




Test Report Issued Under the Responsibility of:  
**ITC ENGINEERING SERVICES, INC.**

FCC CFR Title 47 Part 15 Subpart C 15.205, 15.2-09, 15.247	
Report Reference No. .... :	20151015-01R-7 Glasses_FCC_2.4 wifi
Date of Issue .... :	12/16/2015
Total Number of Pages..... :	39
Testing Laboratory..... :	ITC Engineering Services, Inc.
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Test Specification Standard .....	FCC CFR Title 47 Part 15 Subpart C 15.205, 15.209, 15.247
Test Procedure .....	KDB 558074 D01 DTS Meas Guidance v03r04 & 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 5 GHz, GPS/GLONASS Enabled Augmentation Eyewear
Manufacturer Logo .....	
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)



ISO/IEC 17025:2005 Accredited Laboratory

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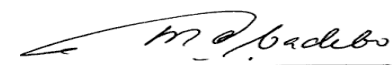
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## documentation

## 1.1 Testing Location

<input checked="" type="checkbox"/>	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)	:	Michael Gbadebo, PE	
	Approved By (Name + Signature)	:	Michael Gbadebo, PE	
<input type="checkbox"/>	Manufacturer Facility	:		
	Testing Location/Address	:		
	Tested By (Name + Signature)	:		
	Approved By (+ Signature)	:		
<input type="checkbox"/>	3 <sup>rd</sup> Party Test Facility	:		
	Testing Location/Address	:		
	Tested By (Name + Signature)	:		
	Approved By (+ Signature)	:		

## 1.2 Revision History

#	Revision Date	Revision
1	01/15/2016	Tested radiated emissions at middle low and high frequency page 10 Tested Radiated spurious emissions middle low and high frequency page 27

## 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
<b>802.11 b/g/n</b>	
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
<b>Bluetooth 4.1 Smart</b>	
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.
<b>802.11n (5 GHz)</b>	
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.
<b>Antenna</b>	
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 Equipments 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:

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

The requirements according to the technical regulations are:

<input checked="" type="checkbox"/>	Met	<input type="checkbox"/>	Not Met
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The Equipment Under Test does:

<input checked="" type="checkbox"/>	Fulfill the general approval requirements	<input type="checkbox"/>	Not fulfill the general approval requirements
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## 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 Emissions	Passed
15.247 (a)(2)	6 dB Bandwidth	Passed
15.247 (b)(3)	Peak Conducted Output Power	Passed
15.247 (e)	Power Spectral Density	Passed
15.247 (d)	Band-Edge Measurement	Passed
2.1049 (h)	Occupied Bandwidth	Passed
15.209/.205	Conducted Spurious & Restricted Band Emissions	Passed
15.247 (b)(4)	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	$\pm 1.5$
2	Radiated emission of transmitter (30MHz - 1 GHz ) @ 3m	$\pm 3.2$
3	Radiated emission of transmitter (1-25 GHz ) @ 3m	$\pm 2.5$



## 1.11 Test Set up Photos



Figure 1: Conducted RF Test Setup

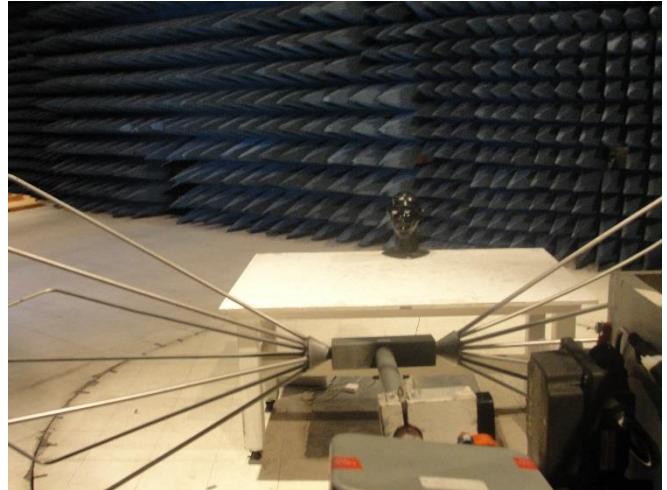


Figure 2: RE Test Setup – Biconical Antenna

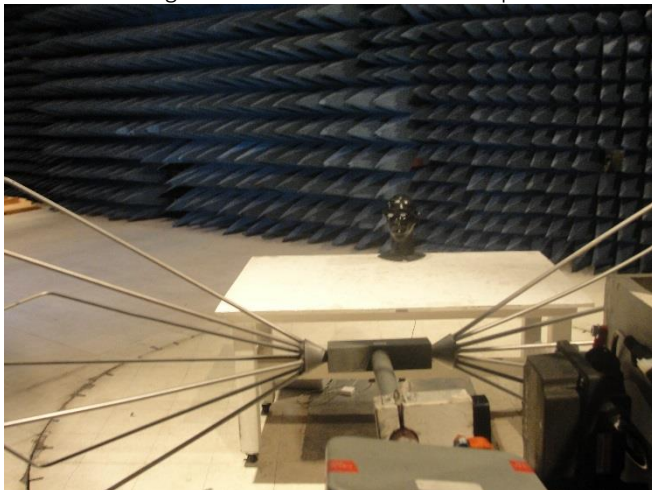


Figure 3: RE Test Setup - Log Periodic Antenna



Figure 4: EUT RE Test Setup



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

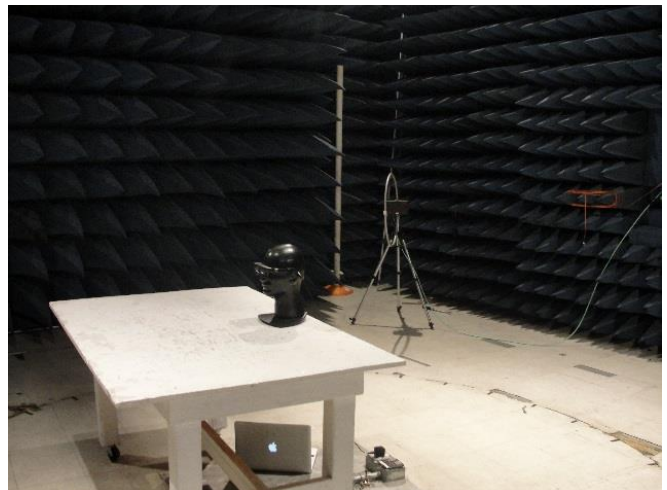


Figure 6: RE Test Setup - Active Loop Antenna,  
Horizontal Polarization

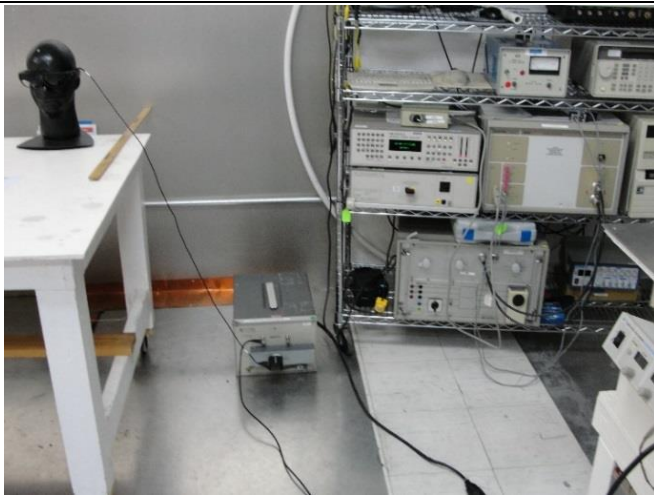


Figure 7: CE Test Setup - Front View



Figure 8: CE Test Setup - Side View



Figure 9: RE Test Setup DRG Horn Antenna(1-18GHz)

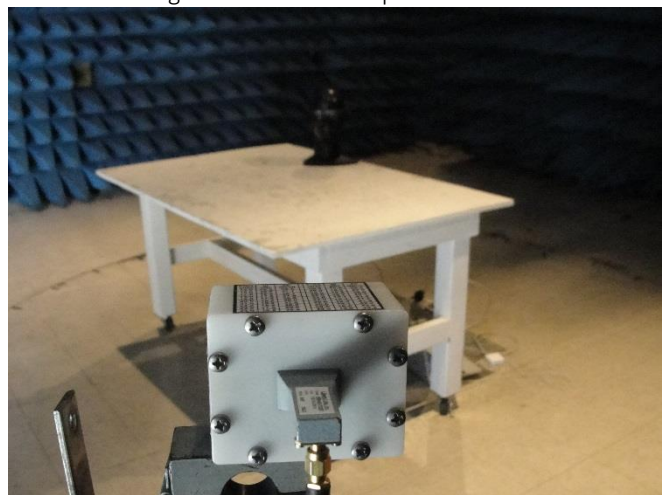


Figure 10: RE Test Setup Horn Antenna(18-40GHz)

## 2 Radiated Emissions Per FCC Part 15.209

### 2.1 Administrative and Environmental Details

Site Used:	Semi Anechoic Chamber
Test Date:	1/15/16
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 2-6.

### 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 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.



**2.6 Radiated Emissions Test Data Tables 802.11B****9 KHz-30MHz Radiated Emissions**

Transmit Freq (MHz)	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		
2412	27.14	11.4	37.33	34.88	29.54	23.89	30.98	27.82	Passed	43
2437	26.99	11.46	32.45	32.67	25.36	32.48	28.79	28.33	Passed	43
2462	27.09	11.39	34.71	35.08	23.01	26.27	28.78	27.14	Passed	43

**30-200 MHz Radiated Emissions**

Transmit Freq (MHz)	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		
2412	192	42.63	38.82	31.97	38.01	25.62	37.33	30.66	Passed	43.5
2437	192	42.63	39.06	31.63	36.95	24.41	37.16	30.56	Passed	43.5
2462	192	30.64	38.87	27.86	37.55	6.99	37.21	23.15	Passed	43.5

**200-1000 MHz Radiated Emissions**

Transmit Freq (MHz)	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		
2412	417.3	548.3	43.03	40.97	40.36	38.34	37.67	35.11	Passed	46
2437	588.4	415.7	41.01	42.11	40.86	39.26	37.81	37.14	Passed	46
2462	587.8	415.7	41.47	42.29	40.57	40.99	36.41	37.23	Passed	46

**2.7 Radiated Emissions Test Data Tables 802.11G****9 KHz-30 MHz Radiated Emissions**

Transmit Freq (MHz)	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		
2412	28.28	1.547	34.79	43.22	26.38	41.34	29.38	39.9	Passed	43
2437	28.31	1.402	36.49	35.64	24.19	33.03	29.17	32.25	Passed	43
2462	11.39	1.549	35.08	44.65	26.27	43.69	27.24	40.87	Passed	43

**30-200 MHz Radiated Emissions**

Transmit Freq (MHz)	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		
2412	192	42.34	37.13	26.9	34.58	6.99	35.75	26.87	Passed	43.5
2437	192	42.34	38.35	17.08	35.99	26.06	36.62	12.13	Passed	43.5
2462	192	42.5	37.3	14.32	34.61	21.02	35.86	8.57	Passed	43.5

**200-1000 MHz Radiated Emissions**

Transmit Freq (MHz)	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		
2412	415.7	587.7	42.53	41.16	17.53	37.62	37.19	36.81	Passed	46
2437	415.7	582.4	42.25	40.75	27.22	39.66	36.5	38.0	Passed	46
2462	415.7	593.4	41.8	40.11	37.62	38.27	36.49	36.5	Passed	46

