LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
Testing Cert. 1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

TEST REPORT # 310117
LSR Job #: C-884

Compliance Testing of:
TiWi Module

Test Date(s):
April 15, 22, May 6, June 13, August 7-9, 24, 31, Sept 8, 2010

Prepared For:
LS Research
Attn: Brian Petted
W66 N220 Commerce Ct
Cedarburg, WI 53012

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 210 Annex 8
Operating in the Frequency Band 2400 MHz – 2483.5 MHz

This Test Report is issued under the Authority of:

Signature: Thomas T. Smith Date: 10.20.2010

Test Report Reviewed by:	**Tested by:**
Signature: Thomas T. Smith Date: 10.20.2010	Peter Feilen, EMC Engineer Signature: Peter Feilen Date: 10.20.10

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EXHIBIT 1. INTRODUCTION

1.1 SCOPE

References:	FCC Part 15, Subpart C, Section 15.247 and 15.209 FCC Part 2, Section 2.1043 paragraph (b)1. RSS GEN and RSS 210 Annex 8
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	• Commercial, Industrial or Business • Residential

1.2 NORMATIVE REFERENCES

Publication	Year	Title
47 CFR, Parts 0-15 (FCC)	2008-10	Code of Federal Regulations - Telecommunications
RSS 210 Annex 8	2007 June	Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-1-1	2006-03 A1: 2006-09 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003 A1: 2004-04 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	2007	Measurement of Digital Transmission Systems operating under Section 15.247.

1.3 LS Research, LLC TEST FACILITY

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation may be accessed on our web site: www.lsr.com. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at LS Research, LLC:

- Compact Chamber
- Semi-Anechoic Chamber
- Open Area Test Site (OATS)

1.5 TEST EQUIPMENT UTILIZED

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated in accordance with A2LA standards.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	**LS Research**
Address:	**W66 N220 Commerce Ct, Cedarburg, WI 53012**
Contact Name:	**Brian Petted**

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	**TiWi**
Model Number:	**TIWI-R1 and TIWI-R2**
Serial Number:	**TIWI01-00-2544**

2.3 ASSOCIATED ANTENNA DESCRIPTION

Antenna Option 1:

A dipole antenna with dual orientation capability was used. This antenna has a peak gain of +4.3 dBi and is connected via SMA.

Antenna Option 2:

A PIFA with an average gain of -0.6dBi. It has a u.fl connector and is used for applications such as
• Notebook Computers, Access Points, Industrial Handhelds, and WiFi enabled Televisions & Monitors.

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Bluetooth

EUT Frequency Range (in MHz)	2402-2480 MHz
RF Power (Watts)	0.00631 W
Conducted Output Power (in dBm)	8.0 dBm
Field Strength at 3 meters	Dipole: 98.32 dBuV/m PIFA: 105.88 dBuV/m
Occupied Bandwidth (99% BW)	875 kHz
Type of Modulation	GFSK
Emission Designator	87k5F1D
EIRP (in mW)	Dipole: 8.32 mW PIFA: 5.50 mW
Transmitter Spurious (worst case)	55.9 dBuV/m @ 4803.80 MHz
Receiver Spurious (worst case)	44.9 dBuV/m @ 3756.90 MHz
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Antenna Information	
Detachable/non-detachable	Detachable, each antenna is detachable
Type	Dipole PIFA (trace)
Gain (in dBi)	Dipole: +4.3dbi average PIFA: -0.6 dBi average
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	210
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

RF Technical Information:

Type of Evaluation		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	X	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100 %
- Standard used for evaluation: OET 65
- Measurement Distance: 20 cm
- RF Value: 0.03379 ☐ V/m ☐ A/m ☒ W/m^2
  ☒ Measured ☐ Computed ☐ Calculated

WLAN

EUT Frequency Range (in MHz)	2412-2462 MHz
RF Power (Watts)	1 Mbps data rate: 0.092683 W MCS7 data rate: 0.020277 W
Conducted Output Power (in dBm)	20.1 dBm at 1Mbps data rate 15.6 dBm at MCS7 data rate
Field Strength at 3 meters	Dipole: 121.50 dBuV/m @ 3m PIFA: 109.25 dBuV/m @ 3m
Occupied Bandwidth (99% BW)	1320 kHz at 1 Mbps data rate 1795 kHz at MCS7 data rate
Type of Modulation	FSK
Emission Designator	1M795D1D
EIRP (in mW)	Dipole and 1 mbps data rate: 134.90 mW Dipole and MCS7 data rate: 47.86 mW PIFA and 1 mbps data rate: 89.13 mW PIFA and MCS7 data rate: 31.62 mW
Transmitter Spurious (worst case)	39.7 dBuV/m at 3161 MHz
Receiver Spurious (worst case)	44.5 dBuV/m at 3756 MHz
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Antenna Information	
Detachable/non-detachable	Detachable
Type	Dipole
Gain (in dBi)	Dipole: +4.3 dBi average PIFA:-0.6 dBi average
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	210
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

RF Technical Information:

Type of Evaluation		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	X	RF Evaluation

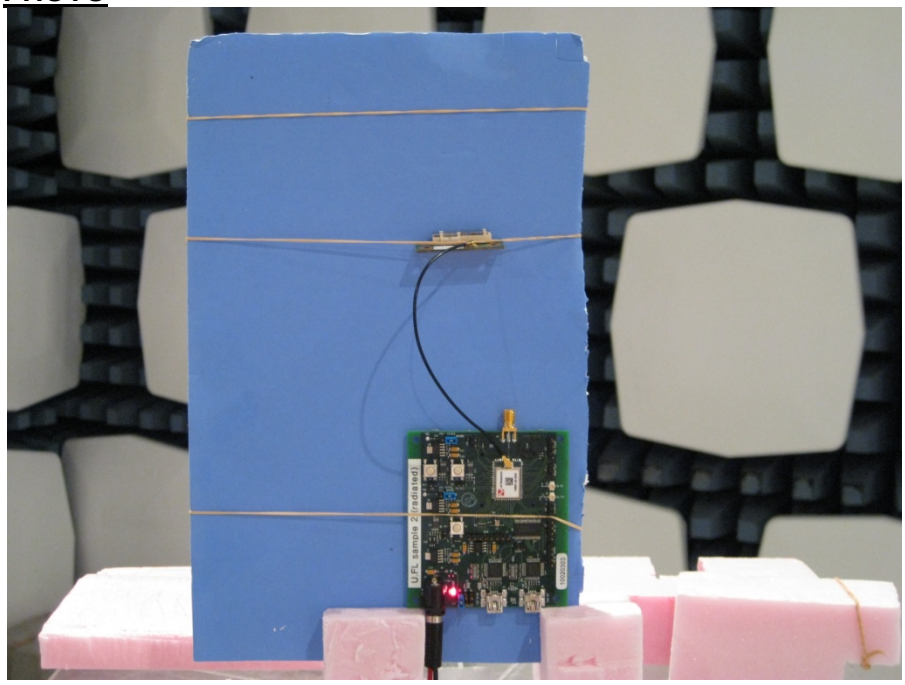
If RF Evaluation checked above, test engineer to complete the following:

- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100 %
- Standard used for evaluation: OET 65
- Measurement Distance: 20 cm
- RF Value: 0.54794 ☐ V/m ☐ A/m ☒ W/m^2
  ☒ Measured ☐ Computed ☐ Calculated

2.5 PRODUCT DESCRIPTION

The TiWi module is a multi-standard module with support for WLAN (802.11 b/g/n), Bluetooth, FM broadcast receiver and FM transmitter. The WLAN features include an output power that is rated at 19dBm with an RF sensitivity of up to -75dBm.

PHOTO



Radio module shown on host board with PIFA antenna

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	15-35 ˚C
Humidity:	30-60%
Pressure:	725-745 mmHg

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC and IC Paragraph	Test Requirements	Compliance (yes/no)
FCC : 15.207 IC : RSS GEN sect. 7.2.2	Power Line Conducted Emissions Measurements	Yes
FCC : 15.247(a)(2) IC : RSS 210 A8.2(a)	6 dB Bandwidth of a Digital Modulation System	Yes
IC : RSS GEN section 4.6.1	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(c) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC : 15.247(d) IC : RSS 210 A8.2(b)	Transmitted Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers (RSS GEN and RSS 210 of IC). The Receiver Test Report is available upon request.		

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☒ **None** ☐ **Yes (explain below)**

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☒ **None** ☐ **Yes (explain below)**

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 7 (2007), Section Annex 8 (section 8.2).

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in normal mode, and final testing was performed using normal mode, using power as provided by a bench top supply set for 5 VDC. The unit has the capability to operate on 11 channels, controllable via laptop PC.

The applicable limits apply at a 3 meter distance. Measurements above 4 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: WiFi: low (2412 MHz), middle (2437 MHz) and high (2462 MHz), and Bluetooth: low (2402 MHz), middle (2441 MHz) and high (2480 MHz) to comply with FCC Part 15.35. The channels and operating modes were changed using a PC.

5.2 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 4 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. From 4 GHz to 25 GHz, the EUT was measured at a 1.0 meter separation, using a standard gain Horn Antenna and pre-amplifier, raising the antenna between 1 and 1.8m.

The EUT was rotated along three orthogonal axes during the investigations to find the highest emission levels.

5.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. Correction factors obtained from calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz From 4 GHz to 18 GHz, an Agilent E4446A Spectrum Analyzer and an EMCO Horn Antenna were used. From 18 GHz to 25 GHz, the Agilent E4446A Spectrum Analyzer with a standard gain horn, and preamp were used.

Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
EMI Receiver	Agilent	E4445A	3617A00320
EMI Receiver Pre-Select.	Agilent	N9039A	3448A00296
Spectrum Analyzer	Agilent	E4446A	US45300564
Log Periodic Antenna	EMCO	93146	9701-4855
Horn Antenna	EMCO	3115	6907
Bicon Antenna	EMCO	93110B	9702-2918
Pre-Amp	Adv. Microwave	WLA612	1145A04094
Horn Antenna – Std. Gain	EMCO	3160-09	9809-1120

5.4 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-210, Issue 7 (2007), Annex 8. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 CALCULATION OF RADIATED EMISSIONS LIMITS

The maximum peak output power of an intentional radiator in the 2400-2483.5 MHz band, as specified in Title 47 CFR 15.247 (b)(3) and RSS 210 A8.4 is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d) and RSS 210 A8.2(b), shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c) for FCC and section 2.2,2.6 and 2.7 of RSS 210 for IC.

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS 210 section 2.7.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
> 960	500	54.0	63.5

Sample conversion from field strength μV/m to dBμV/m:
$dB\mu V/m = 20 \log_{10} (100)$
= 40 dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

> 960 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

For measurements made at 0.3 meter, a 20 dB correction has been invoked.

960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 20 = 74 dB/μV/m at 0.3 meters

Generic example of reported data at 200 MHz:

Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor)
= 35.45 (dBμV/m).

5.6 **RADIATED EMISSIONS TEST DATA CHART**

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.205 and 15.247(
RSS 210 A8, sections 2.2,2.6 and 2.7
Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	LS Research						
Date(s) of Test:	April 15, 22, May 6, June 13, August 8, 9, 24, 31, Sept. 8, 28, 29, 2010						
Test Engineer(s):	Peter Feilen, Tom Smith, Ryan Urness						
Voltage:	5 VDC						
Operation Mode:	Normal mode						
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %						
EUT Power:		Single Phase ___VAC		3 Phase ___VAC			
		Battery	X	Other: DC Bench Supply			
EUT Placement:	X	80cm non-conductive table		10cm Spacers			
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	X	Final	
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average	

A. WLAN Data

Data for WLAN radio and Dipole Antenna

The following table depicts the level of significant spurious radiated RF emissions found:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
35.33	V/H	1.00	90	12.1	40.0	27.9
180.31	V/H	1.00	187	21.5	43.0	21.6
295.68	V/H	1.00	0	24.4	46.0	21.6
982.50	H/H	1.00	0	29.7	54.0	24.4
940.10	V/V	1.00	0	27.6	46.0	18.4
299.05	H/V	1.00	0	26.0	46.0	20.0
35.96	V/V	1.00	0	12.2	40.0	27.8
1224.38	V/S	1.00	0	34.3	54.0	19.7
1005.28	V/S	1.00	0	35.1	54.0	18.9
1178.32	H/V	1.00	0	34.8	54.0	19.2
1005.28	V/V	1.00	0	35.0	54.0	19.0
3161.09	H/V	1.00	0	39.7	54.0	14.3
2554.57	V/H	1.00	21	36.0	54.0	18.0

RADIATED EMISSIONS DATA CHART *(continued)*

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 1

Frequency (MHz)	Ant. Polarity	Height (meters)	Azimuth (0° - 360°)	Measured Peak Value (dBuV/m)	Peak Limit Value (dBuV/m)	Peak Margin (dB)	Measured Average Value (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
4824.00	Horizontal	1.16	346	51.9	83.5	31.6	47.0	63.5	16.5
7230.67	Horizontal	1.03	44	49.1	83.5	34.4	37.8	63.5	25.7
9648.00	Horizontal	1.03	51	71.7	101.5	29.8	71.4	101.5	30.1
12059.40	Horizontal	1.03	317	49.7	83.5	33.8	39.2	63.5	24.3
14471.80	Horizontal	1.03	10	52.0	83.5	31.5	44.6	63.5	18.9
16877.77	Horizontal	1.03	11	53.0	101.5	48.5	40.6	101.5	60.9
19296.00	Horizontal	1.00	0	49.8	83.5	33.7	47.3	63.5	16.2
21708.00	Horizontal	1.00	0	Note 3	101.5	-	Note 3	101.5	-
24120.00	Horizontal	1.00	0	Note 3	101.5	-	Note 3	101.5	-
4824.17	Vertical	1.07	200	50.2	83.5	33.3	43.0	63.5	20.5
7235.77	Vertical	1.03	7	47.9	83.5	35.6	36.9	63.5	26.6
9648.00	Vertical	1.09	8	60.8	101.5	40.7	59.2	101.5	42.3
12061.03	Vertical	1.05	332	49.7	83.5	33.8	38.0	63.5	25.5
14471.83	Vertical	1.26	339	51.4	83.5	32.1	43.1	63.5	20.4
16875.03	Vertical	1.03	4	52.7	101.5	48.8	40.7	101.5	60.8
19296.00	Vertical	1.00	0	Note 3	83.5	-	Note 3	63.5	-
21708.00	Vertical	1.00	0	44.6	101.5	56.9	41.8	101.5	59.7
24120.00	Vertical	1.00	0	49.2	101.5	52.3	45.3	101.5	56.2

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 6:

Frequency (MHz)	Ant. Polarity	Height (meters)	Azimuth (0° - 360°)	Measured Peak Value (dBuV/m)	Peak Limit Value (dBuV/m)	Peak Margin (dB)	Measured Average Value (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
4874.13	Horizontal	1.15	26.2	50.3	83.5	33.2	44.7	63.5	18.8
7318.67	Horizontal	1.08	325.1	48.4	83.5	35.1	37.2	63.5	26.3
9747.93	Horizontal	1.10	244.1	56.4	101.5	45.1	53.9	101.5	47.6
12182.97	Horizontal	1.07	309.2	50.6	83.5	32.9	40.2	63.5	23.3
14621.77	Horizontal	1.00	307.1	52.7	83.5	30.8	44.2	63.5	19.3
17062.37	Horizontal	1.04	9.1	55.0	101.5	46.5	42.9	101.5	58.6
19496.00	Horizontal	1.00	179	50.1	83.5	33.4	43.4	63.5	20.1
21933.00	Horizontal	1.00	0	48.0	101.5	-	44.6	101.5	56.9
24370.00	Horizontal	1.00	0	49.2	101.5	-	43.9	101.5	57.6
4874.07	Vertical	1.09	179.2	48.6	83.5	34.9	42.5	63.5	21
7316.93	Vertical	1.04	5.6	48.5	83.5	35.0	36.4	63.5	27.1
9747.93	Vertical	1.09	18.3	54.9	101.5	46.6	50.8	101.5	50.7
12183.93	Vertical	1.02	347	51.5	83.5	32.0	43	63.5	20.5
14622.00	Vertical	1.29	311.9	54.0	83.5	29.5	47.9	63.5	15.6
17057.63	Vertical	1.02	17.8	53.9	101.5	47.6	42.9	101.5	58.6
19496.00	Vertical	1.00	0	51.3	83.5	-	42.2	63.5	21.3
21933.00	Vertical	1.00	0	49.8	101.5	51.7	41.8	101.5	59.7
24370.00	Vertical	1.00	0	57.1	101.5	44.4	44.1	101.5	57.4

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 11:

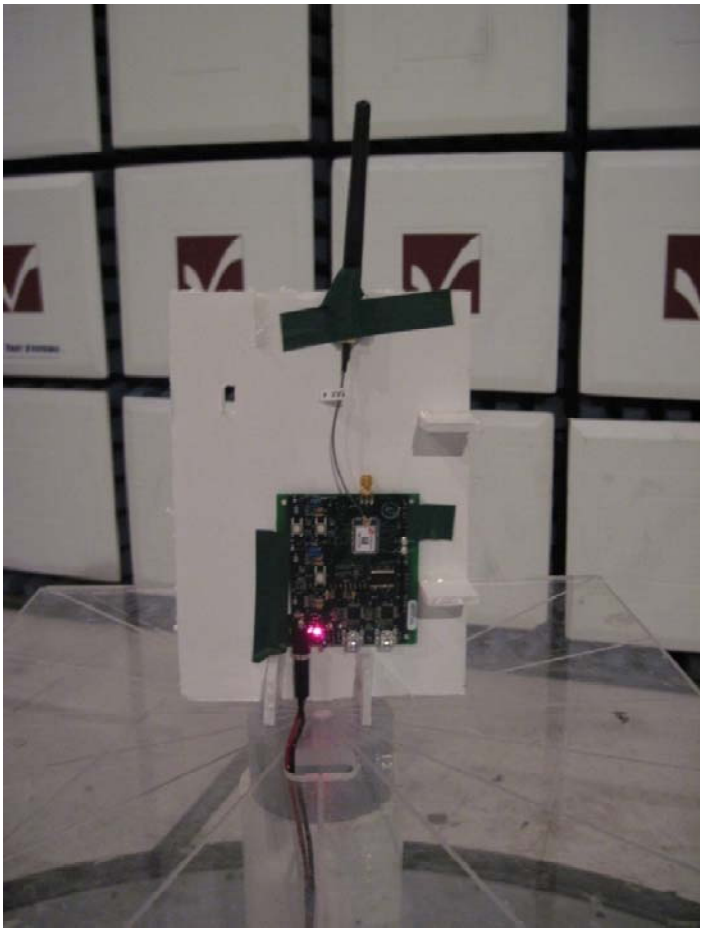
Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measure Peak Value (dBμV/m)	Peak Limit Value (dBuV/m)	Peak Margin (dB)	Measured Average Value (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
4924.03	Horizontal	1.02	229.8	50.5	83.5	33.0	43.7	63.5	19.8
7381.53	Horizontal	1.04	105.5	47.9	83.5	35.6	36.3	63.5	27.2
9847.87	Horizontal	1.01	231.3	52.0	101.5	49.5	51.4	101.5	50.1
12312.00	Horizontal	1.01	161.9	50.1	83.5	33.4	40.6	63.5	22.9
14772.03	Horizontal	1.15	201.5	53.8	83.5	29.7	43.5	63.5	20
17225.80	Horizontal	1.06	16.7	55.5	101.5	46.0	43.9	101.5	57.6
19696.00	Horizontal	1.00	175	50.3	83.5	33.2	42.7	63.5	20.8
22158.00	Horizontal	1.00	0	50.7	101.5	-	42.8	101.5	58.7
24620.00	Horizontal	1.00	0	56.5	101.5	-	43.4	101.5	58.1
4924.20	Vertical	1.08	85.6	50.4	83.5	33.1	44.9	63.5	18.6
7376.10	Vertical	1.03	120.9	49.3	83.5	34.2	37.4	63.5	26.1
9847.80	Vertical	1.29	74.7	55.5	101.5	46.0	51.9	101.5	49.6
12310.03	Vertical	1.06	59.3	51.4	83.5	32.1	41.3	63.5	22.2
14772.07	Vertical	1.16	194.6	54.4	83.5	29.1	49.3	63.5	14.2
17225.80	Vertical	1.05	4	55.6	101.5	45.9	43.9	101.5	57.6
19696.00	Vertical	1.00	0	49.8	83.5	-	43.1	63.5	20.4
22158.00	Vertical	1.00	0	48.5	101.5	53.0	41.4	101.5	60.1
24620.00	Vertical	1.00	0	55.4	101.5	46.1	45.9	101.5	55.6

Notes:

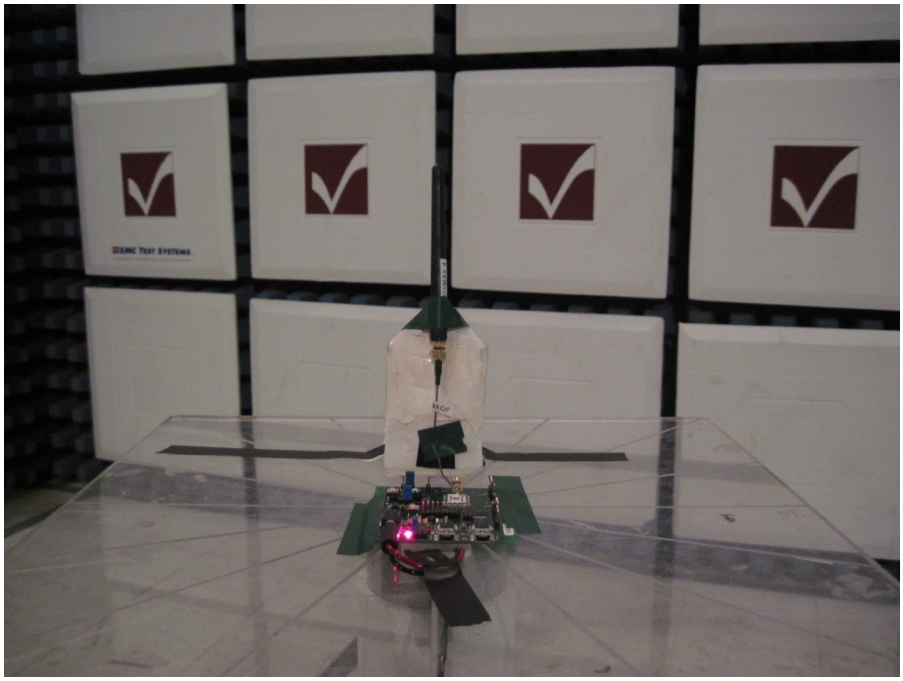
1) Measurements above 4 GHz were made at 1 meters of separation from the EUT
2) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak Detector was used in measurements above 1 GHz. Only the results from the video-averaged measurements using a Peak detector are published in the table above. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
3) Measurement at receiver system noise floor.
4) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=10 MHz.

5.7 Test Setup Photo(s) – Radiated Emissions Test

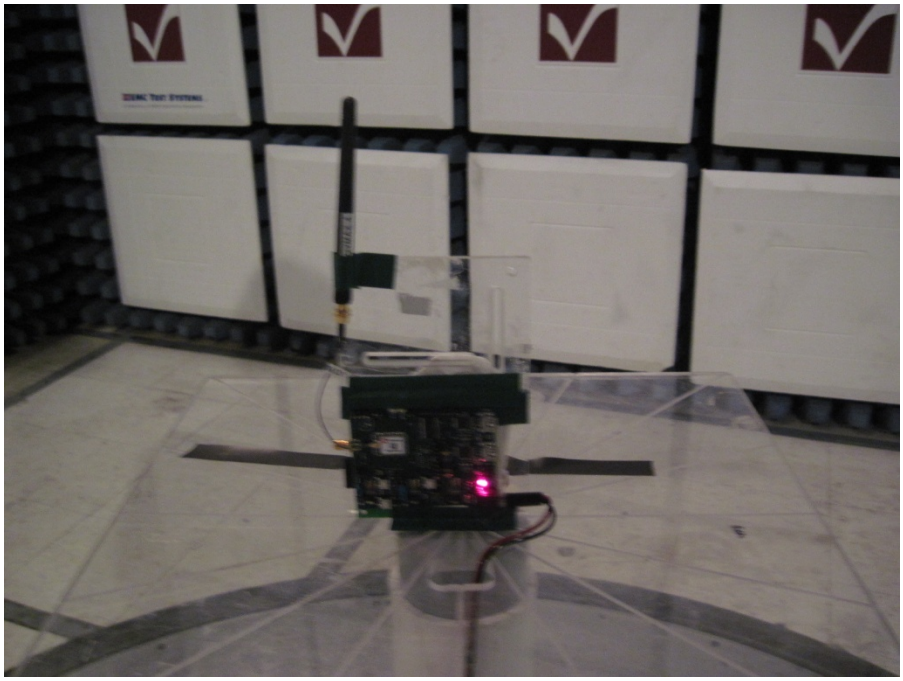
Vertical Orientation



Horizontal Orientation



Side Orientation



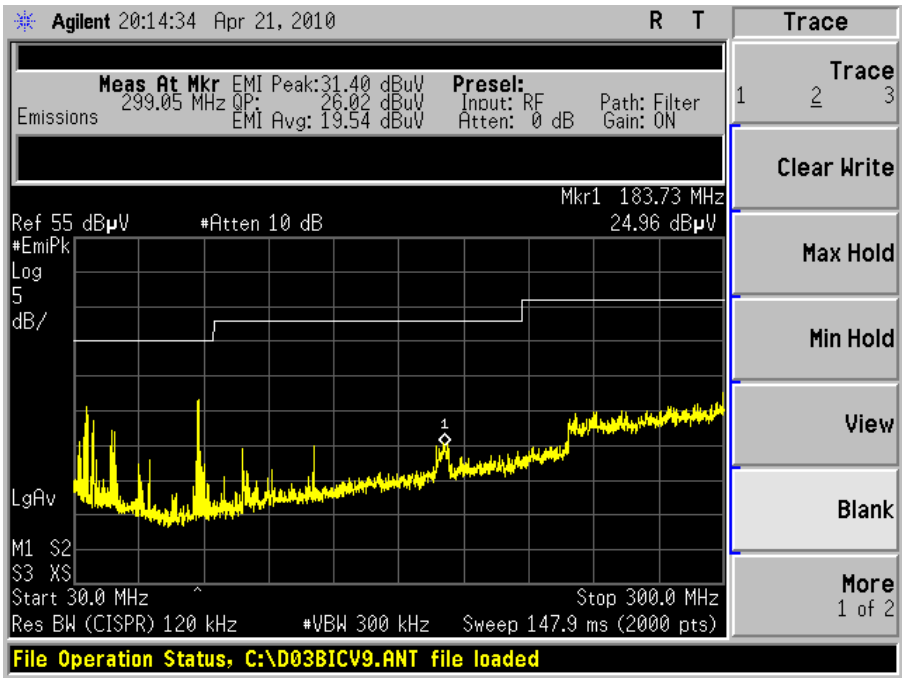
Radio module shown on host board with dipole antenna

5.8 Screen Captures - Radiated Emissions Test

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

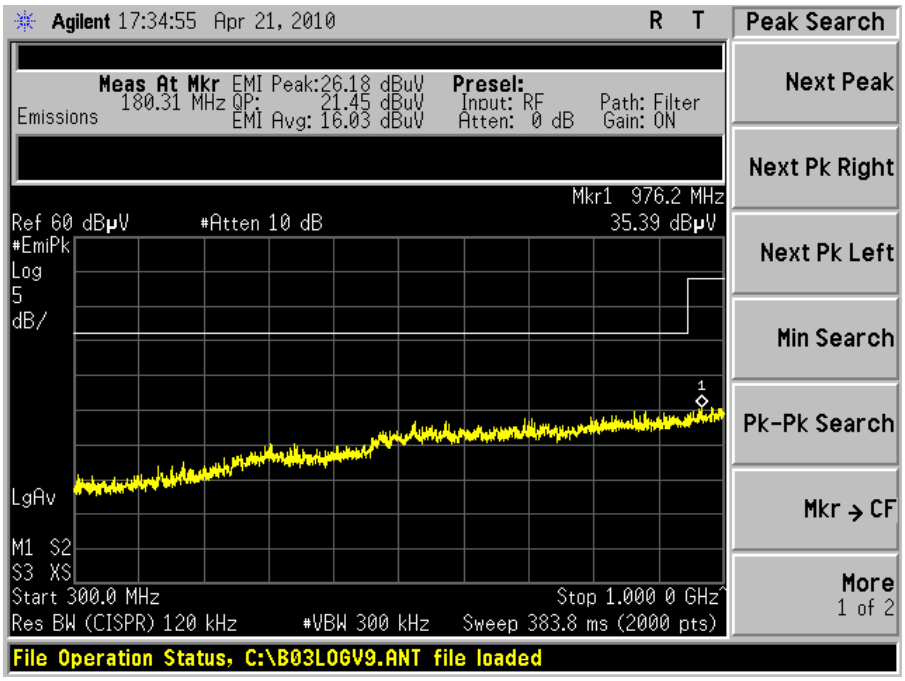
The signature scans shown here are from worst-case emissions, as measured on channels 1, 6, or 11 of the WiFi radio, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 1, Antenna Vertically Polarized, 30-300 MHz, at 3m

