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ENGINEERING TEST REPORT # 309166, C-632

Compliance Testing of:
Pro-FLEX 2.4 GHz Zigbee Module

Test Date(s):
May 28-June 16, 2009

Prepared For:
LS Research, LLC.
Attn: Mr William Steinike
W66 N 220 Commerce Ct
Cedarburg, WI 53012

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Transmitters (DTS) Operating in the
Frequency Band 2400 MHz – 2483.5 MHz
And RSS-210
Issue 2 June 2007

This Test Report is issued under the Authority of:
Ryan Urness, EMC Lab Manager

Signature:  Date: June 18, 2009

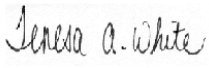
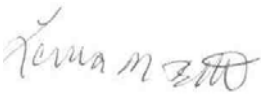
Test Report Reviewed by:	**Tested by:**
Teresa A. White, Quality Manager	Laura Bott, EMC Engineer
Signature: 	Signature: 
Date: June 18, 2009	Date: June 18, 2009

TABLE OF CONTENTS *(page 1 of 2)*

TABLE OF CONTENTS *(Page 2 of 2)*

LSC Revision Control

Date	Revision #	Revised By
9-06-06	2.0	AS/TAW

EXHIBIT 1. INTRODUCTION

1.1 SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Telecommunication – Code of Federal Regulations, CFR 47, Part 15
References:	RSS-210, Issue 2, June 2007
Title:	General Requirements and Information for the Certification of Radiocommunication Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Digital Modulation Transmitters (and Receivers) operating in the Frequency Band of 2400 MHz – 2483.5 MHz
Test Procedures:	Both conducted and radiated emissions measurements were performed 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 from 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)	2005	Code of Federal Regulations - Telecommunications
RSS-Gen Issue2,	2007	Spectrum Management and Telecommunications Radio Standards Specification
ANSI C63.4	2003	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	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003	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	2005, 03-23	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, LLC**
Address:	**W66 N220 Commerce Ct Cedarburg, WI 53012**
Contact Person:	**Mr. William Steinike 262.421.4970 bsteinike@lsr.com**

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	Pro-FLEX
Model Number:	PFLX01-A01
Serial Number:	2, 4, 5, 65, 66

2.3 ASSOCIATED ANTENNA DESCRIPTION

There are two antennas associated with this module.

1) Trace inverted F antenna with a measured gain (over a reflective ground plane) of 4.83 dBi.

2) External Nearson dipole with a standard gain of 2.0 dBi. This antenna may be configured in a straight position, or bent at 90 ° and was tested under both conditions. (Additional information on this antenna is available in Annex C.)

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Frequency Range (in MHz)	2400-2483.5 MHz
RF Power in Watts	0.099 Watts
Conducted Output Power (in dBm)	19.95 dBm (2420 MHz)
Field Strength (and at what distance)	119.65 dBµV/m (2420 MHz) @ 3 m
Occupied Bandwidth (99% BW)	3025 kHz (CH 19, 2445 MHz)
Type of Modulation	O-QPSK
Emission Designator	3M025G1D
EIRP (in mW)	300.61 mW (PIFA) 156.67 mW (Dipole)
Transmitter Spurious (worst case)	64.9 dBµV/m (9780 MHz) @ 1 meter (measured with dipole antenna)
Receiver Spurious (worst case)	54.6 dBµV/m @ 1 meter
Receiver Bandwidth	2.5 MHz
Receiver Sensitivity	-98 dBm
Frequency Tolerance %, Hz, ppm	Within ±100 ppm
Microprocessor Model # (if applicable)	MSP430F5437
Antenna Information	
Detachable/non-detachable	Detachable whip and non-detachable Inverted F trace antenna
Type	Dipole whip and PIFA
Gain (in dBi)	4.83 dBi (PIFA)[Note 1] 2.0 dBi (Nearson dipole)[Note 2]
EUT will be operated under FCC Rule Part(s)	§15.247
Modular Filing	☒ Yes ☐ No
Portable/Mobile	☐ Portable ☒ Mobile

Note 1: The gain for the PIFA was calculated using the measured field strength of the fundamental at 3 meters (which was taken over a reflective ground plane) and subtracting 95.23 and the measured conducted output power at the corresponding frequency.
(gain = E(dBµV/m) – 95.23)

Note 2: The gain was extracted from the data sheet.

RF Technical Information:

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	√	RF Evaluation

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

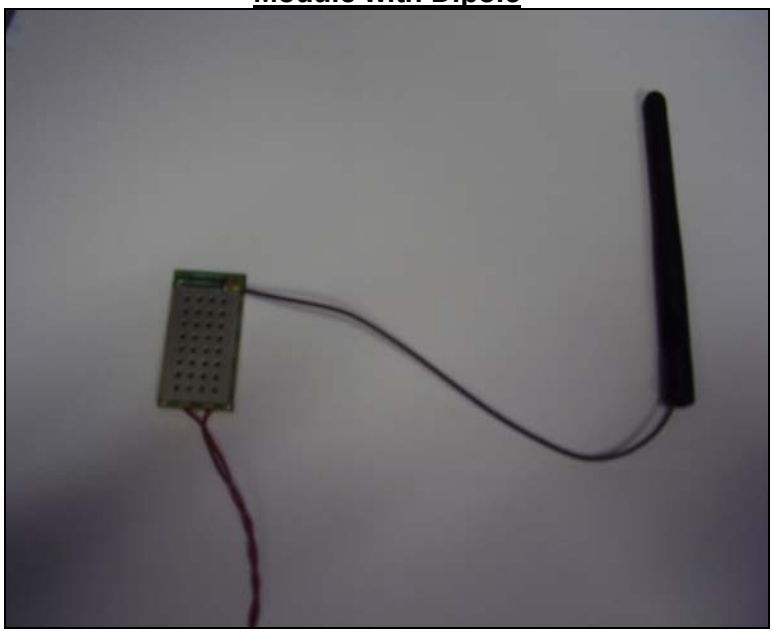
- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100 %
- Standard used for evaluation: OET 65
- Measurement Distance: 20 cm
- RF Value: 0.598 ☐ V/m ☐ A/m ☒ W/m^2
  ☐ Measured ☐ Computed ☒ Calculated

2.5 PRODUCT DESCRIPTION

The Pro-FLEX module is an integrated module with a 2.4GHz IEEE 802.15.4 radio and microcontroller. The module supports the Smart Energy profile, advanced Mesh Networking functionality, Point-to-point protocols, Star networks, simple repeating, and Zigbee Pro networking.

PHOTO

Module with Dipole



With PIFA

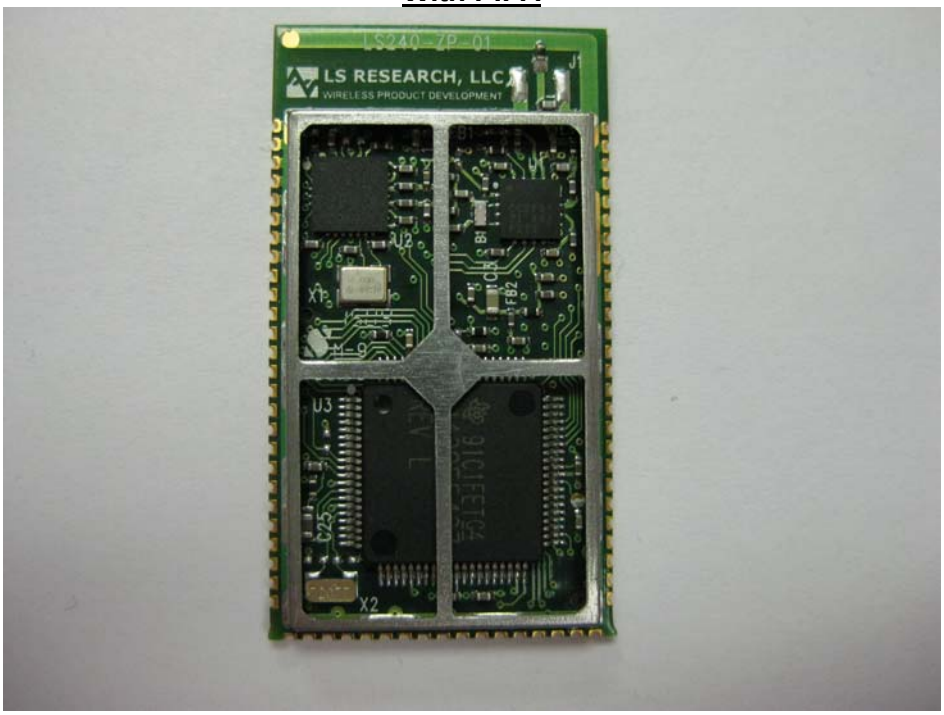


EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	20-25°C
Humidity:	30-60%
Pressure:	86-106 kPa

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Paragraph	Test Requirements	Compliance (yes/no)
15.207	Power Line Conducted Emissions Measurements	Yes
15.247(a)(2)	6 dB Bandwidth of a Digital Modulation System	Yes
15.247(b) & 1.1310	Maximum Output Power	Yes
15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(c)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d)	Transmitted Power Spectral Density of a Digital Modulation System	Yes
15.247(c), 15.209 & 15.205	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 and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers. The Receiver Test Report is available upon request.		

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☐ **None** ☒ **Yes (explain below)**

In order to meet compliance standards, it is necessary to program the following channels with corresponding power settings as follows:
Channels 11 – 13 → power 0xE0
Channels 14 – 24 → power 0xF9
Channel 25 → power 0xE0

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, RSS-Gen, and Industry Canada RSS-210 Issue 7 (2007), Annex 8 (section 8.2) for a Digital Spread Spectrum (DTS) Transmitter.

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

Transmit Mode

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2003.

Measurements at frequencies 30 MHz – 4 GHz where taken with the EUT 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. Radiated emissions measurements were taken at a 3 meter separation distance, per FCC §15.109.

Measurements above 4 GHz were performed at a 1.0 meter separation distance in a semi-anechoic mini chamber. The calculations to determine the limits at the 1.0 meter separation distance are detailed in the following pages.

The EUT was tested in continuous modulated transmit mode. Power was supplied to the EUT by a bench type power supply. Five units were tested; each was programmed to a single channel, using internal proprietary firmware.

The test sample was operated on one of five (5) standard channels: the lowest (2405 MHz) and highest (2475 MHz) channels of operation, which were programmed to transmit at a reduced power, and the low (2420 MHz), middle (2445 MHz) and high (2470 MHz) channels programmed to transmit at full power, to comply with FCC § 15.31(m).

Please refer to Appendix A for a complete list of test equipment.

5.2 Test Procedure

Radiated Emissions measurements were taken from 30-25000 MHz. Measurements from 30 - 4000 MHz were performed at a 3 meter separation distance in a Semi-Anechoic, FCC listed Chamber. Measurements from 4000-18000 MHz were taken at a 1 meter separation distance, and 1800-25000 MHz at a separation distance of 30 cm in a semi-anechoic mini chamber. The radiated RF emission levels were manually noted at discrete turntable azimuths and measurement antenna heights, corresponding to peak emission levels at various frequencies.

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 18 GHz, and a Standard Gain Horn Antenna was used for measurements from 18 to 25 GHz. The maximum radiated RF emissions were found by rotating the EUT 360°, and raising and lowering the antenna between 1 and 4 meters, for measurements taken at 3 meters, and 1 and 1.8 meters for measurements taken at 1 meter, using both horizontal and vertical antenna polarities.

The EUT was rotated along three orthogonal axes during the investigations, configured with the inverted F antenna and the dipole in straight and bent positions, 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 a N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading.

5.4 Test Results

The EUT was found to meet the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for a DTS transmitter [Canada RSS-210 Issue 7 (2007)], Annex 8 (section 8.2). 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), is 1 Watt. The harmonic and spurious RF emissions, measured in any 100 kHz bandwidth, as specified in 15.247 (d), 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).

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.

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

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 to 25,000 MHz

500μV/m or 54.0 dB/μV/m at 3 meters

54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

5.6 RADIATED EMISSIONS DATA CHART

Test Standard: 47CFR, Part 15.205 and 15.247(DTS)
Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	LS Research, LLC					
Date(s) of Test:	May 28-June 15, 2009					
Test Engineer(s):	Laura Bott					
Voltage:	3.3 VDC					
Operation Mode:	Normal, continuous transmit, modulated mode					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
		Battery	√	Other: bench power supply		
EUT Placement:	√	80cm non-conductive table		10cm Spacers		
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average

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

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
2405	1.03	2	117.3	116.0	125.0	9.0	Horizontal	Side
4810	1.03	172	59.9	57.9	63.5	5.6	Vertical	Side
7215	1.19	145	60.9	53.2	105.5	52.3	Horizontal	Side
9620	1.00	188	57.9	48.3	105.5	57.1	Horizontal	Flat
12025	1.07	66	61.7	53.7	63.5	9.8	Horizontal	Side
14430	1.00	128	54.1	43.3	105.5	62.1	Horizontal	Flat
16835	1.15	123	55.9	45.2	105.5	60.3	Vertical	Vertical
19240				Note 2	63.5			
21645				Note 2	105.96			
24050				Note 2	105.96			

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 14 with inverted F antenna:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
2420	1.14	315	121.8	119.7	125.0	5.3	Horizontal	Flat
4840	1.05	257	66.2	59.7	63.5	3.8	Vertical	Side
7260	1.21	164	70.3	63.3	63.5	0.2	Vertical	Vertical
9680	1.00	263	70.0	60.8	109.2	48.4	Vertical	Vertical
12100	1.05	65	69.7	62.2	63.5	1.3	Horizontal	Side
14520	1.11	216	55.3	45.6	109.2	63.5	Vertical	Side
16940	1.03	115	56.5	46.7	109.2	62.4	Vertical	Vertical
19360				Note 2	63.5			
21780				Note 2	107.99			
24200				Note 2	107.99			

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 19 with inverted F antenna:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
2445	1.00	202	121.6	119.4	125	5.6	Vertical	Vertical
4890	1.10	3	62.1	56.2	63.5	7.3	Horizontal	Flat
7335	1.23	176	66.6	59.8	63.5	3.7	Vertical	Vertical
9780	1.03	96	68.2	60.7	108.9	48.2	Vertical	Side
12225	1.04	142	66.6	59.0	63.5	4.5	Horizontal	Flat
14670	1.06	226	60.0	50.0	108.9	58.9	Horizontal	Vertical
17115	1.02	136	57.4	46.5	108.9	62.4	Horizontal	Vertical
19560				Note 2	63.5			
22005				Note 2	109.4			
24450				Note 2	109.4			

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 24 with inverted F antenna:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
2470	1.94	2	120.9	117.8	125.0	7.2	Horizontal	Side
4940	1.04	174	61.0	58.5	63.5	5.0	Vertical	Side
7410	1.02	173	62.7	56.9	63.5	6.6	Horizontal	Side
9880	1.02	88	66.6	63.3	107.3	44.0	Horizontal	Vertical
12350	1.03	72	64.0	59.5	63.5	4.0	Horizontal	Side
14820	1.05	308	51.9	40.0	107.3	67.3	Vertical	Flat
17290				Note 2	107.77			
19760				Note 2	63.5			
22230				Note 2	63.5			
24700				Note 2	107.77			

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 25 with inverted F antenna:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
2475	1.17	264	120.2	117.5	125.0	7.5	Horizontal	Flat
4950	1.00	192	62.6	61.3	63.5	2.2	Horizontal	Vertical
7425	10..	358	61.6	56.8	63.5	6.7	Vertical	Side
9900	1.00	191	62.1	58.9	107.0	48.1	Horizontal	Flat
12375	1.03	76	59.4	54.2	63.5	9.3	Horizontal	Side
14850	1.14	93	53.1	42.6	107.0	64.4	Vertical	Flat
17325				Note 2	107.48			
19800				Note 2	63.5			
22275				Note 2	63.5			
24750				Note 2	107.48			

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

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation	Dipole Position
2405	1.11	100	119.1	116.1	125.0	8.9	Horizontal	Vertical	Bent
4810	1.05	196	59.8	56.5	63.5	7.0	Horizontal	Vertical	Straight
7215	1.00	0	61.0	53.2	105.6	52.4	Vertical	Vertical	Straight
9620	1.10	236	60.5	56.7	105.6	48.9	Horizontal	Flat	Bent
12025	1.10	0	59.3	50.5	63.5	13.0	Vertical	Side	Bent
14430	1.00	216	55.8	45.2	105.6	60.4	Vertical	Vertical	Bent
16835	1.24	190	55.0	44.6	105.6	61.0	Horizontal	Vertical	Bent
19240				Note 2	63.5				
21645				Note 2	105.6				
24050				Note 2	105.6				

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 14 with dipole antenna connected:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation	Dipole Position
2420	1.15	259	118.8	117.7	125.0	7.3	Horizontal	Vertical	Bent
4840	1.02	214	66.3	59.1	63.5	4.4	Horizontal	Vertical	Straight
7260	1.03	225	64.0	61.6	63.5	1.9	Vertical	Side	Straight
9680	1.02	347	66.7	63.4	107.2	43.8	Horizontal	Flat	Bent
12100	1.10	218	61.7	57.2	63.5	6.3	Vertical	Vertical	Bent
14520	1.21	299	56.9	46.4	107.2	60.8	Vertical	Vertical	Straight
16940				Note 2	107.2				
19360				Note 2	63.5				
21780				Note 2	107.2				
24200				Note 2	107.2				

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 19 with dipole antenna connected:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation	Dipole Position
2445	1.15	54	119.4	118.3	125.0	6.7	Horizontal	Vertical	Bent
4890	1.04	217	61.3	58.5	63.5	5.0	Horizontal	Vertical	Straight
7335	1.00	354	68.8	62.2	63.5	1.3	Horizontal	Flat	Bent
9780	1.00	282	73.2	64.9	107.8	42.9	Vertical	Vertical	Straight
12225	1.05	39	66.4	58.8	63.5	4.7	Horizontal	Flat	Bent
14670	1.00	232	55.7	45.6	107.8	62.1	Horizontal	Vertical	Bent
17115	1.00	223	58.2	47.9	107.8	59.8	Horizontal	Flat	Bent
19560				Note 2	63.5				
22005				Note 2	107.8				
24450				Note 2	107.8				

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 24with dipole antenna connected:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation	Dipole Position
2470	1.36	258	120.9	118.1	125.0	6.9	Horizontal	Vertical	Bent
4940	1.00	226	59.1	57.7	63.5	5.8	Horizontal	Vertical	Straight
7410	1.12	172	66.9	59.8	63.5	3.7	Vertical	Vertical	Bent
9880	1.00	265	71.6	63.0	107.6	44.6	Horizontal	Flat	Straight
12350	1.00	186	64.7	56.6	63.5	6.9	Vertical	Vertical	Bent
14820	1.00	240	57.0	47.1	107.6	60.5	Horizontal	Vertical	Bent
17290	1.26	98	58.9	57.0	107.6	50.5	Horizontal	Vertical	Bent
19760				Note 2	63.5				
22230				Note 2	63.5				
24700				Note 2	107.6				

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 24with dipole antenna connected:

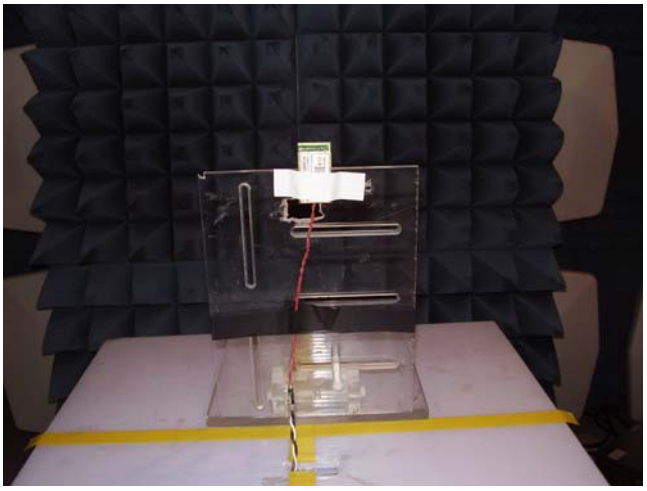
Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation	Dipole Position
2475	1.14	108	112.0	110.7	125.0	14.3	Horizontal	Vertical	Bent
4950	1.03	198	59.4	57.6	63.5	5.9	Horizontal	Vertical	Bent
7425	1.03	101	67.3	59.6	63.5	3.9	Vertical	Flat	Straight
9900	1.14	120	70.5	61.7	100.2	38.5	Horizontal	Flat	Bent
12375	1.08	202	58.7	49.2	63.5	14.3	Horizontal	Side	Straight
14850	1.11	100	54.5	44.2	100.2	56.0	Horizontal	Vertical	Straight
17325	1.00	235	56.9	46.3	100.2	54.0	Vertical	Flat	Bent
19800				Note 2	63.5				
22275				Note 2	63.5				
24750				Note 2	100.2				

Notes:

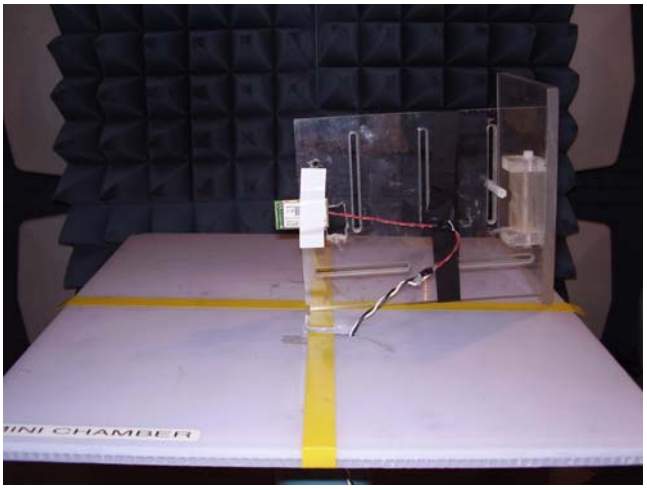
1) Measurements above 4 GHz were made at 1 meters of separation from the EUT.
2) Measurement at receiver system noise floor.
3) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.

5.7 Test Setup Photo(s) – Radiated Emissions Test with PIFA

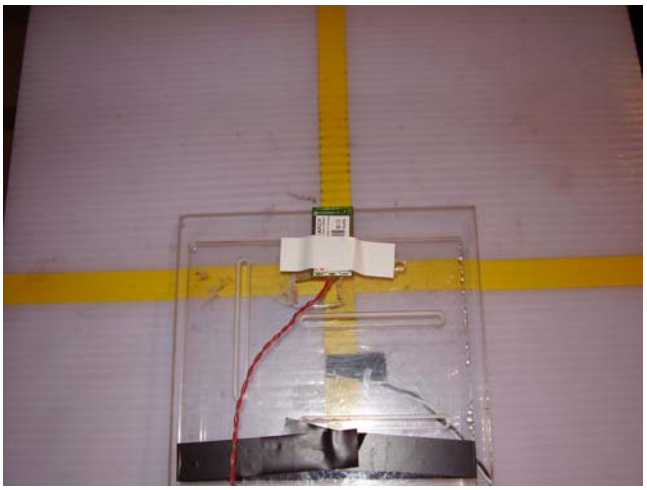
Vertical Orientation



Side Orientation

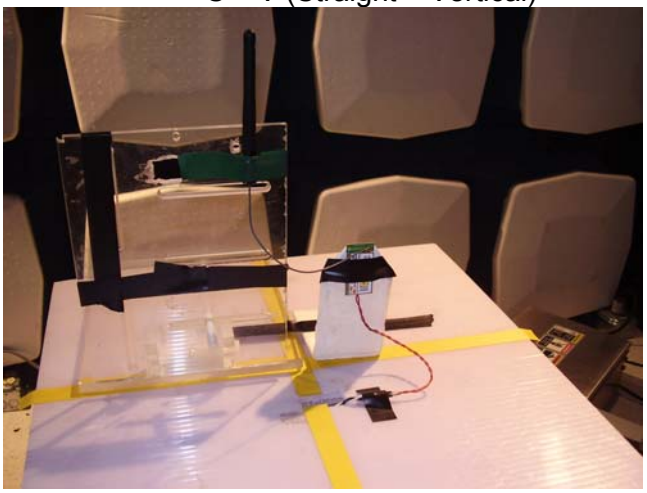


Flat Orientation

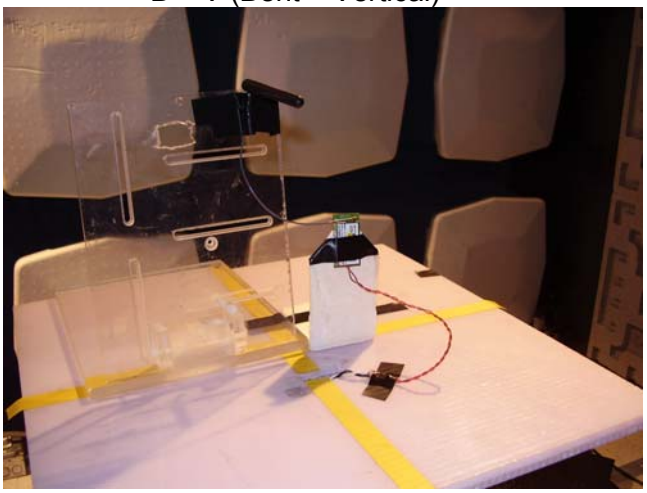


Test Setup Photo(s) – Radiated Emissions Test with external dipole

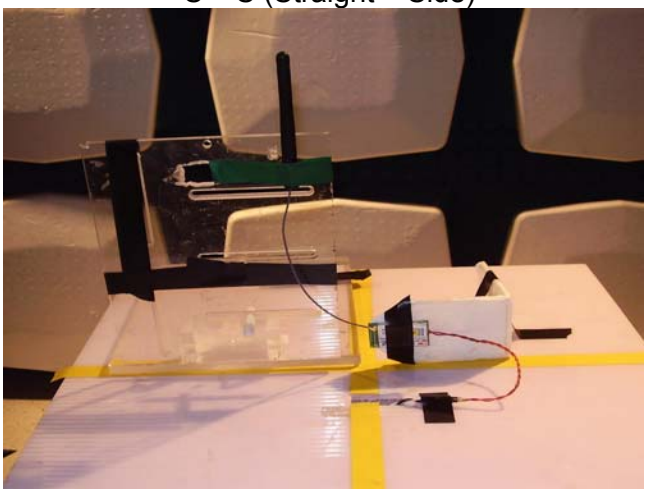
S – V (Straight – Vertical)



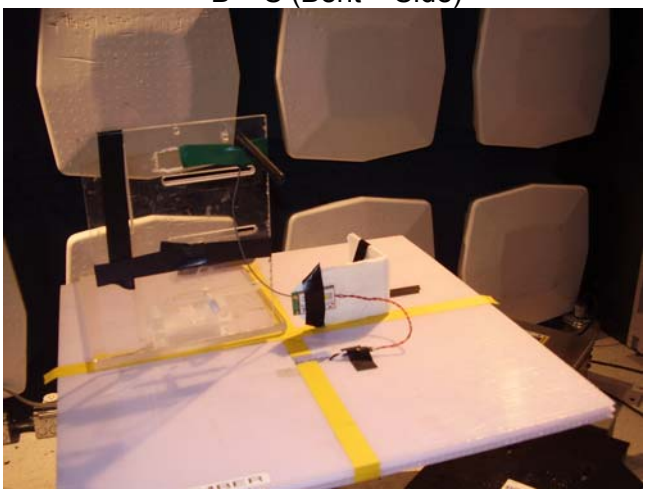
B – V (Bent – Vertical)



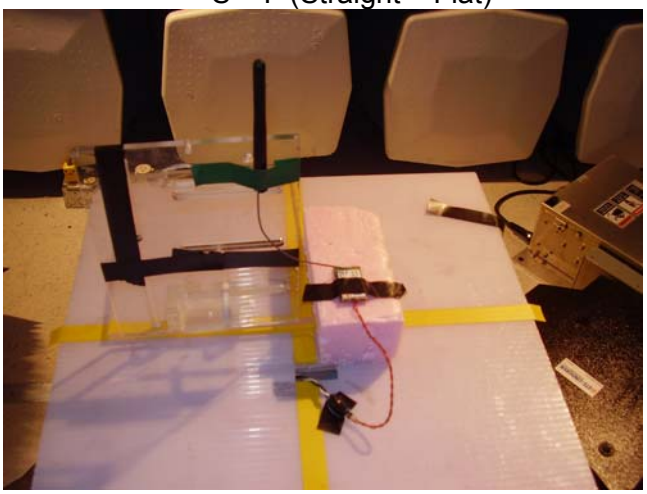
S – S (Straight – Side)



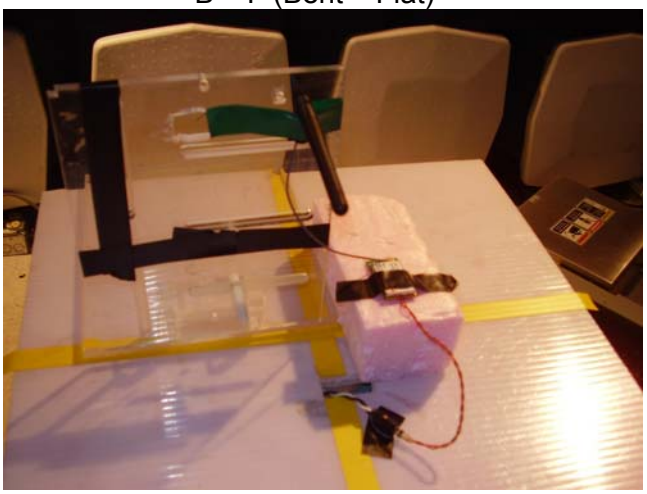
B – S (Bent – Side)



S – F (Straight – Flat)



B – F (Bent – Flat)

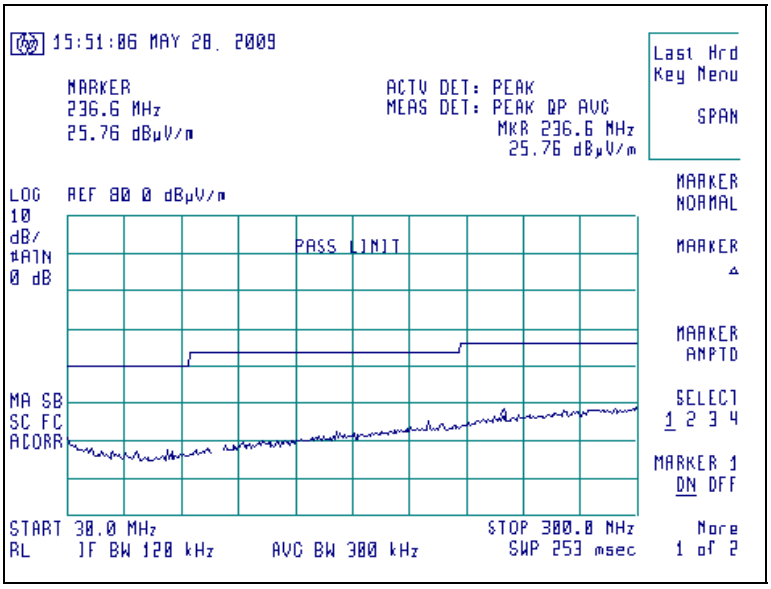


5.8 Screen Captures - Radiated Emissions Testing

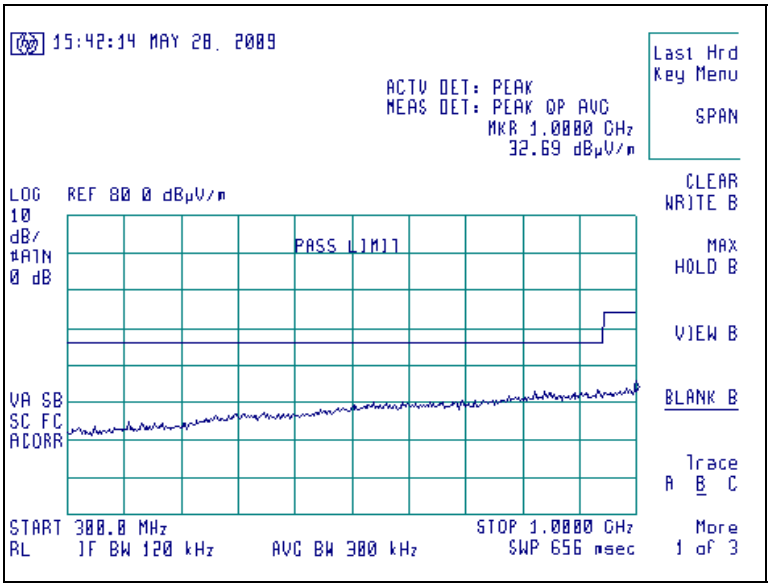
Transmit Mode

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. The signature scans shown here are from worst-case emissions, as measured on channels 11, 14, 19, 24 or 25, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

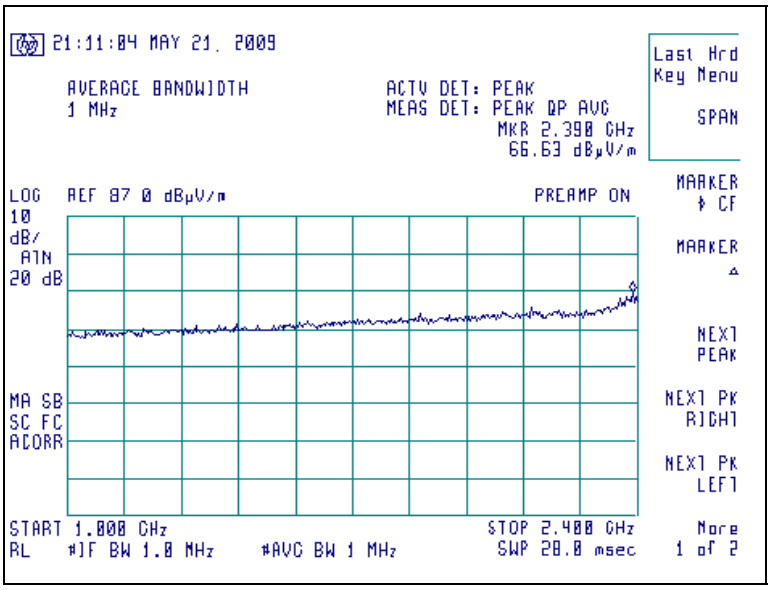
Channel 19, Antenna Vertically Polarized, EUT Flat
30-300 MHz, at 3 m
Inverted F Antenna



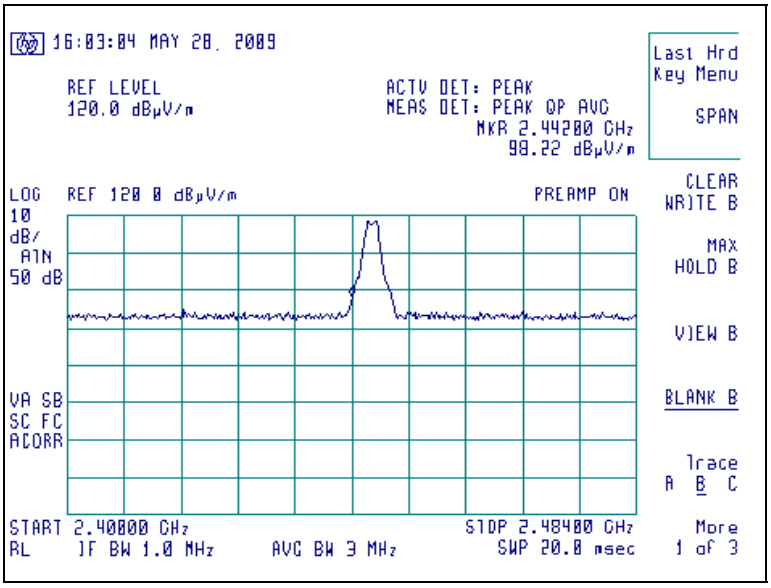
Channel 19, Antenna Vertically Polarized, EUT Flat
300-1000 MHz, at 3 m
Inverted F Antenna



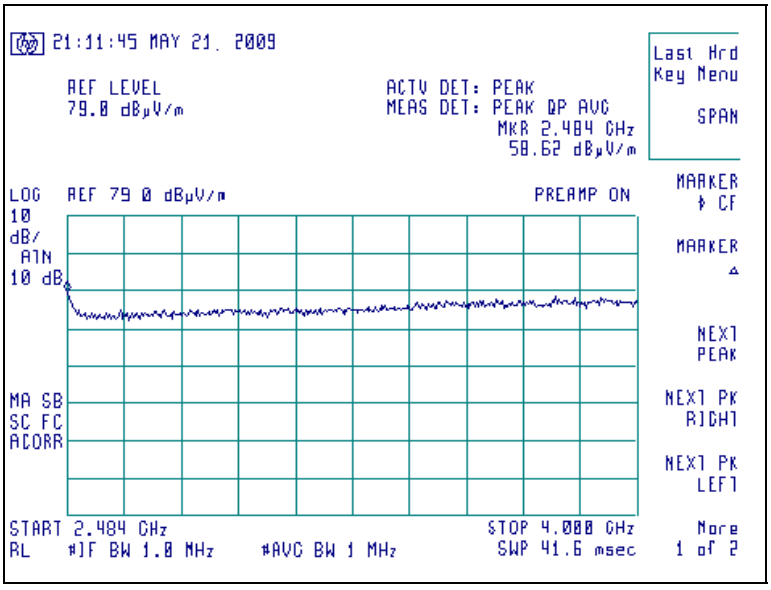
Channel 19, Antenna Vertically Polarized, EUT Vertical
1000-2400 MHz, at 3 m
Inverted F Antenna



