

**COMPLIANCE WORLDWIDE INC.  
TEST REPORT 511-15R1**

In Accordance with the Requirements of  
**FCC PART 15.247, SUBPART C  
INDUSTRY CANADA RSS-247, ISSUE 1**

**Low Power License-Exempt Radio Communication Devices  
Intentional Radiators**

Issued to  
**David Clark Company  
360 Franklin Street  
Worcester, MA 01604**

for the  
**Omega Bluetooth Headset  
2.4 GHz Bluetooth Interface  
DC ONE-X**

**FCC ID: Y3J-DCCI-BT  
IC: 9409A-DCCIBT**

**Report Issued on January 15, 2016  
Report R1 Issued on May 3, 2016  
Tested by**

  
\_\_\_\_\_  
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Reviewed by

  
\_\_\_\_\_  
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## 1. Scope

This test report certifies that the David Clark Company Bluetooth Headset 2.4 GHz Bluetooth Interface, as tested, meets the FCC Part 15.247, and Industry Canada RSS-247, Issue 1 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required.

Revision R1 – Added a sentence to section 4.3 stating that all references to IC RSS-Gen refer to Issue 4, November 2014.

## 2. Product Details

- 2.1. Manufacturer:** David Clark Company
- 2.2. Model Number:** DC ONE-X (Part # 43102G-01)  
DC ONE-XP (Part # 43102G-02)
- 2.3. Serial Number:** None
- 2.4. Description:** Headphone Bluetooth Interface
- 2.5. Power Source:** 3.0 VDC (2 AA Alkaline Batteries)
- 2.6. Hardware Rev.:** C
- 2.7. Software Rev.:** DC-SRX-BTM710-01\_20150720 (Firmware)
- 2.8. EMC Modifications:** Added two 1.2 pF capacitors and a 3.3 nH inductor to populate the Pi filter pads in line from the RF output to the antenna on the transmitter PCB. This provided a 3<sup>rd</sup> order, 0.1 dB ripple Chebychev low pass filter with a 2.775 GHz cutoff. The filter components were installed to attenuate the harmonics of the intentional radiator frequencies.

### 3. Product Configuration

#### 3.1. Operational Characteristics & Software

CSR BlueTest3 was used as the control software for the Bluetooth transmitter. Once the software and driver were installed, the transmitter could be configured to function in a number of ways.

Notes: The default transmitter power settings set by the client were maintained throughout the testing.

To facilitate setting the required transmitter test modes, the following device hardware setup was used: A USB cable from the laptop containing the test software to an SPI converter. The SPI converter, in turn, was attached to a custom headset test module. A custom built cable ran from the test module to the In-Line Control Module which also contains the DUT Bluetooth transmitter. This cable was removed once the test parameters were loaded into the In-Line Control Module.

The following test modes were utilized to perform the testing:

TXSTART – The transmitter transmits a single carrier on a selected frequency from channel 0 to 78.

TXDATA 1 – Initiates a modulated output on the selected transmitter channel.

TXDATA 2 – Initiates the hopping sequence defined by the CFG HOPPING SEQ section.

CFG HOPPING SEQ – Selects the channel(s) to be included in a hopping sequence.

General Setup Parameters:

RF Test Mode: CFG FREQ  
TX/RX INT (µs): 6250  
Loopback (µs): 1875  
Report Int (s): 1

RF Test Mode: CFG PKT  
Packet Type: 30  
Packet Size: 679

RF Test Mode: CFG BIT ERR  
Bit Count: 16000000  
Reset: FALSE

LO Freq (MHz): 2402.000 (e.g.)  
Hi-Side: FALSE  
RX Atten: 0

### 3. Product Configuration (continued)

#### 3.1. Operational Characteristics & Software (continued)

During the measurement testing, the product was mounted on a polystyrene form to facilitate rotating the In-Line Control Module through three orthogonal axes as required by ANSI C63.10-2013, section 5.10.1, for a hand held or body worn device. The three axes were defined as follows:

- X-Axis Horizontal with the top of the In-Line Control Module facing to the left. The front of the In-Line Control Module was facing the antenna at 0° turntable azimuth.
- Y-Axis Vertical with the top of the In-Line Control Module facing up. The front of the In-Line Control Module was facing the antenna at 0° turntable azimuth.
- Z-Axis The front of the In-Line Control Module was facing up. The bottom of the In-Line Control Module was facing the antenna at 0° turntable azimuth.



X-Axis



Y-Axis



Z-Axis

### 3. Product Configuration (continued)

#### 3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Voltage	Frq (Hz)	Description/Function
David Clark	DC ONE-X (43102G-01) DC ONE-XP (43102G-02)	None	3.0 V	DC	Bluetooth Headset

#### 3.3. EUT Cables/Transducers

Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
None	N/A	1	Y	Aircraft audio panel cables

#### 3.4. Miscellaneous EUT Items

Manufacturer	Model/Part #	Qty	Description / Function
None			

#### 3.5. Support Equipment

Device	Manufacturer	Model	Serial No.	Comment
Laptop	Toshiba	Satelite A105	X6208961Q	For CSR BlueSuite
Headset Test Module	David Clark Co.	43001G-12	N/A	
USB-SPI Converter	CSR	1324	288782	Bluetooth to SPI USB converter

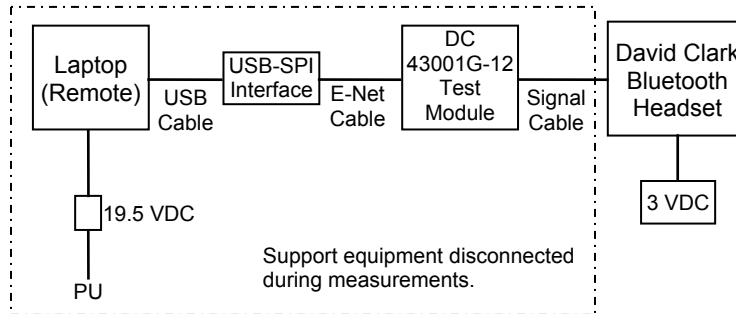
#### 3.6. Support Equipment Cables

Part #	Shielded Y or N	Length	Description / Function
N/A	Y	1 m	Standard USB Cable
N/A	N	0.25 m	Ethernet cable used as a test module interface, not for Ethernet
HDR-170674-01	N	0.5 m	Custom 20 pin interface cable.

Note: The 20 pin interface cable is removed after the test instructions are loaded into the In-Line Control Module.

### 3. Product Configuration (continued)

#### 3.7. Block Diagram



### 4. Measurements Parameters

#### 4.1 Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
EMI Test Receiver, 9kHz - 7GHz <sup>1</sup>	Rohde & Schwarz	ESR7	101156	7/23/2017	2 Years
Spectrum Analyzer 20 Hz - 40 GHz <sup>2</sup>	Rohde & Schwarz	FSV40	100899	7/23/2017	2 Years
Spectrum Analyzer, 9 kHz to 40 GHz <sup>3</sup>	Rohde & Schwarz	FSVR40	100909	7/23/2017	2 Years
EMI Receiver, 9 kHz to 6.5 GHz	Hewlett Packard	8546A	3650A00360	6/4/2016	2 Years
Loop Antenna, 9 kHz to 30 MHz	EMCO	6512	9309-1139	9/23/2016	2 Years
Biconilog Antenna, 30 MHz to 2 GHz	Sunol Sciences Corp	JB1	25509	5/15/2016	3 Years
Horn Antenna, 960 MHz - 18 GHz	Electro-Metrics	RGA-50 / 60	2813	7/15/2016	2 Years
Horn Antenna, 18 GHz - 40 GHz	Com-Power	AH-840	3075	9/24/2016	2 Years
Preamplifier, 1 GHz to 26.5 GHz	Hewlett Packard	8449B	3008A01323	7/21/2017	2 Years
LISN 50 Ω 50 μH, 9 kHz to 30 MHz	EMCO	3825/2	9109-1860	7/23/2016	1 Year
Digital Barometer	Control Company	4195	ID236	10/8/2017	2 Years
Temperature Chamber	Associated Research	E-0029	N/A	N/A	---

<sup>1</sup> ESR7 Firmware revision: V2.26, Date installed: 8/15/2014 Previous V2.17, installed 6/11/2014.  
<sup>2</sup> FSV40 Firmware revision: V2.30 SP1 Date installed: 10/22/2014 Previous V2.30, installed 7/23/2014.  
<sup>3</sup> FSVR40 Firmware revision: V2.23, Date installed: 10/20/2014 Previous V1.63 SP1, installed 8/28/2013.

#### 4.2. Measurement & Equipment Setup

Test Dates: Oct 29<sup>th</sup> 2015 – Jan 13<sup>th</sup>, 2016  
 Test Engineer: Brian Breault  
 Normal Site Temperature (15 - 35°C): 21.6  
 Relative Humidity (20 - 75%RH): 35  
 Frequency Range: 30 kHz to 25 GHz  
 Measurement Distance: 3 Meters  
 EMI Receiver IF/Resolution Bandwidth: 100 kHz - 30 MHz to 1 GHz  
 1 MHz - Above 1 GHz  
 EMI Receiver Average/Video Bandwidth: 300 kHz - 30 MHz to 1 GHz  
 3 MHz - Above 1 GHz  
 Detector Function: Peak, Quasi-Peak & Average

**3. Product Configuration (continued)**

**4.3. Measurement Procedure**

Test measurements were made in accordance with FCC Part 15.247 and IC RSS-247 Annex II: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz. In addition, all references to RSS-Gen refer to Issue 4, November 2014.

The test methods used to generate the data in this test report is in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

**5. Measurements Summary**

Test Requirement	FCC Rule Requirement	IC Rule Requirement	Report Section	Result
Antenna requirement	15.203	RSS-GEN 7.1.2	6.1	Compliant
Number of hopping channels	15.247 (a) (1) (iii)	RSS-247 5.1 (4)	6.2	Compliant
Minimum 20 dB bandwidth	15.247 (a) (1) (iii)	RSS-247 5.1 (2)	6.3	Compliant
Hopping channel carrier frequency separation	15.247 (a) (1)	RSS-247 5.1 (2)	6.4	Compliant
Average time of occupancy	15.247 (a) (1) (iii)	RSS-247 5.1 (4)	6.5	Compliant
Maximum peak conducted output power	15.247 (b) (1)	RSS-247 5.1 (2) & 5.4 (1)	6.6	Compliant
Lower and Upper Band edge	15.247 (d)	RSS-247 5.5	6.7	Compliant
99% (occupied) bandwidth	N/A	RSS-GEN 4.6.1	6.8	Compliant
Spurious harmonic radiated emissions	ANSI C63.10 10.2.8.2	RSS-GEN 8.9	6.9	Compliant
Spurious radiated emissions	15.209	RSS-GEN 8.9	6.10	Compliant
Unwanted Emissions in Non-Restricted Frequency Bands	15.247(d)	RSS-247 5.5	6.11	Compliant
Power line conducted emissions	15.207	RSS-GEN	Not Required	DUT operates on 2 AA Batteries
Public exposure to radio frequency energy levels	15.247 (1) 1.1307 (b)(1)	RSS-GEN RSS-102	6.12	Compliant



**6. Measurement Data**

**6.1. Antenna Requirement (15.203, RSS-GEN, Section 7.1.2)**

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

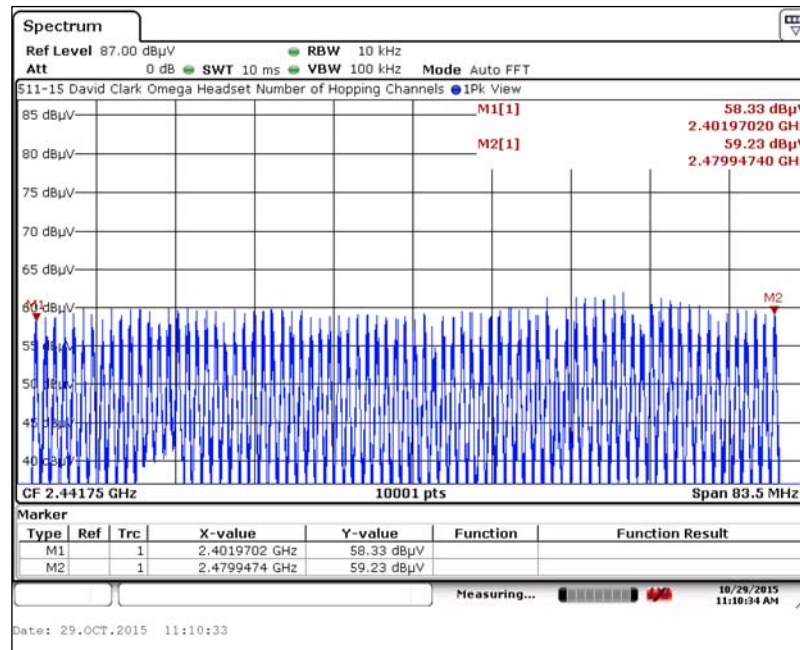
Status: The device under test utilizes a Johanson Technology 2450AT45A100E chip antenna that is contained within the In-Line Control Module. It is inaccessible to the user.

**6.2. Number of Hopping Channels (15.247 (a) (1) (iii), RSS-247 5.1(4))**

Requirement: Systems Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Status: The device under test utilizes 79 hopping channels from 2402 MHz to 2480 MHz.

Result: Compliant



6. Measurement Data (continued)

6.3. Minimum 20 dB Bandwidth (15.247 (a) (1), RSS-247 5.1(2))

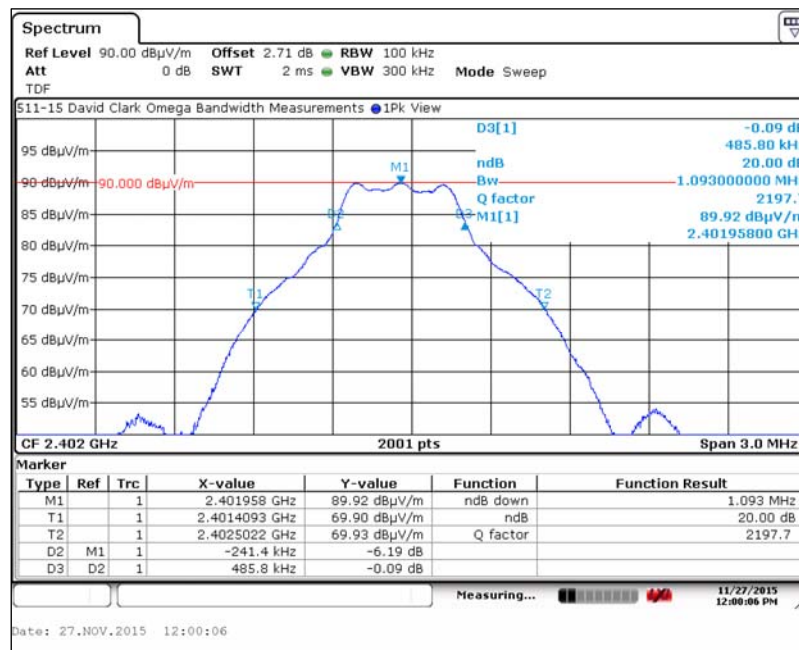
Requirement: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Note: The  $\frac{2}{3} \times 20$  dB bandwidth of the hopping channel is the greater of the values. Frequency hopping channel separation data is detailed in section 6.4.

Resolution Bandwidth : 100 kHz  
Video Bandwidth : 300 kHz

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	20 dB Bandwidth x $\frac{2}{3}$ (kHz)	Result
Low	2402	1093.0	728.67	Compliant
Middle	2441	1088.5	725.67	Compliant
High	2480	1104.9	736.60	Compliant

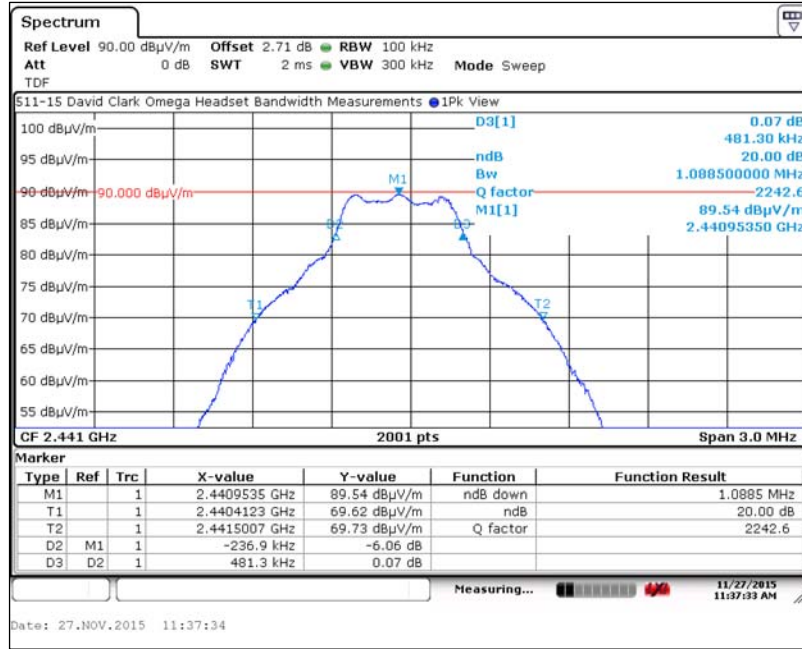
6.3.1. 20 dB Bandwidth – Low Frequency (2402 MHz)



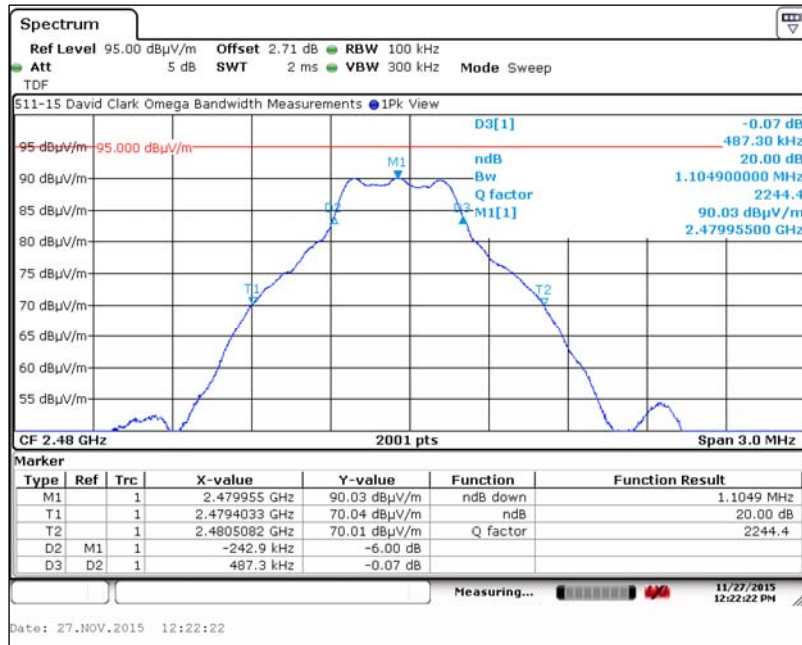
6. Measurement Data

6.3. Minimum 20 dB Bandwidth (15.247 (a) (1), RSS-247 5.1(2)) (continued)

6.3.2. 20 dB Bandwidth – Middle Frequency (2441 MHz)



6.3.3. 20 dB Bandwidth – High Frequency (2480 MHz)



6. Measurement Data

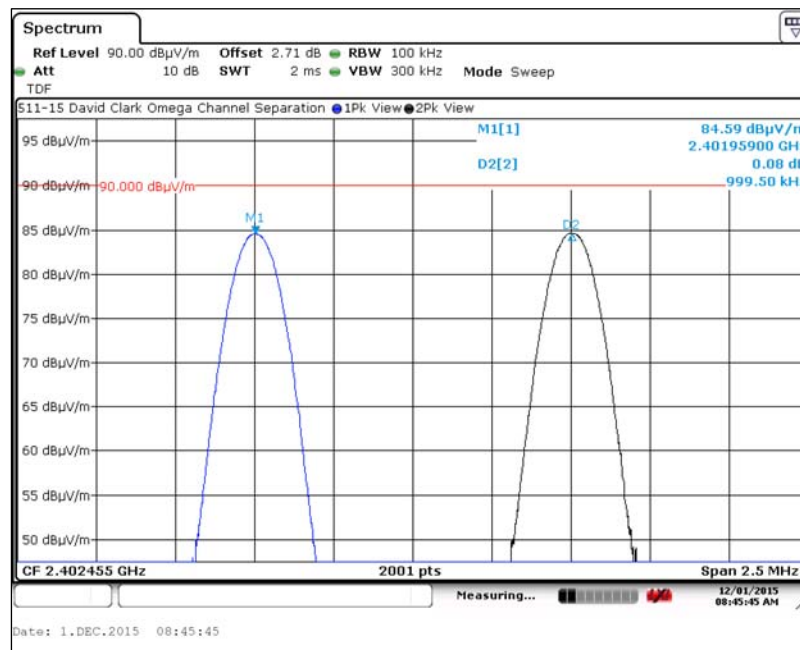
6.4. Frequency Hopping Channel Separation (15.247 (a) (1), RSS-247 5.1(2)) (continued)

Requirement: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Result: The channel separation is greater than two-thirds of the 20 dB bandwidth detailed in section 6.3.

Channel Pair	Channel Pair	Channel Separation (kHz)	Required Channel Separation (kHz)	Result
Low	2402	999.5	>728.67 kHz	Compliant
	2403			
Middle	2440	994.5	>725.67 kHz	Compliant
	2441			
High	2479	1000.0	>736.60 kHz	Compliant
	2480			

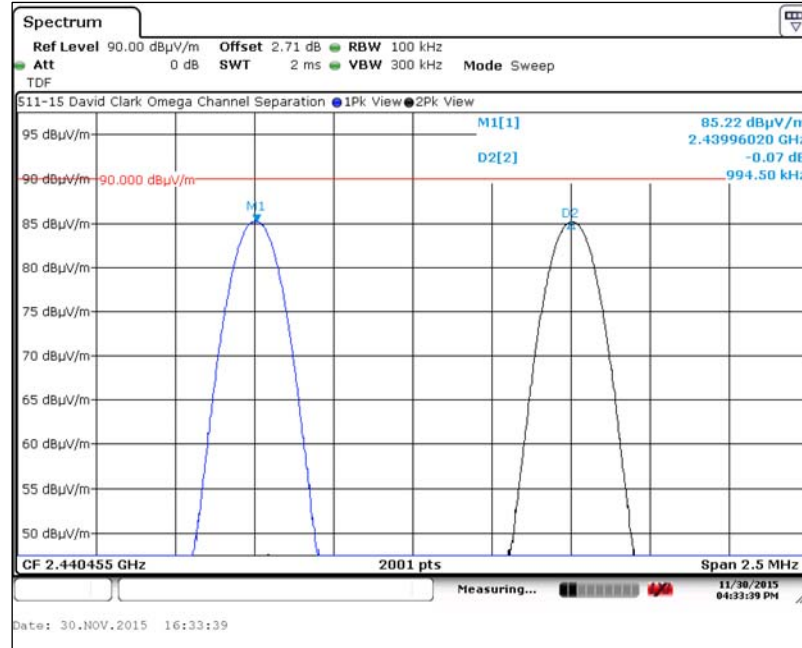
6.4.1. Channel Separation – Low Frequency (2402/2403 MHz)



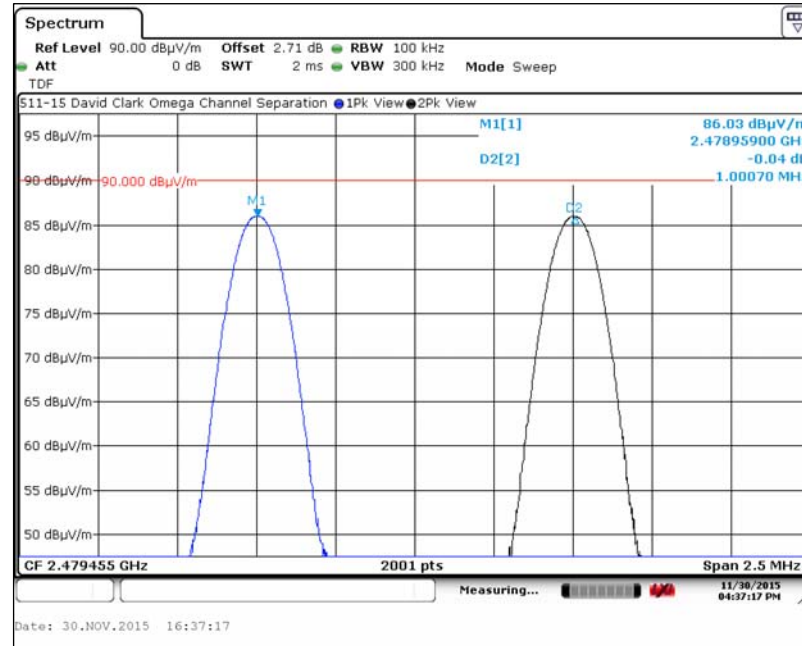
6. Measurement Data

6.4. Frequency Hopping Channel Separation (15.247 (a) (1), RSS-247 5.1(2)) (continued)

6.4.2. Channel Separation – Middle Frequency (2440/2441 MHz)



6.4.3. Channel Separation – High Frequency (2479/2480 MHz)



6. Measurement Data

6.5. Average Time of Occupancy (15.247 (a) (1) (iii), RSS-247 5.1 (4)) (continued)

Requirement: 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.

Test Note: A sweep time of 8 seconds was used to facilitate counting the pulses on a given frequency. This number was multiplied by 4 to determine the number of pulses in a 32 second interval.

