Test Report Issued Under the Responsibility of:

ITC ENGINEERING SERVICES, INC.

FCC CFR Title 47 Part 15 Subpart E 15.407, KDB 789033 D02	
Report Reference No. .....:	20151015-01R-7 Glasses_FCC
Date of Issue .....:	01/13/2016
Total Number of Pages.....:	49
Testing Laboratory .....:	ITC Engineering Services, Inc.
Address .....:	9959 Calaveras Road, Box 543, Sunol CA 94586
Applicant's Name .....:	Osterhout Design Group
Address .....:	153 Townsend Street, Suite 570, San Francisco, CA USA 94107
Contact.....:	Mr. Brian Donnelly
Phone .....:	415-644-4000
Fax .....:	415-644-4039
Test Specification Standard .....:	FCC CFR Title 47 Part 15 Subpart E 15.205, 15.209, 15.407
Test Procedure .....:	KDB 789033 DO2 General UNII Test Procedures New Rules v01 & ANSI C63.4:2009, ANSI C63.10:2009 (Test Procedures)
Judgment .....:	Complies as tested
Test Item Description .....:	802.11 b/g/n, Bluetooth 4.1 Smart, 802.11n 5GHz, GPS/GLONASS Enabled Augmentation Eyewear
Manufacturer Logo .....:	ODG
Manufacturer .....:	Osterhout Design Group
Model/Type Reference .....:	R-7 Glasses
RF Operating Frequency Bands .....:	2.402 - 2.48 GHz, 5.18 - 5.240 GHz, 5.260 – 5.320 GHz, 5.500 – 5.700 GHz, 5.745 – 5.825 GHz (only 20 MHz BW for wifi)

A2LA ACCREDITED
TESTING CERT #3382.01

ISO/IEC 17025:2005 Accredited Laboratory

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1.1 Testing Location

☒ ITC Testing Laboratory:	:	ITC Engineering Services, Inc.	
Testing Location/Address	:	9959 Calaveras Road, PO Box 543, Sunol, CA 94586, USA	
Prepared By (Name + Signature)	:	Shane Duncan	Shane Duncan
Tested By (Name + Signature)	:	Shane Duncan	Shane Duncan
Approved By (Name + Signature)	:	Michael Gbadebo, PE	M. Gbadebo

☐ Manufacturer Facility	:
Testing Location/Address	:
Tested By (Name + Signature)	:
Approved By (+ Signature)	:
☐ 3rd Party Test Facility	:
Testing Location/Address	:
Tested By (Name + Signature)	:
Approved By (+ Signature)	:

1.2 Revision History

#	Revision Date	Revision
1	01/19/2016	Added Frequency Stability page 34 Tested radiated emissions at middle low and high frequency for each U-NII band page 12 Added Emission Bandwidth page 23 Tested Radiated spurious emissions middle low and high frequency for each U-NII band page 40 Tested 6 dB Bandwidth U-NII-3 fixed the markers to show 6 dB bandwidth page 22

1.3 Declaration/Disclaimer

It is the manufacturer's responsibility to assure that additional production units of these models are manufactured with identical electrical and mechanical characteristics. This report is the confidential property of the applicant. As a mutual protection to our applicants, the public, and ourselves, extracts from the test report shall not be reproduced except in full without ITC Engineering Service's written approval. The applicant/manufacturer shall not use this report to claim product endorsement by any US Government agency.

1.4 Condition of EUT

Equipment Under Test (EUT) was tested as it was received. The radiated mode tests utilize the EUT internal antenna. Both the WiFi and the Bluetooth radios use the same antenna. For the conducted mode tests, the internal antenna RF cable connector is disconnected from the PCB and a suitable patch cable to the spectrum analyzer is used. The EUT WiFi and Bluetooth radios are software controllable by means of a laptop and a USB connection.

1.5 General Description of EUT

Product	R-7 Glasses
Model No.	N/A
Power Supply	Internal rechargeable Lithium Polymer battery, 1300 mAH (2)
I/O Ports	Custom magnetic USB / charging receptacle
Operating Frequency Range	2.402- 2.48 GHz, 5.18- 5.825 GHz
802.11 b/g/n	
FCC ID	2ADCMR7
Modulation Type	CCK, BPSK, QPSK, 16-QAM, 64-QAM

Modulation Technology	b: DSSS; g: DSSS, OFDM; n: OFDM
Transfer Rate	b: 1-11 Mbps, g: 6-54 Mbps, n: 7.2-72.2 Mbps (20 MHz channel)
Number of Channels	11
Maximum Output Power	+20dBm
Bluetooth 4.1 Smart	
FCC ID	2ADCMR7
Modulation Type	GFSK (1 Mbps)
Modulation Technology	FHSS, AFH
Transfer Rate	1 Mbps
Number of Channels	40
Maximum Output Power	0 dBm typ.
802.11n (5 GHz)	
FCC ID	2ADCMR7
Modulation Type	CCK, BPSK, QPSK, 16-QAM, 64-QAM
Modulation Technology	n: OFDM
Transfer Rate	n: 7.2-72.2 Mbps (20 MHz channel)
Number of Channels	45
Maximum Output Power	+11 to +16 dBm typ.
Antenna	
Antenna Type	Chip antenna
Antenna Gain, Peak	1.5
Radiation Pattern	Omni-directional

1.6 Operational Description of EUT

The R-7 Smart Glasses offers immersive 3D HD viewing of stored or streaming video content, with stereo audio, in a static setting, or in a head orientation tracking augmented vision mode.

1.7 List of Applicant Peripherals/ Supporting Equipment Used During Test

Description	Manufacturer	Model Name	Serial Number
Laptop	Apple	MacBook Pro	N/A*
AC Adapter	Apple	N/A*	N/A*

*N/A-Not Applicable

1.8 General Test Remarks

The EUT was operated under the following conditions during the testing:

☐	Standby	☐	Test Program (H – Pattern)
☐	Test Program (Color Bar)	☐	Test Program (Applicant Specific)
☐	TV/VCR Signal Input	☐	Signal Generator Input
☐	Continuous Audio Tone (1kHz)	☐	Cycled Audio Tone (1kHz)
☐	Printer/Parallel Function	☐	Modem/Serial Function
☐	Serpentine Program with I/O	☐	Serpentine Program without I/O
☐	Practice Operation	☐	Normal Operating Mode
☐	Essential Operation (Functional Safety)	☐	Continuous Unmonitored Operation
☒	Continuous Monitored Operation	☐	Non-Continuous Operation

The requirements according to the technical regulations are:

☒	Met	☐	Not Met

The Equipment Under Test does:

☒	Fulfill the general approval requirements	☐	Not fulfill the general approval requirements

1.9 Summary of Tests

ITC Engineering Services, Inc. as an independent testing laboratory, declares that the equipment specified above was tested to the requirements of:

Section of FCC Title 47 CFR	Test Description	Result
15.209	Radiated Emissions, general	Passed
15.207	Conducted Powerline Emissions	Passed
15.407(e)	6 dB Bandwidth	Passed
15.407(a)(5)	Emission Bandwidth	Passed
15.407(a)	Peak Conducted Output Power	Passed
15.407(a)(5)	Power Spectral Density	Passed
15.407(b)	Band-Edge Measurement	Passed
15.407	99 Percent Occupied Bandwidth	Passed
15.407g	Frequency Stability	Passed
15.209/.205	Conducted Spurious & Restricted Band Emissions	Passed
15.407(a)	Gain of Transmission Antenna	Passed

1.10 Measurement Uncertainty

The measurement of uncertainty levels were estimated based on calculation in accordance with TR 100-028-1. Using the value k = 2 for expanded uncertainty, this provides a 95% level of confidence.

	Measurement Method	Calculated Uncertainty (dB)
1	RF Power, Conducted	± 1.5
2	Radiated emission of transmitter (30MHz - 1 GHz) @ 3m	± 3.2
3	Radiated emission of transmitter (1 - 40 GHz) @ 3m	± 2.5

1.11 Test Set up Photos

Figure1: Conducted RF Test Setup

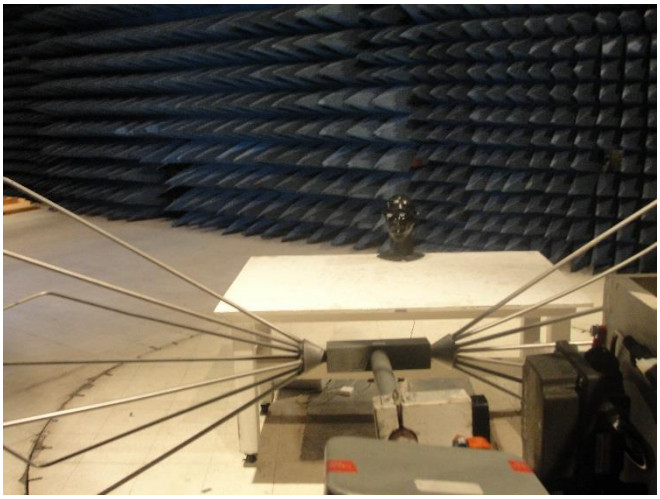


Figure 2: RE Test Setup – Biconical Antenna

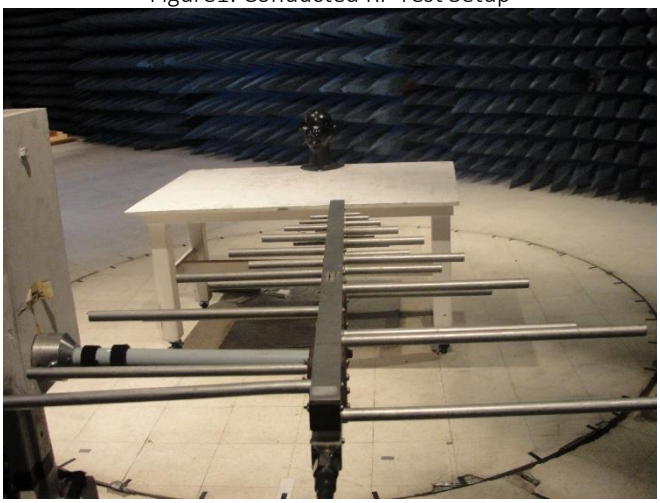


Figure 3: RE Test Setup - Log Periodic Antenna

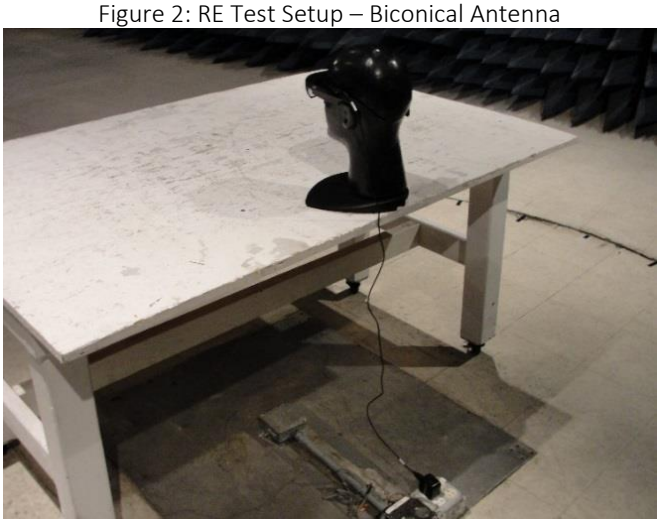


Figure 4: EUT RE Test Setup

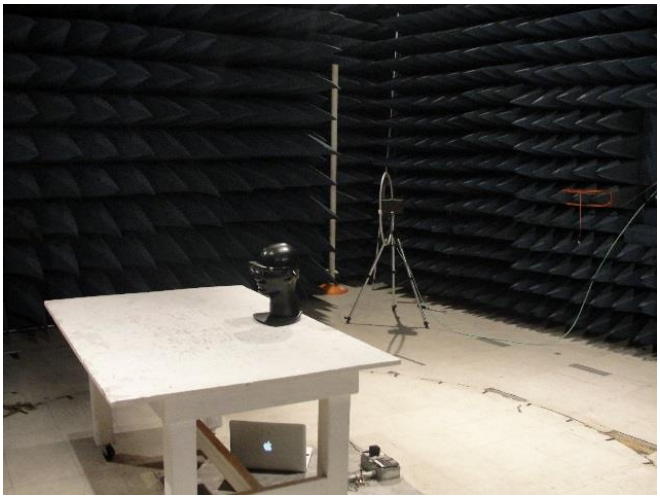


Figure 5: RE Test Setup - Active Loop Antenna, Horizontal Polarization

Figure 6: Conducted Spurious Emissions Test Setup
For frequencies >26.5 GHz

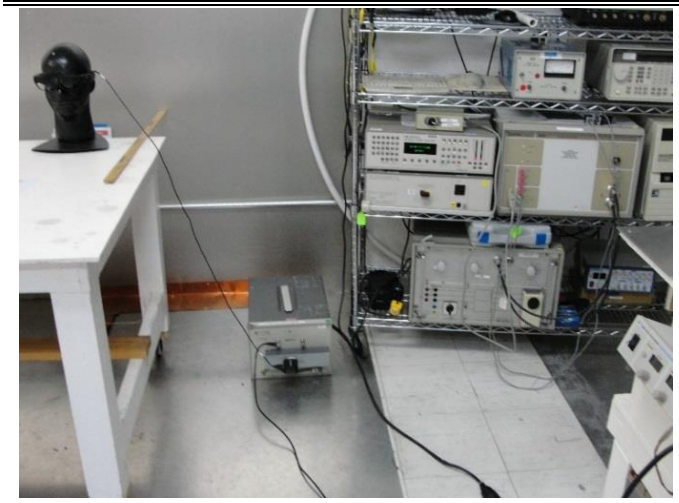


Figure 7: CE Test Setup - Front View

Figure 8: CE Test Setup - Side View

Figure 9: Frequency Stability Test Setup

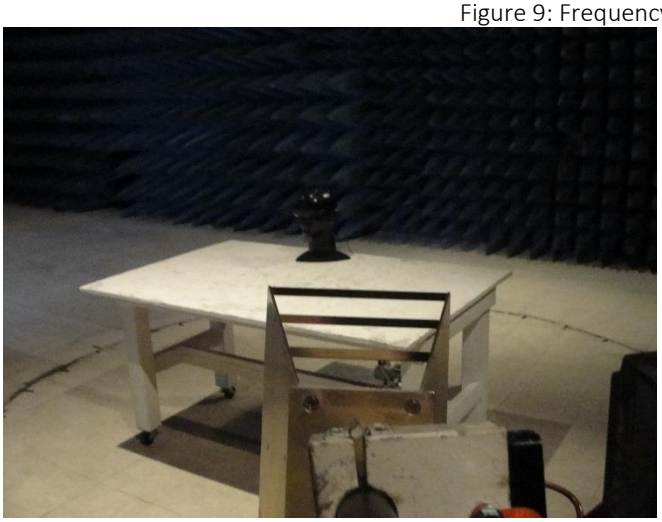


Figure 10: RE Test Setup DRG Horn Antenna(1-18GHz)

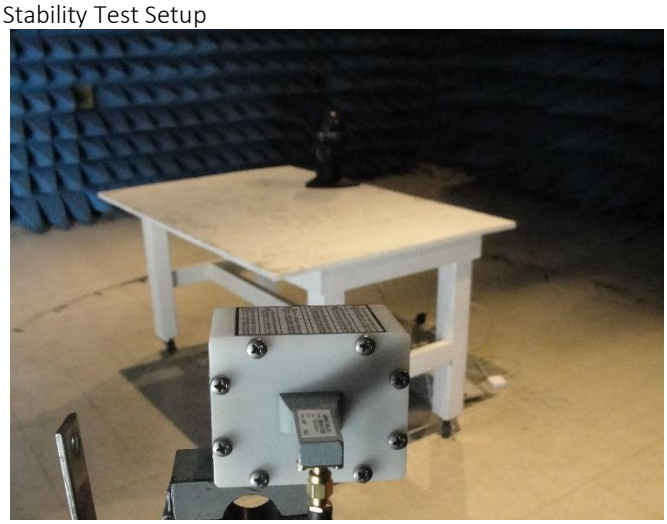


Figure 11: RE Test Setup Horn Antenna(18-40GHz)

2 Radiated Emissions Per FCC Part 15.209

2.1 Administrative and Environmental Details

Site Used:	Semi Anechoic Chamber
Test Date:	01/11-12/16
Test Engineer:	Shane Duncan
Temperature	23°C avg.
Humidity:	33% avg.

2.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
EMC Analyzer	Agilent	E7402A	MY45112375	7/16/16	2 yr
Active Loop Antenna	EMCO	6502	1071/1001	10/14/16	2 yr
Bi-Conical Antenna	EMCO	3104	3459	10/14/16	2 yr
Log Periodic Antenna	EMCO	3146	9510-4202	6/16/16	2 yr

2.3 Test Set up Photo(s)

Refer to Figures 2-5.

