**Test Report issued under the responsibility of:**

# ITC ENGINEERING SERVICES, INC.

| FCC CFR Title 47 Part 15 Subpart C 15.205, 15.209, 15.247 | |
|---|---|
| **Report Reference No. ..... :** | 20140924-01R1 R-6 Glasses_FCC |
| Date of Issue .....: | November 11, 2014 |
| Total Number of Pages .....: | 57 |
| **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 C 15.205, 15.209, 15.247 |
| Test Procedure .....: | ANSI C63.4:2009, ANSI C63.10:2009 (Test Procedures) & Public Notice DA 00-705:2000 |
| Judgment .....: | Complies |
| **Test Item Description..... :** | 802.11 b/g/n, Bluetooth 2.0 + EDR, GPS/GLONASS enabled Augmentation Eyewear |
| Manufacturer Logo.....: | ODG |
| Manufacturer .....: | Osterhout Design Group |
| Model/Type Reference.....: | R-6 Glasses |
| RF Operating Frequency Band.....: | 2.400 - 2.4835 GHz |

A2LA ACCREDITED
TESTING CERT #3382.01

**ISO/IEC 17025:2005 Accredited Laboratory**

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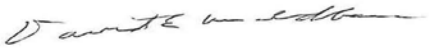
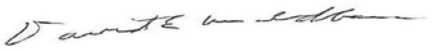
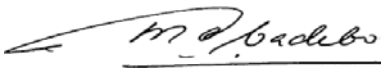
# 1 DOCUMENTATION

## 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) | : | D.E. Waldbeser |  |
| Tested By (Name + Signature) | : | D.E. Waldbeser |  |
| Approved By (Name + Signature) | : | Michael Gbadebo, PE |  |
| ☐ 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 | Old Report Number | New Report Number | Revision |
|---|---|---|---|---|
| 1 | 11/10/2014 | 20140924-01 R-6 Glasses_FCC | 20140924-01R1 R-6 Glasses_FCC | FCC ID & antenna type inserted, page 7.; Orthogonal planes clause inserted at section 2.5, page 12. |

## 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-6 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 | 2.400- 2.4835 GHz |
| **802.11 b/g/n** | |
| FCC ID | 2ADCMODGR-6 |
| 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 | +13 to +18 dBm typ. |
| **Bluetooth 2.0 + EDR** | |
| FCC ID | 2ADCMODGR-6 |
| Modulation Type | GFSK (1 Mbps), EDR: π/4-DPSK (2 Mbps), 8DPSK (3 Mbps) |
| Modulation Technology | FHSS, AFH |
| Transfer Rate | 1 , 2, 3Mbps |
| Number of Channels | 79 |
| Maximum Output Power | +7 to +9 dBm typ. |
| **Antenna** | |
| Antenna Type | |
| Antenna Gain, Peak | 0 dBi |
| Radiation Pattern | Omni-directional |

## 1.6 OPERATIONAL DESCRIPTION OF EUT

The R-6 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 | |
| AC Adapter | Apple | | - |

## 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 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 | 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 | ± 1.5 |
| **2** | Radiated emission of transmitter (30MHz - 1 GHz ) @ 3m | ± 3.2 |
| **3** | Radiated emission of transmitter (1 GHz - 24 GHz) @ 3m | ± 2.5 |

## 1.11 TEST SET UP PHOTOS

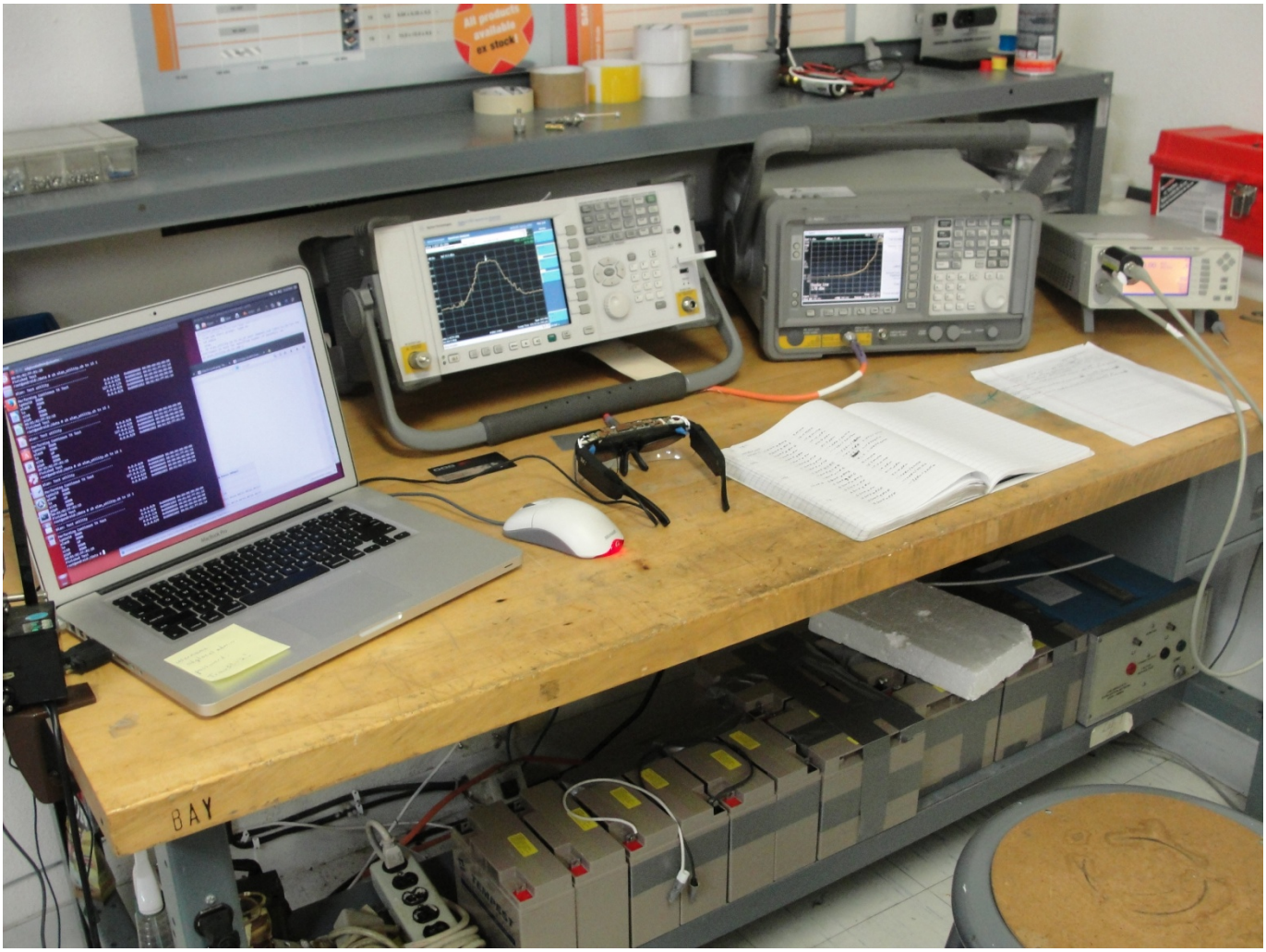



**FIGURE 1: Conducted RF Test Setup**

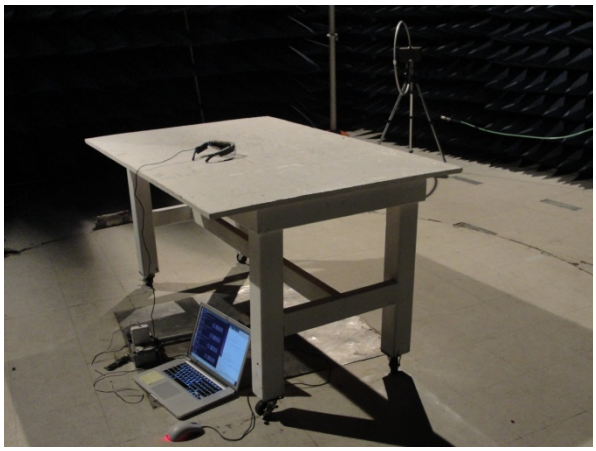


**FIGURE 2: RE Test Setup - Active Loop Antenna**

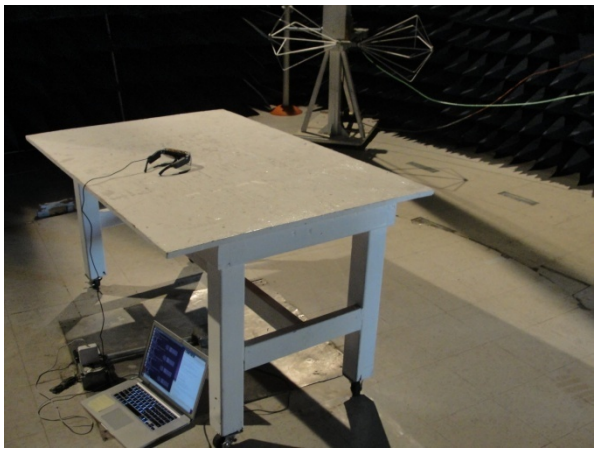
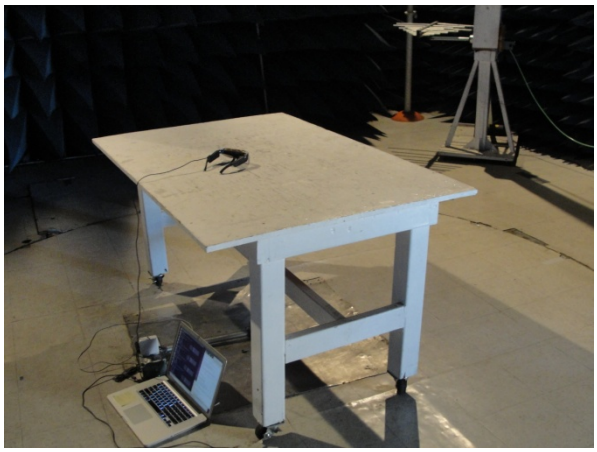
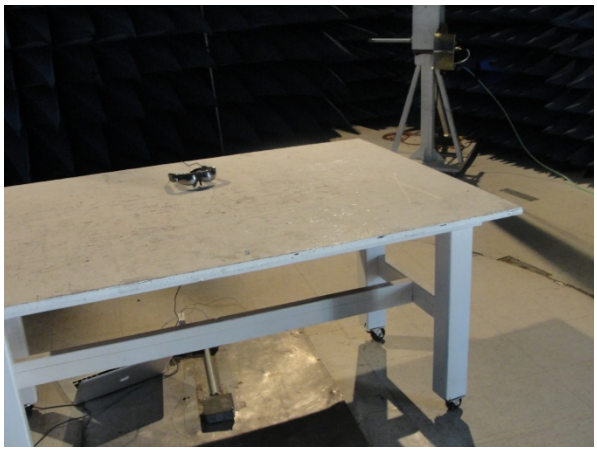


**FIGURE 3: RE Test Setup - Biconical Antenna**



**- Log Periodic Antenna**



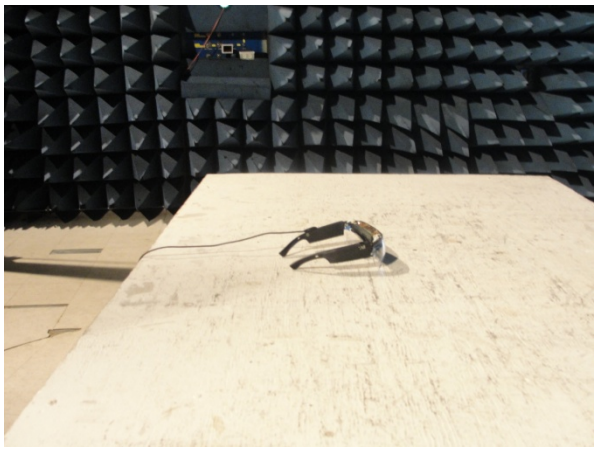


**FIGURE 4: RE Test Setup - Horn Antennas**

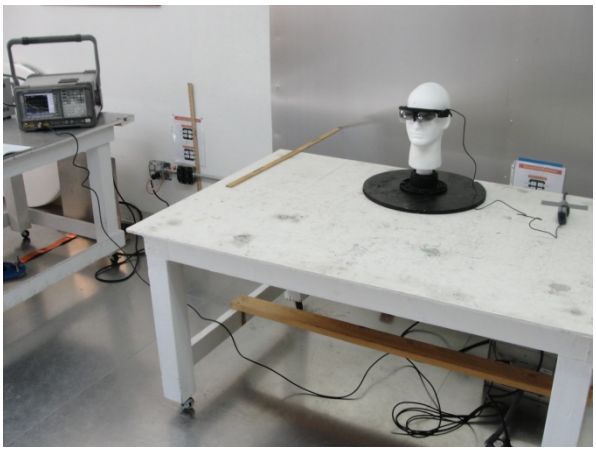



**FIGURE 5: CE Test Setup - Front View - Side View**

# 2 RADIATED EMISSIONS PER FCC PART 15.209

## 2.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 10/28-29/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 21°C avg. |
| **Humidity:** | 48% avg. |

## 2.2 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| EMC Analyzer | Agilent | E7402A | MY45112375 | 7/31/15 | 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 Section 1.10 (Figures 2-4).

## 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 [x] | 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 | - | - |

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

## 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, log-periodic and DRG horn 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 TEST DATA PLOTS

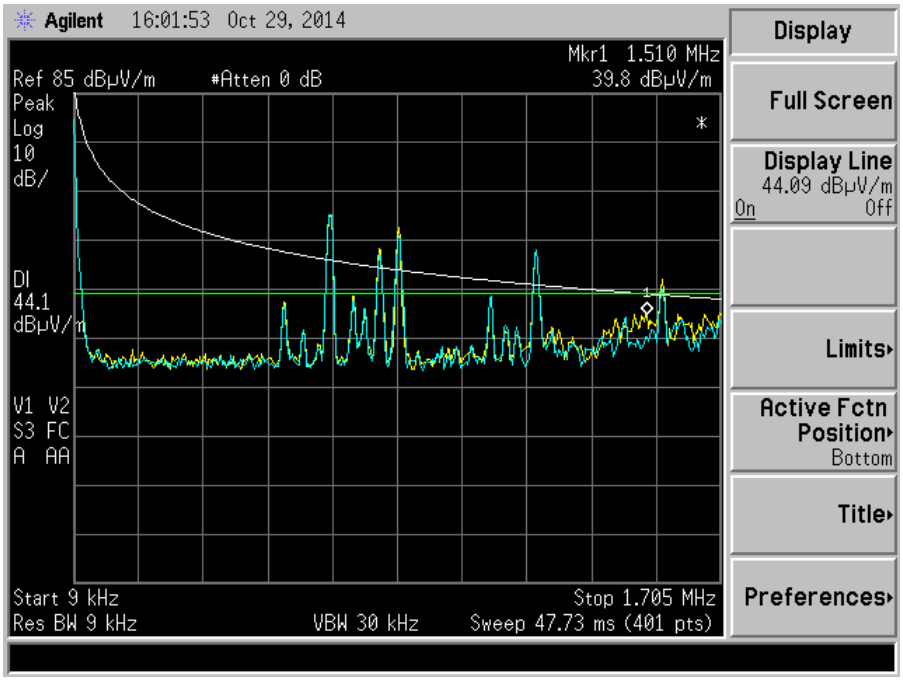



**FIGURE 6: Radiated Emissions – Active Loop, 9 kHz – 1.705 MHz**
**Blue trace = EUT off, Yellow trace = EUT on**


**FIGURE 7: Radiated Emissions – Active Loop, 1.705 – 30 MHz**
**Blue trace = EUT off, Yellow trace = EUT on**

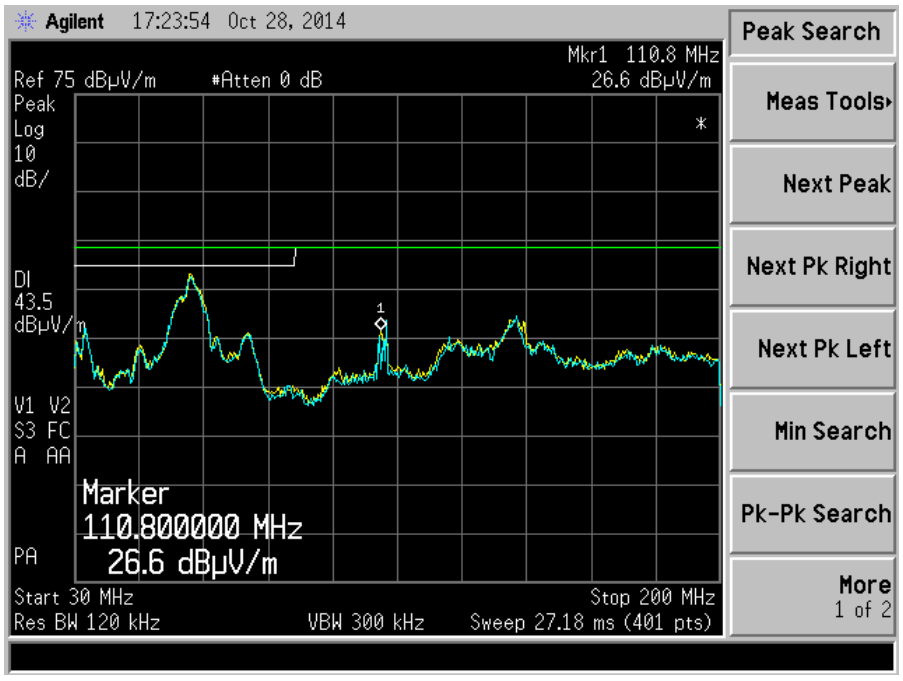



**FIGURE 8: Radiated Emissions – Biconical, Horizontal Polarization**
**Blue trace = EUT off, Yellow trace = EUT on**


**FIGURE 9: Radiated Emissions – Biconical, Vertical Polarization**
**Blue trace = EUT off, Yellow trace = EUT on**

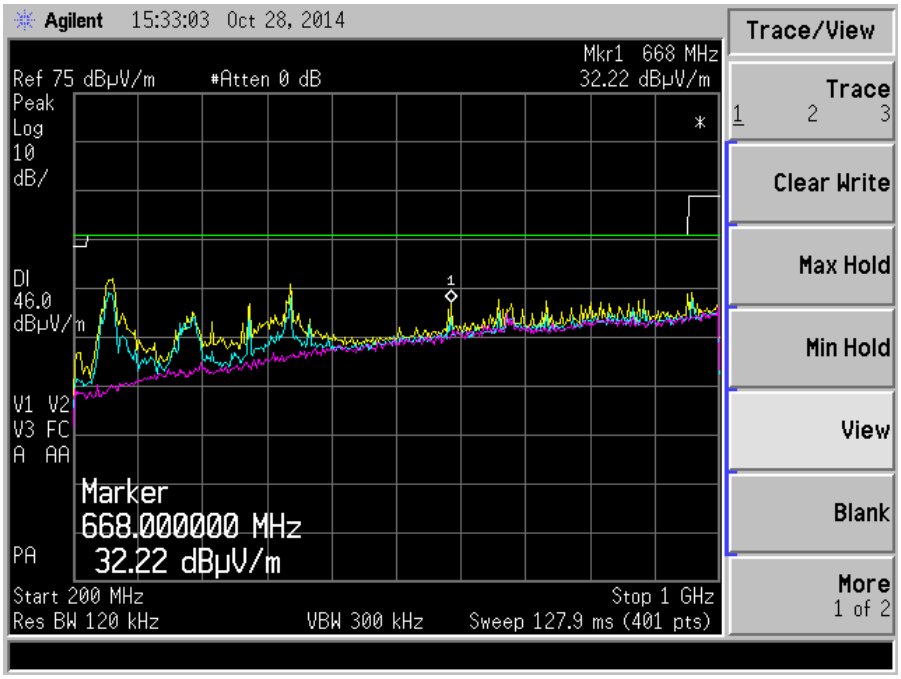



**FIGURE 10: Radiated Emissions – Log-periodic, Horizontal Polarization**
**Blue trace = EUT off, Yellow trace = EUT on, Magenta = chamber background**

