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TEST REPORT # 310207
LSR Job #: C-949

Compliance Testing of:

T301W

Test Date(s):

July 13th-20th, 2010

Prepared For:

Ekahau
Attn: Arttu Huhtiniemi
Hiilikatu 3
Helinski, Finland 00180

In accordance with:
Federal Communications Commission (FCC) Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 210 Annex 8 for Digital Modulation Transmitters (DTS)

This Test Report is issued under the Authority of:

Signature: Date: 5/5/11

Quality Assurance by:	**Project Engineer:**
Khairul Aidi Zainal, Senior EMC Engineer	Shane D. Rismeyer, EMC Engineer
Signature: Date: 5/5/11	Signature: Date: 5/1/11

TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION

1.1 - Scope

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

1.2 – Normative References

Publication	Title
47 CFR, Parts 0-15 (FCC)	Code of Federal Regulations - Telecommunications
RSS 210 Annex 8	Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
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.
CISPR 16-1-1	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC ET Docket No. 99-231	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	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:

TESTING CERT #1255.01

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

Industrie Canada Industry Canada

Canada

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:	Ekahau
Address:	Hiilikatu 3 Helinski, Finland 00180
Contact Name:	Arttu Huhtiniemi

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	T301W
Model Number:	T301W
Serial Number:	N/A

2.3 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2412 – 2462 MHz
RF Power in Watts	
Minimum:	0.0249
Maximum:	0.0234
Conducted Output Power (in dBm)	13.97
Field Strength at 3 meters	106.9dBµV/m
Occupied Bandwidth (99% BW)	13.1MHz
Type of Modulation	DSSS 1 Mbit/2Mbit CCK 5.5Mbit/11Mbit
Emission Designator	13M1D1D
EIRP (in mW)	24.95
Corrected EIRP (in mW)	0.87
Transmitter Spurious (worst case) at 3 meters	30.24 dBµV/m
Receiver Spurious (worst case) at 3 meters	31.34 dBµV/m
Stepped (Y/N)	No
Step Value:	N/A
Frequency Tolerance %, Hz, ppm	+/- 10 PPM per crystal data sheet
Microprocessor Model # (if applicable)	2 ARM7 cores integral to GS1011 system-on-a-chip
Antenna Information	
Detachable/non-detachable	Non-detachable
Type	Antenova Mica - Chip Antenna
Gain (in dBi)	1.8 dBi Peak / -1.9 dBi Average
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	RSS 210
Modular Filing	☐ Yes ☒ No
Portable or Mobile?	Portable

Exposure Limits:

For portable devices:

$$Output\ Power\ \leq \frac{60}{f}(mW)$$

$$0.87 \leq 24.59\ mW$$

Note: Since the peak output power of 0.87 mW is below the low threshold of 24.59mW this device does not need SAR evaluation. Calculation of duty cycle corrected EIRP can be found in Appendix E.

2.4 - Product Description

The T301W is a wrist watch-sized, battery powered, location tag device, which utilizes 802.11b radio technology. The device contains a System-on-Chip SoC running Green Hills u-velOSity operating system and application software.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 - Climate Test Conditions

Temperature:	21°C
Humidity:	35%
Pressure:	745mmHg

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	N/A
FCC : 15.247(a)(2) IC : RSS 210 A8.2(a)	6 dB Bandwidth of a Digital Modulation System	Yes
IC : RSS GEN section 4.6.1	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(c) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC : 15.247(d) IC : RSS 210 A8.2(b)	Transmitted Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers (RSS GEN and RSS 210 of IC). The Receiver Test Report is available upon request.		

3.3 - Modifications Incorporated in the EUT For Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 - Deviations & Exclusions from Test Specifications

☒ None ☐ Yes (explain below)

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 7 (2007), Section Annex 8 (section 8.2) 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 normal mode (with modulation), and testing was performed using power as provided by the unit's battery. The unit had the capability to operate on three channels, controllable via a button. 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 (2412 MHz), middle (2437 MHz) and high (2462 MHz) to comply with FCC Part 15.35. The channels and operating modes were changed using a push button.

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. The battery voltage was checked frequently, and was charged as needed. 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. 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 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):

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

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

960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

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

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

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

73.45 dBμV/m + 28.52 dB + 4.93 dB = 106.9 dBμV/m

5.6 - Radiated Emissions Test Data Chart

Manufacturer:	Ekahau					
Date(s) of Test:	7/14/10-7/16/10					
Test Engineer(s):	Shane Rismeyer					
Voltage:	Battery					
Operation Mode:	Modulated and CW					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
	X	Battery		Other:		
EUT Placement:		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)
295.0	H/Flat	1.00	0	26.32	46.0	19.68
985.6	H/Flat	1.00	0	30.24	54.0	23.76

RADIATED EMISSIONS DATA CHART (continued)

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 2412:

Frequency (MHz)	Ant./EUT Polarity	Height (cm)	Azimuth (degrees)	Avg EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2412.0	V/V	114	0	104.7	125.2	18.3
4824.0	H/V	104.0	348.5	46.02	63.5	17.48
9648.1	V/V	101.7	327.7	42.32	63.5	21.18
7236.0	VS	110.2	20.8	32.42	63.5	31.08

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 2437:

Frequency (MHz)	Ant./EUT Polarity	Height (cm)	Azimuth (degrees)	Avg EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2437.00	V/V	113.0	0	102.7	125.2	20.3
9748.03	V/F	112.2	293.7	40.02	63.5	23.48
7311.00	H/V	102.6	326.2	35.32	63.5	28.18
4873.93	V/S	105.1	342.4	47.32	63.5	16.18

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 2462:

Frequency (MHz)	Ant./EUT Polarity	Height (cm)	Azimuth (degrees)	Avg EFI (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2462.0	V/V	114.0	0	104.6	125.2	18.4
9848.0	H/V	108.1	305.2	41.82	63.5	21.68
7386.0	H/V	105.7	28.5	40.32	63.5	23.18
4924.0	V/S	104.0	343.8	46.62	63.5	16.88

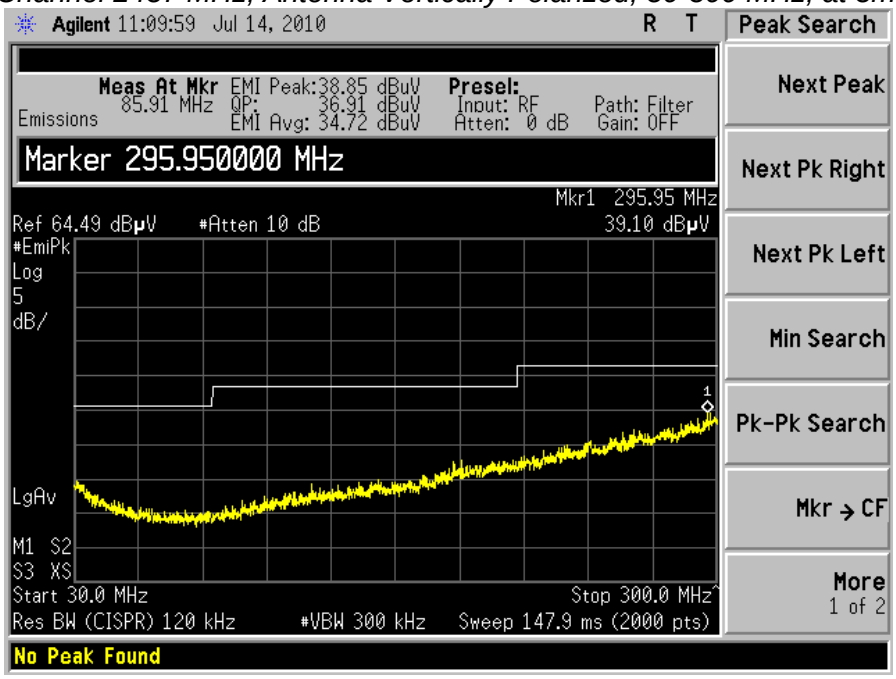
Notes:

- 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. Any emissions not documented within the tables were greater than 20dB from the limit.
- A relaxation of the limit is invoked based on the average duty factor of the transmitter on-air-time. Justification appears in Appendix D. Harmonic measurements have been recalculated and reduced by -28.76 dB as justified by the averaging factor.
- For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=1 MHz. The expected bandwidth of the device is 17 MHz so an equation was used to calculate the reading if an appropriate RBW could be used.

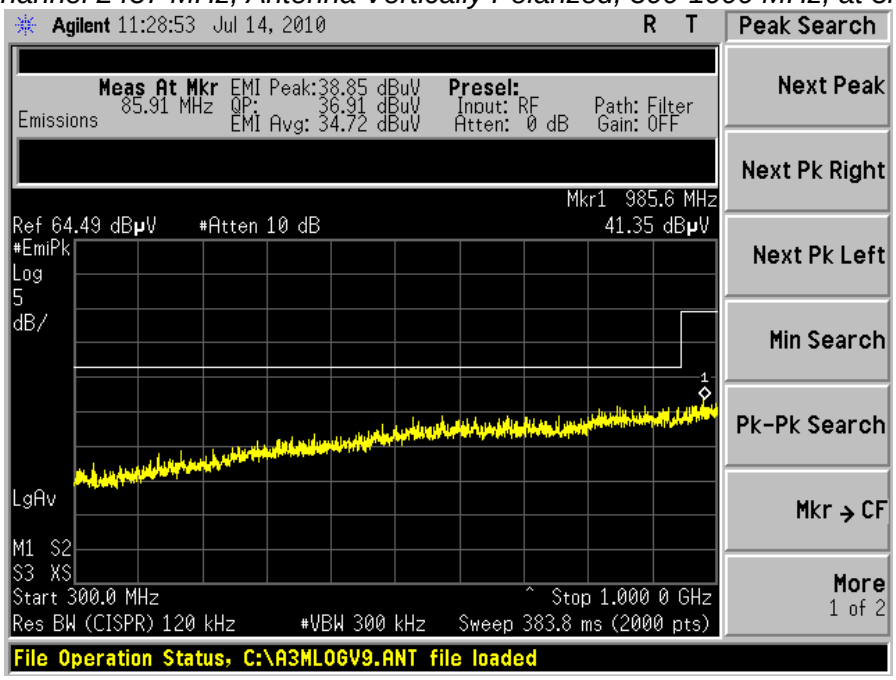
5.7 - Screen Captures - Radiated Emissions Test

Note: The signature scans shown here are from worst-case emissions, as measured on channels 2437 MHz, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

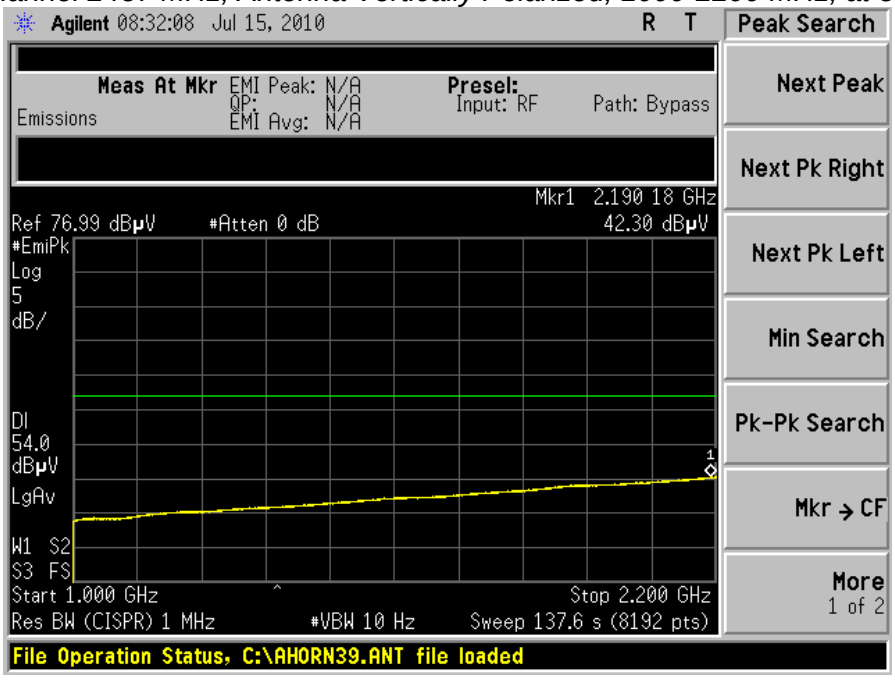
Channel 2437 MHz, Antenna Vertically Polarized, 30-300 MHz, at 3m



