00	71.88	-20.00**	30.96	82.84	94.0	3.0m./VERT	11.2	**PK**
4804.00	54.21	-20.00**	1.98	36.19	54.0	3.0m./VERT	17.8	**PK**
7206.00	50.11	-20.00**	4.87	34.98	54.0	3.0m./VERT	19.0	**PK**
2426.00	71.35	-20.00**	30.96	82.31	94.0	3.0m./VERT	11.7	**PK**
4852.00	52.19	-20.00**	1.95	34.14	54.0	3.0m./VERT	19.8	**PK**
7278.00	47.48	-20.00**	4.81	32.29	54.0	3.0m./VERT	21.7	**PK**
2480.00	70.74	-20.00**	30.96	81.70	94.0	3.0m./VERT	12.3	**PK**
4960.00	48.26	-20.00**	1.26	29.52	54.0	3.0m./VERT	24.5	**PK**
7440.00	44.09	-20.00**	5.14	29.23	54.0	3.0m./VERT	24.7	**PK**

All other emissions were at least 20 dB below the applicable limit.
*measurements at 1 meter were extrapolated to 3 meter using a factor of -9.5 dB.
*duty cycle factor = -20 dB

Sample Calculation at 4804 MHz:

Magnitude of Measured Frequency	54.21	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	1.98	dB/m
Duty Cycle Correction Factor	-20.00	dB
Corrected Result	36.19	dBuV/m

Test Date: October 2, 2015
Tested By
Signature: _____ Name: Carrie Ingram

2.13 99% Occupied Bandwidth (IC RSS 210, A8.1)

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 ≥ RBW. The results of this test are given in Table 12 and Figures 21-23.

Table 7. 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)
2401.00	0.900
2402.00	1.350
2426.00	1.380
2480.00	1.368