**2.8 Radiated Emissions Test Data Tables 802.11N****9 KHz-30 MHz Radiated Emissions**

Transmit Freq (MHz)	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		
2412	1.549	27.7	43.6	35.69	39.82	30.17	39.83	29.83	Passed	43
2437	27.95	1.53	32.25	40.75	18.79	37.69	28.94	38.81	Passed	43
2462	28.3	1.53	36.46	32.67	27.52	27.75	29.89	29.62	Passed	43

**30-200 MHz Radiated Emissions**

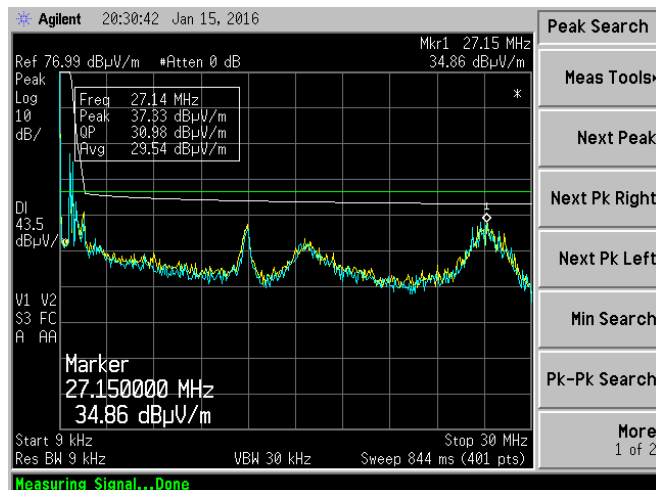
Transmit Freq (MHz)	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
2412	134.4	136.1	26.49	36.41	12.55	32.74	25.14	33.22	Passed	43.5
2437	134.4	192	36.83	33.64	32.27	27.36	35.22	31.74	Passed	43.5
2462	135.4	192	35.96	33.52	32.08	25.49	32.91	31.64	Passed	43.5

**200-1000 MHz Radiated Emissions**

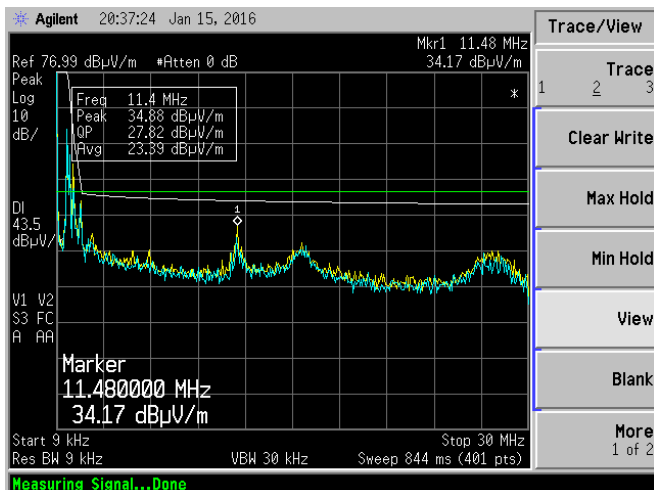
Transmit Freq (MHz)	Freq (MHz)		Peak Emission (dBuV/m)		Average (dBuV/m)		Quasi-Peak (dBuV/m)		Result	Limit (dBuV/m)
	H	V	H	V	H	V	H	V		
2412	415.7	587.6	41.53	40.59	27.48	38.5	36.02	36.25	Passed	46
2437	593.1	415.7	40.58	41.8	39.99	37.62	37.83	36.49	Passed	46
2462	592.1	595.4	40.68	40.11	38.89	38.27	38.21	36.5	Passed	46

**Note:** H means Horizontal and V means Vertical Antenna Polarizations

## 2.9 Test Data Plots 802.11B



a) Horizontal polarization



b) Vertical polarization

Figure 11: Radiated Emissions – Active Loop, 9 kHz – 30 MHz 802.11B(Channel 1 Shown, 6 &amp; 11 Similar)



a) Horizontal Polarization

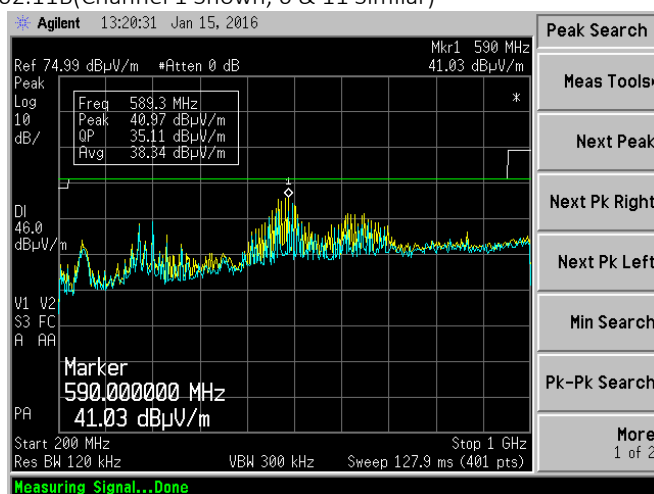


b) Vertical Polarization

Figure 12: Radiated Emissions – Biconical 802.11B(Channel 1 Shown, 6 &amp; 11 Similar)



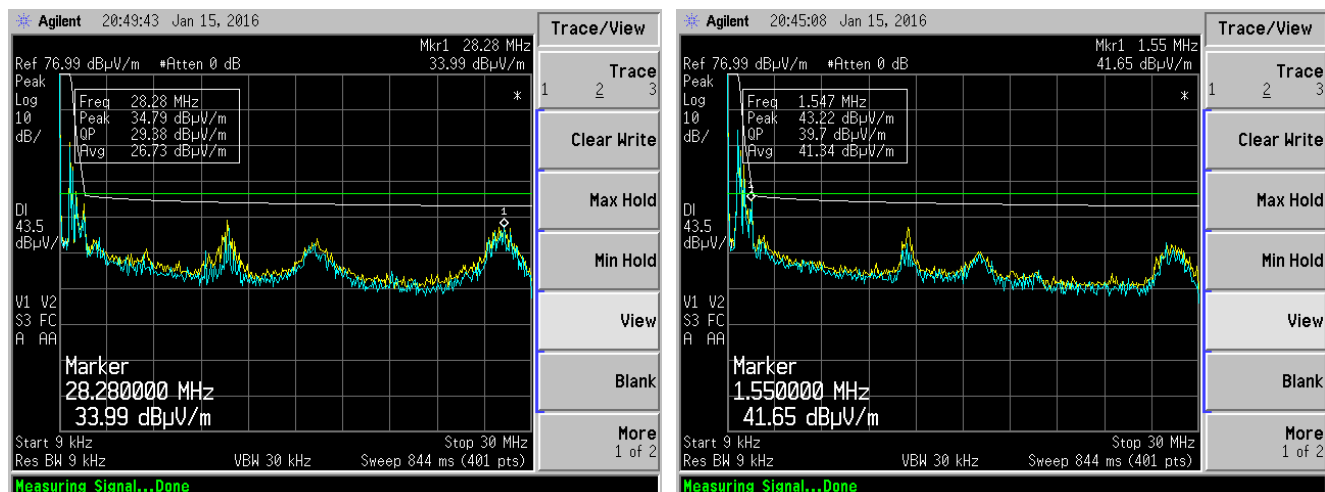
a) Vertical Polarization



b) Horizontal Polarization

Figure 13: Radiated Emissions –Log Periodic 802.11B(Channel 1 Shown, 6 &amp; 11 Similar)

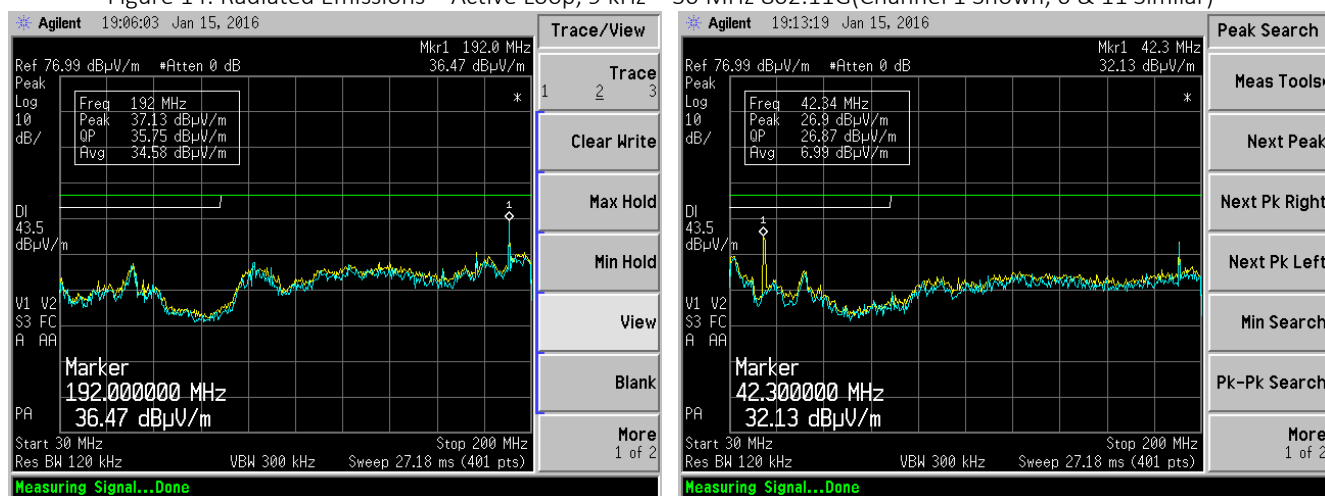
## 2.10 Test Data Plots 802.11G



c) Horizontal polarization

d) Vertical polarization

Figure 14: Radiated Emissions – Active Loop, 9 kHz – 30 MHz 802.11G(Channel 1 Shown, 6 &amp; 11 Similar)



c) Horizontal Polarization

d) Vertical Polarization

Figure 15: Radiated Emissions – Biconical 802.11G(Channel 1 Shown, 6 &amp; 11 Similar)

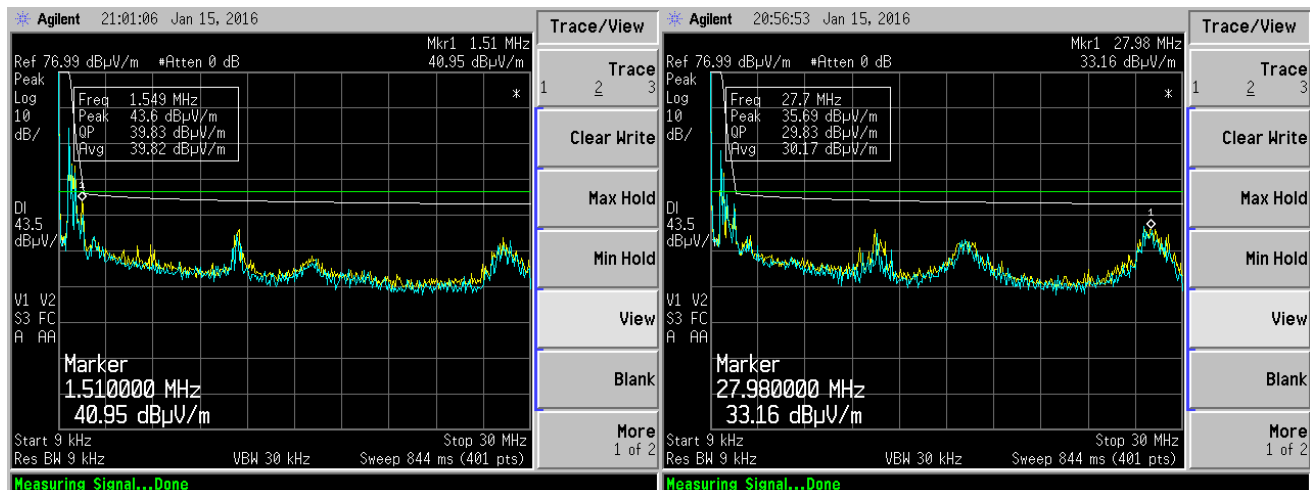


c) Vertical Polarization

d) Horizontal Polarization

Figure 16: Radiated Emissions –Log Periodic 802.11G(Channel 1 Shown, 6 &amp; 11 Similar)