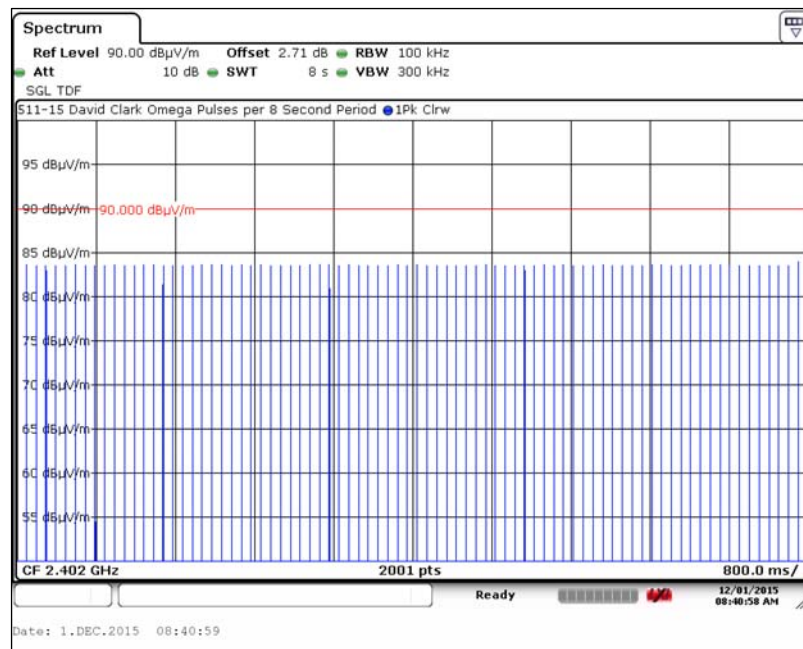
Result: The average time of occupancy on any channel is less than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

$$79 \text{ Channels} \times 0.4 \text{ Seconds} = 32 \text{ Seconds}$$

Channel	Frequency (MHz)	Number of Pulses per 8s Period	Number of Pulses per 32s Period	Pulse Width (µS)	Dwell Time per Period (32 Seconds)	Allowable Dwell Time per Period	Result
Low	2402	81	324	410.00	0.1328	0.4	Compliant
Middle	2441	81	324	410.00	0.1328	0.4	Compliant
High	2480	81	324	412.50	0.1337	0.4	Compliant

6.5.1. Pulses per 8 Second Period

6.5.1.1. Pulses per 8 Second Period – Low Frequency (2402 MHz)

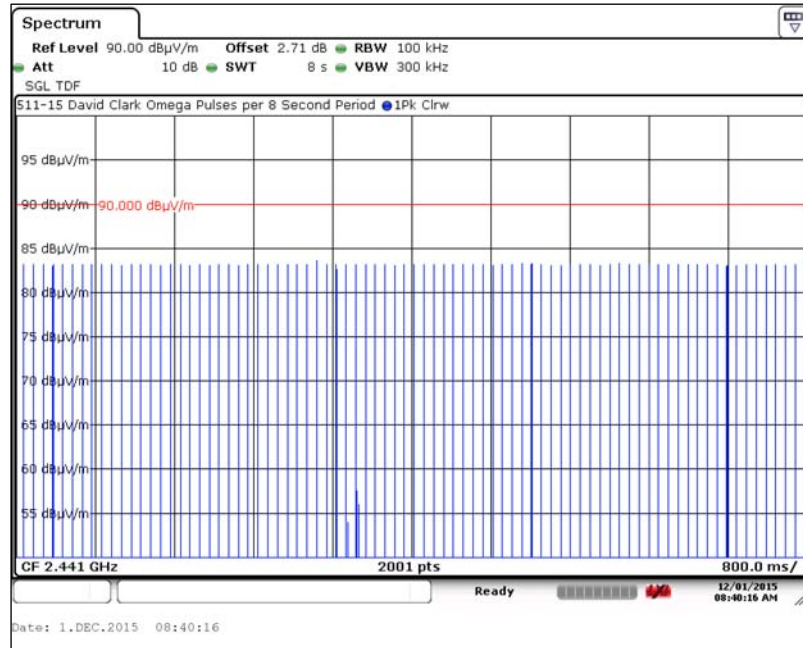


6. Measurement Data

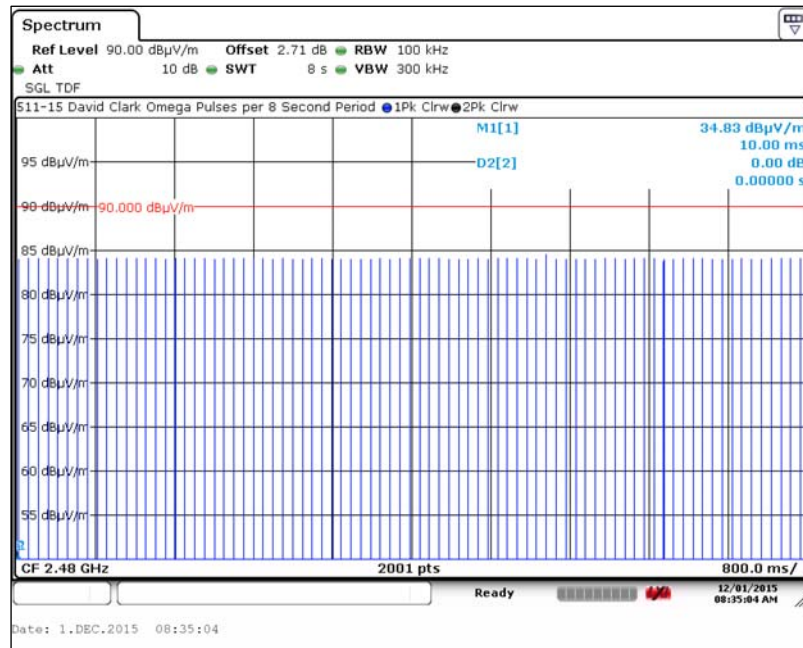
6.5. Average Time of Occupancy (15.247 (a) (1) (iii), RSS-210 A8.1 (d))

6.5.1. Pulses per 8 Second Period (continued)

6.5.1.2. Pulses per 8 Second Period – Middle Frequency (2441 MHz)



6.5.1.3. Pulses per 8 Second Period – High Frequency (2480 MHz)

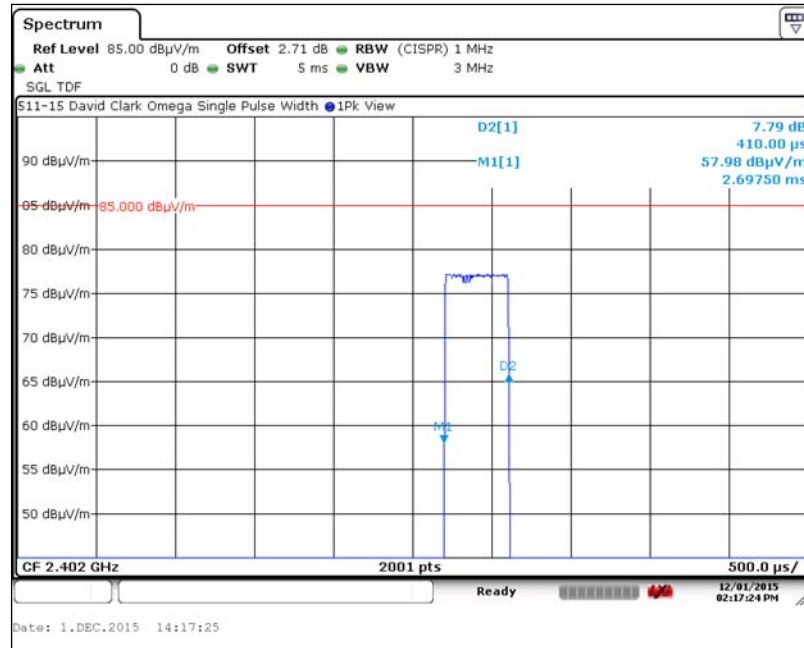


6. Measurement Data

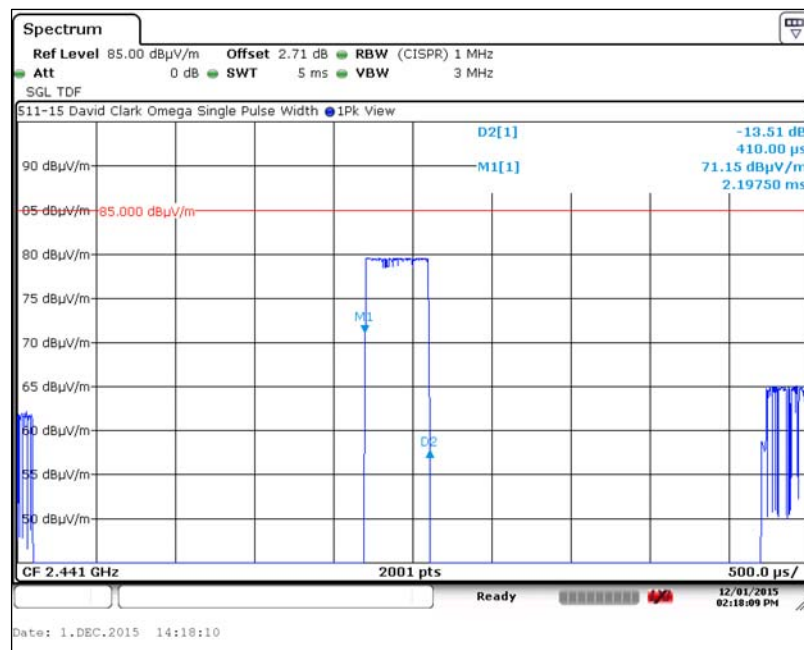
6.5. Average Time of Occupancy (15.247 (a) (1) (iii), RSS-247 5.1 (4)) (continued)

6.5.2. Transmitter Individual Pulse Width

6.5.2.1. Transmitter Individual Pulse Width – Low Frequency (2402 MHz)



6.5.2.2. Transmitter Individual Pulse Width – Middle Frequency (2441 MHz)



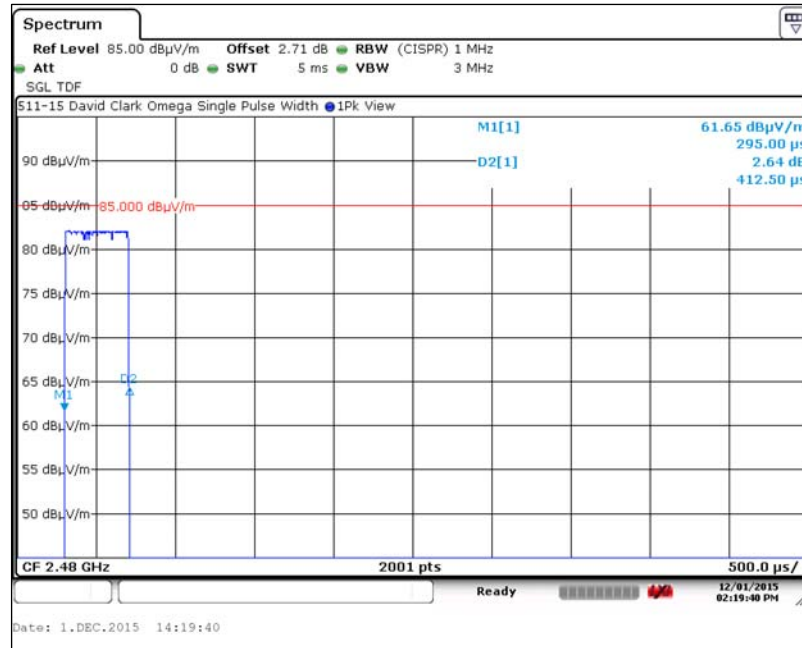


6. Measurement Data

6.5. Average Time of Occupancy (15.247 (a) (1) (iii), RSS-247 5.1 (4)) (continued)

6.5.2. Transmitter Individual Pulse Width (continued)

6.5.2.3. Transmitter Individual Pulse Width – High Frequency (2480 MHz)



**6. Measurement Data**

**6.6. Maximum Peak Conducted Output Power (15.247 (b) (1), RSS-247 5.1 (2))**

Requirement: The maximum peak conducted output power of the intentional radiator shall not exceed 1 watt for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels.

Test Note<sup>1</sup>: The device under test does not facilitate conducted power measurements. Radiated field strength measurements were made and converted to units of power using the following formula:

$$P = \frac{(E \times d)^2}{(30 \times G)}$$

- P = the power in Watts (power has been converted to milliwatts in the table).
- E = the measured maximum field in V/m
- G = the numeric gain of the transmitting antenna over an isotropic radiator.
- d = the distance in meters of the field strength measurement.

<sup>1</sup> Reference FCC OET 412172: Determining ERP and EIRP

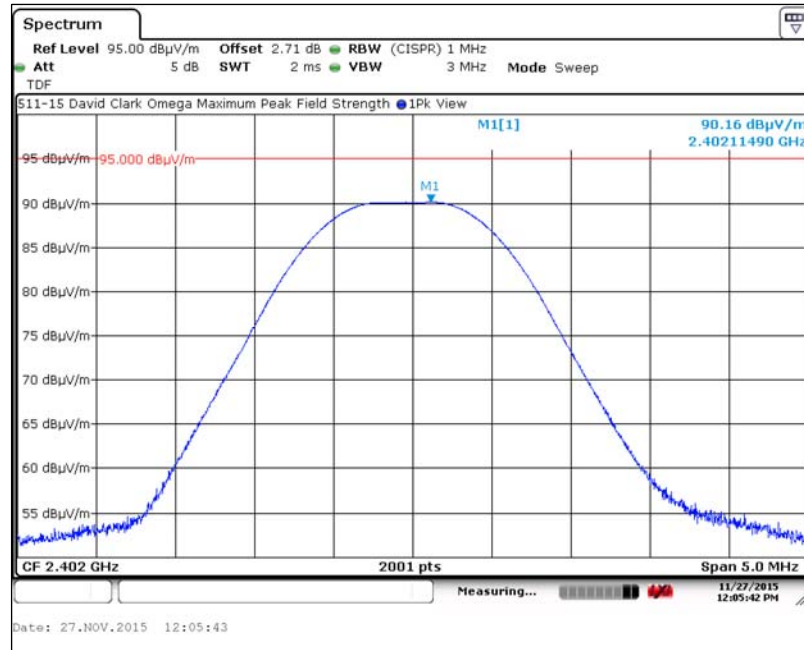
Channel	Freq.	Peak Field Strength	Distance	Antenna Gain <sup>1</sup>		Measured Output Power	Output Power Limit	Result
	(MHz)	(dBµV/m)	(m)	(dBi)	(numeric)	(mW)	(mW)	
Low	2402	90.16	3.0	1.00	1.259	0.25	1000.0	Compliant
Middle	2441	89.40	3.0	1.00	1.259	0.21	1000.0	Compliant
High	2480	90.02	3.0	1.00	1.259	0.24	1000.0	Compliant

<sup>1</sup> Taken from the antenna manufacturer's data guide.

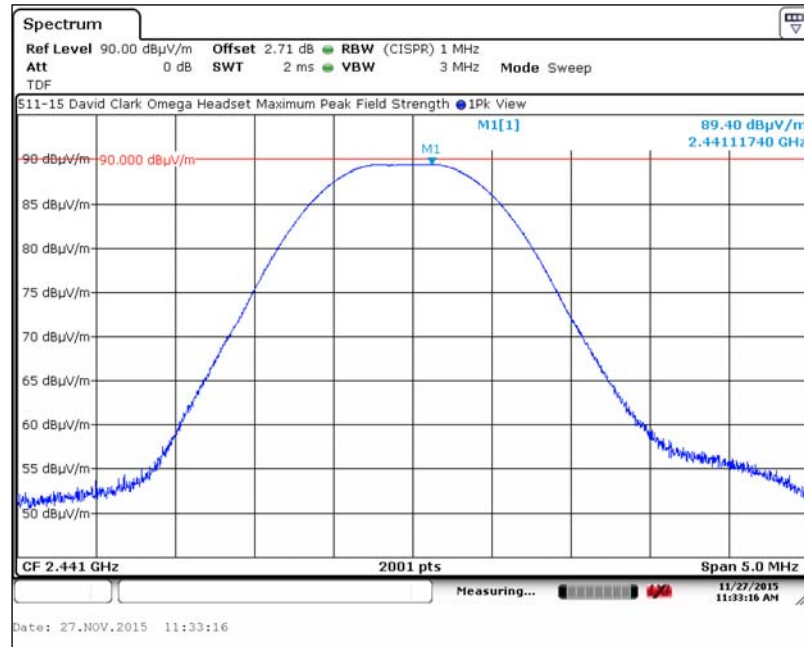
6. Measurement Data

6.6. Maximum Peak Conducted Output Power (15.247 (b) (1), RSS-240 5.1 (2))

6.6.1. Field Strength – Low Frequency (2402 MHz)



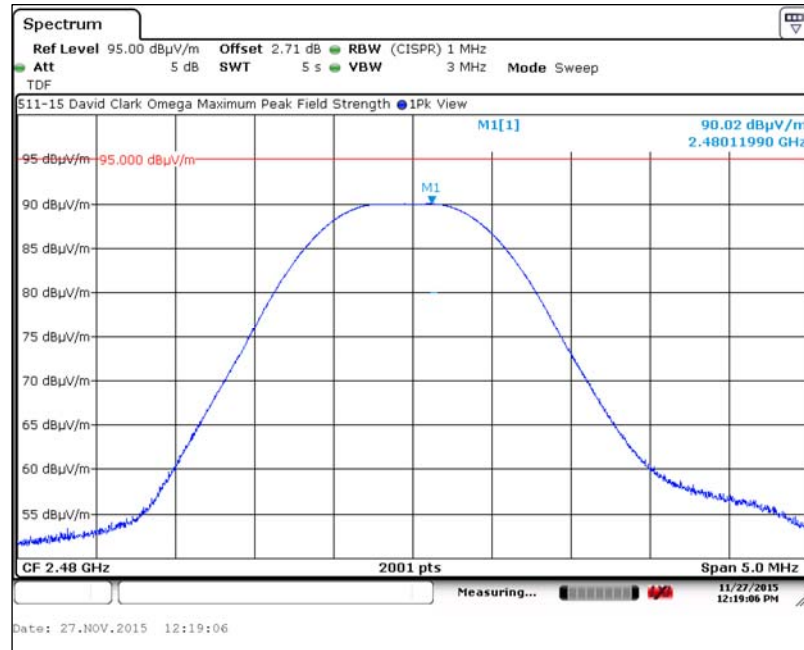
6.6.2. Field Strength – Middle Frequency (2441 MHz)



6. Measurement Data

6.6. Maximum Peak Conducted Output Power (15.247 (b) (1), RSS-240 5.1 (2))

6.6.3. Field Strength – High Frequency (2480 MHz)



6. Measurement Data

6.7. Band Edge Measurements(15.247 (d), RSS-247 5.5)

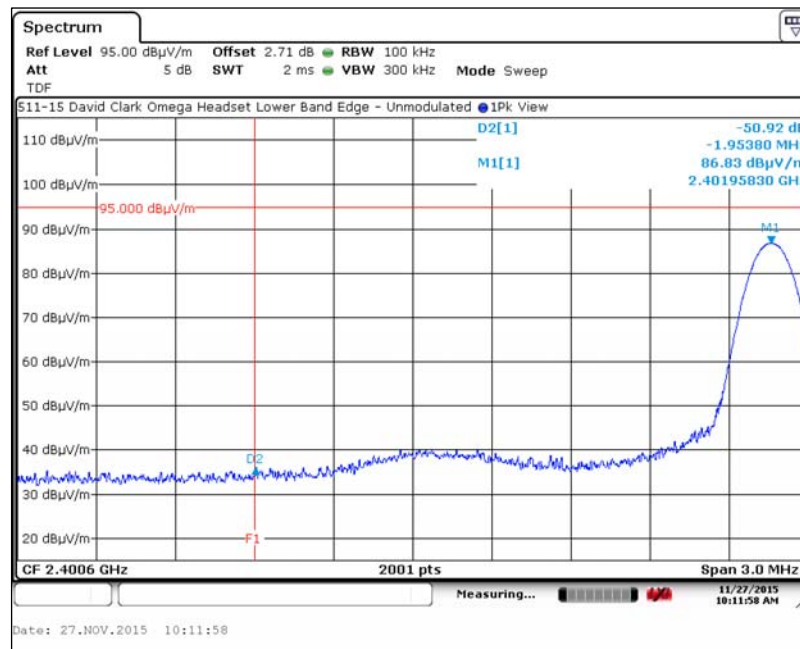
Requirement: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that 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.

Resolution Bandwidth : 100 kHz  
 Video Bandwidth : 300 kHz

6.7.1. Lower Band Edge

6.7.1.1. Unmodulated Carrier

Lowest Channel	Field Strength (dBµV/m)		Band Edge Frequency (MHz)	Field Strength (dBµV/m)		Required Offset (dB)	Actual Offset (dB)	Result
	Peak	Average		Peak	Average			
2402.	86.83	---	2400	35.91	---	>20 dB	50.92	Compliant



6. Measurement Data (continued)

6.7. Band Edge (15.247 (d), RSS-210 A8.5, RSS-247 5.5))

6.7.1. Lower Band Edge

6.7.1.2. Frequency Hopping

Lowest Channel (MHz)	Field Strength (dBm)		Band Edge Frequency (MHz)	Field Strength (dBm)		Required Offset (dB)	Actual Offset (dB)	Result
	Peak	Average		Peak	Average			
2402.	87.13	---	2400	48.31	---	>20 dB	38.82	Compliant



6. Measurement Data

6.7. Band Edge (15.247 (d), RSS-210 A8.5, RSS-247 5.5))

6.7.2. Upper Band Edge

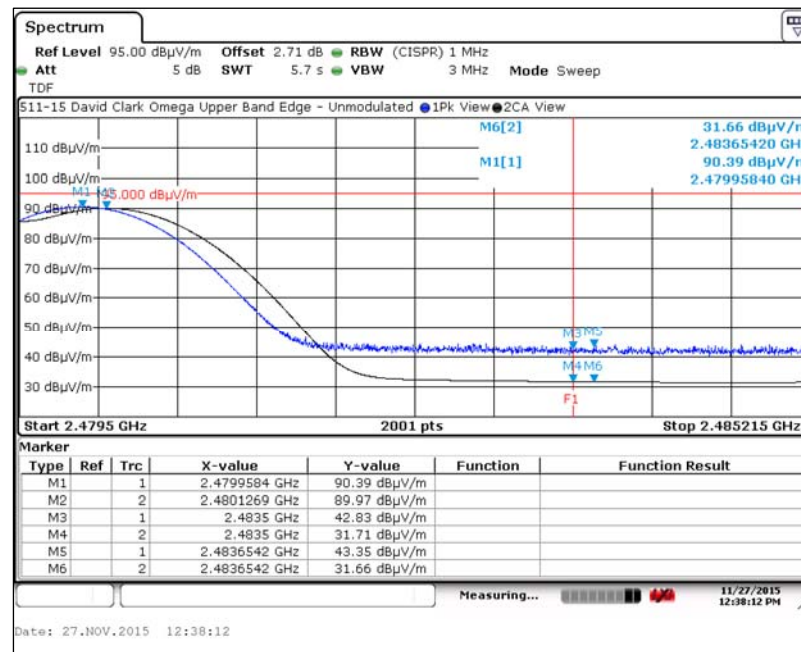
6.7.2.1. Unmodulated Carrier

Band Edge

Highest Channel (MHz)	Field Strength (dBµV/m)		Upper Band Edge (MHz)	Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dB)		Result
	Peak	Average		Peak	Average	Peak	Average	Peak	Average	
2480	90.39	89.97	2483.5	42.83	31.71	74	54	-31.17	-22.29	Compliant

Worst-case Out of Band

Frequency (MHz)	Field Strength (dBµV/m)		15.209 Limit (dBµV/m)		Margin (dB)		Result
	Peak	Average	Peak	Average	Peak	Average	
2483.6542	43.35	31.66	74	54	-30.65	-22.34	Compliant



6. Measurement Data

6.7. Band Edge (15.247 (d), RSS-210 A8.5, RSS-247 5.5))

6.7.2. Upper Band Edge

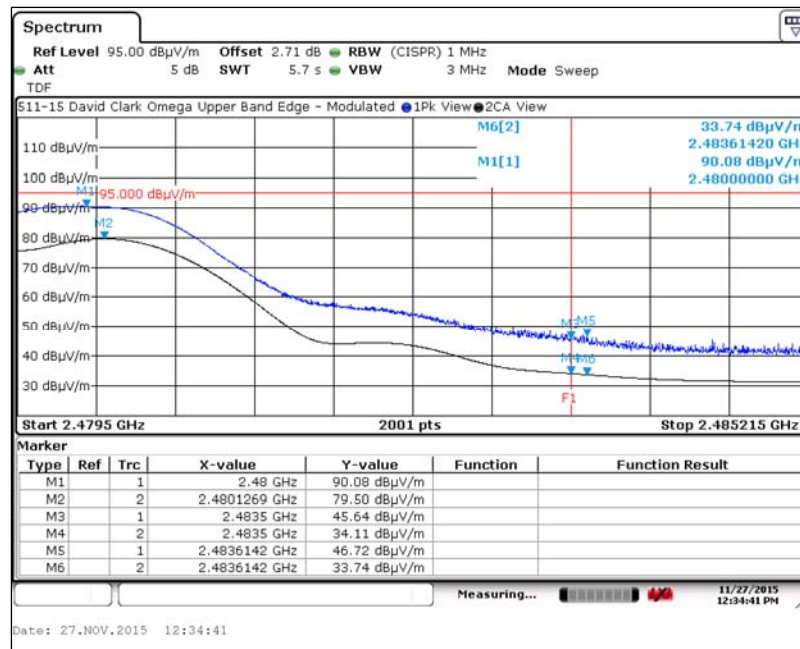
6.7.2.2. Frequency Hopping

Band Edge

Highest Channel (MHz)	Field Strength (dBµV/m)		Upper Band Edge (MHz)	Field Strength (dBµV/m)		Limit (dBµV/m)		Margin (dB)		Result
	Peak	Average		Peak	Average	Peak	Average	Peak	Average	
2480	90.08	79.5	2483.5	46.64	34.11	74	54	-27.36	-19.89	Compliant

Worst-case Out of Band

Freq. (MHz)	Field Strength (dBµV/m)		15.209 Limit (dBµV/m)		Margin (dB)		Result
	Peak	Average	Peak	Average	Peak	Average	
2483.655	46.72	33.74	74	54	-27.28	-20.26	Compliant