Test Date: October 8, 2015
Tested By
Signature: _____ Name: Carrie Ingram

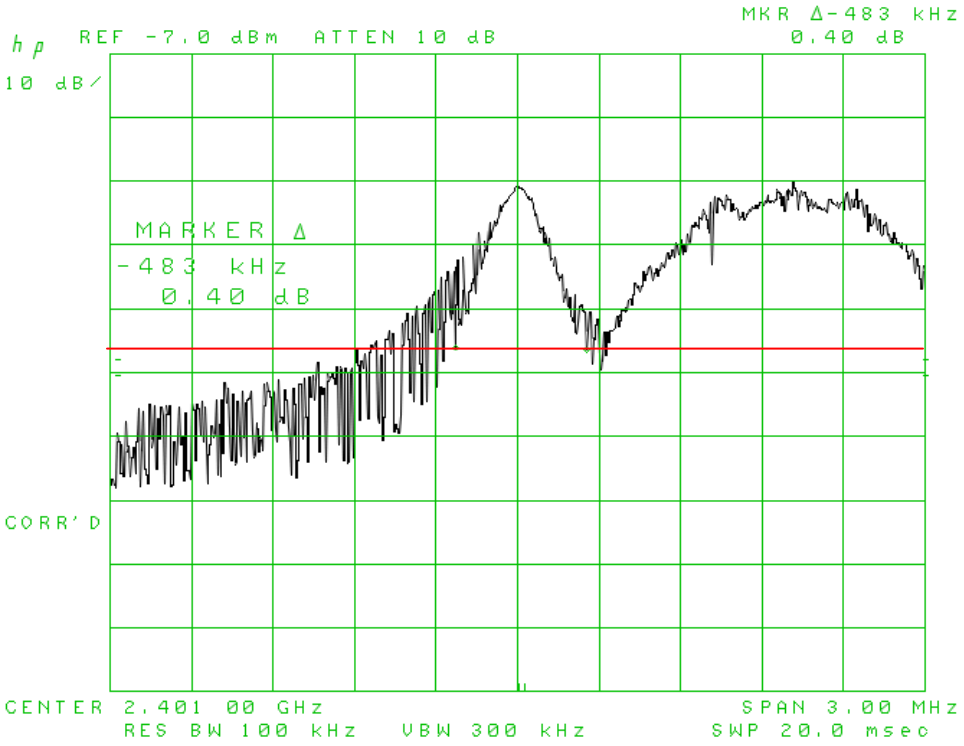

Figure 4. 2401 Mhz Channel Bandwidth

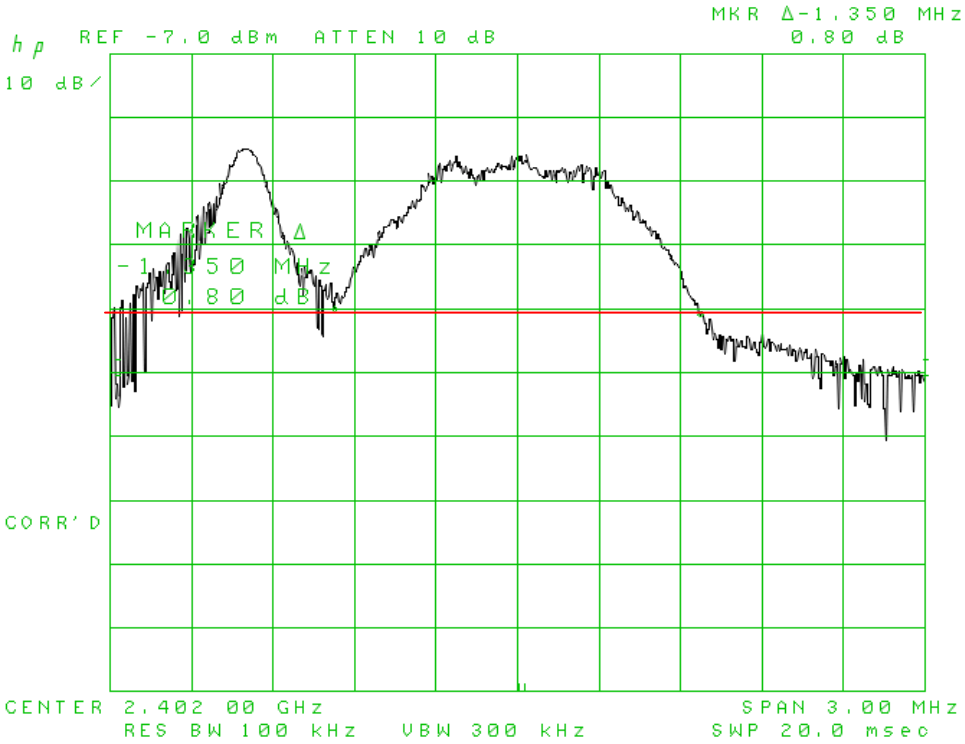

Figure 5. 2402 Mhz Channel Bandwidth

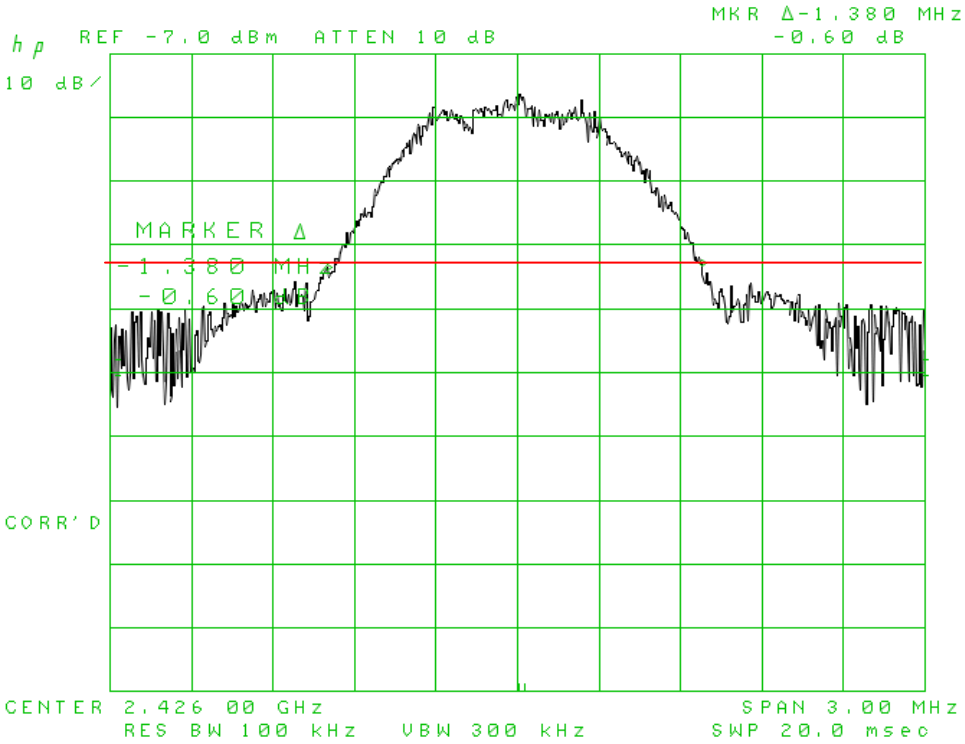

Figure 6. 2426 Mhz Channel Bandwidth

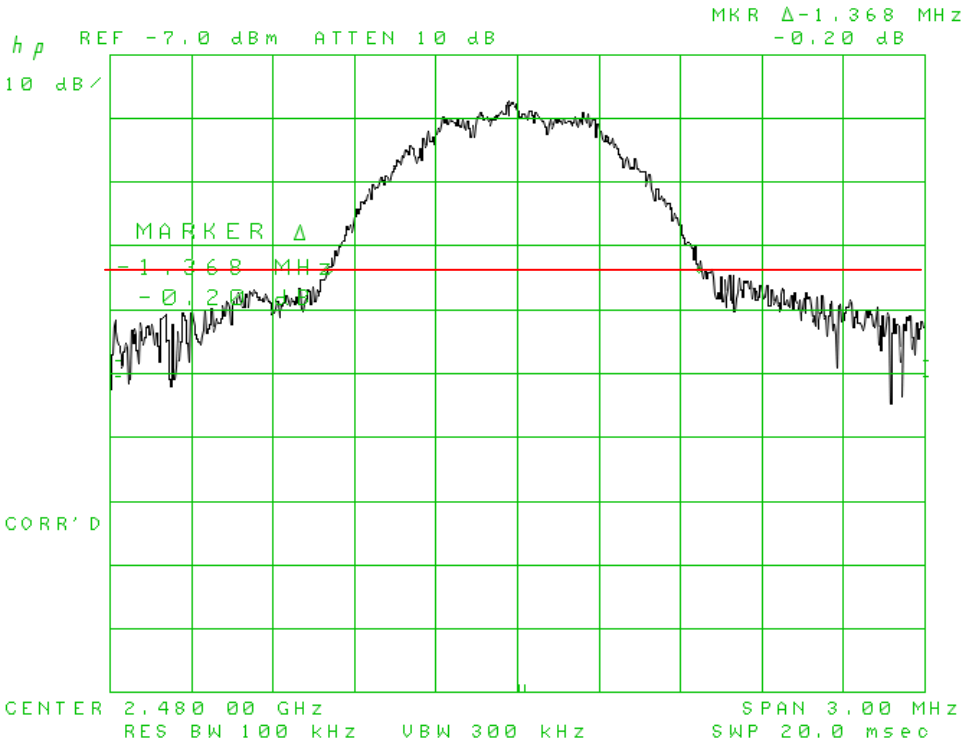

Figure 7. 2480 Mhz Channel Bandwidth

2.12 Band Edge Measurements and Restricted Bands (CFR15.249(d))

Band edge measurements were made at a Low Channel and High Channel peak at highest EUT related emission outside the upper and lower occupied bandwidth. A measurement was made of the fundamental and the emission was measured using a quasi peak or AVG detector setting. A Resolution Bandwidth of > 1% of the emission bandwidth was used.

The limit per section 15.249(d) states: emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

2.12.1 High Band Edge

PEAK: The High Channel fundamental recorded in Table 5 is 101.70 dBuV/m:
101.70- 39.83 = 61.87; Passing Margin= 74 – 61.87 = 12.13 dB

AVG: The High Channel fundamental recorded in Table 5 is 101.70 dBuV/m:
101.70- 39.83 = 61.87; 61.87- Duty cycle (-20 dB) = 41.87
Passing Margin= 54 – 41.87 = 12.13 dB

