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

TEST REPORT #: 310038
LSR Job #: C-881

Compliance Testing of:
AvaLAN AW2400MR Ethernet Bridge
Serial Number: AV10120140008

Test Date(s):
July 31st – September 19th, 2010

Prepared For:
AvaLAN Wireless
Attn: Mike Derby
125A Castle Drive
Madison, AL 35758

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 2400 MHz – 2483.5 MHz

This Test Report is issued under the Authority of:
Thomas T. Smith, Manager EMC Test Services

Signature: Date: 10.04.10

Quality Assurance:	**Project Engineer:**
Ryan Urness, EMC Laboratory Manager	Khairul Zainal, Sr. EMC Engineer
Signature: Date: 10.04.10	Signature: Date: 10.04.10

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EXHIBIT 1 INTRODUCTION

1.1 SCOPE

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

1.2 NORMATIVE REFERENCES

Publication	Year	Title
47 CFR, Parts 0-15 (FCC)	2009-10	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	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	2010-01	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003 A1: 2004-04 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	2007	Measurement of Digital Transmission Systems operating under Section 15.247.

1.3 LS Research, LLC TEST FACILITY

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

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. 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:

- Semi-Anechoic Compact Chamber
- Semi-Anechoic FCC-Listed 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 by accredited calibration laboratories conforming to the requirements of ISO/IEC 17025, and traceable to the SI standard.

EXHIBIT 2 PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	AvaLAN Wireless
Address:	125A Castle Drive Madison, AL 35758
Contact Name:	Mike Derby

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

Product Name:	Wireless Ethernet Bridge
Model Number:	AW2400MR
Serial Number:	AV10120140008

2.3 ASSOCIATED ANTENNA DESCRIPTION

Aw2-2400 Omni-directional Monopole – Maximum Gain: 5dBi

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

EUT Frequency Range (in MHz)	2416.667 MHz – 2475.000 MHz
RF Power in Watts	
Minimum:	0.051286 W
Maximum:	0.066069 W
Conducted Output Power (in dBm)	18.2 dBm
Field Strength at 3 meters	120.77dBµV/m
Occupied Bandwidth (99% BW)	2.75 MHz
Type of Modulation	FSK
Emission Designator	2M75F1D
EIRP (in mW)	208.93 mW
Transmitter Spurious (worst case) at 3m	61.35 dBµV/m @ 7318.749 MHz
Frequency Tolerance %, Hz, ppm	< 100ppm
Microprocessor Model # (if applicable)	XC1220-R3004
Antenna Information	
Detachable/non-detachable	Detachable
Type	Omni-Directional Monopole
Gain (in dBi)	5dBi (Max)
EUT will be operated under FCC Rule Part(s)	47 CFR Part 15 Subpart C Section 15.247
EUT will be operated under RSS Rule Part(s)	RSS-210, Issue 7, Annex 8
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile
Receiver Bandwidth	1.75 MHz
Receiver Sensitivity	-97dBm at 10^{-4} BER
Type of De-Modulation	FSK, DSSS
Receiver Spurious (worst case) at 3m	40.78 dBµV/m @ 3m (350 MHz)
EUT will be operated under FCC and IC Rule Part(s)	FCC: 47 CFR Part 15 Subpart B Section(s) 15.109 and 15.107 IC: RSS-GEN 2007 and RSS-210, Issue 7, 2007

RF Technical Information:

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

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

- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100%
- Standard used for evaluation: OET Bulletin 65
- Measurement Distance: 3m
- RF Value: 0.41565 ☐ V/m ☐ A/m ☒ W/m^2
  ☒ Measured ☐ Computed ☐ Calculated

2.5 PRODUCT DESCRIPTION

The AvaLAN AW2400 is a point to multi-point Ethernet Bridge that operates in the 2.4 GHz ISM band. The product has an HTTP interface and automatically selects one of twelve available non-overlapping frequency channels by monitoring the data error rate of the receiver.

When transmitting, data enters the system through a 10/100 Ethernet RJ45 connector and is held in a buffer until the system is able to process the data. Once the system is ready, it encrypts the data using a 128Bit key. The data is then scrambled using a 5/6 coding DSSS technique to ensure spectral whiteness of better than 8dBm/3KHz. The data is then sent to the RF Section at 1.5Mb/s and is FSK modulated and then transmitted through the antenna port. The occupied bandwidth is 2MHz and the FSK frequency deviation is 512 kHz.

When receiving, data enters through the antenna port. The radio energy is then FSK demodulated, clocks recovered, reframed and send to the DSSS demodulator to extract the data stream. This section also monitors the error rate of the passing data and reports to the baseband controller the performance of the current radio channel. The data departs the demodulator and is decrypted and sent to the buffer to be sent out the RJ45 Ethernet connector.

Channel changing is handled by the baseband controller receiving error information from the receive demodulator. If excessive errors are detected the baseband will initiate a channel change sequence by transmitting a channel change bit in the next transmission. The units then change channel on the next transmitted packet.

PHOTO (Optional)

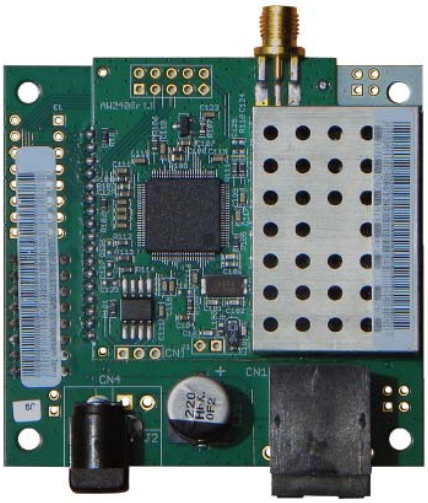


EXHIBIT 3 EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	23° C
Humidity:	44 %RH
Pressure:	101.58 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)**

Lower and Upper Channels were removed for Band-edge compliance purposes. Lower Channels removed were 2404.167 MHz (1) to 2414.583 MHz (6). Upper Channels removed were 2477.083 MHz (36) to 2479.167 MHz (37).

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☐ **None** ☒ **Yes (explain below)**

Measurements of radiated harmonics were taken prior to the lower and upper channel removal; and as such, the represented harmonics are represented as exemplar and are from channel 1, 18, and 37 rather than channel 7, 18, and 35.

EXHIBIT 4 DECLARATION OF CONFORMITY

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

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated with final testing performed using continuous transmit mode, using power as provided by the customer provided 12V DC Class 2 AC Adapter. The unit has the capability to operate on 29 channels, controllable via PCB dip-switches.

The applicable limits apply at a 3 meter distance. Measurements above 4 GHz were performed at a 1 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2416.667 MHz), middle (2439.583MHz) and high (2475.000MHz) to comply with FCC Part 15.31(m).

5.2 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT for measurements between 30 MHz to 4000 MHz; and the EUT was placed on a non-conductive pedestal in the Semi-Anechoic Compact Chamber, with the antenna mast placed such that the antenna was 1 meter from the EUT for measurements between 4000 MHz to 25000 MHz.

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 from 18 GHz to 25 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height in the 3 meter Chamber, and between 1 and 1.8 meters in height in the Compact Chamber, using both horizontal and vertical antenna polarities. Pre-amplifiers were utilized for measurements between 4 GHz and 25 GHz.

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

5.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an Agilent E4445A/N9039A EMI System. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the 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. These correction factors are loaded onto the EMI receiver when measurements are performed:

Reported Measurement data = Raw receiver measurement (dBµV/m) + Antenna correction Factor + Cable factor (dB) + Miscellaneous factors when applicable (dB) – amplification factor [when applicable] (dB).

The EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz).

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	500	54.0	63.5

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

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

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

Generic example of reported data at 200 MHz:

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

5.6 RADIATED EMISSIONS TEST DATA CHART

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

Manufacturer:	AvaLAN Wireless					
Date(s) of Test:	July 31st – Sept 19th, 2010					
Test Engineer(s):	Johnny Lineau, Ryan Urness, and Peter Feilen					
Voltage:	12V DC					
Operation Mode:	Continuous Transmit					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
		Battery		Other: 12V DC		
EUT Placement:	X	80cm non-conductive table		10cm Spacers		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

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

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
149.99	H/TT	3.27	281	31.5	43.5	12.0
199.98	H/TT	1.69	94	26.2	43.5	17.3
295.78	H/TT	1.00	0	25.1	46.0	20.9
42.66	V/TT	1.00	0	30.8	40.0	9.2
100.01	V/TT	1.00	159	27.6	43.5	15.9
149.99	V/TT	1.00	195	36.8	43.5	6.7
250.00	V/TT	1.00	169	35.0	46.0	11.0
349.99	H/TT	2.86	0	29.7	46.0	16.3
471.92	V/TT	1.00	0	27.2	46.0	18.8
349.99	V/TT	1.41	0	42.9	46.0	3.1
2260.00	V/TT	1.00	0	43.7	54.0	10.3
3570.00	V/TT	1.00	0	50.3	54.0	3.7

RADIATED EMISSIONS DATA CHART *(continued)*

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

Frequency (MHz)	Ant./EUT Polarity	EUT Ant Config	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2404.167	H/V	H/Str	1.12	254°	120.58	125.23	4.65
4808.334	H/S	V/90°	1.13	37°	57.31	63.5	6.19
7212.501	V/F	H/Str	1.12	334°	61.61	100.6	38.99
9616.668	H/F	H/Str	1.00	307°	55.49	100.6	45.11
12020.84	V/F	V/90°	1.07	278°	48.02	63.5	15.48
14425.00	--	--	--	--	Note 3	--	--
16829.17	--	--	--	--	Note 3	--	--
19233.34	V/V	V/Str	1.00	150°	43.00	63.5	20.5
21637.50	H/F	V/Str	1.00	219°	41.93	100.6	58.67
24041.67	--	--	--	--	Note 3	--	--

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 18:

Frequency (MHz)	Ant./EUT Polarity	Host Mode	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2439.583	H/S	H/Str	1.10	263°	120.77	125.23	4.46
4879.166	H/S	V/Str	1.13	43°	57.84	63.5	5.66
7318.749	H/V	V/90°	1.00	155°	61.35	63.5	2.15
9758.332	H/S	V/90°	1.12	0°	57.22	100.8	43.58
12197.92	H/V	V/Str	1.13	99°	54.35	63.5	9.15
14637.50	H/S	V/Str	1.08	305°	51.83	100.8	48.97
17077.08	--	--	--	--	Note 3	--	--
19516.66	H/F	H/Str	1.00	234°	42.23	63.5	21.27
21956.25	H/V	V/Str	1.00	31°	43.86	100.8	56.94
24395.83	--	--	--	--	Note 3	--	--

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 37:

Frequency (MHz)	Ant./EUT Polarity	Host Mode	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2479.167	H/S	H/Str	1.08	262°	119.41	125.23	5.82
4958.334	V/S	V/90°	1.02	323°	56.98	63.5	6.52
7437.501	H/S	V/90°	1.01	4°	58.85	63.5	4.65
9916.668	H/S	V/90°	1.04	8°	54.55	99.4	44.85
12395.84	--	--	--	--	Note 3	--	--
14875	--	--	--	--	Note 3	--	--
17354.17	--	--	--	--	Note 3	--	--
19833.34	V/S	V/Str	1.00	132°	41.85	63.5	21.65
22312.5	V/S	V/Str	1.00	0°	42.72	63.5	20.78
24791.67	V/S	V/Str	1.00	344°	43.42	99.4	55.98

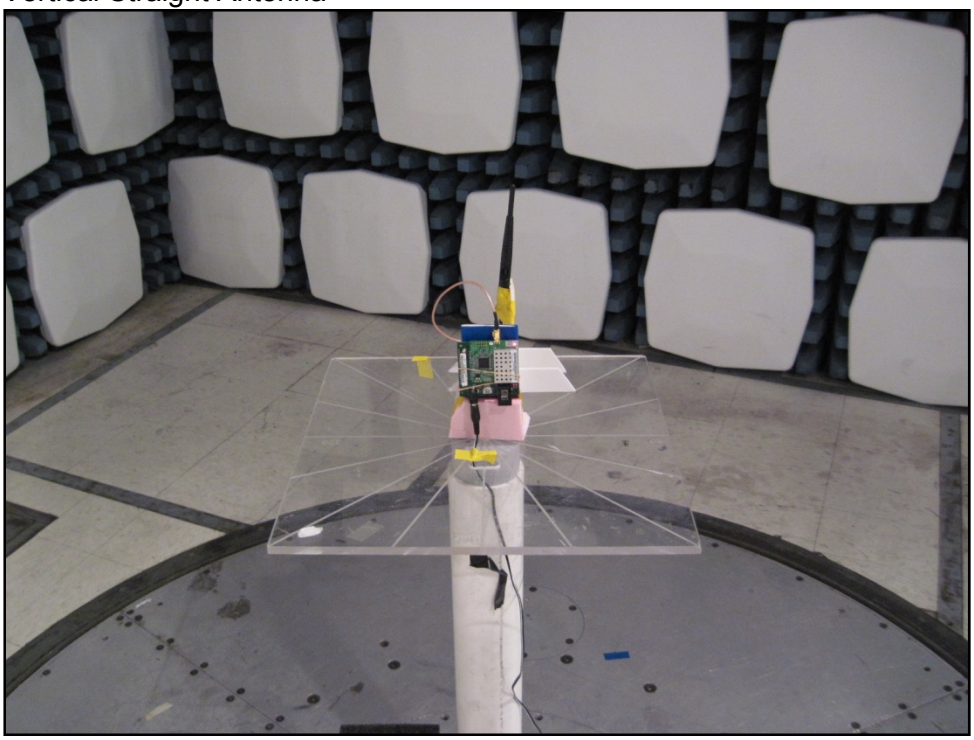
Notes:

1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as a 10 Hz Video Averaged Peak Detector was used in measurements above 1 GHz. Only the results from the Video Averaged detector are published in the table above. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
2) Measurements above 4 GHz were made at 1 meters of separation from the EUT.
3) Measurement at receiver system noise floor.
4) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.
5) H = Horizontal, V = Vertical, S = Side, F = Flat, Str = Straight, 90° = EUT antenna bent 90°

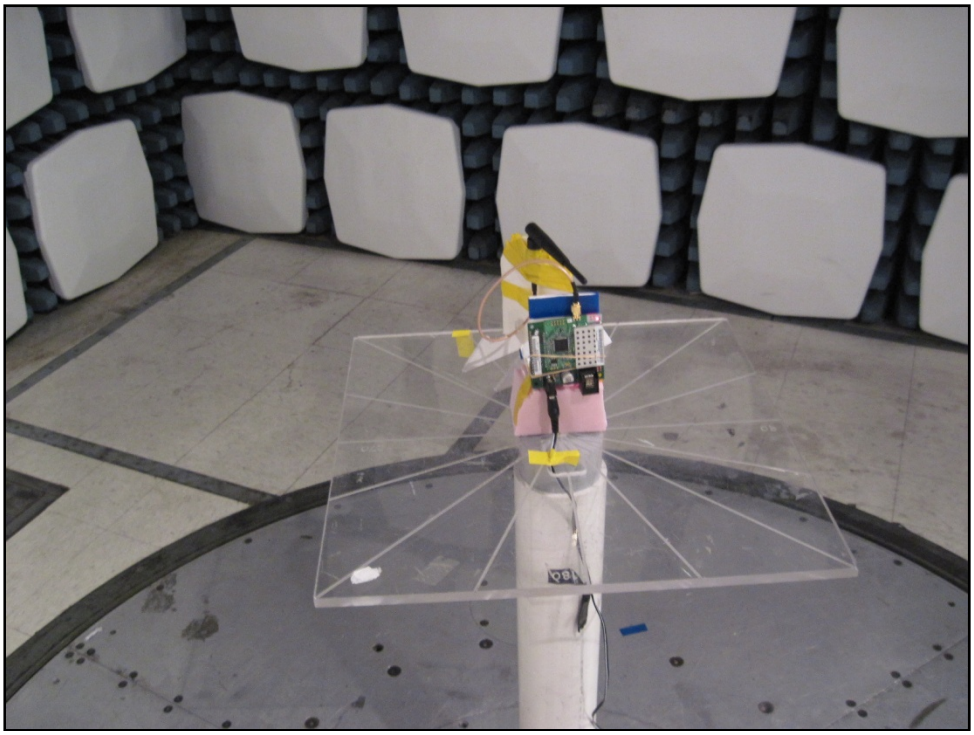
5.7 Test Setup Photo(s) – Radiated Emissions Test