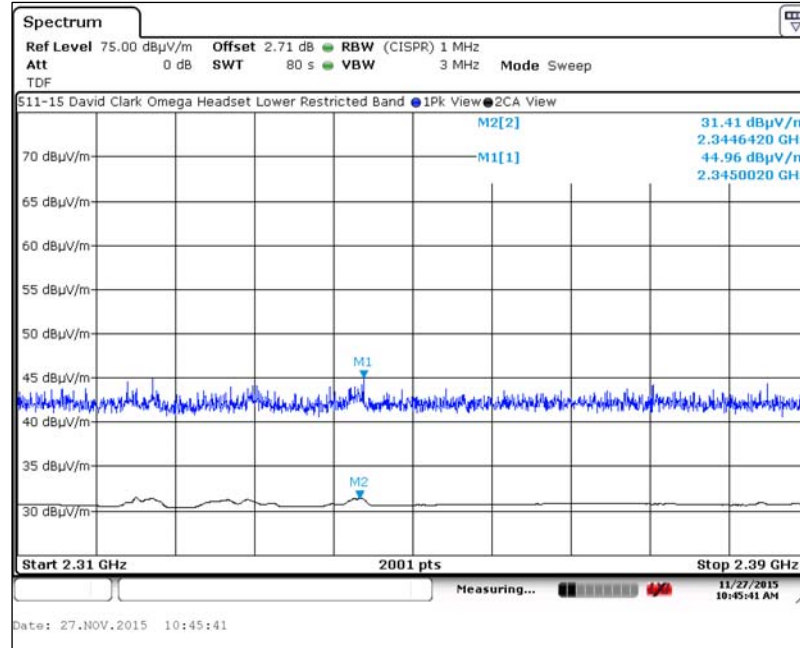




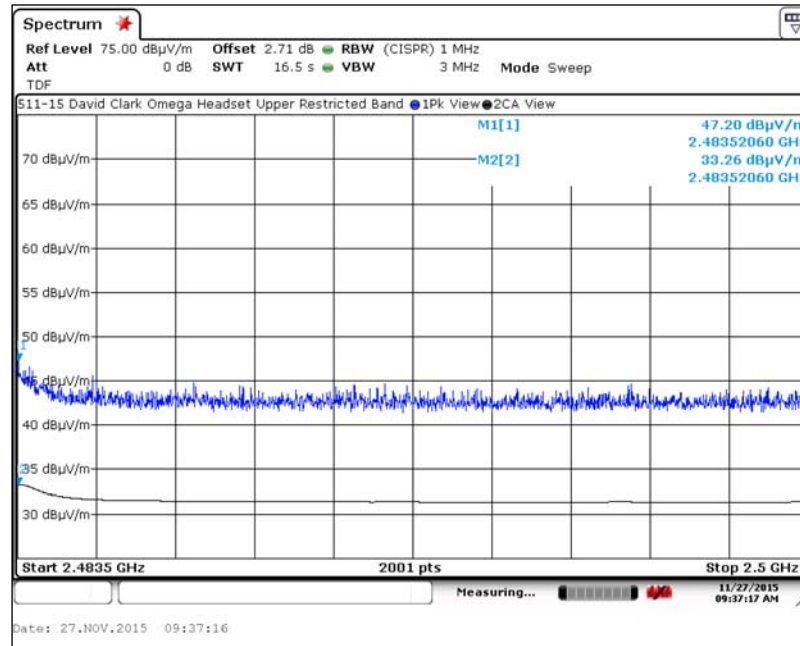
6. Measurement Data

6.7. Band Edge (15.247 (d), RSS-210 A8.5, RSS-247 5.5))

6.7.3. Lower Restricted Band (2310 MHz to 2390 MHz)



6.7.4. Upper Restricted Band (2483.5 MHz to 2500 MHz)



**6. Measurement Data (continued)**

**6.8. 99% (Occupied) Bandwidth**

Requirement: For devices operating above 900 MHz, the 99% bandwidth shall be no wider than 0.5% of the center frequency.

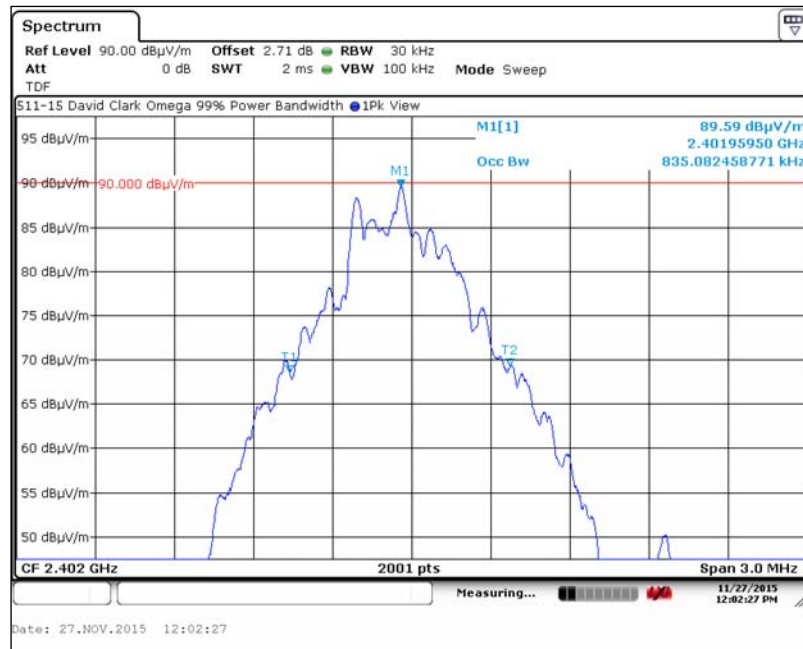
The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.

Resolution Bandwidth : 30 kHz  
 Video Bandwidth : 100 kHz

**6.8.1. Measurement Results**

Channel	Channel Frequency (MHz)	99% Power Bandwidth (MHz)
Low	2402	0.835
Middle	2441	0.823
High	2480	0.837

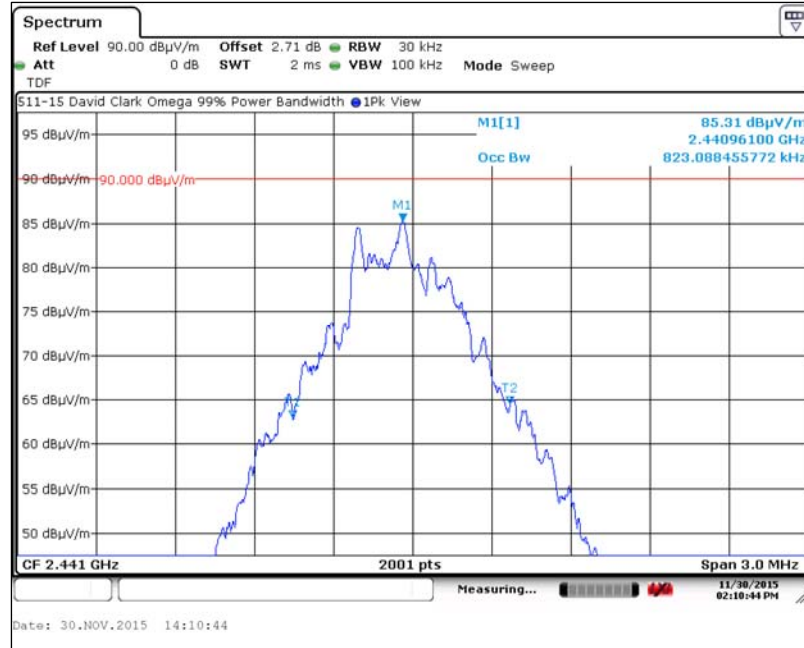
**6.8.1.1. 99% Power Bandwidth – Low Frequency (2402 MHz)**



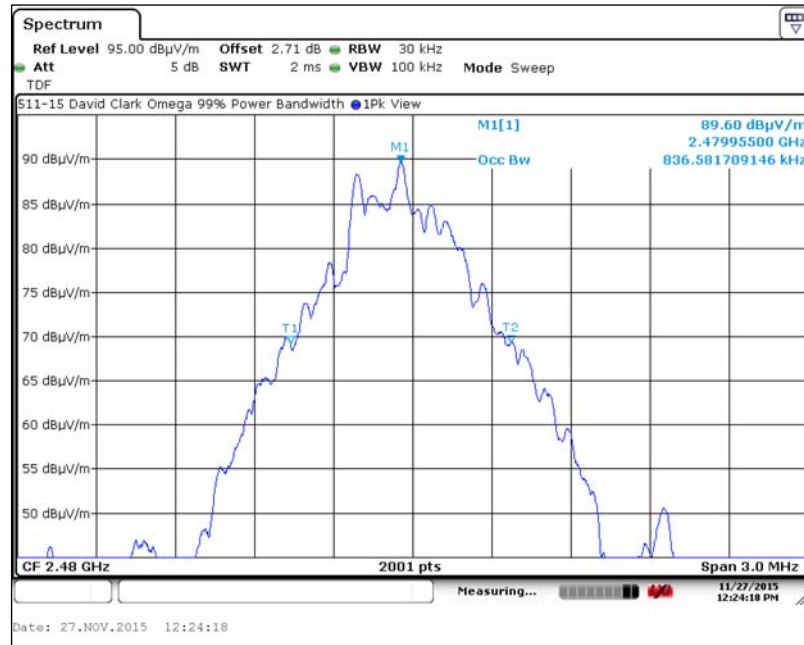
6. Measurement Data (continued)

6.8. 99% Bandwidth

6.8.1.2. 99% Power Bandwidth – Middle Frequency (2441 MHz)



6.8.1.3. 99% Power Bandwidth – High Frequency (2480 MHz)



**6. Measurement Data (continued)**

**6.9. Combined Spurious Harmonic Radiated Emissions (ANSI C63.4 Section 10.2.8.2, RSS-210 A8.9)**

Test Note: The following table represents the worst case measurement of each harmonic emission, taking into account the ANSI C63.4 requirement of rotating the DUT through three orthogonal axes.

Resolution Bandwidth : 1 MHz  
 Video Bandwidth : 3 MHz

Frequency (MHz)	Field Strength (dBµV/m) <sup>1</sup>		Limit (dBµV/m)		Margin (dB)		Pol (H/V)	Results
	Peak	Avg	Peak	Avg	Peak	Avg		
4804.000	54.66	39.53	74.00	54.00	-19.34	-14.47	H	Compliant
4882.000	55.05	40.04	74.00	54.00	-18.95	-13.96	H	Compliant
4960.000	51.38	38.04	74.00	54.00	-22.62	-15.96	H	Compliant
7323.000	53.07	39.01	74.00	54.00	-20.93	-14.99	V	Compliant
7440.000	55.60	41.98	74.00	54.00	-18.40	-12.02	H	Compliant
12010.000	59.25	45.11	74.00	54.00	-14.75	-8.89	H	Compliant
12205.000	59.77	45.42	74.00	54.00	-14.23	-8.58	H	Compliant
12400.000	60.12	45.43	74.00	54.00	-13.88	-8.57	V	Compliant
19216.000	61.85	47.36	74.00	54.00	-12.15	-6.64	V	Compliant
19528.000	60.82	47.49	74.00	54.00	-13.18	-6.51	H	Compliant
19840.000	63.02	49.55	74.00	54.00	-10.98	-4.45	H	Compliant
22320.000	63.02	49.55	74.00	54.00	-10.98	-4.45	H	Compliant

**6. Measurement Data (continued)**

**6.10. Spurious Radiated Emissions Test Results (15.209), RSS-GEN 8.9**

Requirement: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Regulatory Limits: FCC Part 15.209

Frequency Range (MHz)	Distance (Meters)	Limit (dBµV/m) <sup>1</sup>
0.009 to 0.490	3	128.5 to 93.8
0.490 to 1.705	3	73.8 to 63.0
1.705 to 30	3	69.5
30 to 88	3	40.0
88 to 216	3	43.5
216 to 960	3	46.0
>960	3	54.0

<sup>1</sup> Measurements in the 9 to 90 kHz, 110 to 490 kHz and above 1000 MHz ranges employ an average detector. Otherwise a quasi-peak detector is used.

Procedure: Test measurements were made in accordance with ANSI C63.10-2009, American National Standard for Testing Unlicensed Wireless Devices.

Test Notes: The frequency span that includes the Bluetooth transmitters was omitted from the spurious emissions scan. Appendix A contains the screen captures taken for the spurious emissions test.

Result: The device under test met the spurious emissions requirements.

**Worst Case Measurements**

Range (MHz)	Frequency (MHz)	Peak Field Strength (dBµV/m)	FCC 15.209 Limit (dBµV/m)	Margin (dB)	Result	Appendix A Reference
0.03 to 0.15	0.0307	95.36	117.848	-22.49	Compliant	A1.2
0.15 to 30.0	0.4925	64.55	73.756	-9.21	Compliant	A2.1
30 to 1000	319.5570	34.15	46.000	-11.85	Compliant	A3.5
1000 to 2400	2399.8600	46.82	54.000	-7.18	Compliant	A4.4
2483.5 to 7000	4888.6000	51.76	54.000	-2.24	Compliant	A5.3
7000 to 12000	9641.0000	51.53	54.000	-2.47	Compliant	A6.3
12000 to 18000	17959.8000	50.39	54.000	-3.61	Compliant	A7.3
18000 to 25000	24141.3000	47.72	54.000	-6.28	Compliant	A8.5

**6. Measurement Data (continued)**

**6.11. Unwanted Emissions in Non-Restricted Frequency Bands (15.209), RSS-GEN 8.9**

Requirement: 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Procedure: The procedure detailed in publication 558074 D01 - DTS Measurement Guidance v03r03, June 9, 2015, Section 11: *Emissions in non-restricted frequency bands* was used to perform the following measurements.

Test Notes: Reference Section 6.3, Screen Capture 6.3.3 for the in-band reference used to set the -20 dB limit for the measurements taken in this section. The Channel 78 100 kHz measurement level of 90.30 dB $\mu$ V/m was used as the reference for the out of band measurements.  
Reference Appendix B for the emissions in non-restricted frequency bands screen captures.

Result: The device under test met the spurious emissions requirements.

Worst Case Measurements

Range	Frequency	Peak Field Strength	W/C In-Band -20 dB	Margin	Result	Appendix B Reference
(MHz)	(MHz)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)		
30 to 1000	993.011	54.46	70.03	-15.57	Compliant	B1.5
1000 to 2400	1603.980	36.30	70.03	-33.73	Compliant	B2.1
2483.5 to 10000	9632.500	38.79	70.03	-31.24	Compliant	B3.3
10000 to 18000	17917.600	57.60	70.03	-12.43	Compliant	B4.6
18000 to 25000	24361.000	39.06	70.03	-30.97	Compliant	B5.4

**6. Measurement Data (continued)**

**6.12. Public Exposure to Radio Frequency Energy Levels (15.247(i) (1.1307 (b)(1))  
RSS-GEN, Section 5.5, RSS 102)**

**6.12.1. 15.247(i) (1.1307 (b)(1)) Requirements**

Requirement: Portable devices are subject to radio frequency radiation exposure requirements.

For a 1-g SAR, the test exclusion result must be  $\leq 3.0$ .

Test Notes: The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by the following formula:

$$\text{SAR Test Exclusion} = \frac{P_{\text{MAX}}}{d_{\text{MIN}}} \times \sqrt{f_{\text{(GHz)}}} \quad (1)$$

$P_{\text{MAX}}$  mW Maximum power of channel, including tune-up tolerance

$d_{\text{MIN}}$  mm Minimum test separation distance, mm ( $\leq 50$  mm)

$f_{\text{(GHz)}}$  GHz  $f_{\text{(GHz)}}$  is the RF channel transmit frequency in GHz ( $>100$  MHz and  $<6$  GHz)

(1) FCC OET 447498 - Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

Result: The device under test meets the exclusion requirement detailed in FCC OET 447498.

<b>Input:</b> $P_{\text{MAX}}^1$ (mW)	0.25	0.21	0.24
$d_{\text{MIN}}$ (mm)	5.00	5.00	5.00
$f_{\text{(GHz)}}$	2.402	2.402	2.480
<b>Test Exclusion:</b>	<b>0.08</b>	<b>0.06</b>	<b>0.08</b>
<b>Limit Exemption:</b>	<b>3.00</b>	<b>3.00</b>	<b>3.00</b>

<sup>1</sup> Taken from column 7 of the table in Section 6.6 of this report.

**6.12.2. RSS-102 Issue 5 Requirements**

Requirement: SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. Portable devices are subject to radio frequency radiation exposure requirements.

Test Notes: The limit was taken from Table 1 of RSS-102 Issue 5.

Frequency (MHz)	Separation Distance (mm)	Maximum Power (mW)	RSS-102 Limit (mW)	Result
2402.00	$\leq 5$	0.25	4.26	Compliant
2441.00	$\leq 5$	0.21	4.05	Compliant
2480.00	$\leq 5$	0.24	3.94	Compliant

## 7. Test Setup Images

### 7.1. Radiated Emissions – Front View





## 7. Test Setup Images

### 7.2. Radiated Emissions – Rear View Below 30 MHz



**7. Test Setup Images**

**7.3. Radiated Emissions – Rear View 30 MHz to 1 GHz**



## 7. Test Setup Images

### 7.4. Microwave Emissions – Front View



**7. Test Setup Images**

**7.5. Microwave Emissions – Rear View 1 GHz to 18 GHz**



## 7. Test Setup Images

### 7.6. Microwave Emissions – Rear View above 18 GHz



## 8. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with Federal Communications Commission (FCC), Industry Canada, and Voluntary Control Council Interference (VCCI) standards. A description of the test sites is on file with the FCC (registration number 96392), Industry Canada (file number IC 3023A-1), and VCCI (Member number 3168), Registration numbers C-3673, G-167, R-3305 & T-1809.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 22, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 22.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane required by EN 55022.

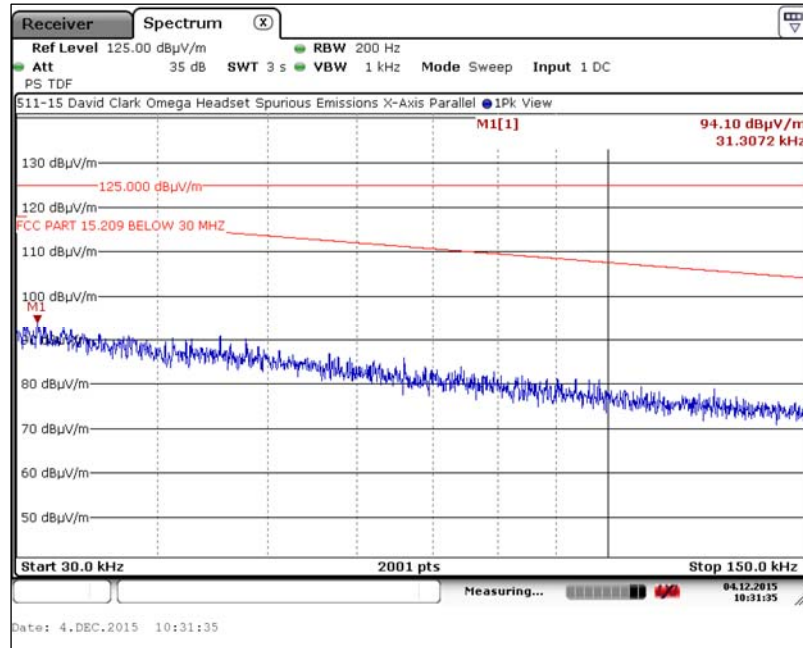
Both sites are designed to test products or systems 1.5 meters W x 1.5 meters L x 2.0 meters H, floor standing or table top.

Appendix A

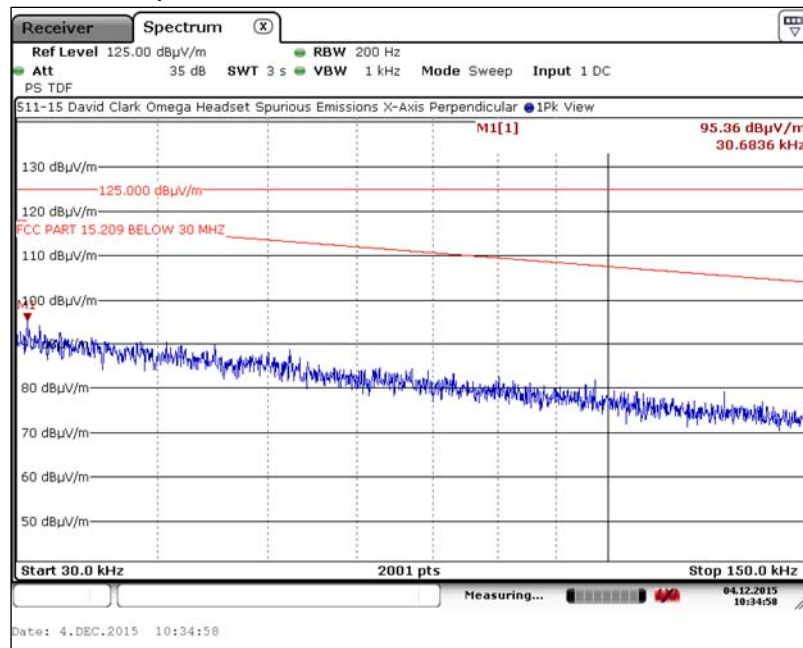
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A1. Measurement Results – 30 kHz to 150 kHz

A1.1. X-Axis, Parallel Antenna



A1.2. X-Axis, Perpendicular Antenna

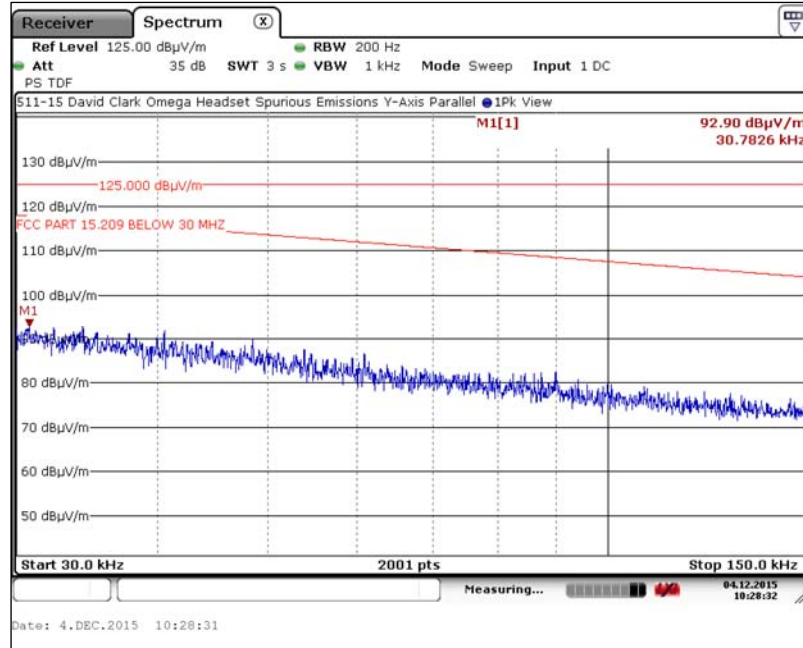


Appendix A (continued)

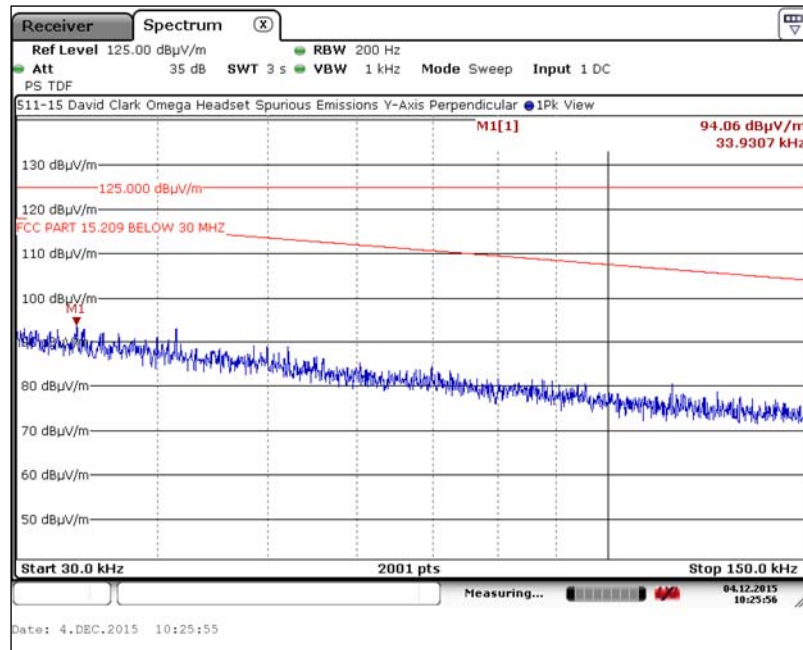
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A1. Measurement Results – 30 kHz to 150 kHz (continued)

A1.3. Y-Axis, Parallel Antenna



A1.4. Y-Axis, Perpendicular Antenna



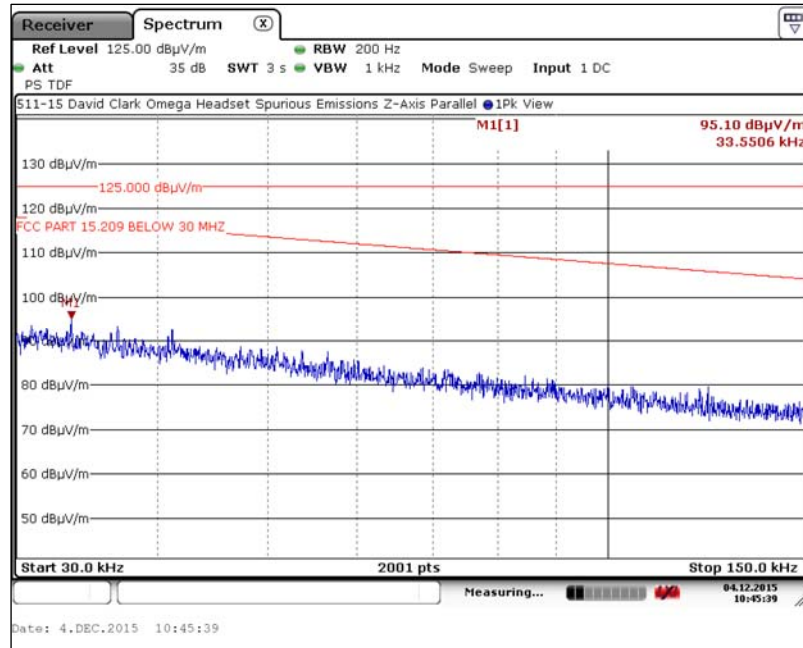


Appendix A (continued)