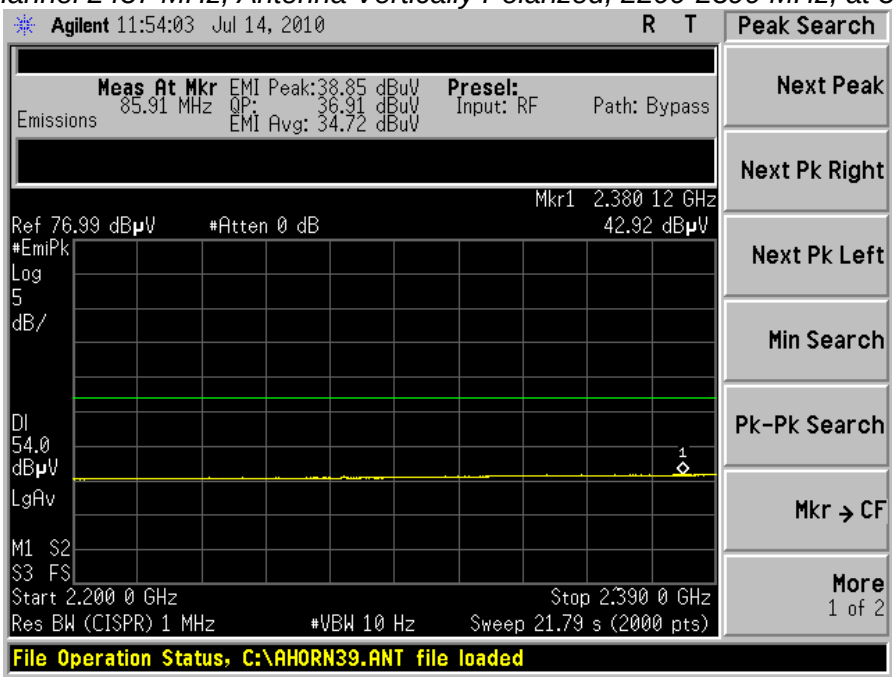
Channel 2437 MHz, Antenna Vertically Polarized, 300-1000 MHz, at 3m



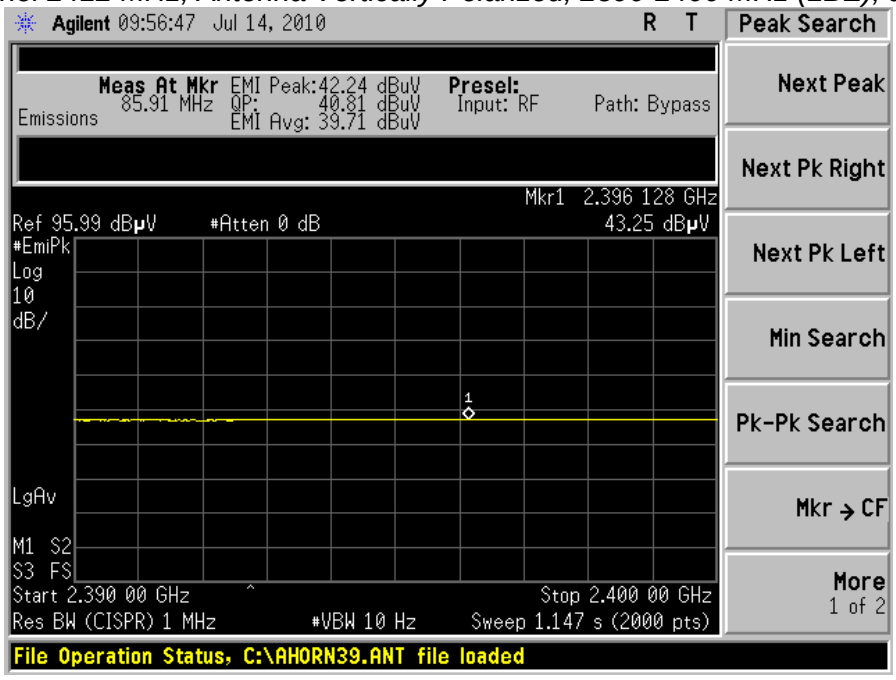
Channel 2437 MHz, Antenna Vertically Polarized, 1000-2200 MHz, at 3m



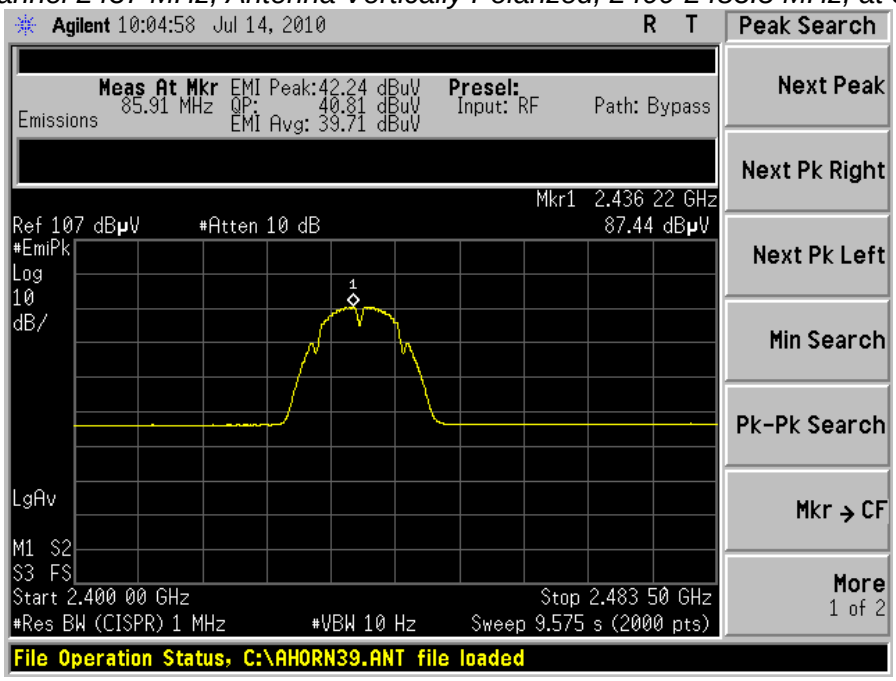
Channel 2437 MHz, Antenna Vertically Polarized, 2200-2390 MHz, at 3m



