

LS Research, LLC

W66 N220 Commerce Court • Cedarburg, WI 53012 • USA

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www.lsr.com

ENGINEERING TEST REPORT 307224.2 TCB Rev. 1 Job # R-383

Compliance Testing of:

APEX module with PCB inverted-F antenna

Test Date(s):

October 15th – December 27th 2007

Prepared For:

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, WI 53012

**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

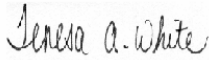


Signature:

Date: December 28, 2007

Test Report Reviewed by:

Teresa A. White, Quality Manager



Signature:

Date: December 28, 2007

Tested by:

Khairul Aidi Zainal, Senior EMC Engineer



Signature:

Date: December 28, 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: | <ul style="list-style-type: none"> • 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. |

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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.

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EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

| | |
|---------------------------|--|
| Manufacturer Name: | LS Research, LLC |
| Address: | W66 N220 Commerce Court, Cedarburg, Wi. 53012 |
| Contact Person: | William Steinike |

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

| | |
|-----------------------|------------|
| Product Name: | APEX |
| Model Number: | ZAXM-201-1 |
| Serial Number: | 07040109 |

2.3 ASSOCIATED ANTENNA DESCRIPTION

Antenna on the module was a PCB trace inverted F antenna.

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2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

| | |
|---|--|
| Frequency Range (in MHz) | 2400 MHz to 2483.5 MHz |
| RF Power in Watts | 0.093 Watts |
| Conducted Output Power (in dBm) | 19.7 dBm (2405MHz and 2470MHz) |
| Field Strength (and at what distance) | 119.0 dB μ V/m at 3m (2440MHz) |
| Occupied Bandwidth (20db/6dB) | 2680 kHz / 1670 kHz |
| Type of Modulation | O-QPSK |
| Emission Designator | G1D2M68 |
| EIRP (in mW) | 238.2 mW |
| Transmitter Spurious (worst case) | 68.3 dB μ V/m at 9760MHz (1m distance) |
| Frequency Tolerance %, Hz, ppm | Better than 100 ppm |
| Microprocessor Model # (if applicable) | Ember EM250 |
| Antenna Information | |
| Detachable/non-detachable | Non- detachable |
| Type | PCB trace inverted F |
| Gain (in dBi) | 4.17 dBi (calculated from measurements based on the channel with maximum field strength) |
| EUT will be operated under FCC Rule Part(s) | CFR 47 15.247 RSS 210 |
| Modular Filing | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |

RF Technical Information:

| | | |
|--------------------------------|-------------------------------------|---|
| Type of Evaluation (check one) | <input type="checkbox"/> | SAR Evaluation: Device Used in the Vicinity of the Human Head |
| | <input type="checkbox"/> | SAR Evaluation: Body-worn Device |
| | <input checked="" type="checkbox"/> | 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: 3 m
- RF Value: 0.891 V/m A/m W/m²
 Measured Computed Calculated

| | | |
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2.5 PRODUCT DESCRIPTION

The APEX module is a 802.15.4/Zigbee module based upon the Ember EM250 transceiver. It is used in point to point, point to multi-point, and mesh networks. It operates in the 2.4GHz ISM band. The modulation is standard IEEE 802.15.4 format, O-QPSK with half sine filter operating with a chip rate of 2 Mcps. The effective bit rate is 250kbps. The modulation data is generated by the EM250 transceiver itself and spread using 16 orthogonal sequences. 16 channels are used in 5 MHz steps from 2405 to 2480 MHz. An external supply running at 3.3VDC typically is used. A serial port is used to program the test modes with the module. Two antenna configurations are used, an on-board PCB trace antenna and an external whip antenna.

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EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

| | |
|--------------|----------------|
| Temperature: | 71° Fahrenheit |
| Humidity: | 38% |
| 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 |
| <i>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.</i> | | |

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3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None Yes (explain below)

The module was operated in reduced power setting on 2 channels:

| Channel | Power Setting |
|--------------|-------------------------------|
| b (2405MHz) | 3 (maximum setting) |
| 12 (2440MHz) | 3 (maximum setting) |
| 18 (2470MHz) | 3 (maximum setting) |
| 19 (2475MHz) | -12 (reduced setting) |
| 1a (2480MHz) | -2b (minimum reduced setting) |

Note: Channels and power level settings are in hex.

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

None Yes (explain below)

1. Although the fundamental and the band edge measurements were made on 5 channels, the harmonics measurements were made on the lowest, medium and highest channel at full power (instead of reduced power on the lowest channel). Based on sound engineering principles, it would be valid to conclude that if the harmonics on the lowest channel operating at full power are below the limit, the harmonics of the remaining channels operating at reduced power levels will also.

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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.

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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 4 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of five (5) standard channels: b (2405MHz), 12 (2440MHz), 18(2470MHz), 19(2475MHz), 1a (2480MHz), to comply with FCC Part 15.35. The channels and operating modes were changed using an APEX interface board (to provide the USB to RS232 translation) which was controlled using hyper-terminal software.

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 during the investigations to find the highest emission levels.

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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 50 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 E4446A Spectrum Analyzer with a standard gain horn, and preamp were used.

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 |

5.4 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.

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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 $\mu\text{V/m}$ | 3 m Limit (dB $\mu\text{V/m}$) | 1 m Limit (dB $\mu\text{V/m}$) |
|-----------------|---------------------------|---------------------------------|---------------------------------|
| 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 $\mu\text{V/m}$ to dB $\mu\text{V/m}$:

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

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

$$\begin{aligned} &960 \text{ MHz to } 10,000 \text{ MHz} \\ &500\mu\text{V/m or } 54.0 \text{ dB}/\mu\text{V/m at } 3 \text{ meters} \\ &54.0 + 9.5 = 63.5 \text{ dB}/\mu\text{V/m at } 1 \text{ meter} \end{aligned}$$

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

$$\begin{aligned} &960 \text{ MHz to } 10,000 \text{ MHz} \\ &500\mu\text{V/m or } 54.0 \text{ dB}/\mu\text{V/m at } 3 \text{ meters} \\ &54.0 + 20 = 74 \text{ dB}/\mu\text{V/m at } 0.3 \text{ meters} \end{aligned}$$

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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: | LS Research, LLC | | | | |
| Date(s) of Test: | October 15 th – December 28 th 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 | | Quasi-Peak | √ Average |

The following table depicts the level of radiated RF fundamental measured at a separation distance of 3 meter.

| Frequency (MHz) | Ant./EUT Polarity | Channel | Height (meters) | Azimuth (0° - 360°) | Measured EFI (PEAK) (dBμV/m) | Measured EFI (AVG) (dBμV/m) | 15.247 Limit (dBμV/m) | Margin (dB) |
|-----------------|-------------------|---------|-----------------|---------------------|------------------------------|-----------------------------|-----------------------|-------------|
| 2405 | V/V | b | 1.49 | 255 | 120.2 | 116.7 | 125.2 | 8.5 |
| 2440 | V/V | 12 | 1.19 | 260 | 121.5 | 119.0 | 125.2 | 6.2 |
| 2470 | V/V | 18 | 1.16 | 268 | 120.6 | 117.3 | 125.2 | 7.9 |
| 2475 | V/V | 19 | 1.15 | 272 | 108.5 | 104.9 | 125.2 | 20.3 |
| 2480 | V/V | 1a | 1.44 | 282 | 82.2 | 79.9 | 125.2 | 45.3 |

Notes:

- 1) An average Detector was used in measurements above 1 GHz. Only the results from the average detector are published in the table above.
- 2) For measurements of the fundamental power, because of spectral bandwidth, the receiver was set to RBW=VBW=3 MHz.

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

| Frequency (MHz) | Ant./EUT Polarity | Height (meters) | Azimuth (0° - 360°) | Measured EFI (PEAK) (dBμV/m) | Measured EFI (AVG) (dBμV/m) | 15.247 Limit (dBμV/m) | Margin (dB) |
|-----------------|-------------------|-----------------|---------------------|------------------------------|-----------------------------|-----------------------|-------------|
| 4810 | H/H | 1.16 | 212 | 62.3 | 54.3 | 63.5 | 9.2 |
| 7215 | H/H | 1.00 | 55 | 53.4 | 46.5 | 108.5 | 62.0 |
| 9620 | H/V | 1.00 | 8 | 76.0 | 65.8 | 108.5 | 42.7 |
| 12025 | H/S | 1.00 | 214 | 51.5 | 45.2 | 63.5 | 18.3 |
| 14430 | H/V | 1.00 | 223 | 63.0 | 54.7 | 108.5 | 53.8 |
| 16835 | H/V | 1.00 | 109 | 50.9 | 47.7 | 108.5 | 60.8 |
| 19240 | V/S | 1.00 | 147 | 56.6 | 53.0 | 63.5 | 10.5 |
| 21645 | V/S | 1.00 | 229 | 51.7 | 48.8 | 108.5 | 59.7 |
| 24050 | V/S | 1.00 | 89 | 50.4 | 48.0 | 108.5 | 60.5 |

The following table depicts the level of significant radiated harmonic emissions seen on Channel 12:

| Frequency (MHz) | Ant./EUT Polarity | Height (meters) | Azimuth (0° - 360°) | Measured EFI (PEAK) (dBμV/m) | Measured EFI (AVG) (dBμV/m) | 15.247 Limit (dBμV/m) | Margin (dB) |
|-----------------|-------------------|-----------------|---------------------|------------------------------|-----------------------------|-----------------------|-------------|
| 4880 | H/H | 1.09 | 211 | 60.9 | 58.8 | 63.5 | 4.7 |
| 7320 | H/H | 1.00 | 55 | 53.0 | 45.6 | 63.5 | 17.9 |
| 9760 | H/V | 1.00 | 12 | 78.7 | 68.3 | 108.5 | 40.2 |
| 12200 | H/S | 1.00 | 169 | 49.6 | 42.6 | 63.5 | 20.9 |
| 14640 | H/V | 1.00 | 222 | 59.7 | 52.3 | 108.5 | 56.2 |
| 17080 | H/V | 1.05 | 15 | 51.6 | 48.3 | 108.5 | 60.2 |
| 19520 | H/S | 1.00 | 173 | 59.5 | 55.3 | 63.5 | 8.2 |
| 21960 | V/S | 1.00 | 75 | 54.2 | 51.4 | 108.5 | 57.1 |
| 24400 | V/S | 1.00 | 56 | 53.0 | 50.2 | 108.5 | 58.3 |

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

| Frequency (MHz) | Ant./EUT Polarity | Height (meters) | Azimuth (0° - 360°) | Measured EFI (PEAK) (dBμV/m) | Measured EFI (AVG) (dBμV/m) | 15.247 Limit (dBμV/m) | Margin (dB) |
|-----------------|-------------------|-----------------|---------------------|------------------------------|-----------------------------|-----------------------|-------------|
| 4960 | H/H | 1.10 | 194 | 66.5 | 59.8 | 63.5 | 3.7 |
| 7440 | H/H | 1.00 | 44 | 53.8 | 46.8 | 63.5 | 16.7 |
| 9920 | H/V | 1.00 | 14 | 74.9 | 65.1 | 108.5 | 43.4 |
| 12400 | H/S | 1.00 | 164 | 52.2 | 45.2 | 63.5 | 18.3 |
| 14880 | H/V | 1.00 | 127 | 62.1 | 53.8 | 108.5 | 54.7 |
| 17360 | H/V | 1.08 | 174 | 55.5 | 52.8 | 108.5 | 55.7 |
| 19840 | V/S | 1.00 | 74 | 61.9 | 58.1 | 63.5 | 5.4 |
| 22320 | V/S | 1.00 | 230 | 51.2 | 48.6 | 63.5 | 14.9 |
| 24800 | V/S | 1.00 | 42 | 54.1 | 51.1 | 108.5 | 57.4 |

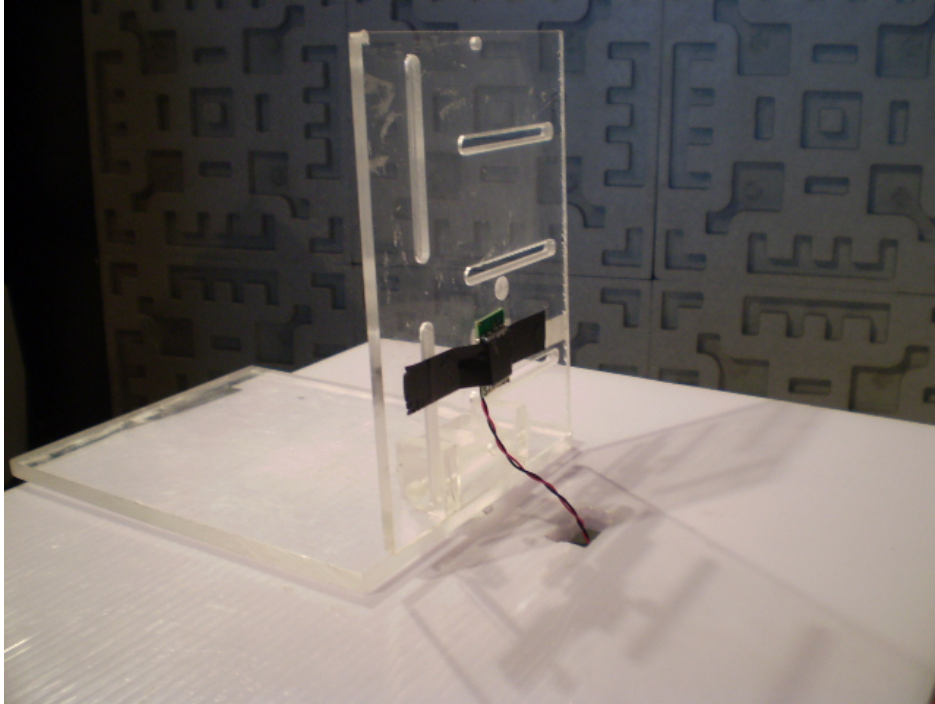
Notes:

- 1) 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.
- 2) Measurement at receiver system noise floor.
- 3) All measured channels were set at power level '3' (maximum operating power level) for measurements of harmonics, even though 1b operates on a reduced power level.