## 2.11 Test Data Plots 802.11N



e) Horizontal polarization

f) Vertical polarization

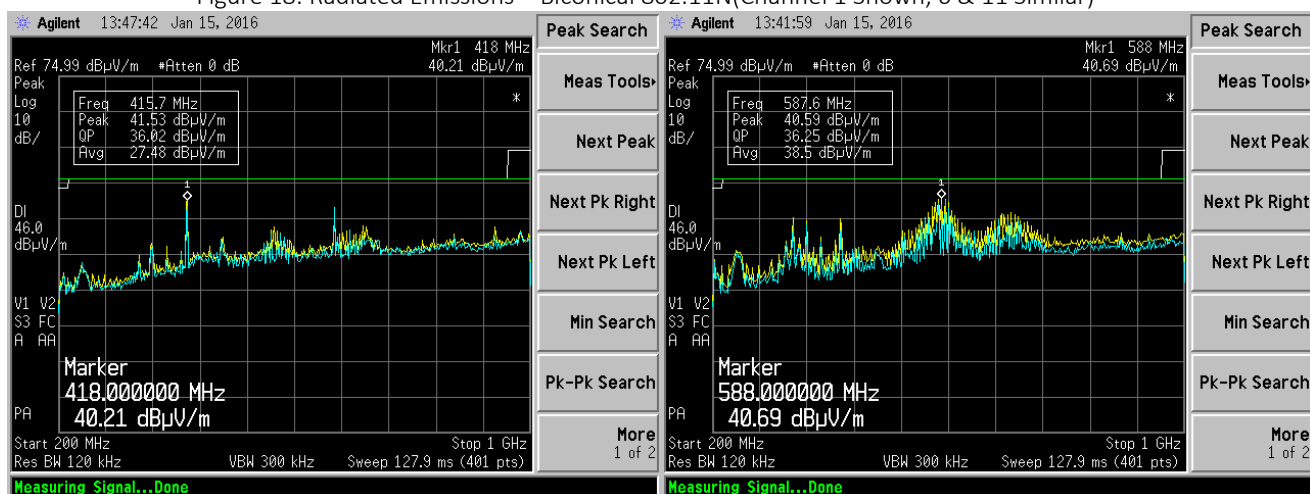
Figure 17: Radiated Emissions – Active Loop, 9 kHz – 30 MHz 802.11N(Channel 1 Shown, 6 &amp; 11 Similar)



e) Horizontal Polarization

f) Vertical Polarization

Figure 18: Radiated Emissions – Biconical 802.11N(Channel 1 Shown, 6 &amp; 11 Similar)



e) Vertical Polarization

f) Horizontal Polarization

Figure 19: Radiated Emissions –Log Periodic 802.11N(Channel 1 Shown, 6 &amp; 11 Similar)



### 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 Impedance 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

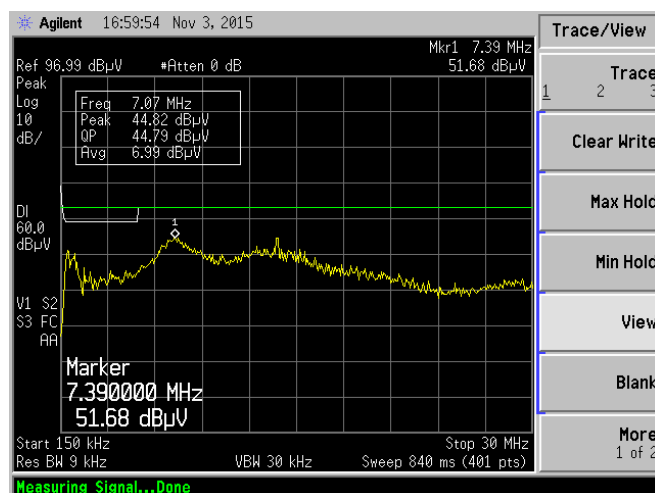


Figure 20: Conducted Emissions Test Data 60 Hz  
Hot 0.15-30 MHz

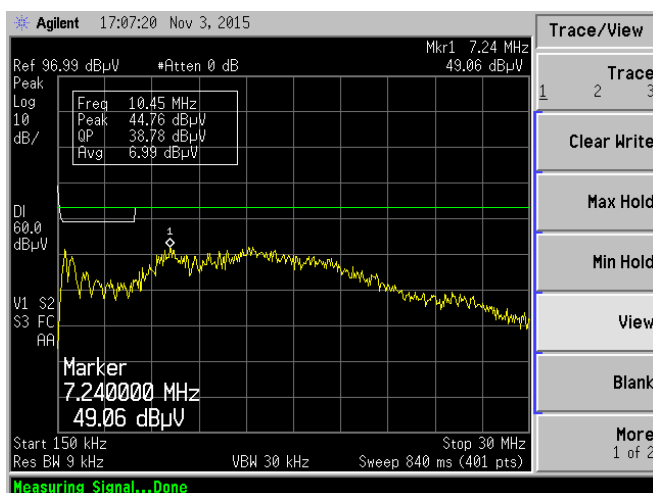


Figure 9: Conducted Emissions Test Data 60 Hz  
Neutral 0.15-30 MHz

#### 4 Minimum 6 DB Bandwidth Per FCC Part 15.247 (a)(2) – 802.11b/g/n

##### 4.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	12/14/15
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 Figure1.

##### 4.4 Limits/Requirements

The minimum 6 dB bandwidth shall be at least 500 kHz.

##### 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 6 dB 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 6 dB 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.

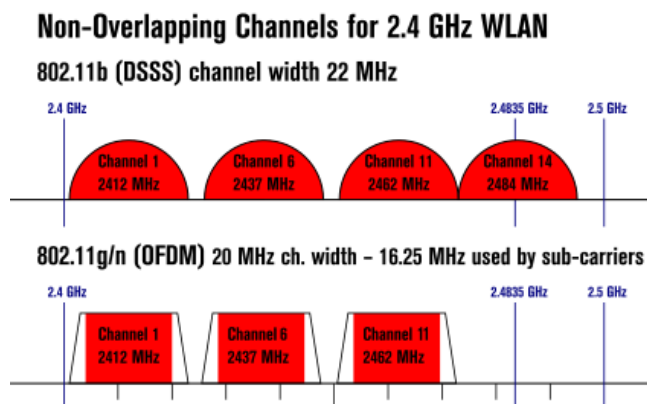


Figure 22: 802.11 Channels

##### 4.6 6 dB Bandwidth Measurement Test Data

Channel	Freq.(MHz)	Measured 6 dB BW (MHz)			Result
		b	g	n	
1	2412	8.3	16.2	17.4	Pass
6	2437	8.6	16.4	17.5	Pass
11	2462	8.8	16.4	17.5	Pass

#### 4.7 6 dB Bandwidth measurement plots

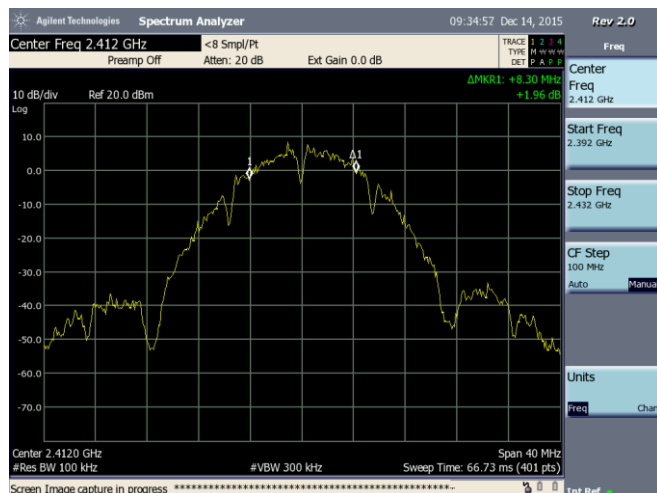


Figure 23: 802.11b 6 dB Bandwidth  
(Ch1 Shown, Ch6 & 11 Similar)

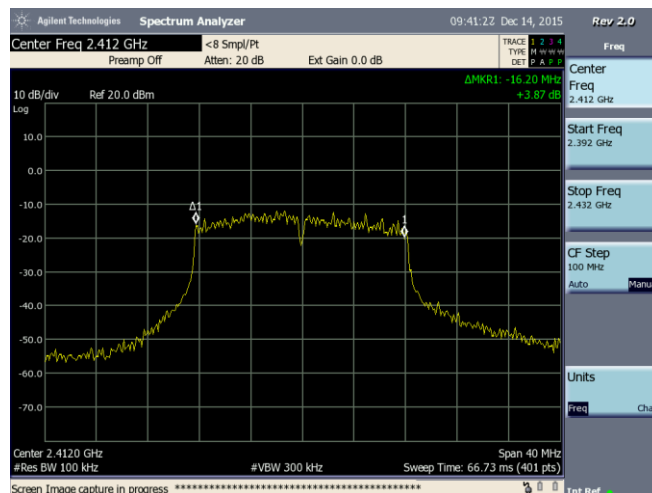


Figure 24: 802.11g 6 dB Bandwidth  
(Ch1 Shown, Ch6 & 11 Similar)

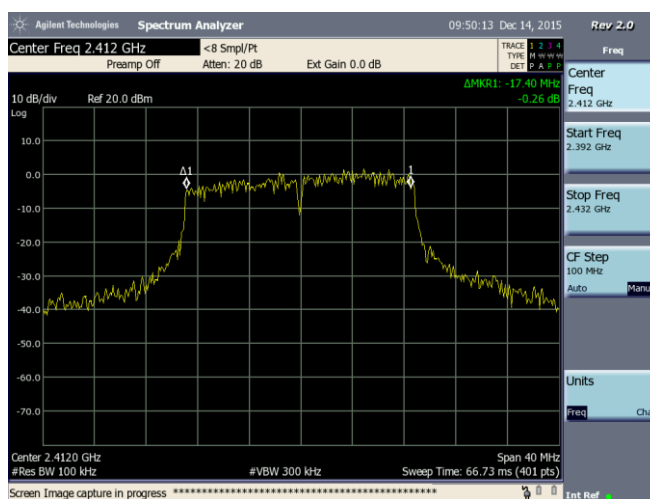


Figure 25: 802.11n 6 dB Bandwidth (Ch1 Shown, Ch6 & 11 Similar)

#### 4.8 Carrier Frequency Separation Plot

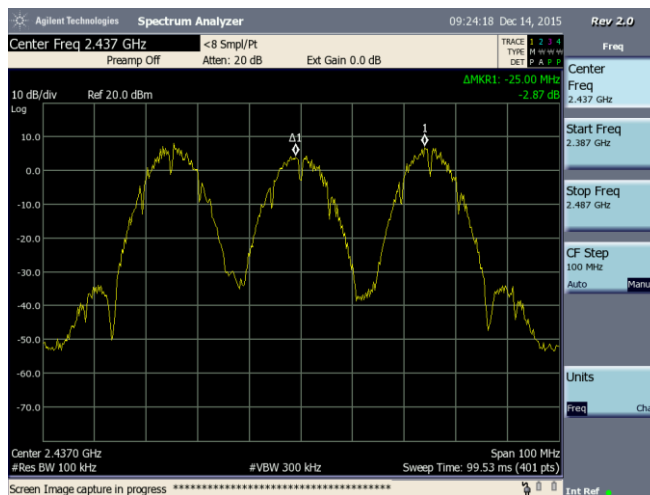


Figure 26: Carrier Frequency Separation 25 MHz (Ch1, 6 & 11)

**5 Peak Conducted Output Power Per FCC Part 15.247 (b)(3) – 802.11b/g/n****5.1 Administrative and Environmental Details**

Site Used:	EMC Lab 2A
Test Date:	12/14/15
Test Engineer:	Shane Duncan
Temperature	23°C avg.
Humidity:	41% 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**

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation shall not exceed: 1 Watt or 30 dBm.

