**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 Finger Controller_FCC |
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| **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..... :** | Bluetooth 2.0 Finger Controller for R-6 Glasses |
| Manufacturer Logo.....: | ODG |
| Manufacturer .....: | Osterhout Design Group |
| Model/Type Reference.....: | Wireless Finger Controller |
| 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

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|---|---|---|
| ☒ 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, P.E. |
| ☐ 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 | 12/2/14 | 20140924-01 Finger Controller_FCC | 20140924-01R1 Finger Controller_FCC | Section 1.9 added test: Time of Occupancy; added Section 8 Time of Occupancy; corrected wording in Test Description and Procedure Sections 2.5, 3.5, 4.5 & 5.5. |

## 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. For the conducted mode tests, the internal antenna is bypassed and an RF cable is connected from the PCB to the spectrum analyzer. The EUT Bluetooth radio is software controllable by means of a laptop and a USB connection.

## 1.5 GENERAL DESCRIPTION OF EUT

| | |
|---|---|
| Product | Wireless Finger Controller |
| Model No. | N/A |
| Power Supply | Removable rechargeable Lithium Polymer battery |
| I/O Ports | Battery terminal, custom |
| Operating Frequency Range | 2.400- 2.4835 GHz |
| **Bluetooth 2.0 + EDR** | |
| FCC ID | 2ADCMF-1 |
| Modulation Type | GFSK (1 Mbps), π/4-DPSK (2 Mbps), 8DPSK (3 Mbps) |
| Modulation Technology | FHSS, AFH |
| Transfer Rate | 1 – 3 Mbps |
| Number of Channels | 79 |
| Maximum Output Power | 0 dBm typ. |
| **Antenna** | |
| Antenna Type | Multilayer Ceramic Chip, Monopole |
| Antenna Gain, Peak | 0.9 dBi (2450 MHz) |
| Radiation Pattern | Toroidal |

## 1.6 OPERATIONAL DESCRIPTION OF EUT

The Wireless Finger Controller is a HID intended to work exclusively with the ODG R-6 Smart Glasses platform to control all functions without physical interaction with the head-mounted eyewear.

## 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 |
| 15.247 (a)(1) | Time of Occupancy | 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

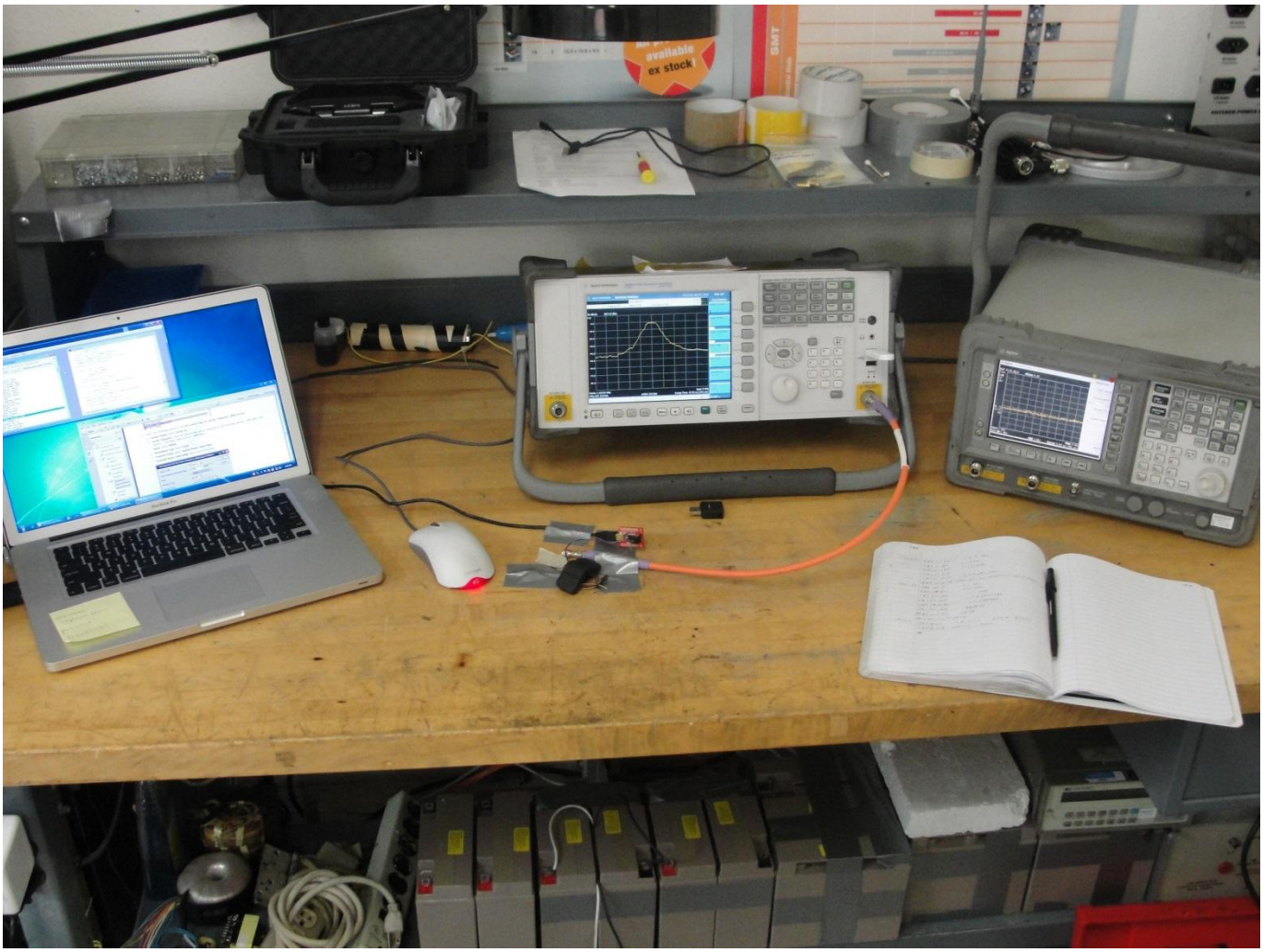


**FIGURE 1: Conducted RF Test Setup**

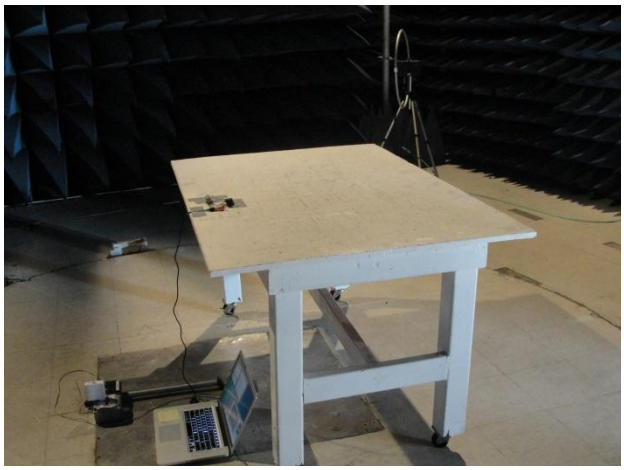
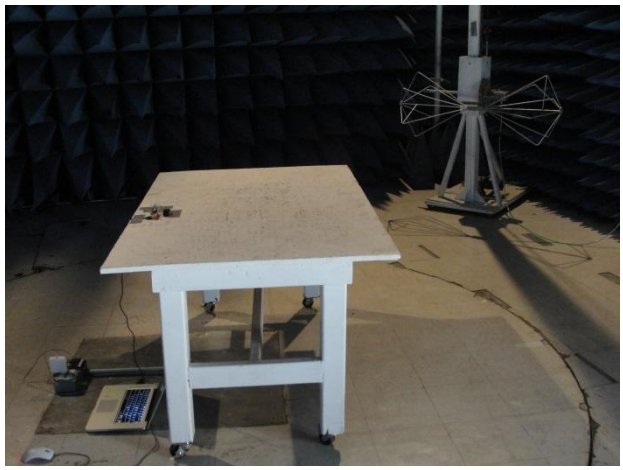


**FIGURE 2: RE Test Setup - Active Loop Antenna**



**- Biconical Antenna**

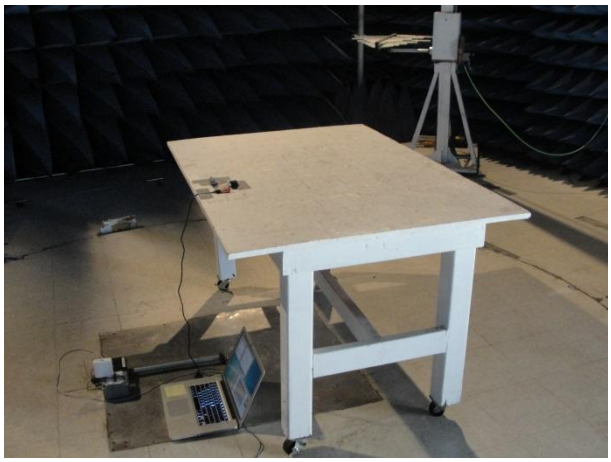
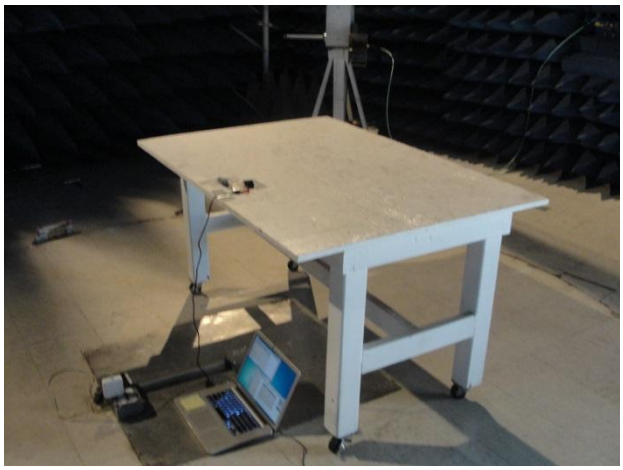


**FIGURE 3: RE Test Setup – Log Periodic Antenna**



**- DRG Horn Antenna**

# 2 RADIATED EMISSIONS PER FCC PART 15.209

## 2.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 11/12/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 21°C |
| **Humidity:** | 48% |

## 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 |
| DRG Horn Antenna | A.H. Systems | SAS-571 | 887 | 10/14/16 | 2 yr |

## 2.3 TEST SET UP PHOTO(S)

Refer to Section 1.11 (Figures 2-3).