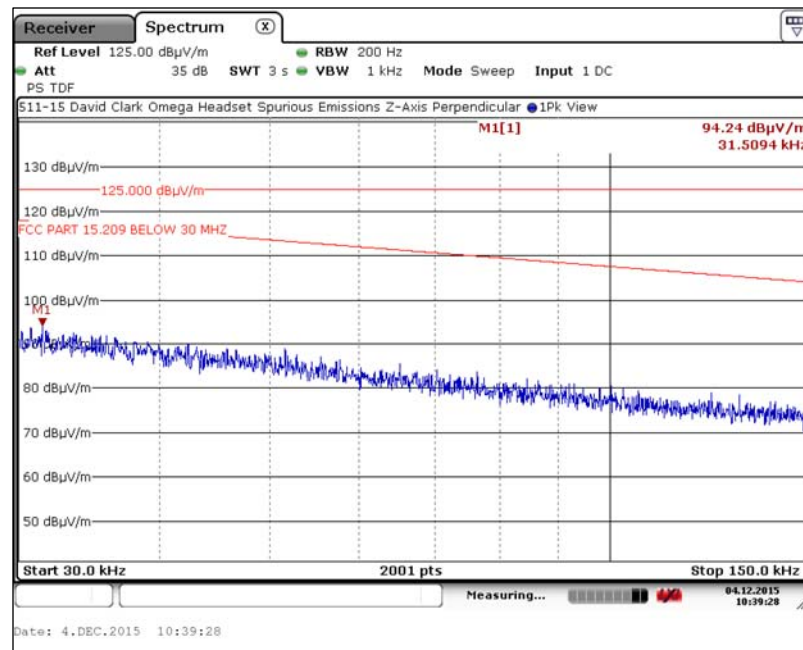
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A1. Measurement Results – 30 kHz to 150 kHz (continued)

A1.5. Z-Axis, Parallel Antenna



A1.6. Z-Axis, Perpendicular Antenna

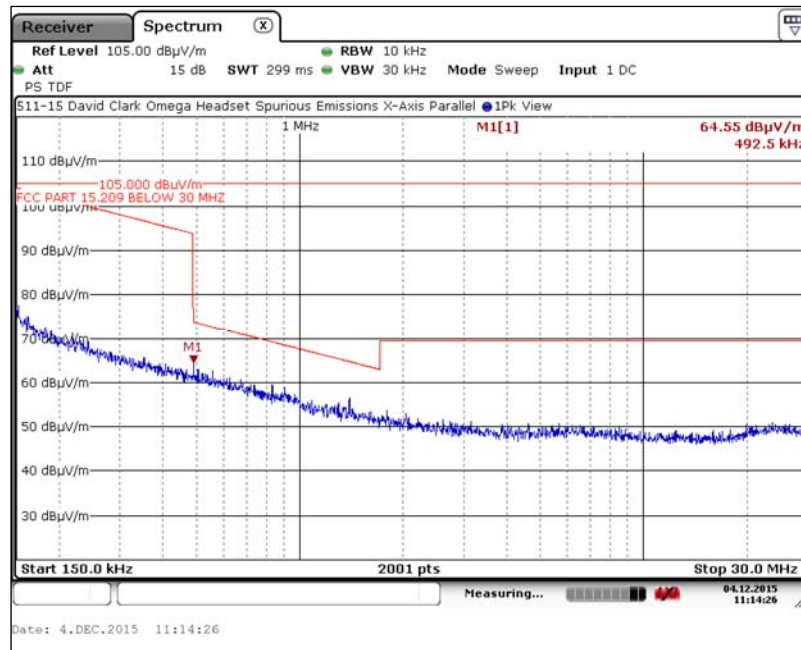


Appendix A (continued)

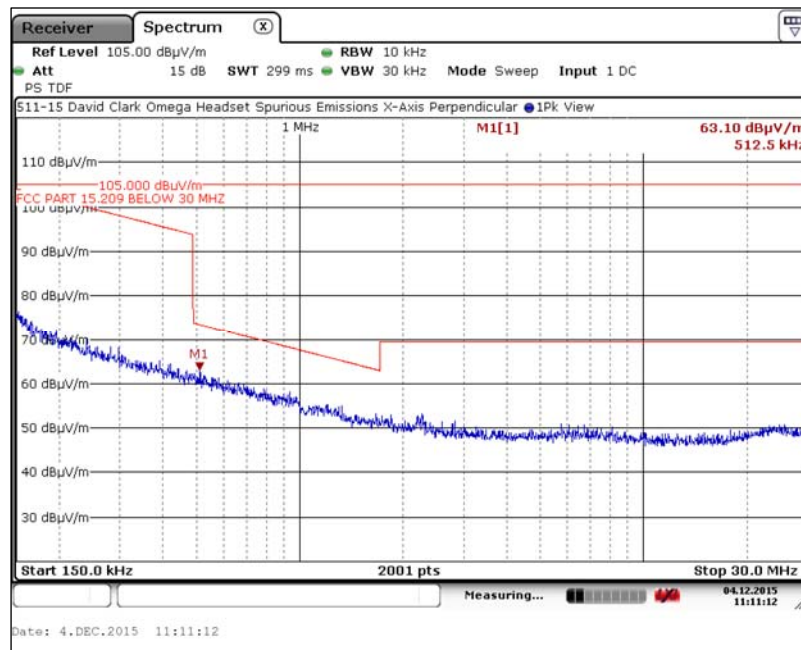
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A2. Measurement Results – 150 kHz to 30 MHz

A2.1. X-Axis, Parallel Antenna



A2.2. X-Axis, Perpendicular Antenna

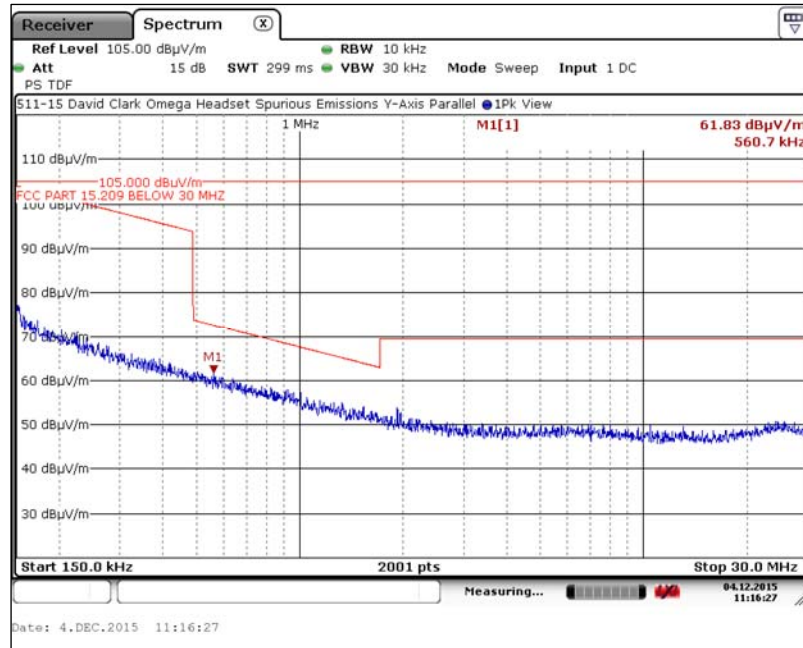


Appendix A (continued)

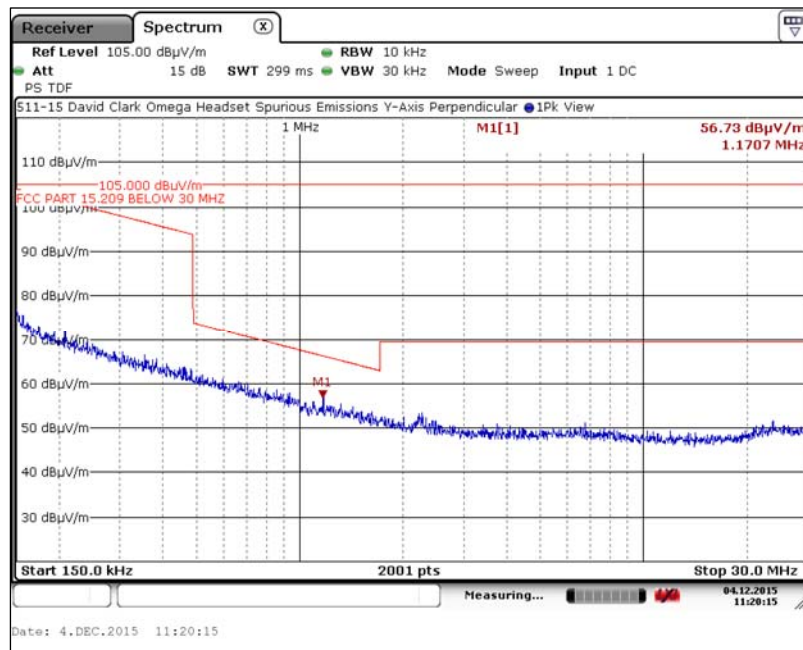
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A2. Measurement Results – 150 kHz to 30 MHz (continued)

A2.3. Y-Axis, Parallel Antenna



A2.4 Y-Axis, Perpendicular Antenna

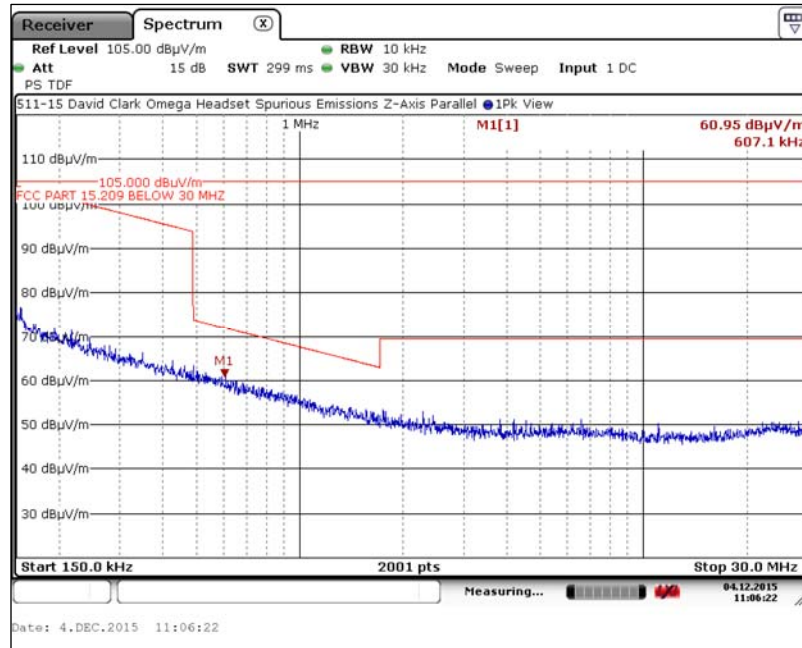


Appendix A (continued)

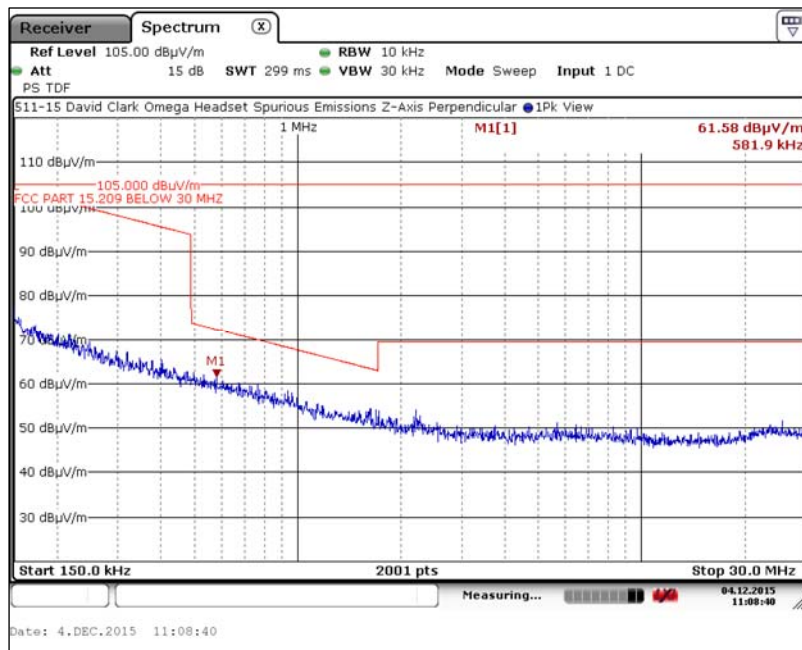
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A2. Measurement Results – 150 kHz to 30 MHz (continued)

A2.5. Z-Axis, Parallel Antenna



A2.6. Z-Axis, Perpendicular Antenna

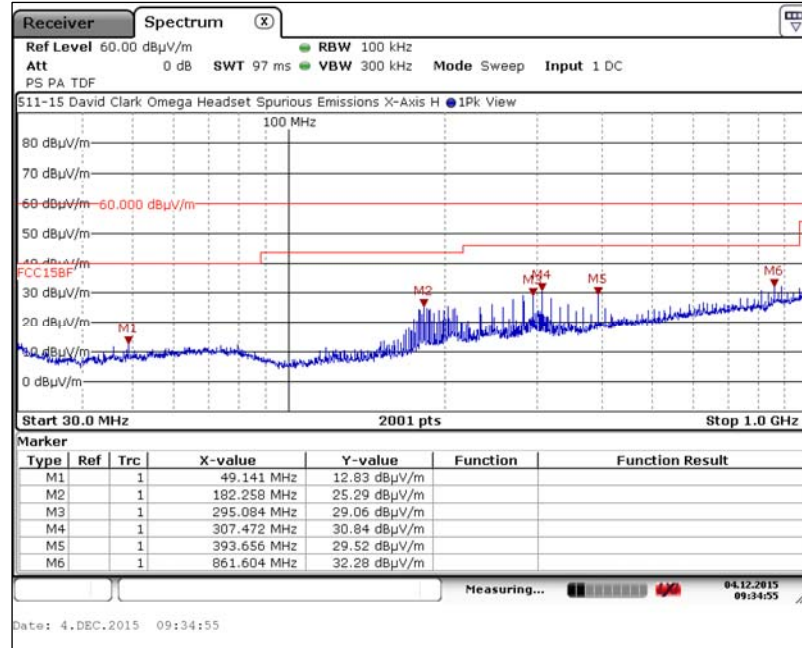


Appendix A (continued)

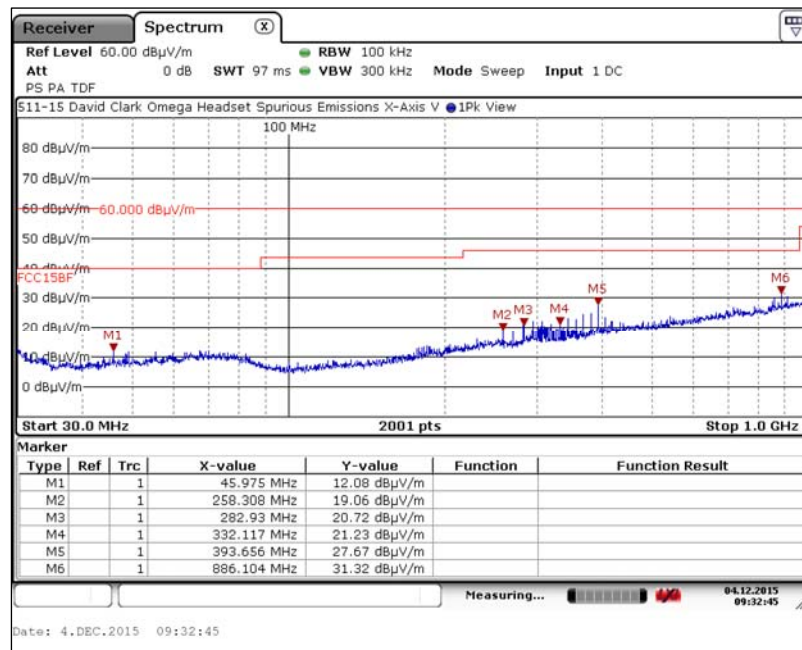
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A3. Measurement Results – 30 MHz to 1 GHz

A3.1. X-Axis, Horizontal Antenna



A3.2. X-Axis, Vertical Antenna

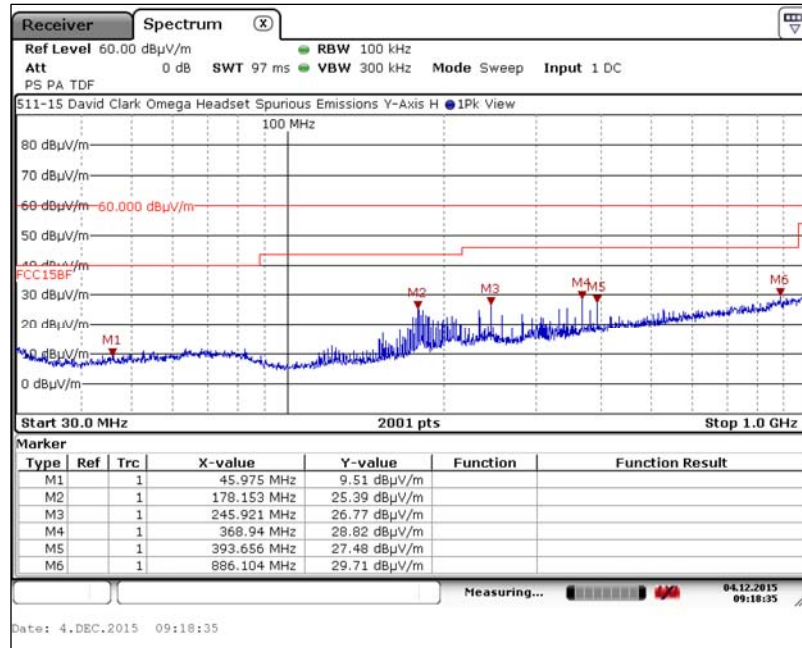


Appendix A (continued)

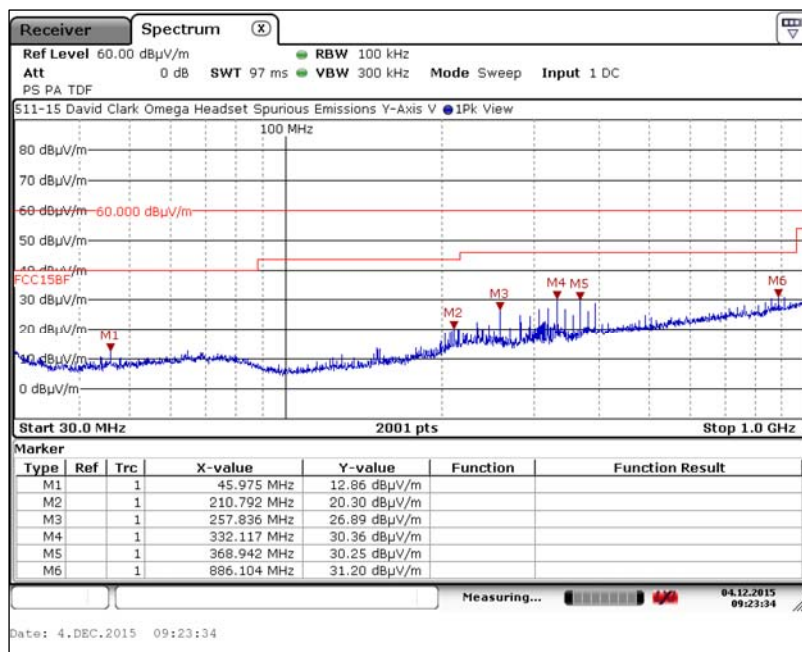
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A3. Measurement Results – 30 MHz to 1 GHz (continued)

A3.3. Y-Axis, Horizontal Antenna



A3.4. Y-Axis, Vertical Antenna

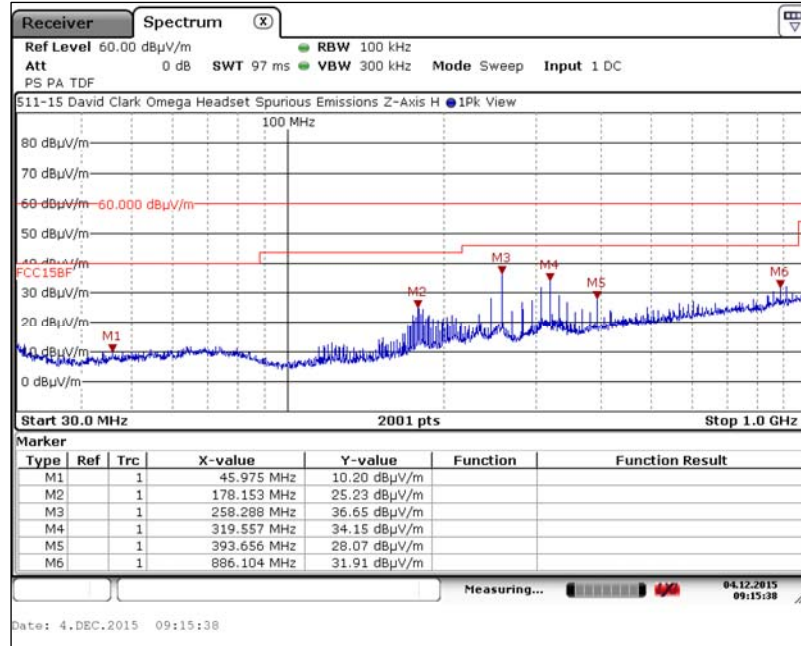


Appendix A (continued)

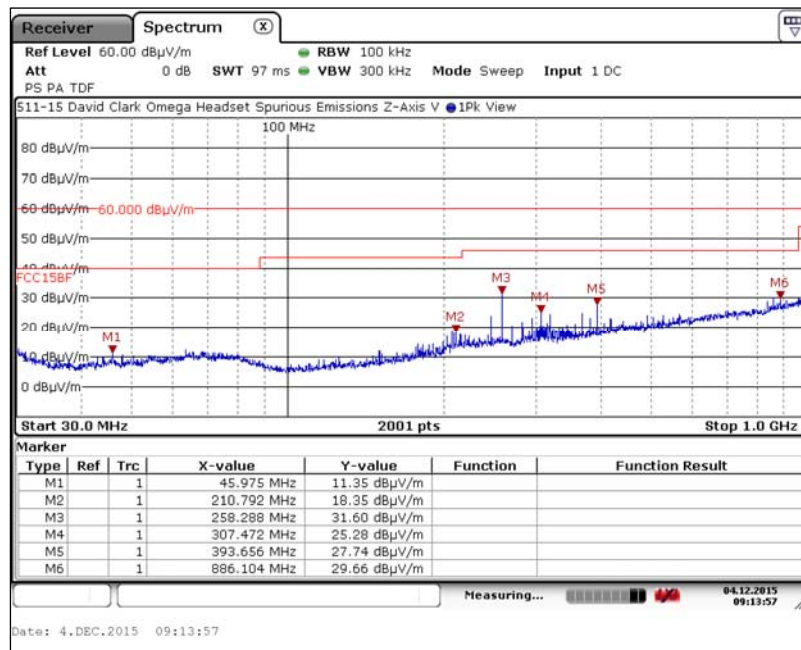
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A3. Measurement Results – 30 MHz to 1 GHz (continued)

A3.5. Z-Axis, Horizontal Antenna



A3.6. Z-Axis, Vertical Antenna

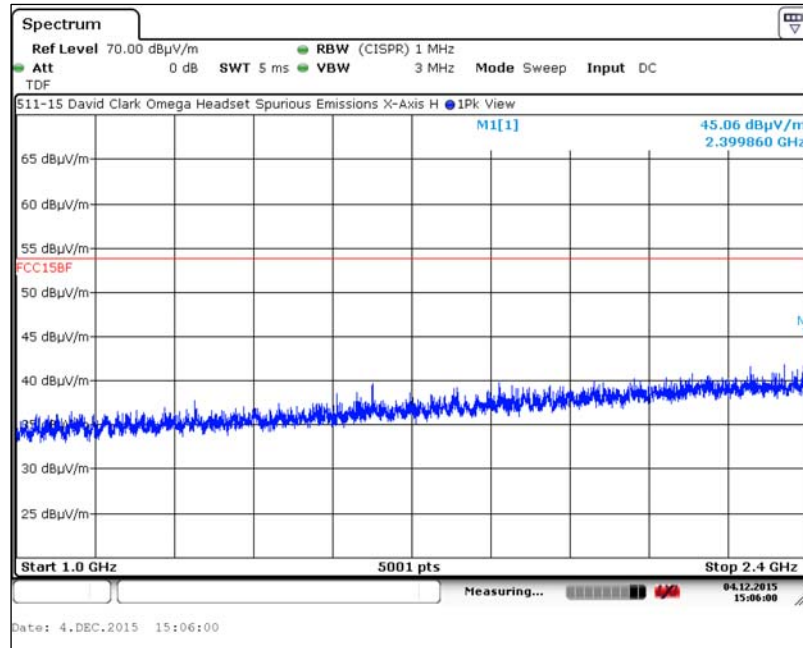


Appendix A (continued)