**5.5 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.

**5.6 Test Data Tables**

Channel	Freq.(MHz)	MPP (dBm)			CPP (dBm)			Margin = 30 - CPP (dB)			Result
		b	g	n	b	g	n	B	g	n	
1	2412	20.05	17.99	17.56	22.05	19.99	19.56	7.95	10.01	10.44	Passed
6	2437	17.6	16.16	16.54	19.6	18.16	18.54	10.4	11.84	11.46	Passed
11	2462	20.81	17.08	18.88	22.81	19.08	20.88	7.19	9.12	9.12	Passed

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

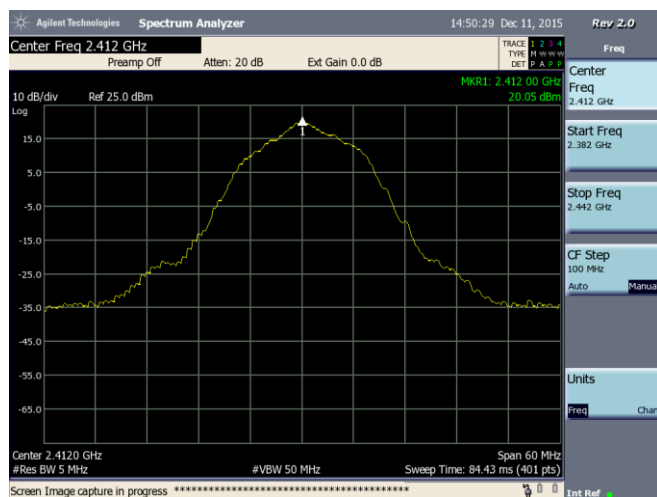
**5.7 Peak Power Plots**

Figure 8: 802.11b Peak Power (Ch1 Shown, Ch6 & 11 Similar)

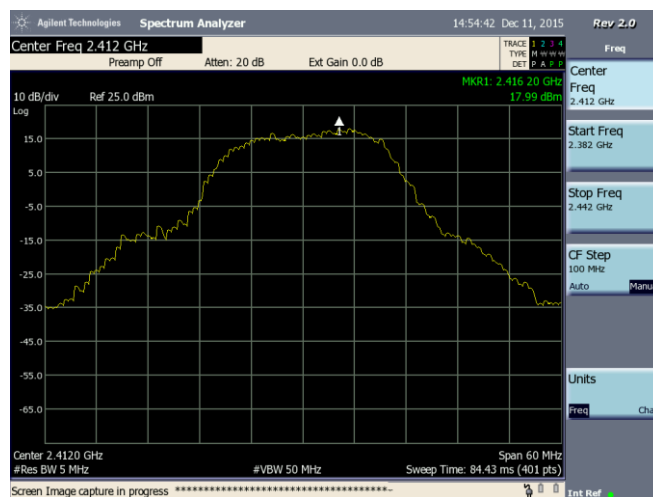


Figure 27: 802.11g Peak Power (Ch1 Shown, Ch6 & 11 Similar)

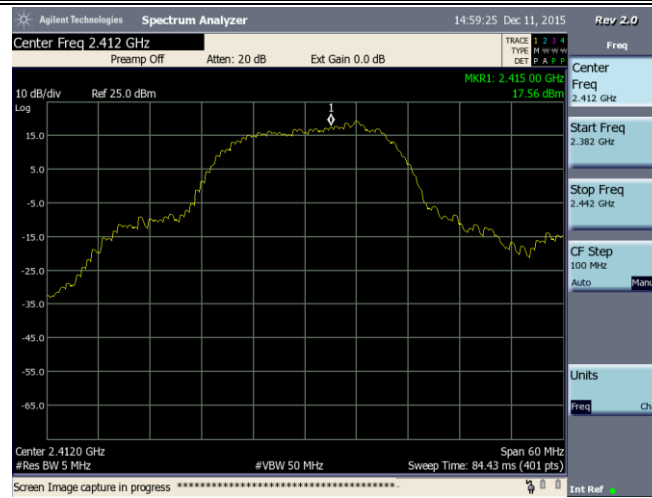


Figure 28: 802.11n Peak Power (Ch1 Shown, Ch6 &amp; 11 Similar)

## 6 Power Spectral Density Per FCC Part 15.247 (d) – 802.11b/g/n

### 6.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	12/14/15
Test Engineer:	Shane Duncan
Temperature	23°C
Humidity:	41%

### 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 Figure1.

### 6.4 Limits/Requirements

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### 6.5 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.

### 6.6 Test Data Tables

Channel	Freq.(MHz)	MPSD(dBm/3 kHz)			CPSD (dBm/3 kHz)			Margin = 8 – CPSD (dB)			Result
		b	g	n	b	g	n	b	g	n	
1	2412	-10.69	-14.69	-13.92	-8.69	-12.69	-11.92	16.69	20.69	19.92	Passed
6	2437	-14.48	-16.78	-15.56	-12.48	-14.78	-13.56	20.48	22.78	21.56	Passed
11	2462	-12.15	-14.94	-14.36	-10.15	-12.94	-12.36	18.15	20.94	20.36	Passed

MPSD = Measured Power Spectral Density    CPSD = Corrected Power Spectral Density = MPSD + Cable Loss 2 dB

### 6.7 Power Spectral Density Plots

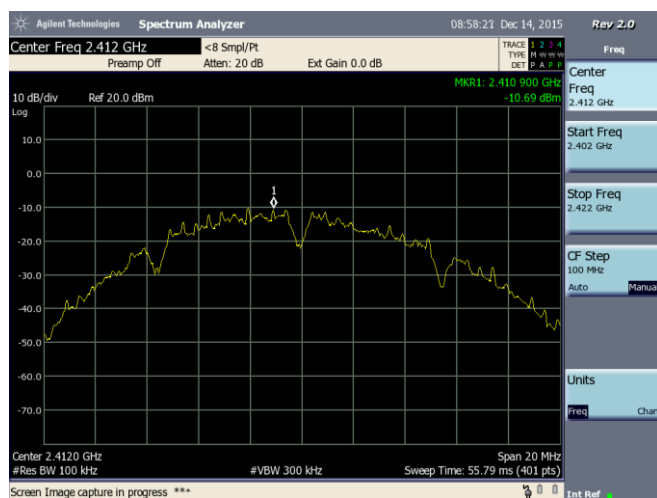


Figure 29: 802.11b Power Spectral Density (Ch1 Shown, Ch6 & 11 Similar)

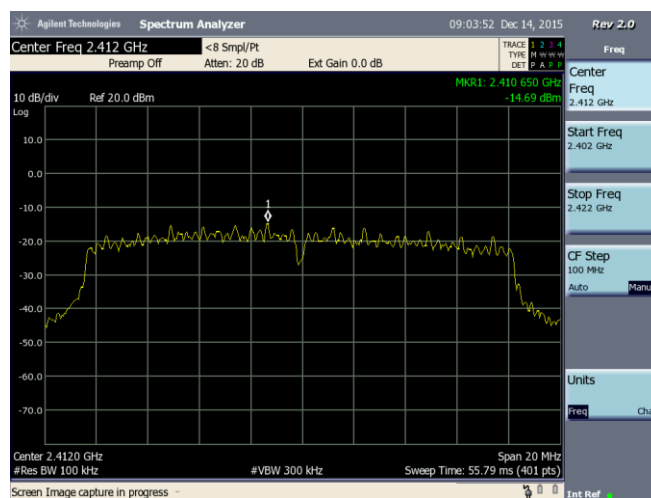


Figure 30: 802.11g Power Spectral Density (Ch1 Shown, Ch6 & 11 Similar)

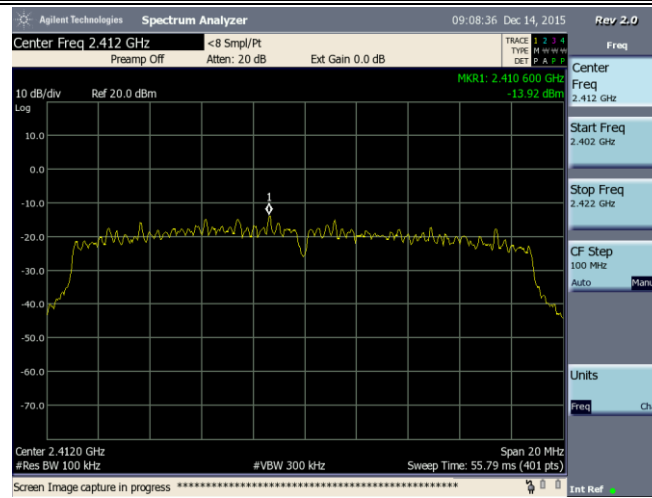


Figure 31: 802.11n Power Spectral Density (Ch1 Shown, Ch6 &amp; 11 Similar)

## 7 Lower/Upper Band Edge Per FCC Part 15 Section 15.247 (d) – 802.11b/g/n

### 7.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	12/14/15
Test Engineer:	Shane Duncan
Temperature	23°C avg
Humidity:	41% avg.