## 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. Data presented below represents worst case signal levels.

## 2.6 TEST DATA PLOTS

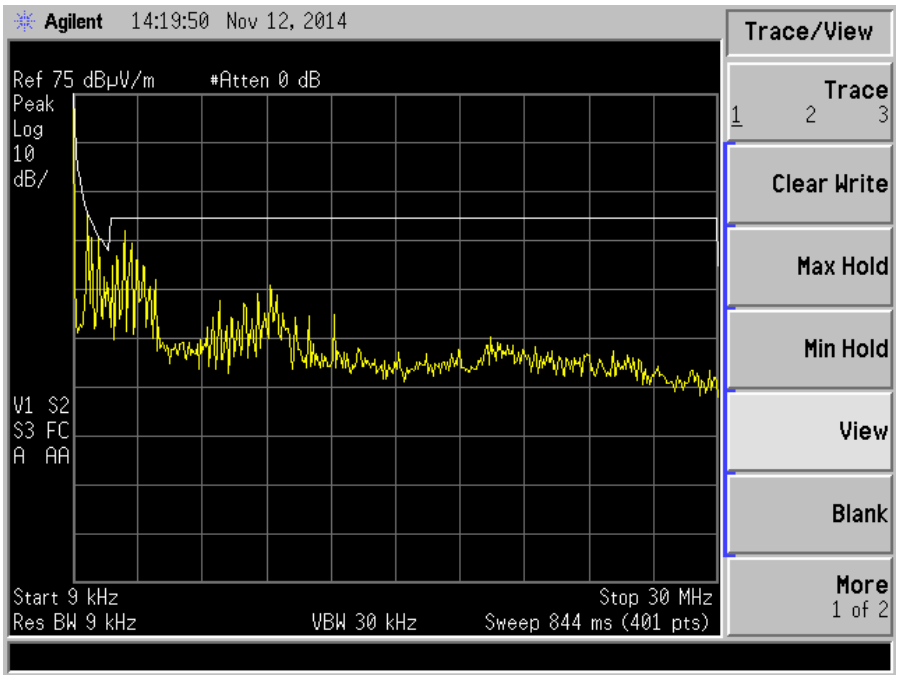



**FIGURE 4: Radiated Emissions – Active Loop, Horizontal Polarization**

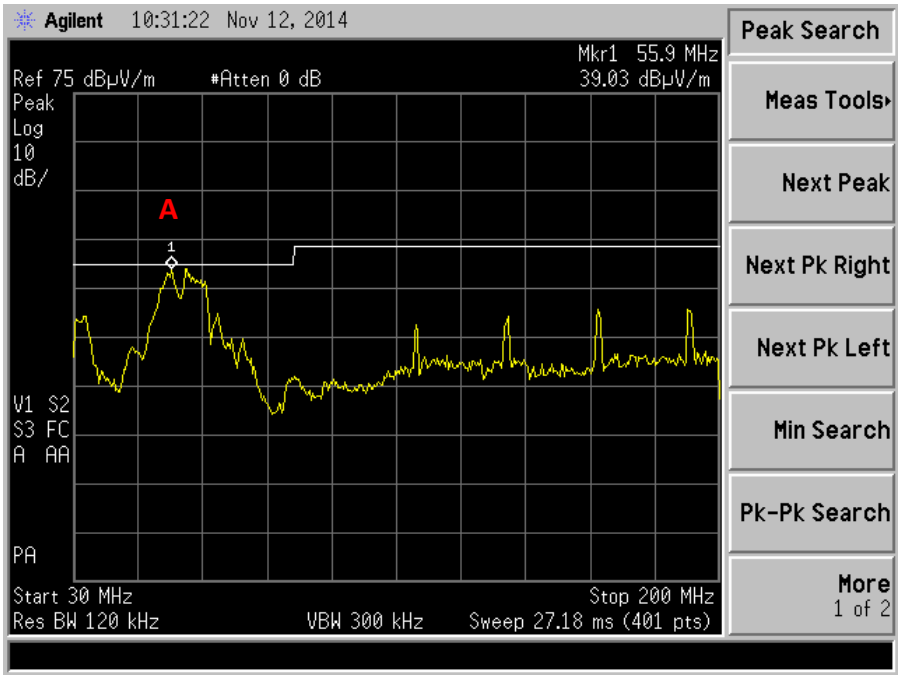



**FIGURE 5: Radiated Emissions – Biconical, Horizontal Polarization**

**A = ambient**

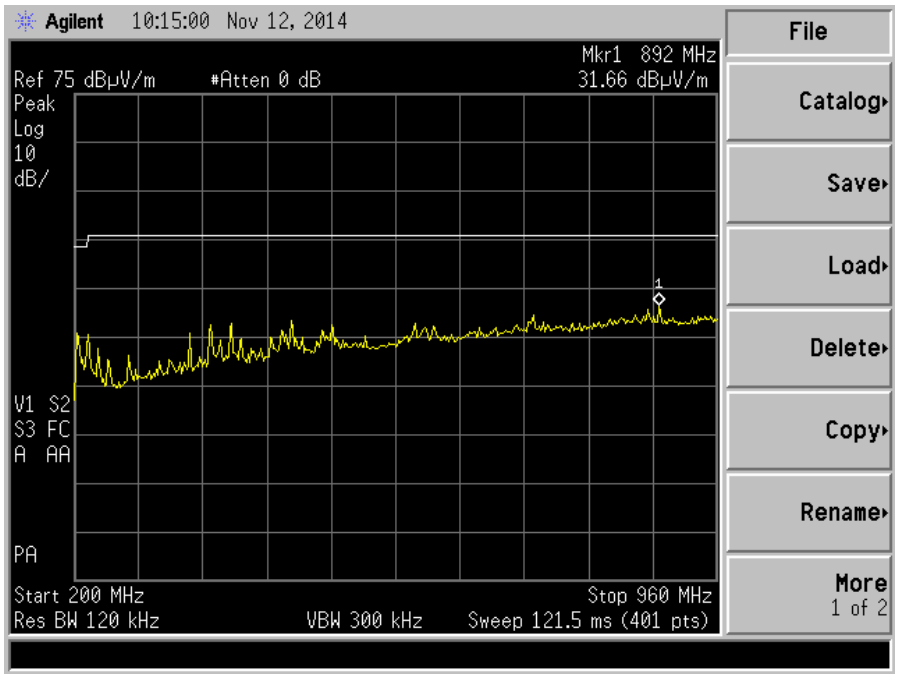



**FIGURE 6: Radiated Emissions – Log-periodic, Horizontal Polarization**

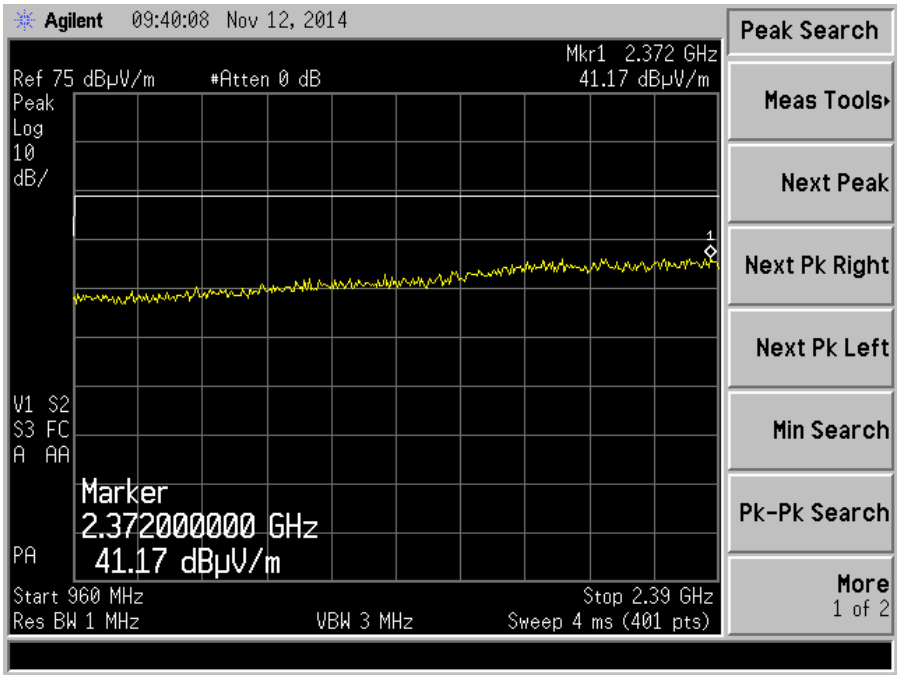



**FIGURE 7: Radiated Emissions – DRG Horn, Horizontal Polarization**

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

## 3.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 11/7/14 |
| **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 |
|---|---|---|---|---|---|
| CSA Spectrum Analyzer | Agilent | N1996A | MY45371881 | 1/17/15 | 2 yr |

## 3.3 TEST SET UP PHOTO(S)

Refer to Section 1.11 (Figure1).

