LS Research, LLC
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

ENGINEERING TEST REPORT # 307402.1 TX_4

Compliance Testing of:
Trilliant 1 watt module with dipole antenna

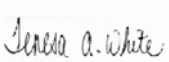
Test Date(s):
November 15th – 28th 2007

Prepared For:
Trilliant Networks, Inc.
Attn.: Mr. Bob Fischette
1100 Island Drive, Sutie 201
Redwood City, CA 94065

In accordance with:
Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Transmitters (DTS) Operating in the
Frequency Band 2400 MHz – 2483.5 MHz

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

Signature:  Date: December 3, 2007

Test Report Prepared by:	**Tested by:**
Teresa A. White, Document Coordinator	Khairul Aidi Zainal, Senior EMC Engineer
Signature: 	Signature: 
Date: December 3, 2007	Date: December 3, 2007

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LSC Revision Control

Date	Revision #	Revised By
9-06-06	2.0	AS/TAW

EXHIBIT 1. INTRODUCTION

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 2400 MHz – 2483.5 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
47 CFR, Parts 0-15 (FCC)	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:	**Trilliant Networks**
Address:	**11000 Island Drive, Suite 201** **Redwood City, CA 94065**
Contact Person:	**Bob Fischette, Director-Wireless Products**

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	1 Watt Module
Model Number:	EM-0038B
Serial Number:	n/a

2.3 ASSOCIATED ANTENNA DESCRIPTION

The antenna used was a Centurion WCR2400 half wave coaxial dipole antenna with reverse SMA connector. The gain of the antenna is listed as 2.0 dBi with a nominal impedance of 50Ω and capable of handling up to 50 watts.

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Frequency Range (in MHz)	2400 MHz to 2483.5 MHz
RF Power in Watts	1.00 watt
Conducted Output Power (in dBm)	30.0 dBm at 2440MHz
Field Strength (and at what distance)	138.0 dBµV/m at 1m (2440MHz)
Occupied Bandwidth (20db/6dB)	2670 kHz/1620 kHz
Type of Modulation	16-ary O-QPSK, 62.5 Kcps
Emission Designator	FD12M67
EIRP (in mW)	2103 mW
Transmitter Spurious (worst case)	70.9 dBµV/m at 1m on channel 15 (Full Power instead of reduced power)
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Microprocessor Model # (if applicable)	Freescale MC13213
Antenna Information	
Detachable/non-detachable	Detachable with reverse sma connectors.
Type	Sleeve Dipole
Gain (in dBi)	3.2 dBi (calculated from measurements) 2.0 dBi (From data sheet)
EUT will be operated under FCC Rule Part(s)	CFR 47 15.247 RSS 210
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: CFR 47-15.247,RSS 210
- Measurement Distance: 1 m
- RF Value: 7.94 ☒ V/m ☐ A/m ☐ W/m^2
  ☒ Measured ☐ Computed ☐ Calculated

2.5 PRODUCT DESCRIPTION

The Trilliant Networks radio module is a direct sequence spread spectrum transceiver operating in the 2400 – 2483.5 MHz ISM band. The system is based on the IEEE 802.15.4 standard with channels spaced at 5 MHz intervals in the ISM band. The system operates at a chip rate of 2 Mcps, a symbol rate of 62.5 ksps, and a bit rate of 250kbps. O-QPSK modulation is used with 16-ary orthogonal symbols. The module transmits with a maximum power of 1 Watt (+30 dBm) into a printed circuit board trace L antenna or an external Centurion whip antenna through a U.FL connector.

The receiver is a low-IF receiver. The received RF signal is amplified by a low noise amplifier and down-converted to a 1st IF of 65MHz and then down-converted in quadrature (I and Q) to the intermediate frequency (IF) of 1 MHz. The digital back end performs Differential Chip Detection, the correlator de-spreads the Direct Sequence Spread Spectrum O-QPSK signal, determines the symbols and packets, and detects the data.

Each module has a Personal Area Network (PAN) ID used to establish a network of transceivers. Only devices with the same PAN ID can communicate with one another. The Trilliant Networks module runs a proprietary protocol to be used with the operation of electric meters.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	71º Fahrenheit
Humidity:	40%
Pressure:	753 mmHg

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)(2)	6 dB Bandwidth of a Digital Modulation 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	Yes
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)

The module was operated in reduced power setting on several channels:

Channel	Power Setting
0 (2405MHz)	7
1 (2410MHz)	13
7 (2440MHz)	13
11(2460MHz)	13
12(2465MHz)	11
13(2470MHz)	7
14(2475MHz)	5
15(2480MHz)	0

The maximum power setting possible for the module is 15, however the manufacturer will set the maximum at 13 by means of firmware. The end user will not have access to power control and thus will limit the maximum power setting at 13. Power settings as listed above will be set by the manufacturer in the final product.

Note: Power level 13 will hence be called full power in the remainder of this report.

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☐ None ☒ Yes (explain below)

1. **A 20 dB relaxation factor is used when comparing emissions to the limits due to the transmission nature of the module. Justification and request for relaxation is included in the report in Appendix D.**
2. **Although the fundamental and the band edge measurements were made on 8 channels, the harmonics measurements were made on the lowest, medium and highest channel at full power (instead of reduced power on the lowest and highest channel). Based on sound engineering principles, it would be valid to conclude that if the harmonics on the lowest and highest channels operating at full power are below the limit, the harmonics of the remaining channels operating at reduced power levels will also.**

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 8.2) for a Digital Spread Spectrum (DTS) Transmitter.

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

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

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous modulated transmit mode for final testing using power as provided by a standard bench DC supply. The unit has the capability to operate on 8 channels, controllable via Metrowerks Code warrior development software installed on a laptop PC.

The applicable limits apply at a 3 meter distance. Measurements above 5 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 (8) standard channels: 0(2405MHz), 1(2410MHz), 7 (2440MHz), 11 (2460MHz), 12(2465MHz), 13(2470MHz), 14(2475MHz), 15(2480MHz), to comply with FCC Part 15.35. The channels and operating modes were changed using Metrowerks Code warrior development software installed 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 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. From 18 GHz to 25 GHz, the EUT was measured at a 0.3 meter separation, using a standard gain Horn Antenna and pre-amplifier.

The EUT was rotated along three orthogonal axes with the antenna in two antenna configuration (straight and 90 degree bend) 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 From 1 GHz to 18 GHz, an HP E4446A Spectrum Analyzer and an EMCO Horn Antenna were used. From 18 GHz to 25 GHz, the HP E4407B Spectrum Analyzer with a standard gain horn, and preamp were used.

Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for a DTS transmitter [Canada RSS-210 (2005), Annex 8 (section 8.2). The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

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 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), 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	-
960-24,000	500	54.0	63.5

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

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

= 40 dBμV/m (from 30-88 MHz)

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

960 MHz to 10,000 MHz

500μV/m or 54.0 dB/μV/m at 3 meters

54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

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

960 MHz to 10,000 MHz

500μV/m or 54.0 dB/μV/m at 3 meters

54.0 + 20 = 74 dB/μV/m at 0.3 meters

5.6 RADIATED EMISSIONS DATA CHART

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.205 and 15.247(DTS)
Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	Trilliant Networks						
Date(s) of Test:	November 15th – 28th 2007						
Test Engineer(s):	Khairul Aidi Zainal						
Voltage:	3.3 VDC						
Operation Mode:	continuous transmit, modulated						
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %						
EUT Power:		Single Phase ___VAC		3 Phase ___VAC			
		Battery	√	Other: Bench 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 (Measurements above 1GHz)	√	Quasi-Peak (Measurements below 1GHz)		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)
320	H/HS	15	1.00	133	35.8	46.0	10.2
352	H/HS	7	1.00	146	37.4	46.0	8.6
368	H/HS	0	1.00	124	40.6	46.0	5.4
400	H/HS	0	1.00	159	39.9	46.0	6.1
408	H/HS	7	1.00	157	40.1	46.0	5.9
408	H/HS	15	1.00	157	40.3	46.0	5.7
416	H/HS	0	1.00	160	44.6	46.0	1.4
424	H/HS	7	1.00	157	43.1	46.0	2.9
424	H/HS	15	1.00	141	42.5	46.0	3.5
1000 Note 2	V/HB	0	1.00	14	40.2	46.0	5.8

Note:

1. *These spurious emissions are only present when the EUT is in transmit mode.*
2. *Measurement at this frequency was performed with RBW=120kHz with a QP detector.*
3. *Emissions below 1GHz were measured using a QP detector.*

RADIATED EMISSIONS DATA CHART *(continued)*

The following table depicts the level of radiated RF fundamental measured at a separation distance of 1 meter.

Frequency (MHz)	Ant./EUT Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Limit with relaxation (dBμV/m)	Margin (dB)
2405	V/HB	0	1.00	183	128.8	134.8	154.8	26.0
2410	V/HB	1	1.00	186	137.1	134.8	154.8	17.7
2440	V/HB	7	1.00	188	138.0	134.8	154.8	16.8
2460	V/HB	11	1.00	187	137.1	134.8	154.8	17.7
2465	V/HB	12	1.00	181	135.1	134.8	154.8	19.7
2470	V/HB	13	1.00	183	129.3	134.8	154.8	25.5
2475	V/HB	14	1.00	179	126.1	134.8	154.8	28.7
2480	V/HB	15	1.00	174	116.7	134.8	154.8	38.1

Notes:

1) A Peak Detector was used in measurements above 1 GHz. Only the results from the peak detector are published in the table above. The peak detector was used in order to apply the 20dB relaxation factor.
2) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.
3) A relaxation of the limit is invoked based on the average duty factor of the transmitter on-air-time. Justification appears in Appendix D. The limits have been recalculated and increased by 20 dB as justified by the averaging factor.

Naming convention for EUT and antenna configuration.

	Sense Antenna	EUT	EUT antenna (dipole)
H/HS	Horizontal	Horizontal	Straight
V/HS	Vertical	Horizontal	Straight
V/HB	Vertical	Horizontal	Bent
H/HB	Horizontal	Horizontal	Bent
H/VS	Horizontal	Vertical	Straight
V/VS	Vertical	Vertical	Straight
V/VB	Vertical	Vertical	Bent
H/VB	Horizontal	Vertical	Bent
H/SS	Horizontal	Side	Straight
V/SS	Vertical	Side	Straight
V/SB	Vertical	Side	Bent
H/SB	Horizontal	Side	Bent

The following table depicts the level of significant radiated harmonic emissions seen on Channel 0:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Limit with Relaxation (dBμV/m)	Margin (dB)
4810	H/HB	1.00	157	64.4	63.5	83.5	19.1
7215	H/HB	1.00	165	63.3	118.0	138.0	74.7
9620	V/VS	1.00	157	52.9	118.0	138.0	85.1
12025	V/VS	1.04	153	56.5	63.5	83.5	27
14430	V/HB	1.02	181	55.4	118.0	138.0	82.6
16835				Note 3			
19240				Note 3			
21645				Note 3			
24050				Note 3			

The following table depicts the level of significant radiated harmonic emissions seen on Channel 7:

Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Limit with Relaxation (dBμV/m)	Margin (dB)
4880	H/HB	1.18	132	65.8	63.5	83.5	17.7
7320	H/HB	1.00	153	59.9	63.5	83.5	23.6
9760	V/VS	1.00	134	53.8	118.0	138.0	84.2
12200	V/VS	1.23	210	54.7	63.5	83.5	28.8
14640	V/HB	1.00	257	53.7	118.0	138.0	84.3
17080				Note 3			
19520				Note 3			
21960				Note 3			
24400				Note 3			

The following table depicts the level of significant radiated harmonic emissions seen on Channel 15:

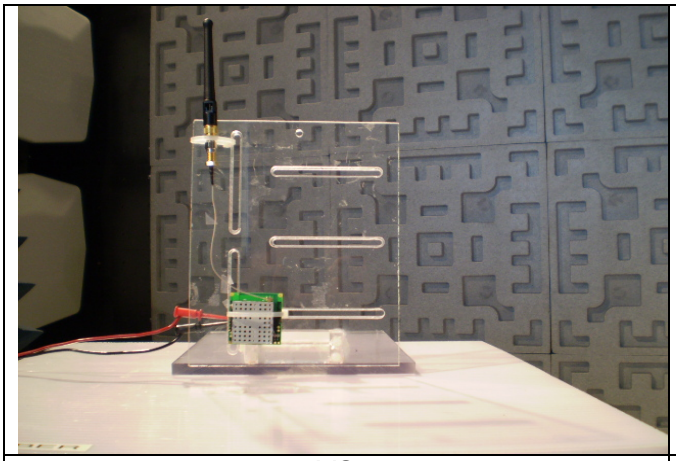
Frequency (MHz)	Ant./EUT Polarity	Height (meters)	Azimuth (0° - 360°)	Measured EFI (dBμV/m)	15.247 Limit (dBμV/m)	Limit with Relaxation (dBμV/m)	Margin (dB)
4960	H/HB	1.00	142	70.9	63.5	83.5	12.6
7440	H/HB	1.00	165	65.6	63.5	83.5	17.9
9920	V/VS	1.00	143	54.3	118.0	138.0	83.7
12400	V/VS	1.07	218	53.5	63.5	83.5	30
14880				Note 3			
17360				Note 3			
19840				Note 3			
22320				Note 3			
24800				Note 3			

Notes:

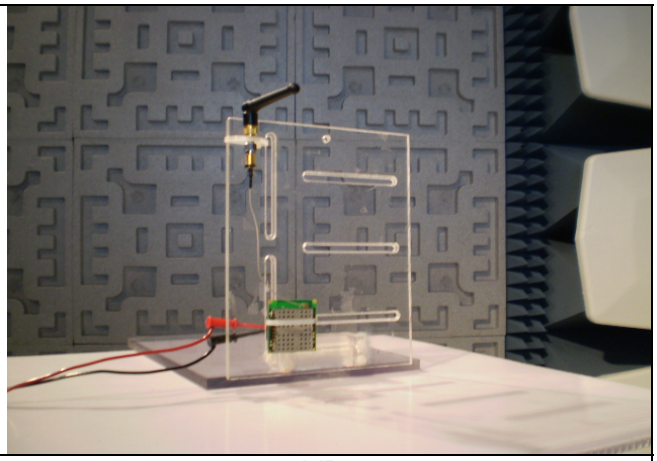
1) A Peak Detector was used in measurements above 1 GHz. Only the results from the peak detector are published in the table above. The peak detector was used in order to apply the 20dB relaxation factor.
2) Measurements above 4 GHz were made at 1 meters of separation from the EUT, and at 0.3 m separation for frequencies between 18 – 25 GHz.
3) Measurement at receiver system noise floor.
4) All measured channels were set at power level '13' (maximum operating power level) for measurements of harmonics, even though channel 0 and channel 15 operates on a reduced power level.
5) A relaxation of the limit is invoked based on the average duty factor of the transmitter on-air-time. Justification appears in Appendix D. The limits have been recalculated and increased by 20 dB as justified by the averaging factor.

