LS Research, LLC
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ENGINEERING TEST REPORT # 306324 TX

Compliance Testing of:
Nivis Repnode

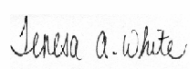
Test Date(s):
June 8th – June 27th 2006

Prepared For:
Nivis, LLC
Attention: Trae Harrison
900 Circle 75 Parkway, 17th Floor
Atlanta, GA 30339

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247 FHSS TX
Frequency Hopping Spread Spectrum Operating in the
Frequency Band 902 MHz – 928 MHz

This Test Report is issued under the Authority of:
Brian E. Petted, VP of Engineering

Signature:  Date: July 30, 2006

Test Report Prepared by:	**Tested by:**
Teresa A. White, Document Coordinator	Khairul Aidi Zainal, EMC Engineer
Signature: 	Signature: 
Date: July 30, 2006	Date: July 30, 2006

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LSR Revision Control

Date	Revision #	Revised By
7-17-06	0	AZ
7-21-06	1	TAW

1.1 SCOPE

References:	FCC Part 15, Subpart C, Section 15.247
Title:	Telecommunication – Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Digital Modulation Transmitters operating in the Frequency Band of 902 MHz – 928 MHz
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
FCC CFR Parts 0-15	2005	Code of Federal Regulations - Telecommunications
ANSI C63.4	2004	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 201: Conducted disturbance measurement.
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding Spread Spectrum Devices.
FCC Procedures	2005, 03-23	Measurement of Digital Transmission Systems operating under Section 15.247.

1.3 LS Research, LLC TEST FACILITY

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

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. A copy of the accreditation may be accessed on our web site: www.lsr.com. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at LS Research, LLC:

- Compact Chamber
- Semi-Anechoic Chamber
- Open Area Test Site (OATS)

1.5 TEST EQUIPMENT UTILIZED

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated in accordance with A2LA standards.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	NIVIS
Address:	900 Circle 75 Parkway, 17th Floor Atlanta, GA 30339
Contact Person:	Trae Harrison

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	NIVIS REPNODE
Model Number:	IC-RN-00-03
Serial Number:	0000409C

2.3 ASSOCIATED ANTENNA DESCRIPTION

The antenna used on the NIVIS RepNode is a PCB trace F antenna. Measurements conducted over a ground plane indicate a perceived gain of 2.49 obtained using the formula below (valid for 3m distance between transmitter and receiver):

$G_T = E-P_T-95.23$
$= 124.4 – 26.68 -95.23$
$= 2.49$

Where P_T = conducted power in dBm
G_T = the gain of the transmitter antenna in dBi
E = the radiated electric field in dBµV/m

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Frequency Range (in MHz)	910 - 928
RF Power in Watts	0.47
Field Strength (and at what distance)	124.4 dBµV/m at 3m
Occupied Bandwidth (99% BW)	59 kHz
Type of Modulation	GFSK
Emission Designator	F1D60K0
Transmitter Spurious (worst case)	55.5 dBµV/m at 897.6 MHz
Frequency Tolerance %, Hz, ppm	100
Microprocessor Model # (if applicable)	M430F149
EUT will be operated under FCC Rule Part(s)	15.247
Modular Filing	☐ Yes ☒ No

RF Technical Information:

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

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

- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100 %
- Standard used for evaluation: FCC 15.247; RSS 210
- Measurement Distance: 3 m
- RF Value: 1.66 ☒ V/m ☐ A/m ☐ W/m^2
  ☒ Measured ☐ Computed ☐ Calculated

2.5 PRODUCT DESCRIPTION

The RepNode is a line voltage powered RF transceiver device that is used to transmit data in a RF network. Communications are via a 900 MHz Spread Spectrum network. The RepNode is fully self-contained and is housed in a Nema 4x weatherproof enclosure with outside dimensions of 6 inches x 5 inches x 2.5 inches.

The Nivis RepNode RF section uses a Chipcon CC1020 transceiver operating in the license-free ISM band of 902-928 MHz. It is a Frequency Hopping Spread Spectrum (FHSS) system, using Gaussian Frequency Shift Keyed (GFSK) modulation. The transmission data rate is 9600 baud and NRZ data format is used. The CC1020 transmit output signal is generated by directly FSK modulating the RF output by the digital data stream fed to the CC1020. The signal is further amplified up to a maximum of +27dBm. The Repeater uses a PCB trace f-antenna.

The system uses 50 hop channels. Each channels bandwidth is set in the CC1020 to 51.2 kHz and the channel separation is 347 kHz. The radio receiver is a low-IF receiver. The RF signal is amplified by a low noise amplifier (LNA), down-converted in quadrature (I&Q) to the intermediate frequency (IF) of 307.2 kHz. At IF, the signal is complex filtered and demodulated. The CC1020 outputs the digitally demodulated data.

PHOTO

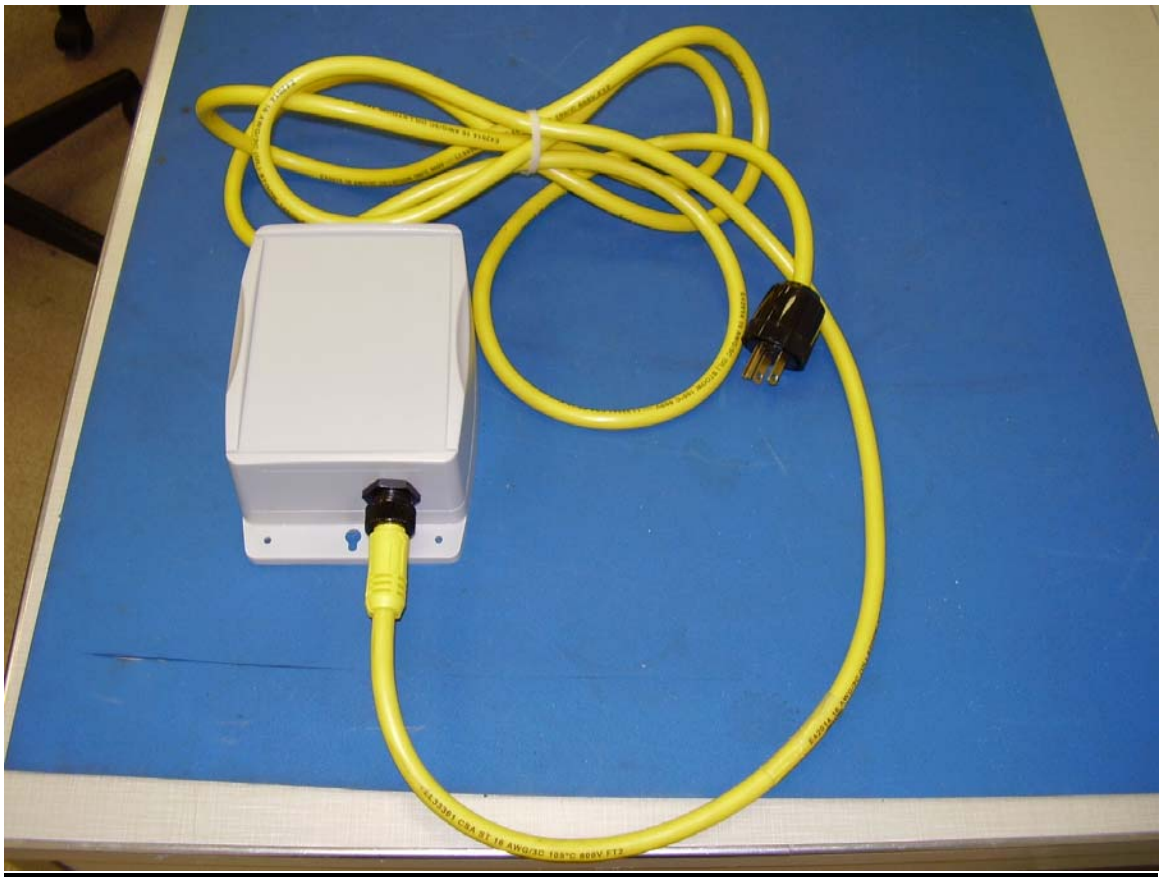


EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	72 Fahrenheit
Humidity:	43 mmHg
Pressure:	50%

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Paragraph	Test Requirements	Compliance (yes/no)
15.207	Power Line Conducted Emissions Measurements	Yes
15.247(a)(1)	Bandwidth of an FHSS System	Yes
15.247(b) & 1.1310	Maximum Output Power	Yes
15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(c)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d)	Transmitted Power Spectral Density of a Digital Modulation System	N/A
15.247(c), 15.209 & 15.205	Transmitter Radiated Emissions	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B – Radio Receivers. The Receiver Test Report is available upon request.		

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☐ **None** ☒ **Yes (explain below)**

Some modifications were made to the design of the product before final testing. In the RF filtering part of the design, a bypass capacitor (C85 in schematic) was changed from 1nF to 6800 pF. At the RF portion of the design, the shielding was soldered at every allowable point onto the PCB.

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☐ **None** ☒ **Yes (explain below)**

The NIVIS RepNode operates in transmission bursts with power from an AC source which would not allow the product to be put in a continuous transmit mode for any significant period of time. Therefore in order to comply with testing procedures, the product was supplied power using a bench DC power supply. This was done by bypassing the rectifier portion of the circuitry. AC mains conducted testing was done with the device in hop mode instead of continuous transmit mode for this same exact reason.

3.5. TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2004	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15-Radio Frequency Device
ANSI C63.4	2003	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 6	2005	Low Power License-Exempt Radio Communication Devices (All Frequency Bands)
IC RSS-212 Issue 1		Test Methods for Radio Equipment
RSS-GEN	2005	General Requirements and Information for the Certification of Radio Communication Equipment
FCC 558074	2004	New Guidance on Measurements for Digital Transmission Systems in Section 15.247

The test procedures used are in accordance with ANSI document C63.4-2003, "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

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 (2005), Section Annex 8 (section 8.1) for a Frequency Hopping Spread Spectrum (FHSS)Transmitter.

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

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

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2003. 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 is intended to be operated in timed burst mode but final testing was performed using continuous transmit and hop mode, using power as provided by a bench DC power supply. The unit has the capability to operate on 50 channels, controllable via a proprietary GUI on a laptop PC.

The applicable limits apply at a 3 meter distance. Measurements above 1 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 (910.5MHz), middle (918.2MHz) and high (927.5MHz) to comply with FCC Part 15.35. The channels and operating modes were changed using a proprietary GUI set up on a laptop PC.

5.2 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 10000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

The EUT was rotated along three orthogonal axis during the investigations to find the highest emission levels.

5.3 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A 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 for peak values and 10 Hz for average values). From 5 GHz to 18 GHz, an HP E4407B Spectrum Analyzer and an EMCO Horn Antenna were used.

5.4 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
EMI Receiver	HP	8546A	3617A00320
EMI Receiver Pre-Select.	HP	85460A	3448A00296
Spectrum Analyzer	Agilent	E4446A	US45300564
Log Periodic Antenna	EMCO	93146	9701-4855
Horn Antenna	EMCO	3115	6907
Bicon Antenna	EMCO	93110B	9702-2918
Pre-Amp	Adv. Microwave	WLA612	1145A04094
Horn Antenna – Std. Gain	EMCO	3160-09	9809-1120

5.5 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for an FHSS transmitter [Canada RSS-210 (2005), Annex 8 (section 8.1). The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.6 CALCULATION OF RADIATED EMISSIONS LIMITS

The maximum peak output power of an intentional radiator in the 902-928 MHz band, as specified in Title 47 CFR 15.247 (b)(1), is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247 (d), shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c).

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24000	500	54.0	63.5

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

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

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

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

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

5.7 RADIATED EMISSIONS DATA CHART

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.205 and 15.247(FHSS)
Frequency Range Inspected: 30 MHz to 10000 MHz

Manufacturer:	Nivis, LLC						
Date(s) of Test:	June 8th – June 27th 2006						
Test Engineer(s):	Khairul Aidi Zainal						
Voltage:	3.6 VDC						
Operation Mode:	continuous transmit						
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %						
EUT Power:		Single Phase ___VAC		3 Phase ___VAC			
		Battery	√	Other: DC power supply			
EUT Placement:	√	80cm non-conductive table		10cm Spacers			
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	√	Final	
Detectors Used:		Peak	√	Quasi-Peak	√	Average	

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

Frequency (MHz)	Ant./EUT Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.205 Limit (dBμV/m)	Margin (dB)
87.3 (Note1)	H/V	01	1.00	46	18.8	104.4	85.6
85.2	V/V	01	1.00	0	24.4	104.4	80
144.3	V/V	01	1.00	0	25.9	104.4	78.5
216.5	V/V	01	1.00	160	25.2	104.4	79.2
218.4	V/V	01	1.00	160	23.2	104.4	81.2
42.8 (Note1)	V/V	50	1.00	226	10.3	103.3	93
143.5	V/H	25	1.00	0	25.1	104.0	78.9
159.2	V/S	01	1.00	0	24.2	104.4	80.2
151.2	V/S	25	1.00	0	24.3	104.0	79.7
151.5	V/S	50	1.00	342	25.5	103.3	77.8
799.9	H/S	01	1.00	0	32.0	104.4	72.4
808.2	H/S	25	1.00	0	32.4	104.0	71.6
816.9	H/S	50	1.00	0	34.0	103.3	69.3
824.3	H/V	50	1.00	166	34.1	103.3	69.2
901.5	H/V	01	1.00	190	50.9	104.4	53.5
897.6	H/V	01	1.00	177	55.5	104.4	48.9
942.3	H/V	50	1.00	189	51.6	103.3	51.7
934.9	H/V	50	1.00	180	52.8	103.3	50.5
928.0	H/V	50	1.00	186	75.1	103.3	28.2
960.3	H/V	50	1.00	184	39.8	54.0	14.2

Note:
1. Signal was intermittent.