Channel 2412 MHz, Antenna Vertically Polarized, 2390-2400 MHz (LBE), at 3m

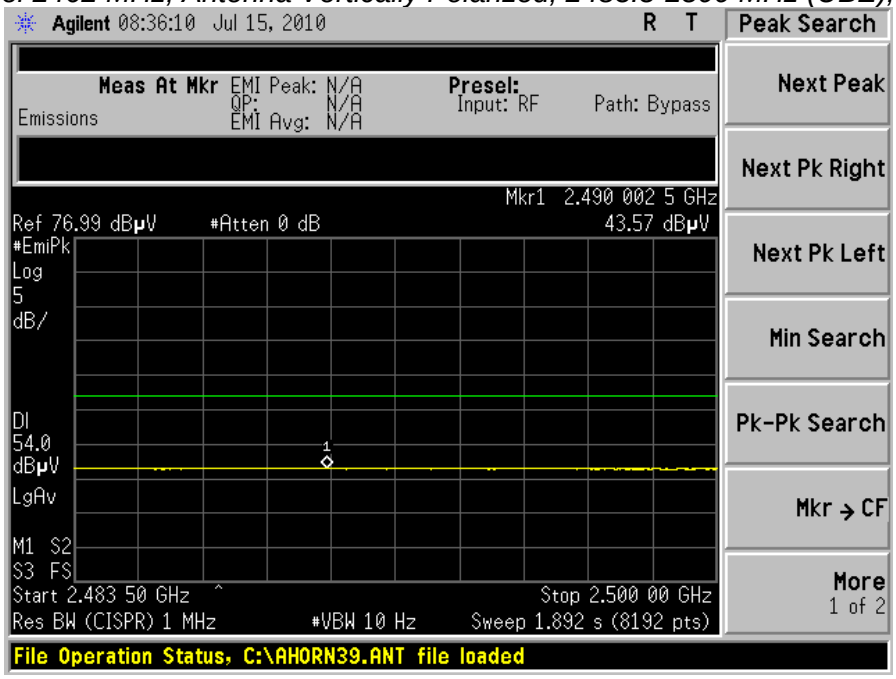


Channel 2437 MHz, Antenna Vertically Polarized, 2400-2483.5 MHz, at 3m

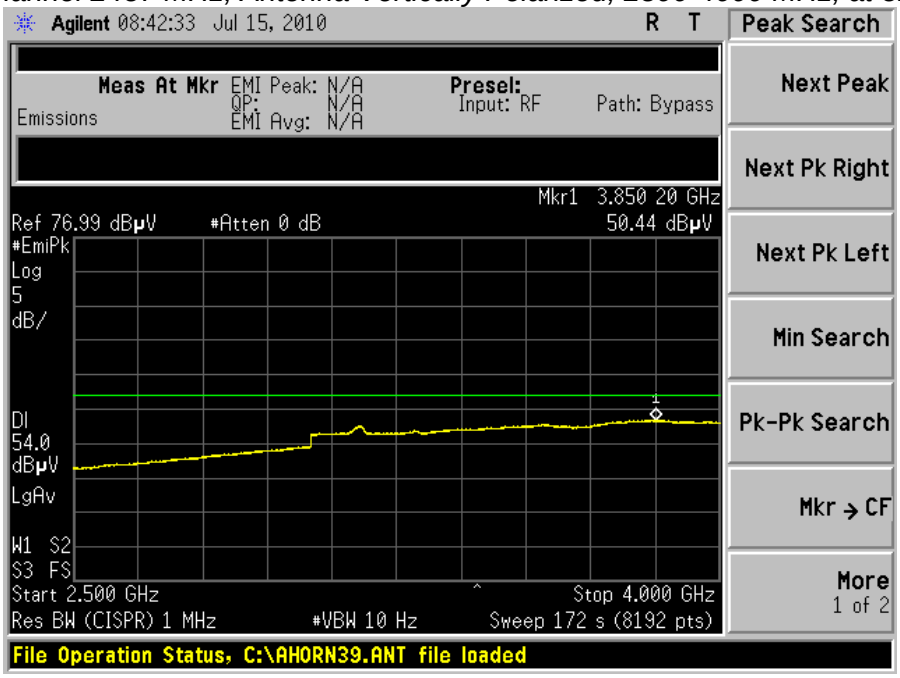


Screen Captures - Radiated Emissions Testing *(continued)*

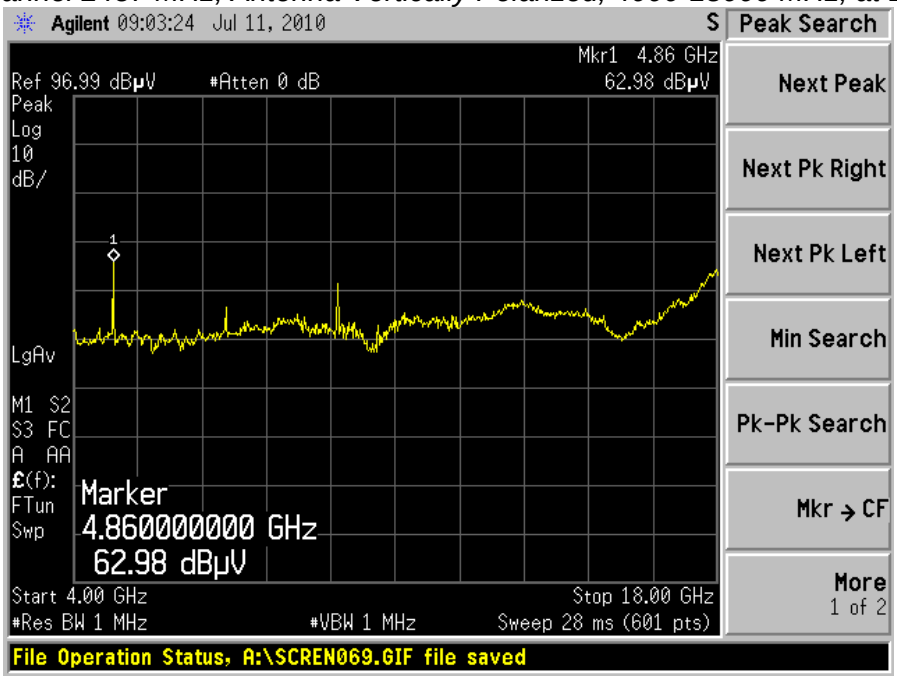
Channel 2462 MHz, Antenna Vertically Polarized, 2483.5-2500 MHz (UBE), at 3m



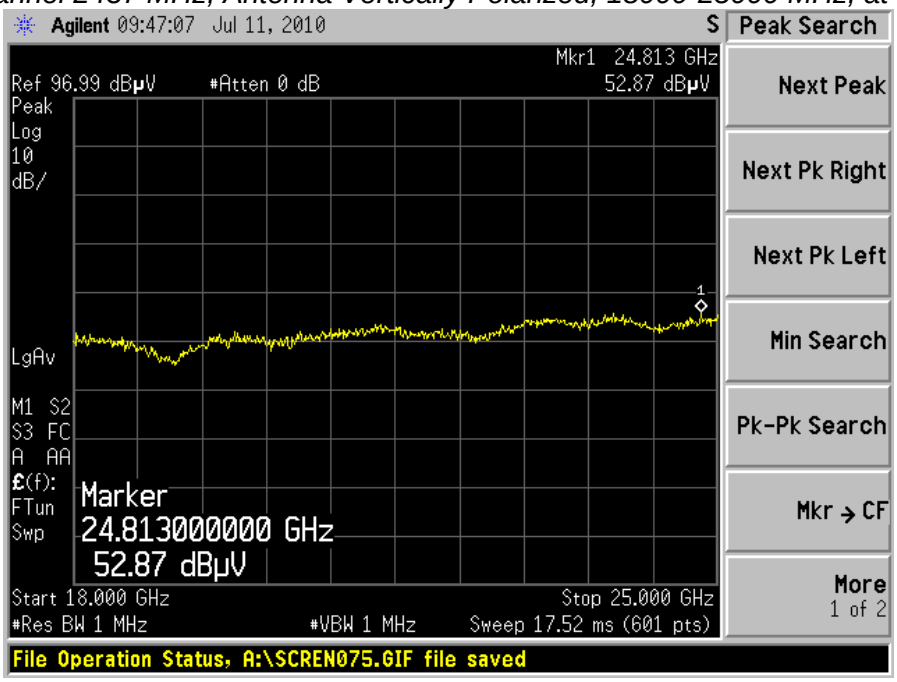
Channel 2437 MHz, Antenna Vertically Polarized, 2500-4000 MHz, at 3m



Channel 2437 MHz, Antenna Vertically Polarized, 4000-18000 MHz, at 1m



Channel 2437 MHz, 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.

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)
299.7	H/Flat	1.00	0	27.12	46.0	18.88
995.6	H/Flat	1.00	0	31.34	54.0	22.66

The following table depicts the level of significant radiated RF harmonic emissions seen on receive Channel 2412:

Frequency (MHz)	Height (m)	Azimuth (degree)	Avg Reading (dBμV/m)	Avg Limit (dBμV/m)	Margin (dB)	Antenna Polarity	EUT orientation
9648.1	113.6	85.4	58.9	63.5	4.7	Vertical	Flat
4824.0	96.3	111.4	60.7	63.5	2.8	Horizontal	Vertical
7235.9	111.8	36.7	49.9	63.5	13.6	Horizontal	Vertical

The following table depicts the level of significant radiated RF harmonic emissions seen on receive Channel 2437:

Frequency (MHz)	Height (m)	Azimuth (degree)	Avg Reading (dBμV/m)	Avg Limit (dBμV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4874	106.9	103.7	61.3	63.5	2.2	Vertical	Flat
4874.0	107.5	348.6	62.2	63.5	1.3	Horizontal	Vertical
7311.0	112.5	31.0	48.0	63.5	15.5	Horizontal	Vertical

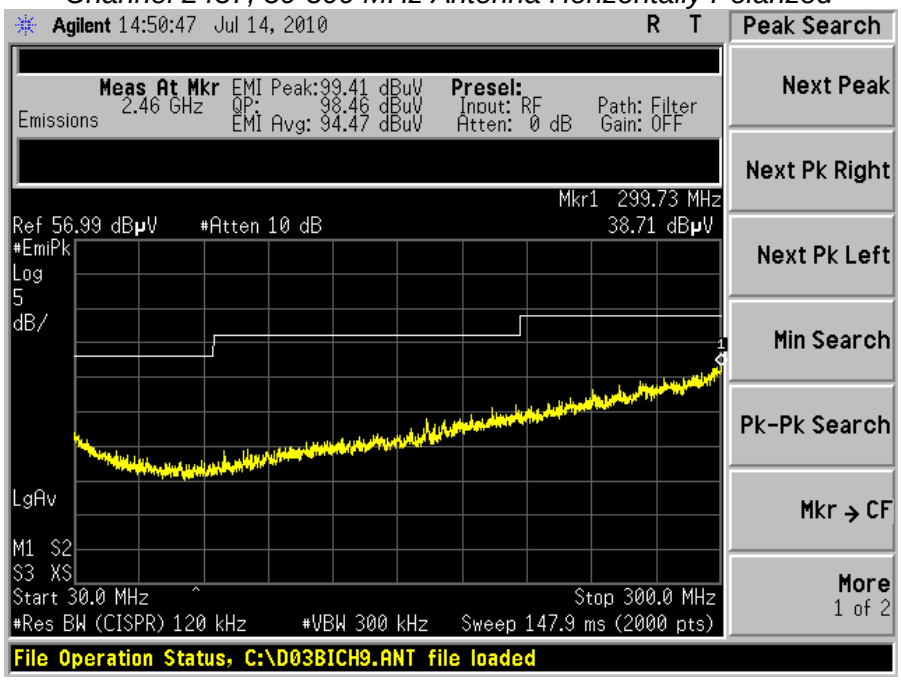
The following table depicts the level of significant radiated RF harmonic emissions seen on receive Channel 2462:

Frequency (MHz)	Height (m)	Azimuth (degree)	Avg Reading (dBμV/m)	Avg Limit (dBμV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4924.0	103.8	106.6	62.7	63.5	0.8	Vertical	Flat
9847.9	111.1	316.1	60.0	63.5	3.5	Horizontal	Vertical
7386.0	124.4	7.8	47.4	47.388	16.1	Vertical	Side

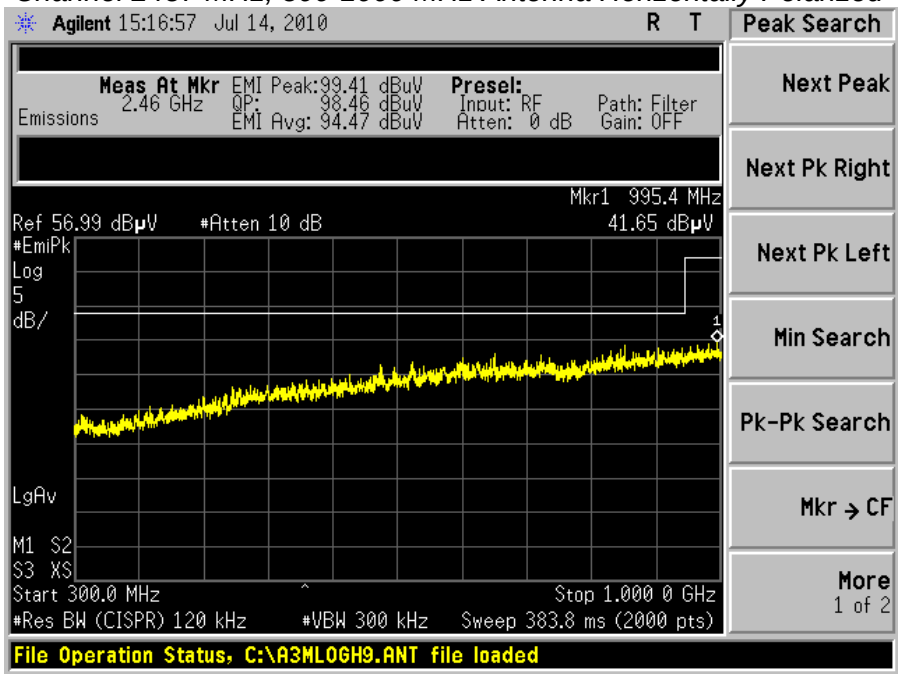
5.9 - Screen Captures - Radiated Emissions Testing – Receive Mode

Note: These screen captures represent Peak Emissions. The signature scans shown here are from worst-case emissions, as measured on the middle channel.