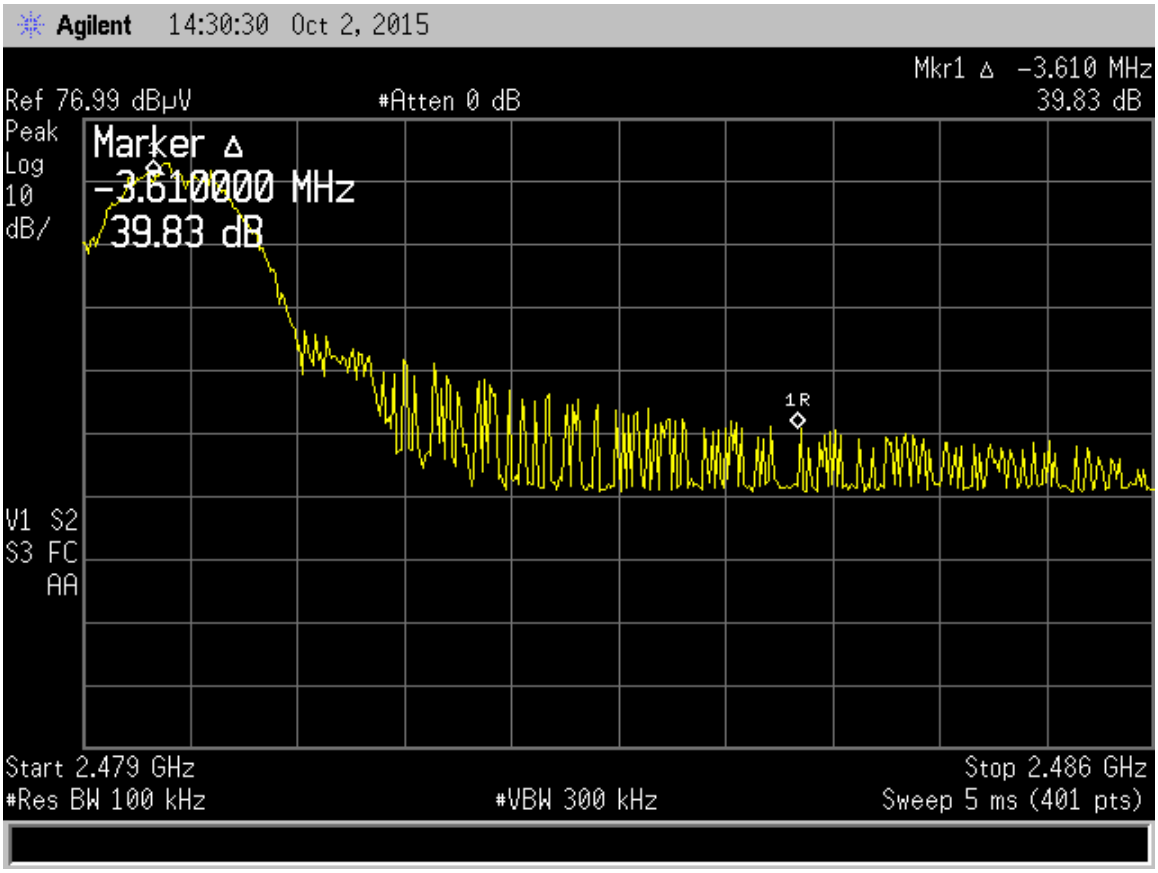

Figure 8. Radiated Band Edge – High Channel Delta

Restricted band emissions verification:

Table 8. Restricted Band Emissions Verification (High Channel)

Frequency (MHz)	AF Table	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2484.75	1HN3mV	40.43	31.92	72.35	74.0	3.0m./VERT	1.6	**PK**
2480.31	1HN3mV	38.05	31.92	69.97	74.0	3.0m./VERT	4.0	**PK**
2492.45	1HN3mV	27.79	31.92	59.71	74.0	3.0m./VERT	14.3	**PK**
2497.48	1HN3mV	26.84	31.92	58.76	74.0	3.0m./VERT	15.2	**PK**

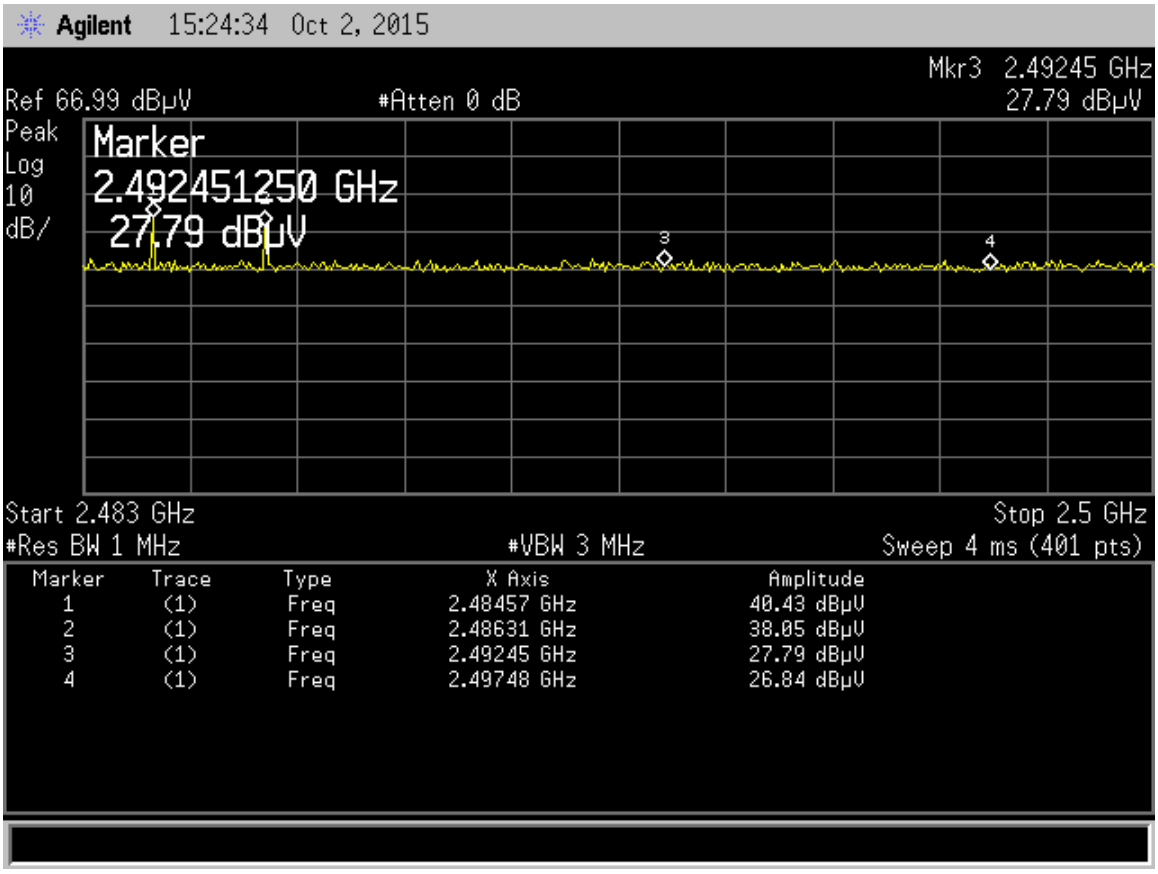

Figure 9. Emissions within the Band 2.483-2.5 GHz

Table 9. Restricted Band Emissions Verification (Low Channel)