RADIATED EMISSIONS DATA CHART *(continued)*

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 01:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
910.5	H/V	1.00	182	124.4	125.2	0.8
1821.0	H/S	1.06	333	67.4	113.9	46.5
2731.5	H/S	1.24	341	60.7	63.5	2.8
3642.0	H/V	1.10	322	49.7	63.5	13.8
4552.5	H/S	1.00	95	60.7	63.5	2.8
5463.0	H/S	1.06	120	70.9	113.9	43
6373.5	H/S	1.02	113	73.2	113.9	40.7
7284.0	V/V	1.00	177	62.3	63.5	1.2
8194.5	V/V	1.00	170	44.5	63.5	19
9105.0	V/H	1.02	170	55.7	63.5	7.8

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

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
918.8	H/V	1.00	190	124.0	125.2	1.2
1837.7	H/S	1.00	307	74.5	113.5	39
2756.5	H/S	1.24	350	62.3	63.5	1.2
3675.3	H/V	1.13	212	56.2	63.5	7.3
4594.2	H/S	1.00	99	60.3	63.5	3.2
5513.0	H/S	1.04	121	70.6	113.5	42.9
6431.8	H/S	1.04	109	71.5	113.5	42
7350.6	V/V	1.04	176	61.7	63.5	1.8
8269.5	V/V	1.00	171	45.4	63.5	18.1
9188.3	V/H	1.04	173	57.3	63.5	6.2

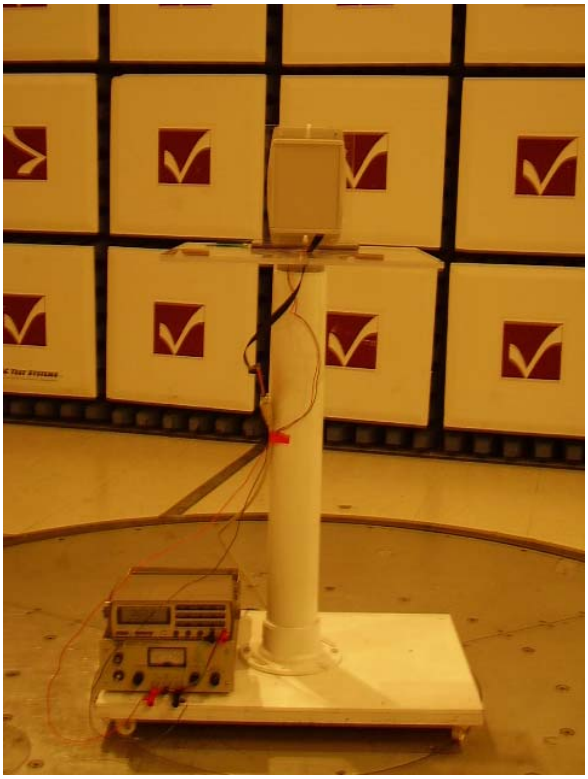
The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 50:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Margin (dB)
927.5	H/V	1.00	187	123.3	125.2	1.9
1855.0	H/S	1.00	307	67.2	112.8	45.6
2782.5	H/S	1.20	351	61.9	63.5	1.6
3710.0	H/V	1.33	329	49.9	63.5	13.6
4637.4	H/S	1.00	106	58.1	63.5	5.4
5564.9	H/S	1.15	119	67.6	112.8	45.2
6492.4	H/S	1.00	113	68.0	112.8	44.8
7419.9	V/V	1.03	173	57.3	63.5	6.2
8347.4	V/V	1.00	176	47.6	63.5	15.9
9274.9	V/H	1.02	170	58.6	112.8	54.2

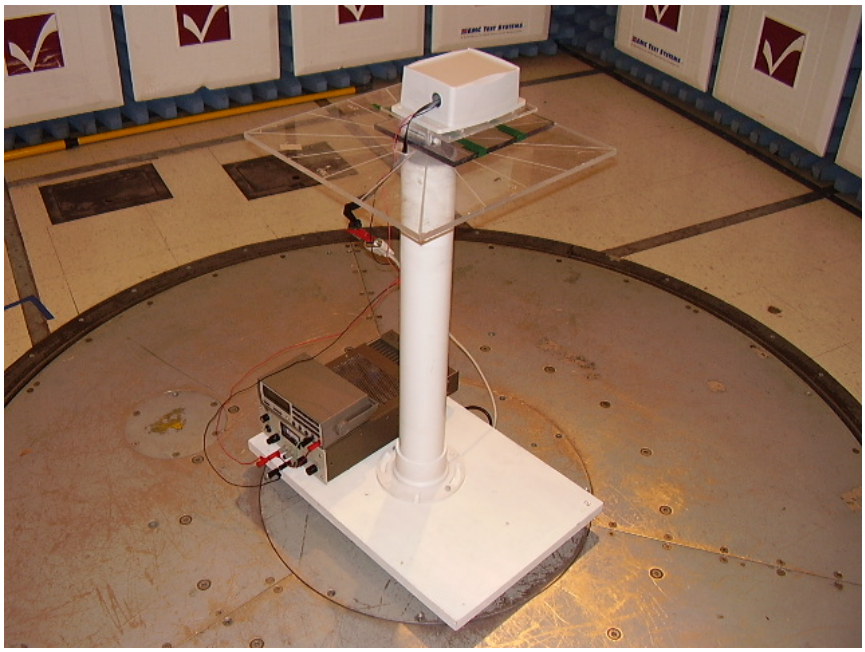
1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. Only the results from the Average detector are published in the table above. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits.
2) Measurements above 1GHz were made at 1 meters of separation from the EUT.
3) Measurement at receiver system noise floor.

5.8 Test Setup Photo(s) – Radiated Emissions Test

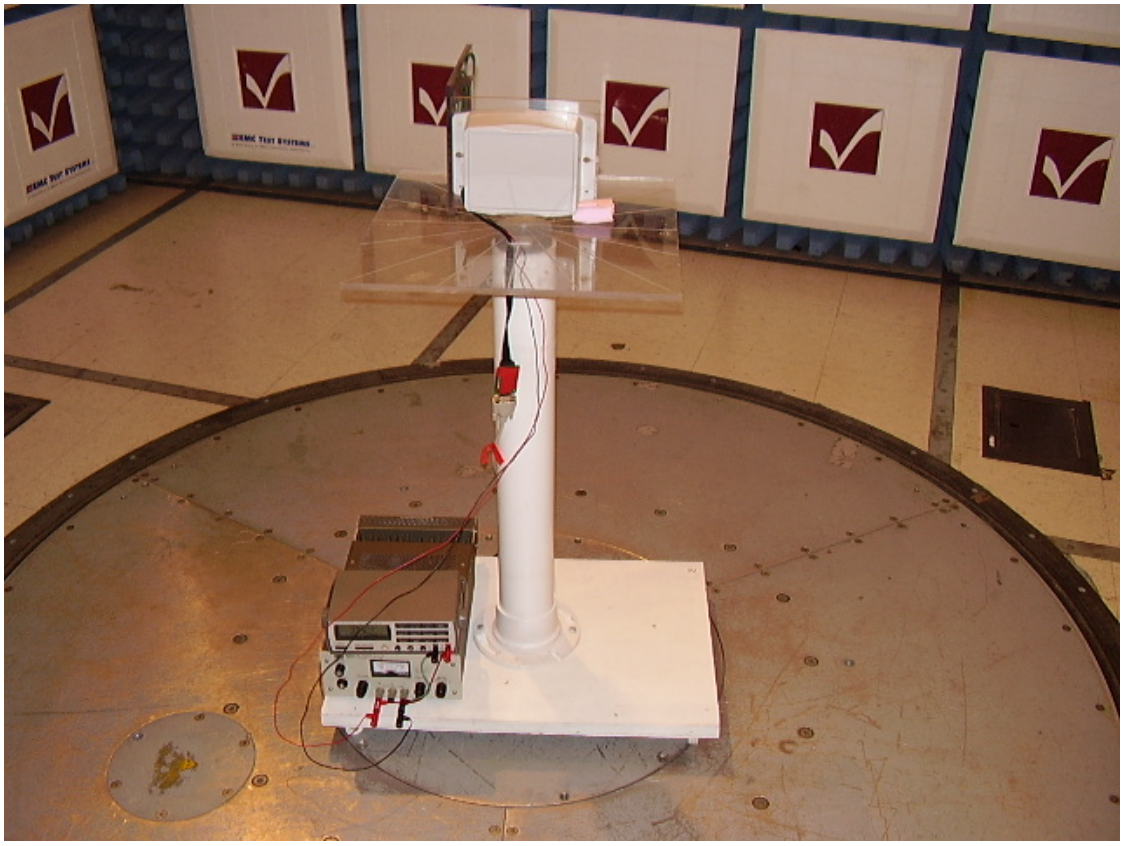
Vertical Orientation



Horizontal Orientation



Side Orientation

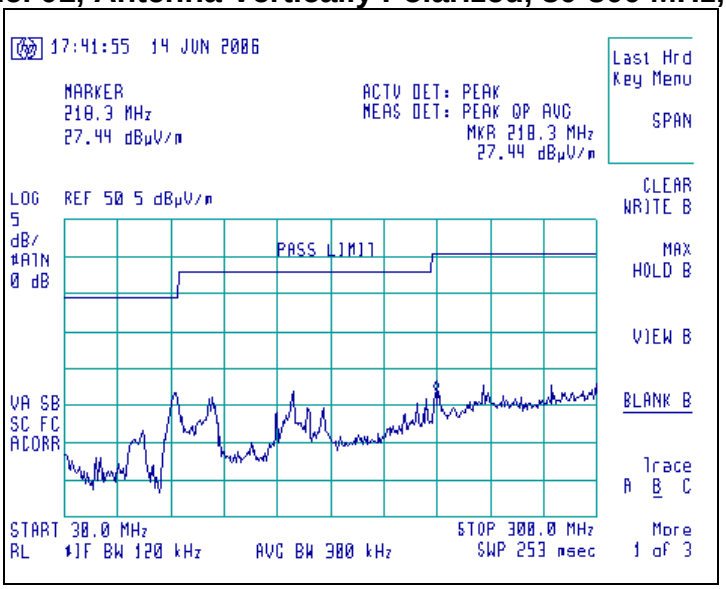


5.9 Screen Captures - Radiated Emissions

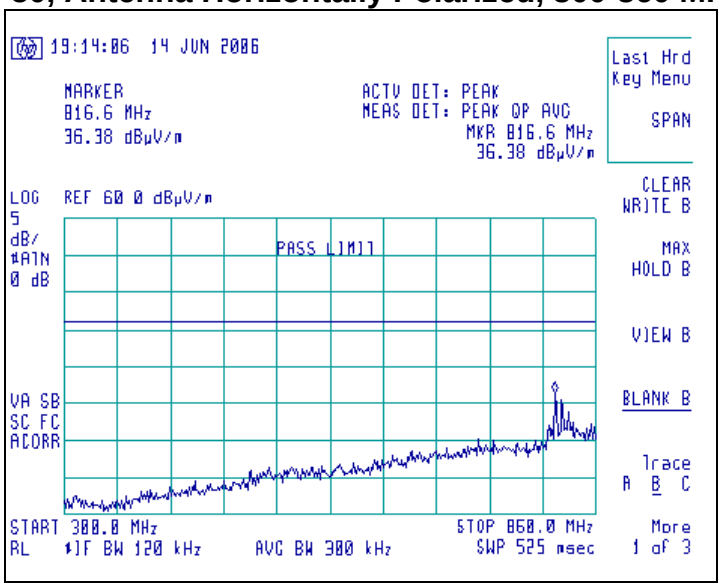
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 01, 25, or 50, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 01, Antenna Vertically Polarized, 30-300 MHz, at 3m

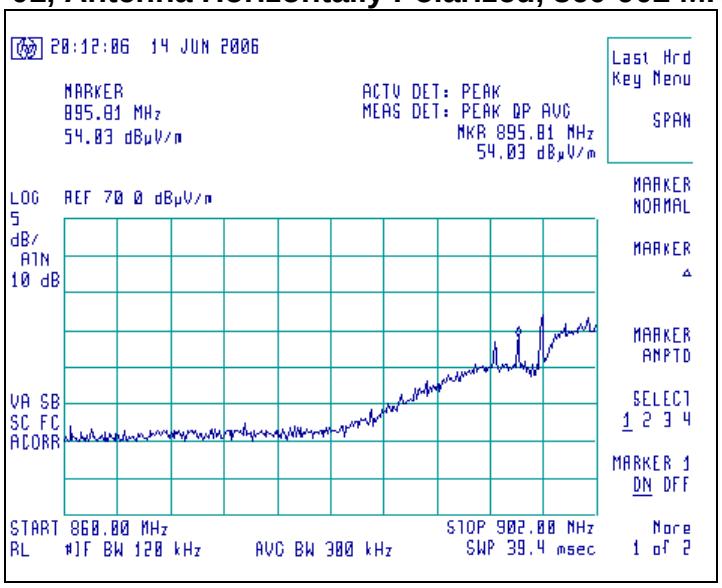


Channel 50, Antenna Horizontally Polarized, 300-860 MHz, at 3m

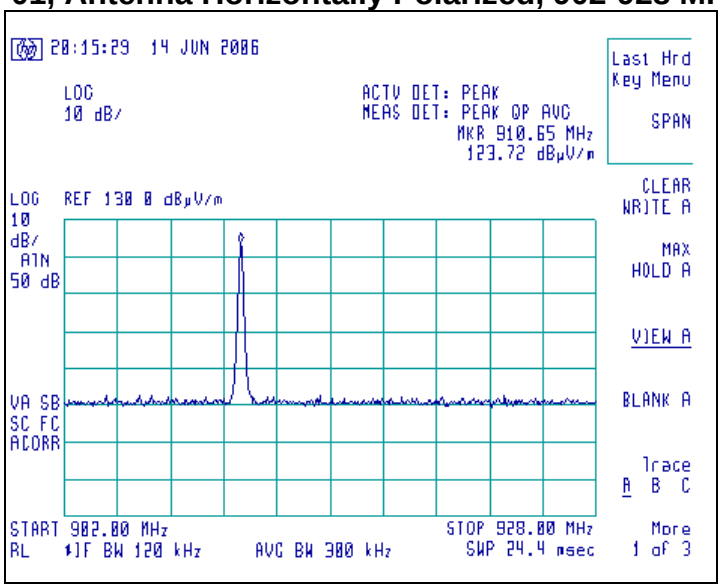


Screen Captures - Radiated Emissions Testing ***(continued)***

Channel 01, Antenna Horizontally Polarized, 860-902 MHz, at 3m

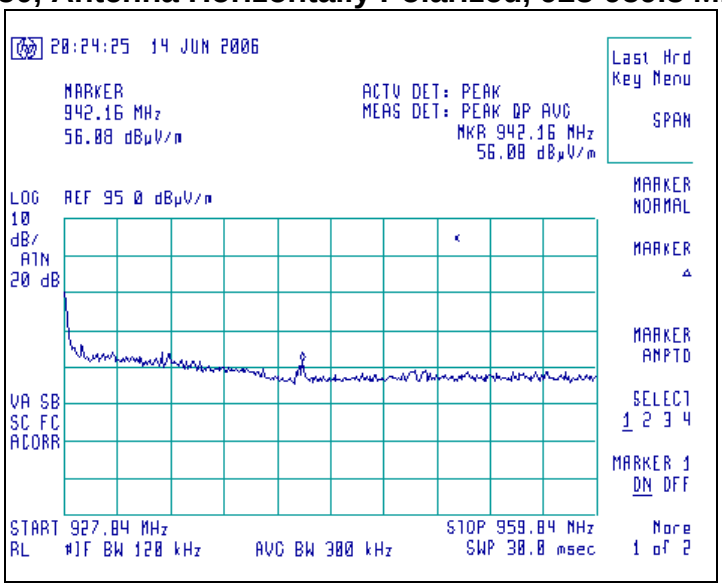


Channel 01, Antenna Horizontally Polarized, 902-928 MHz, at 3m

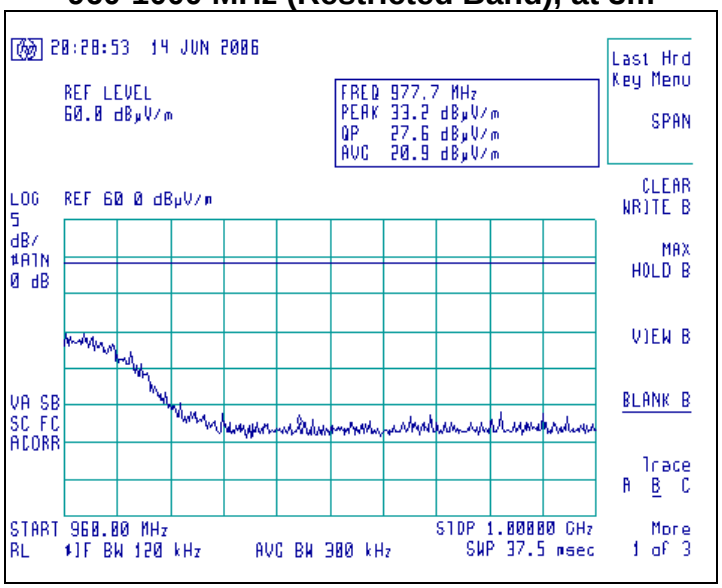


Screen Captures - Radiated Emissions Testing *(continued)*

Channel 50, Antenna Horizontally Polarized, 928-959.8 MHz, at 3m

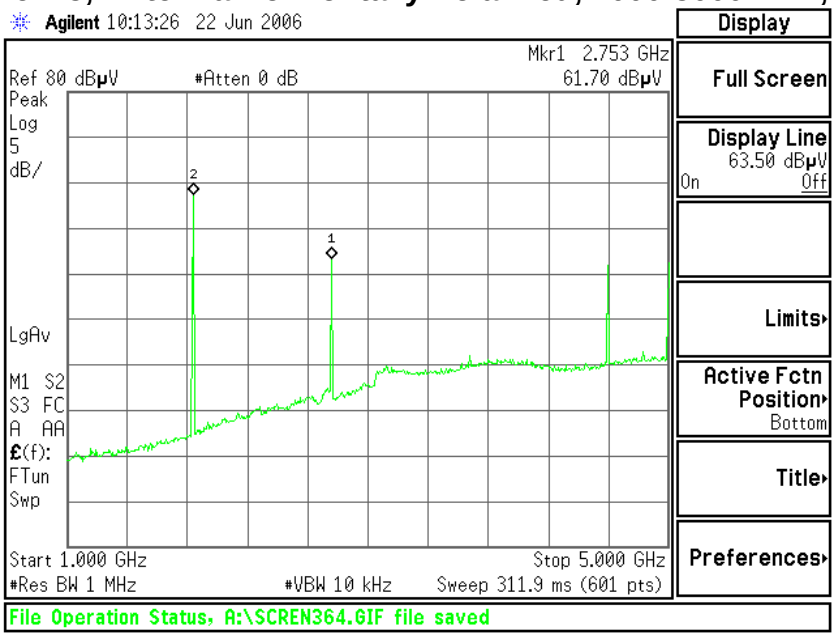


Channel 50, Antenna Horizontally Polarized, 960-1000 MHz (Restricted Band), at 3m



