**FCC CFR47 PART 15 SUBPART C**

**CERTIFICATION TEST REPORT**

**FOR**

**WiMAX + WiFi Router**

**MODEL NUMBER: W801**

**FCC ID: N7N-MHS801**

**REPORT NUMBER: 09U12839-1, Revision B**

**ISSUE DATE: NOVEMBER 24, 2009**

*Prepared for*
**SIERRA WIRELESS INC.**
**2290 COSMOS COURT, CARLSBAD**
**CALIFORNIA 92011, USA**

*Prepared by*
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NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 11/11/09 | Initial Issue | T. Chan |
| A | 11/17/09 | Updated MPE Co-located | T. Chan |
| B | 11/24/09 | Updated model number | A. Zaffar |


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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SIERRA WIRELESS INC.
2290 COSMOS COURT, CARLSBAD
CALIFORNIA 92011, USA

**EUT DESCRIPTION:** WiMAX + WiFi Router

**MODEL:** W801

**SERIAL NUMBER:** H9H239901472014 AND H9H239901122014

**DATE TESTED:** OCTOBER 8 – 12, 2009

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart C | Pass |

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:

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COMPLIANCE CERTIFICATION SERVICES

Tested By:

DEVIN CHANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES


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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, and FCC CFR 47 Part 15.

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

# 4. CALIBRATION AND UNCERTAINTY

## 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

## 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

## 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | UNCERTAINTY |
|---|---|
| Conducted Disturbance, 0.15 to 30 MHz | 3.52 dB |
| Radiated Disturbance, 30 to 1000 MHz | 4.94 dB |

Uncertainty figures are valid to a confidence level of 95%.


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# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT is a WiMAX + WiFi Router.

The WiFi radio module is manufactured by Murata using Marvell 8686.

## 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode | Output Power (dBm) | Output Power (mW) |
|---|---|---|---|
| 2412 - 2462 | 802.11b | 19.08 | 80.91 |
| 2412 - 2462 | 802.11g | 22.16 | 164.44 |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of 1 dBi.

## 5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Labtool, rev. 1.2.5.1.

## 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.


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## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop PC | DELL | PP18L | 30216847141 | DOC |
| AC Adapter | DELL | HS65NS1-00 | 662-47890-86B-C06B | DOC |

**I/O CABLES**

| I/O CABLE LIST | | | | | | |
|---|---|---|---|---|---|---|
| Cable No. | Port | # of Identica Ports | Connector Type | Cable Type | Cable Length | Remarks |
| 1 | AC | 1 | AC | Unshielded | 1.8 m | N/A |
| 2 | DC | 1 | DC | Unshielded | 1.8 m | N/A |
| 3 | USB | 1 | USB | Unshielded | 1.2 m | N/A |

**TEST SETUP**

The EUT is connected to the host laptop computer via USB cable during the tests. Test software exercised the radio card.


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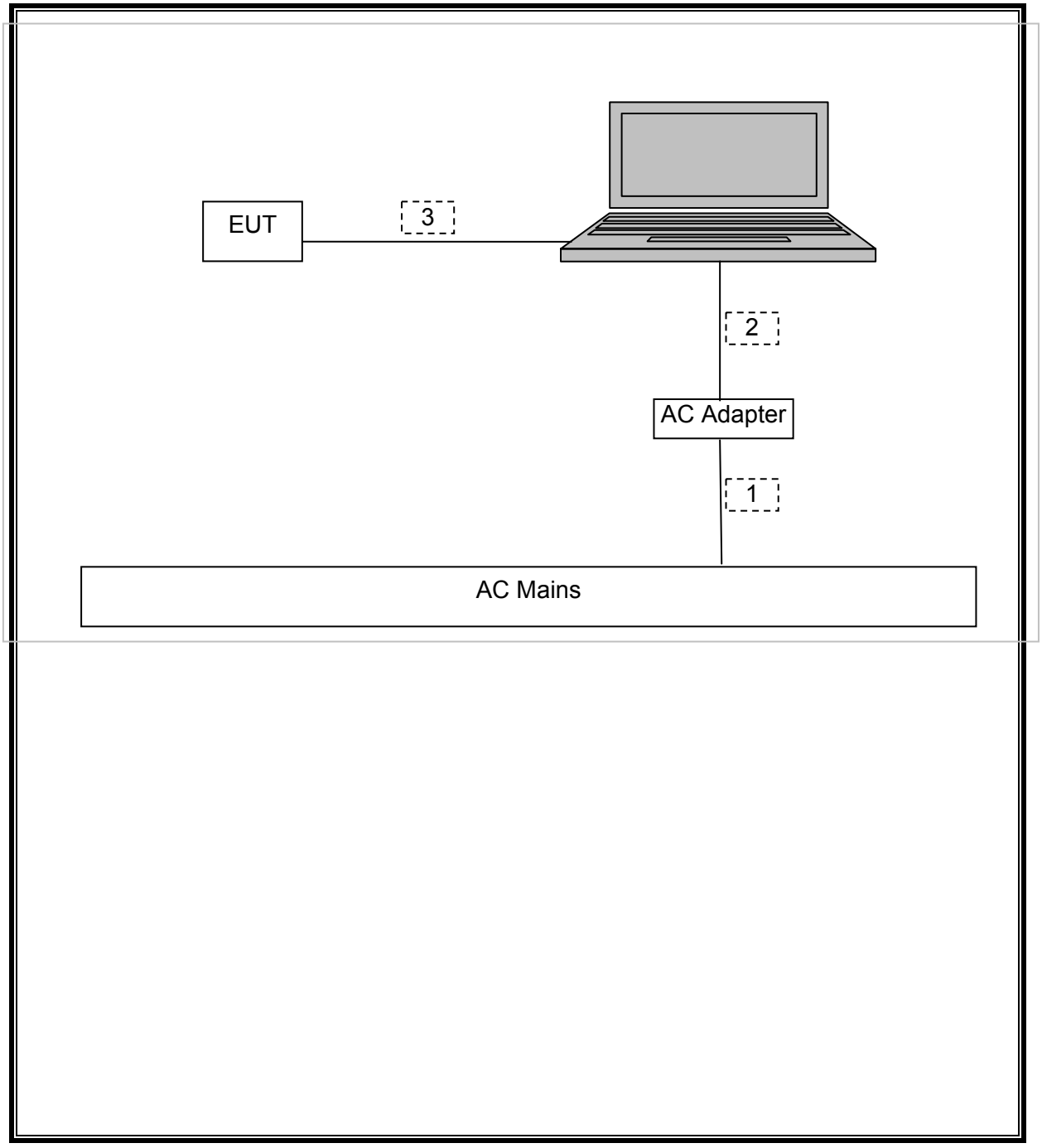
**SETUP DIAGRAM FOR TESTS**





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# 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| TEST EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Asset** | **Cal Due** |
| Preamplifier, 26.5 GHz | Agilent / HP | 8449B | C00749 | 02/04/10 |
| Antenna, Bilog, 2 GHz | Sunol Sciences | JB1 | C01171 | 01/14/10 |
| Preamplifier, 1300 MHz | Agilent / HP | 8447D | C00580 | 12/16/09 |
| Spectrum Analyzer, 44 GHz | Agilent / HP | E4446A | C01012 | 04/20/10 |
| Antenna, Horn, 18 GHz | EMCO | 3115 | C00872 | 04/22/10 |
| EMI Test Receiver, 30 MHz | R & S | ESHS 20 | N02396 | 05/06/11 |
| LISN, 30 MHz | FCC | LISN-50/250-25-2 | N02625 | 11/06/10 |
| LISN, 10 kHz ~ 30 MHz | Solar | 8012-50-R-24-BNC | N02481 | 11/06/10 |
| Power Meter | Agilent / HP | 437B | N02778 | 08/04/10 |
| Power Sensor, 18 GHz | Agilent / HP | 8481A | N02782 | 10/22/10 |
| Highpass Filter, 4.0 GHz | Micro-Tronics | HPM13351 | N02708 | N/A |


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# 7. ANTENNA PORT TEST RESULTS

## 7.1. 802.11b MODE IN THE 2.4 GHz BAND

### 7.1.1. 6 dB BANDWIDTH

**LIMITS**

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---|---|---|---|
| Low | 2412 | 10.05 | 0.5 |
| Middle | 2437 | 10.05 | 0.5 |
| High | 2462 | 10.05 | 0.5 |



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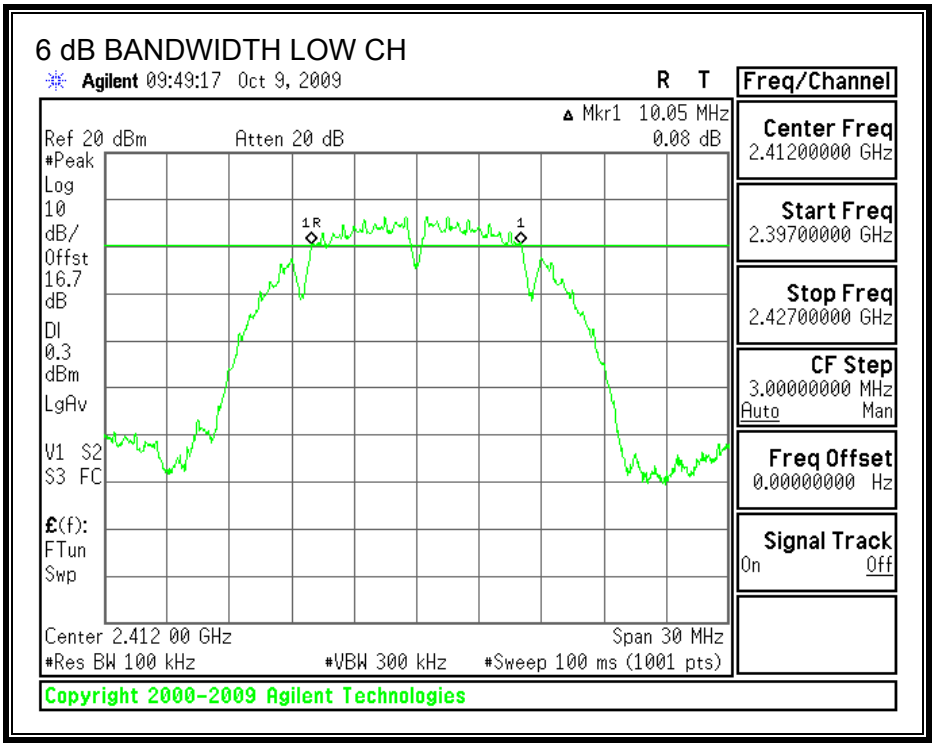
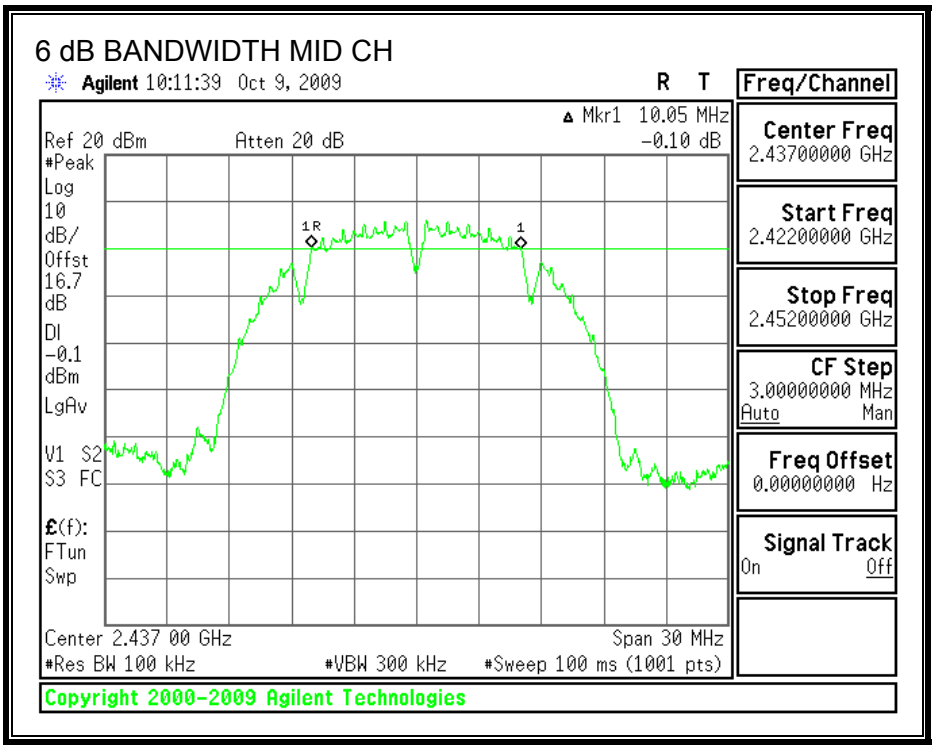
**6 dB BANDWIDTH**



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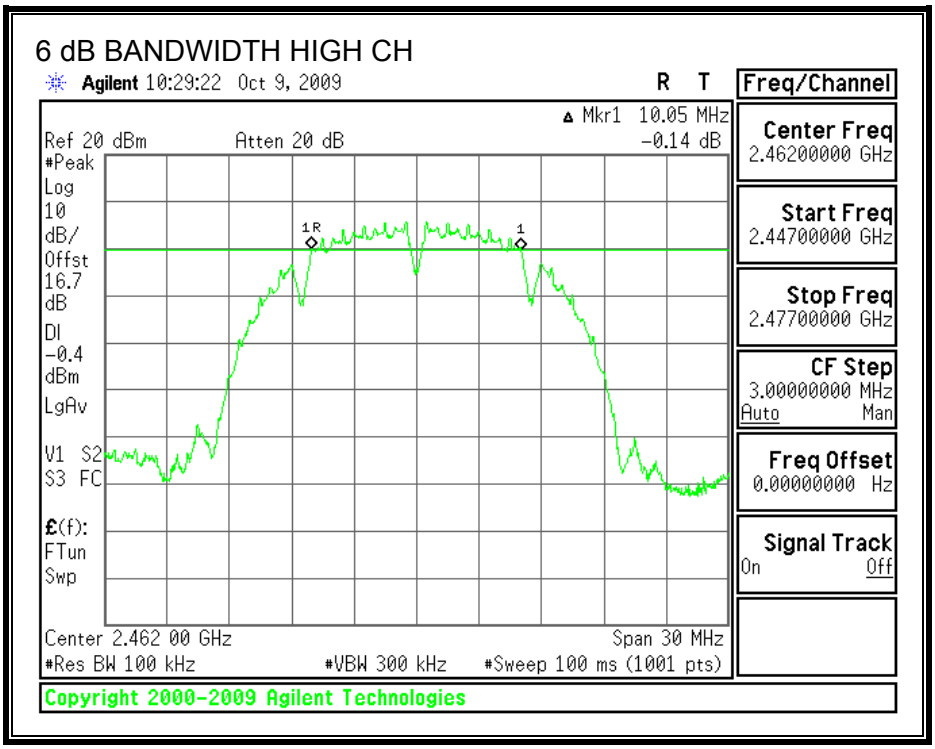




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### 7.1.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 2412 | 13.7271 |
| Middle | 2437 | 13.7385 |
| High | 2462 | 13.6922 |


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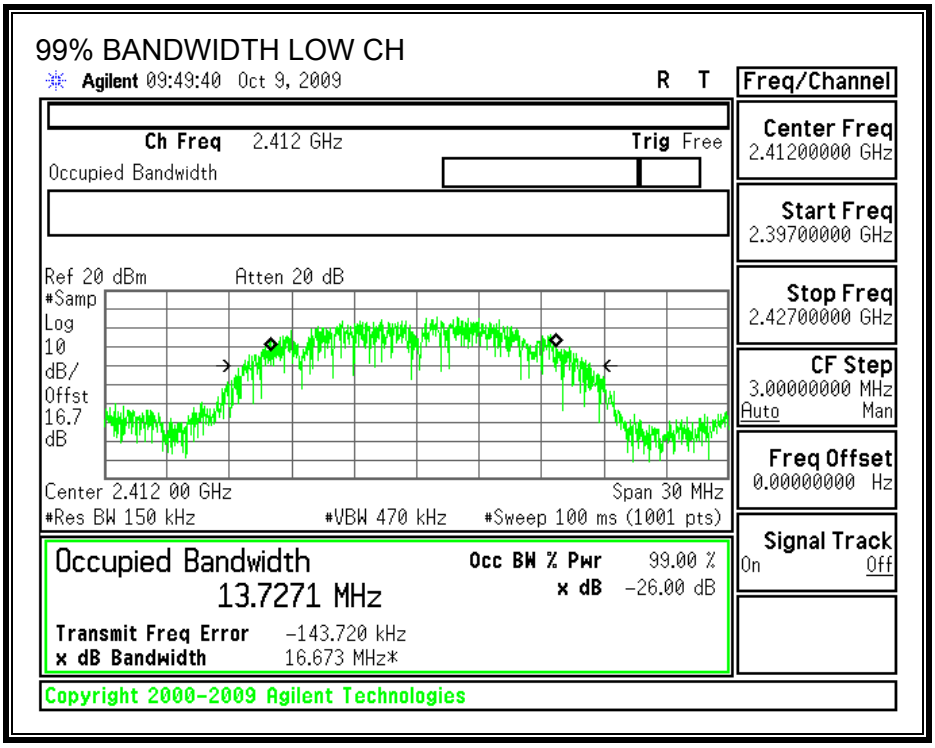
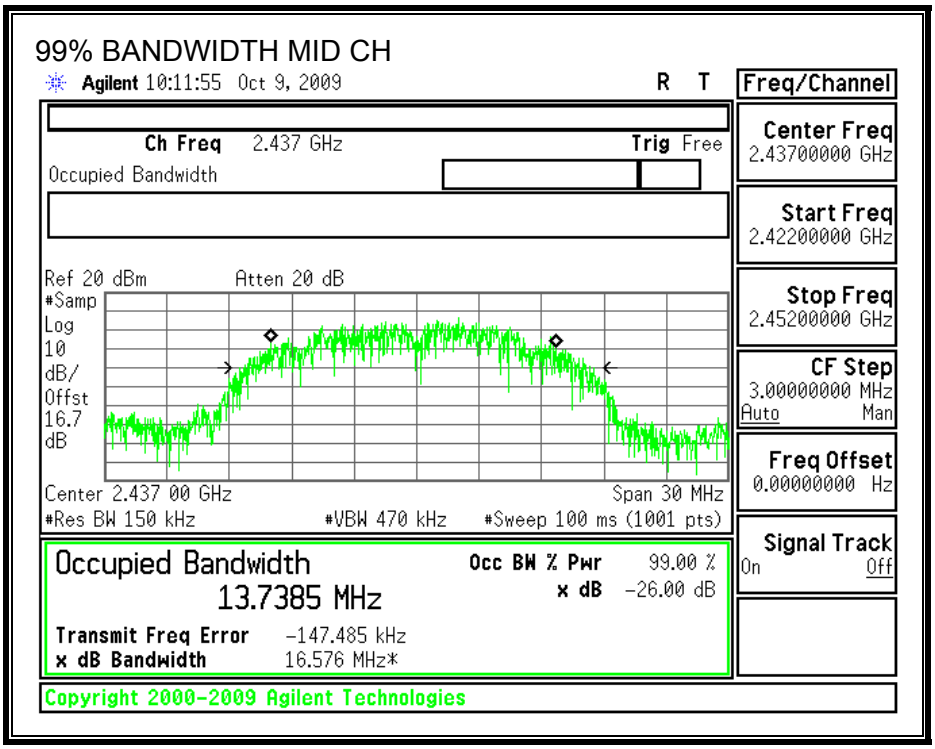
**99% BANDWIDTH**