Vertical Board Orientation

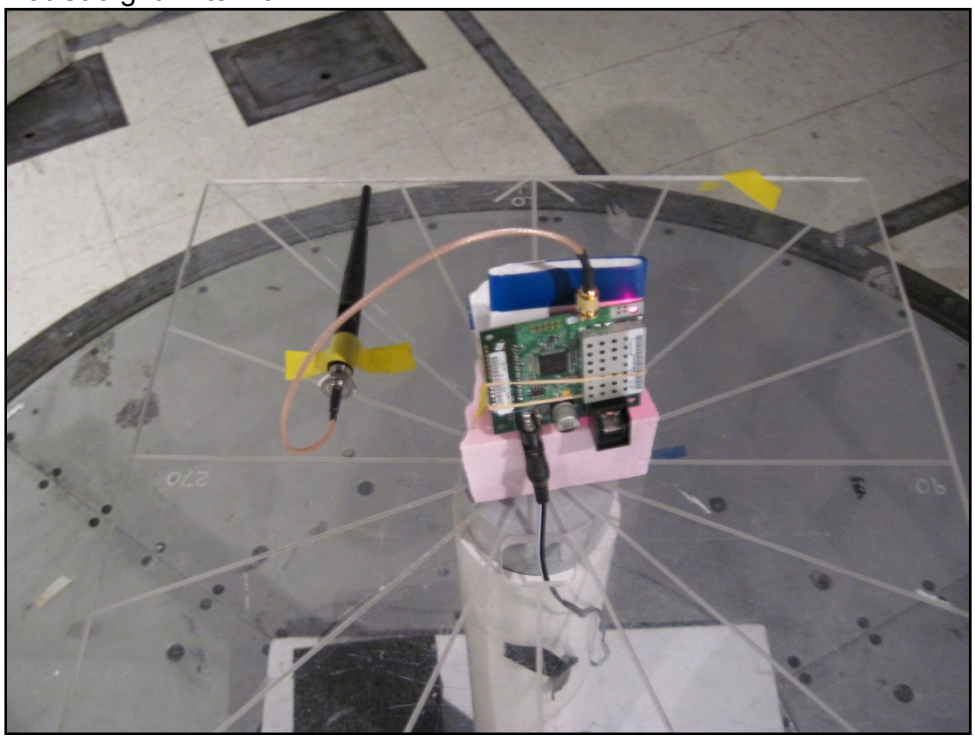
Vertical Straight Antenna



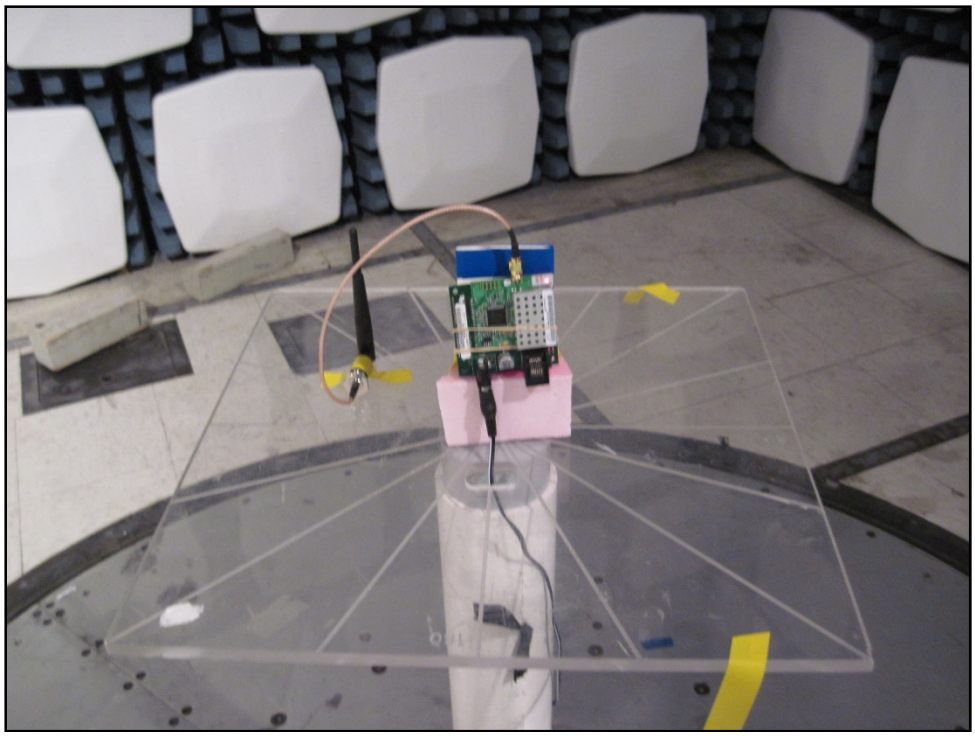
Vertical 90° Bent Antenna



Flat Straight Antenna

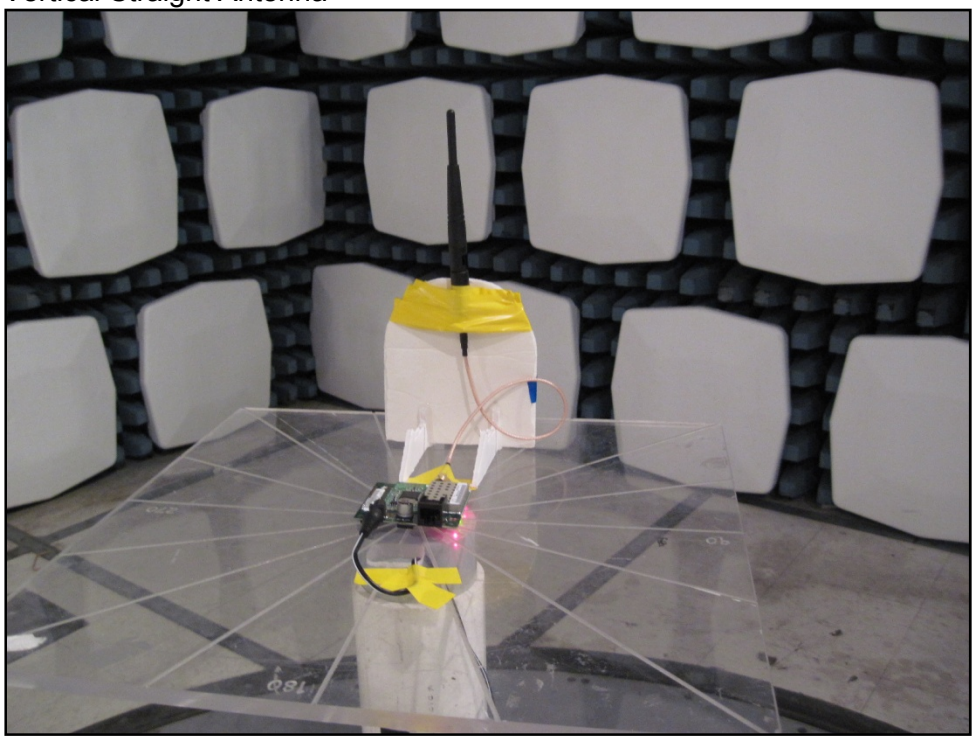


Flat 90° Bent Antenna

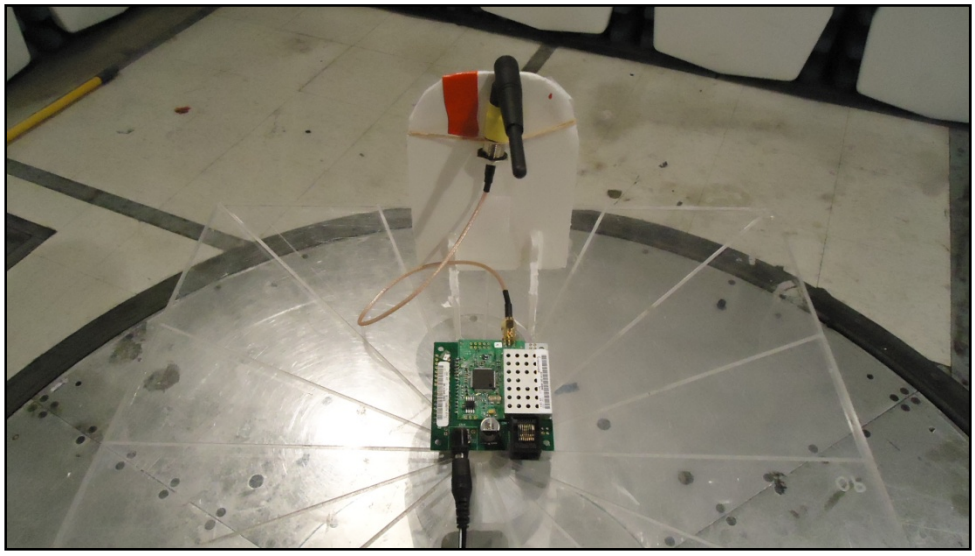


Flat Board Orientation

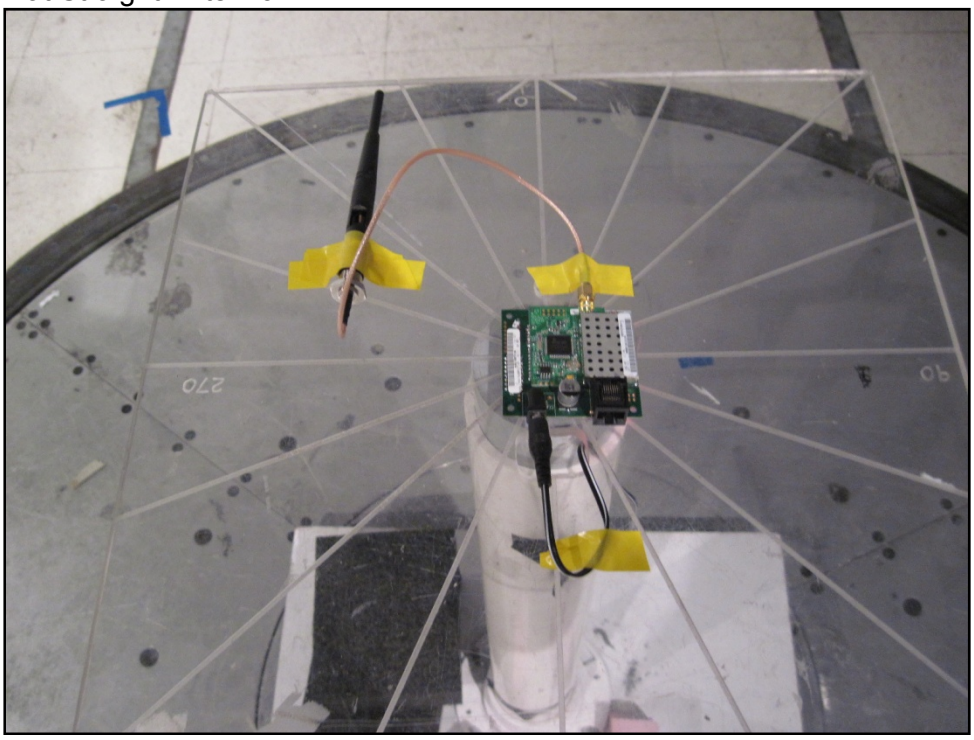
Vertical Straight Antenna



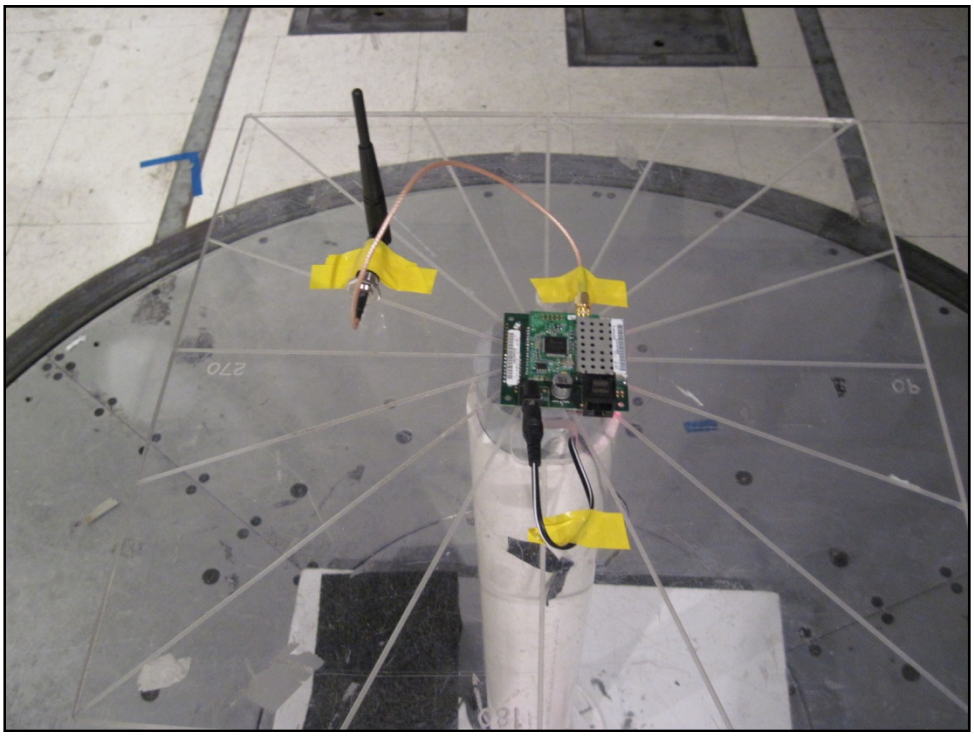
Vertical 90° Bent Antenna



Flat Straight Antenna

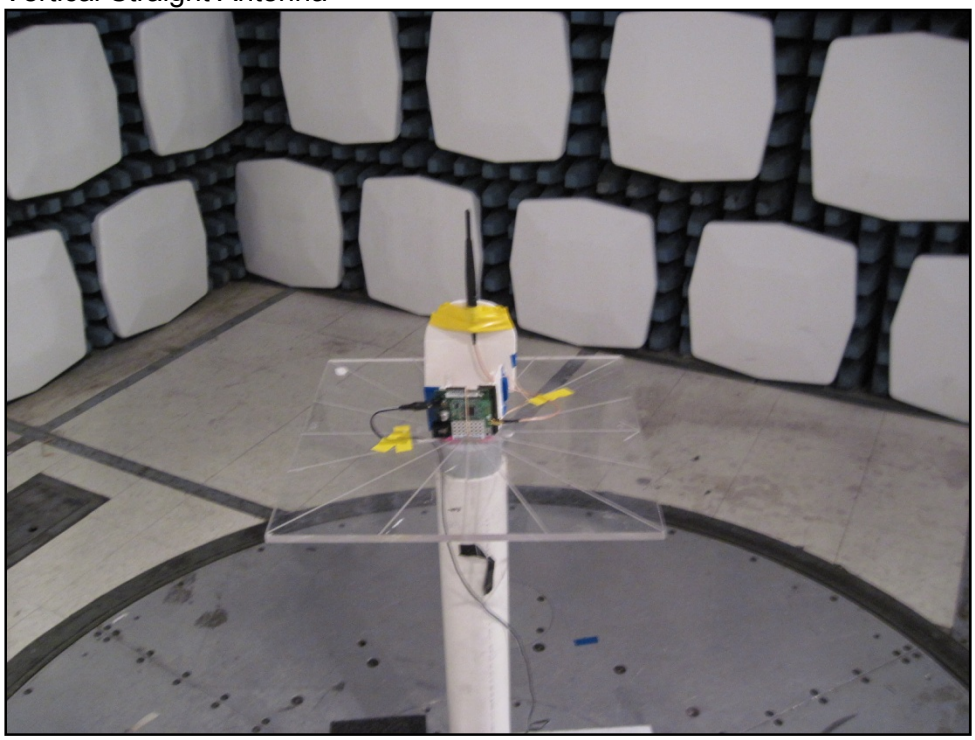


Flat 90°Bent Antenna

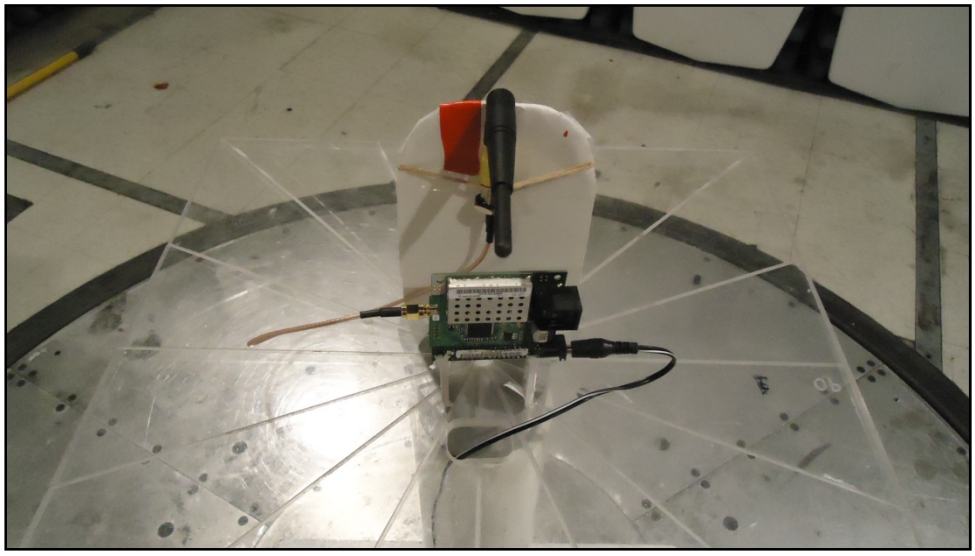


Side Board Orientation

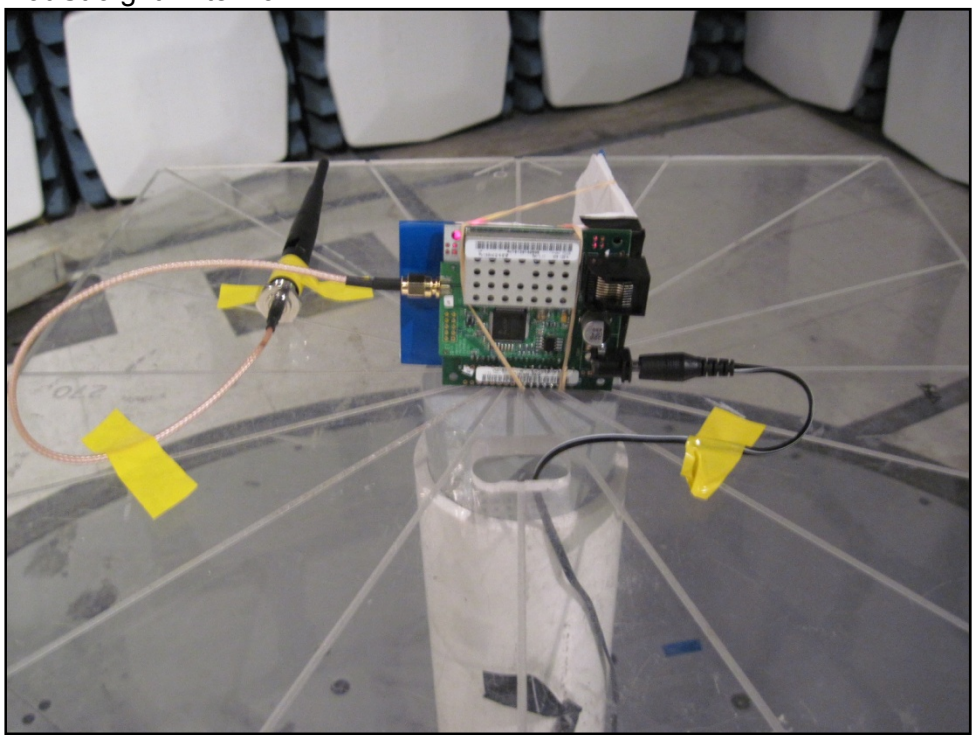
Vertical Straight Antenna



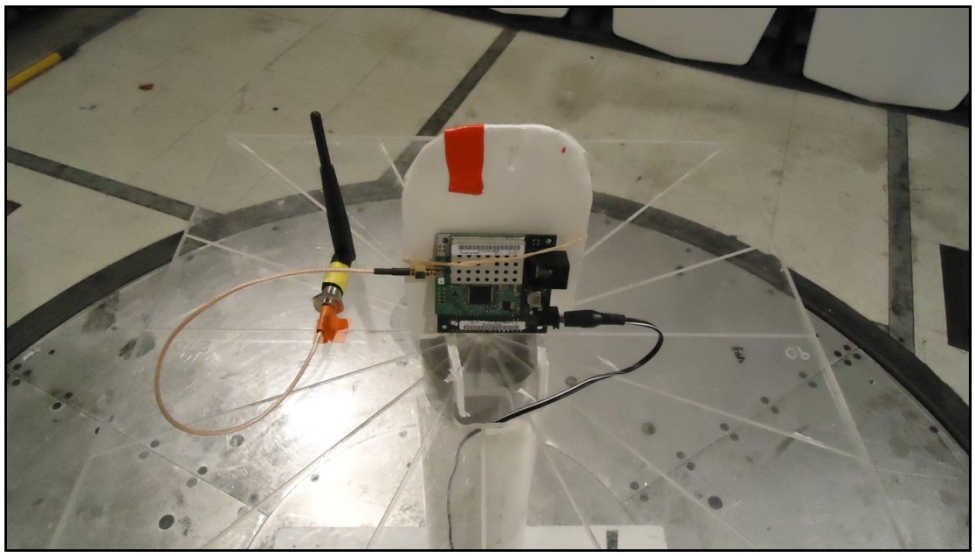
Vertical 90° Bent Antenna



Flat Straight Antenna



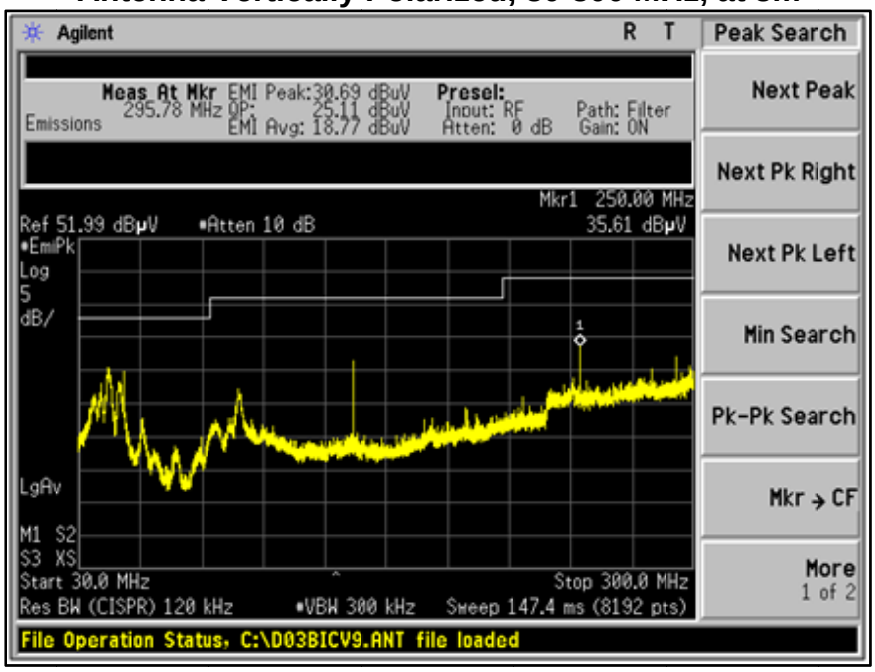
Flat 90° Bent Antenna



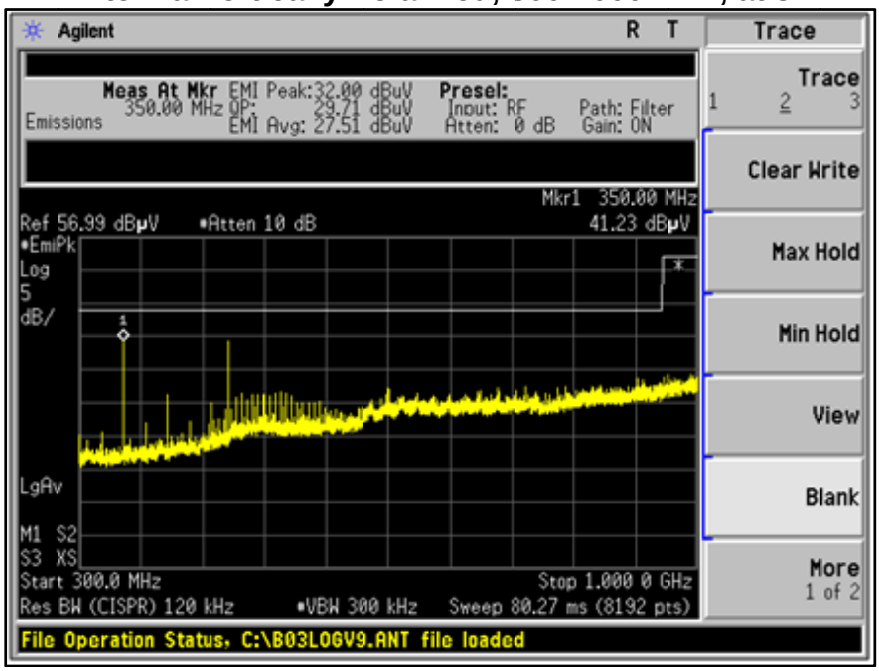
5.8 Screen Captures - Radiated Emissions Test

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz. The signature scans shown here are from worst-case emissions, as measured on channels 1, 18, or 37, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

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

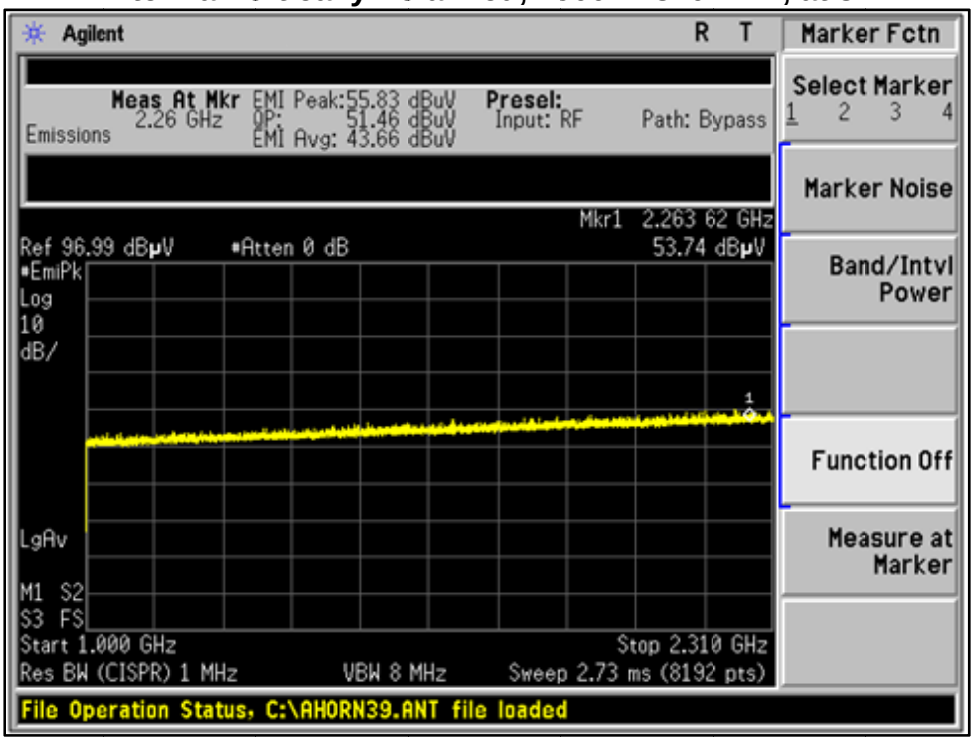


