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TEST REPORT #:310368
LSR Job #: C-1079

Compliance Testing of:

EM357 Module

Test Date(s):

December 16th – 21st, 2010

Prepared For:

CEL
Attn: Tom Benson
1253 N. Old Rand Road
Wauconda, IL 60084

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 210 Issue 8

This Test Report is issued under the Authority of:
Peter Feilen, EMC Engineer

Signature: Date: 3.10.11

Quality Assurance by:	**Project Engineer:**
Peter Feilen, EMC Engineer	Shane D. Rismeyer, EMC Engineer
Signature: Date: 3.10.11	Signature: Date: 3.1.11

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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 Issue 3 and RSS 210 Issue8
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)	2007-10	Code of Federal Regulations - Telecommunications
RSS 210 Issue 8	2010 December	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	2006-03 A1: 2006-09 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003 A1: 2004-04 A2: 2007-07	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	2007	Measurement of Digital Transmission Systems operating under Section 15.247.

1.3 - LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A
On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.
Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 – Client Information

Manufacturer Name:	CEL
Address:	1253 N. Old Rand Road
Contact Name:	Tom Benson

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	EM357 Module
Model Number:	EM357
Serial Number:	N/A

2.3 - Associated Antenna Description

This product uses an inverted F antenna. It is integrated into the module PCB.

2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2405-2475 MHz
RF Power in Watts	
Minimum:	0.00424
Maximum:	0.0684
Conducted Output Power (in dBm)	20.58
Field Strength at 3 meters	120.2 dBµV/m
Occupied Bandwidth (99% BW)	2.22 MHz
Type of Modulation	OQPSK
Emission Designator	2M22G1D
EIRP (in mW)	68.4
Transmitter Spurious (worst case) at 3 meters	34.74 dBµV/m
Receiver Spurious (worst case) at 3 meters	30.0 dBµV/m
Stepped (Y/N)	N
Step Value:	-
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor Model # (if applicable)	Ember EM357
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	Inverted F
Gain (in dBi)	-2dBi
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	210
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

RF Technical Information:

Type of Evaluation (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 65
Measurement Distance: 20cm
RF Value: 0.008142 ☐ V/m ☐ A/m ☒ mW/cm^2

☐ Measured ☐ Computed ☒ Calculated

2.5 - Product Description

CEL's MeshConnect™ EM357 Module combines a high performance RF solution with the market's premier ZigBee stack. The ZICM357P2-1module is based off of Ember's EM357 transceiver platform. It combines this transceiver IC with an on-board 100mW Power Amplifier, voltage regulator, TX/RX switch, external FLASH memory, and an integrated trace antenna. CEL's MeshConnect™ EM357 module (ZICM357P2-1) is based on the Ember EM357 Zigbee compliant SOC IC. The IC is a single-chip solution, compliant with ZigBee specifications and IEEE 802.15.4, a complete wireless solution for all ZigBee applications. The IC consists of an RF transceiver with the baseband modem, a hardwired MAC and an embedded 32-bit ARM® Cortex™-M3 microcontroller with internal RAM (12kB) and Flash (192kB) memory. The device provides numerous general-purpose I/O pins and peripheral functions such as timers and UARTs.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 - Climate Test Conditions

Temperature:	23°C
Humidity:	35%
Pressure:	745 mmHg

3.2 - Applicability & Summary Of EMC Emission Test Results

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
FCC : 15.207 IC : RSS GEN sect. 7.2.4	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	99% Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(c) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC : 15.247(d) IC : RSS 210 A8.2(b)	Transmitted Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers (RSS GEN and RSS 210 of IC). The Receiver Test Report is available upon request.		

3.3 - Modifications Incorporated In the EUT for Compliance Purposes

☐ None ☒ Yes (explain below)

Power on Channel 25 was reduced to setting -14 and power on Channel 24 was reduced to setting -5 to comply with band edge measurements. The remaining channels (1-23) use power level 8.

3.4 - Deviations & Exclusions from Test Specifications

☒ None ☐ Yes (explain below)

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 8 (2010), Section Annex 8 (section 8.2) for a Digital Spread Spectrum (DTS) Transmitter.

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

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

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 - Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4-2003. 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 continuous transmit mode with modulation, using power as provided by a DC lab supply. The unit has the capability to operate on 15 channels, controllable via laptop PC.

The applicable limits apply at a 3 meter distance. Measurements above 4 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2405 MHz), middle (2440 MHz) and high (2475 MHz) to comply with FCC Part 15.31(m).

5.2 - Test Procedure

Radiated RF measurements were performed on the EUT in 3 meter Semi-Anechoic and Compact Semi-Anechoic FCC listed Chambers. 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. For the lower frequency ranges the EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber with the antenna mast placed so that the separation distance between the antenna and EUT was 3 meters. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz, a Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 4 GHz in the 3 meter Semi-Anechoic Chamber. The remaining measurements were taken in the Compact Semi-Anechoic Chamber at a separation distance of 1 meter. The Double-Ridged Waveguide Horn Antenna used from 4 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, using both horizontal and vertical antenna polarities.

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. The Agilent E4445A EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz). From 4 GHz to 25 GHz, an Agilent E4446A Spectrum Analyzer was used.

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 of field strength (μV/m to dBμV/m):

$dB\mu V/m = 20 \log_{10} (100) = 40\ dB\mu V/m$ (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 dBμV/m at 3 meters
54.0 + 9.5 = 63.5 dBμV/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 dBμV/m at 3 meters
54.0 + 20 = 74 dBμV/m at 0.3 meters

Reported data is the raw data corrected for all applicable factors such as antenna factors, cable loss, etc.

Sample reported data:

Raw Data + Antenna Factor + Cable Factor = Reported Data

86.75 dBμV/m + 28.52 dB + 4.93 dB = 120.2 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:	CEL					
Date(s) of Test:	12/16/10					
Test Engineer(s):	Shane Rismeyer					
Voltage:	3.3VDC					
Operation Mode:	Modulated					
Environmental Conditions in the Lab:	Temperature: 20 – 25˚C Relative Humidity: 30 – 60 %					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
		Battery	**X**	Other: 3.3 VDC		
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 (degrees)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
240	V/V	1.00	0	31.59	46.0	14.41
992	V/V	1.00	0	34.74	54.0	19.26

RADIATED EMISSIONS DATA CHART (continued)

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

Frequency (MHz)	Ant./EUT Polarity	Height (cm)	Azimuth (degrees)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2405	H/Side	105.0	196	120.2	125.2	5.0
4810.8	H/Vertical	102.6	222.6	53.918	63.5	9.58
7213.6	H/Vertical	101.4	192.5	52.967	63.5	10.53
9618.0	H/Vertical	102.6	185.8	58.789	63.5	4.71
12022.5	H/Vertical	117.9	13.3	52.463	63.5	11.04
14432.7	H/Vertical	103.9	134.3	55.533	63.5	7.97
16838.3	H/Vertical	101.3	158.0	53.231	63.5	10.27
4811.1	V/Vertical	114.8	198.3	54.022	63.5	9.48
7216.6	V/Vertical	99.9	214.7	54.838	63.5	8.66
9617.8	V/Vertical	101.5	231.8	57.811	63.5	5.69
12022.3	V/Vertical	120.9	162.2	51.127	63.5	12.37
14426.93	V/Vertical	106.1	13.9	56.671	63.5	6.83
16831.43	V/Vertical	100	262.1	54.448	63.5	9.05
4810.8	H/Side	115.0	154.9	57.720	63.5	5.78
7216.5	H/Side	111.2	219.2	55.511	63.5	7.99
9618.0	H/Side	107.5	315.0	60.925	63.5	2.58
12022.5	H/Side	109.9	29.3	50.870	63.5	12.63
14426.9	H/Side	104.4	41.9	55.159	63.5	8.34
16838.3	H/Side	99.9	27.3	58.609	63.5	4.89
4808.9	V/Side	111.4	133.2	58.404	63.5	5.10
7216.4	V/Side	101.5	126.6	57.492	63.5	6.01
9618.0	V/Side	105.7	331.8	60.780	63.5	2.72
12022.5	V/Side	102.8	25.2	47.626	63.5	15.87
14426.8	V/Side	109.6	128.5	53.363	63.5	10.14
16831.3	V/Side	112.9	264.6	50.221	63.5	13.28
4811.0	H/Flat	106.3	213.2	54.813	63.5	8.69
7213.4	H/Flat	100.2	321.1	60.636	63.5	2.86
9617.9	H/Flat	102.5	214.1	59.698	63.5	3.80
12022.3	H/Flat	101.4	132.3	48.943	63.5	14.56
14427.2	H/Flat	108.0	280.3	46.740	63.5	16.76
16831.0	H/Flat	105.8	151.7	51.577	63.5	11.92
4811.1	V/Flat	105.4	196.0	50.275	63.5	13.23
7213.5	V/Flat	102.5	213.2	53.411	63.5	10.09
9617.9	V/Flat	122.2	47.6	58.043	63.5	5.46
12022.3	V/Flat	99.9	103.6	52.056	63.5	11.44
14433.03	V/Flat	104.1	158.6	51.550	63.5	11.95
16831.5	V/Flat	106.3	127.3	53.233	63.5	10.27

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

Frequency (MHz)	Ant./EUT Polarity	Height (cm)	Azimuth (degrees)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2440	V/Vertical	107.0	0	116.7	125.2	8.6
4878.9	H/Vertical	101.5	166.9	54.993	63.5	8.51
7321.5	H/Vertical	102.5	160.9	53.124	63.5	10.38
9757.9	H/Vertical	107.8	21.5	56.215	63.5	7.29
12197.2	H/Vertical	116.3	45.8	52.191	63.5	11.31
14642.9	H/Vertical	108.1	266.4	55.472	63.5	8.03
17083.3	H/Vertical	106.7	175.6	60.306	63.5	3.19
4881.0	V/Vertical	107.1	82.6	49.388	63.5	14.11
7321.6	V/Vertical	99.8	245.0	56.740	63.5	6.76
9762.0	V/Vertical	126.0	103.3	54.110	63.5	9.39
12197.5	V/Vertical	104.1	200.0	51.292	63.5	12.21
14643.02	V/Vertical	106.4	48.6	57.836	63.5	5.66
17083.67	V/Vertical	104.1	35.1	60.179	63.5	3.32
4881.0	H/Side	104.5	230.7	57.358	63.5	6.14
7321.5	H/Side	106.9	242.9	56.991	63.5	6.51
9762.0	H/Side	110.8	330.7	60.281	63.5	3.22
12197.4	H/Side	101.9	130.8	52.401	63.5	11.10
14643.1	H/Side	100.0	192.4	55.120	63.5	8.38
17083.4	H/Side	102.8	33.8	65.390	96.7	31.31
4879.0	V/Side	107.7	175.3	45.798	63.5	17.70
7321.4	V/Side	115.6	164.8	54.360	63.5	9.14
9755.0	V/Side	101.9	353.4	57.613	63.5	5.89
12197.3	V/Side	117.8	21.3	49.901	63.5	13.60
14643.15	V/Side	124.3	174.7	52.946	63.5	10.55
17083.45	V/Side	101.7	141.1	54.190	63.5	9.31
4879.0	H/Flat	114.3	23.3	55.422	63.5	8.08
7321.5	H/Flat	106.7	322.8	59.143	63.5	4.36
9758.0	H/Flat	100.0	241.6	58.997	63.5	4.50
12197.6	H/Flat	104.6	216.6	45.103	63.5	18.40
14642.8	H/Flat	104.3	211.6	49.060	63.5	14.44
17083.3	H/Flat	105.3	139.5	59.744	63.5	3.76
4879.1	V/Flat	124.6	294.1	49.054	63.5	14.45
7321.4	V/Flat	106.5	210.4	56.304	63.5	7.20
9757.8	V/Flat	119.9	39.4	57.493	63.5	6.01
12202.5	V/Flat	114.6	232.5	52.316	63.5	11.18
14642.95	V/Flat	111.8	203.6	55.987	63.5	7.51
17083.62	V/Flat	129.9	136.1	60.310	63.5	3.19