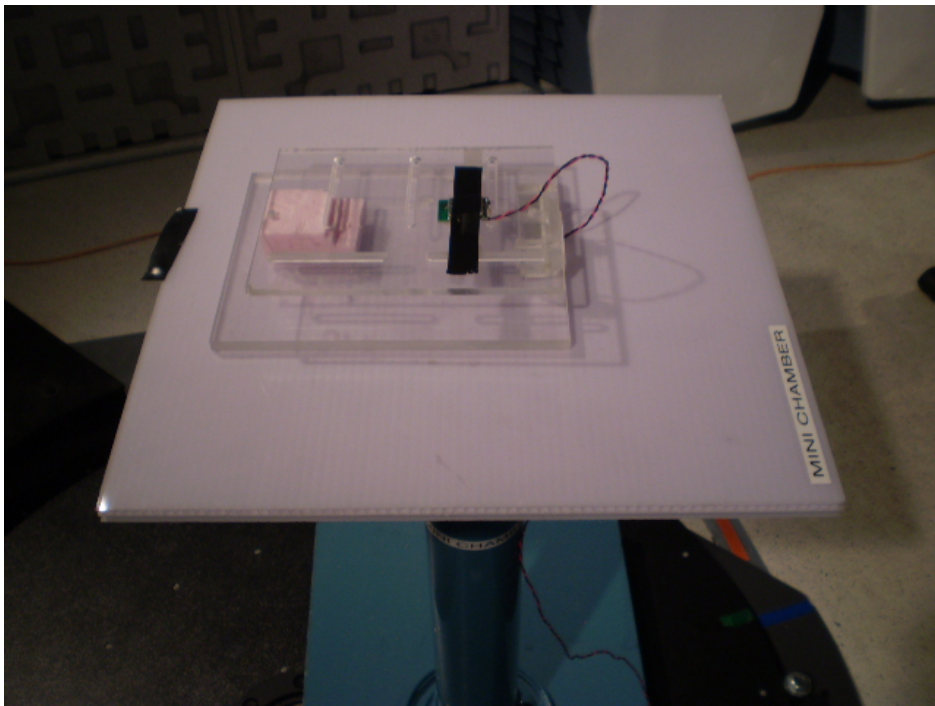
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 16 of 52 |

5.7 Test Setup Photo(s) – Radiated Emissions Test

Vertical Orientation

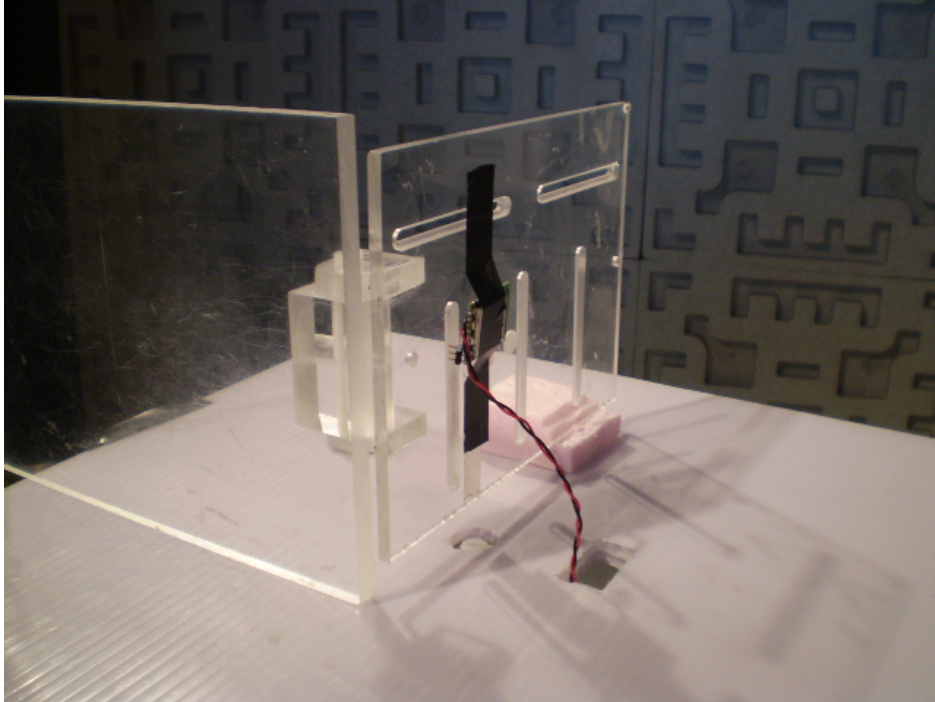


Horizontal Orientation



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 17 of 52 |

Side Orientation



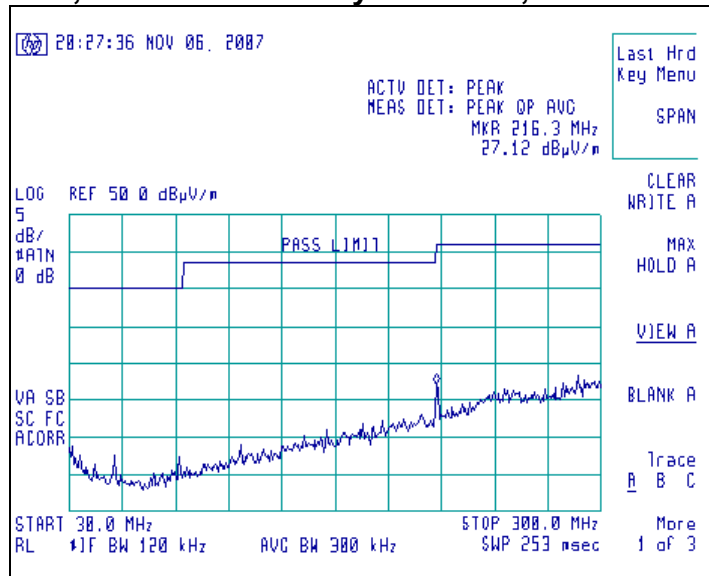
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 18 of 52 |

5.8 Screen Captures - Radiated Emissions Testing

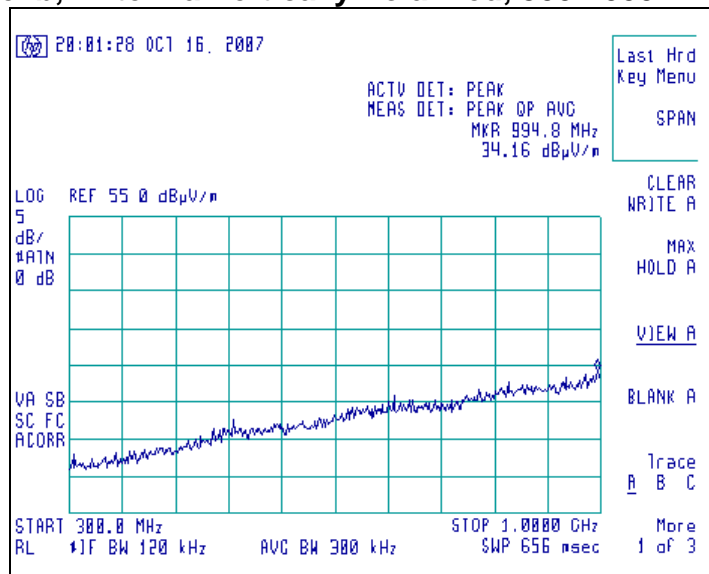
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels b, 12, 18, 19 or 1a with the sense antenna both in vertical and horizontal polarity for worst case presentations.

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



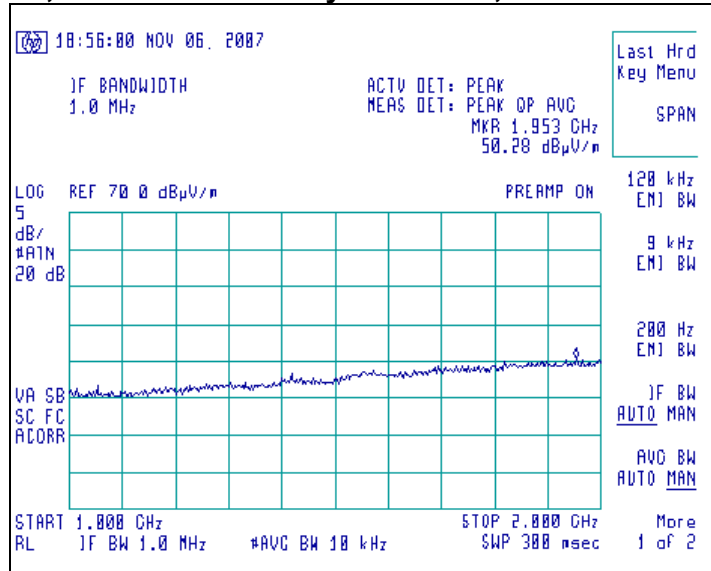
Channel b, Antenna Vertically Polarized, 300-1000 MHz, at 3m



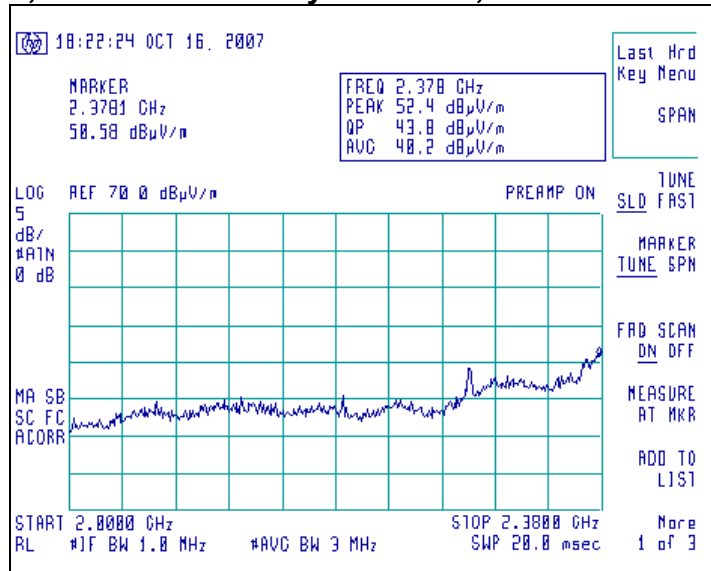
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 19 of 52 |

Screen Captures - Radiated Emissions Testing (continued)