Channel 2437, 30-300 MHz Antenna Horizontally Polarized

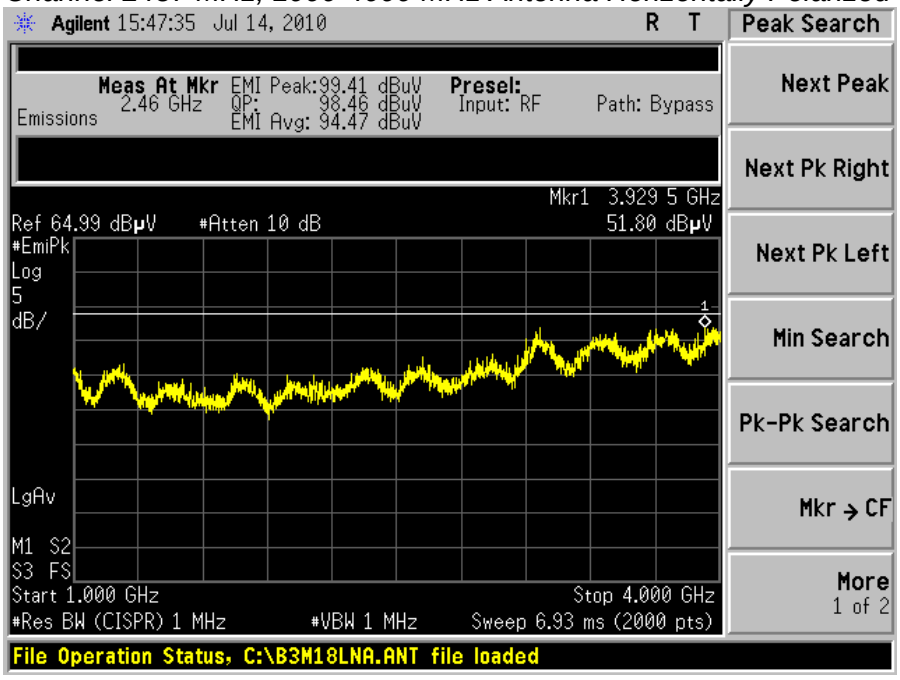


Channel 2437 MHz, 300-1000 MHz Antenna Horizontally Polarized

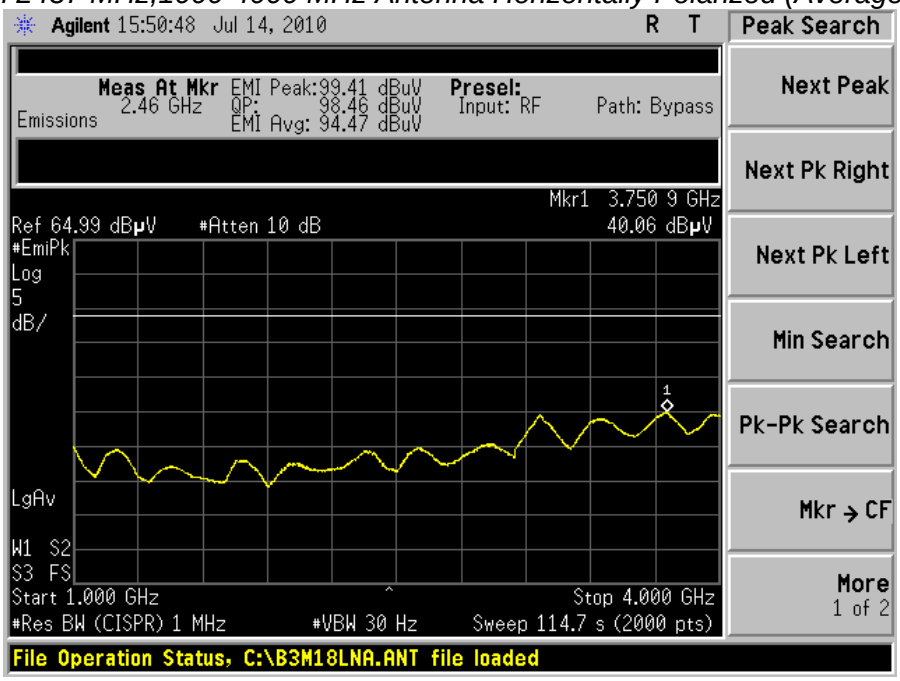


Screen Captures - Radiated Emissions Testing – Receive Mode (continued)

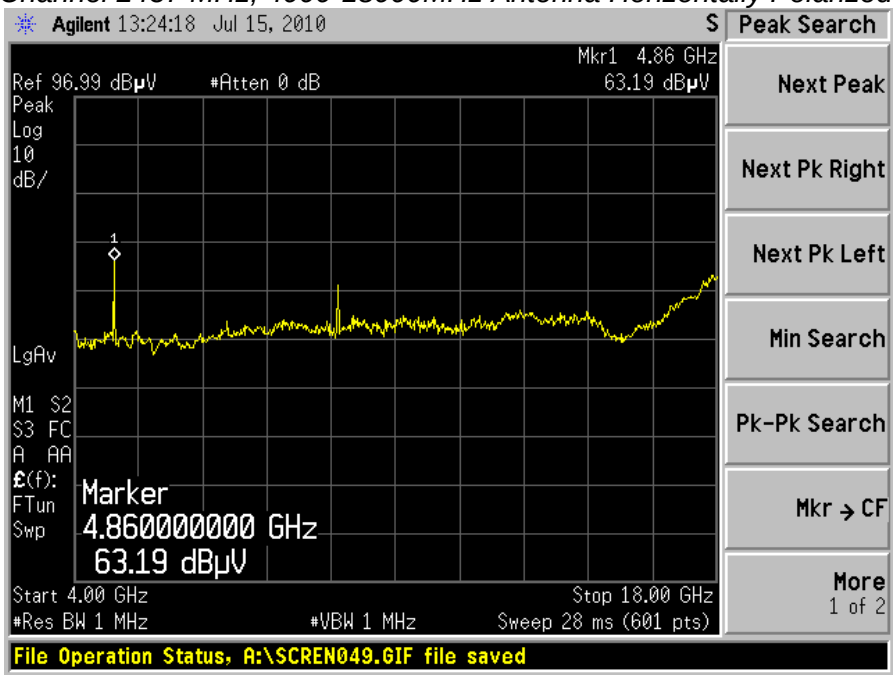
Channel 2437 MHz, 1000-4000 MHz Antenna Horizontally Polarized



Channel 2437 MHz,1000-4000 MHz Antenna Horizontally Polarized (Average Trace)



Channel 2437 MHz, 4000-18000MHz Antenna Horizontally Polarized



Channel 2437 MHz, 18000-25000 MHz Antenna Horizontally Polarized

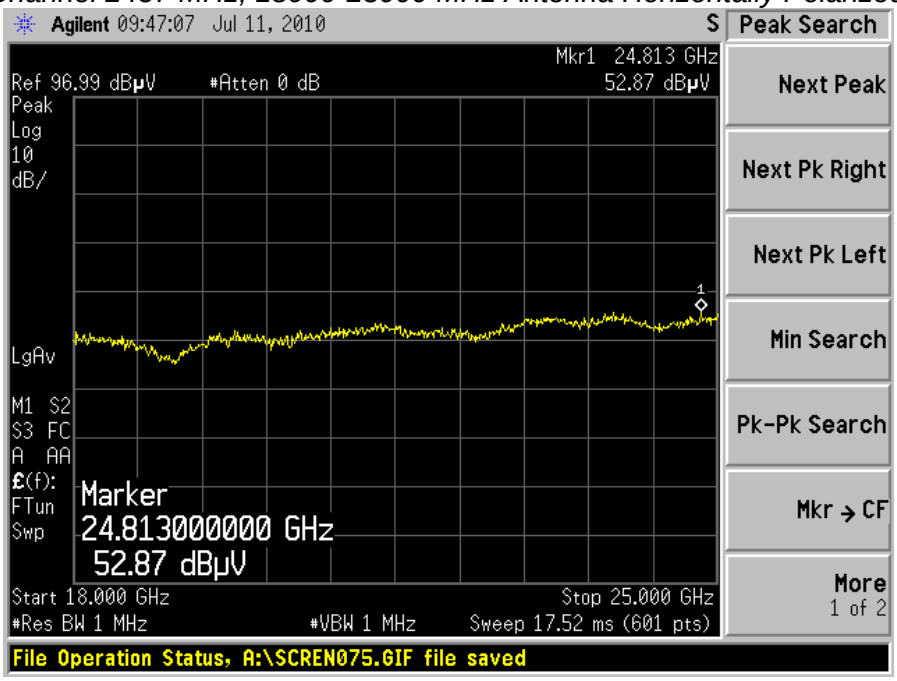


EXHIBIT 6. OCCUPIED BANDWIDTH

6.1 - Limits

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

6.2 - 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 -20dBc occupied bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the Agilent E4446A spectrum analyzer. The spectrum analyzer was used with the resolution bandwidth set to 300 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the closest measurement (6 dB bandwidth) when compared to the specified limit, is 13.092 MHz, which is above the minimum of 500 kHz.

6.3 - Test Equipment List

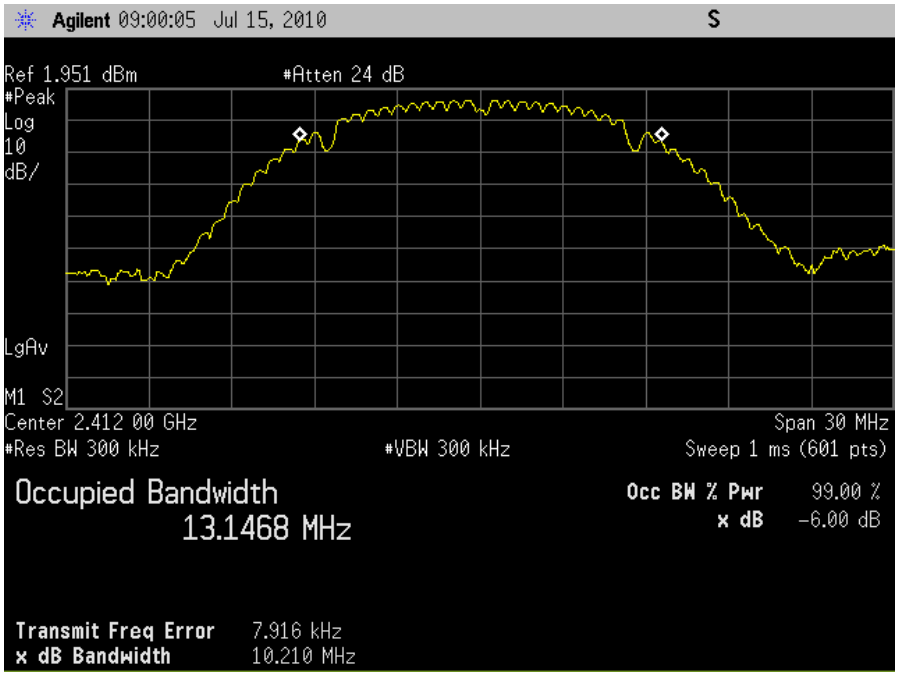
A complete list of test equipment that was used for this test can be found in Appendix A.

