**FCC CFR47 PART 15 SUBPART C**
**INDUSTRY CANADA RSS-210 ISSUE 8**

# CERTIFICATION TEST REPORT

**FOR**

**802.11 b/g/n WLAN module**

**MODEL NUMBER: 1488**

**FCC ID: C3K1488**
**IC: 3048A-1488**

**REPORT NUMBER: 11U13646-1, Revision C**

**ISSUE DATE: APRIL 25, 2011**

*Prepared for*
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NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 03/11/11 | Initial Issue | F. Ibrahim |
| A | 03/22/11 | Revised EUT description, Description of Antennas, and Test Equipment List | F. Ibrahim |
| B | 04/15/11 | Revised MAXIMUM OUTPUT POWER section, and MPE section | F. Ibrahim |
| C | 04/25/11 | Revised test equipment list | F. Ibrahim |

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** MICROSOFT CORPORATION
One Microsoft Way,
Redmond, WA 98052, U.S.A

**EUT DESCRIPTION:** 802.11 b/g/n WLAN module

**MODEL:** 1488

**SERIAL NUMBER:** 005043212364 (CONUCTED) & 5400018183-01L1 (RADIATIED)

**DATE TESTED:** FEBRUARY 10 - MARCH 10, 2011

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart C | Pass |
| INDUSTRY CANADA RSS-210 Issue 8 Annex 8 | Pass |
| INDUSTRY CANADA RSS-GEN Issue 3 | Pass |

Compliance Certification Services (UL 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 UL 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 UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL 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 UL CCS By:

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EMC SUPERVISOR
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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

# 3. FACILITIES AND ACCREDITATION

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

UL 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%.

# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT is an 802.11 b/g/n WLAN module.

## 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 | 21.25 | 133.35 |
| 2412 - 2462 | 802.11g | 24.89 | 308.32 |
| 2412 - 2462 | 802.11n HT20 | 24.51 | 282.49 |
| 2412 - 2462 | 802.11n HT40 | 21.77 | 150.31 |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes two antennas: Antenna-A is a printed balanced metamaterial antenna and Antenna-B is a printed metamaterial antenna. Only one is selected at any point of time, this is SISO device, antenna gain is 1.2 dBi for first one and 1.1 dBi for the second one.

## 5.4. SOFTWARE AND FIRMWARE

FW Installed in EUT: 1.0.3.5
EUT Driver: 1.0.1.27
Test Utility SW: 1.0.1.27

## 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power. Radiated Emissions below 1 GHz and Power Line Conducted Emissions were performed with the EUT set to transmit at the channel with highest output power.

The testing was performed at the following worst-case data rates as provided by the client:

- 802.1 b mode 1Mbps.
- 802.11g mode 6 Mbps.
- 802.11n HT20mode MCS0 6.5 Mbps.
- 802.11n HT40mode MCS0 13.5 Mbps.

The EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that X is the worst-case orientation and therefore, final testing for radiated emissions was performed with EUT laid in the X orientation.

Both RF ports of the EUT were investigated for output power and radiated emissions (harmonics and BE), it was determined that RF port 1 is worst-case; therefore, final testing was performed using antenna port 1.

Radiated Harmonics and Spurious above 1 GHz was performed for CH1 at the higher power level of CH2 for 11g, 11n HT20 and 11n HT40, so it covers both channels.
Radiated Harmonics and Spurious above 1 GHz was performed for CH11 at the higher power level of CH10 for 11g, 11n HT20 and 11n HT40, so it covers both channels.

## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Serial Number** | **FCC ID** |
| Laptop | Dell | Vostro 1000 | 19598708737 | QDS-BRCM1028 |
| AC Adapter | Dell | LA65NS2-01 | CN-0928G4-71615-06E-0D24- | DoC |

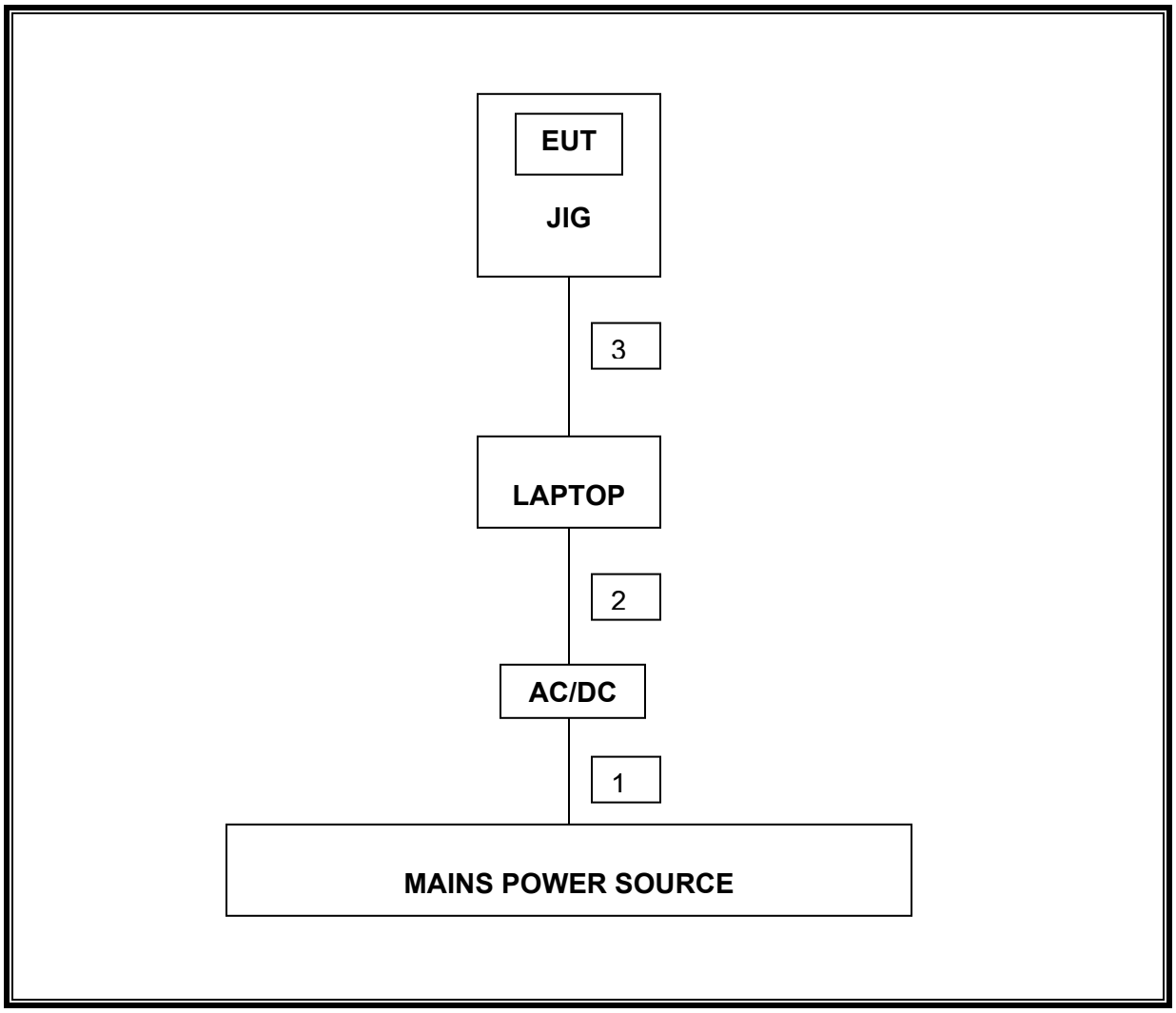
**I/O CABLES**

| I/O CABLE LIST | | | | | | |
|---|---|---|---|---|---|---|
| **Cable No.** | **Port** | **# of Identical Ports** | **Connector Type** | **Cable Type** | **Cable Length** | **Remarks** |
| 1 | AC | 1 | AC | Un-Shielded | 1.0m | N/A |
| 2 | DC | 1 | DC | Un-Shielded | 2.0m | Ferrite at one End |
| 3 | Data | 1 | USB | Un-Shielded | 0.8m | |

**TEST SETUP**

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

**SETUP DIAGRAM FOR TESTS**



# 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** |
| Spectrum Analyzer, 26.5 GHz | Agilent / HP | E4440A | C01179 | 4/19/2012 |
| Spectrum Analyzer, 44 GHz | Agilent / HP | E4446A | C00986 | 3/17/2012 |
| EMI Test Receiver, 30 MHz | R & S | ESHS 20 | N02396 | 5/6/2011 |
| Power Meter | Boonton | 4541 | C01186 | 4/5/2012 |
| Power Sensor | Boonton | 57006 | C01203 | 3/31/2012 |
| LISN, 30 MHz | FCC | LISN-50/250-25-2 | N02625 | 11/10/2011 |
| Preamplifier, 1300 MHz | Agilent / HP | 8447D | C00885 | 1/27/2012 |
| Preamplifier, 26.5 GHz | Agilent / HP | 8449B | C01052 | 7/14/2011 |
| Antenna, Horn, 18 GHz | EMCO | 3115 | C00945 | 6/29/2011 |
| Antenna, Bilog, 2 GHz | Sunol Sciences | JB1 | C01011 | 7/12/2011 |

# 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.

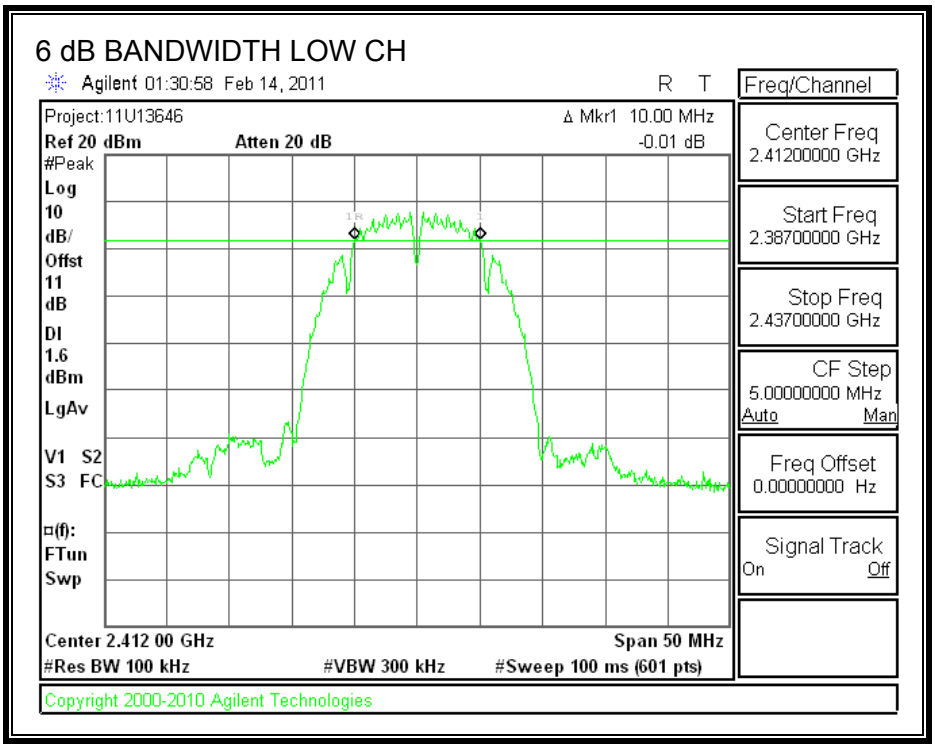
**TEST PROCEDURE**

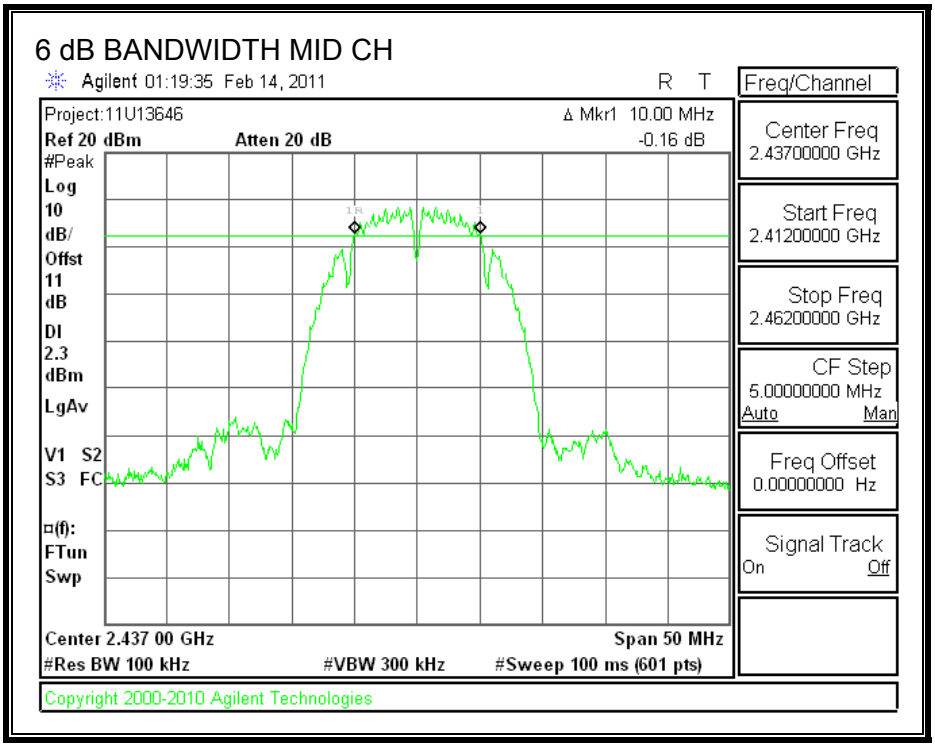
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

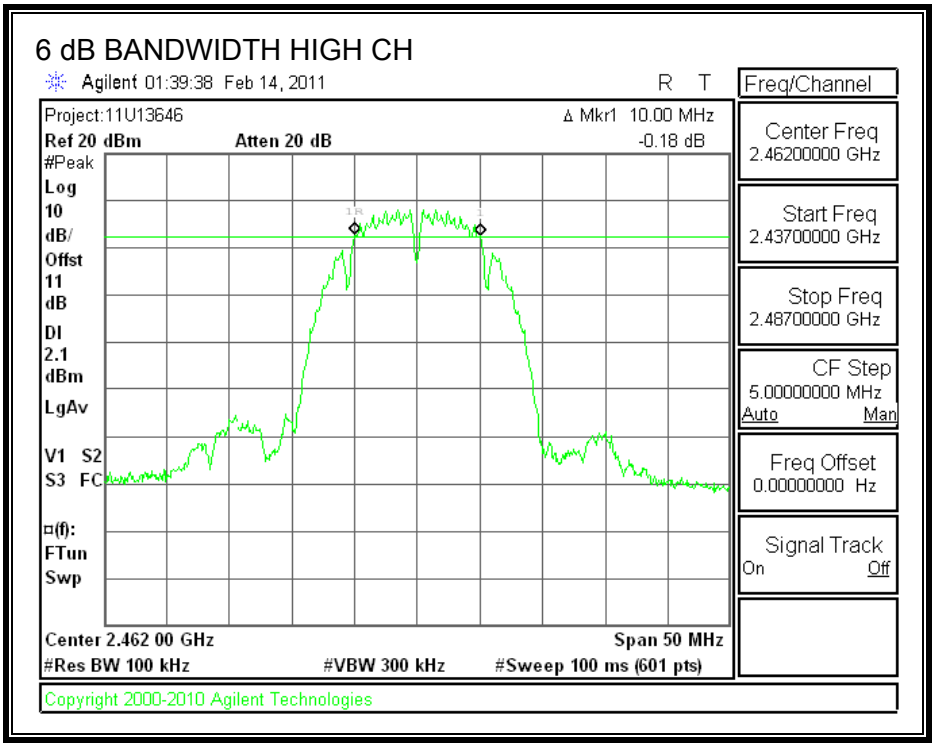
**RESULTS**

| Channel | Frequency | 6 dB Bandwidth | Minimum Limit |
|---|---|---|---|
| | (MHz) | (MHz) | (MHz) |
| Low | 2412 | 10 | 0.5 |
| Middle | 2437 | 10 | 0.5 |
| High | 2462 | 10 | 0.5 |

**6 dB BANDWIDTH**







### 7.1.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

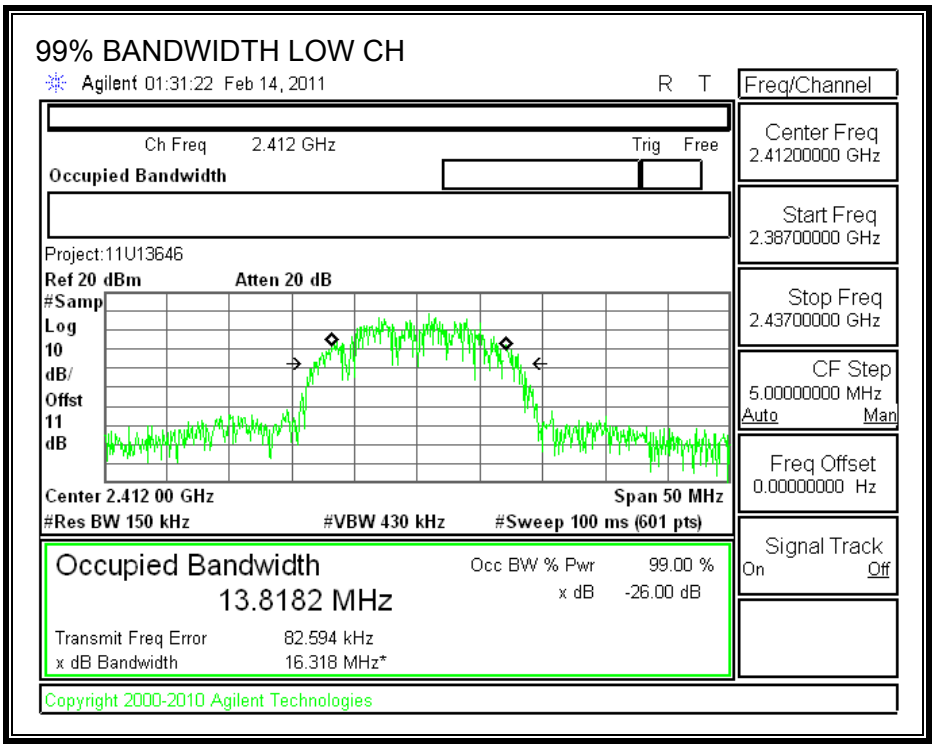
**TEST PROCEDURE**

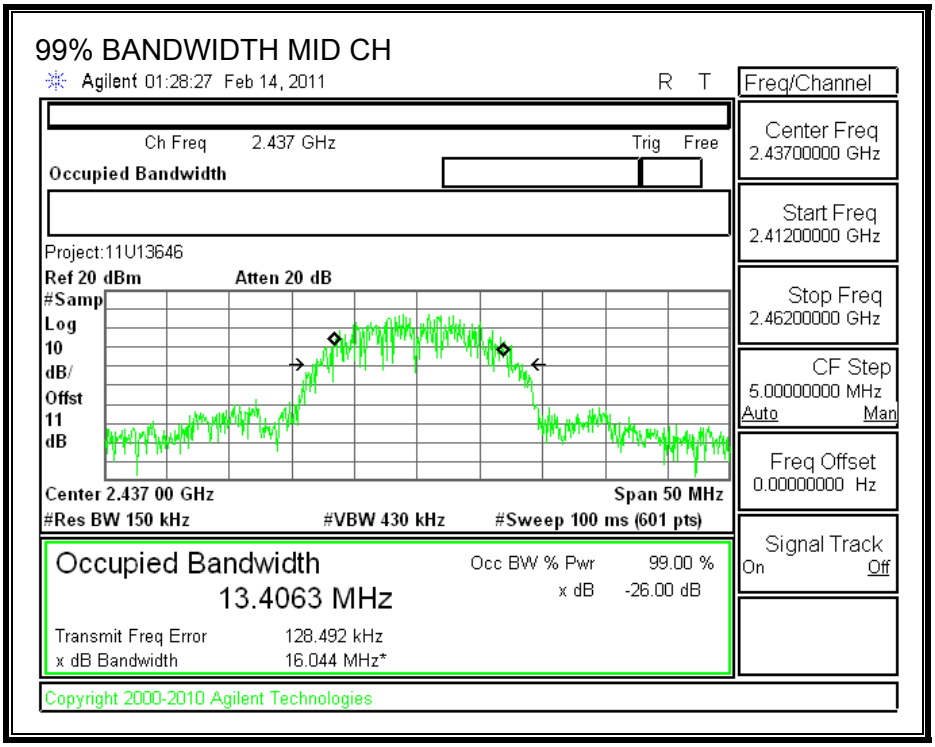
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

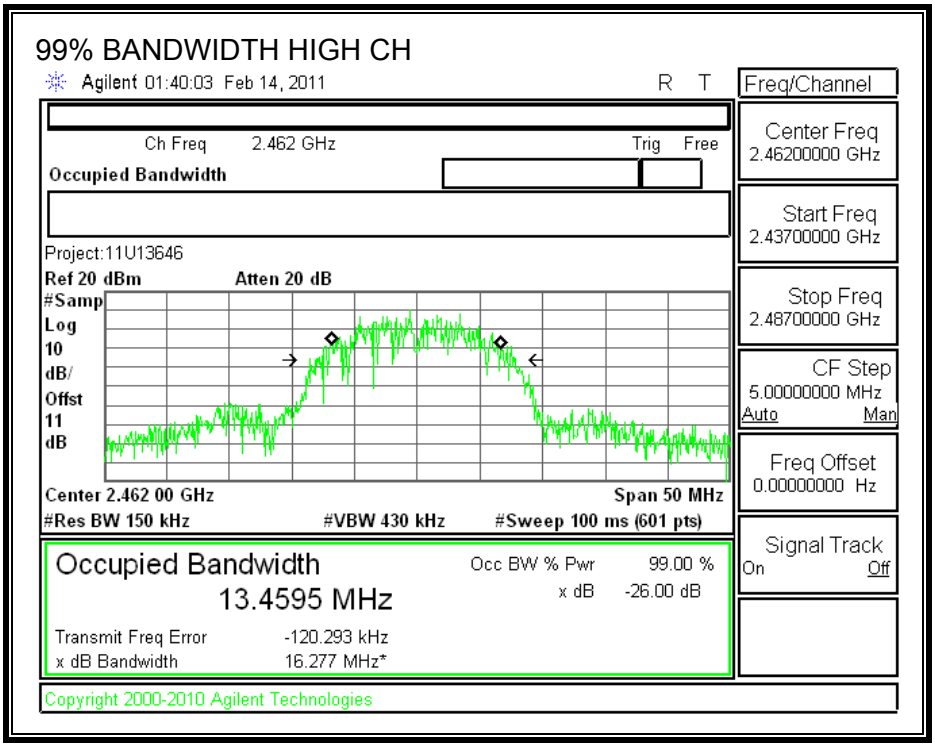
**RESULTS**

| Channel | Frequency | 99% Bandwidth |
|---|---|---|
| | (MHz) | (MHz) |
| Low | 2412 | 13.8182 |
| Middle | 2437 | 13.4063 |
| High | 2462 | 13.4595 |

**99% BANDWIDTH**







## 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 a wide bandwidth Peak Power Meter.

**RESULTS**

| Channel | Frequency (MHz) | Peak Power Meter Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 2412 | 9.84 | 11 | 20.84 | 30 | -9.16 |
| Middle | 2437 | 10.25 | 11 | 21.25 | 30 | -8.75 |
| High | 2462 | 9.97 | 11 | 20.97 | 30 | -9.03 |

## 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 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Avg Power (dBm) |
|---|---|---|
| Low | 2412 | 19.03 |
| Middle | 2437 | 19.27 |
| High | 2462 | 19.18 |

## 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.

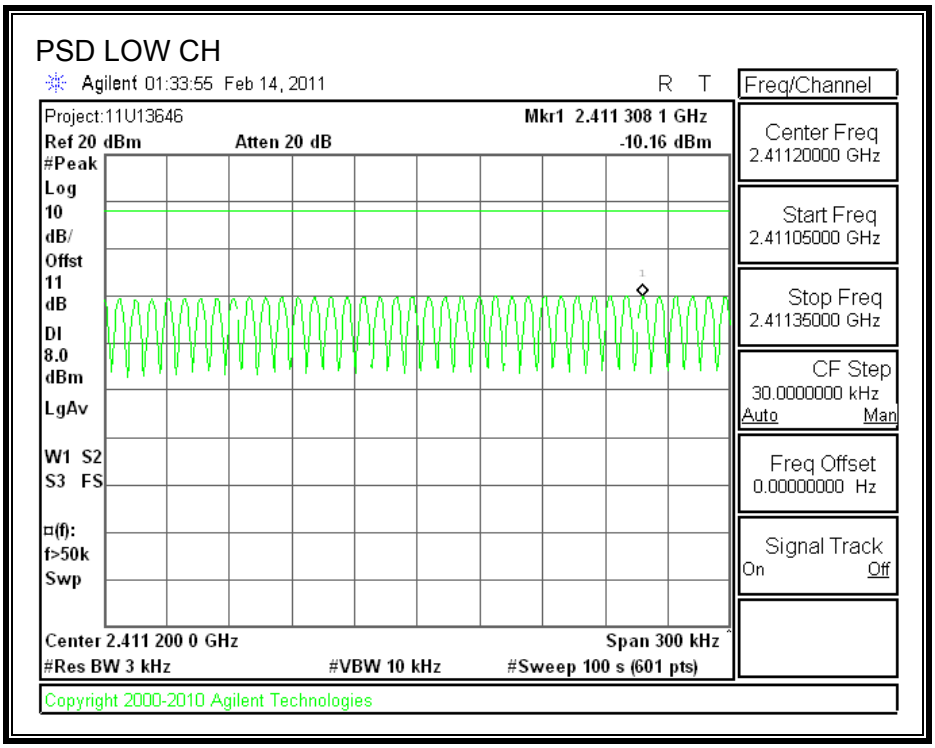
**TEST PROCEDURE**

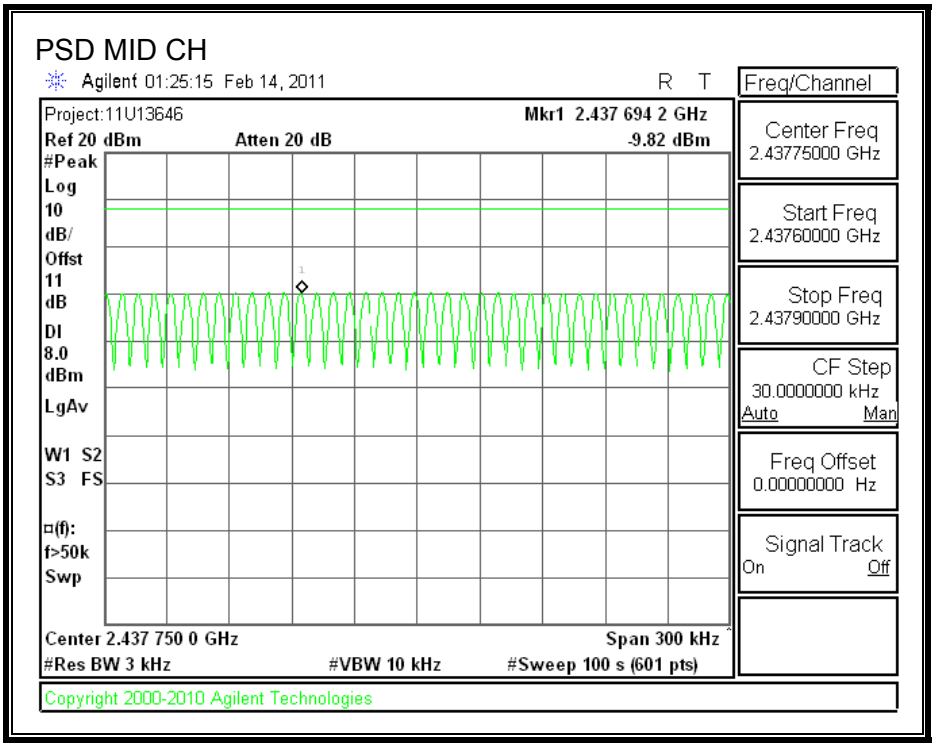
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

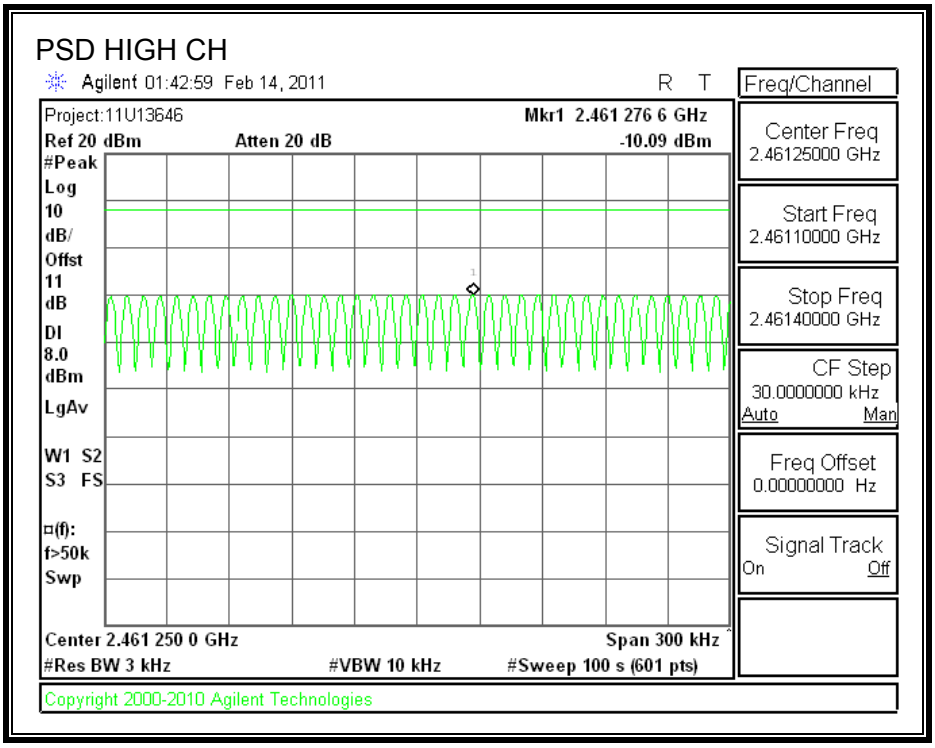
**RESULTS**

| Channel | Frequency | PPSD | Limit | Margin |
|---|---|---|---|---|
| | (MHz) | (dBm) | (dBm) | (dB) |
| Low | 2412 | -10.16 | 8 | -18.16 |
| Middle | 2437 | -9.82 | 8 | -17.82 |
| High | 2462 | -10.09 | 8 | -18.09 |

**POWER SPECTRAL DENSITY**







## 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.

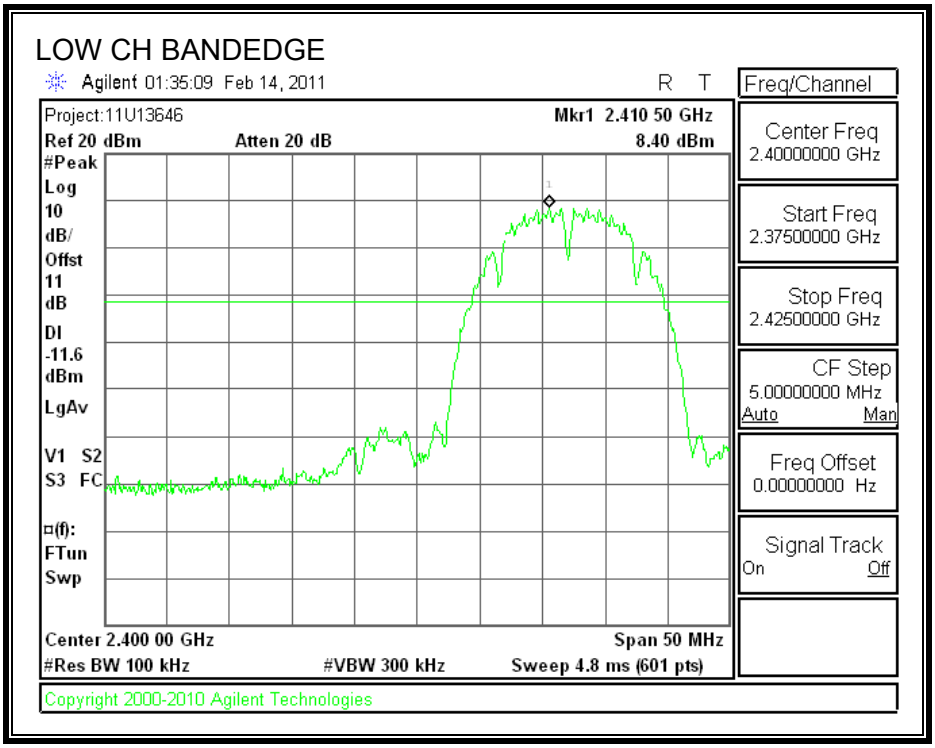
**TEST PROCEDURE**

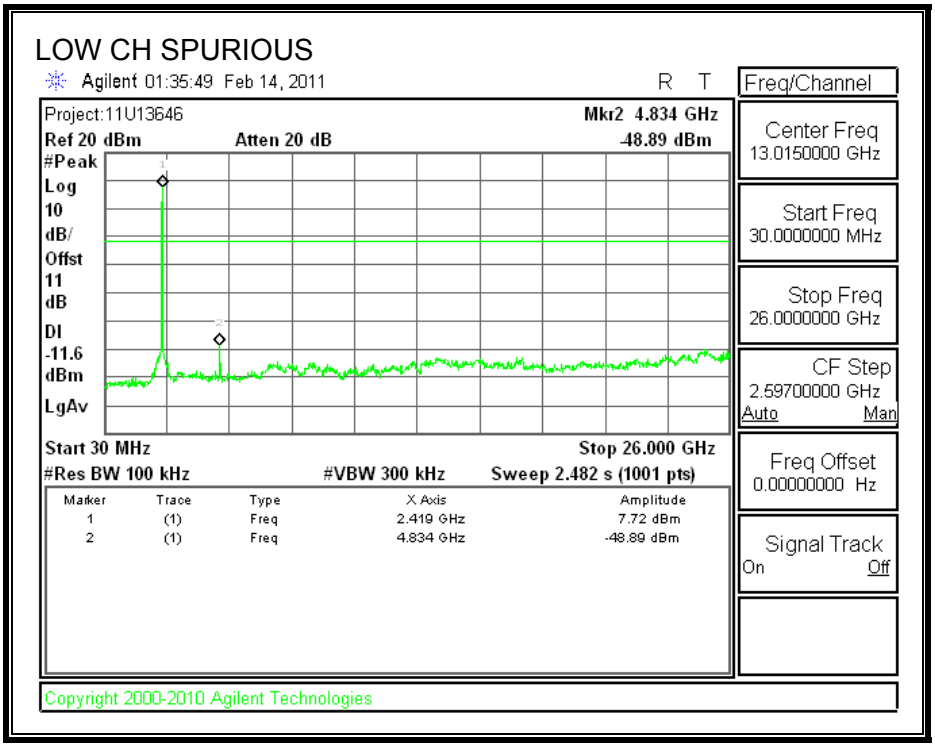
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