2.4 Limits/Requirements

Frequency (MHz)	Field strength Average (µV/m)	Field strength Average (dBµV/m)	Field strength Peak (dBµV/m)	Measurement distance (m)	Average Limit @ 3m (dBµV/m)	Peak Limit @ 3m (dBµV/m)
0.009-0.49	267 – 4.9 **	48.5 - 13.8	68.5 – 33.8	300*	88.5 – 53.8	108.5 – 73.8
0.49-1.705	49 – 14.1 ***	33.8 - 23	53.8 - 43	30*	53.8 - 43	73.8 - 63
1.705-30	30	29.5	49.5	30*	49.5	69.5
30-88	100	40	60	3	-	-
88-216	150	43.5	63.5	3	-	-
216-960	200	46	66	3	-	-
Above 960	500	54	74	3	-	-

*Measurement performed at 3m per 47 CFR 15.31 (f)(2) distance scaling factor.
** 2400/F(kHz)
*** 24000/F(kHz)

2.5 Test Description and Procedure

The EUT was placed on a non-conducting table whose surface is 80 cm above the ground plane. The table may be rotated in order to maximize the signal received by the measurement system. RF emissions from 9 kHz to 1 GHz are received by a series of antennas. The active loop, biconical, and log-periodic are located 3m away from the EUT. The elevation of the antennas above the ground plane is adjusted (1-4 m) for maximum signal, except for the active loop which is fixed at 1m. Both horizontally and vertically polarized signals are detected and recorded. All the radiated emissions tests were performed in three orthogonal planes. Data plots included below are the worst case data. The antenna factors and the cable losses are included in the measurement.

2.6 Radiated Emissions Test Data U-NII-1

9 KHz-30MHz Radiated Emissions

Channel	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5180	17.12	11.62	42.9	34.07	33.72	30.81	33.01	26.63	Passed	43
5200	19.73	13.03	43.9	32.81	44.08	31.80	33.88	26.21	Passed	43
5240	19.58	13.33	47.69	35.81	42.51	35.16	35.74	29.48	Passed	43

30-200 MHz Radiated Emissions

Channel	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5180	30.40	30.33	39.34	39.90	36.32	33.07	36.49	34.59	Passed	43.5
5200	30.12	30.42	37.59	40.66	33.51	36.46	34.60	35.33	Passed	43.5
5240	30.06	57.6	39.51	39.86	35.83	36.85	36.19	35.81	Passed	43.5

200-1000 MHz Radiated Emissions

Channel	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5180	588	415.7	38.91	43.76	36.33	40.49	28.58	38.56	Passed	46
5200	590	416	38.80	42.22	33.00	17.08	32.15	37.13	Passed	46
5240	588.5	415.7	38.79	41.37	36.02	28.92	36.02	35.98	Passed	46

2.7 Radiated Emissions Test Data U-NII-2A

9 KHz-30 MHz Radiated Emissions

Channel	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5260	18	11.43	40.46	35.2	31.31	23.88	29.63	25.99	Passed	43
5280	18.08	13.27	44.41	33.41	35.34	29.25	36.49	29.25	Passed	43
5320	18.68	13.48	45.75	35.28	41.76	27.44	36.53	27.44	Passed	43

30-200 MHz Radiated Emissions

Channel	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5260	30.02	57.58	38.78	40.14	35.67	36.40	35.91	36.61	Passed	43.5
5280	30.07	57.6	39.54	40.12	36.66	36.13	36.23	36.13	Passed	43.5
5320	30.01	30.9	39.66	39.84	37.18	35.58	36.38	35.65	Passed	43.5

200-1000 MHz Radiated Emissions

Channel	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5260	592	417.3	38.58	40.32	31.95	34.15	33.79	34.94	Passed	46
5280	588	415.7	38.78	45.5	36.33	40.14	34.7	40.0	Passed	46
5320	592.4	415.7	38.19	44.68	35.74	43.18	35.75	39.1	Passed	46

Note: H means Horizontal and V means Vertical Antenna Polarizations

2.8 Radiated Emissions Test Data U-NII-2C

9 KHz-30 MHz Radiated Emissions

Channel	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5500	19.64	11.63	44.47	33.08	37.26	17.41	34.51	25.34	Passed	43
5600	18.33	11.29	43.87	32.22	42.17	24.15	35.11	25.91	Passed	43
5700	19.57	13.55	46.42	34.48	43.66	23.39	36.5	28.95	Passed	43

30-200 MHz Radiated Emissions

Band	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5500	30.28	57.59	37.94	40.14	34.15	37.73	34.74	36.96	Passed	43.5
5600	30.22	30.79	38.82	39.35	36.52	35.65	35.83	35.0	Passed	43.5
5700	30.14	30.81	39.26	39.77	36.1	36.28	35.96	35.47	Passed	43.5

200-1000 MHz Radiated Emissions

Band	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5500	586	415.7	38.03	44.78	28.42	24.3	33.26	39.57	Passed	46
5600	592	417.3	37.66	45.82	32.09	31.81	33.77	40.51	Passed	46
5700	585.5	415.7	37.65	42.69	32.75	17.74	34.98	37.59	Passed	46

2.9 Radiated Emissions Test Data U-NII-3

9 KHz-30 MHz Radiated Emissions

Band	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5745	17.85	11.45	44.44	32.89	40.55	12.55	34.11	27.65	Passed	43
5785	18.8	13.47	43.07	36.40	37.45	24.56	35.49	29.21	Passed	43
5825	19.48	13.58	44.49	34.94	38.98	20.74	36.26	28.27	Passed	43

30-200 MHz Radiated Emissions

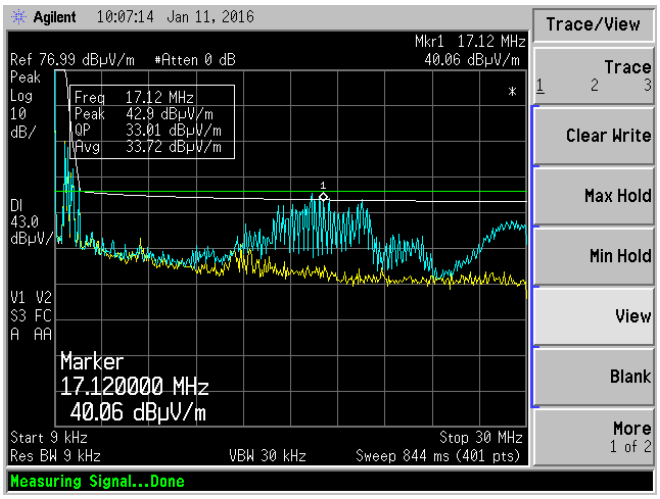
Band	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5745	30.16	57.62	39.2	40.1	37.17	34.76	36.17	36.31	Passed	43.5
5785	30.01	30.95	39.32	39.45	36.07	34.36	36.28	34.83	Passed	43.5
5825	30.9	30.75	41.62	40.16	39.53	36.79	37.97	36.35	Passed	43.5

200-1000 MHz Radiated Emissions

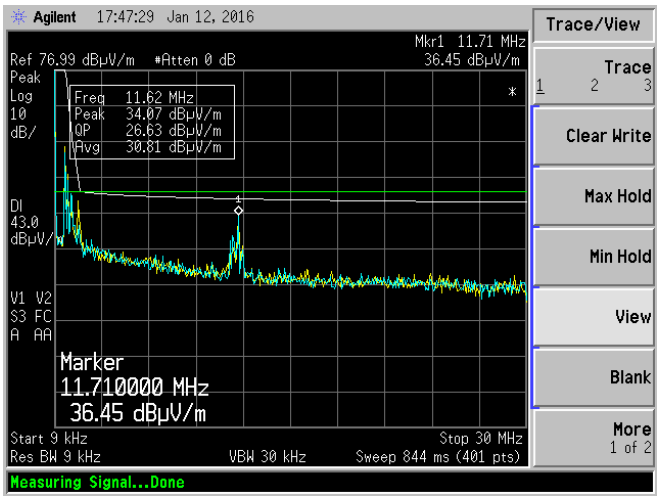
Band	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
5745	591.3	415.7	38.63	43.95	34.23	42.59	35.88	38.6	Passed	46
5785	592.2	415.7	38.81	43.71	36.42	42.98	36.66	38.41	Passed	46
5825	588	415.7	38.83	45.55	33.3	37.61	35.81	40.19	Passed	46

Note: H means Horizontal and V means Vertical Antenna Polarizations

2.10 Test Plots U-NII-1

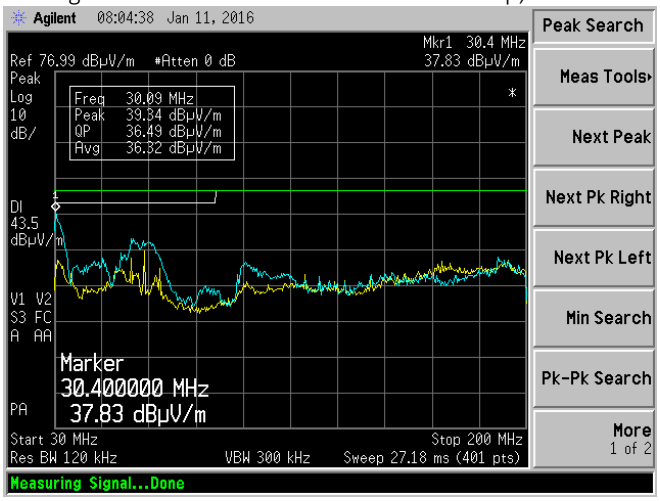


a) Horizontal Polarization (Channel 36 shown 40 &48 similar)

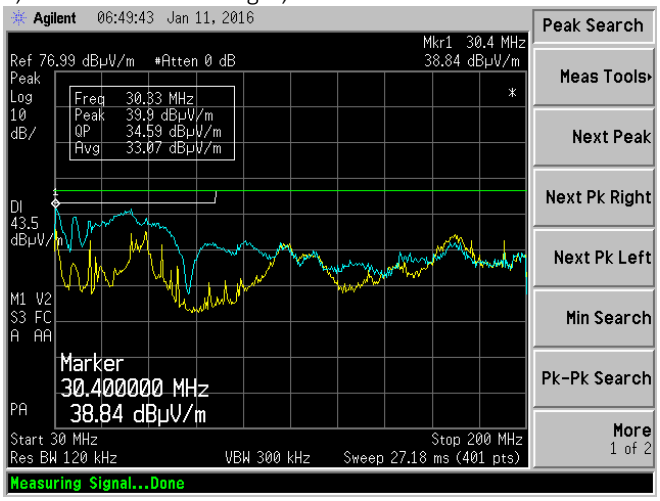


b) Vertical Polarization (Channel 36 shown 40 &48 similar)

Figure 12: Radiated Emissions – Active Loop, 9 kHz – 30 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

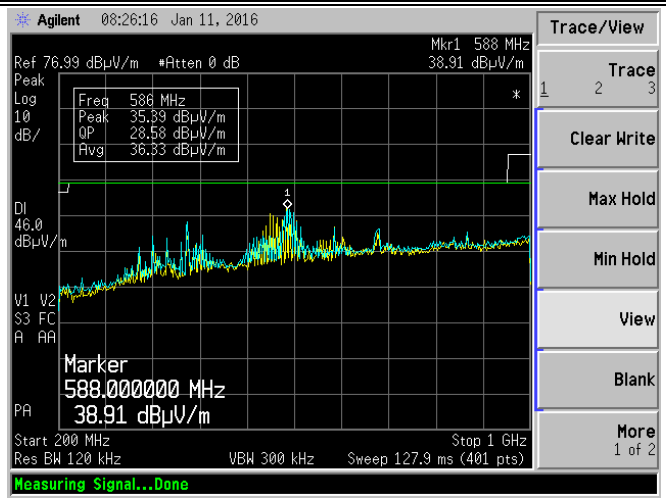


a) Horizontal Polarization (Channel 36 shown 40 &48 similar)



b) Vertical Polarization (Channel 36 shown 40 &48 similar)

Figure 13: Radiated Emissions – Biconical 30-200 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

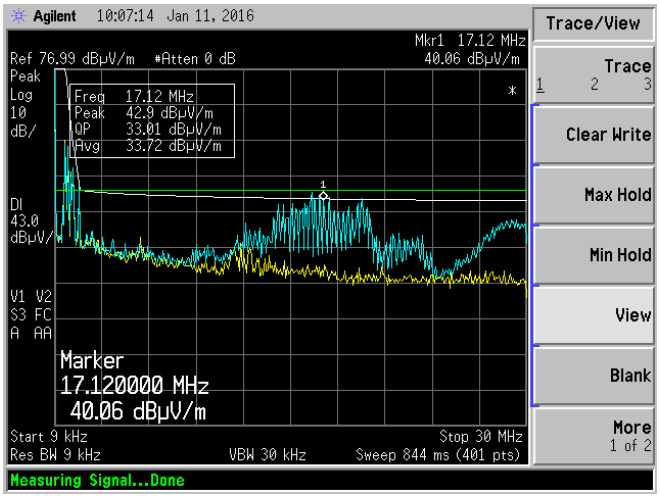


a) Horizontal polarization (Channel 36 shown 40 &48 similar)

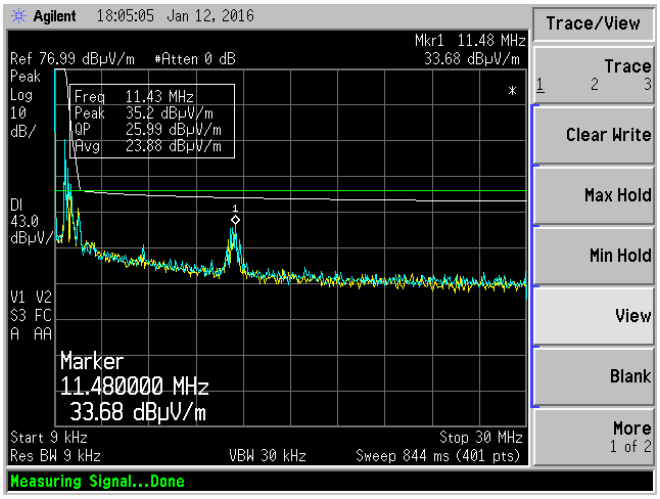
b) Vertical Polarization (Channel 36 shown 40 &48 similar)

Figure 14: Radiated Emissions – Log Periodic 200-1000 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

2.11 Test Plots U-NII-2A

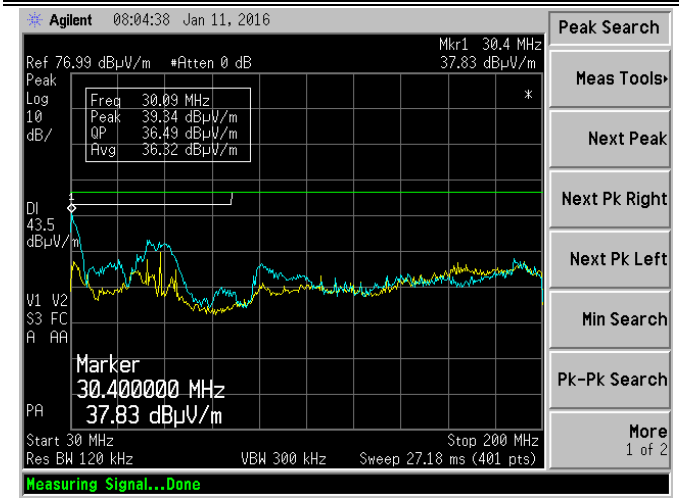


a) Horizontal Polarization (Channel 52 shown 56 &64 similar)

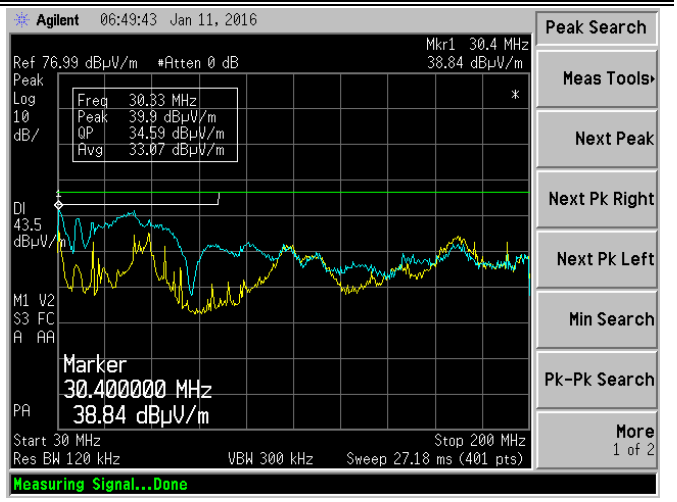


b) Vertical Polarization (Channel 52 shown 56 &64 similar)