## 3.4 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.

## 3.5 TEST DESCRIPTION AND PROCEDURE

The EUT is connected to the spectrum analyzer by opening the connection to the internal chip antenna 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.

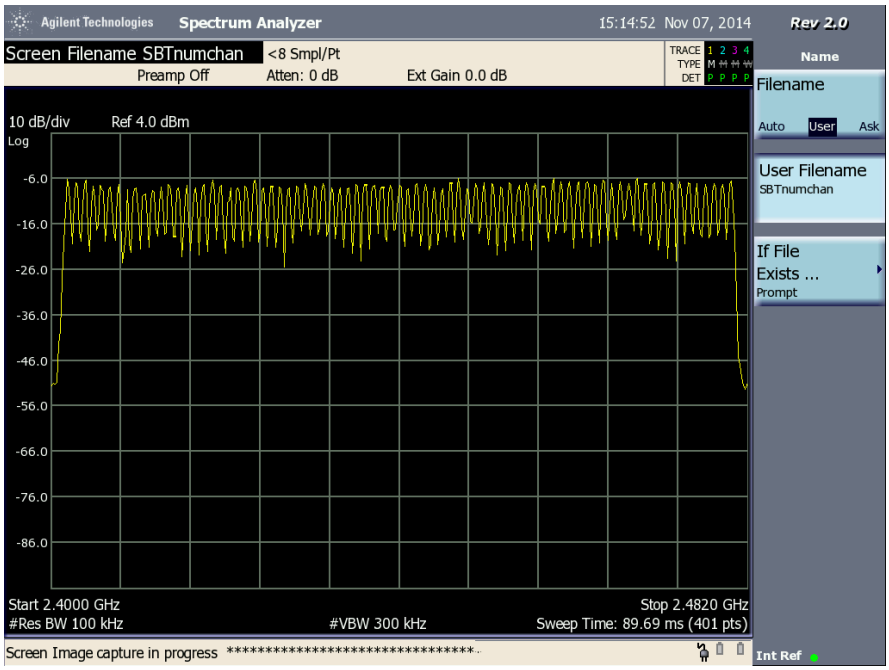



**FIGURE 8: Bluetooth 2.0 + EDR Channels (79)**

## 3.6 6DB BANDWIDTH MEASUREMENT PLOTS

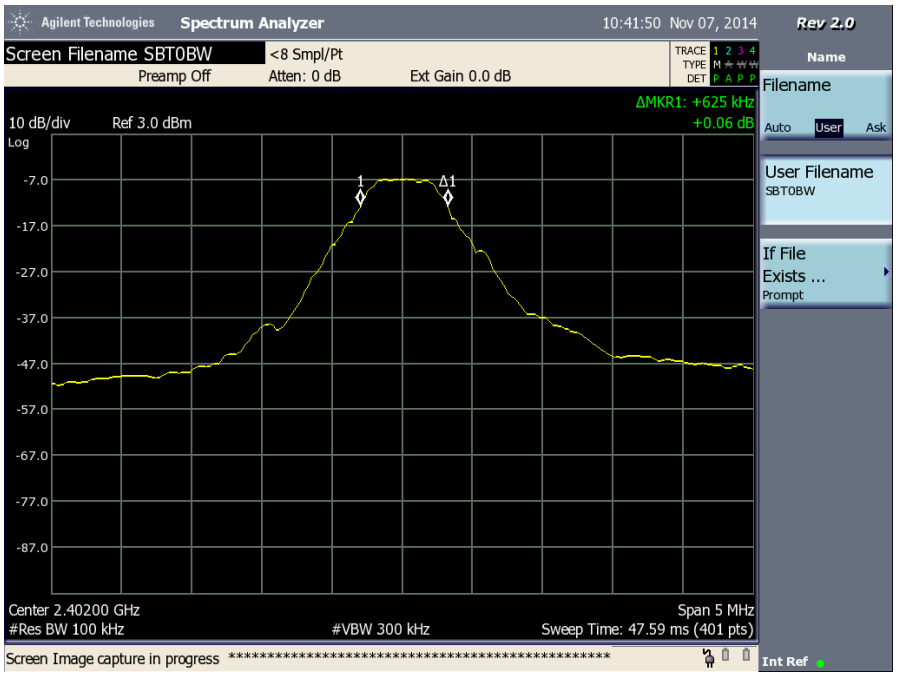



**FIGURE 9: 6dB GFSK bandwidth (Ch0 shown, Ch20 & 39 similar)**

### 3.7 CARRIER FREQUENCY SEPARATION PLOT

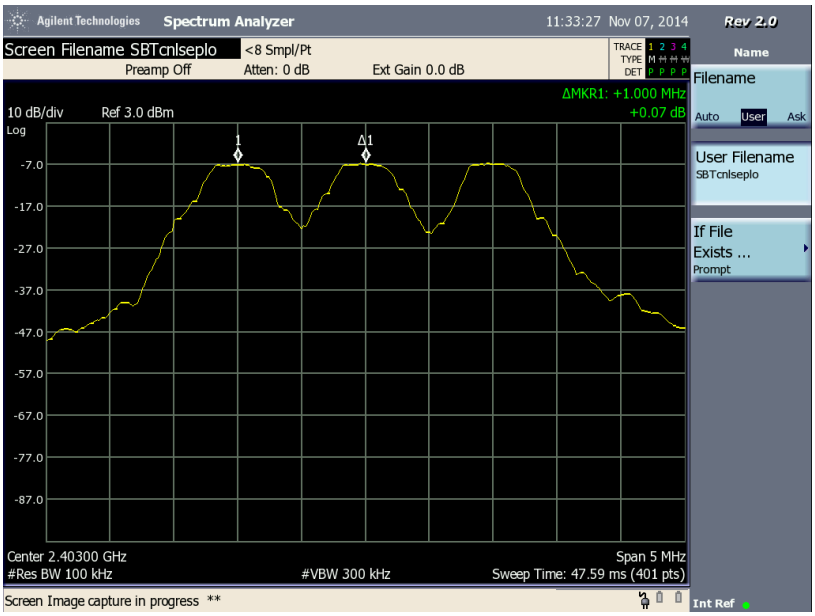



**FIGURE 10: GFSK Carrier Frequency Separation 1 MHz (Ch0, 1 & 2)**

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

## 4.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

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

## 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 1.11 (Figure 1).

## 4.4 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.

## 4.5 TEST DESCRIPTION AND PROCEDURE

The EUT is connected to the spectrum analyzer by opening the connection to the internal chip antenna and attaching a suitable patch cable. 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.

## 4.6 TEST DATA TABLES

| Channel | Freq. (MHz) | MPP (dBm) | CPP (dBm) | Margin = 30 - CPP (dB) | Result |
|---|---|---|---|---|---|
| 0 | 2412 | -6.8 | -6.1 | 36.1 | Passed |
| 20 | 2442 | -6.8 | -6.1 | 36.1 | Passed |
| 39 | 2480 | -6.1 | -5.4 | 35.4 | Passed |