Channel b, Antenna Vertically Polarized, 1000-2000 MHz, at 3m

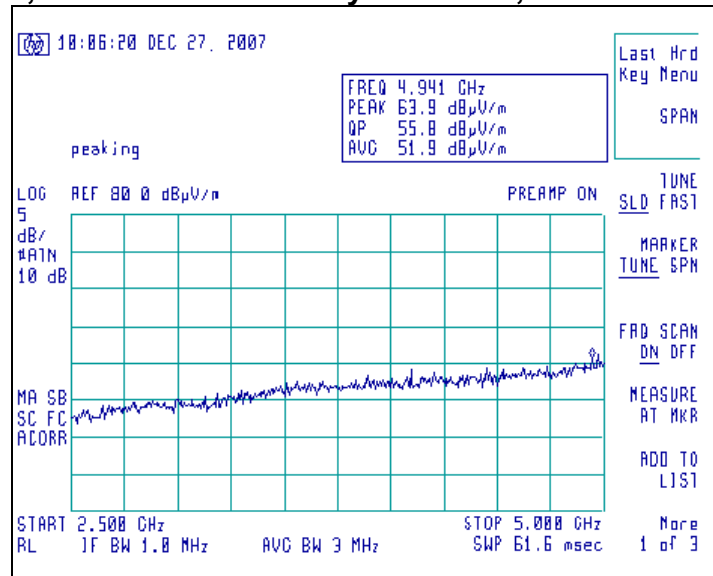


Channel b, Antenna Vertically Polarized, 2000 to 2380 MHz, at 3m

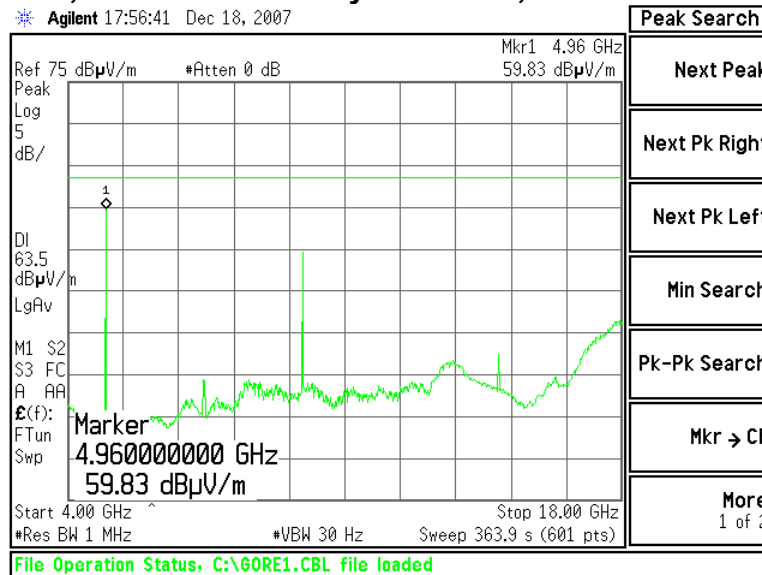


Screen Captures - Radiated Emissions Testing (continued)

Channel 18, Antenna Horizontally Polarized, 2500 - 5000 MHz, at 3m



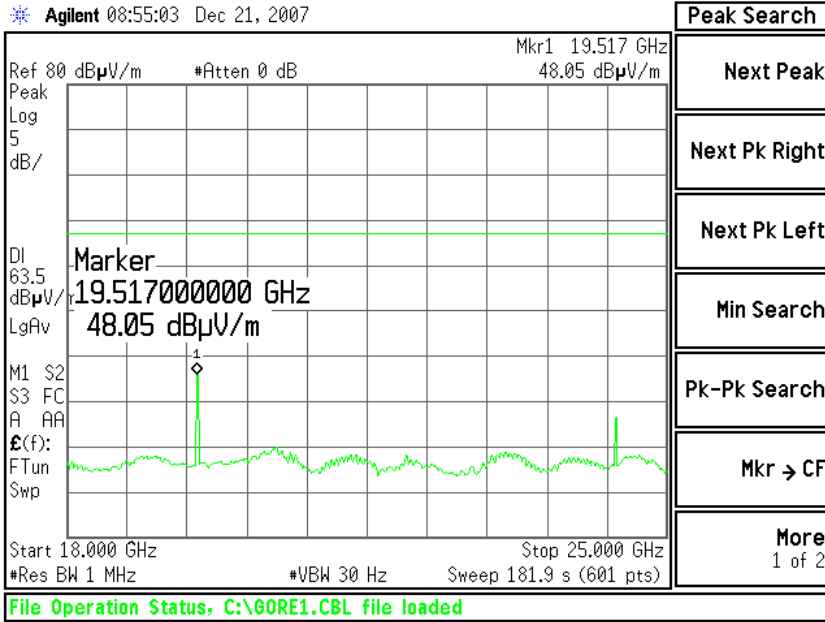
Channel 1a, Antenna Vertically Polarized, 4000-18000 MHz, at 1m



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 21 of 52 |

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

Channel 12, Antenna Horizontally Polarized, 18000-25000 MHz, at 30cm



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 22 of 52 |

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 50 Ω (ohm), 50/250 μ H 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 50 Ω (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.

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.

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 |

6.4 Test Results

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

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 23 of 52 |

6.5 FCC Limits of Conducted Emissions at the AC Mains Ports

| Frequency Range (MHz) | Class B Limits (dB μ V) | | Measuring Bandwidth |
|---|-----------------------------|---------|--|
| | Quasi-Peak | Average | |
| 0.150 -0.50 * | 66-56 | 56-46 | RBW = 9 kHz VBW \geq 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. | | | |

6.6

TEST DATA CHART CONDUCTED EMISSION

Frequency Range inspected: 150 KHz to 30 MHz

Test Standard: FCC 15.207 Class B

| | | | | | |
|--------------------------------------|---|---------------------------------|---|-------------|--------------|
| Manufacturer: | LS Research, LLC | | | | |
| Date(s) of Test: | October 15 th – December 28 th 2007 | | | | |
| Test Engineer: | Khairul Aidi Zainal | | | | |
| Model #: | APX01 | | | | |
| Serial #: | 0704109 | | | | |
| 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 |

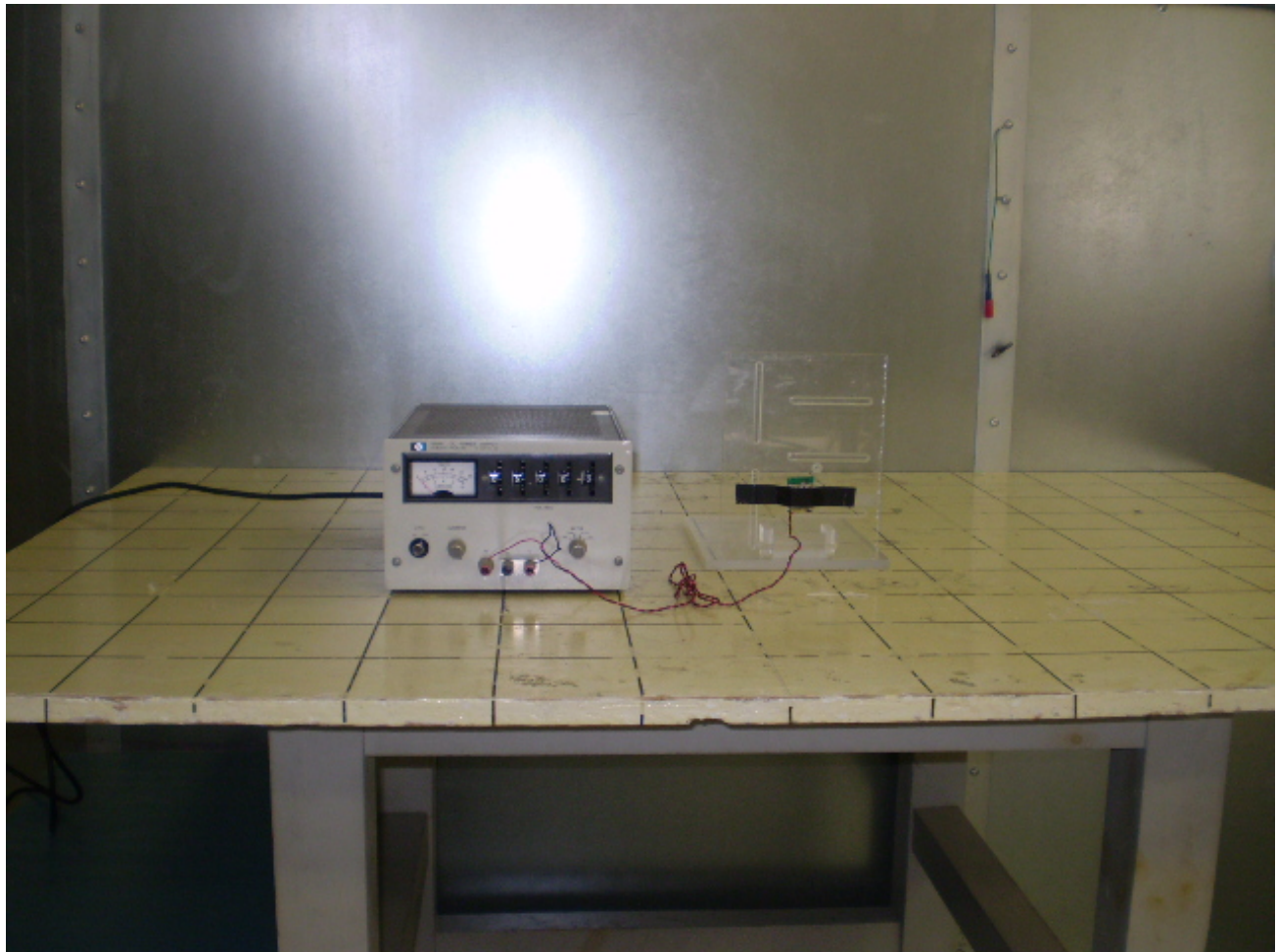
| Frequency (MHz) | Line | <u>QUASI-PEAK</u> | | | <u>AVERAGE</u> | | |
|-----------------|------|-----------------------|----------------------|------------------------|------------------------|-----------------------|---------------------|
| | | Q-Peak Reading (dBμV) | Q-Peak Limit (dBμ V) | Quasi-Peak Margin (dB) | Average Reading (dBμV) | Average Limit (dBμ V) | Average Margin (dB) |
| 0.170 | 1 | 48 | 65.0 | 17 | 20.2 | 55.0 | 34.8 |
| 0.329 | 1 | 45.7 | 59.5 | 13.8 | 18.4 | 49.5 | 31.1 |
| 0.340 | 1 | 45.6 | 59.2 | 13.6 | 18.2 | 49.2 | 31 |
| 0.673 | 1 | 33.5 | 56.0 | 22.5 | 6.2 | 46.0 | 39.8 |
| 4.000 | 1 | 33.6 | 56.0 | 22.4 | 32.3 | 46.0 | 13.7 |
| | | | | | | | |
| 0.320 | 2 | 46.4 | 59.7 | 13.3 | 18.9 | 49.7 | 30.8 |
| 0.341 | 2 | 46.4 | 59.2 | 12.8 | 18.9 | 49.2 | 30.3 |
| 0.360 | 2 | 46 | 58.7 | 12.7 | 18.3 | 48.7 | 30.4 |
| 0.962 | 2 | 28.3 | 56.0 | 27.7 | 2.6 | 46.0 | 43.4 |
| 4.000 | 2 | 33.5 | 56.0 | 22.5 | 32.1 | 46.0 | 13.9 |

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 5 channels tested.