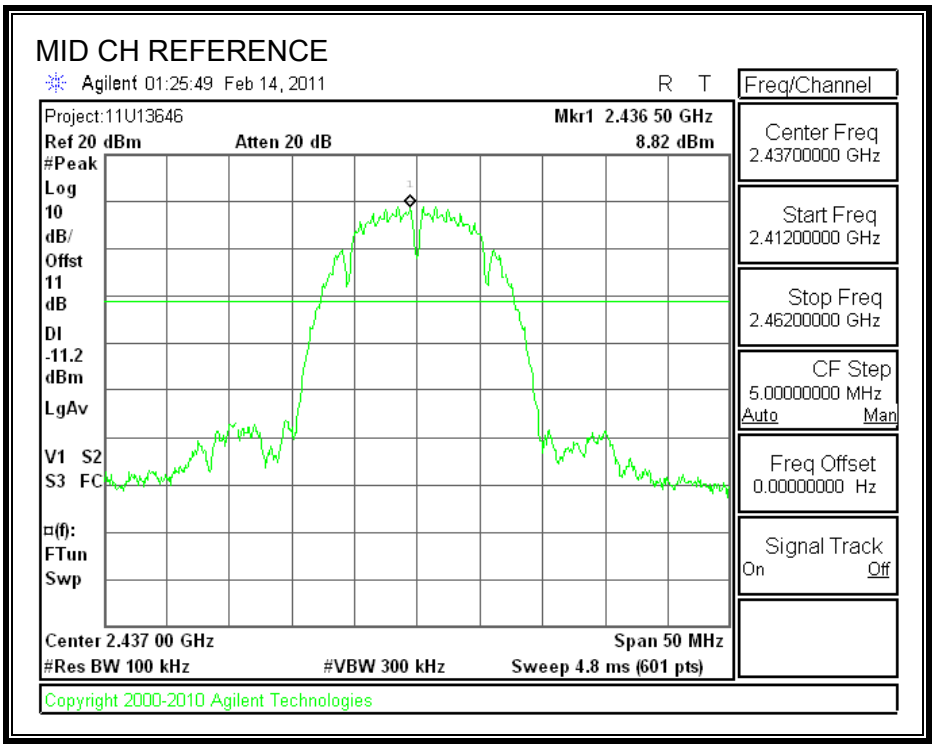
## RESULTS

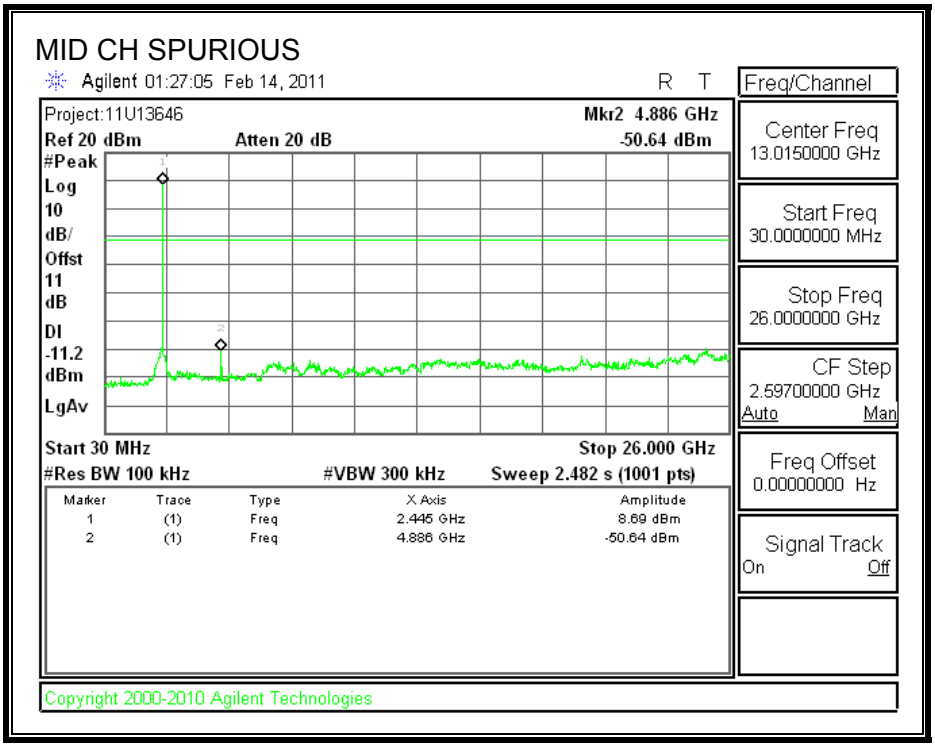
## SPURIOUS EMISSIONS, LOW CHANNEL



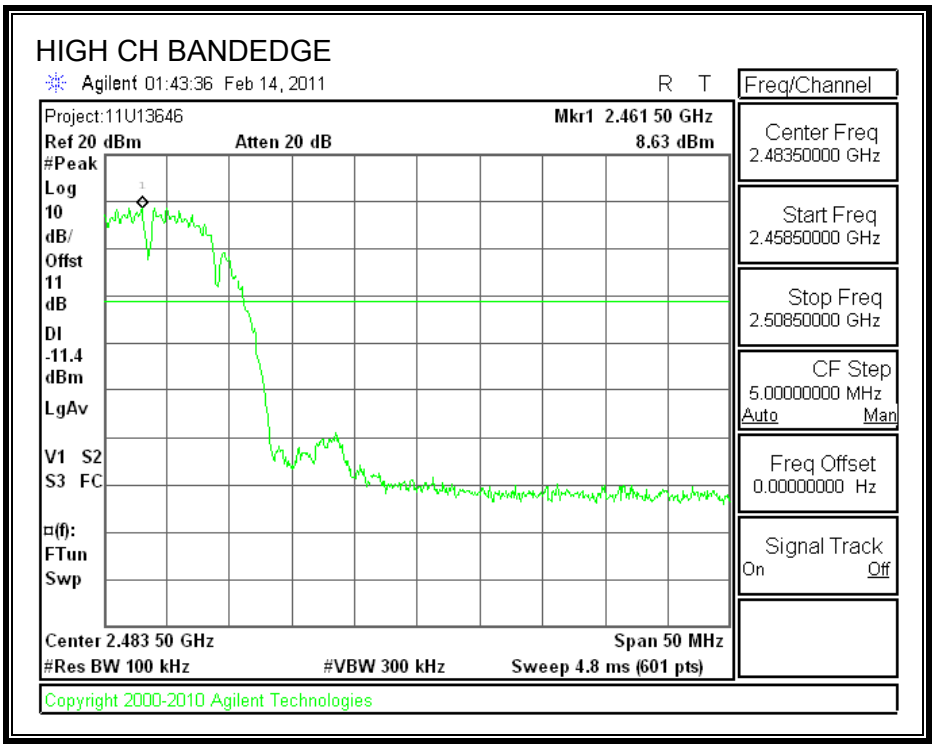


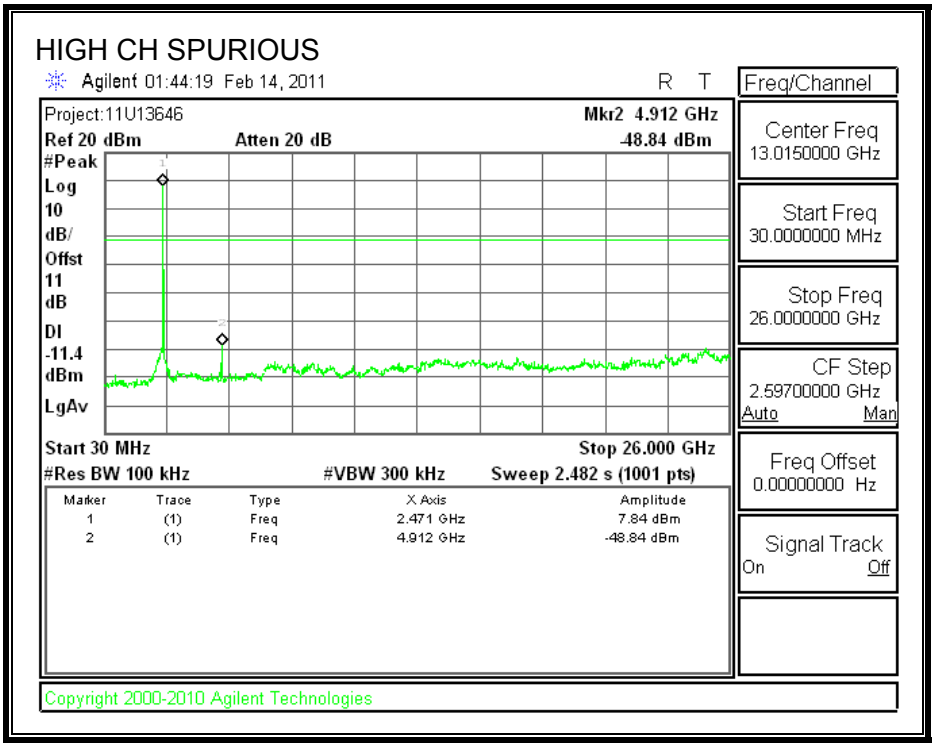
**SPURIOUS EMISSIONS, MID CHANNEL**





**SPURIOUS EMISSIONS, HIGH CHANNEL**





# 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.

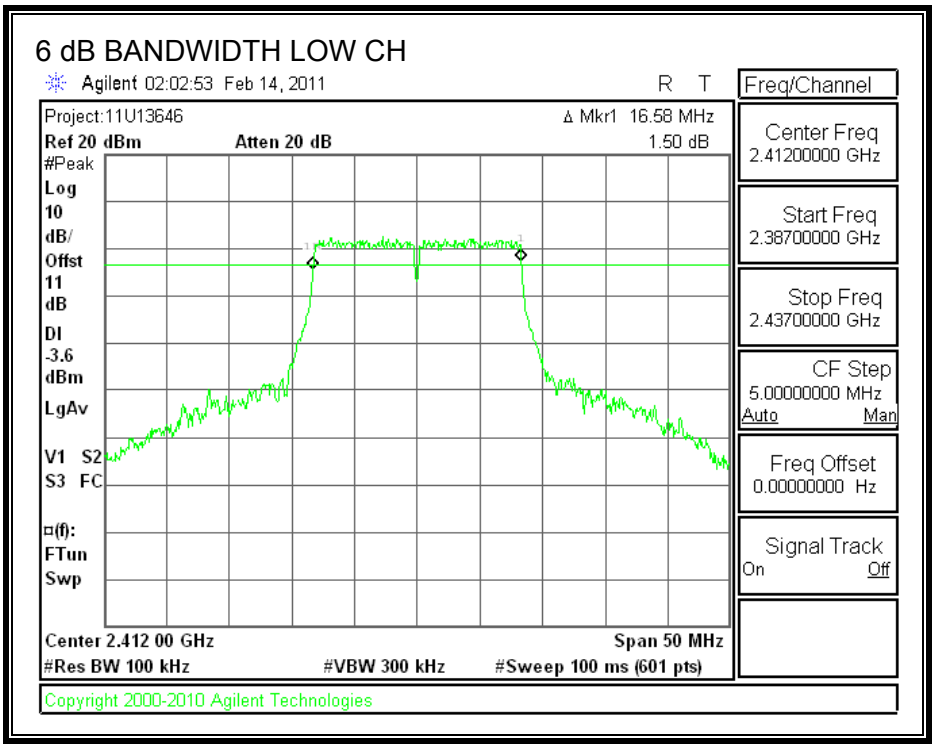
**TEST PROCEDURE**

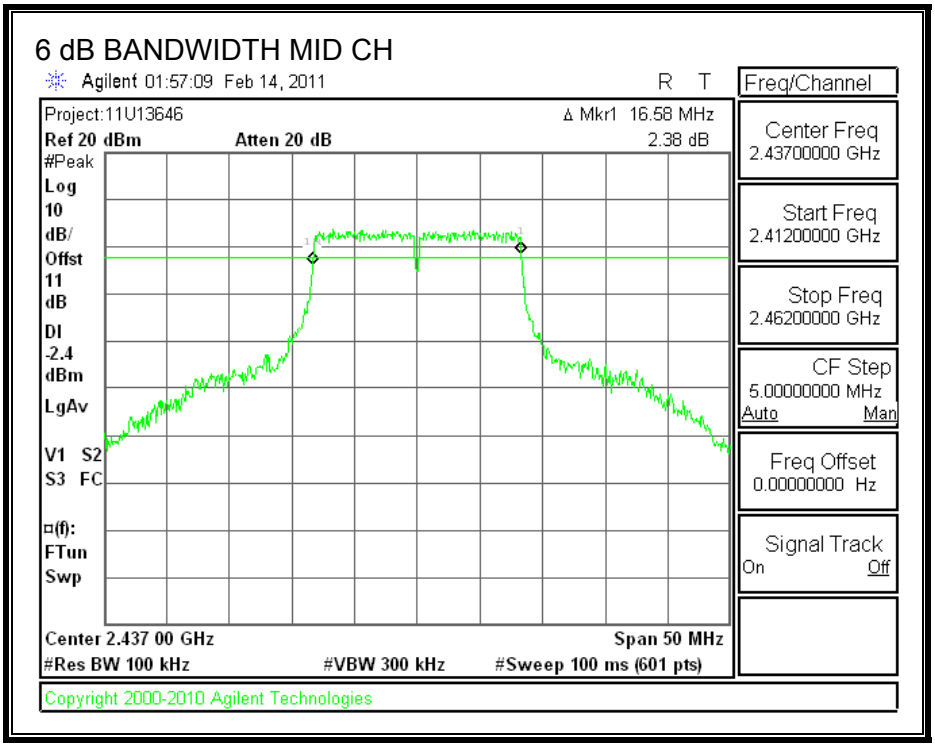
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

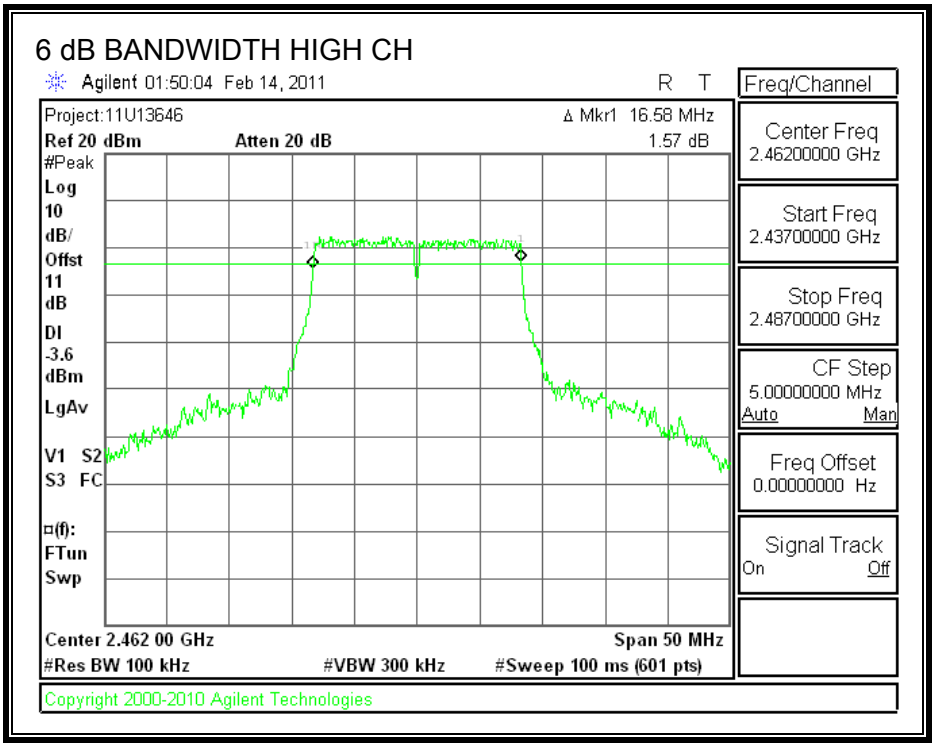
**RESULTS**

| Channel | Frequency | 6 dB Bandwidth | Minimum Limit |
|---|---|---|---|
| | (MHz) | (MHz) | (MHz) |
| Low | 2412 | 16.58 | 0.5 |
| Middle | 2437 | 16.58 | 0.5 |
| High | 2462 | 16.58 | 0.5 |

**6 dB BANDWIDTH**







### 7.2.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

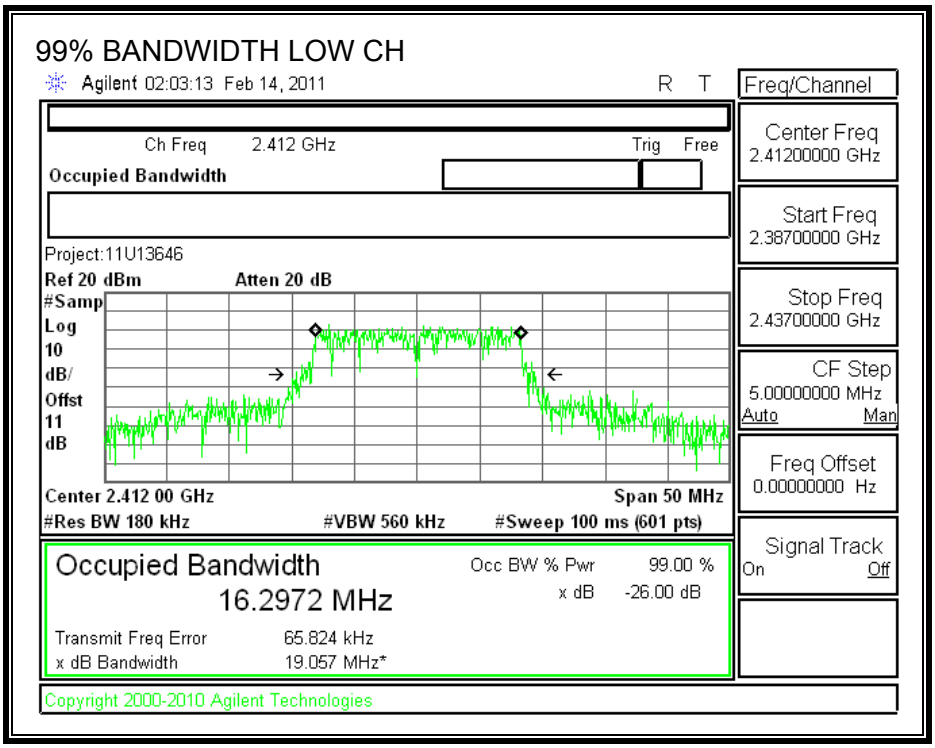
**TEST PROCEDURE**

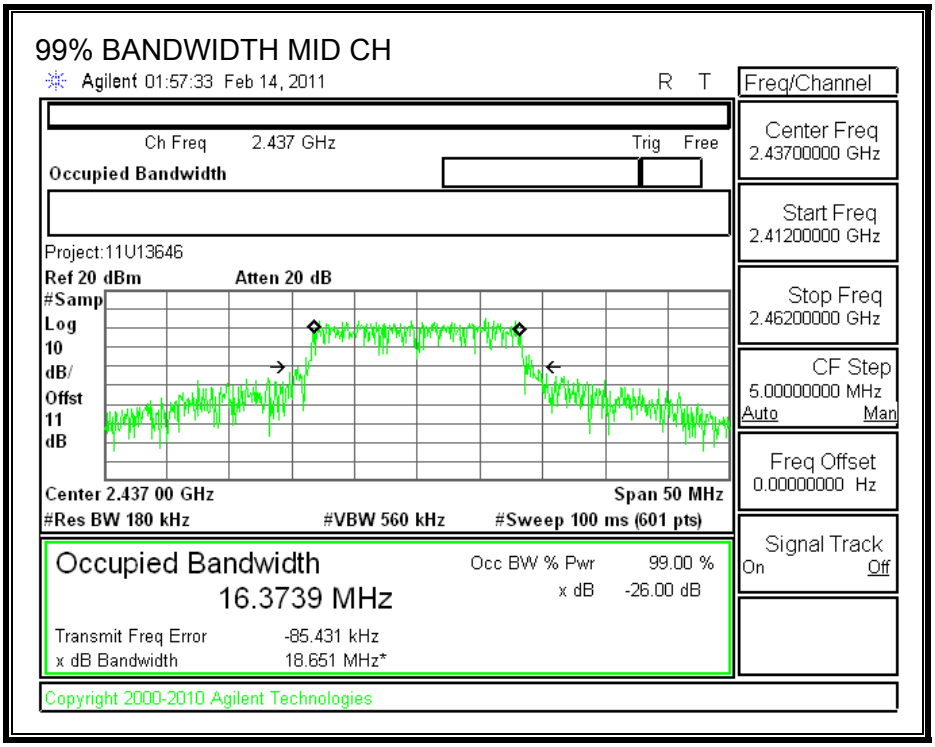
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

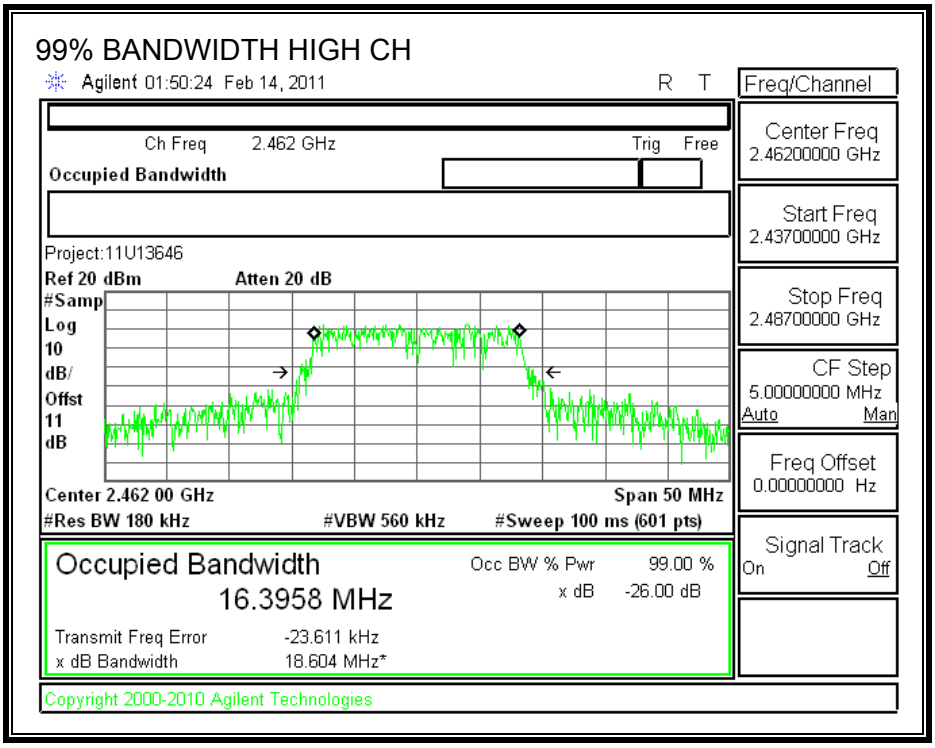
**RESULTS**

| Channel | Frequency | 99% Bandwidth |
|---|---|---|
| | (MHz) | (MHz) |
| Low | 2412 | 16.2972 |
| Middle | 2437 | 16.3739 |
| High | 2462 | 16.3958 |

**99% BANDWIDTH**







## 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 wide bandwidth Peak Power Meter.

**RESULTS**

| Channel | Frequency (MHz) | Peak Power Meter Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| CH1 | 2412 | 13.53 | 11 | 24.53 | 30 | -5.47 |
| CH2 | 2417 | 13.76 | 11 | 24.76 | 30 | -5.24 |
| CH6 | 2437 | 13.89 | 11 | 24.89 | 30 | -5.11 |
| CH10 | 2457 | 13.70 | 11 | 24.70 | 30 | -5.30 |
| CH11 | 2462 | 13.19 | 11 | 24.19 | 30 | -5.81 |

## 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 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Avg Power (dBm) |
|---|---|---|
| CH1 | 2412 | 17.85 |
| CH2 | 2417 | 18.05 |
| CH6 | 2437 | 18.57 |
| CH10 | 2457 | 18.45 |
| CH11 | 2462 | 17.33 |

## 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.

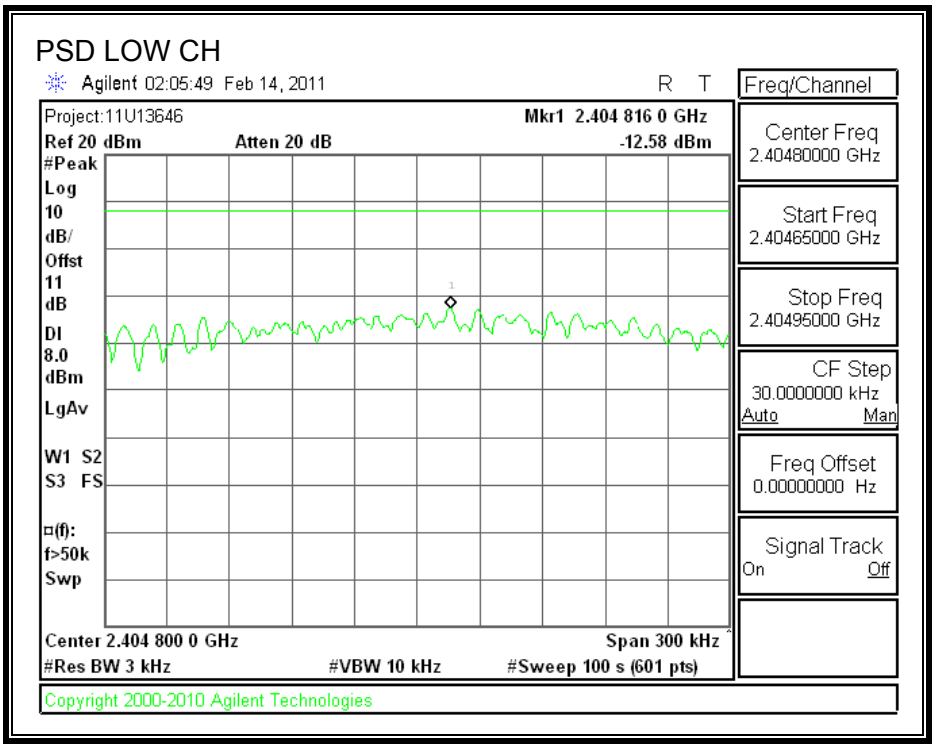
**TEST PROCEDURE**

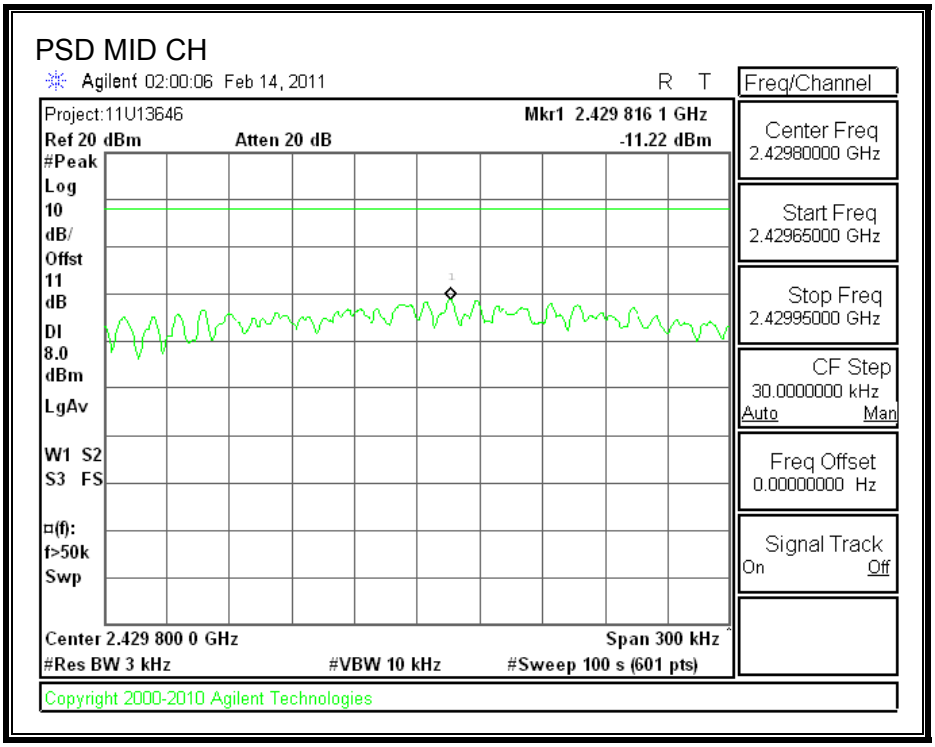
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

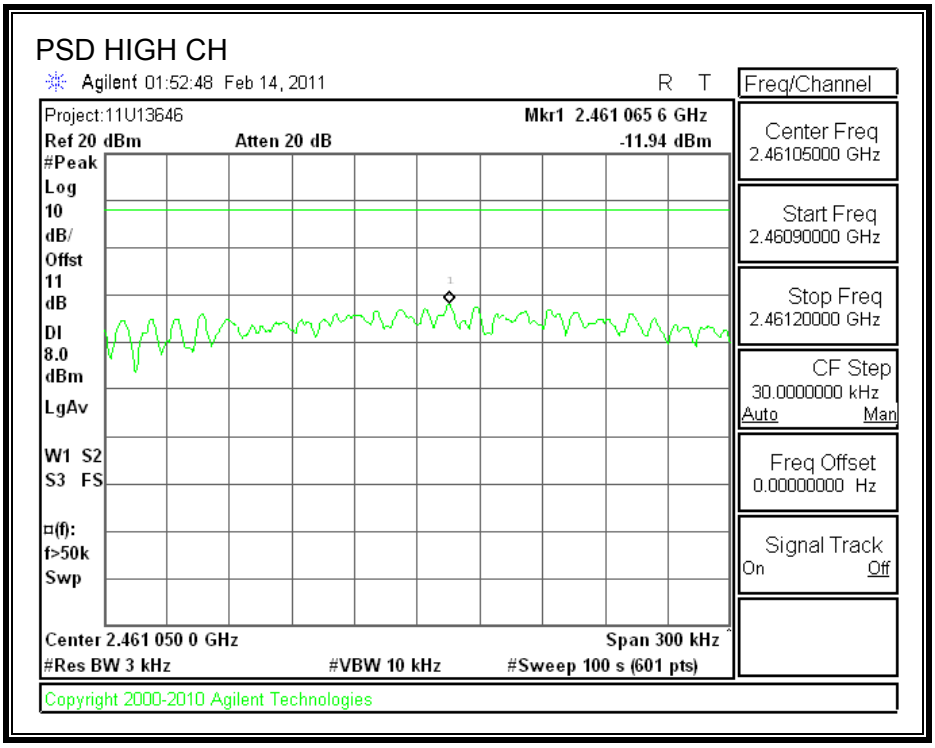
**RESULTS**

| Channel | Frequency | PPSD | Limit | Margin |
|---|---|---|---|---|
| | (MHz) | (dBm) | (dBm) | (dB) |
| Low | 2412 | -12.58 | 8 | -20.58 |
| Middle | 2437 | -11.22 | 8 | -19.22 |
| High | 2462 | -11.94 | 8 | -19.94 |

**POWER SPECTRAL DENSITY**







## 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.

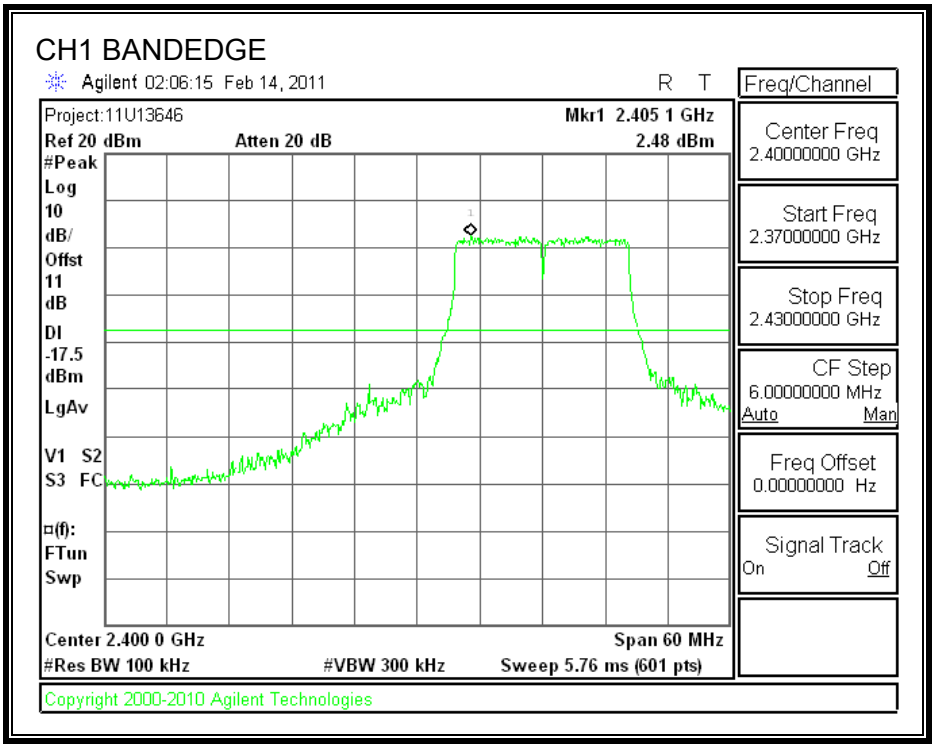
**TEST PROCEDURE**

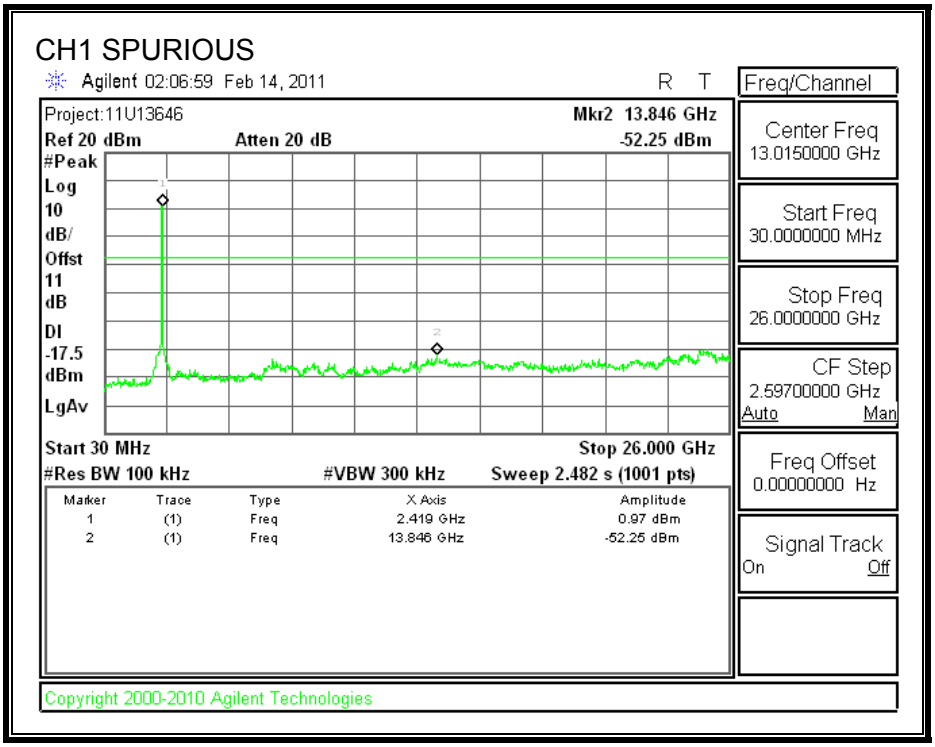
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