Screen Captures - Radiated Emissions Testing *(continued)*

Channel 25, Antenna Horizontally Polarized, 1000-5000 MHz, at 1m



Channel 01, Antenna Vertically Polarized, 5000-10000 MHz, at 1m

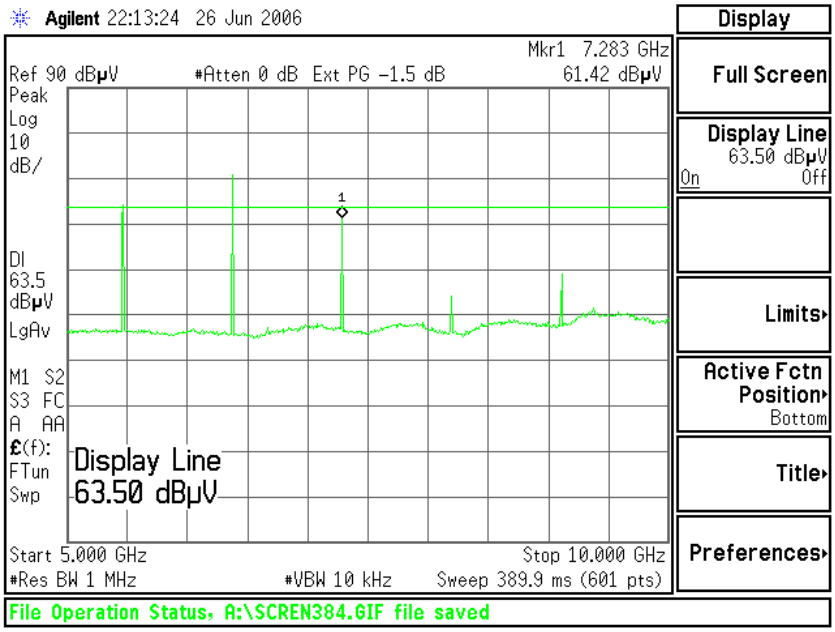


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE: 15.207

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-GEN (section 7.2.2). 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 hopping 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 (2003), Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

6.3 Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for conformance. The emissions are measured on the HP 8546A EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

6.4 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
EMI Receiver	HP	8546A	3617A00320
Spectrum Analyzer	Agilent	E4446A	US45300564
LISN	EMCO	3816/2NM	9701-1057
Transient Limiter	HP	119474A	3107A01708

6.5 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.

6.6 FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBµV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

6.7 TEST DATA CHART CONDUCTED EMISSION

Frequency Range inspected: 150 KHz to 30 MHz

Test Standard: FCC 15.207 Class B

Manufacturer:	Nivis, LLC					
Date(s) of Test:	June 8th – June 27th 2006					
Test Engineer:	Khairul Aidi Zainal					
Model #:	IC-RN-00-03					
Serial #:	0000409C					
Voltage:	120 VAC					
Operation Mode:	Hopping					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:	√	AC Mains Test Bench				Chamber
EUT Placed On:	√	40cm from Vertical Ground Plane				10cm Spacers
	√	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:		Peak	√	Quasi-Peak	√	Average

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµ V)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµ V)	Average Margin (dB)
0.176	L1	38.1	64.7	26.6	8.6	54.7	46.1
0.327	L1	30.0	59.5	29.5	2.5	49.5	47
2.087	L1	10.6	56.0	45.4	4.4	46.0	41.6
4.000	L1	32.5	56.0	23.5	31.2	46.0	14.8
9.518	L1	29.5	60.0	30.5	23.3	50.0	26.7
19.160	L1	20.8	60.0	39.2	15.5	50.0	34.5
0.161	L2	32.6	65.4	32.8	4.3	55.4	51.1
0.355	L2	21.8	58.8	37	1.8	48.8	47
4.000	L2	32.2	56.0	23.8	30.9	46.0	15.1
9.211	L2	27.9	60.0	32.1	22.1	50.0	27.9
11.930	L2	23.0	60.0	37	16.7	50.0	33.3
24.000	L2	20.5	60.0	39.5	17.0	50.0	33

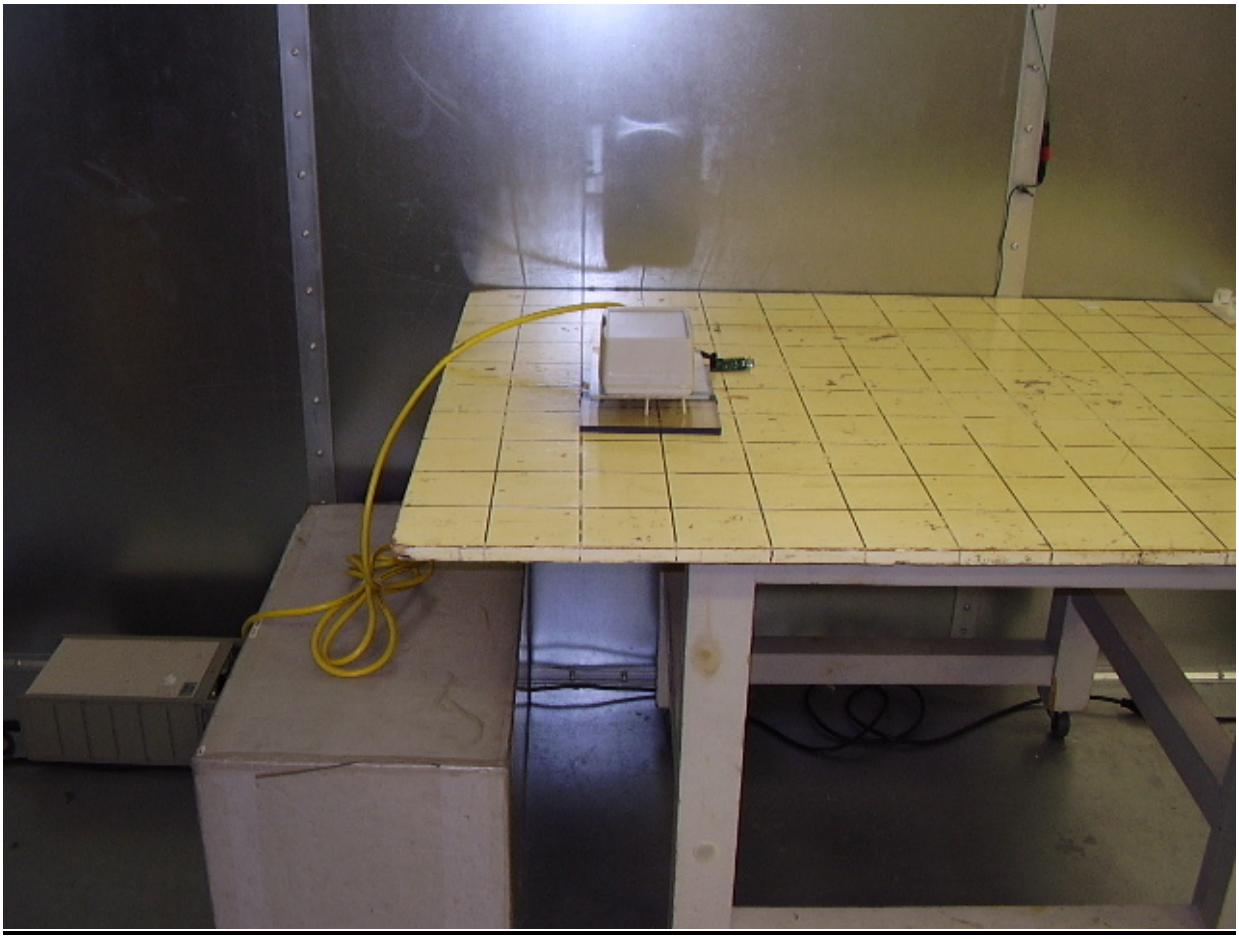
Notes:

1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.

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

3) EUT was put in Hop mode for this test.

6.8 Test Setup Photo(s) – Conducted Emissions Test

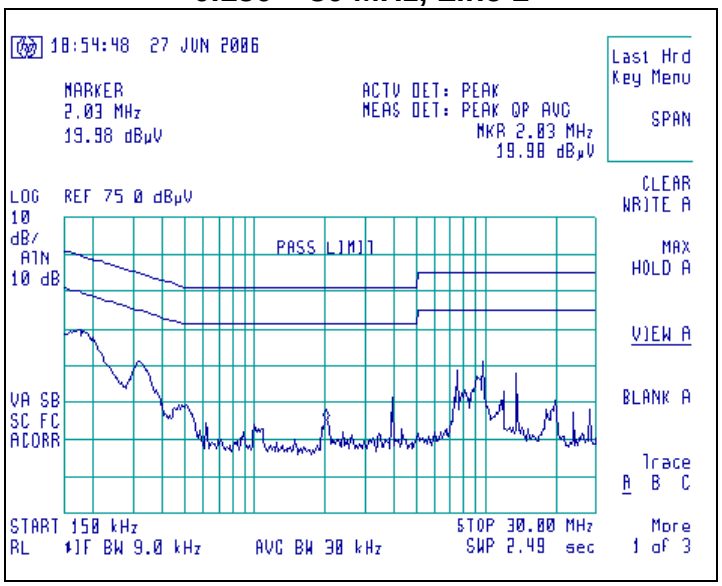


6.9 Screen Captures – Conducted Emissions Test

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

The signature scans shown here are chosen as being a good representative of the EUT.

0.150 – 30 MHz, Line 1



0.150 – 30 MHz, Line 2

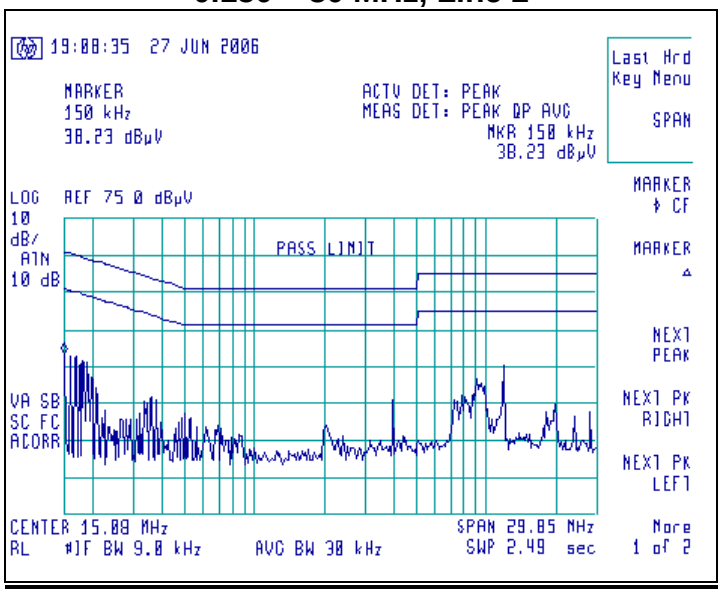


EXHIBIT 7. OCCUPIED BANDWIDTH: 15.247(a)(1)

7.1 Limits

For a Frequency Hopping Spread Spectrum, the -20 dBc bandwidth shall be at most 500 kHz.

7.2 Method of Measurements

Refer to ANSI C63.4 and FCC Procedures (March 23, 2005) for FHSS 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 10 kHz RBW and VBW=10 kHz.

The bandwidth requirement found in FCC Part 15.247(a)(1)(i) requires a maximum -20dBc occupied bandwidth of 500 kHz. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the HP E4407B 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, there by allowing direct readings of the measurements made without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 10 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 when compared to the specified limit, is 59 kHz, which is below the maximum of 500 kHz.

7.3 Test Data

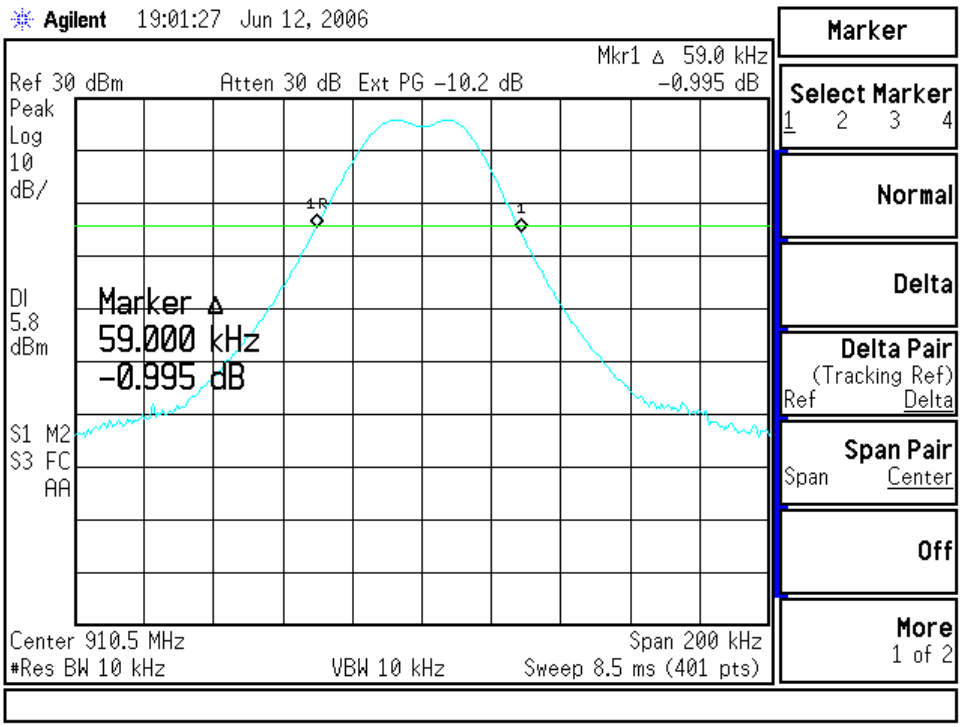
Channel	Center Frequency (MHz)	Measured -20 dBc Occ. BW (kHz)	Maximum -20 dBc Occ. BW Limit (kHz)
01	910.5	59.0	500
25	918.8	58.5	500
50	927.5	57.5	500