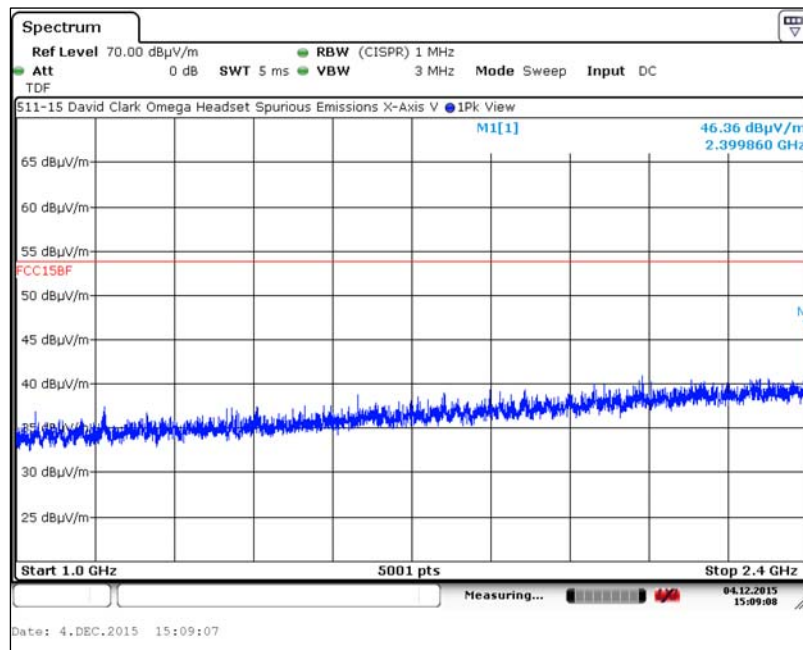
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A4. Measurement Results – 1 GHz to 2.4 GHz

A4.1. X-Axis, Horizontal Antenna



A4.2. X-Axis, Vertical Antenna



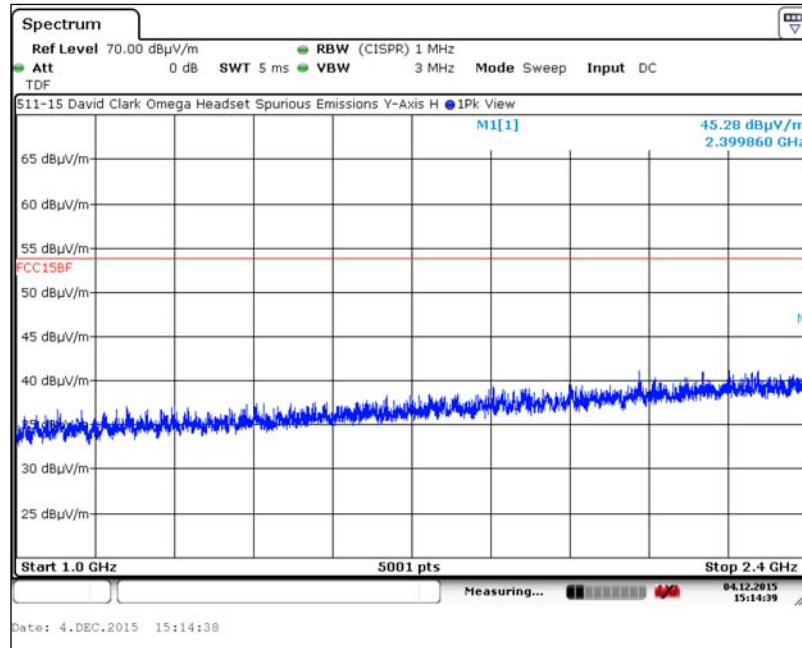


Appendix A (continued)

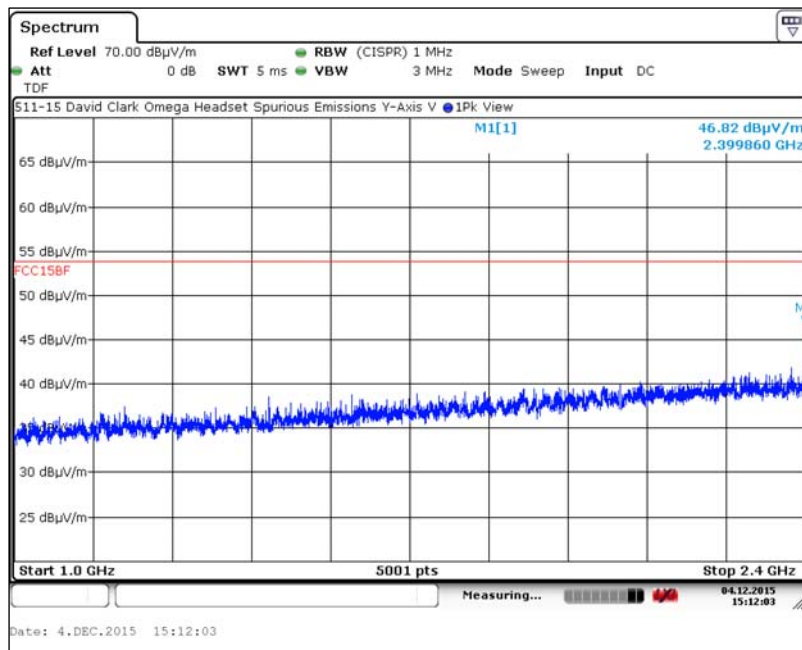
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A4. Measurement Results – 1 GHz to 2.4 GHz (continued)

A4.3. Y-Axis, Horizontal Antenna



A4.4. Y-Axis, Vertical Antenna

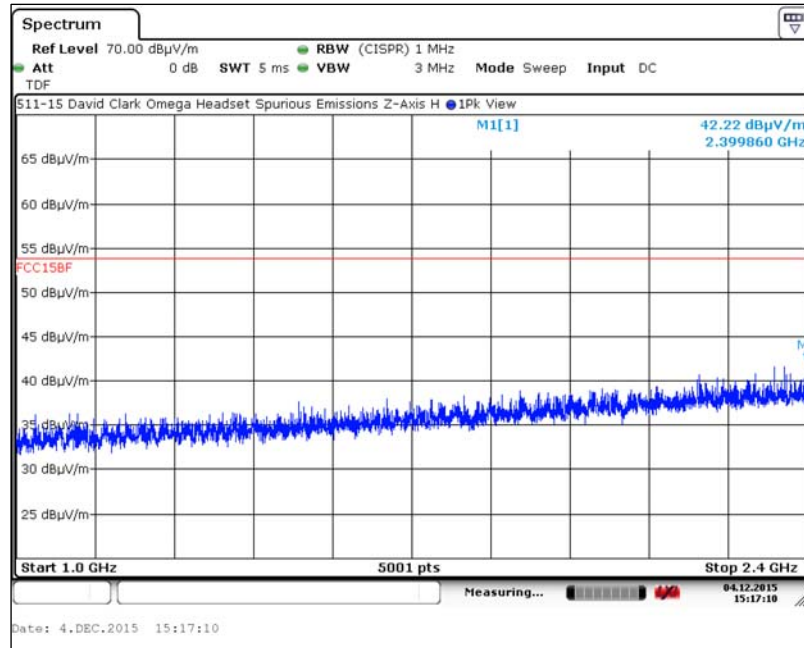


Appendix A (continued)

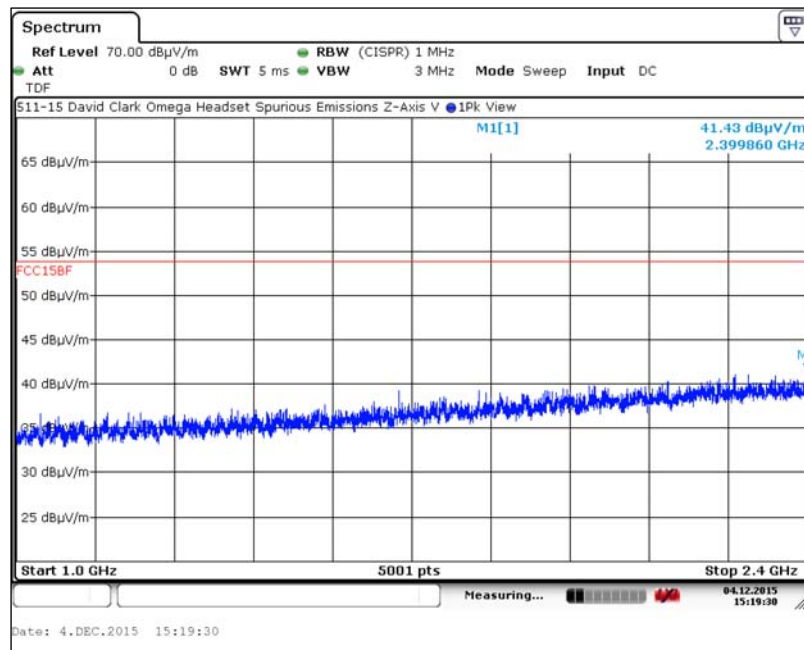
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A4. Measurement Results – 1 GHz to 2.4 GHz (continued)

A4.5. Z-Axis, Horizontal Antenna



A4.6. Z-Axis, Vertical Antenna

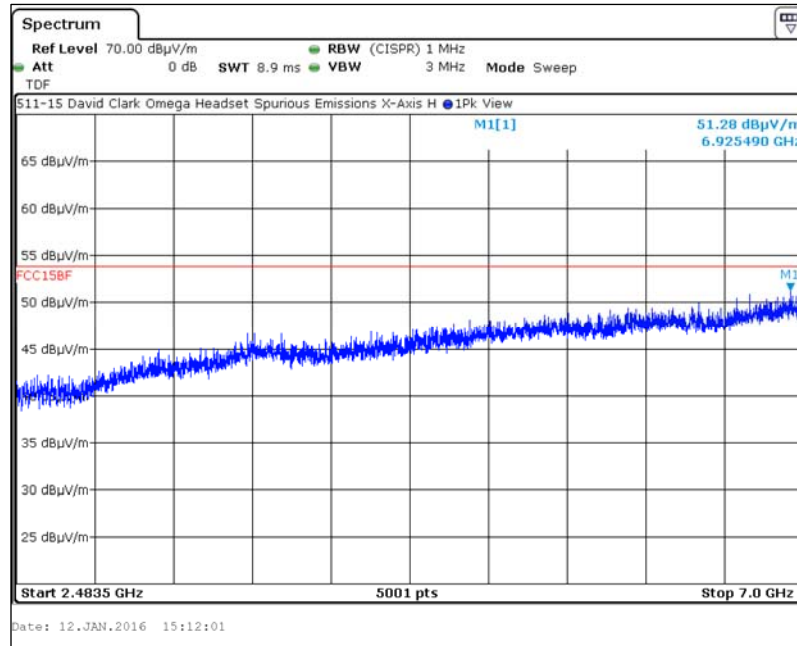


Appendix A (continued)

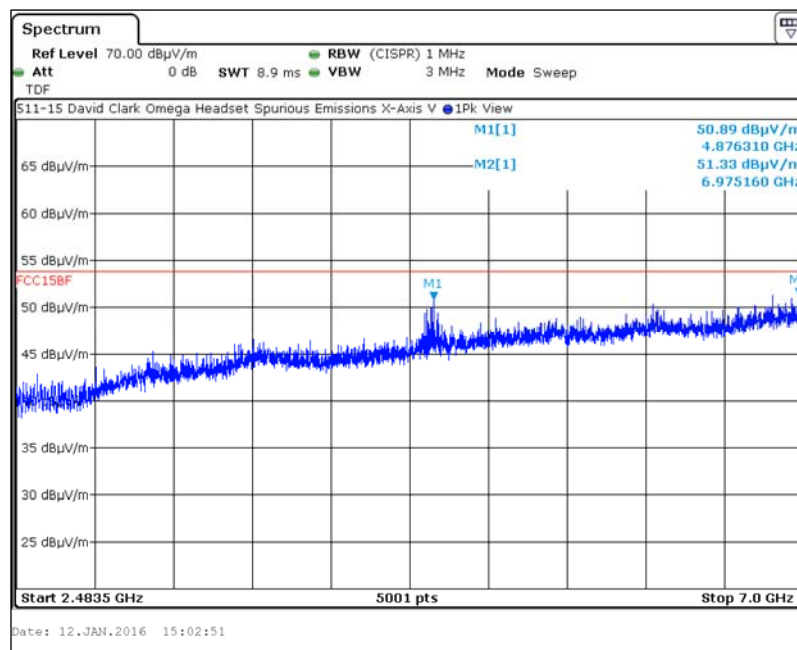
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A5. Measurement Results – 2.4835 GHz to 7 GHz

A5.1. X-Axis, Horizontal Antenna



A5.2. X-Axis, Vertical Antenna

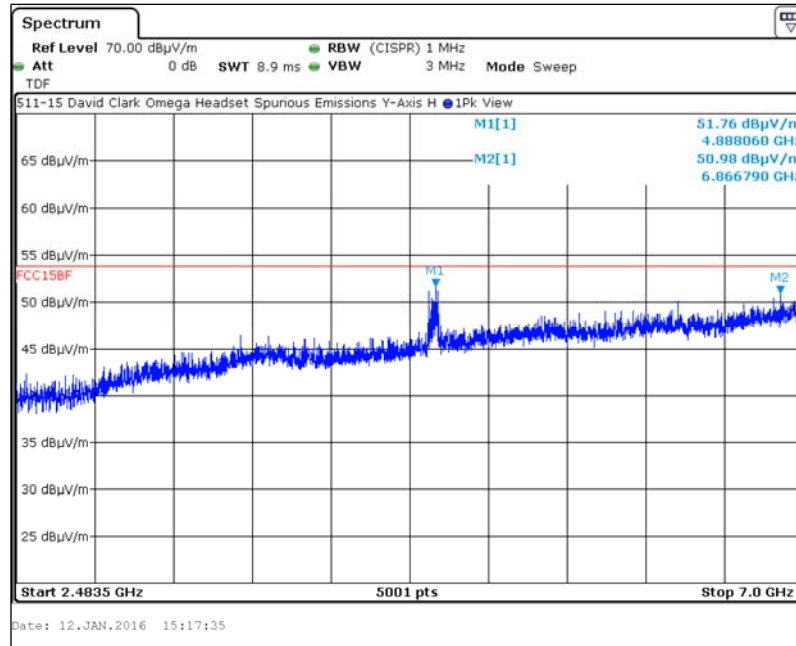


Appendix A (continued)

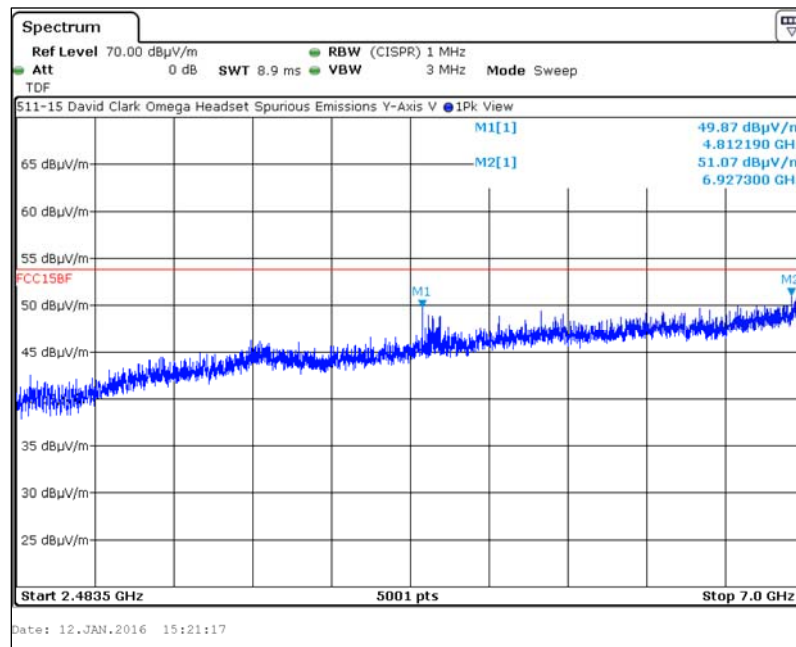
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A5. Measurement Results – 2.4835 GHz to 7 GHz (continued)

A5.3. Y-Axis, Horizontal Antenna



A5.4. Y-Axis, Vertical Antenna

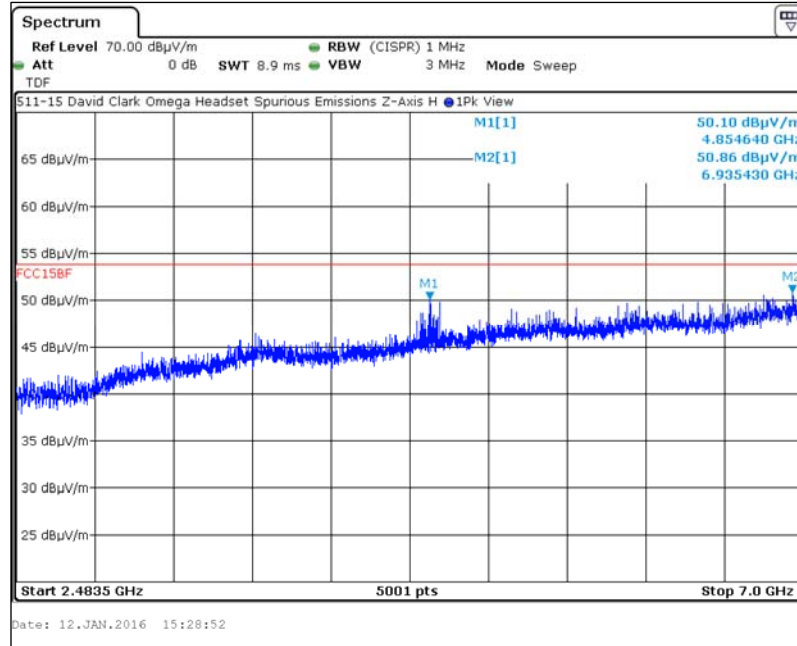


Appendix A (continued)

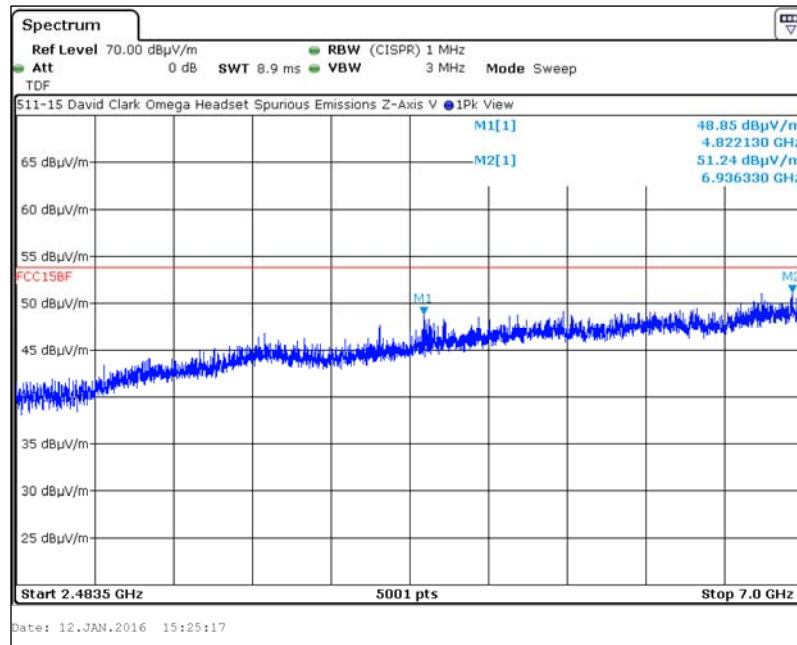
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A5. Measurement Results – 2.483.5 GHz to 7 GHz (continued)

A5.5. Z-Axis, Horizontal Antenna



A5.6. Z-Axis, Vertical Antenna

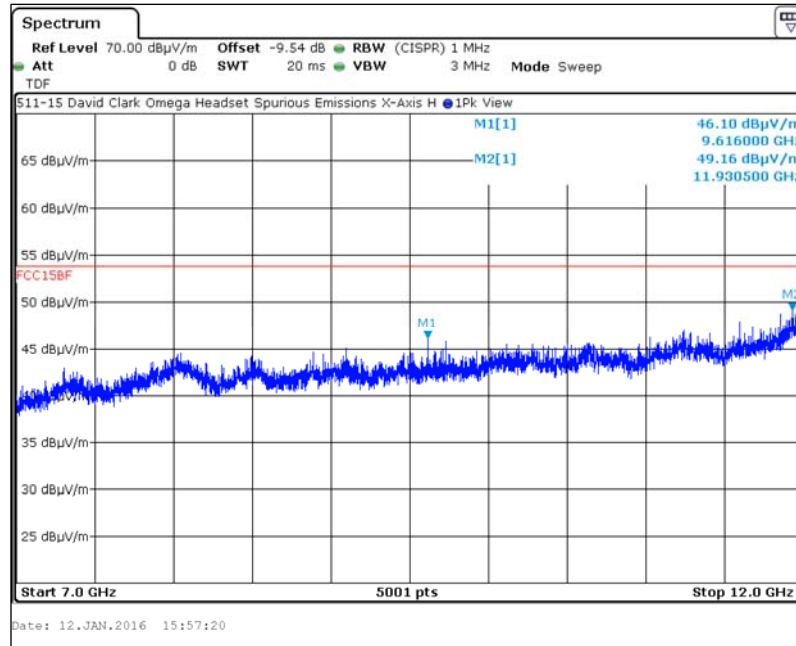


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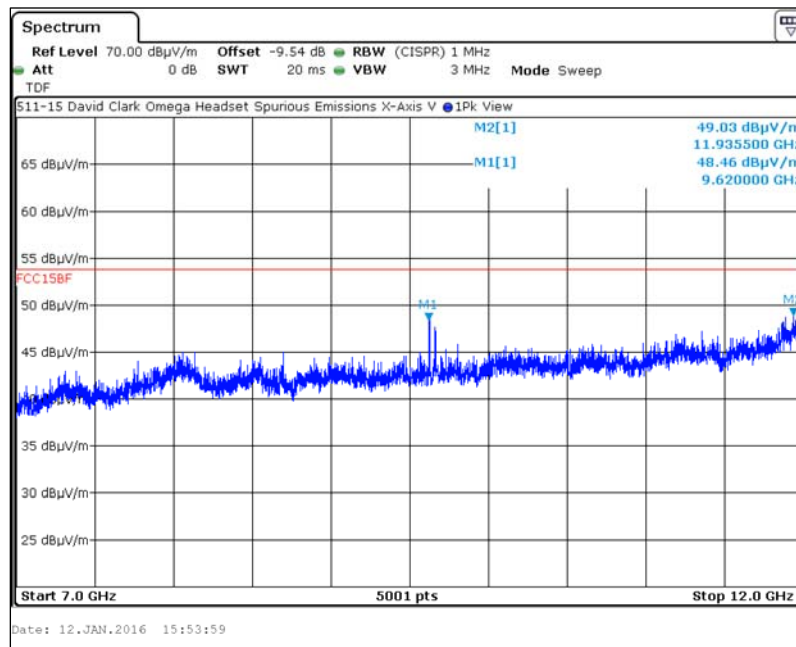
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A6. Measurement Results – 7 GHz to 12 GHz (continued)

A6.1. X-Axis, Horizontal Antenna



A6.2. X-Axis, Vertical Antenna

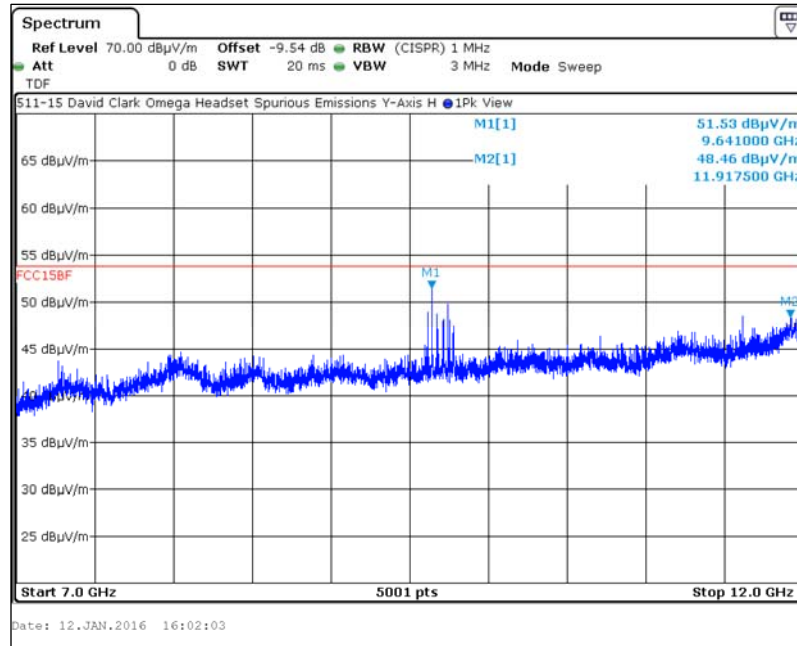


**Appendix A (continued)**

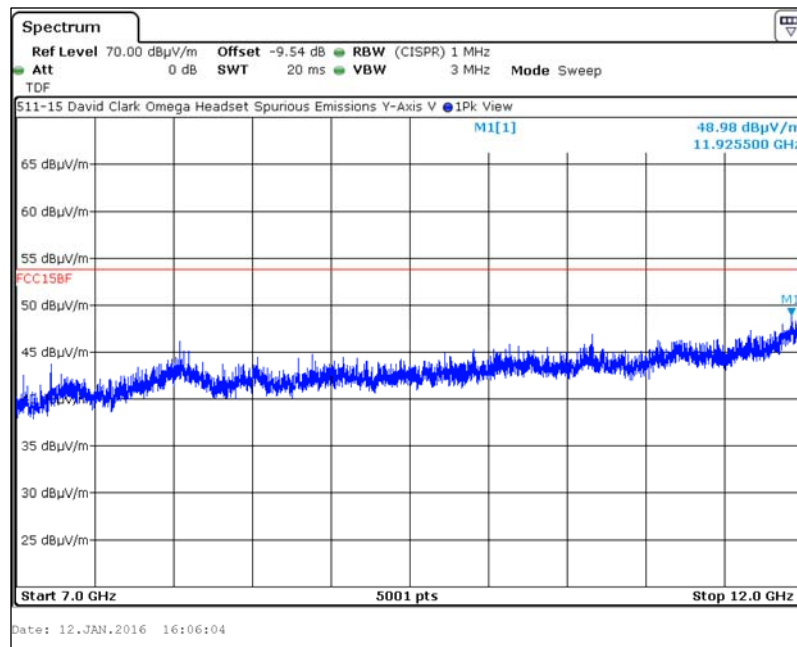
**Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN**