### 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 Figure1.

### 7.4 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.

### 7.5 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.

### 7.6 Test Plots

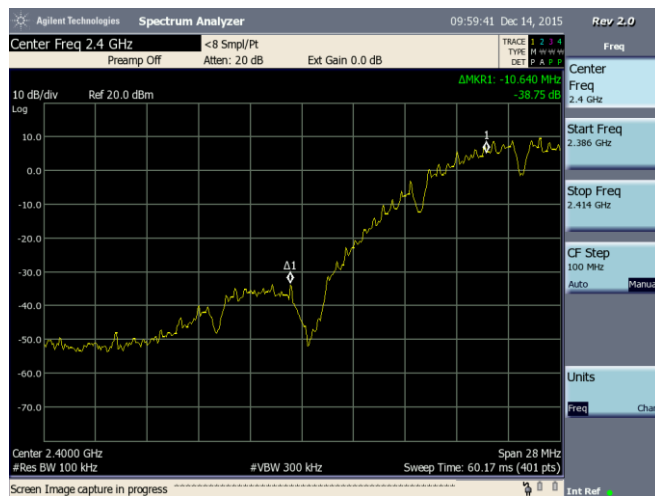


Figure 32: 802.11b Ch1 Lower Band Edge

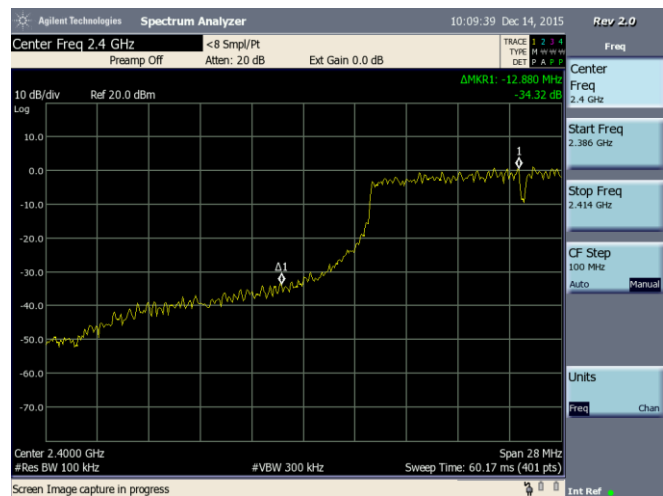


Figure 33: 802.11g Ch1 Lower Band Edge



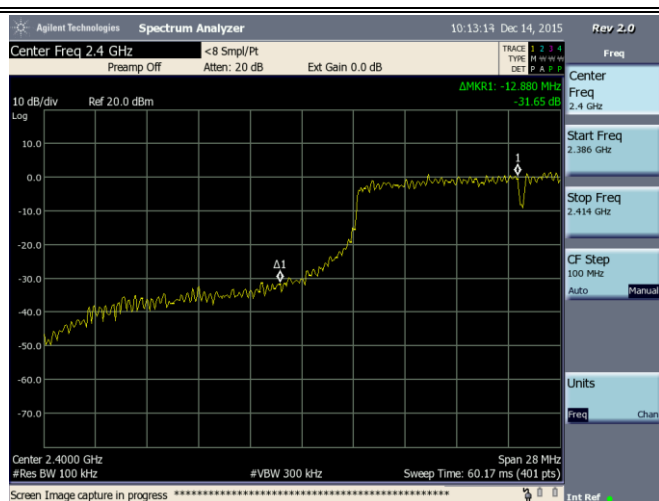


Figure 34: 802.11n Ch1 Lower Band Edge

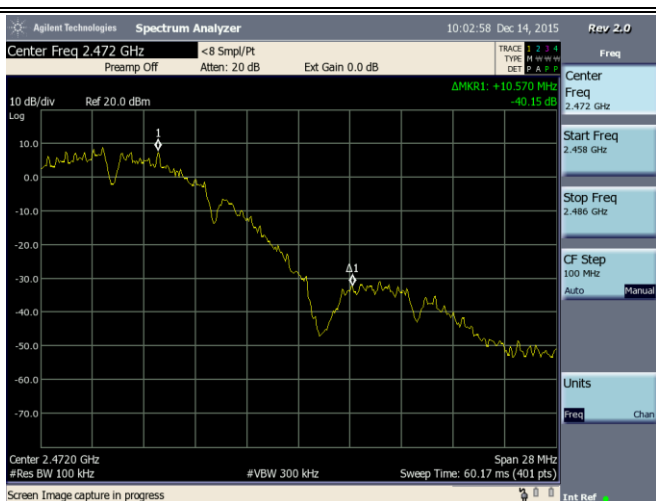


Figure 35: 802.11b Ch1 Upper Band Edge

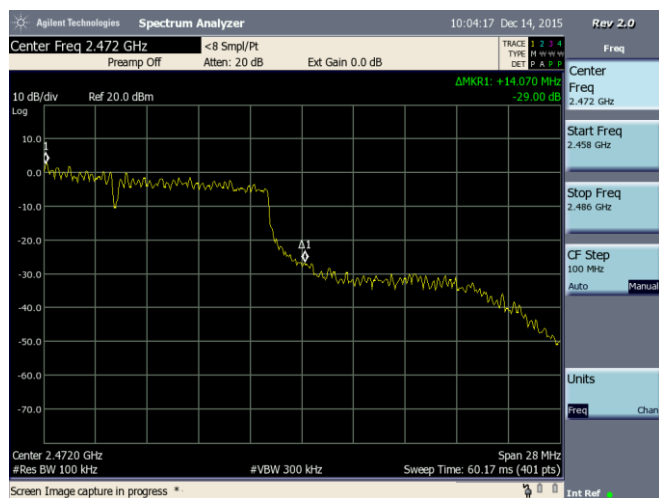


Figure 36: 802.11g Ch1 Upper Band Edge

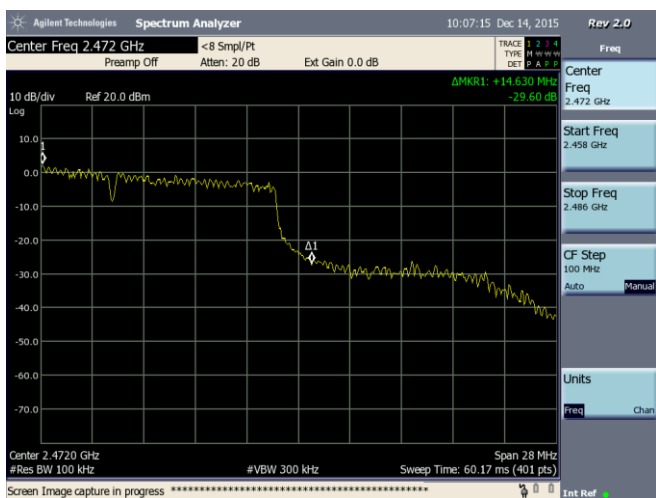


Figure 37: 802.11n Ch1 Upper Band Edge

## 8 Occupied Bandwidth Per FCC Part 2 Section 2.1049 (h) – 802.11b/g/n

### 8.1 Administrative and Environmental Details

Site Used:	EMC Lab 2A
Test Date:	12/11/15
Test Engineer:	Shane Duncan
Temperature	23°C
Humidity:	41%

### 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

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.

### 8.5 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.

### 8.6 Test Plots

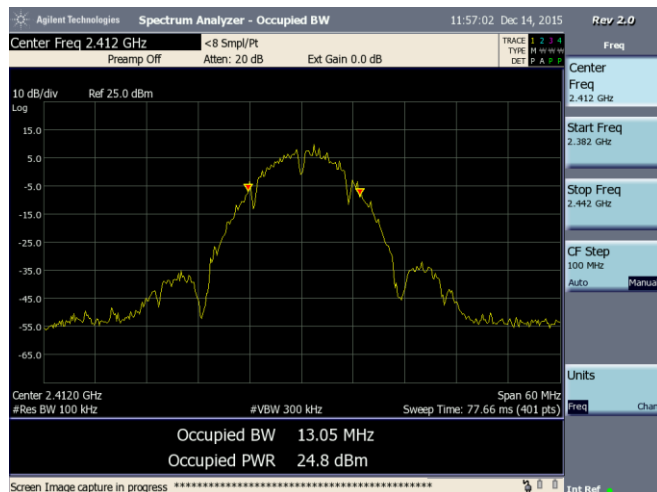


Figure 38: 802.11b Occupied Bandwidth (Ch1 Shown, Ch6 & 11 Similar)

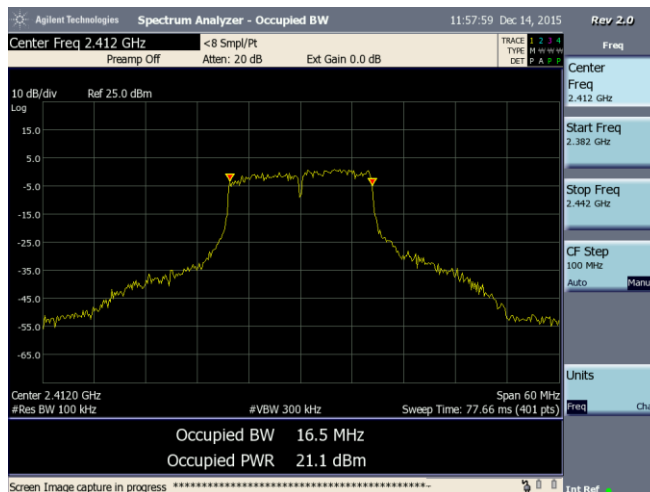


Figure 39: 802.11g Occupied Bandwidth (Ch1 Shown, Ch6 & 11 Similar)

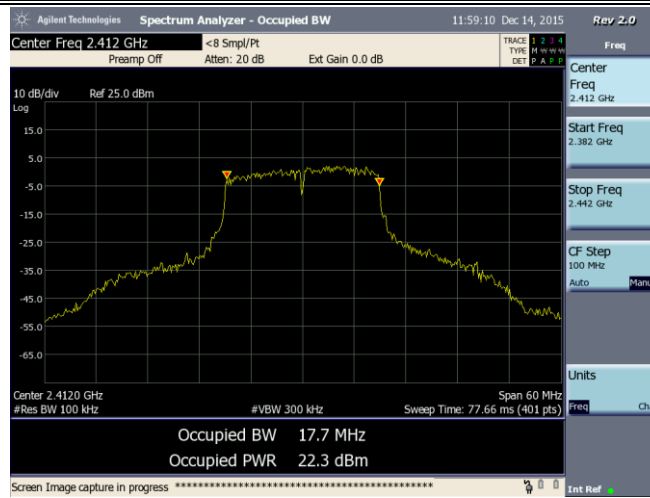


Figure 40: 802.11n Occupied Bandwidth (Ch1 Shown, Ch6 &amp; 11 Similar)

**9 Radiated Spurious & restricted bands emissions Per FCC Part 15 sections 15.209 & 15.205****9.1 Administrative and environmental details**

Site Used:	Semi Anechoic Chamber
Test Date:	1/14/16
Test Engineer:	Shane Duncan
Temperature	20°C
Humidity:	47%

**9.2 Test Equipment**

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date	Calibration Interval
EMC Analyzer	Agilent	E7405A	US40240257	7/16/16	2 yr
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

**9.3 Test Set up Photo(s)**

Refer to Figures 9 and 10.

**9.4 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

## 9.5 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)).

## 9.6 Radiated Spurious Emissions Data for 802.11B

### 1-3 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	1.01	1.93	49.93	48.89	54
2437	6	1.93	1.335	49.36	48.70	54
2462	11	1.93	1.93	50.39	50.77	54

### 3-13 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	12.58	12.50	40.95	42.5	54
2437	6	12.00	12.98	39.07	39.22	54
2462	11	13.00	12.83	39.52	40.23	54

### 13-18 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	17.93	17.94	48.24	48.91	54
2437	6	17.98	17.89	47.85	47.81	54
2462	11	17.55	17.68	48.38	47.99	54

### 18-25 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		24.
		H	V	H	V	
2412	1	18.79	24.90	44.03	44.73	54
2437	6	19.02	24.86	44.1	43.61	54
2462	11	23.64	24.07	43.64	43.85	54

**Note:** H means Horizontal and V means Vertical Antenna Polarizations

## 9.7 Radiated Spurious Emissions Data for 802.11G

### 1-3 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	1.93	1.96	50.81	47.80	54
2437	6	1.01	1.93	49.42	47.34	54
2462	11	1.93	1.93	50.15	48.19	54

### 3-13 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	12.48	12.85	40.89	39.89	54
2437	6	12.30	12.38	40.11	39.53	54
2462	11	13.00	13.00	39.07	39.27	54

### 13-18 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	17.66	17.43	47.68	48.12	54
2437	6	17.90	16.98	47.64	47.56	54
2462	11	17.93	17.90	47.65	48.77	54

### 18-25 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	24.95	18.8	43.82	43.56	54
2437	6	19.93	24.63	43.82	43.22	54
2462	11	25.00	19.14	44.03	44.82	54

**Note:** H means Horizontal and V means Vertical Antenna Polarizations

## 9.8 Radiated Spurious Emissions Data for 802.11N

### 1-3 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	1.93	1.93	49.52	48.12	54
2437	6	1.93	1.93	49.47	51.45	54
2462	11	1.93	1.94	47.61	50.07	54

### 3-13 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	12.20	12.15	39.76	39.56	54
2437	6	12.75	13.00	39.91	39.85	54
2462	11	12.78	13.00	39.56	39.79	54

### 13-18 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	17.74	17.68	48.61	48.39	54
2437	6	17.94	17.43	49.22	48.97	54
2462	11	17.59	17.85	47.82	47.87	54