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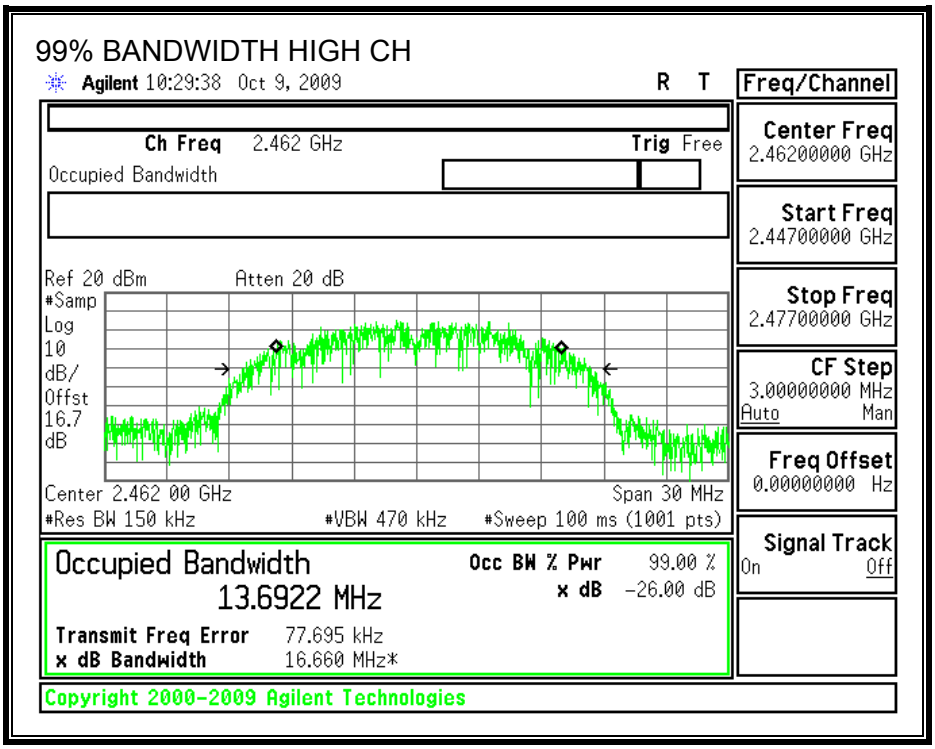




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### 7.1.3. OUTPUT POWER

**LIMITS**

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

**TEST PROCEDURE**

Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

**RESULTS**

| Channel | Frequency (MHz) | Spectrum Analyzer Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 2412 | 2.28 | 16.8 | 19.08 | 30 | -10.92 |
| Middle | 2437 | 1.79 | 16.8 | 18.59 | 30 | -11.41 |
| High | 2462 | 1.60 | 16.8 | 18.40 | 30 | -11.60 |


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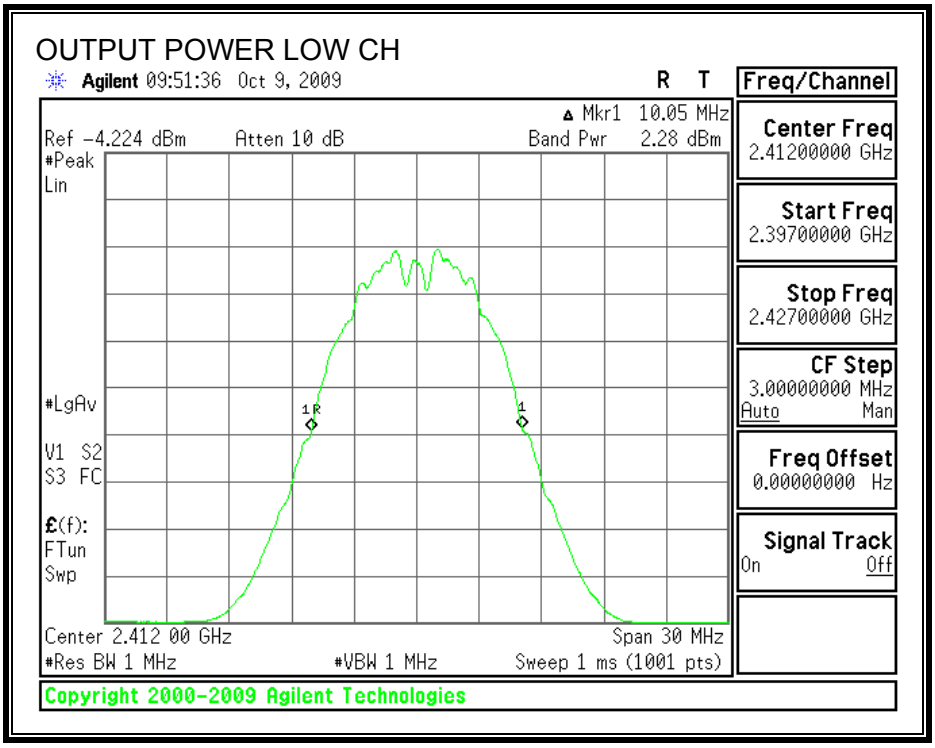
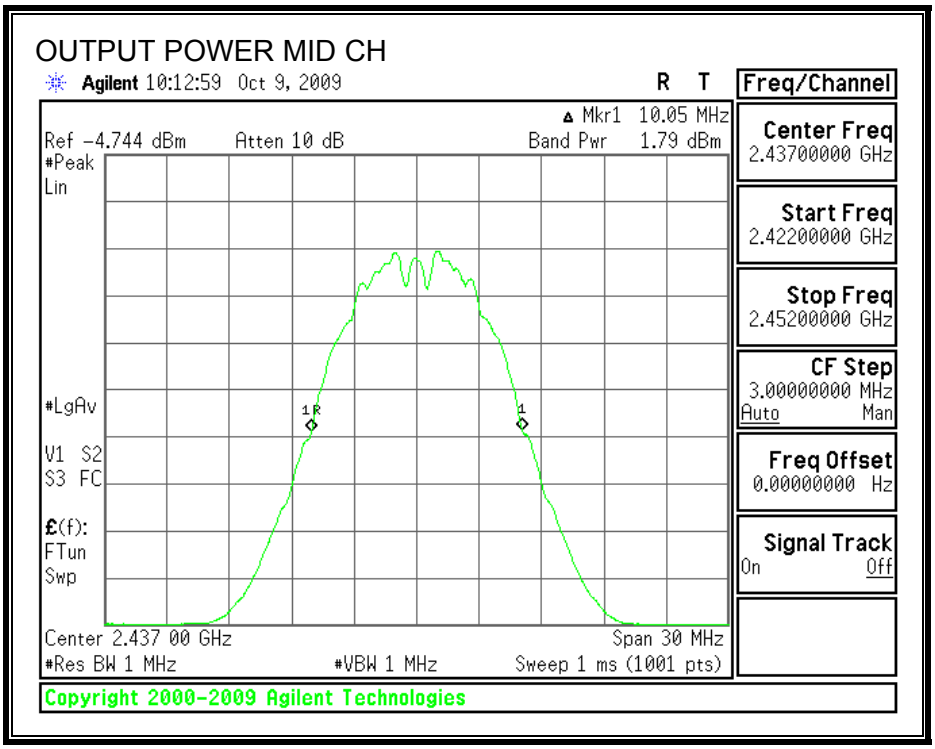
**OUTPUT POWER**





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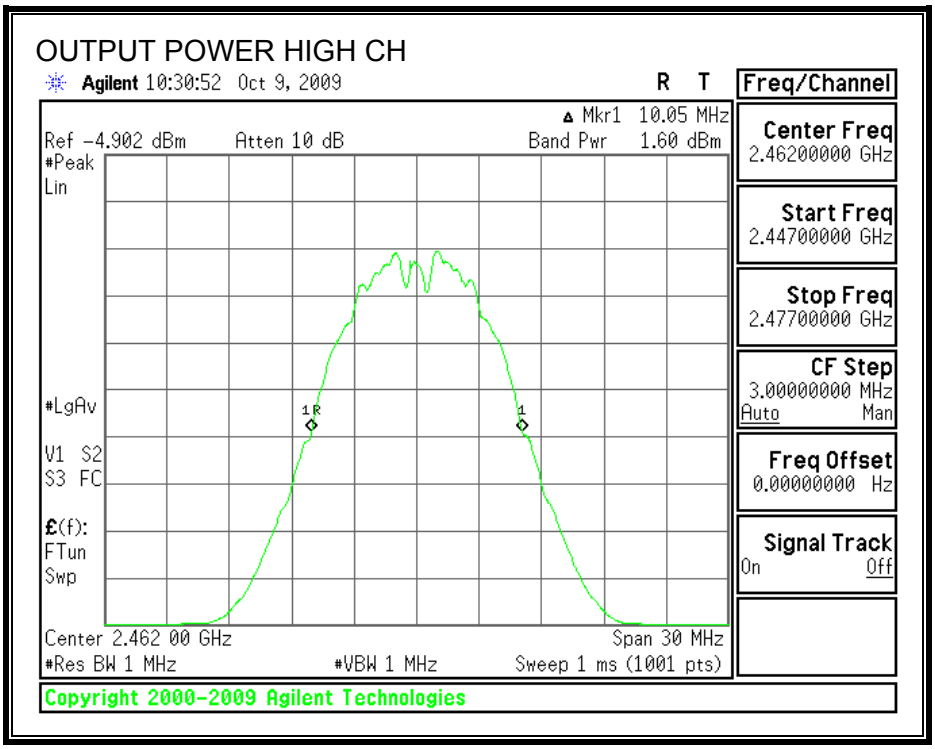




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### 7.1.4. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a power meter.

**RESULTS**

The cable assembly insertion loss of 16.8 dB (including 10 dB pad and 6.8 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Power (dBm) |
|---|---|---|
| Low | 2412 | 17.07 |
| Middle | 2437 | 16.65 |
| High | 2462 | 16.53 |


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## 7.1.5. POWER SPECTRAL DENSITY

**LIMITS**

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

**TEST PROCEDURE**

Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

**RESULTS**

| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | -12.03 | 8 | -20.03 |
| Middle | 2437 | -12.36 | 8 | -20.36 |
| High | 2462 | -12.55 | 8 | -20.55 |



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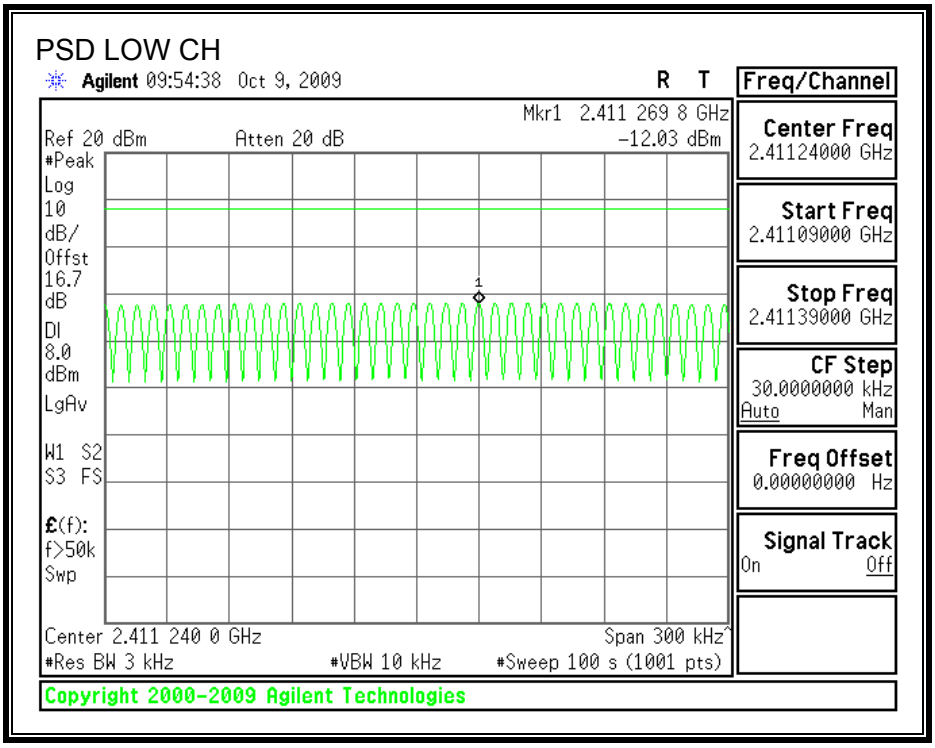
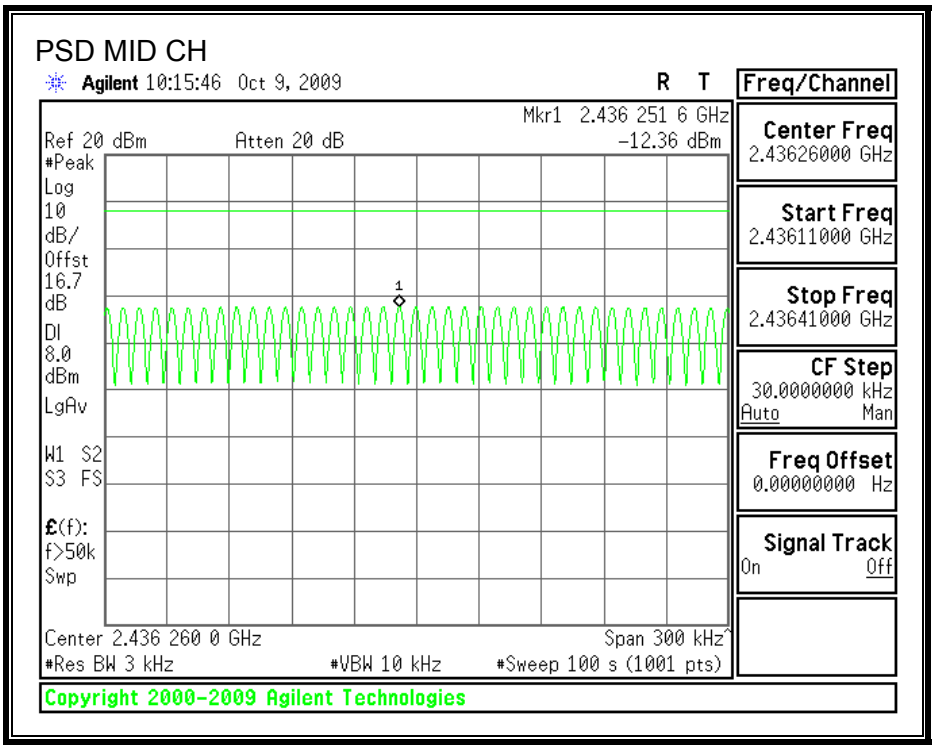
**POWER SPECTRAL DENSITY**



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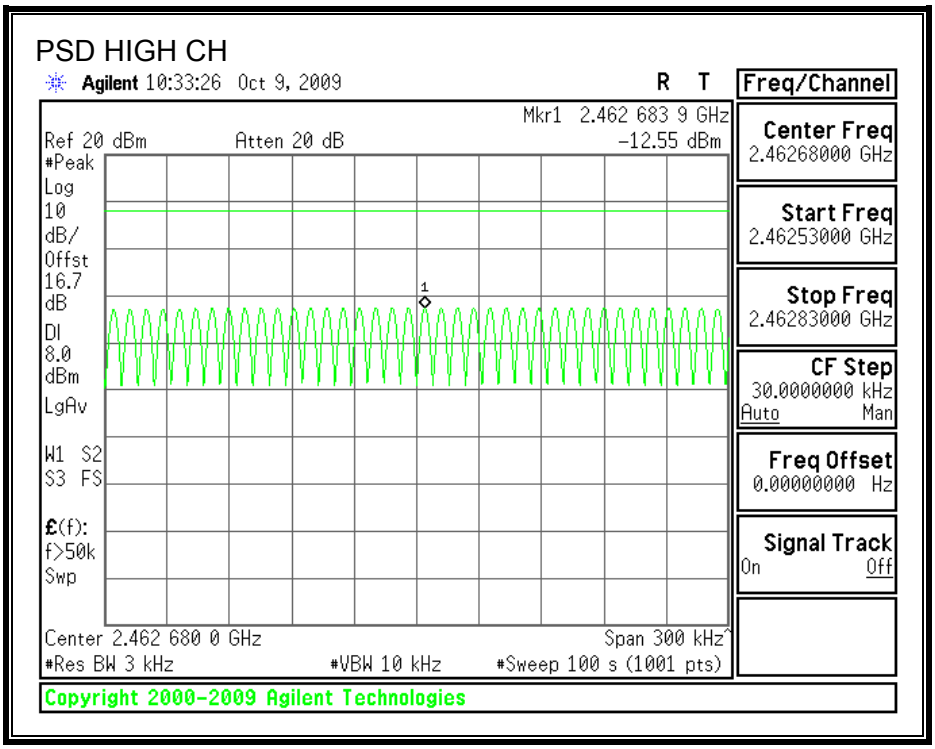
PSD HIGH CH





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## 7.1.6. CONDUCTED SPURIOUS EMISSIONS

**LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.


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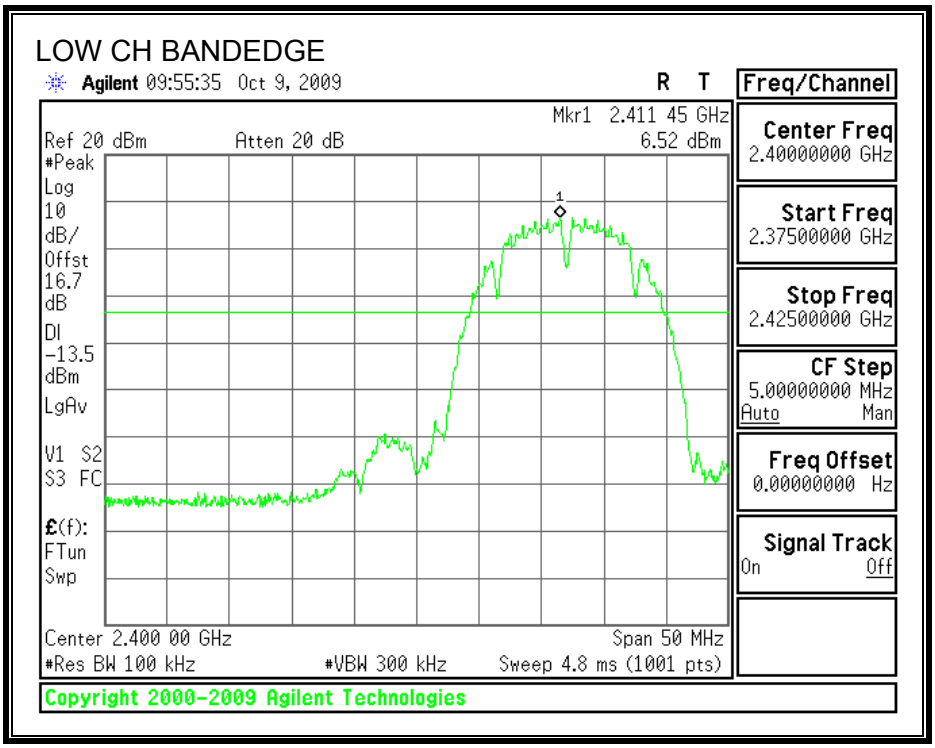
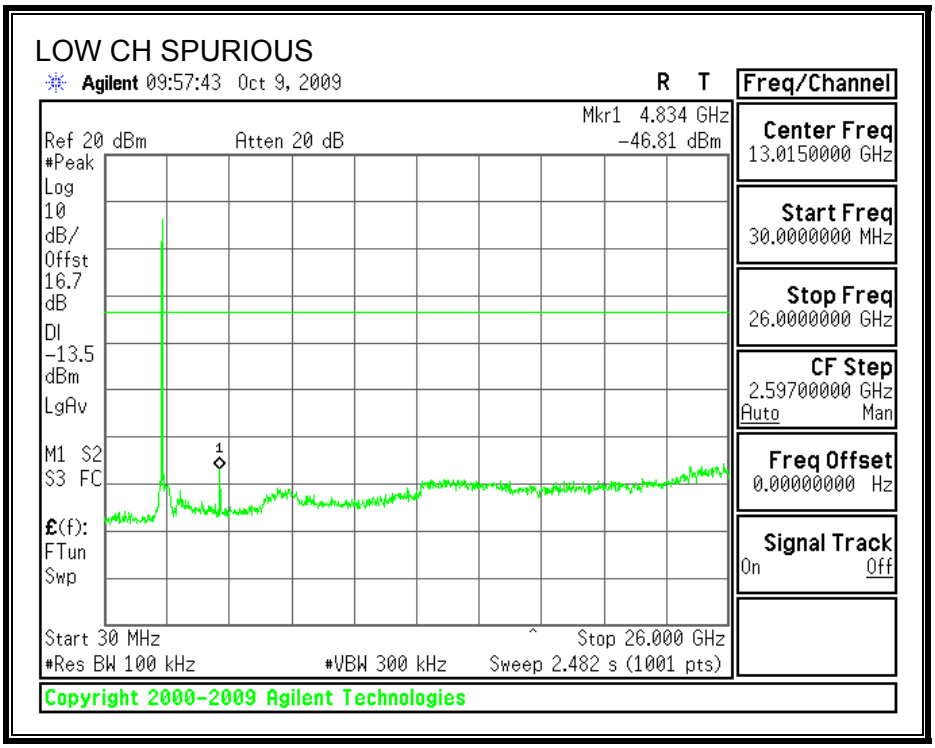
## RESULTS

## SPURIOUS EMISSIONS, LOW CHANNEL





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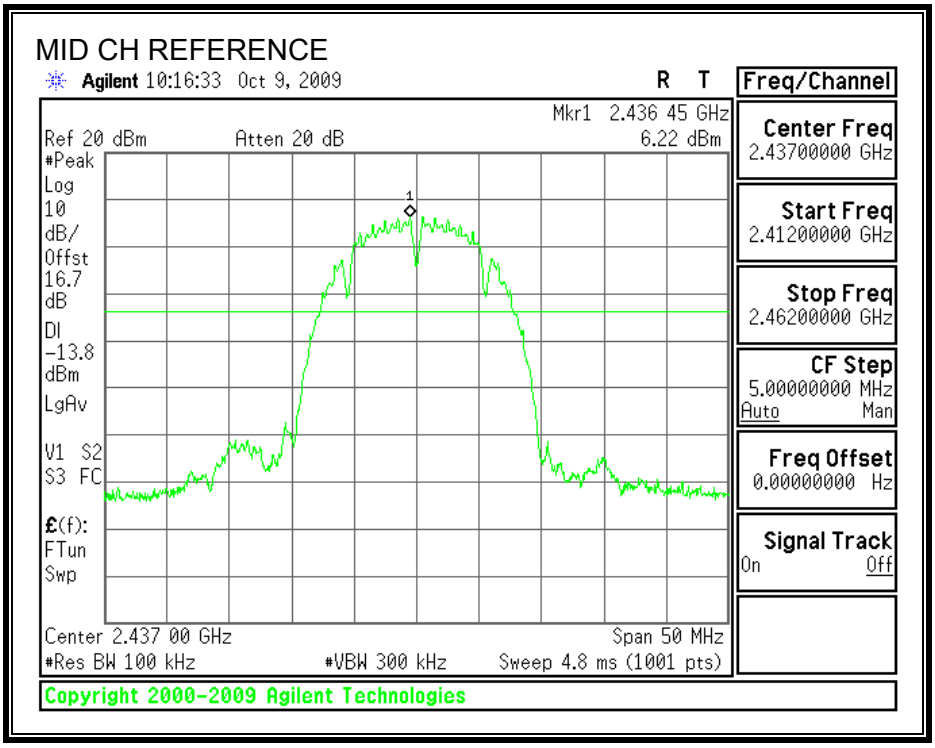
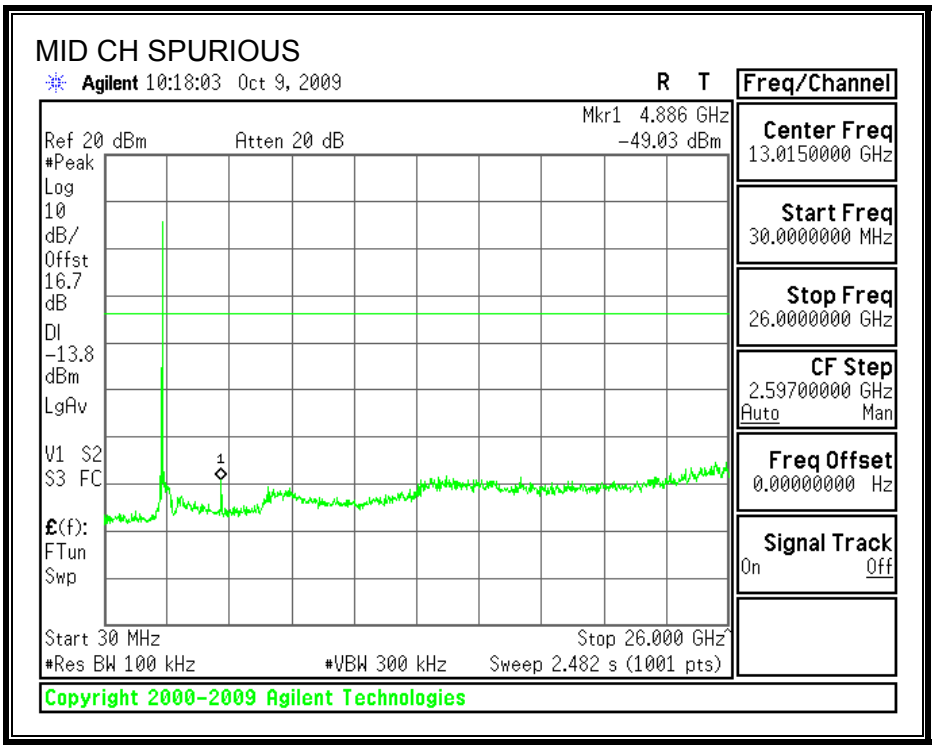
**SPURIOUS EMISSIONS, MID CHANNEL**





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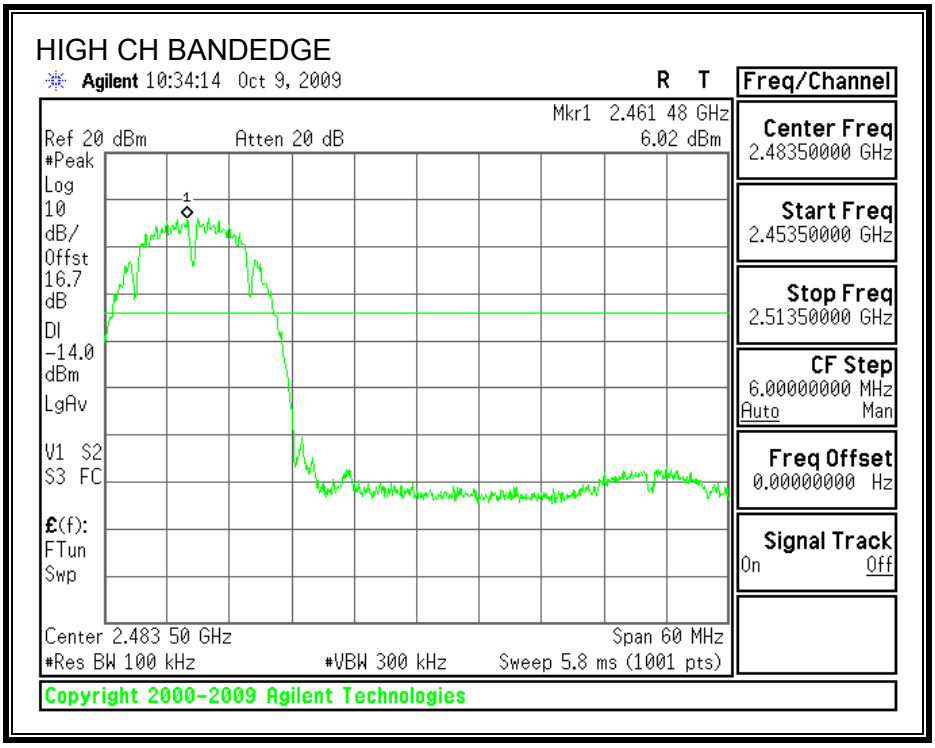
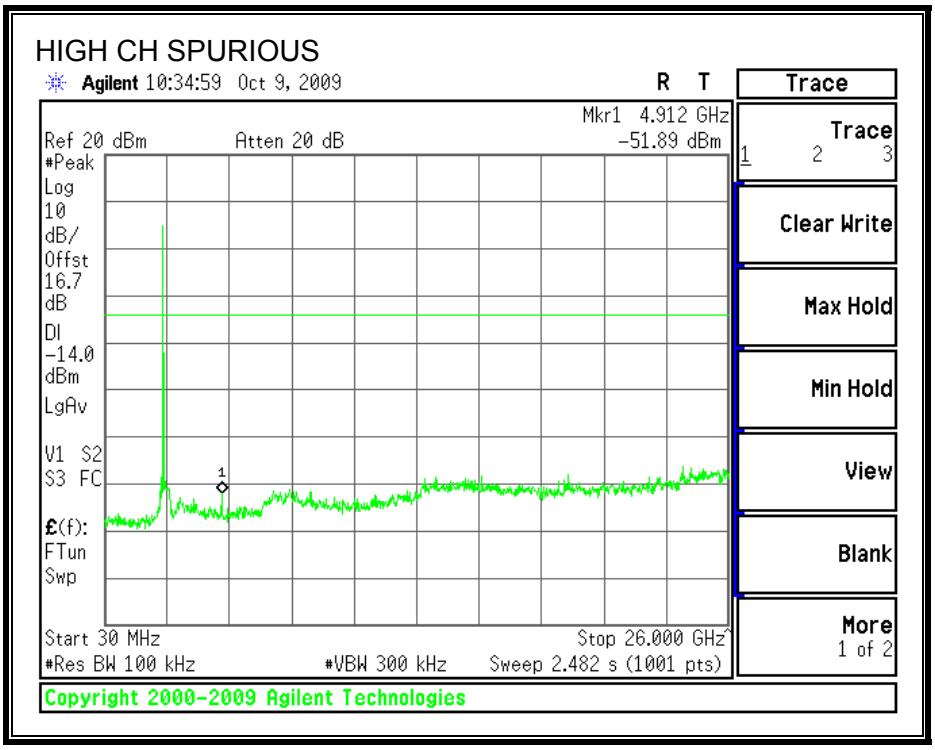
**SPURIOUS EMISSIONS, HIGH CHANNEL**





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# 7.2. 802.11g MODE IN THE 2.4 GHz BAND

## 7.2.1. 6 dB BANDWIDTH

**LIMITS**

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---|---|---|---|
| Low | 2412 | 16.50 | 0.5 |
| Middle | 2437 | 16.56 | 0.5 |
| High | 2462 | 16.56 | 0.5 |



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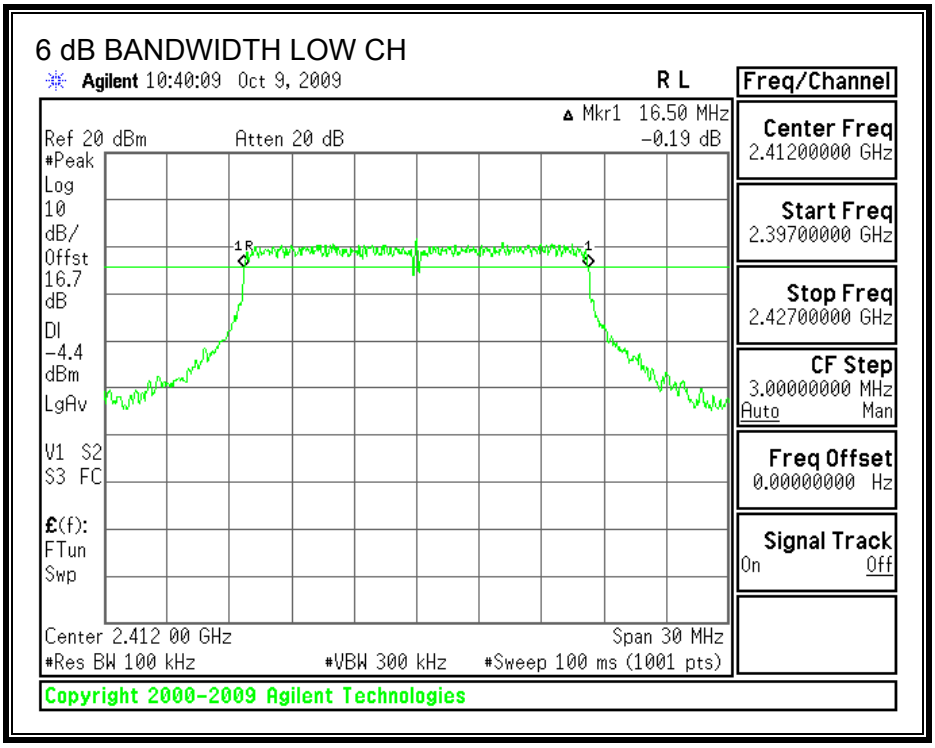
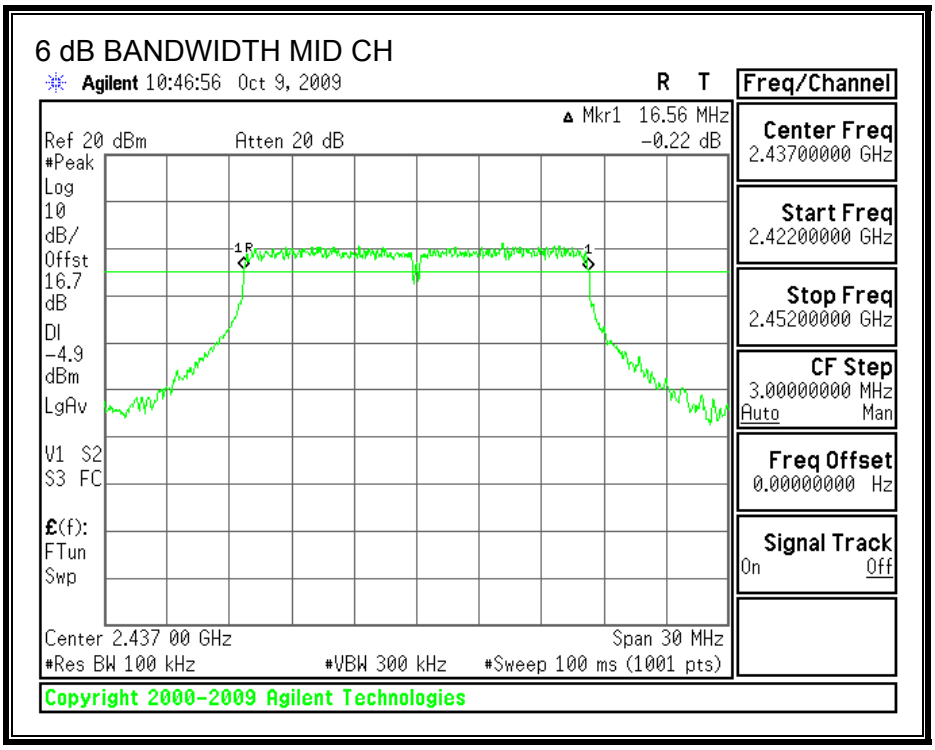
**6 dB BANDWIDTH**





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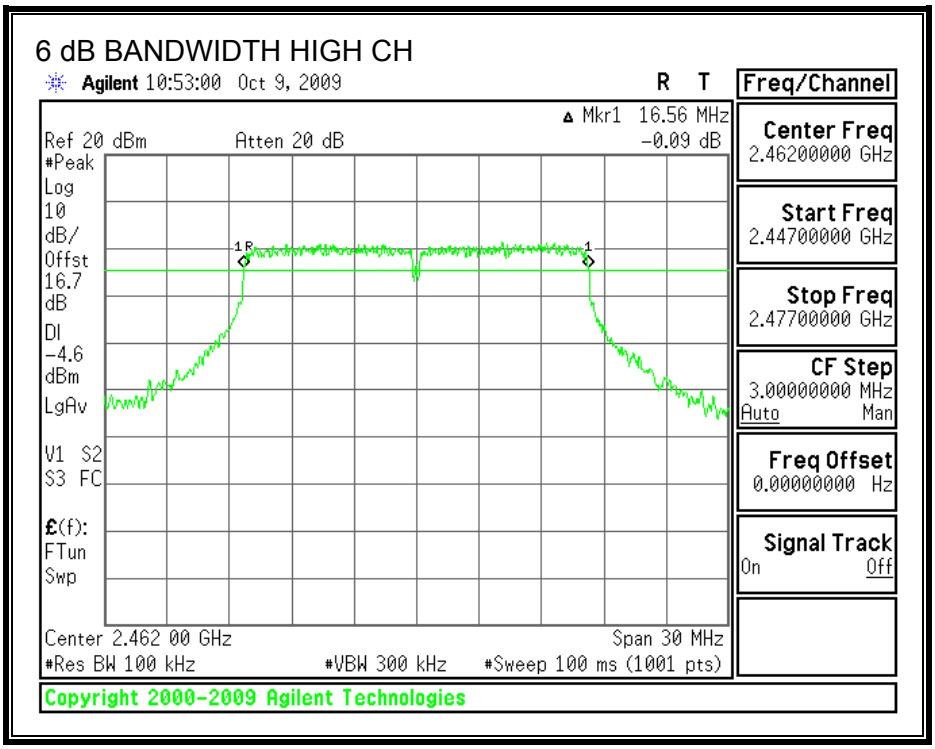




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### 7.2.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 2412 | 16.4682 |
| Middle | 2437 | 16.4351 |
| High | 2462 | 16.5307 |