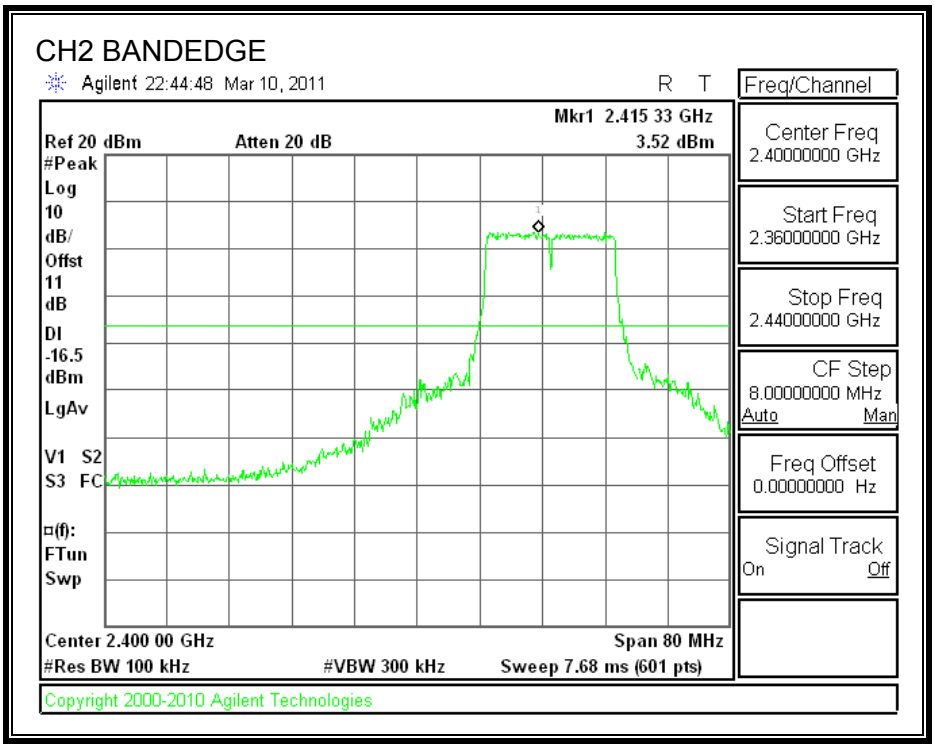
**RESULTS**

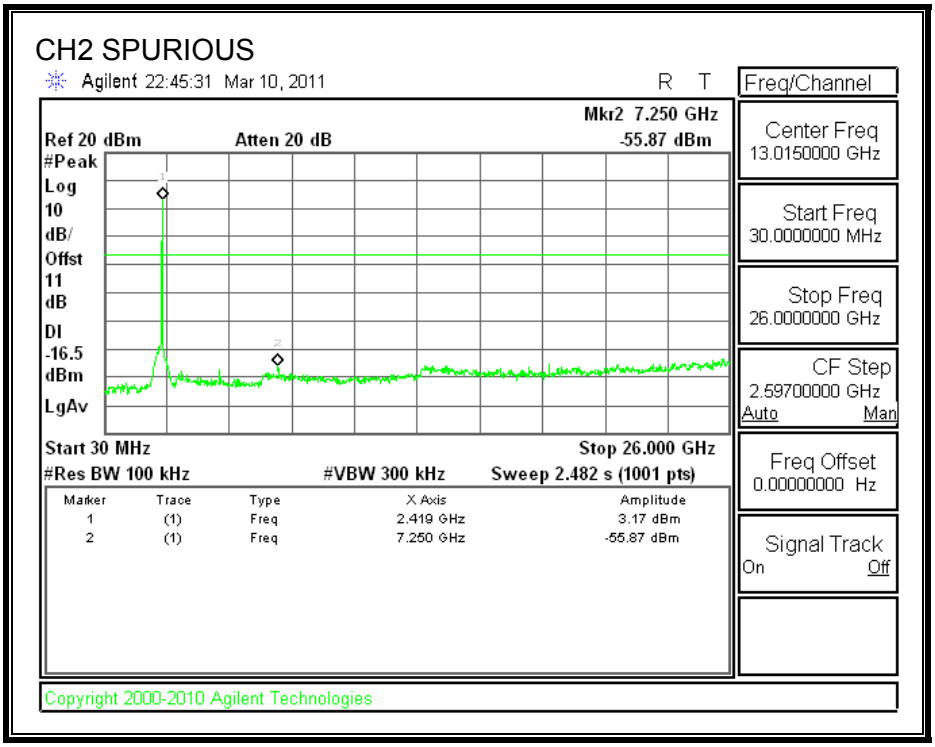
**SPURIOUS EMISSIONS, CH1**



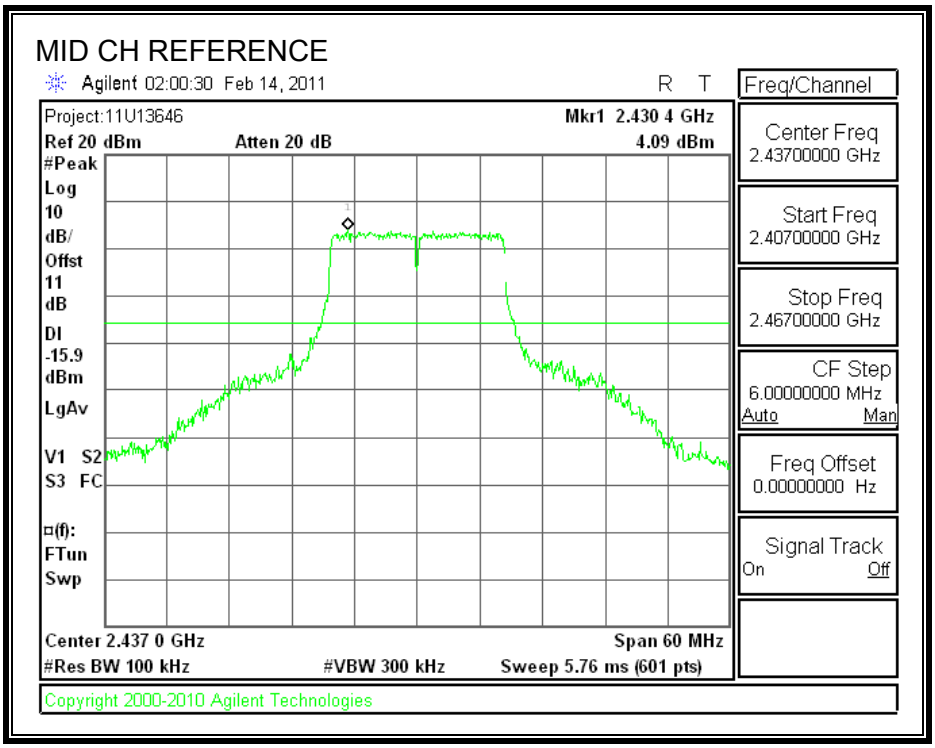


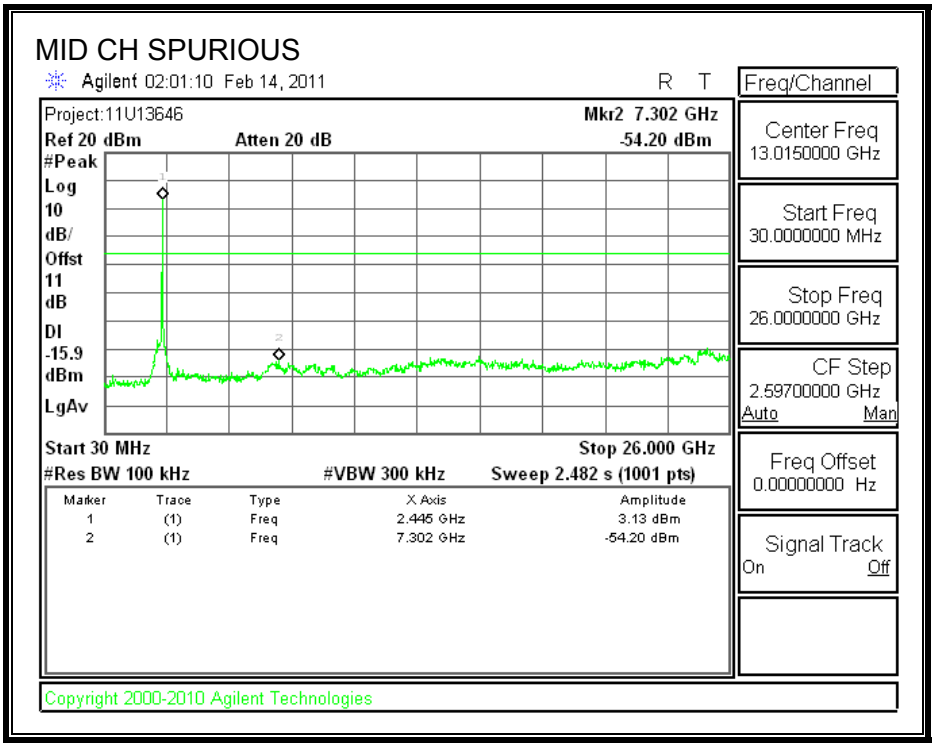
**SPURIOUS EMISSIONS, CH2**



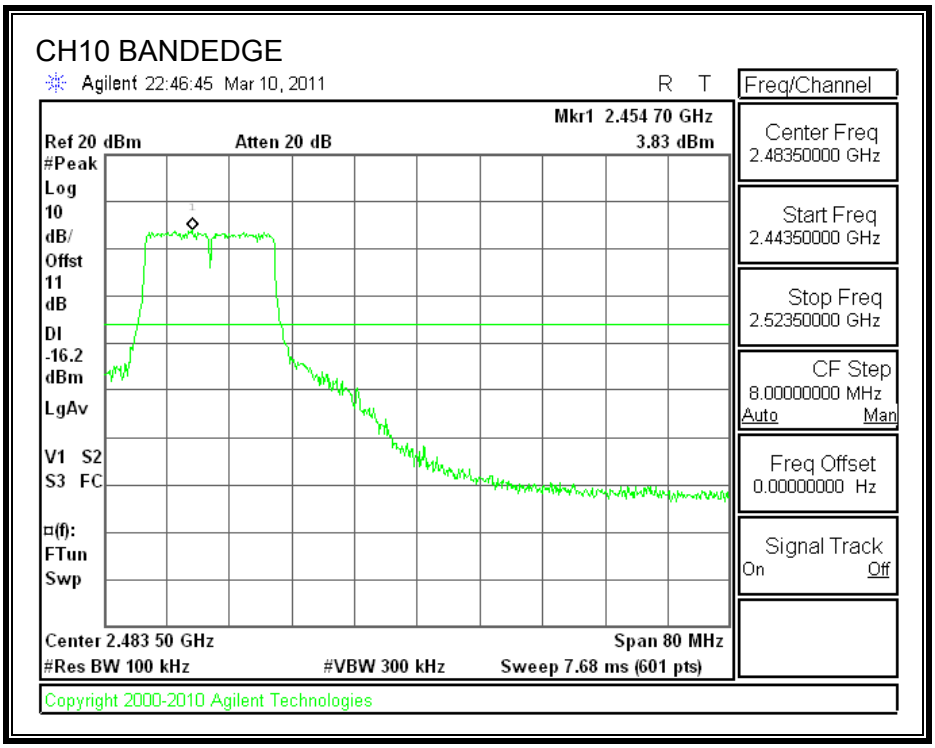


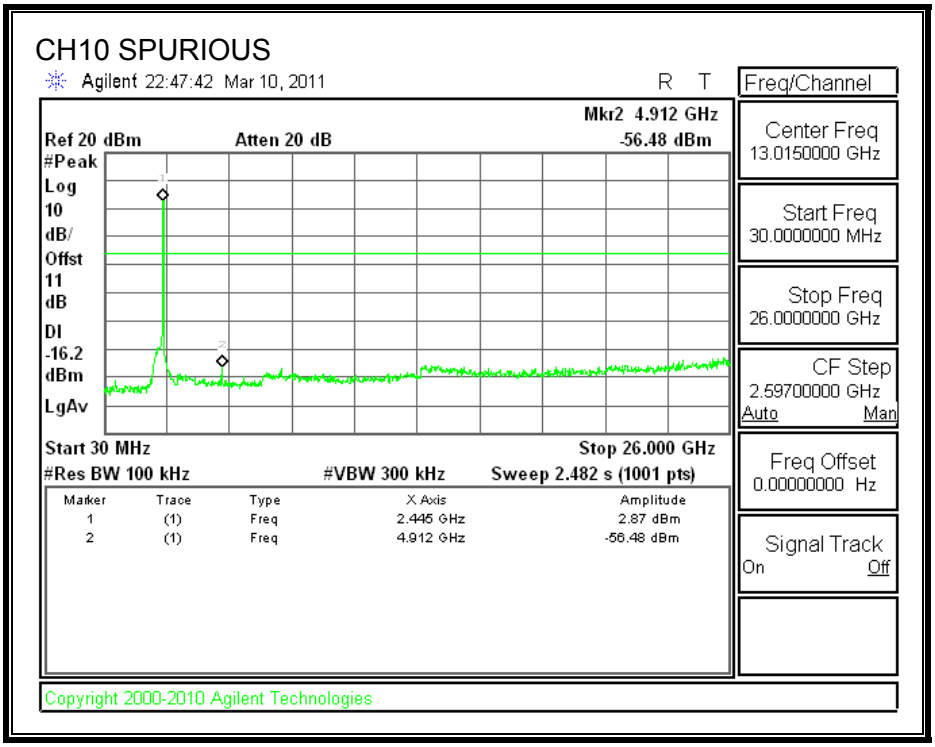
**SPURIOUS EMISSIONS, MID CHANNEL**



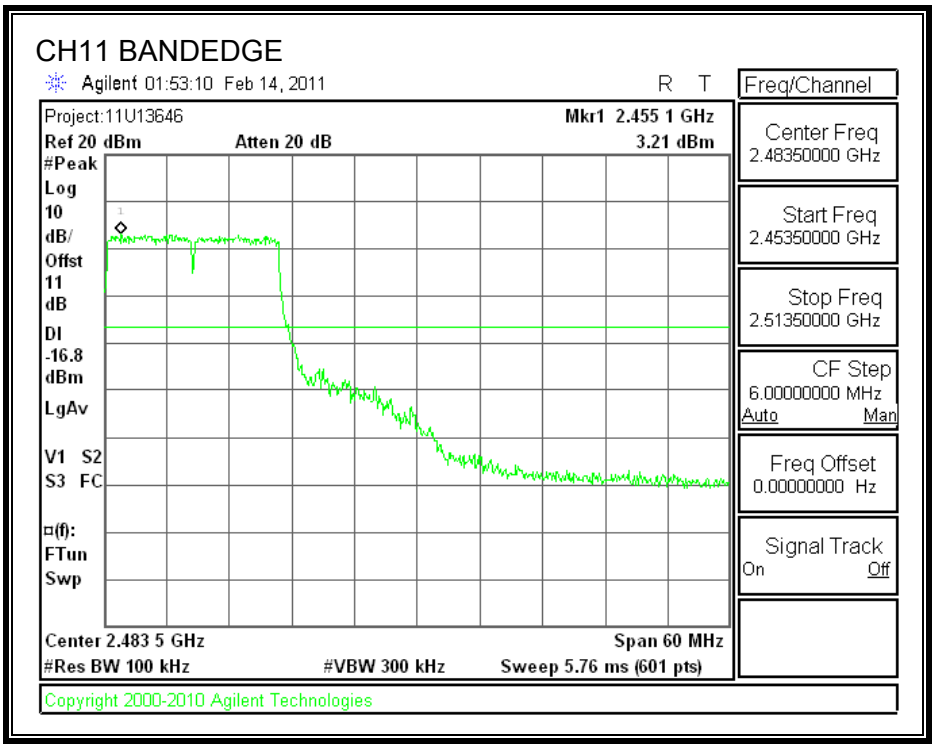


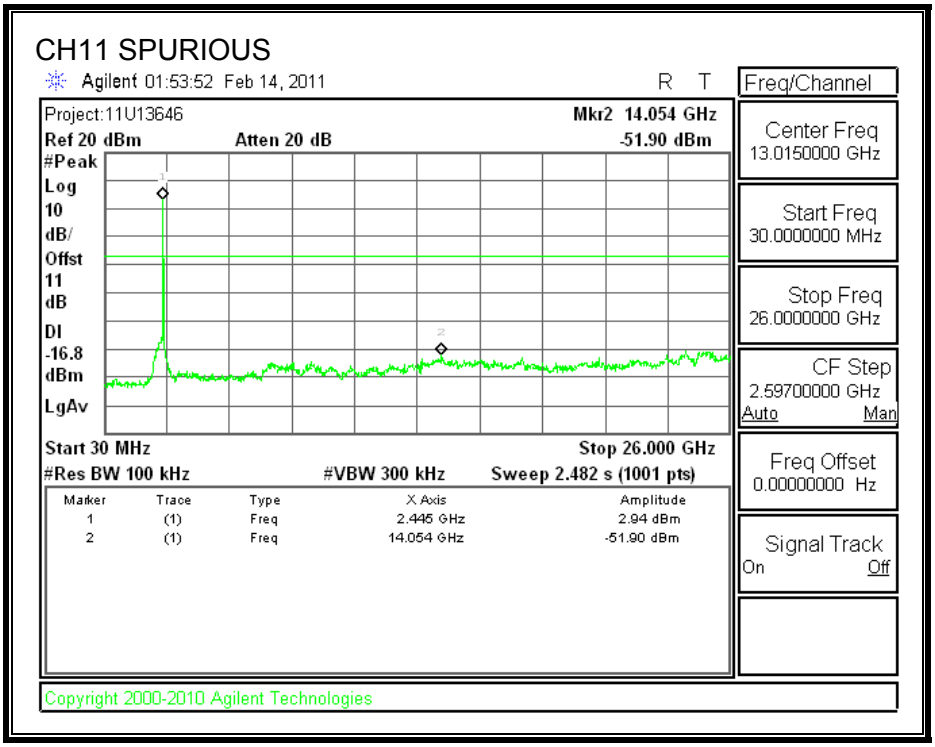
**SPURIOUS EMISSIONS, CH10**





**SPURIOUS EMISSIONS, CH11**





# 7.3. 802.11 HT20 IN THE 2.4 GHz BAND

## 7.3.1. 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.

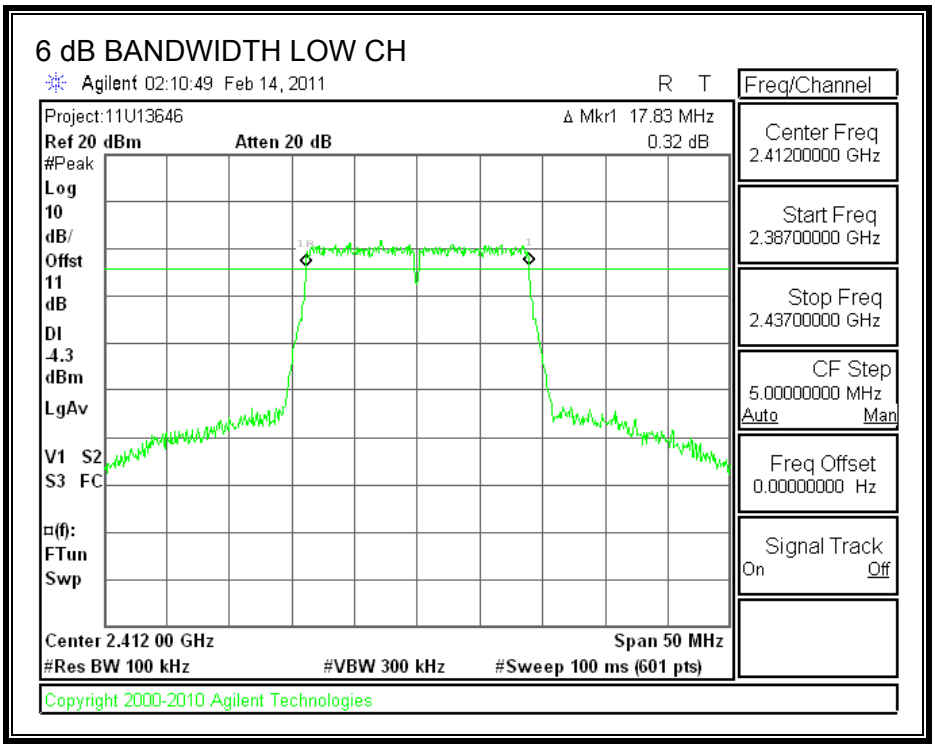
**TEST PROCEDURE**

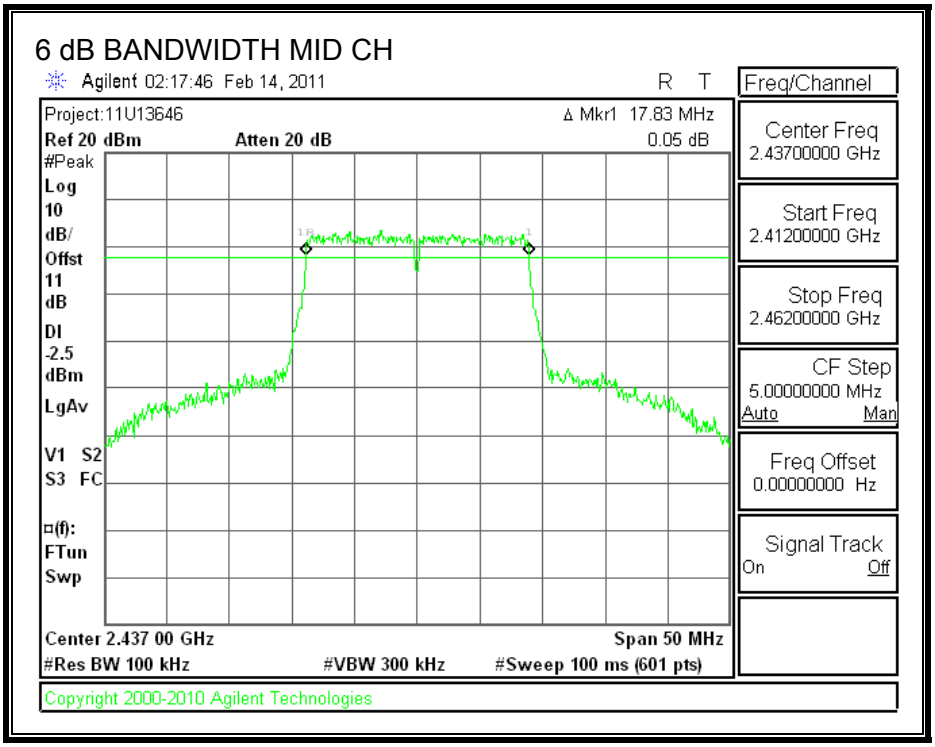
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

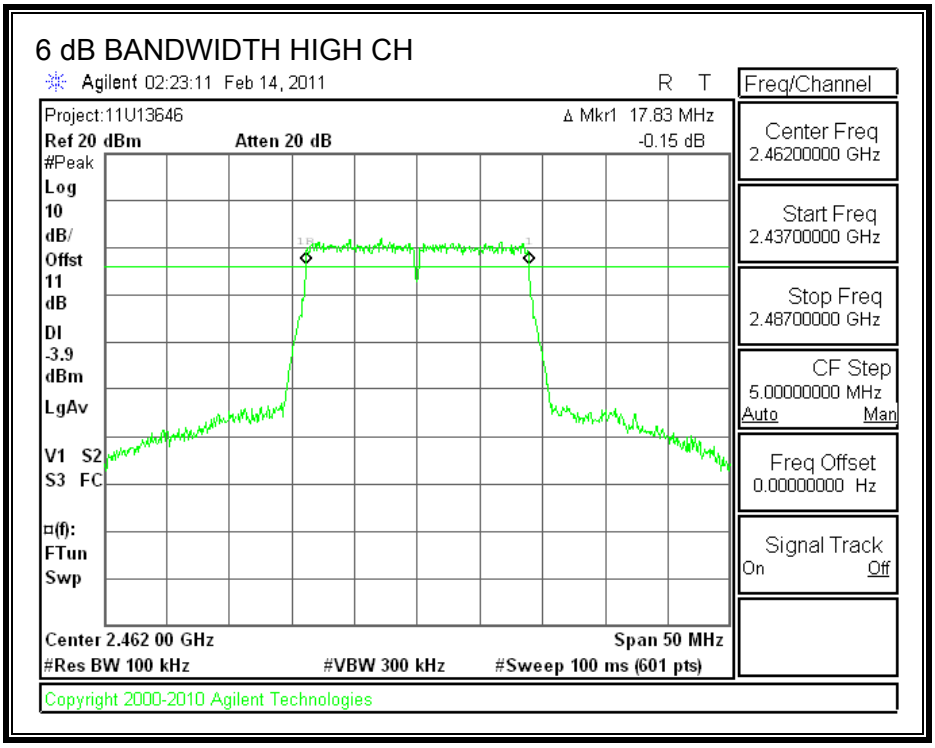
**RESULTS**

| Channel | Frequency | 6 dB Bandwidth | Minimum Limit |
|---|---|---|---|
| | (MHz) | (MHz) | (MHz) |
| Low | 2412 | 17.83 | 0.5 |
| Middle | 2437 | 17.83 | 0.5 |
| High | 2462 | 17.83 | 0.5 |

**6 dB BANDWIDTH**







### 7.3.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

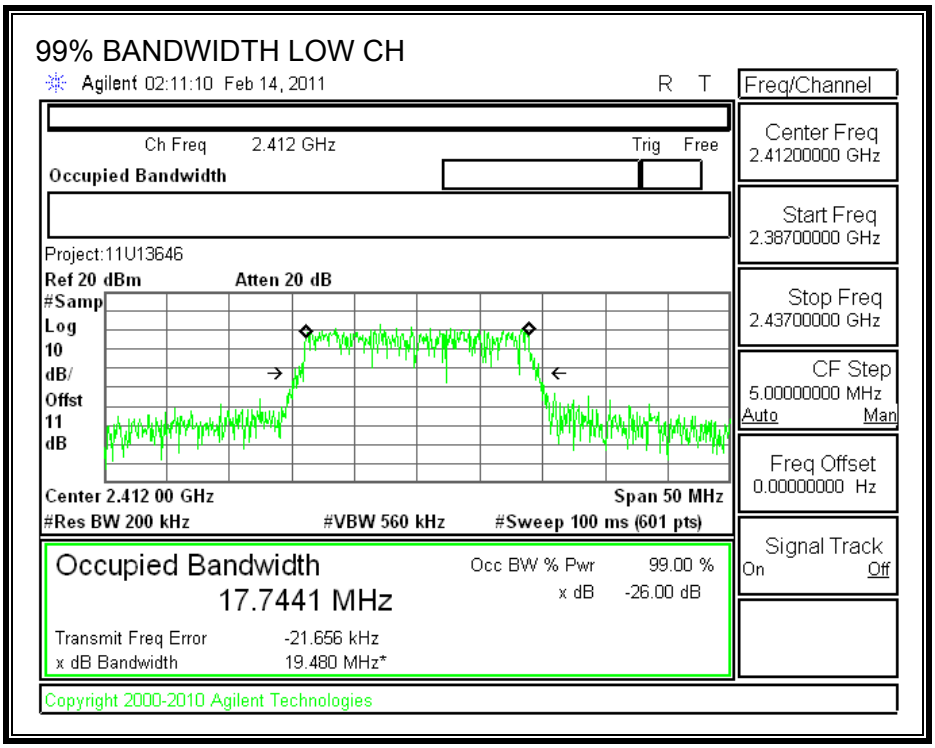
**TEST PROCEDURE**

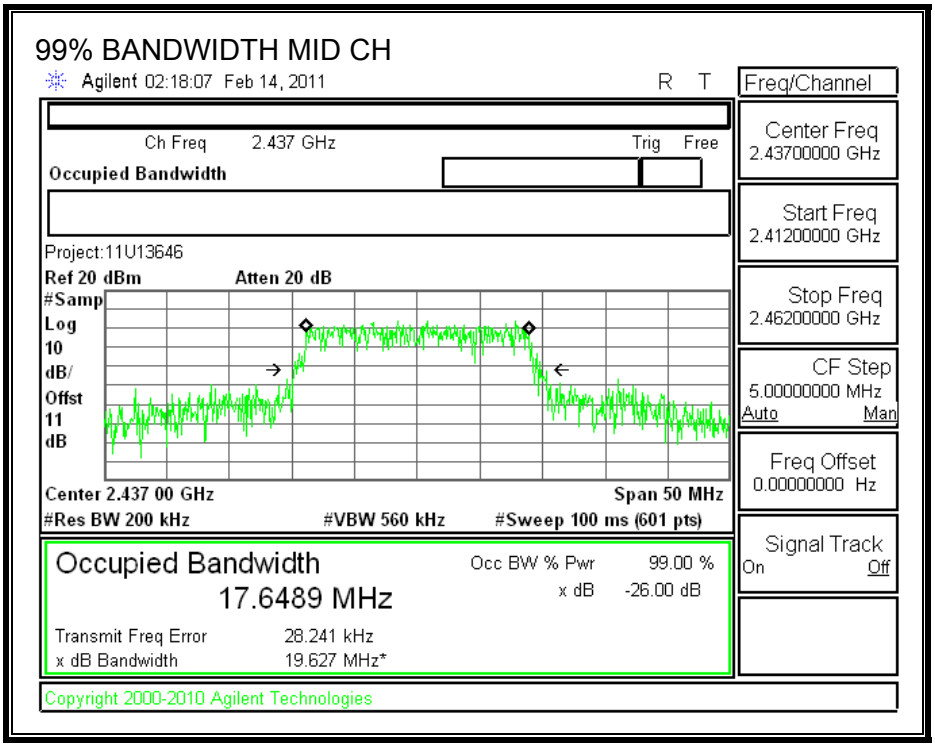
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

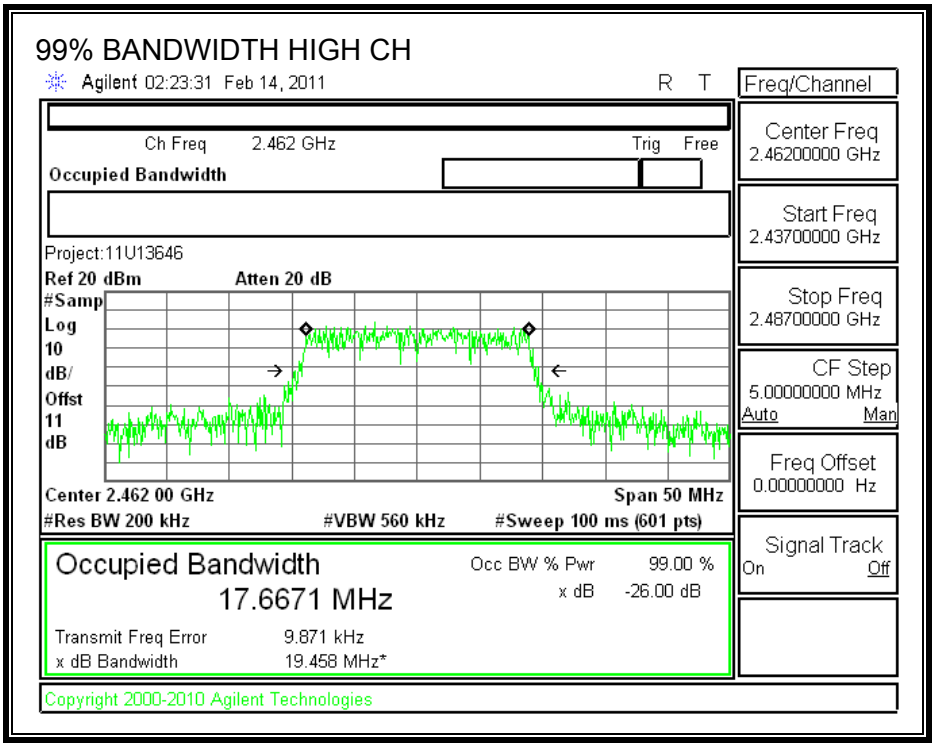
**RESULTS**

| Channel | Frequency | 99% Bandwidth |
|---|---|---|
| | (MHz) | (MHz) |
| Low | 2412 | 17.7441 |
| Middle | 2437 | 17.6489 |
| High | 2462 | 17.6671 |

**99% BANDWIDTH**







## 7.3.3. 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 a wide bandwidth Peak Power Meter.

**RESULTS**

| Channel | Frequency (MHz) | Peak Power Meter Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| CH1 | 2412 | 12.20 | 11 | 23.20 | 30 | -6.80 |
| CH2 | 2417 | 13.22 | 11 | 24.22 | 30 | -5.78 |
| CH6 | 2437 | 13.42 | 11 | 24.42 | 30 | -5.58 |
| CH10 | 2457 | 13.51 | 11 | 24.51 | 30 | -5.49 |
| CH11 | 2462 | 11.39 | 11 | 22.39 | 30 | -7.61 |

## 7.3.4. 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 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Avg Power (dBm) |
|---|---|---|
| CH1 | 2412 | 16.59 |
| CH2 | 2417 | 17.93 |
| CH6 | 2437 | 18.16 |
| CH10 | 2457 | 18.23 |
| CH11 | 2462 | 15.85 |

## 7.3.5. 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.

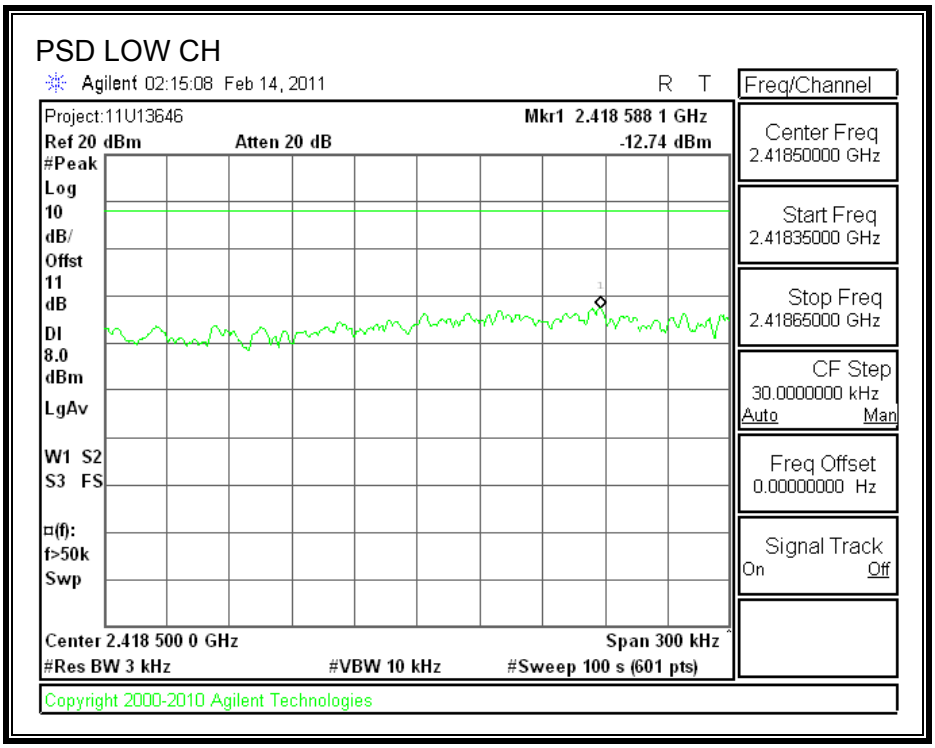
**TEST PROCEDURE**

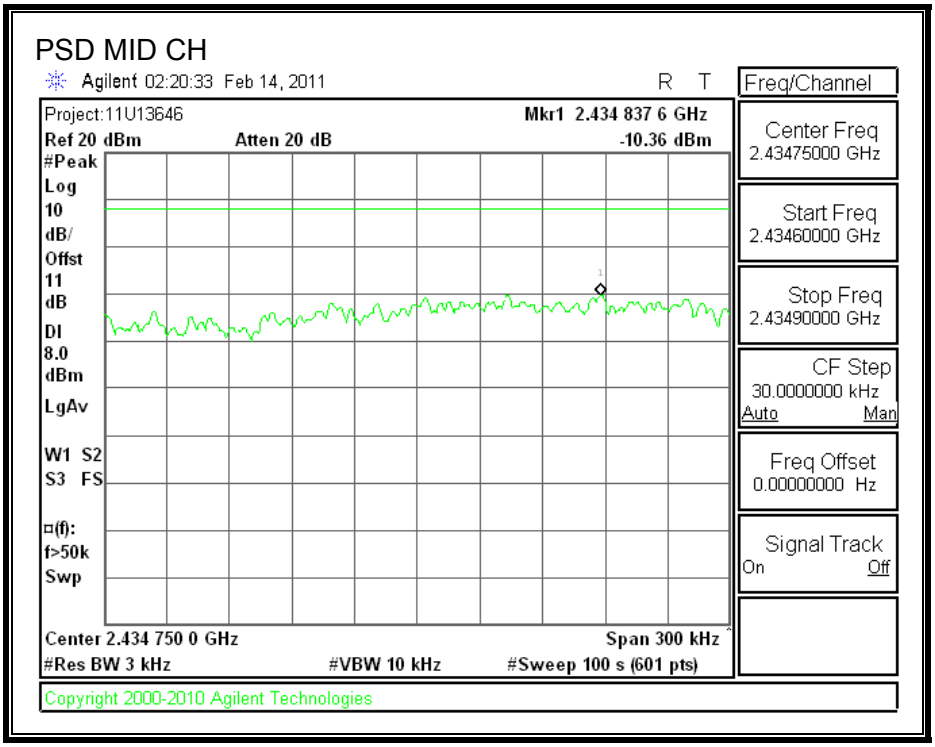
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

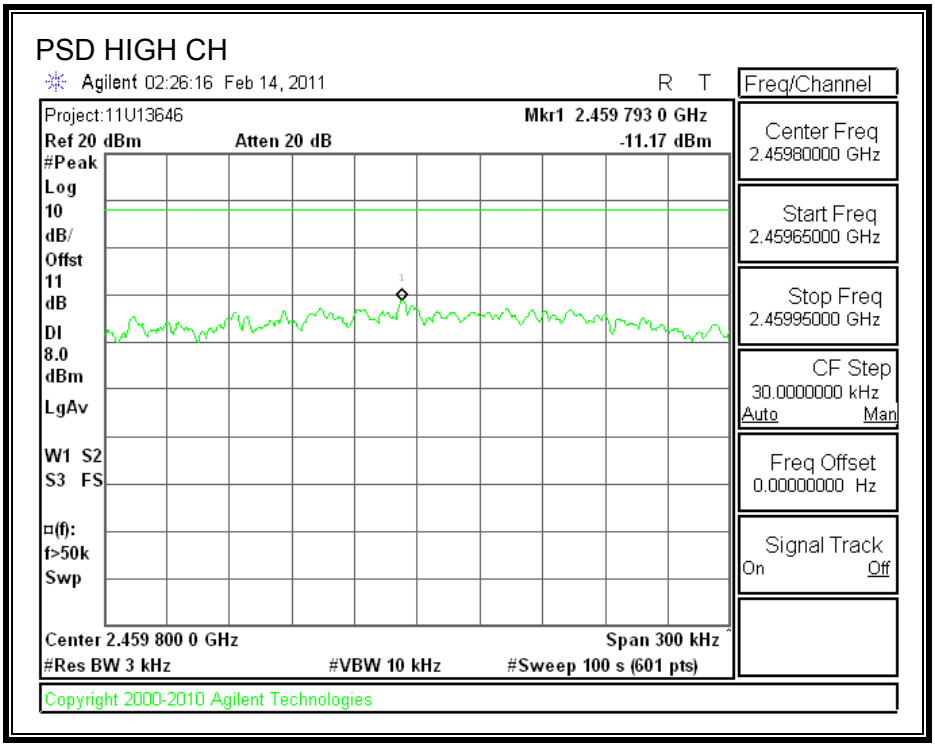
**RESULTS**

| Channel | Frequency | PPSD | Limit | Margin |
|---|---|---|---|---|
| | (MHz) | (dBm) | (dBm) | (dB) |
| Low | 2412 | -12.74 | 8 | -20.74 |
| Middle | 2437 | -10.36 | 8 | -18.36 |
| High | 2462 | -11.17 | 8 | -19.17 |

**POWER SPECTRAL DENSITY**







## 7.3.6. 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.

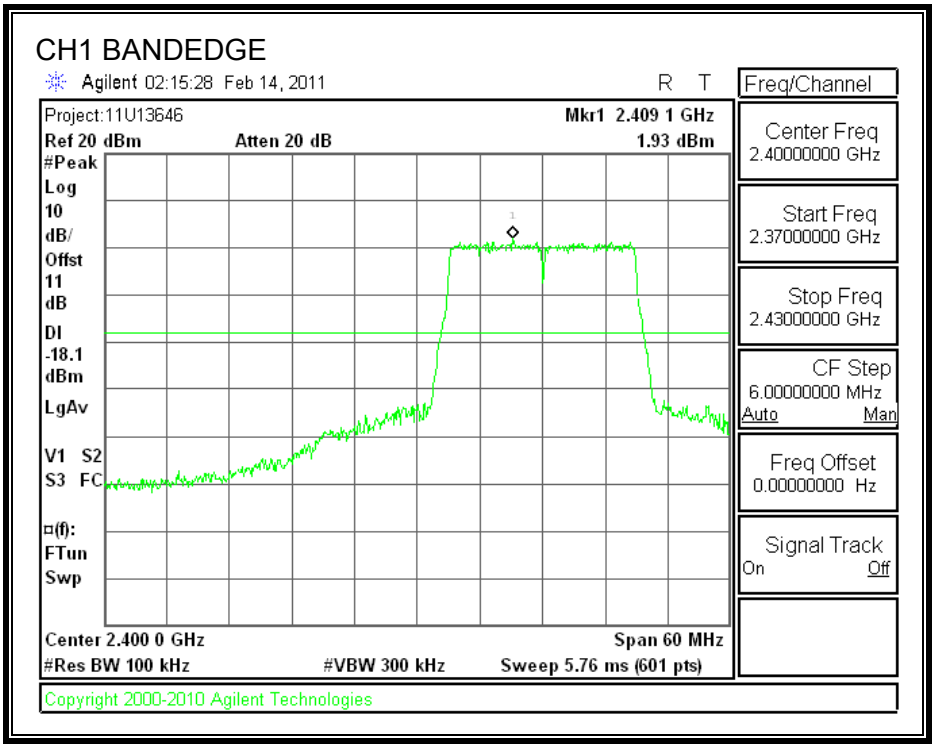
**TEST PROCEDURE**

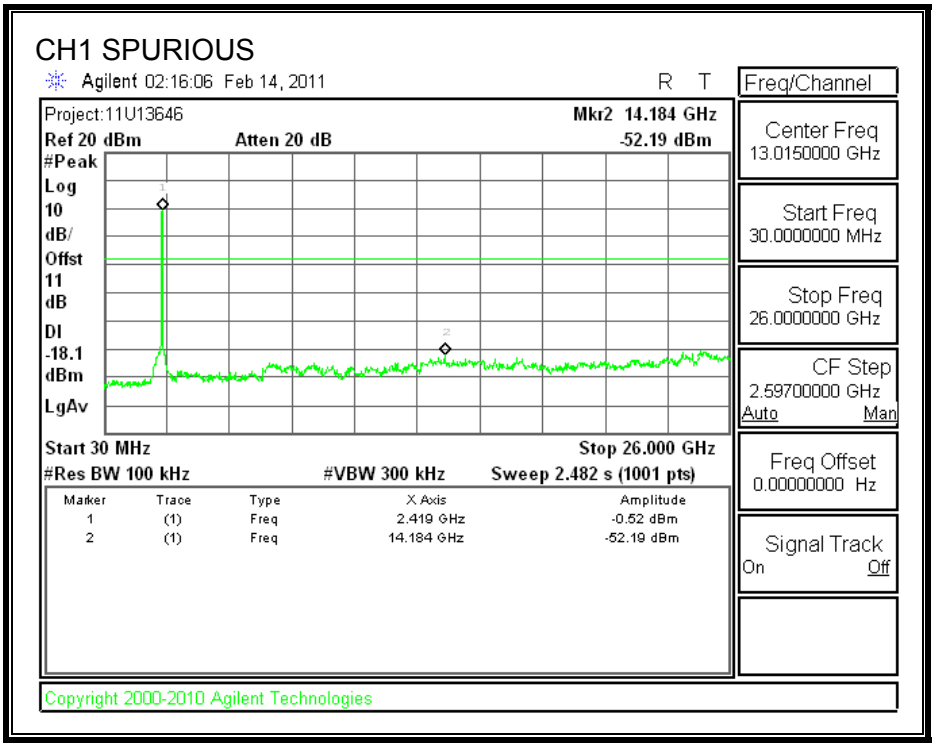
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