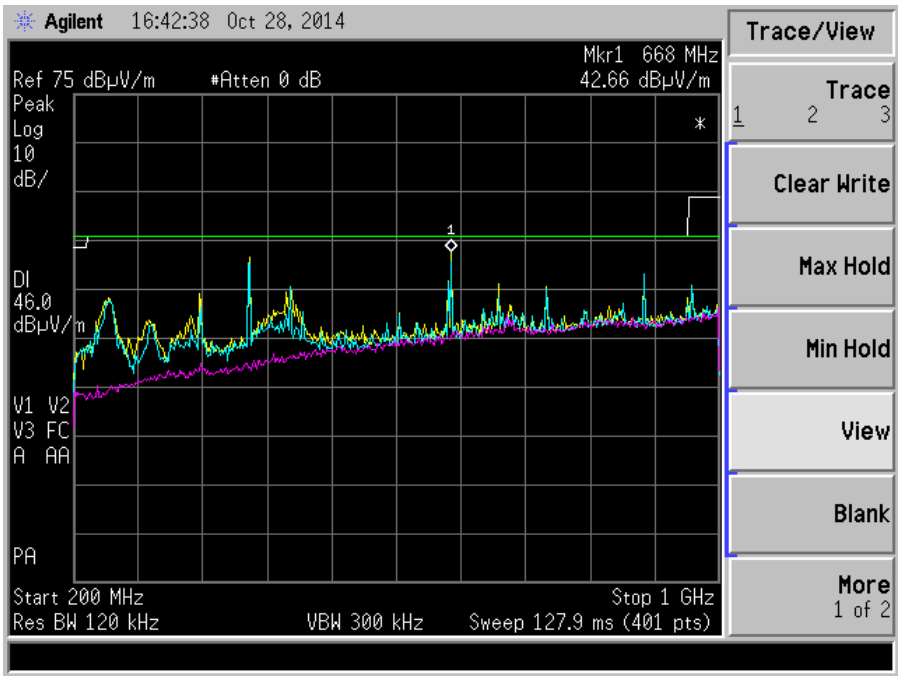



**FIGURE 11: Radiated Emissions – Log-periodic, Vertical Polarization**
**Blue trace = EUT off, Yellow trace = EUT on, Magenta = chamber background**

# 3 CONDUCTED POWER LINE EMISSIONS PER FCC PART 15.207

## 3.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 10/2/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 21°C |
| **Humidity:** | 48% |

## 3.2 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| EMC Analyzer | Agilent | E7402A | MY45112375 | 7/31/15 | 2 yr |
| LISN | EMCO | 3825/2 | 8901-1229 | 10/15/16 | 2 yr |

## 3.3 TEST SET UP PHOTO(S)

Refer to Section 1.10 (Figures 2-3).

## 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.

## 3.5 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.

## 3.6 TEST DATA PLOTS

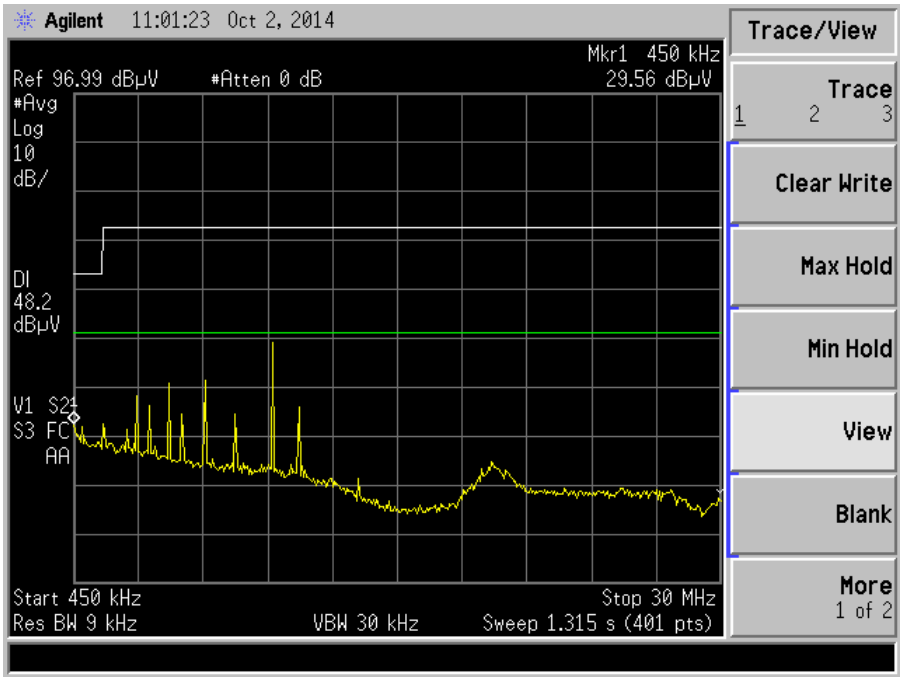



**FIGURE 12: Conducted Emissions – Hot AC Line**

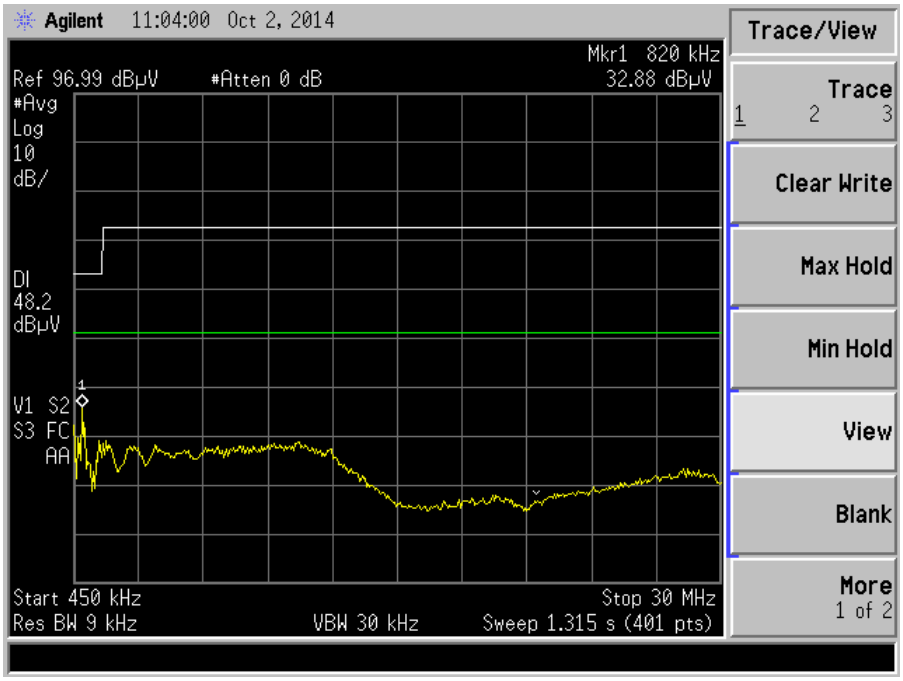



**FIGURE 13: Conducted Emissions – Neutral AC Line**

# 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:** | 10/9/14, 10/13/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 21°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 | 1/17/15 | 2 yr |

## 4.3 TEST SET UP PHOTO(S)

Refer to Section 1.10 (Figure1).

## 4.4 LIMITS/REQUIREMENTS

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. 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 MHF 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 or near the low, mid and high channel of the operating band.

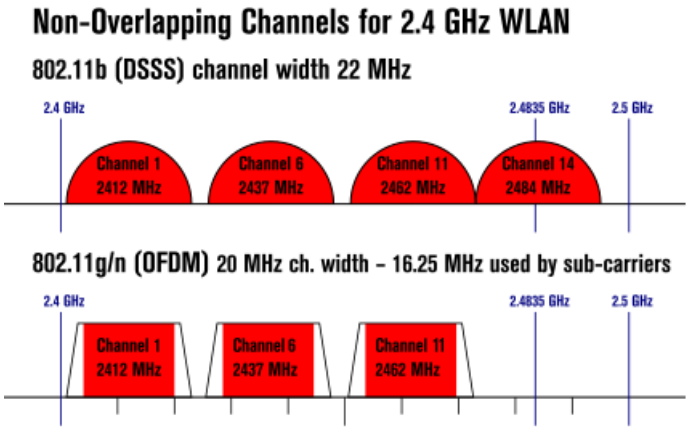



**FIGURE 14: 802.11 Channels**

## 4.6 6DB BANDWIDTH MEASUREMENT TEST DATA

| Channel | Freq. (MHz) | Measured 6dB BW (MHz) | | | Result |
|---|---|---|---|---|---|
| | | b | g | n | |
| 1 | 2412 | 10 | 16.3 | 17.7 | Pass |
| 6 | 2437 | 9.5 | 16.3 | 17.8 | Pass |
| 11 | 2462 | 9 | 16.4 | 17.8 | Pass |

## 4.7 6DB BANDWIDTH MEASUREMENT PLOTS

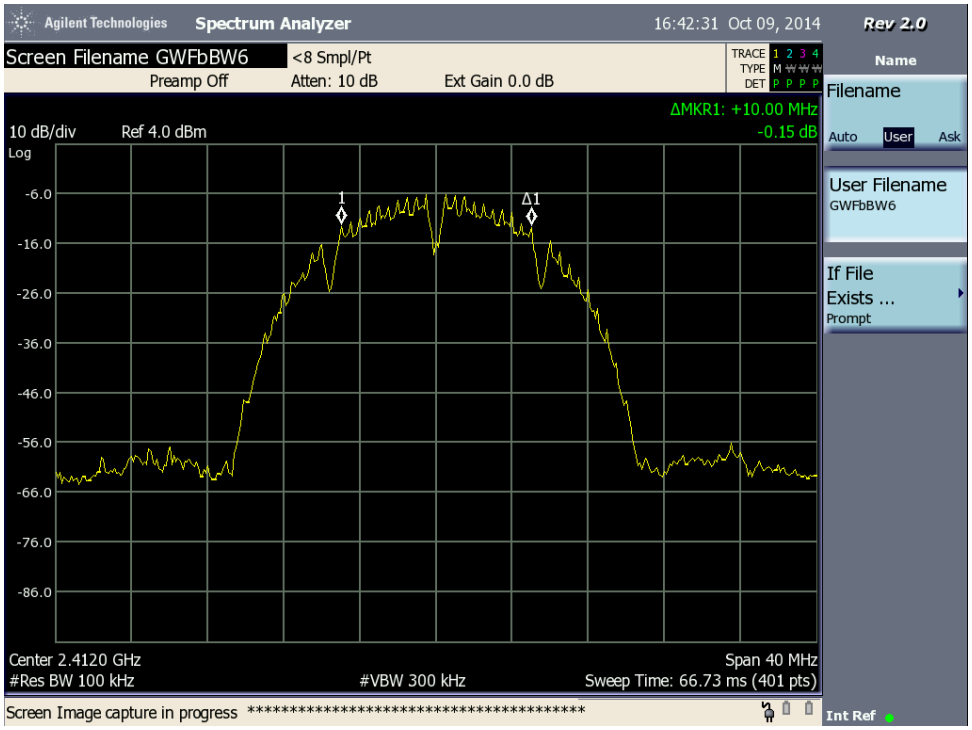



**FIGURE 15: 802.11b 6dB Bandwidth (Ch1 shown, Ch6 & 11 similar)**

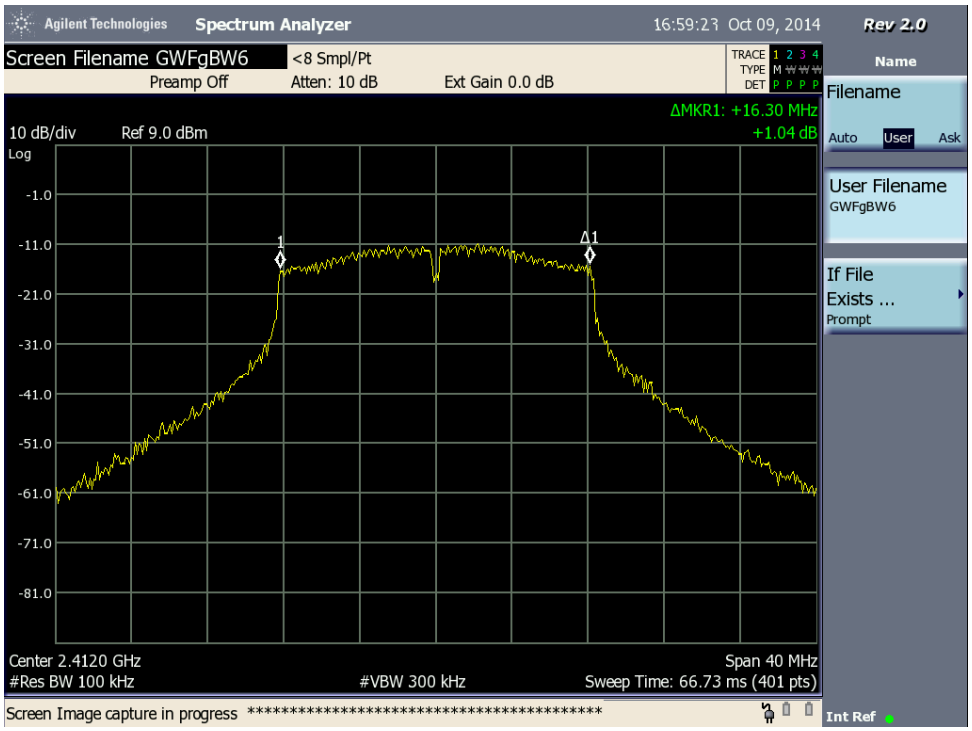



**FIGURE 16: 802.11g 6dB Bandwidth (Ch1 shown, Ch6 & 11 similar)**

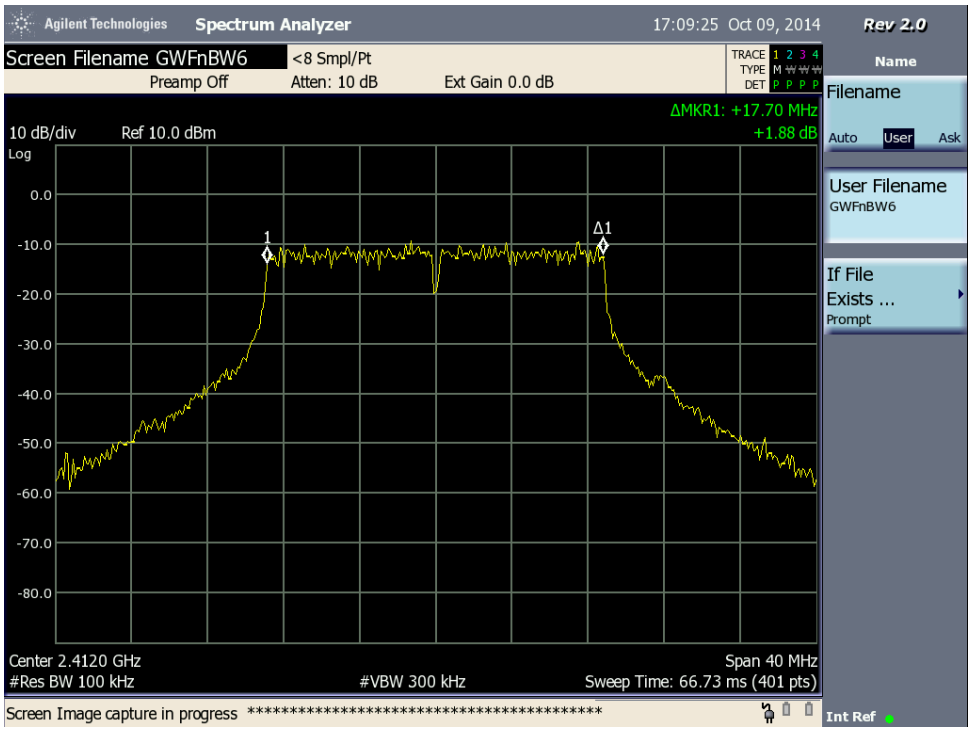



**FIGURE 17: 802.11n 6dB Bandwidth (Ch1 shown, Ch6 & 11 similar)**

## 4.8 CARRIER FREQUENCY SEPARATION PLOT

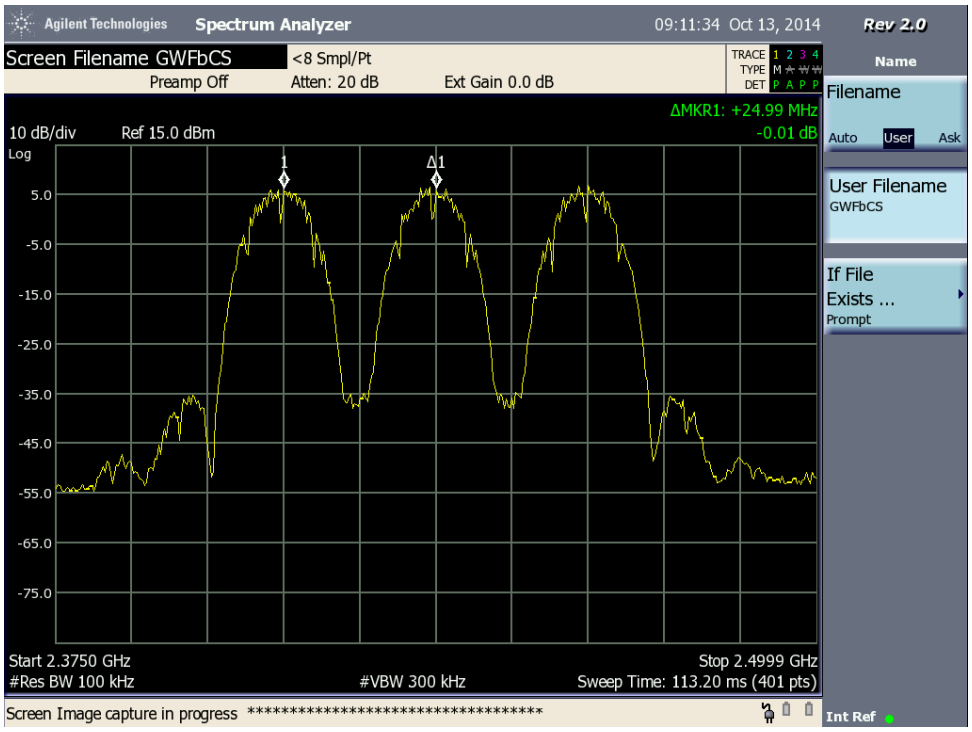



**FIGURE 18: Carrier Frequency Separation 25 MHz (Ch1, 6 & 11)**

# 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:** | 10/9-10/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **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 | 1/17/15 | 2 yr |

## 5.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (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 in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