Antenna Vertically Polarized, 300-1000 MHz, at 3m

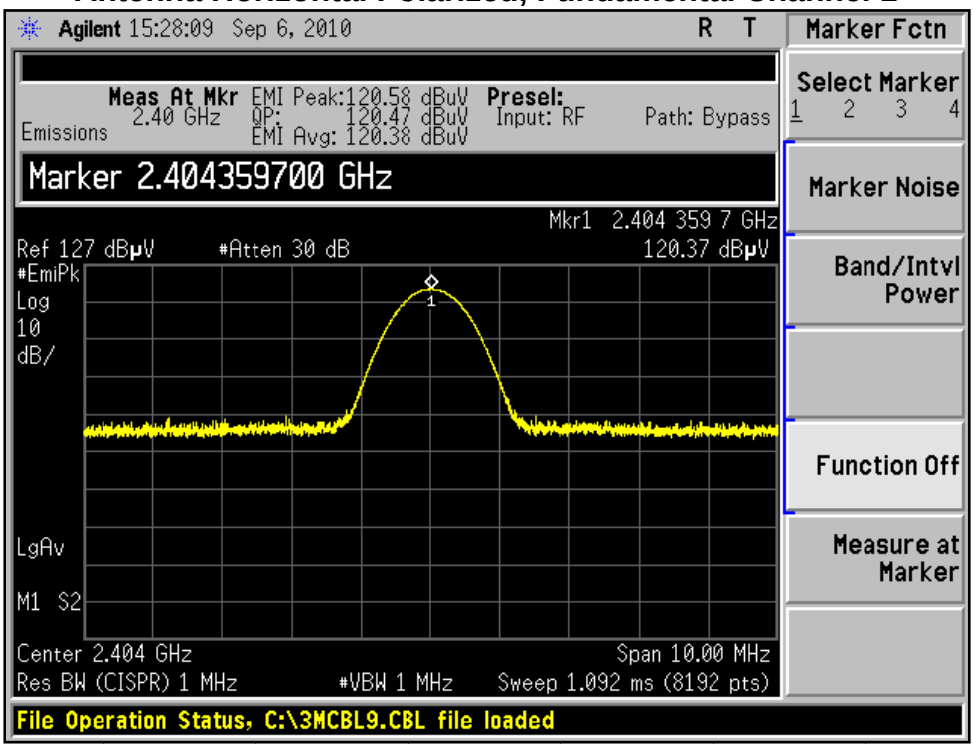


Screen Captures - Radiated Emissions Testing *(continued)*

Antenna Vertically Polarized, 1000-22310 MHz, at 3m

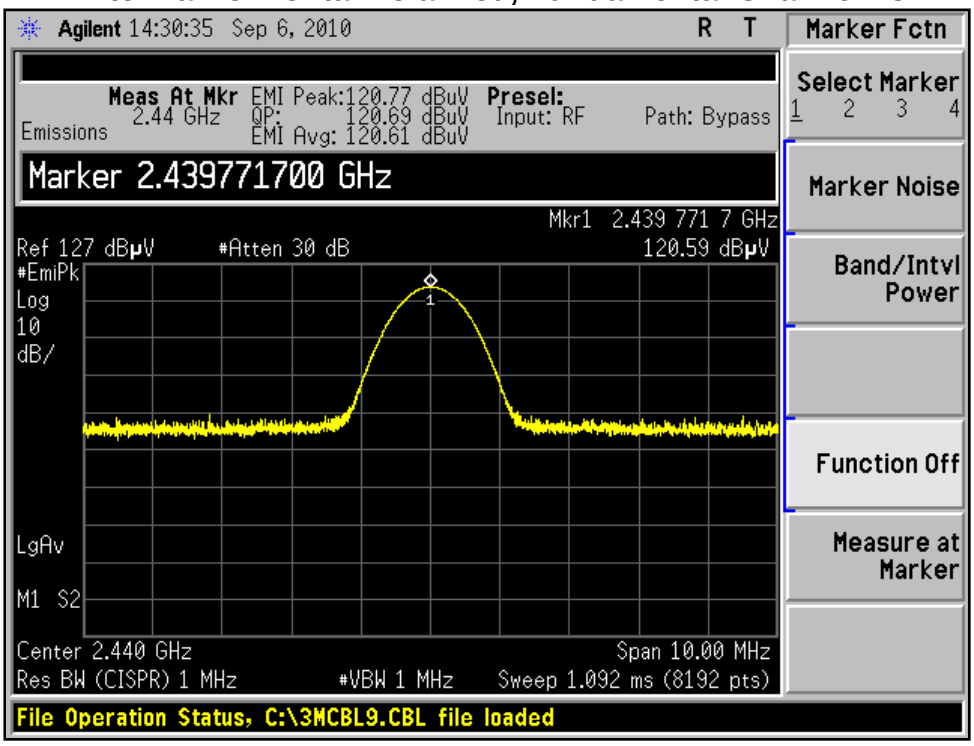


Antenna Horizontal Polarized, Fundamental Channel 1

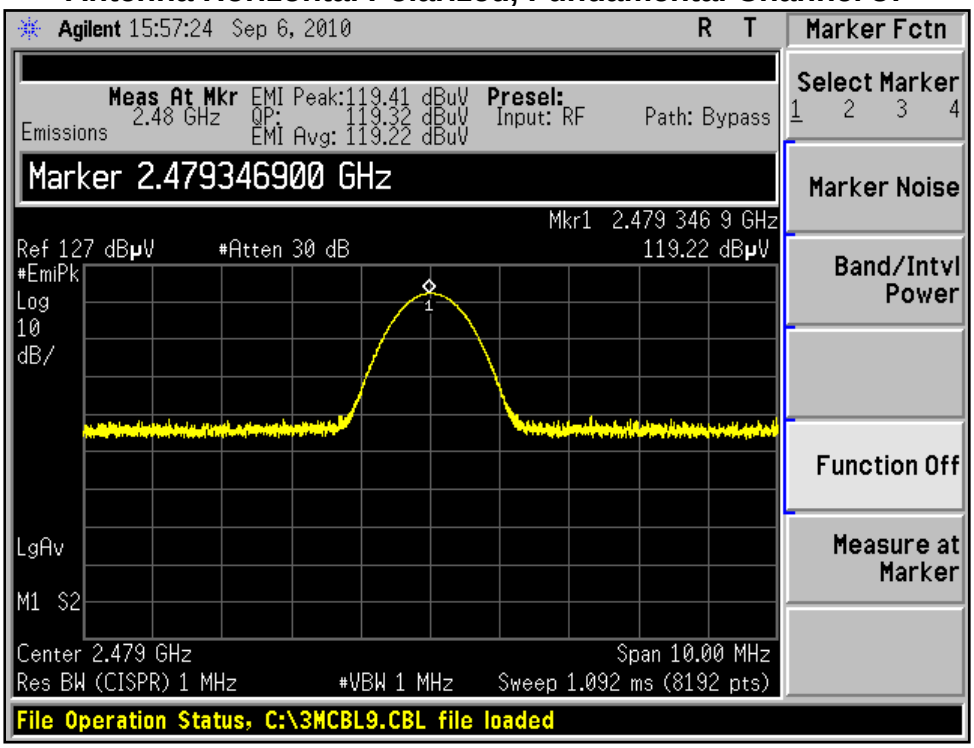


Screen Captures - Radiated Emissions Testing *(continued)*

Antenna Horizontal Polarized, Fundamental Channel 18

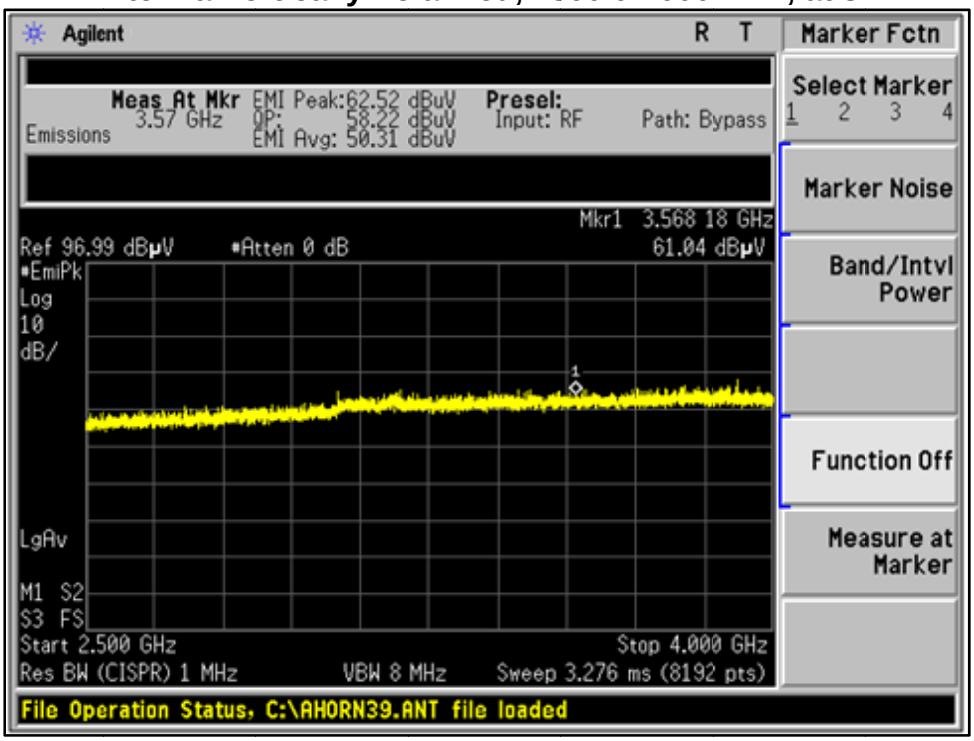


Antenna Horizontal Polarized, Fundamental Channel 37

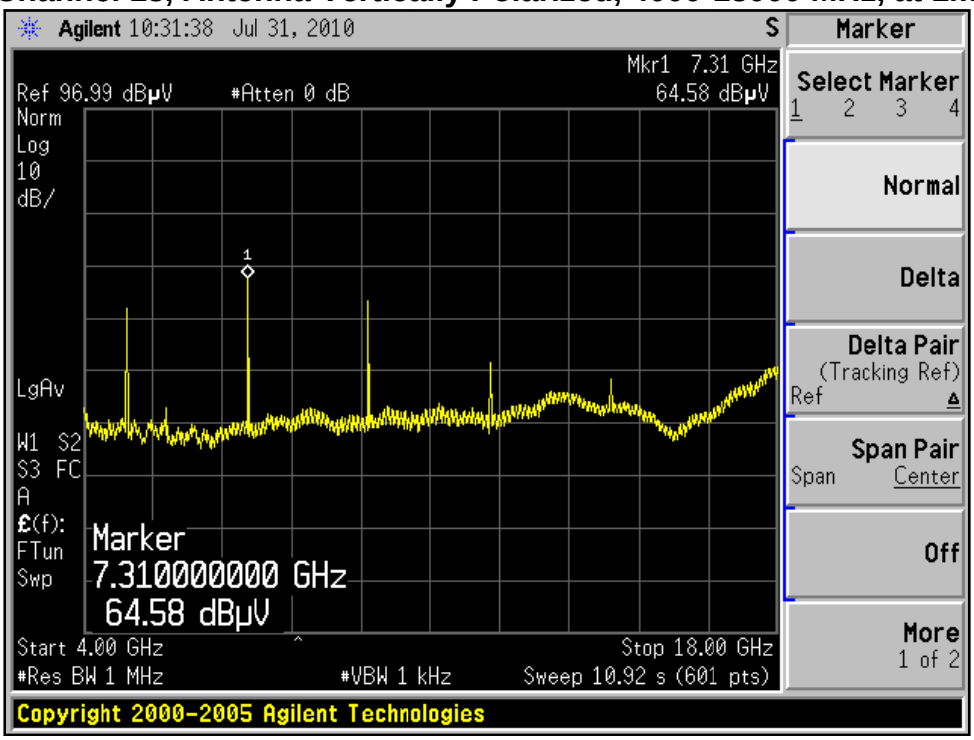


Screen Captures - Radiated Emissions Testing *(continued)*

Antenna Vertically Polarized, 2500.0-4000 MHz, at 3m



Channel 18, Antenna Vertically Polarized, 4000-18000 MHz, at 1m



Screen Captures - Radiated Emissions Testing *(continued)*

Channel 18, Antenna Vertically Polarized, 18000-25000 MHz, at 1m

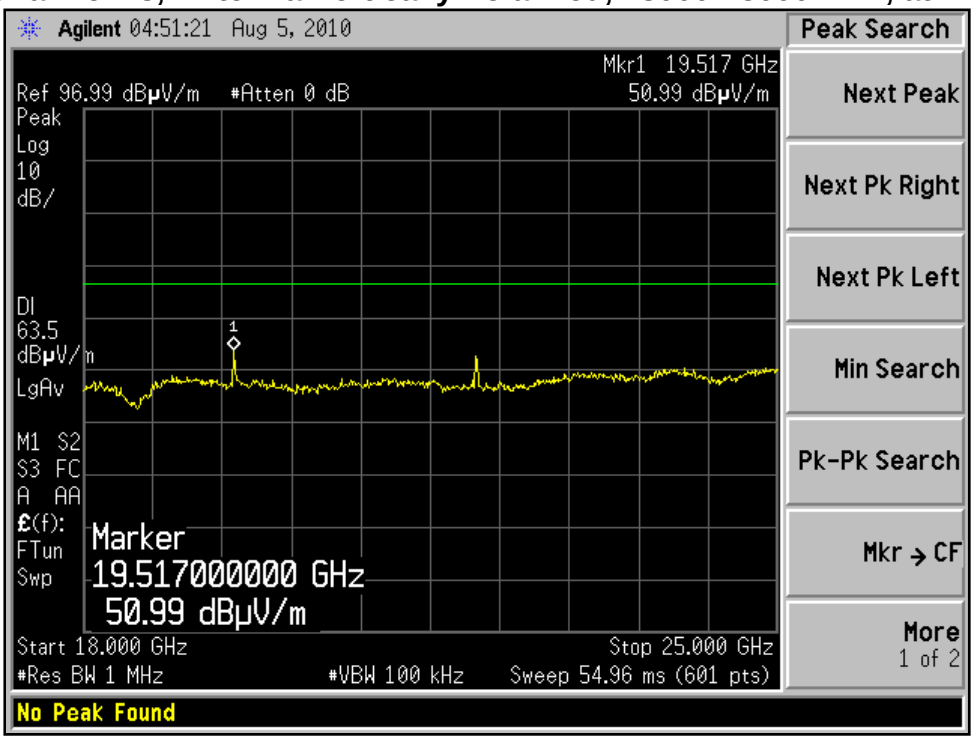


EXHIBIT 6 RADIATED EMISSIONS TEST – RECEIVER

6.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in constant receive mode, using power as provided by a 12VDC power transformer. The unit has the capability to operate on 37 channels, controllable via dip switches.