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

Frequency (MHz)	Ant./EUT Polarity	Height (cm)	Azimuth (degrees)	Measured EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2475	H/Flat	105.0	207	108.8	125.2	16.4
4950.9	H/Vertical	108.0	320.8	59.227	63.5	4.27
7423.6	H/Vertical	111.2	304.6	54.782	63.5	8.72
9898.1	H/Vertical	112.8	38.7	56.161	63.5	7.34
12372.6	H/Vertical	104.1	61.0	47.974	63.5	15.53
14852.93	H/Vertical	102.7	207.1	56.4587	63.5	7.04
17321.58	H/Vertical	133.5	150.1	63.8947	88.8	24.91
4949.07	V/Vertical	103	335.9	51.7997	63.5	11.70
7426.32	V/Vertical	104.6	320.4	59.4307	63.5	4.07
9902.08	V/Vertical	101.9	245.7	56.6587	63.5	6.84
12372.47	V/Vertical	99.7	332.1	47.0567	63.5	16.44
14852.83	V/Vertical	100.1	33.2	52.9107	63.5	10.59
17328.17	V/Vertical	111.3	151.6	64.5137	88.8	24.30
4949.1	H/Side	106.7	121.6	60.143	63.5	3.36
7423.4	H/Side	102.7	223.9	59.307	63.5	4.19
9898.1	H/Side	116.2	212.8	58.194	63.5	5.31
12372.8	H/Side	105.5	223.2	51.274	63.5	12.23
14846.98	H/Side	105.1	13.2	55.8997	63.5	7.60
17321.45	H/Side	100.2	296.7	70.2817	88.8	18.52
4951.03	V/Side	106.5	87	56.9257	63.5	6.57
7426.38	V/Side	104.2	163.2	58.9737	63.5	4.53
9901.9	V/Side	105.4	220	56.5807	63.5	6.92
12372.37	V/Side	102.6	85	49.4547	63.5	14.05
14847.02	V/Side	102.4	244.6	53.9337	63.5	9.57
17321.53	V/Side	104.7	48.8	58.0677	63.5	5.43
4950.9	H/Flat	102.7	152.9	59.465	63.5	4.04
7426.4	H/Flat	106.4	24.9	52.791	63.5	10.71
9898.1	H/Flat	106.5	223.3	54.302	63.5	9.20
12372.3	H/Flat	111.6	130.7	50.461	63.5	13.04
14852.92	H/Flat	99.9	230.6	55.6977	63.5	7.80
17328.22	H/Flat	111.9	146.9	61.1387	63.5	2.36
4951.02	V/Flat	125.1	194.3	50.0657	63.5	13.43
7423.48	V/Flat	110.9	225.4	57.7647	63.5	5.74
9901.78	V/Flat	134.8	360.5	54.1677	63.5	9.33
12377.18	V/Flat	105.3	205	49.1777	63.5	14.32
14852.9	V/Flat	102.7	356.1	56.5707	63.5	6.93
17328.27	V/Flat	99.9	357.5	65.0647	88.8	23.74

Harmonics Notes:

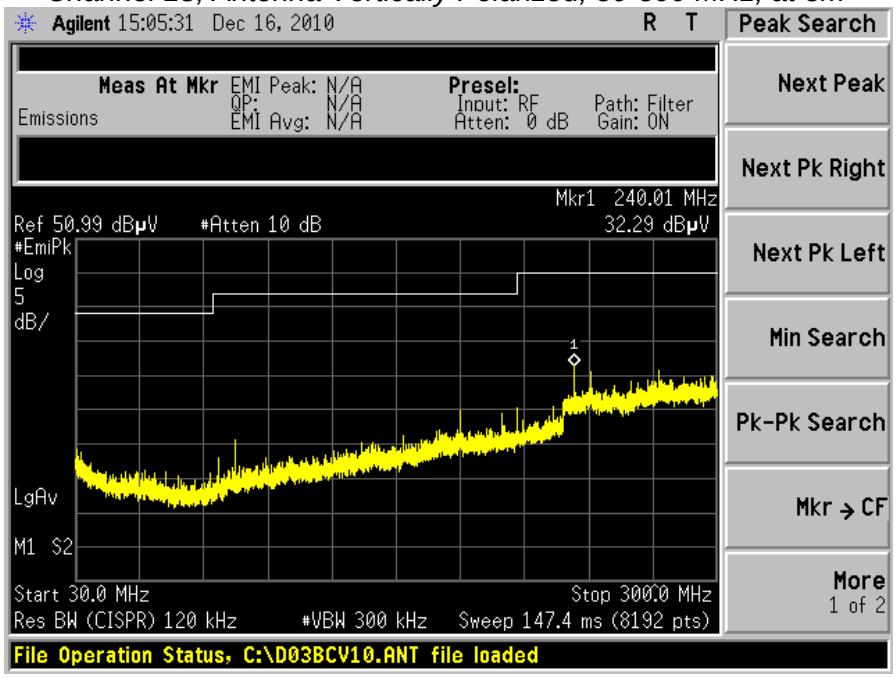
- A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. Only the results from the Average detector are published in the table above. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.

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

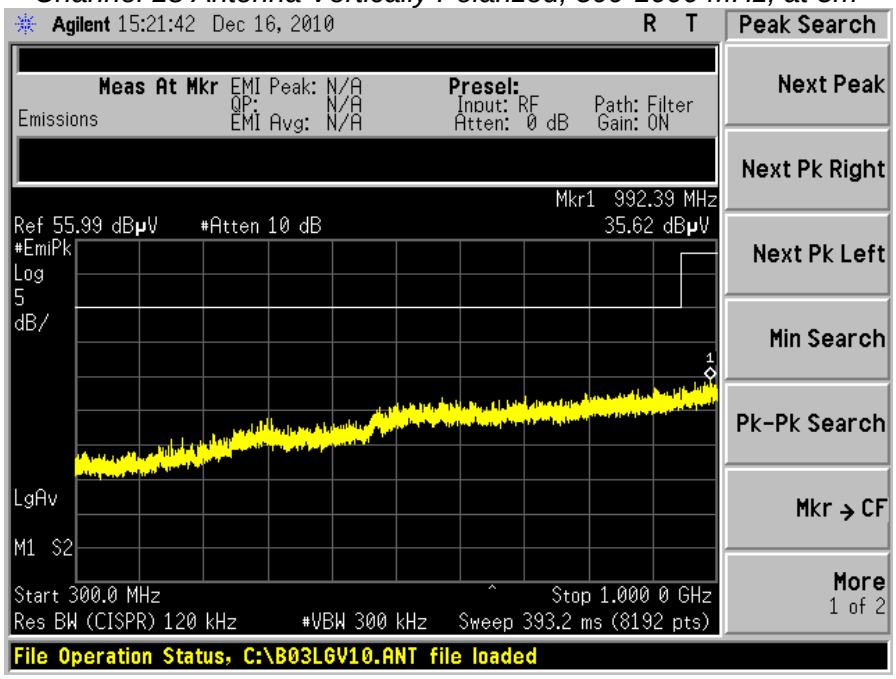
5.7 - Screen Captures - Radiated Emissions Test

These screen captures represent Peak Emissions. The signature scans shown here are from worst-case emissions, as measured on channel 18 with the sense antenna both in vertical and horizontal polarity for worst case presentations.

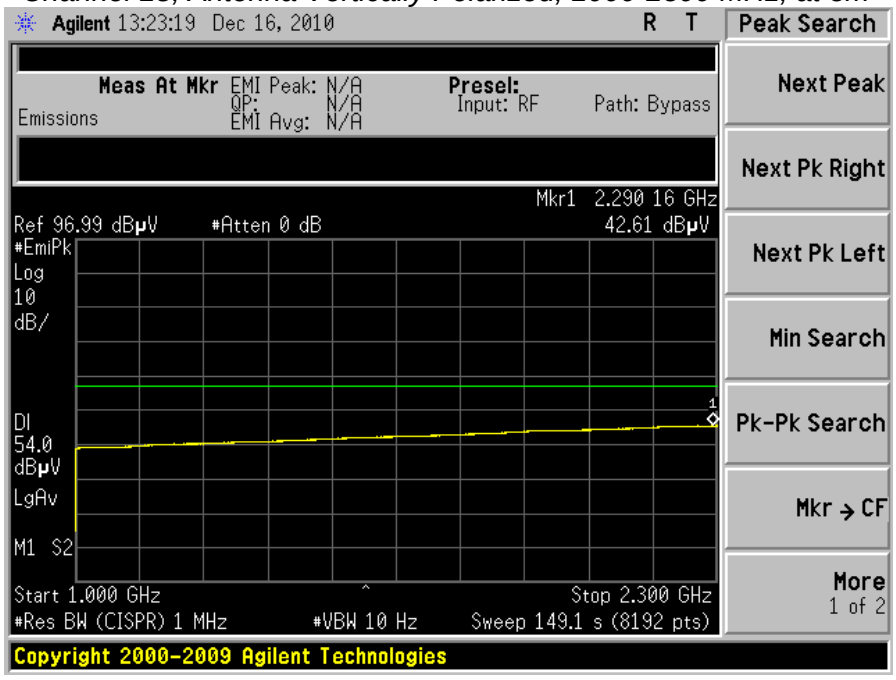
Channel 18, Antenna Vertically Polarized, 30-300 MHz, at 3m



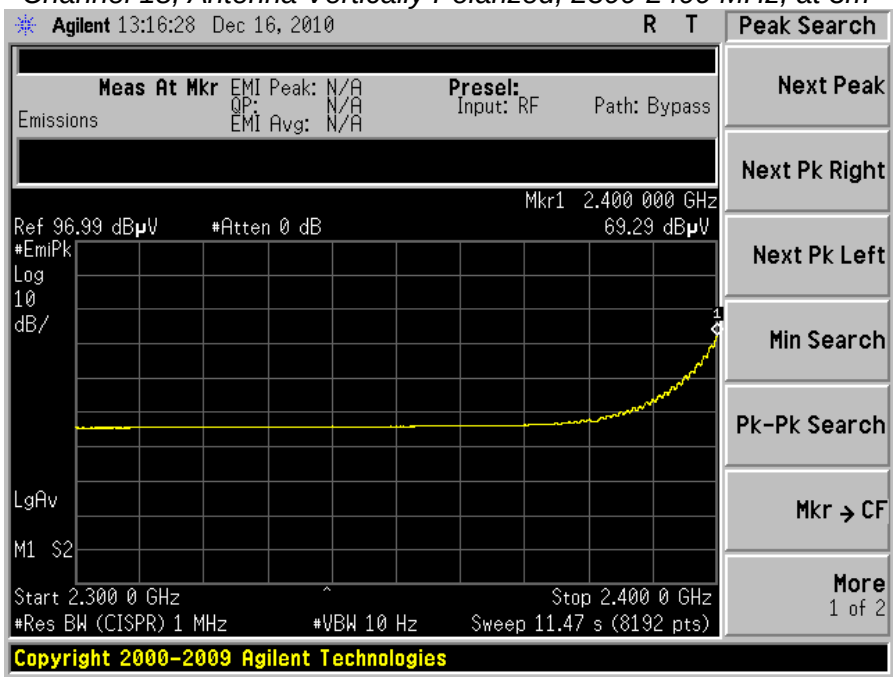
Channel 18 Antenna Vertically Polarized, 300-1000 MHz, at 3m



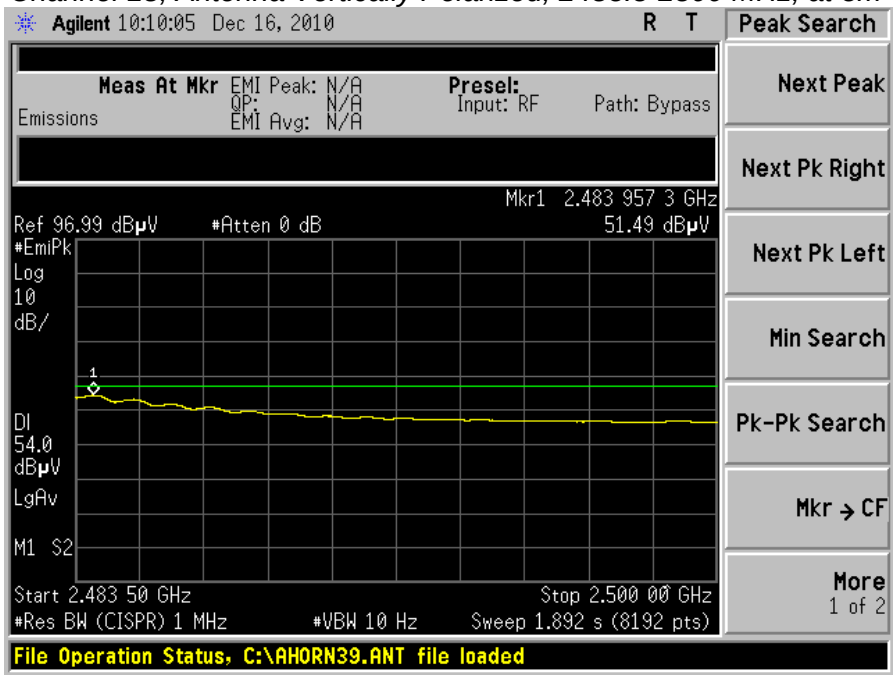
Channel 18, Antenna Vertically Polarized, 1000-2300 MHz, at 3m



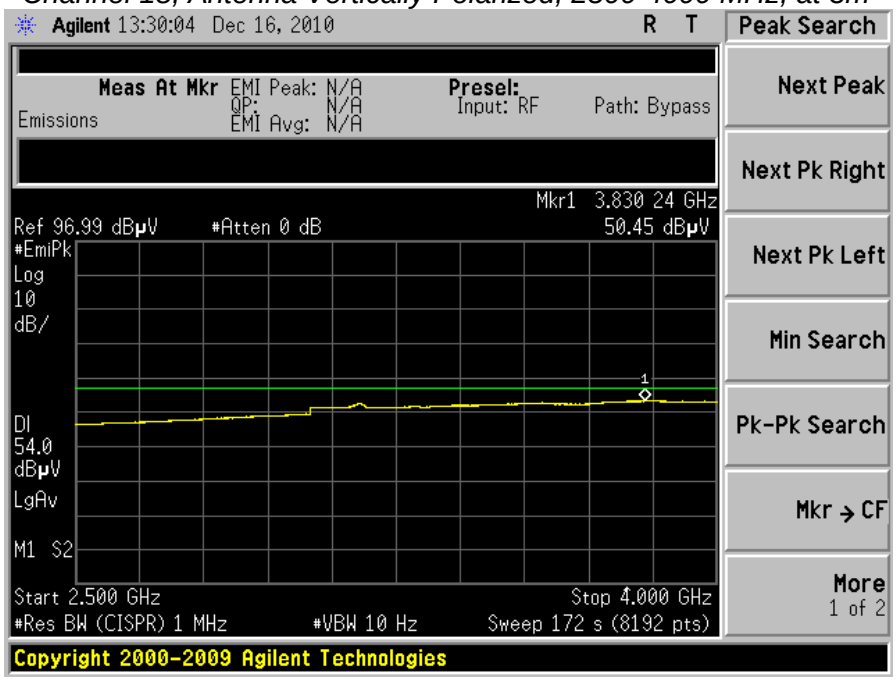
Channel 18, Antenna Vertically Polarized, 2300-2400 MHz, at 3m



