



**FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 7**

CERTIFICATION TEST REPORT

FOR

Wireless 802.11 b/g Embedded Module

MODEL NUMBER: RCM5600W

FCC ID: MCQ-MCWIFI

IC ID: 1846A-MCWIFI

REPORT NUMBER: 08U12300-2

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Prepared for
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NVLAP LAB CODE 200065-0

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: DIGI INTERNATIONAL, INC.
11001 BREN ROAD EAST
MINNETONKA, MN 55343

EUT DESCRIPTION: Wireless 802.11 b/g Embedded Module

MODEL: RCM5600W

SERIAL NUMBER: DA7107

DATE TESTED: JANUARY 07-14, 2009

| APPLICABLE STANDARDS | |
|---|--------------|
| STANDARD | TEST RESULTS |
| CFR 47 Part 15 Subpart C and Subpart E | PASS |
| RSS-210 Issue 7 Annex 8 and RSS-GEN Issue 2 | PASS |

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All expressions of Pass/Fail in this report are opinions expressed by CCS based on interpretations of the test results. 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. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:



FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:



THANH NGUYEN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

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. MEASUREMENT UNCERTAINTY

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

| PARAMETER | UNCERTAINTY |
|-------------------------------|-------------|
| Power Line Conducted Emission | +/- 2.3 dB |
| Radiated Emission | +/- 3.4 dB |

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Wireless 802.11 b/g Embedded Module.

The radio module is manufactured by Airoha Technology Corp.

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 | 21.76 | 149.97 |
| 2412 - 2462 | 802.11g | 22.23 | 167.11 |

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following antennas:

- 1) Dipole Antenna, with a maximum gain of 2 dBi.
- 2) Dipole Antenna Assembly, with a maximum gain of 1.8 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Dynamic C 10.50

The test utility software used during testing was FCC_Minicore_Test_Program.C

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case data rate for each mode is determined to be as follows, based on preliminary tests of the chipset utilized in this radio:

All final tests in the 802.11b mode were made at 5.5 Mb/s.
All final tests in the 802.11g mode were made at 48 Mb/s.

The worst-case channel is determined as the channel with the highest output power, the channel with the highest output power was mid channel in 11g mode; therefore, radiated below 1 GHz and conducted emissions were performed with EUT set to mid channel in 11g mode.

5.6. DESCRIPTION OF TEST SETUP

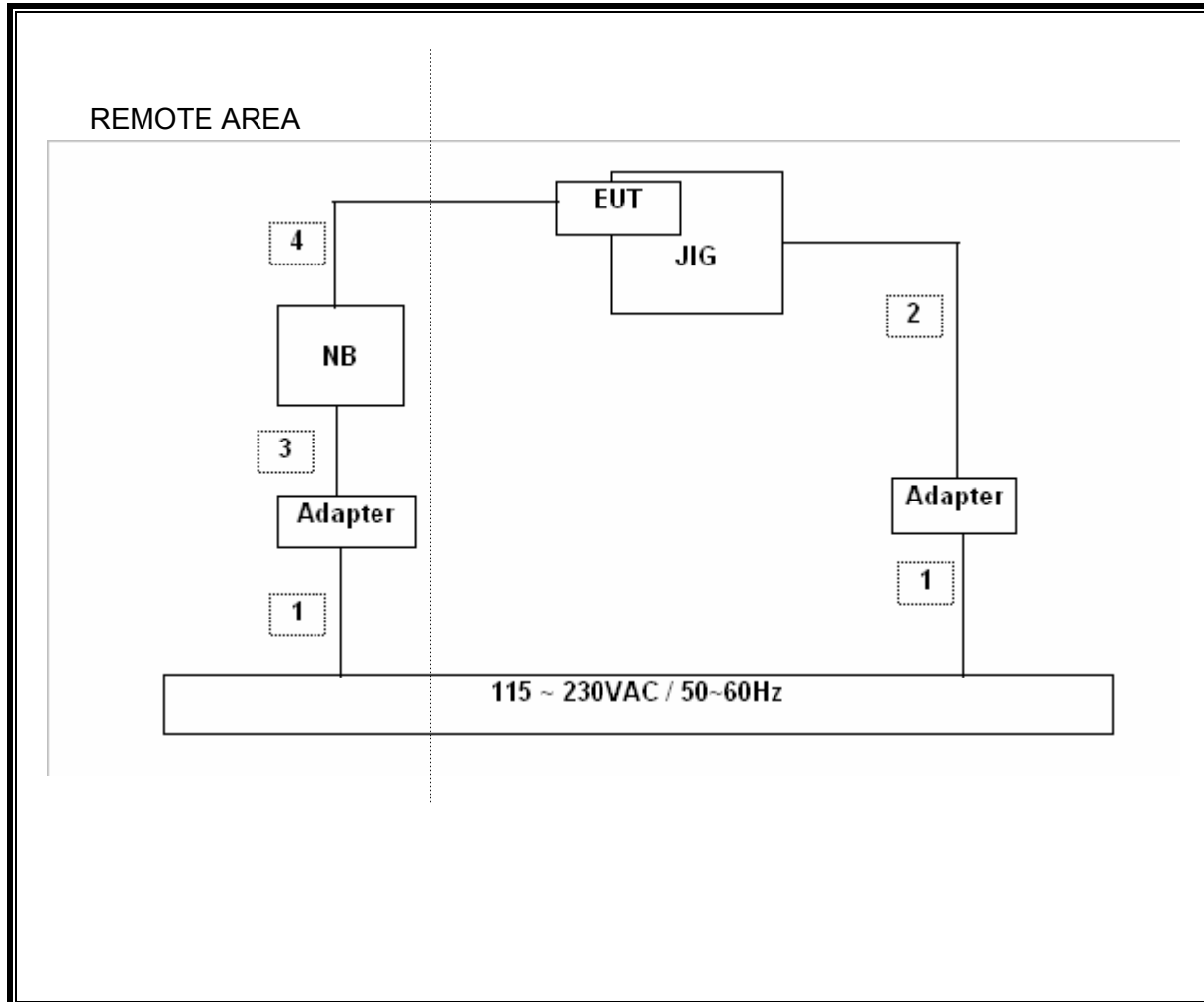
SUPPORT EQUIPMENT

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|-----------------------------------|--------------------|-------------|------------------|--------|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop PC | SONY | PCG-672R | 3000226 | Doc |
| Adapter | SONY | VGP-AC16V8 | 1478860220115500 | Doc |
| USB to RS232 Converter | Digi International | 901-0184 | N/A | N/A |
| JIG Broad | Digi International | N/A | N/A | N/A |
| Adapter | KGCOMP | SPN15-015 | N/A | N/A |
| Adapter | ELPAC | WM075-01950 | N/A | N/A |

I/O CABLES

| I/O CABLE LIST | | | | | | |
|----------------|------|----------------------|----------------|------------|--------------|--------------|
| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length | Remarks |
| 1 | AC | 2 | AC | Unshielded | 1.5m | N/A |
| 2 | DC | 1 | DC | Unshielded | 1.2m | TO JIG Broad |
| 3 | DC | 1 | DC | Unshielded | 1.5m | TO LAPTOP PC |
| 4 | USB | 1 | USB | Unshielded | 2M | N/A |

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 Date | Cal Due |
| EMI Test Receiver, 30 MHz | R & S | ESHS 20 | N02396 | 2/6/2008 | 08/06/09 |
| LISN, 30 MHz | FCC | LISN-50/250-25-2 | N02625 | 10/25/2008 | 10/25/09 |
| Antenna, Bilog, 2 GHz | Sunol Sciences | JB1 | C01016 | 9/28/2008 | 09/28/09 |
| Power Sensor, 18 GHz | Agilent / HP | 8481A | N02782 | 6/12/2008 | 08/22/09 |
| Power Meter | Agilent / HP | 438A | C01068 | 3/20/2008 | 06/20/09 |
| Reject Filter, 2.4-2.5 GHz | Micro-Tronics | BRM50702 | N02685 | 1/0/1900 | CNR |
| Antenna, Horn, 18 GHz | EMCO | 3115 | C00872 | 4/22/2008 | 04/22/09 |
| Antenna, Horn, 26.5 GHz | ARA | SWH-28 | C01015 | 9/29/2008 | 09/28/09 |
| Preamplifier, 26.5 GHz | Agilent / HP | 8449B | C00749 | 8/3/2007 | 09/27/08 |
| Preamplifier, 1300 MHz | Agilent / HP | 8447D | C00580 | 3/31/2008 | 03/31/09 |
| EMI Receiver, 2.9 GHz | Agilent / HP | 8542E | C00957 | 2/6/2008 | 09/19/09 |
| RF Filter Section, 2.9 GHz | Agilent / HP | 85420E | C00958 | 2/7/2008 | 09/20/09 |

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.

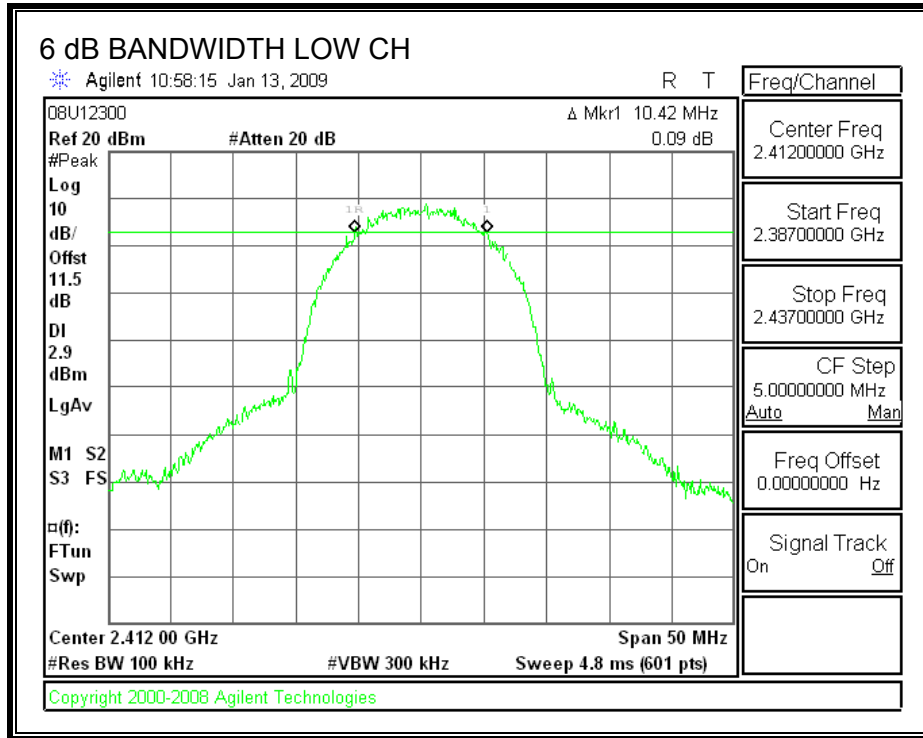
TEST PROCEDURE

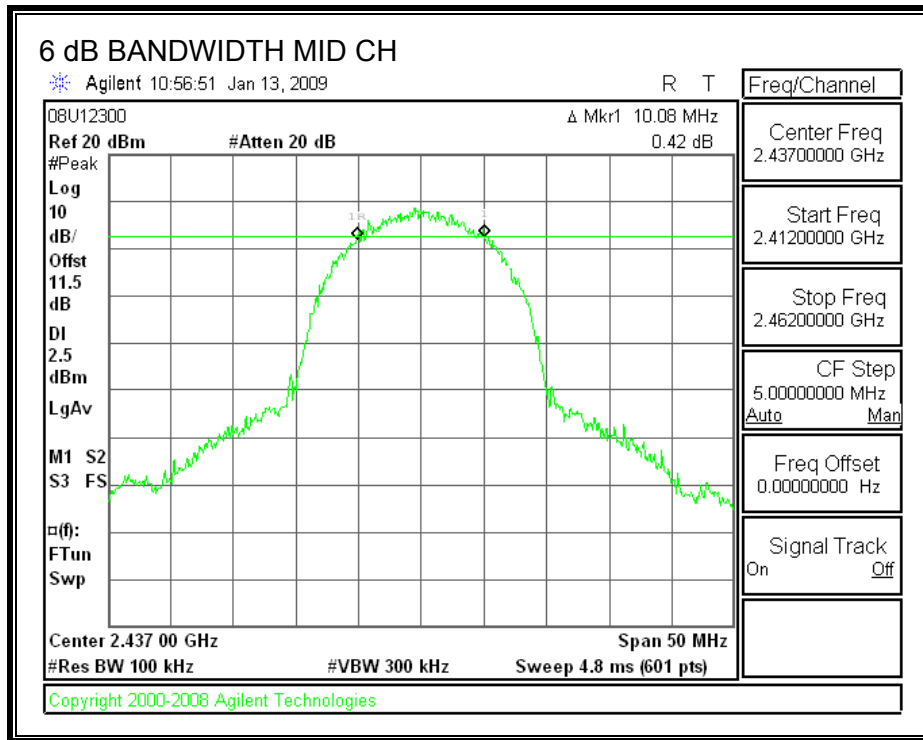
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

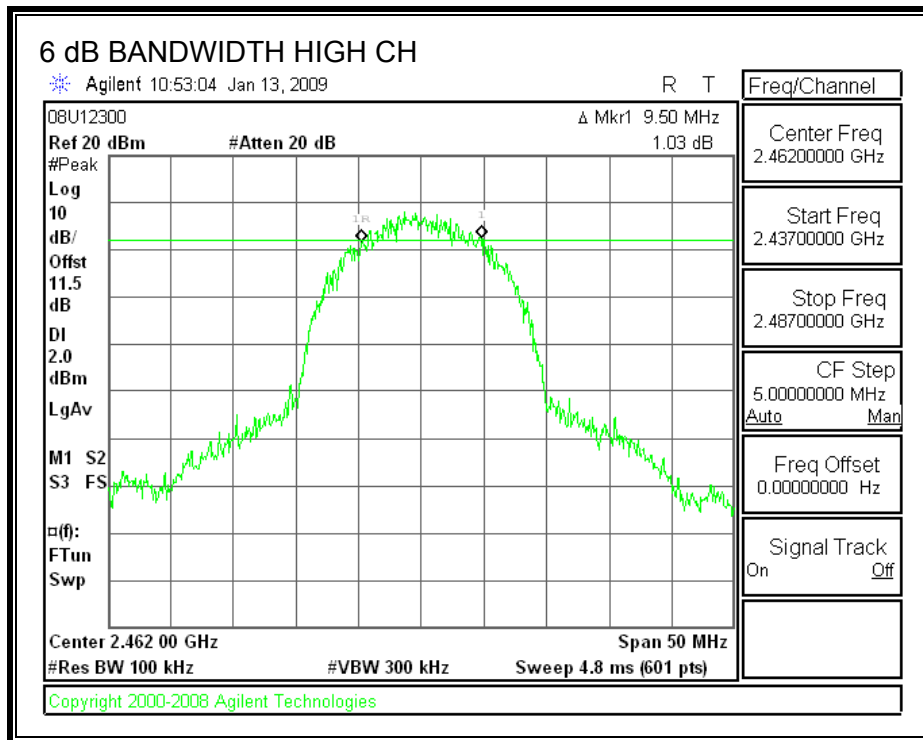
RESULTS

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low | 2412 | 10.42 | 0.5 |
| Middle | 2437 | 10.08 | 0.5 |
| High | 2462 | 9.50 | 0.5 |

6 dB BANDWIDTH







**7.1.2. 99% BANDWIDTH
LIMITS**

None; for reporting purposes only.

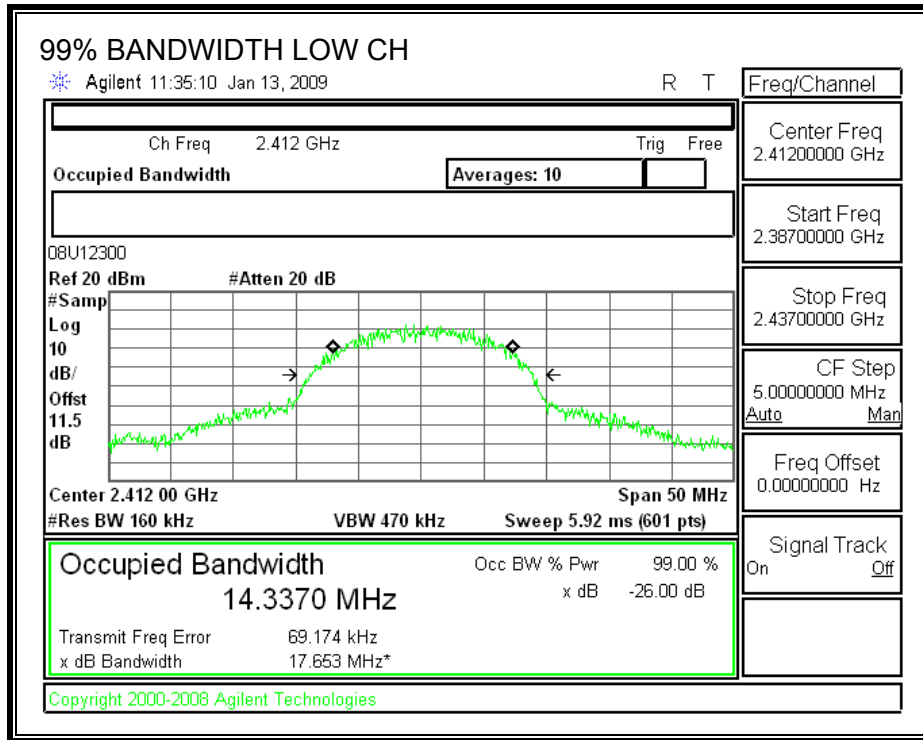
TEST PROCEDURE

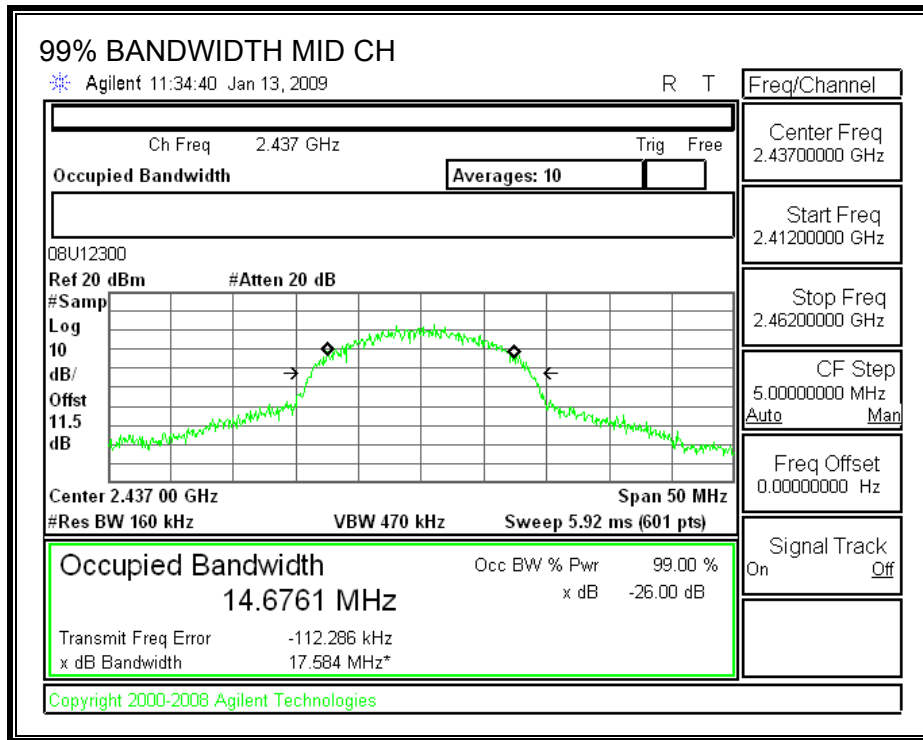
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

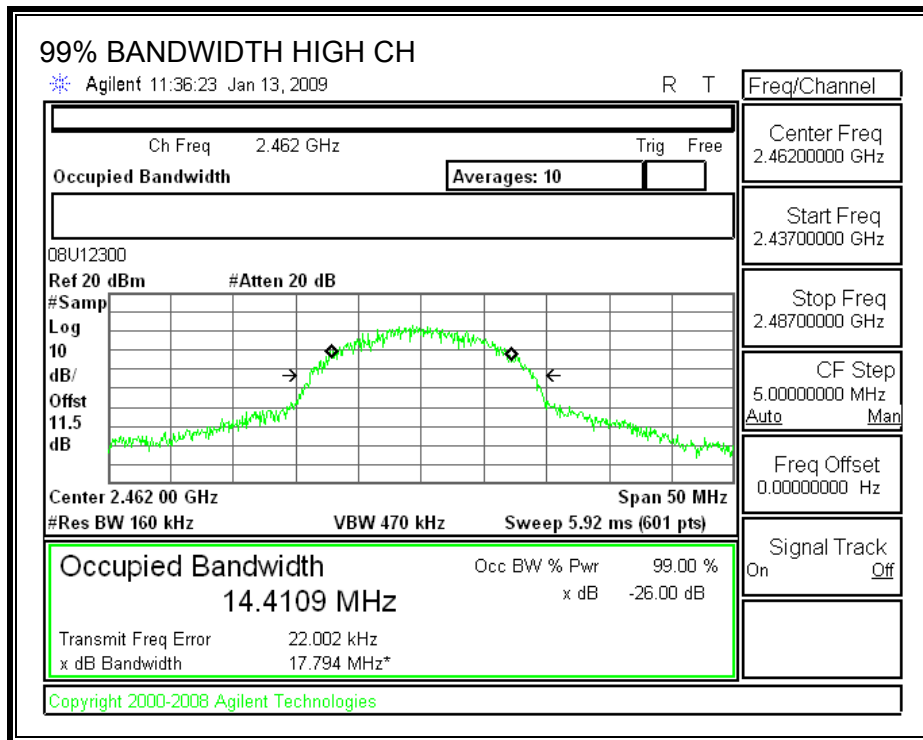
RESULTS

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|--------------------|------------------------|
| Low | 2412 | 14.3370 |
| Middle | 2437 | 14.6761 |
| High | 2462 | 14.4109 |

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.