7.4 Test Equipment List

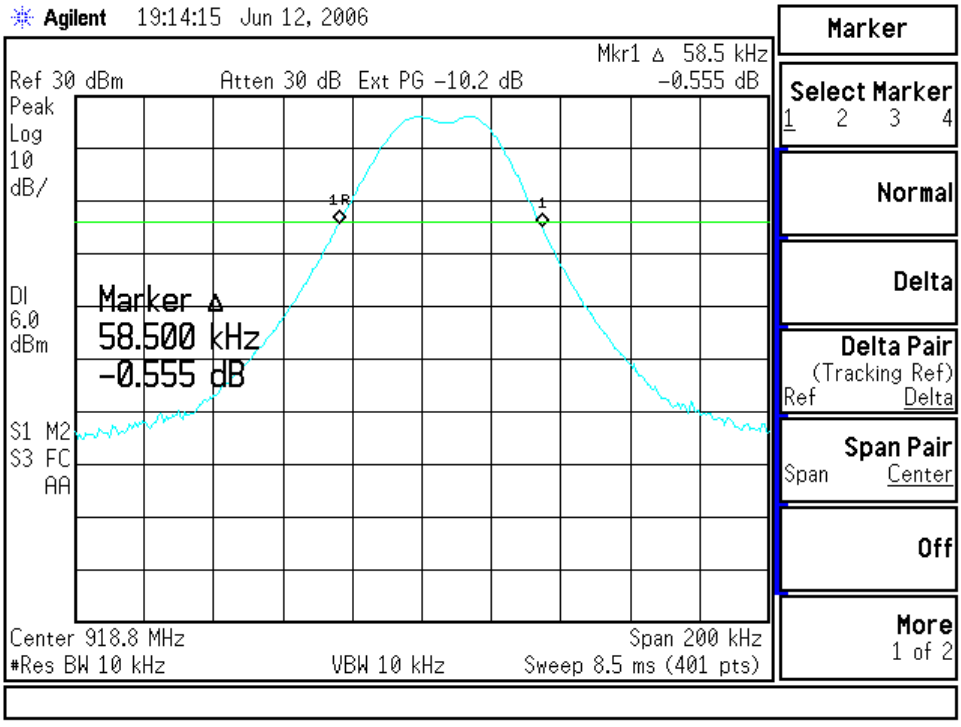
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4407B	US39160256
Spectrum Analyzer	Agilent	E4446A	US45300564

7.5 Screen Captures - OCCUPIED BANDWIDTH

Channel 01 -20 dBc Occupied Bandwidth



Channel 25 -20 dBc Occupied Bandwidth



Screen Captures-Occupied Bandwidth-*continued*

Channel 50 -20 dBc Occupied Bandwidth

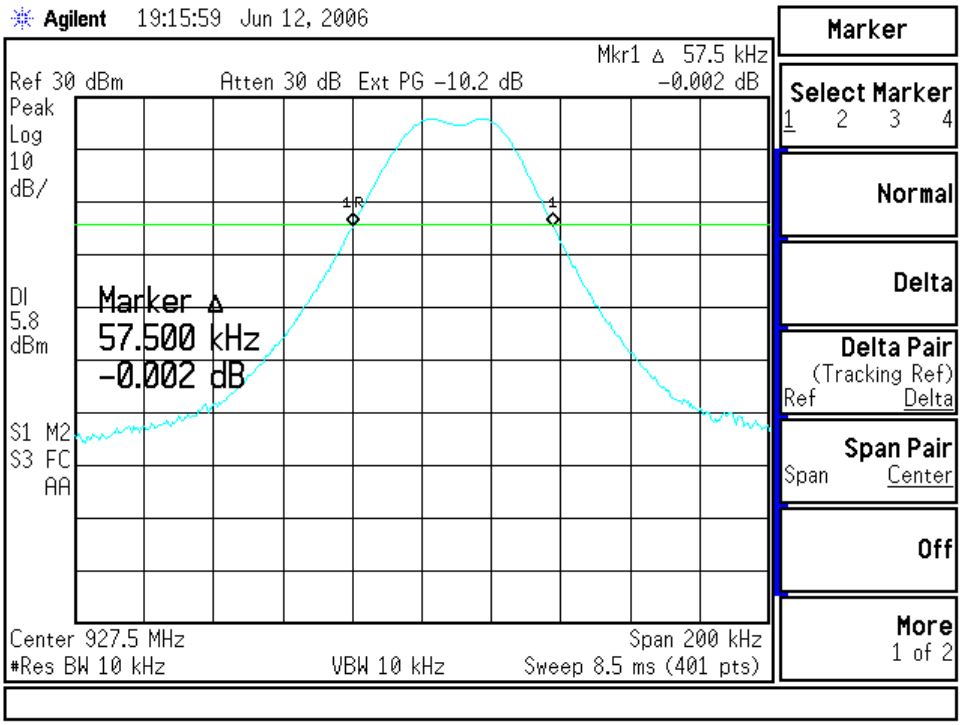


EXHIBIT 8. BAND-EDGE MEASUREMENTS

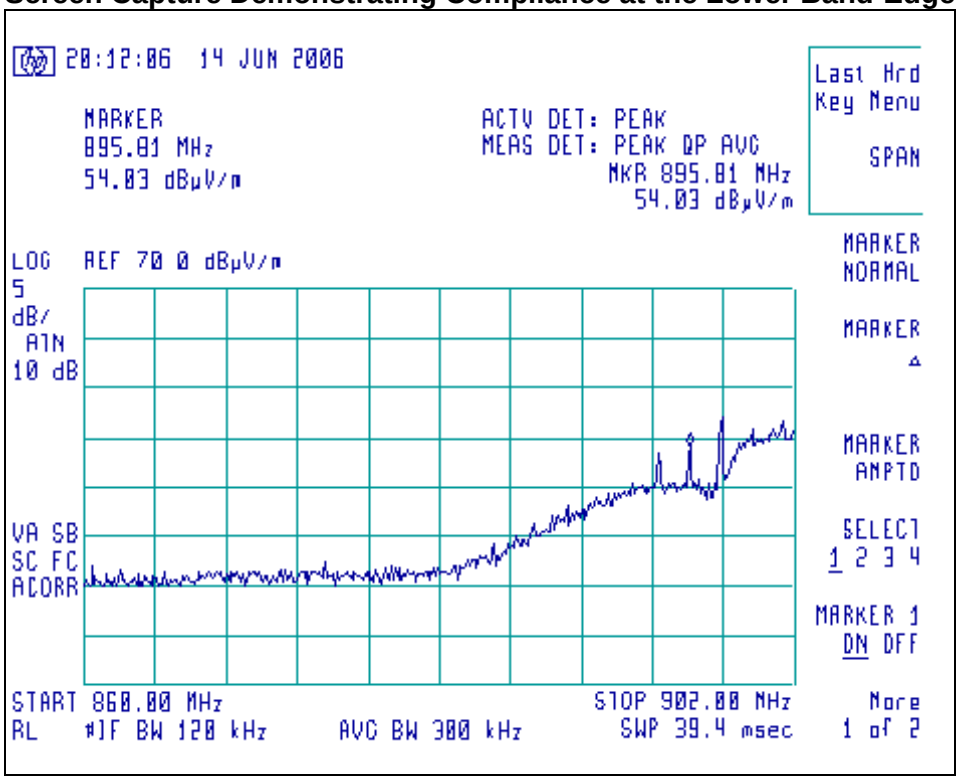
8.1 Method of Measurements

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. The following screen captures demonstrate compliance of the intentional radiator at the 902-928 MHz Band-Edges. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

The Upper and Lower Band-Edge limit, in this case, would be -20 dBc with respect to the fundamental level.

8.2 Screen Captures – Band-Edge

Screen Capture Demonstrating Compliance at the Lower Band-Edge



Screen Captures- Band-Edge *continued*

Screen Capture Demonstrating Compliance at the Higher Band-Edge

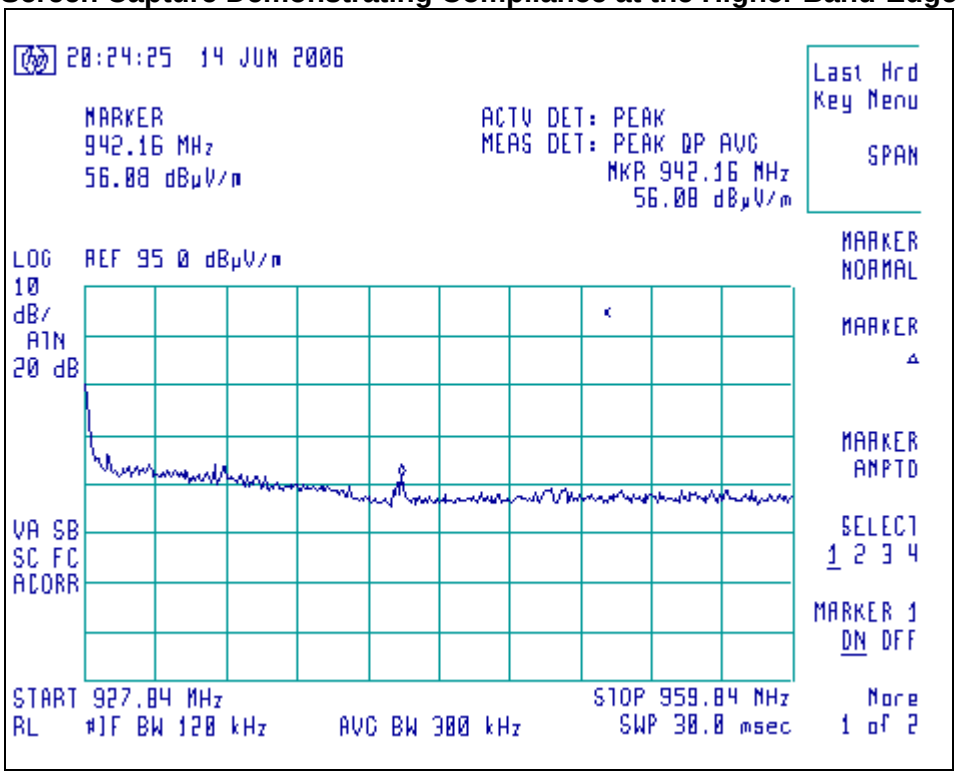


EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

9.1 Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with resolution and video bandwidths set to 100 kHz, and a span of 500 kHz, with measurements from a peak detector presented in the chart below.

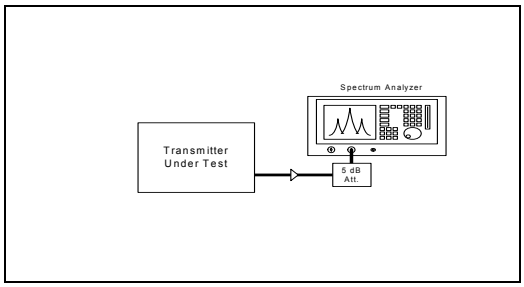
Test Data

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
01	910.5	+30 dBm	26.3	3.7
25	918.8	+30 dBm	26.7	3.3
50	927.5	+30 dBm	26.3	3.7

9.2 Test Data

Transmitter Channel	Freq. (MHz)	Measured Peak ERP at Antenna Terminal (dBm)	Calculated Conducted RF Output Power (dBm) [1]	Conducted Power Limit (dBm)	EIRP Limit (dBm)
Lowest	910.5	29.2	26.7	30.0	36.0
Middle	918.8	28.8	26.3	30.0	36.0
Highest	927.5	28.1	25.6	30.0	36.0

[1] Back Calculation of RF Output Power:
RF Output Power = (Measured ERP at Antenna Terminal (dBm)) - (EUT Antenna gain in dBi)



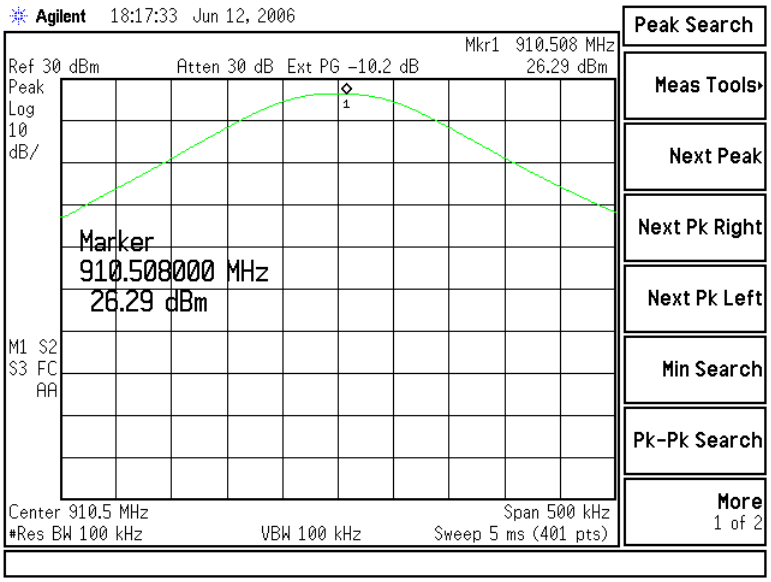
Rated (Manufacturer declared) RF power output (in watts): 0.500
Measured conducted Peak RF Power Output (in Watts): 0.467
Measured (e.i.r.p.) equivalent RF Power Output (in Watts): 0.832

9.3 Test Equipment List

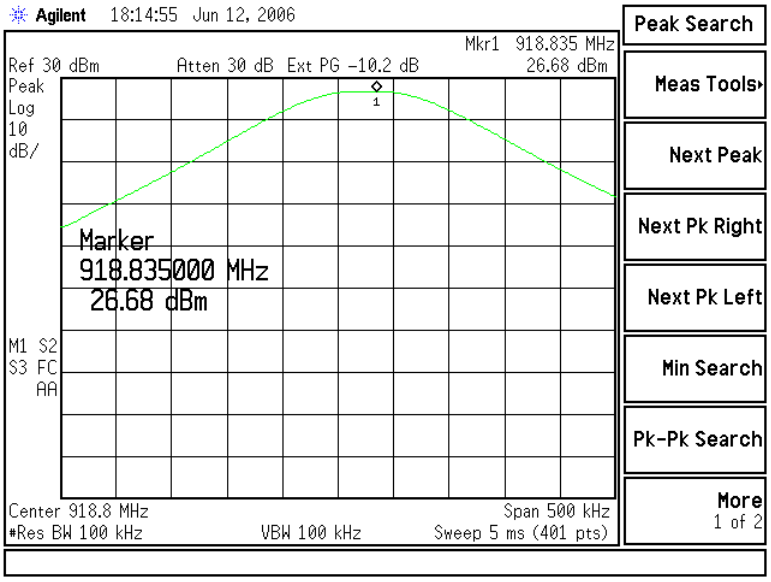
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	3 Hz To 44 GHz