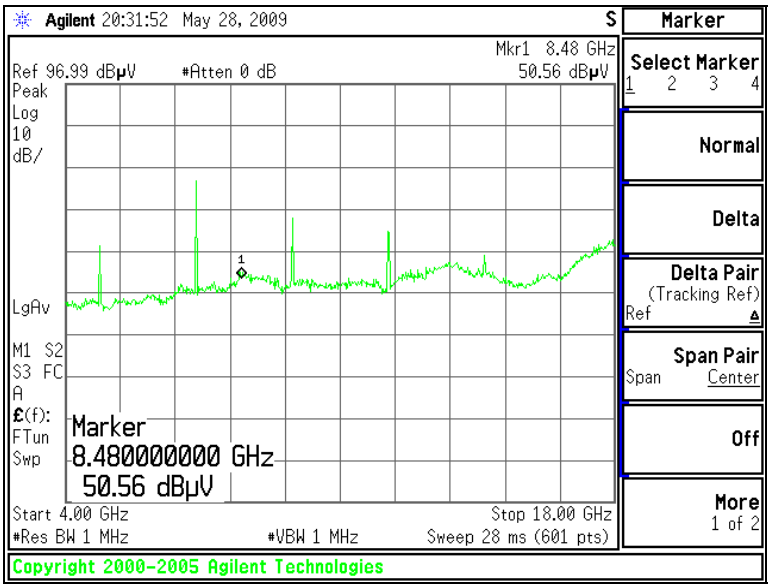
Channel 19, Antenna Vertically Polarized, EUT Vertical
2400-2484 MHz, at 3 m
Inverted F Antenna



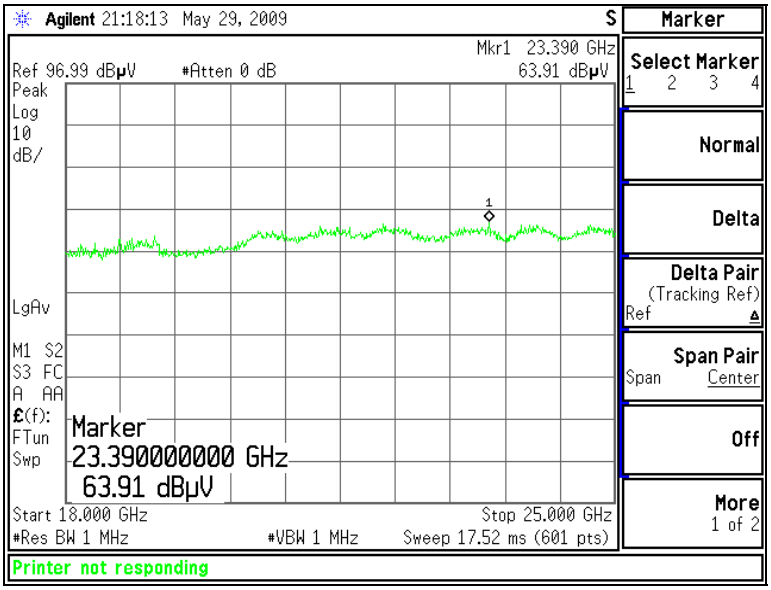
Channel 19, Antenna Vertically Polarized, EUT Vertical
2484.0-4000 MHz, at 3 m
Inverted F Antenna



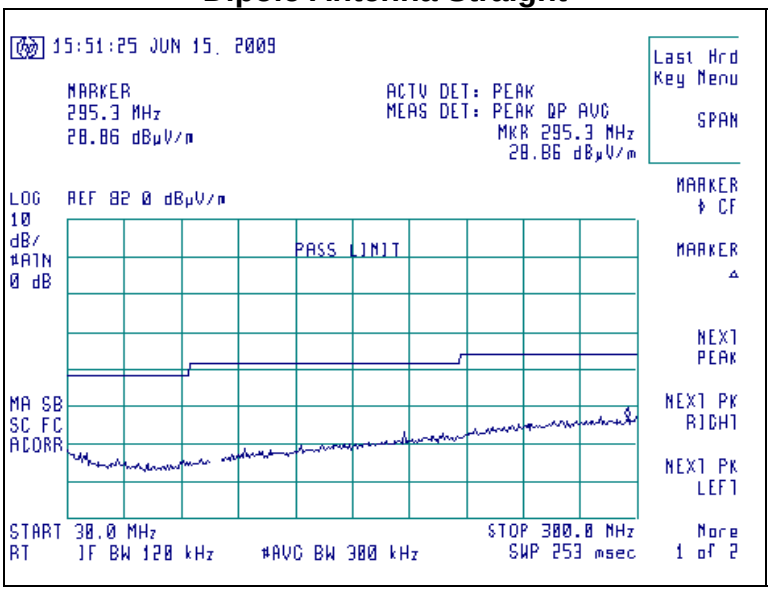
Channel 19, Antenna Vertically Polarized, EUT Vertical
4000-18000 MHz, at 1 m
Inverted F Antenna



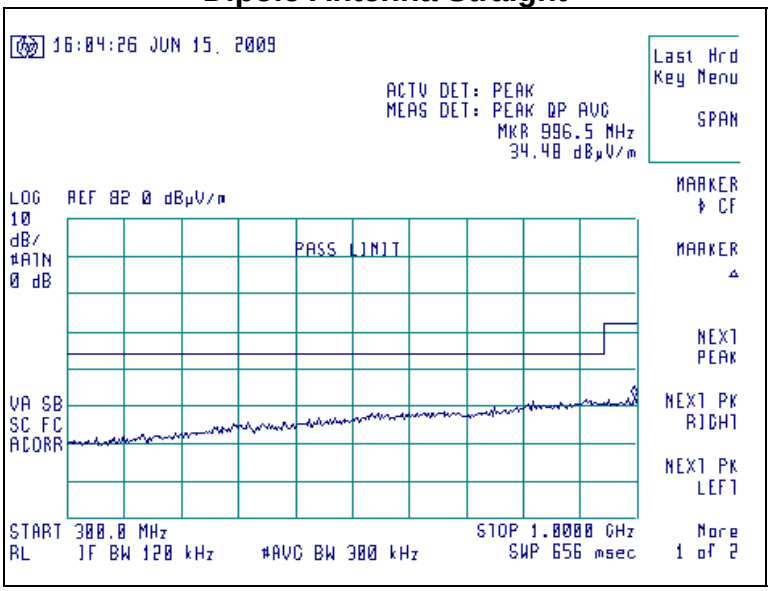
Channel 19, Antenna Vertically Polarized, ET Vertical
18000-25000 MHz, at 1 m
Inverted F Antenna



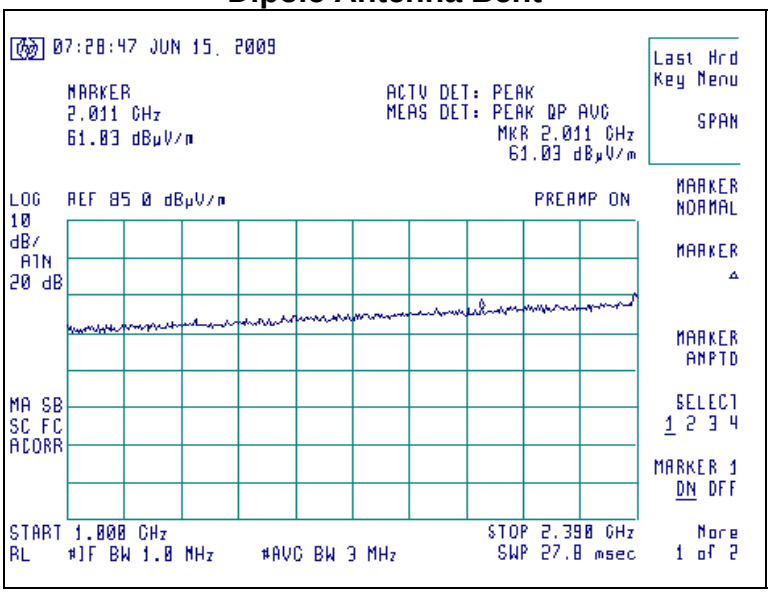
Channel 19, Antenna Vertically Polarized, EUT Vertical
30-300 MHz, at 3 m
Dipole Antenna Straight



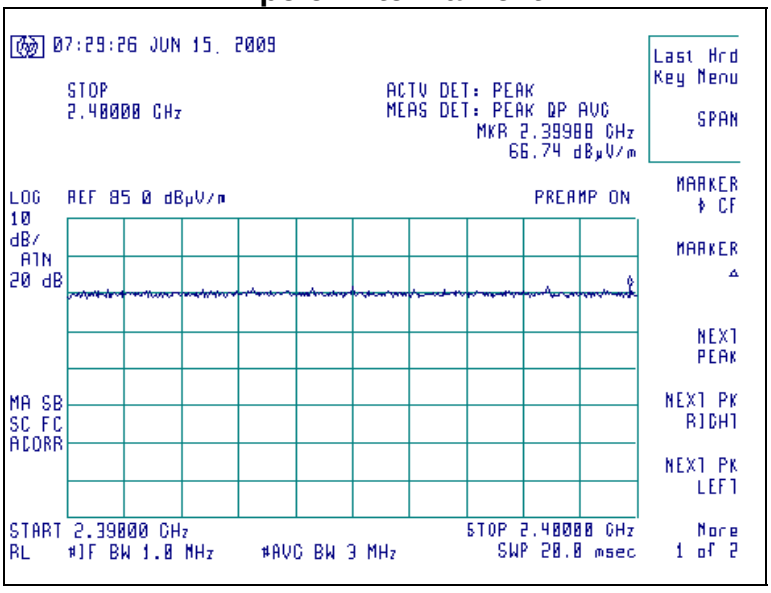
Channel 19, Antenna Vertically Polarized, EUT Vertical
300-1000 MHz, at 3 m
Dipole Antenna Straight



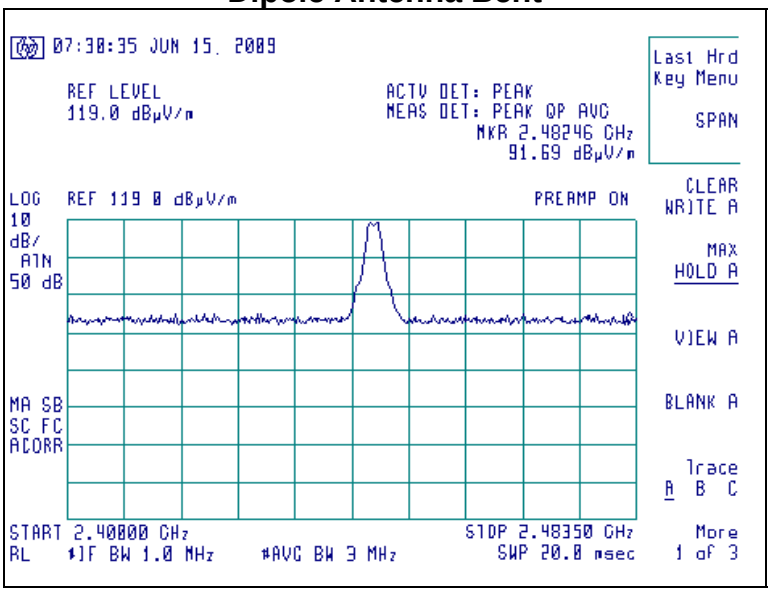
Channel 19, Antenna Horizontally Polarized, EUT Vertical
1000-2390 MHz, at 3 m
Dipole Antenna Bent



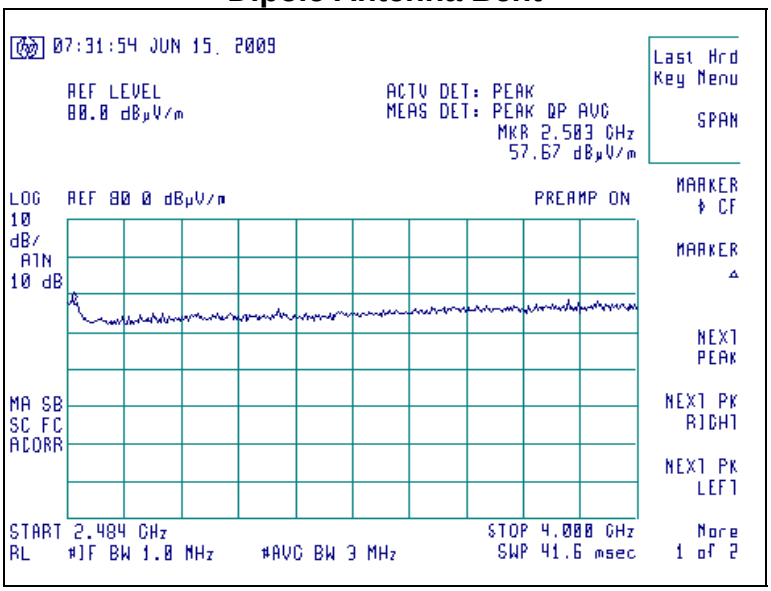
Channel 19, Antenna Horizontally Polarized, EUT Vertical
2390-2400 MHz, at 3 m
Dipole Antenna Bent



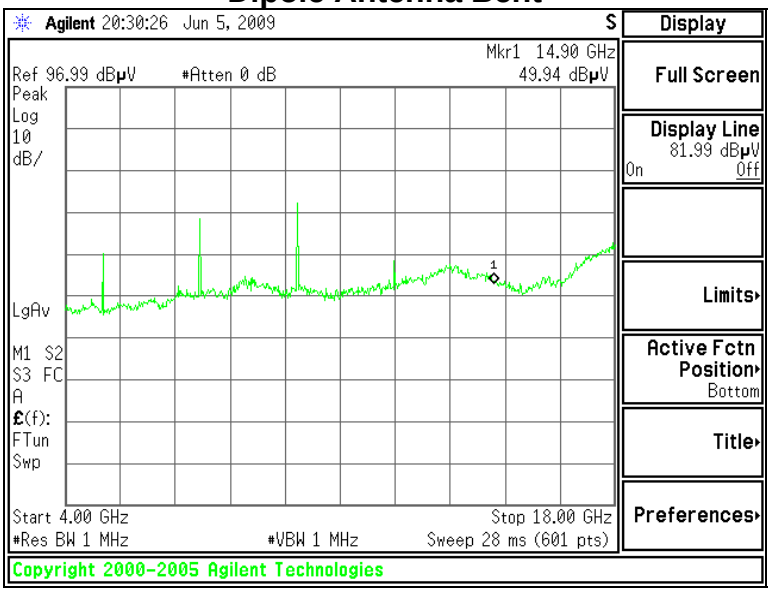
Channel 19, Antenna Horizontally Polarized, EUT Vertical
2400-2483.5 MHz, at 3 m
Dipole Antenna Bent



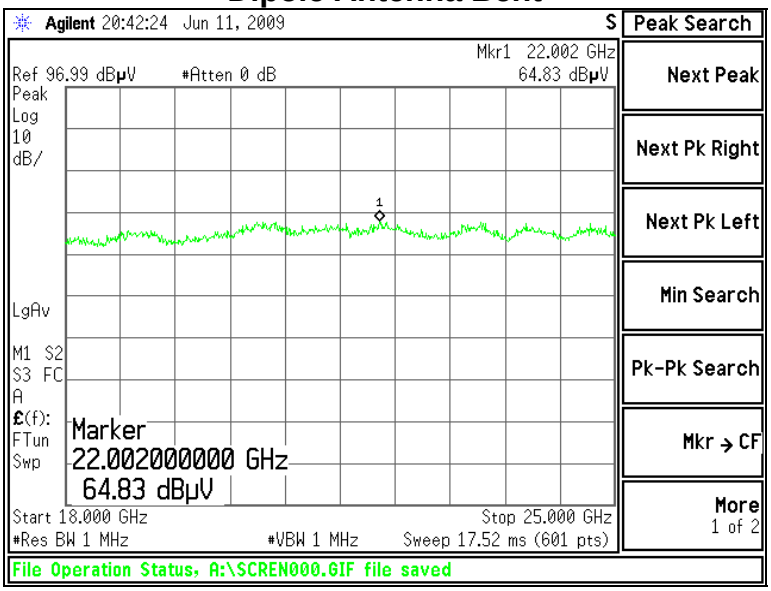
Channel 19, Antenna Horizontally Polarized, EUT Vertical
2484.0-4000 MHz, at 3 m
Dipole Antenna Bent



Channel 25, Antenna Horizontally Polarized, EUT Flat
4000-18000 MHz, at 1 m
Dipole Antenna Bent



Channel 19, Antenna Horizontally Polarized, EUT Flat
18000-25000 MHz, at 1 m
Dipole Antenna Bent



Receive Mode

5.9 Test Setup

The test setup was assembled in accordance with RSS GEN and ANSI C63.4-2003.

Measurements at frequencies 30 MHz – 4 GHz where taken when 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 radiated emissions limits for unintentional radiators, denoted in RSS-Gen Section 6(a) apply at a 3 meter distance; thus, the measurement antenna was placed 3 meters from the EUT radiating element. Measurements 4 – 25 GHz were performed at a 1.0 meter separation distance in a semi-anechoic mini chamber.

The EUT was tested in normal receive mode at the middle channel, per RSS-Gen Section 4.10.

Power was supplied to the EUT by a laboratory power supply. The unit has the capability to operate on 16 channels, controllable via proprietary firmware.

Please refer to Appendix A for a complete list of test equipment.

No significant radiated emissions were noted. Peak readings from the highest emissions in each band are denoted in the tables below and are compared to the limits.