## 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 | 2402 | 19.5 | 22.2 | 19.1 | 20.2 | 22.9 | 19.8 | 9.8 | 7.1 | 10.2 | Passed |
| 6 | 2437 | 20.4 | 21.9 | 19 | 21.1 | 22.6 | 19.7 | 8.9 | 7.4 | 10.3 | Passed |
| 11 | 2462 | 20.3 | 22.6 | 19.4 | 21 | 23.3 | 20.1 | 9.7 | 6.7 | 9.9 | Passed |

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss (0.7 dB)

## 5.7 PEAK POWER PLOTS

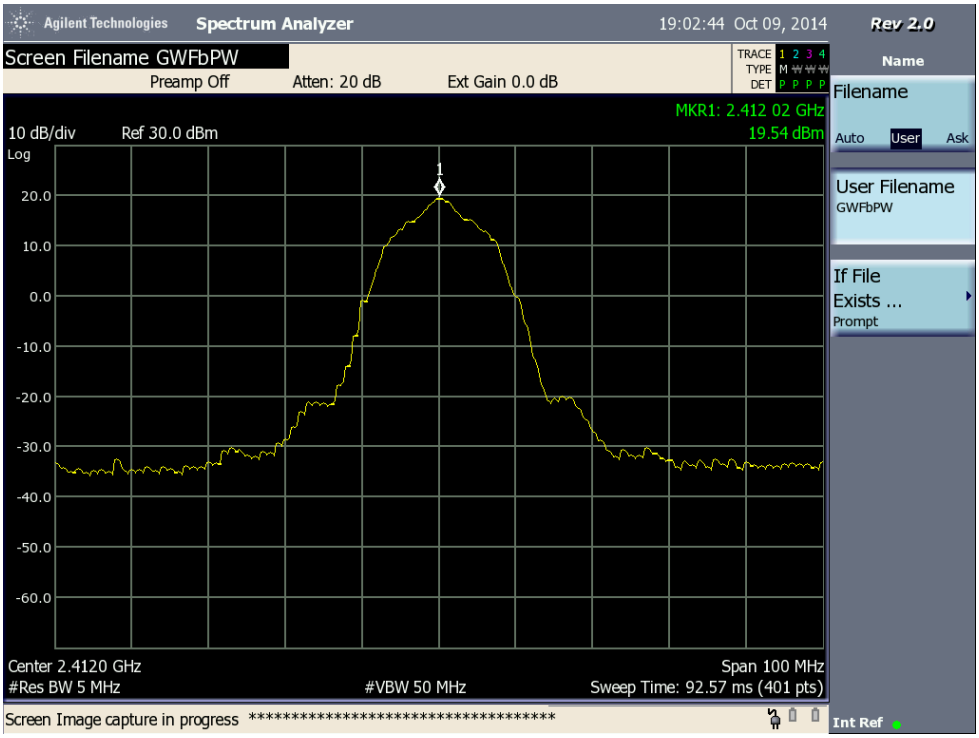



**FIGURE 19: 802.11b Peak Power (Ch1 shown, Ch6 & 11 similar)**

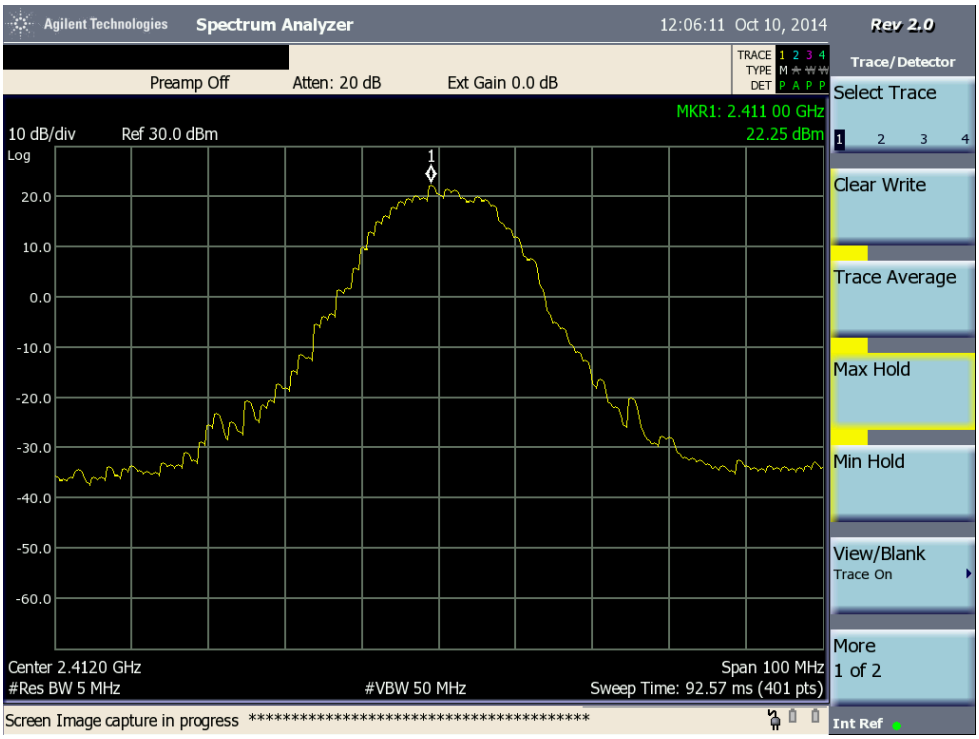



**FIGURE 20: 802.11g Peak Power (Ch1 shown, Ch6 & 11 similar)**

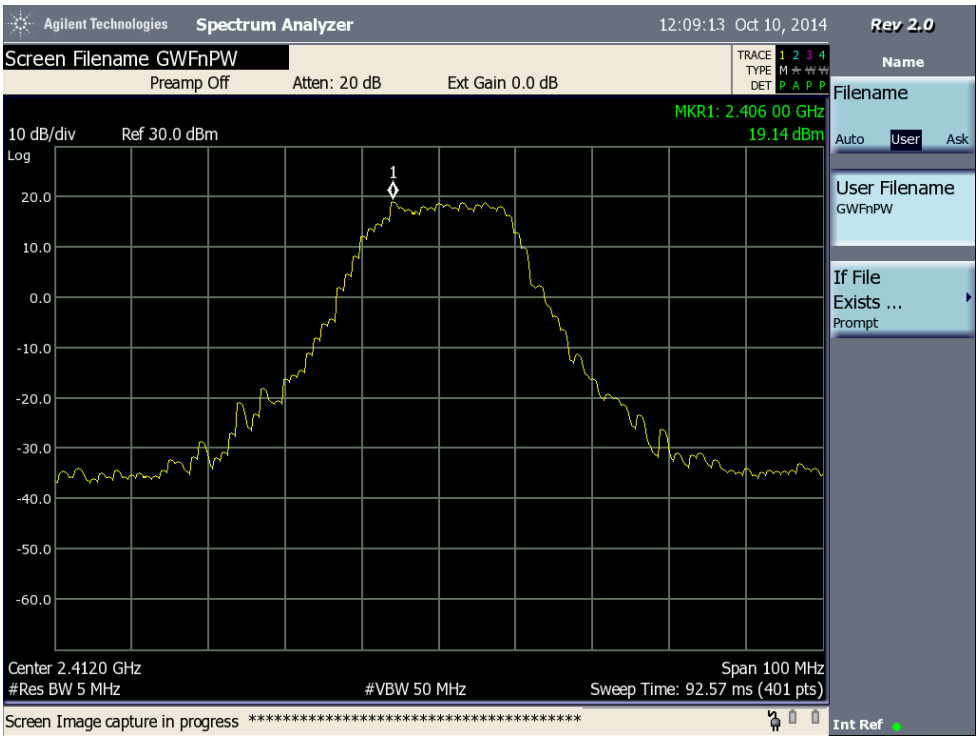



**FIGURE 21: 802.11n Peak Power (Ch1 shown, Ch6 & 11 similar)**

# 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:** | 10/10/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **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 | 1/17/15 | 2 yr |

## 6.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (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 | -10 | -13 | -9.3 | -9.3 | -12.3 | 17.3 | 17.3 | 20.3 | Passed |
| 6 | 2437 | -10 | -10 | -13 | -9.3 | -9.3 | -12.3 | 17.3 | 17.3 | 20.3 | Passed |
| 11 | 2462 | -10 | -10 | -13 | -9.3 | -9.3 | -12.3 | 17.3 | 17.3 | 20.3 | Passed |

MPSD = Measured Power Spectral Density CPSD = Corrected Power Spectral Density = MPSD + Cable Loss (0.7 dB)

## 6.7 POWER SPECTRAL DENSITY PLOTS

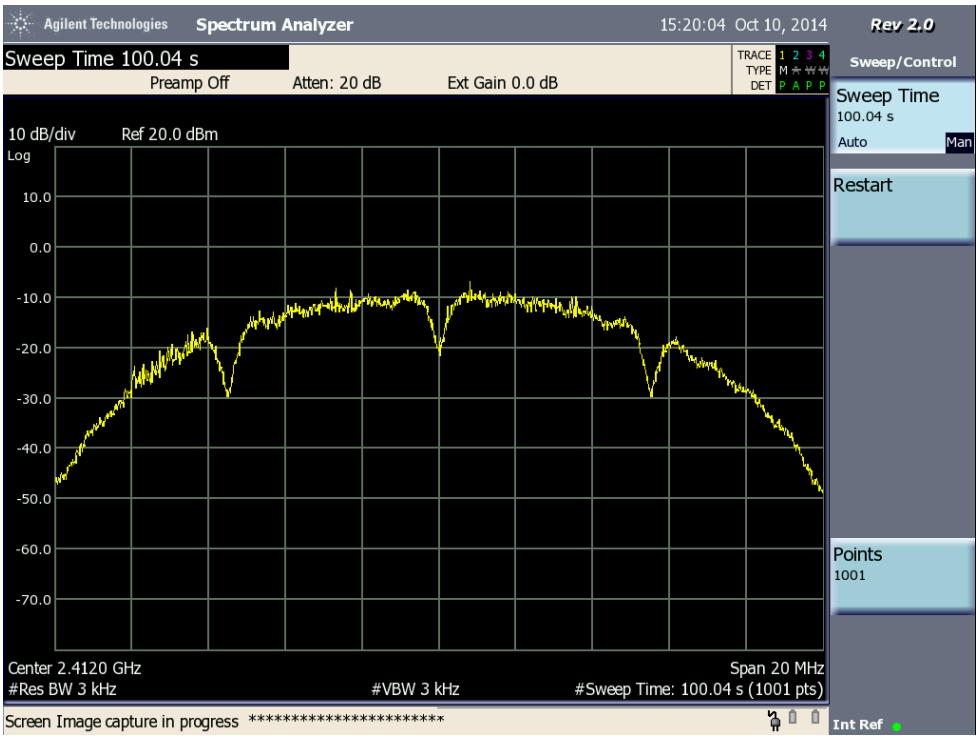



**FIGURE 22: 802.11b Power Spectral Density (Ch1 shown, Ch6 & 11 similar)**

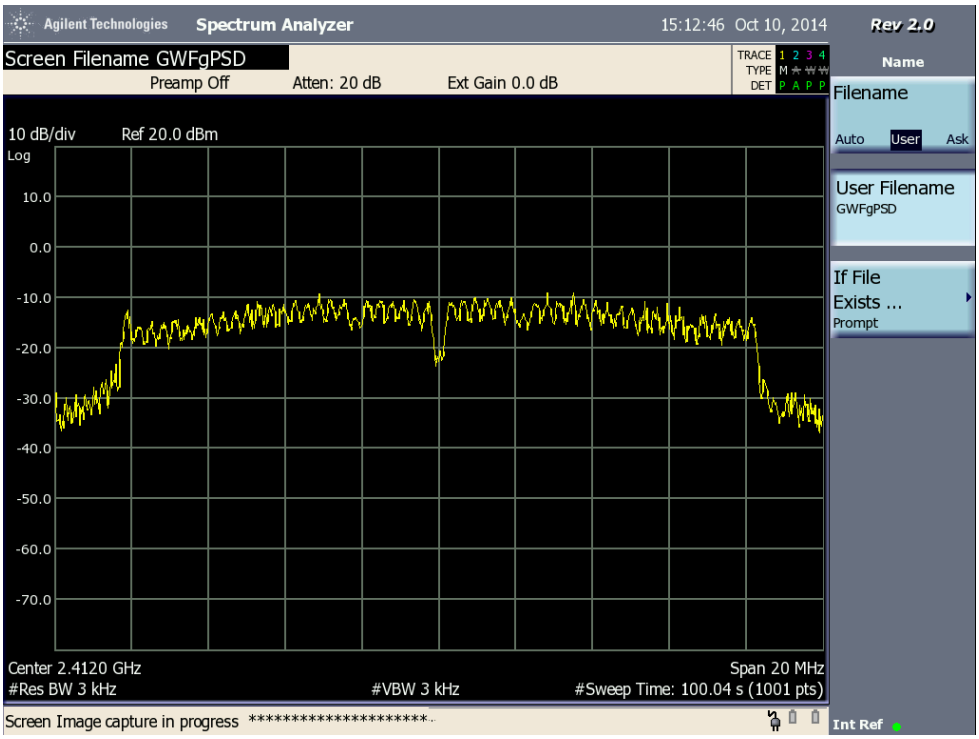



**FIGURE 23: 802.11g Power Spectral Density (Ch1 shown, Ch6 & 11 similar)**

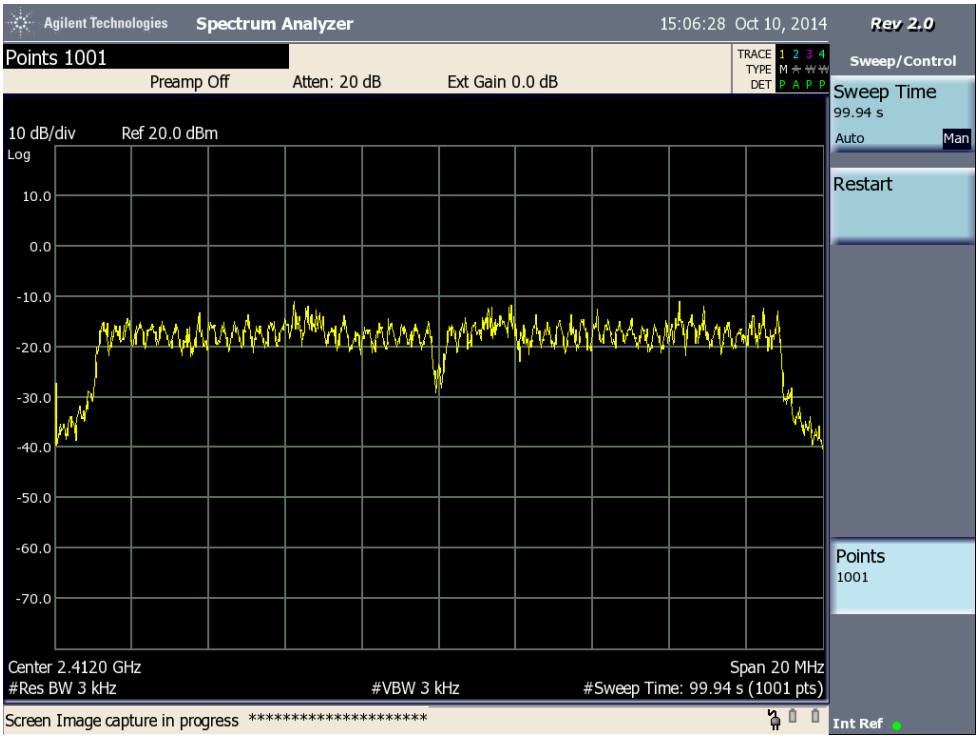



**FIGURE 24: 802.11n Power Spectral Density (Ch1 shown, Ch6 & 11 similar)**

# 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:** | 10/10/14, 10/13/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **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 | 1/17/15 | 2 yr |

