LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
Testing Cert. 1255.01
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TEST REPORT # 309308
LSR Job #: C-720

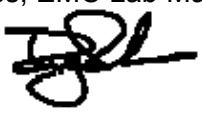
Compliance Testing of:
Si-Flex 900 MHz

Test Date(s):
October 10- November 9, 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
Industry Canada (IC) RSS 210 Annex 8
Digital Modulation Transmitters (DTS) Operating in the Frequency Band 902-928 MHz

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

Signature:  Date: November 13, 2009

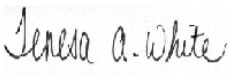
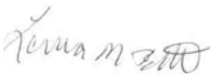
Test Report Reviewed by:	**Tested by:**
Teresa A. White, Quality Manager	Laura Bott, EMC Engineer
Signature: 	Signature: 
Date: November 13, 2009	Date: November 20, 2009

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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 and with the procedures denoted in CFR 47 FCC 15.247.
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	2008	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:	Si-Flex
Model Number:	LS900-SI-02
Serial Number:	4, 5, 44, 83, 90, 95

2.3 ASSOCIATED ANTENNA DESCRIPTION

Wire Whip Antenna with a max gain of 3.85 dBi.

900 MHz ISM Band Straight Nearson Antenna – 467 model with a max gain of 5.34 dBi.

Note: The gain was calculated based off radiated fundamental measurements taken over a reflective ground plane.

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

EUT Frequency Range (in MHz)	906-924 MHz
RF Power in Watts	
Minimum:	0.309 W
Maximum:	0.325 W
Conducted Output Power (in dBm)	25.13 dBm
Field Strength at 3 meters	Wire antenna: 124.21 dBµV/m (906 MHz) Dipole:125.7 dBµV/m (914 MHz) Chip: 121.4 dBµV/m (914 MHz)
Occupied Bandwidth (99% BW)	1710 kHz, 906 MHz
Type of Modulation	BPSK
Emission Designator	1M710G1D
EIRP (in mW)	1114.29 mW
Transmitter Spurious (worst case) at 3 meters	79.9 dBµV/m – wire whip antenna
Receiver Spurious (worst case) at 3 meters	28.7 dBµV/m (945.0 MHz) – wire whip antenna
Stepped (Y/N)	N
Step Value:	N/A
Frequency Tolerance %, Hz, ppm	100 ppm
Microprocessor Model # (if applicable)	ATXMega256A3
Antenna Information	
Type - Detachable/non-detachable	Wire – Non detachable External Dipole – Detachable Chip – Non detachable
Gain (in dBi)[Note 1]	Wire antenna: 3.85 dBi (906 MHz) Dipole:5.34 dBi (906 MHz) Chip: 1.04 dBi (914 MHz)
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	RSS 210
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	☐ Portable ☒ Mobile (per TS)

Note 1: The antenna gain was calculated from the following equation:
$G_{antenna}$ = Fundamental Field strength (measured at 3 meters over a reflective ground plane) dBµV/m – conducted power – 95.23 dBµV/m

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: 3 m
- RF Value:2.2168 ☐ V/m ☐ A/m ☒ W/m^2
  ☐ Measured ☐ Computed ☒ Calculated

2.5 PRODUCT DESCRIPTION

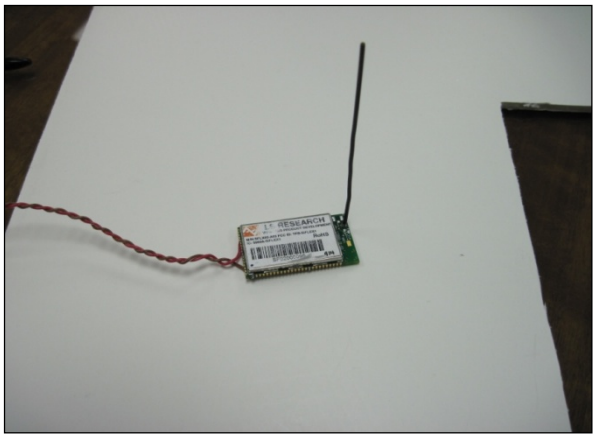
The LS Research SiFLEX02 module is a 900 MHz radio transceiver. The module supports a simple network protocol. The module contains the embedded firmware implementing the radio physical and data layers.

The module contains a direct sequence spread spectrum transceiver operating in the 902 - 928 MHz ISM band. The system is based on the IEEE 802.15.4-2006 standard, with 10 channels spaced at 2 MHz intervals in the ISM band. The system can operate in several modes. 1) BPSK modulation with each bit mapped by a 15-chip PN sequence at a chip rate of 600 kcps, a symbol rate of 40 ksps, and a bit rate of 40 kbps. The chip sequences are modulated onto the carrier using BPSK modulation with raised cosine pulse shaping (roll-off factor = 1). 2) OQPSK modulation with each symbol mapped by a 16-chip PN sequence at a chip rate of 1000 kcps, a symbol rate of 62.5 ksps, and a bit rate of 250 kbps. At the chip rate of 1000 kcps, half-sine pulse shaping is used. 3) OQPSK modulation with each symbol mapped by a 4-chip PN sequence at a chip rate of 1000 kcps, a symbol rate of 250 ksps, and a bit rate of 1Mbps. At the chip rate of 1000 kcps, half-sine pulse shaping is used. The module transmits with an output power of 250 milliwatts (+24 dBm) into a 3.2" long, 22 AWG wire monopole or an external dipole antenna.

PHOTOS

External Dipole

Wire Whip Antenna



Chip Antenna

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 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).		

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)**

Only BPSK was tested, as it was assumed the BPSK would have exhibit the worst case transmission characteristics.

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), 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

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2009.

Measurements at frequencies 30 MHz – 4 GHz where taken when the EUT was placed on an 80 cm 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. Three units were tested; each was programmed to a single channel, using internal proprietary firmware.

The test sample was operated on one of three standard channels: the lowest (906 MHz), middle (914 MHz), and highest (924 MHz), 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 30-10000 MHz. Measurements from 30 - 3000 MHz were performed a 3 meter Semi-Anechoic, FCC listed Chamber. Measurements from 3000-10000 MHz were taken at a 1 meter separation distance. 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 10 GHz. In transmit mode, the horn antenna was used alone between 1 GHz and 1.75 GHz, and a high pass filter was used with a low noise amplifier for frequencies above 1.75 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 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 Agilent E4445A Spectrum Analyzer. The resulting correction factors and the cable loss factors from these calibrations were entered into the Agilent E4445A Spectrum Analyzer database. As a result, the data taken from the Agilent E4445A Spectrum Analyzer 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.

For measurements 30 MHz – 3 GHz, the Agilent E4445A Spectrum Analyzer was used, and an Agilent E4446A Spectrum Analyzer was utilized for measurements 3 GHz – 10 GHz. An EMCO horn antenna was used for measurements between 1 GHz and 10 GHz (accompanied by a preamp for measurements over 4 GHz).

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 for a DTS transmitter. 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	-
960-24,000	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 10,000 MHz

500μV/m or 54.0 dB/μV/m at 3 meters

54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

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

5.6 RADIATED EMISSIONS TEST

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.247(DTS)
RSS 210 A8, sections 2.2, 2.6 and 2.7
Frequency Range Inspected: 30 MHz to 10000 MHz

Manufacturer:	LS Research, LLC						
Date(s) of Test:	October 10- November 9, 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 type 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	

5.6.1 Transmit Mode: Wire Antenna Unit

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

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
53.7	1.00	0	17.16	10.87	40.0	29.1	Horizontal	Vertical
119.2	1.00	0	19.00	12.31	43.5	31.2	Vertical	Vertical
188.9	1.00	0	21.66	15.89	43.5	27.6	Vertical	Flat
264.1	1.00	0	27.54	22.03	46.0	24.0	Horizontal	Flat
676.2	1.42	300	45.08	39.05	46.0	7.0	Horizontal	Flat

The table below shows the radiated measurements of the fundamental frequencies on channels 1, 5, and 10:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
906	1.16	116	122.2	122.1	125.0	2.9	Horizontal	Vertical
914	1.37	46	124.3	124.2	125.0	0.8	Horizontal	Side
924	1.41	259	123.5	123.4	125.0	1.7	Horizontal	Flat

Radiated Emissions Data Chart – Wire Antenna Unit (continued)

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

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1812	1.14	327	76.8	75.9	102.1	26.2	Vertical	Flat
2718	1.25	36	51.2	46.1	54.0	7.9	Horizontal	Side
3624	1.03	52	59.4	54.6	63.5	8.9	Vertical	Vertical
4530	1.02	321	53.6	47.1	63.5	16.4	Horizontal	Side
5436	1.07	346	53.0	45.4	63.5	18.1	Vertical	Side
6342	1.02	327	46.5	36.4	111.6	75.2	Horizontal	Side
7248	1.13	151	50.0	38.6	111.6	73.0	Horizontal	Vertical
8154	1.05	99	48.8	38.2	63.5	25.3	Vertical	Flat
9060	1.04	304	57.8	50.5	63.5	13.0	Vertical	Flat

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 5:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1828	1.15	245	82.4	79.9	104.2	24.3	Vertical	Flat
2742	1.27	45	49.0	43.2	54.0	10.8	Horizontal	Side
3656	1.36	317	55.4	51.7	63.5	11.8	Horizontal	Side
4570	1.02	269	52.8	46.1	63.5	17.4	Horizontal	Vertical
5484	1.04	230	50.0	41.4	113.7	72.3	Horizontal	Vertical
6398	1.07	187	47.7	37.2	113.7	76.5	Horizontal	Vertical
7312	1.07	269	51.1	41.7	63.5	21.8	Vertical	Flat
8226	1.07	305	54.0	46.0	63.5	17.5	Vertical	Flat
9140	1.19	19	52.3	43.6	63.5	19.9	Vertical	Side

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 10:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1848	1.10	175	81.7	79.3	103.4	24.0	Vertical	Flat
2772	1.00	35	50.1	44.6	54.0	9.4	Horizontal	Vertical
3696	1.00	153	54.9	49.7	63.5	13.8	Vertical	Vertical
4620	1.11	243	49.8	42.2	63.5	21.3	Horizontal	Vertical
5544	1.05	322	51.0	43.4	112.9	69.5	Horizontal	Side
6468	1.03	219	49.5	40.6	112.9	72.2	Horizontal	Vertical
7392	1.06	49	48.8	38.9	63.5	24.6	Horizontal	Side
8316	1.07	301	57.2	51.0	63.5	12.5	Horizontal	Vertical
9240	1.03	304	56.0	49.6	112.9	63.3	Vertical	Flat

Notes:

1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
2) Measurements above 3 GHz were made at 1 meters of separation from the EUT.
3) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.

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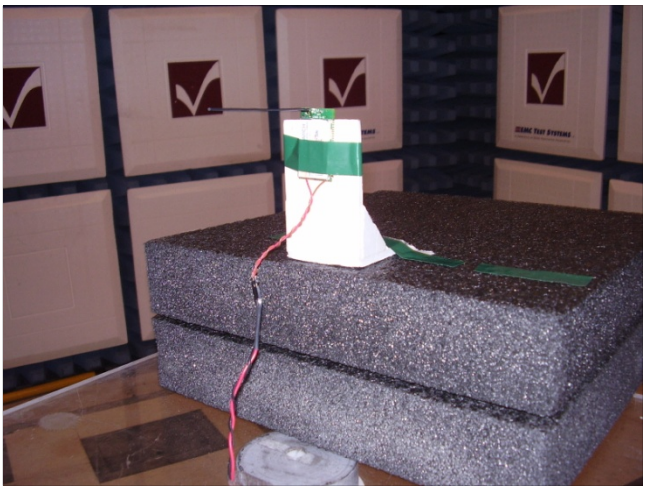
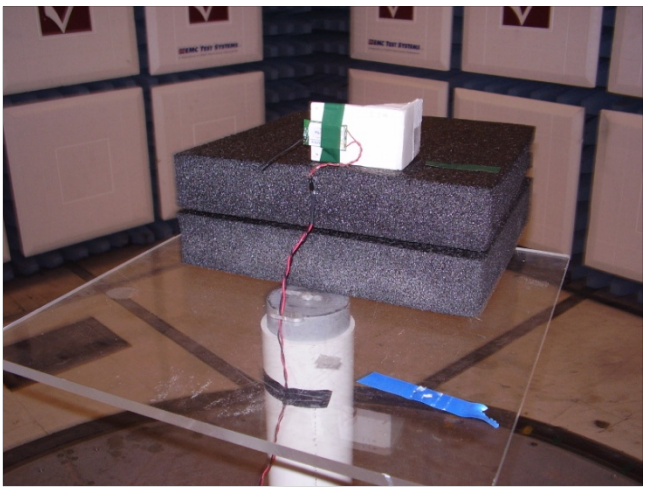
Test Setup Photo(s) – Radiated Emissions Test – Wire Antenna Unit

Vertical Orientation



Side Orientation



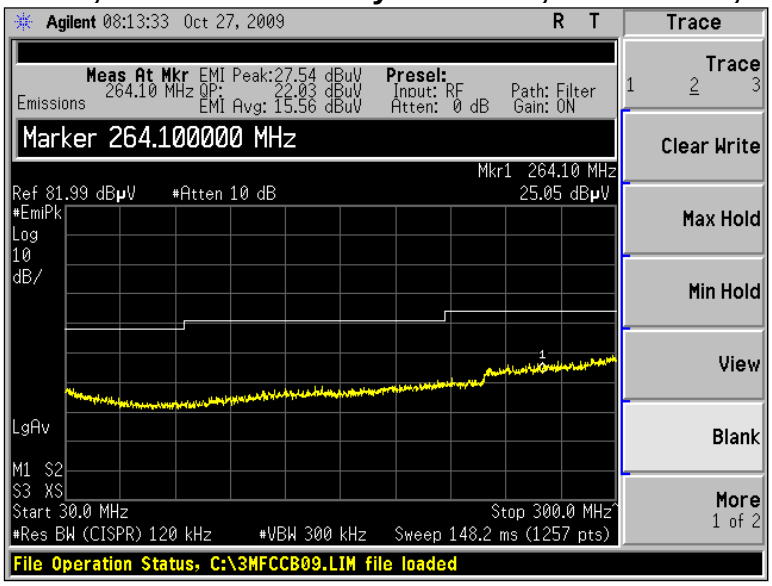
Flat Orientation

Screen Captures - Radiated Emissions Test – Wire Antenna Unit

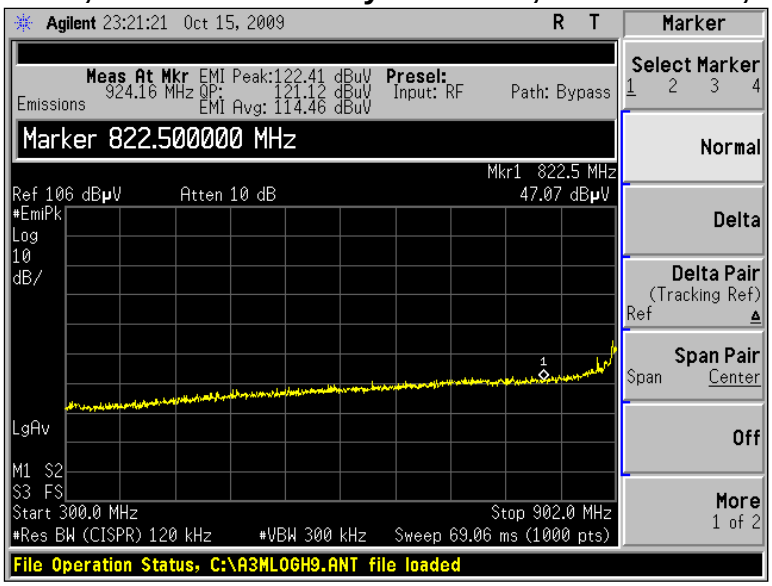
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 6, or 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 6, Antenna Vertically Polarized, 30-300 MHz, at 3m

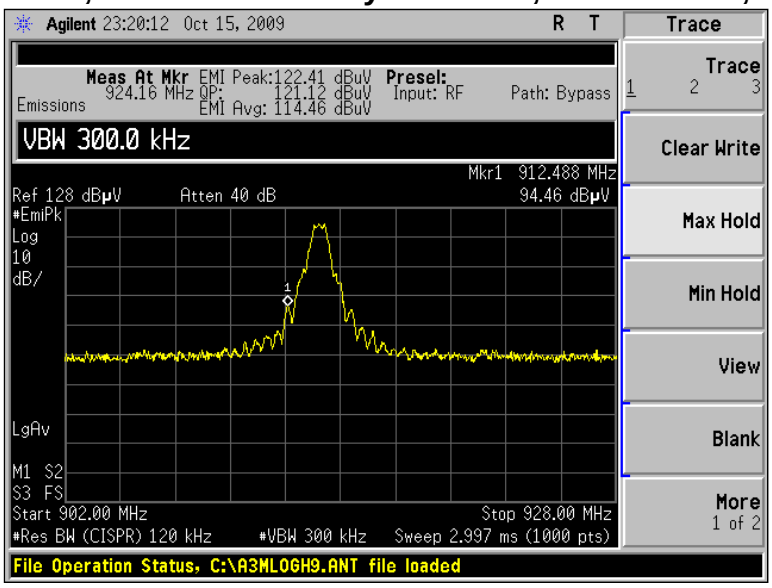


Channel 6, Antenna Vertically Polarized, 300-902 MHz, at 3m

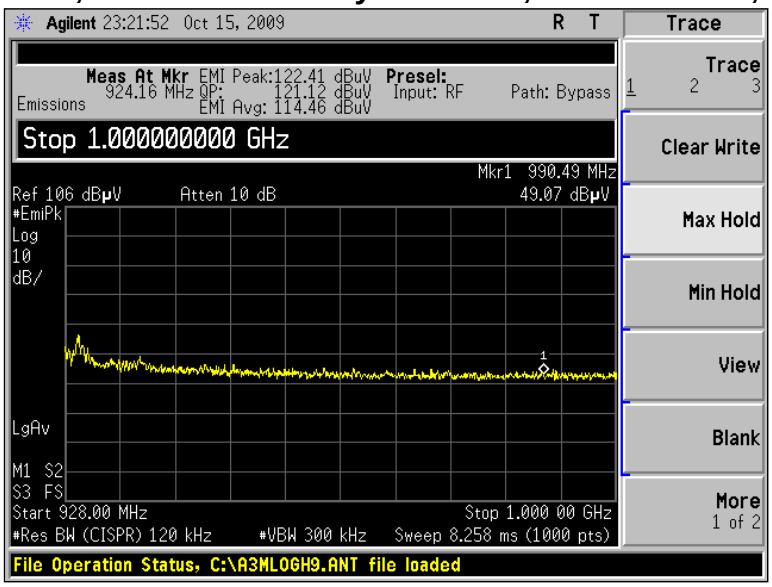


Screen Captures - Radiated Emissions Test – Wire Antenna Unit **(continued)**

Channel 6, Antenna Vertically Polarized, 902-928 MHz, at 3m

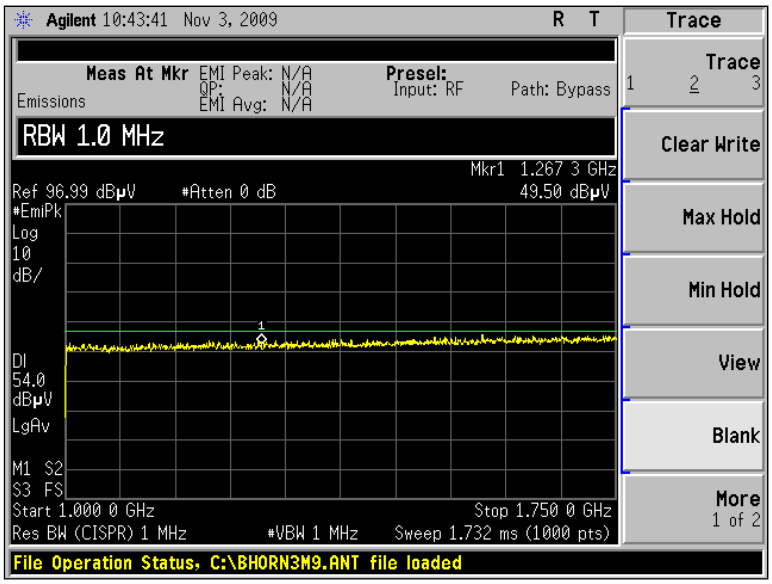


Channel 6, Antenna Vertically Polarized, 928-1000 MHz, at 3m



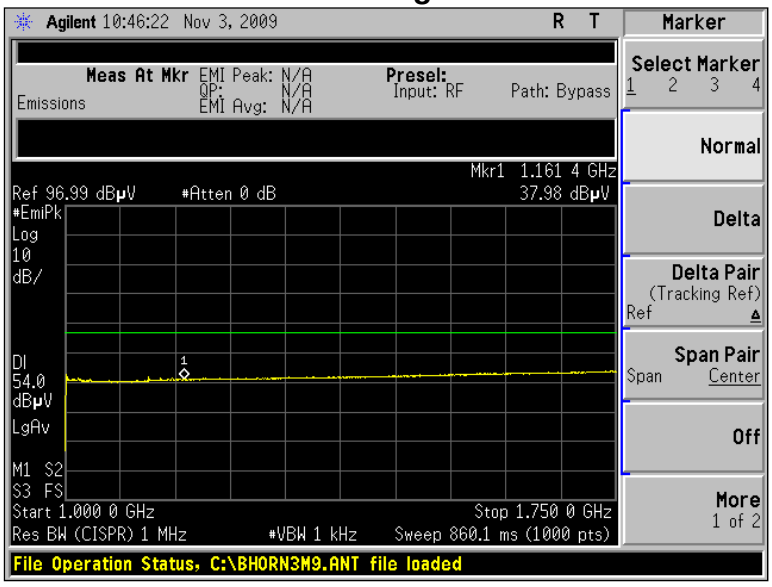
Screen Captures - Radiated Emissions Testing – Wire Antenna Unit *(continued)*