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

## 4.7 PEAK POWER PLOTS

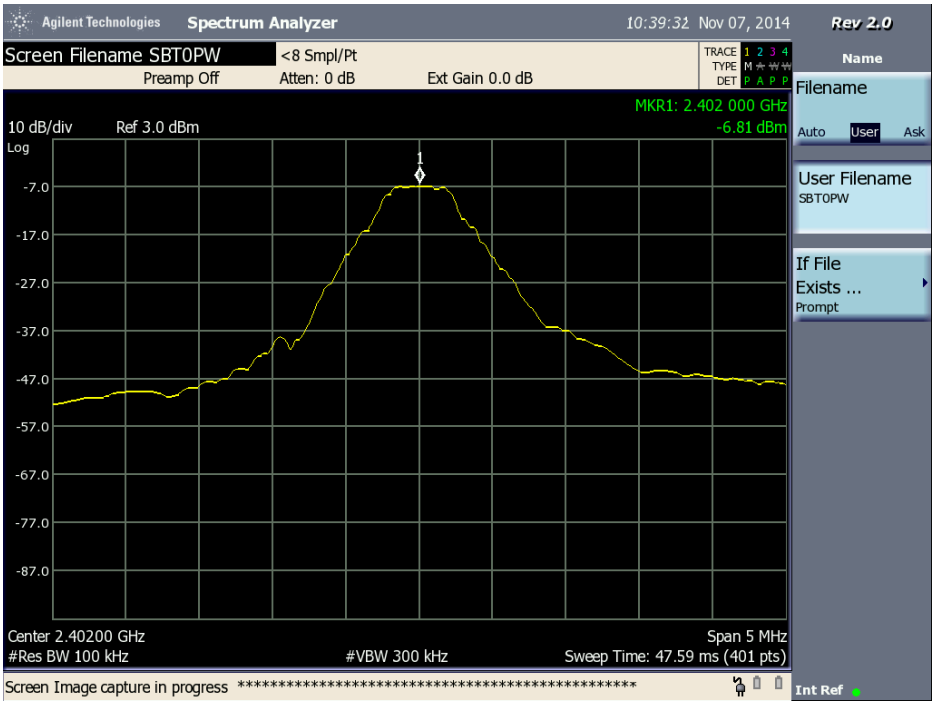



**FIGURE 11: GFSK Peak Power (Ch0 shown, Ch20 & 39 similar)**

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

## 5.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 11/7/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C |
| **Humidity:** | 41% |

## 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 1.11 (Figure1).

## 5.4 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.

## 5.5 TEST DESCRIPTION AND PROCEDURE

The EUT is connected to the spectrum analyzer by opening the connection to the internal chip antenna and attaching a suitable patch cable. The spectrum analyzer power spectral density measurement function is performed at each of the low, mid and high frequencies in the band.

## 5.6 POWER SPECTRAL DENSITY PLOTS

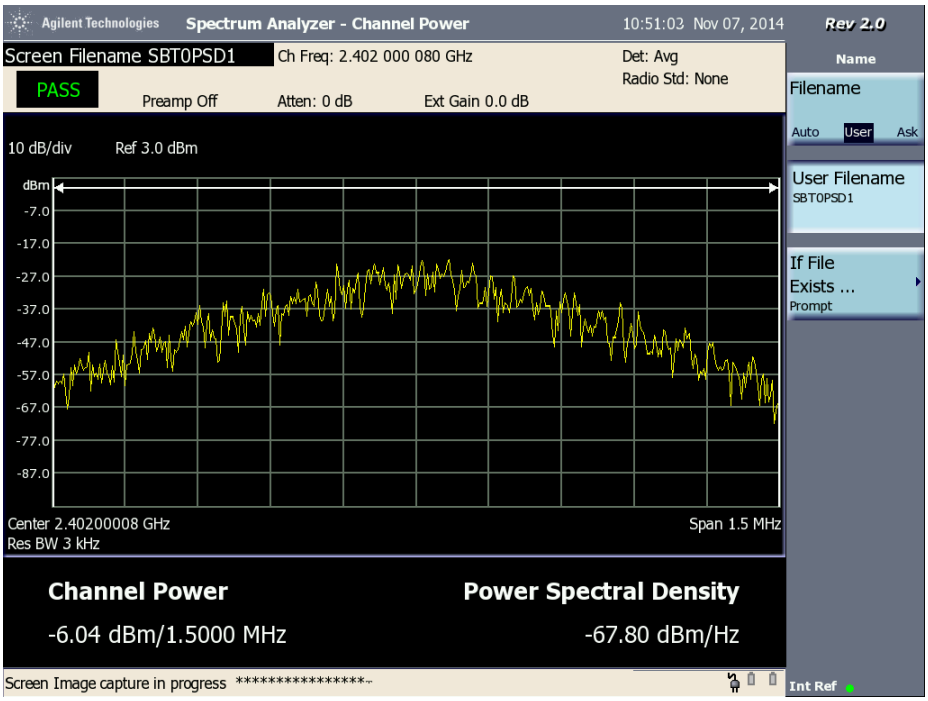



**FIGURE 12: GFSK Power Spectral Density (Ch0 shown, Ch20 & 39 similar)**
**10*log(3k)=34.8 -67.8dBm/Hz + 34.8= -33dBm/3kHz < 8dBm/3kHz**

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

## 6.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 11/7/14 |
| **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 1.11 (Figure1).

## 6.4 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.

## 6.5 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.

## 6.6 TEST PLOTS

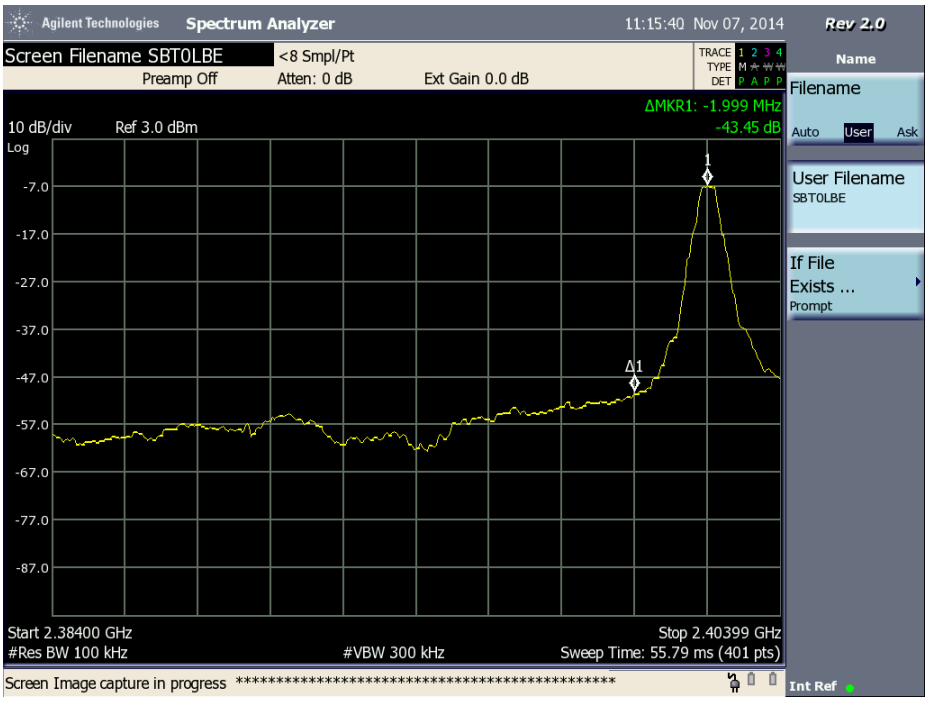



**FIGURE 13: GFSK Ch0 Lower Band Edge**

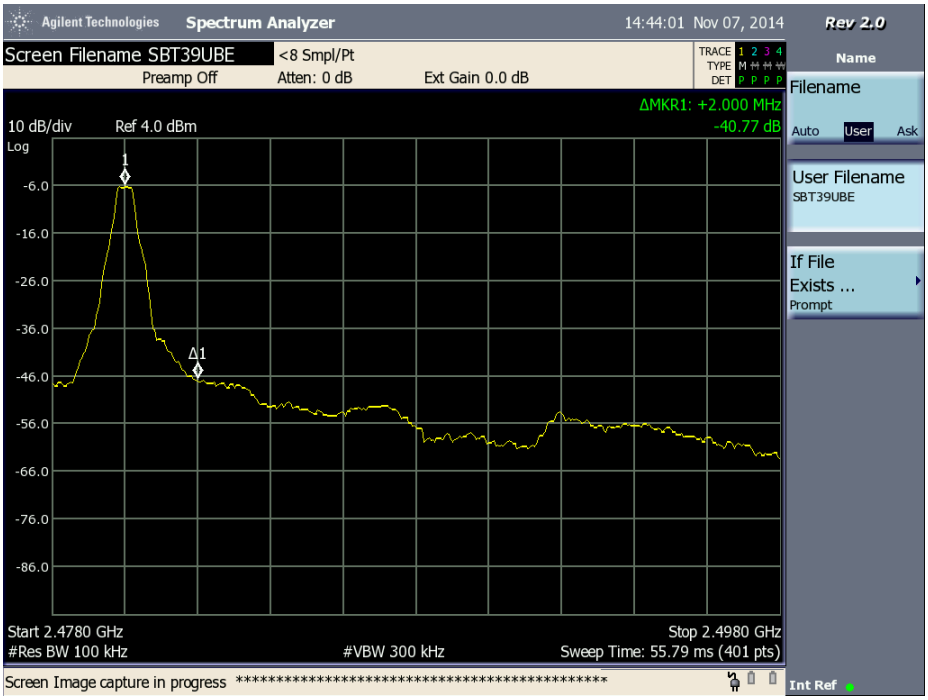



**FIGURE 14: GFSK Ch39 Upper Band Edge**

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

## 7.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 11/7/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C |
| **Humidity:** | 41% |