## 7.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (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

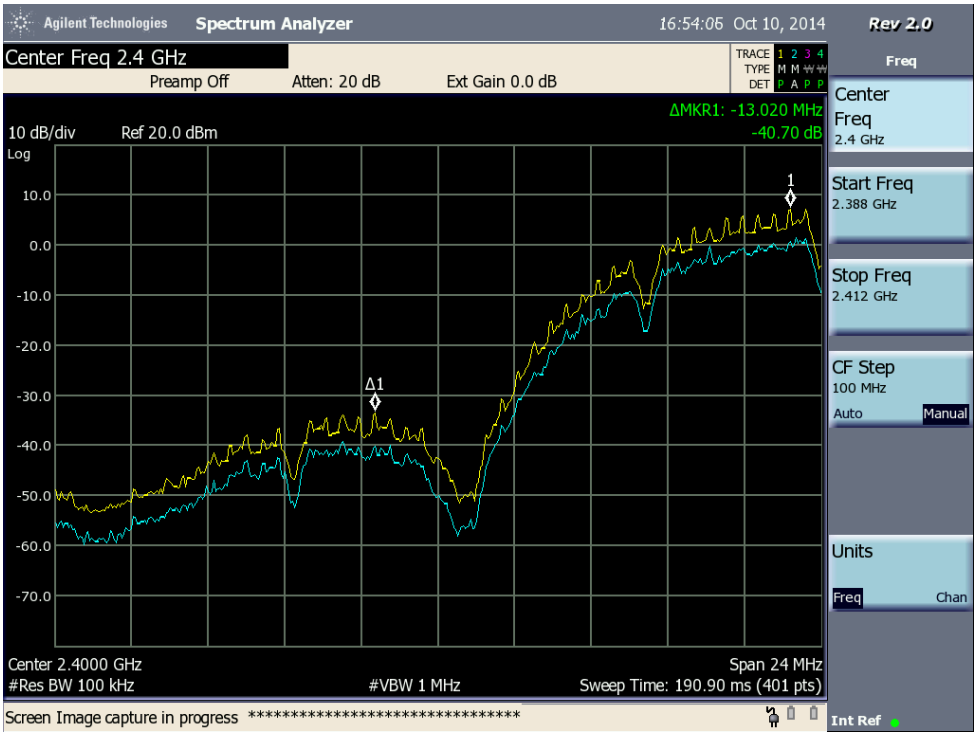



**FIGURE 25: 802.11b Ch1 Lower Band Edge**

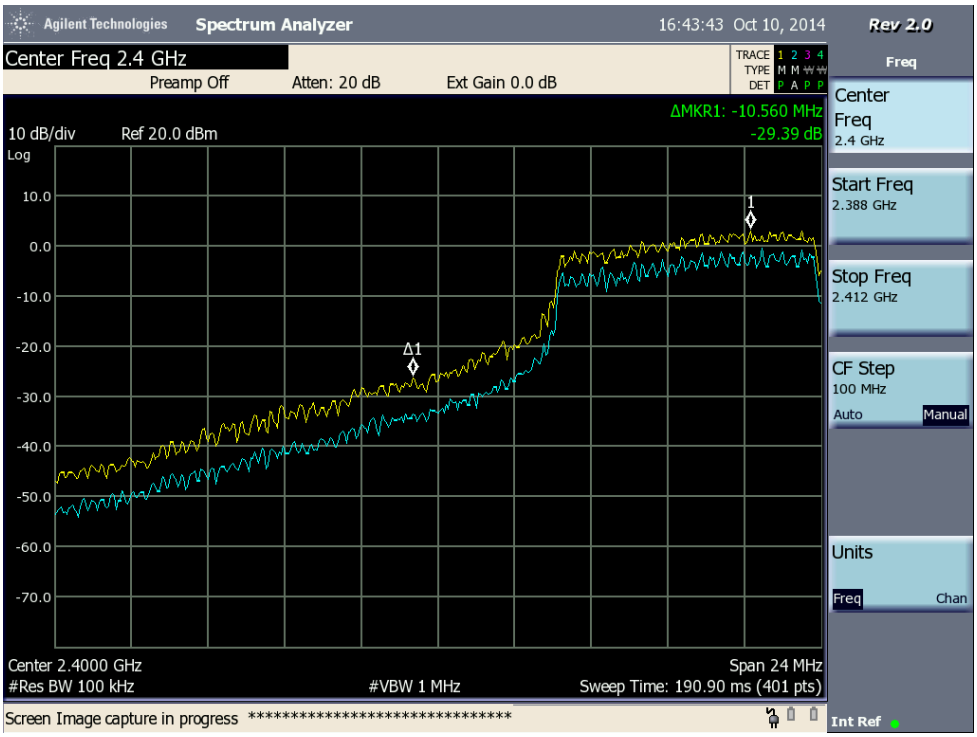



**FIGURE 26: 802.11g Ch1 Lower Band Edge**

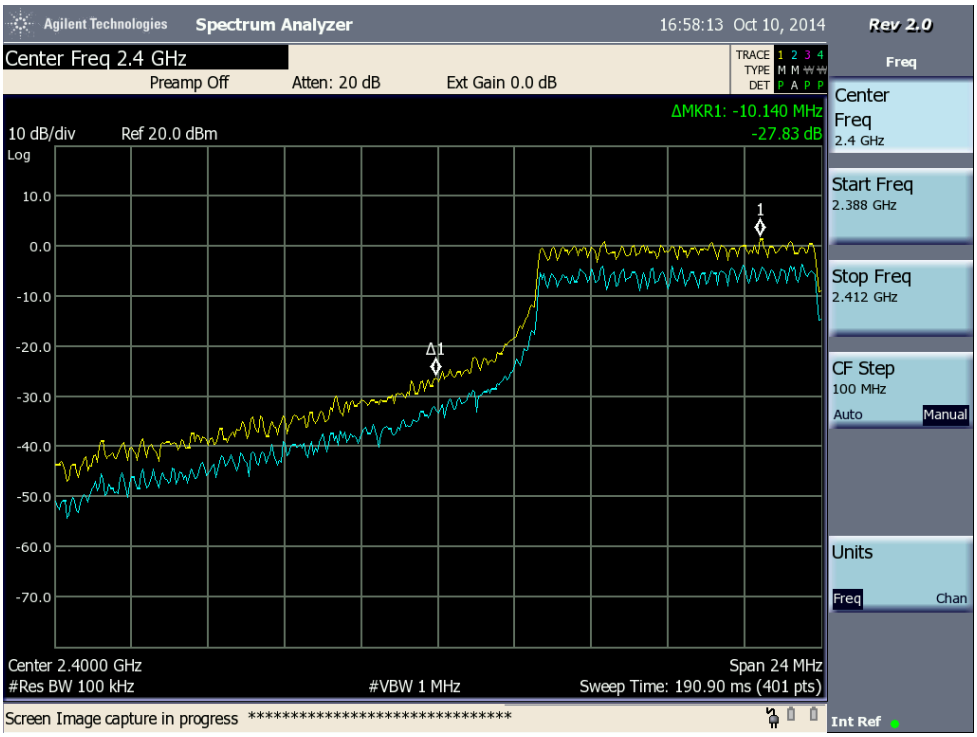



**FIGURE 27: 802.11n Ch1 Lower Band Edge**

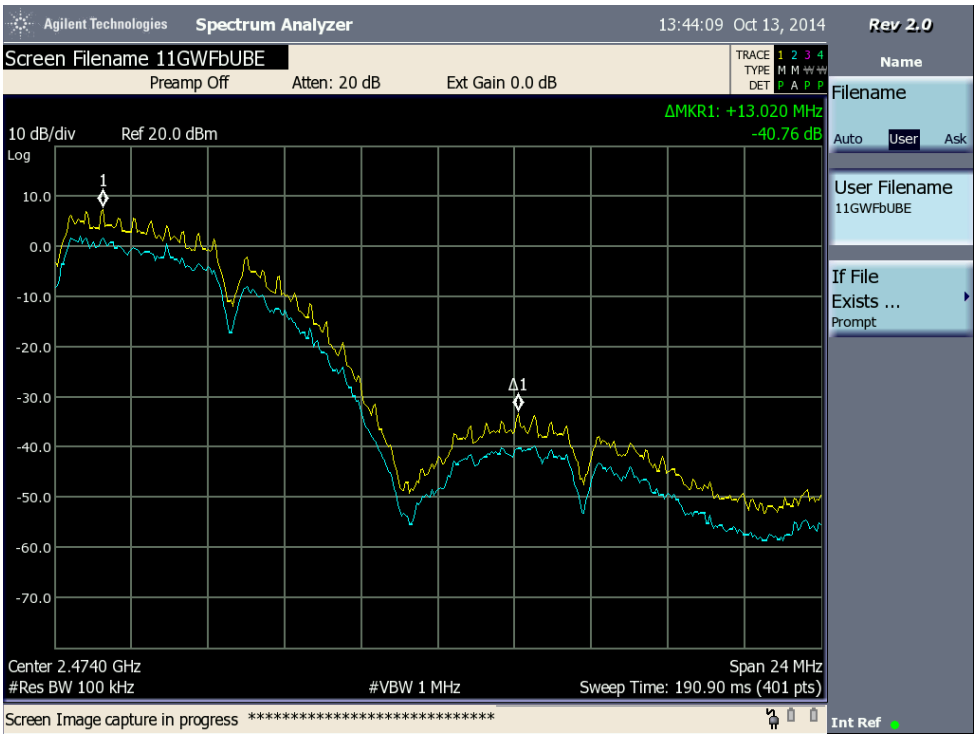



**FIGURE 28: 802.11b Ch11 Upper Band Edge**

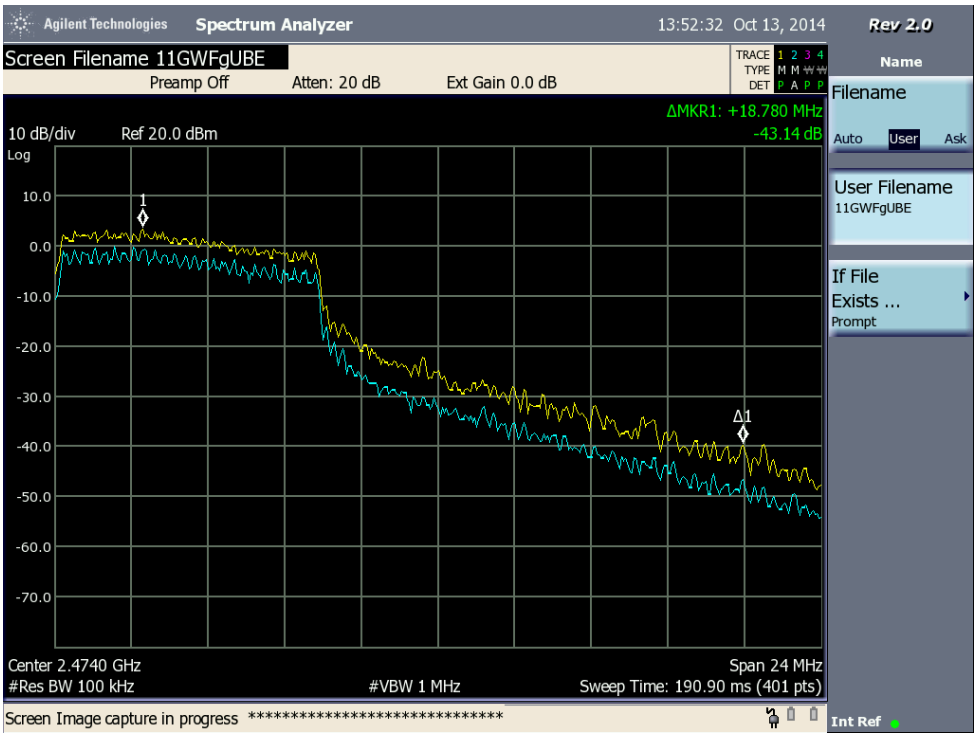



**FIGURE 29: 802.11g Ch11 Upper Band Edge**

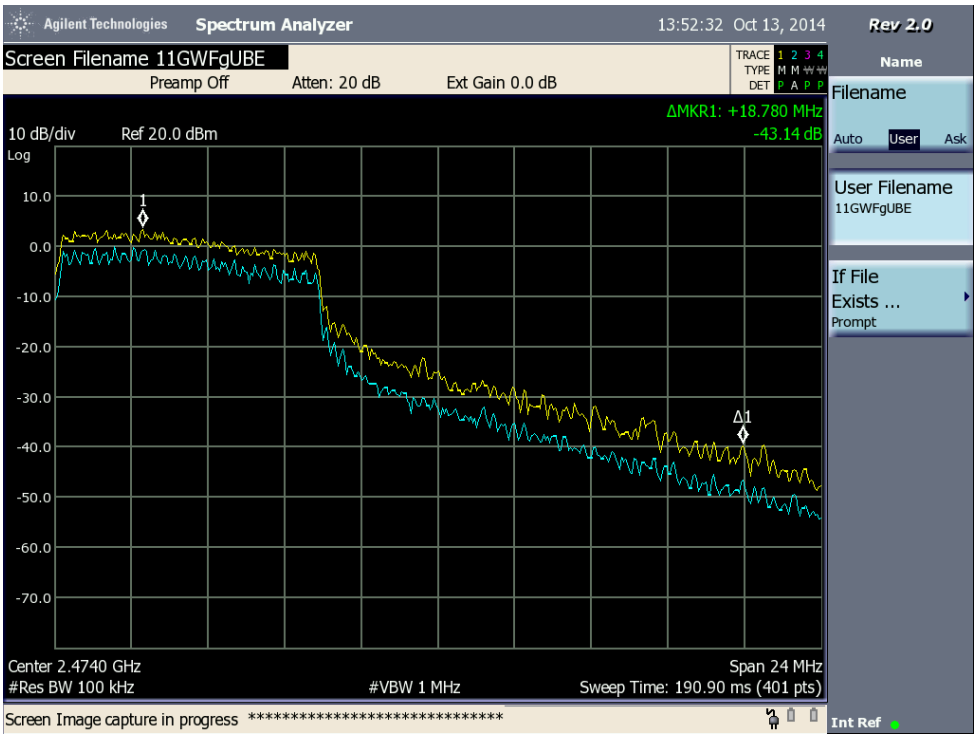



**FIGURE 30: 802.11n Ch11 Upper Band Edge**

# 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:** | 10/14/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C |
| **Humidity:** | 41% |

## 8.1 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| CSA Spectrum Analyzer | Agilent | N1996A | MY45371881 | 1/17/15 | 2 yr |

## 8.1 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1).

## 8.2 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.

## 8.3 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.

## 8.4 TEST PLOTS

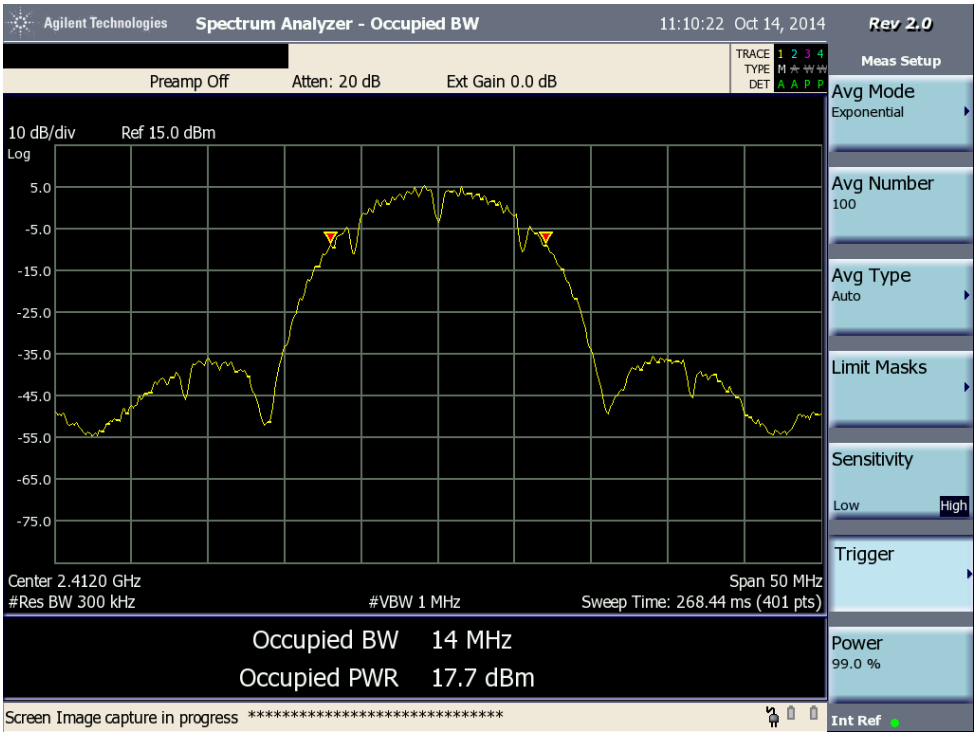



**FIGURE 31: 802.11b Occupied Bandwidth (Ch1 shown, Ch6 & 11 similar)**

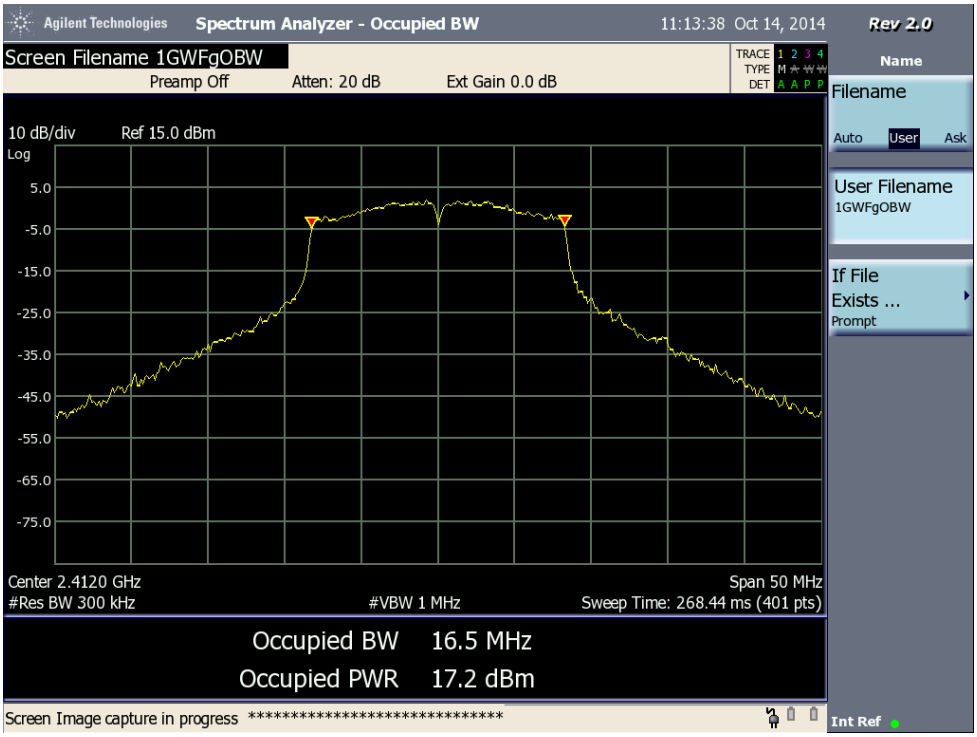



**FIGURE 32: 802.11g Occupied Bandwidth (Ch1 shown, Ch6 & 11 similar)**

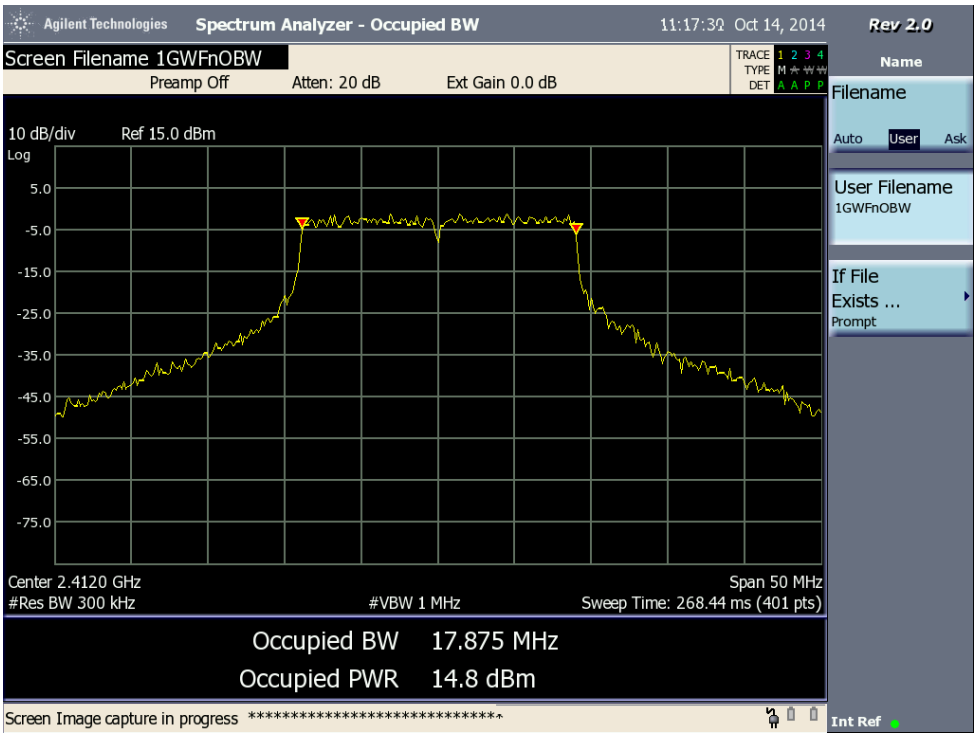



**FIGURE 33: 802.11n Occupied Bandwidth (Ch1 shown, Ch6 & 11 similar)**

# 9 MINIMUM 6 DB BANDWIDTH PER FCC PART 15.247 (A)(2) – BLUETOOTH 2.0 + EDR

## 9.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 10/20-21/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 21°C avg |
| **Humidity:** | 48% avg |

## 9.2 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| CSA Spectrum Analyzer | Agilent | N1996A | MY45371881 | 1/17/15 | 2 yr |

## 9.3 TEST SET UP PHOTO(S)

Refer to Section 1.10 (Figure1).

## 9.4 LIMITS/REQUIREMENTS

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

## 9.5 TEST DESCRIPTION AND PROCEDURE

The EUT is connected to the spectrum analyzer by disconnecting the internal antenna cable from the PCB MHF 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 or near the low, mid and high channel of the operating band.