Frequency (MHz)	AF Table	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2495.17	1HN3mV	15.67	31.92	47.59	54.0	3.0m./VERT	6.4	**AVG**
2489.28	1HN3mV	15.61	31.92	47.53	54.0	3.0m./VERT	6.5	**AVG**
2486.55	1HN3mV	15.58	31.92	47.50	54.0	3.0m./VERT	6.5	**AVG**
2497.48	1HN3mV	15.72	31.92	47.64	54.0	3.0m./VERT	6.4	**AVG**

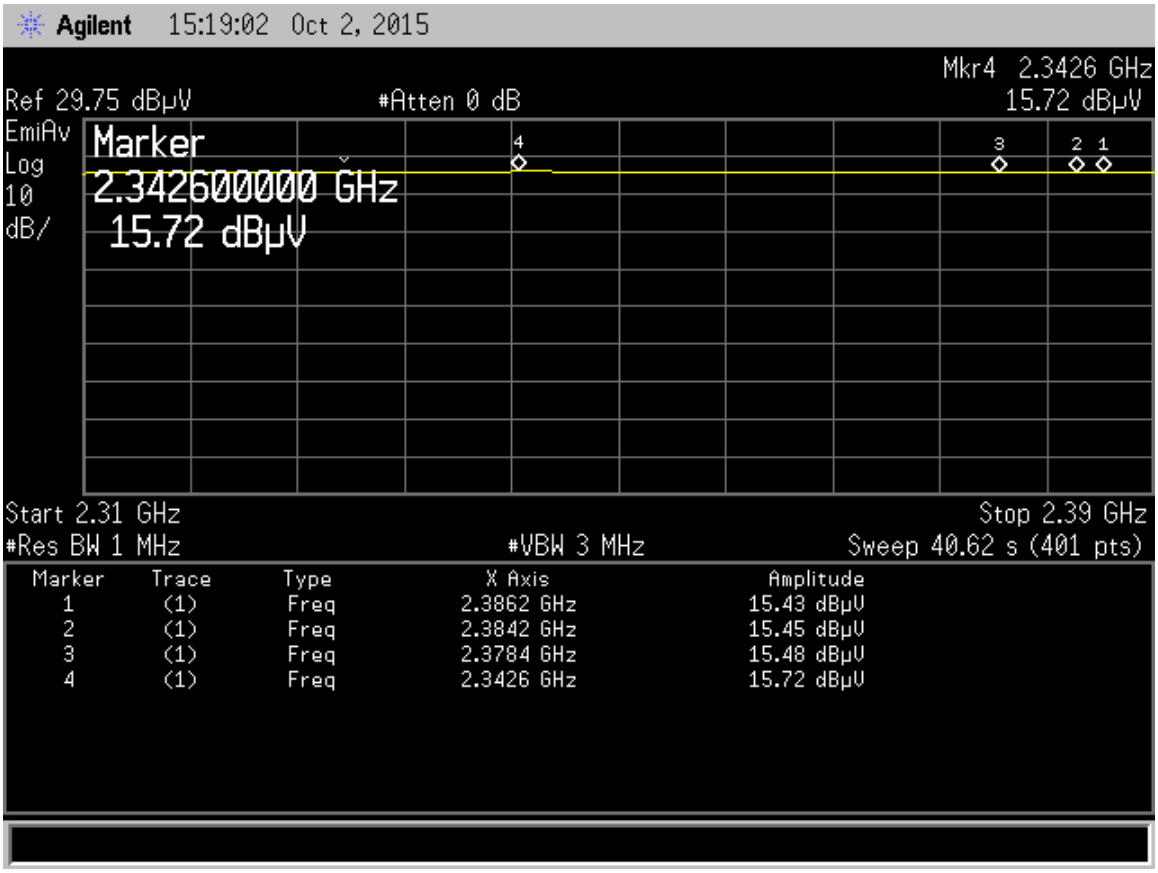

Figure 10. Emissions within the Band 2.31-2.39 GHz

2.12.2 Low Band Edge

PEAK: The High Channel fundamental recorded in Table 5 is 104.97 dBuV/m:
104.97- 32.62 = 72.31; Passing Margin= 74 – 72.31 = 1.69 dB

AVG: The High Channel fundamental recorded in Table 5 is 104.97 dBuV/m:
104.97- 32.62 = 72.31; 72.31 - Duty Cycle (-20 dB) = 52.31
Passing Margin= 54 – 52.31 = 1.69 dB