## 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 1.11 (Figure1).

## 7.4 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.

## 7.5 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.

## 7.6 TEST PLOTS

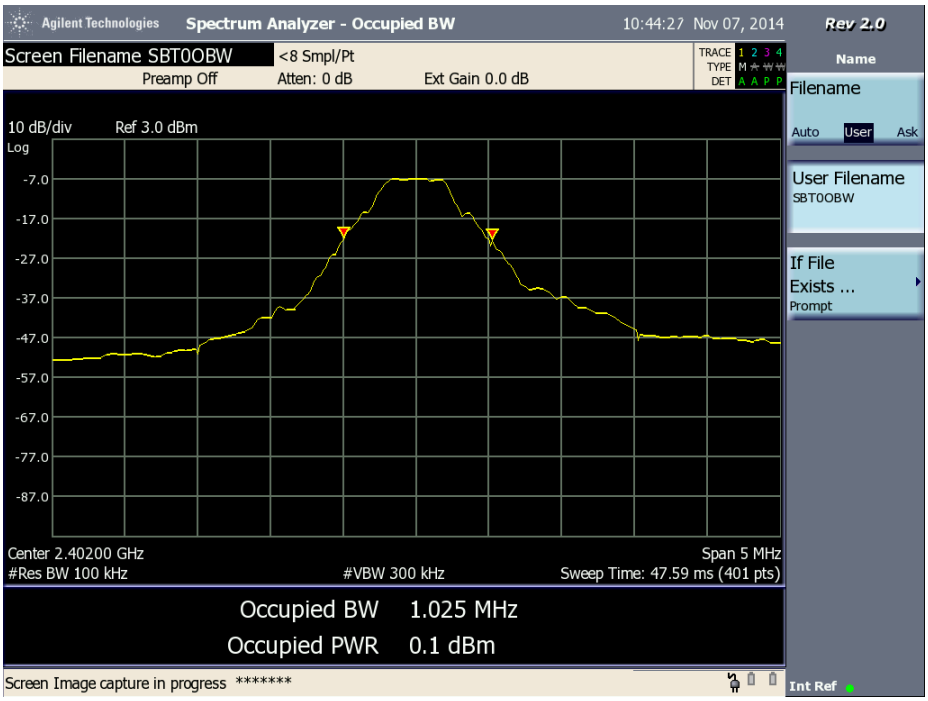



**FIGURE 15: GFSK Occupied Bandwidth (Ch0 shown, Ch20 & 39 similar)**

# 8 TIME OF OCCUPANCY PER FCC PART 15.247 (A)(1)

## 8.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

| | |
|---|---|
| **Site Used:** | EMC Lab 2A |
| **Test Date:** | 12/1-2/14 |
| **Test Engineer:** | D.E. Waldbeser |
| **Temperature** | 23°C avg. |
| **Humidity:** | 51% avg. |

## 8.2 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 |

## 8.3 LIMITS/REQUIREMENTS

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

0.4s * 79 ch = 31.6s period

## 8.4 TEST SET UP PHOTO(S)

Refer to section 1.11 (Figure1).

## 8.5 TEST DESCRIPTION

The EUT is connected to the spectrum analyzer by opening the connection to the internal chip antenna and attaching a suitable patch cable. The time of occupancy requires two measurements to be performed while the EUT is frequency hopping:

Transmit time – The center frequency is set to the frequency to be measured. The span is set to zero span and the sweep time and trigger delay adjusted to isolate the pulse for marker-delta measurement and recording.

Transmit interval – The sweep time is then adjusted in order to see subsequent transmit pulses. As the maximum sweep time for this analyzer is much less than the 31.6s period, a convienient sample interval is:

31.6s / (100/3) = 948ms.

Time of occupancy then is:

# of pulses in the sample interval x transmit time x (100/3)

[(100/3) is the # of sample intervals in 31.6s]

## 8.6 TIME OF OCCUPANCY MEASUREMENT PLOTS

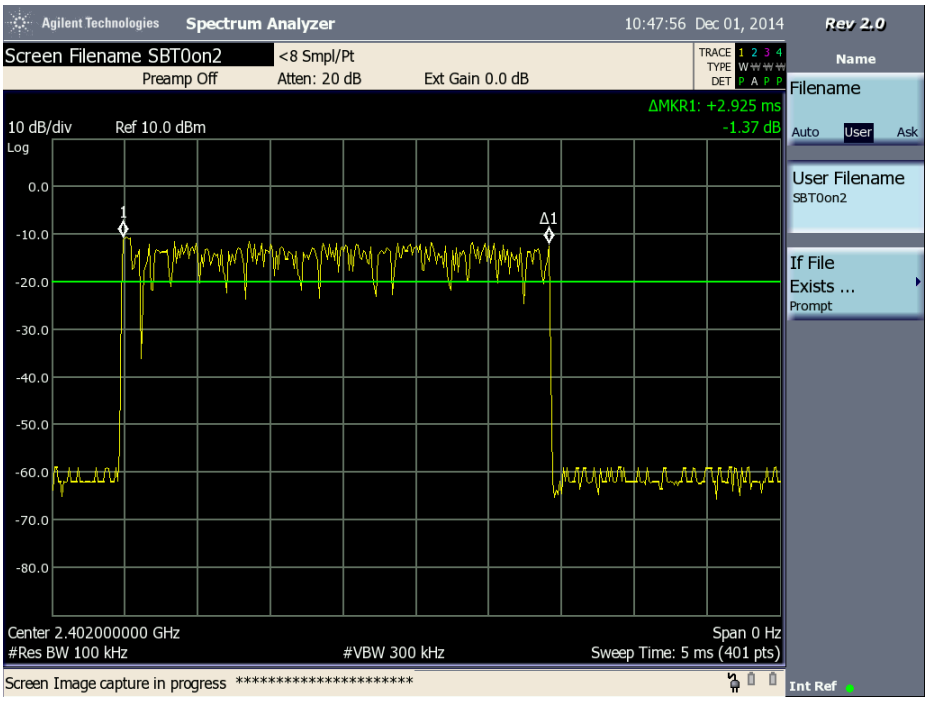



**FIGURE 16: Transmit time (Ch0 shown, Ch20 & 39 similar)**

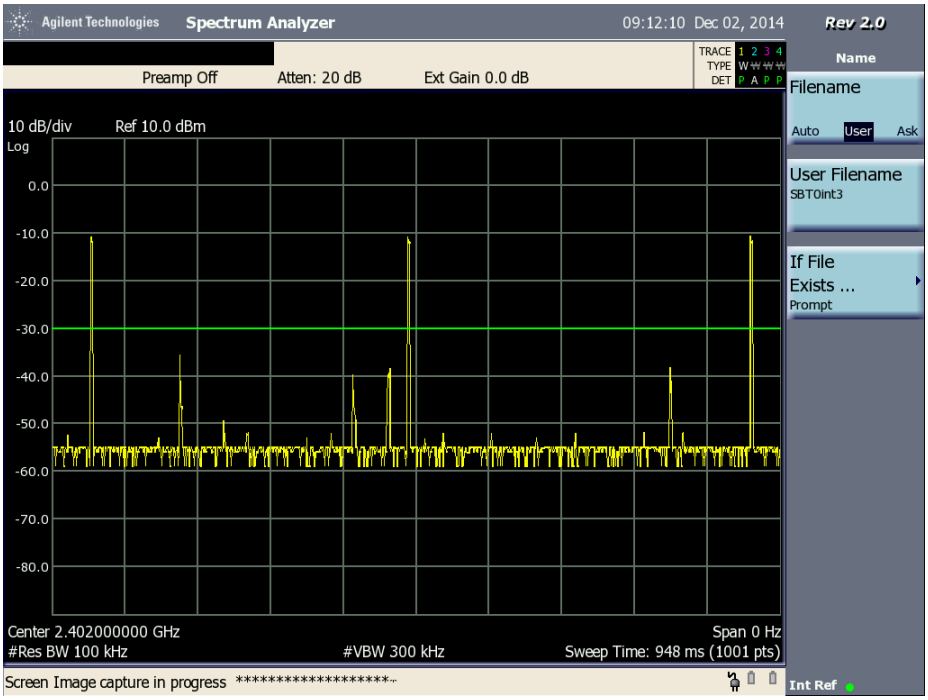



**FIGURE 17: Transmit interval (Ch0 shown, Ch20 & 39 similar)**

**3 x 2.925ms x (100/3) = 292.5ms = 0.293s < 0.4s**

# 9 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:** | 11/12/2014 |
| **Test Engineer:** | D.E. Waldbeser |
| **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 | 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 | A.H. Systems | SAS-571 | 887 | 10/14/16 | 2 yr |
| Horn Antenna | Schwarzbeck | BBHA 9170 | BBHA9170267 | 10/16/16 | 2 yr |

## 9.3 TEST SET UP PHOTO(S)

Refer to section 1.11 (Figures 2-3).