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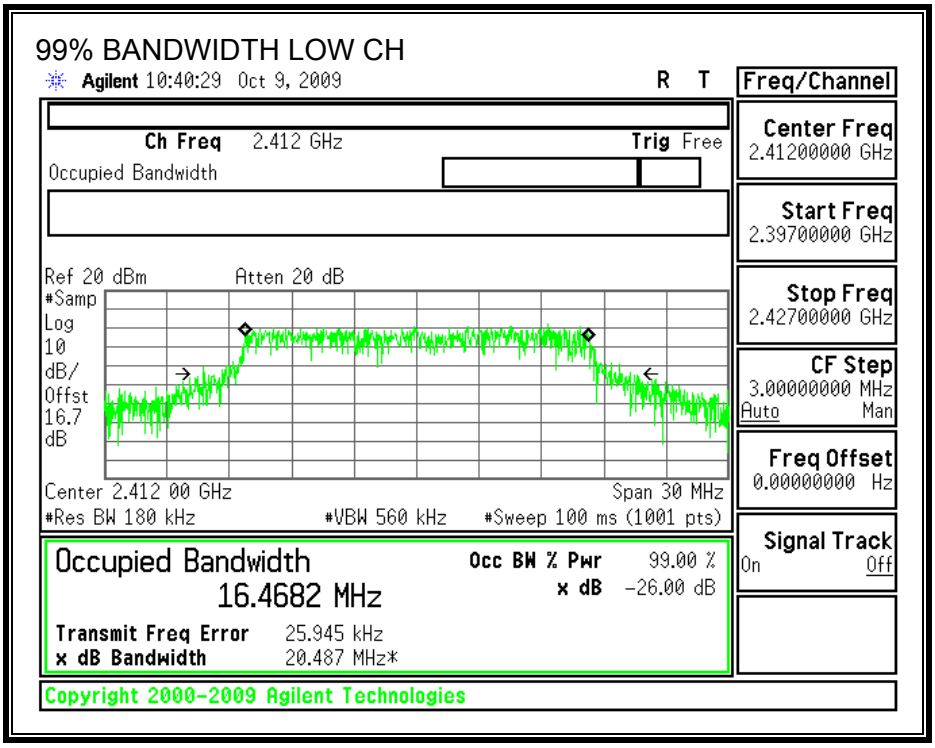
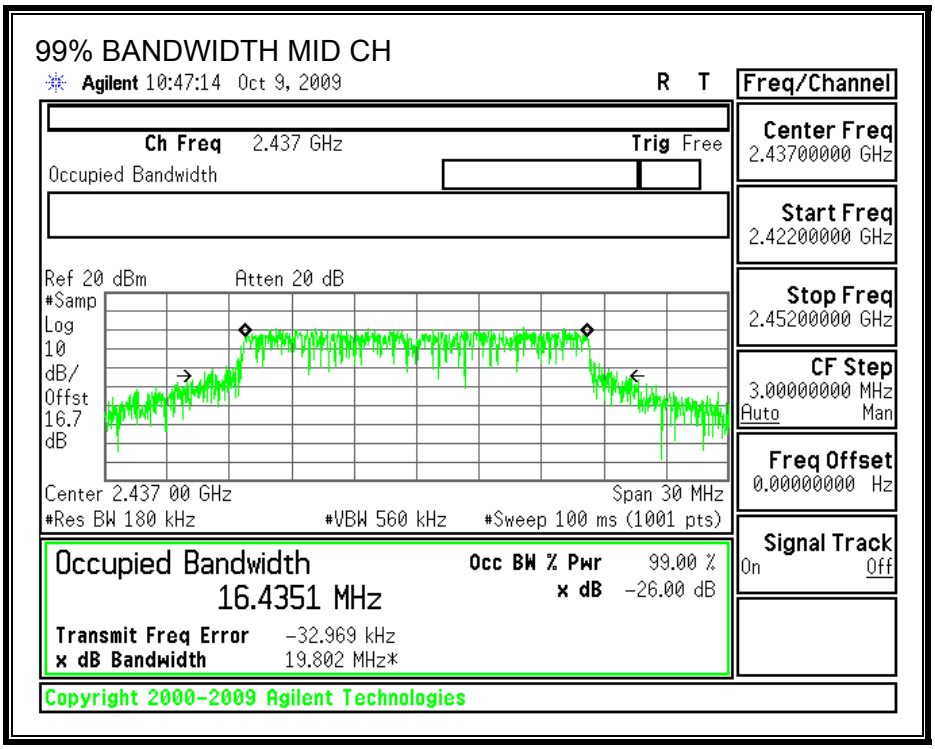
**99% BANDWIDTH**



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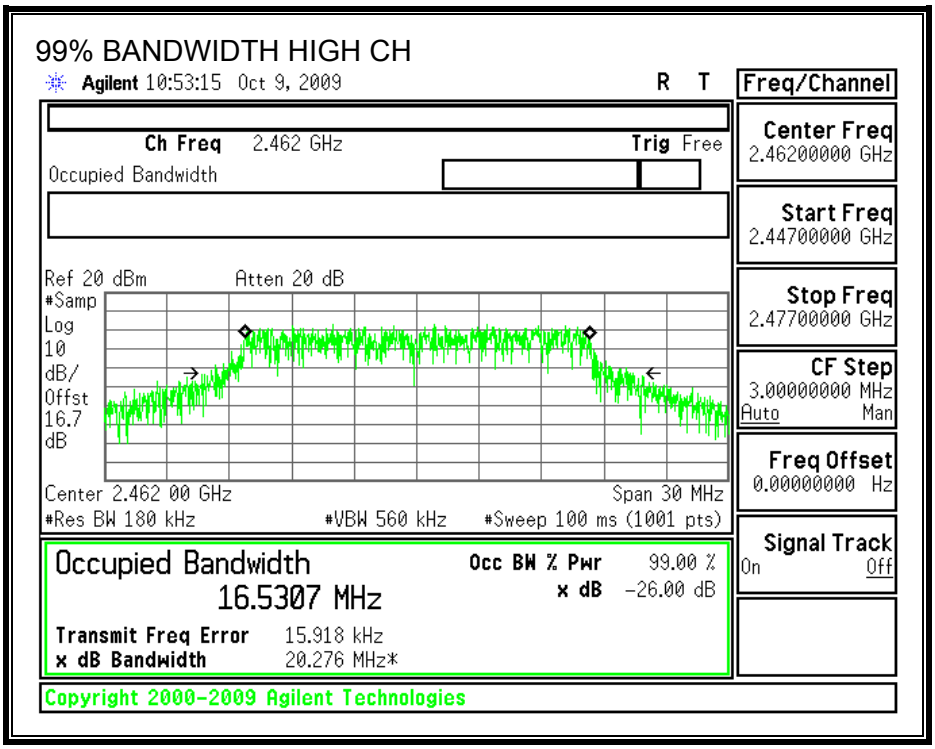




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## 7.2.3. OUTPUT POWER

**LIMITS**

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

**TEST PROCEDURE**

Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

**RESULTS**

| Channel | Frequency (MHz) | Spectrum Analyzer Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 2412 | 4.99 | 16.8 | 21.79 | 30 | -8.21 |
| Middle | 2437 | 4.84 | 16.8 | 21.64 | 30 | -8.36 |
| High | 2462 | 5.36 | 16.8 | 22.16 | 30 | -7.84 |


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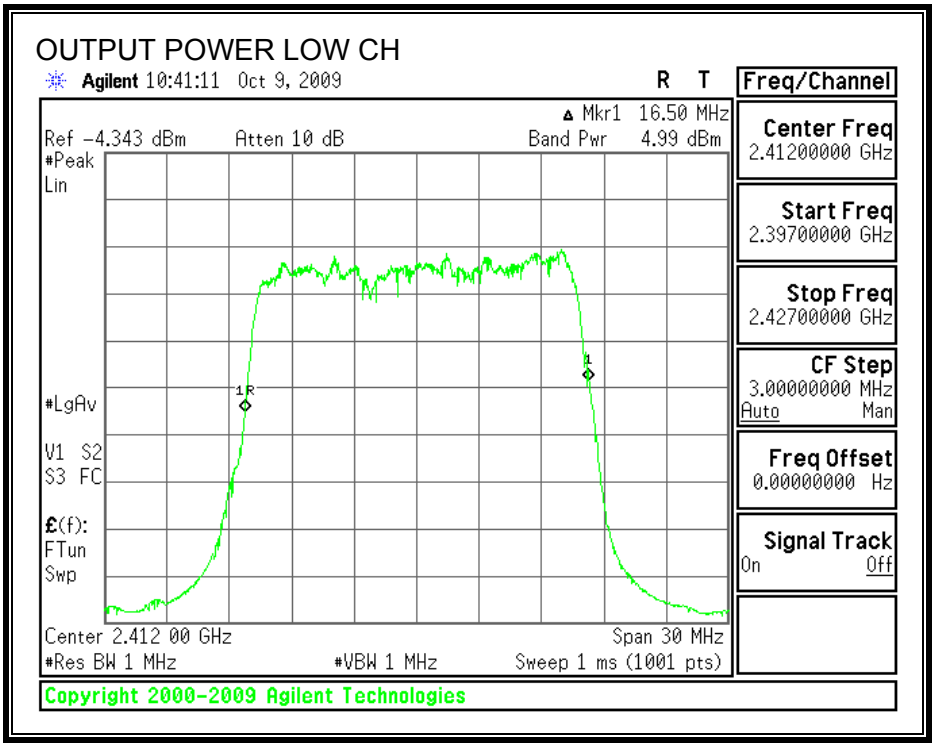
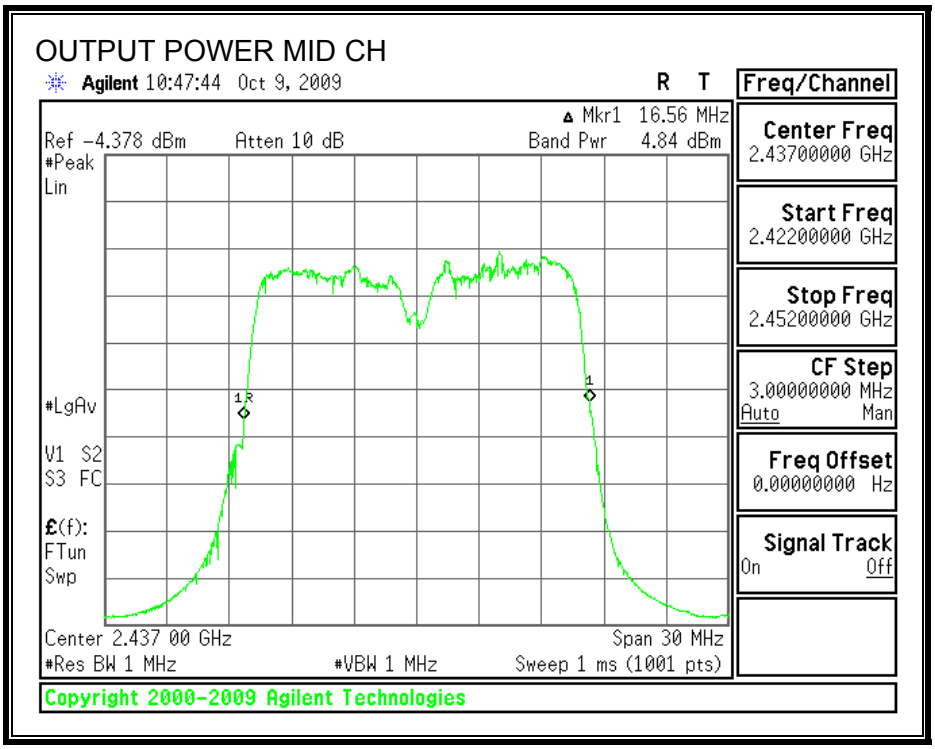
**OUTPUT POWER**





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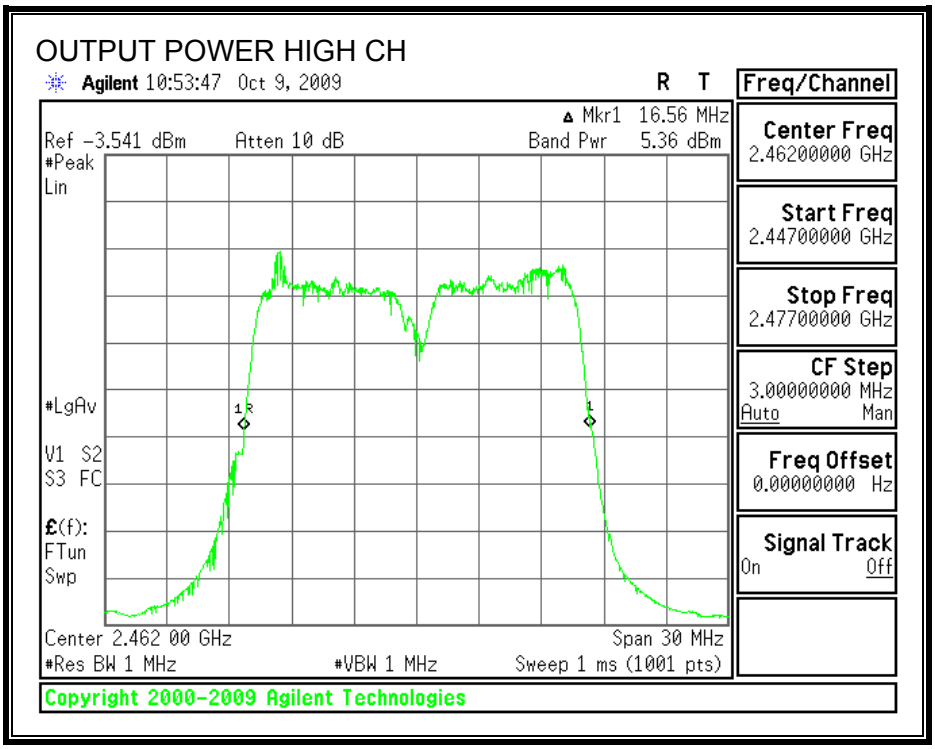




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## 7.2.4. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a power meter.

**RESULTS**

The cable assembly insertion loss of 16.8 dB (including 10 dB pad and 6.8 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Power (dBm) |
|---|---|---|
| Low | 2412 | 15.07 |
| Middle | 2437 | 15.11 |
| High | 2462 | 15.59 |


COMPLIANCE CERTIFICATION SERVICES FORM NO: CCSUP4701C
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## 7.2.5. POWER SPECTRAL DENSITY

**LIMITS**

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

**TEST PROCEDURE**

Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

**RESULTS**

| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2412 | -0.66 | 8 | -8.66 |
| Middle | 2437 | -7.97 | 8 | -15.97 |
| High | 2462 | -9.43 | 8 | -17.43 |



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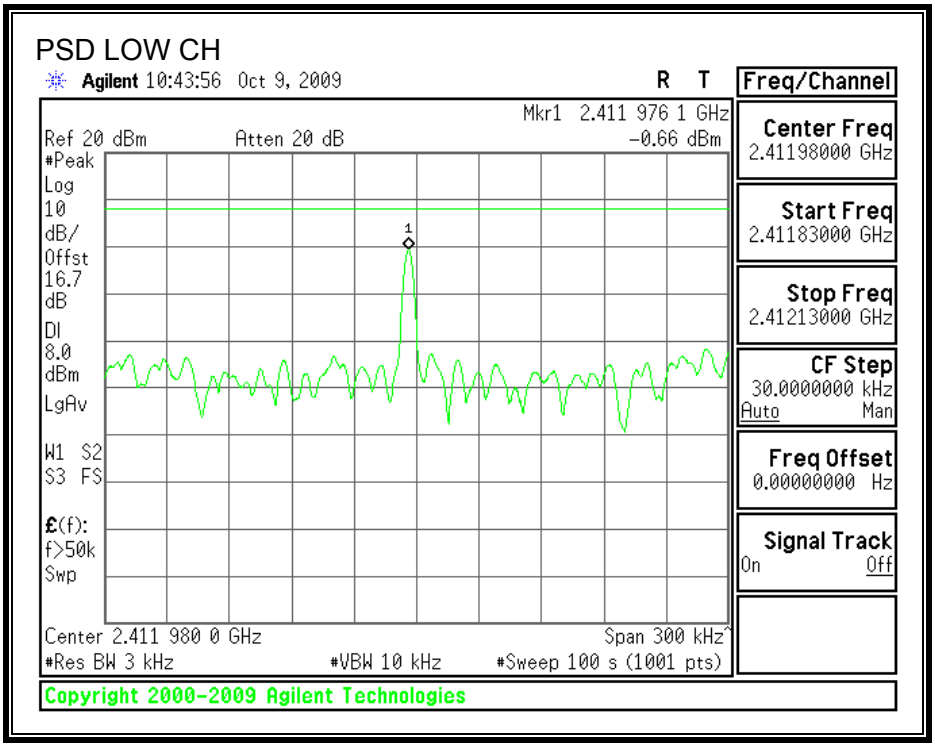
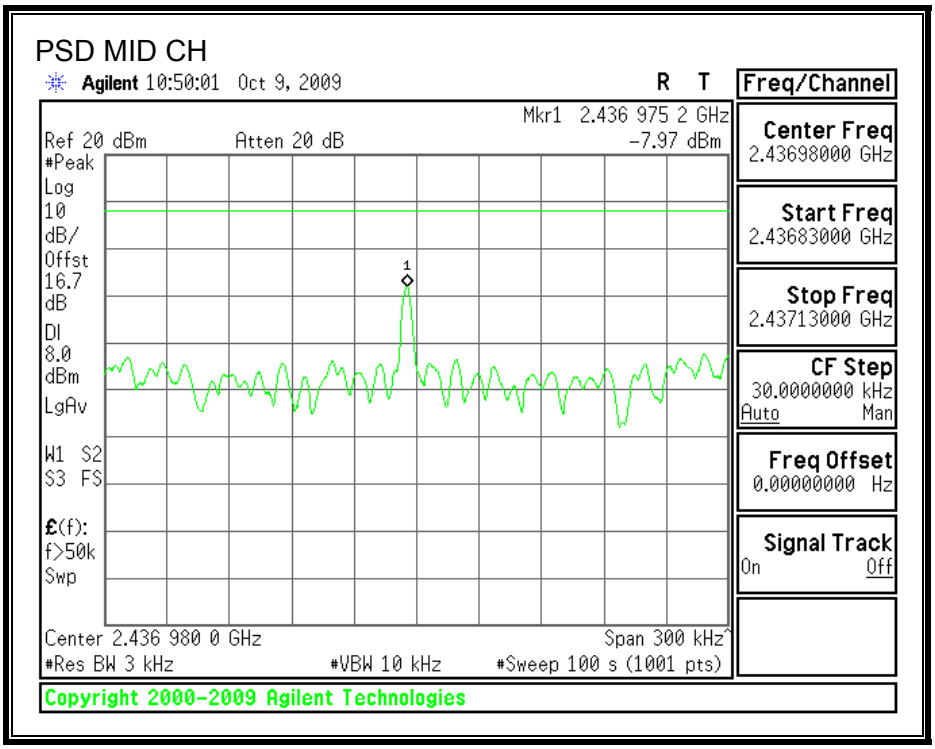
**POWER SPECTRAL DENSITY**