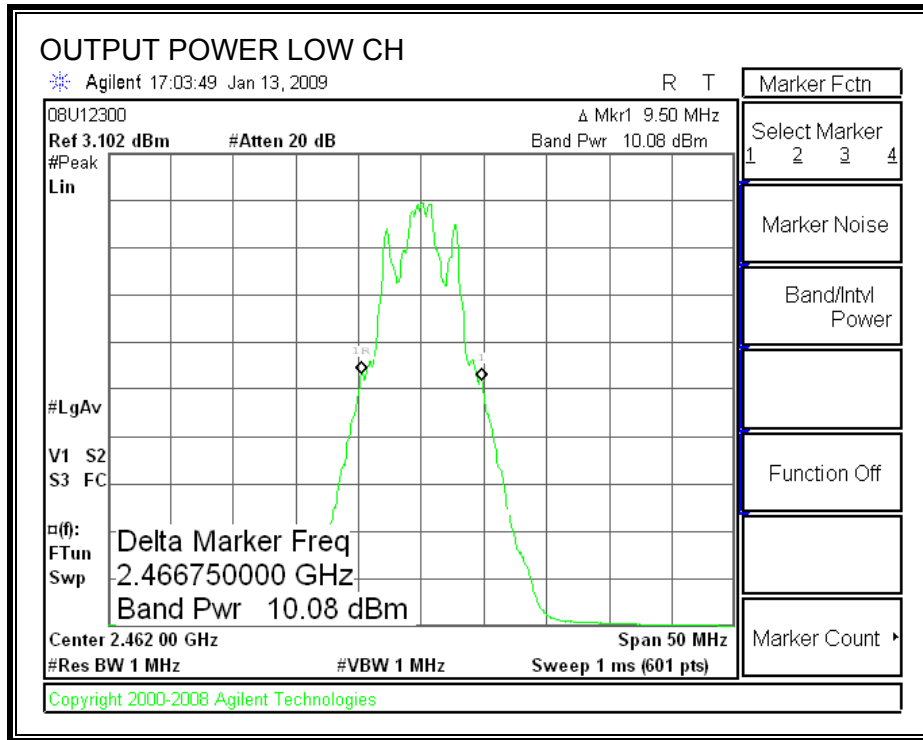
TEST PROCEDURE

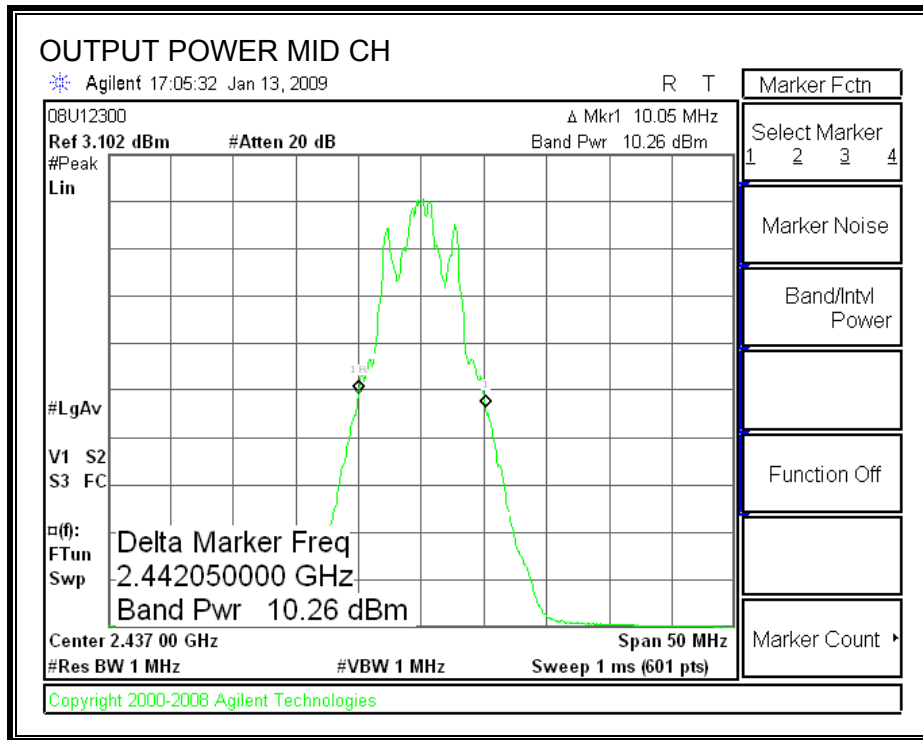
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

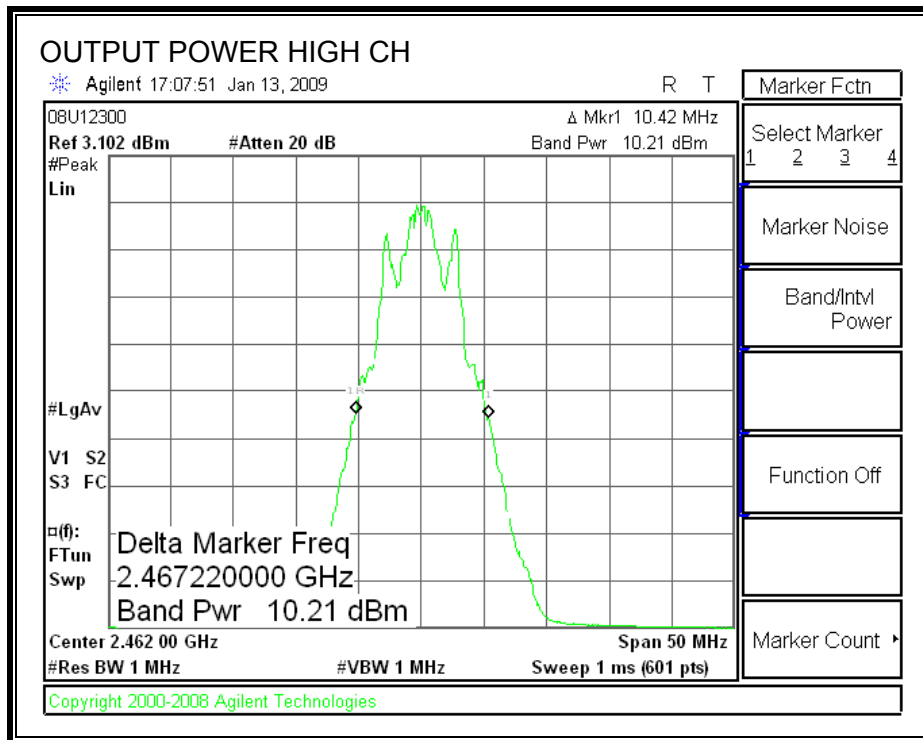
RESULTS

| Channel | Frequency (MHz) | Spectrum Analyzer Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|---------------------------------------|--|--------------------------|----------------|----------------|
| Low | 2412 | 10.08 | 11.5 | 21.58 | 30 | -8.42 |
| Middle | 2437 | 10.26 | 11.5 | 21.76 | 30 | -8.24 |
| High | 2462 | 10.21 | 11.5 | 21.71 | 30 | -8.29 |

OUTPUT POWER







**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 17 dB (including 10 dB pad and 1.5 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 | 17.50 |
| Middle | 2437 | 17.87 |
| High | 2462 | 17.80 |

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.

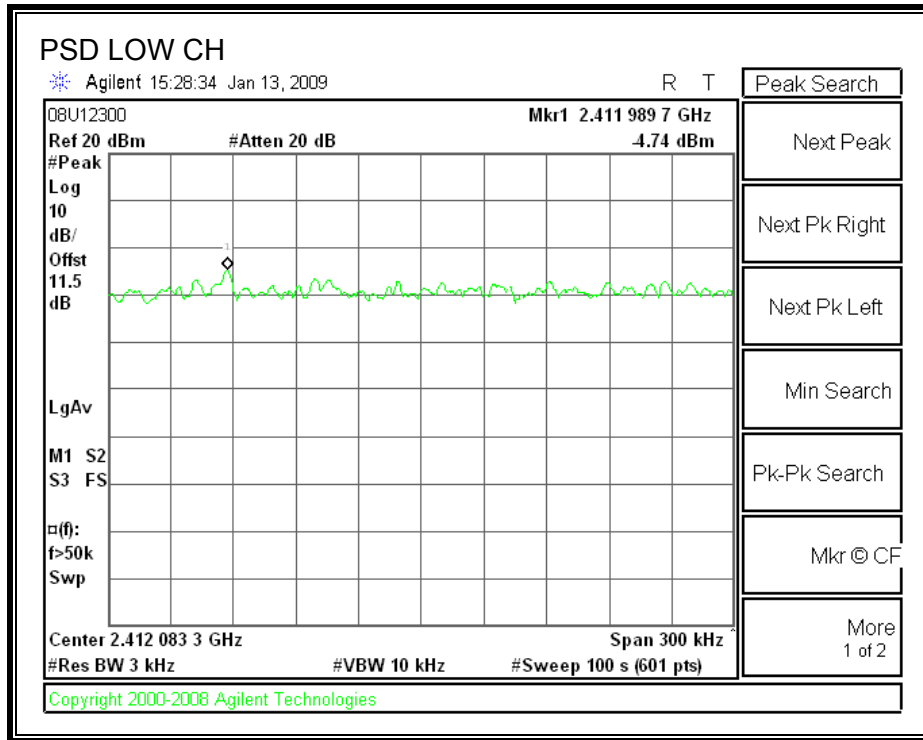
TEST PROCEDURE

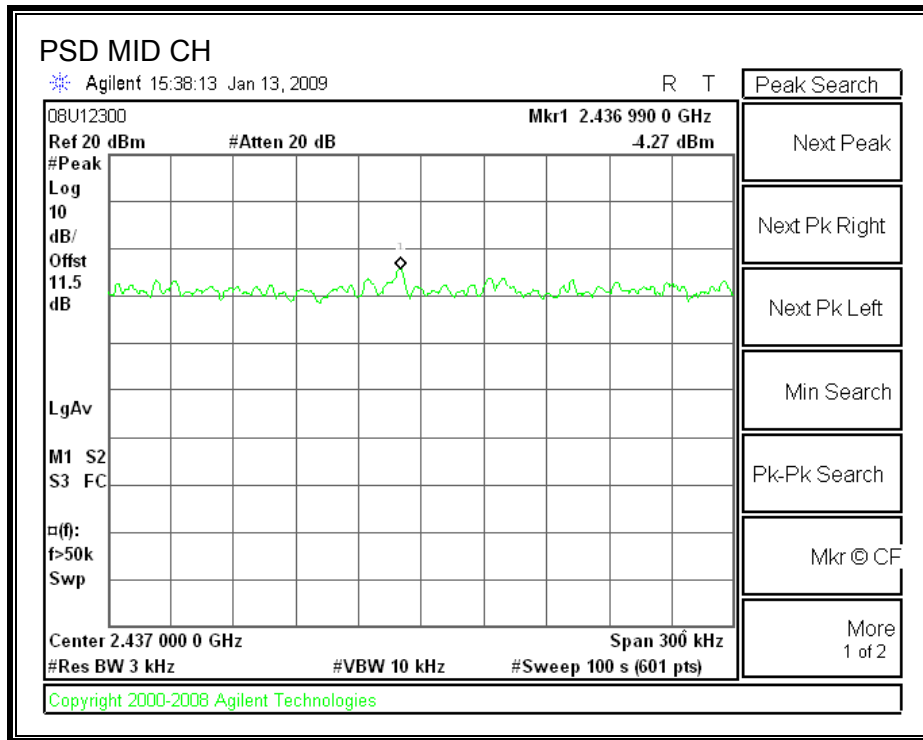
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

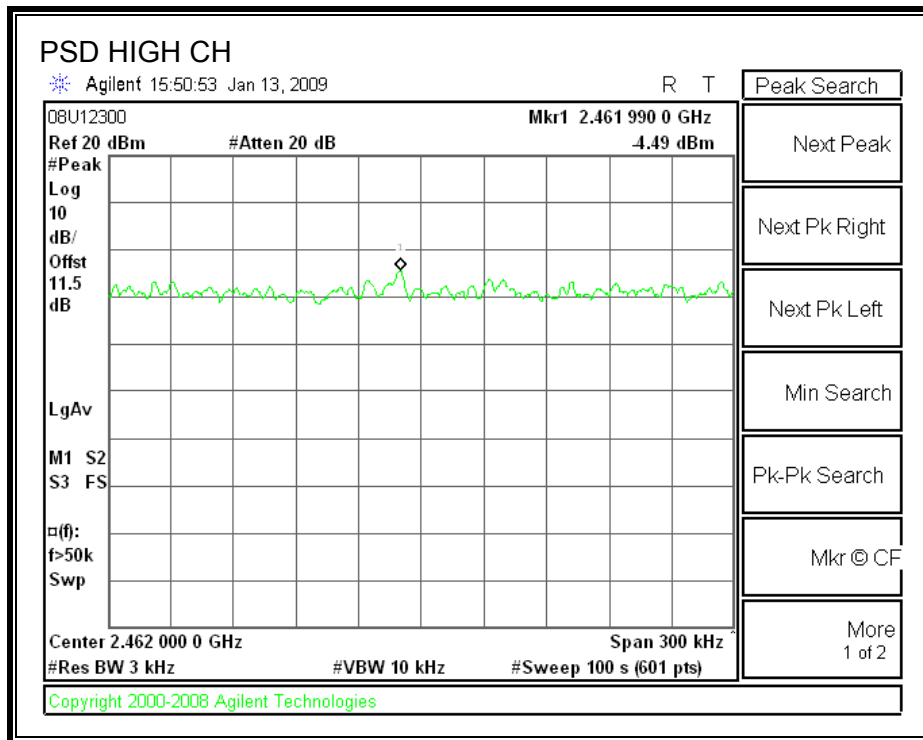
RESULTS

| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|------------|-------------|-------------|
| Low | 2412 | -4.74 | 8 | -12.74 |
| Middle | 2437 | -4.27 | 8 | -12.27 |
| High | 2462 | -4.49 | 8 | -12.49 |

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.

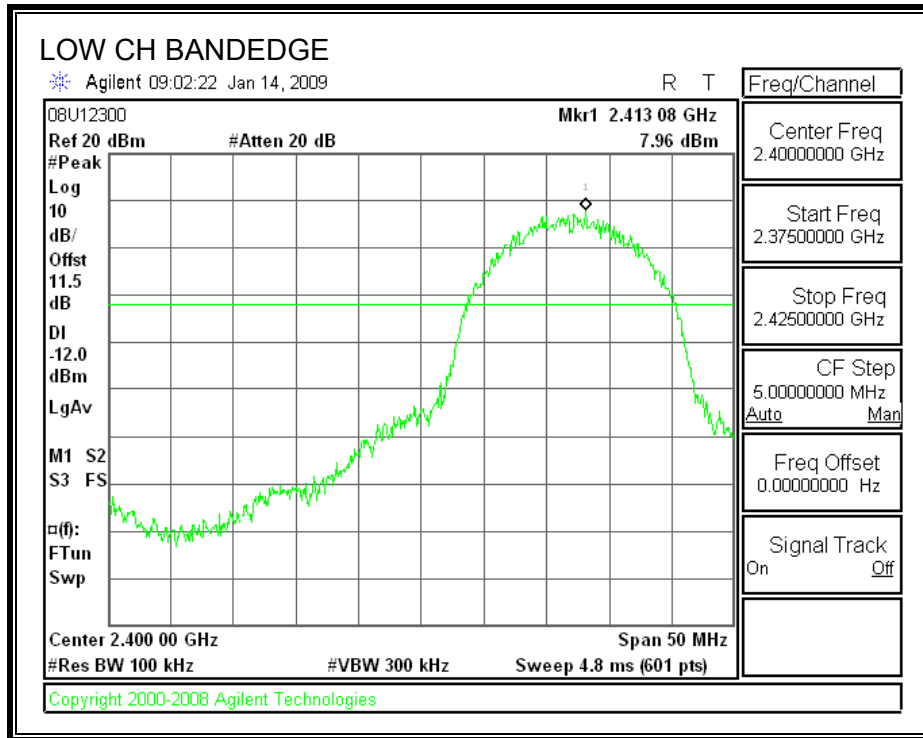
TEST PROCEDURE

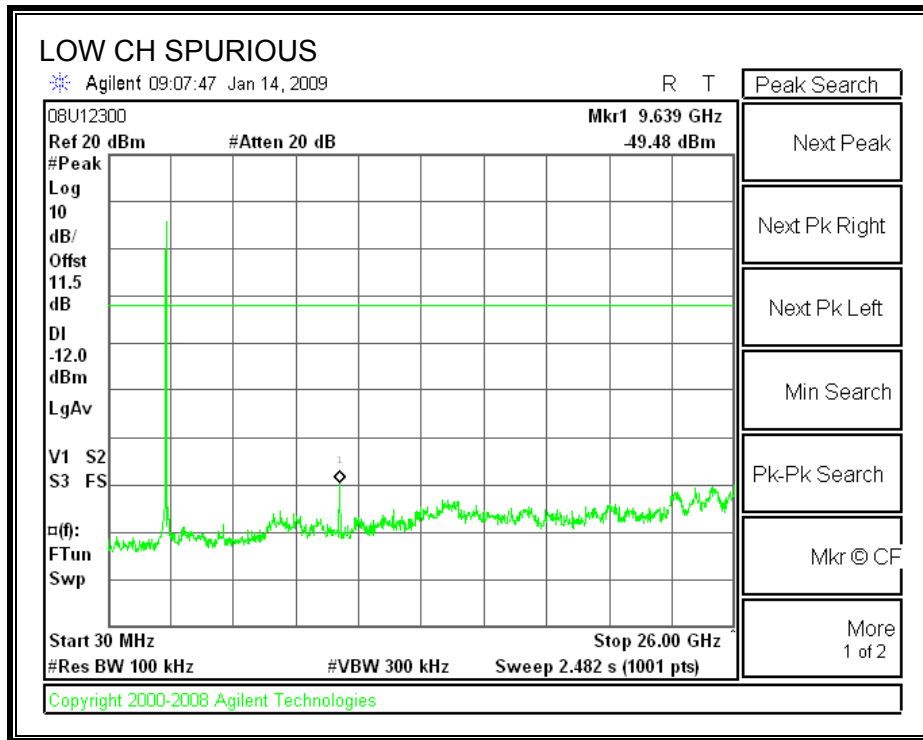
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