6.4 - Test Data

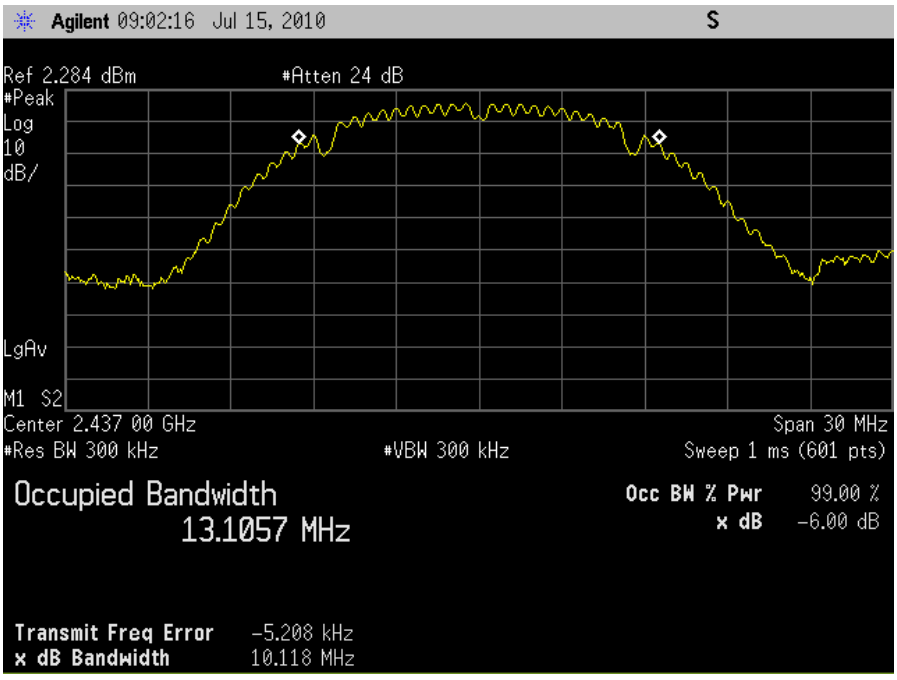
Channel	Center Frequency (MHz)	Measured -6 dBc OBW (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc OBW (kHz)
Low	2412	10210	500	13147
Middle	2437	10118	500	13106
High	2462	10050	500	13092

6.5 - Screen Captures - Occupied Bandwidth

Channel 2412



Channel 2437



Channel 2462

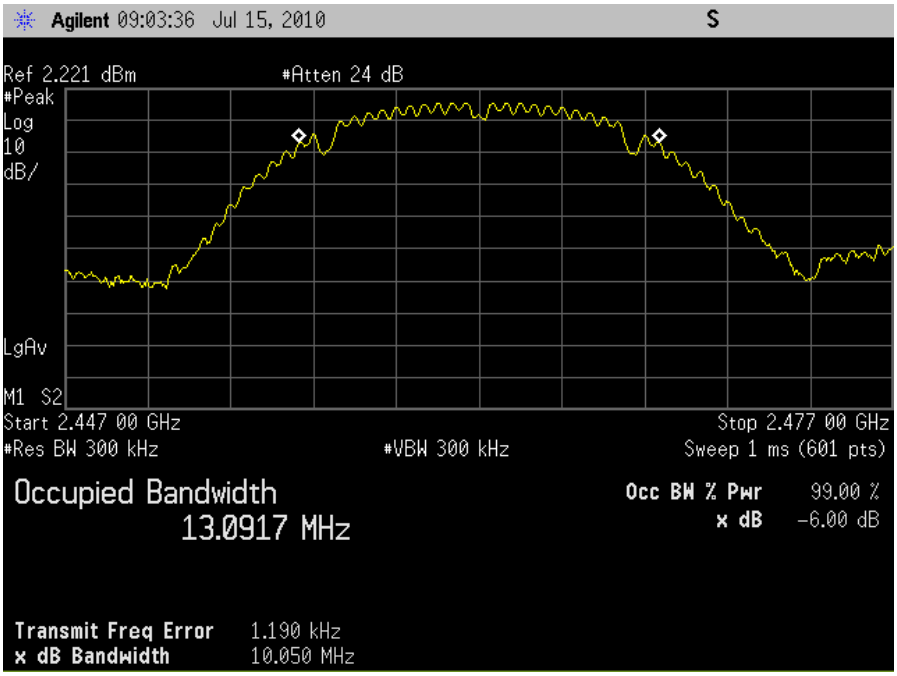
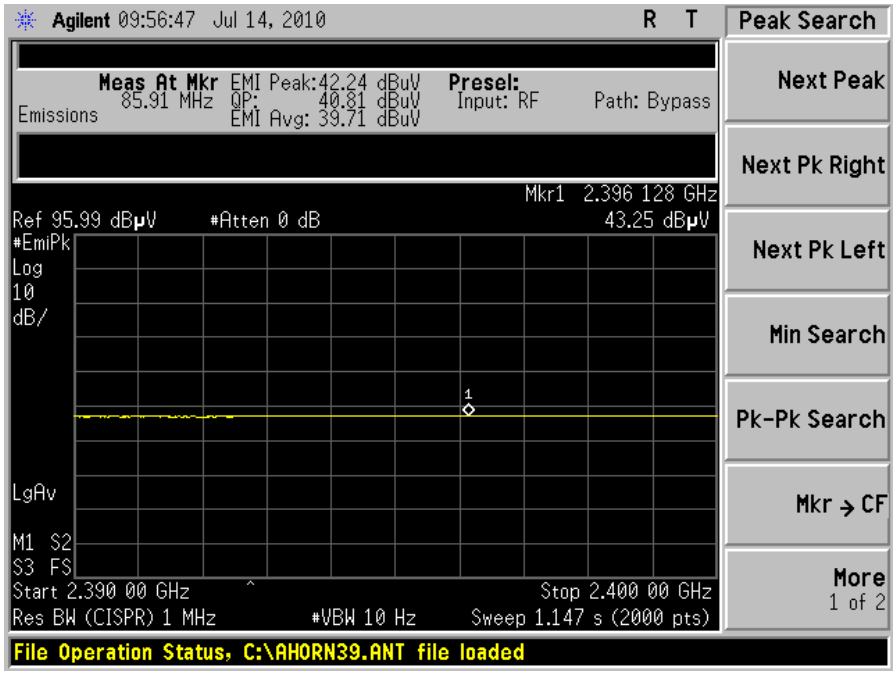


EXHIBIT 7. BAND EDGE MEASUREMENTS

7.1 - Method of Measurements

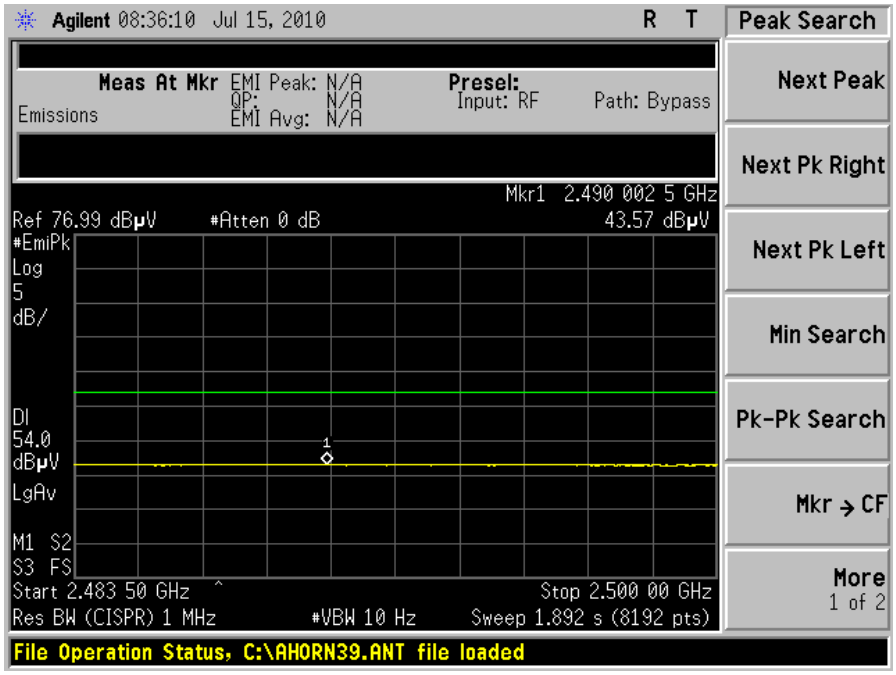
FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. Also, RSS 210 Section 2.2 requires that unwanted emissions meet limits listed in tables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

Screen Capture Demonstrating Compliance at the Lower Band-Edge



The Lower Band-Edge limit, in this case, would be -20 dBc with respect to the fundamental level (91.5dBµV/m).

Screen Capture Demonstrating Compliance at the Higher Band-Edge



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

EXHIBIT 8. POWER OUTPUT (CONDUCTED): 15.247(b)

8.1 - 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 from a modulation source. The spectrum analyzer was used with resolution and video bandwidths set to 3 MHz, and a span of 50 MHz, with measurements from a peak detector presented in the chart below.

8.2 – Test Equipment List

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

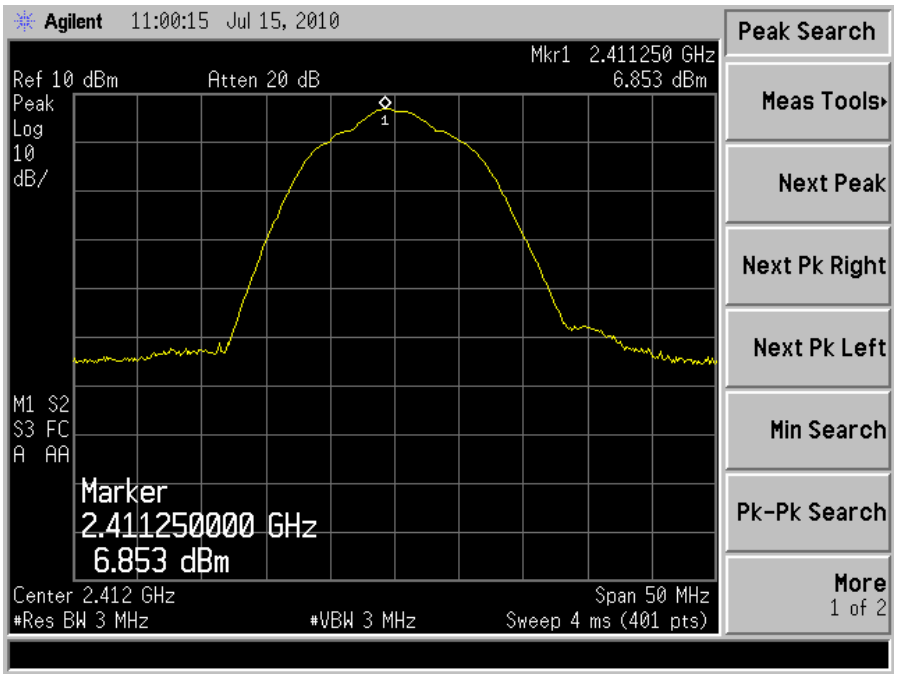
8.3 - Test Data

Transmitter Channel	Freq. (MHz)	Measured Power (dBm)	BW Correction Factor (dB)	Corrected Output Power (dBm)	Calculated EIRP (dBm) [1]	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Low	2412	6.85	5.32	12.17	13.97	30.0	36.0
Middle	2437	6.62	5.28	11.90	13.70	30.0	36.0
High	2462	6.79	5.25	12.04	13.84	30.0	36.0

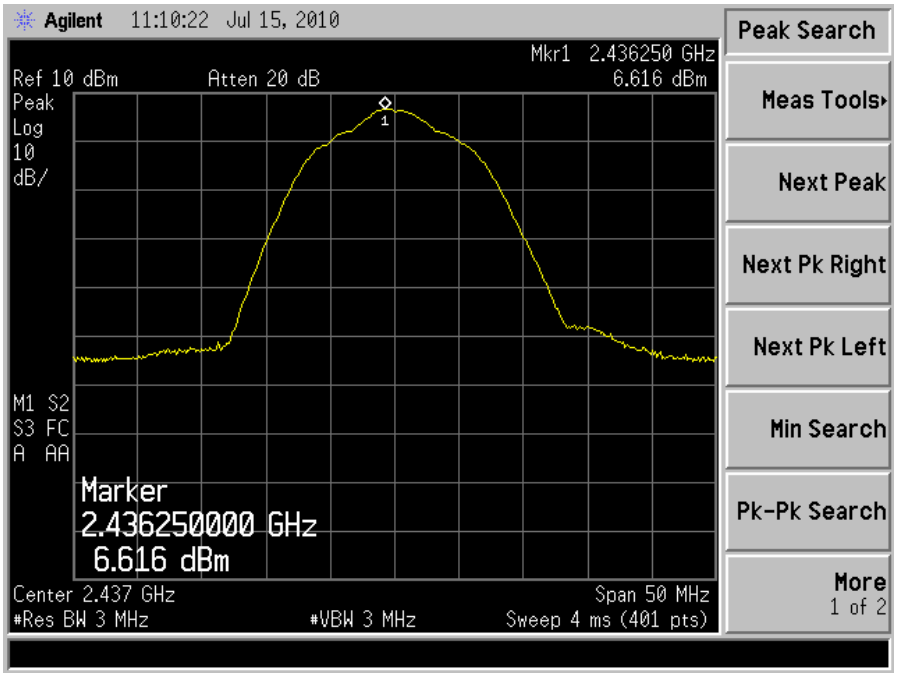
[1] EIRP Calculation:
EIRP = (Peak power at antenna terminal in dBm) + (EUT Antenna gain in dBi)