5.7 Test Setup Photo(s) – Radiated Emissions Test

Vertical Orientation

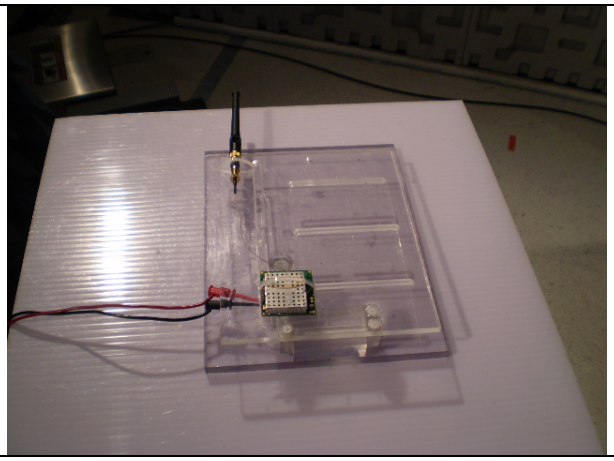


VS

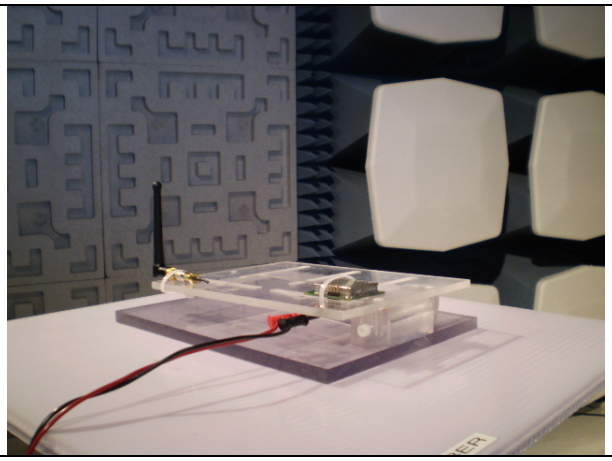


VB

Horizontal Orientation

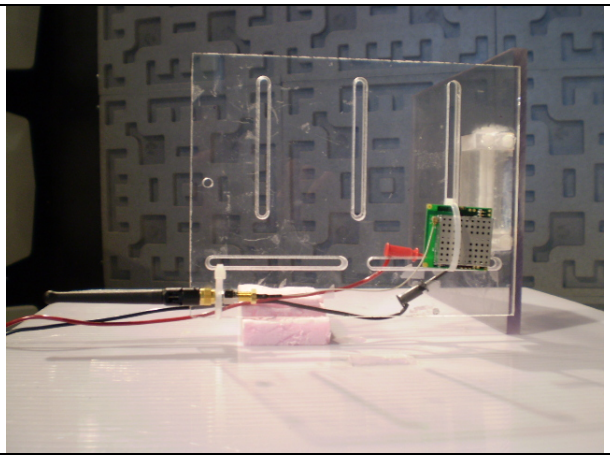


HS

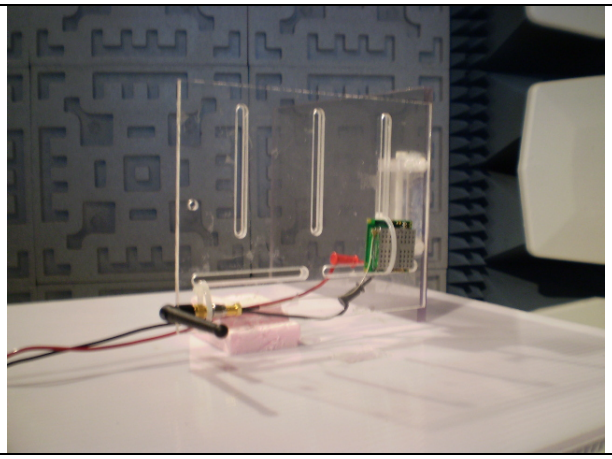


HB

Side Orientation



SS



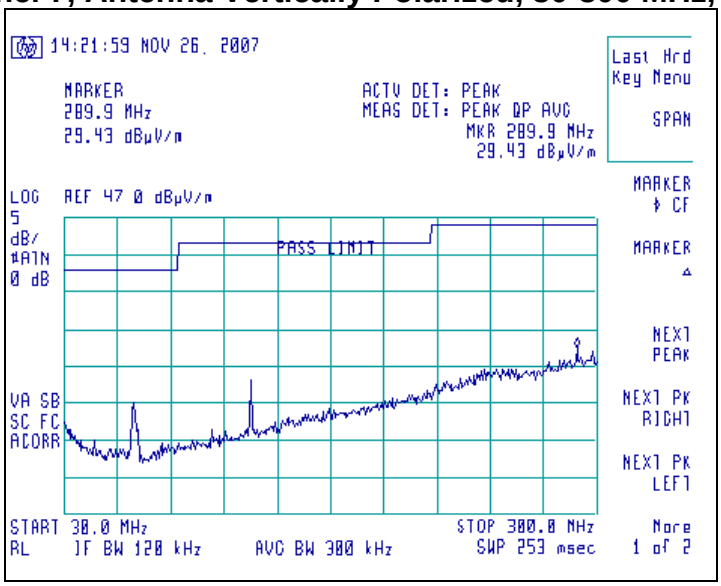
SB

5.8 Screen Captures - Radiated Emissions Testing

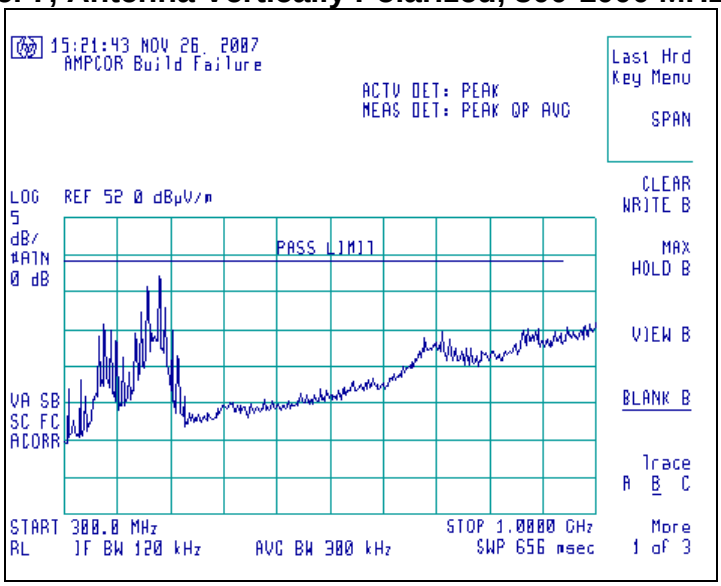
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 0, 1,7,11, 12, 13, 14, or 15, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

Channel 7, Antenna Vertically Polarized, 30-300 MHz, at 3m

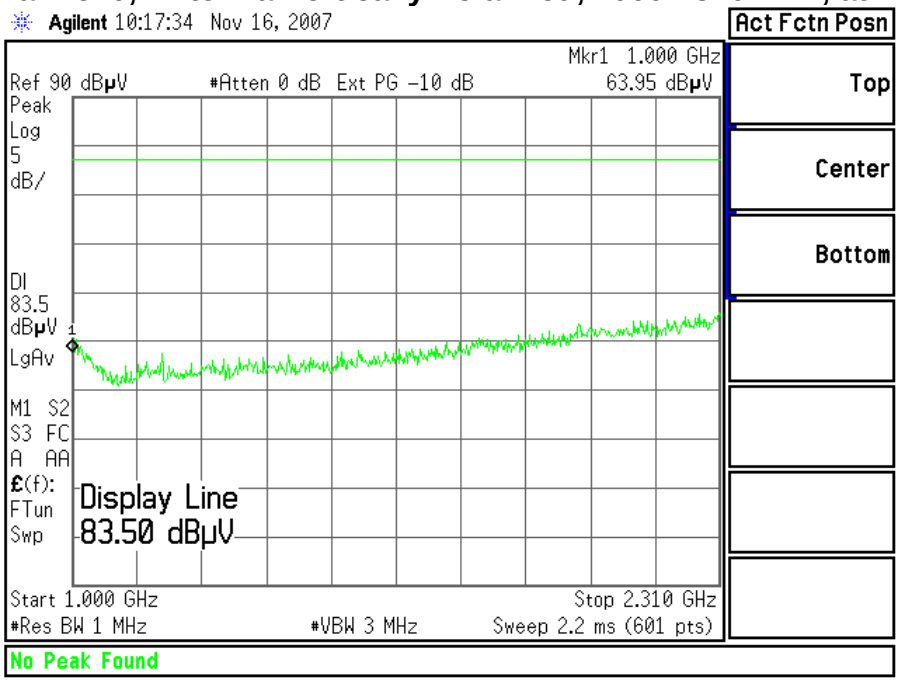


Channel 7, Antenna Vertically Polarized, 300-1000 MHz, at 3m

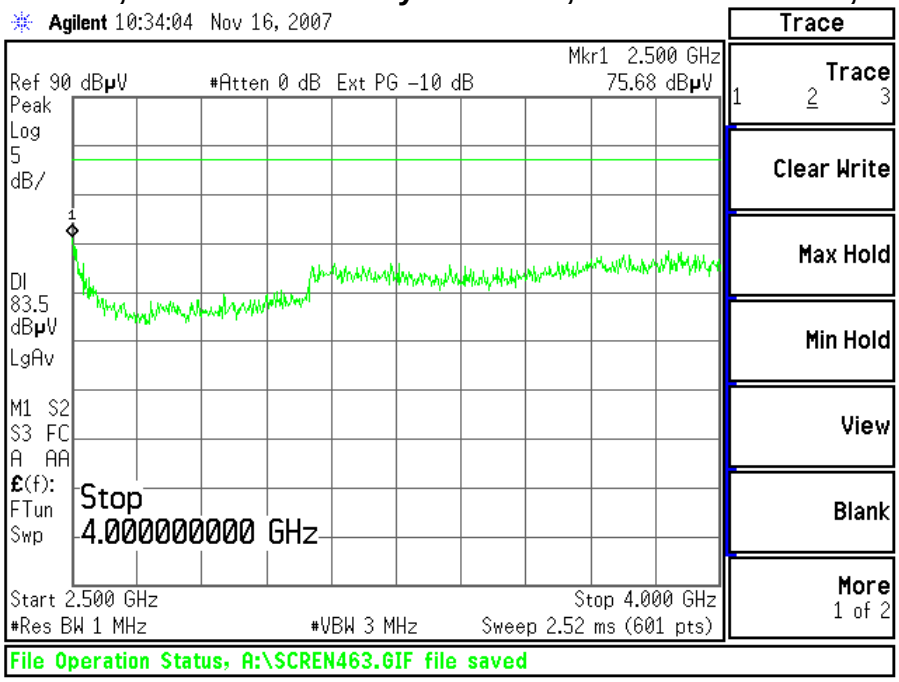


Screen Captures - Radiated Emissions Testing *(continued)*

Channel 0, Antenna Vertically Polarized, 1000-2310 MHz, at 1m

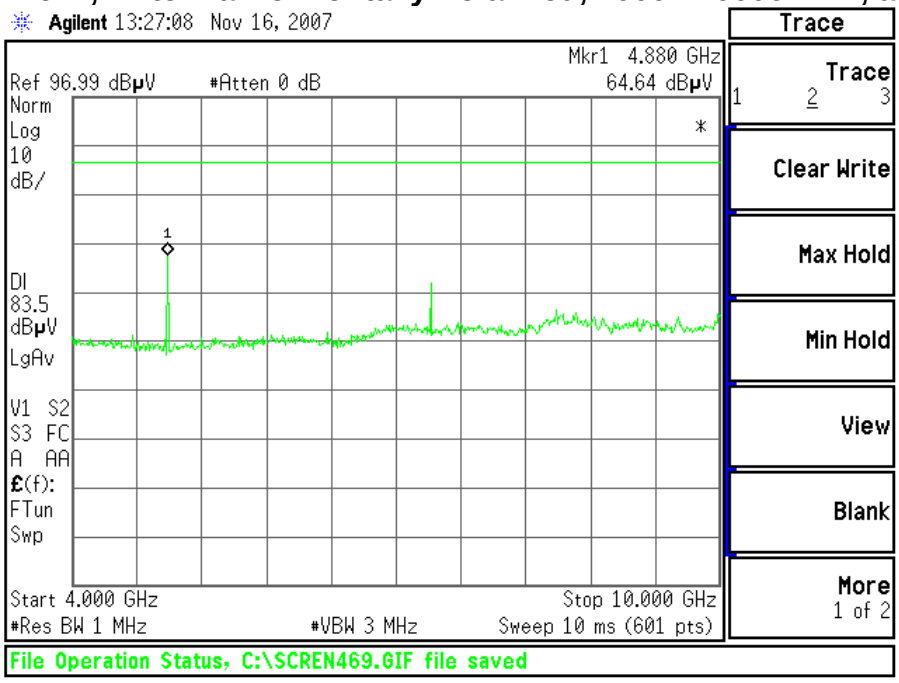


Channel 11, Antenna Vertically Polarized, 2500 to 4000 MHz, at 1m

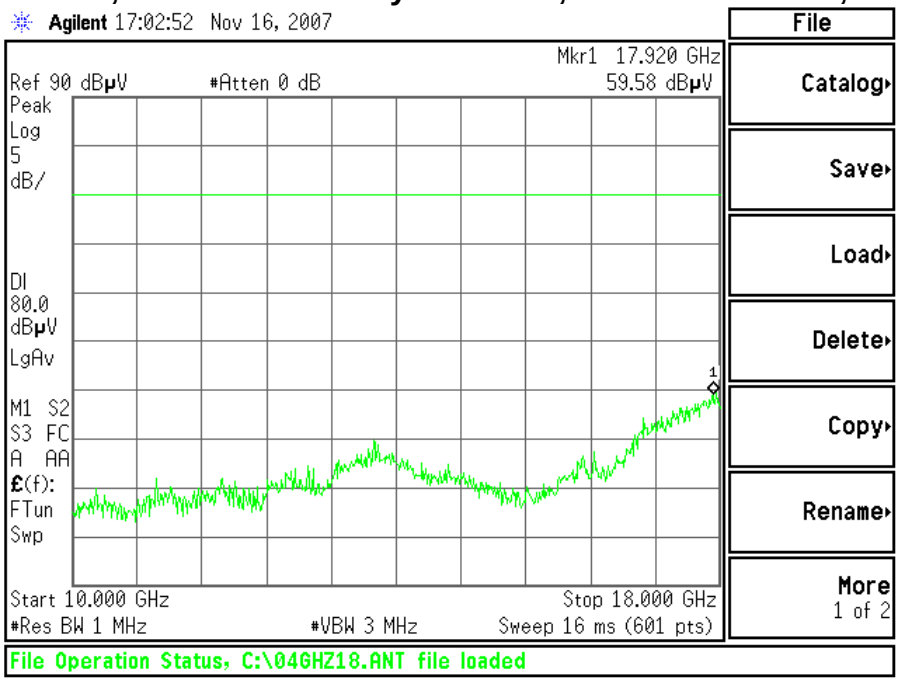


Screen Captures - Radiated Emissions Testing *(continued)*

Channel 7, Antenna Horizontally Polarized, 4000 - 10000 MHz, at 1m



Channel 7, Antenna Vertically Polarized, 10000-18000 MHz, at 1m



Screen Captures - Radiated Emissions Testing *(continued)*

Channel 7, Antenna Horizontally Polarized, 18000-25000 MHz, at 30cm

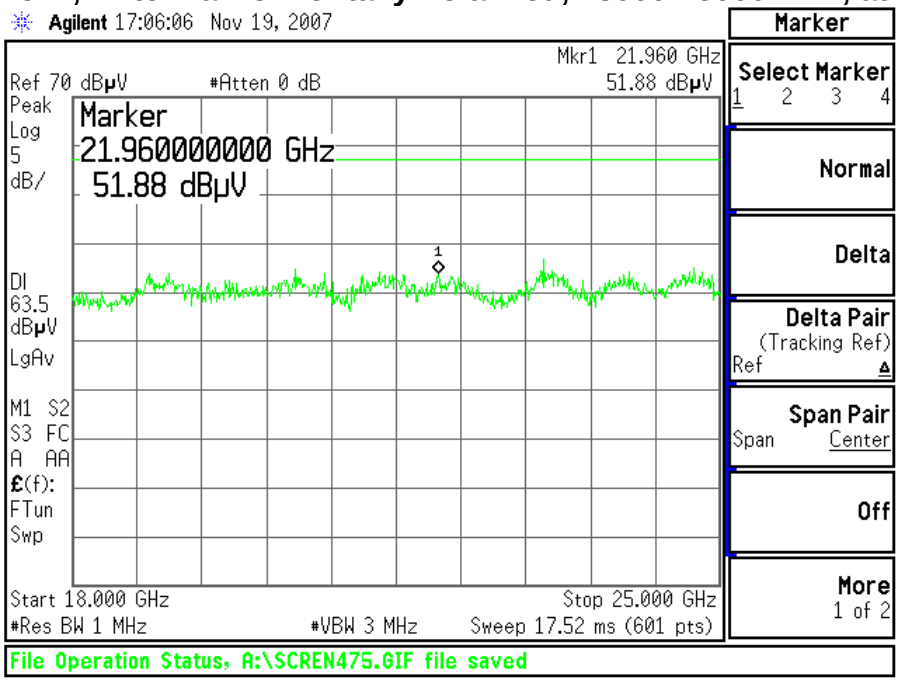


EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE: 15.207

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-210, Issue 6). The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided inside the 3 Meter Semi-Anechoic Chamber via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the HP 8546A EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

6.2 Test Procedure

The EUT was investigated in continuous modulated transmit mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1 (2003), Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30MHz. Final readings were then taken and recorded.

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.

6.3 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

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.

6.4 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.			

6.5 TEST DATA CHART CONDUCTED EMISSION

Frequency Range inspected: 150 KHz to 30 MHz

Test Standard: FCC 15.207 Class B

Manufacturer:	Trilliant Networks					
Date(s) of Test:	November 15th – 28th 2007					
Test Engineer:	Khairul Aidi Zainal					
Model #:	EM-0038B					
Serial #:	n/a					
Voltage:	120 VAC					
Operation Mode:	continuous transmit, modulated					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:						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)
0.1596	1	63.3	65.7	2.4	33.0	55.7	22.7
0.1897	1	55.6	64.9	9.3	27.5	54.9	27.4
0.3328	1	47.5	60.8	13.3	19.9	50.8	30.9
0.4420	1	42.5	57.6	15.1	15.5	47.6	32.1
0.1570	2	63.0	65.8	2.8	33.0	55.8	22.8
0.1822	2	53.3	65.1	11.8	26.3	55.1	28.8
0.3344	2	46.6	60.7	14.1	19.0	50.7	31.7

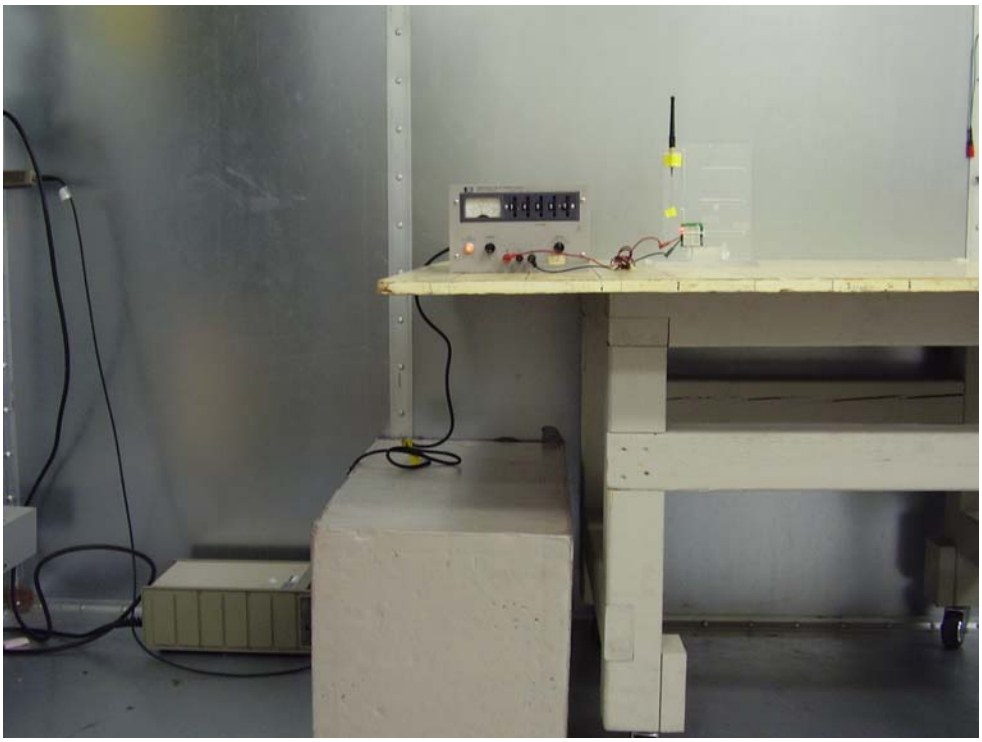
Notes:

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) The EUT exhibited similar emissions in transmit and receive modes, and across all 8 channels tested.