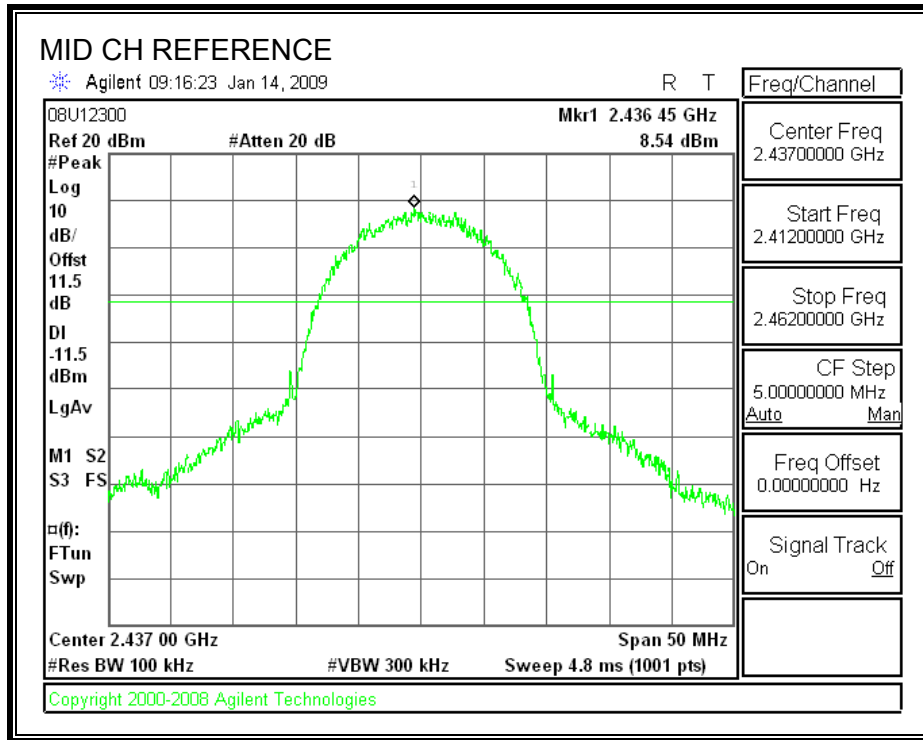
RESULTS

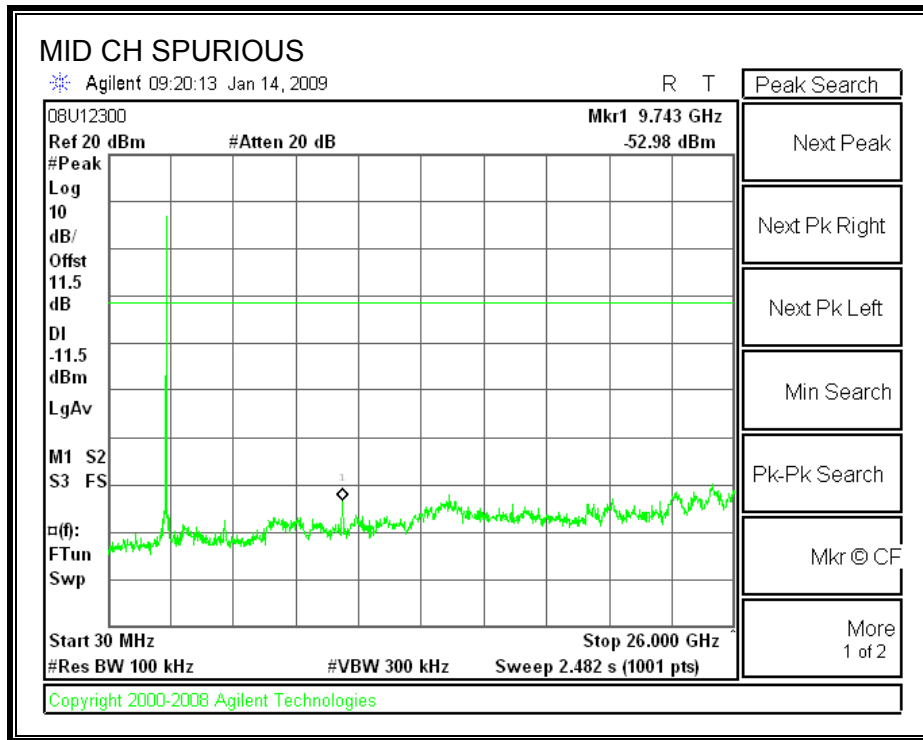
SPURIOUS EMISSIONS, LOW CHANNEL



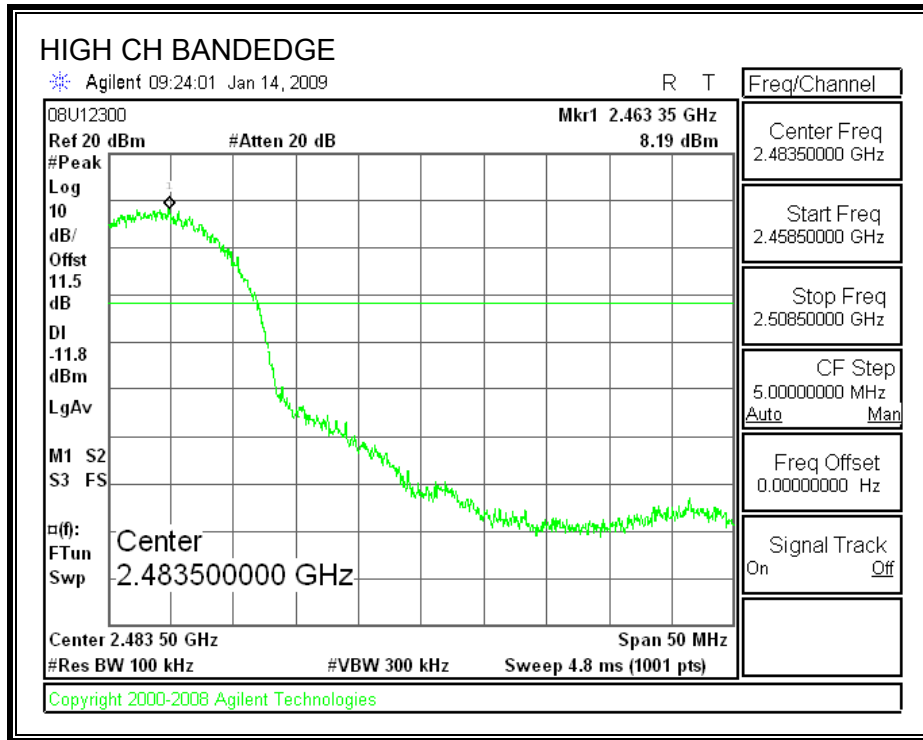


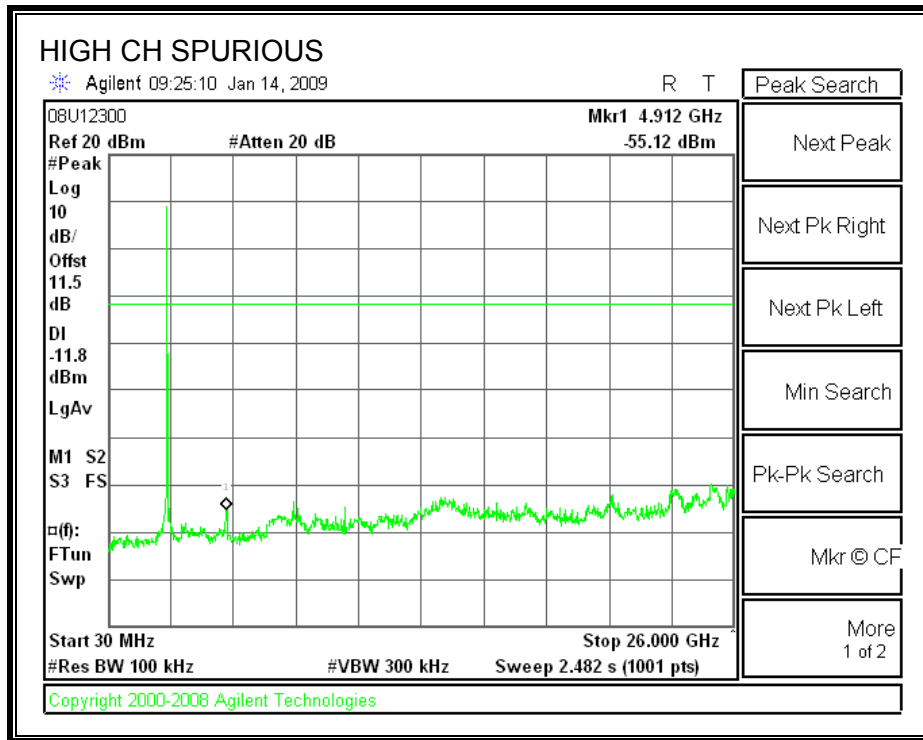
SPURIOUS EMISSIONS, MID CHANNEL





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.

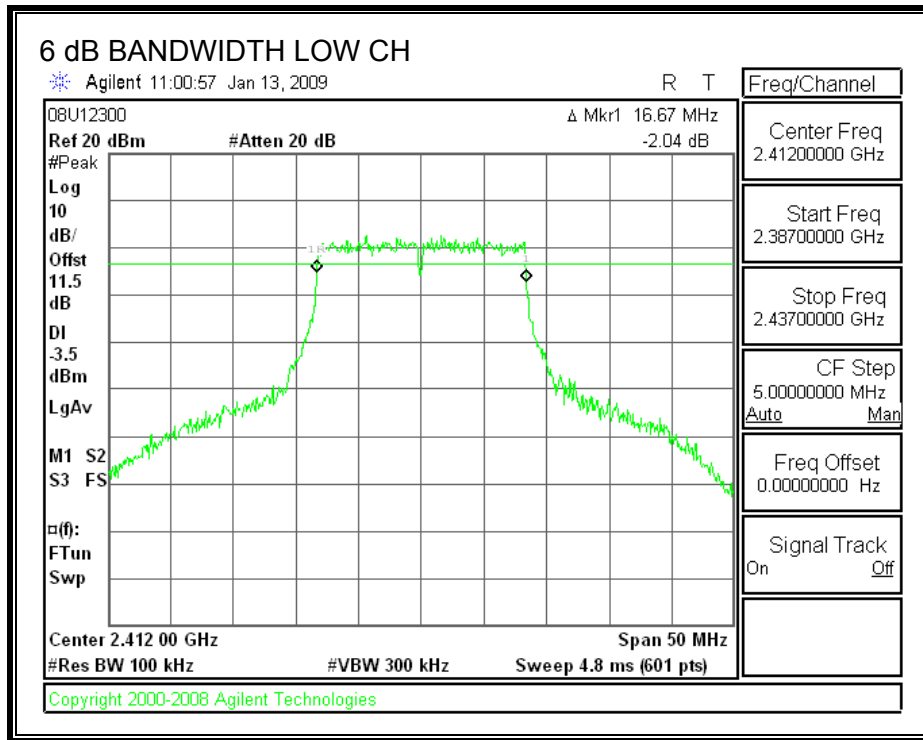
TEST PROCEDURE

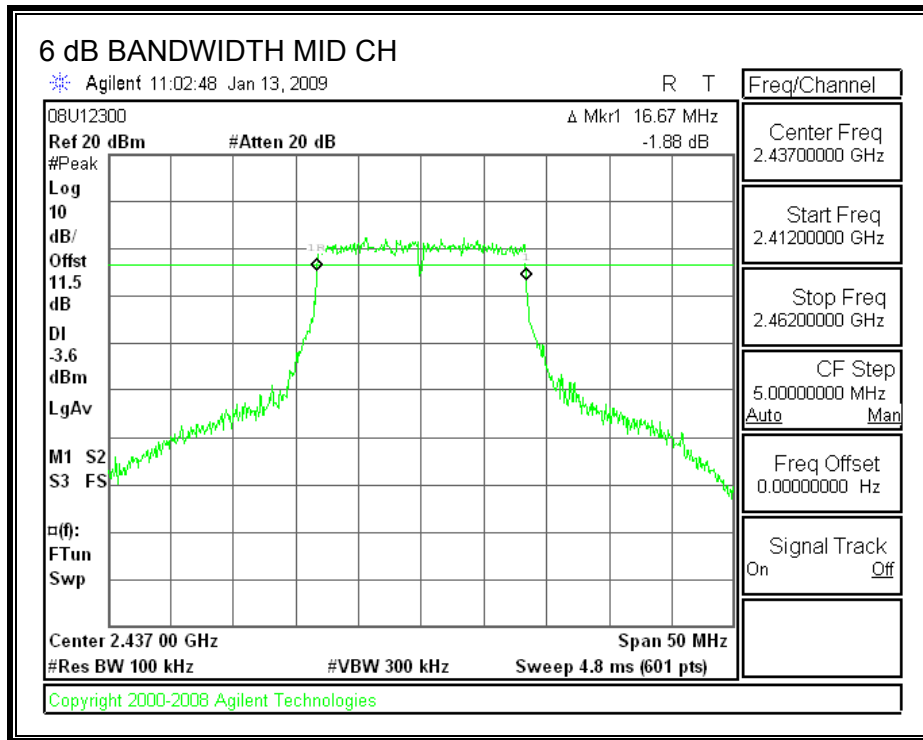
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

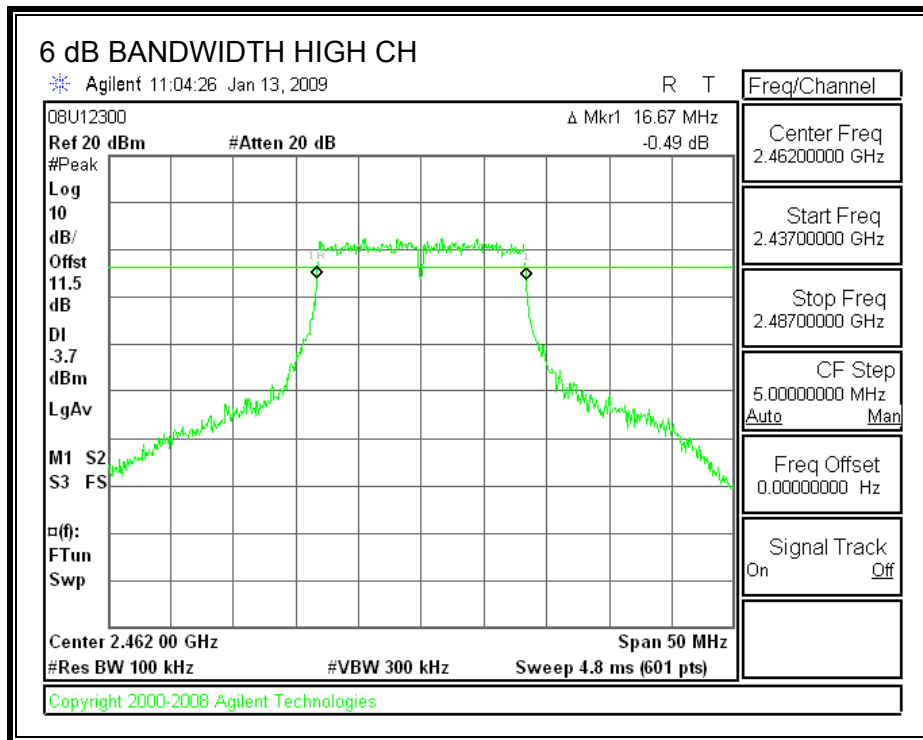
RESULTS

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|--------------------|-------------------------|------------------------|
| Low | 2412 | 16.67 | 0.5 |
| Middle | 2437 | 16.67 | 0.5 |
| High | 2462 | 16.67 | 0.5 |

6 dB BANDWIDTH







7.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

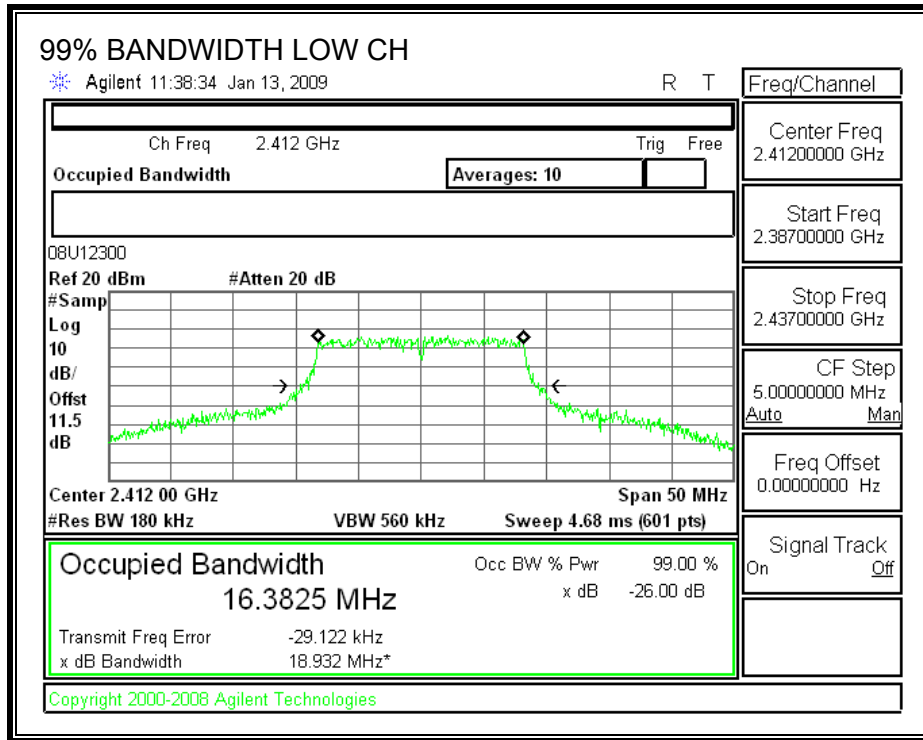
TEST PROCEDURE

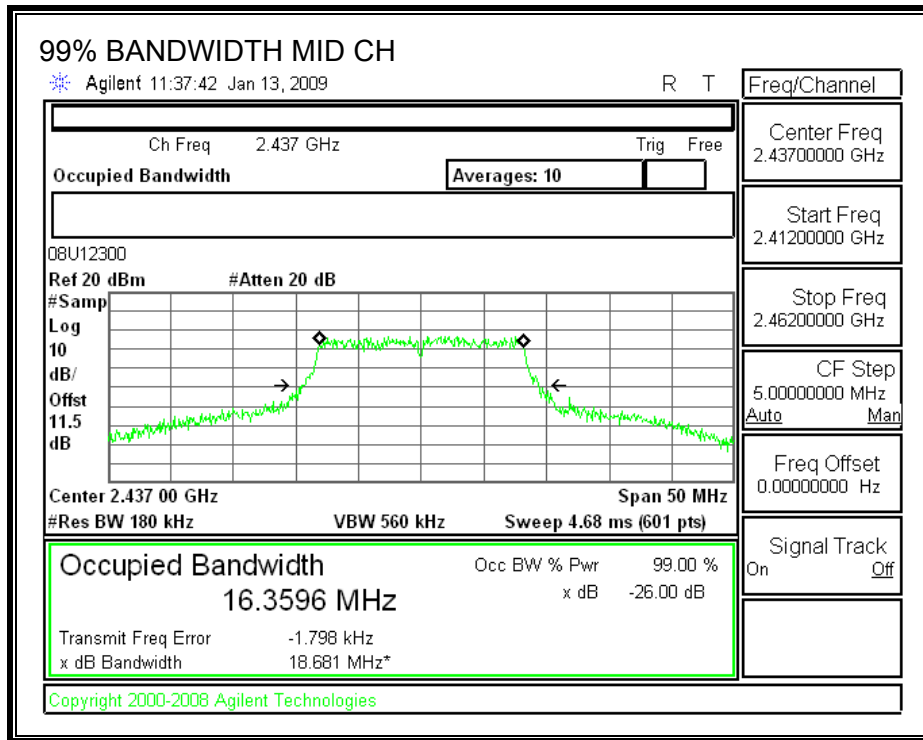
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

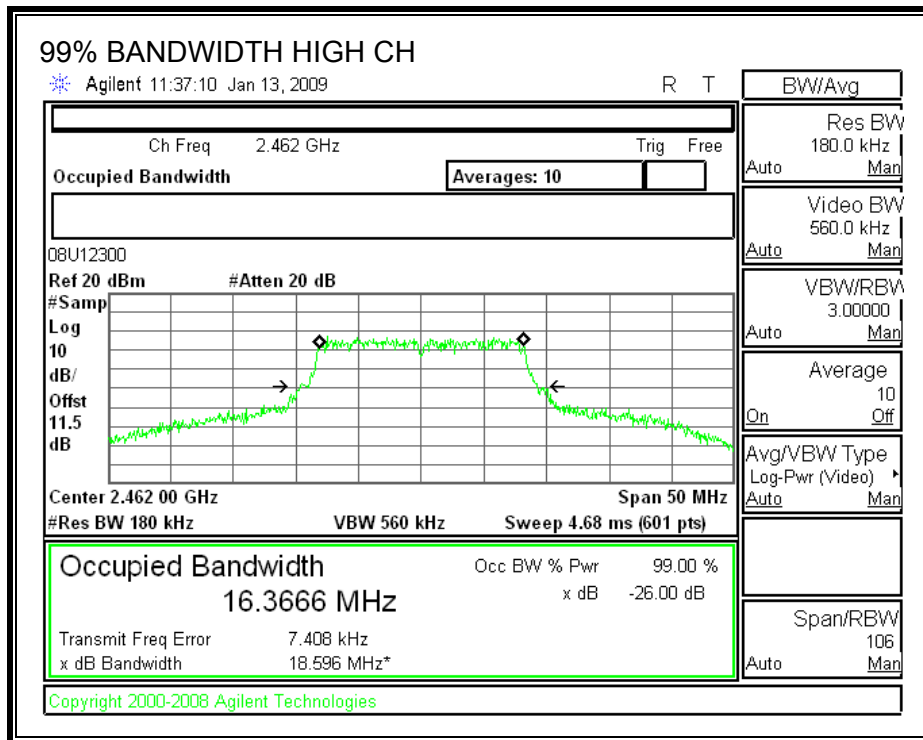
RESULTS

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low | 2412 | 16.3825 |
| Middle | 2437 | 16.3596 |
| High | 2462 | 16.3666 |

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.