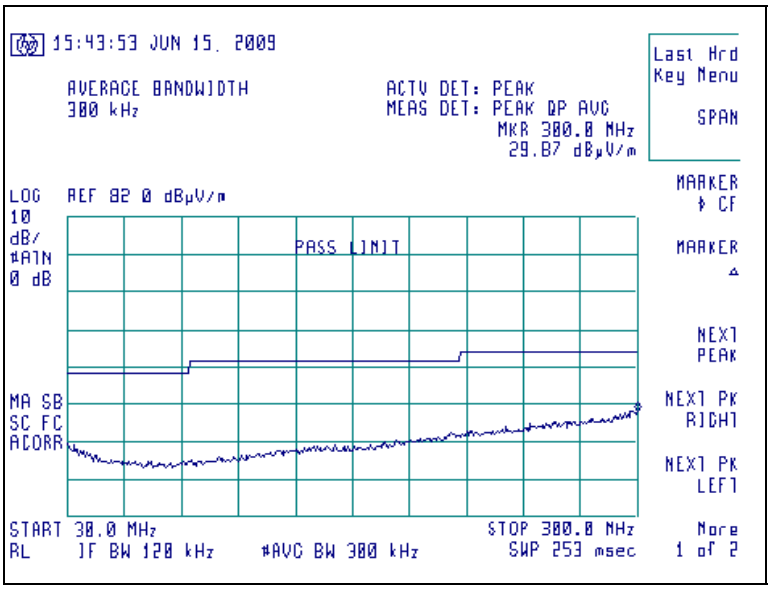
Test data of receive mode with inverted F antenna:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation
300.8	1.00	0	29.9	46.0	16.1	Vertical	Vertical
982.5	1.00	0	34.4	54.0	19.6	Vertical	Vertical
3563	1.00	0	48.0	54.0	6.0	Vertical	Vertical

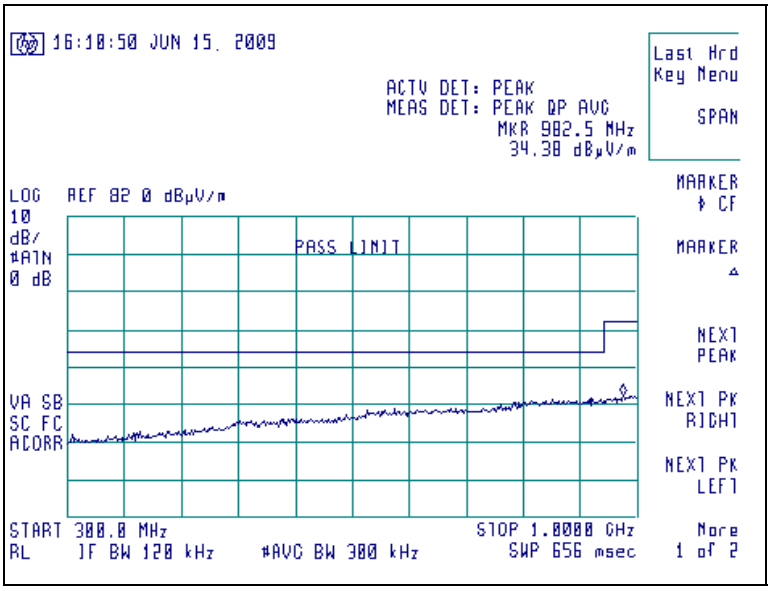
Frequency (MHz)	Height (m)	Azimuth (degree)	10 Hz video averaged Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation
4890	1.00	0	39.0	63.5	24.5	Vertical	Vertical
23915	1.00	0	46.2	63.5	17.3	Vertical	Vertical

Screen Captures of Radiated Emissions

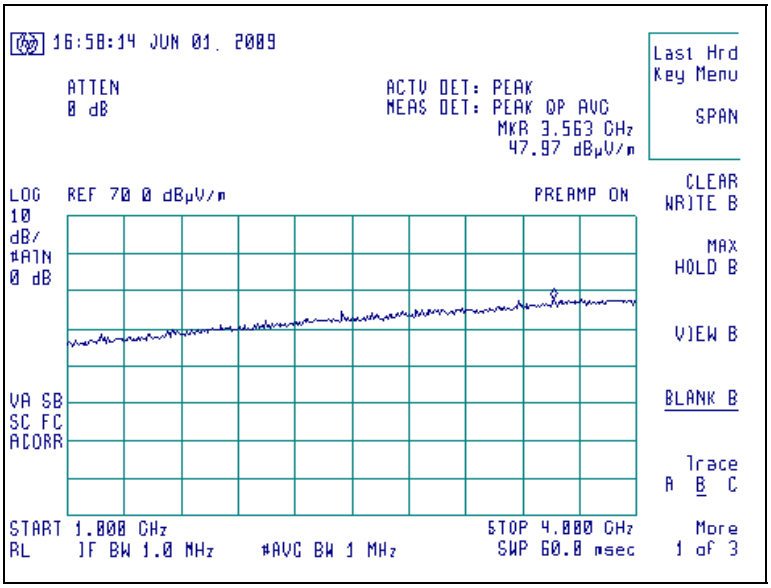
Channel 19, Antenna Vertically Polarized, EUT Vertical
30-300 MHz, at 3 m
Inverted F Antenna



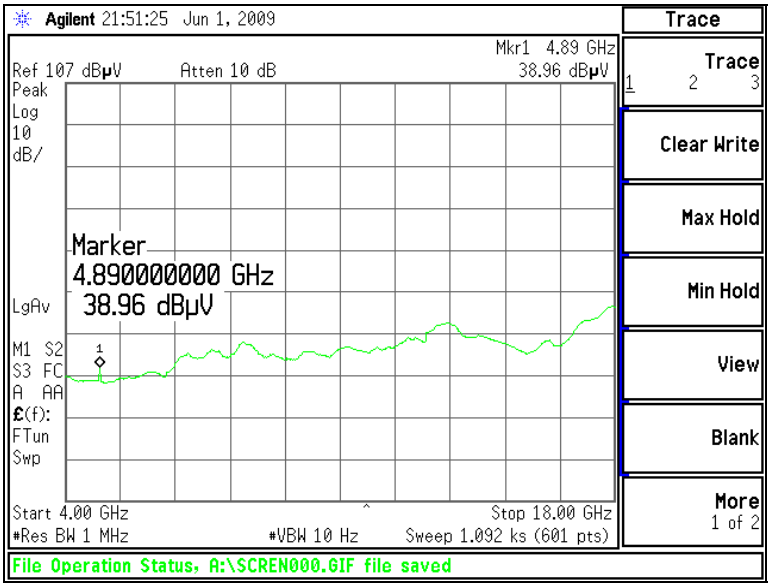
Channel 19, Antenna Vertically Polarized, EUT Vertical
300-1000 MHz, at 3 m
Inverted F Antenna



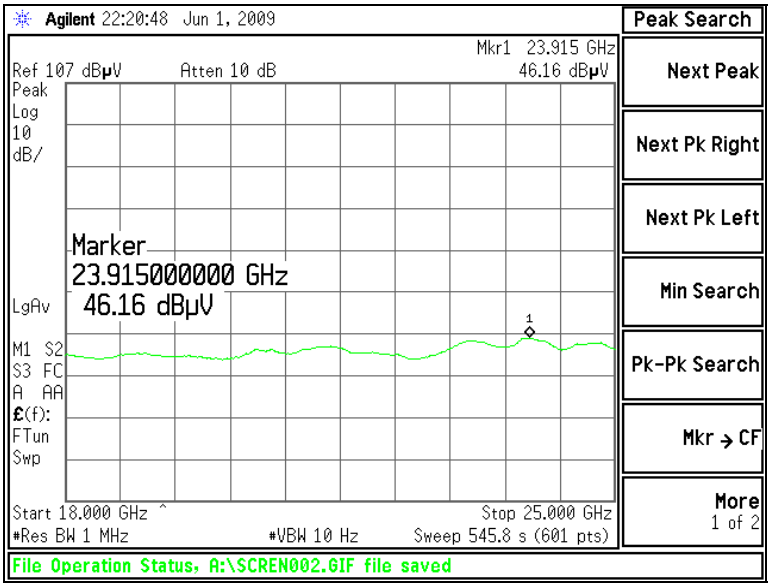
Channel 19, Antenna Vertically Polarized, EUT Vertical
1000-4000 MHz, at 3 m
Inverted F Antenna



Channel 19, Antenna Vertically Polarized, EUT Vertical
4000-18000 MHz, at 1 m
Inverted F Antenna



Channel 19, Antenna Vertically Polarized, EUT Vertical
18000-25000 MHz, at 1 m
Inverted F Antenna

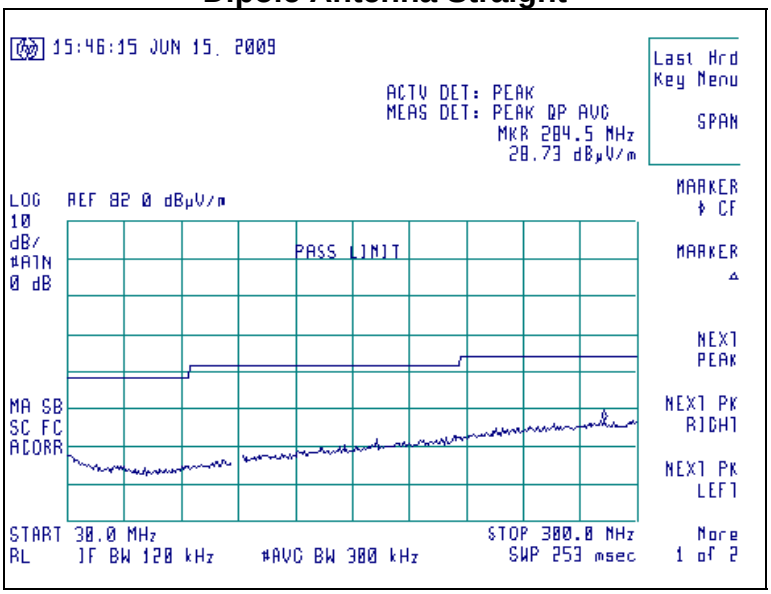


Test data of receive mode with dipole antenna:

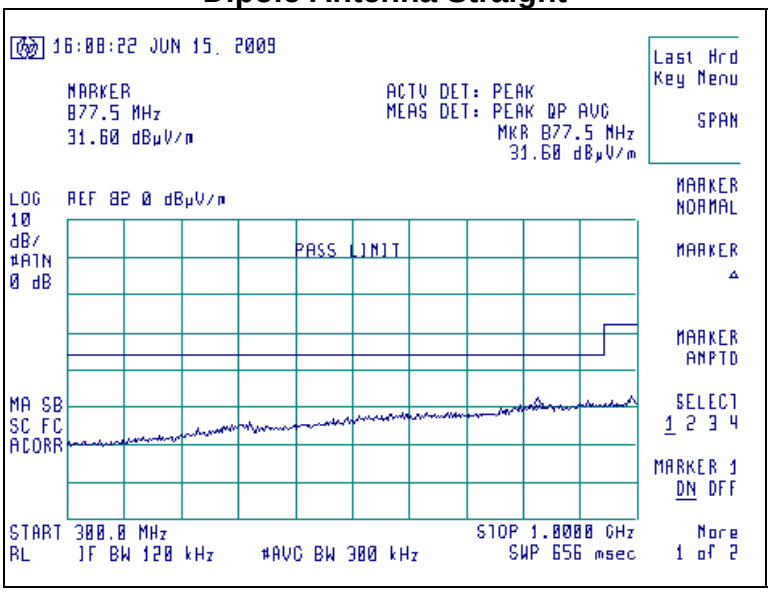
Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation	Dipole Position
284.5	1.00	0	28.7	46.0	17.3	Vertical	Vertical	Straight
977.5	1.00	0	31.7	54.0	22.3	Vertical	Vertical	Straight
3382.0	1.00	0	45.9	54.0	8.1	Vertical	Vertical	Straight

Frequency (MHz)	Height (m)	Azimuth (degree)	10 Hz video averaged Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Measurement Antenna Polarity	EUT orientation	Dipole Position
17980.0	1.00	0	46.0	63.5	17.5	Vertical	Vertical	Straight
20450.0	1.00	0	54.6	63.5	8.9	Vertical	Vertical	Straight

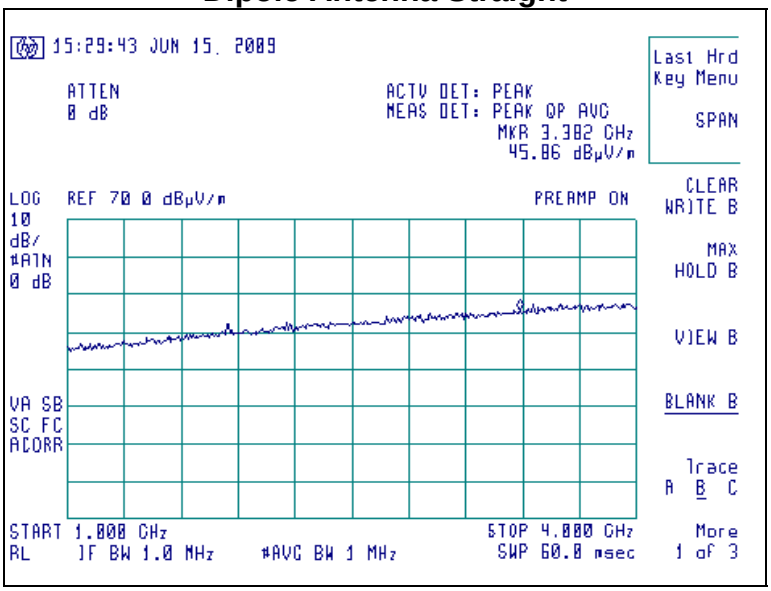
Channel 19, Antenna Vertically Polarized, EUT Vertical
30-300 MHz, at 3 m
Dipole Antenna Straight



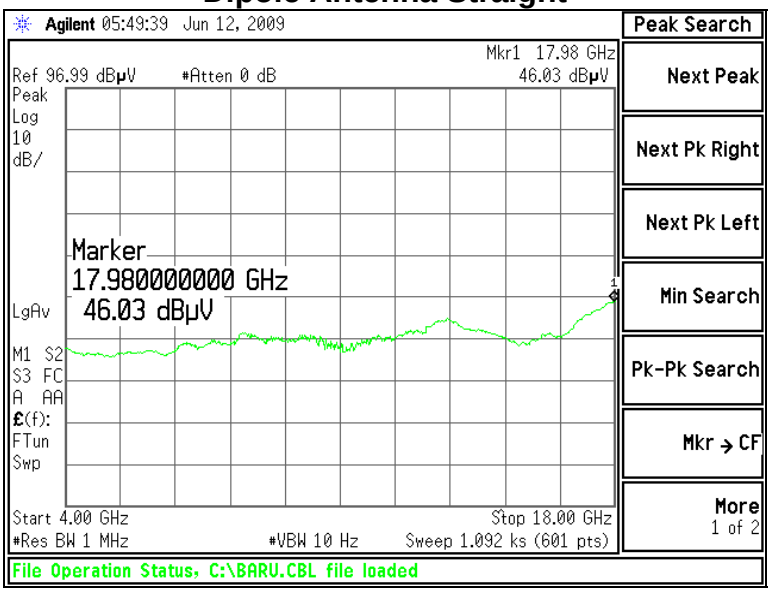
Channel 19, Antenna Vertically Polarized, EUT Vertical
300-1000 MHz, at 3 m
Dipole Antenna Straight



Channel 19, Antenna Vertically Polarized, EUT Vertical
1000-4000 MHz, at 3 m
Dipole Antenna Straight



Channel 19, Antenna Vertically Polarized, EUT Vertical
4000-18000 MHz, at 1 m
Dipole Antenna Straight



Channel 19, Antenna Vertically Polarized, EUT Vertical
18000-25000 MHz, at 1 m
Dipole Antenna Straight

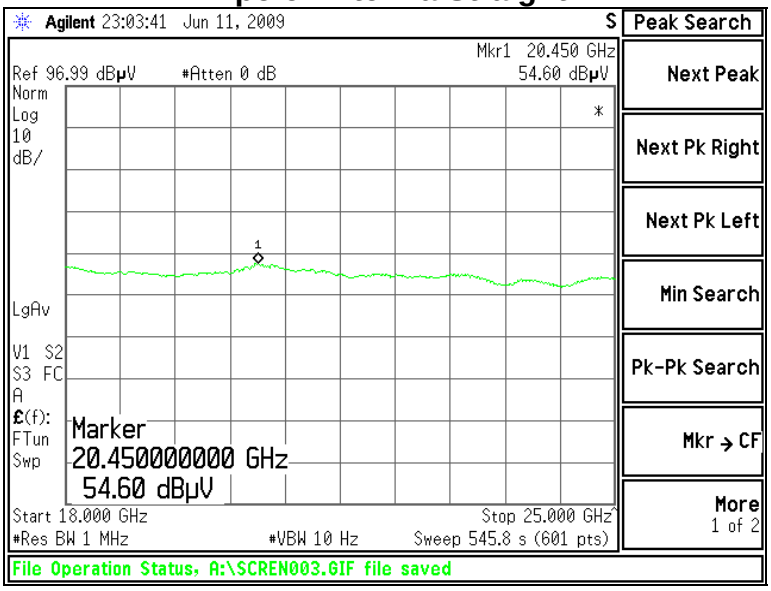


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE: FCC 15.207 and RSS-Gen 7.2.2

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, Issue 7). The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. Power was provided to the EUT via a generic wall pack whose output was connected to a voltage regulator, without additional filtering, to supply the appropriate voltage to the EUT. The wall pack was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The 120 VAC power supply was fed to the test area via an appropriate broadband EMI Filter, and then to the LISN line input. 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 HP 8546A EMI Receiver. The EMCO LISN used terminates the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral), respectively.

6.2 Test Procedure

The EUT was investigated in continuous modulated transmit mode for this portion of the testing. Measurements were made from 150 kHz-30MHz. The Intermediate Frequency Bandwidth was set to 9.0 kHz and the Average Bandwidth to 30 kHz, per CISPR 16-1 (2003), Section 1, Table 1. Plots of peak values were captured and are shown below. Quasi-peak and average signal strength values were measured at discrete frequencies; these are denoted in the table in Section 6.5 of this report.

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 HP 8546A 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 Part 15.207 and RSS-Gen 7.2.2 Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

6.5 FCC and RSS-Gen 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 TEST DATA CHART CONDUCTED EMISSION

Frequency Range inspected: 150 KHz to 30 MHz

Test Standard: FCC 15.207 Class B and RSS-Gen

Manufacturer:	LS Research, LLC					
Date(s) of Test:	June 3, 2009 and June 16, 2009					
Test Engineer:	Laura Bott					
Model #:	LS240-ZP-01-A10					
Serial #:	65					
Voltage:	3.3 VDC					
Operation Mode:	Normal, continuous transmit, modulated or C.W. mode					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:	√	Bench test area				Chamber
EUT Placed On:	√	40cm from Vertical Ground Plane				10cm Spacers
	√	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average

Test Data for test with PIFA:

Frequency (MHz)	Line	Q-Peak Reading	Q-Peak Limit	Margin	Average Reading	Average Limit	Margin
0.153	1	29.80	65.85	36.05	3.40	55.85	52.45
0.287	1	26.50	60.63	34.13	2.30	50.63	48.33
1.105	1	25.30	56.00	30.70	2.20	46.00	43.80
4.000	1	36.40	56.00	19.60	35.20	46.00	10.80
0.177	2	28.20	64.64	36.44	13.90	54.64	40.74
0.242	2	25.60	62.05	36.45	2.50	52.05	49.55
0.985	2	24.20	56.00	31.80	2.00	46.00	44.00
1.999	2	23.50	56.00	32.50	17.60	46.00	28.40
4.000	2	36.50	56.00	19.50	35.30	46.00	10.70

Test Data for test with Dipole

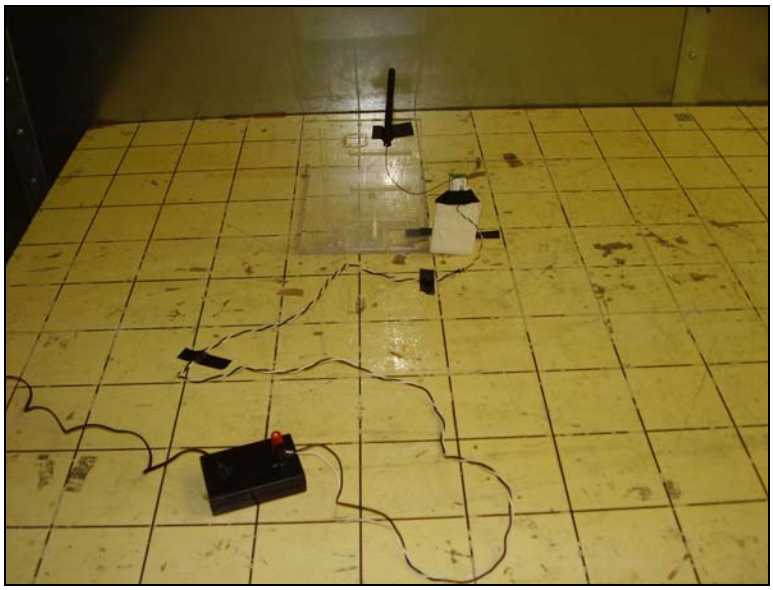
Frequency (MHz)	Line	Q-Peak Reading	Q-Peak Limit	Margin	Average Reading	Average Limit	Margin
0.155	1	25.40	65.71	40.31	2.30	55.71	53.41
0.239	1	20.30	62.14	41.84	2.10	52.14	50.04
0.965	1	17.60	56.00	38.40	1.60	46.00	44.40
4.000	1	35.90	56.00	20.10	34.70	46.00	11.30
0.176	2	24.00	64.66	40.66	11.60	54.66	43.06
0.268	2	19.70	61.18	41.48	1.50	51.18	49.68
1.074	2	20.20	56.00	35.80	1.70	46.00	44.30
2.054	2	16.00	56.00	40.00	11.30	46.00	34.70

Note:

1) The EUT exhibited similar emissions in transmit and receive modes, and across the Low, Middle and High channels tested.