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 25 of 52 |

6.7 Test Setup Photo(s) – Conducted Emissions Test



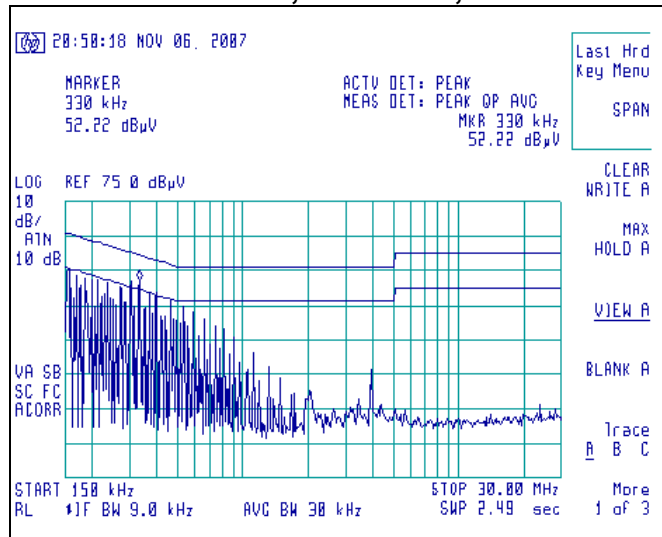
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 26 of 52 |

6.8 Screen Captures – Conducted Emissions Test

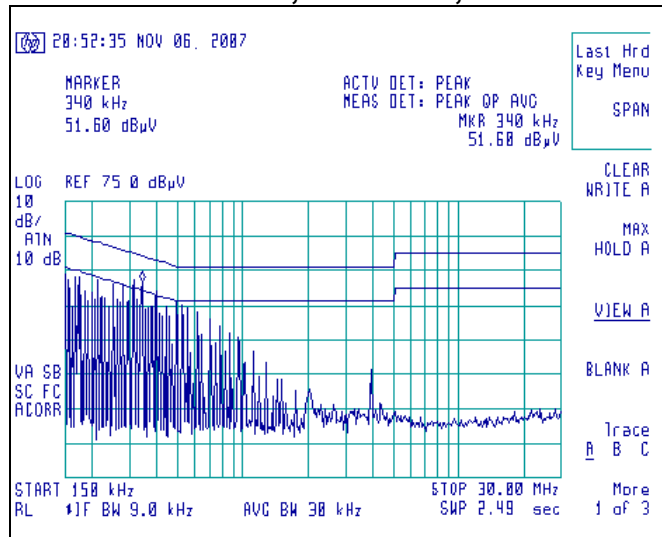
These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207.

The signature scans shown here are from channel 7, chosen as being a good representative of channels.

Channel 12, 2440 MHz, Line 1



Channel 12, 2440 MHz, Line 2



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 27 of 52 |

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 1620 kHz, which is above the minimum of 500 kHz.

Test Data

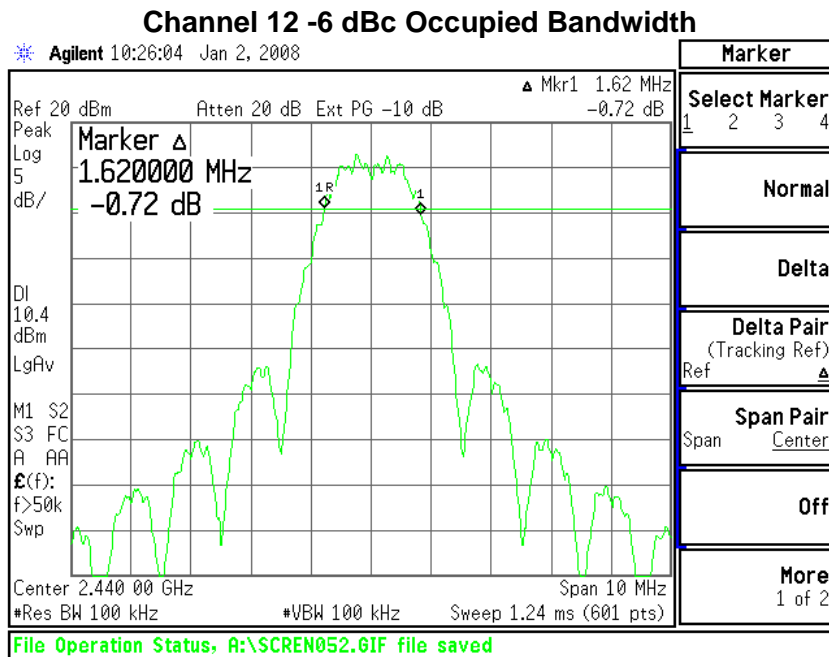
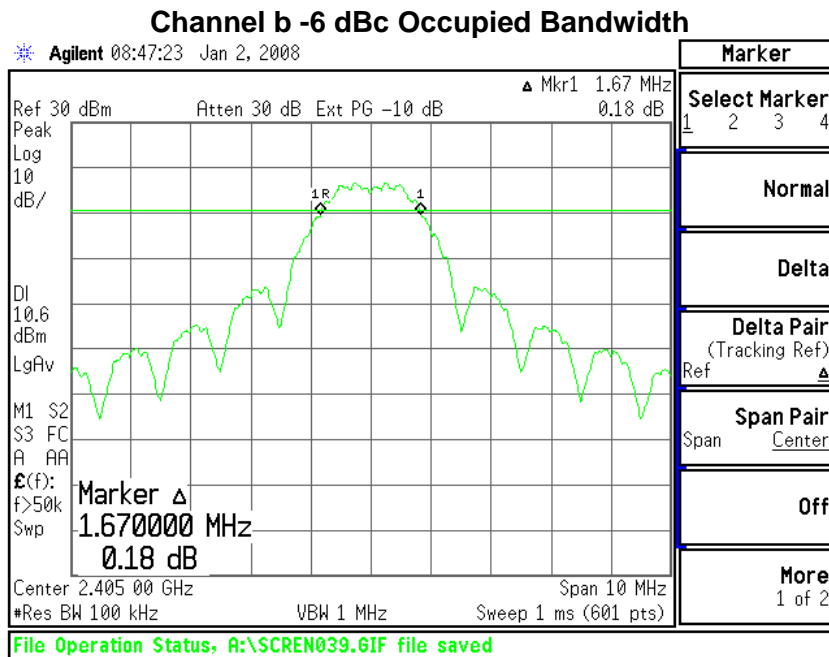
| Channel | Center Frequency (MHz) | Measured -6 dBc Occ. BW (kHz) | Minimum -6 dBc Limit (kHz) | Measured -20 dBc Occ.Bw (kHz) |
|---------|------------------------|-------------------------------|----------------------------|-------------------------------|
| b | 2405 | 1670 | 500 | 2680 |
| 12 | 2440 | 1620 | 500 | 2650 |
| 18 | 2470 | 1670 | 500 | 2670 |
| 19 | 2475 | 1620 | 500 | 2670 |
| 1a | 2480 | 1630 | 500 | 2670 |

7.3 Test Equipment List

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

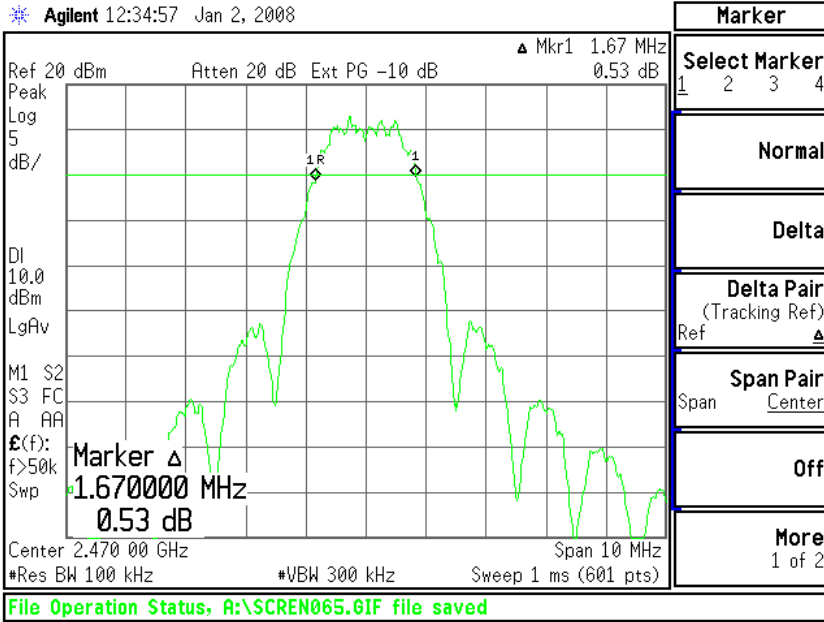
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 28 of 52 |