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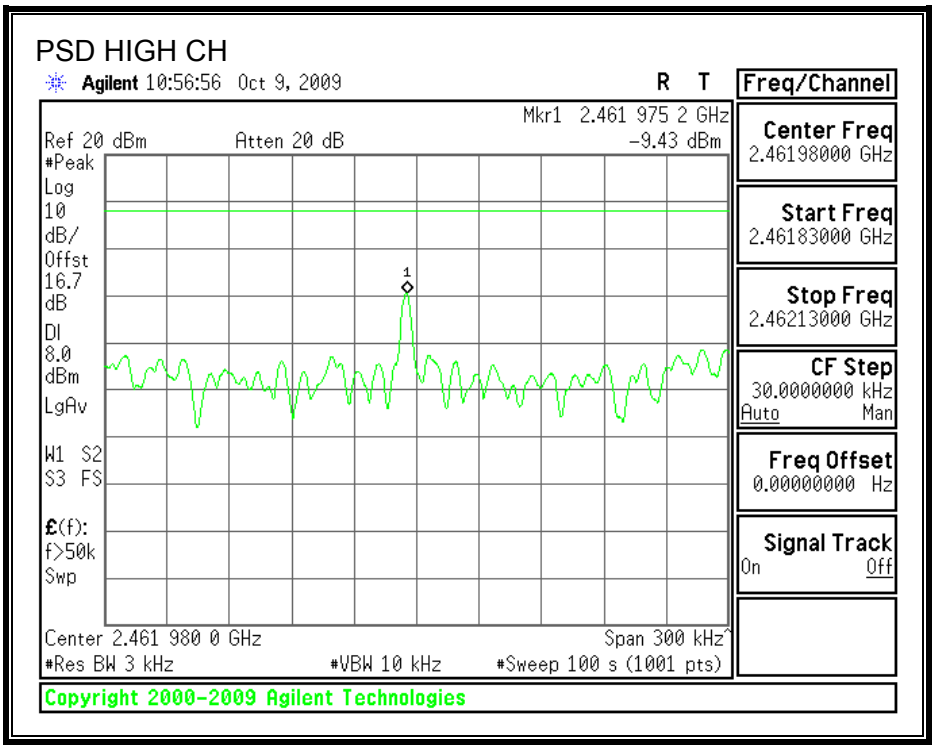
PSD HIGH CH



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## 7.2.6. CONDUCTED SPURIOUS EMISSIONS

**LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.


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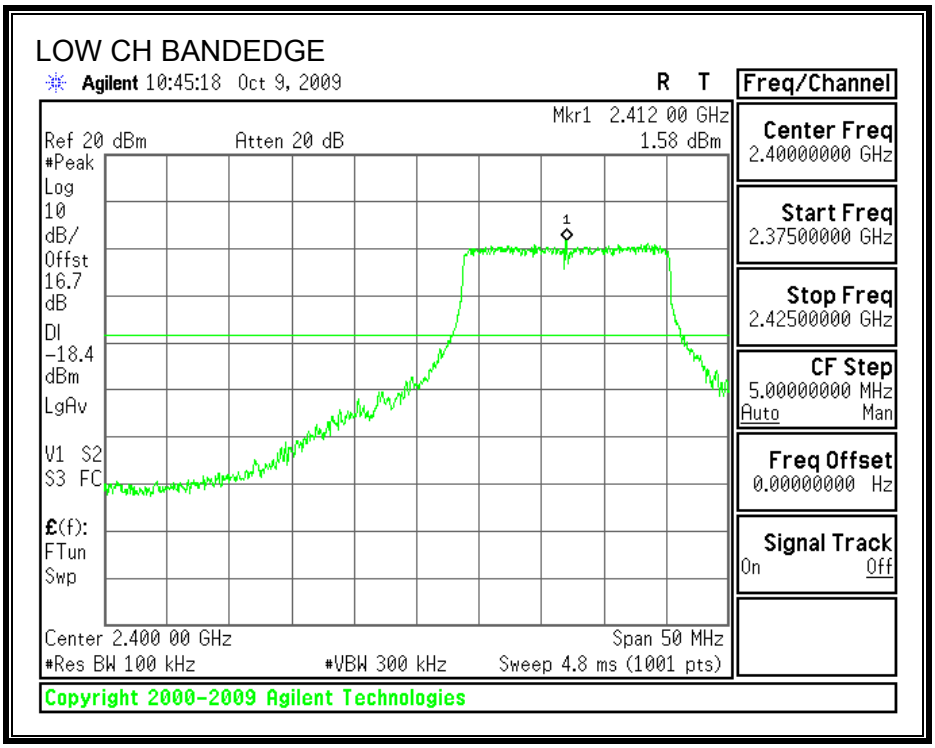
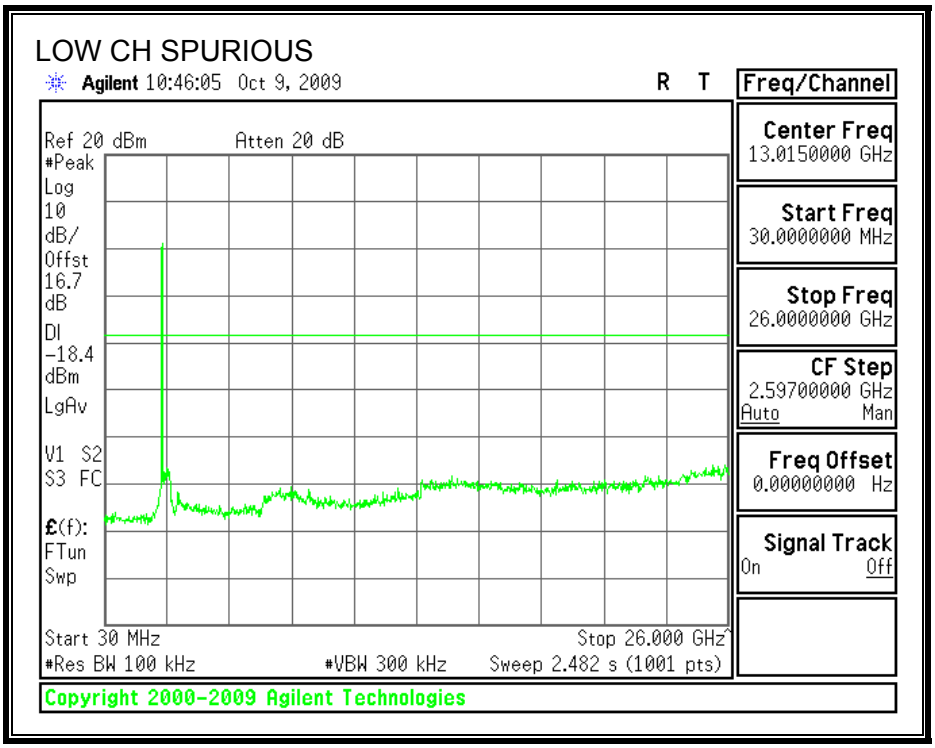
## RESULTS

## SPURIOUS EMISSIONS, LOW CHANNEL



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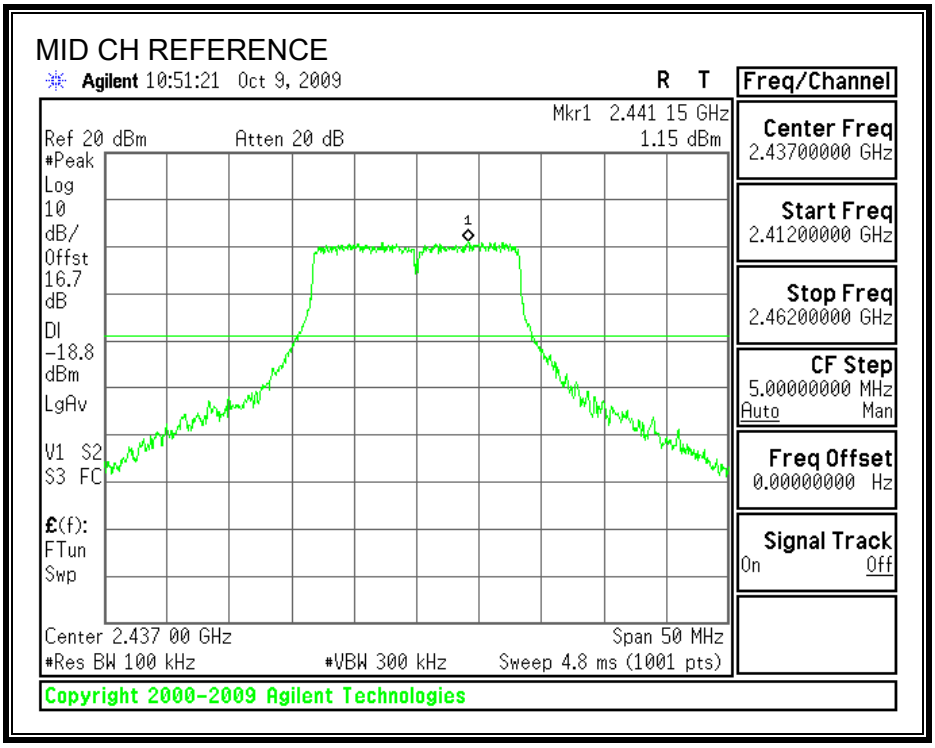
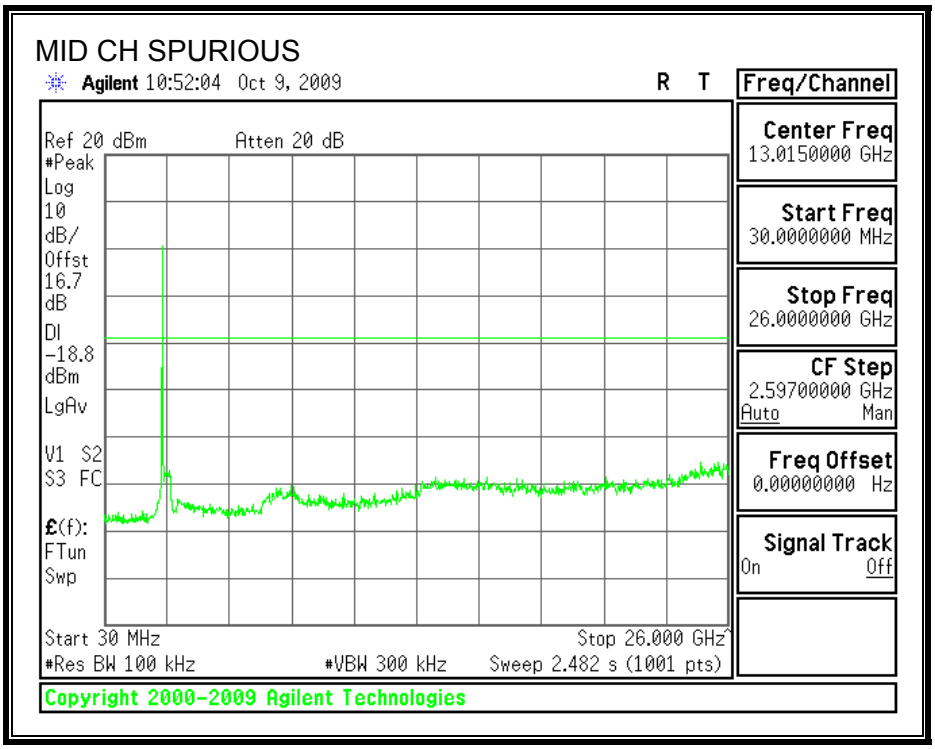
**SPURIOUS EMISSIONS, MID CHANNEL**





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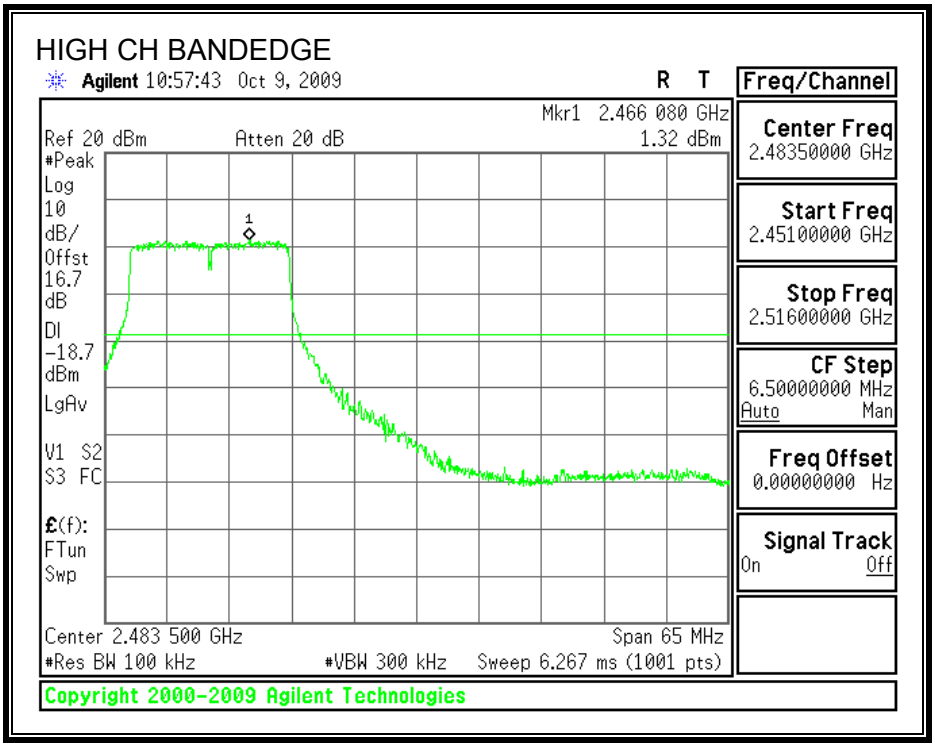
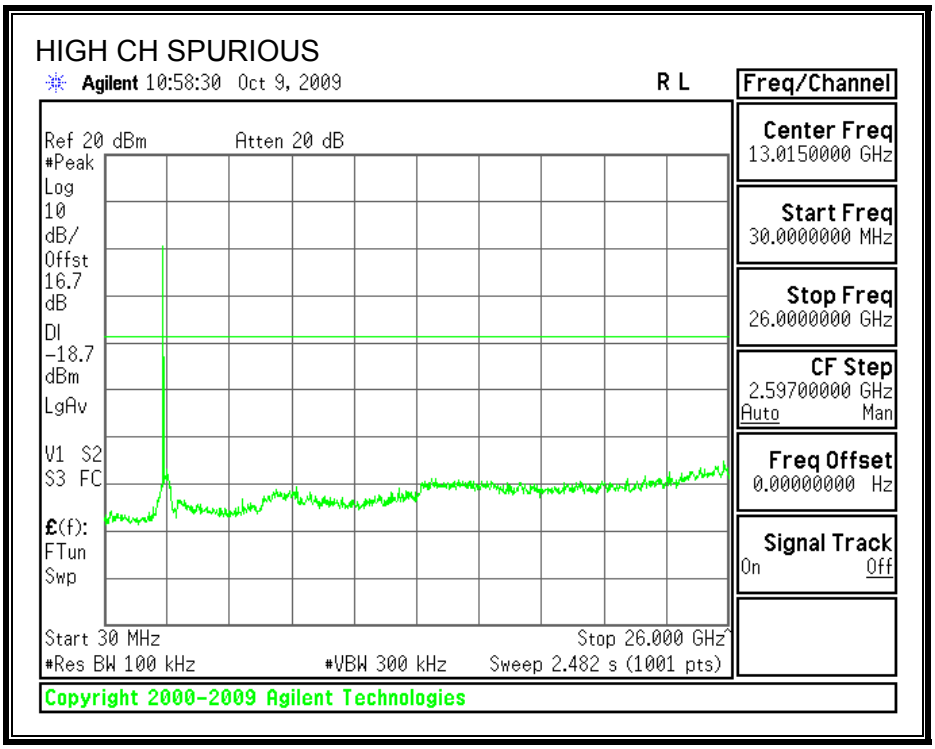
**SPURIOUS EMISSIONS, HIGH CHANNEL**





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# 8. RADIATED TEST RESULTS

## 8.1. LIMITS AND PROCEDURE

**LIMITS**

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|---|---|---|
| 30 - 88 | 100 | 40 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46 |
| Above 960 | 500 | 54 |

**TEST PROCEDURE**

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each appplicable band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.


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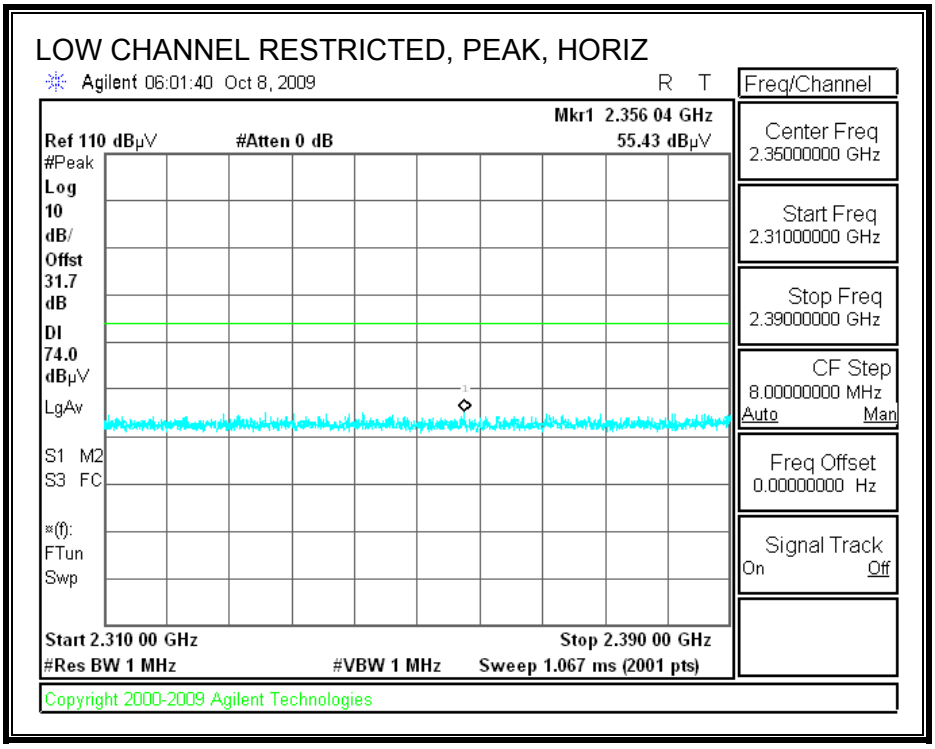
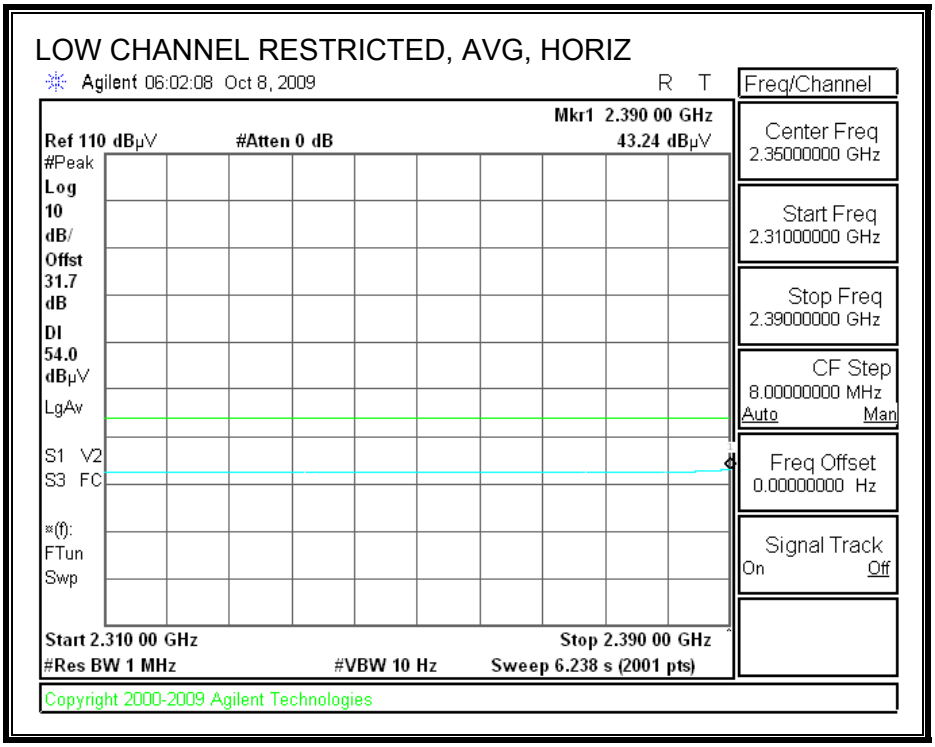
# 8.2.TRANSMITTER ABOVE 1 GHz