Channel 1, Antenna Vertically Polarized, 1000-1750 MHz, at 3m
Peak

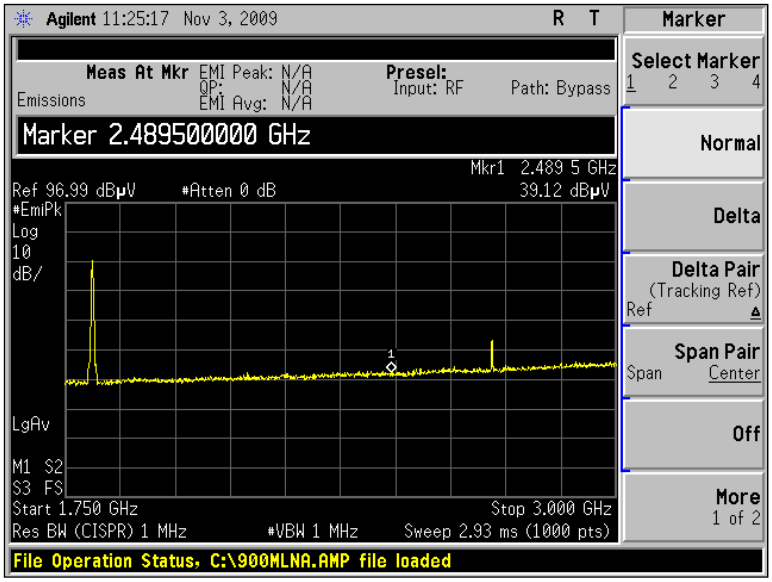


Because the peak values were so close to the limit for frequencies in restricted bands, a video averaged sweep was observed.

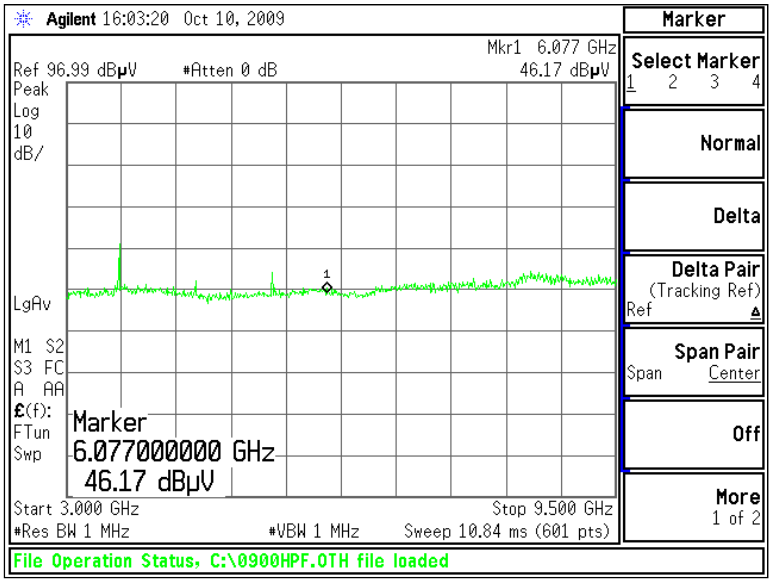
Channel 1, Antenna Vertically Polarized, 1000-1750 MHz, at 3m
Average



Channel 1, Antenna Vertically Polarized, EUT Vertical
1750-3000 MHz, at 3m



Channel 1, Antenna Vertically Polarized, EUT Vertical
3000-9500 MHz, at 3m



5.6.2 Receive Mode Testing - Wire Antenna Unit

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:

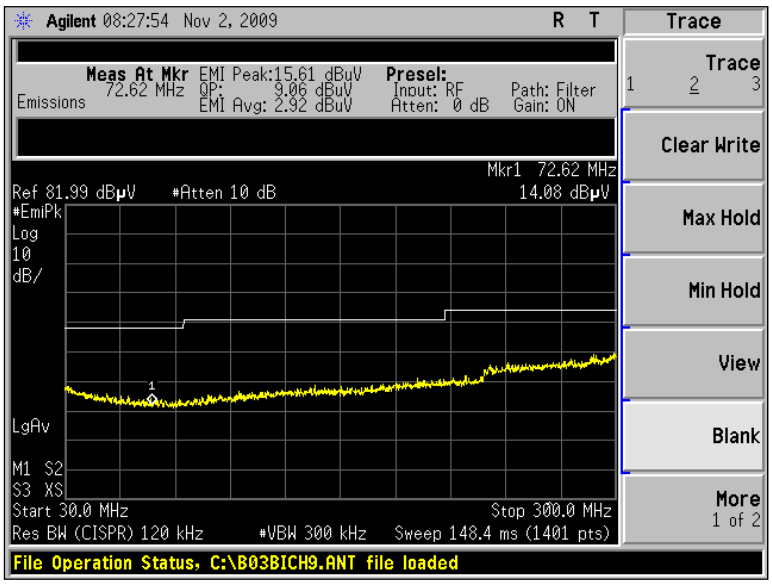
Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
72.6	1.00	0	15.6	9.1	40.0	30.9	Vertical	Vertical
180.0	1.00	0	19.8	13.4	43.5	30.1	Horizontal	Vertical
220.5	1.00	0	23.5	16.2	46.0	29.8	Horizontal	Side
263.0	1.00	0	28.5	22.7	46.0	23.3	Vertical	Vertical
634.5	1.00	0	30.9	25.0	46.0	21.0	Vertical	Vertical
784.0	1.00	0	31.8	26.0	46.0	20.0	Vertical	Side
945.0	1.00	0	34.6	28.7	46.0	17.3	Horizontal	Vertical

Screen Captures - Radiated Emissions Testing on Wire Antenna Unit – Receive Mode

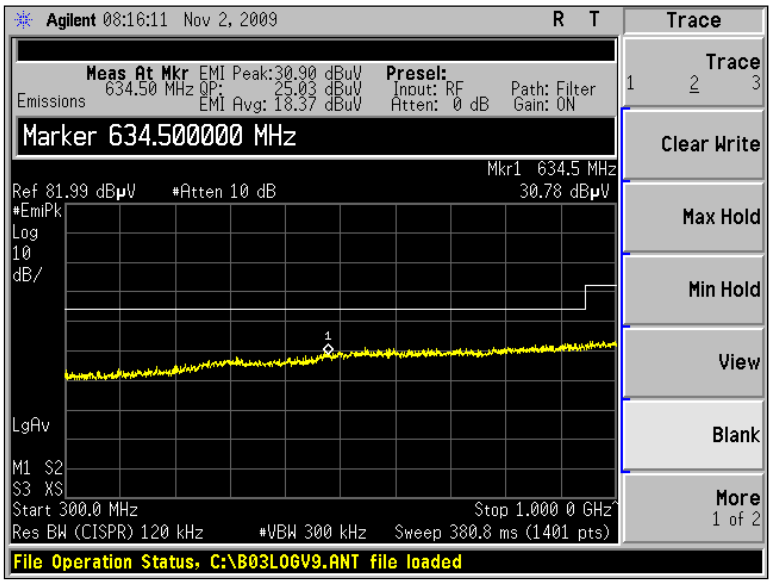
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 5 and 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 5, Antenna Vertically Polarized, EUT Vertical
30-300 MHz

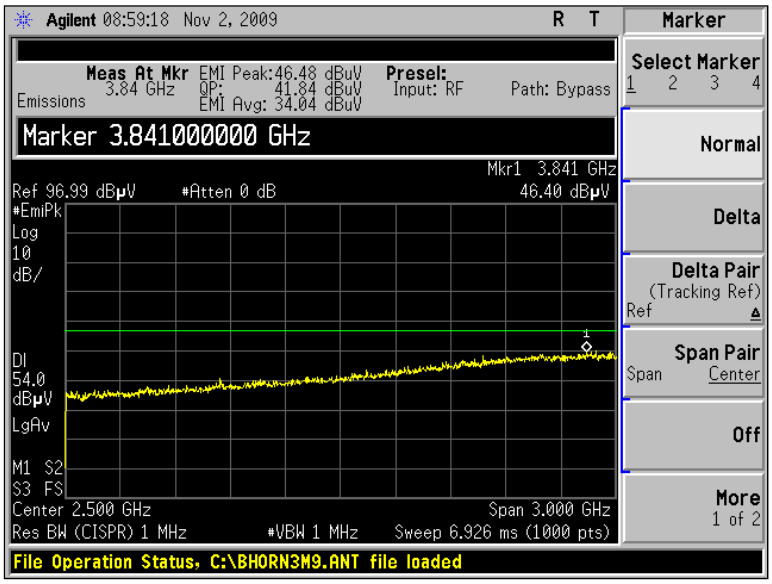


Channel 5, Antenna Vertically Polarized, EUT Vertical
300-1000 MHz

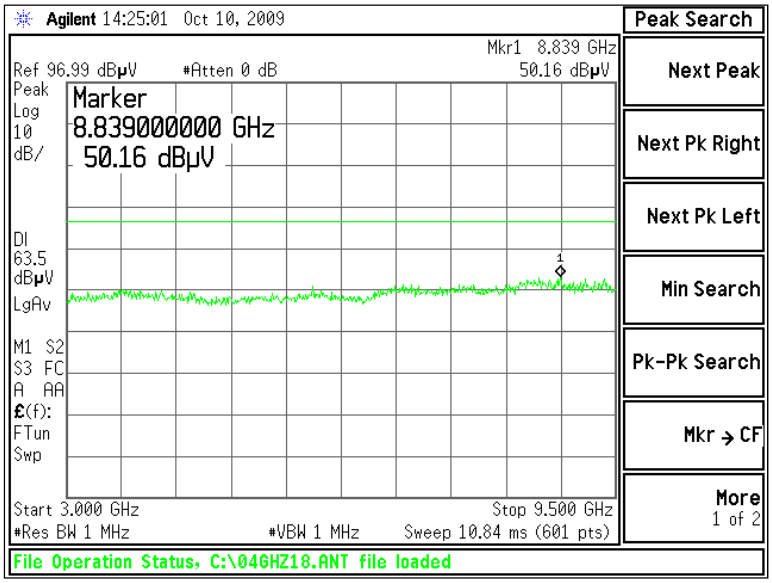


Screen Captures - Radiated Emissions Testing on Wire Antenna Unit – Receive Mode
(continued)

Channel 5, Antenna Vertically Polarized, EUT Vertical
1000-3000



Channel 5, Antenna Vertically Polarized
3000-9500



5.6.3 Transmit Mode: External Dipole Antenna

When testing the radiated emissions characteristics of the SiFlex module with the external dipole, the middle channel fundamental and harmonic measurements were taken with the dipole in a fixed vertical position and rotated the module through three orthogonal axes, and repeated the series of measurements with the dipole in a fixed side and flat position. Measurements of the fundamental power were static when the module was rotated and the dipole remained stationary. Spurious emissions measurements were highest when the antenna was rotated in conjunction with the EUT, so final measurements on all channels were taken where the antenna rotated on the same plane as the module.

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

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
91.6	1.00	0	15.9	8.8	43.5	34.7	Horizontal	Flat
145.7	1.00	0	19.6	11.9	43.5	31.6	Horizontal	Side
158.1	1.00	0	20.8	13.0	43.5	30.5	Vertical	Flat
212.2	1.00	0	21.8	14.8	43.5	28.7	Vertial	Side
242.7	1.00	0	26.5	20.5	46.0	25.6	Vertical	Vertical
267.8	1.00	0	28.34	21.28	46.0	24.7	Vertical	Flat
288.4	1.00	0	27.9	22.5	46.0	23.5	Horizontal	Vertical

The table below shows the radiated measurements of the fundamental frequencies on channels 1, 5, and 10:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Avg Limit (dBµV/m)[Note 1]	Margin (dB)	Antenna Polarity	EUT orientation
906	1.53	115	124.2	124.2	131.0	6.8	Horizontal	Flat
914	1.52	156	125.8	125.7	131.0	5.3	Horizontal	Flat
924	1.57	110	124.2	124.1	131.0	6.9	Horizontal	Flat

Note 1: The limit was derived from 15.247(b)(3) and (4), as the radiated fundamental signal strength resulting from the power delivered to the antenna and the antenna gain.

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)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1812	1.00	115	79.0	77.0	104.2	27.2	Vertical	Vertical
2718	1.13	20	50.5	45.2	54.0	8.8	Horizontal	Vertical
3624	1.03	325	61.1	56.8	63.5	6.7	Horizontal	Side
4530	1.27	327	54.2	47.6	63.5	15.9	Vertical	Flat
5436	1.03	338	52.9	45.5	63.5	18.0	Horizontal	Side
6342	1.03	32	46.5	34.9	113.7	78.7	Horizontal	Vertical
7248	1.02	135	48.3	37.0	113.7	76.7	Horizontal	Vertical
8154	1.05	71	49.0	38.8	63.5	24.7	Horizontal	Vertical
9060	1.11	305	54.2	43.8	63.5	19.7	Vertical	Flat

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 5:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1828	1.02	183	78.2	76.3	105.7	29.4	Horizontal	Side
2742	1.06	25	55.5	51.1	54.0	2.9	Horizontal	Side
3656	1.05	349	60.3	57.8	63.5	5.7	Vertical	Vertical
4570	1.11	120	53.2	45.8	63.5	17.7	Vertical	Vertical
5484	1.09	329	56.0	48.5	115.2	66.8	Horizontal	Side
6398	1.15	254	48.7	39.0	115.2	76.2	Horizontal	Vertical
7312	1.16	175	48.2	37.7	63.5	25.8	Vertical	Side
8226	1.04	60	52.0	42.1	63.5	21.4	Vertical	Flat
9140	1.10	39	54.8	45.8	63.5	17.7	Horizontal	Vertical

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 10:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1848	1.00	0	73.9	73.1	104.1	31.1	Horizontal	Side
2772	1.00	0	54.1	49.3	54.0	4.8	Vertical	Side
3696	1.07	33	54.7	51.2	63.5	12.3	Vertical	Vertical
4620	1.03	66	51.1	44.2	63.5	19.3	Vertical	Flat
5544	1.10	8	54.5	47.8	113.6	65.8	Horizontal	Side
6468	1.08	5	51.4	44.5	113.6	69.1	Vertical	Side
7392	1.29	5	49.9	40.0	63.5	23.5	Vertical	Vertical
8316	1.13	275	56.1	48.3	63.5	15.2	Vertical	Flat
9240	1.16	115	53.8	46.0	113.6	67.6	Vertical	Flat

Notes:

1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
2) Measurements above 3 GHz were made at 1 meters of separation from the EUT.
3) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.

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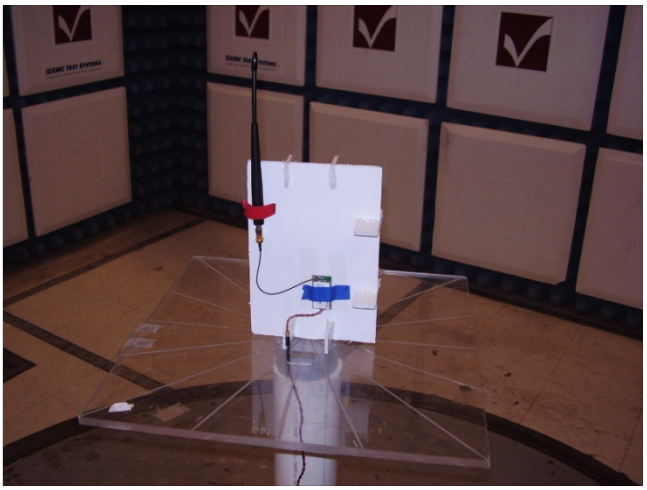
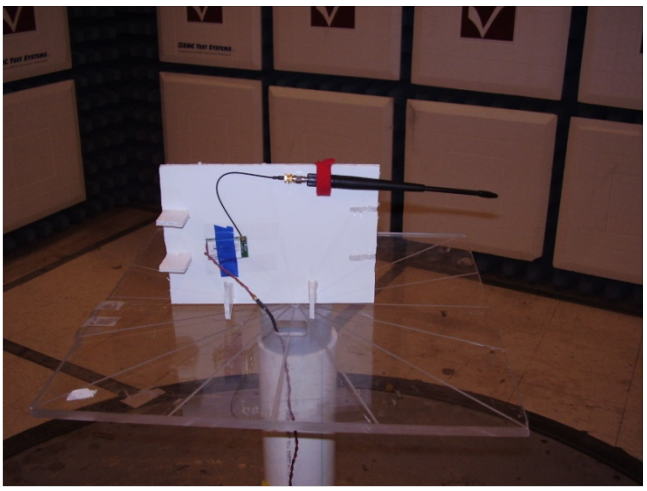
Test Setup Photo(s) – Radiated Emissions Test – External Dipole