Figure 15: Radiated Emissions – Active Loop, 9 kHz – 30 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

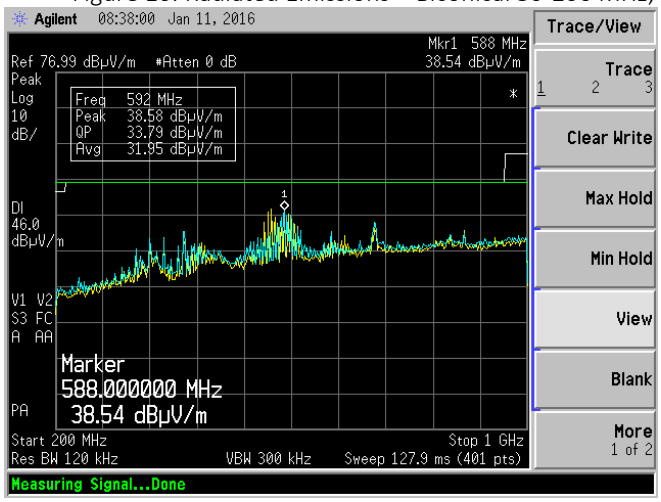


a) Horizontal Polarization (Channel 52 shown 56 &64 similar)

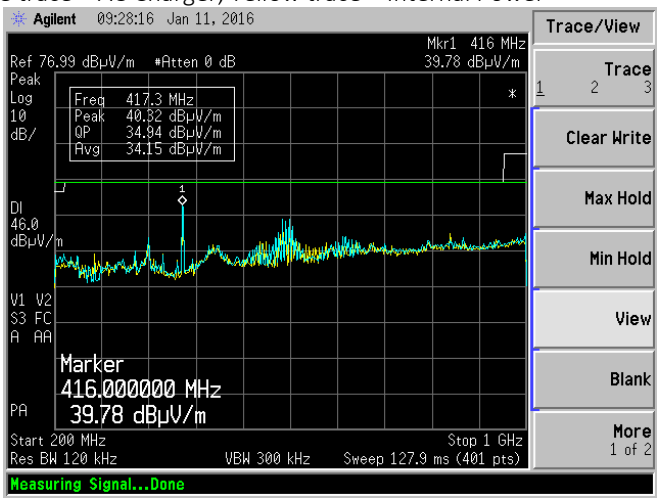


b) Vertical Polarization (Channel 52 shown 56 &64 similar)

Figure 16: Radiated Emissions – Biconical 30-200 MHz, Blue trace = AC Charger, Yellow trace = Internal Power



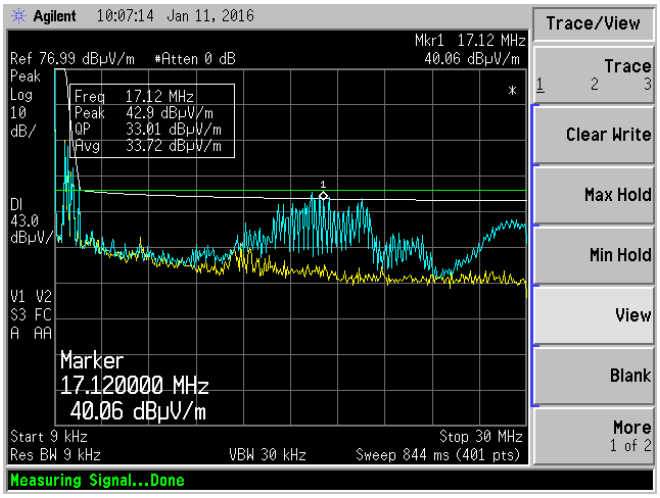
a) Horizontal polarization (Channel 52 shown 56 &64 similar)



b) Vertical Polarization (Channel 52 shown 56 &64 similar)

Figure 17: Radiated Emissions – Log Periodic 200-1000 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

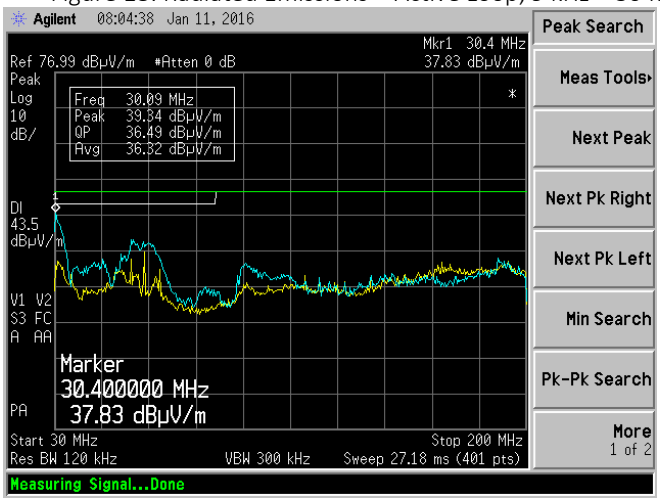
2.12 Test Plots U-NII-2C



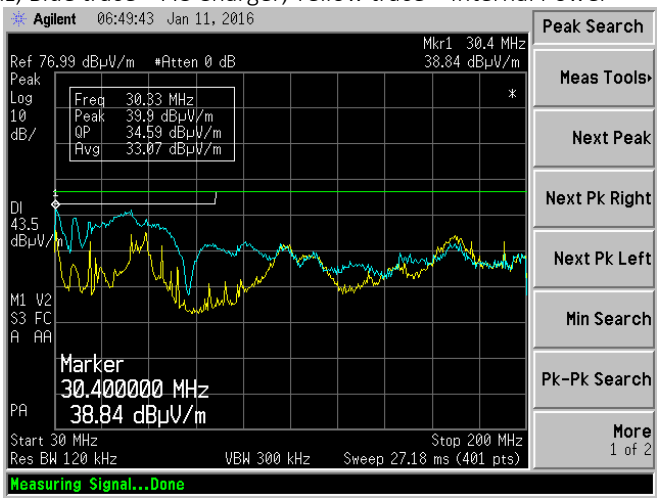
a) Horizontal Polarization (Channel 100 shown 120 &140 similar)

b) Vertical Polarization (Channel 100 shown 120 &140 similar)

Figure 18: Radiated Emissions – Active Loop, 9 kHz – 30 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

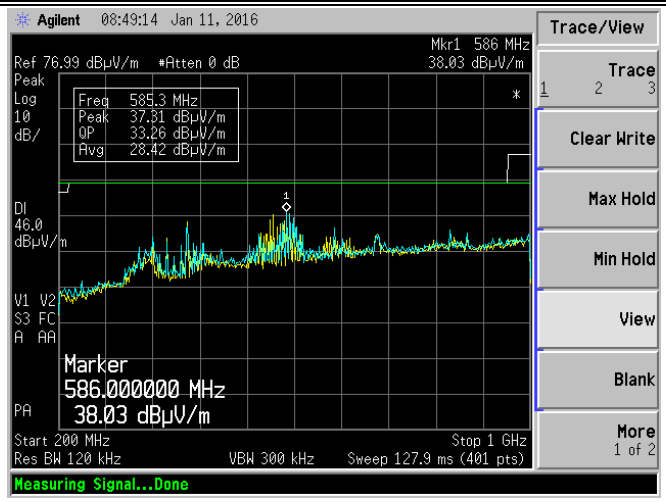


a) Horizontal Polarization (Channel 100 shown 120 &140 similar)

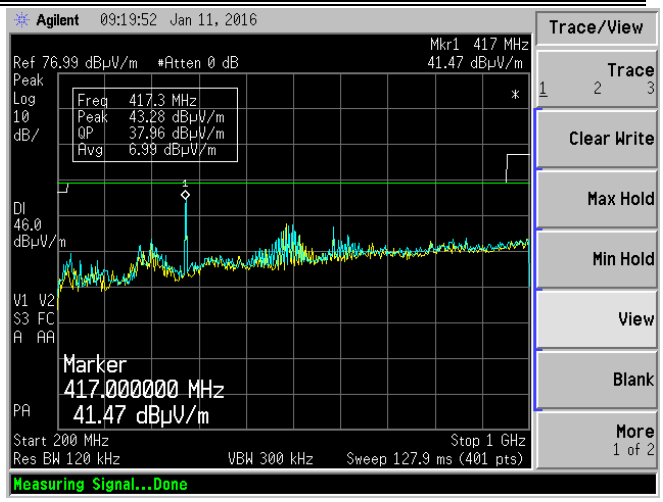


b) Vertical Polarization (Channel 100 shown 120 &140 similar)

Figure 19: Radiated Emissions – Biconical 30-200 MHz, Blue trace = AC Charger, Yellow trace = Internal Power



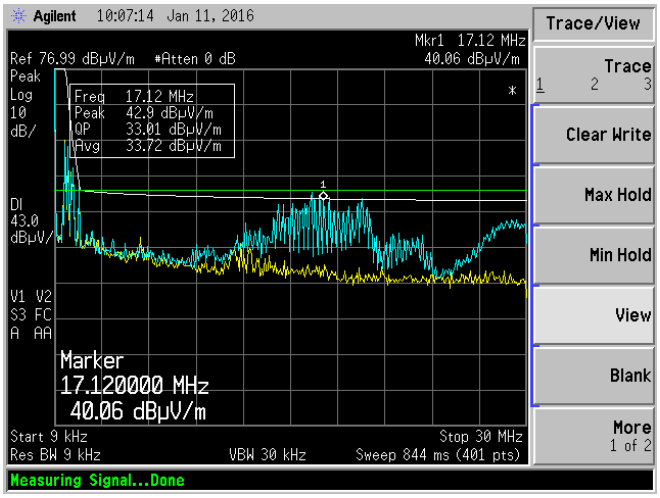
a) Horizontal Polarization (Channel 100 shown 120 &140 similar)



b) Vertical Polarization (Channel 100 shown 120 &140 similar)

Figure 20: Radiated Emissions – Log Periodic 200-1000 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

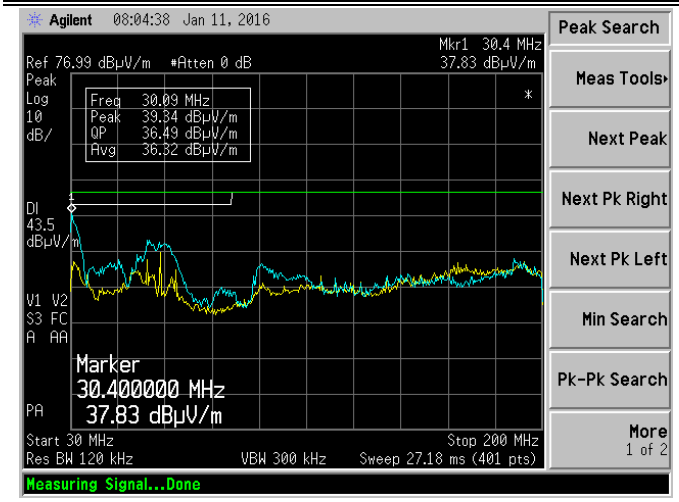
2.13 Test Plots U-NII-3



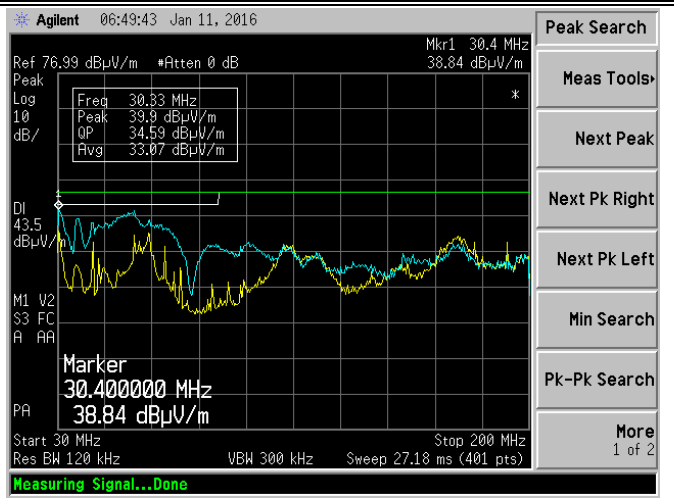
a) Horizontal Polarization (Channel 149 shown 157 &165 similar)

b) Vertical Polarization (Channel 149 shown 157 & 165 similar

Figure 21: Radiated Emissions – Active Loop, 9 kHz – 30 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

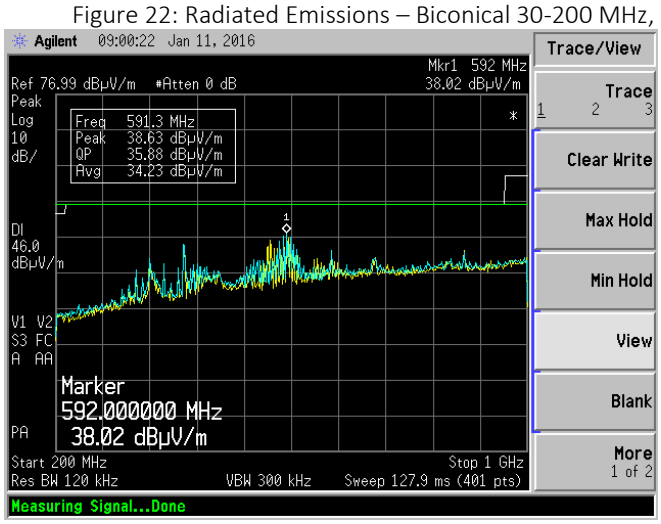


a) Horizontal Polarization (Channel 149 shown 157 & 165 similar)

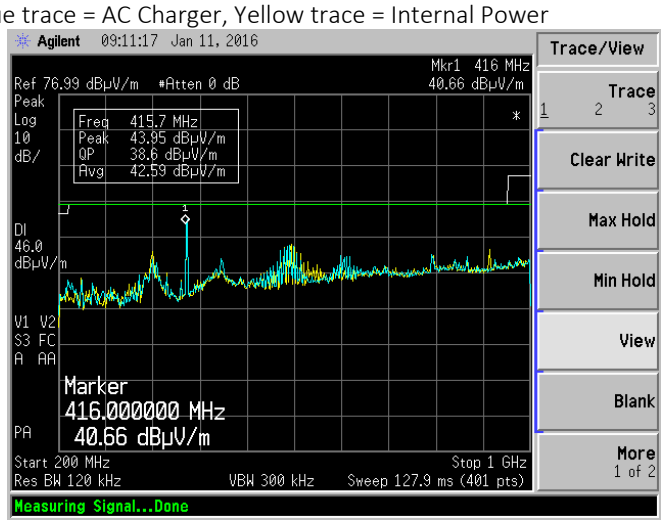


b) Vertical Polarization (Channel 149 shown 157 & 165 similar)

Figure 22: Radiated Emissions – Biconical 30-200 MHz, Blue trace = AC Charger, Yellow trace = Internal Power



a) Horizontal Polarization (Channel 149 shown 157 &165 similar)



b) Vertical Polarization (Channel 149 shown 157 & 165 similar)

Figure 23: Radiated Emissions – Log Periodic 200-1000 MHz, Blue trace = AC Charger, Yellow trace = Internal Power

3 Conducted Power Line Emissions Per FCC Part 15.207

3.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	11/03/15
Test Engineer:	Shane Duncan
Temperature	23°C
Humidity:	33%

3.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
EMC Analyzer	Agilent	E7402A	MY45112375	7/16/16	2 yr
LISN	EMCO	3825/2	8901-1229	10/15/16	2 yr

3.3 Test Set up Photo(s)

Refer to Figures 7-8.

3.4 Limits/Requirements

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

3.1 Test Description and Procedure

The EUT was placed in a shielded room 80 cm above the horizontal ground reference plane and 40 cm away from the vertical ground reference plane. AC mains input to the DC charging adapter was supplied through a LISN (Line Impedence Stabilization Network) and the excess power cord was looped into figure "8" above the LISN. The 5Vdc output of the charging adapter was supplied to the EUT. The line conducted tests were performed on the AC mains hot and neutral lines.