6.6 Test Setup Photo(s) – Conducted Emissions Test

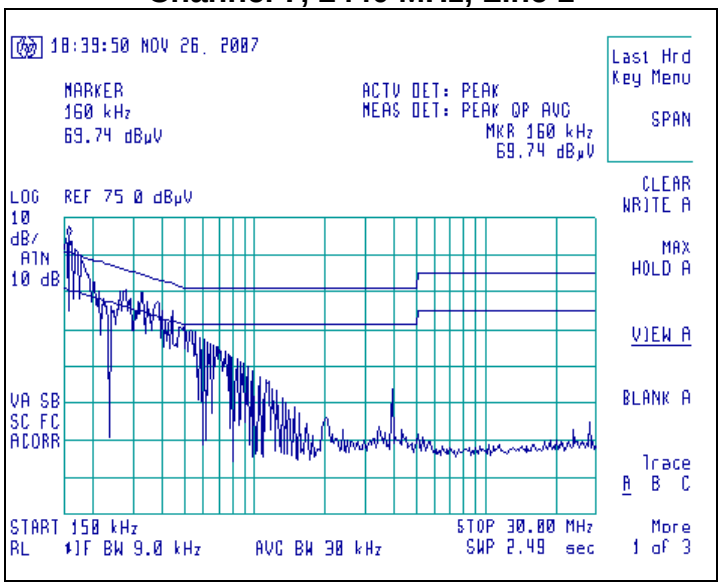


6.7 Screen Captures – Conducted Emissions Test

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 from channel 7, chosen as being a good representative of channels.

Channel 7, 2440 MHz, Line 1



Channel 7, 2440 MHz, Line 2

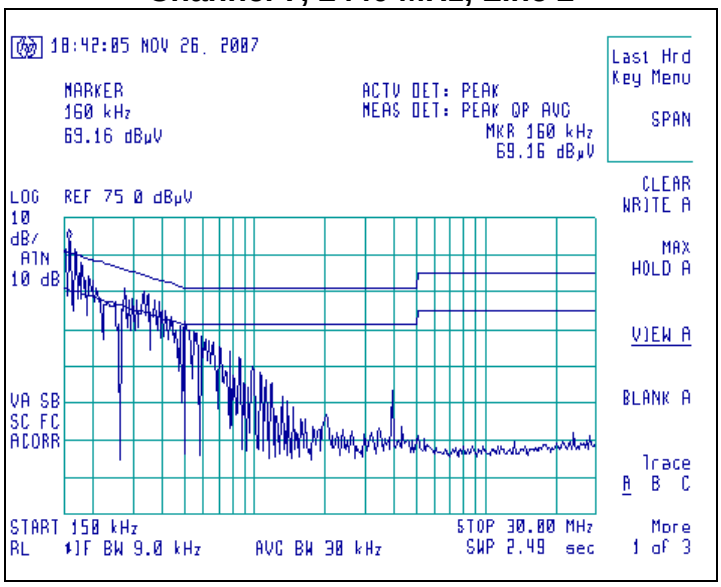


EXHIBIT 7. OCCUPIED BANDWIDTH: 15.247(a)(2)

7.1 Limits

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

7.2 Method of Measurements

Refer to ANSI C63.4 and FCC Procedures (March 23, 2005) 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) requires a minimum -6dBc 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 E4446A 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 measurements, without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the closest measurement when compared to the specified limit is 1520 kHz, which is above the minimum of 500 kHz.

Test Data

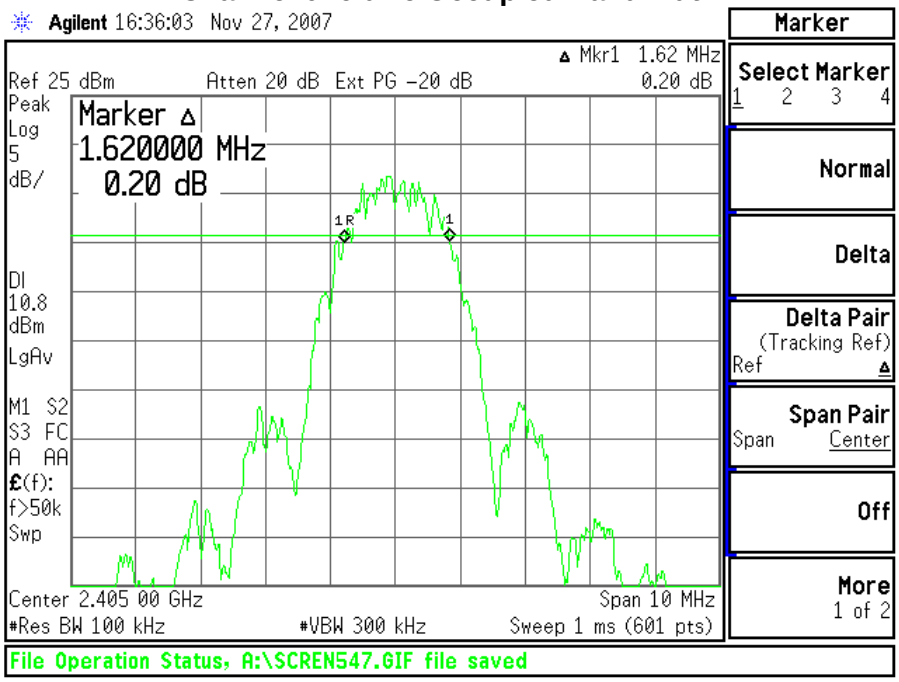
Channel	Center Frequency (MHz)	Measured -6 dBc Occ. BW (kHz)	Minimum -6 dBc Limit (kHz)	Measured -20 dBc Occ.Bw (kHz)
0	2405	1620	500	2650
1	2410	1520	500	2620
7	2440	1600	500	2620
11	2460	1620	500	2670
12	2465	1650	500	2650
13	2470	1650	500	2650
14	2475	1600	500	2650
15	2480	1580	500	2670

7.3 Test Equipment List

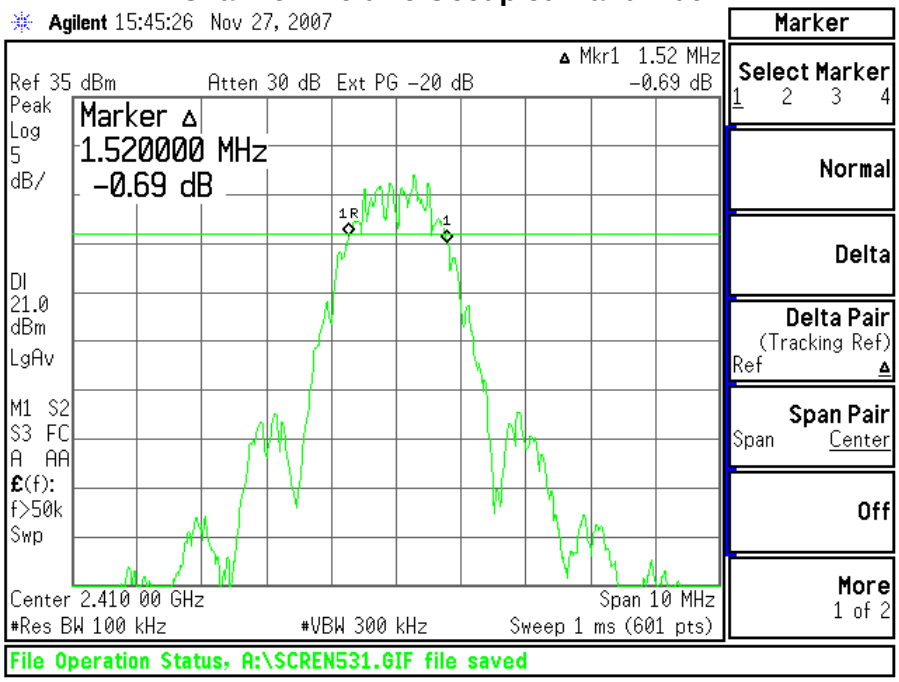
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4407B	US39160256
Spectrum Analyzer	Agilent	E4446A	US45300564