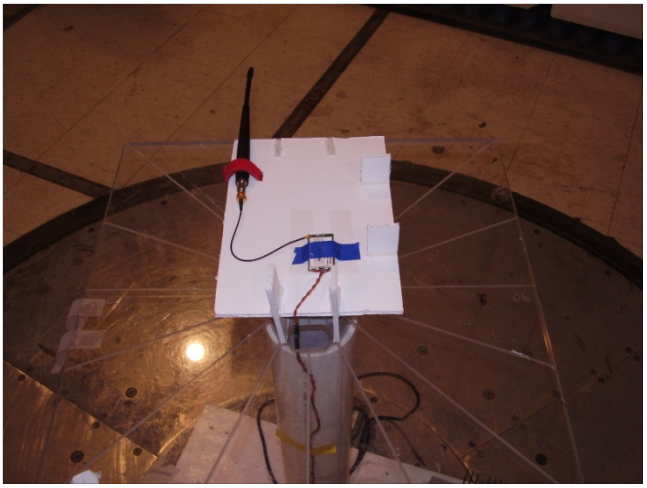
EUT Vertical



EUT on Side



EUT Flat

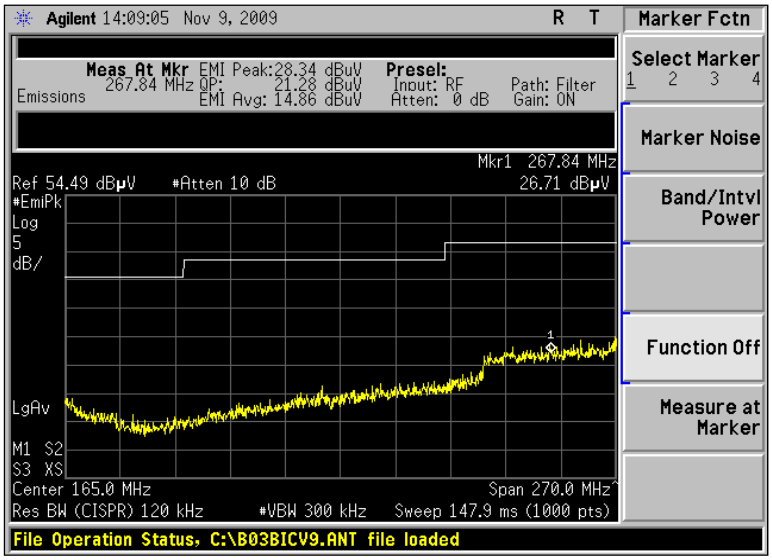


Screen Captures - Radiated Emissions Test External Dipole Antenna

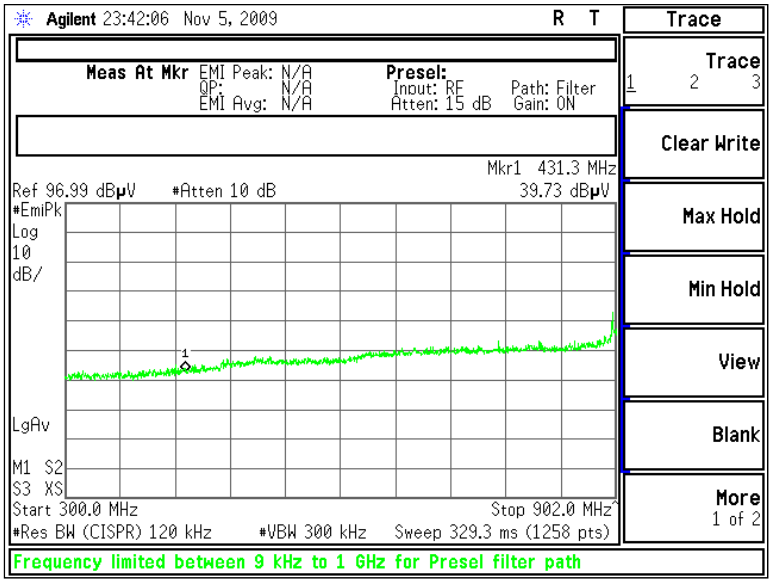
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 5, or 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 5, Antenna Vertically Polarized, EUT on Side 30-300 MHz, at 3m,

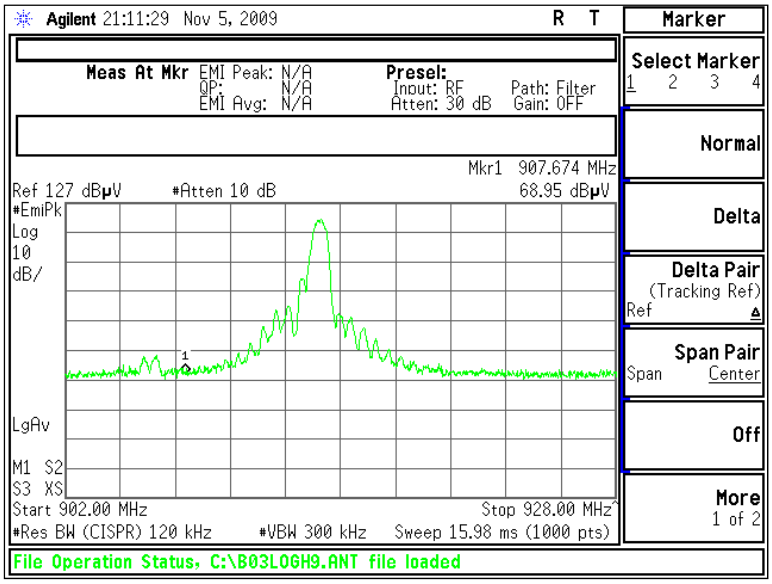


Channel 5, Antenna Vertically Polarized, EUT Flat 300-902 MHz, at 3m

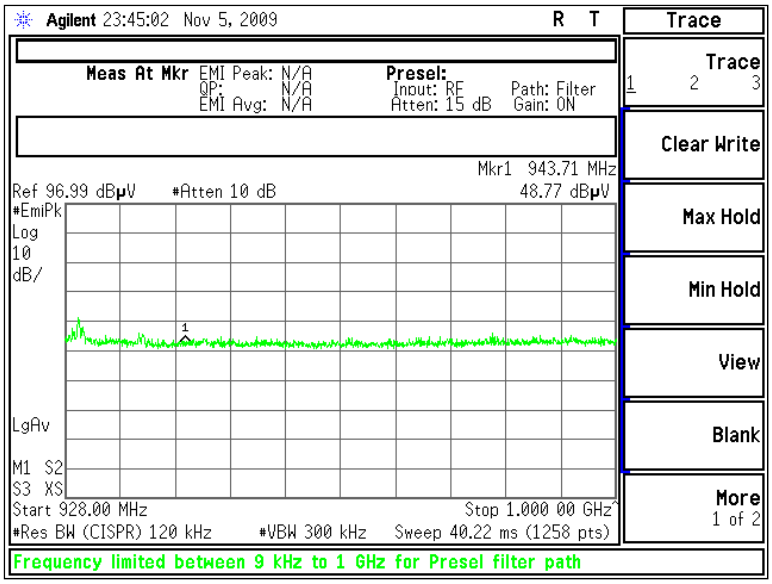


Screen Captures - Radiated Emissions Test External Dipole Antenna **(continued)**

Channel 5, Antenna Vertically Polarized, EUT Flat
902-928 MHz, at 3m

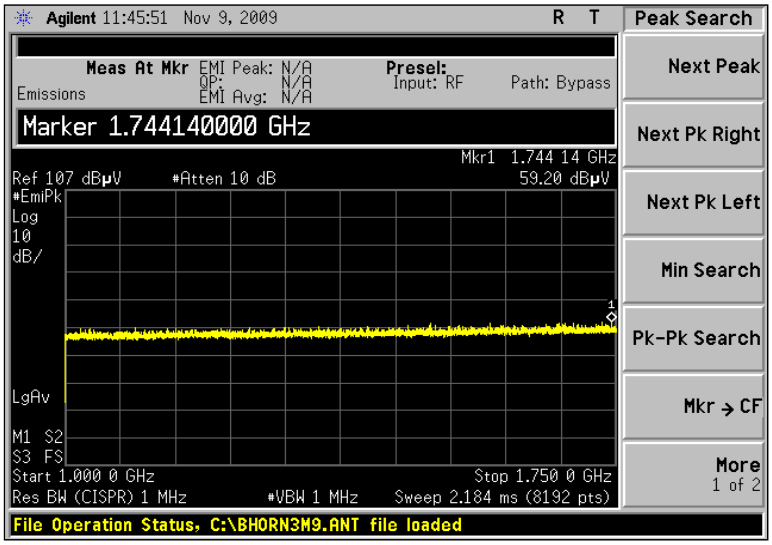


Channel 5, Antenna Vertically Polarized, EUT Flat
928-1000 MHz, at 3m



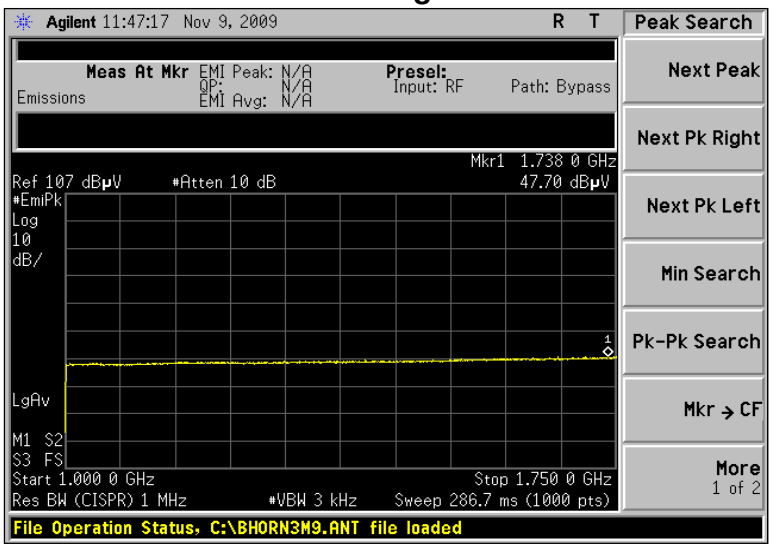
Screen Captures - Radiated Emissions Test External Dipole Antenna (continued)

Channel 5, Antenna Vertically Polarized, EUT Flat
1000-1750 MHz, at 3m
Peak



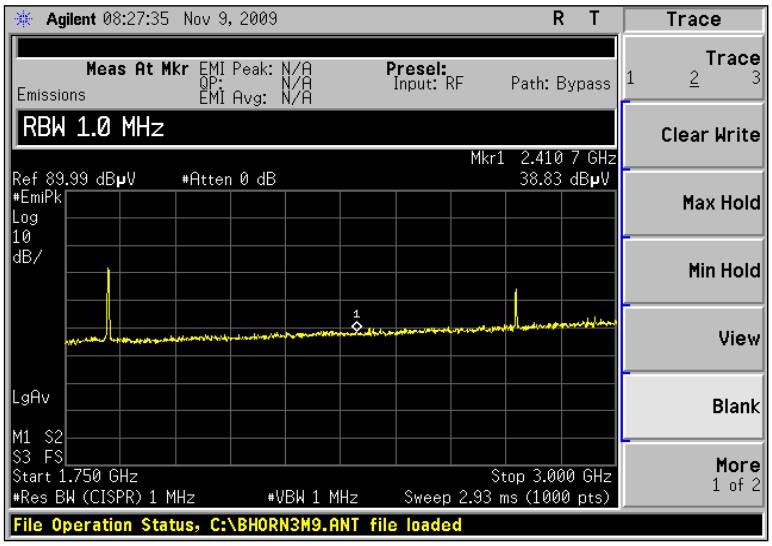
Because the peak values were so close to the limit for frequencies in restricted bands, a video averaged sweep was observed.

Channel 5, Antenna Vertically Polarized, EUT Flat
1000-1750 MHz, at 3m
Average

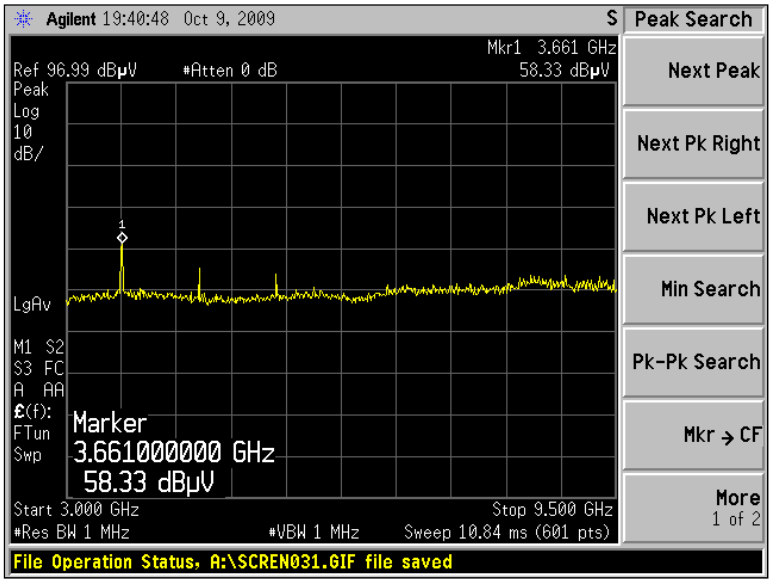


Screen Captures - Radiated Emissions Test External Dipole Antenna (continued)

Channel 10, Antenna Horizontally Polarized, EUT on Side 1750-3000 MHz, at 3m



Channel 10, Antenna Horizontally Polarized, EUT on Side 3000-9500 MHz, at 3m



5.6.4 Receive Mode Testing External Dipole Antenna

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:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	QP Reading (dBµV/m)	QP Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
297.3	1.00	0	27.85	22.39	46.0	23.6	Vertical	Vertical
298.7	1.00	0	30.55	24.11	46.0	21.9	Horizontal	Vertical
299.5	1.00	0	30.54	23.98	46.0	22.0	Horizontal	Flat
970.0	1.00	0	33.29	26.15	54.0	27.9	Horizontal	Vertical
976.5	1.00	0	31.32	25.52	54.0	28.5	Vertical	Vertical
979.0	1.00	0	31.71	25.64	54.0	28.4	Vertical	Side
982.0	1.00	0	32.75	26.79	54.0	27.2	Horizontal	Side
985.5	1.00	0	32.44	26.63	54.0	27.4	Horizontal	Flat

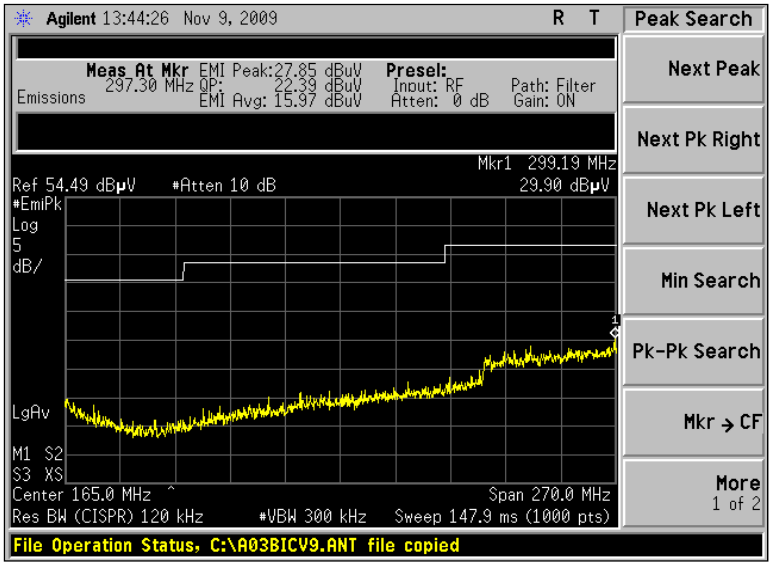
Receive Mode

Screen Captures - Radiated Emissions Testing on External Dipole Antenna

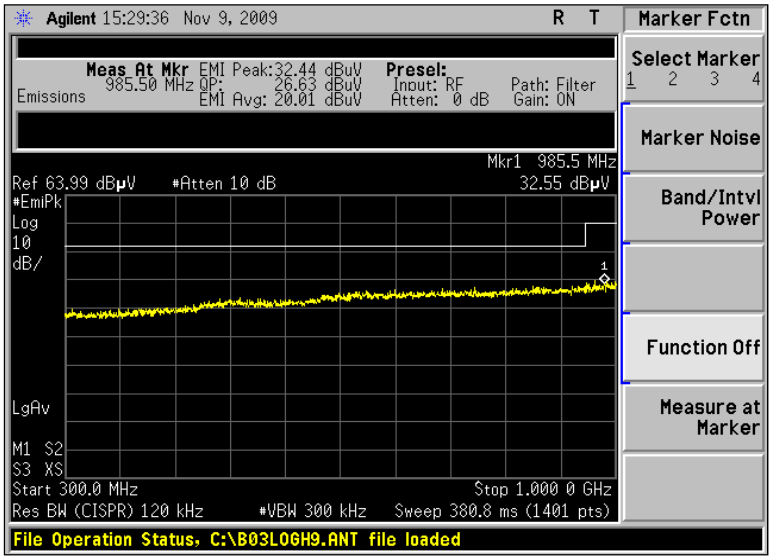
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 5 and 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 5, Antenna Horizontally Polarized, EUT Flat 30-300 MHz



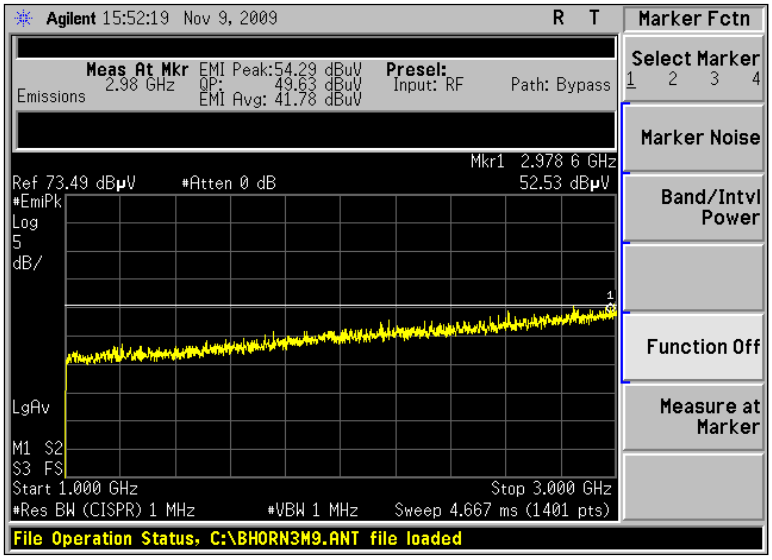
Channel 5, Antenna Horizontally Polarized, EUT Flat 300-1000 MHz



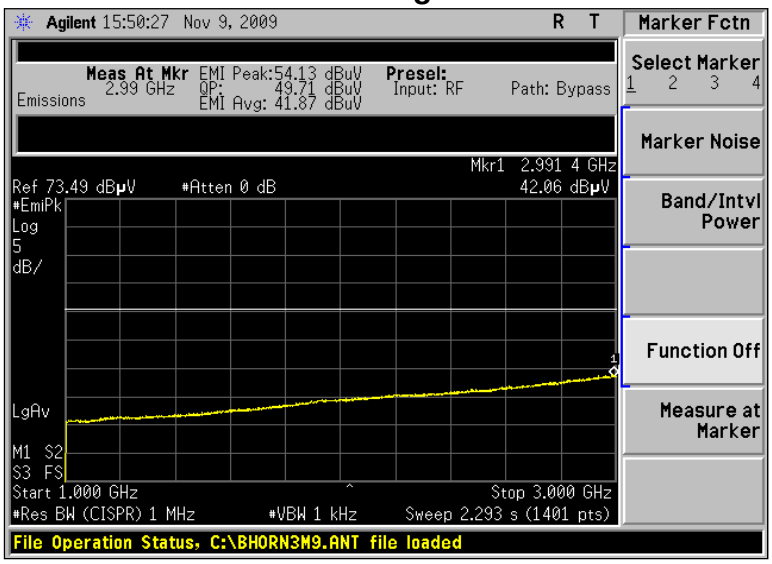
Receive Mode

Screen Captures - Radiated Emissions Testing on External Dipole Antenna (continued)

Channel 5, Antenna Vertically Polarized, EUT Vertical
1000-3000 MHz
Peak



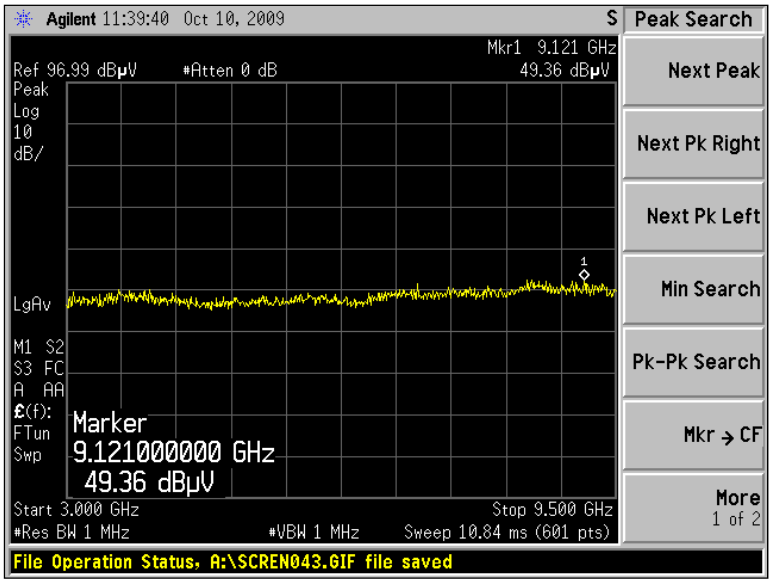
Channel 5, Antenna Vertically Polarized, EUT Vertical
1000-3000 MHz
Average



Receive Mode

Screen Captures - Radiated Emissions Testing on External Dipole Antenna (continued)

Channel 5, Antenna Vertically Polarized, EUT Vertical
3000-9500



5.6.5 Transmit Mode: Chip Antenna

Please note, the radiated emissions measurements for the chip antenna configuration varied slightly from the other setups. Measurements from 30 MHz to 4000 MHz were made at a 3 meter separation distance in the FCC listed semi anechoic 3 meter chamber and measurements from 4000 MHz to 10000 MHz were made at a 1 meter separation distance in a mini chamber.