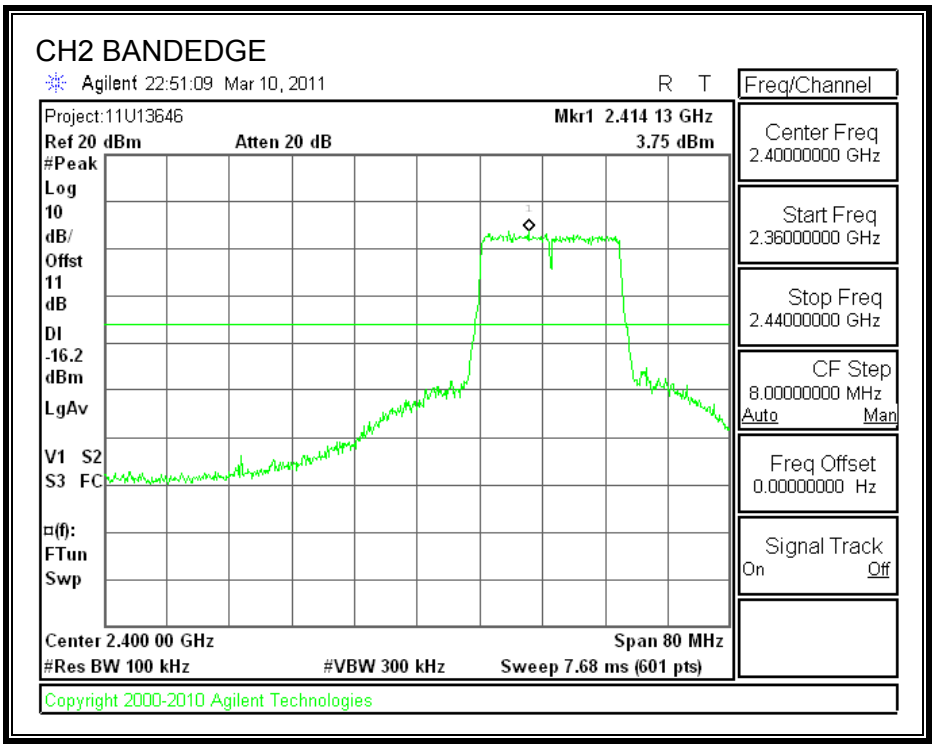
**RESULTS**

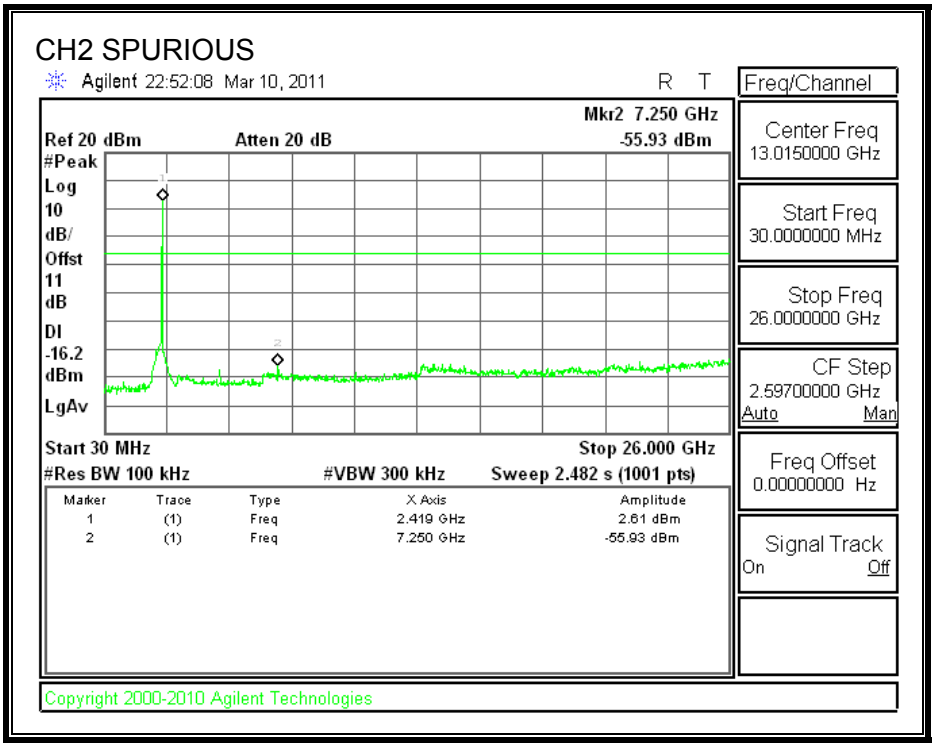
**SPURIOUS EMISSIONS, CH1**



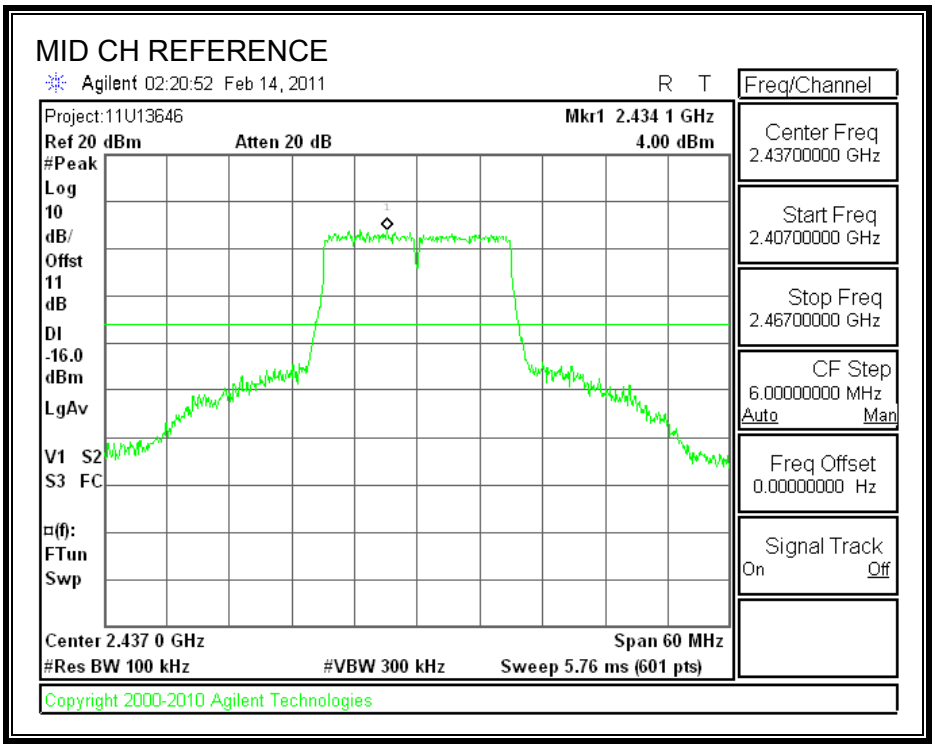


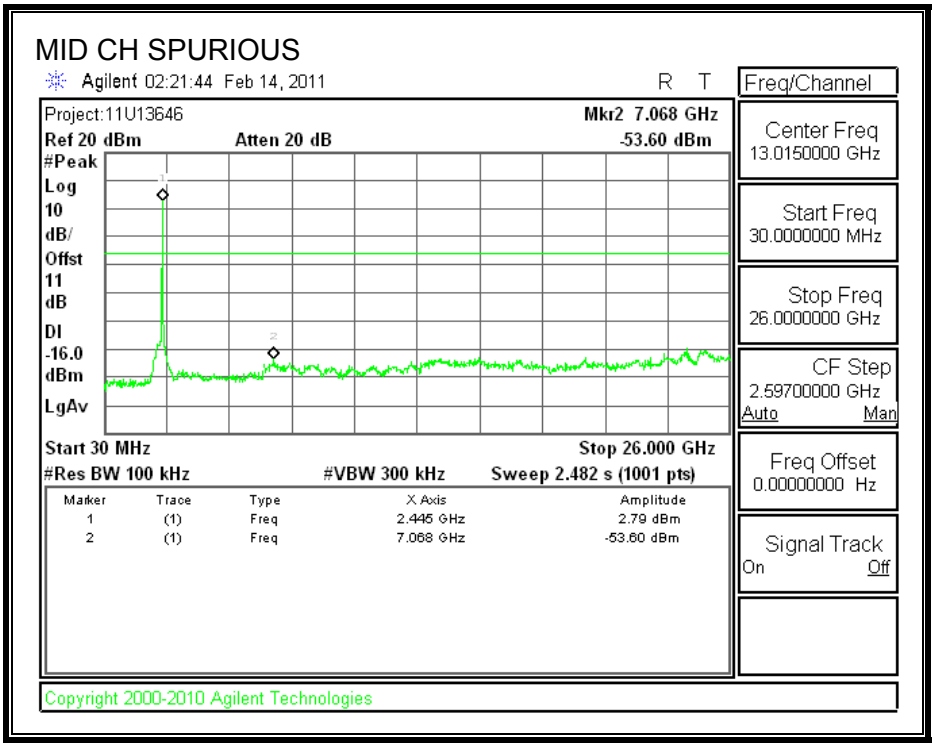
**SPURIOUS EMISSIONS, CH2**



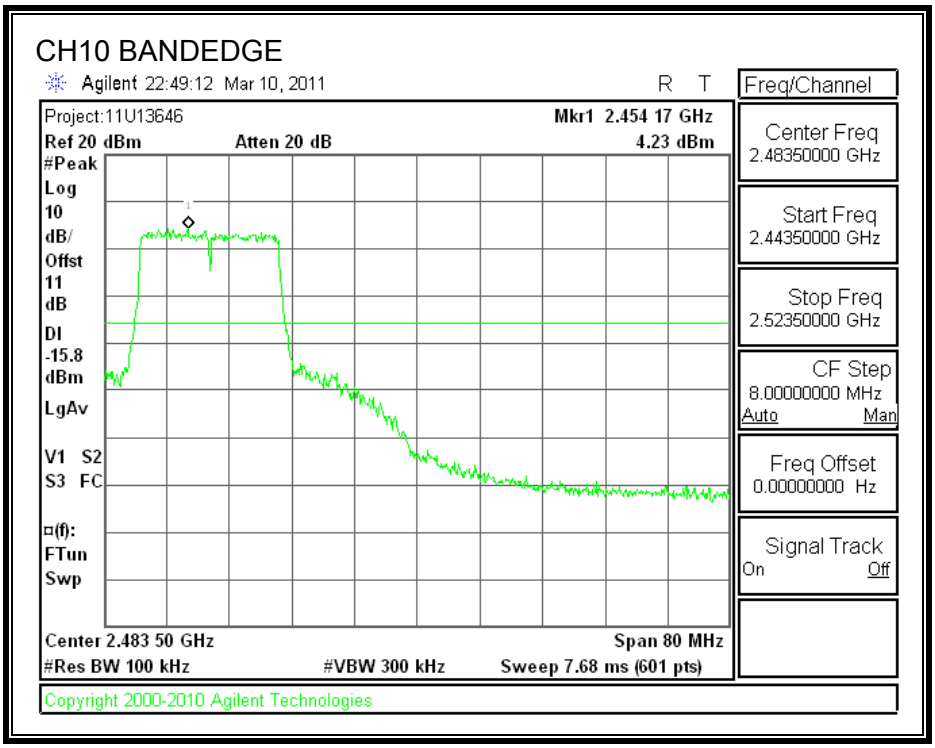


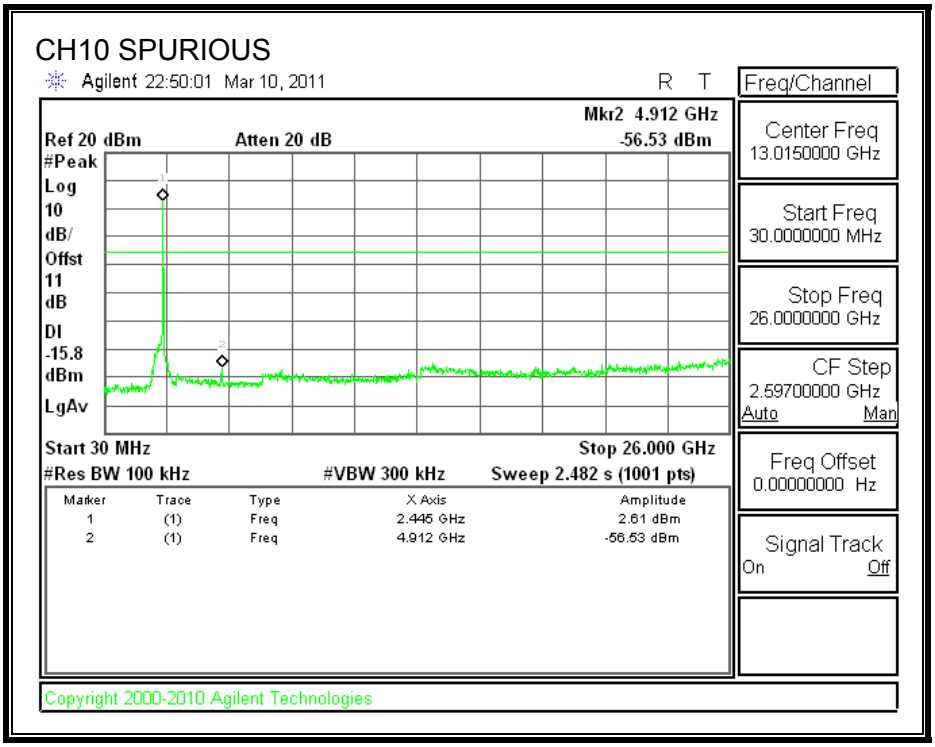
**SPURIOUS EMISSIONS, MID CHANNEL**



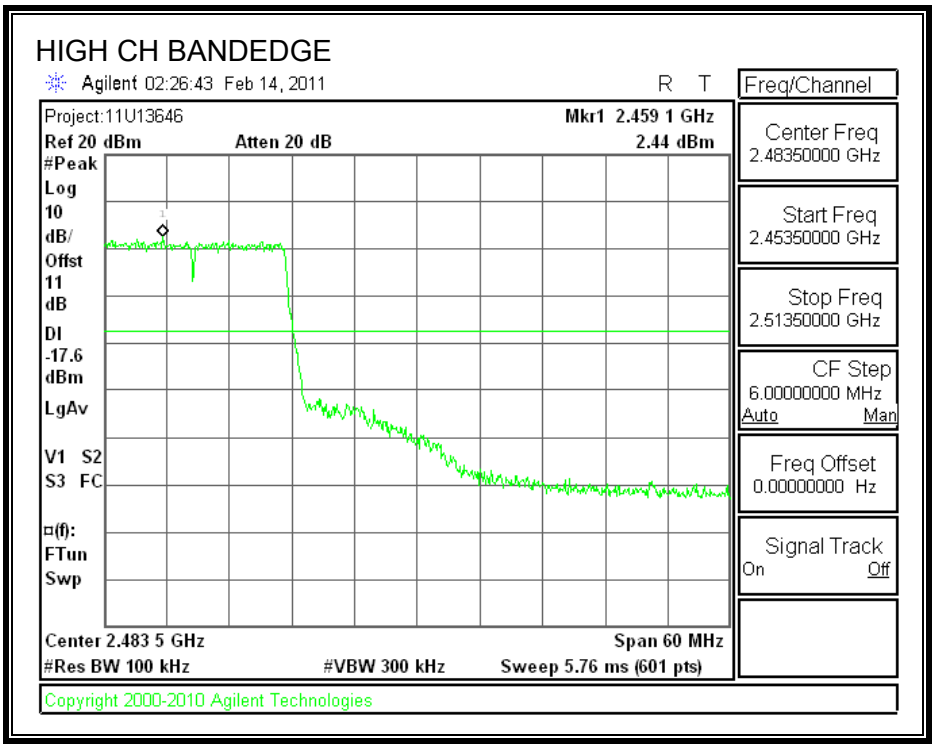


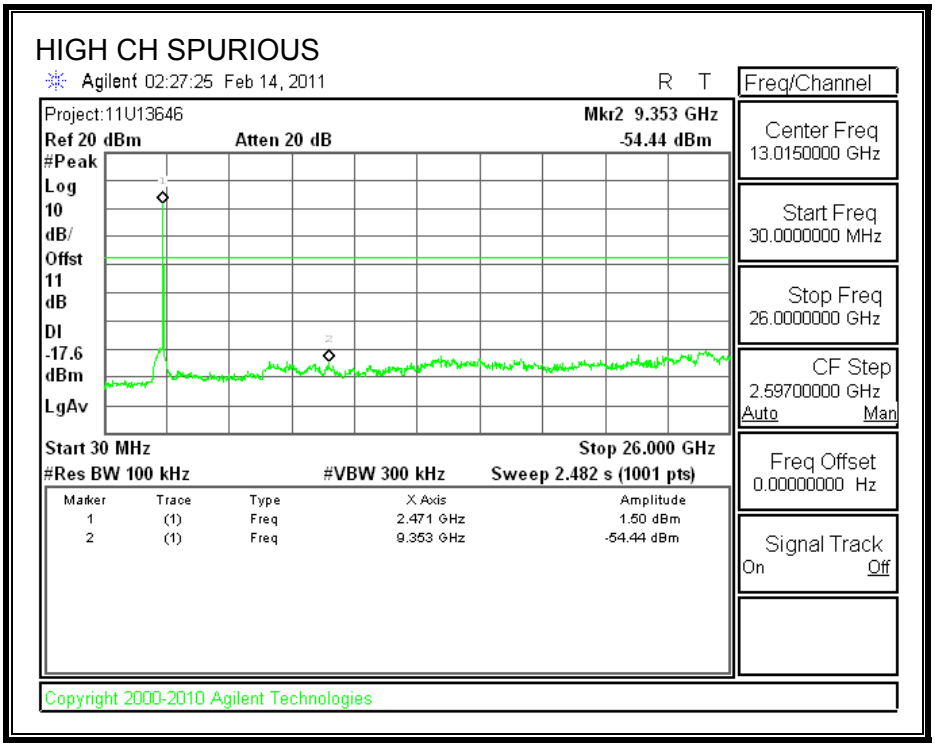
**SPURIOUS EMISSIONS, CH10**





**SPURIOUS EMISSIONS, HIGH CHANNEL**





# 7.4. 802.11 HT40 MODE IN THE 2.4 GHz BAND

## 7.4.1. 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.

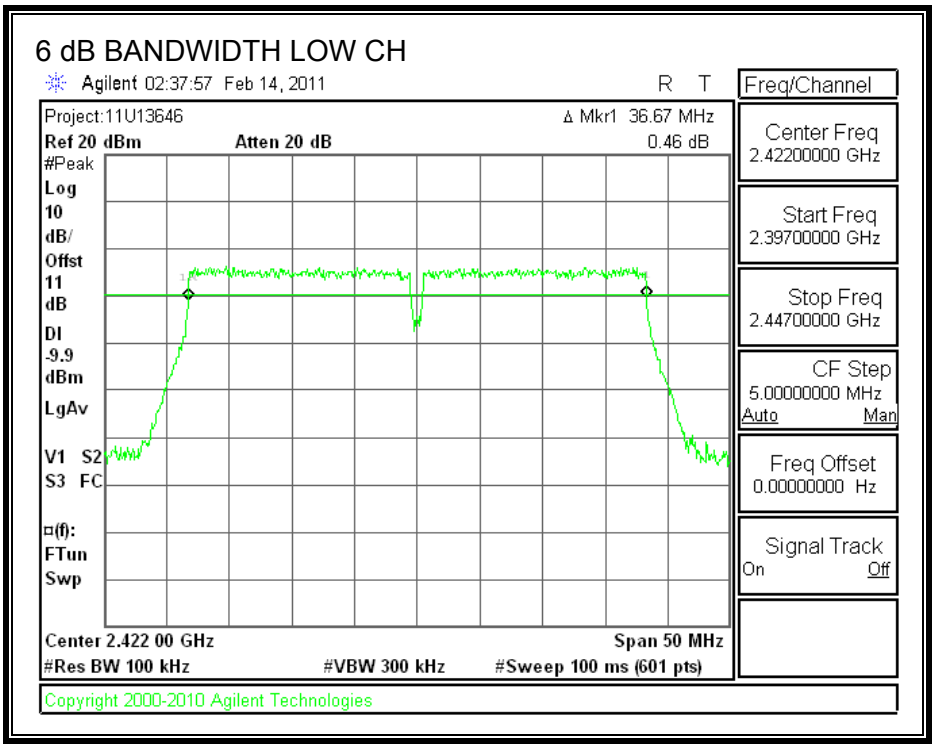
**TEST PROCEDURE**

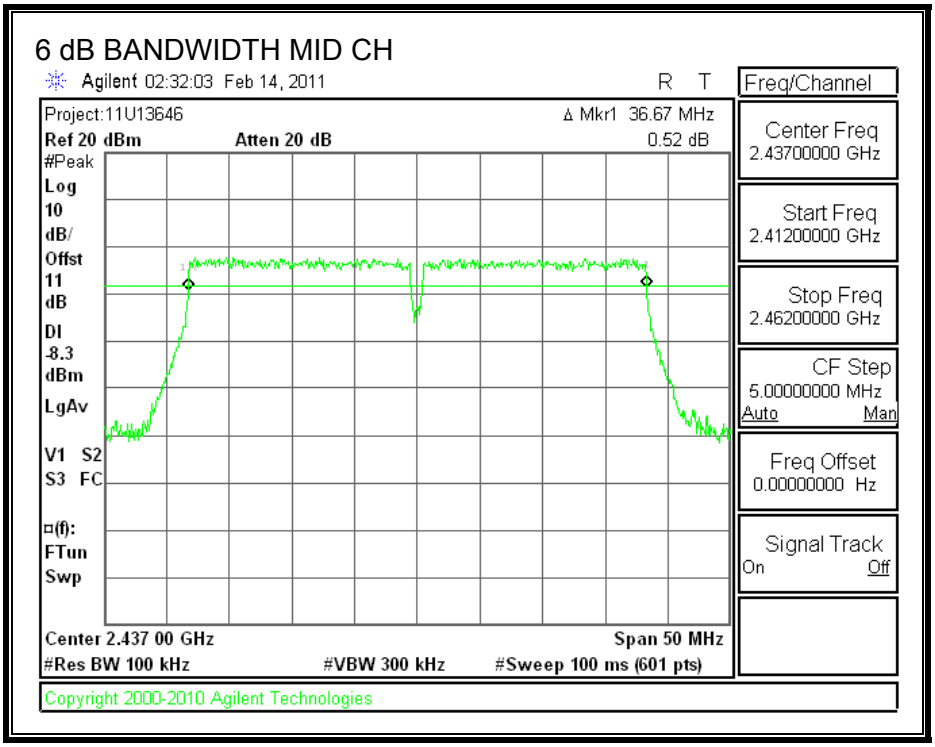
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

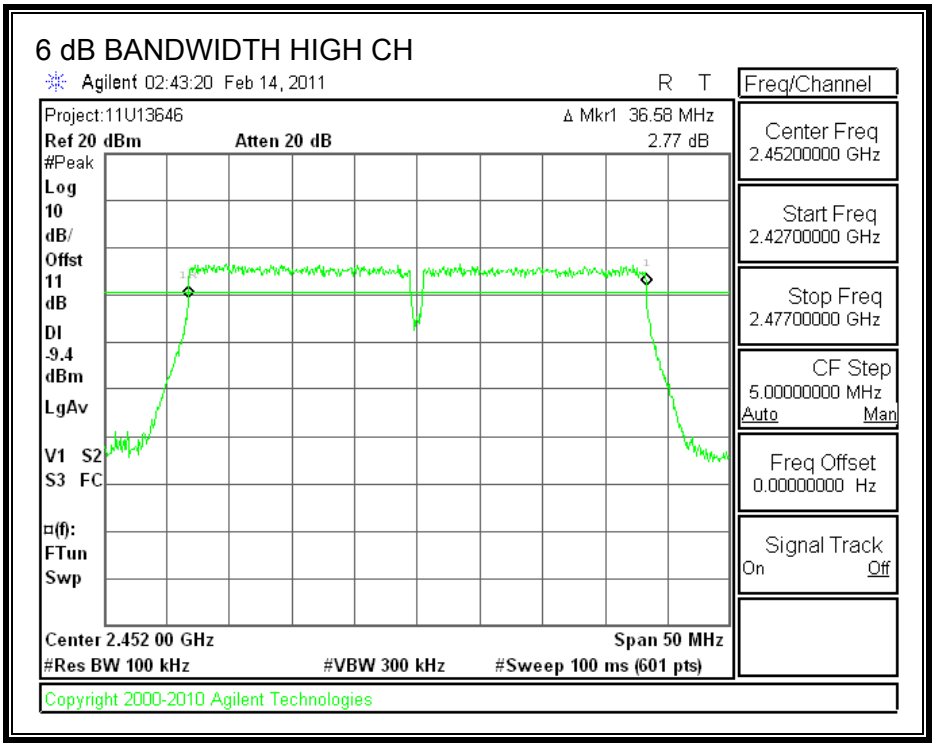
**RESULTS**

| Channel | Frequency | 6 dB Bandwidth | Minimum Limit |
|---|---|---|---|
| | (MHz) | (MHz) | (MHz) |
| Low | 2422 | 36.670 | 0.5 |
| Middle | 2437 | 36.670 | 0.5 |
| High | 2452 | 36.580 | 0.5 |

**6 dB BANDWIDTH**







### 7.4.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

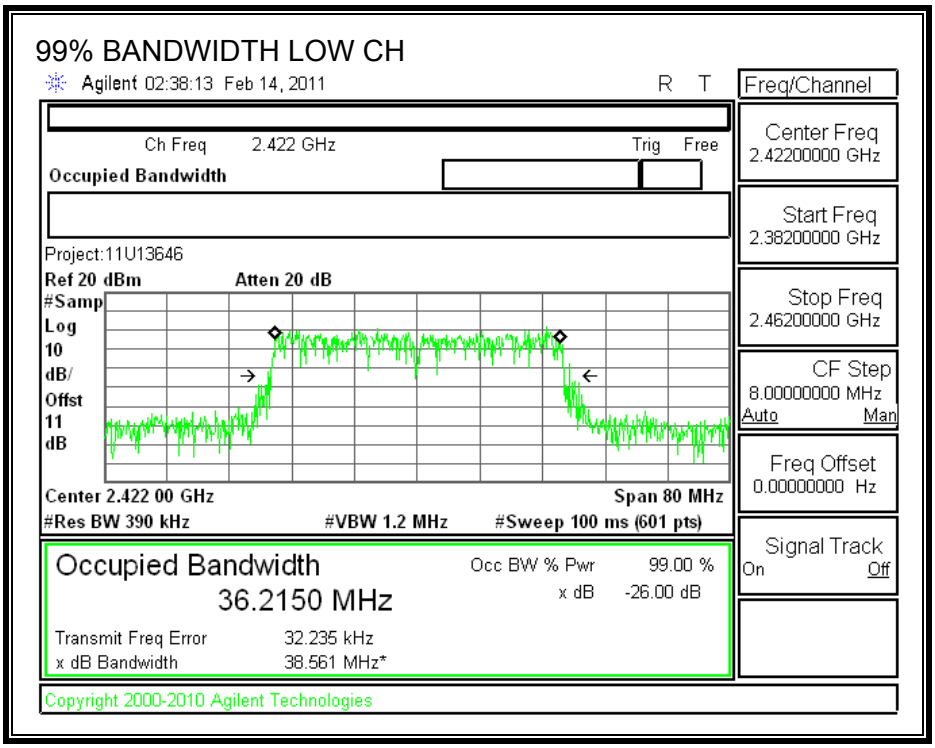
**TEST PROCEDURE**

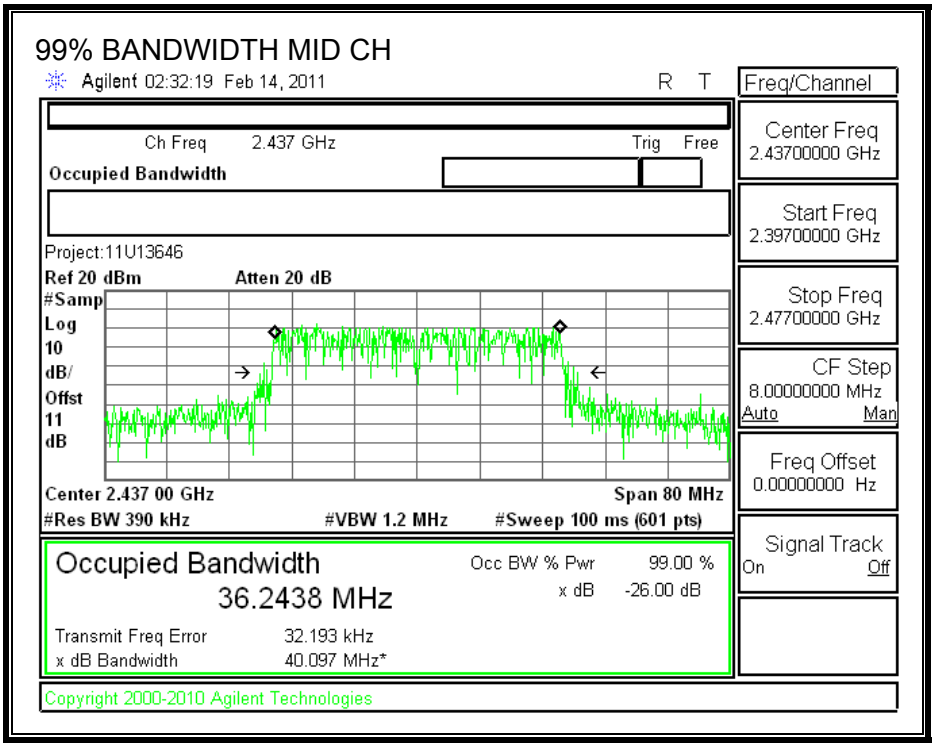
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

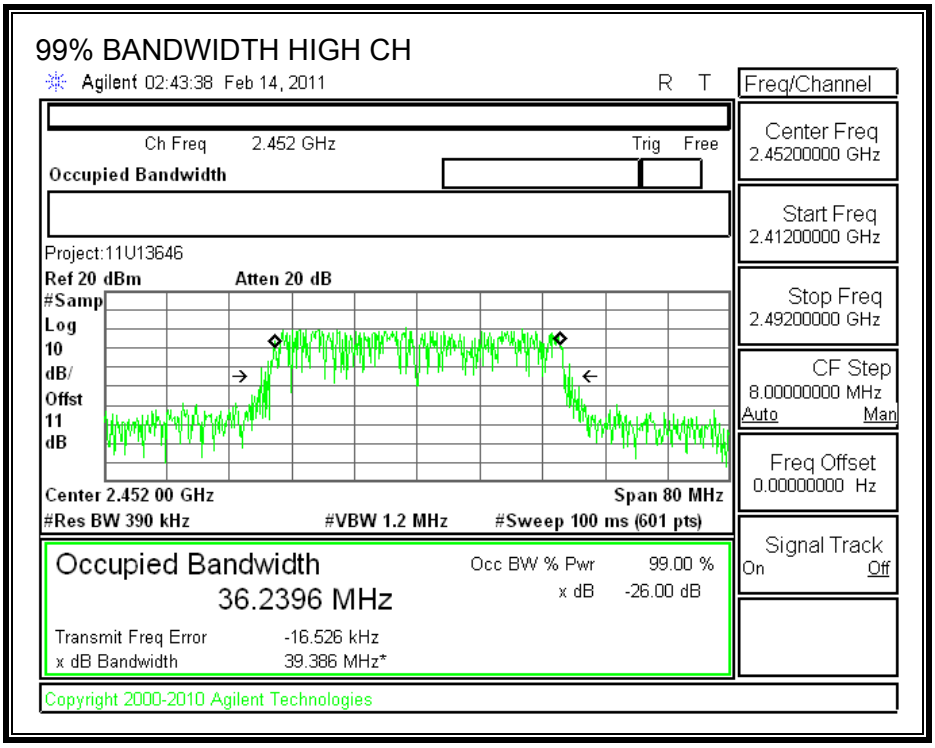
**RESULTS**

| Channel | Frequency | 99% Bandwidth |
|---|---|---|
| | (MHz) | (MHz) |
| Low | 2422 | 36.2150 |
| Middle | 2437 | 36.2438 |
| High | 2452 | 36.2396 |

**99% BANDWIDTH**







## 7.4.3. 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 a wide bandwidth Peak Power Meter.

**RESULTS**

| Channel | Frequency (MHz) | Peak Power Meter Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| CH3 | 2422 | 10.16 | 11 | 21.16 | 30 | -8.84 |
| CH6 | 2437 | 10.45 | 11 | 21.45 | 30 | -8.55 |
| CH9 | 2452 | 10.77 | 11 | 21.77 | 30 | -8.23 |

## 7.4.4. 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 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | Avg Power (dBm) |
|---|---|---|
| CH3 | 2422 | 14.89 |
| CH6 | 2437 | 15.01 |
| CH9 | 2452 | 15.04 |

## 7.4.5. 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.

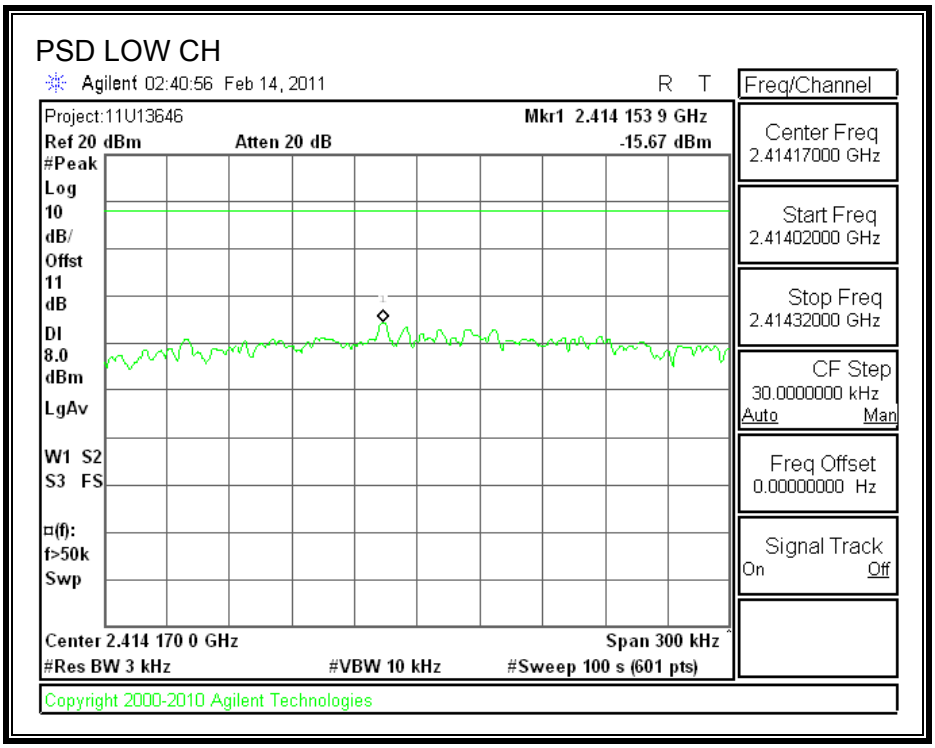
**TEST PROCEDURE**

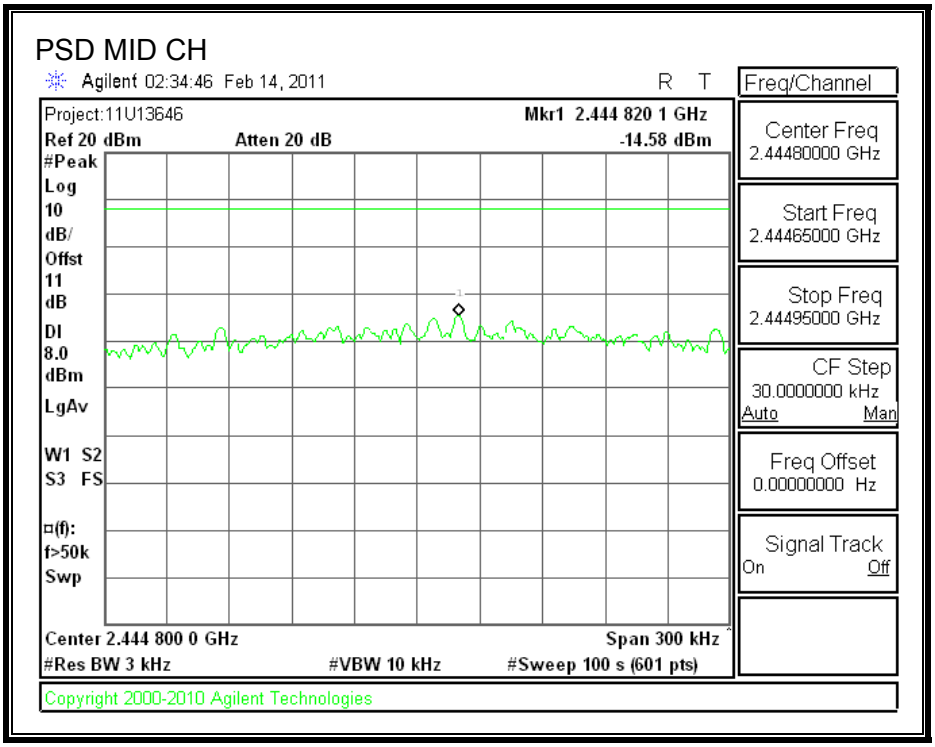
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