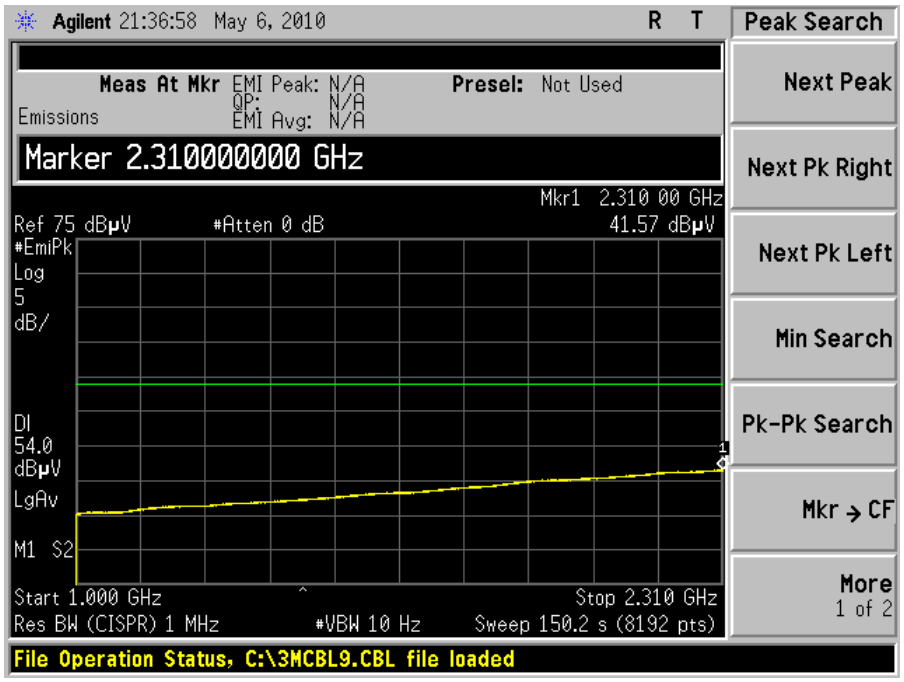


Screen Captures - Radiated Emissions Testing *(continued)*

Channel 1, Antenna Vertically Polarized, 300-1000 MHz, at 3m



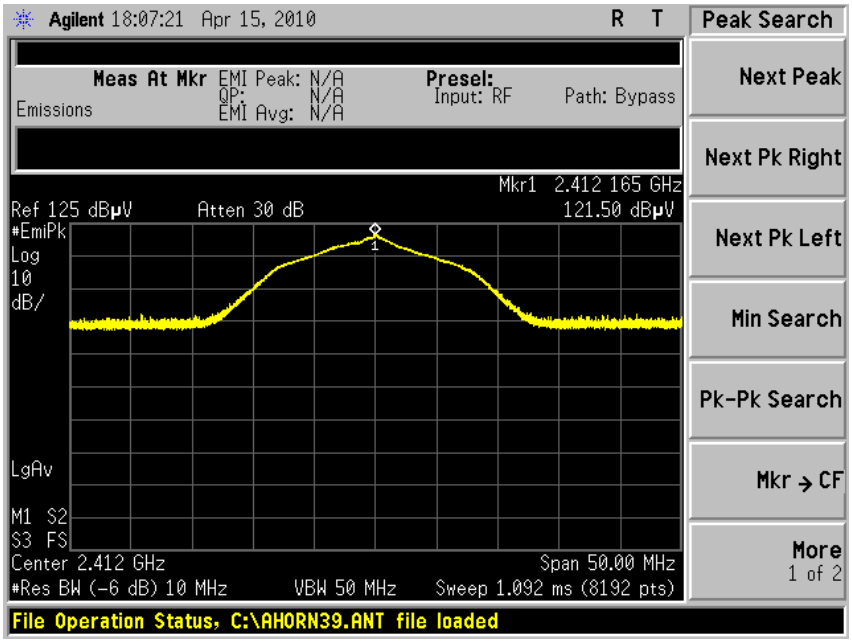
Channel 1, Antenna Vertically Polarized, 1000-2310 MHz, at 3m



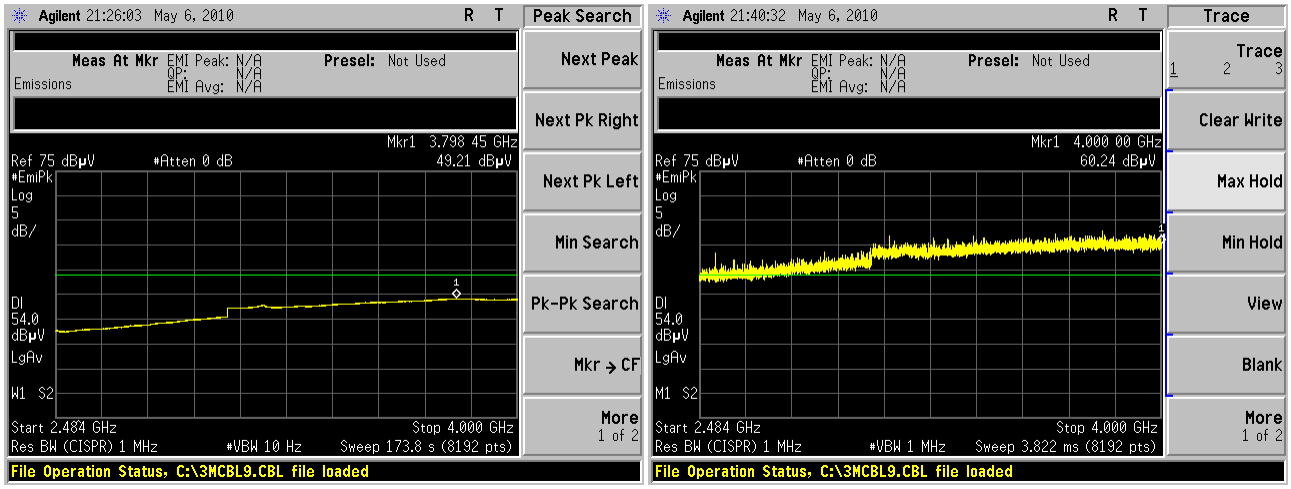
Average limit is 54 dBuV/m

Screen Captures - Radiated Emissions Testing *(continued)*

Channel 1, Antenna Vertically Polarized, 2400-2483.5 MHz, at 3m



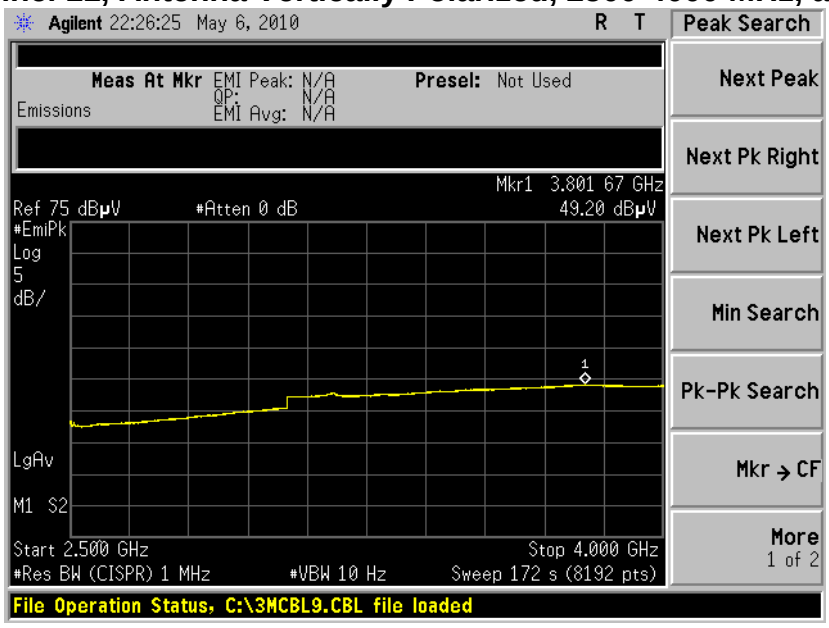
Channel 11, Antenna Vertically Polarized, 2484.0-2500 MHz, at 3m



Average limit is 54 dBuV/m, Peak limit is 74dBuV/m

Screen Captures - Radiated Emissions Testing **(continued)**

Channel 11, Antenna Vertically Polarized, 2500-4000 MHz, at 3m



Average limit is 54 dBuV/m

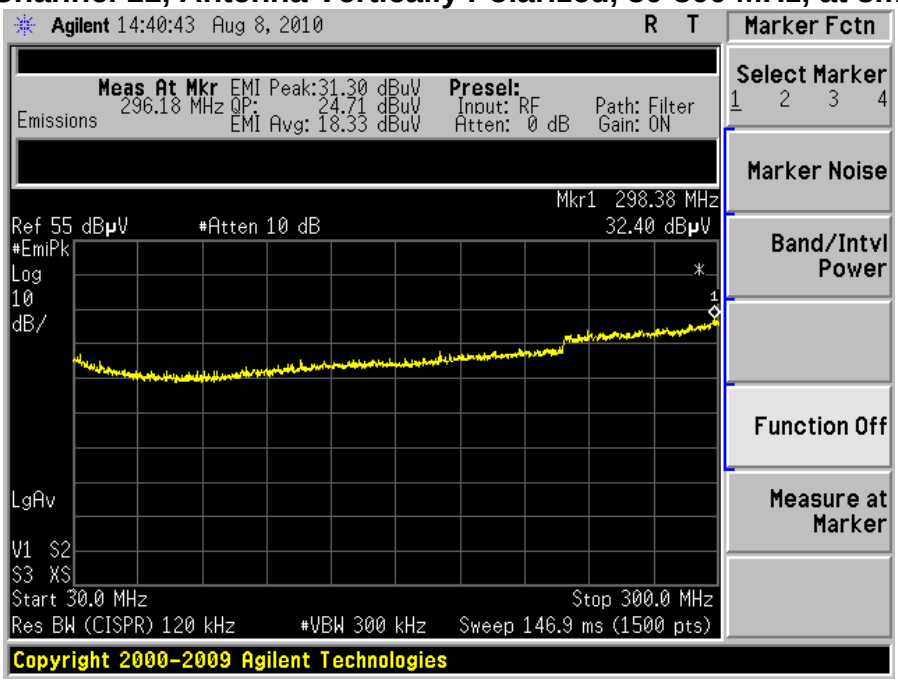
Screen Captures for WLAN radio and PIFA Antenna

Screen Captures - Radiated Emissions Test

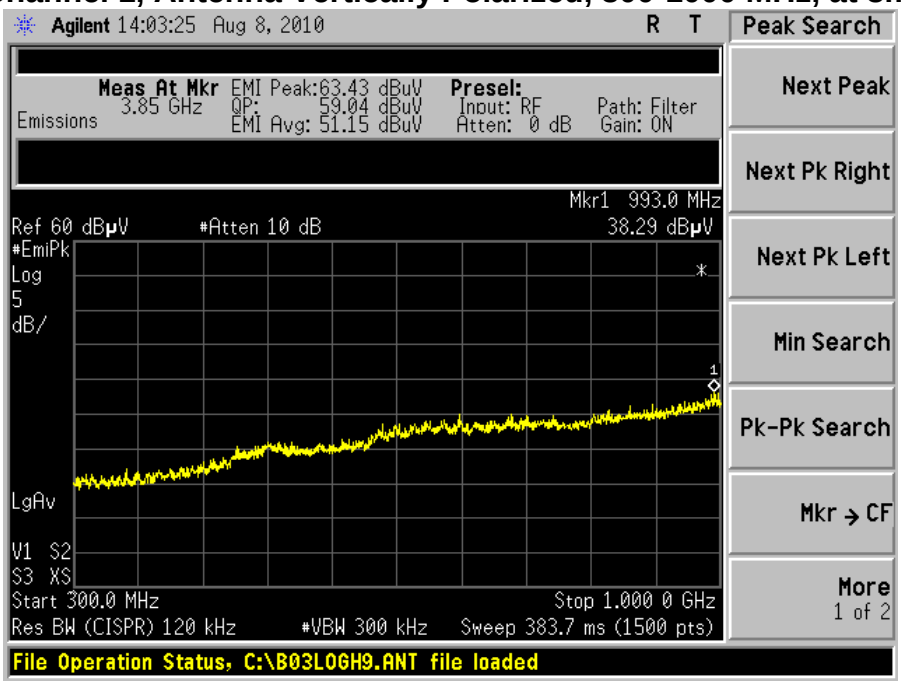
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 6, or 11 of the WiFi radio, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

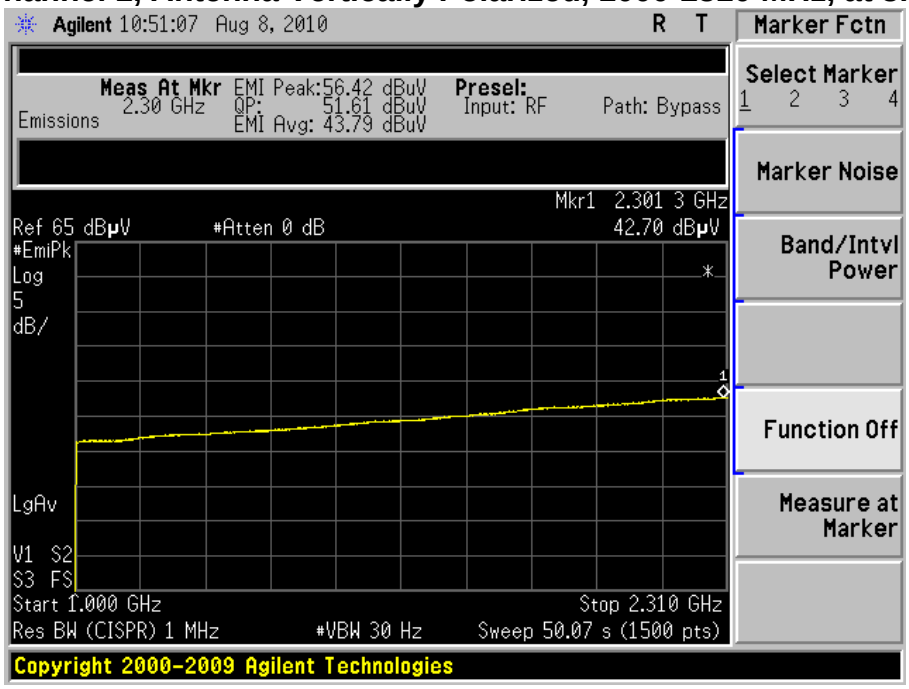
Channel 11, Antenna Vertically Polarized, 30-300 MHz, at 3m



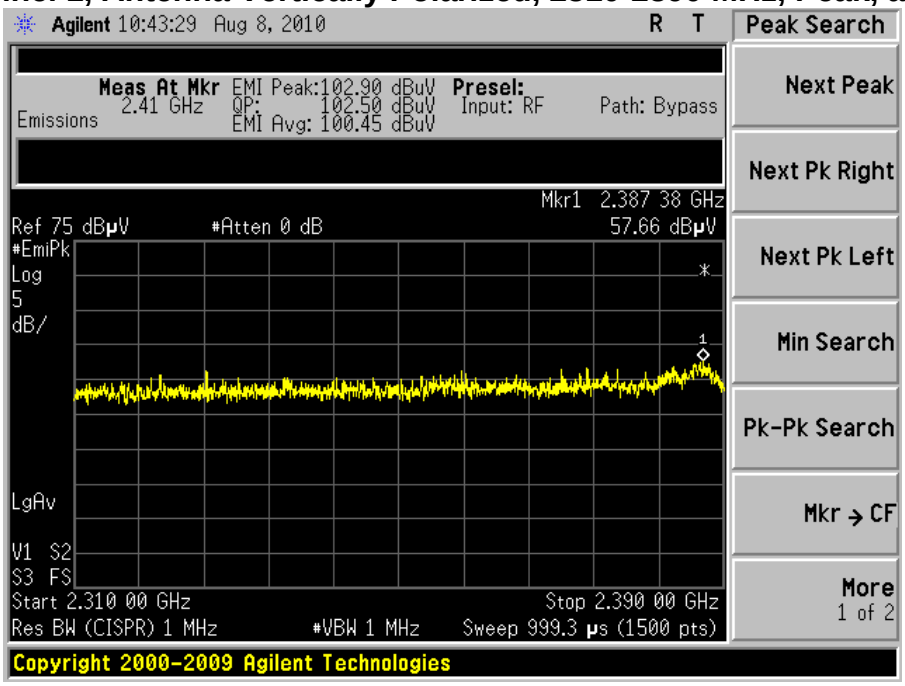
Channel 1, Antenna Vertically Polarized, 300-1000 MHz, at 3m



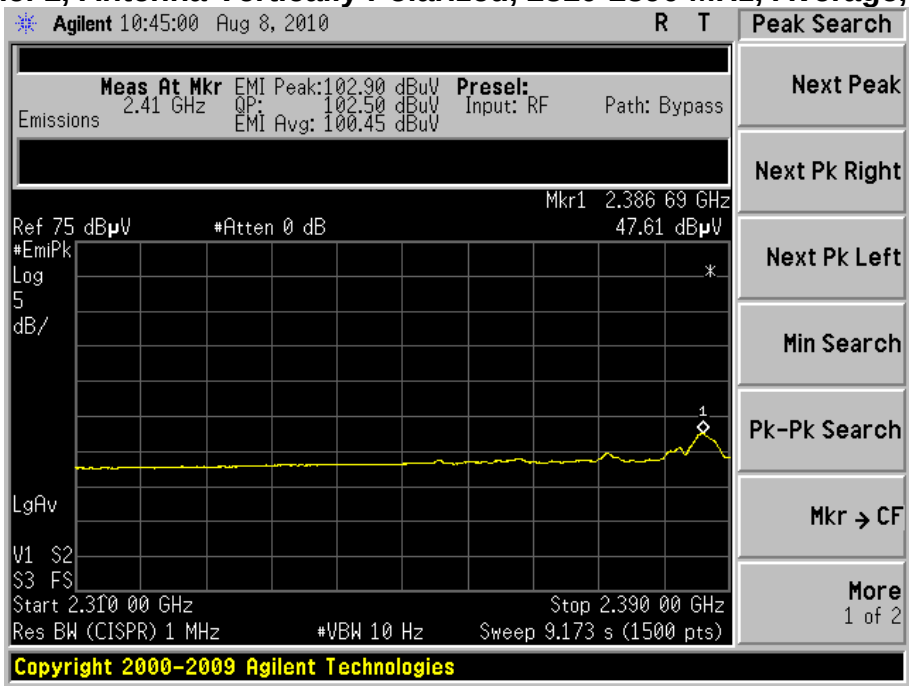
Channel 1, Antenna Vertically Polarized, 1000-2310 MHz, at 3m



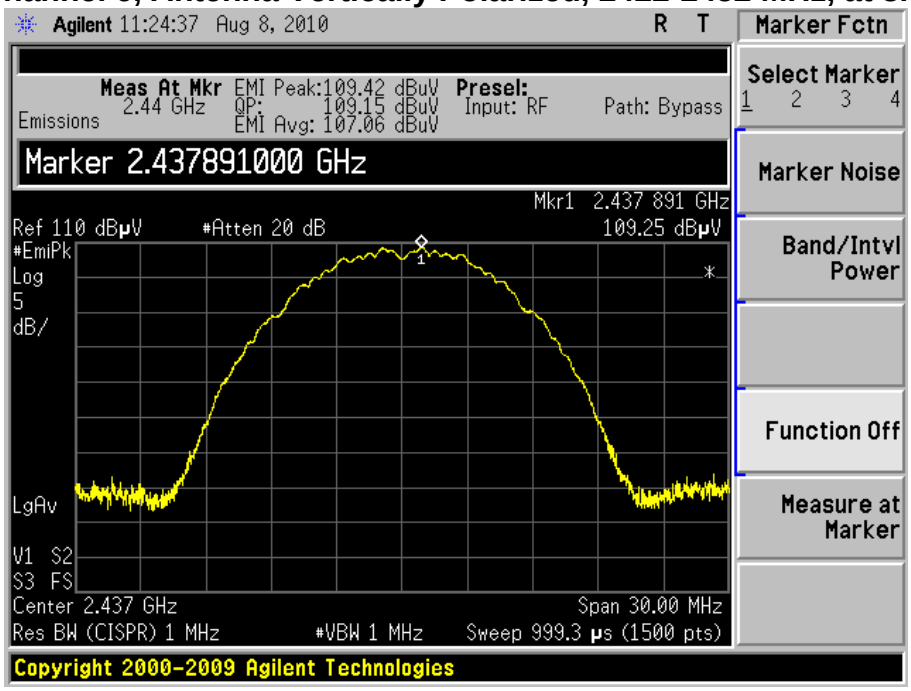
Channel 1, Antenna Vertically Polarized, 2310-2390 MHz, Peak, at 3m



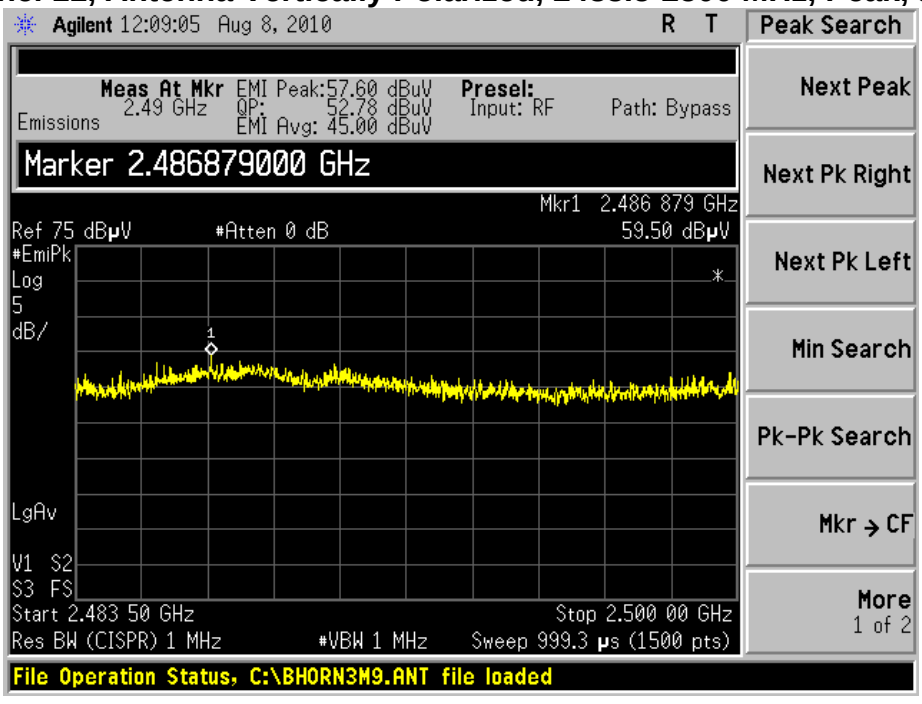
Channel 1, Antenna Vertically Polarized, 2310-2390 MHz, Average, at 3m



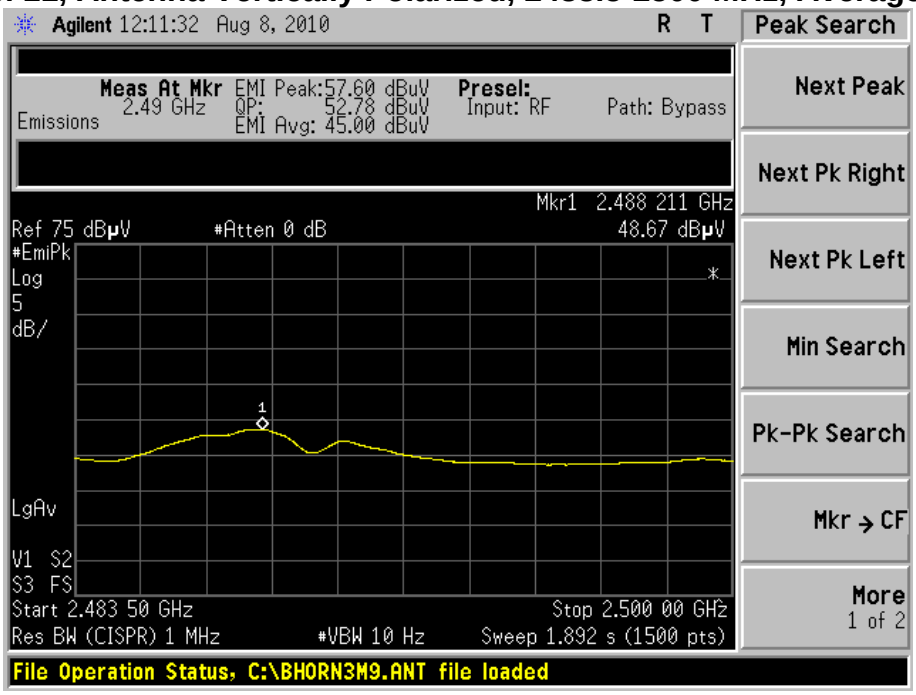
Channel 6, Antenna Vertically Polarized, 2422-2452 MHz, at 3m



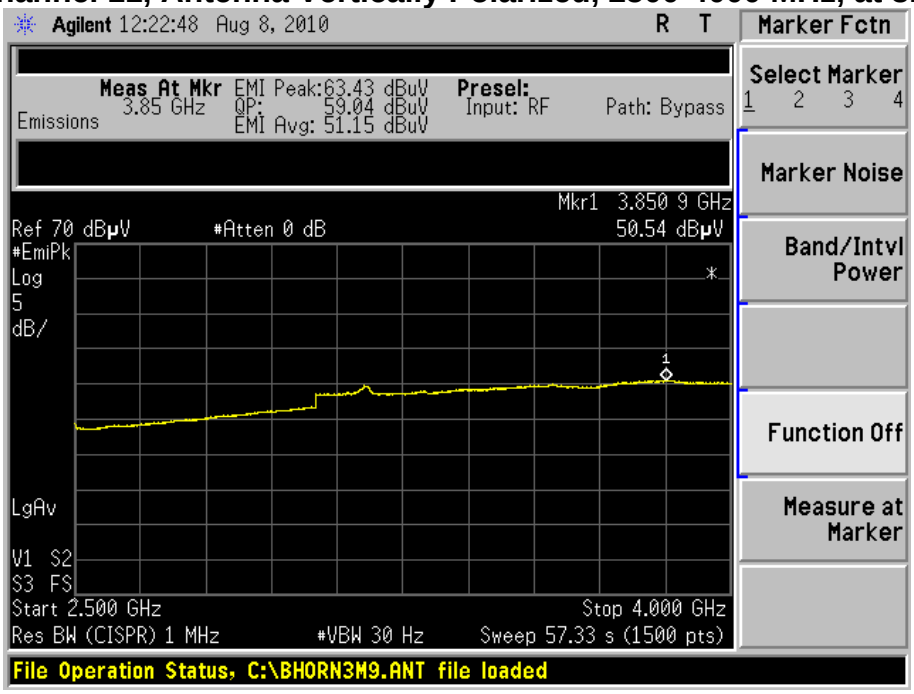
Channel 11, Antenna Vertically Polarized, 2483.5-2500 MHz, Peak, at 3m



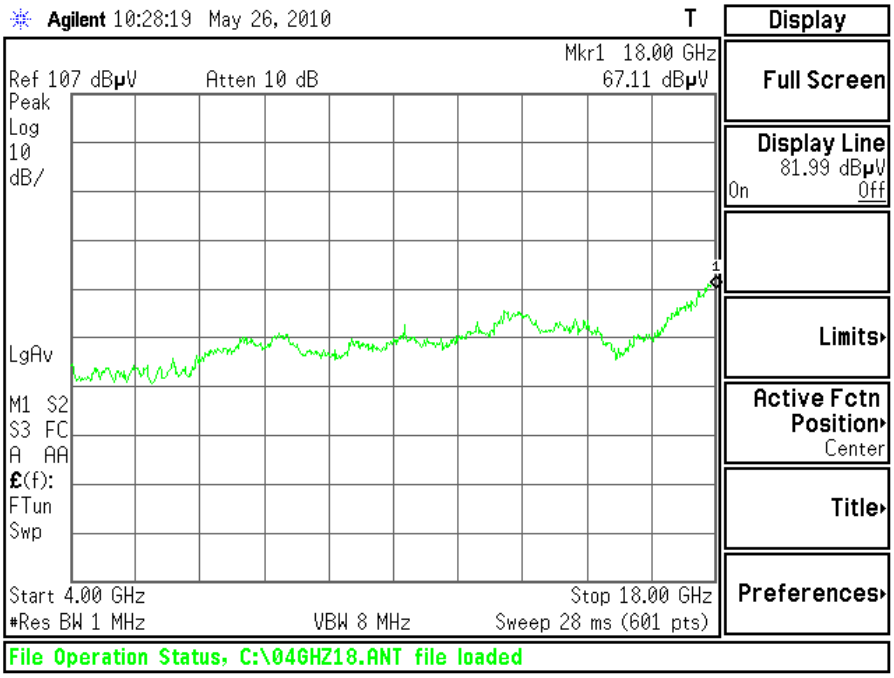
Channel 11, Antenna Vertically Polarized, 2483.5-2500 MHz, Average, at 3m



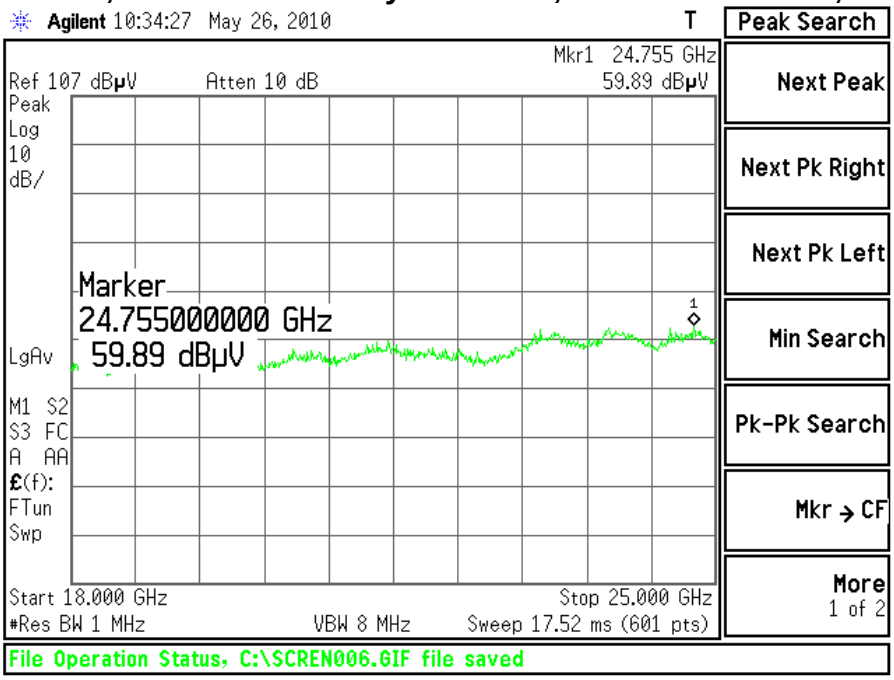
Channel 11, Antenna Vertically Polarized, 2500-4000 MHz, at 3m



Channel 11, Antenna Vertically Polarized, 4000-18000 MHz, at 1m



Channel 1, Antenna Vertically Polarized, 18000-25000 MHz, at 1m



*All 4-18 and 18-25 GHz scans presented similar emissions

B. Bluetooth Data

Data for Bluetooth Radio and Dipole Antenna

Harmonic Data for Bluetooth Radio with Worst Case Data Presented

Bluetooth with Dipole Bent

	Frequency (MHz)	Peak (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Average (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)	Height (cm)	Az (deg)
Horizontal	4803.80	58.9	83.5	44.6	55.9	63.5	7.6	101.6	73
Horizontal	7205.98	54.1	85.9	51.8	48.9	85.9	37.0	106.1	301
Horizontal	9608.77	52.1	85.9	53.8	44.9	85.9	41.0	99.6	108
Horizontal	12013.45	49.7	83.5	53.8	37.8	63.5	25.7	176.8	7
Horizontal	14411.15	60.6	83.5	42.9	51.2	63.5	12.3	109.7	299
Vertical	4803.87	57.5	83.5	46.0	54.1	63.5	9.4	101.2	94
Vertical	7205.93	52.7	85.9	53.2	45.6	85.9	40.3	112.3	224
Vertical	9607.43	50.5	85.9	55.4	40.4	85.9	45.5	106.1	197
Vertical	12010.03	50.5	83.5	53.0	38.7	63.5	24.8	176.5	5
Vertical	14411.03	54.3	83.5	49.2	44.3	63.5	19.2	108.2	118

Bluetooth with Dipole Straight

	Frequency (MHz)	Peak (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Average (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)	Height (cm)	Az (deg)
Horizontal	4804.35	61.8	83.5	41.8	59.9	63.5	3.6	101.8	336.3
Horizontal	7205.75	53.3	85.9	52.6	46.3	85.9	39.6	112.7	314.8
Horizontal	9608.23	53.1	85.9	52.8	45.0	85.9	40.9	106.5	72.8
Horizontal	12012.33	46.3	83.5	57.2	34.9	63.5	28.6	174.3	9.2
Horizontal	14412.7	56.1	83.5	47.4	46.0	63.5	17.5	106.8	315.7
Horizontal	16817.28	51.8	85.9	54.1	40.6	85.9	45.3	104.4	333
Vertical	4803.87	57.5	83.5	24.6	56.0	63.5	7.5	109.6	89.6
Vertical	7205.93	52.7	85.9	33.9	45.6	85.9	40.3	109.5	218.3
Vertical	9607.43	50.5	85.9	33.0	45.2	85.9	40.7	103.9	12.9
Vertical	12010.03	50.5	83.5	34.6	36.8	63.5	26.7	174.1	7.9
Vertical	14411.03	54.3	83.5	29.7	43.1	63.5	20.4	111.5	323

Notes:

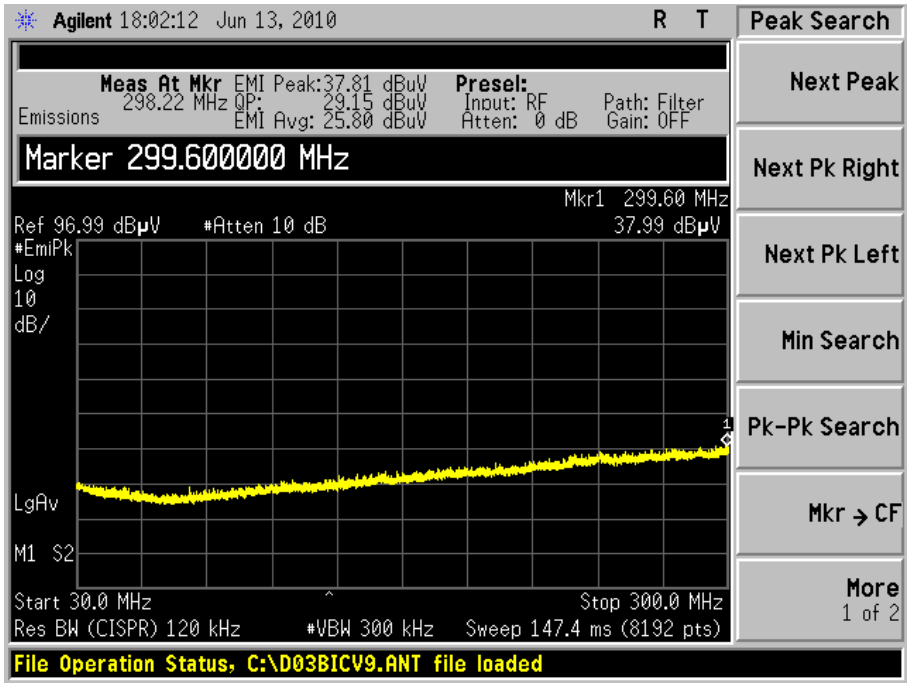
1) Measurements above 4 GHz were made at 1 meters of separation from the EUT
2) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak Detector was used in measurements above 1 GHz. Only the results from the video-averaged measurements using a Peak detector are published in the table above. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
3) Measurement at receiver system noise floor.
4) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=10 MHz.