3.2 Test Data Plots

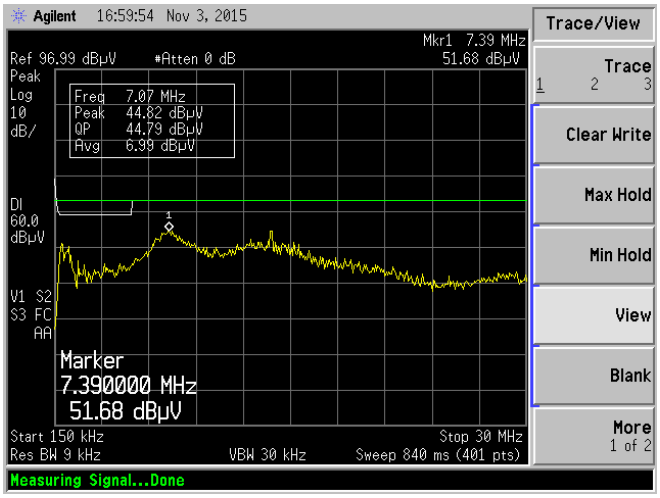


Figure 24: Conducted Emissions Test Data 60 Hz Hot 0.15-30 MHz

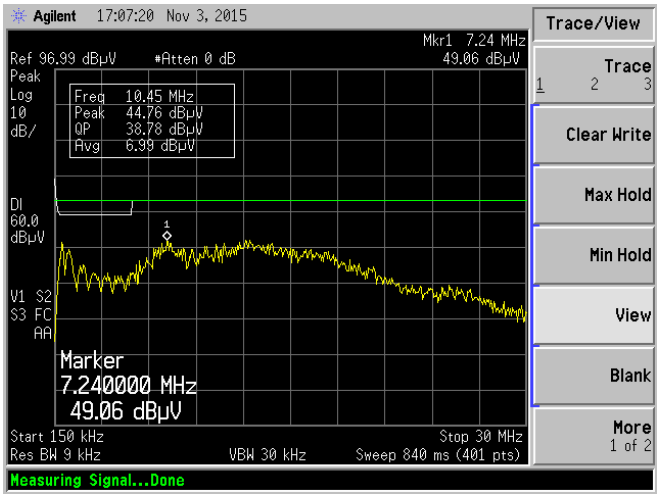


Figure 9: Conducted Emissions Test Data 60 Hz Neutral 0.15-30 MHz

4 Minimum 6 dB Bandwidth Per FCC Part 15.407(e), KDB 789033 D02 – 802.11n (5 GHz)

4.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	01/08/16
Test Engineer:	Shane Duncan
Temperature	23°C avg.
Humidity:	48% avg.

4.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	1/05/18	2 yr

4.3 Test Set up Photo(s)

Refer to Figure 1.

4.4 Limits/Requirements

The minimum 6dB bandwidth is 500 KHz for the U-NII-3 band

4.5 Test Description and Procedure

The EUT is connected to the spectrum analyzer by disconnecting the internal antenna cable from the PCB antenna connector and attaching a suitable patch cable. The minimum 6dB bandwidth is determined by measuring the width of the carrier signal between the lowest frequency and the highest frequency of the carrier signal where the level is 6dB below the maximum signal power. The EUT is set to transmit single channel, modulated and maximum controlled power output. The test is performed at the low, mid and high channel of the operating band. The EUT only operates in 20 MHz bandwidth mode.

4.6 6 dB Bandwidth Measurement Test Data U-NII-3

Channel	Freq.(MHz)	Measured 6dB BW (MHz)	Result
		n	
149	5745	17.9	Pass
157	5785	17.9	Pass
165	5825	17.9	Pass

4.7 6dB Bandwidth Measurement Plots

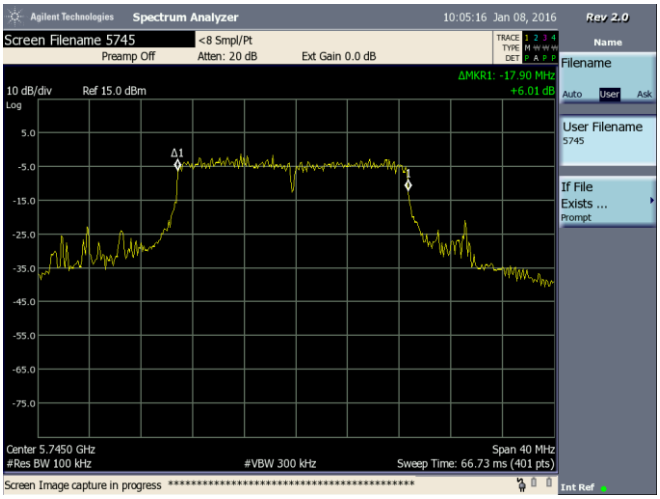


Figure 26: U-NII-3 6dB Bandwidth (Ch149 shown, Ch157 &165 similar)

5 Emission Bandwidth Per FCC Part 15.407 (a)(5), KDB 789033 D02 – 802.11n (5 GHz)

5.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	01/08/16
Test Engineer:	Shane Duncan
Temperature	23°C avg.
Humidity:	48% avg.

5.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	1/05/18	2 yr

5.3 Test Set up Photo(s)

Refer to Figure 1.

5.4 Limits/Requirements

Have the RBW/EBW approximately 1%

5.5 Test Description and Procedure

The EUT is connected to the spectrum analyzer by disconnecting the internal antenna cable from the PCB antenna connector and attaching a suitable patch cable. The minimum 26dB bandwidth is determined by measuring the width of the carrier signal between the lowest frequency and the highest frequency of the carrier signal where the level is 26dB below the maximum signal power. The EUT is set to transmit single channel, modulated and maximum controlled power output. The test is performed at the low, mid and high channel of the operating band.The measurement was done by setting the RBW to 200 KHz so the RBW/EBW was approximately 200 KHz/20 MHz which is approximately 1%.

5.6 Emission Bandwidth Measurement Test Data U-NII-1

Channel	Freq.(MHz)	Measured 26dB BW (MHz)	Result
		n	
36	5180	22.35	Pass
40	5200	22.65	Pass
48	5240	21.15	Pass

5.7 Emission Bandwidth Measurement Test Data U-NII-2A

Channel	Freq.(MHz)	Measured 26dB BW (MHz)	Result
		n	
52	5260	23.40	Pass
56	5280	21.75	Pass
64	5320	22.95	Pass

5.8 Emission Bandwidth Measurement Test Data U-NII-2C

Channel	Freq.(MHz)	Measured 26dB BW (MHz)	Result
		n	
100	5500	22.65	Pass
120	5600	21.30	Pass
140	5700	21.60	Pass

5.9 Emission Bandwidth Measurement Test Data U-NII-3

Channel	Freq.(MHz)	Measured 26dB BW (MHz)	Result
		n	
149	5745	21.00	Pass
157	5785	21.75	Pass
165	5825	21.90	Pass

5.10 26dB Bandwidth Measurement Plots

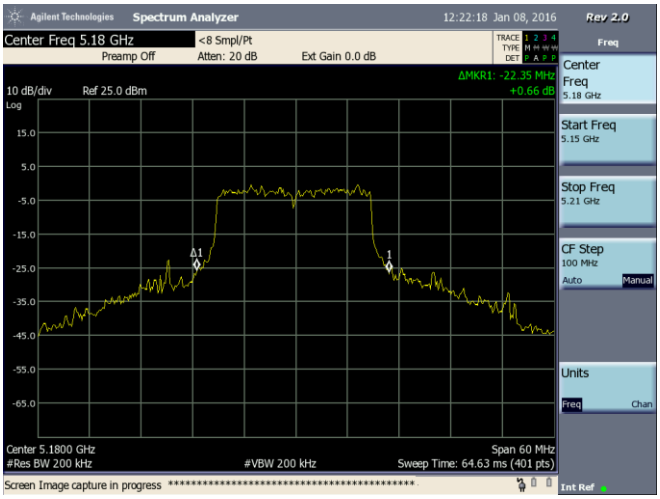


Figure 27: U-NII-1 26dB Bandwidth (Ch36 shown, Ch40 &48 similar)

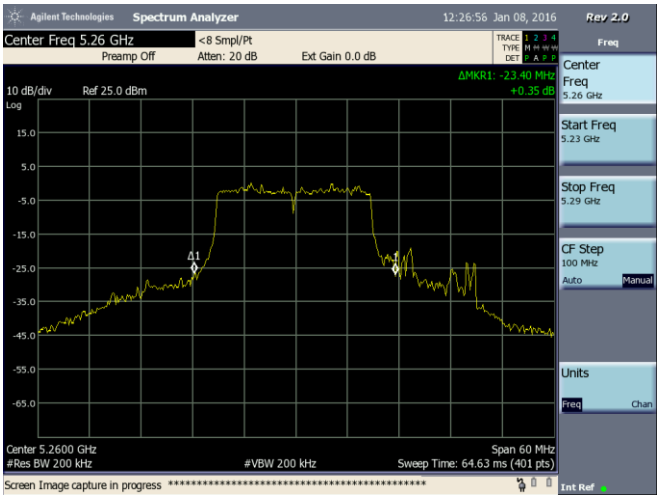


Figure 28: U-NII-2A 26dB Bandwidth(Ch52 shown, Ch56&64 similar)

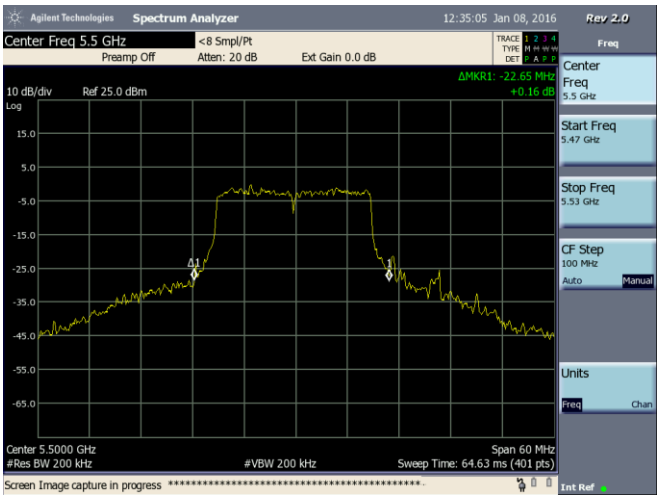


Figure 29: U-NII-2C 26dB Bandwidth (Ch100 shown, Ch120 &140 similar)

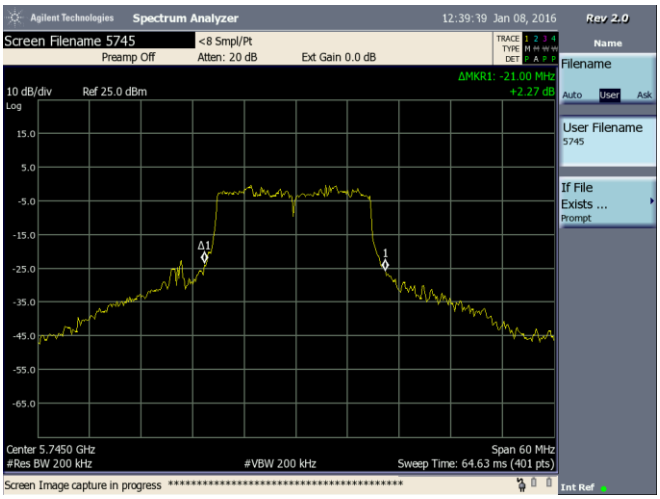


Figure 30: U-NII-3 26dB Bandwidth (Ch149 shown, Ch157 &165 similar)

5.11 Carrier Frequency Separation Plot

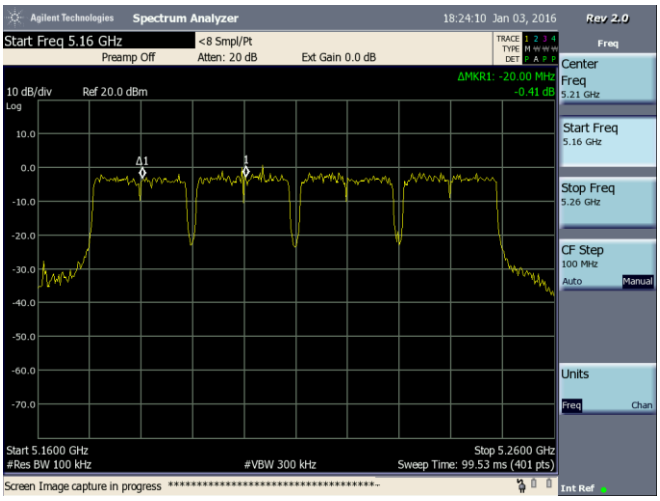


Figure 31: U-NII-1 Carrier Frequency Separation

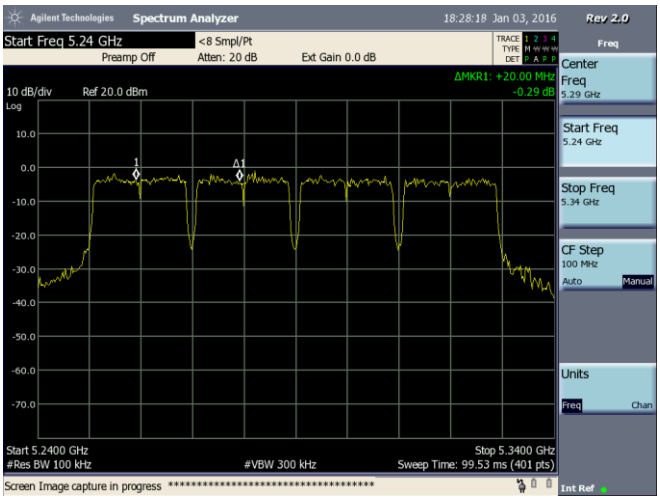


Figure 32: U-NII-2A Carrier Frequency Separation

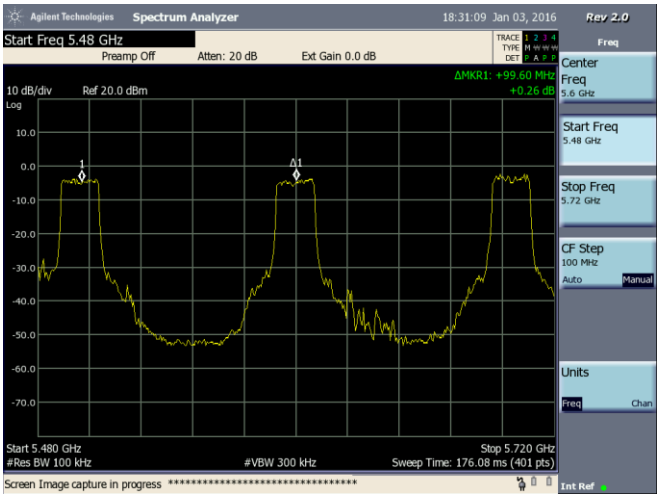


Figure 33: U-NII-2C Carrier Frequency Separation

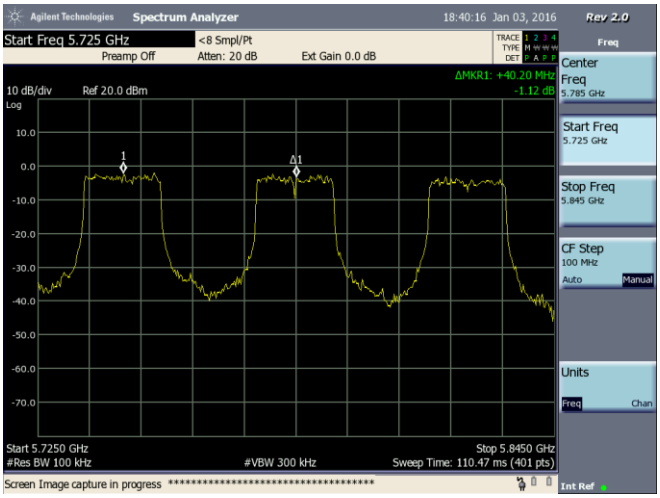


Figure 34: U-NII-3 Carrier Frequency Separation

6 Peak Conducted Output Power Per FCC Part 15.407(a) – 802.11n (5 GHz)

6.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	12/14/15, 01/03/16
Test Engineer:	Shane Duncan
Temperature	23°C avg.
Humidity:	48% avg.

6.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	1/05/18	2 yr

6.3 Test Set up Photo(s)

Refer to section 1.10 (Figure 1)

6.4 Limits/Requirements

(a) The maximum peak conducted power shall not exceed the following:
Shall not exceed 250mW in the U-NII-1, U-NII-2A, U-NII-2C bands, and shall not exceed 1W in the U-NII-3 band.

6.5 Test Description and Procedure

The EUT antenna port is connected to the spectrum analyzer. The maximum peak conducted output power was measured at the center peak of the selected channel. Measurements are performed at each of the low, mid and high frequencies in the band. The EUT only supports 20 MHz bandwidth mode.