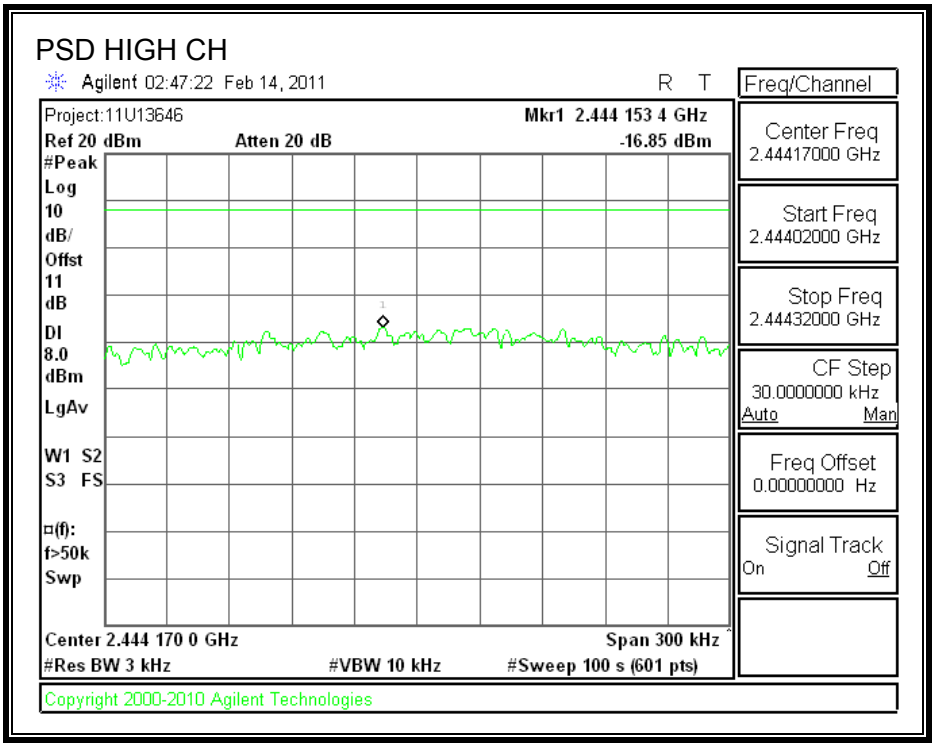
**RESULTS**

| Channel | Frequency | PPSD | Limit | Margin |
|---|---|---|---|---|
| | (MHz) | (dBm) | (dBm) | (dB) |
| Low | 2422 | -15.67 | 8 | -23.67 |
| Middle | 2437 | -14.58 | 8 | -22.58 |
| High | 2452 | -16.85 | 8 | -24.85 |

**POWER SPECTRAL DENSITY**







## 7.4.6. 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.

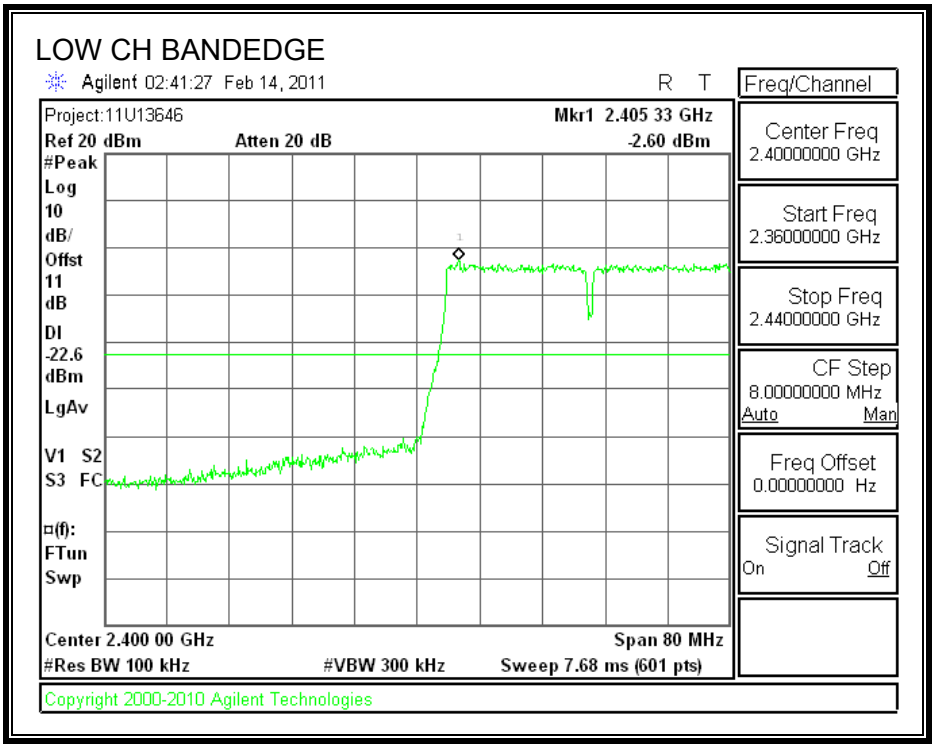
**TEST PROCEDURE**

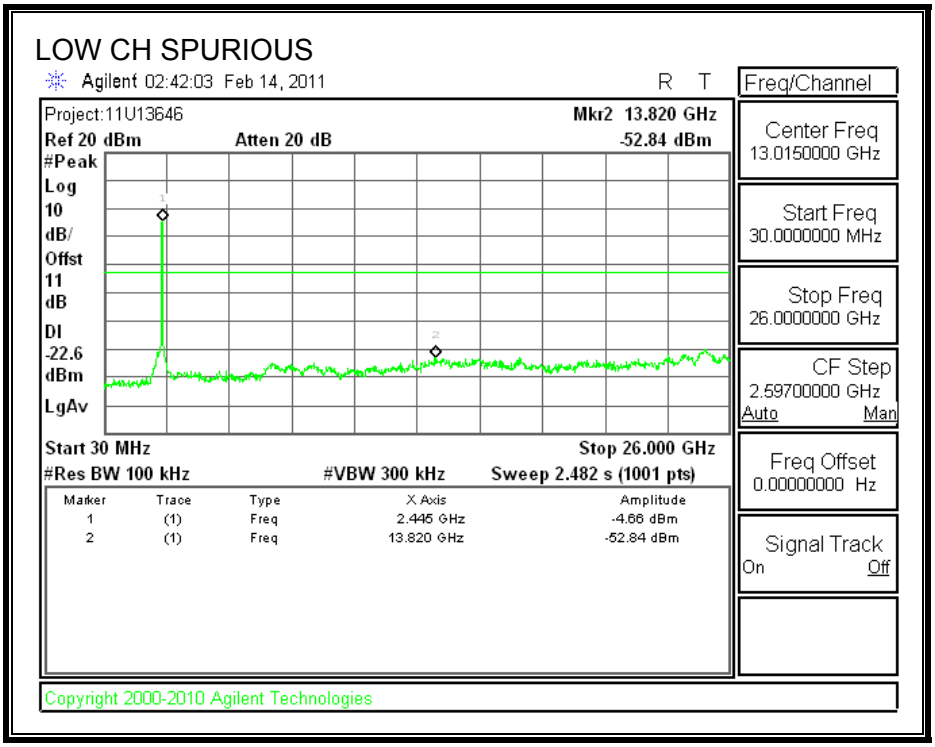
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

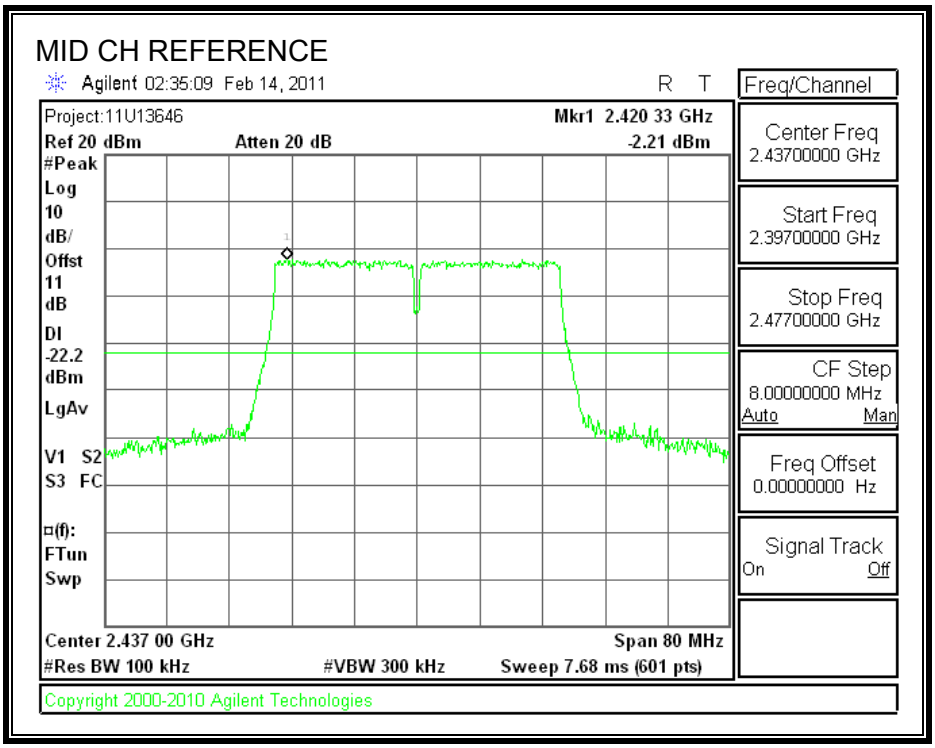
## RESULTS

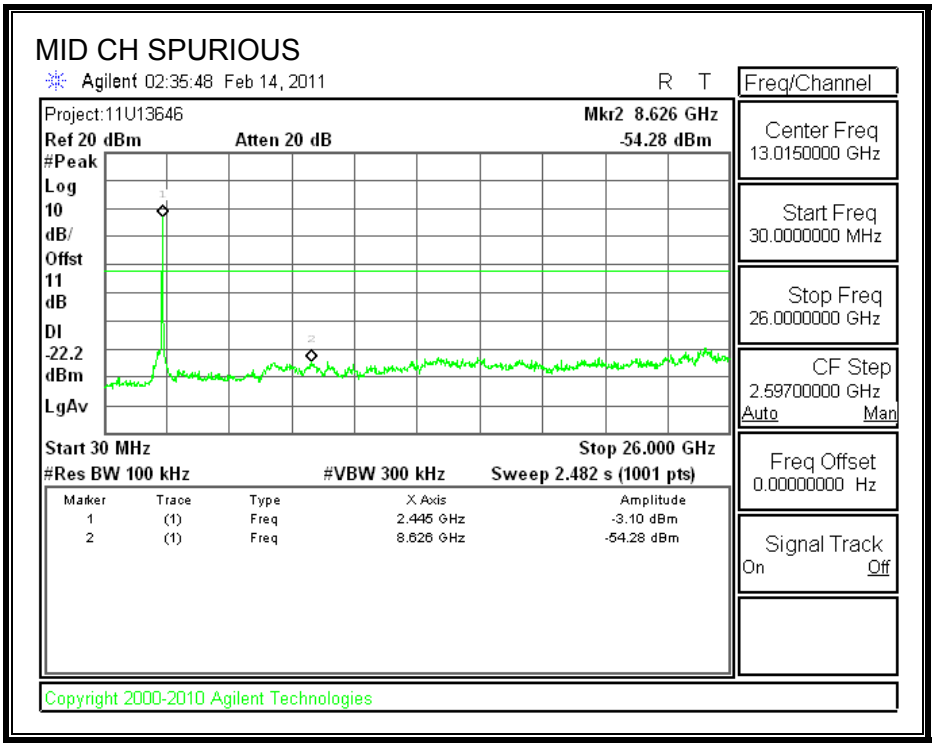
## SPURIOUS EMISSIONS, LOW CHANNEL



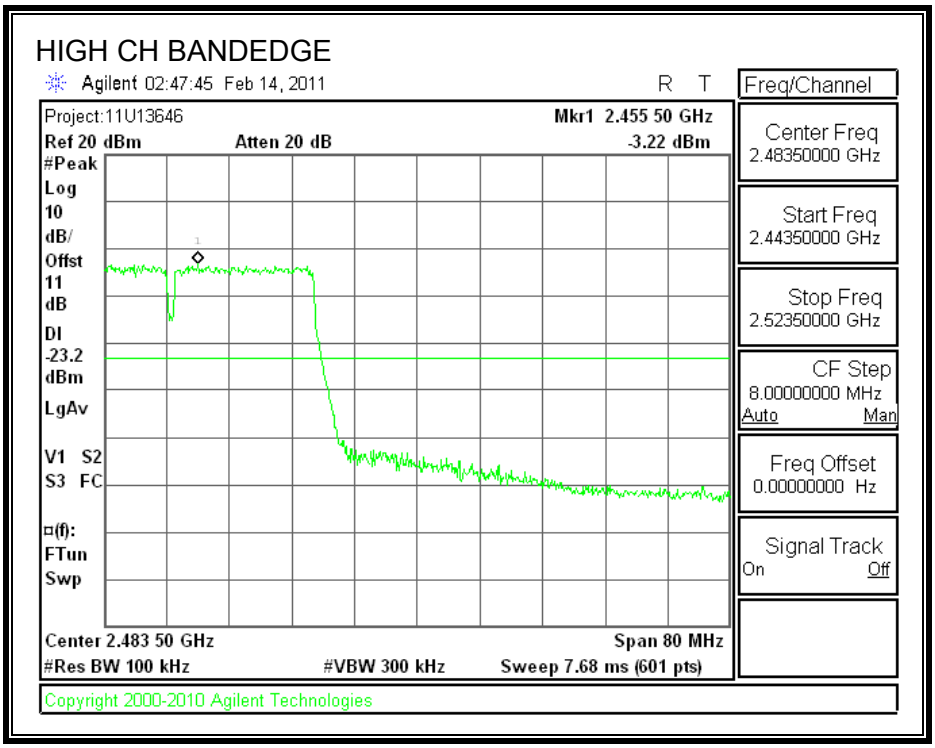


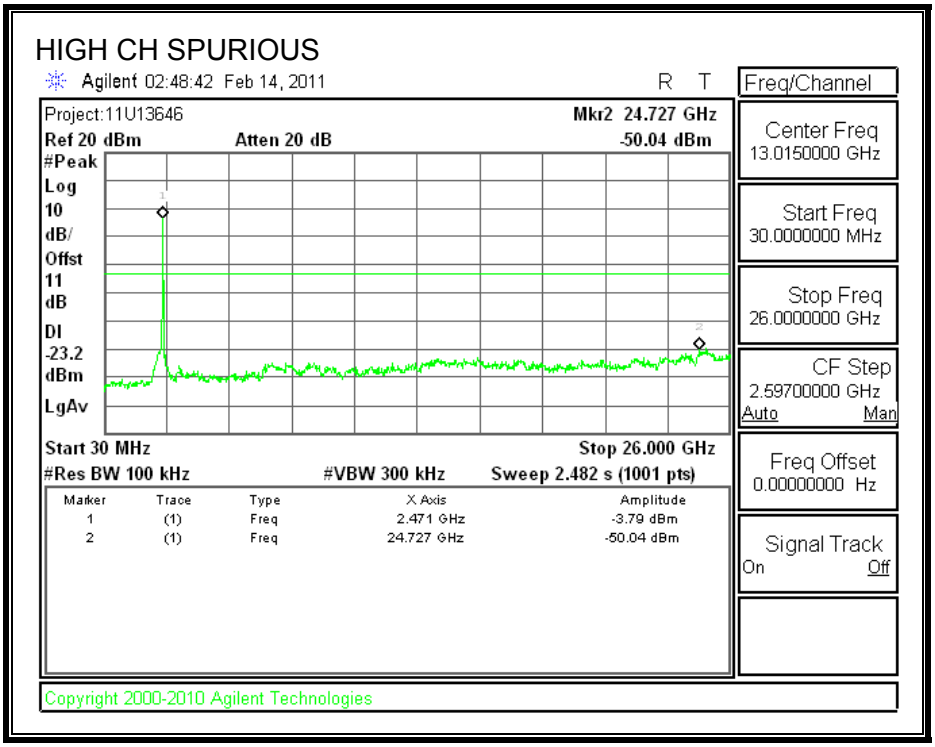
**SPURIOUS EMISSIONS, MID CHANNEL**





**SPURIOUS EMISSIONS, HIGH CHANNEL**





# 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.

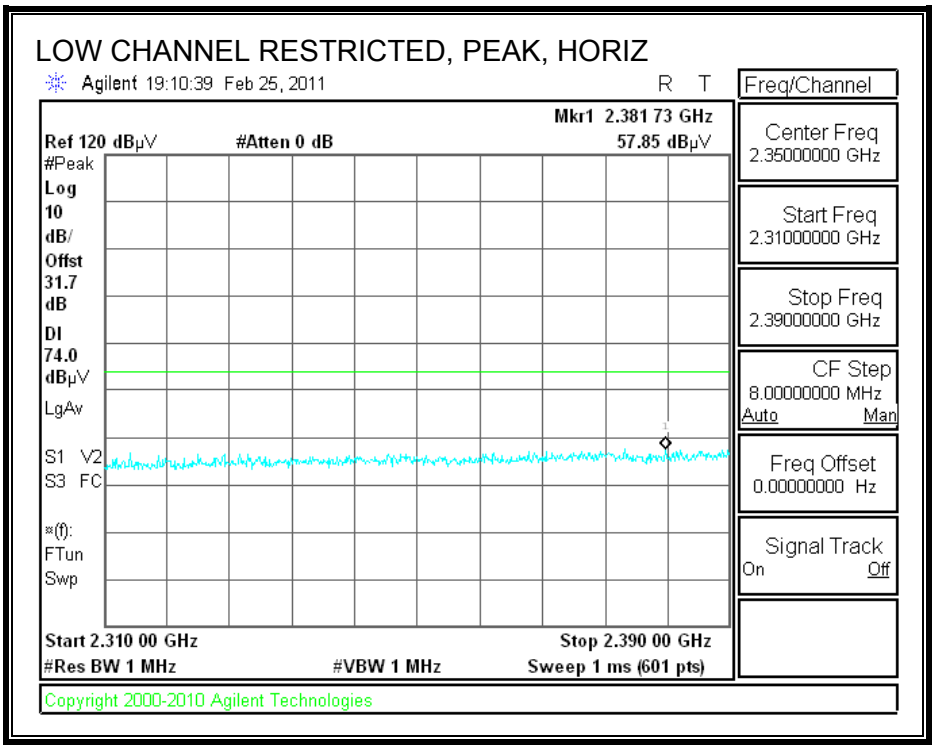
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

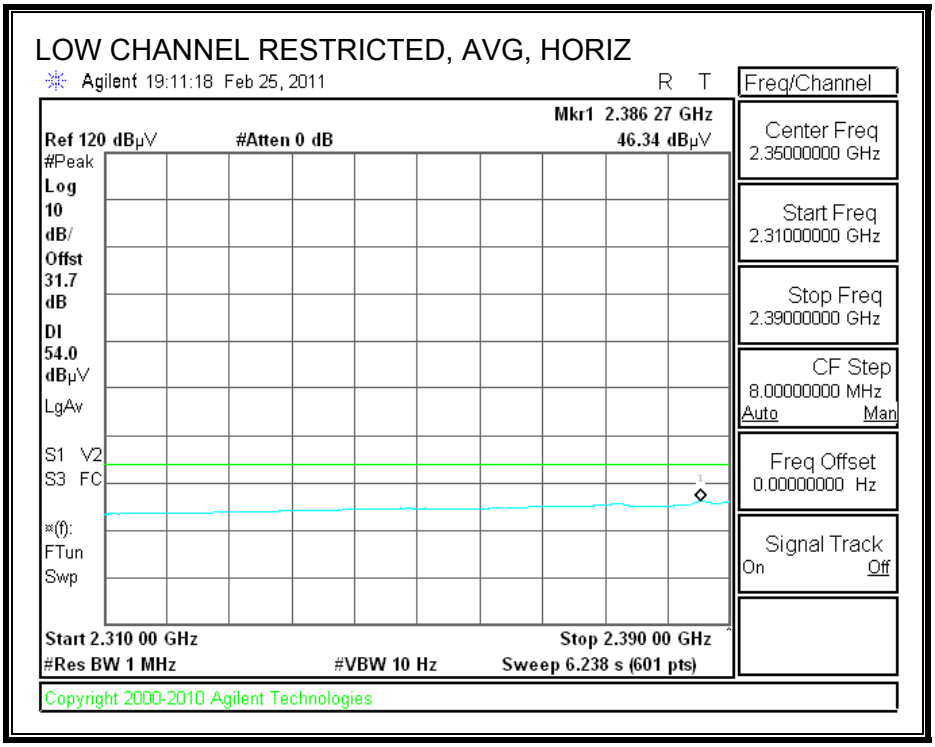
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

# 8.2. TRANSMITTER ABOVE 1 GHz

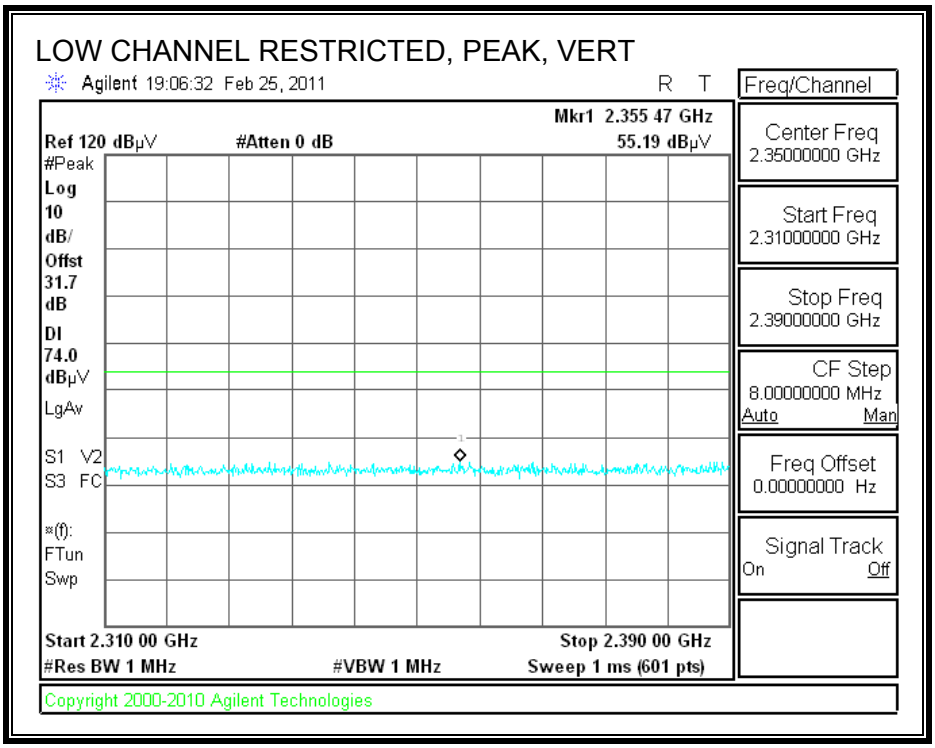
## 8.2.1. TX ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz BAND

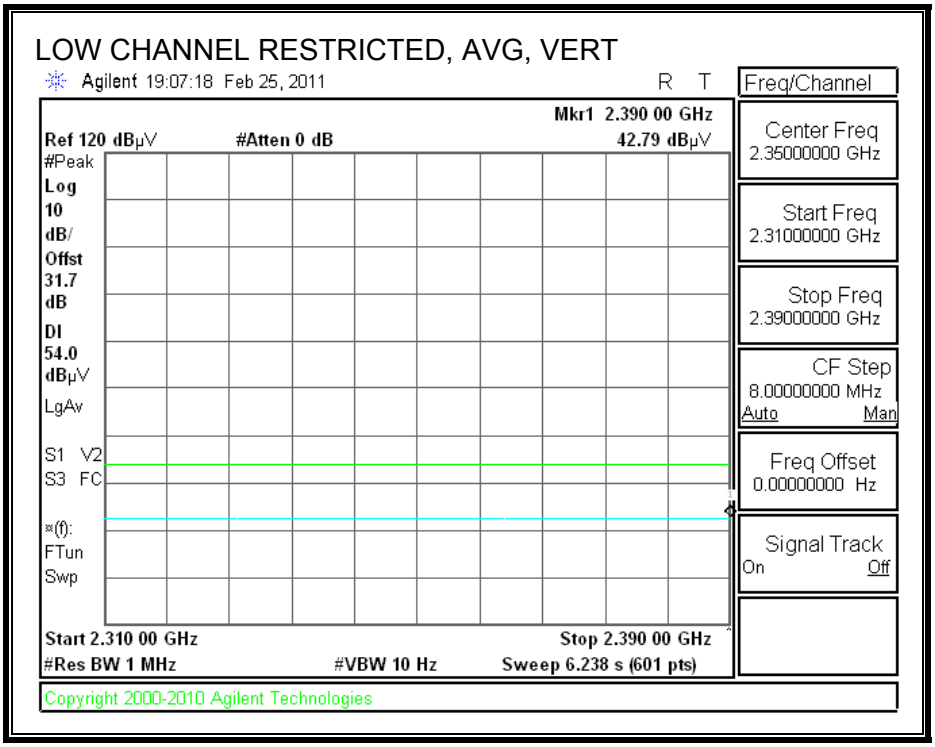
**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



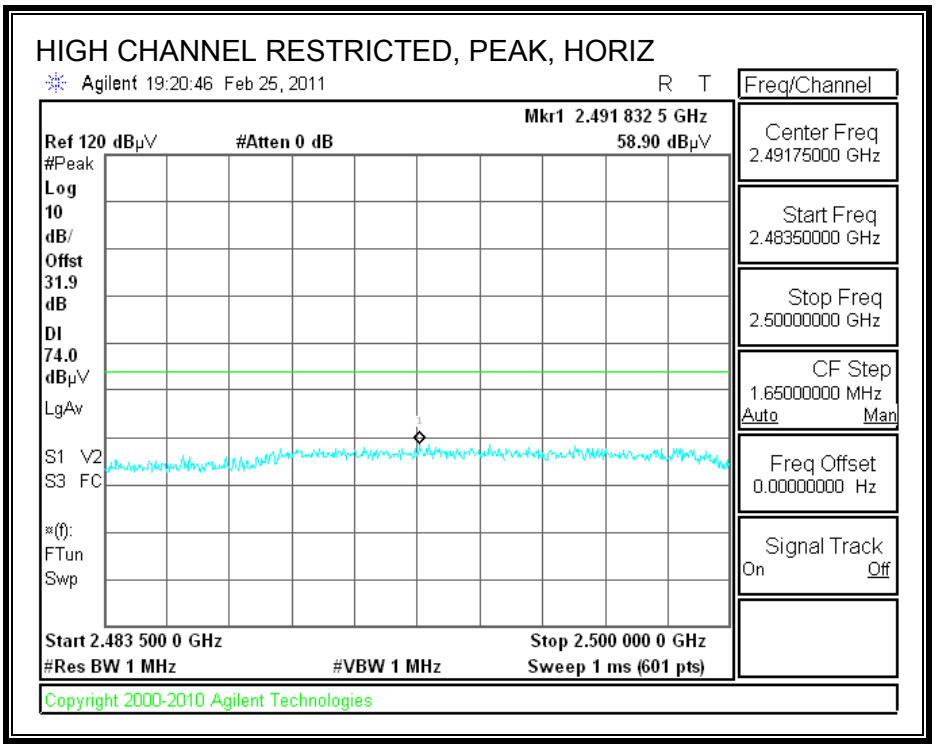


**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

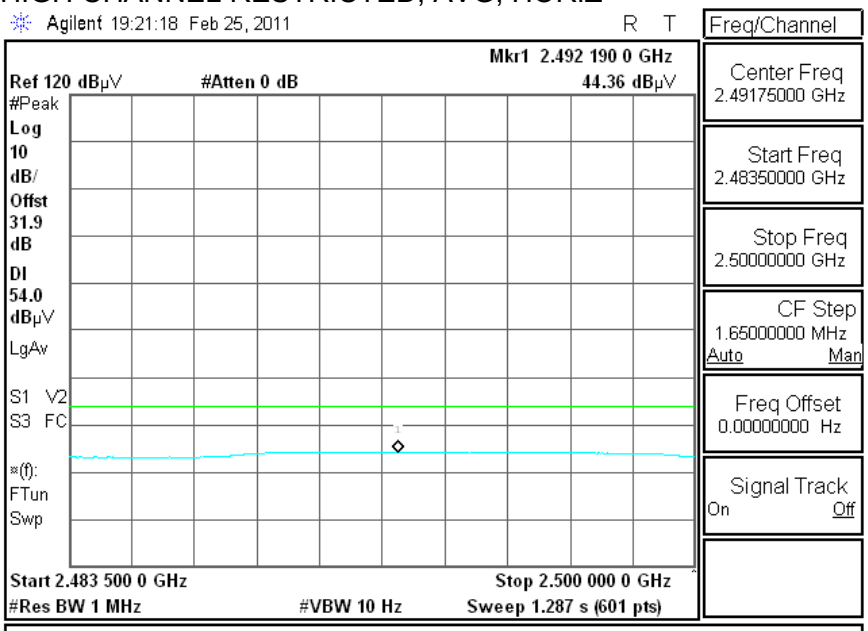




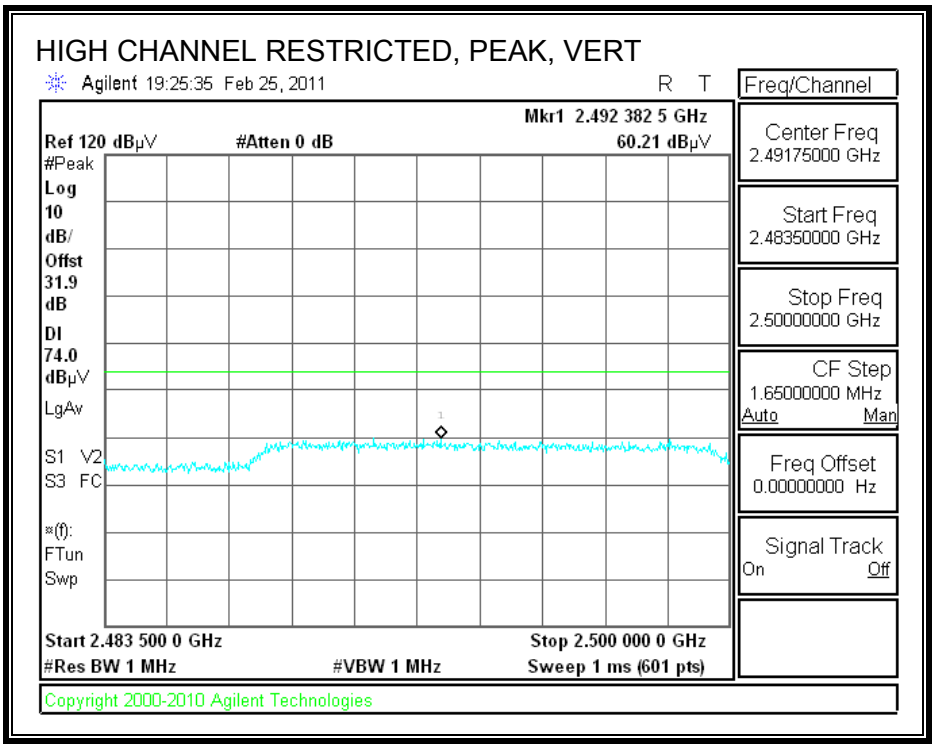
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

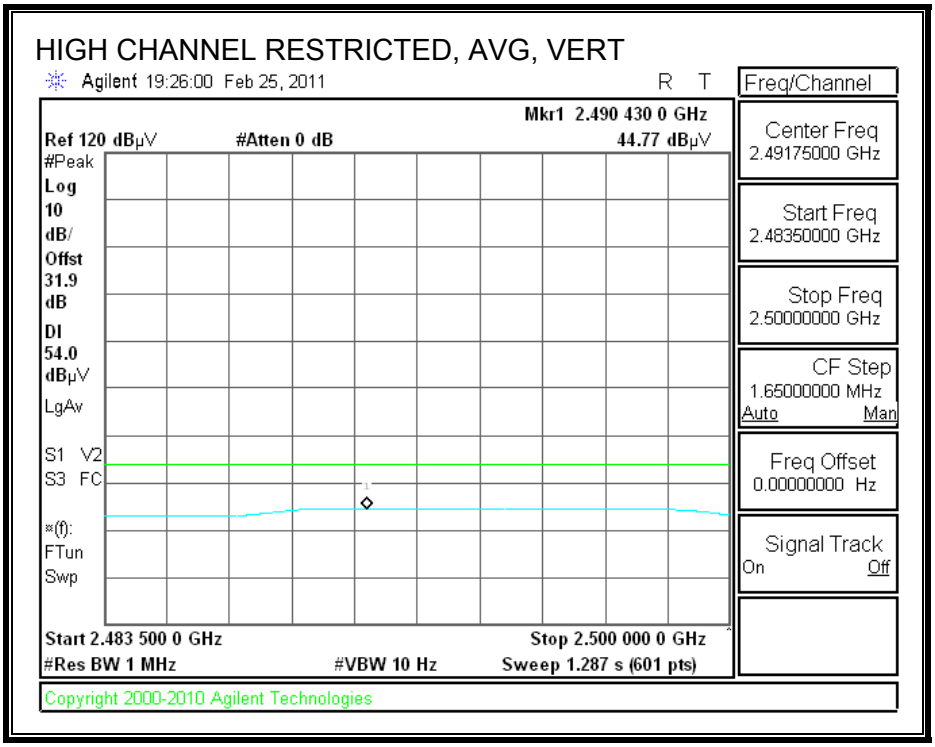


HIGH CHANNEL RESTRICTED, AVG, HORIZ



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





## HARMONICS AND SPURIOUS EMISSIONS

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

| | |
|---|---|
| **Company:** | MARVIELL |
| **Project #:** | 11U13646 |
| **Date:** | 3/2/2011 |
| **Test Engineer:** | MENGISTU MEKURIA |
| **Configuration:** | EUT(#1) SUPPORT LAPTOP |
| **Mode:** | TX, b MODE |

**Test Equipment:**

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T73; S/N: 6717 @3m | T144 Miteq 3008A00931 | | | FCC 15.205 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 |

**Peak Measurements**
RBW=VBW=1MHz
**Average Measurements**
RBW=1MHz ; VBW=10Hz

| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low Channel (2412 MHz)** | | | | | | | | | | | | | | | |
| 4.824 | 3.0 | 48.6 | 46.0 | 33.0 | 5.8 | -36.5 | 0.0 | 0.0 | 50.9 | 48.4 | 74 | 54 | -23.1 | -5.6 | V |
| 4.824 | 3.0 | 48.8 | 46.1 | 33.0 | 5.8 | -36.5 | 0.0 | 0.0 | 51.1 | 48.5 | 74 | 54 | -22.9 | -5.5 | H |
| **Mid Channel (2437 MHz)** | | | | | | | | | | | | | | | |
| 4.874 | 3.0 | 46.2 | 43.0 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 48.6 | 45.5 | 74 | 54 | -25.4 | -8.5 | V |
| 7.311 | 3.0 | 38.0 | 27.8 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 44.4 | 34.2 | 74 | 54 | -29.6 | -19.8 | V |
| 4.874 | 3.0 | 46.3 | 43.2 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 48.8 | 45.7 | 74 | 54 | -25.2 | -8.3 | H |
| 7.311 | 3.0 | 41.0 | 33.7 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 47.4 | 40.0 | 74 | 54 | -26.6 | -14.0 | H |
| **Hi Channel (2462 MHz)** | | | | | | | | | | | | | | | |
| 4.924 | 3.0 | 48.0 | 45.3 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 50.6 | 47.9 | 74 | 54 | -23.4 | -6.1 | V |
| 7.386 | 3.0 | 38.3 | 29.6 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 44.8 | 36.1 | 74 | 54 | -29.2 | -17.9 | V |
| 4.924 | 3.0 | 48.3 | 45.5 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 50.8 | 48.1 | 74 | 54 | -23.2 | -5.9 | H |
| 7.386 | 3.0 | 40.6 | 32.3 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 47.1 | 38.8 | 74 | 54 | -26.9 | -15.2 | H |