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

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
124.05	1.00	0	18.3	12.3	43.5	31.2	Vertical	Vertical
160.54	1.00	0	19.7	12.7	43.5	30.8	Horizontal	Vertical
194.59	1.00	0	22.7	15.1	43.5	28.4	Horizontal	Flat
247.3	1.00	0	29.7	22.5	46.0	23.5	Vertical	Flat
262.16	1.00	0	28.0	22.3	46.0	23.7	Horizontal	Side
289.19	1.00	0	29.9	24.1	46.0	21.9	Vertical	Side

The table below shows the radiated measurements of the fundamental frequencies on channels 1, 5, and 10:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Avg Limit (dBµV/m)[Note 1]	Margin (dB)	Antenna Polarity	EUT orientation
906	1.49	320	119.8	119.7	131.0	11.3	Vertical	Vertical
914	1.45	239	121.5	121.4	131.0	9.6	Horizontal	Flat
924	1.64	61	120.4	120.2	131.0	10.8	Horizontal	Flat

Note 1: The limit was derived from 15.247(b)(3) and (4), as the radiated fundamental signal strength resulting from the power delivered to the antenna and the antenna gain.

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)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1812	1.11	27	79.5	77.7	99.7	22.0	Vertical	Flat
2718	1.44	0	47.7	42.3	54.0	11.7	Vertical	Side
3624	1.13	345	48.6	45.4	54.0	8.6	Horizontal	Side
4530	1.13	47	50.3	42.9	63.5	20.6	Vertical	Vertical
5436	1.03	39	52.2	43.7	63.5	19.8	Horizontal	Flat
6342	1.10	1	46.6	36.9	109.2	72.2	Horizontal	Side
7248	1.23	66	48.2	37.0	109.2	72.2	Vertical	Flat
8154	1.09	45	49.9	40.8	63.5	22.7	Horizontal	Vertical
9060	1.06	232	51.4	42.6	63.5	20.9	Horizontal	Vertical

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 5:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1828	1.71	12	74.7	73.3	101.4	28.1	Horizontal	Side
2742	1.03	45	46.1	41.0	54.0	13.0	Horizontal	Vertical
3656	1.07	22	48.6	43.3	54.0	10.7	Horizontal	Vertical
4570	1.08	31	56.7	50.5	54.0	3.5	Horizontal	Side
5484	1.19	355	53.1	45.2	110.9	65.7	Horizontal	Flat
6398	1.13	25	48.0	38.7	110.9	72.2	Horizontal	Side
7312	1.00	30	47.9	36.8	63.5	26.7	Horizontal	Side
8226	1.11	220	52.3	42.6	63.5	20.9	Horizontal	Vertical
9140	1.08	294	53.5	43.8	63.5	19.7	Vertical	Flat

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 10:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
1848	1.00	17	66.7	65.8	100.2	34.4	Horizontal	Side
2772	1.00	131	48.3	43.6	54.0	10.4	Horizontal	Vertical
3696	1.00	109	51.3	47.7	54.0	6.3	Vertical	Flat
4620	1.03	32	54.2	48.0	54.0	6.0	Horizontal	Side
5544	1.26	346	51.8	43.9	109.7	65.9	Vertical	Vertical
6468	1.11	4	54.4	47.5	109.7	62.2	Horizontal	Vertical
7392	1.15	40	50.1	40.3	63.5	23.2	Vertical	Side
8316	1.04	42	53.8	45.3	63.5	18.2	Horizontal	Vertical
9240	1.17	215	53.3	44.3	109.7	65.5	Horizontal	Flat

Notes:

1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
2) Measurements above 4 GHz were made at 1 meters of separation from the EUT.
3) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.

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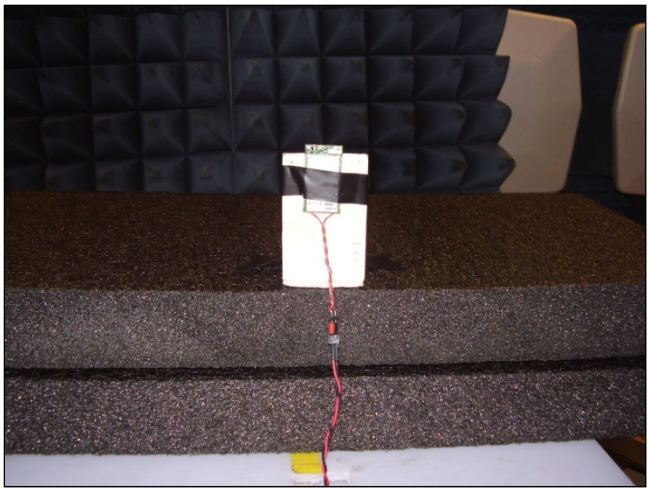
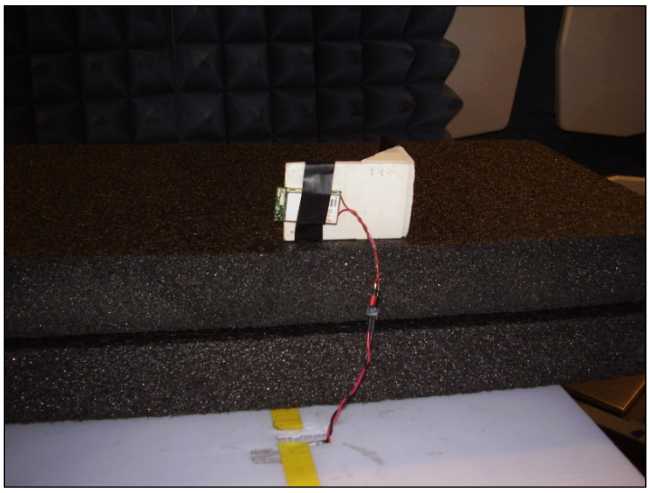
Test Setup Photo(s) – Radiated Emissions Test – Chip Antenna

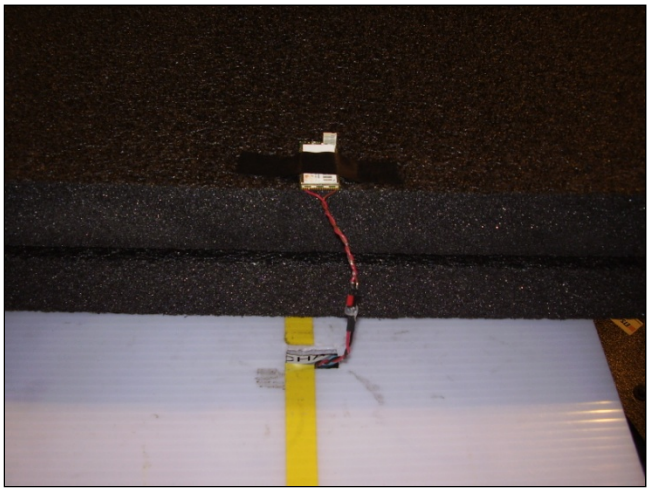
EUT Vertical



EUT on Side



EUT Flat

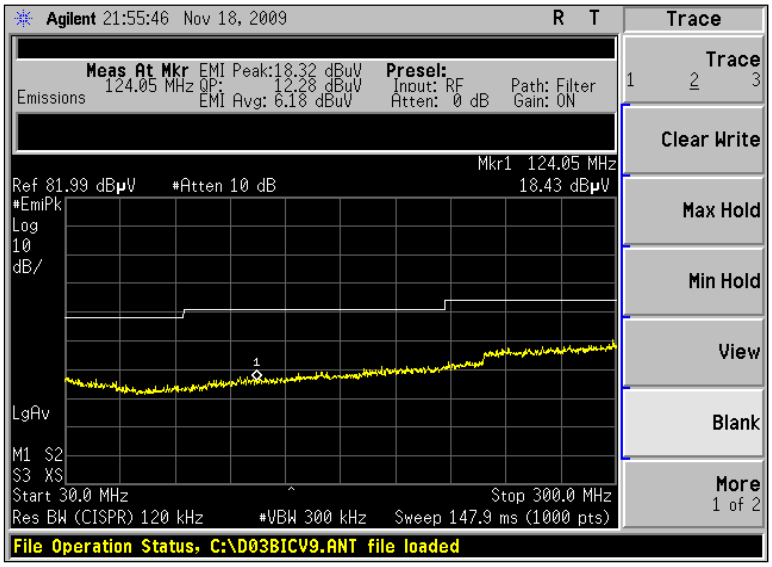


Screen Captures - Radiated Emissions Test - Chip Antenna

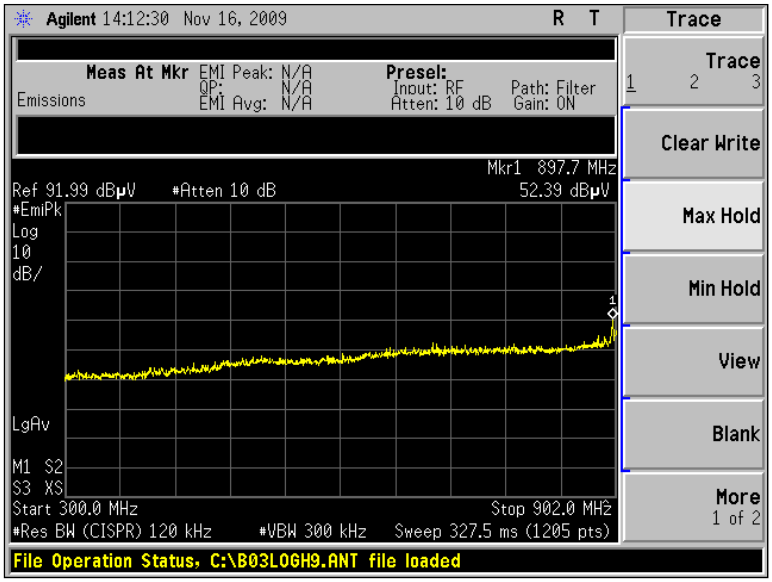
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 5, or 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 5, Antenna Vertically Polarized, EUT Vertical
30-300 MHz, at 3m,

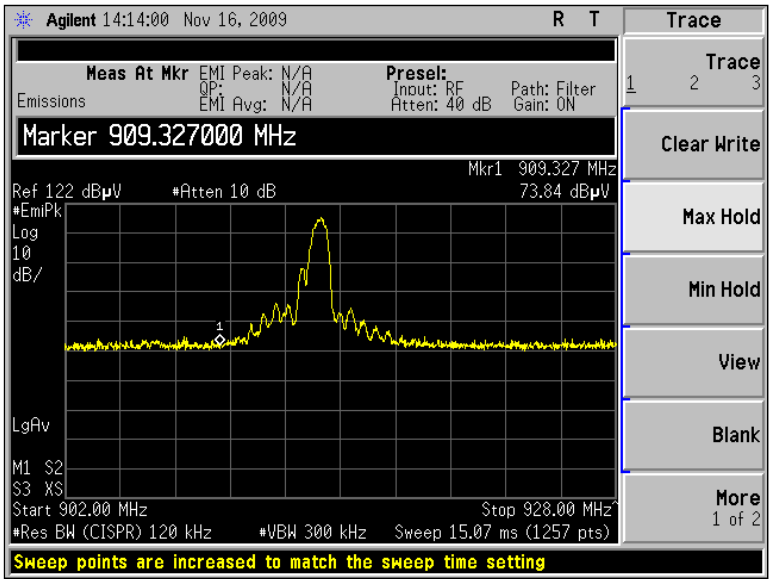


Channel 5, Antenna Horizontally Polarized, EUT Flat
300-902 MHz, at 3m

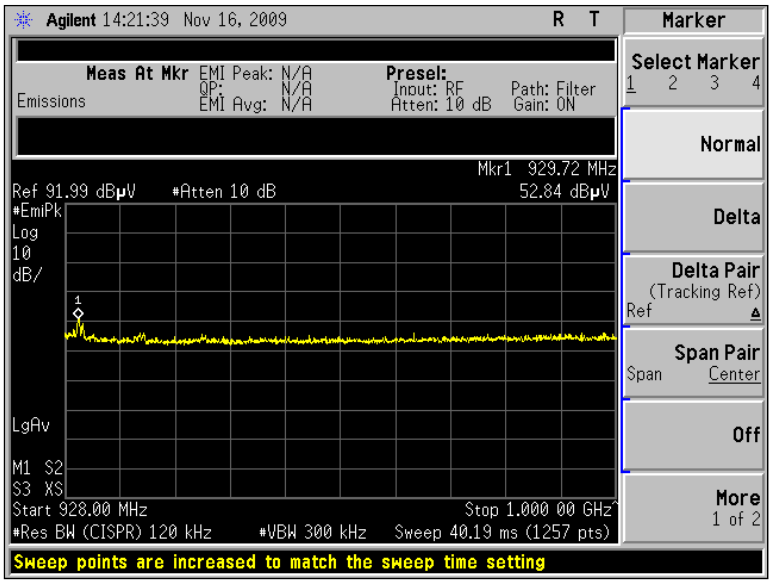


Screen Captures - Radiated Emissions Test - Chip Antenna

Channel 5, Antenna Vertically Polarized, EUT Flat
902-928 MHz, at 3m

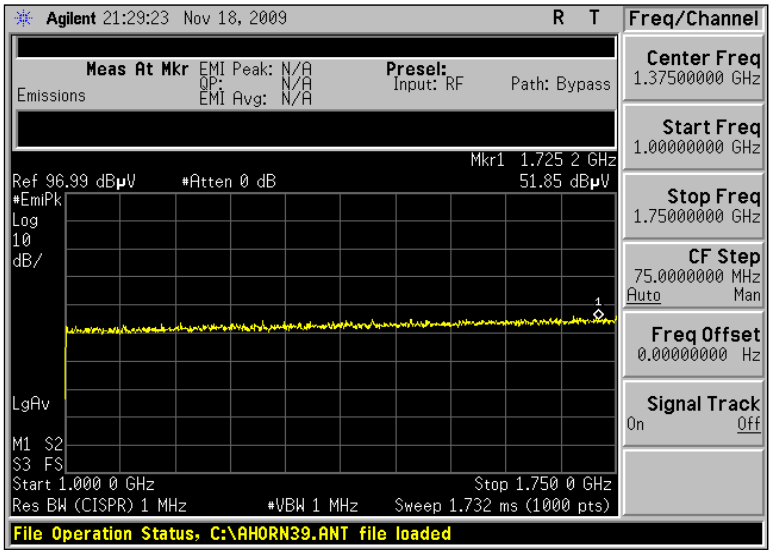


Channel 5, Antenna Vertically Polarized, EUT Flat
928-1000 MHz, at 3m



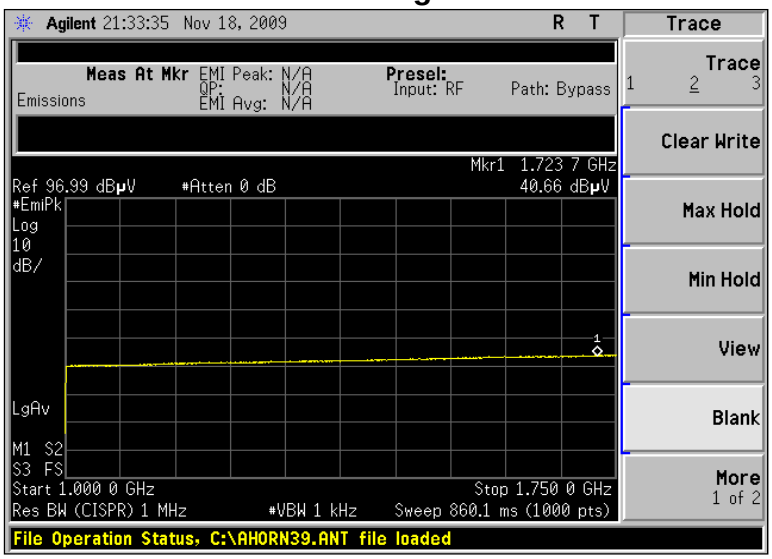
Screen Captures - Radiated Emissions Test - Chip Antenna (continued)

Channel 10, Antenna Vertically Polarized, EUT Flat
1000-1750 MHz, at 3m
Peak



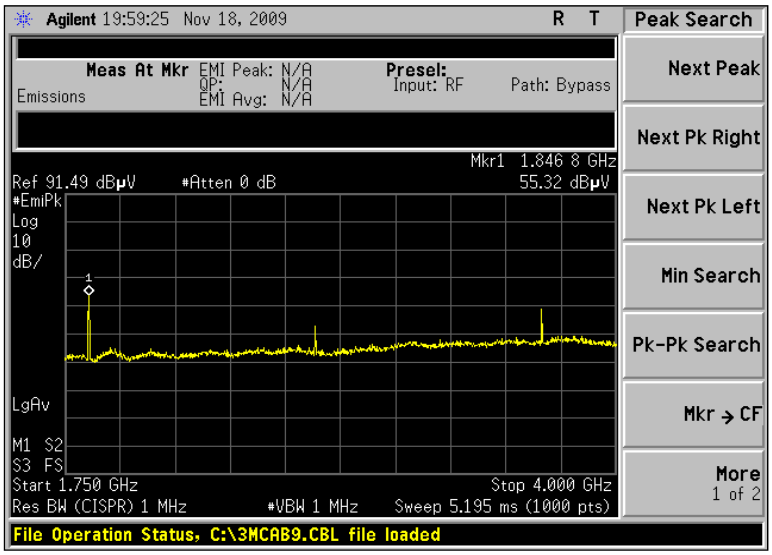
Because the peak values were so close to the limit for frequencies in restricted bands, a video averaged sweep was observed.