6.6 Test Data Tables U-NII-1

Channel	Freq.(MHz)	MPP (dBm)	CPP (dBm)	Margin = 24 - CPP (dB)	Result
		n	n	n	
36	5180	14.09	16.09	7.91	Passed
40	5200	14.81	16.81	7.19	Passed
48	5240	14.51	16.51	7.49	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

6.7 Test Data Tables U-NII-2A

Channel	Freq.(MHz)	MPP (dBm)	CPP (dBm)	Margin = 24 - CPP (dB)	Result
		n	n	n	
52	5260	14.47	16.47	7.53	Passed
56	5280	14.36	16.36	7.64	Passed
64	5320	14.75	16.75	7.25	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

6.8 Test Data Tables U-NII-2C

Channel	Freq.(MHz)	MPP (dBm)	CPP (dBm)	Margin = 24 - CPP (dB)	Result
		n	n	n	
100	5500	14.25	16.25	7.75	Passed
120	5600	13.40	15.40	8.60	Passed
140	5700	14.33	16.33	7.67	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

6.9 Test Data Tables U-NII-3

Channel	Freq.(MHz)	MPP (dBm)	CPP (dBm)	Margin = 30 - CPP (dB)	Result
		n	n	n	
149	5745	14.05	16.05	13.95	Passed
157	5785	14.66	16.66	13.34	Passed
165	5825	14.03	16.03	13.97	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

6.10 Peak Power Plots

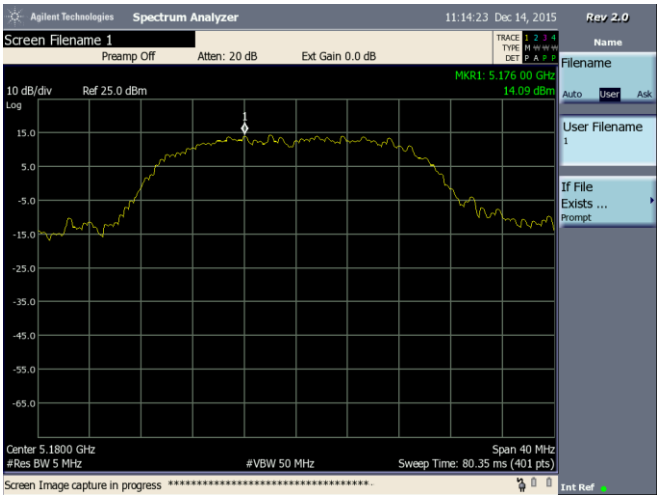


Figure 35: U-NII-1 Peak Power (Ch36 shown, Ch40 &48 similar)

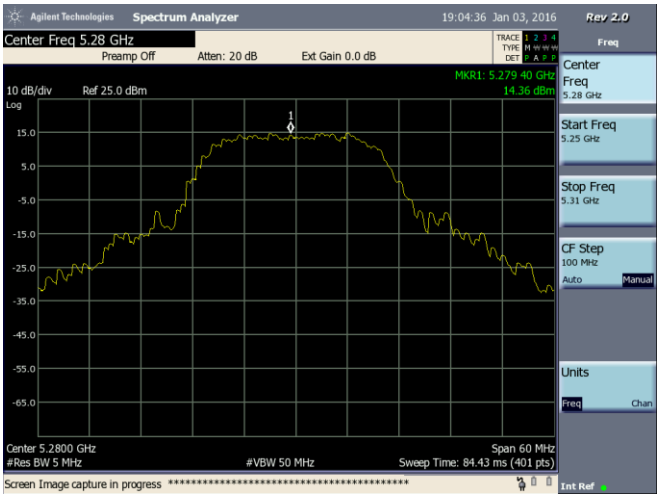


Figure 36: U-NII-2APeak Power (Ch52 shown, Ch56&64 similar)

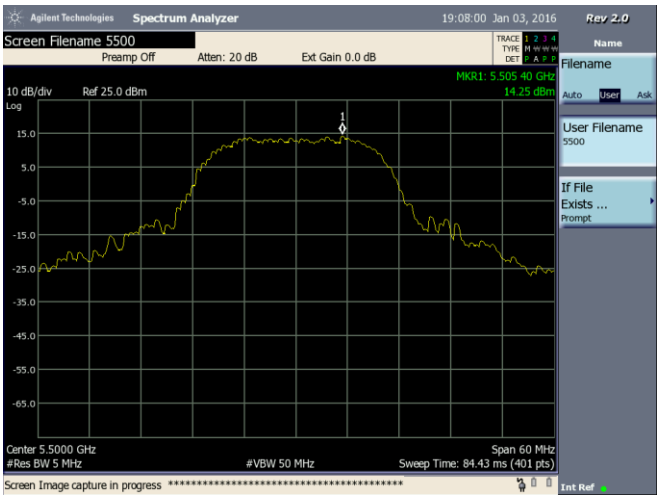


Figure 37: U-NII-2C Peak Power (Ch100 shown, Ch120 &140 similar)

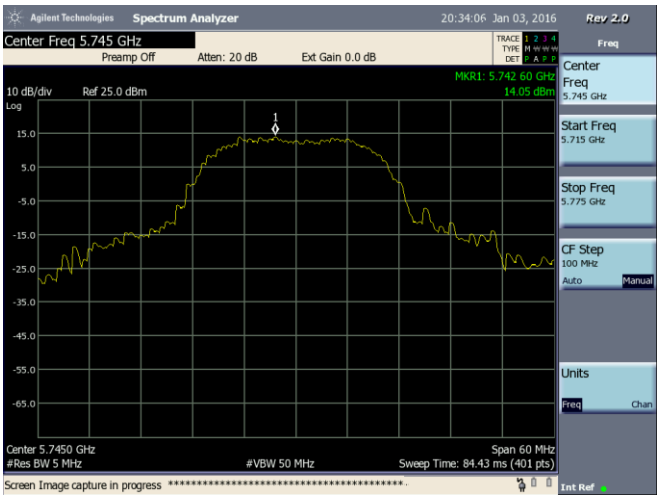


Figure 38: U-NII-3Peak Power (Ch149 shown, Ch157 &165 similar)

7 Power Spectral Density Per FCC Part 15.407(a)(5) – 802.11n (5 GHz)

7.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	01/08/16
Test Engineer:	Shane Duncan
Temperature	23°C
Humidity:	48%

7.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	1/05/18	2 yr

7.3 Test Set up Photo(s)

Refer to Figure 1.

7.4 Limits/Requirements

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 17dBm/MHz in the U-NII-1 band during any time interval of continuous transmission, and shall not exceed the 11 dBm/MHz in the U-NII-2A/2C bands, and shall not exceed 30 dBm/500KHz in the U-NII-3 band. This power spectral density shall be determined in accordance with the provisions of paragraph (a) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

7.5 Test Description and Procedure

The EUT antenna port is connected to the spectrum analyzer. The power spectral density is measured at the center peak of the selected channel. Measurements are performed at each of the low, mid and high frequencies in the band.The EUT only supports 20 MHz bandwidth mode.

7.6 Test Data Tables U-NII-1

Channel	Freq.(MHz)	MPP/MHz (dBm)	CPP/MHz (dBm)	Margin = 17- CPP (dB)	Result
		n	n	n	
36	5180	6.64	8.64	8.36	Passed
40	5200	7.29	9.29	7.71	Passed
48	5240	8.30	10.30	6.70	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

7.7 Test Data Tables U-NII-2A

Channel	Freq.(MHz)	MPP/MHz (dBm)	CPP/MHz (dBm)	Margin = 11 - CPP (dB)	Result
		n	n	n	
52	5260	7.13	9.13	1.87	Passed
56	5280	7.72	9.72	1.28	Passed
64	5320	7.90	9.90	1.10	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

7.8 Test Data Tables U-NII-2C

Channel	Freq.(MHz)	MPP/MHz (dBm)	CPP/MHz(dBm)	Margin = 11 - CPP (dB)	Result
		n	n	n	
100	5500	7.28	9.28	1.72	Passed
120	5600	7.74	9.74	1.26	Passed
140	5700	8.57	10.57	.43	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

7.9 Test Data Tables U-NII-3

Channel	Freq.(MHz)	MPP/500KHz (dBm)	CPP/500KHz (dBm)	Margin = 30 - CPP (dB)	Result
		n	n	n	
149	5745	4.25	6.25	23.75	Passed
157	5785	3.47	5.47	24.53	Passed
165	5825	6.81	8.81	21.19	Passed

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss 2 dB

7.10 Power spectral density Plots

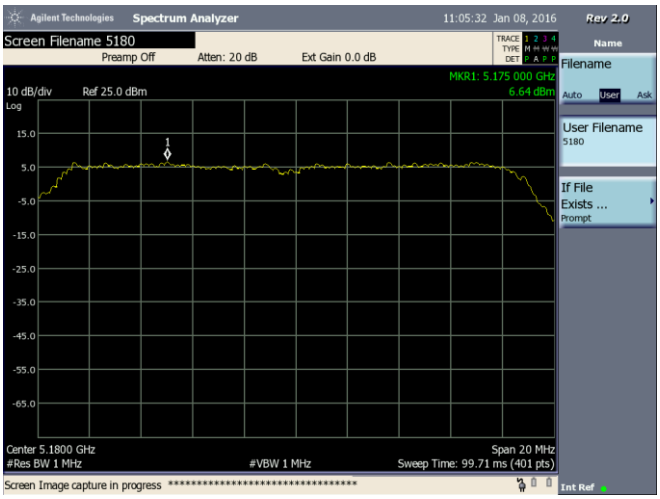


Figure 39: U-NII-1 Power Spectral Density (Ch36 shown, Ch40 &48 similar)

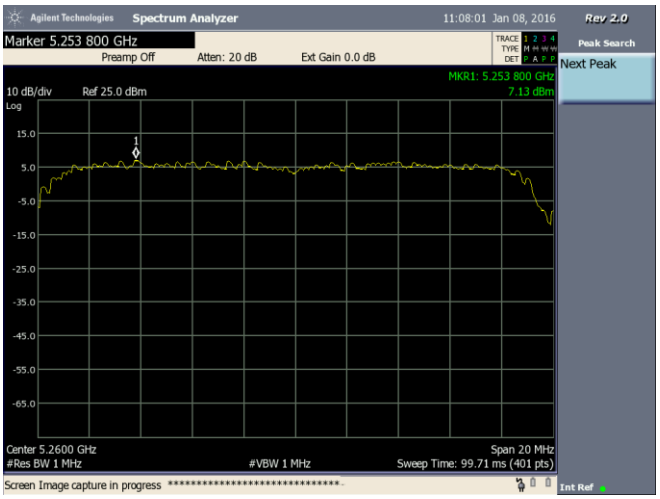


Figure 40: U-NII-2APower Spectral Density(Ch52 shown, Ch56&64 similar)

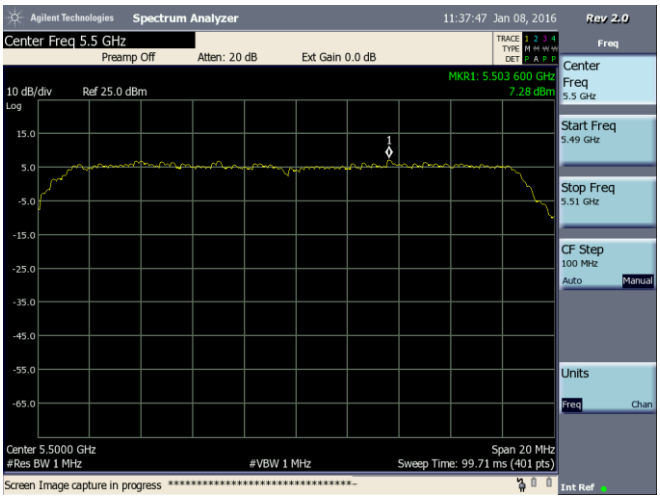


Figure 41: U-NII-2C Power Spectral Density(Ch100 shown, Ch120 &140 similar)

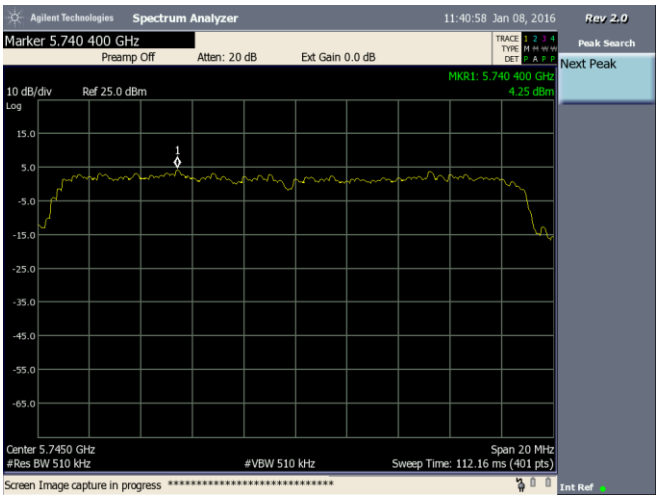


Figure 42: U-NII-3Power Spectral Density(Ch149 shown, Ch157 &165 similar)

8 Lower/Upper Band Edge Per FCC Part 15.407(b) – 802.11n (5 GHz)

8.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	12/14/15, 01/03/16
Test Engineer:	Shane Duncan
Temperature	23°C avg
Humidity:	48% avg.

8.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	1/05/18	2 yr

8.3 Test Set up Photo(s)

Refer to Figure 1.

8.4 Limits/Requirements

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

8.5 Test Description and Procedure

Using the conducted test method, the band edge measurement was made at the peak level of the emission at the band edge (outside of the operating band) relative to the center peak of the operating frequency channel by using marker delta function. The span was set to be wide enough to capture the highest peak level of the operating channel to the band edge. The EUT only supports 20 MHz bandwidth mode.