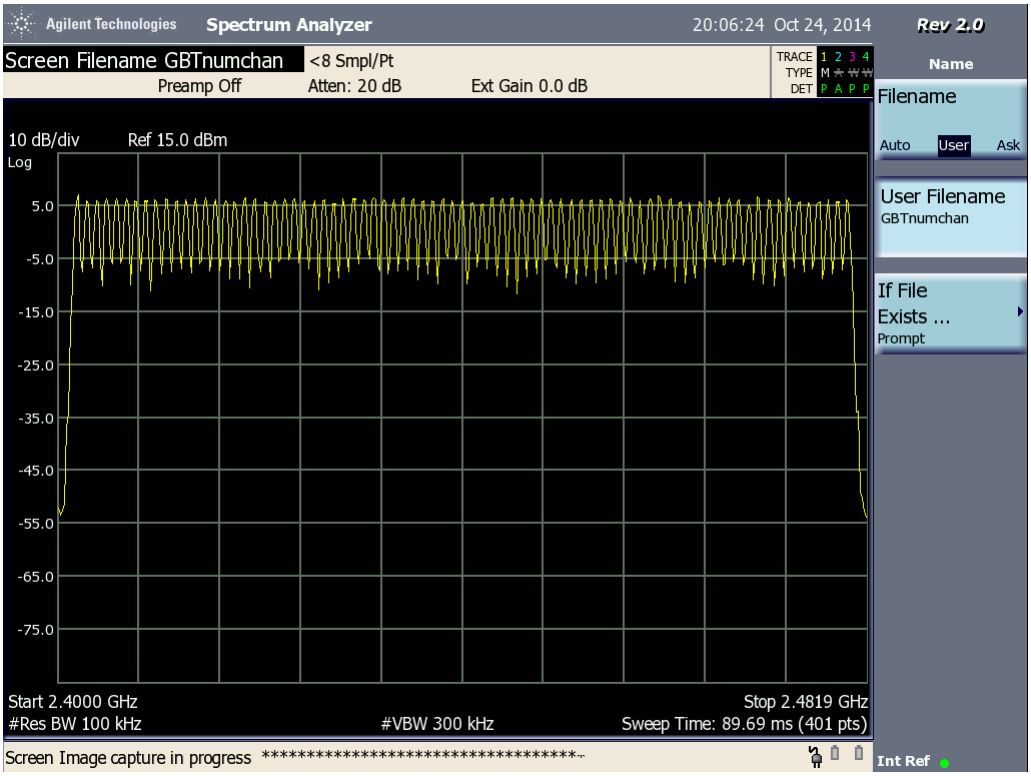



**FIGURE 34: Bluetooth 2.0 + EDR Channels (79)**

## 9.6 6DB BANDWIDTH MEASUREMENT TEST DATA

| Channel | Freq. (MHz) | Measured 6dB BW (MHz) | | Result |
|---|---|---|---|---|
| | | gfsk | edr | |
| 0 | 2402 | 0.5 | 1.09 | Pass |
| 20 | 2442 | 0.53 | 1.09 | Pass |
| 39 | 2480 | 0.5 | 1.09 | Pass |

## 9.7 6DB BANDWIDTH MEASUREMENT PLOTS

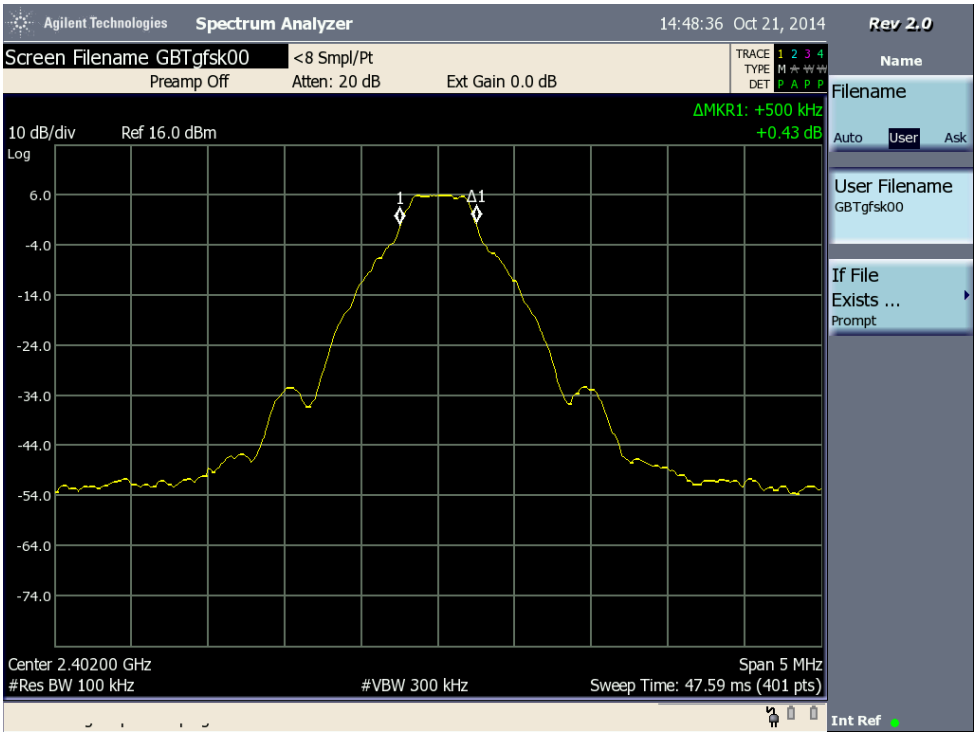



**FIGURE 35: 6dB GFSK bandwidth (Ch0 shown, Ch20 & 39 similar)**

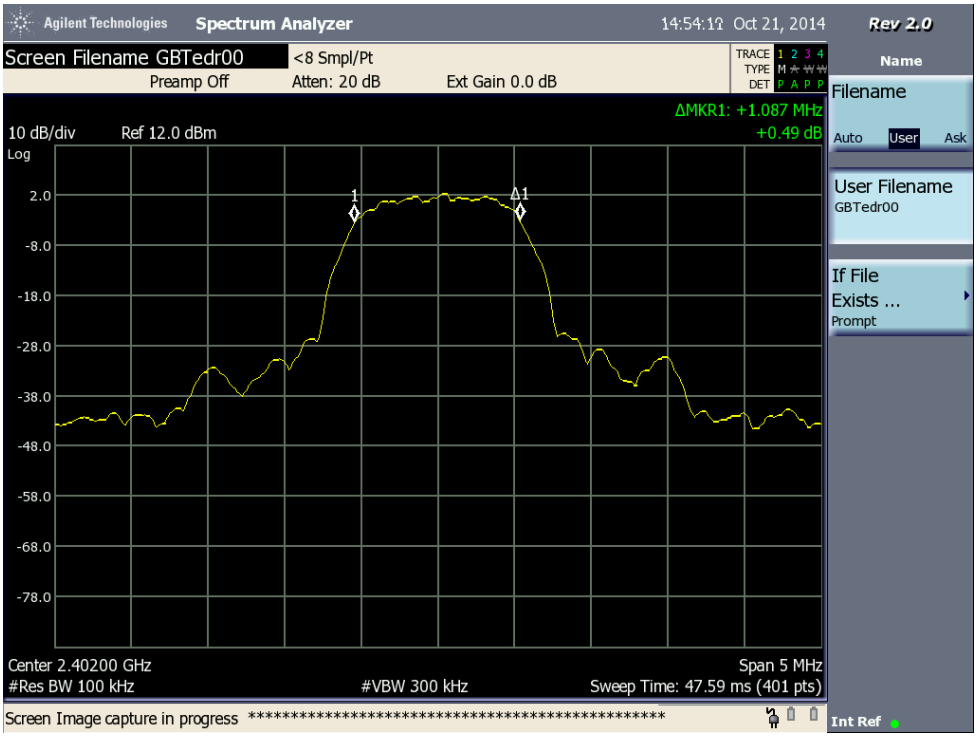



**FIGURE 36: 6dB EDR bandwidth (Ch0 shown, Ch20 & 39 similar)**

## 9.1 CARRIER FREQUENCY SEPARATION PLOT

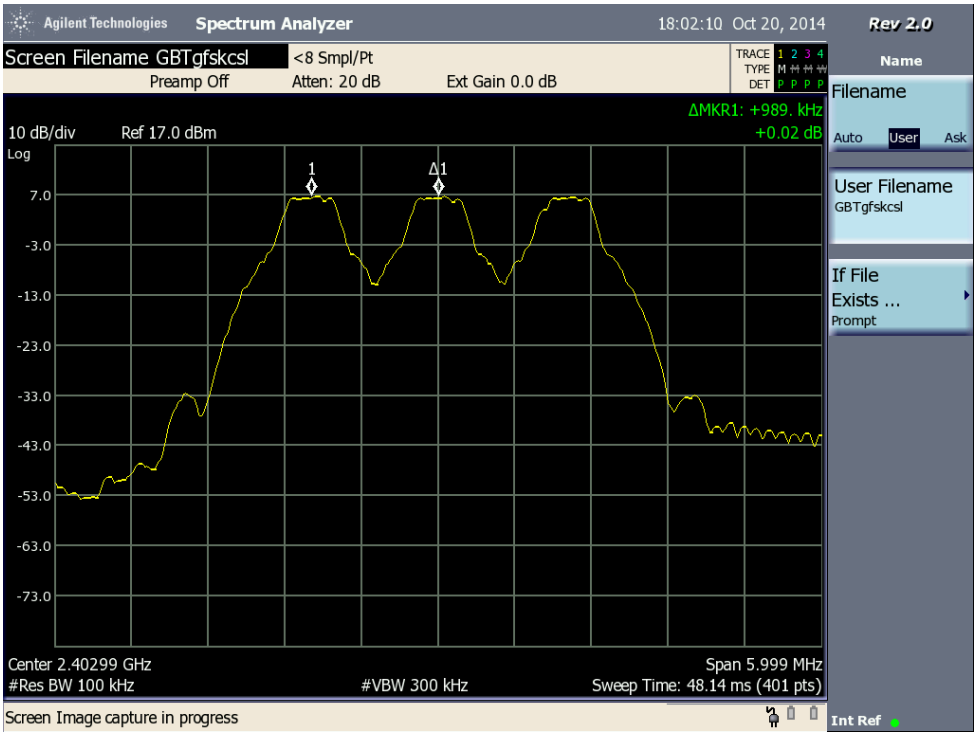



**FIGURE 37: GFSK Carrier Frequency Separation 1 MHz (Ch0, 1 & 2)**

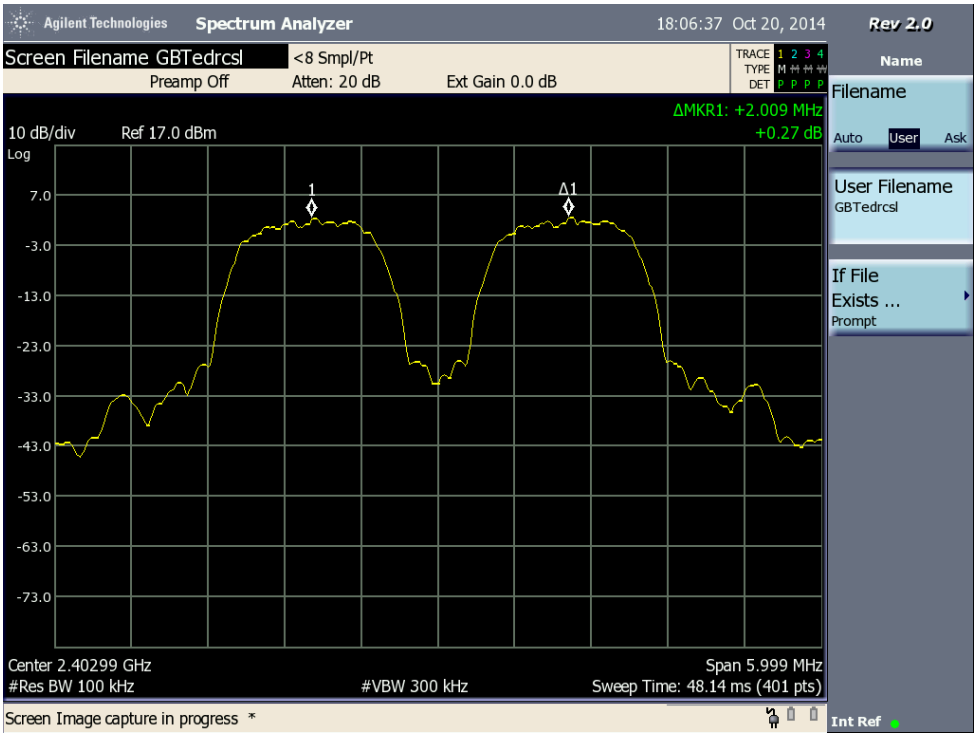



**FIGURE 38: EDR Carrier Frequency Separation 1 MHz (Ch0 & 2 shown)**

# 10 PEAK CONDUCTED OUTPUT POWER PER FCC PART 15.247 (B)(3) – BLUETOOTH 2.0 + EDR

## 10.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 10/21/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C |
| **Humidity:** | 41% |

## 10.2 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| CSA Spectrum Analyzer | Agilent | N1996A | MY45371881 | 1/17/15 | 2 yr |

## 10.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure 1)

## 10.4 LIMITS/REQUIREMENTS

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

## 10.5 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.

## 10.6 TEST DATA TABLES

| Channel | Freq. (MHz) | MPP (dBm) | | CPP (dBm) | | Margin = 30 - CPP (dB) | | Result |
|---|---|---|---|---|---|---|---|---|
| | | gfsk | edr | gfsk | edr | gfsk | edr | |
| 0 | 2412 | 6.6 | 2.5 | 7.3 | 3.2 | 22.7 | 26.8 | Passed |
| 20 | 2442 | 7.1 | 3.3 | 7.8 | 4 | 22.9 | 26 | Passed |
| 39 | 2480 | 7 | 3.4 | 7.7 | 4.1 | 22.3 | 25.9 | Passed |

MPP = Measured Peak Power CPP = Corrected Peak Power = MPP + Cable Loss (0.7 dB)

## 10.1 PEAK POWER PLOTS

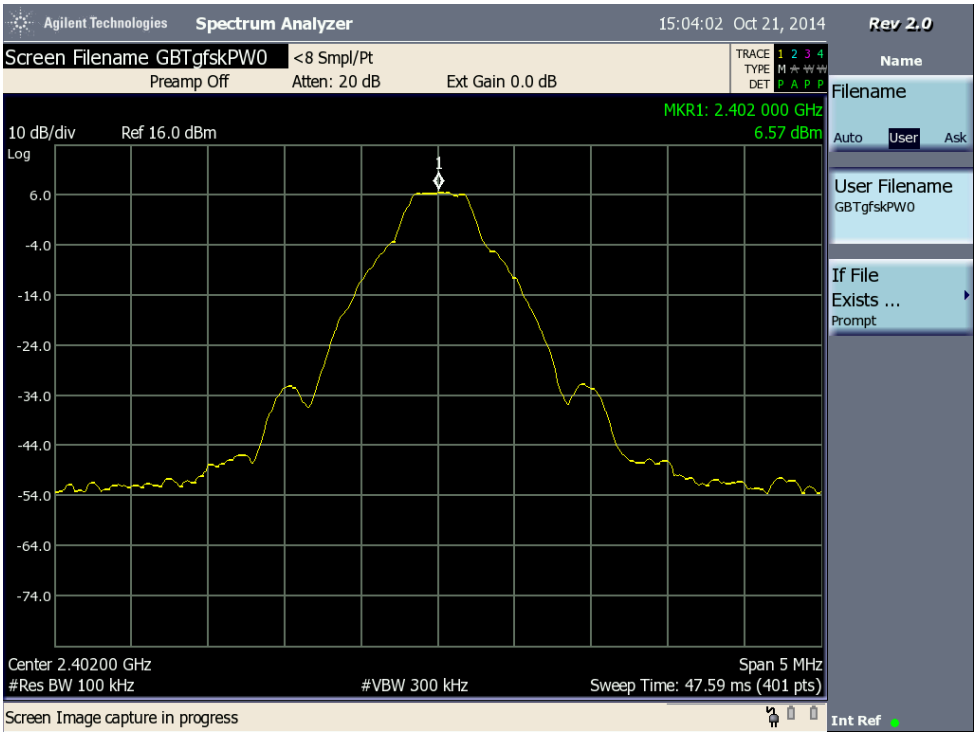



**FIGURE 39: GFSK Peak Power (Ch0 shown, Ch20 & 39 similar)**

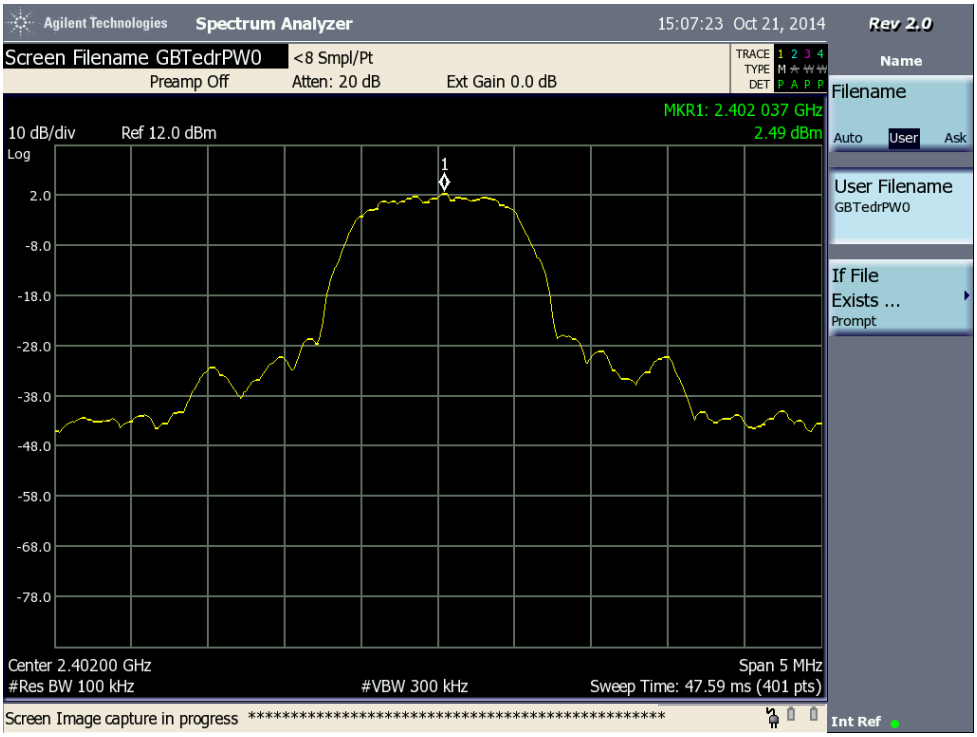



**FIGURE 40: EDR Peak Power (Ch0 shown, Ch20 & 39 similar)**

# 11 POWER SPECTRAL DENSITY PER FCC PART 15.247 (D) – BLUETOOTH 2.0 + EDR

## 11.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 10/21/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C |
| **Humidity:** | 41% |

## 11.3 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| CSA Spectrum Analyzer | Agilent | N1996A | MY45371881 | 1/17/15 | 2 yr |

## 11.6 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1).

## 11.7 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.

## 11.8 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.

## 11.9 TEST DATA TABLES

| Channel | Freq. (MHz) | MPSD (dBm/3 kHz) | | CPSD (dBm/3 kHz) | | Margin = 8 - CPSD (dB) | | Result |
|---|---|---|---|---|---|---|---|---|
| | | gfsk | edr | gfsk | edr | gfsk | edr | |
| 0 | 2402 | -4.1 | -11.8 | -3.4 | -11.1 | 11.4 | 19.1 | Passed |
| 20 | 2442 | -3.9 | -13.5 | -3.2 | -12.8 | 11.2 | 20.8 | Passed |
| 39 | 2480 | -4 | -11.1 | -3.3 | -10.4 | 11.3 | 18.4 | Passed |

MPSD = Measured Power Spectral Density CPSD = Corrected Power Spectral Density = MPSD + Cable Loss (0.7 dB)