Channel 10, Antenna Vertically Polarized, EUT Flat
1000-1750 MHz, at 3m
Average

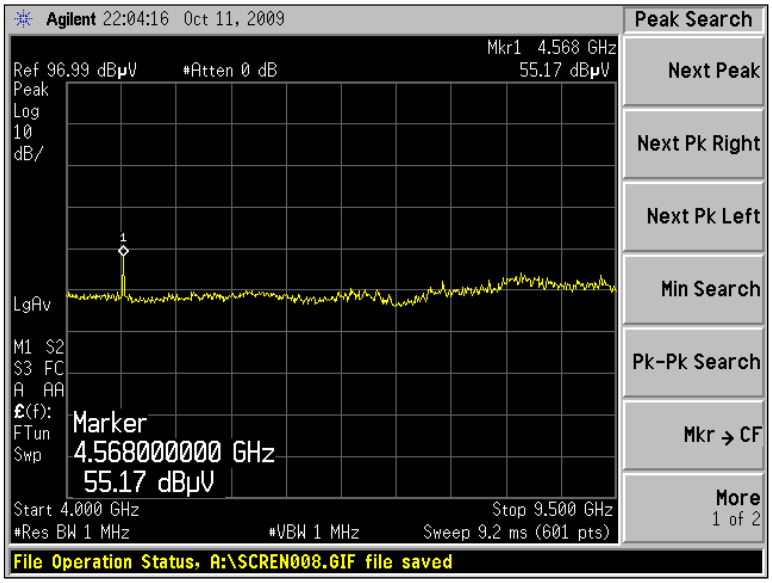


Screen Captures - Radiated Emissions Test - Chip Antenna (continued)

Channel 10, Antenna Vertically Polarized, EUT Flat
1750-4000 MHz, at 3m



Channel 5, Antenna Horizontally Polarized, EUT on Side
4000-9500 MHz, at 3m



5.6.6 Receive Mode Testing Chip Antenna

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:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
171.6	1.00	0	20.5	14.3	43.5	29.2	Vertical	Side
211.6	1.00	0	23.0	16.2	43.5	27.3	Horizontal	Side
271.9	1.00	0	29.9	23.5	46.0	22.5	Vertical	Flat
298.1	1.00	0	31.6	25.9	46.0	20.1	Horizontal	Vertical
491.0	1.00	0	29.3	22.9	46.0	23.2	Vertical	Side
562.5	1.00	0	29.0	22.6	46.0	23.4	Vertical	Vertical
718.0	1.00	0	33.2	27.0	46.0	19.1	Horizontal	Vertical
810.5	1.00	0	33.4	27.0	46.0	19.0	Horizontal	Flat
984.0	1.00	0	35.9	30.0	54.0	24.0	Horizontal	Side

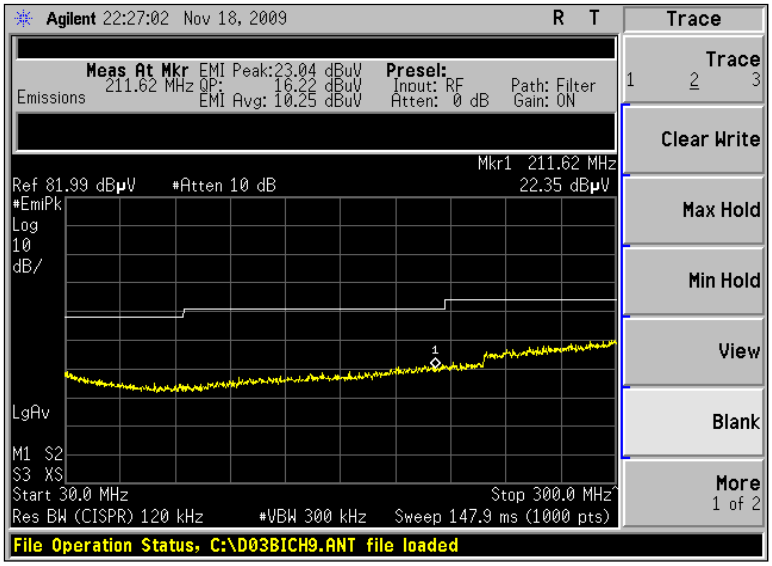
Receive Mode

Screen Captures - Radiated Emissions Testing on Chip Antenna

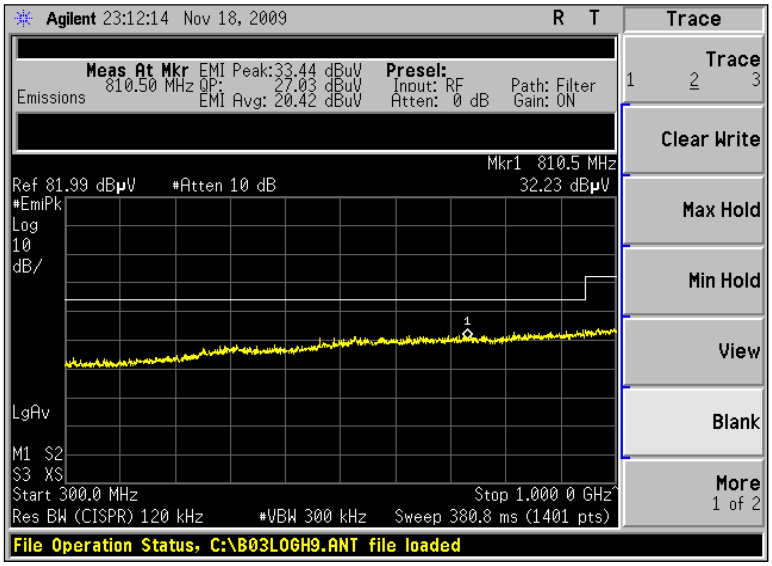
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 1, 5 and 10, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 5, Antenna Horizontally Polarized, EUT on Side
30-300 MHz



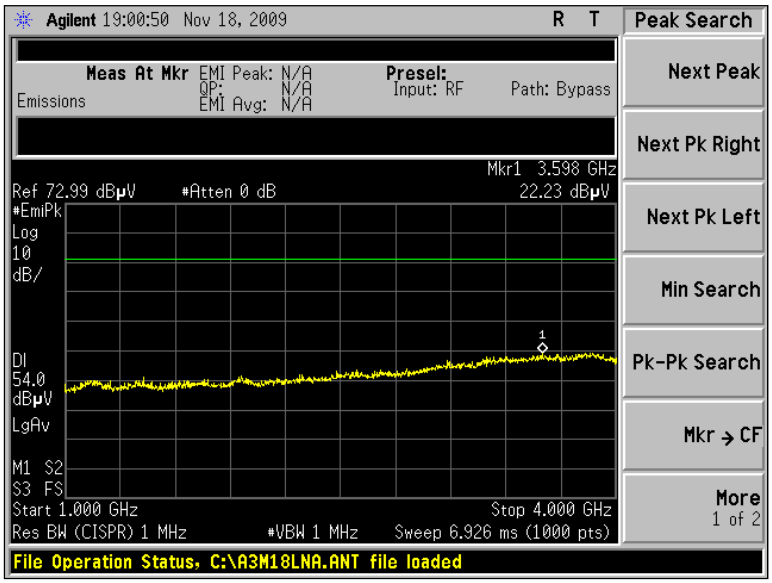
Channel 5, Antenna Horizontally Polarized, EUT Flat
300-1000 MHz



Receive Mode

Screen Captures - Radiated Emissions Testing on Chip Antenna (continued)

Channel 5, Antenna Vertically Polarized, EUT Vertical
1000-4000 MHz



Channel 5, Antenna Horizontally Polarized, EUT Flat
4000-9500 MHz

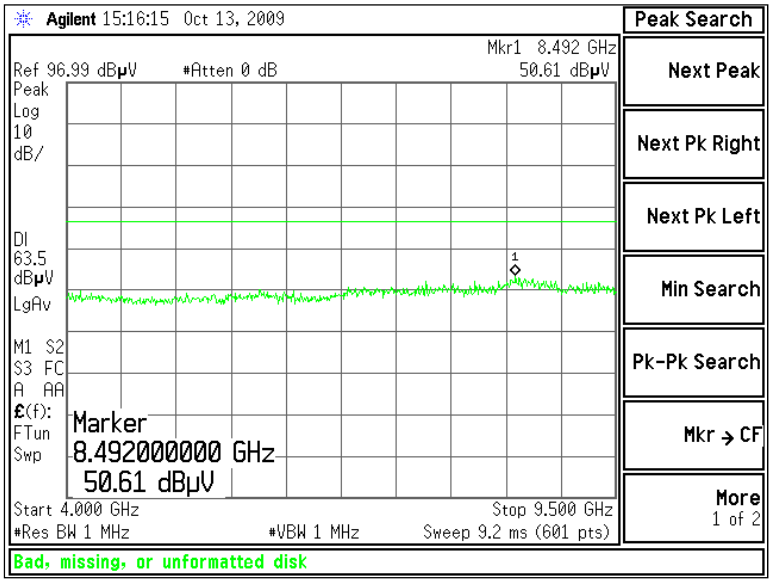


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE:

6.1 Test Setup

The test area and setup are in accordance with ANSI C63.4-2009 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 inside the 3 Meter Semi-Anechoic Chamber 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 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 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 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 Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

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 CONDUCTED EMISSIONS TEST DATA CHART

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

Manufacturer:	LS Research, LLC					
Date(s) of Test:	October 19, and November 3, 2009					
Test Engineer:	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 %					
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

6.6.1 Test on Unit with Wire Antenna

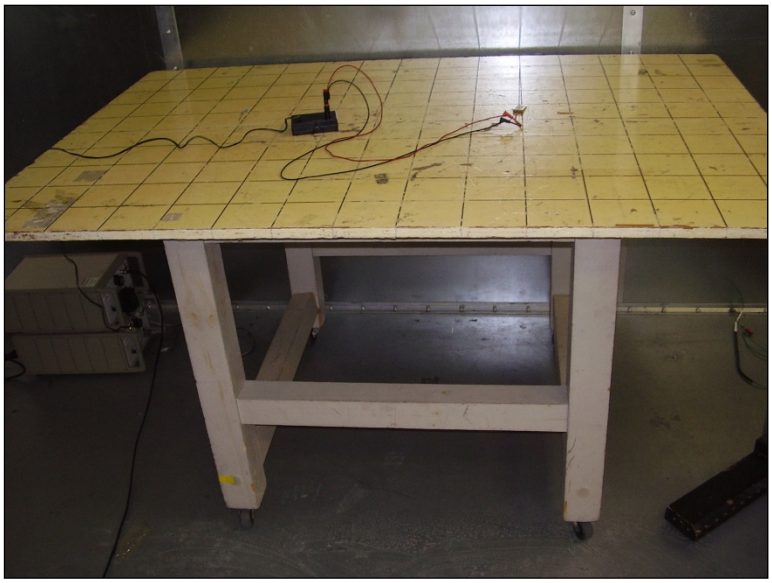
Test Data

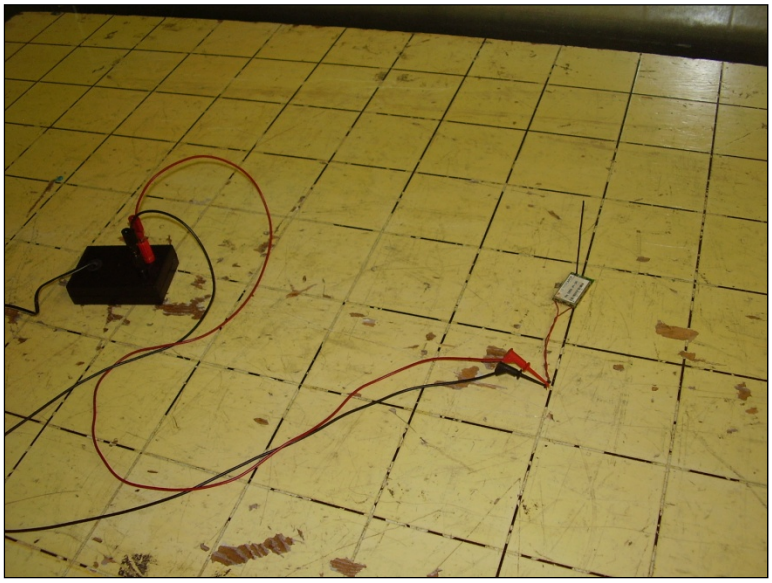
Frequency (MHz)	Line	Q-Peak Reading	Q-Peak Limit	Margin	Average Reading	Average Limit	Margin
0.157	1	30.40	65.65	35.25	11.10	55.65	44.55
0.303	1	25.60	60.16	34.56	14.70	50.16	35.46
1.065	1	25.30	56.00	30.70	0.80	46.00	45.20
0.180	2	32.00	64.47	32.47	27.10	54.47	27.37
0.619	2	32.70	56.00	23.30	30.60	46.00	15.40
1.106	2	24.70	56.00	31.30	1.40	46.00	44.60

Notes:
1) All other emissions were better than 20 dB below the limits.

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

Test Setup Photo(s) for Test with Wire Antenna



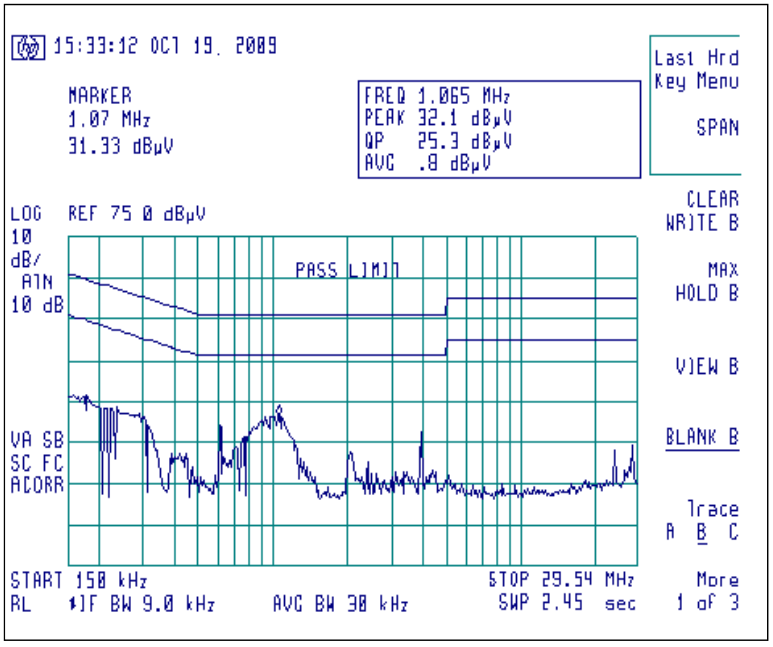


Screen Captures – Conducted Emissions Test with Wire Antenna

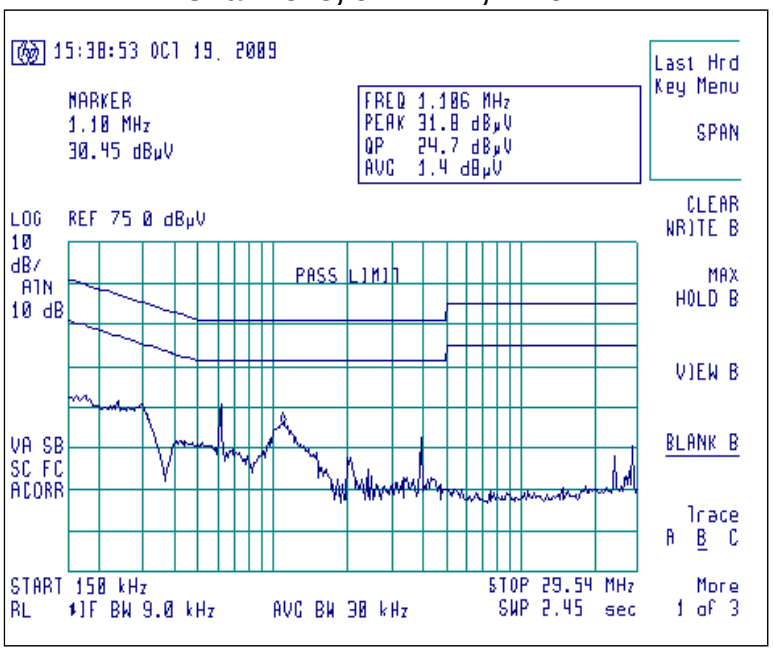
These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207 and RSS GEN 7.2.2 (Table 2).

The signature scans shown here are from channel 5, chosen as a good representative of channels.

Channel 5, 914 MHz, Line 1



Channel 5, 914 MHz, Line 2



6.6.2 Test on Unit with External Dipole Antenna

Test Data

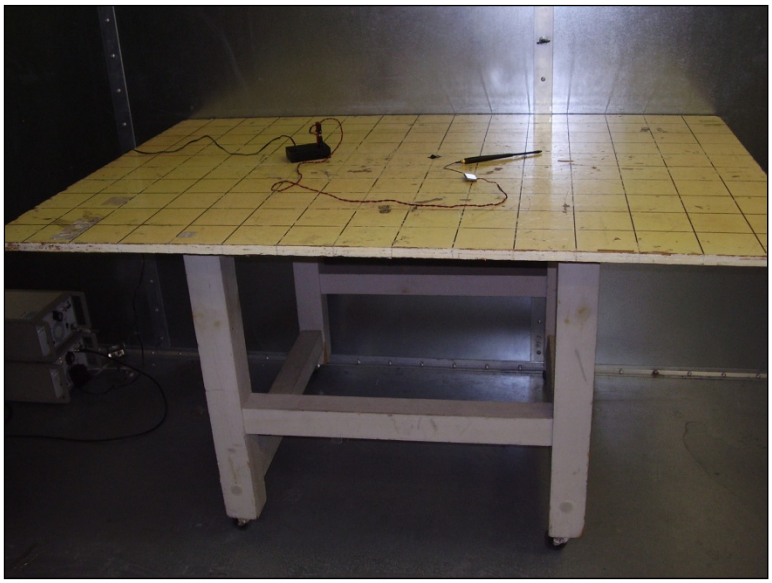
Frequency (MHz)	Line	Q-Peak Reading	Q-Peak Limit	Margin	Average Reading	Average Limit	Margin
0.195	1	29.90	63.83	33.93	4.60	53.83	49.23
1.025	1	26.20	56.00	29.80	0.60	46.00	45.40
4.001	1	33.60	56.00	22.40	32.20	46.00	13.80
0.159	2	33.00	65.53	32.53	16.70	55.53	38.83
0.417	2	22.90	57.51	34.61	3.20	47.51	44.31
1.085	2	25.70	56.00	30.30	1.40	46.00	44.60

Notes:

1) All other emissions were better than 20 dB below the limits.

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

Test Setup Photo(s) for Test with External Dipole Antenna

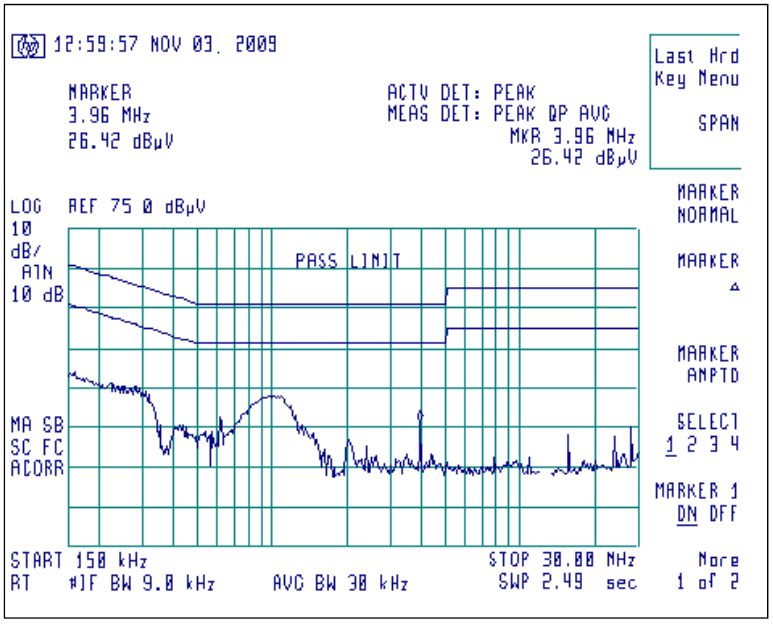


Screen Captures – Conducted Emissions Test with External Dipole Antenna

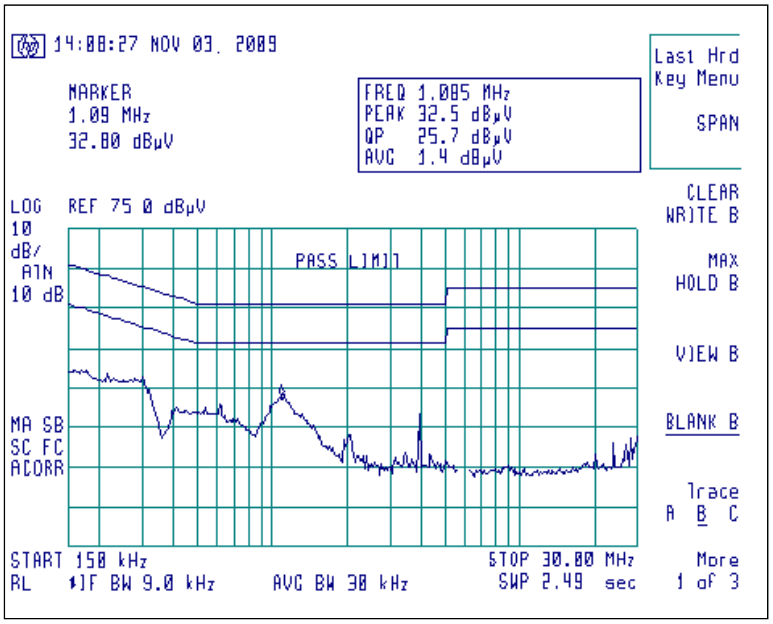
These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207 and RSS GEN 7.2.2 (Table 2).