6.7 Test Setup Photo(s) – Conducted Emissions Test with PIFA

Test Setup Photo(s) – Conducted Emissions Test with Dipole

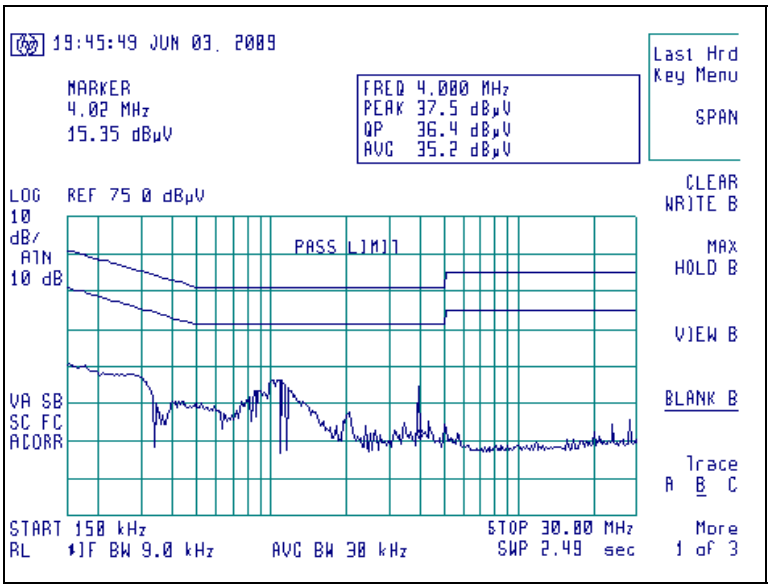


6.8 Screen Captures – Conducted Emissions Test

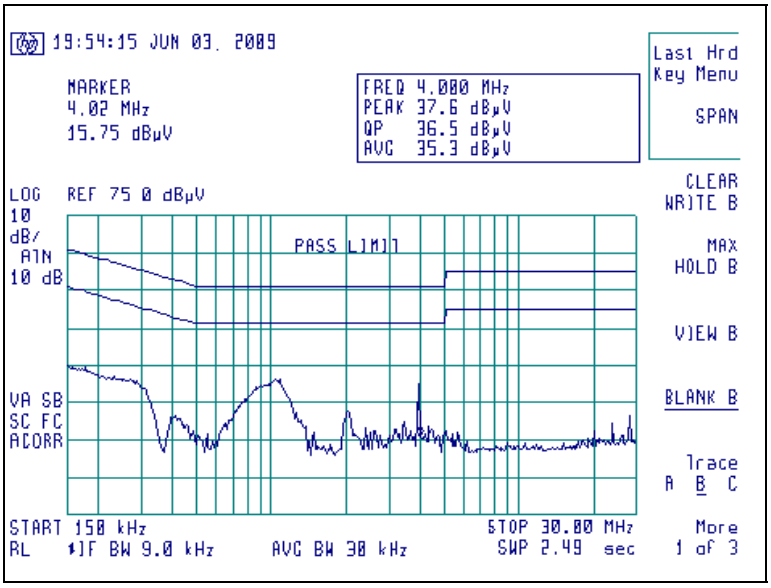
These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207 and RSS-Gen Section 7.2.2 Table 2.

The signature scans shown here are from channel 19, chosen as a good representative of channels.

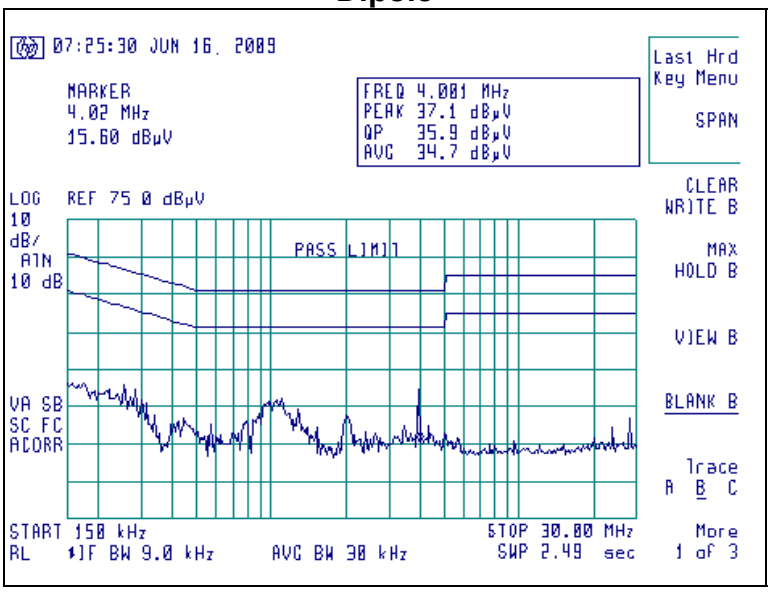
Channel 19, 2445 MHz, Line 1
PIFA



Channel 19, 2445 MHz, Line 2
PIFA



Channel 19, 2445 MHz, Line 1
Dipole



Channel 19, 2445 MHz, Line 2
Dipole

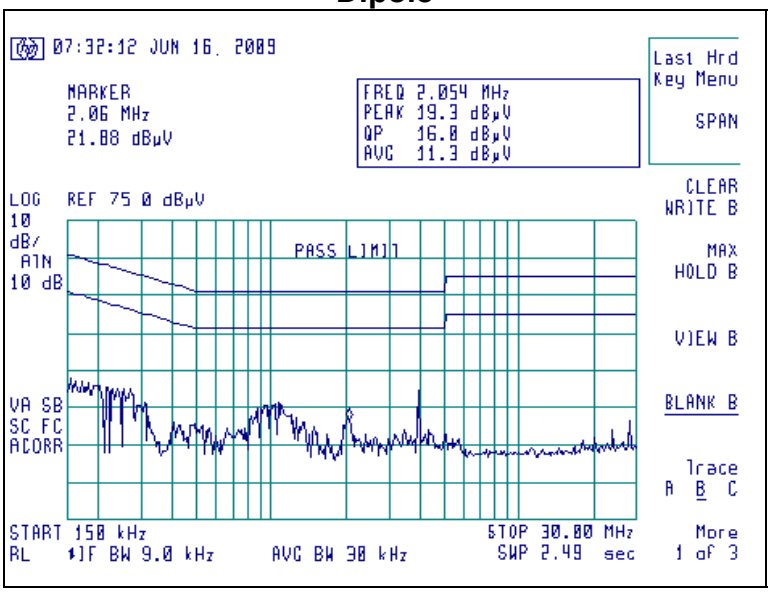


EXHIBIT 7. OCCUPIED BANDWIDTH: 15.247(a)(2)

7.1 Limits

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

7.2 Method of Measurements

Refer to ANSI C63.4 and FCC Procedures (March 23, 2005) 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.

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 HP E4446A spectrum analyzer. Correction factors for the RF cable were loaded onto the spectrum analyzer and the loss from the RF connector at the radio output was added on the analyzer as a negative gain offset.

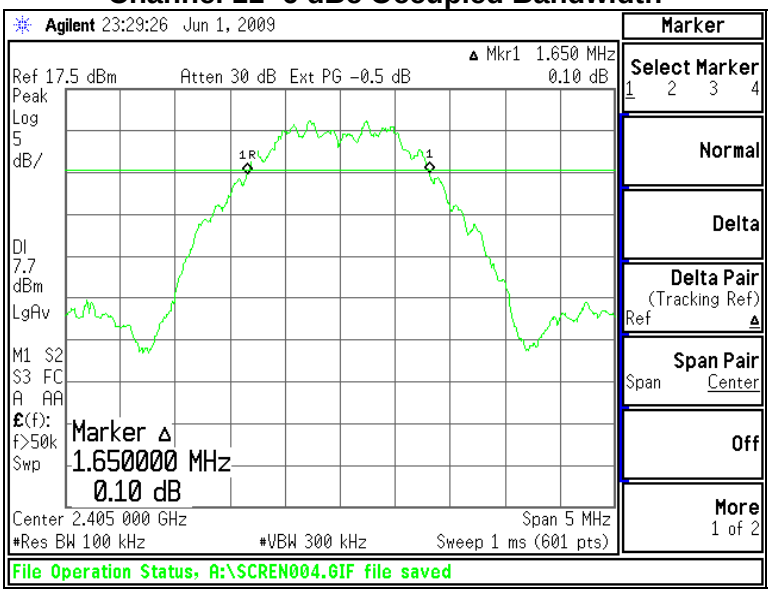
The EUT was configured to run in a continuous transmit, modulated mode. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

7.3 Test Data

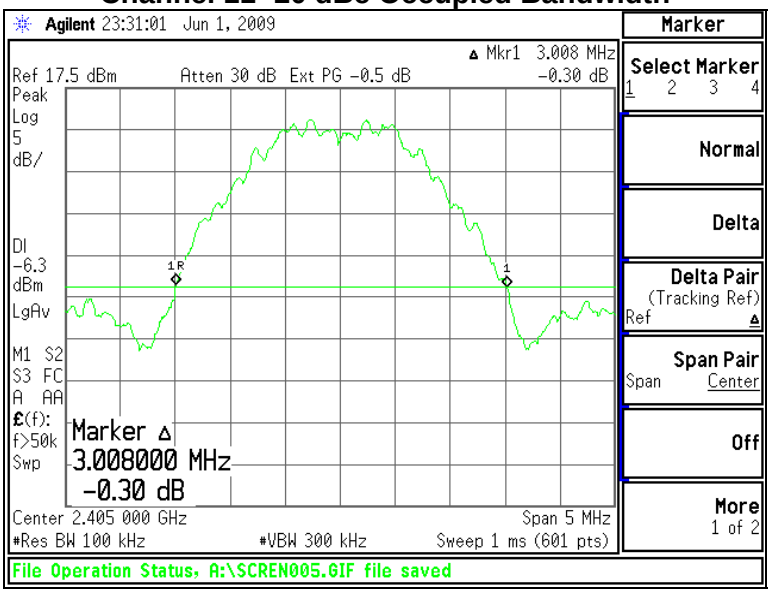
Channel	Center Frequency (MHz)	Measured -6 dBc Occupied Bandwidth (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc Occupied Bandwidth (kHz)
11	2405	1650	500	3008
14	2420	1642	500	2992
19	2445	1633	500	3025
24	2470	1650	500	2933
25	2475	1625	500	2942