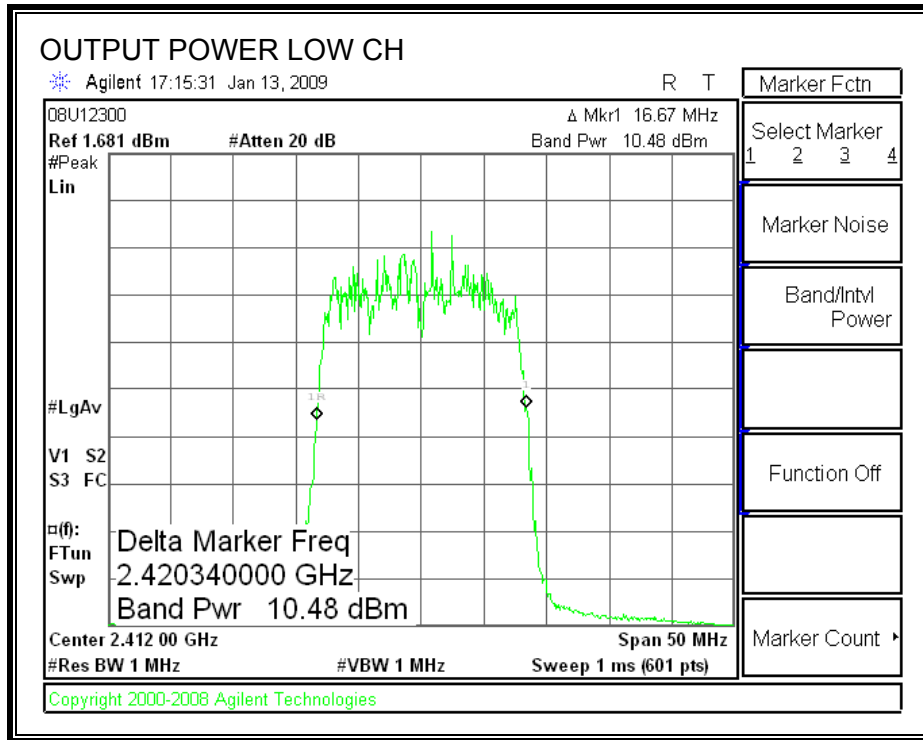
TEST PROCEDURE

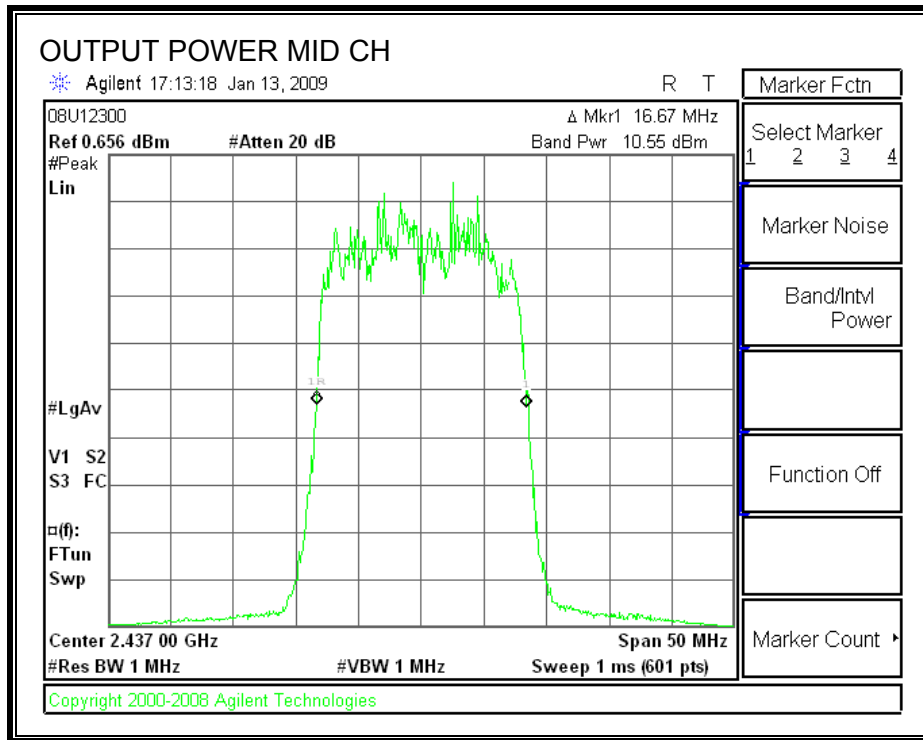
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 99% bandwidth.

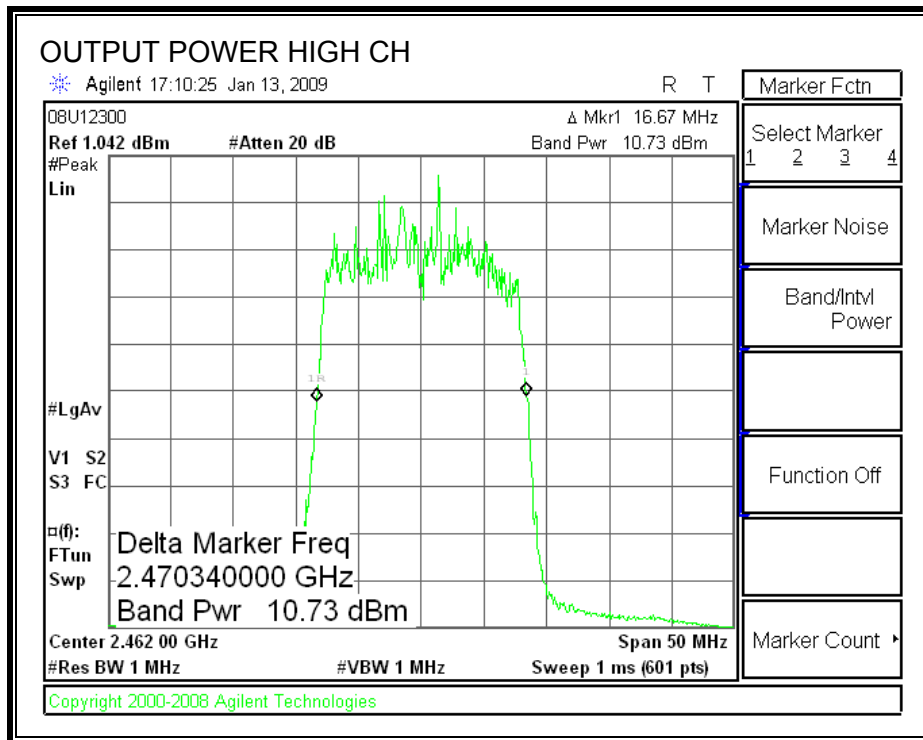
RESULTS

| Channel | Frequency (MHz) | Spectrum Analyzer Reading (dBm) | Attenuator and Cable Offset (dB) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|---------------------------------------|--|--------------------------|----------------|----------------|
| Low | 2412 | 10.48 | 11.5 | 21.98 | 30 | -8.02 |
| Middle | 2437 | 10.55 | 11.5 | 22.05 | 30 | -7.95 |
| High | 2462 | 10.73 | 11.5 | 22.23 | 30 | -7.77 |

OUTPUT POWER







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 17 dB (including 16.3 dB pad and 0.7 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 | 13.90 |
| Middle | 2437 | 13.90 |
| High | 2462 | 14.20 |

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.

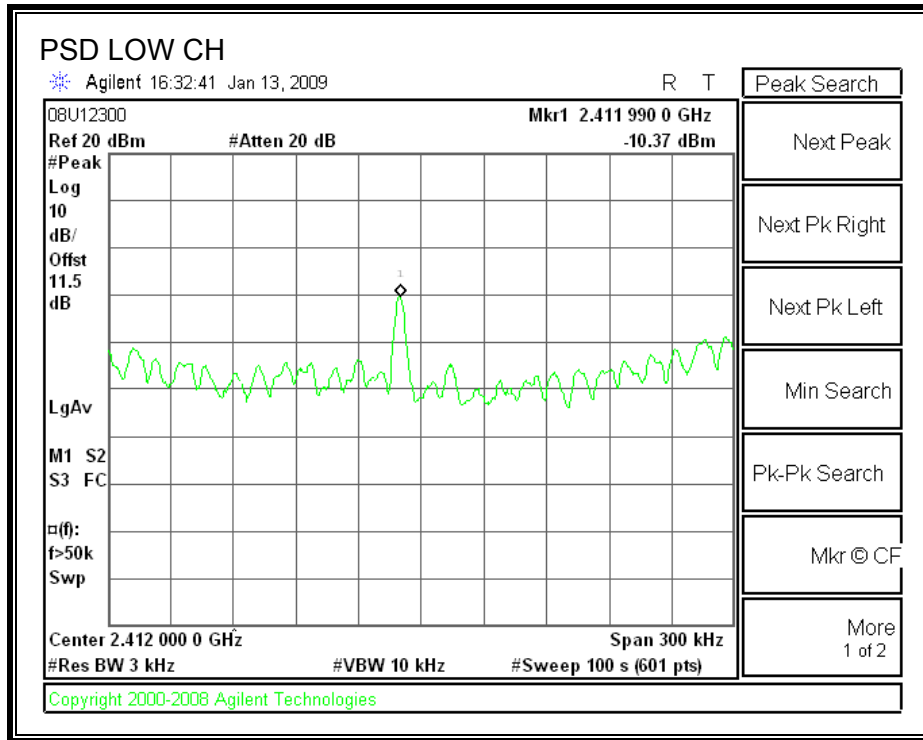
TEST PROCEDURE

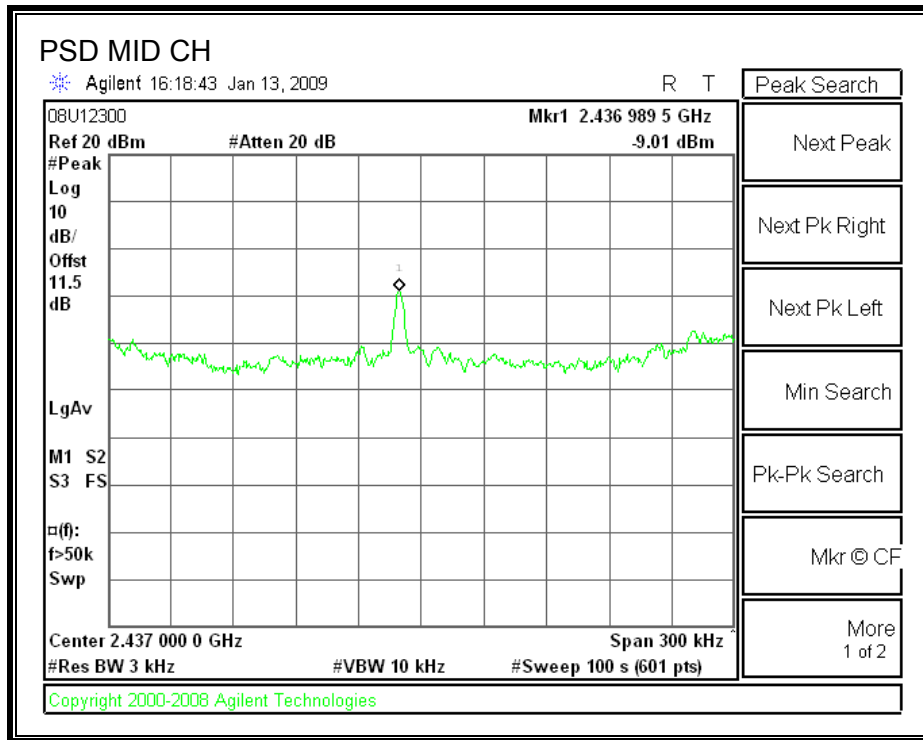
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

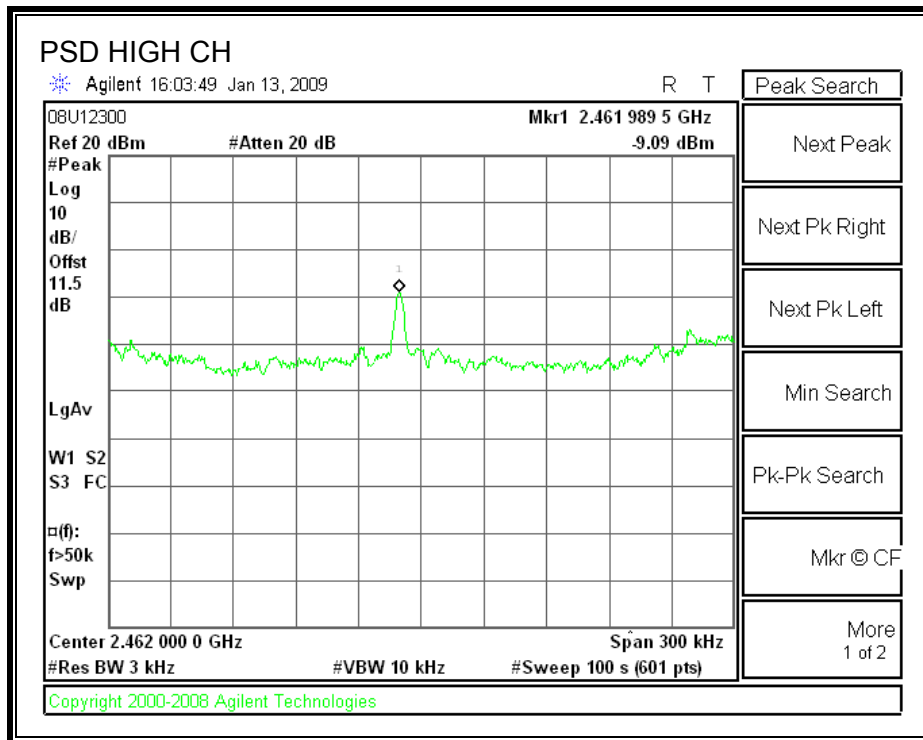
RESULTS

| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|------------|-------------|-------------|
| Low | 2412 | -10.37 | 8 | -18.37 |
| Middle | 2437 | -9.01 | 8 | -17.01 |
| High | 2462 | -9.09 | 8 | -17.09 |

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.

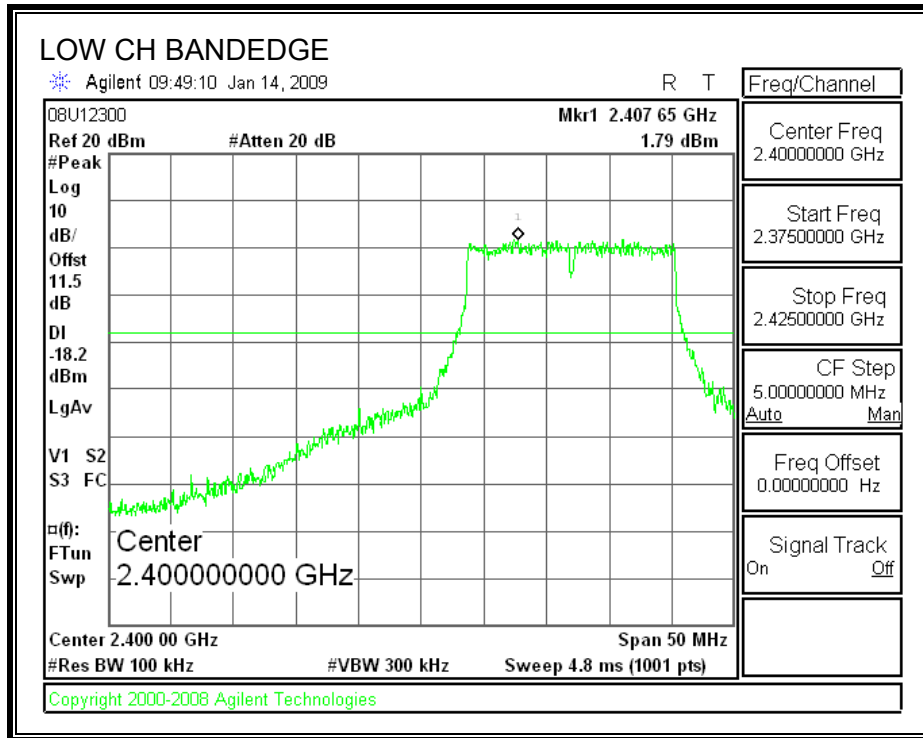
TEST PROCEDURE

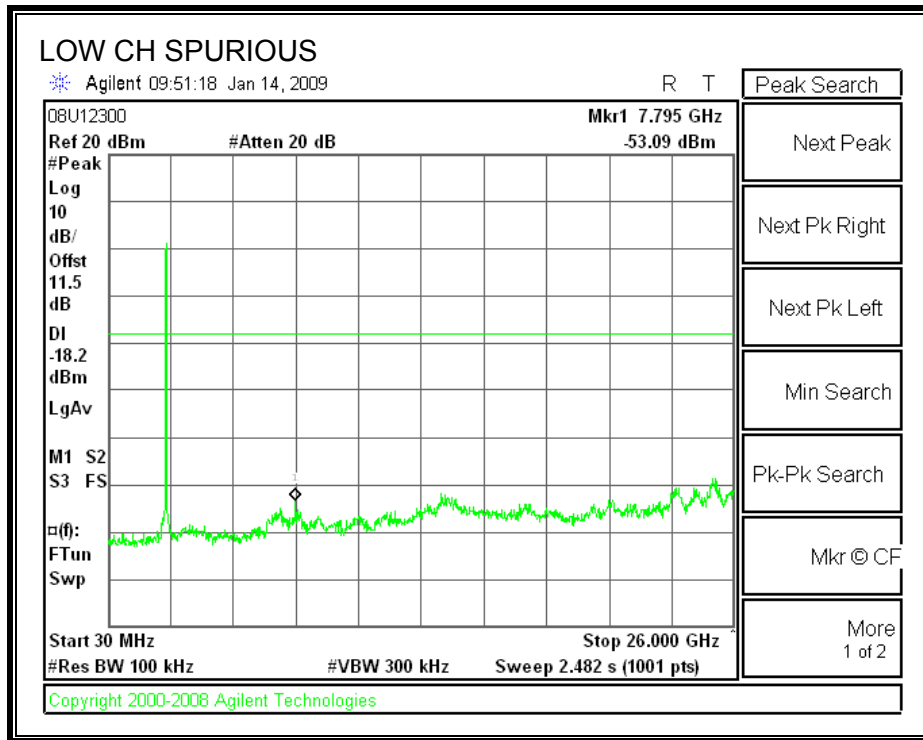
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