The applicable limits apply at a 3 meter distance. Measurements above 4 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2416.667 MHz), middle (2439.583MHz) and high (2475.000MHz) to comply with FCC Part 15.31(m).

6.2 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. From 18 GHz to 25 GHz, the EUT was measured at a 1.0 meter separation, using a standard gain Horn Antenna and pre-amplifier.

6.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an Agilent E4445A/N9039A EMI System. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the 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.

Reported Measurement data = Raw receiver measurement (dBµV/m) + Antenna correction Factor + Cable factor (dB) + Miscellaneous factors when applicable (dB) – amplification factor [when applicable] (dB).

The EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz).

6.4 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.109 for a non-intentional radiator [Canada RSS-210, Issue 7 (2007), Section 7]. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

6.5 CALCULATION OF RADIATED EMISSIONS LIMITS

The following table depicts the Class **B** limits for an unintentional radiator. These limits are obtained from Title 47 CFR, Part 15.109(a), for radiated emissions measurements.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-10,000	500	54.0

Sample conversion from field strength μV/m to dBμV/m:

$dB\mu V/m = 20 \log_{10}$ (3m limit)

from 30-88 MHz for example: $dB\mu V/m = 20 \log_{10} (100)$

$40.0\ dB\mu V/m = 20 \log_{10} (100)$

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

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

Note: Limits are rounded to the nearest tenth of a dB.

6.6 DATA CHART – RADIATED EMISSIONS TEST

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.109
Frequency Range Inspected: 30 MHz to 25000 MHz

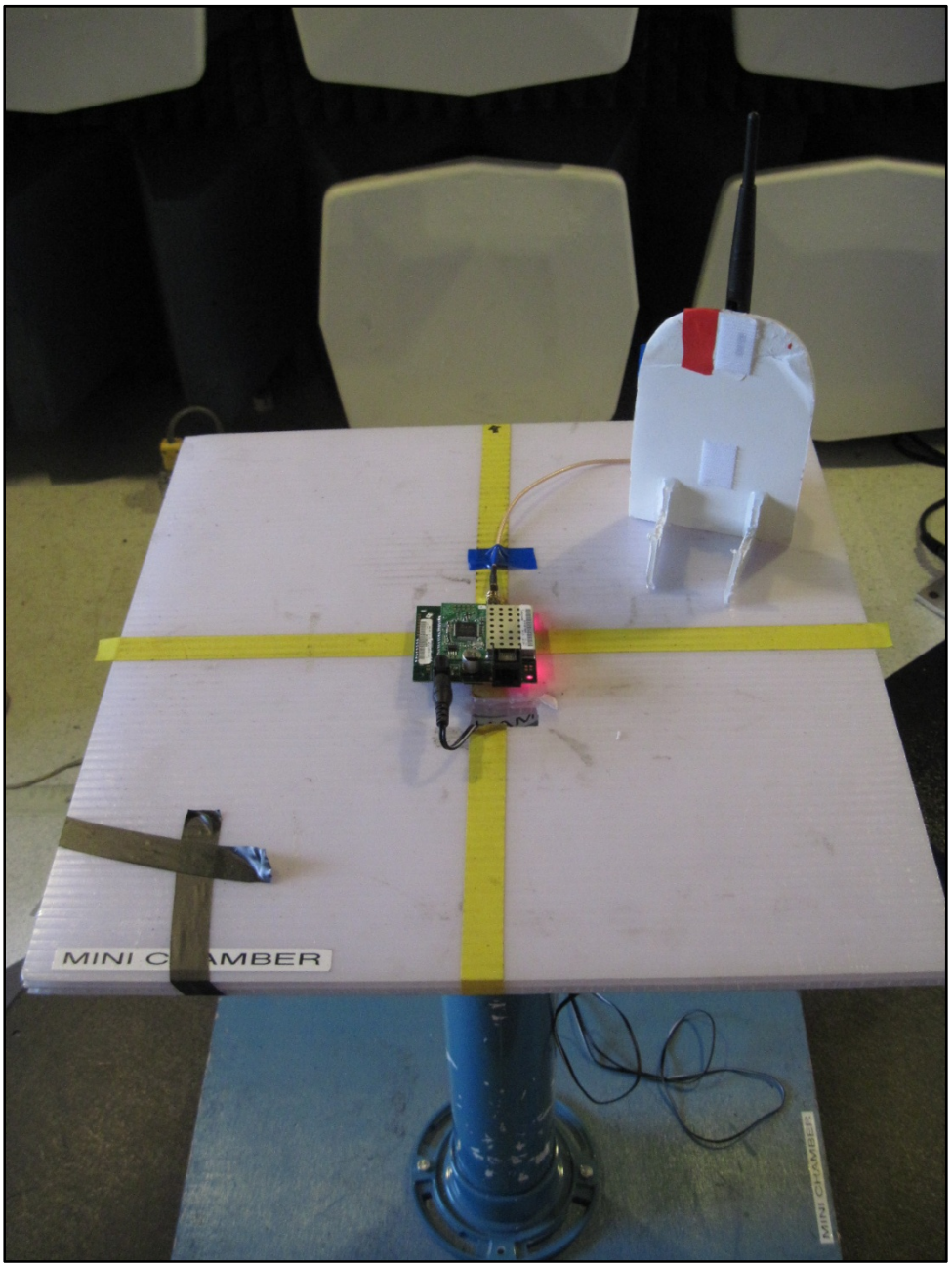
Manufacturer:	AvaLAN Wireless					
Date(s) of Test:	September 19th, 2010					
Test Engineer(s):	Peter Feilen					
Voltage:	12V DC					
Operation Mode:	Normal, continuous receive					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Actual: 22° C Relative Humidity: 30 – 60 % Actual:41% R.H.					
EUT Power:		Single Phase 110 VAC		3 Phase ___VAC		
		Battery	X	Other: 12V DC		
EUT Placement:	X	80cm non-conductive table		10cm Spacers		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

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

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
350.00	V/TT	1.38	0	40.7	46.0	5.3
983.34	H/TT	1.00	0	29.8	54.0	24.2
76.12	H/TT	1.00	0	9.3	40.0	29.7
150.00	H/TT	1.00	265	30.0	43.5	13.5
200.00	H/TT	1.00	248	24.5	43.5	19.0
250.02	V/TT	1.14	0	33.4	46.0	12.6
150.00	V/TT	1.00	182	37.1	43.5	6.4
3802.00	V/TT	1.00	0	36.7	54.0	17.3
17890.00	V/TT	1.00	0	56.4	63.5	7.1

6.7 Test Setup Photo(s) – Radiated Emissions Test

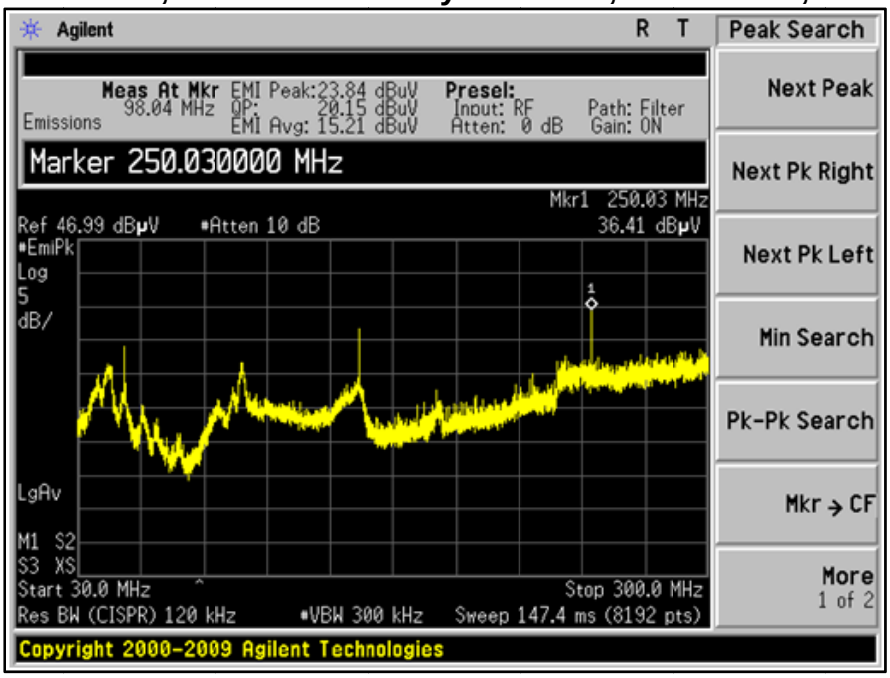
EUT on Test Pedestal



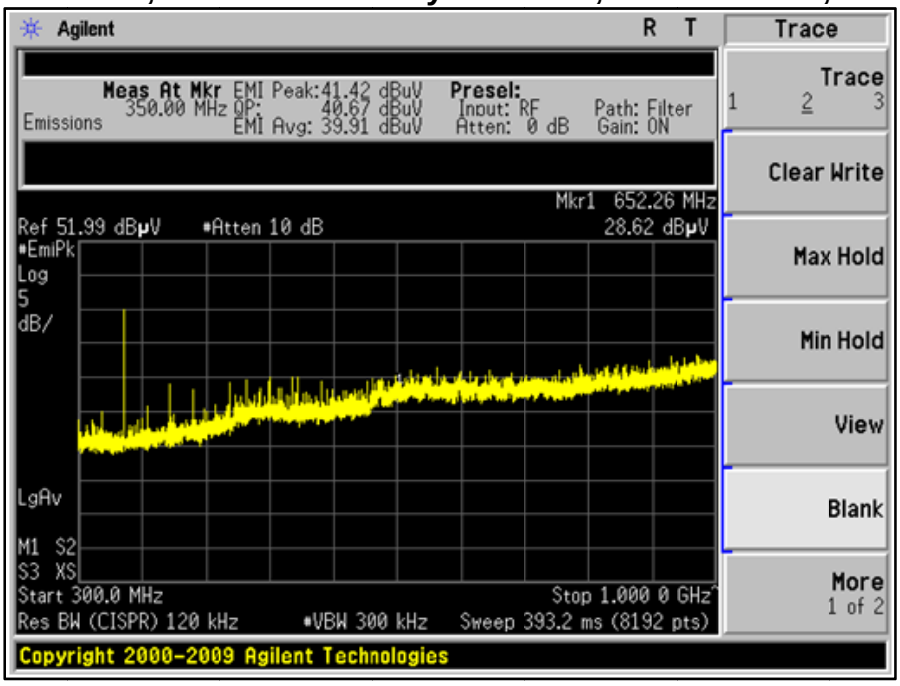
6.8 Screen Captures - Radiated Emissions Testing

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, 18, or 37, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 18, Antenna Vertically Polarized, 30-300 MHz, at 3m

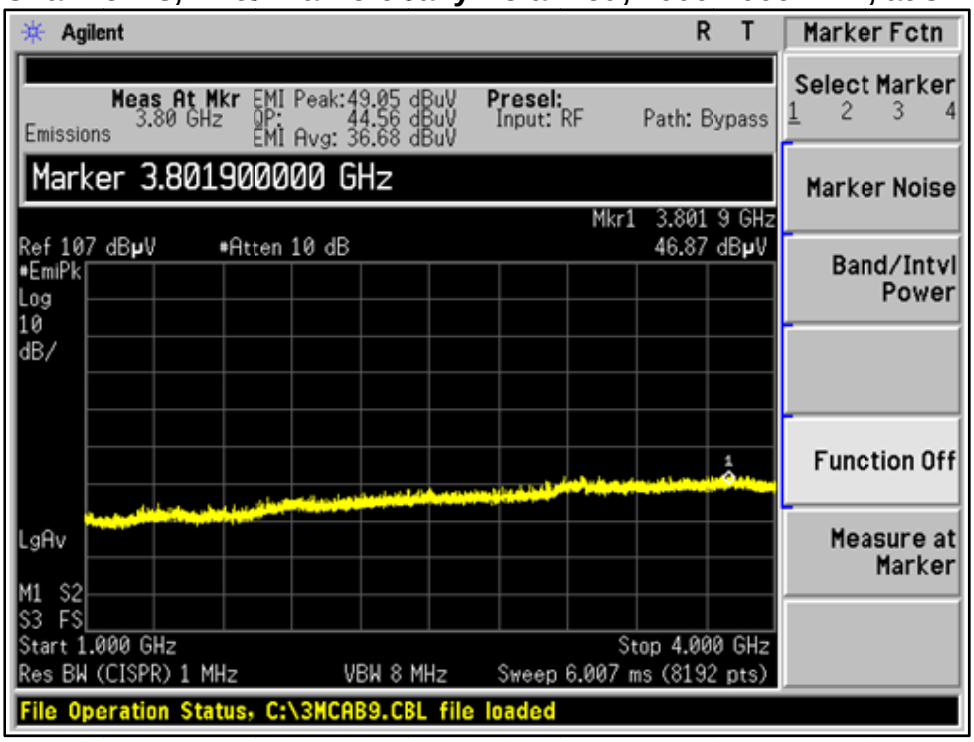


Channel 18, Antenna Vertically Polarized, 300-1000 MHz, at 3m

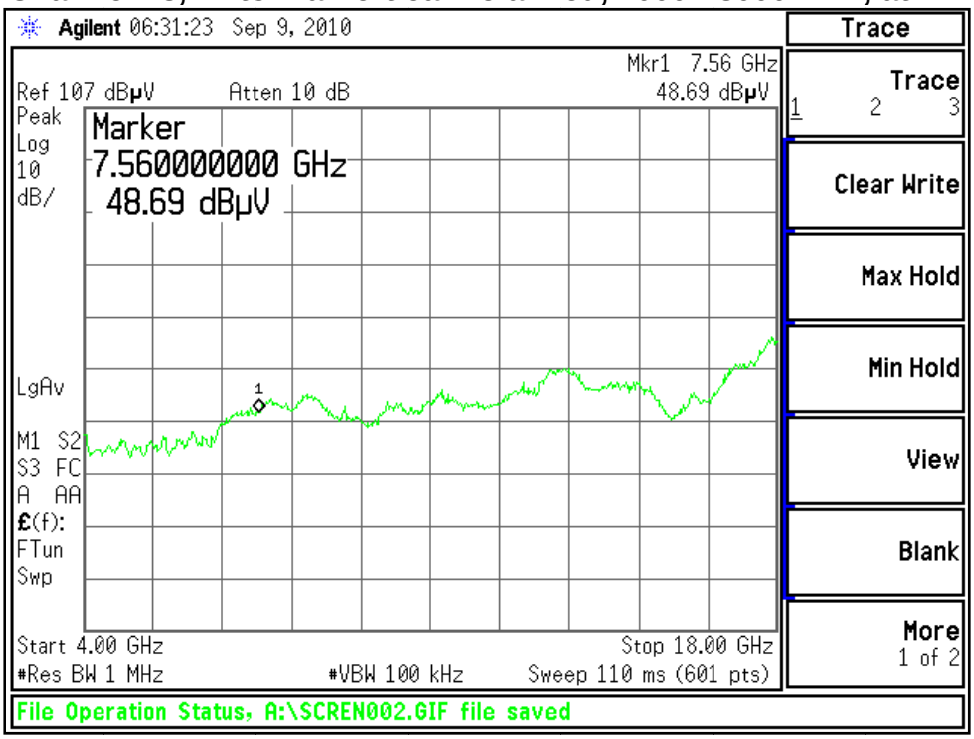


Screen Captures - Radiated Emissions Testing *(continued)*

Channel 18, Antenna Vertically Polarized, 1000-4000 MHz, at 3m



Channel 18, Antenna Vertical Polarized, 4000-18000 MHz, at 1m



Screen Captures - Radiated Emissions Testing *(continued)*

Channel 18, Antenna Vertically Polarized, 18000-25000 MHz, at 1.0m

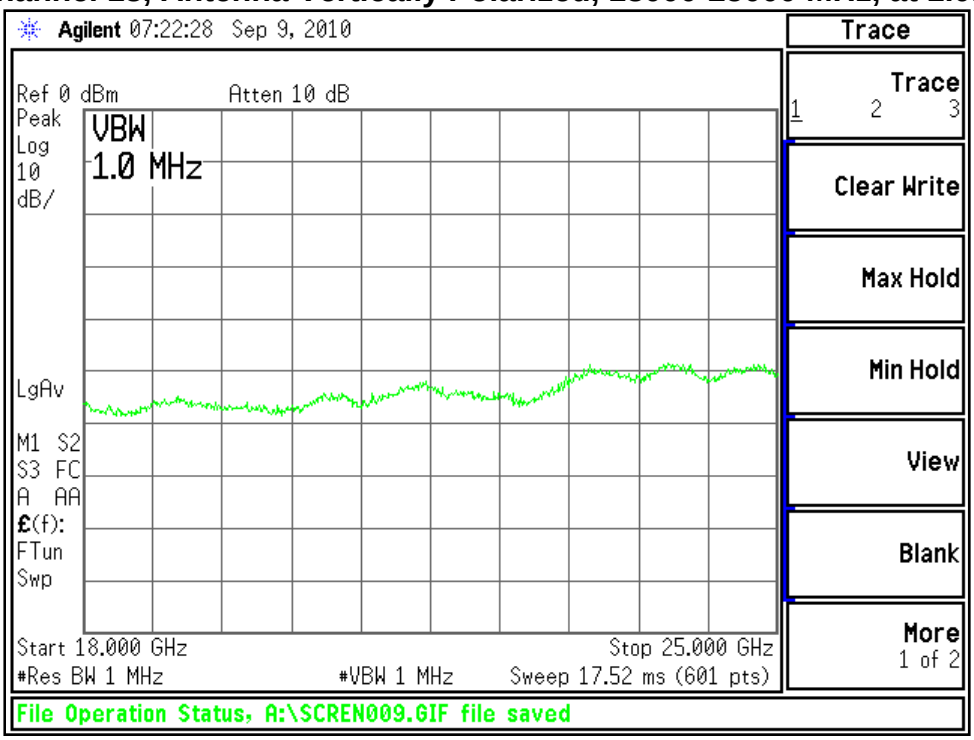


EXHIBIT 7 CONDUCTED EMISSIONS TEST, AC POWER LINE:

7.1 Test Setup

The test area and setup are in accordance with ANSI C63.4 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 Agilent E4445A/N9039A EMI System. 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).

7.2 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.

7.3 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 Agilent E4445A/N9039A EMI System, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
EMI Receiver	Agilent	E4445A/N039A	
Spectrum Analyzer	Agilent	E4446A	US45300564
LISN	EMCO	3816/2NM	9701-1057
Transient Limiter	HP	119474A	3107A01708

7.4 Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15.107 and 15.207 Conducted Emissions for an Unintentional and Intentional Radiator respectfully. See the Data Charts and Graphs for more details of the test results.

7.5 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.			