## 8.2.1. 802.11b MODE IN THE 2.4 GHz BAND

**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



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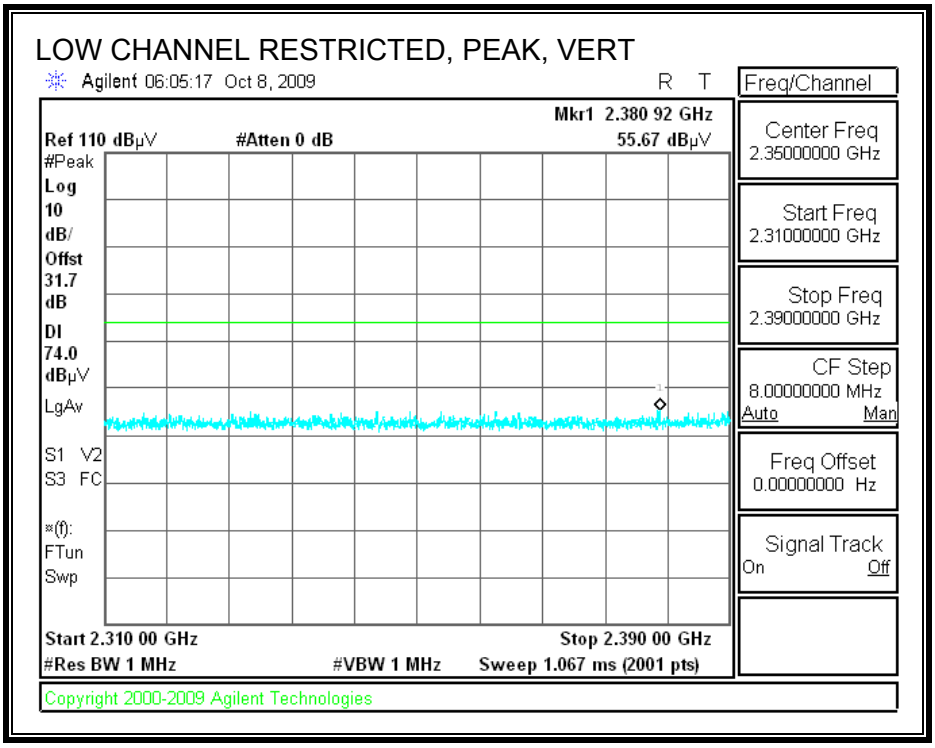
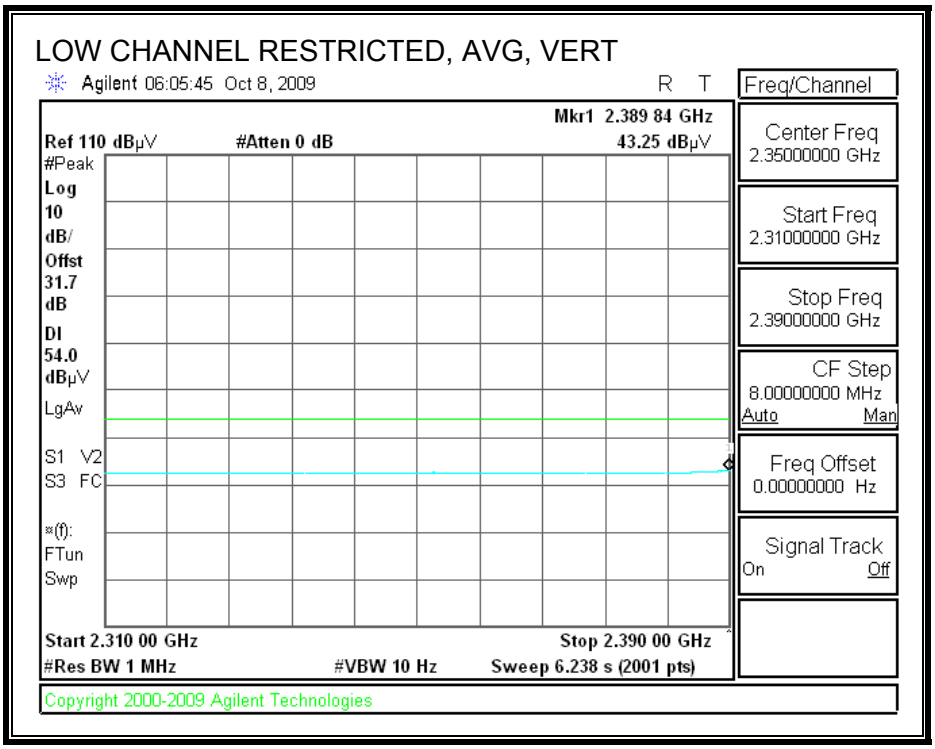
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**





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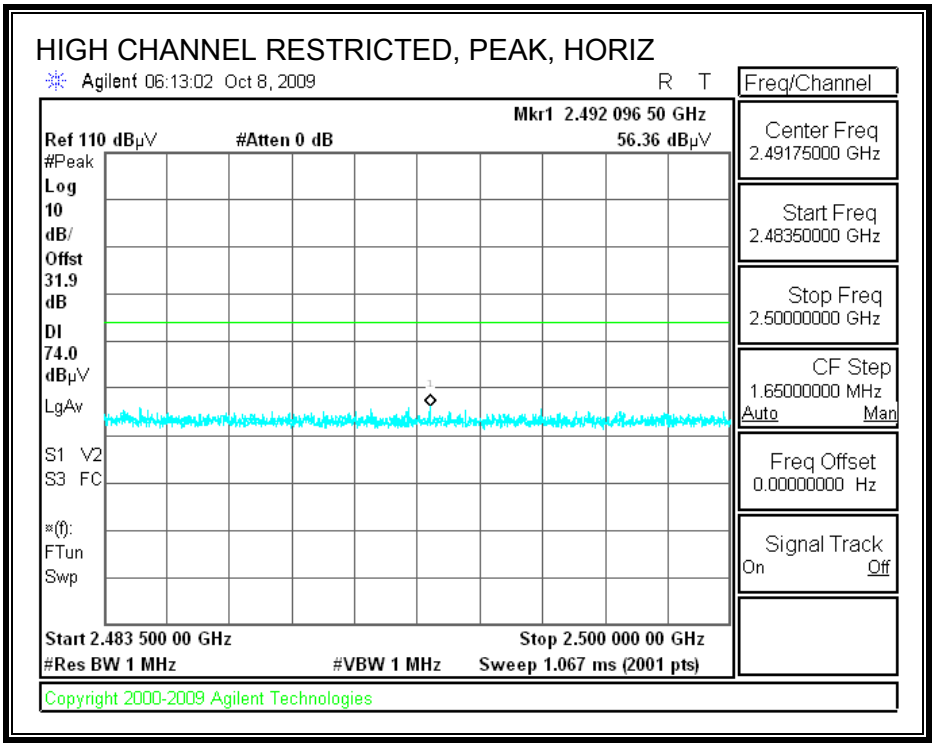
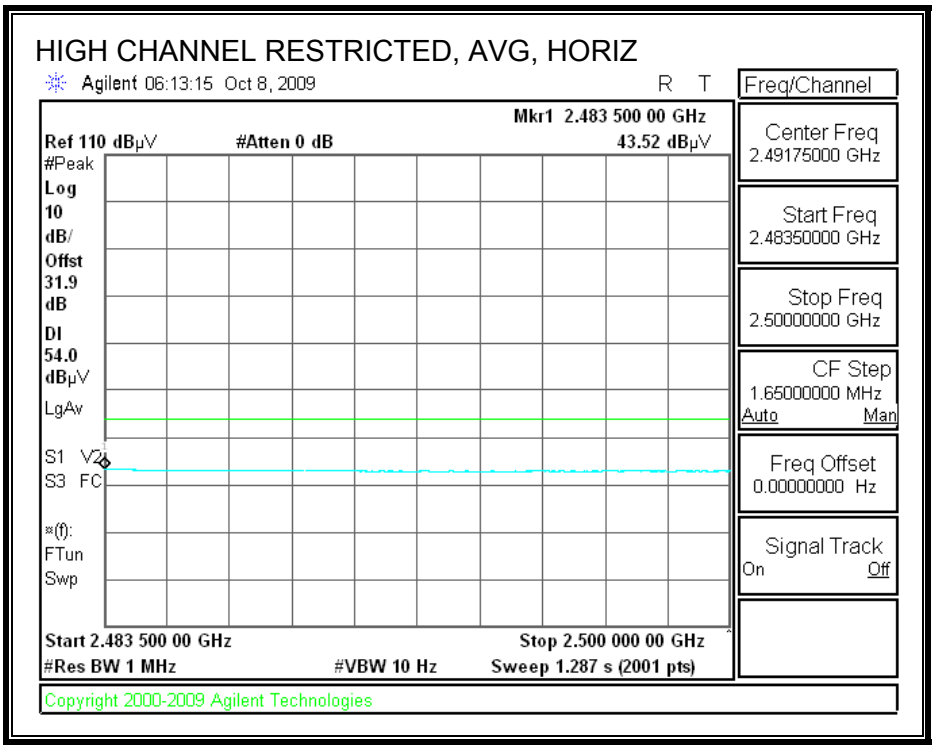
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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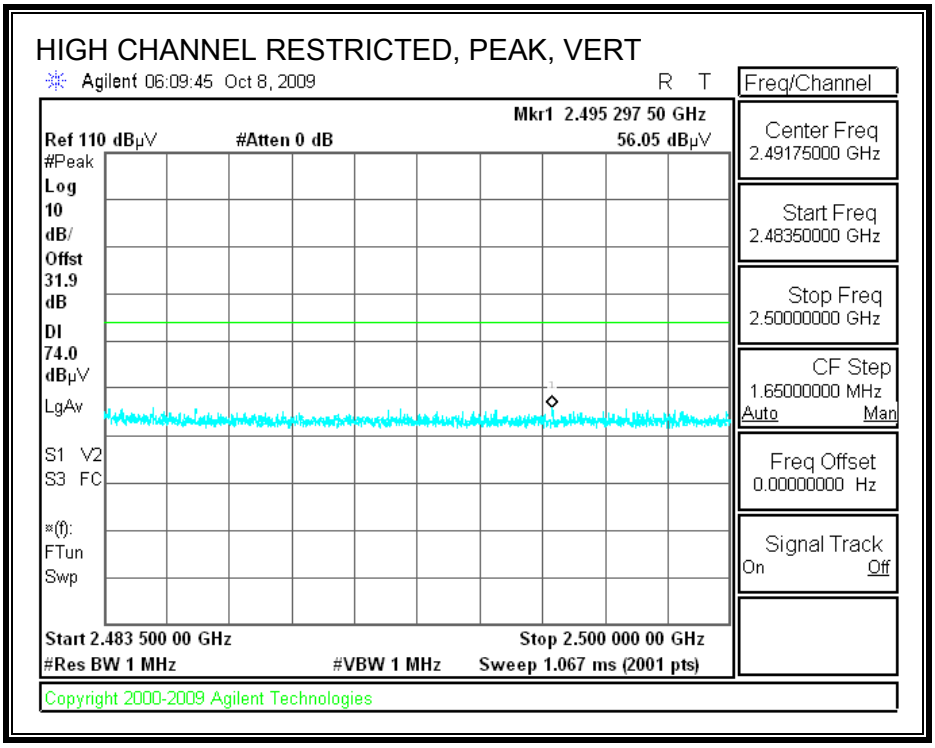
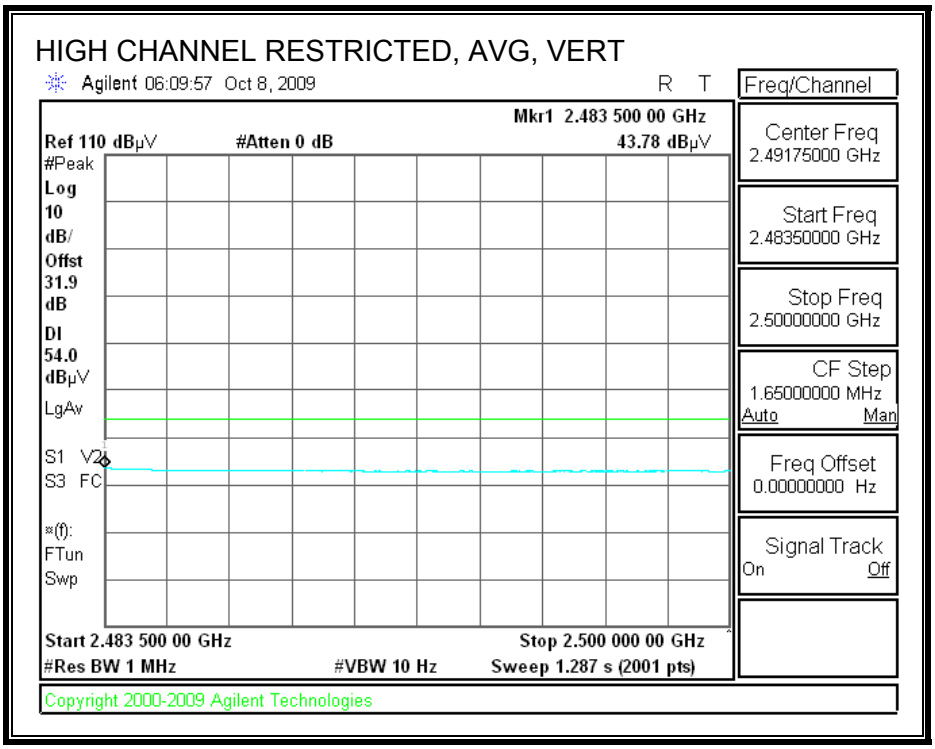
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**





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## HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**
**Compliance Certification Services, Fremont 5m Chamber**

**Test Engr:** Devin Chang
**Date:** 10/08/09
**Project #:** 09U12839
**Company:** Sierra Wireless
**EUT Description:** WiMAX + WiFi Router
**EUT M/N:** Eagle
**Mode Oper:** Tx_b mode

| | | | | |
|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Peak Field Strength Limit |
| Read | Analyzer Reading | Avg | Average Field Strength @ 3 m | Margin vs. Average Limit |
| AF | Antenna Factor | Peak | Calculated Peak Field Strength | Margin vs. Peak Limit |
| CL | Cable Loss | HPF | High Pass Filter | |

| f GHz | Dist (m) | Read dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Corr. dBuV/m | Limit dBuV/m | Margin dB | Ant. Pol. V/H | Det. P/A/QP | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2412MHz | | | | | | | | | | | | | |
| 4.824 | 3.0 | 40.2 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 44.5 | 74.0 | -29.5 | V | P | |
| 4.824 | 3.0 | 30.0 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 34.4 | 54.0 | -19.6 | V | A | |
| 4.824 | 3.0 | 39.1 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 43.4 | 74.0 | -30.6 | H | P | |
| 4.824 | 3.0 | 29.4 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 33.7 | 54.0 | -20.3 | H | A | |
| 2437MHz | | | | | | | | | | | | | |
| 4.874 | 3.0 | 41.0 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 45.4 | 74.0 | -28.6 | V | P | |
| 4.874 | 3.0 | 33.6 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 38.0 | 54.0 | -16.0 | V | A | |
| 7.311 | 3.0 | 38.4 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 46.8 | 74.0 | -27.2 | V | P | |
| 7.311 | 3.0 | 27.3 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 35.7 | 54.0 | -18.3 | V | A | |
| 4.874 | 3.0 | 40.0 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 44.4 | 74.0 | -29.6 | H | P | |
| 4.874 | 3.0 | 29.8 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 34.2 | 54.0 | -19.8 | H | A | |
| 7.311 | 3.0 | 37.2 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 45.6 | 74.0 | -28.4 | H | P | |
| 7.311 | 3.0 | 24.8 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 33.3 | 54.0 | -20.7 | H | A | |
| 2462MHz | | | | | | | | | | | | | |
| 4.924 | 3.0 | 41.8 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 46.3 | 74.0 | -27.7 | V | P | |
| 4.924 | 3.0 | 35.0 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 39.5 | 54.0 | -14.5 | V | A | |
| 7.386 | 3.0 | 38.8 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 47.4 | 74.0 | -26.6 | V | P | |
| 7.386 | 3.0 | 28.4 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 37.0 | 54.0 | -17.0 | V | A | |
| 4.924 | 3.0 | 41.5 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 46.0 | 74.0 | -28.0 | H | P | |
| 4.924 | 3.0 | 33.4 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 37.9 | 54.0 | -16.1 | H | A | |
| 7.386 | 3.0 | 37.3 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 45.9 | 74.0 | -28.1 | H | P | |
| 7.386 | 3.0 | 25.5 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 34.1 | 54.0 | -19.9 | H | A | |

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.