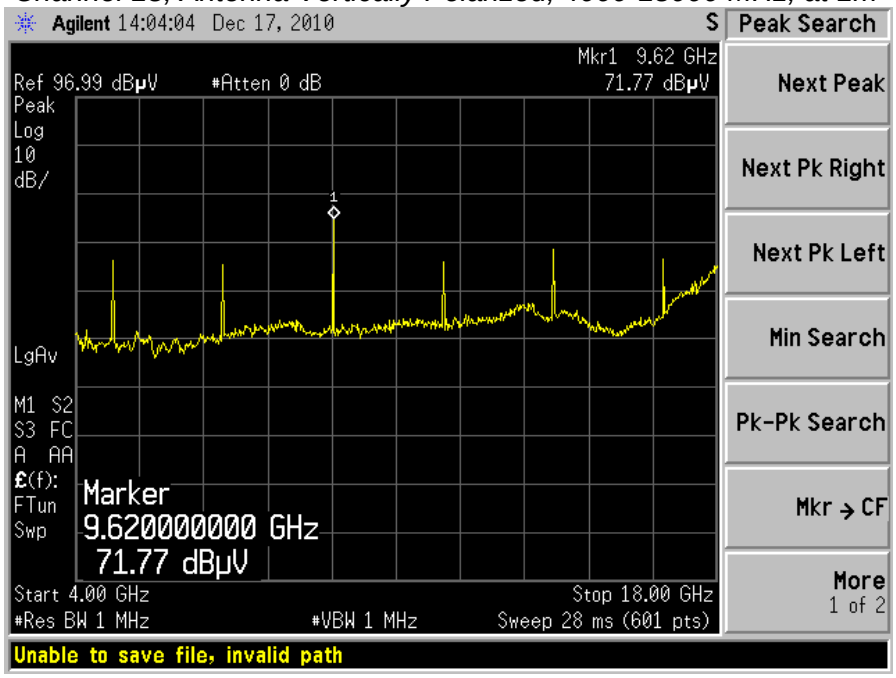
Channel 18, Antenna Vertically Polarized, 2483.5-2500 MHz, at 3m



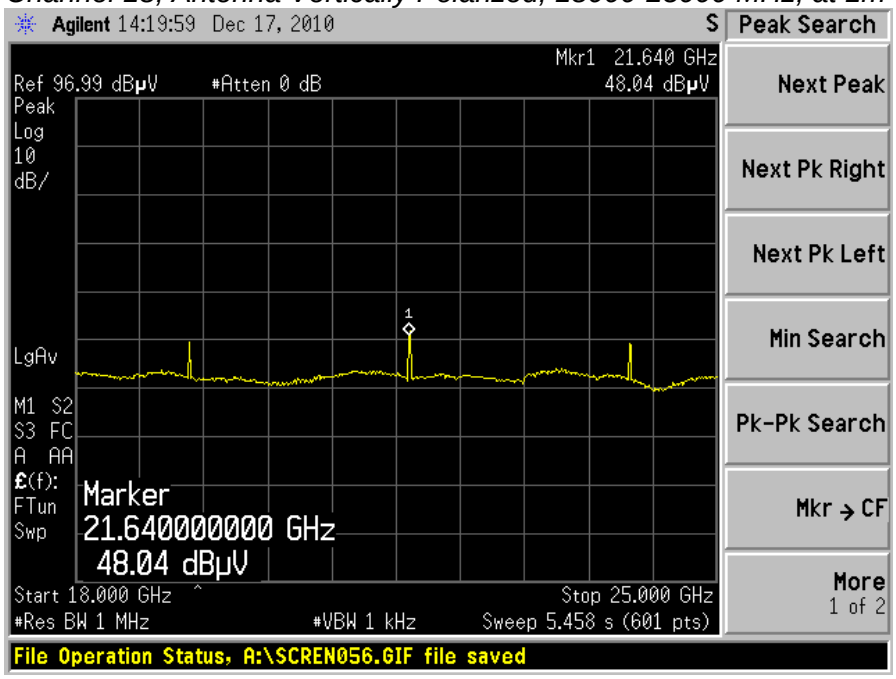
Channel 18, Antenna Vertically Polarized, 2500-4000 MHz, at 3m



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



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



5.8 - Receive Mode Testing

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

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

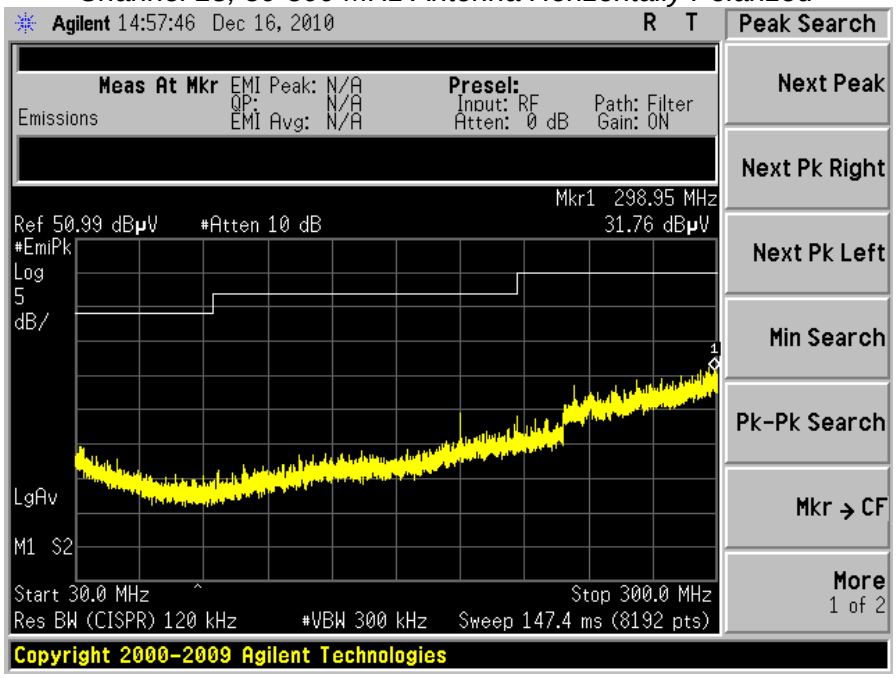
Measurement data and screen captures from the receive tests are presented below:

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
299	1.00	0	30.0	46.0	16.0	H	V
993	1.00	0	29.35	46.0	16.65	H	V

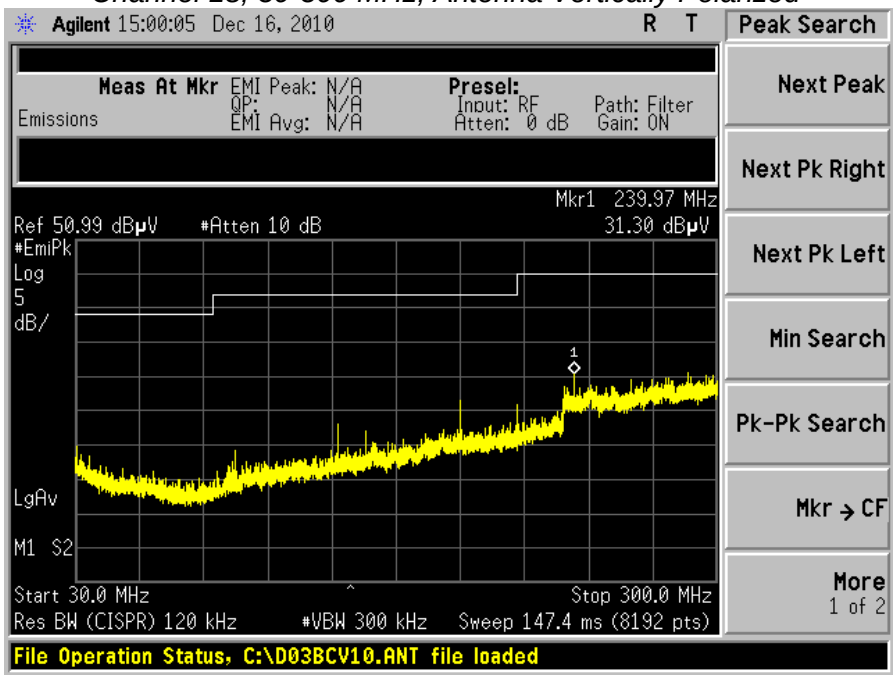
5.9 - Screen Captures - Radiated Emissions Testing – Receive Mode

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

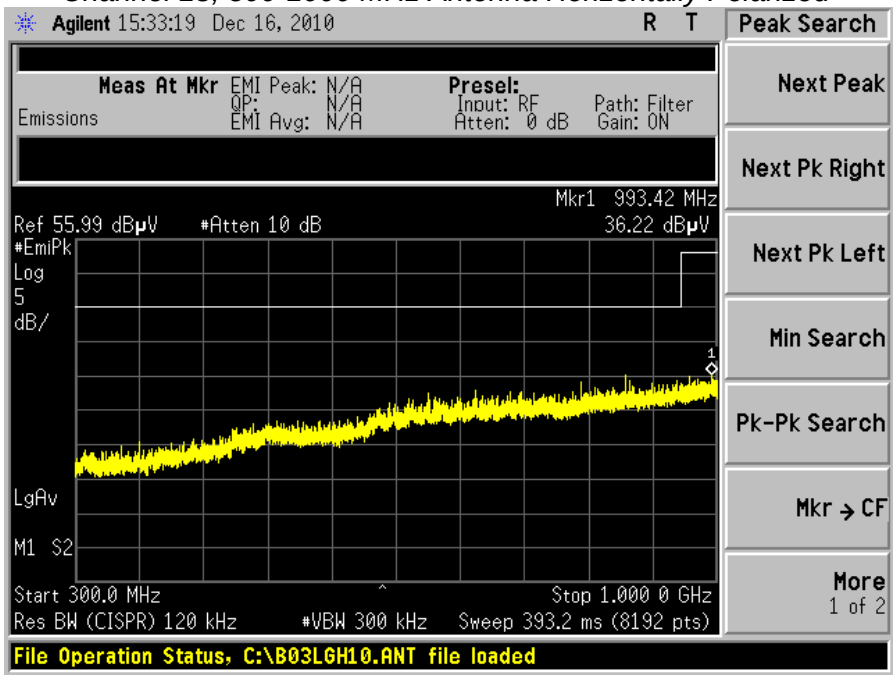
Channel 18, 30-300 MHz Antenna Horizontally Polarized



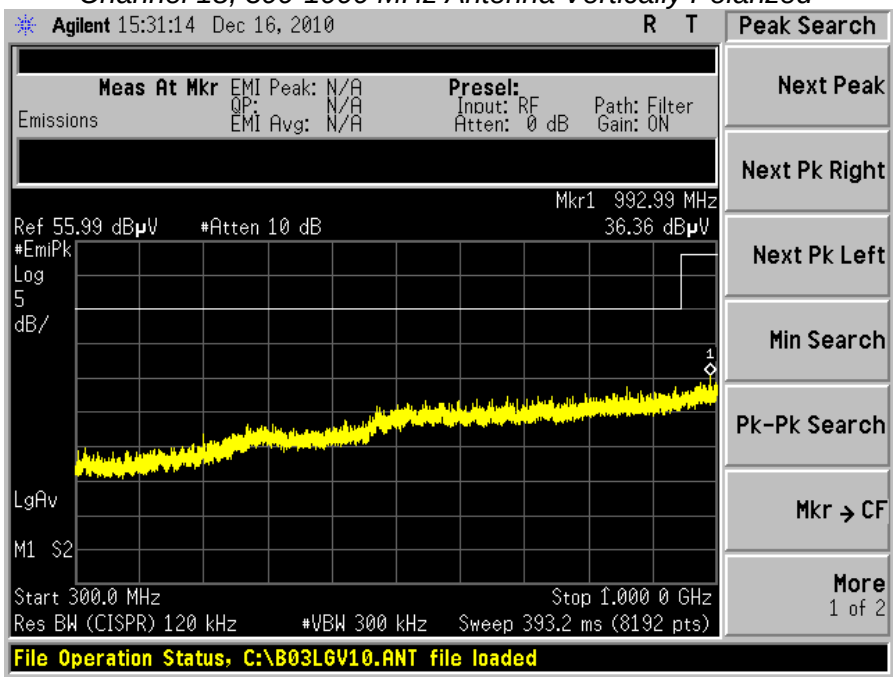
Channel 18, 30-300 MHz, Antenna Vertically Polarized