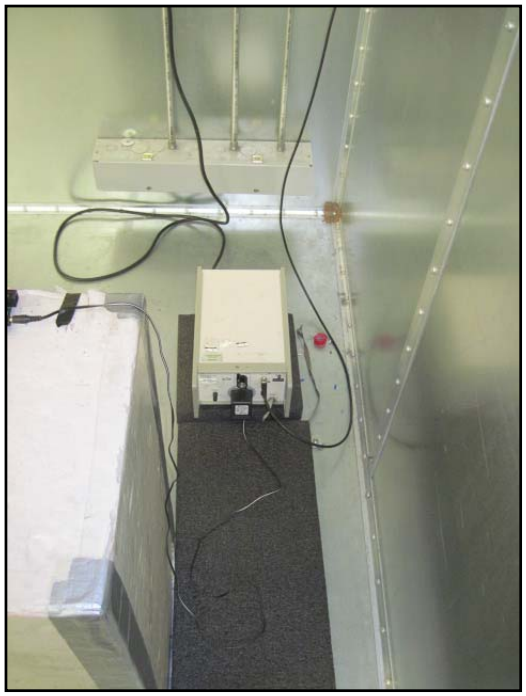
7.6 CONDUCTED EMISSIONS TEST DATA CHART

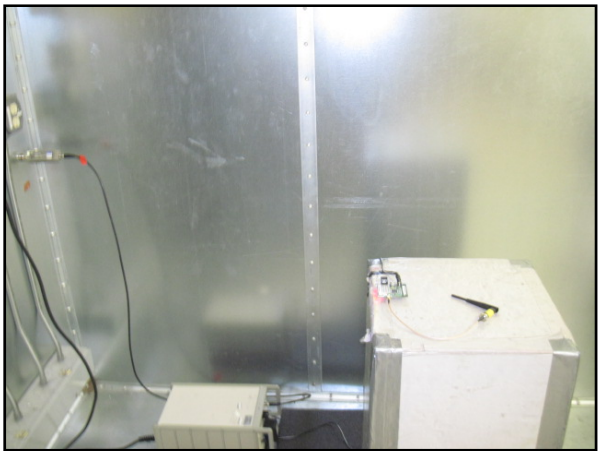
Frequency Range inspected: 150 KHz to 30 MHz
Test Standard: FCC 15.107 and 15.207 Class B
IC RSS GEN 7.2.2

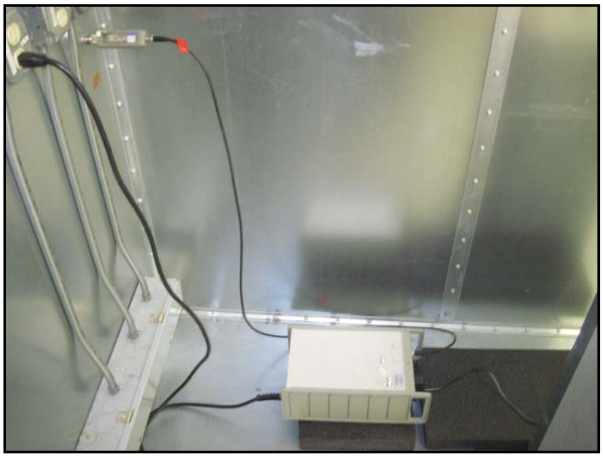
Manufacturer:	AvaLAN Wireless					
Date(s) of Test:	September 19th, 2010					
Test Engineer:	Ryan Urness					
Voltage:	12V DC					
Operation Mode:	Continuous Transmit					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:	X	Conducted Emissions Lab				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

		Quasi-Peak			Average		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
TRANSMIT MODE							
0.743	1.000	28.200	56.000	27.800	1.800	46.000	44.200
1.420	1.000	19.600	56.000	36.400	3.900	46.000	42.100
0.150	2.000	44.400	66.000	21.600	14.600	56.000	41.400
0.451	2.000	39.200	56.859	17.659	9.100	46.859	37.759
0.797	2.000	34.400	56.000	21.600	5.200	46.000	40.800
RECEIVE MODE							
0.145	1.000	29.500	66.282	36.782	23.700	56.282	32.582
0.326	1.000	36.900	59.554	22.654	8.000	49.554	41.554
0.582	1.000	29.300	56.000	26.700	2.800	46.000	43.200
1.010	1.000	12.800	56.000	43.200	-2.800	46.000	48.800
0.147	2.000	13.700	66.168	52.468	9.900	56.168	46.268
0.493	2.000	37.800	56.120	18.320	7.800	46.120	38.320
0.820	2.000	34.100	56.000	21.900	4.800	46.000	41.200
1.010	2.000	25.000	56.000	31.000	0.100	46.000	45.900

7.7 Test Setup Photo(s) – Conducted Emissions Test



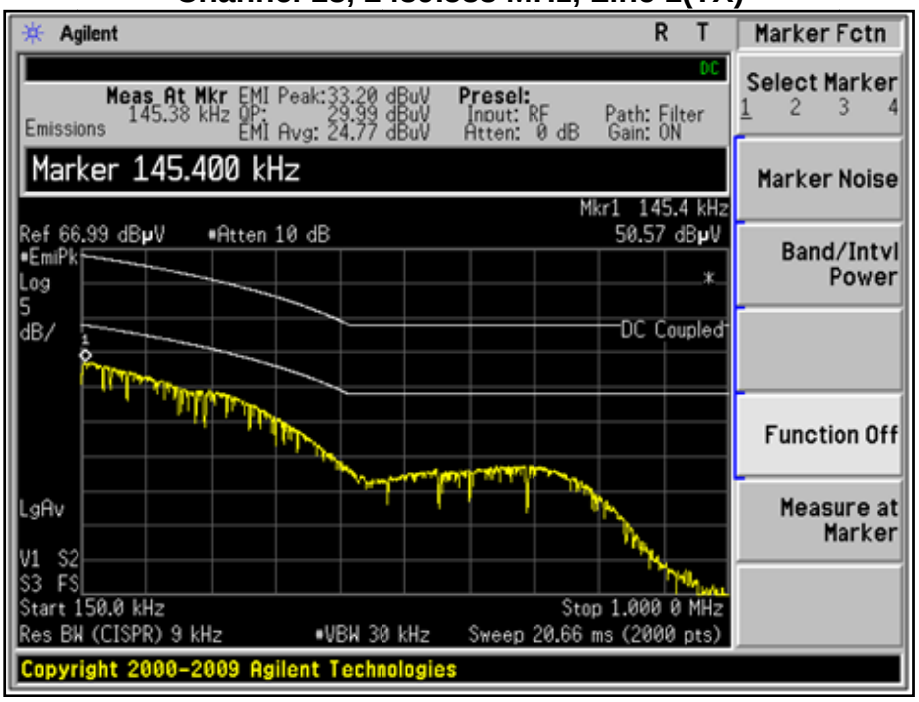


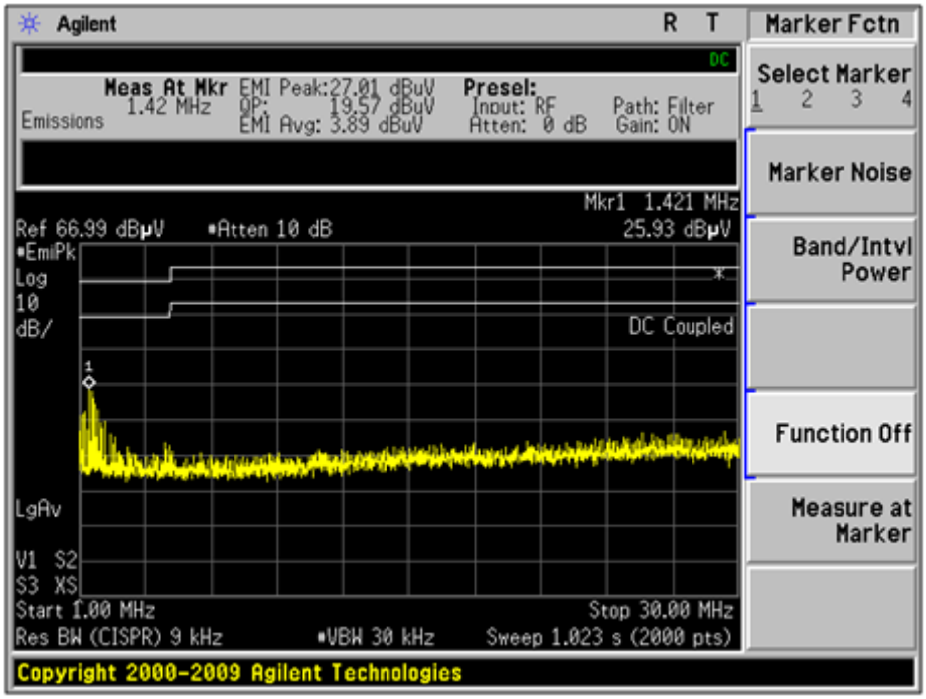


7.8 Screen Captures – Conducted Emissions Test

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 7.2.2 (Table 2). The signature scans shown here are from channel 18 chosen as being a good representative of channels.

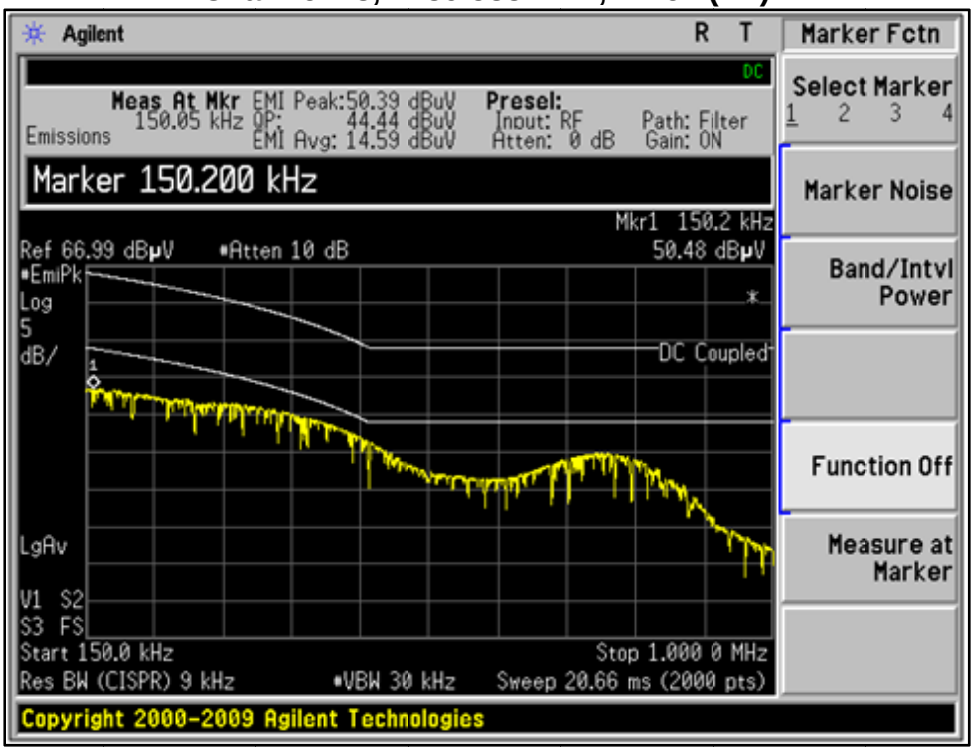
Channel 18, 2439.583 MHz, Line 1(TX)

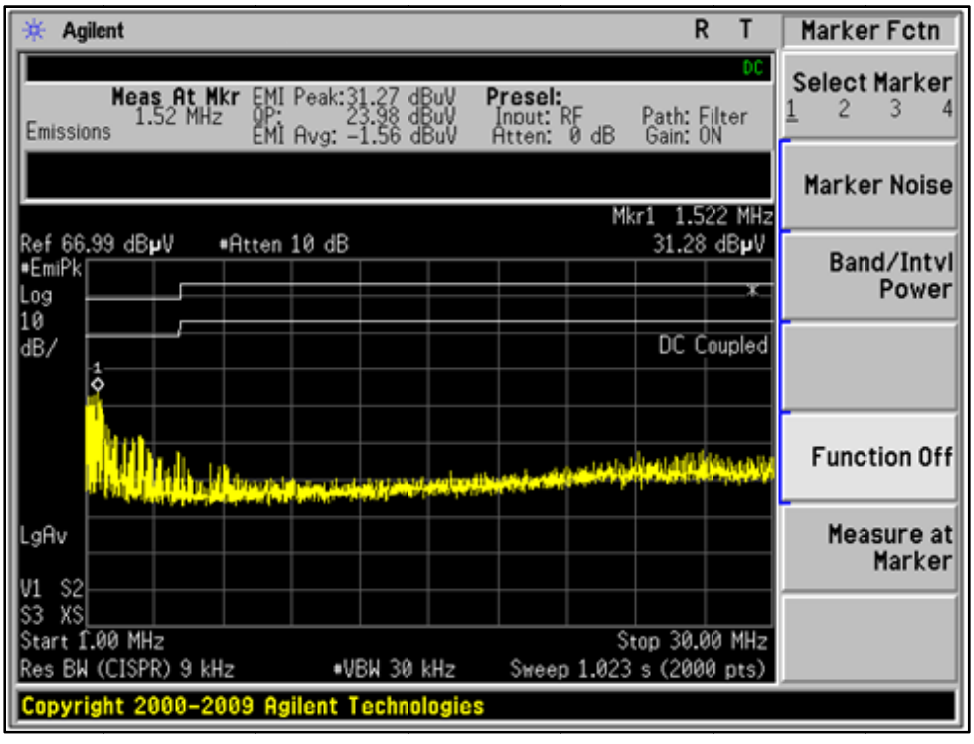




Screen Captures – Conducted Emissions Test *(continued)*

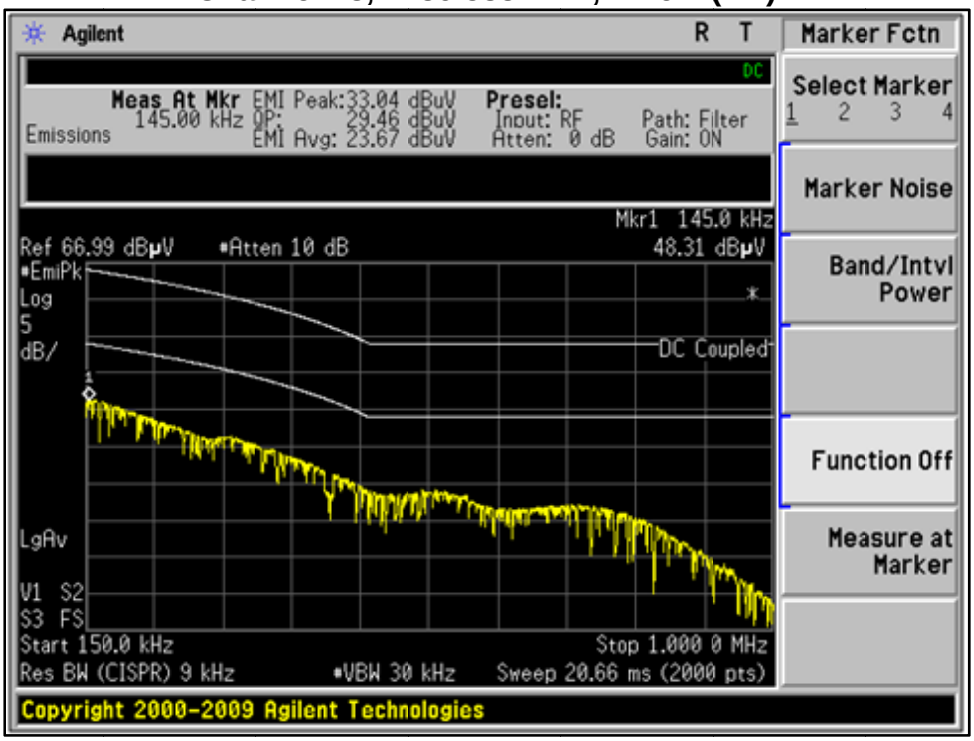
Channel 18, 2439.583 MHz, Line 2(TX)

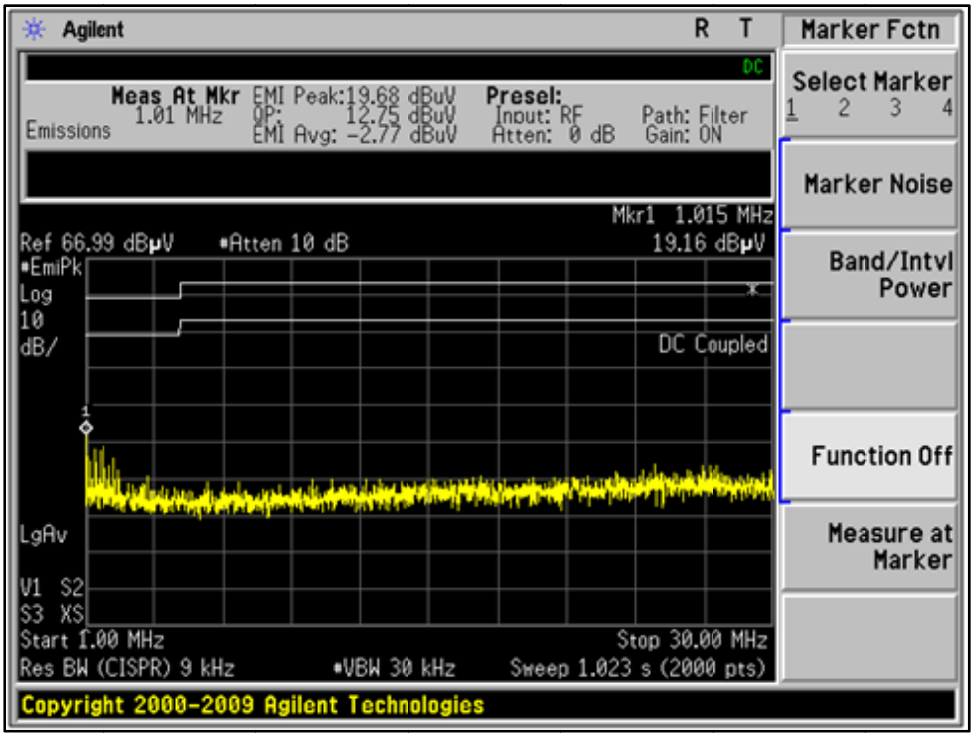




Screen Captures – Conducted Emissions Test *(continued)*

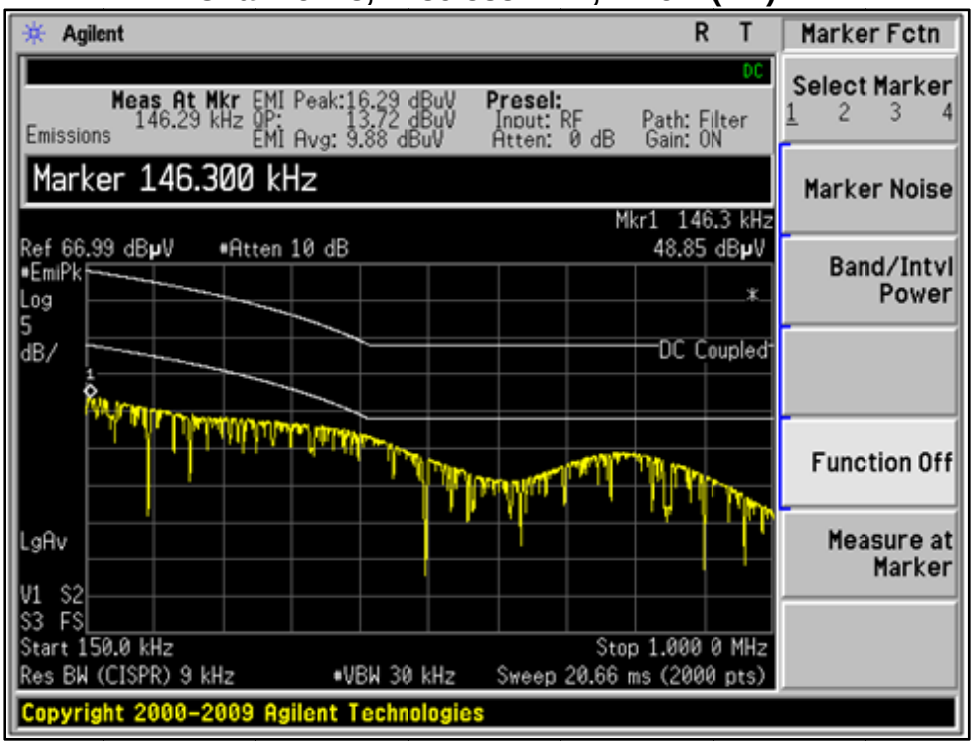
Channel 18, 2439.583 MHz, Line 1 (RX)