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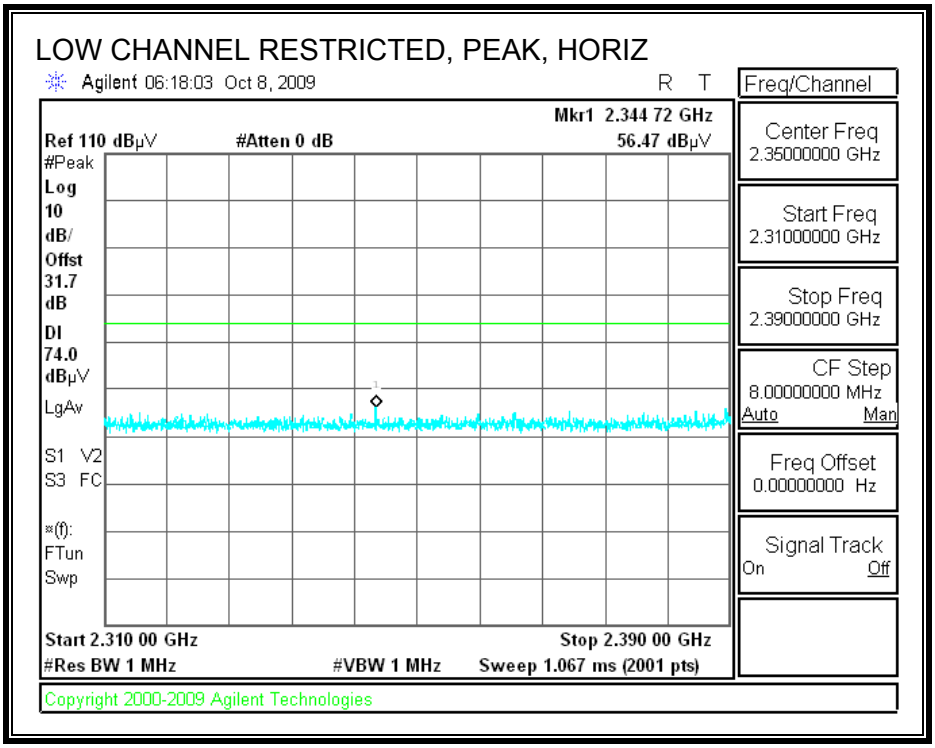
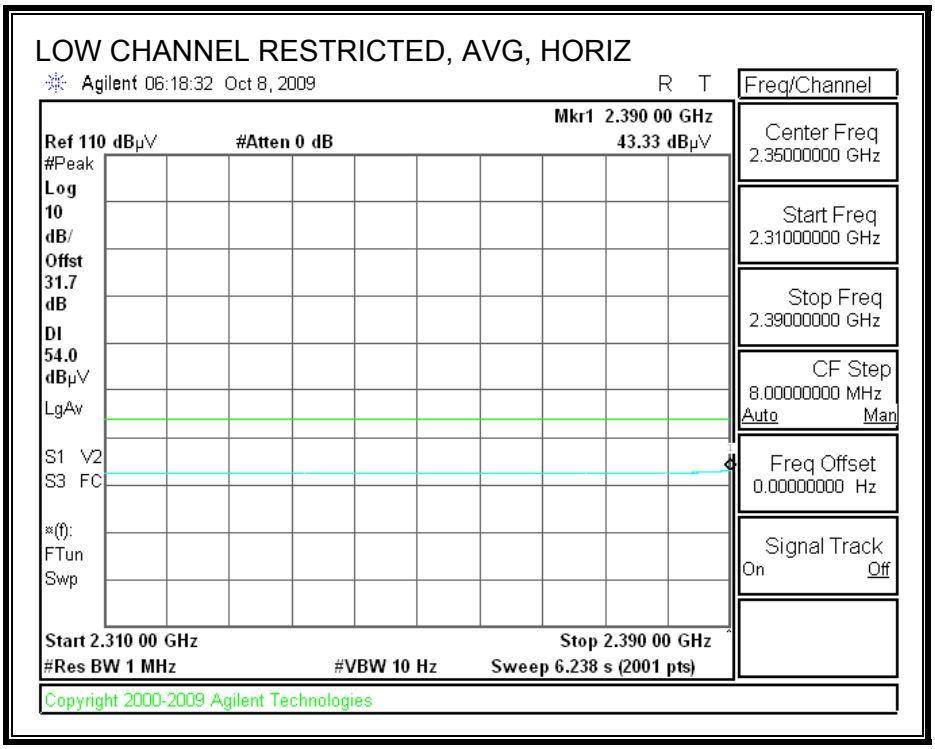
## 8.2.2. 802.11g MODE IN THE 2.4 GHz BAND

**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



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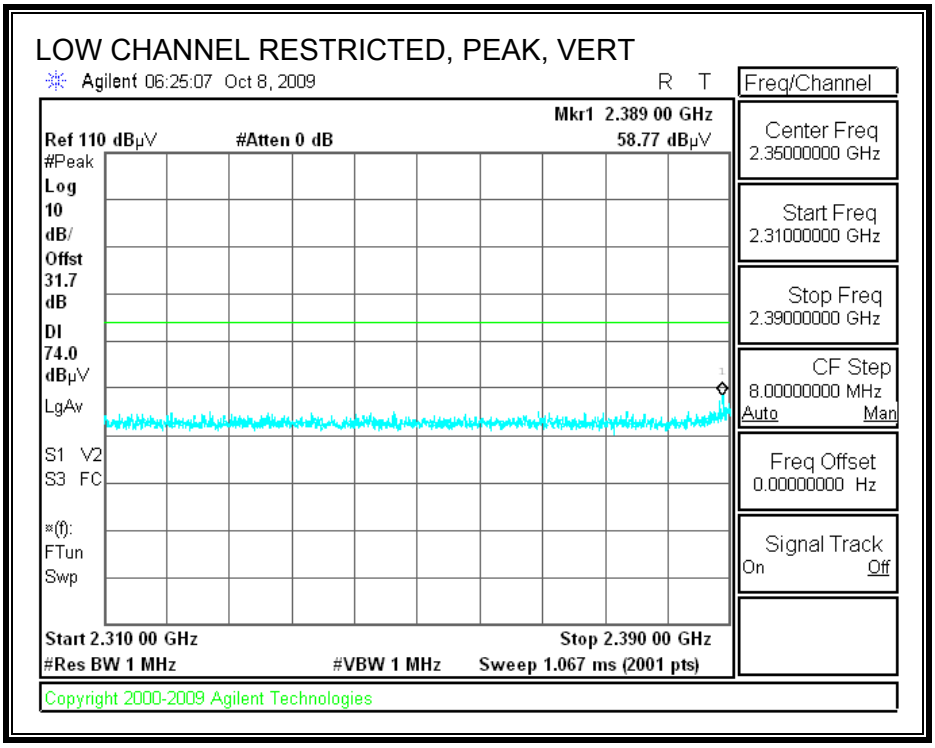
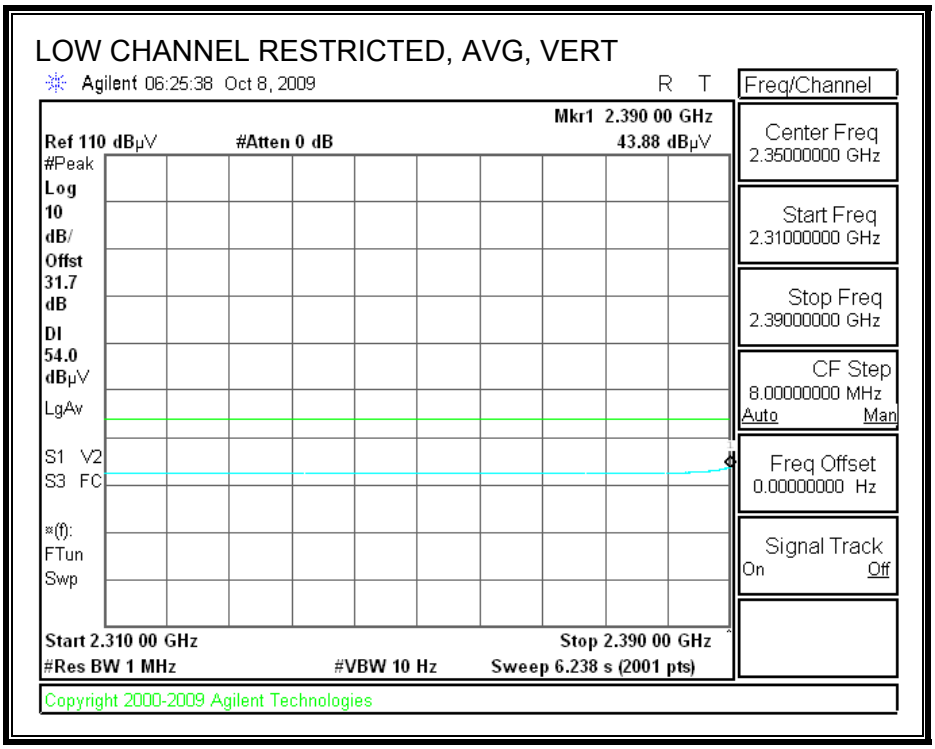
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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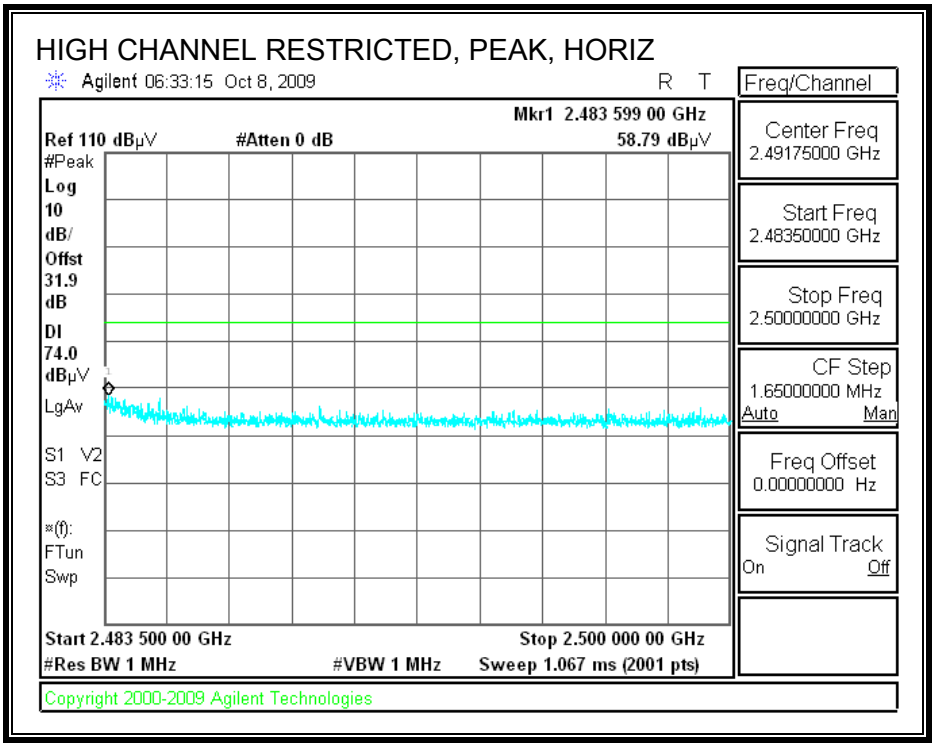
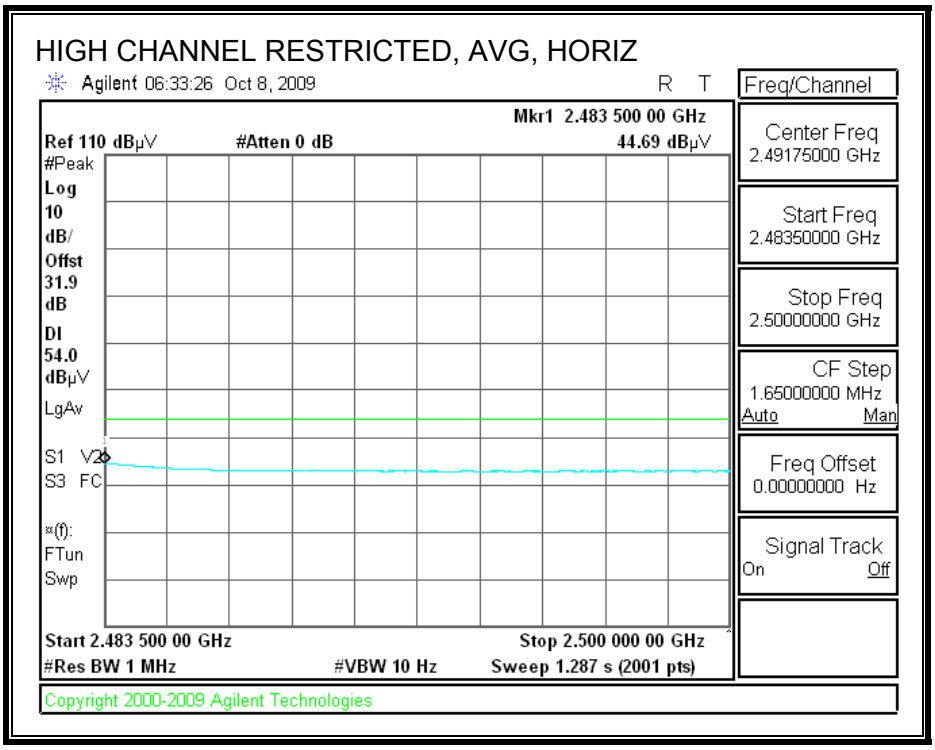
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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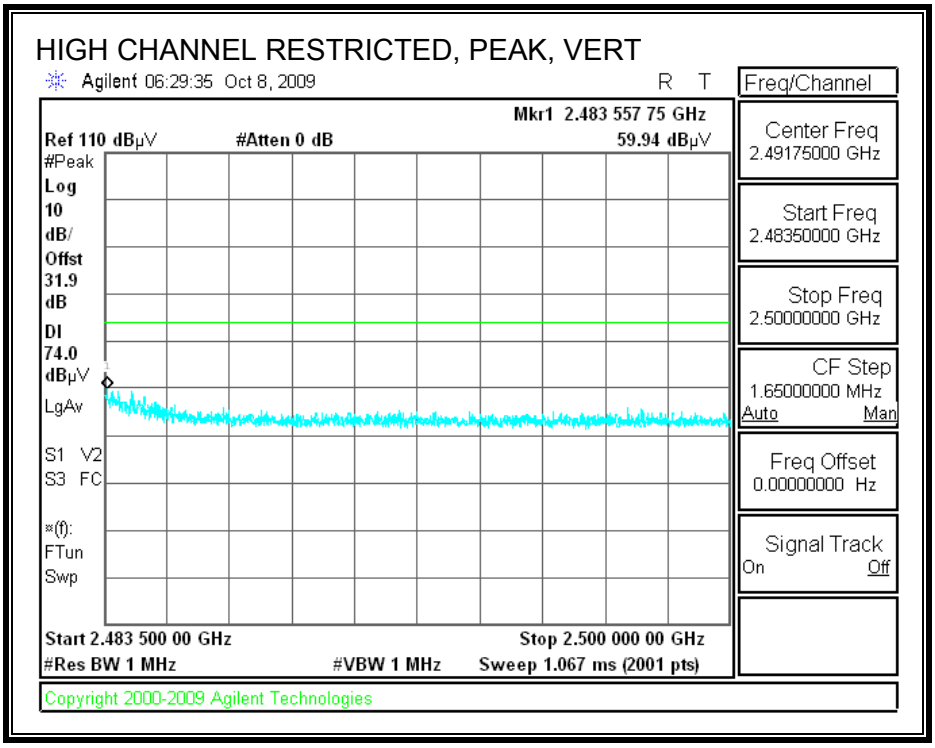
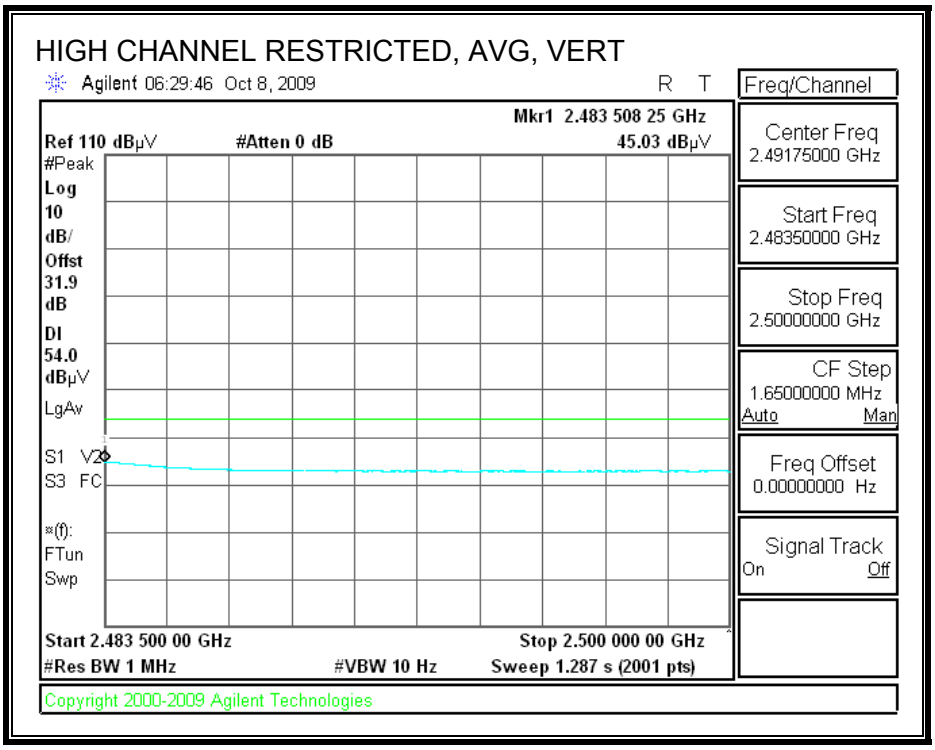
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



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## HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**
**Compliance Certification Services, Fremont 5m Chamber**

**Test Engr:** Devin Chang
**Date:** 10/08/09
**Project #:** 09U12839
**Company:** Sierra Wireless
**EUT Description:** WiMAX + WiFi Router
**EUT M/N:** Eagle
**Mode Oper:** Tx_g mode

| | | | | |
|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Peak Field Strength Limit |
| Read | Analyzer Reading | Avg | Average Field Strength @ 3 m | Margin vs. Average Limit |
| AF | Antenna Factor | Peak | Calculated Peak Field Strength | Margin vs. Peak Limit |
| CL | Cable Loss | HPF | High Pass Filter | |

| f GHz | Dist (m) | Read dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Corr. dBuV/m | Limit dBuV/m | Margin dB | Ant. Pol. V/H | Det. P/A/QP | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2412MHz | | | | | | | | | | | | | |
| 4.824 | 3.0 | 37.8 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 42.1 | 74.0 | -31.9 | V | P | |
| 4.824 | 3.0 | 25.6 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 29.9 | 54.0 | -24.1 | V | A | |
| 4.824 | 3.0 | 37.8 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 42.1 | 74.0 | -31.9 | H | P | |
| 4.824 | 3.0 | 25.5 | 32.8 | 5.8 | -34.8 | 0.0 | 0.6 | 29.9 | 54.0 | -24.1 | H | A | |
| 2437MHz | | | | | | | | | | | | | |
| 4.874 | 3.0 | 38.1 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 42.5 | 74.0 | -31.5 | V | P | |
| 4.874 | 3.0 | 25.4 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 29.8 | 54.0 | -24.2 | V | A | |
| 7.311 | 3.0 | 37.0 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 45.4 | 74.0 | -28.6 | V | P | |
| 7.311 | 3.0 | 25.0 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 33.5 | 54.0 | -20.5 | V | A | |
| 4.874 | 3.0 | 38.0 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 42.4 | 74.0 | -31.6 | H | P | |
| 4.874 | 3.0 | 25.3 | 32.8 | 5.8 | -34.9 | 0.0 | 0.6 | 29.7 | 54.0 | -24.3 | H | A | |
| 7.311 | 3.0 | 37.3 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 45.7 | 74.0 | -28.3 | H | P | |
| 7.311 | 3.0 | 25.0 | 35.2 | 7.3 | -34.7 | 0.0 | 0.6 | 33.4 | 54.0 | -20.6 | H | A | |
| 2462MHz | | | | | | | | | | | | | |
| 4.924 | 3.0 | 38.6 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 43.1 | 74.0 | -30.9 | V | P | |
| 4.924 | 3.0 | 25.7 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 30.2 | 54.0 | -23.8 | V | A | |
| 7.386 | 3.0 | 37.9 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 46.5 | 74.0 | -27.5 | V | P | |
| 7.386 | 3.0 | 25.0 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 33.6 | 54.0 | -20.4 | V | A | |
| 4.924 | 3.0 | 38.3 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 42.8 | 74.0 | -31.2 | H | P | |
| 4.924 | 3.0 | 25.8 | 32.8 | 5.9 | -34.9 | 0.0 | 0.6 | 30.3 | 54.0 | -23.7 | H | A | |
| 7.386 | 3.0 | 38.4 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 47.0 | 74.0 | -27.0 | H | P | |
| 7.386 | 3.0 | 25.1 | 35.3 | 7.3 | -34.6 | 0.0 | 0.6 | 33.7 | 54.0 | -20.3 | H | A | |

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.