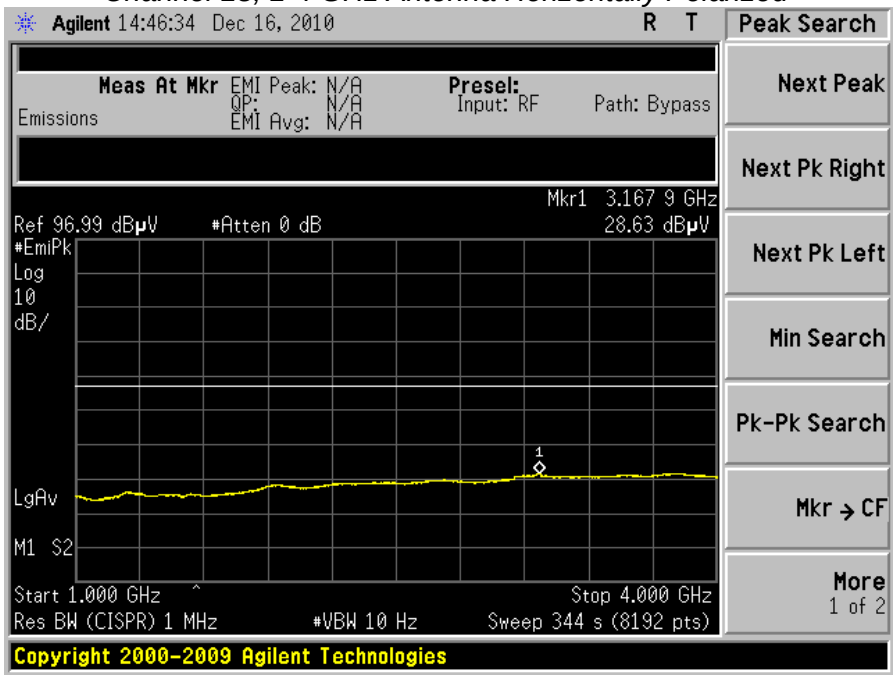
Channel 18, 300-1000 MHz Antenna Horizontally Polarized



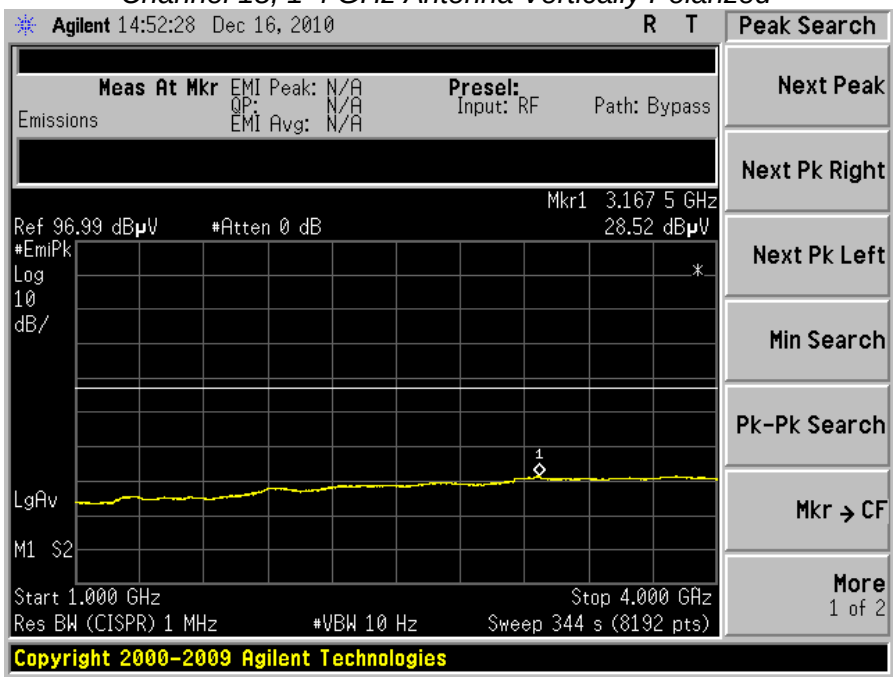
Channel 18, 300-1000 MHz Antenna Vertically Polarized



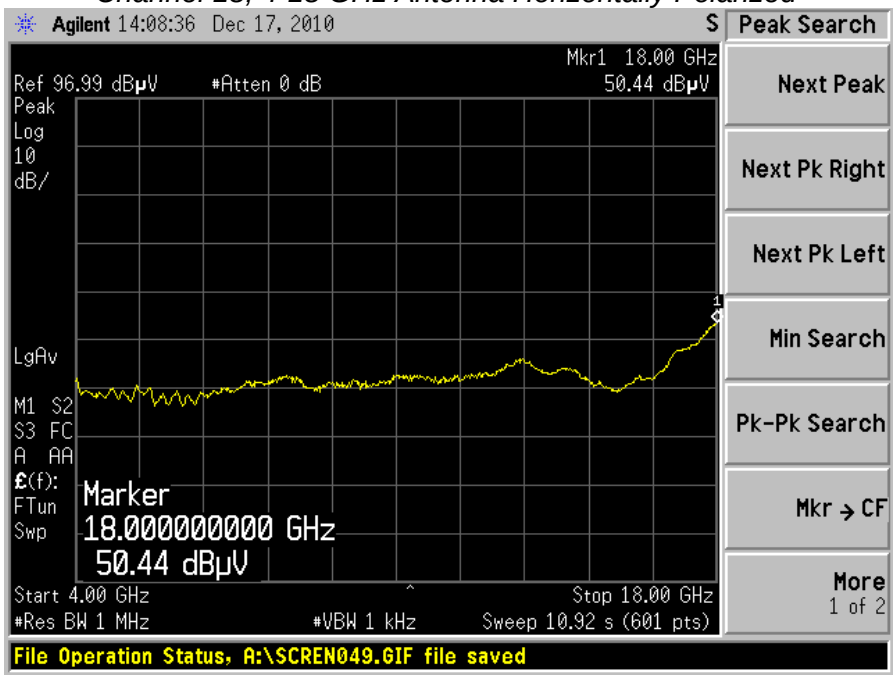
Channel 18, 1-4 GHz Antenna Horizontally Polarized



Channel 18, 1-4 GHz Antenna Vertically Polarized



Channel 18, 4-18 GHz Antenna Horizontally Polarized



Channel 18, 18-25 GHz Antenna Horizontally Polarized

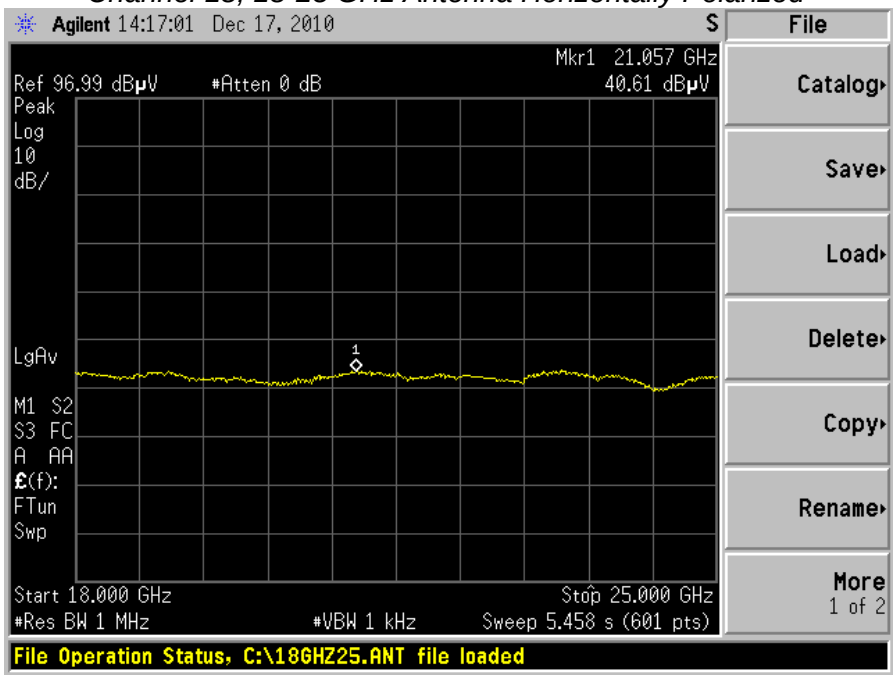


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

6.1 - Test Setup

The test area and setup are in accordance with ANSI C63.4-2003 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided 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.

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

The follow table represents the limits for Conducted Emissions Class B taken from CFR 15.207:

Frequency Range (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.150 -0.50 *	66-56	56-46
0.5 – 5.0	56	46
5.0 – 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

Sample calculation for the limits in the 0.15 to 0.5 MHz:

$$\text{Limit} = -19.12 (\text{Log}_{10} (F\ [\text{MHz}] / 0.15\ [\text{MHz}])) + 66.0\ \text{dB}\mu\text{V}$$

For a frequency of 200 kHz for example:

$$\text{Quasi-Peak Limit (F=200 kHz)} = -19.12 (\text{Log}_{10} (0.2[\text{MHz}] / 0.15\ [\text{MHz}])) + 66.0\ \text{dB}\mu\text{V}$$

$$\text{Quasi-Peak Limit (F=200 kHz)} = 63.6\ \text{dB}\mu\text{V}$$

$$\text{Average Limit (F=200 kHz)} = -19.12 (\text{LOG}_{10} (0.2[\text{MHz}]/0.15[\text{MHz}])) + 56.0\ \text{dB}\mu\text{V}$$

$$\text{Average Limit (F = 200 kHz)} = 53.6\ \text{dB}\mu\text{V}$$

Reported data is the raw data corrected for all applicable factors such as antenna factors, cable loss, etc.

Sample reported data:

Raw Data + Antenna Factor (LISN) + Transient Limiter= Reported Data

17.76 dBµV + 1.0 dB + 10.2 dB = 28.96 dBµV

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:	CEL					
Date(s) of Test:	12/26/10					
Test Engineer:	Shane Rismeyer					
Voltage:	3.3VDC					
Operation Mode:	Normal					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:	**X**	Other				Chamber
EUT Placed On:	**X**	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	**X**	Final
Detector Used:		Peak	**X**	Quasi-Peak	**X**	Average

		QUASI-PEAK			*AVERAGE*		
Frequency (MHz)	**Line**	**Reading (dBµV)**	**Limit (dBµ V)**	**Margin (dB)**	**Reading (dBµV)**	**Limit (dBµ V)**	**Margin (dB)**
0.598	L1	28.960	56.000	27.040	23.940	46.000	22.060
0.598	L2	28.000	56.000	28.000	22.860	46.000	23.140

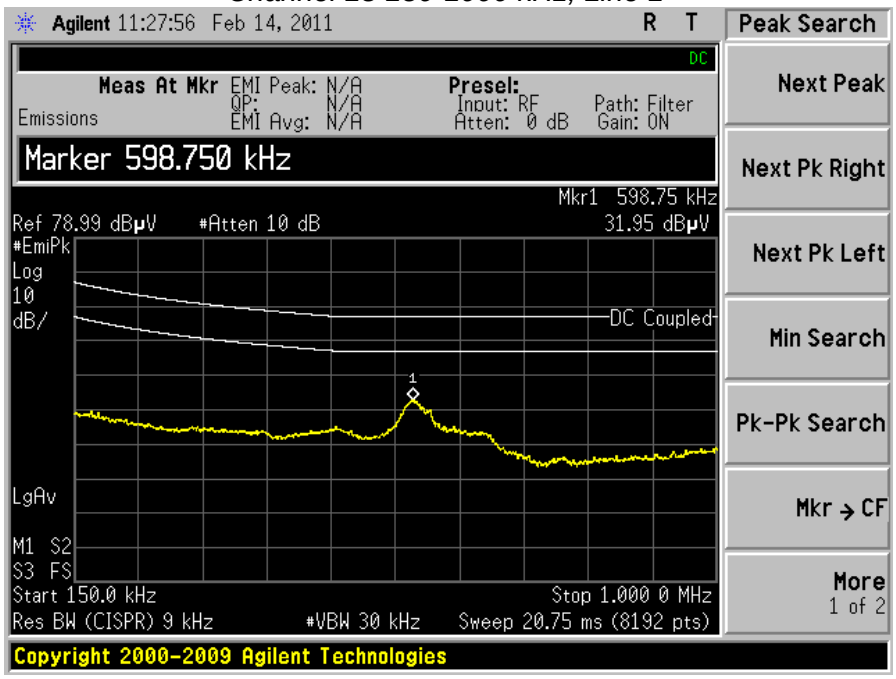
Notes:
1) All other emissions were better than 20 dB below the limits.
2) The EUT exhibited similar emissions in transmit and receive modes, and across the Low, Middle and High channels tested.