7.4 Screen Captures - OCCUPIED BANDWIDTH

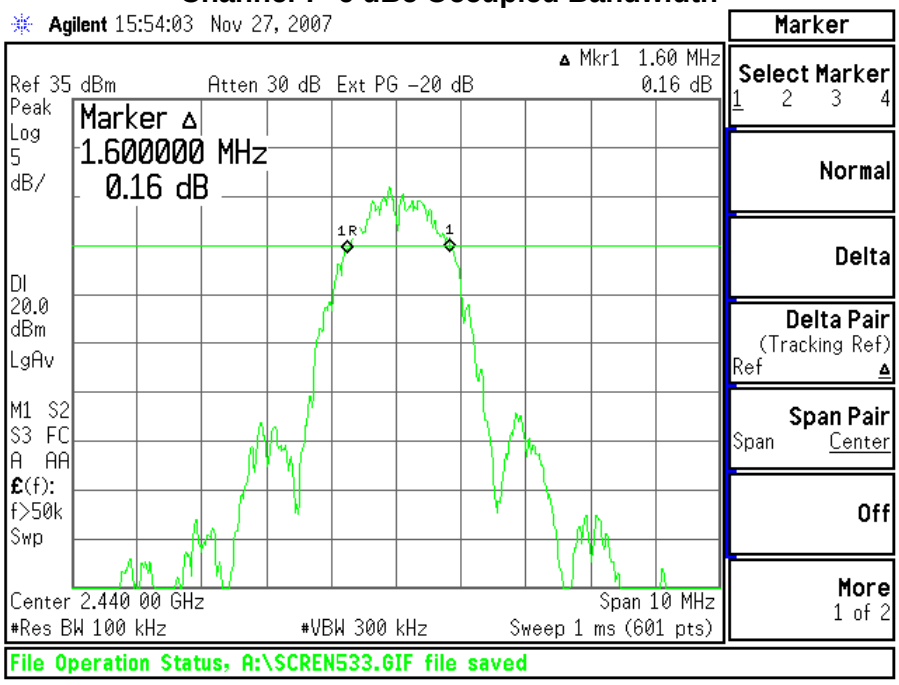
Channel 0 -6 dBc Occupied Bandwidth



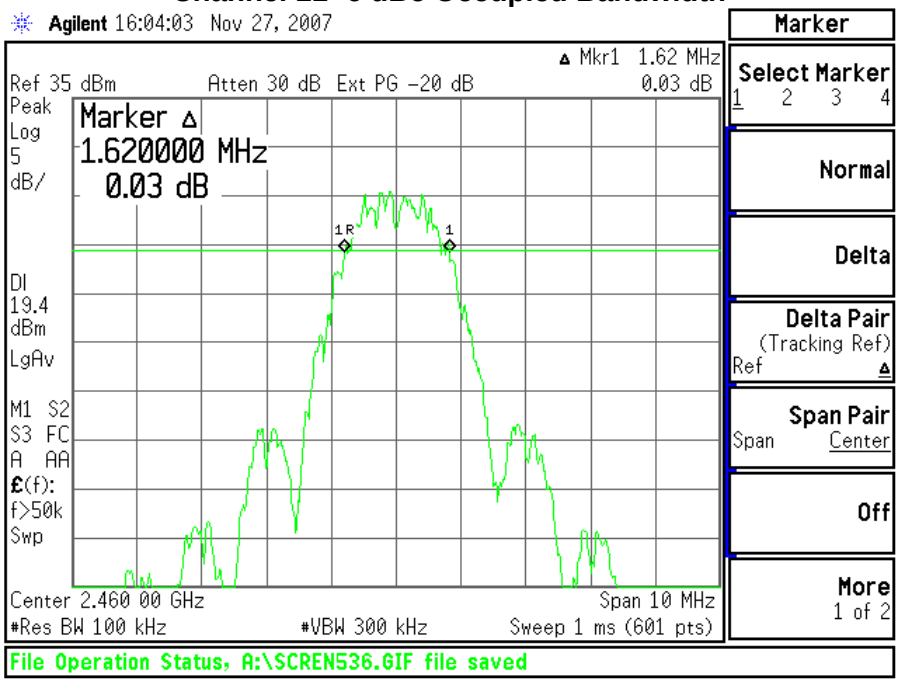
Channel 1 -6 dBc Occupied Bandwidth



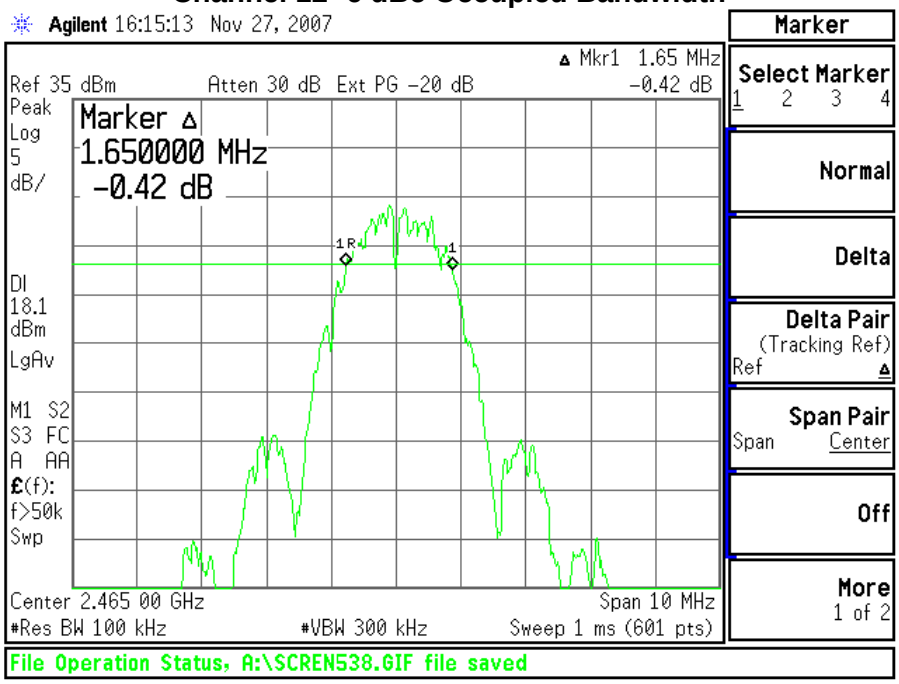
Channel 7 -6 dBc Occupied Bandwidth



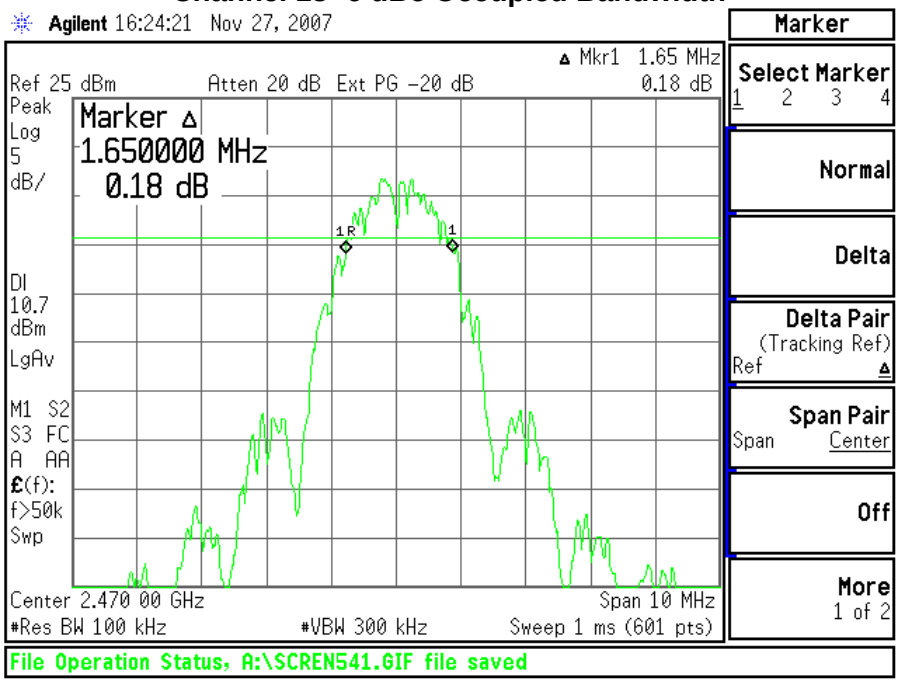
Channel 11 -6 dBc Occupied Bandwidth



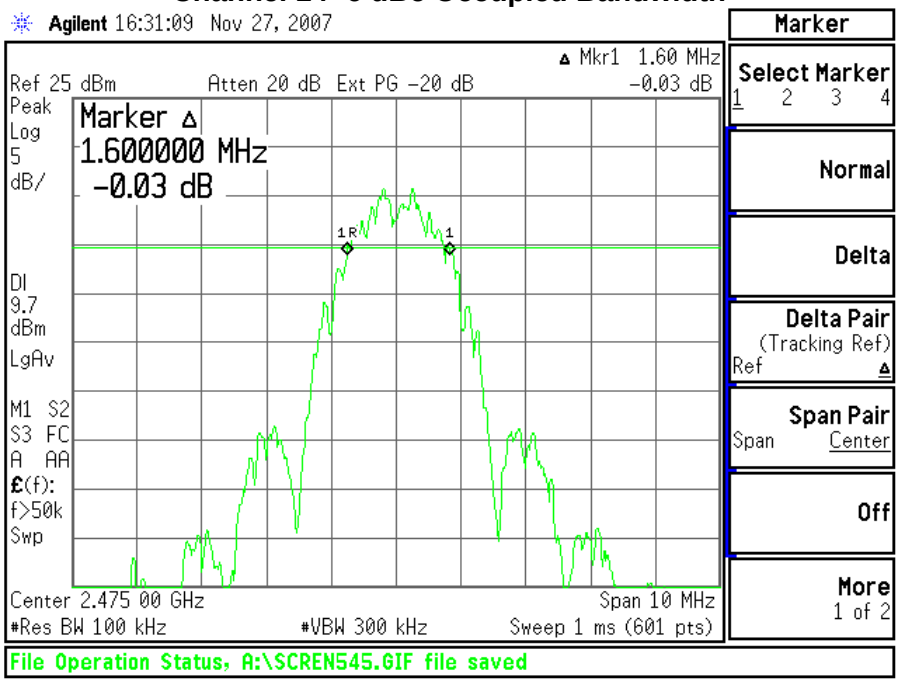
Channel 12 -6 dBc Occupied Bandwidth



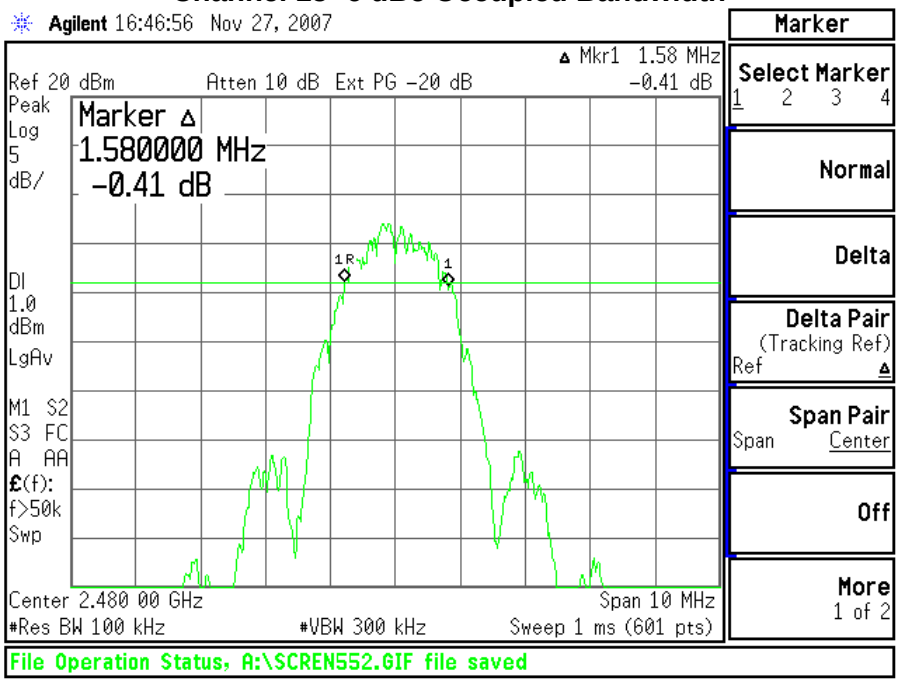
Channel 13 -6 dBc Occupied Bandwidth



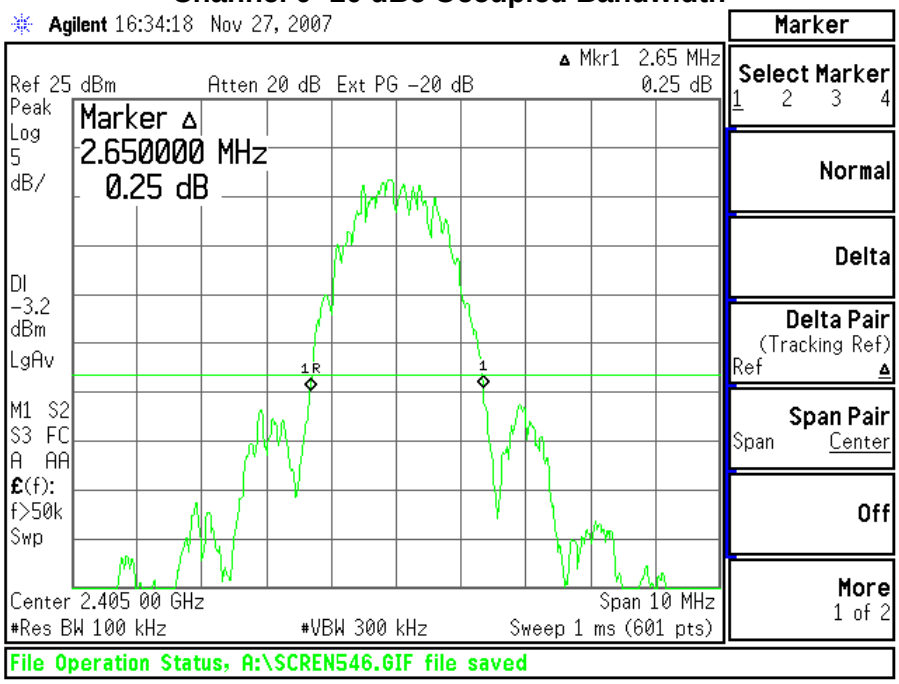
Channel 14 -6 dBc Occupied Bandwidth



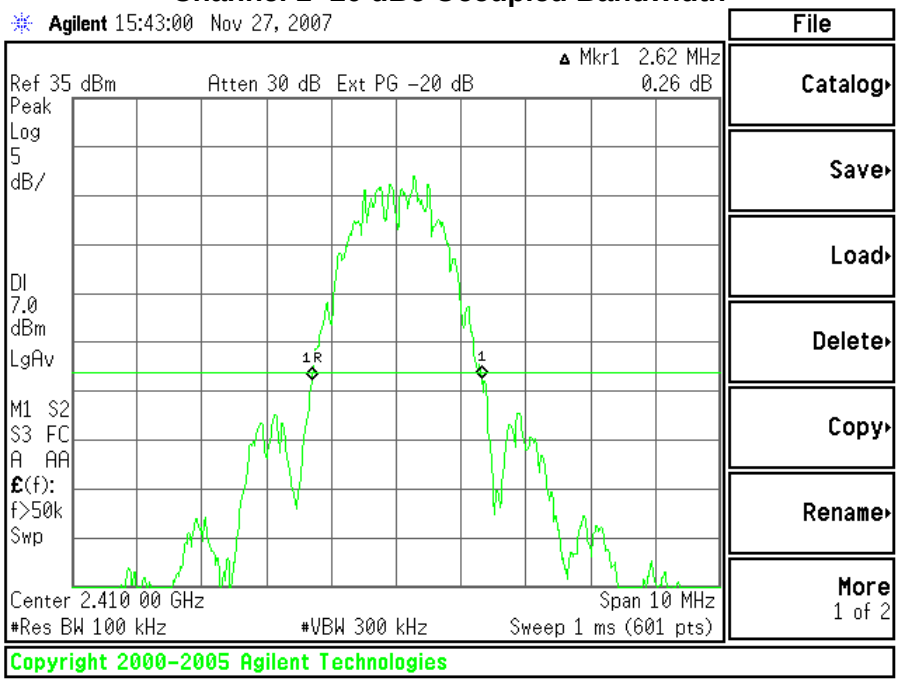
Channel 15 -6 dBc Occupied Bandwidth



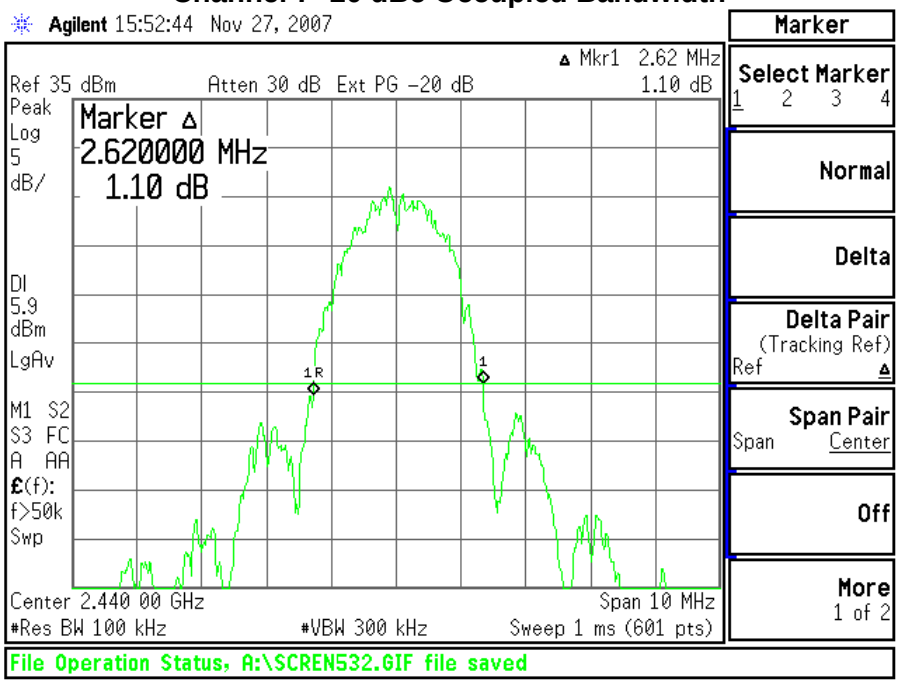
Channel 0 -20 dBc Occupied Bandwidth



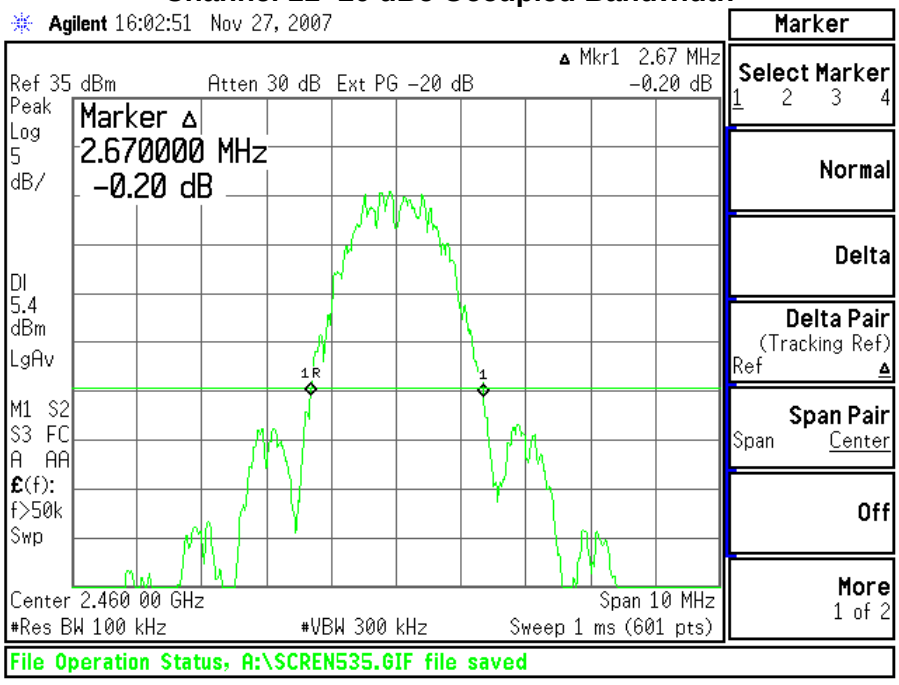
Channel 1 -20 dBc Occupied Bandwidth



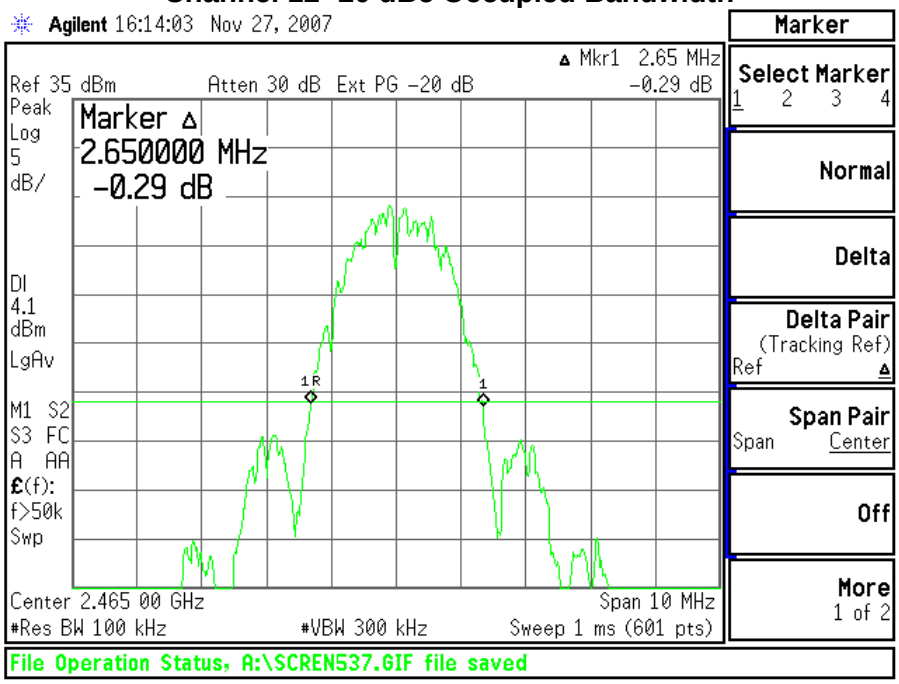
Channel 7 -20 dBc Occupied Bandwidth



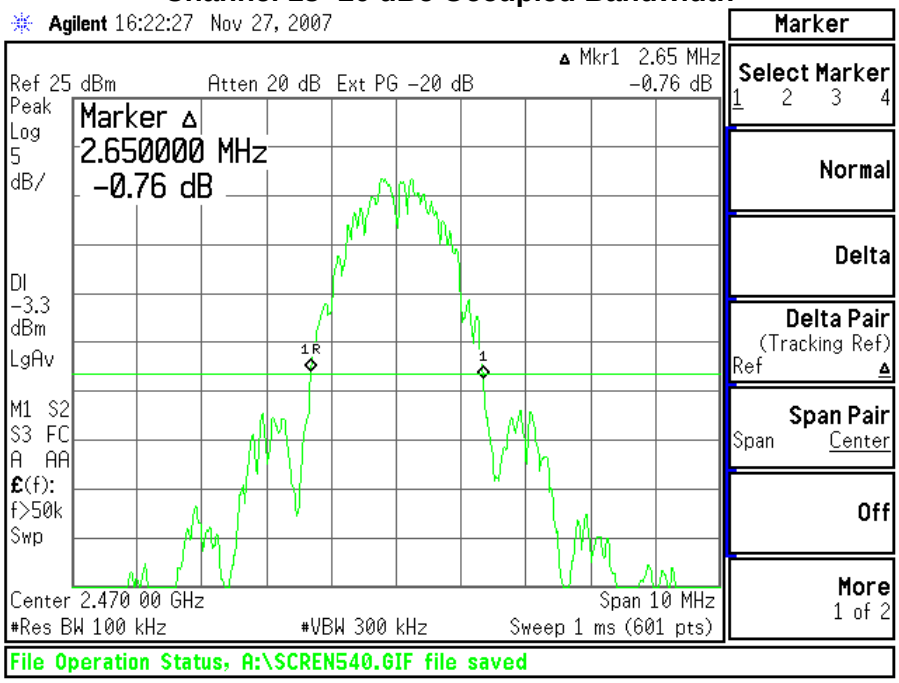
Channel 11 -20 dBc Occupied Bandwidth



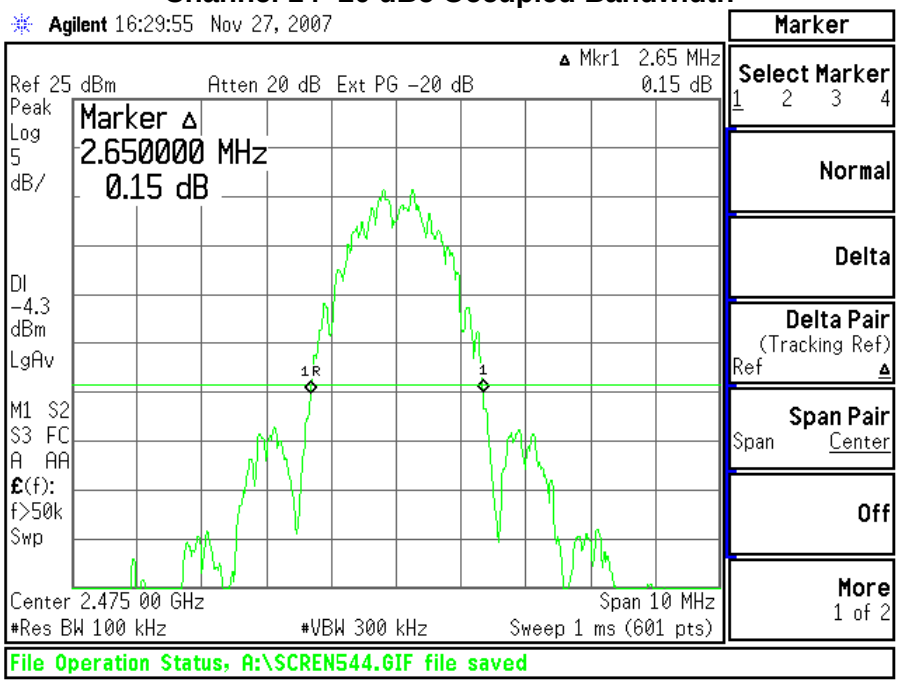
Channel 12 -20 dBc Occupied Bandwidth



Channel 13 -20 dBc Occupied Bandwidth



Channel 14 -20 dBc Occupied Bandwidth



Channel 15 -20 dBc Occupied Bandwidth

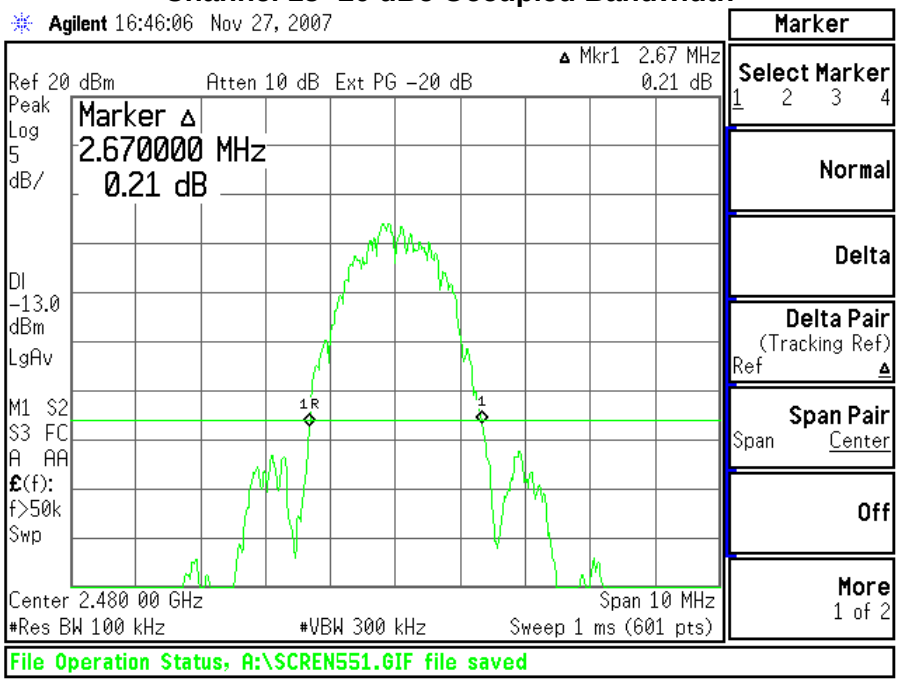


EXHIBIT 8. BAND-EDGE MEASUREMENTS

8.1 Method of Measurements

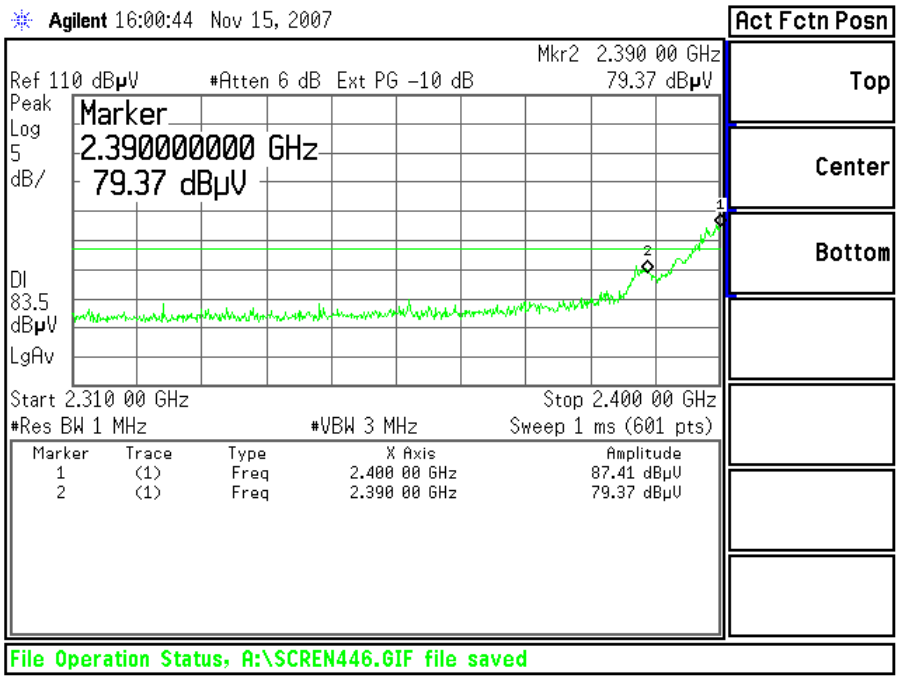
FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, in particular at the Band-Edges where the intentional radiator operates. The following screen captures demonstrate compliance of the intentional radiator at the 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 **2** lowest channels for the investigation of the lower Band-Edge, and at the **5** highest channels for the investigation of the higher Band-Edge.

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

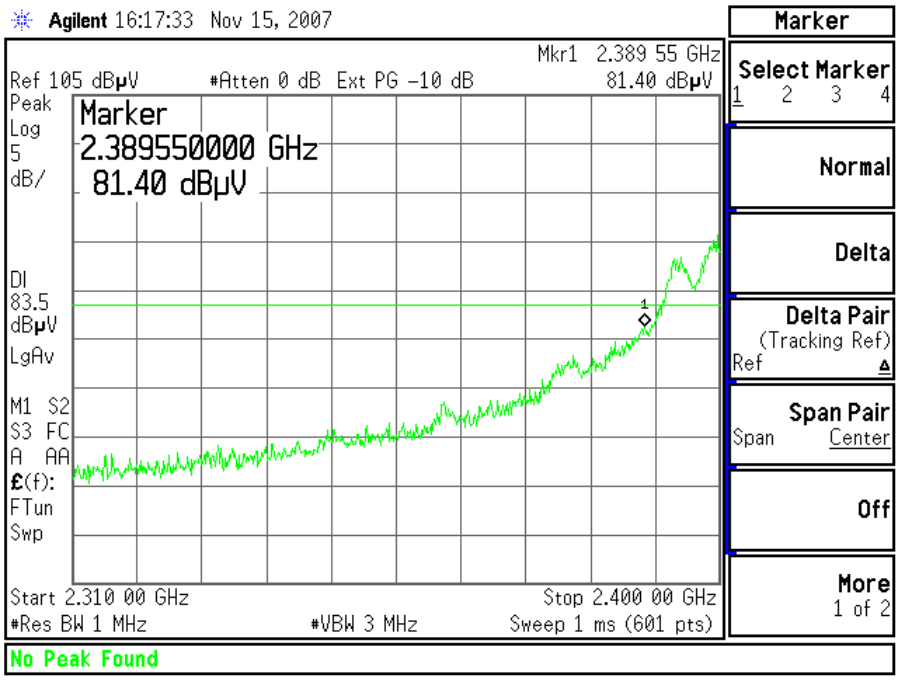
The Upper Band-Edge limit, in this case, would be + 83.5 dBµV/m at 1m (Limit adjusted to include Relaxation)

Screen Captures Demonstrating Compliance at the Lower Band-Edge

Channel 0

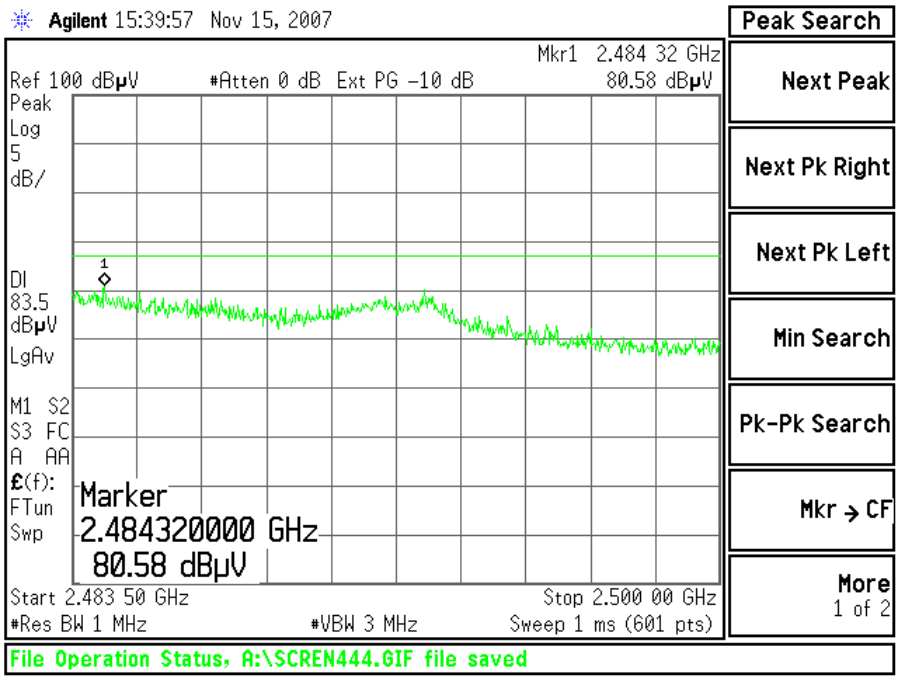


Channel 1

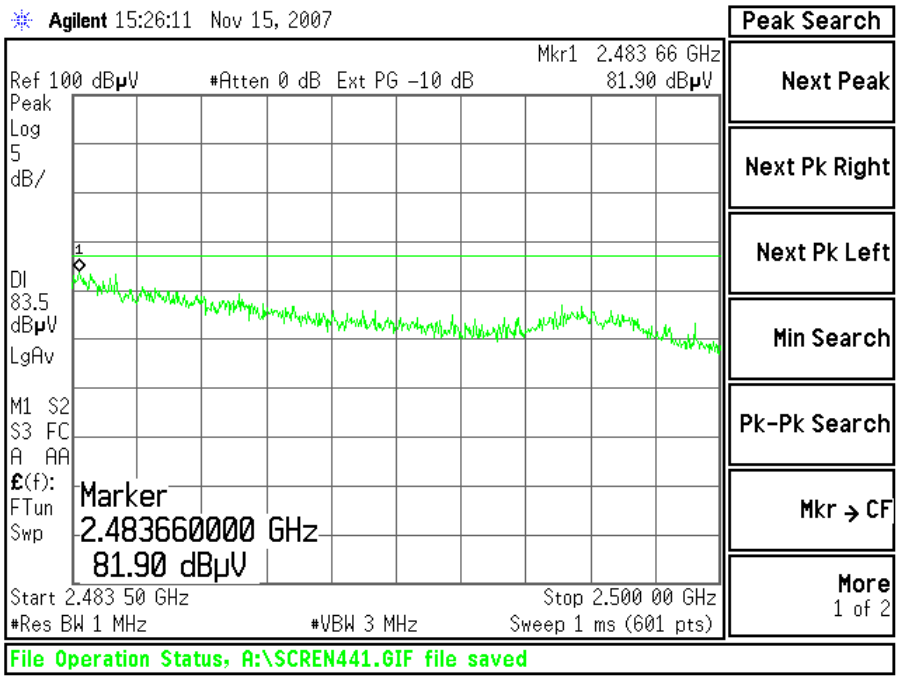


Screen Captures Demonstrating Compliance at the Higher Band-Edge

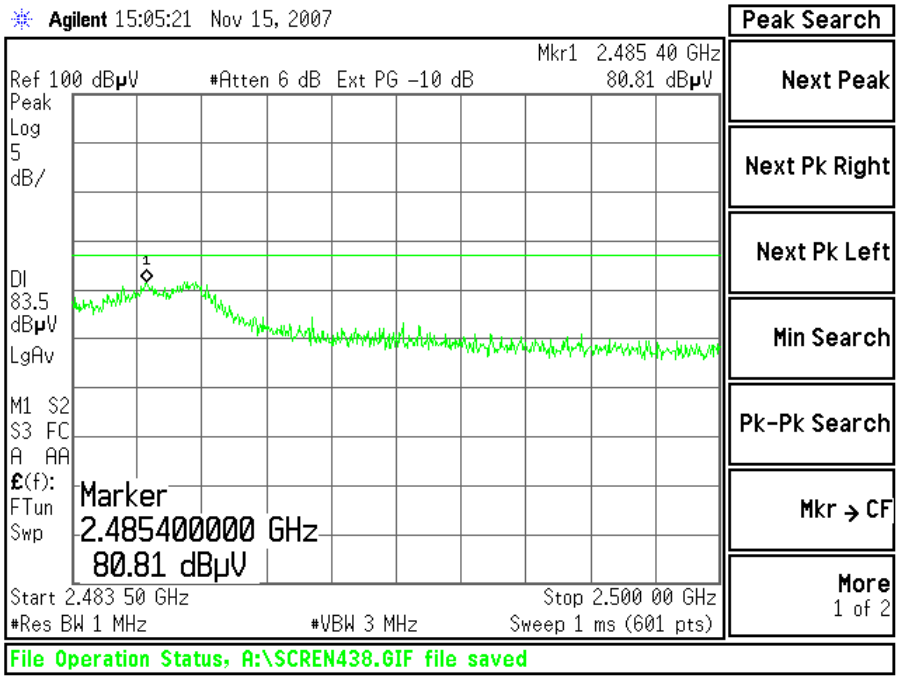
Channel 11



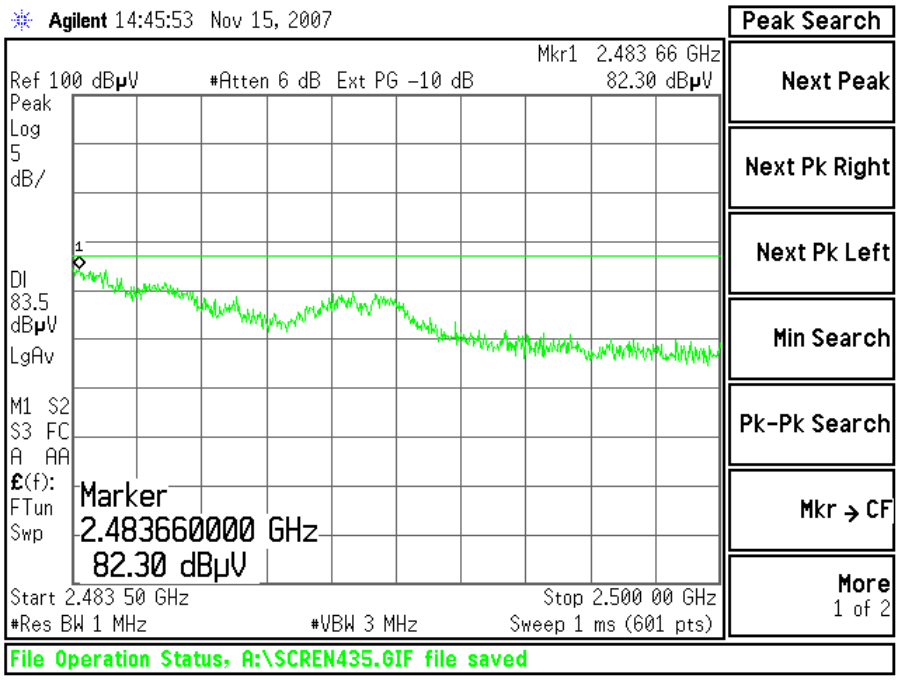
Channel 12



Channel 13



Channel 14



Channel 15

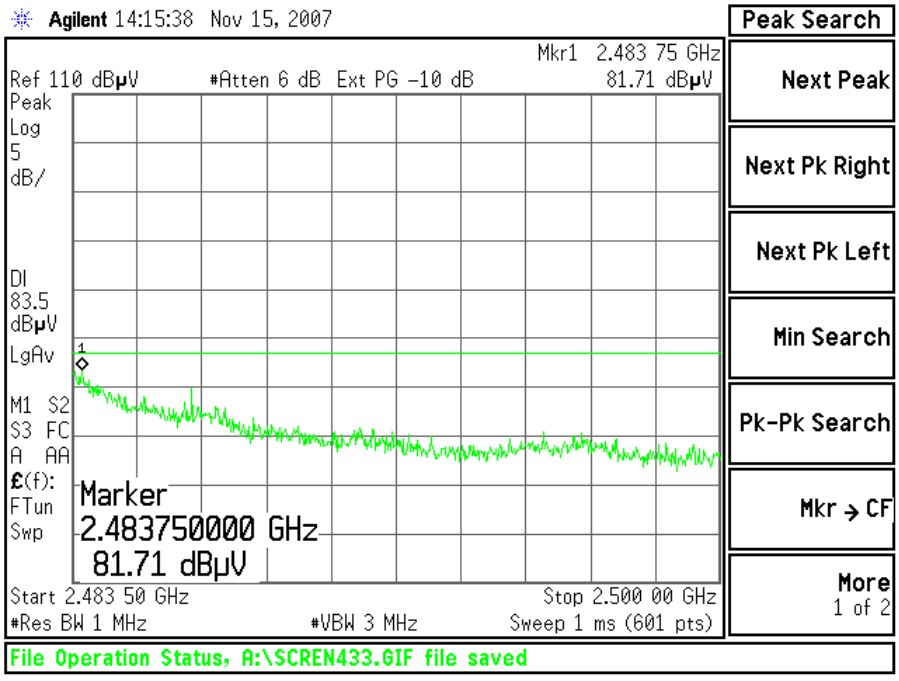


EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

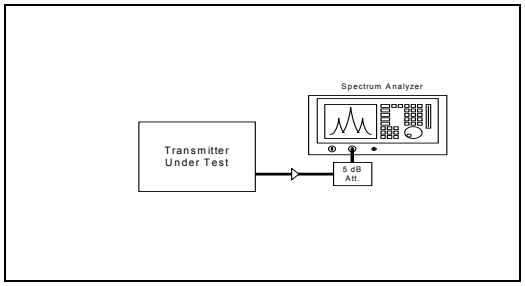
9.1 Method of Measurements

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 measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with resolution and video bandwidths set to 3 MHz, and a span of 20 MHz, with measurements from a peak detector presented in the chart below.