## 11.10 POWER SPECTRAL DENSITY PLOTS

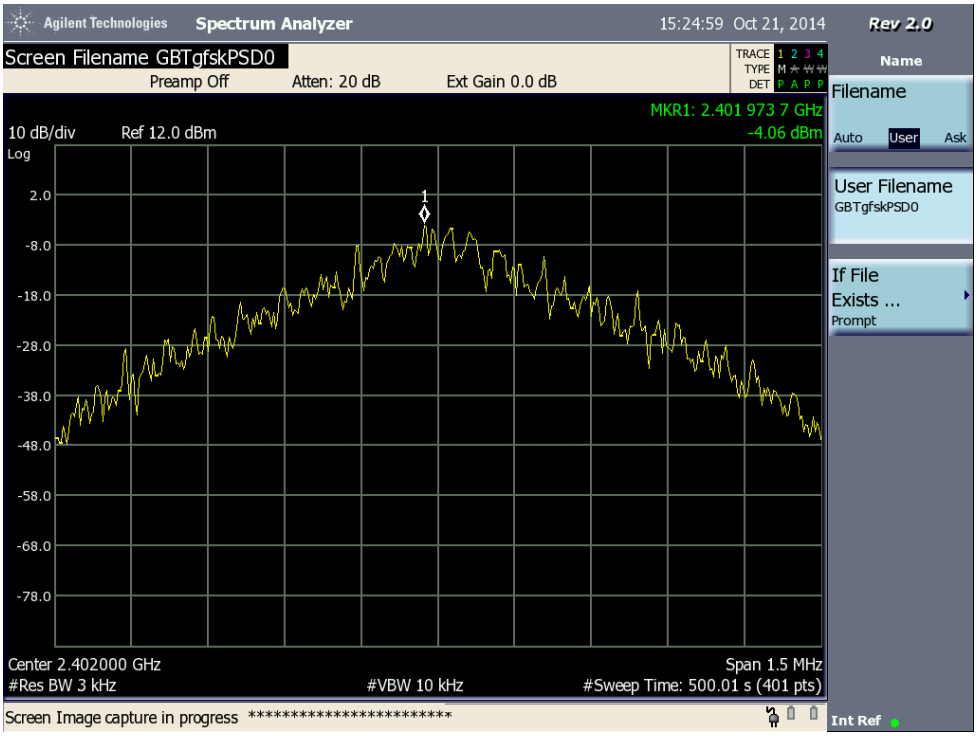



**FIGURE 41: GFSK Power Spectral Density (Ch0 shown, Ch20 & 39 similar)**

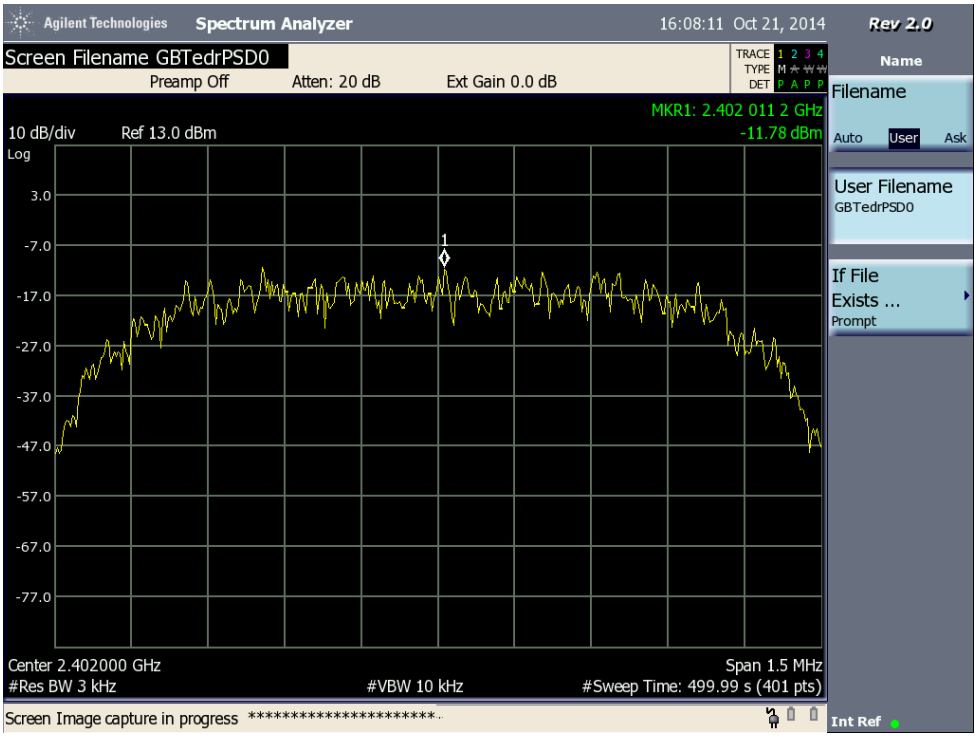



**FIGURE 42: EDR Power Spectral Density (Ch0 shown, Ch20 & 39 similar)**

# 12 LOWER/UPPER BAND EDGE PER FCC PART 15 SECTION 15.247 (D) – BLUETOOTH 2.0 + EDR

## 12.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 10/21-22/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C avg |
| **Humidity:** | 41% avg. |

## 12.2 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| CSA Spectrum Analyzer | Agilent | N1996A | MY45371881 | 1/17/15 | 2 yr |

## 12.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1).

## 12.4 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.

## 12.5 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.

## 12.6 TEST PLOTS

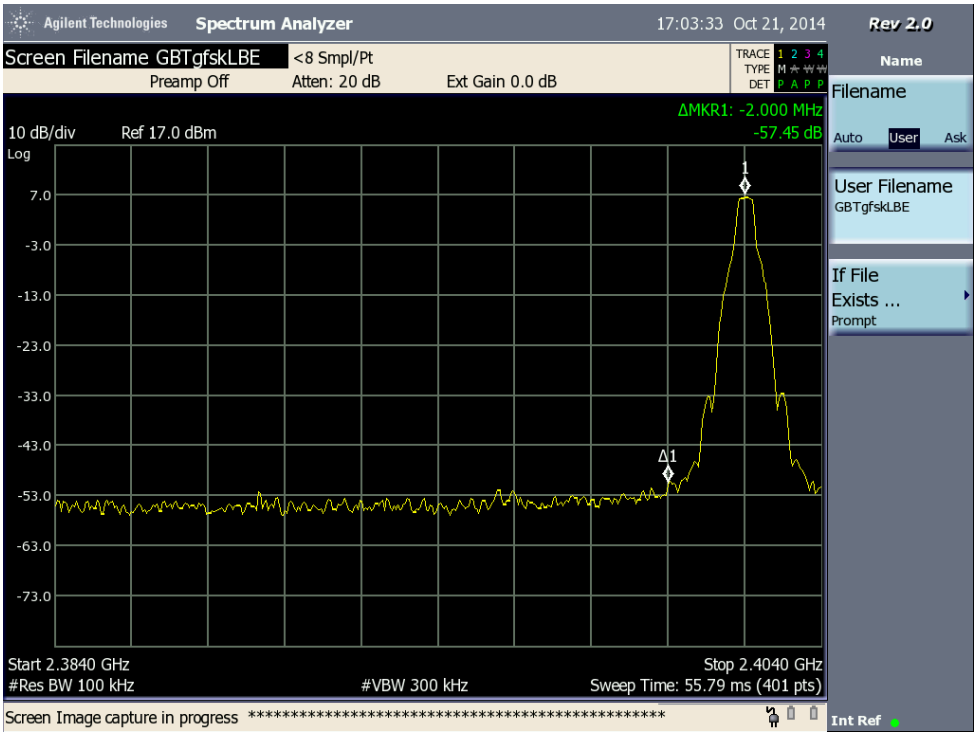



**FIGURE 43: GFSK Ch0 Lower Band Edge**

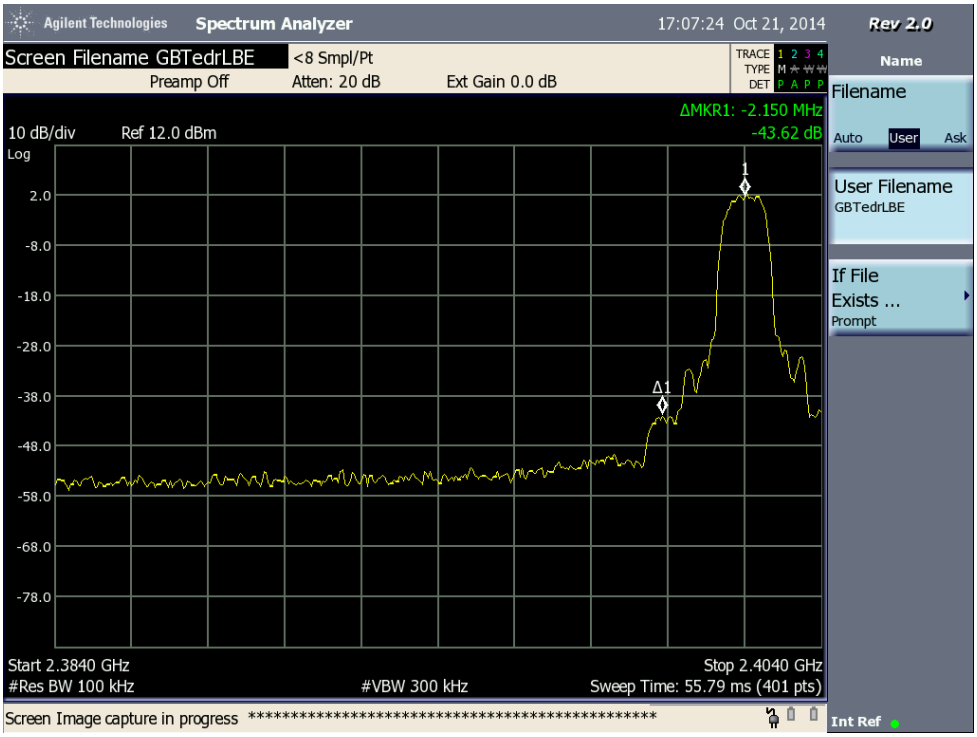



**FIGURE 44: EDR Ch0 Lower Band Edge**

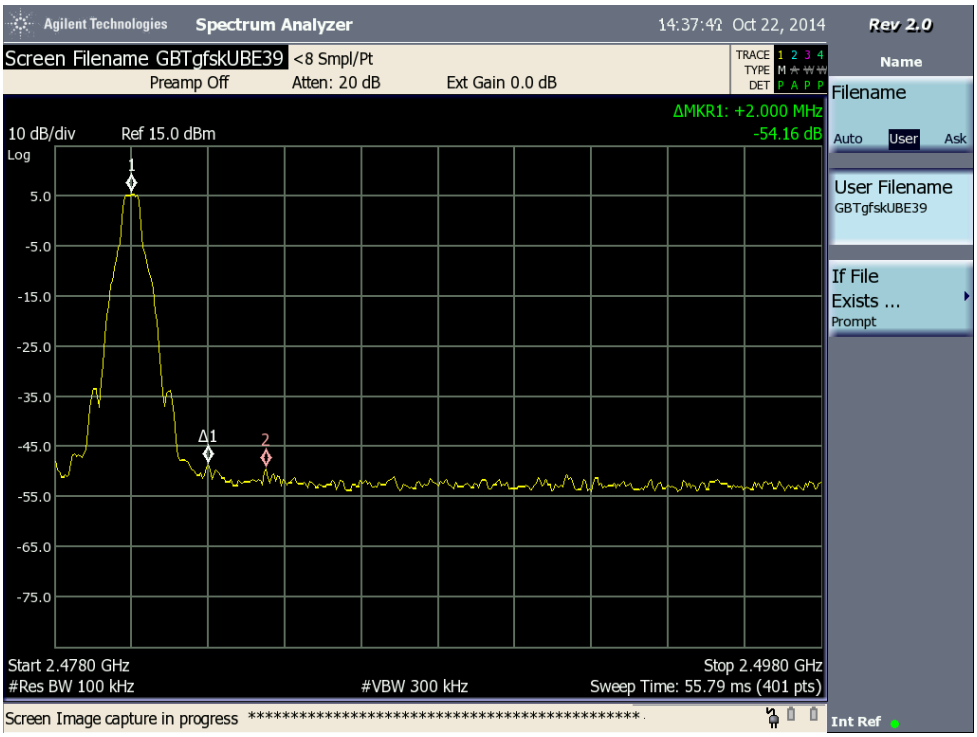



**FIGURE 45: GFSK Ch39 Upper Band Edge**

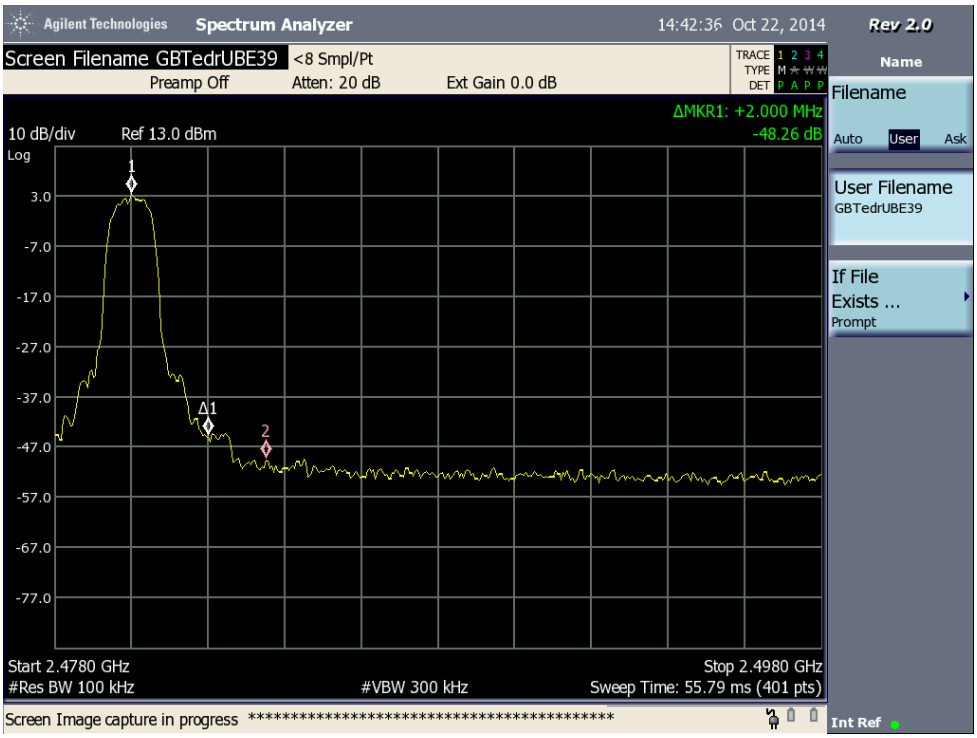



**FIGURE 46: EDR Ch39 Upper Band Edge**

# 13 OCCUPIED BANDWIDTH PER FCC PART 2 SECTION 2.1049 (H) – BLUETOOTH 2.0 + EDR

## 13.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | Semi-Anechoic Chamber |
| **Test Date:** | 10/21/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C |
| **Humidity:** | 41% |

## 13.2 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| CSA Spectrum Analyzer | Agilent | N1996A | MY45371881 | 1/17/15 | 2 yr |

## 13.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1).

## 13.4 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.

## 13.5 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.

## 13.6 TEST PLOTS

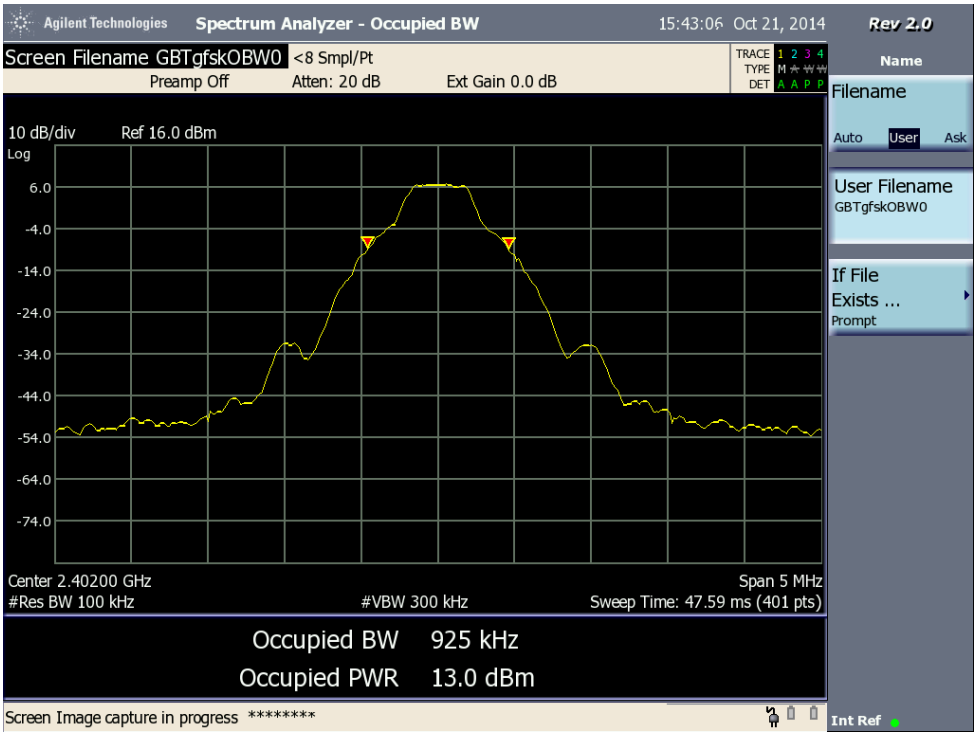



**FIGURE 47: GFSK Occupied Bandwidth (Ch0 shown, Ch20 & 39 similar)**

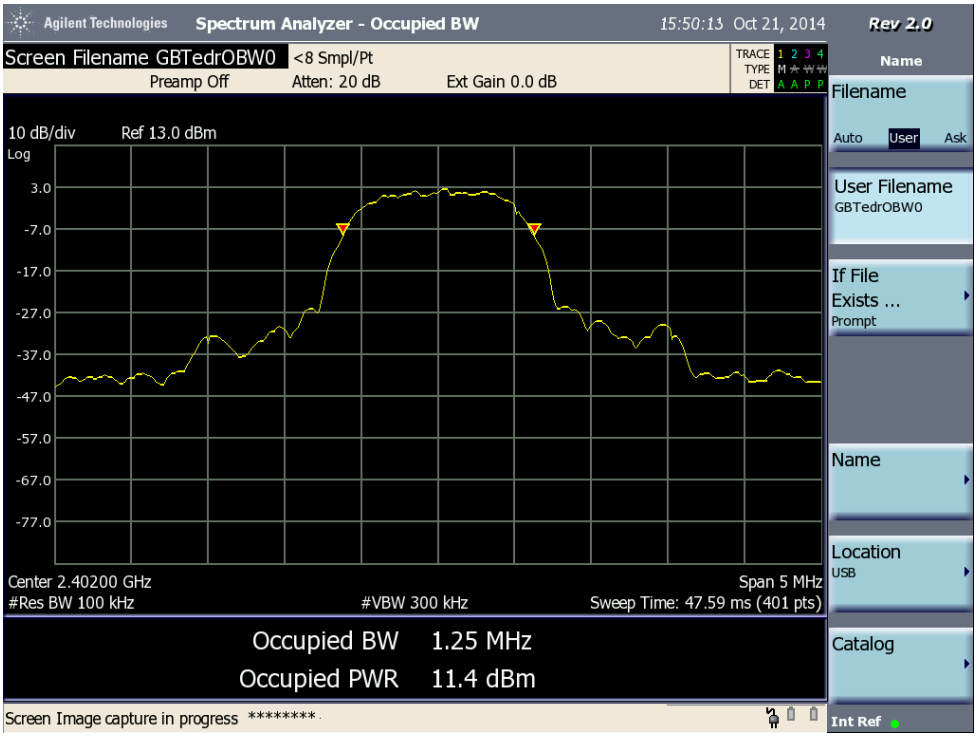



**FIGURE 48: EDR Occupied Bandwidth (Ch0 shown, Ch20 & 39 similar)**

# 14 SPURIOUS & RESTRICTED BANDS EMISSIONS PER FCC PART 15 SECTIONS 15.209 & 15.205

## 14.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | Semi-Anechoic Chamber |
| **Test Date:** | 10/21/2014 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 20°C |
| **Humidity:** | 47% |