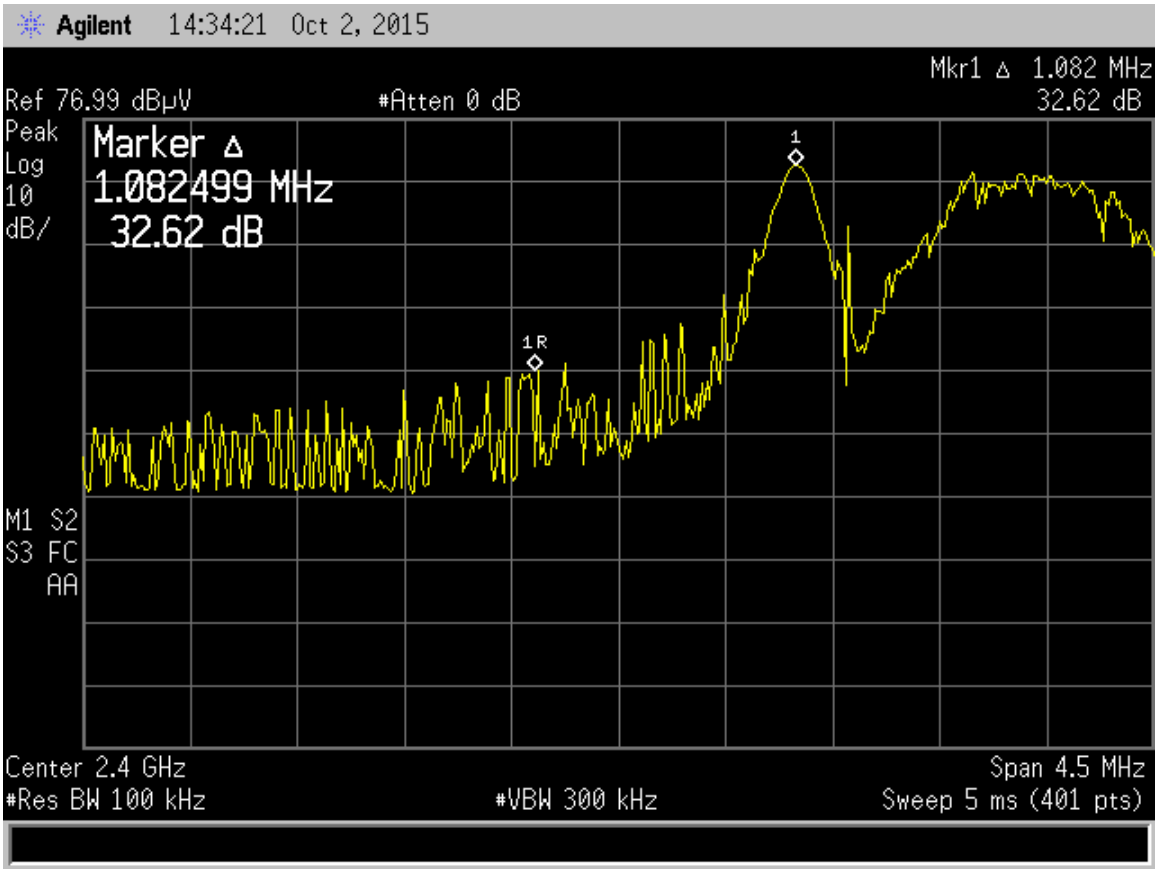

Figure 11. Radiated Band Edge – Low Channel Delta

Restricted band emissions verification:

Table 10. Restricted Band Emissions Verification (Low Channel)

Frequency (MHz)	AF Table	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2386.20	1Hn3mV	36.09	31.76	67.85	74.0	3.0m./VERT	6.2	**PK**
2384.20	1Hn3mV	32.42	31.76	64.18	74.0	3.0m./VERT	9.8	**PK**
2378.40	1Hn3mV	30.10	31.76	61.86	74.0	3.0m./VERT	12.1	**PK**
2358.60	1Hn3mV	30.02	31.76	61.78	74.0	3.0m./VERT	12.2	**PK**