Test Data

9.2 Test Data

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
0	2405	+30 dBm	21.8	8.2
1	2410	+30 dBm	29.5	0.5
7	2440	+30 dBm	29.6	0.4
11	2460	+30 dBm	30.0	0.0
12	2465	+30 dBm	28.4	1.6
13	2470	+30 dBm	22.0	8.1
14	2475	+30 dBm	20.3	9.7
15	2480	+30 dBm	12.0	18.0



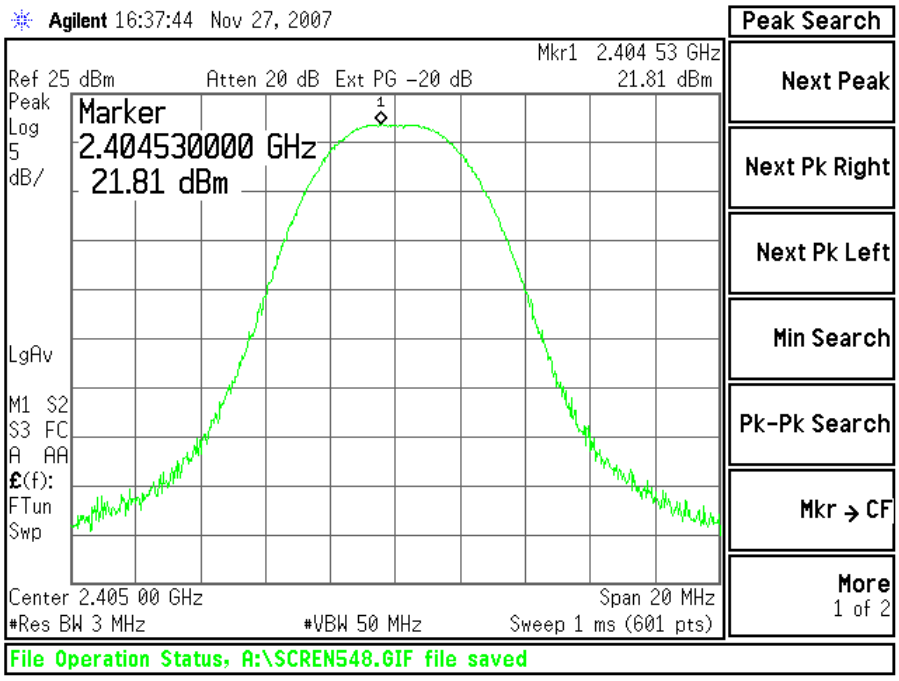
Measured RF Power Output (in Watts): 1 watt
Declared RF Power Output (in Watts): 1 watt

9.3 Test Equipment List

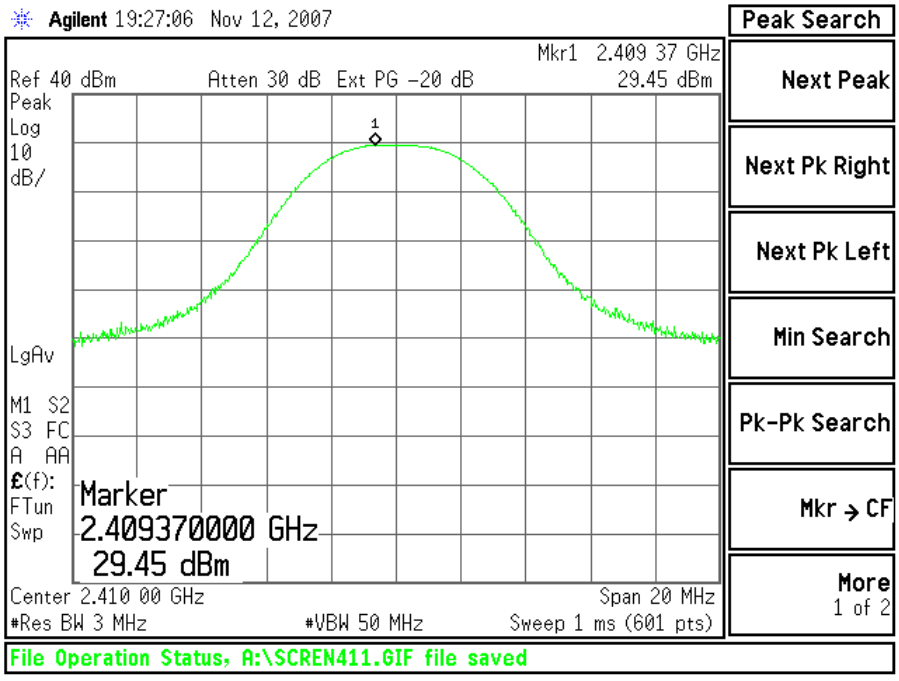
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	Spectrum Analyzer

9.4 Screen Captures – Power Output (Conducted)

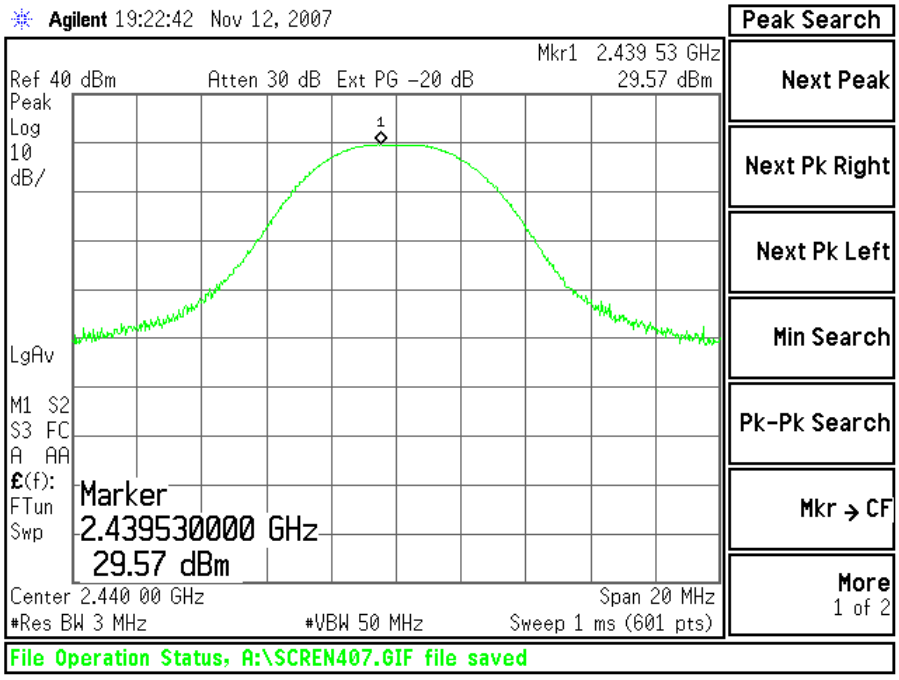
Channel 0



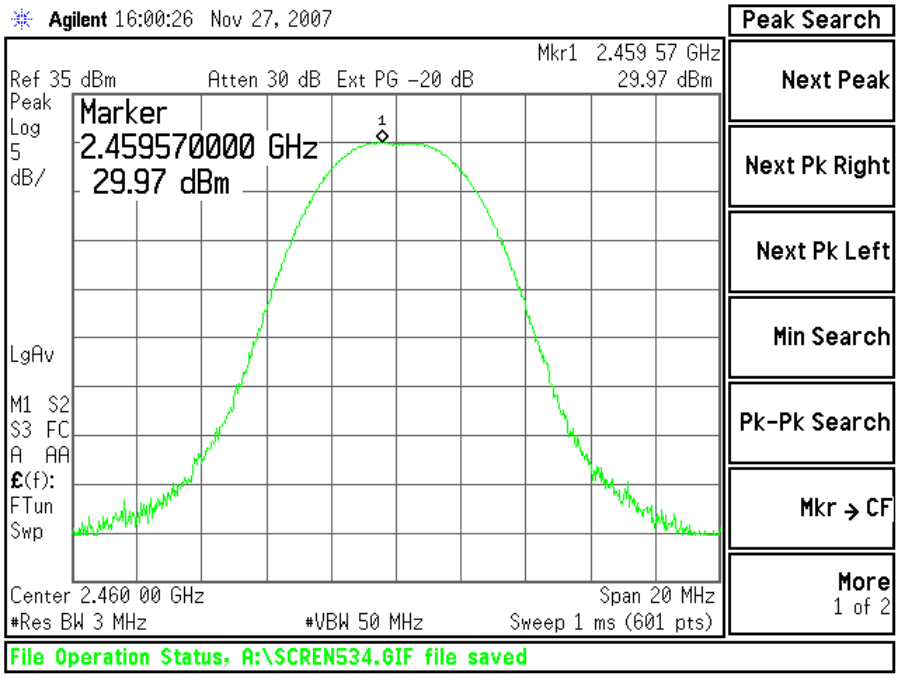
Channel 1



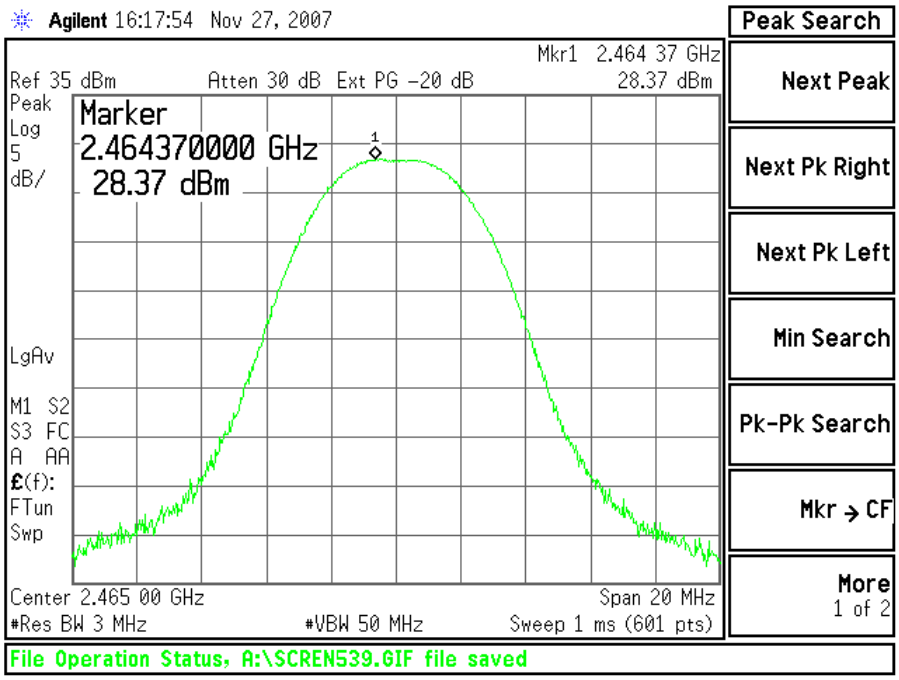
Channel 7



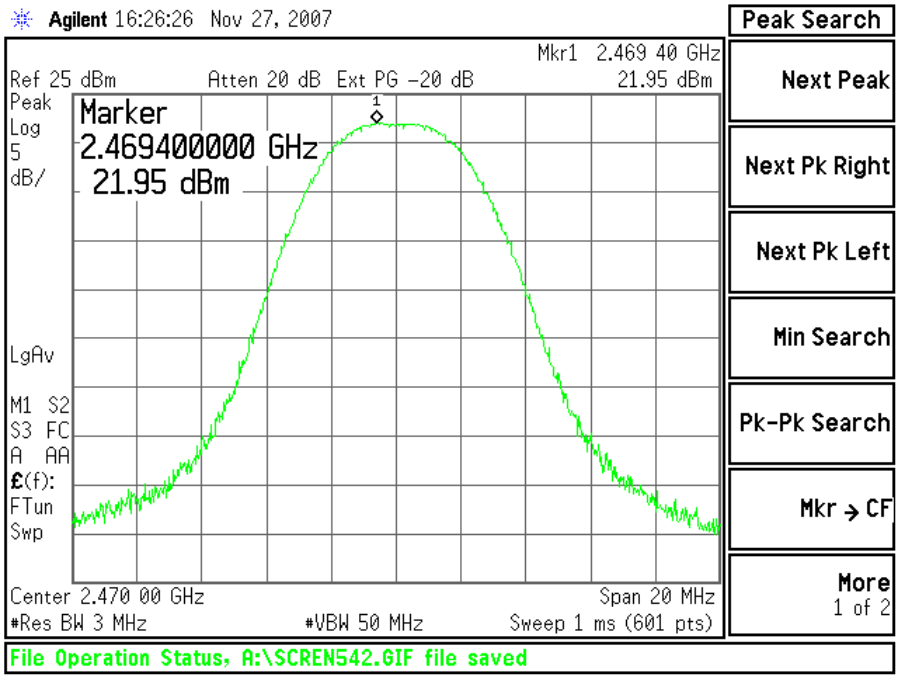
Channel 11



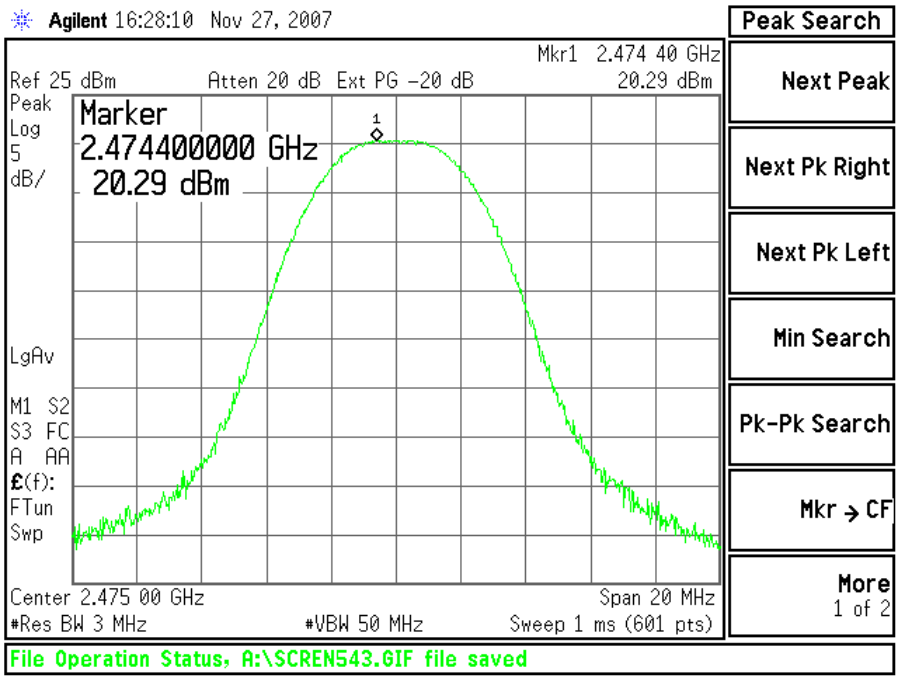
Channel 12



Channel 13



Channel 14



Channel 15

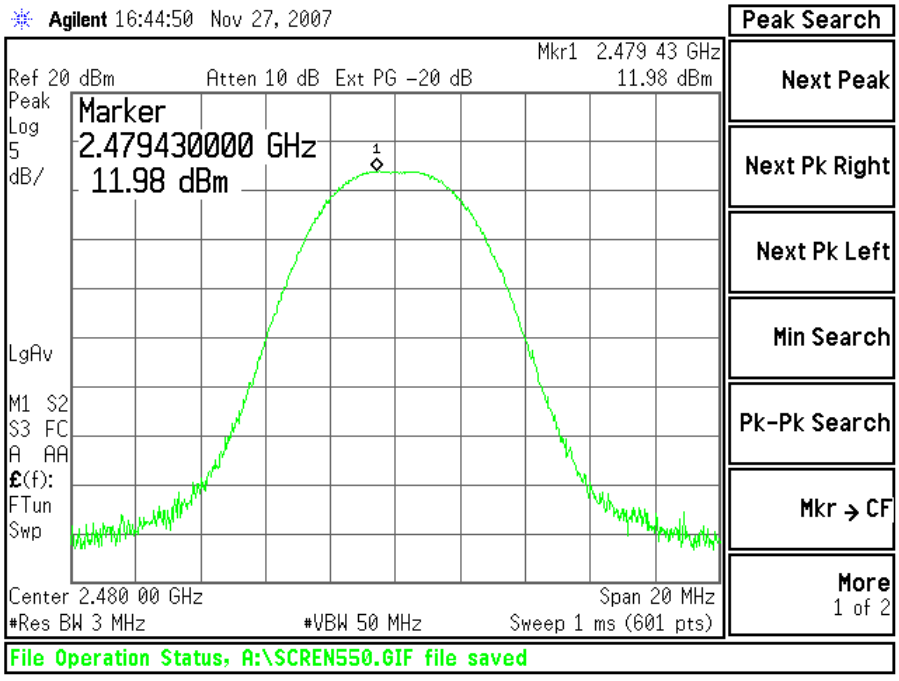


EXHIBIT 10. POWER SPECTRAL DENSITY: 15.247(e)

10.1 Limits

For digitally modulate systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed using the noise marker utility built into the HP Analyzer. The resultant density was then corrected to a 3 kHz bandwidth. The highest density was found to be no greater than 4.1 dBm, which is under the allowable limit by 3.9 dB.