7.3 Screen Captures - OCCUPIED BANDWIDTH

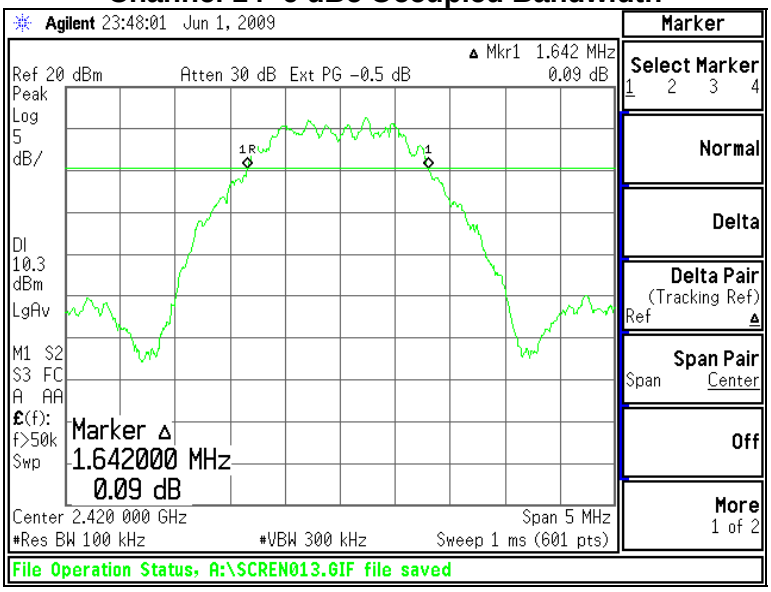
Channel 11 -6 dBc Occupied Bandwidth



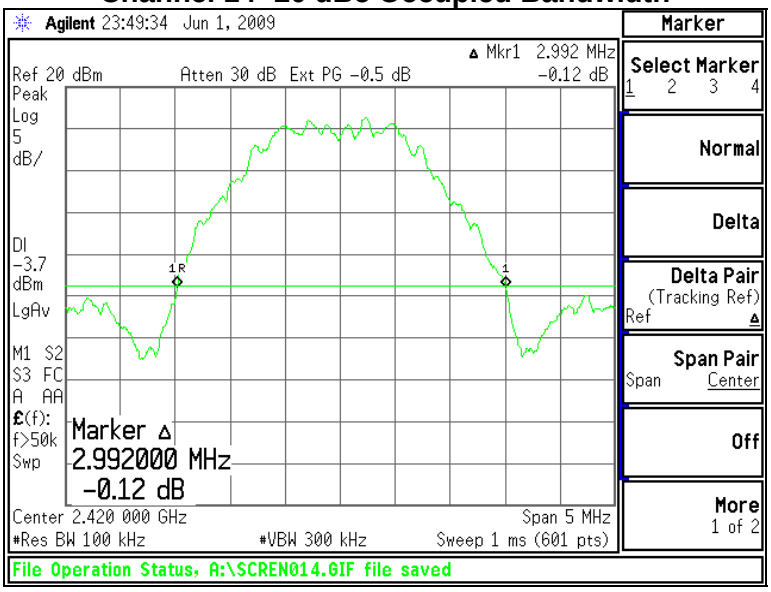
Channel 11 -20 dBc Occupied Bandwidth



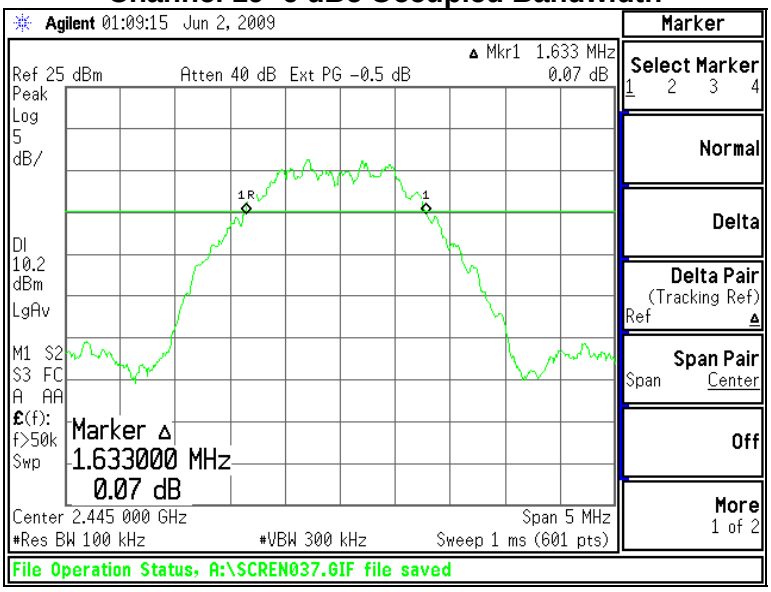
Channel 14 -6 dBc Occupied Bandwidth



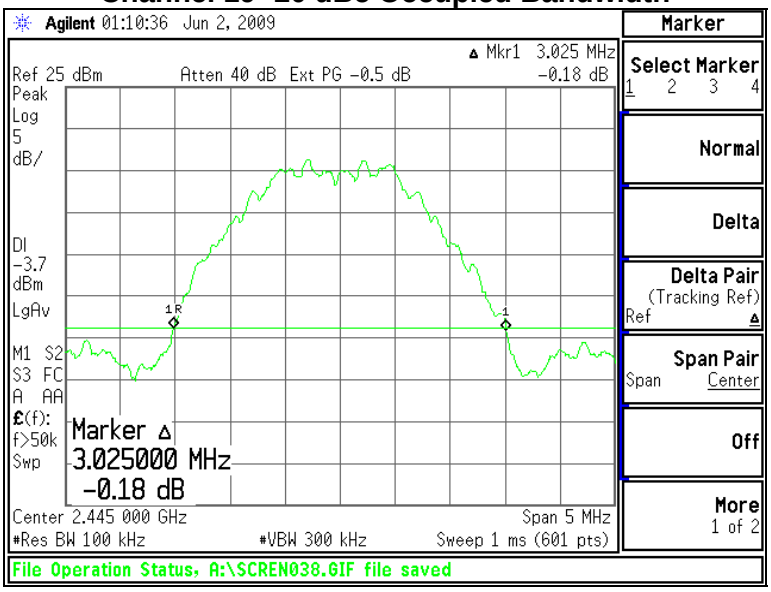
Channel 14 -20 dBc Occupied Bandwidth



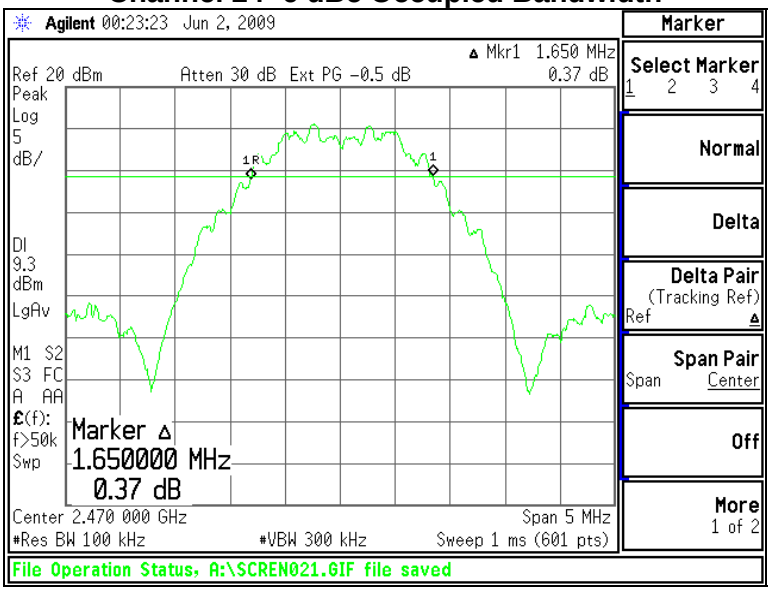
Channel 19 -6 dBc Occupied Bandwidth



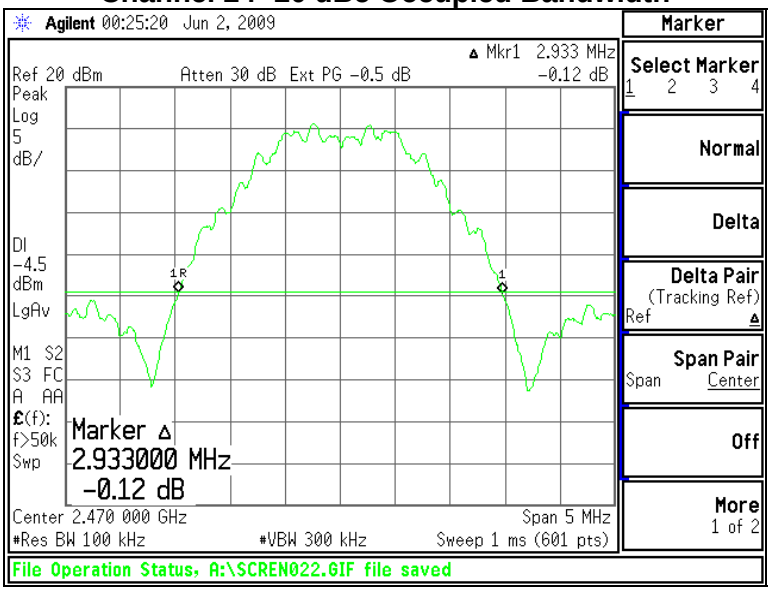
Channel 19 -20 dBc Occupied Bandwidth



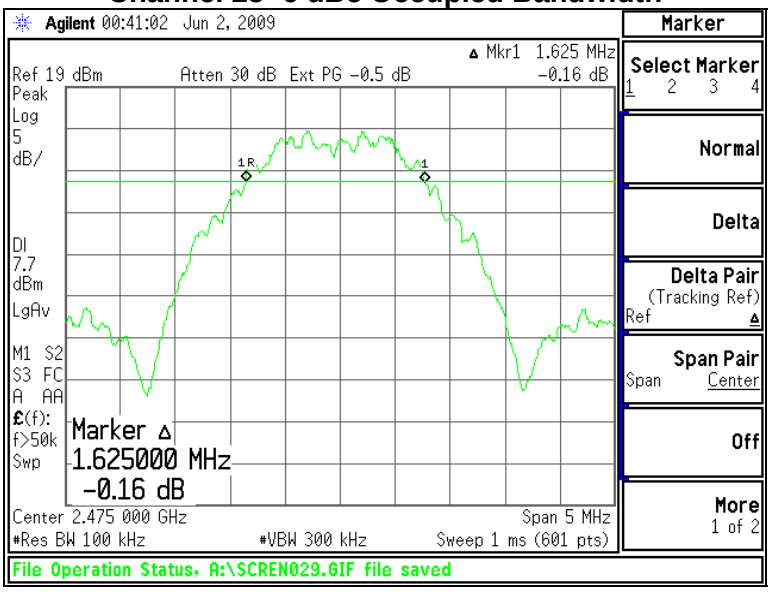
Channel 24 -6 dBc Occupied Bandwidth



Channel 24 -20 dBc Occupied Bandwidth



Channel 25 -6 dBc Occupied Bandwidth



Channel 25 -20 dBc Occupied Bandwidth

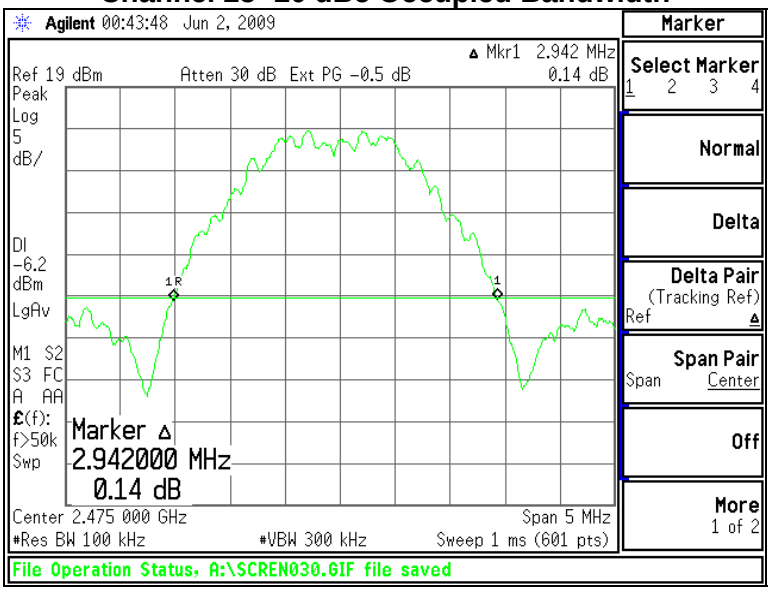


EXHIBIT 8. BAND-EDGE MEASUREMENTS

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. 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.

Lower Band-Edge Limit,

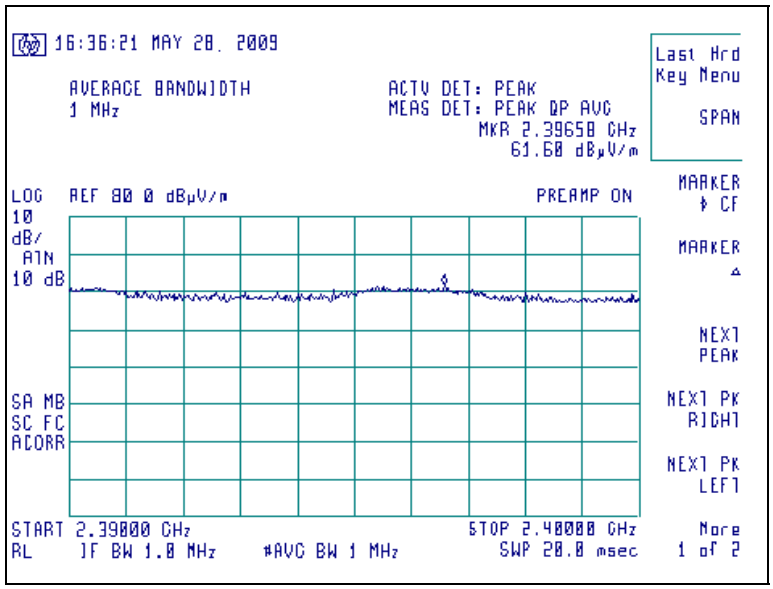
2.39 GHz = +54 dBµV/m at 3m

2.40 GHz = -20 dBc with respect to the peak fundamental radiated emissions.

Upper Band-Edge Limit,

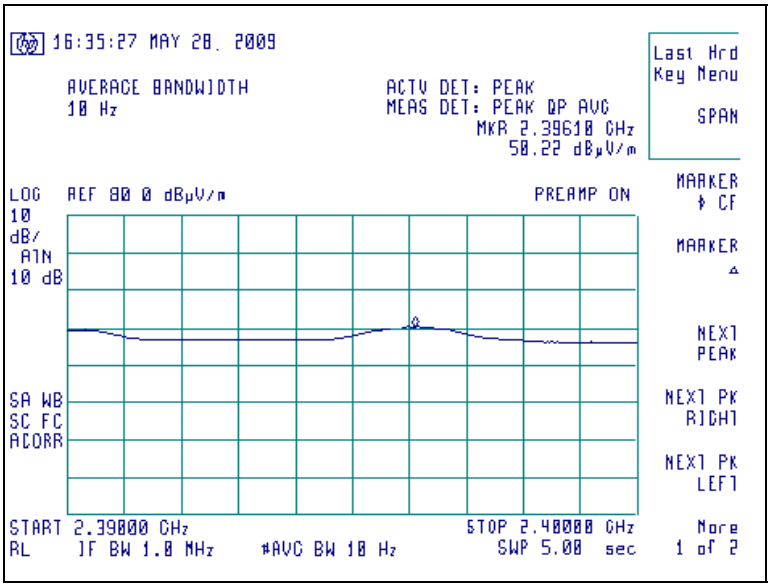
2.4835 GHz = + 54 dBµV/m at 3m.

Screen Capture Demonstrating Compliance at the Low Band-Edge
Channel 2405 Transmitting max power. Peak values
Inverted F Antenna

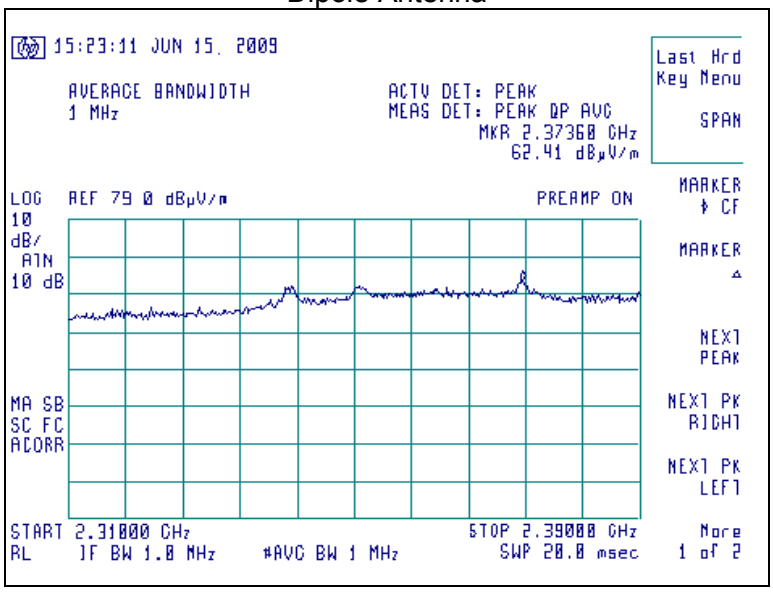


Screen Capture Demonstrating Compliance at the Low Band-Edge
Channel 2405 Transmitting max power. Video averaged values.]

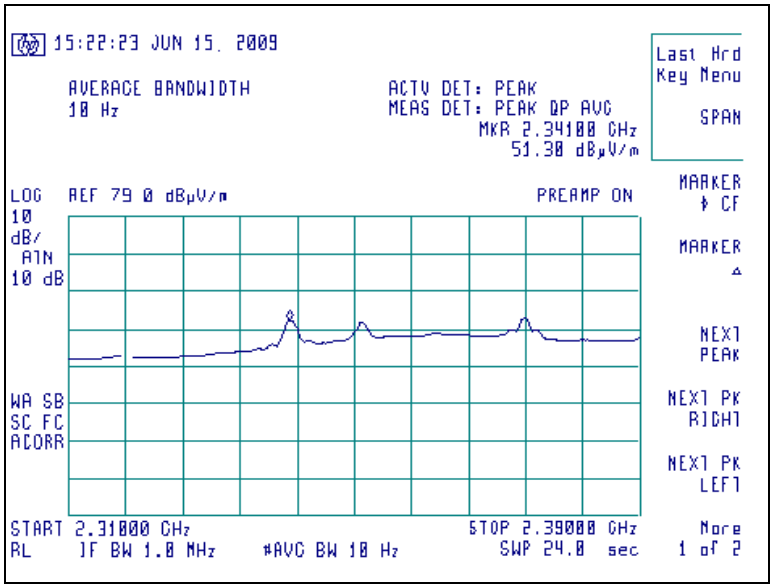
Inverted F Antenna



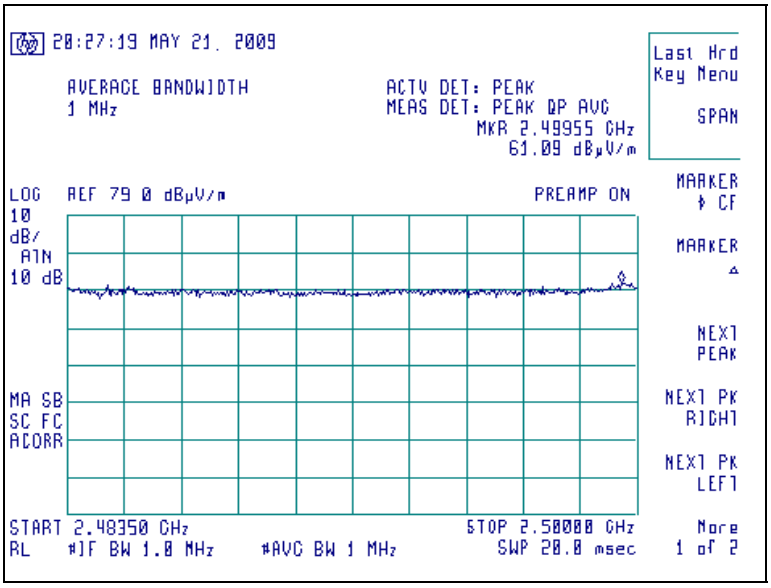
Screen Capture Demonstrating Compliance at the Low Band-Edge
Channel 2405 Transmitting max power. Peak values
Dipole Antenna



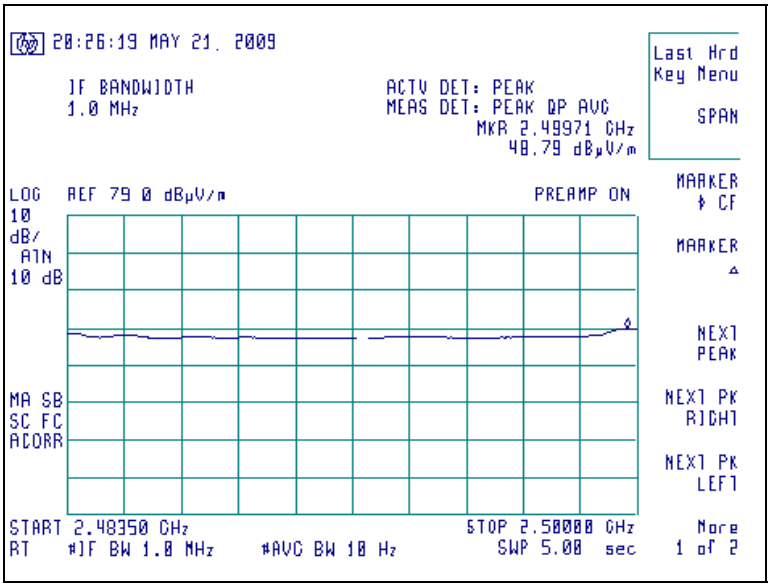
Screen Capture Demonstrating Compliance at the Low Band-Edge
Channel 2405 Transmitting max power. Video averaged values
Dipole Antenna



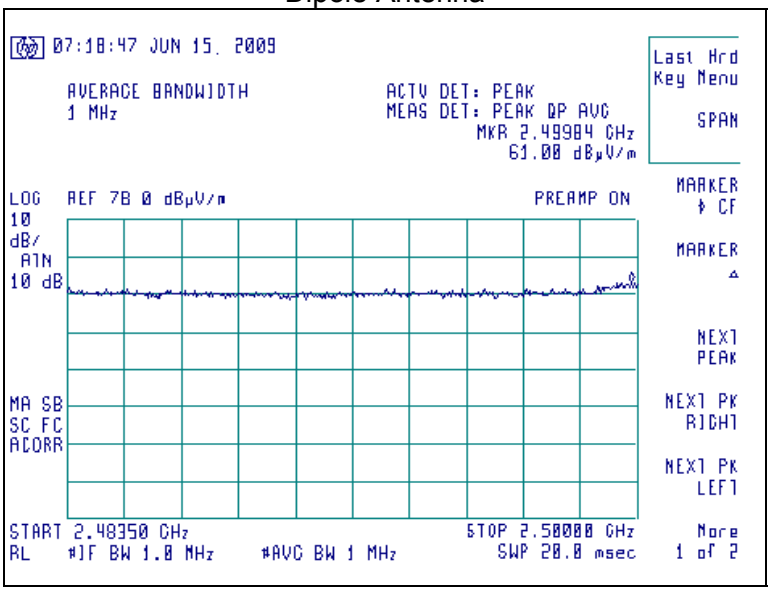
Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2470 Transmitting max power. Peak values.
Inverted F Antenna



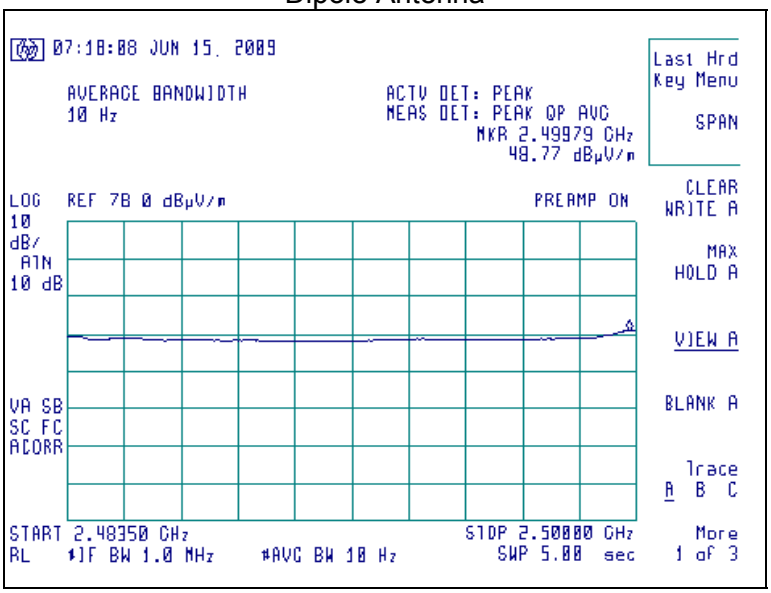
Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2470 Transmitting max power. Video averaged values.
Inverted F Antenna



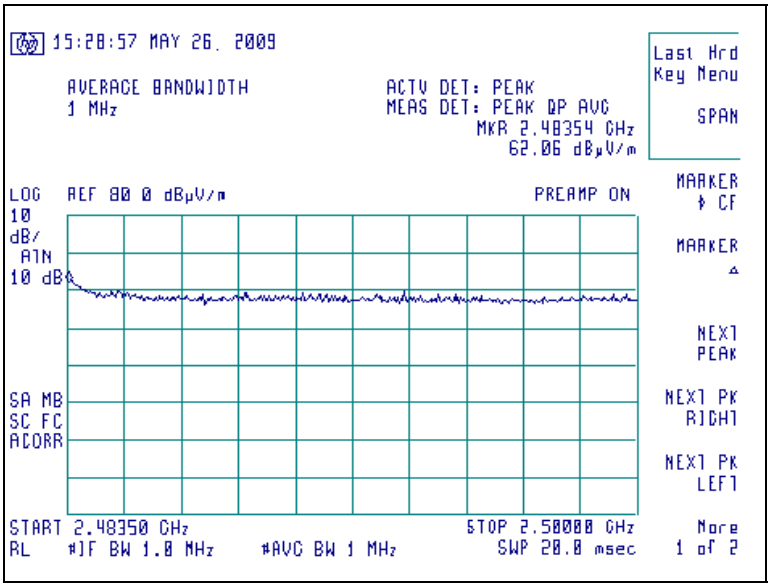
Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2470 Transmitting max power. Peak values.
Dipole Antenna