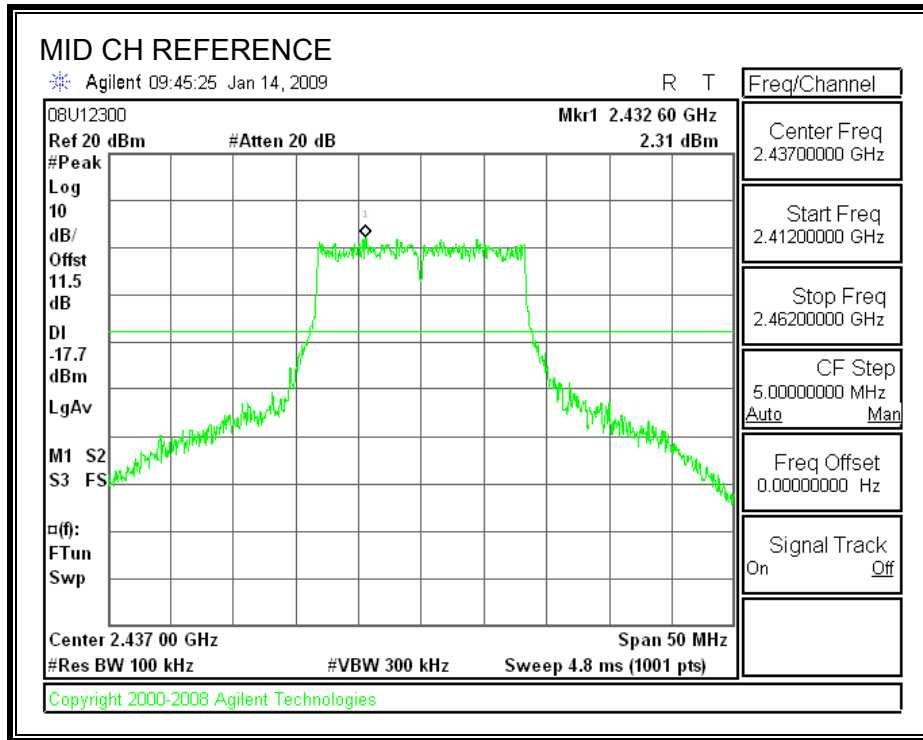
RESULTS

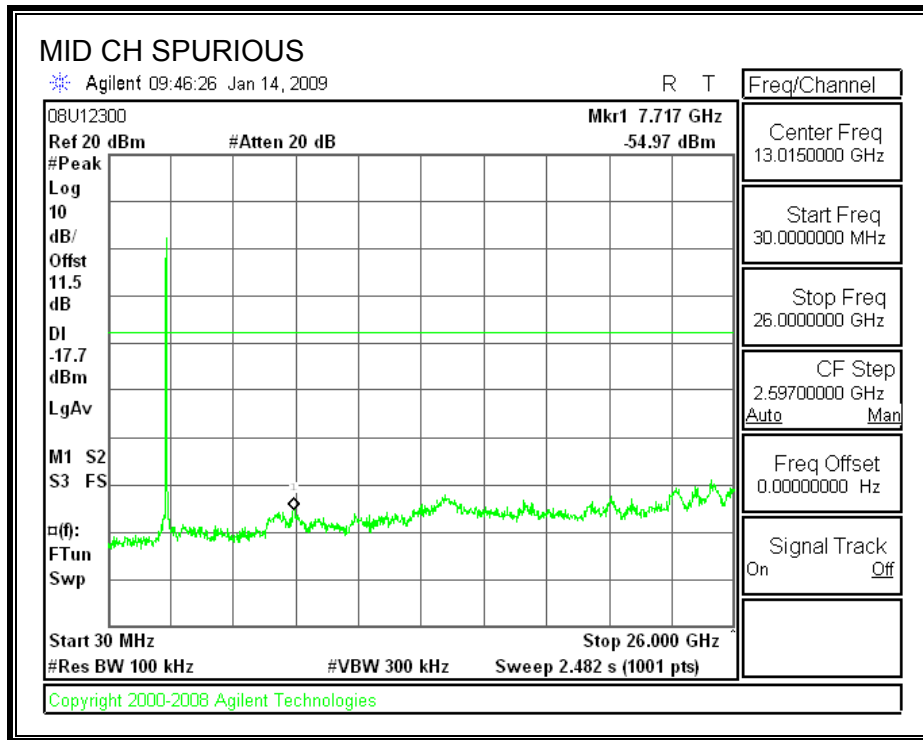
SPURIOUS EMISSIONS, LOW CHANNEL



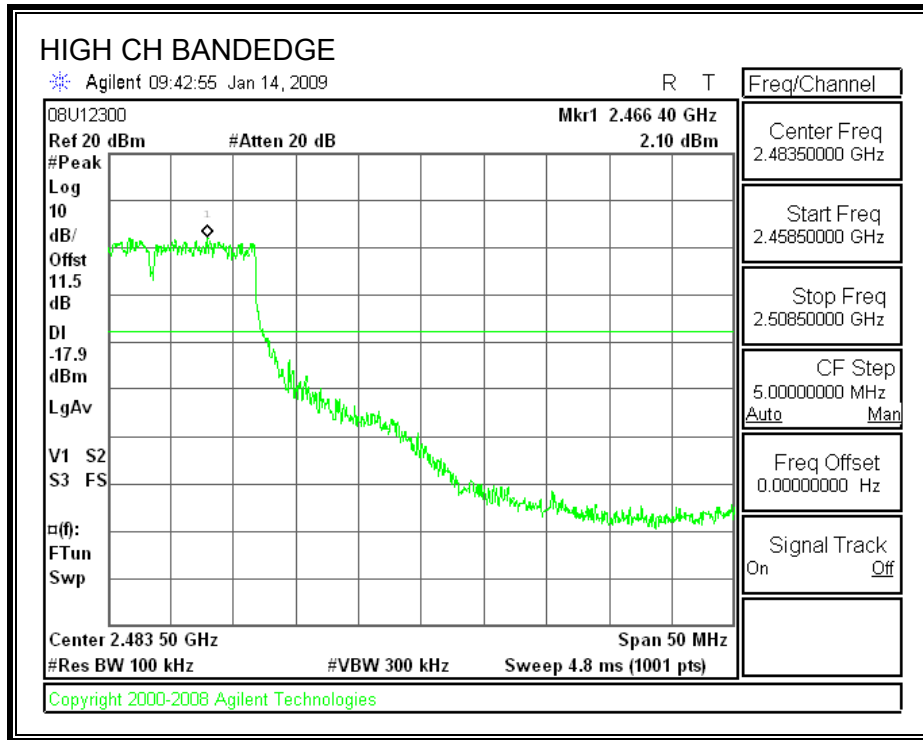


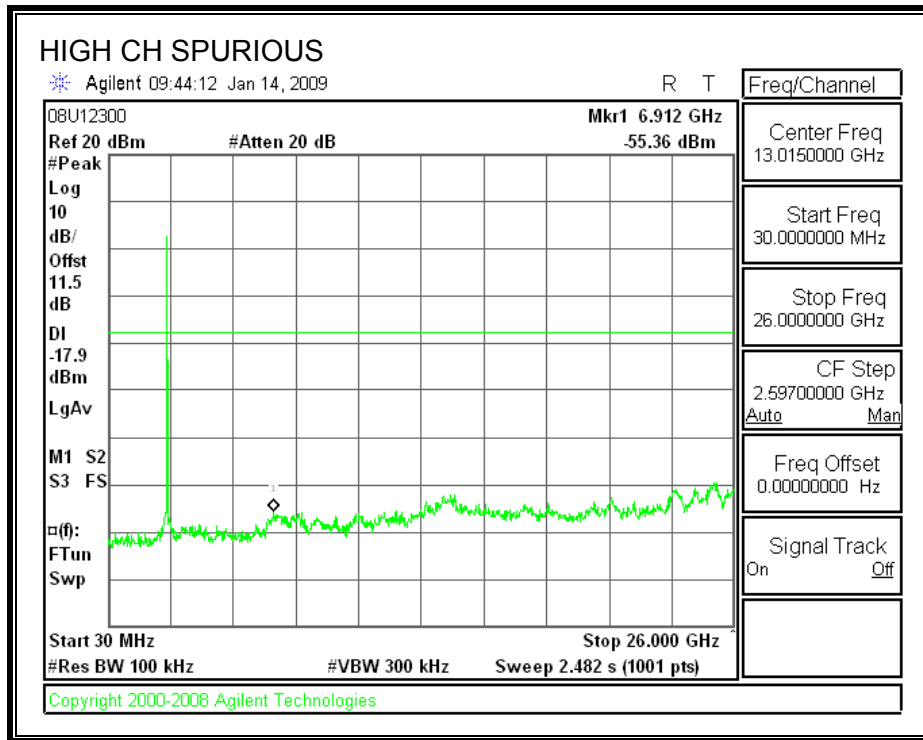
SPURIOUS EMISSIONS, MID CHANNEL





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.

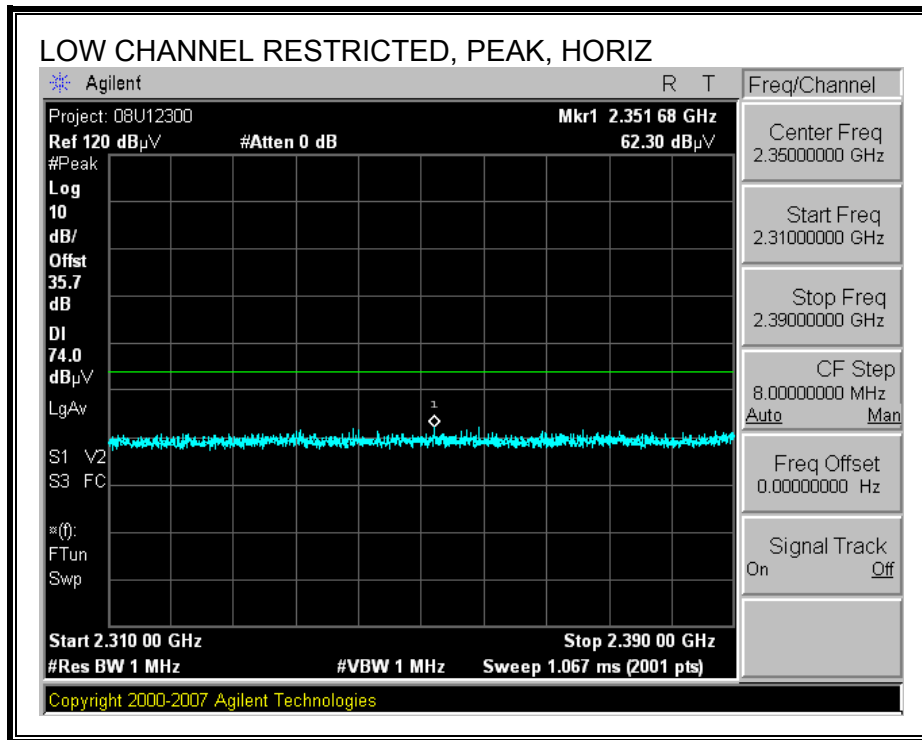
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

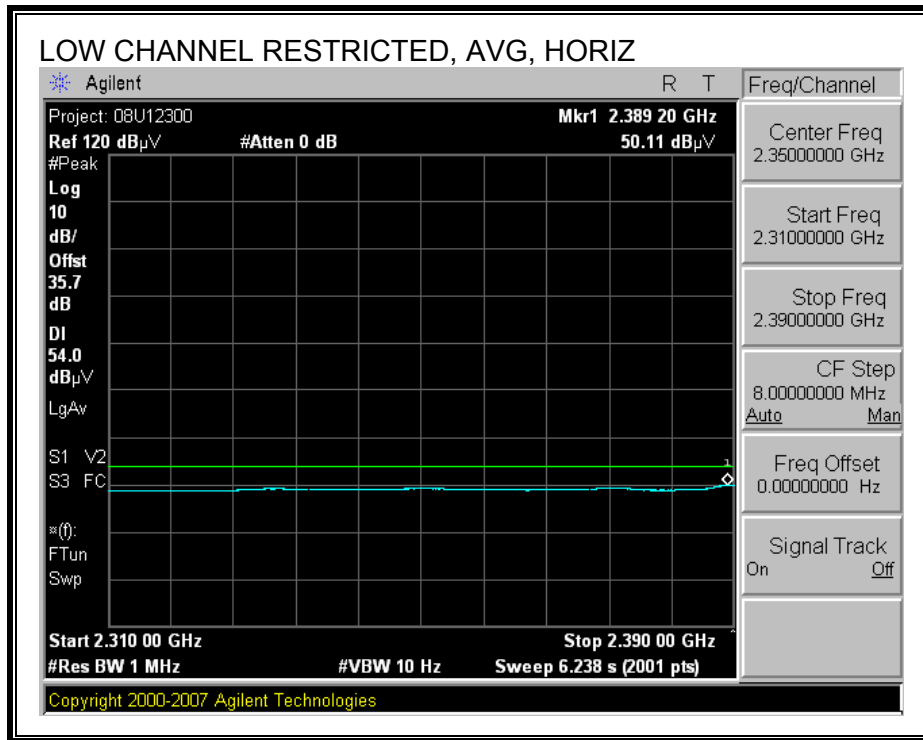
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

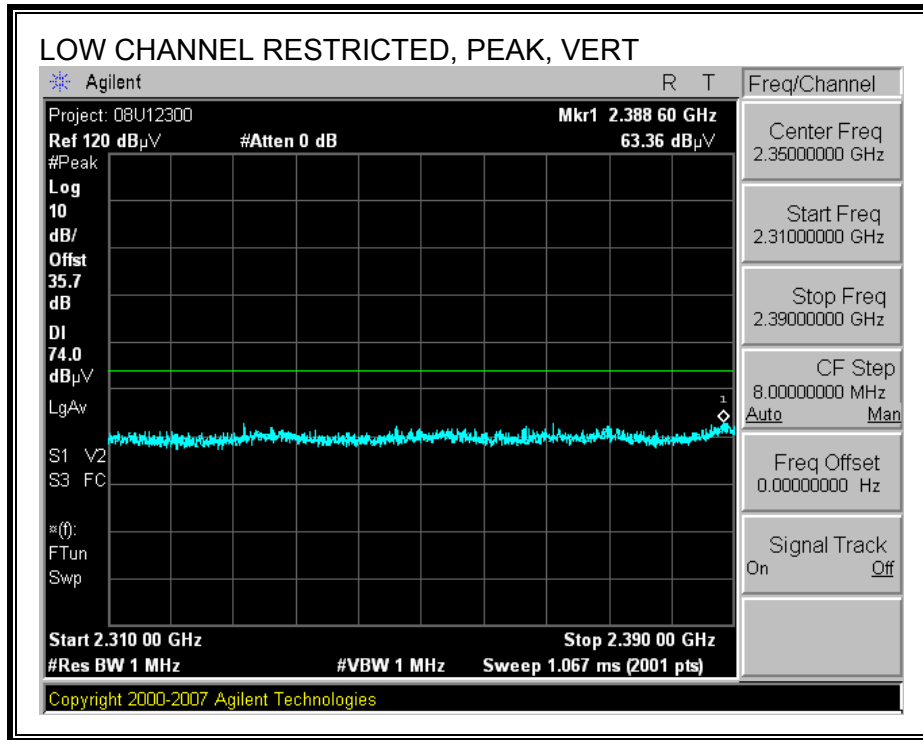
8.2.1. TX ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz BAND

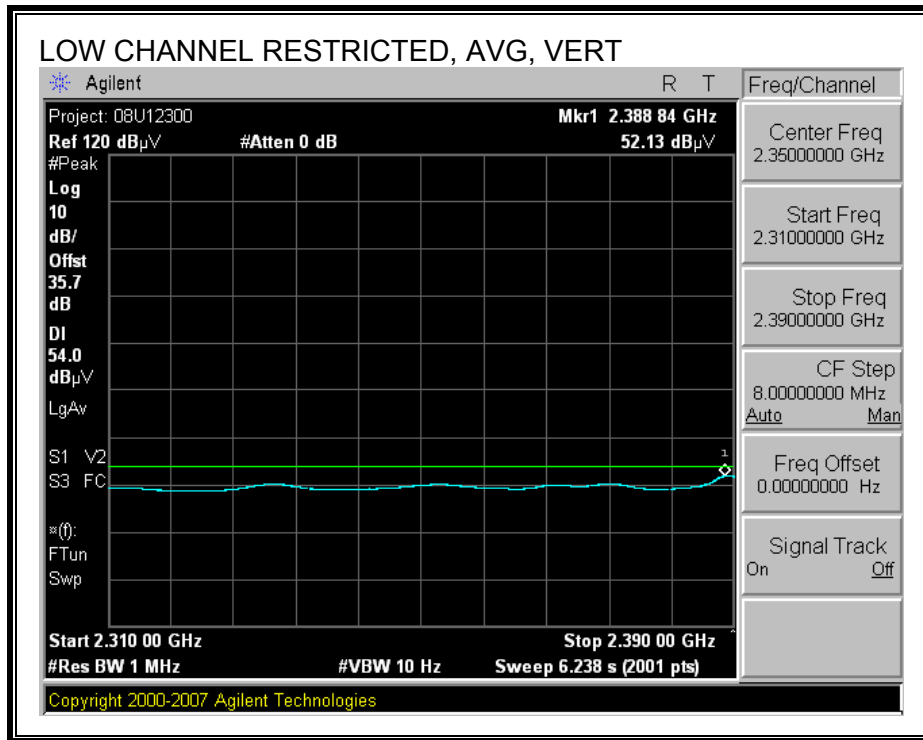
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



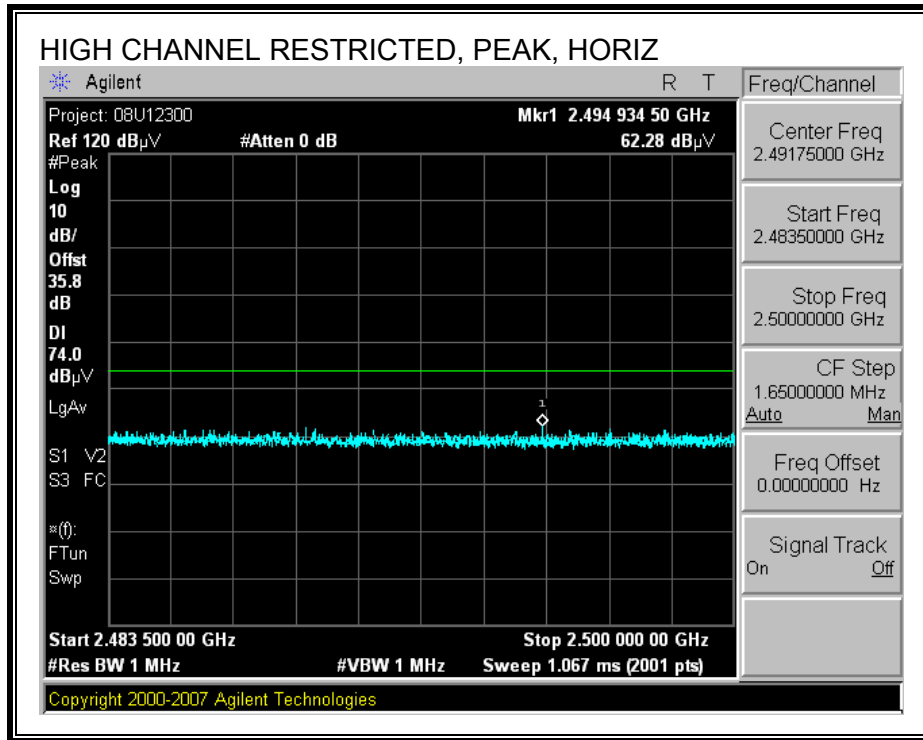


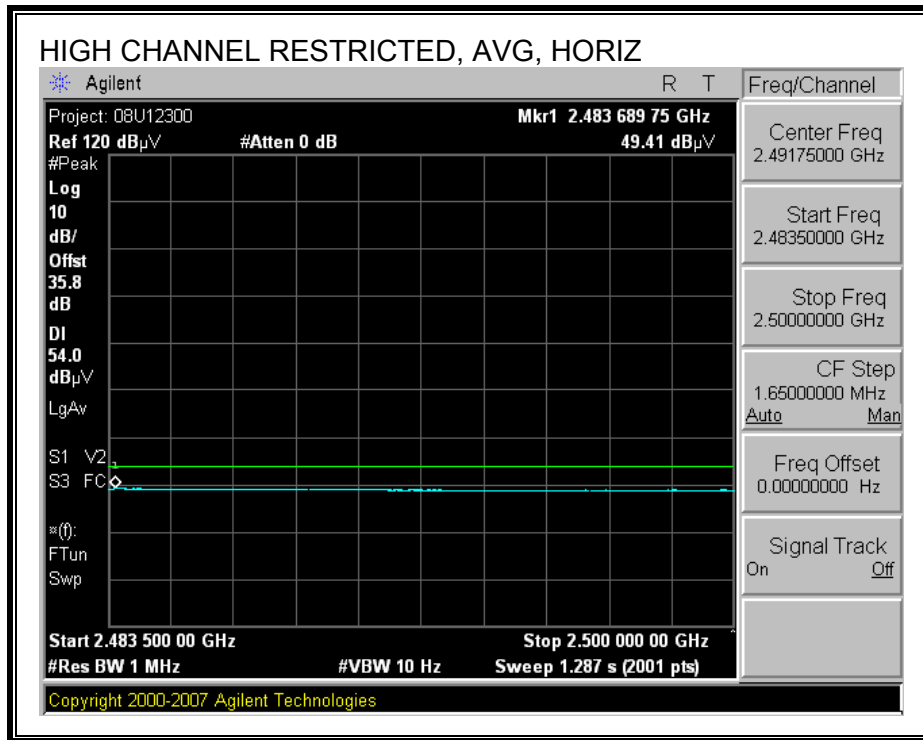
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