Screen Captures – Conducted Emissions Test *(continued)*

Channel 18, 2439.583 MHz, Line 2 (RX)



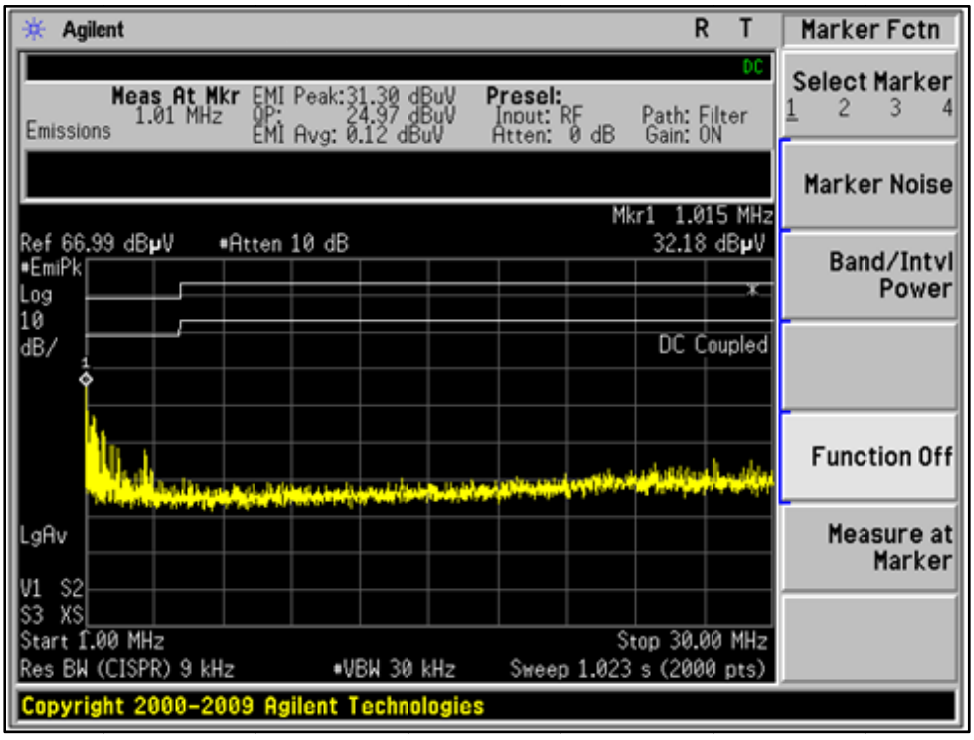


EXHIBIT 8 OCCUPIED BANDWIDTH:

8.1 Limits

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

8.2 Method of Measurements

Refer to ANSI C63.4 and FCC Procedures (2007) for Digital Transmission Systems operating under 15.247.

The transmitter output was connected to the Spectrum Analyzer. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 100 kHz RBW and VBW=300 kHz.

The bandwidth requirement found in FCC Part 15.247(a)(2) and RSS 210 A8.2(a) requires 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 E4407B spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the attenuator was added on the analyzer as gain offset settings, 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.

From this data, the closest measurement (6 dB bandwidth) when compared to the specified limit, is 1545 kHz, which is above the minimum of 500 kHz.

8.3 Test Equipment List

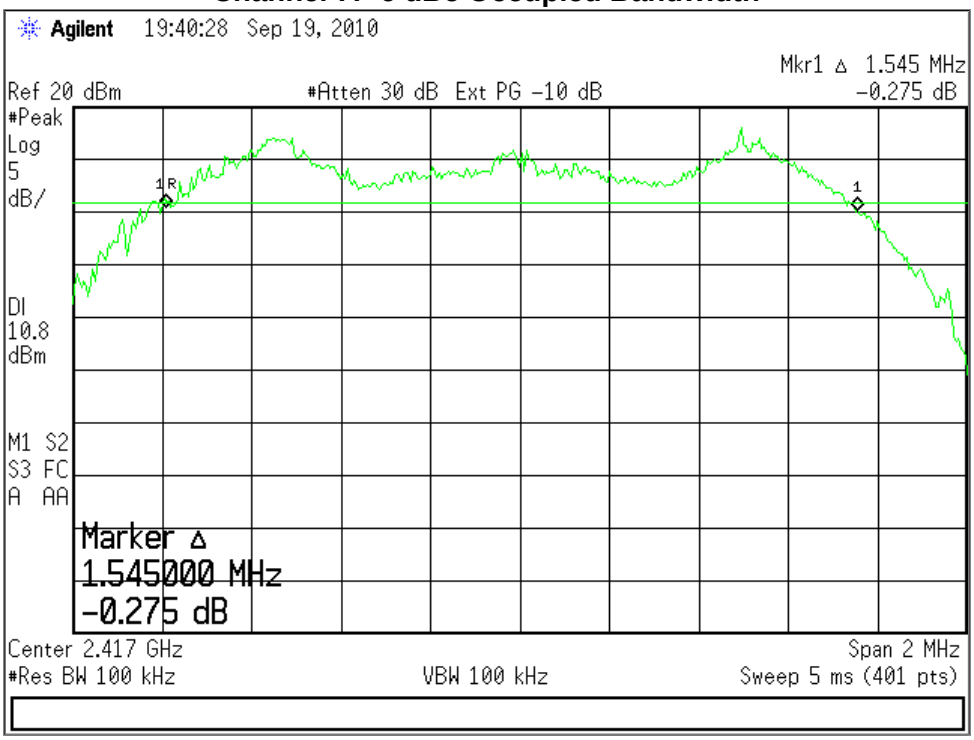
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4407B	US39160256
Spectrum Analyzer	Agilent	E4446A	US45300564

8.4 Test Data

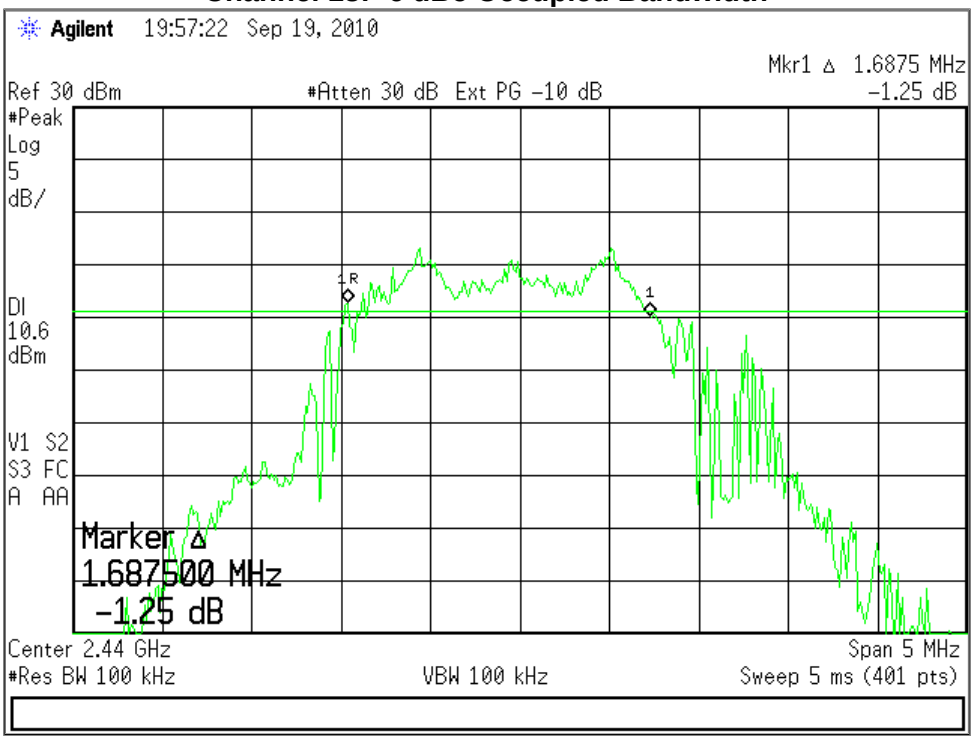
Channel	Center Frequency (MHz)	Measured -6 dBc Occ. BW (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc Occ.BW (kHz)
7	2416.667	1545	500	2300
18	2439.583	1687	500	2750
35	2475.000	1612	500	2150

8.5 Screen Captures - OCCUPIED BANDWIDTH

Channel 7: -6 dBc Occupied Bandwidth

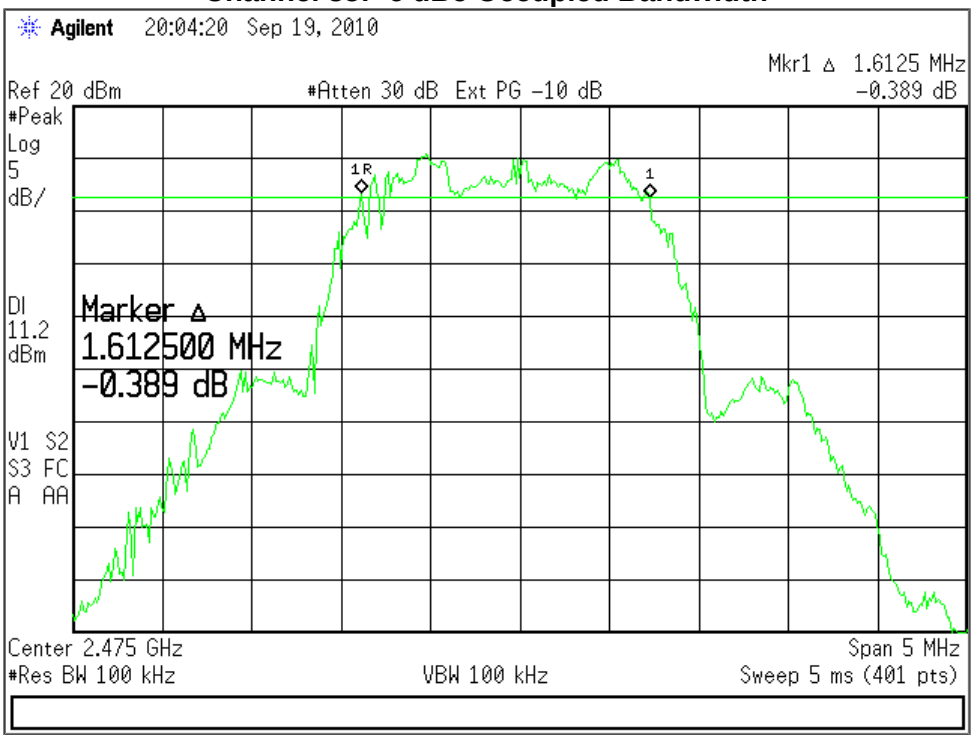


Channel 18: -6 dBc Occupied Bandwidth

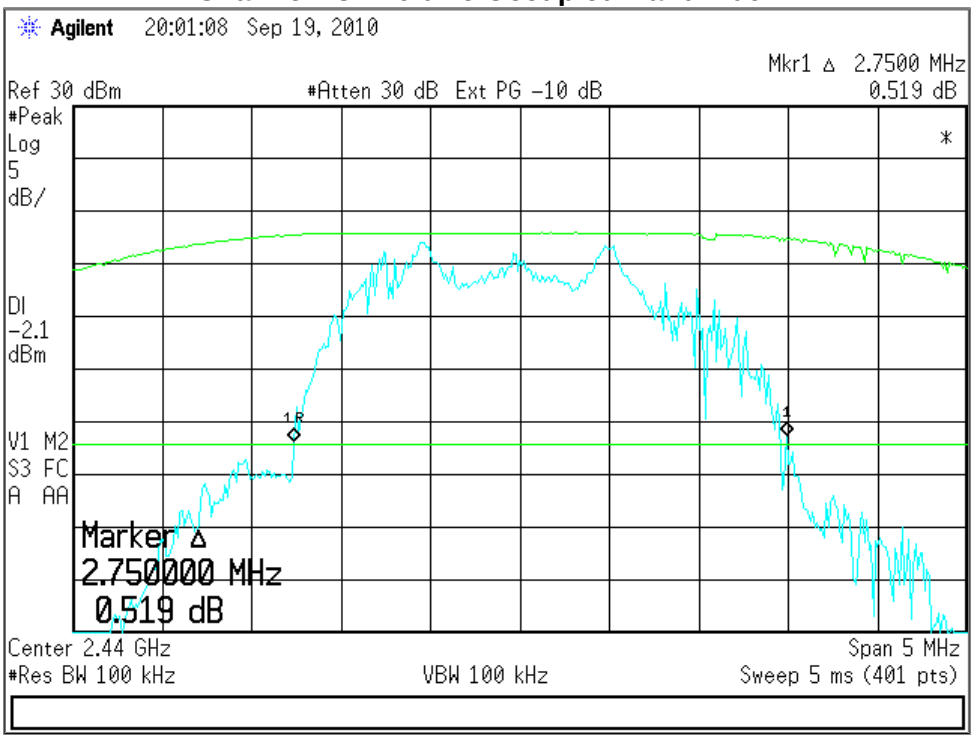


Screen Captures - OCCUPIED BANDWIDTH *(continued)*

Channel 35: -6 dBc Occupied Bandwidth



Channel 18: -20 dBc Occupied Bandwidth



9.1 Method of Measurements

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

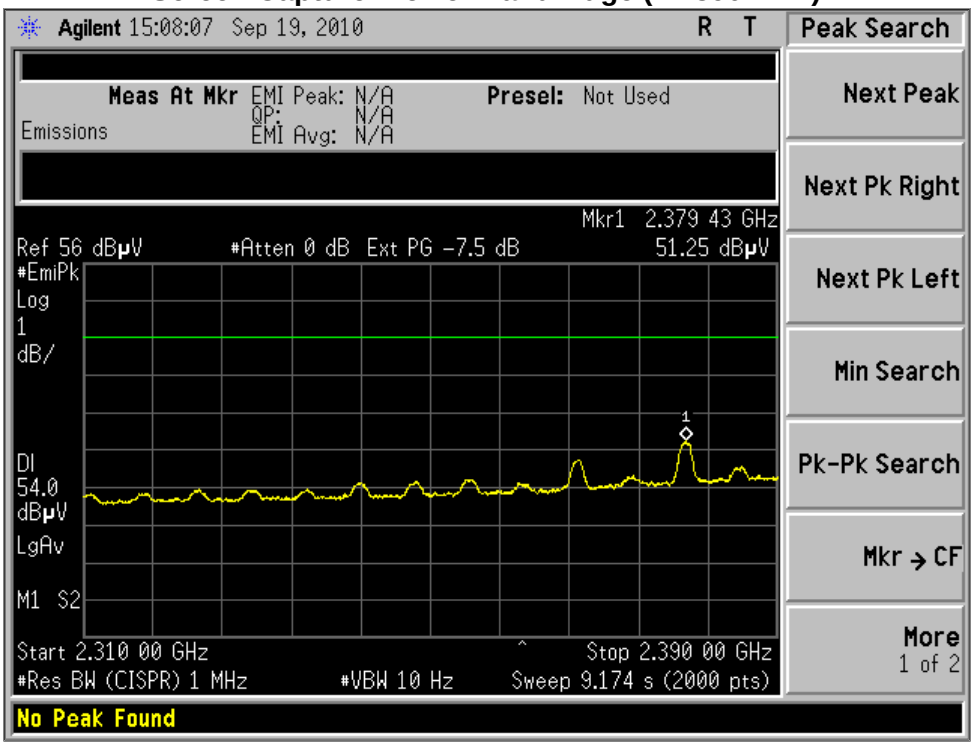
> ***Note**: An adjustment of -7.5dB can be seen as factored into the measurements: There was a 10dB pad on the front of the analyzer, thus the measurement was corrected by applying a -10dB gain adjustment; then the 2.5dB peak to average correction, as outlined in Appendix D, was added; adjusting this correction to -7.5dB.*

The Lower Band-Edge limit, from 2390 MHz to 2400 MHz in this case, would be -20 dBc with respect to the fundamental level.