7.4 Screen Captures - OCCUPIED BANDWIDTH

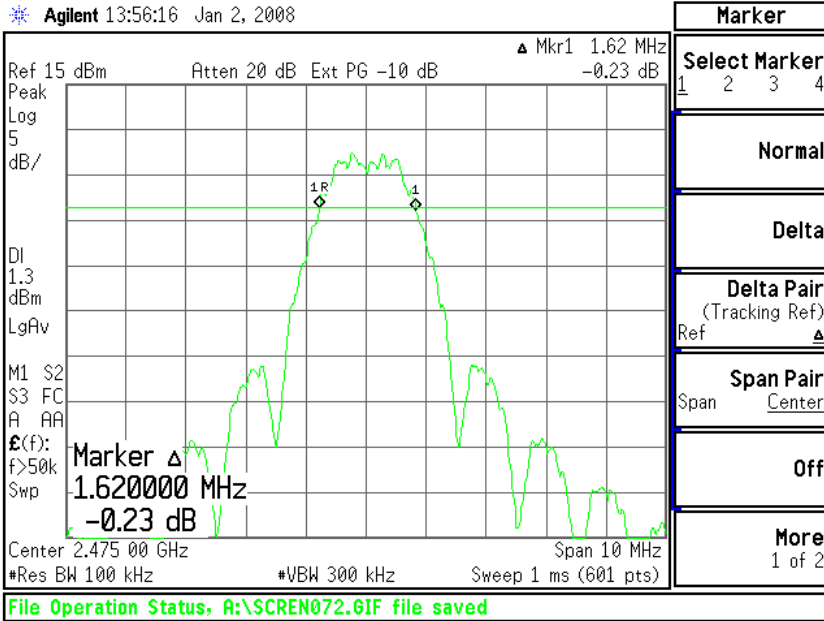


| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 29 of 52 |

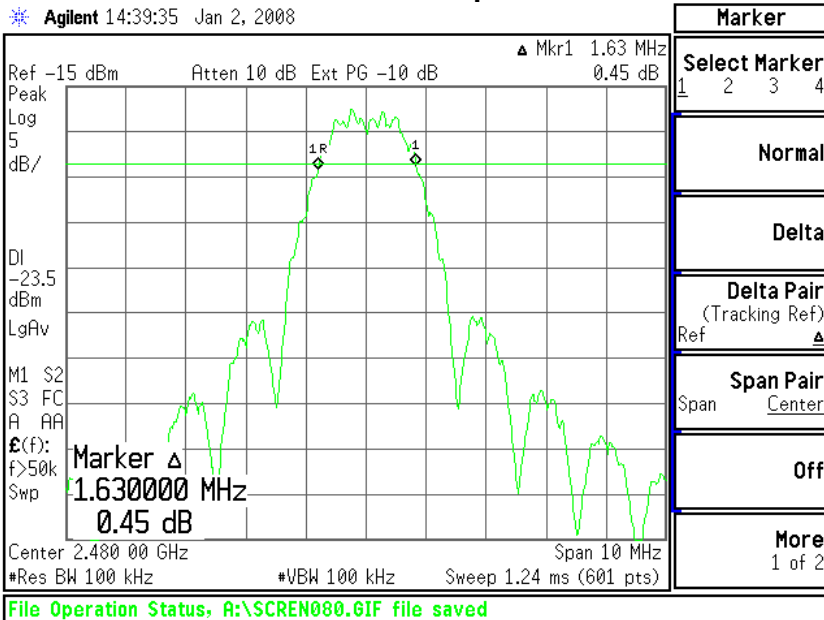
Channel 18 -6 dBc Occupied Bandwidth



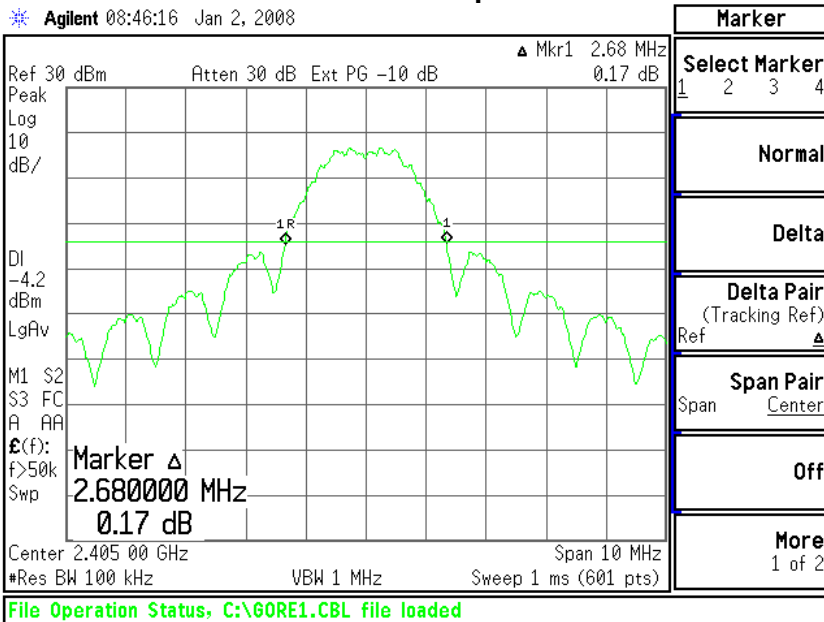
Channel 19 -6 dBc Occupied Bandwidth



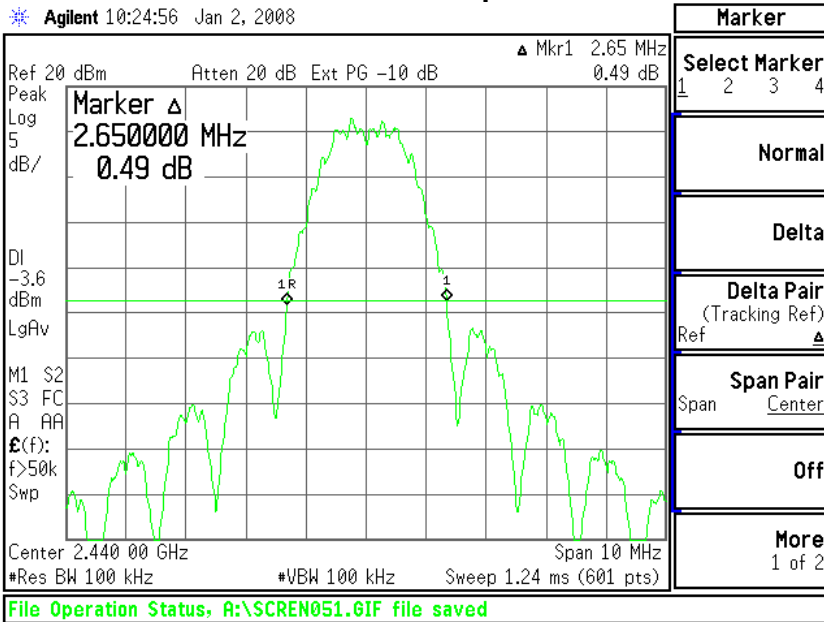
Channel 1a -6 dBc Occupied Bandwidth



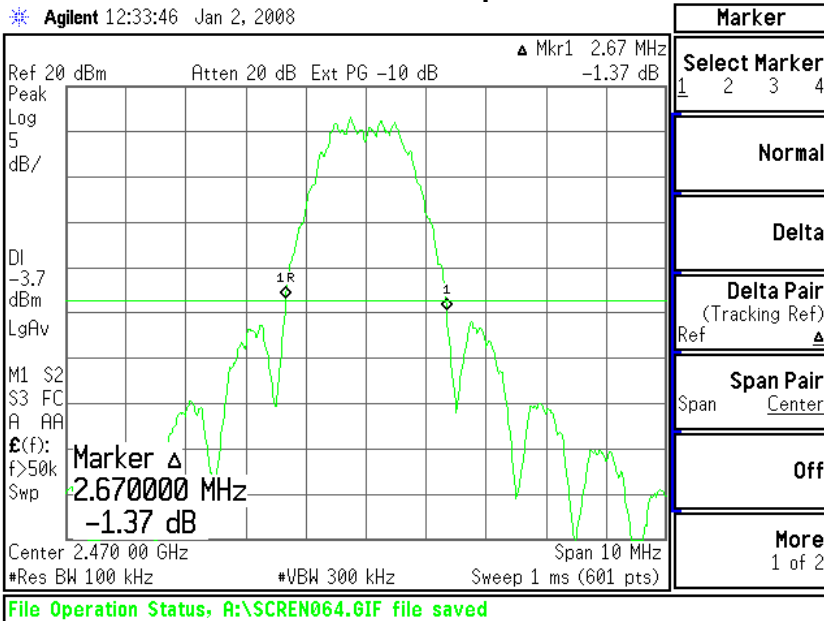
Channel b -20 dBc Occupied Bandwidth



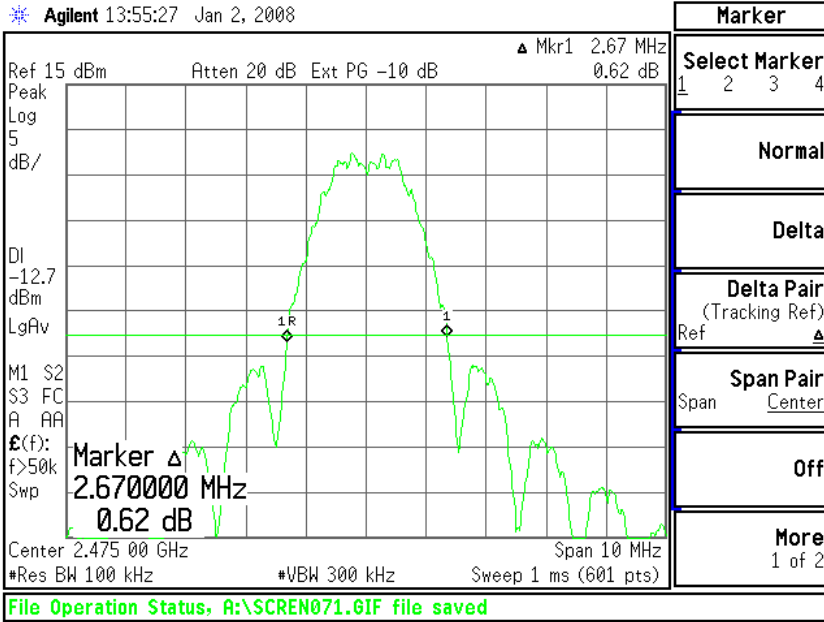
Channel 12 -20 dBc Occupied Bandwidth



Channel 18 -20 dBc Occupied Bandwidth



Channel 19 -20 dBc Occupied Bandwidth



Channel 1a -20 dBc Occupied Bandwidth

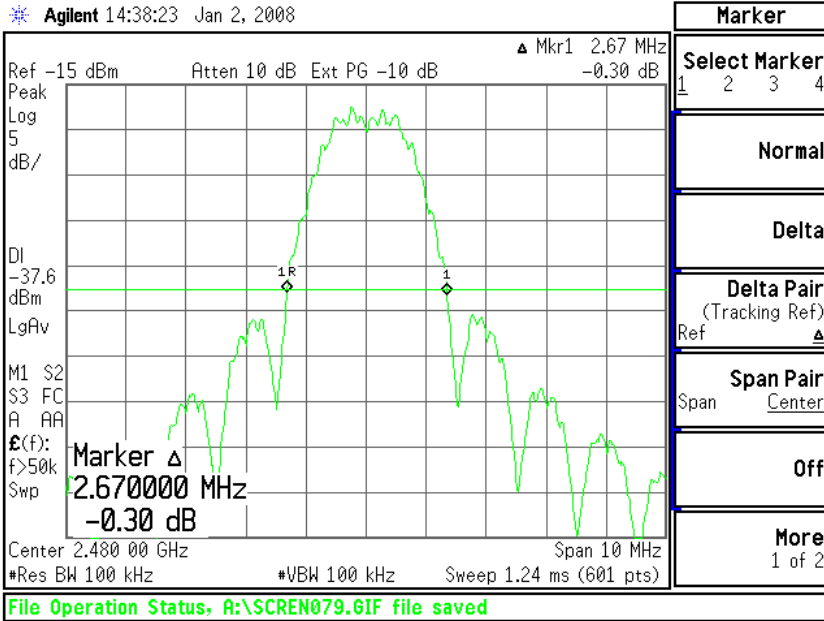


EXHIBIT 8. BAND-EDGE MEASUREMENTS

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 lowest channels for the investigation of the lower Band-Edge, and at the 3 highest channels for the investigation of the higher Band-Edge.

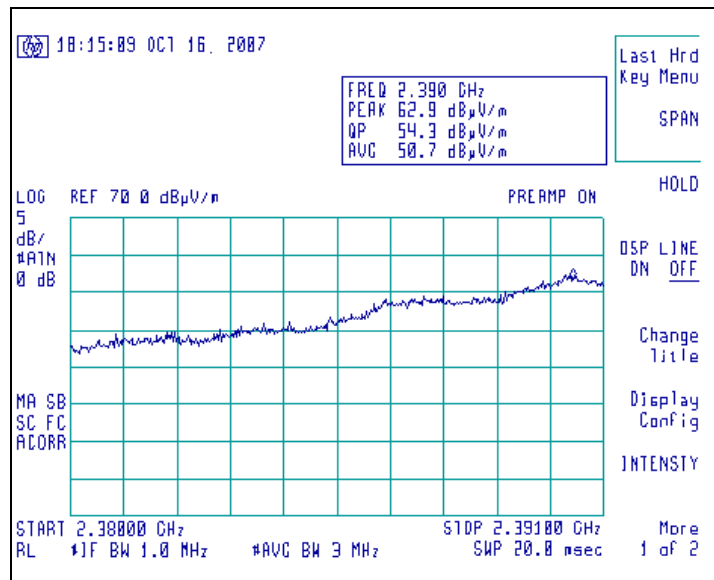
The Lower Band-Edge limit, in this case, would be -20 dBc with respect to the fundamental level.

The Upper Band-Edge limit, in this case, would be +54.0 dBμV/m at 3m

Screen Captures Demonstrating Compliance at the **Lower Band-Edge**

Channel b

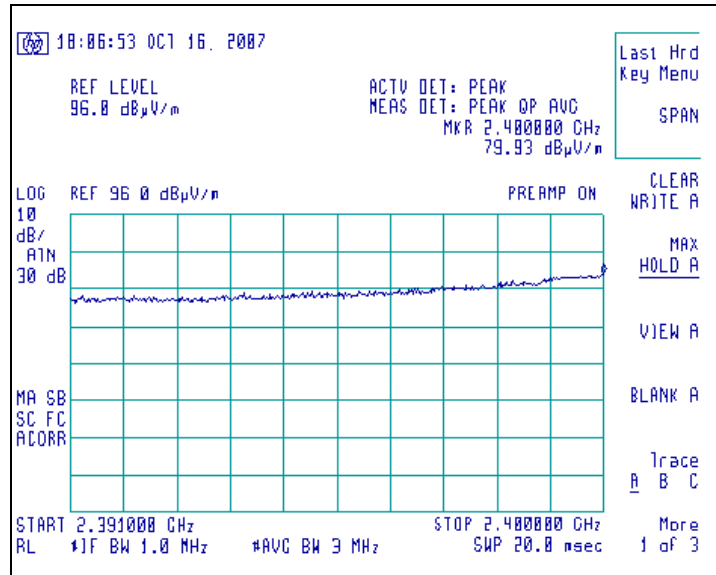
1). 2380MHz to 2391 MHz



Note: At peak point within range, the average detector (since above 1GHz) measurement was below limit (54dBuV/m).