**A6. Measurement Results – 7 GHz to 12 GHz (continued)**

**6.3. Y-Axis, Horizontal Antenna**



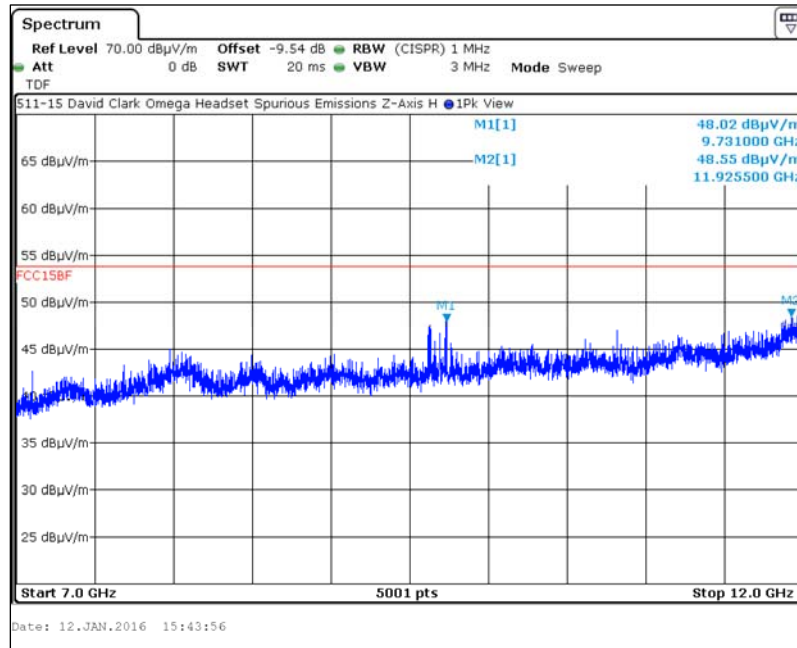
**A6.4. Y-Axis, Vertical Antenna**



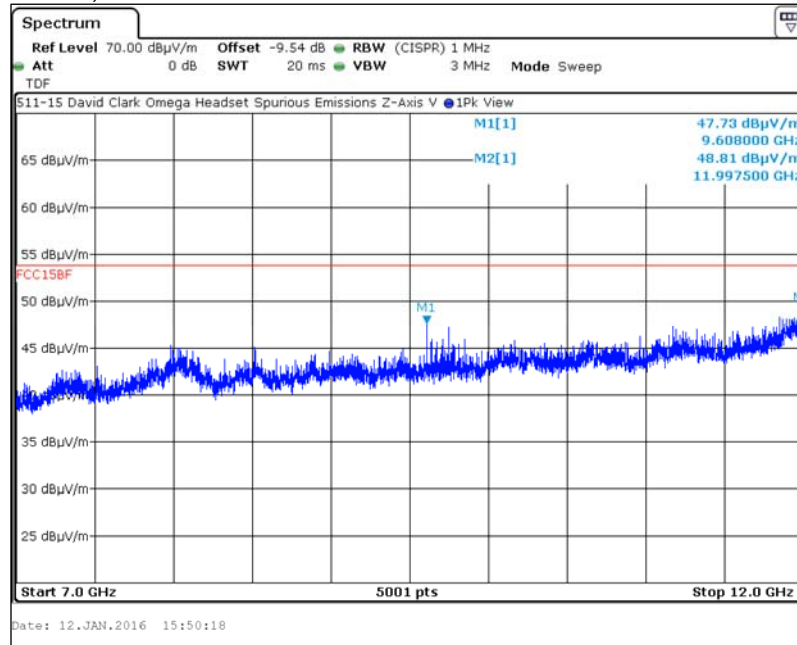
Appendix A (continued)

A6. Measurement Results – 7 GHz to 12 GHz (continued)

A6.5. Z-Axis, Horizontal Antenna



A6.6. Z-Axis, Vertical Antenna



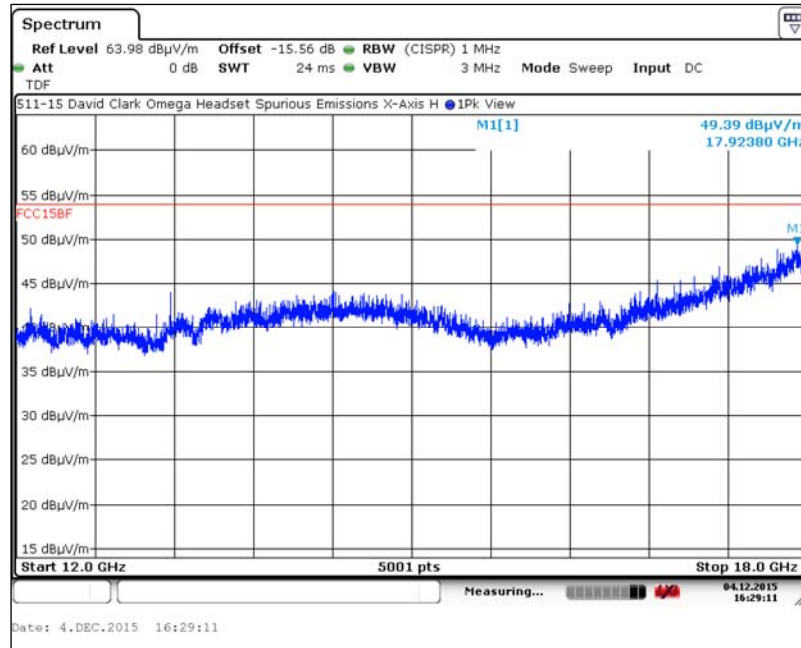


Appendix A (continued)

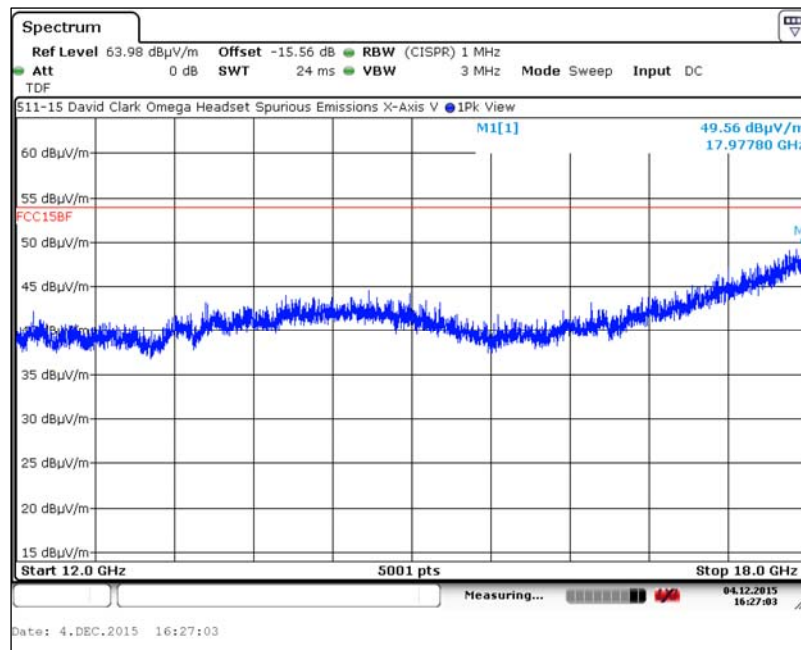
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A7. Measurement Results – 12 GHz to 18 GHz (continued)

A7.1. X-Axis, Horizontal Antenna



A7.2. X-Axis, Vertical Antenna

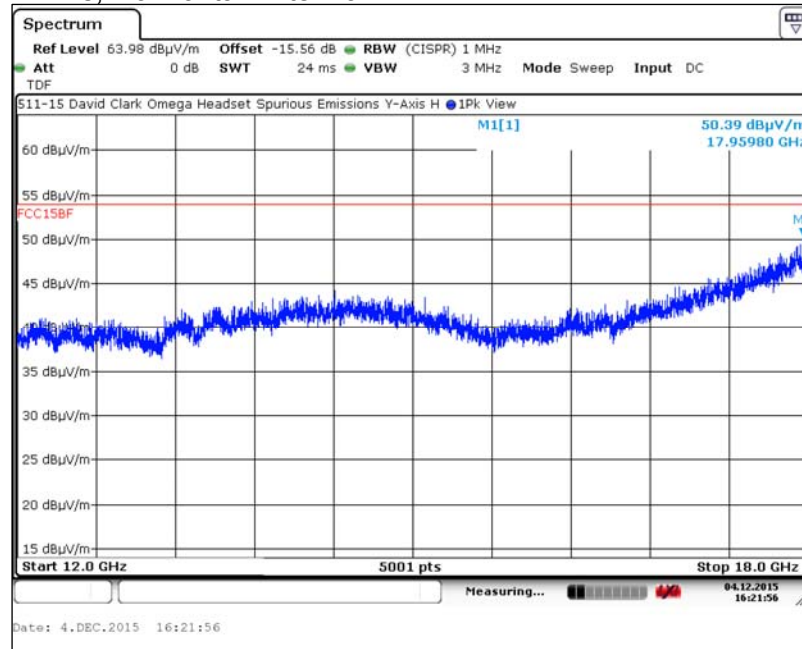


Appendix A (continued)

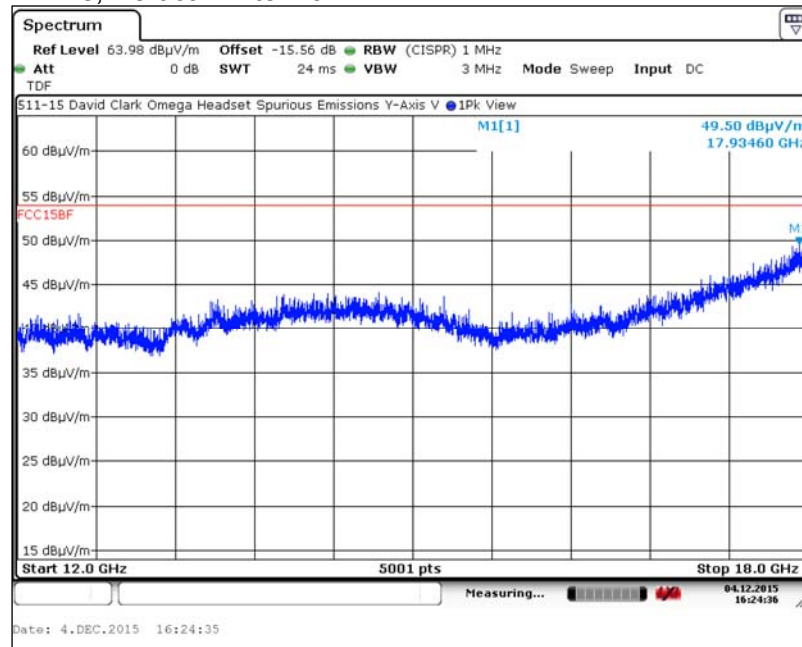
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A7. Measurement Results – 12 GHz to 18 GHz (continued)

A7.3. Y-Axis, Horizontal Antenna



A7.4. Y-Axis, Vertical Antenna

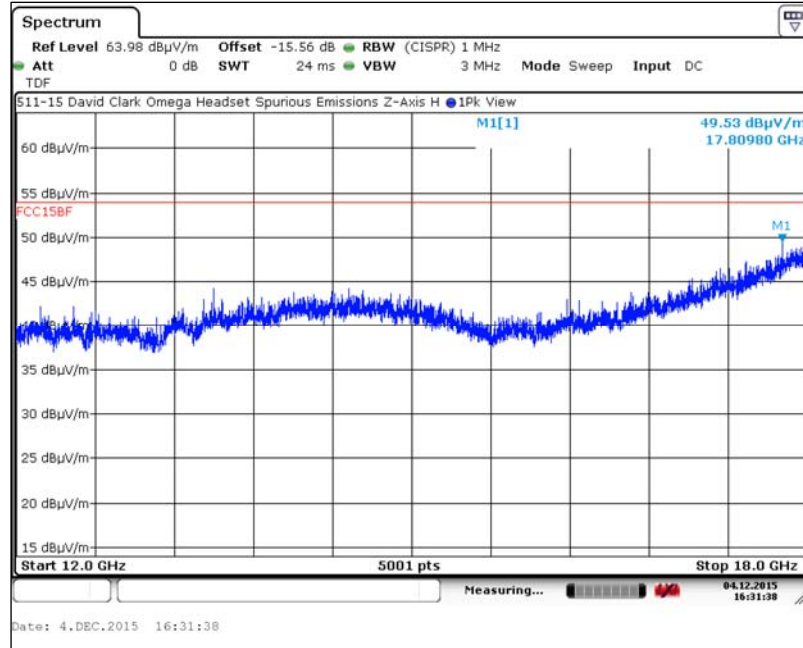


Appendix A (continued)

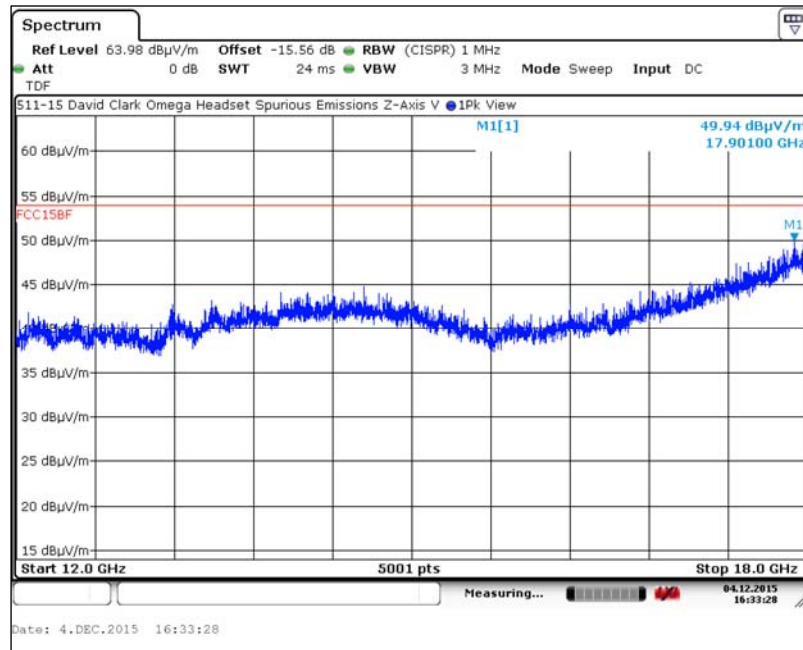
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A7. Measurement Results – 12 GHz to 18 GHz (continued)

A7.5. Z-Axis, Horizontal Antenna



A7.6. Z-Axis, Vertical Antenna

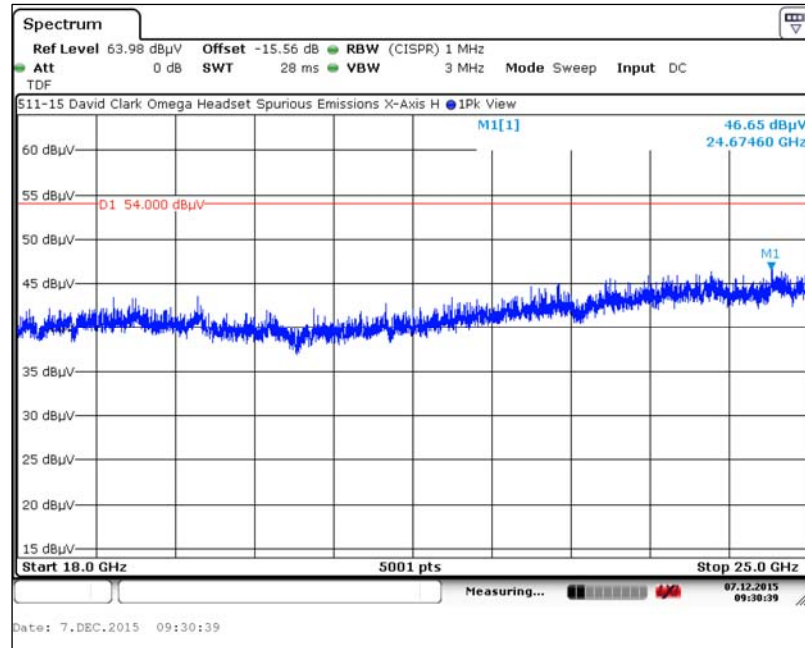


Appendix A (continued)

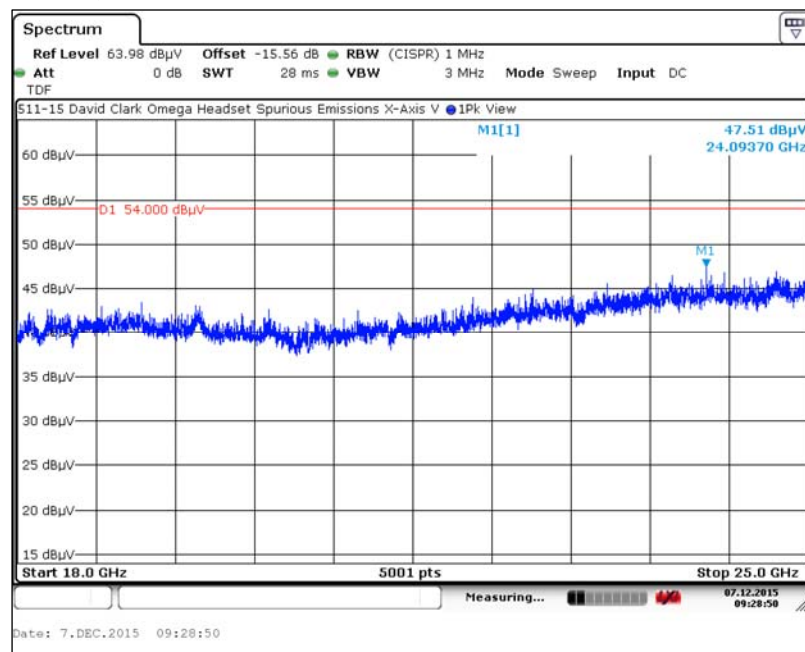
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A8. Measurement Results – 18 GHz to 25 GHz

A8.1. X-Axis, Horizontal Antenna



A8.2. X-Axis, Vertical Antenna

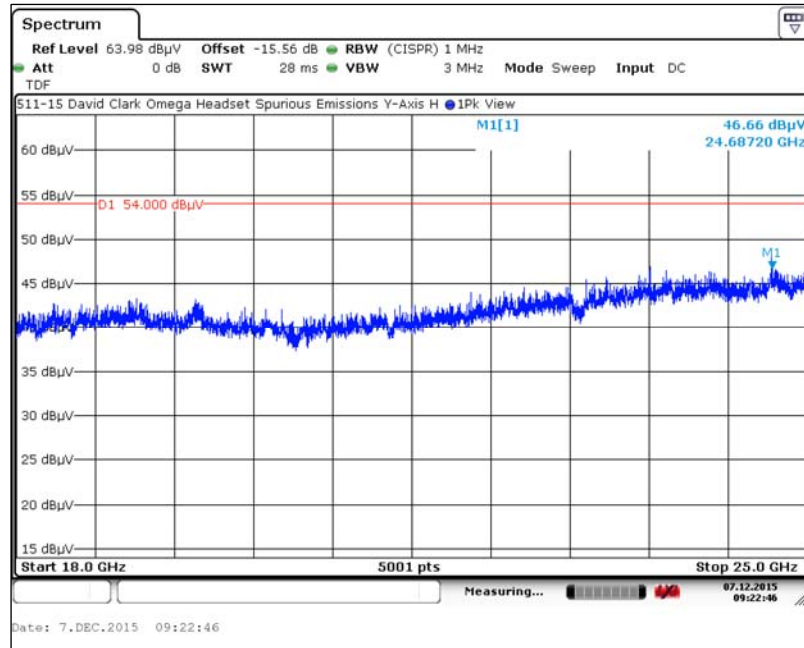


Appendix A (continued)

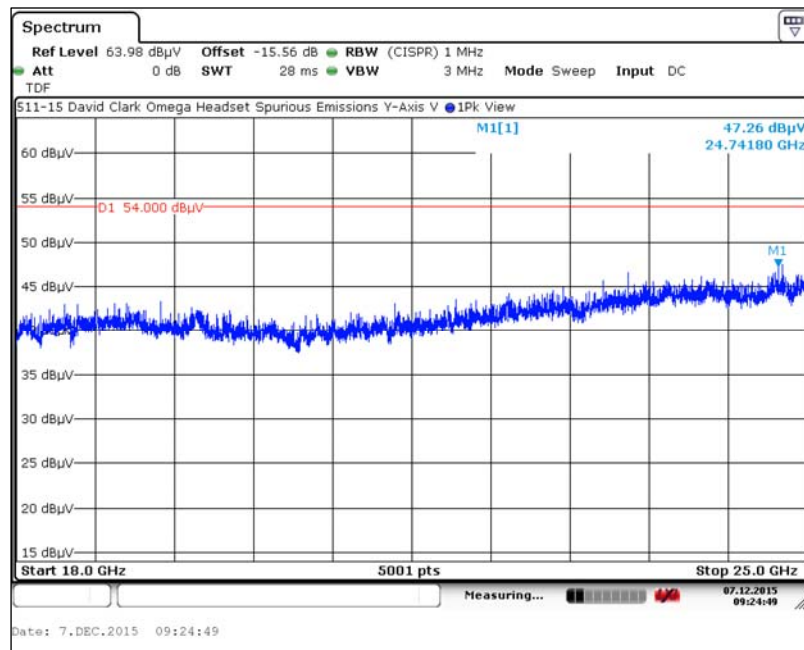
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A8. Measurement Results – 18 GHz to 25 GHz (continued)

A8.3. Y-Axis, Horizontal Antenna



A8.4. Y-Axis, Vertical Antenna

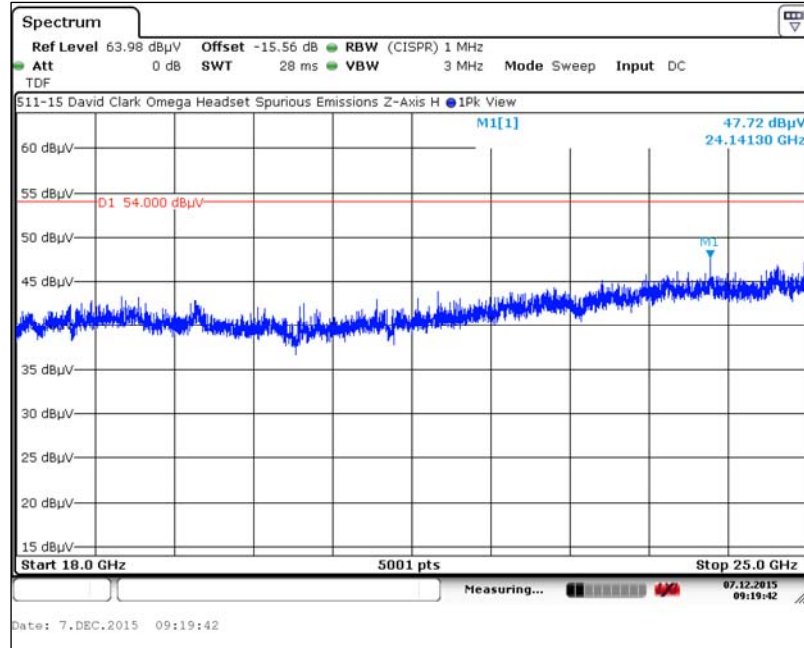


Appendix A (continued)

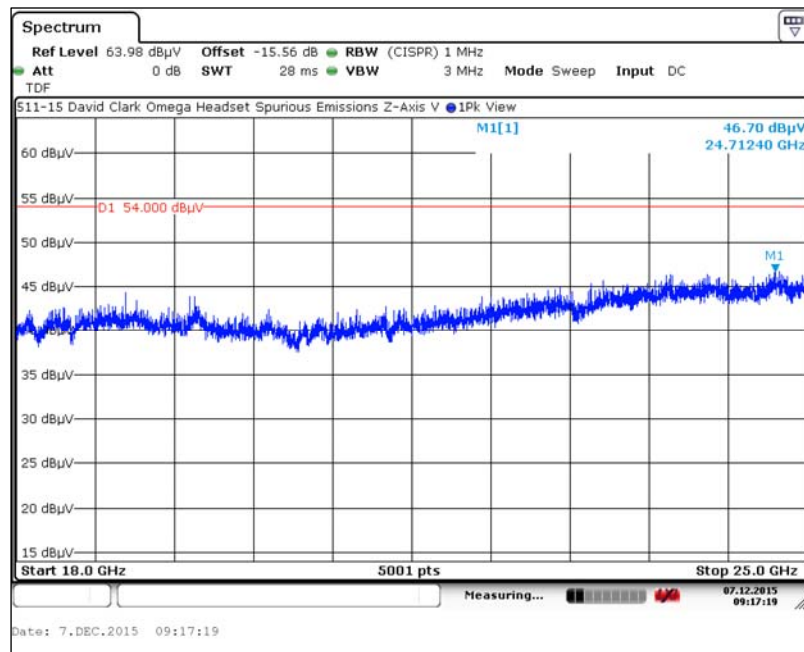
Spurious Radiated Emissions Test Results (15.209), IC RSS-GEN

A8. Measurement Results – 18 GHz to 25 GHz (continued)