9.4 Screen Captures – Power Output (Conducted)

Channel 01



Channel 25



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

Channel 50

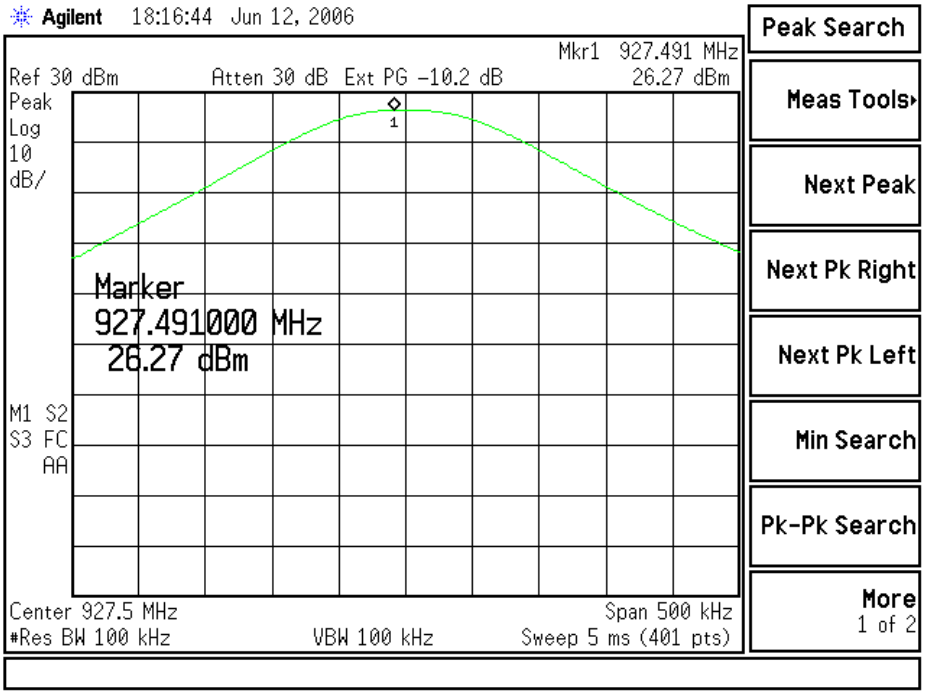


EXHIBIT 10. CHANNEL OCCUPANCY

10.1 Test Setup & Procedure

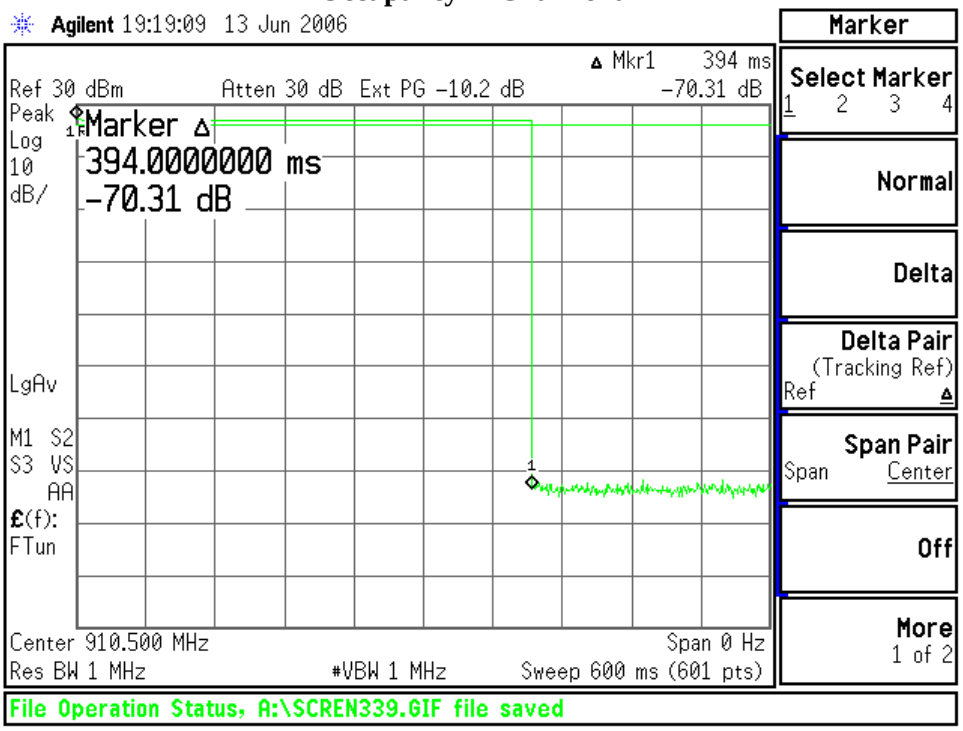
Part 15.247(a)(1)(i) requires a channel occupancy, for this device, of no more than 400 milliseconds in a 10 second period if utilizing between 25 and 50 channels, or in a 20 second period if utilizing 50 or more channels. The channel occupancy for this EUT was measured using an HP E4407B spectrum analyzer, set to zero-span at the frequency of interest. With the analyzer in peak-hold mode, the transmission lengths can be measured by adjusting the sweep rate of the analyzer. A suitable sweep rate was used to measure the channel occupancy at the low, mid and high channels. The longest time any transmission will occur on a single channel is 394 ms. With a total of 50 channels used, each occupying a 394 ms slot, it will take 19.4 seconds for the sequence to repeat. In a 20 second window, each channel would have 1.03 transmission cycles. The maximum occupancy in a 20 second window is calculated by multiplying the 1.03 transmission cycles by 394 ms transmission duration per cycle, to arrive at 400 ms total occupancy.

10.2 Test Data

Channel	Frequency (MHz)	Occupancy Per transmission (ms)	Occupancy in 20 second window (ms)
01	910.5	394.0	394.0
25	918.8	394.0	394.0
50	927.5	394.0	394.0

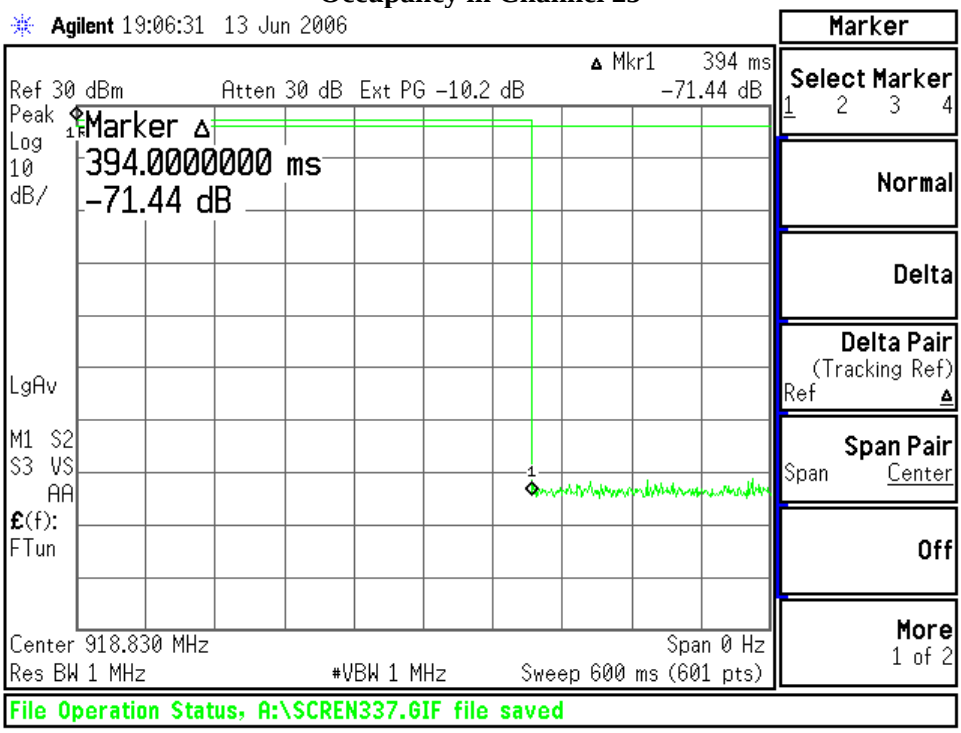
10.3 Plots of Channel Occupancy

Occupancy in Channel 01

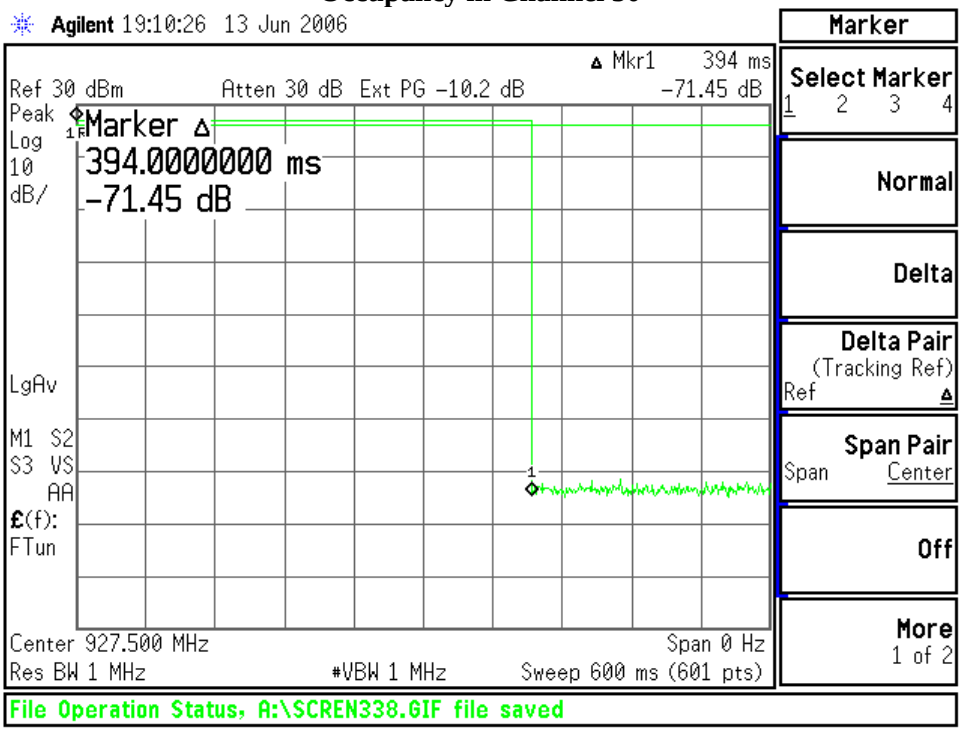


Plots of Channel Occupancy-*continued*

Occupancy in Channel 25

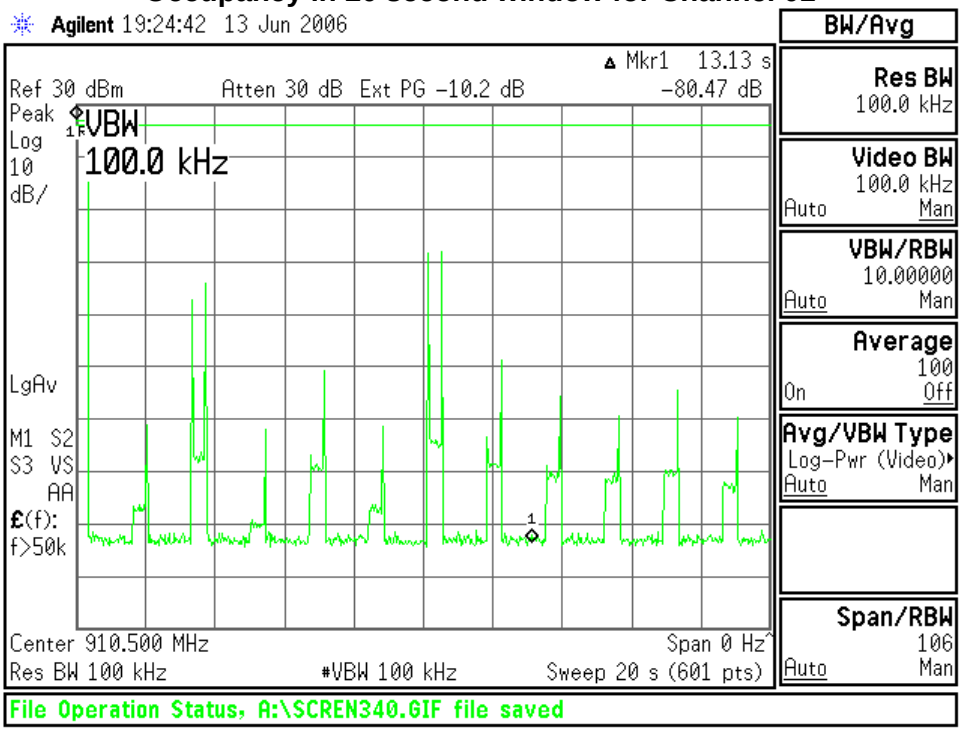


Occupancy in Channel 50

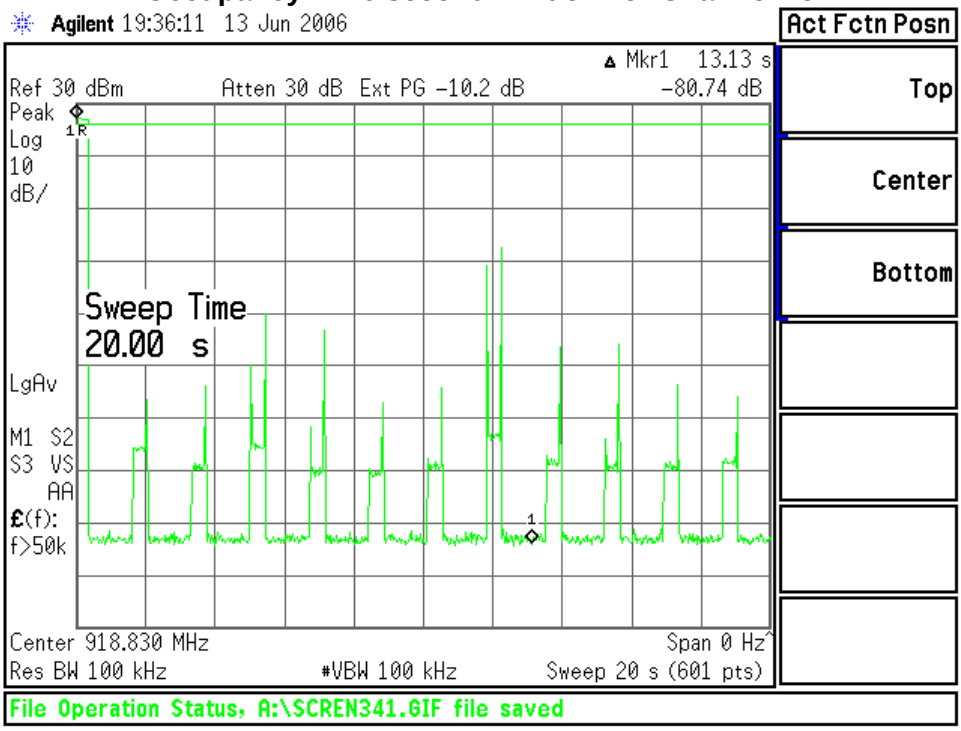


Plots of Channel Occupancy-*continued*

Occupancy in 20 second window for Channel 01



Occupancy in 20 second window for Channel 25



Plots of Channel Occupancy-*continued*

Occupancy in 20 second window for channel 50

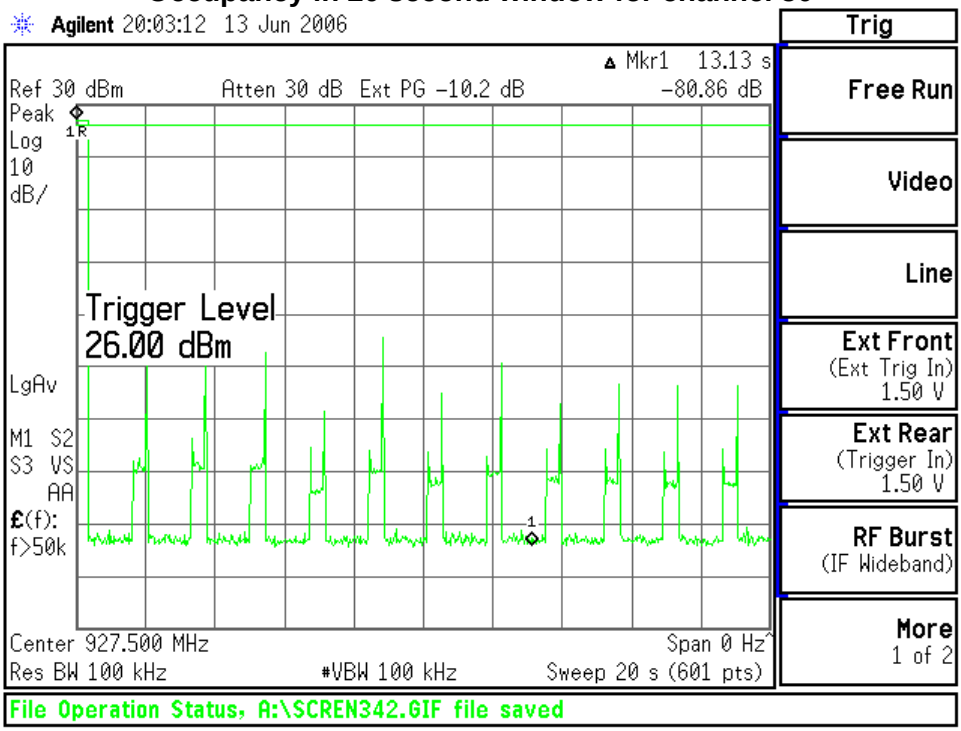


EXHIBIT 11. SPURIOUS EMISSIONS: 15.247(d)

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

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 (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

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

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

	Channel 01	Channel 25	Channel 50
Fundamental	+ 26.3 (dBm)	+ 26.5 (dBm)	+ 26.3 (dBm)
2nd Harmonic	- 37.1 (dBm)	- 36.8 (dBm)	- 37.6 (dBm)
3rd Harmonic	- 38.1 (dBm)	- 39.7 (dBm)	- 40.3 (dBm)
4th Harmonic	- 39.1 (dBm)	- 39.2 (dBm)	- 39.3 (dBm)
5th Harmonic	- 39.9 (dBm)	- 40.2 (dBm)	- 40.5 (dBm)
6th Harmonic	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)

Notes:
(1) Measurement at system noise floor.