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

## 9.5 TEST DESCRIPTION AND PROCEDURE

For radiated emissions, the 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 SPURIOUS EMISSIONS PLOTS

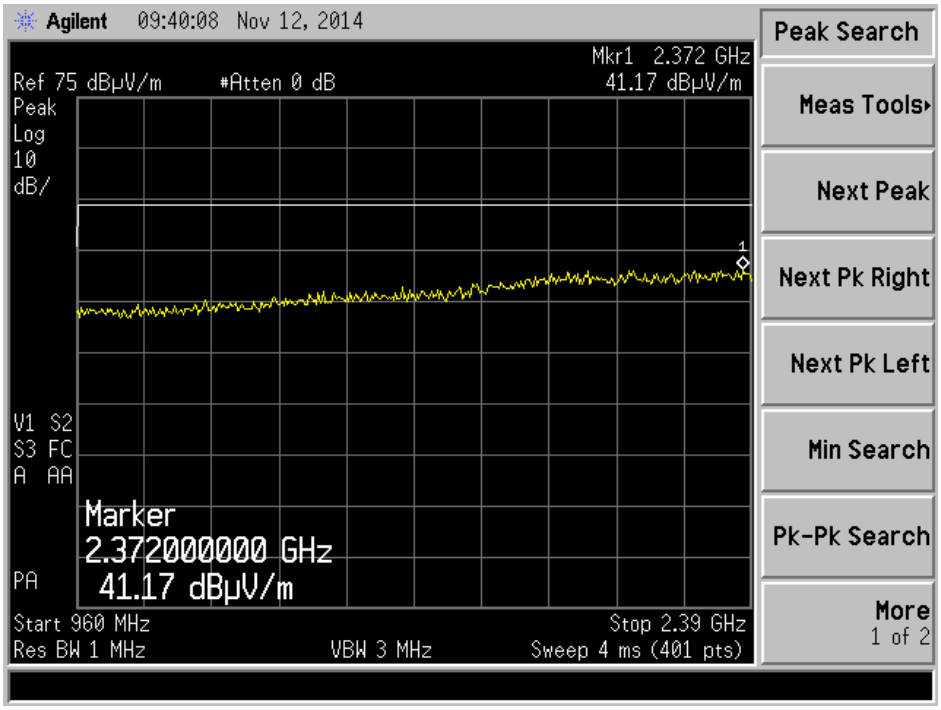



**FIGURE 18: DRG Horn, Horizontal Polarization**

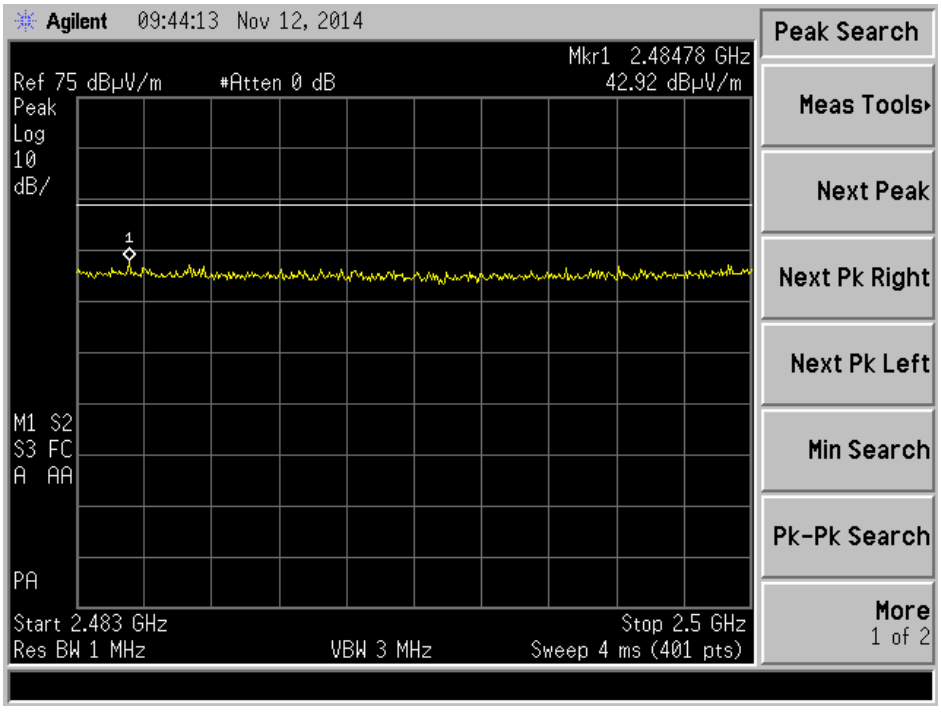



**FIGURE 19: DRG Horn, Horizontal Polarization**

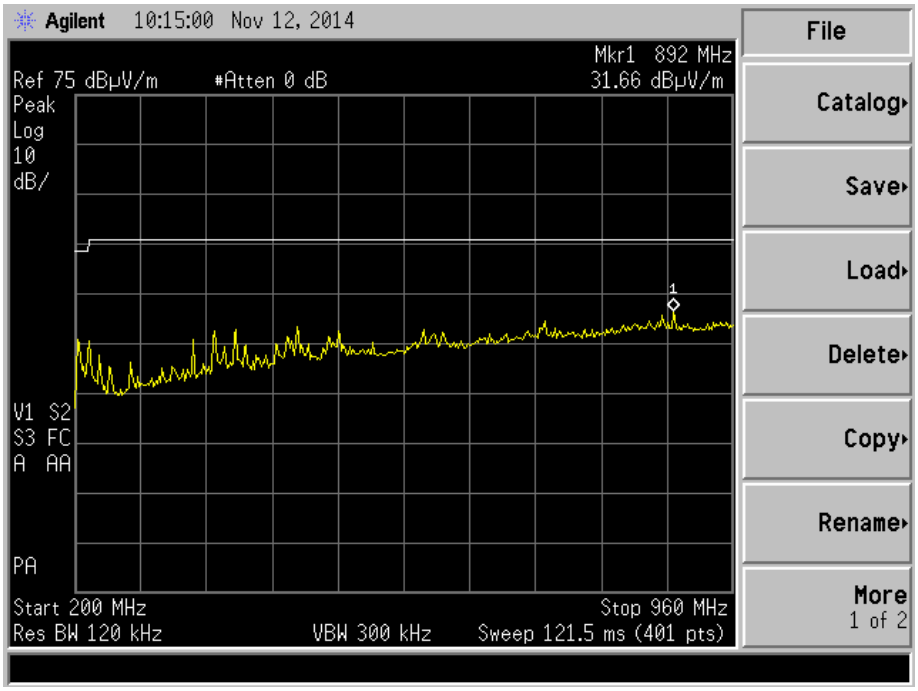



**FIGURE 20: Log-Periodic, Horizontal Polarization**

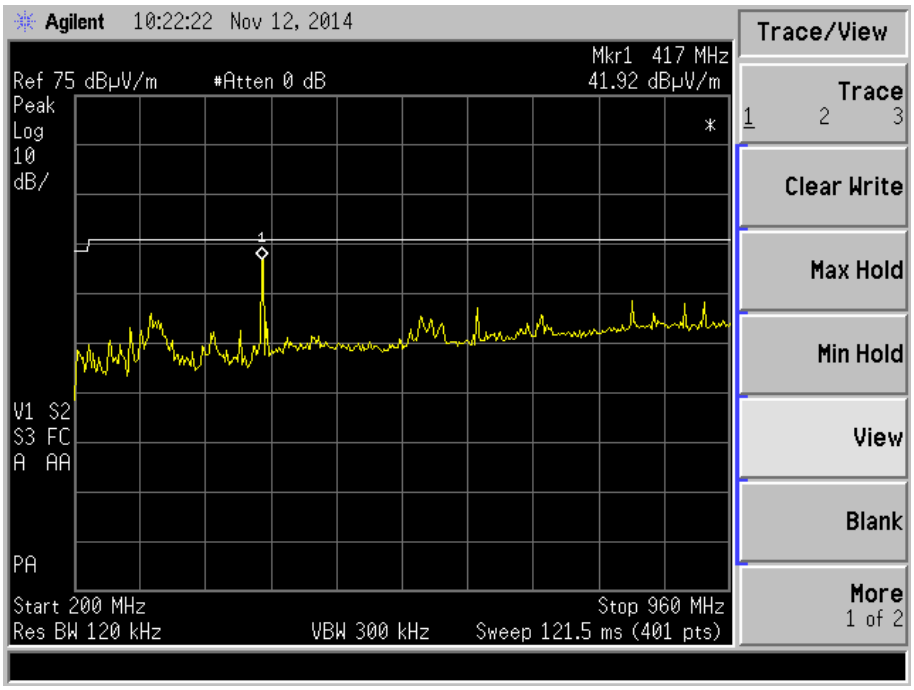



**FIGURE 21: Log-Periodic, Vertical Polarization**
**(USB interface board, not EUT @ 417 MHz)**

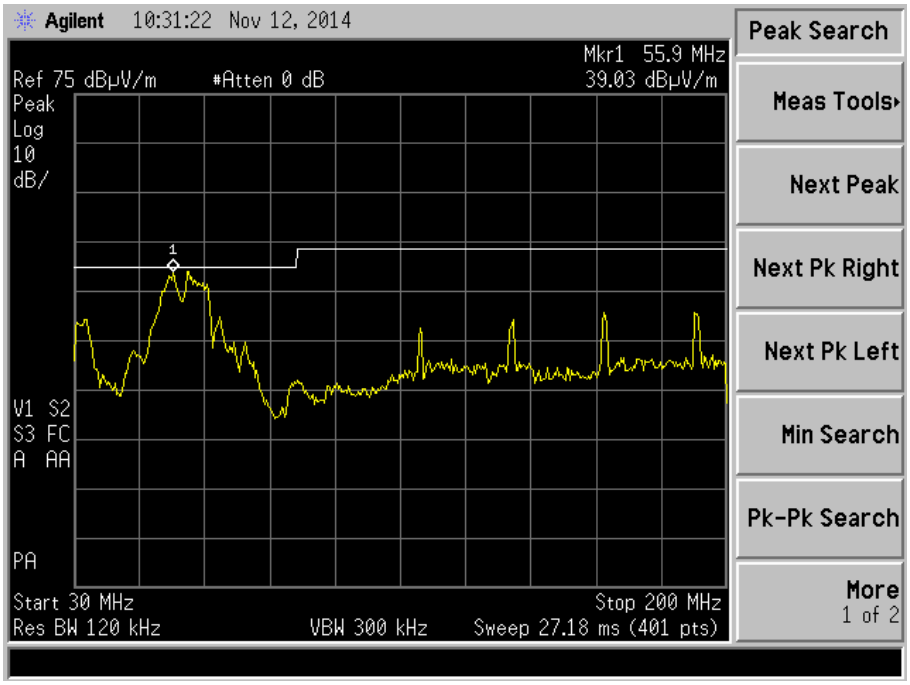



**FIGURE 22: Biconical, Horizontal Polarization**

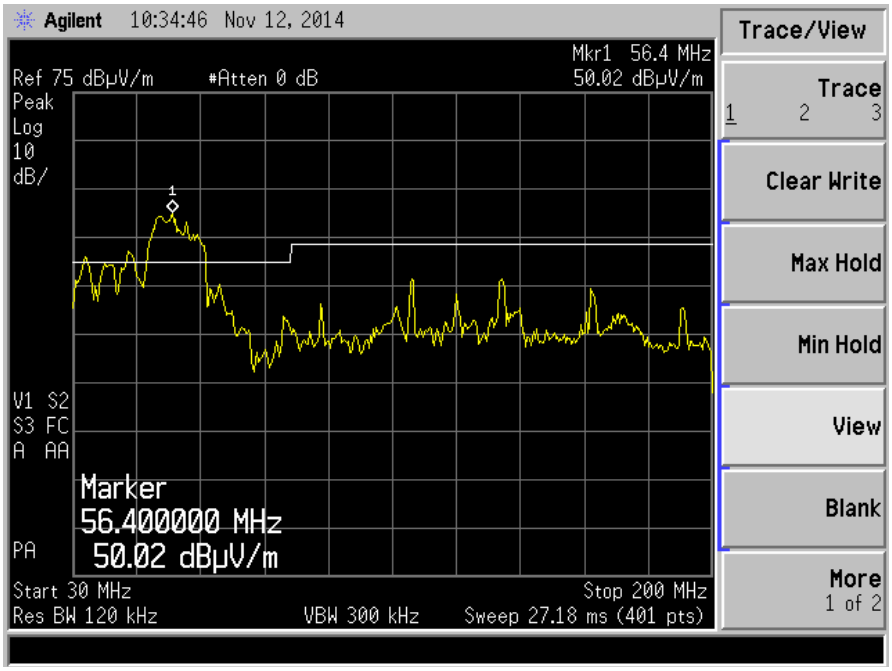



**FIGURE 23: Biconical, Vertical Polarization**
**(USB interface board, not EUT @ 56 MHz)**

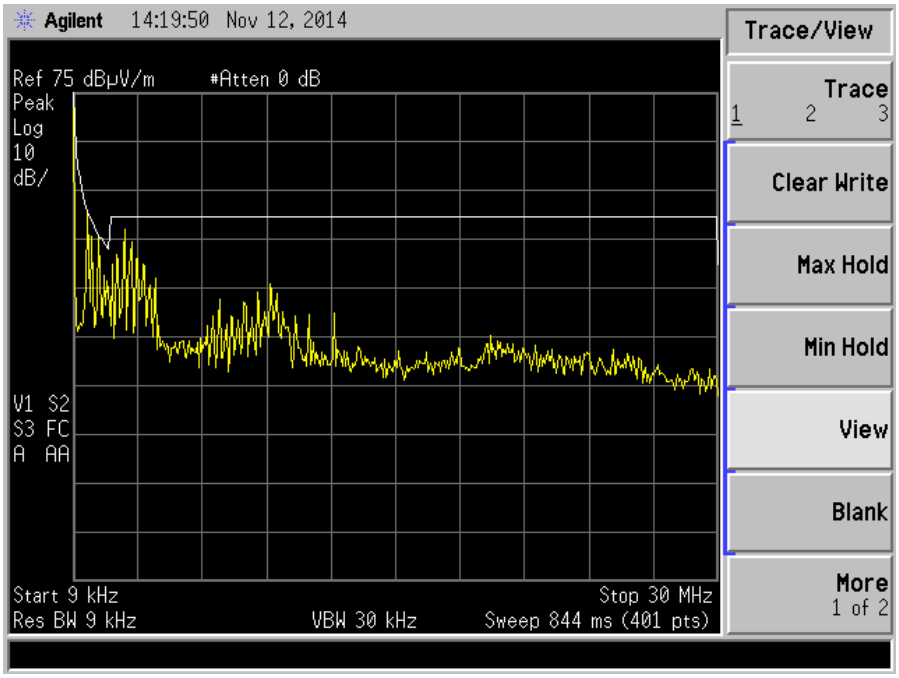



**FIGURE 24: Active Loop, Horizontal Polarization**

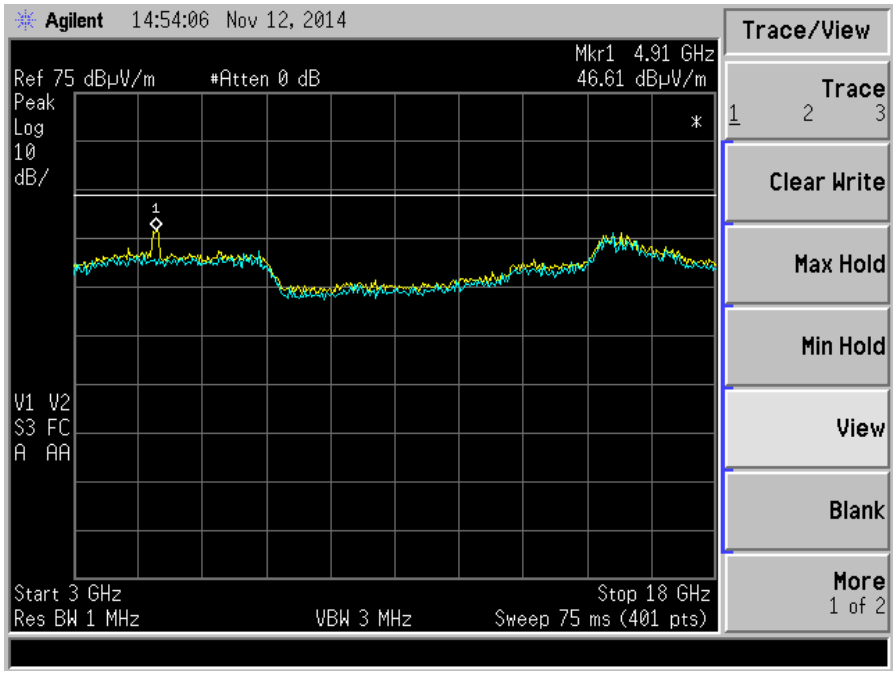



**FIGURE 25: DRG Horn, Horizontal Polarization**
**Blue trace – EUT off, Yellow trace – EUT on**

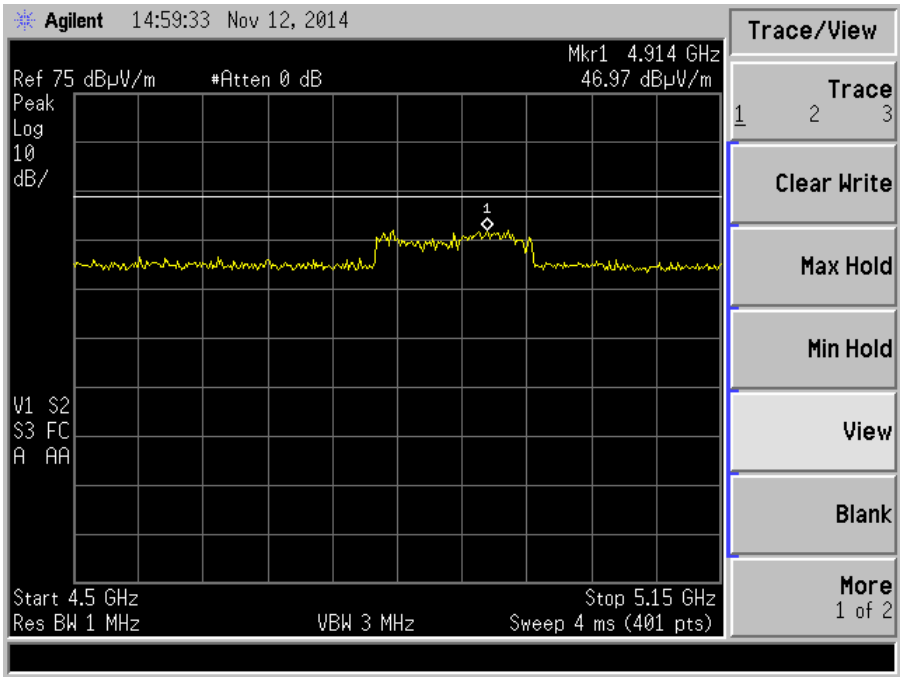