A8.5. Z-Axis, Horizontal Antenna



A8.6. Z-Axis, Vertical Antenna

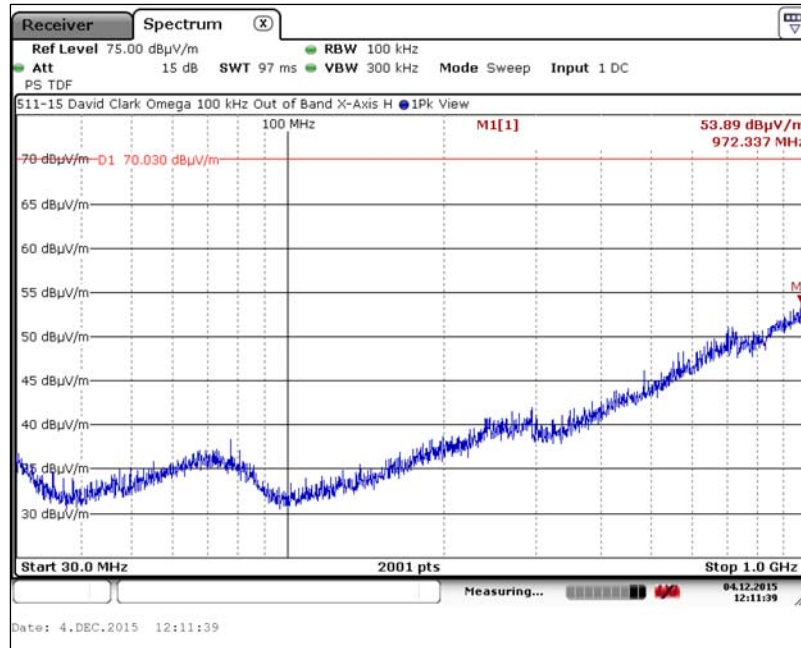


Appendix B (continued)

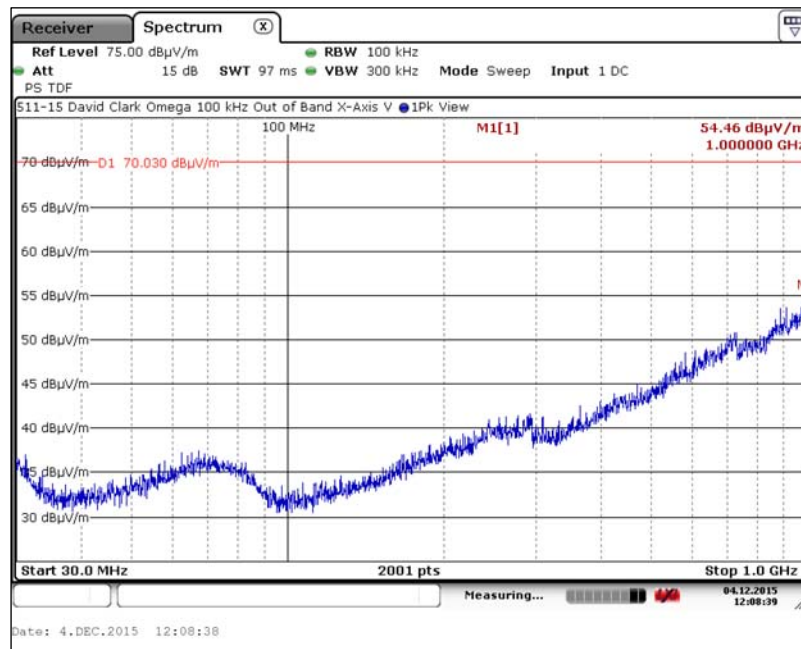
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B1. Measurement Results – 30 MHz to 1 GHz

B1.1. Horizontal Antenna, X-Axis



B1.2. Vertical Antenna, X-Axis

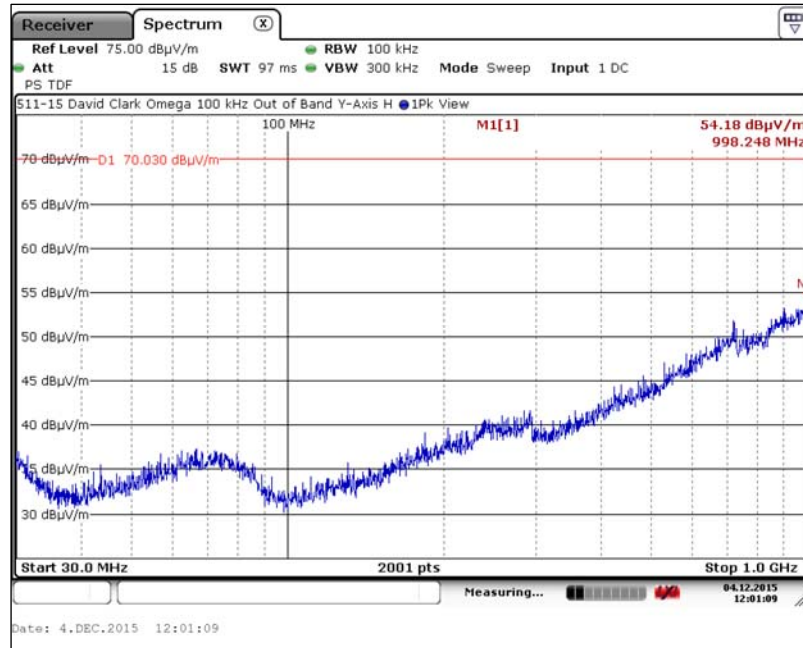


Appendix B (continued)

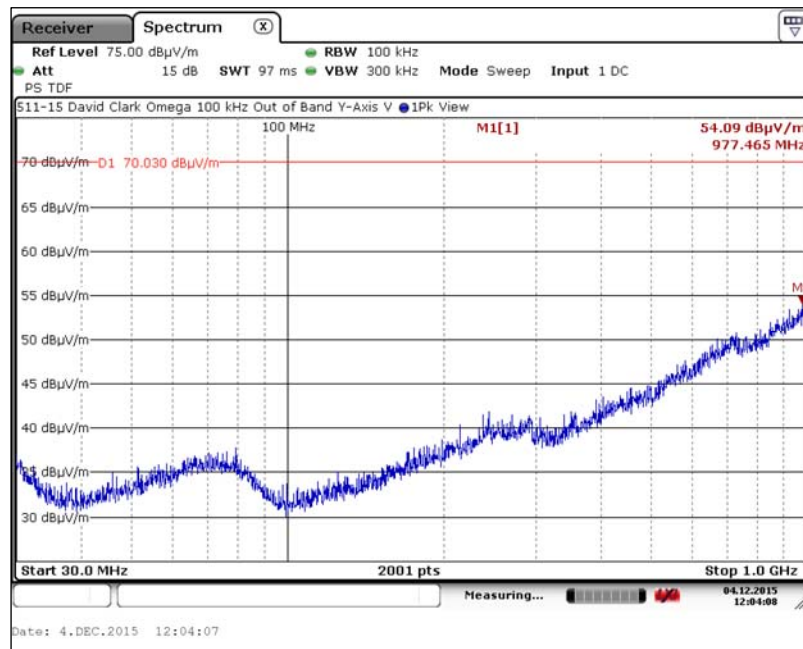
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B1. Measurement Results – 30 MHz to 1 GHz (continued)

B1.3. Horizontal Antenna, Y-Axis



B1.4. Vertical Antenna, Y-Axis



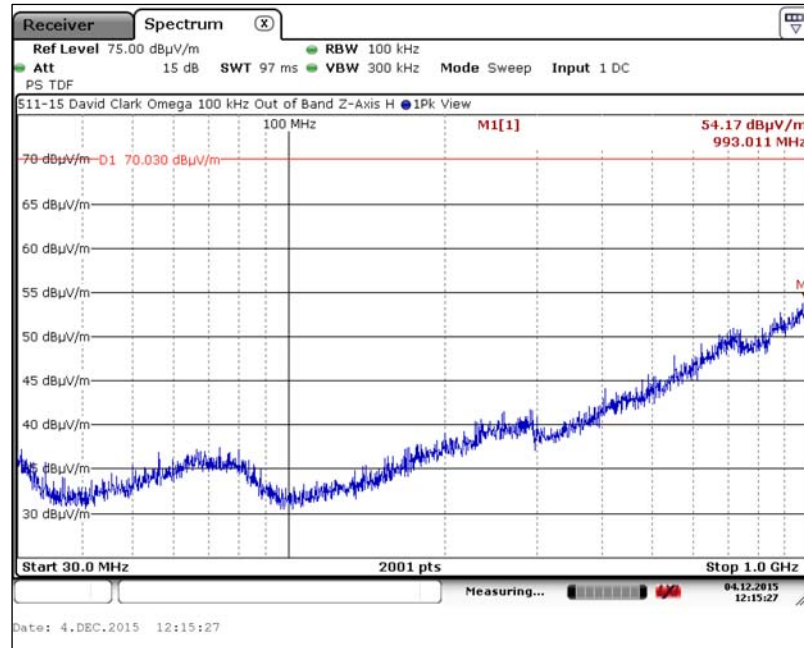


Appendix B (continued)

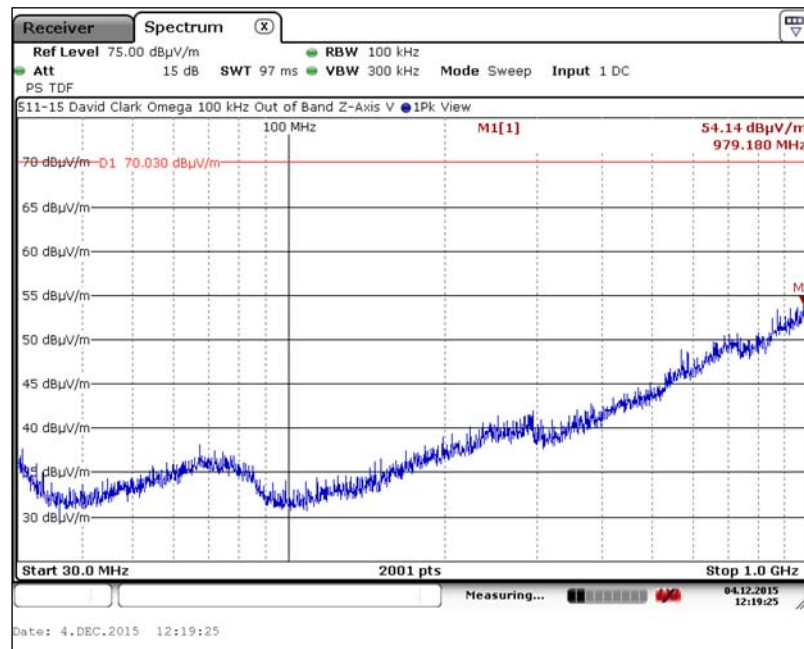
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B1. Measurement Results – 30 MHz to 1 GHz (continued)

B1.5. Horizontal Antenna, Z-Axis



B1.6. Vertical Antenna, Z-Axis

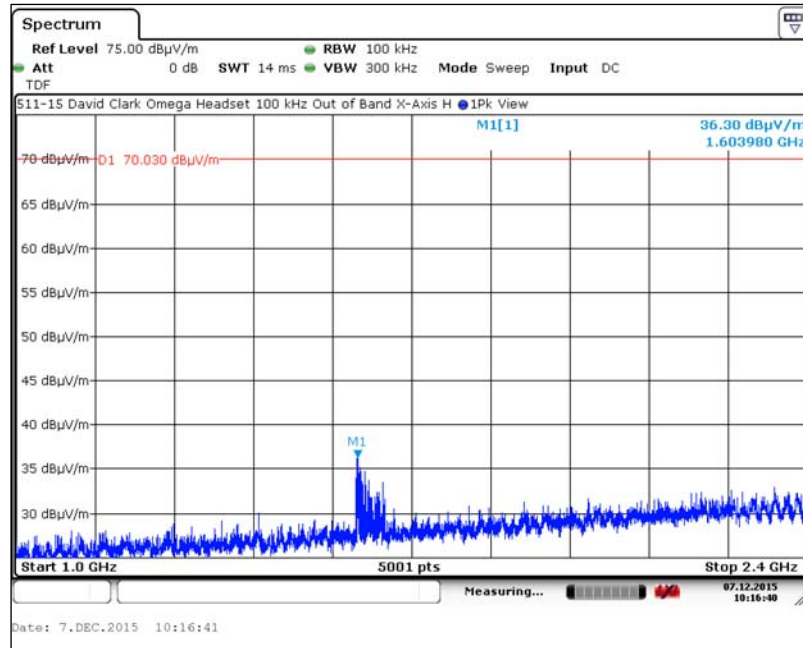


Appendix B (continued)

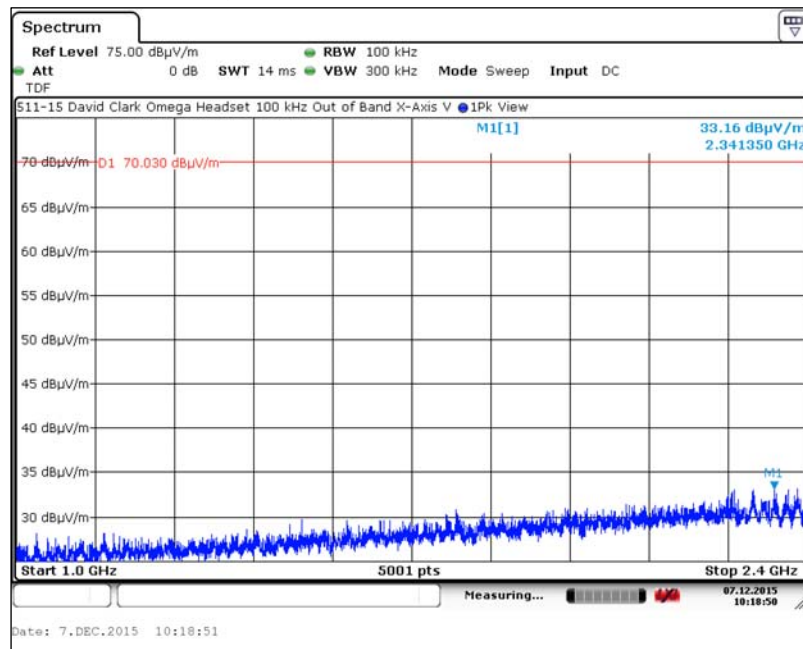
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B2. Measurement Results – 1 GHz to 2.4 GHz

B2.1. Horizontal Antenna, X-Axis



B2.2. Vertical Antenna, X-Axis

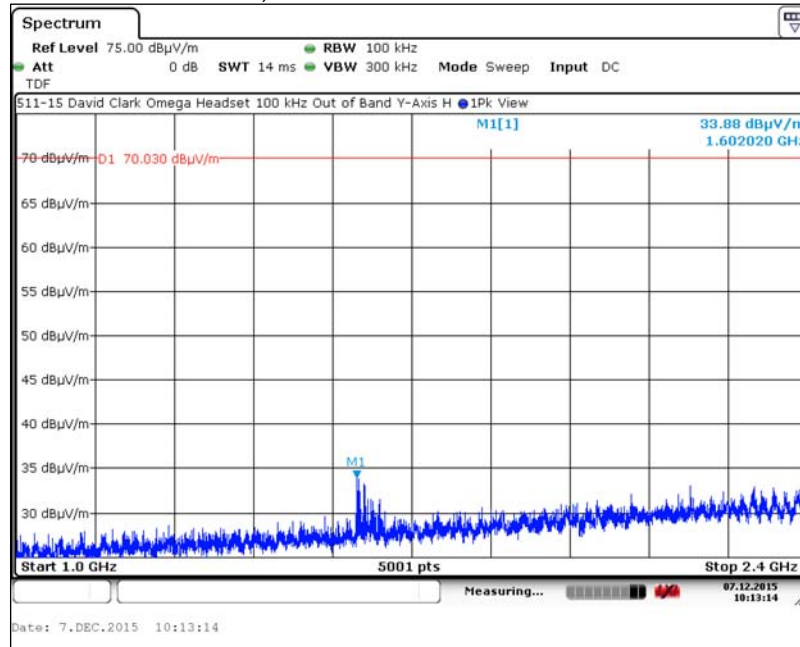


Appendix B (continued)

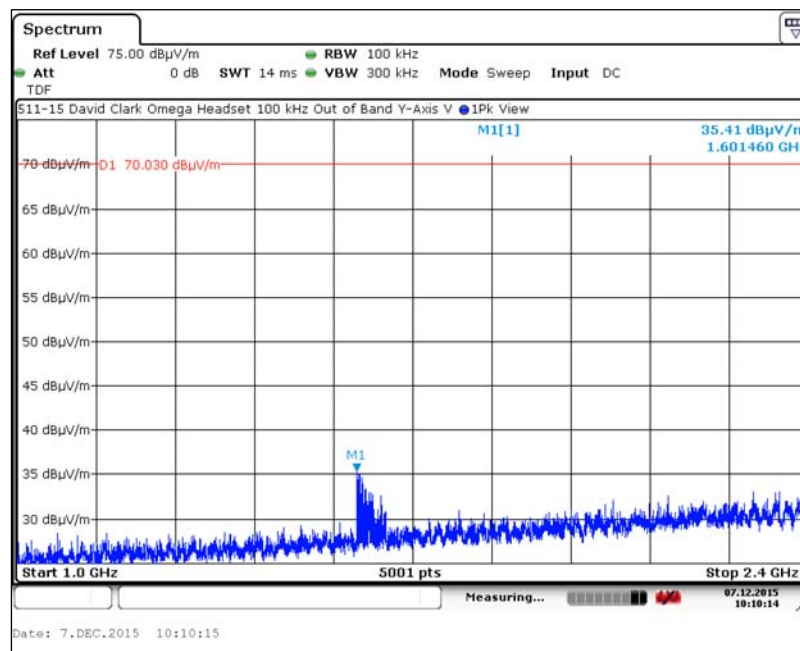
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B2. Measurement Results – 1 GHz to 2.4 GHz (continued)

B2.3. Horizontal Antenna, Y-Axis



B2.4. Vertical Antenna, Y-Axis

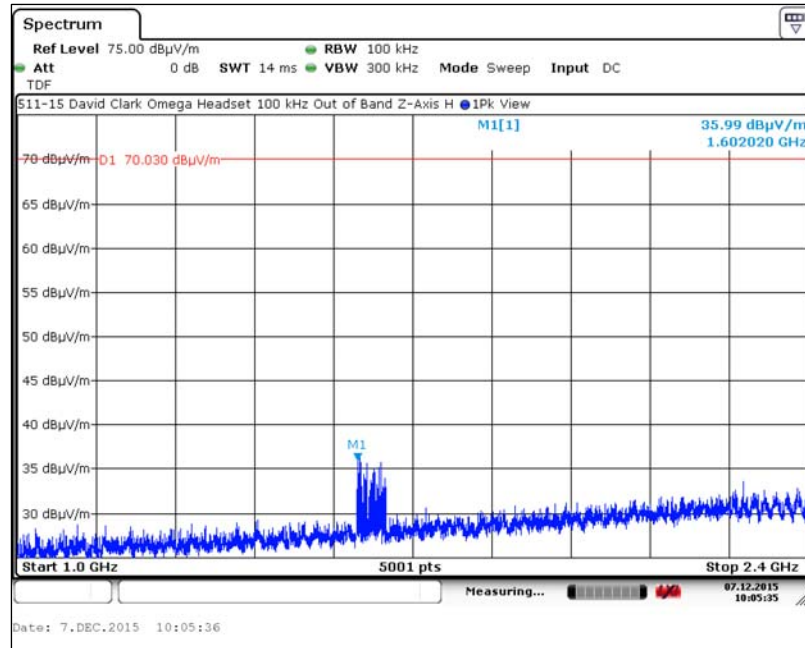


Appendix B (continued)

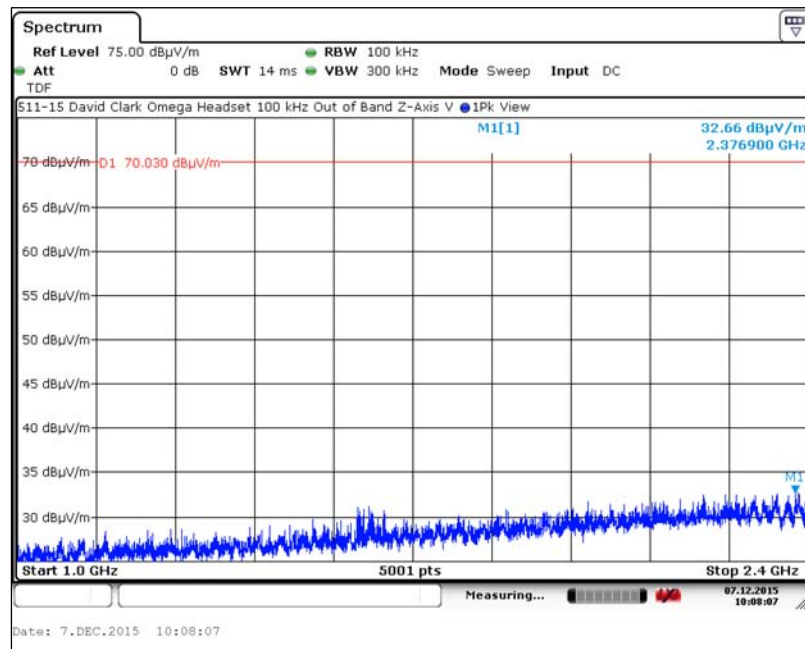
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B2. Measurement Results – 1 GHz to 2.4 GHz (continued)

B2.5. Horizontal Antenna, Z-Axis



B2.6. Vertical Antenna, Z-Axis

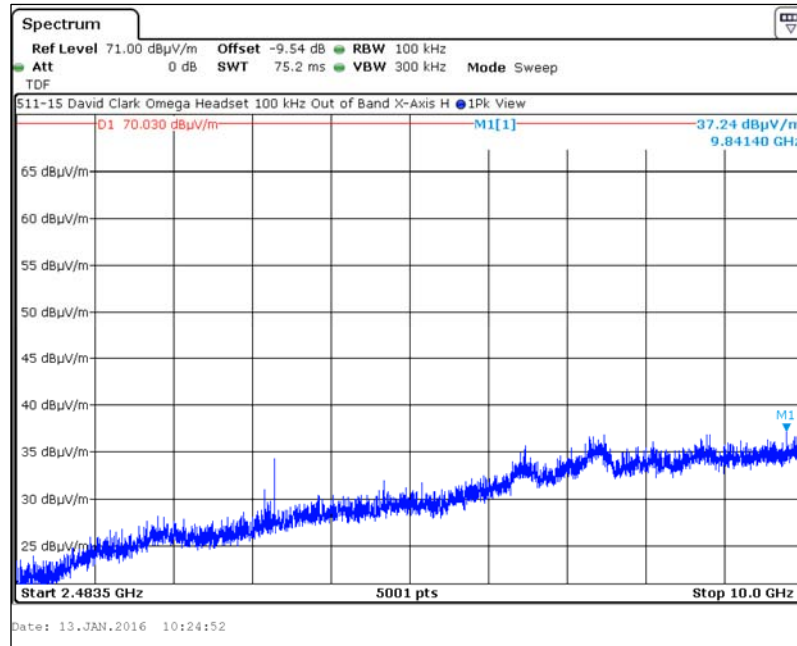


Appendix B (continued)

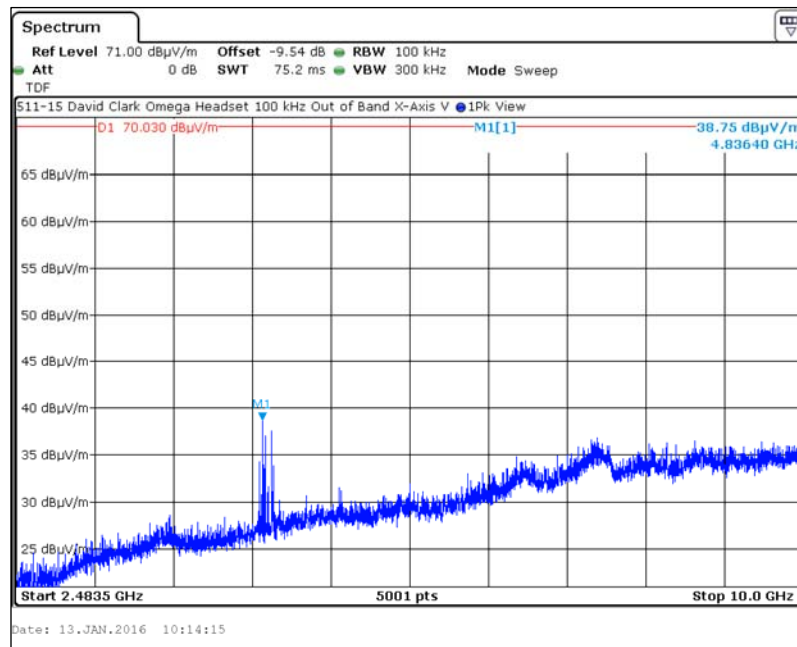
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B3. Measurement Results – 2.4835 GHz to 10 GHz

B3.1. Horizontal Antenna, X-Axis



B3.2. Vertical Antenna, X-Axis

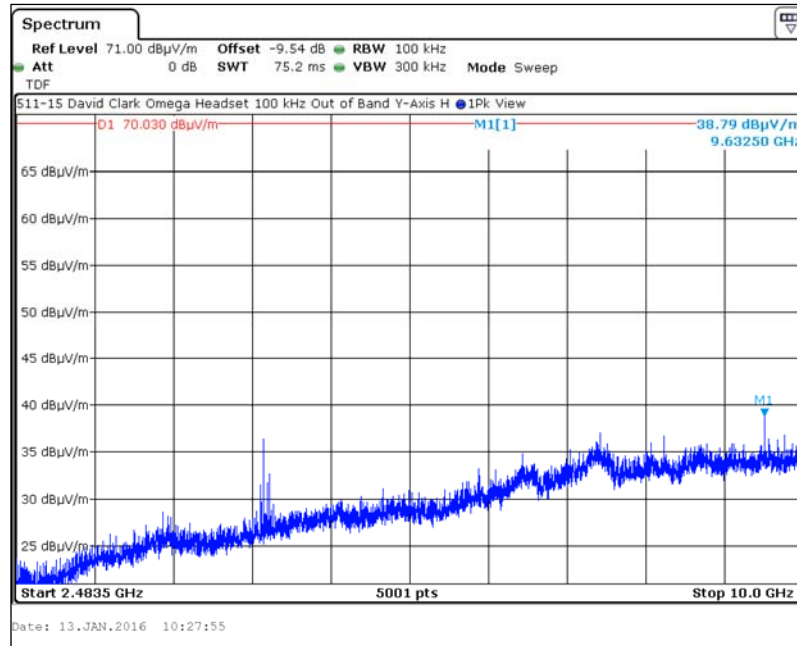


Appendix B (continued)