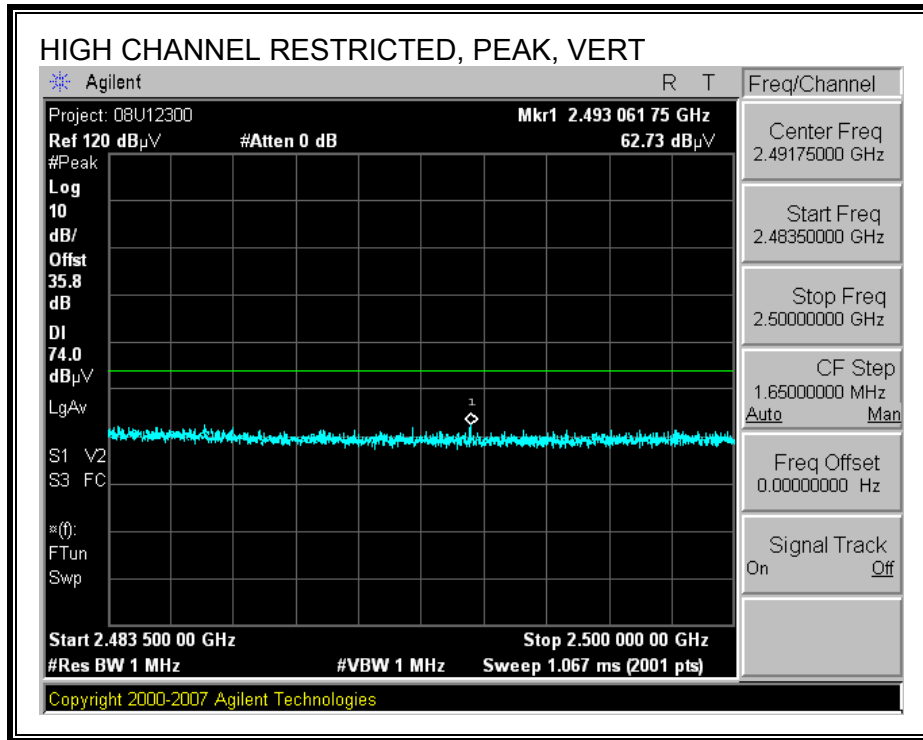


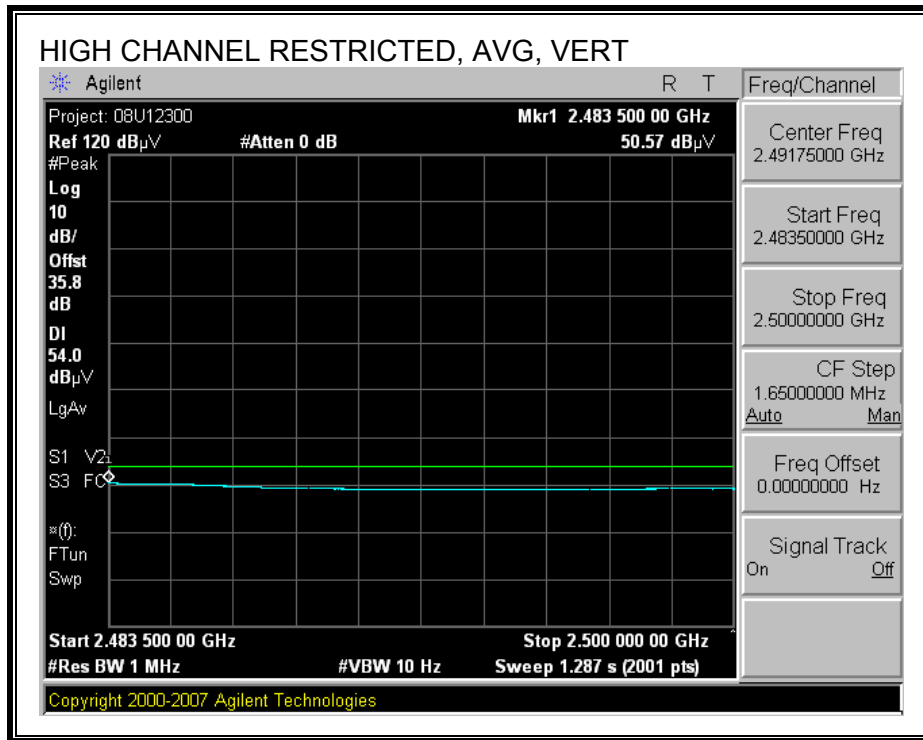
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: Digi International
 Project #: 08U12300
 Date: 01/07/09
 Test Engineer: Thanh Nguyen
 Configuration: EUT and Antenna Up position
 Mode: Transmit b mode 5.5Mb/s

Test Equipment:

| | | | | |
|----------------------|-----------------------|------------------------|------------------------------|------------|
| Horn 1-18GHz | Pre-amplifier 1-26GHz | Pre-amplifier 26-40GHz | Horn > 18GHz | Limit |
| T119; S/N: 29301 @3m | T34 HP 8449B | | T125; ARA 18-26GHz; S/N:1007 | FCC 15.205 |

Hi Frequency Cables

| | | | | | |
|-------------------|--------------------|--------------------|-----|---------------|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter | Peak Measurements RBW=VBW=1MHz |
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 | Average Measurements RBW=1MHz ; VBW=10Hz |

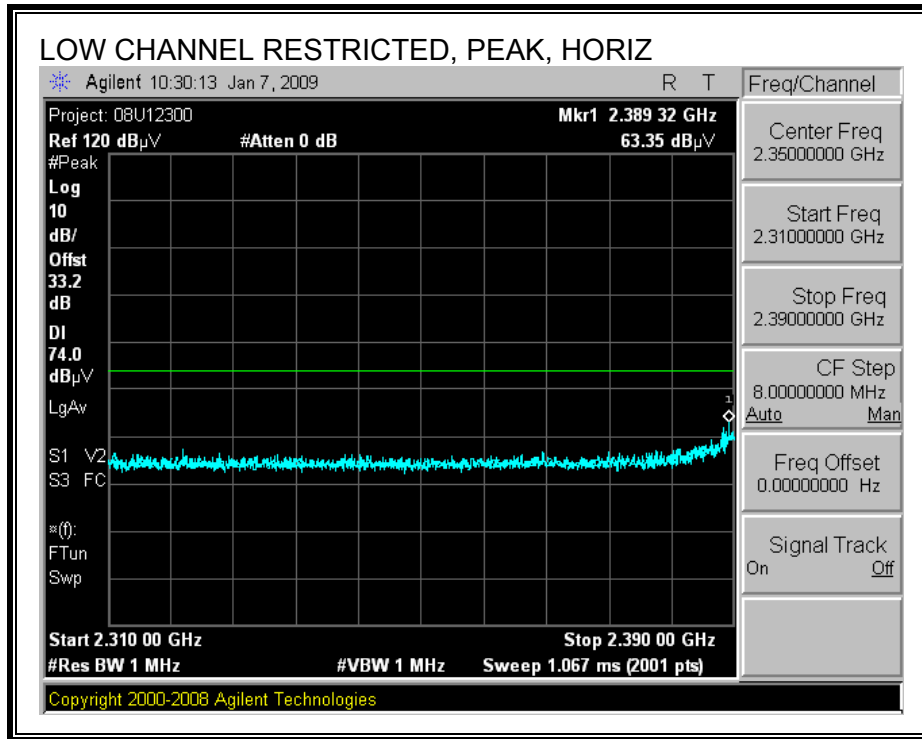
| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Filt dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|---------------------------|----------|--------------|----------------|---------|-------|--------|-----------|---------|-------------|------------|---------------|----------------|-----------|------------|-------------|
| Harmonics Spurious | | | | | | | | | | | | | | | |
| Low Ch 2412MHz | | | | | | | | | | | | | | | |
| 4.818 | 3.0 | 51.21 | 47.06 | 33.5 | 5.8 | -34.8 | 0.0 | 0.0 | 55.7 | 51.6 | 74 | 54 | -18.3 | -2.4 | V |
| 4.829 | 3.0 | 50.39 | 46.05 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 54.9 | 50.6 | 74 | 54 | -19.1 | -3.4 | V |
| 4.818 | 3.0 | 45.98 | 39.95 | 33.5 | 5.8 | -34.8 | 0.0 | 0.0 | 50.5 | 44.5 | 74 | 54 | -23.5 | -9.5 | H |
| 4.829 | 3.0 | 44.89 | 39.40 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 49.4 | 43.9 | 74 | 54 | -24.6 | -10.1 | H |
| Mid Ch 2437MHz | | | | | | | | | | | | | | | |
| 4.687 | 3.0 | 50.33 | 46.00 | 33.4 | 5.7 | -34.9 | 0.0 | 0.0 | 54.5 | 50.2 | 74 | 54 | -19.5 | -3.8 | V |
| 4.879 | 3.0 | 49.89 | 44.86 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 54.5 | 49.5 | 74 | 54 | -19.5 | -4.5 | V |
| 7.311 | 3.0 | 41.36 | 31.22 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 49.1 | 39.0 | 74 | 54 | -24.9 | -15.0 | Noise floor |
| 4.687 | 3.0 | 41.26 | 37.56 | 33.4 | 5.7 | -34.9 | 0.0 | 0.0 | 45.5 | 41.8 | 74 | 54 | -28.5 | -12.2 | H |
| 4.879 | 3.0 | 39.68 | 38.52 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 44.3 | 43.2 | 74 | 54 | -29.7 | -10.8 | H |
| 7.311 | 3.0 | 41.36 | 30.04 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 49.1 | 37.8 | 74 | 54 | -24.9 | -16.2 | Noise floor |
| High ch 2462MHz | | | | | | | | | | | | | | | |
| 4.918 | 3.0 | 51.64 | 46.38 | 33.7 | 5.9 | -34.8 | 0.0 | 0.0 | 56.4 | 51.1 | 74 | 54 | -17.6 | -2.9 | V |
| 4.929 | 3.0 | 50.71 | 46.57 | 33.7 | 5.9 | -34.8 | 0.0 | 0.0 | 55.5 | 51.3 | 74 | 54 | -18.5 | -2.7 | V |
| 7.386 | 3.0 | 42.7 | 30.84 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 50.5 | 38.7 | 74 | 54 | -23.5 | -15.3 | V |
| 4.918 | 3.0 | 44.0 | 33.38 | 33.7 | 5.9 | -34.8 | 0.0 | 0.0 | 48.7 | 38.1 | 74 | 54 | -25.3 | -15.9 | H |
| 4.929 | 3.0 | 42.5 | 33.13 | 33.7 | 5.9 | -34.8 | 0.0 | 0.0 | 47.3 | 37.9 | 74 | 54 | -26.7 | -16.1 | H |
| 7.386 | 3.0 | 40.0 | 30.19 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 47.8 | 38.0 | 74 | 54 | -26.2 | -16.0 | Noise floor |

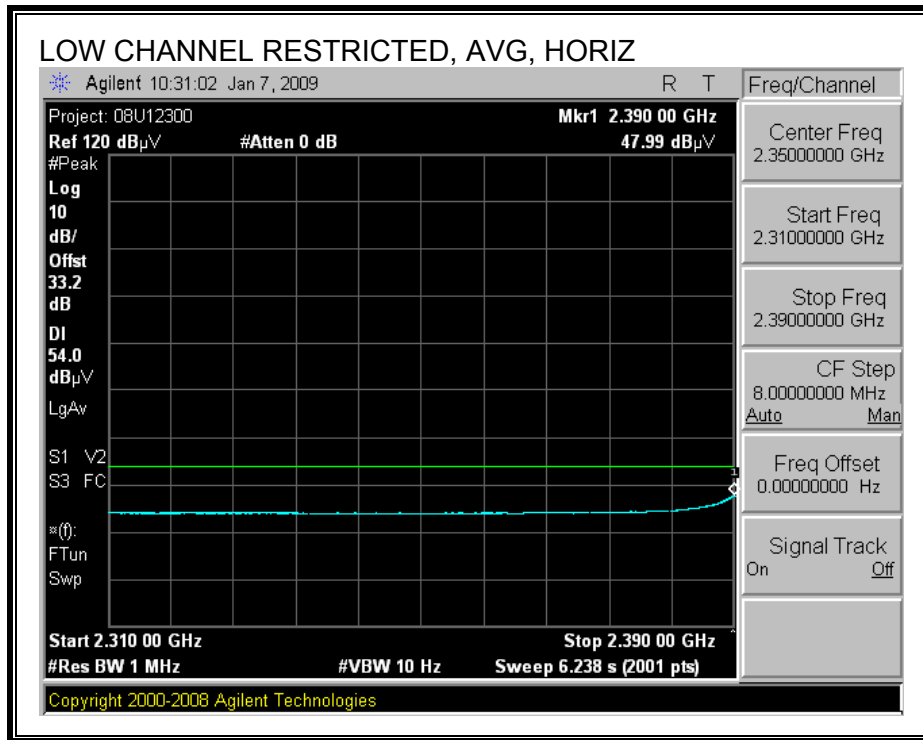
Rev. 10.15.08

| | | | | | |
|------|-----------------------|--------|--------------------------------|---------|------------------------------|
| 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 | | |

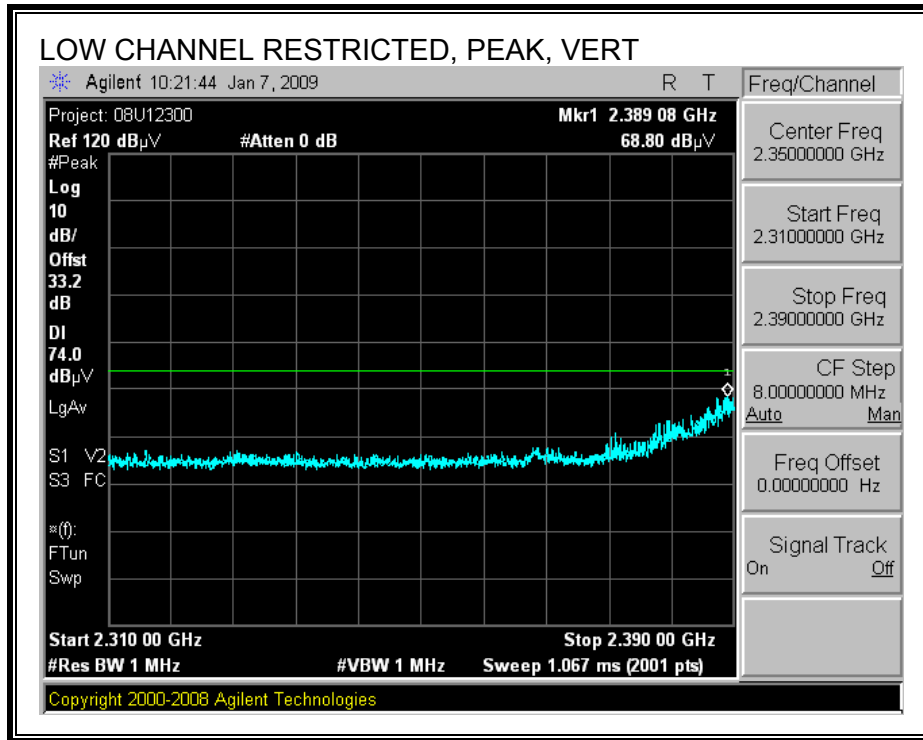
8.2.2. TX ABOVE 1 GHz FOR 802.11g MODE IN THE 2.4 GHz BAND

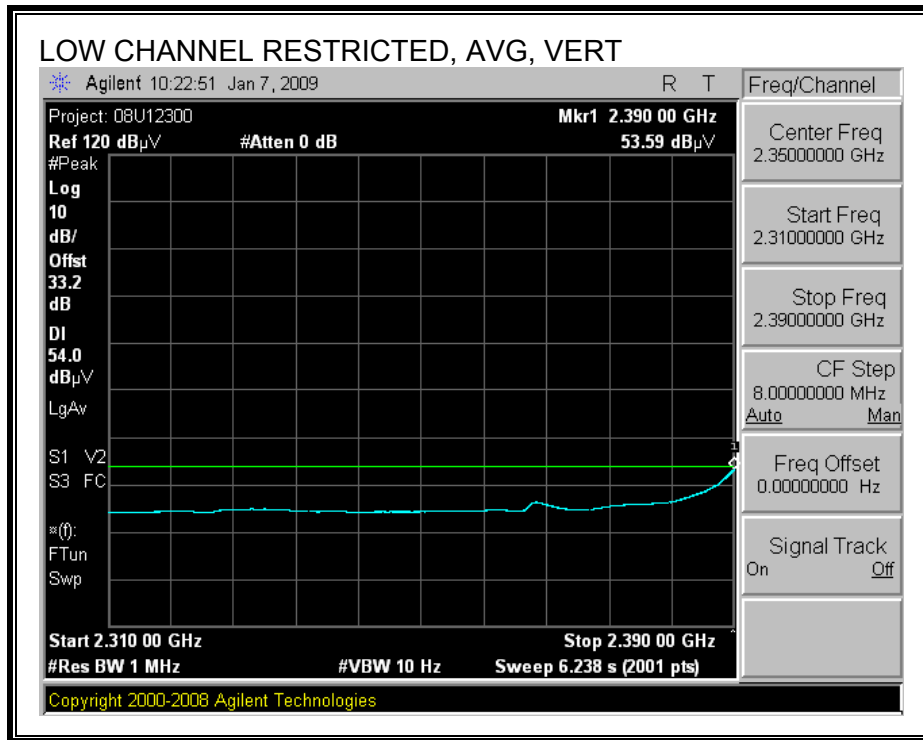
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



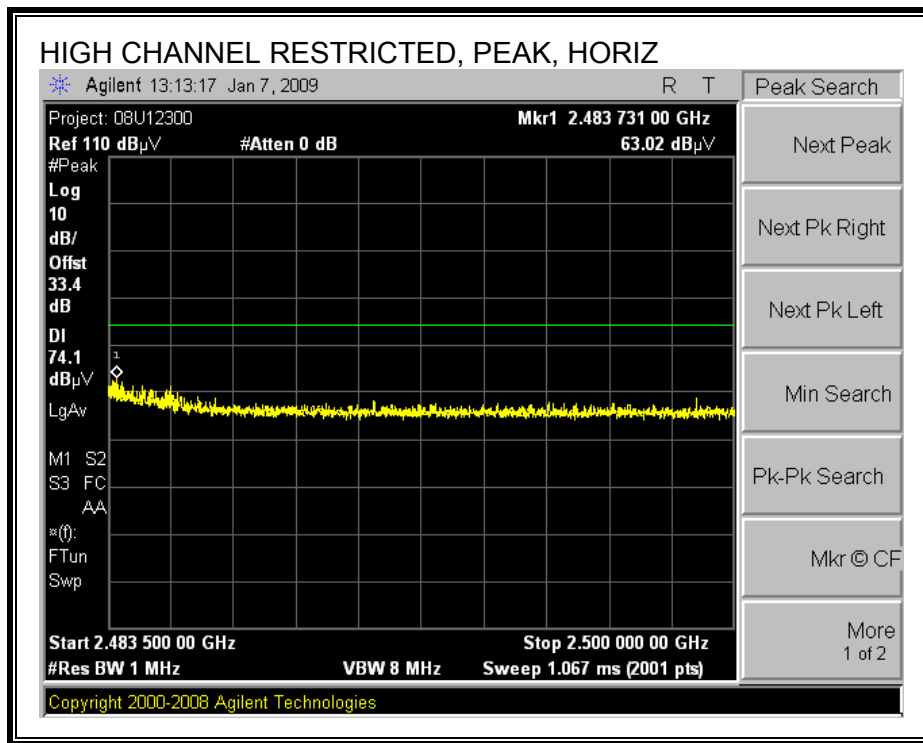


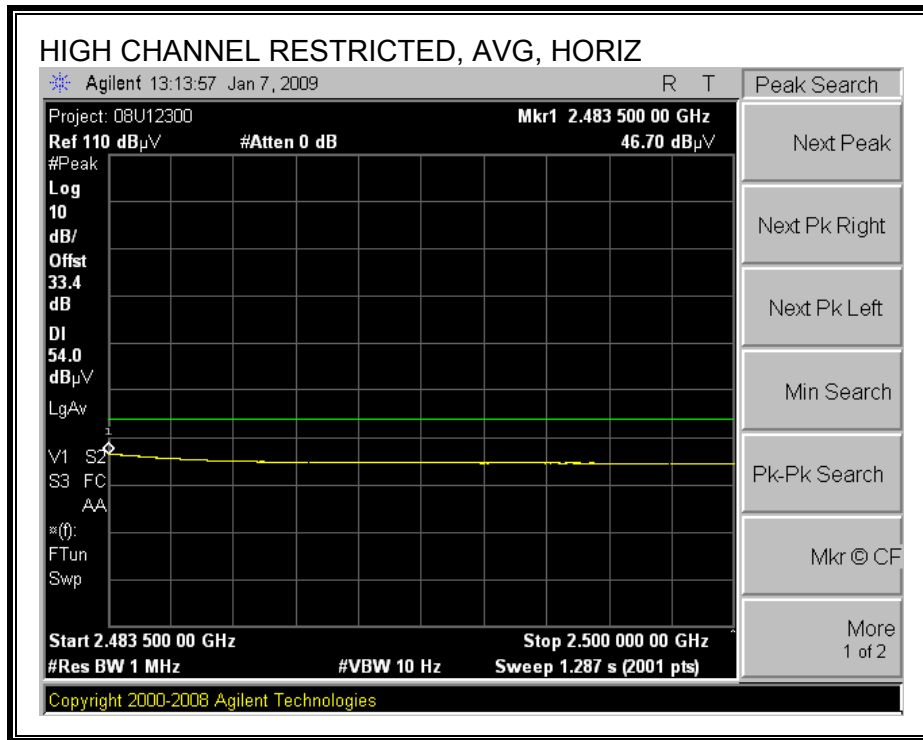
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