11.2 Test Equipment List

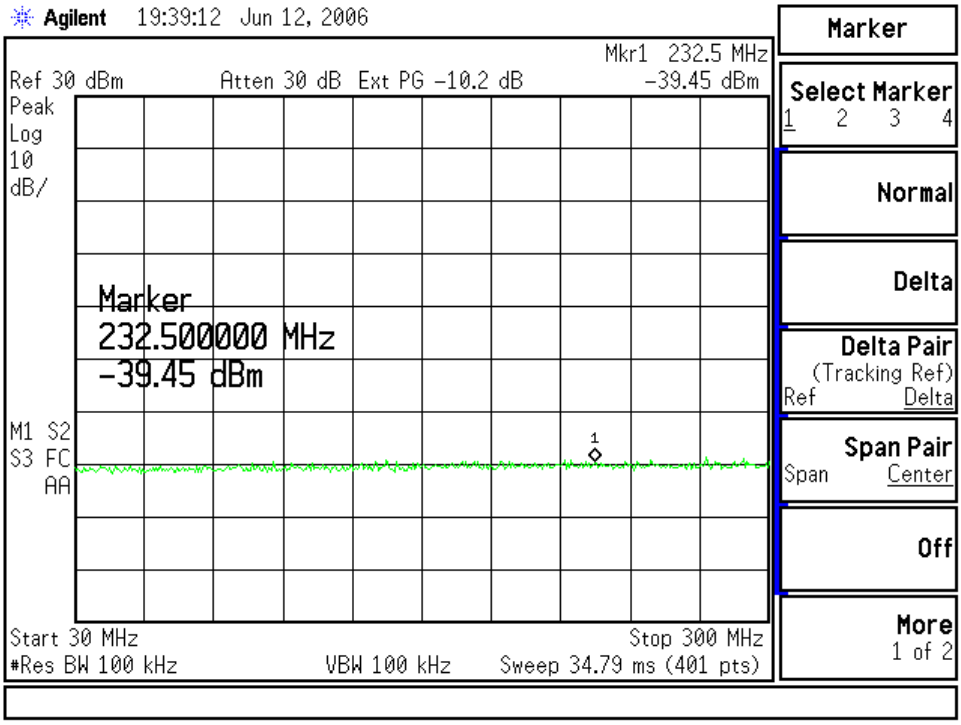
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	3 Hz To 44 GHz

11.3 Spurs other than Harmonics

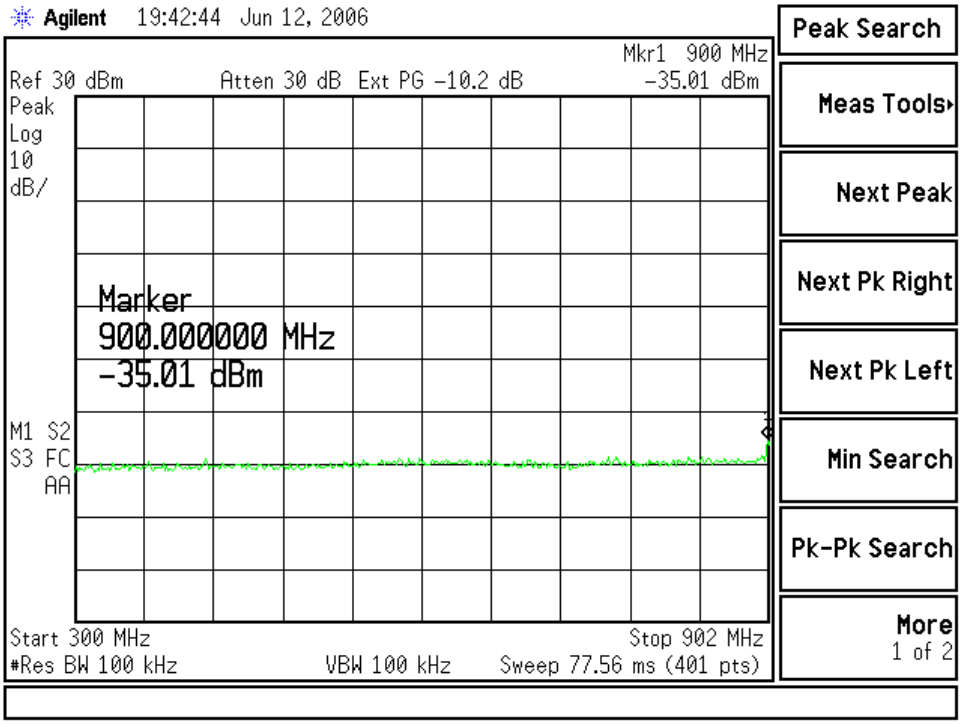
Frequency (MHz)	Measured (dBm)	Channel
212.9	-37.1	01
900.0	-35.0	01
906.8	-34.4	01
914.2	-33.9	01
928.0	-20.1	50
931.6	-35.3	50
2990.0	-35.4	50
7490.0	-37.3	50

11.4 Screen Captures – Spurious Radiated Emissions

Channel 01, shown from 30 MHz up to 300 MHz

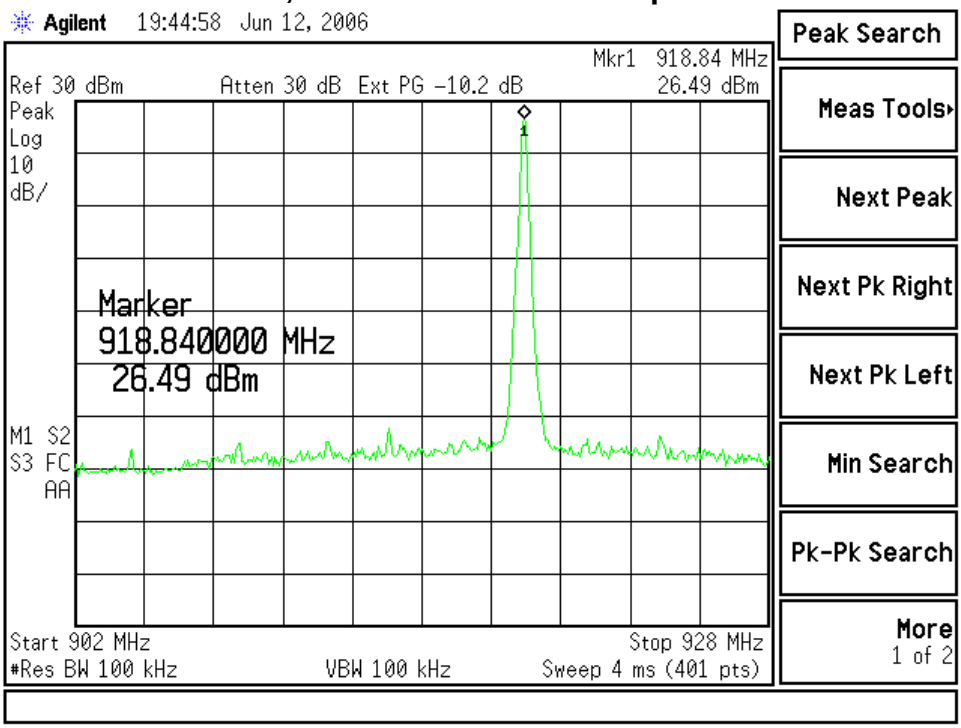


Channel 01 shown from 300 MHz up to 902 MHz

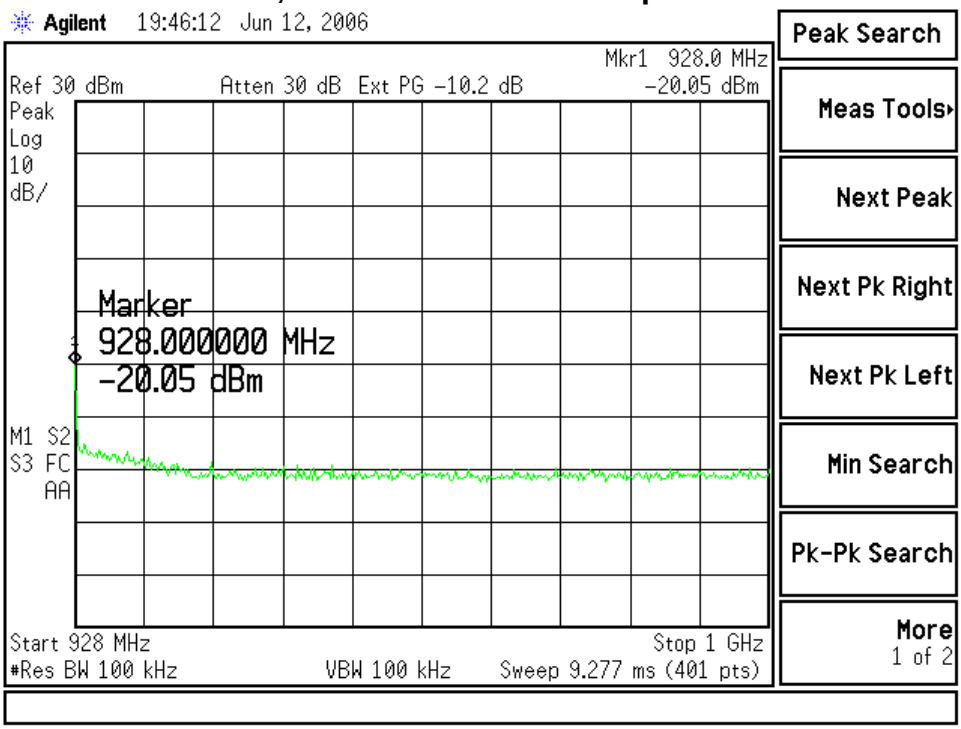


Screen Captures – Spurious Radiated Emissions-*continued*

Channel 25, shown from 902 MHz up to 928 MHz

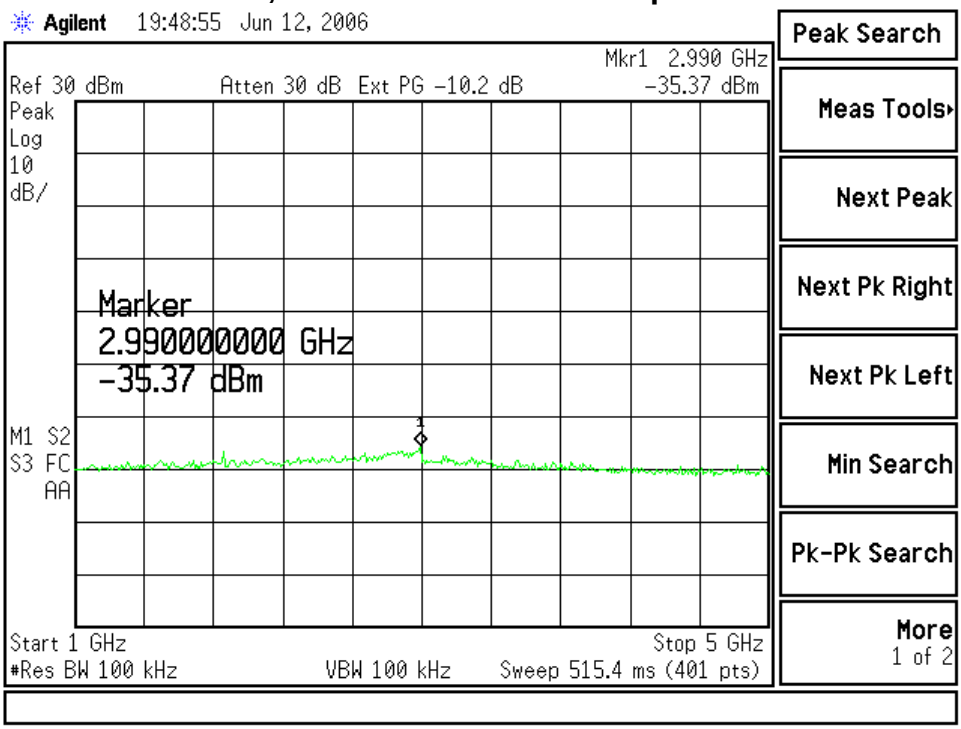


Channel 50, shown from 928 MHz up to 1000 MHz



Screen Captures – Spurious Radiated Emissions-*continued*

Channel 50, shown from 1000 MHz up to 5000 MHz



Channel 50, shown from 5000 MHz up to 10000 MHz

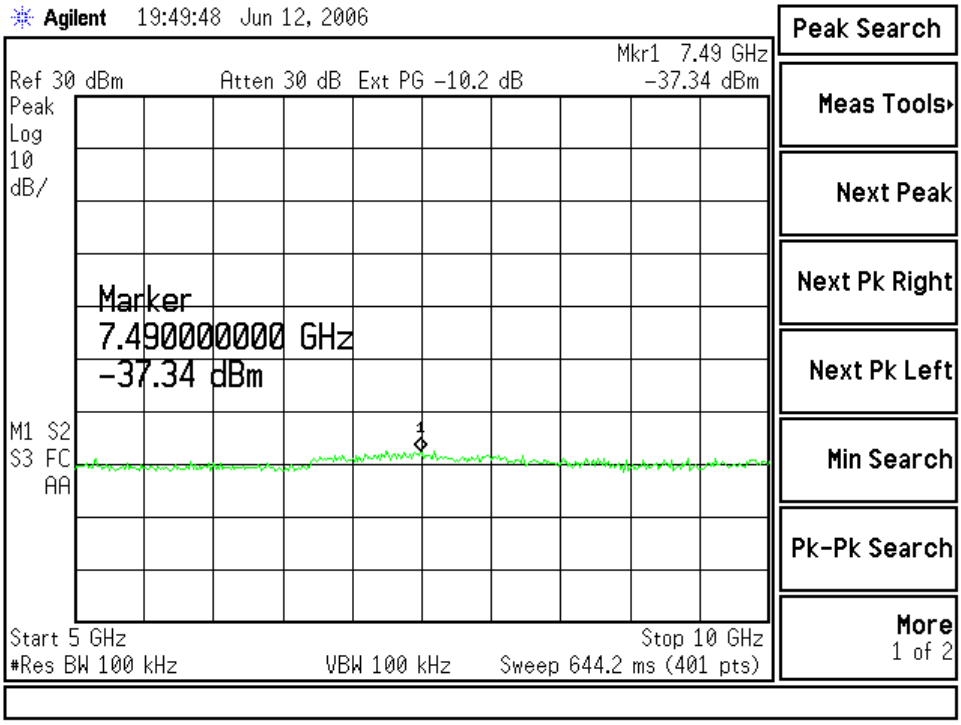


EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE .

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

In this test, the EUT was supplied with power using a bench DC power supply, even though in normal operation the EUT would run off an AC supply. The reason for this modification is because the EUT cannot be set in continuous transmit mode if it were supplied power through the AC mains.

A spectrum analyzer was used to measure the frequency at the appropriate frequency markers. For this test, the EUT was placed in continuous transmit CW mode. Power to the EUT was supplied by an external bench-type variable power supply. The frequency of operation was monitored using the spectrum analyzer with RBW=VBW=100 kHz settings while the voltage was varied.