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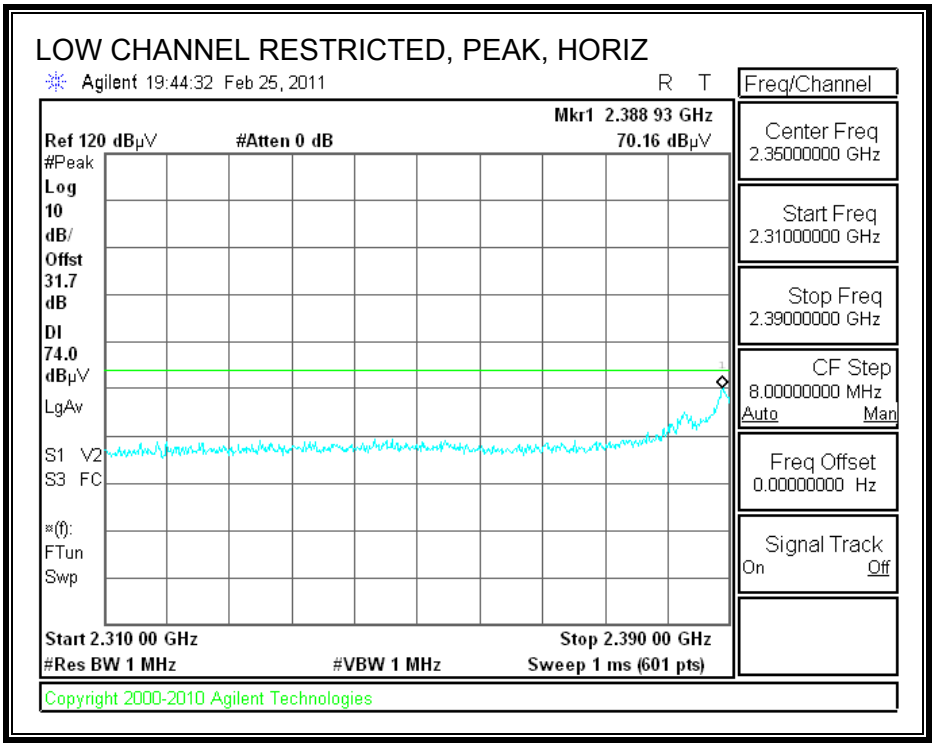
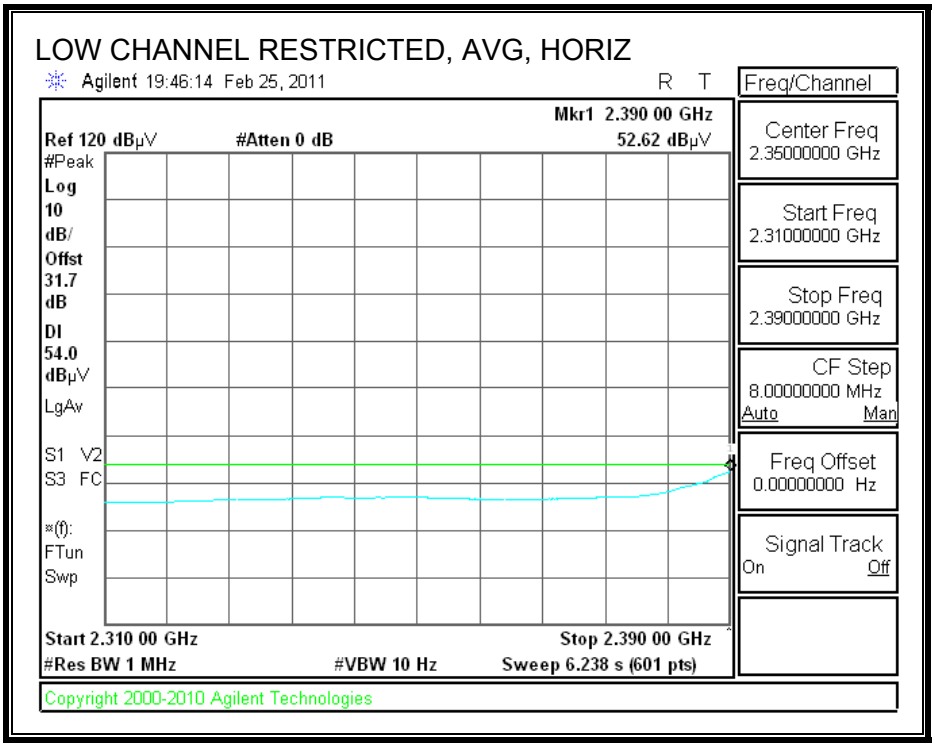
| | | | | | |
|---|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Avg Lim | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Pk Lim | Peak Field Strength Limit |
| Read | Analyzer Reading | Avg | Average Field Strength @ 3 m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

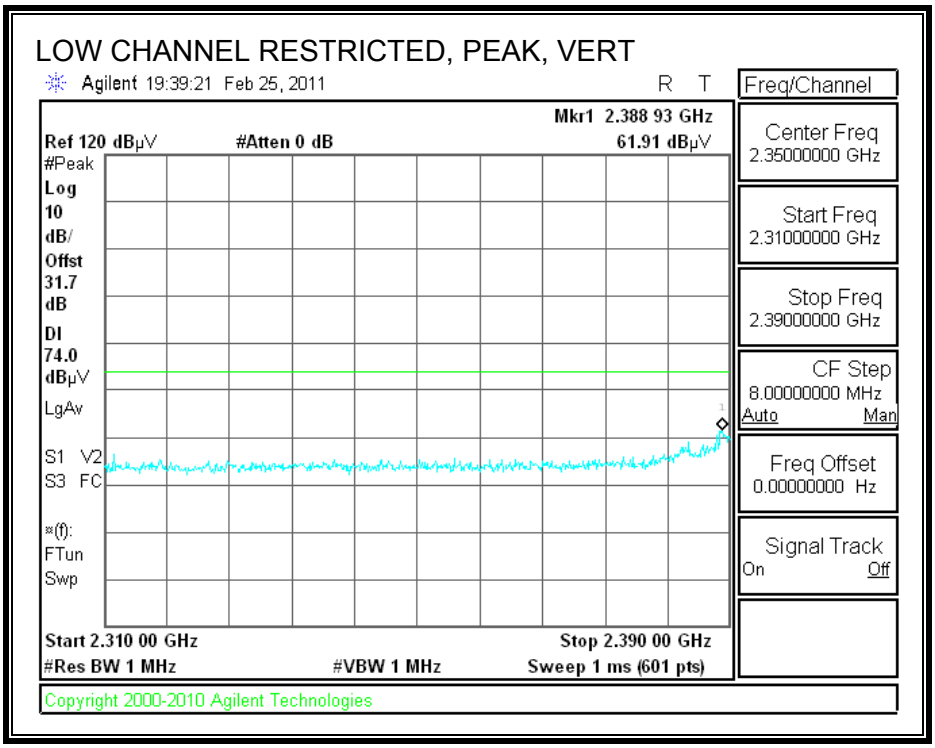
## 8.2.2. TX ABOVE 1 GHz FOR 802.11g MODE IN THE 2.4 GHz BAND

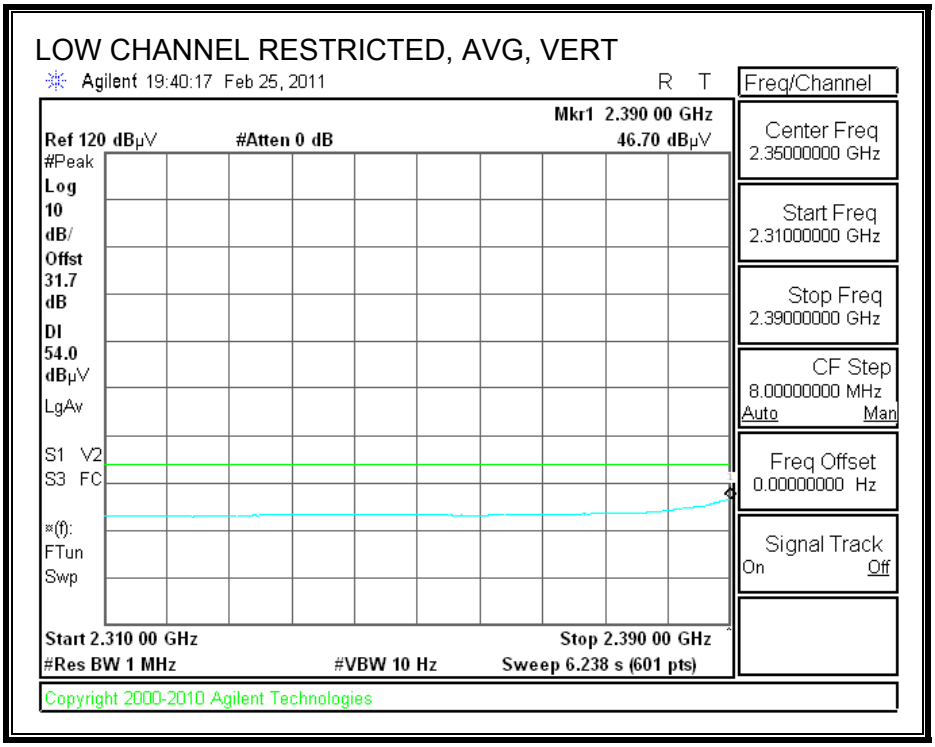
**RESTRICTED BANDEDGE (CH1, HORIZONTAL)**



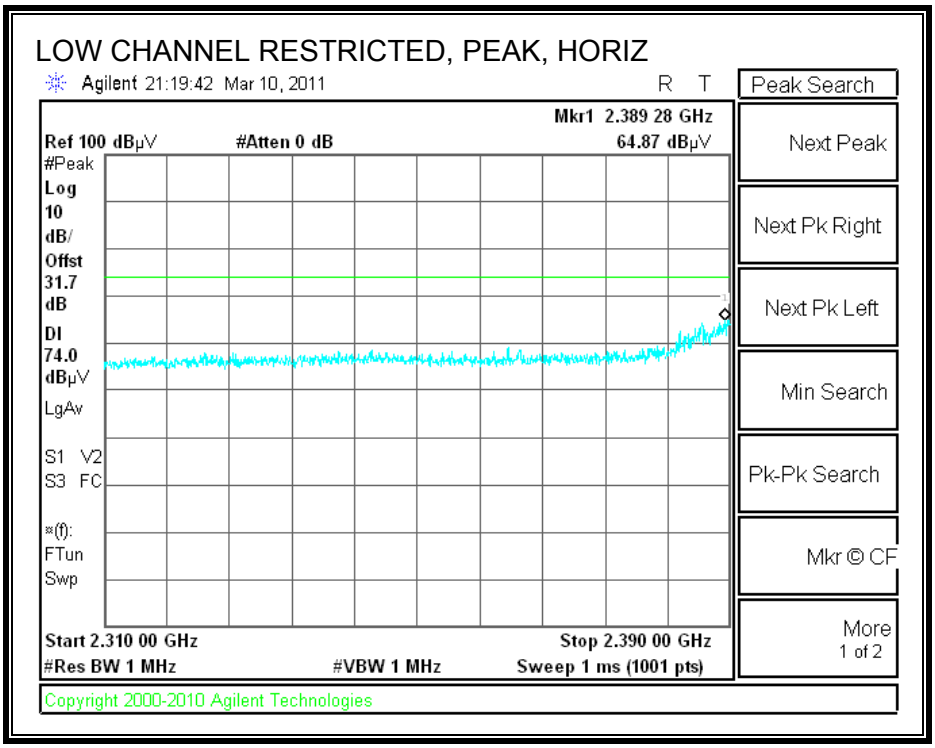


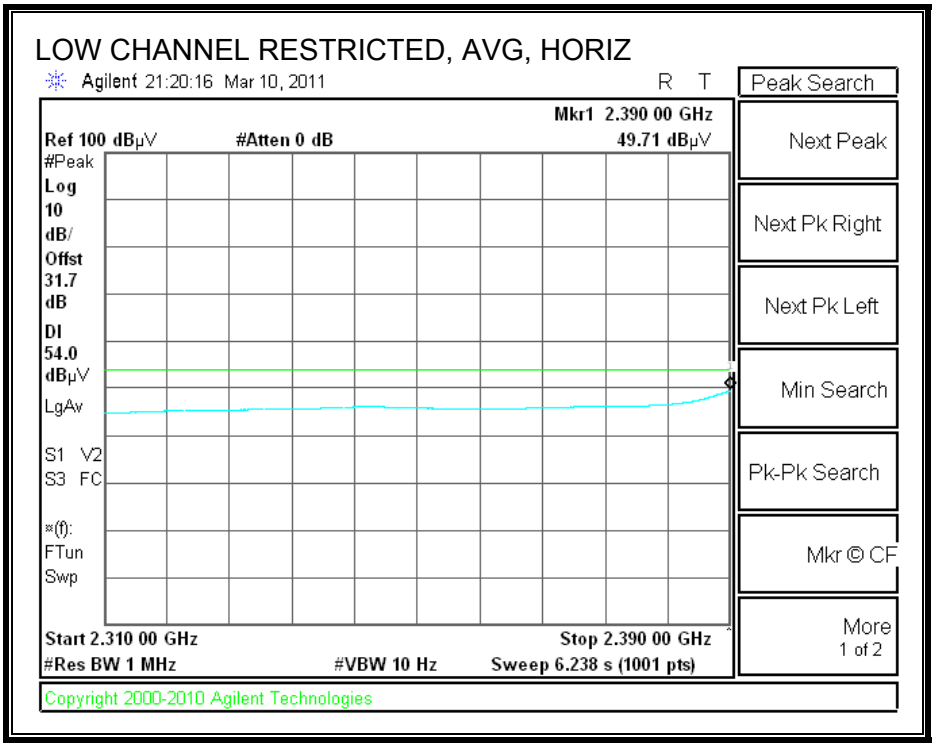
**RESTRICTED BANDEDGE (CH1, VERTICAL)**



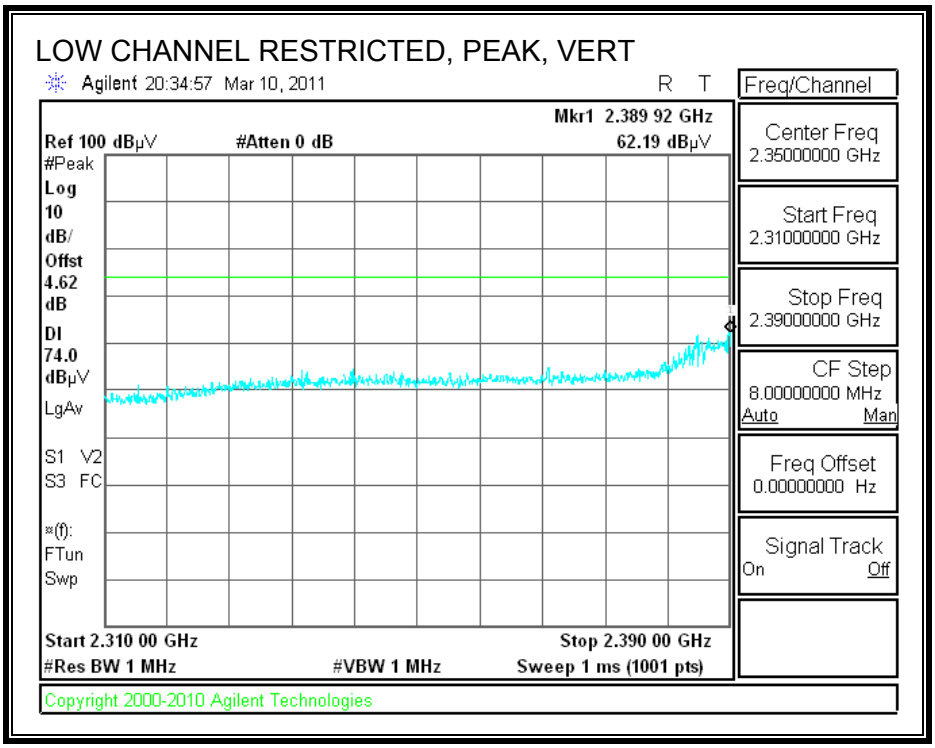


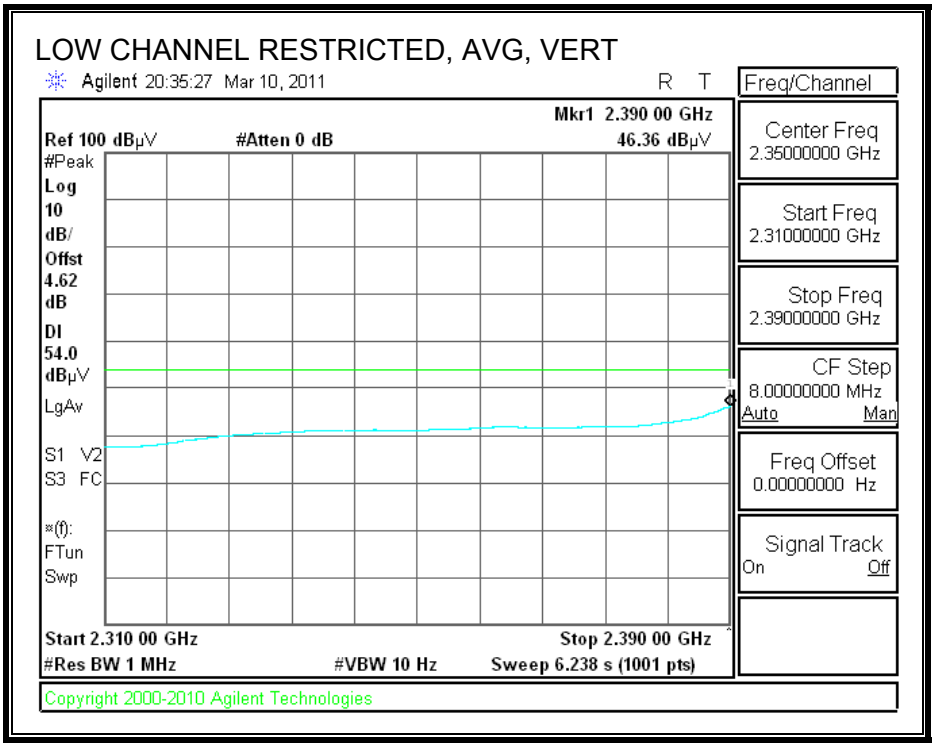
**RESTRICTED BANDEDGE (CH2, HORIZONTAL)**



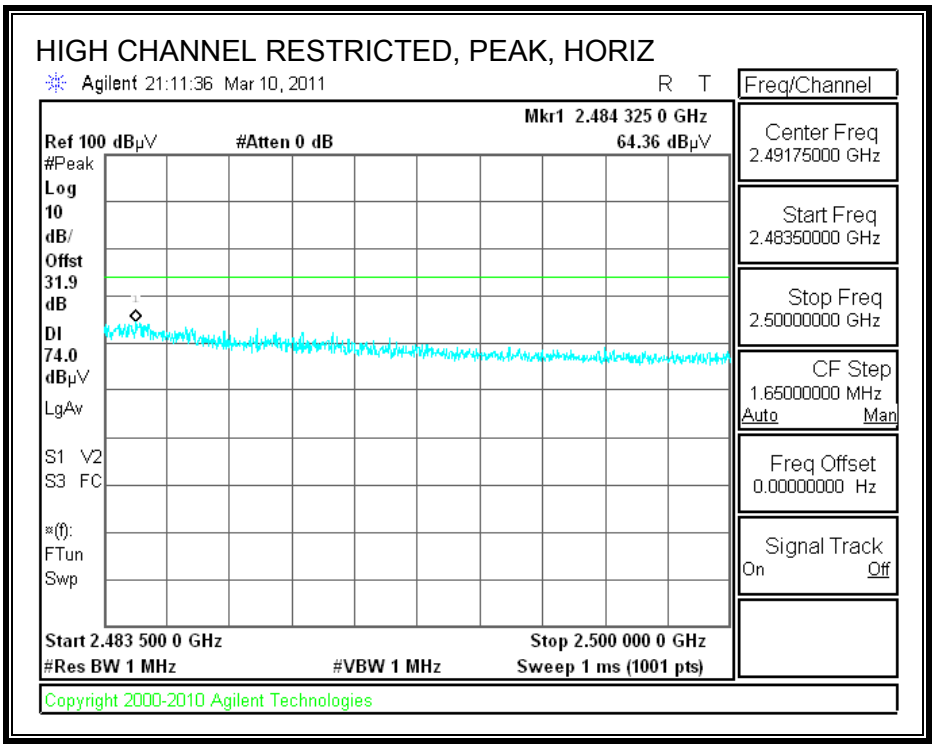


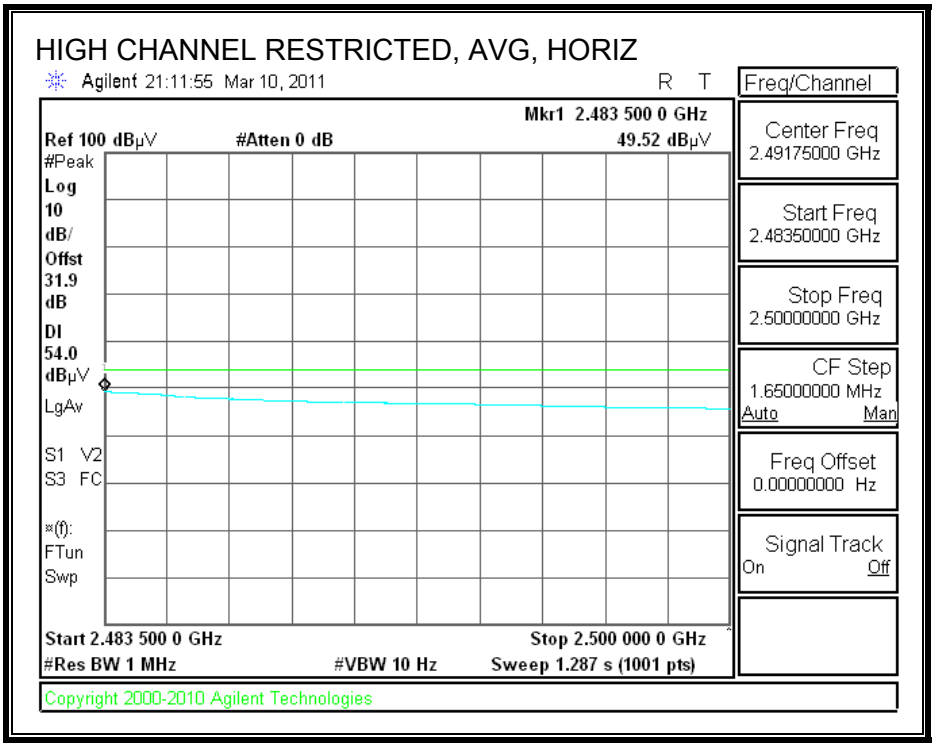
**RESTRICTED BANDEDGE (CH2, VERTICAL)**



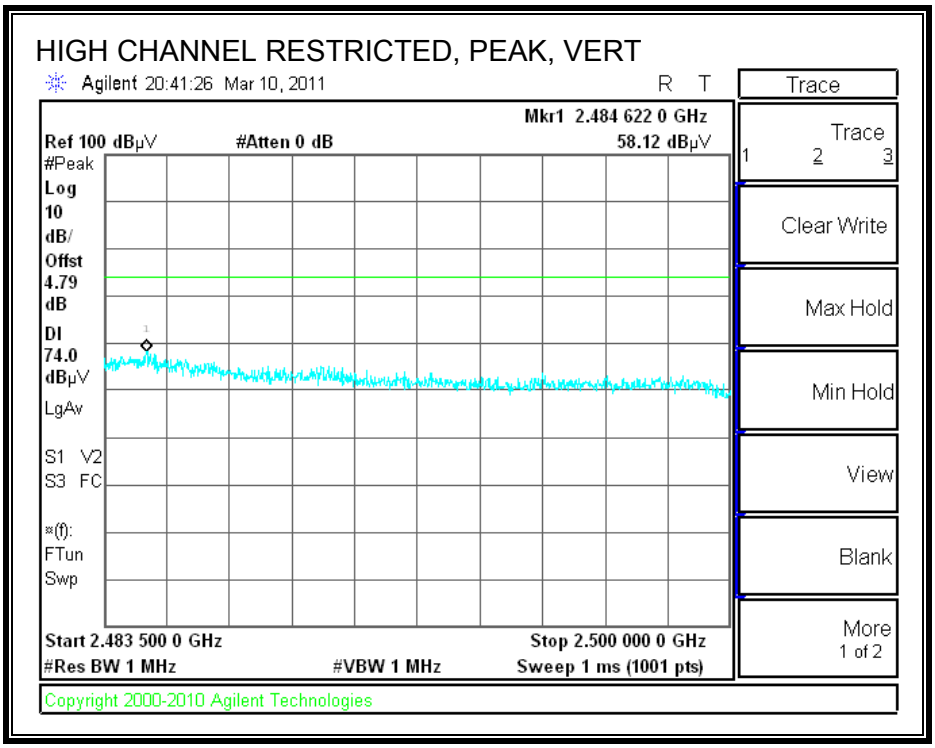


**RESTRICTED BANDEDGE (CH10, HORIZONTAL)**

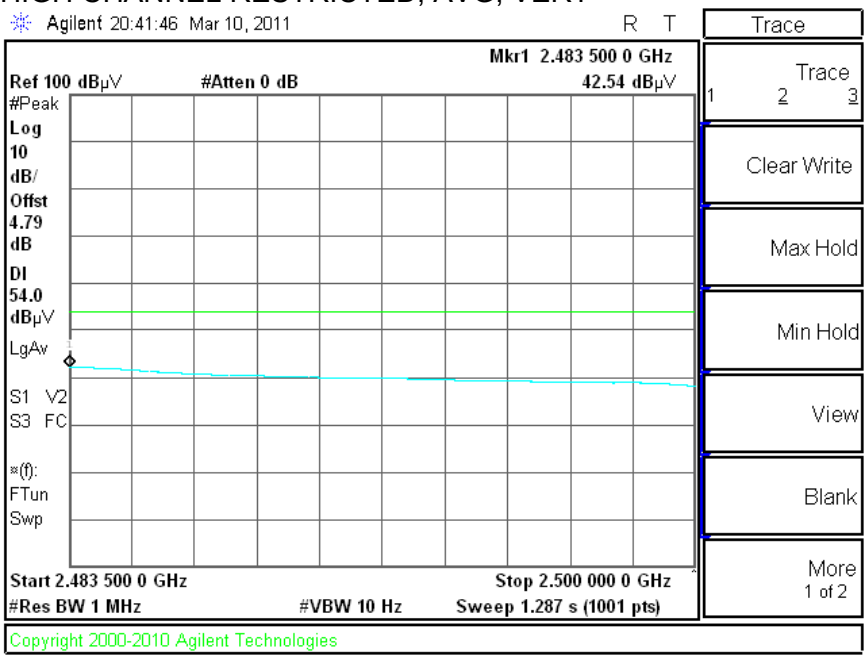




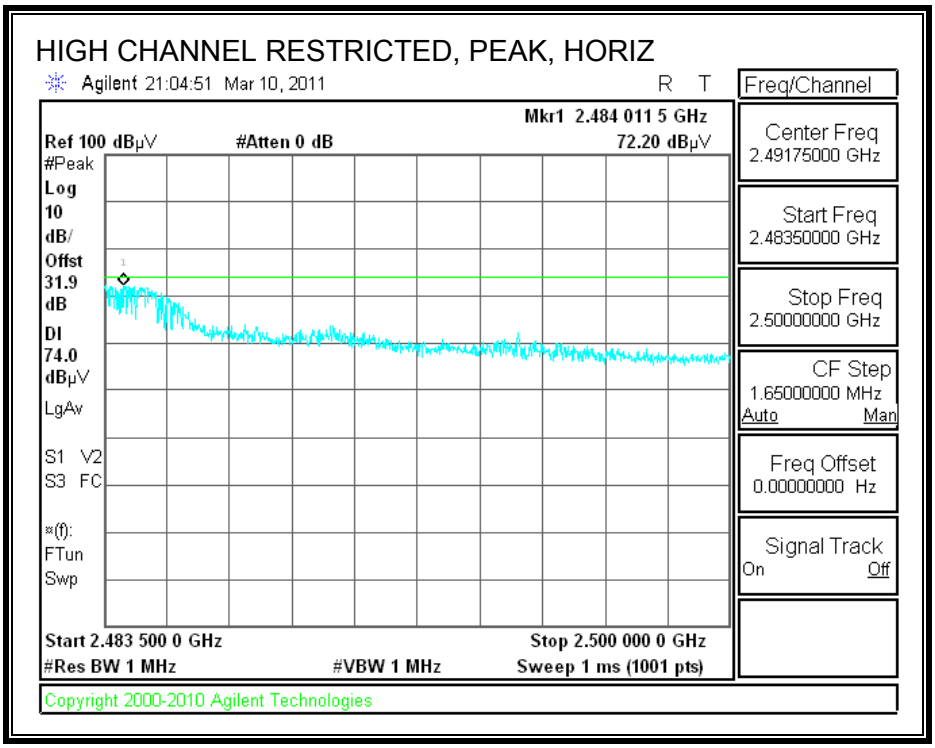
**RESTRICTED BANDEDGE (CH10, VERTICAL)**

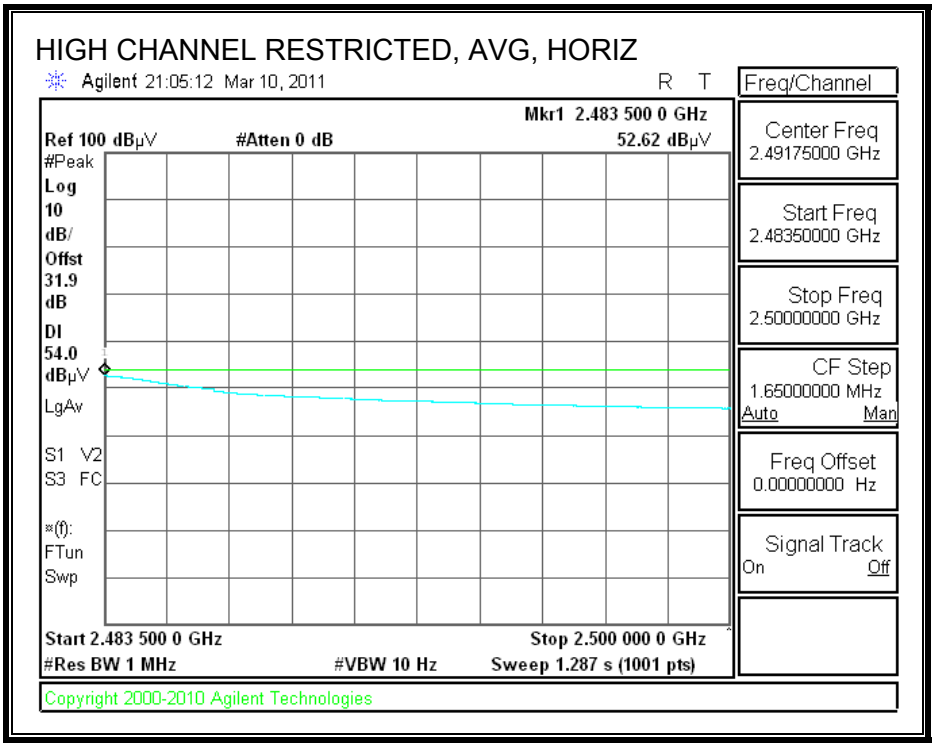


HIGH CHANNEL RESTRICTED, AVG, VERT

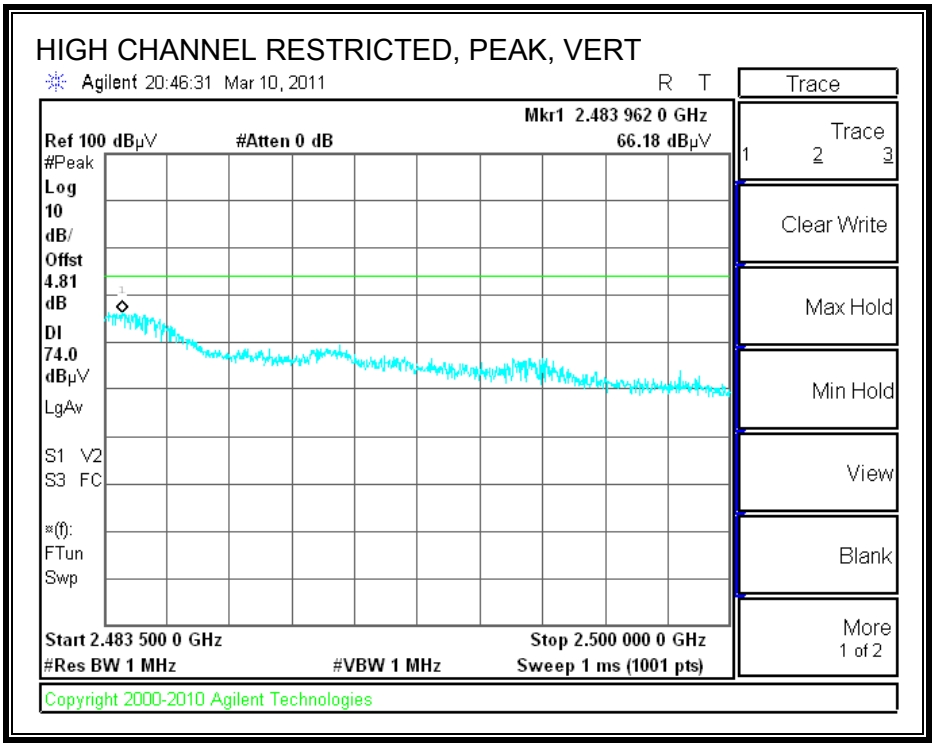


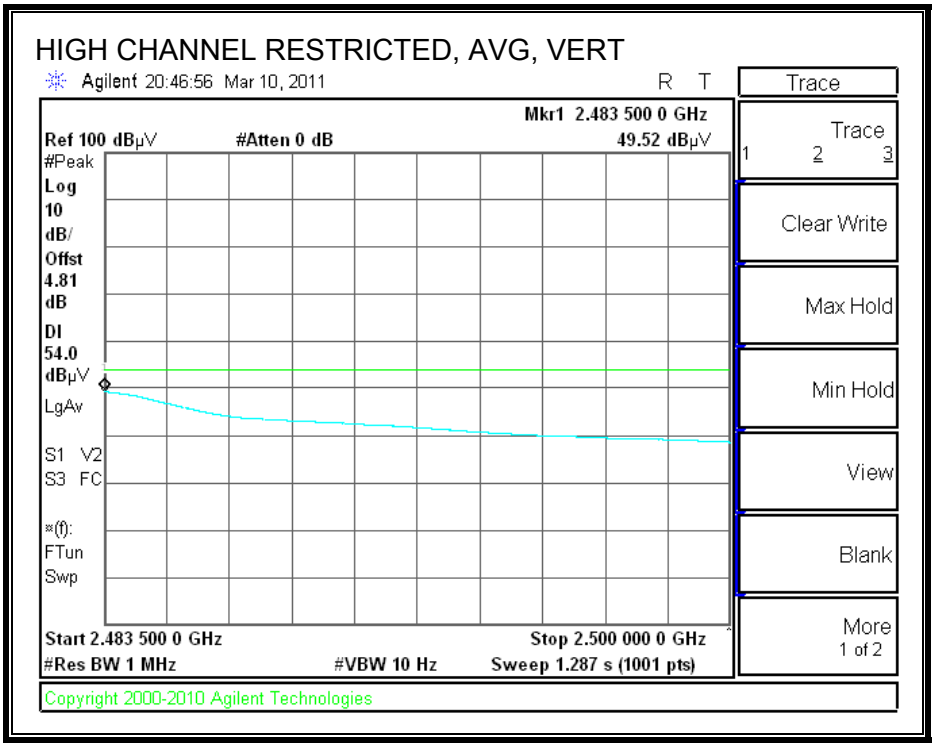
**RESTRICTED BANDEDGE (CH11, HORIZONTAL)**





**RESTRICTED BANDEDGE (CH11, VERTICAL)**





## HARMONICS AND SPURIOUS EMISSIONS

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

| | |
|---|---|
| **Company:** | MARVIELL |
| **Project #:** | 11U13646 |
| **Date:** | 3/1/2011 |
| **Test Engineer:** | MENGISTU MEKURIA |
| **Configuration:** | EUT (#1) SUPPORT LAPTOP |
| **Mode:** | TX, g MODE |

**Test Equipment:**

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T73; S/N: 6717 @3m | T144 Miteq 3008A00931 | | | FCC 15.205 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 |

**Peak Measurements**
RBW=VBW=1MHz
**Average Measurements**
RBW=1MHz ; VBW=10Hz

| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low Channel (2412 MHz)** | | | | | | | | | | | | | | | |
| 4.824 | 3.0 | 44.3 | 31.1 | 33.0 | 5.8 | -36.5 | 0.0 | 0.0 | 46.7 | 33.5 | 74 | 54 | -27.3 | -20.5 | V |
| 4.824 | 3.0 | 48.3 | 35.0 | 33.0 | 5.8 | -36.5 | 0.0 | 0.0 | 50.7 | 37.3 | 74 | 54 | -23.3 | -16.7 | H |
| **Mid Channel (2437 MHz)** | | | | | | | | | | | | | | | |
| 4.874 | 3.0 | 43.7 | 30.8 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 46.2 | 33.3 | 74 | 54 | -27.8 | -20.7 | V |
| 7.311 | 3.0 | 51.8 | 29.7 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 58.2 | 36.0 | 74 | 54 | -15.8 | -18.0 | V |
| 4.874 | 3.0 | 47.3 | 33.2 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 49.8 | 35.7 | 74 | 54 | -24.2 | -18.3 | H |
| 7.311 | 3.0 | 56.3 | 32.1 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 62.7 | 38.4 | 74 | 54 | -11.3 | -15.6 | H |
| **Hi Channel (2462 MHz)** | | | | | | | | | | | | | | | |
| 4.924 | 3.0 | 45.0 | 32.4 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 47.5 | 35.0 | 74 | 54 | -26.5 | -19.0 | V |
| 7.386 | 3.0 | 52.7 | 30.6 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 59.2 | 37.1 | 74 | 54 | -14.8 | -16.9 | V |
| 4.924 | 3.0 | 48.5 | 36.2 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 51.0 | 38.8 | 74 | 54 | -23.0 | -15.2 | H |
| 7.386 | 3.0 | 55.7 | 31.8 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 62.2 | 38.3 | 74 | 54 | -11.8 | -15.7 | H |