**FIGURE 26: DRG Horn, Horizontal Polarization**

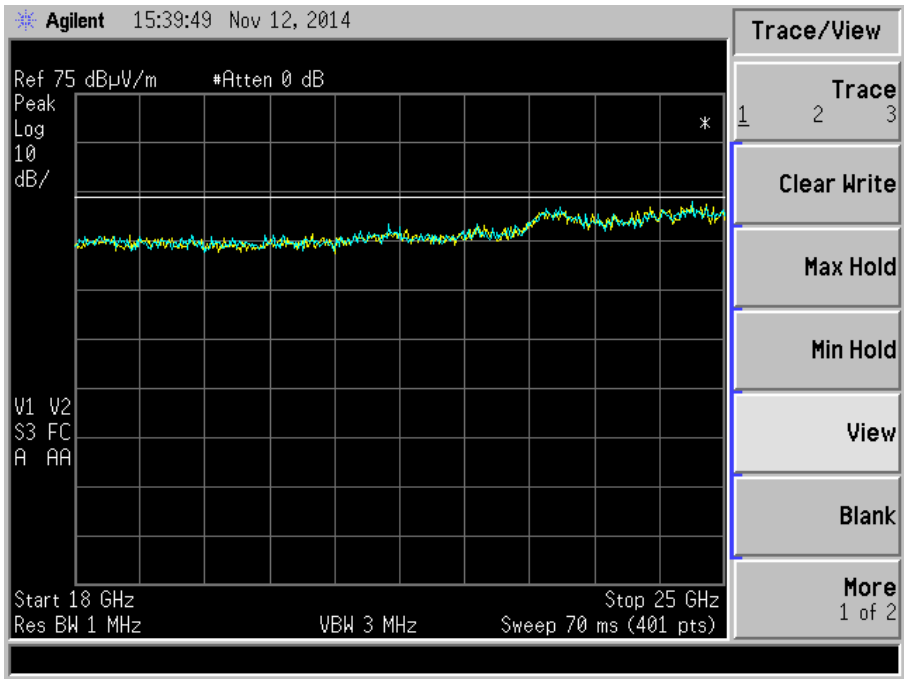


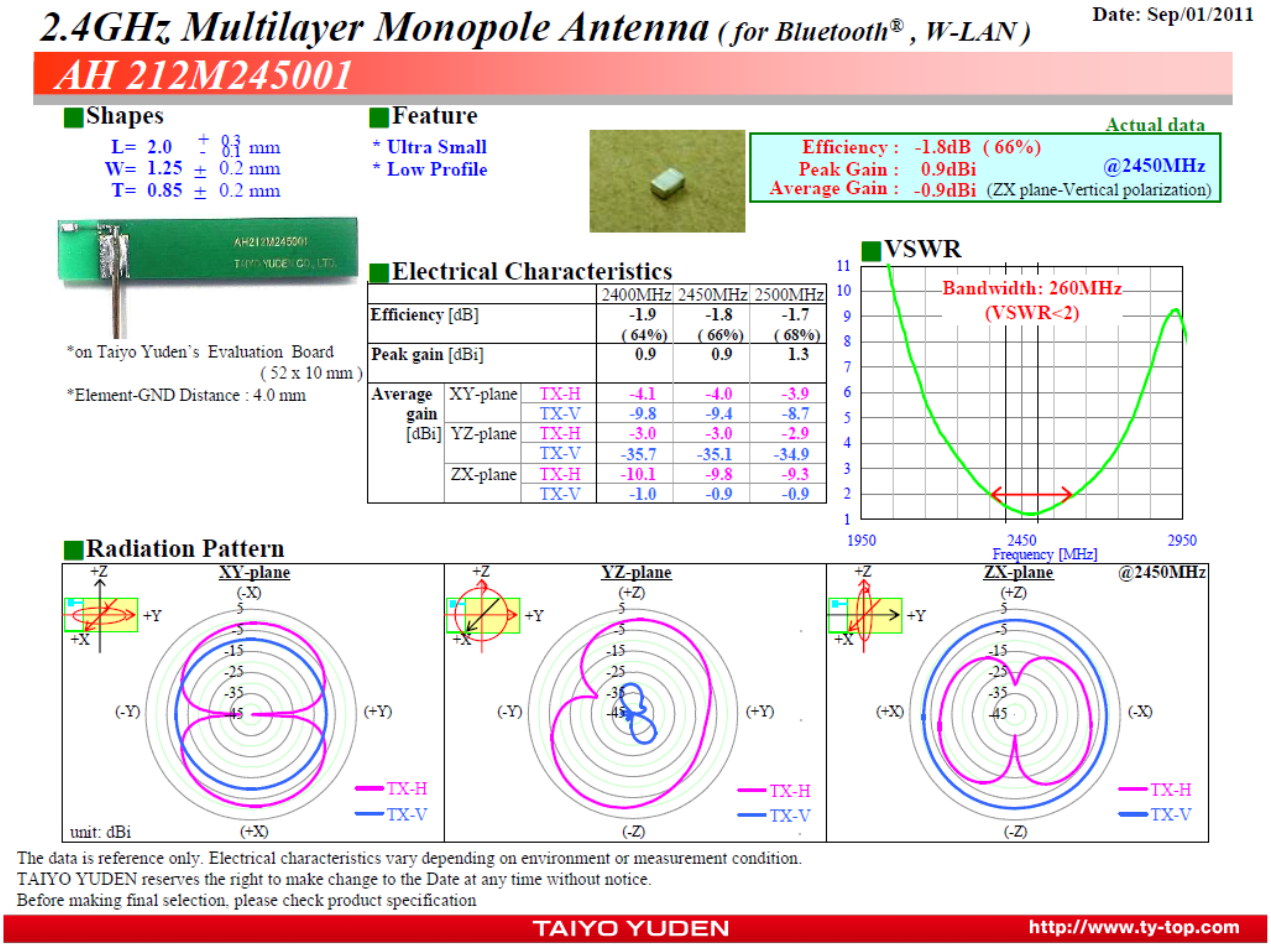

**FIGURE 27: 15-40 GHz Horn, Horizontal Polarization**
**Blue trace – EUT off, Yellow trace – EUT on**

# 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 peak gain of 0.9 dBi @ 2450 MHz.



*2.4GHz Multilayer Monopole Antenna (for Bluetooth®, W-LAN)*

Date: Sep/01/2011

**AH 212M245001**

**Shapes**

L= 2.0 +0.3 -0.1 mm
W= 1.25 ± 0.2 mm
T= 0.85 ± 0.2 mm

**Feature**

* Ultra Small
* Low Profile

Actual data
Efficiency : -1.8dB ( 66%)
Peak Gain : 0.9dBi @2450MHz
Average Gain : -0.9dBi (ZX plane-Vertical polarization)

*on Taiyo Yuden's Evaluation Board ( 52 x 10 mm )
*Element-GND Distance : 4.0 mm

**Electrical Characteristics**

| | | | 2400MHz | 2450MHz | 2500MHz |
|---|---|---|---|---|---|
| Efficiency [dB] | | | -1.9 ( 64%) | -1.8 ( 66%) | -1.7 ( 68%) |
| Peak gain [dBi] | | | 0.9 | 0.9 | 1.3 |
| Average gain [dBi] | XY-plane | TX-H | -4.1 | -4.0 | -3.9 |
| | | TX-V | -9.8 | -9.4 | -8.7 |
| | YZ-plane | TX-H | -3.0 | -3.0 | -2.9 |
| | | TX-V | -35.7 | -35.1 | -34.9 |
| | ZX-plane | TX-H | -10.1 | -9.8 | -9.3 |