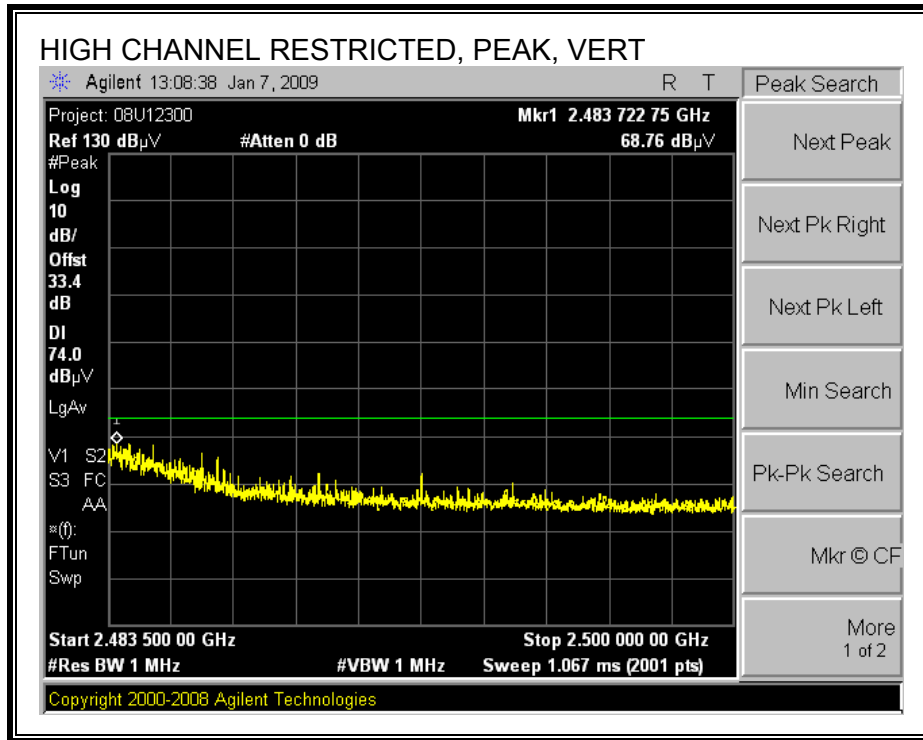


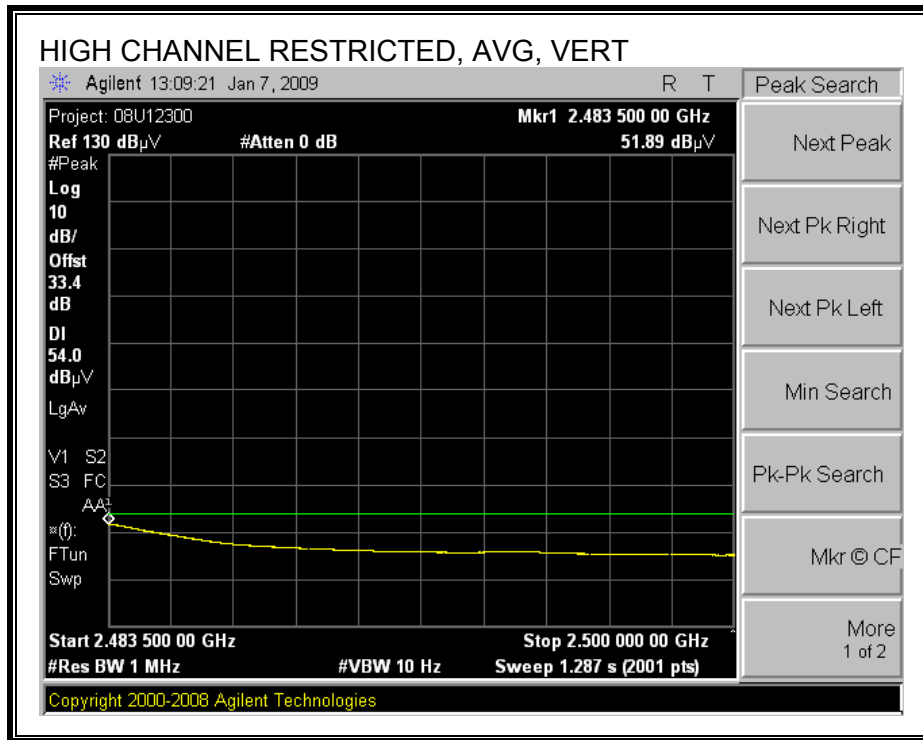
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: Digi International
 Project #: 08U12300
 Date: 01/07/09
 Test Engineer: Thanh Nguyen
 Configuration: EUT and Antenna Up position
 Mode: Transmit g mode 48Mb/s

Test Equipment:

| | | | | |
|----------------------|----------------------|-----------------------|------------------------------|------------|
| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
| T119; S/N: 29301 @3m | T34 HP 8449B | | T125; ARA 18-26GHz; S/N:1007 | FCC 15.209 |

Hi Frequency Cables

| | | | | | |
|-------------------|--------------------|--------------------|-----|---------------|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter | Peak Measurements RBW=VBW=1MHz |
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 | 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) |
|---|----------|--------------|----------------|---------|-------|--------|-----------|---------|-------------|------------|---------------|----------------|-----------|------------|-------------|
| Harmonics Spurious | | | | | | | | | | | | | | | |
| Low Ch 2412MHz | | | | | | | | | | | | | | | |
| 4.824 | 3.0 | 49.87 | 37.97 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 54.4 | 42.5 | 74 | 54 | -19.6 | -11.5 | V |
| 7.236 | 3.0 | 45.23 | 30.12 | 34.6 | 7.2 | -34.1 | 0.0 | 0.0 | 52.9 | 37.8 | 74 | 54 | -21.1 | -16.2 | V |
| 9.648 | 3.0 | 49.32 | 33.42 | 36.1 | 8.5 | -33.6 | 0.0 | 0.0 | 60.4 | 44.5 | 74 | 54 | -13.6 | -9.5 | V |
| 12.060 | 3.0 | 39.63 | 27.35 | 36.8 | 9.8 | -32.5 | 0.0 | 0.0 | 53.7 | 41.4 | 74 | 54 | -20.3 | -12.6 | Noise floor |
| 4.824 | 3.0 | 43.93 | 31.54 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 48.5 | 36.1 | 74 | 54 | -25.5 | -17.9 | H |
| 7.236 | 3.0 | 41.39 | 28.89 | 34.6 | 7.2 | -34.1 | 0.0 | 0.0 | 49.0 | 36.5 | 74 | 54 | -25.0 | -17.5 | H |
| 9.648 | 3.0 | 40.13 | 27.73 | 36.1 | 8.5 | -33.6 | 0.0 | 0.0 | 51.2 | 38.8 | 74 | 54 | -22.8 | -15.2 | Noise floor |
| Mid Ch 2437MHz | | | | | | | | | | | | | | | |
| 4.874 | 3.0 | 45.55 | 35.64 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 50.2 | 40.3 | 74 | 54 | -23.8 | -13.7 | V |
| 7.311 | 3.0 | 36.80 | 26.58 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 44.5 | 34.3 | 74 | 54 | -29.5 | -19.7 | Noise floor |
| 4.874 | 3.0 | 40.34 | 30.35 | 33.6 | 5.8 | -34.8 | 0.0 | 0.0 | 45.0 | 35.0 | 74 | 54 | -29.0 | -19.0 | H |
| 7.311 | 3.0 | 39.41 | 25.74 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 47.1 | 33.5 | 74 | 54 | -26.9 | -20.5 | Noise floor |
| High ch 2462MHz | | | | | | | | | | | | | | | |
| 4.924 | 3.0 | 45.09 | 38.43 | 33.7 | 5.9 | -34.8 | 0.0 | 0.0 | 49.8 | 43.2 | 74 | 54 | -24.2 | -10.8 | V |
| 7.386 | 3.0 | 39.81 | 29.50 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 47.6 | 37.3 | 74 | 54 | -26.4 | -16.7 | V |
| 9.848 | 3.0 | 37.63 | 26.92 | 36.3 | 8.7 | -33.1 | 0.0 | 0.0 | 49.5 | 38.8 | 74 | 54 | -24.5 | -15.2 | Noise floor |
| 4.924 | 3.0 | 40.27 | 32.03 | 33.7 | 5.9 | -34.8 | 0.0 | 0.0 | 45.0 | 36.8 | 74 | 54 | -29.0 | -17.2 | H |
| 7.386 | 3.0 | 37.14 | 26.37 | 34.6 | 7.3 | -34.1 | 0.0 | 0.0 | 45.0 | 34.2 | 74 | 54 | -29.0 | -19.8 | H |
| 9.848 | 3.0 | 35.96 | 24.72 | 36.3 | 8.7 | -33.1 | 0.0 | 0.0 | 47.9 | 36.6 | 74 | 54 | -26.1 | -17.4 | Noise floor |
| No other emissions were detected above noise floor. | | | | | | | | | | | | | | | |
| Rev. 10.15.08 | | | | | | | | | | | | | | | |

| | | | | | |
|------|-----------------------|--------|--------------------------------|---------|------------------------------|
| 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

8.3.1. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 2.4 GHz BAND

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: Digi International
 Project #: 08U12300
 Date: 01/07/09
 Test Engineer: Thanh Nguyen
 Configuration: EUT and Antenna Up position
 Mode: Receive

Test Equipment:

| | | | | |
|----------------------|-----------------------------|------------------------------|------------------------|--------------|
| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
| T119; S/N: 29301 @3m | T34 HP 8449B | | | RX RSS 210 |

Hi Frequency Cables

| | | | | | |
|--------------------------|---------------------------|---------------------------|------------|----------------------|--|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter | Peak Measurements RBW=VBW=1MHz |
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | | Average Measurements RBW=1MHz ; VBW=10Hz |

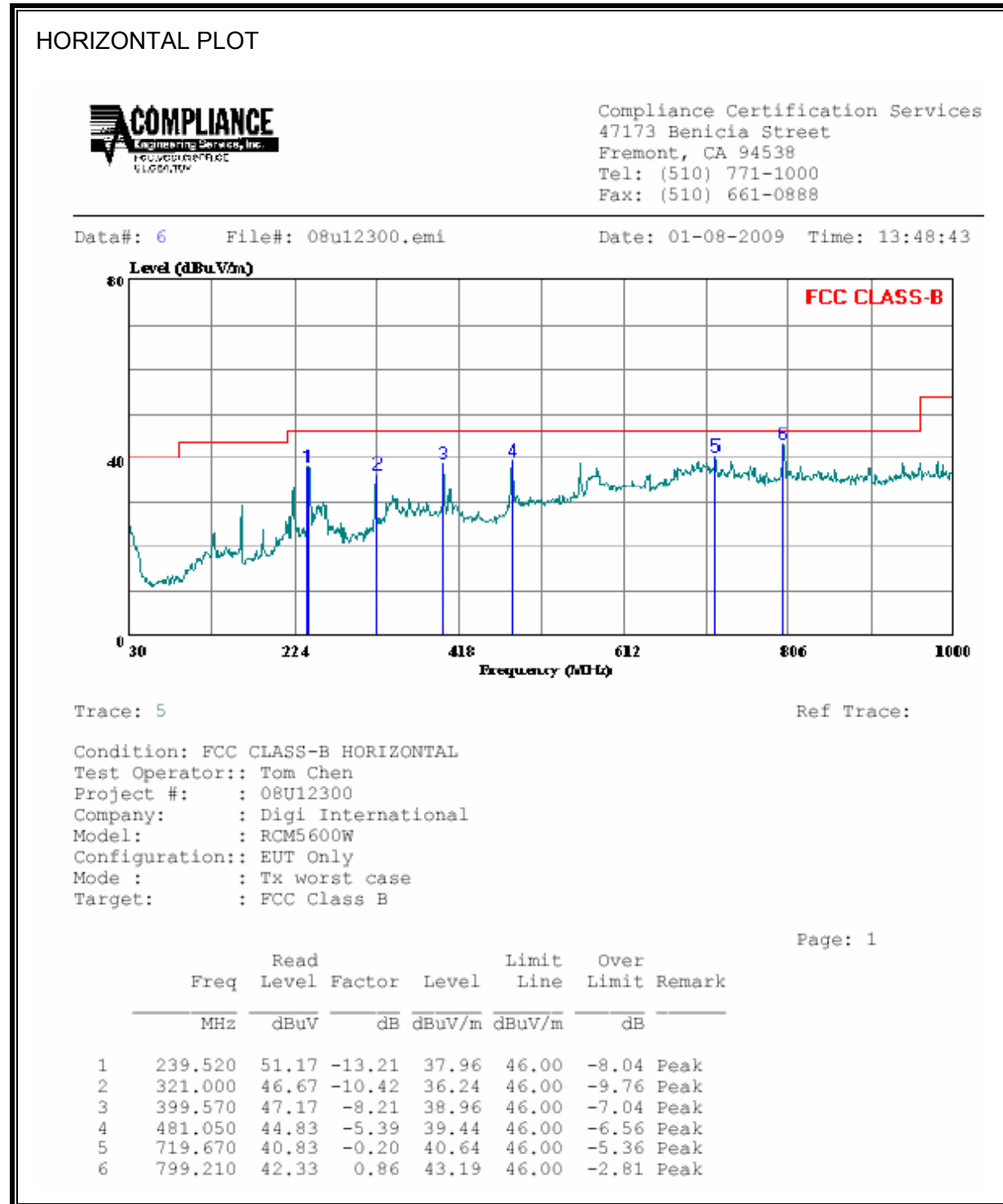
| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Filtr dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|--|-------------|-----------------|-------------------|------------|----------|-----------|--------------|-------------|----------------|---------------|------------------|-------------------|--------------|---------------|----------------|
| Mid Ch 2437MHz | | | | | | | | | | | | | | | |
| 1.086 | 3.0 | 47.49 | 36.87 | 28.3 | 2.5 | -38.1 | 0.0 | 0.0 | 40.1 | 29.4 | 74 | 54 | -33.9 | -24.6 | V |
| 1.353 | 3.0 | 36.00 | 26.58 | 29.1 | 2.8 | -37.8 | 0.0 | 0.0 | 30.1 | 20.7 | 74 | 54 | -43.9 | -33.3 | V |
| 1.033 | 3.0 | 48.46 | 36.86 | 28.1 | 2.4 | -38.2 | 0.0 | 0.0 | 40.7 | 29.1 | 74 | 54 | -33.3 | -24.9 | H |
| 2.880 | 3.0 | 41.92 | 30.56 | 31.9 | 4.2 | -36.0 | 0.0 | 0.0 | 42.1 | 30.7 | 74 | 54 | -31.9 | -23.3 | H |
| No other emissions were detected above noise floor. | | | | | | | | | | | | | | | |

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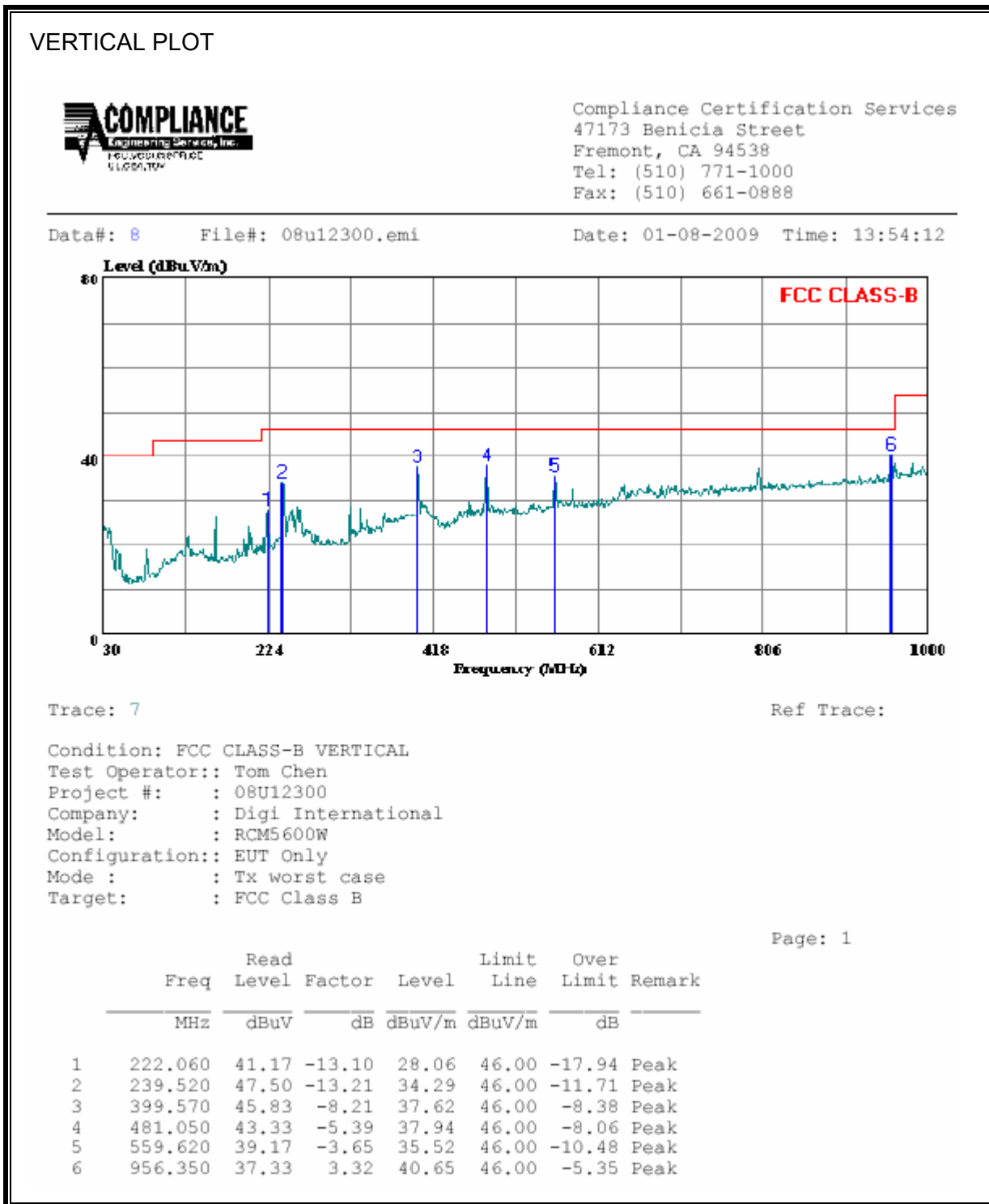
| | | | | | |
|------|-----------------------|--------|--------------------------------|---------|------------------------------|
| f | Measurement Frequency | Amp | Preamp Gain | Avg Lim | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Pk Lim | 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)