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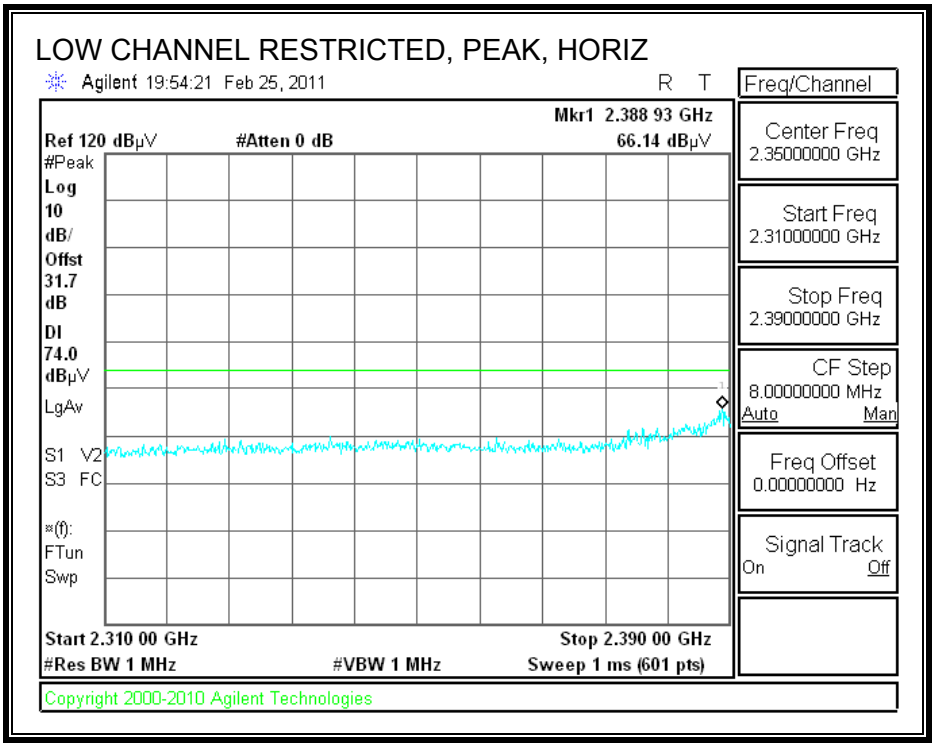
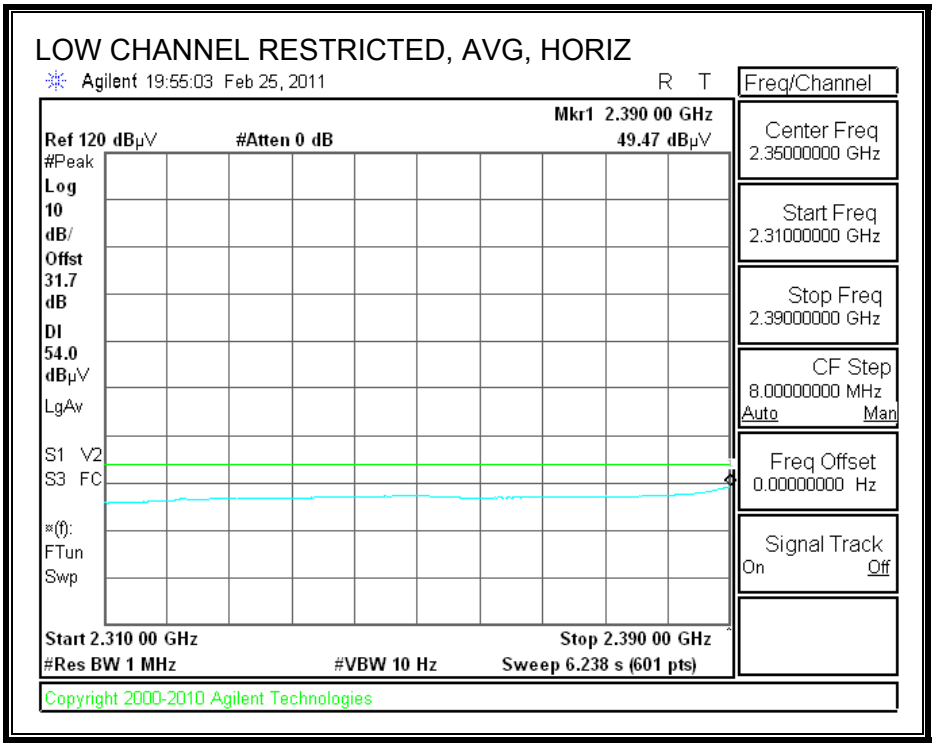
| | | | | | |
|---|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Avg Lim | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Pk Lim | Peak Field Strength Limit |
| Read | Analyzer Reading | Avg | Average Field Strength @ 3 m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

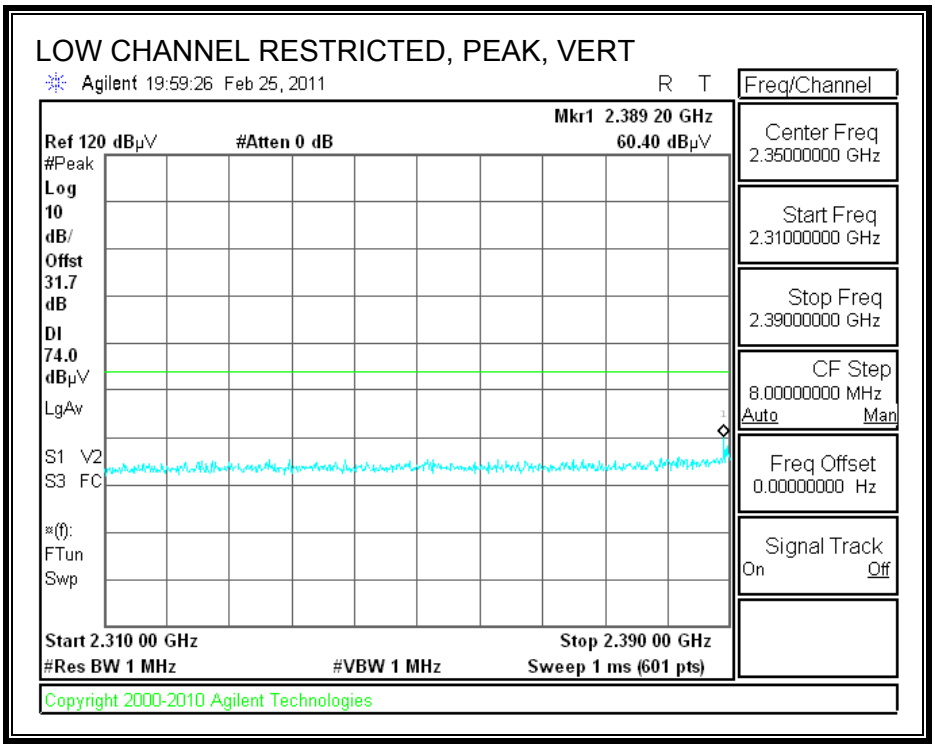
## 8.2.3. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 2.4 GHz BAND

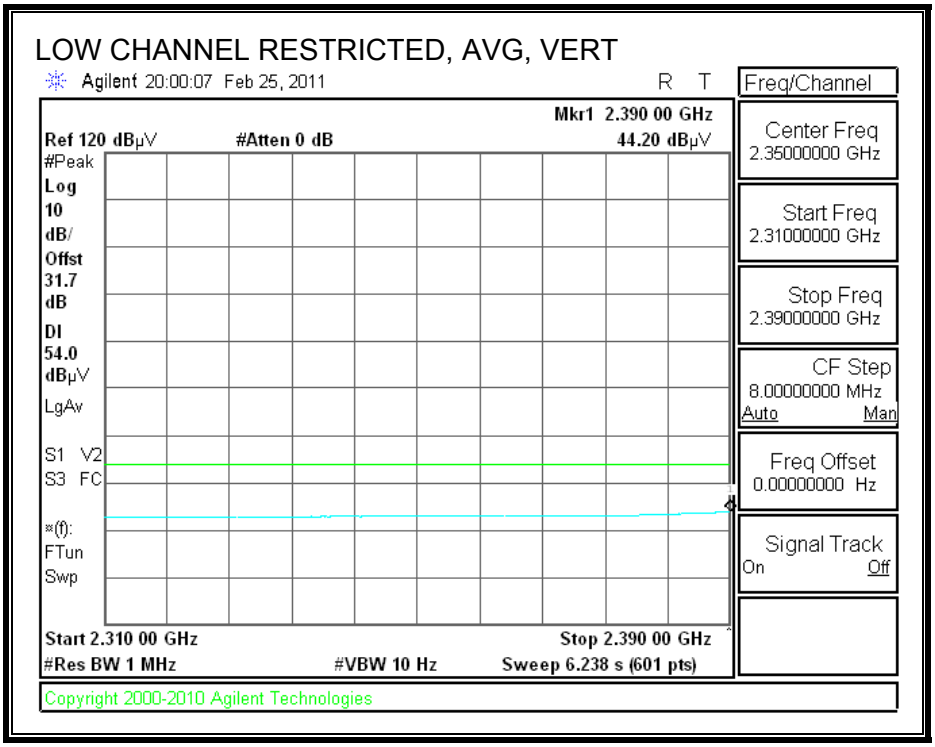
**RESTRICTED BANDEDGE (CH1, HORIZONTAL)**



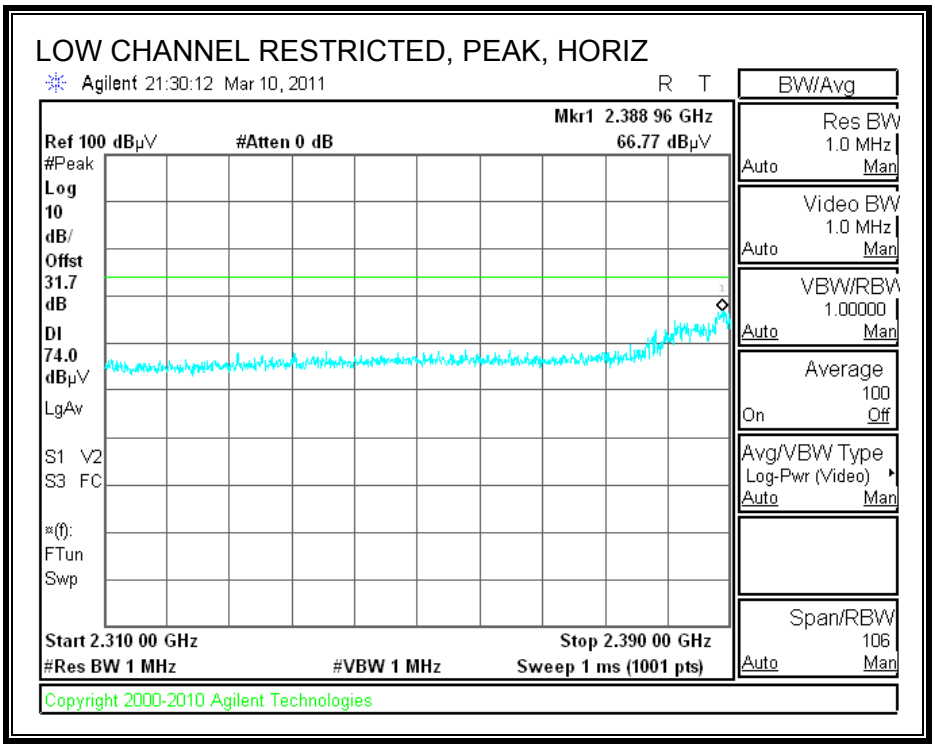


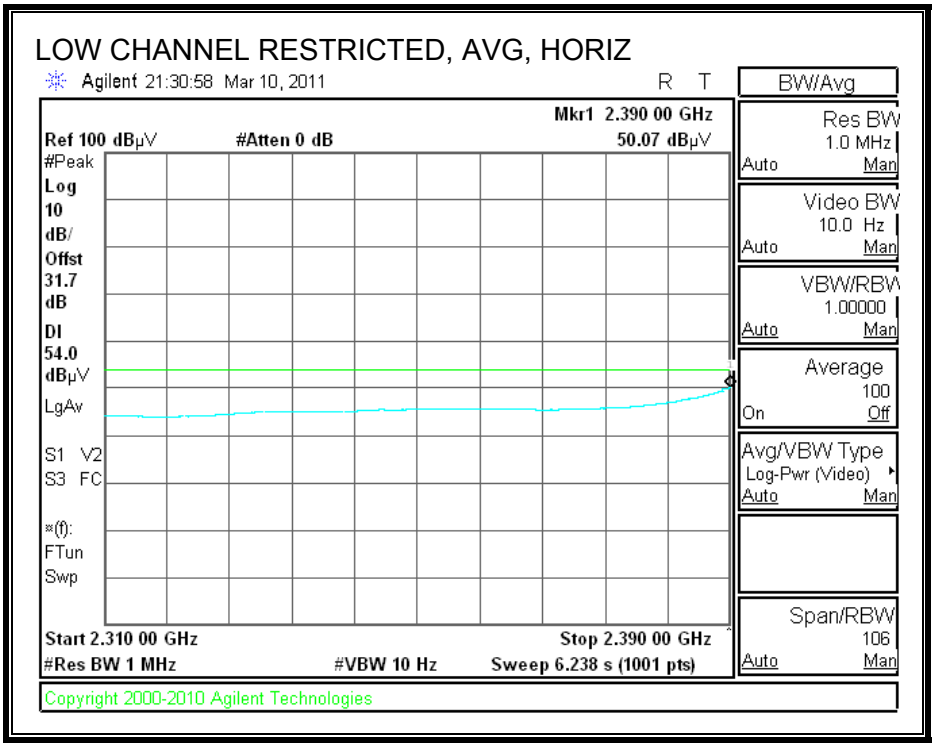
**RESTRICTED BANDEDGE (CH1, VERTICAL)**



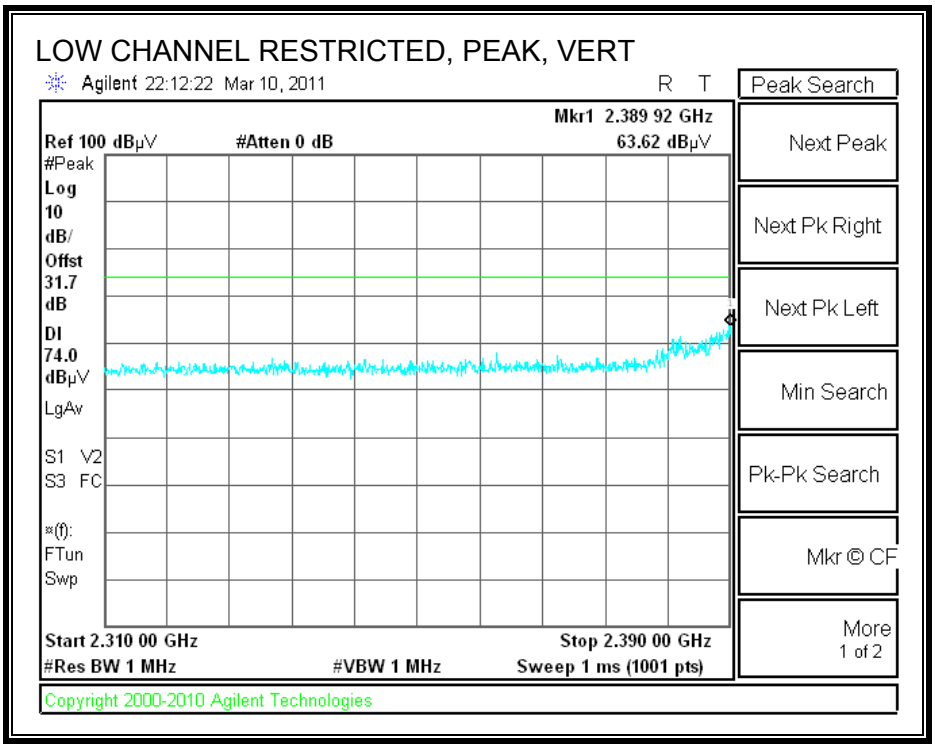


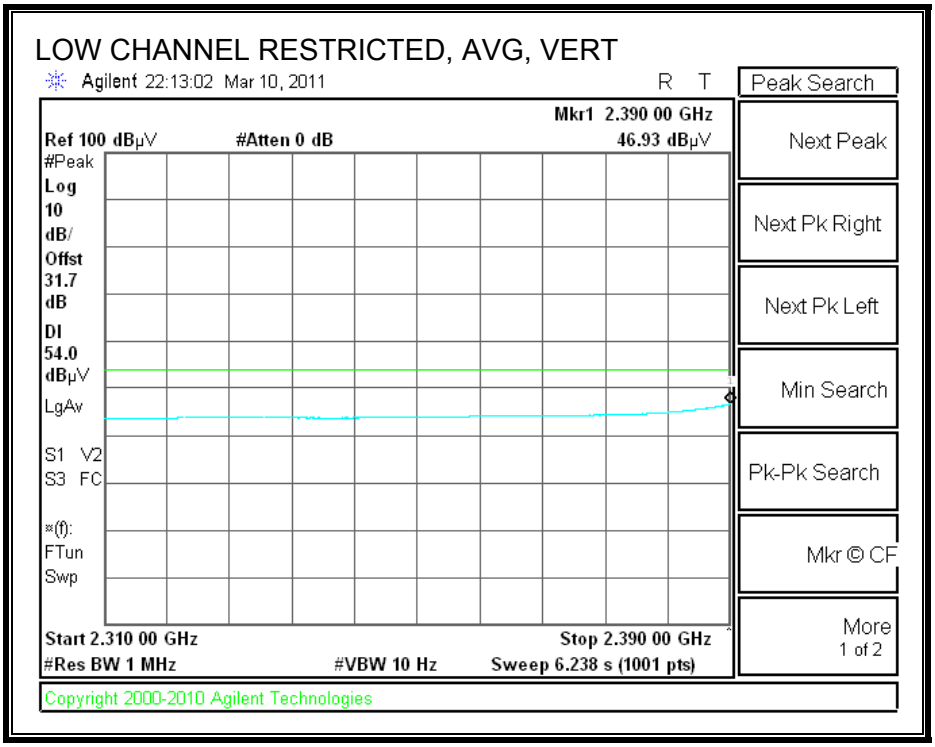
**RESTRICTED BANDEDGE (CH2, HORIZONTAL)**



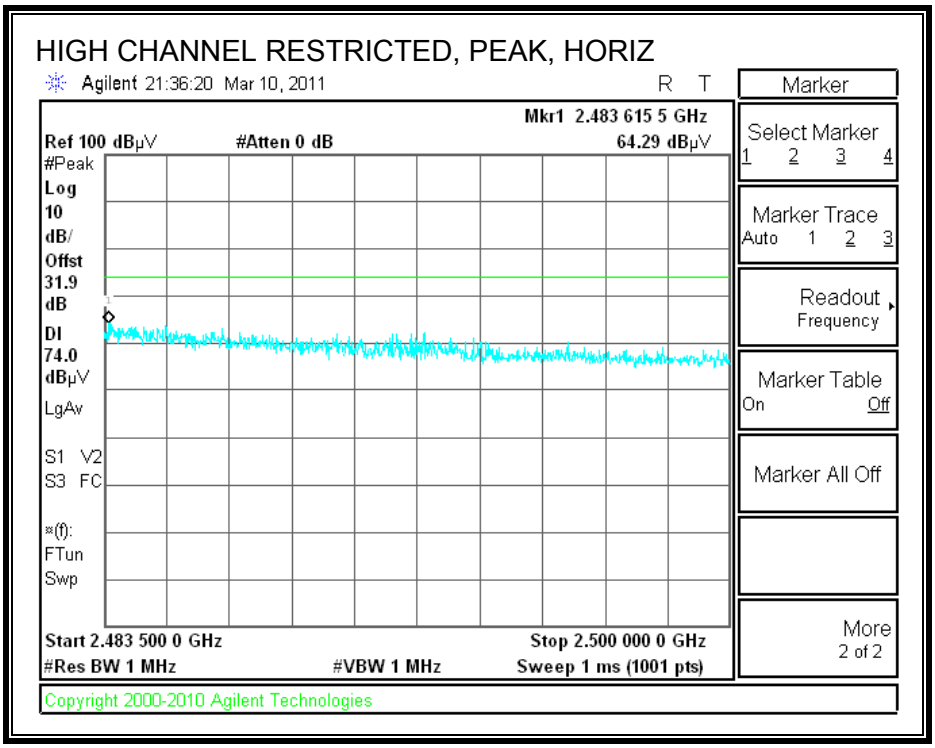


**RESTRICTED BANDEDGE (CH2, VERTICAL)**

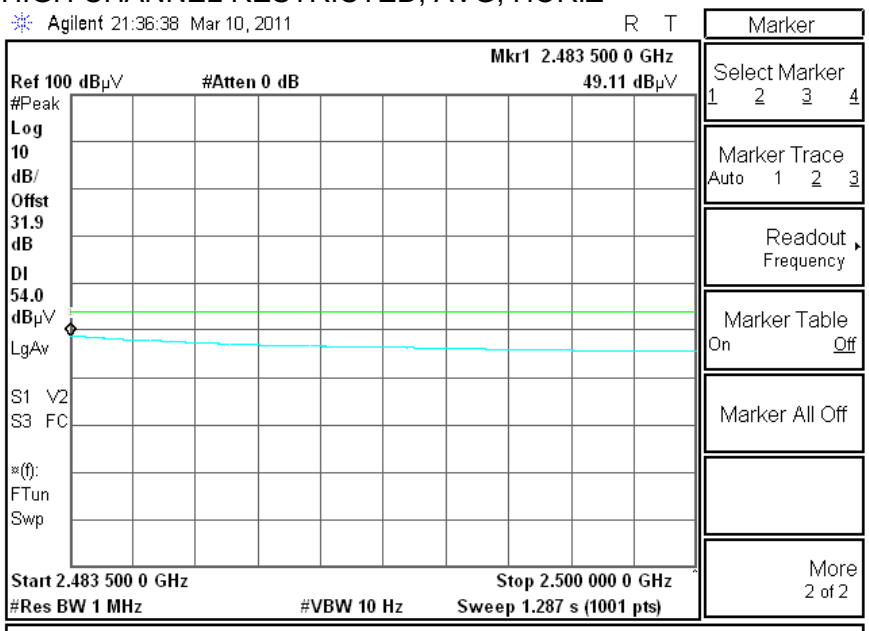




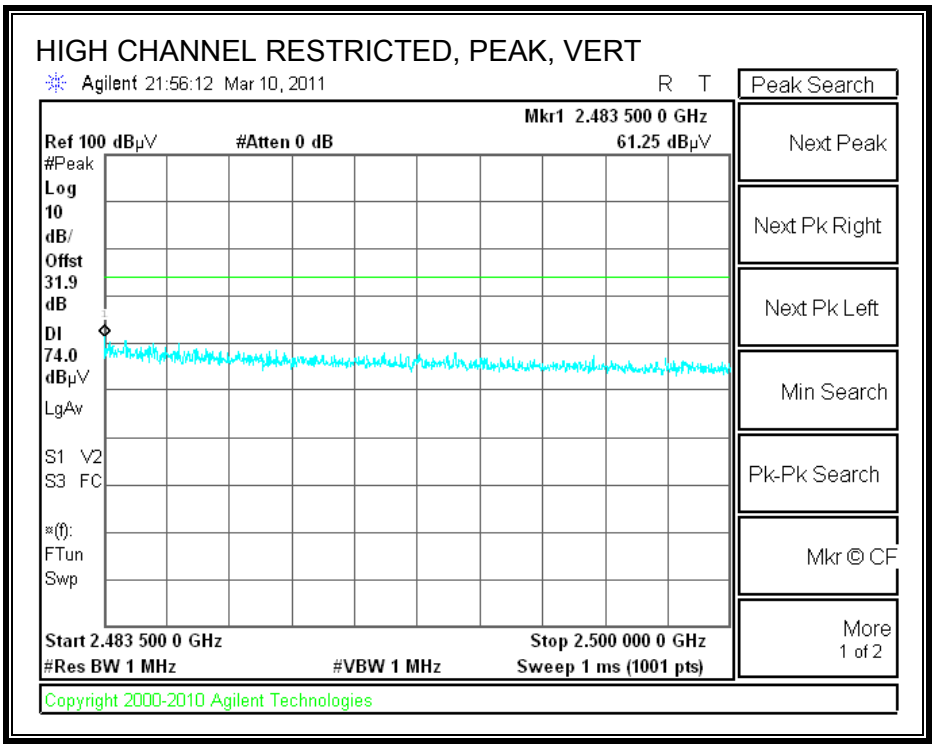
**RESTRICTED BANDEDGE (CH10, HORIZONTAL)**

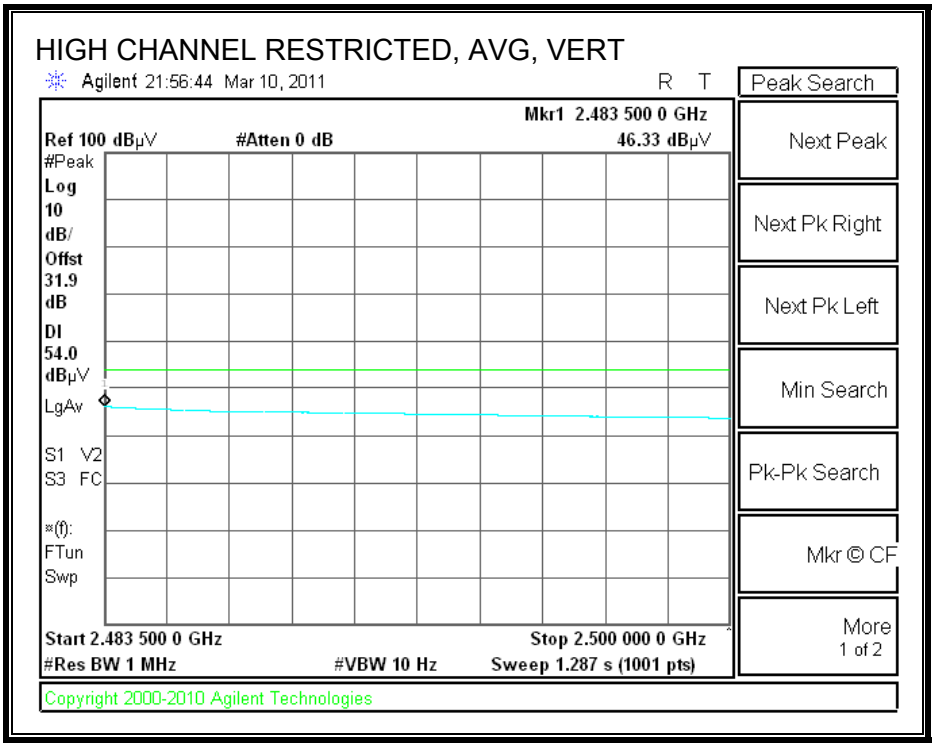


HIGH CHANNEL RESTRICTED, AVG, HORIZ

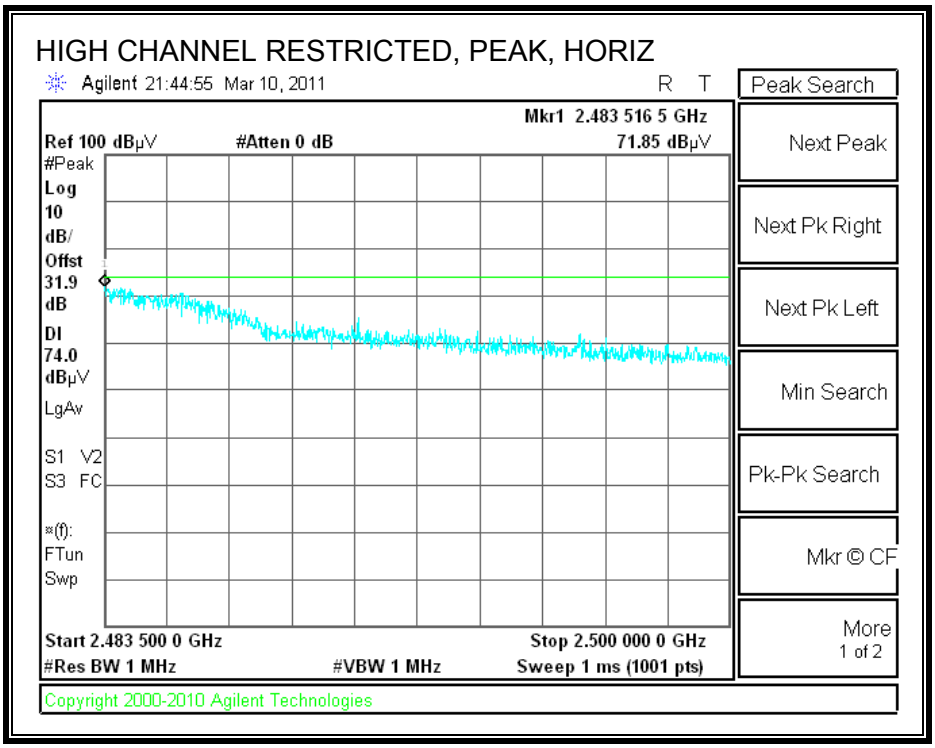


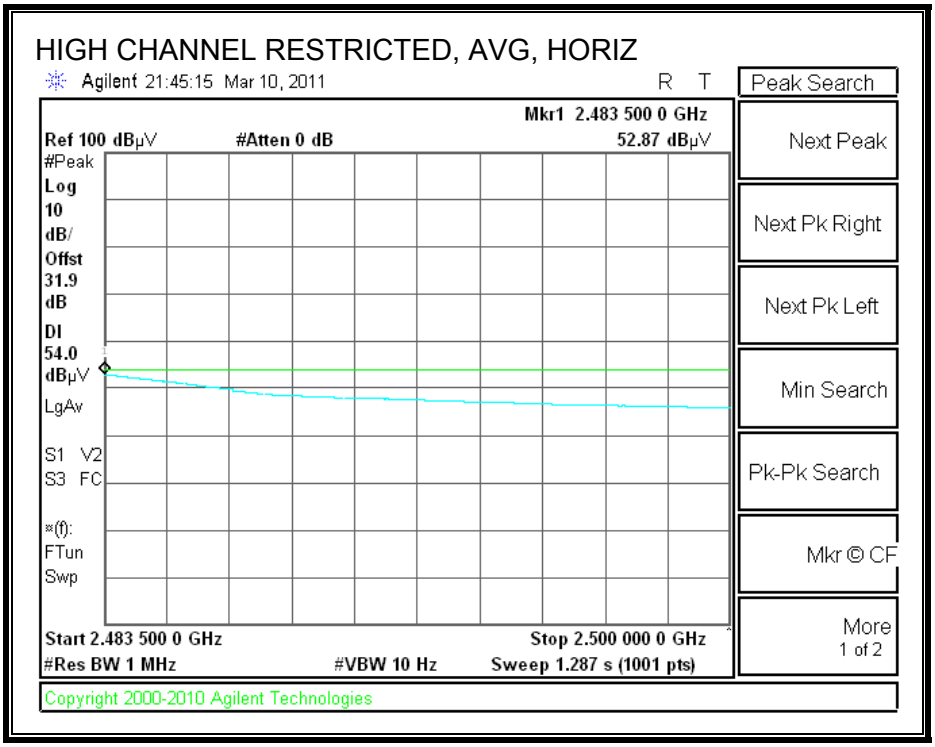
**RESTRICTED BANDEDGE (CH10, VERTICAL)**



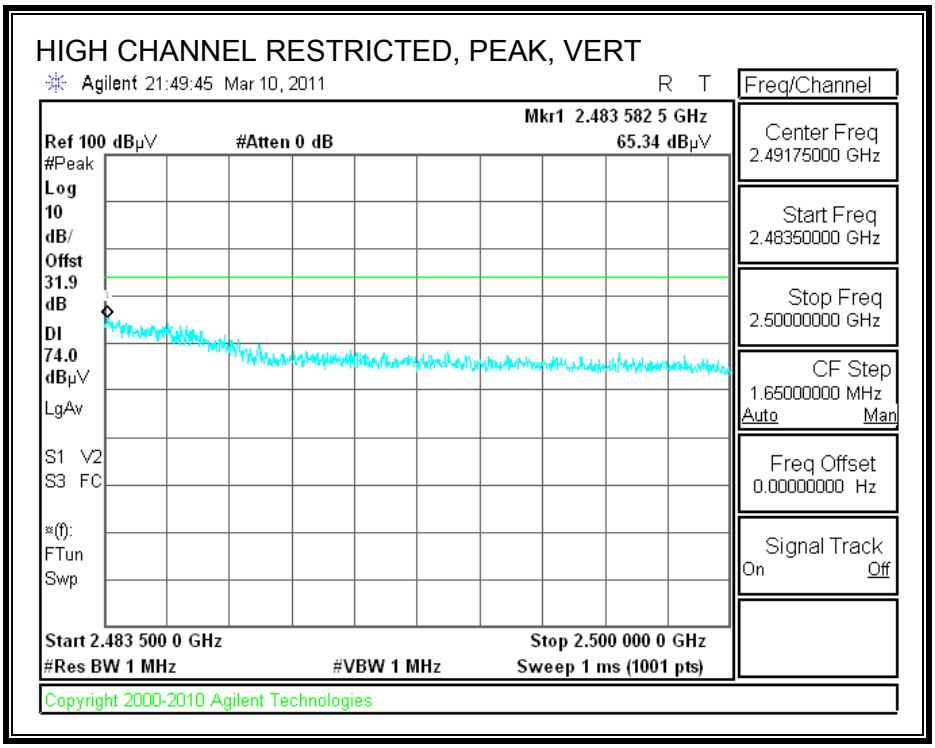


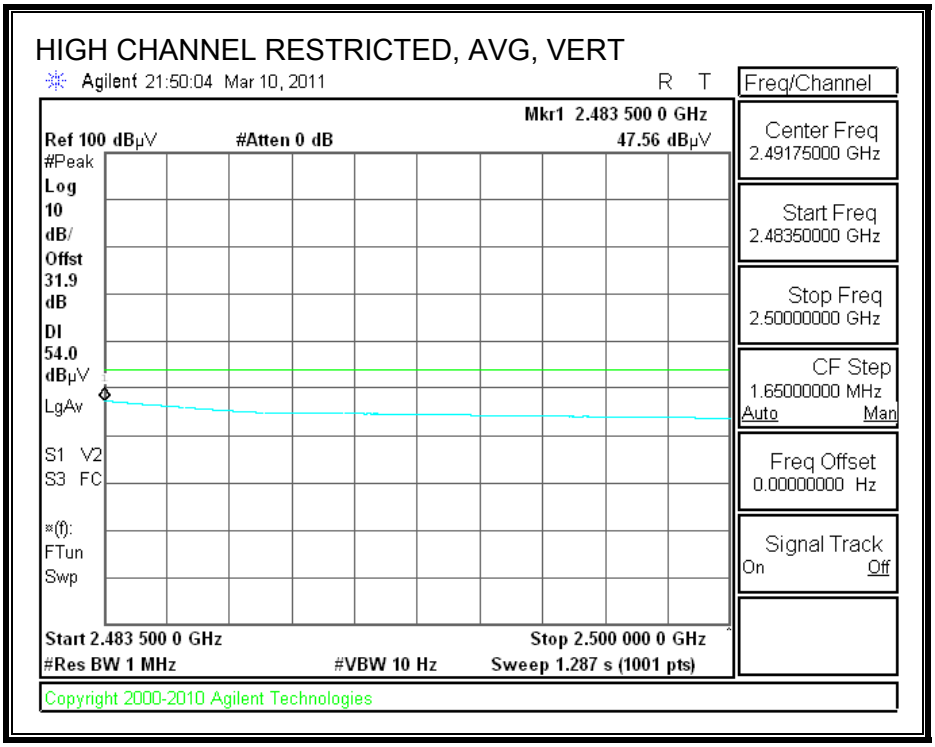
**RESTRICTED BANDEDGE (CH11, HORIZONTAL)**





**RESTRICTED BANDEDGE (CH11, VERTICAL)**





## HARMONICS AND SPURIOUS EMISSIONS

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

| | |
|---|---|
| **Company:** | MARVIELL |
| **Project #:** | 11U13646 |
| **Date:** | 3/1/2011 |
| **Test Engineer:** | MENGISTU MEKURIA |
| **Configuration:** | EUT (#1) SUPPORT LAPTOP |
| **Mode:** | TX, HT20 MODE |

**Test Equipment:**

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T73; S/N: 6717 @3m | T144 Miteq 3008A00931 | | | FCC 15.205 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 |

**Peak Measurements**
RBW=VBW=1MHz
**Average Measurements**
RBW=1MHz ; VBW=10Hz

| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low Channel (2412 MHz)** | | | | | | | | | | | | | | | |
| 4.824 | 3.0 | 47.3 | 31.8 | 33.0 | 5.8 | -36.5 | 0.0 | 0.0 | 49.6 | 34.2 | 74 | 54 | -24.4 | -19.8 | V |
| 4.824 | 3.0 | 51.8 | 33.5 | 33.0 | 5.8 | -36.5 | 0.0 | 0.0 | 54.2 | 35.8 | 74 | 54 | -19.8 | -18.2 | H |
| **Mid Channel (2437 MHz)** | | | | | | | | | | | | | | | |
| 4.874 | 3.0 | 46.5 | 30.6 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 48.9 | 33.1 | 74 | 54 | -25.1 | -20.9 | V |
| 7.311 | 3.0 | 53.6 | 29.2 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 59.9 | 35.5 | 74 | 54 | -14.1 | -18.5 | V |
| 4.874 | 3.0 | 50.7 | 32.5 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 53.2 | 35.0 | 74 | 54 | -20.8 | -19.0 | H |
| 7.311 | 3.0 | 58.1 | 31.8 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 64.4 | 38.2 | 74 | 54 | -9.6 | -15.8 | H |
| **Hi Channel (2462 MHz)** | | | | | | | | | | | | | | | |
| 4.924 | 3.0 | 46.7 | 31.0 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 49.2 | 33.5 | 74 | 54 | -24.8 | -20.5 | V |
| 7.386 | 3.0 | 53.0 | 28.6 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 59.5 | 35.1 | 74 | 54 | -14.5 | -18.9 | V |
| 4.924 | 3.0 | 51.4 | 33.4 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 53.9 | 36.0 | 74 | 54 | -20.1 | -18.0 | H |
| 7.386 | 3.0 | 58.7 | 31.5 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 65.2 | 38.0 | 74 | 54 | -8.8 | -16.0 | H |