Bluetooth with Dipole Antenna Screen Captures - Radiated Emissions Test

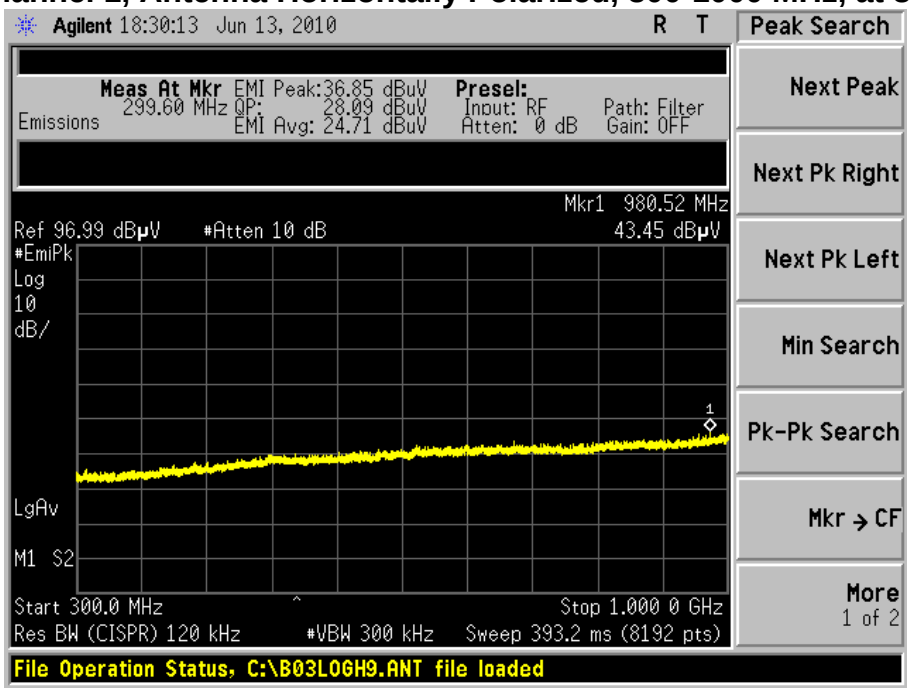
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 11,18, or 25 of the Bluetooth (BT) radio, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

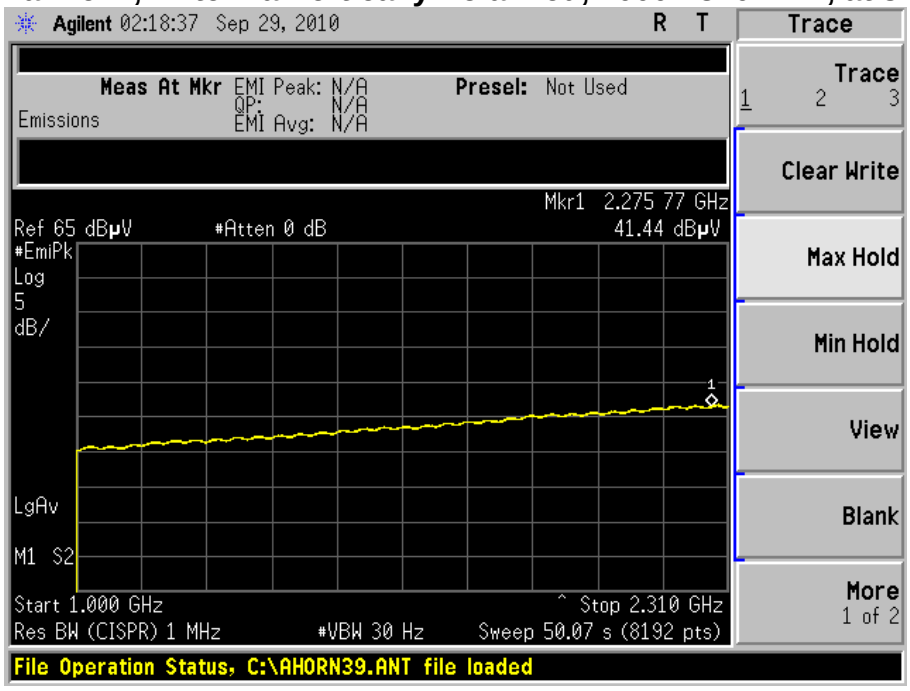
Channel 1, Antenna Vertically Polarized, 30-300 MHz, at 3m



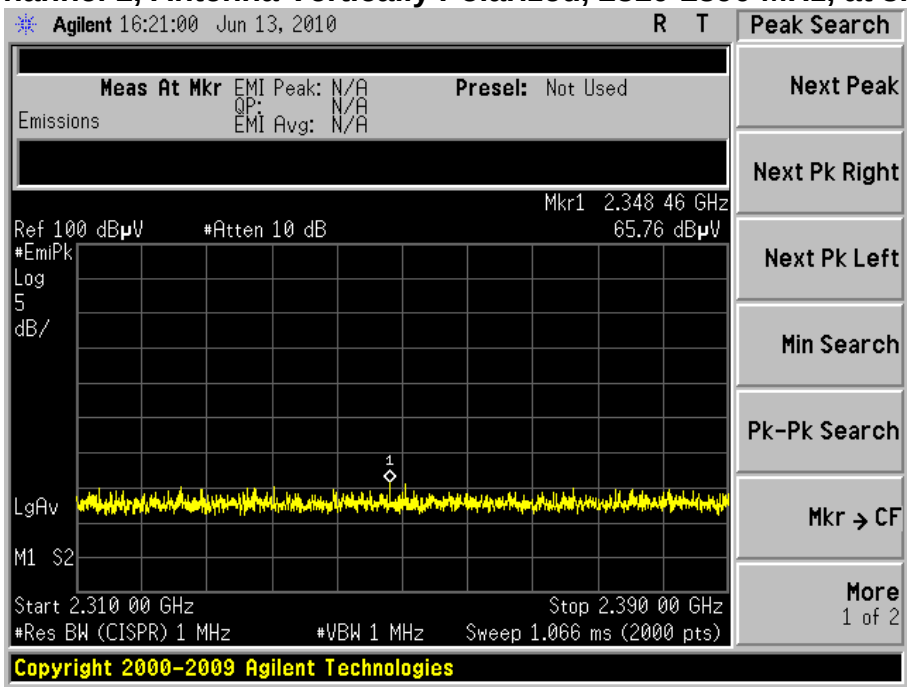
Channel 1, Antenna Horizontally Polarized, 300-1000 MHz, at 3m



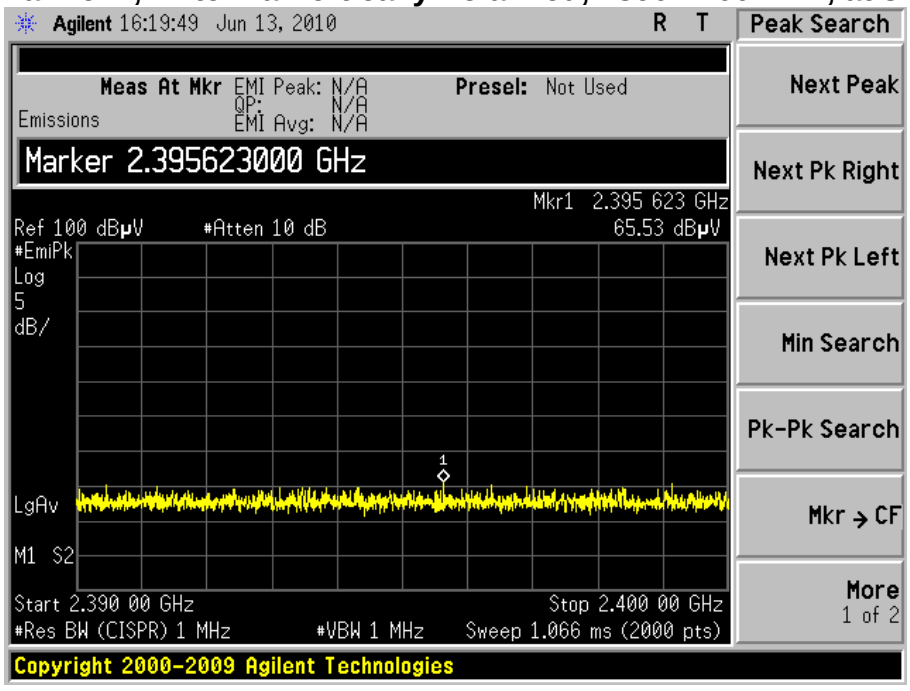
Channel 1, Antenna Vertically Polarized, 1000-2310 MHz, at 3m



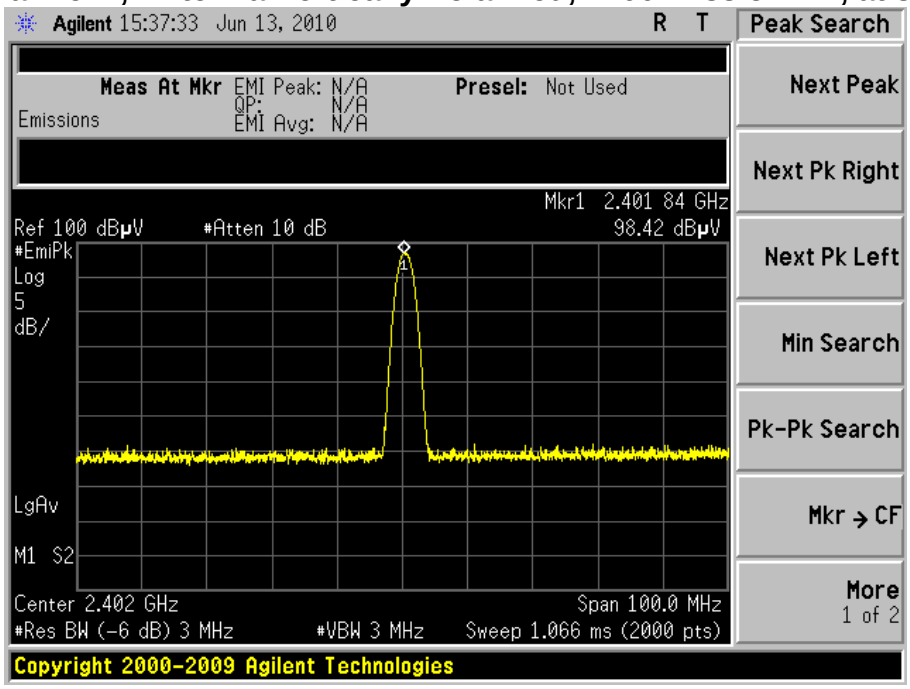
Channel 1, Antenna Vertically Polarized, 2310-2390 MHz, at 3m



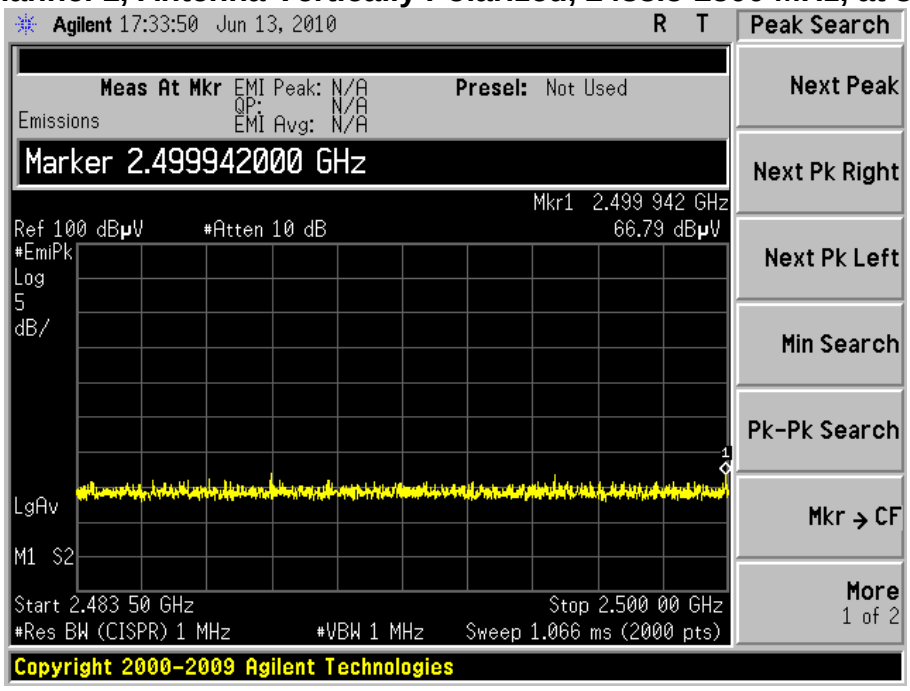
Channel 1, Antenna Vertically Polarized, 2390-2400 MHz, at 3m



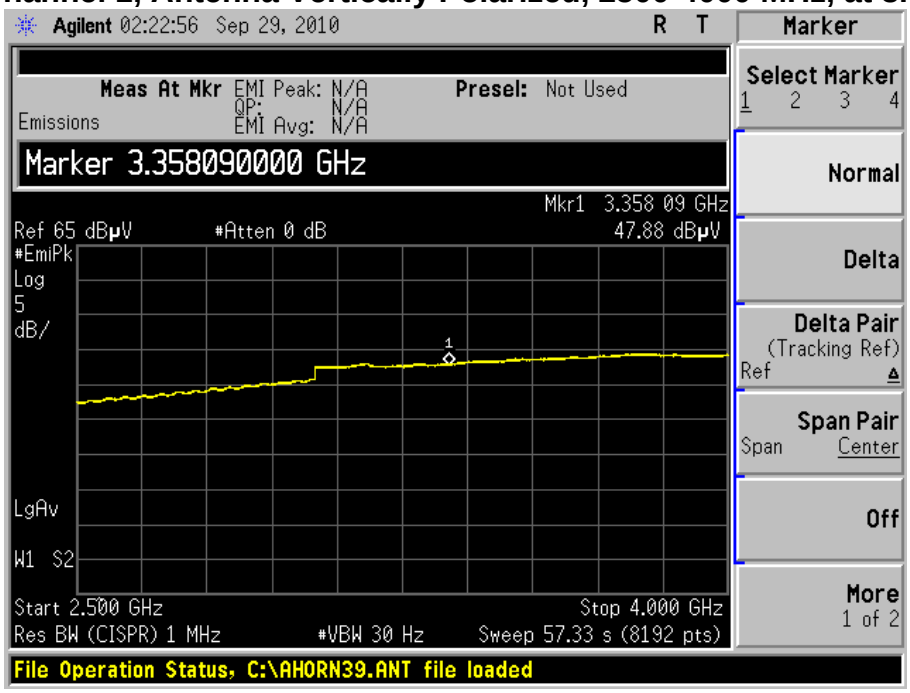
Channel 1, Antenna Vertically Polarized, 2400-2483.5 MHz, at 3m



Channel 1, Antenna Vertically Polarized, 2483.5-2500 MHz, at 3m



Channel 1, Antenna Vertically Polarized, 2500-4000 MHz, at 3m

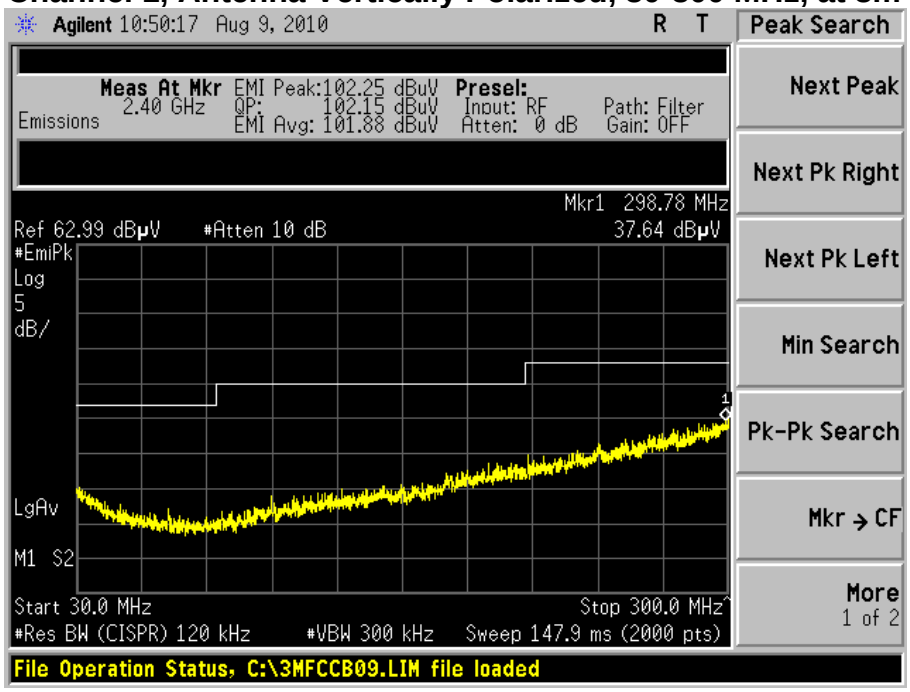


Bluetooth with PIFA Antenna Screen Captures - Radiated Emissions Test

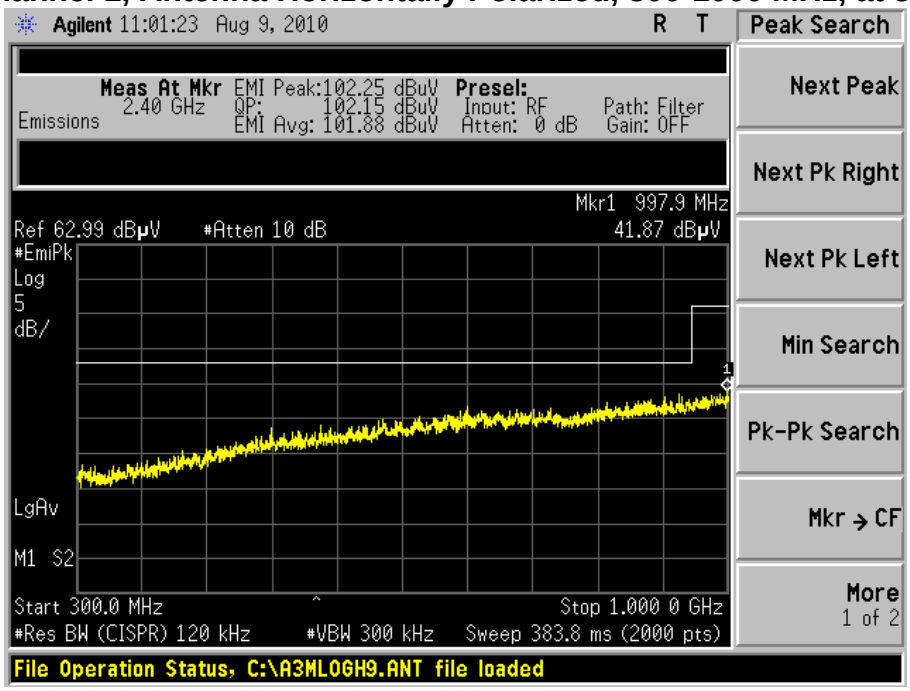
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 11,18, or 25 of the Bluetooth (BT) radio, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

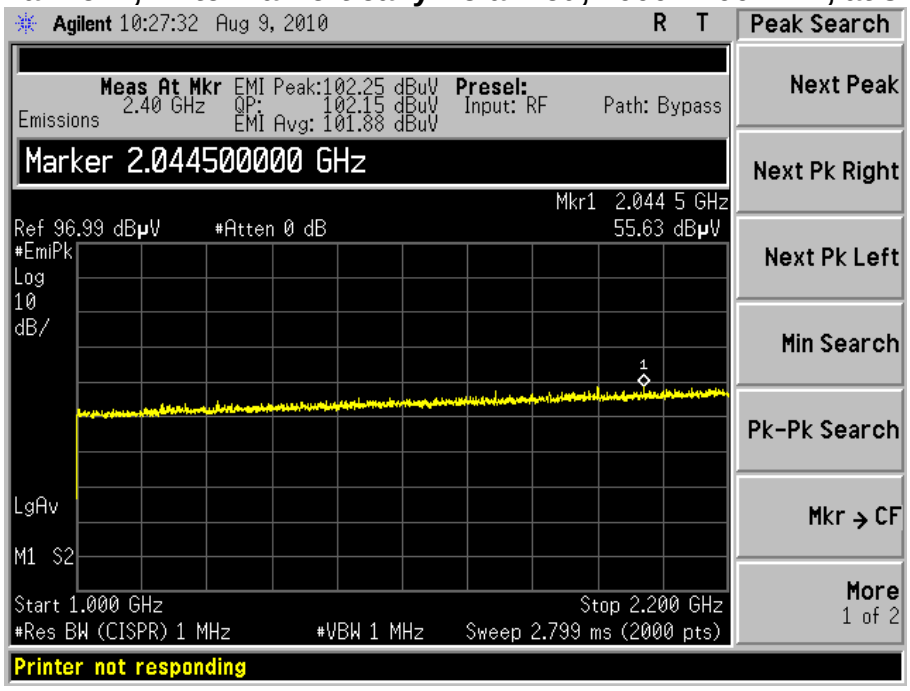
Channel 1, Antenna Vertically Polarized, 30-300 MHz, at 3m



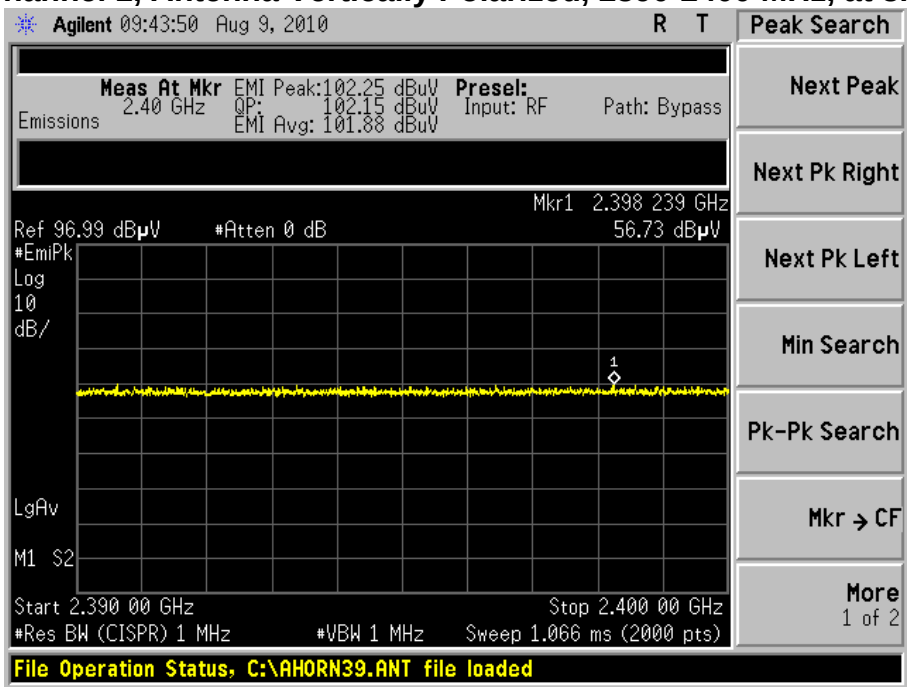
Channel 1, Antenna Horizontally Polarized, 300-1000 MHz, at 3m



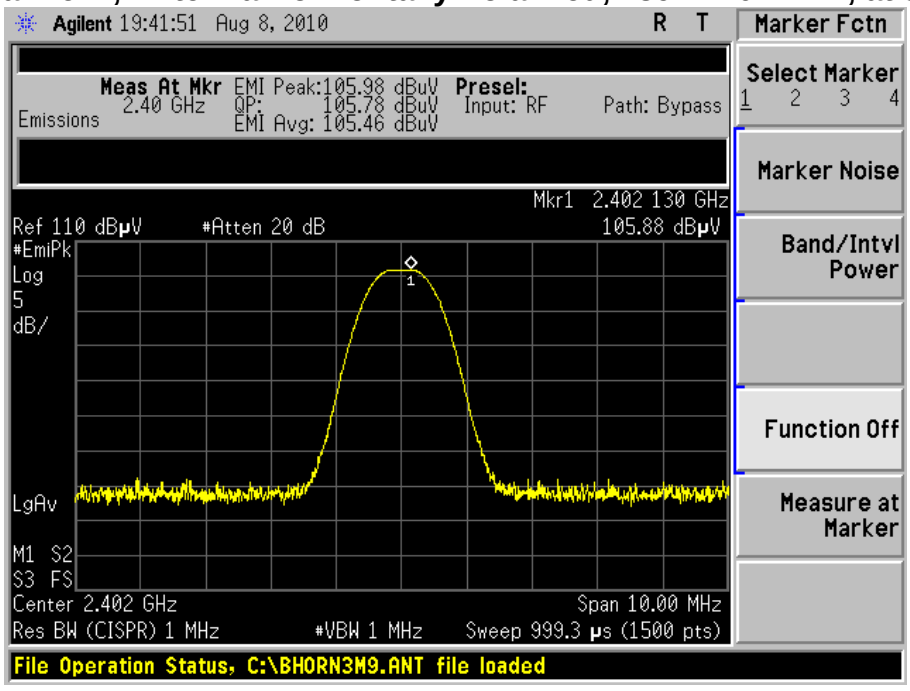
Channel 1, Antenna Vertically Polarized, 1000-2200 MHz, at 3m



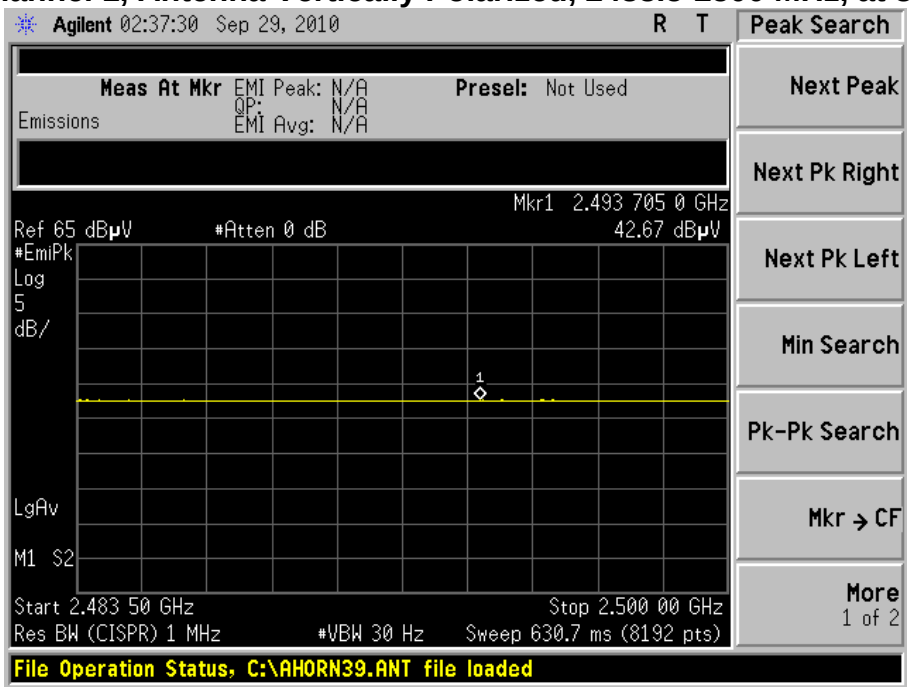
Channel 1, Antenna Vertically Polarized, 2390-2400 MHz, at 3m



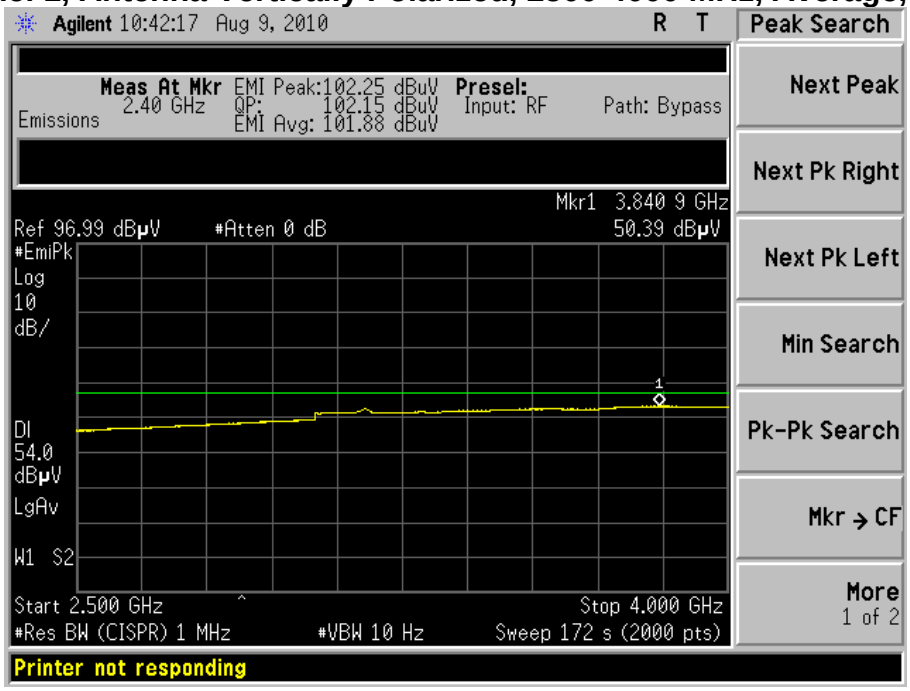
Channel 1, Antenna Horizontally Polarized, 2397-2407 MHz, at 3m



Channel 1, Antenna Vertically Polarized, 2483.5-2500 MHz, at 3m



Channel 1, Antenna Vertically Polarized, 2500-4000 MHz, Average, at 3m



5.9 Receive Mode Testing

Per the requirements of RSS-210, the EUT was placed in continuous receive mode and the radiated spurious emissions were measured and compared to the limits stated in RSS-Gen Section 4.10.