The signature scans shown here are from channel 5, chosen as a good representative of channels.

Channel 5, 914 MHz, Line 1



Channel 5, 914 MHz, Line 2



6.6.3 Test on Unit with Chip Antenna

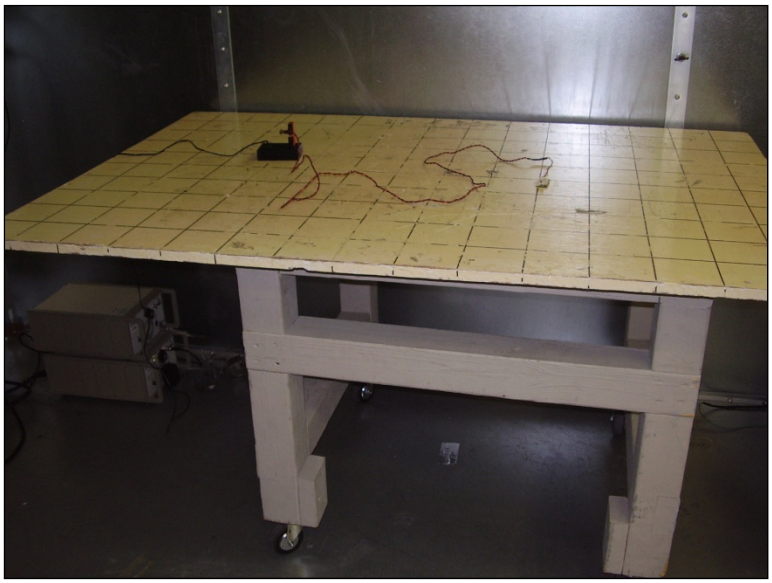
Test Data

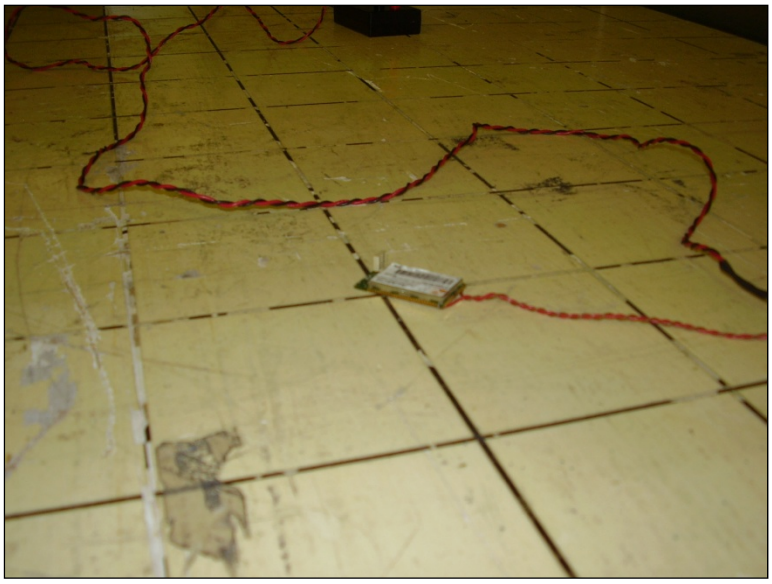
Frequency (MHz)	Line	Q-Peak Reading	Q-Peak Limit	Margin	Average Reading	Average Limit	Margin
0.178	1	31.20	64.60	33.40	24.30	54.60	30.30
1.105	1	26.40	56.00	29.60	1.70	46.00	44.30
4.000	1	36.20	56.00	19.80	34.90	46.00	11.10
0.152	2	31.20	65.91	34.71	8.80	55.91	47.11
0.924	2	26.00	56.00	30.00	2.10	46.00	43.90
4.001	2	36.00	56.00	20.00	34.80	46.00	11.20

Notes:
1) All other emissions were better than 20 dB below the limits.

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

Test Setup Photo(s) for Test with Chip Antenna



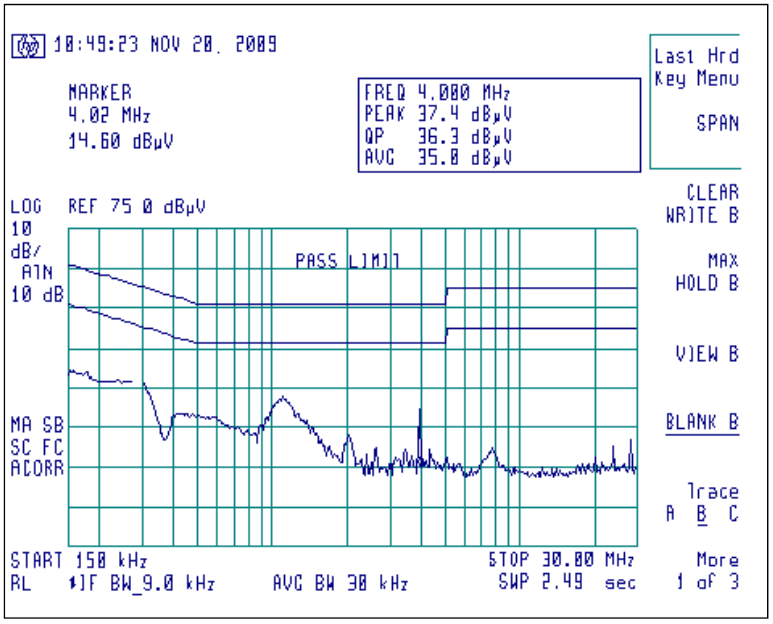


Screen Captures – Conducted Emissions Test with Chip Antenna

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 7.2.2 (Table 2).

The signature scans shown here are from channel 5, chosen as a good representative of channels.

Channel 5, 914 MHz, Line 1



Channel 5, 914 MHz, Line 2

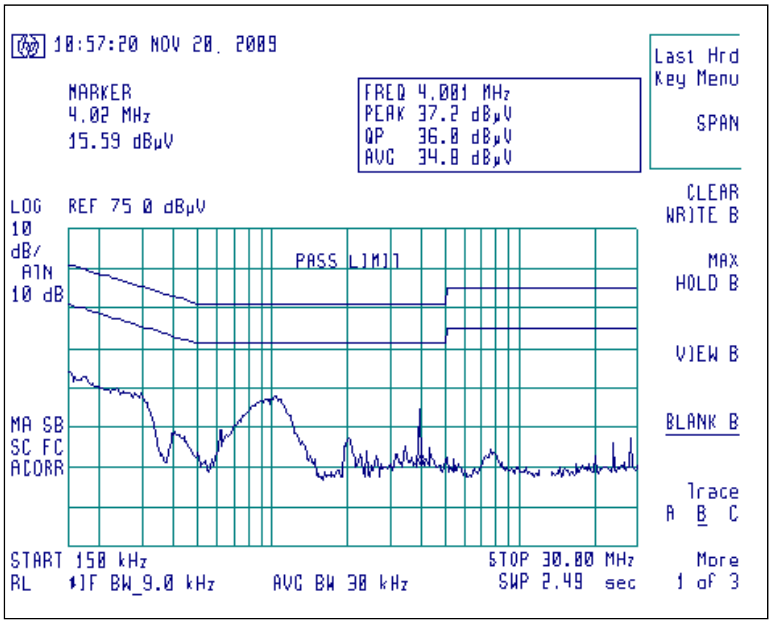


EXHIBIT 7. OCCUPIED BANDWIDTH:

7.1 Limits

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

7.2 Method of Measurements

Refer to ANSI C63.4 (2009) and FCC Procedures (2008) 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 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 HP E4446A spectrum analyzer. The loss from the cable was added on the analyzer from a correction factor file, thereby allowing direct measurements, without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 100 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.

7.3 Test Equipment List

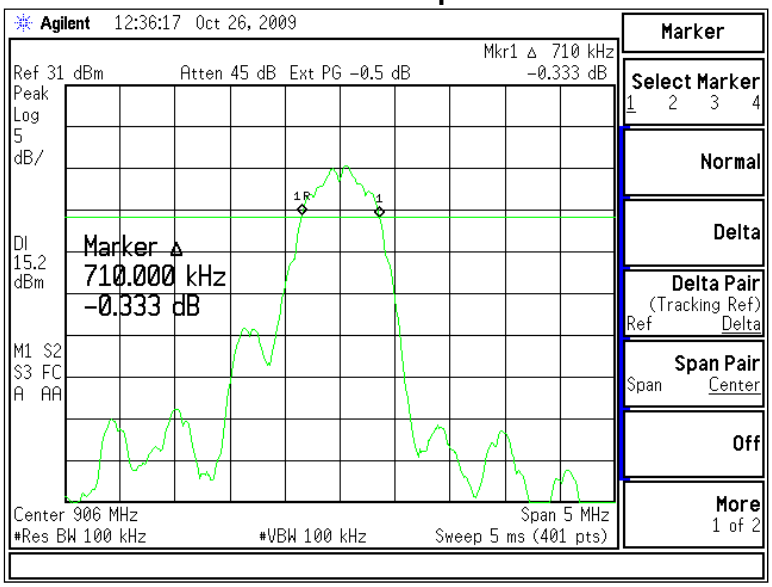
Please refer to Appendix A for a list of equipment used for this test.

7.4 Test Data

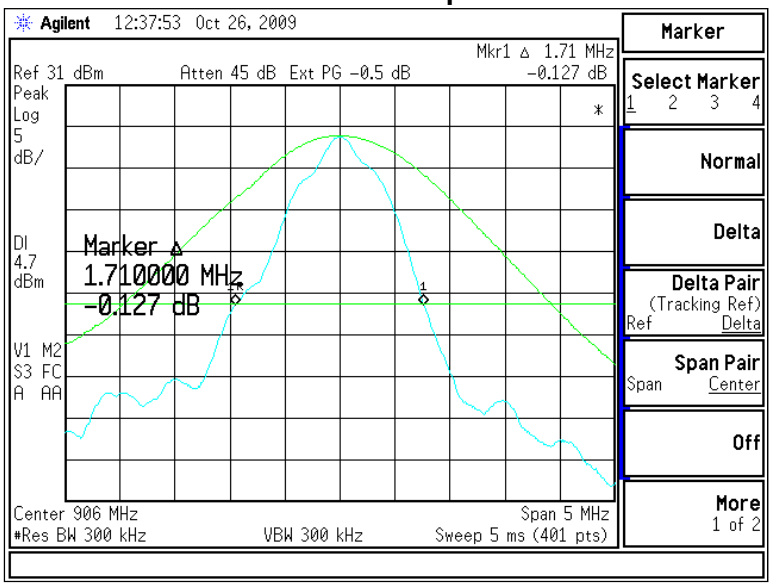
Channel	Center Frequency (MHz)	Measured -6 dBc Occupied Bandwidth (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc Occupied Bandwidth (kHz)
1	906	710	500	1710
5	914	715	500	1700
10	924	700	500	1392

7.5 Screen Captures - OCCUPIED BANDWIDTH

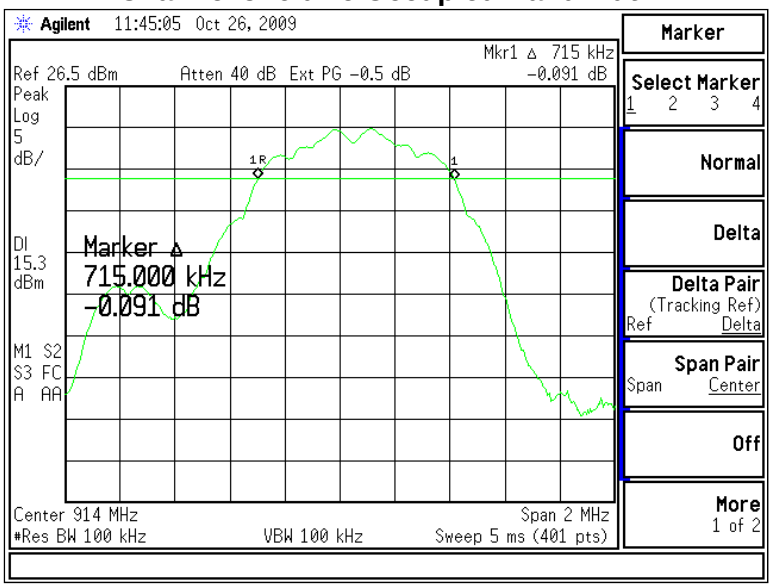
Channel 1 -6 dBc Occupied Bandwidth



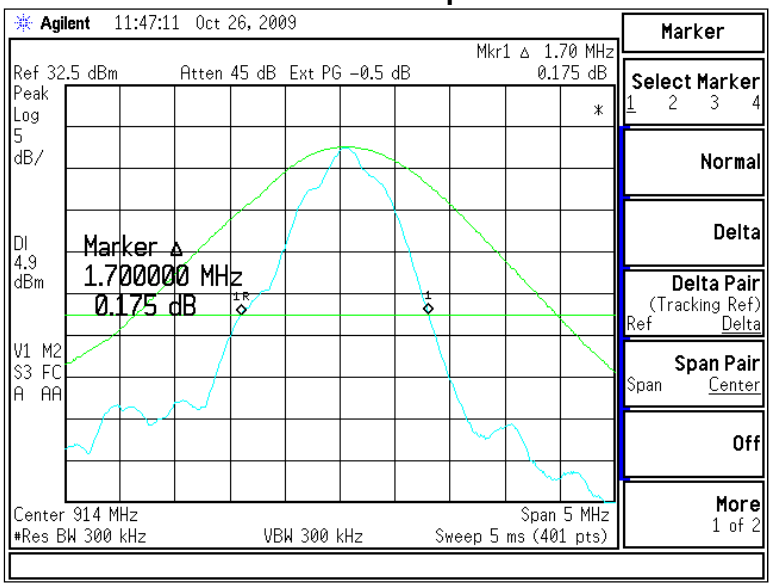
Channel 1 -20 dBc Occupied Bandwidth



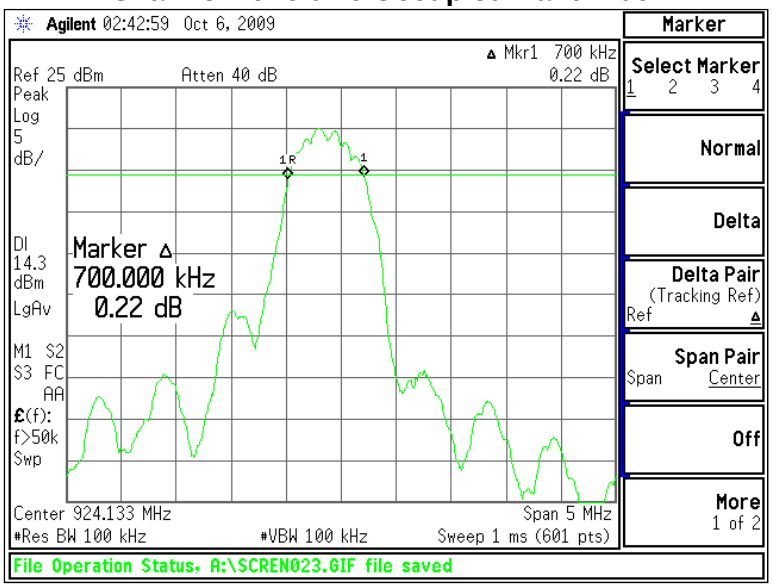
Channel 5 -6 dBc Occupied Bandwidth



Channel 5 -20 dBc Occupied Bandwidth



Channel 10 -6 dBc Occupied Bandwidth



Channel 10 -20 dBc Occupied Bandwidth

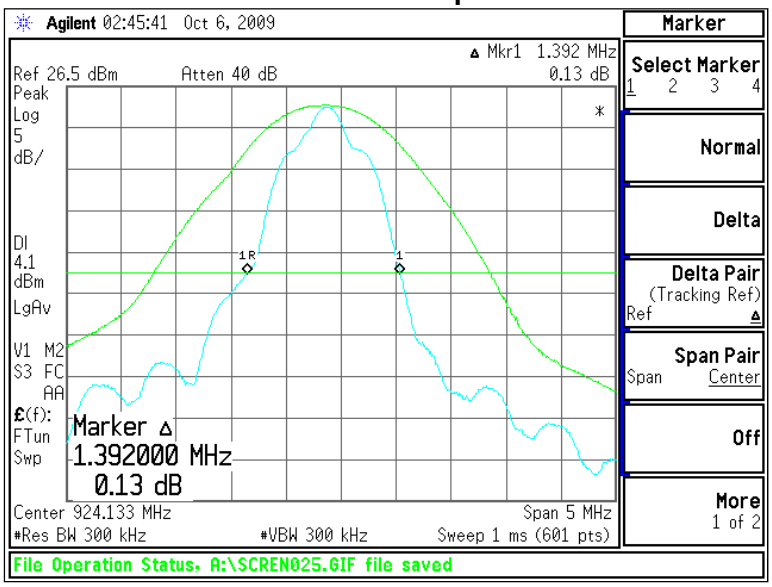


EXHIBIT 8. BAND-EDGE MEASUREMENTS

8.1 Method of Measurements

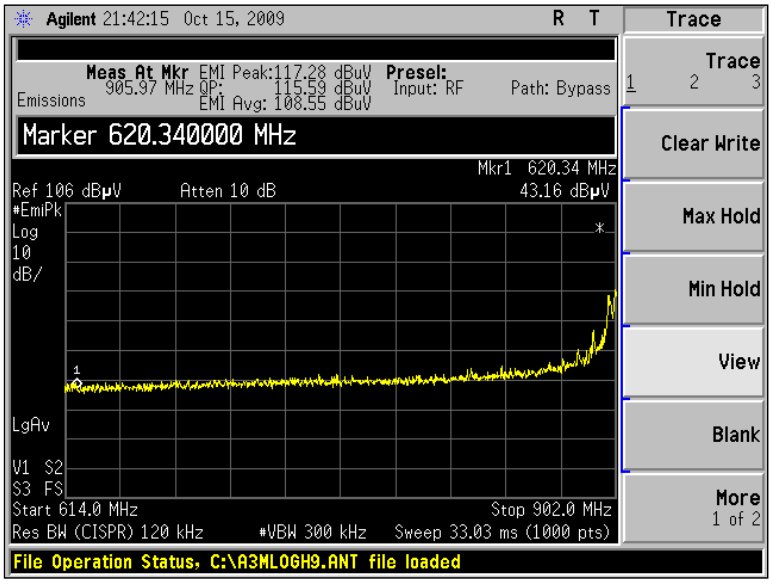
FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in tables 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 902-928 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, in this case, would be -20 dBc with respect to the fundamental level.