## 14.2 TEST EQUIPMENT

| Equipment Description | Manufacturer | Model Name | Serial Number | Calibration Due Date | Calibration Interval |
|---|---|---|---|---|---|
| EMC Analyzer | Agilent | E7405A | US40240257 | 5/30/15 | 2 yr |
| Amplifier | Gigatronics | GT-1040A | 1116009 | N/A | N/A |
| Amplifier | Agilent | 83051 | 9025 | N/A | N/A |
| Active Loop Antenna | EMCO | 6502 | 1071/1001 | 10/14/16 | 2 yr |
| Biconical Antenna | EMCO | 3104 | 3459 | 10/14/16 | 2 yr |
| Log-Periodic Antenna | EMCO | 3146 | 9510-4202 | 6/16/16 | 2 yr |
| DRG Horn Antenna | EMCO | 3115 | 3643A00028 | 10/14/16 | 2 yr |
| Horn Antenna | Schwarzbeck | BBHA 9170 | BBHA9170267 | 10/16/16 | 2 yr |

## 14.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure2 – 4)

## 14.4 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) |
|---|---|---|---|---|
| 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 |

**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 | | | |

## 14.5 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)).

## 14.6 SPURIOUS EMISSIONS PLOTS

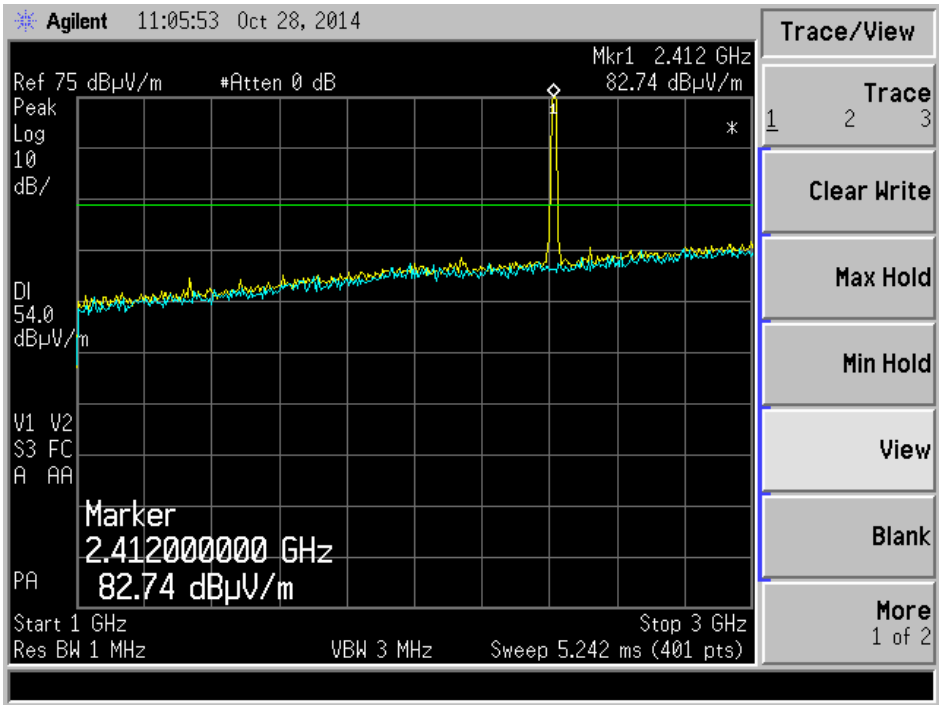



**FIGURE 49: DRG Horn, Horizontal Polarization: 802.11b/g/n (Ch1 shown, Ch6 & 11 similar)**
**Blue trace – EUT off, Yellow trace – EUT on**

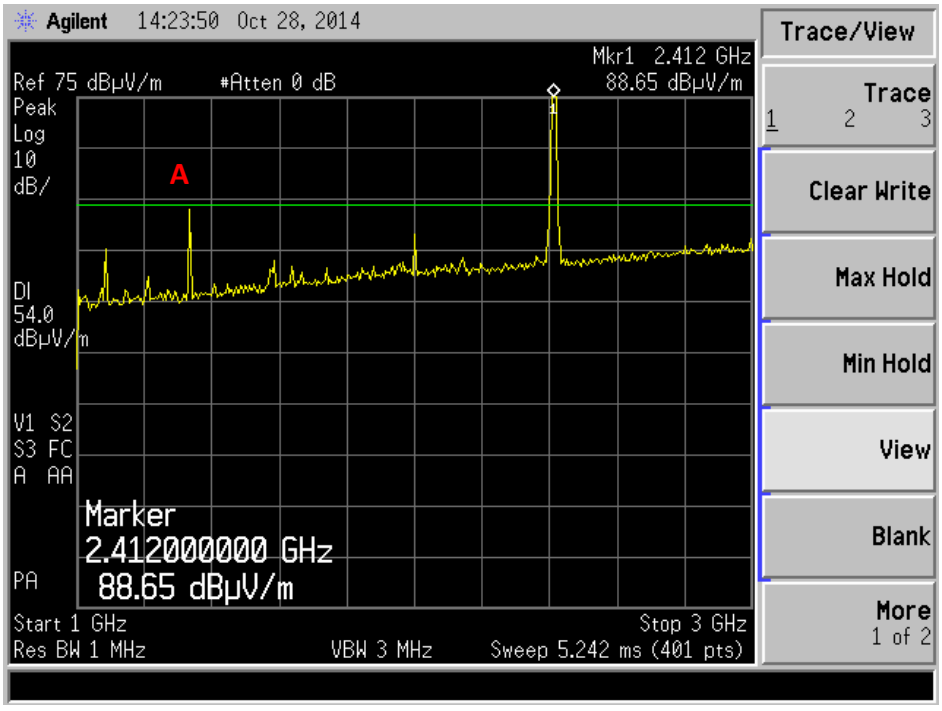



**FIGURE 50: DRG Horn, Vertical Polarization: 802.11b/g/n (Ch1 shown, Ch6 & 11 similar)**
**A** = ambient (laptop)

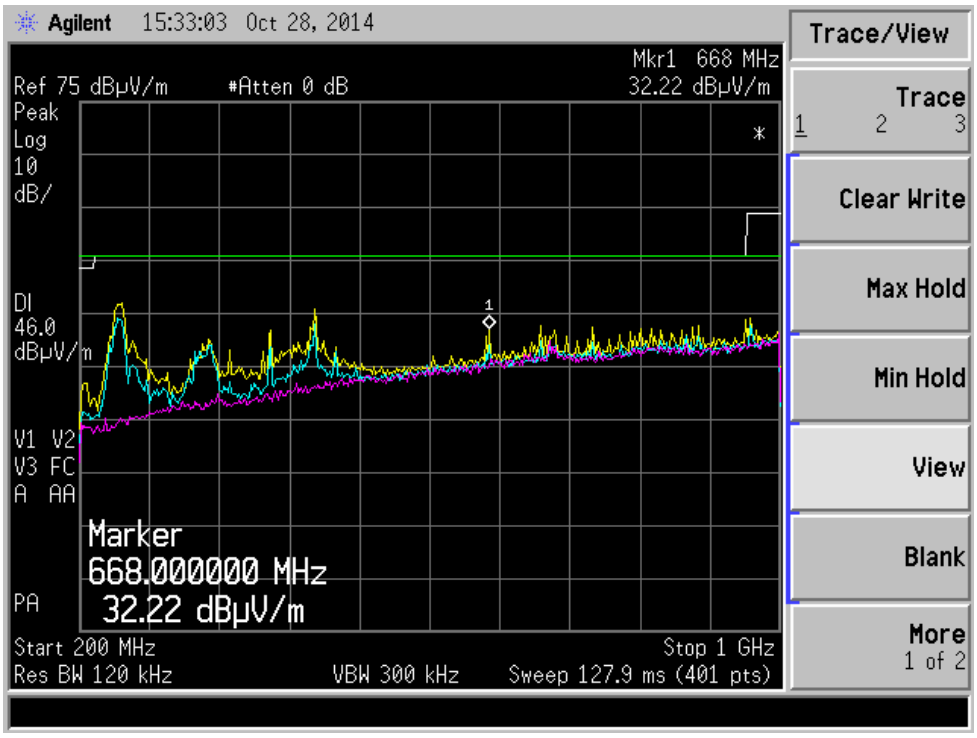



**FIGURE 51: Log-Periodic, Horizontal Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on, Magenta – chamber background**

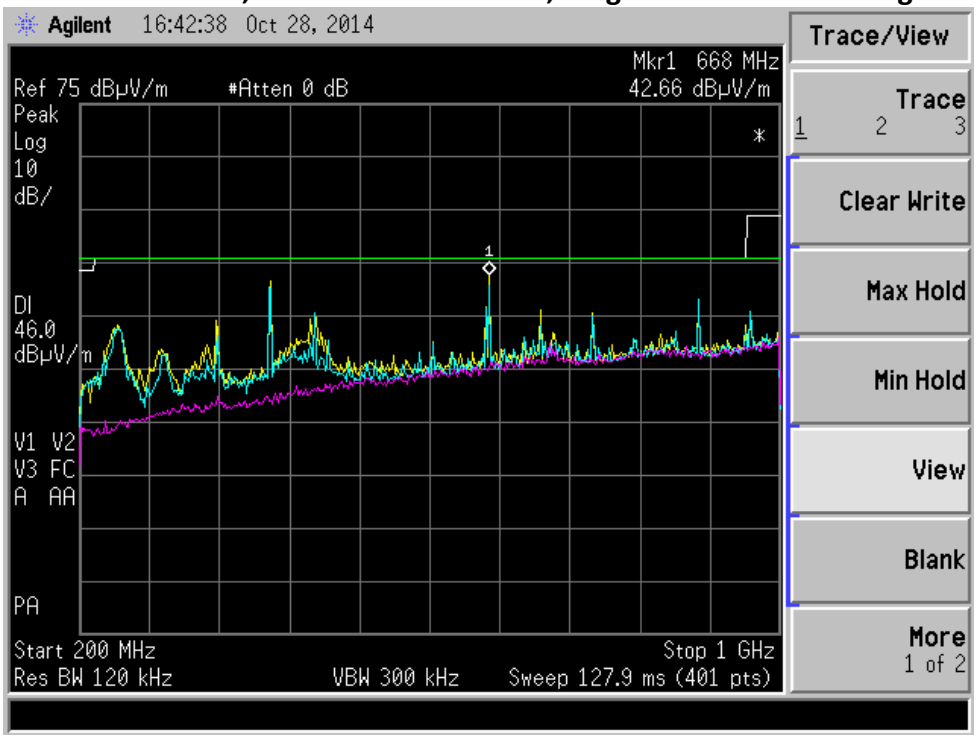



**FIGURE 52: Log-Periodic, Vertical Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on, Magenta – chamber background**