The test setup, procedure, and equipment utilized were identical to that described in sections 5.1, 5.2, and 5.3 of this document.

Measurement data and screen captures from the receive tests are presented below:

Radio	Antenna	Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity
WLAN	Dipole	298.38	1.00	0	26.1	46.0	19.9	H
WLAN	Dipole	2412.50	1.00	0	40.2	54.0	13.8	V
WLAN	Dipole	3756.90	1.00	0	44.5	54.0	9.5	H
WLAN	PIFA	59.32	1.00	0	9.8	40.0	30.2	V
WLAN	PIFA	297.43	1.00	0	24.9	46.0	21.1	V
WLAN	PIFA	295.27	1.00	0	25.2	46.0	20.8	H
WLAN	PIFA	997.20	1.00	0	29.3	54.0	14.7	V
WLAN	PIFA	3761.40	1.00	0	44.2	54.0	9.8	H

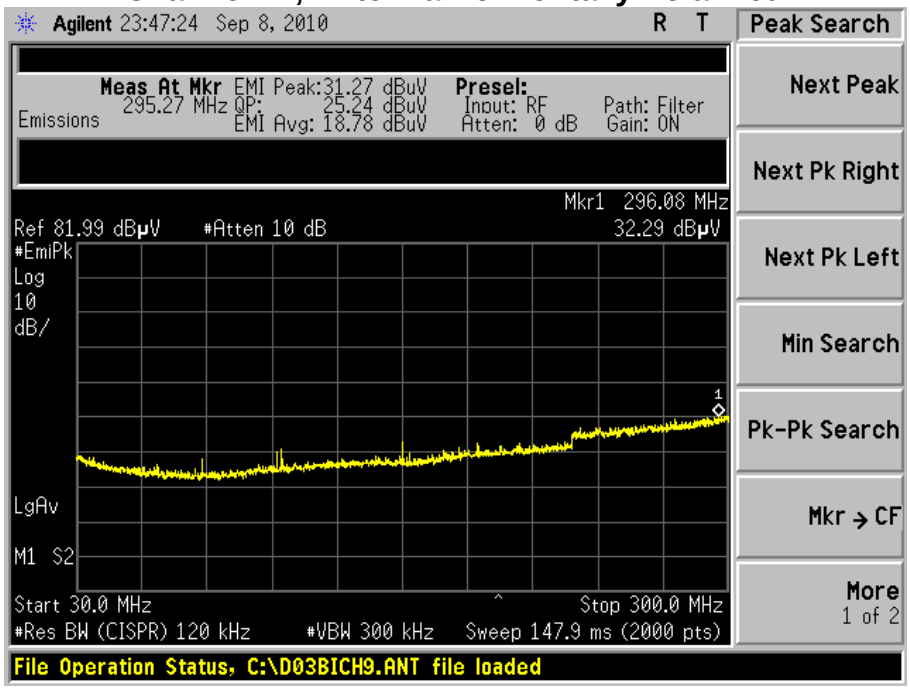
Screen Captures - Radiated Emissions Testing – Receive Mode

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

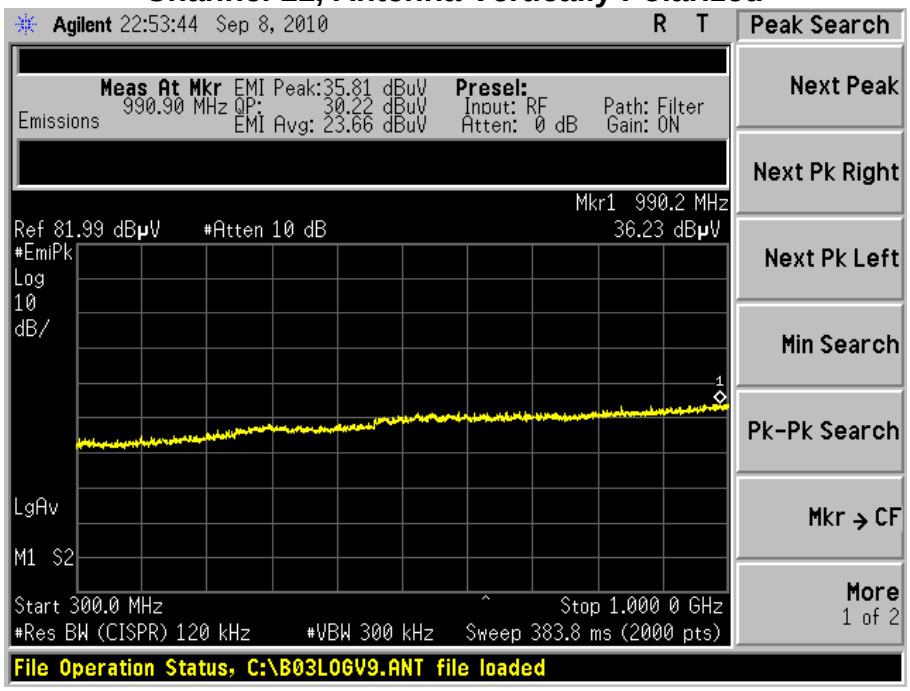
WLAN
The signature scans shown here are from worst-case emissions, as measured on channels 11, 18 and 25, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Data Taken with WLAN Radio and PIFA Antenna – WLAN Radio with Dipole antenna demonstrated similar results

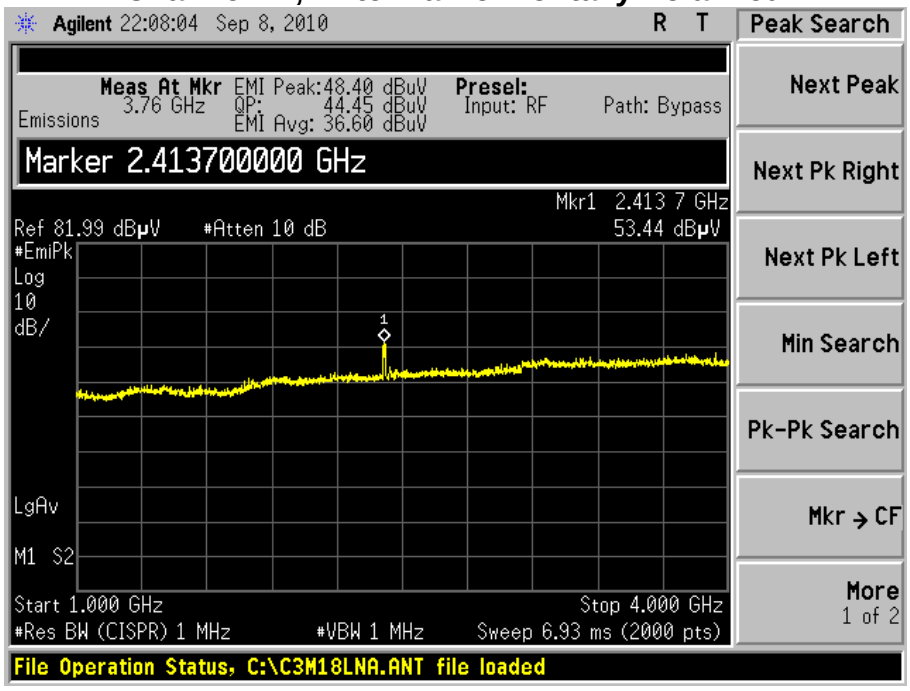
Channel 11, Antenna Horizontally Polarized



Channel 11, Antenna Vertically Polarized

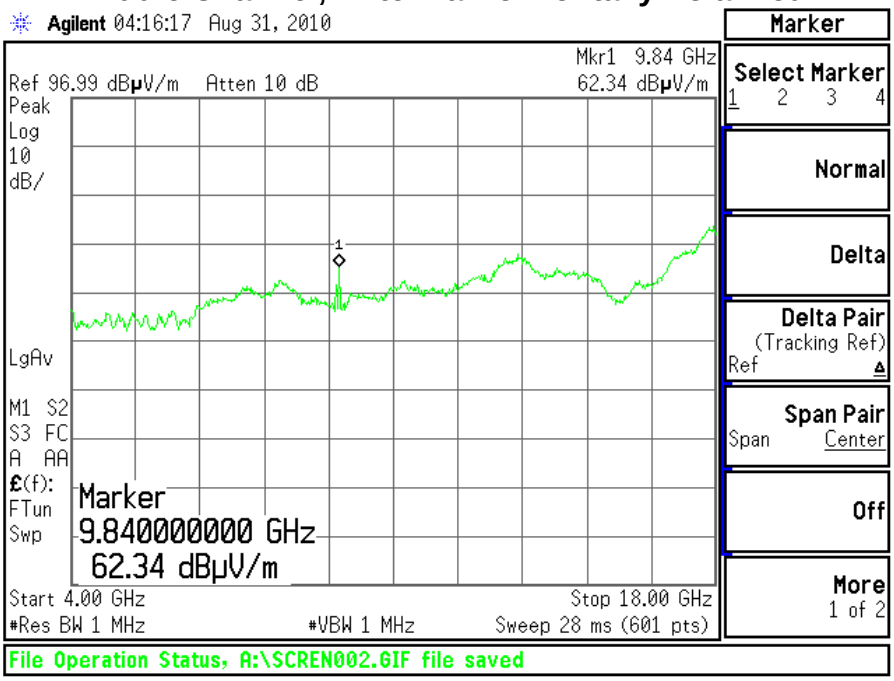


Channel 11, Antenna Horizontally Polarized

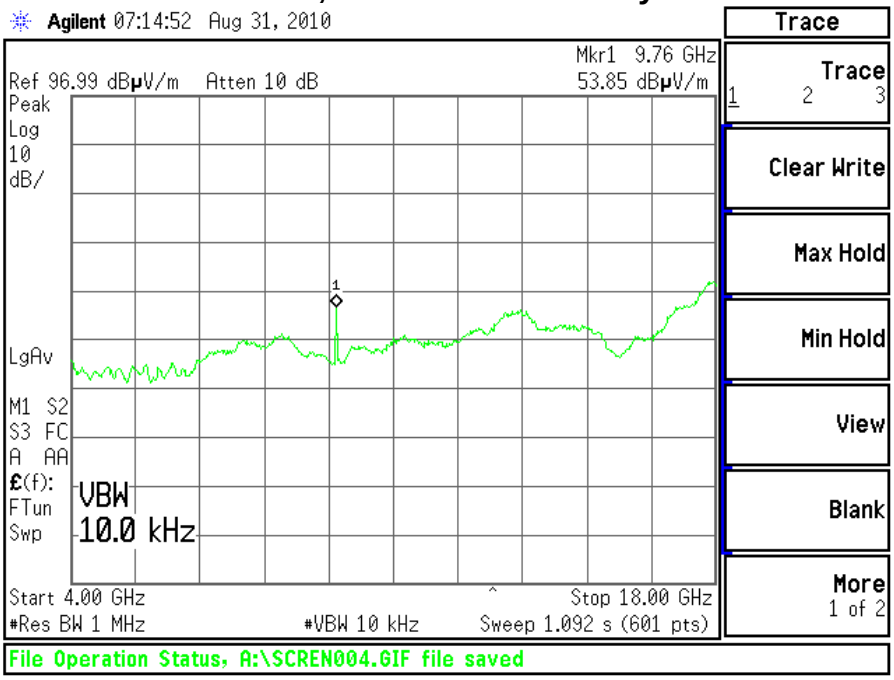


Screen Captures - Radiated Emissions Testing – Receive Mode **(continued)**

Middle Channel, Antenna Horizontally Polarized

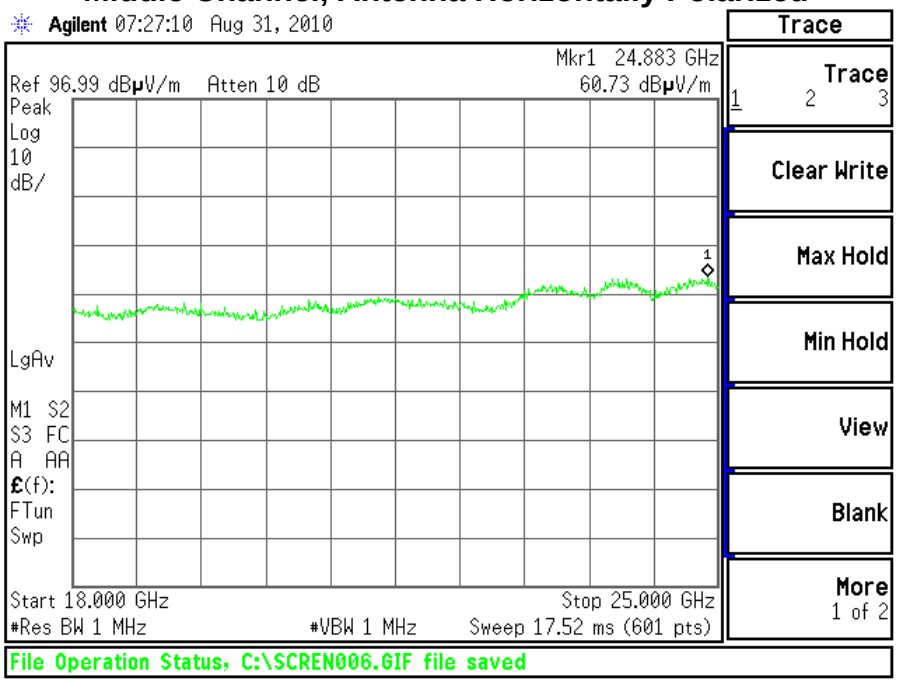


Middle Channel, Antenna Horizontally Polarized

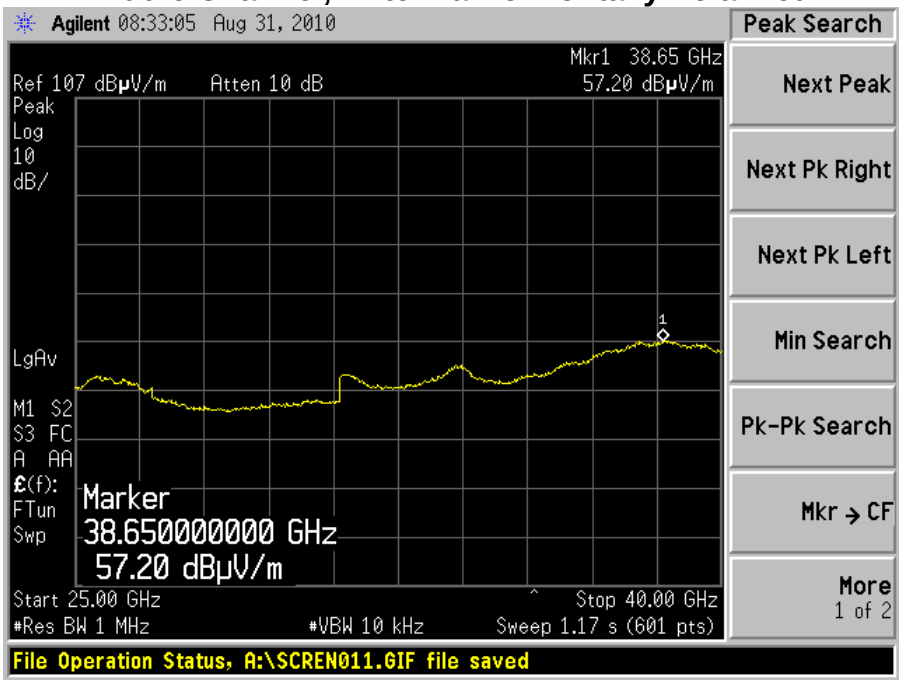


Screen Captures - Radiated Emissions Testing – Receive Mode **(continued)**

Middle Channel, Antenna Horizontally Polarized



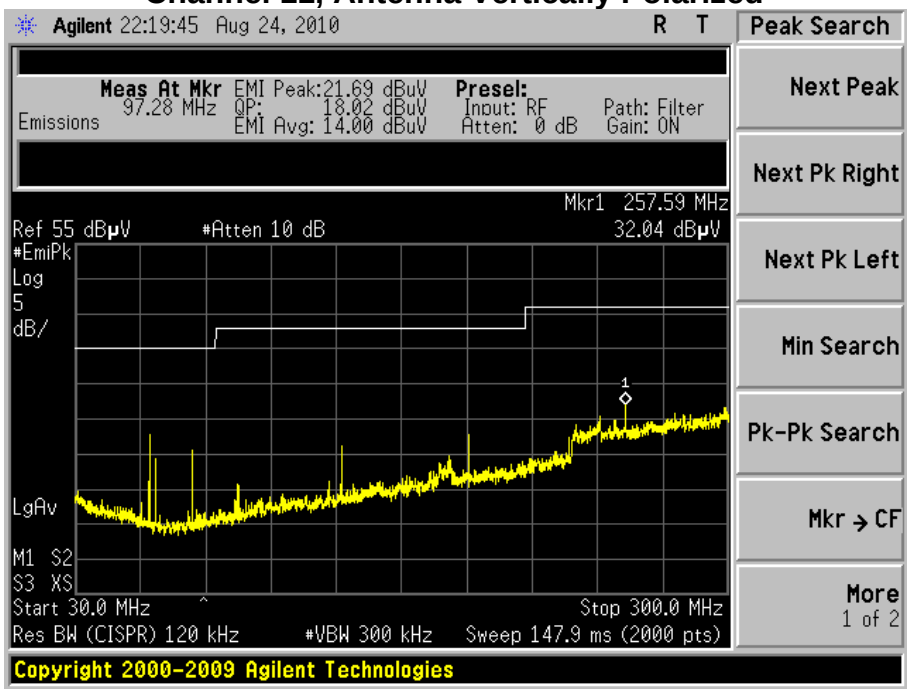
Middle Channel, Antenna Horizontally Polarized



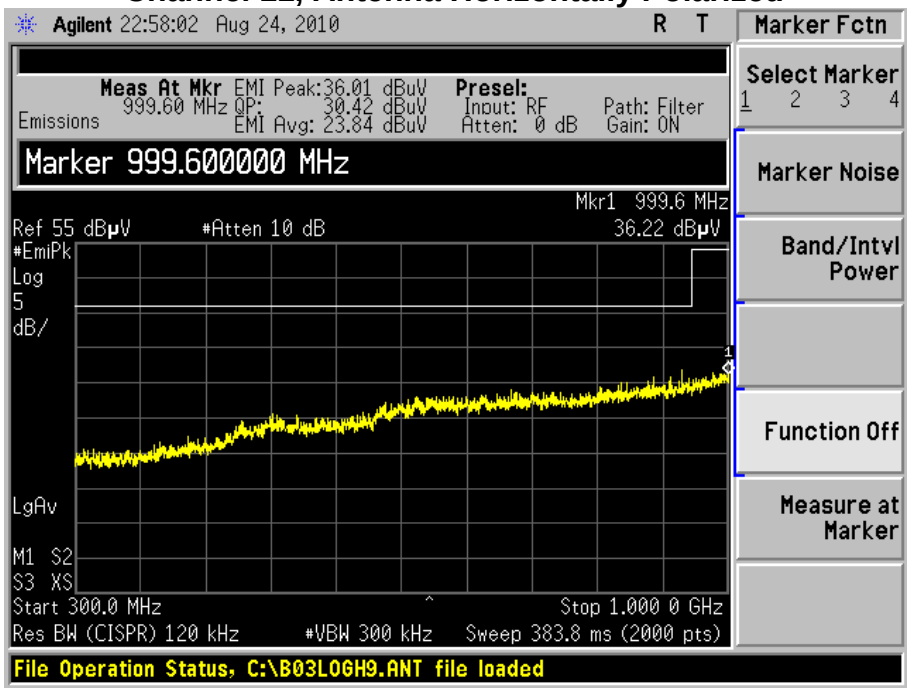
Screen Captures - Radiated Emissions Testing – Receive Mode *(continued)*

BT Radio with PIFA Antenna – BT Radio with Dipole Antenna Produced Similar Results

Channel 11, Antenna Vertically Polarized

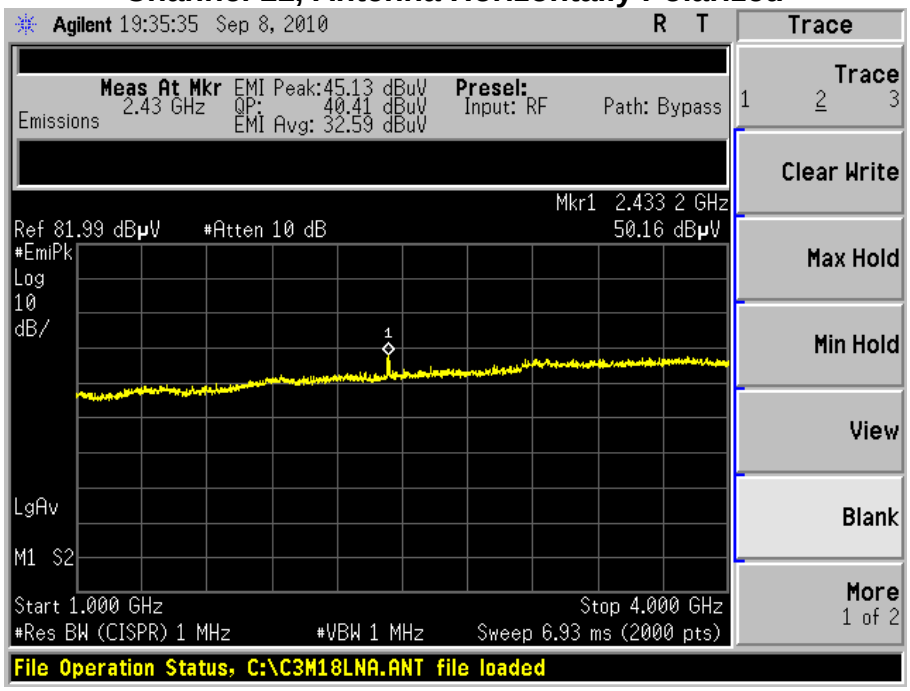


Channel 11, Antenna Horizontally Polarized

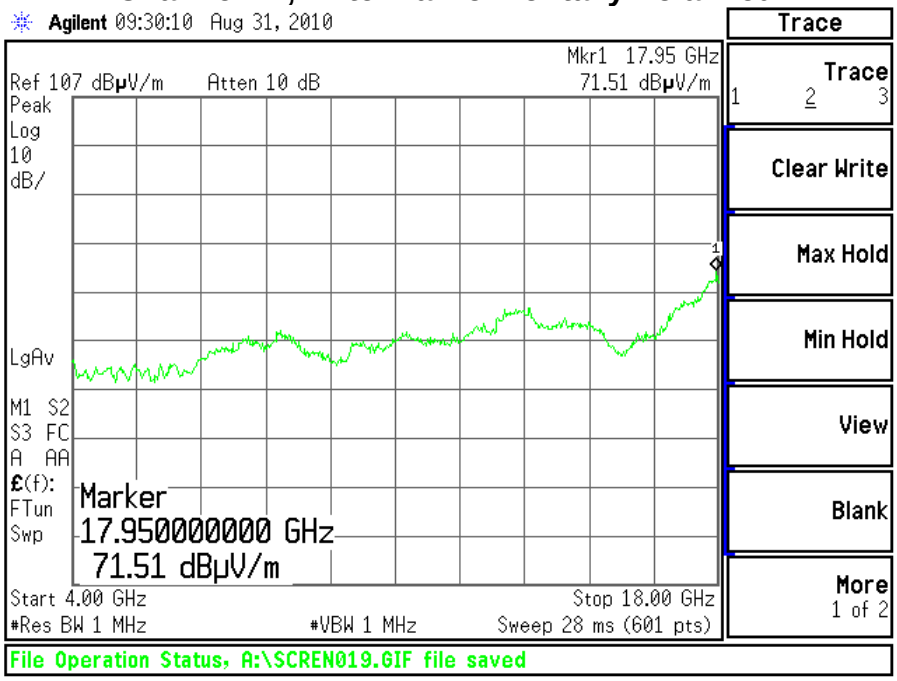


Screen Captures - Radiated Emissions Testing – Receive Mode *(continued)*

Channel 11, Antenna Horizontally Polarized

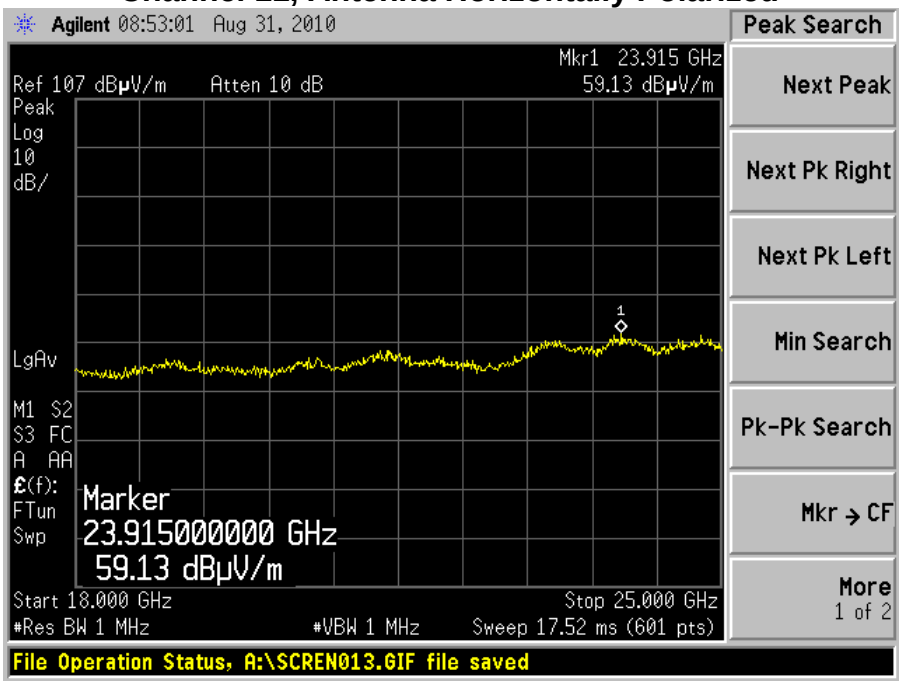


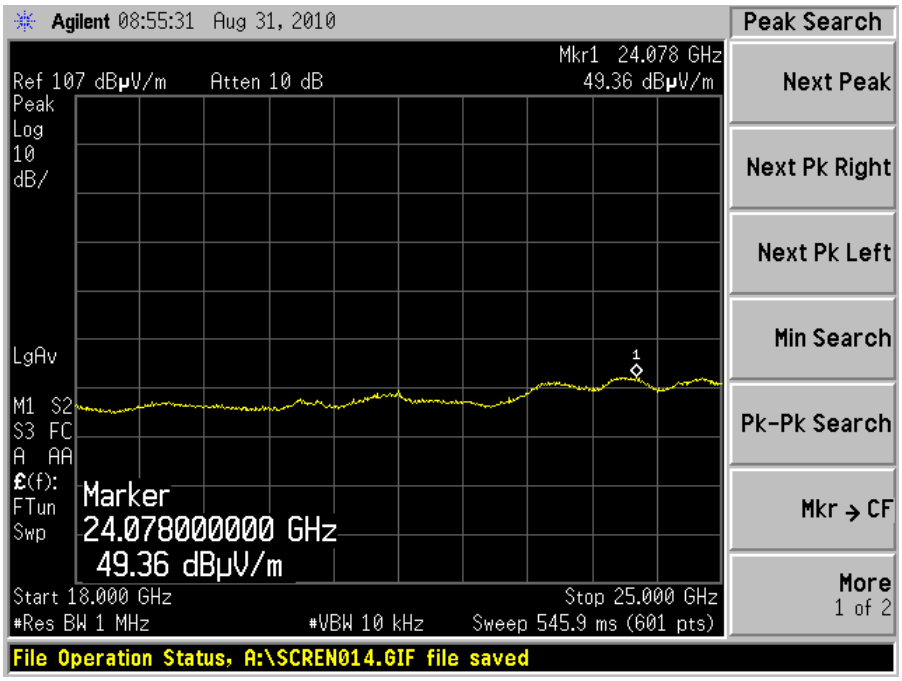
Channel 11, Antenna Horizontally Polarized



Screen Captures - Radiated Emissions Testing – Receive Mode *(continued)*

Channel 11, Antenna Horizontally Polarized





Screen Captures - Radiated Emissions Testing – Receive Mode *(continued)*

Channel 11, Antenna Horizontally Polarized

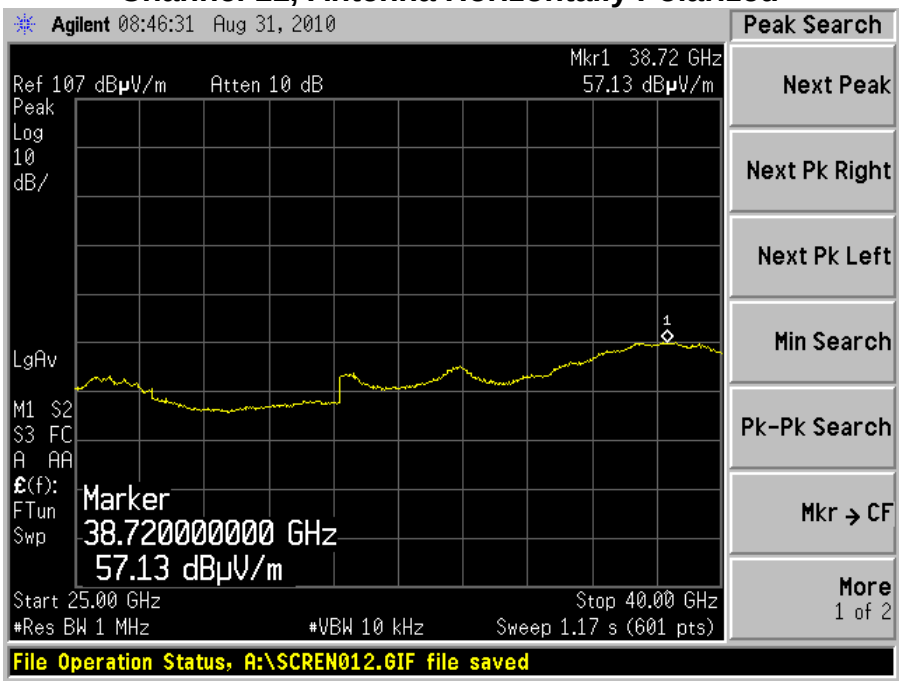


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

6.1 - Test Setup

The test area and setup are in accordance with ANSI C63.4-2003 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. 5VDC was supplied to the EUT via an AC to DC supply converting the 120VAC supply to the necessary 5VDC to operate the radio and host board. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

6.2 - Test Procedure

The EUT was investigated in continuous modulated transmit mode and continuous receive mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

6.3 - Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

6.4 - Test Results

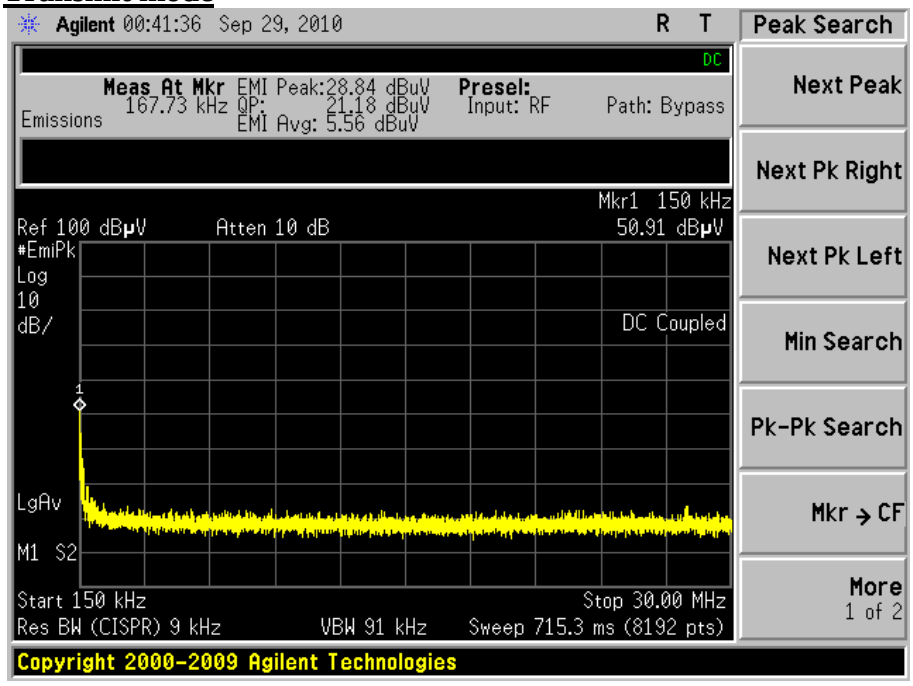
The EUT was found to **MEET** the Conducted Emission requirements of FCC CFR 47 Part **15.207** and **15.107**, Conducted Emissions. See the Data Charts and Graphs for more details of the test results. By virtue of meeting the requirements of FCC, the EUT also meets the requirements of IC **RSS 210** and **RSS GEN**.