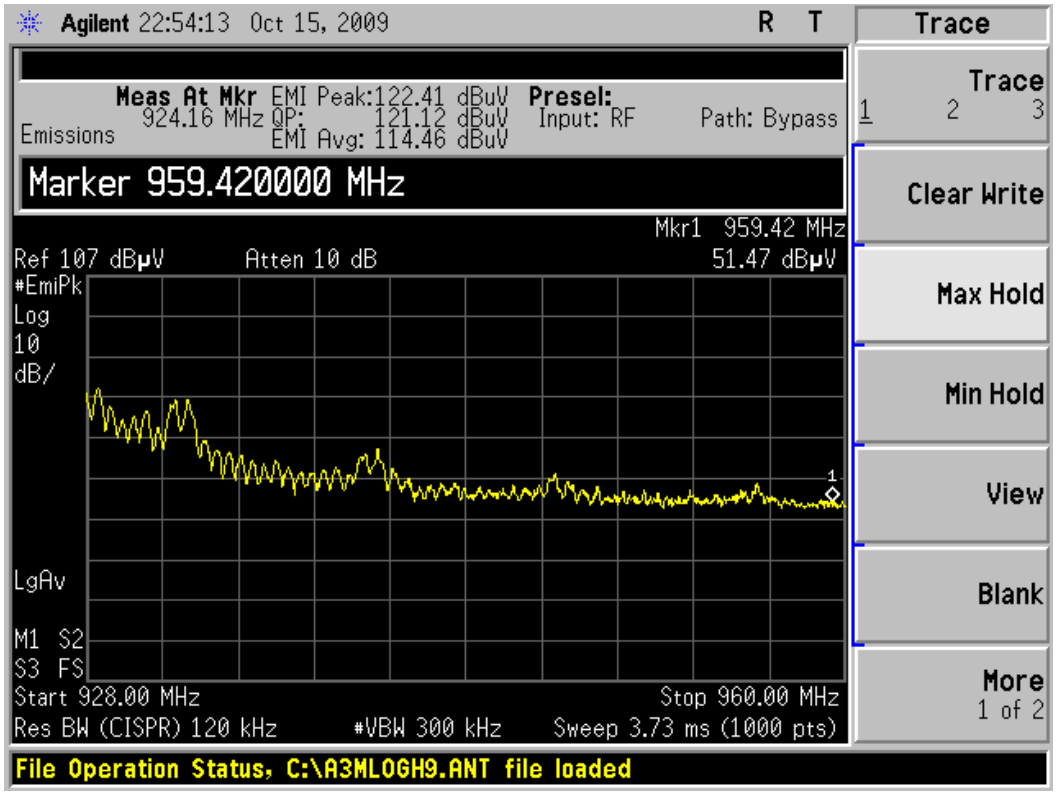
The Upper Band-Edge limit, in this case, would be + 54 dBµV/m at 3m.

8.2 Screen Captures

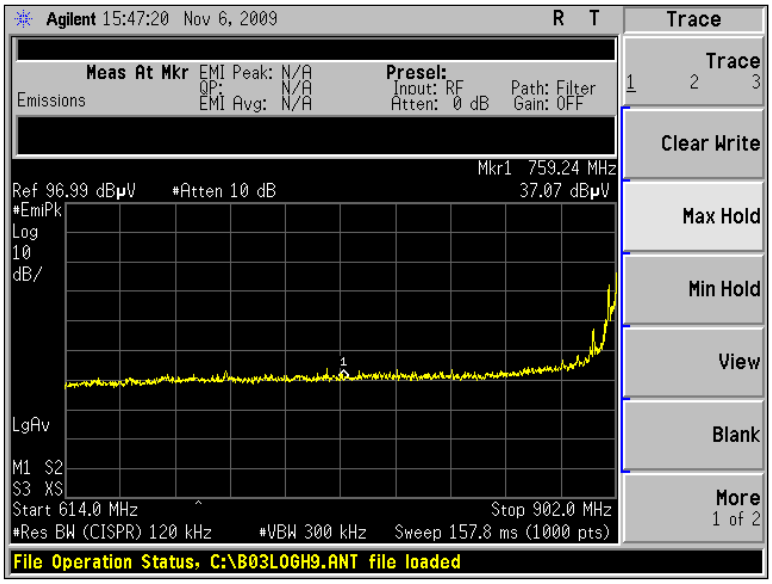
Screen Capture Demonstrating Compliance at the Low Band-Edge
BPSK
Wire Antenna



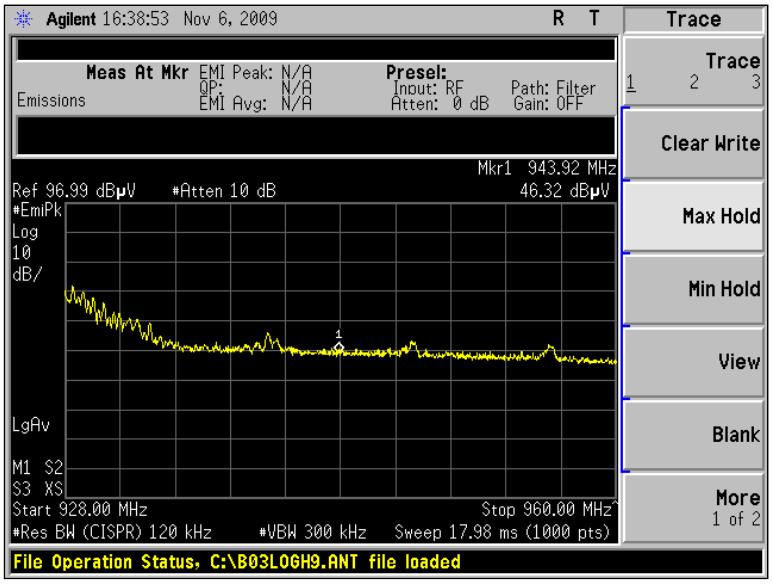
Screen Capture Demonstrating Compliance at the High Band-Edge
BPSK
Wire Antenna



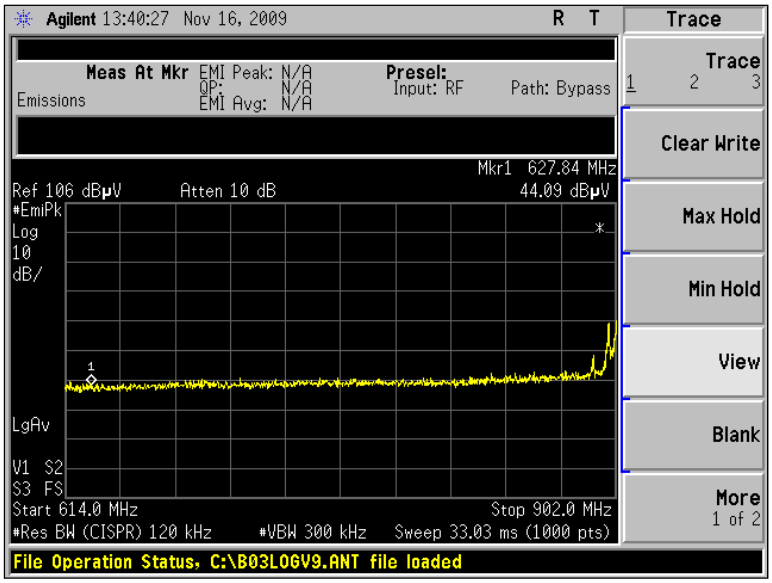
Screen Capture Demonstrating Compliance at the Low Band-Edge
BPSK
Dipole Antenna



Screen Capture Demonstrating Compliance at the High Band-Edge
BPSK
Dipole Antenna



Screen Capture Demonstrating Compliance at the Low Band-Edge
BPSK
Chip Antenna



Screen Capture Demonstrating Compliance at the High Band-Edge
BPSK
Chip Antenna

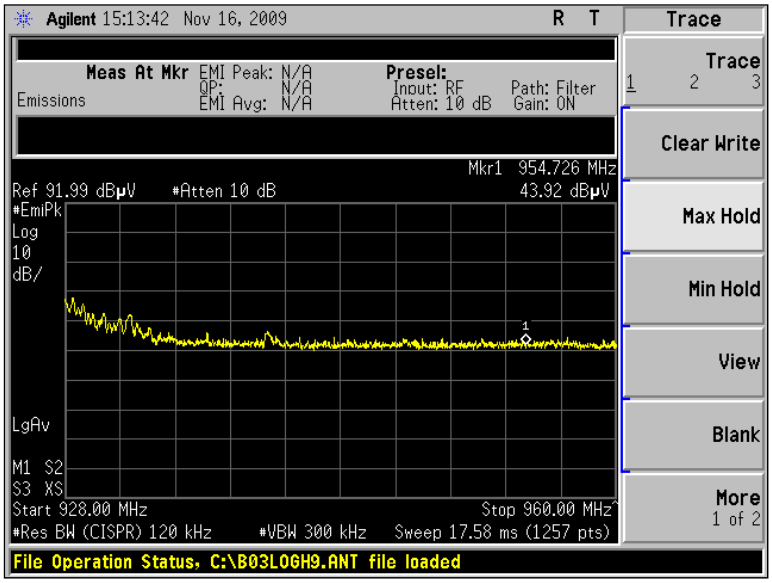


EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

9.1 Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable connected to the spectrum analyzer. The loss from the cable was added on the analyzer via correction factor files. The unit was configured to run in a continuous modulated transmit mode. The spectrum analyzer was used with resolution and video bandwidths set to 3 MHz, and a span of 10 MHz, with measurements from a peak detector presented in the chart below.

9.2 Test Equipment List

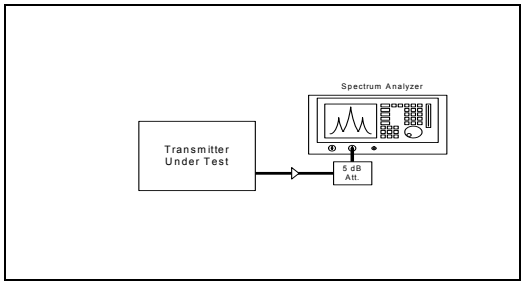
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

9.3 Test Data

Channel	Center Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dB)	Calculated EIRP (dBm)	EIRP Limit (dBm)	Calculated EIRP (mw)
0	906	25.13	30	4.87	30.47	36.0	1114.29
5	914	25.13	30	4.87	30.47	36.0	1114.29
10	924	24.91	30	5.09	30.25	36.0	1059.25

(1) EIRP Calculation:

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

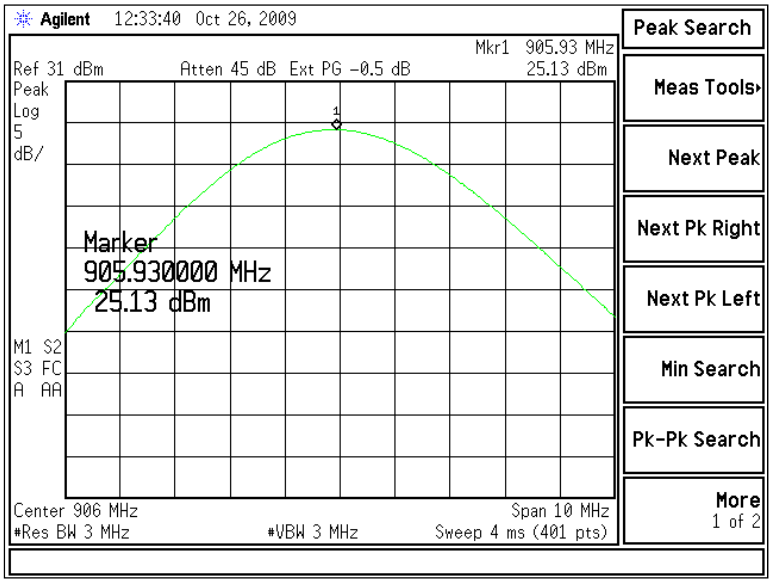


Rated RF power output (in watts): 0.316 W

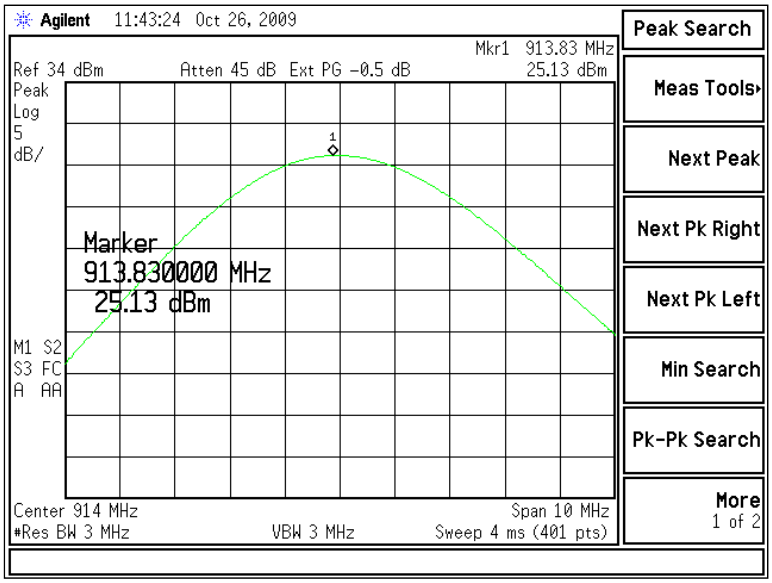
Measured RF Power Output (in Watts): 0.325 W
Declared RF Power Output (in Watts): 0.316 W

9.4 Screen Captures – Power Output (Conducted)

Channel 1



Channel 5



Channel 10

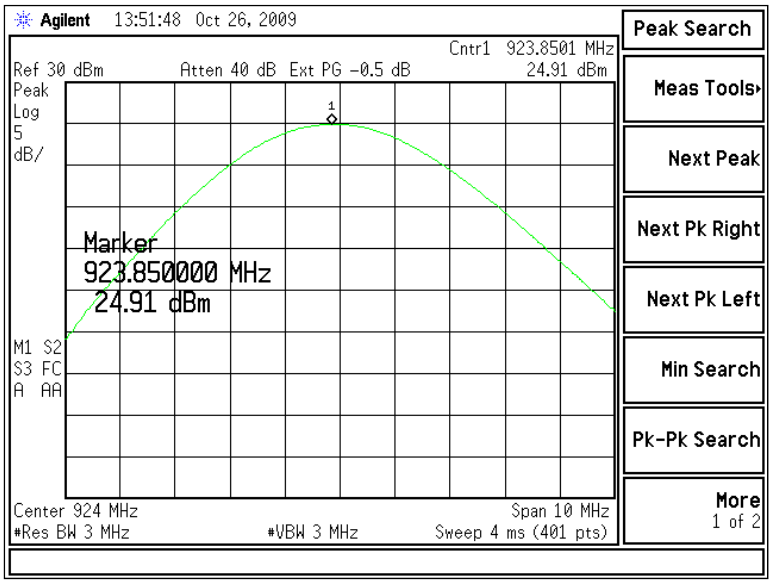

Agilent 13:51:48 Oct 26, 2009
Cntr1 923.8501 MHz
Ref 30 dBm
Atten 40 dB Ext PG -0.5 dB
24.91 dBm
Peak
Log
5
dB/
Marker
923.850000 MHz
24.91 dBm
M1 S2
S3 FC
A AA
Center 924 MHz
#Res BW 3 MHz
#VBW 3 MHz
Span 10 MHz
Sweep 4 ms (401 pts)
Peak Search
Meas Tools
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
More
1 of 2

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.

10.2 Test Equipment List

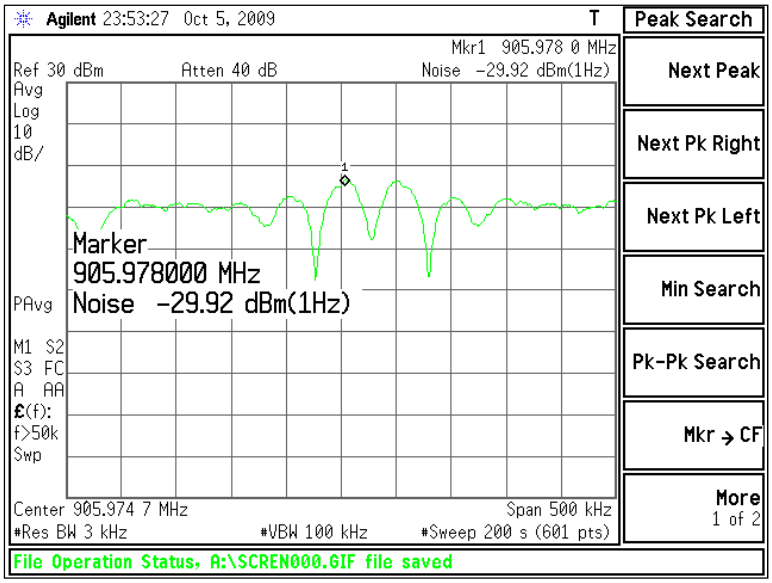
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

10.3 Test Data

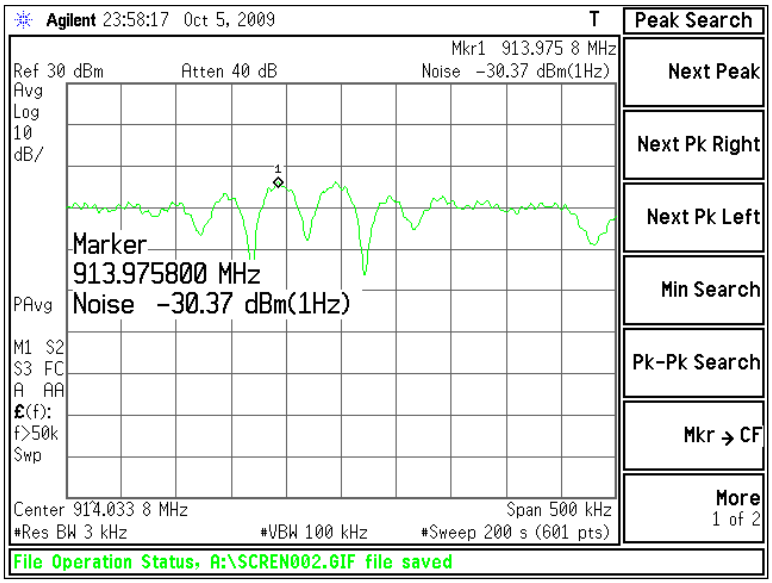
Channel	Center Frequency (MHz)	Measured Channel Power (dBm/1Hz)	3 kHz Correction (dB)	Corrected Power Measurement (dBm/3kHz)	Limit (dBm)	Margin
1	906	-29.92	34.77	4.85	8.0	3.2
5	914	-30.37	34.77	4.40	8.0	3.6
10	924	-30.6	34.77	4.17	8.0	3.8

10.4 Screen Captures – Power Spectral Density

Channel 1



Channel 5



Channel 10

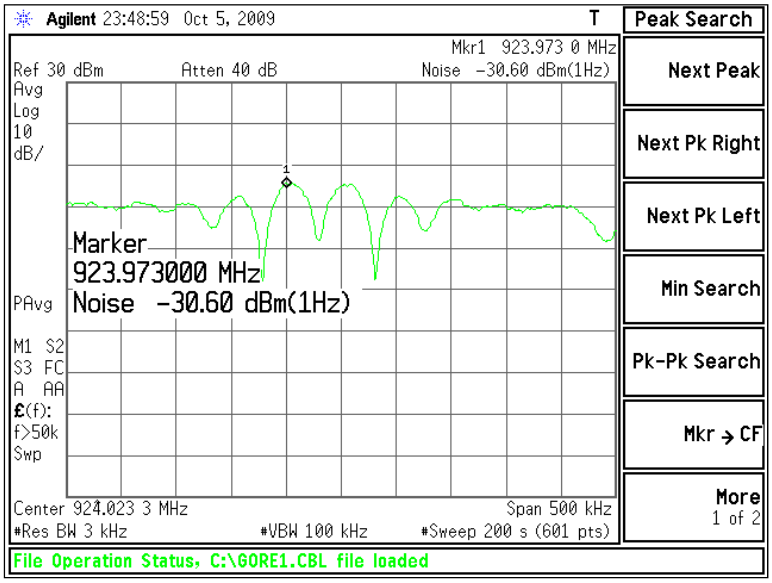


EXHIBIT 11. SPURIOUS CONDUCTED EMISSIONS: 15.247(d)

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.

For data from the radiated measurements, please refer to 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.