8.6 Test Plots

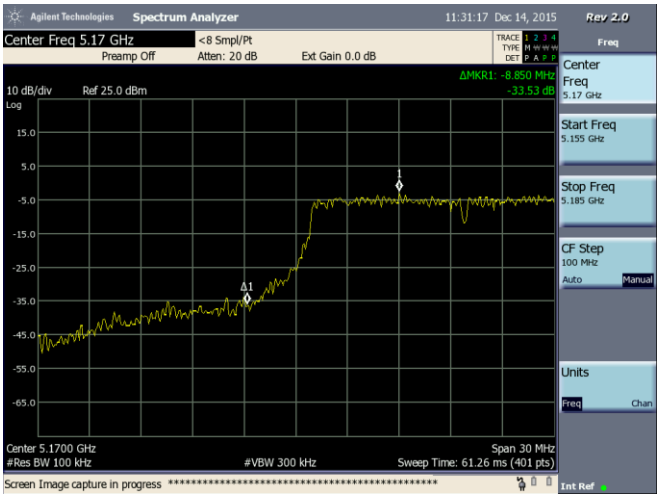


Figure43: U-NII-1 Lower Band Edge

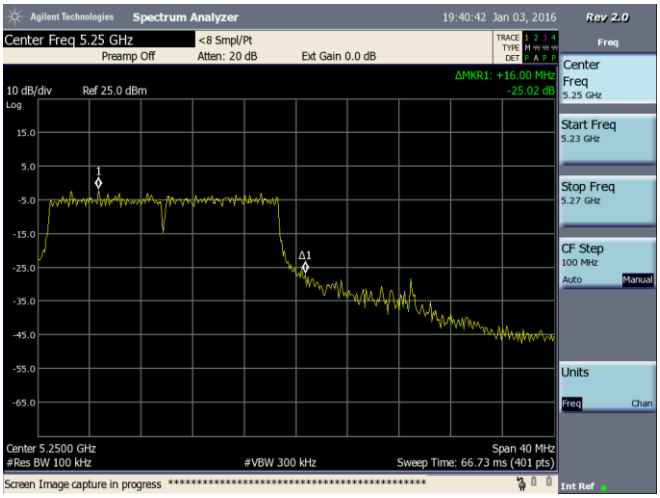


Figure44: U-NII-1 Upper Band Edge

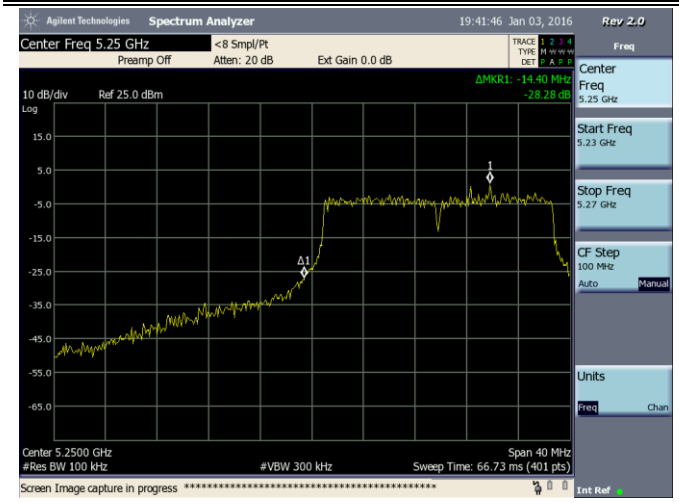


Figure45: U-NII-2A Lower Band Edge

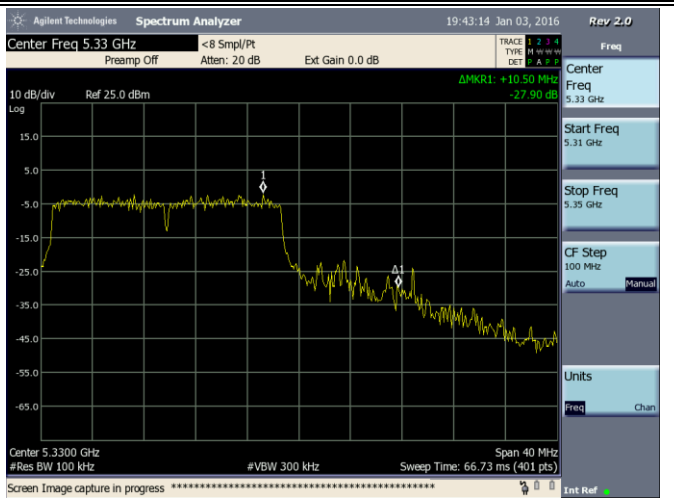


Figure46: U-NII-2A Upper Band Edge

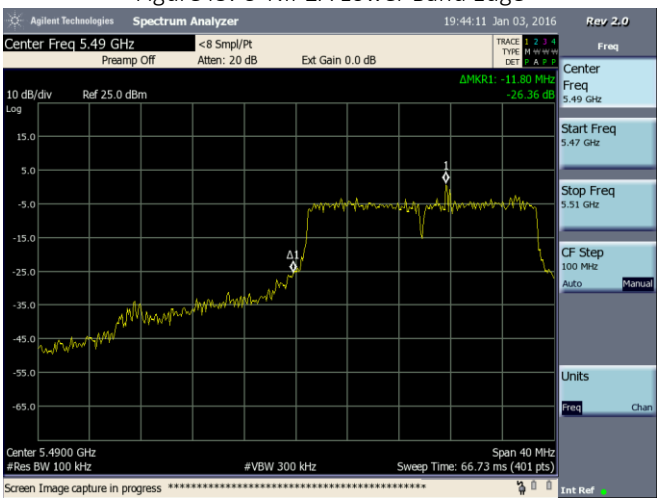


Figure47: U-NII-2C Lower Band Edge

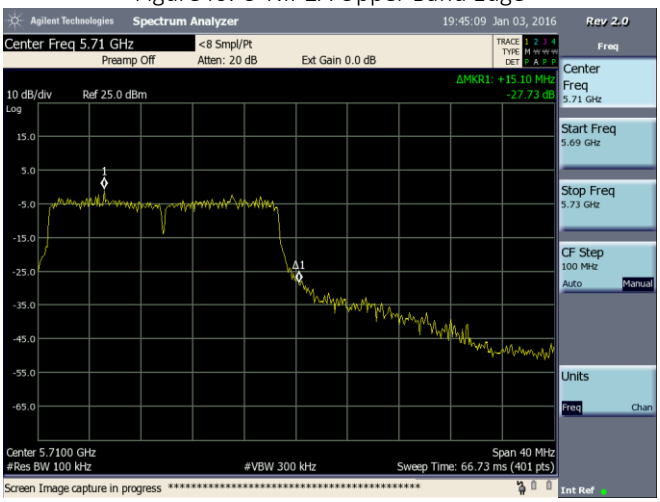


Figure48: U-NII-2C Upper Band Edge

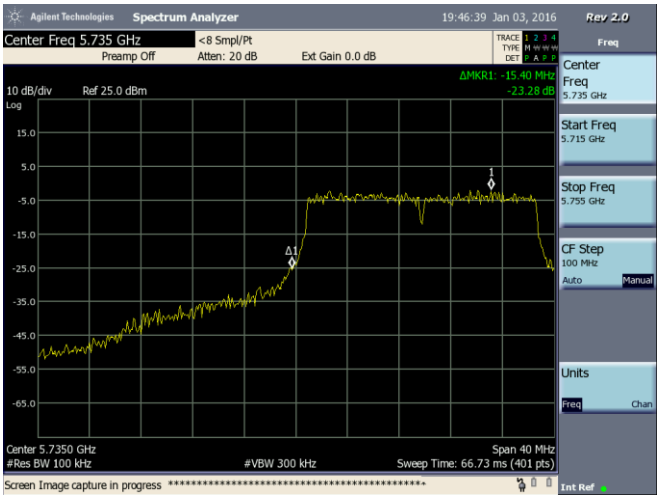


Figure49: U-NII-3 LowerBand Edge

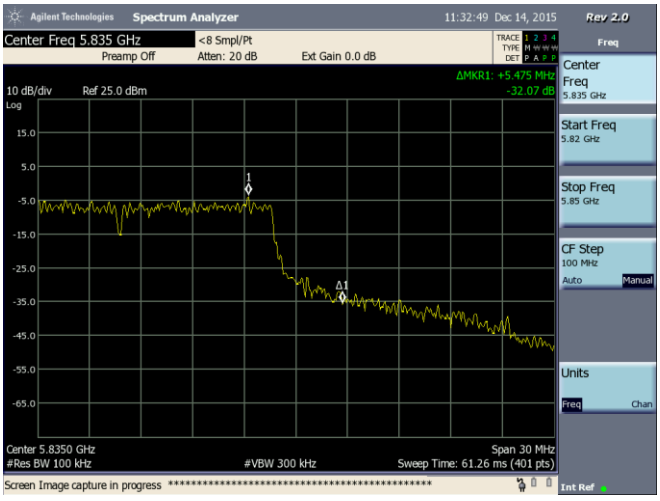


Figure50: U-NII-3 Upper Band Edge

9 99 Percent Occupied Bandwidth per FCC Part 15.407- 802.11n(5 GHz)

9.1 Administrative and environmental details

Site Used:	EMC Lab 2A
Test Date:	12/11/15, 01/03/16
Test Engineer:	Shane Duncan
Temperature	23°C
Humidity:	48%

9.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	1/05/18	2 yr

9.3 Test Set up Photo(s)

Refer to Figure 1.

9.4 Limits/Requirements

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated.

9.5 Test Description and Procedure

Using the conducted test method, the occupied bandwidth measurement was made utilizing the CSA Analyzer's OBW function. The span was set to be wide enough to capture the entire operating channel.The EUT only operates in 20 MHz bandwidth mode.

9.6 99 Percent Occupied Bandwidth Measurement Test Data U-NII-1

Channel	Freq.(MHz)	Measured OCCUPIED BANDWIDTH(MHz)	Result
		n	
36	5180	17.85	Pass
40	5200	17.7	Pass
48	5240	17.85	Pass

9.7 Emission Bandwidth Measurement Test Data U-NII-2A

Channel	Freq.(MHz)	Measured OCCUPIED BANDWIDTH(MHz)	Result
		n	
52	5260	17.7	Pass
56	5280	17.7	Pass
64	5320	17.85	Pass

9.8 99 Percent Occupied Bandwidth Measurement Test Data U-NII-2C

Channel	Freq.(MHz)	Measured OCCUPIED BANDWIDTH(MHz)	Result
		n	
100	5500	17.7	Pass
120	5600	17.7	Pass
140	5700	17.7	Pass

9.9 99 Percent Occupied Bandwidth Measurement Test Data U-NII-3

Channel	Freq.(MHz)	Measured OCCUPIED BANDWIDTH(MHz)	Result
		n	
149	5745	17.7	Pass
157	5785	17.7	Pass
165	5825	17.7	Pass

9.10 Test Plots

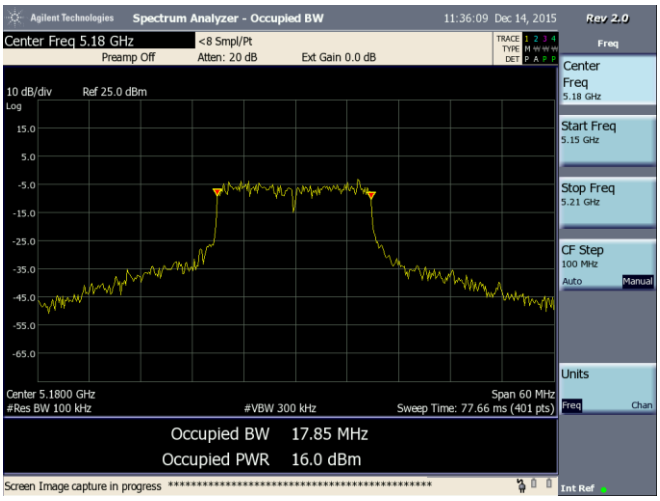


Figure 51: U-NII-1 Occupied Bandwidth (Ch36 shown, Ch40 &48 similar)

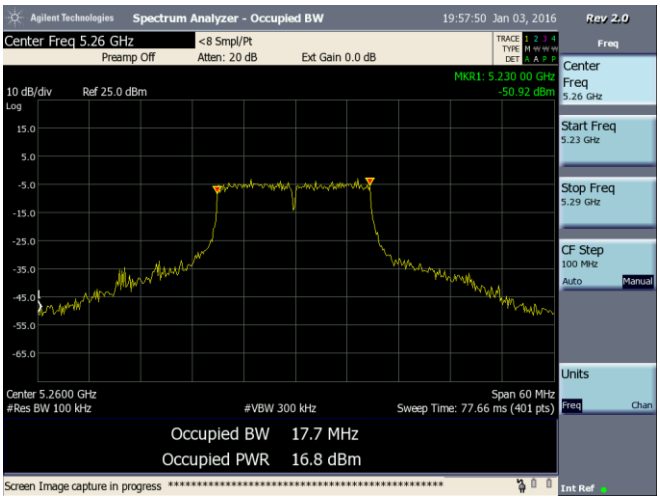


Figure 52: U-NII-2AOccupied Bandwidth(Ch52 shown, Ch56&64 similar)

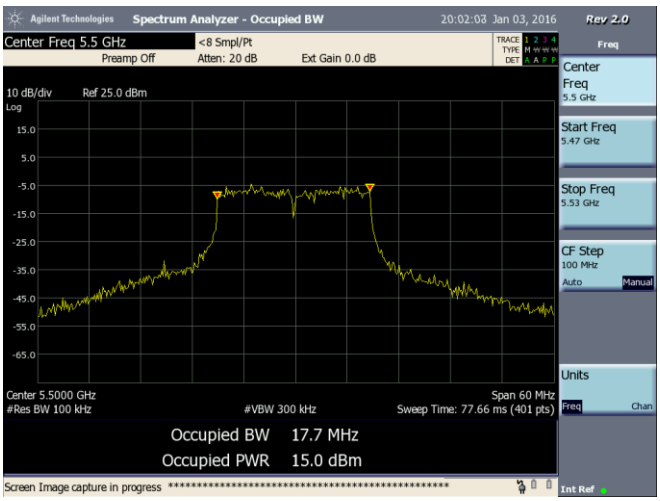


Figure 53: U-NII-2C Occupied Bandwidth (Ch100 shown, Ch120 &140 similar)

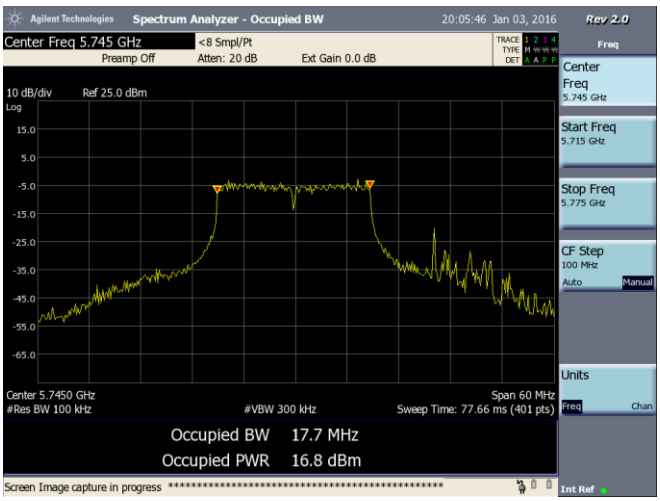


Figure 54: U-NII-3Occupied Bandwidth(Ch149 shown, Ch157 &165 similar)

10 Frequency Stability Per FCC Part 15.407(g)

10.1 Administrative and environmental details

Site Used:	Environmental Lab
Test Date:	01/11/16
Test Engineer:	Shane Duncan
Temperature	23°C
Humidity:	48%

10.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
Temperature Chamber	Test EQUITY	1007H	61322	01/28/17	2 yr
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	1/05/18	2 yr
Digital DC Power Supply	Korad	KA3005D	008250037701	VBU*	N/A**
Multimeter	HP	3468B	2231A02212	10/14/16	1 yr

*Verified Before Use **Not Applicable

10.3 Test Set up Photo(s)

Refer to Figure 9.

10.4 Limits/Requirements

Frequency Stability must be measured in from 50 to -30 degrees Celsius or from the operational specification sheet in increments of 10 degrees. In addition to varying the temperature the EUT must be tested at 85% and 115% of the nominal input voltage.

10.5 Test Description and Procedure

The EUT was placed in a temperature chamber where the temperature was varied based of the operational specification sheet of the battery. In addition the EUT was tested at each temperature and frequency at 85%, 100% and 115% of the input voltage. The nominal input Voltage is 5V from USB, therefore the EUT was also tested at 4.25V and 5.75V. The EUT was tested from 60 to -10 degrees Celsius due to the operational range of the battery from the operational specification sheet.

10.6 Frequency Stability Measurement Test Data U-NII-1

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5180	5179.70	5179.70	5179.70	Pass
50	5180	5179.70	5179.70	5179.70	Pass
40	5180	5179.70	5179.70	5179.70	Pass
30	5180	5179.70	5179.70	5179.70	Pass
20	5180	5179.70	5179.70	5179.70	Pass
10	5180	5179.70	5179.70	5179.70	Pass
0	5180	5179.70	5179.70	5179.70	Pass
-10	5180	5179.70	5179.70	5179.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5200	5199.70	5199.70	5199.70	Pass
50	5200	5199.70	5199.70	5199.70	Pass
40	5200	5199.70	5199.70	5199.70	Pass
30	5200	5199.70	5199.70	5199.70	Pass
20	5200	5199.70	5199.70	5199.70	Pass
10	5200	5199.70	5199.70	5199.70	Pass
0	5200	5199.70	5199.70	5199.70	Pass
-10	5200	5199.70	5199.70	5199.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5240	5139.70	5139.70	5139.70	Pass
50	5240	5139.70	5139.70	5139.70	Pass
40	5240	5139.70	5139.70	5139.70	Pass
30	5240	5139.70	5139.70	5139.70	Pass
20	5240	5139.70	5139.70	5139.70	Pass
10	5240	5139.70	5139.70	5139.70	Pass
0	5240	5139.70	5139.70	5139.70	Pass
-10	5240	5139.70	5139.70	5139.70	Pass

10.7 Frequency Stability Measurement Test Data U-NII-2A

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5260	5259.70	5259.70	5259.70	Pass
50	5260	5259.70	5259.70	5259.70	Pass
40	5260	5259.70	5259.70	5259.70	Pass
30	5260	5259.70	5259.70	5259.70	Pass
20	5260	5259.70	5259.70	5259.70	Pass
10	5260	5259.70	5259.70	5259.70	Pass
0	5260	5259.70	5259.70	5259.70	Pass
-10	5260	5259.70	5259.70	5259.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5280	5279.70	5279.70	5279.70	Pass
50	5280	5279.70	5279.70	5279.70	Pass
40	5280	5279.70	5279.70	5279.70	Pass
30	5280	5279.70	5279.70	5279.70	Pass
20	5280	5279.70	5279.70	5279.70	Pass
10	5280	5279.70	5279.70	5279.70	Pass
0	5280	5279.70	5279.70	5279.70	Pass
-10	5280	5279.70	5279.70	5279.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5320	5319.70	5319.70	5319.70	Pass
50	5320	5319.70	5319.70	5319.70	Pass
40	5320	5319.70	5319.70	5319.70	Pass
30	5320	5319.70	5319.70	5319.70	Pass
20	5320	5319.70	5319.70	5319.70	Pass
10	5320	5319.70	5319.70	5319.70	Pass
0	5320	5319.70	5319.70	5319.70	Pass
-10	5320	5319.70	5319.70	5319.70	Pass

10.8 Frequency Stability Measurement Test Data U-NII-2C

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5500	5499.70	5499.70	5499.70	Pass
50	5500	5499.70	5499.70	5499.70	Pass
40	5500	5499.70	5499.70	5499.70	Pass
30	5500	5499.70	5499.70	5499.70	Pass
20	5500	5499.70	5499.70	5499.70	Pass
10	5500	5499.70	5499.70	5499.70	Pass
0	5500	5499.70	5499.70	5499.70	Pass
-10	5500	5499.70	5499.70	5499.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5600	5599.70	5599.70	5599.70	Pass
50	5600	5599.70	5599.70	5599.70	Pass
40	5600	5599.70	5599.70	5599.70	Pass
30	5600	5599.70	5599.70	5599.70	Pass
20	5600	5599.70	5599.70	5599.70	Pass
10	5600	5599.70	5599.70	5599.70	Pass
0	5600	5599.70	5599.70	5599.70	Pass
-10	5600	5599.70	5599.70	5599.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5700	5699.70	5699.70	5699.70	Pass
50	5700	5699.70	5699.70	5699.70	Pass
40	5700	5699.70	5699.70	5699.70	Pass
30	5700	5699.70	5699.70	5699.70	Pass
20	5700	5699.70	5699.70	5699.70	Pass
10	5700	5699.70	5699.70	5699.70	Pass
0	5700	5699.70	5699.70	5699.70	Pass
-10	5700	5699.70	5699.70	5699.70	Pass