### 18-25 GHz Radiated Emissions

Freq (MHz)	Channel	Freq (GHz)		Measured Peak Emission (dBuV/m)		Limit (dBuV/m)
		H	V	H	V	
2412	1	23.37	24.41	44.08	43.90	54
2437	6	24.88	24.06	44.34	44.06	54
2462	11	24.28	19.14	44.11	43.97	54

**Note:** H means Horizontal and V means Vertical Antenna Polarizations

## 9.9 Radiated Spurious Emissions 802.11B Plots

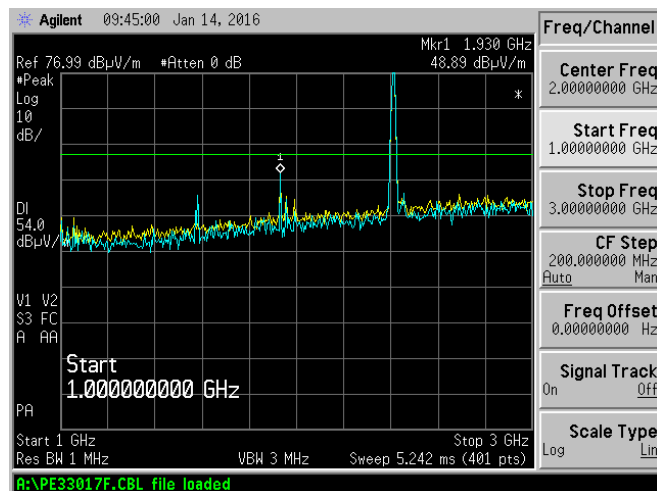


Figure 41: Radiated Spurious Emissions Vertical 802.11B(1-3 GHz) Channel 1 Shown, 6 and 11 Similar

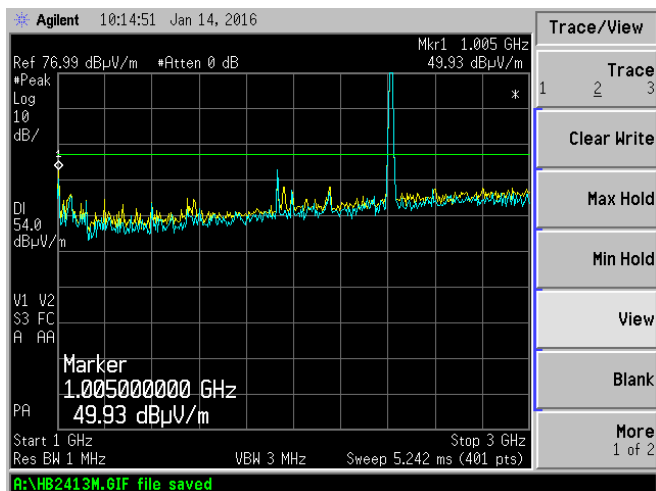


Figure 42: Radiated Spurious Emissions Horizontal 802.11B(1-3 GHz) Channel 1 Shown, 6 and 11 Similar

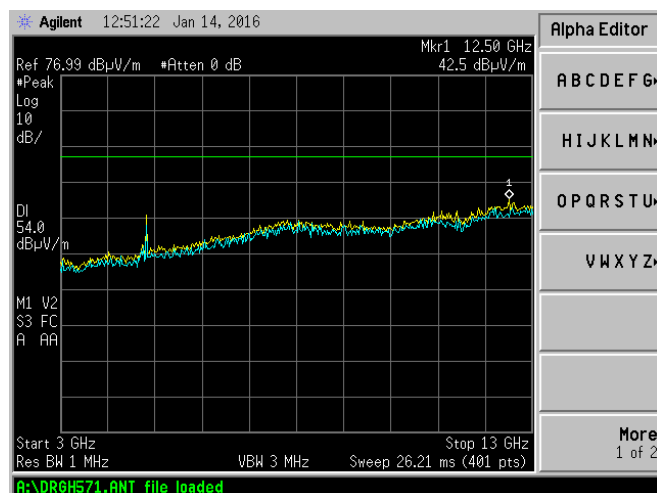


Figure 43: Radiated Spurious Emissions Vertical 802.11B(3-13 GHz) Channel 1 Shown, 6 and 11 Similar

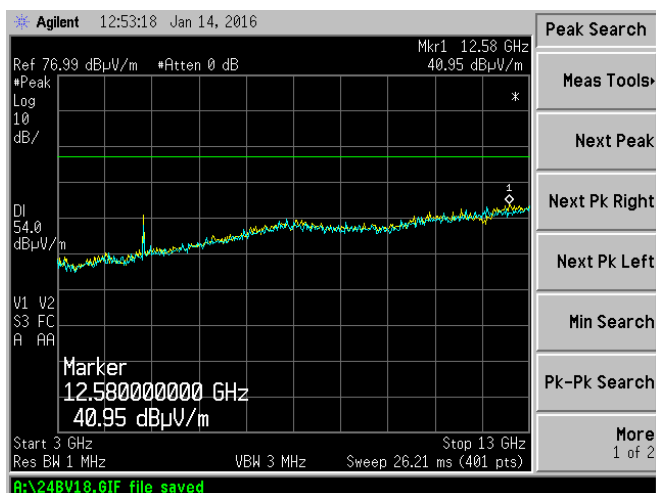


Figure 44: Radiated Spurious Emissions Horizontal 802.11B(3-13 GHz) Channel 1 Shown, 6 and 11 Similar



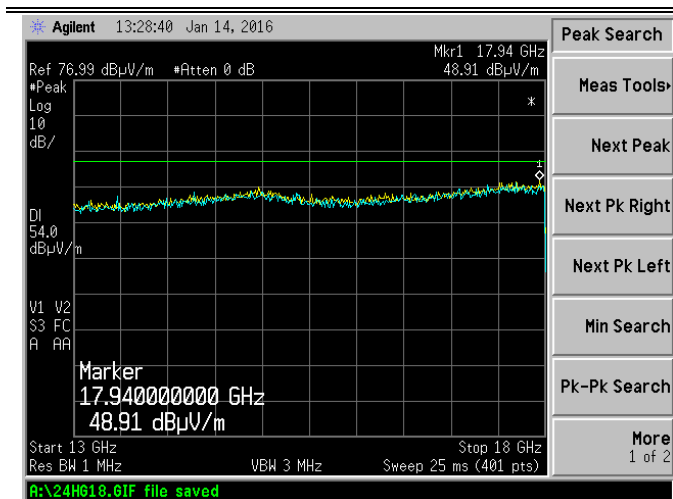


Figure 45: Radiated Spurious Emissions Vertical  
802.11B(13-18 GHz) Channel 1 Shown, 6 and 11 Similar

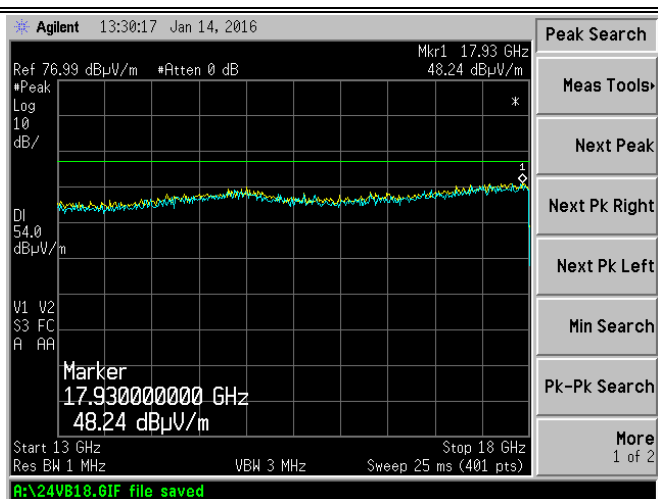


Figure 46: Radiated Spurious Emissions Horizontal  
802.11B(13-18 GHz) Channel 1 Shown, 6 and 11 Similar

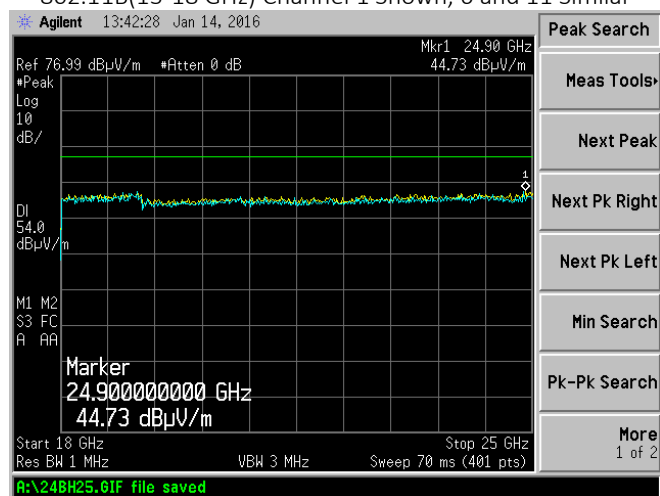


Figure 47: Radiated Spurious Emissions Vertical  
802.11B(18-25 GHz) Channel 1 Shown, 6 and 11 Similar

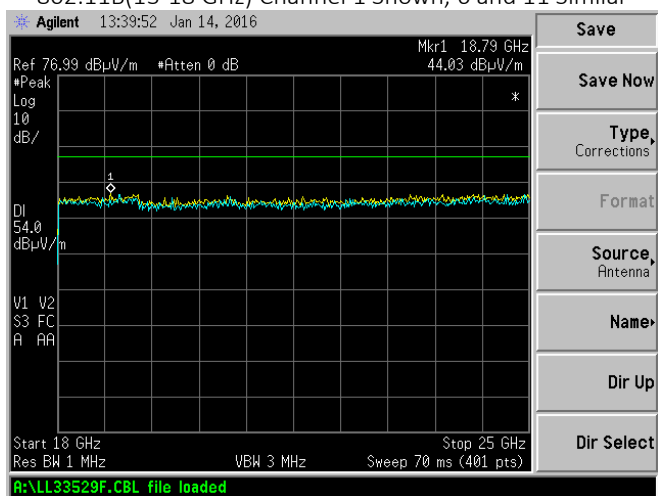


Figure 48: Radiated Spurious Emissions Horizontal  
802.11B(18-25 GHz) Channel 1 Shown, 6 and 11 Similar

## 9.10 Radiated Spurious Emissions 802.11G Plots

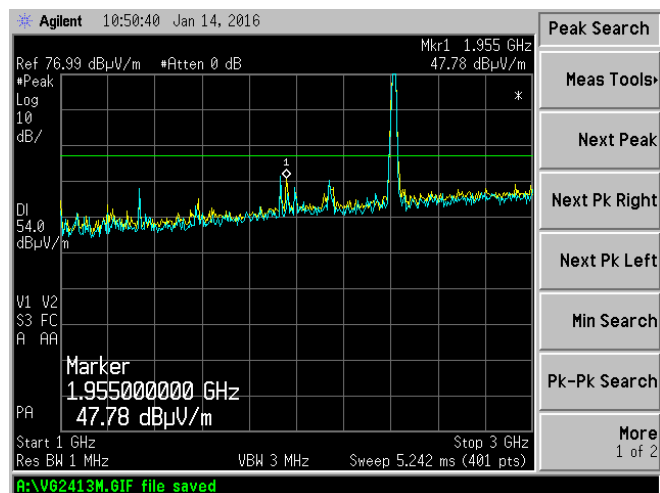


Figure 49: Radiated Spurious Emissions Vertical  
802.11G(1-3 GHz) Channel 1 Shown, 6 and 11 Similar