8.4 - Screen Captures – Power Output (Conducted)

Channel 2412



Channel 2437



Channel 2462

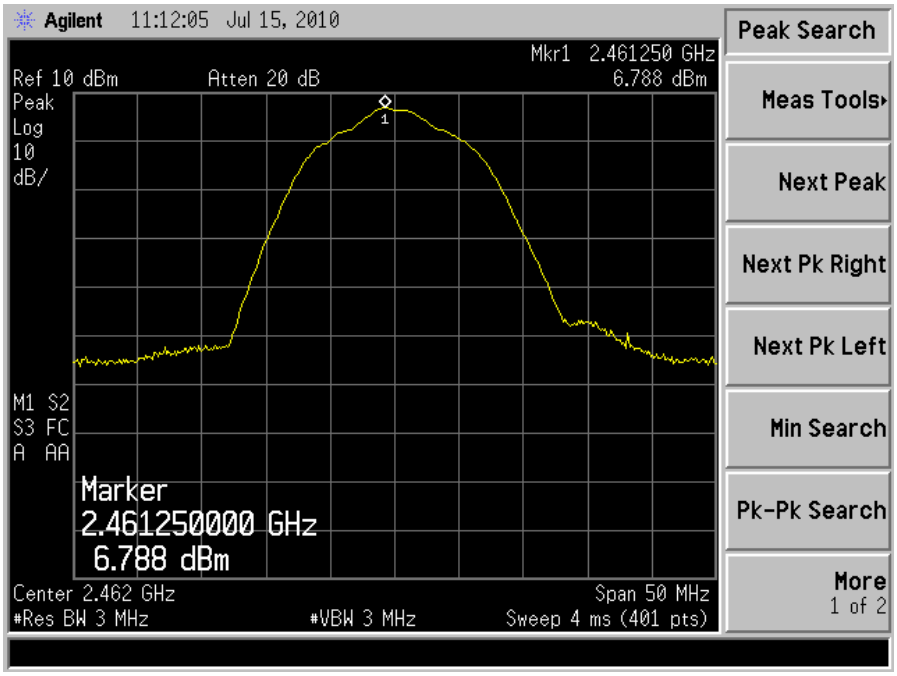


EXHIBIT 9. POWER SPECTRAL DENSITY: 15.247(e)

9.1 - 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 -11.3 dBm, which is under the allowable limit.

9.2 - Test Equipment List

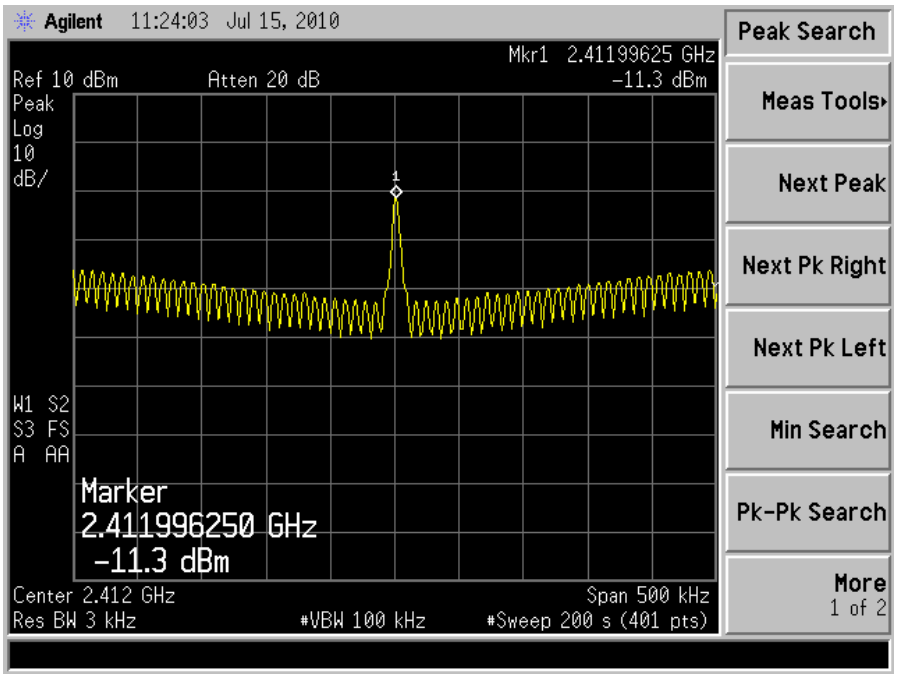
A complete list of test equipment that was used for this test can be found in Appendix A.

9.3 - Test Data

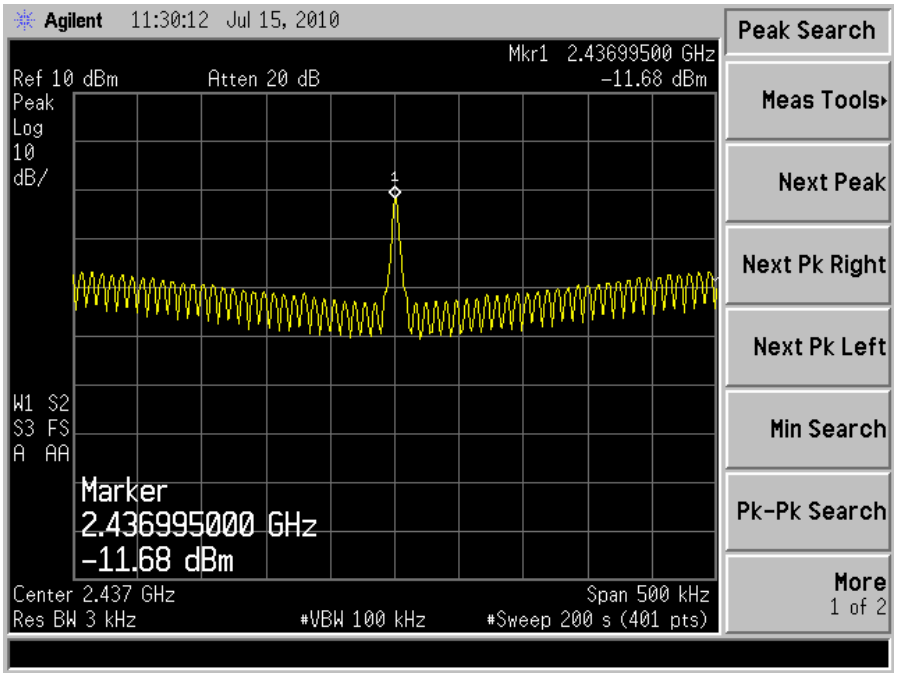
Transmitter Channel	Frequency (MHz)	RF Power Level In 3 kHz BW (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Comments Pass/Fail
Low	2412	-11.30	8.0	19.30	Pass
Middle	2437	-11.68	8.0	19.68	Pass
High	2462	-13.21	8.0	21.21	Pass

9.4 - Screen Captures – Power Spectral Density

Channel 2412



Channel 2437



Channel 2462

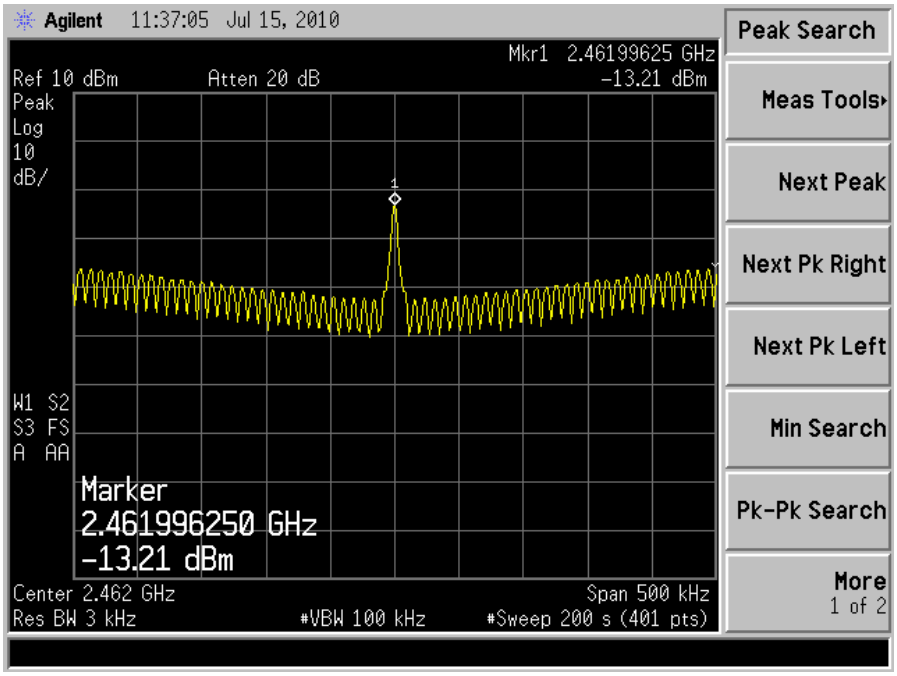


EXHIBIT 10. SPURIOUS RADIATED EMISSIONS: 15.247(d)

10.1 - 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.

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

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

FCC 47 CFR 15.205(a) – Restricted Frequency Bands

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

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

Frequency (MHz)	Field Strength Limits (µV/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):

$dB\mu V/m = 20 \log_{10} (100) = 40\ dB\mu V/m$ (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 dB/μV/m at 1 meter

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

960 MHz to 10,000 MHz
500μV/m or 54.0 dBμV/m at 3 meters
54.0 + 20 = 74 dB/μV/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 + Cable Factor = Reported Data

6.27 dBm + 0.58 dB = 6.85 dBm

10.2 – 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. An Agilent E4446A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, 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.