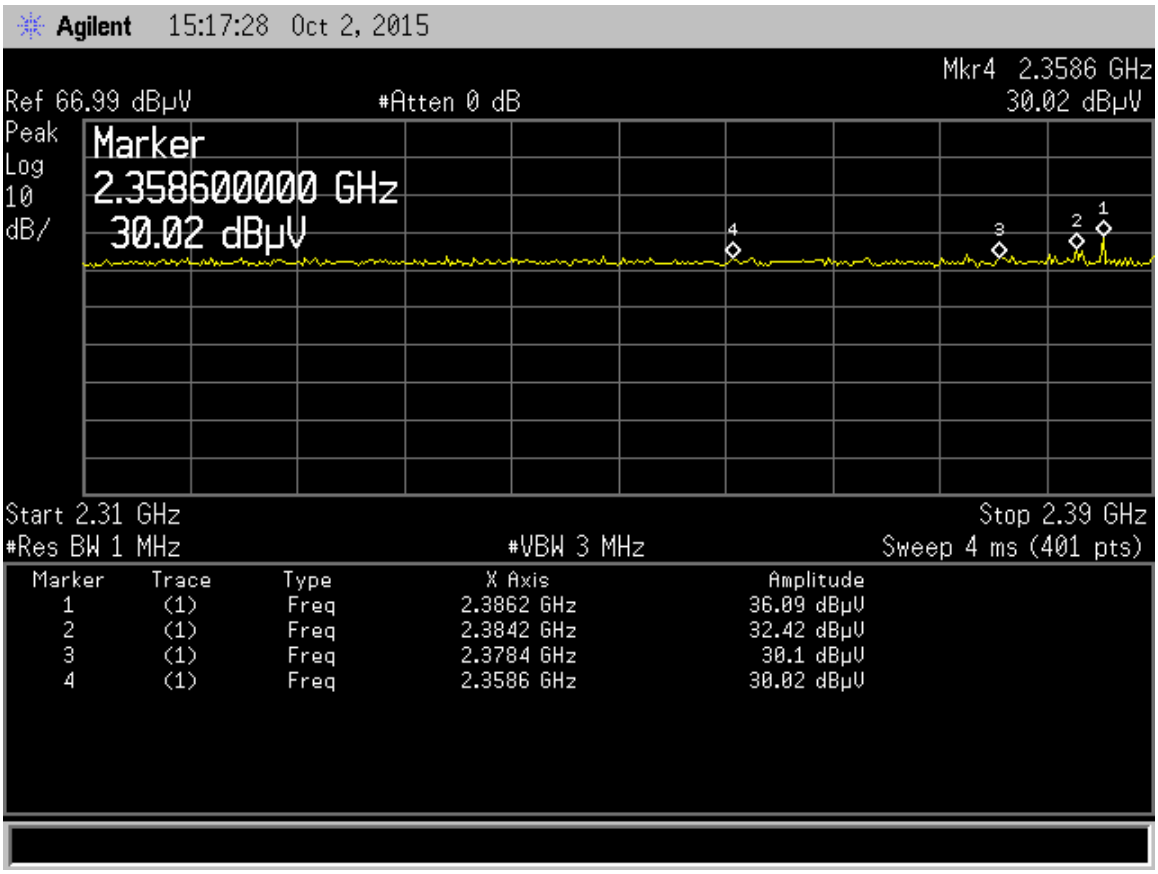

Figure 12. Emissions within the Band 2.31-2.39 GHz

Table 11. Restricted Band Emissions Verification (Low Channel)

Frequency (MHz)	AF Table	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2386.20	1Hn3mV	15.43	31.76	47.19	54.0	3.0m./VERT	6.8	**AVG**
2384.20	1Hn3mV	15.45	31.76	47.21	54.0	3.0m./VERT	6.8	**AVG**
2378.40	1Hn3mV	15.48	31.76	47.24	54.0	3.0m./VERT	6.8	**AVG**
2342.60	1Hn3mV	15.72	31.59	47.31	54.0	3.0m./VERT	6.7	**AVG**