6.7 - Test Setup Photo(s) – Conducted Emissions Test

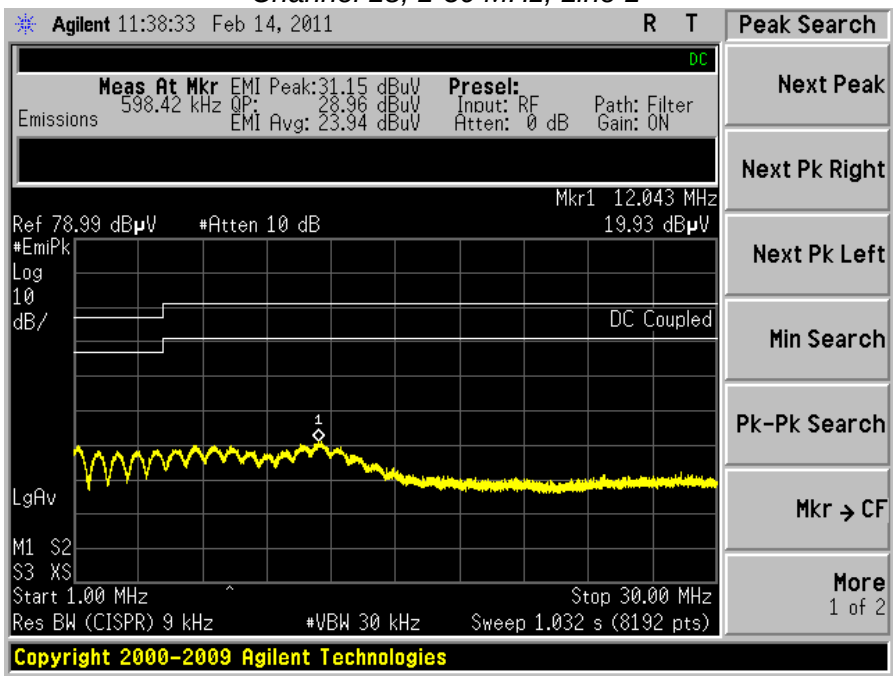
6.8 - Screen Captures – Conducted Emissions Test

These screen captures represent Peak Emissions.

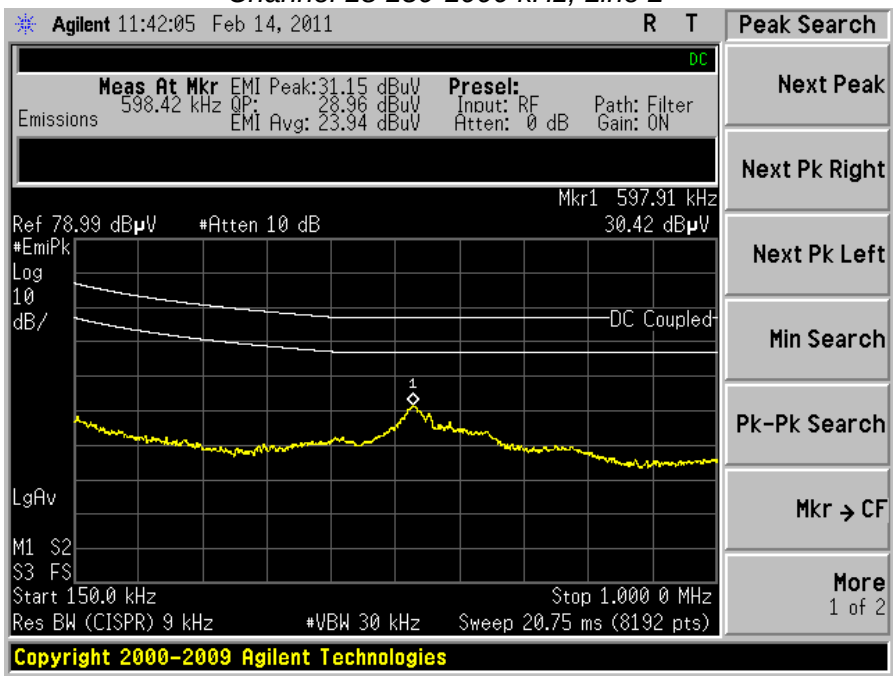
Channel 18 150-1000 kHz, Line 1



Channel 18, 1-30 MHz, Line 1



Channel 18 150-1000 kHz, Line 2



Channel 18, 1-30 MHz, Line 2

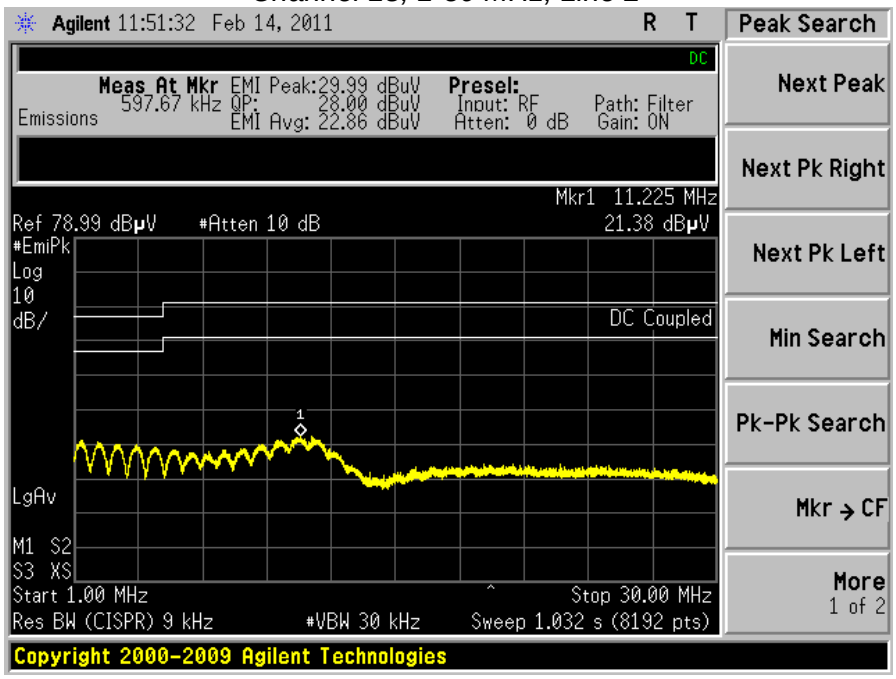


EXHIBIT 7. OCCUPIED BANDWIDTH

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 (2003) 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 99% occupied bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the Agilent E4445A spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct measurements, without the need for any further corrections. An Agilent E4445A 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 1592 kHz, which is above the minimum of 500 kHz.

7.3 - Test Equipment List

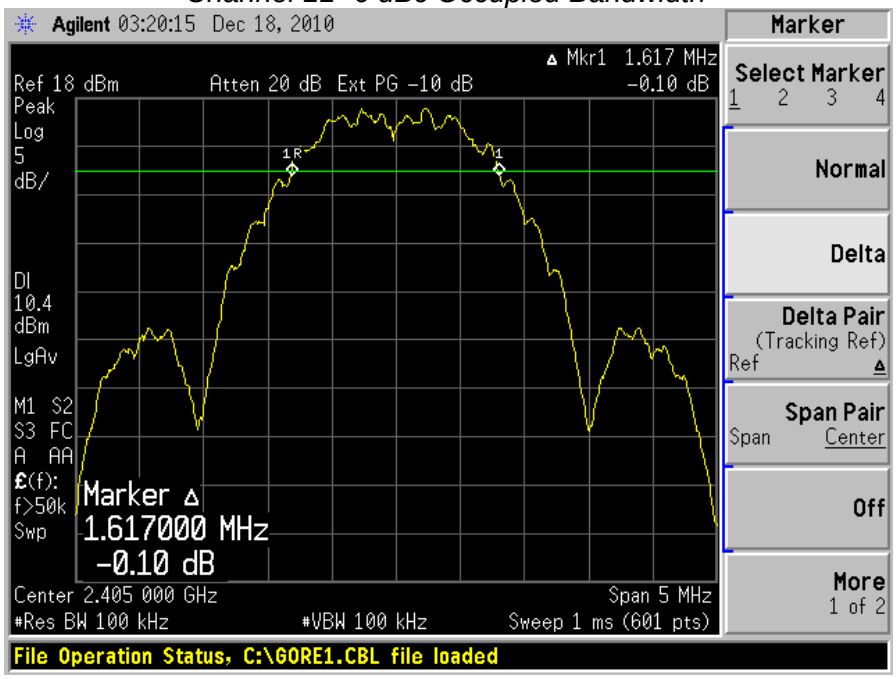
A complete list of test equipment that was used for this test can be found in Appendix A.

7.4 - Test Data

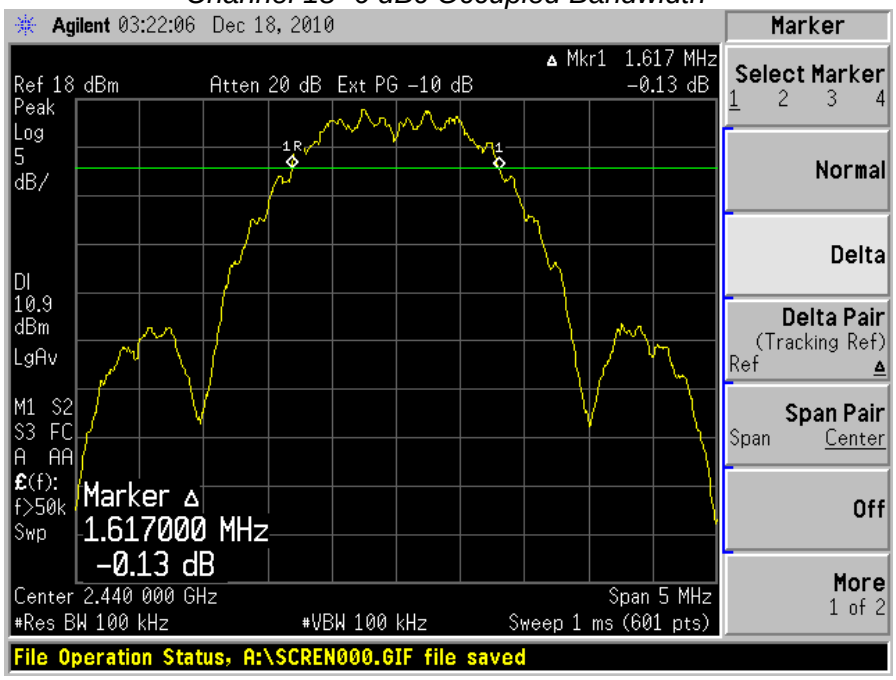
Channel	Center Frequency (MHz)	Measured -6 dBc OBW (kHz)	Minimum -6 dBc Limit (kHz)	Measured 99% OBW (kHz)
Low	2405	1617	500	2421
Middle	2440	1617	500	2422
High	2475	1592	500	2431