6.5 - FCC Limits of Conducted Emissions at the AC Mains Ports

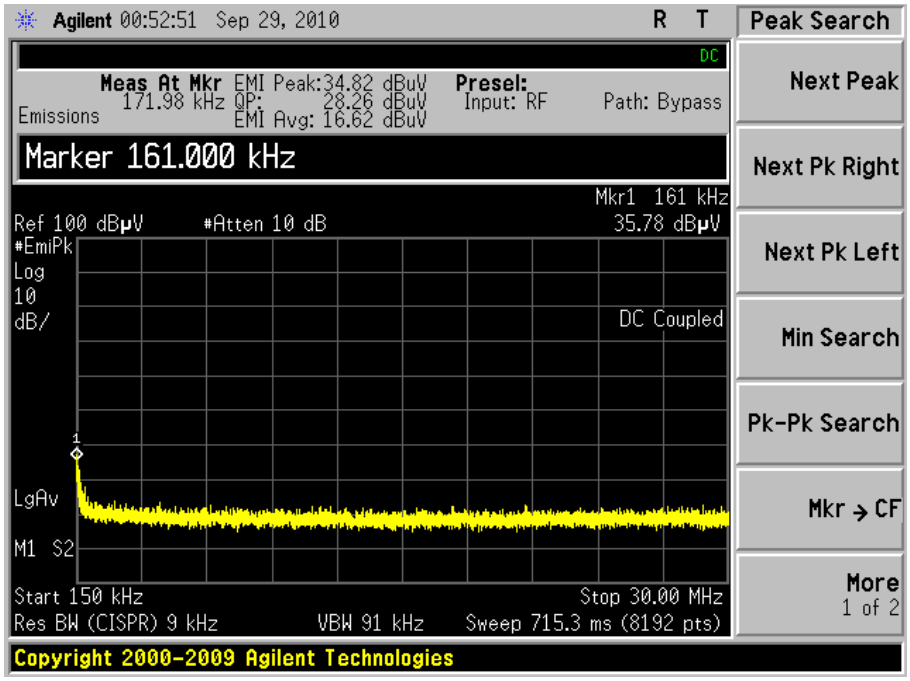
Frequency Range (MHz)	**Class B Limits (dBµV)**		**Measuring Bandwidth**
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

6.6.1 WLAN RADIO:

Transmit mode



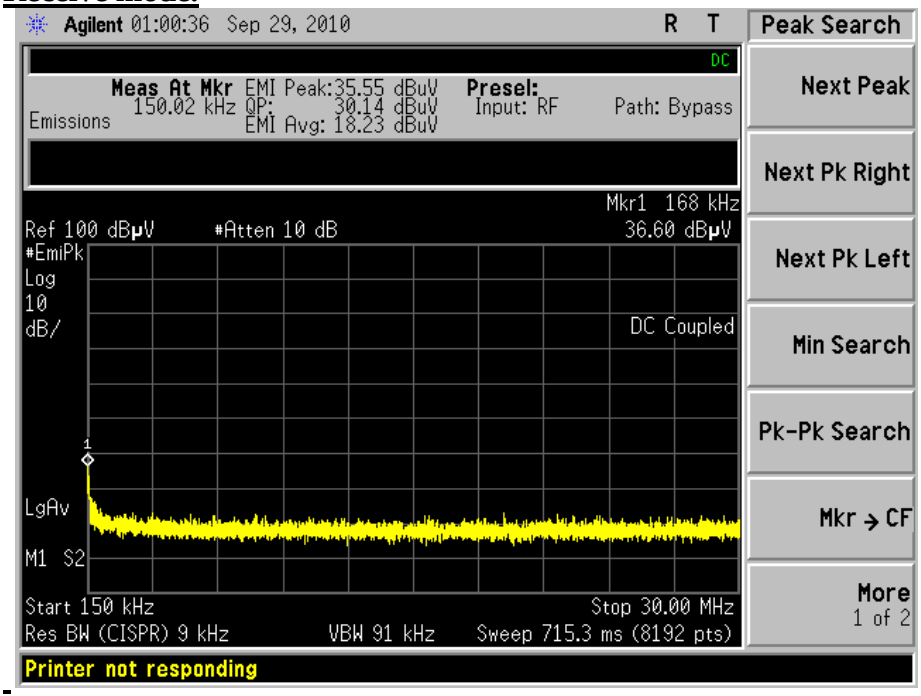
LINE 1



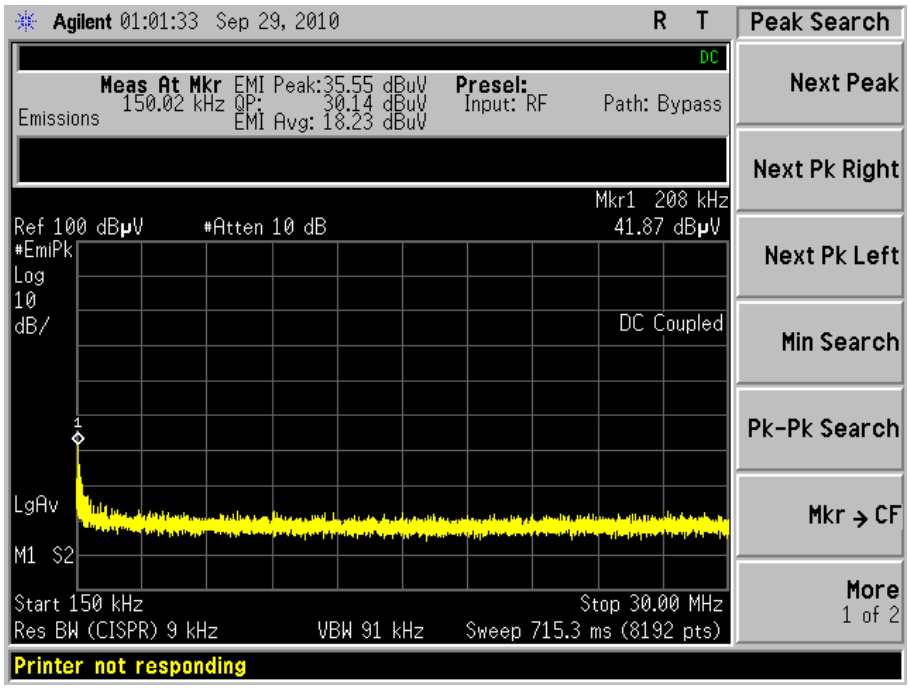
LINE 2

Notes:
1 All other emissions were better than 20 dB below the limits.
2) The EUT exhibited similar emissions across the Low and High channels tested.
3) Measured levels and limits are in units of dBuV/m.
4) Operation was verified by monitoring the emission with a PSA

Receive mode.



LINE 1

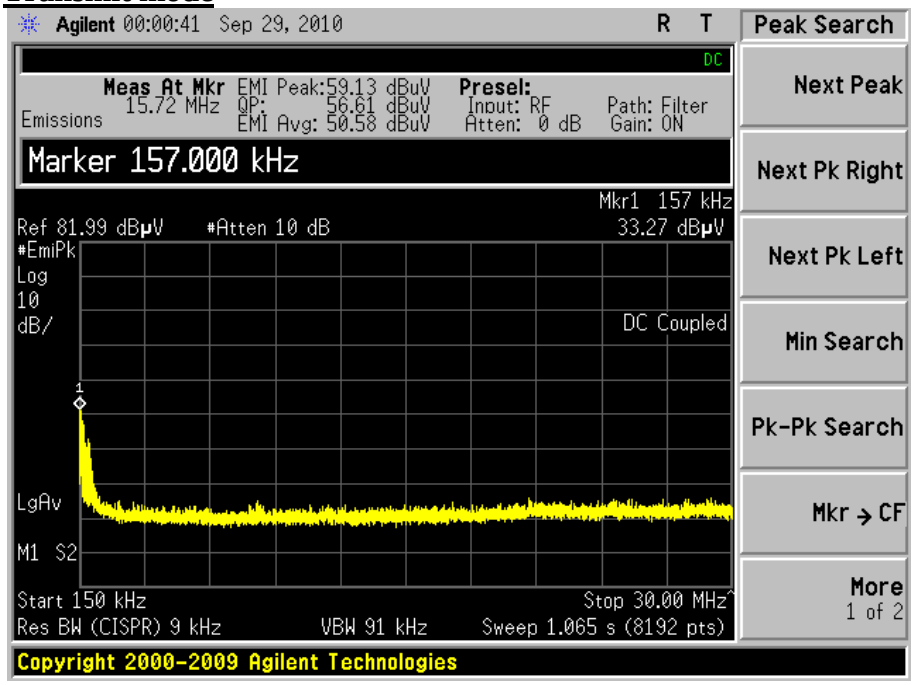


LINE 2

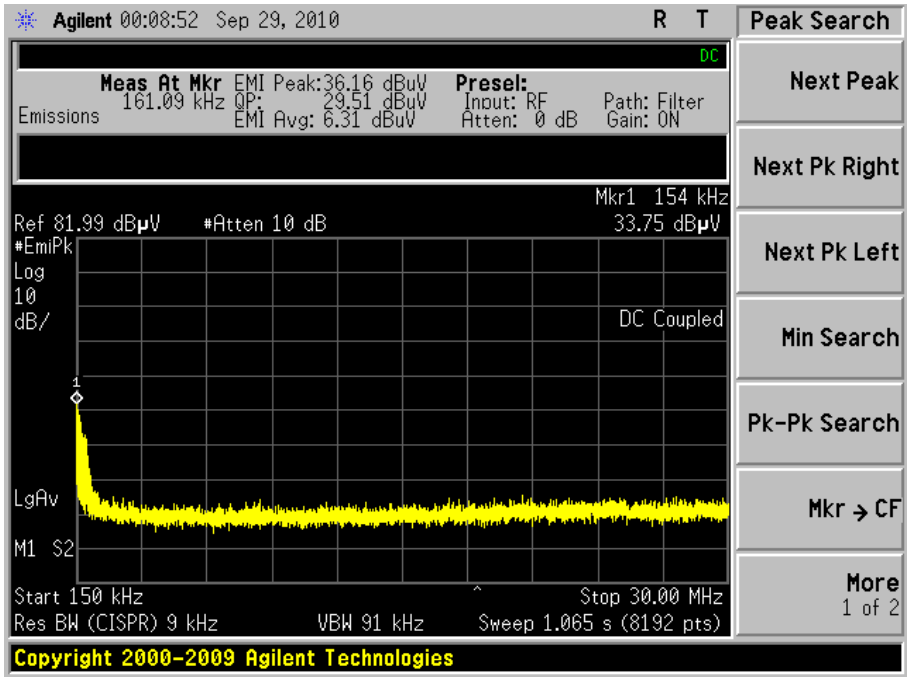
Notes:
1) All other emissions were better than 20 dB below the limits.
2) The EUT exhibited similar emissions across the Low and High channels tested.
3) Measured levels and limits are in units of dBuV/m.

6.6.2 BT RADIO:

Transmit mode

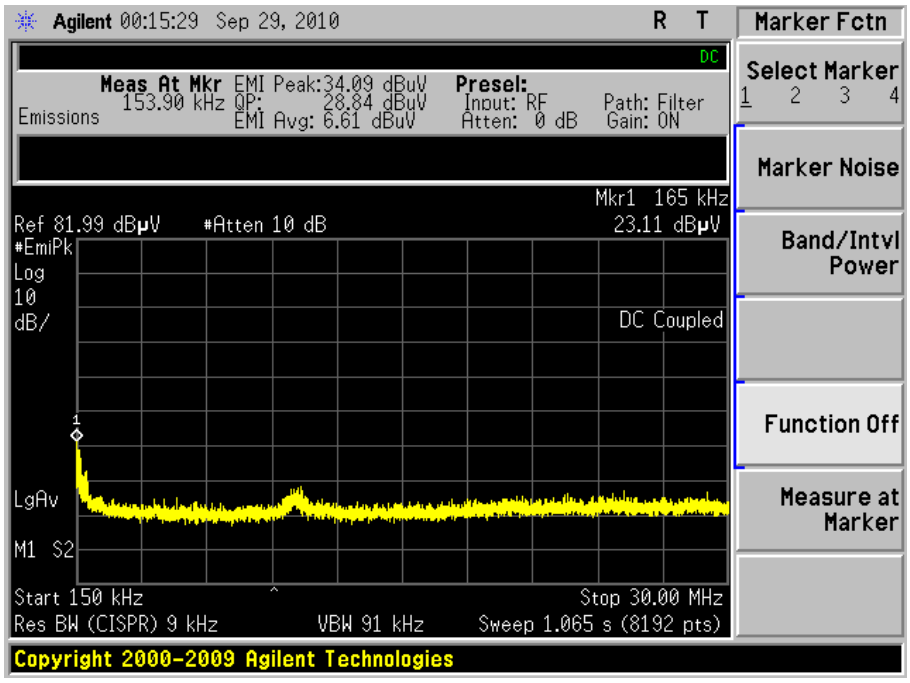


LINE 1

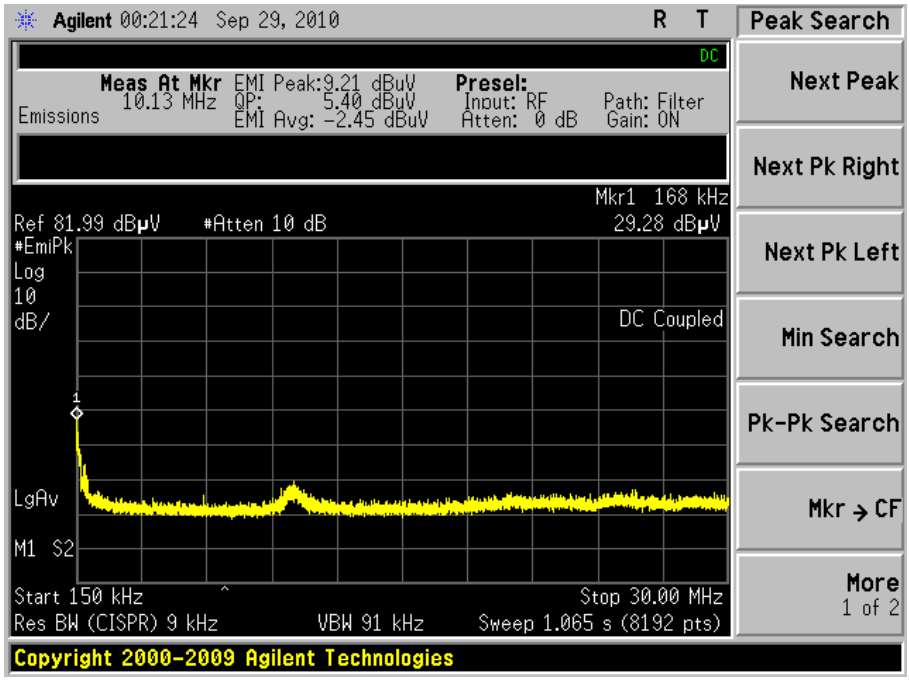


LINE 2

Receive mode.



LINE 1



LINE 2

6.7 – Conducted Emissions Test Data

Frequency Range inspected: 150 KHz to 30 MHz
Test Standard: FCC 15.207 Class B
IC RSS GEN 7.2.2

Manufacturer:	LS Research					
Date(s) of Test:	September 28, 2010					
Project Engineer:	Peter Feilen					
Test Engineer:	Peter Feilen					
Voltage:	5VDC					
Operation Mode:	Continuous TX and Continuous RX					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 % 22° C and 48 % R.H.					
Test Location:		Outside of chamber with VGP and HGP present				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detector Used:	X	Peak	X	Quasi-Peak	X	Average

CONDUCTED AC EMISSIONS DATA

BT	0.157	TX1	29.03	65.62	36.59	6.89	55.62	48.73
	0.161	TX1	29.51	65.41	35.90	6.31	55.41	49.10
	0.157	TX2	28.8	65.62	36.82	6.53	55.62	49.09
	0.154	TX2	28.84	65.78	36.94	6.61	55.78	49.17
	0.165	RX2	16.57	65.21	48.64	4.51	55.21	50.70
	0.167	RX1	21.18	65.11	43.93	5.56	55.11	49.55
WLAN	0.150	TX1	39.01	66.00	26.99	20.77	56.00	35.23
	0.165	TX2	29.26	65.21	35.95	17.56	55.21	37.65
	0.150	RX2	30.14	66.00	35.86	18.23	56.00	37.77
	0.172	RX1	36.77	64.86	28.09	18.58	54.86	36.28

EXHIBIT 7. OCCUPIED BANDWIDTH:

7.1 Limits

For a Digital Modulation System, the 6 dB bandwidth shall be at least 500 kHz.

7.2 Method of Measurements

7.2.1 Method for Bluetooth Measurements

Refer to ANSI C63.4 and FCC Procedures (2007) for Digital Transmission Systems operating under 15.247.
The transmitter output was connected to the Spectrum Analyzer. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 30 kHz resolution bandwidth and 100 kHz video bandwidth.

The bandwidth requirement found in FCC Part 15.247(a)(1) and (a)(1)(iii) and RSS 210 A8.1(a) requires a minimum -6dBc occupied bandwidth of 500 kHz. In addition, Industry Canada (IC RSS GEN 4.6.1) requires the measurement of the -20dBc occupied bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the Agilent E4446A spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct measurements, without the need for any further corrections. An Agilent E4446A spectrum analyzer was used with the resolution bandwidth set to 30 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the closest measurement (20 dB bandwidth) when compared to the specified limit, is 858.33 kHz, which is greater than the minimum of 500 kHz.

7.2.2 Method for WiFi Measurements

Refer to ANSI C63.4 and FCC Procedures (2007) for Digital Transmission Systems operating under 15.247.
The transmitter output was connected to the Spectrum Analyzer. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 100 kHz RBW and VBW=300 kHz.

The bandwidth requirement found in FCC Part 15.247(a)(2) and RSS 210 A8.2(a) requires an occupied bandwidth measurement to insure that channel separation requirements are met. In addition, Industry Canada (IC RSS GEN 4.6.1) requires the measurement of the -20dBc occupied bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the Agilent E4446A spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct measurements, without the need for any further corrections. An Agilent E4446A spectrum analyzer was used with the resolution bandwidth set to 300 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the closest measurement (6 dB bandwidth) when compared to the specified limit, is 9220 kHz, which is greater than the minimum of 500 kHz.

7.3 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

7.4 Test Data

7.4.1 Bluetooth

Channel	Center Frequency (MHz)	Measured -20 dBc Occ.Bw (kHz)
1	2402	866.66
40	2441	858.33
79	2480	875.00

7.4.2 WiFi at 1 Mbps Data Rate

Channel	Center Frequency (MHz)	Measured -6 dBc Occ BW (kHz)	Minimum -6 dBc Occ BW (kHz)	Measured -20 dBc Occ.Bw (kHz)
1	2412	962.50	500	1200.00
6	2437	922.50	500	1320.00
11	2462	922.00	500	1320.00

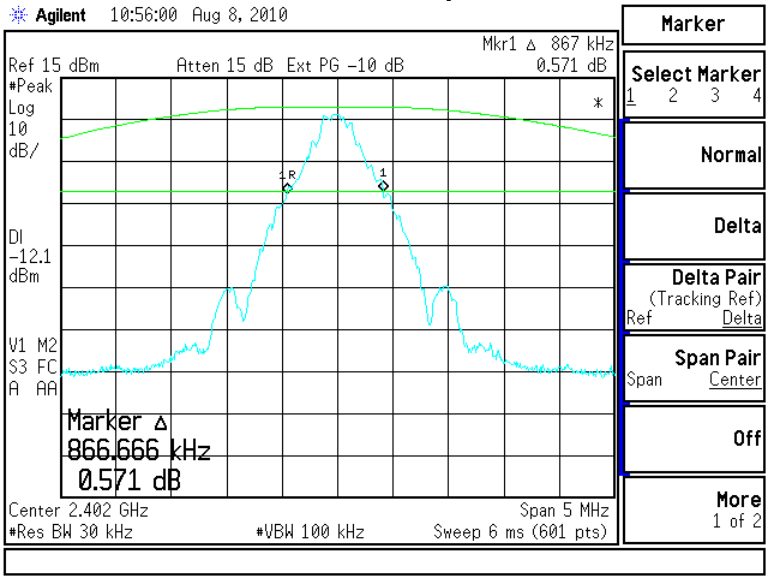
WiFi at MCS7 Data Rate

Channel	Center Frequency (MHz)	Measured -6 dBc Occ BW (kHz)	Minimum -6 dBc Occ BW (kHz)	Measured -20 dBc Occ.Bw (kHz)
1	2412	1731.90	500	1750.00
6	2437	1746.50	500	1795.00
11	2462	1756.40	500	1790.00

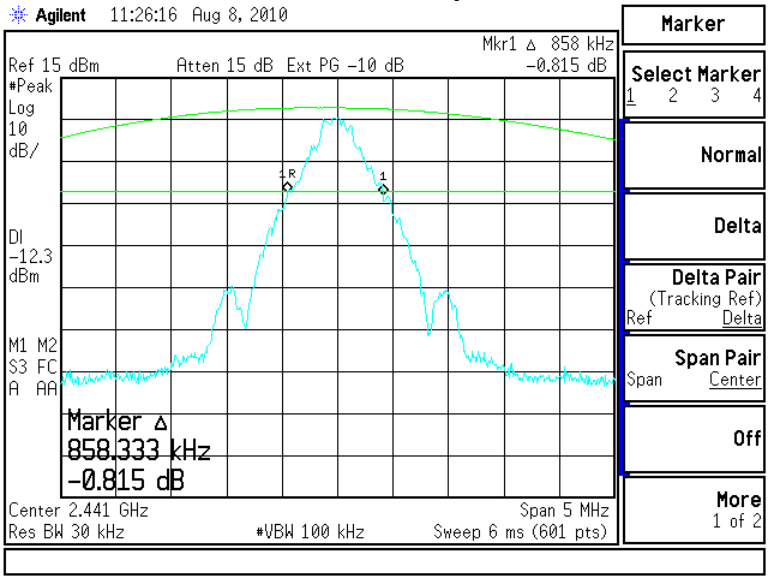
7.5 Screen Captures - OCCUPIED BANDWIDTH