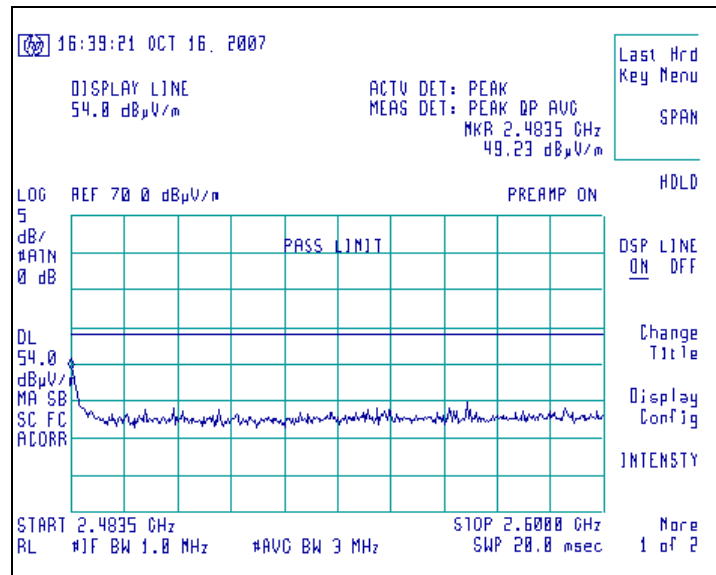
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 34 of 52 |

2). 2391MHz to 2400MHz



Note: Within this range the limit is 20dB below the fundamental (96.7 dB μ V/m)

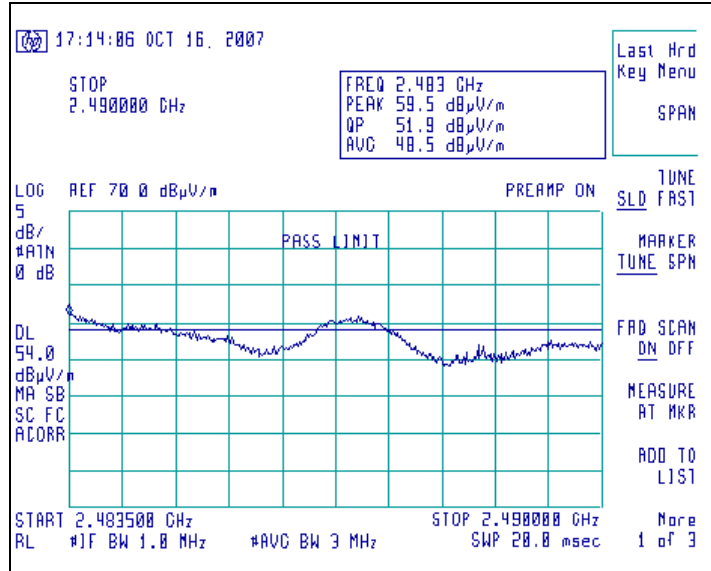
Screen Captures Demonstrating Compliance at the **Higher Band-Edge**
Channel 1a



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 35 of 52 |

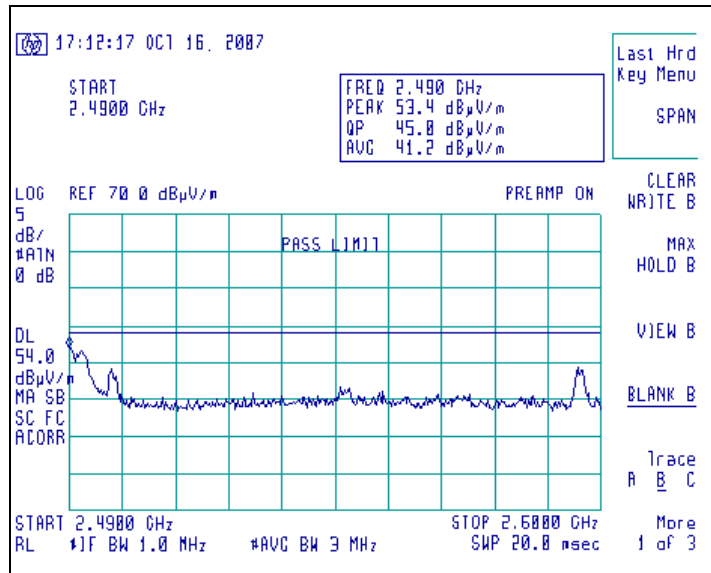
Channel 19

1) 2483.5MHz to 2490MHz



Note: At peak point within range, the average detector (since above 1GHz) measurement was below limit (54dBuV/m).

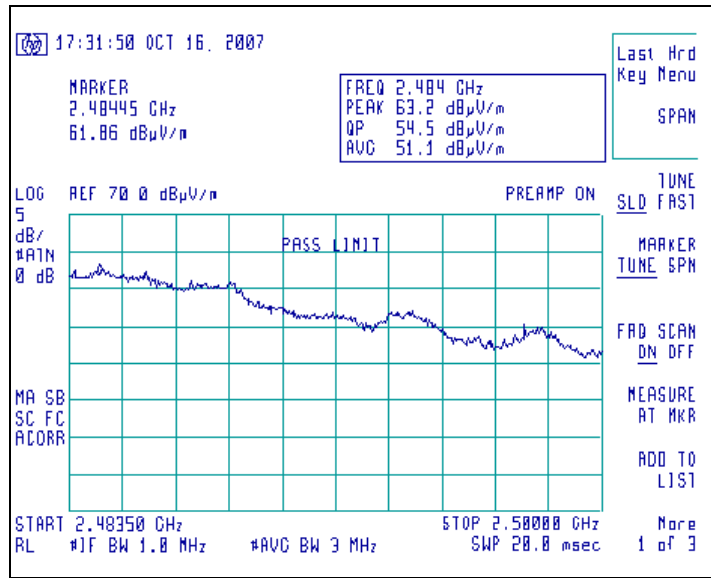
2) 2490MHz to 2600MHz



Note: At peak point within range, the average detector (since above 1GHz) measurement was below limit (54dBuV/m).

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 36 of 52 |

Channel 18



Note: At peak point within range, the average detector (since above 1GHz) measurement was below limit (54dBuV/m).

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 37 of 52 |

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

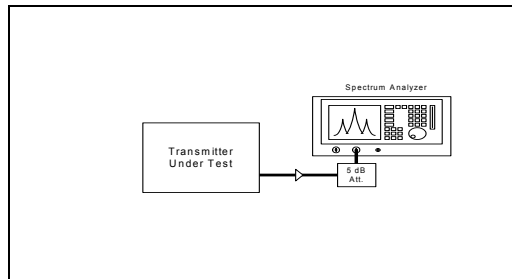
9.1 Method of Measurements

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 10 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) |
|---------|-------------------|-------------|----------------------|-------------|
| b | 2405 | 30 | 19.7 | 10.3 |
| 12 | 2440 | 30 | 19.6 | 10.4 |
| 18 | 2470 | 30 | 19.7 | 10.3 |
| 19 | 2475 | 30 | 10.4 | 19.6 |
| 1a | 2480 | 30 | -14.3 | 44.3 |



Measured RF Power Output (in Watts): 0.093 watts

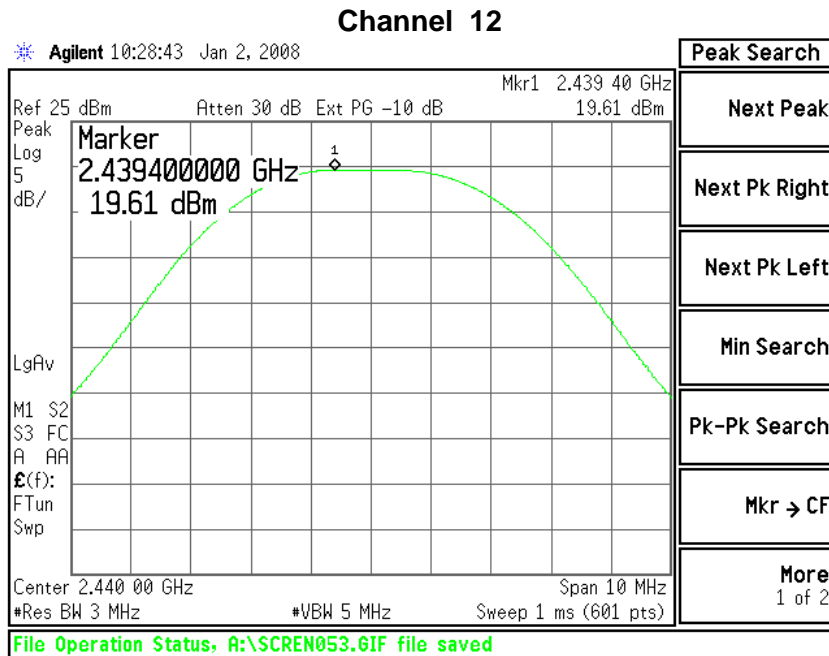
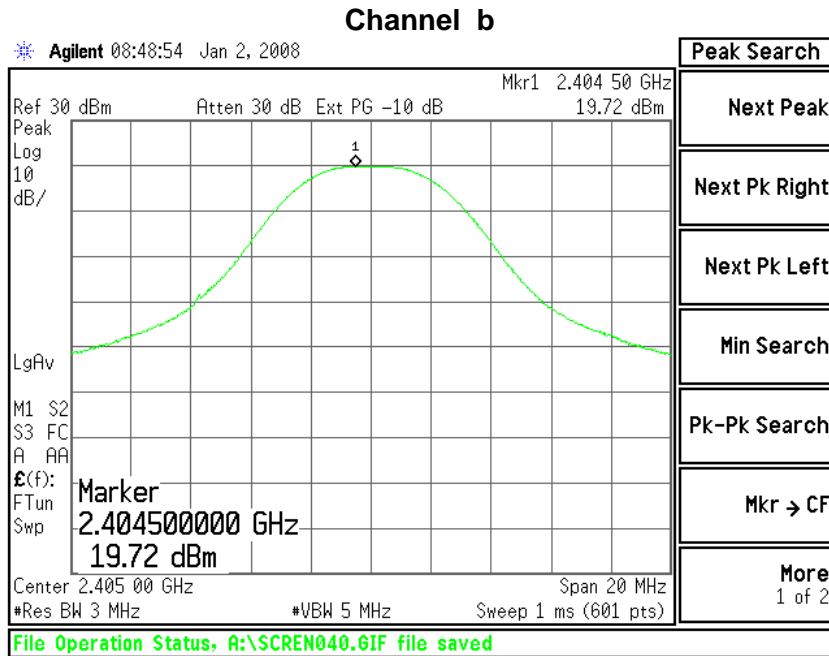
Declared RF Power Output (in Watts): 0.100 watts

9.3 Test Equipment List

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

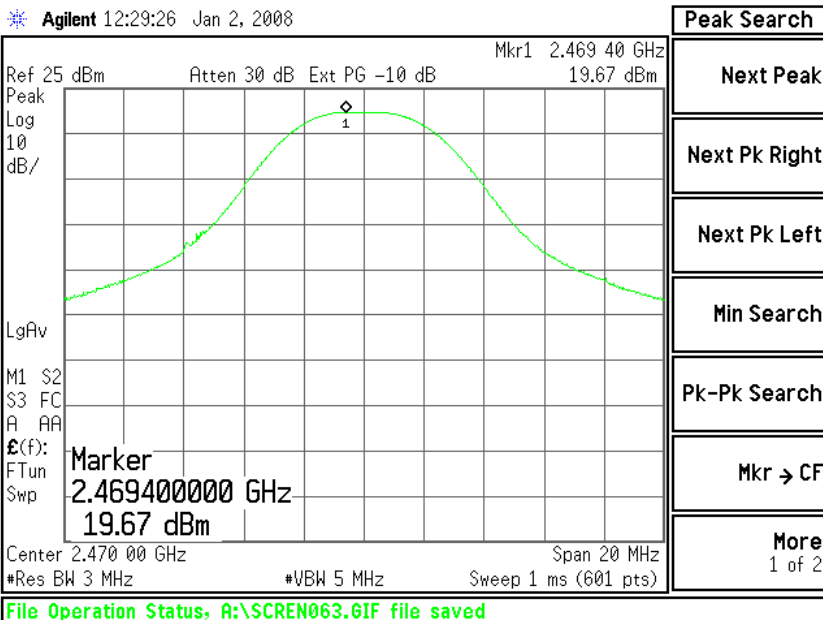
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 38 of 52 |