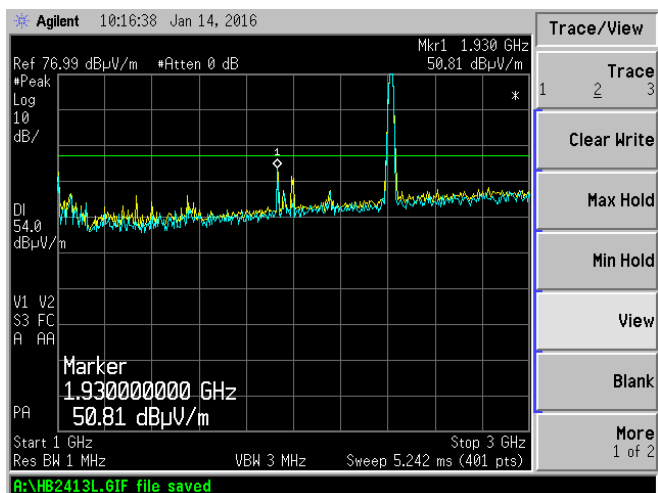


Figure 50: Radiated Spurious Emissions Horizontal  
802.11G(1-3 GHz) Channel 1 Shown, 6 and 11 Similar

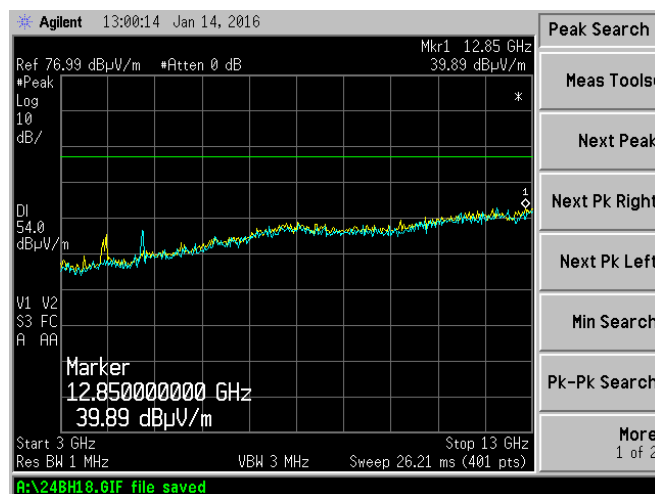


Figure 51: Radiated Spurious Emissions Vertical  
802.11G(3-13 GHz) Channel 1 Shown, 6 and 11 Similar

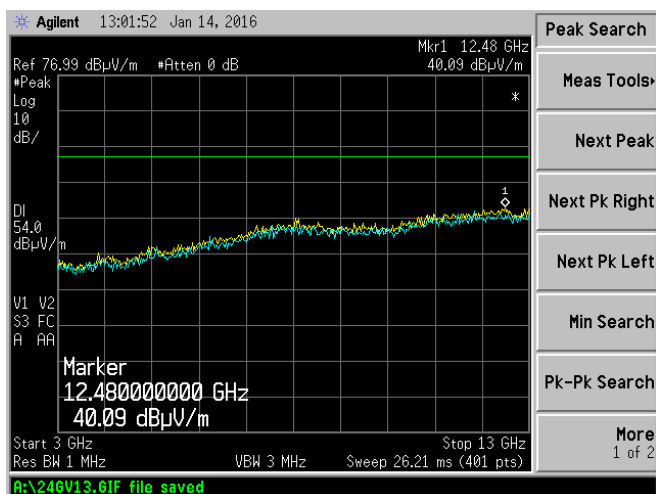


Figure 52: Radiated Spurious Emissions Horizontal  
802.11G(3-13 GHz) Channel 1 Shown, 6 and 11 Similar

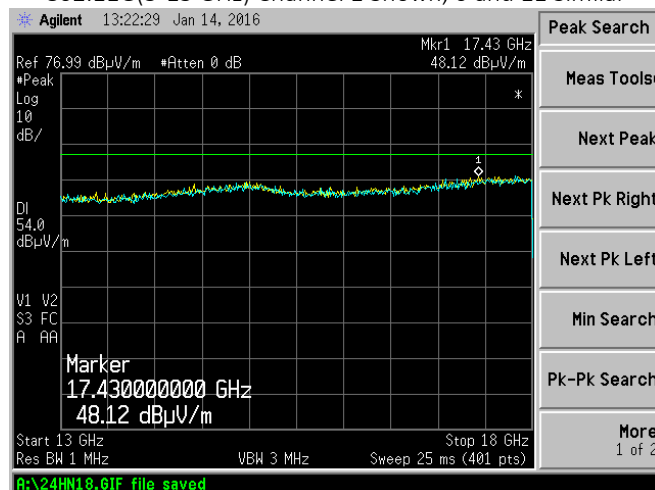


Figure 53: Radiated Spurious Emissions Vertical  
802.11G(13-18 GHz) Channel 1 Shown, 6 and 11 Similar

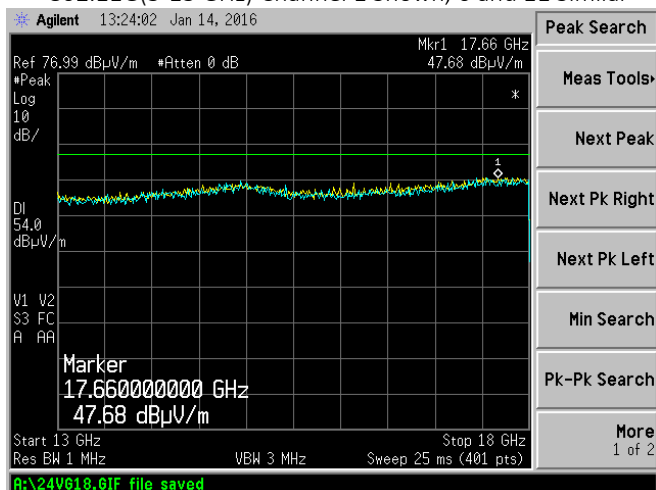


Figure 54: Radiated Spurious Emissions Horizontal  
802.11G(13-18 GHz) Channel 1 Shown, 6 and 11 Similar

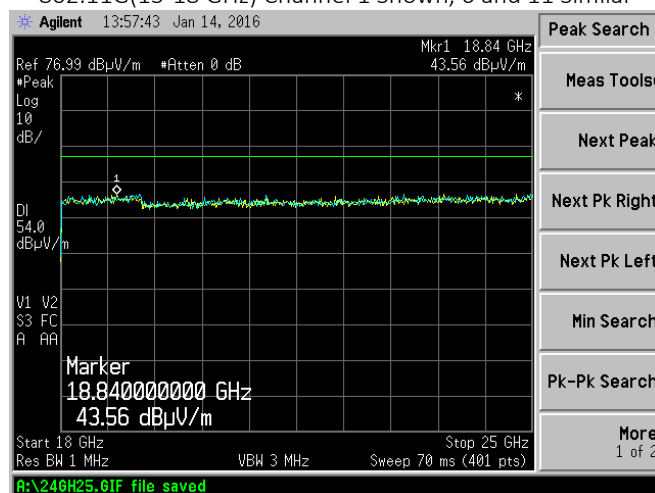


Figure 55: Radiated Spurious Emissions Vertical  
802.11G(18-25 GHz) Channel 1 Shown, 6 and 11 Similar

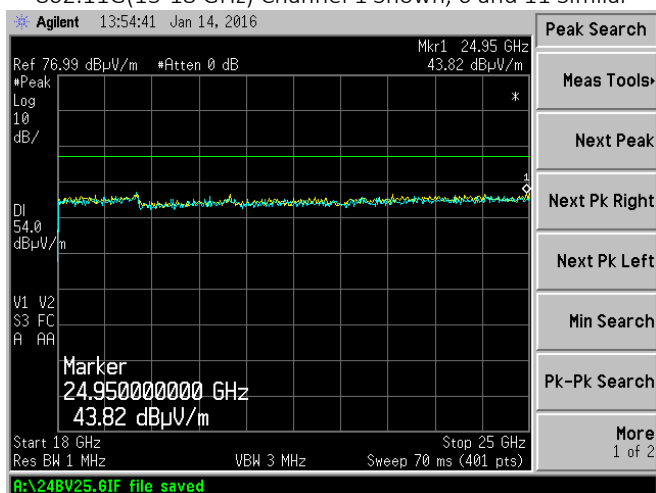


Figure 56: Radiated Spurious Emissions Horizontal  
802.11G(18-25 GHz) Channel 1 Shown, 6 and 11 Similar

## 9.11 Radiated Spurious Emissions 802.11N Plots

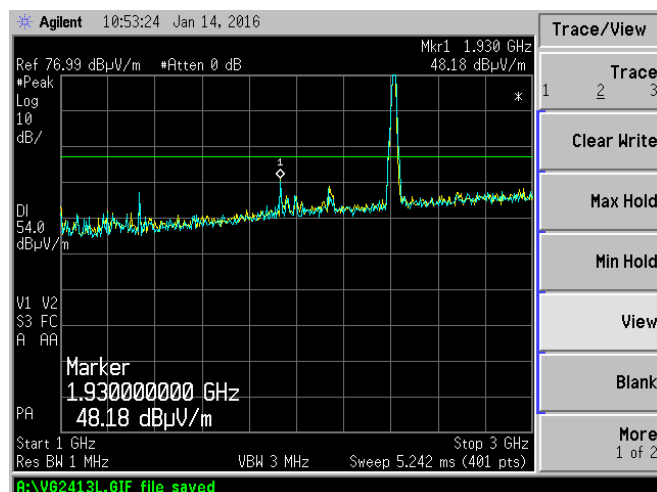


Figure 57: Radiated Spurious Emissions Vertical 802.11N(1-3 GHz) Channel 1 Shown, 6 and 11 Similar

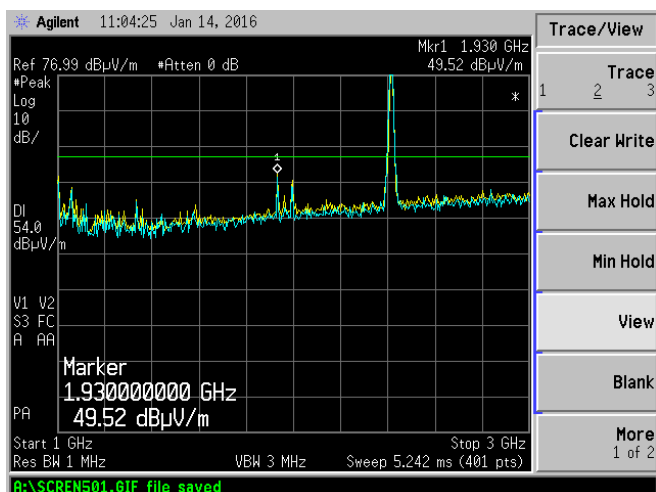


Figure 58: Radiated Spurious Emissions Horizontal 802.11N(1-3 GHz) Channel 1 Shown, 6 and 11 Similar

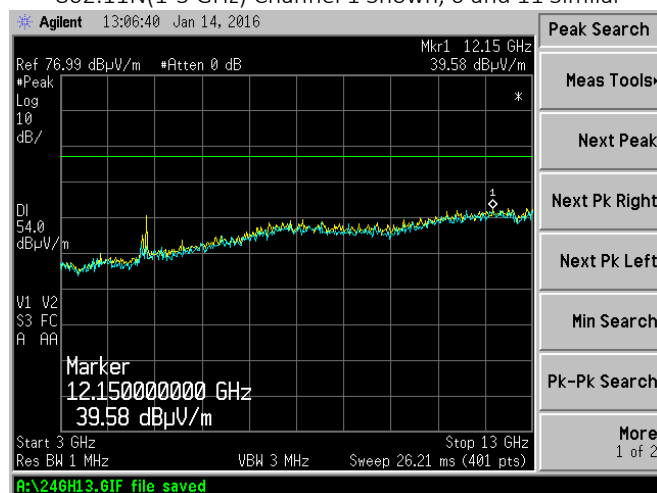


Figure 59: Radiated Spurious Emissions Vertical 802.11N(3-13 GHz) Channel 1 Shown, 6 and 11 Similar