Frequency	Channel 2412	Channel 2437	Channel 2462
Fundamental	+ 6.85 (dBm)	+ 6.62 (dBm)	+ 6.79 (dBm)
2nd Harmonic	- 48.12 (dBm)	- 49.9(dBm)	- 50.8 (dBm)
3rd Harmonic	Note (1)	Note (1)	Note (1)
4th Harmonic	- 61.18(dBm)	- 66.73 (dBm)	- 61.49 (dBm)
5th Harmonic	Note (1)	Note (1)	Note (1)
6th Harmonic	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

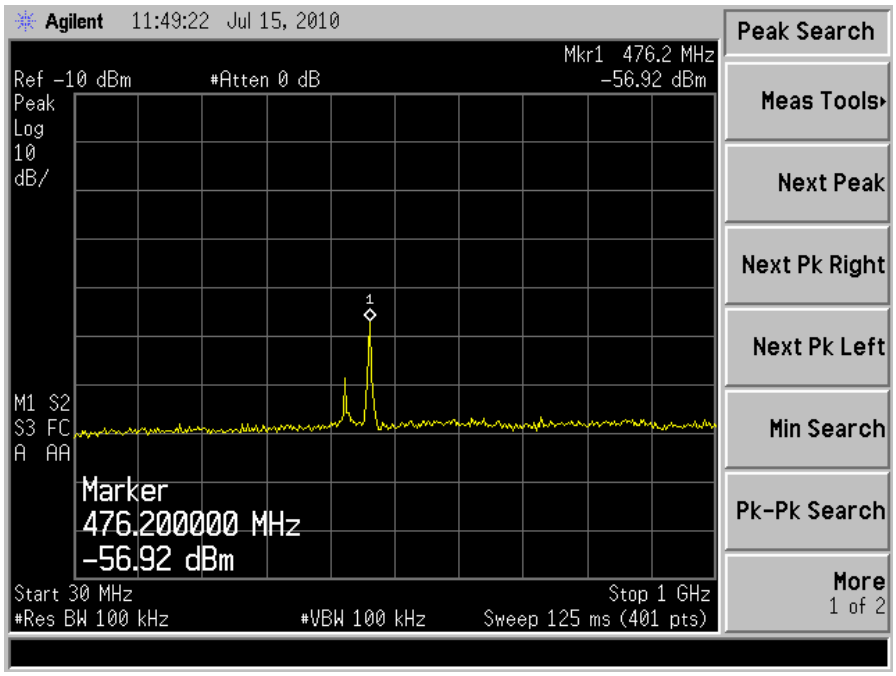
Note 1): Measurement at system noise floor.

10.3 - Test Equipment List

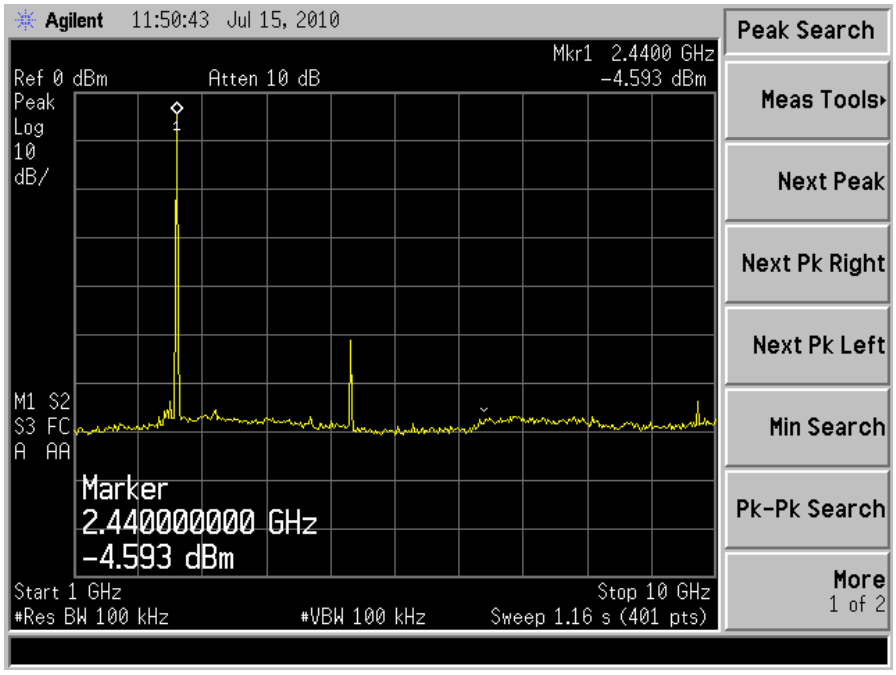
A complete list of test equipment that was used for this test can be found in Appendix A.

10.4 - Screen Captures – Spurious Radiated Emissions

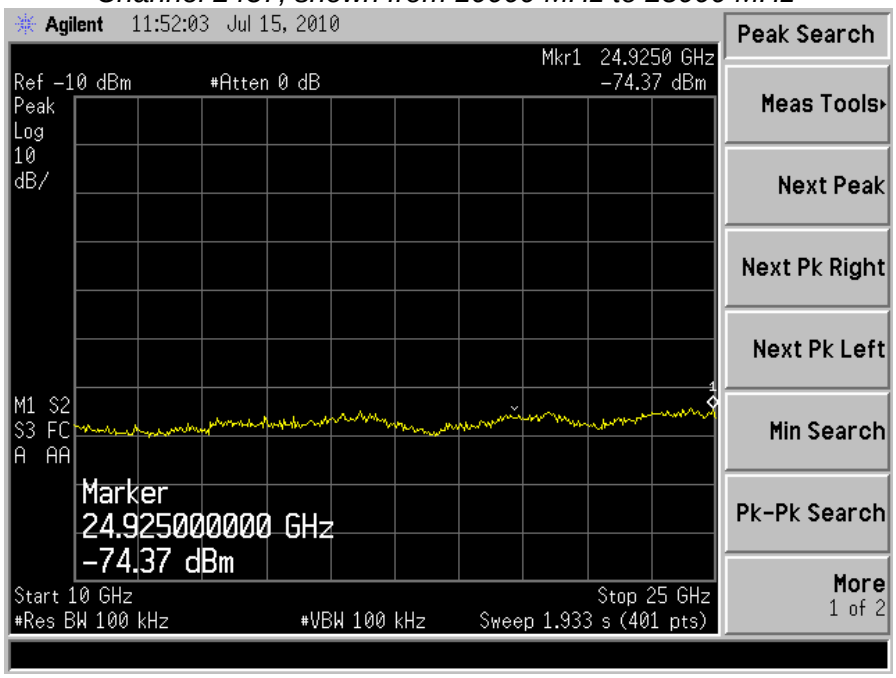
Channel 2437, shown from 30 MHz to 1000 MHz



Channel 2437, shown from 1000 MHz to 10000 MHz



Channel 2437, shown from 10000 MHz to 25000 MHz



Appendix A – Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 13-Jul-2010 Type Test: Spurious Emissions Job #: C-949

Prepared By: Shane Rismeyer Customer: Ekahau (LSR) Quote #: 310207

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 13-Jul-2010 Type Test: Power Spectral Density Job #: C-949

Prepared By: Shane Rismeyer Customer: Ekahau (LSR) Quote #: 310207

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 13-Jul-2010 Type Test: Occupied Bandwidth (6dB & 20dB) Job #: C-949

Prepared By: Shane Rismeyer Customer: Ekahau (LSR) Quote #: 310207

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 13-Jul-2010 Type Test: Conducted Power Output Job #: C-949

Prepared By: Shane Rismeyer Customer: Ekahau (LSR) Quote #: 310207

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	9/16/2009	9/16/2010	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/17/2009	9/17/2010	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 13-Jul-2010 Type Test: Radiated Emissions Job #: C-949

Prepared By: Shane Rismeyer Customer: Ekahau (LSR) Quote #: 310207

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	7/2/2009	7/2/2010	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	3/17/2009	3/17/2010	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	10/16/2009	10/16/2010	Active Calibration
5	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/3/2009	11/3/2010	Active Calibration
6	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	11/10/2009	11/10/2010	Active Calibration
7	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	12/28/2009	12/28/2010	Active Calibration
8	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	3/7/2009	3/7/2010	Active Calibration
9	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro	WLA622-4	123001	6/30/2009	6/30/2010	Active Calibration

Project Engineer: Quality Assurance:

Appenix B – Test Standards: Current Publication Dates Radio

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003		
CISPR 11	2009-05		
CISPR 12	2007-05		
CISPR 14-1	2005-11	2008-11	
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2006-03	2006-09	2007-07
CISPR 16-1-2 Note 1	2003	2004-04	2006-07
CISPR 22	2008-09		
CISPR 24	1997-09	2001-07	2002-10
EN 55011	2007-05		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006	2007	
EN 60601-1-2	2007-03		
EN 61000-3-2	2006-05		
EN 61000-3-3	2008-12		
EN 61000-4-2	2001	1998	2001
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2007-08		
EN 61000-4-8	1993	1994-01	
EN 61000-4-11	2004-10		
EN 61000-6-1	2007-02		
EN 61000-6-2	2005-12		
EN 61000-6-3	2007-02		
EN 61000-6-4	2007-02		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2008		
FCC Public Notice DA 00-1407	2000		
FCC ET Docket # 99-231	2002		
FCC Procedures	2007		
ICES 001	2006-06		
ICES 002	2007-02		
ICES 003	2004-02		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005-11	2008-03	
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2008-12		
IEC 61000-4-3	2008-04	incl in 2006	
IEC 61000-4-4	2004-07		

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-06		
IEC 61000-4-8	2001-03		
IEC 61000-4-11	2004-03		
IEC 61326-1	2006-06		
ISO 14082	1998-07		
MIL Std. 461E	1999-08		
RSS GEN	2007-06		
RSS 119	2007-06		
RSS 123	1999-11		
RSS 125	2000-03		
RSS 131	2003-07		
RSS 136	2002-10		
RSS 137	2009-02		
RSS 210	2007-06		
RSS 213	2005-12		
RSS 243	2005-11		
RSS 310	2007-06		

Note 1: Test not on LSR Scope of Accreditation.

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

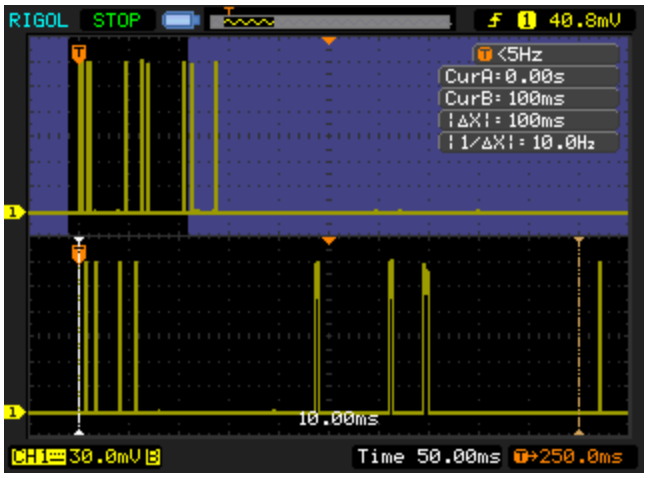
Average (Relaxation) Factor
Average Factor = 20* Log_{10} (Worst Case EUT On-time over 100 ms time window)

Total transmit on-time= 0.308 + 0.308 + 0.656 + 0.656 + 1.208 + 0.180 + 0.110 + 0.220 = 3.646 ms

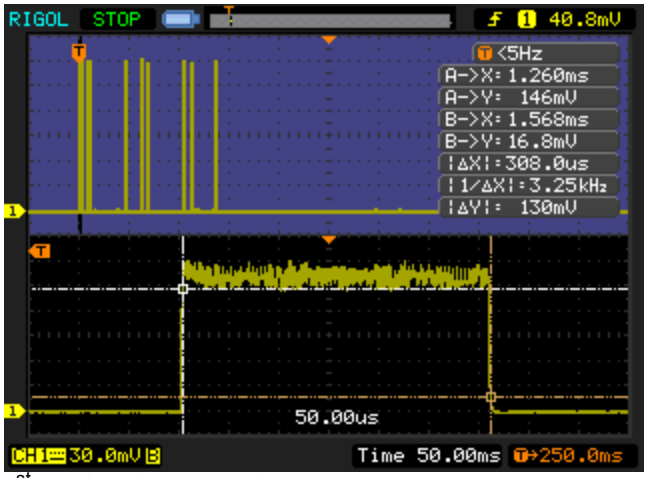
The transmit packets occupy 3.646 ms of time, within any 100 ms window. Therefore, the relaxation factor allowance is calculated as:

Average Factor = 20* Log_{10} (3.646 / 100 ms) = -28.76dB

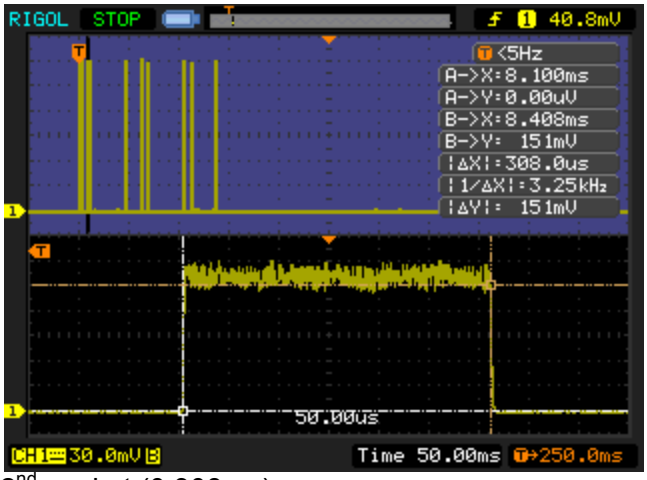
A relaxation factor of -28.76 dB would be allowable for this product.