9.4 Screen Captures – Power Output (Conducted)

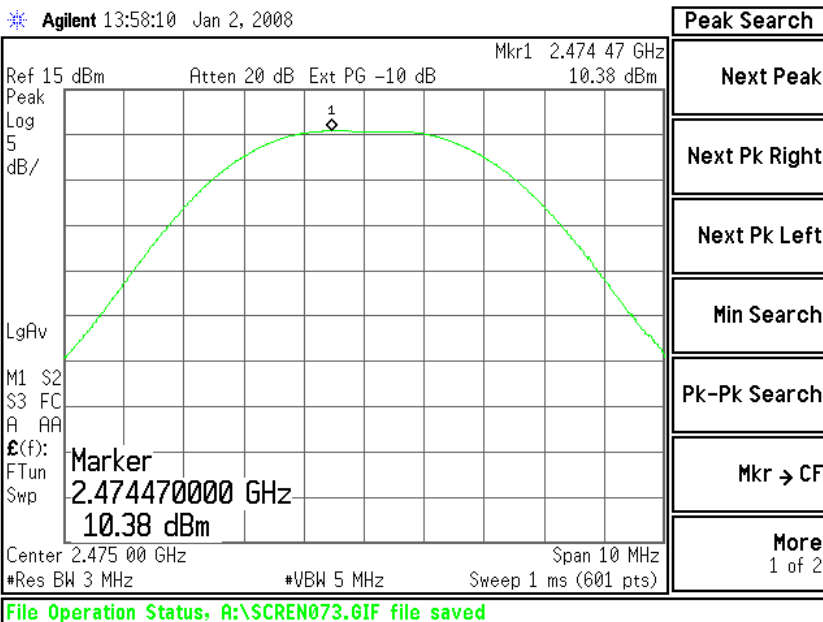


| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 39 of 52 |

Channel 18

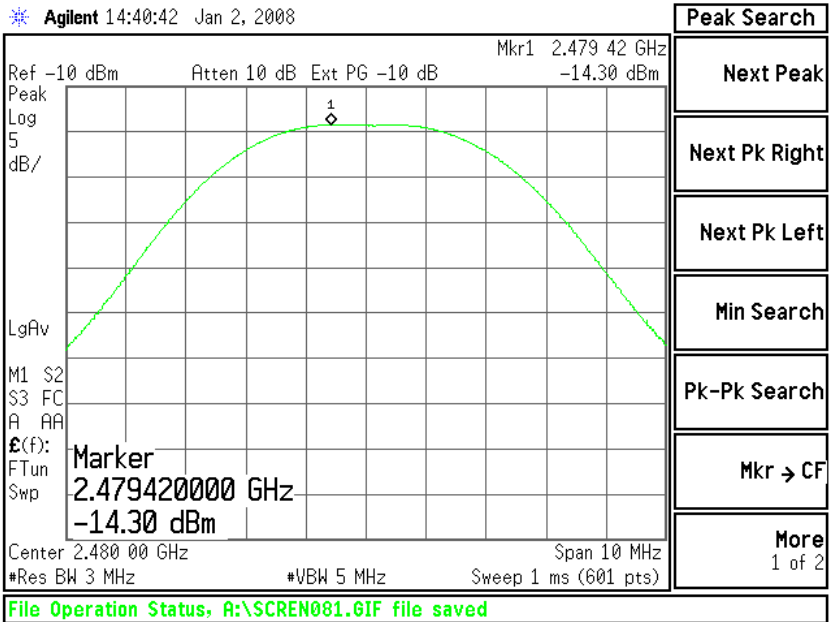


Channel 19



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 40 of 52 |

Channel 1a



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 41 of 52 |

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 -5.2 dBm, which is under the allowable limit by 13.2 dB.

10.2 Test Equipment List

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

10.3 Test Data

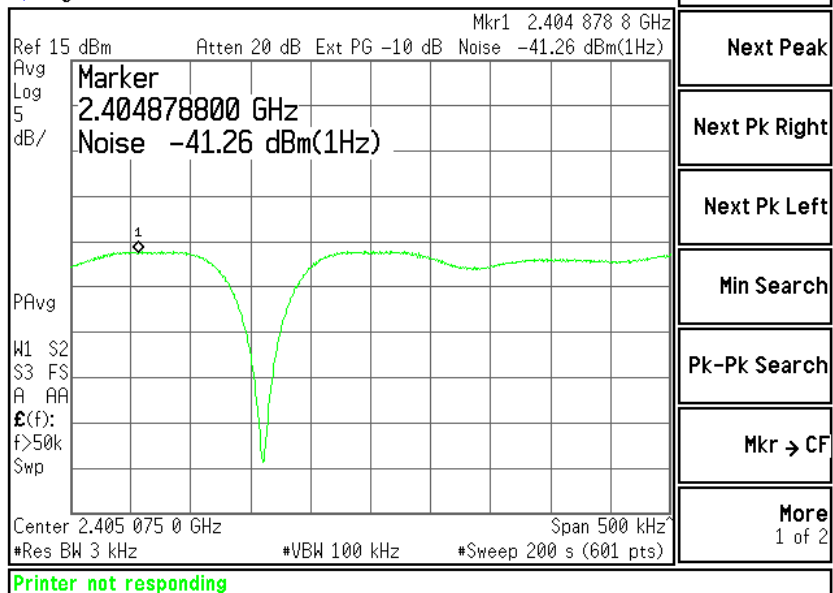
| Channel | Frequency (MHz) | Noise Marker (dBm/1 Hz) | RF Power Level In 3 kHz BW (dBm/3 kHz) | Limit (dBm/3 kHz) | Margin (dB) | Comments Pass/Fail |
|---------|-----------------|-------------------------|--|-------------------|-------------|--------------------|
| b | 2405 | -41.3 | -6.5 | 8.0 | 14.5 | Pass |
| 12 | 2440 | -41.2 | -6.4 | 8.0 | 14.4 | Pass |
| 18 | 2470 | -39.9 | -5.2 | 8.0 | 13.2 | Pass |
| 19 | 2475 | -49.4 | -14.6 | 8.0 | 22.6 | Pass |
| 1a | 2480 | -74.0 | -39.2 | 8.0 | 47.2 | Pass |

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 42 of 52 |

10.4 Screen Captures – Power Spectral Density

Channel b

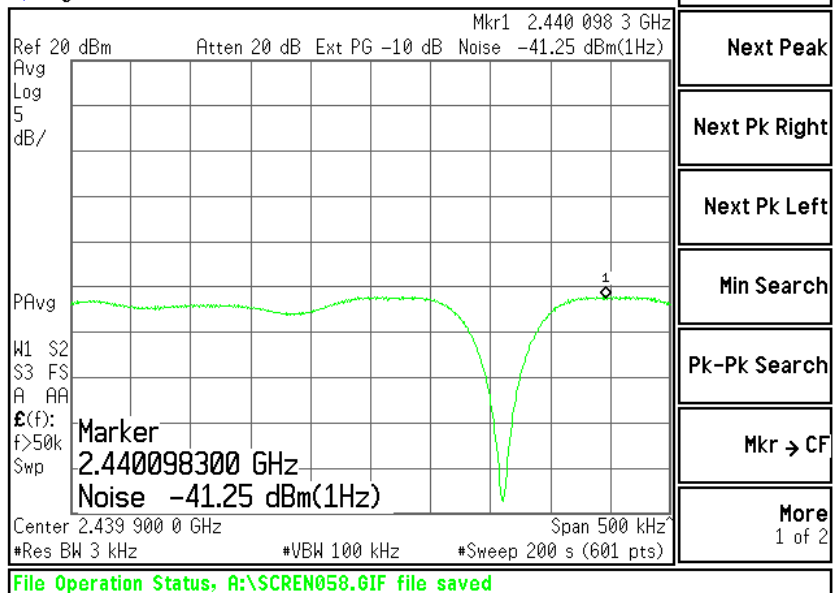
Agilent 09:01:47 Jan 2, 2008



- Peak Search
- Next Peak
- Next Pk Right
- Next Pk Left
- Min Search
- Pk-Pk Search
- Mkr → CF
- More
1 of 2

Channel 12

Agilent 10:52:49 Jan 2, 2008

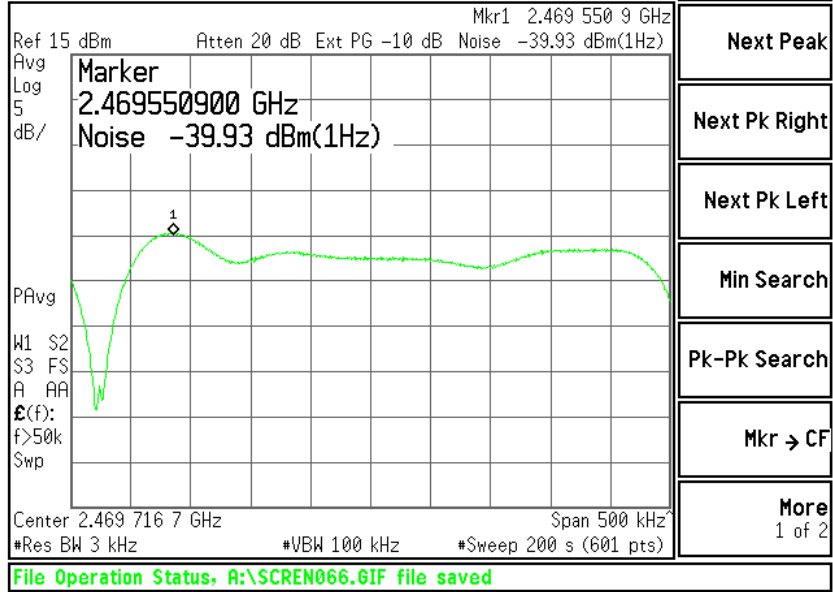


- Peak Search
- Next Peak
- Next Pk Right
- Next Pk Left
- Min Search
- Pk-Pk Search
- Mkr → CF
- More
1 of 2

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 43 of 52 |

Channel 18

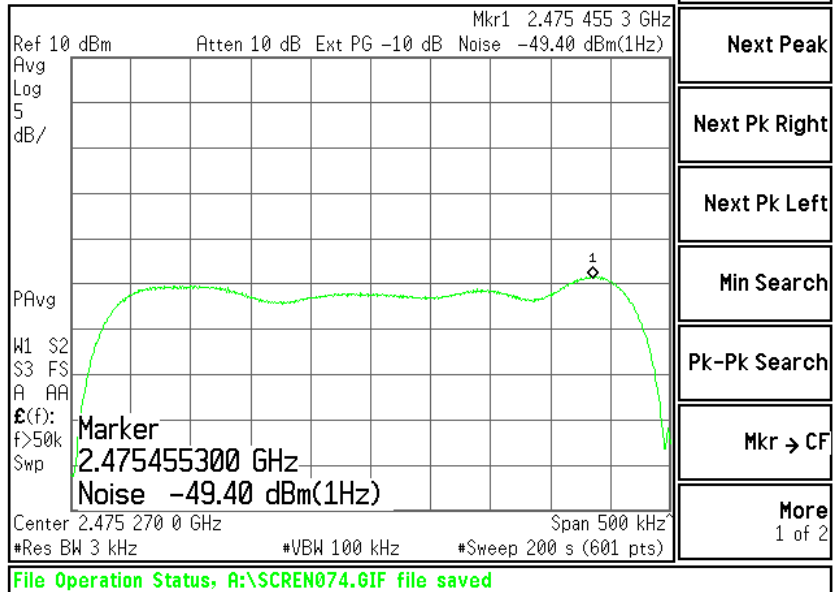
Agilent 12:52:03 Jan 2, 2008



- Peak Search
- Next Peak
- Next Pk Right
- Next Pk Left
- Min Search
- PK-Pk Search
- Mkr → CF
- More
1 of 2

Channel 19

Agilent 14:10:21 Jan 2, 2008

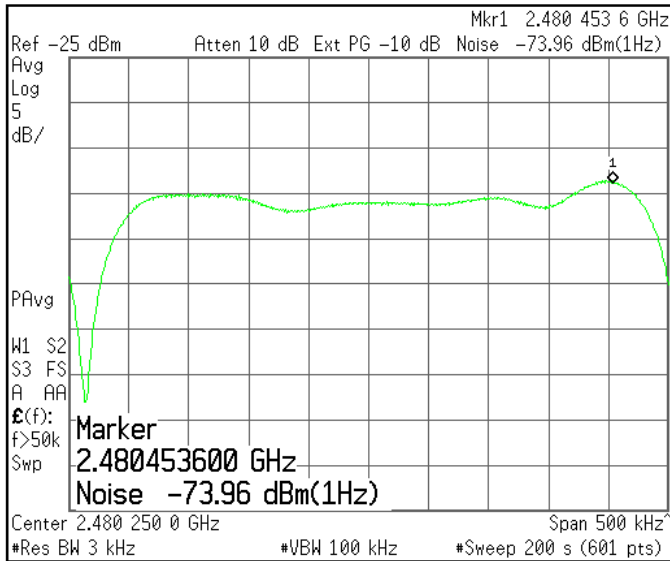


- Peak Search
- Next Peak
- Next Pk Right
- Next Pk Left
- Min Search
- PK-Pk Search
- Mkr → CF
- More
1 of 2

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 44 of 52 |

Channel 1a

Agilent 14:48:50 Jan 2, 2008



| |
|----------------|
| Peak Search |
| Next Peak |
| Next Pk Right |
| Next Pk Left |
| Min Search |
| PK-Pk Search |
| Mkr → CF |
| More 1 of 2 |

File Operation Status, A:\SCREN082.GIF file saved

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 45 of 52 |

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

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

Remarks:

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

FCC 47 CFR 15.205(a) – Restricted Frequency Bands

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

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

| Frequency (MHz) | Field Strength Limits (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 ($\mu\text{V}/\text{m}$) | 3 m Limit ($\text{dB}\mu\text{V}/\text{m}$) | 1 m Limit ($\text{dB}\mu\text{V}/\text{m}$) |
|-----------------|--------------------------------------|---|---|
| 30-88 | 100 | 40.0 | - |
| 88-216 | 150 | 43.5 | - |
| 216-960 | 200 | 46.0 | - |
| 960-25,000 | 500 | 54.0 | 63.5 |

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 46 of 52 |

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 -60 dBc of the fundamental level for this product.