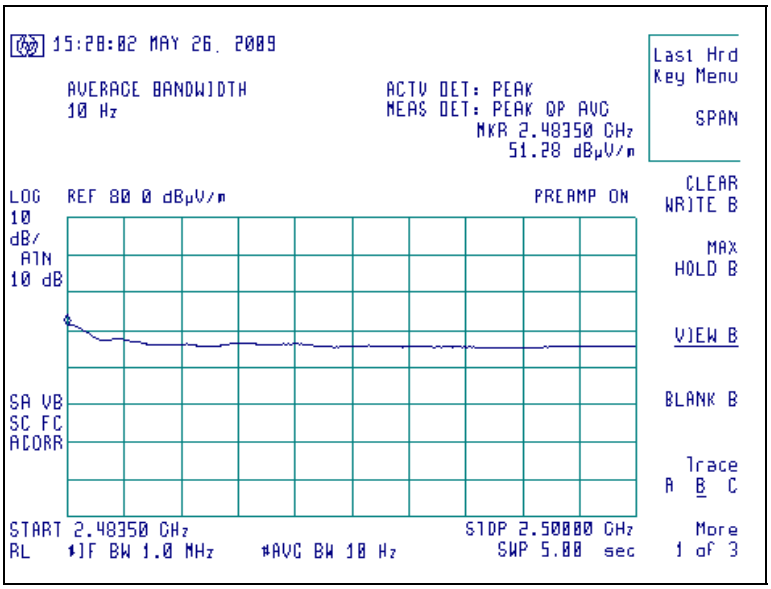
Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2470 Transmitting max power. Video averaged values.
Dipole Antenna



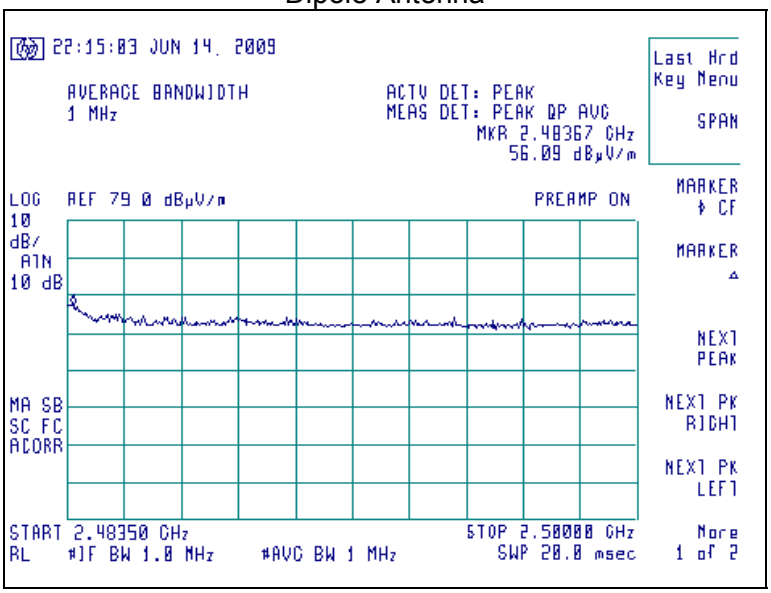
Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2475 Transmitting reduced power. Peak values.
Inverted F Antenna



Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2475 Transmitting reduced power. Video averaged values.
Inverted F Antenna



Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2475 Transmitting reduced power. Peak values.
Dipole Antenna



Screen Capture Demonstrating Compliance at the High Band-Edge
Channel 2475 Transmitting reduced power. Video averaged values.
Dipole Antenna

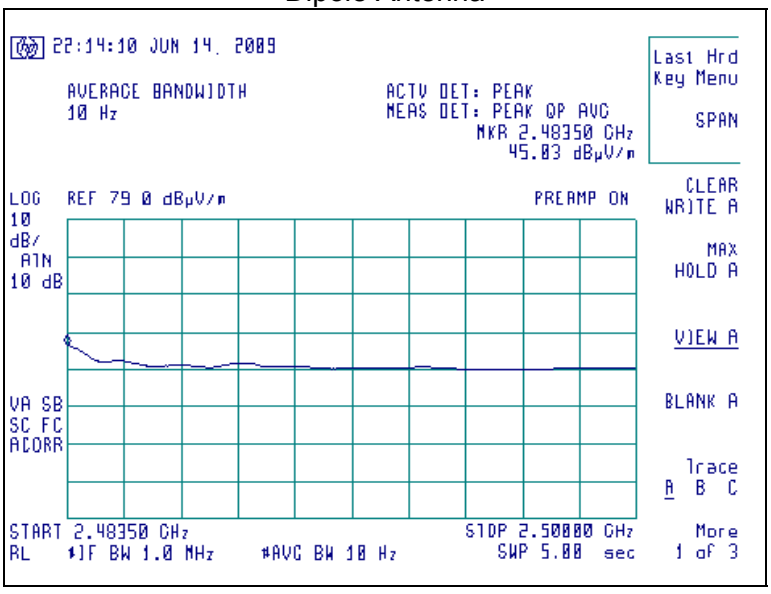


EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

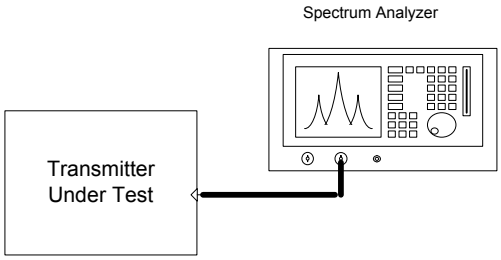
9.1 Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable. Correction factors for the RF cable were loaded onto the spectrum. The unit was configured to run in a continuous transmit mode. The spectrum analyzer was used with resolution bandwidth set to 3 MHz and video bandwidth set greater to or equal to that of the resolution bandwidth, and a span of 20 MHz, with measurements from a peak detector presented in the chart below.

9.2 Test Data

Transmitter Channel	Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	Calculated EIRP (dBm) (1)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
11	2405	17.12	21.95	30.0	36.0
14	2420	19.95	24.78	30.0	36.0
19	2445	19.70	24.53	30.0	36.0
24	2470	18.78	23.61	30.0	36.0
25	2475	17.42	22.25	30.0	36.0

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



Rated RF power output (in watts): 0.1 Watts

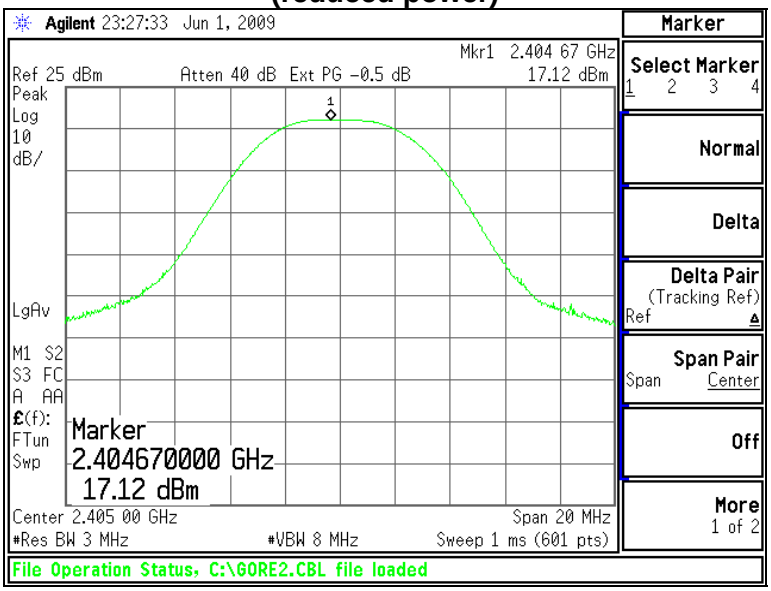
Measured RF Power Output (in Watts): 0.098 Watts
Declared RF Power Output (in Watts): 0.1 Watts

9.3 Test Equipment List

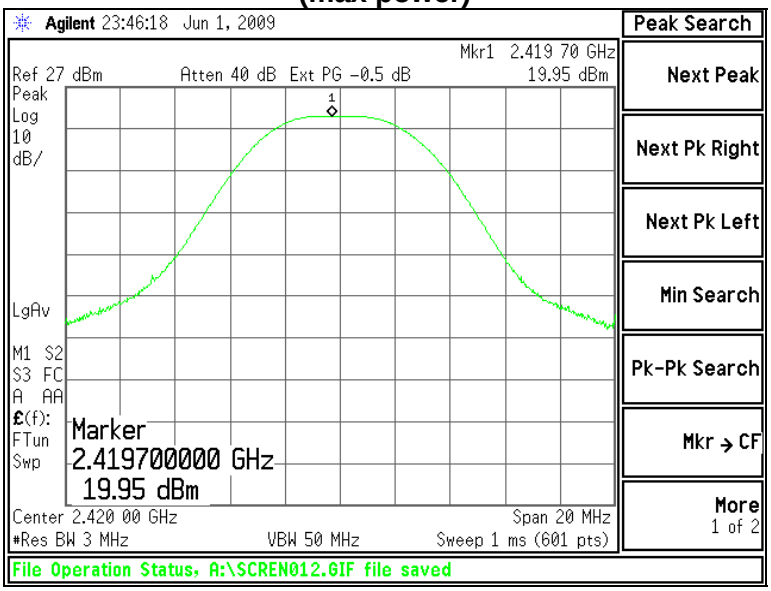
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

9.4 Screen Captures – Power Output (Conducted)

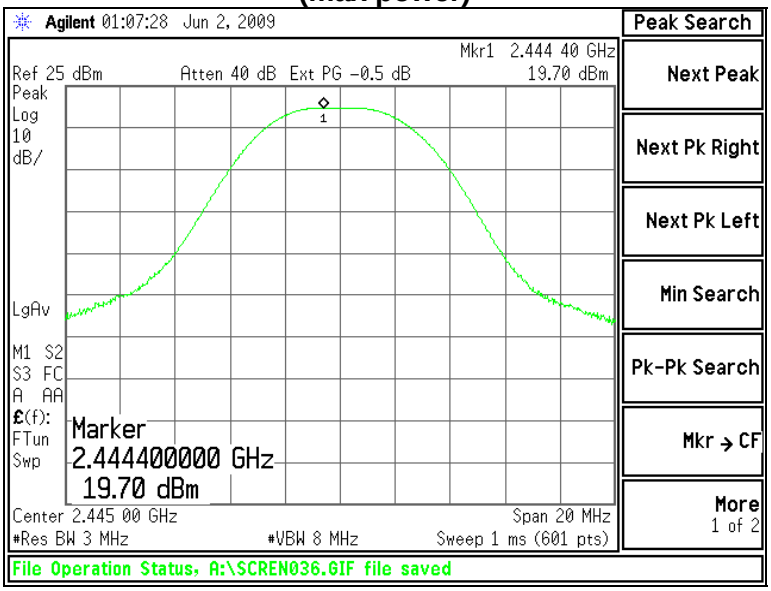
Channel 0: 2405 MHz
(reduced power)



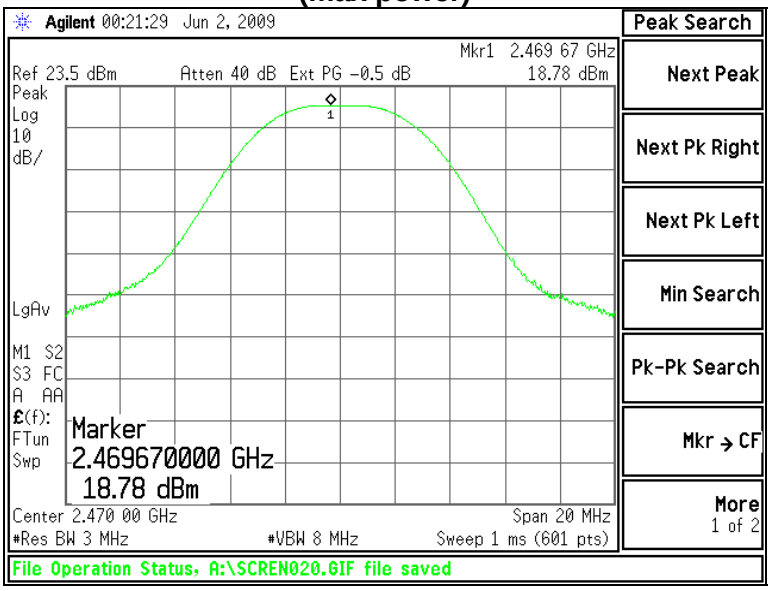
Channel 0: 2420 MHz
(max power)



Channel 7: 2445 MHz
(max power)



Channel 0: 2470 MHz
(max power)



Channel 15: 2475 MHz
(reduced power)

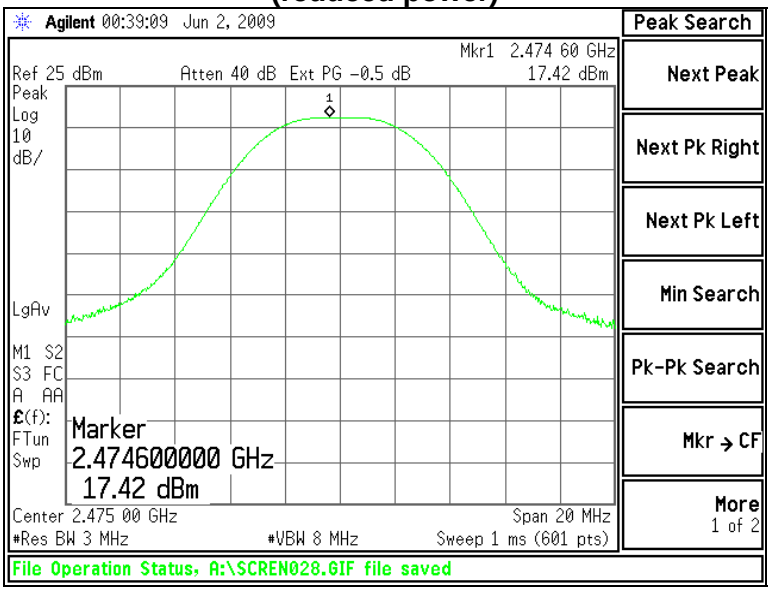


EXHIBIT 10. POWER SPECTRAL DENSITY: 15.247(e)

10.1 Limits

In accordance with FCC Part 15.247(e), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. 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 Agilent Analyzer. The resultant density was then corrected to a 3 kHz bandwidth.

10.2 Test Equipment List

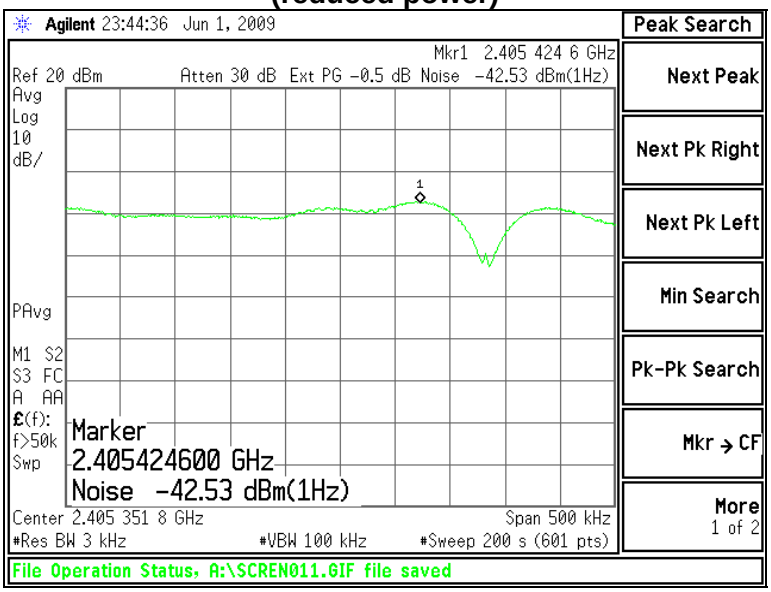
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

10.3 Test Data

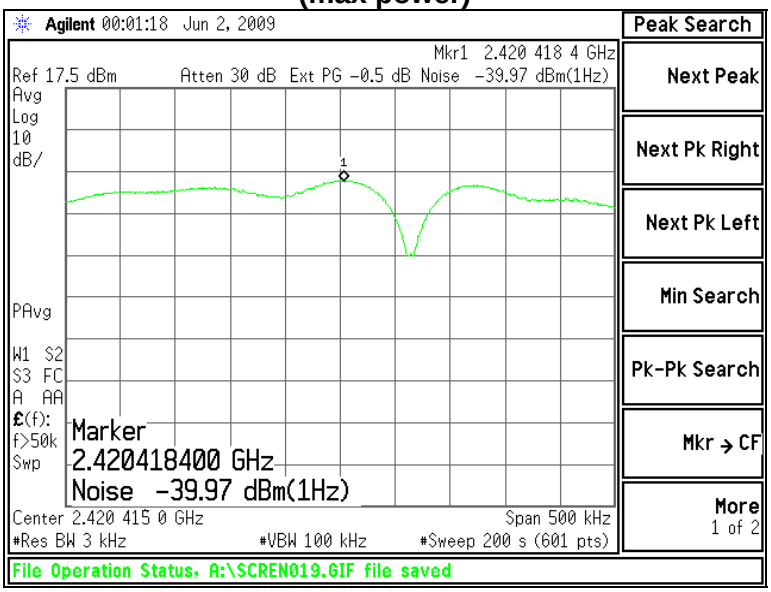
Channel	Center Frequency (MHz)	Measured Channel Power (dBm/1Hz)	3 kHz Correction (dB)	Corrected Power Measurement (dBm/3kHz)	Limit (dBm)	Margin
11	2405	-42.53	34.77	-7.76	8.0	15.8
14	2420	-39.97	34.77	-5.20	8.0	13.2
19	2445	-41.65	34.77	-6.88	8.0	14.9
24	2470	-41.85	34.77	-7.08	8.0	15.1
25	2475	-42.92	34.77	-8.15	8.0	16.2