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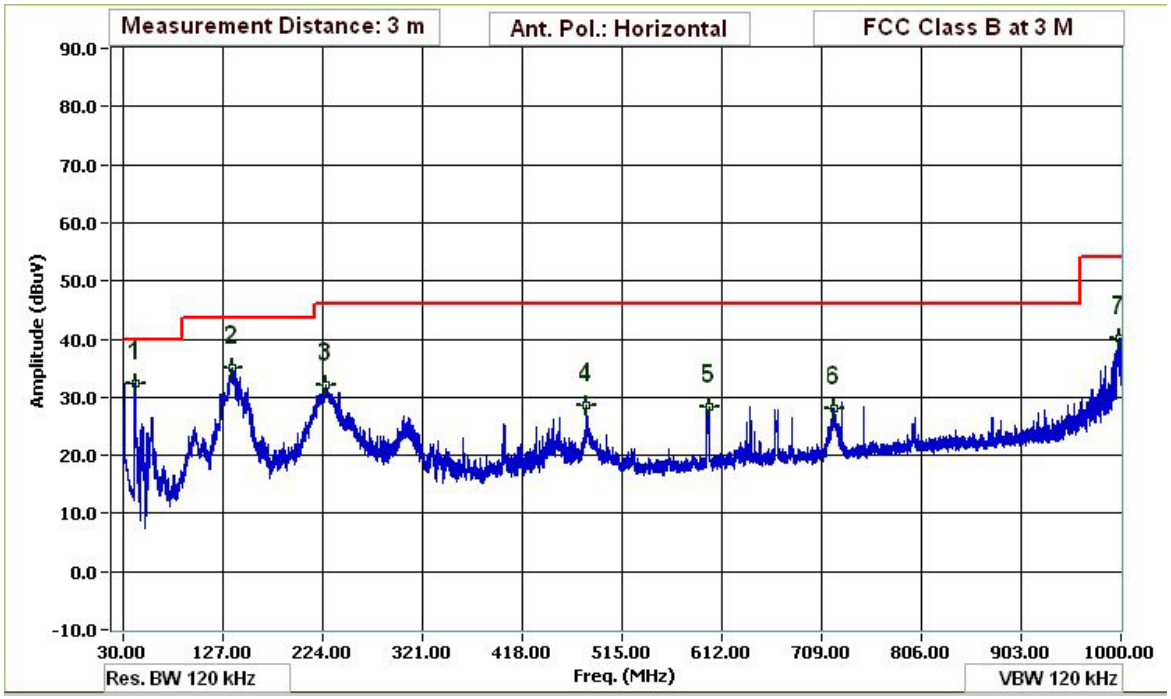
## 8.3. WORST-CASE BELOW 1 GHz

**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)**

HORIZONTAL PLOT



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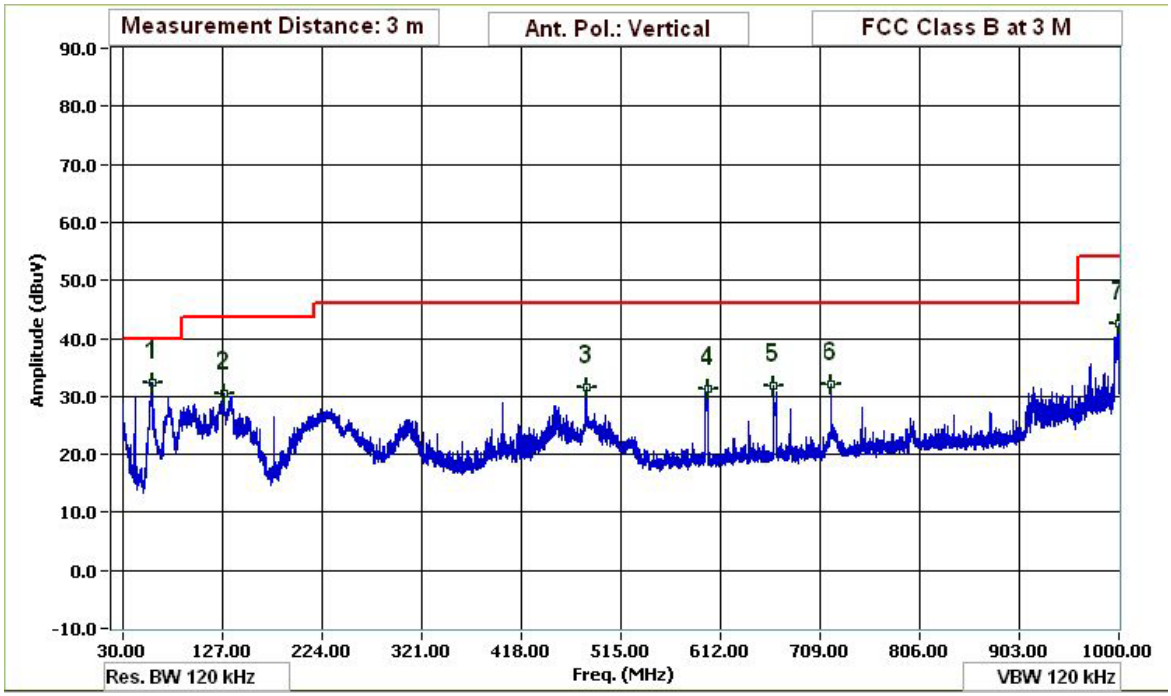
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL PLOT



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DATA

**30-1000MHz Frequency Measurement**
**Compliance Certification Services, Fremont 5m Chamber**

**Test Engr:** Devin Chang
**Date:** 10/07/09
**Project #:** 09U12839
**Company:** Sierra Wireless
**EUT Description:** WiMAX + WiFi Router
**EUT M/N:** Eagle
**Mode Oper:** Tx mode

| | | | | | |
|---|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Margin | Margin vs. Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | | |
| Read | Analyzer Reading | Filter | Filter Insert Loss | | |
| AF | Antenna Factor | Corr. | Calculated Field Strength | | |
| CL | Cable Loss | Limit | Field Strength Limit | | |

| f MHz | Dist (m) | Read dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Filter dB | Corr. dBuV/m | Limit dBuV/m | Margin dB | Ant. Pol. V/H | Det. P/A/QP | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.081 | 3.0 | 53.4 | 7.9 | 0.7 | 29.6 | 0.0 | 0.0 | 32.4 | 40.0 | -7.6 | V | EP | |
| 128.524 | 3.0 | 45.1 | 13.7 | 1.0 | 29.4 | 0.0 | 0.0 | 30.5 | 43.5 | -13.0 | V | EP | |
| 481.699 | 3.0 | 42.6 | 16.5 | 2.1 | 29.7 | 0.0 | 0.0 | 31.5 | 46.0 | -14.5 | V | EP | |
| 599.423 | 3.0 | 40.4 | 18.2 | 2.4 | 29.6 | 0.0 | 0.0 | 31.4 | 46.0 | -14.6 | V | EP | |
| 663.746 | 3.0 | 40.1 | 18.9 | 2.5 | 29.6 | 0.0 | 0.0 | 31.9 | 46.0 | -14.1 | V | EP | |
| 720.028 | 3.0 | 39.4 | 19.6 | 2.6 | 29.5 | 0.0 | 0.0 | 32.2 | 46.0 | -13.8 | V | EP | |
| 999.400 | 3.0 | 45.2 | 22.6 | 3.2 | 28.4 | 0.0 | 0.0 | 42.6 | 54.0 | -11.4 | V | EP | |
| 41.520 | 3.0 | 48.4 | 13.2 | 0.6 | 29.6 | 0.0 | 0.0 | 32.5 | 40.0 | -7.5 | H | EP | |
| 136.324 | 3.0 | 50.1 | 13.4 | 1.0 | 29.4 | 0.0 | 0.0 | 35.1 | 43.5 | -8.4 | H | EP | |
| 227.048 | 3.0 | 47.6 | 11.9 | 1.4 | 28.8 | 0.0 | 0.0 | 32.1 | 46.0 | -13.9 | H | EP | |
| 480.019 | 3.0 | 39.7 | 16.4 | 2.1 | 29.6 | 0.0 | 0.0 | 28.6 | 46.0 | -17.4 | H | EP | |
| 600.024 | 3.0 | 37.3 | 18.3 | 2.4 | 29.6 | 0.0 | 0.0 | 28.3 | 46.0 | -17.7 | H | EP | |
| 720.508 | 3.0 | 35.2 | 19.6 | 2.6 | 29.5 | 0.0 | 0.0 | 28.0 | 46.0 | -18.0 | H | EP | |
| 998.080 | 3.0 | 42.7 | 22.6 | 3.2 | 28.4 | 0.0 | 0.0 | 40.1 | 54.0 | -13.9 | H | EP | |

**Rev. 1.27.09**
**Note: No other emissions were detected above the system noise floor.**



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# 9. AC POWER LINE CONDUCTED EMISSIONS

**LIMITS**

FCC §15.207 (a)

RSS-Gen 7.2.2

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 * | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

**TEST PROCEDURE**

ANSI C63.4

**RESULTS**

**6 WORST EMISSIONS**

**CONDUCTED EMISSIONS DATA (115VAC 60Hz)**

| Freq. | Reading | | | Closs | Limit | FCC_B | Margin | | Remark |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | PK (dBuV) | QP (dBuV) | AV (dBuV) | (dB) | QP | AV | QP (dB) | AV (dB) | L1 / L2 |
| 0.18 | 55.75 | -- | 41.05 | 0.00 | 64.63 | 54.63 | -8.88 | -13.58 | L1 |
| 4.38 | 36.25 | -- | 25.54 | 0.00 | 56.00 | 46.00 | -19.75 | -20.46 | L1 |
| 21.49 | 41.04 | -- | 25.40 | 0.00 | 60.00 | 50.00 | -18.96 | -24.60 | L1 |
| 0.18 | 54.23 | -- | 40.35 | 0.00 | 64.63 | 54.63 | -10.40 | -14.28 | L2 |
| 0.24 | 45.94 | -- | 32.15 | 0.00 | 62.17 | 52.17 | -16.23 | -20.02 | L2 |
| 4.38 | 39.49 | -- | 27.20 | 0.00 | 56.00 | 46.00 | -16.51 | -18.80 | L2 |
| 6 Worst Data | | | | | | | | | |



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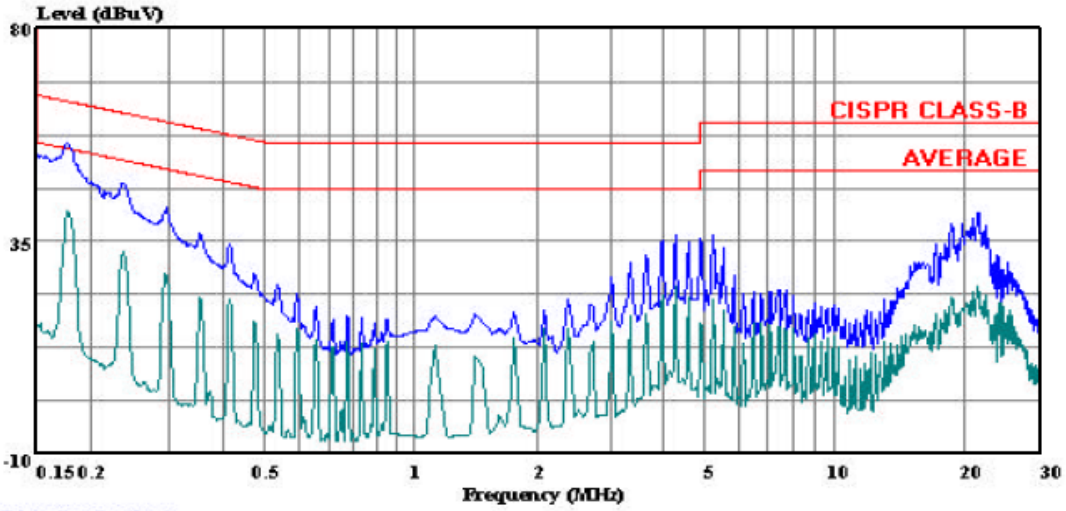
**LINE 1 RESULTS**

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 7 File#: 09u12839.EMI Date: 10-12-2009 Time: 14:27:02




(Line Conduction)

Trace: 5 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Devin Chang
Project #: : 09U12839
Company: : Sierra Wireless
EUT Description:: EUT With Laptop PC
Mode: : USB Link mode
Target: : FCC CLASS B
Voltage: : 115V/50Hz
: L1 Peak ( Blue ) , Average (Green )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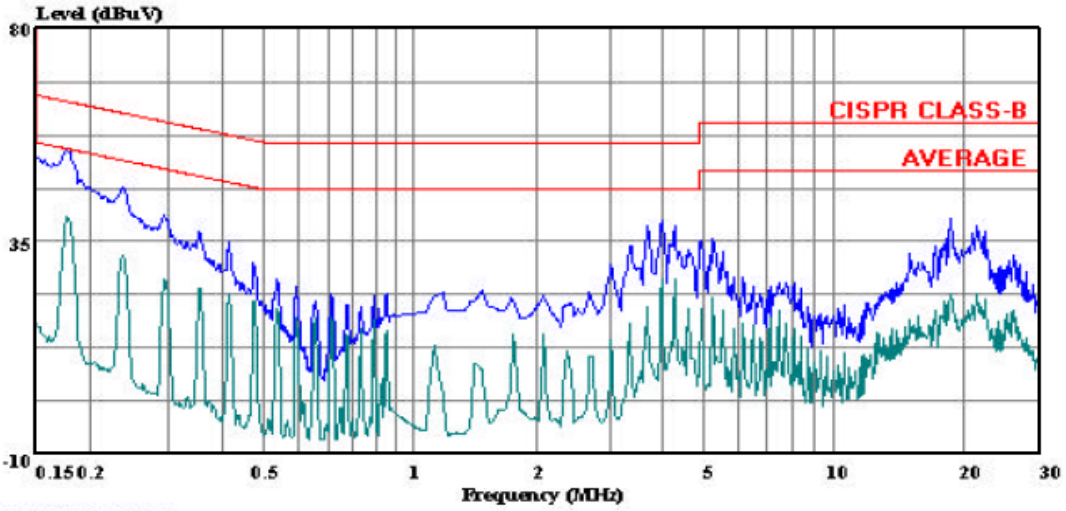
**LINE 2 RESULTS**

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 14 File#: 09u12839.EMI Date: 10-12-2009 Time: 14:33:57




(Line Conduction)

Trace: 12 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Devin Chang
Project #: : 09U12839
Company: : Sierra Wireless
EUT Description:: EUT With Laptop PC
Mode: : USB Link mode
Target: : FCC CLASS B
Voltage: : 115V/50Hz
: L2 Peak ( Blue ) , Average (Green )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# 10. MAXIMUM PERMISSIBLE EXPOSURE

## 10.1. Limits

### 10.1.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density ($mW/cm^2$) | Averaging time (minutes) |
|---|---|---|---|---|
| (A) Limits for Occupational/Controlled Exposures | | | | |
| 0.3–3.0 | 614 | 1.63 | *(100) | 6 |
| 3.0–30 | 1842/f | 4.89/f | *($900/f^2$) | 6 |
| 30–300 | 61.4 | 0.163 | 1.0 | 6 |
| 300–1500 | | | f/300 | 6 |
| 1500–100,000 | | | 5 | 6 |
| (B) Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3–1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34–30 | 824/f | 2.19/f | *($180/f^2$) | 30 |

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density ($mW/cm^2$) | Averaging time (minutes) |
|---|---|---|---|---|
| 30–300 | 27.5 | 0.073 | 0.2 | 30 |
| 300–1500 | | | f/1500 | 30 |
| 1500–100,000 | | | 1.0 | 30 |

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.


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### 10.1.2. IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

**Table 5**
**Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)**

| 1 Frequency (MHz) | 2 Electric Field Strength; rms (V/m) | 3 Magnetic Field Strength; rms (A/m) | 4 Power Density ($W/m^2$) | 5 Averaging Time (min) |
|---|---|---|---|---|
| 0.003–1 | 280 | 2.19 | | 6 |
| 1–10 | $280/f$ | $2.19/f$ | | 6 |
| 10–30 | 28 | $2.19/f$ | | 6 |
| 30–300 | 28 | 0.073 | 2* | 6 |
| 300–1 500 | $1.585f^{0.5}$ | $0.0042f^{0.5}$ | $f/150$ | 6 |
| 1 500–15 000 | 61.4 | 0.163 | 10 | 6 |
| 15 000–150 000 | 61.4 | 0.163 | 10 | $616\,000/f^{1.2}$ |
| 150 000–300 000 | $0.158f^{0.5}$ | $4.21 \times 10^{-4}f^{0.5}$ | $6.67 \times 10^{-5}f$ | $616\,000/f^{1.2}$ |

* Power density limit is applicable at frequencies greater than 100 MHz.

**Notes:** 1. Frequency, $f$, is in MHz.
2. A power density of 10 $W/m^2$ is equivalent to 1 $mW/cm^2$.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

### 10.1.3. LIMITS APPLICABLE TO THE EUT

For mobile radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency, as 824 MHz / 1500 = 0.55 mW/cm^2 (FCC) and 824 MHz / 150 = 5.5 W/m^2 (IC).

For operation in the PCS band, the 2.4 GHz band and the 5 GHz bands, from FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2 and from IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2.


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## 10.2. EQUATIONS

Power density is given by:

S = EIRP / (4 * Pi * D^2)

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

Total EIRP = (P1 * G1) + (P2 * G2) + ... + (Pn * Pn)

where

Px = Power of transmitter x
Gx = Numeric gain of antenna x

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply, either the lowest limit applicable to the operating frequency ranges of the co-located transmitters can be applied or a fraction of the exposure limit is established for each band, such that the sum of the fractions is less than or equal to one.

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.


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## 10.3. RESULTS

### 10.3.1. SINGLE TRANSMITTER (WLAN)

| Band | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|---|---|---|---|---|---|---|
| 2.4 GHz - b mode | WLAN | 0.20 | 19.08 | 1.00 | 0.20 | 0.020 |
| 2.4 GHz - g mode | WLAN | 0.20 | 22.16 | 1.00 | 0.41 | 0.041 |

Each Power Density is less than 10 W/m^2 or 1 mW/cm^2, which is the limit for these operating frequency ranges.

### 10.3.2. CO-LOCATED TRANSMITTERS (WiMAX AND WLAN)

| Band | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|---|---|---|---|---|---|---|
| 2.4GHz g mode | WLAN | | 22.16 | 1.00 | | |
| 5MHz 16QAM | WiMAX | | 24.78 | -0.50 | | |
| Combined | | 0.20 | | | 0.95 | 0.095 |

The co-located Power Density is less than 10 W/m^2 or 1 mW/cm^2, which is the limit for these operating frequency ranges.

### 10.3.3. CO-LOCATED TRANSMITTERS (WLAN and CDMA 800)

| Band | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|---|---|---|---|---|---|---|
| 2.4GHz g mode | WLAN | | 22.16 | 1.00 | | |
| 800 MHz | CDMA | | 29.82 | 0.00 | | |
| Combined | | 0.20 | | | 2.32 | 0.232 |

The co-located Power Density is less than 5.5 W/m^2 or 0.55 mW/cm^2, which is the most stringent of the limits for the above operating frequency ranges.


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### 10.3.4. CO-LOCATED TRANSMITTERS (WLAN and CDMA 1900)

| Band | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|---|---|---|---|---|---|---|
| 2.4GHz g mode | WLAN | | 22.16 | 1.00 | | |
| 1900 MHz | CDMA | | 29.11 | 0.00 | | |
| Combined | | 0.20 | | | 2.03 | 0.203 |

The co-located Power Density is less than 10 W/m^2 or 1 mW/cm^2, which is the limit for these operating frequency ranges.


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