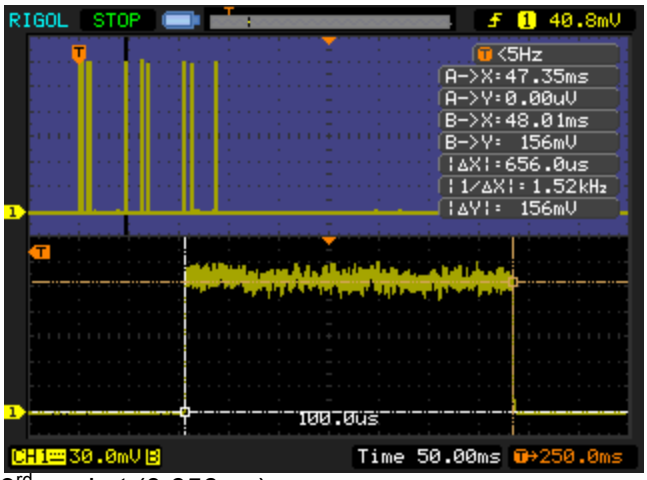
100ms capture



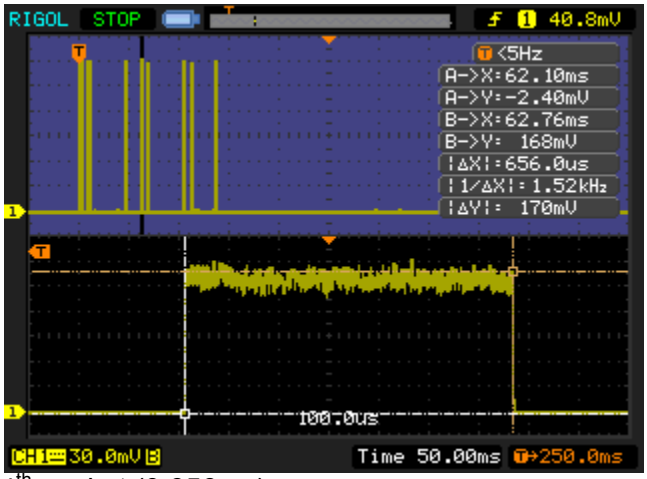
1st packet (0.308ms)



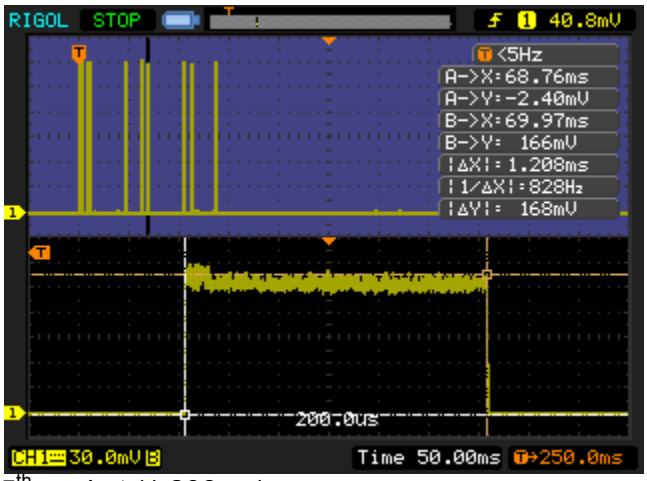
2nd packet (0.308ms)



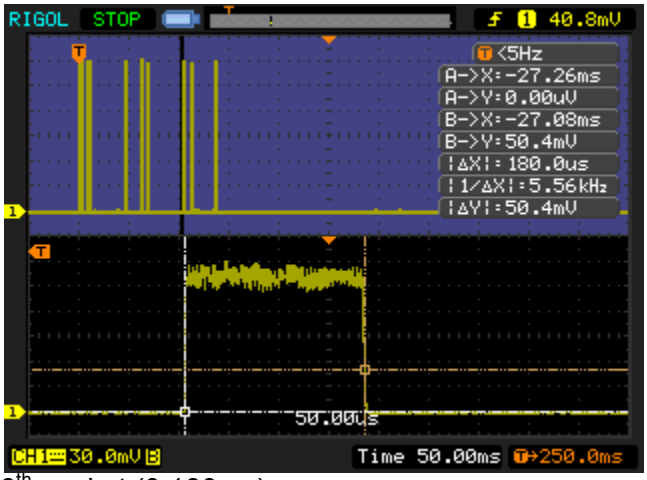
3rd packet (0.656ms)



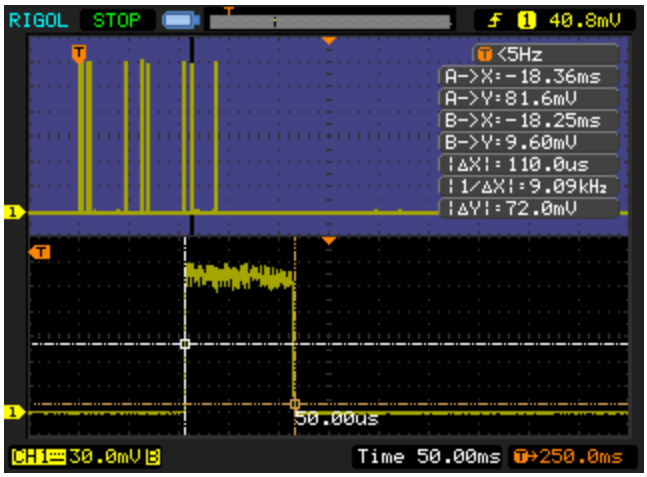
4th packet (0.656ms)



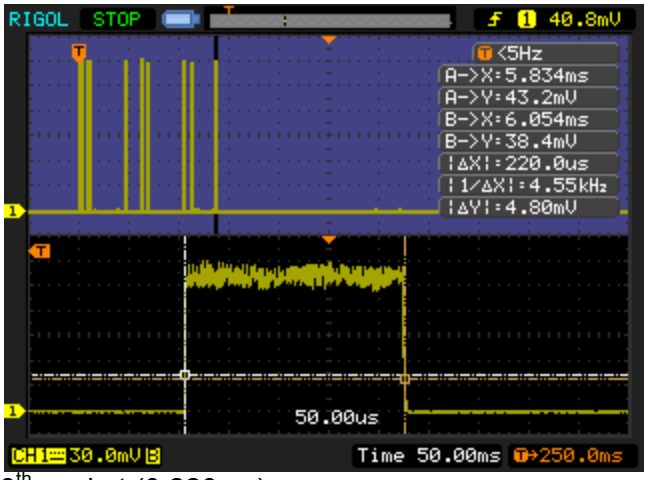
5th packet (1.208ms)



6th packet (0.180ms)



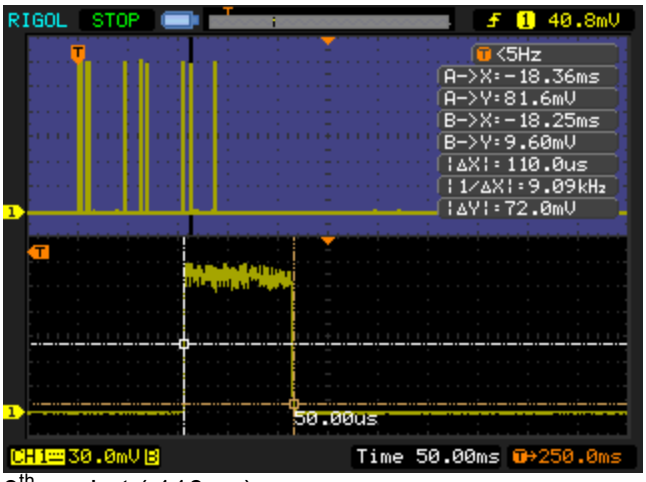
7th packet (0.110ms)



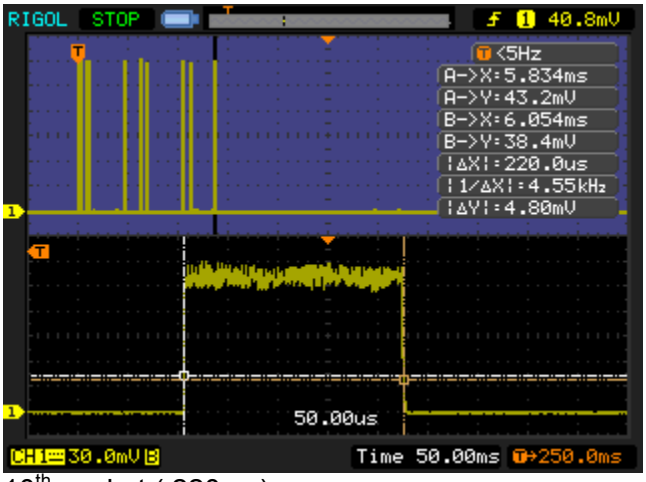
8th packet (0.220ms)

Appendix E – Portable RF Exposure Evaluation

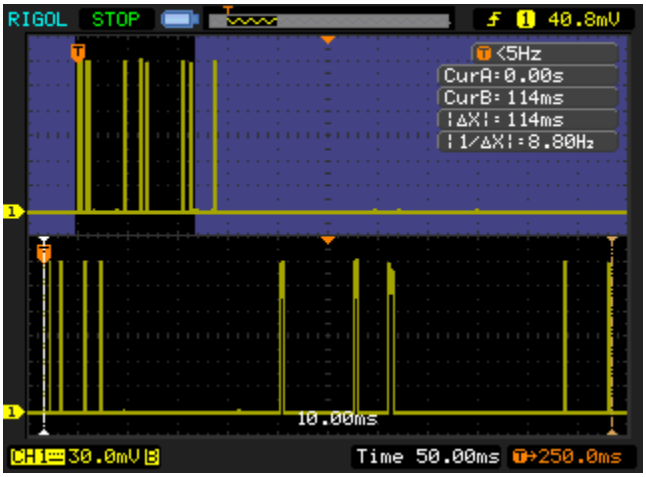
Starting with the on-time used for the duty cycle calculations the on-time is 3.646ms. The transmit cycle of the EUT is 114ms so two additional packets are taken into account.



9th packet (.110ms)



10th packet (.220ms)



Capture of 114ms transmit cycle

Correction Factor = 10log(3.976ms/114ms) = -14.57 dB

Duty Cycle corrected EIRP = 13.97dBm - 14.57dB = -0.6dBm