10.4 Screen Captures – Power Spectral Density

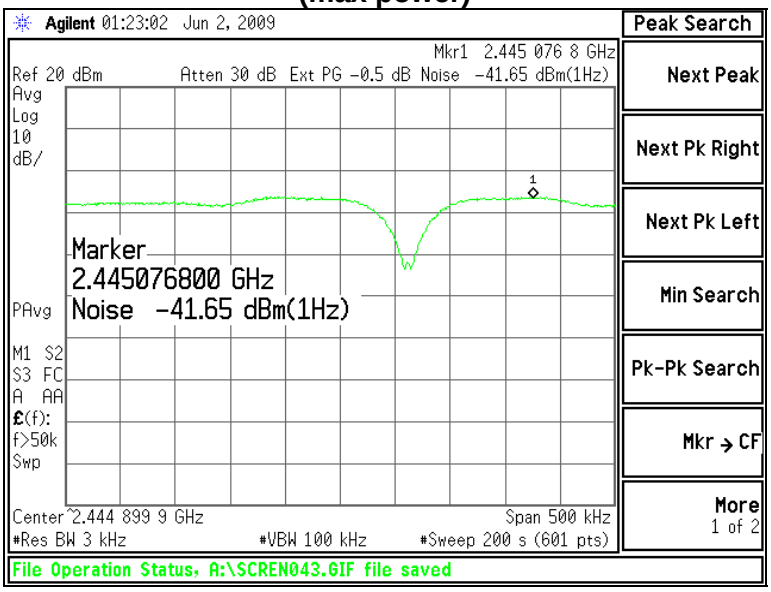
Channel 11: 2405 MHz
(reduced power)



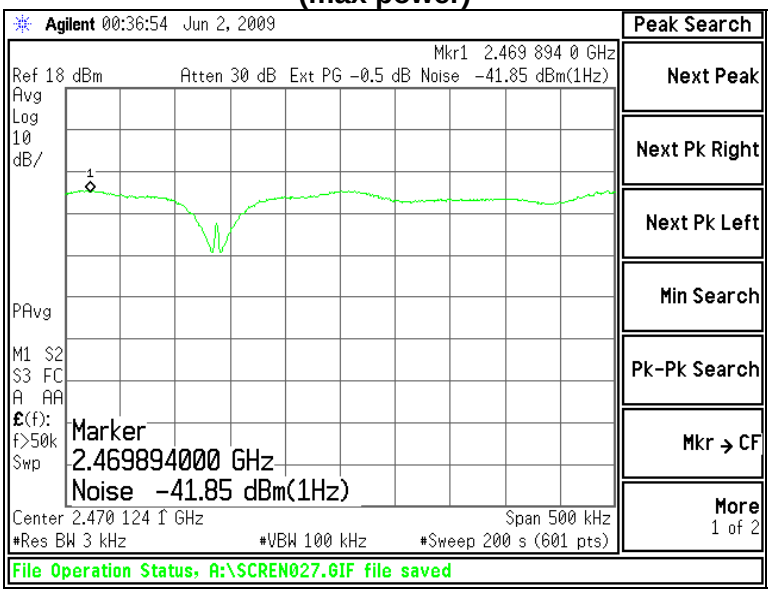
Channel 14: 2420MHz
(max power)



Channel 19: 2445 MHz
(max power)



Channel 24: 2470 MHz
(max power)



Channel 25: 2475 MHz
(reduced power)

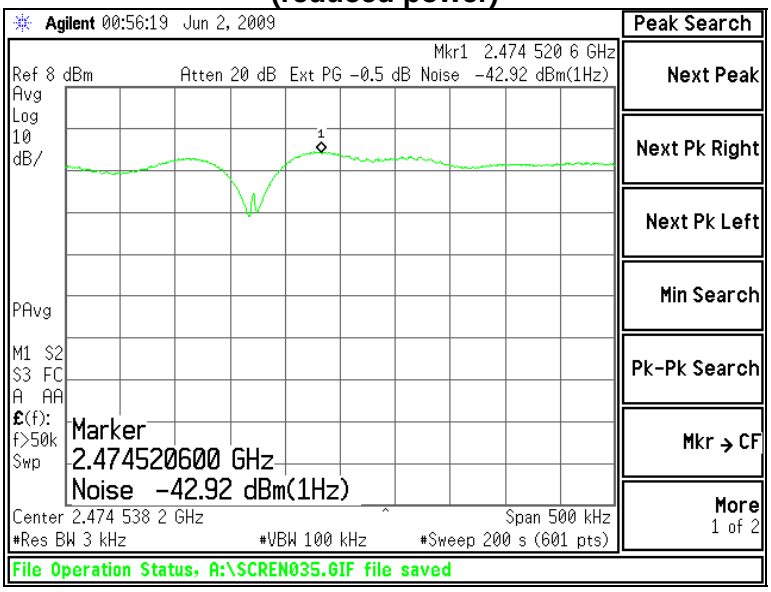


EXHIBIT 11. SPURIOUS CONDUCTED EMISSIONS: 15.247(d)

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 least 20 db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Data for radiated spurious emissions can be found in section 5.6 of this report

FCC Part 15.247(d) 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. The cable calibration file was loaded into the spectrum analyzer to compensate for the loss of the cable between the antenna port of the EUT to the spectrum analyzer. A Hewlett Packard model E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode. 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.

11.2 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	To 44 GHz

11.3 Test Data

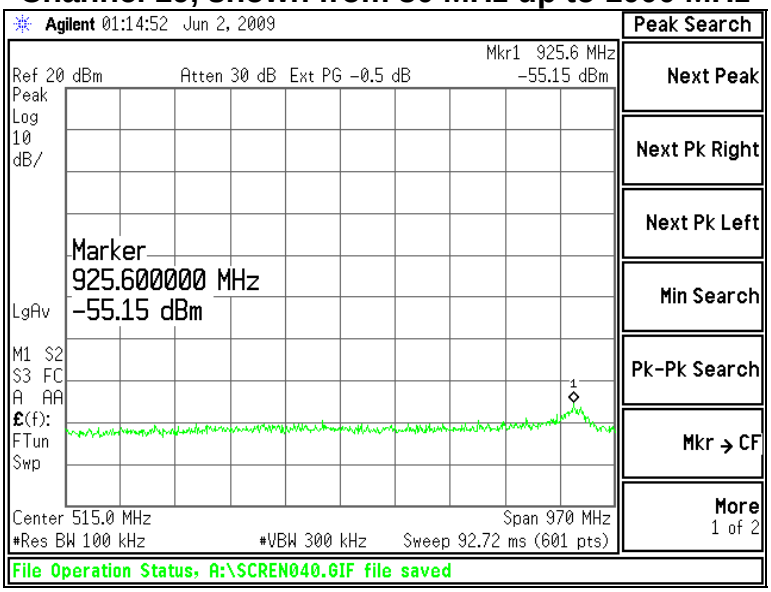
No significant emissions could be noted within -50 dBc of the fundamental level for this product.

	Channel 11	Channel 14	Channel 19	Channel 24	Channel 25
	Power in dBm				
Fundamental	12.25	14.27	14.31	14.95	12.19
2nd Harmonic	-68.02	-55.5	-54.74	-64.78	*Note 1*
3rd Harmonic	-52.96	-44.31	-44.14	-48.33	-57.16
4th Harmonic	-45.96	-40.88	-39.58	-43.96	-49.87
5th Harmonic	-57.47	-49.43	-49.7	-55.47	-58.81
6th Harmonic	*Note 1*	*Note 1*	*Note 1*	*Note 1*	*Note 1*
7th Harmonic	*Note 1*	*Note 1*	*Note 1*	*Note 1*	*Note 1*
8th Harmonic	*Note 1*	*Note 1*	*Note 1*	*Note 1*	*Note 1*
9th Harmonic	*Note 1*	*Note 1*	*Note 1*	*Note 1*	*Note 1*
10th Harmonic	*Note 1*	*Note 1*	*Note 1*	*Note 1*	*Note 1*

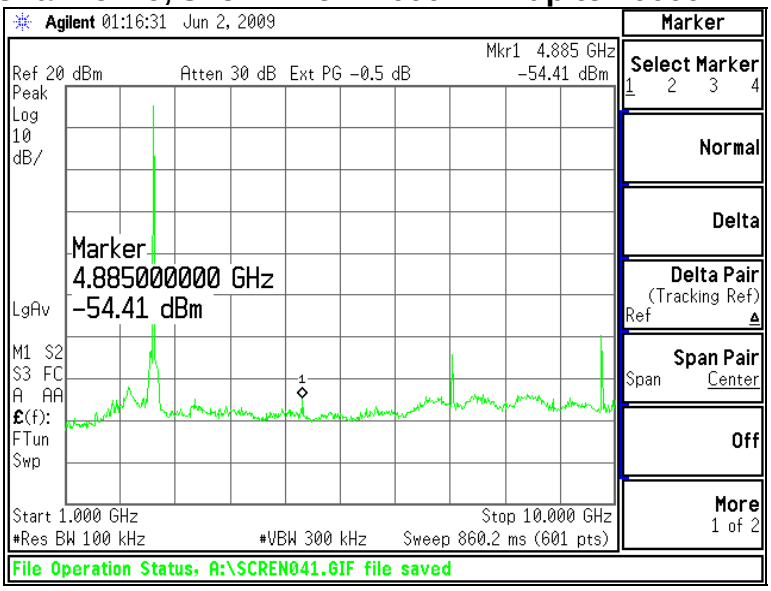
Notes:
(1) Measurement at system noise floor.

11.4 Screen Captures – Spurious Radiated Emissions

Channel 19, shown from 30 MHz up to 1000 MHz



Channel 19, shown from 1000 MHz up to 10000 MHz



Channel 19, shown from 10000 MHz up to 25000 MHz

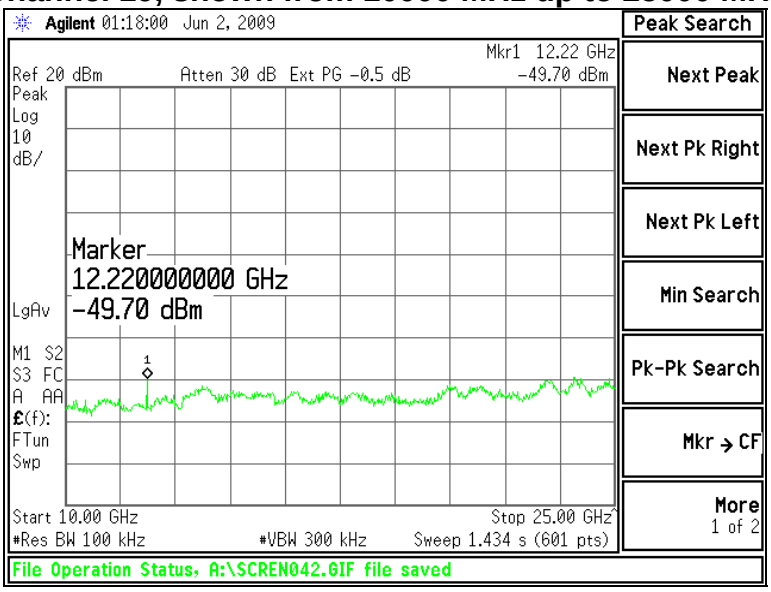


EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

The stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers. The transmitter of the EUT placed in modulated continuous transmit mode. Power was supplied by an external bench-type variable power supply, and the frequency of operation was monitored using the spectrum analyzer.

In this case, the EUT uses a single type operates on a nominal voltage of 3.3 VDC. The test was performed to measure the stability of the frequency and power at ±15% of the nominal operating voltage: 2.8V and 3.8V.

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=10Hz settings while the voltage was varied.

	DC/AC Voltage Source		
	2.8 VDC	3.3 VDC	3.8 VDC
Channel 14	2419.982792 (MHz)	2419.983234 (MHz)	2419.983254 (MHz)
Channel 19	2444.968671 (MHz)	2444.969221 (MHz)	2444.969205 (MHz)
Channel 24	2470.963260 (MHz)	2470.963995 (MHz)	2470.963795 (MHz)

The RF Power Output of the EUT was also monitored in a separate test, also using a Spectrum Analyzer with RBW=VBW=1 MHz setting while the voltage was varied.

	DC/AC Voltage Source		
	2.8 VDC	3.3 VDC	3.8 VDC
Channel 14	19.89 (dBm)	20.61 (dBm)	21.19 (dBm)
Channel 19	19.91 (dBm)	20.63 (dBm)	21.29 (dBm)
Channel 24	17.86 (dBm)	18.27 (dBm)	18.68 (dBm)

EXHIBIT 14. MPE CALCULATIONS

The following MPE calculations are based on a 1.8 centimeter inverted-F printed circuit board trace antenna, with a measured ERP of 119.65 dBµV/m, at 3 meters, and conducted RF power of +19.95 dBm as presented to the antenna. The calculated gain of the inverted F antenna, based on the ERP measurements is 4.83 dBi.

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:	19.95	(dBm)
Maximum peak output power at antenna input terminal:	98.855	(mW)
Antenna gain(typical):	4.83	(dBi)
Maximum antenna gain:	3.041	(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:	0.059804	(mW/cm^2)
Maximum allowable antenna gain:	17.1	(dBi)
Margin of Compliance at 20 cm =	12.2	dB

APPENDIX A

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 22-May-2009 Type Test : Radiated Emissions Job # : C-632

Prepared By: L Bott Customer : LSR Quote #: 309166

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	6/17/2008	6/17/2009	Active Calibration
2	AA 960056	Active Mon. Antenna	EMCO	3301B	9805-4003	9/23/2008	9/23/2009	Active Calibration
3	AA 960077	Bicon Antenna	EMCO	93110B	9702-2918	11/24/2008	11/24/2009	Active Calibration
4	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/20/2008	10/20/2009	Active Calibration
5	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	9/26/2008	9/26/2009	Active Calibration
6	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	9/23/2008	9/23/2009	Active Calibration
7	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	9/23/2008	9/23/2009	Active Calibration
8	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/26/2008	9/26/2009	Active Calibration
9	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro	WLA622-4	123001	6/10/2008	6/17/2009	Active Calibration
10	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/10/2008	6/10/2009	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 22-May-2009 Type Test : Conducted Emissions Job # : C-632

Prepared By: L Bott Customer : LSR Quote #: 309166

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960009	LISN	EMCO	3810/2NM	9509-1152	9/24/2008	9/24/2009	Active Calibration
2	AA 960031	Transient Limiter	HP	11947A	3107A01708	9/23/2008	9/23/2009	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 22-May-2009 Type Test : Occupied Bandwidth (6dB & 20dB) Job # : C-632

Prepared By: L Bott Customer : LSR Quote #: 309166

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/26/2008	9/26/2009	Active Calibration
2	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/10/2008	6/10/2009	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 22-May-2009 Type Test : Conducted Power Output Job # : C-632

Prepared By: L Bott Customer : LSR Quote #: 309166

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/26/2008	9/26/2009	Active Calibration
2	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/10/2008	6/10/2009	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 22-May-2009 Type Test : Power Spectral Density Job # : C-632

Prepared By: L Bott Customer : LSR Quote #: 309166

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/26/2008	9/26/2009	Active Calibration
2	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/10/2008	6/10/2009	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 22-May-2009 Type Test : Spurious Emissions Job # : C-632

Prepared By: L Bott Customer : LSR Quote #: 309166

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/26/2008	9/26/2009	Active Calibration
2	AA 960144	Phaseflex	Gore	EkD01D010720	5800373	6/10/2008	6/10/2009	Active Calibration

Appendix B

TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003		
CISPR 11	2009-05		
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	2006-03	2006-09	2007-07
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	2001	1998	2001
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2007-08		
EN 61000-4-8	1993	1994-01	
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	2007-02		
ICES 003	2004-02		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005-11	2008-03	
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2008-12		
IEC 61000-4-3	2008-04	incl in 2006	
IEC 61000-4-4	2004-07		

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-06		
IEC 61000-4-8	2001-03		
IEC 61000-4-11	2004-03		
IEC 61326-1	2006-06		
ISO 14082	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 5-13-09

Appendix C

Uncertainty Statement

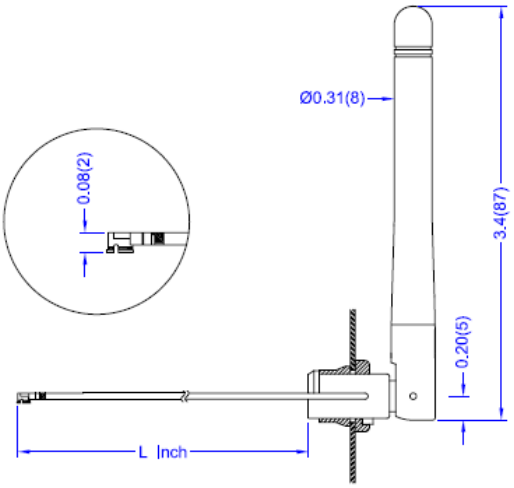
This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

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

Antenna Specification(s)



Electrical Properties:

Frequency Range:	2.4~2.5 GHz
Impedance:	50Ω nominal
VSWR:	<2.0:1
Gain:	*2.0 dBi
Radiation:	Omni
Polarization:	Vertical

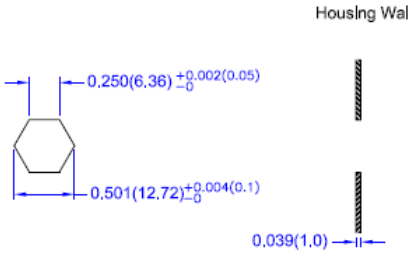
*Gain is measured under no flying lead.

Mechanical Properties:

Cable:	1.37mm dia. Coax
Cable Length:	Standard length L=6 Inches or to be specified.
Connector:	IPEX MHF micro coaxial connector Plug(female) 20278-**1R-32 fit for IPEX: 20279-001E-01; Hirose: CL331-0471-0-10
Material:	
Overmold:	Polyurethene(Black); BASF
Bushing:	Polycarbonate(Black); Bayer
Swivel:	Polyurethene(Black); BASF and Polycarbonate(Black); Bayer
Operation Temp.:	-20°C to +65°C
Storage Temp.:	-30°C to +75°C

TITLE	2.4GHz flying lead panel click antenna - 131 model	DATE	SHEET
		123004	1 of 4
UNIT	DWG. NO.	S131CL - L - PX - 2450S	
In.(mm)			
SCALE			
None			

NEARSON
http://www.nearson.com

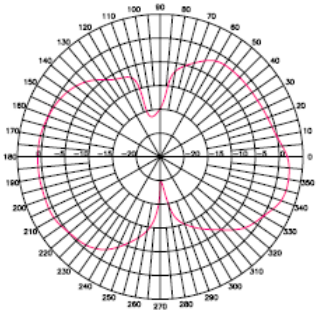


Recommended Mounting - Hole Dimensions

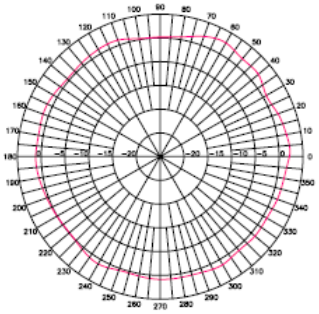
L (Inch)	Attenuation (dB)
3"	0.23 dB
4"	0.30 dB
5"	0.38 dB
6"	0.45 dB
8"	0.60 dB
10"	0.75 dB
12"	0.90 dB

Flying Lead Cable Length v.s. Attenuation Table
1.37mm Cable Measured @ 2.45GHz

E-Plane Pattern @ 2.45GHz



H-Plane Pattern @ 2.45GHz



TITLE	2.4GHz flying lead panel click antenna - 131 model	DATE 123004	SHEET 2 of 4
UNIT	DWG. NO.	S131CL - L - PX - 2450S	
In.(mm)			
SCALE			
None			

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http://www.nearson.com