	DC Voltage Source		
	3.06 VDC	3.6 VDC	4.14 VDC
Channel 01	910.5 (MHz)	910.5 (MHz)	910.5 (MHz)
Channel 25	918.8 (MHz)	918.8 (MHz)	918.8 (MHz)
Channel 50	927.5 (MHz)	927.5 (MHz)	927.5 (MHz)

The RF Power Output of the EUT was also monitored in a separate test, also using a Spectrum Analyzer with RBW=VBW=100 kHz setting while the voltage was varied.

	DC/AC Voltage Source		
	3.06 VDC	3.6 VDC	4.14 VDC
Channel 01	24.6 (dBm)	26.3 (dBm)	26.9 (dBm)
Channel 25	24.8 (dBm)	26.7 (dBm)	27.0 (dBm)
Channel 50	24.4 (dBm)	26.3 (dBm)	26.8 (dBm)

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

No anomalies were noted in the measured transmit power, varying less than 2 dB, during the voltage variation tests. FCC requires that conducted power not exceed the limit when voltage is varied.

EXHIBIT 13. CHANNEL PLAN AND SEPARATION

An HP E4407B spectrum analyzer was used with a resolution bandwidth of 30 kHz to measure the channel separation of the EUT.

The minimum and maximum channel-separations measured for this device are 347 kHz and 350 kHz respectively. The maximum occupied bandwidth of the device, as reported in the previous section is 59 kHz. The following plots describe this spacing, and also establish the channel separation and plan.

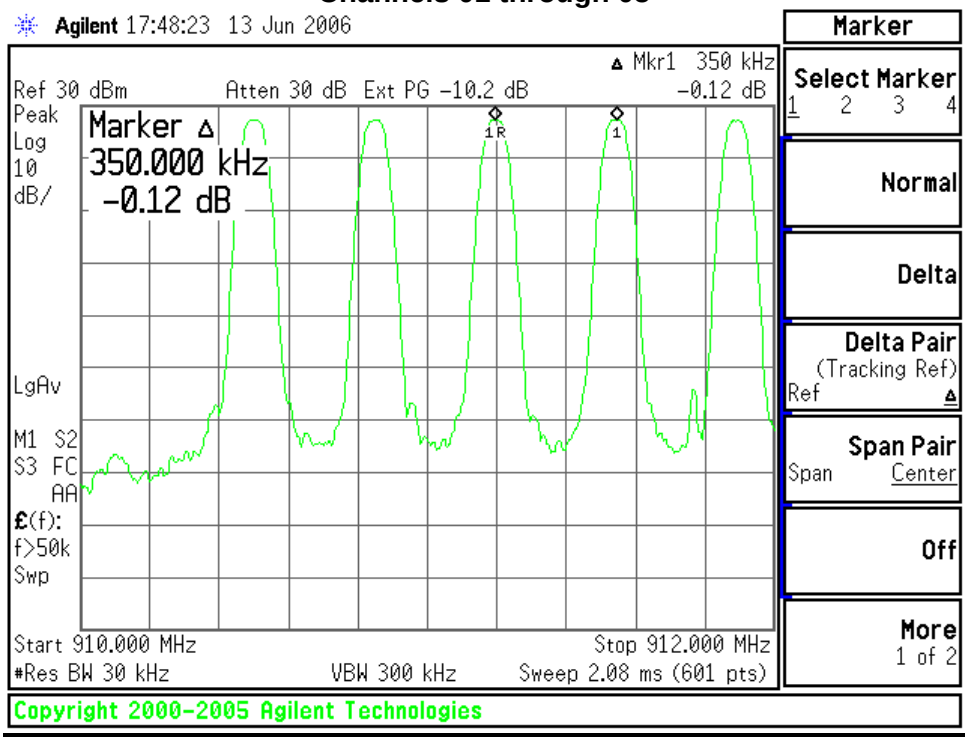
13.1 Test Data

Frequency Span	Number of Channels	Minimum Separation (kHz)
910 to 912 MHz	5	350
912 to 914 MHz	6	350
914 to 916 MHz	6	350
916 to 918 MHz	5	348
918 to 920 MHz	6	350
920 to 922 MHz	6	350
922 to 924 MHz	5	347
924 to 926 MHz	6	350
926 to 928 MHz	5	350
Total	**50 channels**	

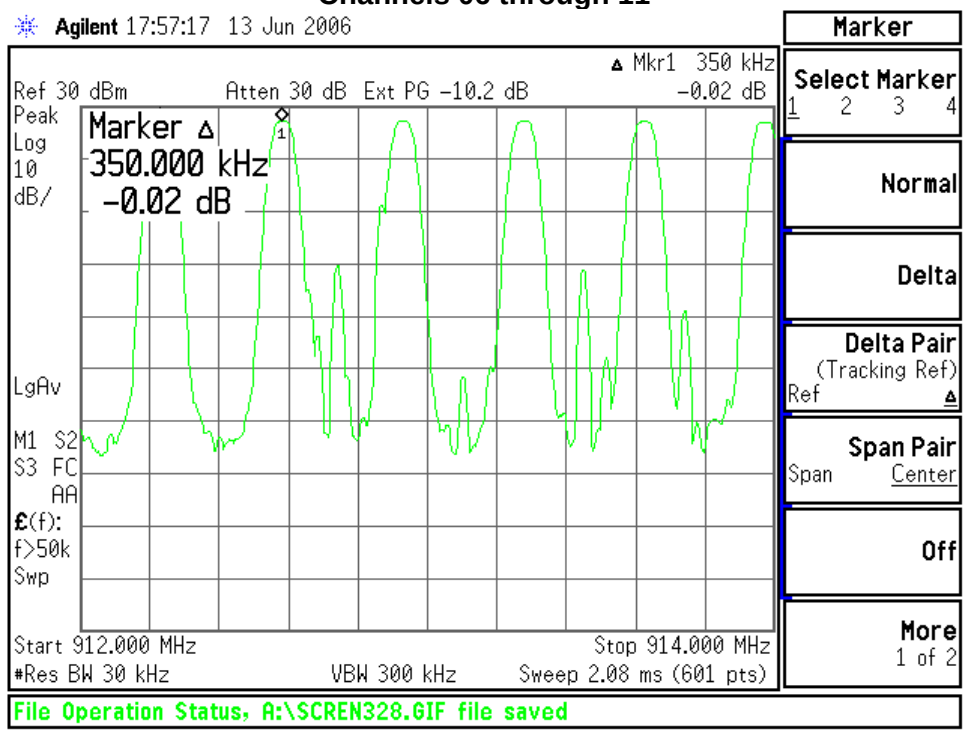
The system **MEETS** the minimum requirement of utilizing the following channels, as well as maintaining a minimum channel separation of 347 kHz, which is greater than the -20 dBc OCCBW of 59 kHz. Since the -20 dBc OCCBW is less than 250kHz, FCC requires a minimum of 50 channels, which is the case for this EUT.