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

11.2 Test Equipment List

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

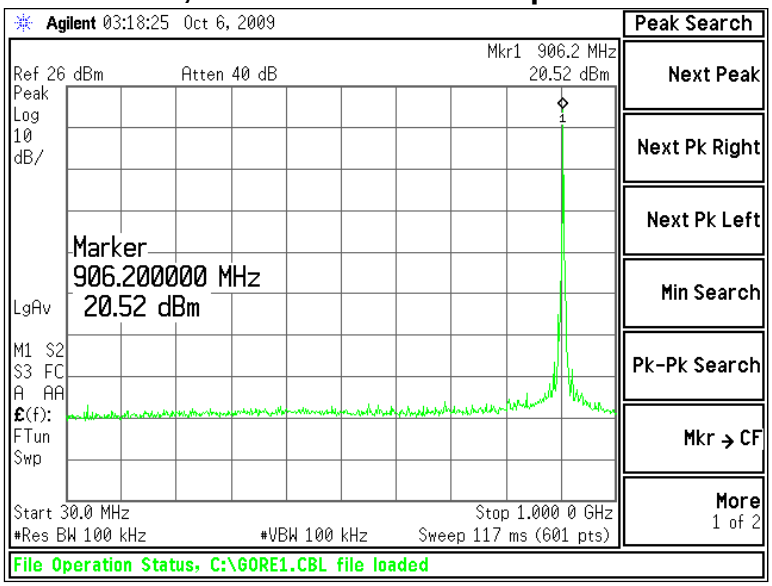
11.3 Test Data

	Channel 1	Channel 5	Channel 10
Fundamental	+ 20.52 (dBm)	+ 20.71 (dBm)	+ 23.51 (dBm)
2nd Harmonic	- 13.32 (dBm)	- 11.06 (dBm)	- 12.03 (dBm)
3rd Harmonic	- 42.33 (dBm)	- 42.00 (dBm)	Note (1)
4th Harmonic	Note (1)	Note (1)	Note (1)
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)

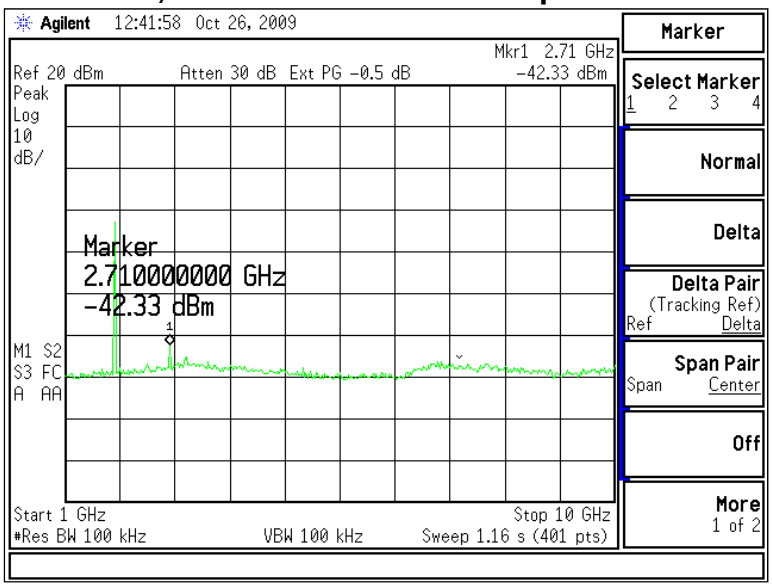
Notes:
(1) Measurement at system noise floor.

11.4 Screen Captures – Spurious Radiated Emissions

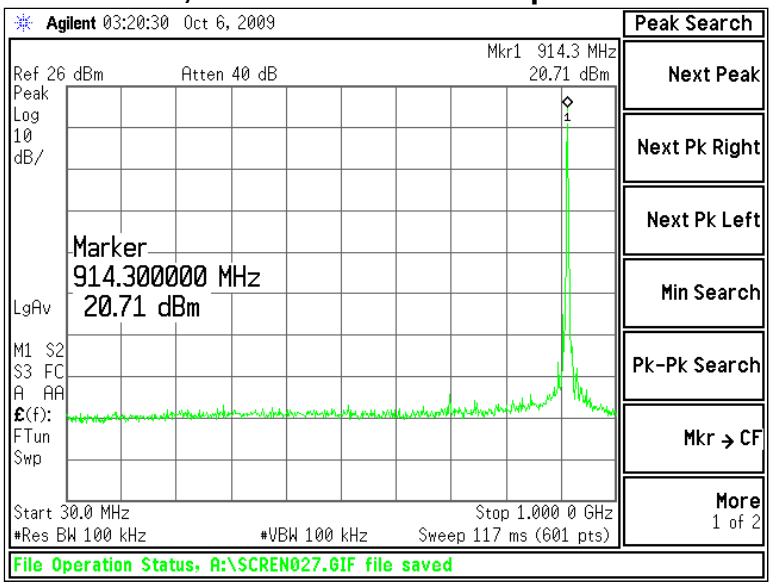
Channel 1, shown from 30 MHz up to 1000 MHz



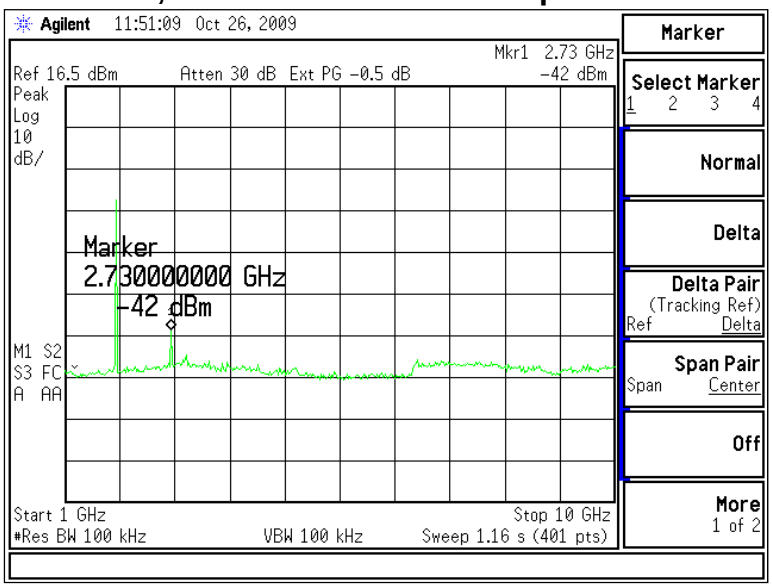
Channel 1, shown from 1000 MHz up to 10000 MHz



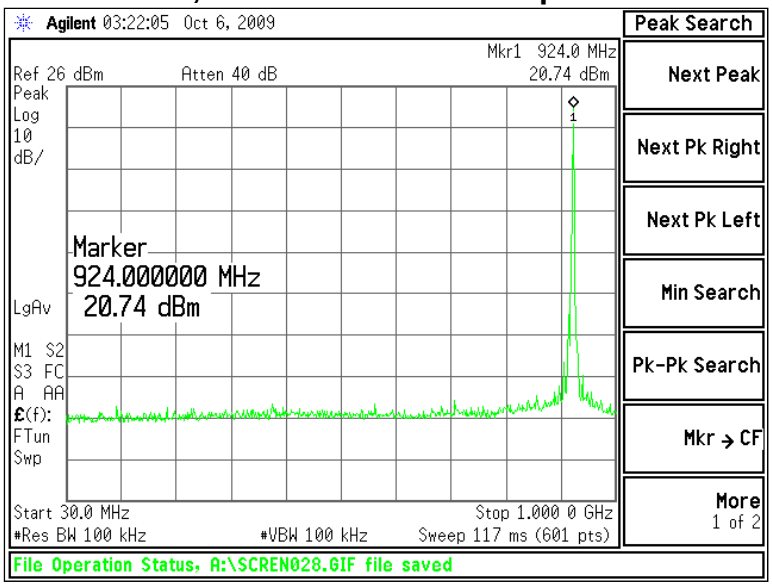
Channel 5, shown from 30 MHz up to 1000 MHz



Channel 5, shown from 1000 MHz up to 10000 MHz



Channel 10, shown from 30 MHz up to 1000 MHz



Channel 10, shown from 1000 MHz up to 10000 MHz

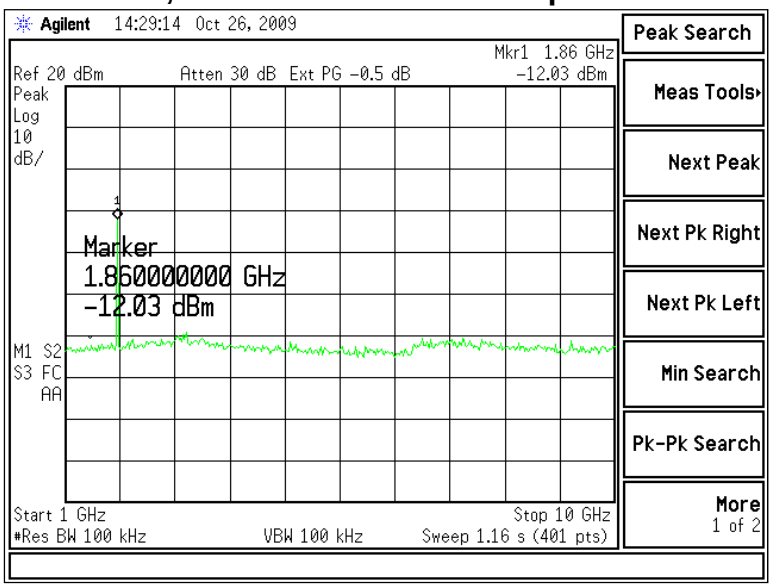


EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE & TEMPERATURE VARIATIONS

The stability of the device was examined as a function of the input voltage available to the EUT.For measurements of the frequency and voltage stability, the transmitter was placed inside a temperature controlled environmental chamber (Thermotron S-8C). A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers. For this test, the EUT was place inside a temperature chamber, with the transmitter portion of the EUT placed in CW modulated continuous transmit mode. Power was supplied by an external bench-type variable power supply, and the frequency of operation was monitored via a conducted measurement. The spectrum analyzer was placed outside of the thermal chamber and an sma cable was fed through a porthole on the side of the chamber and connected to the module.

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.

		2.8 VDC	3.3 VDC	3.8 VDC
		Frequency in MHz		
-20° C	Channel 1	906.008900	906.008800	906.009170
	Channel 5	914.008200	914.008700	914.008670
	Channel 10	924.008570	924.007730	924.008700
25° C	Channel 1	906.003550	906.003330	906.003830
	Channel 5	914.002930	914.003320	914.003380
	Channel 10	924.003350	924.003700	924.003570
55° C	Channel 1	905.994830	905.994930	905.995130
	Channel 5	913.994570	913.994800	913.994970
	Channel 10	923.994100	923.994700	923.995030

The RF Power Output of the EUT was also monitored in a separate test, also using a Spectrum Analyzer with RBW=VBW=3 MHz setting while the voltage was varied.

		2.8 VDC	3.3 VDC	3.8 VDC
			Power in dBm	
-20° C	Channel 1	21.58	22.47	23.08
	Channel 5	21.57	22.32	22.91
	Channel 10	21.41	22.19	22.71
25° C	Channel 1	21.34	22.22	22.91
	Channel 5	21.33	22.11	22.70
	Channel 10	21.22	21.96	22.49
55° C	Channel 1	20.94	21.79	22.39
	Channel 5	20.92	21.68	22.29
	Channel 10	20.81	21.57	22.10

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characterizes were well behaved, and the system returned to the same state of operation as before the power cycle.

At the extreme temperature settings, a wide frequency sweep was also investigated, with minimum and maximum input voltages, to ensure that no unexpected anomalies have occurred.

No anomalies were noted, in the measured transmit power, during the voltage variation tests.

EXHIBIT 13. MPE CALCULATIONS

The following MPE calculations are based on a Nearson dipole antenna, with a measured ERP of 125.7 dBµV/m, at 3 meters, and conducted RF power of +25.13 dBm as presented to the antenna. The calculated gain of this antenna, based on the ERP measurements is 5.34 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:	25.13	(dBm)
Maximum peak output power at antenna input terminal:	325.837	(mW)
Antenna gain(typical):	5.34	(dBi)
Maximum antenna gain:	3.420	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	900	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.6	(mW/cm^2)
Power density at prediction frequency:	0.221682	(mW/cm^2)
Maximum allowable antenna gain:	9.7	(dBi)
Margin of Compliance at 20 cm =	4.3	dB

APPENDIX A

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Radiated Emissions Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	12/23/2008	12/23/2009	Active Calibration
2	AA 960077	Bicon Antenna	EMCO	93110B	9702-2918	11/24/2008	11/24/2009	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/20/2008	10/20/2009	Active Calibration
4	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	3/7/2009	3/7/2010	Active Calibration
5	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
6	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Band-Edge Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/20/2008	10/20/2009	Active Calibration
2	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	3/7/2009	3/7/2010	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

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Occupied Bandwidth (6dB & 20dB) Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Conducted Power Output Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Power Spectral Density Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Spurious Emissions Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Radiated Emissions (109) Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	12/23/2008	12/23/2009	Active Calibration
2	AA 960077	Bicon Antenna	EMCO	93110B	9702-2918	11/24/2008	11/24/2009	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/20/2008	10/20/2009	Active Calibration
4	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	3/7/2009	3/7/2010	Active Calibration
5	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	Active Calibration
6	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2009 Type Test : Conducted Emissions Job # : C-720

Prepared By: L Bott Customer : LSR Quote #: 309308

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	9/17/2009	9/17/2010	Active Calibration
2	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	9/17/2009	9/17/2010	Active Calibration
3	AA 960031	Transient Limiter	HP	11947A	3107A01708	9/15/2009	9/15/2010	Active Calibration
4	AA 960075	LISN	EMCO	3810/2NM	9612-1710	9/16/2009	9/16/2010	Active Calibration

APPENDIX B
TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

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		
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	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		

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-4	2004-07		
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		
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 2006	
Note 1: Test not on LSR Scope of Accreditation.			

Updated on 10-21-09

APPENDIX C
Uncertainty Statement

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

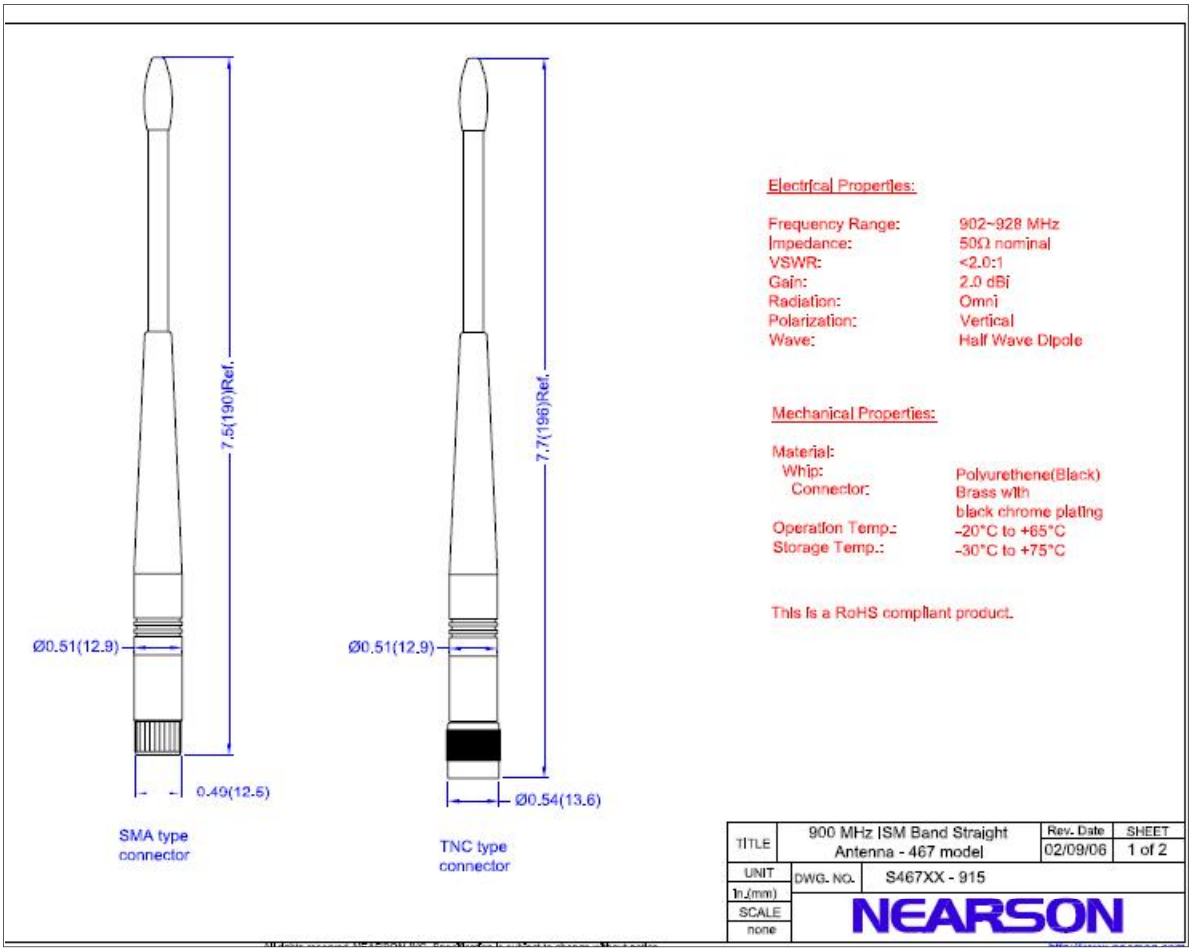
Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

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)

Nearson Dipole



Helical SMD-Antenna

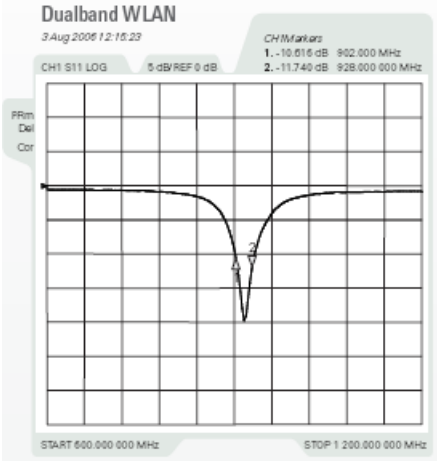
ISM 900MHz

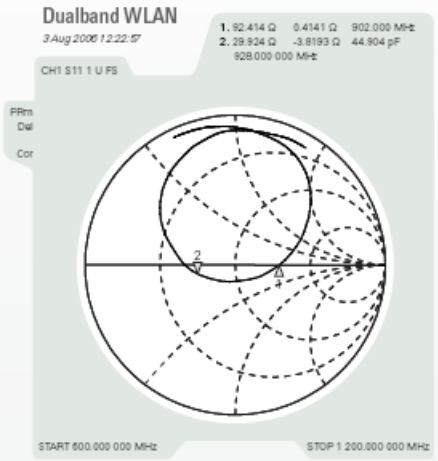
Typical performance (testboard size 100 x 40 mm, PWB ground clearance area 6.00 x 11.00 mm)

Frequency Range [MHz]	Max Gain [dBi]	Efficiency [%] / [dB]	Return loss min. [dB]	Impedance [Ω]	Operating Temperature [°C]
902 – 928	0.9 (peak) -0.3 (band edges)	67 / -1.7 (peak) 50 / -3 (band edges)	-10	50	-40 to +85

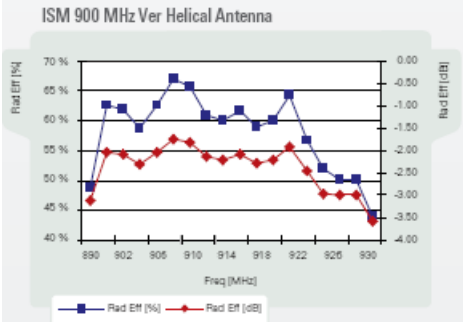
Typical Electrical Characteristics (T=25 °C)

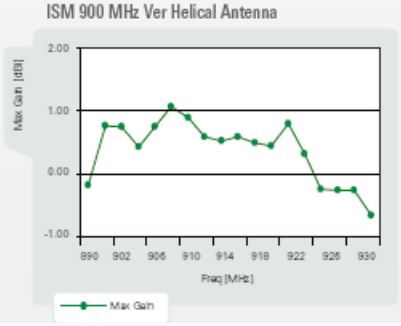
Typical Return Loss S11/ impedance,
measured on the 100 x 40 mm test board with matching circuit





Free space efficiency and maximum gain, PWB ground clearance area 6.00 x 11.00 mm





Typical Free space Radiation Patterns