10.9 Frequency Stability Measurement Test Data U-NII-3

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5745	5749.70	5749.70	5749.70	Pass
50	5745	5749.70	5749.70	5749.70	Pass
40	5745	5749.70	5749.70	5749.70	Pass
30	5745	5749.70	5749.70	5749.70	Pass
20	5745	5749.70	5749.70	5749.70	Pass
10	5745	5749.70	5749.70	5749.70	Pass
0	5745	5749.70	5749.70	5749.70	Pass
-10	5745	5749.70	5749.70	5749.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5785	5784.70	5784.70	5784.70	Pass
50	5785	5784.70	5784.70	5784.70	Pass
40	5785	5784.70	5784.70	5784.70	Pass
30	5785	5784.70	5784.70	5784.70	Pass
20	5785	5784.70	5784.70	5784.70	Pass
10	5785	5784.70	5784.70	5784.70	Pass
0	5785	5784.70	5784.70	5784.70	Pass
-10	5785	5784.70	5784.70	5784.70	Pass

Temperature (C)	Freq.(MHz)	4.25 V	5.0 V	5.75 V	Result
60	5825	5824.70	5824.70	5824.70	Pass
50	5825	5824.70	5824.70	5824.70	Pass
40	5825	5824.70	5824.70	5824.70	Pass
30	5825	5824.70	5824.70	5824.70	Pass
20	5825	5824.70	5824.70	5824.70	Pass
10	5825	5824.70	5824.70	5824.70	Pass
0	5825	5824.70	5824.70	5824.70	Pass
-10	5825	5824.70	5824.70	5824.70	Pass

11 Radiated Spurious & restricted bands emissions Per FCC Part 15 sections 15.209, 15.205

11.1 Administrative and environmental details

Site Used:	Semi Anechoic Chamber
Test Date:	01/13/16
Test Engineer:	Shane Duncan
Temperature	20°C
Humidity:	47%

11.2 Test Equipment

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
Pre-Amplifier	Agilent	83051A	0000009025	VBU*	N/A**
Amplifier	Giga-tronics	GT-1040A	1112003	VBU*	N/A**
DRG Horn Antenna	AH Systems	SAS-571	587	10/14/16	1yr
Horn Antenna	Schwarzbeck	15633	BBHA9170267	10/16/16	1yr
HP Spectrum Analyzer	HP	8565E	07017	7/16/16	1yr

*Verified Before Use, **Not Applicable

11.3 Test Set up Photo(s) –Refer to Figures 10 and 11.

11.4 Limits/Requirements

FCC Part 15 section 15.209 Radiated emission limits

Frequency (MHz)	Field strength Average (microvolts/meter)	Field strength Average (dBuV/meter)	Field strength Peak (dBuV/meter)	Measurement distance (meters)
Above 960	500	54	74	3

Table 1- FCC Part 15 section 15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	
13.36-13.41			

11.5 Test Description and Procedure

For radiated emissions, the packaged EUT was placed 80 cm above the ground plane on a non-conducting table. The transmit and receive configuration of the EUT was controlled by the same means as the conducted tests. Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)). All measurements were made with a peak detector.

11.6 Radiated Spurious Emissions Test Data U-NII-1

1-10 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5180	8.45	7.39	35.50	36.17	26	26	7	24	44.50	44.17	54/74
5200	9.1	7.26	34.00	34.23	26	26	7	24	43.00	43.23	54/74
5240	8	8.89	34.73	34.73	26	26	7	24	43.73	43.73	54/74

10-18 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5180	13.71	13.64	37.50	37.67	26	26	10	24	49.50	49.67	54/74
5200	15.64	13.88	35.9	35.57	26	26	10	24	47.9	47.57	54/74
5240	13.76	15.65	36.23	35.73	26	26	10	24	48.23	47.73	54/74

Note: No Spurious Emissions were found for frequencies greater than 18 GHz

Note: H means Horizontal and V means Vertical Antenna Polarizations

11.7 Radiated Spurious Emissions Test Data U-NII-2A

1-10 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5260	9.03	6.78	36.17	36.0	26	26	7	24	45.17	45.0	54/74
5280	9.01	7.34	34.5	33.40	26	26	7	24	43.5	42.40	54/74
5320	7.36	9.4	34.23	37.07	26	26	7	24	43.23	46.07	54/74

10-18 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5260	13.63	17.23	37.83	38.33	26	26	10	24	49.83	50.33	54/74
5280	13.34	14.90	35.9	36.40	26	26	10	24	47.9	48.40	54/74
5320	13.44	14.70	35.73	35.57	26	26	10	24	47.73	47.57	54/74

Note: No Spurious Emissions were found for frequencies greater than 18 GHz

Note: H means Horizontal and V means Vertical Antenna Polarizations

11.8 Radiated Spurious Emissions Test Data U-NII-2C

1-10 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5500	7.57	7.345	35.00	36.5	26	26	7	24	44.0	45.5	54/74
5600	8.45	8.03	34.40	34.57	26	26	7	24	43.40	43.57	54/74
5700	7.48	8.14	33.80	32.90	26	26	7	24	42.80	41.90	54/74

10-18 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5500	14.61	16.37	37.33	38.17	26	26	10	24	49.33	50.17	54/74
5600	14.86	15.33	36.90	35.73	26	26	10	24	48.90	47.73	54/74
5700	14.93	13.61	35.73	36.40	26	26	10	24	47.73	48.40	54/74

Note: No Radiated Spurious Emissions were found for frequencies greater than 18 GHz

Note: H means Horizontal and V means Vertical Antenna Polarizations

11.9 Radiated Spurious Emissions Test Data U-NII-3

1-10 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5745	7.63	6.94	35.33	35.33	26	26	7	24	44.33	44.33	54/74
5785	7.33	7.64	33.57	34.40	26	26	7	24	42.57	43.40	54/74
5825	6.71	8.5	33.73	34.23	26	26	7	24	42.73	43.23	54/74

10-18 GHz Radiated Emissions

Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Antenna Factor (dB/m)		Cable Loss (dB)	Amplifier Gain (dB)	Corrected Peak Emission (dBuV/m)		Limit (dBuV/m) Avg/Peak
	H	V	H	V	H	V			H	V	
5745	13.75	13.64	38.00	37.83	26	26	10	24	50.00	49.83	54/74
5785	13.68	13.77	36.07	36.07	26	26	10	24	48.07	48.07	54/74
5825	13.82	17.77	35.73	35.90	26	26	10	24	47.73	47.90	54/74

Note: No Radiated Spurious Emissions were found for frequencies greater than 18 GHz

Note: H means Horizontal and V means Vertical Antenna Polarizations

11.10 Radiated Spurious Emissions Plots U-NII-1

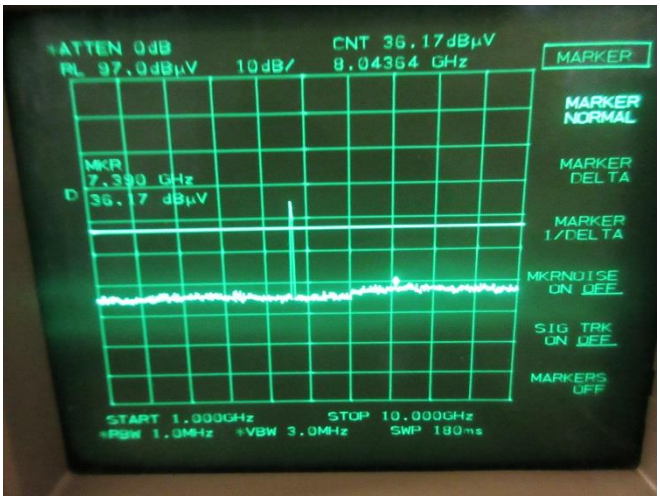


Figure 55: Radiated Spurious Emissions Vertical
Channel 36 shown 40 & 48 similar (1-10GHz)

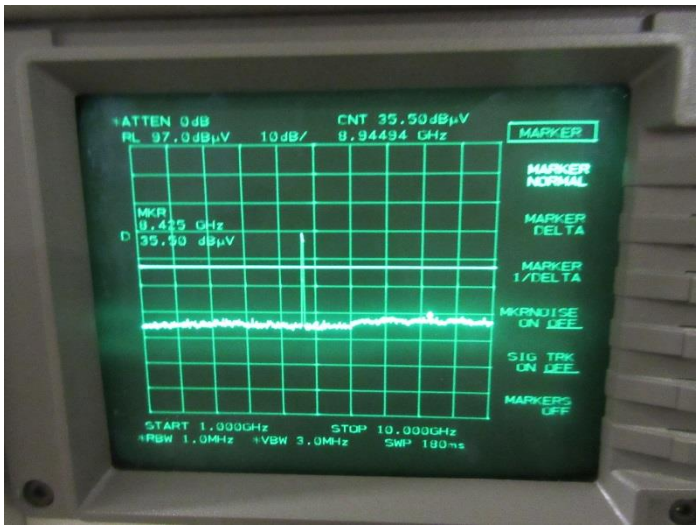


Figure 56: Radiated Spurious Emissions Horizontal
Channel 36 shown 40 & 48 similar (1-10 GHz)

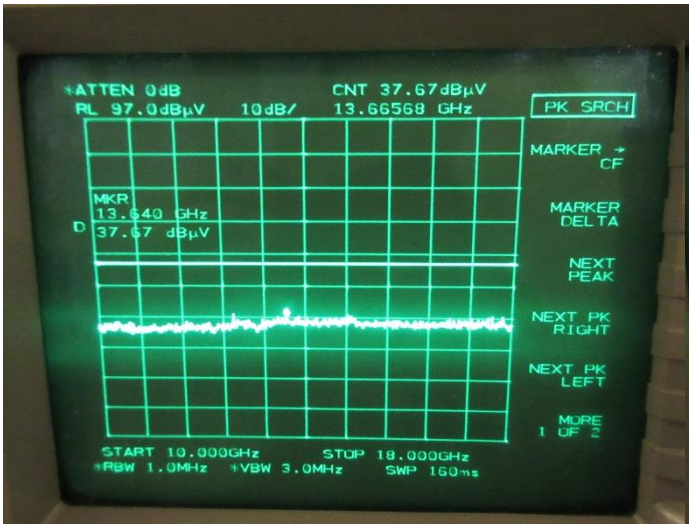


Figure 57: Radiated Spurious Emissions Vertical
Channel 36 shown 40 & 48 similar (10-18 GHz)

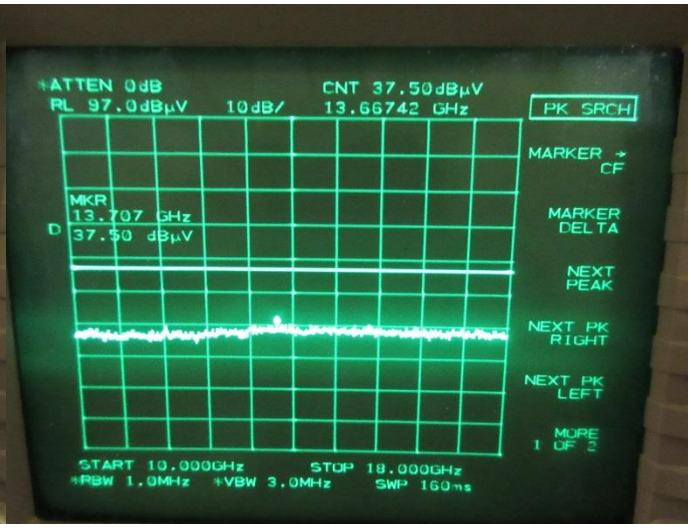


Figure 58: Radiated Spurious Emissions Horizontal
Channel 36 shown 40 & 48 similar (10-18 GHz)

11.11 Radiated Spurious Emissions Plots U-NII-2A

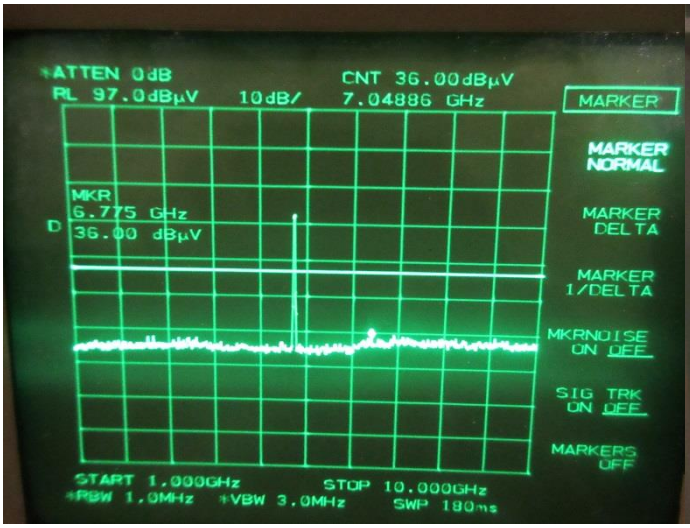


Figure 59: Radiated Spurious Emissions Vertical Channel 52 shown 56 & 64 similar (1-10 GHz)

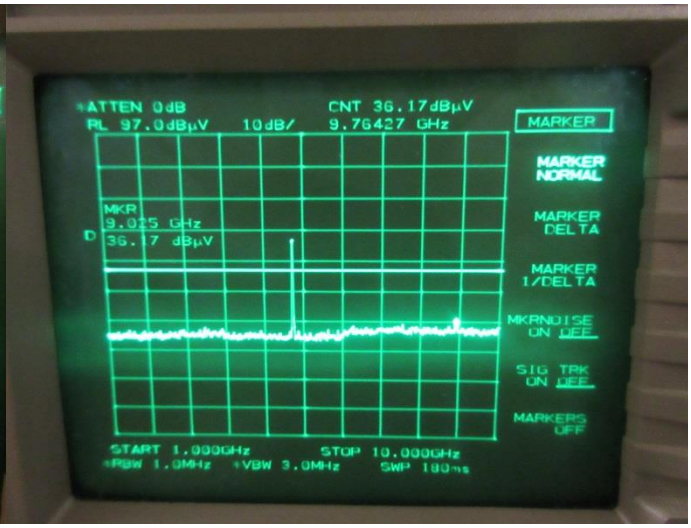


Figure 60: Radiated Spurious Emissions Horizontal Channel 52 shown 56 & 64 similar (1-10 GHz)

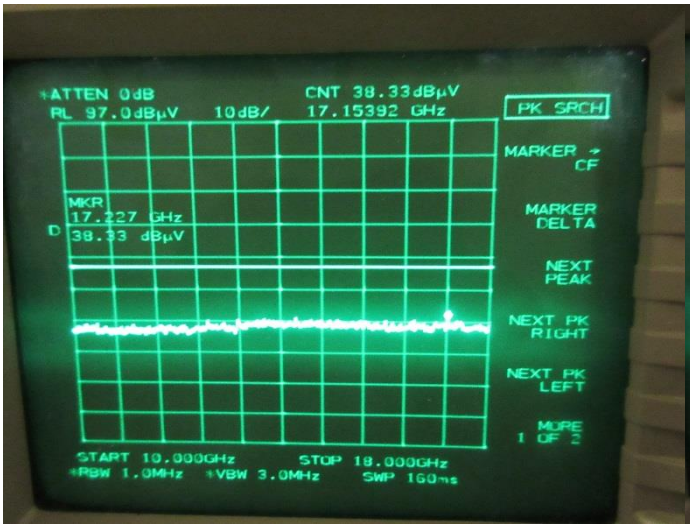


Figure 61: Radiated Spurious Emissions Vertical Channel 52 shown 56 & 64 similar (10-18 GHz)

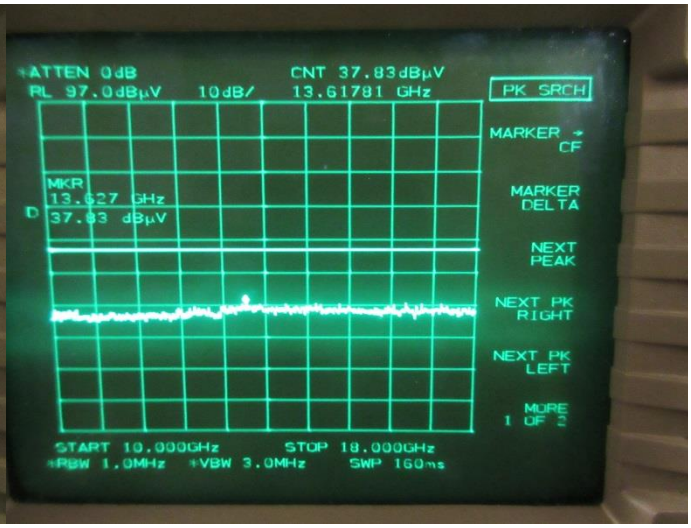


Figure 62: Radiated Spurious Emissions Horizontal Channel 52 shown 56 & 64 similar (10-18 GHz)