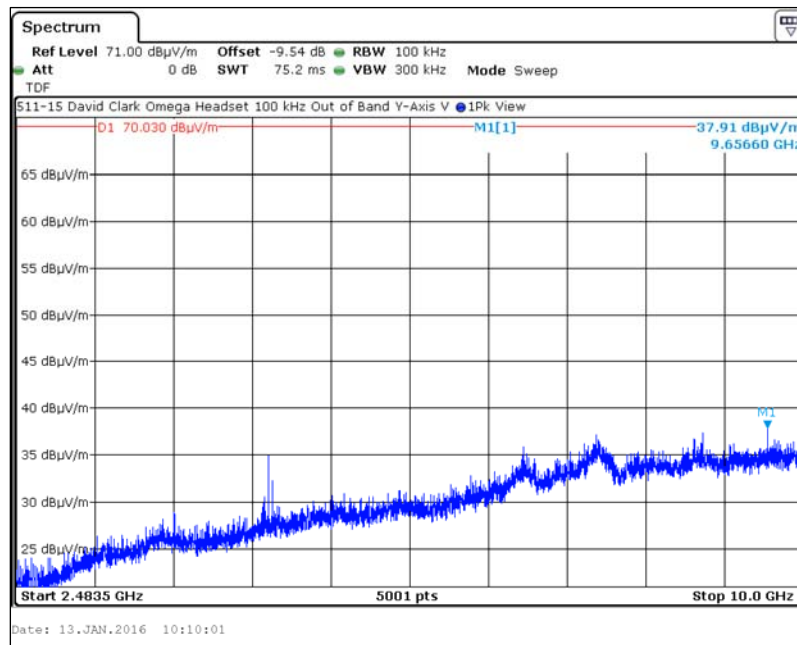
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B3. Measurement Results – 2.4835 GHz to 10 GHz (continued)

B3.3. Horizontal Antenna, Y-Axis



B3.4. Vertical Antenna, Y-Axis

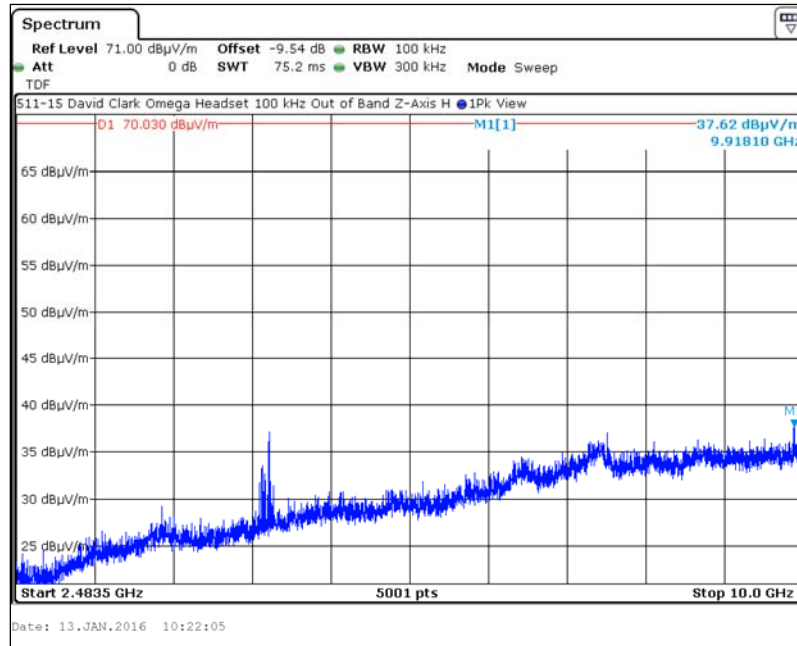


Appendix B (continued)

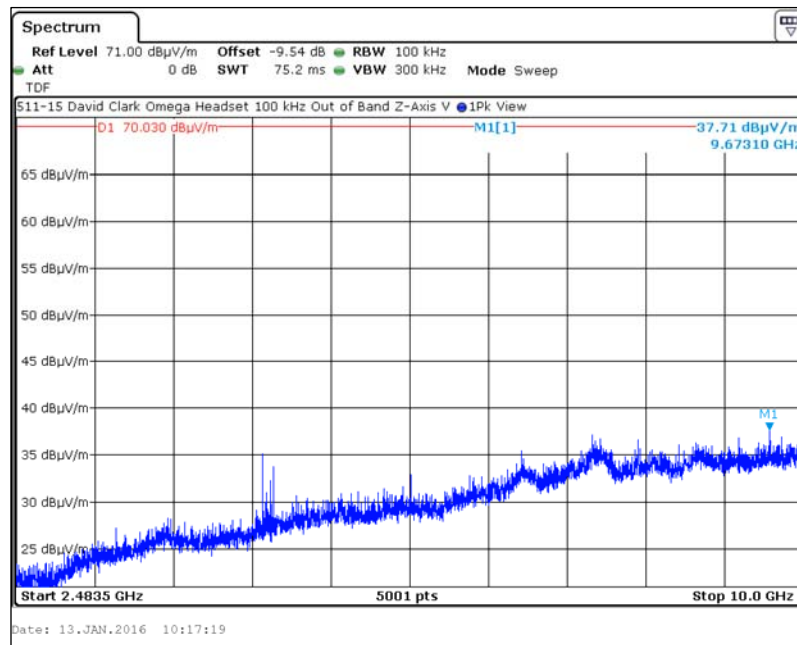
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B3. Measurement Results – 2.4835 GHz to 10 GHz (continued)

B3.5. Horizontal Antenna, Z-Axis



B3.6. Vertical Antenna, Z-Axis

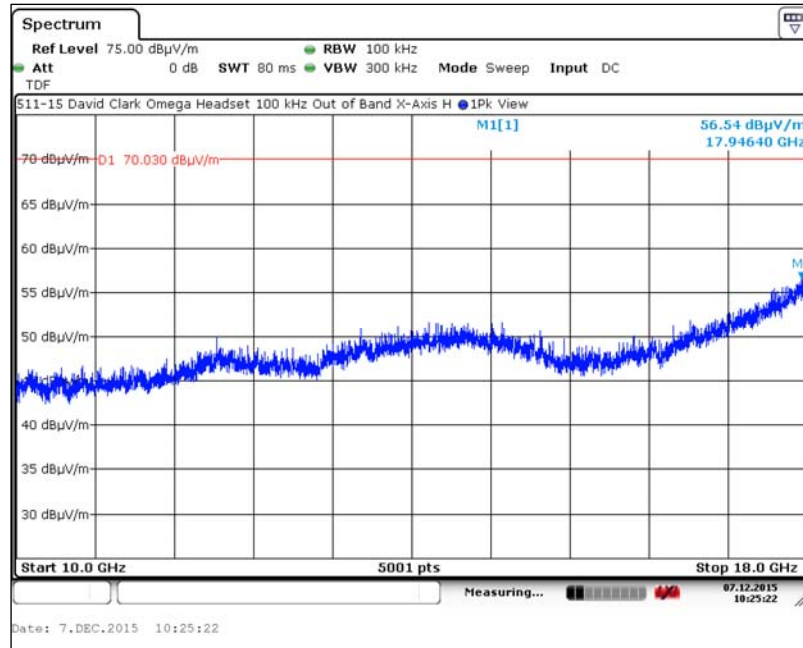


Appendix B (continued)

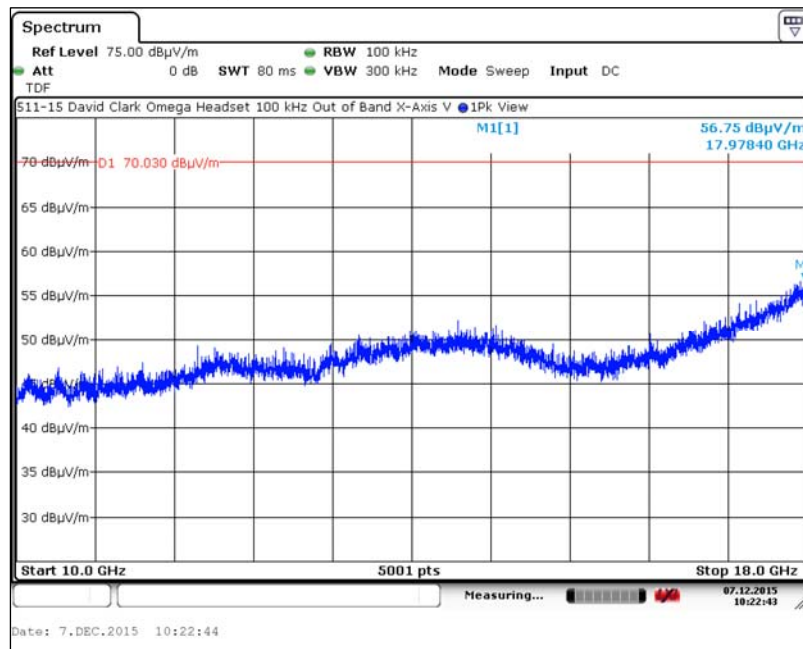
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B4. Measurement Results – 10 GHz to 18 GHz

B4.1. Horizontal Antenna, X-Axis



B4.2. Vertical Antenna, X-Axis



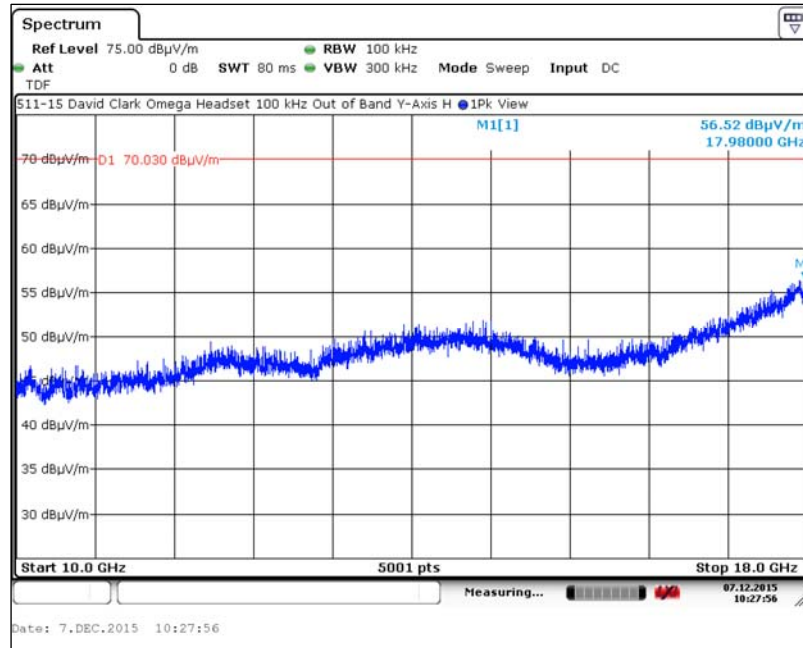


Appendix B (continued)

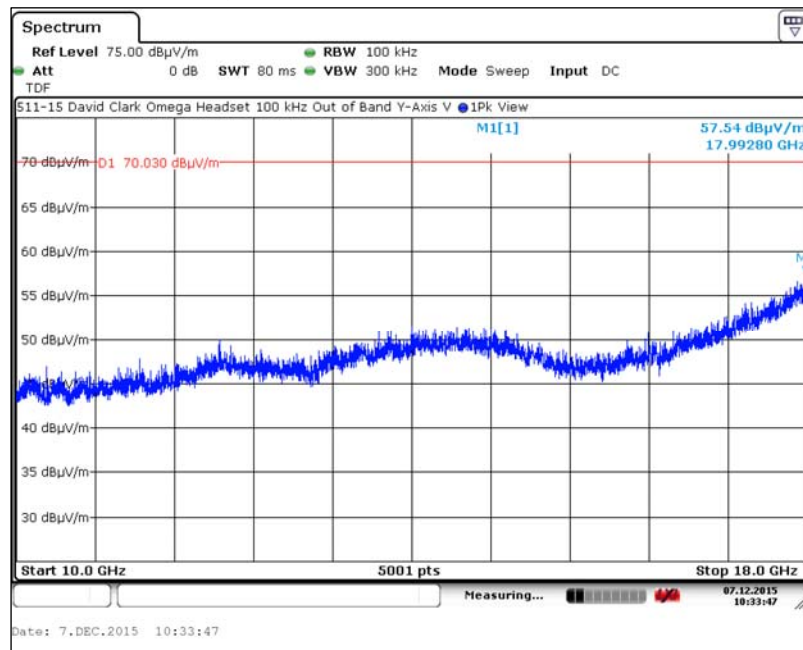
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B4. Measurement Results – 10 GHz to 18 GHz (continued)

B4.3. Horizontal Antenna, Y-Axis



B4.4. Vertical Antenna, Y-Axis

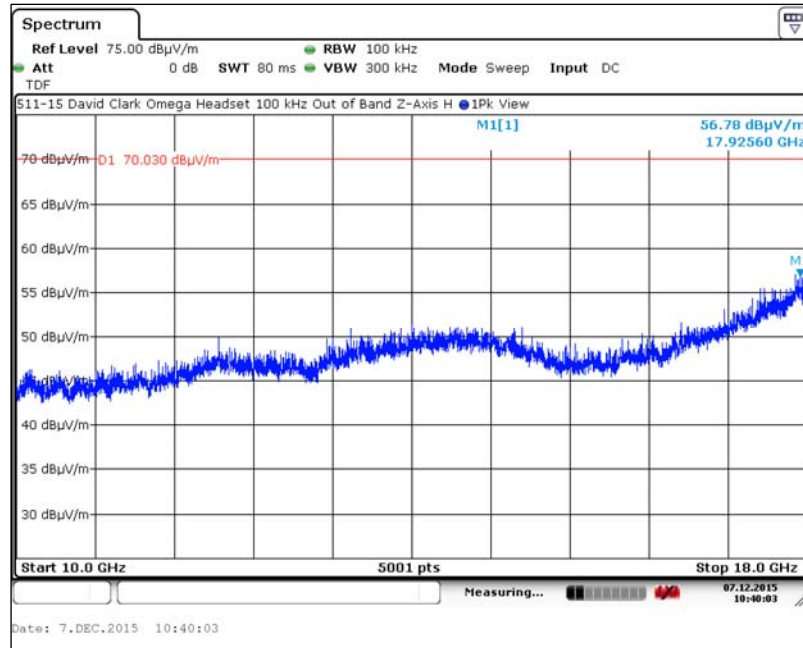


Appendix B (continued)

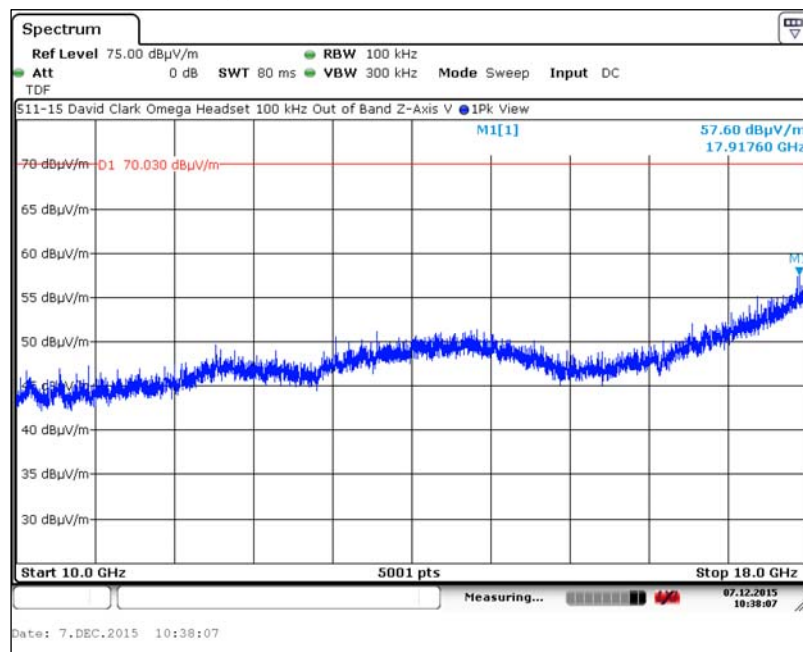
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B4. Measurement Results – 10 GHz to 18 GHz (continued)

B4.5. Horizontal Antenna, Z-Axis



B4.6. Vertical Antenna, Z-Axis

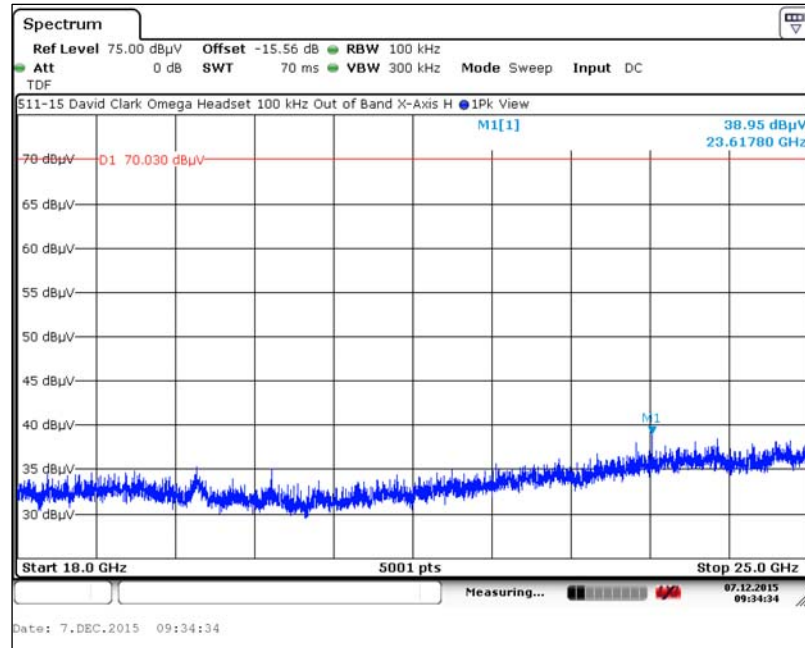


Appendix B (continued)

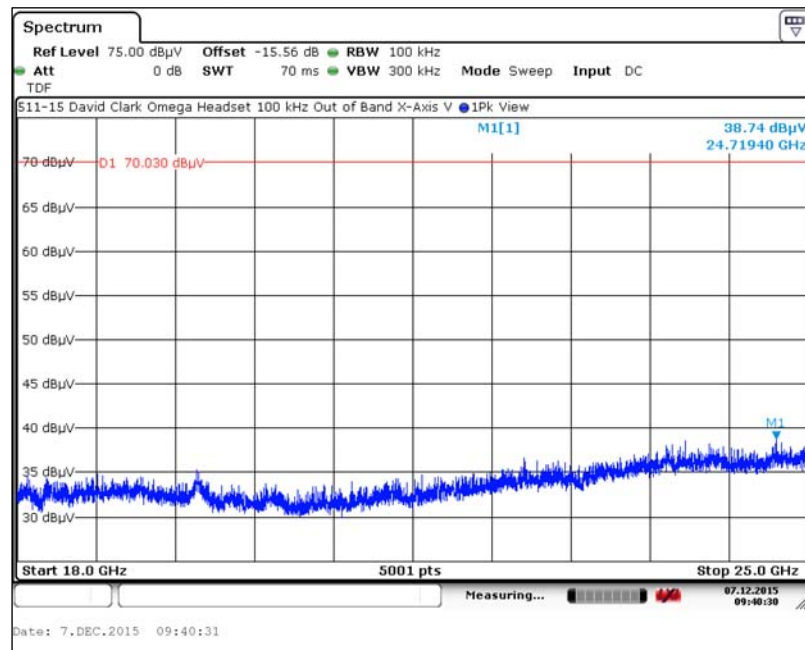
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B5. Measurement Results – 18 GHz to 25 GHz

B5.1. Horizontal Antenna, X-Axis



B5.2. Vertical Antenna, X-Axis

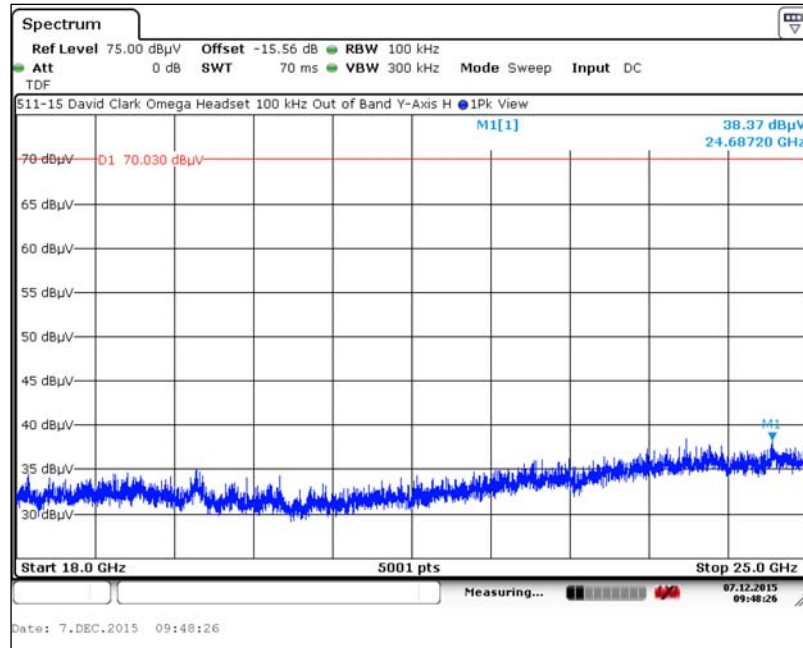


Appendix B (continued)

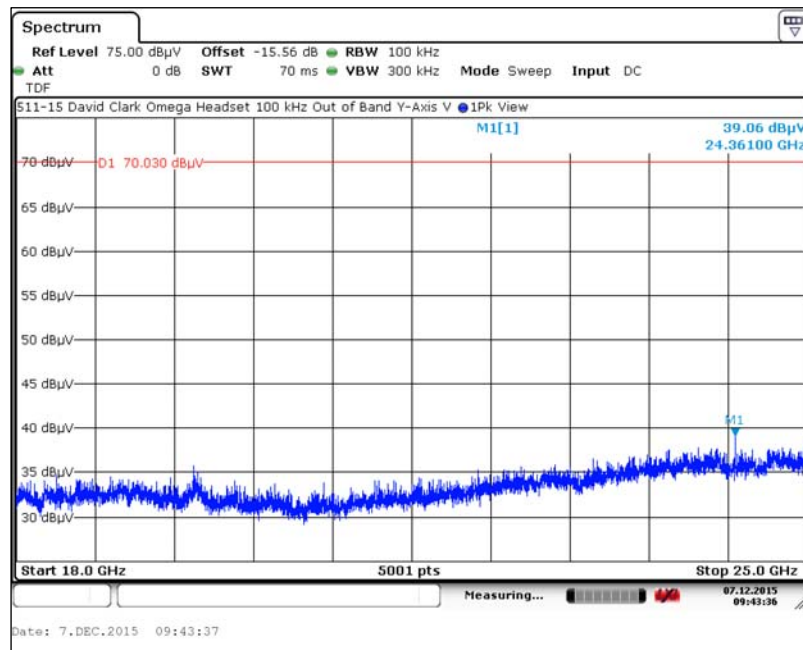
Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

5. Measurement Results – 18 GHz to 25 GHz (continued)

B5.3. Horizontal Antenna, Y-Axis



5.4. Vertical Antenna, Y-Axis

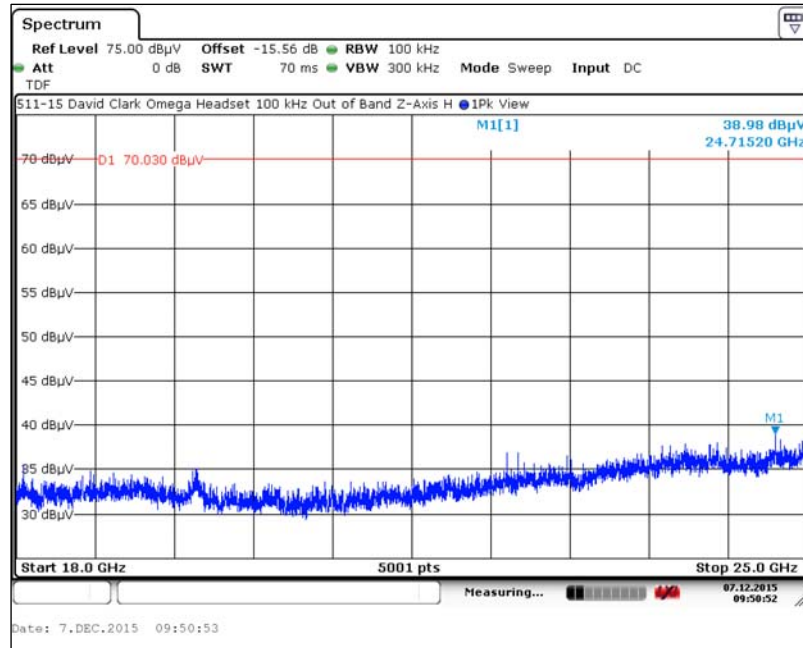


Appendix B (continued)

Emissions in Non-Restricted Frequency Bands (15.247(d)) (continued)

B5. Measurement Results – 18 GHz to 25 GHz (continued)

B5.5. Horizontal Antenna, Z-Axis



5.6. Vertical Antenna, Z-Axis