7.5 - Screen Captures - Occupied Bandwidth

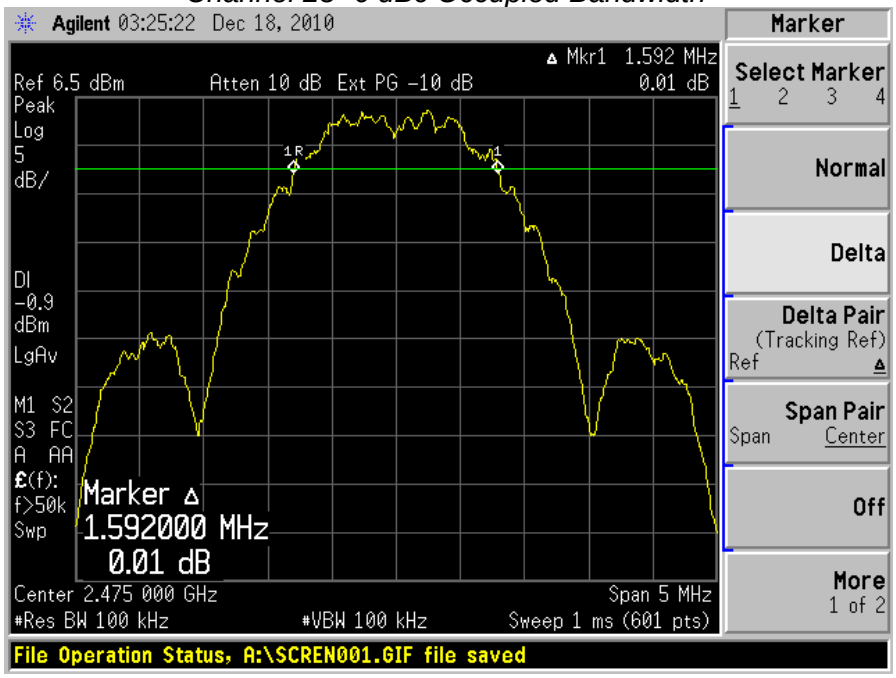
Channel 11 -6 dBc Occupied Bandwidth



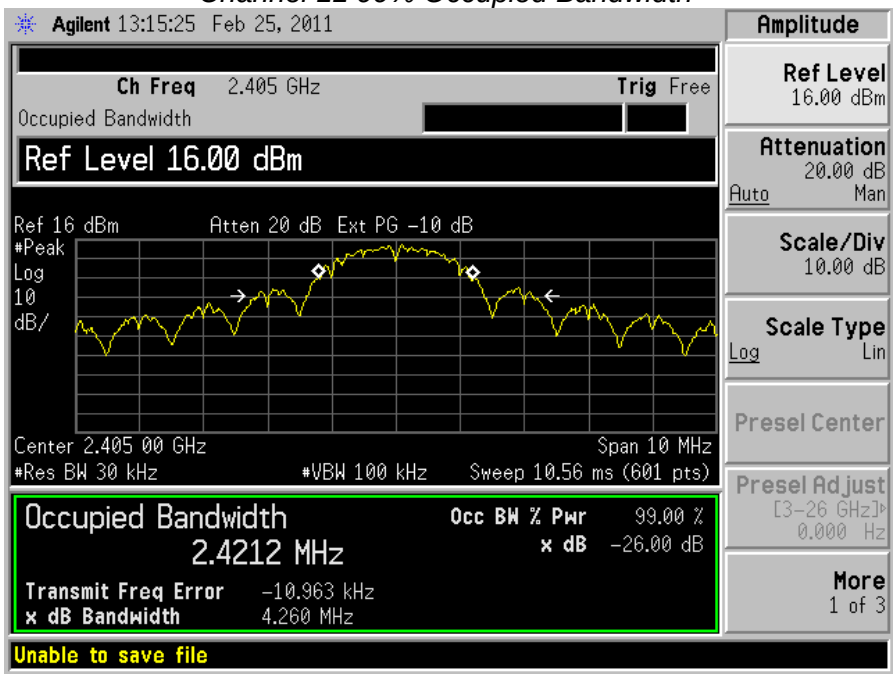
Channel 18 -6 dBc Occupied Bandwidth



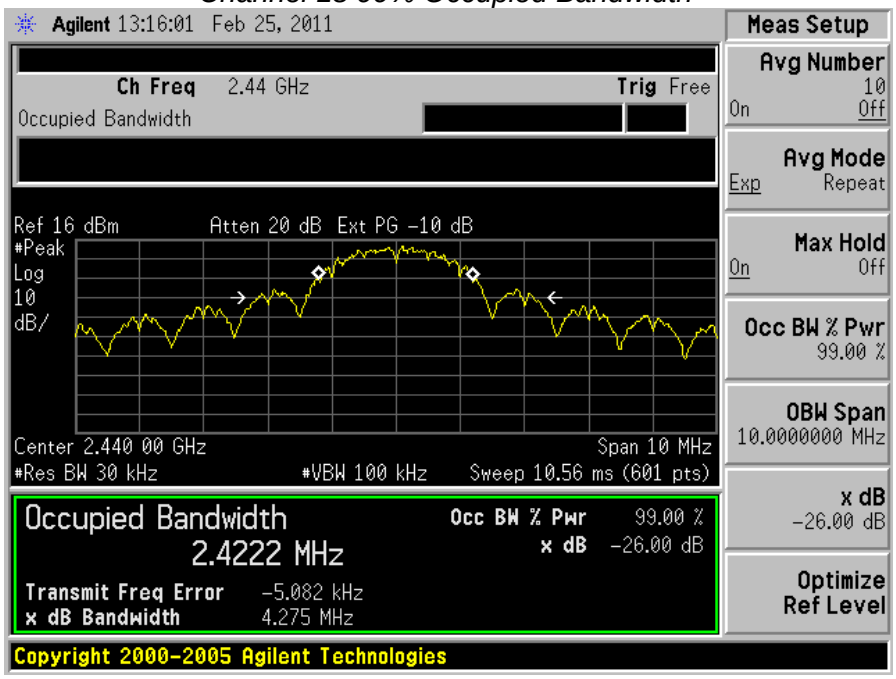
Channel 25 -6 dBc Occupied Bandwidth



Channel 11 99% Occupied Bandwidth



Channel 18 99% Occupied Bandwidth



Channel 25 99% Occupied Bandwidth

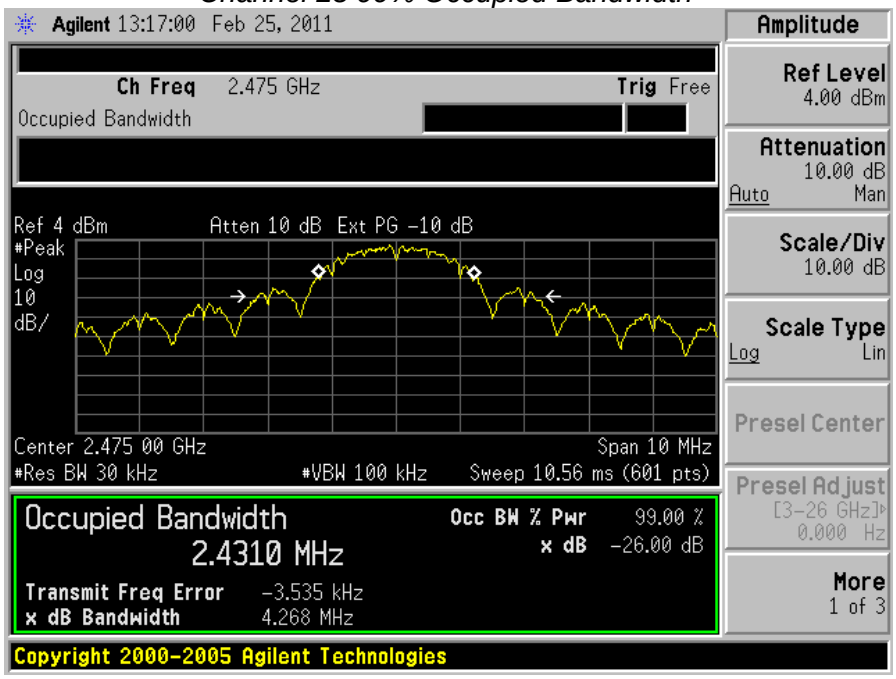


EXHIBIT 8. BAND EDGE MEASUREMENTS

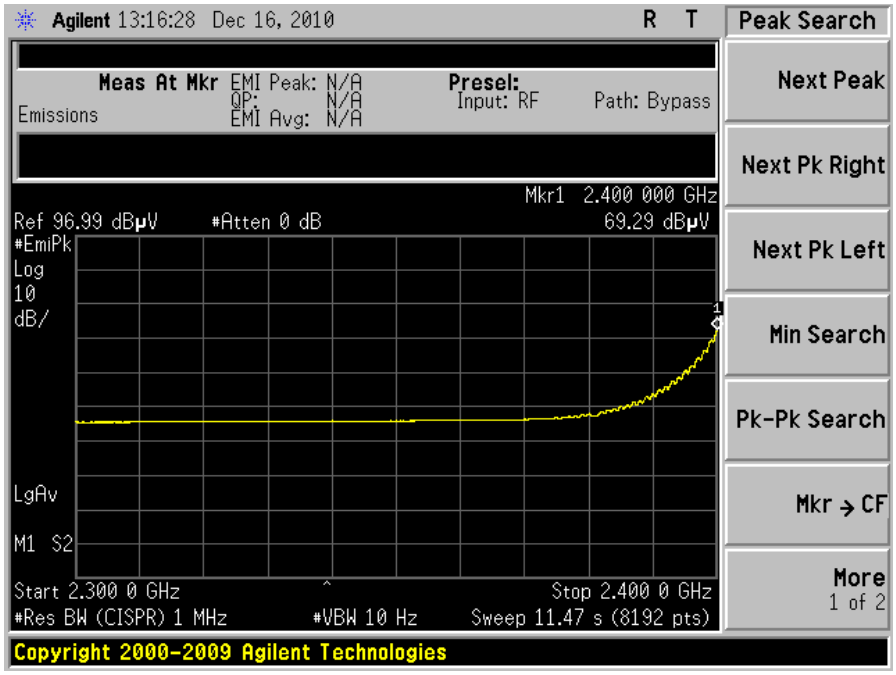
8.1 - Method of Measurements

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

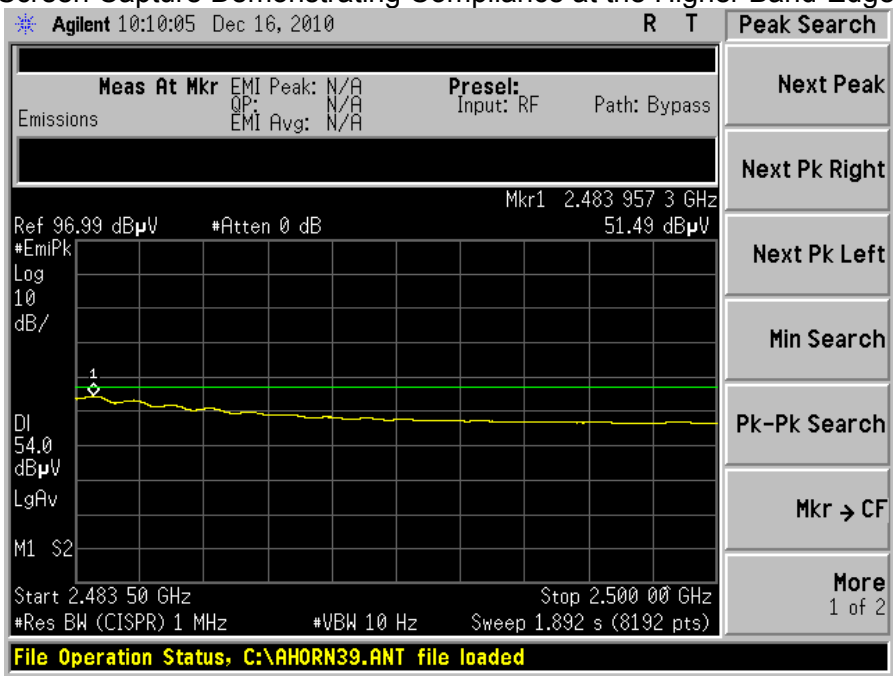
The Lower Band-Edge limit, in this case, would be -20 dBc with respect to the fundamental level (120.2 dBµV/m).

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

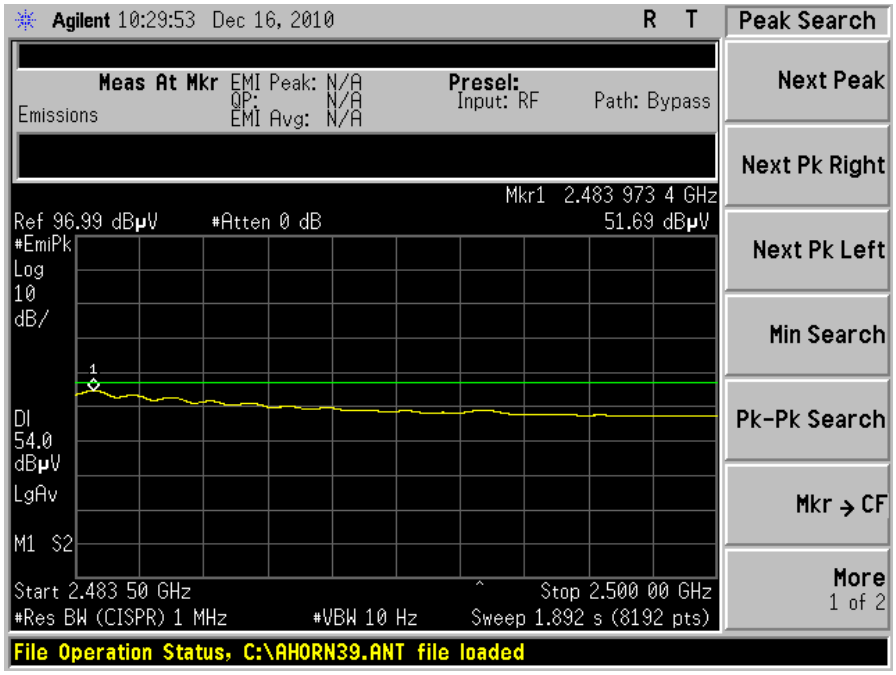
Screen Capture Demonstrating Compliance at the Lower Band-Edge



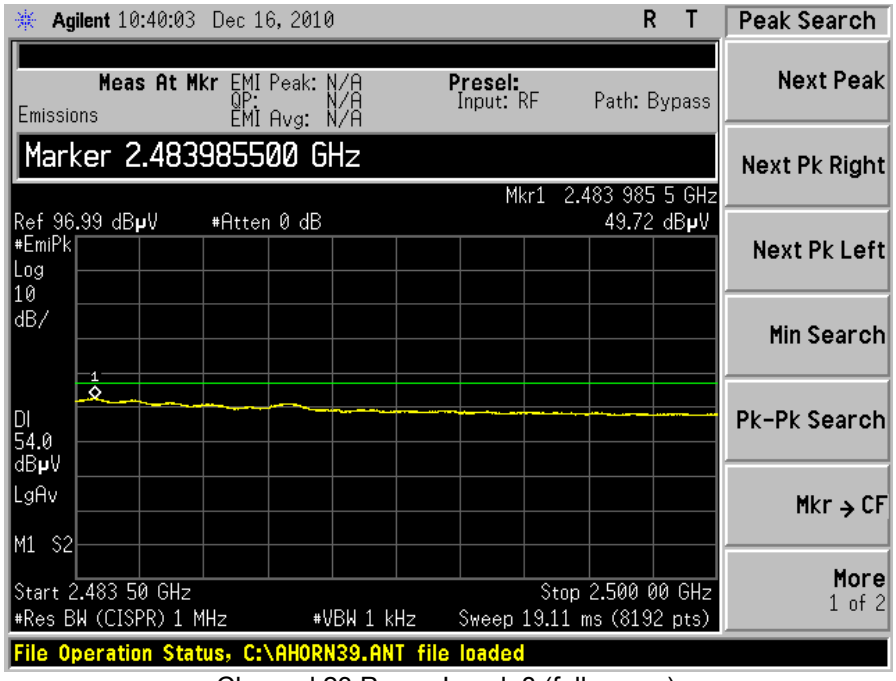
Screen Capture Demonstrating Compliance at the Higher Band-Edge



Channel 25 Power Level: -14



Channel 24 Power Level: -5



Channel 23 Power Level: 8 (full power)

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. 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 20 MHz, with measurements from a peak detector presented in the chart below.

9.2 - Test Equipment List

A complete list of test equipment that was used for this test can be found in Appendix A.