11.12 Radiated Spurious Emissions Plots U-NII-2C

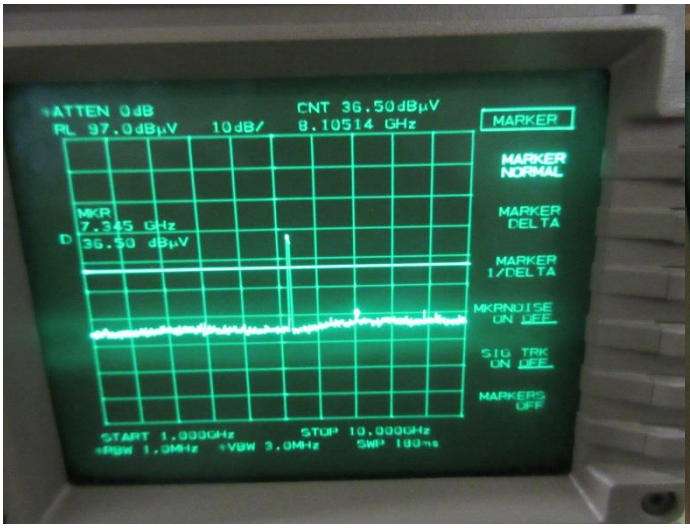


Figure 63: Radiated Spurious Emissions Vertical
Channel 100 shown 120 & 140 similar (1- 10 GHz)

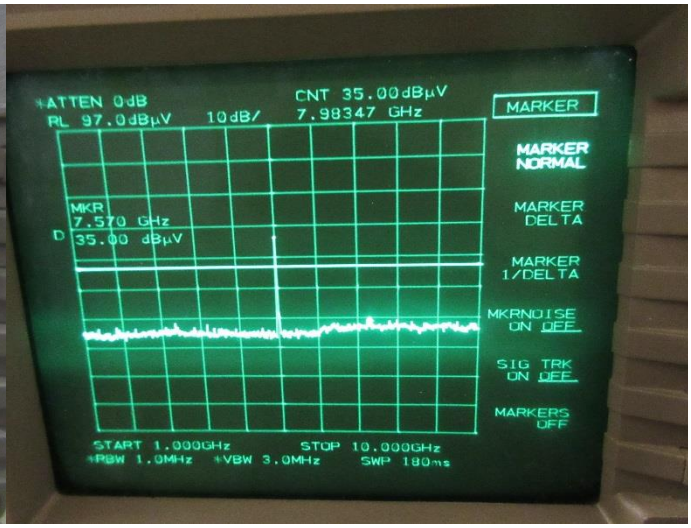


Figure 64: Conducted Spurious Measurement
Channel 100 shown 120 & 140 similar (1-10 GHz)

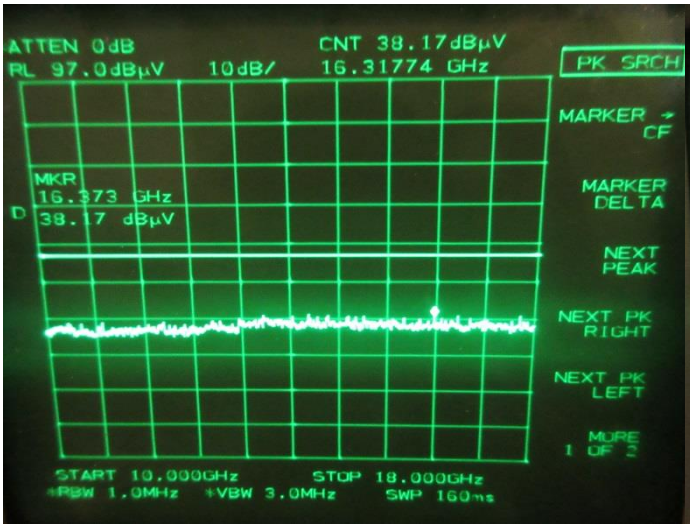


Figure 65: Radiated Spurious Emissions Vertical
Channel 100 shown 120 & 140 similar (10-18 GHz)

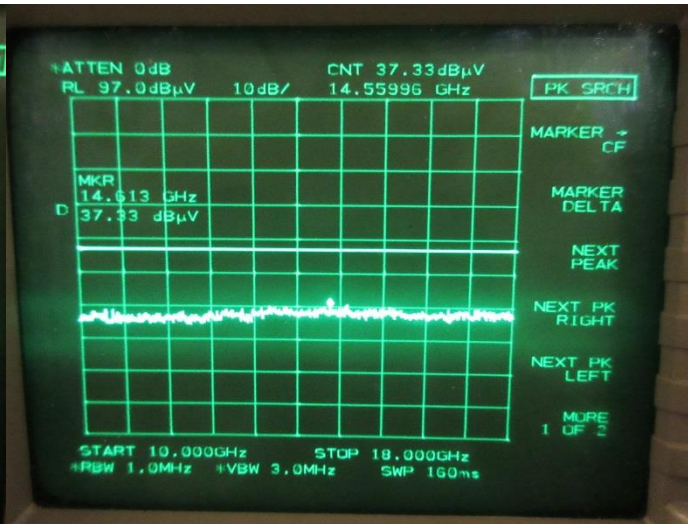


Figure 66: Conducted Spurious Measurement
Channel 100 shown 120 & 140 similar (10-18 GHz)

11.13 Radiated Spurious Emissions Plots U-NII-3

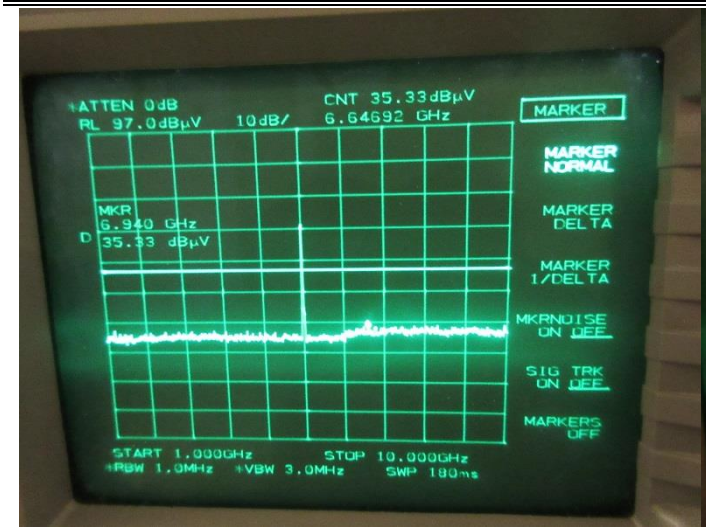


Figure 67: Radiated Spurious Emissions Vertical
Channel 149 shown 157 & 165 similar (1-10 GHz)

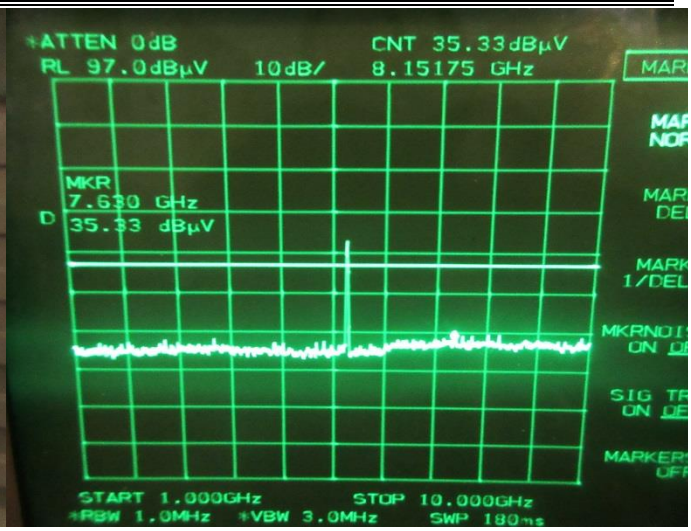


Figure 68: Conducted Spurious Measurement
Channel 149 shown 157 & 165 similar (1-10 GHz)

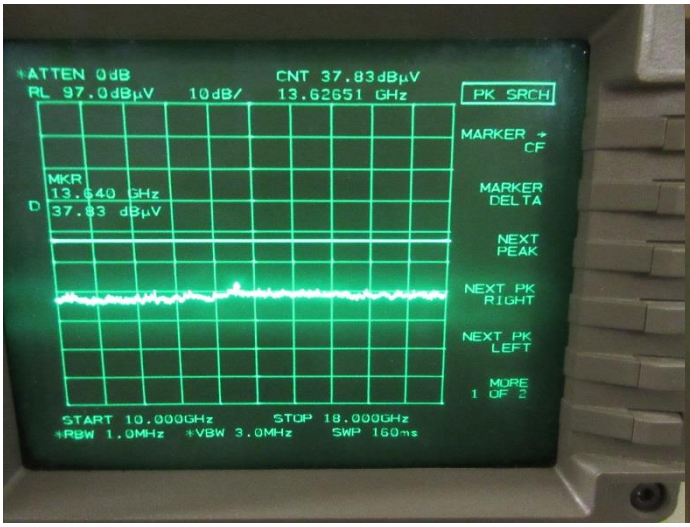


Figure 69: Radiated Spurious Emissions Vertical
Channel 149 shown 157 & 165 similar (10-18 GHz)

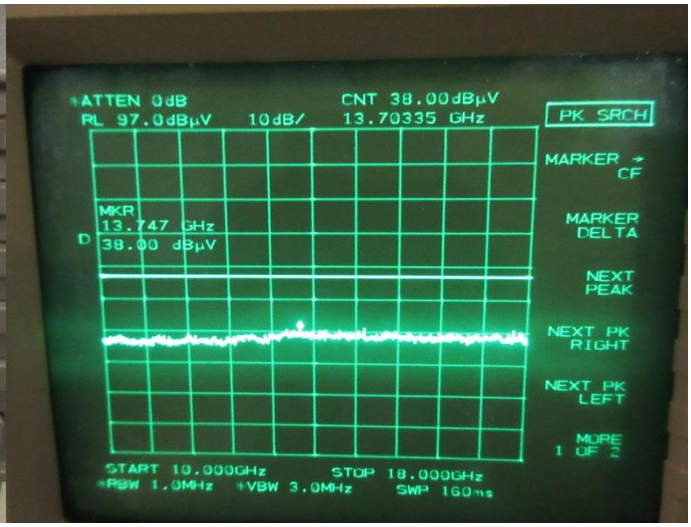
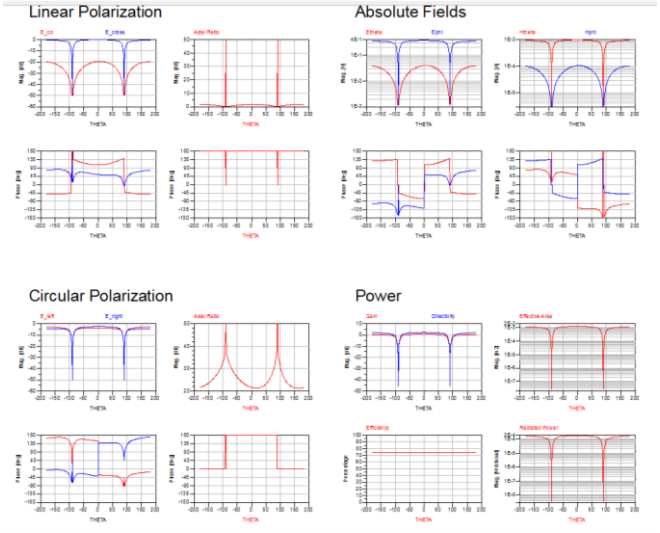


Figure 70: Conducted Spurious Measurement
Channel 149 shown 157 & 165 similar (10-18 GHz)

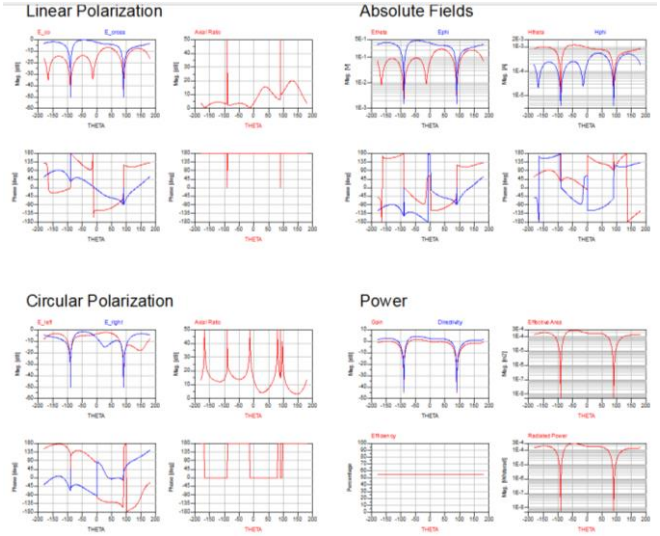
12 Gain of transmission antenna Per FCC Part 15.407(a)

12.1 Limits/Requirements

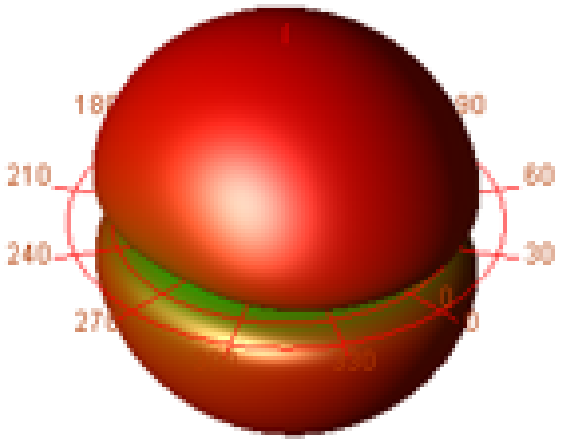
(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.
The EUT antenna used, has a stated gain over the band of ± 1.5 dBi.



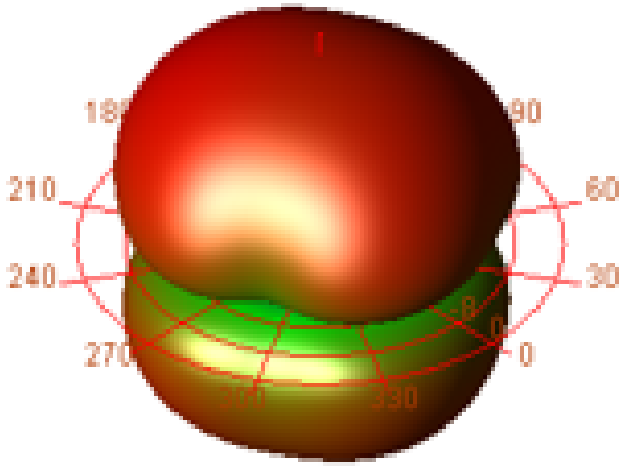
Antenna Specifications in the 2.4-2.5 GHz Band



Antenna Specifications in the 5 GHz Band



2.4 GHz Antenna Radiation Pattern



5 GHz Antenna Radiation Pattern

Figure 71: Antenna Specification

12.2 R-7 Antenna Specification

Electrical	
Antenna chip number	140-00092_REVXX__ANTENNA, WI-FI
Operation frequency (GHz)	2.4, 5.9
Antenna peak gain (dBi)	1.5
Antenna average gain (dBi)	-3
Radiation pattern	Omni
Maximum input power (W)	2
Mechanical	
Antenna element size (mm)	115mm
Coax cable	Micro-coax
Connector	MFH-III

13 APPENDIX

13.1 EUT Technical Specification

Manufacturer:	Osterhout Design Group		
General Description:	The R-7 Smart Glasses offers immersive 3D HD viewing of stored or streaming video content, with stereo audio, in a static setting, or in a head orientation tracking augmented vision mode.		
EUT Name:	Smart Glasses	Model:	R-7
Dimensions:	19cm x 14cm x 4.5cm	Serial Number:	R7-P12
Operating Frequency:	2.402 - 2.48 GHz, 5.18 - 5.240 GHz, 5.260 – 5.320 GHz, 5.500 – 5.700 GHz, 5.745 – 5.825 GHz (only 20 MHz BW for wifi)	Power Cord Type:	☐ Shielded ☒ Un-Shielded

13.2 EUT Photos –attached in the submittal documents