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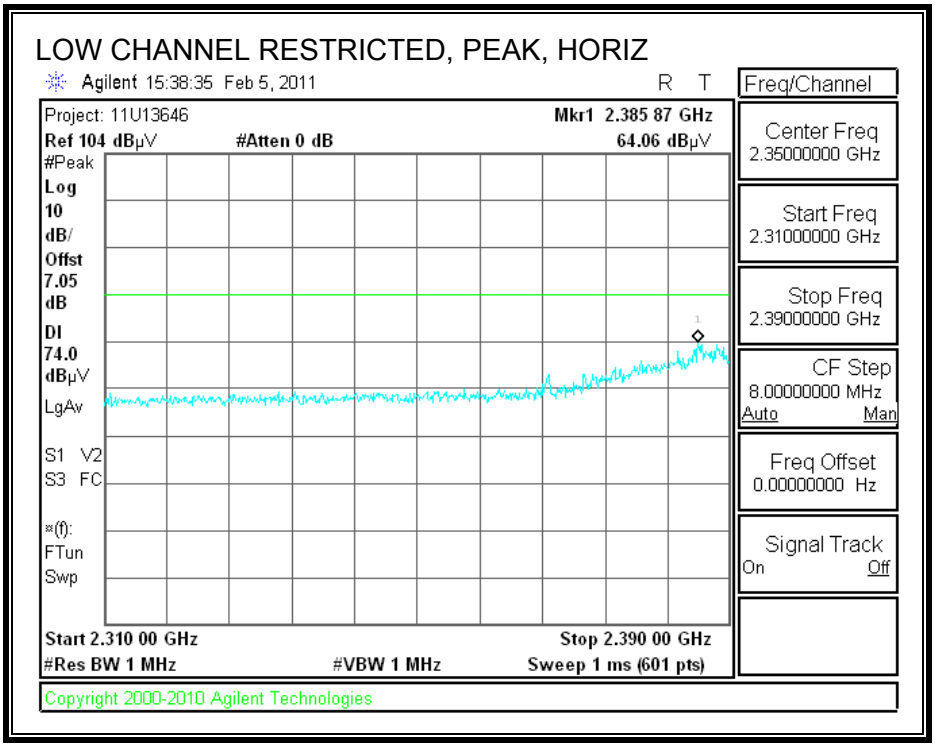
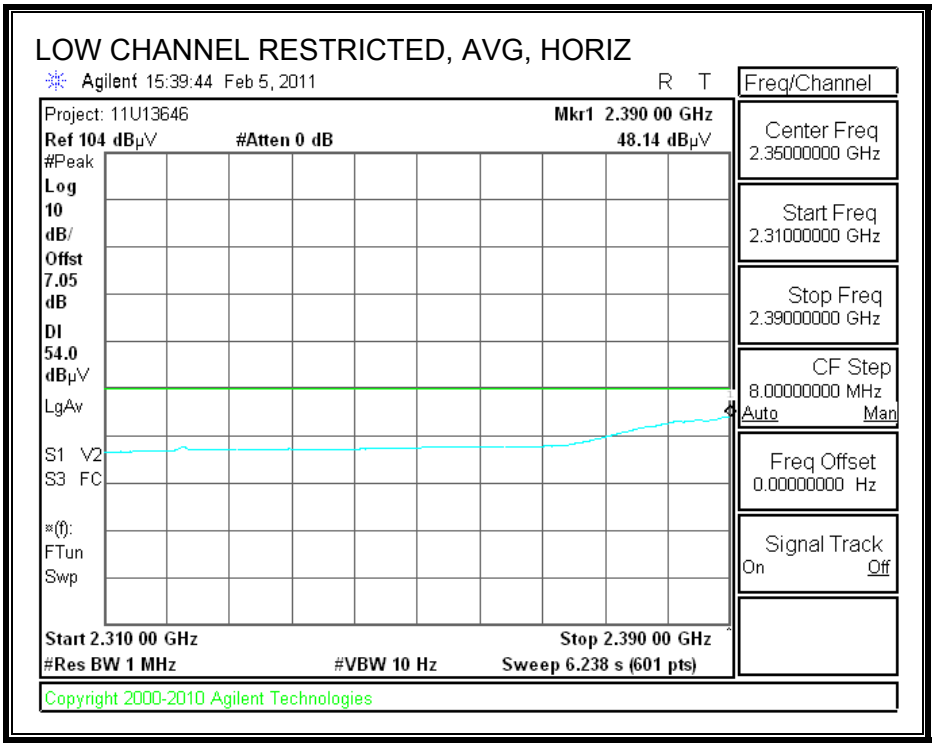
| | | | | | |
|---|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Avg Lim | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Pk Lim | Peak Field Strength Limit |
| Read | Analyzer Reading | Avg | Average Field Strength @ 3 m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

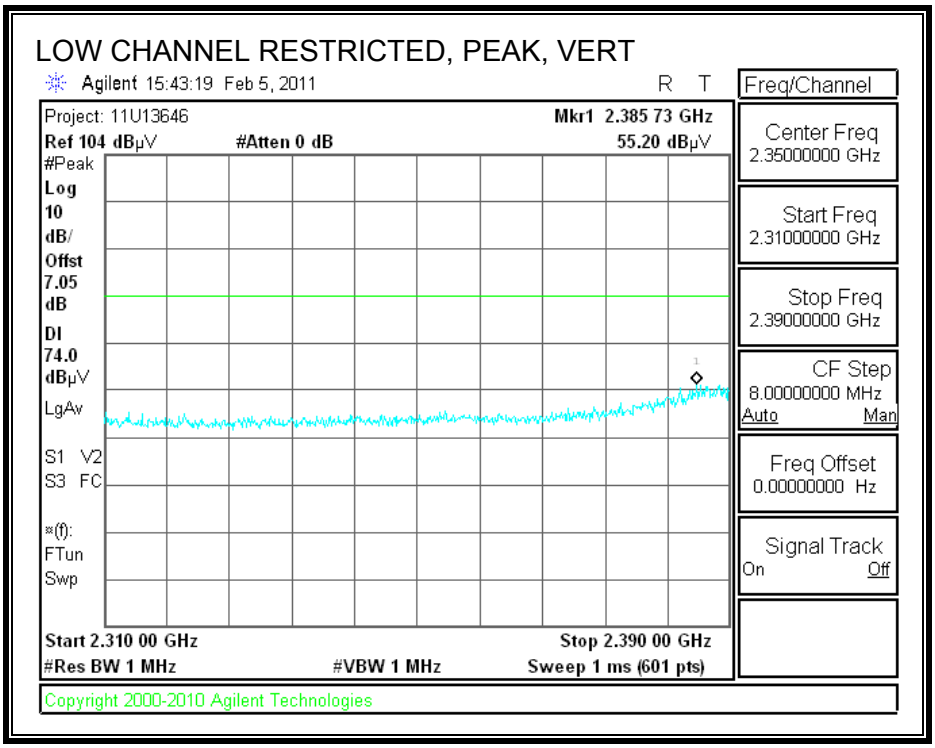
## 8.2.4. TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE 2.4 GHz BAND

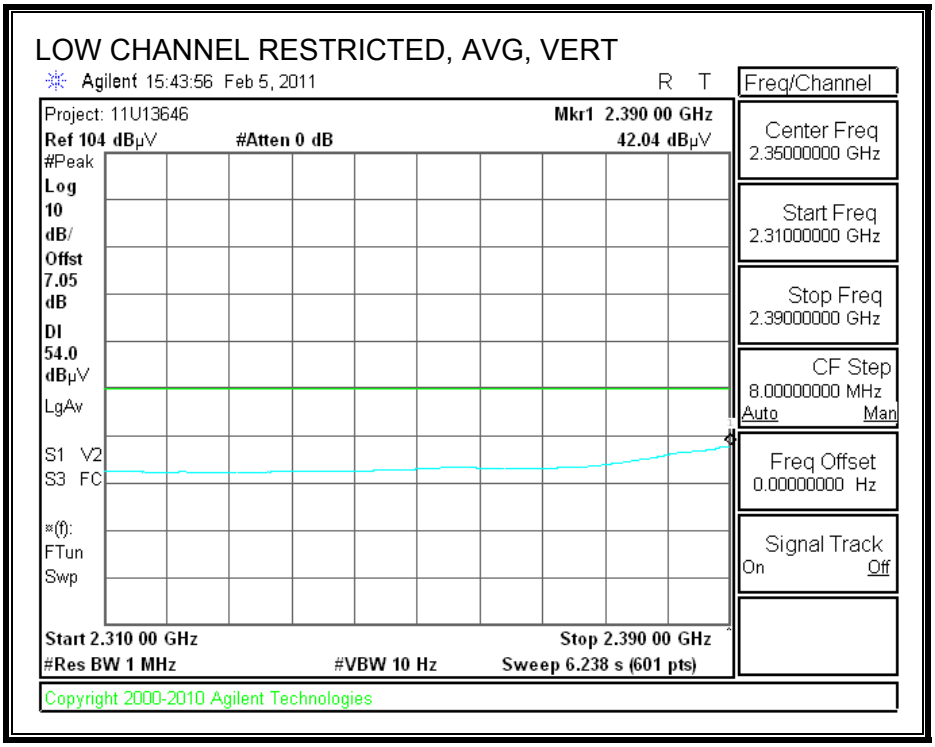
**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



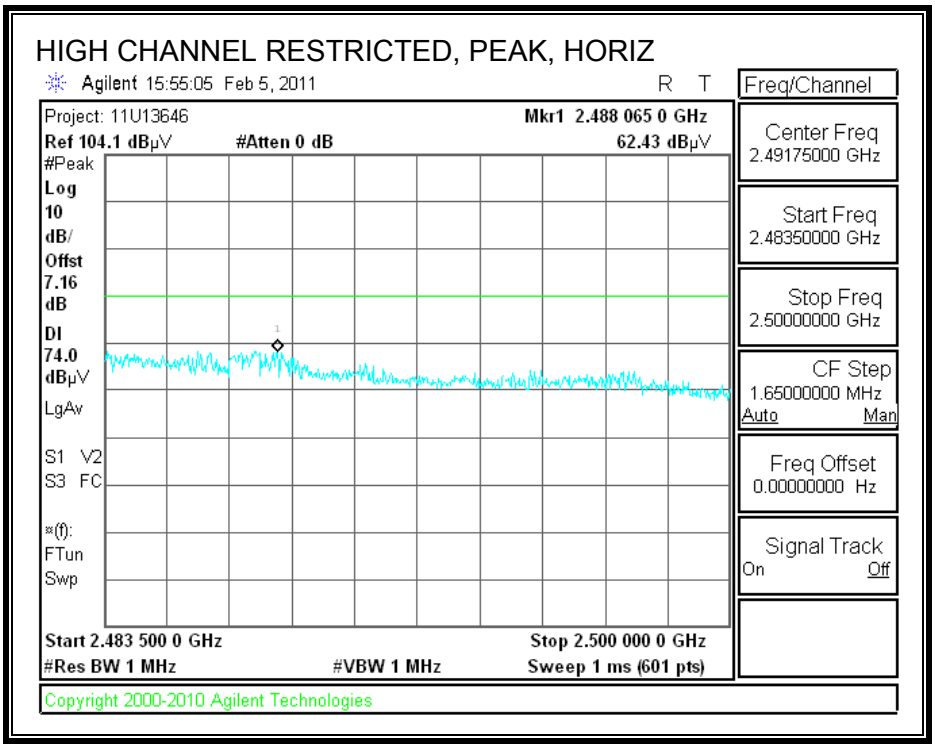


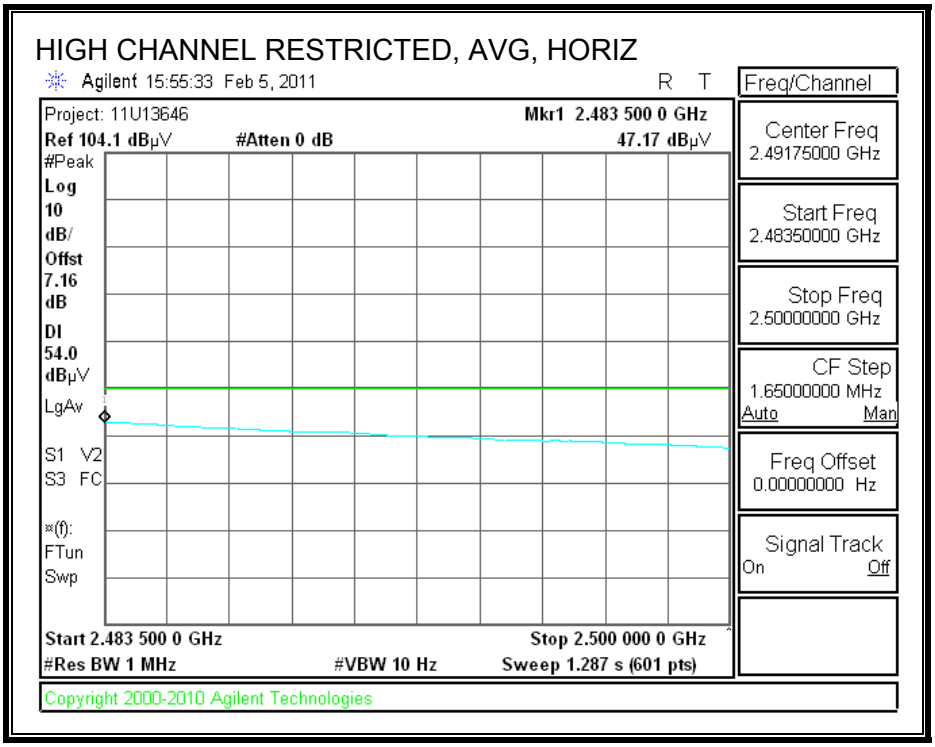
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



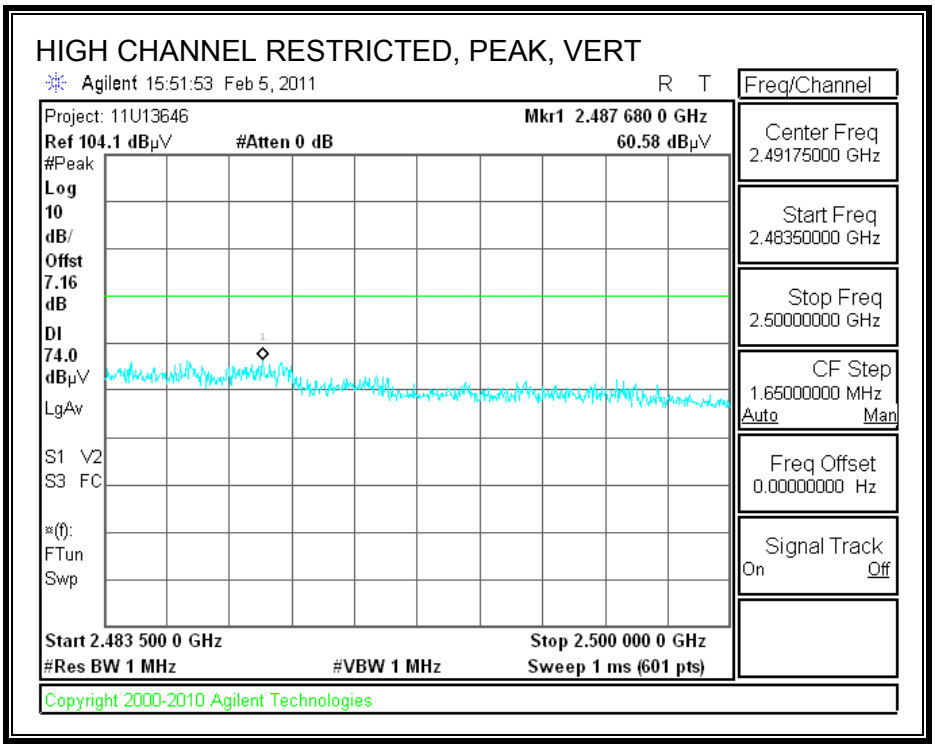


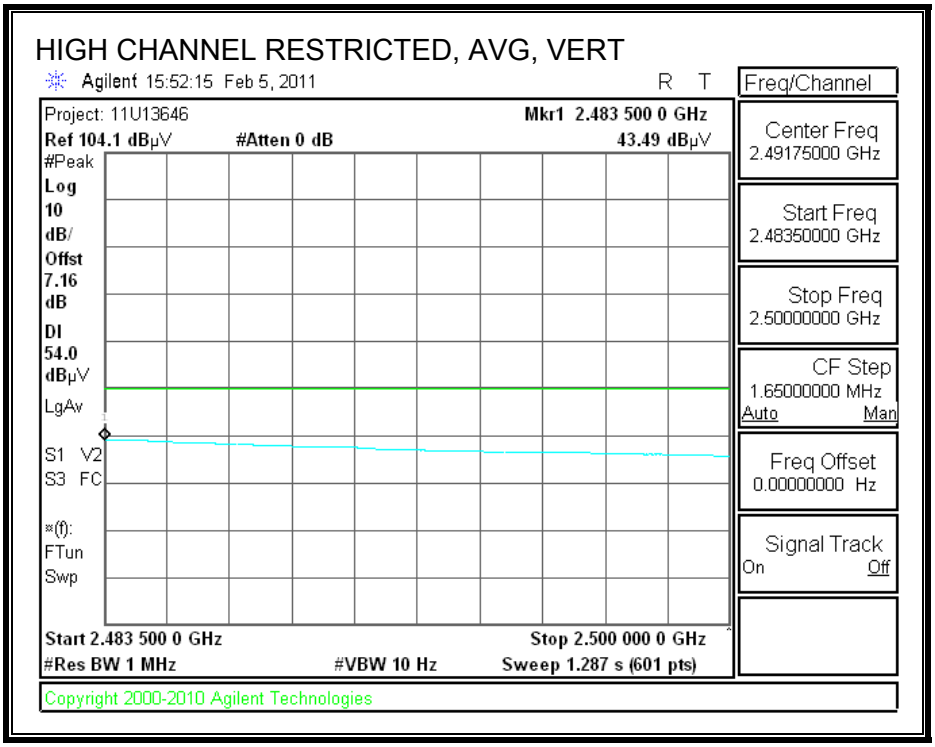
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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





## HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

| | |
|---|---|
| Company: | MARVIELL |
| Project #: | 11U13646 |
| Date: | 3/1/2011 |
| Test Engineer: | MENGISTU MEKURIA |
| Configuration: | EUT (#1) SUPPORT LAPTOP |
| Mode: | TX, HT40 MODE |

Test Equipment:

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T73; S/N: 6717 @3m | T144 Miteq 3008A00931 | | | FCC 15.205 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 |

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low Channel (2422 MHz)** | | | | | | | | | | | | | | | |
| 4.844 | 3.0 | 42.5 | 29.4 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 44.9 | 31.8 | 74 | 54 | -29.1 | -22.2 | V |
| 7.266 | 3.0 | 47.5 | 27.4 | 35.2 | 7.2 | -36.2 | 0.0 | 0.0 | 53.8 | 33.6 | 74 | 54 | -20.2 | -20.4 | V |
| 4.844 | 3.0 | 43.6 | 30.1 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 46.0 | 32.5 | 74 | 54 | -28.0 | -21.5 | H |
| 7.266 | 3.0 | 51.4 | 29.0 | 35.2 | 7.2 | -36.2 | 0.0 | 0.0 | 57.7 | 35.2 | 74 | 54 | -16.3 | -18.8 | H |
| **Mid Channel (2437 MHz)** | | | | | | | | | | | | | | | |
| 4.874 | 3.0 | 40.1 | 27.5 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 42.6 | 30.0 | 74 | 54 | -31.4 | -24.0 | V |
| 7.311 | 3.0 | 46.6 | 26.2 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 52.9 | 32.6 | 74 | 54 | -21.1 | -21.4 | V |
| 4.874 | 3.0 | 41.7 | 29.4 | 33.1 | 5.8 | -36.5 | 0.0 | 0.0 | 44.2 | 31.9 | 74 | 54 | -29.8 | -22.1 | H |
| 7.311 | 3.0 | 50.3 | 28.9 | 35.3 | 7.3 | -36.2 | 0.0 | 0.0 | 56.6 | 35.3 | 74 | 54 | -17.4 | -18.7 | H |
| **Hi Channel (2452 MHz)** | | | | | | | | | | | | | | | |
| 4.904 | 3.0 | 41.0 | 28.1 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 43.5 | 30.6 | 74 | 54 | -30.5 | -23.4 | V |
| 7.356 | 3.0 | 48.7 | 28.5 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 55.1 | 35.0 | 74 | 54 | -18.9 | -19.0 | V |
| 4.904 | 3.0 | 41.8 | 30.0 | 33.1 | 5.9 | -36.5 | 0.0 | 0.0 | 44.3 | 32.5 | 74 | 54 | -29.7 | -21.5 | H |
| 7.356 | 3.0 | 52.2 | 30.5 | 35.4 | 7.3 | -36.2 | 0.0 | 0.0 | 58.6 | 36.9 | 74 | 54 | -15.4 | -17.1 | H |

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

## 8.3. RECEIVER ABOVE 1 GHz

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

**Company:** MARVELL
**Project #:** 11U13646
**Date:** 2/13/2011
**Test Engineer:** MENGISTU MEKURIA
**Configuration:** EUT SUPPORT LAPTOP
**Mode:** RX MODE Worst-Case

**Test Equipment:**

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T73; S/N: 6717 @3m | T144 Miteq 3008A00931 | | | RX RSS 210 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | |

**Peak Measurements**
RBW=VBW=1MHz
**Average Measurements**
RBW=1MHz ; VBW=10Hz

| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mid Channel (2437 MHz) | | | | | | | | | | | | | | | |
| 1.196 | 3.0 | 62.1 | 44.1 | 24.5 | 2.6 | -39.2 | 0.0 | 0.0 | 50.0 | 32.0 | 74 | 54 | -24.0 | -22.0 | V |
| 1.595 | 3.0 | 57.1 | 38.1 | 25.9 | 3.0 | -38.6 | 0.0 | 0.0 | 47.4 | 28.4 | 74 | 54 | -26.6 | -25.6 | V |
| 1.917 | 3.0 | 55.0 | 34.0 | 26.9 | 3.4 | -38.2 | 0.0 | 0.0 | 47.1 | 26.1 | 74 | 54 | -26.9 | -27.9 | V |
| 2.393 | 3.0 | 59.3 | 33.7 | 28.2 | 3.8 | -37.5 | 0.0 | 0.0 | 53.8 | 28.2 | 74 | 54 | -20.2 | -25.8 | V |
| 3.002 | 3.0 | 50.3 | 46.6 | 30.0 | 4.3 | -37.4 | 0.0 | 0.0 | 47.3 | 43.6 | 74 | 54 | -26.7 | -10.4 | V |
| 1.196 | 3.0 | 59.1 | 43.0 | 24.5 | 2.6 | -39.2 | 0.0 | 0.0 | 47.0 | 30.9 | 74 | 54 | -27.0 | -23.1 | H |
| 1.595 | 3.0 | 51.6 | 33.2 | 25.9 | 3.0 | -38.6 | 0.0 | 0.0 | 41.8 | 23.4 | 74 | 54 | -32.2 | -30.6 | H |
| 2.000 | 3.0 | 51.7 | 32.6 | 27.2 | 3.5 | -38.1 | 0.0 | 0.0 | 44.3 | 25.2 | 74 | 54 | -29.7 | -28.8 | H |
| 2.393 | 3.0 | 58.3 | 32.9 | 28.2 | 3.8 | -37.5 | 0.0 | 0.0 | 52.8 | 27.4 | 74 | 54 | -21.2 | -26.6 | H |
| 3.002 | 3.0 | 49.6 | 46.3 | 30.0 | 4.3 | -37.4 | 0.0 | 0.0 | 46.6 | 43.3 | 74 | 54 | -27.4 | -10.7 | H |

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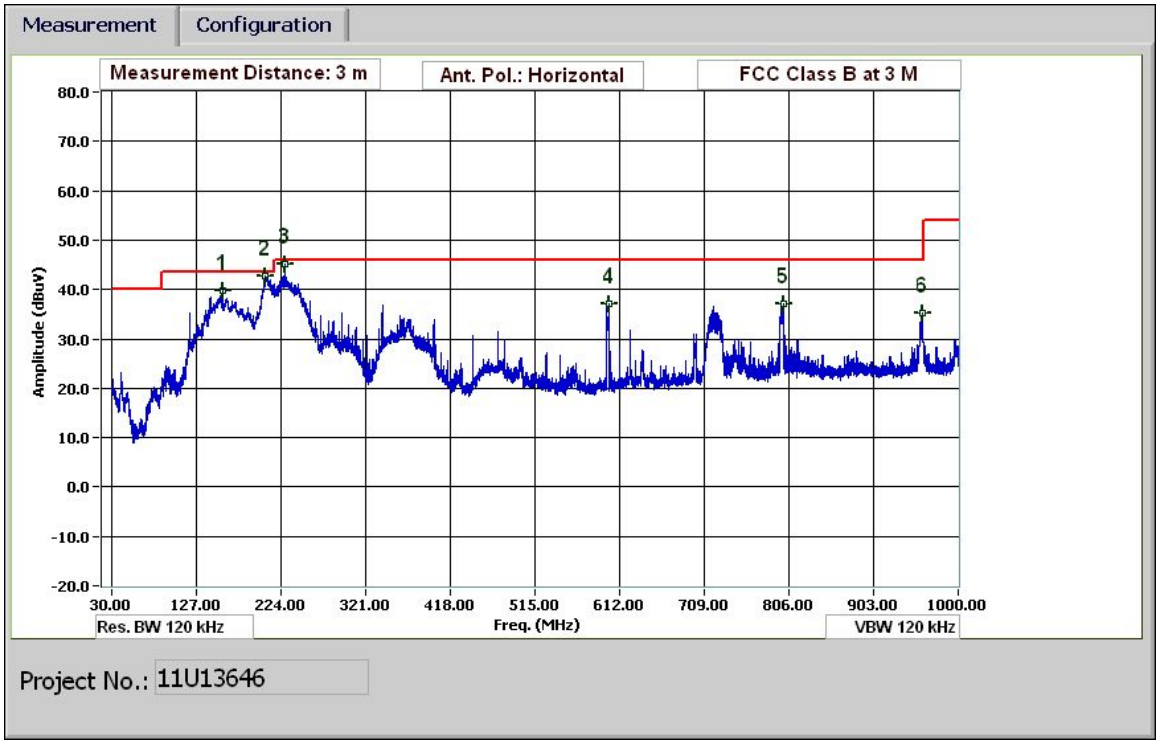
| | | | | | |
|---|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Avg Lim | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Pk Lim | Peak Field Strength Limit |
| Read | Analyzer Reading | Avg | Average Field Strength @ 3 m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

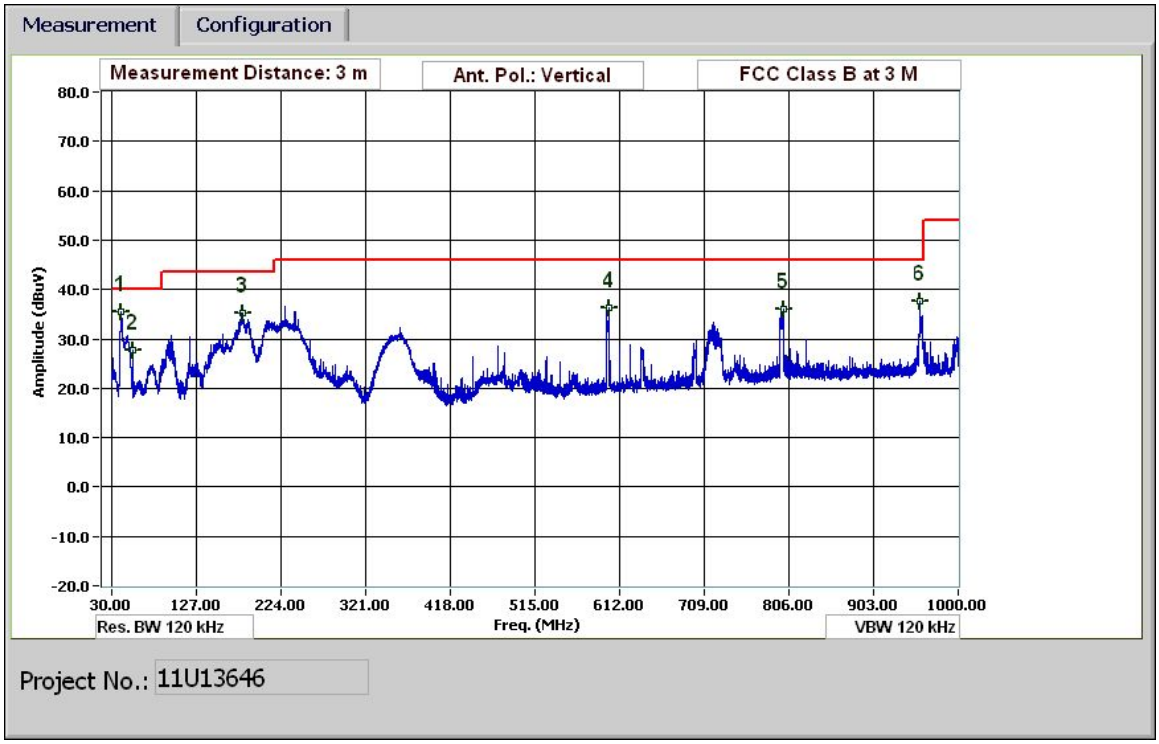
## 8.4. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



VERTICAL PLOT



## HORIZONTAL AND VERTICAL DATA

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

**Test Engr:** MENGISTU MEKURIA
**Date:** 02/13/11
**Project #:** 11U13646
**Company:** MARVELL
**Test Target:** FCC CLASS B
**Mode Oper:** TX, WORST CASE

| | | | | | |
|---|---|---|---|---|---|
| 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 | Pad dB | Corr. dBuV/m | Limit dBuV/m | Margin dB | Ant. Pol. V/H | Det. P/A/QP | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Horizontal | | | | | | | | | | | | | |
| 157.445 | 3.0 | 55.0 | 11.9 | 1.1 | 28.3 | 0.0 | 0.0 | 39.7 | 43.5 | -3.8 | H | P | |
| 207.421 | 3.0 | 57.7 | 12.0 | 1.3 | 28.2 | 0.0 | 0.0 | 42.7 | 43.5 | -0.8 | H | P | |
| 207.421 | 3.0 | 54.2 | 12.0 | 1.3 | 28.2 | 0.0 | 0.0 | 39.2 | 43.5 | -4.3 | H | QP | |
| 229.088 | 3.0 | 60.2 | 11.9 | 1.3 | 28.2 | 0.0 | 0.0 | 45.2 | 46.0 | -0.8 | H | P | |
| 229.09 | 3.0 | 57.9 | 11.9 | 1.3 | 28.2 | 0.0 | 0.0 | 42.9 | 46.0 | -3.1 | H | QP | |
| 599.663 | 3.0 | 44.0 | 18.4 | 2.2 | 27.5 | 0.0 | 0.0 | 37.1 | 46.0 | -8.9 | H | P | |
| 799.592 | 3.0 | 41.0 | 21.0 | 2.6 | 27.4 | 0.0 | 0.0 | 37.2 | 46.0 | -8.8 | H | P | |
| 959.078 | 3.0 | 38.0 | 22.2 | 2.9 | 27.9 | 0.0 | 0.0 | 35.3 | 46.0 | -10.7 | H | P | |
| Vertical | | | | | | | | | | | | | |
| 40.92 | 3.0 | 50.1 | 13.3 | 0.6 | 28.4 | 0.0 | 0.0 | 35.6 | 40.0 | -4.4 | V | P | |
| 54.961 | 3.0 | 47.4 | 8.1 | 0.7 | 28.4 | 0.0 | 0.0 | 27.8 | 40.0 | -12.2 | V | P | |
| 179.406 | 3.0 | 51.1 | 11.0 | 1.2 | 28.2 | 0.0 | 0.0 | 35.1 | 43.5 | -8.4 | V | P | |
| 599.663 | 3.0 | 43.3 | 18.4 | 2.2 | 27.5 | 0.0 | 0.0 | 36.4 | 46.0 | -9.6 | V | P | |
| 799.472 | 3.0 | 39.8 | 21.0 | 2.6 | 27.4 | 0.0 | 0.0 | 36.0 | 46.0 | -10.0 | V | P | |
| 956.798 | 3.0 | 40.5 | 22.2 | 2.9 | 27.9 | 0.0 | 0.0 | 37.7 | 46.0 | -8.3 | V | P | |

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

# 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**

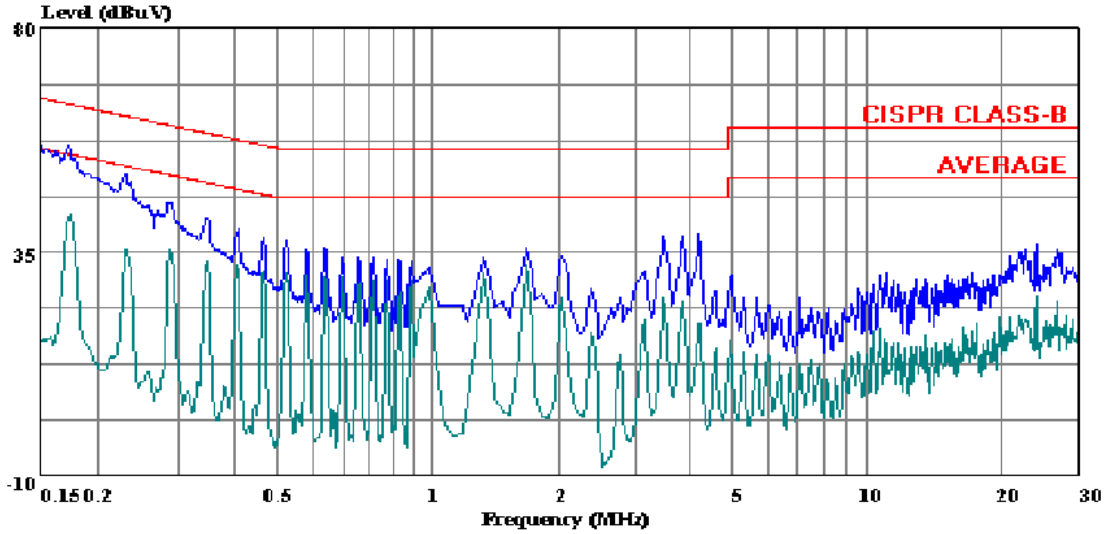
CONDUCTED EMISSIONS DATA (115VAC 60Hz)

| Freq. | Reading | | | Closs | Limit | EN_B | Margin | | Remark |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | PK (dBuV) | QP (dBuV) | AV (dBuV) | (dB) | QP | AV | QP (dB) | AV (dB) | L1 / L2 |
| 0.17 | 56.55 | -- | 42.50 | 0.00 | 64.77 | 54.77 | -8.22 | -12.27 | L1 |
| 0.23 | 50.86 | -- | 35.68 | 0.00 | 62.52 | 52.52 | -11.66 | -16.84 | L1 |
| 0.29 | 45.11 | -- | 35.50 | 0.00 | 60.55 | 50.55 | -15.44 | -15.05 | L1 |
| 0.17 | 56.27 | -- | 40.78 | 0.00 | 64.77 | 54.77 | -8.50 | -13.99 | L2 |
| 0.23 | 49.99 | -- | 35.97 | 0.00 | 62.38 | 52.38 | -12.39 | -16.41 | L2 |
| 0.29 | 44.75 | -- | 33.14 | 0.00 | 60.55 | 50.55 | -15.80 | -17.41 | L2 |
| 6 Worst Data | | | | | | | | | |

**LINE 1 RESULTS**

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

Data#: 7 File#: 11U13646_LC.EMI Date: 02-14-2011 Time: 04:14:32



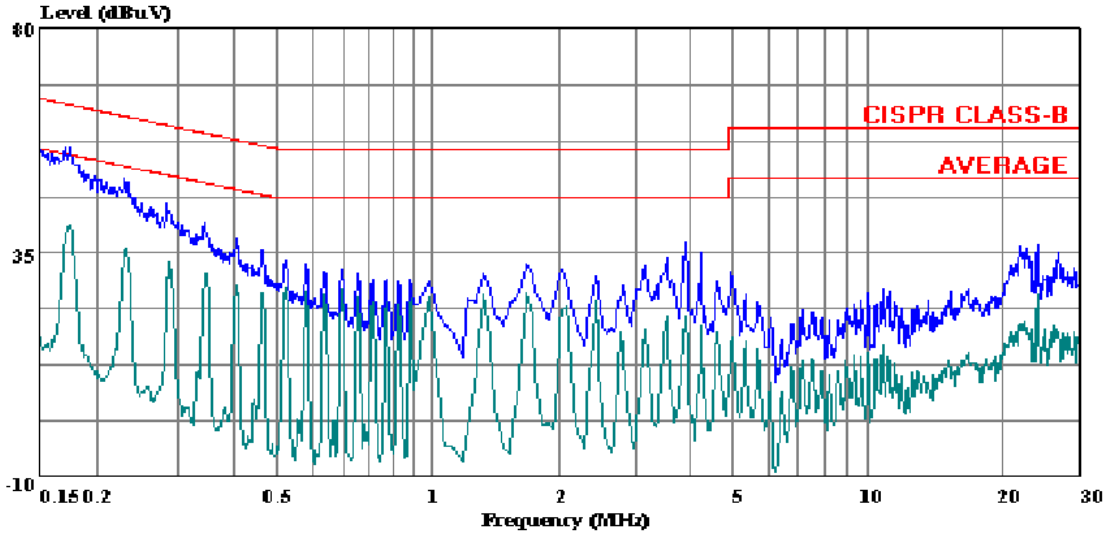

Trace: 5 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: Mengistu Mekuria
Project # : 11U13646
Company : Marvell
Configuration: EUT and Support Laptop
EUT Descript : 802.11 b/g/n SISO Radio Module
Mode : TX worst-CAse
Target : FCC Class B
Voltage : 115VAC 60Hz
: L1: Blue (Peak), Green (Average)

**LINE 2 RESULTS**

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

Data#: 14 File#: 11U13646_LC.EMI Date: 02-14-2011 Time: 04:20:28




Trace: 12 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: Mengistu Mekuria
Project # : 11U13646
Company : Marvell
Configuration: EUT and Support Laptop
EUT Descript : 802.11 b/g/n SISO Radio Module
Mode : TX worst-CAse
Target : FCC Class B
Voltage : 115VAC 60Hz
: L2: Blue (Peak), Green (Average)

# 10. MAXIMUM PERMISSIBLE EXPOSURE

**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.

**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).

**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

Power density in units of W/m^2 is converted to units of mWc/m^2 by dividing by 10.

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.

**LIMITS**

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

**RESULTS**

| 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 | WLAN | 0.20 | 24.89 | 1.20 | 0.81 | 0.081 |