9.3 - Test Data

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
11	2405	+30 dBm	20.55	9.45
18	2440	+30 dBm	20.58	9.42
25	2475	+30 dBm	8.50	21.50

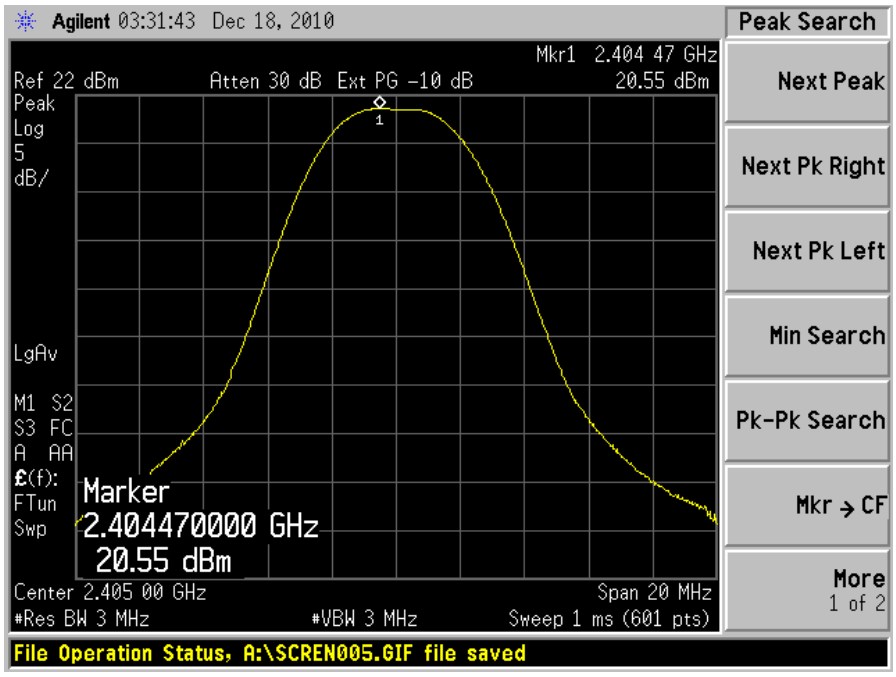
Transmitter Channel	Freq. (MHz)	Peak Power at Antenna Terminal (dBm)	Calculated EIRP (dBm) (1)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Lowest	2405	20.55	18.32	30.0	36.0
Middle	2445	20.58	18.35	30.0	36.0
Highest	2480	8.50	6.27	30.0	36.0

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

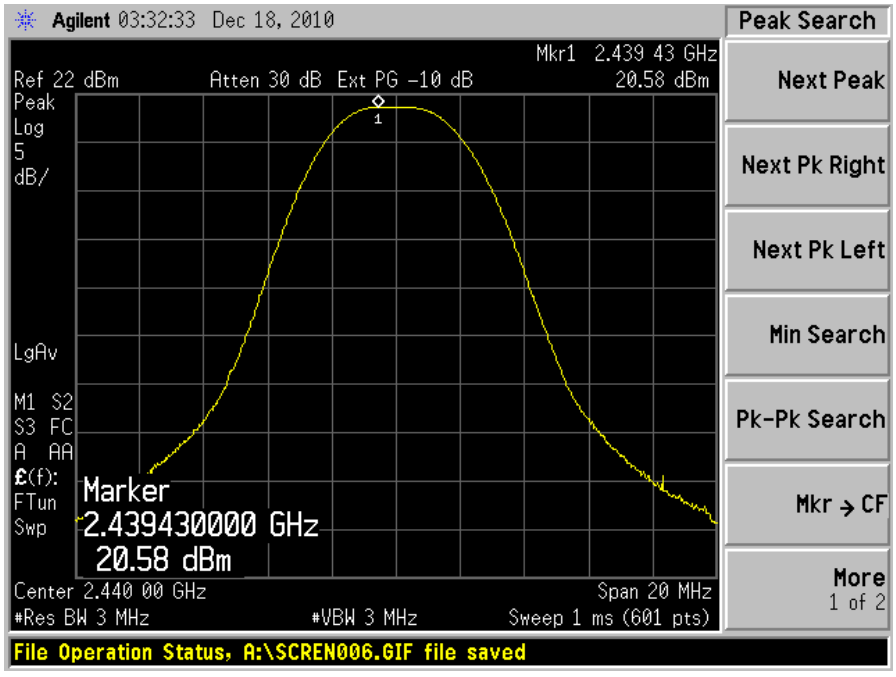
Measured RF Power Output : 67mW

9.4 - Screen Captures – Power Output (Conducted)

Channel 11



Channel 18



Channel 25

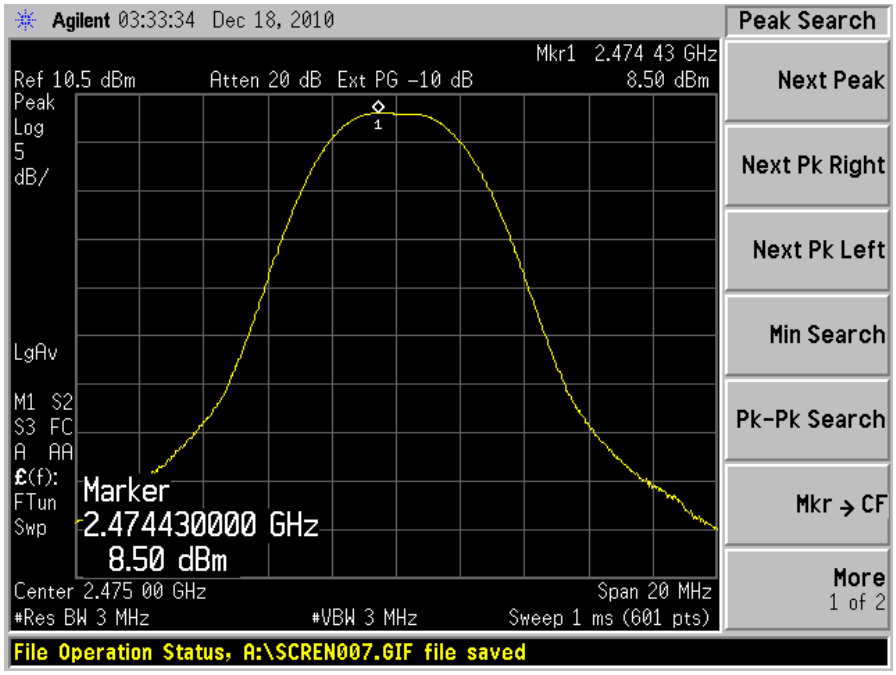

Agilent 03:33:34 Dec 18, 2010
Peak Search
Mkr1 2.474 43 GHz
Ref 10.5 dBm
Atten 20 dB Ext PG -10 dB
8.50 dBm
Peak
Log
5
dB/
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
LgAv
M1 S2
S3 FC
A AA
£(f):
FTun
Swp
Marker
2.474430000 GHz
8.50 dBm
Center 2.475 00 GHz
Span 20 MHz
#Res BW 3 MHz
#VBW 3 MHz
Sweep 1 ms (601 pts)
File Operation Status, A:\SCREN007.GIF file saved

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. The resultant density was then corrected to a 3 kHz bandwidth. The highest density was found to be no greater than 2.166 dBm, which is under the allowable limit by 5.8 dB.

10.2 - Test Equipment List

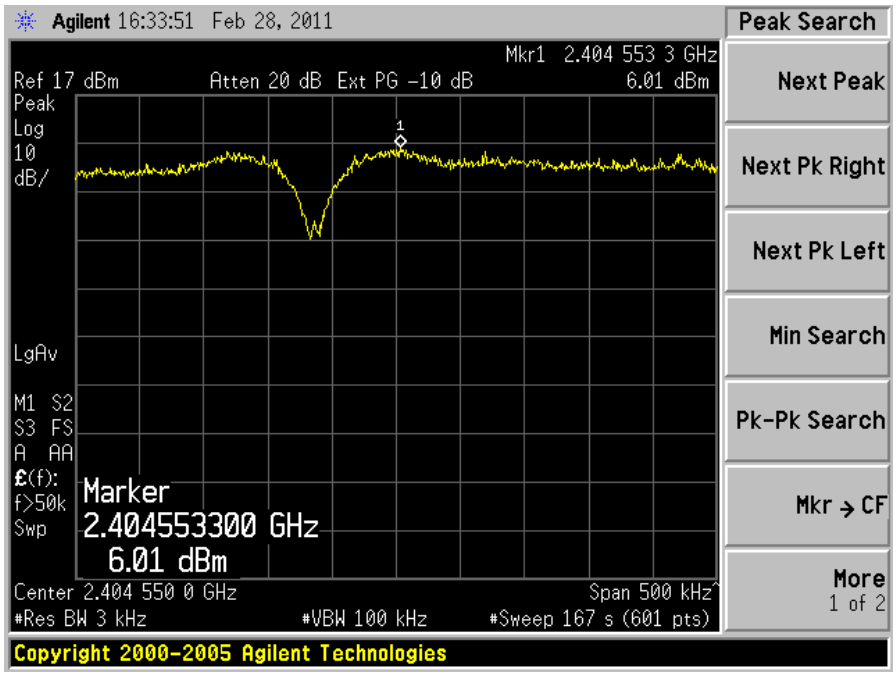
A complete list of test equipment that was used for this test can be found in Appendix A.

10.3 - Test Data

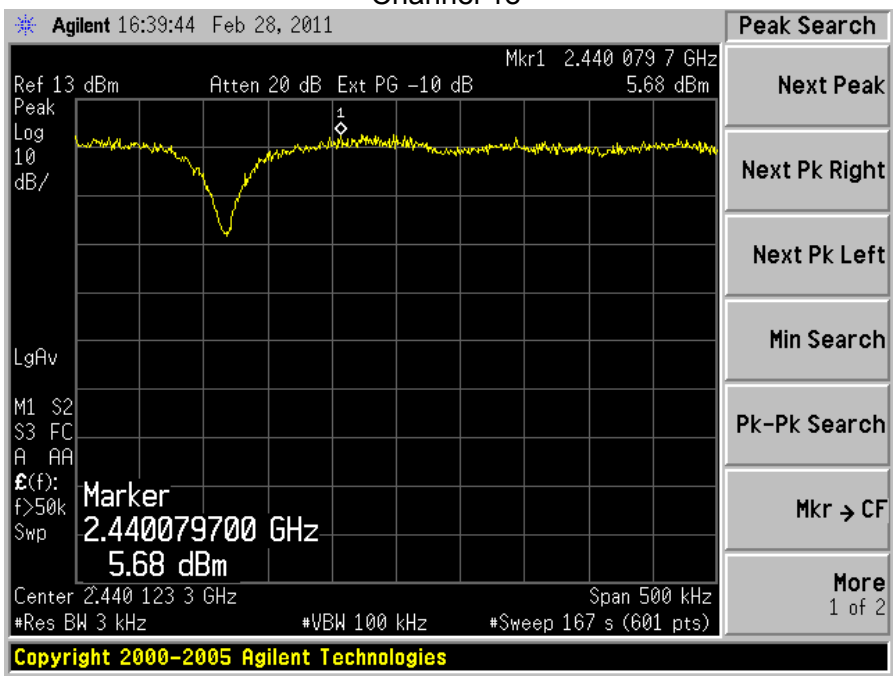
Transmitter Channel	Frequency (MHz)	RF Power Level In 3 kHz BW (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
Low	2405	6.01	8.0	1.99
Middle	2445	5.68	8.0	2.32
High	2475	-6.00	8.0	14.00

10.4 - Screen Captures – Power Spectral Density

Channel 11



Channel 18



Channel 25

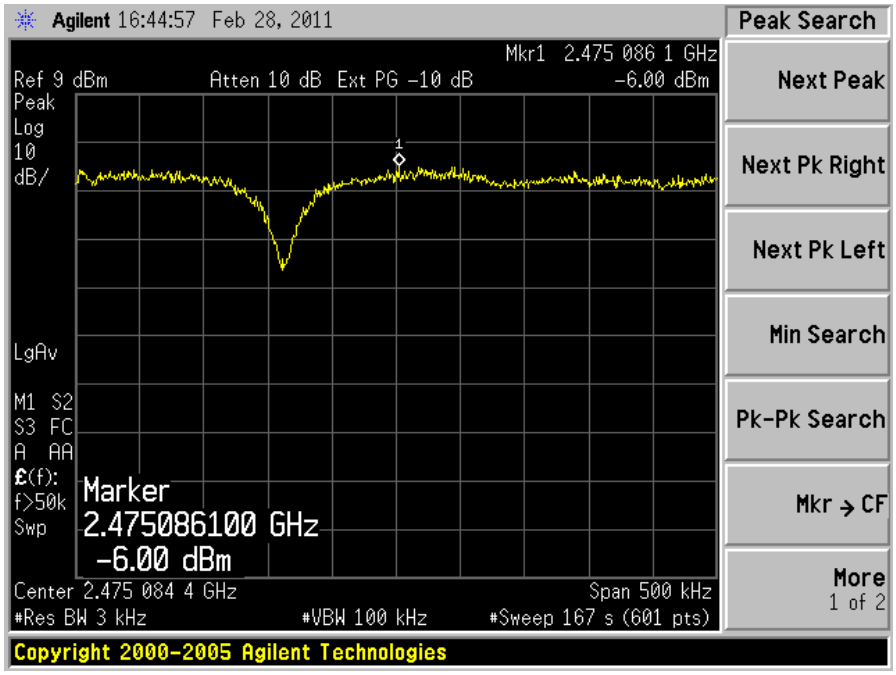

Agilent 16:44:57 Feb 28, 2011
Peak Search
Mkr1 2.475 086 1 GHz
Ref 9 dBm
Atten 10 dB Ext PG -10 dB
-6.00 dBm
Peak
Log
10
dB/
Next Peak
Next Pk Right
Next Pk Left
Min Search
Pk-Pk Search
Mkr → CF
More
1 of 2
LgAv
M1 S2
S3 FC
A AA
£(f):
f>50k
Swp
Marker
2.475086100 GHz
-6.00 dBm
Center 2.475 084 4 GHz
Span 500 kHz
#Res BW 3 kHz
#VBW 100 kHz
#Sweep 167 s (601 pts)
Copyright 2000-2005 Agilent Technologies

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.