10.2 Test Equipment List

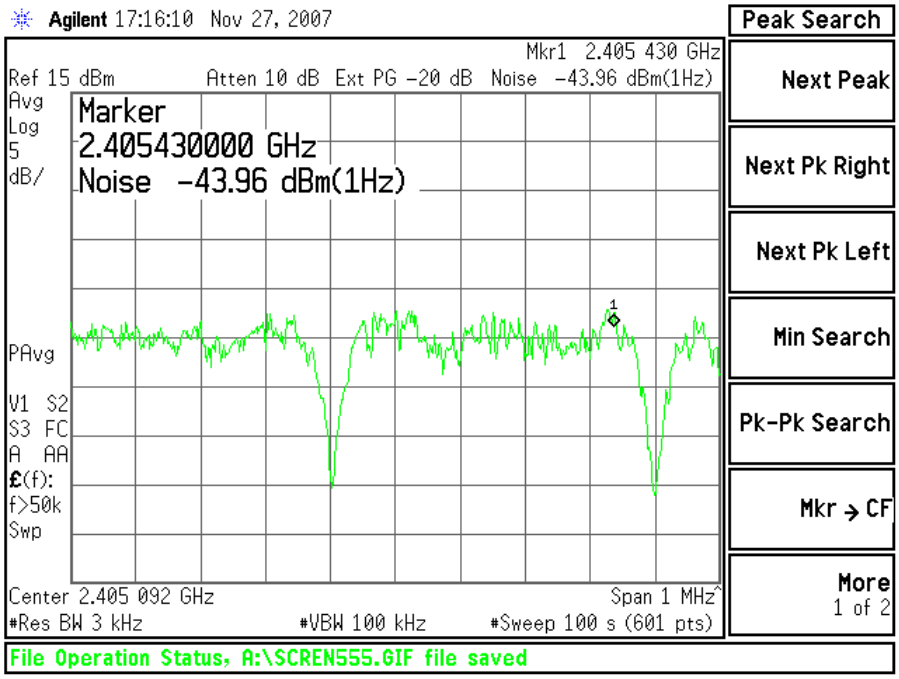
Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

10.3 Test Data

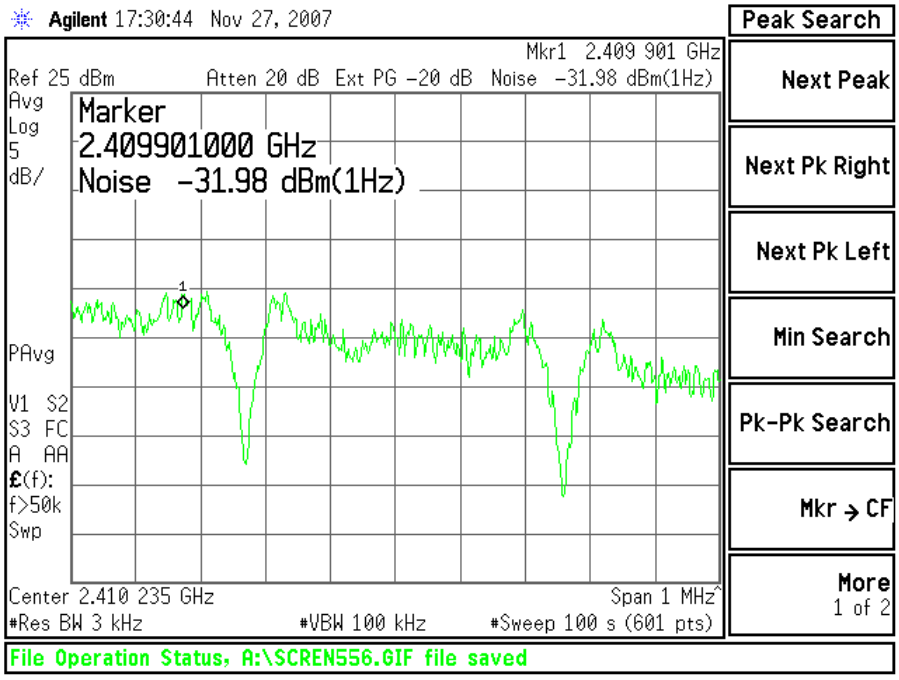
Channel	Frequency (MHz)	Noise Marker (dBm/1 Hz)	RF Power Level In 3 kHz BW (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Comments Pass/Fail
0	2405	-44.0	-9.2	8.0	17.2	Pass
1	2410	-32.0	2.8	8.0	5.2	Pass
7	2440	-32.6	2.2	8.0	5.8	Pass
11	2460	-30.7	4.1	8.0	3.9	Pass
12	2465	-33.9	0.9	8.0	7.1	Pass
13	2470	-43.0	-8.2	8.0	16.2	Pass
14	2475	-45.1	-10.3	8.0	18.3	Pass
15	2480	-51.9	-17.1	8.0	25.1	Pass

10.4 Screen Captures – Power Spectral Density

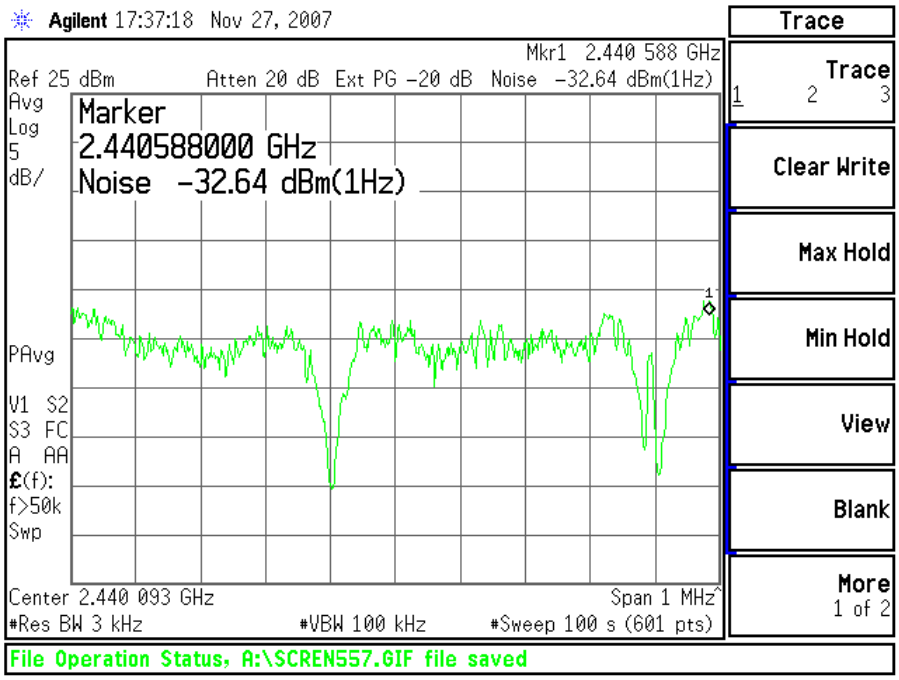
Channel 0



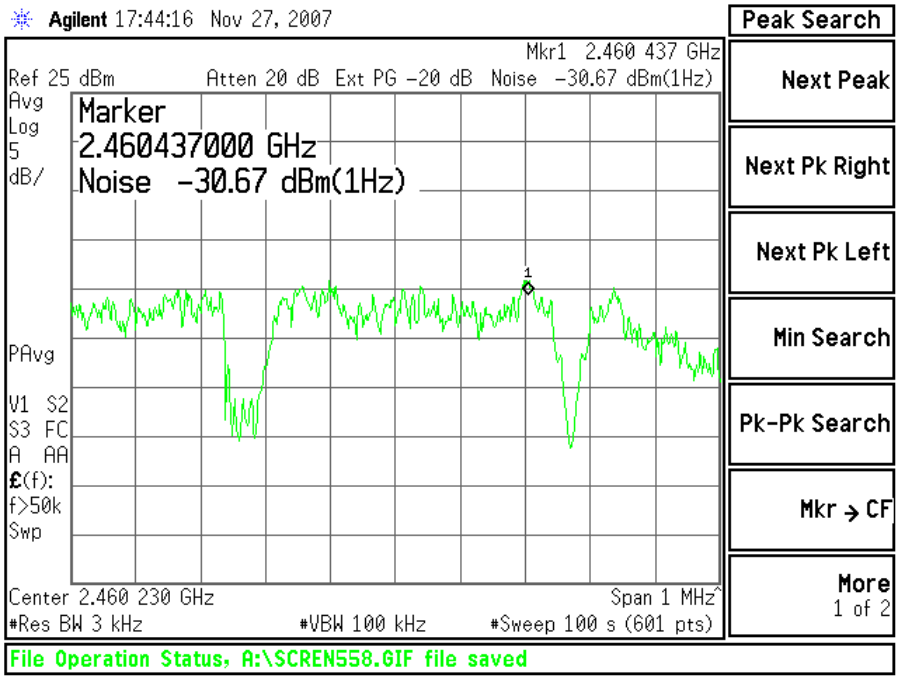
Channel 1



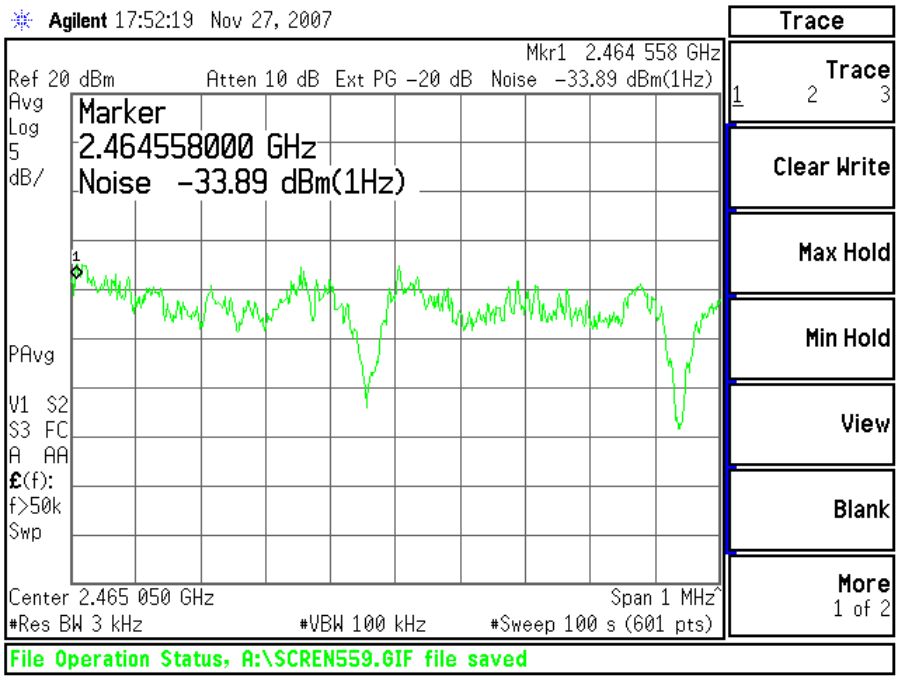
Channel 7



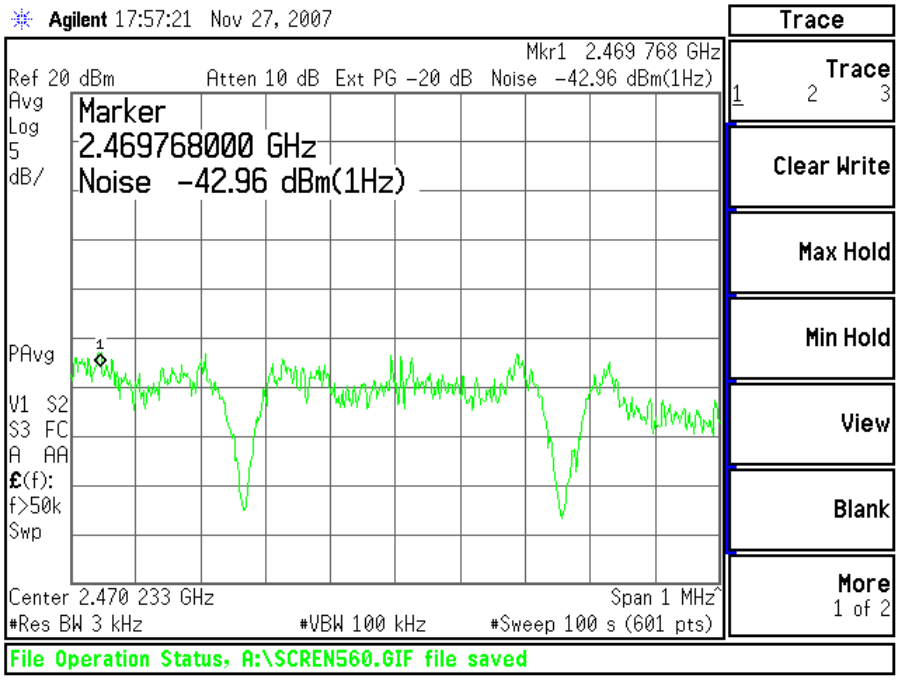
Channel 11



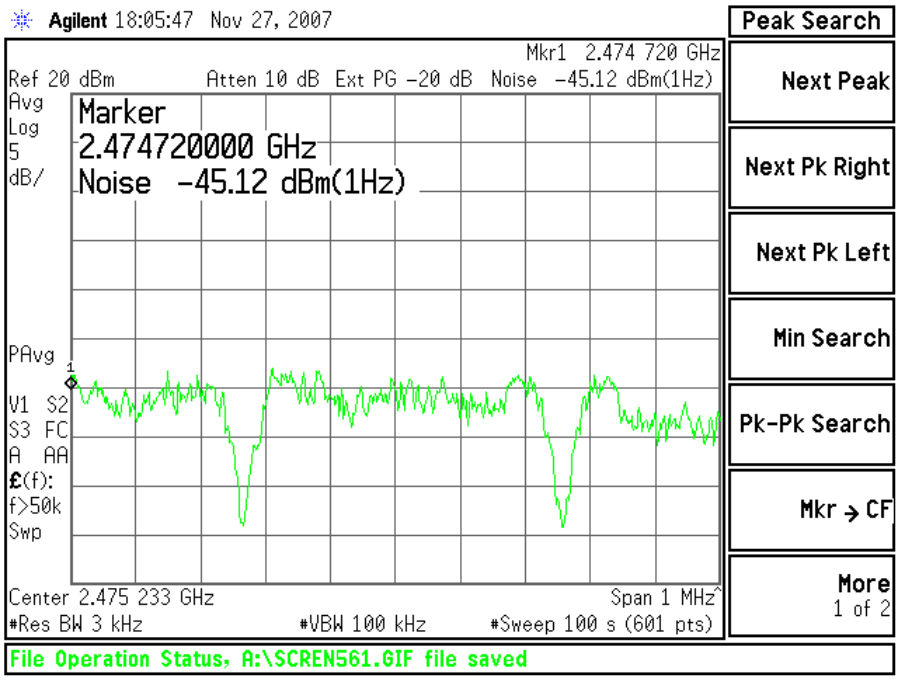
Channel 12



Channel 13



Channel 14



Channel 15

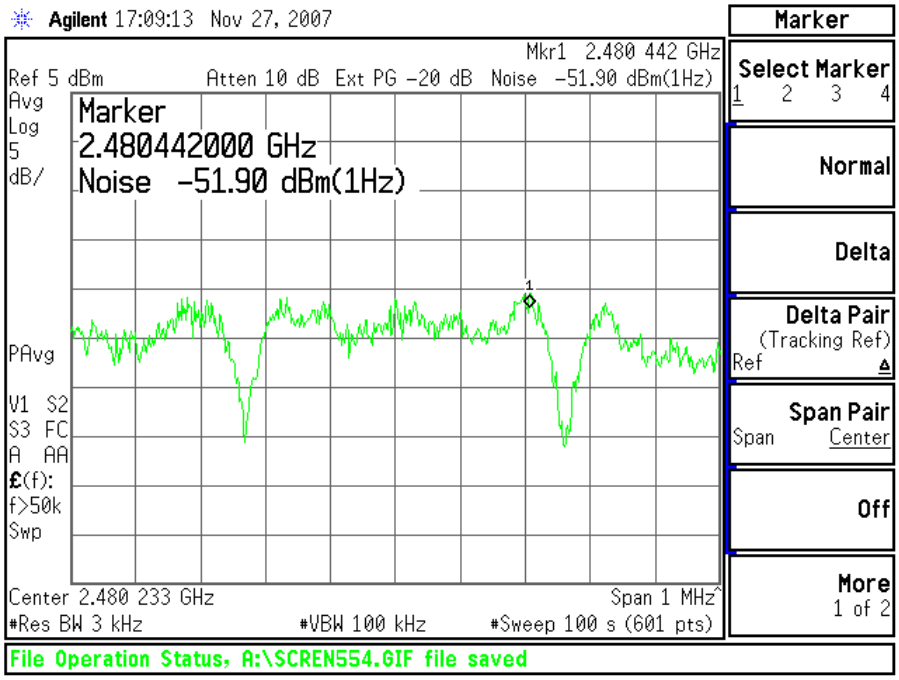


EXHIBIT 11. SPURIOUS RADIATED EMISSIONS: 15.247(d)

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 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 -65 dBc of the fundamental level for this product.