13.2 Screen Captures – Channel Separation

Channels 01 through 05

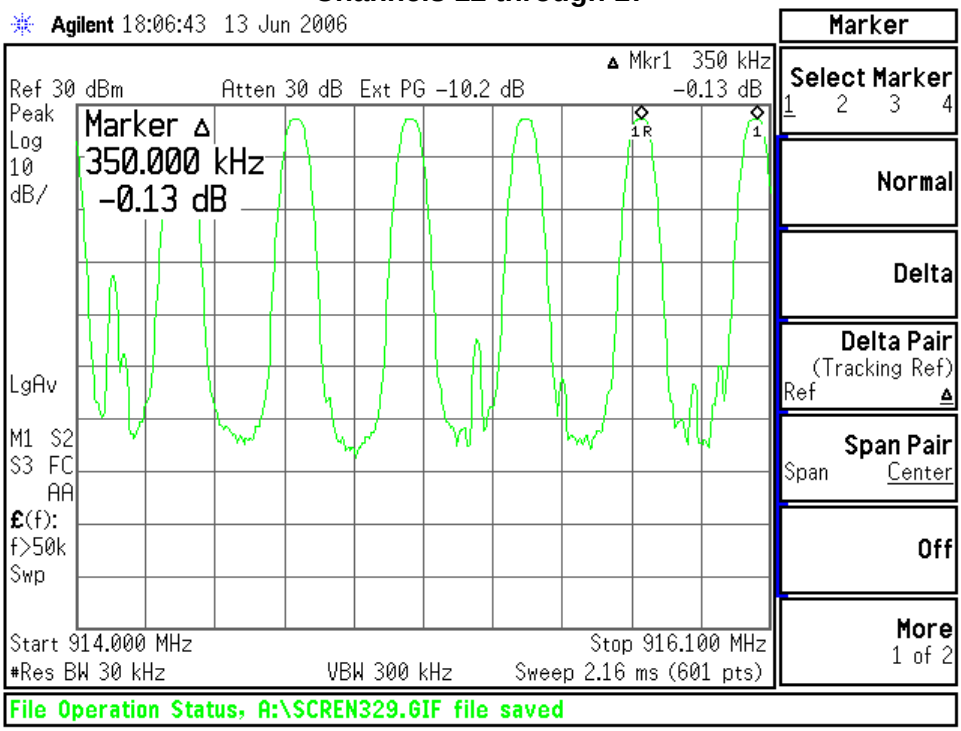


Channels 06 through 11

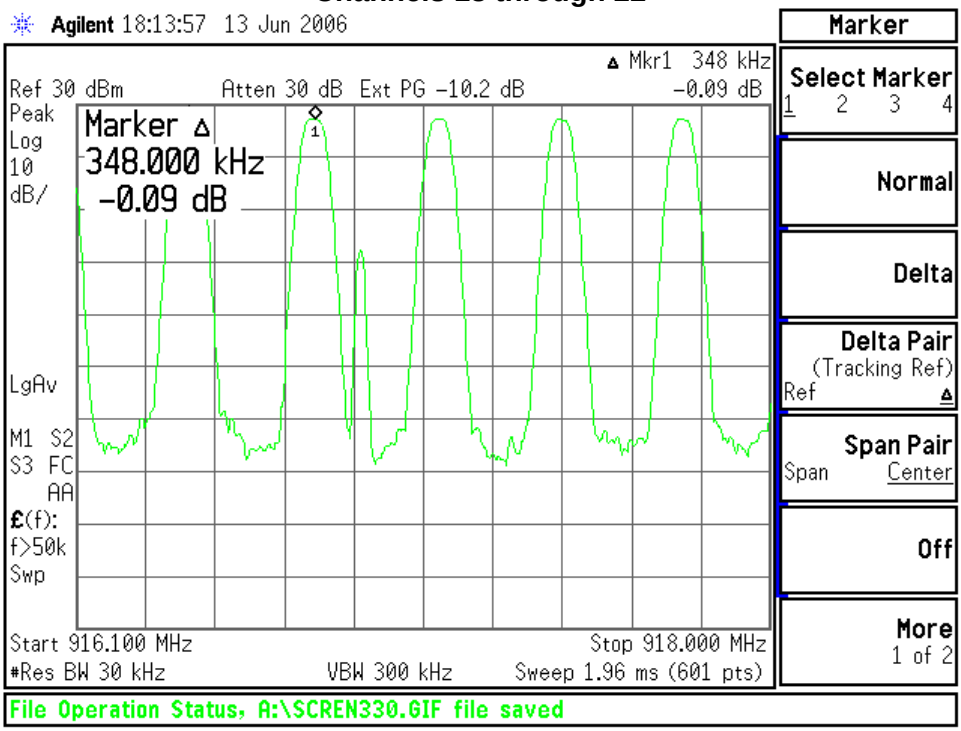


Screen Captures – Channel Separation *(continued)*

Channels 12 through 17

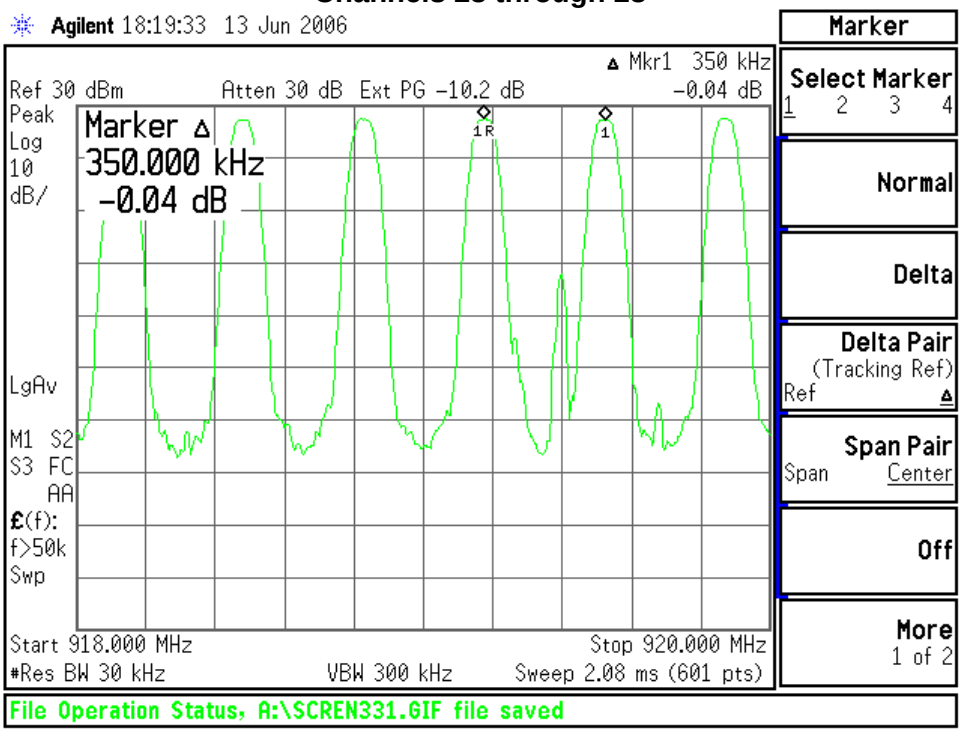


Channels 18 through 22

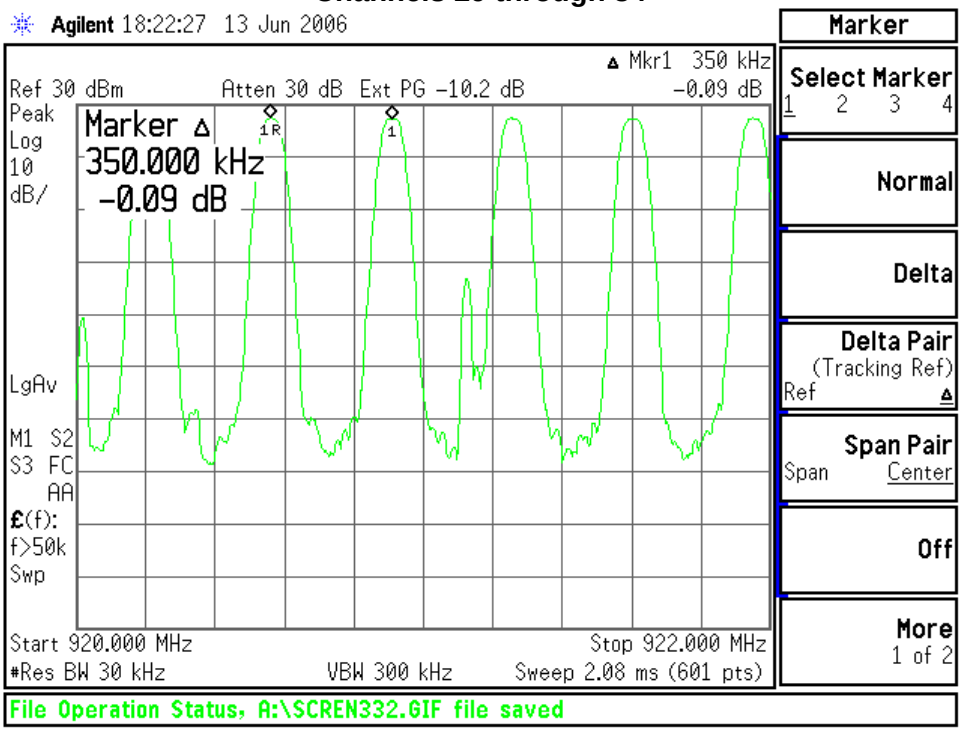


Screen Captures – Channel Separation *(continued)*

Channels 23 through 28

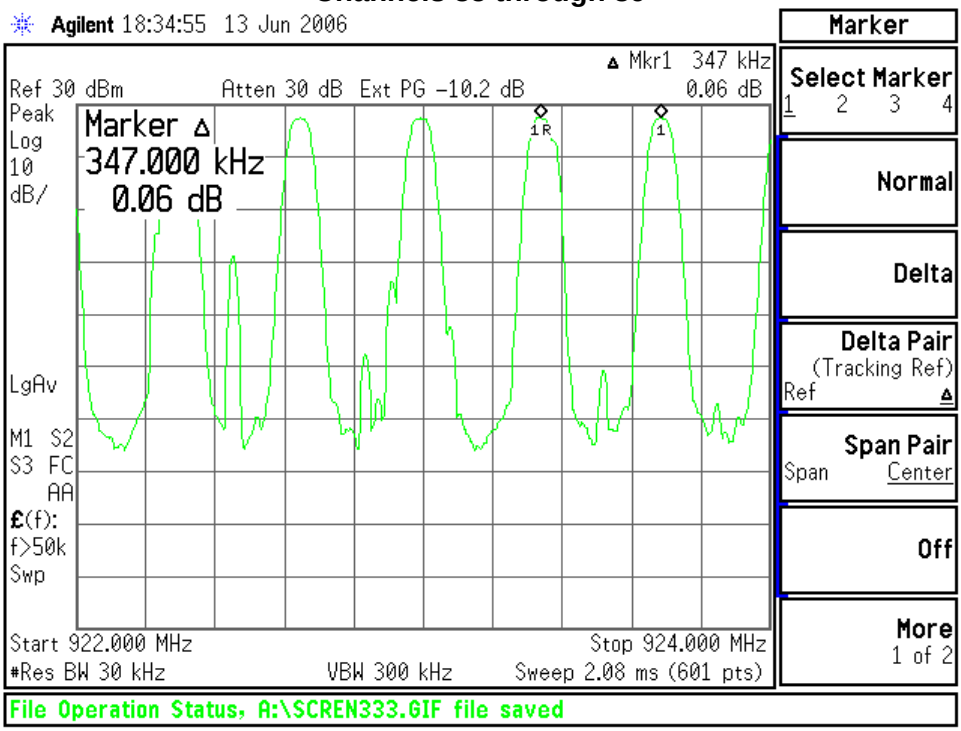


Channels 29 through 34

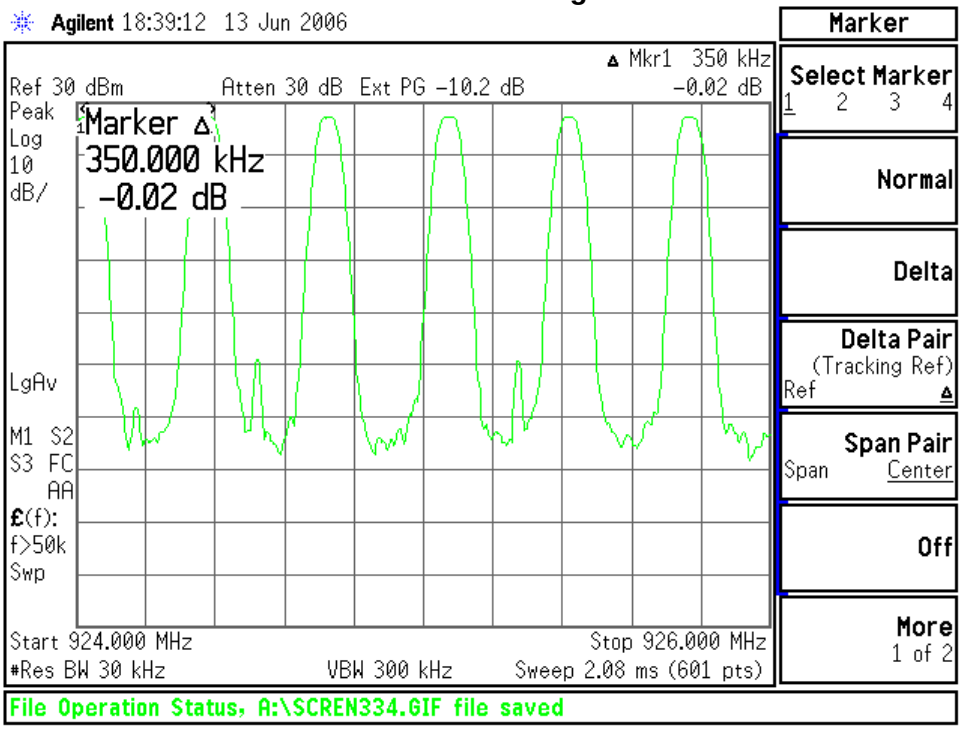


Screen Captures – Channel Separation *(continued)*

Channels 35 through 39



Channels 40 through 45



Screen Captures – Channel Separation *(continued)*

Channels 46 through 50

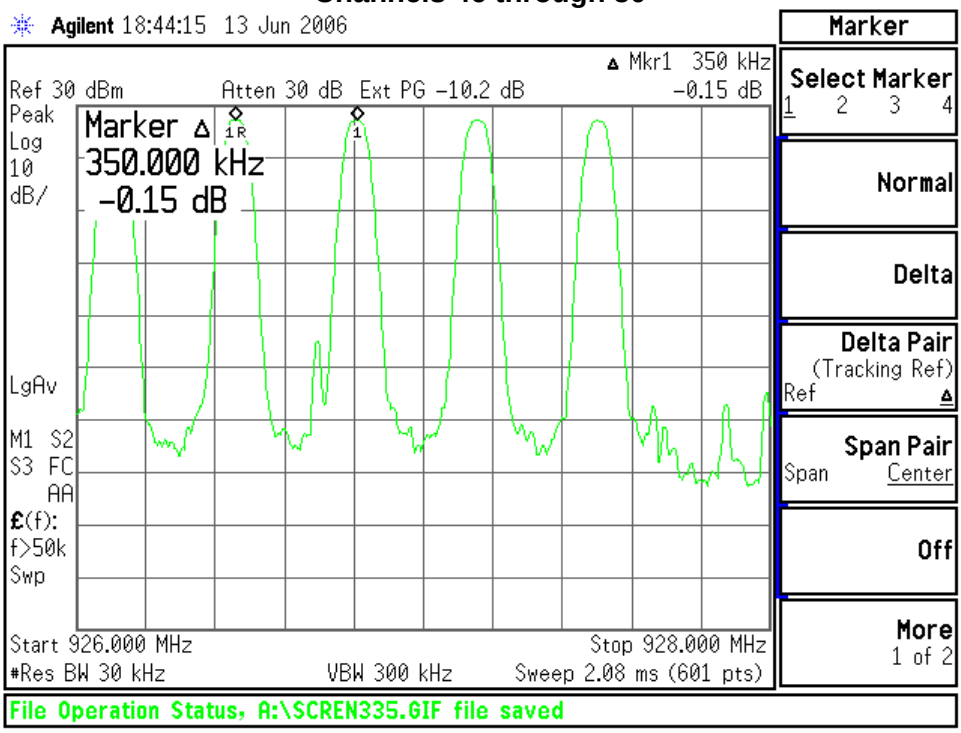


EXHIBIT 14. EQUAL CHANNEL USAGE

The 50 channels are arrayed in a table which the system uses to determine the next hopping channel. Each time a transmission is made the system uses the next frequency in the table. The table is started over once the end has been reached. Thus, any given frequency will not be reused until all other frequencies have been accessed. This also addresses part 15.247(g) concerns. The following table shows the channel separation between each channel from 910.5 MHZ to 927.5 MHz.

Channel	Frequency	Separation
0	910.500000	-
29	910.846938	0.347
12	911.193876	0.347
41	911.540814	0.347
31	911.887752	0.347
24	912.234690	0.347
17	912.581628	0.347
46	912.928566	0.347
42	913.275504	0.347
38	913.622442	0.347
11	913.969380	0.347
43	914.316318	0.347
36	914.663256	0.347
25	915.010194	0.347
16	915.357132	0.347
3	915.704070	0.347
5	916.051008	0.347
19	916.397946	0.347
8	916.744884	0.347
9	917.091822	0.347
49	917.438760	0.347
21	917.785698	0.347
6	918.132636	0.347
1	918.479574	0.347
2	918.826512	0.347
20	919.173450	0.347
27	919.520388	0.347
30	919.867326	0.347
32	920.214264	0.347
33	920.561202	0.347
10	920.908140	0.347
35	921.255078	0.347
22	921.602016	0.347
18	921.948954	0.347
4	922.295892	0.347
34	922.642830	0.347
39	922.989768	0.347
40	923.336706	0.347
26	923.683644	0.347
15	924.030582	0.347
45	924.377520	0.347
37	924.724458	0.347
48	925.071396	0.347
47	925.418334	0.347
28	925.765272	0.347
7	926.112210	0.347
23	926.459148	0.347
14	926.806086	0.347
44	927.153024	0.347
13	927.499962	0.347

EXHIBIT 15. PSEUDORANDOM HOPPING PATTERN

The hopping patterns were chosen to maintain uniform usage of the spectrum, while maintaining the pseudorandom nature of the channels. The following table addresses part 15.247(h) concerns.

Channel	Frequency
0	910.500000
1	918.479574
2	918.826512
3	915.704070
4	922.295892
5	916.051008
6	918.132636
7	926.112210
8	916.744884
9	917.091822
10	920.908140
11	913.969380
12	911.193876
13	927.499962
14	926.806086
15	924.030582
16	915.357132
17	912.581628
18	921.948954
19	916.397946
20	919.173450
21	917.785698
22	921.602016
23	926.459148
24	912.234690
25	915.010194
26	923.683644

(Pseudorandom Hopping Pattern - table continued from previous page)

Channel	Frequency
27	919.520388
28	925.765272
29	910.846938
30	919.867326
31	911.887752
32	920.214264
33	920.561202
34	922.642830
35	921.255078
36	914.663256
37	924.724458
38	913.622442
39	922.989768
40	923.336706
41	911.540814
42	913.275504
43	914.316318
44	927.153024
45	924.377520
46	912.928566
47	925.418334
48	925.071396
49	917.438760

EXHIBIT 16. MPE CALCULATIONS

The following MPE calculations are based on an inverted-F printed circuit board trace antenna, with a 56mm straight section, and18 mm away from the ground plane. The measured ERP of the EUT was 124.4 dBµV/m at 3 meters, and conducted RF power of +26.7 dBm as presented to the antenna. The calculated gain of this antenna, based on the ERP measurements is 2.5 dB.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density

P = power input to the antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	26.70	(dBm)
Maximum peak output power at antenna input terminal:	467.735	(mW)
Antenna gain(typical):	2.5	(dBi)
Maximum antenna gain:	1.778	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	915	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.62	(mW/cm^2)
Power density at prediction frequency:	0.165474	(mW/cm^2)
Maximum allowable antenna gain:	8.2	(dBi)
Margin of Compliance at 20 cm =	5.7	dB

APPENDIX A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	9/27/05	9/27/06
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/27/05	9/27/06
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/27/05	9/27/06
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	12/07/05	12/07/06
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	12/29/05	12/29/06
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/29/05	9/29/06
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/29/05	9/29/06
EE960073	Agilent	E4446A	US45300564	Spectrum Analyzer	2/01/06	2/01/07
N/A	LSC	Cable	0011	3 Meter ½" Armored Cable	Note 1	Note 1
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	Note 1	Note 1
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1

Note 1 - Equipment calibrated within a traceable system.

Uncertainty Statement

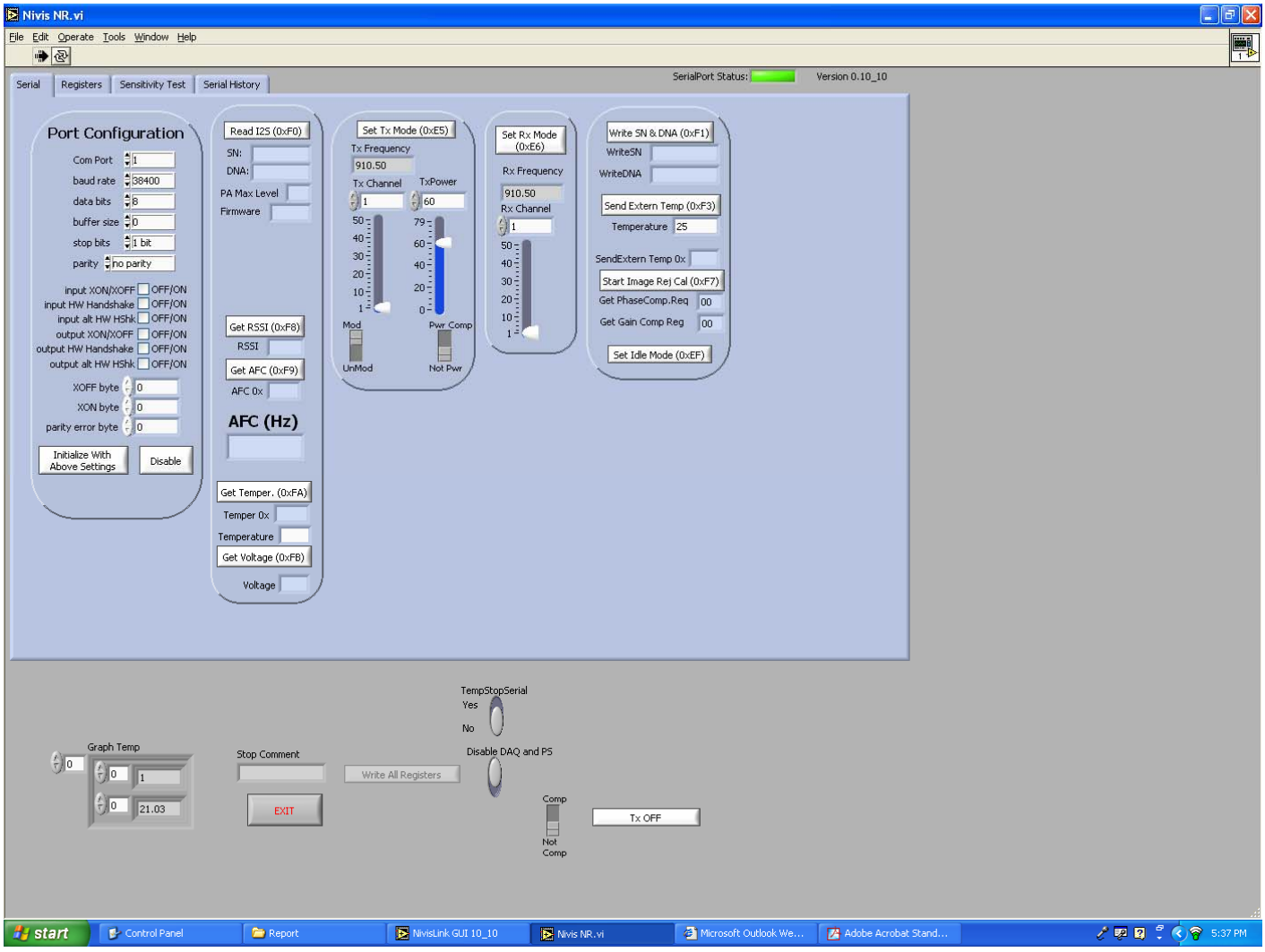
This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

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 B

GUI setting for continuous transmit mode.



GUI setting for Hop Mode.