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



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

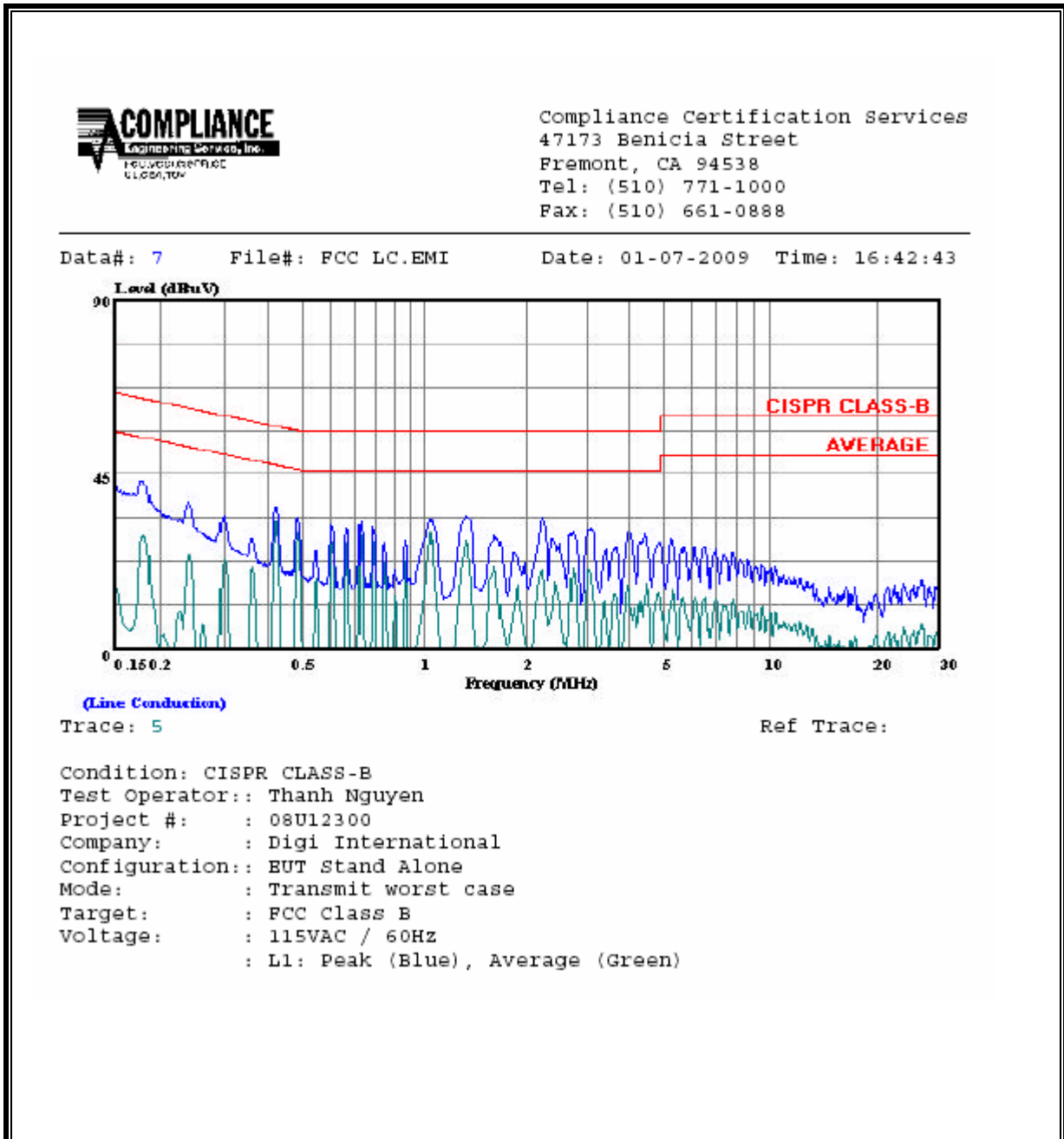
ANSI C63.4

RESULTS

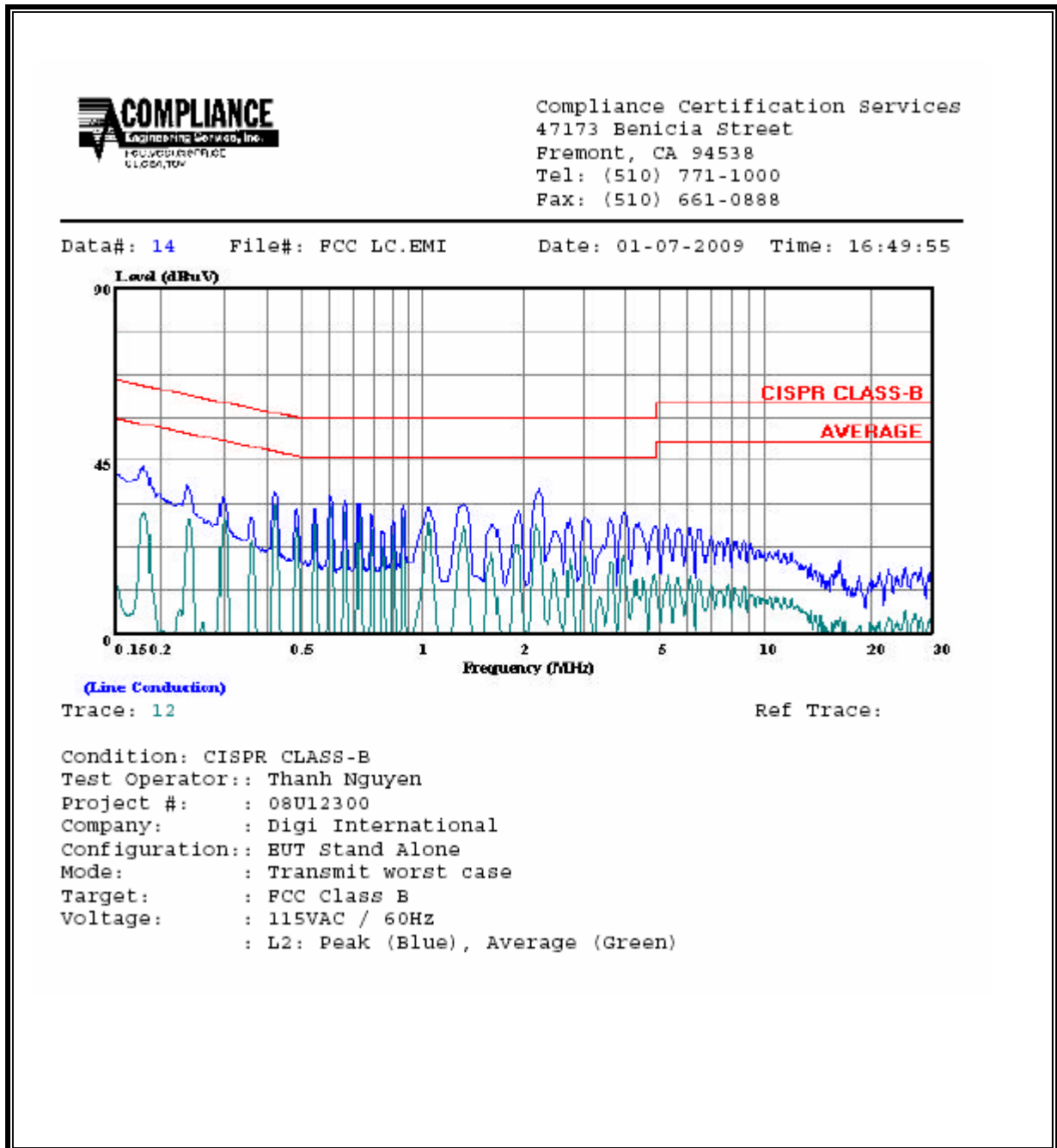
6 WORST EMISSIONS

| CONDUCTED EMISSIONS DATA (115VAC 60Hz) | | | | | | | | | | |
|--|-----------|-----------|-----------|---------------|-------------|-------|---------|---------|----|-------------------|
| Freq. (MHz) | Reading | | | Class (dB) | Limit QP | EN B | | Margin | | Remark L1 / L2 |
| | PK (dBuV) | QP (dBuV) | AV (dBuV) | | | AV | QP (dB) | AV (dB) | | |
| 0.18 | 43.31 | -- | -- | 0.00 | 64.53 | 54.53 | -21.22 | -11.22 | L1 | |
| 0.42 | 36.77 | -- | -- | 0.00 | 57.47 | 47.47 | -20.70 | -10.70 | L1 | |
| 1.43 | 33.91 | -- | -- | 0.00 | 56.00 | 46.00 | -22.09 | -12.09 | L1 | |
| 0.18 | 43.47 | -- | -- | 0.00 | 64.49 | 54.49 | -21.02 | -11.02 | L2 | |
| 0.60 | 35.78 | -- | -- | 0.00 | 56.00 | 46.00 | -20.22 | -10.22 | L2 | |
| 2.33 | 37.70 | -- | -- | 0.00 | 56.00 | 46.00 | -18.30 | -8.30 | L2 | |
| 6 Worst Data | | | | | | | | | | |

LINE 1 RESULTS



LINE 2 RESULTS



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/ <i>f</i> | 2.19/ <i>f</i> | | 6 |
| 10–30 | 28 | 2.19/ <i>f</i> | | 6 |
| 30–300 | 28 | 0.073 | 2* | 6 |
| 300–1 500 | 1.585 <i>f</i> ^{0.5} | 0.0042 <i>f</i> ^{0.5} | <i>f</i> /150 | 6 |
| 1 500–15 000 | 61.4 | 0.163 | 10 | 6 |
| 15 000–150 000 | 61.4 | 0.163 | 10 | 616 000 / <i>f</i> ^{1.2} |
| 150 000–300 000 | 0.158 <i>f</i> ^{0.5} | 4.21 x 10 ⁻⁴ <i>f</i> ^{0.5} | 6.67 x 10 ⁻⁵ <i>f</i> | 616 000 / <i>f</i> ^{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/m² is equivalent to 1 mW/cm².
 3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

CALCULATIONS

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm²

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10^{((P + G) / 10)} / (d^2)$$

The power density in units of mW/cm² is converted to units of W/m² by multiplying by a factor of 10.

LIMITS

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

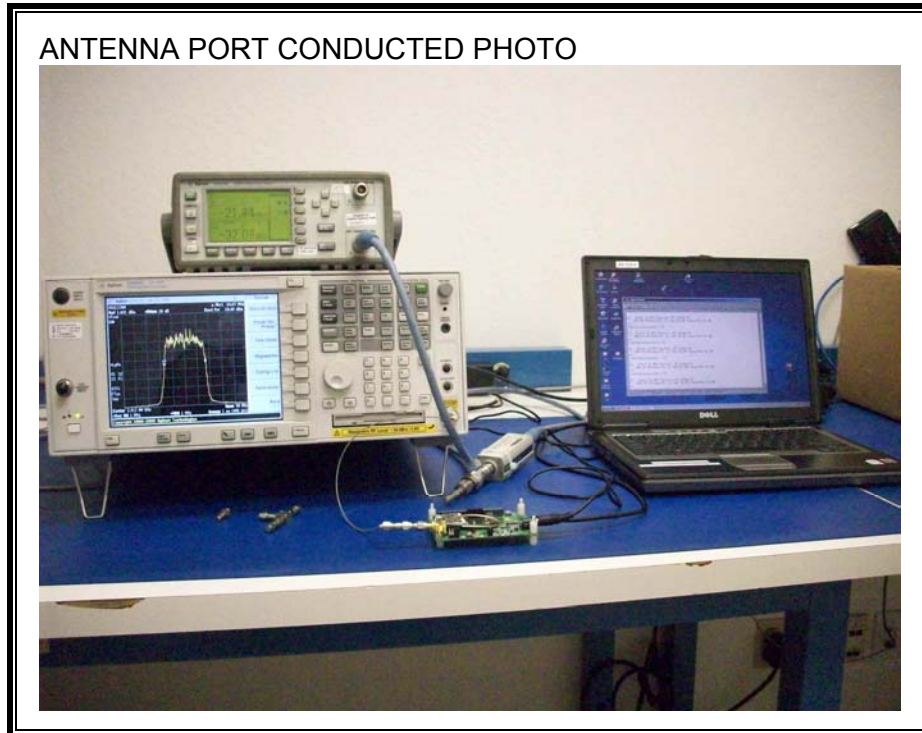
From IC Safety Code 6, Section 2.2 Table 5 Column 4, $S = 10 \text{ W/m}^2$

RESULTS

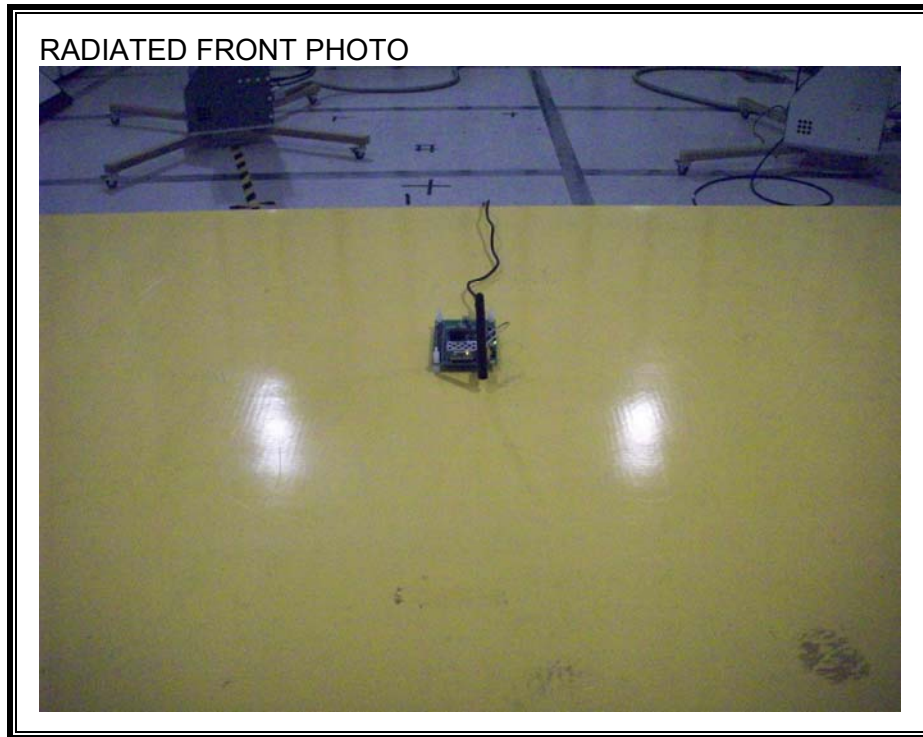
| Mode | Band | MPE Distance (cm) | Output Power (dBm) | Antenna Gain (dBi) | FCC Power Density (mW/cm ²) | IC Power Density (W/m ²) |
|------|---------|-------------------------|--------------------------|--------------------------|---|--|
| WLAN | 2.4 GHz | 20.0 | 22.23 | 2.00 | 0.05 | 0.53 |

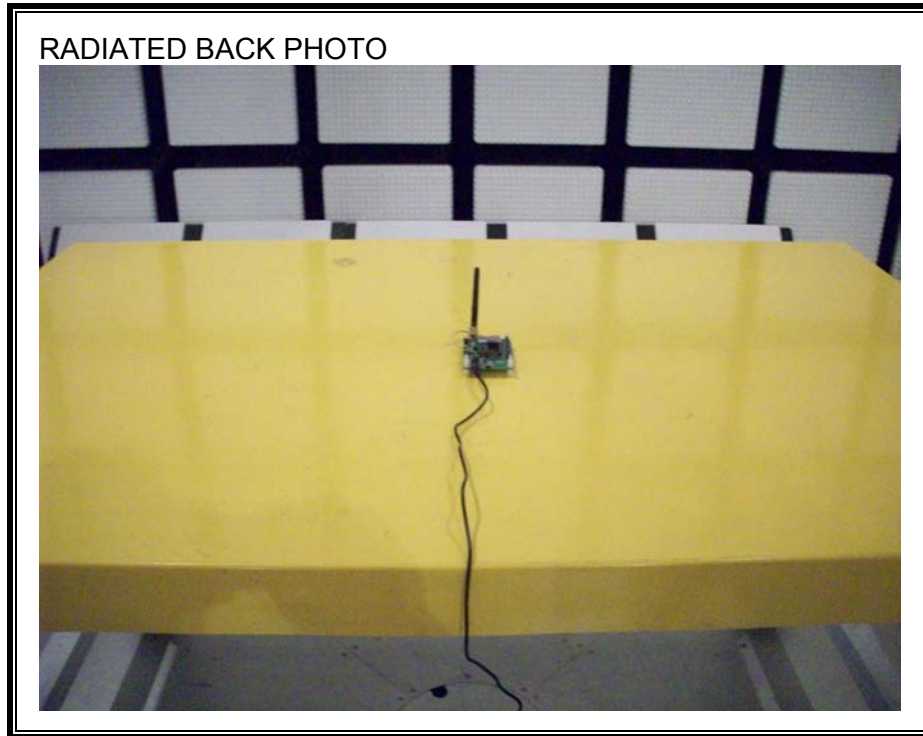
11. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

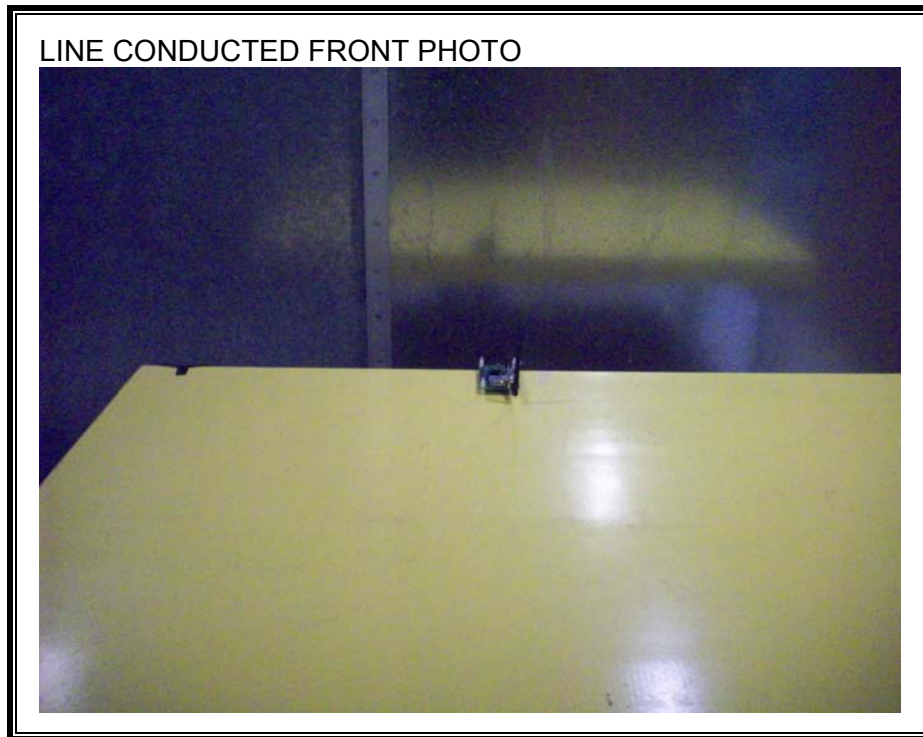


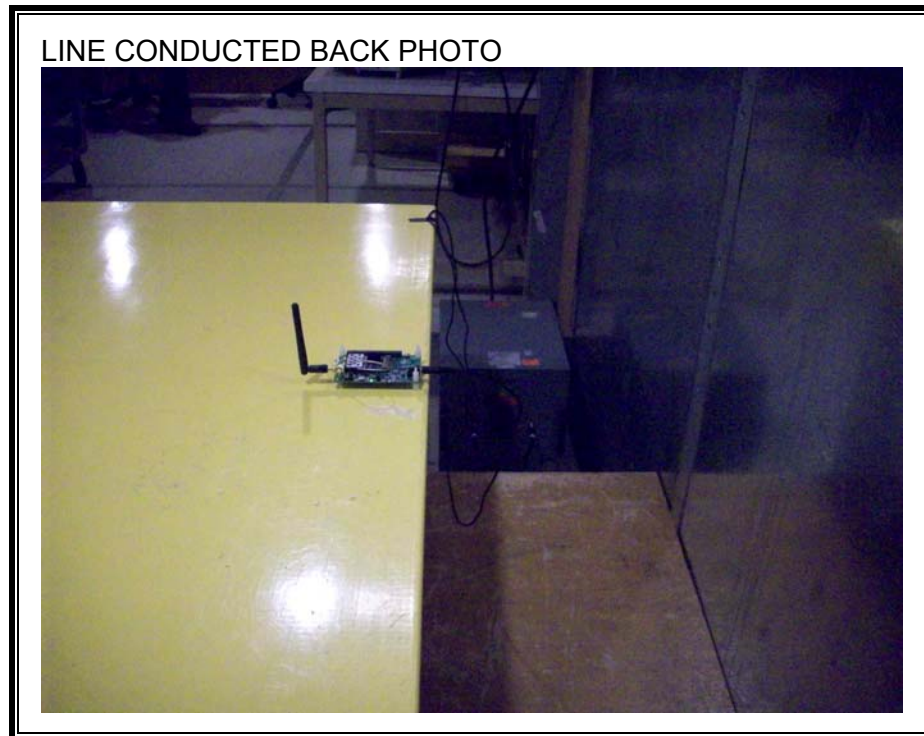
RADIATED RF MEASUREMENT SETUP





POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP





END OF REPORT