7.5.1 BLUETOOTH

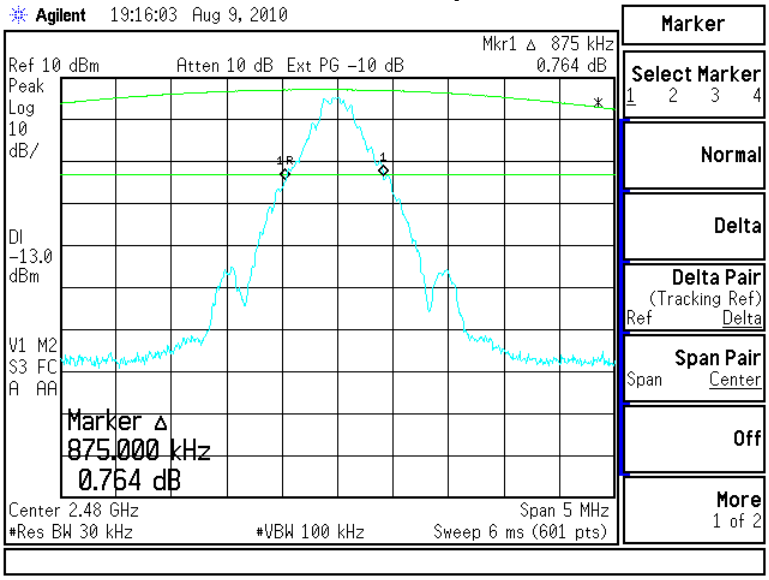
Channel 1, -20 dBc Occupied Bandwidth



Channel 40, -20 dBc Occupied Bandwidth



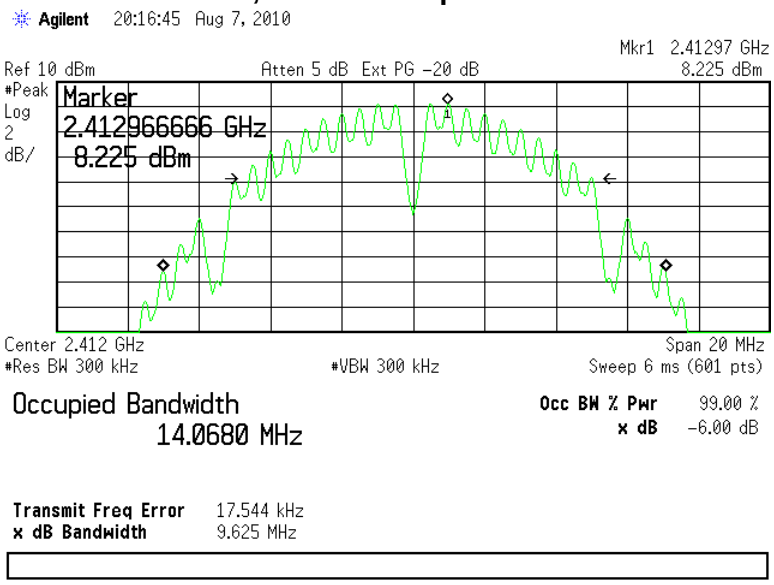
Channel 79, -20 dBc Occupied Bandwidth



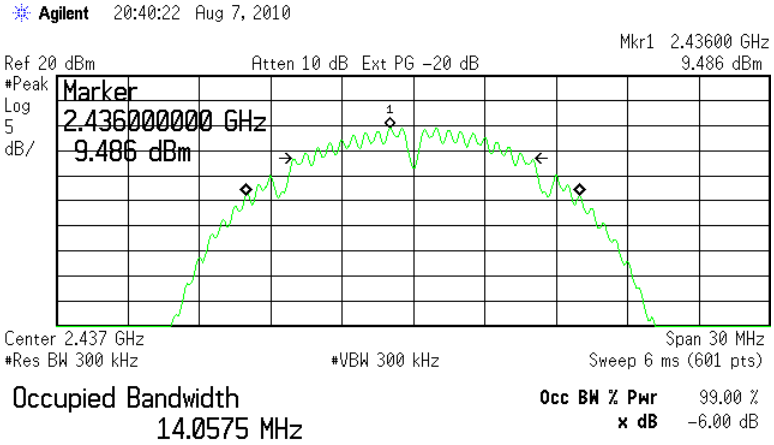
7.5.2 WiFi

i. 1 Mbps Data Rate

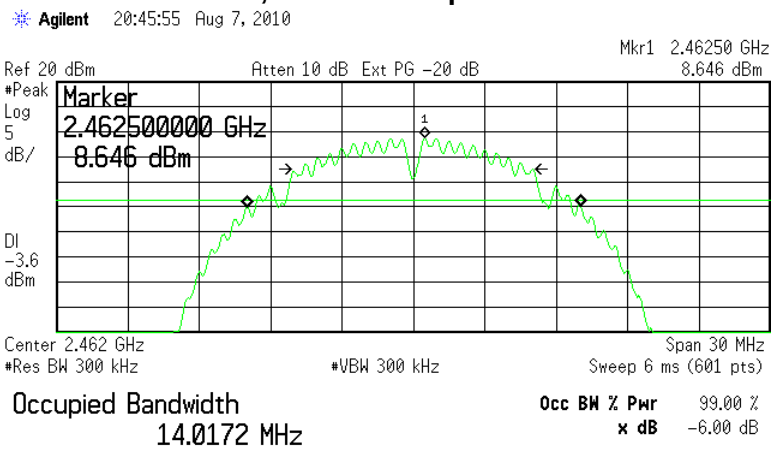
Channel 1, -6 dBc Occupied Bandwidth



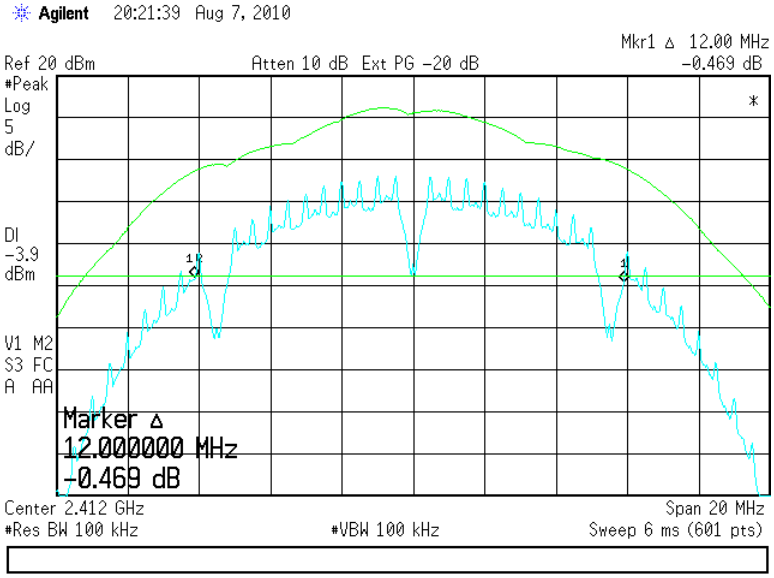
Channel 6, -6 dBc Occupied Bandwidth



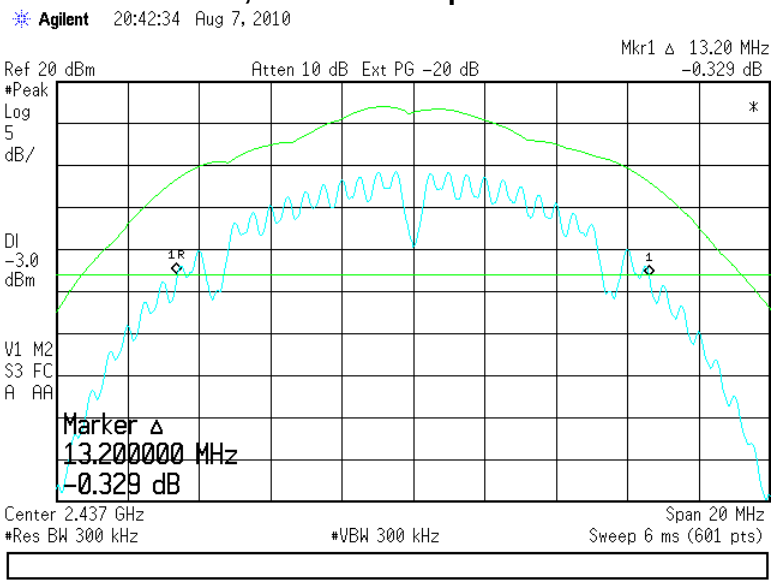
Channel 11, -6 dBc Occupied Bandwidth



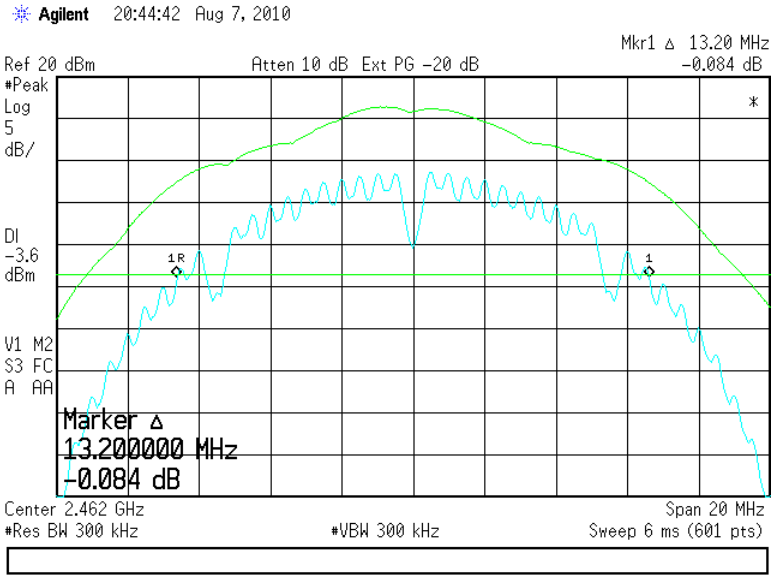
Channel 1, -20 dBc Occupied Bandwidth



Channel 6, -20 dBc Occupied Bandwidth

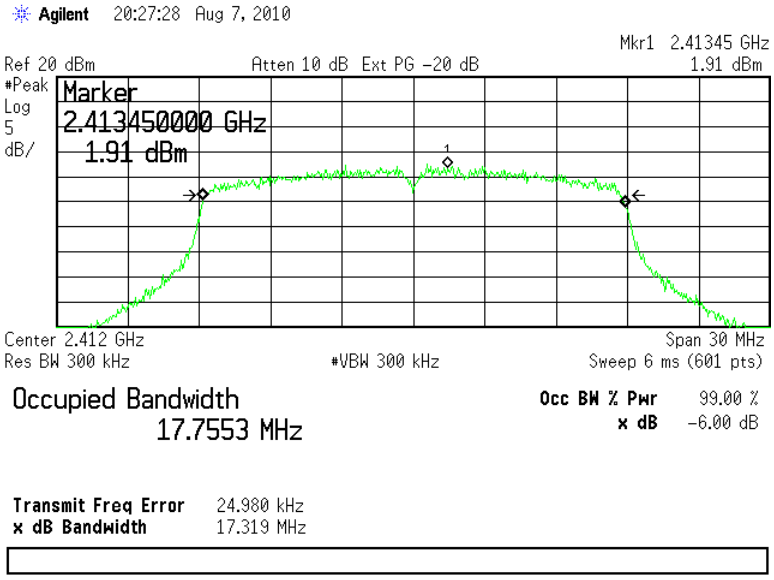


Channel 11, -20 dBc Occupied Bandwidth

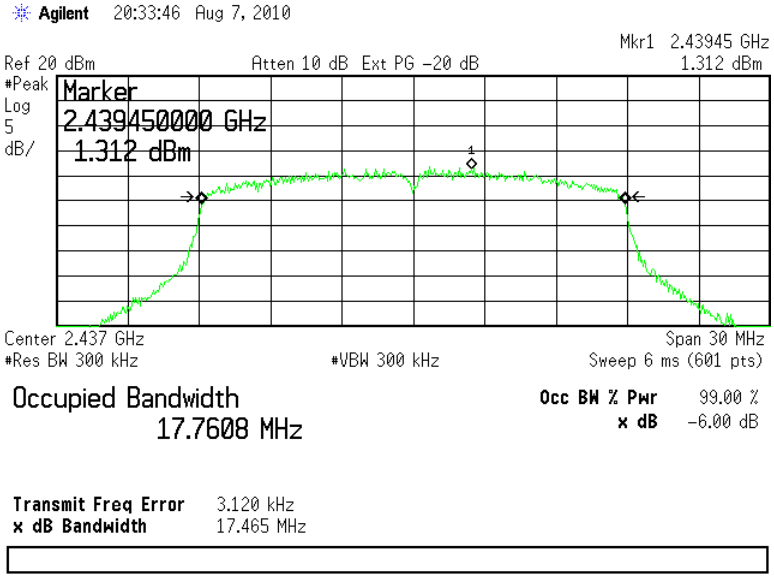


ii. MCS7 Data Rate

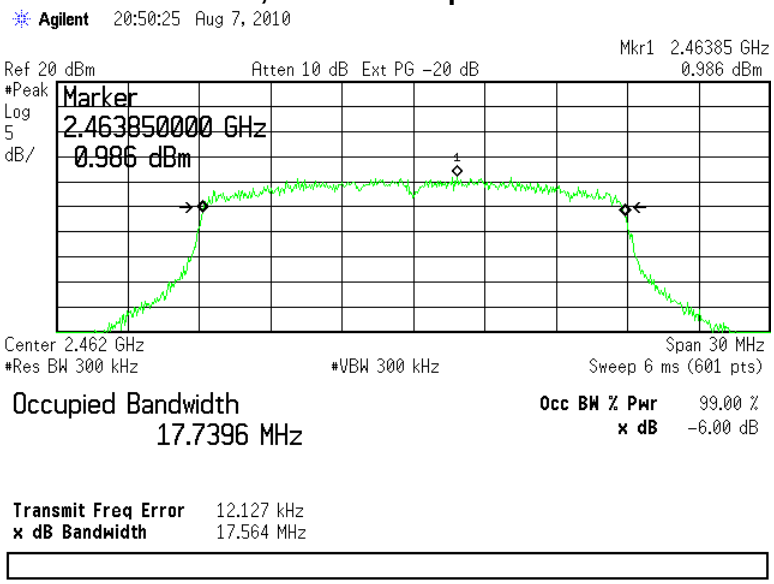
Channel 1, -6 dBc Occupied Bandwidth



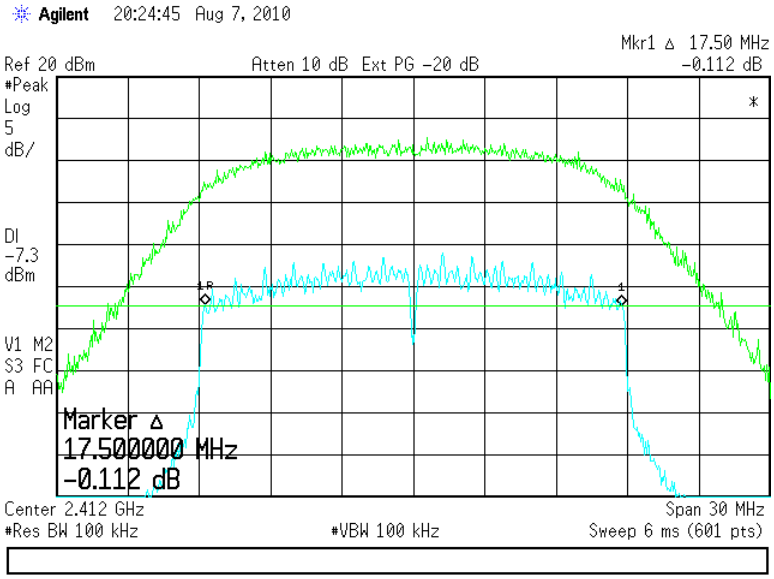
Channel 6, -6 dBc Occupied Bandwidth



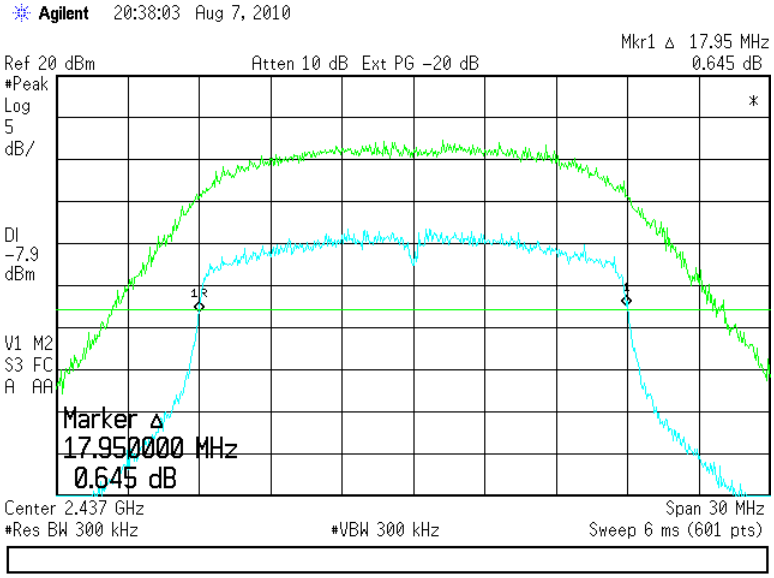
Channel 11, -6 dBc Occupied Bandwidth



Channel 1, -20 dBc Occupied Bandwidth



Channel 6, -20 dBc Occupied Bandwidth



Channel 11, -20 dBc Occupied Bandwidth

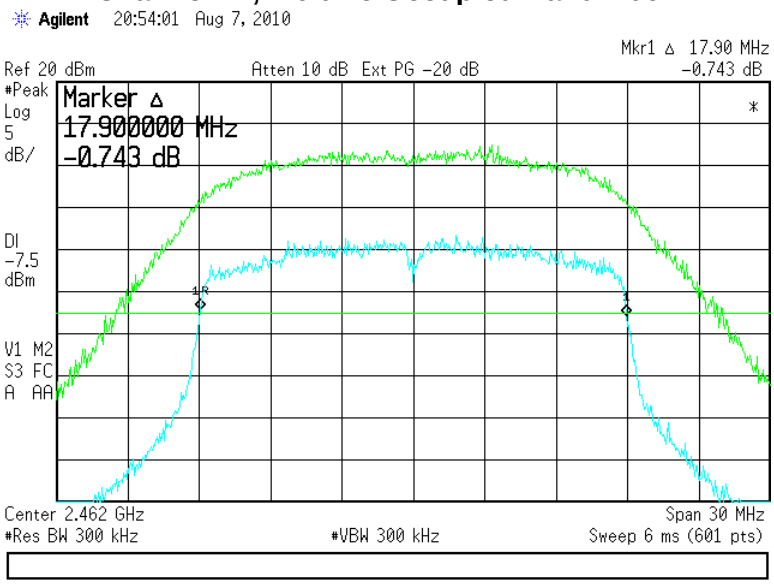


EXHIBIT 8. BAND-EDGE MEASUREMENTS

8.1 Method of Measurements

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in tables 2 and 3 of the same standard and also to the limits in the applicable annex. The following screen captures demonstrate compliance of the intentional radiator at the 2400-2483.5 MHz Band-Edges. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

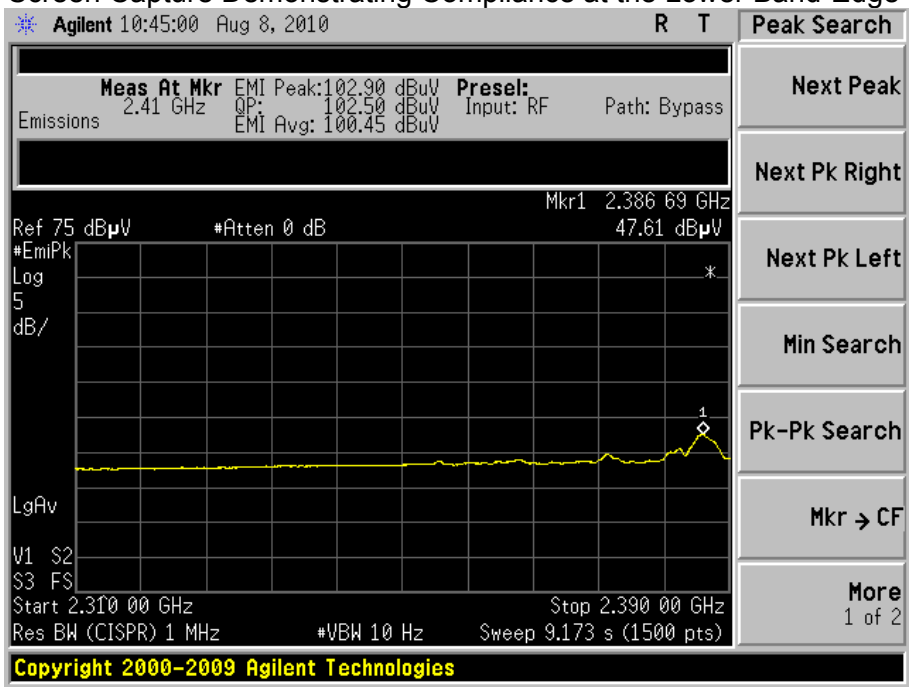
The Lower Band-Edge limit from 2390-2400(MHz) would be -20 dBc with respect to the fundamental level.

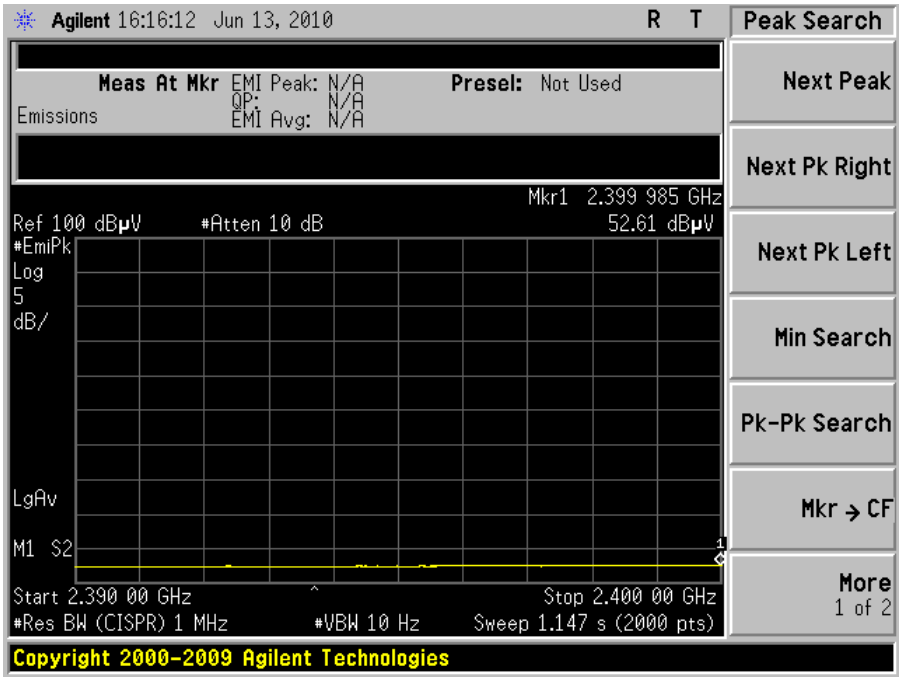
The Lower Band-Edge (2310-2390MHz) and Upper Band-Edge limit(2483.5-2500MHz), in this case, would be + 54 dBµV/m at 3m.

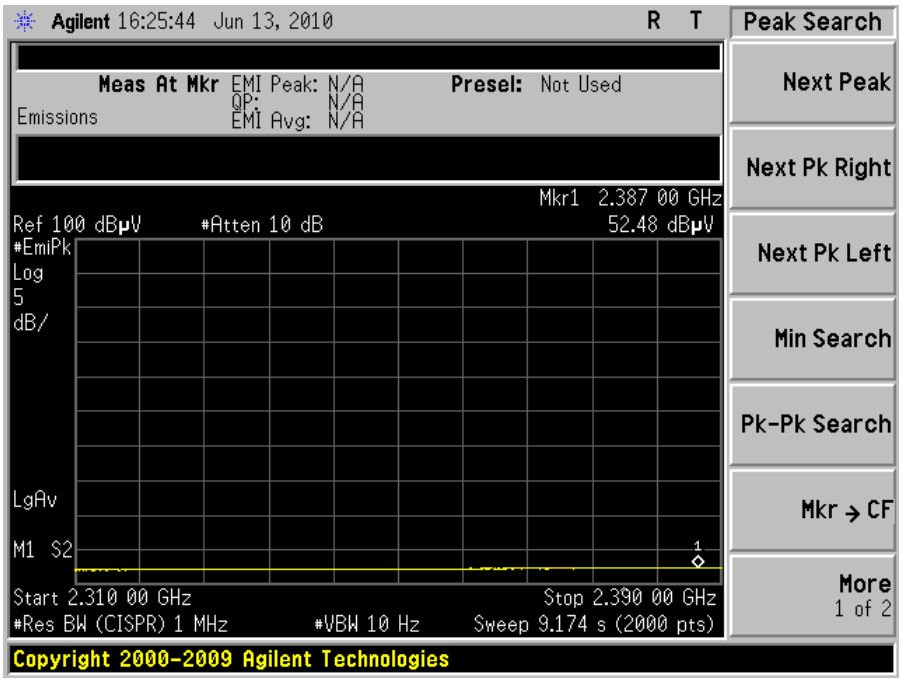
8.2 Screen Captures

BLUETOOTH:

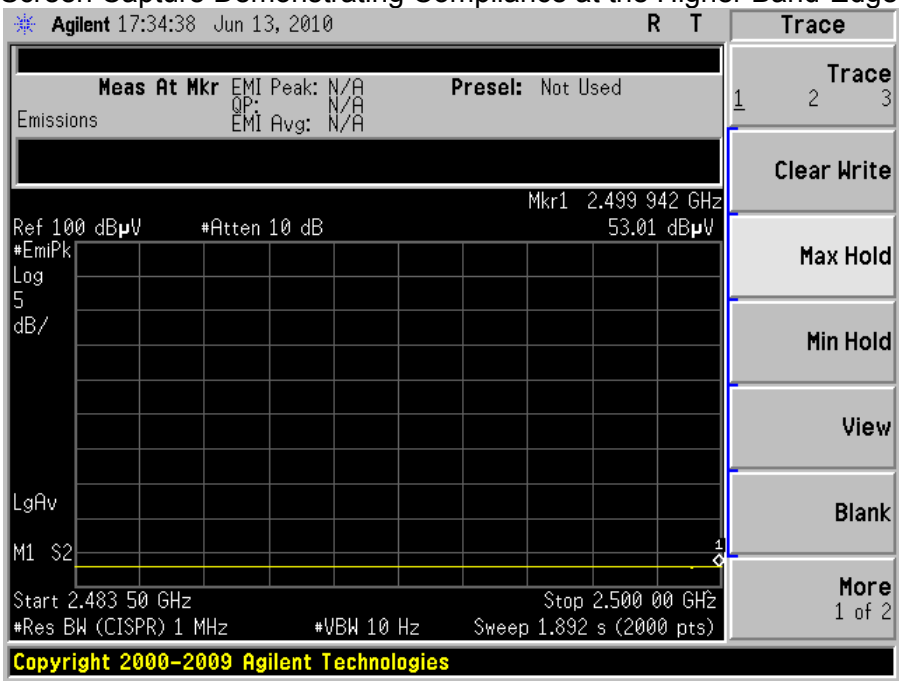
Screen Capture Demonstrating Compliance at the Lower Band-Edge




Agilent 16:16:12 Jun 13, 2010
R T
Peak Search
Meas At Mkr EMI Peak: N/A
QP: N/A
EMI Avg: N/A
Presel: Not Used
Emissions
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Mkr1 2.399 985 GHz
Ref 100 dBµV
#Atten 10 dB
52.61 dBµV
#EmiPk
Log
5
dB/
LgAv
M1 S2
Start 2.390 00 GHz
Stop 2.400 00 GHz
#Res BW (CISPR) 1 MHz
#VBW 10 Hz
Sweep 1.147 s (2000 pts)
Copyright 2000-2009 Agilent Technologies

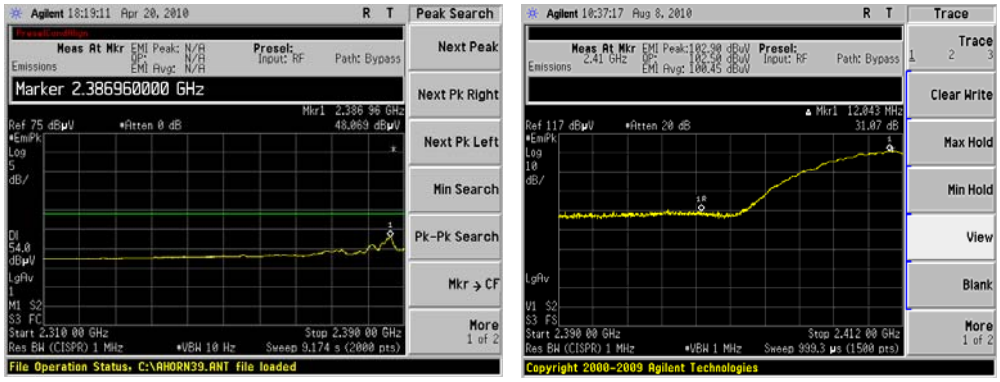

Agilent 16:25:44 Jun 13, 2010
R T
Peak Search
Meas At Mkr EMI Peak: N/A
QP: N/A
EMI Avg: N/A
Presel: Not Used
Emissions
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
Mkr1 2.387 00 GHz
Ref 100 dBµV
#Atten 10 dB
52.48 dBµV
#EmiPk
Log
5
dB/
LgAv
M1 S2
Start 2.310 00 GHz
Stop 2.390 00 GHz
#Res BW (CISPR) 1 MHz
#VBW 10 Hz
Sweep 9.174 s (2000 pts)
Copyright 2000-2009 Agilent Technologies

Screen Capture Demonstrating Compliance at the Higher Band-Edge



WIFI:

Screen Capture Demonstrating Compliance at the Lower Band-Edge



Screen Capture Demonstrating Compliance at the Higher Band-Edge

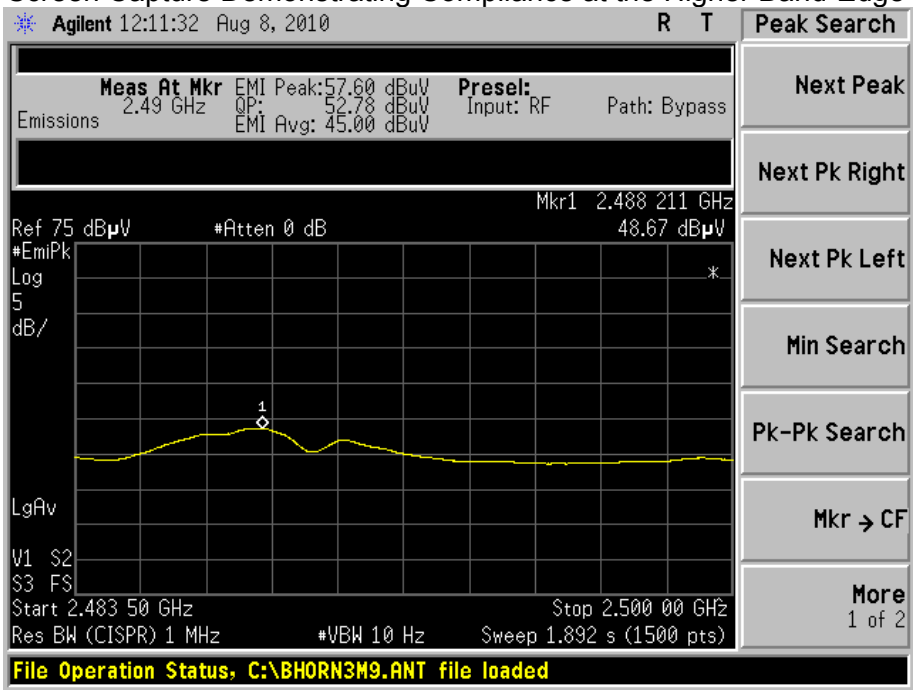


EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

9.1 Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

For the WiFi radio in 1 Mbps mode conducted output power test the spectrum analyzer was used with resolution and video bandwidths set to 1 MHz, and a span of 5 MHz respectively, and in MCS7 mode conducted output power test the spectrum analyzer was used with resolution and video bandwidths set to 3 MHz, and a span of 10 MHz respectively, with measurements from a peak detector presented in the chart below for each setup.