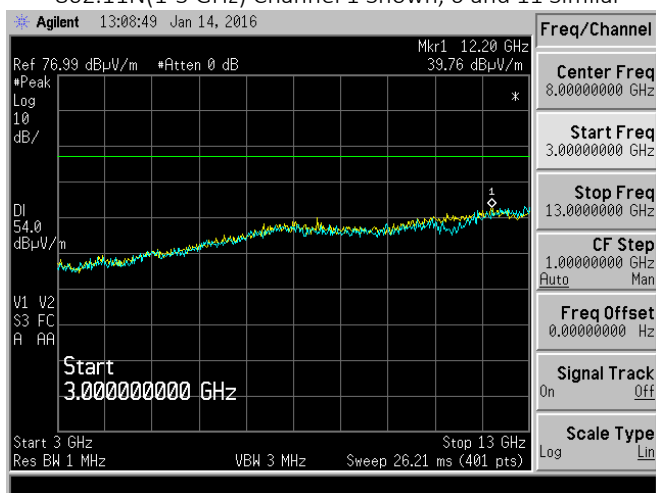


Figure 60: Radiated Spurious Emissions Horizontal 802.11N(3-13 GHz) Channel 1 Shown, 6 and 11 Similar

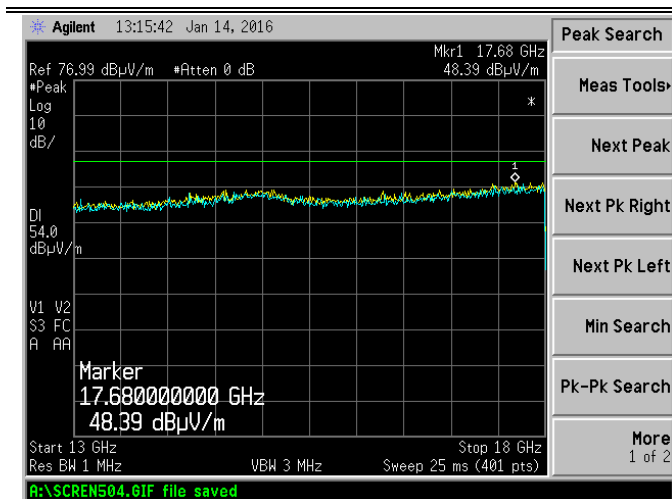


Figure 61: Radiated Spurious Emissions Vertical  
802.11N(13-18 GHz) Channel 1 Shown, 6 and 11 Similar

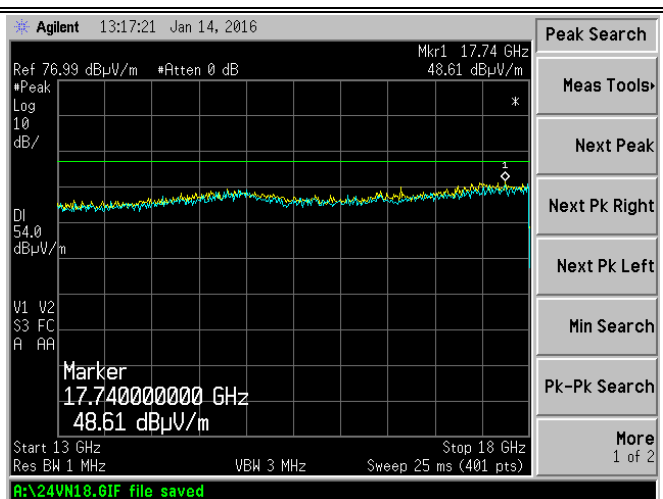


Figure 62: Radiated Spurious Emissions Horizontal  
802.11N(13-18 GHz) Channel 1 Shown, 6 and 11 Similar

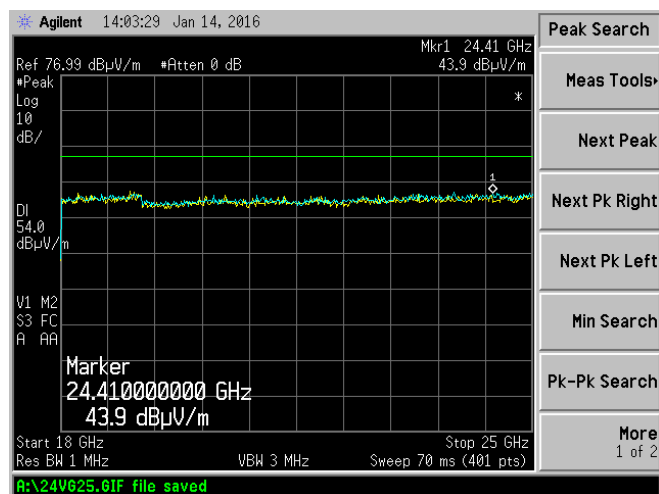


Figure 63: Radiated Spurious Emissions Vertical  
802.11N(18-25 GHz) Channel 1 Shown, 6 and 11 Similar

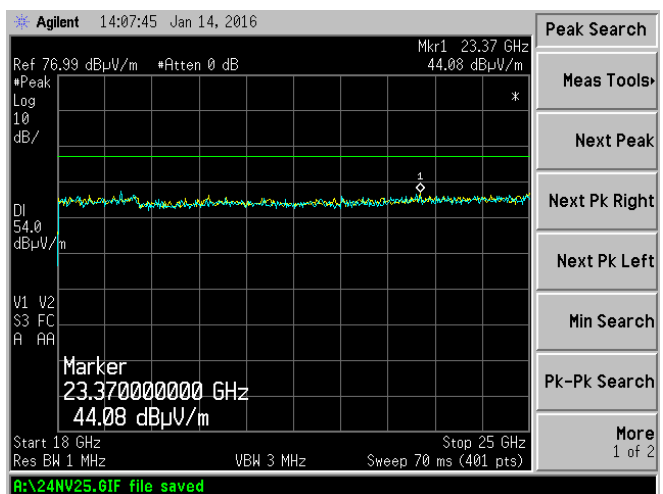


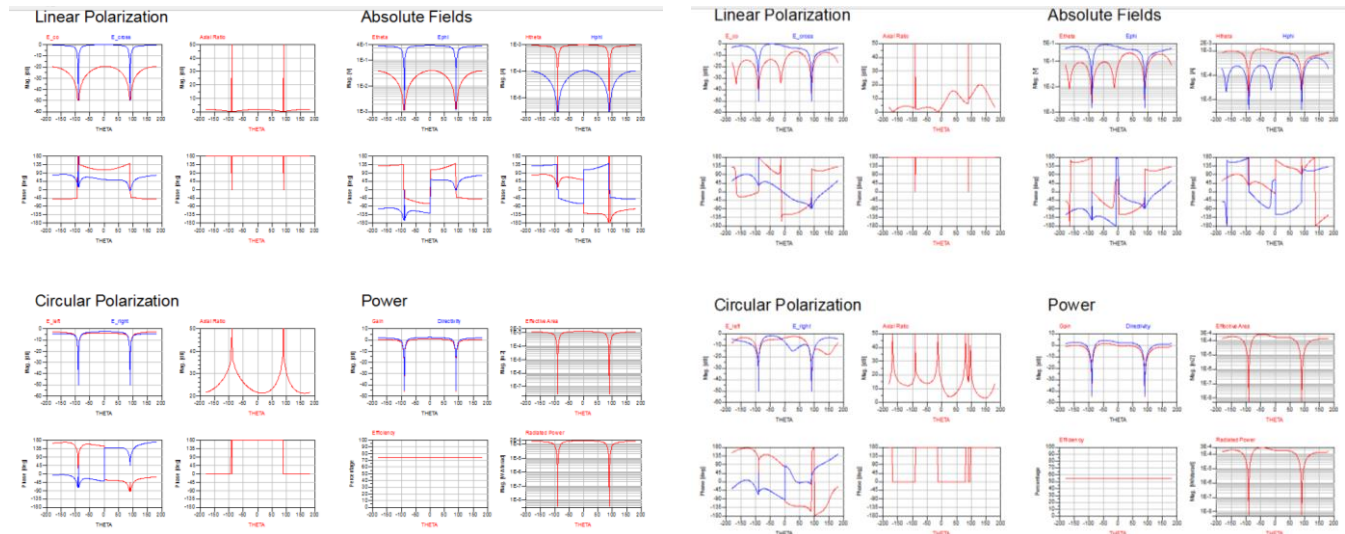
Figure 64: Radiated Spurious Emissions Horizontal  
802.11N(18-25 GHz) Channel 1 Shown, 6 and 11 Similar

## 10 Gain of transmission antenna Per FCC Part 15.247 (b)(4)

### 10.1 Limits/Requirements

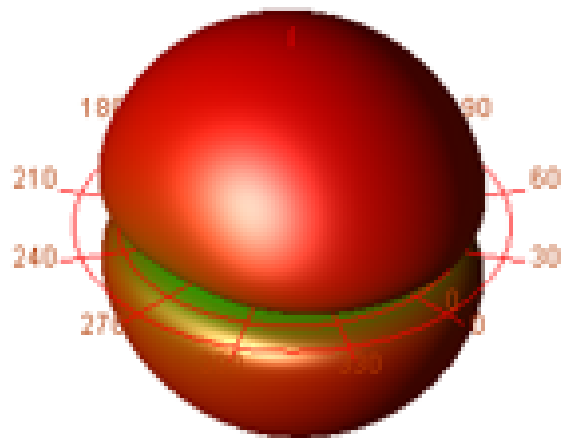
(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

The EUT antenna used, has a stated gain over the band of  $\pm 1.5$  dBi.

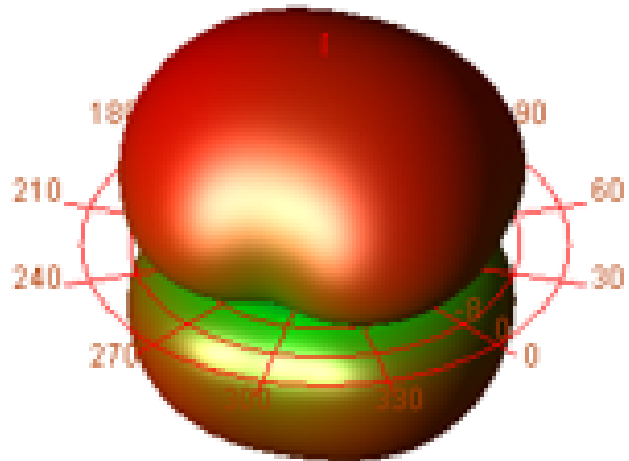


Antenna Specifications in the 2.4-2.5 GHz Band

Antenna Specifications in the 5 GHz Band



2.4 GHz Antenna Radiation Pattern



5 GHz Antenna Radiation Pattern

Figure 65: Antenna Specification

**10.2 R-7 Antenna Specification**

<b>Electrical</b>	
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
<b>Mechanical</b>	
Antenna element size (mm)	115mm
Coax cable	Micro-coax
Connector	MFH-III

## 11 APPENDIX

### 11.1 EUT Technical Specification

<b>Manufacturer:</b>	Osterhout Design Group		
<b>General Description:</b>	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.		
<b>EUT Name:</b>	Smart Glasses	<b>Model:</b>	R-7
<b>Dimensions:</b>	19cm x 14cm x 4.5cm	<b>Serial Number:</b>	R7-P12
<b>Operating Frequency:</b>	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)	<b>Power Cord Type:</b>	<input type="checkbox"/> Shielded <input checked="" type="checkbox"/> Un-Shielded

### 11.2 EUT Photos-attached in the submittal documents