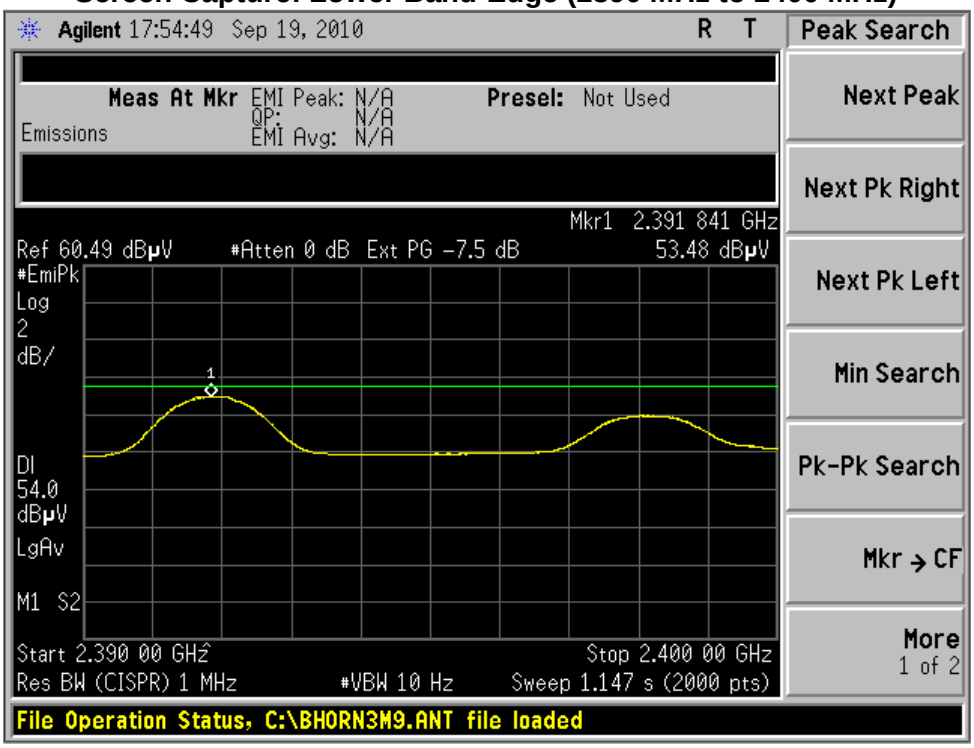
The Lower Band-Edge limit, below 2390 MHz in this case, would be +54 dBµV/m at 3m

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

Screen Capture: Lower Band-Edge (< 2390 MHz)



Screen Capture: Lower Band-Edge (2390 MHz to 2400 MHz)



Screen Capture: Higher Band-Edge

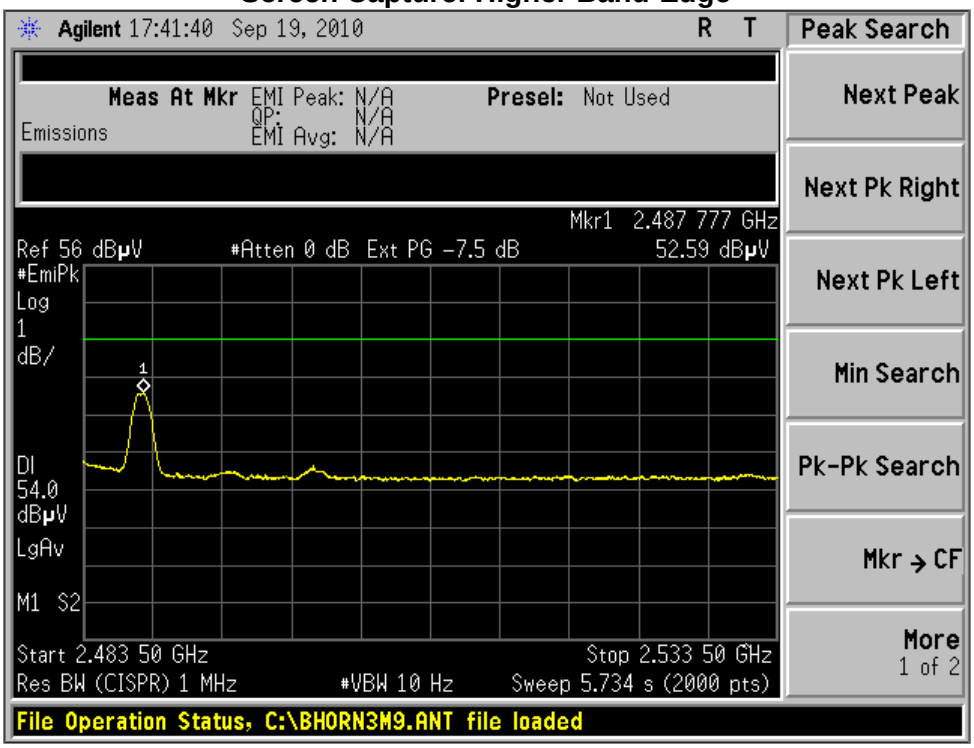


EXHIBIT 10 POWER OUTPUT (CONDUCTED): 15.247(b)

10.1 Method of Measurements

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

10.2 Test Equipment List

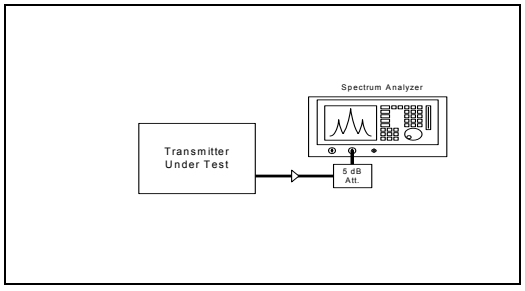
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

10.3 Test Data

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
7	2416.667	30.0	18.2	11.8
18	2439.583	30.0	17.9	12.1
35	2475.000	30.0	17.1	12.9

Transmitter Channel	Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	Calculated EIRP (dBm) [1]	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Lowest	2416.667	18.2	23.2	30.0	36.0
Middle	2439.583	17.9	22.9	30.0	36.0
Highest	2475.000	17.1	22.1	30.0	36.0

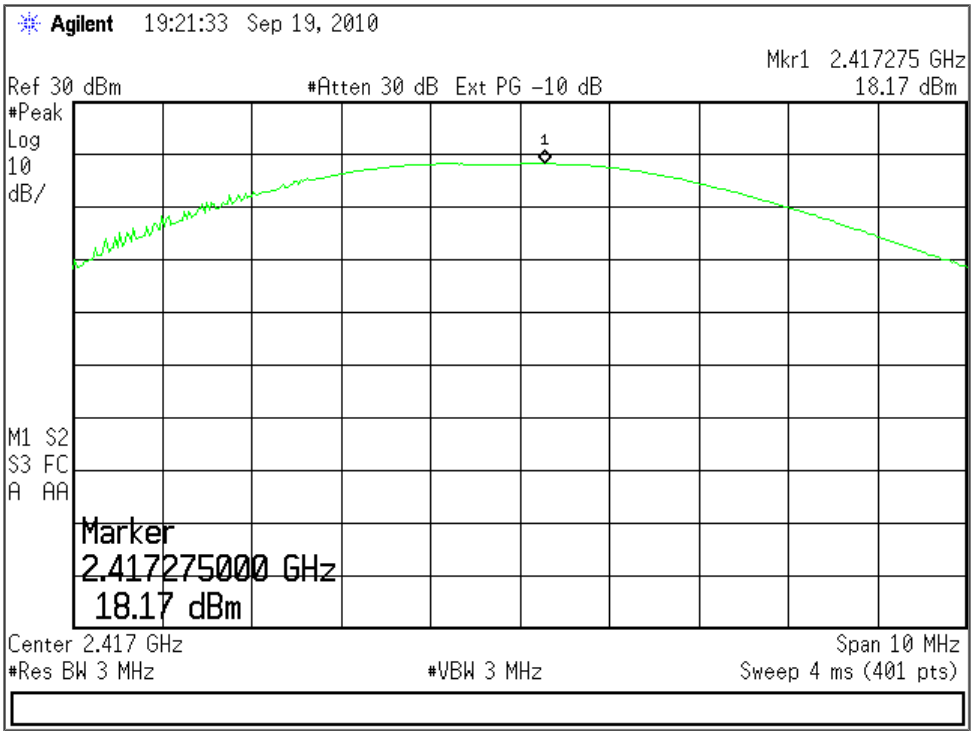
(1) EIRP Calculation:
EIRP = (Peak power at antenna terminal in dBm) + (EUT Antenna gain in dBi)



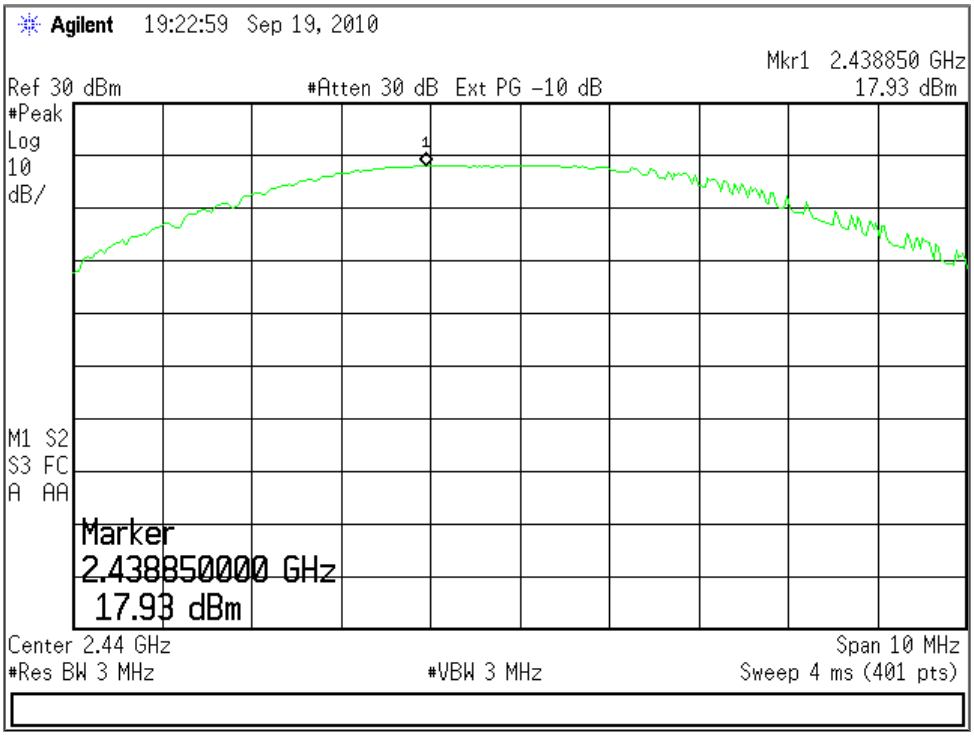
Measured RF Power Output (in Watts): 0.065W

10.4 Screen Captures – Power Output (Conducted)

Channel 7



Channel 18



Screen Captures – Power Output (Conducted) *(continued)*

Channel 35

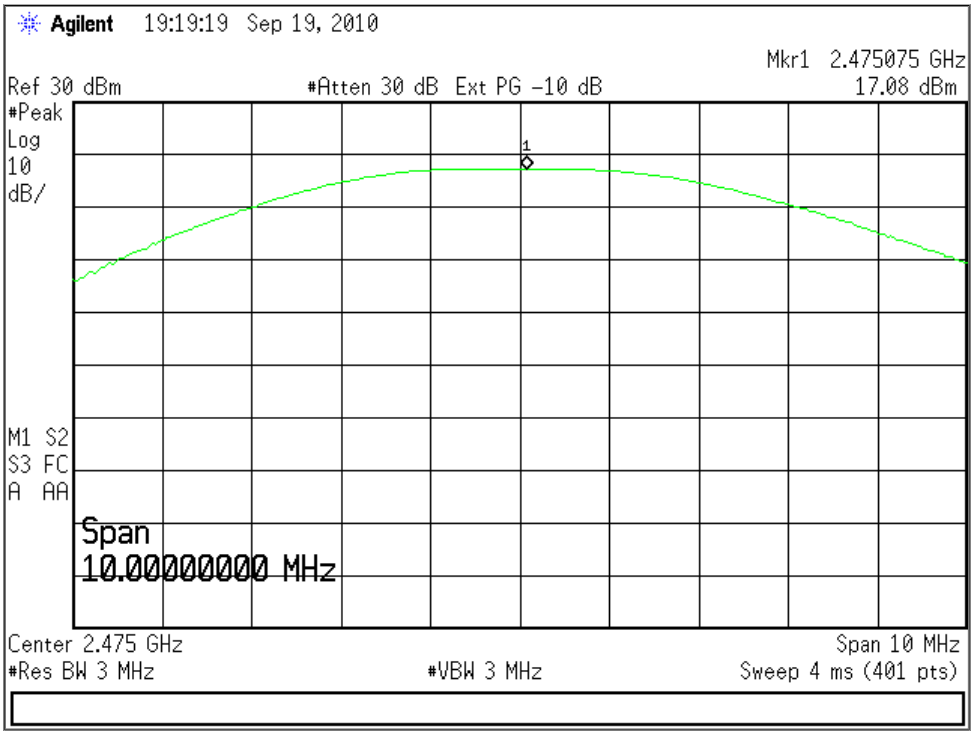


EXHIBIT 11 POWER SPECTRAL DENSITIES: 15.247(e)

11.1 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. The highest density was found to be no greater than 6.81 dBm, which is under the allowable limit by 1.19 dB.

11.2 Test Equipment List

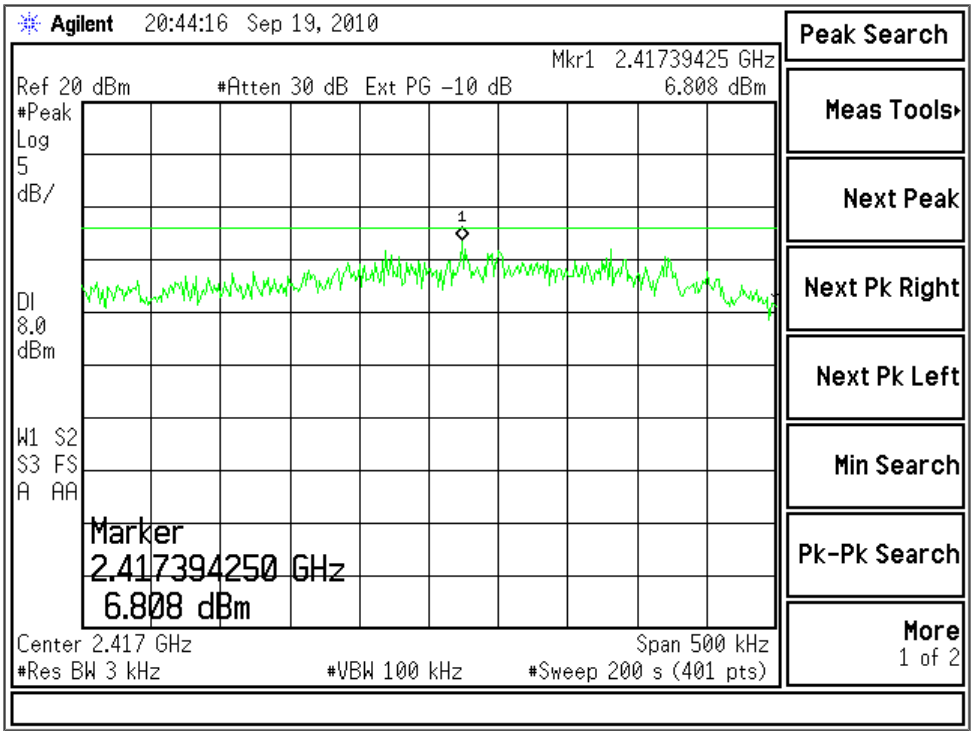
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

11.3 Test Data

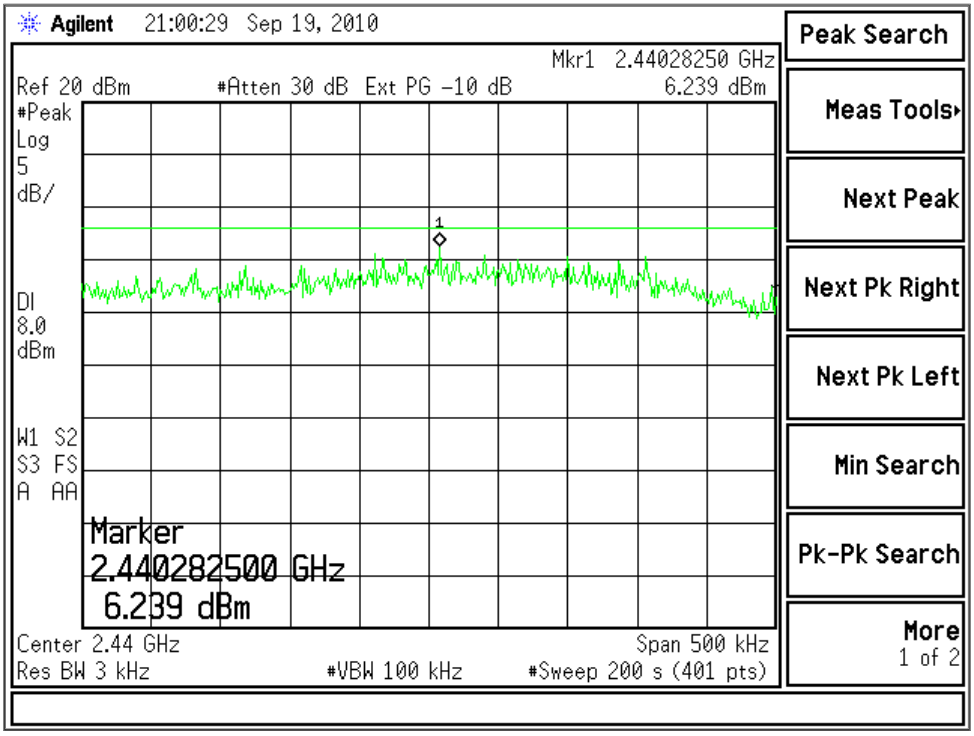
Transmitter Channel	Frequency (MHz)	RF Power Level In 3 kHz BW (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Comments Pass/Fail
Lowest	2416.667	5.21	8.0	2.79	PASS
Middle	2439.583	6.81	8.0	1.19	PASS
Highest	2475.000	6.24	8.0	1.76	PASS

11.4 Screen Captures – Power Spectral Density

Channel 7



Channel 18



Screen Captures – Power Spectral Density *(continued)*

Channel 35

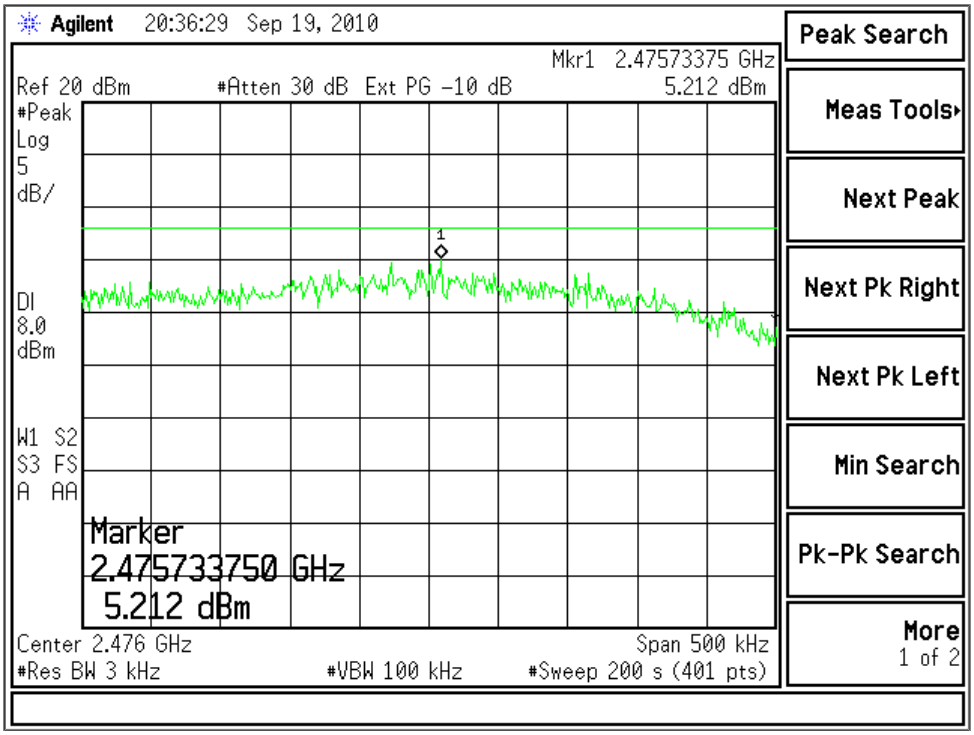


EXHIBIT 12 SPURIOUS CONDUCTED EMISSIONS: 15.247(d)

12.1 Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at lease 20 db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

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

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

	Channel 7	Channel 18	Channel 35
Fundamental	+ 17.84 (dBm)	+ 16.96 (dBm)	+ 16.32 (dBm)
2nd Harmonic	- 55.2 (dBm)	- 55.8 (dBm)	- 56.2 (dBm)
3rd Harmonic	- 66.4 (dBm)	- 66.5 (dBm)	Note (1)
4th Harmonic	- 42.4 (dBm)	- 42.4 (dBm)	- 54.2 (dBm)
5th Harmonic	- 63.6 (dBm)	- 52.3 (dBm)	- 59.7 (dBm)
6th Harmonic	- 63.9 (dBm)	- 58.6 (dBm)	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.