9.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	HP	E4407B	US39160256
Spectrum Analyzer	Agilent	E4446A	US45300564

9.3 Test Data

Bluetooth with Dipole Antenna:

Channel	Center Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	(1) Calculated EIRP (dBm)	Conducted Power Limit (dBm)	Peak Power Margin (dB)	EIRP Limit (dBm)
Low	2402	8.00	12.30	30.00	22.00	36.00
Middle	2441	7.70	12.00	30.00	22.30	36.00
High	2480	7.30	11.60	30.00	22.70	36.00

Bluetooth with Ethertronix Antenna:

Channel	Center Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	(1) Calculated EIRP (dBm)	Conducted Power Limit (dBm)	Peak Power Margin (dB)	EIRP Limit (dBm)
Low	2402	8.00	7.40	30.00	22.00	36.00
Middle	2441	7.70	7.10	30.00	22.30	36.00
High	2480	7.30	6.70	30.00	22.70	36.00

WiFi:

Test Data for 1 Mbps with Dipole antenna

Channel	Center Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	(1) Calculated EIRP (dBm)	Conducted Power Limit (dBm)	Peak Power Margin (dB)	EIRP Limit (dBm)
Low	2412	19.54	23.84	30.00	10.46	36.00
Middle	2437	19.67	23.97	30.00	19.67	36.00
High	2462	18.80	23.10	30.00	11.20	36.00

Test Data for 1 Mbps with PIFA antenna

Channel	Center Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	(1) Calculated EIRP (dBm)	Conducted Power Limit (dBm)	Peak Power Margin (dB)	EIRP Limit (dBm)
Low	2412	19.54	18.94	30.00	10.46	36.00
Middle	2437	19.67	19.07	30.00	19.67	36.00
High	2462	18.80	18.20	30.00	11.20	36.00

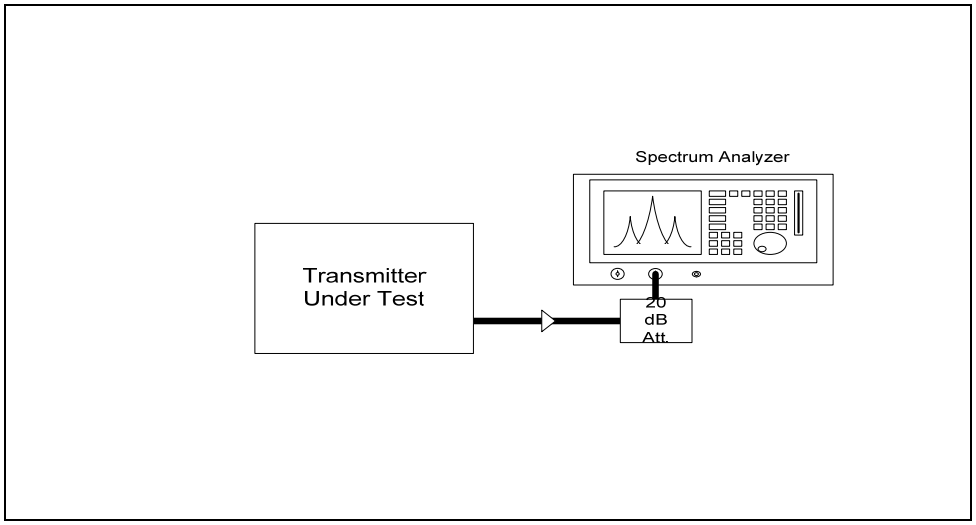
Test Data for MCS7 with Dipole antenna

Channel	Center Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	(1) Calculated EIRP (dBm)	Conducted Power Limit (dBm)	Peak Power Margin (dB)	EIRP Limit (dBm)
Low	2412	13.07	17.37	30.00	16.93	36.00
Middle	2437	12.66	16.96	30.00	17.34	36.00
High	2462	12.22	16.52	30.00	17.78	36.00

Test Data for MCS7 with PIFA antenna

Channel	Center Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	(1) Calculated EIRP (dBm)	Conducted Power Limit (dBm)	Peak Power Margin (dB)	EIRP Limit (dBm)
Low	2412	13.07	12.47	30.00	16.93	36.00
Middle	2437	12.66	12.06	30.00	17.34	36.00
High	2462	12.22	11.62	30.00	17.78	36.00

(1) EIRP Calculation:
EIRP = (Peak power at antenna terminal in dBm) + (EUT Antenna gain in dBi)



Bluetooth
Measured RF Power Output (in Watts): 0.006310 W
Declared RF Power Output (in Watts): 0.006310 W

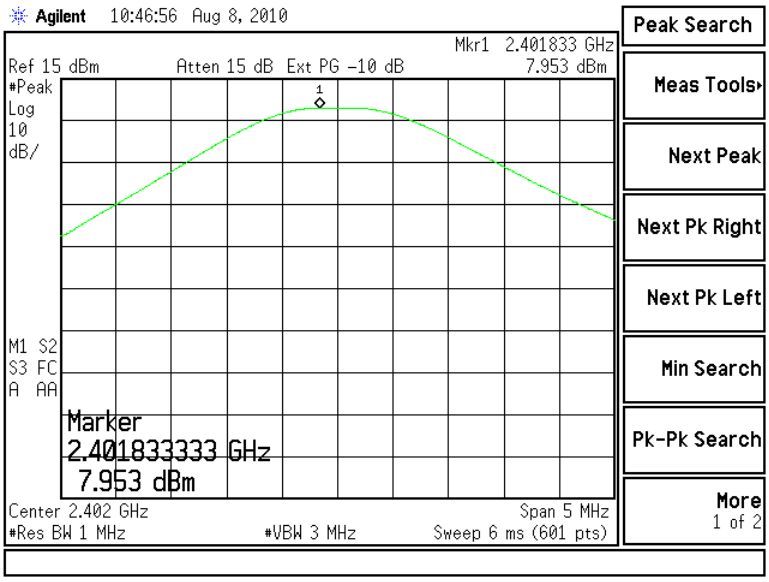
WiFi (with 1 Mbps Data Rate)
Measured RF Power Output (in Watts): 0.092683 W
Declared RF Power Output (in Watts): 0.092863 W

WiFi (with MCS7 Data Rate)
Measured RF Power Output (in Watts): 0.020277 W
Declared RF Power Output (in Watts): 0.020277 W

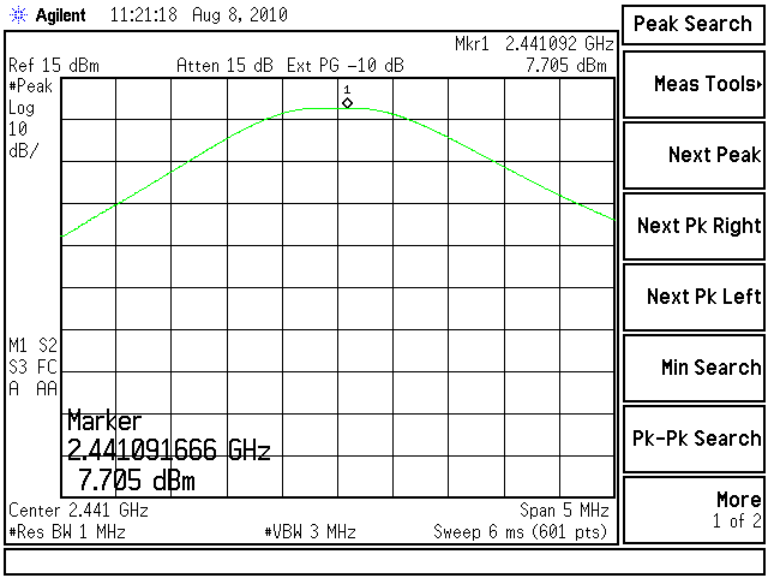
9.4 Screen Captures – Power Output (Conducted)

Bluetooth:

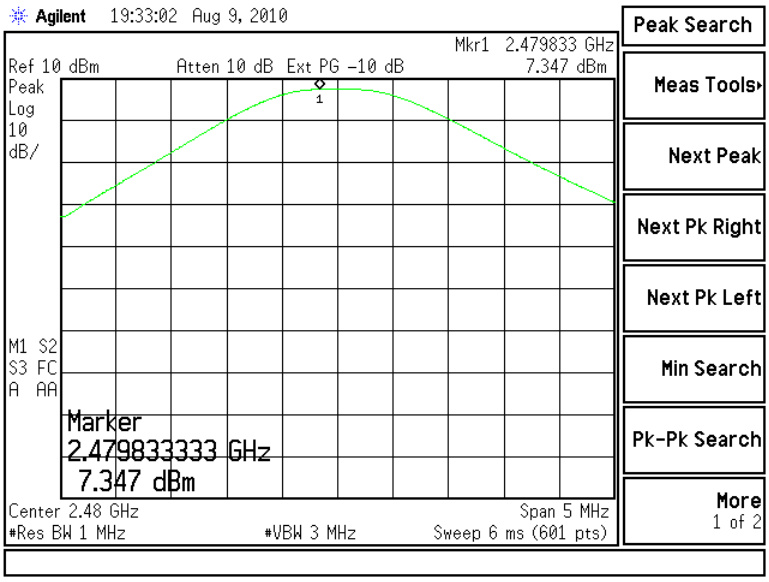
Channel 1



Channel 40

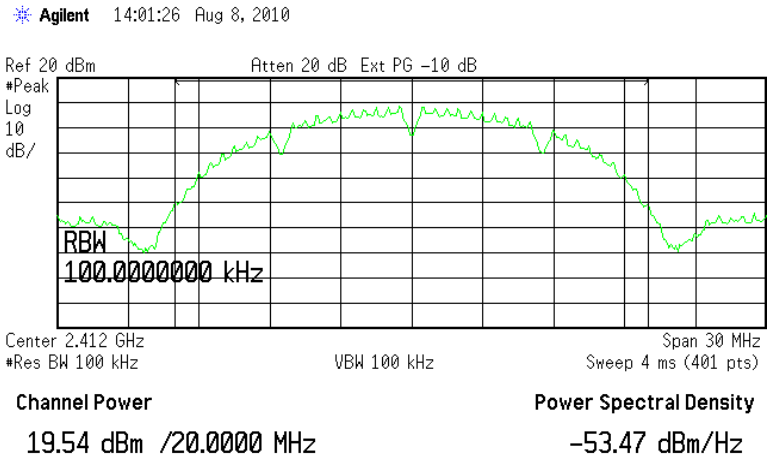


Channel 79


Agilent 19:33:02 Aug 9, 2010
Mkr1 2.479833 GHz
Ref 10 dBm
Atten 10 dB Ext PG -10 dB
7.347 dBm
Peak
Log
10
dB/
M1 S2
S3 FC
A AA
Marker
2.479833333 GHz
7.347 dBm
Center 2.48 GHz
Span 5 MHz
#Res BW 1 MHz
#VBW 3 MHz
Sweep 6 ms (601 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

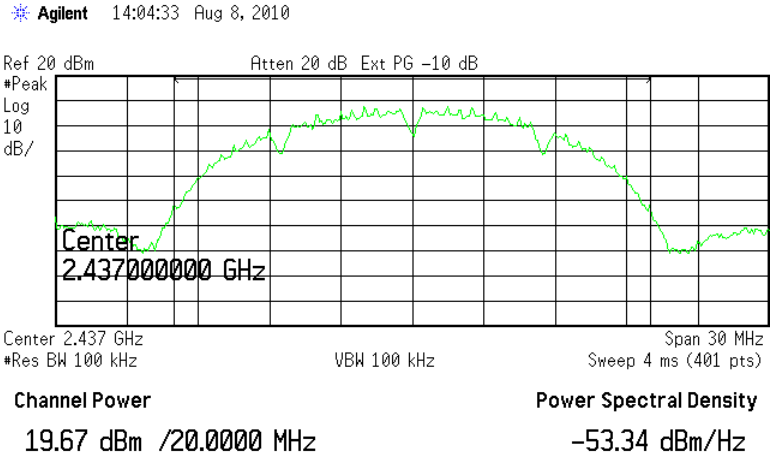
WiFi:
1 Mbps Data Rate

Channel 1



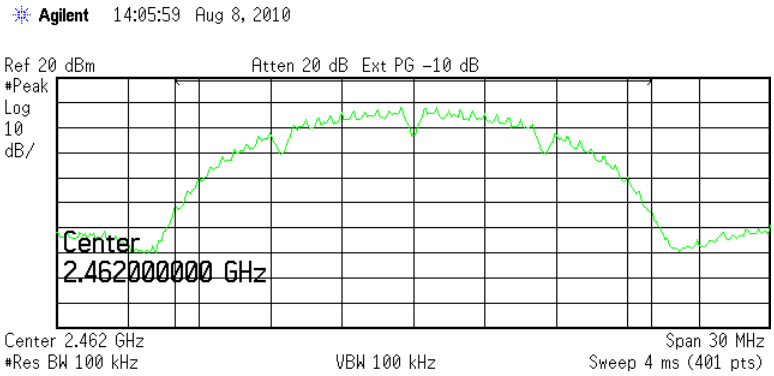
Channel Power	Power Spectral Density
19.54 dBm /20.0000 MHz	-53.47 dBm/Hz

Channel 6



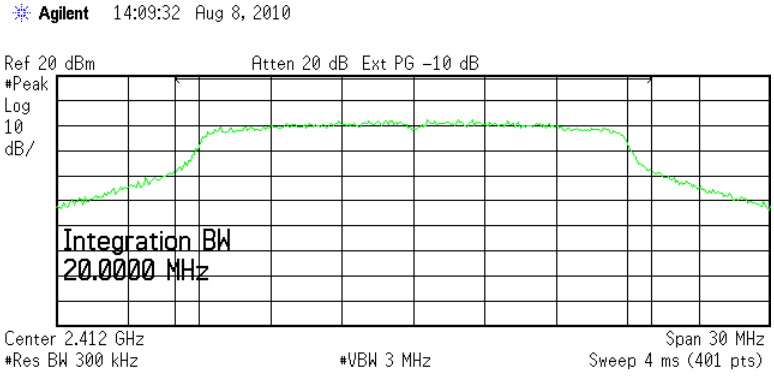
Channel Power	Power Spectral Density
19.67 dBm /20.0000 MHz	-53.34 dBm/Hz

Channel 11

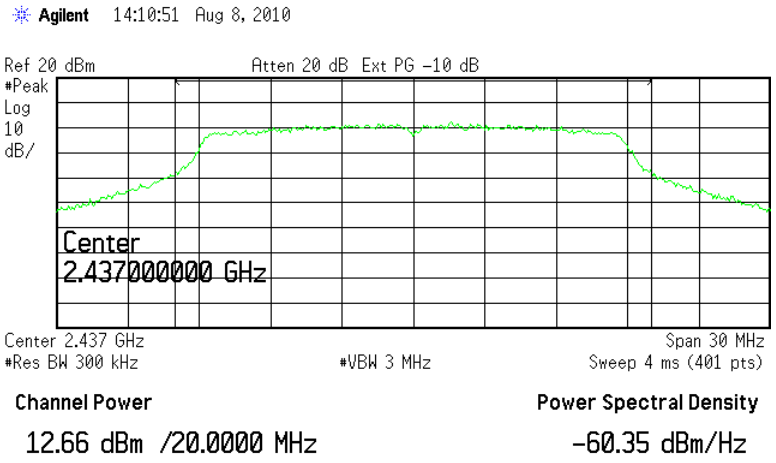


MCS7 Data Rate

Channel 1

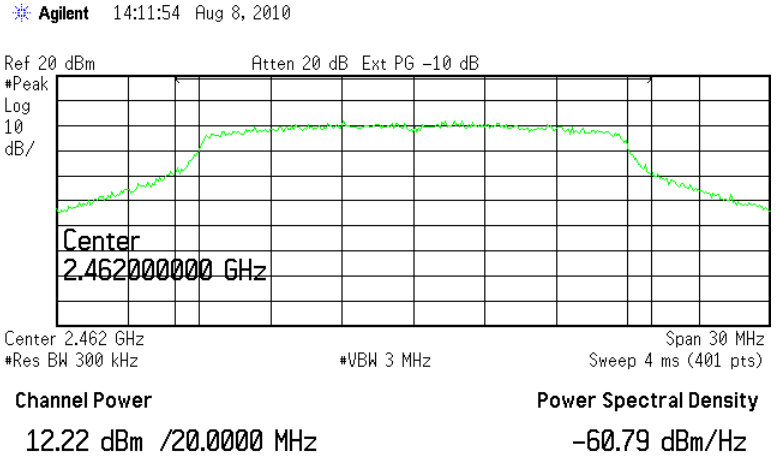


Channel 6



Channel Power	Power Spectral Density
12.66 dBm /20.0000 MHz	-60.35 dBm/Hz

Channel 11



Channel Power	Power Spectral Density
12.22 dBm /20.0000 MHz	-60.79 dBm/Hz

EXHIBIT 10. POWER SPECTRAL DENSITY: 15.247(e)

10.1 Limits

For digitally modulate 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.

In accordance with FCC Part 15.247(e) and RSS 210 A8.2(b), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed using the utility built into the HP Analyzer. The resultant density was then corrected to a 3 kHz bandwidth. The highest density was found to be no greater than -3.3 dBm, which is under the allowable limit by 11.3 dB.

10.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

10.3 Test Data

WiFi at 1 Mbps

Transmitter Channel	Frequency (MHz)	RF Power Level In 3 kHz BW (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Comments Pass/Fail
Lowest	2412	-4.3	8.0	12.3	Pass
Middle	2437	-3.3	8.0	11.3	Pass
Highest	2462	-4.1	8.0	12.1	Pass

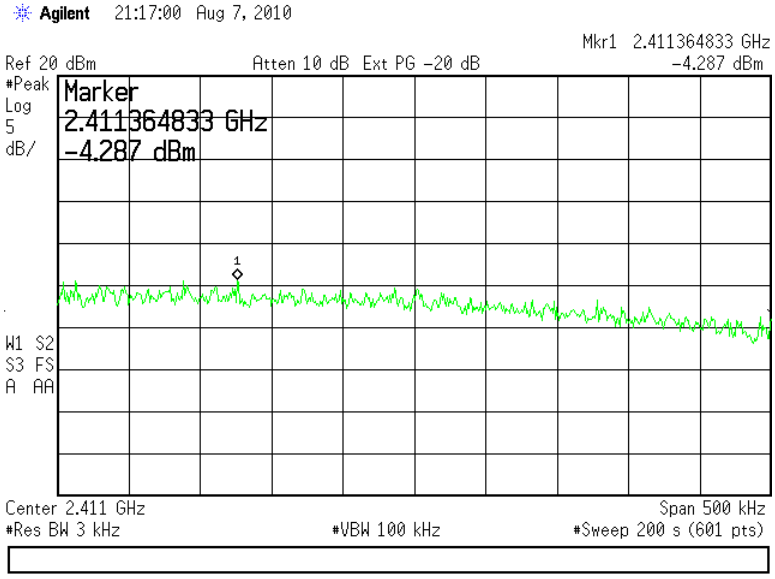
WiFi at MCS7

Transmitter Channel	Frequency (MHz)	RF Power Level In 3 kHz BW (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Comments Pass/Fail
Lowest	2412	-16.0	8.0	24.0	Pass
Middle	2437	-16.0	8.0	24.0	Pass
Highest	2462	-15.8	8.0	23.8	Pass

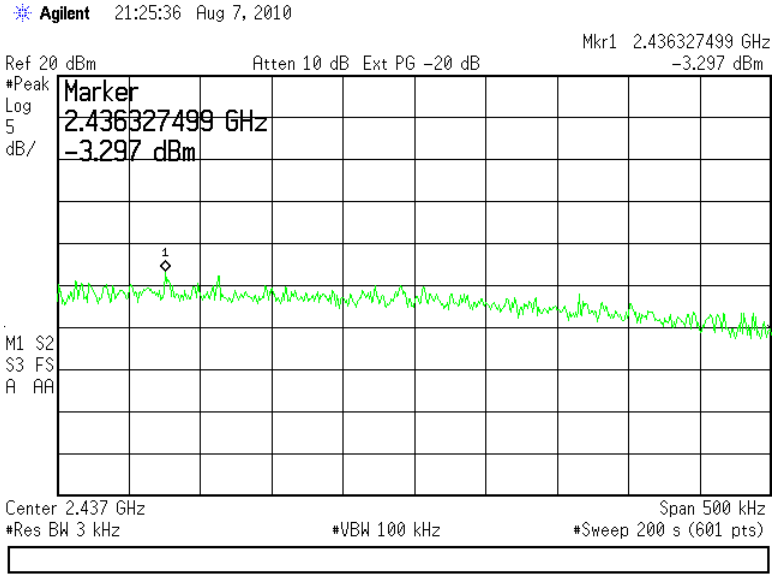
10.4 Screen Captures – Power Spectral Density

WiFi at 1 Mbps Data Rate

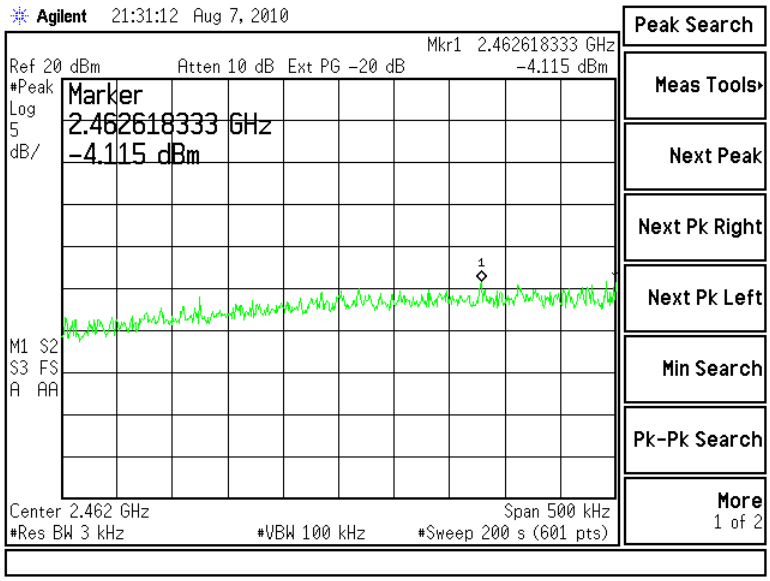
Channel 1



Channel 6

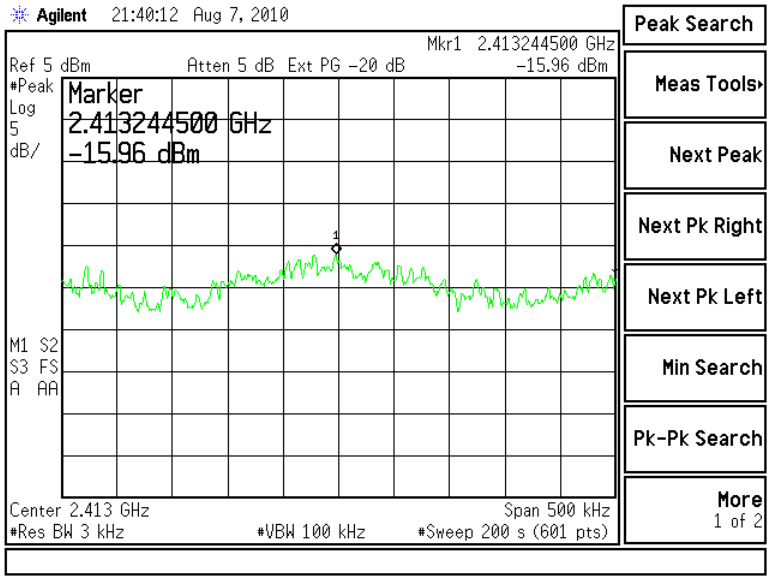


Channel 11

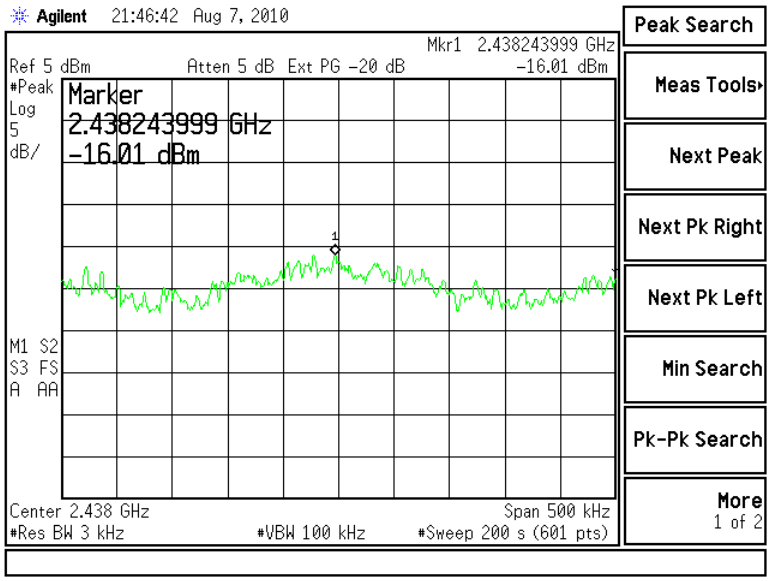


WiFi at MCS7 Data Rate

Channel 1



Channel 6



Channel 11

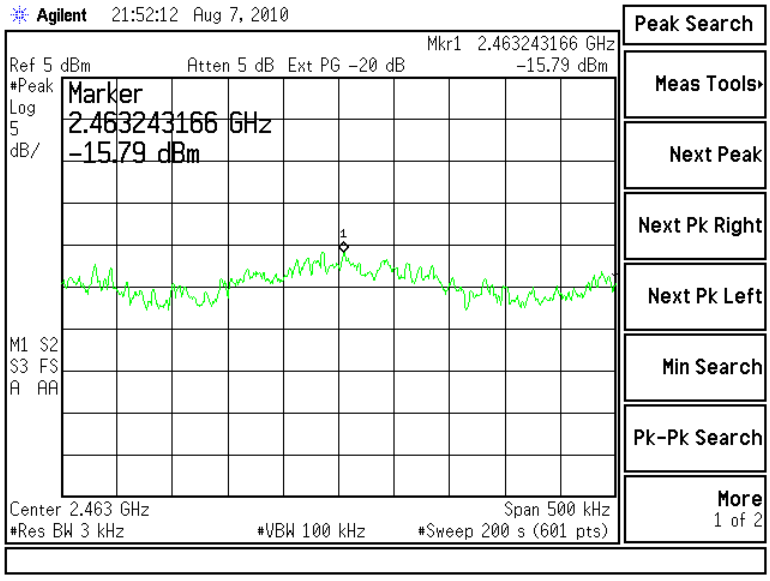


EXHIBIT 11. SPURIOUS EMISSIONS

11.1 Limits

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 lease 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.

In addition, radiated emissions, which fall in the restricted band, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(e)

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in Section 15.35 for limiting peak emissions apply.

FCC 47 CFR 15.205(a) – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 – 0.110	162.0125 – 167.17	2310 – 2390	9.3 – 9.5
0.49 – 0.51	167.72 – 173.2	2483.5 – 2500	10.6 – 12.7
2.1735 – 2.1905	240 – 285	2655 – 2900	13.25 – 13.4
8.362 – 8.366	322 – 335.4	3260 – 3267	14.47 – 14.5
13.36 – 13.41	399.9 – 410	3332 – 3339	14.35 – 16.2
25.5 – 25.67	608 – 614	3345.8 – 3358	17.7 – 21.4
37.5 – 38.25	960 – 1240	3600 – 4400	22.01 – 23.12
73 – 75.4	1300 – 1427	4500 – 5250	23.6 – 24.0
108 – 121.94	1435 – 1626.5	5350 – 5460	31.2 – 31.8
123 – 138	1660 – 1710	7250 – 7750	36.43 – 36.5
149.9 – 150.05	1718.8 – 1722.2	8025 – 8500	Above 38.6
156.7 – 156.9	2200 – 2300	9000 – 9200	

FCC 47 CFR 15.209(a) Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 – 0.490	2,400 / F (kHz)	300
0.490 – 1.705	24,000 / F (kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

Calculation of Radiated Emission Measurements

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-25,000	500	54.0	63.5

FCC Part 15.247(d) and IC RSS 210 A8.5 requires a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used to make measurements. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

No significant emissions could be noted within -35 dBc of the fundamental level for this product.

Bluetooth:

	Channel 2402	Channel 2441	Channel 2480
2nd Harmonic	- 55.9 (dBm)	- 59.2 (dBm)	- 53.7 (dBm)
3rd Harmonic	- 61.1 (dBm)	- 62.7 (dBm)	- 63.0 (dBm)
4th Harmonic	- 60.6 (dBm)	- 66.1 (dBm)	- 67.3 (dBm)
5th Harmonic	- 69.6 (dBm)	Note (1)	- 67.6 (dBm)
6th Harmonic	- 61.7 (dBm)	- 62.4 (dBm)	- 66.3 (dBm)
7th Harmonic	- 65.7 (dBm)	- 66.8 (dBm)	- 67.7 (dBm)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

WiFi 1 Mbps Data Rate

	Channel 2412	Channel 2437	Channel 2462
2nd Harmonic	- 53.0 (dBm)	Note (1)	- 54.8 (dBm)
3rd Harmonic	Note (1)	Note (1)	Note (1)
4th Harmonic	- 47.9 (dBm)	- 48.3 (dBm)	- 48.2 (dBm)
5th Harmonic	Note (1)	Note (1)	Note (1)
6th Harmonic	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

WiFi MCS7 Data Rate

	Channel 2412	Channel 2437	Channel 2462
2nd Harmonic	Note (1)	Note (1)	Note (1)
3rd Harmonic	Note (1)	Note (1)	Note (1)
4th Harmonic	- 47.9 (dBm)	- 48.3 (dBm)	- 48.2 (dBm)
5th Harmonic	Note (1)	Note (1)	Note (1)
6th Harmonic	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

Notes:
(1) Measurement at system noise floor.