11.2 Test Data

	Channel 0	Channel 1	Channel 7	Channel 11	Channel 12	Channel 13	Channel 14	Channel 15
Fundamental	16.5 (dBm)	25.1 (dBm)	26.8 (dBm)	26.4 (dBm)	23.8 (dBm)	17.0 (dBm)	14.4 (dBm)	6.4 (dBm)
2nd Harmonic	-61.3 (dBm)	-38.2 (dBm)	-34.3 (dBm)	-30.1 (dBm)	-36.5 (dBm)	-54.5 (dBm)	-64.2 (dBm)	Note (1)
3rd Harmonic	Note (1)	-55.3 (dBm)	-51.7 (dBm)	-51.1 (dBm)	-62.1 (dBm)	Note (1)	Note (1)	Note (1)
4th Harmonic	Note (1)	-60.6 (dBm)	-56.5 (dBm)	-54.1 (dBm)	Note (1)	Note (1)	Note (1)	Note (1)
5th Harmonic	Note (1)	-64.9 (dBm)	-62.6 (dBm)	-67.2 (dBm)	Note (1)	Note (1)	Note (1)	Note (1)
6th Harmonic	Note (1)	-60.1 (dBm)	Note (1)	-62.3 (dBm)	Note (1)	Note (1)	Note (1)	Note (1)
7th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)

	Channel 0 (Power set at 13 instead of the reduced setting 7)	Channel 15 (Power set at 13 instead of the reduced setting 0)
Fundamental	26.1(dBm)	26.6(dBm)
2nd Harmonic	-38.0(dBm)	-31.2(dBm)
3rd Harmonic	-55.3(dBm)	-50.6(dBm)
4th Harmonic	-59.1(dBm)	-52.9(dBm)
5th Harmonic	-61.9(dBm)	-58.4(dBm)
6th Harmonic	-63.9(dBm)	-63.0(dBm)
7th Harmonic	Note (1)	Note (1)
8th Harmonic	Note (1)	Note (1)
9th Harmonic	Note (1)	Note (1)
10th Harmonic	Note (1)	Note (1)

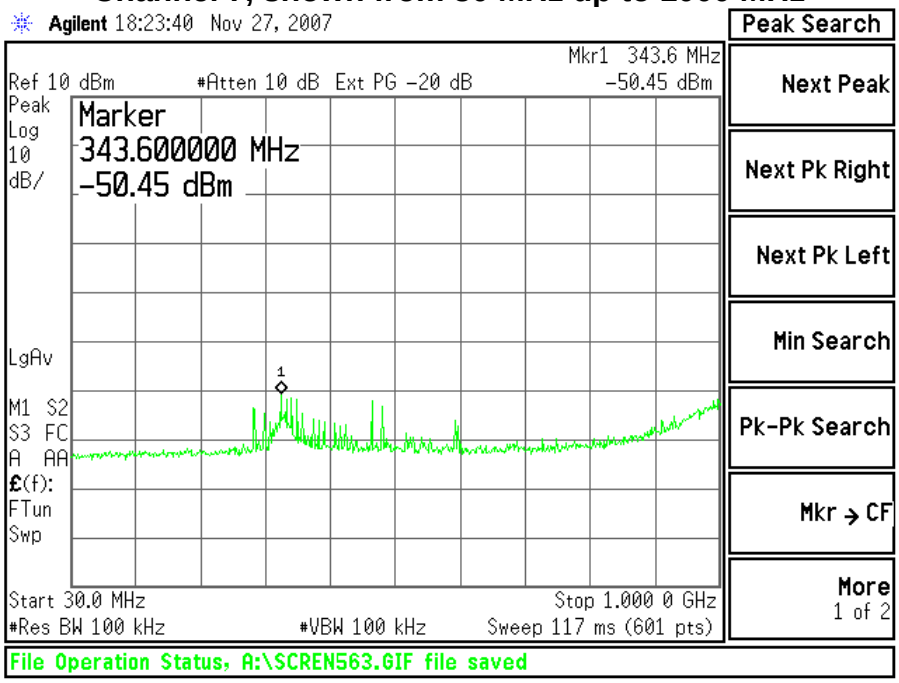
Notes:
(1) Measurement at system noise floor.

11.3 Test Equipment List

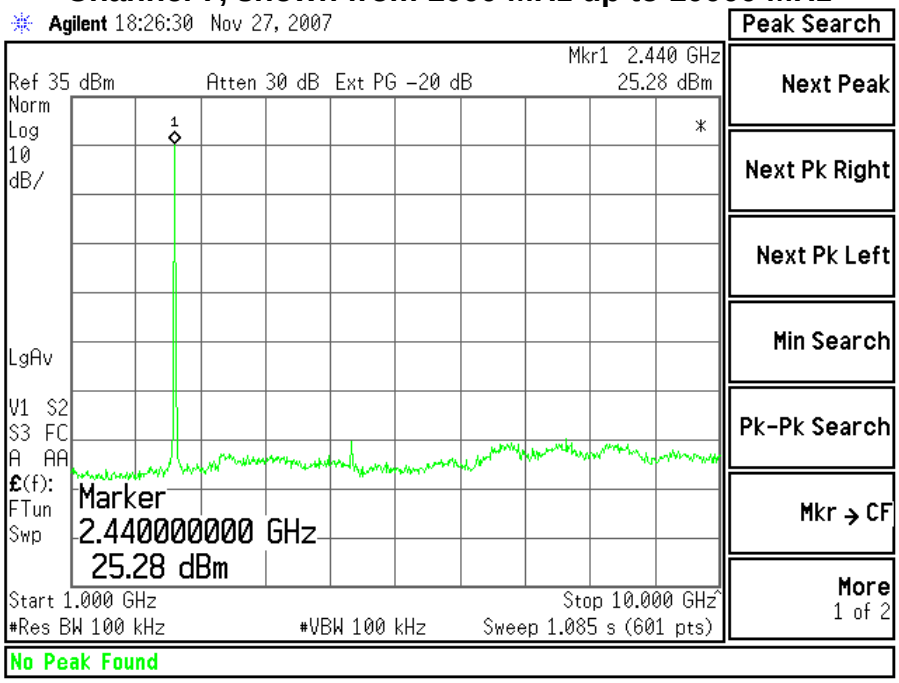
Test Equipment	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Agilent	E4446A	US45300564	To 44 GHz

11.4 Screen Captures – Spurious Radiated Emissions

Channel 7, shown from 30 MHz up to 1000 MHz



Channel 7, shown from 1000 MHz up to 10000 MHz



Channel 7, shown from 10000 MHz up to 25000 MHz

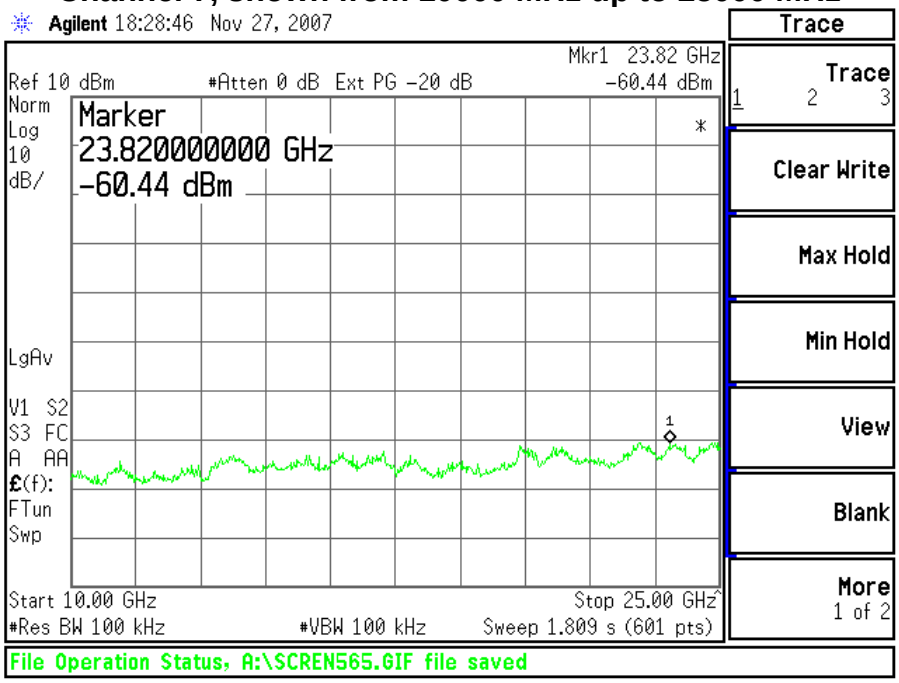


EXHIBIT 12. FREQUENCY & POWER STABILITY OVER VOLTAGE

In this case, the EUT was powered using a standard bench DC supply with a nominal voltage of 3.3 VDC.

A spectrum analyzer was used to measure the frequency at the appropriate frequency markers. For this test, the EUT was placed in continuous transmit CW mode. Power to the EUT was supplied by an external bench-type variable power supply. The frequency of operation was monitored using the spectrum analyzer with RBW=VBW=1 kHz settings while the voltage was varied.

	DC Voltage Source		
	2.8 VDC	3.3 VDC	3.8 VDC
Channel 0	2405000000 (Hz)	2404992000(Hz)	2405000000(Hz)
Channel 7	2440000000 (Hz)	2440000000(Hz)	2440000000(Hz)
Channel 15	2480000000 (Hz)	2480000000(Hz)	2480000000(Hz)

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

	DC Voltage Source		
	2.8 VDC	3.3 VDC	3.8 VDC
Channel 0	19.8(dBm)	21.8(dBm)	21.4(dBm)
Channel 7	28.4(dBm)	29.6(dBm)	29.8(dBm)
Channel E	10.1(dBm)	12.0(dBm)	12.2(dBm)

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

EXHIBIT 13. CHANNEL PLAN AND SEPARATION

Optional for DTS

EXHIBIT 14. MPE CALCULATIONS

The following MPE calculations are based on the Centurion WCR2400 half wavelength dipole antenna, with a measured ERP of 138.0, at 1 meter, and conducted RF power of +30 dBm as presented to the antenna. The calculated gain of this antenna, based on the specification sheet is 2.0 dB.

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:	30.00	(dBm)
Maximum peak output power at antenna input terminal:	1000.000	(mW)
Antenna gain(typical):	2	(dBi)
Maximum antenna gain:	1.585	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2405	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.315304	(mW/cm^2)
Maximum allowable antenna gain:	7.0	(dBi)
Margin of Compliance at 20 cm =	5.0	dB

APPENDIX A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	12/6/07	12/6/08
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	9/19/07	9/19/08
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/19/07	9/19/08
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	12/04/06	12/04/07
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	1/11/07	1/11/08
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/20/07	9/20/08
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/20/07	9/20/08
EE960073	Agilent	E4446A	US45300564	Spectrum Analyzer	8/17/07	8/17/08
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

Antenna Specification(s)

WCR

Model Number:
WCR2400

External Antenna – Connector Mount

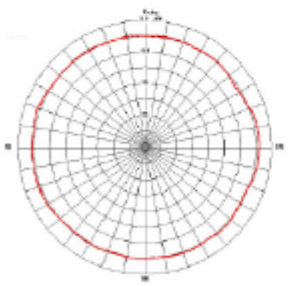
Specifications:

- ½ wave coaxial dipole
- Clutch allows 360° rotation
- Flexible element
- FCC Part 15 compliant polarized connector

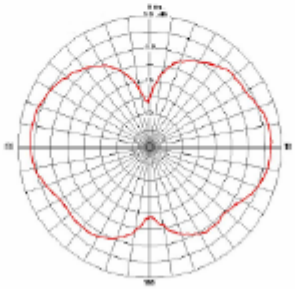
Frequency	2.4 – 2.5 GHz	
Polarization	Vertical	
Gain	MMCX	1.0 dBi
	SMA	2.0 dBi
	SMRP	1.0 dBi
Nominal Impedance	50 ohms	
VSWR	1.5:1 max at resonance	
RF Power Handling	50 watts	
Size (Length)	8cm	
Temperature Range	-40° to +80°C	
Drop Test	1M	

Connectors:

Model #	Part #	Connector
WCR2400-MMCX	WCR2400MMCX	MMCX Straight
WCR2400-SMA	WCR2400SMA	SMA-Male
WCR2400-SMRP	WCR2400SMRP	RP-SMA-Male (gold)



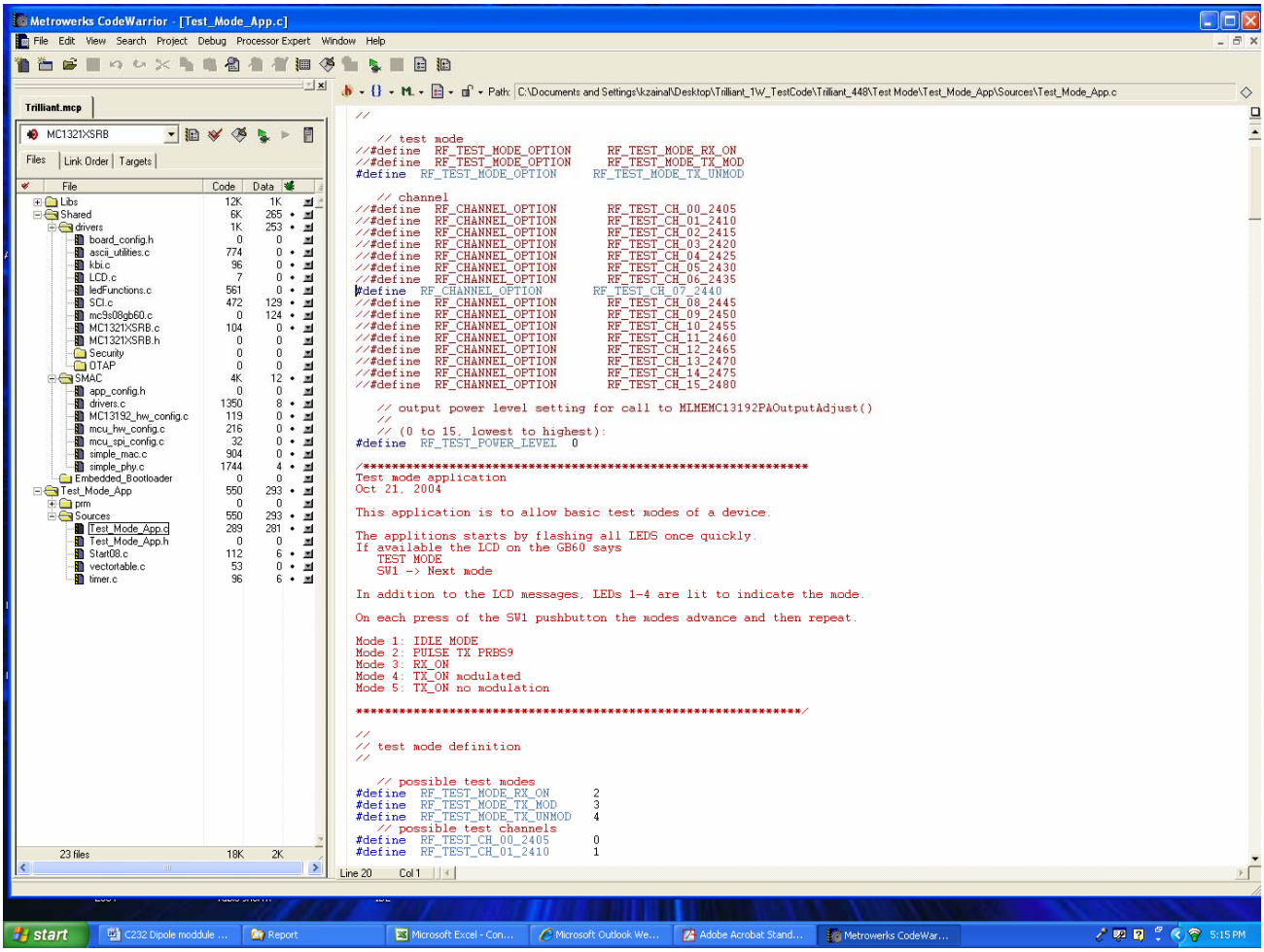
Azimuth
WCR2400MMCX



Elevation
WCR2400MMCX

Appendix C

Firmware and Setup Instructions



To set channels and power profile, the tester will need to activate the appropriate C commands and recompiling the C code.

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)

The transmit packet occupies 6 ms of time, within any 100 ms window. Therefore, the relaxation factor allowance is calculated as:

Average Factor = 20* Log_{10} (6ms / 100 ms) = -24.4

A relaxation factor of 20 dB which is the maximum allowable would be applied to this product.

Trilliant Networks High Sensitivity 1 Watt Radio Module - Relaxation Factor

November 12, 2007

The Trilliant Networks High Sensitivity 30dBm Radio Module does not transmit for more than 10ms over a 100ms time period. The reason allows timeouts between packets for acknowledgements to individual messages that exceeds the 100ms timeframe. The radio module receives its information by a host module and is limited by both communication speed and timeouts allowed for responses from the mesh network. Shown below are two examples of communication, packet retry and subsequent packets.

A typical example where a packet is retried over the network:

A) Message is transmitted by the radio, with the total transmission requiring 6ms over the air time.

B) We allow up to 125ms for an acknowledgement before message retries.

C) In the retry scenario, the message would be resent 125ms after the first message.

An example of subsequent different messages would be:

A) Message packet 1 is transmitted by the radio, with the total transmission requiring 6ms over the air time.

B) An acknowledgement is received quickly, within 35ms.

C) The radio sends the host module that the ACK occurred, and a second packet is sent from the host module to the radio. Due to different communication speeds and protocol, the second message is sent to the radio within 75ms.

D) In the subsequent message scenario, the second packet of 6ms duration is sent 110ms in an absolute best-case scenario after the first message is completed.

In both cases, the transmission time is max. 6 milliseconds within a 110 or 125 millisecond time window.

Trilliant Networks, Inc. 950 Rue Cowie Granby, Quebec J2J 1P2 Canada Phone (450) 375-0556