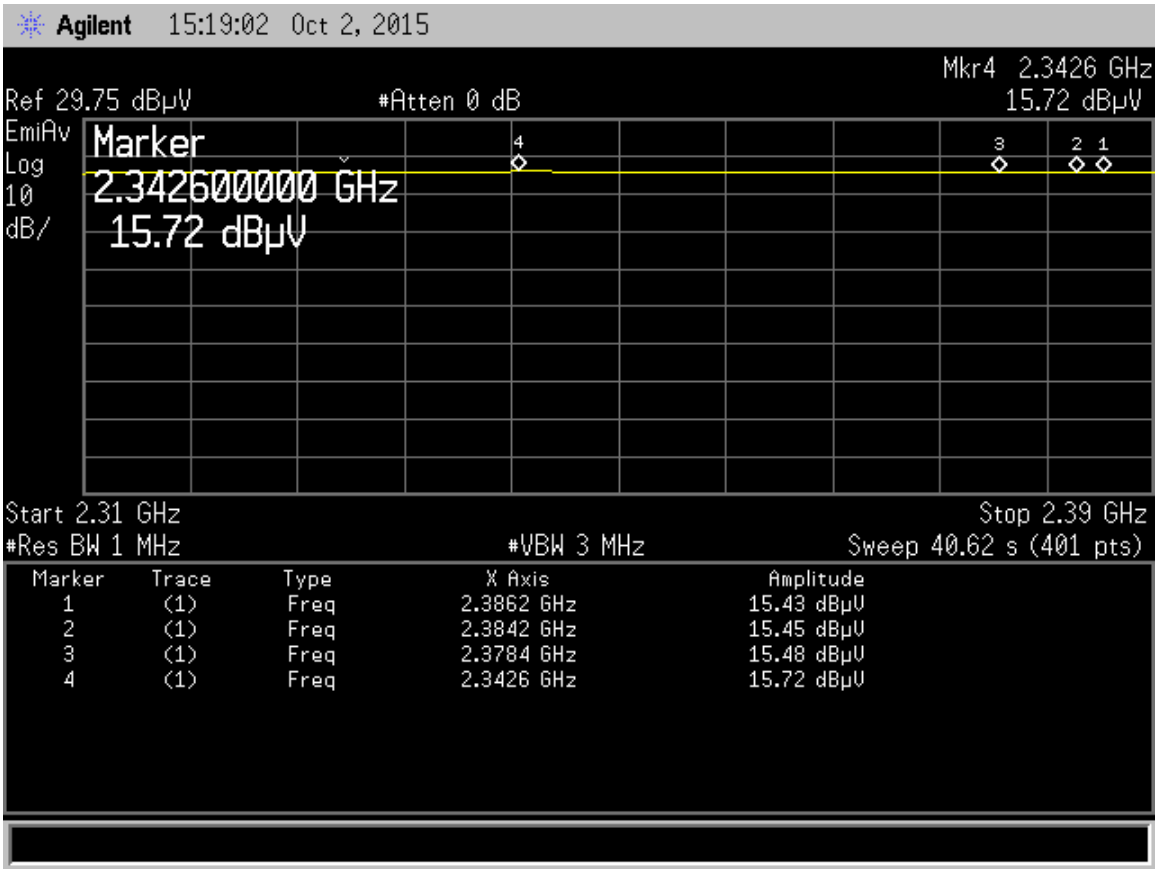

Figure 13. Emissions within the Band 2.31-2.39 GHz

2.13 Unintentional Radiator, Power Conducted Emissions (CFR 15.107, 15.207)

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits of CFR 15.207 (a), as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The power line conducted voltage emission measurements have not been carried out because the EUT is DC powered by batteries and does not connect to the AC mains.

Table 12. Power line Conducted Emissions Data

Power Line Conducted Emissions			
Test By: CF	Test: FCC Power Line Conducted Emissions 150 KHz – 30 MHz		**Client:** Swirl Networks
	Project: 15-0230	Sect. 15.107/15.207 Class: A	**Model:** 4XAA

Frequency (MHz)	Test Data (dBuV)	IL+CL -PA (dB)	Results (dBuV)	AVG Limits (dBuV)	Phase /Neutral	Margin (dB)	PK / QP
EUT is battery operated and does not connect to the AC mains. This test is not applicable.							

SAMPLE CALCULATIONS:

Test Date: November 20, 2015
Tested By
Signature: _____ Name: Carrie Ingram

2.14 Unintentional Radiator, Radiated Emissions (CFR 15.109, 15.209)

Radiated emissions disturbance Measurements were performed with an instrument having both peak and quasi-peak detectors over the frequency range of 9 kHz to ten time the highest clock frequency generated or used by the EUT. The provisions of CFR 15.209(a) were followed. 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 9 kHz to 4 GHz was 10.4 dB below the limit at 156.17 MHz. This signal is found in the table below. All other radiated emissions were 12.9 dB or more below the limit.

Table 13. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109, 15.209)

9 kHz to 1000 MHz with Class B Limits							
Test: Radiated Emissions				**Client: Swirl Networks**			
Project: 15-0230				**Model: 4XAA**			
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**
175.21	35.44	-5.97	29.47	43.5	3m./HORZ	14.0	**PK**
156.17	38.68	-5.57	33.11	43.5	3m./VERT	10.4	**PK**
958.41	22.98	10.14	33.12	46.0	3m./HORZ	12.9	**PK**
693.85	23.86	3.97	27.83	46.0	3m./VERT	18.2	**PK**
All other emissions found were more than 20 dB from the limit.							

Tested from 150 kHz to 1.0 GHz.
No other emissions found less than 20 dB from the limit.

Sample Calculation at 172.51 MHz:

Magnitude of Measured Frequency	35.44	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-5.97	dB/m
	29.47	dBuV/m

Test Date: October 5, 2015
Tested By
Signature: _____ Name: Carrie Ingram

Table 14. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109, 15.209)

Above 1 GHz							
Test: Radiated Emissions				**Client:** Swirl Networks			
Project: 15-0230				**Model**: 4XAA			
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**
No emissions seen less than 20 dB from the limit.							

Tested from 1 GHz to 25 GHz.
No other emissions found less than 20 dB from the limit.

Test Date: October 5, 2015
Tested By
Signature: _____ Name: Carrie Ingram

2.15 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%.

2.15.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

The EUT is battery operated. This test was not applicable.

2.15.2 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 ±5.3 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 ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±2.45 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.