12.2 Test Equipment List

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

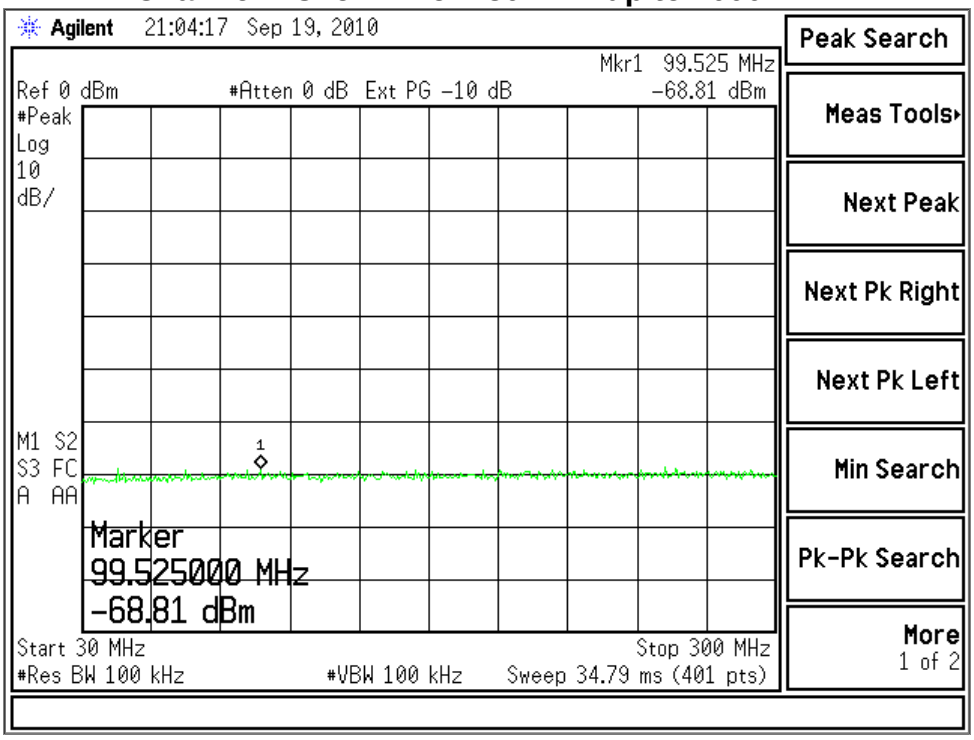
12.3 Test Data

Fundamental Frequency: 2416.667, 2439.583, 2475.000
Modulation: FSK
Frequency Test Range: 30 MHz – 25000 MHz

Frequency (MHz)	RF Peak Level (dBm)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
455.75	-46.7	-2.16	44.54	PASS
480.25	-44.0	-3.04	40.96	PASS
515.25	-53.4	-3.68	49.72	PASS

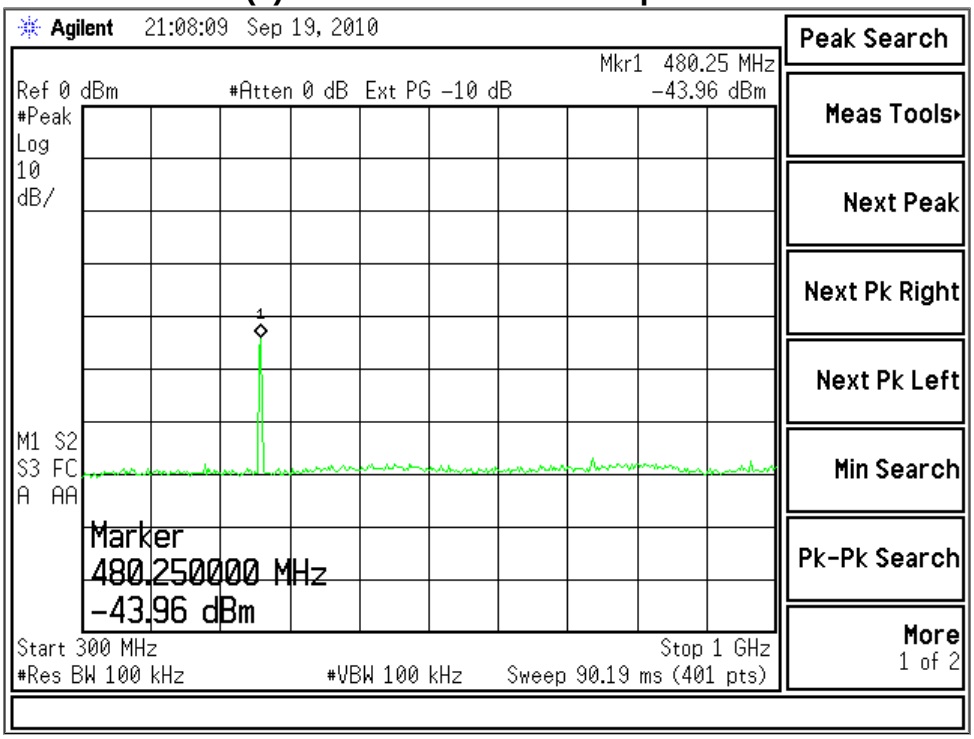
12.4 Screen Captures – Spurious Radiated Emissions

Channel 7 shown from 30 MHz up to 1000 MHz

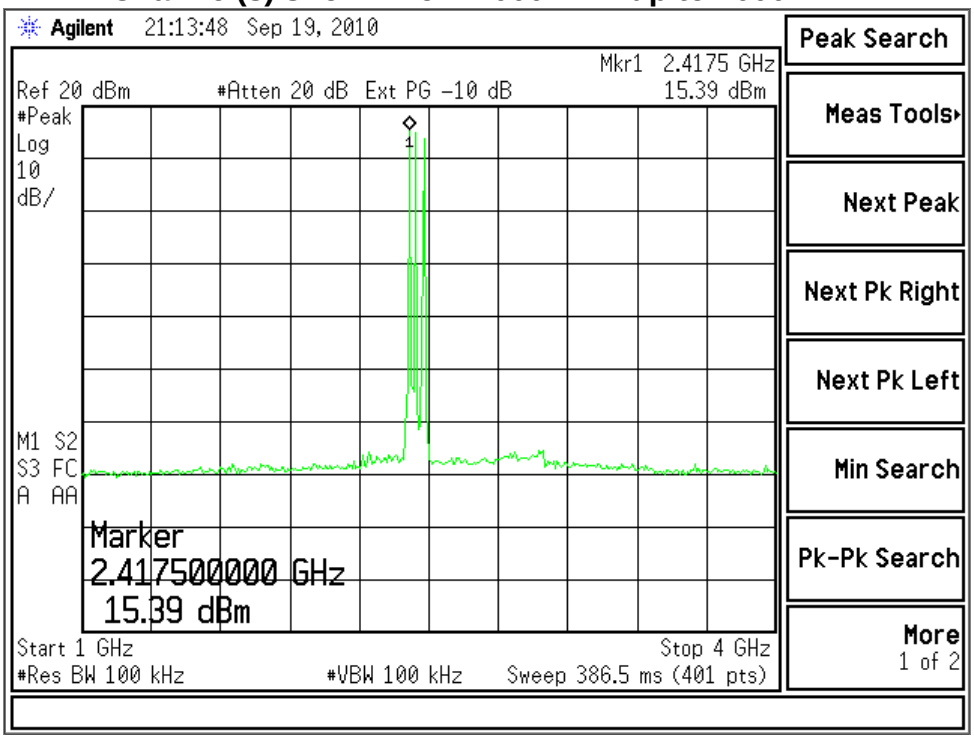


Screen Captures – Spurious Radiated Emissions *(continued)*

Channel(s) shown from 300 MHz up to 1000 MHz

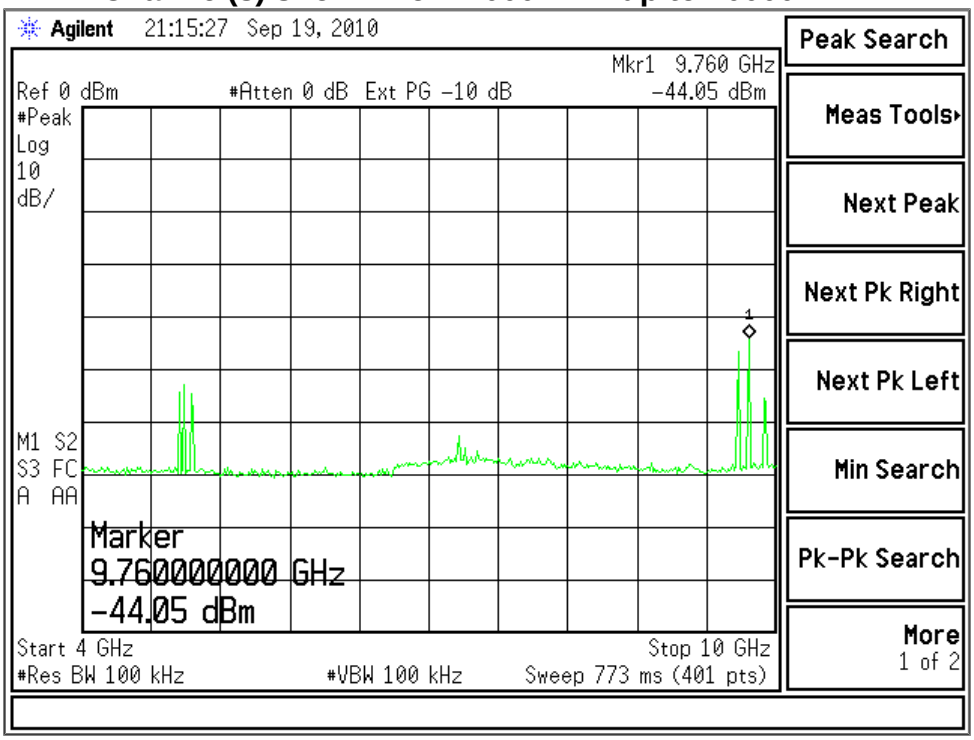


Channel(s) shown from 1000 MHz up to 4000 MHz



Screen Captures – Spurious Radiated Emissions *(continued)*

Channel(s) shown from 4000 MHz up to 10000 MHz



Channel(s) shown from 10000 MHz up to 25000 MHz

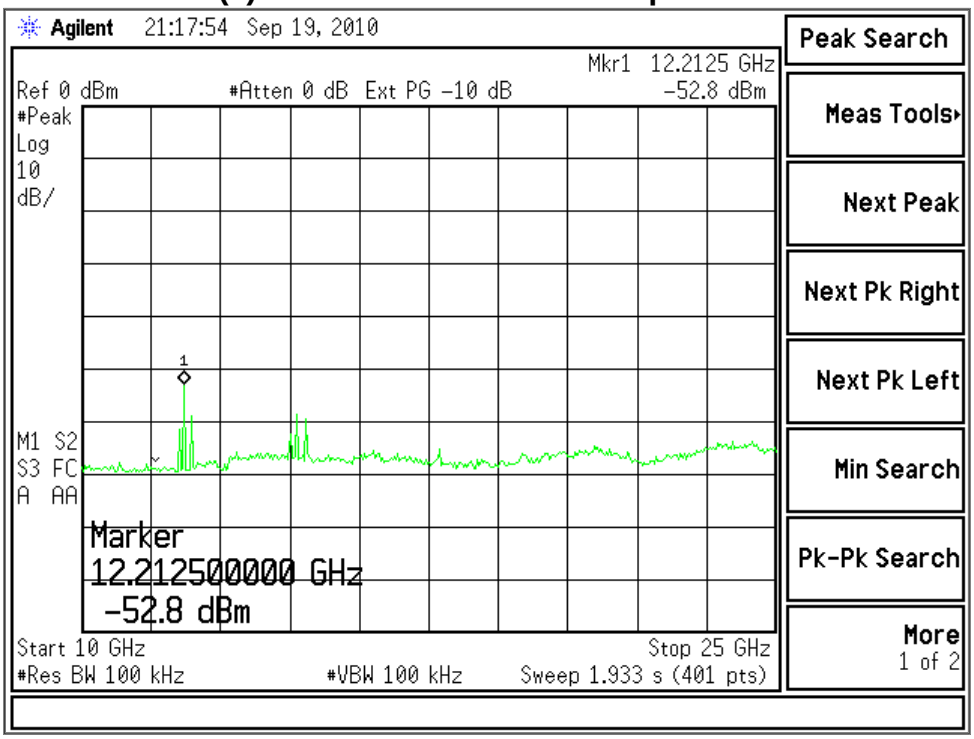


EXHIBIT 13 FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

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. For this test, the EUT 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 using the spectrum analyzer.

In this case, the EUT uses a Class 2 AC Adapter, with a nominal voltage of 12.0 VDC.

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.

	DC Voltage Source	
	10.2V DC	13.8V DC
Channel 7	2416.860949(MHz)	2416.860949(MHz)
Channel 18	2439.779550(MHz)	2439.779350(MHz)
Channel 35	2475.199530(MHz)	2475.199280(MHz)

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.

	DC Voltage Source	
	10.2V DC	13.8V DC
Channel 7	17.52 (dBm)	17.44 (dBm)
Channel 18	17.03 (dBm)	16.27 (dBm)
Channel 35	15.99 (dBm)	16.17 (dBm)

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.

No anomalies were noted; in the measured transmit power, varying less than 1 dB, during the voltage variation tests.

EXHIBIT 14 MPE CALCULATIONS

The following MPE calculations are based on a 5 dBi Omni-directional monopole antenna, with a measured ERP of 120.77 dBµV/m, at 3 meters, and conducted RF power of +18.2 dBm as presented to the antenna. The maximum gain of this antenna, based on the manufacturer's documentation is 5 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:	18.20	(dBm)
Maximum peak output power at antenna input terminal:	66.069	(mW)
Antenna gain(typical):	5	(dBi)
Maximum antenna gain:	3.162	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2417	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)

Power density at prediction frequency:	0.041565	(mW/cm^2)
Maximum allowable antenna gain:	18.8	(dBi)
Margin of Compliance at 20 cm =	13.8	dB

APPENDIX A

INSTRUMENTATION SHEETS

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : September 19th 2010 Type Test : Emissions Job # : C-881

Prepared By: P. Feilen Customer : AvaLAN Wireless Quote #: 310038

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
3	AA 960077	Bicon Antenna	EMCO	93110B	9702-2918	11/20/2009	11/20/2010	Active Calibration
4	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/16/2009	10/16/2010	Active Calibration
5	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	12/22/2009	12/22/2010	Active Calibration
6	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration
7	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/20/2009	9/20/2010	Active Calibration
8	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/4/2010	6/4/2011	Active Calibration

Constructed By: Peter Feilen Quality Assurance:

APPENDIX B

TEST STANDARDS – CURRENT PUBLICATION DATES

STANDARD #	DATE	Am. 1	Am. 2	STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003			FCC Procedures	2007		
ANSI C63.10	2009			ICES 001	2006-06		
CISPR 11	2009-05	2009-12 P		ICES 002	2009-08		
CISPR 12	2007-05			ICES 003	2004-02		
CISPR 14-1	2005-11	2008-11		IEC 60601-1-2 Note 1	2007-03		
CISPR 14-2	2001-11	2001-11	2008-05	IEC 61000-3-2	2005-11	2008-03	2009-02
CISPR 16-1-1 Note 1	2010-01			IEC 61000-3-3	2008-06		
CISPR 16-1-2 Note 1	2003	2004-04	2006-07	IEC 61000-4-2	2008-12		
CISPR 22	2008-09			IEC 61000-4-3	2008-04	incl in 2008-04	2009-12 FD
CISPR 24	1997-09	2001-07	2002-10	IEC 61000-4-4	2004-07	2010-10	
EN 55011	2007-05			IEC 61000-4-5	2005-11		
EN 55014-1	2006			IEC 61000-4-6	2008-10		
EN 55014-2	1997			IEC 61000-4-8	2009-09		
EN 55022	2006	2007		IEC 61000-4-11	2004-03		
EN 60601-1-2	2007-03			IEC 61000-6-1	2005-03		
EN 61000-3-2	2006-05			IEC 61326-1	2006-06		
EN 61000-3-3	2008-12			ISO 14982	1998-07		
EN 61000-4-2	2009-05			MIL Std. 461E	1999-08		
EN 61000-4-3	2006-07	2008-05		RSS GEN	2007-06		
EN 61000-4-4	2004			RSS 119	2007-06		
EN 61000-4-5	2006-12			RSS 123	1999-11		
EN 61000-4-6	2009-05			RSS 125	2000-03		
EN 61000-4-8	1994	2001		RSS 131	2003-07		
EN 61000-4-11	2004-10			RSS 136	2002-10		
EN 61000-6-1	2007-02			RSS 137	2009-02		
EN 61000-6-2	2005-12			RSS 210	2007-06		
EN 61000-6-3	2007-02			RSS 213	2005-12		
EN 61000-6-4	2007-02			RSS 243	2005-11		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2008			RSS 310	2007-06		
FCC Public Notice DA 00-1407	2000						
FCC ET Docket # 99-231	2002						
				Note 1: Test not on LSR Scope of Accreditation.			

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

APPENDIX C

UNCERTAINTY STATEMENT

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

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

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

APPENDIX D

JUSTIFICATIONS OF AVERAGE DUTY FACTOR CALCULATIONS

According to the guidance provided in KDB publication number 55074, Measurement of Digital Transmission Systems Operating under Section 15.247 March 23, 2005, Section 15.247(c) – Spurious emissions for radiated emissions applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. This section of the guidance document states, "If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation as described in Section 15.35(b) and (c)."

Section 15.35(c) states:

> Unless otherwise specified[…] when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

As a result, the unit was placed in a continuous transmit mode during testing, and in the even the measurement was observed over the specified limits, the measurements would be corrected using the calculation as factored below, and justified providing the guidance information provided by the KDB.

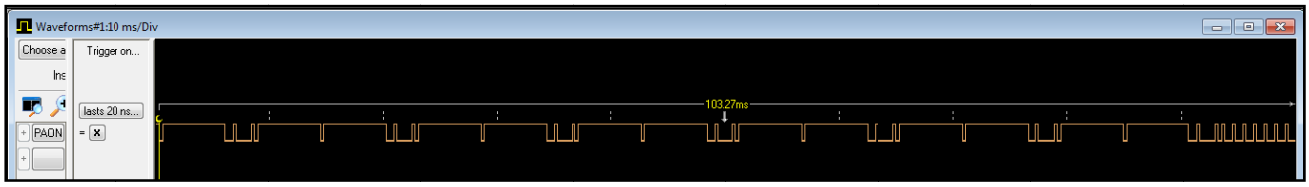
Average (Relaxation) Factor

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

The transmit packet occupies 74.98 ms of time, within any 100 ms window. Therefore, the relaxation factor allowance is calculated as:

Average Factor = 20*Log_{10} (74.98/100 ms) = -2.501

A relaxation factor of **2.5 dB** would be allowable for this product.



APPENDIX E

PRODUCT CONFIGURATION INSTRUCTIONS

DIP 1
ON – TX mode
OFF – RX Mode

DIP 2
ON – Continuous Wave mode
OFF – Modulated mode (95% TX / 5% RX duty cycle)

DIP 3
ON – add 1 to channel
OFF – add 0 to channel

DIP 4
ON – add 2 to channel
OFF – add 0 to channel

DIP 5
ON – add 4 to channel
OFF – add 0 to channel

DIP 6
ON – add 8 to channel
OFF – add 0 to channel

DIP 7
ON – add 16 to channel
OFF – add 0 to channel

DIP 8
ON – add 32 to channel
OFF – add 0 to channel

Channel LEDs show current operating channel (1 to 37 spaced 2.083 MHz apart)