11.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Hewlett-Packard	E4407	

11.3 Test Data

Bluetooth:

Frequency (MHz)	Measured RF Level (dBm)	Channel Measured On	Limit 15.247 (dBm)	Margin (dB)	Pass/ Fail
479.40	-70.2	MID	-12.3	-57.9	Pass
814.10	-53.2	MID	-12.3	-40.9	Pass
1630.00	-50.3	MID	-12.3	-38.0	Pass
801.15	-52.0	LOW	-12.0	-40.0	Pass
1600.00	-51.2	LOW	-12.0	-39.2	Pass
827.00	-50.5	HIGH	-12.7	-37.8	Pass
1660.00	-50.0	HIGH	-12.7	-37.3	Pass

WiFi at 1 Mbps Data Rate

Frequency (MHz)	Measured RF Level (dBm)	Channel Measured On	Limit 15.247 (dBm)	Margin (dB)	Pass/ Fail
479.40	-70.2	MID	-12.3	-57.9	Pass
814.10	-53.2	MID	-12.3	-40.9	Pass
1630.00	-50.3	MID	-12.3	-38.0	Pass
801.15	-52.0	LOW	-12.0	-40.0	Pass
1600.00	-51.2	LOW	-12.0	-39.2	Pass
827.00	-50.5	HIGH	-12.7	-37.8	Pass
1660.00	-50.0	HIGH	-12.7	-37.3	Pass

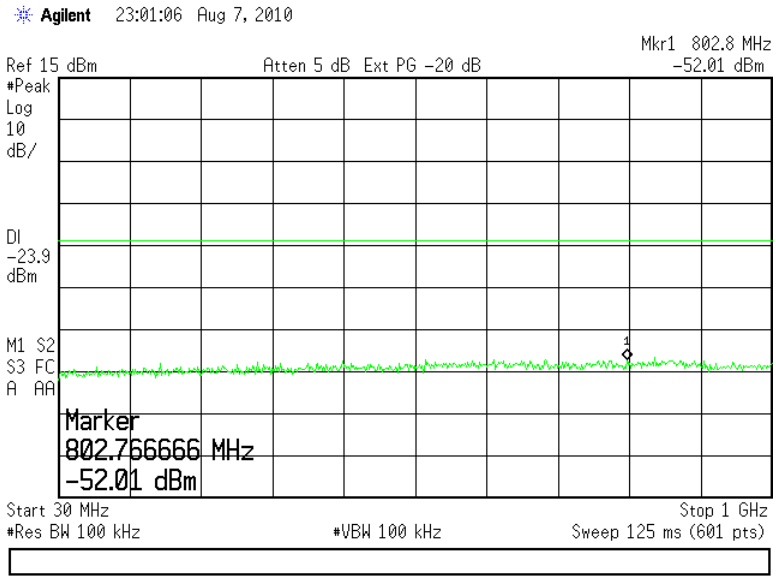
WiFi at MCS7 Data Rate

Frequency (MHz)	Measured RF Level (dBm)	Channel Measured On	Limit 15.247 (dBm)	Margin (dB)	Pass/ Fail
479.40	-70.2	MID	-12.3	-57.9	Pass
814.10	-53.2	MID	-12.3	-40.9	Pass
1630.00	-50.3	MID	-12.3	-38.0	Pass
801.15	-52.0	LOW	-12.0	-40.0	Pass
1600.00	-51.2	LOW	-12.0	-39.2	Pass
827.00	-50.5	HIGH	-12.7	-37.8	Pass
1660.00	-50.0	HIGH	-12.7	-37.3	Pass

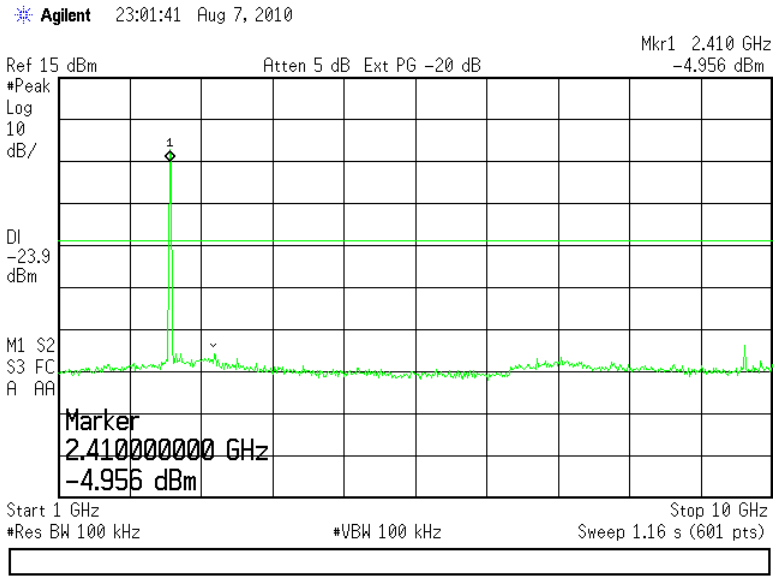
11.4 Screen Captures – Spurious Radiated Emissions

Bluetooth:

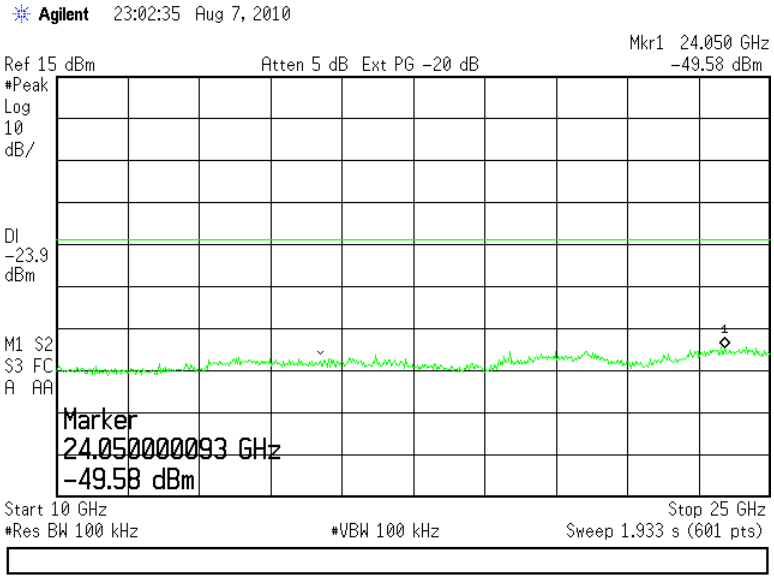
Channel 2402, shown from 30 MHz up to 1000 MHz



Channel 2402, shown from 1000 MHz up to 10000 MHz

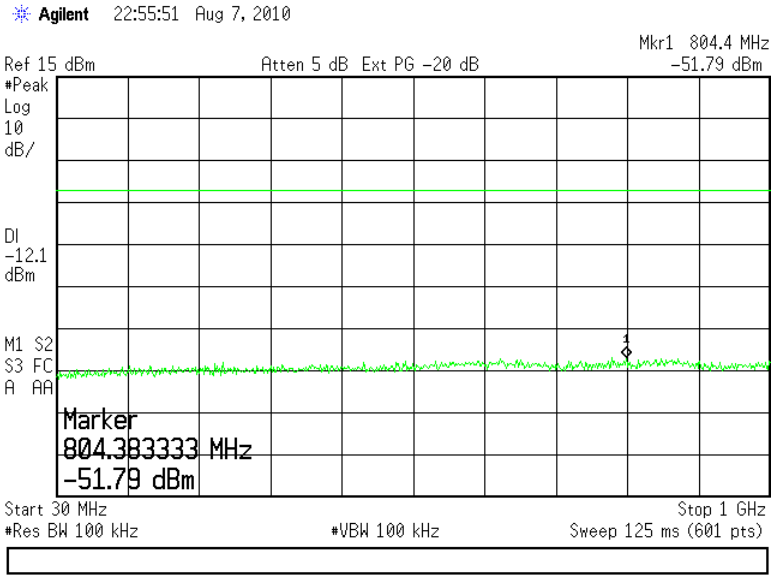


Channel 2402, shown from 10000 MHz up to 25000 MHz

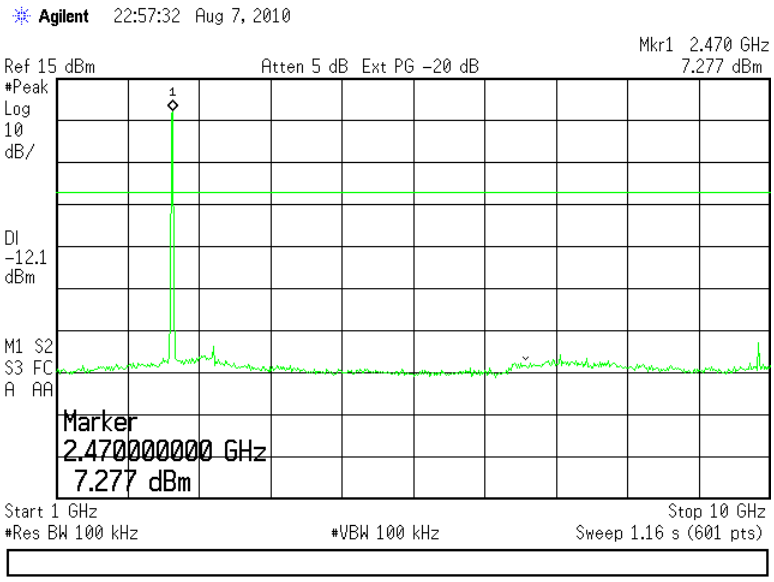


WiFi: 1Mbps Data Rate

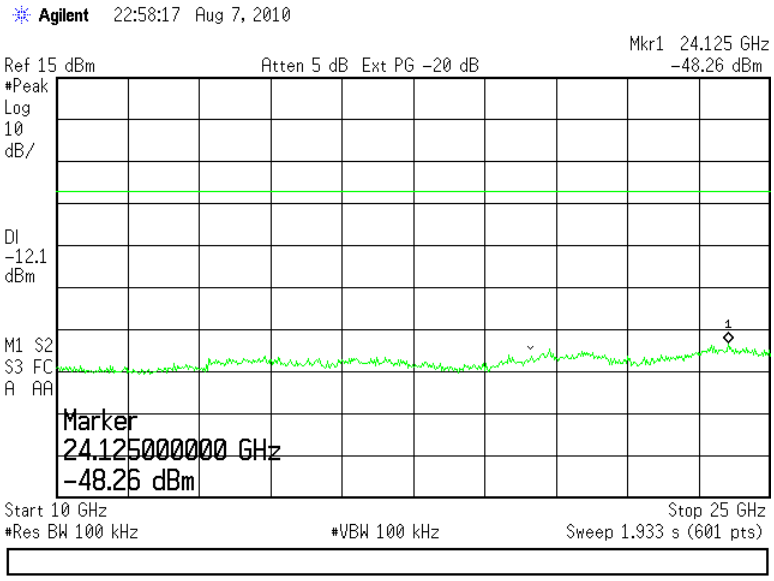
Channel 2480, shown from 30 MHz up to 1000 MHz



Channel 2480, shown from 1000 MHz up to 10000 MHz

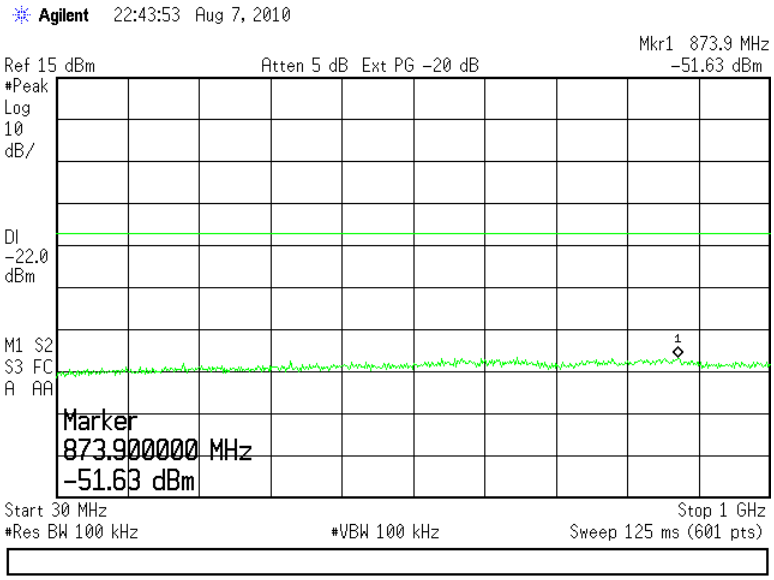


Channel 2480, shown from 10000 MHz up to 25000 MHz

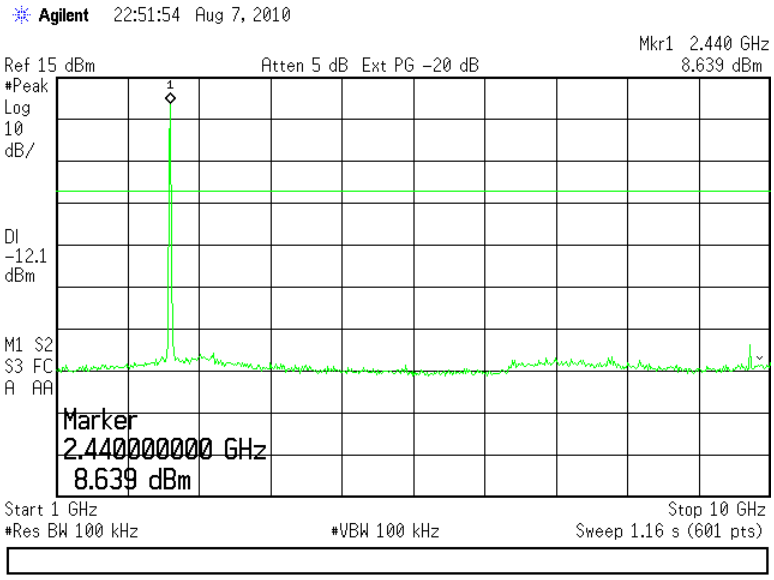


WiFi: MCS7 Data Rate

Channel 2437, shown from 30 MHz up to 1000 MHz



Channel 2437, shown from 1000 MHz up to 10000 MHz



Channel 2437, shown from 10000 MHz up to 25000 MHz

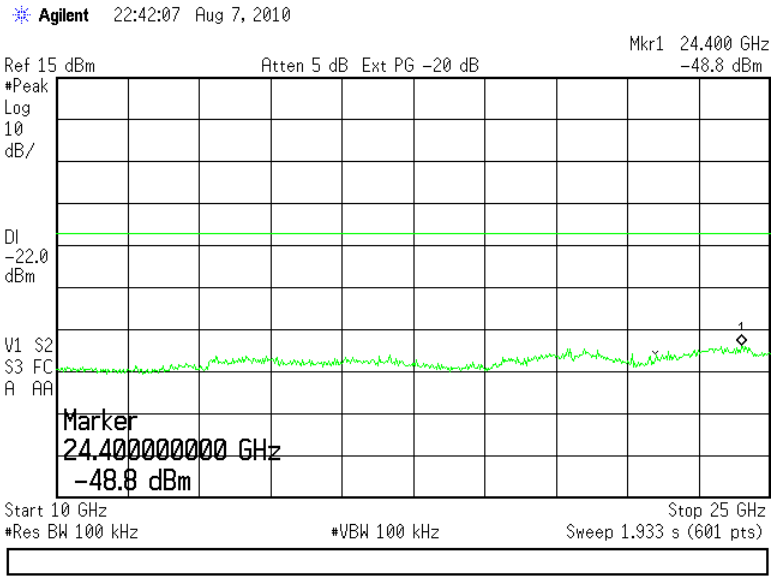


EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

A spectrum analyzer was used to measure the frequency at the appropriate frequency markers. For this test, the EUT was placed in continuous transmit CW mode. Power to the EUT was supplied by an external bench-type variable power supply. The frequency of operation was monitored using the spectrum analyzer with RBW=VBW=1 kHz settings while the voltage was varied.

Bluetooth

4.25		5.0		5.75		
Power	Frequency	Power	Frequency	Power	Frequency	Channel
8.0	2401991193	**8.0**	2401991199	**8.1**	2401991216	LOW
7.5	2440991100	**7.7**	2440991100	**7.7**	2440991050	MID
7.3	2479990916	**7.3**	2479990950	**7.3**	2479990883	2480

Frequency Drift for Bluetooth Radio over voltage variation

Channel	max	min	freq drift (Hz)
lo	2401991216	2401991193	23
mid	2440991100	2440991050	50
2479	2478991032	2478990999	33
2480	2479990950	2479990883	67

EXHIBIT 13. CHANNEL PLAN AND SEPARATION

An HP E4407B spectrum analyzer was used with a resolution bandwidth of 30 kHz to measure the channel separation of the Bluetooth FHSS Radio on the TiWi product.

The minimum and maximum channel-separations measured for this device are 997.50 kHz and 1021.25 kHz respectively. The maximum occupied bandwidth of the device, as reported in the previous section is 875.00 kHz. The following plots describe this spacing, and also establish the channel separation and plan.

13.1 Data Table

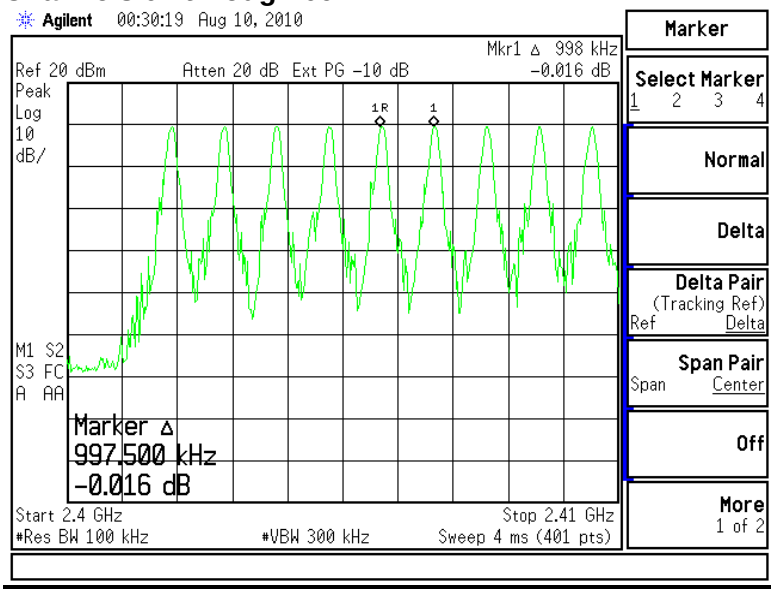
RANGE (MHz)	# OF CHANS	Max separation (Hz)
2400 - 2410.5	9.0	997.50
2410.5 - 2420	9.5	1021.25
2420 - 2430	10.0	1000.00
2430 - 2440	10.0	1000.00
2440-2450	10.0	1000.00
2450-2460	10.0	1000.00
2460-2470	10.0	1000.00
2470-2483.5	10.5	1011.25

13.2 Summary Table

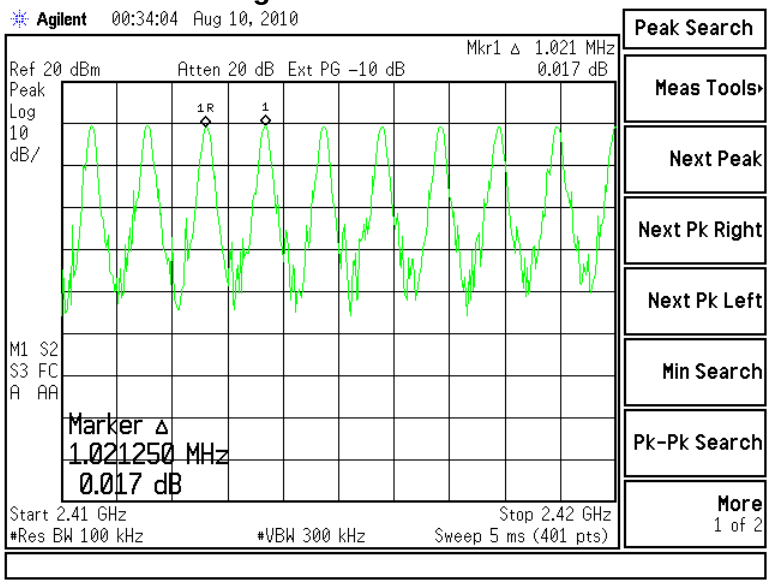
Total Chans	79
Max separation	1021.25
Min Separation	997.50

13.3 Screen Captures – Channel Separation

Channels 01 through 09

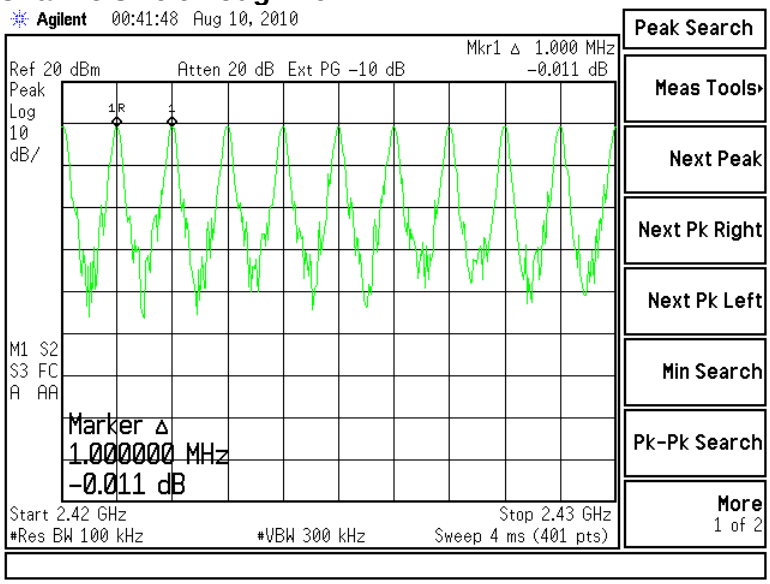


Channels 10 through 19

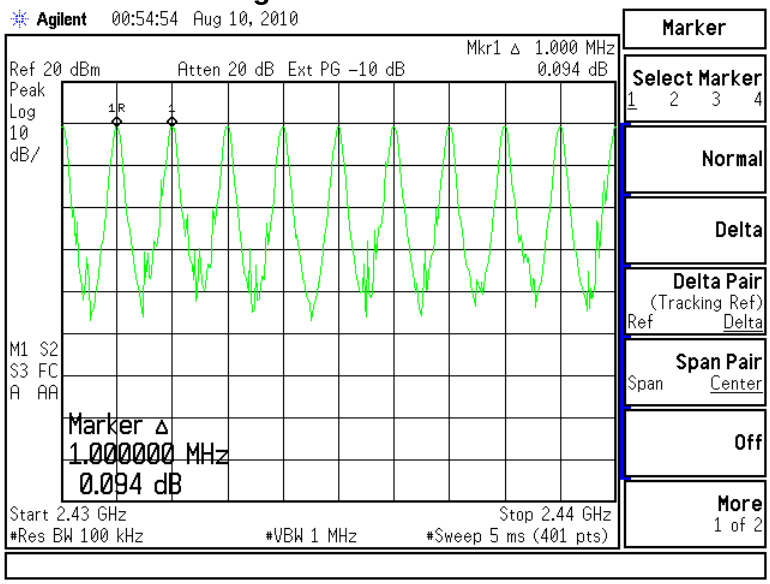


Screen Captures – Channel Separation *(continued)*

Channels 19 through 29

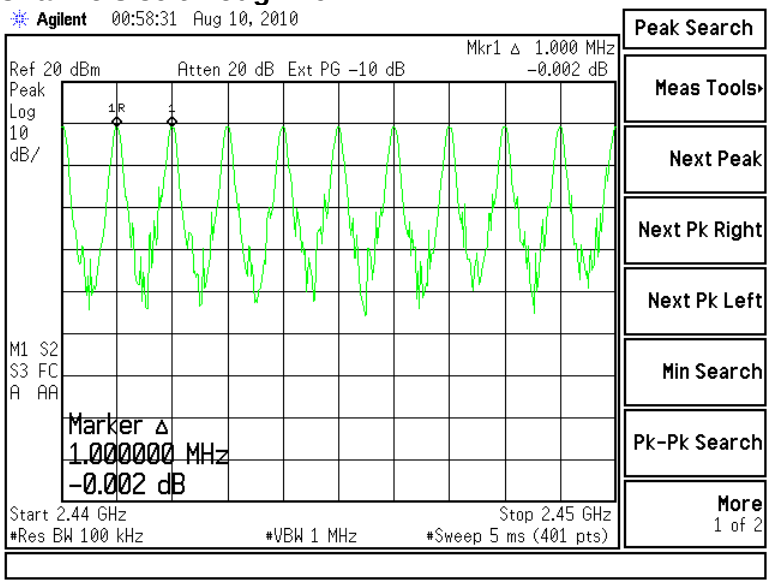


Channels 29 through 39

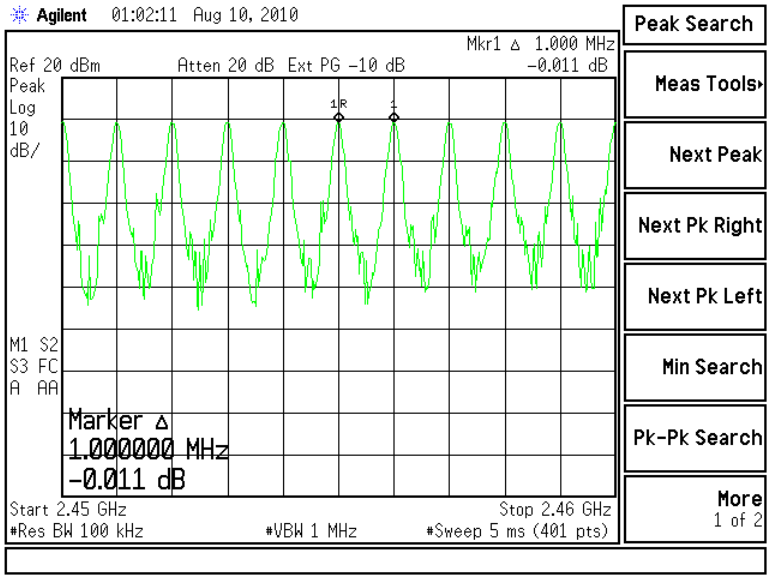


Screen Captures – Channel Separation *(continued)*

Channels 39 through 49

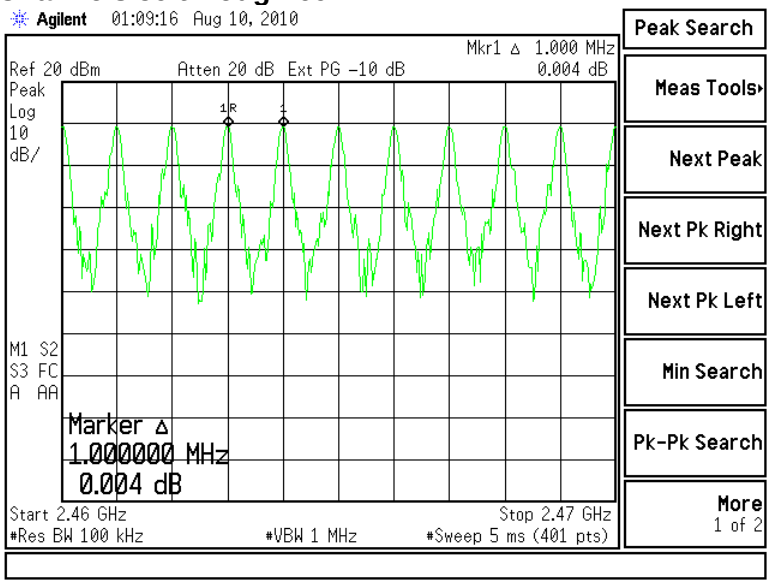


Channels 49 through 59



Screen Captures – Channel Separation *(continued)*

Channels 59 through 69



Channels 69 through 79

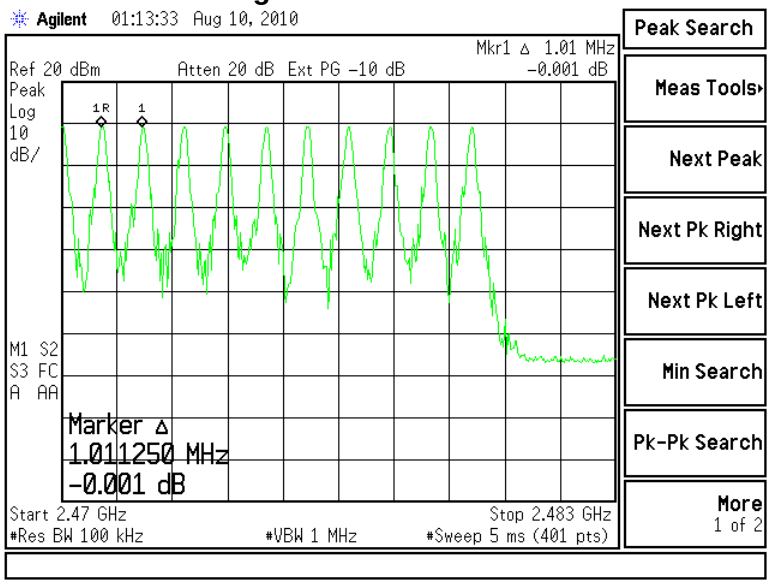


EXHIBIT 14. MPE CALCULATIONS

The following MPE calculations are based on a dipole antenna or printed circuit board antenna, and a Bluetooth and WLAN radio paired to each.

BT With Dipole Antenna

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	8.00	(dBm)
Maximum peak output power at antenna input terminal:	6.310	(mW)
Antenna gain(typical):	4.3	(dBi)
Maximum antenna gain:	2.692	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2400	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.003379	(mW/cm^2)
Maximum allowable antenna gain:	29.0	(dBi)
Margin of Compliance at 20 cm =	24.7	dB

BT With PIFA Antenna

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	8.00	(dBm)
Maximum peak output power at antenna input terminal:	6.310	(mW)
Antenna gain(typical):	-0.6	(dBi)
Maximum antenna gain:	0.871	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2402	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.001093	(mW/cm^2)
Maximum allowable antenna gain:	29.0	(dBi)
Margin of Compliance at 20 cm =	29.6	dB

WLAN With Dipole Antenna

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	20.10	(dBm)
Maximum peak output power at antenna input terminal:	102.329	(mW)
Antenna gain(typical):	4.3	(dBi)
Maximum antenna gain:	2.692	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2402	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.054794	(mW/cm^2)
Maximum allowable antenna gain:	16.9	(dBi)
Margin of Compliance at 20 cm =	12.6	dB

WLAN With PIFA Antenna

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	20.10	(dBm)
Maximum peak output power at antenna input terminal:	102.329	(mW)
Antenna gain(typical):	-0.6	(dBi)
Maximum antenna gain:	0.871	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2402	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.017731	(mW/cm^2)
Maximum allowable antenna gain:	16.9	(dBi)
Margin of Compliance at 20 cm =	17.5	dB

APPENDIX A

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 29-Sep-2010 Type Test : Radiated Emissions Job # : C-884

Prepared By: Peter Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
4	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
5	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
6	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration
7	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
8	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 29-Sep-2010 Type Test : Spurious Emissions Job # : C-884

Prepared By: Peter Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	CC 000221C	Spectrum Analyzer	HP	E4407B	US39160256	3/9/2009	3/9/2010	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
3	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
4	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
5	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
6	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
7	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
8	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration
9	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration
10	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 15-Jun-2010 Type Test : Occupied Bandwidth (6dB & 20dB) Job # : C-884

Prepared By: Peter Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	CC 000221C	Spectrum Analyzer	HP	E4407B	US39160256	3/9/2009	3/9/2010	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
3	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration
4	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 5-Jun-2010 Type Test : Conducted Power Output Job # : C-884

Prepared By: Peter Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
2	CC 000221C	Spectrum Analyzer	HP	E4407B	US39160256	3/9/2009	3/9/2010	Active Calibration
3	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration
4	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 15-Jun-2010 Type Test : Power Spectral Density Job # : C-884

Prepared By: Peter Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	CC 000221C	Spectrum Analyzer	HP	E4407B	US39160256	3/9/2009	3/9/2010	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
3	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration
4	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/25/2009	6/25/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 29-Sep-2010 Type Test : Band-Edge Job # : C-884

Prepared By: Peter Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2010	3/17/2011	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 20-Apr-2010 Type Test : Radiated Emissions (109) Job # : C-884

Prepared By: Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
3	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
4	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
5	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
6	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration
7	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 28-Sep-2010 Type Test : Conducted AC Emissions Job # : C-884

Prepared By: Peter Customer : LSR Quote #: 310117

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960008	LISN	EMCO	3816/2NM	9701-1057	12/15/2009	12/15/2010	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
3	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
4	AA 960072	Transient Limiter	HP	11947A	3107A01708	9/15/2009	10/15/2010	Active Calibration

APPENDIX B
TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2009		
ANSI C63.10	2009		
CISPR 11	2009-05	2009-12 P	
CISPR 12	2007-05		
CISPR 14-1	2005-11	2008-11	
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2010-01		
CISPR 16-1-2 Note 1	2003	2004-04	2006-07
CISPR 22	2008-09		
CISPR 24	1997-09	2001-07	2002-10
EN 55011	2007-05		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006	2007	
EN 60601-1-2	2007-03		
EN 61000-3-2	2006-05		
EN 61000-3-3	2008-12		
EN 61000-4-2	2009-05		
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2009-05		
EN 61000-4-8	1994	2001	
EN 61000-4-11	2004-10		
EN 61000-6-1	2007-02		
EN 61000-6-2	2005-12		
EN 61000-6-3	2007-02		
EN 61000-6-4	2007-02		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2008		
FCC Public Notice DA 00-1407	2000		
FCC ET Docket # 99-231	2002		
FCC Procedures	2007		
ICES 001	2006-06		
ICES 002	2009-08		
ICES 003	2004-02		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005-11	2008-03	2009-02
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2008-12		
IEC 61000-4-3	2008-04	incl in 2008-04	2009-12 FD

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-4	2004-07	2010-10	
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-10		
IEC 61000-4-8	2009-09		
IEC 61000-4-11	2004-03		
IEC 61000-6-1	2005-03		
IEC 61326-1	2006-06		
ISO 14982	1998-07		
MIL Std. 461E	1999-08		
RSS GEN	2007-06		
RSS 119	2007-06		
RSS 123	1999-11		
RSS 125	2000-03		
RSS 131	2003-07		
RSS 136	2002-10		
RSS 137	2009-02		
RSS 210	2007-06		
RSS 213	2005-12		
RSS 243	2005-11		
RSS 310	2007-06		

Note 1: Test not on LSR Scope of Accreditation.

Updated on 02-03-10
P=Project FD= Final Draft

APPENDIX C
Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V

Appendix D

Justifications of Average Duty Factor Calculations

BLUETOOTH RADIO

Average (Relaxation) Factor

Average Factor = 20* Log_{10} (Worst Case EUT On-time over 100 ms time window)

The transmit packet occupies 0.98 ms of time, within any 100 ms window. Therefore, the relaxation factor allowance is calculated as:

Average Factor = 20* Log_{10} (.98 / 100 ms) = 40.18

A maximum relaxation factor of 20 dB would be allowable for this product.