11.2 Test Data

| | Channel b | Channel 12 | Channel 18 | Channel 19 | Channel 1a |
|---------------------------|-------------|-------------|-------------|-------------|-------------|
| Fundamental | 16.5 (dBm) | 16.1 (dBm) | 16.3 (dBm) | 7.3 (dBm) | -17.6 (dBm) |
| 2 nd Harmonic | -51.4 (dBm) | -52.1 (dBm) | -54.2 (dBm) | -77.2 (dBm) | Note (1) |
| 3 rd Harmonic | -59.1 (dBm) | -59.6 (dBm) | -60.5 (dBm) | Note (1) | Note (1) |
| 4 th Harmonic | -55.2 (dBm) | -63.6 (dBm) | -72.6 (dBm) | Note (1) | Note (1) |
| 5 th Harmonic | Note (1) | -75.0 (dBm) | -74.0 (dBm) | Note (1) | Note (1) |
| 6 th Harmonic | -72.1 (dBm) | -72.3 (dBm) | -72.9 (dBm) | Note (1) | Note (1) |
| 7 th Harmonic | Note (1) | | Note (1) | Note (1) | Note (1) |
| 8 th Harmonic | -74.4 (dBm) | -75.4 (dBm) | -75.0 (dBm) | Note (1) | Note (1) |
| 9 th Harmonic | Note (1) | Note (1) | Note (1) | Note (1) | Note (1) |
| 10 th Harmonic | Note (1) | Note (1) | Note (1) | Note (1) | Note (1) |

| | Channel 1a (Power set at maximum instead of the reduced setting -2b) |
|---------------------------|---|
| Fundamental | 16.3(dBm) |
| 2 nd Harmonic | -55.6(dBm) |
| 3 rd Harmonic | -63.2(dBm) |
| 4 th Harmonic | -70.9(dBm) |
| 5 th Harmonic | -73.3(dBm) |
| 6 th Harmonic | -73.0(dBm) |
| 7 th Harmonic | Note (1) |
| 8 th Harmonic | -74.4(dBm) |
| 9 th Harmonic | Note (1) |
| 10 th Harmonic | Note (1) |

Notes:

(1) Measurement at system noise floor.

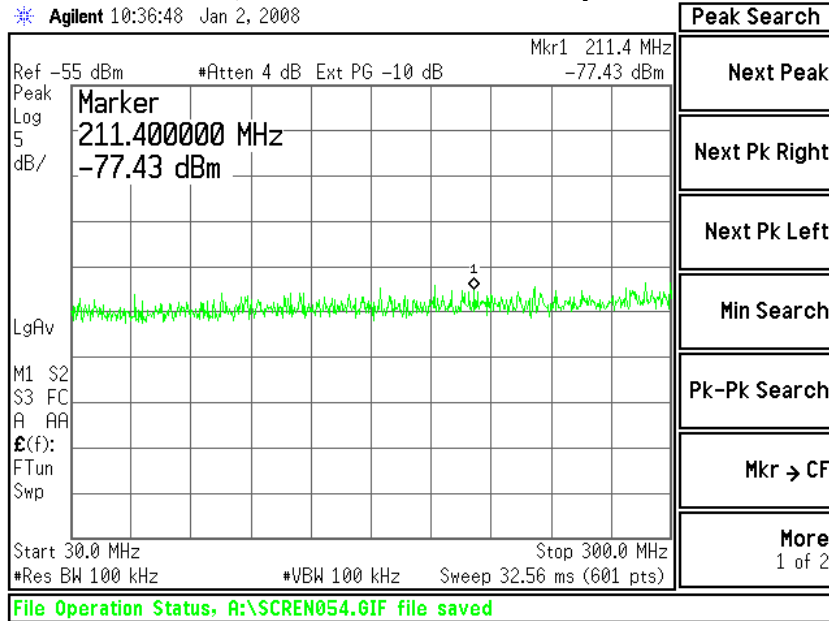
| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 47 of 52 |

11.3 Test Equipment List

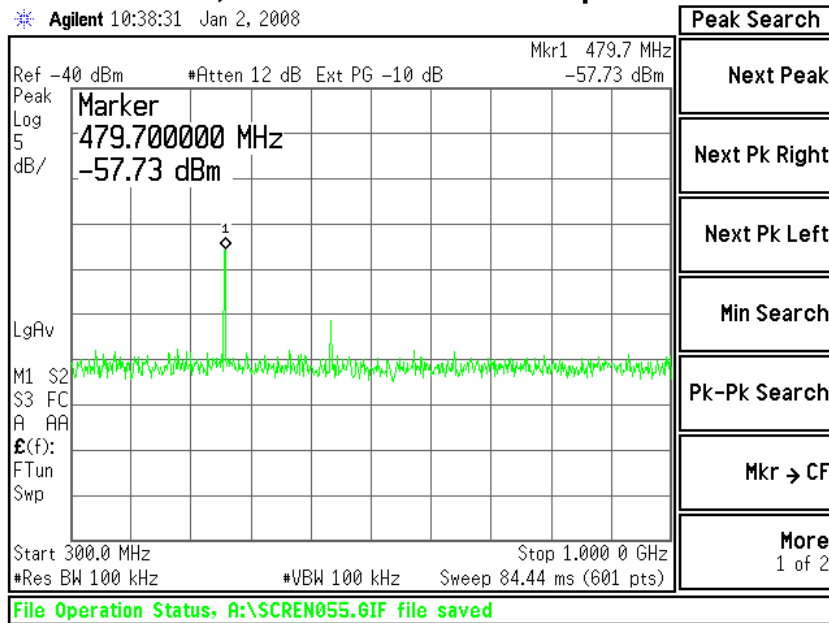
| Test Equipment | Manufacturer | Model No. | Serial No. | Frequency Range |
|-------------------|--------------|-----------|------------|-----------------|
| Spectrum Analyzer | Agilent | E4446A | US45300564 | To 44 GHz |

11.4 Screen Captures – Spurious Radiated Emissions

Channel 12, shown from 30 MHz up to 300 MHz



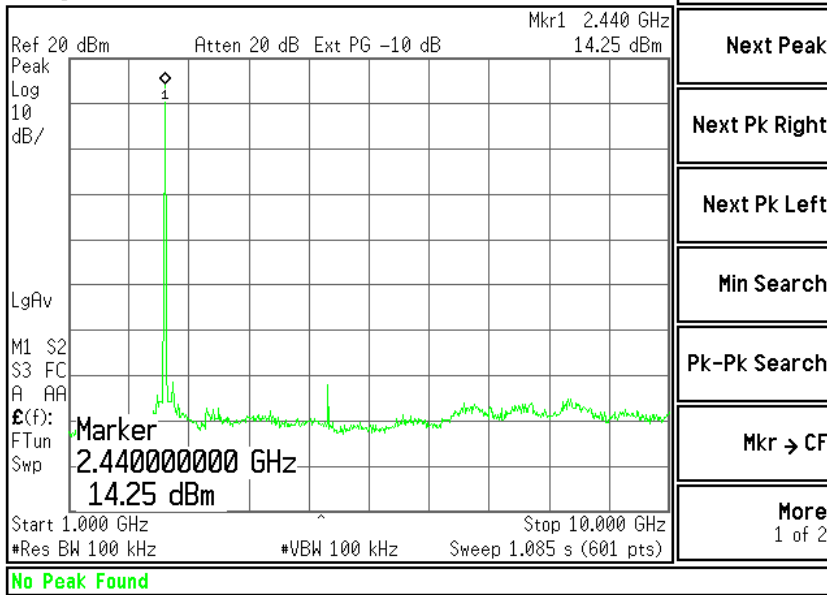
Channel 12, shown from 300 MHz up to 1000 MHz



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 48 of 52 |

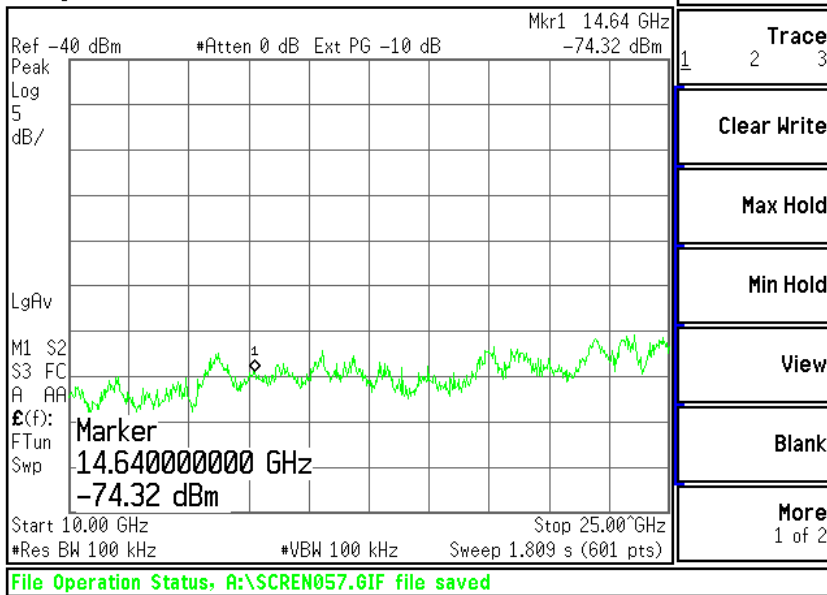
Channel 12, shown from 1000 MHz up to 10000 MHz

Agilent 10:43:06 Jan 2, 2008



Channel 12, shown from 10000 MHz up to 25000 MHz

Agilent 10:46:12 Jan 2, 2008



| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 49 of 52 |

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=3 kHz settings while the voltage was varied.

| | DC Voltage Source | | |
|------------|-------------------|----------------|----------------|
| | 2.8 VDC | 3.3 VDC | 3.8 VDC |
| Channel b | 2405008000 (Hz) | 2405009800(Hz) | 2405008700(Hz) |
| Channel 12 | 2440011600(Hz) | 2440012400(Hz) | 2440011900(Hz) |
| Channel 1a | 2480011500(Hz) | 2480011800(Hz) | 2480011800(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 b | 19.6(dBm) | 19.7(dBm) | 19.9(dBm) |
| Channel 12 | 19.5(dBm) | 19.6(dBm) | 19.7(dBm) |
| Channel 1a | -16.4(dBm) | -14.3(dBm) | -11.8(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 trace PCB inverted F antenna with a measured ERP of 119.0 dbuV/m (at 3 meters) and conducted RF power of 19.6 dBm as presented to the antenna. The calculated gain of this antenna is 4.17 dB.

| <u>Prediction of MPE limit at a given distance</u> | |
|--|--|
| 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: | 19.60 (dBm) |
| Maximum peak output power at antenna input terminal: | 91.201 (mW) |
| Antenna gain(typical): | 4.17 (dBi) |
| Maximum antenna gain: | 2.612 (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: | 0.047395 (mW/cm ²) |
| Maximum allowable antenna gain: | 17.4 (dBi) |
| Margin of Compliance at 20 cm = | 13.2 dB |

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 51 of 52 |

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 | 12/04/07 | 12/04/08 |
| 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 1/2" 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 |

| | | |
|----------------------------------|-----------------------------|--------------------------------------|
| Prepared For: LS Research, LLC | Model #: ZAXM-201-1 | LS Research, LLC |
| EUT: Apex | Serial #: 07040109 | Template: 15.247 DTS TX (V2 9-06-06) |
| Report #: 307224.2 TX TCB Rev. 1 | Customer FCC ID #: TFB-APEX | Page 52 of 52 |