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

FCC 47 CFR 15.205(a) – Restricted Frequency Bands

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

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

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

Calculation of Radiated Emission Measurements:

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

Sample conversion of field strength (μV/m to dBμV/m):

$$dB\mu V/m = 20 \log_{10} (100) = 40\ dB\mu V/m \text{ (from 30-88 MHz)}$$

Reported data is the raw data corrected for all applicable factors such as antenna factors, cable loss, etc.

Sample reported data:

Raw Data + Cable Factor = Reported Data

14.63 dBm + 0.58 dB = 15.21 dBm

11.2 – Conducted Harmonic and Spurious RF Measurements

FCC Part 15.247(d) and IC RSS 210 A8.5 both 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. An Agilent E4445A 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 -40 dBc of the fundamental level for this product.

Frequency (MHz)	Channel	Level (dBm)
445	11	-50.15
479	18	-40.90
639	18	-50.29

Frequency	Channel 11	Channel 18	Channel 25
Fundamental	+ 15.21 (dBm)	+ 15.34 (dBm)	+ 3.64 (dBm)
2nd Harmonic	- 47.39 (dBm)	- 45.74(dBm)	- 72.26 (dBm)
3rd Harmonic	- 53.06 (dBm)	- 51.28 (dBm)	Note (1)
4th Harmonic	- 64.86 (dBm)	- 64.79 (dBm)	Note (1)
5th Harmonic	- 72.25 (dBm)	- 71.45 (dBm)	Note (1)
6th Harmonic	- 64.77 (dBm)	- 63.85 (dBm)	Note (1)
7th Harmonic	- 57.66 (dBm)	- 59.57 (dBm)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	- 72.91 (dBm)	- 72.34 (dBm)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

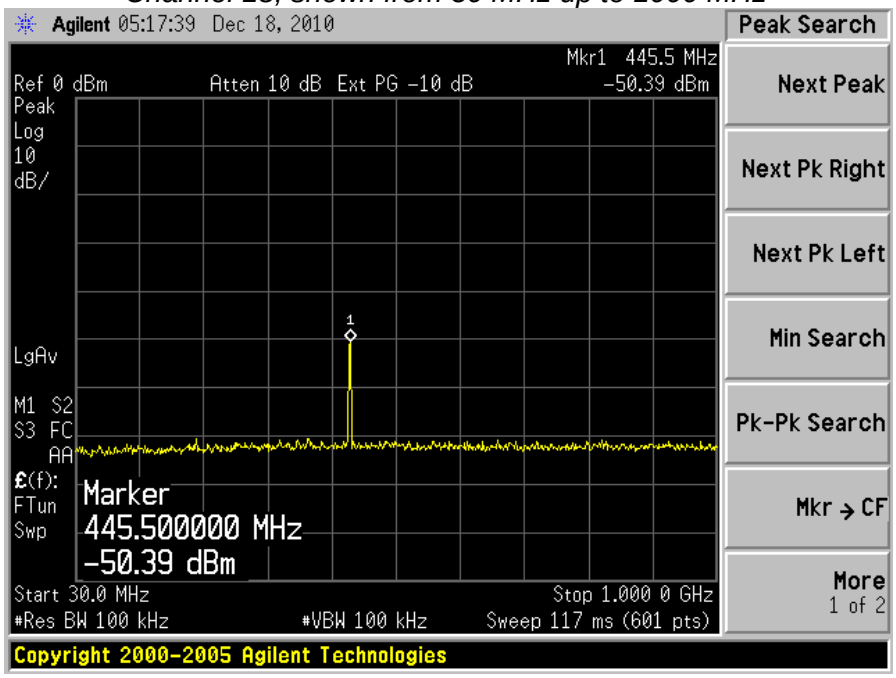
Note 1): Measurement at system noise floor.

11.3 - Test Equipment List

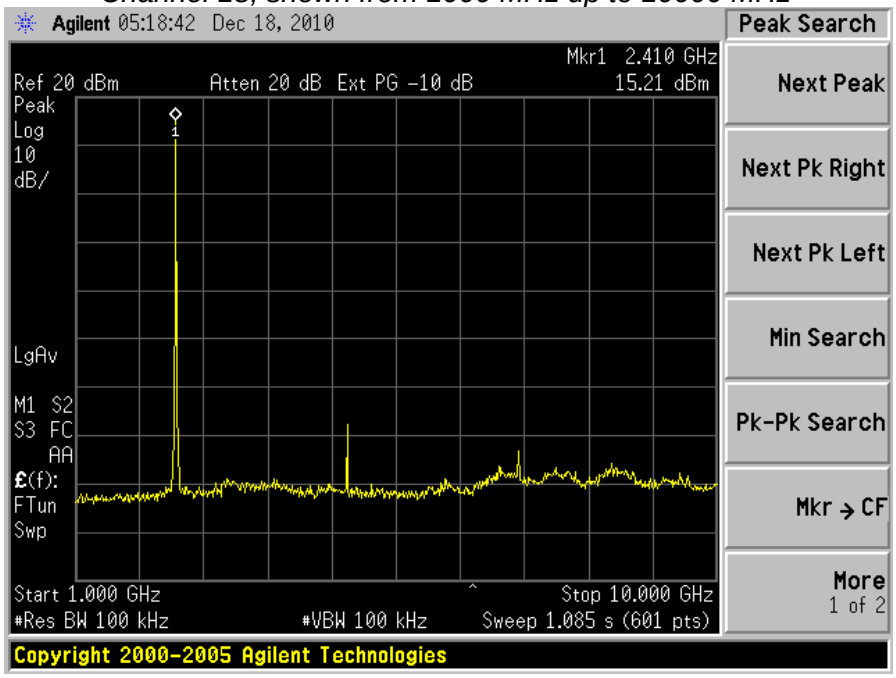
A complete list of test equipment that was used for this test can be found in Appendix A.

11.4 - Screen Captures – Spurious Radiated Emissions

Channel 18, shown from 30 MHz up to 1000 MHz



Channel 18, shown from 1000 MHz up to 10000 MHz



Channel 18, shown from 10000 MHz up to 25000 MHz

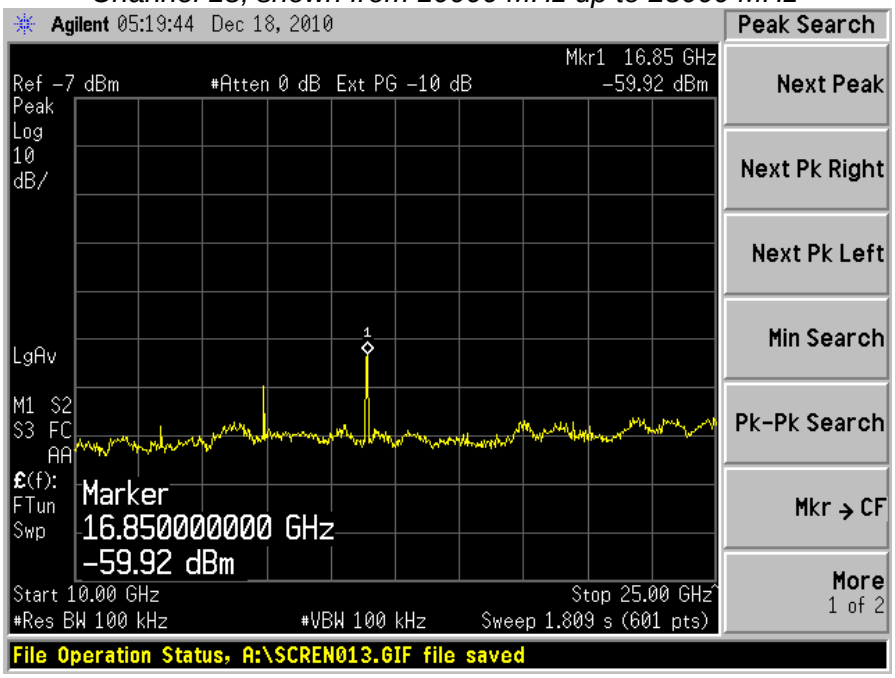


EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE VARIATIONS

Power to the EUT was supplied by an external bench-type variable power supply. The frequency of operation was monitored using the spectrum analyzer. 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 was placed in continuous transmit mode with typical data for modulation. 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. Measurements in MHz.

	DC Voltage Source		
	3.0 VDC	3.3 VDC	3.6 VDC
Channel 11	2405.557	2405.543	2405.417
Channel 18	2440.56	2440.55	2440.43
Channel 25	2474.563	2474.74	2475.44

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. Measurements in dBm.

	DC Voltage Source		
	3.0 VDC	3.3 VDC	3.6 VDC
Channel 11	19.93	19.98	20.00
Channel 18	19.98	20.03	20.06
Channel 25	7.43	8.17	8.71

APPENDIX A – Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 16-Dec-2010 Type Test: Power Spectral Density Job #: C-1079

Prepared By: Shane Rismeyer Customer: CEL Quote #: 310368

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/22/2011	9/22/2012	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/22/2010	9/22/2011	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 16-Dec-2010 Type Test: Conducted Power Output Job #: C-1079

Prepared By: Shane Rismeyer Customer: CEL Quote #: 310368

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/22/2011	9/22/2012	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/22/2010	9/22/2011	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 16-Dec-2010 Type Test: Occupied Bandwidth (6dB & 20dB) Job #: C-1079

Prepared By: Shane Rismeyer Customer: CEL Quote #: 310368

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/22/2011	9/22/2012	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/22/2010	9/22/2011	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 16-Dec-2010 Type Test: Radiated Emissions Job #: C-1079

Prepared By: Shane Rismeyer Customer: CEL Quote #: 310368

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/7/2010	6/7/2011	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/7/2010	6/7/2011	Active Calibration
3	EE 960130	Multi-Device Controller	ETS	2090	45968	XXX	XXX	Cal Not Required
4	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/19/2010	10/19/2011	Active Calibration
5	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	10/19/2010	10/19/2011	Active Calibration
6	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/9/2010	11/9/2011	Active Calibration
7	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	1/4/2010	1/4/2011	Active Calibration
8	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	6/7/2010	6/7/2011	Active Calibration
9	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro	WLA622-4	123001	10/13/2010	10/13/2011	Active Calibration

Project Engineer: Quality Assurance:

APPENDIX B – Test Standards: CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2	STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003			IEC 61000-4-5	2005-11		
CISPR 11	2009-05			IEC 61000-4-6	2008-06		
CISPR 12	2007-05			IEC 61000-4-8	2001-03		
CISPR 14-1	2005-11	2008-11		IEC 61000-4-11	2004-03		
CISPR 14-2	2001-11	2001-11	2008-05	IEC 61326-1	2006-06		
CISPR 16-1-1 Note 1	2006-03	2006-09	2007-07	ISO 14082	1998-07		
CISPR 16-1-2 Note 1	2003	2004-04	2006-07	MIL Std. 461E	1999-08		
CISPR 22	2008-09			RSS GEN	2010-12		
CISPR 24	1997-09	2001-07	2002-10	RSS 119	2007-06		
EN 55011	2007-05			RSS 123	1999-11		
EN 55014-1	2006			RSS 125	2000-03		
EN 55014-2	1997			RSS 131	2003-07		
EN 55022	2006	2007		RSS 136	2002-10		
EN 60601-1-2	2007-03			RSS 137	2009-02		
EN 61000-3-2	2006-05			RSS 210	2010-12		
EN 61000-3-3	2008-12			RSS 213	2005-12		
EN 61000-4-2	2001	1998	2001	RSS 243	2005-11		
EN 61000-4-3	2006-07	2008-05		RSS 310	2007-06		
EN 61000-4-4	2004						
EN 61000-4-5	2006-12						
EN 61000-4-6	2007-08						
EN 61000-4-8	1993	1994-01					
EN 61000-4-11	2004-10						
EN 61000-6-1	2007-02						
EN 61000-6-2	2005-12						
EN 61000-6-3	2007-02						
EN 61000-6-4	2007-02						
FCC 47 CFR, Parts 0-15, 18, 90, 95	2008						
FCC Public Notice DA 00-1407	2000						
FCC ET Docket # 99-231	2002						
FCC Procedures	2007						
ICES 001	2006-06						
ICES 002	2007-02						
ICES 003	2004-02						
IEC 60601-1-2 Note 1	2007-03						
IEC 61000-3-2	2005-11	2008-03					
IEC 61000-3-3	2008-06						
IEC 61000-4-2	2008-12						
IEC 61000-4-3	2008-04	incl in 2006					
IEC 61000-4-4	2004-07						

Updated on 6-26-09

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