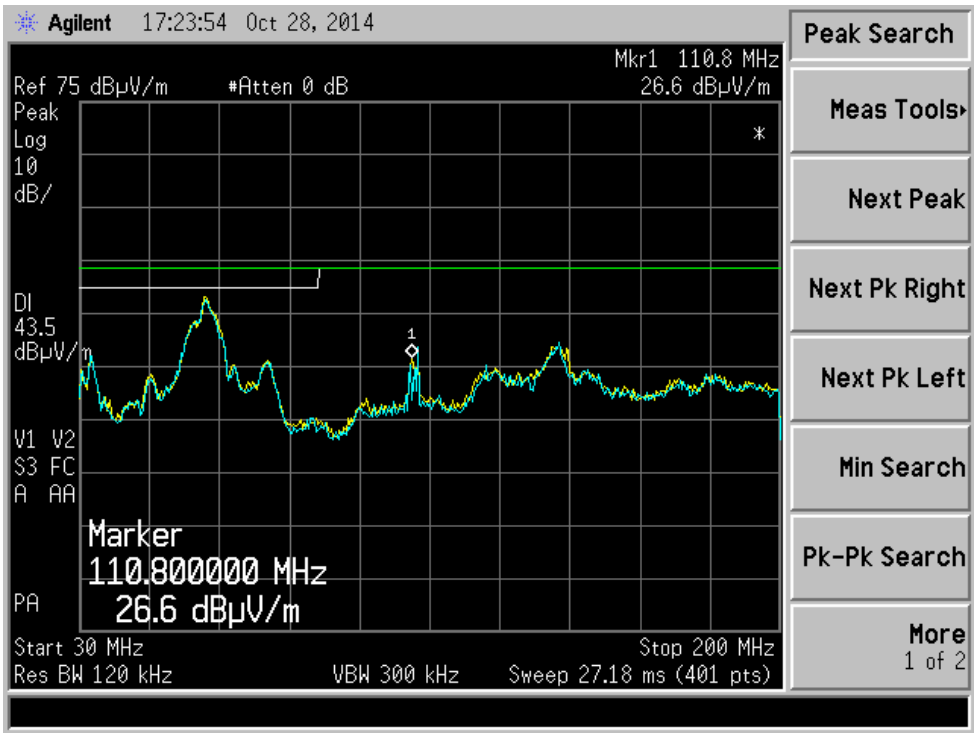



**FIGURE 53: Biconical, Horizontal Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**


**FIGURE 54: Biconical, Vertical Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**

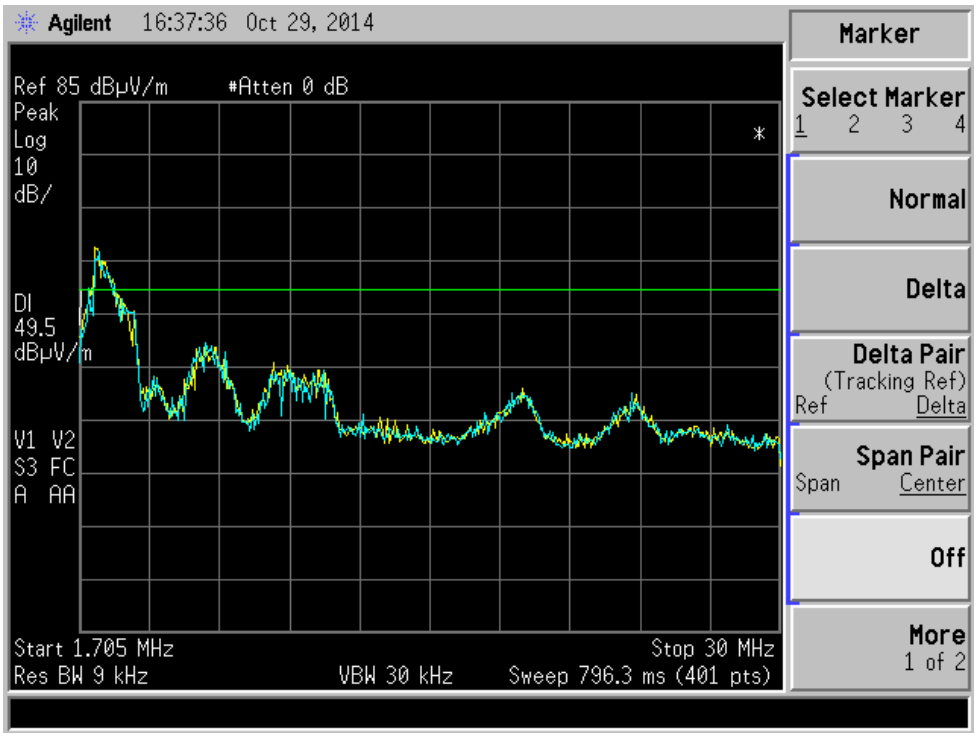



**FIGURE 55: Active Loop, Horizontal Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**


**FIGURE 56: Active Loop, Vertical Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**

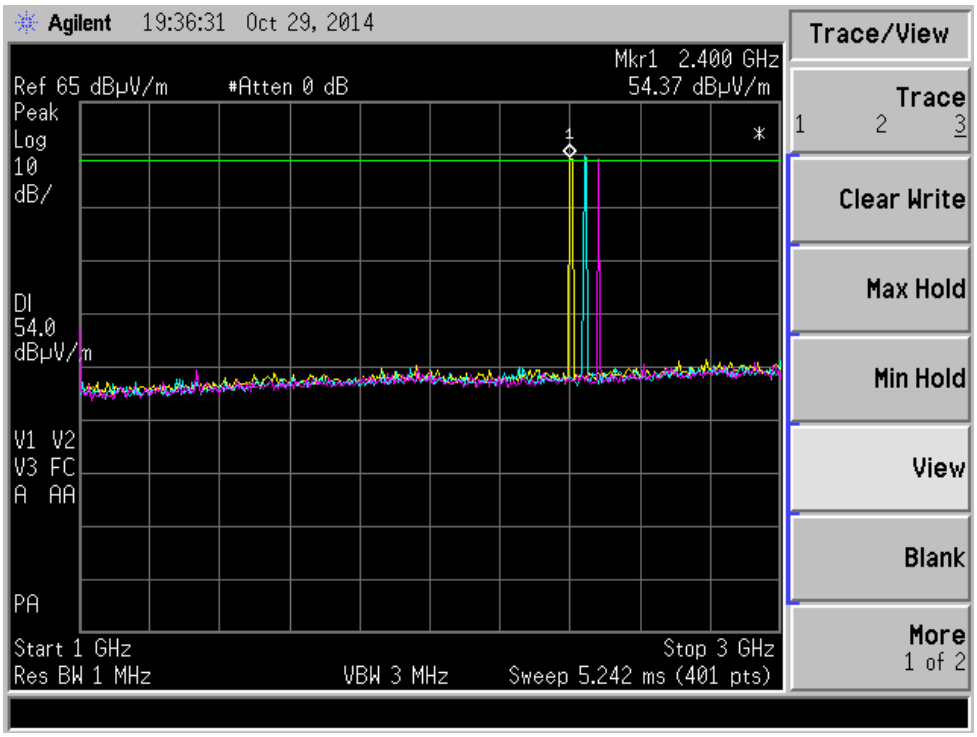



**FIGURE 57: DRG Horn, Horizontal Polarization: BT Ch0, 20, 39**

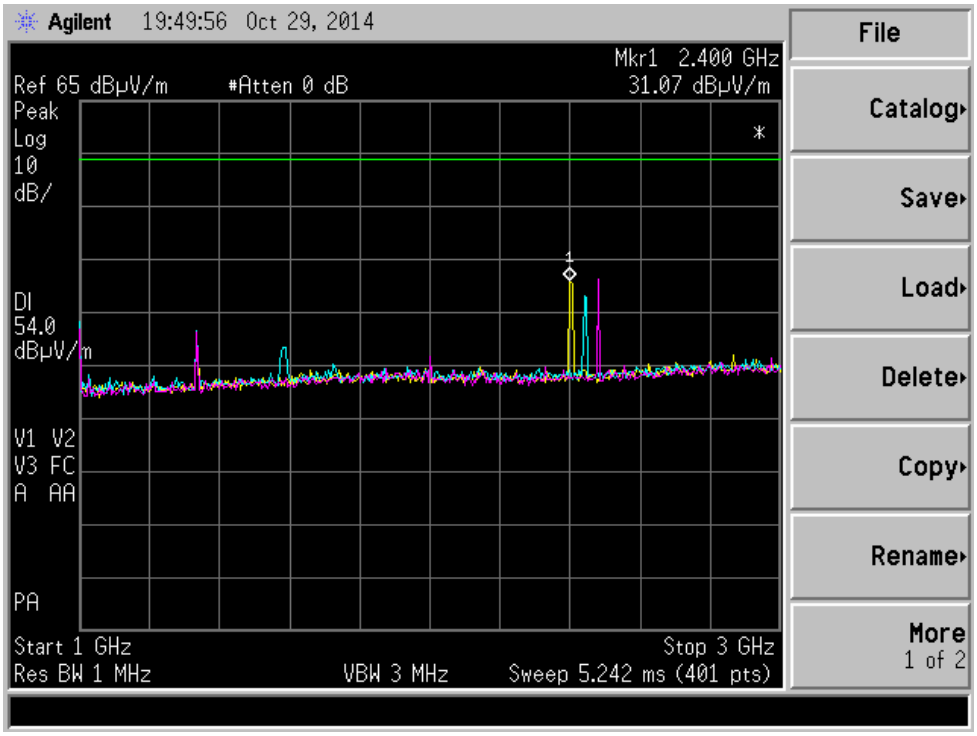



**FIGURE 58: DRG Horn, Vertical Polarization: BT Ch0, 20, 39**

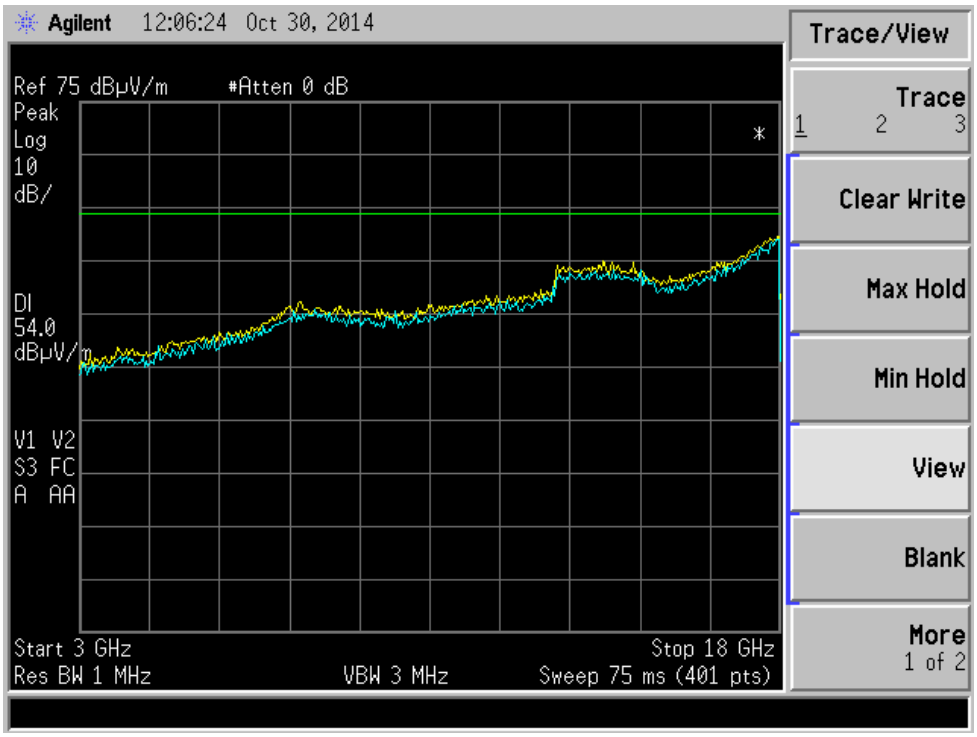



**FIGURE 59: DRG Horn, Horizontal Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**

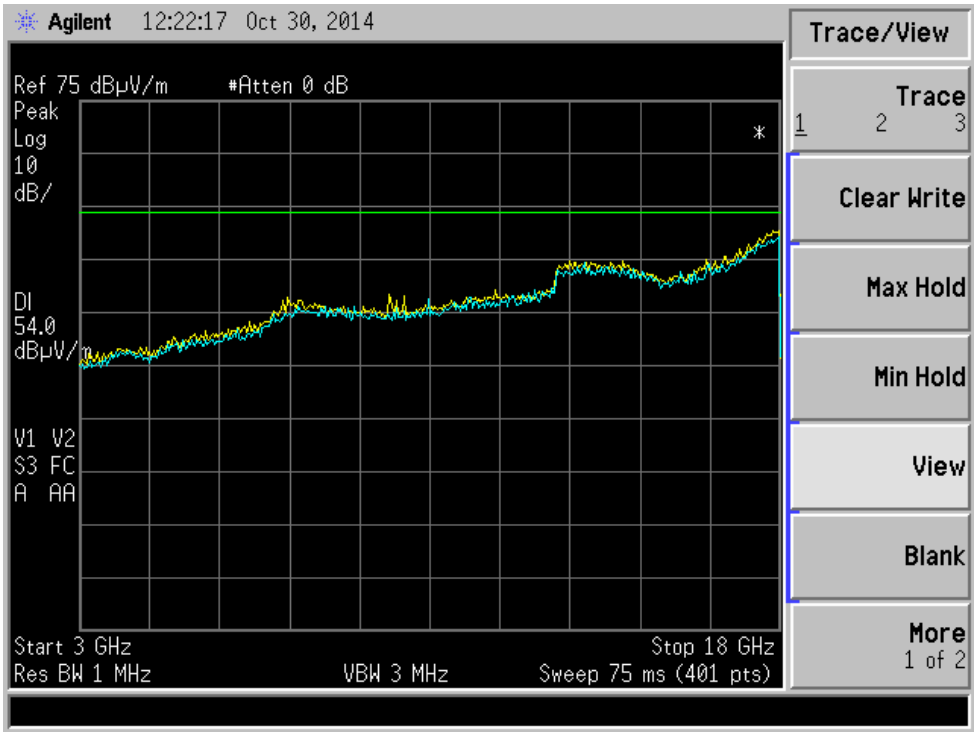



**FIGURE 60: DRG Horn, Vertical Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**

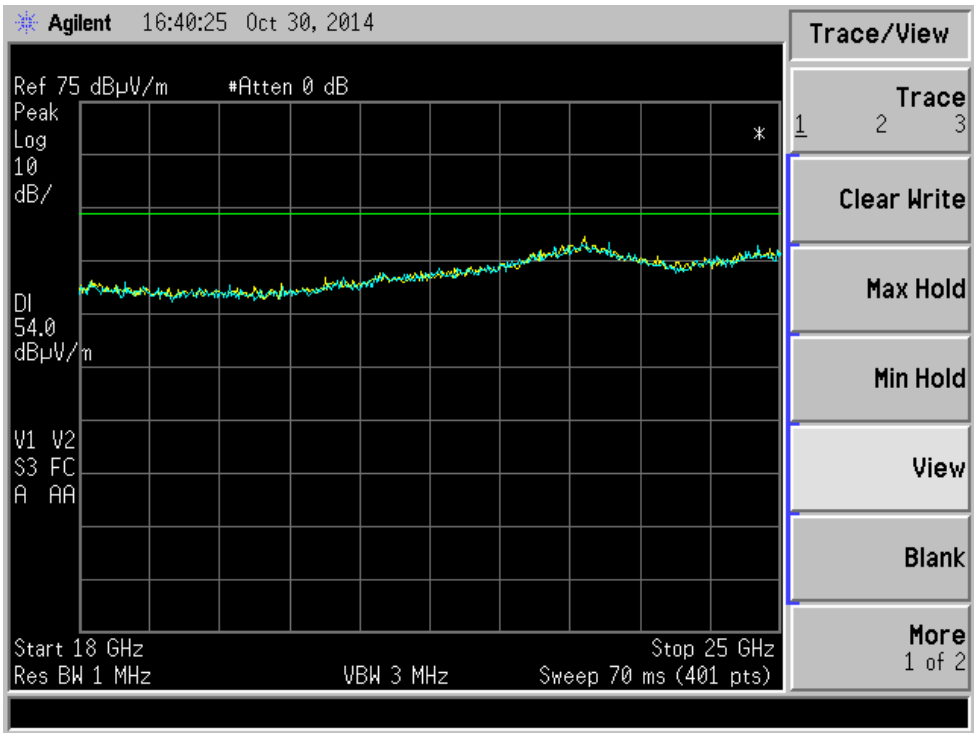



**FIGURE 61: 15-40GHz Horn, Horizontal Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**

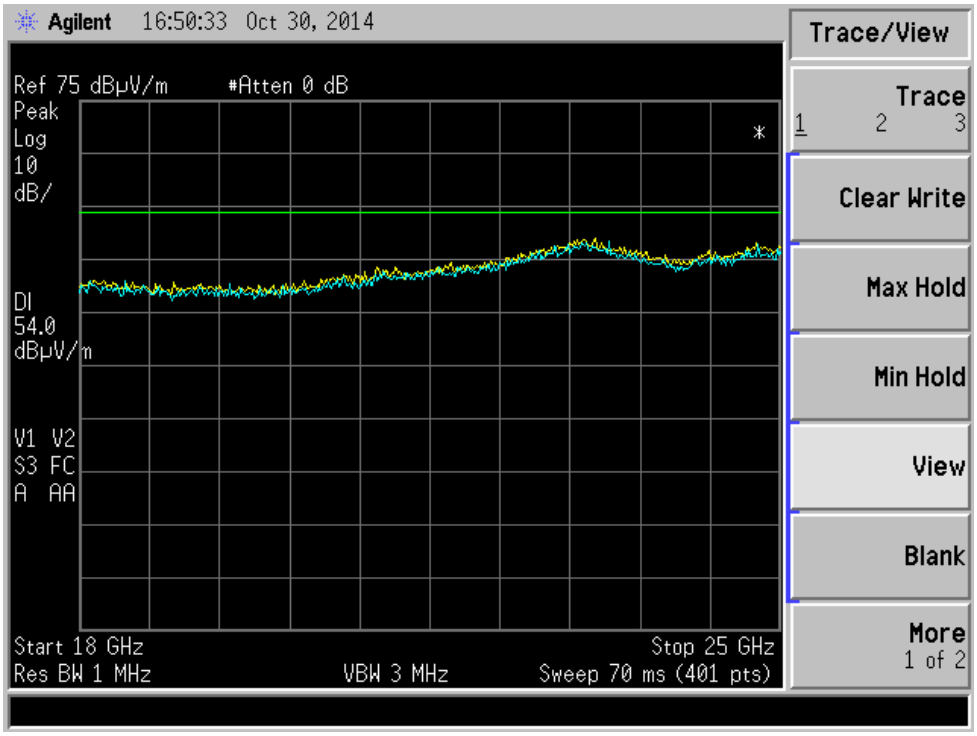



**FIGURE 62: 15-40GHz Horn, Vertical Polarization: 802.11 & BT**
**Blue trace – EUT off, Yellow trace – EUT on**

# 15 GAIN OF TRANSMISSION ANTENNA PER FCC PART 15.247 (B)(4)

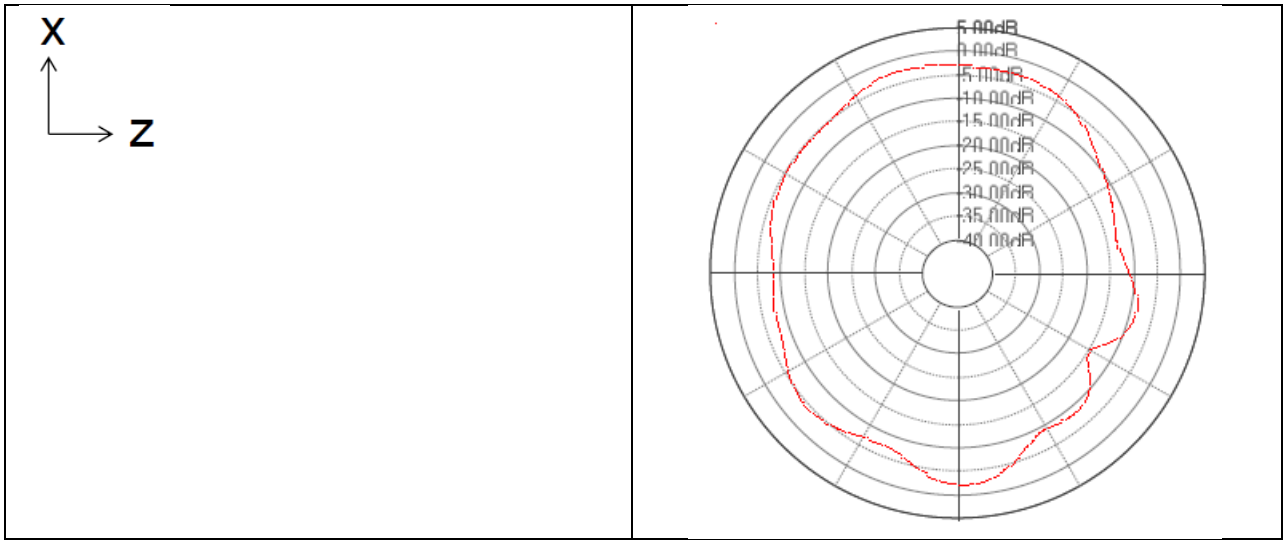
## 15.1 LIMITS/REQUIREMENTS

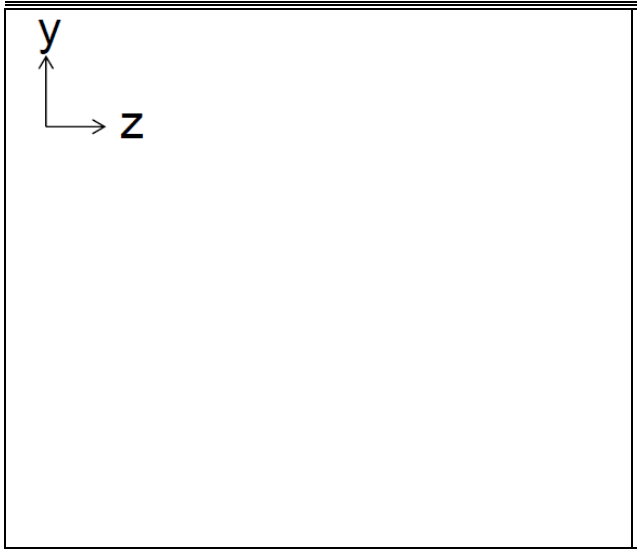
(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.
The EUT antenna used, , has a stated gain over the band of ± 0.5 dBi.

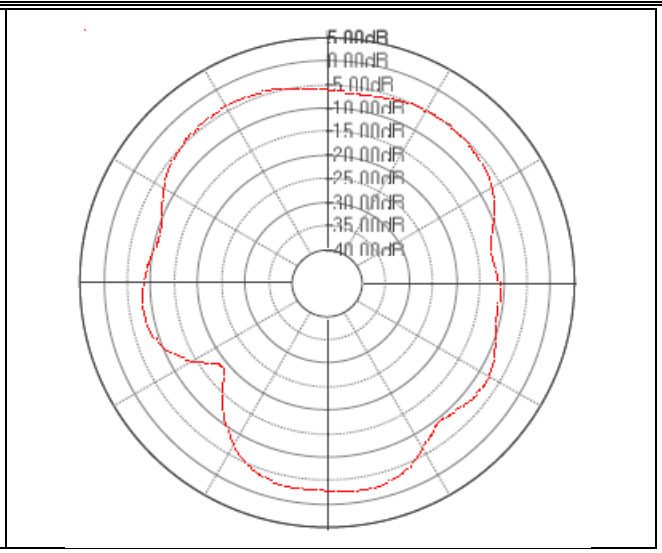
**ODG Antenna Specification**

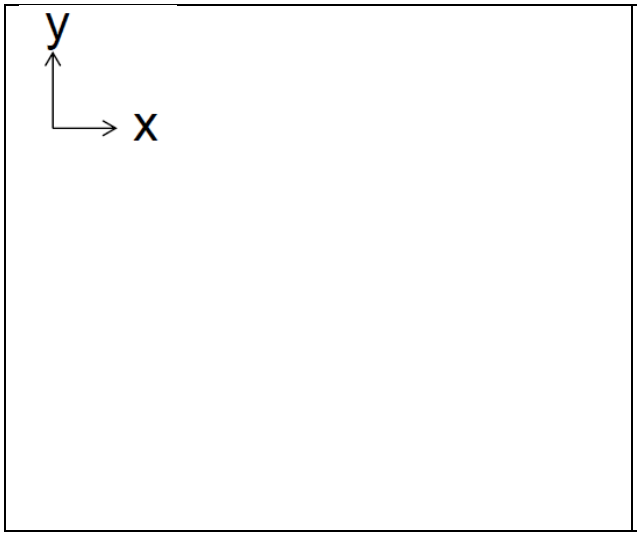
**WIFI antenna**

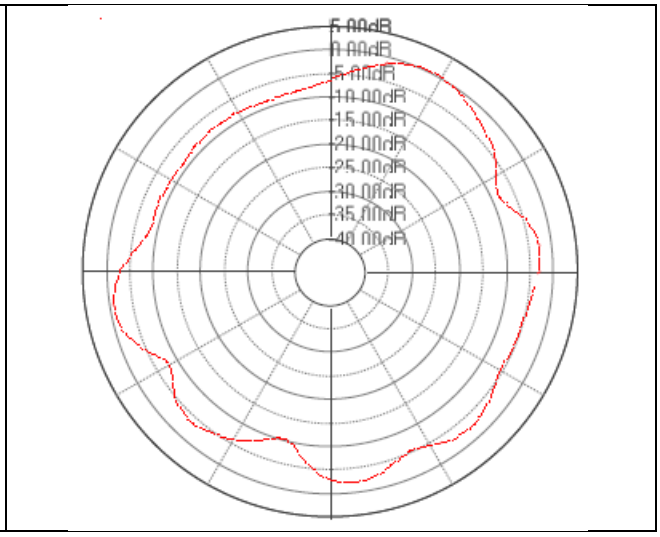
| **Electrical** | |
|---|---|
| Operation frequency (GHz) | 2.4-2.5 |
| Antenna peak gain (dBi) | 0 |
| Antenna average gain (dBi) | -5 |
| Antenna efficiency (%) | 36.5 |
| Radiation pattern | Omni |
| Maximum input power (W) | 2 |
| **Mechanical** | |
| Antenna element size (mm) | 45.7 (L) x 5.7 (W) x 0.15 (T) |
| Coax cable | Micro-coax 0.81 mm |
| Connector | MFH III male / Right angle |







# 16 APPENDIX

## 16.1 EUT TECHNICAL SPECIFICATIONS

| | | | |
|---|---|---|---|
| **Manufacturer:** | Osterhout Design Group | | |
| **General Description:** | The R-6 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-6 |
| **Dimensions:** | 15mm x 17mm x 5.5mm | **Serial Number:** | |
| **Operating Frequency:** | 2.400 GHz- 2.4835 GHz | **Power Cord Type:** | ☐ Shielded ☐ Un-Shielded |

## 16.2 EUT PHOTOS

**FIGURE 63: Front Oblique View**

**FIGURE 64: Rear Oblique View**