| | | TX-V | -1.0 | -0.9 | -0.9 |

**VSWR**

Bandwidth: 260MHz (VSWR<2)

1950 2450 2950
Frequency [MHz]

**Radiation Pattern**

XY-plane, YZ-plane, ZX-plane @2450MHz
TX-H
TX-V
unit: dBi

The data is reference only. Electrical characteristics vary depending on environment or measurement condition.
TAIYO YUDEN reserves the right to make change to the Date at any time without notice.
Before making final selection, please check product specification

TAIYO YUDEN http://www.ty-top.com

# 11 APPENDIX

## 11.1 EUT TECHNICAL SPECIFICATIONS

| | | | |
|---|---|---|---|
| **Manufacturer:** | Osterhout Design Group | | |
| **General Description:** | The Wireless Finger Controller is a HID intended to work exclusively with the ODG R-6 Smart Glasses platform to control all functions without physical interaction with the head-mounted eyewear. | | |
| **EUT Name:** | Wireless Finger Controller | **Model:** | WFC |
| **Dimensions:** | 6cm x 2.3cm x 3.2cm | **Serial Number:** | None |
| **Operating Frequency:** | 2.400 GHz- 2.4835 GHz | **Power Cord Type:** | ☐ Shielded ☐ Un-Shielded |

## 11.2 EUT PHOTOS

**FIGURE 28: Front View**

**FIGURE 29: Side Oblique View**